

Ovation I/O Reference Manual

OW351_R1150

(For Ovation 3.5.1 systems)

March 2014

Copyright Notice

Since the equipment explained in this document has a variety of uses, the user and those responsible for applying this equipment must satisfy themselves as to the acceptability of each application and use of the equipment. Under no circumstances will Emerson Process Management be responsible or liable for any damage, including indirect or consequential losses resulting from the use, misuse, or application of this equipment.

The text, illustrations, charts, and examples included in this manual are intended solely to explain the use and application of the OvationTM Unit. Due to the many variables associated with specific uses or applications, Emerson Process Management cannot assume responsibility or liability for actual use based upon the data provided in this manual.

No patent liability is assumed by Emerson Process Management with respect to the use of circuits, information, equipment, or software described in this manual.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, including electronic, mechanical, photocopying, recording or otherwise without the prior express written permission of Emerson Process Management.

The document is the property of and contains Proprietary Information owned by Emerson Process Management and/or its subcontractors and suppliers. It is transmitted in confidence and trust, and the user agrees to treat this document in strict accordance with the terms and conditions of the agreement under which it was provided.

This manual is printed in the USA and is subject to change without notice.

Ovation is the mark of Emerson Process Management. Other marks are the property of their respective holders.

Copyright © Emerson Process Management Power & Water Solutions, Inc. All rights reserved.

Emerson Process Management
Power & Water Solutions
200 Beta Drive
Pittsburgh, PA 15238
USA

E-Mail: Technical.Communications@Emerson.com
Web site: <https://www.ovationusers.com>

Summary of Changes

Ovation I/O Reference Manual
OW351_R1150
March 2014

The March 2014 version of Ovation I/O Reference Manual contains Additions/Corrections/Deletions about the following items:

New items:

- Added 5X00605 Contact Input Sequence of Events module (HDSOE) (32 Channel) (see page 415).
- Added 5X00594 Thermocouple Input module (16 Channel) (HDTI) (see page 433).
- Added 5X00583 Relay Output module (HROE) (32 Channel) (see page 505).
- Added new power supply information Ovation power supply information (see page 623).
- Added KC Compliance information KC Compliance mark (see page 622).
- Added field connections and drawings for the Loop Interface module - (LI).
- Added new tables for Thermocouple types and coefficients - (AI-13) & (HSAI) (see page 60).
- Added new section and links: I/O Module configurations (see page 35).

Changes and modifications:

- Redesigned the overall layout of the manual for ease of use.
- Aligned the manual to coordinate with the information displayed on our website.
- Removed all Bus and Specialty modules and created a new manual specifically for Bus and Specialty modules (OW351_R1152).
- Extracted the RVP module information and created a new Valve Positioner manual (CON_048).
- Extracted the RSR module information and created a new Servo Driver manual (CON_047).
- Updated DeviceNet, Fieldbus, ELC, and Profibus with Emod and Pmod information.
- Removed duplicate topics and information.

Contents

1	I/O Module general information	17
1.1	Overview	17
1.2	Ovation I/O module features	18
1.3	I/O reference terminology.....	18
1.4	Installing Ovation modules	22
1.5	Ovation module configuration and status.....	22
1.6	Ovation module diagnostic LEDs	23
1.7	Replacement of user serviceable fuses	23
1.7.1	Electronics module fuses	23
1.7.2	Personality module fuses	24
1.7.3	Ovation cabinet fuses.....	25
1.8	Personality module jumpers.....	25
1.9	I/O environmental specifications	26
1.10	Standard module components	27
1.10.1	Marshalling Base Unit (5X00334G01)unit.....	30
1.11	Relay module components.....	31
2	I/O Module configurations	35
2.1	Analog Input modules	35
2.2	Analog Output modules.....	37
2.3	Digital Input modules.....	38
2.4	Digital Output modules	40
2.5	Specialty I/O modules	41
2.6	Bus Interface modules	43
3	Analog Input module 4-20 mA (16 Channel)	45
3.1	16 Channel 4-20mA Analog Input module overview.....	45
3.2	Electronics modules (Emod) - 16 Channel 4-20mA Analog Input	46
3.3	Personality modules (Pmod) - 16 Channel 4-20mA Analog Input	46
3.4	Valid module combinations - 16 Channel 4-20mA Analog Input	46
3.5	Terminal block wiring information 16 Channel 4-20mA Analog Input (2-Wire).....	46
3.6	Terminal block wiring information - 16 Channel Analog Input 4-20mA (4-Wire).....	48
3.7	Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (2-Wire).....	49
3.8	Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (4-Wire).....	50
3.9	Configuration/Status Register information - 16 Channel 4-20mA Analog Input	50
3.10	Channel Enable/Mask Register - 16 Channel 4-20mA Analog Input.....	52
3.11	Channel Status Register - 16 Channel 4-20mA Analog Input	53
3.12	Diagnostic LEDs - 16 Channel 4-20mA Analog Input.....	54

3.13	Specifications - 16 Channel 4-20mA Analog Input	54
4	Analog Input high speed module (14-Bit) - (HSAI) (8 Channel)	57
4.1	8 Channel Analog Input high speed module overview (14-Bit) - (HSAI)	57
4.2	Electronics modules (Emod) - (HSAI)	58
4.3	Personality modules (Pmod) - (HSAI)	58
4.4	Valid module combinations - (HSAI)	58
4.5	External power supply information - (HSAI)	59
4.6	Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)	59
4.7	Thermocouple types and coefficients - (AI-13) & (HSAI)	60
4.8	Temperature sensor Personality module (1C31116G04) - (HSAI)	63
4.9	Module block diagram - (HSAI)	64
4.10	Terminal block wiring information - (HSAI)	65
4.11	Field connection diagrams - (HSAI)	66
4.12	Field connection wiring diagrams (Pmod 1C31227) - (HSAI)	67
4.13	Field connection wiring diagrams (Pmod 1C31227) (CE Mark) - (HSAI)	68
4.14	Field connection wiring diagrams (Pmod 1C31116) - (HSAI)	69
4.15	Field connection wiring diagrams, Pmod (Pmod 1C31116) (CE Mark) - (HSAI)	70
4.16	Input address locations (Group 1) - (HSAI)	71
4.17	Input address locations (Group 2) - (HSAI)	73
4.18	Input address locations (Group 3) - (HSAI)	75
4.19	Input address locations (Group 4) - (HSAI)	77
4.20	Module register information - (HSAI)	79
4.21	Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	80
4.22	Specifications - (HSAI)	80
5	Analog Input module (14-Bit) - (8 Channel) (AI-14)	83
5.1	8 Channel Analog Input module overview (14-Bit) - (AI-14)	83
5.2	Electronics modules (Emod) - (AI-14)	83
5.3	Personality modules (Pmod) - (AI-14)	83
5.4	Valid module combinations - (AI-14)	84
5.5	External power supplies - (AI-14)	84
5.6	Terminal block wiring information - (AI-14)	84
5.7	Voltage input connection wiring diagram - (AI-14)	86
5.8	Current input connection wiring diagram - (AI-14)	87
5.9	Field connection wiring diagrams (CE Mark) - (AI-14)	88
5.10	Module block diagram - (AI-14)	89
5.11	Configuration/status register information - (AI-14)	89
5.12	Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	91
5.13	Specifications - (AI-14)	92
6	Analog Input module (13-Bit) - (8 Channel) (AI-13)	95
6.1	8 Channel Analog Input module overview (13-Bit) - (AI-13)	95

6.2	Electronics modules (Emod) - (AI-13)	95
6.3	Personality modules and jumper settings (Pmod) - (AI-13)	96
6.4	Valid module combinations - (AI-13)	96
6.5	External power supply information - (AI-13)	97
6.6	Terminal block wiring information - (AI-13)	98
6.7	Field connection wiring diagrams - (AI-13)	100
6.8	Field connection wiring diagrams (CE Mark) - (AI-13)	101
6.9	Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)	102
6.10	Thermocouple types and coefficients - (AI-13) & (HSAI)	103
6.11	Configuration/Status Register information - (AI-13)	106
6.12	Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	108
6.13	Specifications - (AI-13)	109
7	HART Analog Input module - (HAI) (8 Channel)	111
7.1	8 Channel HART Analog Input module overview - (HAI)	111
7.2	Electronics modules (Emod) - (HAI)	112
7.3	Personality modules (Pmod) - (HAI)	112
7.4	Valid module combinations - (HAI)	112
7.5	Module block diagram information - (HAI)	113
7.6	External power supply information - (HAI)	114
7.7	Terminal block wiring information - (HAI)	115
7.8	Field connection wiring diagrams - (HAI)	116
7.9	Field connection wiring diagrams (CE Mark) - (HAI)	117
7.10	Field wiring cable requirements - (HAI)	118
7.11	Configuration/Status Register information - (HAI)	121
7.12	Diagnostic Logic card LEDs - (HAI)	123
7.13	Specifications - (HAI)	124
8	HART High Performance Analog Input module - (HHPAI) (8 Channel)	125
8.1	8 Channel HART High Performance Analog Input module overview - (HHPAI)	125
8.2	Electronics modules (Emod) - (HHPAI)	126
8.3	Personality modules (Pmod) - (HHPAI)	126
8.4	Valid module combinations - (HHPAI)	126
8.5	Field wiring diagram - (HHPAI)	127
8.6	Field wiring diagram (CE Mark) - (HHPAI)	128
8.7	Power supply information - (HHPAI)	129
8.8	Terminal block wiring information - (HHPAI)	130
8.9	Field wiring cable requirements - (HHPAI)	131
8.10	Field connection wiring diagrams - (HHPAI)	131
8.11	Field connection wiring diagrams (CE Mark) - (HHPAI)	133
8.12	Personality Jumper Information - (HHPAI)	135
8.13	Configuration/Status Register information - (HHPAI)	135

8.14	Diagnostic Logic card LEDs - (HHPAI)	138
8.15	Specifications - (HHPAI)	139
9	RTD Input module - (RTD-4) (4 Channel)	141
9.1	4 Channel RTD Input module overview - (RTD-4)	141
9.2	Electronics modules (Emod) - (RTD-4)	141
9.3	Personality modules (Pmod) - (RTD-4)	141
9.4	Valid module combinations - (RTD-4)	142
9.5	Terminal block wiring information (Pmod 1C31164G01) - (RTD-4)	142
9.6	Terminal block wiring information (Pmod 1C31164G02) - (RTD-4)	143
9.7	Field wiring diagrams for (Pmod 1C31164G01) - (RTD-4)	144
9.8	Field wiring diagrams for (Pmod 1C31164G02) - (RTD-4)	145
9.9	Field wiring diagrams for (Pmod 1C31164G02) (CE Mark) - (RTD-4)	146
9.10	RTD ranges - (RTD-4)	147
9.11	Configuration/Status Register information - (RTD-4)	148
9.12	Diagnostic Logic card LEDs - (RTD-4)	149
9.13	Specifications - (RTD-4)	149
10	RTD Input module - (RTD-8) (8 Channel)	151
10.1	8 Channel RTD Input module overview - (RTD-8)	151
10.2	Electronics modules (Emod) - (RTD-8)	152
10.3	Personality modules (Pmod) - (RTD-8)	152
10.4	Valid module combinations - (RTD-8)	152
10.5	Terminal block wiring information (Pmod 5X00121G01) - (RTD-8)	152
10.6	Module and field connection wiring - (RTD-8)	153
10.7	Module and field connection wiring (CE Mark) - (RTD-8)	155
10.8	Ranges - (RTD-8)	156
10.9	Configuration/Status Register information - (RTD-8)	157
10.10	Diagnostic Logic card LEDs - (RTD-8)	158
10.11	Specifications - (RTD-8)	159
11	Analog Output module - (AO) (4 Channel)	161
11.1	4 Channel Analog Output module overview - (AO)	161
11.2	Electronics modules (Emod) - (AO)	161
11.3	Personality modules (Pmod) - (AO)	162
11.4	Valid module combinations - (AO)	162
11.5	Terminal block wiring information - (AO)	163
11.6	Field connection wiring diagrams (simplex) - (AO)	164
11.7	Field connection wiring diagrams (CE Mark) (simplex) - (AO)	165
11.8	Field connection wiring diagrams (Redundant) - (AO)	166
11.9	Redundant interface cable assembly routing configuration (Redundant) - (AO)	167
11.10	Configuration/Status Register information - (AO)	167
11.11	Diagnostic Logic card LEDs - (AO)	170

11.12	Specifications - (AO)	170
12	HART Analog Output module - (HAO) (8 Channel)	173
12.1	8 Channel HART Analog Output module overview - (HAO)	173
12.2	Electronics modules (Emod) - (HAO)	174
12.3	Personality modules (Pmod) - (HAO)	174
12.4	Valid module combinations - (HAO)	174
12.5	Module block diagrams - (HAO)	175
12.6	External power supply information - (HAO)	176
12.7	Terminal block wiring information - (HAO)	177
12.8	Field connection wiring diagrams - (HAO)	178
12.9	Field connection wiring diagrams (CE Mark) - (HAO)	179
12.10	Field wiring cable requirements - (HAO)	180
12.11	Open loop detect register - (HAO)	180
12.12	Configuration/Status Register information - (HAO)	181
12.13	Diagnostic Logic card LEDs - (HAO)	184
12.14	Specifications - (HAO)	184
13	HART High Performance Analog Output module - (HHPAO) (4 Channel)	187
13.1	4 Channel HART High Performance Analog Output module overview - (HHPAO)	187
13.2	Electronics modules (Emod) - (HHPAO)	187
13.3	Personality modules (Pmod) - (HHPAO)	188
13.4	Valid module combinations - (HHPAO)	188
13.5	Module Block Diagrams - (HHPAO)	189
13.6	Terminal block wiring information - (HHPAO)	191
13.7	Field Connection wiring diagrams (Emod) - (HHPAO)	192
13.8	Field Connection wiring diagrams (CE Mark) - (HHPAO)	193
13.9	Field Connection wiring diagrams (Pmod 5X00211G03) - (HHPAO)	194
13.10	Field Connection wiring diagrams (Pmod 5X00211G03) (CE Mark) - (HHPAO)	195
13.11	Field wiring cable requirements - (HHPAO)	196
13.12	Configuration/Status Register information - (HHPAO)	196
13.13	Diagnostic Logic card LEDs - (HHPAO)	199
13.14	Specifications - (HHPAO)	200
14	Digital Input module 24 VDC (32 Channel)	201
14.1	32 Channel 24 VDC Digital Input module overview	201
14.2	Electronics modules (Emod) - 32 Channel 24V DC Digital Input	201
14.3	Personality modules (Pmod) - 32 Channel 24V DC Digital Input	201
14.4	Valid module combinations - 32 Channel 24V DC Digital Input	202
14.5	Terminal block wiring information - 32 Channel 24V DC Digital Input	202
14.6	Field connection wiring diagrams - 32 Channel 24V DC Digital Input	203
14.7	Configuration/Status Register information - 32 Channel 24V DC Digital Input	204

14.8	Diagnostic LEDs - 32 Channel 24V DC Digital Input	204
14.9	Specifications - 32 Channel 24V DC Digital Input.....	205
15	Digital Input module - (DI) (16 Channel)	207
15.1	16 Channel Digital Input module overview - (DI)	207
15.2	Electronics modules (Emod) - (DI)	208
15.3	Personality modules (Pmod) - (DI).....	208
15.4	Valid module combinations - (DI)	208
15.5	External power supply information single-ended (front end) - (DI)	209
15.6	External power supply information differential (front end) - (DI)	210
15.7	Terminal block wiring information - (DI)	211
15.8	Field wiring configuration considerations - (DI).....	212
15.9	Field connection wiring diagrams - (DI)	212
15.10	Field connection wiring diagrams (CE Mark) - (DI).....	213
15.11	Configuration/Status Register information - (DI)	214
15.12	Diagnostic Logic card LEDs - (DI).....	215
15.13	Specifications - (DI).....	215
16	Compact Digital Input module - (CompactDI) (16 Channel)	217
16.1	16 Channel Compact Digital Input module overview - (CompactDI)	217
16.2	Electronics modules (Emod) - (CompactDI)	218
16.3	Personality modules (Pmod) - (CompactDI)	218
16.4	Valid module combinations - (CompactDI)	218
16.5	External Power Supply information - (CompactDI)	219
16.6	Terminal block wiring information - (CompactDI).....	220
16.7	Leakage resistance considerations - (CompactDI)	221
16.8	Field connection wiring diagrams - (CompactDI)	222
16.9	Field connection wiring diagrams (CE Mark) - (CompactDI)	229
16.10	Configuration/Status Register information - (CompactDI)	236
16.11	Diagnostic Logic card LEDs - (CompactDI)	237
16.12	Specifications - (CompactDI)	237
17	Contact Digital Input module overview - (ContactDI) (16 Channel)	239
17.1	16 Channel Contact Digital Input module overview - (ContactDI)	240
17.2	Electronics modules (Emod) - (ContactDI)	240
17.3	Personality modules (Pmod) - (ContactDI)	240
17.4	Valid module combinations - (ContactDI)	241
17.5	Terminal block wiring information - (ContactDI).....	241
17.6	Field wiring restrictions - (ContactDI)	242
17.7	Field wiring cable lengths - (ContactDI)	242
17.8	Field connection wiring diagrams (front end) - (ContactDI)	244
17.9	Cable impedances in field wiring - (ContactDI).....	245
17.10	Field connection wiring diagrams - (ContactDI)	246

17.11	Field connection wiring diagrams (CE Mark) - (ContactDI)	247
17.12	Configuration/Status Register information - (ContactDI) & (CCDI)	248
17.13	Power checking (ContactDI - CCDI)	249
17.14	Diagnostic Logic card LEDs - (ContactDI)	250
17.15	Specifications - (ContactDI)	250
18	Contact Digital Input module (Compact) - (CCDI) (16 Channel)	251
18.1	16 Channel Compact Contact Digital Input module overview - (CCDI)	252
18.2	Electronics modules (Emod) - (CCDI)	252
18.3	Personality Module (Pmod) - (CCDI)	253
18.4	Valid module combinations - (CCDI)	253
18.5	Terminal block wiring information - (CCDI)	253
18.6	Field wiring restrictions - (CCDI)	254
18.7	Field wiring cable lengths - (CCDI)	255
18.8	Cable impedances in field wiring - (CCDI)	256
18.9	Field wiring diagrams - (CCDI)	257
18.10	Field connection wiring diagrams (CE Mark) - (CCDI)	259
18.11	Configuration/Status Register information - (ContactDI) & (CCDI)	261
18.12	Power checking (ContactDI - CCDI)	262
18.13	Diagnostic Logic card LEDs - (CCDI)	263
18.14	Specifications - (CCDI)	263
19	Sequence of Events Digital Input module - (SOEDI) (16 Channel)	265
19.1	16 Channel Sequence of Events Digital Input module overview - (SOEDI)	266
19.2	Electronics modules (Emod) - (SOEDI)	267
19.3	Personality modules (Pmod) - (SOEDI)	267
19.4	Valid module combinations - (SOEDI)	267
19.5	External power supply information - (SOEDI)	267
19.6	Wiring information - (SOEDI)	267
19.7	Field interface - (SOEDI)	268
19.8	Terminal block wiring information - (SOEDI)	269
19.9	Field wiring configuration considerations - (SOEDI)	270
19.10	Field wiring diagrams configuration - (SOEDI)	271
19.11	Field connection wiring diagrams - (SOEDI)	273
19.12	Field connection wiring diagrams (CE Mark) - (SOEDI)	274
19.13	Configuration/Status Register information - (SOEDI)	275
19.14	Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI)	276
19.15	Specifications - (SOEDI)	276
20	Sequence of Events Contact Digital Input Field Interface module - (SOEContactDI) (16 Channel)	279
20.1	16 Channel Sequence of Events Contact Digital Input Field Interface module overview - (SOEContactDI)	280

20.2	Electronics modules (Emod) - (SEContactDI).....	280
20.3	Personality modules (Emod) - (SEContactDI)	280
20.4	Valid module combinations - (SEContactDI).....	280
20.5	Field wiring restrictions - (SEContactDI)	281
20.6	Field wiring diagrams - (SEContactDI).....	282
20.7	Field wiring cable lengths - (SEContactDI)	283
20.8	Terminal block wiring information - (SEContactDI)	284
20.9	Field connection wiring diagrams - (SEContactDI)	285
20.10	Field connection wiring diagrams (CE Mark) - (SEContactDI).....	286
20.11	Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI)	287
20.12	Specifications - (SEContactDI).....	287
21	Sequence of Events Compact Digital Input Field Interface module 1 - (SOECompactDI) (16 Channel)	289
21.1	16 Channel Sequence of Events Compact Digital Input Field Interface module 1 overview - (SOECompactDI)	290
21.2	Electronics modules (Emod) - (SOECompactDI).....	291
21.3	Personality modules (Pmod) - (SOECompactDI).....	291
21.4	Valid module combinations - (SOECompactDI).....	292
21.5	External power supply information - (SOECompactDI)	292
21.6	Wiring information - (SOECompactDI).....	292
21.7	Field wiring diagrams configuration (Front end) (G04) - (SOECompactDI).....	293
21.8	Field interface - (SOECompactDI)	293
21.9	Field wiring field interface restrictions (G01-G03) - (SOECompactDI)	294
21.10	Field wiring cable lengths (G04) - (SOECompactDI)	294
21.11	Field wiring restrictions (G04) - (SOECompactDI)	295
21.12	Terminal block wiring information - (SOECompactDI)	296
21.13	Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI) ..	297
21.14	Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)	304
21.15	Field connection wiring diagram (G04) - (SOECompactDI).....	311
21.16	Field connection wiring diagram (CE Mark) (G04) - (SOECompactDI)	313
21.17	Configuration/Status Register information - (SOECompactDI).....	315
21.18	Diagnostic Logic card LEDs - (SOECompactDI).....	317
21.19	Specifications and ranges (G01-3) - (SOECompactDI)	318
21.20	Specifications and ranges (G04) - (SOECompactDI)	319
22	Enhanced Compact Sequence of Events Digital Input module - (ECISOEDI) (16 Channel)	321
22.1	16 Channel Enhanced Compact Sequence of Events Digital Input module overview - (ECISOEDI).....	322
22.2	Electronics modules (Emod) - (ECISOEDI)	323
22.3	Personality modules (Pmod) - (ECISOEDI)	323
22.4	Valid module combinations - (ECISOEDI)	324
22.5	One shot function - (ECISOEDI)	325

22.6	Wire break detect function - (ECISOEDI)	325
22.7	Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECISOEDI).....	326
22.7.1	Module-base unit interconnection diagram (5X00357G01) - (ECISOEDI)	327
22.7.2	Field wiring (5X00357G01) - (ECISOEDI)	328
22.7.3	Field connection wiring - 5X00357G01	329
22.7.4	External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05).....	333
22.7.5	Voltage-current curve (5X00357G01) - (ECISOEDI)	334
22.7.6	Specifications (5X00357G01) - (ECISOEDI)	335
22.8	Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECISOEDI).....	337
22.8.1	Module-base unit interconnection (5X00357G02) - (ECISOEDI)	338
22.8.2	Module-base unit interconnection (Individually Fused) (5X00357G02) - (ECISOEDI).....	339
22.8.3	Field wiring (5X00357G02) - (ECISOEDI)	340
22.8.4	Field connection wiring (5X00357G02) - (ECISOEDI).....	341
22.8.5	Field connection wiring Individually Fused (5X00357G02) - (ECISOEDI)	344
22.8.6	External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05).....	349
22.8.7	Voltage-current curve (5X00357G02) - (ECISOEDI)	349
22.8.8	Specifications (5X00357G02) - (ECISOEDI)	350
22.9	Enhanced Compact Sequence of Events Digital Input module (5X00357G03) (FDI) - (ECISOEDI).....	352
22.9.1	Module-base unit interconnection (5X00357G03) - (ECISOEDI)	353
22.9.2	Module-base unit interconnection individually Fused (5X00357G03) - (ECISOEDI) 354	
22.9.3	Field wiring (5X00357G03) - (ECISOEDI)	355
22.9.4	Field connection wiring (5X00357G03) - (ECISOEDI).....	356
22.9.5	Field connection wiring Individually Fused (5X00357G03) - (ECISOEDI)	359
22.9.6	External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05).....	362
22.9.7	Voltage-current curve (5X00357G03) - (ECISOEDI)	362
22.9.8	Specifications (5X00357G03) - (ECISOEDI)	363
22.10	Enhanced Compact Sequence of Events Digital Input module (5X00357G04) (FCI) - (ECISOEDI).....	365
22.10.1	Module-base unit interconnection (5X00357G04) - (ECISOEDI)	366
22.10.2	Field wiring (5X00357G04) - (ECISOEDI)	367
22.10.3	Field wiring (5X00357G04) (contact) - (ECISOEDI)	368
22.10.4	Field connection wiring (5X00357G04) - (ECISOEDI).....	370
22.10.5	Specifications (5X00357G04) - (ECISOEDI)	375
22.11	Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI).....	377
22.11.1	Module-base unit interconnection (5X00357G05) - (ECISOEDI)	378
22.11.2	Module-base unit interconnection (5X00357G05) (individually fused) - (ECISOEDI).....	379
22.11.3	Field wiring (5X00357G05) - (ECISOEDI)	380
22.11.4	Field connection wiring (5X00357G05) - (ECISOEDI).....	381
22.11.5	External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05).....	386
22.11.6	Voltage-current curve (5X00357G05) - (ECISOEDI)	387
22.11.7	Specifications (5X00357G05) - (ECISOEDI)	388
22.12	Event buffer read procedure - (ECISOEDI)	389
22.13	Configuration/Status Register information - (ECISOEDI)	390

22.14	Diagnostic Logic card LEDs - (ECISOEDI)	394
22.15	Environmental Specifications - (ECISOEDI)	396
23	Redundant Digital Input module - (RDI) (16 Channel)	397
23.1	16 Channel Redundant Digital Input module overview - (RDI)	398
23.2	Electronics modules (Emod) - (RDI)	399
23.3	Personality modules (Pmod) - (RDI)	399
23.4	Valid module combinations - (RDI)	399
23.5	Terminal block wiring information - (RDI).....	400
23.6	Field connection wiring diagrams - (RDI).....	401
23.7	Redundant interface cable assembly routing - (RDI)	402
23.8	Module block diagrams - (RDI)	403
23.9	Functional block diagram - (RDI)	404
23.10	Signal propagation delay - (RDI).....	406
23.11	Voltage-current curve - (RDI)	407
23.12	Switching Input Voltage Current Curve - (RDI)	408
23.13	Logic Card Digital Debounce Filter Propagation Delay - (RDI).....	409
23.14	Configuration/Status Register information - (RDI)	409
23.15	Blown Fuse Detection - (RDI)	411
23.16	Cross Cable in Place circuit - (RDI)	412
23.17	Diagnostic Logic card LEDs - (RDI)	412
23.18	Specifications -(RDI)	413
24	Contact Input Sequence of Events module (HDSOE) (32 Channel)	415
24.1	32 Channel Contact Input Sequence of Events module overview (HDSOE)	416
24.2	Electronics module (HDSOE).....	416
24.3	Personality module (HDSOE)	416
24.4	Valid module combinations (HDSOE)	416
24.5	Terminal block wiring information (HDSOE)	417
24.6	Logic board block diagram (HDSOE).....	418
24.7	Field card block diagram (HDSOE).....	419
24.8	Contact Input channel diagram (HDSOE)	420
24.9	Ground fault detection on Contact Input diagram (HDSOE)	421
24.10	LSH Logic function block diagram (HDSOE)	422
24.11	Contact Input field wiring with 32 return lines (HDSOE)	423
24.12	Contact Input field wiring with 1 return line (HDSOE)	423
24.13	Field wiring cable impedances (HDSOE).....	424
24.14	Maximum cable lengths (HDSOE)	425
24.15	Configuration/Status Register Command Data information (HDSOE).....	426
24.16	I/O address and Buffer control register command data information (HDSOE)	427
24.17	Configuration/Status Register Reply Data information (HDSOE)	428
24.18	I/O address and Buffer control register reply data information (HDSOE)	429
24.19	Diagnostic LEDs (HDSOE)	431

24.20	Specifications (HDSOE)	431
25	Thermocouple Input module (16 Channel) (HDTI)	433
25.1	16 Channel Thermocouple Input module overview (HDTI)	434
25.2	Electronics module (HDTI)	435
25.3	Personality module (HDTI)	435
25.4	Valid module combinations (HDTI)	435
25.5	Terminal block wiring information (HDTI)	436
25.6	Terminal block pin assignments for the Thermocouple Emod (HDTI)	436
25.7	Field connection wiring information (HDTI)	437
25.8	Field connection wiring information (HDTI)	438
25.9	Logic board block diagram (HDTI)	439
25.10	Field board block diagram (HDTI)	440
25.11	Point Quality Register (HDTI)	440
25.12	Mask Register (HDTI)	442
25.13	Configuration/Status Register information (HDTI)	443
25.14	Diagnostic LEDs (HDTI)	445
25.15	Specifications (HDTI)	445
26	DC Digital Output module 24V (32 Channel)	449
26.1	32 Channel 24 VDC Digital Output module overview	450
26.2	Electronics modules (Emod) - 32 Channel 24V DC Digital Output	450
26.3	Personality modules (Pmod) - 32 Channel 24V DC Digital Output	450
26.4	Valid module combinations - 32 Channel 24V DC Digital Output	450
26.5	Terminal block wiring information - 32 Channel 24V DC Digital Output	451
26.6	Field connection wiring diagram - 32 Channel 24V DC Digital Output	452
26.7	Configuration/Status Register information - 32 Channel 24V DC Digital Output	452
26.7.1	Channel Status Register - 32 Channel 24V DC Digital Output	453
26.8	Diagnostics - 32 Channel 24V DC Digital Output	455
26.9	Specifications - 32 Channel 24V DC Digital Output	455
27	Digital Output module (DO) (16 Channel)	457
27.1	16 Channel Digital Output module overview - (DO)	458
27.2	Electronics modules (Emod) - (DO)	458
27.3	Personality modules (Pmod) - (DO)	458
27.4	Valid module combinations - (DO)	459
27.5	External power supply information - (DO)	459
27.6	Relay Panels - (DO)	460
27.7	Solid State Relay module for DIN Rail Layout (5A22410H01 / 5A22410H02) - (DO)	462
27.8	Solid State Relay module Terminations (5A22410H01 / 5A22410H02) - (DO)	463
27.9	Specifications - (LI)	464
27.10	G2R Style Relay module for DIN Rail Layout (5A22411H01) - (DO)	468
27.11	Blown Fuse Detection Circuit - (DO)	469

27.12	G2R Style Relay module terminations (5A22411H01) - (DO)	470
27.13	KUEP Style Relay module for DIN Rail Layout (5A22412G01 / 5A22412G02) - (DO)... ..	471
27.14	KUEP (2 Form C) Relay module Terminations (5A22412G01) - (DO)	472
27.15	KUEP (Form X) Relay module terminations (5A22412G02) - (DO).....	473
27.16	Terminal block wiring information - (DO)	474
27.17	Field connection wiring diagram - (DO)	475
27.18	Field connection wiring diagram (Group 1) (CE Mark) - (DO)	476
27.19	Wiring diagram to relay module (G2R or Solid State) locally powered - (DO).....	477
27.20	Wiring diagram to relay module (G2R or Solid State) - (DO).....	478
27.21	Wiring diagram to relay module (KUEP Style) locally powered (CE Mark) - (DO)	479
27.22	Wiring diagram to relay module (KUEP style remotely powered (CE Mark) - (DO)	480
27.23	Relay panel application diagrams - (DO)	481
27.24	Configuration/Status Register information - (DO)	484
27.25	Diagnostic Logic card LEDs - (DO).....	485
27.26	Specifications - (DO)	486

28 High Side Digital Output (24 VDC) module - (HSDO) (16 Channel) 489

28.1	16 Channel High Side Digital Output (24 VDC) module overview - (HSDO).....	490
28.2	Electronics modules (Emod) - (HSDO)	490
28.3	Personality modules (Pmod) - (HSDO)	490
28.4	Valid module combinations - (HSDO)	491
28.5	Module block diagram - (HSDO).....	491
28.6	Redundant module interconnection - (HSDO)	492
28.7	Field signal wiring information - (HSDO).....	493
28.8	Field power wiring information for module base unit terminal blocks - (HSDO)	494
28.9	Module cables for High Side Digital Output 24VDC - (HSDO)	495
28.10	HSDO to HSDO Cable Assembly Routing Information Redundant Configuration - (HSDO)	495
28.11	Module channel fault register - (HSDO)	496
28.12	Field power shutoff - (HSDO).....	496
28.13	Configuration/Status Register information - (HSDO)	497
28.14	Diagnostic logic card LED's - (HSDO)	501
28.15	Specifications - (HSDO)	503

29 Relay Output module (HROE) (32 Channel) 505

29.1	32 Channel Relay Output module overview (HROE).....	505
29.2	Electronics module (HROE)	506
29.3	Base assemblies (HROE)	506
29.4	Valid Emod and base combinations (HROE).....	506
29.5	32 Channel Relay Output Electronics module block diagram (HROE).....	507
29.6	Single channel illustration (HROE)	508
29.7	Terminal block wiring information (HROE).....	508
29.8	32 Channel non-fused relay base field wiring information (HROE)	509

29.9	32 Channel fused relay base field wiring information (HROE)	509
29.10	Power supply requirement for the 32 Channel Relay output module (HROE)	510
	29.10.1 Voltage requirements	510
	29.10.2 Power requirements	510
29.11	Configuration register information (HROE)	511
29.12	Status register information (HROE)	512
29.13	Channel Relay Output Emod Addressing	512
29.14	Channel Relay Output Emod Register (HROE)	513
29.15	Communication timeout (HROE).....	513
29.16	Blown fuse detection circuit (HROE).....	514
29.17	Diagnostic LEDs (HROE).....	514
29.18	Specifications (HROE)	515
30	Relay Output module - (RO)	517
30.1	Relay Output overview - (RO)	518
30.2	Electronics modules (Emod) - (RO)	518
30.3	Base assemblies - (RO)	518
30.4	Panel kits - (RO).....	519
30.5	External power supply information (RO)	519
30.6	Using bases (RO).....	520
30.7	Terminal block wiring information (RO).....	521
30.8	Base unit layouts - (RO).....	522
30.9	Field connection wiring diagrams for the Relay Output module	524
30.10	Field connection wiring diagrams (CE Mark) - (RO)	525
30.11	Configuration/Status Register information - (RO)	526
30.12	Blown fuse detection circuit (RO).....	528
30.13	Diagnostic Logic card LEDs (RO)	528
30.14	Specifications - (RO)	528
31	Relay Output with Contact Monitoring - (ROCM)	531
31.1	Relay Output with Contact Monitoring module overview - (ROCM).....	532
31.2	Electronics modules (Emod) - (ROCM)	532
31.3	Base assemblies - (ROCM)	532
31.4	Emod and base assembly combinations - (ROCM).....	533
31.5	External power supply information - (ROCM)	533
31.6	Operating temperature - (ROCM)	533
31.7	Configuration/Status Register information - (ROCM)	534
31.8	Base unit layouts - (ROCM)	536
31.9	Blown fuse detection circuit - (ROCM).....	537
31.10	Contact input monitoring circuits - (ROCM)	537
31.11	Terminal block wiring information - (ROCM).....	539
31.12	Field connection wiring diagram - (ROCM).....	540
31.13	Diagnostic Logic card LEDs - (ROCM)	540
31.14	Specifications - (ROCM)	540

32	Relay Output with Contact Monitoring (Fused) - (FRO)	543
32.1	Fused Relay Output module overview - (FRO)	544
32.2	Electronics modules (Emod) - (RO)	544
32.3	Base assemblies - (FRO)	545
32.4	External power supply information - (FRO)	545
32.5	Using bases - (FRO)	546
32.6	Terminal block wiring information - (FRO)	547
32.7	Base unit layouts - (FRO)	548
32.8	Field connection wiring diagrams - (FRO)	549
32.9	Configuration/Status Register information - (FRO)	550
32.10	Blown fuse detection circuit - (FRO)	552
32.11	Diagnostic Logic card LEDs - (FRO)	552
32.12	Specifications - (FRO)	552
33	Noise minimization and causes	555
33.1	Electrical noise and causes	555
33.2	Noise discrimination	556
33.3	Noise energy level	556
33.4	Noise frequency	557
33.5	Signal and noise sources	557
33.6	Noise sources	558
33.7	Noise classes	558
33.8	Noise rejection for digital signals	559
33.9	Analog signal noise rejection	559
33.10	Output signal noise rejection	559
33.11	Noise-sensitive circuit noise rejection	560
	33.11.1 Physical circuit separation	560
	33.11.2 Twisted-pair wiring	560
	33.11.3 Proper grounding and shielding	561
	33.11.4 Surge protection	561
33.12	Analog signal shielding techniques	562
33.13	Common input considerations	564
34	Defining and addressing the I/O for the Controllers	565
34.1	What is the process for planning the I/O for your system?	566
34.2	What are the Ovation I/O module base types?	567
	34.2.1 What is a standard I/O module base?	567
	34.2.2 What is a relay output module base?	567
34.3	What is an Ovation I/O module address?	568
	34.3.1 What are the guidelines for positioning I/O modules in cabinets?	568
	34.3.2 What is the addressing format for I/O modules?	569
	34.3.3 Examples of Controller cabinet I/O module addresses	571
	34.3.4 Examples of extended I/O cabinet module addresses	572
	34.3.5 Examples of remote node I/O cabinet module addresses	573

34.3.6	Examples of Relay Output module addresses.....	574
34.3.7	Q-Line I/O module addressing	575
34.4	What are the Ovation Controller I/O interfaces?	575
34.4.1	Network Interface ports	575
34.4.2	I/O interface ports.....	577
34.4.3	What are Small Form-factor Pluggable transceivers (SFPs)?	578
34.5	Common cabinet components (Controller, remote node, and extended cabinet)	578
34.5.1	Ovation Power Distribution Module (PDM)	579
34.5.2	Ovation Standard I/O Modules and Base Units	579
34.5.3	Relay Output Modules and Bases	580
34.5.4	I/O Dual Branch Transition Panel (ROP)	581
34.5.5	Ovation I/O Single Branch Transition Panels.....	582
34.5.6	Remote Node Controller (RNC)	583
34.5.7	Remote Node Transition Panel (TND)	584
34.5.8	MAU with typical fiber-optic connector pairs (OCR400 Controller and OCR1100 Controller).....	584
34.6	Common cabinet configurations.....	585
34.6.1	Controller cabinet components and cabling (local and remote I/O) (OCR400 Controller).....	585
34.7	Local I/O	586
34.7.1	Local I/O system configuration for the OCR400 Controller and OCR1100 Controller	587
34.8	Remote I/O	588
34.8.1	Remote I/O features (OCR400 Controller and OCR1100 Controller).....	589
34.8.2	Controller cabinet components (Remote I/O) (OCR400 Controller and OCR1100 Controller).....	589
34.9	Extended I/O cabinet components	591
34.10	Remote node cabinet components	594
34.10.1	Typical Remote Node Cabinet	596
34.10.2	Placing the MAU module.....	597
34.10.3	Remote node addressing switch.....	598
34.10.4	Daisy-Chain Control of I/O Branches	598
34.10.5	Power Supply	599
34.10.6	Example of typical MAU cable connections to Remote Nodes (OCR400 Controller).....	600
34.11	Selecting the I/O interface cards	601
34.12	What changes can you make to an I/O device?	601
34.12.1	To modify an I/O device	601
34.12.2	To modify an external Ovation networks device	601
34.13	General requirements for I/O cable.....	601
34.13.1	I/O communications cable (5A26141)	601
34.13.2	AUI Cable (5A26147)	602
34.13.3	Fiber-Optic Cable (3A98763 - Green) (3A98764 - Yellow)	602
34.13.4	Ovation Remote I/O Acceptable Optical Link Power Loss Budget	602
34.14	Power distribution scheme	605
35	I/O system status and diagnostic LEDs	607
35.1	Status LEDs for the Controller processor module.....	608
35.2	Diagnostic LEDs.....	610
35.3	MAU Module.....	610
35.4	RNC Module.....	611

36	Ovation Electronic ID	613
36.1	Electronic ID (EID)	613
36.2	Serial number	613
36.3	Index number	615
36.4	I/O Module EID programming format	617
	36.4.1 Serial number	617
	36.4.2 Index number	618
36.5	Bar code label	619
37	Compliance standards	621
37.1	CE Mark Certified systems.....	621
	37.1.1 CE Mark accuracy considerations	622
37.2	IEC61131-2 system.....	622
37.3	KC Compliance mark	622
38	Ovation power supply information	623
38.1	Power supply front view	624
	38.1.1 Diagnostic power supply LEDs	625
38.2	Power supply wiring illustration	626
38.3	Power supply wiring connections	627
38.4	Functional diagram.....	628
38.5	Power supply locking mechanism	629
38.6	Power supply specifications	629
39	Replacing power supplies	633
39.1	Power supply replacement cautions	633
	39.1.1 To replace redundant power supplies.....	633
40	Using an external power supply	635
40.1	What is an external supply?	635
	40.1.1 To prepare for connecting an external power supply.....	636
	Index	641

SECTION 1

I/O Module general information

IN THIS SECTION

<i>Overview</i>	<i>17</i>
<i>Ovation I/O module features</i>	<i>18</i>
<i>I/O reference terminology.....</i>	<i>18</i>
<i>Installing Ovation modules</i>	<i>22</i>
<i>Ovation module configuration and status.....</i>	<i>22</i>
<i>Ovation module diagnostic LEDs</i>	<i>23</i>
<i>Replacement of user serviceable fuses</i>	<i>23</i>
<i>Personality module jumpers.....</i>	<i>25</i>
<i>I/O environmental specifications</i>	<i>26</i>
<i>Standard module components</i>	<i>27</i>
<i>Relay module components.....</i>	<i>30</i>

1.1 Overview

The Ovation I/O Reference manual provides general information of standard Analog and Digital Ovation I/O modules.

For information on Bus and Specialty modules, refer to the [Ovation Bus and Specialty I/O Reference Manual](#). Information on Bus and Specialty modules is also available in the following module specific user guides:

- [DeviceNet User Guide for Ovation](#).
- [Ethernet Link Controller User Guide for Ovation](#).
- [Foundation Fieldbus User Guide for Ovation](#).
- [Profibus User Guide for Ovation](#).
- [Servo Driver User Guide for Ovation](#).
- [Valve Positioner User Guide for Ovation](#).
- [Ovation to Numalogic Fast Ethernet Remote Node](#).

For information on Q-line to Ovation I/O module conversion, refer to the following manual:

- [Q-Line I/O to Ovation I/O Migration Reference Manual](#).

1.2 Ovation I/O module features

- Ovation I/O is available in both remote and local configurations.
- Modular, plug-in components.
- Quick installation and configuration of the modules.
- DIN Rail mounting of the I/O Base Units.
- Wiring schematic labels are provided on Personality modules and cavity inserts.
- Wiring directions (Normally Closed, Normally Open, Common) are provided on the Base Unit for Relay Output modules.
- Writable surface labels are provided on Electronics modules so that up to 16 point names can be identified on each label.
- The labels on the Personality and Electronics modules are color-coded to match the appropriate modules.
- Unique base unit interconnection scheme eliminates most power and communications wiring.
- Module style, group, serial number, and revision are stored electronically on each I/O module.
- Hot swapping capabilities streamline maintenance. (See *Planning Your Ovation System*.)
- Status indicators that display standardized diagnostic LED color codes.
- Up to 128 Local Ovation module units per Controller.
- Up to 1024 Remote Ovation module units per Controller.
- Base Unit common to all Standard I/O modules.
- Two Base Unit styles (G2R and KUEP) are available for Relay Output modules.
- Test-point/probe holder on each field terminal of standard I/O Base Units.
- Built-in spare fuse holders and wire strip gauge, located on top of the middle plastic separator section (between the terminal strips) of a base unit.
- Most modules are CE Mark compliant.

1.3 I/O reference terminology

TERM	DESCRIPTION
AWG	American wire gauge is used in the United States as a standard method of denoting wire diameter. Increasing gauge numbers give decreasing wire diameters. Outside of North America, wire sizes for electrical purposes are usually given as the cross sectional area in square millimeters.
A Side	Refers to the left side board-to-board connector of the base unit when the terminal block or AUI Cable connector is facing the viewer. Also can refer to the Controller cabinet or the "A" cabinet.
Attention	The Ovation I/O bus cycle status when the Electronics module returns a reply requesting attention.
B Side	Refers to the right side board-to-board connector of the base unit when the terminal block or AUI Cable connector is facing the viewer. Also can refer to the Termination cabinet or the "B" cabinet.

TERM	DESCRIPTION
Base Unit	The DIN Rail mounted Ovation Base serves as the mechanical means to hold & secure the Ovation I/O Electronics and personality modules while providing an electrical interface between customers field connections, Ovation I/O controller & transition panels. The Ovation Bases when connected together form the Ovation I/O bus used by the Ovation controller to communicate with its I/O subsystem and the distribute power to the I/O modules. Each standard 2-slot base can house up to two sets of electronic and personality I/O modules, while 4-slot base units can house up to four sets of I/O modules.
Base Unit, Relay Output	The Relay Output base unit houses one Electronics module.
Branch	A set of two 4-slot base units or four standard 2-slot bases configured consecutively on a DIN rail with a local Ovation I/O bus being connected to the Ovation Controller. A Maximum of eight I/O modules is supported on a branch.
Chatter Control Flag	A bit indicating the input channel has changed states enough to be checked until the flag is reset.
Chattering	A condition when the input changes exceeded a specified number in the time between when the DPU read the event buffer, or the rate of input changes exceed a specified amount.
Contact Input	An input where the electronics module supplies the contact wetting voltage.
Controller	Interface between the Network and the I/O. The Controller is typically located in the Ovation I/O or "A" cabinet. OCR400 or OCR1100. (See <i>Planning Your Ovation System</i> .)
Current Sinking Digital Input	A digital voltage input circuit made of an input voltage protection, a serial current limiting circuit and an output interface. Each channel circuit terminates the connection between the logic input and its associated high side sensor or switch. Any short circuit to the reference potential or field wire breakages are interpreted as the "off" or "0" state.
Electronics module	A plastic housing with associated lenses and labeling that contains the necessary electronics to interface between field devices and the Ovation I/O bus. Electronics modules are inserted directly into a base unit.
Event	A digital input change of state detected by the Ovation Higher Density Digital Input electronics module
FPGA	Field Programmable Gate Array. A standard off-the-shelf user-configuration integrated circuit that is used to implement custom logic functions.
Galvanic Isolation	The principle of isolating functional sections of electronic circuits so that charge-carrying particles cannot move from one section to another, for example, there is no electrical current flowing directly from one section to the next. Energy and/or information can still be exchanged between the sections by other means, however, such as by capacitance, electromagnetic waves, or mechanical means.
High Density Base Unit	This Base Unit consists of a printed circuit card, various connectors, and plastic housing. The Base Unit provides a mechanism to land field wiring and provide a connection from the field signals to the personality module and then to the electronics module. The Base Unit enables the electronics module to receive power and communicate over the I/O bus and provides a low-impedance earth-ground connection. Each Base Unit can house four sets of Electronics and Personality Modules, along with the associated field wiring.
Hot swappable	Provides the capability of removing and installing the I/O module from the Base Unit with power applied.
IOIC Card	Generic name for the Controller PCI I/O Interface card. The OCR400 Controller and OCR1100 Controller only need the IOIC module.

TERM	DESCRIPTION
IOSC	The I/O Slave Controller FPGA, located on every Electronics Module, provides a slave interface to the master controllers.
I/O Module	Standard I/O modules are made up of an Electronics module and a Personality module. These modules perform the interface between the I/O Controller and the field devices. Compact modules and Relay Output modules do not contain a Personality module.
LSB	Least significant bit.
MAU	Media Attachment Unit (MAU) is an alternate name for the Attachment Unit Module and includes the Electronics module and Personality module combined. This device interfaces the PCRR card (via the AUI cable) to the RNC (via fiber-optic cable) in remote I/O applications.
MSB	Most significant bit.
Node	Active element on a Fast Ethernet network that has an address. Can be a station or a switch. Up to 1000 nodes are permitted per network.
Ovation Network	Local area network in which Ovation drops communicate with each other through Fast Ethernet media.
Partial Rotation	A partial rotation is directly associated with sample. Samples, representing pulses and time elapsed for those pulses, are combined each sample period into the pulse count and time elapsed for a full rotation. Typically, a partial rotation is what is sampled.
Personality module	Portion of an I/O module that provides a plastic housing with associated lenses and labeling. It contains a printed circuit board to perform the necessary signal interconnections required for interfacing the I/O modules to particular field devices. Typically, the module contains only passive components, but the Media Attachment Unit module and Remote Node Controller module contains fiber-optic transmitters, receivers, and transceivers in their Personality modules. The Link Controller I/O module contains optical couplers and RS-232/RS-485 transceivers in its Personality module. The module plugs directly into the base.
Remote I/O	A configuration where the I/O is located remotely from the Controller.
Remote Node	A grouping of I/O modules that communicates with the Controller via media that can carry control signals over a long distance (for example, fiber-optic).
RNC	Remote Node Controller (RNC) is an alternate name for the module containing the Remote Node Electronics module and Remote Node Personality module. The RNC interfaces the I/O modules in the Remote Node to an MAU module at the Controller via a fiber-optic communication link.
Rotation Time	The time of a full rotation of the toothed wheel given in 24 MHz timer ticks. Normally the rotation time is the summation of a number of sample times.
Router	A hardware or software set-up that handles the connection between two or more networks.
SCSI	Small Computer System Interface, a peripheral-connect interface used to connect hard drives, CDROM drives, and other storage devices to a computer.
Server	A computer, or software program that provides a specific kind of service to client software running on other computers.
Single attachment	Connection to one switch. A Single Attached Station (SAS) is a node that is connected to one switch.

TERM	DESCRIPTION
SNMP	Simple Network Management Protocol. Network management protocol of TCP/IP. Monitors and reports about the activity in various devices on the network. This information is maintained in a structure known as a management information block.
Software Server	A drop on a network that provides storage and control of system software files.
Station	Addressable node on Fast Ethernet network; can transmit and receive data.
Synchronous	High speed data communication that is time critical. Must be guaranteed service for nodes transmitting synchronous data. Typically provided periodically.
System ID	System Identification number. The network reference number for each point which may be transmitted.
TCP/IP	Transmission Control Protocol / Internet Protocol, a set of communication protocols that allows dissimilar computers to share information over a network.
Termination cabinet	Refers to the Ovation "B" cabinet. The termination cabinet houses termination block locations to land internal and external wiring.
Transition Panels	Types are: ROP - I/O transition panel. TND - Remote Node transition panel. RRP - Relay Base transition panel (top location). RRB - Relay Base transition panel (bottom location).
Watchdog Timer	A timer which, if allowed to expire, will reset the microcontroller.
Working area	Part of the Master Database that is used when working with the system. This is where all interaction with the database takes place. This is the only part of the database that can be edited.
Workstation	Windows-based computer that receives and sends data in order to perform any operations needed to run a process. These workstations (drops) are typically connected to a switch, which is, in turn, connected to the Ovation network.

1.4 Installing Ovation modules

Standard and Compact I/O modules

The Ovation standard and compact modules are installed in base units mounted on DIN rails in Ovation cabinets. Each base unit can contain two I/O modules, and even if you only use one I/O module, you must still use a base unit that contains two terminal blocks.

Relay Output modules

The Ovation Relay Output modules are installed in base units mounted on DIN rails in Ovation cabinets. Each base unit can contain one Relay Output Electronics module and the appropriate relays.

There are two styles of Relay Output Base Units (see page 30):

- 1C31223 (16 G2R relays)
- 1C31222 (12 KUEP relays)

DIN rails and modules are typically installed at the factory according to system requirements. If you need to replace or add Relay Output modules to your system, refer to the [Planning Your Ovation System](#) reference manual.

1.5 Ovation module configuration and status

An Ovation I/O module has 16 address locations, but a module might not use all 16 addresses.

There are four possible address locations in each I/O module that are reserved for special use. Three of these addresses provide configuration (Write) and status (Read) information.

Definitions for these locations are provided for each module in the module reference pages:

- **Address word 13** (D in Hex) is present for every module and is used for configuration and status. The module status provides diagnostic information that is read by the Controller when it is online. The status register can be read by using the Point Information window at an Ovation Operator Station. The Bit Pattern Field can be read on the Hardware Tab of the Point Information window (See the [Ovation Operator Station User Guide](#).)
- **Address word 14** (E in Hex) is used as a secondary or expansion configuration register and is only used when needed.
- **Address word 12** (C in Hex) is used for reporting point specific fault information and optionally as an expansion configuration register.
- **Address word 15** (F in Hex), is used for the module Electronic ID (see page 613) information. This location and its use are identical for all modules.

Configuration settings for these registers for each point can be viewed in the [Ovation Developer Studio User Guide](#).

1.6 Ovation module diagnostic LEDs

Each Ovation module contains diagnostic LEDs. The LEDs are used to indicate the status of the module and to alert you to any module problems.

Ovation I/O modules typically contain the following LEDs:

- **P** = (Green) Power OK LED is lit when the power supply to the module is good.
- **C** = (Green) Communications OK LED is lit when the Controller is communicating with the module, and when the communication watchdog timer is not timed out.
- **E** = (Red) Optional External Error LED is lit when there is a problem external to the module, such as a blown common auxiliary power supply fuse.
- **I** = (Red) Internal Fault LED is lit when a failure internal to the module has occurred. This LED is typically an indication that the Electronics module needs to be replaced.

Note: A communication timeout also lights the Internal Fault LED and turns off the Communications OK LED.

The other LEDs for each module vary according to the functions of the module. Definitions for LEDs are provided for each module in their individual sections.

1.7 Replacement of user serviceable fuses

Some Electronics modules (Emods) and Personality modules (Pmods) may contain fuses. These fuses are typically 5 x 20 mm micro-fuses, and are located for easy replacement.

1.7.1 Electronics module fuses

If a fuse needs to be replaced, push the fuse cap in, turn it one-quarter turn counter-clockwise and the fuse can be removed. Replace the blown fuse with an exact replacement fuse. Fuse sizes are indicated on the Electronics module label. Refer to the following table for descriptions of fuses used by Ovation Electronics modules.

Note: Typically, replaceable fuses for CE Mark Certified systems are noted on your project drawings and include the fuse type and the fuse rating. Fuses should only be replaced by qualified technicians.

TYPE	RATING	MODEL	PART #
5 x 20 mm cartridge	0.50A; 250V; Fast acting	Compact Digital Input Emod (1C31232G01) Compact Sequence of Events Emod (1C31233G01)	EX06100

1.7.2 Personality module fuses

If a 5x20 mm cartridge fuse needs to be replaced, push the fuse cap in, turn it one-quarter turn counter-clockwise and the fuse can be removed. Replace the blown fuse with an exact replacement fuse. Fuse sizes are indicated on the Personality module label. Refer to the following table for descriptions of fuses used by Ovation Personality modules.

If the fuse is a micro fuse, pull the blown fuse out of its holder and plug the replacement fuse into the vacated holder.

Note: Typically, replaceable fuses for CE Mark Certified systems are noted on your project drawings and include the fuse type and the fuse rating. Fuses should only be replaced by qualified technicians.

TYPE	RATING	MODEL	PART #
5 x 20 mm ²	0.50A; 250V ¹	Digital Input Pmods Sequence of Events (1C31110G01)	EX06100
5 x 20 mm ²	0.063A; 250V ¹	Analog Input Pmods 1C31116G02 - G03 Loop Interface Pmods 1C31177G02 - G03	EX06102
5 x 20 mm ²	0.63A; 250V ¹	Pulse Accumulator Pmods 1C31150G01 - G03	EX06071
5 x 20 mm ²	1.0A; 250V ¹	Relay Base 16 G2R - 1C31223G01	EX06104
5 x 20 mm ²	1.25A; 250V ¹	Loop Interface Pmods 1C31177G01 - G03 Digital Output Pmods - 1C31125G01 Valve Positioner Pmods 1C31197G01 - G04 Relay Panels (Solid State) 5A22410H01 - H02 Relay Panels (16 G2R) - 5A22411H01	EX06098
5 x 20 mm ²	2.0A; 250V ¹	Relay Panels (8 KU) - 5A22412H01 Relay Base (12 KUEP) - 1C31222G01	EX06105
5 x 20 mm ²	3.15A; 250V ¹	Digital Output Pmods - 1C31125G02	EX06101
Micro-Fuse ³	0.5A; 125V ¹	16 Point Individually fused, Digital Input Pmod - 5X00034G01 HART Analog Input Pmods 5X00063G01	1X00030H02
Micro-Fuse ³	0.063A; 125V ¹	HART Analog Input Pmods Analog Inputs - 5X00059G01	1X00030H01
Micro-Fuse ³	0.6A; 125V ¹	HART Analog Output Pmods 5X00063G01	1X00030H05
¹ Fast Acting ² Cartridge ³ Plug-in			

1.7.3 Ovation cabinet fuses

In addition to Personality module fuses, there are other fuses that are user serviceable. Refer to the following table for descriptions of fuses used in Ovation cabinets.

TYPE	RATING	MODEL	PART #	NOTES
Micro-Fuse	5.0A; 250V; Fast acting	CBO Backplane 3A99200G01 - G02 ROP Panel 4D33922G01 TND Panel 4D33924G01 RRP Panel 3A99252G01 RRB Panel 3A99253G01	4A00120H01	Auxiliary power Branch fuses CBO: F1 -F4 ROP: F1, F2, F7, F8 TND: F1, F2, F6, F7 RRP: F1, F2 RRB: F1, F2
0001.2515 Schurter	12.5A; 5x20; 250VAC; 125VDC Type T	Power Distribution Panel 5X00489G01	1X00728H01L	AUX Power Fuse F1

1.8 Personality module jumpers

Most Ovation Personality modules do not have configurable jumpers. However, if a module does have configurable jumpers, and the default settings need to be changed, the card must be removed from the Personality module case in order to be configured. Use the following procedure to open a Personality module case:

Note: Be sure to observe static electricity guidelines.

1. Use a small straight-edge screwdriver to press in one of the clips located on the side of the module until the module cap is loosened. Remove the module cap.
2. Push both clips on the module bottom outward until the card is free to slide.
3. Slide the card out the top of the module and make the desired jumper changes.
4. Slide the card back into the module case, being sure the card is positioned in the card channels, and the bottom clips are engaged.
5. Replace the module cap.

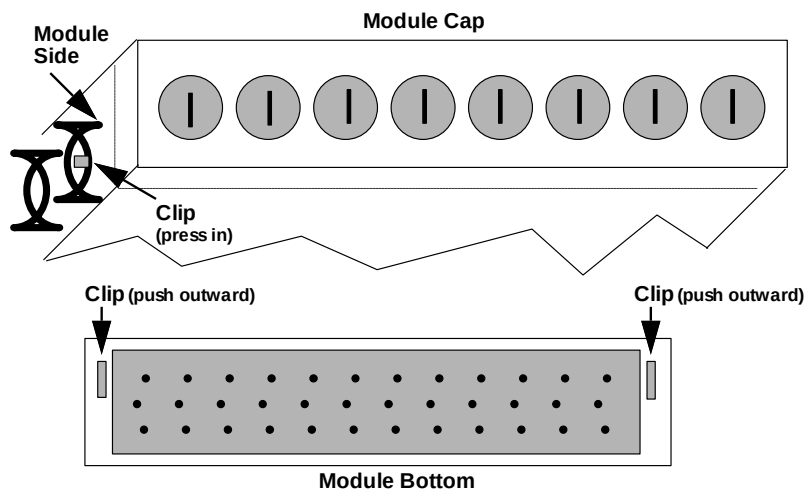


Figure 1: Module Cap

1.9 I/O environmental specifications

The following tables provide common environmental specifications for the Ovation I/O modules.

I/O Module specifications

DESCRIPTION	MINIMUM VALUE	MAXIMUM VALUE
Temperature	0°C (32°F) Operating - 40°C (-40°F) Storage	60°C (140°F) Operating 85°C (185°F) Storage
Humidity (non-condensing)	0% Operating	95% Operating 90% Operating (CE Mark) Maximum wet bulb temp 35°C

Relay Output module specifications

DESCRIPTION	MINIMUM VALUE	MAXIMUM VALUE
Temperature ¹ Relay Output G2R/KUEP Form X Relay Output KUEP Form C	0°C (32°F) Operating - 40°C (-40°F) Storage 0°C (32°F) Operating - 40°C (-40°F) Storage	60°C (140°F) Operating 70°C (158°F) Storage 45°C (113°F) Operating 50°C (122°F) Storage
Humidity (non-condensing) Relay Output G2R Relay Output KUEP Form X/Form C	35% Operating N/A	85% Operating Maximum wet bulb temp 35°C N/A
¹ See Relay Output Module (see page 518) for additional temperature and derating information relative to specific cabinet configuration.		

1.10 Standard module components

Standard I/O modules combine special Personality modules with Electronics modules in order to operate at a wide range of signals, and perform a multitude of functions.

The standard Ovation modules are illustrated below and consist of the following:

- Base Units (containing I/O bus power, signals, and field terminations).
- Electronics modules.
- Personality modules (foam inserts are used instead of Personality modules for some I/O modules).

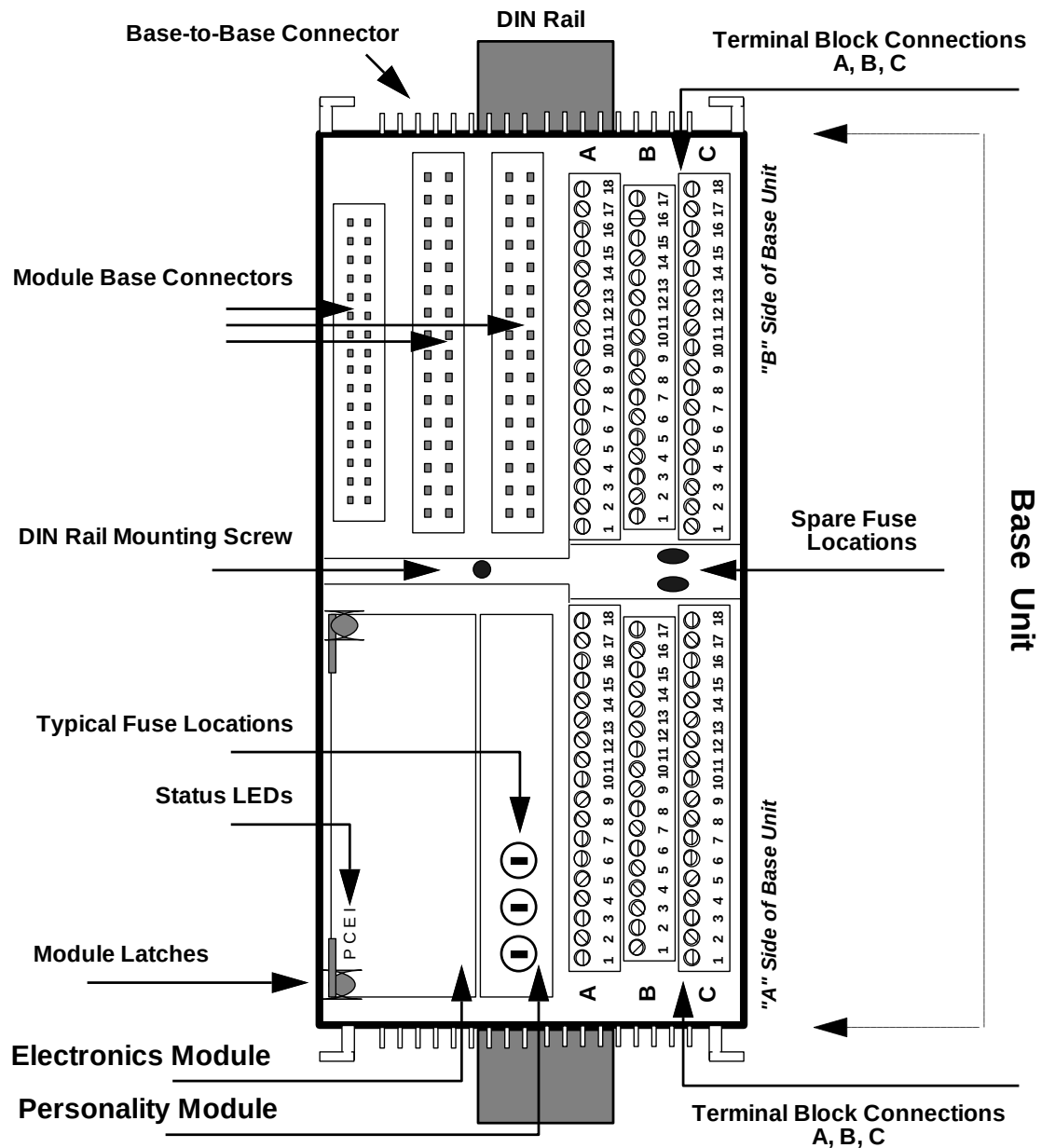


Figure 2: Ovation modules (Top View)

1. Base Unit

The base unit (containing two terminal blocks) mounts onto a DIN rail. Each base unit accommodates two I/O modules.

The footprint of the base unit (containing Electronic and Personality module) is:

27.9 cm Long (11 in)

12.7 cm Wide (5 in)

16.5 cm High (6.5 in)

If you use only one I/O module, you still must use a base unit that contains two terminal blocks.

For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See *Marshaling Base Unit* (see page 30) for more information.

CAUTION! For CE Mark Certified Systems:

Base units containing differential digital input modules configuration with hazardous input voltages (>30 V RMS, 42.4 V peak, or 60 VDC) listed in the following table must include a hazardous voltage warning label (1B30025H01) on that base unit. Hazardous voltage is present on the individual module terminal blocks and module connector(s).

Differential digital input module configurations with hazardous input voltages

CONFIGURATION	EMOD	PMOD
125VAC/VDC Digital Input (Diff)	1C31107G02	1C31110G02
125VAC/VDC Compact Digital Input (Diff)	1C31232G03	1C31238H01
125VDC Sequence of Events (Diff)	1C31157G02	1C31110G02
125VDC Compact Sequence of Events (Diff)	1C31233G03	1C31238H01
125VDC Enhanced Compact Sequence of Events (Diff)	5X00357G03	1C31238H01

CAUTION! Base units containing single-ended or fused digital input modules with hazardous voltages (>30 V RMS, 42.4 V peak, or 60 VDC) listed in the following table must include a hazardous voltage warning label (1B30025H01) on the base unit as well as ALL base units of the branch. Hazardous voltage is present on terminal block and module connectors of bases on an entire branch. In addition, auxiliary power fuses must be removed and a fuse cover kit should be added (see page 635).

Base units containing single-ended or fused digital input modules with hazardous voltages

CONFIGURATION	EMOD	PMOD
125VAC/VDC Digital Input (Sing)	1C31107G02	1C31110G01
125VAC/VDC Compact Digital Input (Fused)	1C31232G03	5X00034G01
125VDC Sequence of Events (Sing)	1C31157G02	1C31110G01
125VDC Compact Sequence of Events (Fused)	1C31233G03	5X00034G01
125VDC Enhanced Compact Sequence of Events (Fused)	5X00357G03	5X00034G01

CAUTION! Hazardous labels must be placed in a visible location on the base unit, preferably above the spare fuse location. This information is indicated in the application specific project drawings.

2. **Electronics module** (Emod)

The Electronics module (configured by adding the appropriate Personality module) fits into the base unit.

3. **Personality module** (Pmod)

The Personality module (configures the Electronics module) fits into the base unit beside the appropriate Electronics module.

Note: *The Personality module is installed in the base unit **first**. Then, the Electronics module is installed and interlocks with the Personality module. The blue corner latches on the Electronics module locks both modules into the base unit.*

Wires from customer field devices are connected to terminal block in the base unit.

The wiring connections to the terminal block for each combination of Electronics module and Personality module are printed on each Personality module, and are illustrated in each module description in the following sections.

1.10.1 Marshalling Base Unit (5X00334G01)unit

Cable Connector (1X00439H01)

The Ovation Marshalling Base Unit serves as an interface between the field connections, the I/O bus, and the Personality and Electronics Modules. The I/O bus is used by the Controller to communicate with the I/O subsystem via the Ovation Marshalling Base Unit Backplane. Power is also distributed to the Electronics Modules via the I/O bus.

The Ovation Marshalling Base Unit is similar to the Ovation I/O Base (1B30035) except the field termination terminal block is replaced with 17 Pin Headers. The Headers are mated to a plug with a screw flange and with a 17-position screw connection. This arrangement allows the use of pre-fabricated cables for the field wiring and provides secure anchoring of the cable.

The following figure depicts the Marshalling Base Unit identifying the Aux power terminals (+) A17 and (-) B17.

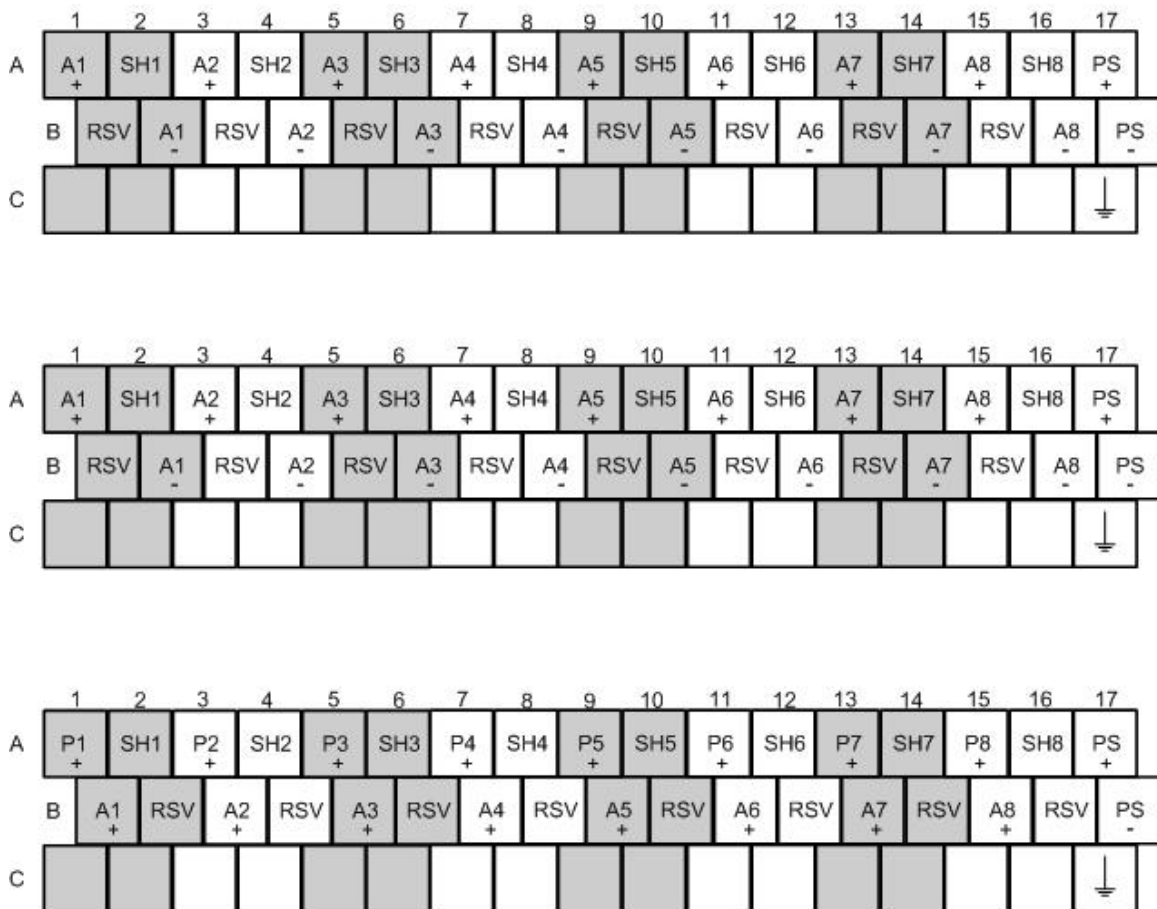


Figure 3: Marshalling Base Unit

1.11 Relay module components

The Ovation Relay module consists of two parts, refer to the following figures:

1. Base Unit

The relay base assembly consists of a backplane with connectors, a plastic housing, and a DIN rail clamping/grounding mechanism. This unit accommodates the relays for interfacing with field devices.

2. Relay Output Electronics module

The relay output Electronics module is an on-line replaceable module that provides the relay output circuit board. This board contains relay coil drive interfacing as well as I/O bus and bus power interface. This module plugs into the desired relay output base unit.

The wires from the customer field devices are connected to the terminal block in the base unit.

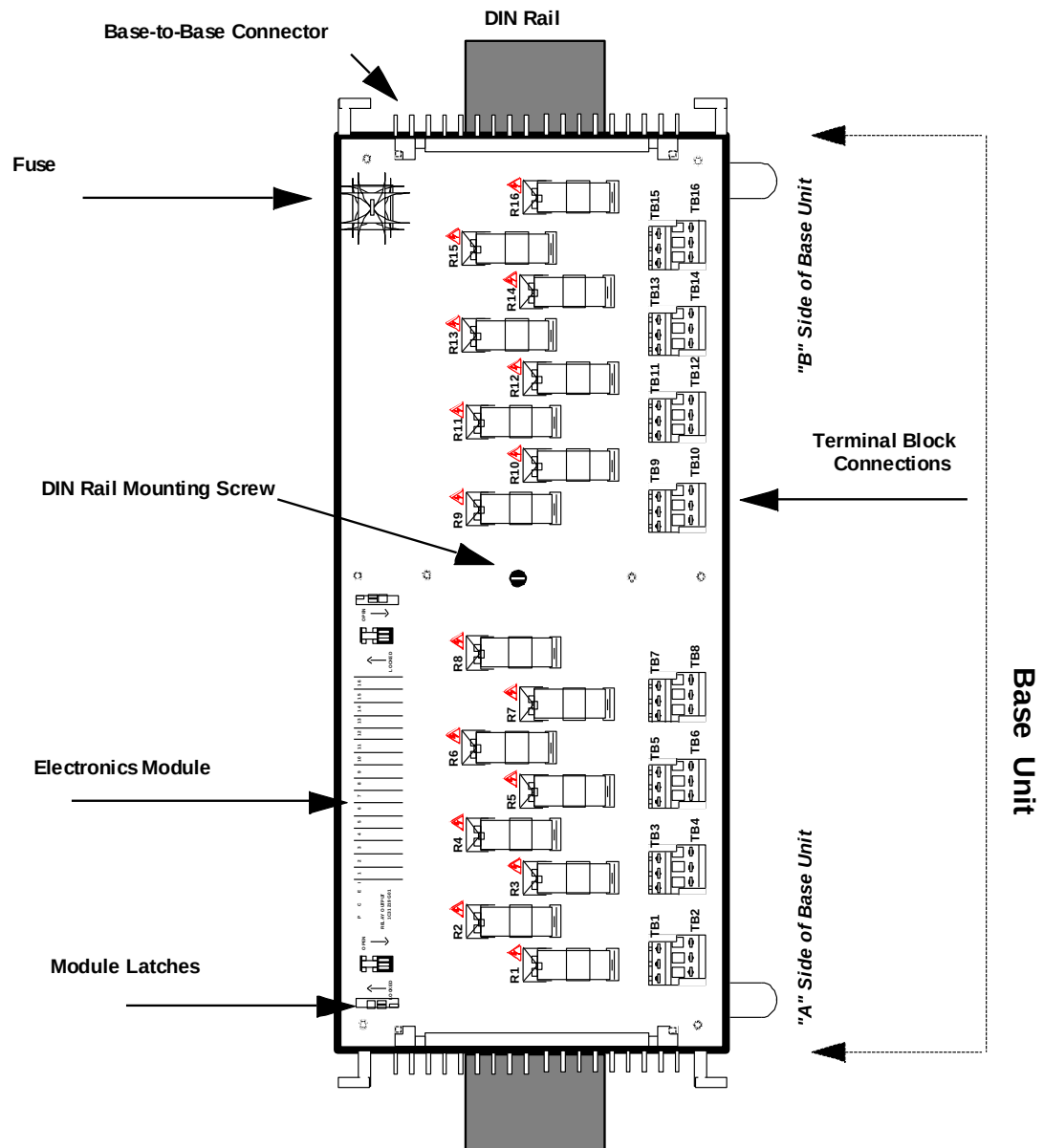


Figure 4: Relay Output Panel G2R

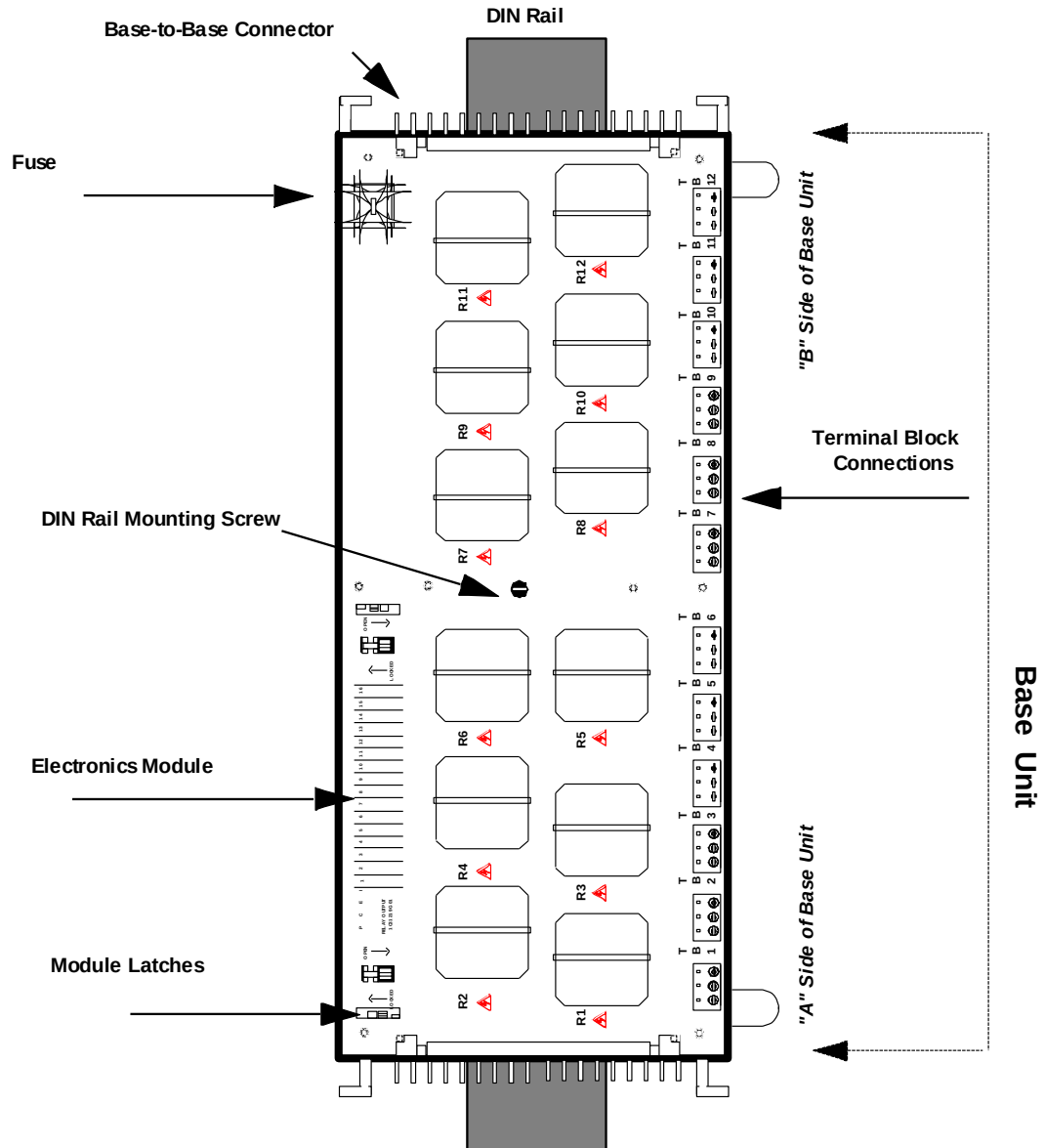


Figure 5: Relay Output KUEP

SECTION 2

I/O Module configurations

IN THIS SECTION

<i>Analog Input modules</i>	35
<i>Analog Output modules</i>	36
<i>Digital Input modules</i>	37
<i>Digital Output modules</i>	40
<i>Specialty I/O modules</i>	41
<i>Bus Interface modules</i>	42

2.1 Analog Input modules

The following Ovation Analog Input modules are available:

- 16 Channel Analog Input 4-20mA.
- Analog Input (13 bits) (Legacy product).
- Analog Input (14 bits).
- Analog High Speed Input (14 bits).
- HART Analog Input.
- HART High Performance Analog Input.
- RTD (4-Inputs).
- RTD (8-Inputs).

Analog Input modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
5X00501	16 Channel Analog Input module 4-20mA (see page 45).
5X00070	8 Channel Analog Input high speed module (14-Bit) - (High Speed) (see page 111).
1C31224	8 Channel Analog Input module (14-Bit) - (AI-14) (see page 83). (Std Speed)
1C31113	8 Channel Analog Input module (13-Bit) - (AI-13) (see page 95). (Legacy)
5X00058	8 Channel HART Analog Input module - (HAI) (see page 111).
5X00106	8 Channel HART High Performance Analog Input module - (HHPAI) (see page 125).
1C31161	4 Channel RTD Input module - (RTD-4) (see page 141).
5X00119	8 Channel RTD Input module - (RTD-8) (see page 151).

16 Channel 4-20mA Analog Input module - provides an interface between the Ovation Controller and 16 field devices that use a 4-20mA current loop. Up to 16 4-20mA (2-wire or 4-wire) transmitters can be connected per module.

Analog Input module (13 bits) - (Legacy product) - provides an interface to eight galvanically isolated analog inputs with sampling rates of approximately 10 time/sec. Several voltage and current configurations are available including cold junction compensation for thermocouple inputs.

Analog Input module (14 bits) - provides an interface to eight galvanically isolated analog inputs with a minimum sampling rate of 10 time/sec. A low cost 4-20 mA current input is available along with a 1V voltage input (legacy) configuration.

Analog Input High Speed module (14-Bit) - provides an interface to eight galvanically isolated analog inputs with sampling rates of medium speed (16/20 time/sec.) or high speed (50/60 times/sec.). Several voltage and current input configurations are available including cold junction compensation for thermocouple inputs.

HART Analog Input module - provides an interface for eight galvanically isolated HART field devices with 4-20 mA current loop analog inputs (common reference). In addition to the analog inputs, digital information can be exchanged between HART compliant devices and the Controller.

HART High Performance Analog Input module - provides an interface for eight galvanically isolated HART field devices with 4-20 mA current loop analog inputs. In addition to the analog inputs, digital information can be exchanged between HART compliant devices and the Controller.

RTD module (4 Channel) - provides an interface to four galvanically isolated Resistance Temperature Detectors. Several 3 and 4 wire RTD types are supported. A 50/60 Hz filtered configuration is available for CE Mark applications.

RTD module (8 Channel) - provides an interface to eight galvanically isolated Resistance Temperature Detectors. Several 3 and 4 wire RTD types are supported.

2.2 Analog Output modules

The following Ovation Analog Output module are available:

Analog Output modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
1C31129	4 Channel Analog Output module - (AO) (see page 161).
5X00062	8 Channel HART Analog Output module - (HAO) (see page 173).
5X00167	4 Channel HART High Performance Analog Output module - (HHPAO) (see page 187).

Analog Output module - provides an interface to four galvanically isolated analog outputs using 12-bit digital-to-analog converters.

HART Analog Output module - provides an interface for eight galvanically isolated HART field devices using 4-20 mA current loop analog outputs (common reference). In addition to the analog outputs, digital information can be exchanged between HART compliant devices and the Controller.

HART High Performance Analog Output module - provides an interface for four galvanically isolated HART field devices using 4-20 mA current loop analog outputs. In addition to the analog outputs, digital information can be exchanged between HART compliant devices and the Controller.

2.3 Digital Input modules

The following Ovation Digital Input modules are available:

- 32 Channel 24V DC Digital Input.
- Digital Input (16 Channel).
- Compact Digital Input (16 Channel).
- Contact Digital Input (16 Channel).
- Compact Contact Digital Input (16 Channel).
- Sequence of Events Digital Input (16 Channel).
- Sequence of Events Contact Digital Input Field Interface (16 Channel).
- Sequence of Events Compact Digital Input Field Interface (16 Channel).
- Enhanced Compact Sequence of Events Digital Input (16 Channel).
- Redundant Digital Input (Windows Ovation 3.2 and above) (16 Channel).

Digital Input modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
5X00499	32 Channel 24 VDC Digital Input module (see page 201).
1C31107	16 Channel Digital Input module - (DI) (see page 207).
1C31232	16 Channel Compact Digital Input module - (CompactDI) (see page 217).
1C31142	16 Channel Contact Digital Input module overview - (ContactDI) (see page 239).
1C31234	16 Channel Compact Contact Digital Input module - (CCDI) (see page 251).
1C31157	16 Channel Sequence of Events Digital Input module - (SOEDI) (see page 265).
1C31157	16 Channel Sequence of Events Contact Digital Input Field Interface module - (SOEContactDI) (see page 279).
1C31233	16 Channel Sequence of Events Compact Digital Input Field Interface module 1 - (SOECompactDI) (see page 289).
5X00357	16 Channel Enhanced Compact Sequence of Events Digital Input module - (ECISOEDI) (see page 321).
5X00411	16 Channel Redundant Digital Input module - (RDI) (see page 397).

32 Channel 24V DC Digital Input module - monitors the state ("0" or "1") of 32 single-ended field digital inputs. The 32 Channel 24V DC Digital Input module is designed to meet IEC 61131-2 type 3 characteristics for 24VDC digital inputs in industrial automation.

Digital Input module - provides an interface for 16 current-sinking digital inputs using a Personality module. Various input configurations are available.

Redundant Digital Input module – provides 16 digital channels to monitor the states ("0" or "1") of 16 field digital inputs. The module contains two voltage sensing circuits for each of the 16 I/O channels located on the module. Redundant power for all 16 digital input channels is either supplied by the Ovation auxiliary power supply or by an external 24V auxiliary power source. In either situation, the redundant pair module shares a common 24VDC auxiliary power source.

Compact Digital Input module - provides a low cost interface for 16 current-sinking digital inputs without requiring a personality module.

Contact Digital Input module – provides an interface for 16 current-sourcing digital (contact) inputs using a personality module. The following input configuration is available: 48 VDC (single-ended – channels have a common return, which is the return for the on-module 48 VDC current limited contact wetting power supply).

Compact Contact Digital Input module – provides a low cost interface for 16 current-sourcing digital (contact) inputs without requiring a personality module. The following input configuration is available: 48 VDC (single-ended – channels have a common return, which is the return for the on-module 48 VDC current limited contact wetting power supply).

Sequence of Events Digital Input module – provides an interface for 16 digital inputs using a personality module. The Sequence of Events module monitors the states of the 16 digital inputs and uses digital filtering to reject state changes less than 4 msec. It performs event tagging and chatter control for each digital input.

Sequence of Events Contact Digital Input Field Interface module - provides 16 contact input current detecting channels with common returns.

Sequence of Events Compact Digital Input Field module – provides a low cost interface for 16 digital inputs without requiring a personality module. The Compact Sequence of Events module monitors the states of the 16 digital inputs and uses digital filtering to reject state changes less than 4 msec. It performs event tagging and chatter control for each digital input.

Enhanced Compact Sequence of Events Digital Input module – provides a low cost interface for 16 digital inputs without requiring a personality module. The Enhanced Compact Sequence of Events module monitors the states of the 16 digital inputs and uses digital filtering to reject state changes less than 4 msec. It performs event tagging and chatter control for each digital input. Unlike other Ovation Sequence of Events (SOE) modules, the Enhanced Compact Sequence of Events module also offers a field digital input state change detection feature (SOE One Shot).

2.4 Digital Output modules

The following Ovation Digital Output modules are available:

- 24 VDC Digital Output (32 Channel).
- Digital Output (16 Channel).
- High Side Digital Output (24 VDC) (16 Channel).
- Relay Output (32 Channel).
- Relay Output with Contact Monitoring.
- Fused Relay Output.

Digital Output modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
5X00500	32 Channel 24 VDC Digital Output module (see page 449).
1C31122	16 Channel Digital Output module (DO) (see page 457).
5X00270	16 Channel High Side Digital Output (24 VDC) module - (HSDO) (see page 489).
5X00583	32 Channel Relay Output module (HDSOE) (see page 505).
1C31219	Relay Output module - (RO) (see page 517).
1C31219	Relay Output with Contact Monitoring - (ROCM) (see page 531).

32 Channel 24 VDC Digital Output module - contains 32 24-volt single-ended digital output channels. Each digital output channel is capable of sourcing up to 500 mA of output current with a 2A maximum total output current limit per module.

Digital Output module - provides a means to switch up to 60 VDC at moderate currents (for example, relay coils and lamps). The Digital Output module contains 16 current sinking transistor outputs capable of switching 60 VDC loads at up to 500mA.

High Side Digital Output (24 VDC) module - an intelligent microcontroller-based digital output module. The HSDO consists of two modules, (electronics and personality), that are inserted into an Ovation I/O module base unit. The HSDO module contains sixteen optically isolated digital output channels. Each digital output channel is capable of sourcing up to 500 mA of output current.

Relay Output module - consists of an Electronics module, a base assembly, and relays. The Relay Output module provides a means to switch high AC voltages at high currents to field devices. There are two versions of the Relay Output base assembly which contain either 12 or 16 relays within each base.

The Relay Output base assembly does not incorporate a Personality module. For more information about module configuration, refer to the following topics: Electronics modules (Emod) - (RO), Base assemblies - (RO), and Panel kits - (RO) in the Ovation I/O Reference manual.

Relay Output with Contact Monitoring module - consists of an Electronics module, a base assembly, and relays. The Relay Output module provides a means to switch high AC voltages at high currents to field devices. It provides a single FORM X relay contact to drive the field devices. In addition, the module has two monitoring circuits per channel, which provide a feedback to the standard Ovation Contact Input module or Digital Input Module to indicate the contact state of the relay.

The Relay Output base assembly does not incorporate a Personality module. For more information about module configuration, refer to the following topics: [Electronics modules \(Emod\) - \(ROCM\)](#) and [Base assemblies - \(ROCM\)](#) in the [Ovation I/O Reference](#) manual.

Fused Relay Output module - provides a means to switch high current and voltage devices located in the field. You have a choice between a fused low power relay output assembly and a fused high power relay output assembly for differing applications.

The Fused Relay Output base assembly does not incorporate a Personality module. For more information about module configuration, refer to the following topics: [Electronics modules \(Emod\) - FRO and Base assemblies - \(FRO\)](#) in the [Ovation I/O Reference](#) manual.

2.5 Specialty I/O modules

The following Ovation Specialty modules are available:

- Link Controller.
- Loop Interface.
- Pulse Accumulator.
- Servo Driver. For additional information, refer to the [Servo Driver User Guide](#).
- Small Loop Interface.
- Speed Detector.
- Valve Positioner. For additional information, refer to the [Valve Positioner User Guide](#).
- Numalogic Fast Ethernet Remote I/O. For additional information, refer to the [Ovation to Numalogic Fast Ethernet Remote Node](#) manual.

Specialty I/O modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
1C31166	Link Controller module - (LC).
1C31174	Loop Interface module - (LI).
1C31147	Pulse Accumulator module - (PA).
1C31199	Servo Driver module - (RSR).
4D33741	Small Loop Interface module - (SLIM).
1C31189	Speed Detector module - (SD).
1C31194	Valve Positioner module - (eRVP).
5X00467	Numalogic Fast Ethernet Remote I/O.
Note: Refer to the Ovation Bus and Specialty I/O Reference Manual for additional information.	

Link Controller module – provides a serial RS232, RS422, or RS485 data communications link to a third-party device or system. To use this module, the appropriate SLC algorithm must reside in the Ovation Controller.

Loop Interface module – provides an interface to the analog and digital I/O needed to control a single process loop (up to 2 AI, 1 AO, 2 DI, 2 DO). In addition, the loop interface can display the process information and provide for manual control via a local operator interface station (SLIM).

Pulse Accumulator module – counts pulse for up to two input channels and provides the information to the Controller. The Pulse accumulator may be used to count over a defined time period to measure speed (frequency), count until instructed to stop, or can be used to measure the duration of a pulse.

Servo Driver module – provides an interface to an electro-hydraulic servo actuator (servo-motor) used to control a steam turbine.

Small Loop Interface module – contains displays and keyboard inputs needed for an operator to monitor and control the I/O functions of the Ovation Loop Interface or Valve Positioner module. The SLIM is located external to the Ovation I/O cabinet and connected to the Loop Interface or Valve Positioner via cable.

Speed Detector module – provides the Controller with frequency measurements of a sinusoidal or pulse train input signal. A 16-bit speed output is updated at a rate of 5 ms for over-speed detection (G01 only), and a 32-bit speed output is updated at a variable rate for speed regulation (G01 and G03). G03 Speed Detector modules also provide a 16-bit acceleration output that is updated at the same rate as the 32-bit speed output.

Valve Positioner module – provides an interface to an electro-hydraulic servo actuator. Governor valves, interceptor valves, extraction valves, and bypass valves can be controlled. The module provides closed loop valve positioning control and also interfaces to a local operator interface station (SLIM).

Numalogic Fast Ethernet Remote Node - is a remote I/O subsystem which provides an interface to the Numalogic PC700 series Remote I/O. The NFE-RN is comprised of a base assembly, power supplies, and redundant Numalogic Fast Ethernet Remote Node Controllers (NFE-RNCs). The NFE-RNCs contain four Ethernet ports.

2.6 Bus Interface modules

The following Ovation Bus interface modules are available:

- DeviceNet. For additional information, refer to the [DeviceNet User Guide](#).
- Foundation Fieldbus. For additional information, refer to the [Foundation Fieldbus User Guide](#).
- Ethernet Link Controller. For additional information, refer to the [Ethernet Link Controller User Guide](#).
- Profibus. For additional information, refer to the [Profibus User Guide](#).

Bus Interface modules

ELECTRONICS MODULE	DESCRIPTION AND REFERENCE
5X00376	DeviceNet module.
5X00419	Ethernet Link Controller (ELC).
5X00301	Foundation Fieldbus module.
5X00300	Profibus DP module (DP).
Note: Refer to the Ovation Bus and Specialty I/O Reference Manual for additional information.	

DeviceNet module – The Ovation DeviceNet Module provides an interface with one or two DeviceNet networks, respectively. The DeviceNet has an associated Personality Module. DeviceNet offers robust, efficient data handling based on Producer/Consumer technology that allows you to determine effectively what information is needed and when.

Ethernet Link Controller – The Ethernet Link Controller provides an interface with a single Ethernet link. This module uses a straight RJ45 connector which allows the port to be accessed outside of the Electronics module.

Foundation Fieldbus module – The Ovation Foundation Fieldbus module provides a means to interface the Ovation system to industry standard Foundation Fieldbus devices. The interface to the module is through the Ovation I/O bus; therefore, this module is native to Ovation as opposed to an add-on or linking approach.

The Ovation Foundation Fieldbus module interfaces with one or two networks. The module supports redundancy and can be installed on each network. Only one module can be the master at any given time. Inter-module redundancy communication is handled through a private RS232 communication link between the redundant pair. The communication cable is connected to a RJ45 jack on the Pmod.

Profibus module – Profibus (**Process Field Bus**) DP (decentralized periphery) is an all digital, two-way communication system that links devices (also known as slaves) and automation systems. A decentralized periphery uses a network bus (in this instance, Profibus) between the Controller (Ovation) and its connected I/O channels. Therefore, the I/O is decentralized as compared to a programmable logic Controller (PLC) that has its I/O arranged centrally. At the base level in the hierarchy of plant networks, Profibus serves as a Local Area Network (LAN) for instruments.

SECTION 3

Analog Input module 4-20 mA (16 Channel)

IN THIS SECTION

16 Channel 4-20mA Analog Input module overview.....	45
Electronics modules (Emod) - 16 Channel 4-20mA Analog Input	45
Personality modules (Pmod) - 16 Channel 4-20mA Analog Input	46
Valid module combinations - 16 Channel 4-20mA Analog Input	46
Terminal block wiring information 16 Channel 4-20mA Analog Input (2-Wire).....	46
Terminal block wiring information - 16 Channel Analog Input 4-20mA (4-Wire).....	48
Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (2-Wire).....	49
Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (4-Wire).....	50
Configuration/Status Register information - 16 Channel 4-20mA Analog Input	50
Channel Enable/Mask Register - 16 Channel 4-20mA Analog Input.....	52
Channel Status Register - 16 Channel 4-20mA Analog Input	53
Diagnostic LEDs - 16 Channel 4-20mA Analog Input.....	54
Specifications - 16 Channel 4-20mA Analog Input	54

3.1 16 Channel 4-20mA Analog Input module overview

The Ovation 16 Channel 4-20mA Analog Input module provides an interface between the Ovation Controller and 16 field devices that use a 4-20mA current loop. Up to 16 4-20mA (2-wire or 4-wire) transmitters can be connected per module.

Note: The Ovation 16 Channel 4-20mA Analog Input module (2-wire and 4-wire configurations) requires the following to function properly: Ovation software release 3.4.0 or later and OCR400 Controller with G03 IOIC (5X00226G03 I/O interface controller). Also, this module is only for local I/O branch applications.

In a 2-wire 4-20mA configuration, user input signals are routed directly to the Analog Input Emod without the use of a Personality module (Pmod). A Pmod cavity insert is used to cover the unused connector and provide terminal wiring information.

In a 4-wire 4-20mA configuration, a Personality Module (5X00501G01) is required to interface the user signals to the Analog Input Emod.

Note: A 16 Channel 4-20mA Analog Input module must be inserted into an Ovation 4-slot I/O base (5X00497G01) for proper operation. The Ovation 16 Channel Analog Input module will not function in a standard 2-slot Ovation I/O base. Refer to I/O Module General Information (see page 17) for environmental, installation, wiring, and fuse information for I/O modules.

3.2 Electronics modules (Emod) - 16 Channel 4-20mA Analog Input

- **5X00501G01** - 16 Channel 4-20mA Analog Input Electronics module.

3.3 Personality modules (Pmod) - 16 Channel 4-20mA Analog Input

- **5X00502G01** - 16 Channel 4-20mA Analog Input Personality module for both 4-wire and 2-wire configurations.
- **1X00692H01** - 16 Channel 4-20mA Analog Input Personality cavity insert for 2-wire configurations only.

3.4 Valid module combinations - 16 Channel 4-20mA Analog Input

16 Channel 4-20mA Analog Input valid module combinations

DESCRIPTION	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
16 Channel 4-20mA Analog Input, 2-wire and 4-wire	16	5X00501G01	5X00502G01
16 Channel 4-20mA Analog Input, 2-wire only	16	5X00501G01	1X00692H01
This module configuration is CE Mark certified.			

Note: The 16 Channel 4-20mA Analog Input requires the use of an Ovation 4-slot I/O Base (5X00497G01) to provide additional wire terminations to support the 16 channels. The Ovation 16 Channel 4-20mA Analog Input CANNOT be used in the standard I/O bases (1B30035H01, 1X00014H01, or 5X00334G01).

3.5 Terminal block wiring information 16 Channel 4-20mA Analog Input (2-Wire)

The following figure and table are for the terminal block arrangement for the 2-wire 4-20mA 16 Channel Analog Input module. Row A is not used; no external connections are to be made to Row A. Row B is Analog Input (n+). Row C is utilized to provide power to the “+” field terminals of 2-wire loop-powered transmitter. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The table lists and defines the abbreviations used in those diagrams.

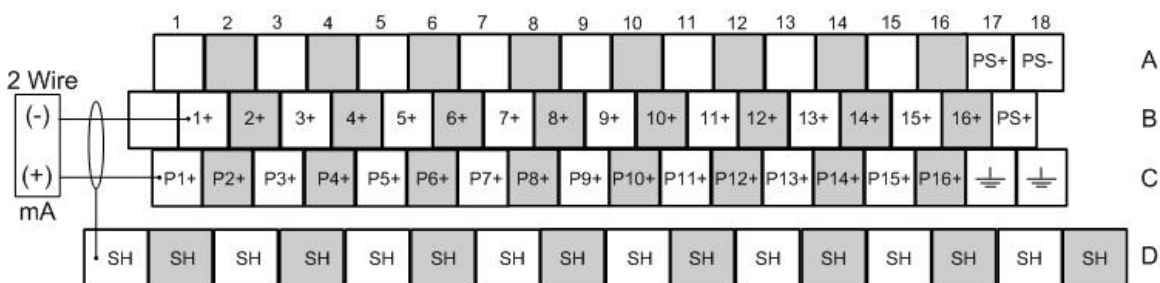


Figure 6: Terminal block connections for the 2-Wire 16 Channel 4-20mA Analog Input module

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
1+ through 16+	Analog Input positive terminal connection (connect to the negative terminal of the field device).
P1+ through P16+	Loop power output terminals (connect to the positive terminal of the field device).
PS+, PS-	Auxiliary power supply terminals. No external connections required when using Ovation +24V DC Auxiliary Power Supply. Ovation Aux Supply provided to module through branch.
	Reserved terminals. Connections should not be made on these unmarked terminals.
SH	Shield terminal connections. All shield connections are tied together internally on a 4-slot I/O base and connected to Earth ground on the module.
+24VDC Auxiliary Power enters the module through the internal branch connection or terminal block (PS+/PS-). Power is fused on the module then individually current limited and delivered to the channel loop power output terminal (P1+ through P16+) for connection to the field device (+) terminal. Each field device (-) terminal then connects to the Analog Input channel positive terminal (1+ through 16+) where it is read by the module. The negative reference for all 16 channels is PS-. All shields are tied together on the base terminal strip and connected to Earth ground on the module.	

Note: For CE Mark Certified Systems: All field wiring must be Braid Shielded and Grounded at the entry point of the cabinet using recommended hardware. Refer to the Cable Guidelines section of the applicable Ovation Installation manual.

When using locally powered (2-wire) Analog Input 4-20mA Inputs, the Power Distribution Module (5X00489G01) must have the Main GND and AUX GND referenced together. Therefore, ensure that the Main grounding bar (J10) and AUX grounding bar (J11) are installed and referenced to earth on the Power Distribution Module.

3.6 Terminal block wiring information - 16 Channel Analog Input 4-20mA (4-Wire)

The following figure and table are for the terminal block arrangement of the 4-wire 4-20mA 16 Channel Analog Input module. Row A is Analog Input (n-). Row B is Analog Input (n+). Row C is not used in 4-wire applications; however, in 2-wire applications, Row C can be used to supply loop power (Pn+) to circuit. This diagram indicates how to connect a single 4-wire field device to the terminal block in the base unit. The table lists and defines the abbreviations used in those diagrams.

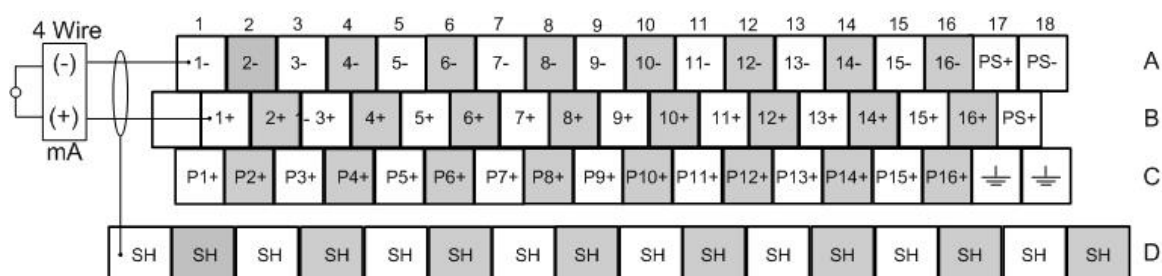


Figure 7: Terminal block connections for the 4-Wire 16 Channel 4-20mA Analog Input module

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
1+ through 16+	Analog Input Positive Terminal (connect to positive terminal of 4-wire field device; connect to negative terminal of 2-wire field device)
1- through 16-	Analog Input Negative Terminal (connect to negative terminal of 4-wire field device; leave unconnected for 2-wire field device)
PS+, PS-	Auxiliary power supply input terminals. No external connections required when using Ovation +24V DC Auxiliary Power Supply. Ovation Aux Supply provided to module through branch.
P1+ through P16+	Loop Power Output Terminals (leave unconnected for 4-wire device; connect to positive terminal of 2-wire device)
SH	Shield terminal connection.
For 4-wire Devices: Loop Power enters from the field device. The field device output (+) terminal connects to the Analog Input channel positive terminal (1+ through 16+) where it is read by the module. Each field device output (-) terminal connects to the Analog Input channel negative terminal (1- through 16-). The negative reference (1- through 16-) of all 16 analog inputs are tied together on the Pmod and tied through the Emod to Earth ground and all shields (SH) on the terminal strip.	
For 2-wire Devices: +24VDC Auxiliary Power enters through the internal branch connection or the terminal block connections (PS+/PS-). Power is fused on the module then individually current limited and delivered to channel Loop Output Terminals (P1+ through P16+) for connection to the 2-wire field device (+) terminal. Each 2-wire field device (-) terminal then connects to the Analog Input channel positive terminal (1+ through 16+) where it is read by the module. The negative reference for all 16 channels is tied together with all shields (SH) of terminal strip and Earth ground on module.	

Note: For CE Mark Certified Systems: All field wiring must be Braid Shielded and Grounded at the entry point of the cabinet using the recommended hardware. Refer to the Cable Guidelines section of the applicable Ovation Installation manual.

When using locally powered (2-wire) Analog Input 4-20mA Inputs, the Power Distribution Module (5X00489G01) must have the Main GND and AUX GND referenced together. Therefore, ensure that the Main grounding bar (J10) and AUX grounding bar (J11) are installed and referenced to earth on the Power Distribution Module.

3.7 Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (2-Wire)

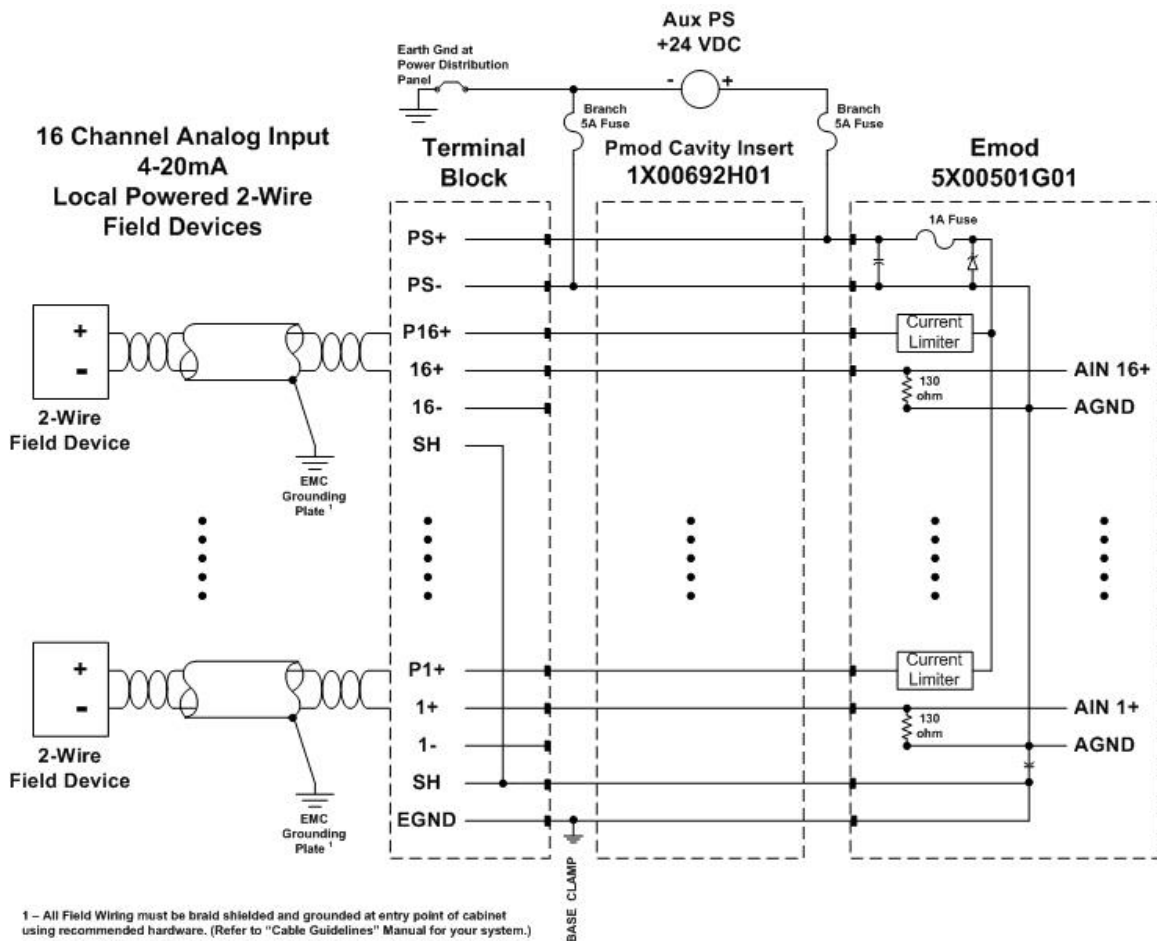


Figure 8: Wiring diagram - 16 Channel 4-20mA Analog Input module (2-wire configuration)

3.8 Field connection wiring diagrams - 16 Channel 4-20mA Analog Input (4-Wire)

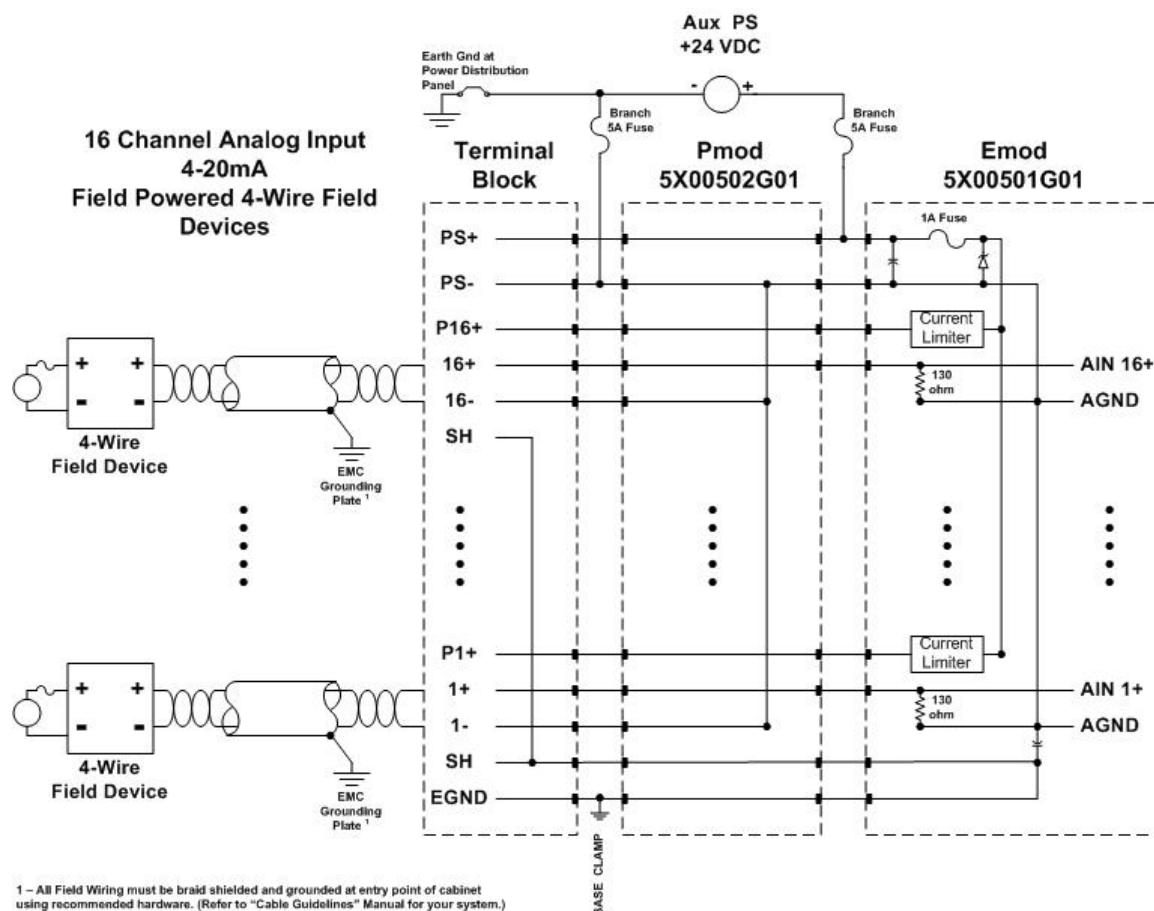


Figure 9: Wiring diagram - 16 Channel 4-20mA Analog Input module (4-wire configuration)

3.9 Configuration/Status Register information - 16 Channel 4-20mA Analog Input

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (See the *Ovation Operator Station User Guide*).

16 Channel 4-20mA Analog Input - Module Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module	1 = configured 0 = not configured *
1	Internal or forced error	1 = forced error set by controller 0 = no forced error *

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
2	Not defined	1 = Calibration in Progress 0 = Default *
3	Not defined	1 = Gain Calibration Complete 0 = Default *
4	Not defined	1 = Calibration Fault 0 = Default *
5	Not defined	Not defined, 0 = Permanent Value
6	Not defined	1 = Not Calibrated 0 = Calibrated *
7	Not defined	1= Blown Fuse Detected 0= Fuse OK *
8	Not defined	0 = Permanent Value
9	Select 50/60 Hz System	1= 50 Hz * 0= 60 Hz
10	Start Gain Calibration **	1 = Gain calibration in progress 0 = Default *
11	Start Offset Calibration **	1= Offset Calibration in Progress 0= Default *
12	Not defined	1= Offset Calibration Complete 0 = Default *
13	Not defined	1= Un-Calibration Started 0 = Default *
14	Start Un-calibration **	1= Un-Calibration Complete 0 = Default *
15	Not defined	1= Channel Fault detected 0 = No Channel Fault detected *
* Default value.		
** These commands are used during module factory test only and are not used or performed during normal system operation.		

Bits defined for diagnostics are used only during factory testing.

Bit 0: This bit configures the module (write) and indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into its error state. The read of bit 1 indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is reflected in the module's Internal Error LED (I) LED (see *Diagnostic LEDs - 16 Channel 4-20mA Analog Input* (see page 54)). Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2, 3, 4, 5, 6, 8, 10, 11, 12, 13, 14: These bits are used only for diagnostics and calibration during factory testing and should not be modified. The default read values during normal system operation are listed.

Bit 7: Blown fuse detection bit.

Bit 9: Indicates if the module is set up for a 50 or 60 Hz system.

Bit 15: Indicates a fault in at least one enabled channel was detected. Channel Status Register (0xC) can be read to determine which channel(s) are in fault.

3.10 Channel Enable/Mask Register - 16 Channel 4-20mA Analog Input

Word address 14 (E in Hex) is used to enable or disable individual analog input channels on the module. Masking an unused channel can prevent open-loop errors from being reported to the system if the channel is not wired.

Channel Enable/Mask Register (Address 14 or E in Hex)

BIT	DESCRIPTION (WRITE)	DESCRIPTION (READ)
0	1 = Enable Channel 1 0 = Mask Channel 1 Faults	1 = Channel 1 Enabled 0 = Channel 1 Faults Masked
1	1 = Enable Channel 2 0 = Mask Channel 2 Faults	1 = Channel 2 Enabled 0 = Channel 2 Faults Masked
2	1 = Enable Channel 3 0 = Mask Channel 3 Faults	1 = Channel 3 Enabled 0 = Channel 3 Faults Masked
3	1 = Enable Channel 4 0 = Mask Channel 4 Faults	1 = Channel 4 Enabled 0 = Channel 4 Faults Masked
4	1 = Enable Channel 5 0 = Mask Channel 5 Faults	1 = Channel 5 Enabled 0 = Channel 5 Faults Masked
5	1 = Enable Channel 6 0 = Mask Channel 6 Faults	1 = Channel 6 Enabled 0 = Channel 6 Faults Masked
6	1 = Enable Channel 7 0 = Mask Channel 7 Faults	1 = Channel 7 Enabled 0 = Channel 7 Faults Masked
7	1 = Enable Channel 8 0 = Mask Channel 8 Faults	1 = Channel 8 Enabled 0 = Channel 8 Faults Masked
8	1 = Enable Channel 9 0 = Mask Channel 9 Faults	1 = Channel 9 Enabled 0 = Channel 9 Faults Masked
9	1 = Enable Channel 10 0 = Mask Channel 10 Faults	1 = Channel 10 Enabled 0 = Channel 10 Faults Masked
10	1 = Enable Channel 11 0 = Mask Channel 11 Faults	1 = Channel 11 Enabled 0 = Channel 11 Faults Masked
11	1 = Enable Channel 12 0 = Mask Channel 12 Faults	1 = Channel 12 Enabled 0 = Channel 12 Faults Masked
12	1 = Enable Channel 13 0 = Mask Channel 13 Faults	1 = Channel 13 Enabled 0 = Channel 13 Faults Masked
13	1 = Enable Channel 14 0 = Mask Channel 14 Faults	1 = Channel 14 Enabled 0 = Channel 14 Faults Masked
14	1 = Enable Channel 15 0 = Mask Channel 15 Faults	1 = Channel 15 Enabled 0 = Channel 15 Faults Masked
15	1 = Enable Channel 16 0 = Mask Channel 16 Faults	1 = Channel 16 Enabled 0 = Channel 16 Faults Masked

3.11 Channel Status Register - 16 Channel 4-20mA Analog Input

Word address 12 (C in Hex) is used to report the status of the individually enabled analog input channels. A reported fault may indicate an open loop, over-range, under-range, or calibration fault on an enabled channel.

Channel Status Register (Address 12 or C in Hex)

BIT	DESCRIPTION (READ ONLY)
0	1 = Enabled Channel 1 Fault Exists 0 = No Fault Reported on Channel 1
1	1 = Enabled Channel 2 Fault Exists 0 = No Fault Reported on Channel 2
2	1 = Enabled Channel 3 Fault Exists 0 = No Fault Reported on Channel 3
3	1 = Enabled Channel 4 Fault Exists 0 = No Fault Reported on Channel 4
4	1 = Enabled Channel 5 Fault Exists 0 = No Fault Reported on Channel 5
5	1 = Enabled Channel 6 Fault Exists 0 = No Fault Reported on Channel 6
6	1 = Enabled Channel 7 Fault Exists 0 = No Fault Reported on Channel 7
7	1 = Enabled Channel 8 Fault Exists 0 = No Fault Reported on Channel 8
8	1 = Enabled Channel 9 Fault Exists 0 = No Fault Reported on Channel 9
9	1 = Enabled Channel 10 Fault Exists 0 = No Fault Reported on Channel 10
10	1 = Enabled Channel 11 Fault Exists 0 = No Fault Reported on Channel 11
11	1 = Enabled Channel 12 Fault Exists 0 = No Fault Reported on Channel 12
12	1 = Enabled Channel 13 Fault Exists 0 = No Fault Reported on Channel 13
13	1 = Enabled Channel 14 Fault Exists 0 = No Fault Reported on Channel 14
14	1 = Enabled Channel 15 Fault Exists 0 = No Fault Reported on Channel 15
15	1 = Enabled Channel 16 Fault Exists 0 = No Fault Reported on Channel 16

3.12 Diagnostic LEDs - 16 Channel 4-20mA Analog Input

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when module main power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit to indicate Auxiliary 24VDC field power is not present, is below threshold, or the module's Auxiliary 24VDC fuse is blown.
I (Red)	Internal Fault LED. Lit whenever there is any type of internal module error. Possible causes include: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Internal hardware error. ▪ Module reset. ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed. Note: Failure of Auxiliary 24VDC power is considered to be an external error.
1-16 (Red)	A channel error LED is lit when a fault is detected on an enabled channel. Possible causes include: ▪ Over-range fault: Input current >22mA ▪ Under-range fault: Input current <2.5mA ▪ Open loop fault ▪ Blown fuse fault (2-wire)

Note: 24V Auxiliary Fuse Rating: 1 A, 250V Fast-acting fuse 5X20 mm.

3.13 Specifications - 16 Channel 4-20mA Analog Input

16 Channel 4-20mA Analog Input module specifications

DESCRIPTION	VALUE
Number of channels	16
Input types and ranges	4 - 20 mA $\pm 1V$; 2-wire or 4-wire single-ended Valid Input Range: 2.5 to 22mA Under Current : <2.5mA Over Current: >22mA (Broken) Open Loop: 0 to 2.5mA
Resolution	14-Bits, no missing code
Accuracy	$\pm 0.10\%$ of full scale value $\pm 1/2LSB$ @99.7% confidence. Resolution conditions: 25 degrees C ± 1 degree 50% $\pm 1\%$ RH 0V common mode

DESCRIPTION	VALUE
Input impedance	130 Ohms +/- 0.1%
Sampling rate	Data rate of 50 samples per second when configured for 50Hz rejection. Data rate of 60 samples per second when configured for 60Hz rejection. Refresh rate: 200 ms for 16 channels
Self-calibration	Self calibration is performed only during factory test on demand over the I/O bus. Calibration is not performed during normal module operation.
Diagnostics	Internal module operating faults, Out of range detection, Open loop detection, and Module (Auxiliary 24VDC power supply) blown fuse
Dielectric isolation: Channel to logic	1000 V AC/DC Channel to Channel is common
Normal mode rejection	NMRR 50dB at 50SPS / 60 SPS
Common mode rejection	CMRR 120 dB
Module power	▪ Drawn from Main: 1.20W typical; 1.38W maximum ▪ Drawn from Auxiliary: 0.48W typical; 0.56W maximum (4-wire) 8.16W typical; 9.38W maximum (2-wire) ▪ Power Dissipated in Emod/Pmod: 1.69W typical; 1.94W maximum
2-Wire Transmitter Power	19.18V available for current loops @ 20mA (4.82V drop on module) 16 channel @ 20mA Each channel current limited to 26.5mA
Operating temperature range	0 to 60 degrees C (32 degrees F to 140 degrees F)
Storage temperature range	-40 degrees C to 85 degrees C (-40 degrees F to 185 degrees F)
Humidity (non-condensing)	0 to 95%

SECTION 4

Analog Input high speed module (14-Bit) - (HSAI) (8 Channel)

IN THIS SECTION

8 Channel Analog Input high speed module overview (14-Bit) - (HSAI).....	57
Electronics modules (Emod) - (HSAI)	58
Personality modules (Pmod) - (HSAI).....	58
Valid module combinations - (HSAI)	58
External power supply information - (HSAI).....	59
Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)	59
Thermocouple types and coefficients - (AI-13) & (HSAI).....	60
Temperature sensor Personality module (1C31116G04) - (HSAI).....	63
Module block diagram - (HSAI)	64
Terminal block wiring information - (HSAI)	65
Field connection diagrams - (HSAI)	66
Field connection wiring diagrams (Pmod 1C31227) - (HSAI)	67
Field connection wiring diagrams (Pmod 1C31227) (CE Mark) - (HSAI).....	68
Field connection wiring diagrams (Pmod 1C31116) - (HSAI)	69
Field connection wiring diagrams, Pmod (Pmod 1C31116) (CE Mark) - (HSAI)	70
Input address locations (Group 1) - (HSAI).....	71
Input address locations (Group 2) - (HSAI).....	73
Input address locations (Group 3) - (HSAI).....	75
Input address locations (Group 4) - (HSAI).....	77
Module register information - (HSAI).....	79
Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	80
Specifications - (HSAI)	80

4.1 8 Channel Analog Input high speed module overview (14-Bit) - (HSAI)

The combined Personality and Electronics modules form the High Speed Analog Input module. Eight sets of galvanically isolated input channels provide 14-bit resolution with 50 or 60 samples per second conversion rates. The input signals are conditioned and routed through the appropriate Personality module to the Electronics module. The Personality module also provides surge protection to protect the input circuits of the Electronics module. The Electronics module performs the analog to digital conversions and provides interfacing to the Ovation Serial I/O Bus.

The 14-Bit High Speed Analog Input is applicable for CE Mark certified systems.

Note: I/O Module General Information (see page 17) contains information on for environmental, installation, wiring, and fuse information for I/O modules.

4.2 Electronics modules (Emod) - (HSAI)

- **5X00070G01** interfaces to current signals with an input range of 4 to 20 mA.
- **5X00070G02** interfaces to voltage signals with an input range of $\pm 1V$, $\pm 250mV$, $\pm 100mV$.
- **5X00070G03** interfaces to voltage signals with an input range of $\pm 5V$, $\pm 10V$.
- **5X00070G04** interfaces to thermocouple inputs $\pm 20mV$, $\pm 50Vm$, $\pm 100mV$.
- **5X00070G05** interfaces to thermocouple inputs $\pm 20mV$, $\pm 50Vm$, $\pm 100mV$, (Non-EMC Cabinet).

4.3 Personality modules (Pmod) - (HSAI)

- **1C31227G01** interfaces to current input with an input range of 4 - 20 mA.
- **1C31227G02** voltage input.
- **1C31116G02** field powered current input $\pm 1mA$.
- **1C31116G03** local powered $\pm 1mA$ current only.
- **1C31116G04** voltage inputs to temperature sensor.

4.4 Valid module combinations - (HSAI)

High Speed Analog Input valid module combinations (14-bit)

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
4 - 20mA, Field or Locally powered	8	5X00070G01 ^{1,2}	1C31227G01
$\pm 100mV$, $\pm 250mV$, $\pm 1V$	8	5X00070G02 ^{1,2}	1C31227G02
$\pm 1mA$ 2 wire local powered	8	5X00070G02 ^{1,2}	1C31116G03
$\pm 1mA$ 4wire field powered	8	5X00070G02 ^{1,2}	1C31116G02
$\pm 5V$, $\pm 10V$	8	5X00070G03 ^{1,2}	1C31227G02
$\pm 20mV$, $\pm 50mV$, ± 100 (Thermocouple)	8	5X00070G04 ¹	1C31116G04
$\pm 20mV$, $\pm 50mV$, ± 100 (Thermocouple)	8	5X00070G05 ²	1C31116G04
¹ This module configuration is CE Mark certified. ² This module configuration is CE Mark certified (Non-EMC Cabinet).			

4.5 External power supply information - (HSAI)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and **NOT** from the AC or DC Mains.

If the High Speed Analog Input module uses the current input 1C31227G01 or 1C31116G03 Personality modules, the required voltage source may be obtained from the internal auxiliary power supply (backplane).

If the High Speed Analog Input module uses Pmod 1C31227G01 or 1C1116G02, field powered current loops can be used. Note that 1C31227G01 supplies both field and local power.

4.6 Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)

When two dissimilar metals (a thermocouple) are joined together, a voltage (the Seebeck Voltage) is generated between them. This voltage is directly related to the temperature at the junction of the two metals. The relationship between the voltage and the temperature can be best described by a fifth order polynomial, determined by the two types of metals that are joined.

To measure the voltage (V_t) between the two metals, a voltmeter (in this case, an analog input card) must be connected to each wire. Unfortunately, this produces two new junctions and voltages (V_1 and V_2) between the terminals and the thermocouples. The following formula is used to find V_t : $V_t = V_m - V_1 - V_2$.

It is not possible to measure V_1 and V_2 without inducing more junctions and voltages; therefore, the analog input subsystem has a temperature sensor on the Personality module (1C31116G04) to measure the temperature (T_j) at the terminal block of the base unit.

A conversion formula, determined from the junction metal and thermocouple metals, is used to calculate the combined voltage of V_1 and V_2 . This is called **Cold Junction Compensation**.

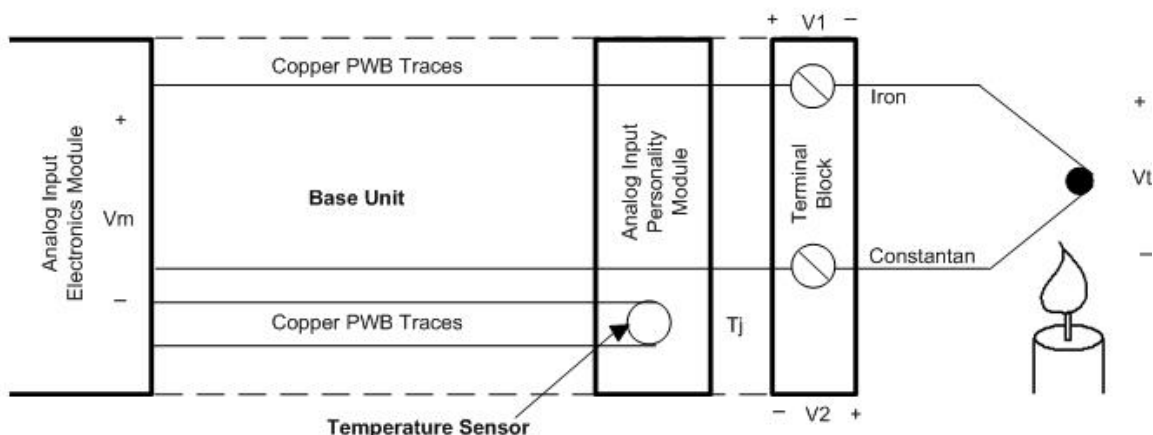


Figure 10: Thermocouple illustration

Select one of the Field Instrumentation Types. The Ovation system assigns the default thermocouple coefficients based on the Thermocouple Type selected. Refer to Thermocouple types and coefficients (see page 60) for valid thermocouple types and coefficients.

If you override the default coefficients by entering new values, the new values remain **until** you select another thermocouple type. The values then return to the values for the type just selected.

4.7 Thermocouple types and coefficients - (AI-13) & (HSAI)

The following tables list the valid thermocouple types and coefficients:

Thermocouple type B or TB

MILLIVOLT RANGE B or TB	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 13.814 0.006 to 13.814	0 to 1820 Degrees C 0 to 3308 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 3.5164700E+02 COEF_2 = 6.1388490E+05 COEF_3 = -1.5397740E+08 COEF_4 = 3.3593730E+10 COEF_5 = -4.0518260E+12 COEF_6 = 2.0039330E+14 COEF_7 = -5.7368636E-06 COEF_8 = 4.1848114E-08		Centigrade COEF_1 = 1.7758167E+02 COEF_2 = 3.4104717E+05 COEF_3 = -8.5543000E+07 COEF_4 = 1.8663183E+10 COEF_5 = -2.2510144E+12 COEF_6 = 1.1132961E+14 COEF_7 = -4.3977239E-06 COEF_8 = 7.5326606E-08

Thermocouple type E or TE

MILLIVOLT RANGE E or TE	TEMPERATURE RANGE	BEST FIT MODULE
- 9.835 to 19.945 - 9.835 to 19.945	- 270 to 286 Degrees C - 450 to 548 Degrees F	20 mv module 20 mv module
- 9.835 to 49.992 - 9.835 to 49.956	- 270 to 661 Degrees C - 450 to 1221 Degrees F	50 mv module 50 mv module
- 9.835 to 76.358 - 9.835 to 76.358	- 270 to 1000 Degrees C - 450 to 1832 Degrees F	100 mv module 100 mv module
Fahrenheit COEF_1 = 3.1672830E+01 COEF_2 = 3.0306280E+04 COEF_3 = -3.3449490E+05 COEF_4 = 6.8495880E+06 COEF_5 = -6.9753490E+07 COEF_6 = 2.9236530E+08 COEF_7 = -1.0939E-03 COEF_8 = 3.365E-05		Centigrade COEF_1 = -1.8176111E-01 COEF_2 = 1.6836822E+04 COEF_3 = -1.8583050E+05 COEF_4 = 3.8053267E+06 COEF_5 = -3.8751939E+07 COEF_6 = 1.6242517E+08 COEF_7 = -1.71E-05 COEF_8 = 6.057E-05

Thermocouple type J or TJ

MILLIVOLT RANGE J OR TJ	TEMPERATURE RANGE	BEST FIT MODULE
– 8.096 to 19.971 – 8.137 to 19.977	– 210 to 366 Degrees C – 350 to 691 Degrees F	20 mv module 20 mv module
– 8.096 to 42.922 – 8.137 to 42.922	– 210 to 760 Degrees C – 350 to 1400 Degrees F	50 mv module 50 mv module
Fahrenheit COEF_1 = 3.112531E+01 COEF_2 = 3.6070270E+04 COEF_3 = –4.2886170E+05 COEF_4 = 2.2613820E+07 COEF_5 = –5.1743790E+08 COEF_6 = 3.9727830E+09 COEF_7 = –9.256E-04 COEF_8 = 2.862E-05		Centigrade COEF_1 = –4.8593889E-01 COEF_2 = 2.0039039E+04 COEF_3 = –2.3825650E+05 COEF_4 = 1.2563233E+07 COEF_5 = –2.8746550E+08 COEF_6 = 2.2071017E+09 COEF_7 = –9.76E-06 COEF_8 = 5.1516E-05

Thermocouple type K or TK

MILLIVOLT RANGE K OR TK	TEMPERATURE RANGE	BEST FIT MODULE
– 6.458 to 19.959 – 6.456 to 19.978	– 270 to 484 Degrees C – 450 to 904 Degrees F	20 mv module 20 mv module
– 6.458 to 49.988 – 6.456 to 49.996	– 270 to 1232 Degrees C – 450 to 2250 Degrees F	50 mv module 50 mv module
– 6.458 to 54.875 – 6.456 to 54.845	– 270 to 1372 Degrees C – 450 to 2500 Degrees F	100 mv module 100 mv module
Fahrenheit COEF_1 = 3.0344730E+01 COEF_2 = 4.4031910E+04 COEF_3 = 1.615839E+05 COEF_4 = –1.616257E+07 COEF_5 = 4.4011090E+08 COEF_6 = –3.599650E+09 COEF_7 = –7.259E-04 COEF_8 = 2.243E-05		Centigrade COEF_1 = –9.1959444E-01 COEF_2 = 2.4462172E+04 COEF_3 = 8.9768833E+04 COEF_4 = –8.9792056E+06 COEF_5 = 2.4450606E+08 COEF_6 = –1.9998056E+09 COEF_7 = –8.14E-06 COEF_8 = 4.0374E-05

Thermocouple type N or TN

MILLIVOLT RANGE N OR TN	TEMPERATURE RANGE	BEST FIT MODULE
-4.345 to 19.990 -4.345 to 19.990	-270 to 584 Degrees C -454 to 1083 Degrees F	20 mv module 20 mv module
-4.345 to 47.514 -4.345 to 47.514	-270 to 1300 Degrees C -454 to 2372 Degrees F	50 mv module 50 mv module
Fahrenheit COEF_1 = 2.7795251549E+01 COEF_2 = 7.6249124464E+04 COEF_3 = -2.8626852972E+06 COEF_4 = 1.3017695115E+08 COEF_5 = -2.7644988772E+09 COEF_6 = 2.1988892938E+10 COEF_7 = -4.8744444444E-04 COEF_8 = 1.4888888888E-05		Centigrade COEF_1 = -2.3359713617E+00 COEF_2 = 4.2360624702E+04 COEF_3 = -1.5903807207E+06 COEF_4 = 7.2320528414E+07 COEF_5 = -1.5358327096E+09 COEF_6 = 1.2216051632E+10 COEF_7 = -1.1000000000E-05 COEF_8 = 2.6800000000E-05

Thermocouple type R or TR

MILLIVOLT RANGE R OR TR	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 19.998 0.089 to 19.997	0 to 1684 Degrees C 0 to 3063 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 8.3628480E+01 COEF_2 = 2.2737160E+05 COEF_3 = -1.2482860E+07 COEF_4 = 1.2062540E+09 COEF_5 = -7.4221280E+10 COEF_6 = 1.89930000E+12 COEF_7 = -1.084E-04 COEF_8 = 3.24E-06		Centigrade COEF_1 = 2.8682489E+01 COEF_2 = 1.2631756E+05 COEF_3 = -6.9349222E+06 COEF_4 = 6.7014111E+08 COEF_5 = -4.1234044E+10 COEF_6 = 1.0551667E+12 COEF_7 = -4.72E-06 COEF_8 = 5.832E-06

Thermocouple type S or TS

MILLIVOLT RANGE S OR TS	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 18.698 -0.092 to 18.696	0 to 1768 Degrees C 0 to 3214 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 1.1803440E+02 COEF_2 = 1.9859180E+05 COEF_3 = -1.9730960E+04 COEF_4 = -5.0093290E+08 COEF_5 = 4.1104880E+10 COEF_6 = -1.1557940E+12 COEF_7 = -1.0847E-04 COEF_8 = 3.26E-06		Centigrade COEF_1 = 4.7796889E+01 COEF_2 = 1.1032878E+05 COEF_3 = -1.0961644E+04 COEF_4 = -2.7829606E+08 COEF_5 = 2.2836044E+10 COEF_6 = -6.4210778E+11 COEF_7 = -4.15E-06 COEF_8 = 5.868E-06

Thermocouple type T or TT

MILLIVOLT RANGE T OR TT	TEMPERATURE RANGE	BEST FIT MODULE
– 6.258 to 19.945 – 6.254 to 19.979	– 270 to 385 Degrees C – 450 to 726 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 3.1892240E+01 COEF_2 = 4.6693280E+04 COEF_3 = –1.3257390E+06 COEF_4 = 6.9620670E+07 COEF_5 = –2.3278080E+09 COEF_6 = 3.3306460E+10 COEF_7 = –7.3333E-04 COEF_8 = 2.243E-05		Centigrade COEF_1 = –5.9866667E-02 COEF_2 = 2.5940711E+04 COEF_3 = –7.3652167E+05 COEF_4 = 3.8678150E+07 COEF_5 = –1.2932267E+09 COEF_6 = 1.8503589E+10 COEF_7 = –1.55700E-05 COEF_8 = 4.0374E-05

4.8 Temperature sensor Personality module (1C31116G04) - (HSAI)

Personality module 1C1116G04 of the analog input subsystem includes a temperature sensor IC. This is used for measuring the temperature of the terminal block to provide cold junction compensation for thermocouple inputs.

This module is used in conjunction with a terminal block cover (1C31207H01) to maintain a uniform temperature of the terminal block and sensor area. The cover fits over an entire base; however, the sensor only accurately measures the temperature under the half of the cover where the temperature sensor Personality module is installed. Therefore, if both modules under the cover require cold junction compensation, they each require the temperature sensor Personality module.

Note: Installation instructions for the terminal block cover are provided in the Temperature Compensation Cover Mounting Kit (1B30047G01).

The Group 4 Personality module provides a terminal block temperature measurement feature with the following specifications:

- Sampling Rate = 600 msec, Maximum, 300 msec, typical
- Resolution = +/- 0.5 degrees C (+/- 0.9 degrees F)
- Accuracy = +/- 0.5 degrees C over a 0 degrees C to 70 degrees C range
(+/- 0.9 degrees F over a 32 degrees F to 158 degrees F range)

4.9 Module block diagram - (HSAI)

The simplified block diagram for the voltage input configuration of the High Speed Analog Input module is shown in the following figure. The channel 1 input is grounded locally at the cabinet, and grounding at the field device is shown for the channel 8 input.

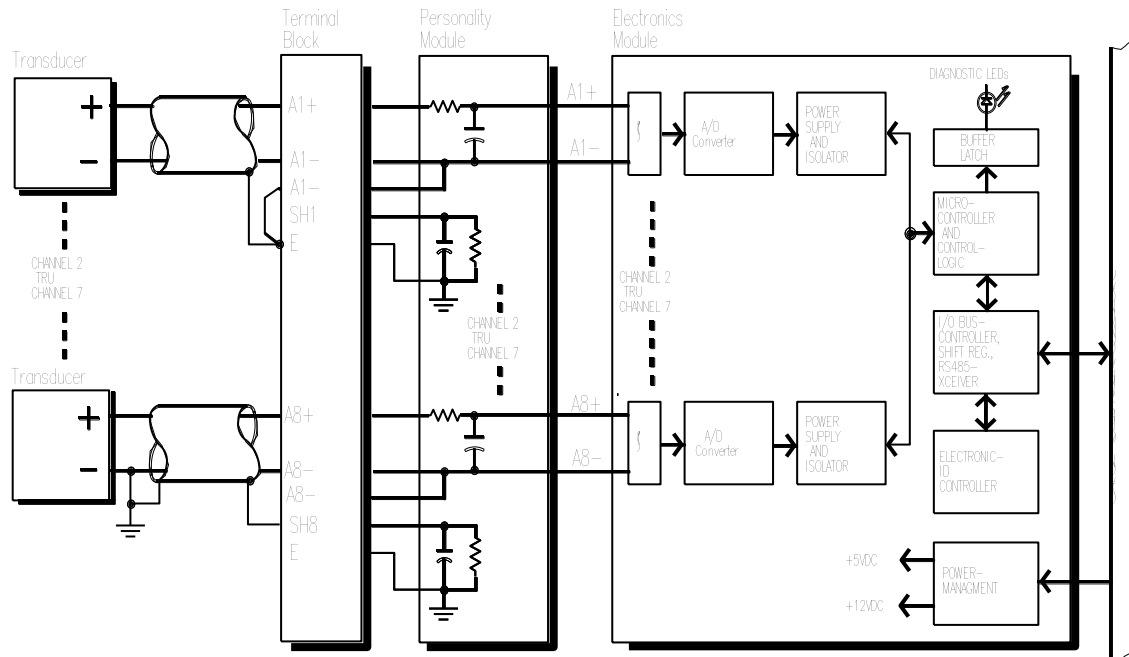


Figure 11: Voltage input configuration using Pmod 1C31227G02

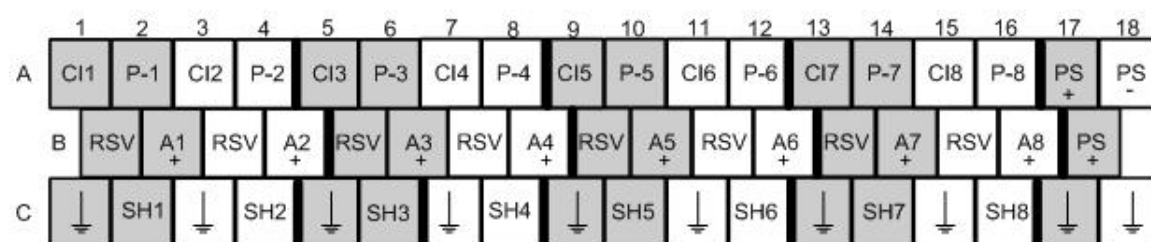
4.10 Terminal block wiring information - (HSAI)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

The diagrams for the analog input Personality modules are illustrated in the field connections diagrams (see page 67). The following table lists and defines the abbreviations used in those diagrams.

Current Loop (1C31227G01)



Voltage Input (1C31227G02)

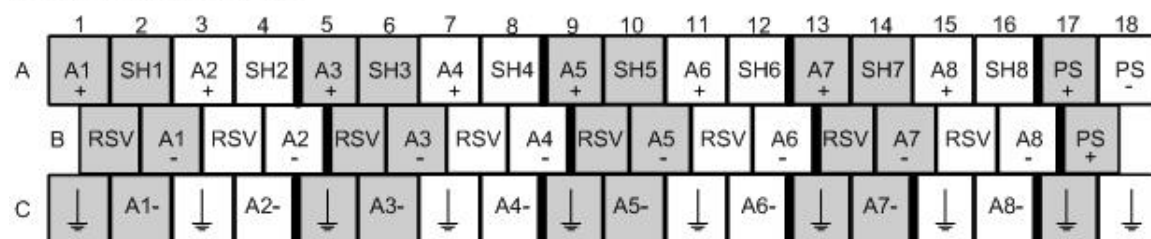


Figure 12: Terminal Block Connections for the Analog Input 1C31227 Pmods

Abbreviations used in diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
A1 - A8 +	Analog Input positive terminal connection (connected to the positive terminal of the field device).
A1 - A8 -	Analog Input negative terminal connection (voltage input group only).
CI1 - CI8	Current input terminals.
P-1 - P-8	Loop power output terminals (for locally powered loops).

ABBREVIATION	DEFINITION
PS+, PS-	Auxiliary power supply terminals.
RSV	Reserved terminal. No connections allowed on these terminals.
SH1 - SH8	Shield terminal connection.

Use shielded twisted pair wire for the field wiring. Tie the Analog Input negative terminal and shield together and to earth ground, either locally at the cabinet or at the field device. Voltage inputs use the 1C31227G02 Personality modules. Grounding the shield and the analog input negative terminal at the cabinet or at the field device is arranged by the proper Terminal Block connections.

Similarly, current inputs using the 1C31227G01 Personality modules can accommodate field or locally powered devices by using the correct terminal block connections.

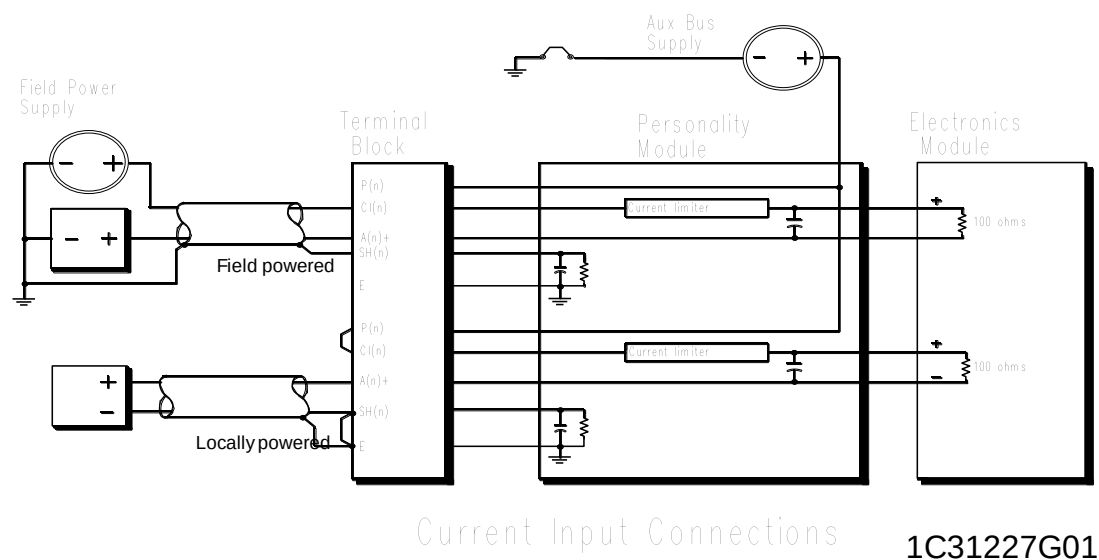
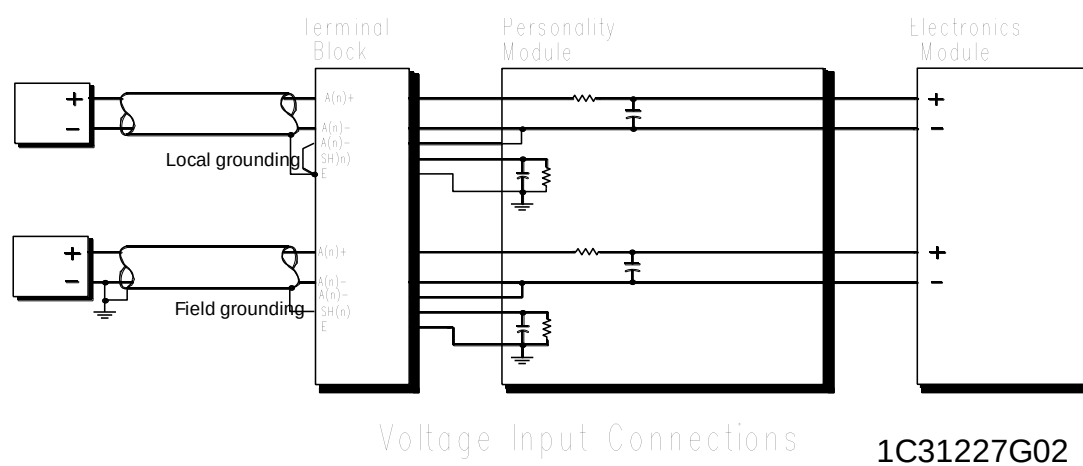
The Personality modules have a field connection diagram label on top of each module to facilitate field wiring. The following figures show the implementations of the field connections for the various Personality module and field device combinations.

4.11 Field connection diagrams - (HSAI)

As is standard for analog signals, shielded twisted-pair wire should be used for the field interface. For the analog input, the negative (-) and shield should be tied together and to earth ground, either locally at the cabinet or at the field device.

The following four figures show how the various Personality modules require these connections or how the options are implemented. The fifth drawing illustrates the jumper settings for the Personality module.

4.12 Field connection wiring diagrams (Pmod 1C31227) - (HSAI)

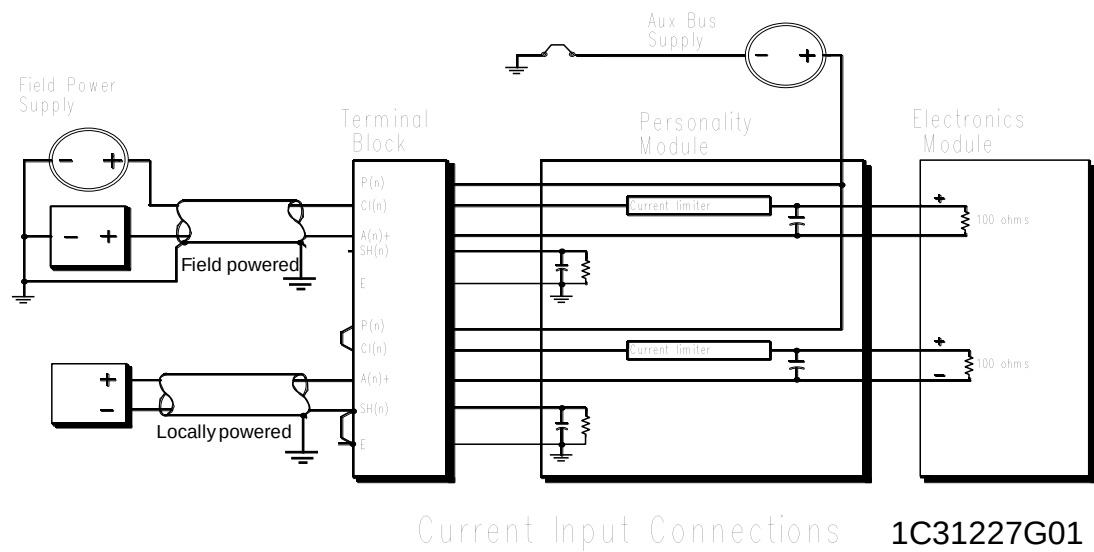
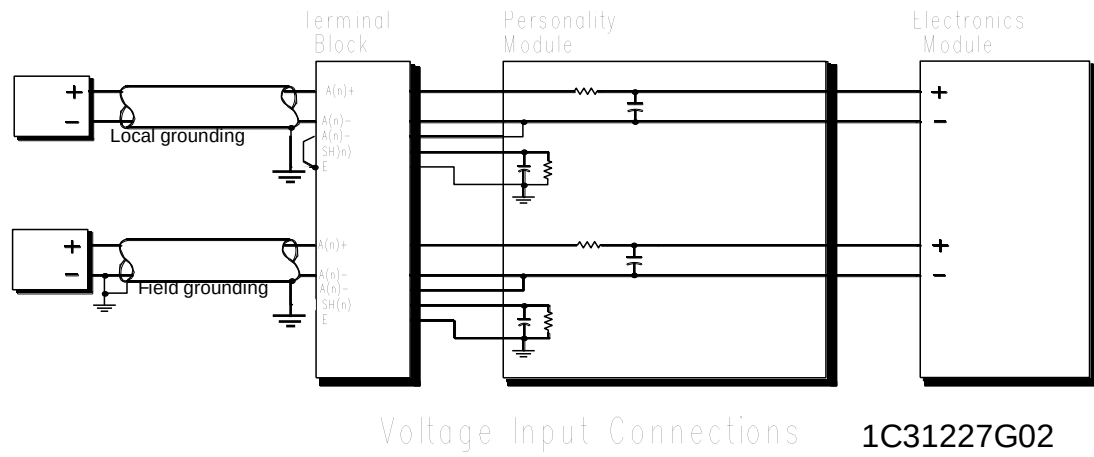


Caution

When using locally powered current inputs, the power distribution panel **MUST** be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

Figure 13: Field connections for the input connectors

4.13 Field connection wiring diagrams (Pmod 1C31227) (CE Mark) - (HSAI)



Caution

When using locally powered current inputs, the power distribution panel **MUST** be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

All field wiring must be braid shielded and grounded at the entry point of the cabinet using recommended hardware (refer to "Cable Guidelines" in the applicable Ovation installation manual for your system).

Figure 14: Field connections for the input connectors (CE Mark)

4.14 Field connection wiring diagrams (Pmod 1C31116) - (HSAI)

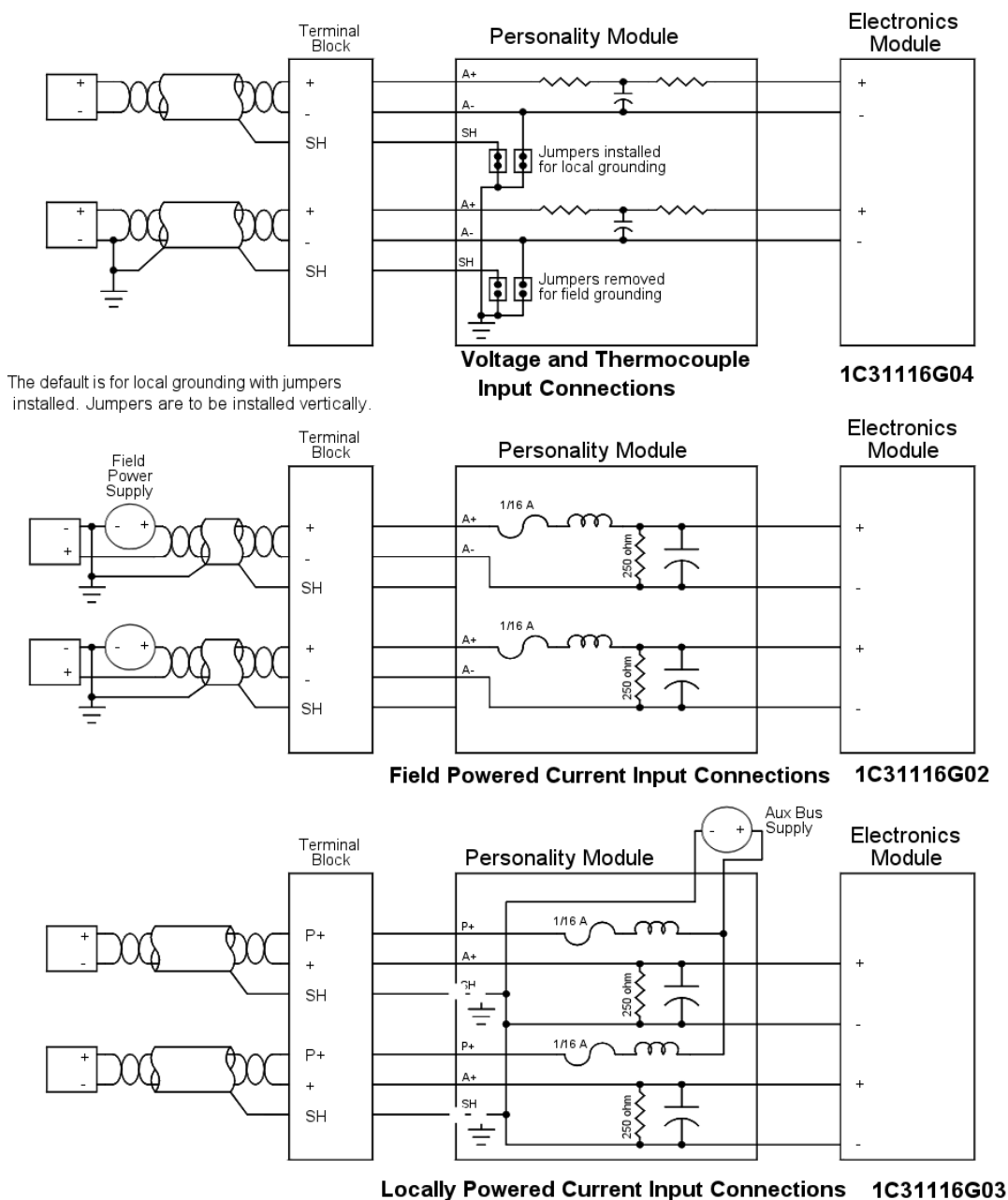


Figure 15: Field connections for the Analog Input Pmod

4.15 Field connection wiring diagrams, Pmod (Pmod 1C31116) (CE Mark) - (HSAI)

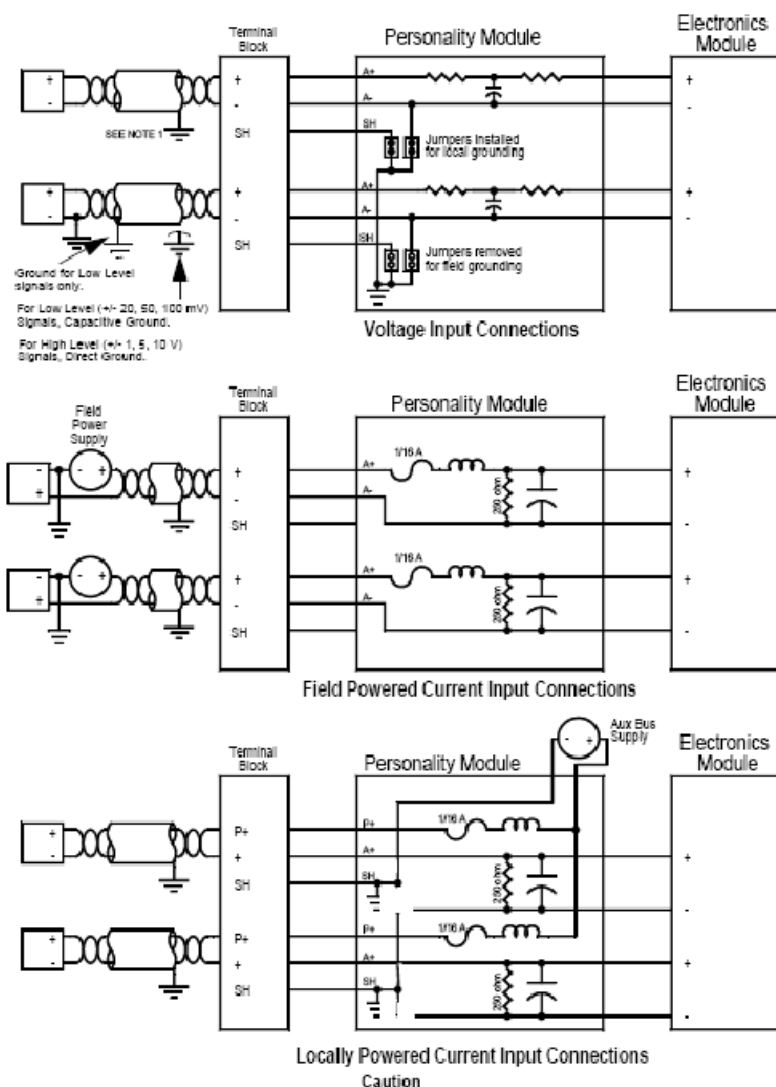


Figure 16: Field connections for the Analog Input Personality module (CE Mark)

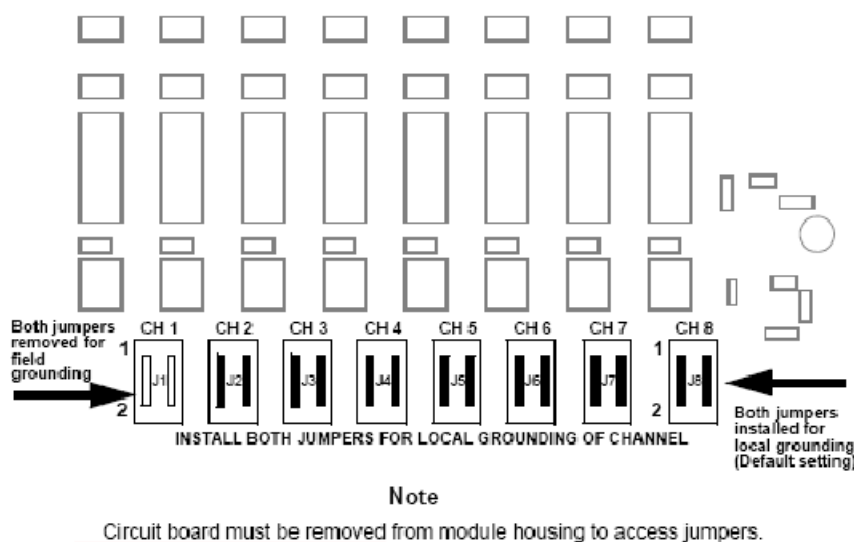


Figure 17: Jumper settings for Analog Input Personality module (1C31116G04)

4.16 Input address locations (Group 1) - (HSAI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

The data format for the configuration/module status register for Group 1 module is shown in the following table:

Group 1 configuration/module status register definitions

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	(Not Used)
3	0, (ADD5 bit During Diagnostics)	(Not Used)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	Not Defined	(Not Used)
10	0, (Initiates system calibration during Diagnostics)	SYS_CAL In Progress (During Diagnostics)

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)
12	Not Defined	SYS_CAL Failed (During Diagnostics)
13	Not Defined	Internal Memory Error
14	Not Defined	Module In Diagnostic Mode (During Diagnostics)
15	Not Defined	Point Fault ¹
¹ Refer to the Point Quality Register for the descriptions of the Point Faults.		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module; write to this bit configures the conversion rate of A/D converters as shown in the following table.

Conversion Rate (1/sec.)	Bit 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bit 9: This bit is not used and is read as “0” under normal operation.

Bit 10: This bit is not used and is read as “0” under normal operation.

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and is read as “0” under normal operation

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

4.17 Input address locations (Group 2) - (HSAI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

The data format for the configuration/module status register for Group 2 module is shown in the following table:

Group 2 configuration/module status register definitions

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	250mv select (14-Bit)/Not Defined (13-Bit)	250mv select (14-Bit)/ 0 (13-Bit)
10	100mv select (14-Bit)/Not Defined(13-Bit)	100mv select(14-Bit)/0 (13-Bit)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)
12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	(Not Used) ¹
15	Not Defined	Point Fault ¹
¹ Refer to the Point Quality Register for the descriptions of the Point Faults		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

CONVERSION RATE (1/SEC.)	BIT 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges.

FULL SCALE	BIT 9	BIT 10
1V	0	0
250 mv	1	0
100 mv	0	1
invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and is read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

4.18 Input address locations (Group 3) - (HSAI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following table.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

The data format for the configuration/module status register for Group 3 module is shown in the following table:

Group 3 configuration/module status register definitions

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	5V select (14-Bit)/Don't care (13-Bit)	250mv select (14-Bit)/ 0 (13-Bit)
10	0 (14-Bit)/Don't care(13-Bit)	100mv select(14-Bit)/0 (13-Bit)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)
12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	(Not Used)
15	Not Defined	Point Fault ¹
¹ Refer to the Point Quality Register for the descriptions of the Point Faults.		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the Warming state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set since all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

CONVERSION RATE (1/SEC.)	BIT 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges as follows for 14-Bit operation. For 13-Bit operation, these bits have no meaning.

Full Scale	Bit 9	Bit 10
10V	0	0
5V	1	0
2.5V(not supported)	0	1
invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is two per second. The status (read) bit is not used and read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set as the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

4.19 Input address locations (Group 4) - (HSAI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. It varies slightly with the different groups (1-4), primarily in module calibration and range selection. The bit information contained within these words is shown in the following tables.

These status words are only updated once per input channel sampling period; therefore, any Controller action based on changing the configuration (writing to address 13) must take this delay into account.

The data format for the configuration/module status register for Group 4 module is shown in the following table:

Group 4 configuration/module status register definitions

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	0, (ADD4 bit During Diagnostics)	SYS_CAL In Progress (During Diagnostics)
3	0, (ADD5 bit During Diagnostics)	Module In Diagnostic Mode (During Diagnostics)
4	0, (ADD6 bit During Diagnostics)	Warming
5	0, (ADD7 bit During Diagnostics)	(Not Used)
6	0, (ADD8 bit During Diagnostics)	(Not Used)
7	0, (DIAG_SET, Initiates Diagnostics)	Module is Not Calibrated
8	50/60 Hz Selection (1 = 50Hz)	50 Hz/60 Hz System (1 = 50Hz)
9	50mv select (14 bit)/Don't care (13-Bit)	50mv select (14 bit)/ 0 (13-Bit)
10	100mv select (14 bit)/Don't care(13-Bit)	100mv select (14 bit)/0 (13-Bit)
11	SELF_CAL (Initiates Self Calibration)	SYS_CAL Completed (During Diagnostics)

BIT	DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DESCRIPTION - MODULE STATUS REGISTER (READ)
12	0, (Initiates system calibration during Diagnostics)	SYS_CAL Failed (During Diagnostics)
13	0, Lock Calibration Gain (concurrent with the initiation of calibration during diagnostics)	Internal Memory Error
14	0, Clear Calibration (concurrent with the initiation of calibration during diagnostics)	Temperature Sensor Failure
15	Not Defined	Point Fault ¹
¹ Refer to the Point Quality Register for the descriptions of the Point Faults		

Bits defined for Diagnostics are only used during factory testing.

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the “Warming” state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the module error LED is lit. The point fault bit is also set as all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: The status of this bit (read) indicates the conversion rate of the input module, write to this bit configures the conversion rate of A/D converters as shown in the following table.

CONVERSION RATE (1/SEC.)	BIT 8
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bits 9-10: These bits are used to configure the ranges as follows

FULL SCALE	Bit 9	Bit 10
20 mv	0	0
50 mv	1	0
100 mv	0	1
invalid	1	1

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is 2 per second. The status (read) bit is not used and is read as “0” under normal operation

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set as the condition of the module is undetermined.

Bit 14: This bit, if set, indicates that the temperature sensor has failed.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point-quality status bits, plus the bits 1, 4, 7, and 13 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Point Quality Register (Address 12, C in Hex) reveals the point(s) that have bad quality. The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

4.20 Module register information - (HSAI)

Word address 14 (E in Hex) is not used and is read as “0” under normal operation.

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs.

High Speed Analog Input point quality register (address 12 or C in Hex)

POINT	BIT	DESCRIPTION
1 - 8	0, 2, 4, 6, 8, 10, 12, 14	Communication to the Channel Failed.
1 - 8	1, 3, 5, 7, 9, 11, 13, 15	Overrange Input/Blown Fuse/Open Loop.

Communication to the Channel Failed - This bit is set when the communication to the corresponding channel has failed.

Over-range Input/Blown Fuse/Open Loop – This bit is set as follows:

- **Current Input Emods** – When an input current less than 2.5mA (a blown fuse or open loop condition) is detected, or an overrange (greater than 24.6mA) of full scale is present.
- **Voltage Input Emods** – When an overrange input of $\pm 121\%$ of the full scale value is read.

4.21 Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module except for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Internal hardware error. ▪ Module reset ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
1 - 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Current loop out of range ▪ Calibration readings out of range.
9 through 16	These LED locations are not used for this module.

4.22 Specifications - (HSAI)

Analog Input High Speed Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	G01: 4-20 ma G02: $\pm 100\text{mv}$, $\pm 250\text{mv}$, $\pm 1\text{V}$ G03: $\pm 5\text{V}$, $\pm 10\text{V}$ G04-05: $\pm 20\text{mv}$, $\pm 50\text{mv}$, $\pm 100\text{mv}$
Resolution	G01: 14 bits unipolar, G02 - G05: 14 bits including polarity.
Data format	G01: 14 bit binary, G02 - G05: 14 bit two's compliment.
Conversion type	Sigma Delta.
Operating Mode	self-scan.
Monotonicity	yes
Nonlinearity	0.003% of full scale.

DESCRIPTION	VALUE
Repeatability	Within guaranteed accuracy
Guaranteed accuracy (@25°C)	$\pm 0.10\%$ of full scale value $\pm 1/2\text{LSB}$ @99.7% confidence.
Temperature coefficient	$\pm 0.24\%$ of the full scale value over 0 to 60°C.
Input impedance:	3.3 M ohms (G02, G03, G05) field configured, 2.2 M ohms (G03) field configured; 300 ohms @20 mA for G01 field configured.
Maximum Overload	G01: $\pm 48\text{VDC}$ or Vrms, G02 - G04: $\pm 120\text{VDC}$ or Vrms.
Sample Duration time (msec)	50Hz configuration: G01 - G03: 20; G04, G05: 60. 60 Hz configuration: G01 - G03: 16.67; G04, G05: 50.
Self-calibration	On demand by the Ovation Controller.
Sample Repetition (msec)	50 Hz configuration: G01 - G03: 20; G04, G05: 64. 60 Hz configuration: G01 - G03: 16.67; G04, G05: 54.
Diagnostics	Internal module operating faults. Out of range detection. Open loop detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB @50 Hz $\pm 1/2\%$ or @60 Hz $\pm 1/2\%$ (when properly configured). 30 dB (typical) @50 Hz $\pm 5\%$ or @60 Hz $\pm 5\%$ (when properly configured).
Common mode rejection and channel-channel crosstalk	120 dB @ DC or @ the nominal (50/60 Hz) line frequency $\pm 1/2\%$ and harmonics. 100 dB (typical) for nominal line frequency $\pm 5\%$ and harmonics.
Module power	Main: 2.4 W typical; 3.125 W Maximum Aux: When used (1C31227G01) Aux power supply voltage = 24 VDC 3.84 W typical (8 inputs @ 20mA each)
Operating temperature range	0 to 60°C (32°F to 140°F).
Storage temperature range	-40°C to 85°C (-40°F to 185°F).
Humidity (non-condensing)	0 to 95%
Filtering	Digital, Sinc, 3dB cutoff: 13.1 Hz for 50Hz; 15.7 Hz for 60 Hz.

SECTION 5

Analog Input module (14-Bit) - (8 Channel) (AI-14)

IN THIS SECTION

8 Channel Analog Input module overview (14-Bit) - (AI-14)	83
Electronics modules (Emod) - (AI-14)	83
Personality modules (Pmod) - (AI-14)	83
Valid module combinations - (AI-14)	84
External power supplies - (AI-14)	84
Terminal block wiring information - (AI-14)	84
Field connection wiring diagrams - (AI-14)	86
Field connection wiring diagrams (CE Mark) - (AI-14)	88
Module block diagram - (AI-14)	89
Configuration/status register information - (AI-14)	89
Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	91
Specifications - (AI-14)	92

5.1 8 Channel Analog Input module overview (14-Bit) - (AI-14)

The combined Personality and Electronics modules form the 14 Bit Analog Input module. Eight sets of galvanically isolated input channels are provided. The input signals are conditioned and routed through the appropriate Personality module to the Electronics module. The Personality module also provides surge protection to protect the input circuits of the Electronics module. The Electronics module performs the analog to digital conversions and provides interfacing to the Ovation Serial I/O Bus.

No thermocouple provisions are provided for this module.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

5.2 Electronics modules (Emod) - (AI-14)

- **1C31224G01** provides current signals with an input range of 4 to 20 mA.
- **1C31224G02** provides voltage signals with an input range of $\pm 1V$.

5.3 Personality modules (Pmod) - (AI-14)

- **1C31227G01** provides current signals with an input range of 4 to 20 mA.
- **1C31227G02** provides voltage signals with an input range of $\pm 1V$.

5.4 Valid module combinations - (AI-14)

Analog Input valid module combinations (14-bit)

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
4 - 20mA, Field or Locally powered ¹	8	1C31224G01 ¹	1C31227G01
± 1 VDC	8	1C31224G02 ¹	1C31227G02
¹ The 4-20mA configuration is CE Mark certified.			

5.5 External power supplies - (AI-14)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and **NOT** from the AC or DC Mains.

If the 14-Bit Analog Input module uses the 1C31227G01 Personality module, the required voltage source is obtained from the internal auxiliary power supply (backplane).

Also, Personality module 1C31227G01 supports field-powered configurations.

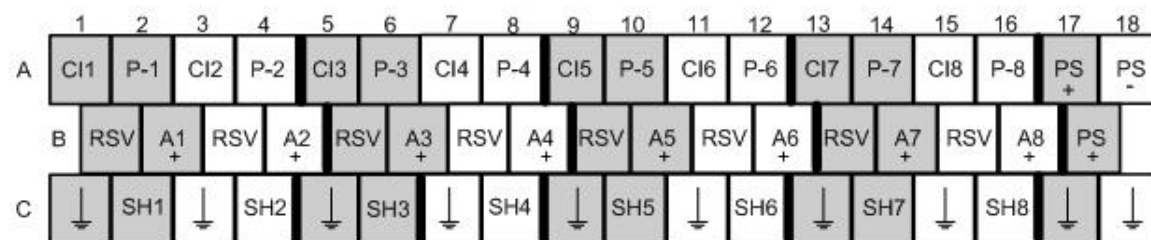
5.6 Terminal block wiring information - (AI-14)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

Note: For the Standard I/O Marshaling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

The diagrams for the Analog Input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

Current Loop (1C31227G01)



Voltage Input (1C31227G02)

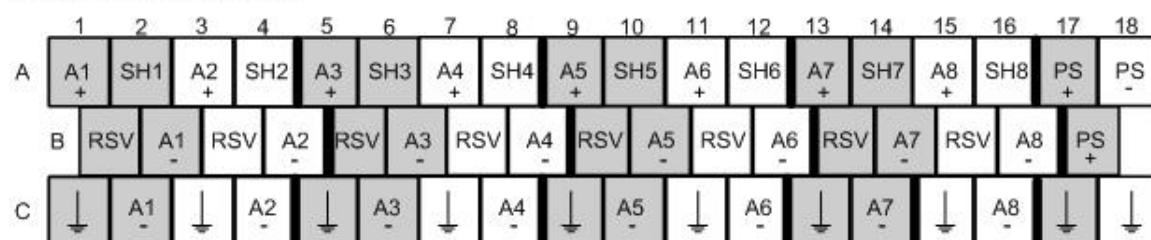


Figure 18: Terminal Block Connections for the Analog Input Personality Modules

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
A1 - A8 +	Analog Input positive terminal connection (connected to the positive terminal of the field device).
A1 - A8 -	Analog Input negative terminal connection (voltage input group only).
CI1 - CI8	Current input terminals.
P-1 - P-8	Loop power output terminals (for locally powered loops).
PS+, PS-	Auxiliary power supply terminals.
RSV	Reserved terminal. No connections allowed on these terminals.
SH1 - SH8	Shield terminal connection.

Use shielded twisted pair wire for the field wiring. Tie the Analog Input negative terminal and shield together and to earth ground, either locally at the cabinet or at the field device. Voltage inputs use the 1C31227G02 Personality modules. Grounding the shield and the analog input negative terminal at the cabinet or at the field device is arranged by the proper Terminal Block connections.

Similarly, current inputs using the 1C31227G01 Personality modules can accommodate field or locally powered devices by using the correct terminal block connections.

The Personality modules have a field connection diagram label on top of each module to facilitate field wiring. The figures in 14-Bit Analog Input Field Connection Wiring Diagrams (see page 86) show the implementations of the field connections for the various Personality module and field device combinations.

5.7 Voltage input connection wiring diagram - (AI-14)

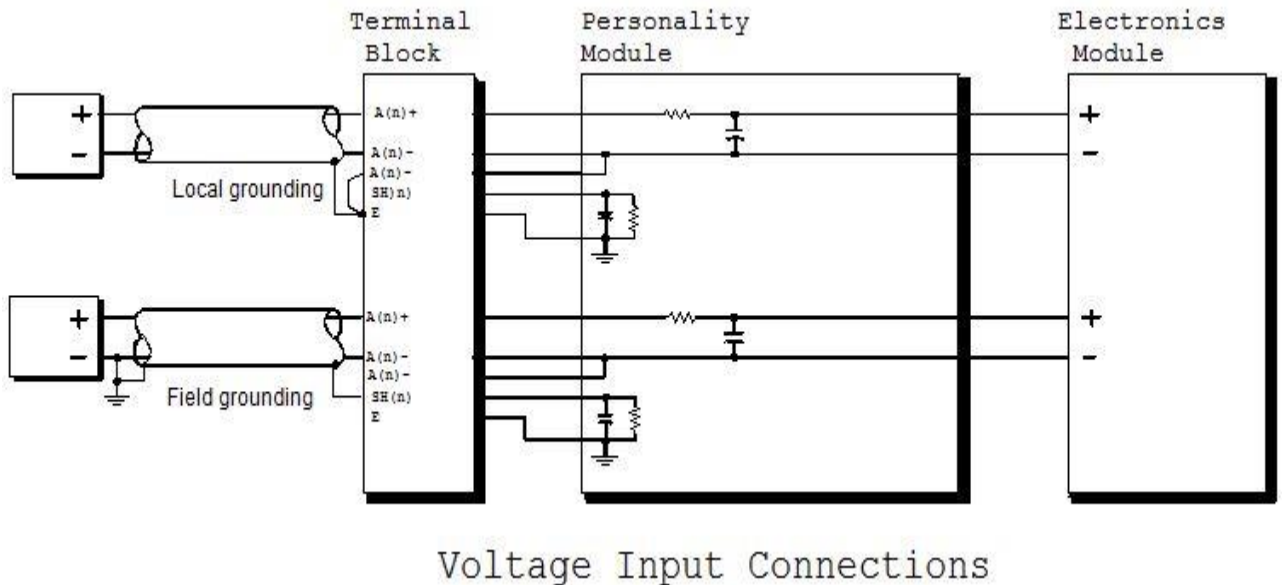


Figure 19: Voltage Input connections

5.8 Current input connection wiring diagram - (AI-14)

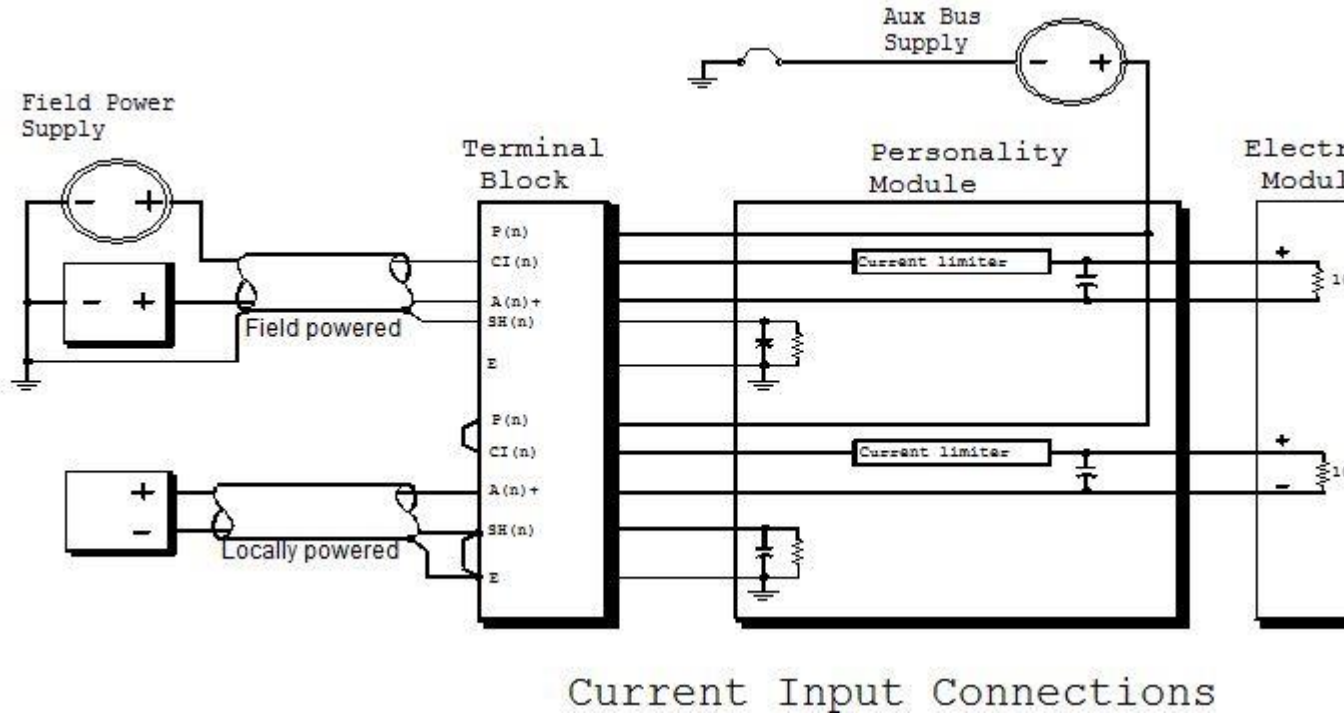
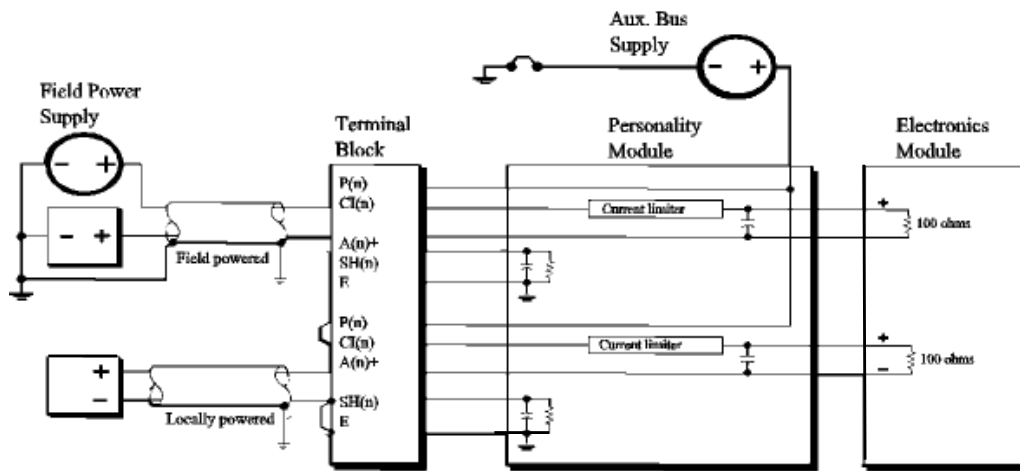


Figure 20: Current input connections

5.9 Field connection wiring diagrams (CE Mark) - (AI-14)



Caution

When using locally powered current inputs, the power distribution panel **MUST** be equipped with jumper module 5A26471G01 to ensure proper grounding of the aux Bus supply.

All field wiring must be braid shielded and grounded at the entry point of the cabinet using recommended hardware (refer to "Cable Guidelines" in the applicable Ovation installation manual for your system).

Figure 21: Field connections for Input Connectors (CE Mark)

5.10 Module block diagram - (AI-14)

The simplified block diagram for the voltage input configuration of the 14-Bit Analog Input module is shown in the following figure. The channel 1 input is grounded locally at the cabinet, and grounding at the field device is shown for the channel 8 input.

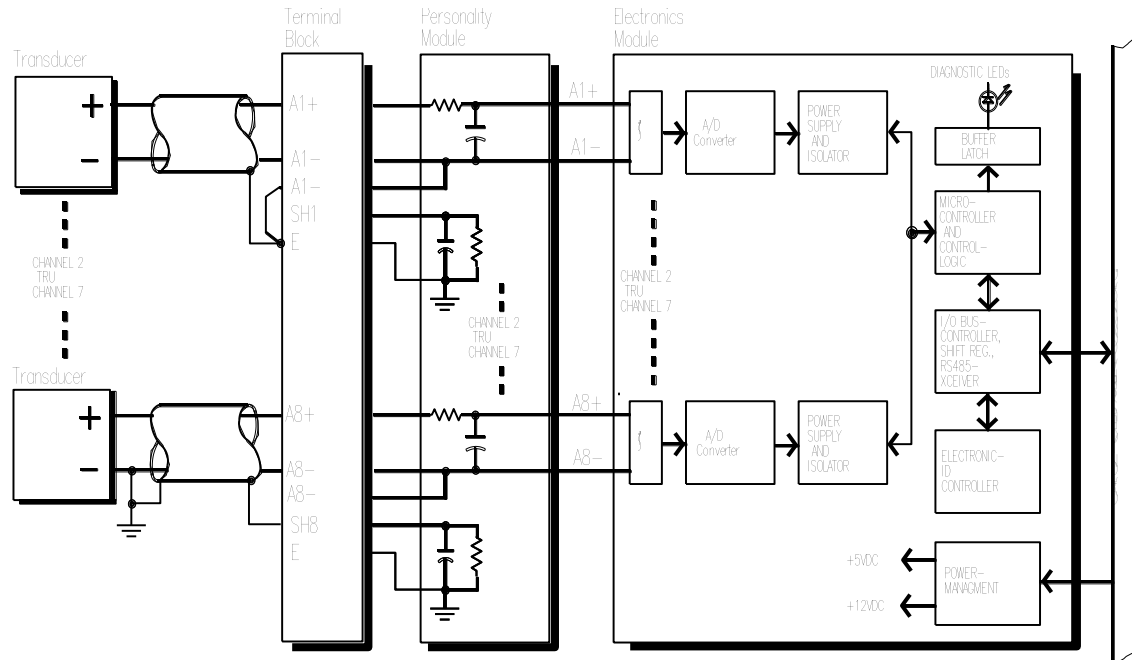


Figure 22: Voltage input connections

5.11 Configuration/status register information - (AI-14)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (See the *Ovation Operator Station User Guide*).

14-Bit Analog Input configuration/status (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2	0, (ADD4 bit during diagnostics)	Not Used (0)
3	0, (ADD5 bit during diagnostics)	Not Used (0)
4	0, (ADD6 bit during diagnostics)	Warning
5	0, (ADD7 bit during diagnostics)	Not Used (0)
6	0, (ADD8 bit during diagnostics)	Not Used (0)
7	0, (DIAG_SET, initiates diagnostics)	Module is not calibrated

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
8	50/60 Hz Selection (0 = 60Hz, 1 = 50Hz)	50 Hz/60 Hz System (0 = 60Hz; 1 = 50Hz)
9	A/D conversion rate selection bit (0 = Normal, 1 = High speed)	A/D conversion rate bit (0 = Normal, 1 = High speed)
10	0, (SYS_CAL, initiates system calibration during diagnostics)	SYS_CAL in progress (during diagnostics)
11	SELF_CAL (initiates self calibration)	SYS_CAL completed (during diagnostics)
12	Not defined	SYS_CAL failed (during diagnostics)
13	Not defined	Internal Memory Error (FLASH Checksum, Register, or Static RAM Error)
14	Not defined	Module in diagnostic mode (during diagnostics)
15	Not defined	Point Fault ¹
¹ Refer to the Point Quality Register for descriptions of the Point Faults.		

Bits defined for diagnostics are used only during factory testing.

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into its error state, resulting in the error LED being lit. The read of bit 1 indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module's Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bits 2-3: These bits are not used and are read as “0” under normal operation.

Bit 4: This bit (read) indicates that the module is in the “Warming” state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 5-6: These bits are not used and are read as “0” under normal operation.

Bit 7: This bit is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the error is indicated by the module error LED being lit. The point fault bit is set as all the point data is not calibrated. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bits 8: A write to this bit configures the conversion rate of the A/C converters as follows:

CONVERSION RATE (1/SEC)	BIT 8
20 (for 60Hz systems)	0
25 (for 50Hz systems)	1

The status of these bits (read) indicate the conversion rate to which the module is set.

Bit 9: Reserved

Bit 10: This bit is not used and is read as “0” under normal operation.

Bit 11: This bit (write) is used to initiate self-calibration. The sampling rate during self-calibration is 2 per second. The status (read) bit is not used and is read as “0” under normal operation.

Bit 12: This bit is not used and is read as “0” under normal operation.

Bit 13: This bit (read) indicates that the module has internal memory error (FLASH, checksum, Register, or Static RAM error). If this error is present, the module error LED is lit, the point fault bit is also set since the condition of the module is undetermined.

Bit 14: This bit is not used and is read as “0” under normal operation.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point quality statuses plus bits 1, 7, 12, and 13 of this register. A “0” indicates that all eight points have good quality and no module errors exist.

When bits 1, 4, 7 or 13 of the Status Register are not set, this bit (when set to “1”) indicates that at least one of the points has bad quality.

A subsequent read of the Point Quality Register at Address 12 (C in Hex) reveals the point(s) that have bad quality (see the following table). The Address 12 (C in Hex) Point Quality Register contains data only when the module fault is due to a bad point quality.

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs. The bit definitions for this register are encoded as shown in the following table.

Point quality register (Address 12 or C in Hex)

POINT	BIT	DESCRIPTION
1 - 8	0, 2, 4, 6, 8, 10, 12, 14	Communication to the Channel Failed
1 - 8	1, 3, 5, 7, 9, 11, 13, 15	Overrange Input/Blown Fuse/Open Loop

Communication to the Channel Failed - This bit is set when the communication to the corresponding channel has failed.

Overrange Input/Blown Fuse/Open Loop – This bit is set as follows:

- Current Input (Group 1) – When an input current less than 2.5mA (a blown fuse or open loop condition) is detected, or an overrange (greater than 24.6mA) of full scale is present.
- Voltage Input (Group 2) – When an overrange input of $\pm 121\%$ of the full scale value is read.

5.12 Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.

LED	DESCRIPTION
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module except for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Internal hardware error. ▪ Module reset ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
1 - 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Current loop out of range ▪ Calibration readings out of range.
9 through 16	These LED locations are not used for this module.

5.13 Specifications - (AI-14)

Analog Input (14- Bit 8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	4 - 20 mA ¹ ±1V ²
Resolution	Group 1:14-Bits, Group 2:13-Bits & Sign
Guaranteed accuracy (@25°C)	±0.10% of full scale value ±1/2LSB @99.7% confidence.
Temperature coefficient	±0.24% of the full scale value over 0 to 60 degrees C.
Input impedance: ³	G01 modules = 300 ohms max @ 20 ma G02 modules = 10 M ohms
Sampling rate	20 times per second minimum when configured for 60 Hz rejection 25 times per second minimum when configured for 50Hz rejection
Self-calibration	On demand by the Ovation Controller.
Diagnostics	Internal module operating faults. Out of range detection. Open loop detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB @50 Hz ± 1/2% or @60 Hz ± 1/2% (when properly configured) 30 dB (typical) @50 Hz ± 5% or @60 Hz ± 5% (when properly configured)

DESCRIPTION	VALUE
Common mode rejection	120 dB @ DC or @ nominal (50/60 Hz) line frequency $\pm 1/2\%$ and harmonics. 100 dB (typical) for nominal line frequency $\pm 5\%$ and harmonics.
Module power	Main: 2.4 W typical; 3.125 W Maximum Aux: When used (1C31227G01) Aux power supply voltage = 24 VDC 3.84 W typical (8 inputs @ 20mA each)
Operating temperature range	0 to 60 degrees C (32 degrees F to 140 degrees F)
Storage temperature range	-40 degrees C to 85 degrees C (-40 degrees F to 185 degrees F)
Humidity (non-condensing)	0 to 95%
¹ Current inputs when using Personality module 1C31224G01 with 1C31227G01 Electronics module. ² Voltage inputs when using Personality module 1C31224G02 with 1C31227G02 Electronics module. ³ Only for the voltage input module (Personality module 1C31224G02 with 1C31227G02 Electronics module).	

SECTION 6

Analog Input module (13-Bit) - (8 Channel) (AI-13)

IN THIS SECTION

8 Channel Analog Input module overview (13-Bit) - (AI-13)	95
Electronics modules (Emod) - (AI-13)	95
Personality modules and jumper settings (Pmod) - (AI-13)	96
Valid module combinations - (AI-13)	96
External power supply information - (AI-13)	97
Terminal block wiring information - (AI-13)	98
Field connection wiring diagrams - (AI-13)	100
Field connection wiring diagrams (CE Mark) - (AI-13)	101
Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)	102
Thermocouple types and coefficients - (AI-13) & (HSAI)	103
Configuration/Status Register information - (AI-13)	106
Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)	108
Specifications - (AI-13)	109

6.1 8 Channel Analog Input module overview (13-Bit) - (AI-13)

The Ovation Analog Input module with an associated Personality module provides signal conditioning and analog-to-digital conversion for eight galvanically isolated analog inputs. Field inputs are surge protected and routed by the appropriate Personality module and then sent to the Electronics module for conversion.

The Analog Input module (13 bits) is applicable for CE Mark Certified Systems.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

6.2 Electronics modules (Emod) - (AI-13)

- **1C31113G01** provides voltage input range of ± 20 mV.
- **1C31113G02** provides voltage input range of ± 50 mV.
- **1C31113G03** provides voltage input range of ± 100 mV.
- **1C31113G04** provides voltage input range of ± 1 V.
- **1C31113G05** provides voltage input range of ± 5 V.
- **1C31113G06** provides voltage input range of ± 10 V.

6.3 Personality modules and jumper settings (Pmod) - (AI-13)

- **1C31116G01** provides voltage analog inputs.
- **1C31116G02** provides field-powered current analog inputs.
- **1C31116G03** provides locally powered current analog inputs.
- **1C31116G04** provides voltage analog inputs with a temperature sensor for cold junction thermocouple compensation.

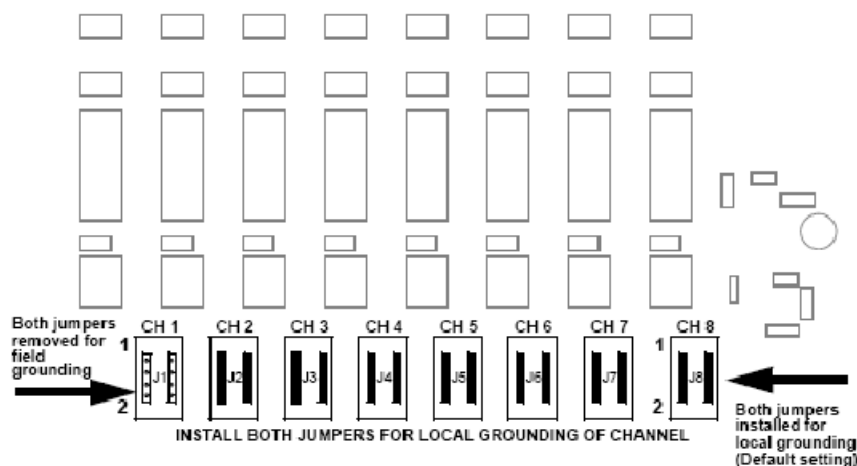


Figure 23: Jumper settings for analog input personality module (1C31116G01 & 04)

Note: The circuit board must be removed from the module housing to access the jumpers (see page 25).

6.4 Valid module combinations - (AI-13)

Analog Input valid module combinations (13-bit)¹

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
± 20mV	8	1C31113G01 ¹	1C31116G01
± 50mV	8	1C31113G02 ¹	1C31116G01
± 100mV	8	1C31113G03 ¹	1C31116G01
± 20mV Compensated (Thermocouple)	8 ³	1C31113G01 ¹	1C31116G04
± 50mV Compensated (Thermocouple)	8 ³	1C31113G02 ¹	1C31116G04
± 100mV Compensated (Thermocouple)	8 ³	1C31113G03 ¹	1C31116G04
± 1 VDC	8	1C31113G04 ¹	1C31116G01
± 5 VDC	8	1C31113G05 ¹	1C31116G01
± 10 VDC	8	1C31113G06 ¹	1C31116G01

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
0-20 mA Field powered (4-20 mA Field powered can also be selected)	8	1C31113G05 ^{1, 2}	1C31116G02
0-20 mA Locally powered (4-20 mA Locally powered can also be selected)	8	1C31113G05 ^{1, 2}	1C31116G03
¹ This module configuration is CE Mark certified. ³ This module configuration is CE Mark certified (Non-EMC Cabinet). ³ A ninth logical channel (does not connect to a device) is provided when using the Analog Input module with temperature sensor. This ninth point is needed for the CJ Compensation field when defining the eight other thermocouple points for the AI module. (See the <i>Ovation Developer Studio User Guide</i> .			

6.5 External power supply information - (AI-13)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24VDC main power supply and from the auxiliary power supply (if required) and **NOT** from the AC or DC Mains.

If the Analog Input module uses the 1C31116G03 Personality module (configured with locally powered current analog inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 635) contains steps follow before connecting the external power supply to the Analog Input module base unit terminal block. The Analog Input module auxiliary supply voltage level (24 VDC or 48 VDC) depends on the external transmitter devices being interfaced to the (AI) module's analog inputs.

6.6 Terminal block wiring information - (AI-13)

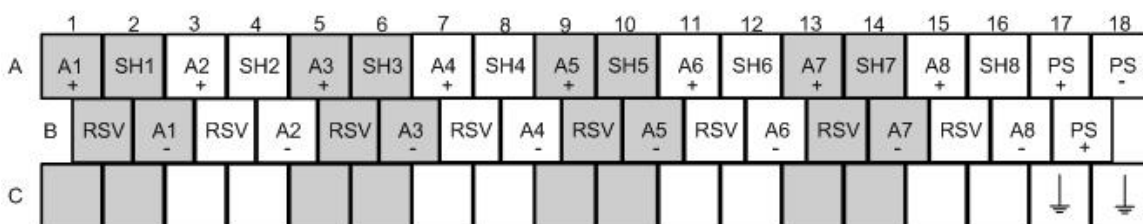
Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

Note: For the Standard I/O Marshaling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

The diagrams for the analog input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

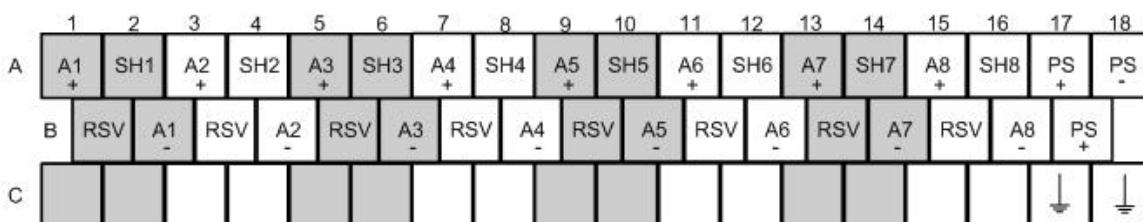
Voltage Input: (1C31116G01)

Thermocouple Input: (1C31116G04)



Note: Internal jumpers are in this personality module for locally grounding the shield and (-) connections to earth ground.

Field Powered Current Loop: (1C31116G02)



Locally Powered Current Loop: (1C31116G03)

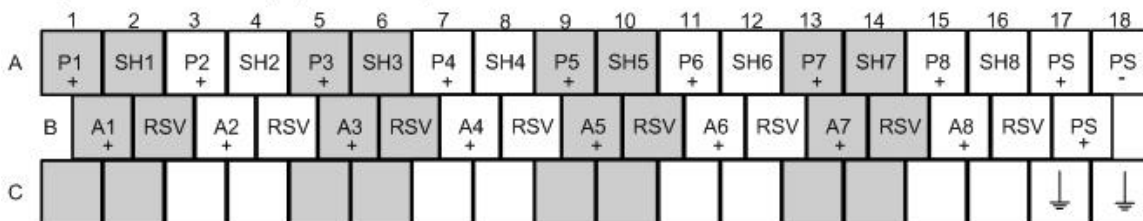
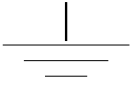


Figure 24: Terminal block connections for the Analog Input Personality modules

Shielded twisted-pair wire should be used for the field interface. For analog input signals; the (-) and shield should be tied together to earth ground either locally at the cabinet or at the field device.

Abbreviations used in diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
A1 - A8 +	Analog Input positive terminal connection
A1 - A8 -	Analog Input negative terminal connection
P1 - P8 +	Positive terminal connection for current loop power
PS+, PS-	Auxiliary power supply terminals
RSV	Reserved terminal. No connections allowed on these terminals.
SH1 - SH8	Shield terminal connection.

Note: Do **not** use unmarked terminal block locations.

Shield terminals (SH) are **not** connected in CE Mark systems.

6.7 Field connection wiring diagrams - (AI-13)

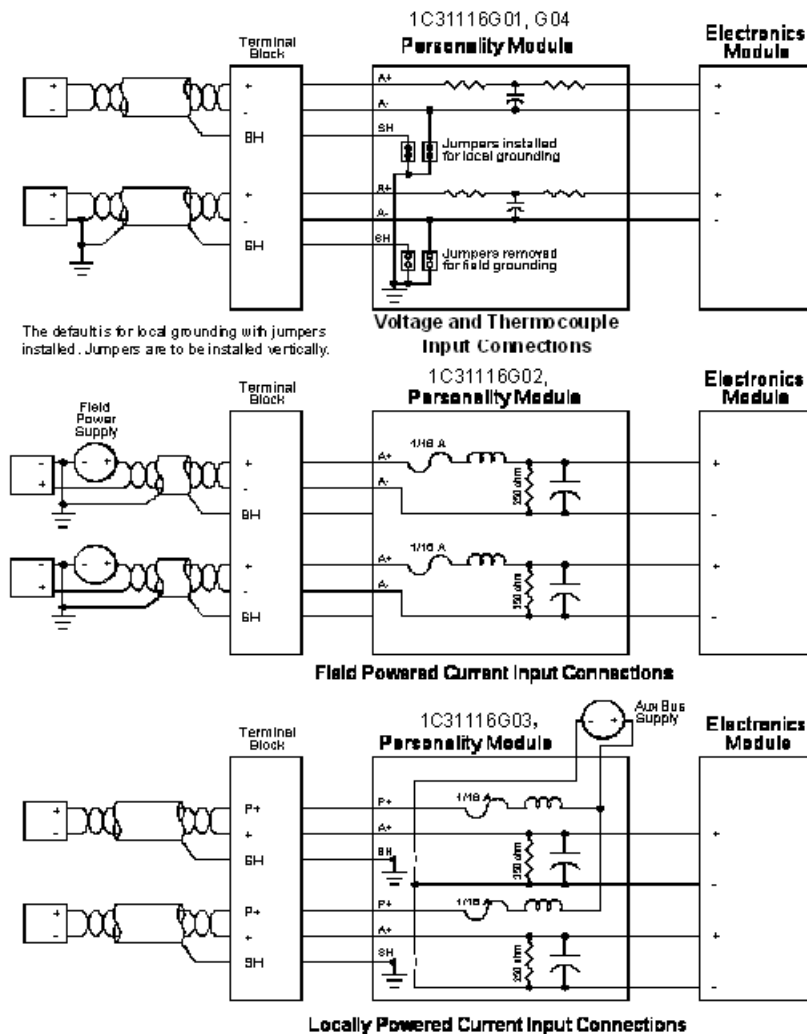
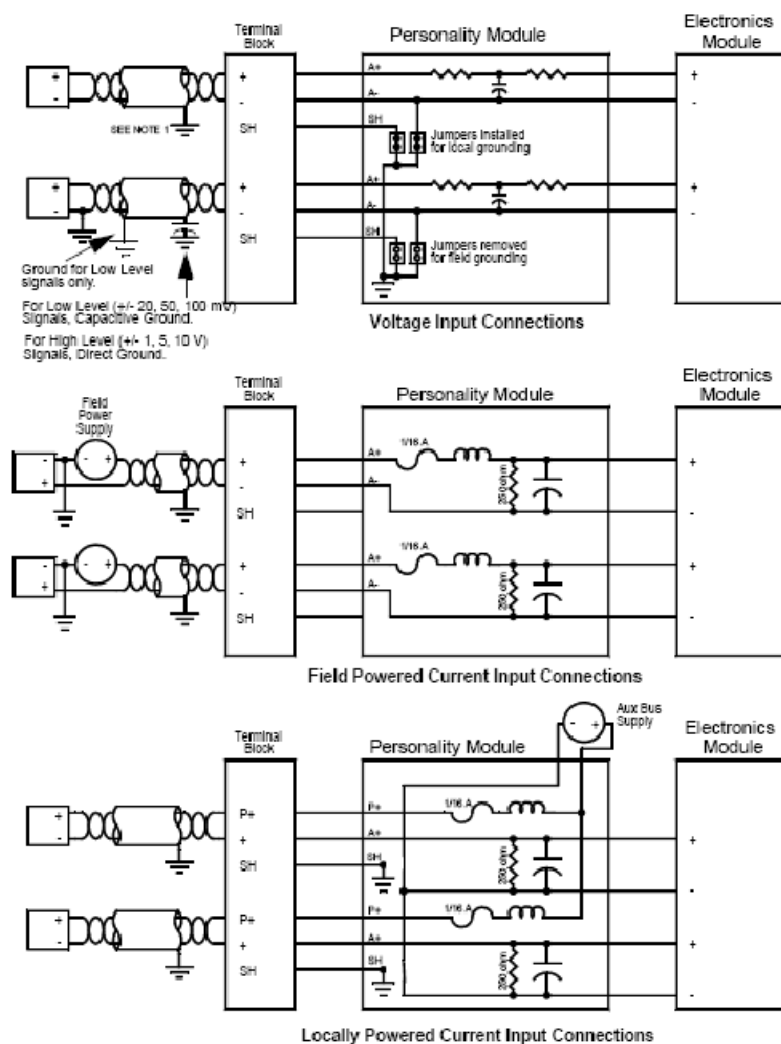


Figure 25: Field connections, Analog Input Personality module

Note: See Personality module Jumpers (see page 25) for details on accessing the jumpers.

6.8 Field connection wiring diagrams (CE Mark) - (AI-13)



1. All field wiring MUST be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation Installation manual).

Figure 26: Field connections for the Analog Input Personality module (CE Mark)

6.9 Thermocouple Personality module functionality & coefficients - (AI-13) & (HSAI)

When two dissimilar metals (a thermocouple) are joined together, a voltage (the Seebeck Voltage) is generated between them. This voltage is directly related to the temperature at the junction of the two metals. The relationship between the voltage and the temperature can be best described by a fifth order polynomial, determined by the two types of metals that are joined.

To measure the voltage (V_t) between the two metals, a voltmeter (in this case, an analog input card) must be connected to each wire. Unfortunately, this produces two new junctions and voltages (V_1 and V_2) between the terminals and the thermocouples. The following formula is used to find V_t : $V_t = V_m - V_1 - V_2$.

It is not possible to measure V_1 and V_2 without inducing more junctions and voltages; therefore, the analog input subsystem has a temperature sensor on the Personality module (1C31116G04) to measure the temperature (T_j) at the terminal block of the base unit.

A conversion formula, determined from the junction metal and thermocouple metals, is used to calculate the combined voltage of V_1 and V_2 . This is called **Cold Junction Compensation**.

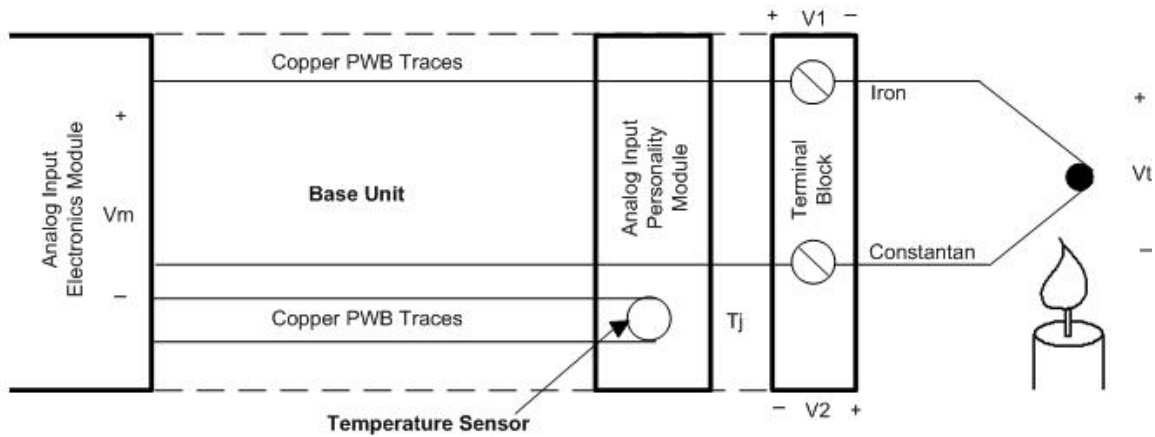


Figure 27: Thermocouple illustration

Select one of the Field Instrumentation Types. The Ovation system assigns the default thermocouple coefficients based on the Thermocouple Type selected. Refer to Thermocouple types and coefficients (see page 60) for valid thermocouple types and coefficients.

If you override the default coefficients by entering new values, the new values remain **until** you select another thermocouple type. The values then return to the values for the type just selected.

6.10 Thermocouple types and coefficients - (AI-13) & (HSAI)

The following tables list the valid thermocouple types and coefficients:

Thermocouple type B or TB

MILLIVOLT RANGE B or TB	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 13.814 0.006 to 13.814	0 to 1820 Degrees C 0 to 3308 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 3.5164700E+02 COEF_2 = 6.1388490E+05 COEF_3 = -1.5397740E+08 COEF_4 = 3.3593730E+10 COEF_5 = -4.0518260E+12 COEF_6 = 2.0039330E+14 COEF_7 = -5.7368636E-06 COEF_8 = 4.1848114E-08		Centigrade COEF_1 = 1.7758167E+02 COEF_2 = 3.4104717E+05 COEF_3 = -8.5543000E+07 COEF_4 = 1.8663183E+10 COEF_5 = -2.2510144E+12 COEF_6 = 1.1132961E+14 COEF_7 = -4.3977239E-06 COEF_8 = 7.5326606E-08

Thermocouple type E or TE

MILLIVOLT RANGE E or TE	TEMPERATURE RANGE	BEST FIT MODULE
- 9.835 to 19.945 - 9.835 to 19.945	- 270 to 286 Degrees C - 450 to 548 Degrees F	20 mv module 20 mv module
- 9.835 to 49.992 - 9.835 to 49.956	- 270 to 661 Degrees C - 450 to 1221 Degrees F	50 mv module 50 mv module
- 9.835 to 76.358 - 9.835 to 76.358	- 270 to 1000 Degrees C - 450 to 1832 Degrees F	100 mv module 100 mv module
Fahrenheit COEF_1 = 3.1672830E+01 COEF_2 = 3.0306280E+04 COEF_3 = -3.3449490E+05 COEF_4 = 6.8495880E+06 COEF_5 = -6.9753490E+07 COEF_6 = 2.9236530E+08 COEF_7 = -1.0939E-03 COEF_8 = 3.365E-05		Centigrade COEF_1 = -1.8176111E-01 COEF_2 = 1.6836822E+04 COEF_3 = -1.8583050E+05 COEF_4 = 3.8053267E+06 COEF_5 = -3.8751939E+07 COEF_6 = 1.6242517E+08 COEF_7 = -1.71E-05 COEF_8 = 6.057E-05

Thermocouple type J or TJ

MILLIVOLT RANGE J or TJ	TEMPERATURE RANGE	BEST FIT MODULE
- 8.096 to 19.971 - 8.137 to 19.977	- 210 to 366 Degrees C - 350 to 691 Degrees F	20 mv module 20 mv module
- 8.096 to 42.922 - 8.137 to 42.922	- 210 to 760 Degrees C - 350 to 1400 Degrees F	50 mv module 50 mv module

MILLIVOLT RANGE J OR TJ	TEMPERATURE RANGE	BEST FIT MODULE
Fahrenheit COEF_1 = 3.112531E+01 COEF_2 = 3.6070270E+04 COEF_3 = -4.2886170E+05 COEF_4 = 2.2613820E+07 COEF_5 = -5.1743790E+08 COEF_6 = 3.9727830E+09 COEF_7 = -9.256E-04 COEF_8 = 2.862E-05		Centigrade COEF_1 = -4.8593889E-01 COEF_2 = 2.0039039E+04 COEF_3 = -2.3825650E+05 COEF_4 = 1.2563233E+07 COEF_5 = -2.8746550E+08 COEF_6 = 2.2071017E+09 COEF_7 = -9.76E-06 COEF_8 = 5.1516E-05

Thermocouple type K or TK

MILLIVOLT RANGE K OR TK	TEMPERATURE RANGE	BEST FIT MODULE
– 6.458 to 19.959 – 6.456 to 19.978	– 270 to 484 Degrees C – 450 to 904 Degrees F	20 mv module 20 mv module
– 6.458 to 49.988 – 6.456 to 49.996	– 270 to 1232 Degrees C – 450 to 2250 Degrees F	50 mv module 50 mv module
– 6.458 to 54.875 – 6.456 to 54.845	– 270 to 1372 Degrees C – 450 to 2500 Degrees F	100 mv module 100 mv module
Fahrenheit COEF_1 = 3.0344730E+01 COEF_2 = 4.4031910E+04 COEF_3 = 1.615839E+05 COEF_4 = -1.616257E+07 COEF_5 = 4.4011090E+08 COEF_6 = -3.599650E+09 COEF_7 = -7.259E-04 COEF_8 = 2.243E-05		Centigrade COEF_1 = -9.1959444E-01 COEF_2 = 2.4462172E+04 COEF_3 = 8.9768833E+04 COEF_4 = -8.9792056E+06 COEF_5 = 2.4450606E+08 COEF_6 = -1.9998056E+09 COEF_7 = -8.14E-06 COEF_8 = 4.0374E-05

Thermocouple type N or TN

MILLIVOLT RANGE N OR TN	TEMPERATURE RANGE	BEST FIT MODULE
– 4.345 to 19.990 – 4.345 to 19.990	– 270 to 584 Degrees C – 454 to 1083 Degrees F	20 mv module 20 mv module
– 4.345 to 47.514 – 4.345 to 47.514	– 270 to 1300 Degrees C – 454 to 2372 Degrees F	50 mv module 50 mv module
Fahrenheit COEF_1 = 2.7795251549E+01 COEF_2 = 7.6249124464E+04 COEF_3 = -2.8626852972E+06 COEF_4 = 1.3017695115E+08 COEF_5 = -2.7644988772E+09 COEF_6 = 2.1988892938E+10 COEF_7 = -4.8744444444E-04 COEF_8 = 1.4888888888E-05		Centigrade COEF_1 = -2.3359713617E+00 COEF_2 = 4.2360624702E+04 COEF_3 = -1.5903807207E+06 COEF_4 = 7.2320528414E+07 COEF_5 = -1.5358327096E+09 COEF_6 = 1.2216051632E+10 COEF_7 = -1.1000000000E-05 COEF_8 = 2.6800000000E-05

Thermocouple type R or TR

MILLIVOLT RANGE R or TR	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 19.998 0.089 to 19.997	0 to 1684 Degrees C 0 to 3063 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 8.3628480E+01 COEF_2 = 2.2737160E+05 COEF_3 = -1.2482860E+07 COEF_4 = 1.2062540E+09 COEF_5 = -7.4221280E+10 COEF_6 = 1.89930000E+12 COEF_7 = -1.084E-04 COEF_8 = 3.24E-06		Centigrade COEF_1 = 2.8682489E+01 COEF_2 = 1.2631756E+05 COEF_3 = -6.9349222E+06 COEF_4 = 6.7014111E+08 COEF_5 = -4.1234044E+10 COEF_6 = 1.0551667E+12 COEF_7 = -4.72E-06 COEF_8 = 5.832E-06

Thermocouple type S or TS

MILLIVOLT RANGE S or TS	TEMPERATURE RANGE	BEST FIT MODULE
0.000 to 18.698 -0.092 to 18.696	0 to 1768 Degrees C 0 to 3214 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 1.1803440E+02 COEF_2 = 1.9859180E+05 COEF_3 = -1.9730960E+04 COEF_4 = -5.0093290E+08 COEF_5 = 4.1104880E+10 COEF_6 = -1.1557940E+12 COEF_7 = -1.0847E-04 COEF_8 = 3.26E-06		Centigrade COEF_1 = 4.7796889E+01 COEF_2 = 1.1032878E+05 COEF_3 = -1.0961644E+04 COEF_4 = -2.7829606E+08 COEF_5 = 2.2836044E+10 COEF_6 = -6.4210778E+11 COEF_7 = -4.15E-06 COEF_8 = 5.868E-06

Thermocouple type T or TT

MILLIVOLT RANGE T or TT	TEMPERATURE RANGE	BEST FIT MODULE
-6.258 to 19.945 -6.254 to 19.979	-270 to 385 Degrees C -450 to 726 Degrees F	20 mv module 20 mv module
Fahrenheit COEF_1 = 3.1892240E+01 COEF_2 = 4.6693280E+04 COEF_3 = -1.3257390E+06 COEF_4 = 6.9620670E+07 COEF_5 = -2.3278080E+09 COEF_6 = 3.3306460E+10 COEF_7 = -7.3333E-04 COEF_8 = 2.243E-05		Centigrade COEF_1 = -5.9866667E-02 COEF_2 = 2.5940711E+04 COEF_3 = -7.3652167E+05 COEF_4 = 3.8678150E+07 COEF_5 = -1.2932267E+09 COEF_6 = 1.8503589E+10 COEF_7 = -1.55700E-05 COEF_8 = 4.0374E-05

6.11 Configuration/Status Register information - (AI-13)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

Analog Input configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2 - 6	Not Used	Not Used (0)
7	Not Used	EEPROM Checksum Error - Module Uncalibrated (1 = error; 0 = no error)
8	50/60 Hz Selection (0 = 60Hz, 1 = 50Hz)	50 Hz/60 Hz System (0 = 60Hz; 1 = 50Hz)
9	Use Line Sync if Present (1 = use)	Using Line Sync
10	Not Used	Line Frequency Tracking Active
11	Not Used	EE PROM Program Enabled
12	Not Used	PSD Generator Malfunction
13	Not Used	Internal Memory Error (EPROM Checksum or Static RAM Error)
14	Not Used	Temperature Sensor Failure
15	Not Used	Point Fault ¹
¹ Refer to Point Quality registers for descriptions of the Point Faults.		

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, accessing addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into its error state, resulting in the error LED being lit. The read of bit 1 indicates the error state of the module, with “1” indicating that there is an internal error in the module or the Controller has forced the module into an error state. The state of this bit is always reflected by the module's Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when the point data is read (that is, accessing addresses 0 through 11).

Bits 2 - 6: These bits are “not used” values and are read as “0” under normal operation.

Bit 7: This bit is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If this error is present, the error is indicated by the module error LED being lit and the module does not process the point information. The point fault bit is also set as all the point data is uncalibrated. When this error is present, no other processing takes place. The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 8: This bit indicates if the on-board integrating timebase is 80 msec (4 line cycles of a 50 Hz system) or 83.3 msec (5 line cycles of a 60 Hz system). A “0” indicates that the timebase is 83.3 msec (60 Hz line frequency) and is the default setting.

Bit 9: This bit indicates whether to use the line frequency tracking if it is present. A write of “1” indicates to use the tracking input. A read of “1” indicates that the module is using the tracking input. The default state is a “0.”

Note: Line frequency tracking is presently **NOT** supported by the Ovation I/O system.

Bit 10: This bit indicates whether the line frequency tracking signal is present and active for greater normal and common mode rejection. A “0” indicates that the line frequency tracking signal is NOT present.

Bit 11: This bit indicates whether the hardware EEPROM PE signal is active. A “0” indicates that the module is in normal operating mode and calibration and ID programming commands are not processed.

Bit 12: This bit reflects the detection of the internal 625 KHz PSD signal at module initialization. This verifies that the multifunction FPGA and the microcontroller's timer 0 are functioning. A “0” indicates that there is no error condition. A “1” indicates an unrecoverable error condition in the field.

Bit 13: This bit is a basic check of program and data memory, along with the microcontroller's data, address, and control buses. A “0” indicates that there is no error condition. A “1” indicates an unrecoverable error condition in the field.

Bit 14: This bit indicates the fault status of the digital temperature sensor. A “0” indicates the sensor is present and communicating properly with the microcontroller. A “1” indicates a fault exists; either there is no sensor present, or problems exist in communicating with the sensor. On an uncalibrated module, a sensor failure is always reported because the uncalibrated status prevents the sensor from being checked.

Bit 15: This bit indicates the point fault status of the module. It is the logical “OR” of the eight individual point quality statuses plus bits 1, 7, 12, and 13 of this register. A “0” indicates that all eight points have good quality and no module errors exist. A “1” indicates that at least one of the points has bad quality and is therefore in fault.

A subsequent read of the Point Quality status register at Address 12 (C in Hex) reveals which of the eight points has bad quality and the cause of the bad quality condition. The Address 12 (C in Hex) Point Quality Status Register contains data only when the module fault is due to a bad point quality; that is, bits 7, 12, and 13 of this register or the forced error bit are not set. Note that the Temperature Sensor (Address 8) status is treated separately and is not included in this module point fault bit.

Word address 12 (C in Hex) serves the purpose of reporting the point quality of the eight channel inputs. The bit definitions for this register are encoded as shown in the following table.

Point Quality register (address 12 or C in Hex)

POINT	BIT	DESCRIPTION
1 - 8	0, 2, 4, 6, 8, 10, 12, 14	Auto Calibration Reasonability Check Failed
1 - 8	1, 3, 5, 7, 9, 11, 13, 15	Overrange Input/Blown Fuse/Open Loop/Open Thermocouple

Auto Calibration Reasonability Check Failed - This bit is set when the auto calibration zero or reference reading is out of tolerance ($\pm 6\%$ of the nominal reading).

Overrange Input/Blown Fuse/Open Loop/Open Thermocouple - This bit is set under the following conditions:

- **Voltage Input Configuration** (all groups) - when an overrange input of $\pm 125\%$ of the full scale value is read on the input.
- **Current Input Configuration** (Group 5) - when an input less than 2.5mA (a blown fuse or open loop condition) is detected or an overrange of greater than 25mA of full scale is present.

Secondary configuration/status register (address 14 or E in Hex)

BIT	DATA DESCRIPTION - CURRENT/VOLTAGE CONFIGURATION (WRITE)	DATA DESCRIPTION - CURRENT/VOLTAGE STATUS (READ)
0 - 7	Select Point 1 - 8 Current/Voltage (1 = Current)	Select Point 1 - 8 Current/Voltage (1 = Current)
8 - 15	Not Used	Point 1 - 8 Current Blown Fuse (1 = Blown)

Word address 14 (E in Hex) serves the purpose of the Current/Voltage Configuration/Status Register. The bit definitions for this register are encoded as shown in the following table.

The default state of the register under normal operation is "0" for voltage inputs. The lower 8 bits are configuration bits which are written to and read from the module. The upper 8 bits are read-only status bits indicating the blown fuse status only for those channels which have been configured as current inputs.

6.12 Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module except for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Internal hardware error. ▪ Module reset ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.

LED	DESCRIPTION
1 - 8 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Current loop out of range ▪ Calibration readings out of range.
9 through 16	These LED locations are not used for this module.

6.13 Specifications - (AI-13)

Analog Input (13-Bit 8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range ¹	G01: ± 20 mv G02: ± 50 mv G03: ± 100 mv G04: ± 1 V G05: ± 5 V 2 G06: ± 10 V
Resolution	13-Bit (including polarity)
Data format	13-bit, two's complement, and error indicator bits
Conversion type	Sigma Delta
Operating mode	Self-scan
Monotonicity	Yes
Non-linearity	0.003% of full scale
Repeatability	Within guaranteed accuracy
Guaranteed accuracy (@25°C)	Accuracy over -25% to 100% range of full scale input level: ▪ $\pm 0.10\%$ of upper range value $\pm 10\mu\text{V} \pm 1/2\text{LSB}$ @99.7% confidence. ▪ Accuracy over -100% to -25% range of full scale input level: ▪ $\pm 0.15\%$ of upper range value $\pm 10\mu\text{V} \pm 1/2\text{LSB}$ @99.7% confidence.
Temperature coefficient	$\pm 0.24\%$ of the upper range value $\pm 24\mu\text{V}$ over 0 to 60°C.
Input impedance: ³ Groups G01 through G05 Group G06 (± 10 V input only)	10 M-ohms 2 M-ohms
Maximum overload	G01 - G03: ± 10 Vdc or Vrms G04 - G06: ± 120 Vdc or Vrms
Sample duration time (msec)	50 Hz configuration : 80 60 Hz configuration: 83.33

DESCRIPTION	VALUE
Sample repetition (msec)	50 Hz configuration : 80 60 Hz configuration: 83.33
Filtering	Digital, Sinc, 3dB cutoff: 13.1 Hz for 50 Hz, 15.7 Hz for 60 Hz
Offset and gain temperature drift compensation	Automatic
Diagnostics	Internal module operating faults. ▪ Out of range detection. ▪ Open thermocouple detection for thermocouple inputs. ▪ Open loop/blown fuse detection for current inputs.
Dielectric isolation: Channel to channel Channel to logic	1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB at 50 Hz $\pm 1/2\%$ or 60 Hz $\pm 1/2\%$ 30 dB (typical) at 50 Hz $\pm 5\%$ or 60 Hz $\pm 5\%$
Common mode rejection and channel to channel crosstalk	120 dB at DC, power line frequency and its harmonics $\pm 1/2\%$ tracking. 100 dB (typical) for nominal line frequency $\pm 5\%$ and harmonics.
Module power	Main: 2.5 W typical; 3.38 W Maximum Aux: When used (1C31116G03) Aux power supply voltage = 24 VDC 3.84 W typical (8 inputs @ 20mA each)
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ Ranges are available through separate modules. ² Current inputs when using Personality module 1C31116G02 or 1C31116G03 with $\pm 5V$ Electronics module. The input range 0 to 20 mA is also available, but if selected, blown fuse detection will be disabled. If you select 0 to 20 mA, the software adds a suffix "A" to the Personality module identification. This "A" is not displayed, it is only used by the database to differentiate between 0 to 20 mA and 4 to 20 mA, in order to generate correct coefficients. ³ Only for modules used with voltage input Personality modules (1C1116G01 and 1C1116G04).	

SECTION 7

HART Analog Input module - (HAI) (8 Channel)

IN THIS SECTION

8 Channel HART Analog Input module overview - (HAI)	111
Electronics modules (Emod) - (HAI)	111
Personality modules (Pmod) - (HAI)	112
Valid module combinations - (HAI)	112
Module block diagram information - (HAI)	113
External power supply information - (HAI)	114
Terminal block wiring information - (HAI)	115
Field connection wiring diagrams - (HAI)	116
Field connection wiring diagrams (CE Mark) - (HAI)	117
Field wiring cable requirements - (HAI)	118
Configuration/Status Register information - (HAI)	121
Diagnostic Logic card LEDs - (HAI)	123
Specifications - (HAI)	123

7.1 8 Channel HART Analog Input module overview - (HAI)

HART (Highway Addressable Remote Transducer) is a digital communication protocol designed for industrial process measurement applications.

Field measurement devices (transmitters) interface a process control system via an analog 4-to-20 mA current loop. HART uses a low-level frequency shift-keyed sine wave signal that is superimposed on the standard 4-to-20 mA process measurement current loop.

Since the HART sine wave signal is small and its average value is zero, the current loop analog 4-to-20 mA signal is not significantly affected by the presence of the HART signal. Using HART allows a field device to provide more than one measurement, which is a feature not available when using only the 4-to-20 A analog current signal.

“Smart” field devices may be described as field devices in which the analog 4-to-20 mA signal, digital communication, and sometimes power, co-exist on the same pair of wires. The Ovation HART Analog Input (HAI) module is a standard form factor Ovation I/O module, which permits Ovation to communicate with HART devices.

The HART Analog Input Module is a CE Mark certified module.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

7.2 Electronics modules (Emod) - (HAI)

- **5X00058G01** interfaces to eight current loop signals with an input range of 4-20 mA.

7.3 Personality modules (Pmod) - (HAI)

- **5X00059G01** contains a single printed circuit board assembly with eight fused two-wire loop-powered or non-fused active-source (four-wire isolated current output) transmitter inputs. Eight user serviceable fuses (one fuse for each analog input channel) are located on the Pmod. Each fuse protects the auxiliary power supply only if the associated analog input channel is connected to a two-wire loop powered current transmitter.

Note: Revision 02 and later Personality modules contain a ninth user serviceable fuse (1/2 A) for the Electronics module +24 VDC auxiliary power input.

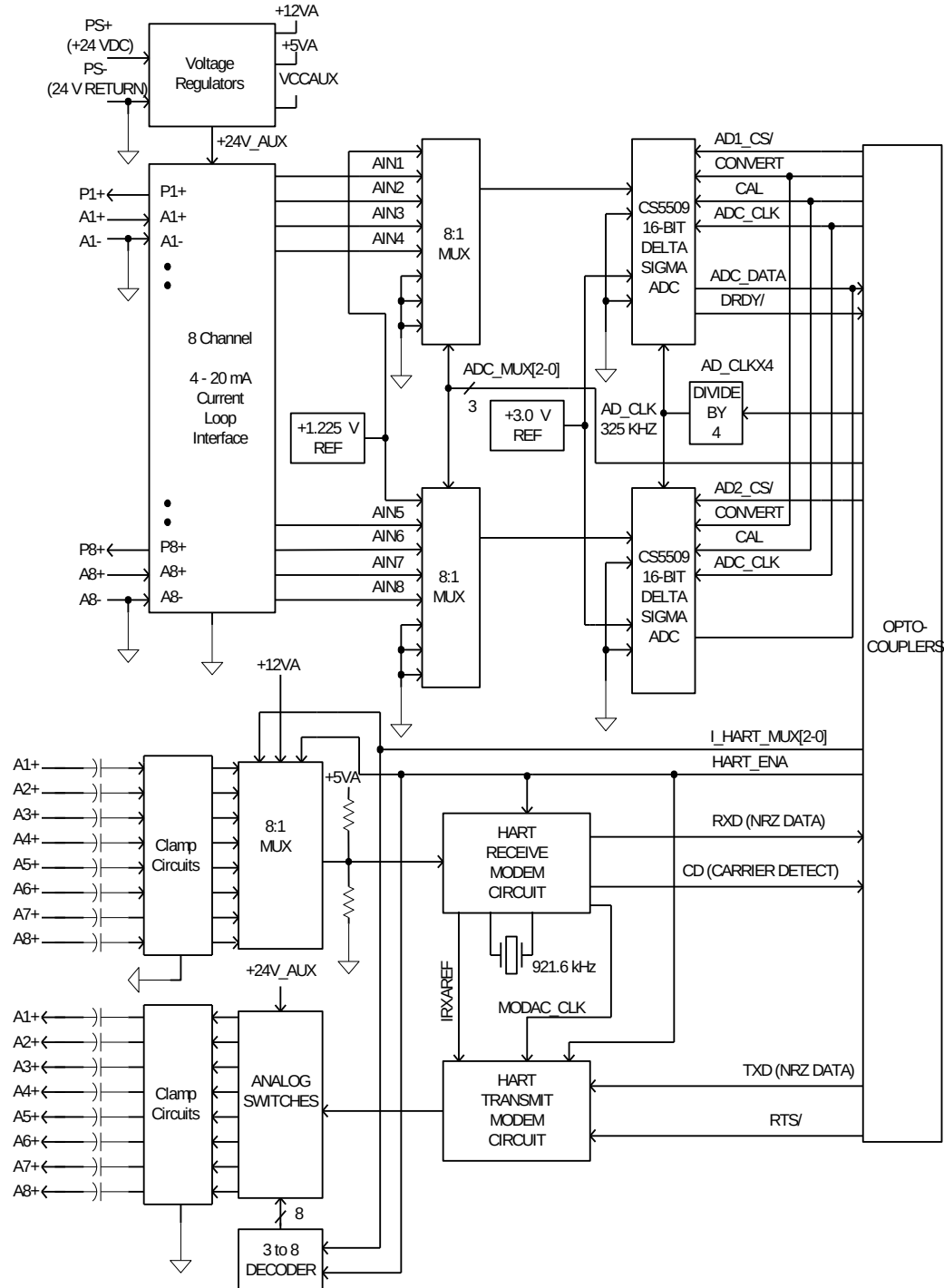
7.4 Valid module combinations - (HAI)

*HART Analog Input valid module combinations (16-bit)*¹

RANGE	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE
4-20 mA loop powered (2 wire) or active source (4 wire)	8	5X00058G01 ¹	5X00059G01
¹ This module configuration is CE Mark certified.			

7.5 Module block diagram information - (HAI)

The Ovation HART Analog Input Module assembly consists of two modules: an Electronics module containing a logic printed circuit board (LHA) and a field printed circuit board (FHI). The simplified block diagram for the FHI field board is shown below. The Electronics module is used in conjunction with a Personality module, which contains a single printed circuit board (PHAI).



7.6 External power supply information - (HAI)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and **NOT** from the AC or DC mains.

The HART Analog Input Module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

The HART Analog Input Module utilizes a +24 auxiliary power supply to provide the power required for the field circuitry. This includes all 4-20 mA loop power, A/D conversion, and the remaining output channel components.

It is recommended that the HART Analog Input module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS Maximum for all rated loads across the frequency range of 500 HZ to 10 KHz, see the following figure.

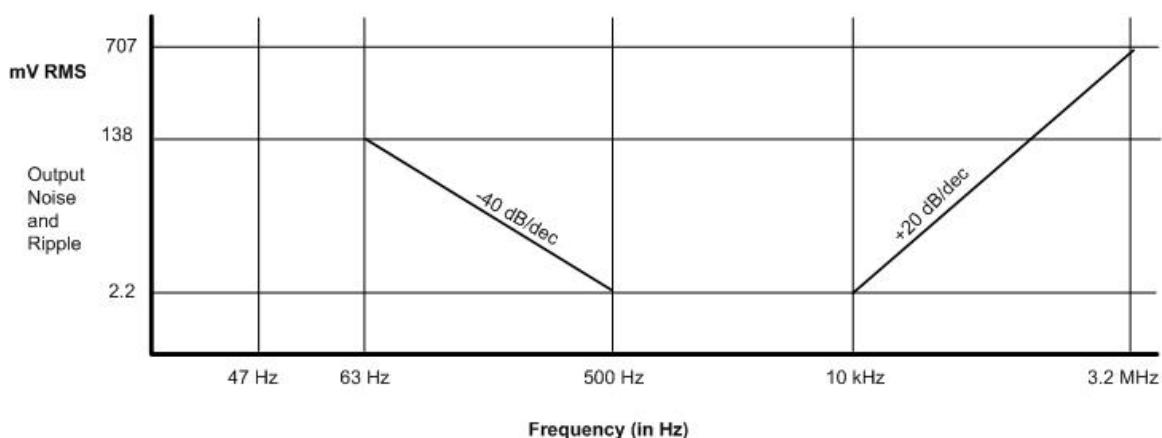


Figure 28: Power supply output noise requirements

If an external power supply is used, Using an External Power Supply (see page 635) contains steps to be undertaken before connecting the external power supply to the Ovation I/O base unit terminal block.

In addition, all modules utilizing the auxiliary power supplies, including the HART modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART modules. This includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the type of power supply chosen by the user.

7.7 Terminal block wiring information - (HAI)

Each Personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how the wiring from the field is to be connected to the terminal block in the base unit.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

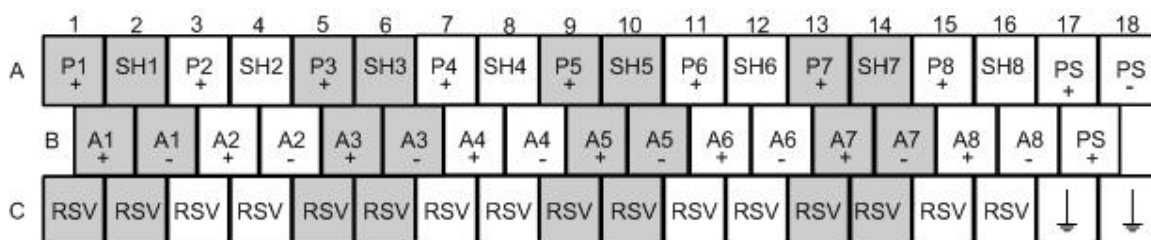


Figure 29: HART Analog Input terminal block pin assignments

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
A1 - A8 +	Analog Input terminal connection (connected to the negative terminal of a loop powered two-wire current transmitter or the positive terminal of an active-source current transmitter).
A1 - A8 -	Analog Input negative terminal connection (active-source only).
P1 - P8 +	Loop power output terminals (for loop powered two-wire current transmitters - connect to their positive terminal).
PS+, PS-	External Auxiliary power supply terminals.
RSV	Reserved terminal. No connections are allowed on these terminals.
SH1 - SH8	Shield terminal connection.

7.8 Field connection wiring diagrams - (HAI)

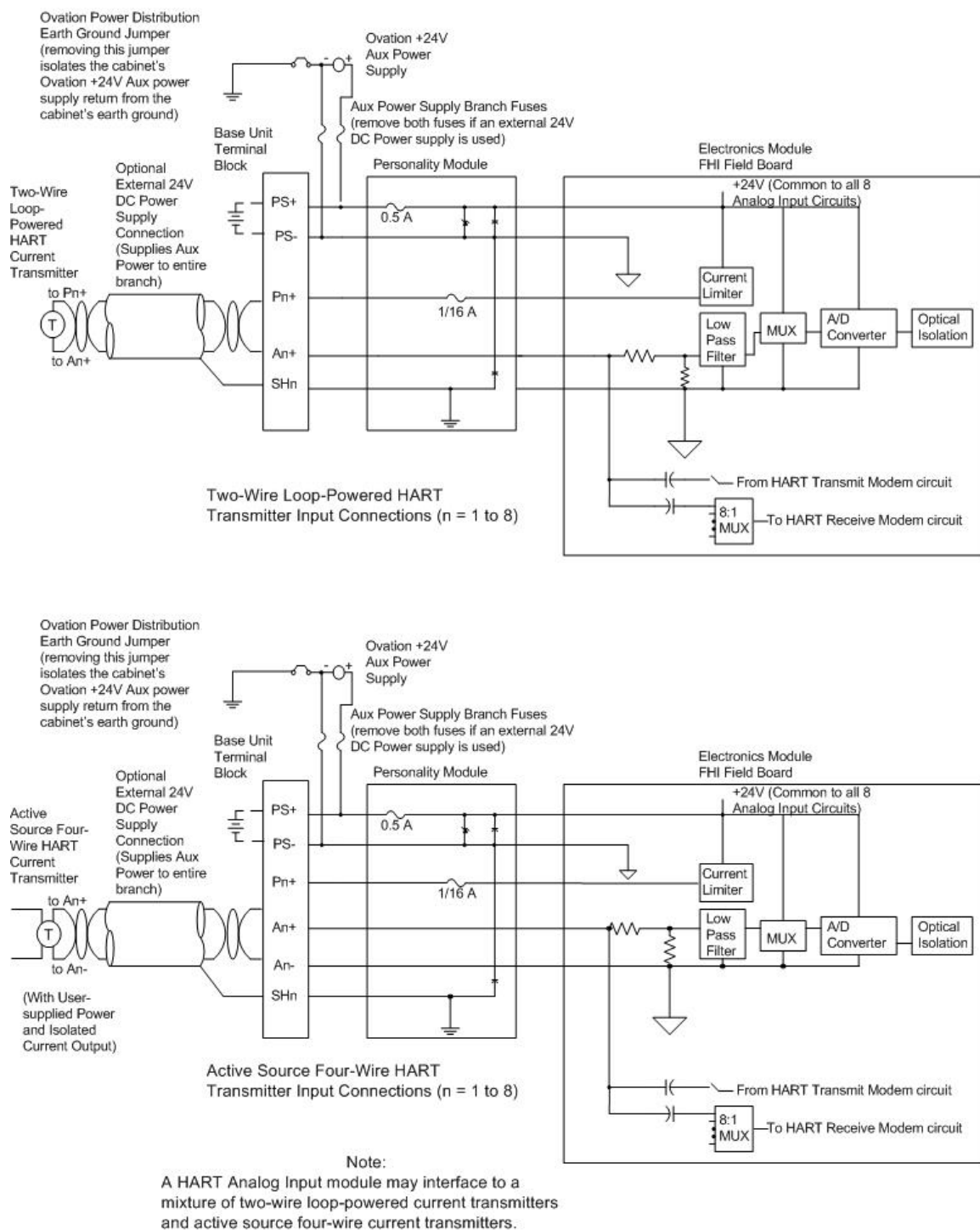


Figure 30: HART Analog Input connections

7.9 Field connection wiring diagrams (CE Mark) - (HAI)

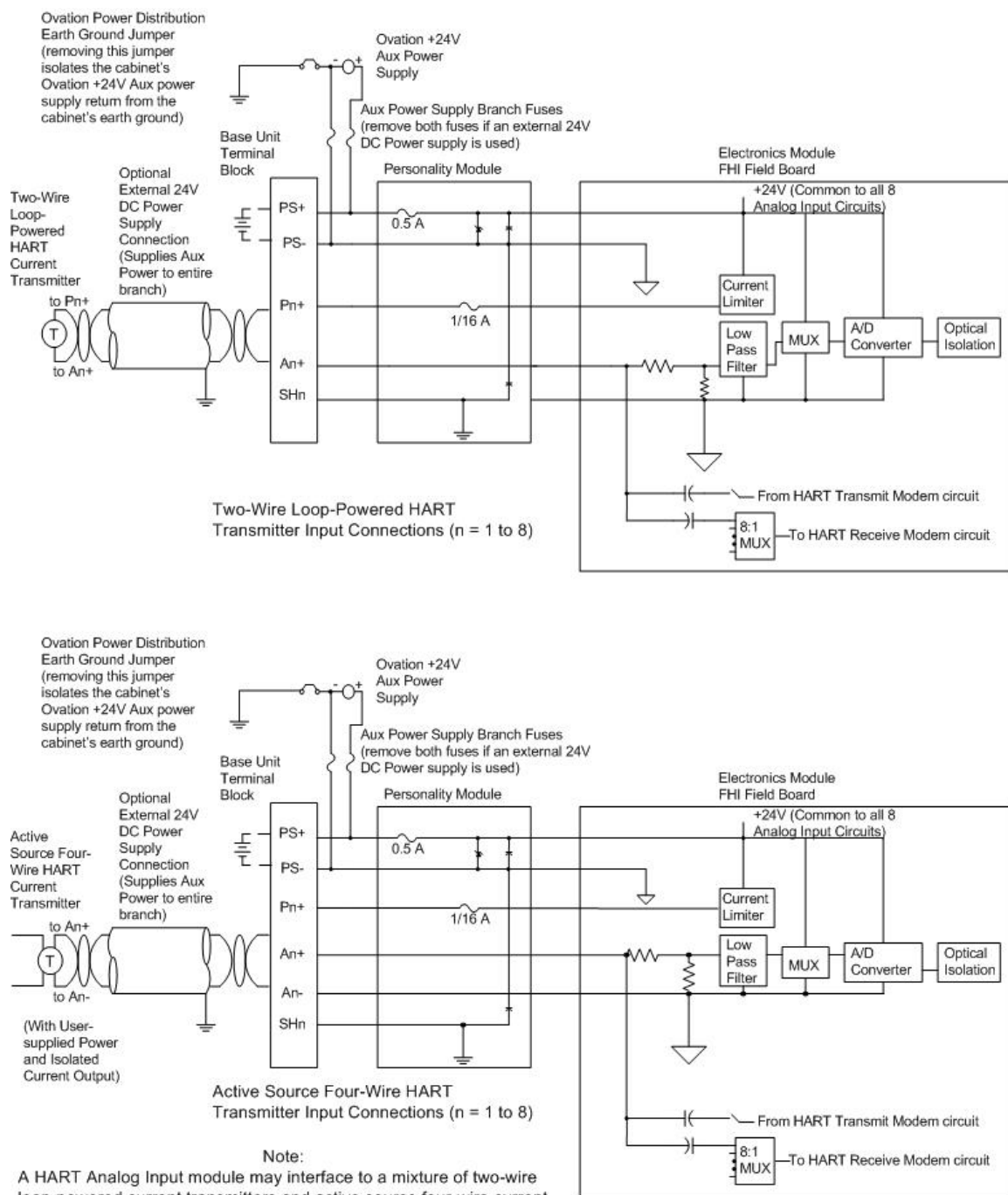


Figure 31: HART Analog Input Field Connections (CE Mark)

7.10 Field wiring cable requirements - (HAI)

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended minimum conductor size

CABLE LENGTH	MIN. CONDUCTOR SIZE	CABLE TYPE
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The Maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

In a HART network, long cable lengths are possible when the dominant low impedance device (the HART Analog Input module) has an input impedance of approximately 250 ohms. Low capacitance good-quality cable is used, and the Smart transmitter (high impedance device) has a low input capacitance (less than 5000 pF) and a high input resistance (greater than 100 K ohm).

Example: Cable Length Calculation

Single Smart Transmitter, parallel network resistance = 250 ohm (HART Analog Input module input impedance)

Smart Transmitter Capacitance: 5000 pF

Cable Capacitance (Cx): 50 pF/ft.

Cable Resistance (Rx): 0.016 ohm/ft. (22 AWG)

Cx = Cable capacitance per unit length (feet or meters): The capacitance from one conductor to all other conductors (including the shield if shielded). This value is usually available from the cable manufacturer.

Rx = Cable resistance per unit length (feet or meters): This value should be available from the cable manufacturer. The table below contains the resistance values of some common copper wire sizes. The resistance per unit length is for a single wire but the length calculations and charts take into account the resistance of both wires.

Copper wire resistance table

WIRE SIZE (AWG)	RESISTANCE PER FT. (OHMS)	RESISTANCE PER METER (OHMS)	WIRE SIZE (SQMM)	RESISTANCE PER METER (OHMS)
16	0.0040	0.013	0.5	0.0368
17	0.0050	0.016	0.75	0.0265
18	0.0064	0.021	1.0	0.0184
19	0.0080	0.026	1.5	0.0123
20	0.010	0.032	—	—
21	0.013	0.042	—	—
22	0.016	0.052	—	—
23	0.020	0.066	—	—

WIRE SIZE (AWG)	RESISTANCE PER FT. (OHMS)	RESISTANCE PER METER (OHMS)	WIRE SIZE (SQMM)	RESISTANCE PER METER (OHMS)
24	0.026	0.085	—	—
25	0.032	0.10	—	—
26	0.041	0.13	—	—
27	0.051	0.17	—	—
28	0.065	0.21	—	—
29	0.082	0.27	—	—
30	0.100	0.33	—	—

From the following figure, using cable capacitance (C_x) of 50 pF/unit length and resistance (R_x) of 0.016 ohm/unit length, a direct reading of the corresponding length on the y-axis is approximately 3600 feet (unit length of feet from above parameters).

Allowable cable length for single-device networks with 5000 pF device capacitance and 250 ohm network resistance.
(No miscellaneous series impedance.)

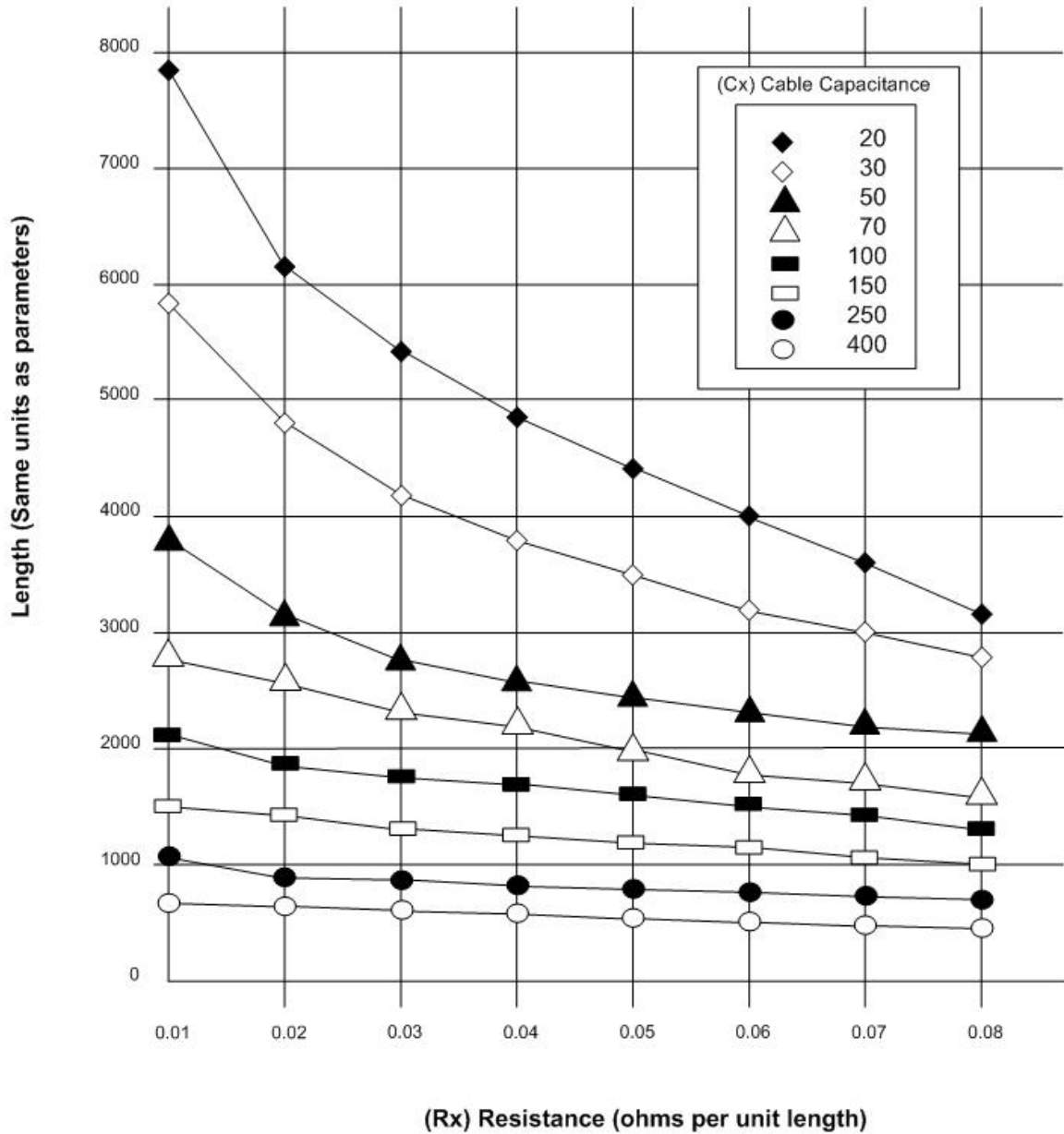


Figure 32: Length graph - single device network

7.11 Configuration/Status Register information - (HAI)

Each of the 16 direct registers on the HART (AI) module is summarized here and shown in more detail in the following tables. The status register can be read by using the Point Information window at an Operator's Station.

HART Analog Input register map

REG	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data.
2 - 9	NA	Analog Input - Channel 1 - 8.
10	NA	Firmware Status Flags.
11	NA	HAI Firmware Revision.
12	NA	Channel Error Bits.
13	Module Configuration Register	Module Status Register (See table below.)
14	HART Enable	NA
15	NA	Module Electronic ID Data.

HART Analog Input configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
0	Configure Module	Module Configured (1 = configured; 0 = unconfigured.)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)
2 - 5	Reserved	NA
6	Reserved for Factory Test (must always be set to 0)	NA
7	Reserved for Factory Test (must always be set to 0)	NA
8	NA	Hardware Error.
9	NA	Bank 1 reference error.
10	NA	Bank 2 reference error.
11 - 13	Not Used	Not Used.
14	NA	Field power failed.
15	Reserved	Reserved.

Bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: This bit configures the module (write) or indicates the configuration state of module (read). A “1” indicates that the module is configured.

Bit 1: Forces the module into error state, illuminating the module’s Error LED.

Bits 2 - 5: Reserved

Bits 6 - 7: Reserved for factory test, must always be set to 0.

Bit 8: Hardware error. Indicates one or more of the following is true:

- The FPGA did not program correctly on startup.
- The EE memory checksum is incorrect.
- The PROM checksum test has failed.
- Internal memory diagnostic has failed.

Bit 9: Reference error on first mux/AD combination.

Bits 11 - 13: Not used by the module.

Bit 10: Reference error on second mux/AD combination.

Bit 14: Field power failed.

Bit 15: Reserved.

HART Analog Input enable register (address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 7	Multivariable Channel 1 - 8	Not Used.
8 - 15	HART Enabled - Channel 1 - 8	Not Used.

Bit definitions for this register are encoded as shown in the above table and described below:

Bits 0-7: These bits are set to enable multivariable messaging. Refer to the I/O configuration guide for additional information.

The HAI, HAO, and IAH modules have the ability to retrieve additional variables from a field device. These variables are referred to as ‘multivariable’ and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module periodically retrieves whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 754, a floating-point format.

You must configure I/O point records to cause the Controller to scan the module and retrieve the variables. (Refer to the [*Ovation Developer Studio User Guide*](#).)

Bits 8-15: In the I/O configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including multivariable messaging, to flow on that channel.

You should ensure that these bits are cleared for non-HART field devices. To avoid a HART communication error message, set each bit at “0” when connecting a non-HART output device.

7.12 Diagnostic Logic card LEDs - (HAI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Error LED. Illuminated upon loss of external auxiliary (field) power, as indicated by the loss of normal transitions of the EOC (end-of-convert) signal.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module except for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred. ▪ Register, static RAM, or FLASH checksum error. ▪ Module reset. ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
1 -8 (Red)	LEDs 1 through 8 are used to indicate HART communication activity. When a HART message is sent, the LED for that particular channel is illuminated. When the HART response is received correctly, the LED is extinguished. When all is normal, that is, messages and responses are properly exchanged, a single LED blink is observed on the module's front cap. ▪ If a HART message is sent and no response is received, the HART Analog Input module exclusive-OR's the channel LED display with hex code 0xFF, resulting in all channel LEDs being illuminated except for the selected channel. For example, if the HART Analog Input module sent a HART message to device on channel 2, but the device was not connected to channel 2, the module would first illuminate LED 2 (all seven other channel LEDs extinguished). The module would then extinguish LED 2 and flash the other seven channel LEDs. This status indicates that the module sent a HART message on channel 2 and did not receive a valid response message after the initial message attempt or after any of the subsequent message retries.
9 through 16	These LED locations are not used for this module.

7.13 Specifications - (HAI)

HART Analog Input (8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	4 to 20 mA normal operation. 0 to 23 mA with under-range and over-range levels user selected and Controller monitored.
A/D Resolution	16 bits
Reference accuracy (@ 25 degrees C)	+/-0.05% of span @ 99.7% confidence.
Accuracy over temperature	+/-0.1% of span over the full operating temperature range.
Sampling rate (per ms)	Each channel is sampled every 24 ms.
Dielectric isolation: Channel to channel Channel to logic	No channel to channel isolation. 1000 VAC/VDC for one minute.
Operating temperature range	0 degrees to 60 degrees C. (32 degrees F to 140 degrees F).
Humidity (non-condensing)	0% to 95%
Module power	Main: 1.2W typical. 2.5W Maximum. Aux. power supply voltage = 24 VDC -5%, +6.25% Aux: 4.1W typical. 7.2W Maximum.
Two-wire transmitter power	13.5V minimum (Pn+ to An+) @ 20 mA. where n = 1 to 8 (current limited to 32 mA Maximum)

SECTION 8

HART High Performance Analog Input module - (HHPAI) (8 Channel)

IN THIS SECTION

8 Channel HART High Performance Analog Input module overview - (HHPAI).....	125
Electronics modules (Emod) - (HHPAI).....	126
Personality modules (Pmod) - (HHPAI)	126
Valid module combinations - (HHPAI).....	126
Field wiring diagram - (HHPAI)	127
Field wiring diagram (CE Mark) - (HHPAI).....	128
Power supply information - (HHPAI)	129
Terminal block wiring information - (HHPAI).....	130
Field wiring cable requirements - (HHPAI).....	131
Field connection wiring diagrams - (HHPAI)	131
Field connection wiring diagrams (CE Mark) - (HHPAI).....	133
Personality Jumper Information - (HHPAI).....	135
Configuration/Status Register information - (HHPAI).....	135
Diagnostic Logic card LEDs - (HHPAI)	138
Specifications - (HHPAI)	139

8.1 8 Channel HART High Performance Analog Input module overview - (HHPAI)

The HART (Highway Addressable Remote Transducer) High Performance Analog Input module is a standard Ovation I/O Module that provides eight galvanically isolated 4-20 mA analog inputs with HART transceivers. Each transceiver provides optically isolated communication to a dedicated UART (Universal Addressable Remote Transducer), thereby Maximizing HART communication throughout. Each channel may be individually configured for field powered or local powered transmitters via user accessible jumpers on the Personality module.

HART is a digital communication protocol designed for industrial process measurement applications. Field measurement devices (transmitters) interface for a process control system via an analog 4-to-20 mA current loop. HART uses a low-level frequency-shift-keyed sine wave signal that is superimposed on the standard 4-to-20 mA process measurement current loop.

Since the HART sine wave signal is small and its average value is zero, the current loop analog 4-to-20 mA signal is not significantly affected by the presence of the HART signal. Using HART allows a field device to provide more than one measurement, which is a feature not available when using only the 4-to-20mA analog current signal.

“Smart” field devices may be described as field devices in which the analog 4-to-20 mA signal, digital communication, and sometimes power, co-exist on the same pair of wires. The Ovation HART Fast Analog Input (IAH) module is a standard form factor Ovation I/O module, which permits Ovation to communicate with HART devices.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

8.2 Electronics modules (Emod) - (HHPAI)

- **5X00106G01** interfaces to eight current loop signals with an input range of 4-20 mA.
- **5X00106G02** interfaces to eight current loop signals with an input range of 4-20 mA, (Reduced radiated emissions).

8.3 Personality modules (Pmod) - (HHPAI)

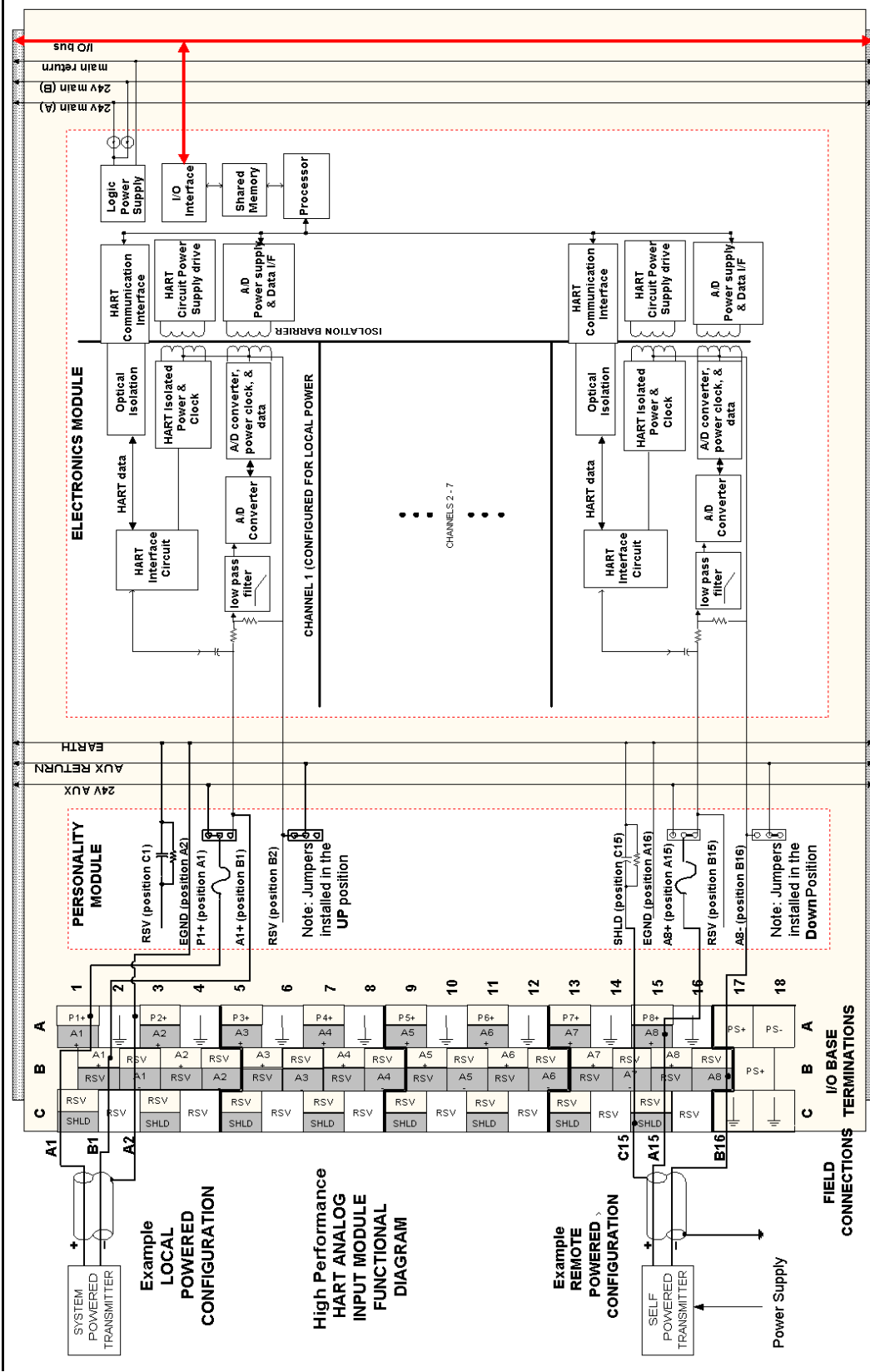
- **5X00109G01** contains eight fused input and user accessible jumpers that configure the channels for field powered or local powered transmitters on an individual basis.
- **5X00109G02** contains eight fused input and user accessible jumpers that configure the channels for field powered or local powered transmitters on an individual basis. Has the addition of active current limiting in the two-wire mode. This module is available on Ovation 3.4.0 releases and later.

8.4 Valid module combinations - (HHPAI)

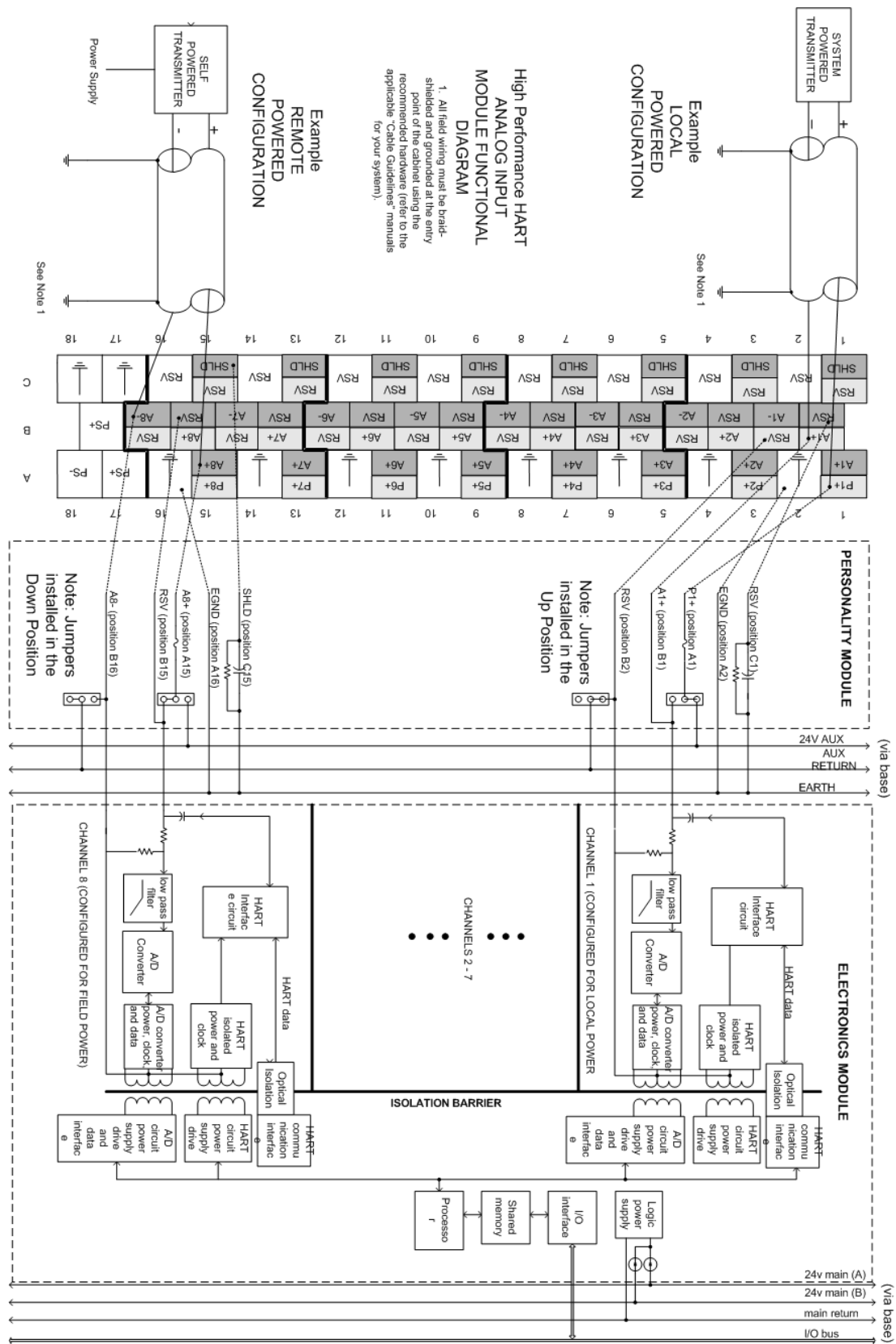
HART High Performance Analog Input valid module combinations (14-bit)

RANGE	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE
4-20 mA ¹	8	5X00106G01	5X00109G01 or 5X00109G02 - This module is available on Ovation 3.4.0 and later software releases
4-20 mA ² (Reduced radiated emissions).	8	5X00106G02	5X00109G01 or 5X00109G02 - This module is available on Ovation 3.4.0 and later software releases.
¹ This module configuration is CE Mark certified. ² This module configuration is CE Mark certified (Non-EMC Cabinet).			

8.5 Field wiring diagram - (HHPAI)



8.6 Field wiring diagram (CE Mark) - (HHPAI)



8.7 Power supply information - (HHPAI)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and **NOT** from the AC or DC mains.

The HART High Performance Analog Input module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

When one or more loop powered two-wire current transmitters are interfaced to the HART High Performance Analog Input module, the module utilizes a +24 auxiliary power supply to provide the power required by the current transmitters and their current loops.

It is recommended that the High Performance Analog Input module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the module's branch from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART High Performance Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS Maximum for all rated loads across the frequency range of 500 HZ to 10 KHz.

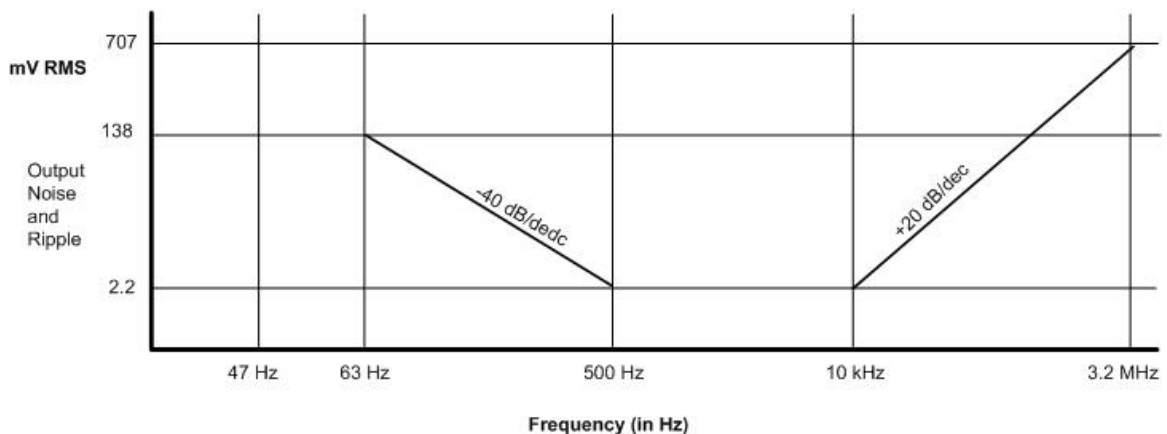


Figure 33: Power supply output noise requirements

All modules utilizing the auxiliary power supplies, including the HART High Performance Analog Input modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART High Performance Analog Input module. This requirement includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the user selected power supply style.

8.8 Terminal block wiring information - (HHPAI)

Each Personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. Note that there are two wiring configurations for each channel dependent upon whether the channel is configured for Local or Field powered transmitters.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

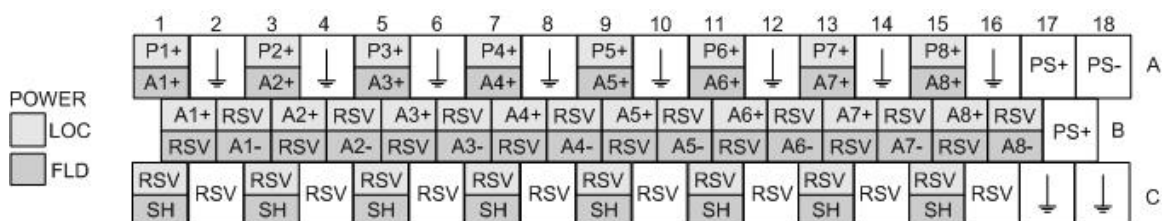


Figure 34: Wiring diagram label

The diagrams for the HART High Performance Analog Input Personality modules are illustrated in the figure above. The following table lists and defines the abbreviations used in those diagrams.

Wiring diagram label definitions

ABBREVIATION	ABBREVIATION
A1 - A8 +	Analog Input terminal connection (connected to the negative terminal of a local powered transmitter or the positive terminal of field powered transmitter).
A1 - A8 -	Analog Input negative terminal connection (field powered configuration only).
P1 - P8 +	Loop power output terminals (for local powered configuration only. Connected to the positive).
SH1 - SH8	Shield terminal connection. (For landing shields where the shield is to be grounded at the transmitter).
	Earth ground terminals. (For landing shields where the shield is to be grounded at the module).
PS+, PS-	External Auxiliary power supply terminals.
RSV	Reserved terminal. No connections are allowed on these terminals.

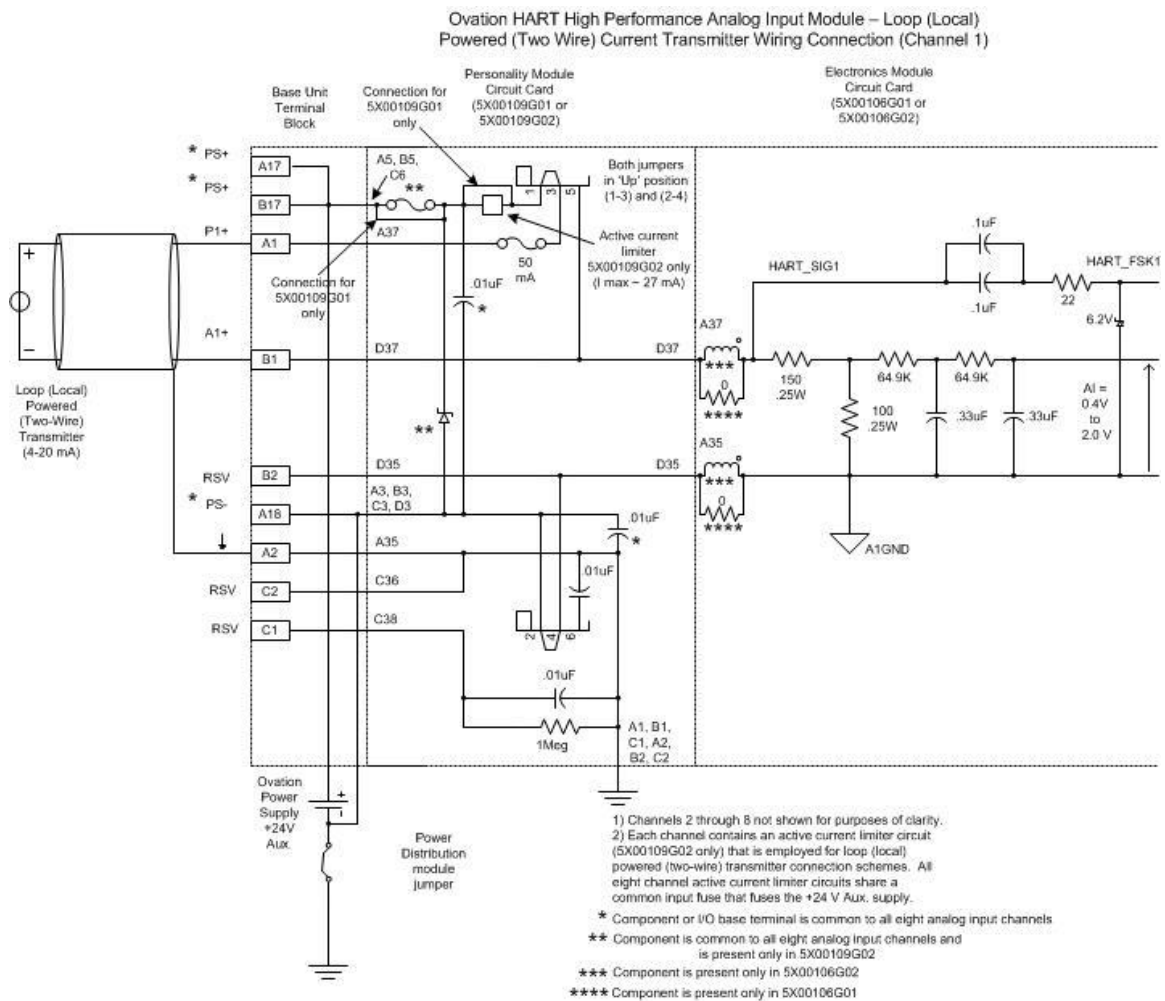
8.9 Field wiring cable requirements - (HHPAI)

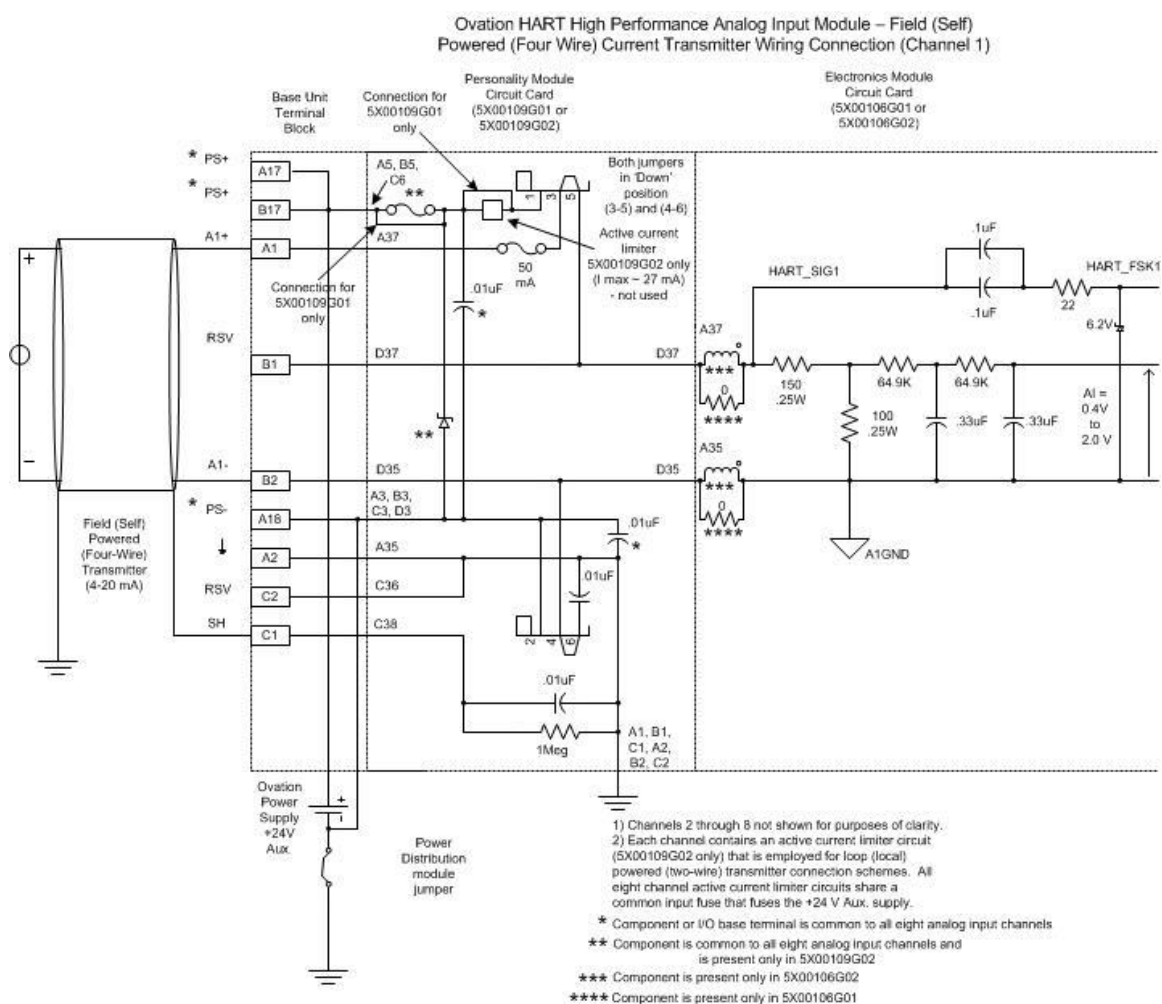
Recommended minimum conductor size

CABLE LENGTH	MIN. CONDUCTOR SIZE	CABLE TYPE
Less than 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair with over-all shield.
Greater than 5,000 feet, but less than 10,000 feet (3048 meters)	20 AWG (0.81 mm dia.)	Single-twisted pair with over-all shield.

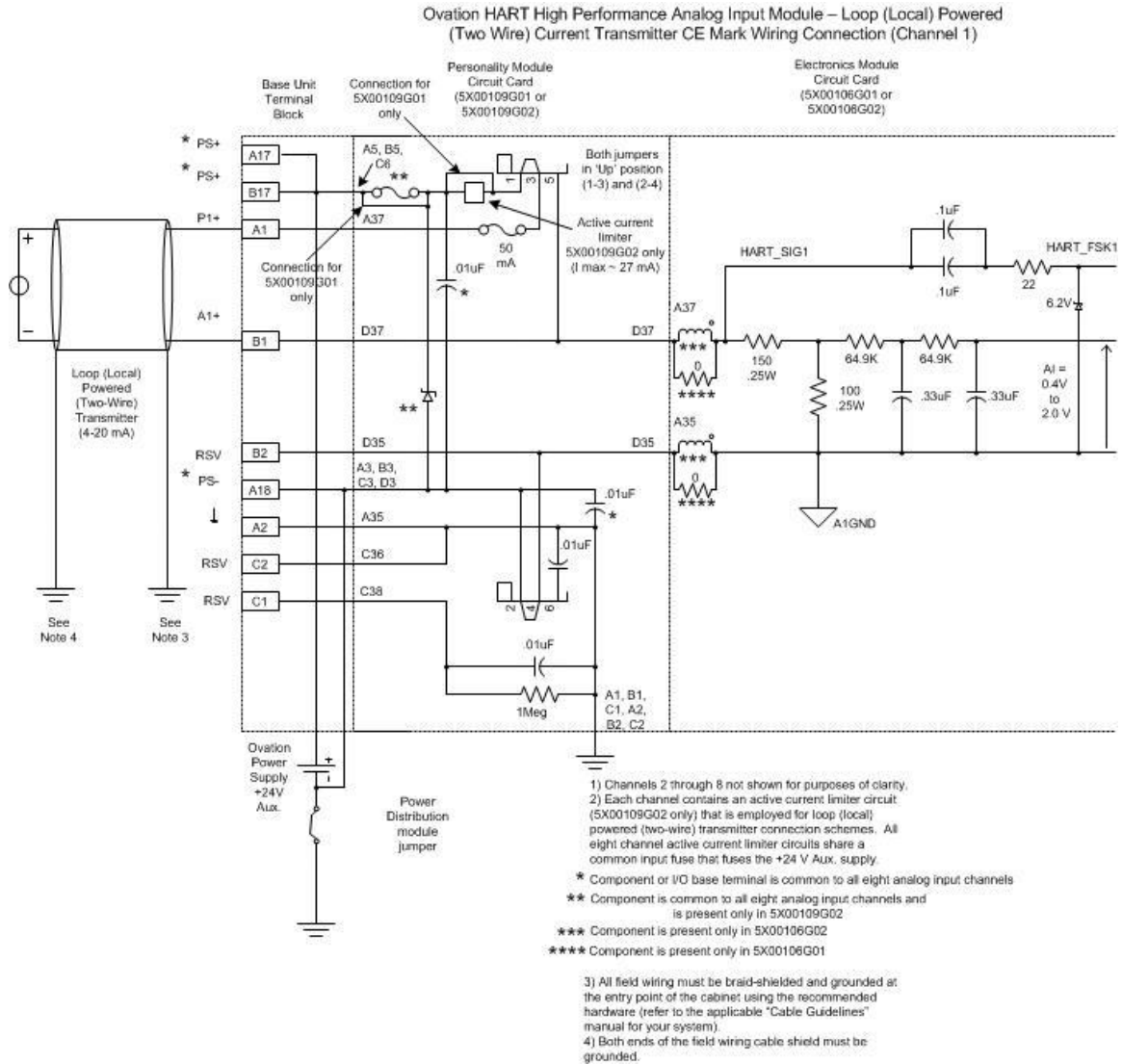
Refer to the HART FSK Physical Layer Specification (HFC_SPEC-54) for additional cabling information.

8.10 Field connection wiring diagrams - (HHPAI)

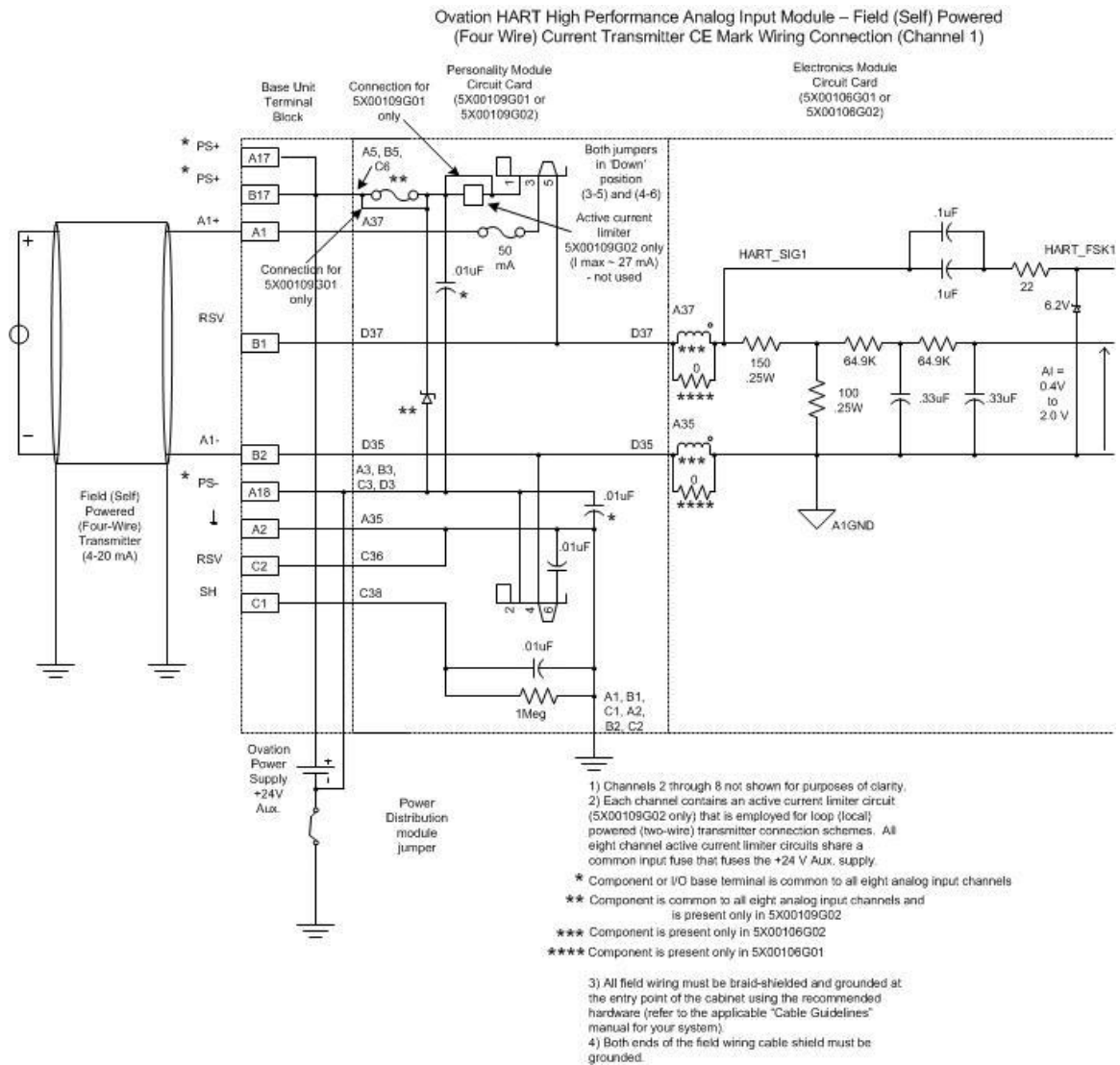




8.11 Field connection wiring diagrams (CE Mark) - (HHPAI)



8.11 Field connection wiring diagrams (CE Mark) - (HHPAI)



8.12 Personality Jumper Information - (HHPAI)

Each Personality module provides a 1/20 A fuse on each channel for loop protection. Additionally, each channel provides a pair of user accessible jumpers for configuring each channel for local powered transmitters or field powered transmitters. This configuration is on a per channel basis. The fuses and jumpers are accessible through the top of the module. The label, shown in the following figure, on the top of the module indicates how to position the jumpers. Note that there are two jumpers per channel and they must be positioned together.

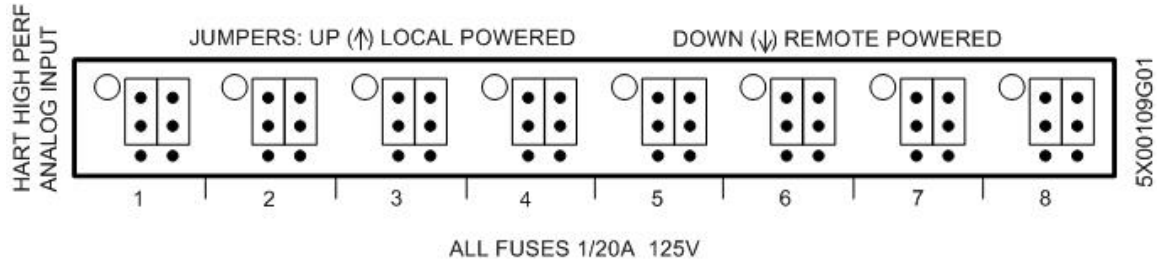


Figure 35: HART High Performance Analog Input Personality module

Note: Jumpers are shown in the local powered configuration for all channels.

8.13 Configuration/Status Register information - (HHPAI)

The module configuration/status register is module I/O register 13 (0xD). The register bit assignments are defined as follows:

Module configuration/status register

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
0	Configure Module	Module Configured (1 = configured)
1	Force Error	Internal or forced error (1 = forced error)
2	50/60 Hz selection (1=50 hz)	50/60 Hz System (1=50 Hz)
3	SELF_CAL (Initiates Self Calibration)	SELF_CAL (Initiates Self Calibration)
4	Toggle Bit (80C32 to 90S8515)	0, (Not Used)
5	0, (Not Used)	0, (Not Used)
6	0, (Not Used)	0, (Not Used)
7	80C32 diagnostics	80C32 diagnostics
8	0, (Not Used)	80C32 Memory Error
9	0, (Not Used)	90S8515 Internal Error
10	0, (Not Used)	90S8515 Memory Error
11	0, (Not Used)	Module not calibrated
12	0, (Not Used)	0, (Not Used)
13	Toggle Bit (90S8515 to 80C32)	Toggle Bit (90S8515 to 80C32)
14	0, (Not Used)	0, (Not Used)

BIT	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
15	0, (Not Used)	Point Fault ¹
¹ Refer to the Channel Error Register for the descriptions of the Point Faults.		

Bit 0: The Ovation Controller must set bit 0 of the Module Configuration register in order to access module I/O registers 0 through 11 (0xB). If bit 0 is not set, reading module I/O registers 0 through 11 (0xB) yields an Attention Status.

Bit 1: This bit (write “1”) forces the module into error state, illuminating the module’s internal Error LED. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the modules Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when addresses 0 through 11 (B in Hex) are read.

Bit 2: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of the A/D converters as shown in the following table.

CONVERSION RATE (SAMPLES/SEC)	BIT #2
20 (for 60Hz systems)	0
16 (for 50Hz systems)	1

Bit 3: This bit (write) is used to initiate self-calibration. The sample rate during self-calibration is two per second. The status (read) bit is one as long as the configuration bit is set. If this is set, the module imitates one self calibration cycle. For subsequent self-calibration to occur, the bit must be cleared and reset or different configuration written to the card with this bit set.

Bit 4: Reserved for inter-module handshaking.

Bit 7: Reserved for Factory diagnosis.

Bit 8: This bit (read) indicates that the module has internal memory error. If this error is present, the internal error LED is lit.

Bit 9: This bit is set if bit 10 or 11 is set. If this bit is set, the internal error LED is lit. The Point Fault bit is set as the condition of the module is undetermined. Also, I/O channel registers 2-9 will be in attention.

Bit 10: This bit (read) indicates that the module has internal memory error (FLASH checksum, Register or Static RAM error). Bit 9 is set as well.

Bit 11: This bit indicates that the module is not calibrated. Bit 9 is set as well.

Bit 13: Reserved for inter-module handshaking.

Bit 15: Bit indicates point fault status of the module. It is the logical “OR” of any individual channel error status bits in register C, plus bit 9 of this register. A “0” indicates that all eight points have good quality and no module error exists. When bit 9 of the Status Register is not set, this bit (when set to “1”) indicates that at least one of the points has bad quality. A subsequent read of the Channel Error Register (address C) reveals the point(s) that have bad quality. The Channel Error Register contains data only when the module fault is due to a bad point quality.

HART High Performance Analog Input Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 7	Multivariable Channel 1 - 8	Not Used
8 - 15	HART Enabled - Channel 1 - 8	Not Used

Bit 0-7: A “1” in any of these bits causes Multivariable messaging on the corresponding channel.

Bit 8-15 A “1” in any of these bits indicate that a HART compliant device exists on the corresponding channel.

To avoid a HART communication error message, set each bit to “0” when connecting a non-HART output device.

The HART High Performance AI, HART High Performance AO, and IAH modules have the ability to retrieve additional variables from a field device. These variables are referred to as ‘multivariable’ and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

The point data registers occupy locations 2-9 for analog input points 1-8 respectively. The data format is as follows:

Bit 15	Bit 14	Bit 13 - 0
		14 bit value
	Over-range Bit	
Point quality: (for good point quality (and proper card operation))		
Example Values		
Output Data in Hex	Data Description	
8CCC	4 ma input	
C000	20 ma input	
CZZZ	+ Over Range	
*0000-7FFF	*Card Trouble/Not Warmed Up/Bad Quality	

Each of the 16 direct registers on the HART High Performance Analog Input module is summarized in the following tables and shown in more detail in the following tables. The module status register 13 (D in Hex) can be read by using the Point Information window at an Operator’s Station. (See the [Ovation Operator Station User Guide](#).)

HART High Performance Analog input register map

REG	DATA DESCRIPTION (WRITE)	DATA DESCRIPTION (READ)
0	Indirect Memory Index	NA
1	Indirect Memory Data	Indirect Memory Data
2 - 9	NA	Analog Input - Channel 1 - 8
10	Calibration Register (Factory use only)	Calibration Register (Factory use only)
11	Flash memory download handshaking	The exchange of signals between the transmitter and receiver to ensure synchronization before downloading a firmware revision to the flash memory.
12	NA	Channel Error Bits
13	Module Configuration Register	Module Status Register
14	HART Enable	HART Enable
15	NA	Module Electronic ID Data

Word address 12 (C in Hex) is used to report the channel errors on the eight input channels. The following table is for reference only, Individual bits are not user accessible.

Channel error register output data format (read)

POINT	BIT	DESCRIPTION
1 - 8	0, 2, 4, 6, 8, 10, 12, 14	Communication to the Channel has failed
1 - 8	1, 3, 5, 7, 9, 11, 13, 15	Over/under-range, Input/blown fuse/Open Loop

Communication to the Channel has failed - this bit is set when the communication to the corresponding channel has failed.

Over/under-range, Input/blown fuse/Open Loop - this bit is set when the corresponding Points input is less than 2.5mA (open loop condition), or greater than 25mA (over-range).

8.14 Diagnostic Logic card LEDs - (HHPAI)**Diagnostic logic card LED's**

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	N/A

LED	DESCRIPTION
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: ▪ The Controller sets the module's Force Error bit. ▪ Communications with the Controller is lost. ▪ The module is not calibrated. ▪ Flash memory, EE memory or RAM diagnostic failure.
1 - 8 (Red)	The eight channel LEDs serve two functions. ▪ LEDs 1-8 are used to indicate the firmware state during module startup. ▪ Used to indicate HART communication activity and analog input health during normal module operation. After module configuration, the bank of eight channel LEDs (LEDs 1-8) are used to indicate HART communications activity and the health of the analog input. ▪ If the Analog Input for the associated analog input channel is healthy (bit 15 set in the point data word), then the LED is on. ▪ If the analog input channel is bad, then the LED is off. ▪ When a HART message is sent and received correctly, the LED blinks off for 100 msec if the analog input is healthy. ▪ When a HART message is sent and received incorrectly, the LED blinks off for 400 msec if the analog input is unhealthy.
9 - 16	N/A

8.15 Specifications - (HHPAI)

HART High Performance Analog Input (8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	8
Input range	2.5 to 25 mA with under-range and over-range checking.
A/D Resolution	14 bits
Data format	14 bit binary
Bit weight	0.00122 ma
Conversion type	Sigma Delta
Operating Mode	self-scan
Monotonicity	yes
Nonlinearity	0.003% of full scale.
Repeatability	Within guaranteed accuracy.
Reference accuracy (@ 25oC)	+/-0.1% of full scale value (20mA) @ 99.7% confidence.
Accuracy over temperature	+/-0.24% of full scale value (20mA) over the full operating temperature range.
Input Sample duration (period) (msec)	50 when configured for 60 Hz rejection. 60 when configured for 50 Hz rejection.

DESCRIPTION	VALUE
Input Sample Rate (conversations/sec)	20 when configured for 60 Hz rejection 16 when configured for 50 Hz rejection.
Dielectric isolation: Channel to channel Channel to logic	1000 VAC/VDC for one minute. 1000 VAC/VDC for one minute.
Operating temperature range	0 ⁰ to 60 ⁰ C (32 ⁰ F to 140 ⁰ F).
Humidity (non-condensing)	0% to 95%
Module power	Drawn from Main: 4.1W typical. 4.5W Maximum. Drawn from Aux.: 3.84W typical (20mA X 8 loops X 24V). Dissipation in module: 5.06W typical (Emod + Pmod).
Input Impedance	300 ohms maximum when using 5X00109G01 Pmod 347 ohms + 1.5V maximum when using 5X00109G02 Pmod
Maximum Overload	For the field (self) powered transmitter interface, the positive input is fused with a 50mA user accessible fuse. For the local powered transmitter interface, the loop power supply output is fused with a 50mA user accessible fuse. In addition to the 50mA fuse, the 5X00109G02 personality module actively limits the loop power supply current draw by the transmitter to 27mA.
Normal Mode Rejection	60 dB @50 Hz $\pm$ 1/2% or @60 Hz $\pm$ 1/2% (when properly configured) 30 dB (typical) @50 Hz $\pm$ 5% or @60 Hz $\pm$ 5% (when properly configured).
Common mode rejection and channel-channel crosstalk	120 dB @ DC or @ the nominal (50/60 Hz) line frequency $\pm$ 1/2% and harmonics. 100 dB (typical) for nominal line frequency $\pm$ 5% and harmonics.
Filtering	Digital, Sinc, ³ 3dB cutoff: 13.1 Hz for 50 Hz; 15.7 Hz for 60 Hz.

Note: Each channel reports current from about 2.5 to 25 ma. Above and below these values, the channel reports an error in the channel error register (4.5.10).

SECTION 9

RTD Input module - (RTD-4) (4 Channel)

IN THIS SECTION

4 Channel RTD Input module overview - (RTD-4)	141
Electronics modules (Emod) - (RTD-4)	141
Personality modules (Pmod) - (RTD-4)	141
Valid module combinations - (RTD-4)	142
Terminal block wiring information (Pmod 1C31164G01) - (RTD-4)	142
Terminal block wiring information (Pmod 1C31164G02) - (RTD-4)	143
Field wiring diagrams for (Pmod 1C31164G01) - (RTD-4)	144
Field wiring diagrams for (Pmod 1C31164G02) - (RTD-4)	145
Field wiring diagrams for (Pmod 1C31164G02) (CE Mark) - (RTD-4)	146
RTD ranges - (RTD-4)	147
Configuration/Status Register information - (RTD-4)	148
Diagnostic Logic card LEDs - (RTD-4)	149
Specifications - (RTD-4)	149

9.1 4 Channel RTD Input module overview - (RTD-4)

The RTD module is used to convert inputs from Resistance Temperature Detectors (RTDs) to digital data. The digitized data is transmitted to the Controller.

The RTD Module is applicable for CE Mark Certified Systems.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

9.2 Electronics modules (Emod) - (RTD-4)

- **1C31161G01** converts inputs for all ranges and is compatible only with Personality module 1C31164G01 (not applicable for CE Mark certified systems).
- **1C31161G02** converts inputs for all ranges and is compatible with Personality module 1C31164G02 (applicable for CE Mark certified systems).

9.3 Personality modules (Pmod) - (RTD-4)

- **1C31164G01** converts inputs for all ranges and is compatible only with Electronics module 1C31161G01 (not for new systems and is not applicable for CE Mark certified systems).
- **1C31164G02** (50/60 Hz filtered) converts inputs for all ranges and is only compatible with Electronics module 1C31161G02 (applicable for CE Mark certified systems).

9.6 Terminal block wiring information (Pmod 1C31164G02) - (RTD-4)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. The following diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

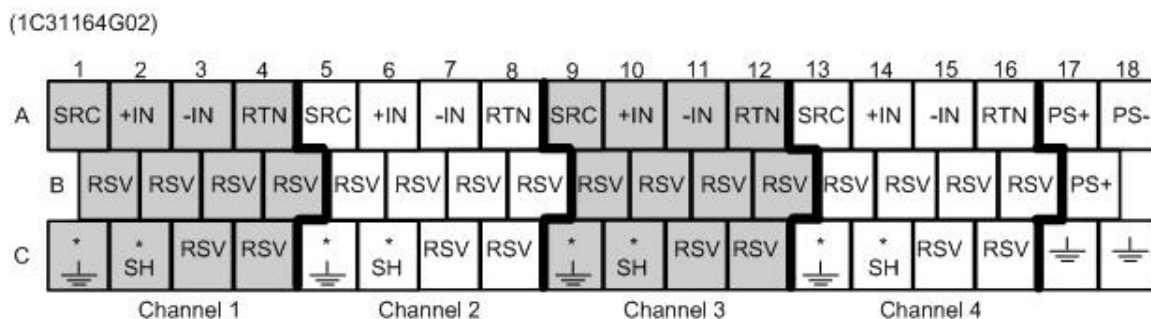


Figure 37: Terminal block connections for the RTD Pmod (1C31164G02)

The following table lists and defines the abbreviations used in this diagram.

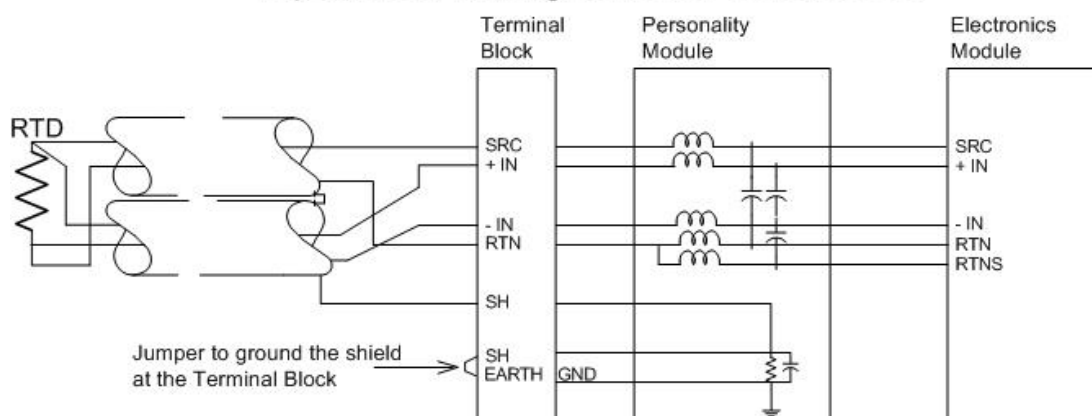
Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminal.
+IN, -IN	Positive and negative sense input connection.
PS+, PS-	Auxiliary power supply terminals.
RTN	Return for current source connection.
RSV	Reserved terminal. No connections allowed on these terminals.
SH	Shield connector.
SRC	Current source connection.

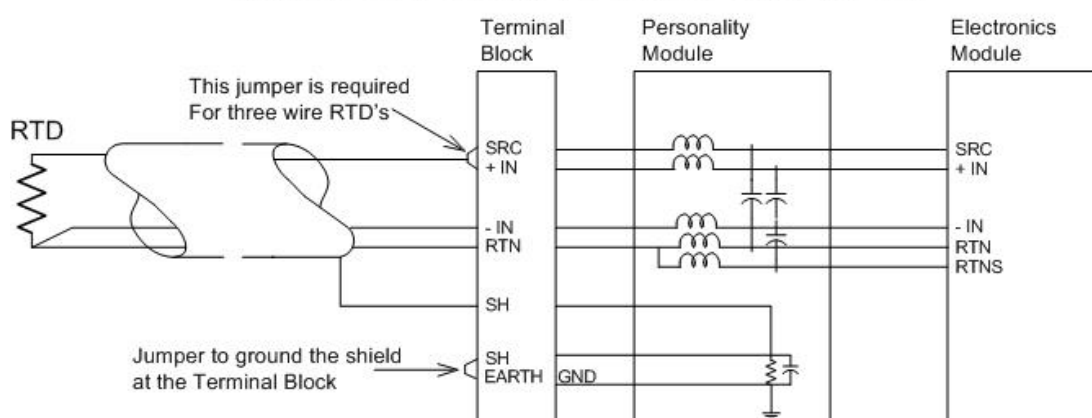
Note: Do **not** use unmarked terminal block locations.
PS+ and PS- are not used by this module.

9.7 Field wiring diagrams for (Pmod 1C31164G01) - (RTD-4)

Input Field Wiring for Four Wire RTD's



Input Field Wiring for Three Wire RTD's



Input Field Wiring for Two Wire RTD's

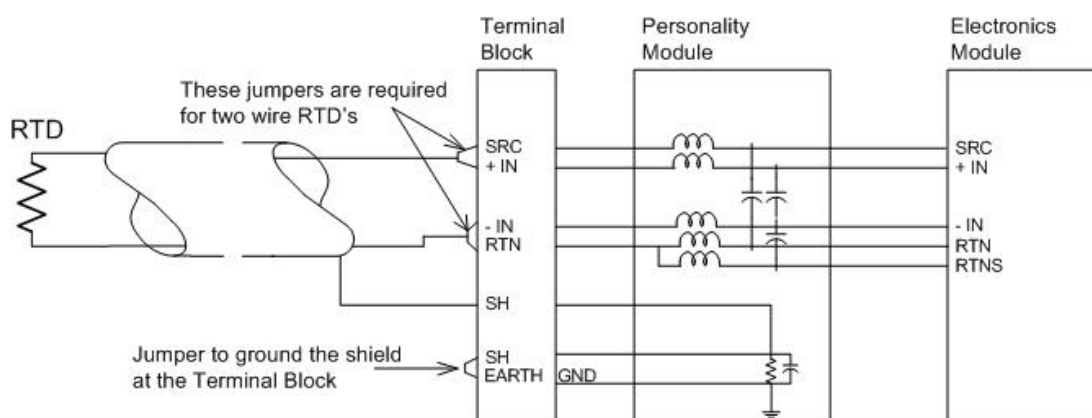
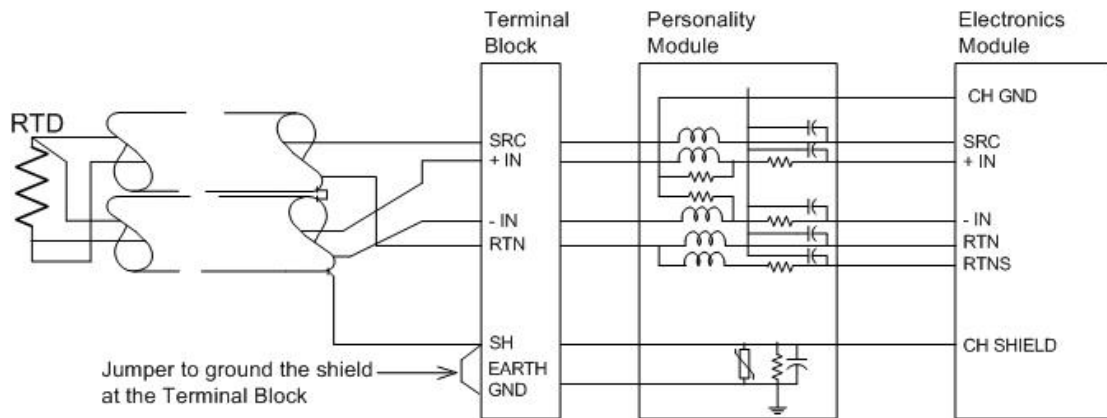


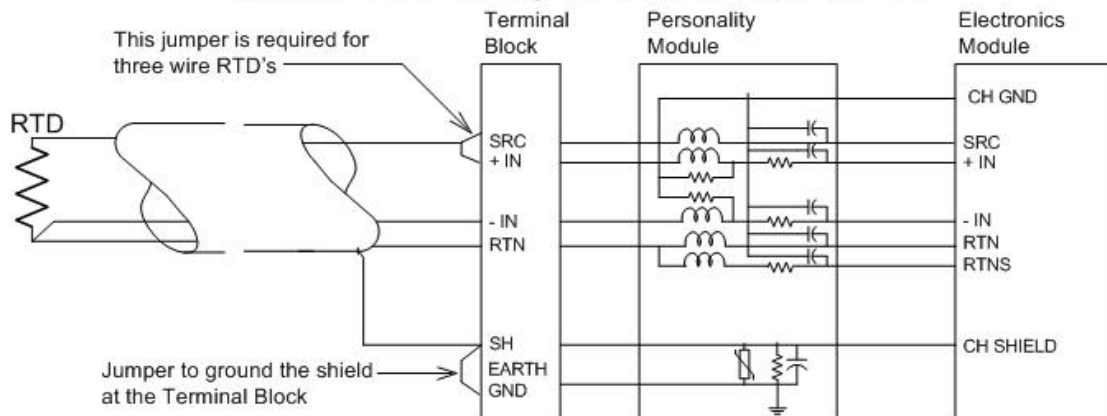
Figure 38: Field Connection for the RTD Pmod 1C31164G01

9.8 Field wiring diagrams for (Pmod 1C31164G02) - (RTD-4)

Input Field Wiring for Four Wire RTD's



Input Field Wiring for Three Wire RTD's



Input Field Wiring for Two Wire RTD's

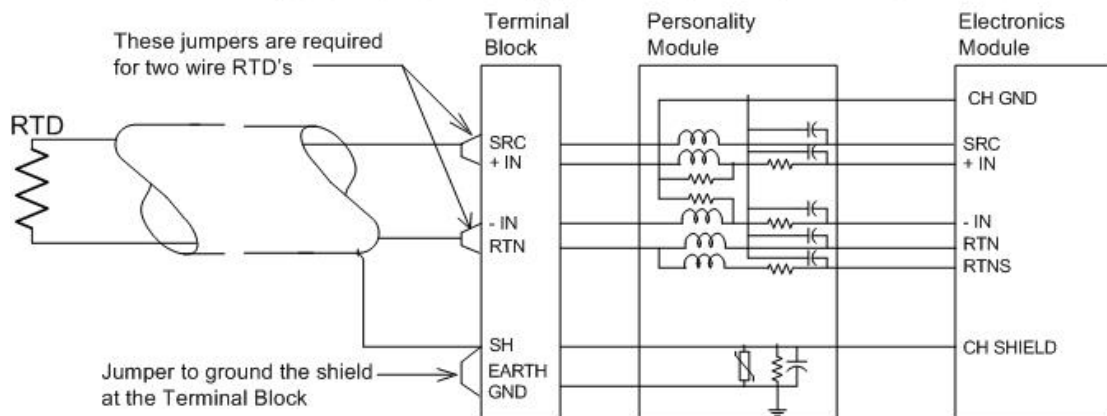
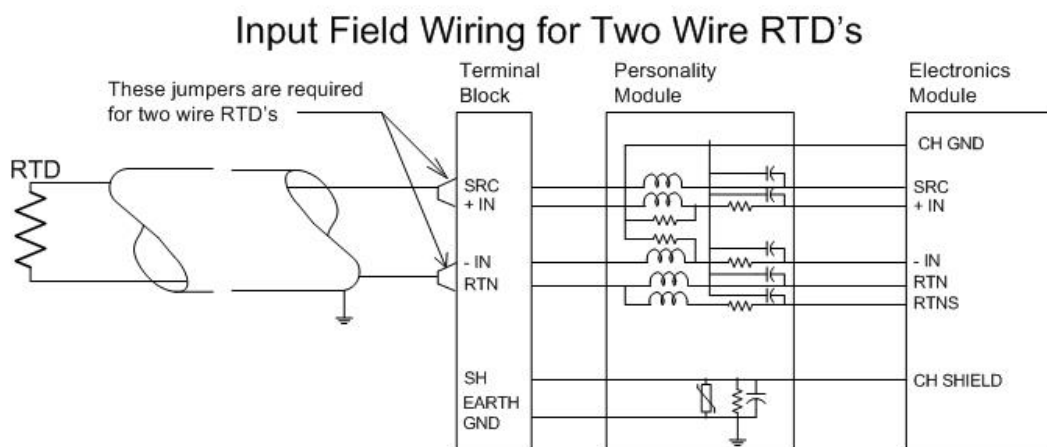
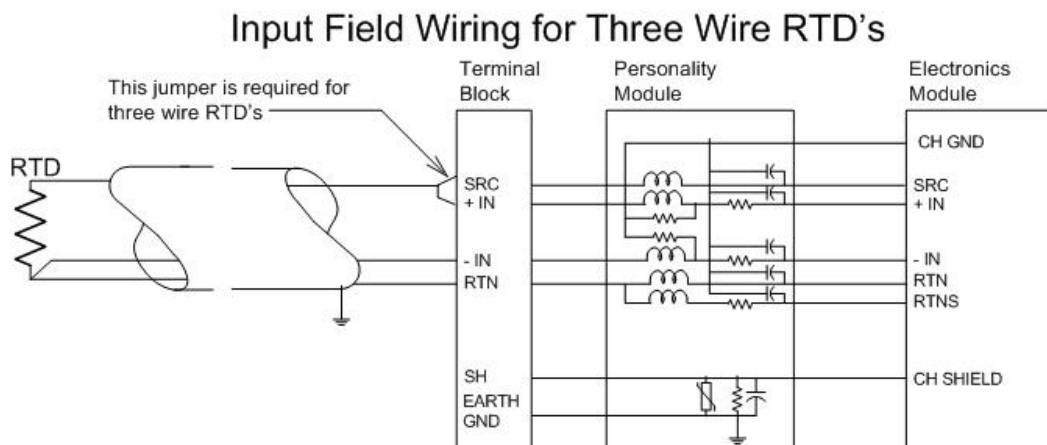
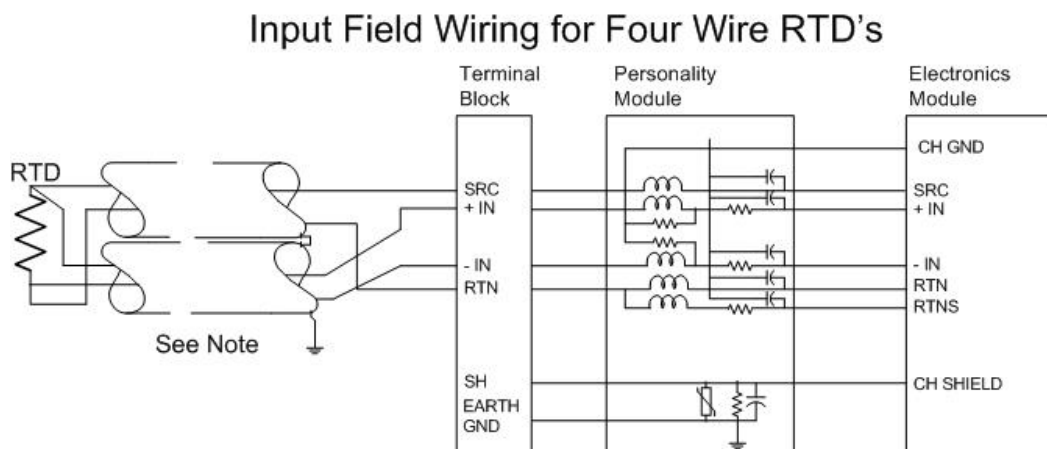


Figure 39: Field Connection for the RTD Personality Module

9.9 Field wiring diagrams for (Pmod 1C31164G02) (CE Mark) - (RTD-4)



Note: All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the appropriate *Planning Your Ovation System* manual).

Figure 40: Field Connection for the RTD Personality Module (CE Mark)

9.10 RTD ranges - (RTD-4)

RTD ranges

SCALE # (HEX)	WIRES	TYPE	TEMP °F	TEMP °C	R _{COLD} (OHM)	R _{HOT} (OHM)	EXCITATION CURRENT (mA)	ACCU-RACY ± CTS	ACCU-RACY ±% OF SPAN
1	3	10 Ohm PL	0 to 1200	-18 to 649	6	106.3	0.1556	9	0.22
2	3	10 Ohm CU	0 to 302	-18 to 150	8.5	16.5	1.51	13	0.32
D	3	10 Ohm CU	32 to 284	0 to 140	50	80	1.0756	11	0.27
11	3	10 Ohm CU	32 to 230	0 to 110	53	78	1.1291	12	0.30
19	3	100 Ohm PL	-4 to 334	-20 to 168	92	163.67	0.5121	11	0.27
22	3	100 Ohm PL	32 to 520	0 to 271	100	200	0.4087	10	0.25
23	3	100 Ohm PL	32 to 1040	0 to 560	100	301	0.2554	10	0.25
25	3	120 Ohm NI	-12 to 464	-11 to 240	109	360	0.2104	10	0.25
26	3	120 Ohm NI	32 to 150	0 to 66	120	170	0.5240	13	0.32
28	3	120 Ohm NI	32 to 252	0 to 122	120	225	0.3682	11	0.27
80	4	100 Ohm PL	32 to 544	0 to 290	100	208	0.3921	10	0.25
81	4	100 Ohm PL	356 to 446	180 to 230	168	186	0.5240	30	0.74
82	4	200 Ohm PL	32 to 698	0 to 370	200	473	0.1675	12	0.30
83	4	200 Ohm PL	514 to 648	268 to 342	402	452	0.2142	29	0.71
84	4	100 Ohm PL	32 to 124	0 to 51	100	120	0.7860	19	0.47
85	4	100 Ohm PL	32 to 217	0 to 103	100	140	0.6386	13	0.32
86	4	100 Ohm PL	32 to 412	0 to 211	100	180	0.4644	11	0.27
87	4	100 Ohm PL	32 to 714	0 to 379	100	240	0.3296	10	0.25
88	4	200 Ohm PL	511 to 662	266 to 350	200	230	0.4170	24	0.59

9.11 Configuration/Status Register information - (RTD-4)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller.

Word address 13 (D in Hex) low byte is used for module configuration.

Word address 13 (D in Hex) high byte is used to define the scale for Channel 2.

The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See *Ovation Operator Station User Guide*.)

RTD configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module	Module Configured (1 = configured; 0 = un-considered.)
1	Force error	Internal or forced error (1 = forced error; 0 = no forced error.)
2	Not used	Point Fault bit (set when any point specific fault exists.)
3	Not used	Card trouble bit (set during card failure.)
4	Not used	Warning bit (set during power up or configuration.)
5	50/60 Hz select (0 = 60Hz, 1 = 50Hz)	50/60 Hz select readback (0 = 60Hz, 1 = 50Hz.)
6	Enable line frequency tracking.	Status of the line frequency tracking enable signal.
7	Diagnostic bit (do not use). When set in the "Diagnostics" mode, Bits 0 to 6 of the configuration register represent a word address of the Micro Controller's internal memory.	Sync Fault (set if SYNC is missing or the reasonability test failed while the line frequency tracking is enabled.)
8 - 15	Channel #2 scale configuration	Channel #2 scale configuration read back

Note: Line frequency tracking is presently NOT supported by the Ovation I/O system.

Word address 14 (E in Hex) is used to define the scales for Channels 3 and 4.

Expansion configuration and status register (address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 7	Channel 3 scale configuration	Channel 3 scale configuration read back.
8 - 15	Channel 4 scale configuration	Channel 4 scale configuration read back.

Point status register (address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0, 2, 4	Reserved for Point Status	Channel 1 - 4 reasonability test failed (Zero or Common mode.)
1, 3	Reserved for Point Status	Channel 1 - 4 current loop reasonability test failed.
8 - 15	Configure Channel 1 scales	Channel 1, scale configuration read back.
Note: Status bits when set (1) indicate the fault condition.		

Word address 12 (C in Hex) low byte is used for point status.

Word address 12 (C in Hex) high byte is used during write to define the scales for Channels 3 and 4.

The bit definitions for this register during read are encoded.

9.12 Diagnostic Logic card LEDs - (RTD-4)**Diagnostic logic card LED's**

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when the IMOK signal is false (0) indicating failures of part or all of the logic common to the input channels.
1 - 4 (Red)	Channel #1 - 4 error. Lit whenever there is an error associated with Channel 1 - 4.
5 through 16	These LED locations are not used for this module.

9.13 Specifications - (RTD-4)**RTD Input (4 Channel) Specifications**

DESCRIPTION	VALUE
Number of channels	4
Sampling rate	Four per second (two per second during auto calibration.)
RTD ranges	Refer to the following RTD Ranges table.
Resolution	12 bits

DESCRIPTION	VALUE
Guaranteed accuracy (@25°C)	$0.10\% \pm [0.045 (R_{cold}/R_{span})]\% \pm [((R_{cold} + R_{span})/4096 \text{ OHM})]\% \pm [0.5 \text{ OHM}/R_{span}]\% \pm 10 \mu\text{V} \pm 1/2\text{LSB}$, where: R_{cold} and R_{span} are in Ohms.
Temperature coefficient	10ppm/°C
Dielectric isolation: Channel to channel Channel to logic	1000 V AC/DC 1000 V AC/DC
Input impedance	100 M OHM, 1 M OHM in power down (for input voltages 0 to 0.1 V.)
Module power	3.6 W typical; 4.2 W Maximum.
Operating temperature range	0 to 60°C (32°F to 140°F.)
Storage temperature range	-40°C to 85°C (-40°F to 185°F.)
Humidity (non-condensing)	0 to 95%

SECTION 10

RTD Input module - (RTD-8) (8 Channel)

IN THIS SECTION

8 Channel RTD Input module overview - (RTD-8)	151
Electronics modules (Emod) - (RTD-8)	151
Personality modules (Pmod) - (RTD-8)	152
Valid module combinations - (RTD-8)	152
Terminal block wiring information (Pmod 5X00121G01) - (RTD-8)	152
Module and field connection wiring - (RTD-8)	153
Module and field connection wiring (CE Mark) - (RTD-8)	155
Ranges - (RTD-8)	156
Configuration/Status Register information - (RTD-8)	157
Diagnostic Logic card LEDs - (RTD-8)	158
Specifications - (RTD-8)	159

10.1 8 Channel RTD Input module overview - (RTD-8)

The 8-channel RTD module is used to convert inputs from Resistance Temperature Detectors (RTDs) to digital data. The digitized data is transmitted to the Controller.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

CAUTION! The following applies to channels that are subsequently wired to an RTD after power is applied to the module.

If an RTD is wired into a live eight channel RTD module, one of the following two conditions must be met to ensure reading of the RTD:

1. Cycle module power *after* the RTD is installed.
2. Configure or re-configure the particular point to which the RTD is installed.

Note that there are no considerations necessary if the RTD is installed prior to power being applied to the module. Further, once the conditions for proper operations are met, the RTD can be removed and subsequently re-installed at which time it is read correctly without any further considerations.

10.2 Electronics modules (Emod) - (RTD-8)

- **5X00119G01** converts inputs for all ranges and is compatible only with Personality module 5X00121G01
- **5X00119G02** converts inputs for all ranges and is compatible only with Personality module 5X00121G01 (Non-EMC cabinet).

10.3 Personality modules (Pmod) - (RTD-8)

- **5X00121G01** converts inputs for all ranges and is compatible only with Electronics module 5X00119G01.

10.4 Valid module combinations - (RTD-8)

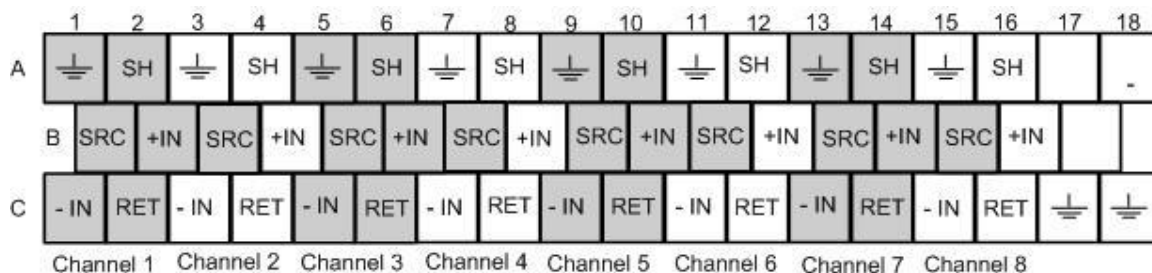
RTD module (8-Channel) valid module combinations¹

CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
8	5X00119G01 ¹	5X00121G01
8	5X00119G02 ²	5X00121G01
¹ This module configuration is CE Mark certified. ² This module configuration is CE Mark certified (Non-EMC cabinet).		

10.5 Terminal block wiring information (Pmod 5X00121G01) - (RTD-8)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The following table lists and defines the abbreviations used in this diagram.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.



Abbreviations used in wiring diagrams

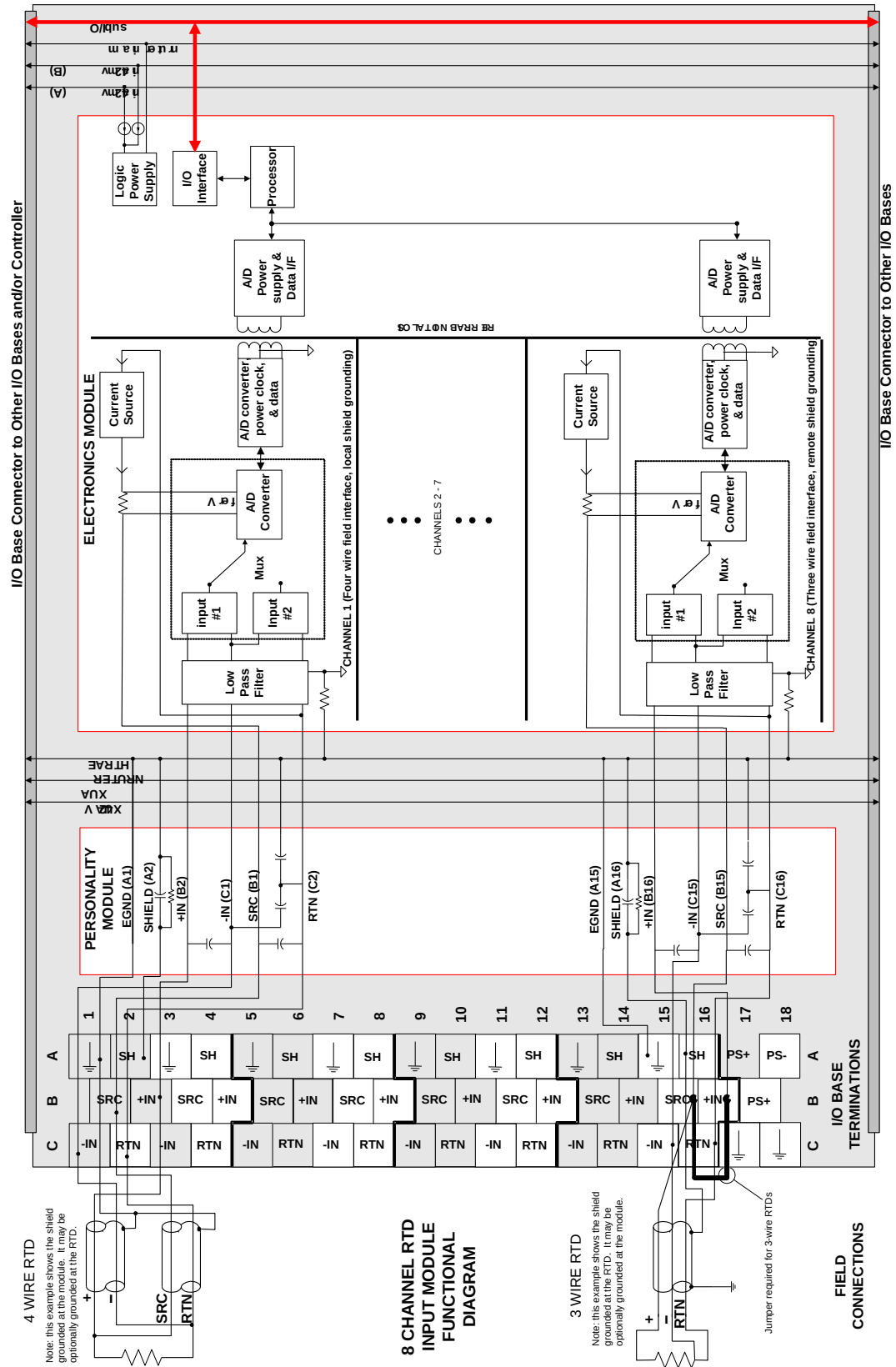
Abbreviation	Definition
	Earth ground terminal. Used for landing shields when the shield is to be grounded at the module.
+IN, -IN	Positive and negative sense input connection.
PS+, PS-	Auxiliary power supply terminals.
RTN	Return for current source connection.
SH	Shield connector. Used for landing shields when the shield is to be grounded at the RTD.
SRC	Current source connection.

Note: PS+ and PS- are not used by this module.

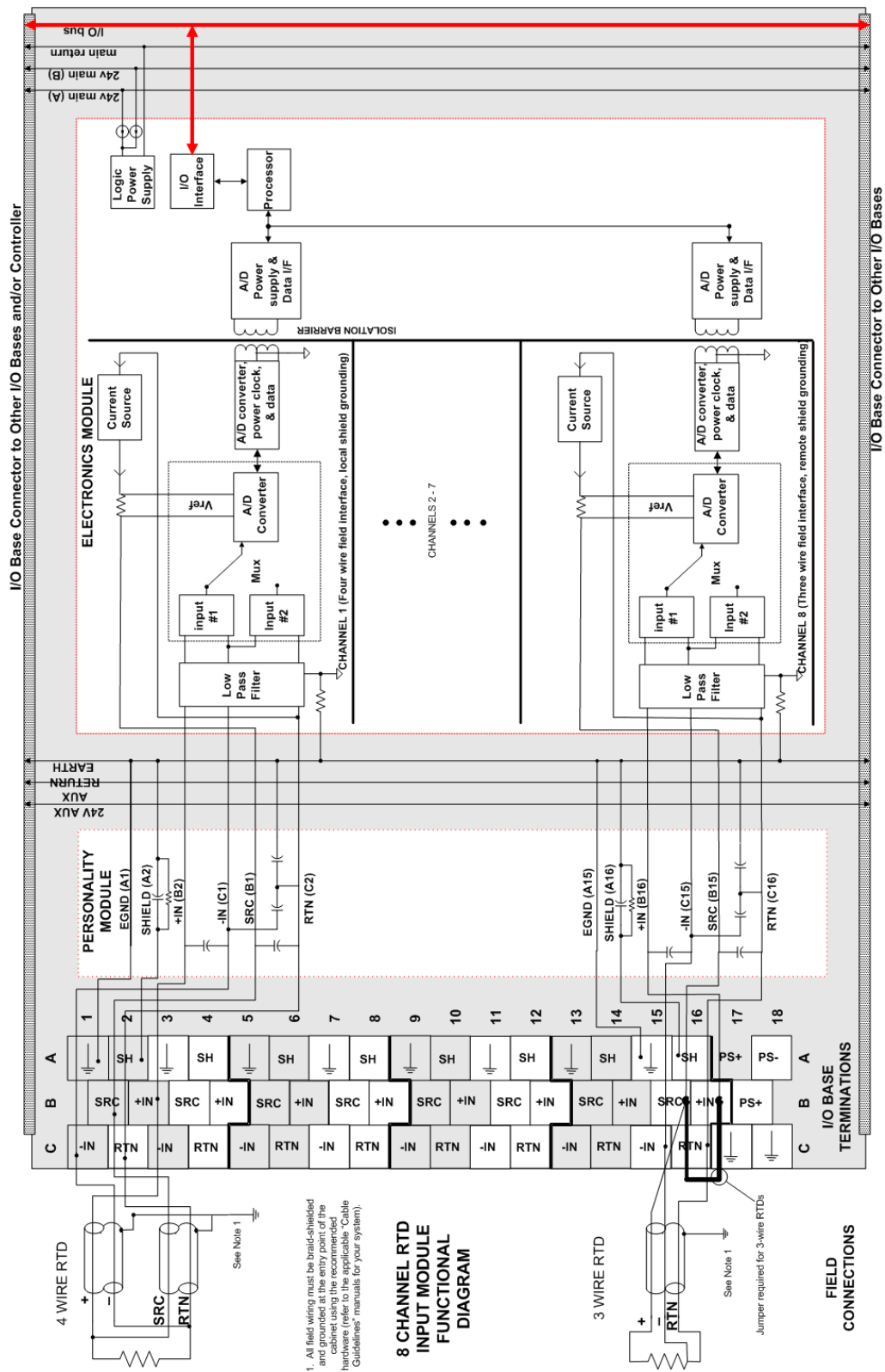
10.6 Module and field connection wiring - (RTD-8)

The Ovation 8-Channel RTD module consists of two modules, an Electronics module containing a logic printed circuit board (LIA) and a printed circuit board (FTD). The Electronics module is used in conjunction with a Personality module, which contains a single printed circuit board (PTD). The block diagram for the 8-channel RTD module is shown below.

Note: Shielded twisted pair wiring should be used for Maximum noise immunity. The shield may be grounded at the module or in the field as outlined in the following diagrams



10.7 Module and field connection wiring (CE Mark) - (RTD-8)



10.8 Ranges - (RTD-8)

SCALE # (HEX) ¹	SCALE # HEX 2	WIRES	TYPE	TEMP °F	TEMP °C	RCOLD (OHM)	RHOT (OHM)	EXCITATION CURRENT (MA)	ACCURACY COUNTS	ACCURACY % OF SPAN
0	0	3	10 Ohm PL	0 to 1200	-18 to 649	6	106.3	1.0	9	0.22
1	1	3	10 Ohm CU	0 to 302	-18 to 150	8.5	16.5	1.0	13	0.32
2	2	3	10 Ohm CU	32 to 284	0 to 140	50	80	1.0	11	0.27
3	3	3	10 Ohm CU	32 to 230	0 to 110	53	78	1.0	12	0.30
4	4	3	100 Ohm PL	-4 to 334	-20 to 168	92	163.67	1.0	11	0.27
5	5	3	100 Ohm PL	32 to 520	0 to 271	100	200	1.0	10	0.25
6	6	3	100 Ohm PL	32 to 1040	0 to 560	100	301	1.0	10	0.25
7	7	3	120 Ohm NI	-12 to 464	-11 to 240	109	360	1.0	10	0.25
8	8	3	120 Ohm NI	32 to 150	0 to 66	120	170	1.0	13	0.32
9	9	3	120 Ohm NI	32 to 252	0 to 122	120	225	1.0	11	0.27
0	10	4	100 Ohm PL	32 to 544	0 to 290	100	208	1.0	10	0.25
1	11	4	100 Ohm PL	356 to 446	180 to 230	168	186	1.0	30	0.74
2	12	4	200 Ohm PL	32 to 698	0 to 370	200	473	1.0	12	0.30
3	13	4	200 Ohm PL	514 to 648	268 to 342	402	452	1.0	29	0.71
4	14	4	100 Ohm PL	32 to 124	0 to 51	100	120	1.0	19	0.47
5	15	4	100 Ohm PL	32 to 217	0 to 103	100	140	1.0	13	0.32
6	16	4	100 Ohm PL	32 to 412	0 to 211	100	180	1.0	11	0.27
7	17	4	100 Ohm PL	32 to 714	0 to 379	100	240	1.0	10	0.25
8	18	4	200 Ohm PL	511 to 662	266 to 350	200	230	1.0	24	0.59
¹ For Hardware configuration.										
² For Software Purposes. This value is used in Import/Export files.										

10.9 Configuration/Status Register information - (RTD-8)

Word addresses 12 and 14 (described in the following two tables) are used to configure the appropriate scales for Channels 1 - 8 (refer to Column 1 in the table in Specifications (see page 159)).

Data format for the channel scale configuration register (address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 3	Configure Channel #1 scale - Bit 0 - 3.	Channel #1 scale configuration (read back) - Bit 0 - 3.
4 - 7	Configure Channel #2 scale - Bit 0 - 3.	Channel #2 scale configuration (read back) - Bit 0 - 3.
8 - 11	Configure Channel #3 scale - Bit 0 - 3.	Channel #3 scale configuration (read back) - Bit 0 - 3.
12 - 15	Configure Channel #4 scale - Bit 0 - 3.	Channel #4 scale configuration (read back) - Bit 0 - 3.

CAUTION: Configuring any or all channel scales while the system is running causes all channels to return attention status for up to two seconds following the reconfiguration.

Data format for the channel scale configuration register (address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 3	Configure Channel #5 scale - Bit 0 - 3.	Channel #5 scale configuration (read back) - Bit 0 - 3.
4 - 7	Configure Channel #6 scale - Bit 0 - 3.	Channel #6 scale configuration (read back) - Bit 0 - 3.
8 - 11	Configure Channel #7 scale - Bit 0 - 3.	Channel #7 scale configuration (read back) - Bit 0 - 3.
12 - 15	Configure Channel #8 scale - Bit 0 - 3.	Channel #8 scale configuration (read back) - Bit 0 - 3.

CAUTION: Configuring any or all channel scales while the system is running causes all channels to return attention status for up to two seconds following the reconfiguration.

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (Bit Pattern Field on the Hardware Tab). (See the [Ovation Operator Station User Guide](#).)

8-Channel RTD configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure Module.	Module Configured (1 = configured; 0 = unconfigured.)
1	Force error.	Internal/forced error (1 = forced error; 0 = no forced error.)
2	50/60 Hz select (0 = 60Hz, 1 = 50Hz.)	50/60 Hz System (1 = 50Hz) (read back.)
3	SELF_CAL (Initiates Self Calibration.)	Warming bit (set during power up or configuration.)
4	0	0

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
5	0	0
6	0	Module Not Calibrated.
7	0	0
8 - 15	Channel 1 - 8 _ 3/4 Wire.	Channel 1 - 8 _ 3/4 Wire - Configuration (read back.)

Bit 0: This bit configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Note that until the module is configured, reading from addresses 0 through 11 (B in Hex) produces an attention status.

Bit 1: This bit (write “1”) forces the module into the error state, resulting in the error LED being lit. The read of bit “1” indicates that there is an internal module error, or the Controller has forced the module into the error state. The state of this bit is always reflected by the module’s Internal Error LED. Whenever this bit is set, an attention status is returned to the Controller when address 0 through 11 (B in Hex) are read.

Bit 2: The status of this bit (read) indicates the conversion rate of the module, write to this bit configures the conversion rate of A/D converters as shown below.

CONVERSION RATE (1/SEC.)	BIT 2
60 (for 60Hz systems)	0
50 (for 50Hz systems)	1

Bit3: Write: This bit is used to initiate self-calibration. Read: This bit indicates that the module is in the “Warming” state. This state exists after power up and terminates after 8.16 seconds. The module is in the error condition during the warm up period.

Bits 4 - 5: These bits are not used and read as “0” under normal operation.

Bit 6: This bit (read) is the result of a checksum test of the EEPROM. A failure of this test can indicate a bad EEPROM, but it typically indicates that the module has not been calibrated. A “0” indicates that there is no error condition. If an error is present, the internal error LED is lit and attention status is returned for all address offsets 0-11 (0x0 - 0xB). The “1” state of this bit indicates an unrecoverable error condition in the field.

Bit 7: This bit is not used and read as “0” under normal operation.

Bits 8 - 15: These bits are used to configure channels 1 - 8 respectively for 3 or 4 wire operation. A “0” indicates 3 wire and a “1” indicates 4 wire operation, see the tables below).

10.10 Diagnostic Logic card LEDs - (RTD-8)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.

LED	DESCRIPTION
I (Red)	Internal Fault LED. Lit whenever there is any type of error with the module except to a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus time-out has occurred. ▪ Register, static RAM, or FLASH checksum error. ▪ Module reset. ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
1 - 8 (Red)	Channel #1 - 8 error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange. ▪ Negative overrange. ▪ Communication with the channel has failed.
9 through 16	These LED locations are not used for this module.

10.11 Specifications - (RTD-8)

RTD Input (8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels.	8
Sample repetition time and sample duration time (msec.)	50 HZ mode: 40/sec. normally. In 3 wire mode, lead resistance measurement occurs once every 6.45 sec. during which the time rises to 333. 60 HZ mode: 20/sec. normally. In 3 wire mode, lead resistance measurement occurs once every 6.45 sec. during which the time rises to 500. Self Calibration Mode: Occurs on demand only. The rate drops to 1/sec. once during each self calibration cycle.
RTD ranges.	Refer to the following RTD Ranges table.
Resolution.	12 bits + polarity.
Data format.	Two's compliment.
Conversion type.	Sigma Delta.
Operating Mode.	Self-scan.
Monotonicity.	Yes
Nonlinearity.	0.003% of full scale.
Repeatability.	With guaranteed accuracy.
Guaranteed accuracy (@25°C.)	$0.10\% \pm [0.045 (R_{cold}/R_{span})]\% \pm [((R_{cold} + R_{span})/4096 \text{ OHM})]\% \pm [0.5 \text{ OHM}/R_{span}]\% \pm 10 \mu\text{V} \pm 1/2\text{LSB}$ where: R_{cold} and R_{span} are in Ohms.
Temperature coefficient.	10ppm/ °C.

DESCRIPTION	VALUE
Dielectric isolation: Channel to channel. Channel to logic.	200V AC/DC. 1500 V AC/DC.
Input impedance.	100 M OHM. 50 K OHM in power down.
Maximum Overload.	Fused at 50 ma.
Module power.	3.6 W typical; 4.2 W Maximum.
Operating temperature range.	0 to 60 ⁰ C (32 ⁰ F to 140 ⁰ F.)
Storage temperature range.	-40 ⁰ C to 85 ⁰ C (-40 ⁰ F to 185 ⁰ F.)
Humidity (non-condensing).	0 to 95%.
Self Calibration.	On Demand by Ovation Controller.
Common Mode Rejection and Channel Crosstalk.	120 dB @ DC and nominal power line frequency (+/- 1/2%.)
Normal Mode Rejection.	100 dB @ DC and nominal power line frequency (+/- 1/2%.)
Filtering.	Digital, Sinc - 3dB cutoff: 13.1 Hz for 50 Hz; 15.7 Hz for 60 Hz.

SECTION 11

Analog Output module - (AO) (4 Channel)

IN THIS SECTION

4 Channel Analog Output module overview - (AO).....	161
Electronics modules (Emod) - (AO)	161
Personality modules (Pmod) - (AO)	162
Valid module combinations - (AO)	162
Terminal block wiring information - (AO).....	163
Field connection wiring diagrams (simplex) - (AO)	164
Field connection wiring diagrams (CE Mark) (simplex) - (AO).....	165
Field connection wiring diagrams (Redundant) - (AO).....	166
Redundant interface cable assembly routing configuration (Redundant) - (AO)	167
Configuration/Status Register information - (AO)	167
Diagnostic Logic card LEDs - (AO)	170
Specifications - (AO)	170

11.1 4 Channel Analog Output module overview - (AO)

The Analog Output Electronics module uses low-power-drain 12-bit serial digital-to-analog converters (DACs) to provide four galvanically isolated output channels. The serial clock and data allow the four channels to be updated every 1.5 ms. The serial interface uses opto-isolators for high-voltage isolation.

The Analog Output module is a CE Mark certified module.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

11.2 Electronics modules (Emod) - (AO)

- **1C31129G01** provides voltage output range of 0 to 5 VDC (for simplex applications).
- **1C31129G02** provides voltage output range of 0 to 10 V (for simplex applications).
- **1C31129G03** provides current output range of 0 to 20 mA with diagnostics (for simplex applications).
- **1C31129G04** provides current output range of 0 to 20 mA without diagnostics (for simplex applications).
- **1C31129G05** provides current output range of 4 to 20 mA with diagnostics (for redundant applications).

11.3 Personality modules (Pmod) - (AO)

- **1C31132G01** for simplex Analog Output Electronics modules.
- **1C31132G02** for redundant Analog Output Electronics modules.
- **5X00170G01** for HART High Performance Analog Output Electronics modules - provides Analog Output (current output) module I/O Base pin-compatibility.

11.4 Valid module combinations - (AO)

Analog Output valid module combinations

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
0-5 Volts DC	4	1C31129G01 ¹	1C31132G01
0-10 Volts DC	4	1C31129G02 ¹	1C31132G01
0-20 mA with Diagnostics (4-20 mA with Diagnostics can also be selected).	4	1C31129G03 ¹	1C31132G01
0-20 mA without Diagnostics (4-20 mA without Diagnostics can also be selected).	4	1C31129G04 ¹	1C31132G01
4-20 mA with Diagnostics (For Redundant applications).	4	1C31129G05 ²	1C31132G02
¹ This module configuration is CE Mark certified. ² For Redundant applications using Windows Ovation 3.2 and above.			

11.5 Terminal block wiring information - (AO)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagram for the analog output Personality module is illustrated in the following figure. The following table lists and defines the abbreviations used in this diagram.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

Shielded twisted pair wiring should be used for Maximum noise immunity.

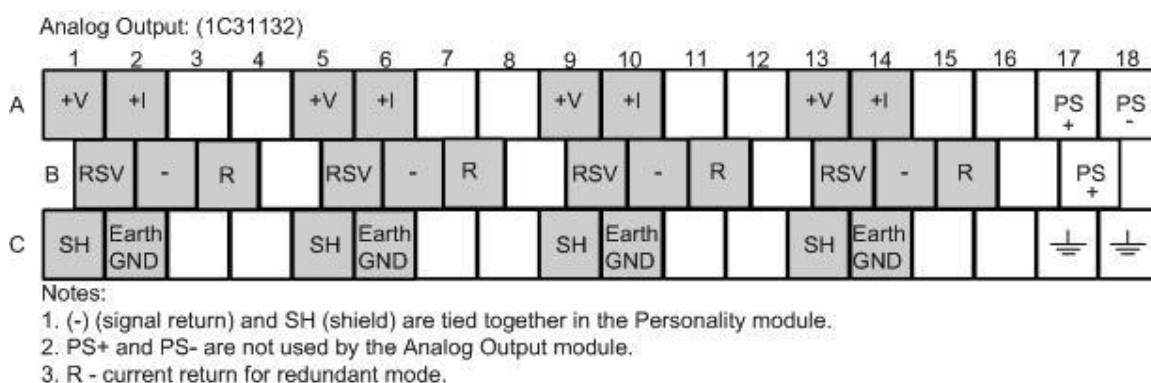


Figure 41: Terminal block connections for the Analog Output Personality module

Note: 1. R is only used with the combination of 1C31129G05 and 1C31132G02.
 2. Do **not** use unmarked terminal block locations.
 3. Shield terminals (SH) are **not** connected in CE Mark systems.

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
+I	Current output source terminal.
RSV	Reserved terminal. No connections allowed on these terminals.
SH	Shield terminal connection.
+V	Voltage output source terminal connection.
PS+, PS-	Auxiliary power supply terminals.
-	Reference for voltage and current output.
R	Current return for redundant mode.

The loads can be floating or grounded. For Maximum noise immunity, it is best to reference a floating load to local earth by placing a jumper between the SH terminal and the adjacent earth GND terminal.

11.6 Field connection wiring diagrams (simplex) - (AO)

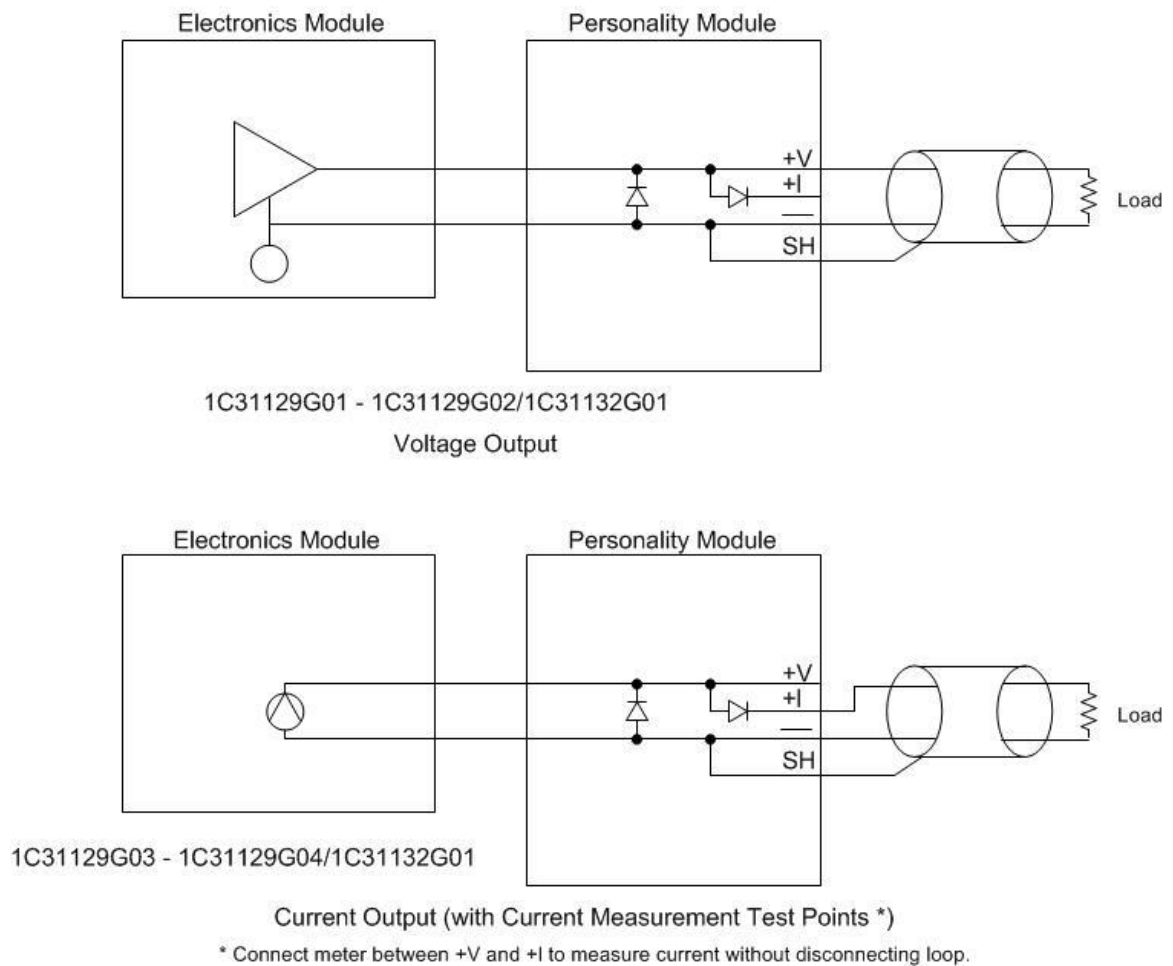
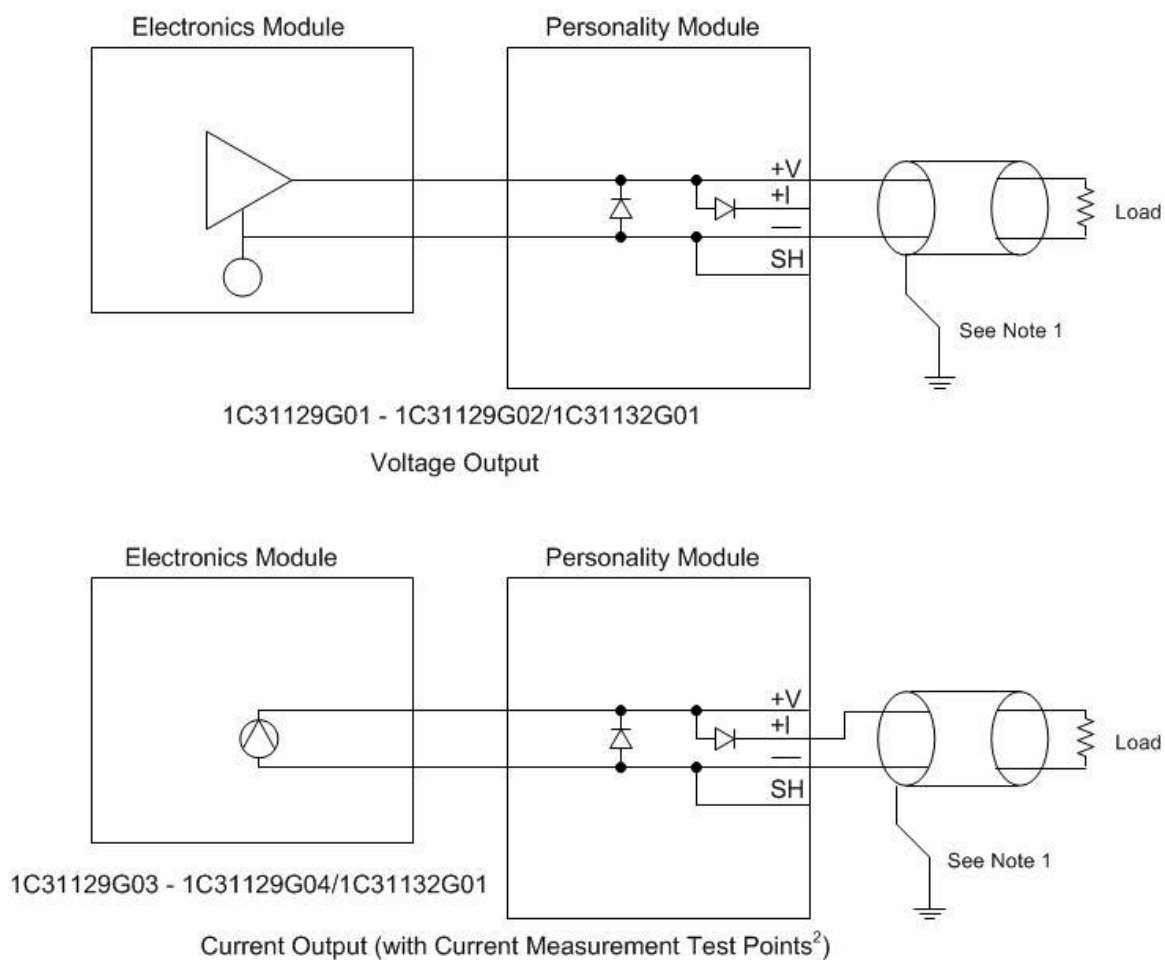


Figure 42: Field connection for the Simplex Analog Output module

11.7 Field connection wiring diagrams (CE Mark) (simplex) - (AO)



Notes

1. All field wiring MUST be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).
2. Connect meter between +V and +I to measure current without disconnecting loop.

Figure 43: Field Connection for the Simplex Analog Output module (CE Mark)

11.8 Field connection wiring diagrams (Redundant) - (AO)

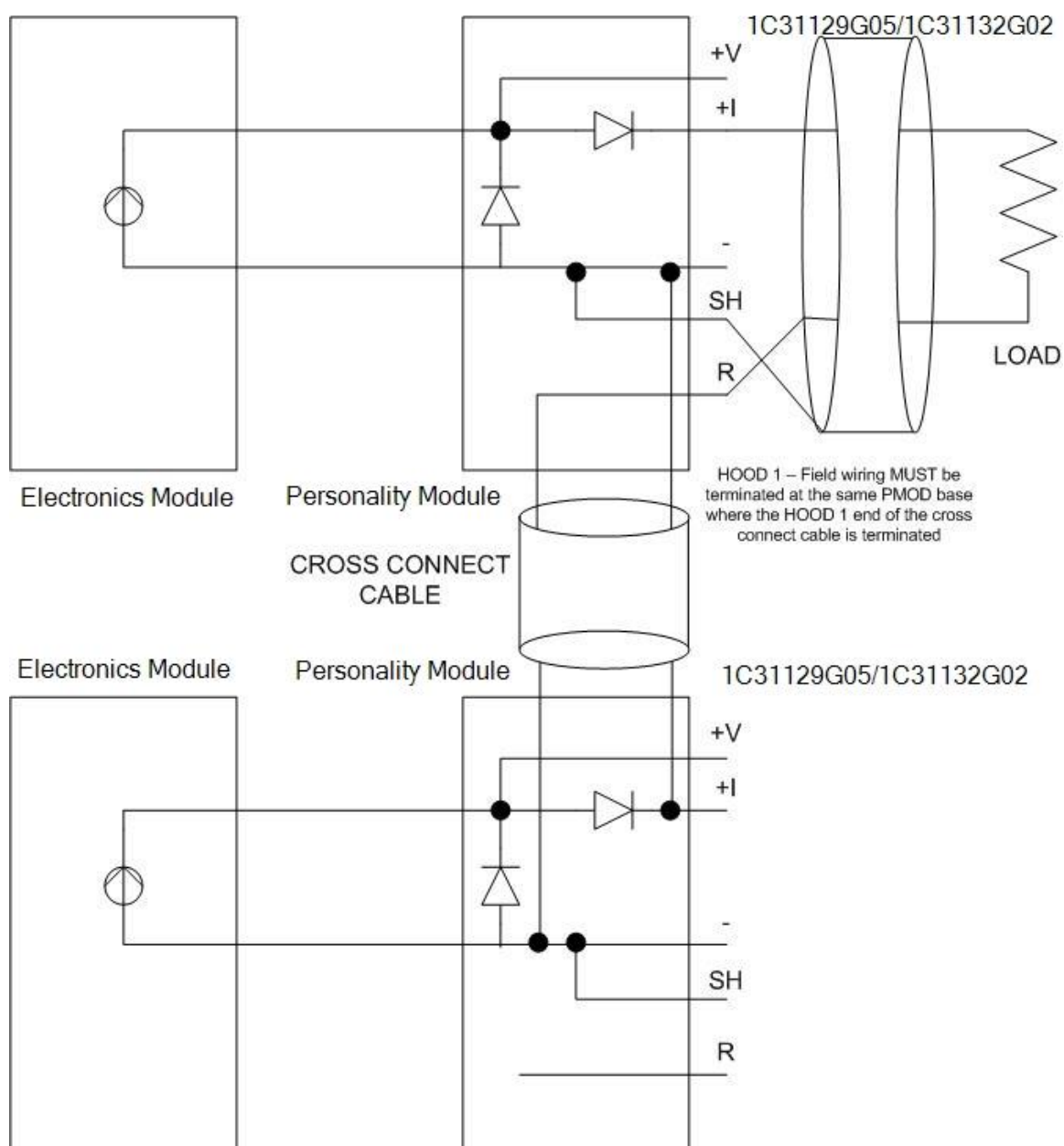


Figure 44: Field connection for the Redundant Analog Output module

11.9 Redundant interface cable assembly routing configuration (Redundant) - (AO)

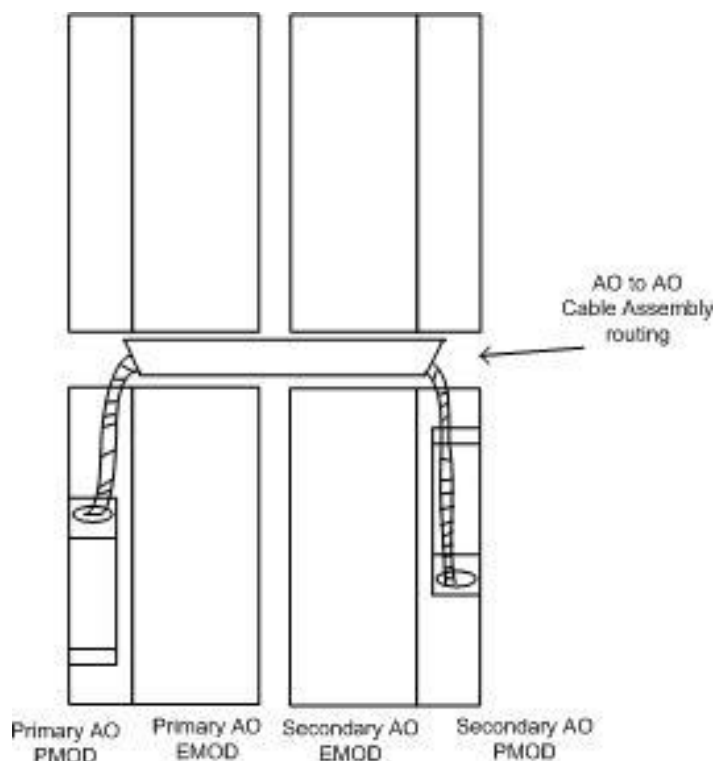


Figure 45: Redundant interface cable

Note: The AO to AO cable assembly end labeled Hood 1 must be connected to the 1C31132G02 personality module whose I/O base terminals are wired to the field load."

11.10 Configuration/Status Register information - (AO)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

Analog Output configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure	Configured (1 = configured; 0 = unconfigured)
1	Force Error	Forced Error (1 = forced error; 0 = no forced error)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)																																																																								
2 - 4	Communications Timeout Setting ¹	Communications Timeout Setting ¹																																																																								
	<table><tr><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Timeout</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table>	Bit 4	Bit 3	Bit 2	Timeout	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 milliseconds	1	0	1	250 milliseconds	1	1	0	125 milliseconds	1	1	1	62.5 milliseconds	<table><tr><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Timeout</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table>	Bit 4	Bit 3	Bit 2	Timeout	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 milliseconds	1	0	1	250 milliseconds	1	1	0	125 milliseconds	1	1	1	62.5 milliseconds
	Bit 4	Bit 3	Bit 2	Timeout																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 milliseconds																																																																						
	1	0	1	250 milliseconds																																																																						
	1	1	0	125 milliseconds																																																																						
	1	1	1	62.5 milliseconds																																																																						
Bit 4	Bit 3	Bit 2	Timeout																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 milliseconds																																																																							
1	0	1	250 milliseconds																																																																							
1	1	0	125 milliseconds																																																																							
1	1	1	62.5 milliseconds																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
3	Communication Timeout Bit ¹	Communication Timeout Bit 1 ¹																																																																								
4	Communication Timeout Bit ¹	Communication Timeout Bit 2 ¹																																																																								
5	Hold Output	Hold Output.																																																																								
6	Not used	Channel error (G05 only).																																																																								
7	Disable power	Disable power.																																																																								
15	Redundant Operation (G05 only)	Redundant Operation (G05 only).																																																																								
¹ The tolerance on the timeout period is +/- 35%.																																																																										

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: When Bit 0 is set, the module is configured. The module cannot be read and does not operate until the configure bit is set with a write. Subsequent writes to address 13 should also have Bit 0 set.

Bit 1: Bit 1 is the Force-Error bit. When Bit 1 is set, the Internal Error LED is turned on, and data registers can be written, but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: This bit is Hold Output on communication timeout. If Bit 5 is set and no communication to the module occurs for the defined time period, only the communication LED goes off, and the Internal Error LED goes on, but the outputs hold their last value.
If Bit 5 is not set and no communication to the module occurs for the defined time period, the outputs reset to zero and the Internal Error LED goes on.

Bit 6: Group 5 only - Set on any channel error (over-current, under-current, Power Supply failure).

Bit 7: This bit is the disable power bit.

Bit 15: Group 5 only - Set to indicate redundant operation.

All the bits are cleared to zero on power up.

CAUTION! This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio or the DBID tool.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system. Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET, either through the DBID tool or in the Developer Studio, before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

The register at address 12 (C in Hex) is for diagnostics and is a read-only register. The overcurrent and undercurrent status bits may be read from this register. The following table shows the overcurrent and undercurrent bits for each channel. The overcurrent bits are used for both the voltage groups and current groups. The undercurrent bits only have meaning for the current group. The voltage output groups do not implement the undercurrent bit.

The simultaneous setting of a channel's overcurrent and undercurrent bits indicates a loss of Field Card power supply for that channel. Overcurrent and undercurrent bits indicate the output current status of this module and not the loop current.

Note: Group 4 current output Field Cards do not have these diagnostic capabilities and the overcurrent and undercurrent bits are strapped in the logical zero state. Since the Group 4 modules do not have diagnostics, the information is not available to the Ovation Controller to support redundancy logic calculations. Groups 1 and 2 do not have undercurrent indication.

Output Current Status register address location information (address 12 or C in Hex)

BIT	DESCRIPTION
0, 2, 4, 6	Channel 1 - 4 Overcurrent
1, 3, 5, duced radiated	Channel 1 - 4 Undercurrent

Current Output Modules with Diagnostics - 1C31129G03 and 1C31129G05

Overcurrent Condition (bit set) = Output current $\geq 20.25 \text{ mA} \pm 0.15 \text{ mA}$

Undercurrent Condition (bit set) = Output current $\leq 2 \text{ mA} \pm 0.25 \text{ mA}$

Loss of channel field power = both Overcurrent and Undercurrent limit bits are set

Voltage Output Modules - 1C31129G01 and 1C31129G02

Overcurrent Condition (bit set) = Output current $\geq 12.5 \text{ mA}$

11.11 Diagnostic Logic card LEDs - (AO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module.
1 - 4 (Red)	Channel 1 - 4 error. Over-current or undercurrent indication. ▪ On groups 1, 2, 3, and 5, the LEDs are ON after power up until the module is configured. ▪ On groups 1 and 2, the LED is ON for over-current output or loss of output D/A power. ▪ On group 3, and 5, the LED is ON for over-current/undercurrent output or loss of output D/A power. ▪ Group 4 does not have diagnostic LEDs.
5 through 16	These LED locations are not used for this module.

11.12 Specifications - (AO)

Analog Output (4 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	4
Maximum update time	2 msec
Output range	0 – 5 V ¹ , 0 -10 V ¹ , 0 - 20 mA ²
Resolution	12 bits
Data Format	Binary
Bit Weight	Current Output: 0.005 ma - Voltage output: 2.5 mv.
Setting time (full scale change) to 1% of range	Current Output: 660 usec
Overshoot	None
Inductive Loads (current outputs)	10 mH
Power up/down	The outputs power up at 0 mA (G03, G04), 4mA (G05) or 0 V (G01, G02).
Monotonicity	Yes
Crosstalk between channels	>60dB
Nonlinearity	1/2 LSB
Repeatability	<1 LSB

DESCRIPTION	VALUE
Output noise	5 mv Max
Guaranteed accuracy (@25°C)	0.1% of full scale.
Temperature coefficient	30 ppm/°C.
User loop voltage	Power for current loop output is supplied by module.
Dielectric isolation: Channel to channel - Channel to logic	1000 V AC/DC - 1000 V AC/DC.
Output loading: Current Voltage	0 Ohms minimum; 750 Ohms Maximum. 10 mA Maximum.
Module power Current output Voltage output	4 W typical; 6 W Maximum. 2 W typical; 3 W Maximum.
Operating temperature range	0 to 60°C (32°F to 140°F).
Storage temperature range	-40°C to 85°C (-40°F to 185°F).
Humidity (non-condensing)	0 to 95%
¹ Overcurrent load indications. ² Module supplied loop voltage, overcurrent and undercurrent diagnostic indication. Provides the ability to measure current without disconnecting loop.	

SECTION 12

HART Analog Output module - (HAO) (8 Channel)

IN THIS SECTION

<i>8 Channel HART Analog Output module overview - (HAO)</i>	<i>173</i>
<i>Electronics modules (Emod) - (HAO).....</i>	<i>173</i>
<i>Personality modules (Pmod) - (HAO).....</i>	<i>174</i>
<i>Valid module combinations - (HAO).....</i>	<i>174</i>
<i>Module block diagrams - (HAO).....</i>	<i>175</i>
<i>External power supply information - (HAO)</i>	<i>176</i>
<i>Terminal block wiring information - (HAO).....</i>	<i>177</i>
<i>Field connection wiring diagrams - (HAO)</i>	<i>178</i>
<i>Field connection wiring diagrams (CE Mark) - (HAO).....</i>	<i>179</i>
<i>Field wiring cable requirements - (HAO).....</i>	<i>180</i>
<i>Open loop detect register - (HAO)</i>	<i>180</i>
<i>Configuration/Status Register information - (HAO).....</i>	<i>181</i>
<i>Diagnostic Logic card LEDs - (HAO).....</i>	<i>183</i>
<i>Specifications - (HAO).....</i>	<i>184</i>

12.1 8 Channel HART Analog Output module overview - (HAO)

The Ovation HART (Highway Addressable Remote Transducer) Analog Output Module consists of an Electronics module and a personality mode.

The Ovation HART Analog Output Module is designed to interface with eight HART compliant output devices utilizing a 4-20 mA control loop signal. A HART compliant output device exchanges digital information with the Ovation control system in addition to the standard 4-20 mA control loop signal.

The digital information is imposed on the 4-20 mA signal according to the guidelines of the HART Protocol Specification. HART uses a low-level frequency shift-keyed sine-wave signal that is superimposed on the 4-20 mA signal. The average value of the HART signal is zero. Therefore, the HART signal does not interfere with the 4-20 mA control signal.

The HART Analog Output module is a CE Mark certified module.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

12.2 Electronics modules (Emod) - (HAO)

- **5X00062G01** contains eight multiplexed, 4-20 mA output channels that interface with eight HART output devices.

12.3 Personality modules (Pmod) - (HAO)

- **5X00063G01** contains passive circuitry for each of the eight channels. There is a user-serviceable fuse located on the Personality module. This fuses the auxiliary power supplying the field side circuitry of the eight output channels.

12.4 Valid module combinations - (HAO)

HART Analog Output valid module combinations (14 bit)¹

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
4-20 mA	8	5X00062G01 ¹	5X00063G01
¹ This module configuration is CE Mark certified.			

12.6 External power supply information - (HAO)

Note: Module power specifications (main and auxiliary) refer to the actual power drawn by the module from the 24 VDC main power supply and from the +24 VDC auxiliary power supply and **NOT** from the AC or DC mains.

The HART Analog Output Module utilizes the standard +24V Ovation main power supply to provide the power required for the logic circuitry.

The HART Analog Output Module utilizes a +24 auxiliary power supply to provide the power required for the field circuitry. This includes all 4-20 mA loop power, D/A conversion, and the remaining output channel components.

It is recommended that the HART Analog Output module utilize the Ovation cabinet's Auxiliary +24V DC power that is obtained from the standard Ovation DIN Rail power supply auxiliary output.

However, if an external auxiliary power supply is utilized by the HART Analog Input module, the power supply output noise cannot exceed 2.2 mVRMS Maximum for all rated loads across the frequency range of 500 HZ to 10 KHz .

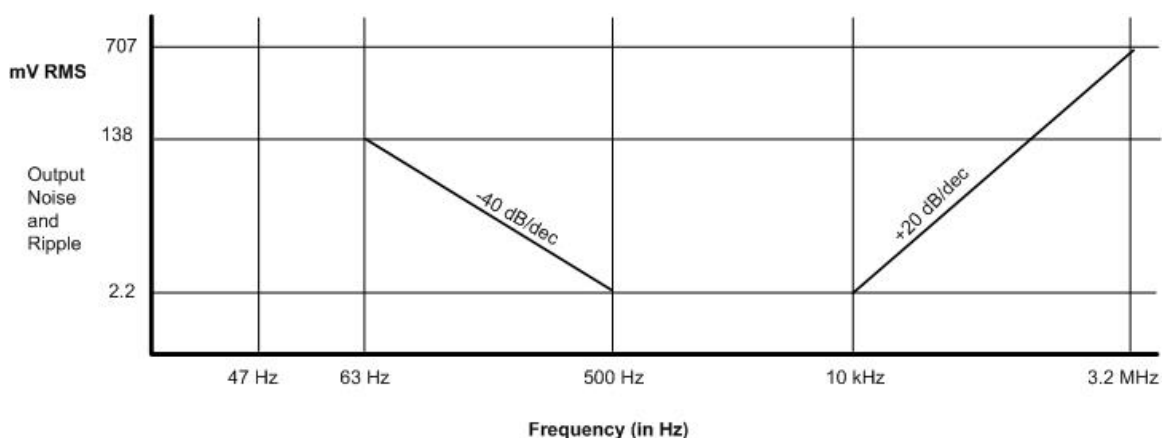


Figure 47: Power supply output noise requirements

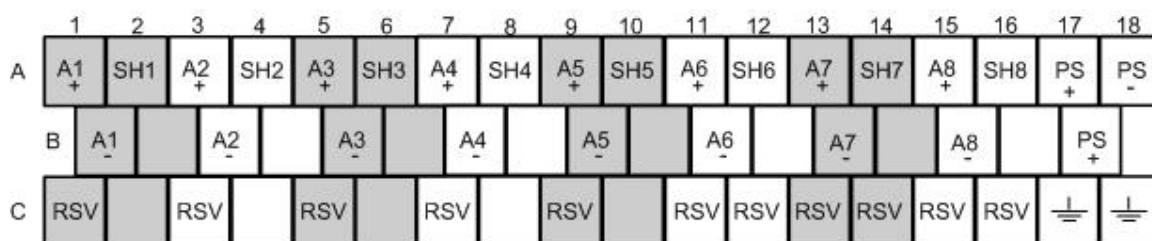
If an external power supply is used, Using an External Power Supply (see page 635) contains steps to be undertaken before connecting the external power supply to the Ovation I/O base unit terminal block.

In addition, all modules utilizing the auxiliary power supplies, including the HART modules, **MUST** utilize shielded I/O cables in order to suppress coupled noise and transients into the HART modules. This includes modules on the same branch utilizing the auxiliary power, or modules on other branches utilizing the same auxiliary power. This recommendation applies regardless of the type of power supply chosen by the user.

12.7 Terminal block wiring information - (HAO)

Each Personality module has a simplified wiring diagram label on its side which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagrams for the HART Analog Output Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.



Note: Do not make connections to RSV or unlabeled terminals.

Figure 48: HART Analog Output terminal block pin assignments

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
A1 - A8 +	Analog Output positive terminal connection (connected to the positive terminal of a HART analog output device).
A1 - A8 -	Analog Output negative terminal connection (connected to the negative terminal of a HART analog output device.)
PS+, PS-	External Auxiliary power supply terminals.
SH1 - SH8	Shield terminal connection.

12.8 Field connection wiring diagrams - (HAO)

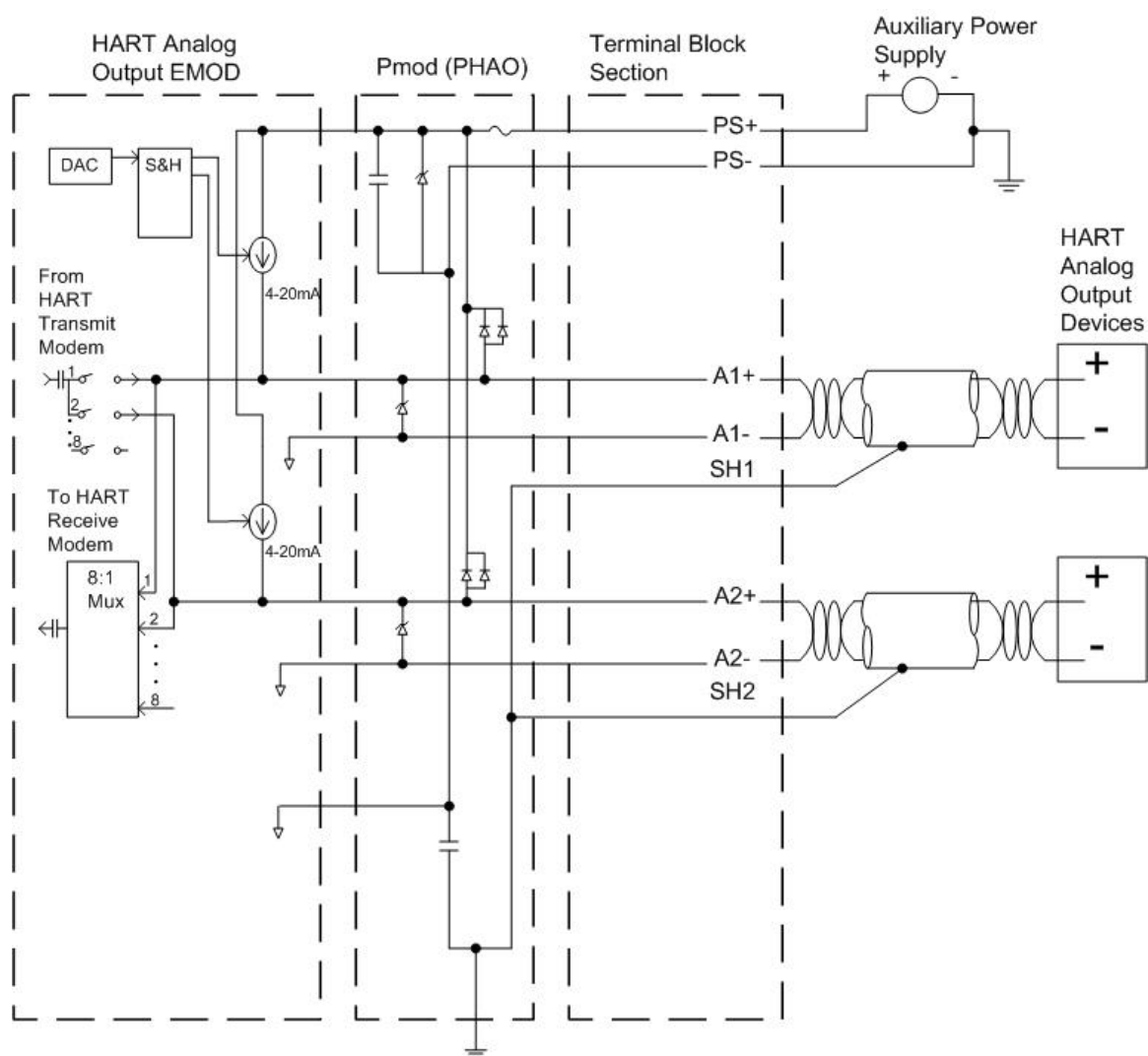
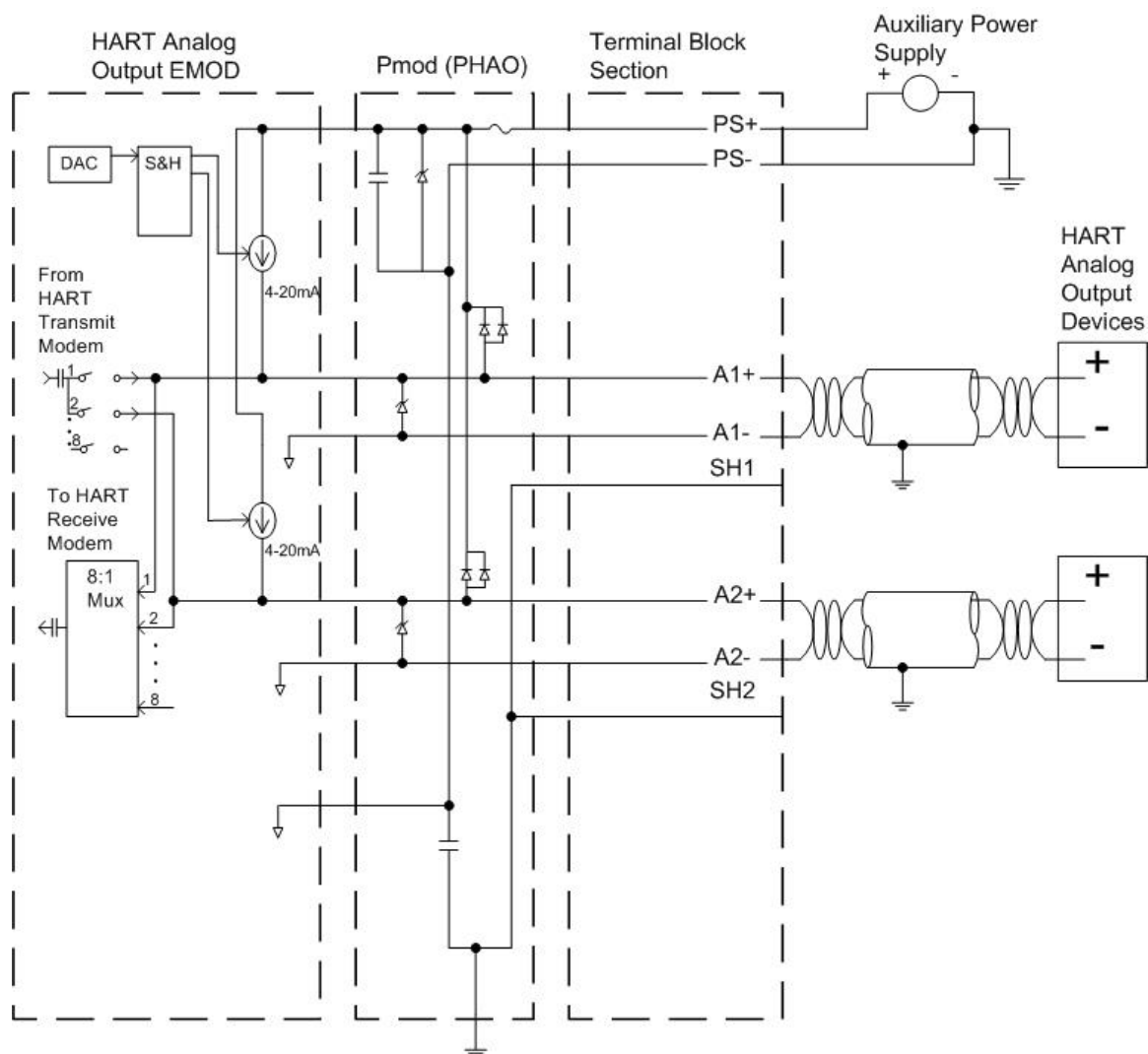


Figure 49: Field wiring (non-CE Mark) (2 of 8 channels depicted)

12.9 Field connection wiring diagrams (CE Mark) - (HAO)



Note:

All field wiring must be braid-shielded and grounded at the point of entry of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 50: Field wiring (CE Mark) (2 of 8 channels depicted)

12.10 Field wiring cable requirements - (HAO)

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple-pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended minimum conductor size

CABLE LENGTH	MIN. CONDUCTOR SIZE	CABLE TYPE
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The Maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

In a HART network, long cable lengths are possible when the dominant low impedance device (the HART field device) has an input impedance of approximately 250 ohms and the signal cable is good quality having low capacitance (Cx) and resistance (Rx) per unit length.

Cx = Cable capacitance per unit length (feet or meters): The capacitance from one conductor to all other conductors (including the shield if shielded). This value is usually available from the cable manufacturer.

Rx = Cable resistance per unit length (feet or meters): This value should be available from the cable manufacturer. Filed Wiring Requirements (see page 118) for the HART Analog Input Module contains the resistance values of some common copper wire sizes. The resistance per unit length is for a single wire but the length calculations and charts take into account the resistance of both wires.

Refer to field device manufacturer's literature for more information on cabling lengths since device impedances may vary among field devices. In addition, refer to the HART FSK Physical Layer Specification (HCF_SPEC - 54) for additional information.

12.11 Open loop detect register - (HAO)

If one of these bits is set, the channel readback diagnostic indicates the difference between the desired value and the actual value that exceeds the accepted deadband. This bit signifies an open loop condition.

Pass/Fail per channel register (address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 7	NA	Channel 1 - 8 bad
8 - 16	Not Used	Not Used

12.12 Configuration/Status Register information - (HAO)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

HART Analog Output register map

REG	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Indirect Memory Index.	NA
1	Indirect Memory Data.	Indirect Memory Data.
2 - 9	Analog Output - Channel 1 - 8	NA
10	Calibration Register (Factory use only).	Calibration Register (Factory use only.)
11	NA	HAI Firmware Revision.
12	NA	Channel Error Bits.
13	Module Configuration Register.	Module Status Register.
14	NA	HART Enable (See the table below.)
15	Module Electronic ID Data.	NA

HART HAO Configuration/Status Register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)																																																																								
0	Configure module	Module Configured. (1 = configured; 0 = unconfigured.)																																																																								
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error.)																																																																								
2 - 4	Communications Timeout Setting ¹	Communications Timeout Setting ¹																																																																								
	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 milliseconds	1	0	1	250 milliseconds	1	1	0	125 milliseconds	1	1	1	62.5 milliseconds	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 milliseconds</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 milliseconds</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 milliseconds</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 milliseconds</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 milliseconds	1	0	1	250 milliseconds	1	1	0	125 milliseconds	1	1	1	62.5 milliseconds
	BIT 4	BIT 3	BIT 2	TIMEOUT																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 milliseconds																																																																						
	1	0	1	250 milliseconds																																																																						
	1	1	0	125 milliseconds																																																																						
	1	1	1	62.5 milliseconds																																																																						
	BIT 4	BIT 3	BIT 2	TIMEOUT																																																																						
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 milliseconds																																																																							
1	0	1	250 milliseconds																																																																							
1	1	0	125 milliseconds																																																																							
1	1	1	62.5 milliseconds																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
5	Timeout Action	NA																																																																								

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)
6	Reserved for Factory Test (must be set to 0.)	NA
7	Reserved for Factory Test (must be set to 0.)	NA
8	NA	Hardware Error.
9 - 13	Not Used.	Not Used.
14	NA	Field Power Failed.
15	Reserved	Reserved.
¹ The tolerance on the timeout period is +/- 35%.		

Bit definitions for this register are encoded as shown above and described below:

Bit 0: Configures the module (write) or indicates the configuration state of the module (read). A “1” indicates that the module is configured. Until the module is configured, addresses 0 through 11 produce an attention status.

Bit 1: This bit (write “1”) forces the module into its error state causing the Internal Error LED to light.

Bits 2-4: These bits are used to select the Controller communications timeout period.

Bit 5: If this bit is set and the Controller times out, the module continues to output the last value received. If the bit is cleared and the Controller times out, the module outputs zero to the DAC for each channel, yielding 0 mA on the outputs after the time out period defined by bits 2-4.

Bits 6-7: Reserved for use by the Factory Test. These bits must always be set to 0.

Bit 8: When set, this indicates one or more of the following conditions are true:

- The FPGA did not program correctly upon startup.
- The EE memory checksum is incorrect.
- The PROM checksum test has failed.
- Internal memory diagnostic has failed.

Bits 9-13: Not Used.

Bit 14: Field power failed.

Bit 15: Reserved.

CAUTION! This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system. Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

HART Analog Output Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 7	Multi-variable Enabled.	NA
8 - 15	HART Enabled - Channel 1 - 8.	NA

Bits 0-7: These bits are set to enable multivariable messaging.

The HAI, HAO, HART High Performance AI and HART High Performance AO modules have the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module periodically retrieves whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 754, a floating-point format.

You must configure I/O point records to cause the Controller to scan the module and retrieve the variables. (Refer to the *Ovation Developer Studio User Guide* for additional information).

Bits 8-15: In the I/O configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including Multivariable messaging, to flow on that channel.

If one of these bits is set, the channel readback diagnostic indicates the difference between the desired value and the actual value that exceeds the accepted deadband. This bit signifies an open loop condition.

12.13 Diagnostic Logic card LEDs - (HAO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Error LED. Illuminated upon loss of external auxiliary (field) power, as indicated by the loss of normal transitions of the EOC (end-of-convert) signal.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: ▪ The Controller sets the module's Force Error bit. ▪ Communications with the Controller is lost. ▪ EPROM, EE memory or RAM diagnostic failure.
1 - 8 (Green)	After module configuration, the bank of eight channel LEDs (LEDs 1 through 8) is used to indicate HART communication activity. When a HART message is sent, the LED for that particular channel is illuminated. When the HART response is received correctly, the LED is extinguished. Therefore, when all is normal, that is, messages and responses are properly exchanged, a single LED blink is observed on the module's front cap. If a HART message is sent and no response is received, the HART Analog Output module exclusive-OR's the channel LED display with hex code 0xFF. This results in all channel LEDs being illuminated except for the selected channel. For example, if the HART Analog Output module sent a HART message to a device on channel 2, but the device was not connected to channel 2, the module would first illuminate LED 2 (all seven other channel LEDs extinguished). The module would then extinguish LED 2 and flash the other seven channel LEDs. This status indicates that the module sent a HART message on channel 2 and did not receive a valid response message after the initial message attempt or after any of the subsequent message retries.
9 through 16	These LED locations are not used for this module.

12.14 Specifications - (HAO)

HART Analog Output (8 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	8
Channel Update Rate	24 mS (Each channel is updated once every 24 mS by the on-board microcontroller, 14 Bit resolution typical)
Output Range	4 to 20 mA
D/A Resolution	14 Bits
Accuracy over Temperature Range	0.25% of Span
User Loop Voltage	Power for loop current is supplied through the module by an auxiliary power supply.
Diagnostics	Open loop feedback detection. 8 Pass/Fail bits are stored in data register 0xC in Hex.

DESCRIPTION	VALUE
Dielectric isolation: Channel to Channel Channel to logic	None 1000 VAC/VDC for 1 minute.
Output Loading	4-20 mA into 700 ohm load Maximum (230 ohm minimum to 600 ohm Maximum). ¹
Output Compliance	20 mA@21.6 VDC Supply into 700 ohm load.
Operating Temperature Range	0 ⁰ to 60 ⁰ C
Humidity (non-condensing)	0% to 95%
Module Power	Main: 24 VDC, 1.2 W typical, 2.5W Maximum Aux: 24 VDC (-5%,+6.25%), 6W typical, 7.2W Maximum
¹ Per the HART Physical Layer Specification (HCF_SPEC - 54).	

SECTION 13

HART High Performance Analog Output module - (HHPAO) (4 Channel)

IN THIS SECTION

4 Channel HART High Performance Analog Output module overview - (HHPAO)	187
Electronics modules (Emod) - (HHPAO)	187
Personality modules (Pmod) - (HHPAO)	188
Valid module combinations - (HHPAO)	188
Module Block Diagrams - (HHPAO)	189
Terminal block wiring information - (HHPAO)	191
Field Connection wiring diagrams (Emod) - (HHPAO)	192
Field Connection wiring diagrams (CE Mark) - (HHPAO)	193
Field Connection wiring diagrams (Pmod 5X00211G03) - (HHPAO)	194
Field Connection wiring diagrams (Pmod 5X00211G03) (CE Mark) - (HHPAO)	195
Field wiring cable requirements - (HHPAO)	196
Configuration/Status Register information - (HHPAO)	196
Diagnostic Logic card LEDs - (HHPAO)	199
Specifications - (HHPAO)	200

13.1 4 Channel HART High Performance Analog Output module overview - (HHPAO)

The Ovation HART High Performance Analog Output module consists of an Electronics module and a personality mode cavity insert. The Ovation HART High Performance Analog Output module is designed to interface with four HART compliant output devices utilizing a 4-20 mA control loop signal. A HART compliant output device exchanges digital information with the Ovation control system in addition to the standard 4-20 mA control loop signal. The digital information is imposed on the 4-20 mA signal according to the guidelines of the HART Protocol Specification. HART uses a low-level frequency shift-keyed sine-wave signal that is superimposed on the 4-20 mA signal. The average value of the HART signal is zero. Therefore, the HART signal does not interfere with the 4-20 mA control signal.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

13.2 Electronics modules (Emod) - (HHPAO)

- **5X00167G01** contains four independent self-powered, 4-20 mA output channels that interface with 4 HART output devices.
- **5X00167G31** contains four independent self-powered, 4-20 mA output channels that interface with 4 HART output devices (Q-line migration).

13.3 Personality modules (Pmod) - (HHPAO)

- 1X00188H01 (molded plastic cavity insert)
- 5X00211G03 (Q-line migration)

13.4 Valid module combinations - (HHPAO)

HART High Performance Analog Output valid module combinations (16-bit)¹

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
4-20 mA	4	5X00167G01 ¹	1X00188H01 (molded plastic cavity insert)
4-20 mA	4	5X00167G31	5X00211G03 (Q-line migration)
¹ This module configuration is CE Mark certified.			

A Personality module is not required in order to use the HART High Performance Analog Output module. However, there may be requirements to use the Ovation Analog Output module base unit terminal assignments for the actuator interface field wiring. In those cases, you must use the 5X00170G01 HART High Performance Analog Output Personality module.

Warning! The following non-HART product does not work correctly with the HART High Performance Analog Output module's analog outputs:

Manufacturer: BLX

Manufacturer Part Number: V100 Positioner

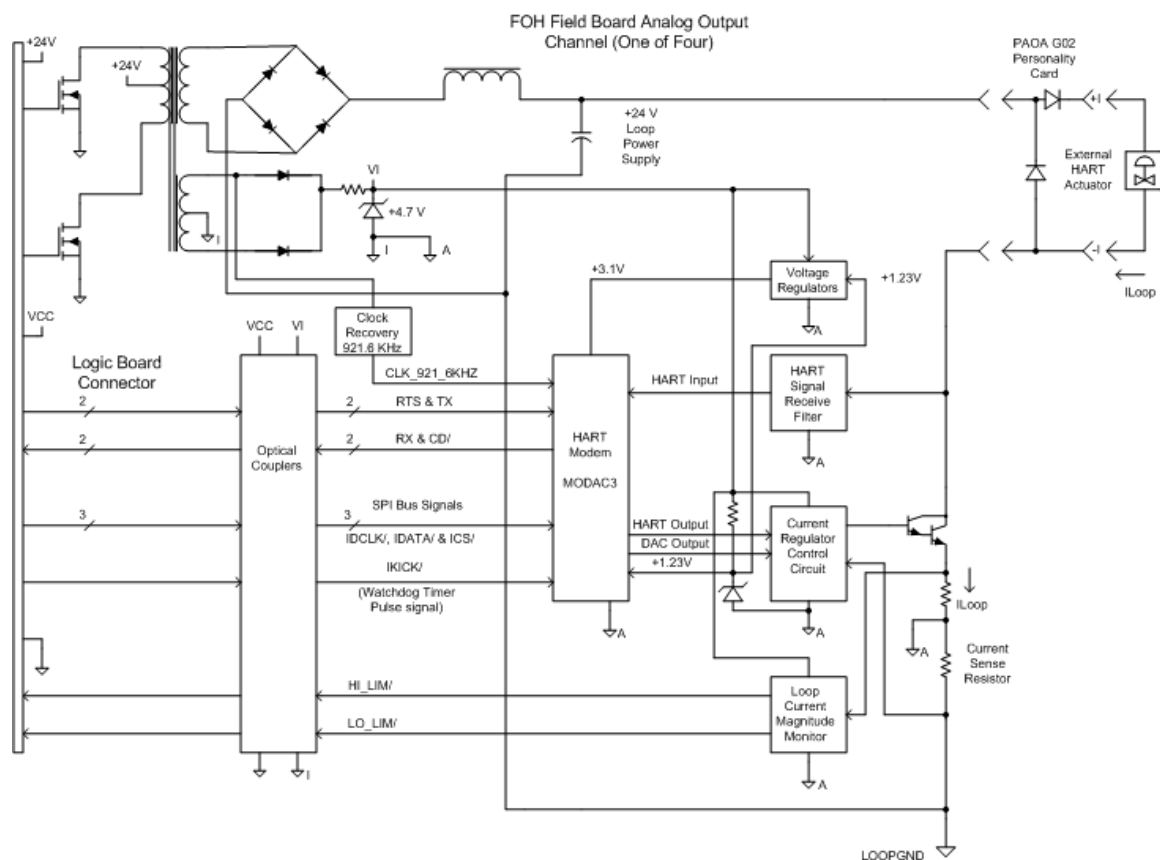
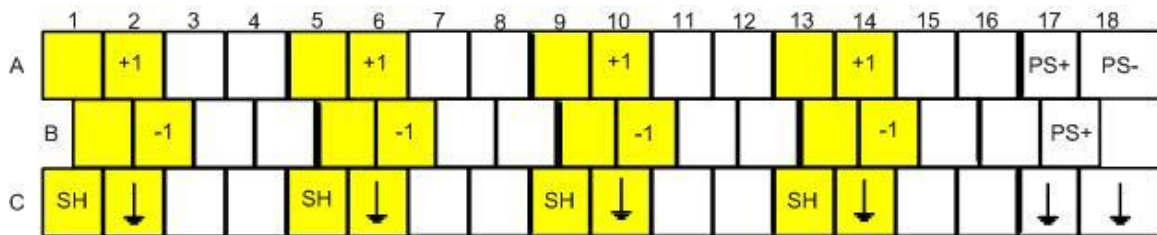
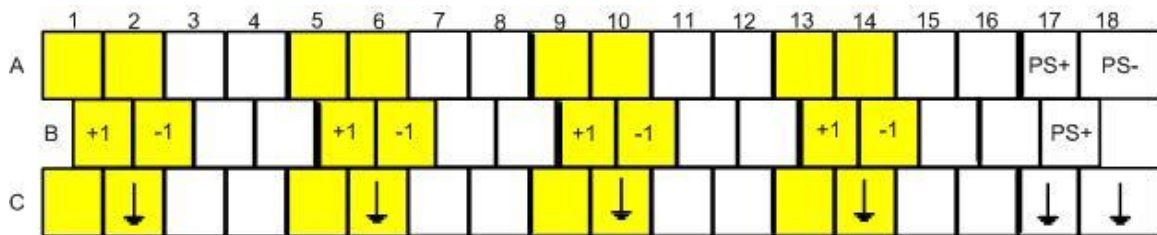


Figure 52: HART High Performance Analog Output Field Board Block Diagram (5X00170G01 Personality Module Present)

13.6 Terminal block wiring information - (HHPAO)

Each Personality module cavity insert has a simplified wiring diagram label on its top which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The wiring diagrams for the HART High Performance Analog Output Personality modules are illustrated in HART Analog Output Field Connection Wiring Diagrams.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.



HART High Performance Analog Output (with 5X00170G01 Personality Module)

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
+I	Analog Output positive terminal connection (connected to the positive terminal of a HART analog output device).
-I	Analog Output negative terminal connection (connected to the negative terminal of a HART analog output device)
PS+, PS-	External Auxiliary power supply terminals (Not Used)

Note: All unused channels must have a wired jumper installed across the channel output terminals in order to prevent channel Under current alarms. Starting with Ovation 3.4 systems, a resistor or wired jumper is not necessary because the Ovation Developer Studio will mask off module alarms for an unused channel and eliminate the nuisance alarm.

13.7 Field Connection wiring diagrams (Emod) - (HHPAO)

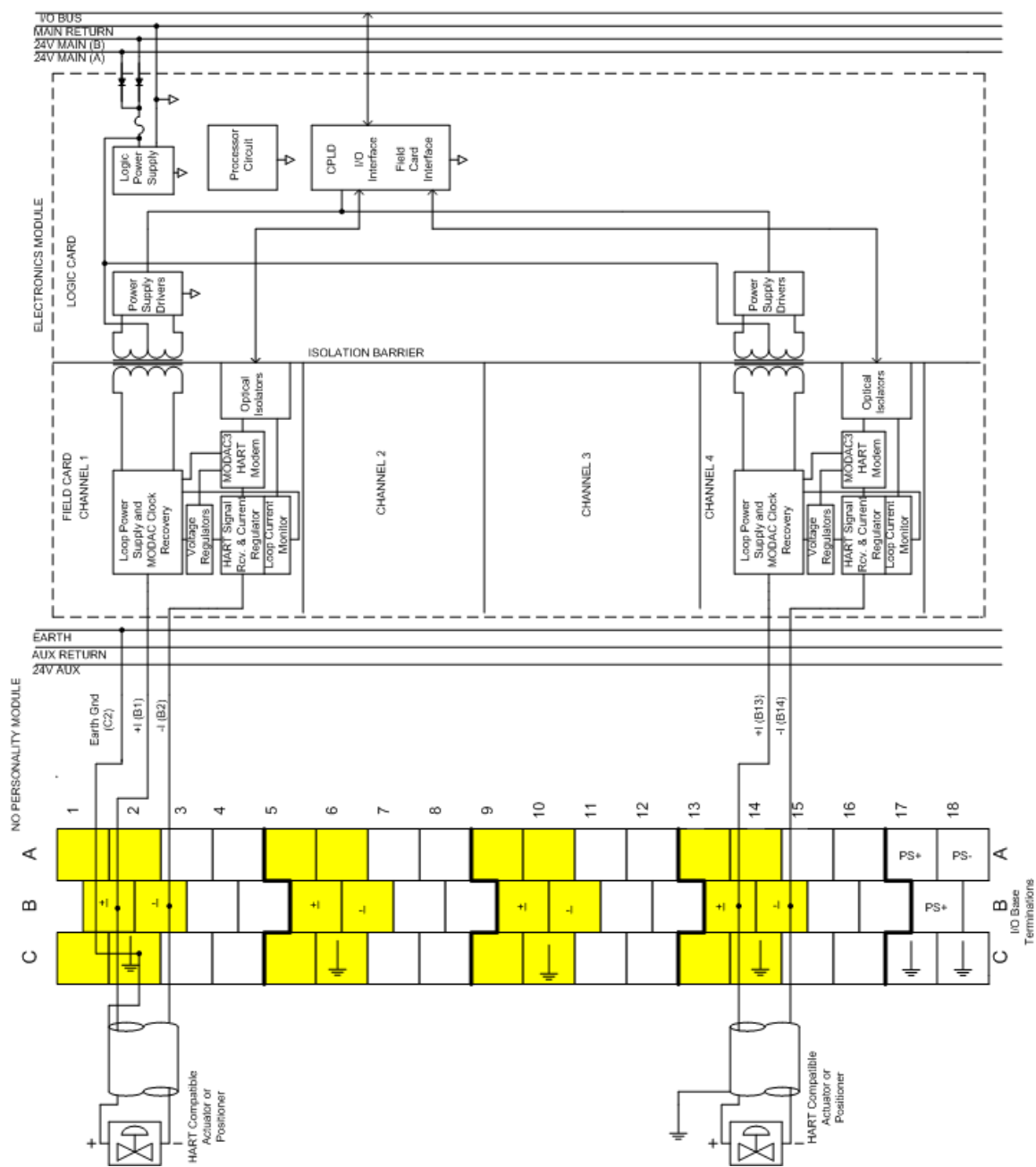


Figure 53: Field wiring with cavity insert

13.8 Field Connection wiring diagrams (CE Mark) - (HHPAO)

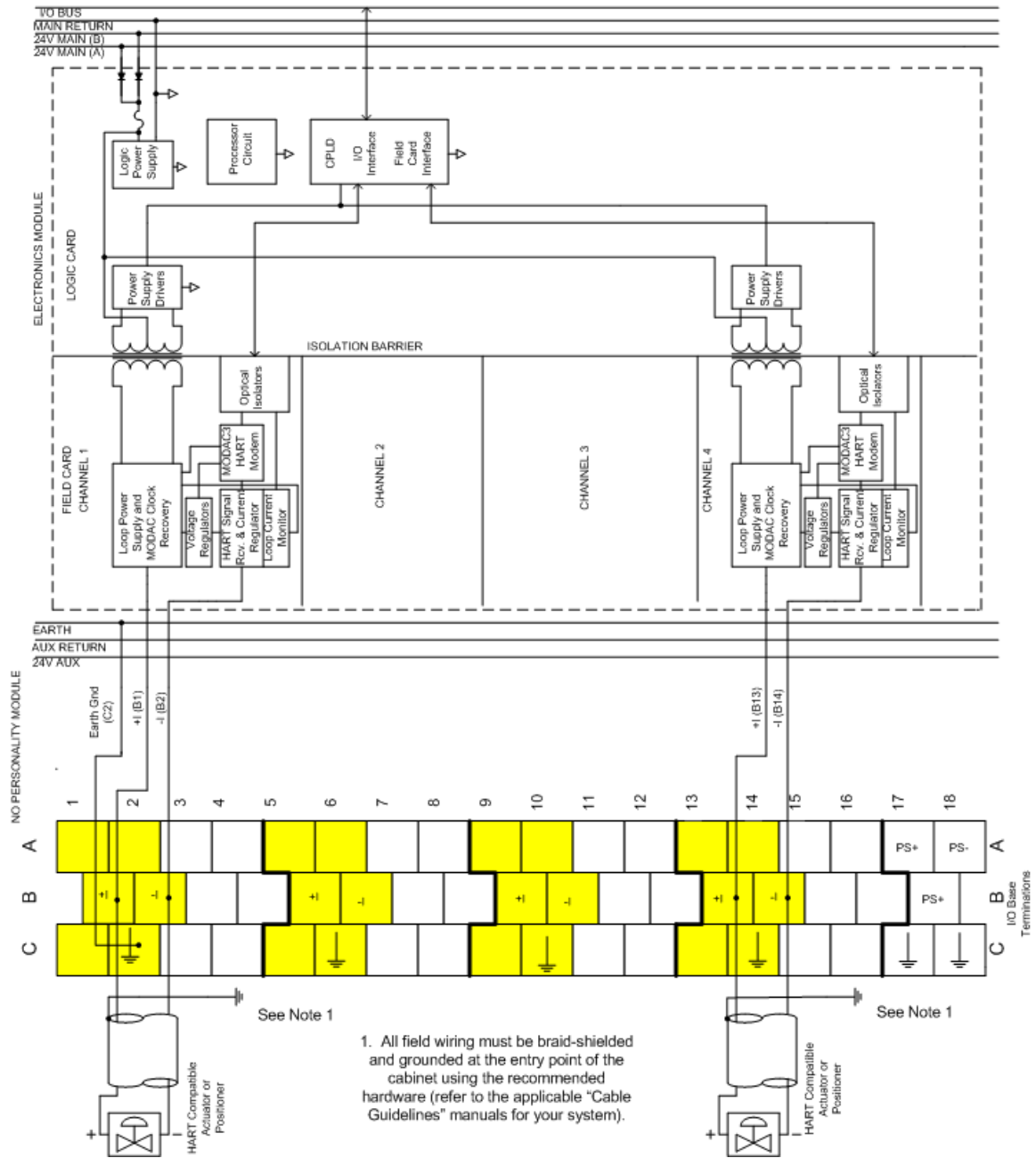


Figure 54: Field wiring with cavity insert (CE Mark)

13.9 Field Connection wiring diagrams (Pmod 5X00211G03) - (HHPAO)

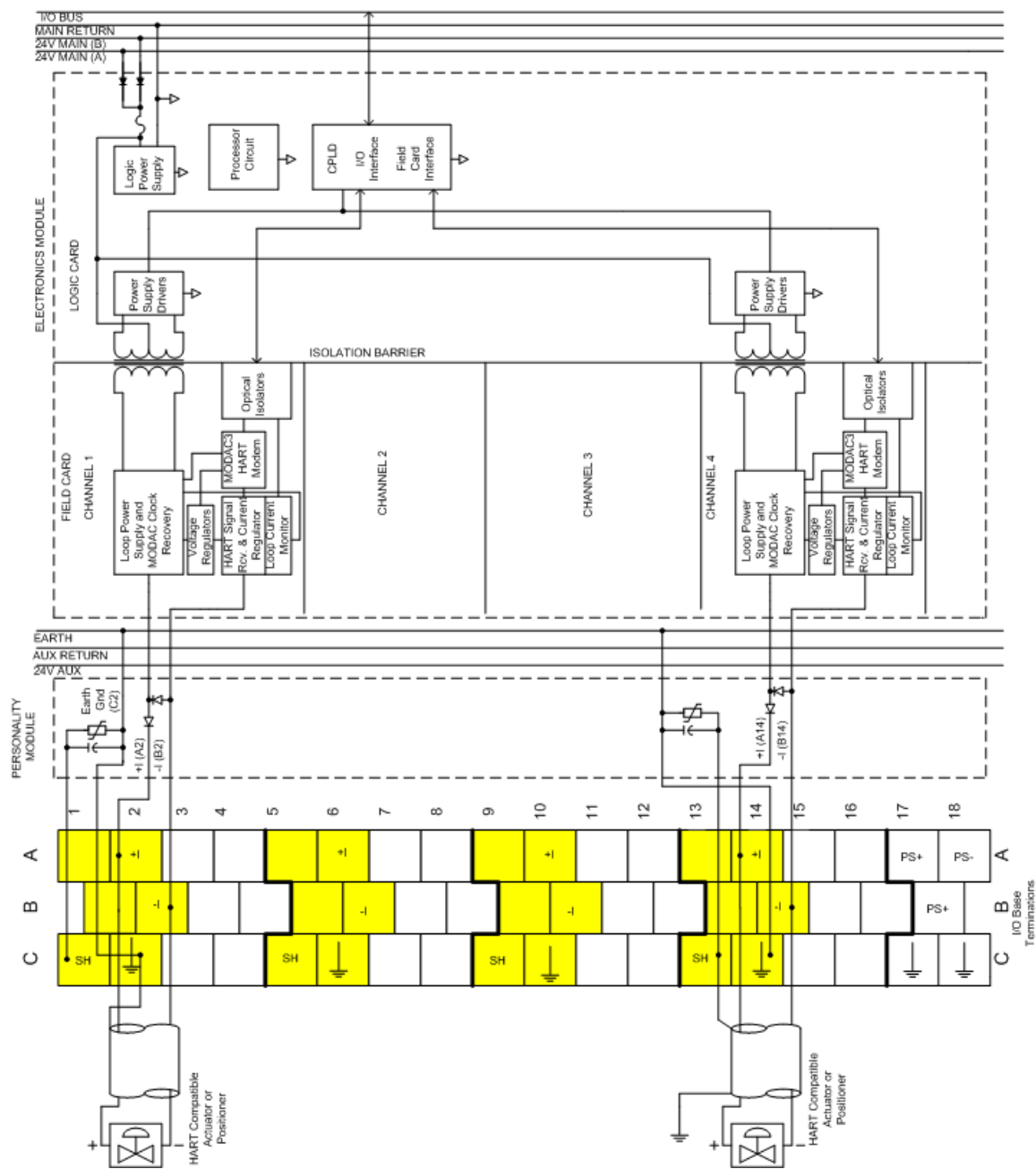


Figure 55: Field wiring with cavity insert

13.11 Field wiring cable requirements - (HHPAO)

Field I/O cable must be one or more single-twisted pair shielded or multiple-twisted pair with overall shield. Single and multiple-pair may be combined provided that all of the shields share a common connection to earth ground in the Ovation cabinet.

Recommended minimum conductor size

CABLE LENGTH	MIN. CONDUCTOR SIZE	CABLE TYPE
Below 5,000 feet (1524 m)	24 AWG (0.51 mm dia.)	Single-twisted pair shielded or multiple-twisted pair with over-all shield.
Above 5,000 (1524 m)	20 AWG (0.81 mm dia.)	Single-twisted pair shielded.

The Maximum length of cable per HART network is dependent on the characteristics of the devices connected to the network and the characteristics of the cable to be used.

13.12 Configuration/Status Register information - (HHPAO)

Word address 13 (D in Hex) is used to write to the Module Configuration Register and to read the Module Status Register.

The status register information is copied to the A2 field of the module's RM record. The A2 field can be viewed by using the Point Information window at an Operator Station to display the RM record and then clicking the Value tab. (See [Ovation Operator Station User Guide](#) for more information on the Point Information window.)

Prior to the Ovation 3.4 release, a module alarm would be generated when any of the module's channels were unused. Starting with Ovation 3.4, unused channels will not cause an alarm to be reported.

Configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - (WRITE)	DATA DESCRIPTION - (READ)
0	Configure module	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error	Internal or forced error (1 = forced error; 0 = no forced error)

BIT	DATA DESCRIPTION - (WRITE)				DATA DESCRIPTION - (READ)			
2 - 4	Communications Timeout Setting ¹				Communications Timeout Setting ¹			
	BIT 4	BIT 3	BIT 2	TIMEOUT	BIT 4	BIT 3	BIT 2	TIMEOUT
	0	0	0	16 seconds	0	0	0	16 seconds
	0	0	1	4 seconds	0	0	1	4 seconds
	0	1	0	2 seconds	0	1	0	2 seconds
	0	1	1	1 seconds	0	1	1	1 seconds
	1	0	0	500 milliseconds	1	0	0	500 milliseconds
	1	0	1	250 milliseconds	1	0	1	250 milliseconds
	1	1	0	125 milliseconds	1	1	0	125 milliseconds
	1	1	1	62.5 milliseconds	1	1	1	62.5 milliseconds
	The tolerance on the timeout period is +/- 35%.				The tolerance on the timeout period is +/- 35%.			
5	Timeout Action				NA			
6	Factory Test				Not Used			
7	Reserved				Reserved			
8 - 11	NA				Channel 1 - 4, over-under			
12 - 15	Not Used				Not Used			
¹ The tolerance on the timeout period is +/- 35%.								

Bit 0: Configures the module (write) or indicates the configuration state of the module (read). "1" indicates that the module is configured. Until module is configured, addresses 0 through 11 produces an attention status.

Bit 1: This bit (write "1") forces the module into its error state causing the Internal Error LED to light.

Bits 2-4: These bits are used to select the Controller communications timeout period.

Bit 5: If this bit is set and the Controller times out, the module continues to output the last value received. If the bit is cleared and the Controller times out, the module outputs data to the DAC for each channel, that yields 4mA on the outputs after the time-out period defined by bits 2-4.

Bit 6: This bit is only used in the manufacturing test. When the bit is set and PE is active, the module enters a factory test mode.

Bits 7: Reserved.

Bit 8: 1=Channel 1 output current is overrange or underrange.

Bit 9: 1=Channel 2 output current is overrange or underrange.

Bit 10: 1=Channel 3 output current is overrange or underrange.

Bit 11: 1=Channel 4 output current is overrange or underrange.

Bits 12-15: Not Used.

Output Communication Timeout Settings

TIMEOUT BIT 2	TIMEOUT BIT 1	TIMEOUT BIT 0	TIMEOUT PERIOD
0	0	0	16 seconds
0	0	1	4 seconds
0	1	0	2 seconds
0	1	1	1 second
1	0	0	500 milliseconds
1	0	1	250 milliseconds
1	1	0	125 milliseconds
1	1	1	62.5 milliseconds

Time-outs have a tolerance of +/- 35%. The default after a power-up is 16 seconds.

CAUTION! This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system. Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

The following table is for reference only, Individual bits are not user accessible.

Over/Under current limit register (address 12 or C in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 3	NA	Channel 1 - 4 Under Current
4 - 7	NA	Channel 1 - 4 Over Current
8 - 15	Not Used	Not Used

Enable Register (Address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0 - 3	Multi-variable Enabled - Channel 1 - 4	NA
4 - 7	Not Used	Not Used

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
8 - 11	HART Enabled - Channel 1 - 4	NA
12 - 15	Not Used	Not Used

Bits 0-3: These bits are set to enable multivariable messaging. Refer to the I/O configuration guide for additional information.

The HAI, HAO, HART High Performance AI, HART High Performance AO modules have the ability to retrieve additional variables from a field device. These variables are referred to as 'multivariables' and are named PV (primary variable), SV (secondary variable), TV (tertiary variable), and QV (quarterly variable).

If the bit is set, the module periodically retrieves whatever variables exist for the device.

The definitions of PV, SV, TV, and QV are found in the user manual for the field device supplied by the device manufacturer. The standard format of these four variables is IEEE 754, a floating-point format.

You must configure I/Opoint records to cause the Controller to scan the module and retrieve the variables. (Refer to the *Ovation Developer Studio User Guide* for additional information).

Bits 8-11: In the I/O configuration tool, you can set these flags on a per-channel basis to allow HART messaging, including Multivariable messaging, to flow on that channel.

You should ensure that these bits are cleared for non-HART field devices. To avoid a HART communication error message, set each bit at "0" when connecting a non-HART output device.

13.13 Diagnostic Logic card LEDs - (HHPAO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	Internal Error LED. Illuminated whenever there is any type of error within the module except for a loss of external auxiliary power. Possible causes are: ▪ The Controller sets the module's Force Error bit. ▪ Communications with the Controller is lost. ▪ EPROM, EE memory or RAM diagnostic failure.
1 - 4 (Green)	After module configuration, the bank of four channel LEDs (LEDs 1 through 4) is used to indicate HART communication activity and the health of the analog outputs. If the analog output for the associated analog output channel is healthy (no overcurrent or undercurrent condition), then the channel LED will be ON. If the analog output channel is bad (an overcurrent or undercurrent is present), then the channel LED will be off. When a HART message is sent and received correctly, the channel LED blinks off for 100 msec if the analog output is healthy. When a HART message is sent and received incorrectly, the channel LED blinks off for 400 msec if the analog output is healthy.
5 through 16	These LED locations are not used for this module.

13.14 Specifications - (HHPAO)

HART High Performance Analog Output (4 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	4
Sample duration time (msec)	33 mSec (Maximum)
Output range	4 to 20 mA nominal signal voltage (Span) 0 to 23.5 mA (full signal range)
D/A resolution	16 bits
Bit weight	0.000305 mA
Data format	16-bit binary output
Conversion type	Sigma Delta DAC
Operating mode	Self scan
Monotonicity	Yes
Non-linearity	DNL: <1 LSB full scale, INL: <0.1 LSB full scale
Repeatability	Within guaranteed accuracy
Power up/Power down	Power up and power down to 4mA
Type of loads	HART compatible devices
Maximum inductive load	Per the HART physical layer specification
Settling time	Per the HART physical layer specification
Overshoot	Per the HART physical layer specification
Crosstalk	Per the HART physical layer specification
Output ripple	Per the HART physical layer specification
Sample repetition (msec)	33 msec Maximum
Filtering	2-pole low pass filter at 10 Hz
Reference Accuracy Temperature Range	0.10% of full scale (20mA) @25° C
Temperature Coefficient	25ppm of full scale / ° C
Current Loop Power	For each channel, power for loop current is supplied by the module
Diagnostics	Loop Current Overrange/Underrange detection. Eight Error bits are stored in data register 0xC in Hex (Address 12)
Dielectric isolation: Channel to Channel/logic	1000 VAC/VDC for 1 minute/1000 VAC/VDC for 1 minute
Output Loading	4-20 mA (0 ohm minimum to 600 ohm Maximum)
Operating Temperature Range	0° to 60° C (32° to 140° F)
Storage Temperature Range	-40° to 85° C (-40° to 185° F)
Humidity (non-condensing)	0% to 95%
Module Power	Main: 24 VDC, 4.56W nominal, 6.75W Max, Aux: 24 VDC, Not Used.

SECTION 14

Digital Input module 24 VDC (32 Channel)

IN THIS SECTION

32 Channel 24 VDC Digital Input module overview	201
Electronics modules (Emod) - 32 Channel 24V DC Digital Input.....	201
Personality modules (Pmod) - 32 Channel 24V DC Digital Input	201
Valid module combinations - 32 Channel 24V DC Digital Input.....	202
Terminal block wiring information - 32 Channel 24V DC Digital Input.....	202
Field connection wiring diagrams - 32 Channel 24V DC Digital Input	203
Configuration/Status Register information - 32 Channel 24V DC Digital Input.....	204
Diagnostic LEDs - 32 Channel 24V DC Digital Input	204
Specifications - 32 Channel 24V DC Digital Input.....	205

14.1 32 Channel 24 VDC Digital Input module overview

The Ovation 32 Channel 24 VDC Digital Input module monitors the state ("0" or "1") of 32 single-ended field digital inputs. The 32 Channel 24 VDC Digital Input module is designed to meet IEC 61131-2 type 3 characteristics for 24VDC digital inputs in industrial automation.

Note: The Ovation 32 Channel 24 VDC Digital Input module is only available for Ovation software releases 3.4 and later.

Power for all 32 field contacts is supplied by the Ovation 24VDC Auxiliary cabinet power supply.

The 32 Channel 24 VDC Digital Input module consists of an Electronics module (Emod) and a Personality cavity insert. A Personality module (Pmod) is not required.

Note: The 32 Channel 24 VDC Digital Input module requires the use of an Ovation 4-slot I/O base (5X00497G01) which provides additional wire terminations to support the 32 channels. The 32 Channel 24 VDC Digital Input module cannot be used with the standard I/O Bases (1B30035H01, 1X00014H01, or 5X00334G01).

The I/O Module General Information (see page 17) section contains environmental, installation, wiring, and fuse information for I/O modules.

14.2 Electronics modules (Emod) - 32 Channel 24V DC Digital Input

- **5X00499G01** - 32 Channel 24V DC Digital Output Electronics module (single-ended).

14.3 Personality modules (Pmod) - 32 Channel 24V DC Digital Input

- **1X00690H01** - The 32 Channel 24V DC single-ended Digital Input does not require a Pmod for any electrical connections. A cavity insert is used in the Pmod location to cover the unused Pmod connector and provide terminal wiring information.

14.4 Valid module combinations - 32 Channel 24V DC Digital Input

32 Channel 24V DC Digital Input Valid module combinations

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
32 Channel 24V DC single-ended Digital Input	32	5X00499G01	1X00690H01
This module configuration is CE Mark certified.			

Note: The 32 Channel 24V DC single-ended Digital Input requires the use of an Ovation 4-slot I/O base (5X00497) to provide additional wire terminations to support the 32 channels.

14.5 Terminal block wiring information - 32 Channel 24V DC Digital Input

Wiring for the 32 Channel 24V DC single-ended Digital Input is illustrated in the following figure. The following table lists and defines the abbreviations used in the diagram.

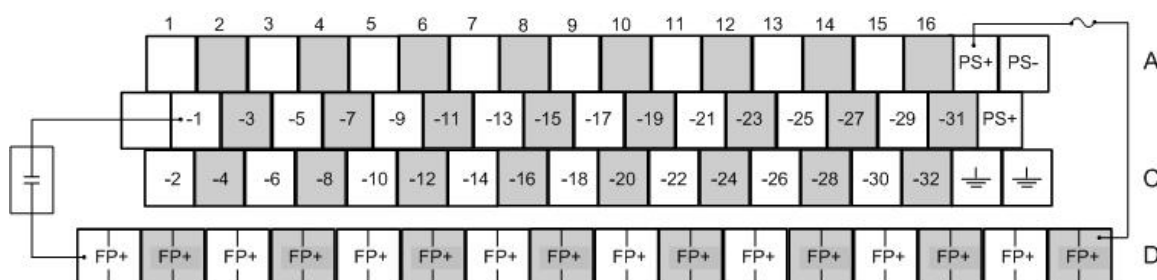


Figure 57: Terminal block connections for the 32 Channel Single-Ended Digital Input module

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
-1 through -32	Digital Input Negative terminals (connect to field device contact negative side)
FP+	Fused Power Terminal Connection (connect to field device contact positive side) All FP+ terminals are tied together on module Note: Sixteen (16) screws are supplied for terminations. Two (2) wires per screw terminal are used to achieve termination points for all 32 channels.
PS+, PS-	Auxiliary Power Supply terminals. No external connections required when using Ovation +24V DC Auxiliary Power Supply. Ovation Aux. Supply provided to module through branch.

ABBREVIATION	DEFINITION
	Reserved terminal. No connection allowed on these unmarked terminals.
+24V DC Auxiliary power is supplied through an internal branch or through terminal block connections (PS+/PS-). Power is fused on the Emod, then supplied to all FP+ connection terminals for connection to the positive side of the field device contact. The negative side of the field device is connected through a digital input negative terminal (-1 through -32) to the module where its status is monitored.	

14.6 Field connection wiring diagrams - 32 Channel 24V DC Digital Input

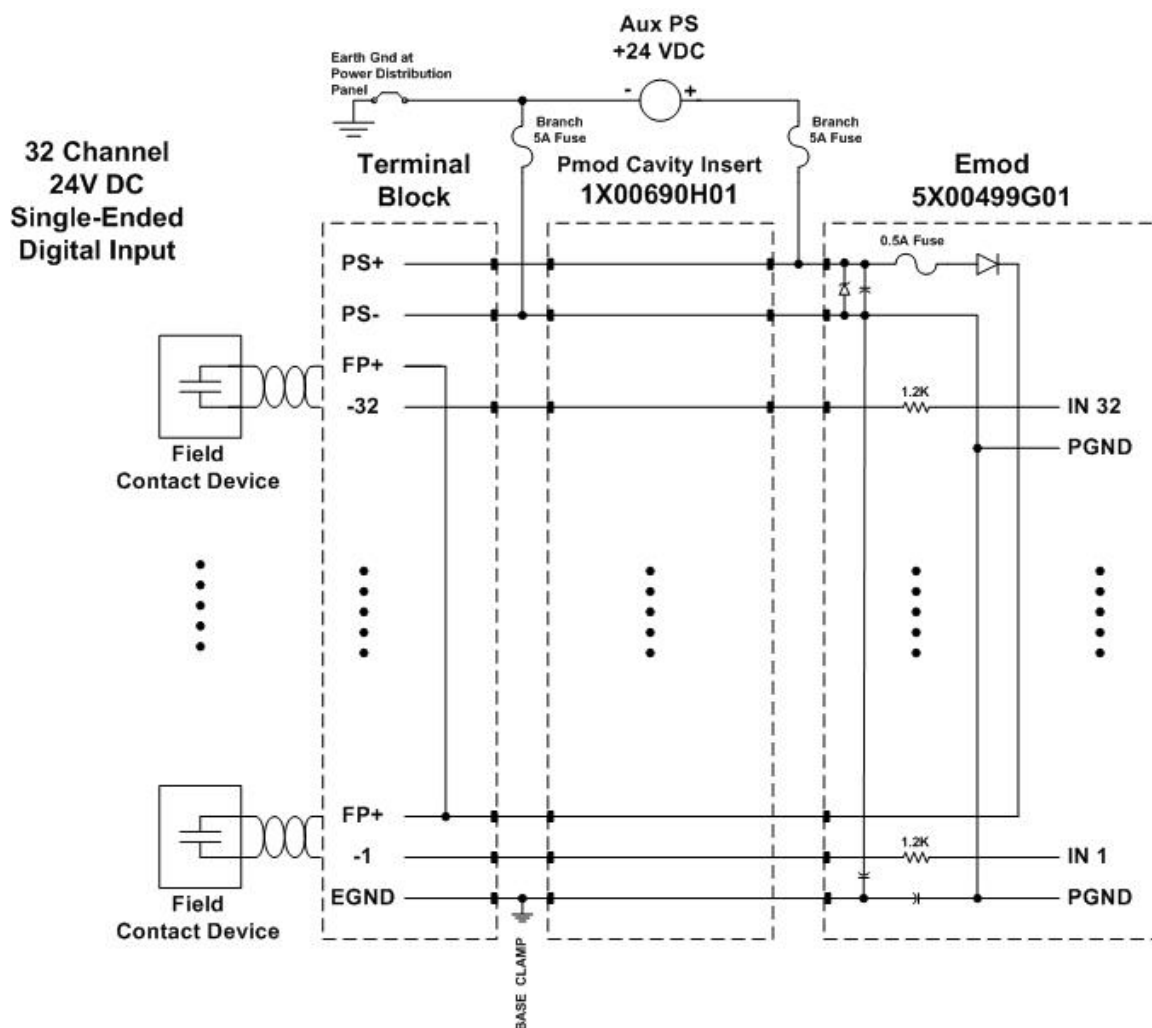


Figure 58: Wiring diagram - 32 Channel 24V DC single-ended Digital Input module

14.7 Configuration/Status Register information - 32 Channel 24V DC Digital Input

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window (Bit Pattern field on the Hardware tab) at an Operator Station sSee the *Ovation Operator Station User Guide*).

32 Channel 24V DC single-ended Digital Input Configuration/Status (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module 1 = configure 0 = not configured, causing an attention status	Module Configured 1 = configured* 0 = not configured
1	Force Error 1 = force an attention status 0 = no forced error*	Forced error 1 = forced error set 0 = no forced error*
2-6	Not defined	Not defined, 0 = Permanent Value
7	Not defined	Fuse status 1 = Blown fuse detected 0 = Fuse OK*
8	Not defined	Ch1 - Ch4 Status 1 = Fault detected on Ch1 - Ch4 0 = No fault detected on Ch1 - Ch4*
9	Not defined	Ch5 - Ch8 Status 1 = Fault detected on Ch5 - Ch8 0 = No fault detected on Ch5 - Ch8*
10	Not defined	Ch9 - Ch12 Status 1 = Fault detected on Ch9 - Ch12 0 = No fault detected on Ch9 - Ch12*
11	Not defined	Ch13 - Ch16 Status 1 = Fault detected on Ch13 - Ch16 0 = No fault detected on Ch13 - Ch16*
12-15	Not defined	Not defined, 0 = Permanent Value
* Default value		

14.8 Diagnostic LEDs - 32 Channel 24V DC Digital Input

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when module main power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit to indicate the Auxiliary 24V DC field power is not present, is below threshold, or Auxiliary 24V DC fuse is blown.

LED	DESCRIPTION
I (Red)	Internal Fault LED. Lit when: ▪ The Force Error bit (Bit-1) of the Configuration Register is set. ▪ The Ovation Controller is not communicating with the module. ▪ A channel fault exists.
1 - 32 (Green)	Point Status LED. Each of the 32 channel LEDs will light when the input voltage of the corresponding channel is greater than the minimum On Input Voltage.

Note: Fuse Rating: 0.5A, 250V Fast-acting Fuse 5X20 mm

14.9 Specifications - 32 Channel 24V DC Digital Input

32 Channel 24V DC single-ended Digital Input Specifications

DESCRIPTION	VALUE
Number of channels (IEC 61131-2, Type 3)	32
Input Voltage category	24 VDC
Input Operating Voltage	0 to 30 VDC
Channels per Common	32
Input range (single-ended or differential)	Refer to the following Digital Input Range table.
Digital Filter Contact Debounce	3ms +/- 5%
Cable length	1000 feet maximum @ 50pF/ft or better
Diagnostics Internal module operating faults.	Blown fuse detection, 10.0 VDC threshold
Galvanic isolation: Between channels and I/O Bus Between channels	Yes, 1000 VDC/Vrms No
Module power	▪ Drawn from Main: 0.70W typ; 0.81W maximum with all inputs off 1.49W typ; 1.71W maximum with all inputs on ▪ Drawn from Auxiliary: 0.96W typ; 1.13W max with all inputs off 2.88 typ; 3.31W max with all inputs on ▪ Power Dissipation in Emod/Pmod: 1.66W typ; 1.94W maximum with all inputs off 4.37W typ; 5.03W max with all inputs on
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

Digital Input ranges

INPUT LEVEL	ON INPUT VOLTAGE UH (VDC)		OFF INPUT VOLTAGE UL (VDC)		ON INPUT CURRENT IH (mA)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
24 VDC	8.2	30	0	7.2	2.43	2.6
Field input voltages equal to or greater than the minimum ON voltage (UH) and field input currents equal to or less than the maximum ON input current (IH) will guarantee a logic one be read by the digital input module.						

SECTION 15

Digital Input module - (DI) (16 Channel)

IN THIS SECTION

<i>16 Channel Digital Input module overview - (DI)</i>	<i>207</i>
<i>Electronics modules (Emod) - (DI)</i>	<i>207</i>
<i>Personality modules (Pmod) - (DI)</i>	<i>208</i>
<i>Valid module combinations - (DI)</i>	<i>208</i>
<i>External power supply information single-ended (front end) - (DI)</i>	<i>209</i>
<i>External power supply information differential (front end) - (DI)</i>	<i>210</i>
<i>Terminal block wiring information - (DI)</i>	<i>211</i>
<i>Field wiring configuration considerations - (DI)</i>	<i>212</i>
<i>Field connection wiring diagrams - (DI)</i>	<i>212</i>
<i>Field connection wiring diagrams (CE Mark) - (DI)</i>	<i>213</i>
<i>Configuration/Status Register information - (DI)</i>	<i>214</i>
<i>Diagnostic Logic card LEDs - (DI)</i>	<i>215</i>
<i>Specifications - (DI)</i>	<i>215</i>

15.1 16 Channel Digital Input module overview - (DI)

The Digital Input module contains 16 channels where each channel has voltage level sensing circuitry used to detect whether an input is on or off. The module is available with 16 galvanically isolated differential inputs, or 16 single-ended (common return) digital inputs with on-card blown fuse detection for the auxiliary power supply. The selection of the Personality module determines if the inputs are differential or single-ended. The input voltage level monitored by the module is determined by the particular card group in the module.

The field side circuitry for the single-ended configuration (see page 209), and for the differential configuration (see page 210) are described in their respective sections. An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side.

The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the auxiliary supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the Personality module.
- Auxiliary supply level is lower than minimum On Input Voltage.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

15.2 Electronics modules (Emod) - (DI)

- **1C31107G01** provides for 24/48 VAC/VDC single-ended or differential inputs.
- **1C31107G02** provides for 125 VAC/VDC single-ended or differential inputs.

15.3 Personality modules (Pmod) - (DI)

- **1C31110G01** provides for single-ended inputs.
- **1C31110G02** provides for differential inputs.

15.4 Valid module combinations - (DI)

Digital Input valid module combinations ¹

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
24/48 VAC/VDC Single-ended Differential	16 16	1C31107G01 1C31107G01	1C31110G01 1C31110G02
125 VAC/VDC Single-ended Differential	16 16	1C31107G02 1C31107G02	1C31110G01 1C31110G02
¹ All module configurations listed in the table are CE Mark certified.			

When the 125VAC/VDC Digital Input Emod (1C31107G02) is used in applications with the unfused Differential Pmod (1C31110G02), external fusing or other current limiting devices are recommended on the hazardous inputs to provide protection to the external wiring and power source.

CAUTION! For CE Mark certified systems, any base unit that contains a 125VAC/DC Digital Input Electronics module (1C31107G02) with a Differential Digital Input Personality module (1C31110G02) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Digital Input Electronics module (1C31107G02) with a Single-ended Digital Input Personality module (1C31110G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

Place this label in a visible location on the base unit, preferably above the spare fuse location. The project drawings should indicate this.

15.5 External power supply information single-ended (front end) - (DI)

If the Digital Input subsystem uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, refer to Using an External Power Supply (see page 635) this section contains steps to follow before connecting the external power supply to the Digital Input module base unit terminal block.

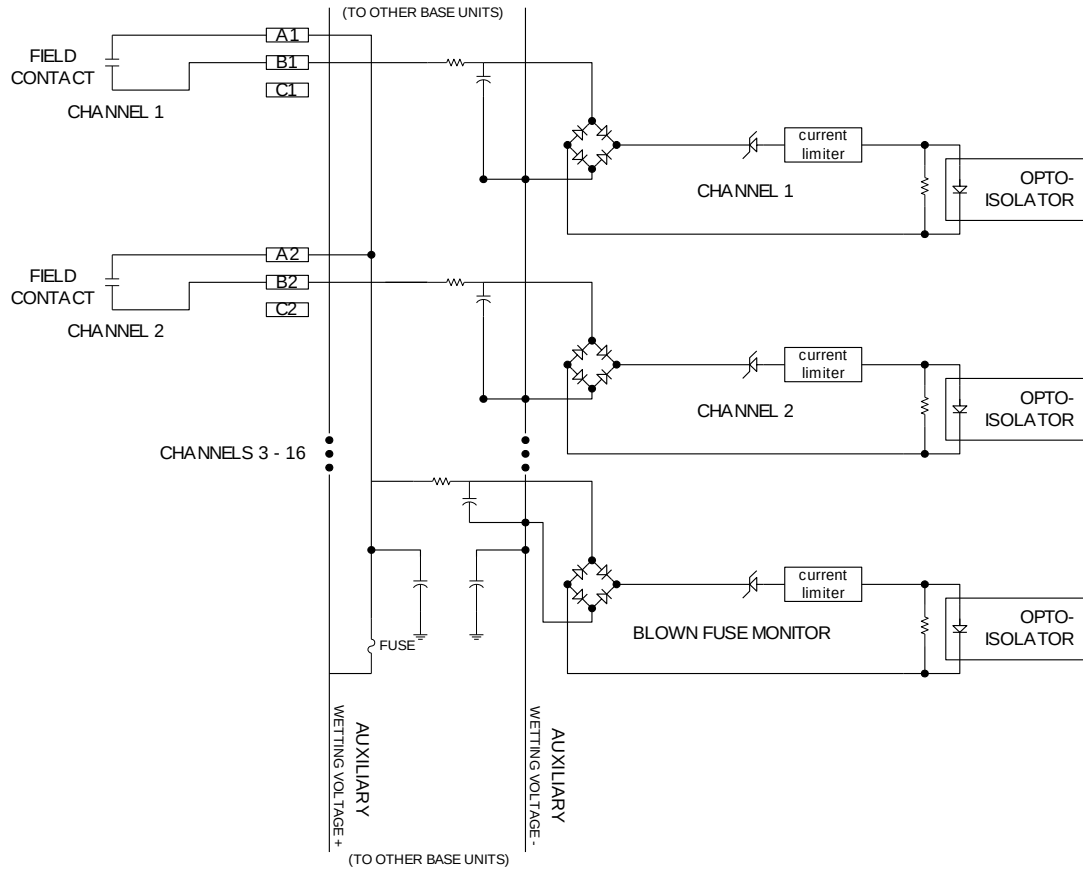


Figure 59: Single-Ended Digital Input front end

15.6 External power supply information differential (front end) - (DI)

If the Digital Input subsystem uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 635) contains steps to be undertaken before connecting the external power supply to the Digital Input module base unit terminal block.

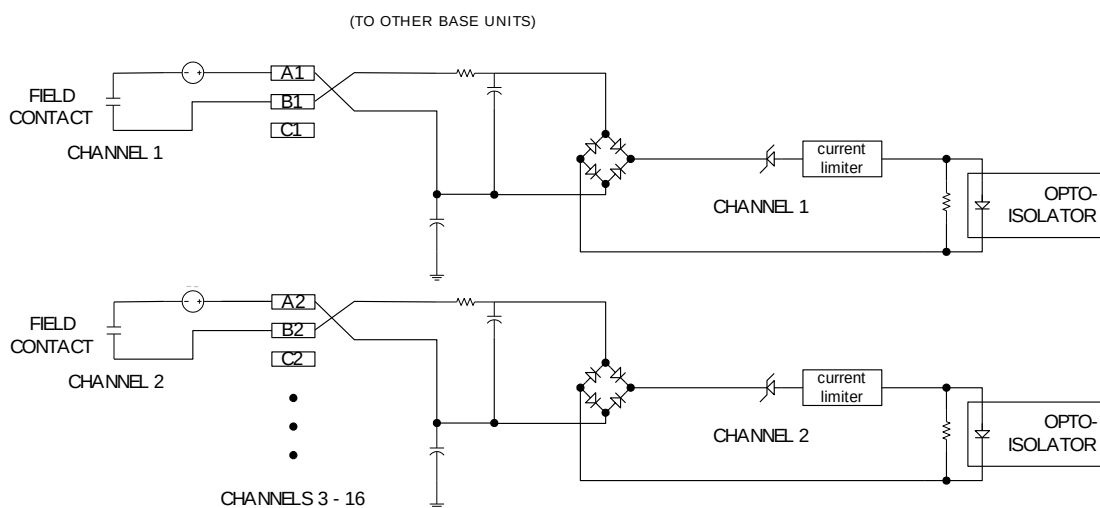


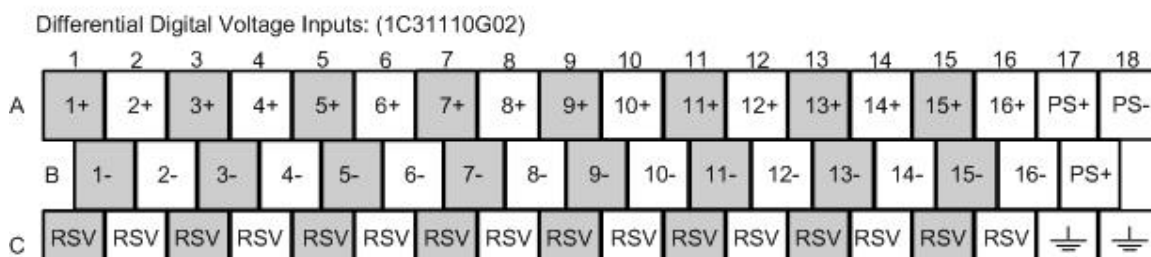
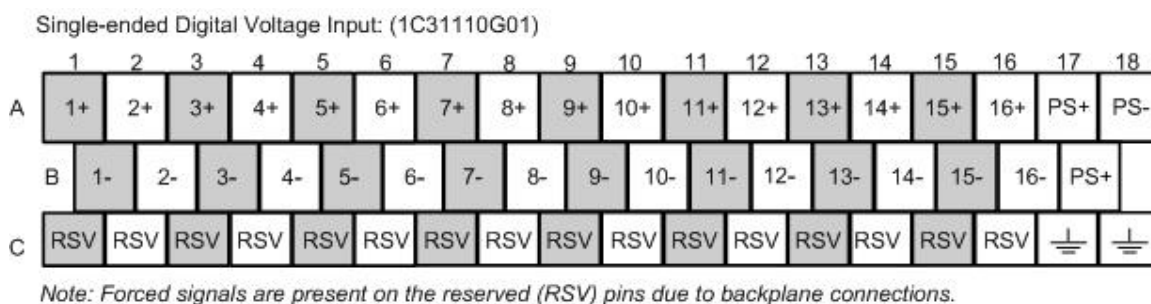
Figure 60: Differential Digital Input front end

15.7 Terminal block wiring information - (DI)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

The diagrams for the digital input Personality modules are illustrated in the following figure. The following table lists and defines the abbreviations used in those diagrams.

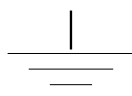


Notes:

1. Auxiliary power supply return is present on the reserved (RSV) pins due to backplane connections.
2. Each channel has a diode bridge at the front-end; therefore, the inputs to Row A and B are reversible.
The terminal block label indicates polarity only to be uniform with other terminal block labels where Row A is for high-side (+) signals, and Row B is for return (-) signals.

Figure 61: Terminal block connections for Digital Voltage Input Pmods

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No connection allowed on these terminals

Do **not** use terminal block locations marked RSV.

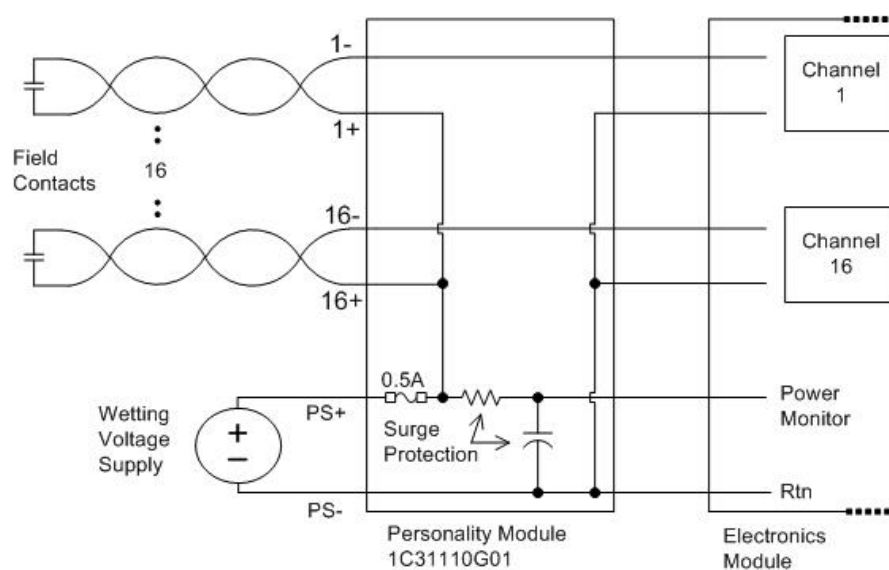
15.8 Field wiring configuration considerations - (DI)

The following minimum leakage resistances of the cable and the interface devices apply:

- 24/48 VDC - 175 K ohms
- 24 VAC - 50 K ohms
- 125 VDC - 250 K ohms
- 125 VAC - 50 K ohms

15.9 Field connection wiring diagrams - (DI)

Single-Ended Digital Voltage Inputs



Differential Digital Voltage Inputs

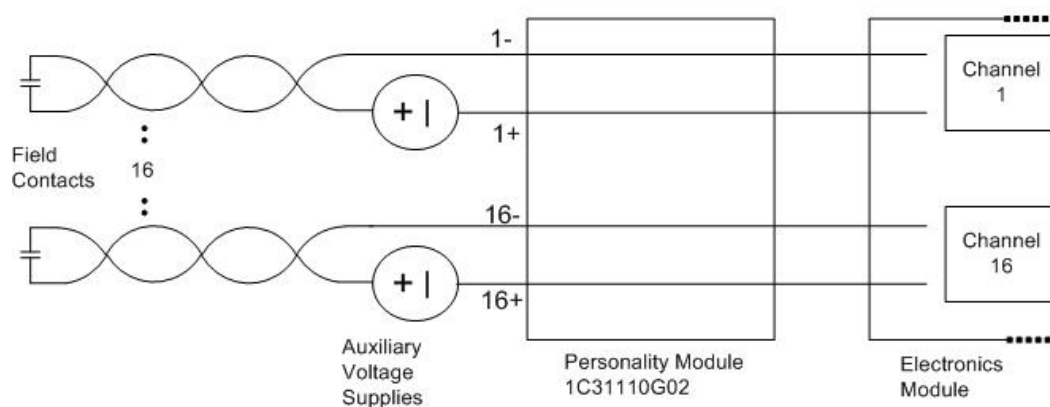
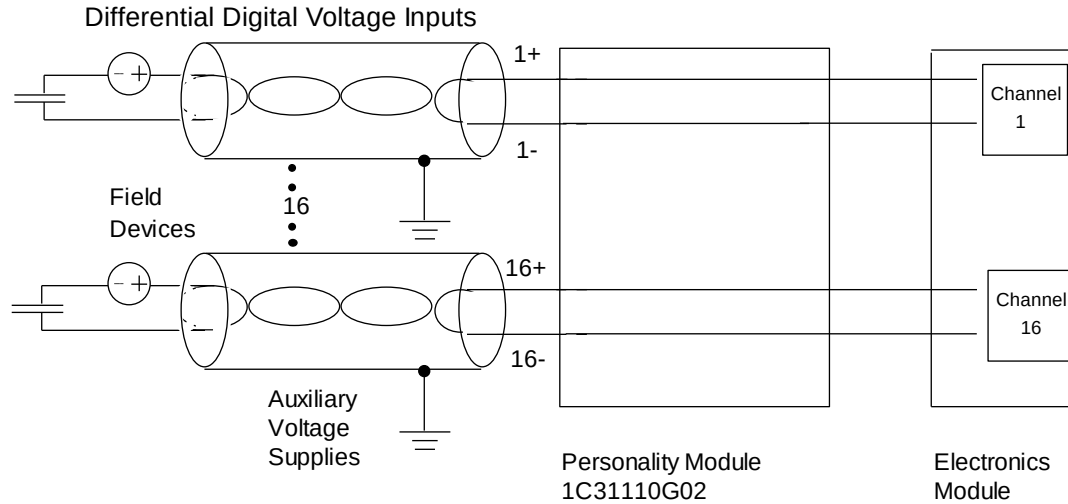
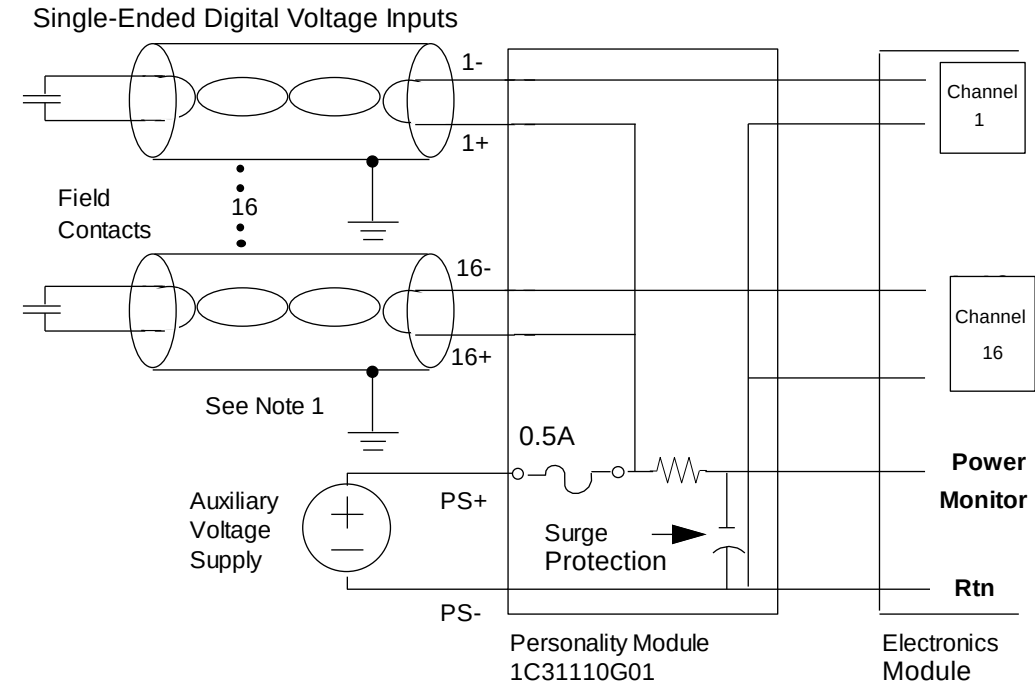


Figure 62: Field connections for the Digital Input Personality module (non-CE Mark)

15.10 Field connection wiring diagrams (CE Mark) - (DI)



Note

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to the applicable "Cable Guidelines" information for your system).

Figure 63: Field connection for the Digital Input Personality module (CE Mark)

15.11 Configuration/Status Register information - (DI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module 1 = configured. 0 = unconfigured, causing an attention status.	Module Configured 1 = configured. 0 = unconfigured.
1	Force Error 1 = force an attention status to be read by Controller. 0 = no forced error.	Forced error 1 = forced error set by Controller. 0 = no forced error.
2 - 5	Not defined.	Not defined.
6	Blown fuse enable ¹ 1 = enable blown fuse detection. 0 = disable blown fuse detection.	Blown fuse enable 1 = blown fuse detection is enabled. 0 = blown fuse detection is disabled.
7	Not defined.	Blown fuse 1 = fuse blown or auxiliary voltage not present. 0 = fuse OK and auxiliary voltage present.
8	Not defined.	Reserved.
9	Reserved.	Reserved.
10	Not defined.	Reserved.
11 - 15	Not defined.	Not defined.
¹ Blown Fuse Enable should always be set to "0" on the differential modules (1C31232G02 and 1C31232G03).		

Bit definitions for this register are encoded as shown in the table above and described below:

Bit 0: After the Compact Digital Input module power is cycled, this bit is "0." A "1" must be written to this bit. If the module is not configured in this manner, an attention status is sent to the Controller upon an attempt to read the point data.

Bit 1: This bit is "0" after the Compact Digital Input module power is cycled. If the Controller sets this bit, an attention status is issued.

Bits 2-5 Not Defined

Bit 6: The Blown Fuse Enable bit is "0" after the Digital Input module power is cycled. This bit must be set by the Controller for Compact Digital Input modules, using the single-ended personality module, to detect a blown auxiliary power supply fuse when it reads the Status Register. Blown Fuse Enable should always be set to "0" on the differential modules (1C31232G02 and 1C31232G03). The bit may be read back through the Module Status Register.

Bit 7: This bit is set in the Status Register only if the Blown Fuse Enable bit (6) is set and the single-ended on-board auxiliary supply fuse has blown or the auxiliary voltage is not present. This bit is not defined in the Configuration Register.

Bit 8: These bits are reserved in the Status Register. These bits are not defined in the Configuration Register.

Bit 9: This bit is reserved.

Bit 10: Reserved

Bits 11-15: These bits are not defined in the Configuration register and are read as high in the Status register.

15.12 Diagnostic Logic card LEDs - (DI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E	This LED location is not used for this module.
I (Red)	External Fault LED. Lit when the Blown Fuse bit (Bit 7) of the Status Register is set. This indicates the field supply fuse is blown or the auxiliary power supply is not present. This LED should never light if the Digital Input module is installed since the Blown Fuse Enable bit (Bit 6) of the Status Register should be set to the inactive state by the Controller.
1 - 16 (Green)	Point Status LED. Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum On Input Voltage.

15.13 Specifications - (DI)

Digital Input specifications (16 channel)

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential)	Refer to the following table.
Debounce Filter Propagation delay Field card output to Point Data Register:	3.75 msec. Minimum 4.0 msec. Typical 4.25 msec. Maximum
Digital Debounce Circuit Delay Time:	4.0 msec. Typical
Cable length (quality is 50pF/ft or better)	1000 feet Maximum @ 50pF/ft or better
Diagnostics	Internal module operating faults. Blown fuse detection. ³
Dielectric isolation: Channel to channel Channel to logic	No Isolation 1000V AC/DC
Module power (drawn from logic supply)	Main: 1.1 W typical, 1.5 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)

DESCRIPTION	VALUE
Humidity (non-condensing)	0 to 95%
¹ Blown fuse detection applies to single-ended channel configuration only, where an on-board fuse is provided for the auxiliary power supply.	

Digital Input ranges

INPUT LEVEL	ON INPUT VOLTAGE (VDC OR VAC RMS)		OFF INPUT VOLTAGE (VDC OR VAC RMS)	ON INPUT CURRENT (mA)		OFF INPUT CURRENT (mA)	POWER IN FRONT END (WATTS)
	MIN	MAX	MAX	MIN	MAX	MAX	TYPICAL
24 VDC	18	60	9	0.6	2.6	0.33	0.75
24 VAC	22	30	7	2.8	5.5	0.6	0.80
48 VDC	18	60	9	0.6	2.6	0.33	1.50
125 VDC	75	132	55	0.65	2.0	0.37	2.80
125 VAC	85	132	40	8.2	13.5	1.9	3.30

SECTION 16

Compact Digital Input module - (CompactDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Compact Digital Input module overview - (CompactDI)</i>	217
<i>16 Channel Compact Digital Input module overview - (CompactDI)</i>	217
<i>Electronics modules (Emod) - (CompactDI)</i>	218
<i>Personality modules (Pmod) - (CompactDI)</i>	218
<i>Valid module combinations - (CompactDI)</i>	218
<i>External Power Supply information - (CompactDI)</i>	219
<i>Terminal block wiring information - (CompactDI)</i>	220
<i>Field wiring considerations - (CompactDI)</i>	221
<i>Field connection wiring diagrams - (CompactDI)</i>	221
<i>Field connection wiring diagrams (CE Mark) - (CompactDI)</i>	229
<i>Configuration/Status Register information - (CompactDI)</i>	236
<i>Diagnostic Logic card LEDs - (CompactDI)</i>	237
<i>Specifications - (CompactDI)</i>	237

16.1 16 Channel Compact Digital Input module overview - (CompactDI)

The Compact Digital Input module contains 16 channels where each channel has voltage level sensing circuitry used to detect whether an input is on or off. The input voltage level sensed by the module is determined by the particular card group of the module.

The module is available for three options:

- 16 galvanically isolated differential inputs (unfused) (24/48 VAC/VDC or 125 VAC/VDC).
- 16 single-ended (common return) digital inputs with a common fuse and on-card blown fuse detection for the auxiliary power supply (24/48 VDC).
- 16 individually fused digital inputs using a common power supply. Blown fuse detection is not available with this option (24/48 VDC or 24 VAC or 125 VAC/VDC).

Refer to the following cross references for information concerning:

- Field side circuitry for the single-ended configuration (see page 221).
- Circuitry information for the differential configuration.
- Field side circuitry for the 16 individually fused configuration.

An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side.

The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the auxiliary supply (blown fuse detection). Two events cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the Electronics module.
- Auxiliary supply level is lower than minimum On Input Voltage.

In addition, a cavity insert that includes a wiring diagram is available for placement in the Personality module cavity in the Base Unit in all configurations except the 16 point individually fused option which requires a personality module (5X00034). The Compact Digital Input module is a CE Mark certified module.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

16.2 Electronics modules (Emod) - (CompactDI)

- **1C31232G01** provides for 24/48 VDC single-ended inputs.
- **1C31232G02** provides for 24/48 VDC or 24 VAC differential inputs and supports the 16 point individually fused option.
- **1C31232G03** provides for 125 VAC/VDC differential inputs and supports the 16 point individually fused option.

16.3 Personality modules (Pmod) - (CompactDI)

- **5X00034G01** provides for 16 point individual fusing with a common supply.

This is an optional Personality module that is available for use with the differential input Electronics modules (1C31232G02, 1C31232G03) for applications requiring individual point fusing with a common supply.

Note: This Personality module is not available for use with the Single-Ended Compact Digital Input electronics module 1C31232G01. In the event that individual fusing is not required, a cavity insert (1C31238H01) is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

16.4 Valid module combinations - (CompactDI)

Compact Digital Input valid module combinations

RANGE ¹	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE OR CAVITY INSERT ²
24/48 VDC Single-ended	16	1C31232G01	1C31238H01 (molded plastic cavity insert)
24 VAC/VDC Differential 48 VDC Differential	16	1C31232G02	5X00034G01(Fused Pmod) 1C31238H01 (molded plastic cavity insert)
125 VAC/VDC Differential	16	1C31232G03	5X00034G01 (Fused Pmod) 1C31238H01(molded plastic cavity insert)

RANGE ¹	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE OR CAVITY INSERT ²
¹ All module configurations listed in the table are CE Mark certified. ² This is an insert that fits into the Personality module position and provides a wiring schematic label for the module.			

When the 125VAC/VDC Compact Digital Input Emod (1C31232G03) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

16.5 External Power Supply information - (CompactDI)

The required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply when using the following modules:

- **1C31232G01** single-ended Electronics module (configured for 16 single-ended inputs).
- **1C31232G02** or **1C31232G03** 16 point individually fused configuration Electronics modules with 5X00034 Personality module.

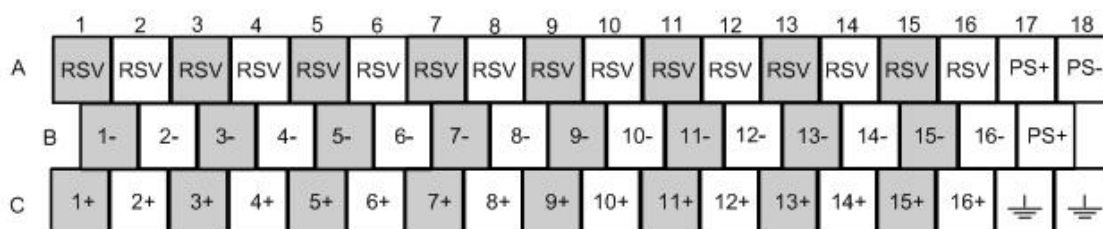
If an external power supply is used, refer to Using an External Power Supply (see page 635) which contains steps to be undertaken before connecting the external power supply to the Compact Digital Input module base unit terminal block.

16.6 Terminal block wiring information - (CompactDI)

The available cavity insert or Personality module has a simplified wiring diagram label on top, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit.

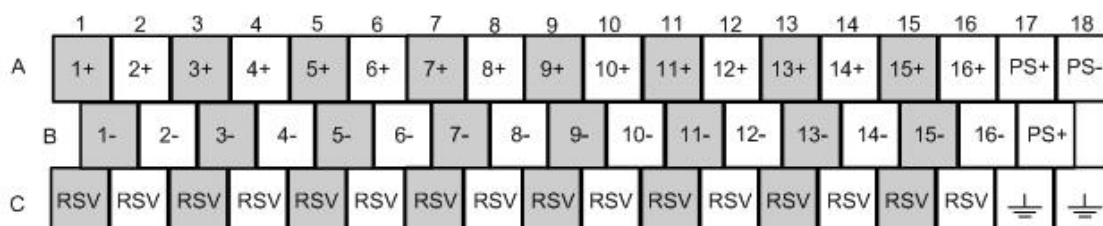
Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

The following table lists and defines the abbreviations used in the diagram.



Configuration Using the Foam Insert (16 point single-ended or differential)

Note: On the differential modules (1C31232G02 and 1C31232G03 only), each channel has a diode bridge at the front-end. Therefore, the inputs to Row B and C are reversible.



Configuration Using the 16 Point Individually Fused Personality Module

Figure 64: Terminal Block Connections for the Compact Digital Input Module

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. Do not use, except where indicated.

16.7 Leakage resistance considerations - (CompactDI)

The following minimum leakage resistances of the cable and the interface devices apply:

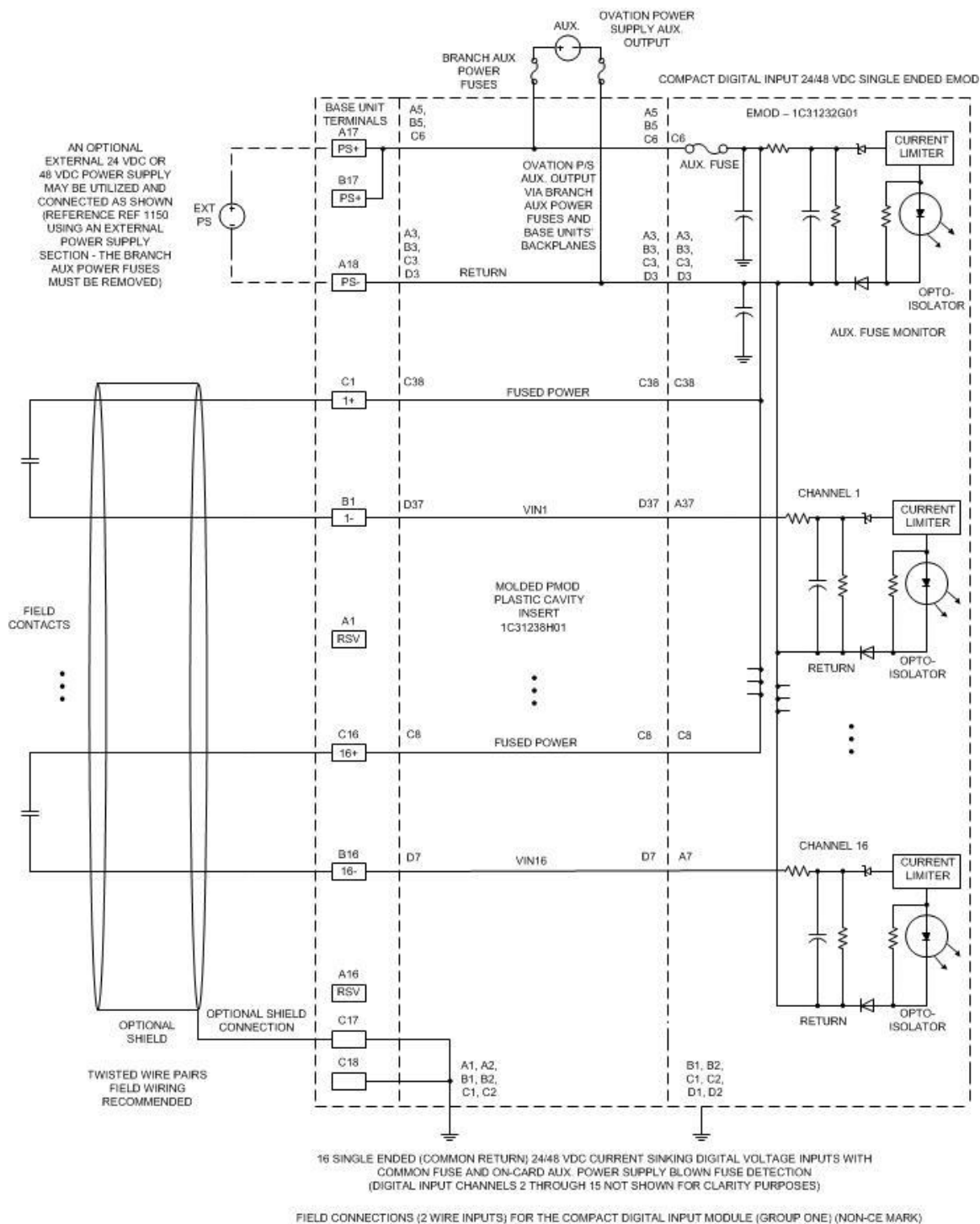
- 24/48VDC - 175 K ohms
- 24 VAC - 50 K ohms
- 125 VDC - 225 K ohms
- 125 VAC - 50 K ohms

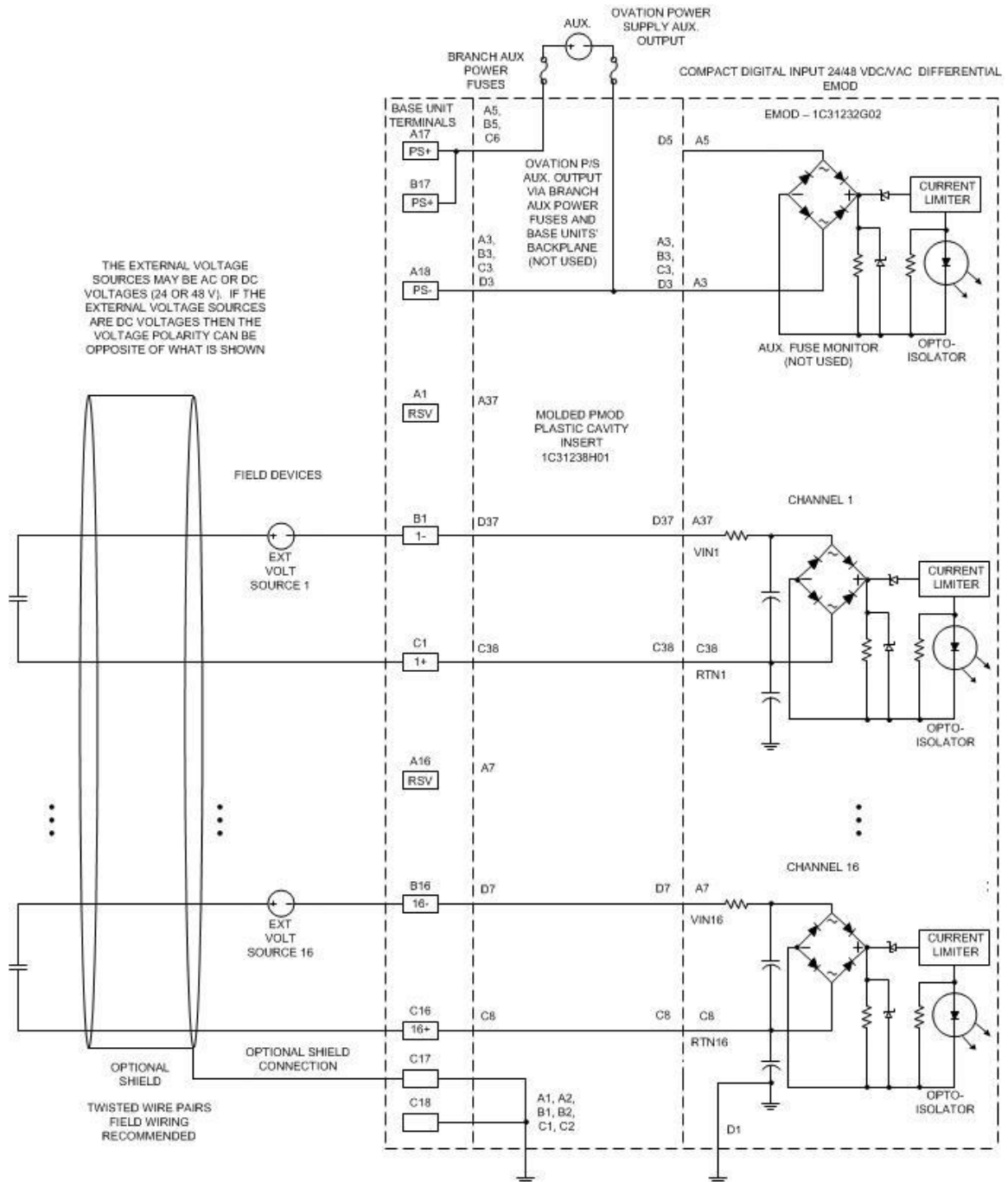
CAUTION! For CE Mark certified systems: Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with cavity insert (1C31238H01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VAC/DC Compact Digital Input Electronics module (1C31232G03) with the individually fused Personality module (5X00034G01) and interfaces to hazardous voltage (>30 V RMS, 42.4 V peak, or 60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

Place this label in a visible location on the base unit, preferably above the spare fuse location. The project drawings should indicate this.

16.8 Field connection wiring diagrams - (CompactDI)



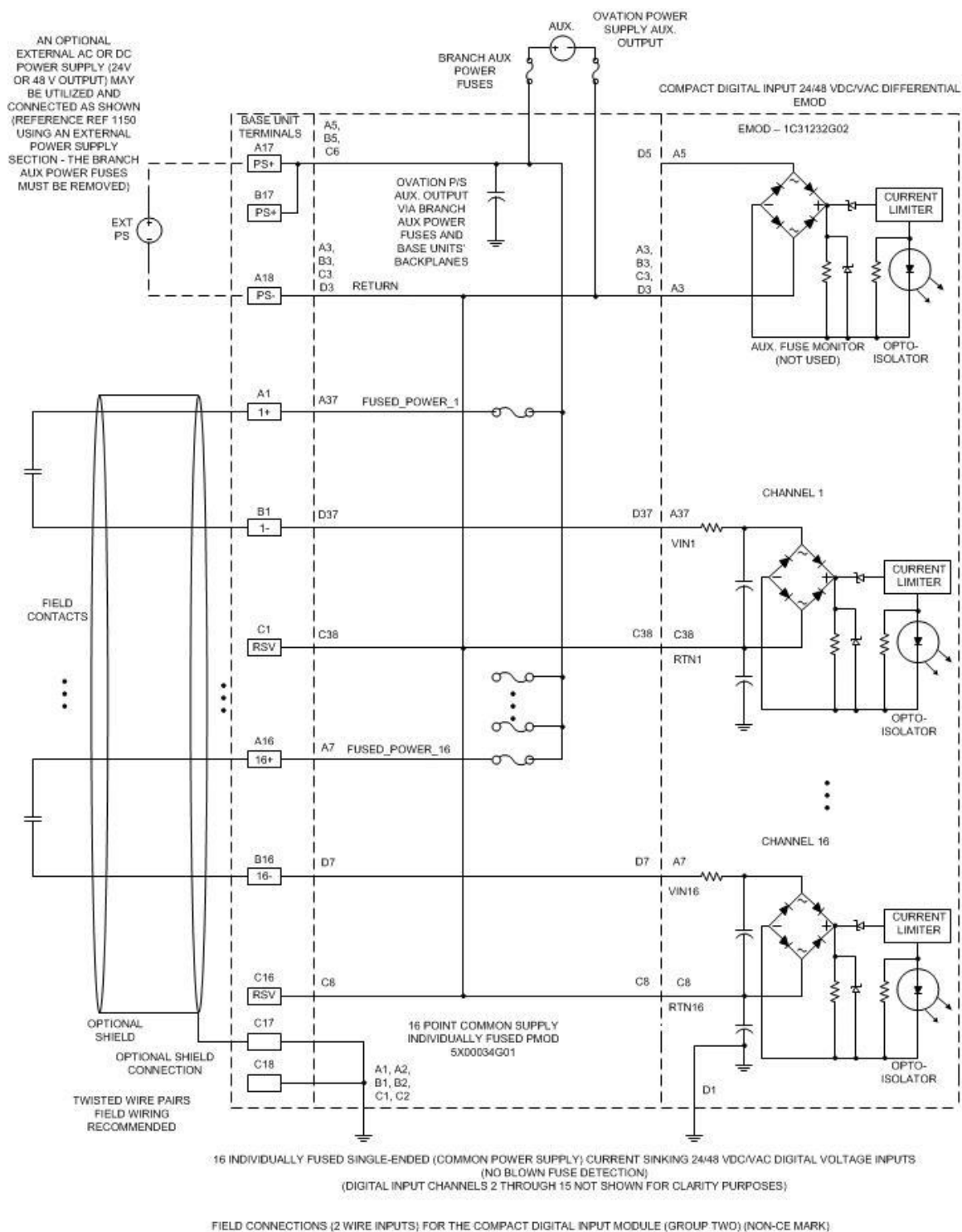


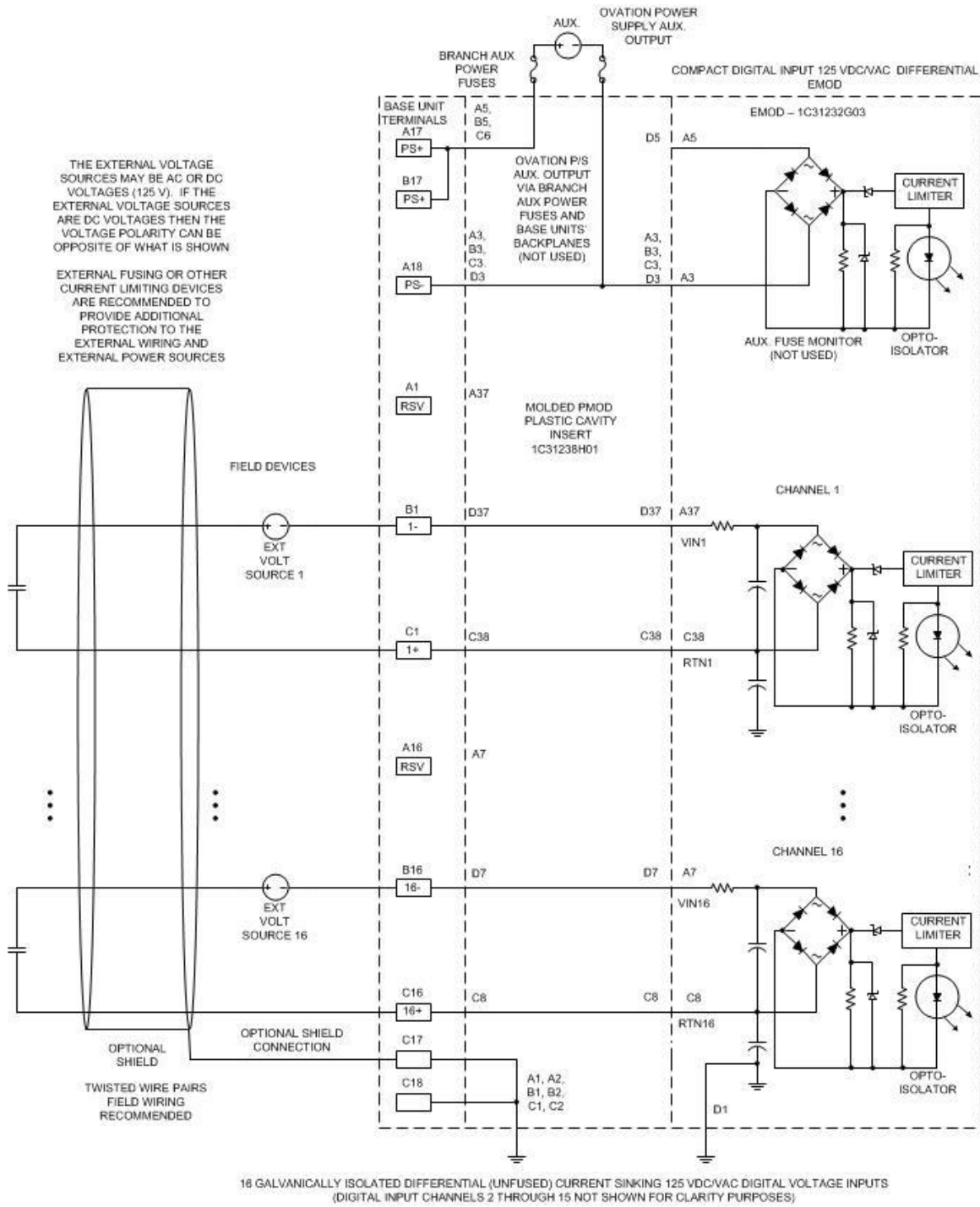
16 GALVANICALLY ISOLATED DIFFERENTIAL (UNFUSED) CURRENT SINKING 24/48 VDC/VAC DIGITAL VOLTAGE INPUTS
(DIGITAL INPUT CHANNELS 2 THROUGH 15 NOT SHOWN FOR CLARITY PURPOSES)

FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT DIGITAL INPUT MODULE (GROUP TWO) (NON-CE MARK)

224

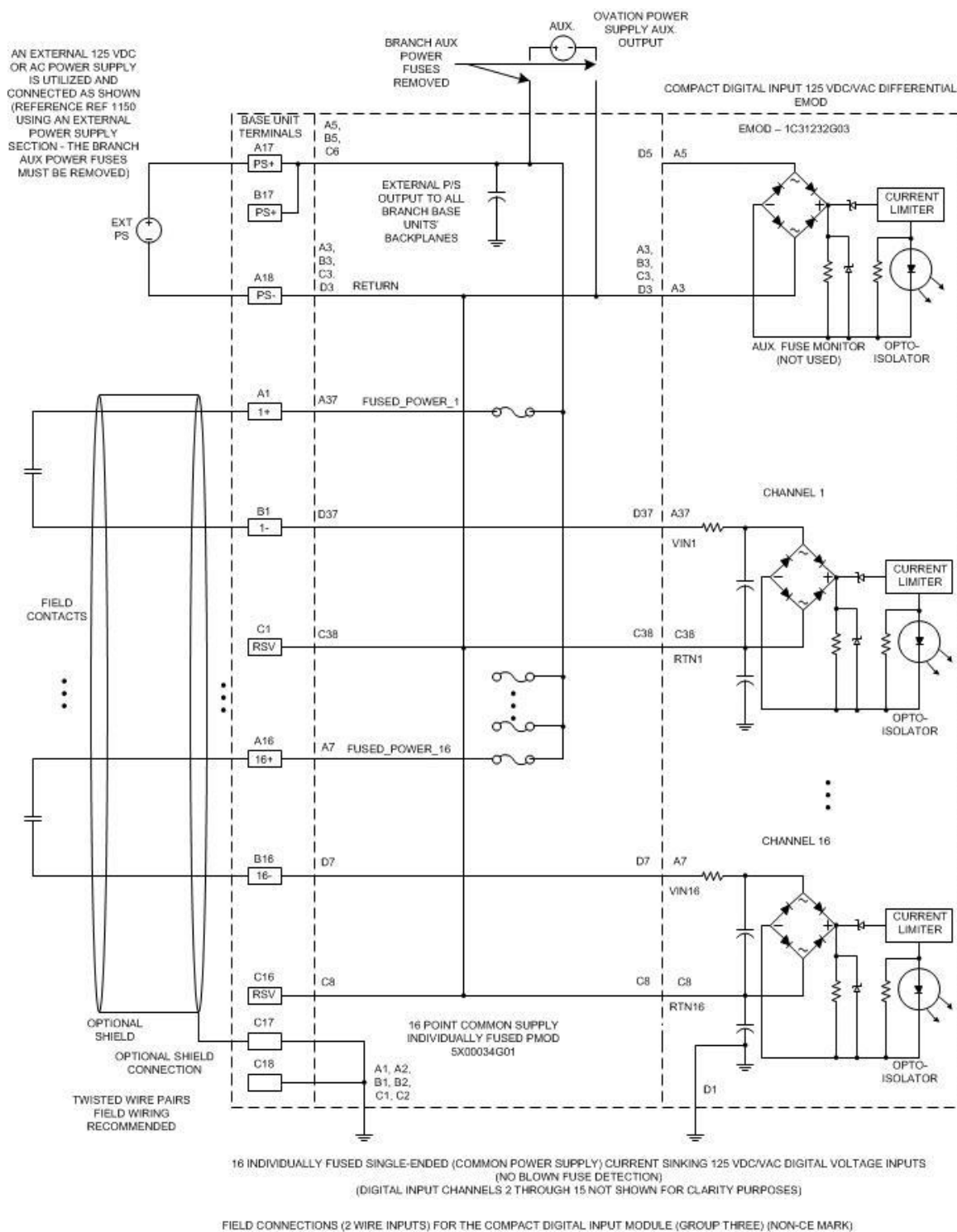
OW351_R1150

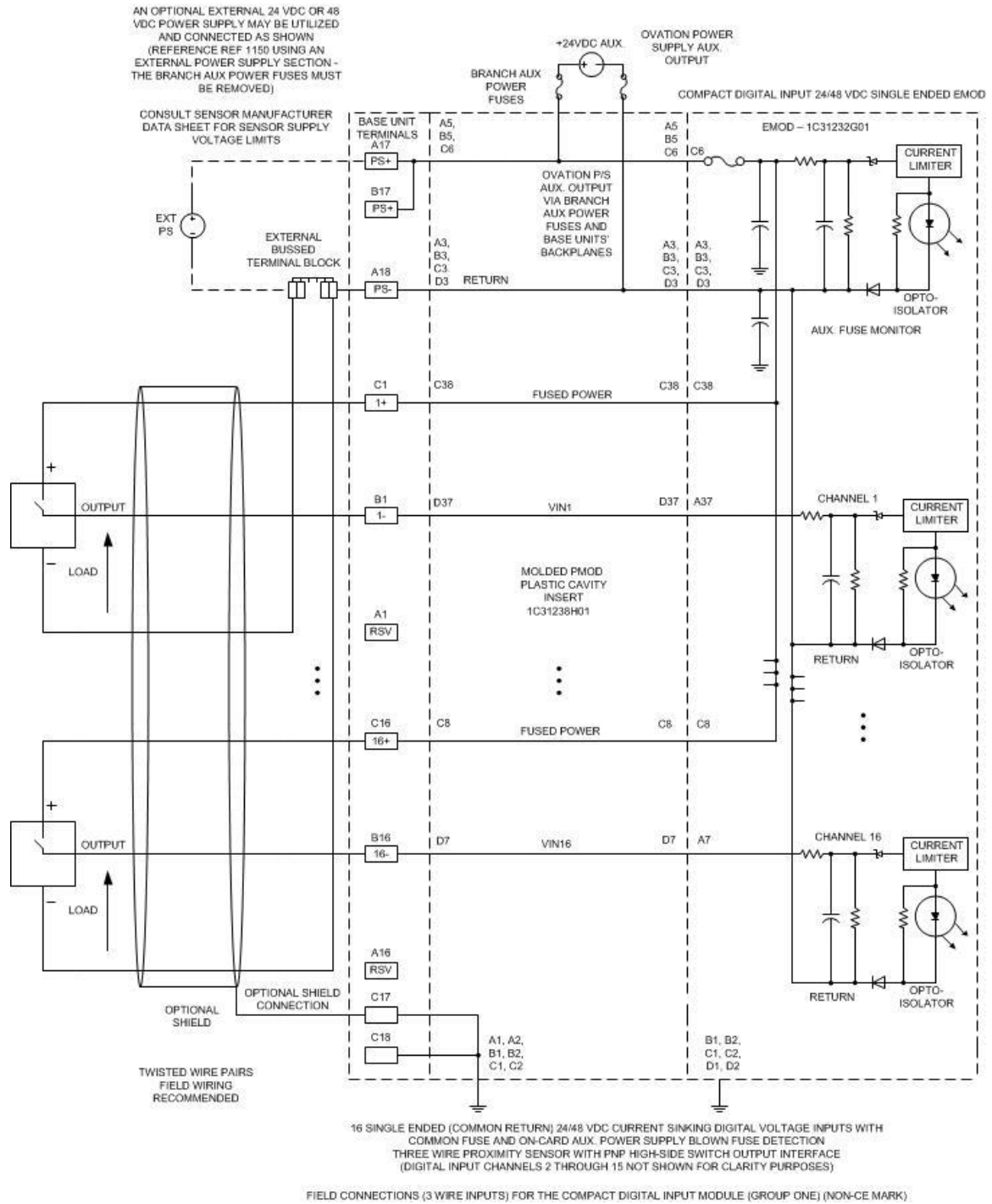




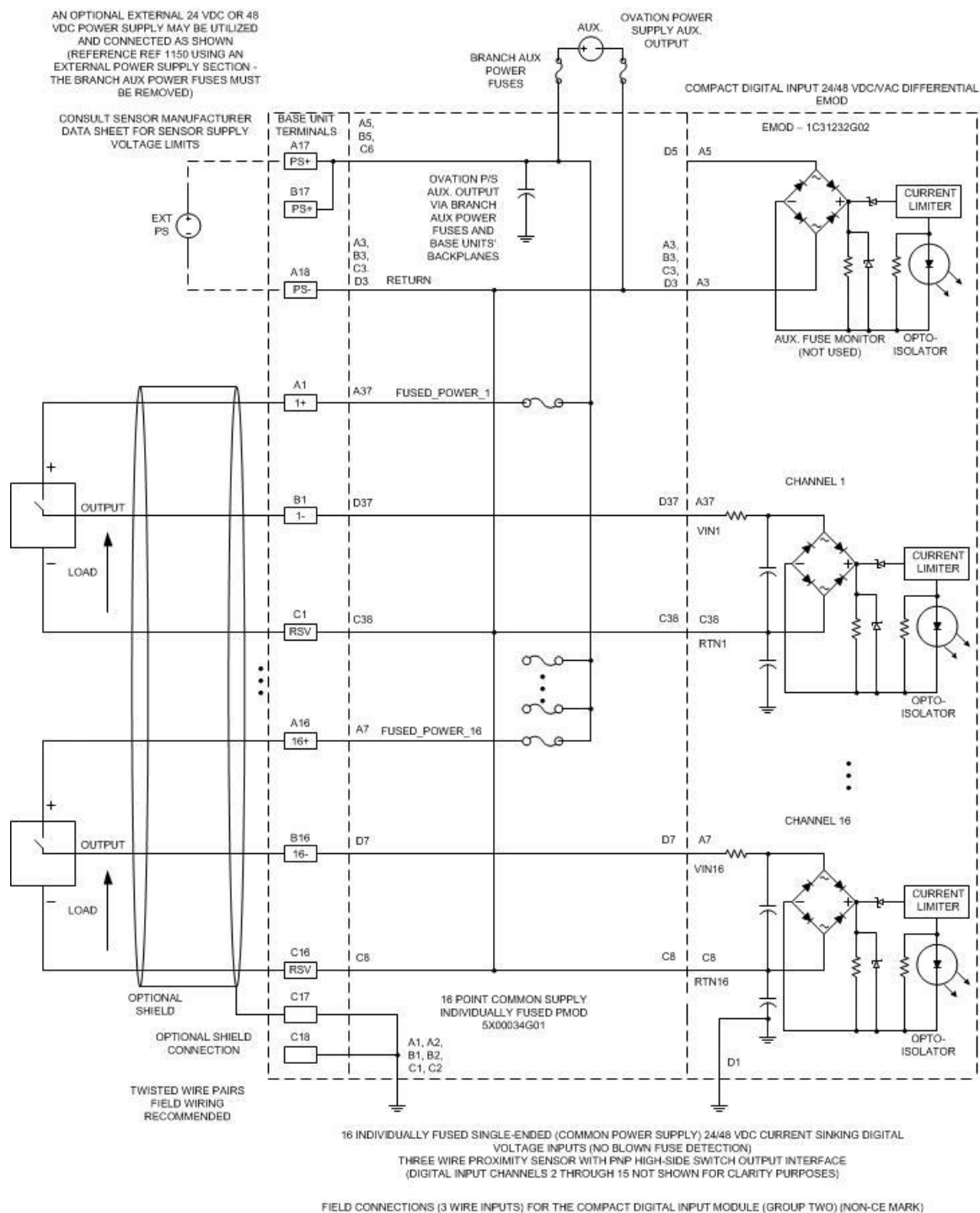
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT DIGITAL INPUT MODULE (GROUP THREE) (NON-CE MARK)

16.8 Field connection wiring diagrams - (CompactDI)

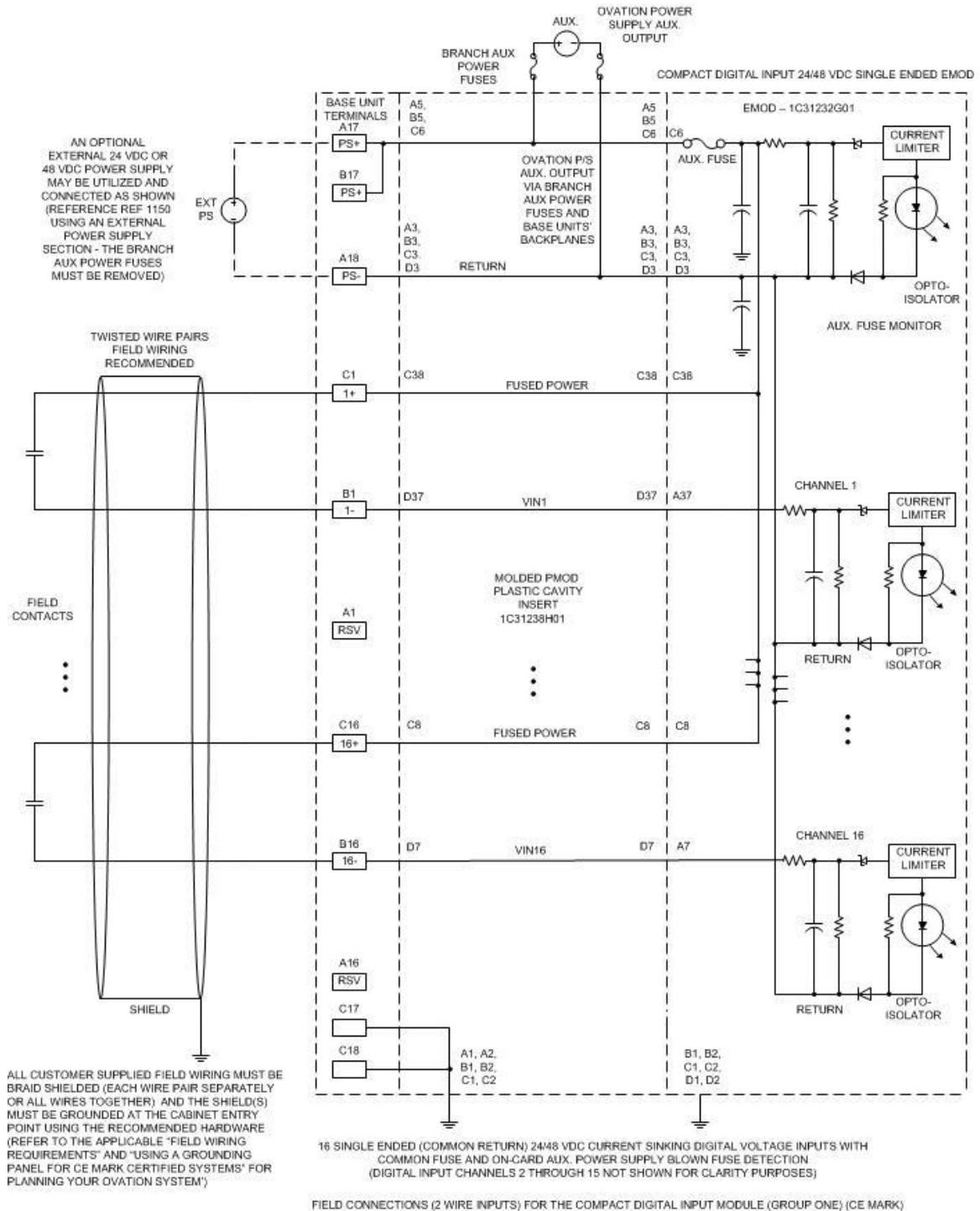




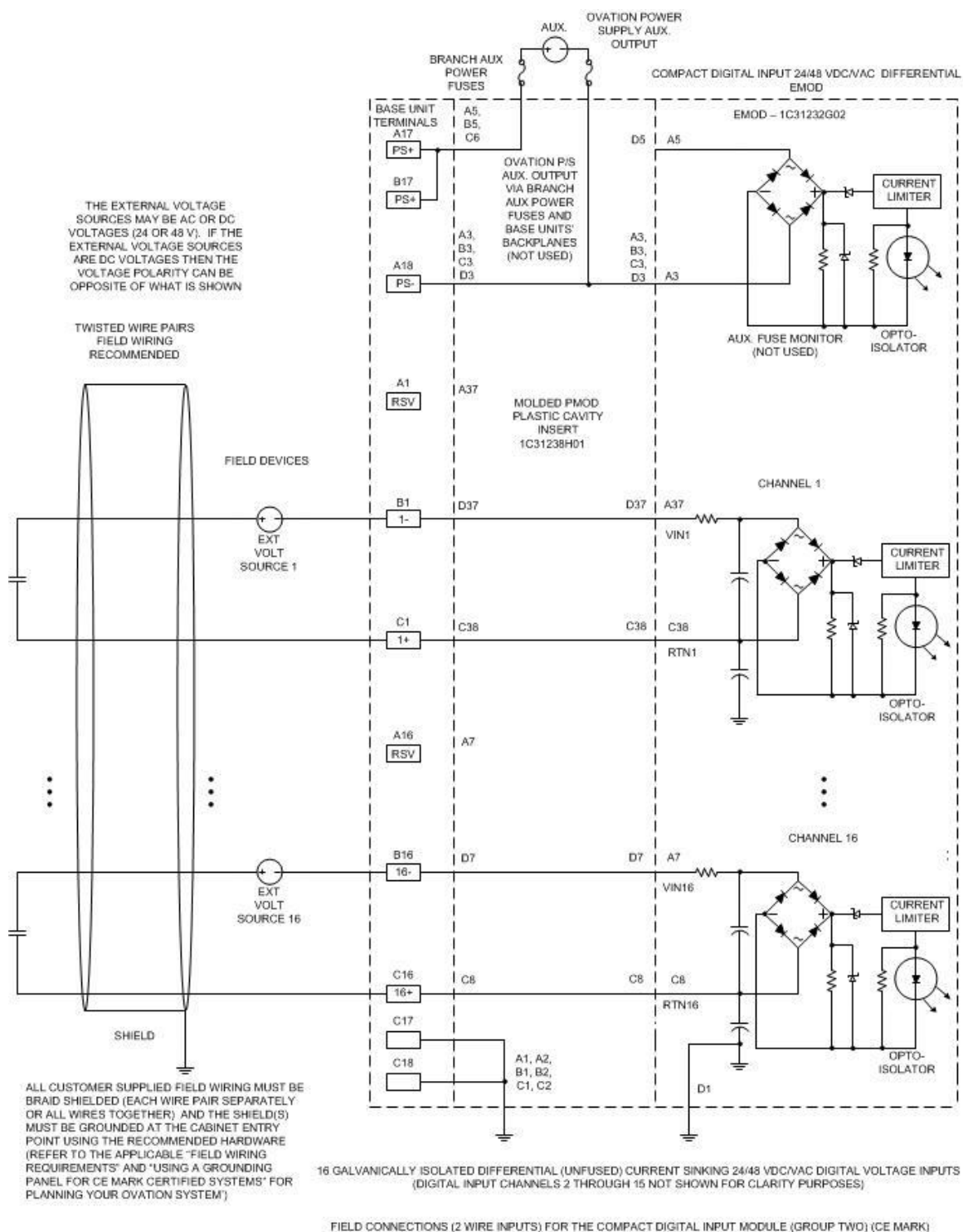
16.8 Field connection wiring diagrams - (CompactDI)



16.9 Field connection wiring diagrams (CE Mark) - (CompactDI)



16.9 Field connection wiring diagrams (CE Mark) - (CompactDI)

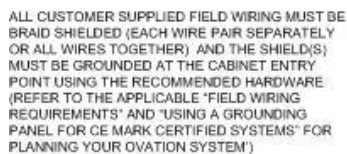


OW351 R1150



232

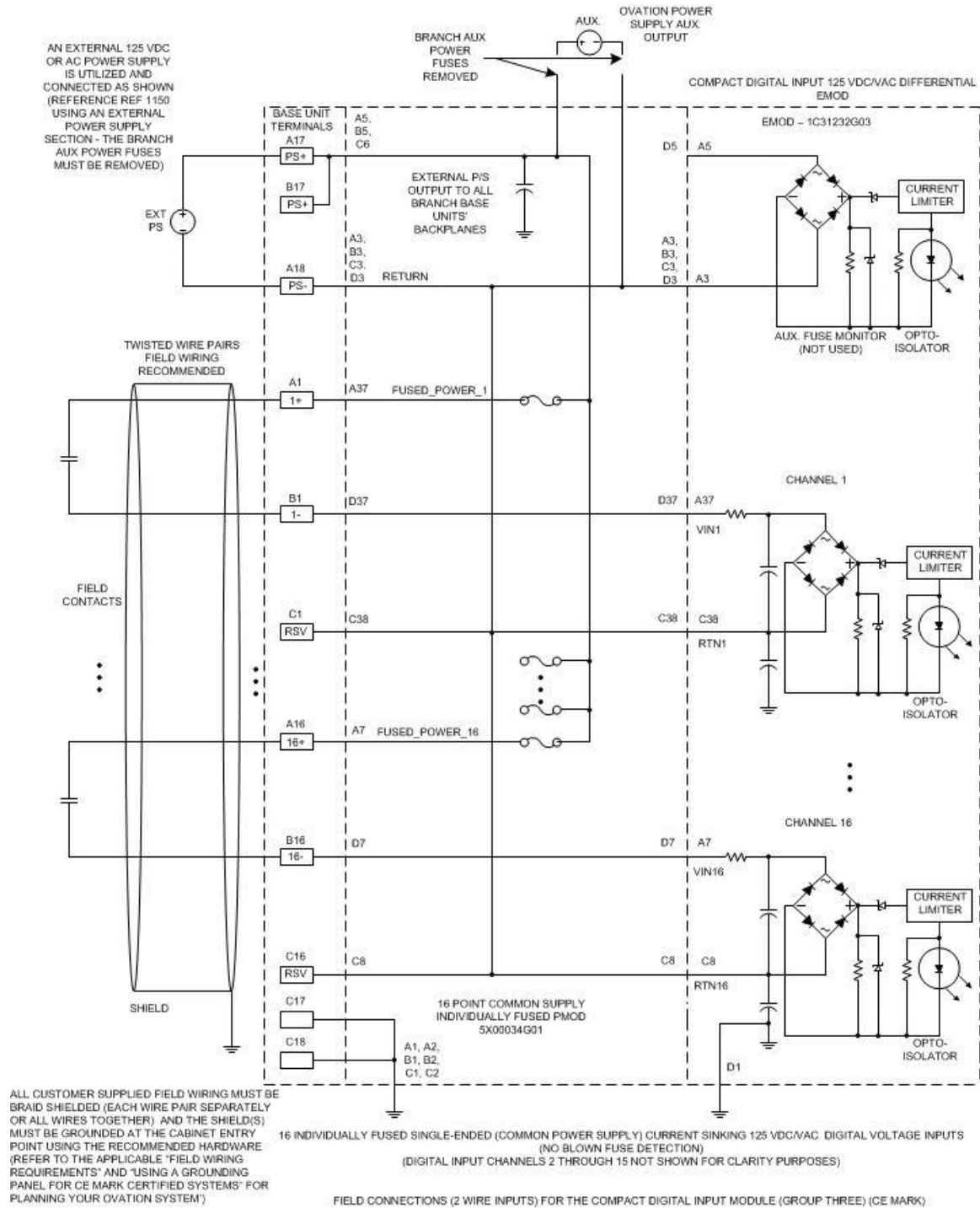
EXTERNAL FUSING OR OTHER
CURRENT LIMITING DEVICES
ARE RECOMMENDED TO
PROVIDE ADDITIONAL
PROTECTION TO THE
EXTERNAL WIRING AND
EXTERNAL POWER SOURCES



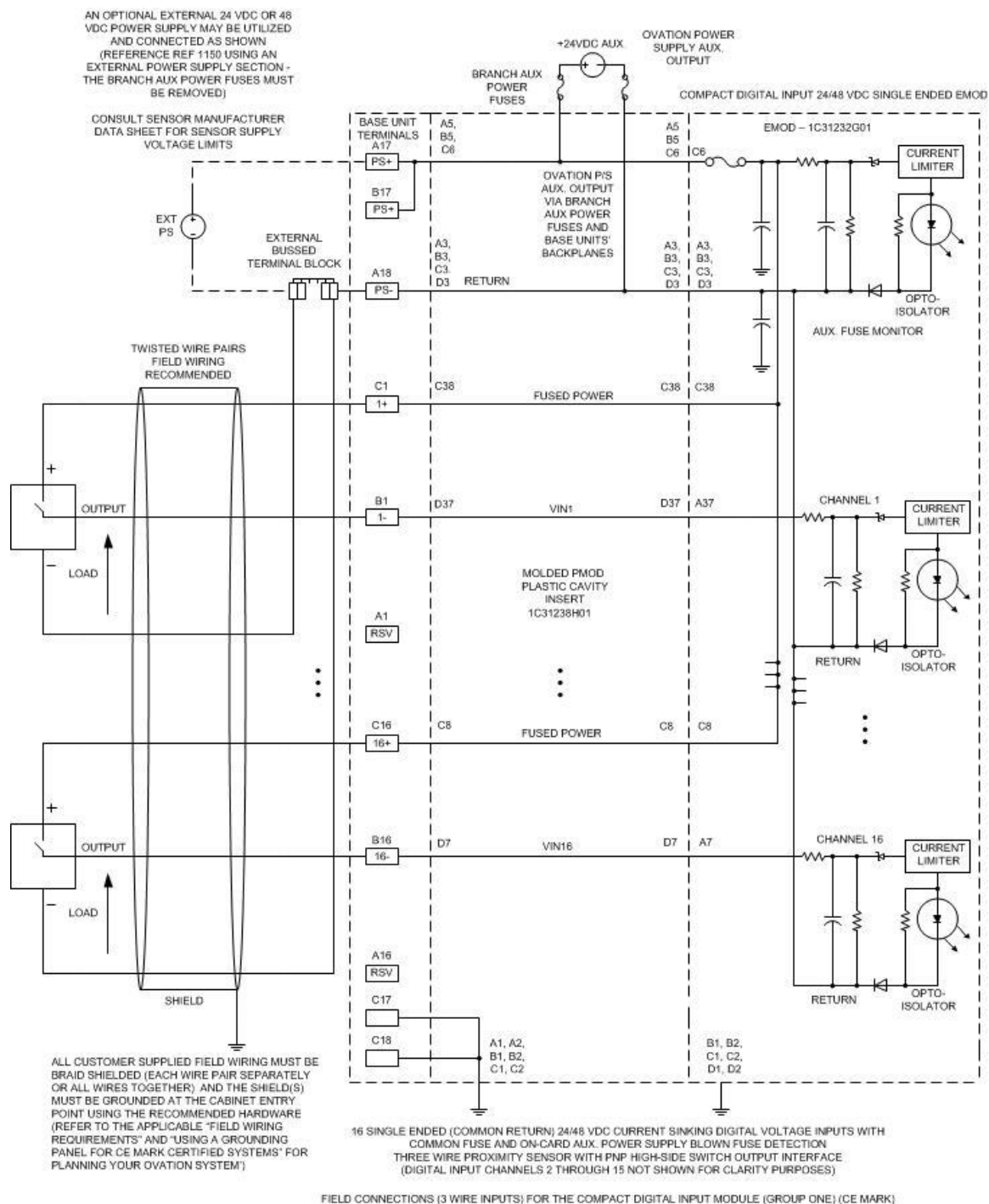
16 GALVANICALLY ISOLATED DIFFERENTIAL (UNFUSED) CURRENT SINKING 125 VDC/VAC DIGITAL VOLTAGE INPUTS
(DIGITAL INPUT CHANNELS 2 THROUGH 15 NOT SHOWN FOR CLARITY PURPOSES)

FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT DIGITAL INPUT MODULE (GROUP THREE) (CE MARK)

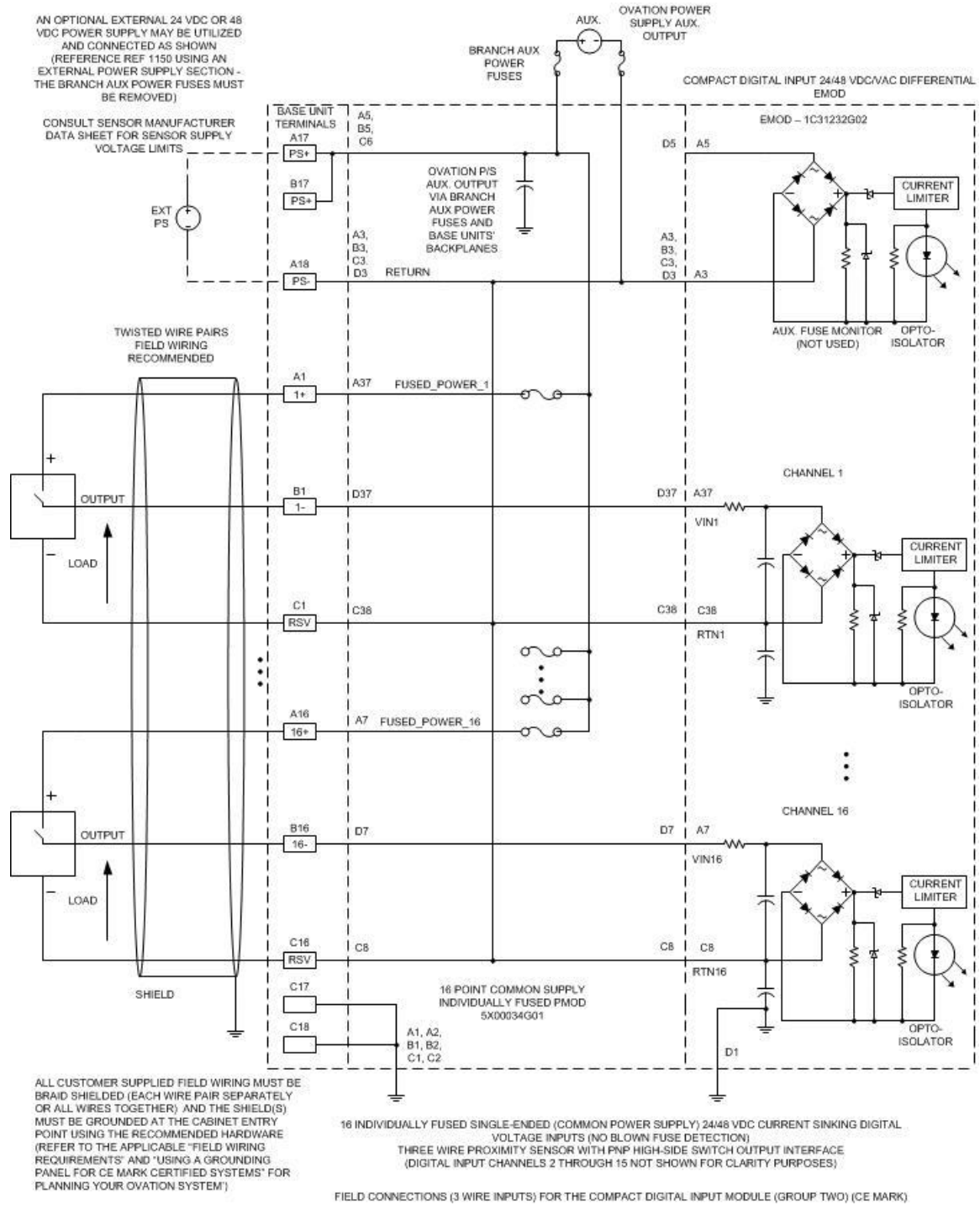
16.9 Field connection wiring diagrams (CE Mark) - (CompactDI)



16.9 Field connection wiring diagrams (CE Mark) - (CompactDI)



16.9 Field connection wiring diagrams (CE Mark) - (CompactDI)



16.10 Configuration/Status Register information - (CompactDI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module (1 = configure; 0 = unconfigure, causing an attention status)	Module Configured (1 = configured; 0 = unconfigured)
1	Force Error (1 = force an attention status to be read by Controller; 0 = no forced error)	Forced error (1 = forced error set by Controller; 0 = no forced error)
2 - 5	Not defined	Not defined
6	Blown fuse enable ¹ (1 = enable blown fuse detection; 0 = disable blown fuse detection)	Blown fuse enable (1 = blown fuse detection is enabled; 0 = blown fuse detection is disabled)
7	Not defined	Blown fuse (1 = fuse blown or auxiliary voltage not present; 0 = fuse OK and auxiliary voltage present)
8	Not defined	Reserved
9	Reserved	Reserved
10	Not defined	Reserved
11 - 15	Not defined	Not defined
¹ Blown Fuse Enable should always be set to "0" on the differential modules (1C31232G02 and 1C31232G03).		

Bit definitions for this register are encoded as shown in the table above and described below:

Bit 0: After the Compact Digital Input module power is cycled, this bit is "0." A "1" must be written to this bit. If the module is not configured in this manner, an attention status is sent to the Controller upon an attempt to read the point data.

Bit 1: This bit is "0" after the Compact Digital Input module power is cycled. If the Controller sets this bit, an attention status is issued.

Bits 2-5 Not Defined

Bit 6: The Blown Fuse Enable bit is "0" after the Digital Input module power is cycled. This bit must be set by the Controller for Compact Digital Input modules, using the single-ended personality module, to detect a blown auxiliary power supply fuse when it reads the Status Register. Blown Fuse Enable should always be set to "0" on the differential modules (1C31232G02 and 1C31232G03). The bit may be read back through the Module Status Register.

Bit 7: This bit is set in the Status Register only if the Blown Fuse Enable bit (6) is set and the single-ended on-board auxiliary supply fuse has blown or the auxiliary voltage is not present. This bit is not defined in the Configuration Register.

Bit 8: These bits are reserved in the Status Register. These bits are not defined in the Configuration Register.

Bit 9: This bit is reserved.

Bit 10: Reserved

Bits 11-15: These bits are not defined in the Configuration register and are read as high in the Status register.

16.11 Diagnostic Logic card LEDs - (CompactDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED is Lit when: ▪ The Blown Fuse bit (Bit-7) of the Module Status Register (see Register configuration/address information - (Compact DI) (see page 236)) is set. This indicates that the auxiliary supply fuse has blown or the auxiliary supply is not present or below its acceptable threshold.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the (see Register configuration/address information - (Compact DI) (see page 236)) is active or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module.
1 - 16 (Green)	Point Status LEDs 1-16. Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum On Input Voltage.

16.12 Specifications - (CompactDI)

SOE Digital Input (16 Channel Compact) Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) ¹	Refer to the table below.
Propagation delay time for contact closing 24V/48VDC 24VAC 125VDC 125VAC	3.5 mSec maximum 3.5 mSec maximum 4.0 mSec maximum 4.0 mSec maximum
Propagation delay time for contact opening ² 24V/48VDC 24VAC 125VDC 125VAC	16.0 mSec maximum 14.0 mSec maximum 20.0 mSec maximum 25.0 mSec maximum

DESCRIPTION	VALUE
Additional delay time for contact opening due to cable capacitance (1,000 foot cable assumed)	
25 pF/ft cable –24V/48VDC	1.0 mSec maximum
25 pF/ft cable –24VAC	1.0 mSec maximum
25 pF/ft cable –125VDC	1.0 mSec maximum
25 pF/ft cable –125VAC	2.0 mSec maximum
50 pF/ft cable –24V/48VDC	2.0 mSec maximum
50 pF/ft cable –24VAC	2.0 mSec maximum
50 pF/ft cable –125VDC	2.0 mSec maximum
50 pF/ft cable –125VAC	4.0 mSec maximum
Cable length	1,000 ft maximum (50 pF/ft quality or better)
Cable capacitance	50,000 pF maximum
Diagnostics	Internal module operating faults, Ground Fault Detection ³
Dielectric isolation: Channel to Channel ⁴ Channel to logic	1000 VAC 2,000 VAC (differential inputs); 1,000 VAC (single-ended inputs)
Module Main +24V Power drawn	1.1 W typical, 1.5 W maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ Input range level is dependent on module group. ² Does not include the effects of field cable capacitance. ³ Blown fuse detection applies to single-ended channel configuration only (Group 1), where an on-board fuse is provided for the auxiliary power supply. ⁴ Channel to channel isolation applies to differential channel configuration only.	

Compact Digital Input Ranges

GROUP	INPUT LEVEL	ON INPUT VOLTAGE (VDC OR VAC RMS)		OFF INPUT VOLTAGE (VDC OR VAC RMS)	ON INPUT CURRENT (mA)		OFF INPUT CURRENT (mA)	INPUT POWER (WATTS)
		Min	Max	Max	Min	Max	Max	Typical
1	24 VDC	20	60	9	1.3	2.6	0.33	0.65
1	48 VDC	20	60	9	1.3	2.6	0.33	1.70
2	24 VDC	20	60	9	1.3	2.6	0.33	0.69
2	24 VAC	22	30	7	2.8	5.5	0.60	0.80
2	48 VDC	18	60	9	1.3	2.6	0.33	1.75
3	125 VDC	80	140	55	1.3	2.8	0.33	4.26
3	125 VAC	85	132	40	2.8	14.0	3.00	5.10

SECTION 17

Contact Digital Input module overview - (ContactDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Contact Digital Input module overview - (ContactDI)</i>	<i>240</i>
<i>Electronics modules (Emod) - (ContactDI)</i>	<i>240</i>
<i>Personality modules (Pmod) - (ContactDI)</i>	<i>240</i>
<i>Valid module combinations - (ContactDI)</i>	<i>241</i>
<i>Terminal block wiring information - (ContactDI)</i>	<i>241</i>
<i>Field wiring restrictions - (ContactDI)</i>	<i>242</i>
<i>Field wiring cable lengths - (ContactDI)</i>	<i>242</i>
<i>Field connection wiring diagrams (front end) - (ContactDI)</i>	<i>244</i>
<i>Cable impedances in field wiring - (ContactDI)</i>	<i>245</i>
<i>Field connection wiring diagrams - (ContactDI)</i>	<i>246</i>
<i>Field connection wiring diagrams (CE Mark) - (ContactDI)</i>	<i>247</i>
<i>Configuration/Status Register information - (ContactDI) & (CCDI)</i>	<i>248</i>
<i>Power checking (ContactDI - CCDI)</i>	<i>249</i>
<i>Diagnostic Logic card LEDs - (ContactDI)</i>	<i>249</i>
<i>Specifications - (ContactDI)</i>	<i>250</i>

17.1 16 Channel Contact Digital Input module overview - (ContactDI)

The Contact Input module, comprised of an Electronics module and Personality module, provides 16 contact input current detecting channels with common returns. The field side circuitry and terminal connections (see page 244) for three of these channels are shown (see page 242).

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

On-Board power supply checking:

A common voltage monitor circuit examines the 10V and 48V voltages and sets a module status register bit (bit 8) if there is an issue with the 10V and 48V power supply. If this on-board power supply fails, all channels are affected.

There are two methods of wiring field devices to the Contact Input module termination block (see page 244). Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same Contact Input module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition occurs as well as a degradation of the common mode surge protection.

Debouncing of a contact input signal is done by an RC filter and digital debouncer on the logic side. If a contact changes state for less than 3 ms, the change of state is always rejected. If the Contact changes state for more than 7 ms, the change of state always accepted.

Ground fault detection circuitry on a Contact Input module activates when an input or return line for any channel finds a low impedance (<5 K ohms) path to earth ground. A single ground fault wire does not cause an error in the point data, but multiple ground faults (if they include input and return lines) could cause faulty data (that is, channels appearing as if contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit in the Status Register (see page 248) is set. If the GND Fault (see page 244) Attention Enable bit is set in the Configuration Register (see page 248), a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. The Contact Input module is a CE Mark certified module.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

17.2 Electronics modules (Emod) - (ContactDI)

- **1C31142G01** provides 48 VDC on-card auxiliary power for 16 contact inputs with common return.

17.3 Personality modules (Pmod) - (ContactDI)

- **1C31110G03** contains surge-protection components for 16 inputs.

17.4 Valid module combinations - (ContactDI)

Contact Digital Input valid module combinations¹

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
48 VDC On-Card Auxiliary (Legacy)	16	1C31142G01	1C31110G03
¹ This module configuration is CE Mark certified.			

17.5 Terminal block wiring information - (ContactDI)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagram for the contact input Personality module (also known as digital input) is illustrated in the following figure.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

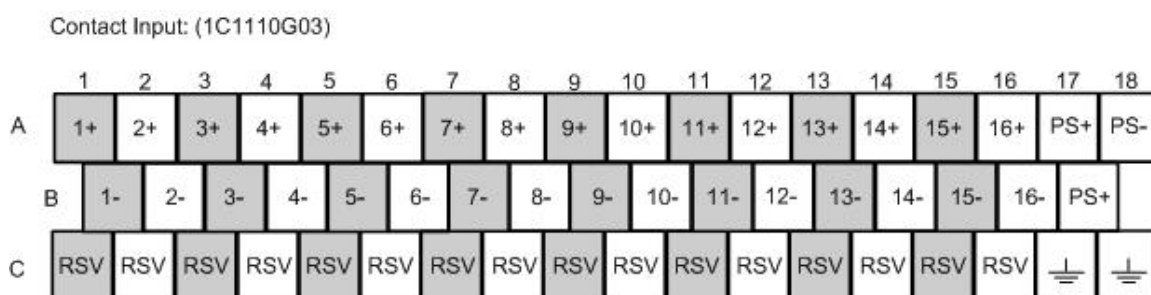


Figure 65: Terminal Block Connections for the Contact Input Personality Modules

The following table lists and defines the abbreviations used in this diagram.

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Contact input positive terminal connection
1- through 16-	Contact input negative terminal connection
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No connection allowed on these terminals

Note: Do **not** use terminal block locations marked RSV.

17.6 Field wiring restrictions - (ContactDI)

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Cable resistances (see page 245) that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
 - ☐ Rshunt across contact must be $\geq 10k$ ohms to always recognize an open contact as open.
 - ☐ Rshunt across contact must be $\geq 50k$ ohms to maintain the high level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
 - ☐ Rshunt across contact must be $\geq 150k$ ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
 - ☐ Rfault from either line to ground must be $\leq 5K$ ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
 - ☐ Rwiring through field wiring to contact must be < 100 ohms to always recognize a closed contact as closed.

17.7 Field wiring cable lengths - (ContactDI)

The following two tables list the Maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The following table applies when there are individual common return lines brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum cable length for 16 individual common returns

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The following table applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum cable length for a single common return for all 16 inputs

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

17.8 Field connection wiring diagrams (front end) - (ContactDI)

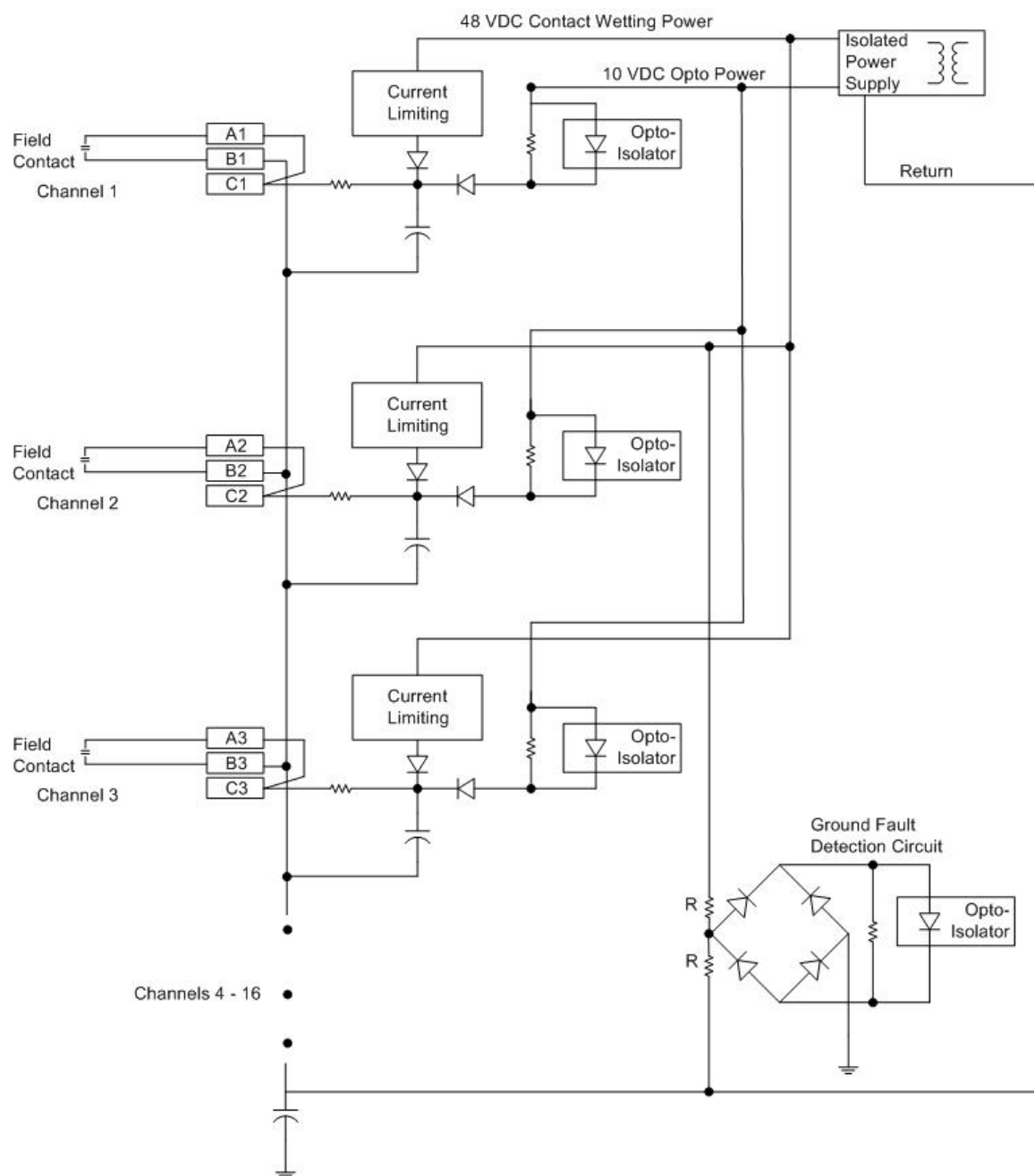


Figure 66: Contact Input module front end

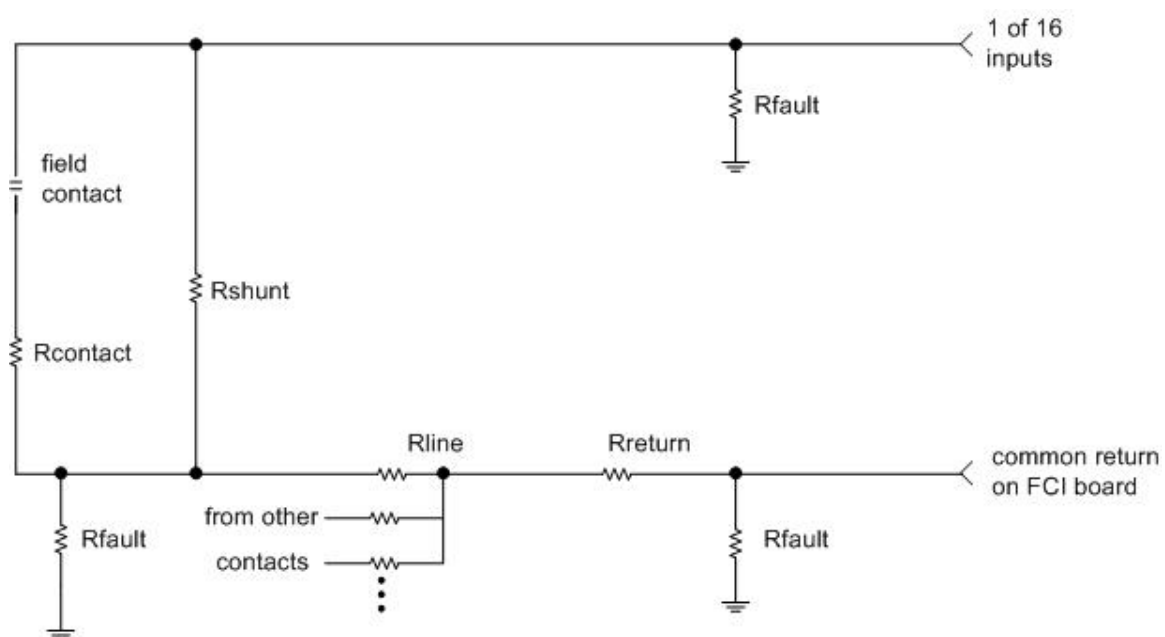
17.9 Cable impedances in field wiring - (ContactDI)

Figure 67: Cable impedances in field wiring

17.10 Field connection wiring diagrams - (ContactDI)

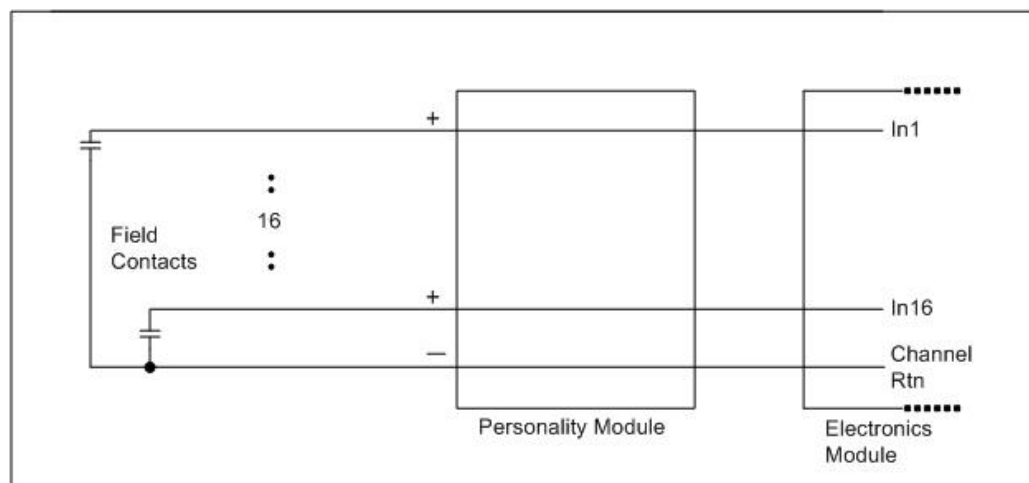
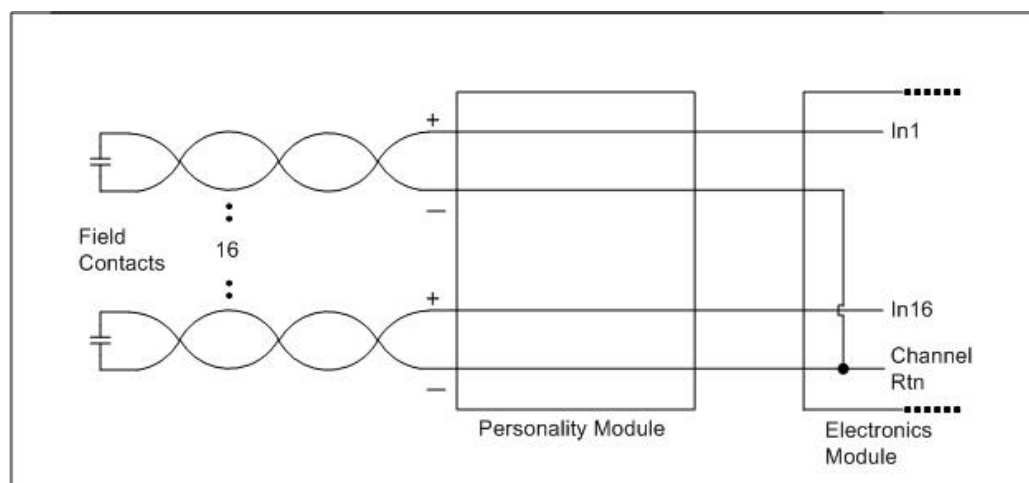
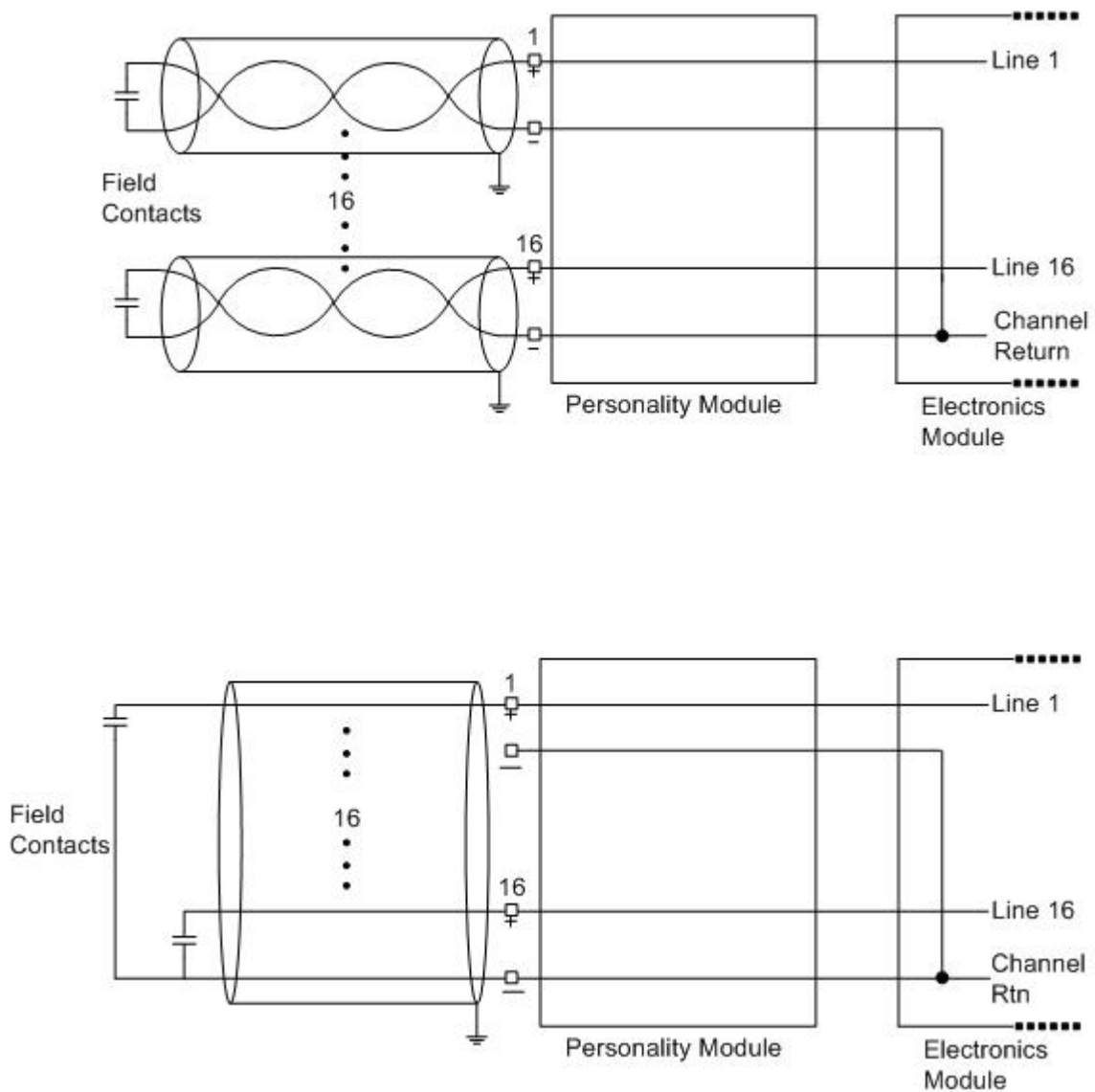


Figure 68: Field connection for the Contact Input Personality module

17.11 Field connection wiring diagrams (CE Mark) - (ContactDI)**Figure 69: Field connection for the Contact Input Personality module (CE Mark)**

Note: All field wiring *MUST* be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware.

17.12 Configuration/Status Register information - (ContactDI) & (CCDI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

Contact (and Compact Contact) Input configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module 1 = configure 0 = unconfigure, causing an attention status	Module Configured 1 = configured 0 = unconfigured
1	Force Error 1 = force an attention status to be read by Controller 0 = no forced error	Forced error 1 = forced error set by Controller 0 = no forced error
2-5	Not defined	Not defined
6-7	Reserved	Reserved
8	Not defined	Wetting Voltage Failure 1 = +48V wetting Voltage Failed 0 = +48V wetting Voltage OK.
9	Ground Fault Attention Enable 1 = configure GND fault to cause an attention status 0 = configure GND fault to not cause an attention status	Ground Fault Attention Enable 1 = GND fault causes attention status 0 = GND fault does not cause an attention status
10	Not defined	Ground Fault 1 = field wiring has a ground fault 0 = field wiring does not have a ground fault
11-15	Not defined	Not defined

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: After the Contact Input module power is cycled, this bit is “0.” A “1” must be written to the Configure module bit. If the module is not configured in this manner, an attention status is sent to the Controller upon an attempt to read the point data. The bit may be read back through the Status Register.

Bit 1: The Force Error bit is “0” after the Contact Input module power is cycled. If the Controller sets the Force Error bit, an attention status is issued. The bit may be read back through the Status Register.

Bits 2-5: These bits are not defined.

Bit 6 & 7: These bits are reserved in the Status Register.

Bit 8: This bit is set in the Status Register if the +48V supply on the FCI board fails.

Bit 9: The GND Fault Attention Enable bit is “0” after the Contact Input module power is cycled. This bit must be set by the Controller if a ground fault is to be treated as a catastrophic failure. If Bit 9 is set, a ground fault causes an attention status to be returned to the Controller upon accessing the module, and no point data can be read. If the bit is not set, a ground fault does not inhibit the Controller from reading point data. In the latter case, if more than one ground fault occurs on the field wiring to a Contact Input module, false point data may possibly be read on channels with open contacts.

Bit 10: This bit is set in the Status Register if a ground fault occurs in the field wiring. This bit is not defined in Configuration Register.

Bits 11-15: These bits are not defined in the Configuration register and are read as high in the Status register. These bits cannot be accessed by the Controller during a write to the module.

17.13 Power checking (ContactDI - CCDI)

The module has an internal 48 transistor voltage supply and is capable of looking at 16 different contact inputs. Each input that is connected to a dry contact requires a digital point name or packed group point name with bit position. A closed contact will produce a one (true) value for the associated point whereas an open contact produces a zero (false) value. If the power supply were to fail, all points would have a zero (false) value.

Power on checking uses one of the sixteen inputs to verify that the 48 volt supply has not failed. The selected point is hard wired to simulate a closed contact, and should therefore always be a one (true) statement.

To implement the feature, when building the points for the field inputs, within the point config tab, the power on checking is enabled, and the channel is used (hardwired) is declared. When the field inputs are scanned, the hard wired channel is also scanned to verify that it has a value of one. If not, the field inputs will be tagged with “bad quality”.

If desired, a point may be built for the hard wired channel and be set to alarm on zero.

Note: *The terminal wiring for the Contact Digital Input and Compact Contact Digital Input modules is different.*

17.14 Diagnostic Logic card LEDs - (ContactDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when GND Fault bit (Bit 10) of the Status Register (see page 248) is set. This indicates that a ground fault has occurred in the field wiring. An attention status is generated when the External Fault LED is lit only if the GND Fault Attention Enable bit (Bit 9) is set.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set or when the on-board +48V/+10V wetting power supply fails. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module. An attention status is always generated when the LED is lit.
1 (Green)	Point Status LEDs 1-16. Lit when the input contact of the LED's corresponding channel is closed.

17.15 Specifications - (ContactDI)

Contact Digital Input (16 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V Maximum
Propagation delay	7 mSec Maximum
Contact bounce rejection Always rejects contact change of state Always accepts contact change of state	< 3 mSec > 7 mSec
Closed contact output current	4 mA minimum 8 mA Maximum
Diagnostics	Internal module operating faults. Ground Fault Detection
Dielectric isolation: Channel to logic	1000 V AC/DC
Module power	4.56 W typical 4.75 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 18

Contact Digital Input module (Compact) - (CCDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Compact Contact Digital Input module overview - (CCDI)</i>	<i>252</i>
<i>Electronics modules (Emod) - (CCDI).....</i>	<i>252</i>
<i>Personality Module (Pmod) - (CCDI)</i>	<i>253</i>
<i>Valid module combinations - (CCDI).....</i>	<i>253</i>
<i>Terminal block wiring information - (CCDI)</i>	<i>253</i>
<i>Field wiring restrictions - (CCDI)</i>	<i>254</i>
<i>Field wiring cable lengths - (CCDI)</i>	<i>255</i>
<i>Cable impedances in field wiring - (CCDI)</i>	<i>256</i>
<i>Field wiring diagrams - (CCDI).....</i>	<i>257</i>
<i>Field connection wiring diagrams (CE Mark) - (CCDI).....</i>	<i>259</i>
<i>Configuration/Status Register information - (ContactDI) & (CCDI).....</i>	<i>261</i>
<i>Power checking (ContactDI - CCDI)</i>	<i>262</i>
<i>Diagnostic Logic card LEDs - (CCDI).....</i>	<i>262</i>
<i>Specifications - (CCDI).....</i>	<i>263</i>

18.1 16 Channel Compact Contact Digital Input module overview - (CCDI)

The Compact Contact Input Electronics module provides 16 contact input current detecting channels with common returns.

Additionally, a cavity insert that includes a wiring diagram is available for placement in the Personality module cavity in the base unit.

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

On-Board power supply checking

A common voltage monitor circuit examines the 10V and 48V voltages and sets a module status register bit (bit 8) if there is an issue with the 10V and 48V power supply. If this on-board power supply fails, all channels are affected.

There are two methods of wiring field devices to the Compact Contact Input module termination block. Each field contact may have a separate input and return line. Alternatively, field contacts wired to the same Contact Input module may share a return line. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition occurs as well as a degradation of the common mode surge protection.

Debouncing of a contact input signal is done by an RC filter and digital debouncer on the logic side. If a contact changes state for less than three ms, the change of state always is rejected. If the Contact changes state for more than seven ms, the change of state always is accepted.

Ground fault detection circuitry on the Compact Contact Input module activates when the input or return line for any channel finds a low impedance (<5K ohms) path to earth ground. A single wire with a ground fault does not cause an error in the point data, but multiple ground faults, if they include input and return lines, could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit in the Status Register is set. If the GND Fault Attention Enable bit is set in the Configuration Register, a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller.

The Compact Contact Input module is applicable for CE Mark certified systems.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

18.2 Electronics modules (Emod) - (CCDI)

- **1C31234G01** provides 48 VDC on-card auxiliary power for 16 contact inputs with common return.

18.3 Personality Module (Pmod) - (CCDI)

A cavity insert is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

- **1C31238H01** Personality Module Cavity Plastic insert

18.4 Valid module combinations - (CCDI)

Compact Contact Digital Input valid module combinations ¹

RANGE	CHANNELS	ELECTRONICS MODULE	MOLDED PLASTIC CAVITY INSERT ²
Compact Contact with 48 VDC On-Card Auxiliary	16	1C31234G01	1C31238H01
¹ This module configuration is CE Mark certified. ² This is an insert that fits into the Personality module position and provides a wiring schematic label for the module.			

18.5 Terminal block wiring information - (CCDI)

The available cavity insert has a simplified wiring diagram label on its top, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagram for the Compact Contact Input module is illustrated in the following figure. The following table lists and defines the abbreviations used in this diagram.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

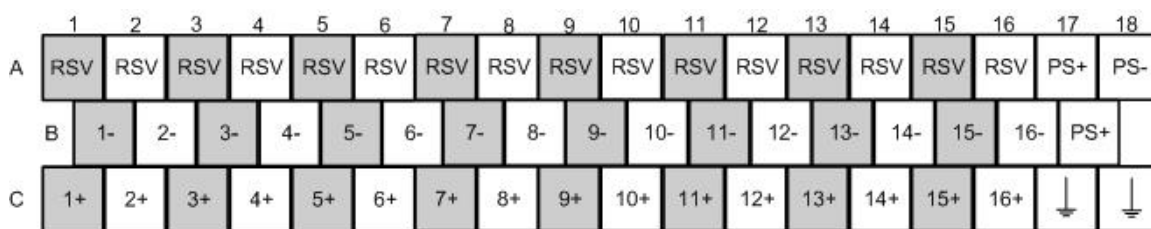


Figure 70: Terminal block connections for the Compact Contact Input modules

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Contact input positive terminal connection

ABBREVIATION	DEFINITION
1- through 16-	Contact input negative terminal connection
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal. No internal connection

18.6 Field wiring restrictions - (CCDI)

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Cable resistances (see page 256) that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
 - ☐ Rshunt across contact must be $\geq 10k$ ohms to always recognize an open contact as open.
 - ☐ Rshunt across contact must be $\geq 50k$ ohms to maintain the high level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
 - ☐ Rshunt across contact must be $\geq 150k$ ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
 - ☐ Rfault from either line to ground must be $\leq 5K$ ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
 - ☐ Rwiring through field wiring to contact must be < 100 ohms to always recognize a closed contact as closed.

18.7 Field wiring cable lengths - (CCDI)

The following two tables list the Maximum cable lengths for field wiring to the contacts. For both tables, assume R_{contact} is 0 ohms.

The following table applies when there are individual common return lines brought to the card edge. This implies that R_{return} is 0 ohms.

Maximum cable length for 16 individual common returns

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The following table applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum cable length for a single common return for all 16 inputs

WIRE GAUGE	OHMS PER THOUSAND FEET - (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH - (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

18.8 Cable impedances in field wiring - (CCDI)

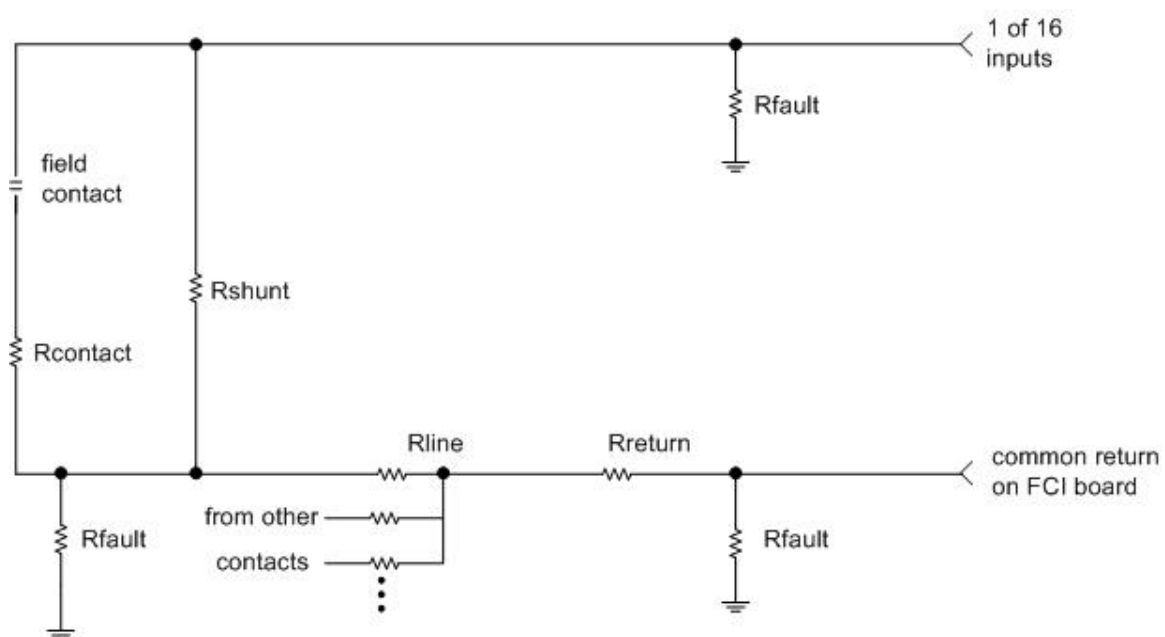
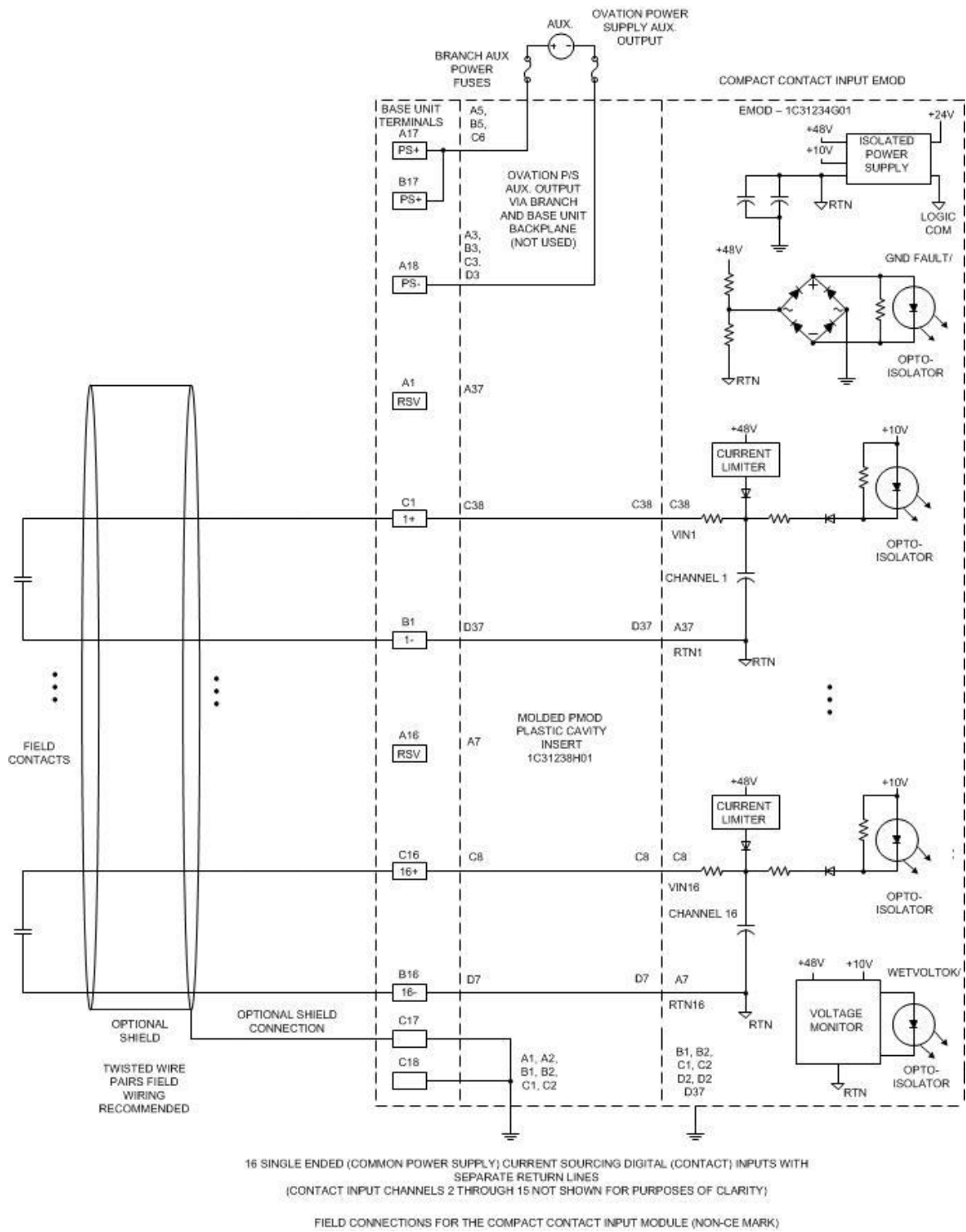
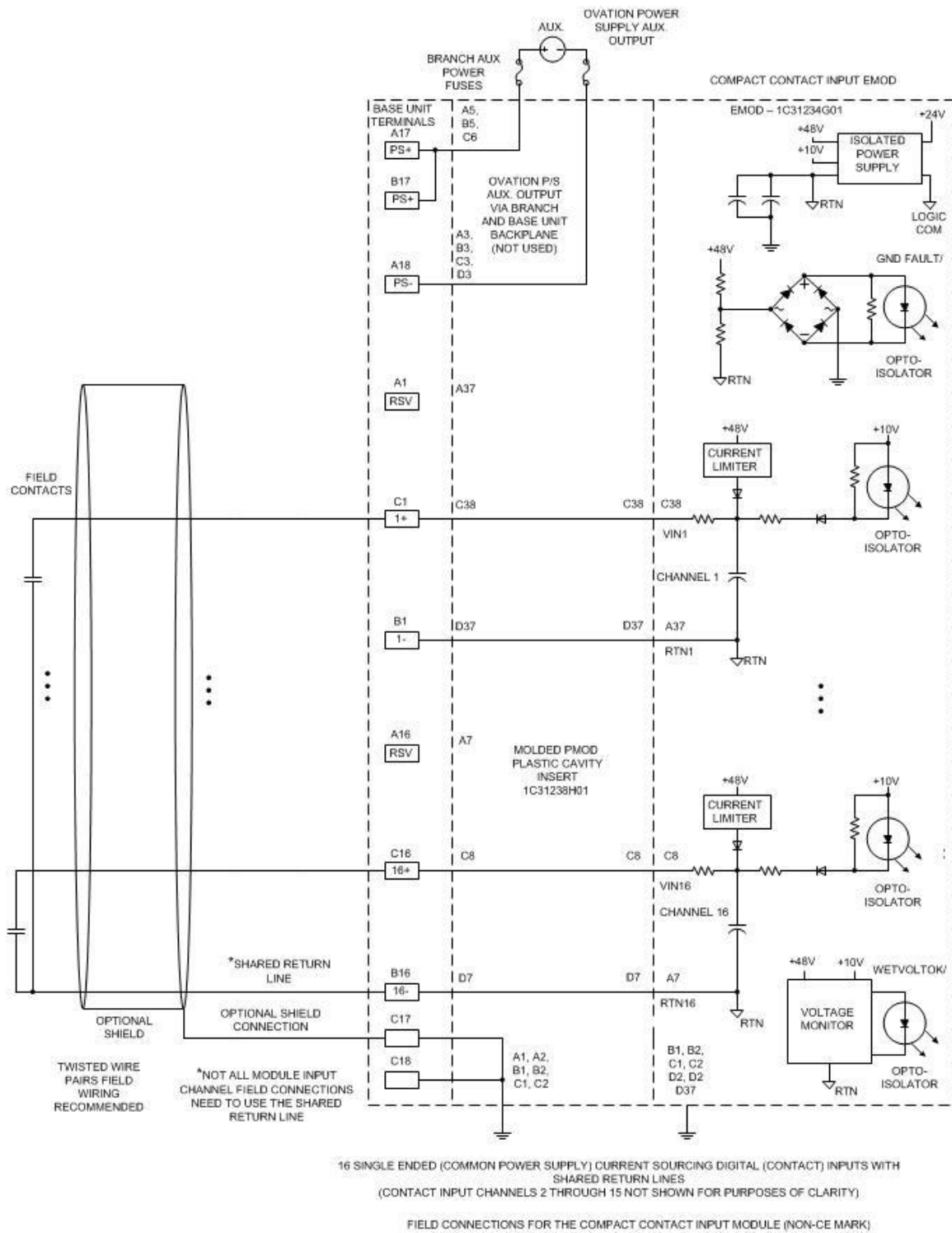


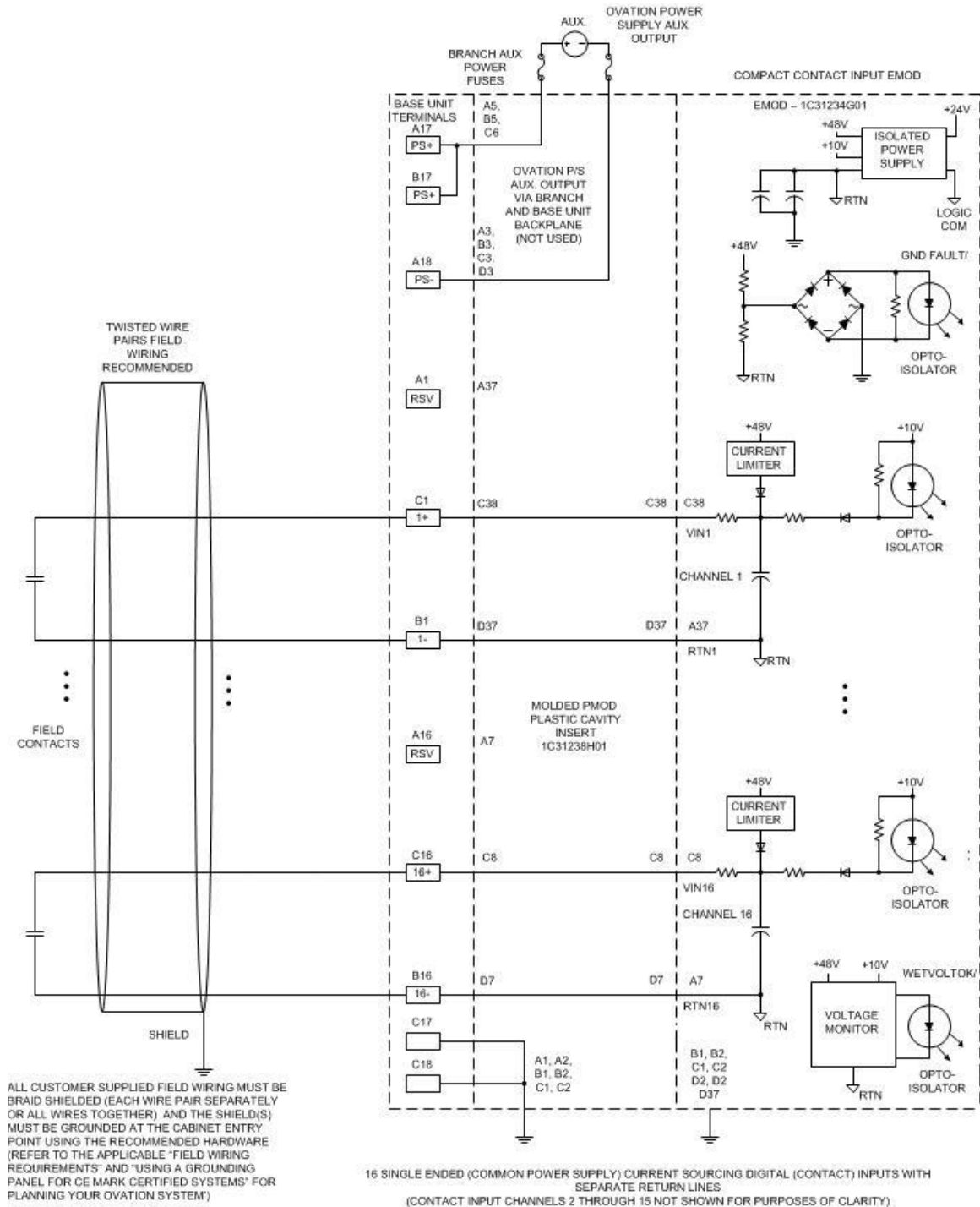
Figure 71: Cable impedances in field wiring

18.9 Field wiring diagrams - (CCDI)

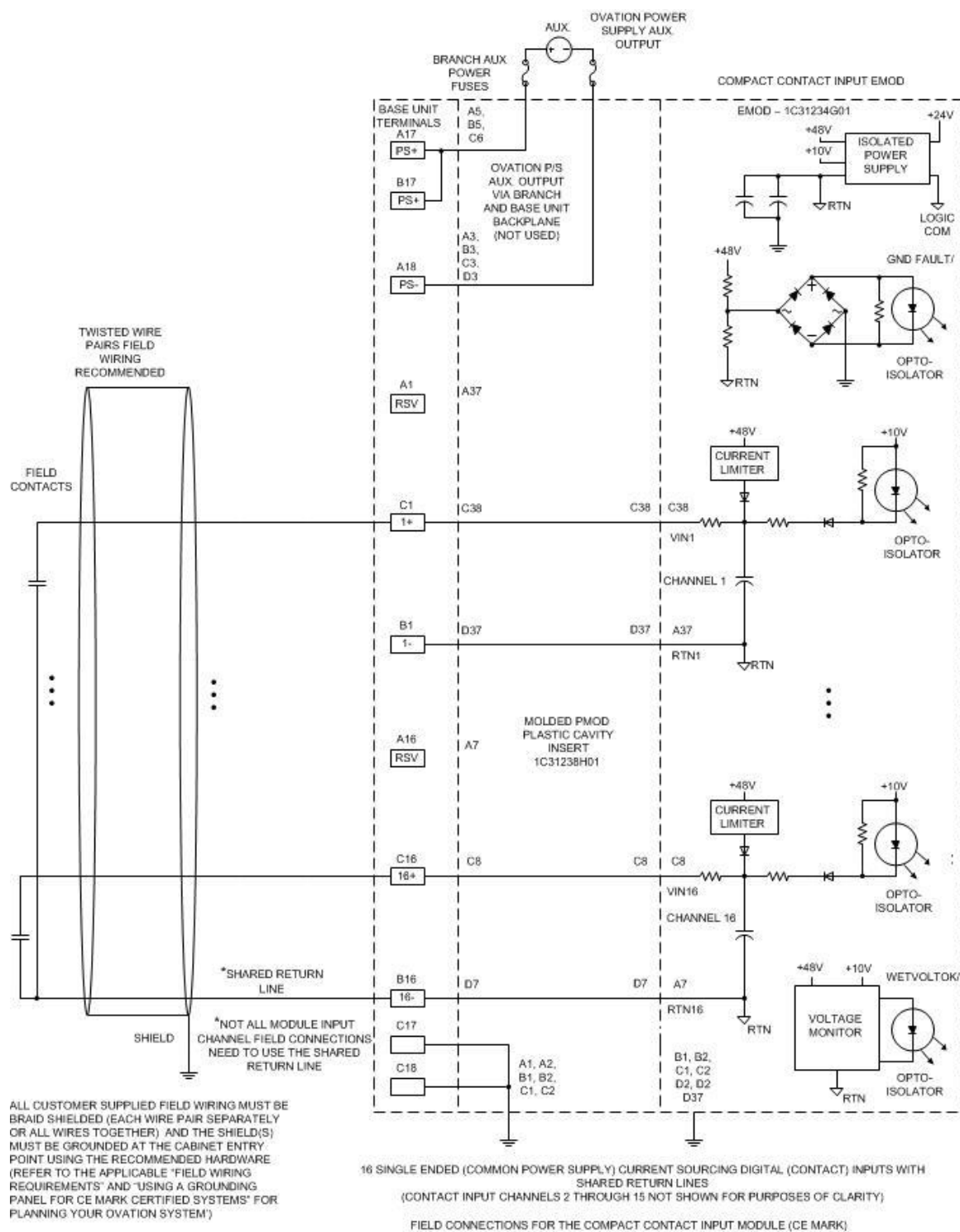




18.10 Field connection wiring diagrams (CE Mark) - (CCDI)



18.10 Field connection wiring diagrams (CE Mark) - (CCDI)



18.11 Configuration/Status Register information - (ContactDI) & (CCDI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

Contact (and Compact Contact) Input configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module 1 = configure 0 = unconfigure, causing an attention status	Module Configured 1 = configured 0 = unconfigured
1	Force Error 1 = force an attention status to be read by Controller 0 = no forced error	Forced error 1 = forced error set by Controller 0 = no forced error
2-5	Not defined	Not defined
6-7	Reserved	Reserved
8	Not defined	Wetting Voltage Failure 1 = +48V wetting Voltage Failed 0 = +48V wetting Voltage OK.
9	Ground Fault Attention Enable 1 = configure GND fault to cause an attention status 0 = configure GND fault to not cause an attention status	Ground Fault Attention Enable 1 = GND fault causes attention status 0 = GND fault does not cause an attention status
10	Not defined	Ground Fault 1 = field wiring has a ground fault 0 = field wiring does not have a ground fault
11-15	Not defined	Not defined

The bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: After the Contact Input module power is cycled, this bit is “0.” A “1” must be written to the Configure module bit. If the module is not configured in this manner, an attention status is sent to the Controller upon an attempt to read the point data. The bit may be read back through the Status Register.

Bit 1: The Force Error bit is “0” after the Contact Input module power is cycled. If the Controller sets the Force Error bit, an attention status is issued. The bit may be read back through the Status Register.

Bits 2-5: These bits are not defined.

Bit 6 & 7: These bits are reserved in the Status Register.

Bit 8: This bit is set in the Status Register if the +48V supply on the FCI board fails.

Bit 9: The GND Fault Attention Enable bit is “0” after the Contact Input module power is cycled. This bit must be set by the Controller if a ground fault is to be treated as a catastrophic failure.

If Bit 9 is set, a ground fault causes an attention status to be returned to the Controller upon accessing the module, and no point data can be read.

If the bit is not set, a ground fault does not inhibit the Controller from reading point data.

In the latter case, if more than one ground fault occurs on the field wiring to a Contact Input module, false point data may possibly be read on channels with open contacts.

Bit 10: This bit is set in the Status Register if a ground fault occurs in the field wiring. This bit is not defined in Configuration Register.

Bits 11-15: These bits are not defined in the Configuration register and are read as high in the Status register. These bits cannot be accessed by the Controller during a write to the module.

18.12 Power checking (ContactDI - CCDI)

The module has an internal 48 transistor voltage supply and is capable of looking at 16 different contact inputs. Each input that is connected to a dry contact requires a digital point name or packed group point name with bit position. A closed contact will produce a one (true) value for the associated point whereas an open contact produces a zero (false) value. If the power supply were to fail, all points would have a zero (false) value.

Power on checking uses one of the sixteen inputs to verify that the 48 volt supply has not failed. The selected point is hard wired to simulate a closed contact, and should therefore always be a one (true) statement.

To implement the feature, when building the points for the field inputs, within the point config tab, the power on checking is enabled, and the channel is used (hardwired) is declared. When the field inputs are scanned, the hard wired channel is also scanned to verify that it has a value of one. If not, the field inputs will be tagged with “bad quality”.

If desired, a point may be built for the hard wired channel and be set to alarm on zero.

Note: *The terminal wiring for the Contact Digital Input and Compact Contact Digital Input modules is different.*

18.13 Diagnostic Logic card LEDs - (CCDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when GND Fault bit (Bit 10) of the Status Register is set. This indicates that a ground fault has occurred in the field wiring. An attention status is generated when the External Fault LED is lit only if the GND Fault Attention Enable bit (Bit 9) is set.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set or when the on-board +48V/+10V wetting power supply fails. Also lit when a timeout of the watchdog timer occurs when Controller stops communicating with module. An attention status is always generated when the LED is lit.
1 - 16 (Green)	Point Status LEDs 1-16. Lit when the input contact of the LED's corresponding channel is closed.

18.14 Specifications - (CCDI)

SOE Digital Input (16 Channel Compact Contact) Specifications

DESCRIPTION	VALUE
Number of channels	16
On board auxiliary power supply	42 V minimum 55 V Maximum
Propagation delay	7 mSec Maximum
Contact bounce rejection Always rejects contact change of state Always accepts contact change of state	< 3 mSec > 7 mSec
Closed contact output current	4 mA minimum 8 mA Maximum
Diagnostics	Internal module operating faults, Ground Fault Detection
Dielectric isolation: Channel to logic	1000 V AC/DC
Module power	4.56 W typical 4.75 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 19

Sequence of Events Digital Input module - (SOEDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Sequence of Events Digital Input module overview - (SOEDI)</i>	<i>266</i>
<i>Electronics modules (Emod) - (SOEDI)</i>	<i>267</i>
<i>Personality modules (Pmod) - (SOEDI)</i>	<i>267</i>
<i>Valid module combinations - (SOEDI)</i>	<i>267</i>
<i>External power supply information - (SOEDI)</i>	<i>267</i>
<i>Wiring information - (SOEDI)</i>	<i>267</i>
<i>Field interface - (SOEDI)</i>	<i>268</i>
<i>Terminal block wiring information - (SOEDI)</i>	<i>269</i>
<i>Field wiring configuration considerations - (SOEDI)</i>	<i>270</i>
<i>Field wiring diagrams configuration - (SOEDI)</i>	<i>271</i>
<i>Field connection wiring diagrams - (SOEDI)</i>	<i>273</i>
<i>Field connection wiring diagrams (CE Mark) - (SOEDI)</i>	<i>274</i>
<i>Configuration/Status Register information - (SOEDI)</i>	<i>275</i>
<i>Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI)</i>	<i>276</i>
<i>Specifications - (SOEDI)</i>	<i>276</i>

19.1 16 Channel Sequence of Events Digital Input module overview - (SOEDI)

The Sequence of Events (SOE) module provides 16 digital channels to monitor the open or closed state of digital inputs or contacts in the field. The module provides a filter to reject changes of state less than four milliseconds. The Sequence of Events module can also perform event tagging and chatter control for each input channel.

The Ovation Controller writes a channel event tagging mask to the Electronics module to enable event tagging for specific input channels. It has a chatter control flag for each channel to indicate that an input channel has changed state too many times in a period of time or is changing state at too fast a rate. It also has a channel ID to indicate which channel changed state.

Each channel is checked every 125 microseconds. If the channel event tagging mask bit is zero, that channel is not checked. Time synchronization is accomplished by the Ovation Controller writing a time reference simultaneously to all Sequence of Events modules with a one millisecond resolution.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules. All SOE modules in a Controller **MUST** be connected to the IOIC card that is configured as the Time Keeper.

A control bit written by the Ovation Controller provides two options for handling input chatter:

- The first option sets the chatter control flag if the rate of change for an input is greater than 1 per 100 milliseconds.
- The second option sets the chatter control flag if four or more state changes occur on an input between reads of the event buffer.

There are two 32 event buffers. This allows the event tagging and chatter control function to be writing into one event buffer while the Ovation Controller is reading the other event buffer. The Ovation Controller only reads each module a small portion of the loop time. This allows both event buffers to be available the rest of the loop time.

Each event buffer contains 64 words with up to 32 Channel-IDs and 32 Event-Times. The event buffers are memories. The memory control circuit controls which event buffer to write into and which event buffer to read from. Before reading the event buffer, the buffer status register must be read to determine the number of words to read.

The Sequence of Events module is a CE Mark certified module.

CAUTION! (For CE Mark certified systems) Any base unit that contains a 125VDC Sequence of Events Electronics module (1C31157G02) with differential Digital Input Personality module (1C31110G02) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit that contains a 125VDC Sequence of Events Electronics module (1C31157G02) with single-ended Digital Input Personality module (1C31110G01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

Place this label in a visible location on the base unit, preferably above the spare fuse location. The project drawings should indicate this.

19.2 Electronics modules (Emod) - (SOEDI)

- **1C31157G01** provides for 24/48 VDC single-ended or differential inputs.
- **1C31157G02** provides for 125 VDC single-ended or differential inputs.

19.3 Personality modules (Pmod) - (SOEDI)

- **1C31110G01** (single-ended inputs) and **1C31110G02** (differential input) are used for digital input (see page 268).

19.4 Valid module combinations - (SOEDI)

Sequence of Events Digital Input valid module combinations

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
24/48 VDC Single-ended (Legacy)	16	1C31157G01	1C31110G01
Differential (Legacy)	16	1C31157G01	1C31110G02
125 VDC Single-ended (Legacy)	16	1C31157G02	1C31110G01
Differential (Legacy)		1C31157G02	1C31110G02
All module configurations listed in the table are CE Mark certified unless they contain a 5FDI.			

When the 125VDC Sequence of Events Digital Input Emod (1C31157G02) is used in applications without the un-fused Differential Pmod (1C31110G02), external fusing or other current limiting devices are recommended on the hazardous inputs to provide protection to the external wiring and power source.

19.5 External power supply information - (SOEDI)

If the Sequence of Events Digital Input module uses the 1C31110G01 Personality module (configured for 16 single-ended inputs), the required voltage source may be obtained from the internal auxiliary power supply (backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 635) contains steps to be undertaken before connecting the external power supply to the Sequence of Events Digital Input module base unit terminal block.

19.6 Wiring information - (SOEDI)

The Sequence of Events modules can be divided into two types depending on their front end connections. The digital Input field Interface modules can be broken down further into Single-Ended and Differential as well as low and high voltage.

The following wiring section topics are divided to show the wiring of the Sequence of Events Digital Input Field Interface modules and then the Sequence of Events Contact Field Interface modules.

19.7 Field interface - (SOEDI)

The Digital Input configuration contains 16 channels, where each channel has voltage level sensing circuitry used to detect whether an input is on or off.

The Sequence of Events module has 16 galvanically isolated differential inputs to accommodate separate external auxiliary supplies, or 16 single-ended (common return) digital inputs with an on-card blown fuse detector to accommodate a common external auxiliary supply for all channels.

The selection of the Personality module determines if the inputs are differential or single-ended. The input voltage level monitored by the module is determined by the particular card group in the module.

The field side circuitry for the single-ended configuration and the differential configuration is shown under Field Wiring Considerations for the Digital Input Configuration (see page 270). An input resistor provides the normal mode surge protection and limits the current during normal operation.

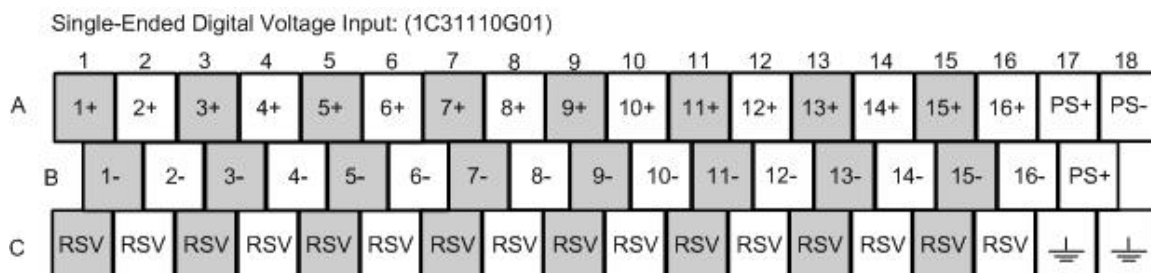
An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side. The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the wetting supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the PDIA.
- Auxiliary supply level is lower than minimum On Input Voltage.

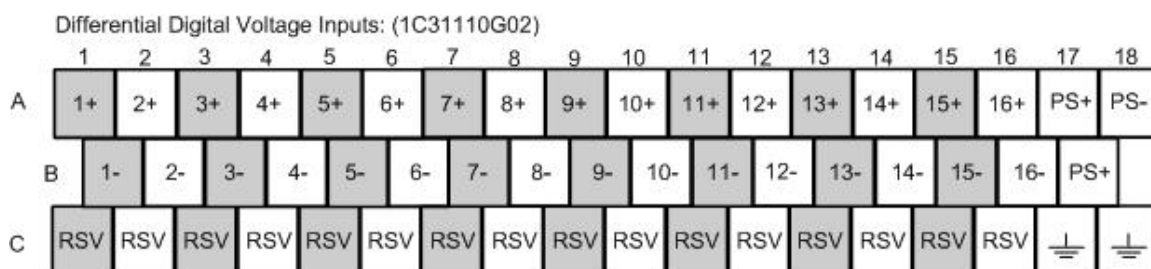
19.8 Terminal block wiring information - (SOEDI)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagrams for the Sequence of Events digital input Personality modules are illustrated below.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.



Note: Forced signals are present on the reserved (RSV) pins due to backplane connections.



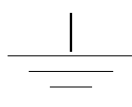
Notes:

1. Forced signals are present on the reserved (RSV) pins due to backplane connections.
2. Each channel has a diode bridge at the front-end; therefore, inputs to Row A and B are reversible.
3. The terminal block label indicates polarity only to be uniform with other terminal block labels where Row A is for high-side (+) signals, and Row B is for return (-) signals.

Figure 72: Terminal block connections for the Sequence of Events Digital Input Pmods

The following table lists the abbreviations used in the terminal block diagrams.

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
PS+, PS-	Auxiliary Power Supply terminals

ABBREVIATION	DEFINITION
RSV	Reserved terminal. No connection allowed on these terminals

Note: Do **not** use unmarked terminal block locations.

19.9 Field wiring configuration considerations - (SOEDI)

The following minimum leakage resistances of the cable and the interface devices apply:

24 VDC - 100 K ohms
48 VDC - 150 K ohms
125 VDC - 250 K ohms

19.10 Field wiring diagrams configuration - (SOEDI)

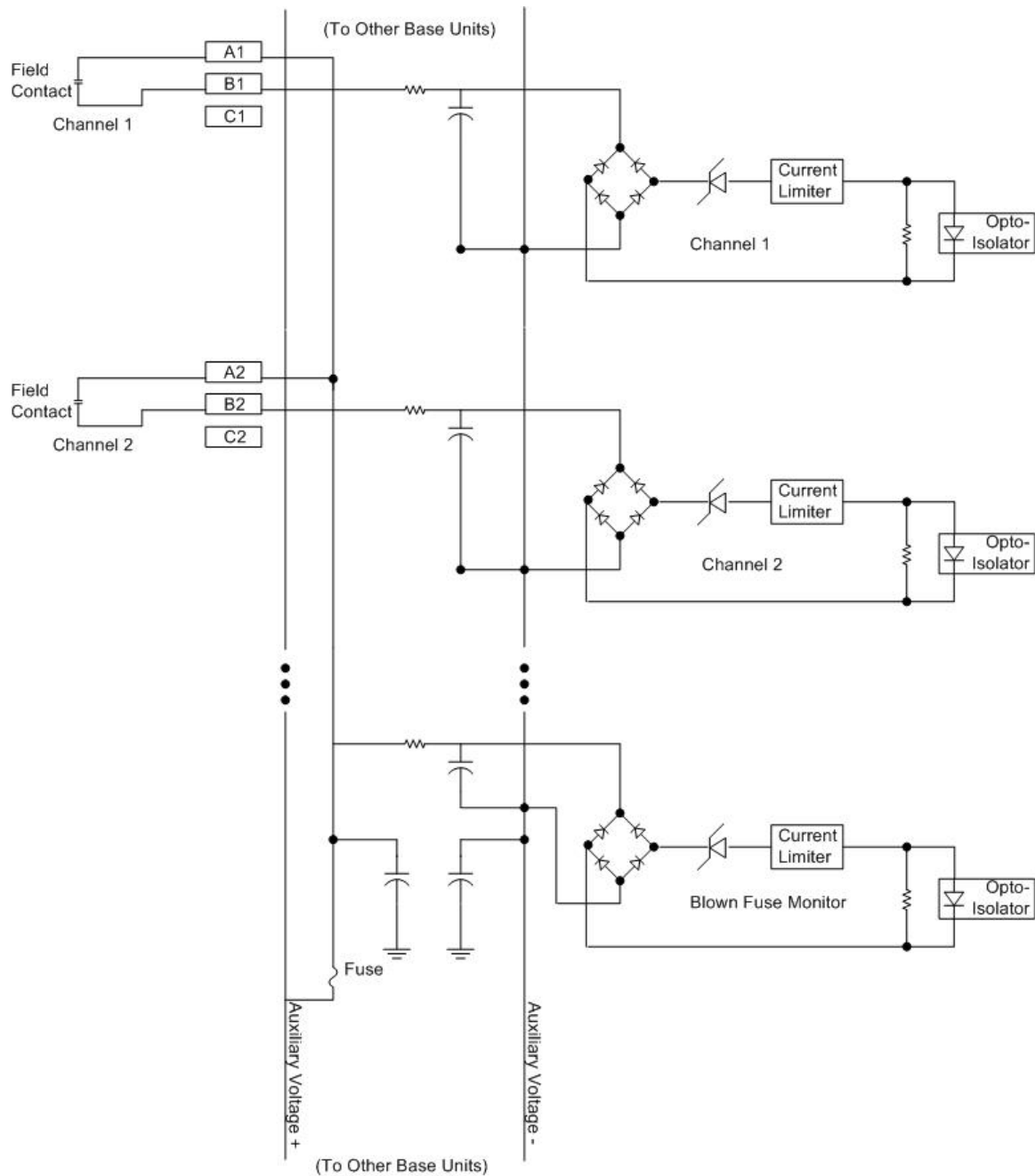


Figure 73: Sequence of Events module single-ended Digital Input front end

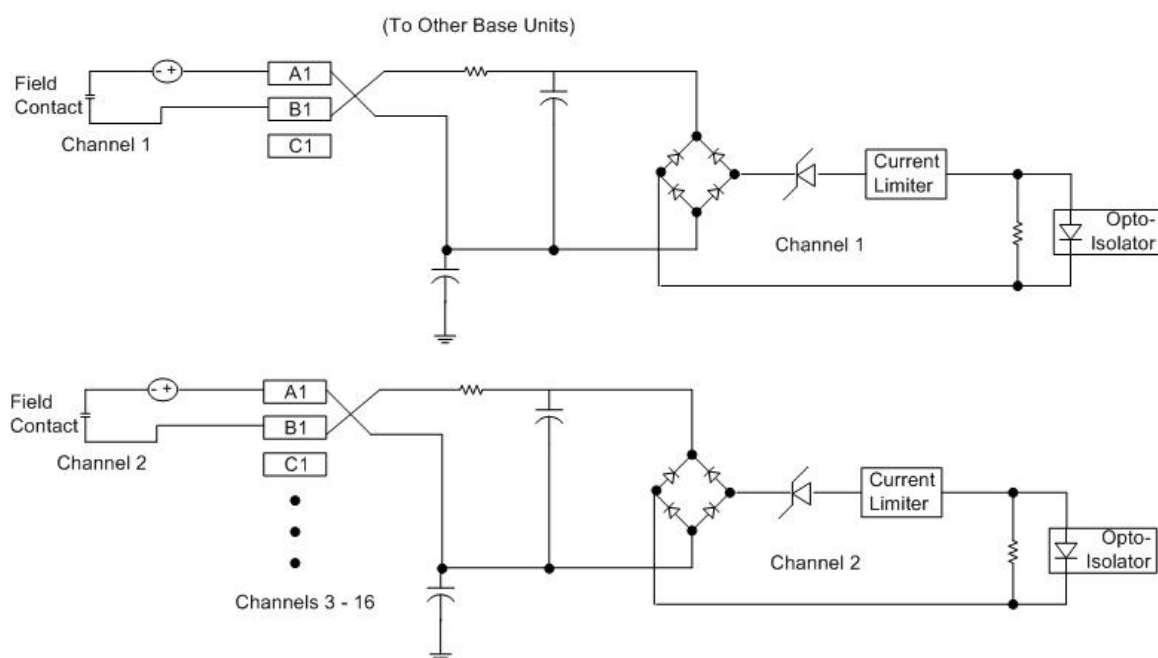


Figure 74: Sequence of Events module differential Digital Input front end

19.11 Field connection wiring diagrams - (SOEDI)

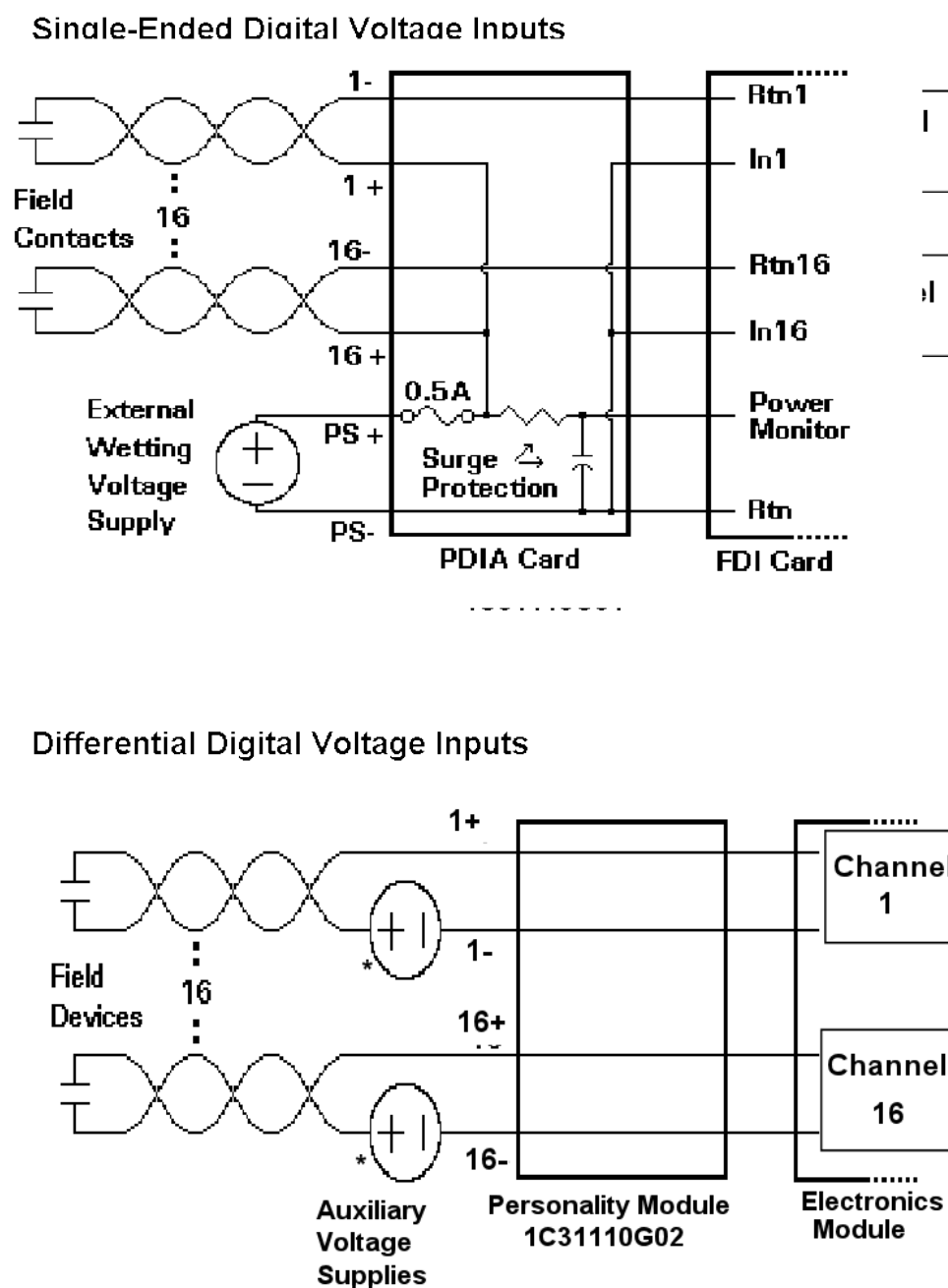
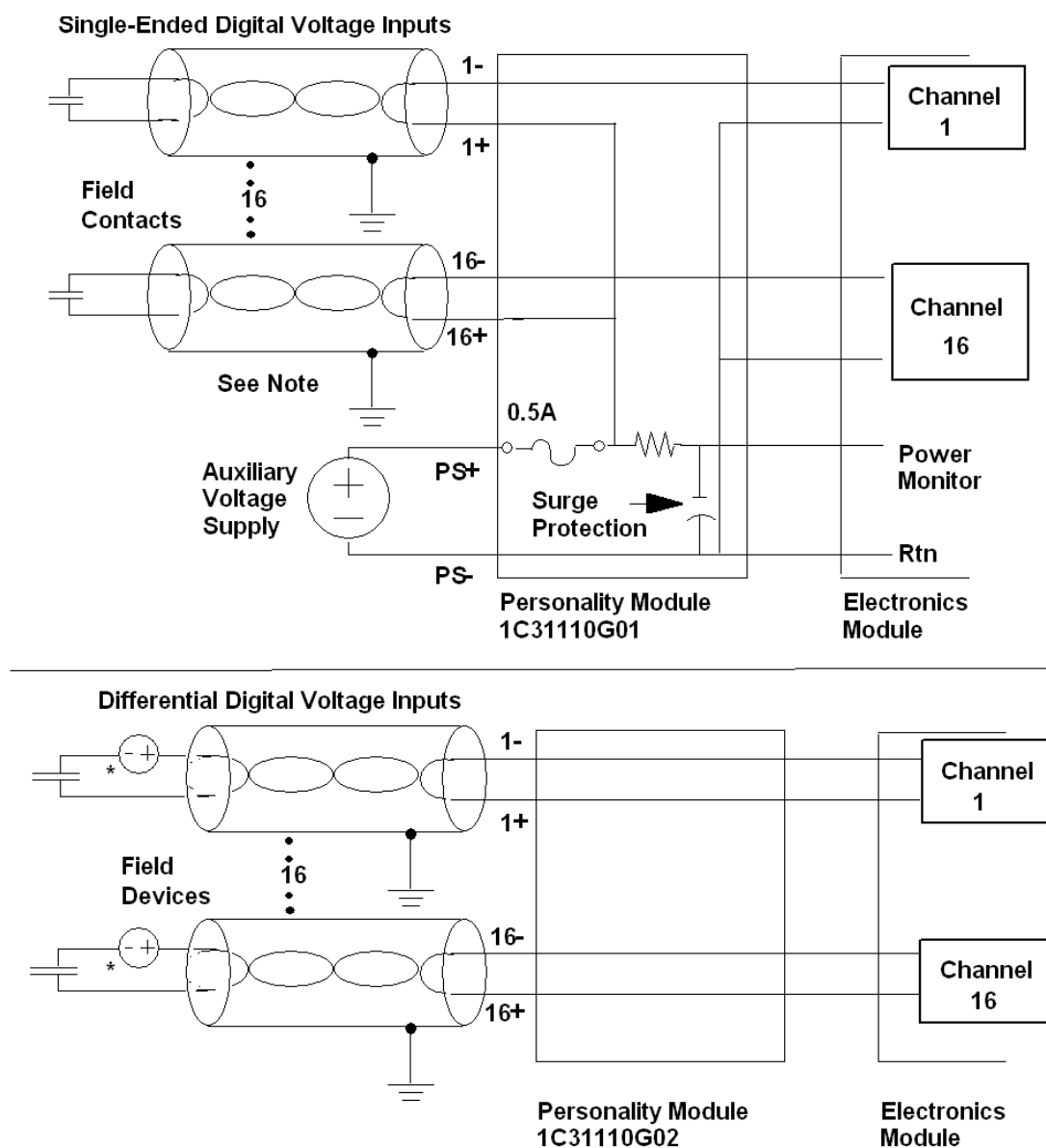


Figure 75: Field connections for the SOE Digital Input Pmod

19.12 Field connection wiring diagrams (CE Mark) - (SOEDI)



Note

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 76: Field connections for the SOE Digital Input Pmod (CE Mark)

19.13 Configuration/Status Register information - (SOEDI)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the [Ovation Operator Station User Guide](#).)

Sequence of Events Digital Input configuration/Status Register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module	Module configured (1 = configured; 0=not configured)
1	Force internal error	Internal error (1 = forced error; 0=no forced error)
2 - 5	Not used. Should be set to zero (0).	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input.
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault
12	Disable chatter control	Disable chatter control
13	Chatter control option.	Status of chatter control option.
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.

Bit 0: Module does not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bit 6: This bit should be set for a single-ended input and cleared for a differential input.

Bits 8 - 10: These bits should be cleared to zero (0).

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event is recorded until the event buffer overflows. Default state is "0" and enables the chatter control function.

Bit 13: When this bit is set, chatter is flagged when an input changes state four or more times between event buffer reads. When cleared, chatter is flagged for state changes greater than 1 per 100 milliseconds.

Bits 14 - 15: Not used in the Configuration Register. Bit 14 is clock synchronized in the Status Register.

Word address 14 (E in Hex) is used to enable or disable the channel event tagging mask.

Secondary/expansion configuration/status register (address 14 or E in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION (WRITE)	DATA DESCRIPTION - STATUS (READ)
0 - 15	Channel Event Tagging mask	Channel Event Tagging mask

19.14 Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	For single-ended Digital Input: Lit when fuse blows or there is a loss of the auxiliary power supply (only when Bit 6 of Configuration register is set; then Bit 7 of the Status register is set). For Differential Digital Input: Not lit since the configuration bit is not set, and the blown fuse signal from the field card is ignored.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when Controller stops communicating with the module.
1 - 16 (Green)	Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum "On Input Voltage."

19.15 Specifications - (SOEDI)

SOE Digital Input (16 Channel) Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) ¹	Refer to the table below
Propagation delay of contact change of state ²	
24V/48 VDC	3.75 Millisecond Minimum 4.25 Millisecond Maximum
125VDC	3.75 Millisecond Minimum 4.45 Millisecond Maximum
Signal rejection	
Always rejects change of state	< 3.87 ms
Always accepts change of state	> 4.13 ms

DESCRIPTION	VALUE
Cable length (quality is 50pF/ft or better)	1000 feet Maximum
Diagnostics	Internal module operating faults and Blown fuse detection. ³
Dielectric isolation: Channel to channel ⁴ Channel to logic	1000 VDC 500 VAC 1000 VAC/DC
Module power from logic supply	Main: 1.44 W typical, 1.8 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ Input range level is dependent on module group. ² Does not include cable capacitance. ³ Blown fuse detection applies to single-ended channel configuration only, where an on-board fuse is provided for the auxiliary power supply. ⁴ Channel to channel isolation applies to differential channel configuration only.	

Sequence of Events Digital Input ranges

INPUT LEVEL	ON INPUT VOLTAGE (VDC)		OFF INPUT VOLTAGE (VDC)	ON INPUT CURRENT (mA)		OFF INPUT (WATTS)	INPUT POWER TYPICAL
	Min	Max	Min	Min	Max	Max	
24 VDC	18	60	9	0.9	2.6	0.3	1.1
48 VDC	18	60	9	0.9	2.6	0.3	2.2
125 VDC	80	140	55	0.6	1.5	0.3	3.3

SECTION 20

Sequence of Events Contact Digital Input Field Interface module - (SOEContactDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Sequence of Events Contact Digital Input Field Interface module overview - (SOEContactDI)</i>	<i>280</i>
<i>Electronics modules (Emod) - (SEContactDI).....</i>	<i>280</i>
<i>Personality modules (Emod) - (SEContactDI)</i>	<i>280</i>
<i>Valid module combinations - (SEContactDI).....</i>	<i>280</i>
<i>Field wiring restrictions - (SEContactDI)</i>	<i>281</i>
<i>Field wiring diagrams - (SEContactDI).....</i>	<i>282</i>
<i>Field wiring cable lengths - (SEContactDI)</i>	<i>283</i>
<i>Terminal block wiring information - (SEContactDI).....</i>	<i>284</i>
<i>Field connection wiring diagrams - (SEContactDI)</i>	<i>285</i>
<i>Field connection wiring diagrams (CE Mark) - (SEContactDI).....</i>	<i>286</i>
<i>Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI).....</i>	<i>286</i>
<i>Specifications - (SEContactDI).....</i>	<i>287</i>

20.1 16 Channel Sequence of Events Contact Digital Input Field Interface module overview - (SOEContactDI)

The Contact Input configuration provides 16 contact input current detecting channels with common returns. The field side circuitry and terminal connections for three of these channels are shown in Field Wiring Diagrams for the Contact Input Configuration (see page 282).

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 V power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

There are two methods of wiring field devices to the termination block. Each field contact may have a separate input and return line as shown for channel 1. Alternatively, field contacts wired to the same module may share a return line as shown for channels 2 and 3. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition occurs as well as a degradation of the common mode surge protection.

Ground fault detection circuitry on the Sequence of Events module with Contact Inputs activates when the input or return line for any channel finds a low impedance (<10K ohms) path to earth ground. A single wire with a ground fault does not cause an error in the point data, but multiple ground faults (if they include input and return lines) could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit 11 in the Status Register is set. If the GND Fault Attention Enable bit 8 is set in the Configuration Register, a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. See Field Wiring Diagrams for the Contact Input Configuration (see page 282) for ground fault detection circuitry.

20.2 Electronics modules (Emod) - (SEContactDI)

1C31157G03 (Contact Input) provides for 48 VDC on-card auxiliary power.

20.3 Personality modules (Emod) - (SEContactDI)

1C31110G03 (Contact Input) provides for 48 VDC on-card auxiliary power.

20.4 Valid module combinations - (SEContactDI)

Sequence of Events Contact Digital Input Field interface valid module combinations

RANGE	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE
Contact Input w/ 48 VDC On-Card auxiliary (Legacy)	16	1C31157G03	1C31110G03
All module configurations listed in the table are CE Mark certified unless they contain a 5FDI.			

20.5 Field wiring restrictions - (SEContactDI)

The following definitions apply to the restrictions listed below:

- Rshunt = contact shunt resistance
- Rcontact = resistance associated with a closed contact
- Rreturn = resistance of the common return line
- Rline = resistance of the non-common cable length to and from the contact
- Rwiring = Rcontact + Rline + 16Rreturn
- Rfault = resistance from either line to ground which causes a ground fault

Field Wiring Diagrams for the Contact Input Configuration (see page 282) shows possible cable resistances that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
 - ☐ Rshunt across contact must be greater than or equal to 10k ohms to always recognize an open contact as open.
 - ☐ Rshunt across contact must be greater than or equal to 50k ohms to maintain the high level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
 - ☐ Rshunt across contact must be greater than or equal to 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
 - ☐ Rfault from either line to ground must be less than or equal to 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
 - ☐ Rwiring through field wiring to contact must be less than 100 ohms to always recognize a closed contact as closed.

20.6 Field wiring diagrams - (SEContactDI)

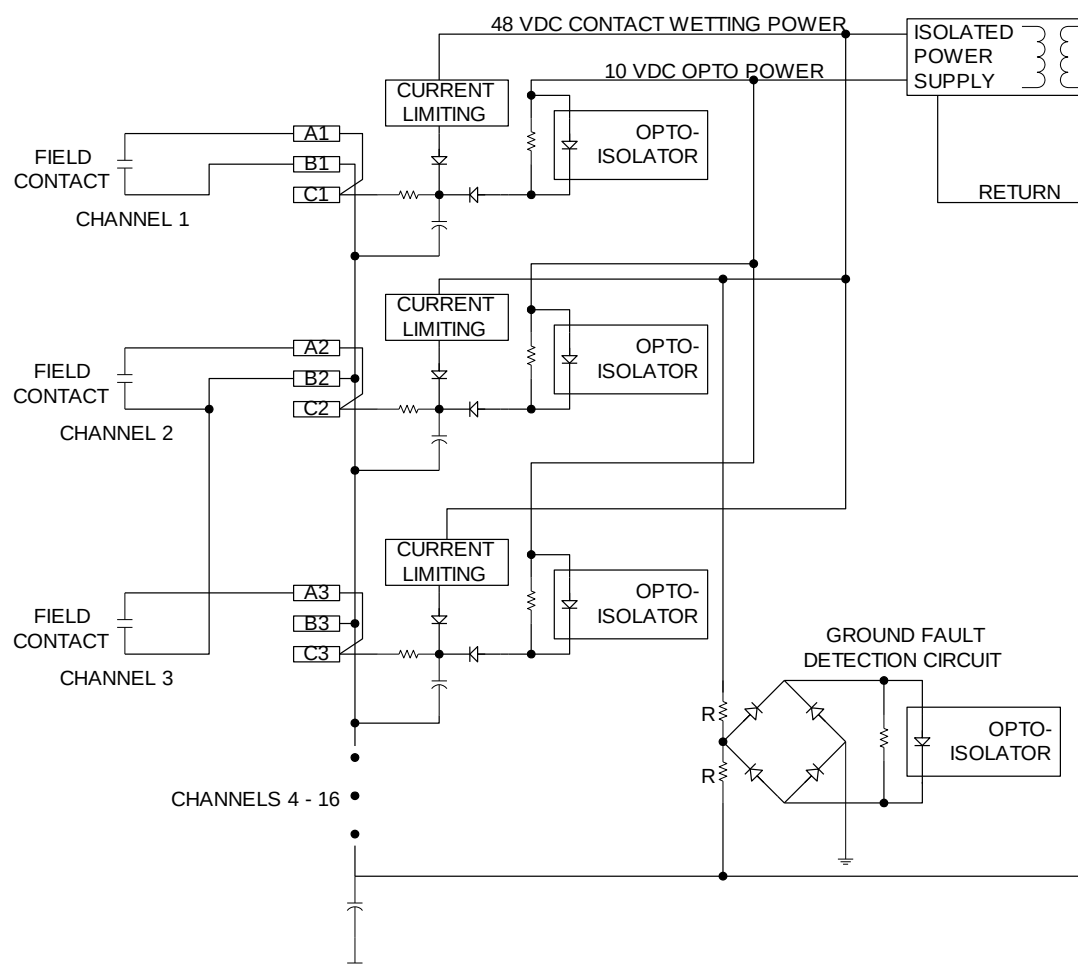


Figure 77: Sequence of Events Module Contact Input Front End

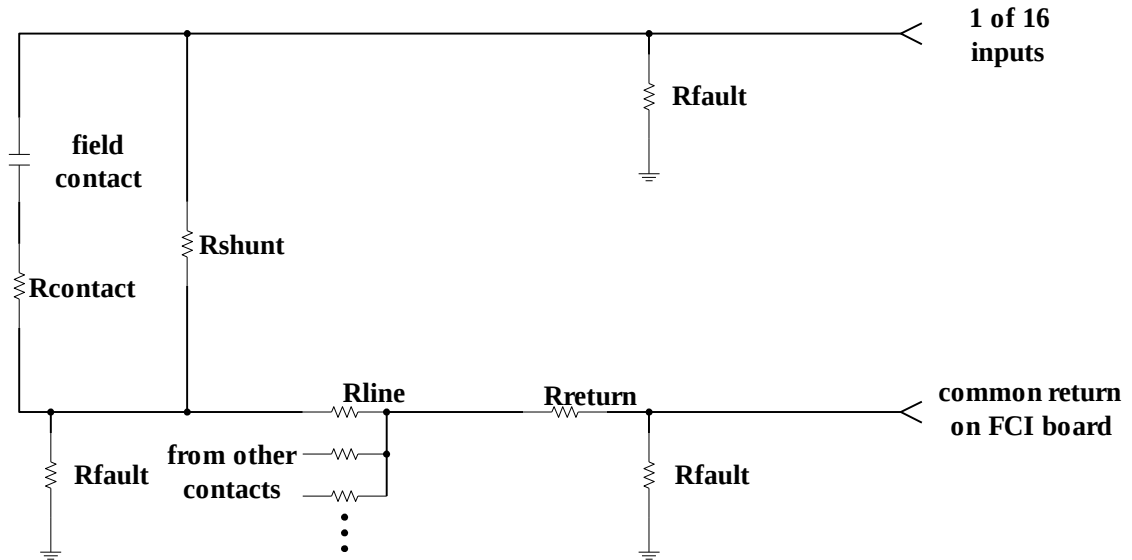


Figure 78: Cable Impedances in Field Wiring

20.7 Field wiring cable lengths - (SEContactDI)

The following two tables list the Maximum cable lengths for field wiring to the contacts. For both, assume R_{contact} is 0 ohms.

The table below applies when there are individual common return lines brought to the card edge. This implies that R_{return} is 0 ohms.

Maximum cable length for 16 individual common returns

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The table below applies when all 16 channels share a common return line. In both tables, the Maximum Cable Length is the length of the cables from the termination block to the contacts in the field.

Maximum cable length for a single common return for all 16 inputs

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
18	6.64	0.89

20.8 Terminal block wiring information - (SEContactDI)

The diagram for the Sequence of Events contact input Personality module is illustrated in the figure below.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

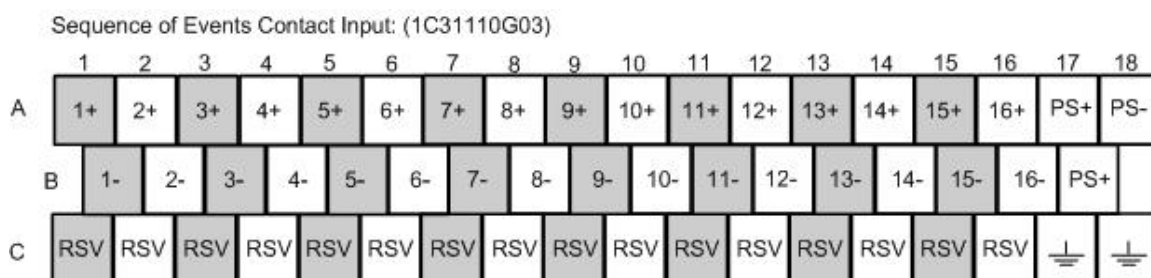


Figure 79: Terminal block connections for the Sequence of Events Contact Input Personality modules

The following table lists and defines the abbreviations used in this diagram.

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
1+ through 16+	Contact input positive terminal connection.
1- through 16-	Contact input negative terminal connection.
PS+, PS-	Auxiliary Power Supply terminals.
RSV	Reserved terminal. No connection allowed on these terminals.

Note: Do **not** use terminal block locations marked RSV.

20.9 Field connection wiring diagrams - (SEContactDI)

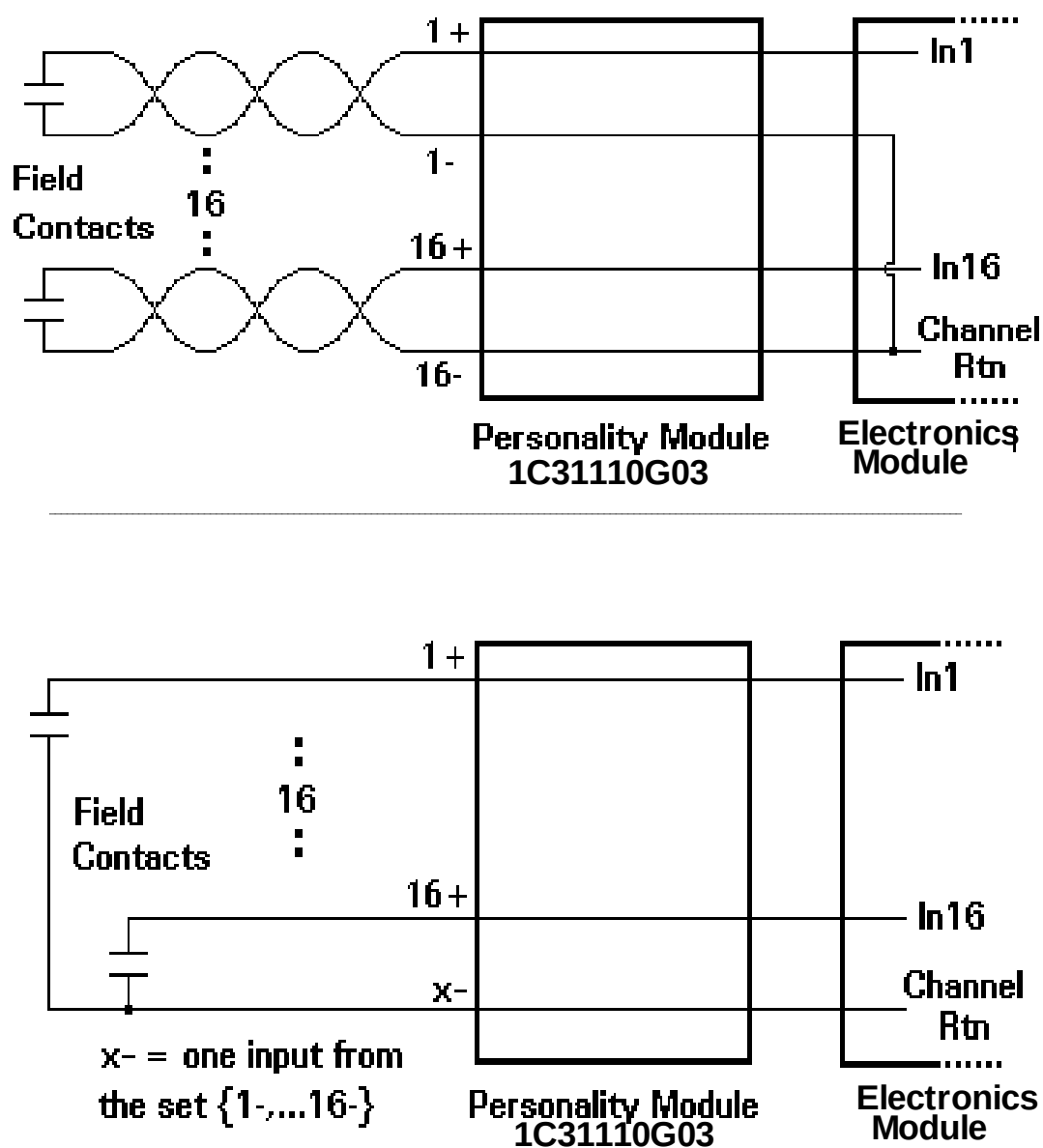
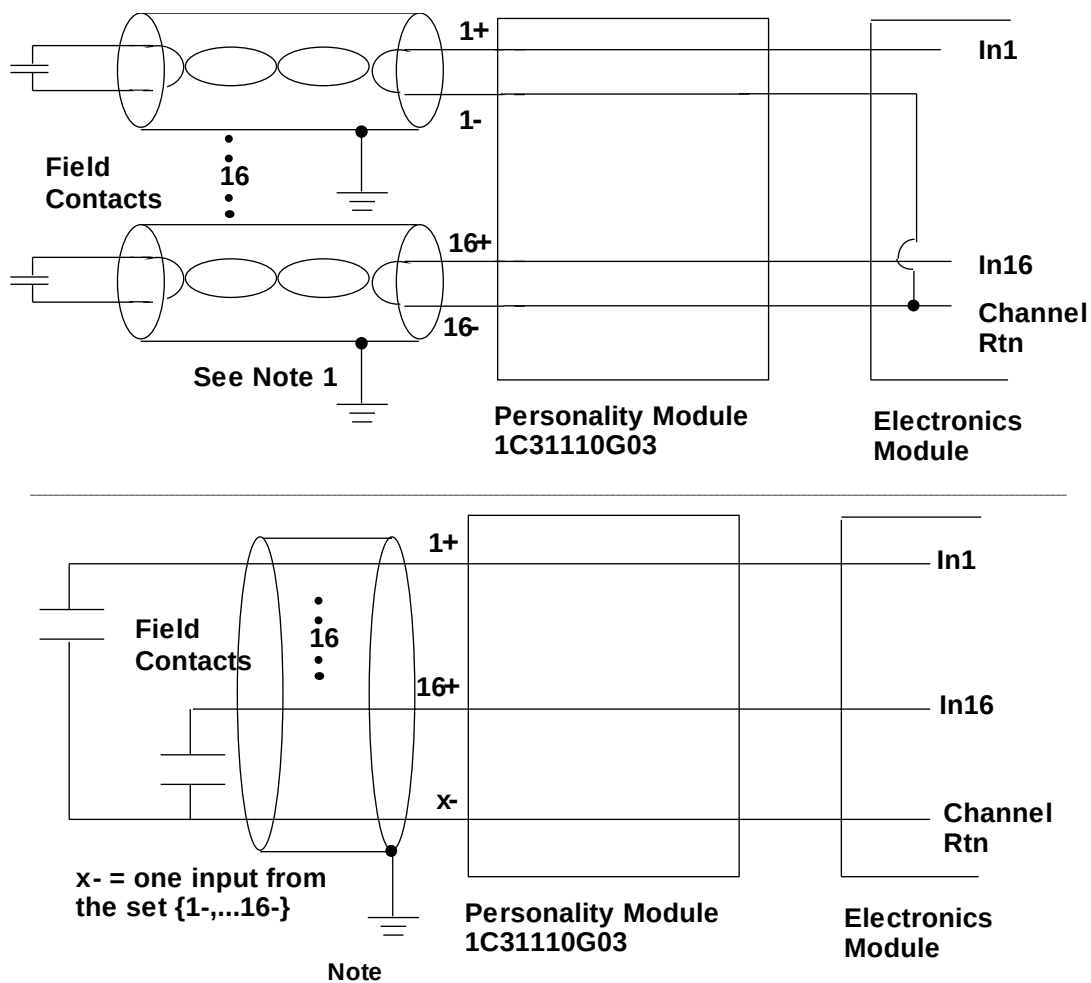


Figure 80: Field connections for the SOE Contact Input Pmod

20.10 Field connection wiring diagrams (CE Mark) - (SEContactDI)

All field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware (refer to "Cable Guidelines" in the applicable Ovation system installation manual).

Figure 81: Field connection for the SOE Contact Input Pmod (CE Mark)

20.11 Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	For single-ended Digital Input: Lit when fuse blows or there is a loss of the auxiliary power supply (only when Bit 6 of Configuration register is set; then Bit 7 of the Status register is set). For Differential Digital Input: Not lit since the configuration bit is not set, and the blown fuse signal from the field card is ignored.
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when Controller stops communicating with the module.
1 - 16 (Green)	Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum "On Input Voltage."

20.12 Specifications - (SEContactDI)

SOE Contact Digital Input Field Interface Specifications

DESCRIPTION	VALUE
Number of channels.	16
On board auxiliary power supply.	42 V Minimum 55 V Maximum
Signal rejection Always rejects contact change of state. Always accepts contact change of state.	< 3.87 Millisecond > 4.13 Millisecond
Propagation delay of contact change of state ¹	3.75 Millisecond Minimum 4.40 Millisecond Maximum
Closed contact output current.	4 Millisecond Minimum 8 Millisecond Maximum
Diagnostics.	Internal module operating faults, Ground Fault Detection
Dielectric isolation: Channel to logic.	1000 V AC/DC
Module power from logic supply.	4.56 W typical (all inputs on), 5.0 W Maximum
Operating temperature range.	0 to 60°C (32°F to 140°F)
Storage temperature range.	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing).	0 to 95%
¹ Does not include cable capacitance.	

SECTION 21

Sequence of Events Compact Digital Input Field Interface module 1 - (SOECompactDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Sequence of Events Compact Digital Input Field Interface module 1 overview - (SOECompactDI)</i>	<i>290</i>
<i>Electronics modules (Emod) - (SOECompactDI)</i>	<i>291</i>
<i>Personality modules (Pmod) - (SOECompactDI)</i>	<i>291</i>
<i>Valid module combinations - (SOECompactDI)</i>	<i>292</i>
<i>External power supply information - (SOECompactDI)</i>	<i>292</i>
<i>Wiring information - (SOECompactDI)</i>	<i>292</i>
<i>Field wiring diagrams configuration (Front end) (G04) - (SOECompactDI)</i>	<i>293</i>
<i>Field interface - (SOECompactDI)</i>	<i>293</i>
<i>Field wiring field interface restrictions (G01-G03) - (SOECompactDI)</i>	<i>294</i>
<i>Field wiring cable lengths (G04) - (SOECompactDI)</i>	<i>294</i>
<i>Field wiring restrictions (G04) - (SOECompactDI)</i>	<i>295</i>
<i>Terminal block wiring information - (SOECompactDI)</i>	<i>296</i>
<i>Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI) ..</i>	<i>297</i>
<i>Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)</i>	<i>304</i>
<i>Field connection wiring diagram (G04) - (SOECompactDI)</i>	<i>311</i>
<i>Field connection wiring diagram (CE Mark) (G04) - (SOECompactDI)</i>	<i>313</i>
<i>Configuration/Status Register information - (SOECompactDI)</i>	<i>315</i>
<i>Diagnostic Logic card LEDs - (SOECompactDI)</i>	<i>317</i>
<i>Specifications and ranges (G01-3) - (SOECompactDI)</i>	<i>318</i>
<i>Specifications and ranges (G04) - (SOECompactDI)</i>	<i>319</i>

21.1 16 Channel Sequence of Events Compact Digital Input Field Interface module 1 overview - (SOECompactDI)

The Compact Sequence of Events (SOE) module provides 16 digital channels to monitor the open or closed state of digital inputs or contacts in the field. The module provides a filter to reject changes of state less than four milliseconds. The Compact Sequence of Events module can also perform event tagging and chatter control for each input channel.

The Ovation Controller writes a channel event tagging mask to the Electronics module to enable event tagging for specific input channels. It has a chatter control flag for each channel to indicate that the input channel has changed state too many times in a period of time, or is changing state at too fast a rate. It also has a channel ID to indicate which channel changed state. Each channel is checked every 125 micro-seconds. If the channel event tagging mask bit is zero, that channel is not checked.

If there is an input channel state change, the change is recorded in the SOE module's Event Buffer and the input channel's Chatter counter is incremented. When the input channel's Chatter counter value reaches four, any additional state changes are not recorded for that input channel. The recording of additional state changes for that input channel is inhibited until the input channel Chatter counter is reset to a zero value.

A control bit written by the Ovation Controller provides two options for resetting an input channel's Chatter counter:

- Each input channel's Chatter counter is reset after the Ovation Controller reads the SOE module's Event Buffer. With this option selected, the SOE module identifies up to four state changes for each of its input channels between successive Ovation Controller Event Buffer read operations.
- Each input channel's Chatter counter is checked every 100 milliseconds and is decremented if its value is greater than zero. When the input channel's Chatter counter value reaches zero, future input channel state changes may be entered into the Event Buffer. With this option selected, an input state change rate greater than 1 per 100 milliseconds results in no new Event Buffer entries for that input channel while a lower input state change rate allows new Event Buffer entries for that input channel.

The Compact Sequence of Events module is a CE Mark certified module.

There are two 32 event buffers which allow the event tagging and chatter control function to be writing into one event buffer while the Ovation Controller is reading the other event buffer. The Ovation Controller only reads each module a small portion of the loop time. This allows both event buffers to be available the rest of the loop time.

Each event buffer contains 64 words with up to 32 Channel-IDs and 32 Event-Times. The event buffers are memories. The memory control circuit controls which event buffer to write into and which event buffer to read from. Before reading the event buffer, the buffer status register must be read to determine the number of words to read.

Time synchronization is accomplished by the Ovation Controller writing a time reference simultaneously to all Sequence of Events modules with a 1 millisecond resolution. The Compact Sequence of Event module is CE Mark applicable.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.
All SOE modules in a Controller **MUST** be connected to the IOIC card that is configured as the Time Keeper.

CAUTION! Do NOT mix the Compact Sequence of Events module (1C31233) with the Sequence of Events module (1C31157) in the same system.

CAUTION! CE Mark certified systems: Any base unit that contains a 125VDC Compact Sequence of Events Electronics module (1C31233G03) with cavity insert (1C31238H01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on that base unit.

Any base unit containing a 125VDC Compact Sequence of Events Electronics module (1C31233G03) with Fused Digital Input Personality module (5X00034G01) and interfaces to hazardous voltage (>60 VDC) must include a hazardous voltage warning label (1B30025H01) on ALL base units on the branch.

Place this label in a visible location on the base unit, preferably above the spare fuse location. The project drawings should indicate this.

The Compact Sequence of Events module comes in five combinations of Electronics and Personality modules:

- 24/48 VDC single-ended digital input.
- 24/48 VDC differential input.
- 125 VDC single-ended digital input.
- 125 VDC differential input.
- 48 VDC contact input with on card auxiliary supply.

21.2 Electronics modules (Emod) - (SOECompactDI)

- **1C31233G01** provides for 24/48 VDC single-ended inputs.
- **1C31233G02** provides for 24/48 VDC differential inputs and supports the 16 point individually fused option.
- **1C31233G03** provides for 125 VDC differential inputs and supports the 16 point individually fused option.
- **1C31233G04** (Contact Input) provides for 48 VDC on-card auxiliary power.

21.3 Personality modules (Pmod) - (SOECompactDI)

A cavity insert is available that fits into the Personality module cavity in the Base Unit and provides wiring information.

- **1C31238H01** Personality Module Cavity Plastic insert
- **5X00034G01** provides for 16 point individual fusing with a common supply.

This is an optional Personality module that is available for use with the differential input Electronics modules (**1C31233G02**, **1C31233G03**) for applications requiring individual point fusing with a common supply.

21.4 Valid module combinations - (SOECompactDI)

Sequence of Events Compact Digital Input Field valid module combinations ¹

DESCRIPTION	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE OR CAVITY INSERT ¹
Compact 24/48 VDC SOE Single-ended digital input	16	1C31233G01	1C31238H01 ² (molded plastic cavity insert)
Compact 24/48 VDC SOE Differential digital input	16	1C31233G02	1C31238H01 ² (molded plastic cavity insert)
Compact 24/48 VDC SOE Single-ended digital input	16	1C31233G02	5X00034G01 (Fused Pmod)
Compact 125 VDC SOE Differential digital input	16	1C31233G03	1C31238H01 ² (molded plastic cavity insert)
Compact 125 VDC SOE Single-ended digital input	16	1C31233G03	5X00034G01 (Fused Pmod)
Compact 48 VDC SOE On-card auxiliary Contact Input w/48V wetting	16	1C31233G04	1C31238H01 ² (molded plastic cavity insert)
¹ All module configurations listed in this table are CE Mark certified. ² This is a cavity insert that fits into the Personality module position and provides a wiring schematic label for the module.			

When the 125VDC Compact Digital Input Emod (1C31233G03) is used in applications without the Fused Pmod (5X00034G01), additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and power source.

21.5 External power supply information - (SOECompactDI)

When using the **1C31233G01** single-ended module, or **1C31233G02/G03** with Personality module **5X00034G01**, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, Using an External Power Supply (see page 635) contains steps to be undertaken before connecting the external power supply to the Compact Sequence of Events Digital Input module base unit terminal block.

21.6 Wiring information - (SOECompactDI)

The Compact Sequence of Events modules can be divided into two types depending on their front end connections. The digital Input field Interface modules can be broken down further into Single-Ended and Differential as well as low and high voltage.

The following wiring section topics are divided to show the wiring of the Compact Sequence of Events Digital Input Field Interface modules and then the Compact Sequence of Events Contact Field Interface modules.

21.7 Field wiring diagrams configuration (Front end) (G04) - (SOECompactDI)

The Contact Input configuration (**1C31233G04**) provides 16 contact input current detecting channels with common returns.

A +48V on-board power supply provides current limited contact wetting voltage if the contact is open. If the contact closes, current is drawn from the +10V supply which turns on the associated opto-isolator; thereby, relaying a closed contact state to the I/O bus. The opto-isolators and the isolation provided by the 10V and 48 Volt power supply provide high dielectric isolation between the field side and the logic or I/O bus side.

On-Board power supply checking:

A common voltage monitor circuit examines the 10V and 48V voltages and sets a module status register bit (bit 8) if there is an issue with the 10V and 48V power supply. If this on-board power supply fails, all channels are affected.

There are two methods of wiring field devices to the termination block. Each field contact may have a separate input and return line. Alternatively, field contacts wired to the same module may share a return line. For either wiring method, **do not** tie the contact return line to earth ground or a ground fault condition occurs, as well as a degradation of the common mode surge protection.

Ground fault detection circuitry on the Sequence of Events module with Contact Inputs activates when the input or return line for any channel finds a low impedance (<5 K ohms) path to earth ground. A single wire with a ground fault does not cause an error in the point data, but multiple ground faults, if they include input and return lines, could cause faulty data (that is, channels appearing as if their contacts are closed when they are really open).

When a ground fault occurs, the external error LED lights, and the GND Fault bit 11 in the Status Register is set. If the GND Fault Attention Enable bit 8 is set in the Configuration Register, a ground fault is seen as a catastrophic error causing an attention status to be sent back to the Controller. See the following figure below for ground fault detection circuitry.

21.8 Field interface - (SOECompactDI)

The Digital Input configuration contains 16 channels, where each channel has voltage level sensing circuitry used to detect whether an input is on or off. Style 1C31233G02/G03 has 16 galvanically isolated differential inputs to accommodate separate external auxiliary supplies. Style **1C31233G01** has 16 single-ended (common return) digital inputs with an on-card blown fuse detect to accommodate a common external auxiliary supply for all channels. The input voltage level monitored by the module is determined by the particular card group in the module.

Also, Style **1C31233G02/G03** can be used with the individually fused Personality module **5X00034G01** for applications requiring individual point fusing with a common supply.

An input resistor provides the normal mode surge protection and limits the current during normal operation. An opto-isolator provides high dielectric isolation between the field side and the logic or I/O bus side. The Single-Ended Digital Input configuration has a circuit used to monitor the presence of the wetting supply. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Ovation Controller:

- Fuse is blown on the module.
- Auxiliary supply level is lower than minimum On Input Voltage.

21.9 Field wiring field interface restrictions (G01-G03) - (SOECompactDI)

The following minimum leakage resistances of the cable and the interface devices apply:

24 VDC - 100 K ohms; 48 VDC - 150 K ohms; 125 VDC 250 K ohms

21.10 Field wiring cable lengths (G04) - (SOECompactDI)

The following two tables list the Maximum cable lengths for field wiring to the contacts. For both, assume Rcontact is 0 ohms.

The table below applies when there are individual common return lines brought to the card edge. This implies that Rreturn is 0 ohms.

Maximum cable length for 16 individual common returns

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH(THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The table below applies when all 16 channels share a common return line. In both tables, the Maximum cable length is the length of the cables from the termination block to the contacts in the field.

Maximum cable length for a single common return for all 16 inputs

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

21.11 Field wiring restrictions (G04) - (SOECompactDI)

The following definitions apply to the restrictions listed below:

- R_{shunt} = contact shunt resistance
- $R_{contact}$ = resistance associated with a closed contact
- R_{return} = resistance of the common return line
- R_{line} = resistance of the non-common cable length to and from the contact
- $R_{wiring} = R_{contact} + R_{line} + 16R_{return}$
- R_{fault} = resistance from either line to ground which causes a ground fault

The figure below shows possible cable resistances that affect contact input performance. The following restrictions apply:

- Under no-ground-fault conditions or if the channel return (low) line has a ground fault:
 - ☐ R_{shunt} across contact must be greater than or equal to 10k ohms to always recognize an open contact as open.
 - ☐ R_{shunt} across contact must be greater than or equal to 50k ohms to maintain the high-level contact-wetting voltage.
- If the input connection from a channel has a ground fault with the contact open:
 - ☐ R_{shunt} across contact must be greater than or equal to 150k ohms to guarantee ground fault is detected.
- For a ground fault on the input or return connection to a channel:
 - ☐ R_{fault} from either line to ground must be less than or equal to 5K ohms to guarantee detection of the ground fault.
- With or without ground fault conditions:
 - ☐ R_{wiring} through field wiring to contact must be < 100 ohms to always recognize a closed contact as closed.

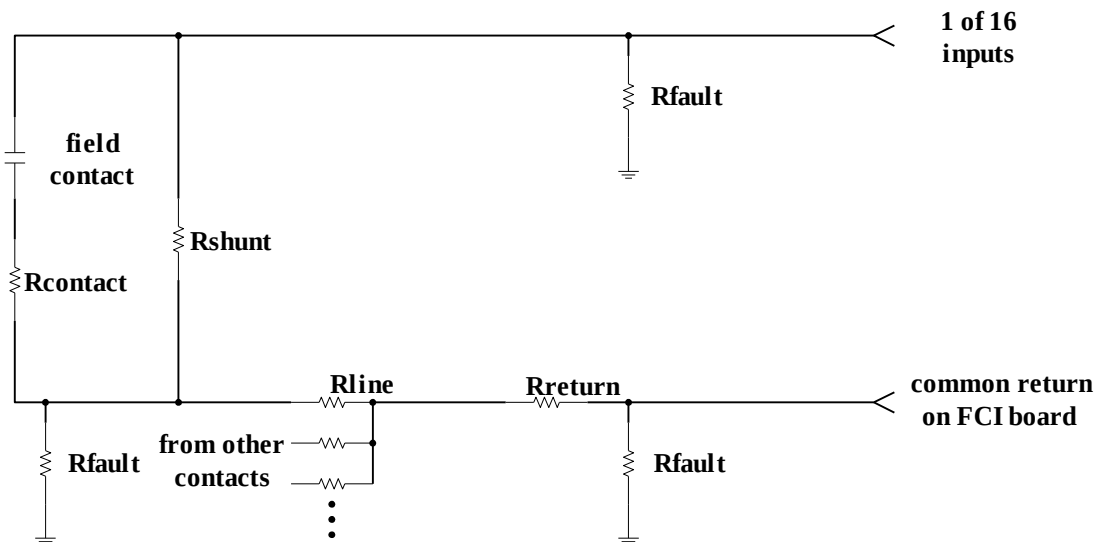
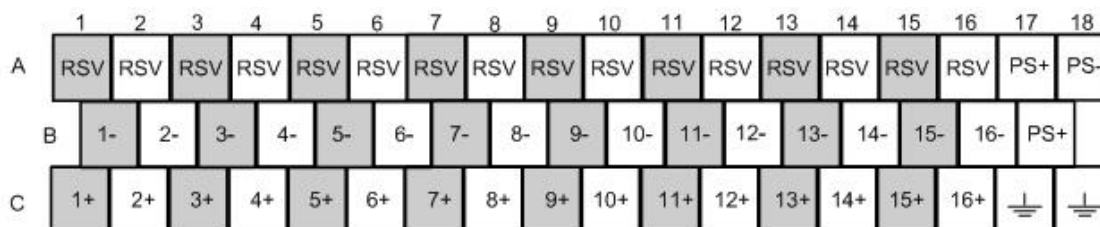


Figure 82: Cable impedances in field wiring

21.12 Terminal block wiring information - (SOECompactDI)

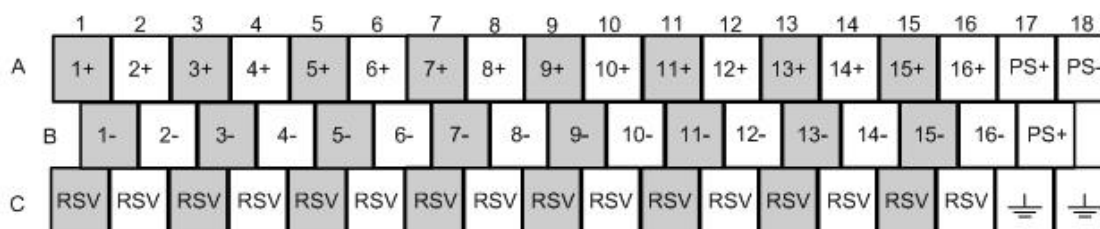
The available cavity insert has a simplified wiring diagram label on top, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagrams for the Compact Sequence of Events Digital Input module are illustrated below.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.



Configuration Using the Foam Insert (16 pt. Single-ended DI, 16 pt. Differential DI or 16 pt. Contact Input)

Note: On the differential modules (1C31233G02 and 1C31233G03 only), each channel has a diode bridge at the front-end. Therefore, the inputs to Row B and C are reversible.

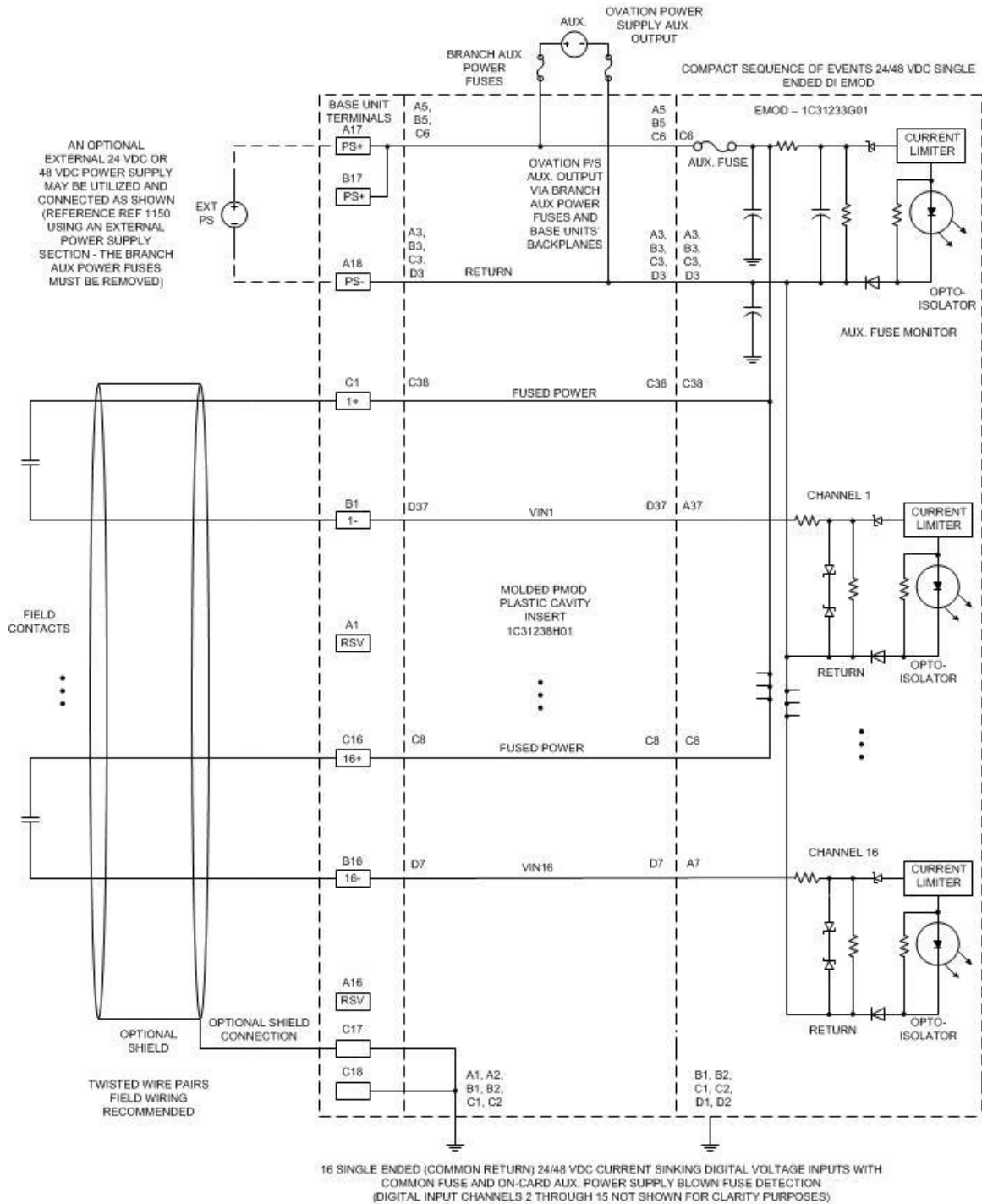


Configuration Using the 16 Point Individually Fused Personality Module

Figure 83: Terminal Block Connections for the Compact Sequence of Events Digital Input Module (1C31233G01-G04)

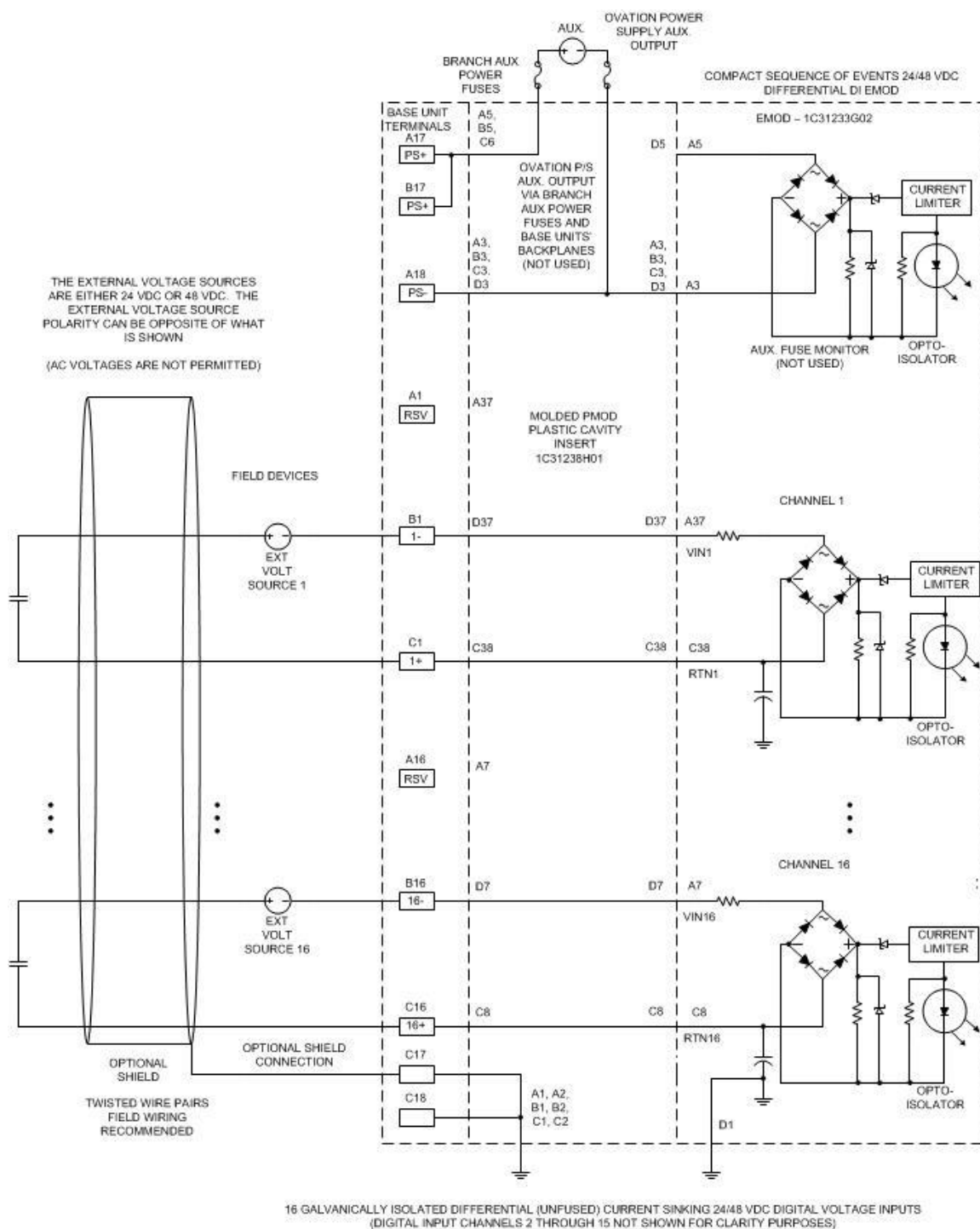
ABBREVIATION	DEFINITION
	Earth ground terminals
1+ through 16+	Digital (Contact) input positive terminal connection.
1- through 16-	Digital (Contact) input negative terminal connection.
PS+, PS-	Auxiliary Power Supply terminals.
RSV	Reserved terminal. No internal connection, except where indicated.

21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)



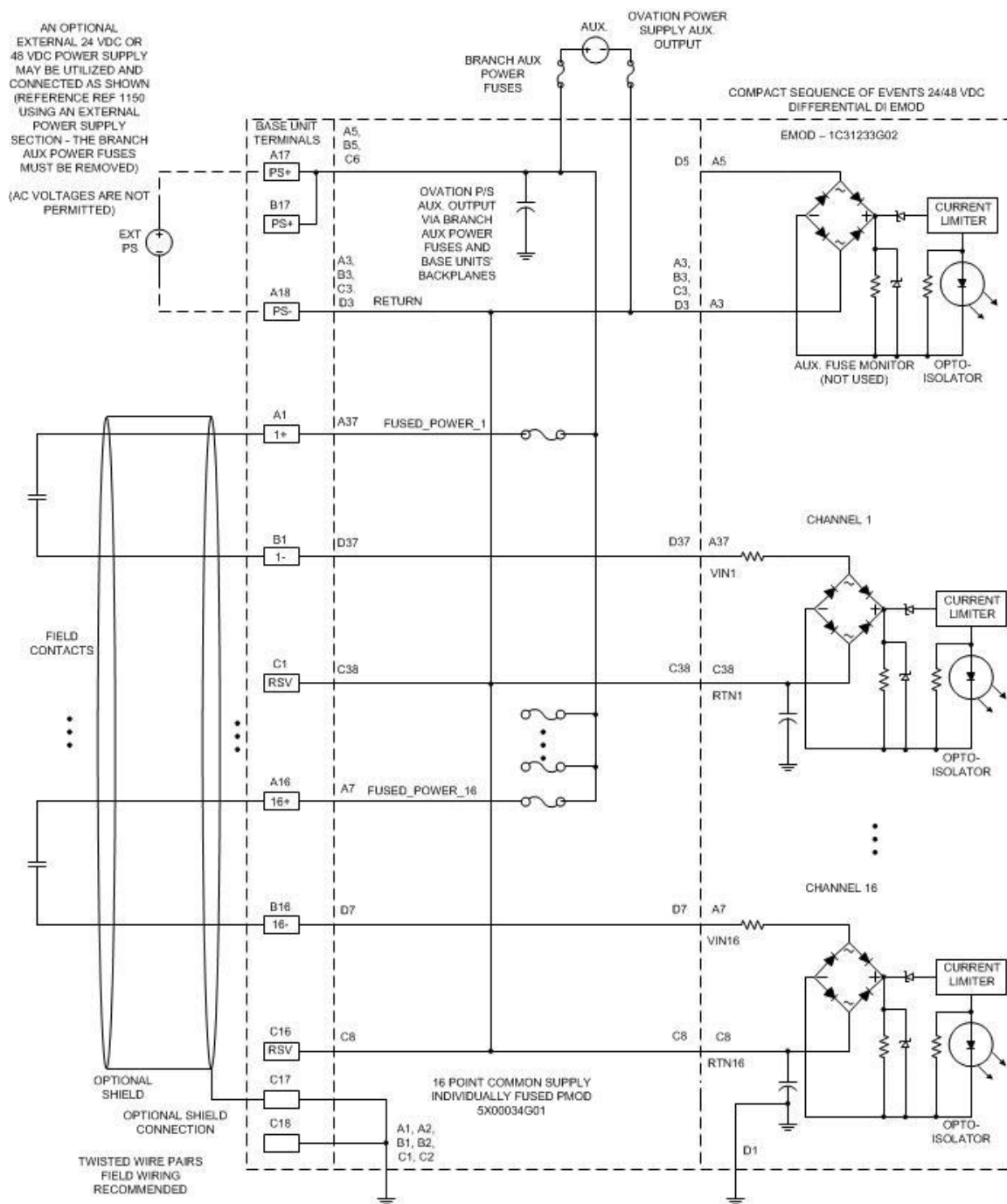
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP ONE) (NON-CE MARK)

21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)



FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (NON-CE MARK)

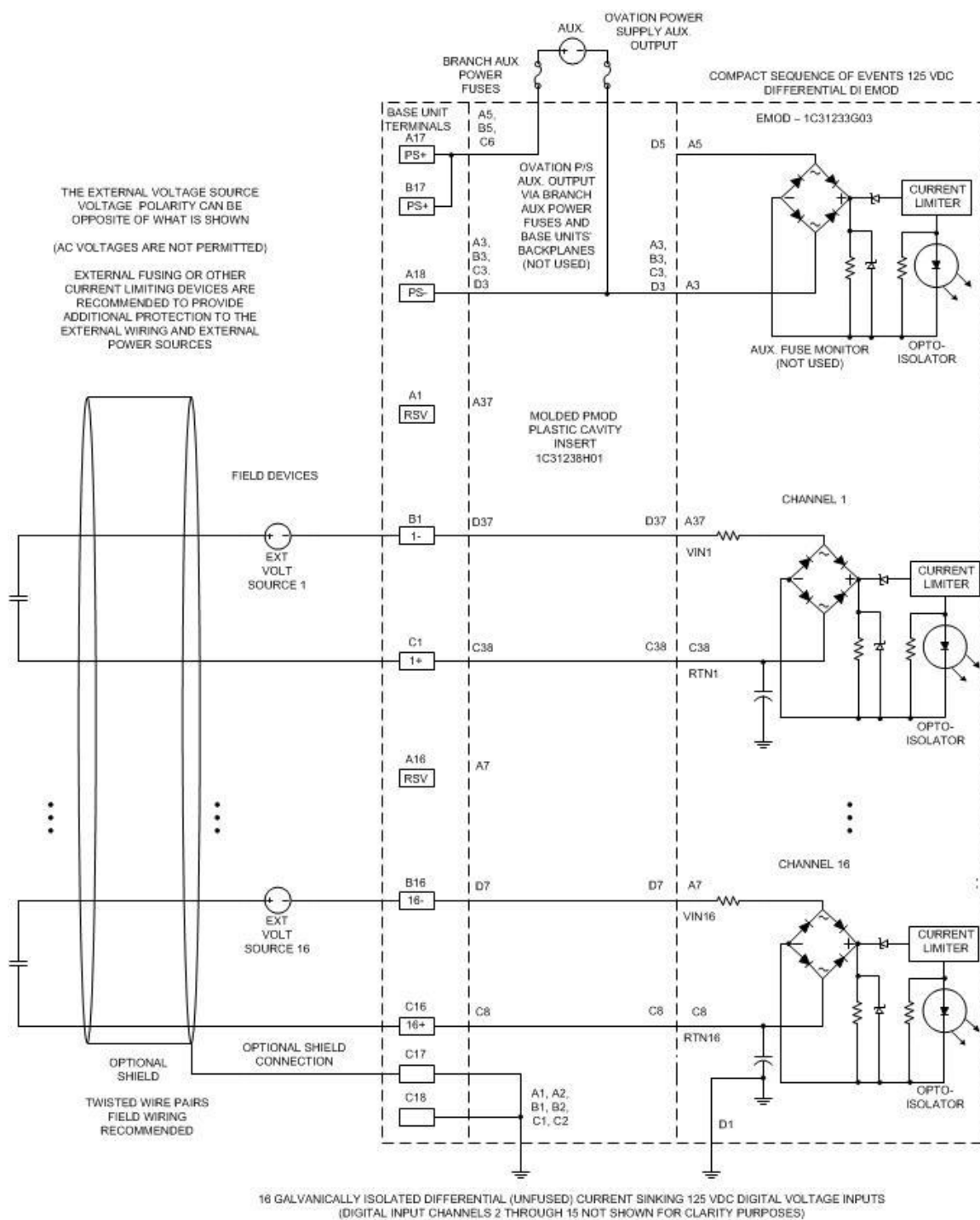
21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)



16 INDIVIDUALLY FUSED SINGLE-ENDED (COMMON POWER SUPPLY) CURRENT SINKING 24/48 VDC DIGITAL VOLTAGE INPUTS
(NO BLOWN FUSE DETECTION)
(DIGITAL INPUT CHANNELS 2 THROUGH 15 NOT SHOWN FOR CLARITY PURPOSES)

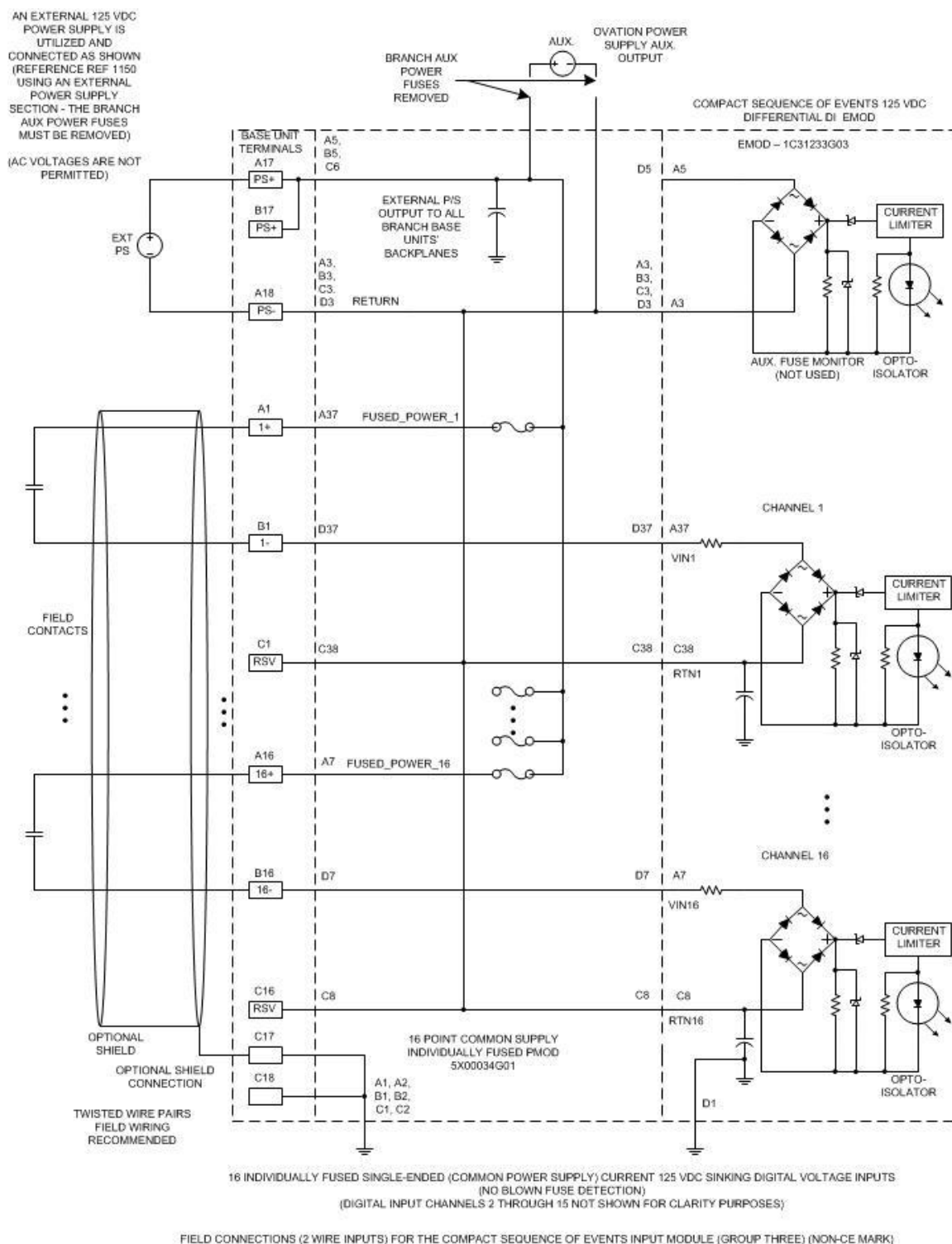
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (NON-CE MARK)

21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)

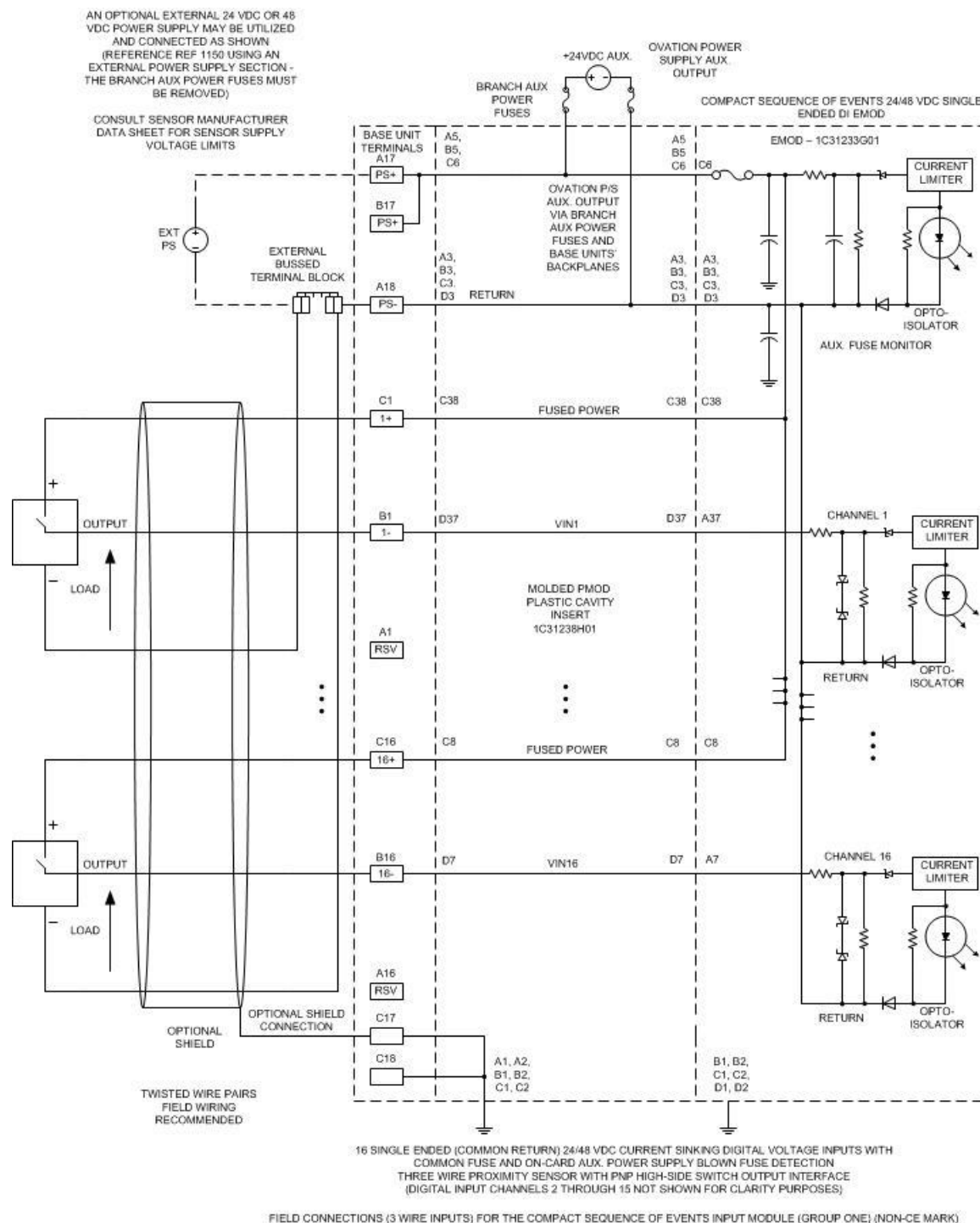


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP THREE) (NON-CE MARK)

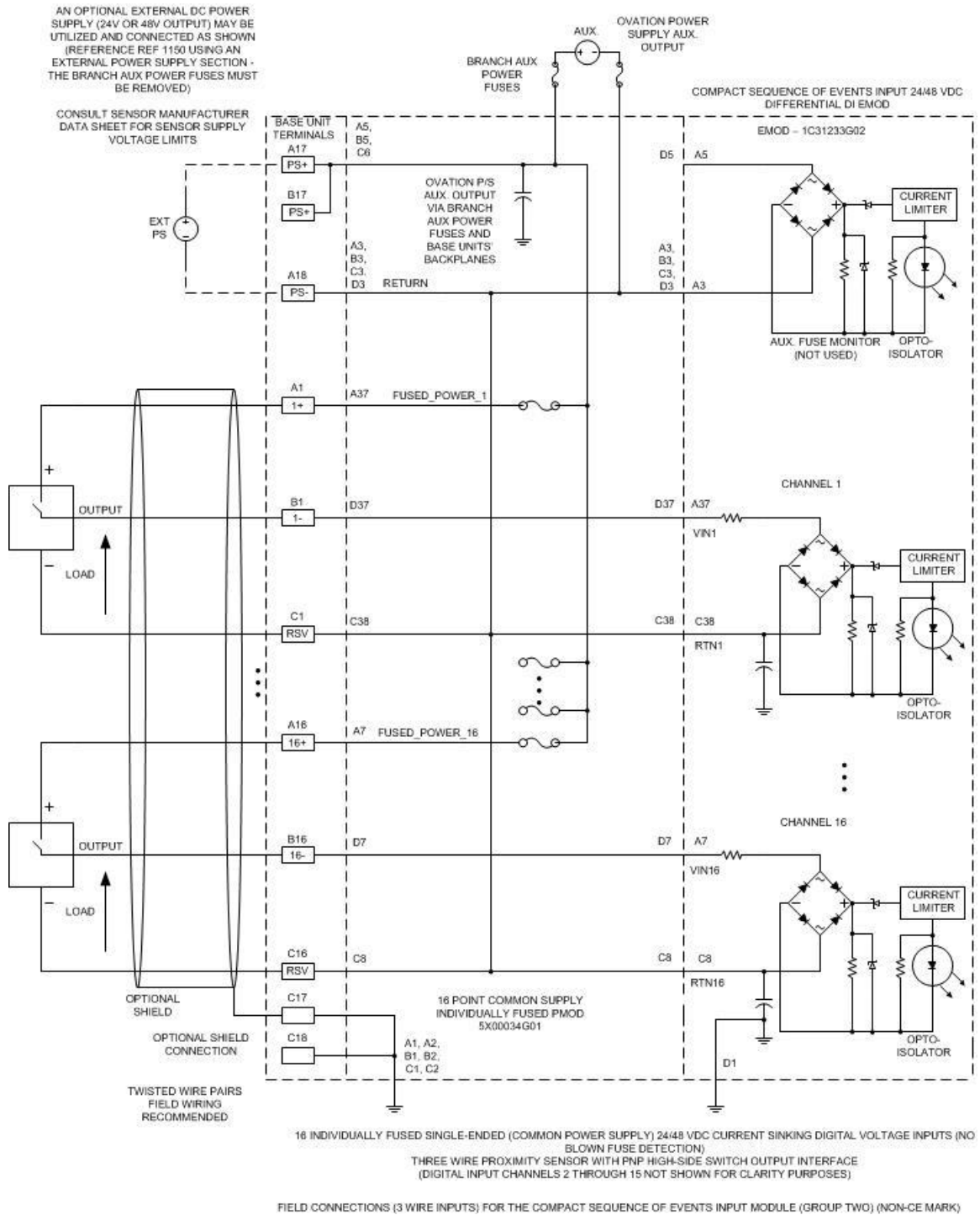
21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)



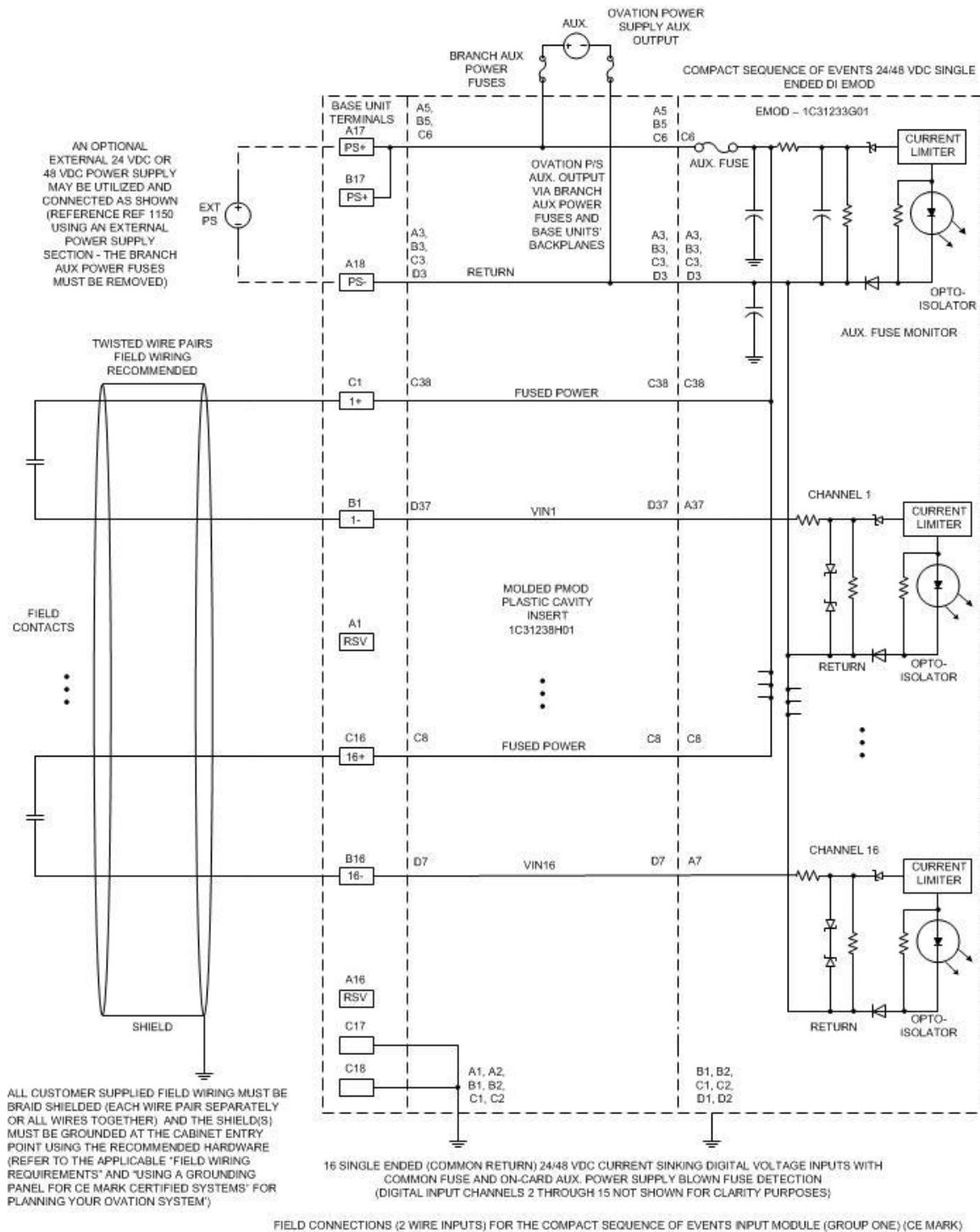
21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)

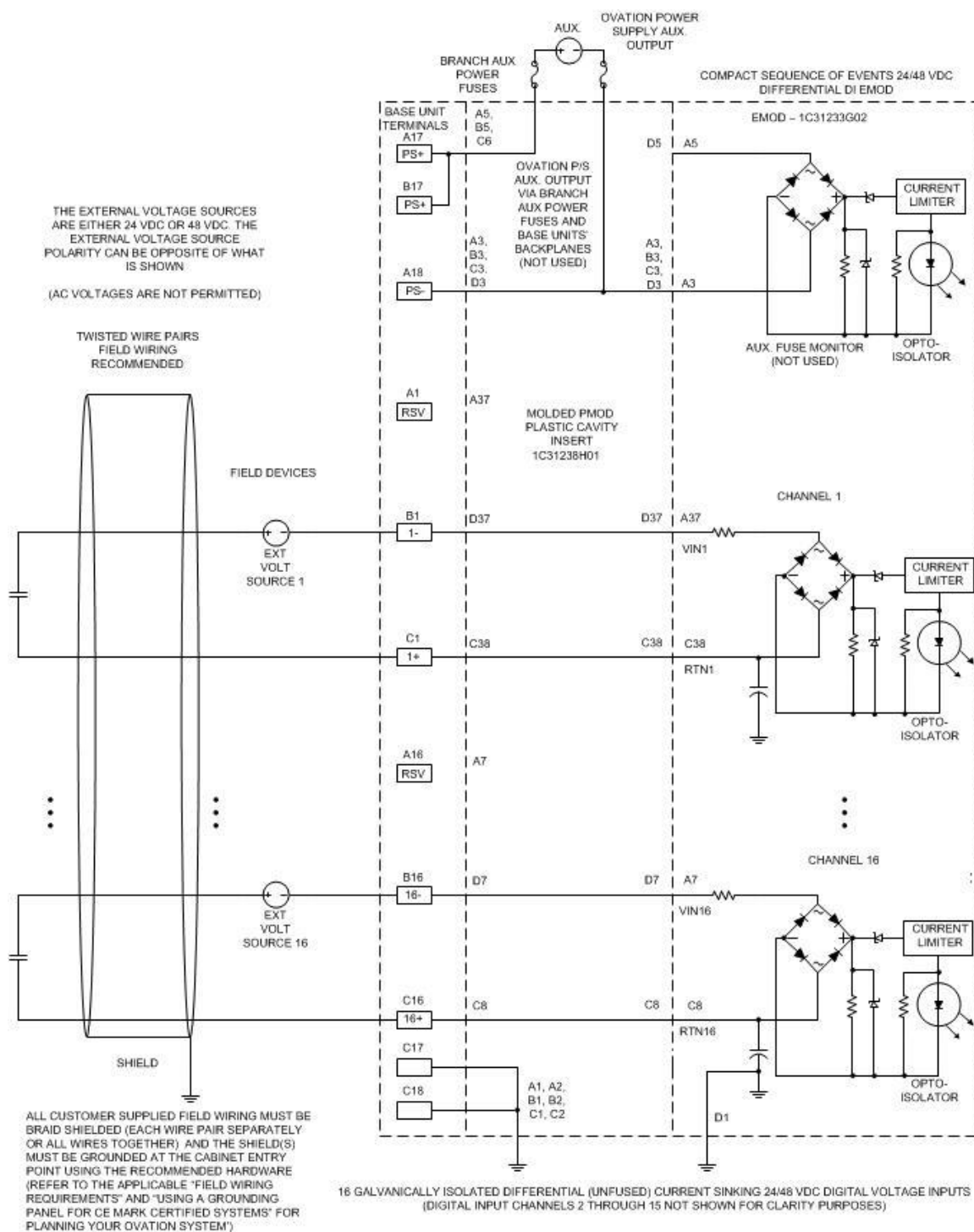


21.13 Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI)



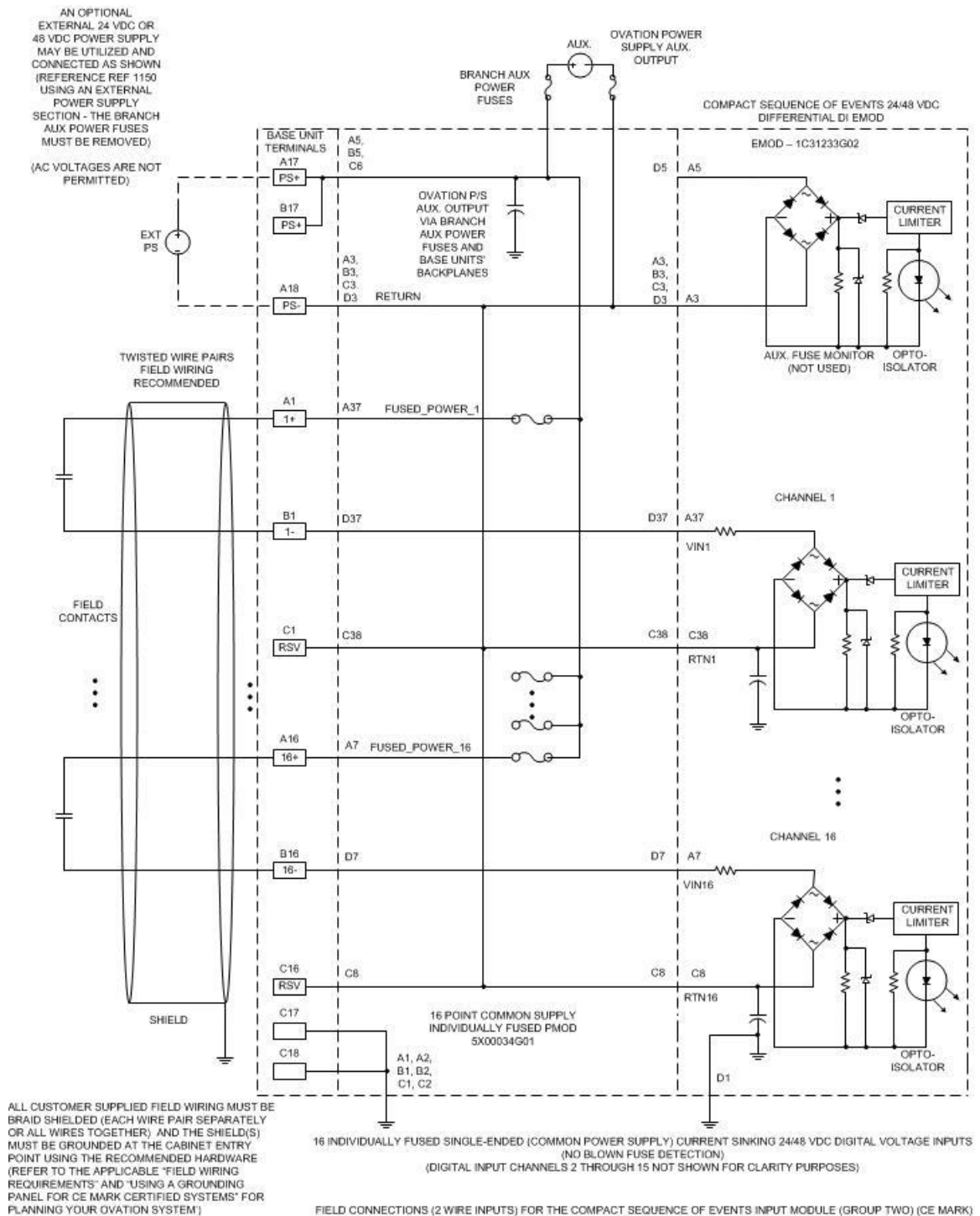
21.14 Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)

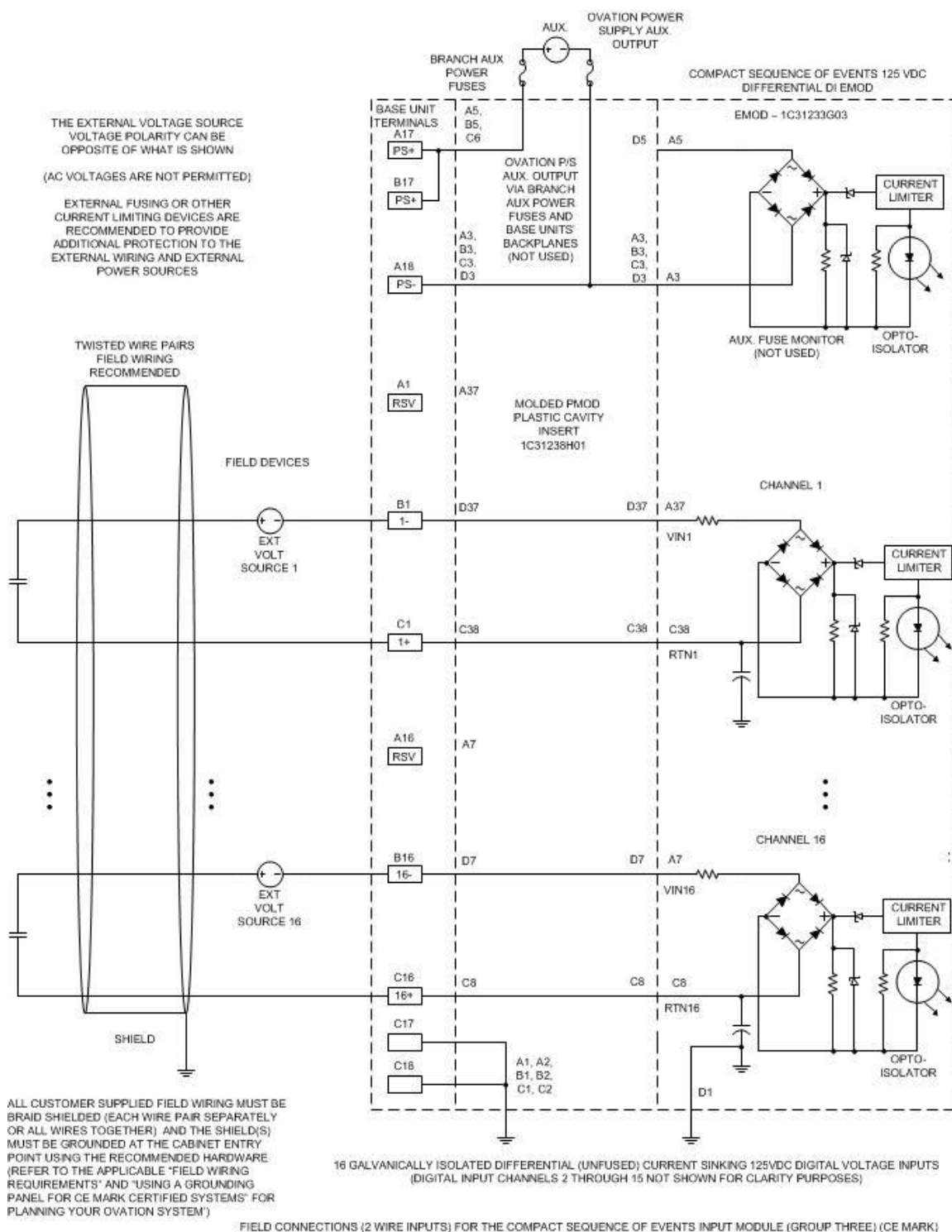




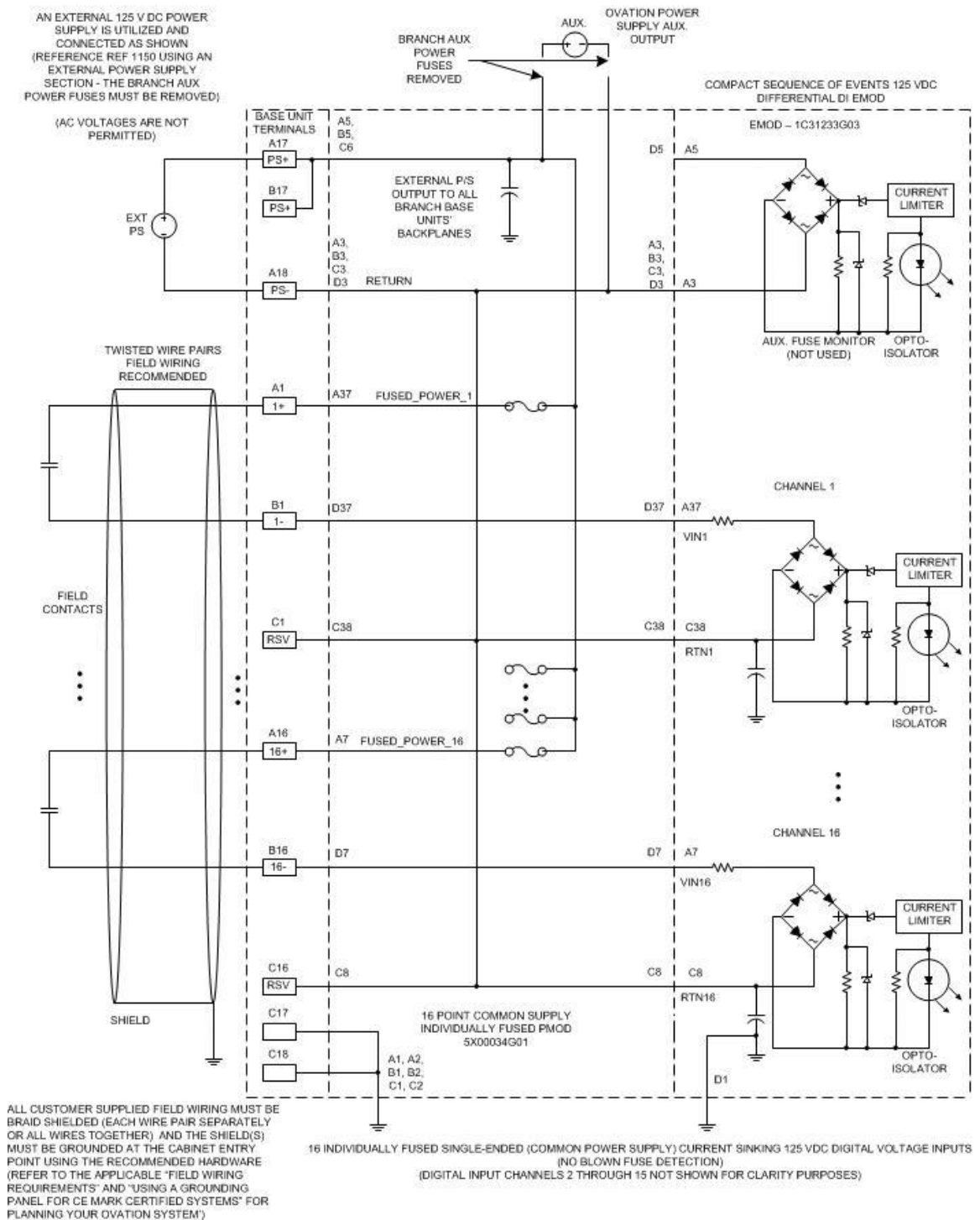
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (CE MARK)

21.14 Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)



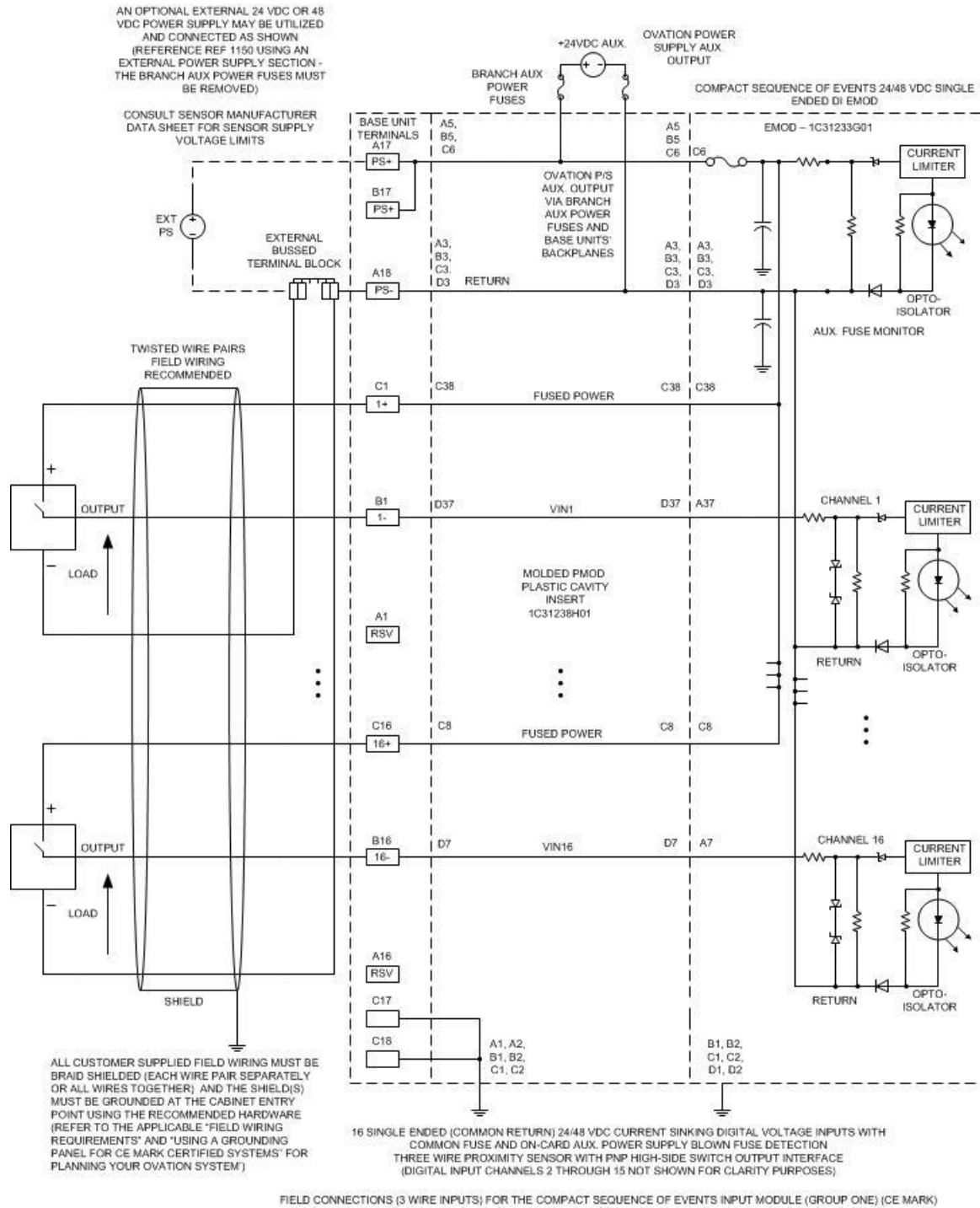


21.14 Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)

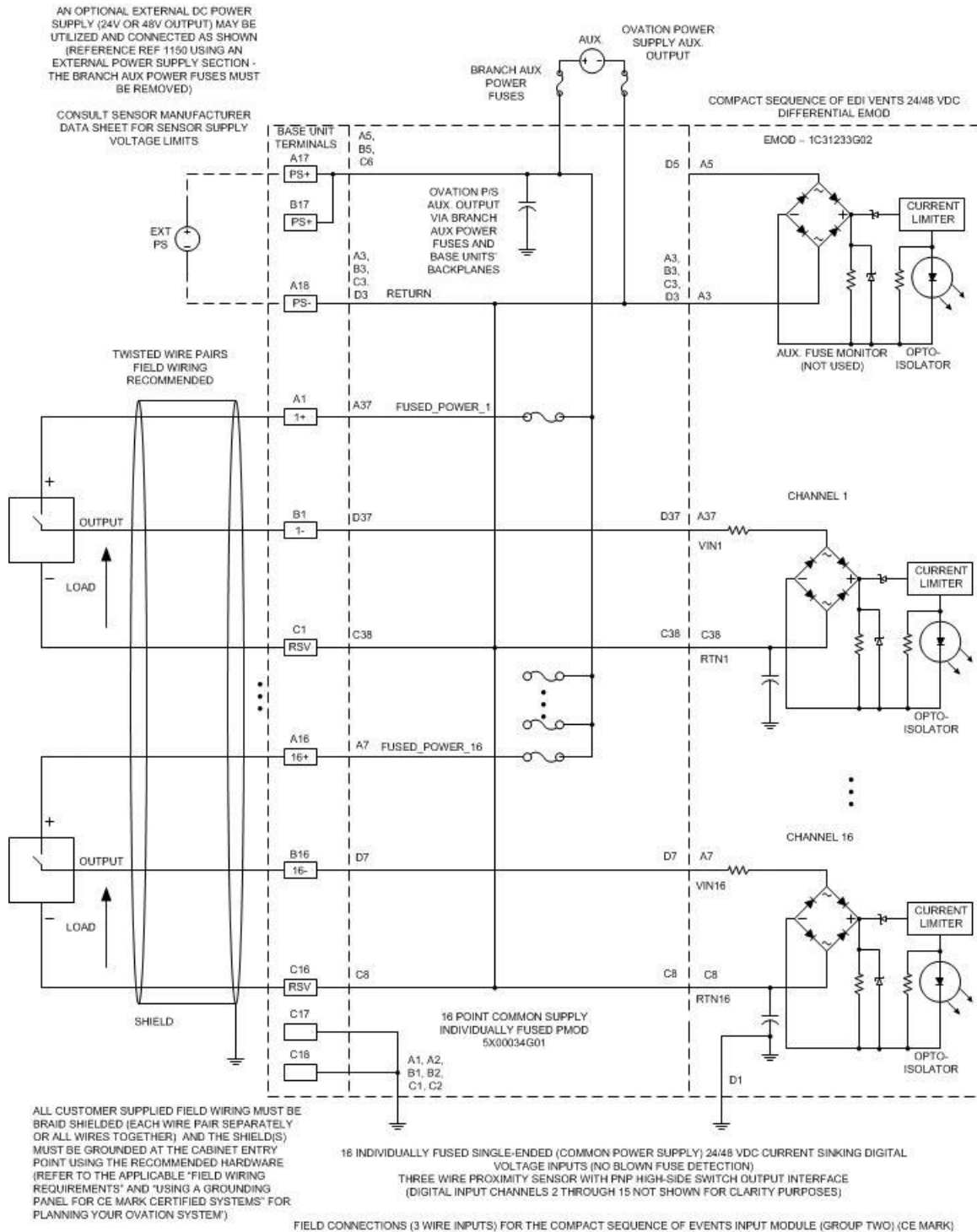


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP THREE) (CE MARK)

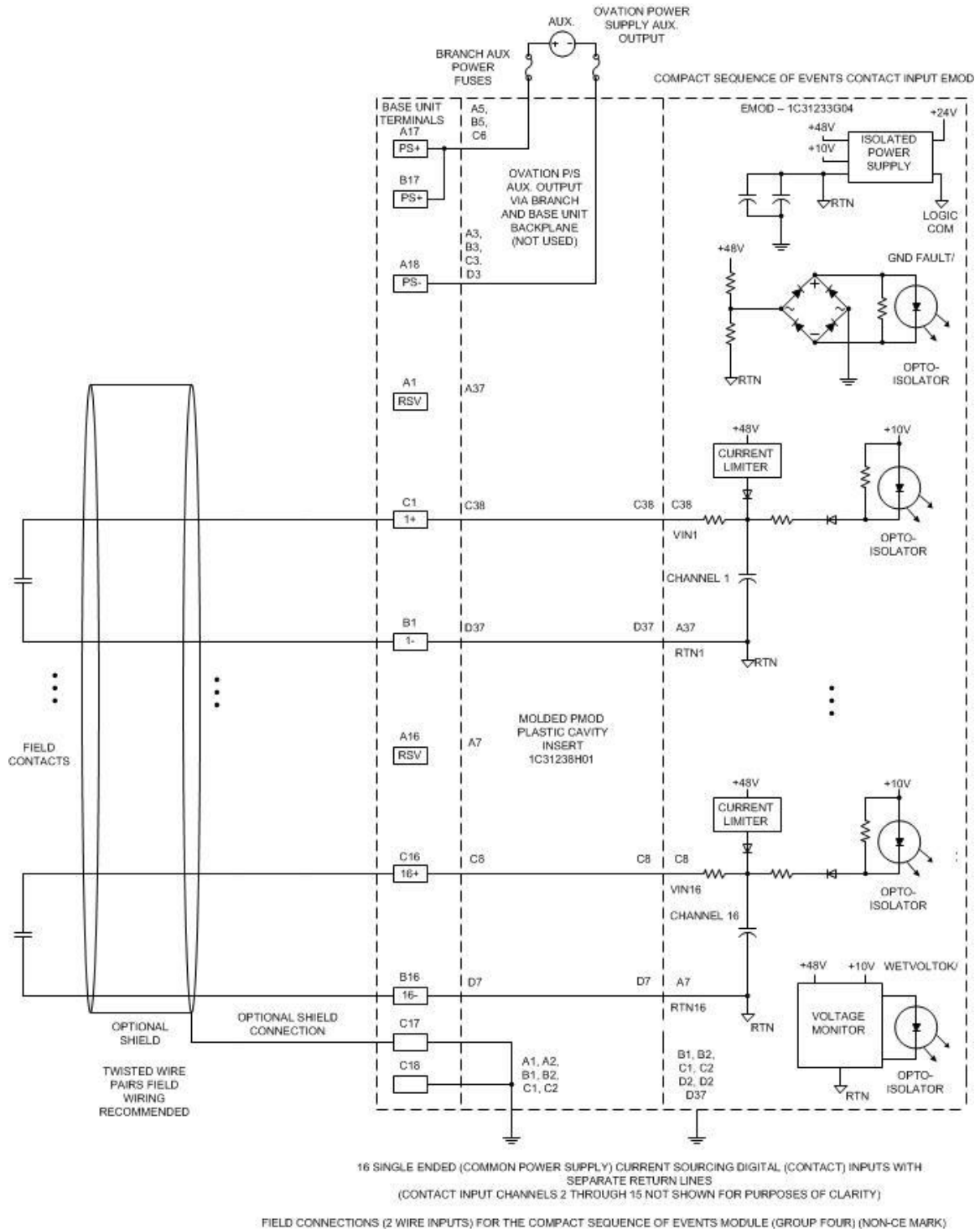
21.14 Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)



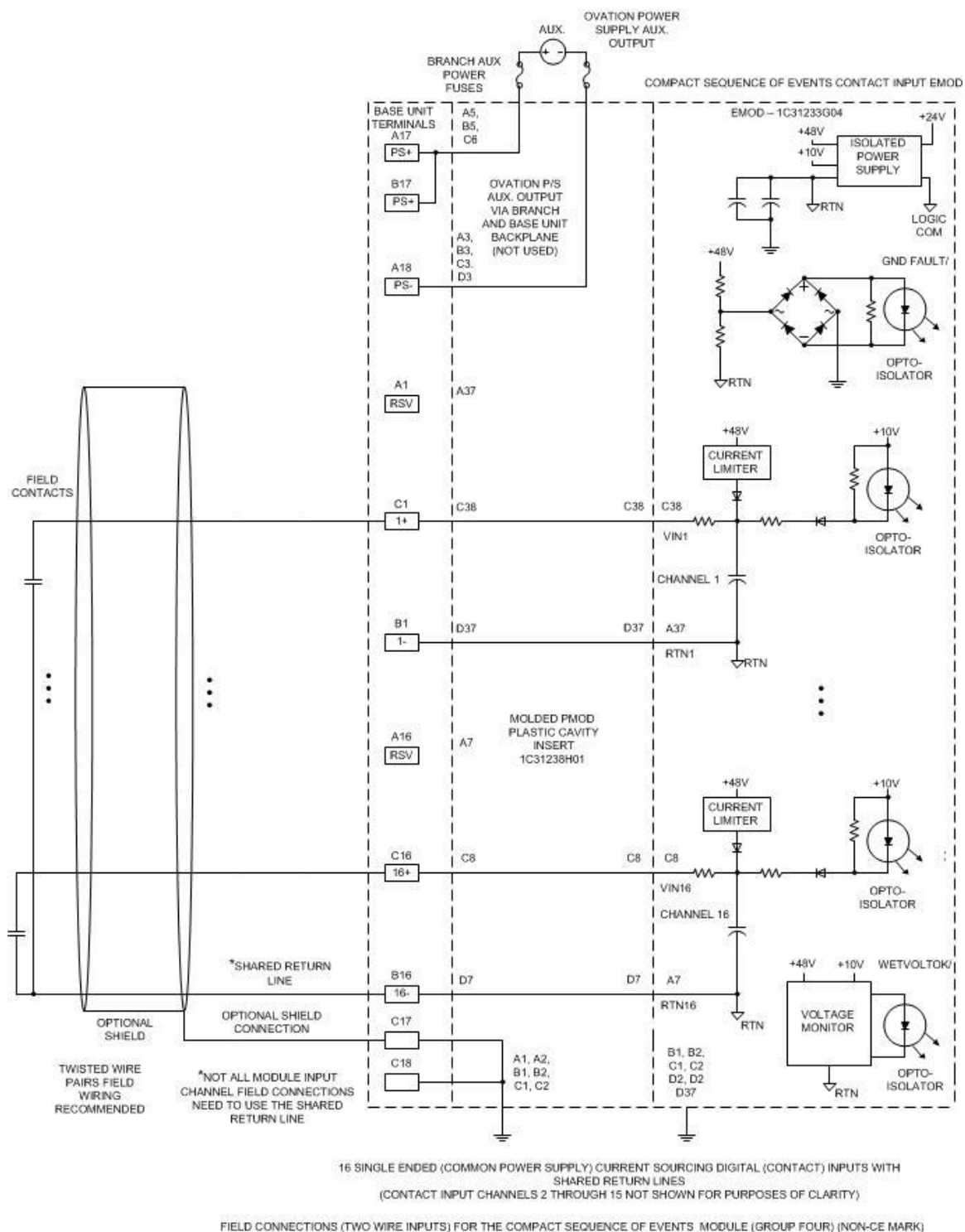
21.14 Field connection wiring diagrams (CE Mark) (G01-3) - (SOECompactDI)



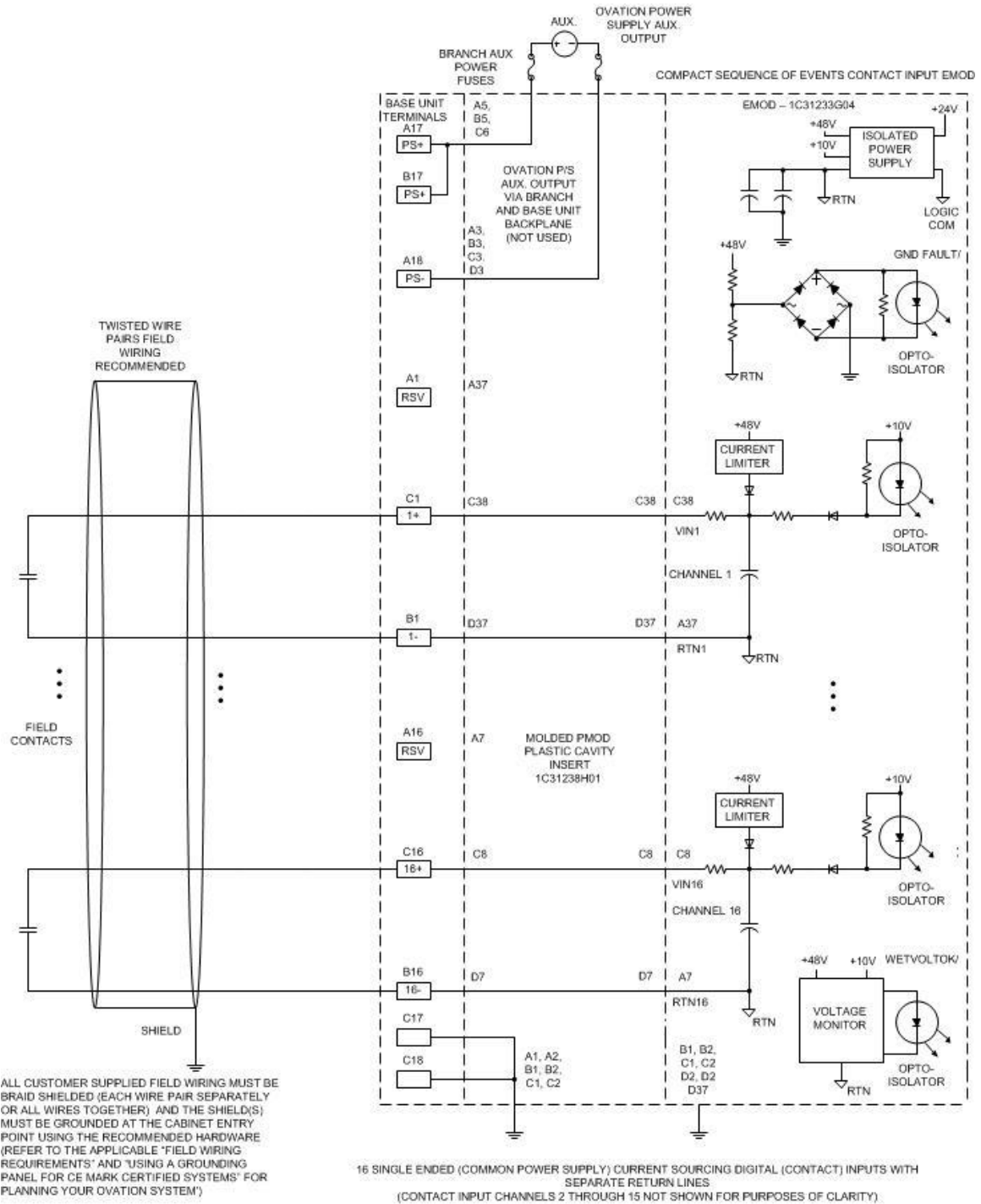
21.15 Field connection wiring diagram (G04) - (SOECompactDI)



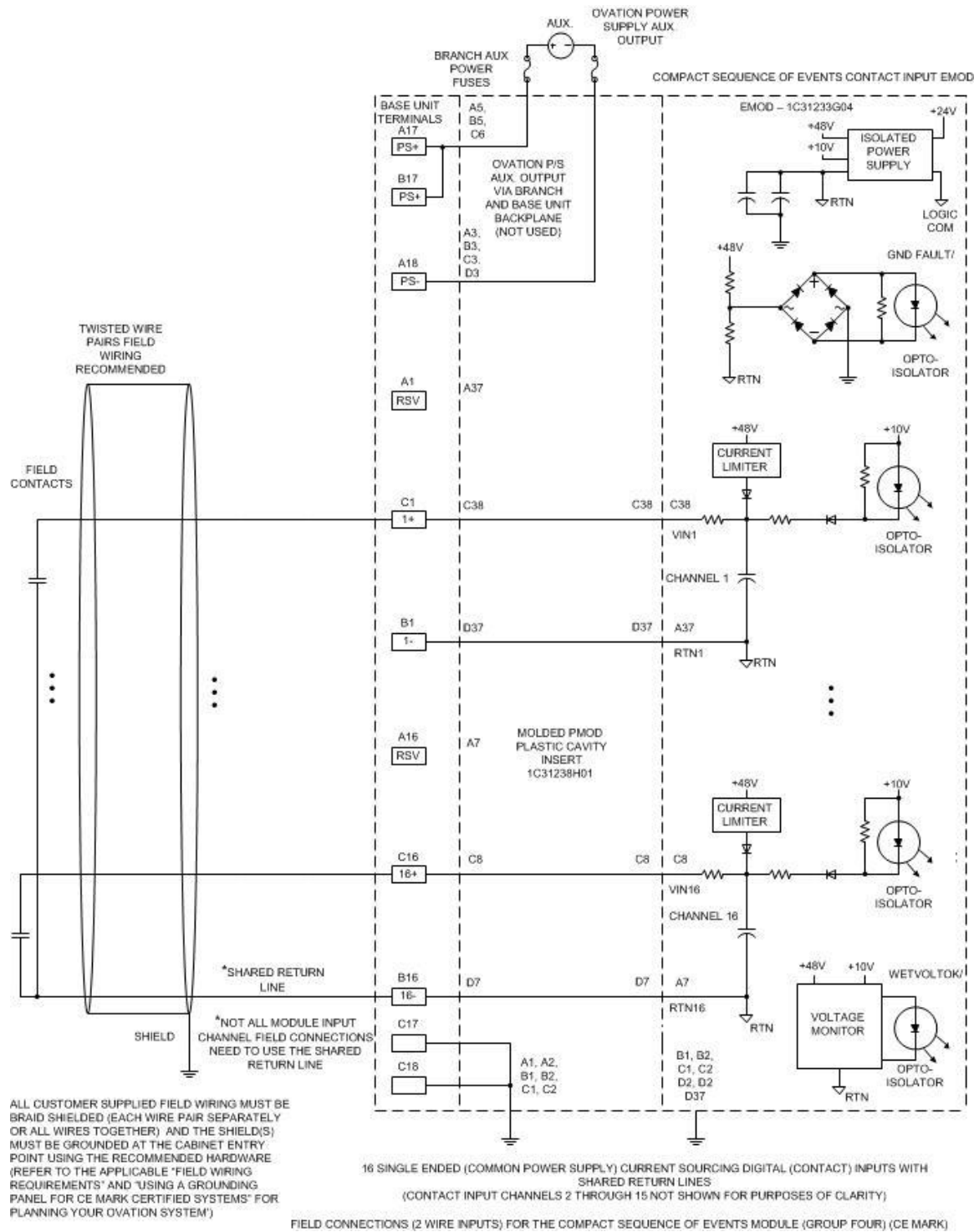
21.15 Field connection wiring diagram (G04) - (SOECompactDI)



21.16 Field connection wiring diagram (CE Mark) (G04) - (SOECompactDI)



21.16 Field connection wiring diagram (CE Mark) (G04) - (SOECompactDI)



21.17 Configuration/Status Register information - (SOECompactDI)

Configuration/Status Register information (1C31233G01 - G03)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). Refer to the applicable [Ovation Operator Station User Guide](#) for information about the Point Information window.

Compact Sequence of Events Digital Input Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module.	Module configured (1 = configured; 0 = not configured)
1	Force internal error.	Internal error (1 = forced error; 0 = no forced error)
2 - 5	Not used. Should be set to zero (0).	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input.
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	Not used.
12	Disable chatter control.	Disable chatter control.
13	Chatter control option.	Status of chatter control option.
14	Not used. Should be set to zero (0).	Not used.
15	Not used. Should be set to zero (0).	Not used.
Applicable for configuration of the Digital Input module (1C31233G01 - G03).		

Bit 0: Module does not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bits 2 - 5 Not used.

Bit 6: This bit should be set for a single-ended digital input (1C31233G01) and cleared for the others.

Bit 7: Not used.

Bit 8: This bit is set to enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry.

Bit 9: Not used.

Bit 10: This bit is set to enable module GND fault attention status.

Bit 11: Not used.

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event is recorded until the event buffer overflows. Default state is "0" and enables the chatter control function.

Bit 13: When this bit is set, chatter will be flagged when an input changes state four or more times between event buffer reads. When cleared, chatter is flagged for state changes greater than 1 per 100 milliseconds.

Bits 14 - 15: Not used

Configuration/Status Register information (1C31233G04)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). (See the [Ovation Operator Station User Guide](#).)

Compact Sequence of Events Contact Input Configuration/Status Register ¹ (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER	DATA DESCRIPTION - STATUS REGISTER (READ)
0	Configure module.	Module configured (1=configured; 0=unconfigured)
1	Force internal error.	Internal error (1=forced error; 0=no forced error)
2 - 5	Not used. Should be set to zero (0).	Not used.
6	Enable digital input blown fuse signal and module attention for blown fuse.	Status of enable digital input blown fuse signal and module attention for blown fuse.
7	Not used. Should be set to zero (0).	Blown fuse for digital input.
8	Contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).	Status of contact input field card (enable contact input auxiliary voltage failure signal and module attention for auxiliary voltage failure and ground fault detection circuitry).
9	Not used. Should be set to zero (0).	Auxiliary voltage failure for contact input.
10	Enable module attention for a GND fault.	Status of Enable module attention for a GND fault.
11	Not used. Should be set to zero (0).	GND fault.
12	Disable chatter control.	Disable chatter control.
13	Reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).	Status of reset chatter control counters on buffer unfreeze (instead of decrementing every 100 milliseconds).
14	Not used. Should be set to zero (0).	Clock synchronized.
15	Not used. Should be set to zero (0).	Not used.

¹ Applicable for configuration of the Contact Input module (1C31233G04).

Bit 0: Module does not operate until this bit is set with a write.

Bit 1: When this bit is set, the internal error LED is turned on, and only the status registers can be read.

Bits 2 - 5: Not used.

Bit 6: This bit should be cleared to zero (0).

Bit 7: Not used.

Bit 8: This bit should be set.

Bit 9: Not used.

Bit 10: This bit should be set according to application need.

Bit 11: Not used.

Bit 12: When this bit is set and an input channel is not masked off, that input can chatter and each event is recorded until the event buffer overflows. Default state is "0" and enables the chatter control function.

Bit 13: When this bit is set, the chatter control counter for each channel is reset each time an event buffer is unfrozen instead of being decremented each 100 milliseconds. Default state is "0" and has the chatter control counter being decremented every 100 milliseconds.

Bits 14 - 15: Not used.

Secondary/Expansion configuration/Status Register

Word address 14 (E in Hex) is used to enable or disable the channel event tagging mask.

Secondary/Expansion configuration/Status Register (address 14 or E in Hex)

BIT	DATA DESCRIPTION CONFIGURATION (WRITE)	DATA DESCRIPTION STATUS (READ)
0 - 15	Channel Event Tagging mask	Channel Event Tagging mask

21.18 Diagnostic Logic card LEDs - (SOECompactDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	For Single-ended Digital Input: Lit when fuse blows or there is a loss of the auxiliary power supply (Only when Bit 6 of Configuration register is set. Then Bit 7 of the Status register is set.) For Differential Digital Input: Not lit since the configuration bit is not set, and the blown fuse signal from the field card is ignored.

LED	DESCRIPTION
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1) of the Configuration Register is set, or when a timeout of the watchdog timer occurs when the Controller stops communicating with the module. Also lit when Controller stops communicating with the module.
1 - 16 (Green)	Lit when the input voltage of the LED's corresponding channel is greater than the channel's minimum "On Input Voltage."

21.19 Specifications and ranges (G01-3) - (SOECompactDI)

Group 1 through 3 Specifications

DESCRIPTION	VALUE
Number of channels	16
Input range (single-ended or differential) ¹	Refer to the table below.
Propagation delay of contact change of state ² 24V/48 VDC 125VDC	3.75 ms Minimum 4.25 ms Maximum 3.75 ms Minimum 4.45 ms Maximum
Signal rejection Always rejects change of state Always accepts change of state	< 3.87 Millisecond > 4.13 Millisecond
Cable length (quality is 50pF/ft or better)	1000 feet Maximum
Diagnostics	Internal module operating faults and Blown fuse detection. ³
Dielectric isolation: Channel to channel ⁴ Channel to logic	1000 VAC 2000 VAC differential 1000 VAC others
Module power from logic supply	Main: 1.44 W Typical 1.8 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ Input range level is dependent on module group. ² Does not include cable capacitance. ³ Blown fuse detection applies to single-ended channel configuration only, when an on-board fuse is provided for the auxiliary power supply. ⁴ Channel to channel isolation applies to differential channel configuration only.	

Compact Sequence of Events Digital Input Ranges

INPUT LEVEL	ON INPUT VOLTAGE (VDC)		OFF INPUT VOLTAGE (VDC)	ON INPUT CURRENT (mA)		OFF INPUT (WATTS)	INPUT POWER TYPICAL
	Min	Max	Max	Min	Max	Max	
24 VDC	20	60	9	1.3	2.6	0.33	0.65
48 VDC	20	60	9	1.3	2.6	0.33	1.7
125 VDC	80	140	55	1.3	2.8	0.33	4.26

21.20 Specifications and ranges (G04) - (SOECompactDI)**Group 4 Specifications**

DESCRIPTION	VALUE
Number of channels	16
Channels per common	16
Voltage Category	48 VDC - nominal open contact wetting voltage.
Open contact voltage	For "0" signal = 42 V minimum - 55 V maximum
Closed contact Input current	For "1" signal = 4 mA minimum - 8 mA maximum
Galvanic isolation	Between channels and I/O bus = Yes, 1,000 VAC. Between channels = No.
Current draw, from I/O base unit, 24 V main power	62 mA typical for all inputs off. 190 mA typical for all inputs on.
Power dissipation of module, 24 V main power	1.5 watts typical for all inputs off. 4.5 watts typical for all inputs on.
Total module response time, (1 foot (0.305 M) long test cable)	"0" Open to "1" Close = 4.125 millisecond typical "1" Close to "0" Open = 4.125 millisecond typical
Resolution	1/8 millisecond resolution for time tagging an event.
Accuracy (time tagged)	1 millisecond relative to clock from the I/O bus. 1/8 millisecond relative to other module channels.
Propagation delay through logic card to Present State register (field card output to Present State register)	3.75 millisecond Minimum 4.25 millisecond Maximum
Logic card digital debounce time	3.75 millisecond Minimum 4.00 millisecond Typical 4.25 millisecond Maximum
Field card signal propagation delay. (1 foot (0.305 M) long test cable)	0.13 millisecond Typical delay time for contact opening. 0.09 millisecond Typical delay time for contact closing.
Additional propagation delay due to field cable capacitance - field contact opening.	0.04 millisecond Typical per 1,000 foot of cable (30 pF/ft.)
Status display	Green LED per channel. LEDs located in logic card circuit.

DESCRIPTION	VALUE
Cable limitations: Contact shunt resistance Wiring resistance	Must be greater than 50 Kohms to maintain high level open contact wetting voltage. Must be greater than 10 Kohms to allow open contact to be recognized as an open contact. Must be less than 100 ohms to allow closed contact to be recognized as a closed circuit.
Diagnostics	Internal module operating faults.
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

SECTION 22

Enhanced Compact Sequence of Events Digital Input module - (ECISOEDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Enhanced Compact Sequence of Events Digital Input module overview - (ECISOEDI).....</i>	<i>322</i>
<i>Electronics modules (Emod) - (ECISOEDI)</i>	<i>323</i>
<i>Personality modules (Pmod) - (ECISOEDI)</i>	<i>323</i>
<i>Valid module combinations - (ECISOEDI)</i>	<i>324</i>
<i>One shot function - (ECISOEDI)</i>	<i>325</i>
<i>Wire break detect function - (ECISOEDI)</i>	<i>325</i>
<i>Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECISOEDI).....</i>	<i>326</i>
<i>Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECISOEDI).....</i>	<i>337</i>
<i>Enhanced Compact Sequence of Events Digital Input module (5X00357G03) (FDI) - (ECISOEDI).....</i>	<i>352</i>
<i>Enhanced Compact Sequence of Events Digital Input module (5X00357G04) (FCI) - (ECISOEDI).....</i>	<i>365</i>
<i>Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI).....</i>	<i>377</i>
<i>Event buffer read procedure - (ECISOEDI)</i>	<i>389</i>
<i>Configuration/Status Register information - (ECISOEDI)</i>	<i>390</i>
<i>Diagnostic Logic card LEDs - (ECISOEDI).....</i>	<i>394</i>
<i>Environmental Specifications - (ECISOEDI).....</i>	<i>396</i>

22.1 16 Channel Enhanced Compact Sequence of Events Digital Input module overview - (ECISOEDI)

The Ovation Enhanced Compact Sequence of Events module provides field wire break detection (Group 5 only) and field digital input state change detection (SOE One Shot).

The SOE one shot feature describes a feature that will enable SOE event detections that happen asynchronously to Controller tasks that read the present input state and event buffers. There are two types of events that are defined.

- A high to low transition of the input.
- A low to high transition of the input.

The two types of events are mutually exclusive of each other. Events registered on various points are also mutually exclusive of each other. SOE one shot events are only recorded if the input state transition is followed by a 4 millisecond minimum steady state time. Otherwise the one shot event is ignored.

The Module performs a sequence of events function for the Ovation distributed control system. It provides sixteen digital channels to monitor the states ("0" or "1") of sixteen field digital inputs. No personality module is required if the sixteen digital channels are used as differential inputs. The Ovation Enhanced Compact Sequence of Events Electronics Module plugs into a standard Ovation Base Unit's electronics module cavity.

The Enhanced Compact Sequence of Events electronics Module consists of an LSW logic card and a field Card (FDJ, FDI, FCI or FDW). The LSW logic card Interfaces to the I/O bus through the Ovation base unit backplane from which it accesses the Ovation serial I/O data bus (serial data and clock signals), base address, and redundant +24 VDC power supplies. The LSW logic card connects to the field card through a pair of inter-card connectors.

If the 5X00034G01 16-Point Individually Fused Channel Personality module is not employed, the Enhanced Compact Sequence of Events electronics module's the field card directly interfaces to the base unit termination block via the base unit backplane.

For the Enhanced Compact Sequence of Events module's 16-point individually fused channel option, the 5X00034G01 personality module is used. The Enhanced Compact Sequence of Events Electronics module FDI or FDW field card interfaces to the base unit terminal block via the 5X00034G01 Personality module's PDIC personality card.

Features

The Enhanced Compact Sequence of Events Electronics Module has 16 field inputs of the levels defined in Electronics module (Emod) for the Enhanced Compact Sequence of Events module (see page 323). The module performs a digital de-bounce on these 16 field input signals in order to obtain the present input state data. The present input state data will be placed in the module's I/O bus Present Input State register. Using the present input state data, the module calculates the event change of state information and status information for the I/O bus.

- 1,000 V dielectric isolation between the field circuits and the Ovation I/O bus common.
- I/O Bus Watchdog Timer
- Module Electronic ID information stored in the logic card EEPROM.
- The I/O module base address is established by the base unit location.
- The base unit provides the electronics module with redundant +24 VDC power supply feeds.

- Module hot swap capability
- Sixteen digital inputs whose present states can be read directly
- Positive Transition Latched register and Negative Transition Latched registers are provided to permit the Controller to directly detect captured low to high and high to low event transitions.
- Field contact wire break detection (Group 5 only)
- 4 millisecond contact de-bounce time.
- 1/8 millisecond resolution event (input change of state) recording.
- 1 millisecond event recording with reference to the time tag clock time sent to the module by the Controller.
- Module can time tag events for 65 seconds before the internal module clock rolls over.
- Internal module time tag clock can be resynchronized by the Controller
- Contains two 32-event buffers
- The module can be configured to mask off specific input channels that will not be checked by the module's event tagging and chatter control logic.
- The module can be configured to enable or disable chatter control for all sixteen input channels. The chatter control counter, if enabled, may be configured to decrement at a defined rate or to be reset when the module event buffers are switched.

22.2 Electronics modules (Emod) - (ECISOEDI)

- **5X00357G01** Sixteen 24/48 VDC single-ended current-sinking digital inputs (FDJ field card)
- **5X00357G02** Sixteen 24/48 VDC differential current-sinking digital inputs (FDI field card) - supports 16-point individually fused channel option
- **5X00357G03** Sixteen 125 VDC differential current-sinking digital inputs (FDI field card) - supports 16-point individually fused channel option
- **5X00357G04** Sixteen 48 VDC single-ended current-sourcing digital inputs (contact inputs) using on-card power supply (FCI field card)
- **5X00357G05** Sixteen 24 VDC IEC 61131-2 compliant Type 1 differential current-sinking digital inputs with wire break detection capability (FDW field card) –supports 16-point individually fused channel option

22.3 Personality modules (Pmod) - (ECISOEDI)

5X00034G01 provides for individual fusing for each of the sixteen digital input channels using a common power supply. This is an optional personality module that available for use for applications requiring individual point fusing with a common power supply.

Note: The use of the 5X00034G01 personality module converts differential current sinking digital inputs into single-ended current sinking digital inputs. The 5X00034G01 personality module taps the base unit's internal auxiliary voltage and distributes this voltage to all sixteen module digital input channels.

22.4 Valid module combinations - (ECISOEDI)

Enhanced Compact Sequence of Events Digital Input valid module combinations

DESCRIPTION	CHANNELS	ELECTRONIC MODULE	PERSONALITY MODULE OR CAVITY INSERT
24/48 VDC Single-ended Digital Input - Current Sinking	16	5X00357G01	1C31238H01 ¹
24/48 VDC Differential Digital Input - Current Sinking	16	5X00357G02	1C31238H01 ¹
24/48 VDC (Individually Fused Channels with Common power supply) Single-Ended Digital Input - Current Sinking	16	5X00357G02	5X00034G01
125 VDC Differential Digital Input - Current Sinking	16	5X00357G03	1C31238H01 ¹
125 VDC (Individually Fused Channels with Common power supply) Single-Ended Digital Input - Current Sinking	16	5X00357G03	5X00034G01
48 VDC Single-ended Digital Input - Current Sourcing (Contact input) with On-Card 48 VDC power supply	16	5X00357G04	1C31238H01 ¹
24 VDC (Differential) Digital Input - Current Sinking, IEC61131-2 Compliant Type 1 Digital Inputs	16	5X00357G05	1C31238H01 ¹
24 VDC (Individually Fused Channels with Common power supply) Single-Ended Digital Input - Current Sinking, IEC61131-2 Compliant Type 1 Digital Inputs	16	5X00357G05	5X00034G01
¹ This is a plastic insert that fits into the base unit's Personality module cavity and provides a base unit terminal block wiring label for the module.			

22.5 One shot function - (ECSOEDI)

The Enhanced Sequence of Events module contains a one-shot function which is accessible through two 16 bits registers that capture two types of events. The digital de-bounce circuit samples each field input channel once every 125 microseconds. If a field input channel's state change remains present for 32 consecutive samples, the event is stored on the corresponding set of latches depending on which type of event occurred.

- The first type of event is a 16 bit register for low to high transition of each digital input. This is known as Positive Transition Latched Register.
- The second is a 16 bit register for high to low transition of each digital input. This is known as Negative Transition Latched Register.

These are mutually exclusive of each other. Events registered on every channel are also mutually exclusive of each other. Each event will set and latch the corresponding bit in the appropriate event register and it will remain in logic '1' value, even if several valid transitions occur. The reset of the entire latched register will only follow if a read of the event register is performed.

A watchdog timer for one-shot registers would clear the one-shot registers if no reads occur to Positive Transition Latched Register or Negative Transition Latched Register within a period of 5 seconds.

After a timeout, the collection of one shot information is prevented until the Controller resumes reading either Positive Transition Latched Register or Negative Transition Latched Register.

- The first read would be a throw away which would re-activate the watchdog timer.
- The second read would yield valid register data.

22.6 Wire break detect function - (ECSOEDI)

The 5X00358 LSW printed circuit card assembly groups available for enhanced compact sequence of events application are Group Two - with one shot function, and Group Three - with one shot function and wire break detection capability. Group Two LSW logic cards will interface to electronic module assembly groups one to four (G01-G04). Group Three LSW logic cards will interface to electronic module assembly group five (G05).

The wire break detect function has a 16 bit mask register stored in latches. If the wire break mask bit is set for a particular input channel, the condition of field wiring will be detected for that channel.

The digital de-bounce circuit samples each field wiring channel once every 125 microseconds. If a field wiring channel's state change remains present for 32 consecutive samples, the module's Channel Wire Break Detect Register is updated with the new status of field wiring channel. Sampling the field wiring channel states for 32 consecutive times yields a nominal 4 millisecond digital de-bounce time period. Any field wiring change that is less than the digital de-bounce time will be rejected by the module.

22.7 Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECISOEDI)

The Enhanced Compact Sequence of Events Digital Input module 5X00357G01 has 16 single-ended (common return) current sinking digital inputs with a field card auxiliary power supply fuse and accommodates a common auxiliary 24 VDC or 48 VDC power supply used by all channels. The required auxiliary power supply voltage source may be obtained from the cabinet's internal auxiliary power supply or it may be obtained from an external power supply. The module's field card contains circuit used to monitor the presence of the auxiliary power supply voltage.

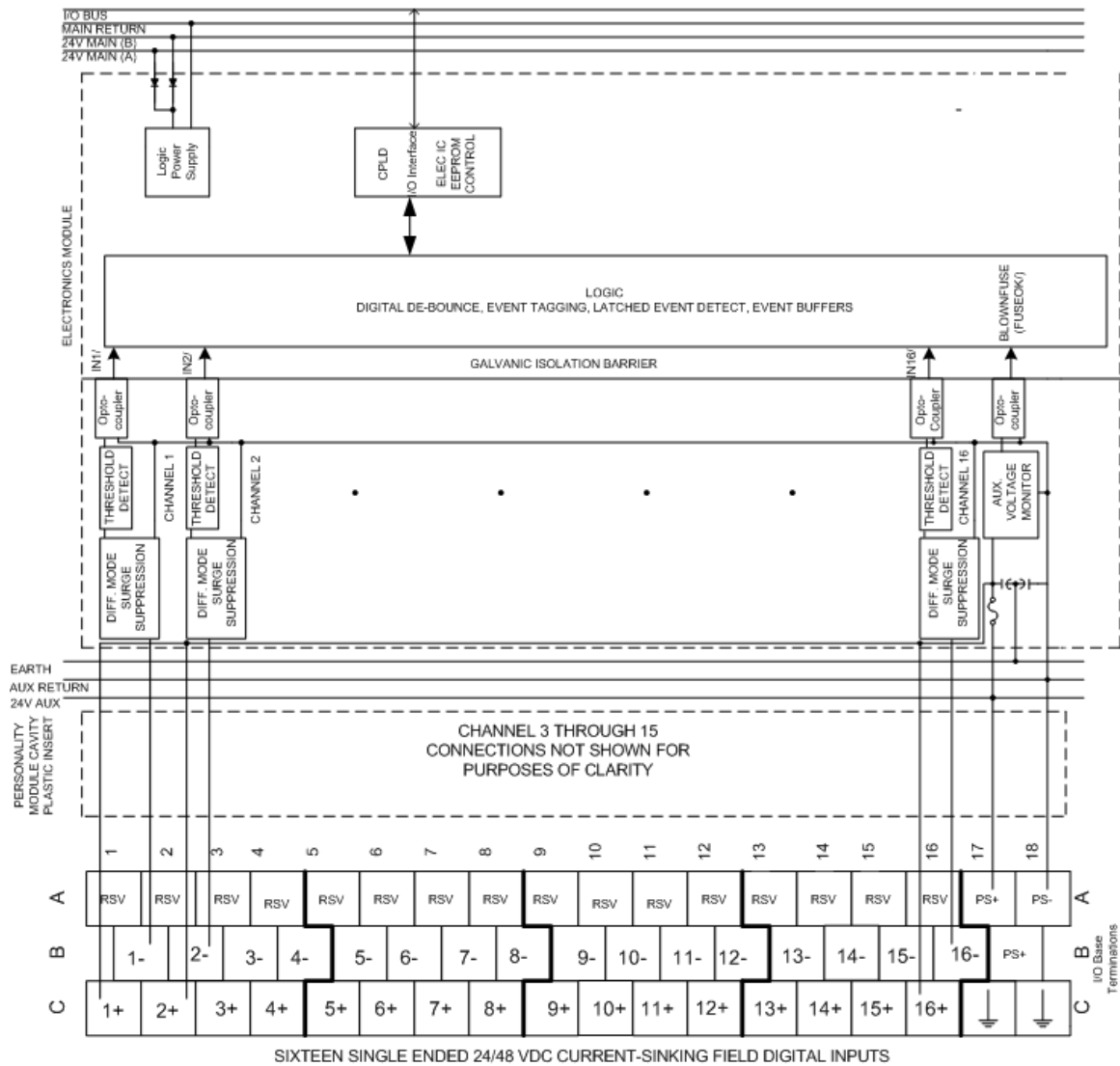
Two cases cause this field card monitor circuitry to report a blown fuse status:

- Module field card auxiliary power supply fuse is open circuited
- Auxiliary power supply voltage level is below the monitor circuit's On input voltage threshold

Each channel contains the following:

- An **input resistor** to provide normal mode surge protection and a current regulator circuit to limit input current during normal operation.
- An **optocoupler** to provide galvanic isolation between the field digital input circuit and module's logic or I/O bus side.

22.7.1 Module-base unit interconnection diagram (5X00357G01) - (ECISOEDI)

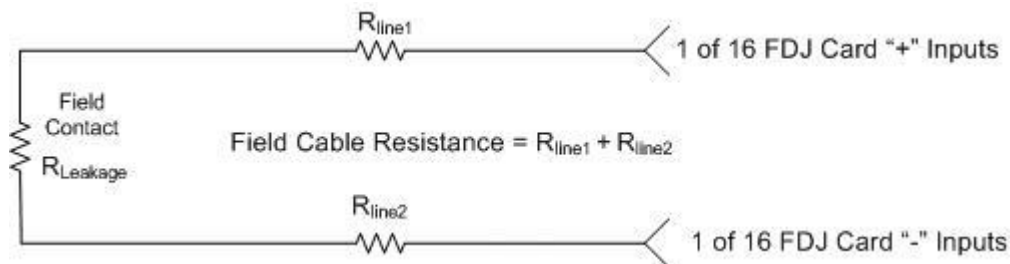


Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

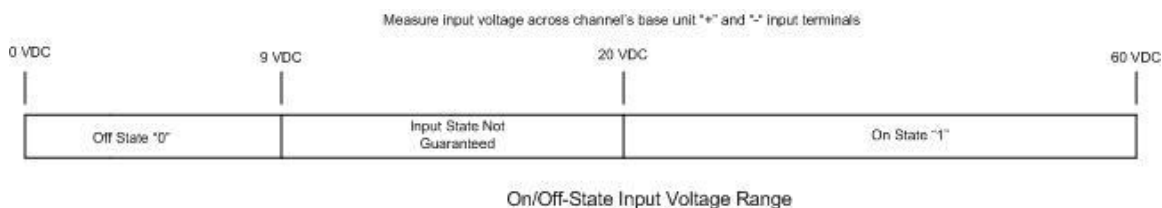
22.7.2 Field wiring (5X00357G01) - (ECISOEDI)

The minimum combined field cable resistance plus field contact leakage resistance value assumes that the Auxiliary power supply voltage is its Maximum allowable value (30 VDC for 24 VDC inputs and 60 VDC for 48 VDC inputs).

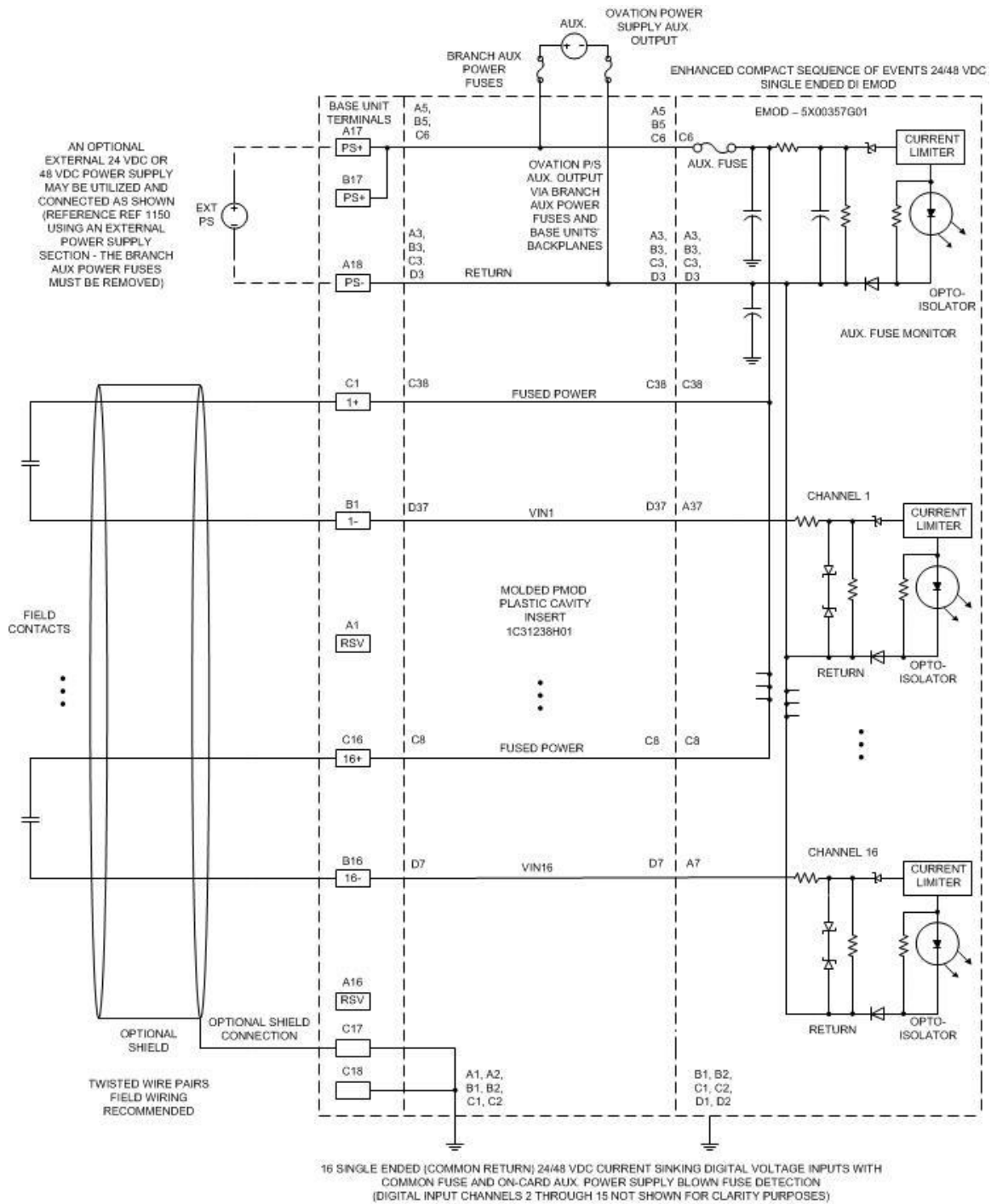
Input voltage level	Minimum field cable resistance plus field contact leakage resistance
24 VDC	100 Kohm
48 VDC	150 Kohm



If a channel's combined field cable resistance and contact leakage resistance is less than the values specified above, the channel may report that its field contact state is closed even though the field contact is actually open.

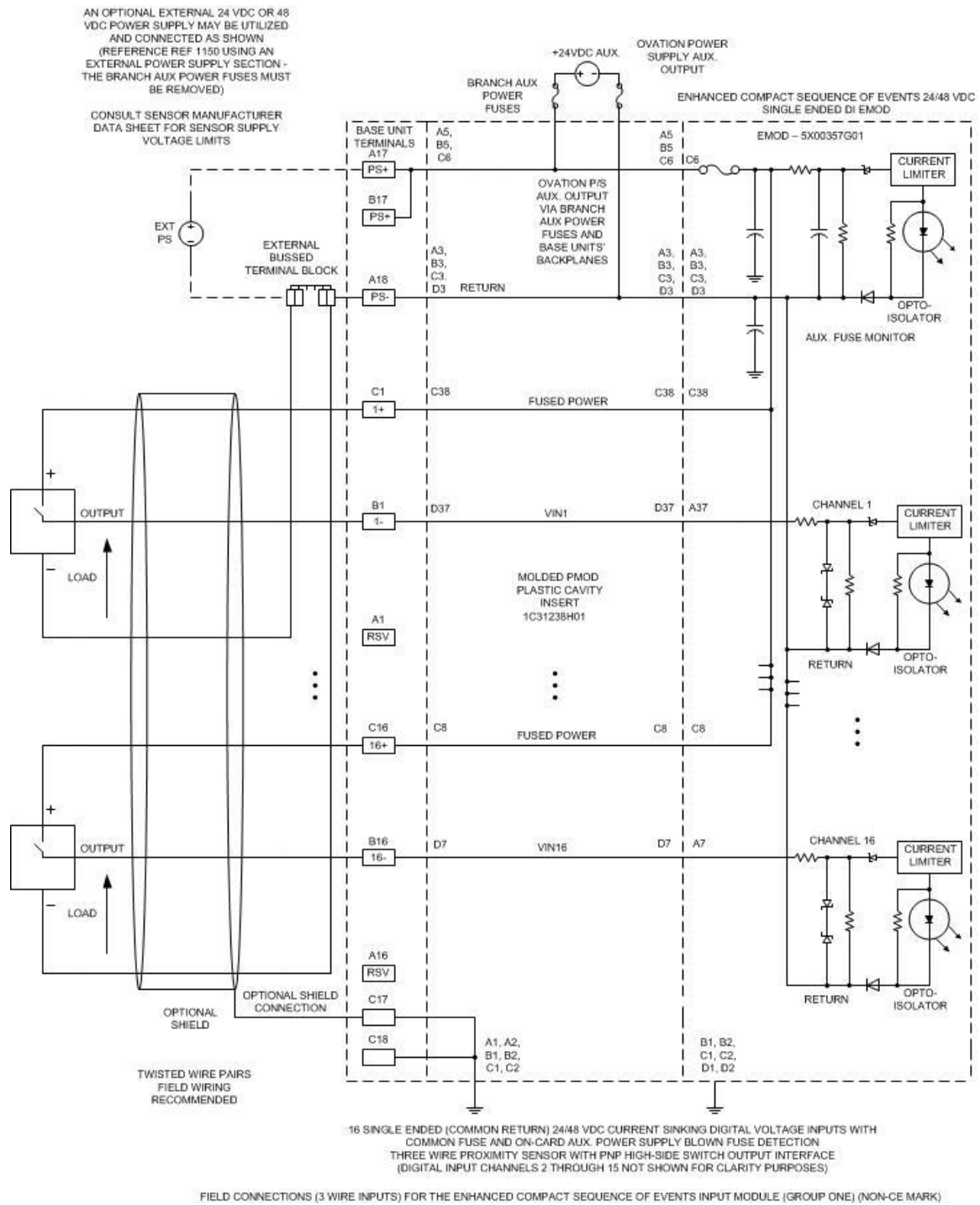


22.7.3 Field connection wiring - 5X00357G01

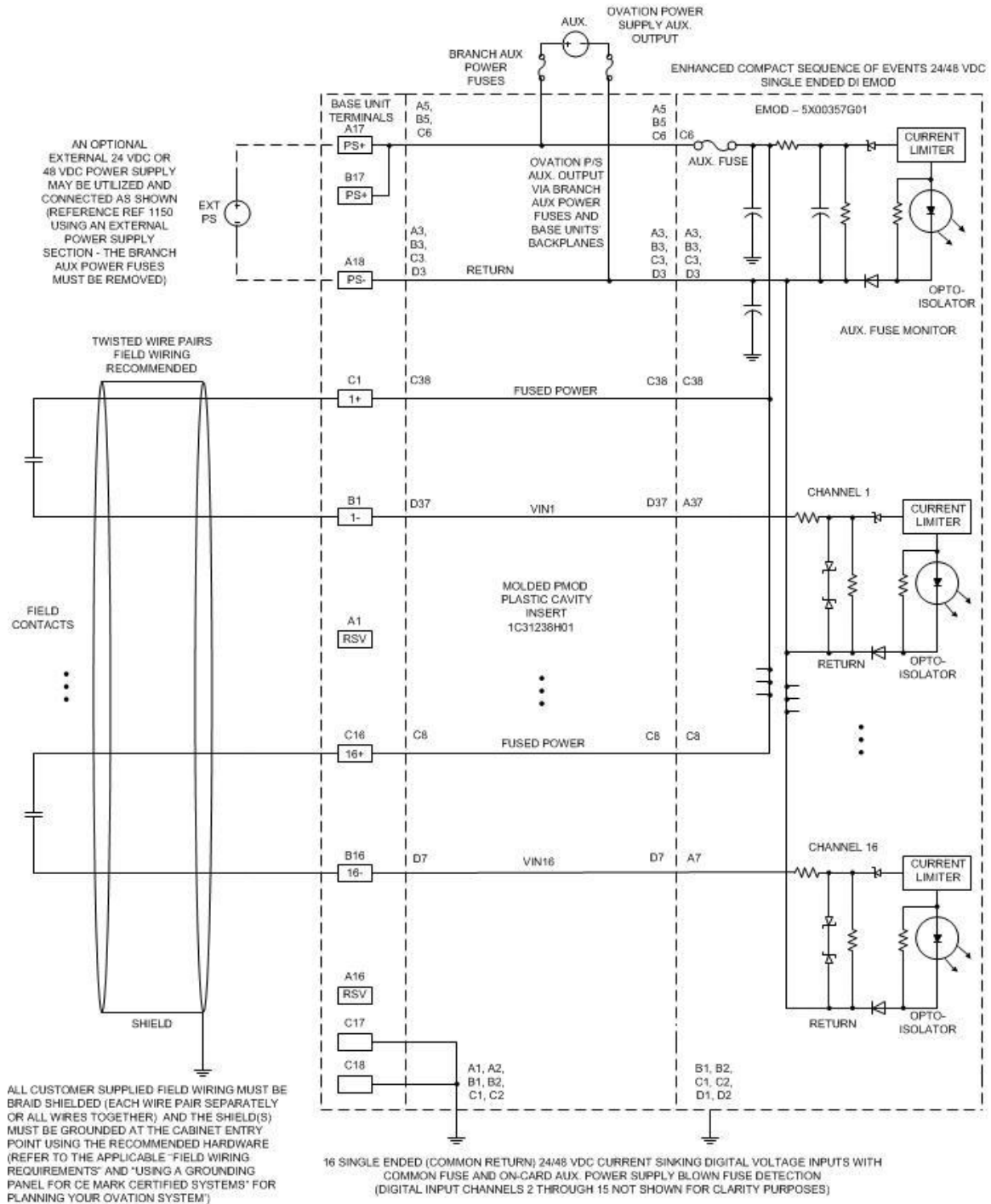


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP ONE) (NON-CE MARK)

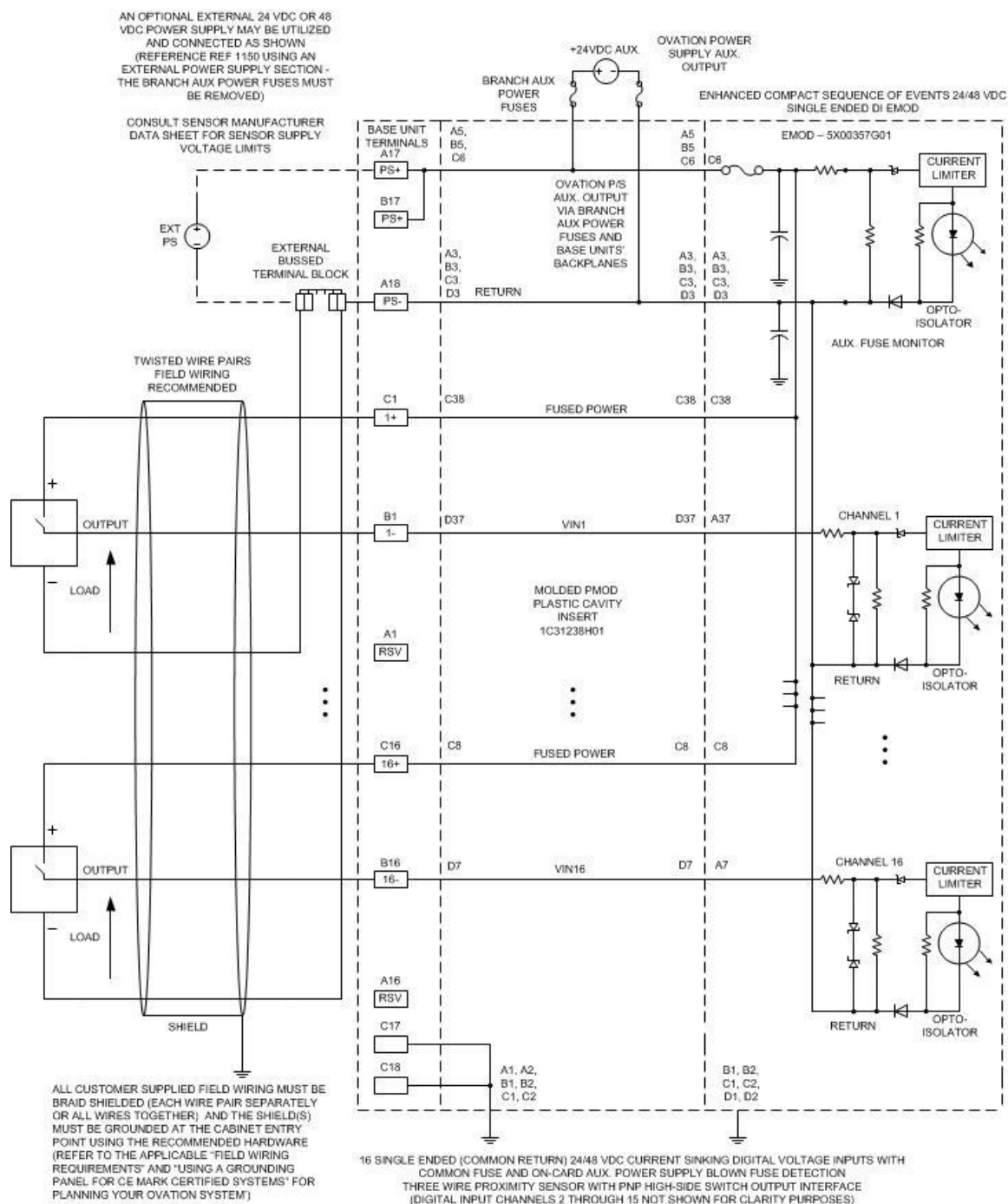
22.7 Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECISOEDI)



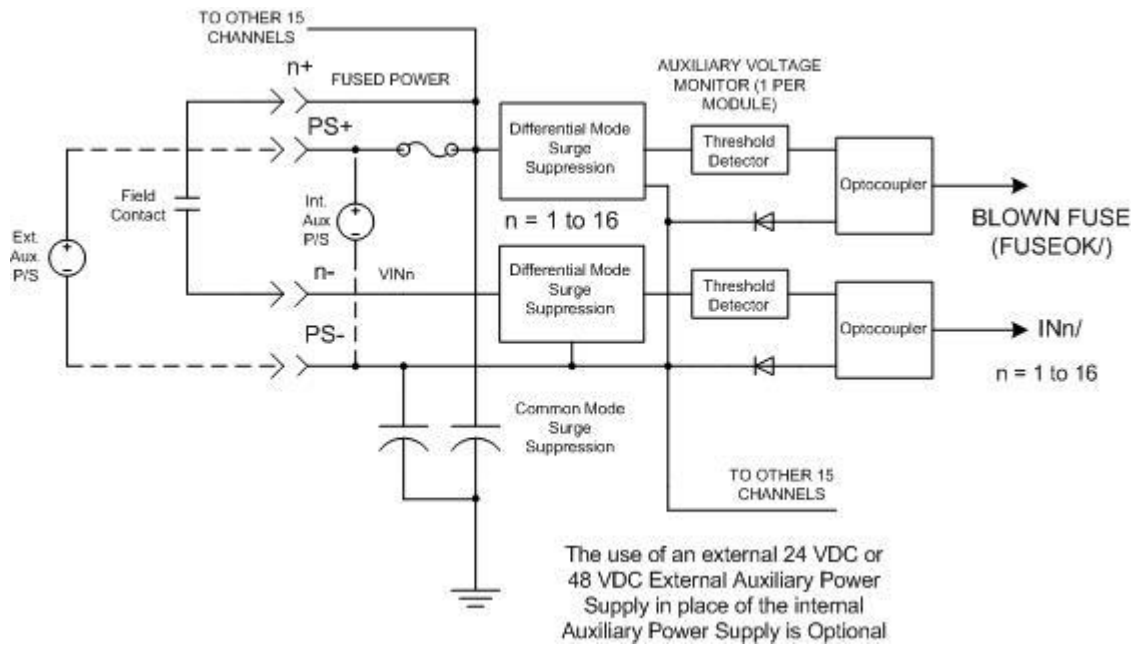
22.7 Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECSEOEDI)



22.7 Enhanced Compact Sequence of Events Digital Input module (5X00357G01) (FDJ) - (ECISOEDI)



FIELD CONNECTIONS (3 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP ONE) (CE MARK)



The "+" inputs are actually the module field card's fused Auxiliary power supply positive rail.

The auxiliary power supply voltage may be derived either from the base unit backplane's printed circuit card auxiliary voltage traces or from an optional external auxiliary power supply

1. To use the base unit backplane's printed circuit backplane Auxiliary voltage, do not connect an external power supply to the base unit termination block PS+ and PS- terminals since the base unit backplane's Auxiliary voltage automatically appears at these terminals

The two plug-in branch Aux. fuses must be installed into their sockets located on the Controller backplane or on the transition panel to which the module's base unit branch interfaces.

2. To use an external 24 VDC or 48 VDC auxiliary power supply, connect the power supply "+" and "-" terminals to the base unit PS+ and PS- terminals as shown. This connection will force all modules on this branch to use the external auxiliary power supply voltage.

The two plug-in branch Aux. fuses must be removed from their sockets located on the Controller backplane or on the transition panel to which the module's base unit branch interfaces.

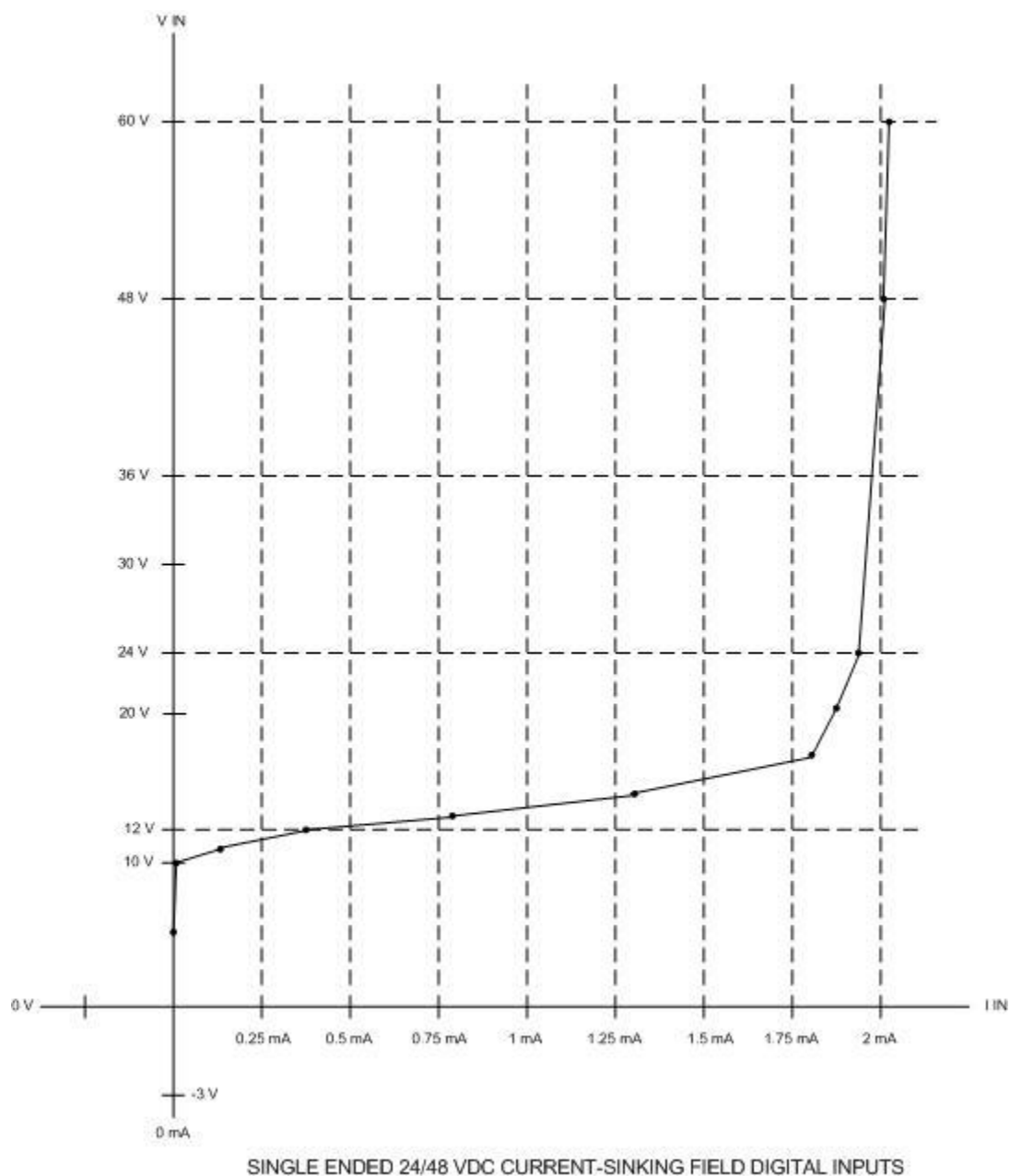
No other external power supplies may be connected to other base unit termination block PS+ or PS- terminals located in the same branch.

22.7.4 External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05)

When using the Enhanced Compact Sequence of Events module, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, there are steps to be undertaken before connecting the external power supply to the Enhanced Compact Sequence of Events Digital Input module base unit terminal block, Refer to *Using an External Power Supply* (see page 635).

22.7.5 Voltage-current curve (5X00357G01) - (ECISOEDI)



22.7.6 Specifications (5X00357G01) - (ECSOEDI)

DESCRIPTION	VALUE
Voltage category	24 VDC or 48 VDC
Reverse polarity protection	Yes, each channel incorporates a diode in series with the optocoupler.
Operating voltage	20-60 VDC.
Input voltage	For "1" signal = 20-60 VDC. For "0" signal = 0-9 VDC.
Input current	For "1" signal = 1.3 mA Min - 2.6 mA Maximum
Number of channels	16
Channels per common	16
Galvanic isolation	Between channels and I/O bus = Yes. Between channels = No.
Current draw, from I/O bus base unit, 24 V main power	44 mA typical for all inputs off. 77 mA typical for all inputs on.
Power dissipation of module Sum of 24V main power and 24V field channel power Sum of 24V main power and 48V field channel power	1.1 W typical for all inputs off. 2.54 W typical for all inputs on. 1.1 W typical for all inputs off. 3.24 W typical for all inputs on.
Total module response time (1 foot (0.305 M) long field cable is assumed)	"0" Open to "1" Close = 4.02 msec typ "1" Close to "0" Open = 4.13 msec typ
Resolution	1/8 msec for time tagging an event.
Accuracy (time tagged)	1 msec relative to clock from I/O bus. 1/8 msec relative to other module channels.
LSW card Propagation delay - field card output to present input state register	3.75 msec. Minimum 4.0 msec. Typical 4.25 msec. Maximum
LSW card digital debounce circuit delay time	4.0 msec. typical
Status Display	Green LED per channel. LEDs located in logic card circuit.

Note: Any module digital input state change time that is less than the LSW card digital debounce time will be rejected by the module and will not appear in the present input state register.

FDJ card signal propagation delay. This is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

Input voltage level	Delay time for contact opening	Delay time for contact closing
24 VDC	0.13 msec. typ.	0.02 msec. typ.
48 VDC	0.13 msec. typ.	0.02 msec. typ.

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

Input voltage level	Additional delay time for contact opening
24 VDC	0.2 msec. typical
48 VDC	0.6 msec. typical

22.8 Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECSOEDI)

The Enhanced Compact Sequence of Events Digital Input module (5X00357G02) has 16 differential (galvanically isolated) current sinking digital inputs that can accommodate a separate 24 VDC or 48 VDC auxiliary power supply for each channel.

This module can be used with the 5X00034G01 individually fused 16 Point personality module for applications requiring individual channel fusing of a common 24 VDC or 48 VDC auxiliary power supply.

The required auxiliary power supply voltage source may be obtained from the cabinet's internal auxiliary power supply or it may be obtained from an external power supply or multiple external power supplies.

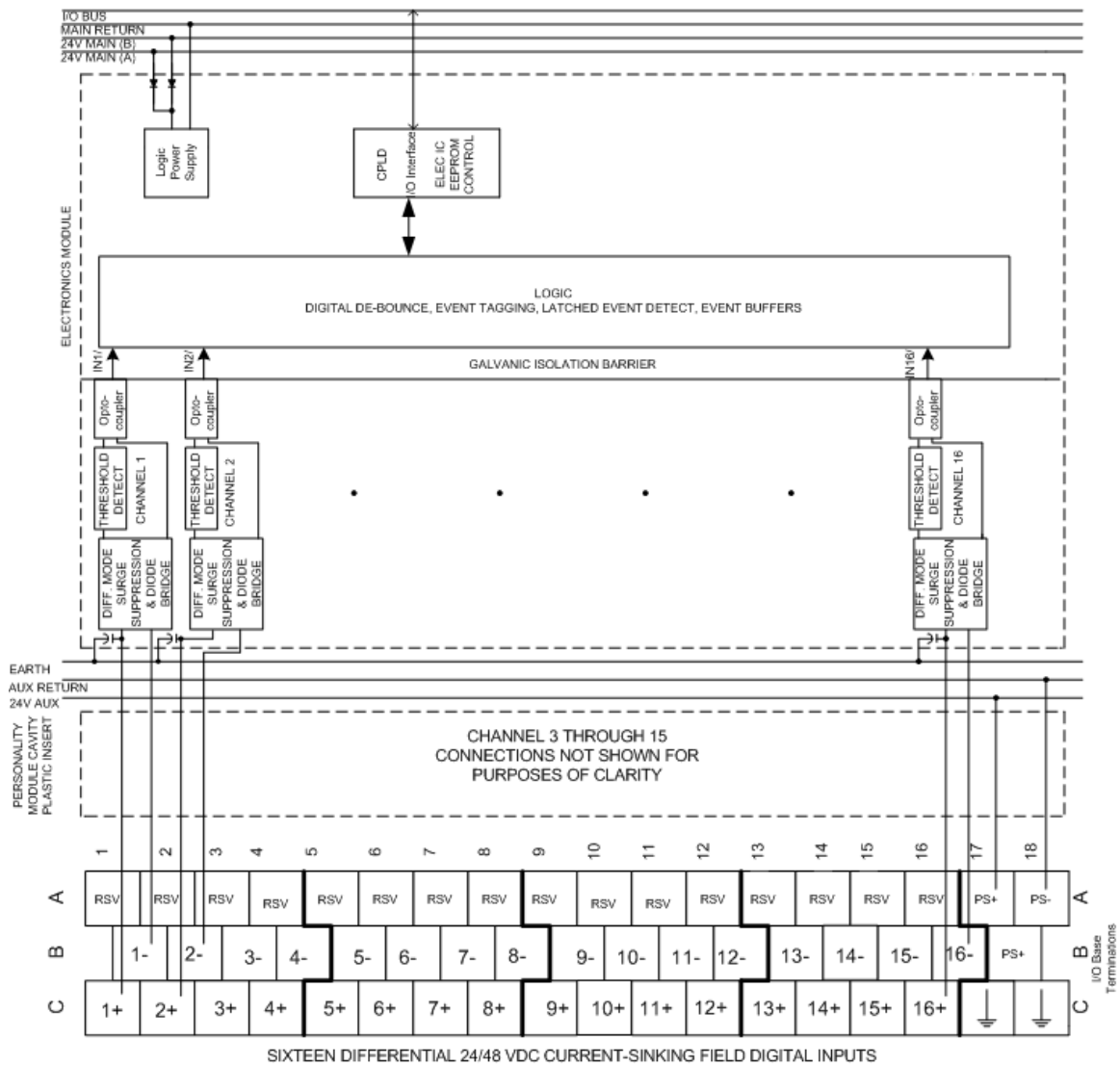
Each channel contains the following:

- An **input resistor** to provide normal mode surge protection and a current regulator circuit to limit input current during normal operation.
- An **optocoupler** to provide galvanic isolation between the field digital input circuit and module's logic or I/O bus side.

A diode bridge allows input voltages of either polarity to be applied.

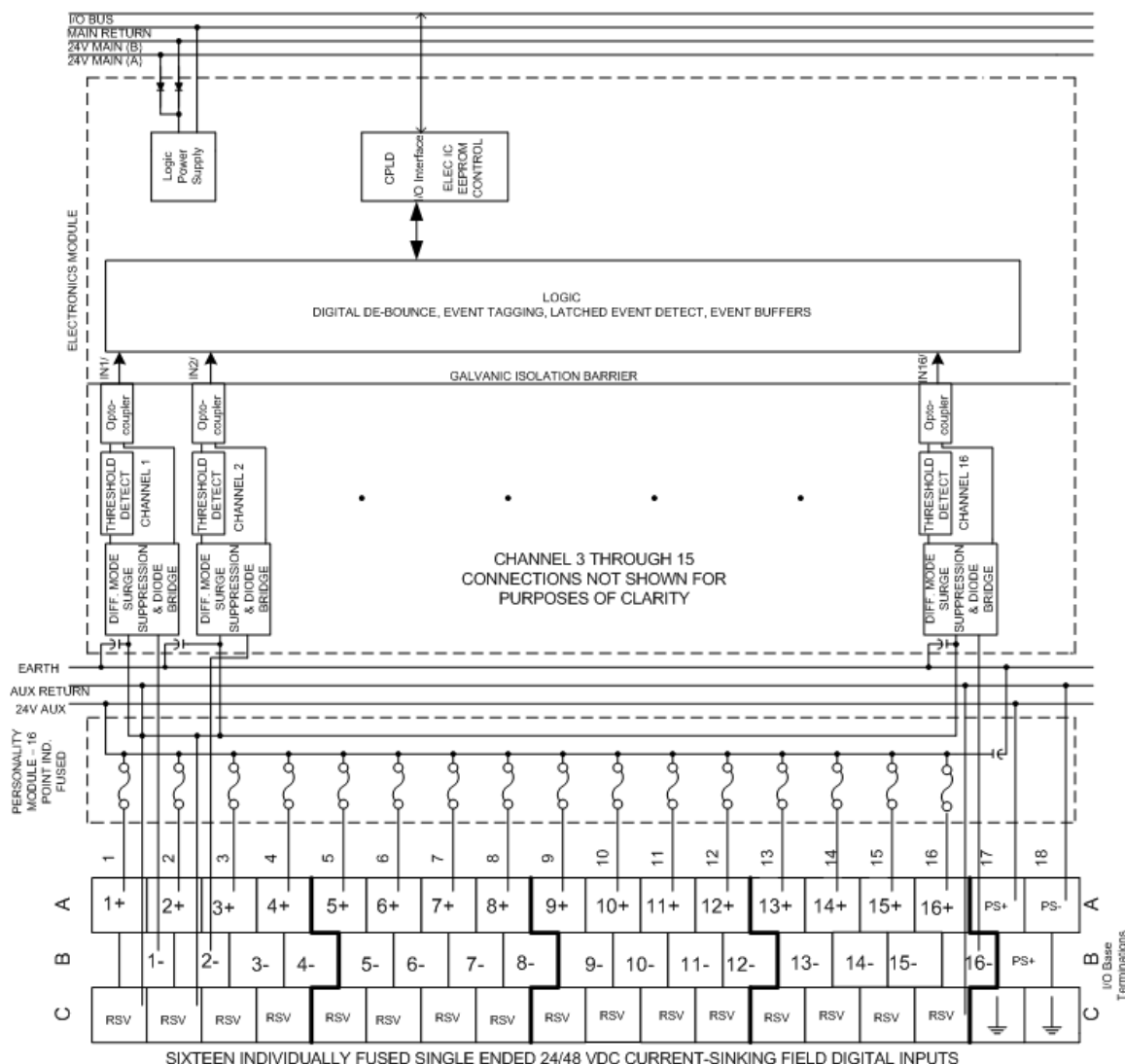
Note: The use of the 5X00034G01 personality module converts differential current sinking digital inputs into single-ended current sinking digital inputs. The 5X00034G01 personality module taps the base unit's internal auxiliary voltage and distributes this voltage to all 16 module digital input channels.

22.8.1 Module-base unit interconnection (5X00357G02) - (ECISOEDI)



Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

22.8.2 Module-base unit interconnection (Individually Fused) (5X00357G02) - (ECISOEDI)

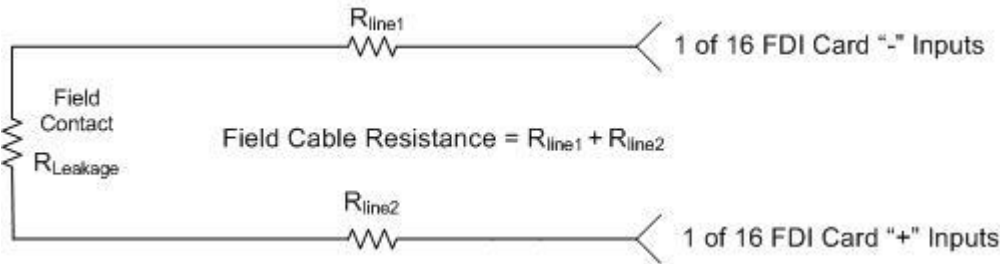


Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

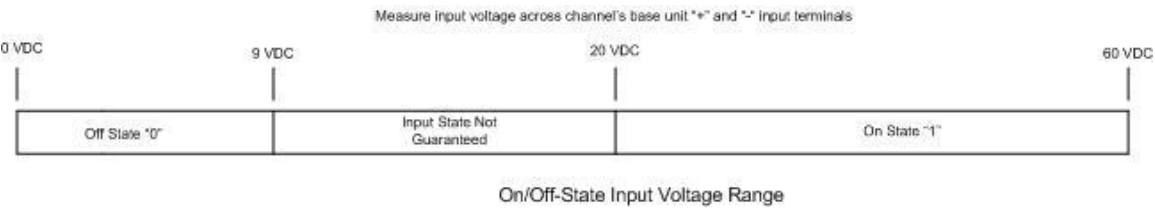
22.8.3 Field wiring (5X00357G02) - (ECISOEDI)

The minimum combined field cable resistance plus field contact leakage resistance value assumes that the Auxiliary power supply voltage is its Maximum allowable value (30 VDC for 24 VDC inputs and 60 VDC for 48 VDC inputs).

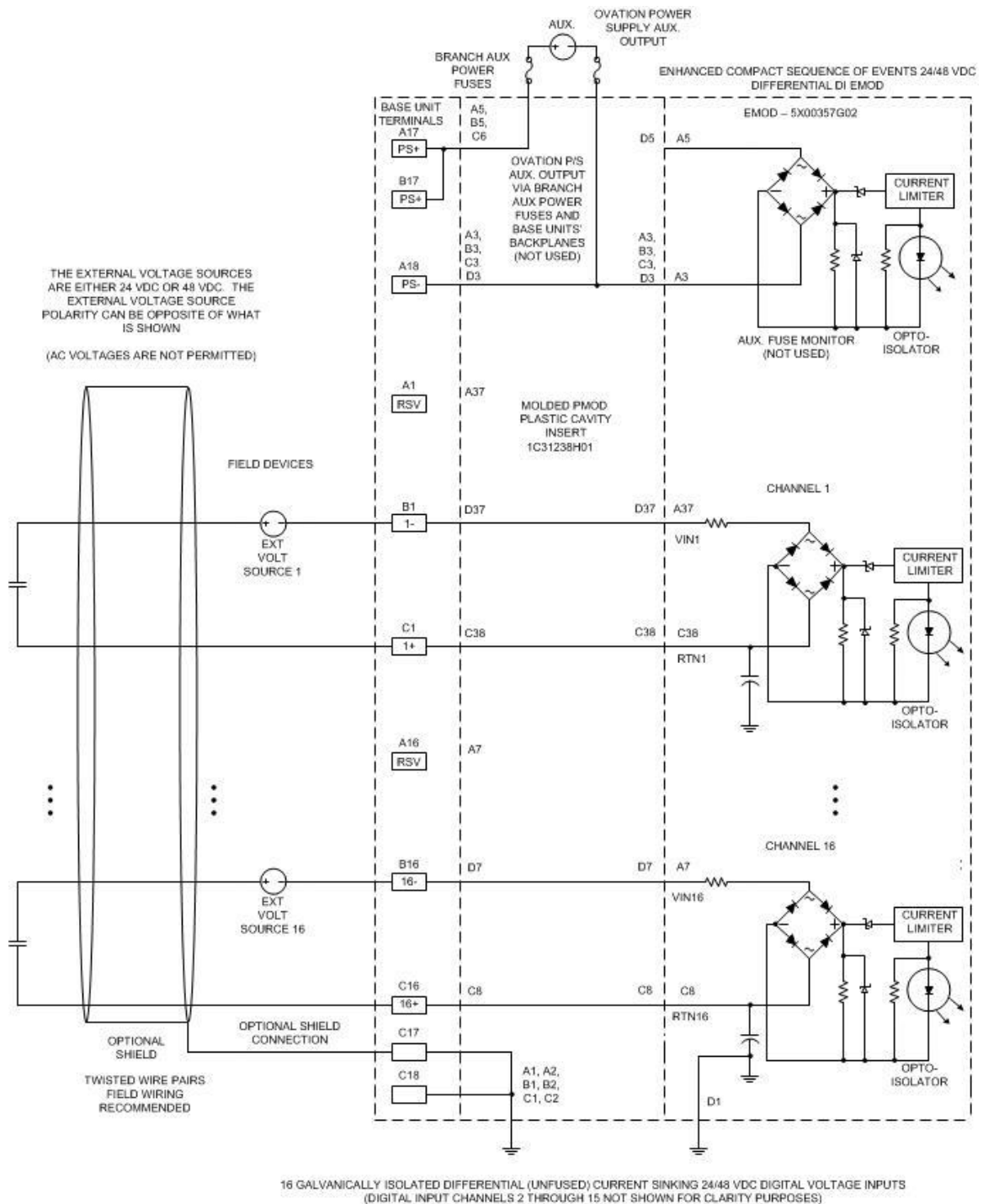
Input voltage level	Minimum field cable resistance plus field contact leakage resistance
24 VDC	100 Kohm
48 VDC	150 Kohm



If a channel's combined field cable resistance and contact leakage resistance is less than the values specified above, the channel may report that its field contact state is closed even though the field contact is actually open.

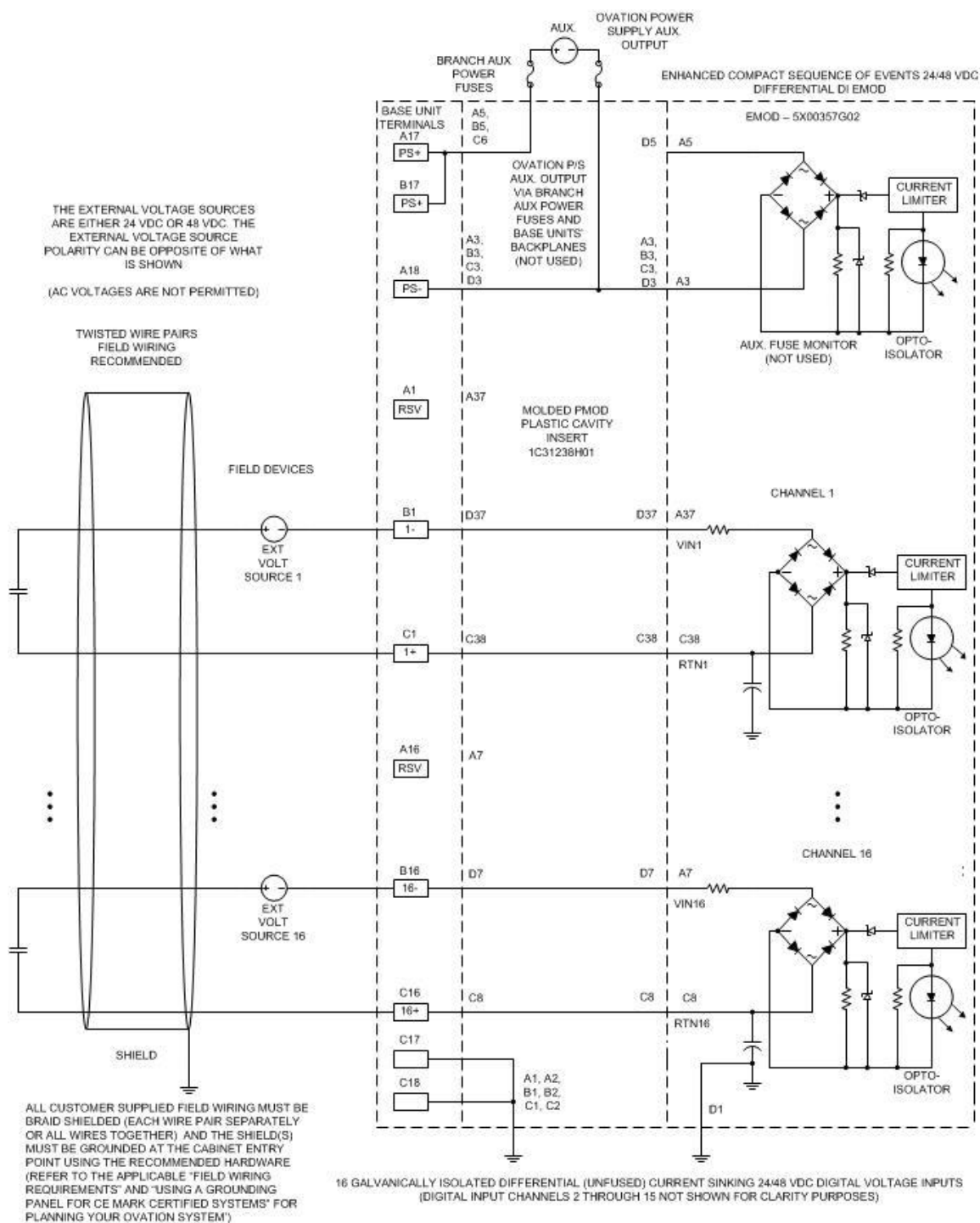


22.8.4 Field connection wiring (5X00357G02) - (ECISOEDI)



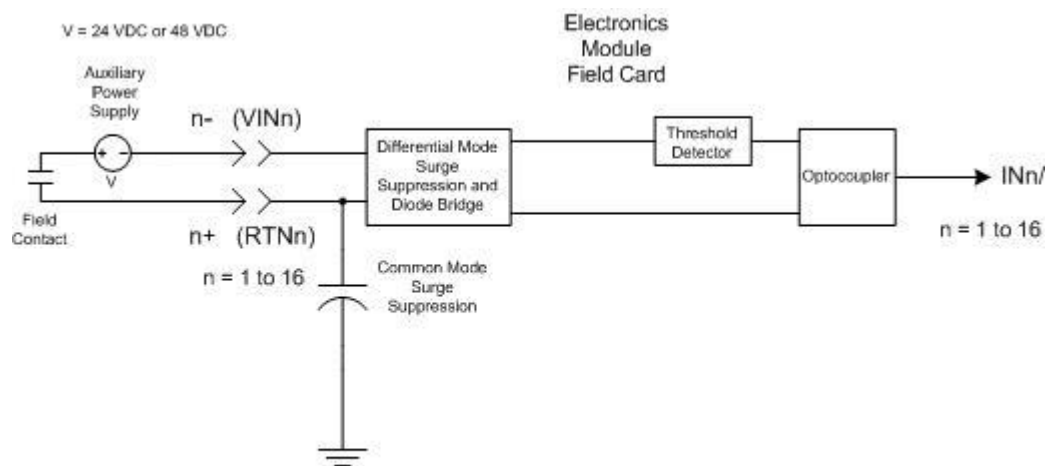
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (NON-CE MARK)

22.8 Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECISOEDI)



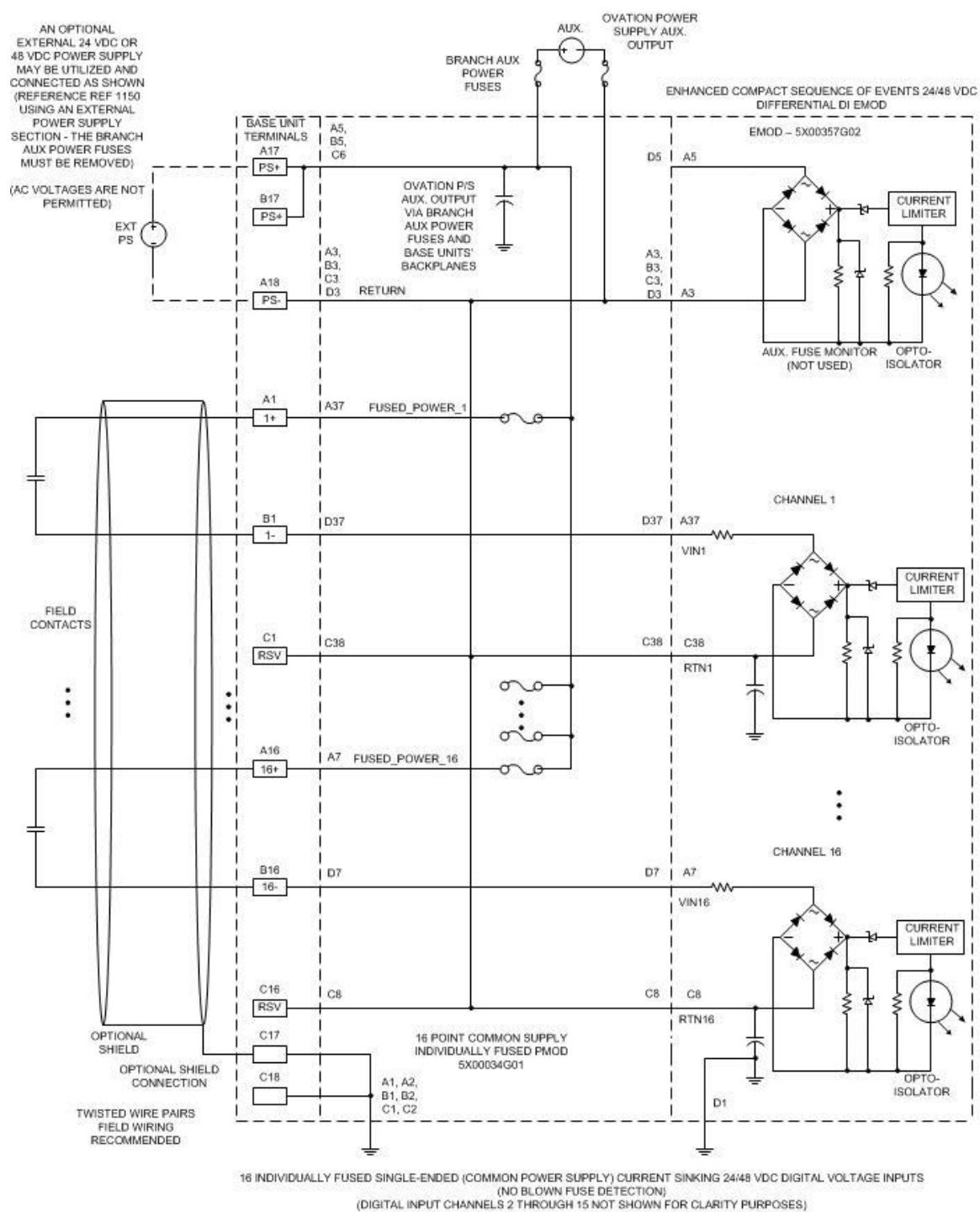
FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (CE MARK)

Note: Channel 4 through 15 input terminals not shown for clarity purposes.



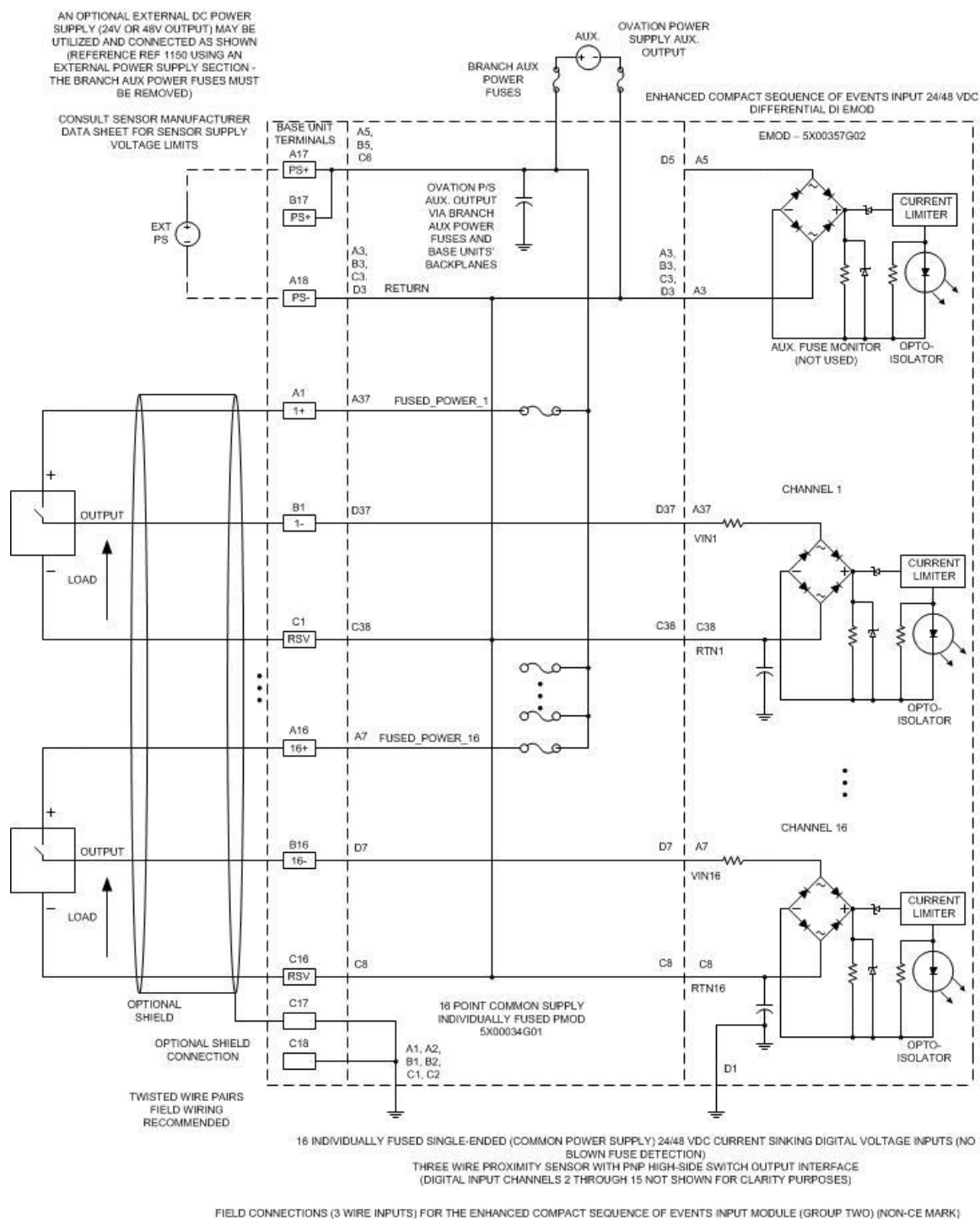
24/48 VDC DIFFERENTIAL CURRENT-SINKING FIELD DIGITAL INPUT CHANNEL

22.8.5 Field connection wiring Individually Fused (5X00357G02) - (ECISOEDI)

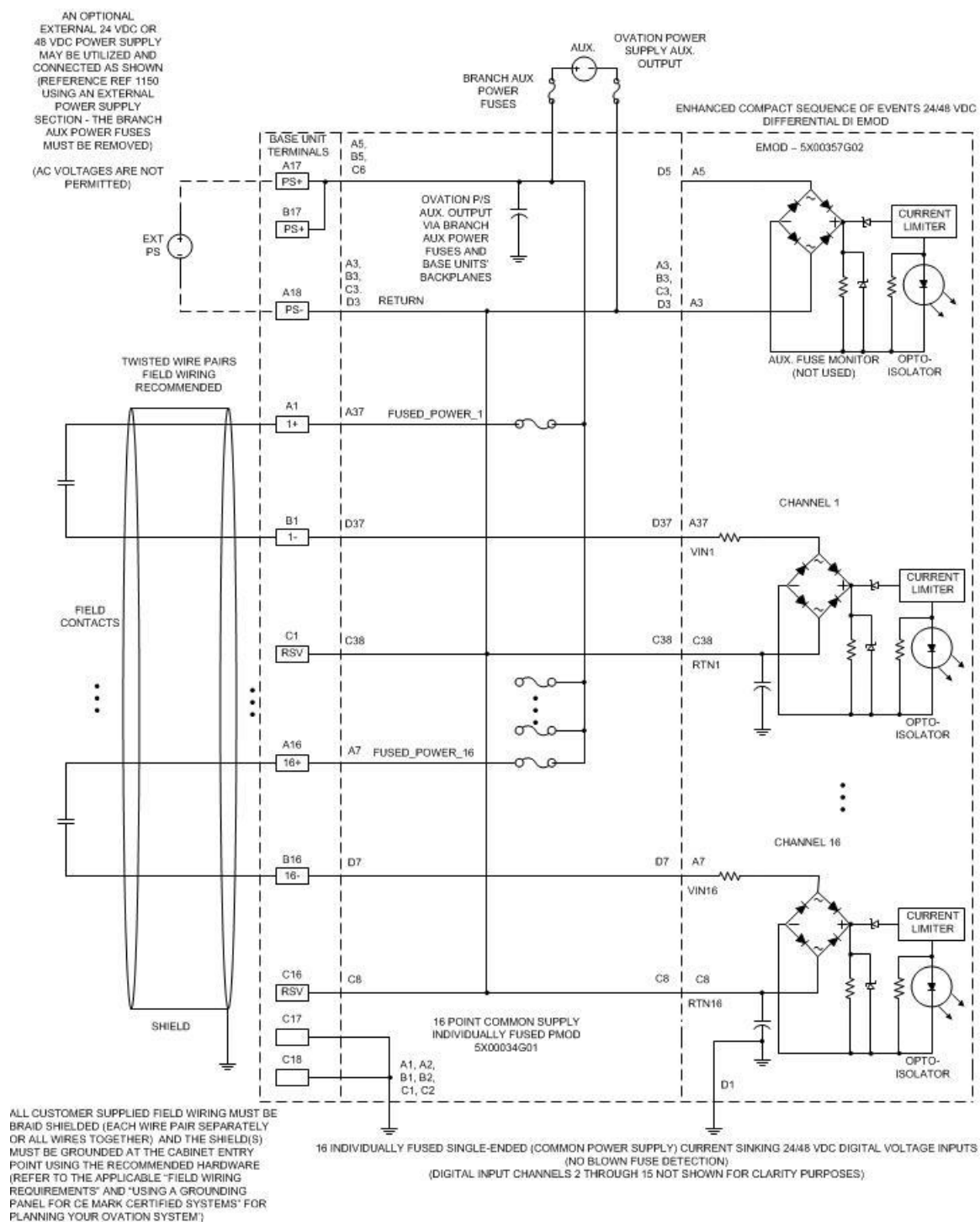


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (NON-CE MARK)

22.8 Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECSEOEDI)

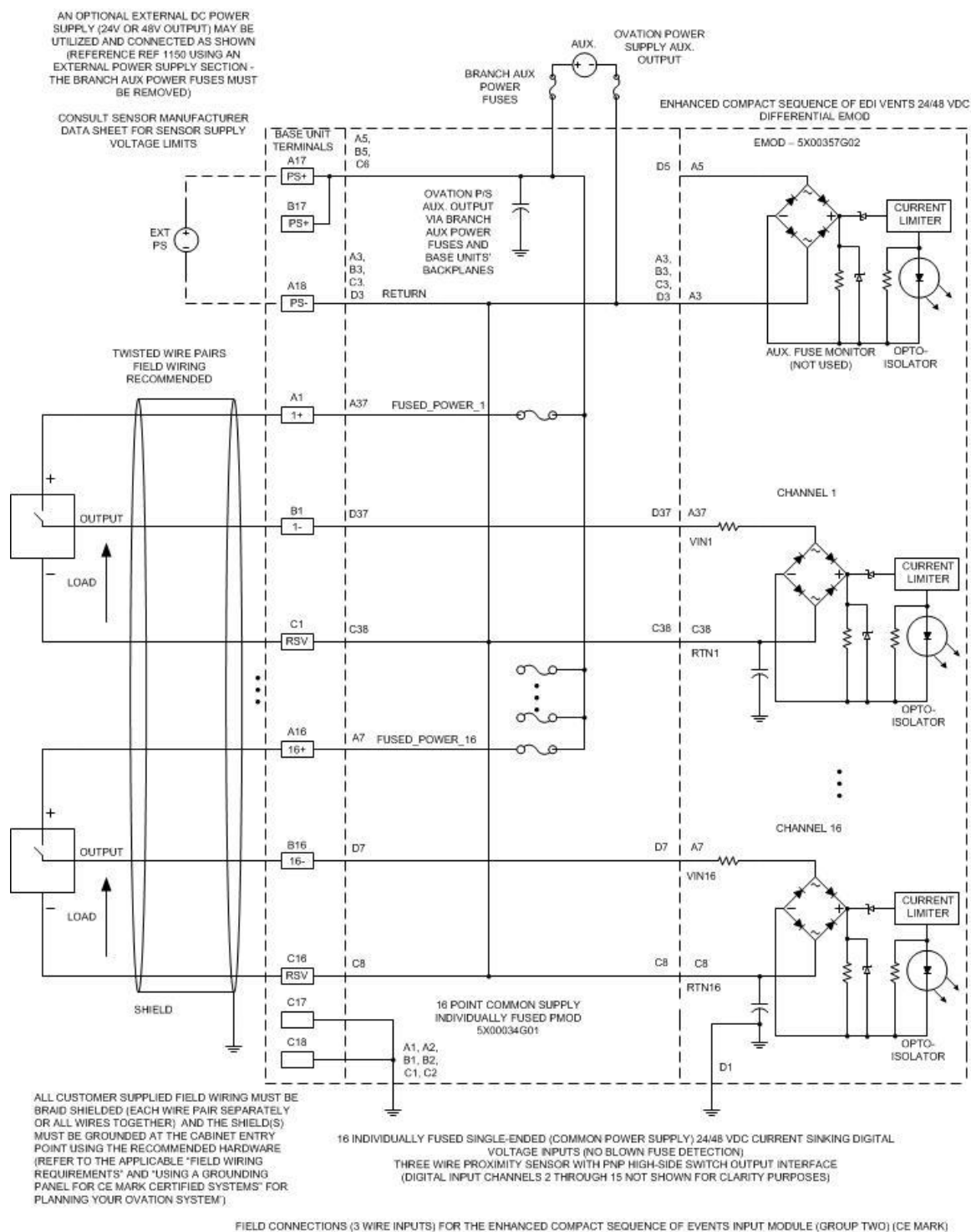


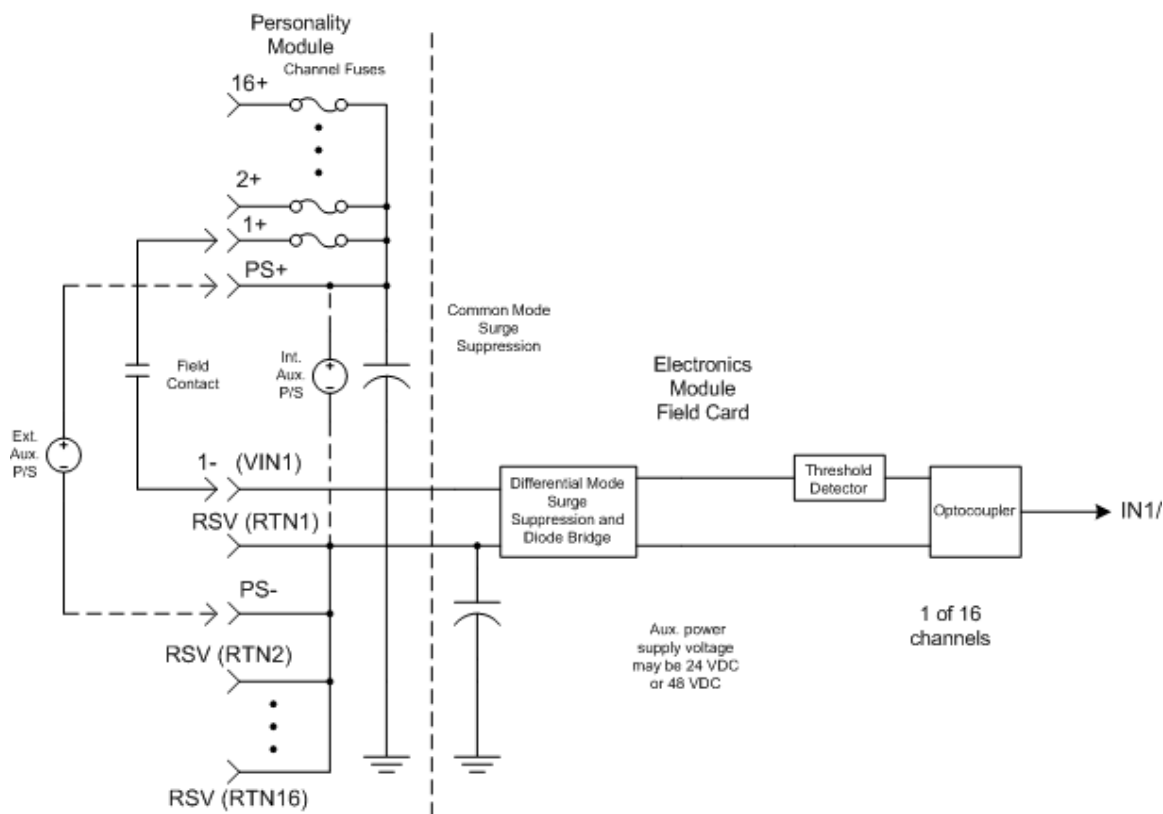
22.8 Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECISOEDI)



FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP TWO) (CE MARK)

22.8 Enhanced Compact Sequence of Events Digital Input module (5X00357G02) (FDI) - (ECSEOEDI)





24/48 VDC INDIVIDUALLY FUSED CURRENT-SINKING FIELD DIGITAL INPUT CHANNEL

The “+” inputs are actually the 5X00034G01 personality module PDIC personality card’s fused Auxiliary power supply positive rail. The “-” inputs are the field card’s channel VIN inputs. The PDIC personality card connects the sixteen field card channel RTN inputs to the auxiliary power supply return.

For 5X00357G02/5X00034G01 module combinations, the auxiliary power supply voltage may be derived either from the base unit backplane's printed circuit card auxiliary voltage traces or from an optional external auxiliary power supply.

1. To use the base unit backplane's printed circuit backplane Auxiliary voltage, do not connect an external power supply to the base unit termination block PS+ and PS- terminals since the base unit backplane's Auxiliary voltage automatically appears at these terminals.

The two plug-in branch Aux. fuses must be installed into their sockets located on the Controller backplane or on the transition panel to which the module's base unit branch interfaces.

2. To use an external 24 VDC (5X00357G02) or 48 VDC (5X00357G02) auxiliary power supply, connect the power supply "+" and "-" terminals to the base unit PS+ and PS- terminals as shown. This connection will force all modules on this branch to use the external auxiliary power supply voltage.

The two plug-in branch Aux. fuses must be removed from their sockets located on the Controller backplane or on the transition panel to which the module's base unit branch interfaces.

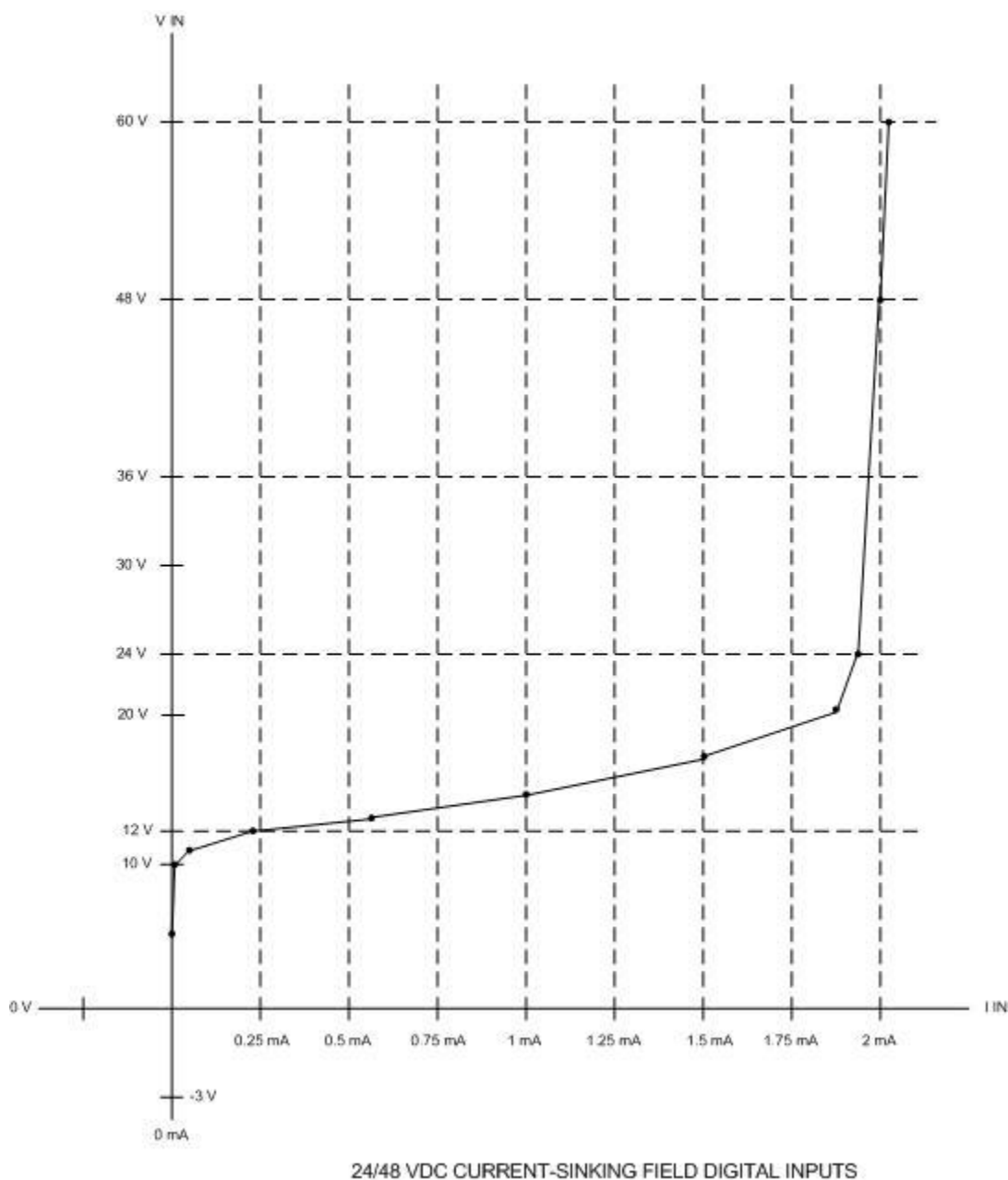
No other external power supplies may be connected to other base unit termination block PS+ or PS- terminals located in the same branch.

22.8.6 External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05)

When using the Enhanced Compact Sequence of Events module, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, there are steps to be undertaken before connecting the external power supply to the Enhanced Compact Sequence of Events Digital Input module base unit terminal block, Refer to *Using an External Power Supply* (see page 635).

22.8.7 Voltage-current curve (5X00357G02) - (ECISOEDI)



22.8.8 Specifications (5X00357G02) - (ECISOEDI)

DESCRIPTION	VALUE
Voltage category	24 VDC or 48 VDC
Reverse polarity protection	Yes, each channel incorporates a front-end diode bridge
Operating voltage	20-60 VDC
Input voltage	For "1" signal = 20-60 VDC For "0" signal = 0-9 VDC
Input current	For "1" signal = 1.3 mA Min - 2.6 mA Max
Number of channels Channels per common	16 1, 5X00357G02/1C31238H01 16, 5X00357G02/5X00034G01
Galvanic isolation	Between channels and I/O bus = Yes Between channels = Yes, 5X00357G02/1C31238H01 No, 5X00357G02/5X00034G01
Current draw, from I/O bus base unit, 24 V main power	44 mA typical for all inputs off 63 mA typical for all inputs on
Power dissipation of module Sum of 24V main power and 24V field channel power. Sum of 24V main power and 48V field channel power	1.06 W typical for all inputs off 2.16 W typical for all inputs on 1.06 W typical for all inputs off 2.82 W typical for all inputs on
Total module response time (1 foot (0.305 M) long field cable is assumed)	"0" Open to "1" Close = 4.02 msec typ "1" Close to "0" Open = 4.13 msec typ
Resolution	1/8 msec for time tagging an event
Accuracy (time tagged)	1 msec relative to clock from I/O bus 1/8 msec relative to other module channels
LSW card Propagation delay - field card output to present input state register	3.75 msec. Minimum 4.0 msec. typical 4.25 msec. Maximum
LSW card digital debounce circuit delay time	4.0 msec. typical
Status Display	Green LED per channel. LEDs located in isolated logic card circuit

Note: Any module digital input state change time that is less than the LSW card digital debounce time is rejected by the module and does not appear in the present input state register.

FDI card signal propagation delay, is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

Input voltage level	Delay time for contact opening	Delay time for contact closing
24 VDC	0.13 msec. typ.	0.02 msec. typ.
48 VDC	0.13 msec. typ.	0.02 msec. typ.

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

Input voltage level	Additional delay time for contact opening
24 VDC	0.2 msec. typical
48 VDC	0.6 msec. typical

22.9 Enhanced Compact Sequence of Events Digital Input module (5X00357G03) (FDI) - (ECISOEDI)

The Enhanced Compact Sequence of Events Digital Input module 5X00357G03 has 16 differential (galvanically isolated) current sinking digital inputs that can accommodate a separate 125 VDC auxiliary power supply for each channel.

This module can be used with the 5X00034G01 Individually Fused 16 Point personality module for applications requiring individual channel fusing of a common 125 VDC auxiliary power supply. The required 125 VDC auxiliary power supply voltage source may be obtained from the module base unit backplane (both module I/O branch plug-in fuses removed and external 125 VDC power supply connected to module base unit PS+ and PS- terminals) or it may be obtained from an external power supply or multiple external power supplies.

When the 5X00357G03 Enhanced Compact Sequence of Events electronics module is used without the 5X00034G01 Individually Fused 16 point personality module, additional external fusing or other current limiting devices are recommended on the hazardous inputs to provide additional protection to the external wiring and 125 VDC power supply.

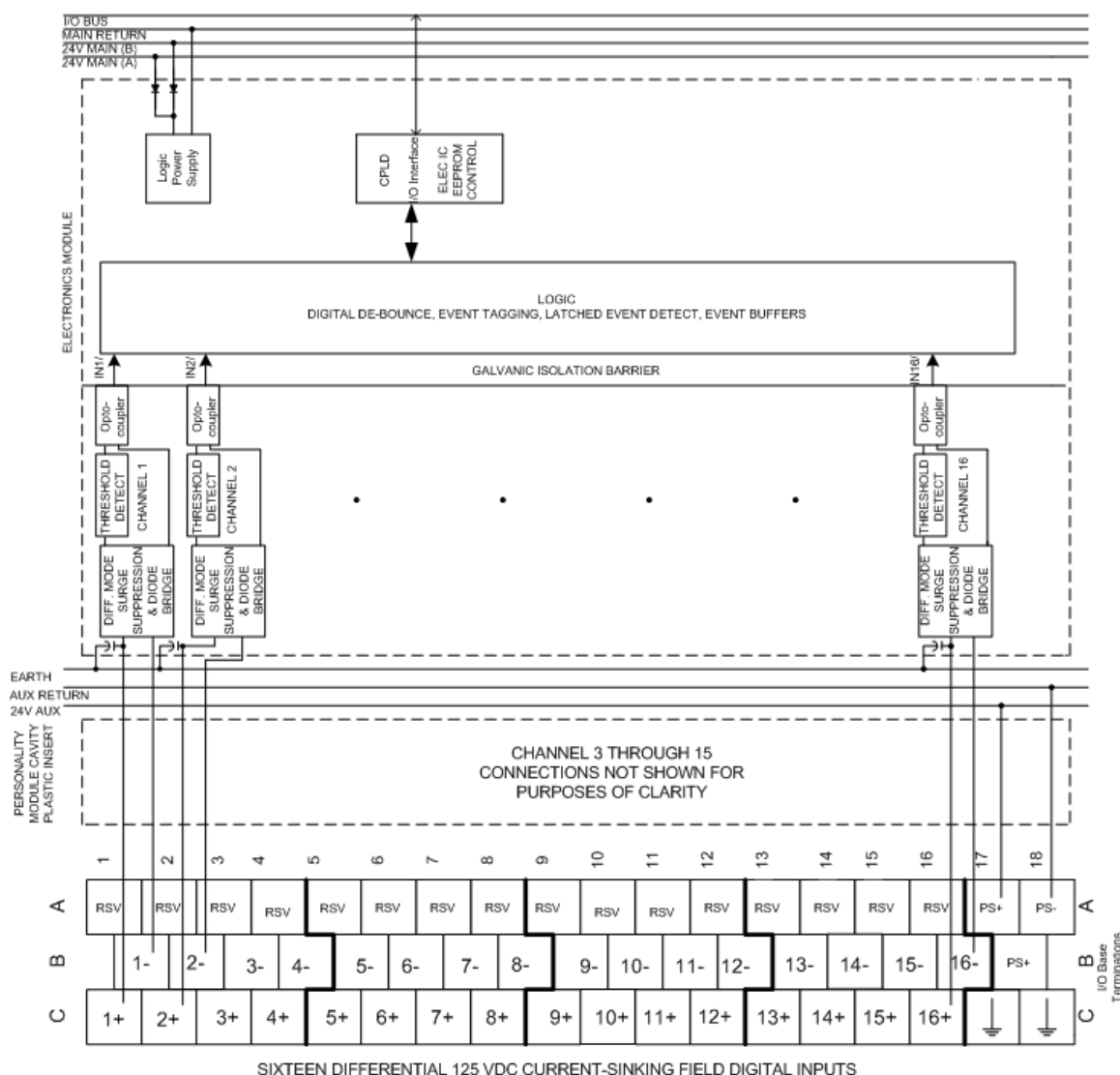
Each channel contains the following:

- An **input resistor** to provide normal mode surge protection and a current regulator circuit to limit input current during normal operation.
- An **optocoupler** to provide galvanic isolation between the field digital input circuit and module's logic or I/O bus side.

A diode bridge allows input voltages of either polarity to be applied.

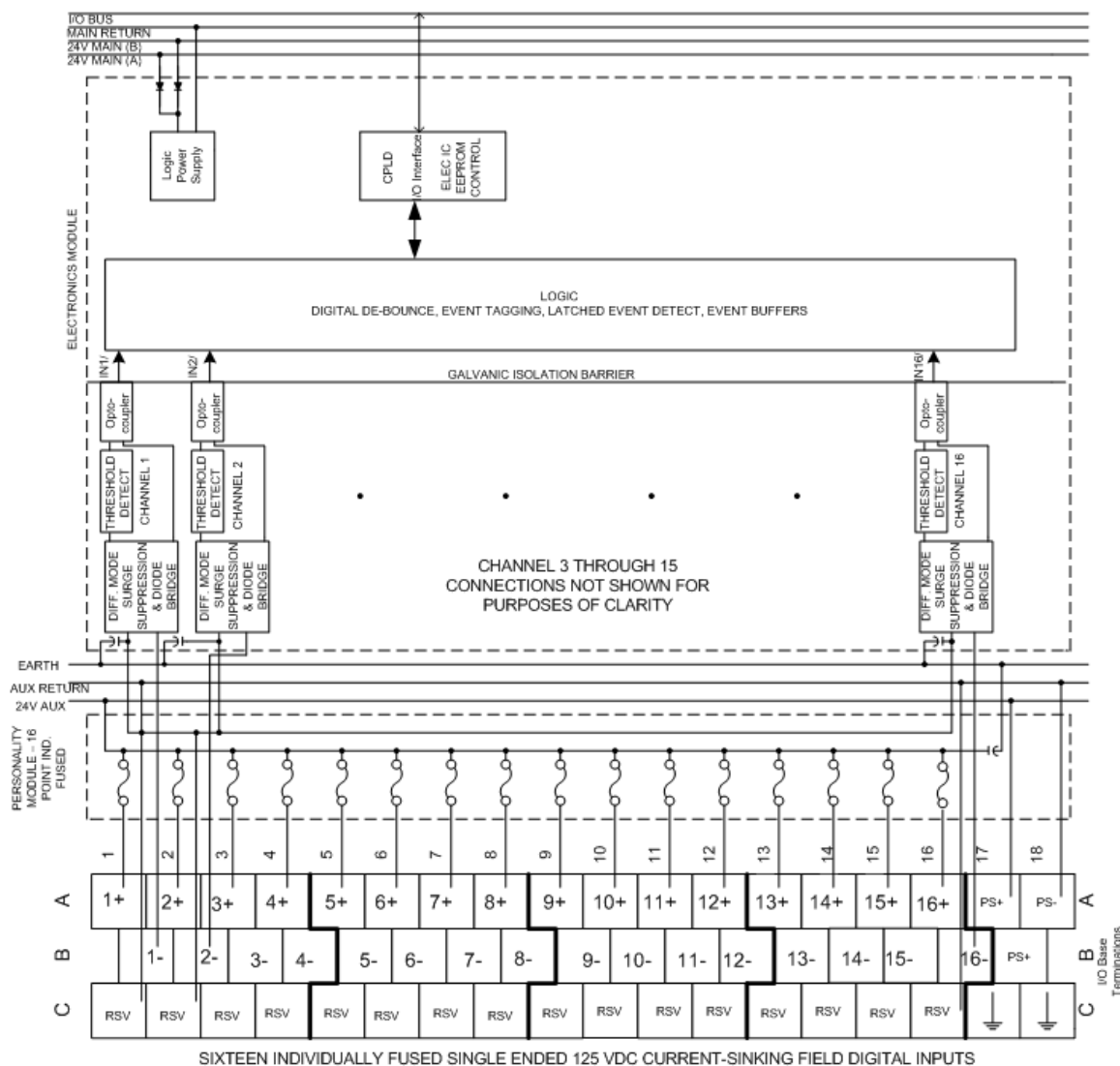
Note: The use of the 5X00034G01 personality module converts differential current sinking digital inputs into single-ended current sinking digital inputs. The 5X00034G01 personality module taps the base unit's internal auxiliary voltage and distributes this voltage to all sixteen module digital input channels.

22.9.1 Module-base unit interconnection (5X00357G03) - (ECISOEDI)



Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

22.9.2 Module-base unit interconnection individually Fused (5X00357G03) - (ECISOEDI)

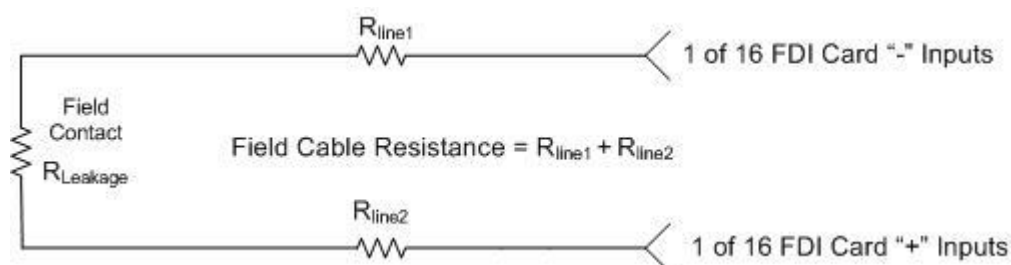


Note: For the Standard I/O Marshaling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

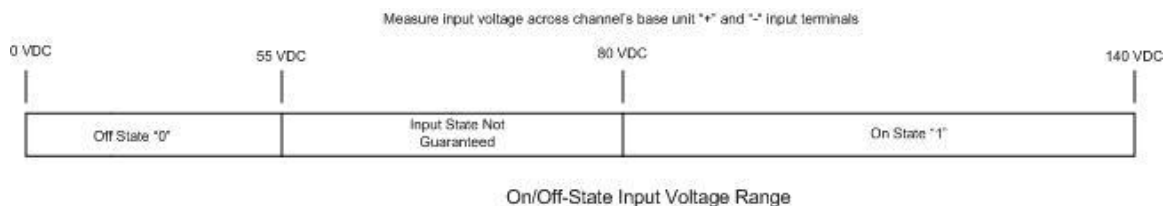
22.9.3 Field wiring (5X00357G03) - (ECISOEDI)

The minimum combined field cable resistance plus field contact leakage resistance value assumes that the Auxiliary power supply voltage is its Maximum allowable value (140 VDC for 125 VDC inputs).

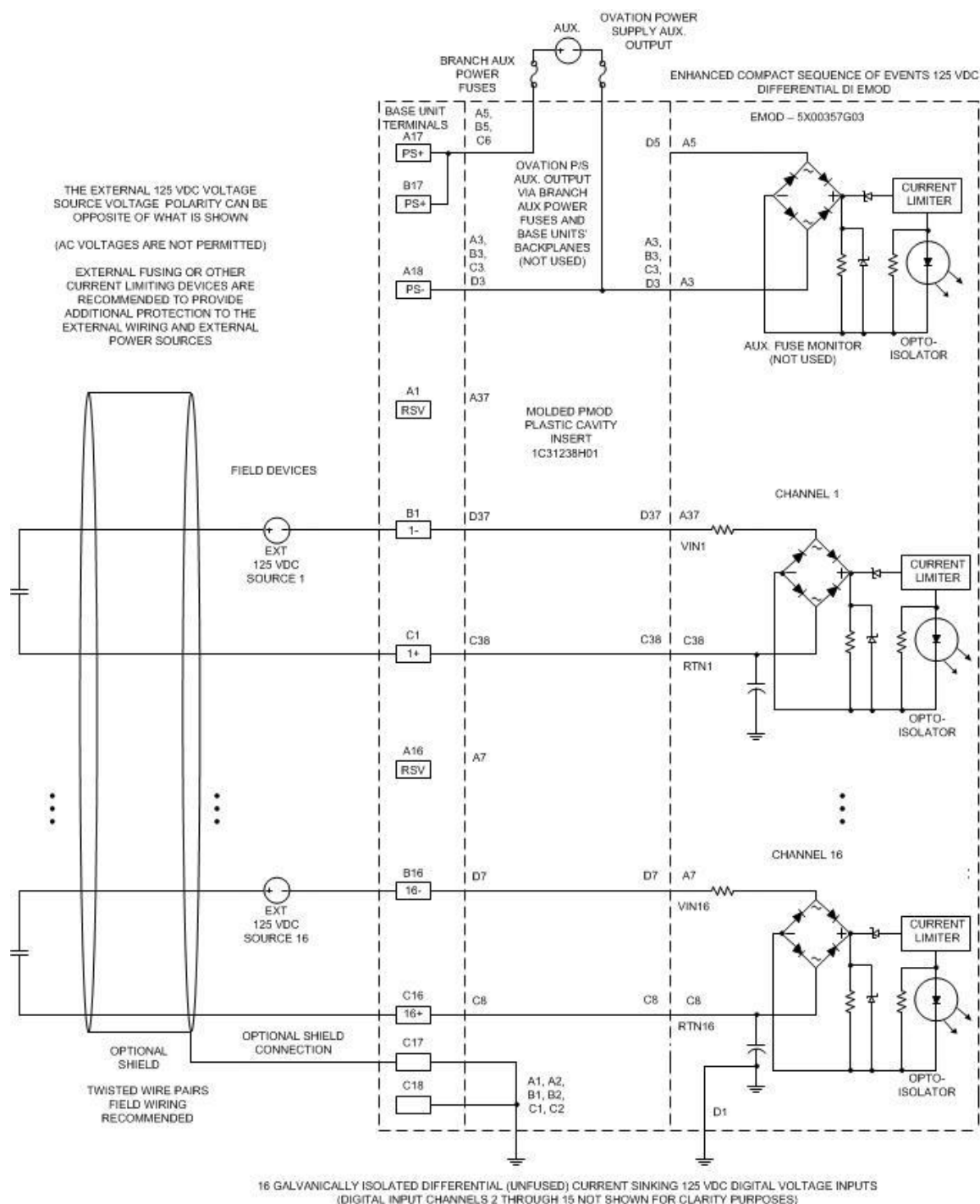
Input voltage level	Minimum field cable resistance plus field contact leakage resistance
125 VDC	250 Kohm



If a channel's combined field cable resistance and contact leakage resistance is less than the values specified above, the channel may report that its field contact state is closed even though the field contact is actually open.

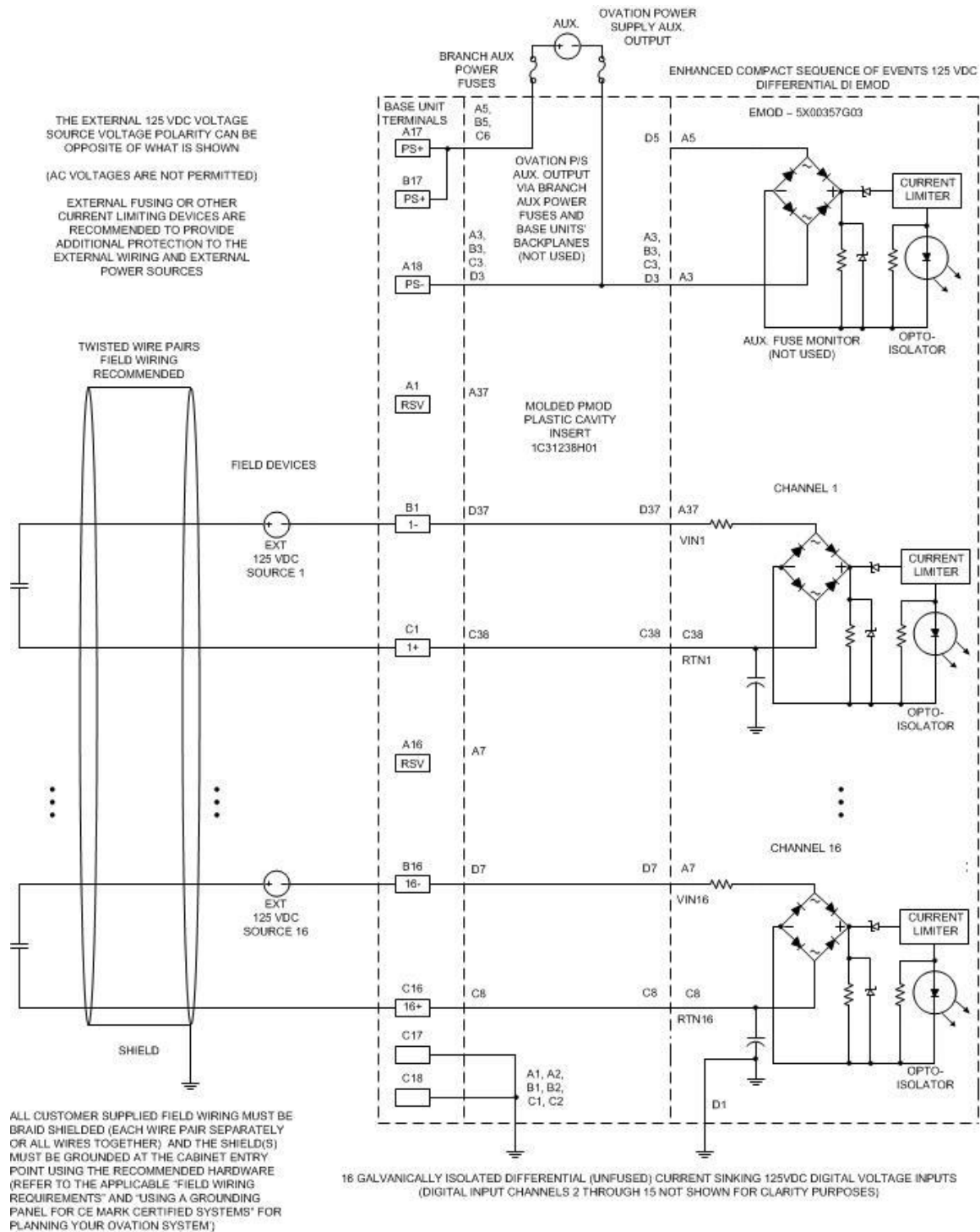


22.9.4 Field connection wiring (5X00357G03) - (ECISOEDI)

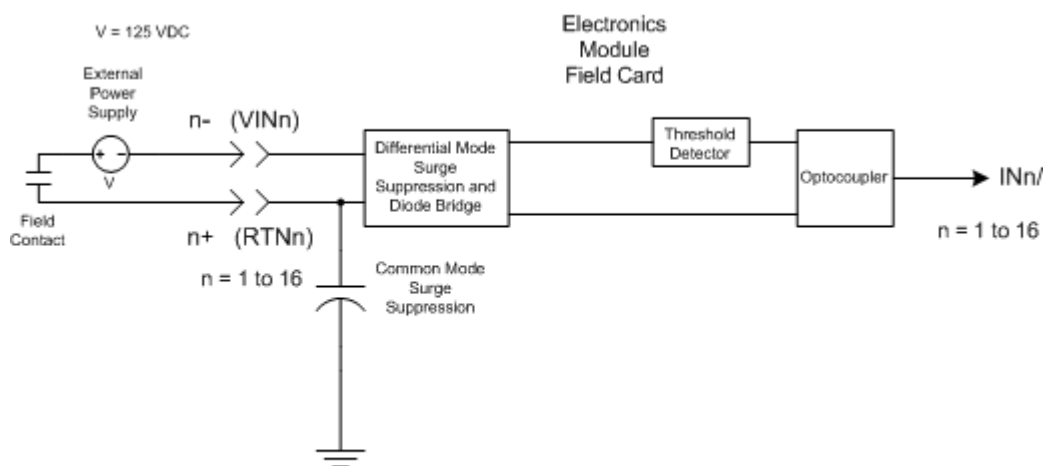


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP THREE) (NON-CE MARK)

22.9 Enhanced Compact Sequence of Events Digital Input module (5X00357G03) (FDI) - (ECSEOEDI)

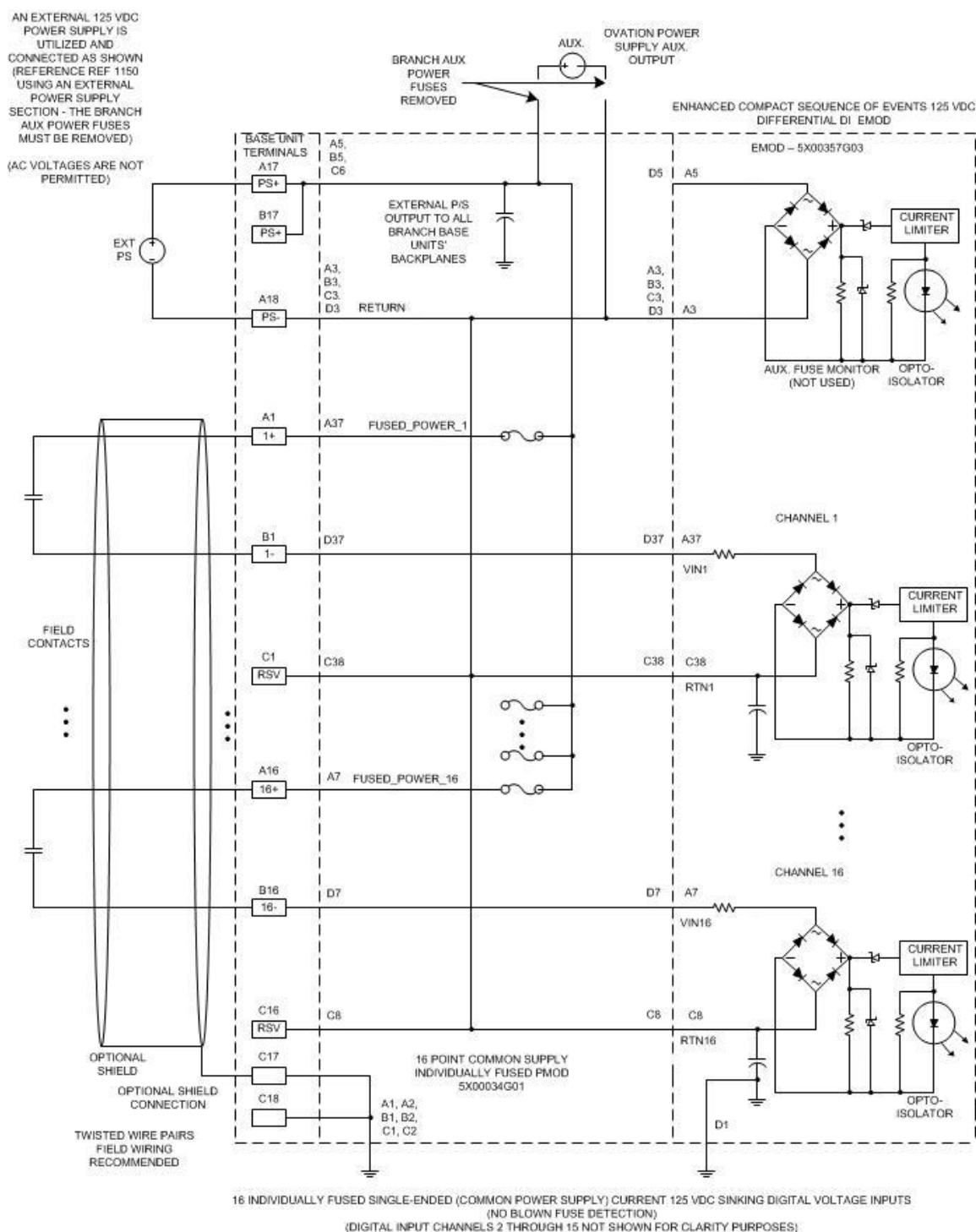


Channel 4 through 15 input terminals not shown for clarity purposes.



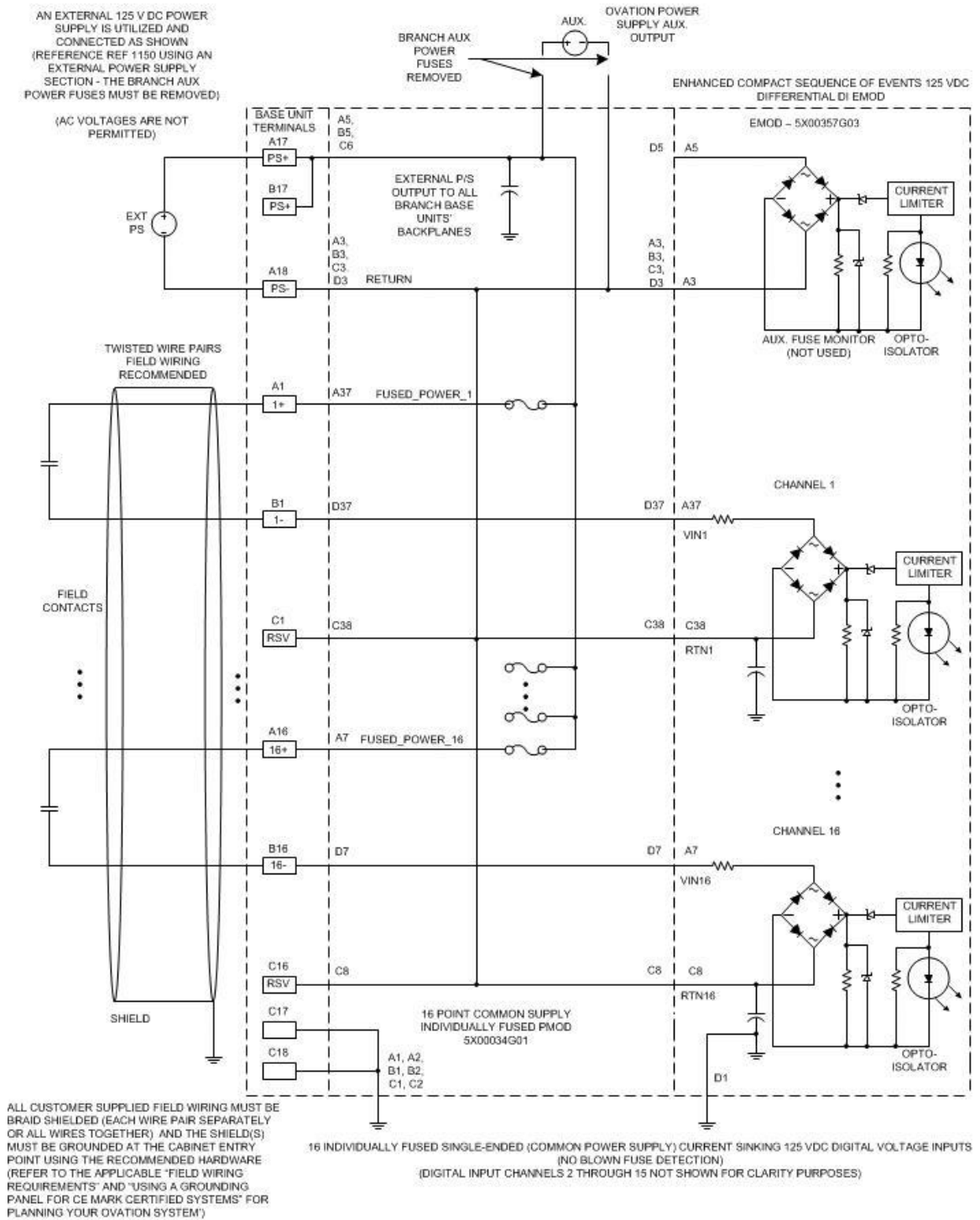
125 VDC DIFFERENTIAL CURRENT-SINKING FIELD DIGITAL INPUT CHANNEL

22.9.5 Field connection wiring Individually Fused (5X00357G03) - (ECISOEDI)

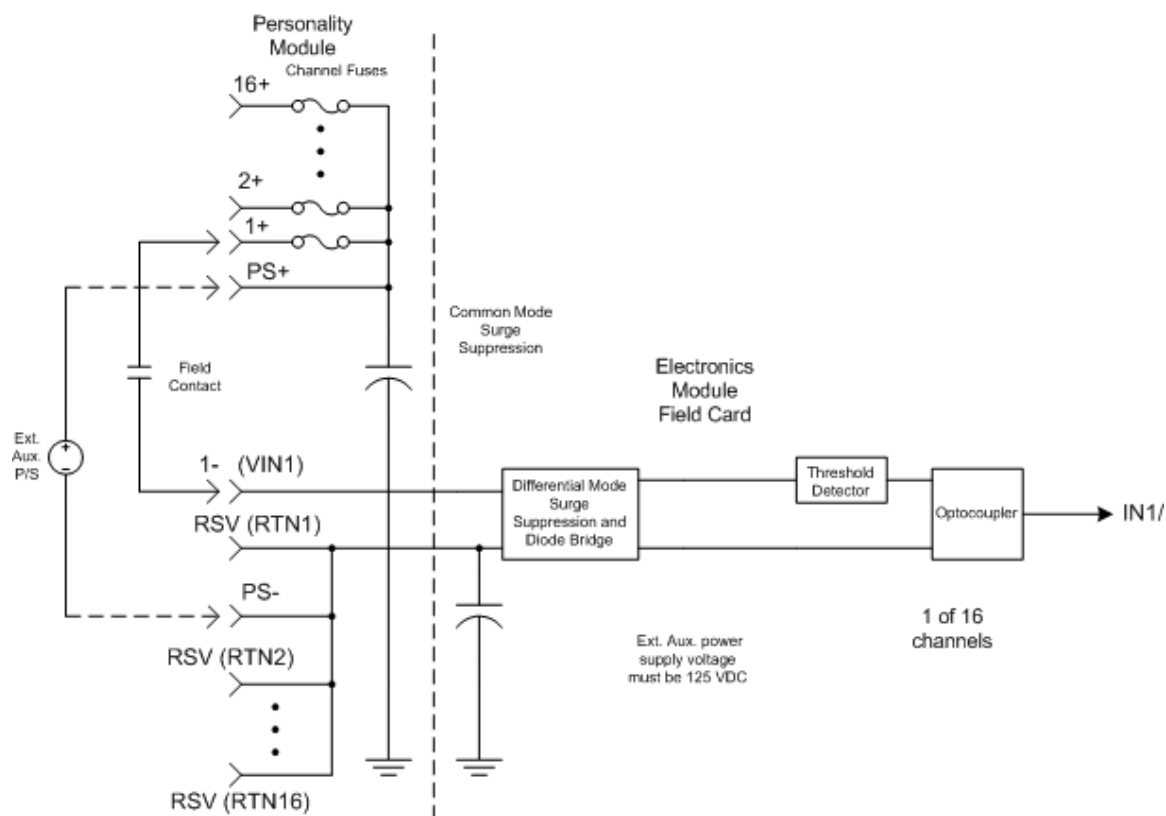


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP THREE) (NON-CE MARK)

22.9 Enhanced Compact Sequence of Events Digital Input module (5X00357G03) (FDI) - (ECSEOEDI)



FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS INPUT MODULE (GROUP THREE) (CE MARK)



125 VDC INDIVIDUALLY FUSED CURRENT-SINKING FIELD DIGITAL INPUT CHANNEL

The “+” inputs are actually the 5X00034G03 personality module PDIC personality card’s fused Auxiliary power supply positive rail. The “-” inputs are the field card’s channel VIN inputs. The PDIC personality card connects the sixteen field card channel RTN inputs to the auxiliary power supply return.

For 5X00357G03 module combinations, the +125 VDC auxiliary power supply voltage must be obtained from an external auxiliary power supply.

To use an external 125 VDC (5X00357G03) auxiliary power supply, connect the power supply “+” and “-” terminals to the base unit PS+ and PS- terminals as shown. This connection will force all modules on this branch to use the external auxiliary power supply voltage.

The two plug-in branch Aux. fuses must be removed from their sockets located on the Controller backplane or on the transition panel to which the module’s base unit branch interfaces.

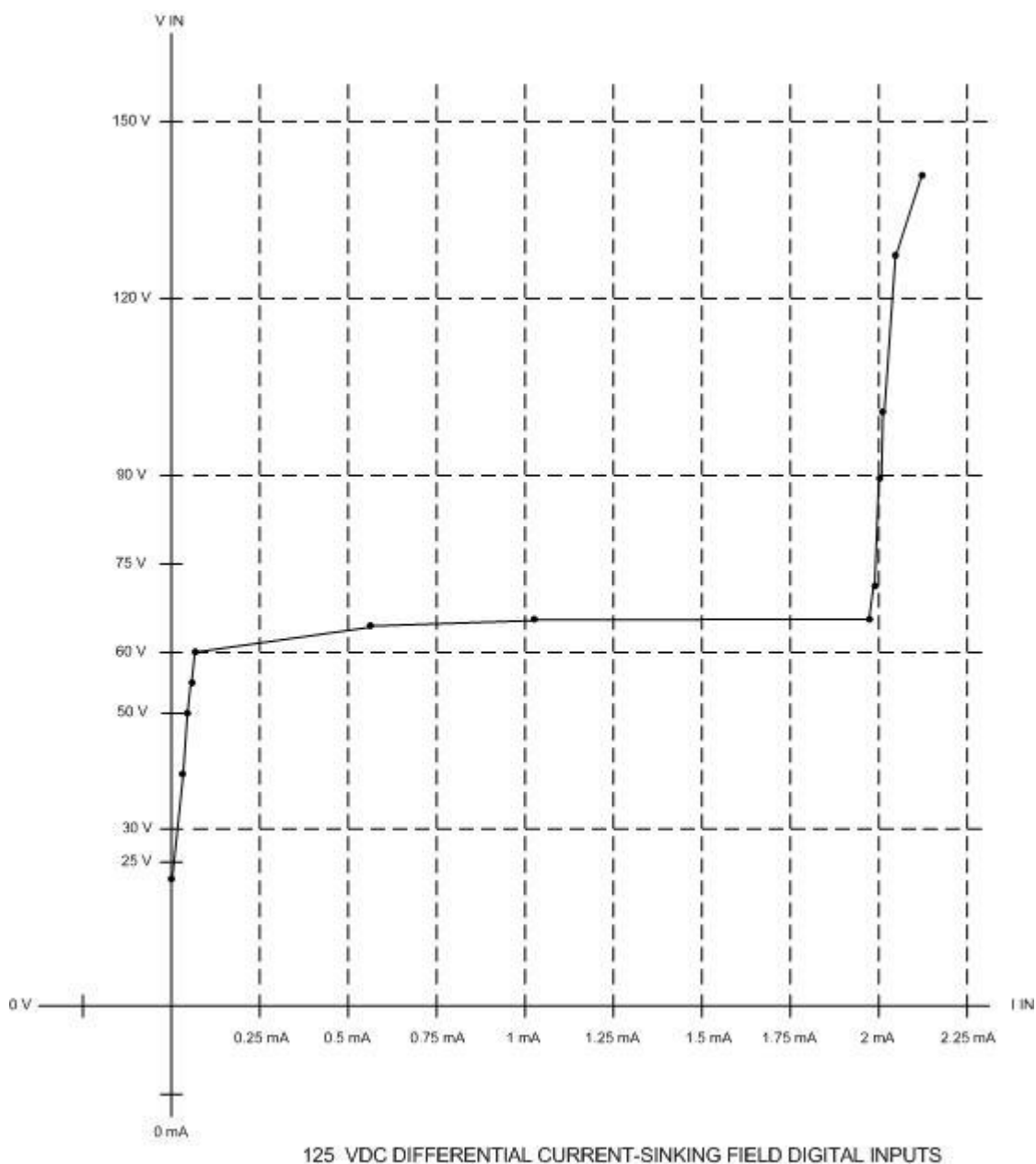
No other external power supplies may be connected to other base unit termination block PS+ or PS- terminals located in the same branch.

22.9.6 External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05)

When using the Enhanced Compact Sequence of Events module, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, there are steps to be undertaken before connecting the external power supply to the Enhanced Compact Sequence of Events Digital Input module base unit terminal block, Refer to *Using an External Power Supply* (see page 635).

22.9.7 Voltage-current curve (5X00357G03) - (ECISOEDI)



22.9.8 Specifications (5X00357G03) - (ECISOEDI)

DESCRIPTION	VALUE
Voltage category	125 VDC
Reverse polarity protection	Yes, each channel incorporates a front-end diode bridge
Operating voltage	80-140 VDC
Input voltage	For "1" signal = 80-140 VDC For "0" signal = 0-55 VDC
Input current	For "1" signal = 0.8 mA Min - 2.8 mA Max
Number of channels Channels per common	16 1,5X00357G03/1C31238H01 16, 5X00357G03/5X00034G01
Galvanic isolation	Between channels and I/O bus = Yes Between channels = Yes, 5X00357G03/1C31238H01 No, 5X00357G03/5X00034G01
Current draw, from I/O bus base unit, 24 V main power	44 mA typical for all inputs off 62 mA typical for all inputs on
Power dissipation of module Sum of 24V main power and 125V field channel power	1.06 W typical for all inputs off 3.36 W typical for all inputs on
Total module response time (1 foot (0.305 M) long field cable is assumed)	"0" Open to "1" Close = 4.02 msec typ "1" Close to "0" Open = 4.2 msec typ
Resolution	1/8 msec for time tagging an event
Accuracy (time tagged)	1 msec relative to clock from I/O bus 1/8 msec relative to other module channels
LSW card Propagation delay - field card output to present input state register	3.75 msec. Minimum 4.0 msec. typical 4.25 msec. Maximum
LSW card digital debounce circuit delay time	4.0 msec. typical
Status Display	Green LED per channel. LEDs located in logic card circuit

Note: Any module digital input state change time that is less than the LSW card digital debounce time is rejected by the module and does not appear in the present input state register.

FDI card signal propagation delay is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

Input voltage level	Delay time for contact opening	Delay time for contact closing
125 VDC	0.2 msec. typ.	0.02 msec. typ.

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

Input voltage level	Additional delay time for contact opening
125 VDC	1.1 msec. typical

22.10 Enhanced Compact Sequence of Events Digital Input module (5X00357G04) (FCI) - (ECISOEDI)

The Enhanced Compact Sequence of Events Digital Input module 5X00357G04 has 16 single-ended current sourcing digital inputs (contact inputs) that share a common return and that all use the module's internal 48 VDC power supply voltage. No power supply is required.

The internal +48 V on-card power supply provides a current limited contact wetting voltage if a channel's field contact is open. When the contact closes, current is drawn from the +10 V on-card power supply and turns on the channel's associated optocoupler, which relays a closed contact state "1" to the I/O bus. The sixteen channel optocouplers and the on-card power supply transformer provide galvanic isolation between the field digital inputs (contact inputs) circuit and the module's logic or I/O bus side.

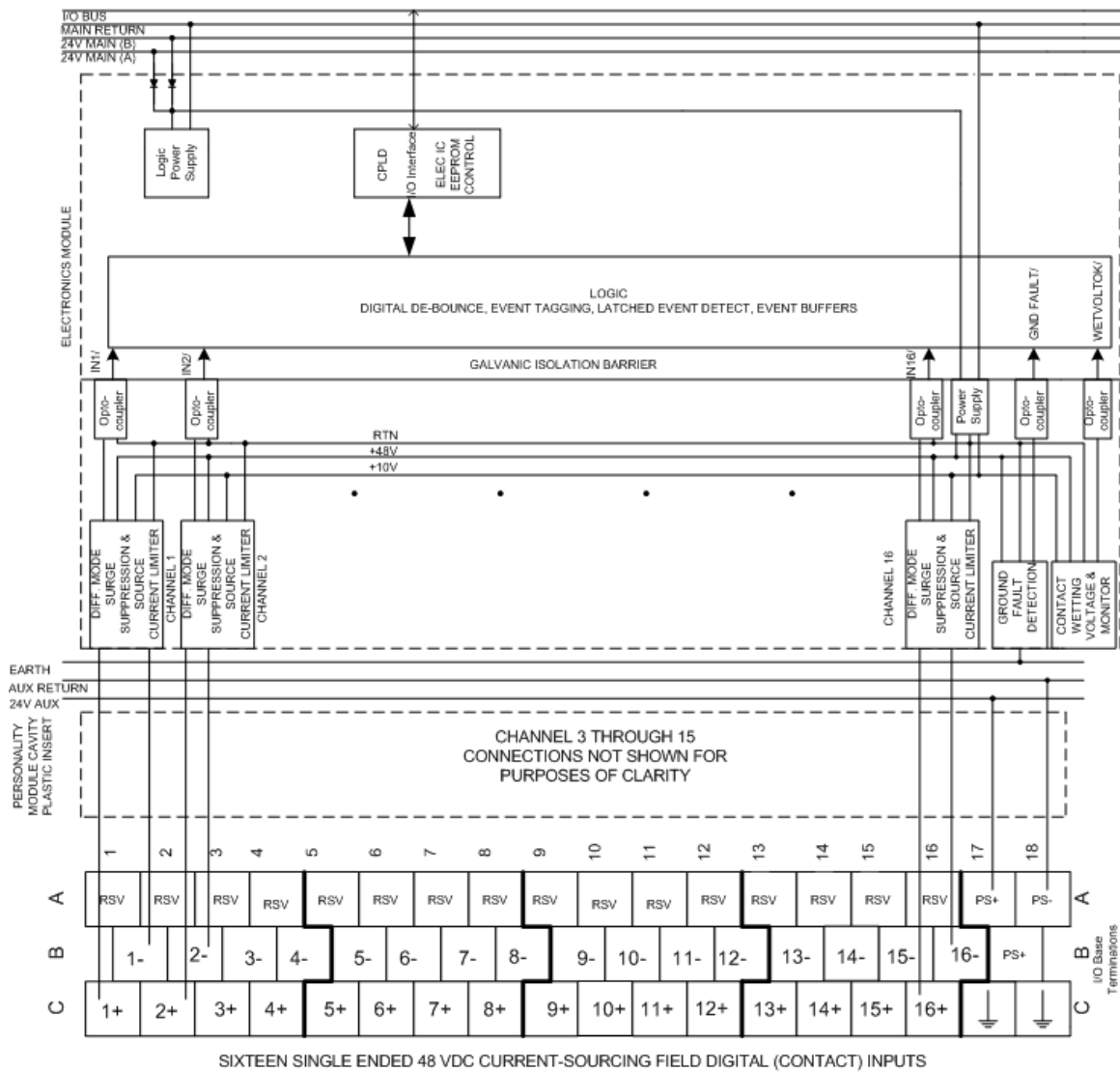
On-Board power supply checking:

A common voltage monitor circuit examines the 10V and 48V voltages and sets a module status register bit (bit 8) if there is an issue with the 10V and 48V power supply. If this on-board power supply fails, all channels are affected.

Each field contact may have a separate input and return wire conductor to the module's base unit terminals. Alternatively, field contacts wired to the same module may share a common return wire conductor.

A Ground fault detection circuit is provided to determine if an input or return wire for any channel find a low impedance path to earth ground. A single wire with a ground fault will not cause an error in point data. However, multiple wire ground faults that include input and return wires, could cause faulty point data (that is, channels appearing as if their field contacts are closed when the contacts are really open).

22.10.1 Module-base unit interconnection (5X00357G04) - (ECISOEDI)



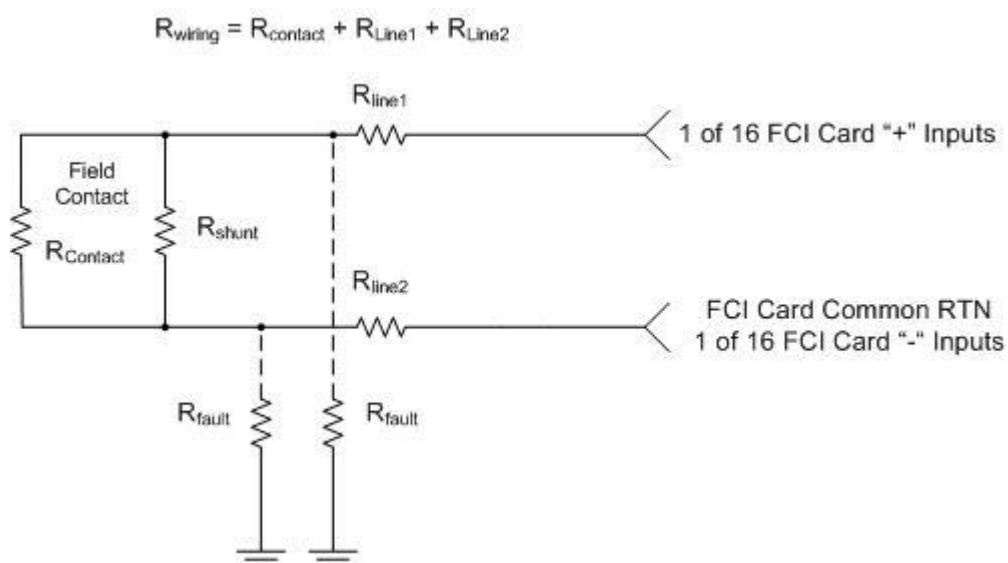
Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

22.10.2 Field wiring (5X00357G04) - (ECISOEDI)

Time required for channel wetting voltage level to exceed 40 V following field contact opening: 6 msec. Maximum

Cabling Limitations

RWiring for closed contact recognition	100 ohms Maximum
Rshunt for open contact recognition	10,000 ohms Minimum
Rshunt for high-level voltage (> 40V) open contact recognition	50,000 ohms Minimum
Rshunt for ground fault detection with open contact and "+" input line ground fault	150,000 ohms Minimum
Rfault from either "+" or "-" input line to ground for ground fault detection	5,000 ohms Maximum



22.10.3 Field wiring (5X00357G04) (contact) - (ECISOEDI)

The figure below shows possible field cable resistances that affect input channel performance. The following definitions apply:

R_{Contact} = resistance associated with a closed contact

R_{shunt} = open contact shunt resistance

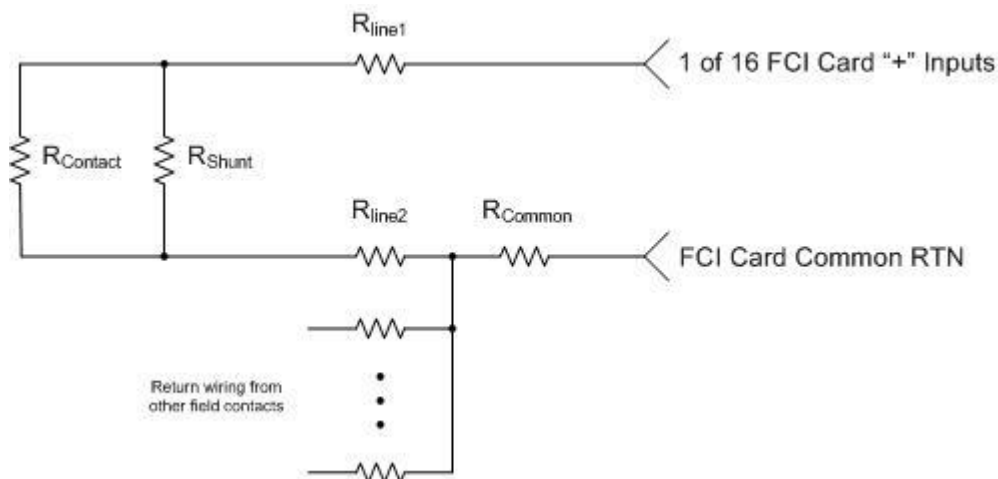
R_{Line1} = resistance of the wire routed from the contact to the FCI "+" input.

R_{Line2} = resistance of the non-common wire routed from the contact to the FCI "-" or RTN input

R_{Common} = resistance of the common wire routed from multiple contacts to the FCI "+" input

$R_{\text{Common}} = 0$ if each field contact has its own pair of "+" and "-" field wires

$R_{\text{Wiring}} = R_{\text{Contact}} + R_{\text{Line1}} + R_{\text{Line2}} + 16 R_{\text{Common}}$



The following constraints are generated from the above figure:

1. No field wire ground faults or a "-" or RTN field wire ground fault:
 R_{shunt} must be $> 10\text{Kohms}$ for the input channel to recognize the field contact state as open.
 R_{shunt} must be $> 50\text{Kohms}$ for the input channel to maintain a high level open contact wetting voltage.
2. "+" field wire ground fault:
 R_{shunt} must be $> 20\text{Kohms}$ for the input channel to recognize the field contact state as open.
 R_{shunt} must be $> 100\text{Kohms}$ for the input channel to maintain at least a 20 V open contact wetting voltage.
3. With or without a field wire ground fault condition:
 R_{Wiring} through the field wiring to the field contact must be $< 100\text{ ohms}$ for the input channel to recognize a closed contact.

The table below lists the Maximum field wiring cable lengths between field contacts and the module base unit termination block when each field contact has its own wire routed between it and the module base unit termination block ($R_{Common} = 0$ ohms). It is assumed that $R_{Contact} = 0$ ohms.

$$R_{Wiring} = R_{Line1} + R_{Line2}$$

$$R_{Wiring} = 100 \text{ ohms Maximum}$$

Assume that $R_{Line1} = R_{Line2}$ since both the field contact "+" and "-" wires should be the same length.

$$2 R_{Line1} = 100 \text{ ohms Maximum}$$

$$R_{Line1} = 50 \text{ ohms Maximum}$$

WIRE GAUGE	OHMS PER 1000 FEET @ 20 DEGREES C (68 DEGREES F) FOR SOLID COPPER WIRE	MAXIMUM CABLE LENGTH (THOUSAND FEET)
18 AWG	6.385	7.5
20 AWG	10.15	4.9
22 AWG	16.14	3.0
24 AWG	25.67	1.9
26 AWG	40.81	1.2

The table below lists the Maximum field wiring cable lengths between field contacts and the module base unit termination block when all module field contacts share a common return wire routed between the field contacts and one of the module base unit termination block "-" terminals. It is assumed that $R_{Contact} = 0$ ohms. To simplify calculations, it is assumed that $R_{Line2} = 0$ ohms and that that $R_{Line1} = R_{Common}$

$$R_{Wiring} = R_{Line1} + 16 R_{Common}$$

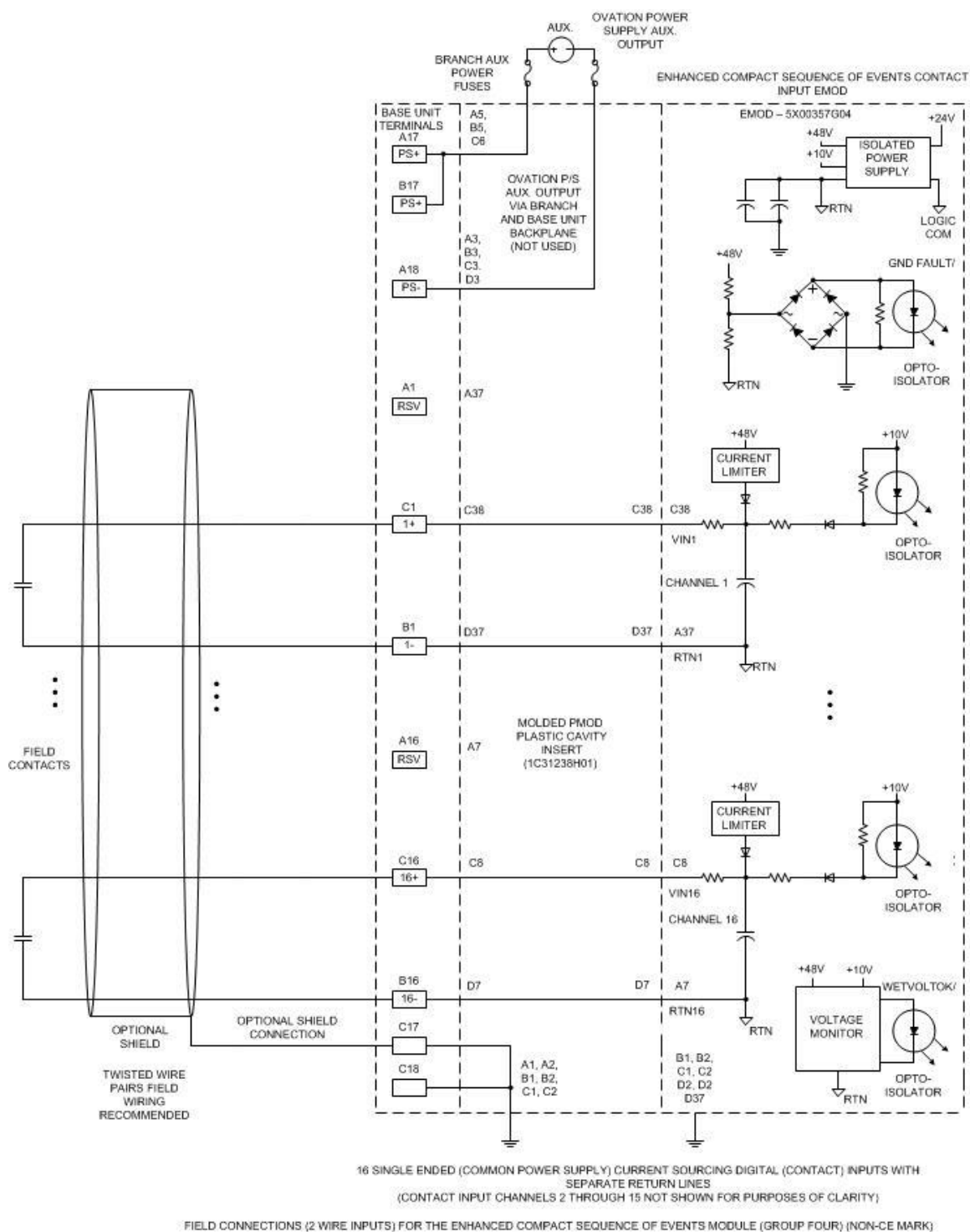
$$R_{Wiring} = 17 R_{Line1}$$

$$R_{Wiring} = 100 \text{ ohms Maximum}$$

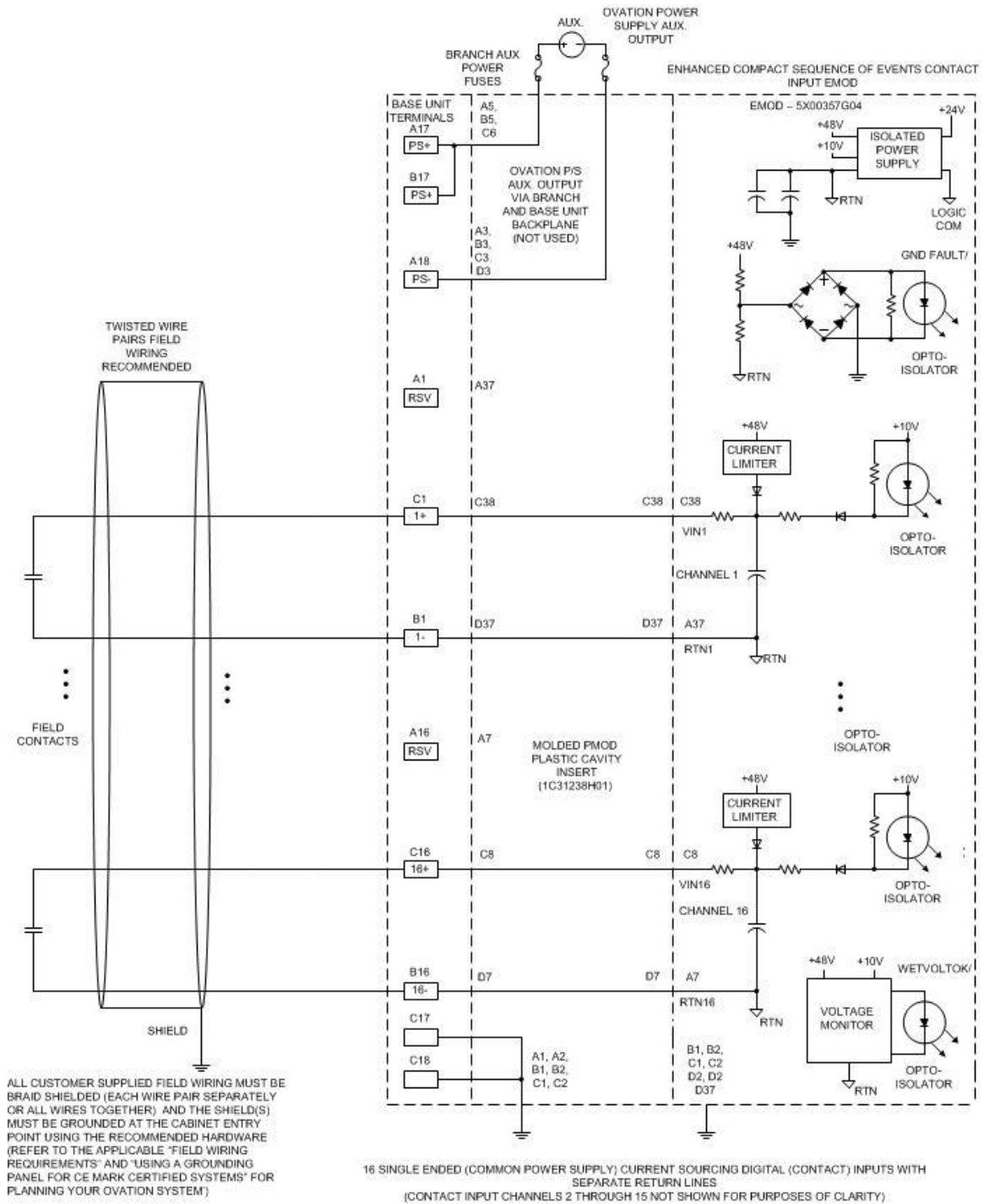
$$R_{Line1} = 5.88 \text{ ohms Maximum}$$

WIRE GAUGE	OHMS PER 1000 FEET @ 20 DEGREES C (68 DEGREES F) FOR SOLID COPPER WIRE	MAXIMUM CABLE LENGTH (THOUSAND FEET)
12 AWG	1.588	3.54
14 AWG	2.525	2.3
16 AWG	4.016	1.4
18 AWG	6.385	0.89
20 AWG	10.15	0.57

22.10.4 Field connection wiring (5X00357G04) - (ECISOEDI)



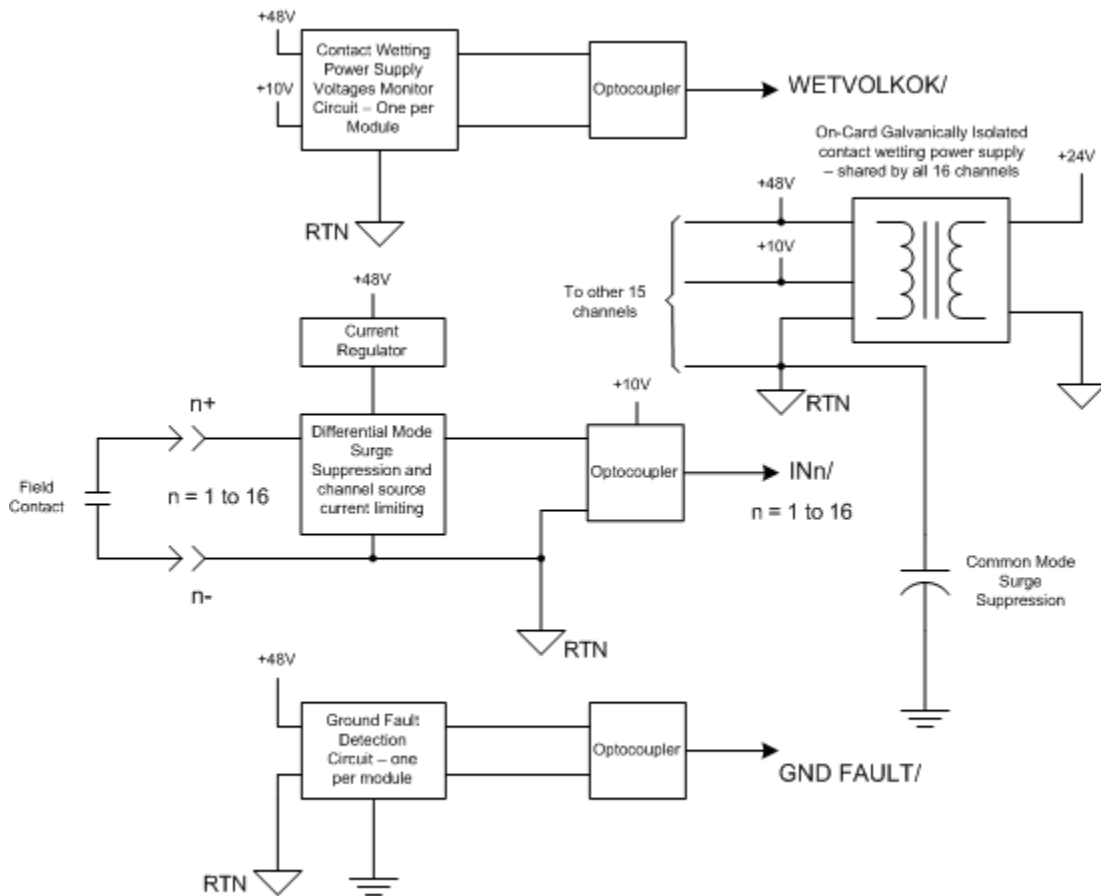
22.10 Enhanced Compact Sequence of Events Digital Input module (5X00357G04) (FCI) - (ECSEOEDI)



Each field contact has a separate input (+) and return (-) line.

The sixteen (-) inputs are tied together on the FCI field card and are connected to the galvanically isolated wetting power supply common return for all sixteen channels.

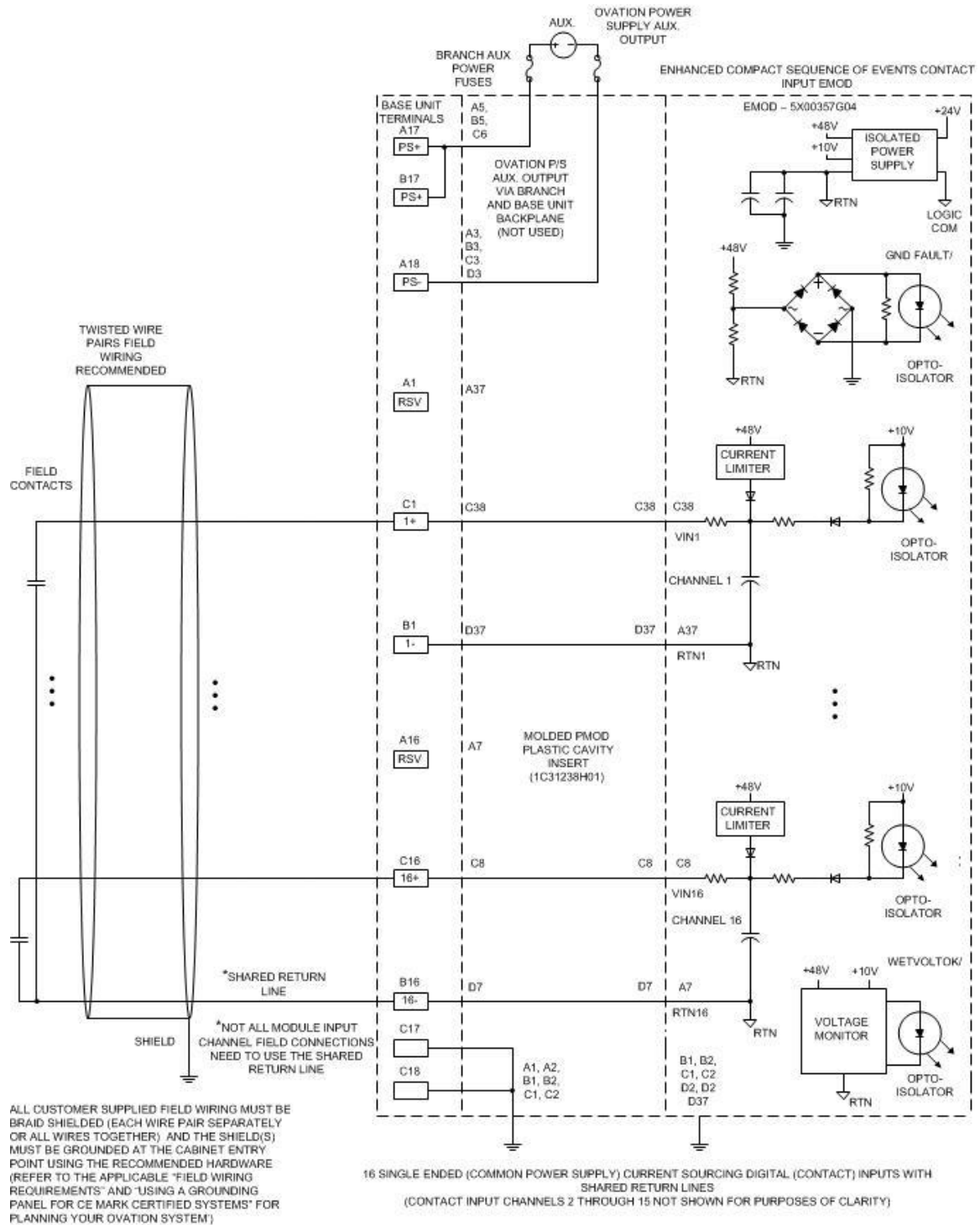
Note: Do not tie any of the (+) or (-) inputs to earth ground. A ground fault condition will occur as well as degradation of the field card's common mode surge protection.



48 VDC SINGLE ENDED CURRENT-SOURCING FIELD DIGITAL (CONTACT) INPUT CHANNEL

OW351_R1150

22.10 Enhanced Compact Sequence of Events Digital Input module (5X00357G04) (FCI) - (ECSEOEDI)



Each field contact has a separate input (+), but shares a common return line connection to a single channel's Return (-) input terminal.

The sixteen (-) inputs are tied together on the FCI field card and are connected to the galvanically isolated wetting power supply common return for all sixteen channels.

Note: Do not tie any of the (+) or (-) inputs to earth ground. A ground fault condition will occur as well as degradation of the field card's common mode surge protection.

22.10.5 Specifications (5X00357G04) - (ECISOEDI)

DESCRIPTION	VALUE
Voltage category	48 VDC –nominal open contact wetting voltage.
Reverse polarity protection	Not applicable, field inputs are dry contacts with power supplied by field card circuit.
Open contact voltage	For "0" signal = 42 V Minimum - 55 V Maximum
Closed contact Input current	For "1" signal = 4 mA Minimum - 8 mA Maximum
Number of channels Channels per common	16 16
Galvanic isolation	Between channels and I/O bus = Yes. Between channels = No.
Current draw, from I/O bus base unit, 24 V main power	62 mA typical for all inputs off. 172 mA typical for all inputs on.
Power dissipation of module 24V main power	1.49 W typical for all inputs off. 4.13 W typical for all inputs on.
Total module response time (1 foot (0.305 M) long field cable is assumed)	"0" Open to "1" Close = 4.09 msec typ "1" Close to "0" Open = 4.13 msec typ
Resolution	1/8 msec for time tagging an event
Accuracy (time tagged)	1 msec relative to clock from I/O bus. 1/8 msec relative to other module channels.
LSW card Propagation delay - field card output to present input state register	3.75 msec. Minimum 4.0 msec. typical 4.25 msec. Maximum
LSW card digital debounce circuit delay time	4.0 msec. typical
Status Display	Green LED per channel. LEDs located in logic card circuit.

Note: Any module digital input state change time that is less than the LSW card digital debounce time is rejected by the module and does not appear in the present input state register.

FCI card signal propagation delay is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

Input voltage level	Delay time for contact opening	Delay time for contact closing
48 VDC	0.13 msec. typ.	0.09 msec. typ.

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

Input voltage level	Additional delay time for contact opening
48 VDC	0.04 msec. typical

22.11 Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI)

The Enhanced Compact Sequence of Events Digital Input module 5X00357G05 has 16 differential (galvanically isolated) IEC 61131-2 compliant Type 1 24 VDC current sinking digital inputs that can accommodate a separate 24 VDC auxiliary power supply for each channel.

This module can be used with the 5X00034G01 Individually Fused 16 point personality module for applications requiring individual channel fusing of a common 24 VDC auxiliary power supply.

The required auxiliary power supply voltage source may be obtained from the cabinet's internal auxiliary power supply or it may be obtained from an external power supply or multiple external power supplies.

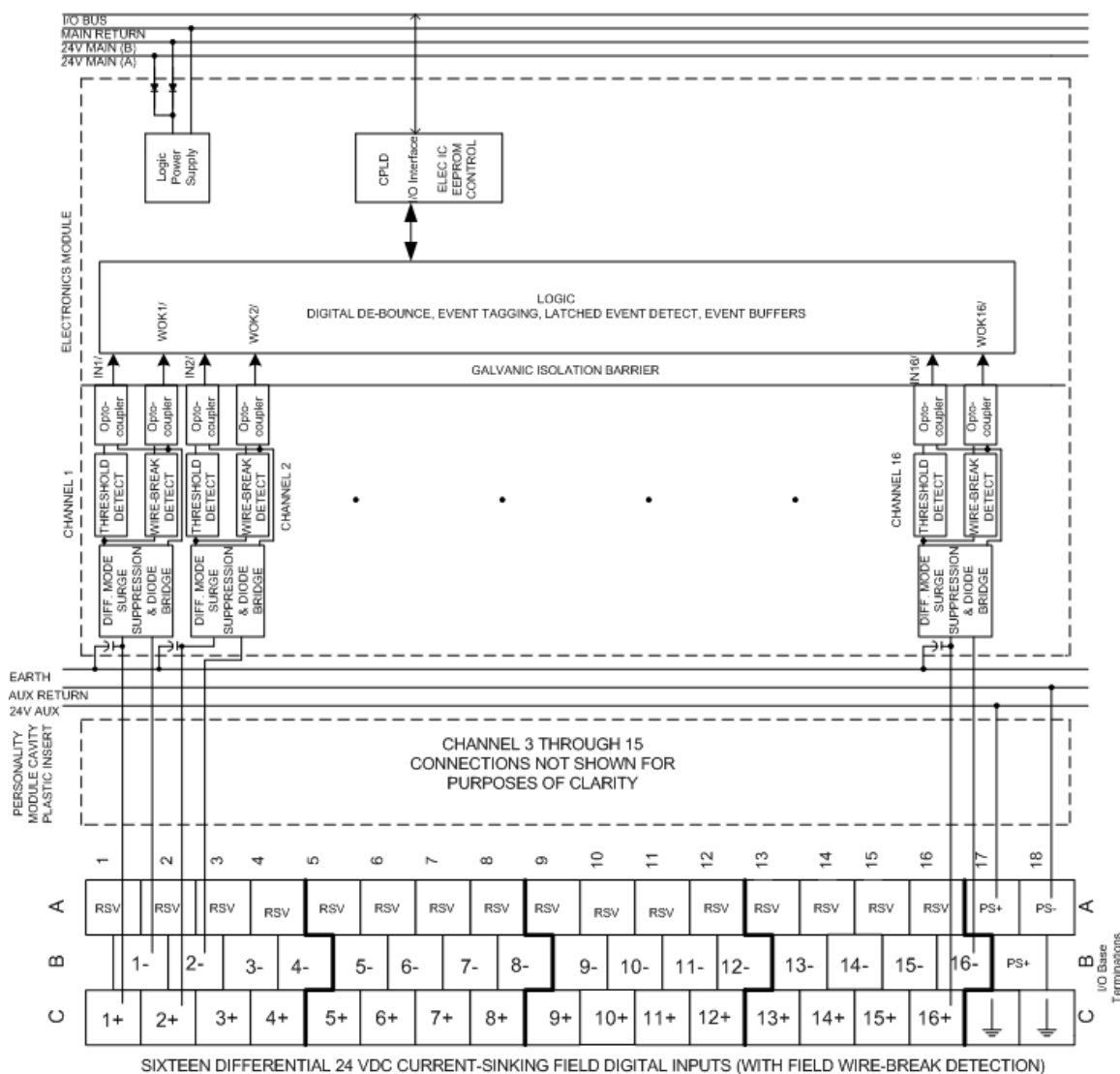
Each channel contains the following:

- An **input resistor** to provide normal mode surge protection and a current regulator circuit to limit input current during normal operation.
- Each channel contains two **optocouplers** to provide galvanic isolation between the field digital input circuit and module's logic or I/O bus side. One optocoupler provides the input state status. The second optocoupler provides the field contact wire break status. This wire break status is only valid if a 10 Kohm resistor is installed directly across the field contact.

A diode bridge allows input voltages of either polarity to be applied.

Note: The use of the 5X00034G01 personality module converts differential current sinking digital inputs into single-ended current sinking digital inputs. The 5X00034G01 personality module taps the base unit's internal auxiliary voltage and distributes this voltage to all sixteen module digital input channels.

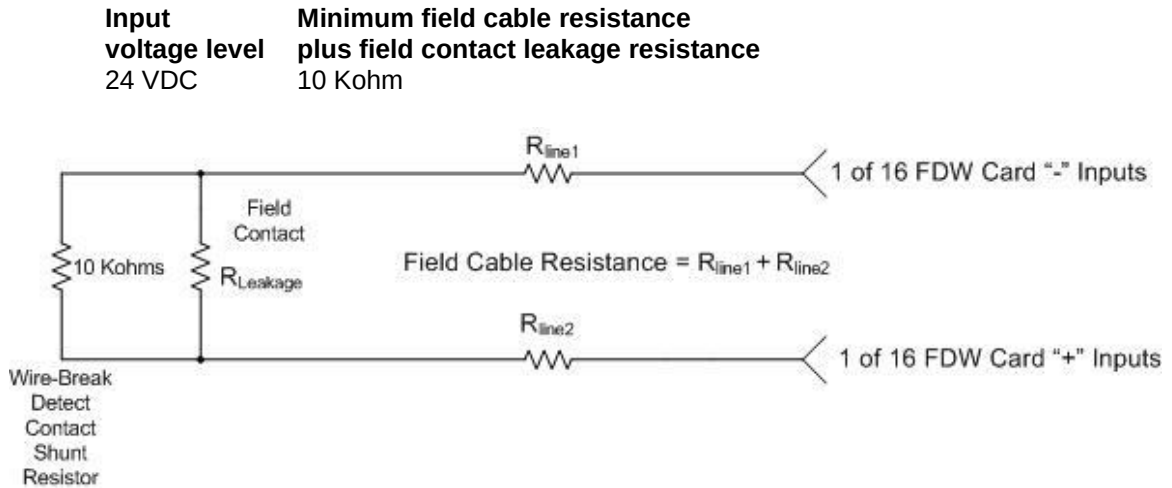
22.11.1 Module-base unit interconnection (5X00357G05) - (ECISOEDI)



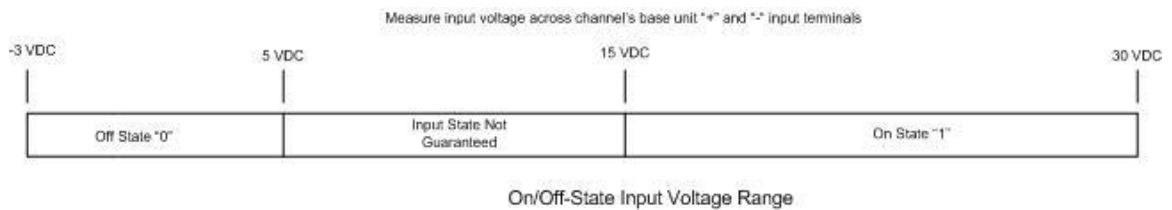
Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

22.11.3 Field wiring (5X00357G05) - (ECISOEDI)

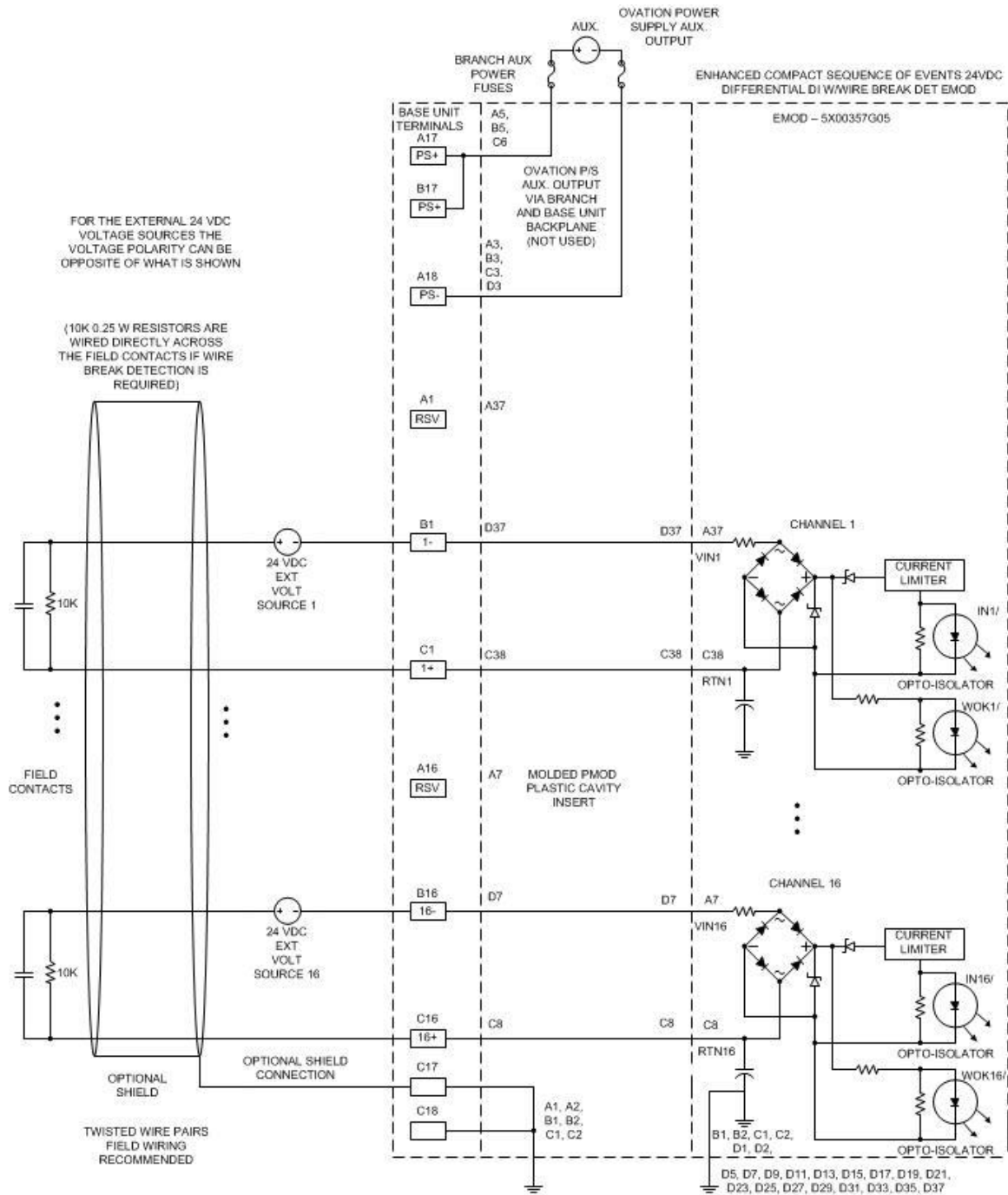
The minimum combined field cable resistance plus field contact leakage resistance value assumes that the Auxiliary power supply voltage is its Maximum allowable value (30 VDC for 24 VDC inputs and 60 VDC for 48 VDC inputs).



If a channel's combined field cable resistance and contact leakage resistance is less than the values specified above, the channel may report that its field contact state is closed even though the field contact is actually open.



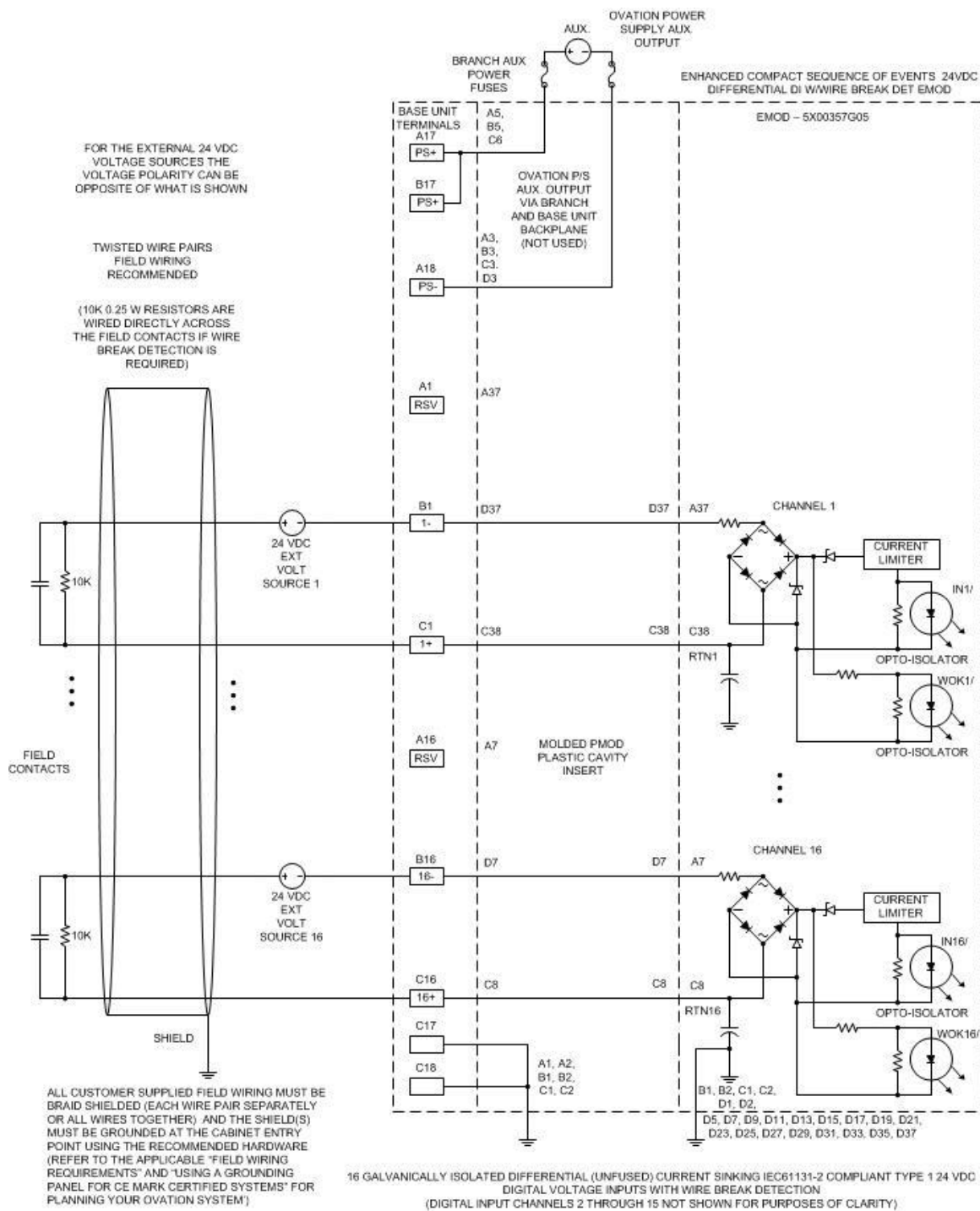
22.11.4 Field connection wiring (5X00357G05) - (ECISOEDI)



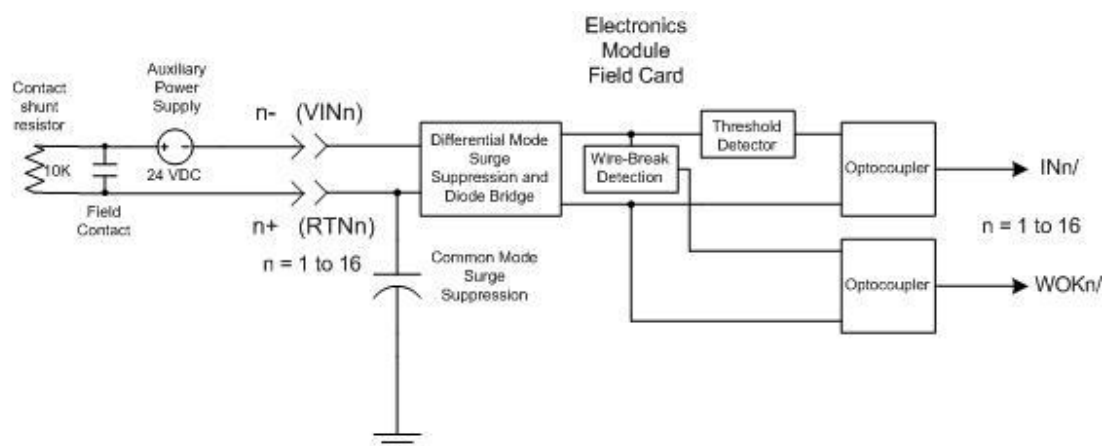
16 GALVANICALLY ISOLATED DIFFERENTIAL (UNFUSED) CURRENT SINKING IEC61131-2 COMPLIANT TYPE 1 24 VDC DIGITAL VOLTAGE INPUTS WITH WIRE BREAK DETECTION
(DIGITAL INPUT CHANNELS 2 THROUGH 15 NOT SHOWN FOR PURPOSES OF CLARITY)

FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS MODULE (GROUP FIVE) (NON-CE MARK)

22.11 Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI)

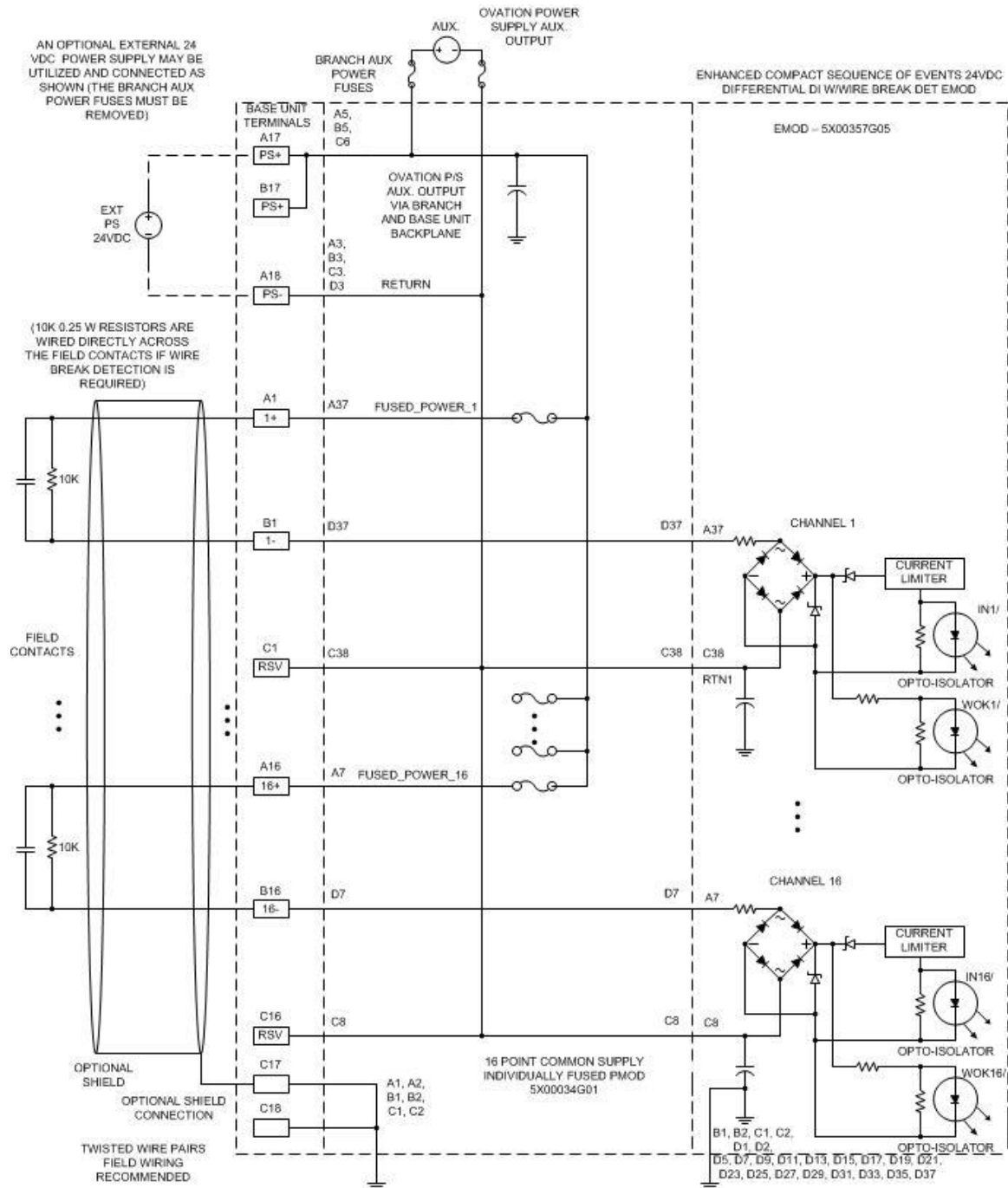


FIELD CONNECTIONS (2 WIRE INPUTS) FOR THE ENHANCED COMPACT SEQUENCE OF EVENTS MODULE (GROUP FIVE) (CE MARK)

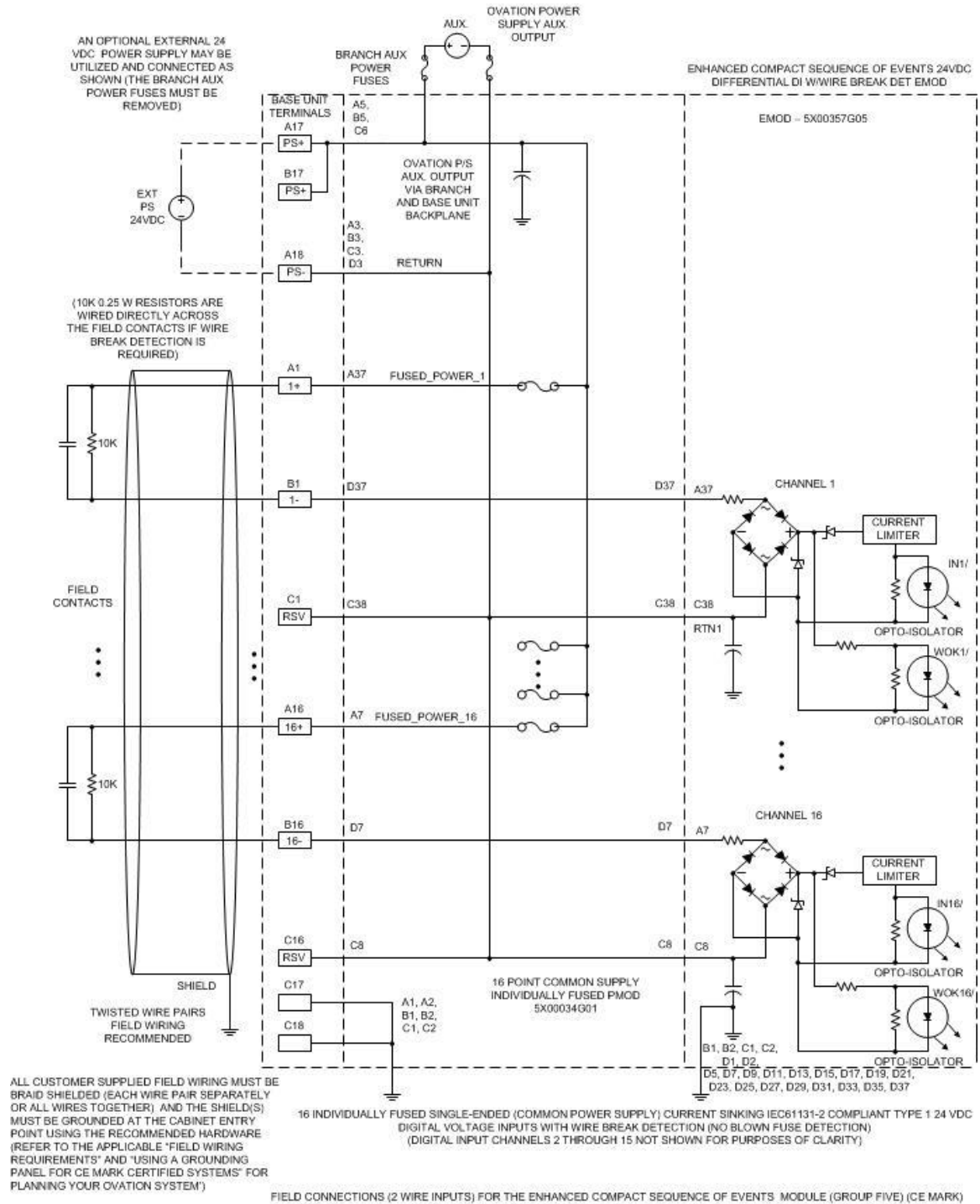


24 VDC DIFFERENTIAL CURRENT-SINKING FIELD DIGITAL INPUT CHANNEL (WITH FIELD WIRE-BREAK DETECTION)

22.11 Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI)



22.11 Enhanced Compact Sequence of Events Digital Input module (5X00357G05) (FDW) - (ECISOEDI)



The “+” inputs are actually the 5X00034G05 personality module PDIC personality card’s fused Auxiliary power supply positive rail. The “-” inputs are the field card’s channel VIN inputs. The PDIC personality card connects the sixteen field card channel RTN inputs to the auxiliary power supply return.

For 5X00357G05 module combinations, the 24 VDC auxiliary power supply voltage may be derived either from the base unit backplane’s printed circuit card auxiliary voltage traces or from an optional external auxiliary power supply.

1. To use the base unit backplane’s printed circuit backplane 24 VDC auxiliary voltage, do not connect an external power supply to the base unit termination block PS+ and PS- terminals since the base unit backplane’s Auxiliary voltage automatically appears at these terminals.

The two plug-in branch Aux. fuses must be installed into their sockets located on the Controller backplane or on the transition panel to which the module’s base unit branch interfaces.

2. To use an external 24 VDC auxiliary power supply, connect the power supply “+” and “-” terminals to the base unit PS+ and PS- terminals as shown. This connection will force all modules on this branch to use the external auxiliary power supply voltage.

The two plug-in branch Aux. fuses must be removed from their sockets located on the Controller backplane or on the transition panel to which the module’s base unit branch interfaces.

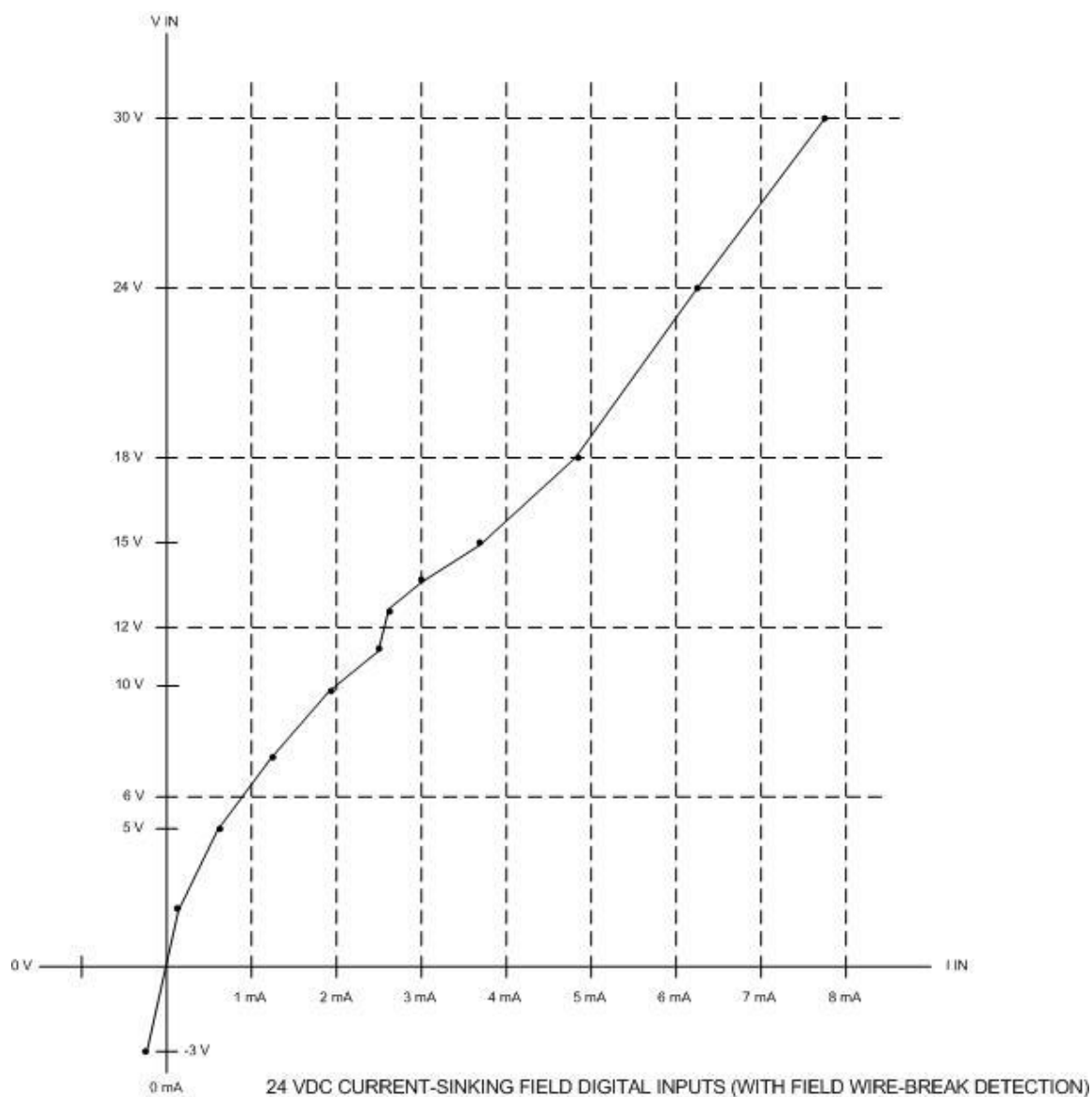
No other external power supplies may be connected to other base unit termination block PS+ or PS- terminals located in the same branch.

22.11.5 External power supply information (5X00357G01 - G05) - (ECISOEDIG01, G02, G03, G05)

When using the Enhanced Compact Sequence of Events module, the required voltage source may be obtained from the internal auxiliary power supply (Controller backplane) or it may be obtained from an external power supply.

If an external power supply is used, there are steps to be undertaken before connecting the external power supply to the Enhanced Compact Sequence of Events Digital Input module base unit terminal block, Refer to *Using an External Power Supply* (see page 635).

22.11.6 Voltage-current curve (5X00357G05) - (ECISOEDI)



22.11.7 Specifications (5X00357G05) - (ECISOEDI)

DESCRIPTION	VALUE
Voltage category	24 VDC
Reverse polarity protection	Yes, each channel incorporates a front-end diode bridge
Operating voltage	15-30 VDC
Input voltage	For "1" signal = 15 to 30 VDC For "0" signal = -3 to 5 VDC
Input current	For "1" signal = 6mA typical, 8.5 mA Max For wire-break detect = ≤ 0.2 mA guaranteed to assert a wire break detected state For "0" signal = 0.5 mA Max
Field Contact Shunt Resistance (used only for wire break detect)	10,000 ohms +/- 5%
Input Characteristic	IEC 61131-2, Type 1
Number of channels Channels per common	16 1, 5X00357G05/1C31238H01 16, 5X00357G05/5X00034G01
Galvanic isolation	Between channels and I/O bus = Yes Between channels = Yes, 5X00357G05/1C31238H01 No, 5X00357G05/5X00034G01
Current draw, from I/O bus base unit, 24 V main power	45 mA typical for all inputs off 75 mA typical for all inputs on
Power dissipation of module Sum of 24V main power and 24V field channel power	1.08 W typical for all inputs off 3.94 W typical for all inputs on
Status Display	Green LED per channel. LEDs located in logic card circuit
Total module response time (1 foot (0.305 M) long field cable is assumed)	"0" Open to "1" Close = 4.1 msec typ "1" Close to "0" Open = 4.03 msec typ
Resolution	1/8 msec for time tagging an event
Accuracy (time tagged)	1 msec relative to clock from I/O bus 1/8 msec relative to other module channels
LSW card Propagation delay - field card output to present input state register	3.75 msec. Minimum 4.0 msec. typical 4.25 msec. Maximum
LSW card digital debounce circuit delay time	4.0 msec. typical
Diagnostic Function	Field wire break detect. A 10 Kohm resistor must be installed across each field contact.

Note: Any module digital input state change time that is less than the LSW card digital debounce time will be rejected by the module and will not appear in the present input state register.

FDW card signal propagation delay. This is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

Input voltage level	Delay time for contact opening	Delay time for contact closing
24 VDC	0.03 msec. typ.	0.1 msec. typ.

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

Input voltage level	Additional delay time for contact opening
24 VDC	0.06 msec. typical

22.12 Event buffer read procedure - (ECSOEDI)

The Event Buffer read procedure consists of the following steps. An I/O bus error is defined as any of the following bus cycles:

- An unsuccessful cycle.
 - A module needs Attention cycle
 - A module is unconfigured cycle
 - A no response cycle
1. Read the module's Buffer Status register at I/O address 0 to determine if the module Event buffer should be read.
 2. Write to the module's Buffer Control register at I/O address 0 to set the register's Freeze bit and to specify the event buffer address of the next word to be read. The event buffer address will be called N. The event buffer address should always be written as zero unless there is an error retry. This starts the read address at zero. If the Buffer Status register's Buffer Over-flow bit is set, then set the Buffer Control register's Clear Buffer Over-flow bit.
 3. Read the module's Buffer Status register at I/O address 0 to determine the number of words to be read. This number should always be an even number. If there is an I/O bus error during this read operation, the Buffer Status register should be read again before reading any event buffer event data
 4. Read the module Event Buffer register at I/O address 1 to obtain the data from event buffer address N. The I/O module counter which indicates the number of event buffer words to be read is reset during the first Event Buffer register read operation and cannot be read again.
 5. Read the module Event Buffer register at I/O address 1 to obtain the data from event buffer address N+1.
 6. Read the module Event Buffer register at I/O address 1 to obtain the data from event buffer address N+2.

7. Read the module Event Buffer register at I/O address 1 to obtain the data from event buffer address N+3.
8. Continue reading the module's Event buffer register until all of the available event buffer data has been read. After all the event buffer data has been read, perform the following steps.
9. Write to the module Buffer Control register at I/O address 0 in order to clear the register's Freeze bit. At the same time set the register's event buffer address bits to 0. The register's Clear Buffer Over-flow bit should also be cleared.
10. Read the module's Buffer Status register at I/O address 0 in order to determine if the other event buffer contents should be read. If there is data available in the other event buffer, then repeat steps 2 - 9 for the other event buffer.

The following defines the response to an I/O bus error during the event buffer reading procedure. If there is an I/O bus error during a write operation, the write operation should be repeated. If there is an I/O bus error during a read of the module's Buffer Status register located at I/O address 0, read the Buffer Status register again.

If there is an I/O bus error during a read of the module's Event Buffer register located at I/O address 1, the instructions described in Step 2 of the previously documented procedure should be repeated using the event buffer address of the missed data. Next read the module's Event Buffer register location to get the missed data before continuing reading the event buffer until done.

If the Ovation Controller attempts to read the module's Event Buffer register located at I/O address 1 before setting the Buffer Control register's Freeze bit, the reply will be invalid.

If the Ovation Controller reads more than the specified number of event buffer words, the extra words read will be invalid data.

To dump (to clear) the contents of the next event buffer to be read, perform the following actions:

1. Set the Buffer Control register's Freeze bit.
2. Read one word from the Event Buffer register to reset the counter.
3. Clear the Buffer Control register's Freeze bit.

22.13 Configuration/Status Register information - (ECISOEDI)

Configuration/Status Register information Register (D)

The Module Configuration Register is module I/O register 13 (0xD) and is a write register. The register bit assignments are defined in the following table.

BIT	FUNCTION
0	1 = Configure module. Module will not operate until this bit is set to a logic 1.
1	1 = Force Internal Error –LSW card Int. Error LED is illuminated. Only module registers 0xC, 0xD, 0xE and 0xF may be read.
2, 3, 4, 7, 9, 11, 14, 15	Not used –force to logic 0
6	1 = Allow asserted field card BLOWN FUSE signal to illuminate module E (External error) LED and to force a module Attention Status (bit set only for Group 1 modules) 0 = Ignore field card BLOWN FUSE signal

BIT	FUNCTION
8	1 = Allow asserted field card WETVOLTOK/ signal (field card wetting voltage power supply status) to illuminate the module I (Internal Error) LED and to force a module Attention Status. Allow asserted field card GND FAULT/ signal (field card input ground fault status) to illuminate the module E (external Error) LED (bit set only for Group 4 modules) 0 = Ignore field card WETVOLTOK/ signal. Ignore field card GND FAULT/ signal in regards to controlling the module E LED state
10	1 = Allow asserted field card GND FAULT/ signal (field card input ground fault status) to force a module Attention Status. (bit may be set only for Group 4 modules) 0 = Ignore field card GND FAULT/ signal in regards to controlling the module Attention Status state.
12	Disable Chatter 1 = disable chatter control –input can chatter and each event will be recorded in the event buffer until the event buffer overflows (if input channel not masked off) 0 = enable chatter control (default state)
13	Chatter Control Flag Reset Option Select 1 = reset chatter control counter for each channel upon event buffer unfreeze 0 = decrement chatter counter for each channel every 100 milliseconds (default state)

For Group 1 modules, set bit 6 and clear bits 8 and 10

For Group 2, 3 and 5 modules, clear bits 6, 8 and 10

For Group 4 modules, clear bit 6 and set bit 8. Bit 10 is set depending on application requirements.

Bits 12 and 13 are set/cleared depending on application requirements.

Module status (read) register

The Module Status Register is module I/O register 13 (0xD) and is a read register. The register bit assignments are defined below.

BIT	FUNCTION
0	1 = module configured 0 = module unconfigured, I/O addresses below 12 (0xC) cannot be read.
1	State of Module Configuration register bit 1 1 = Internal Error forced 0 = Internal Error not forced
2-4	not used - should be logic 0
6	State of Module Configuration register bit 6 1 = Allow asserted field card BLOWN FUSE signal to illuminate module E (External error) LED and to force a module Attention Status (bit set only for Group 1 modules) 0 = Ignore field card BLOWN FUSE signal
7	1 = Blown field card Auxiliary power supply fuse or low Auxiliary power supply voltage (asserted only for Group 1 modules only if Module Configuration register bit 6 is set and the field card BLOWN FUSE signal is active)
8	State of Module Configuration register bit 8 1 = Allow asserted field card WETVOLTOK/ signal (field card wetting voltage power supply status) to illuminate the module I (Internal Error) LED and to force a module Attention Status. Allow asserted field card GND FAULT/ signal (field card input ground fault status) to illuminate the module E (external Error) LED (bit set only for Group 4 modules) 0 = Ignore field card WETVOLTOK/ signal. Ignore field card GND FAULT/ signal in regards to controlling the module E LED state

BIT	FUNCTION
9	1 = Contact wetting voltage power supply failure (asserted only for Group 4 modules if Module Configuration register bit 8 is set and the field card WETVOLTOK/ signal is asserted)
10	State of Module Configuration register bit 10 1 = Allow asserted field card GND FAULT/ signal (field card input ground fault status) to force a module Attention Status. (bit may be set only for Group 4 modules) 0 = Ignore field card GND FAULT/ signal in regards to controlling the module Attention Status state.
11	1 = Ground Fault (asserted only for Group 4 modules if Module Configuration register bit 8 is set and the field card GND FAULT/ signal is asserted). Bit 11's state is independent of the Module Configuration register bit 10 state.
12	State of Module Configuration register bit 12, Disable Chatter Read Back 1 = disable chatter control - input can chatter and each event will be recorded in the event buffer until the event buffer overflows (if input channel not masked off) 0 = enable chatter control (default state)
13	State of Module Configuration register bit 13, Chatter Control Flag Reset Option Select Read Back 1 = reset chatter control counter for each channel upon event buffer unfreeze 0 = decrement chatter counter for each channel every 100 milliseconds (default state)
14	1 = Clock synchronized
15	1 = Field wiring not intact on one or more input channels if wire break detection is enabled for those channels (Group 5 only) 0 = Field wiring intact on all channels or wire break detection is not enabled for any channel.

Bit 15 is the logical OR of the sixteen inverted Channel Wire Break Detect Register bits.

Registers 2, 3, 4, B, C & E - (ECISOEDI)

Present Input State Register (2)

The Present Input State Register is module I/O register 2 and is a read register. The register bit assignments for a current-sinking digital input field card are defined below.

BITS	FUNCTION
0 - 15	1 = Channel (1 - 16) field input voltage above minimum "1" threshold. 0 = Channel (1 - 16) field input voltage below Maximum "0" threshold.

Positive Transition Latched Register (3)

The Positive Transition Latched Register is module I/O register 3 and is a read register. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = A low to high event transition in Channel (1 - 16) was detected. 0 = No detected low to high event transition in Channel (1 - 16)

Negative Transition Latched Register (4)

The Negative Transition Latched Register is module I/O register 4 and is a read register. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = A high to low event transition in Channel (1 - 16) was detected. 0 = No detected high to low event transition in Channel (1 - 16)

Channel Wire Break Detect Register (B)

The Channel Wire Break Detect Register is module I/O register 11 (0xB) and is a read only register. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = Channel (1 - 16) field wiring intact or Channel (1 - 16) wire break detect not enabled 0 = Channel (1 - 16) field wiring not intact.

Channel Wire Break Detect Mask write Register (C)

The Channel Wire Break Detect Mask Register is module I/O register 12 (0xC) and is a write register. The contents may be read back by the Ovation Controller. Upon module power up, all register bits are cleared to logic 0. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = Channel (1 - 16) field input wire break detection enabled. 0 = Channel (1 - 16) field input wire break detection disabled.

Channel Wire Break Detect Mask read Register (C)

The Channel Wire Break Detect Register is module I/O register 12 (0xC) and is a read register. Upon module power up, all register bits are cleared to a logic 0 value. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = Channel (1 - 16) wire break detect is enabled. 0 = Channel (1 - 16) wire break detect is disabled.

Channel Event Tagging Mask write Register (E)

The Channel Event Tagging Mask Register is module I/O register 14 (0xE) and is a write register whose contents may be read back by the Ovation Controller. Upon module power up, all register bits are cleared to a logic 0 value. The register bit assignments are defined below.

BITS	FUNCTION
0 - 15	1 = Channel (1 - 16) field input checked for change of state every 1/8 milliseconds 0 = Channel (1 - 16) field input change of state monitoring disabled. Channel (1 - 16) chatter counter and Channel (1 - 16) Chatter Control flag are reset.

Channel Event Tagging Mask read Register (E)

The Channel Event Tagging Mask Register is module I/O register 14 (0xE) and is a read register. This registers equal the contents of the Channel Event Tagging Mask Register. Upon module power up, all register bits are cleared to a logic 0 value. The register bit assignments are defined below.

Bits	FUNCTION
0 - 15	1 = Channel (1 - 16) field input checked for change of state every 1/8 milliseconds 0 = Channel (1 - 16) field input change of state monitoring disabled. Channel (1 - 16) chatter counter and Channel (1 - 16) Chatter Control flag are reset.

22.14 Diagnostic Logic card LEDs - (ECISOEDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	The External Error LED is illuminated when faults external to the module are present. - For Group 1 modules, the External Error LED is illuminated only when the field card Auxiliary power supply fuse opens or the Auxiliary power supply voltage level is low (BLOWN FUSE = 1) and the Module Configuration register bit 6 is set. Module Configuration bit 6 must be cleared for all other module groups. - For Group 2, 3 or 5 modules, the External Error LED should not be illuminated. The Module Configuration register bit 6 should be cleared and the field card BLOWN FUSE signal is ignored. The Module Configuration register bit 8 should also be cleared. - For Group 4 modules (contact input), the External Error LED is illuminated only when the field card detects a ground fault in the field wiring (GND FAULT/ = 0) and the Module Configuration register bit 8 is set.
I (Red)	The Internal Error LED is illuminated to indicate internal electronics module faults. - The Internal Error LED is illuminated when Module Configuration Register bit 1 (Force Error) is set. - The Internal Error LED is illuminated for Group 4 electronics modules when the field card's internal 48V/10V contact wetting voltage power supply fails (WETVOLTOK/ = 1) and the Module Configuration Register bit 8 has been set. Module Configuration bit 8 must be cleared for all other module groups. - The Internal Error LED is illuminated when the I/O Bus Controller has not accessed the electronics module for at least a period of 2 seconds.

LED	DESCRIPTION
1 - 16 (Green)	Digital Input Channel State LEDs - For any Group 1, 2, 3 or 5 electronics module current-sinking digital input channel, the channel's digital input state LED is guaranteed to illuminate when the digital input channel's input voltage exceeds the minimum required input voltage for a "1" signal. For any Group 4 electronics module, the channel's digital input state LED is guaranteed to illuminate when the channel's field contact is closed, the sum of the field wiring resistance and contact resistance is less than 100 ohms and the field card's internal 48V/10V wetting power supply is functioning correctly. - Each digital input channel state LED is located on the LSW logic card. The field card's opto-coupler output transistor interfaces a voltage comparator via a pull-up resistor connected to the logic card's VCC voltage bus through a series pull-up resistor. The voltage comparator compares the opto-coupler's output voltage to a fixed reference voltage in order to determine the digital input channel's state. The voltage comparator output transistor's uncommitted collector terminal is routed to the LSW logic card where it is connected to the logic card VCC voltage bus via a pull-up resistor and the digital input channel state LED.

Note: The logic card's I/O Bus communications watchdog timer turns off the Communications OK LED and illuminates the module I LED if the I/O Controller fails to access the Enhanced Compact Sequence of Events Module within 2 seconds.

Upon a timeout, the watchdog timer will clear the Event Mask register, clear the event buffers and clear Module Configuration Register.

A watchdog timer for one shot registers would clear the one shot registers if no reads occur to Positive Transition Latched Register or Negative Transition Latched Register within a period of 5 seconds.

After a timeout, the collection of one shot information is prevented until the Controller resumes reading either Positive Transition Latched Register or Negative Transition Latched Register.
The first read would be a throw away which would re-activate the watchdog timer.
The second read would yield valid register data.

22.15 Environmental Specifications - (ECISOEDI)

AMBIENT AIR TEMPERATURES

The operating ambient air temperature range is from 0 C to 60 C. The temperature is measured approximately 0.5 inches from any point on the module while it is mounted in its normal vertical or horizontal position, and while subject to the air movements which result from natural convection only (that is, no forced air movement).

HUMIDITY (non-condensing)

The humidity range is from 0% to 95% relative humidity, non-condensing, through an ambient air temperature range of 0 C through 60 C, but with a Maximum wet bulb temperature not over 35 C (95 F).

VIBRATION

The module shall remain operational while subject to testing defined in IEC 68-2-6 over the following curve: 0.15mm displacement from 10 to 57 Hz and 2G's from 57 to 500 Hz, when attached to a properly mounted DIN rail.

SHOCK

The module will remain operational and reliable after being subjected to testing defined in IEC 68-2-27 over the following curve: 15 G's for 11 milliseconds and 1/2 sine wave.

POWER SUPPLY VOLTAGE

	Minimum	Nominal	Maximum
Main Primary Voltage:	21.0 V	24.0 V	25.0 V
Main Secondary Voltage:	21.0 V	24.0 V	25.0 V

The two main supply voltages are the redundant power feeds to the electronics module and are diode auctioneered on the electronics module's logic card.

SECTION 23

Redundant Digital Input module - (RDI) (16 Channel)

IN THIS SECTION

<i>16 Channel Redundant Digital Input module overview - (RDI)</i>	<i>398</i>
<i>Electronics modules (Emod) - (RDI)</i>	<i>399</i>
<i>Personality modules (Pmod) - (RDI)</i>	<i>399</i>
<i>Valid module combinations - (RDI)</i>	<i>399</i>
<i>Terminal block wiring information - (RDI)</i>	<i>399</i>
<i>Field connection wiring diagrams - (RDI)</i>	<i>401</i>
<i>Redundant interface cable assembly routing - (RDI)</i>	<i>402</i>
<i>Module block diagrams - (RDI)</i>	<i>403</i>
<i>Functional block diagram - (RDI)</i>	<i>404</i>
<i>Signal propagation delay - (RDI)</i>	<i>406</i>
<i>Voltage-current curve - (RDI)</i>	<i>407</i>
<i>Switching Input Voltage Current Curve - (RDI)</i>	<i>408</i>
<i>Logic Card Digital Debounce Filter Propagation Delay - (RDI)</i>	<i>409</i>
<i>Configuration/Status Register information - (RDI)</i>	<i>409</i>
<i>Blown Fuse Detection - (RDI)</i>	<i>411</i>
<i>Cross Cable in Place circuit - (RDI)</i>	<i>412</i>
<i>Diagnostic Logic card LEDs - (RDI)</i>	<i>412</i>
<i>Specifications -(RDI)</i>	<i>412</i>

23.1 16 Channel Redundant Digital Input module overview - (RDI)

The Ovation Redundant Digital Input module provides sixteen digital channels to monitor the states ("0" or "1") of sixteen field digital inputs. The module is available on Ovation systems that are 3.2 and above software releases.

The module contains two voltage sensing circuits for each of the 16 I/O channels located on the module. These channels are compared for agreement on each of the respective channels located on the module. This comparison provides a channel mismatch indication to the Controller via a comparison register when one of the channels on the module is faulty. Additionally, this mismatch presents a module attention status to the Controller. If all 16 channels are in agreement, the module comparison register indicates the module is functional. Therefore, each module within the redundant pair is checked for functionality and the Controller determines which module is giving a correct indication for control usage.

Redundant power for all sixteen digital input channels is either supplied by the Ovation auxiliary power supply or by an external 24V auxiliary power source. In either situation, the redundant pair module shares a common 24VDC auxiliary power source. The module provides an isolation diode on the contact power feed in order to prevent a single point of failure from the surge components located on the module. Additionally, the personality modules in the redundant pair accept individual power feeds from their respective branches; thereby eliminating a single point of failure due to auxiliary power branch fusing.

The Redundant Ovation Digital Input module operates in redundant mode when a cable assembly is placed between the personality module of two Redundant Digital Input modules. With the redundant cable installed, the field signal wiring needs to be connected to one base unit terminal block. Alternatively, without the redundancy cable installed, the Redundant Digital Input module will function as a standalone input module. The customer field wiring must connect to each respective base in that situation.

Note: *If an external power is used, individual wires must be routed from the supply to each I/O base forming the redundant pair.*

The Redundant Digital Input Module assembly consists of two modules inserted into an Ovation base unit. An electronics module contains the following:

- Logic printed circuit card (LSW)
- Field printed circuit card (FDR)

The electronics module is used in conjunction with a personality module. The logic card uses its electronics module logic side connector located at one end of the logic card, to interface to the Ovation base unit backplane.

Through the backplane, the LSW logic card accesses the Ovation I/O bus, the module base address setting, and the redundant +24VDC I/O module main power supplies. The LSW logic card connects to the FDR field card via an inter-card connector that is located at the opposite end of the logic card.

The FDR field card interfaces the base unit backplane via the FDR card's electronics module field side connector. The base unit backplane allows the FDR field card to interface the personality module's PDR personality printed circuit card and the base unit backplane's termination block.

Features

- 1000V dielectric withstand isolation between field ground and logic ground.
- 16 single-ended digital inputs.
- 24VDC input level support.
- Optical isolation provided for the field inputs to logic.
- Standard Ovation I/O bus interface circuitry.
- On-board wetting voltage fusing and a blown fuse detection monitor for the external wetting voltage power supply for single-ended digital inputs field circuitry.
- Individual channel fusing to eliminate a single point of failure at each input sensing circuit.
- Isolation diode at contact power feed to eliminate a single point of failure within the personality module circuitry.
- Electronic ID, identifying module type, group, serial number, and revision.
- Hot-swapping capability.
- Modules operate in pairs (redundant mode). Pairs of modules used in redundant mode must be located in two independent branches at the same height offset.
- Field termination at one set of I/O terminal blocks per redundant pair.
- LEDs indicate the status of each input contact state.
- Electronic ID information stored in logic card EEPROM.
- The I/O base unit provides the electronics module with redundant +24 VDC power supply feeds.

23.2 Electronics modules (Emod) - (RDI)

- **5X00411G01** Provides 16 redundant 24VDC IEC 61131-2 Compliant, Type 1 differential current sinking inputs with individual channel fusing (non-user serviceable).

23.3 Personality modules (Pmod) - (RDI)

- **5X00414G01** Front end connections, auxiliary power surge protection, and module fuse protection for the 24V common power.

23.4 Valid module combinations - (RDI)

Redundant Digital Input valid module combinations

DESCRIPTION	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
24 V (Single-ended) Digital Input current sinking, IEC 61131-2 Compliant Type 1 digital Inputs.	16	5X00411G01	5X00414G01

23.5 Terminal block wiring information - (RDI)

ABBREVIATION	DEFINITION
1+ through 16+	Digital input positive terminal connection
1- through 16-	Digital input negative terminal connection
	Earth ground terminal
PS+, PS-	Auxiliary Power Supply terminals
RSV	Reserved terminal.

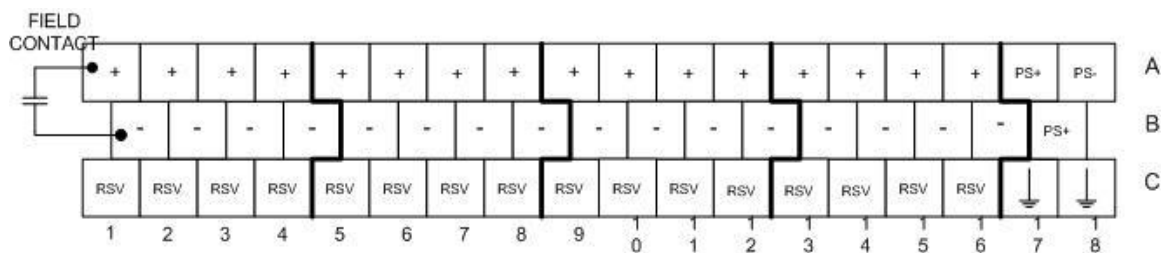


Figure 84: 5X00411 Terminal Block

<notes> No external connections are to be made to any base unit terminal labeled RSV.
 For DI module redundancy, field wiring is only connected to the base unit terminals of one DI module in the redundant pair.
 Unlike the DI module field signal terminations, DI module auxiliary voltage connections must be made to both redundant DI modules' base unit terminal blocks either through the normal auxiliary branch traces or via external power supply connections through terminals A17 and A18.

For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

23.6 Field connection wiring diagrams - (RDI)

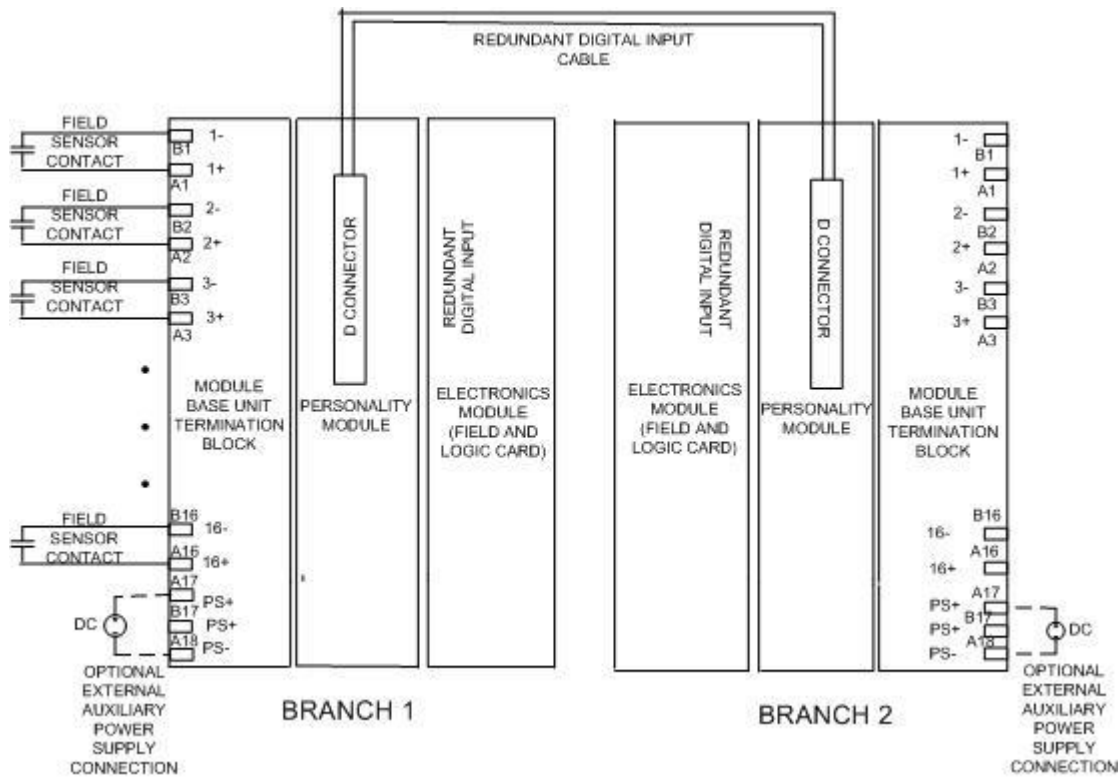


Figure 85: Redundant Current-Sinking Single-Ended Digital Inputs

The “+” inputs are actually the module field card’s fused Auxiliary power supply positive rail. Channel 4 through 15 input terminals not shown for clarity purposes.

The auxiliary power supply voltage may be derived either from the base unit backplane’s printed circuit card auxiliary voltage traces or from an optional external auxiliary power supply.

1. To use the base unit backplane’s printed circuit backplane Auxiliary voltage, do not connect an external power supply to the base unit termination block PS+ and PS- terminals since the base unit backplane’s Auxiliary voltage automatically appears at these terminals.

The two plug-in branch Aux. fuses must be installed into their sockets located on the Controller backplane or on the transition panel to which the module’s base unit branch interfaces.

2. To use an external 24 VDC auxiliary power supply, connect the power supply “+” and “-” terminals to the base unit PS+ and PS- terminals as shown. This connection will force all modules on this branch to use the external auxiliary power supply voltage.

The two plug-in branch Aux. fuses must be removed from their sockets located on the Controller backplane or on the transition panel to which the module’s base unit branch interfaces.

Note: No other external power supplies may be connected to other base unit termination block PS+ or PS- terminals located in the same branch. A common external power supply must include discrete wiring from the power supply to each t/o base for the Redundant Digital Input pair.

23.7 Redundant interface cable assembly routing - (RDI)

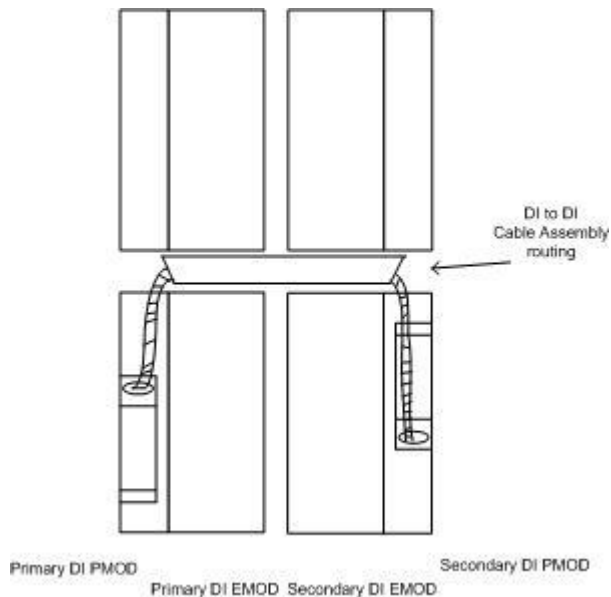


Figure 86: Redundant interface cable

The FDR also includes a cross cable in place circuit to detect the presence of the redundancy cable when utilized in a redundant configuration. This circuit accepts the cross cable power signal from the redundant module and sinks this to ground through the front end of an opto-coupler circuit.

The circuit is a duplicate schematic of the blown fuse detection circuit described above with differing connection signals "Cross Cable Power In" and "Cross Cable In Place". If the module is configured for redundancy and the cross cable is not in place, this will generate an attention status to the Controller from the module which does not have field wiring attached.

23.8 Module block diagrams - (RDI)

The Redundant Digital Input Electronics Module consists of a LSW logic card and a FDR field Card. The LSW logic card interfaces to the I/O bus through the Ovation base unit backplane from which it accesses the Ovation serial I/O data bus (serial data and clock signals), base address, and redundant +24 VDC power supplies. The LSW logic card connects to the field card through a pair of inter-card connectors.

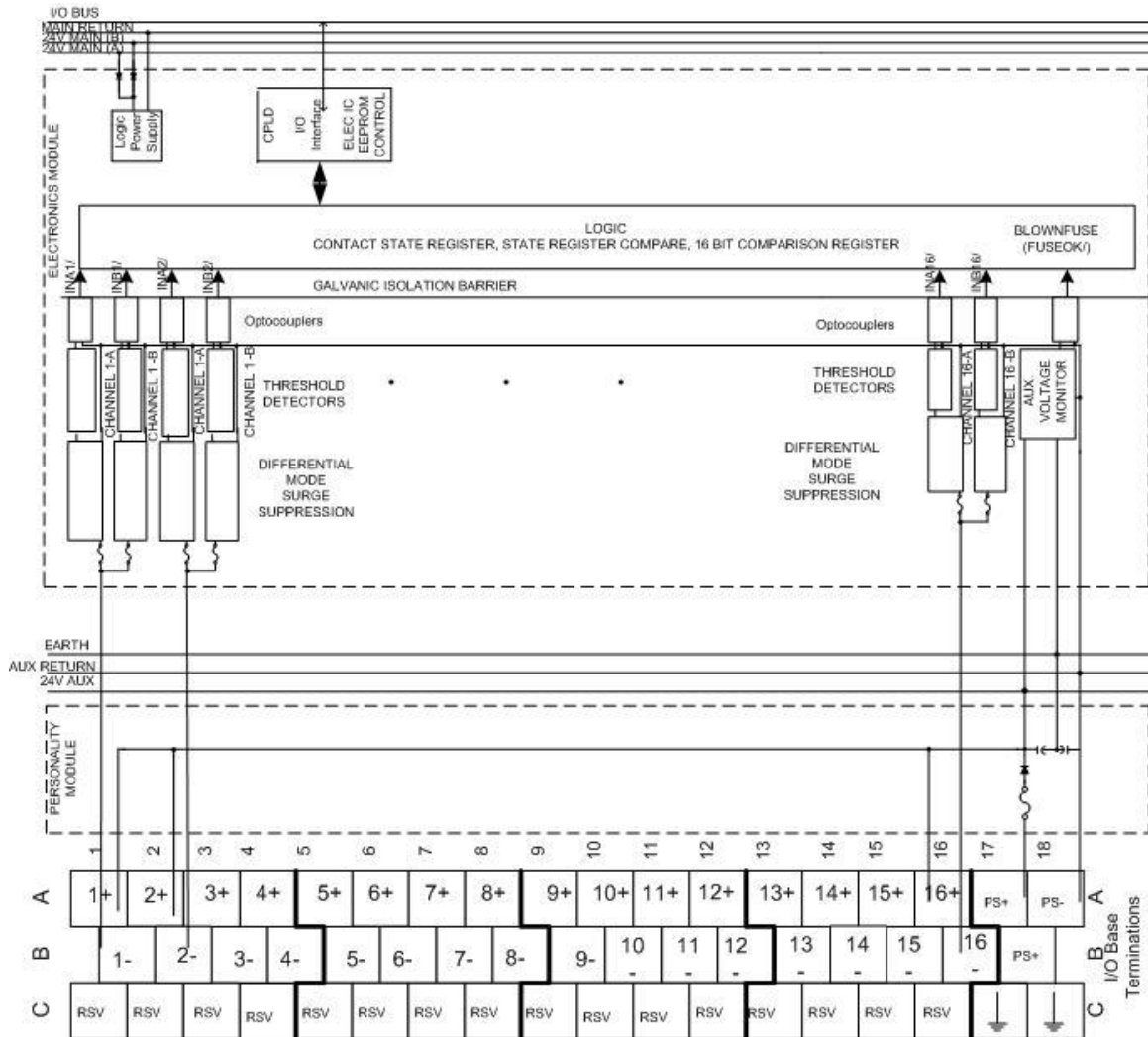
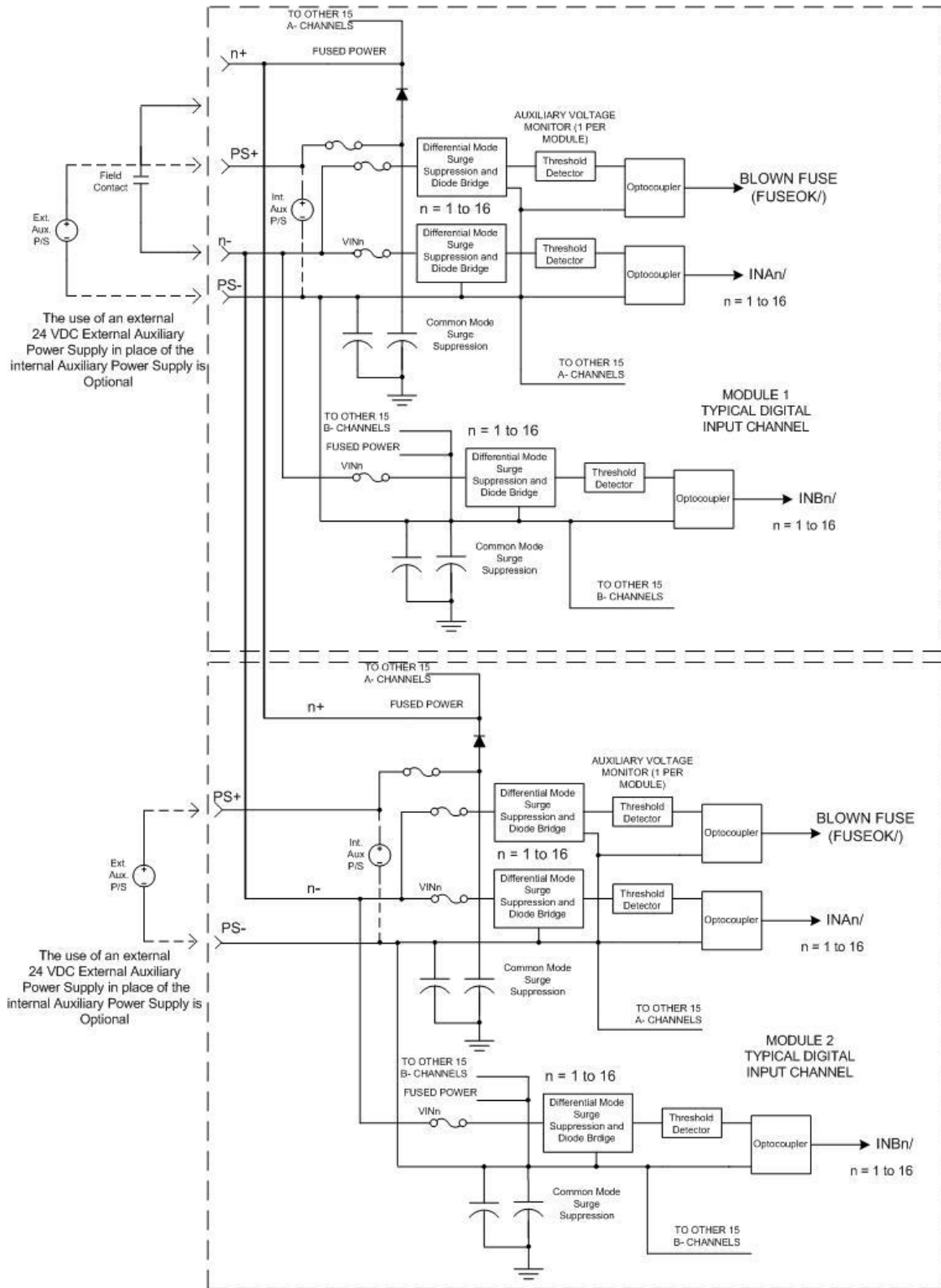


Figure 87: 5X00411 Block Diagram

23.9 Functional block diagram - (RDI)

The FDR contains 16 channels where each channel has duplicate voltage level sensing circuitry used to detect whether an input is on “1” or off “0”. Individual redundant module channels include surface mount fusing for fault isolation in the event of an individual channel failure. The LSW contains the communications circuitry needed to send the input status information back to the Controller and allow channel comparison for sensing a mismatch situation and issue a module attention status to the Controller.

The Redundant Digital Personality Module provides front-end signal connections along with module fuse protection for overall module powering. Additionally, this board provides auxiliary power surge protection. The PDR configures the FDR to handle 16 single-ended digital inputs. It also provides a 37 position D-shell connector for redundancy purposes. The D-shell connector is used to terminate a cable assembly in redundant module configurations linking two Redundant Digital Input modules personality cards together. Both modules access a common group of sixteen input channels via the cable assembly with one set of field terminations landed at one base assembly.



23.10 Signal propagation delay - (RDI)

FDR card signal propagation delay.

This is the typical time elapsed from the time that a field contact opens or closes until the time that associated channel's output signal (INn/ where n = 1 to 16) changes states. Assumes a 1 foot (0.305 m) long test cable.

INPUT	DELAY TIME FOR	DELAY TIME FOR
voltage level	contact opening	contact closing
24 VDC	0.03 msec. typical	0.1 msec. typical

There is an additional propagation delay due to field cable capacitance charging when the field contact opens. This delay is per 1,000 feet of field cable and assumes a 30 pF/foot cable capacitance.

Note: There is no additional propagation delay to consider when the field contact closes.

INPUT	ADDITIONAL DELAY TIME FOR
voltage level	contact opening
24 VDC	0.06 msec. typical

The minimum allowed sum of the combined field cable resistance plus the field contact leakage resistance assumes that the Auxiliary power supply voltage is its Maximum allowable value (30 VDC for 24 VDC inputs).

INPUT	MINIMUM FIELD CABLE RESISTANCE PLUS THE FIELD CONTACT LEAKAGE RESISTANCE VOLTAGE LEVEL
24 VDC	100 Kohm

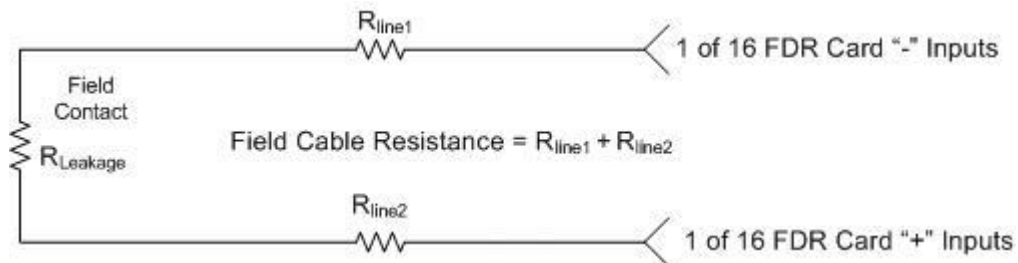


Figure 88: Redundant DI Field Cable Resistance

If a channel's field cable resistance plus the contact leakage resistance is less than the value specified above, the channel may report that its field contact state is closed even though the field contact is actually open.

23.11 Voltage-current curve - (RDI)

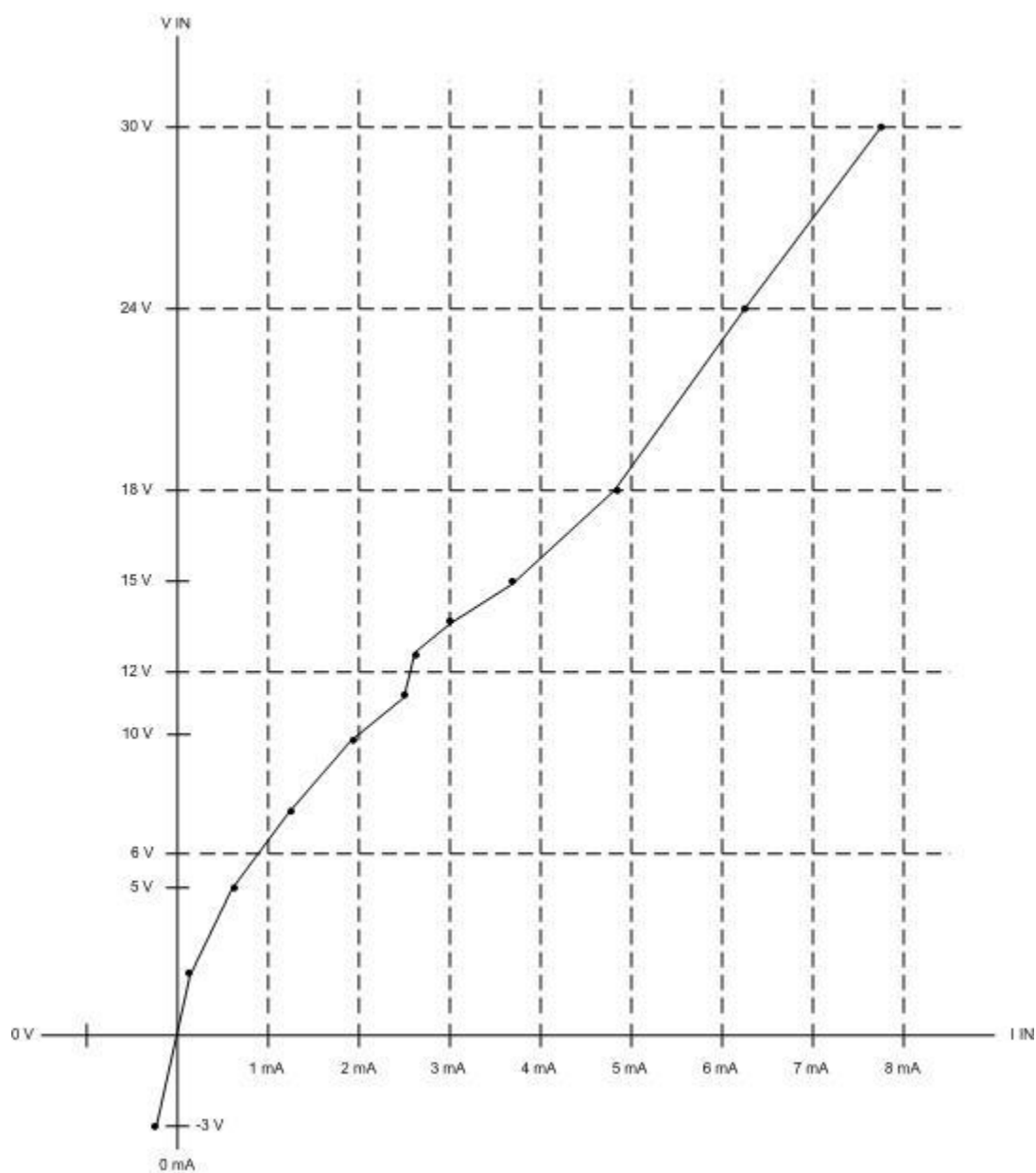


Figure 89: (FDR) Current-sinking Digital Input Voltage/Current Curve

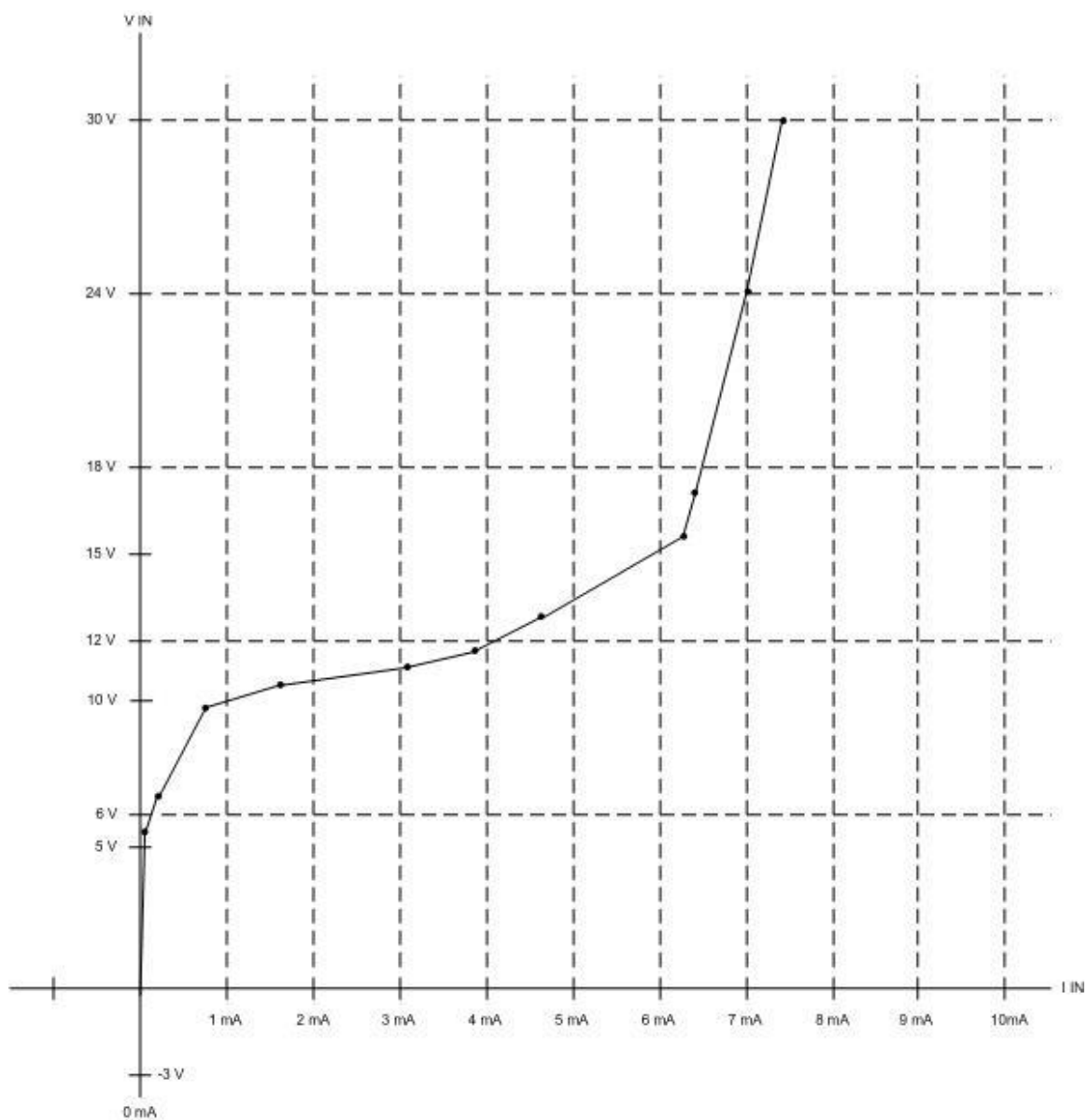
23.12 Switching Input Voltage Current Curve - (RDI)

Figure 90: Switching Input Voltage Current Curve (Redundant Mode)

23.13 Logic Card Digital Debounce Filter Propagation Delay - (RDI)

LSW Card Propagation Delay –Field card output to Point Data Register:

3.75 msec. Minimum
4.0 msec. Typical
4.25 msec. Maximum

LSW Card Digital Debounce Circuit Delay Time:

4.0 msec. typical

Any module digital input state change time that is less than the LSW card Digital Debounce time will be rejected by the module and will not appear in the Point Data Register.

Module Channel Mismatch Digital Debounce

Channel mismatch digital debounce between redundant I/O channels on the module (Channel A and Channel B) to comparison register C.

Total Module Response Time

The following chart lists the typical time that a digital input state change takes to propagate through the field card and the logic card to the module's Point Data Register. A 1 foot (0.305 M) long field cable is assumed.

MODULE ASSEMBLY GROUP	1 –CLOSED TO 0 –OPENED TRANSITION	0 –OPEN TO 1 –CLOSED TRANSITION
Group 1 –24 VDC Digital Inputs	4.1 msec. typical	4.03 msec. typical

23.14 Configuration/Status Register information - (RDI)

The Module Configuration Register is module I/O register 13 (0xD) and is a write register. The register bit assignments are defined in the Table below.

BIT	FUNCTION
0	1 = Configure. 0 = Unconfigured, causing an attention status.
1	1 = Force an attention status to be read by the controller. 0 = No Forced Error.
2 - 5	Not defined.
6	Allow asserted field card BLOWN FUSE signal to illuminate the module E LED and to force a module attention status. 1 = Enable Blown Fuse detection. 0 = Disable field detection circuitry.
7 - 12	Not defined.
13	1= Field Cabling Attached to this module.
14	Not defined.

BIT	FUNCTION
15	1 = Set as a Redundant Module. 0 = Set as a Non-Redundant Module.

The Redundant Digital Input module will not store point data until configured. The point data registers are valid and available as soon as the module is configured.

Electronics modules should have the Module Configuration register bits 6 & 15 set as appropriate and desired during module configuration:

The Module Status Register is module I/O register 13 (0xD) and is a read register. The register bit assignments are defined in the Table below

BIT	FUNCTION
0	1 = configured. 0 = not configured.
1	1 = Forced error set by controller. 0 = No forced error.
2 - 5	Not defined. 1 = permanent value.
6	1 = Blown fuse detection is enabled. 0 = Blown fuse detection is disabled.
7	1 = Fuse blown ¹ . 0 = Fuse OK .
8	0 = permanent value.
9	Cross Cable Absent = 1, Set to 0 when Non-redundant Module ²
10	0 = permanent value.
11 - 12	Not defined. 1 = permanent value.
13	1 = Field Cable Attached to this module selected. ⁴ .
14	Channel Comparison Fault ³ .
15	1= Redundant Module Selected 0 = Non-Redundant Module Selected ⁵ .

¹ When configured for blown fuse detection and true this will cause an attention status to the Controller.

² When the module is not configured for redundancy this bit is set to a permanent value of 0. When the module is configured for redundancy and the cross cable is not in place, this will cause an attention status to the Controller.

³ These bits indicate that one of the on-board redundant channels A & B do not match one another. Each bit corresponds to one of 16 board channels respectively. When configured for the redundant mode a channel comparison fault will produce an attention status. When configured for non-redundant mode a channel comparison fault will NOT produce an attention status.

⁴ This bit indicates a read back of the configuration setting at offset 13 reg D. It indicates that the field cabling will be attached to this module. When this bit is set , removal of the cross connect cable will not produce attention status and the module will allow controller access of the channel registers. If this bit is not set, indicating field cabling is not connected, then any module read will produce attention status when the cross connect cable is removed.

⁵ If the bit is set and one of the on board redundant channels A & B do not match one another, then any module read will produce attention status.

Bits 9 and 13 are irrelevant when the module is configured for non-redundant applications.

The Comparison Register is module I/O register C and is a read register. The register bit assignments are defined in the Table below.

Note: This is the resultant comparison when examining channel register A & B respectively on this module.

BIT	FUNCTION
0 - 15	1 = Channel 1 - 15 of Group A and Group B are different. 0 = Channel 1 - 15 of Group A and Group B are the same.

The watchdog timer illuminates the internal fault LED if the I/O Controller fails to access the Redundant Digital Input Module within the timeout period listed below.

MINIMUM TIMEOUT PERIOD	NOMINAL TIMEOUT PERIOD	MAXIMUM TIMEOUT PERIOD
1.1 sec.	1.6 sec.	2.1 sec.

The Point Data for Channel Group A Register is module I/O register 0 and is a read register. The register bit assignments for a current-sinking digital input field card are defined in the table below.

Note: This is the first of the pair of channels located on this module.

BIT	FUNCTION
0 - 15	Channel 1 - 15 of Group A field contact is closed

The Point Data for Channel Group B Register is module I/O register 1 and is a read register. The register bit assignments for a current-sinking digital input field card are defined in the table below.

Note: This is the second of the pair of channels located on this module.

BIT	FUNCTION
0 - 15	Channel 1 - 15 of Group B field contact is closed

23.15 Blown Fuse Detection - (RDI)

The FDR has a 17th channel used to monitor the presence of the wetting supply for single-ended digital inputs as shown in Module block diagrams for the Redundant Digital Input module (see page 403). It is identical to a typical digital input channel except that the normal mode surge suppression components are located on the personality module PDR and no output voltage comparator is employed and capacitor C3 is added to the circuit output.

C3 acts as a noise filter because the auxiliary voltage monitor circuit output does not provide an input to a four millisecond digital filter as do the outputs of the sixteen digital input channels. Two cases cause this monitor circuitry to report a blown fuse status and issue an attention status to the Controller:

- Fuse is blown on PDR.
- Wetting supply level is lower than minimum On Input Voltage for the FDR.

23.16 Cross Cable in Place circuit - (RDI)

The FDR also includes a cross cable in place circuit to detect the presence of the redundancy cable when utilized in a redundant configuration. This circuit accepts the cross cable power signal from the redundant module and sinks this to ground through the front end of an opto-coupler circuit.

The circuit is a duplicate schematic of the blown fuse detection circuit described above with differing connection signals "Cross Cable Power In" and "Cross Cable In Place". If the module is configured for redundancy and the cross cable is not in place, this will generate an attention status to the Controller from the module which does not have field wiring attached.

23.17 Diagnostic Logic card LEDs - (RDI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED is Lit when: ▪ The Blown Fuse bit (Bit-7) of the Module Status Register is set. This indicates that the external wetting supply fuse on the FDR has blown or the wetting supply is not present or below its acceptable threshold. ▪ The Cross cable is not in place when configured for redundant configurations (Status Register Bit 9).
I (Red)	The Internal Fault LED (LE17) is lit under the following conditions: ▪ The Force Error bit (Bit-1) of the Configuration Register is set. ▪ The Ovation Controller is not communicating with the Ovation Redundant Digital Input electronics module. ▪ One of the 16 channels in comparison register do not match one another. This is derived from the comparison register (CH).
1 - 16 (Green)	Each of the sixteen channel LEDS (LE16- LE1) is guaranteed to light when the input voltage of the LED's corresponding channel is greater than the channel's minimum On Input Voltage. Reference in Specifications -(RDI) (see page 412) for voltage levels.

23.18 Specifications -(RDI)

Redundant Digital Input (16 Channel) specifications

DESCRIPTION	VALUE
Voltage Category:	24 VDC.
Reverse Polarity Protection	Yes, each channel incorporates a front-end diode bridge.
Operating Voltage:	15 to 30 VDC.
Input Voltage For "1" Signal For "0" Signal	15 to 30 VDC. -3 to 5 VDC.
Input Current: For "1" Signal	4 mA typical per Channel –(Includes Channel A & B per Channel). 5.2 mA Maximum per Channel –(Includes Channel A & B per Channel).
Input Current Fuse Monitor: Aux present	2 mA typical 2.6mA Maximum
Input Current Cross Cable: Cable Present	2 mA typical 2.6mA Maximum
Input Characteristic:	IEC 61131-2, Type 1.
Number of Input Channels:	16
Channels per Common:	16
Galvanic isolation: Between channels and I/O Bus Between channels	Yes. No, Single-ended PMOD.
Current drawn: From I/O Bus Base Unit 24 V Main Power	45 mA typical for all inputs off –Channels A & B. 75 mA typical for all inputs on.
Power dissipation of module: (sum of 24 V Main Power and 24 V field channel power)	1.08 W typical for all inputs off. 3.43 W typical for all inputs on.
Status Display	Green LED per channel. LEDs located in non-galvanically isolated logic card circuit.
Diagnostic Function	Blown fuse detection monitor circuit for auxiliary contact power status located on FDR board.

Environmental Specifications

TYPE	DESCRIPTION
Ambient Air Temperature	The operating ambient air temperature range is from 0° C to 60° C. The temperature is measured approximately 0.5 inches from any point on the module while it is mounted in its normal vertical or horizontal position, and while subject to the air movements which result from natural convection only (that is, no forced air movement).
Humidity (non-condensing)	The humidity range is from 0% to 95% relative humidity, non-condensing, through an ambient air temperature range of 0°C through 60°C, but with a Maximum wet bulb temperature not over 35°C (95°F).

TYPE	DESCRIPTION												
Vibration	The module shall remain operational while subject to testing defined in IEC 68-2-6 over the following curve: 0.15mm displacement from 10 to 57 Hz and 2G's from 57 to 500 Hz, when attached to a properly mounted DIN rail.												
Shock	The module will remain operational and reliable after being subjected to testing defined in IEC 68-2-27 over the following curve: 15 G's for 11 milliseconds and 1/2 sine wave.												
Power Supply Voltage	<table><tr><td></td><td>Minimum</td><td>Nominal</td><td>Maximum</td></tr><tr><td>Main Primary Voltage:</td><td>21.0 V</td><td>24.0 V</td><td>25.0 V</td></tr><tr><td>Main Secondary Voltage:</td><td>21.0 V</td><td>24.0 V</td><td>25.0 V</td></tr></table> The two main supply voltages are the redundant power feeds to the electronics module and are diode auctioneered on the electronics module's logic card.		Minimum	Nominal	Maximum	Main Primary Voltage:	21.0 V	24.0 V	25.0 V	Main Secondary Voltage:	21.0 V	24.0 V	25.0 V
	Minimum	Nominal	Maximum										
Main Primary Voltage:	21.0 V	24.0 V	25.0 V										
Main Secondary Voltage:	21.0 V	24.0 V	25.0 V										

SECTION 24

Contact Input Sequence of Events module (HDSOE) (32 Channel)

IN THIS SECTION

<i>32 Channel Contact Input Sequence of Events module overview (HDSOE)</i>	416
<i>Electronics module (HDSOE)</i>	416
<i>Personality module (HDSOE)</i>	416
<i>Valid module combinations (HDSOE)</i>	416
<i>Terminal block wiring information (HDSOE)</i>	417
<i>Logic board block diagram (HDSOE)</i>	418
<i>Field card block diagram (HDSOE)</i>	419
<i>Contact Input channel diagram (HDSOE)</i>	420
<i>Ground fault detection on Contact Input diagram (HDSOE)</i>	421
<i>LSH Logic function block diagram (HDSOE)</i>	422
<i>Contact Input field wiring with 32 return lines (HDSOE)</i>	423
<i>Contact Input field wiring with 1 return line (HDSOE)</i>	423
<i>Field wiring cable impedances (HDSOE)</i>	424
<i>Maximum cable lengths (HDSOE)</i>	424
<i>Configuration/Status Register Command Data information (HDSOE)</i>	425
<i>I/O address and Buffer control register command data information (HDSOE)</i>	427
<i>Configuration/Status Register Reply Data information (HDSOE)</i>	428
<i>I/O address and Buffer control register reply data information (HDSOE)</i>	429
<i>Diagnostic LEDs (HDSOE)</i>	430
<i>Specifications (HDSOE)</i>	431

24.1 32 Channel Contact Input Sequence of Events module overview (HDSOE)

The 32 Channel Contact Input Sequence of Events Electronics Module performs a sequence of event functions. This module provides 32 contact channels in a single ended contact input format to monitor the states ("0" or "1") of 32 field contact inputs.

SOE one shot events are only recorded if the input state transition is followed by a 4 millisecond minimum steady state time. Otherwise the one shot event is ignored.

The SOE one shot feature enables SOE event detection that happen asynchronously to Controller tasks that reads the present input state and event buffers.

There are two types of events, mutually exclusive of each other, that are defined:

- High to low transition of the input.
- Low to high transition of the input.

Events registered on various points are also mutually exclusive of each other.

The 32 Channel Contact Input SOE electronics module is a High Density version the 16 Channel Contact Input SOE module and plugs into a High Density Ovation Base Unit (A 4-Position Base Unit).

Note: This module is not compatible with the 2 slot base unit.

24.2 Electronics module (HDSOE)

- **5X00605G01** - 32 Channel Contact Input Sequence of Events Electronics Module - Thirty-two 48 VDC single-ended current-sourcing digital inputs (contact inputs).

24.3 Personality module (HDSOE)

1X00884H01 - Cavity Insert - No Personality Module is required for this module.

24.4 Valid module combinations (HDSOE)

32 Channel Contact Input Sequence of Events valid module combinations

RANGE	CHANNELS	ELECTRONICS MODULE	CAVITY INSERT
32 Channel Contact Input SOE	32	5X00605G01	1X00884H01
This module is CE Mark compliant.			

24.5 Terminal block wiring information (HDSOE)

The following figure illustrates the base unit termination block for the 32 Channel Contact Input SOE.

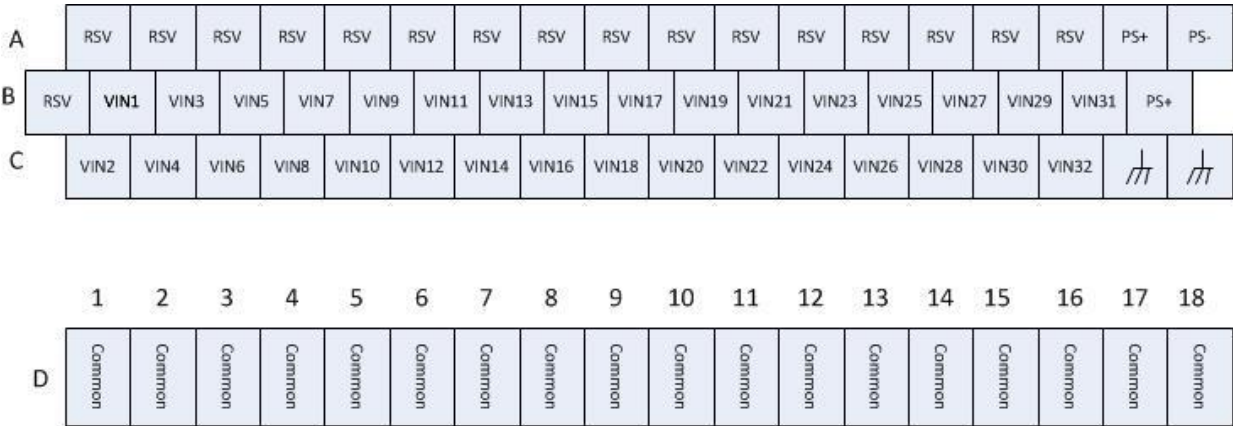


Figure 91: High Density Base Unit Termination Block

24.6 Logic board block diagram (HDSOE)

The following figure illustrates the Logic board for the 32 channel contact input SOE module.

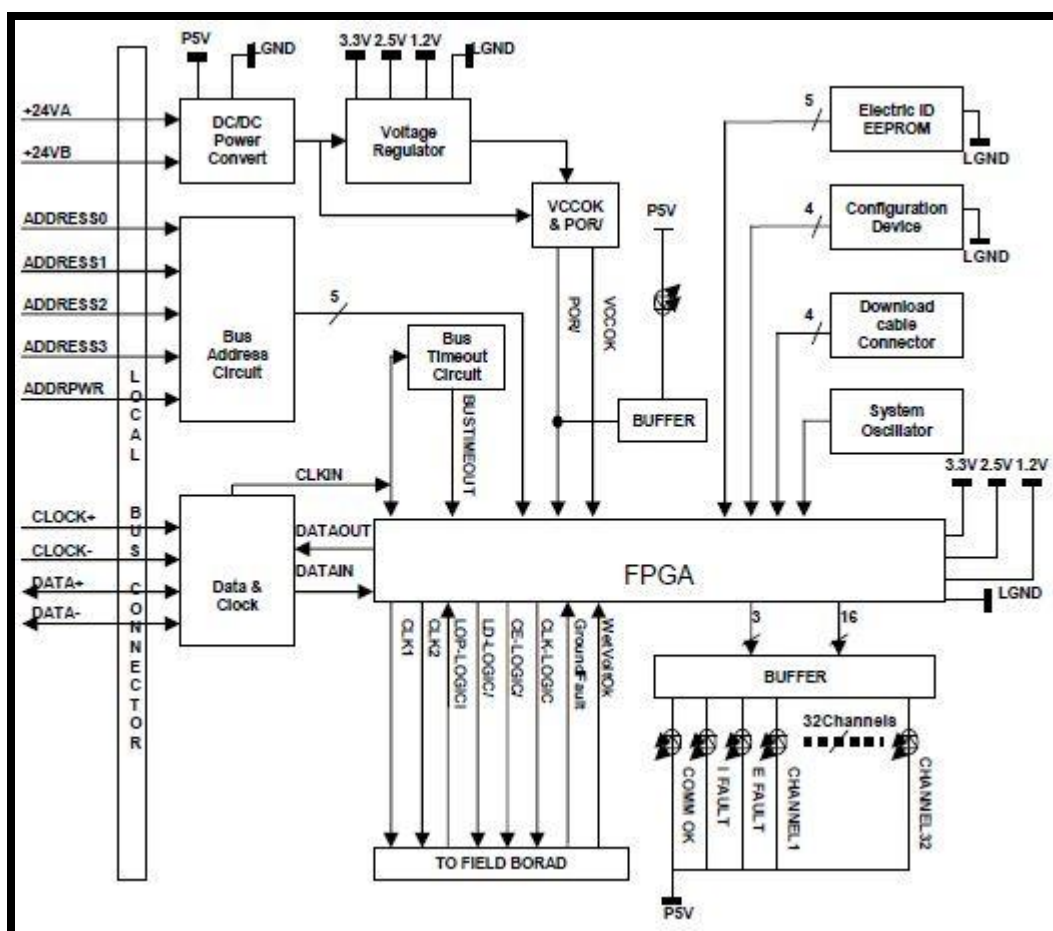


Figure 92: Logic card block diagram

24.7 Field card block diagram (HDSOE)

The following figure illustrates the Field board for the 32 channel contact input SOE module.

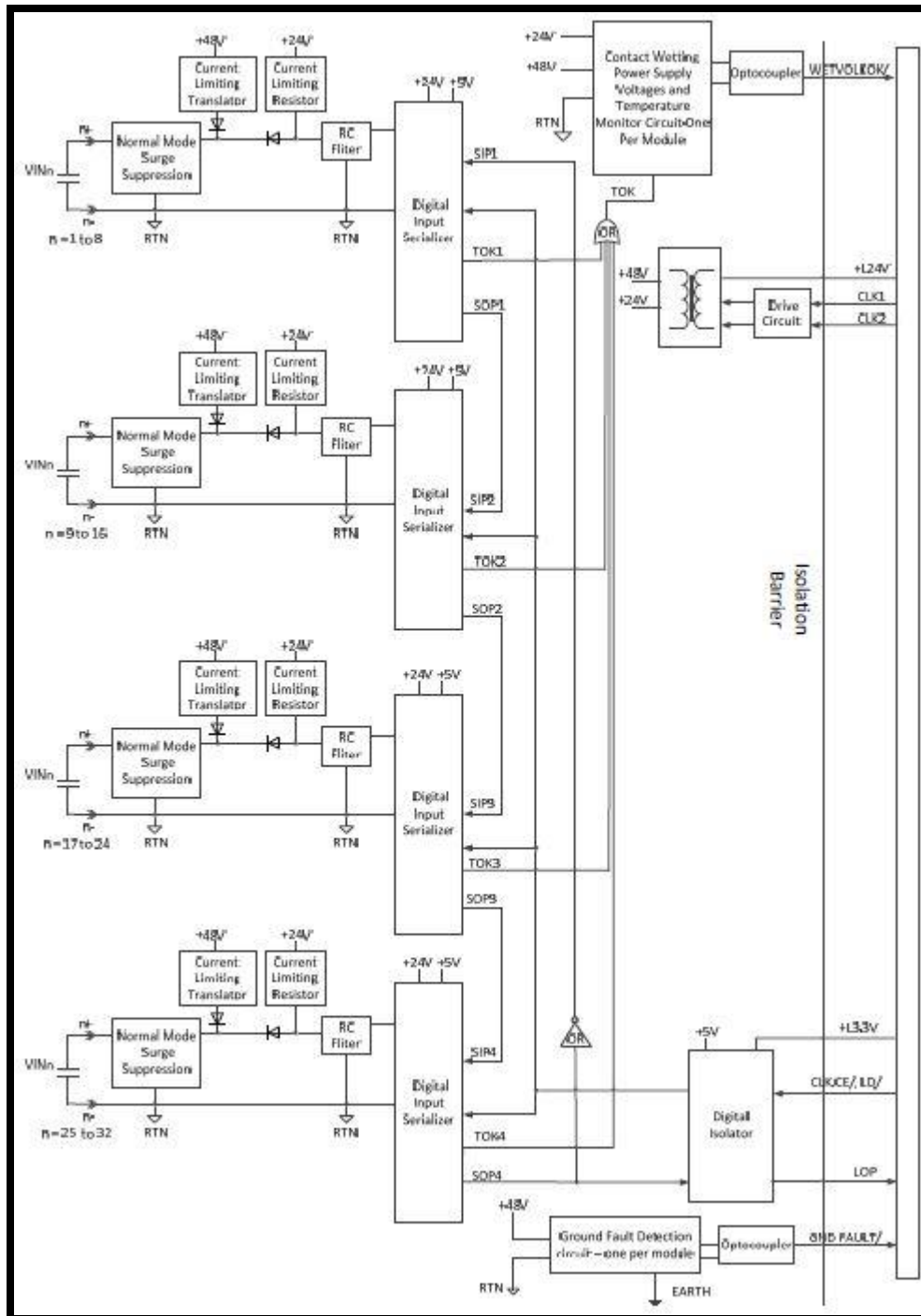


Figure 93: Field board block diagram

24.8 Contact Input channel diagram (HDSOE)

The following figure illustrates the Contact Input channel.

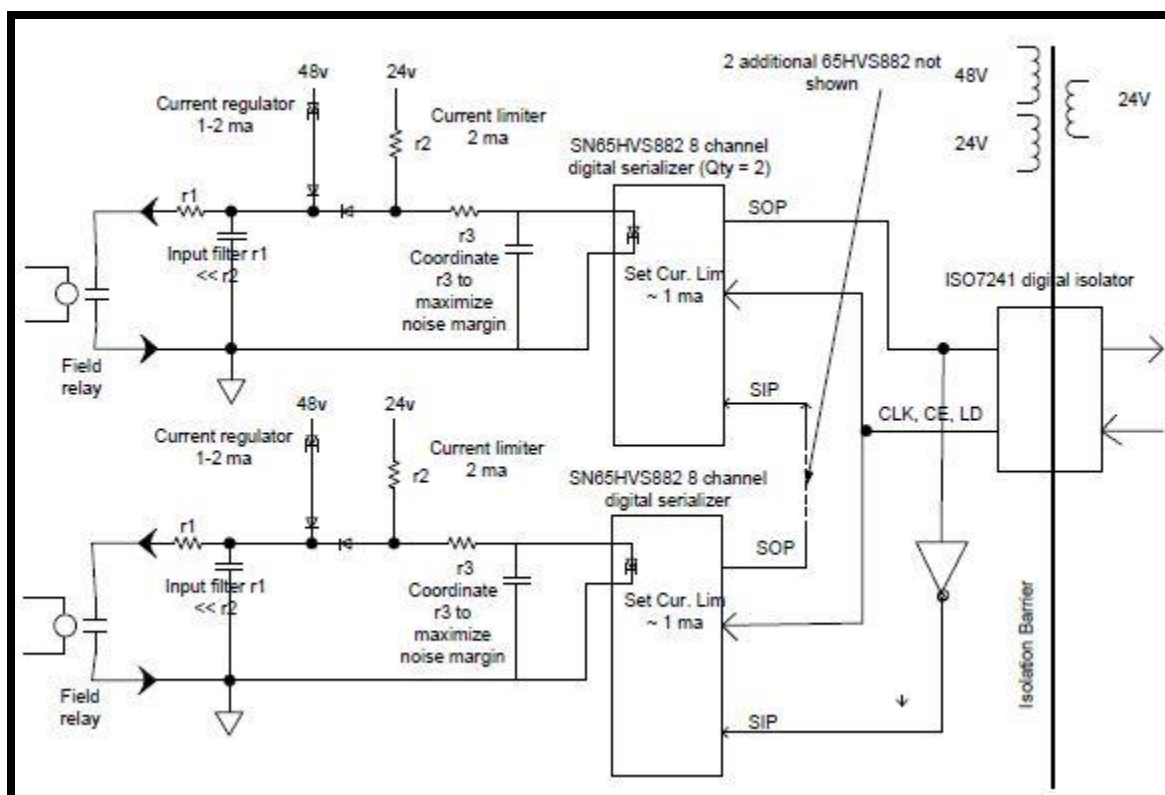


Figure 94: Contact Input channel diagram

24.10 LSH Logic function block diagram (HDSOE)

The following figure shows the Logic card FPGA block diagram.

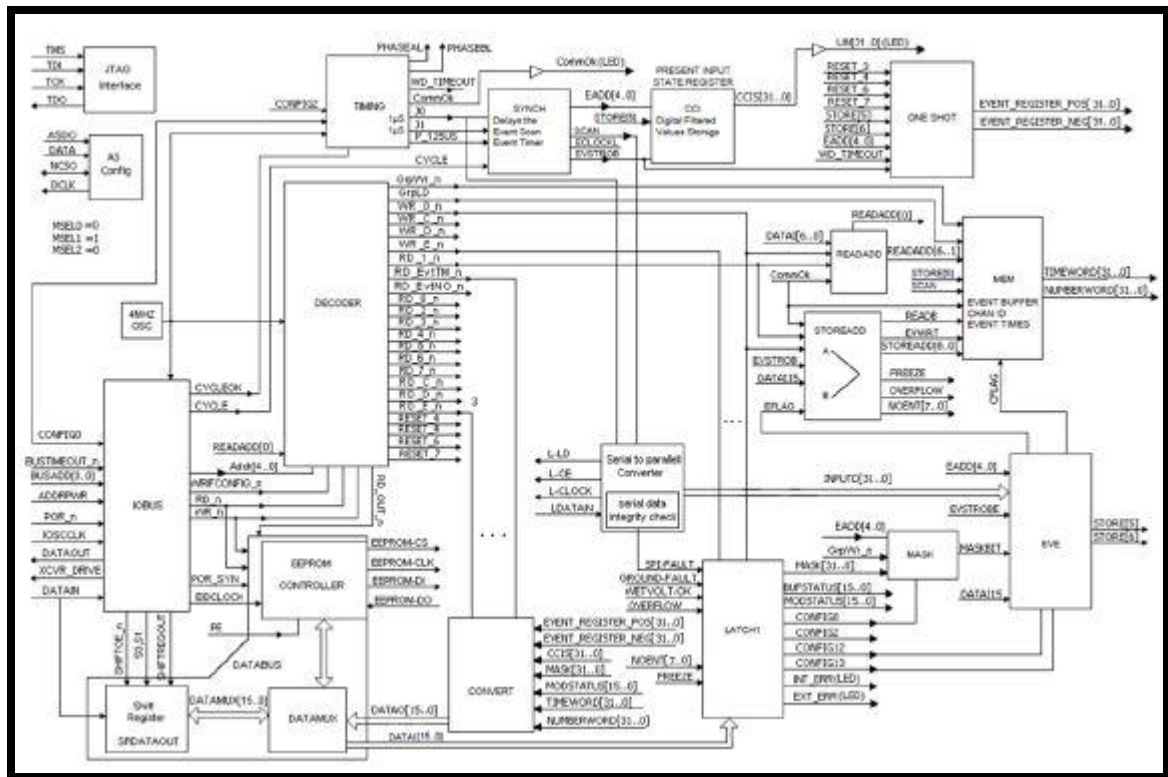


Figure 96: Logic card FPGA block diagram

24.11 Contact Input field wiring with 32 return lines (HDSOE)

The following diagram illustrates the typical Contact Input field wiring with 32 return lines.

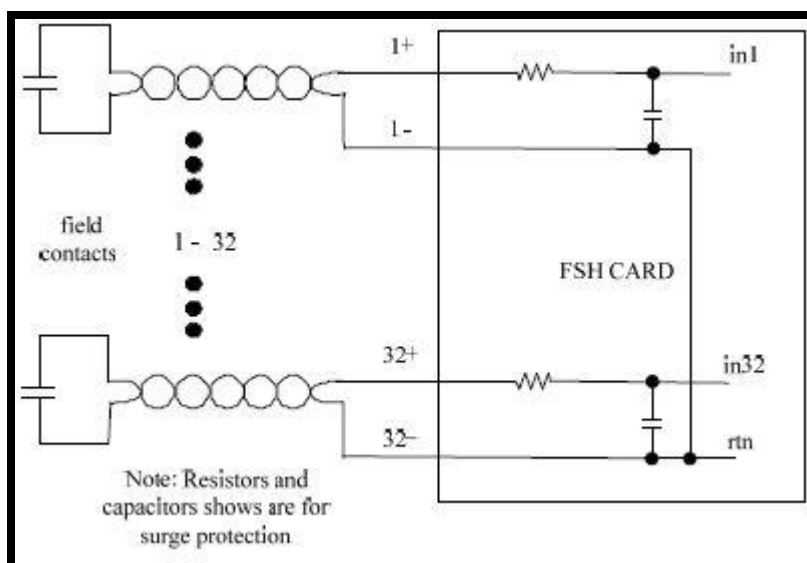


Figure 97: Typical Contact Input field wiring with 32 return lines

24.12 Contact Input field wiring with 1 return line (HDSOE)

The following diagram illustrates the typical Contact Input field wiring with 1 return line.

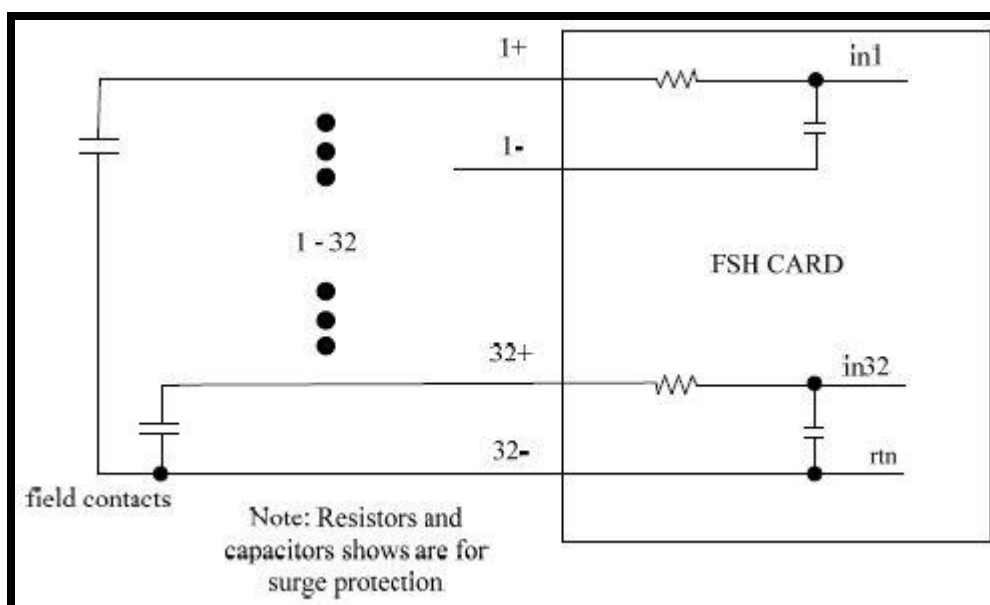


Figure 98: Typical Contact Input field wiring with 1 return line

24.13 Field wiring cable impedances (HDSOE)

The following illustrations shows field wiring cable impedances.

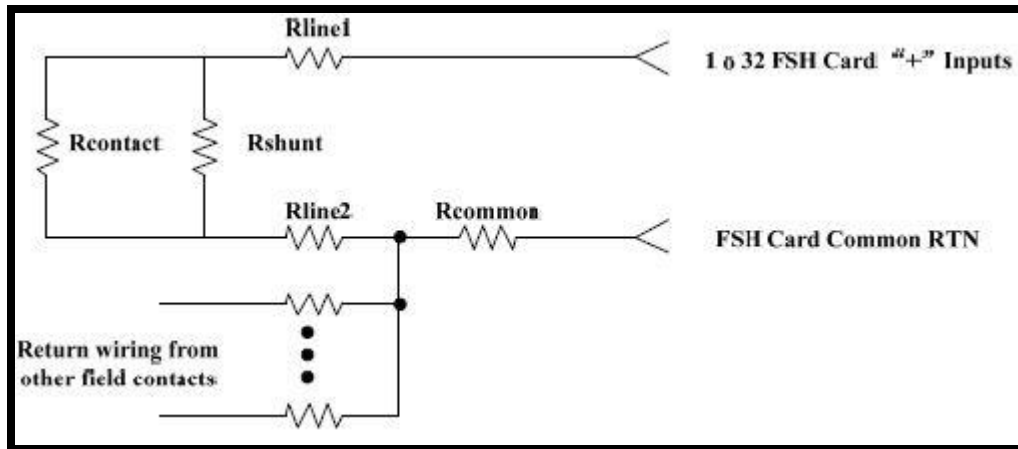


Figure 99: Cable impedances in field wiring

The following definitions apply:

R_{shunt} = contact shunt resistance.

R_{contact} = resistance associated with a closed contact.

R_{return} = resistance of the common return line.

R_{line} = resistance of the non-common cable length to and from the contact.

$R_{\text{wiring}} = R_{\text{contact}} + R_{\text{line}} + 32 R_{\text{return}}$

24.14 Maximum cable lengths (HDSOE)

The following two tables list the maximum cable lengths for field wiring to the contacts.

For both tables assume R_{contact} is 0 ohms.

The following table information applies when there are 32 individual common return lines brought to the card edge. This implies that R_{return} is 0 ohms. The maximum cable length is 1/2 the sum of the wire length to and from the contact.

Maximum cable length for Contact Input with 32 individual common returns

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
18	6.64	7.5
20	10.2	4.9
22	16.2	3.0

The following table information applies when there is one common return cable per card. The maximum cable length is the length of the cables to the contacts.

Maximum cable length for a Contact with a single common return for all 32 inputs

WIRE GAUGE	OHMS PER THOUSAND FEET (SOLID COPPER WIRE)	MAXIMUM CABLE LENGTH (THOUSANDS OF FEET)
12	1.66	3.54
14	2.27	2.59
16	4.18	1.40
18	6.64	0.89

24.15 Configuration/Status Register Command Data information (HDSOE)

The module configuration register bits at I/O address offset DH are the following:

Configuration register bits at I/O address offset DH

BITS	FUNCTION
0	Configure Module 1 = configured 0 = unconfigured
1	Force internal error 1 = forced error 0 = no forced error
2	0 = Do not set. (Reserved for factory test).
3 - 7	Not used (should be set to "0")
8	1 = Allows asserted field card WETVOLTOK/ signal (field card wetting voltage power supply status) to illuminate the module I (Internal Error) LED and to force a module Attention Status. Allow asserted field card GND FAULT/ signal (field card input ground fault status) to illuminate the module E (External Error) LED. 0 = Ignore field card WETVOLTOK/ signal. Ignore field card GND FAULT/ signal in regards to controlling the module E LED state.
9	Not used (should be set to "0").
10	Enable module attention for a GND fault.
11	Not used (should be set to "0").
12	Disable chatter control
13	Reset chatter control counters on buffer unfreeze.
14	Not used (should be set to "0").
15	Not used (should be set to "0").

- **Bit 0** - This is the configuration bit. The module will not operate until the configure bit is set with a write.
- **Bit 1** - When set the Internal error LED illuminates, and only the status registers can be read.
- **Bit 2** - Is for debug only.
- **Bit-10** - (enable module attention for a GND fault) should also be set if an attention reply is wanted for a ground fault in the field wiring.
- **Bit 12** - When set this disables the chatter control function.
When bit 12 = "0" and an input channel is not masked off, that input can chatter and each event will be recorded until the event buffer overflows.
- **Bit 13** - When set the chatter control counter for each channel is reset each time an event buffer is unfrozen instead of being decremented each 100 milliseconds.
The default state of bit 13 = "0" has the chatter control counter being decremented each 100 milliseconds.

Channel event tagging mask register at I/O address offset CH, EH can be written to and read back. A "one" in the channel event tagging mask causes the corresponding input to be checked for change of state every 1/8 millisecond, and in the event of a change of state to enter the change into the event buffer. A "zero" resets the corresponding chatter counter and chatter control flag in order to disable monitoring that channel for change of states. On power up all bits are set to a "0".

Clock synchronization is done using one group write to I/O address offset 0H. The write command contains a 16 bit clock with the LSB representing 1 millisecond. The write command updates the 16 most significant bits of the electronics module internal clock and clears the 3 lower clock bits to zero. The electronics module has a 1 millisecond clock accuracy with reference to when the clock is updated. The event cannot be staggered until synchronized once.

Writing into or reading from the module resets the watchdog timer.

When the contact input module is configured it will read back a wetting voltage failure (bit 9 set) for a few milliseconds while the wetting voltage supply starts up.

24.16 I/O address and Buffer control register command data information (HDSOE)

Module addressing is determined by the module stack. No on-card switches or settings are required.

The following I/O address offset information applies.

I/O address offset

I/O ADDRESS OFFSET	INFORMATION
0H	Buffer control register.
CH	Channel event tagging mask (bits 0 - 15).
DH	Module configuration.
EH	Channel event tagging mask (bits 16 - 31).
FH	Electronic ID feature.
0H (group write)	Clock synch (group write).

The buffer control register at I/O address offset 0H contains the following information:

Buffer Control Register

BITS	FUNCTION
0 - 6	Event buffer address of next word to be read (0 - 127).
7 - 13	Not used (should be set to 0).
14	Clear the buffer over-flow bit in buffer status register.
15	Freeze event buffer to be read.

24.17 Configuration/Status Register Reply Data information (HDSOE)

The following chart relates the input channel number to the bit number for the following:

- Present input state register(offset 2H),
- Positive transition latched register(offset 3H),
- Negative transition latched register(offset 4H)
- Channel event tagging mask register(offset CH).

INPUT CHANNEL	BITS
1	0
2	1
3	2
4	3
5	4
6	5
7	6
8	7
9	8
10	9
11	10
12	11
13	12
14	13
15	14
16	15

The following chart relates the input channel number to the bit number for the

- Present input state register(offset 5H)
- Positive transition latched register(offset 6H)
- Negative transition latched register(offset 7H)
- Channel event tagging mask register(offset EH)

INPUT CHANNEL	BITS
16	0
17	1
18	2
19	3

INPUT CHANNEL	BITS
20	4
21	5
22	6
23	7
24	8
25	9
26	10
27	11
28	12
29	13
30	14
31	15

For the contact input a contact closure produces a "1" to the I/O bus.

The present input state at I/O address offset 2H, 5H are the data after the digital debounce. The present input state is unaffected by the "Channel Event Tagging Mask". The preset input state can be read at any time, it is independent of the event buffer.

The channel event tagging mask can be read back at I/O address offset CH, EH.

The present input state registers at address 2H, 5H and the channel event tagging mask read back registers at address CH, EH are read independent of the event buffer read back procedure.

The 32 channel Contact Input Sequence of Events module provides field digital input state change detection (SOE One Shot), and are also read independent of the event buffer read back procedure.

24.18 I/O address and Buffer control register reply data information (HDSOE)

Configuration register bits at I/O address offset DH

I/O ADDRESS OFFSET	DESCRIPTION
0	Buffer status register.
1	Event buffer.
2	Present input state (0 - 15).
3	Positive transition latched register (0 - 15).
4	Negative transition latched register (0 - 15).

I/O ADDRESS OFFSET	DESCRIPTION
5	Present input state. (16 - 31).
6	Positive transition latched register (16 - 31).
7	Negative transition latched register (16 - 31).
CH	Channel event tagging mask read back (0 - 15).
DH	Module status register.
EH	Channel event tagging mask read back (16 - 31).

The buffer status register at I/O address offset 0H contains the following information:

BITS	FUNCTION
0	LSB
1	
2	Number of words to be read from the next Event buffer.
3	
4	
5	
6	
7	MSB
8 - 12	0 (Not used).
13	1 (Always set to 1).
14	Buffer over-flow.
15	Buffer frozen (read back).

The Channel-ID words are at even locations starting at zero in the event buffer.

The Event-Time words are at odd locations starting at one.

The Channel-Id word at the even location and the Event-Time word at the following odd location make up one event.

24.19 Diagnostic LEDs (HDSOE)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module. Communication timeout delay is 2 seconds.
E (Red)	Indicates faults external to the module. Lit when a ground fault occurs in the field wiring.
I (Red)	Internal Error LED. Lit under the following conditions: ▪ The Force Error bit (Bit-1) of the Configuration Register is set. ▪ The Ovation Controller is not communicating with the 32 channel Contact input Sequence of event electronics module. ▪ On-card +48V/+24V contact wetting supply failure or the SPI data integrity error from the field card or serializer (SN65HVS882) temperature over heated will set Bit-9 of the Module Status Register. ▪ Failure detected by the data integrity circuit.
1 - 32 (Green)	A contact input channel status LED lights when the input contact of the LED's corresponding channel is closed.

24.20 Specifications (HDSOE)

32 Channel Contact Input SOE module specifications

DESCRIPTION	VALUE
Number of channels	32
Closed Contact current	2 mA Minimum 4 mA Maximum
Open Contact current	+43V to +55V at $I_{in} = 0$ mA +42V to +54V at $I_{in} = 1$ mA
On-card wetting supply	+24V to +48V/24V DC-DC converter. 48V supply: Minimum, +46V Nominal, +48V Maximum +55V 24V supply: Minimum, +20V Nominal, +24V Maximum +25V
Resolution	1/8 millisecond resolution for time tagging an event.
Time tagging accuracy	1 millisecond relative to clock from the I/O Bus. 1/8 millisecond relative to other channels on the module.
Delay time for contact opening (using a 1 ft cable)	0.13 millisecond Typical. <i>Note: There is an additional delay of 0.04 milliseconds per 1000 foot of cable, due to the cable capacitance charging when the field contact opens. It does not assume all field transducers will be contacts. It assumes a cable capacitance of 30 PF per foot.</i> <i>There is no additional delay due to the cable when the contact closes.</i>

DESCRIPTION	VALUE
Delay time for contact closing (using a 1 ft cable)	0.09 millisecond Typical.
Digital debounce propagation delay	Digital debounce 3.75 to 4.25 milliseconds Propagation delay 3.75 to 4.25 milliseconds Note: Any input change less than the digital debounce time is rejected. This does not include the field card propagation delay.
Event Buffers	Two event buffers, each can store up to 64 events.
Normal Mode voltage	Surge - The IEEE/SWC test can be applied to the inputs without damage. Continuous - On input voltage range for digital input module. Not applicable for contact input module.
Common Mode voltage	Isolation - Dielectric Withstand from point to point (single ended): 1000VAC or peak DC from point to earth ground: 1414VDC Surge - The IEEE/SWC, EN61000-4-4, and EN61000-4-5 tests can be applied without damage. Accuracy of the reading is reduced during the surge test. Continuous - 150 VAC or VDC for digital input module. 80 VAC typically will not erroneously trip the ground fault detection circuit on the contact input module.
Power dissipation for contact input module	3.31 watts typical with all inputs open 6.96 watts typical with all inputs closed
Power Supply (Backplane supply) current draw	32mA when module is not configured 138mA typical for contact input with all inputs off 290mA typical for contact input with all inputs on
Power Supply voltage	Minimum 21.0 Nominal 24.0 Maximum 25.0
Vibration	0.15mm displacement from 10 to 57 Hz and 2G's from 57 to 500 Hz
Shock	15 G's for 11 millisecond and 1/2 sine wave.
Operating temperature range	0 to 60 degrees C (32 degrees F to 140 degrees F)
Storage temperature range	-40 degrees C to 70 degrees C (-40 degrees F to 158 degrees F)
Humidity (non-condensing)	0 to 95% with a maximum wet bulb not over 35 degrees C (95 degrees F)

SECTION 25

Thermocouple Input module (16 Channel) (HDTI)

IN THIS SECTION

<i>16 Channel Thermocouple Input module overview (HDTI).....</i>	<i>434</i>
<i>Electronics module (HDTI).....</i>	<i>435</i>
<i>Personality module (HDTI).....</i>	<i>435</i>
<i>Valid module combinations (HDTI)</i>	<i>435</i>
<i>Terminal block wiring information (HDTI).....</i>	<i>436</i>
<i>Terminal block pin assignments for the Thermocouple Emod (HDTI)</i>	<i>436</i>
<i>Field connection wiring information (HDTI).....</i>	<i>437</i>
<i>Field connection wiring information (HDTI).....</i>	<i>438</i>
<i>Logic board block diagram (HDTI)</i>	<i>439</i>
<i>Field board block diagram (HDTI).....</i>	<i>440</i>
<i>Point Quality Register (HDTI).....</i>	<i>440</i>
<i>Mask Register (HDTI)</i>	<i>442</i>
<i>Configuration/Status Register information (HDTI)</i>	<i>443</i>
<i>Diagnostic LEDs (HDTI).....</i>	<i>445</i>
<i>Specifications (HDTI)</i>	<i>445</i>

25.1 16 Channel Thermocouple Input module overview (HDTI)

The Ovation 16 Channel I/O Thermocouple Module provides signal conditioning and analog-to-digital conversion for sixteen individually isolated inputs. The module is designed to convert thermocouple signals to digital equivalents. The converted input signals are formatted to conform to the 14 bit Ovation data format and stored on the module.

The module consists of two printed circuit board assemblies:

- Logic board
- Field interface

The module styles signal are +/-20mV, +/-50mV and +/-100mV

The module has a conversion rate of 50 millisecond for 60/50 Hz operation, provides open thermocouple detection, as well as the temperature sensor interface provided on Thermocouple Personality Module.

The field card contains sixteen individually isolated channels. Each channel converts the input voltage to a sixteen bit digital equivalent code. The codes from each channel are serially transmitted through the isolated chip to the Filed Programmable Gate Array (FPGA) on the logic card.

Features of the module are:

- IEEE Surge Withstand Capability (with shielded cable).
- Designed to be CE mark compliant (with shielded cable).
- All internal components are rated for 85^o C maximum operating temperature.
- Electrical isolation (all channels).
- Point quality status reporting.
- Provides both normal and common-mode rejection.
- On-card factory calibration utilizing EEPROM chip for storing calibration constants.
 - ☐ Extensive use of low-power chips.
 - ☐ A switching regulator for local +5V generation.
 - ☐ Three LDOs for FPGA working voltage.
- 3.3V,2.5V and 1.2V generation.
- No configuration necessary for 50 and 60 Hz noise rejection.
- May be read by a Group 3 or later IOIC module.
- Hot-swap capability.
- Over-voltage protection is provided for the module.
- Electronic identification of Electronics Module.

25.2 Electronics module (HDTI)

- **5X00594G01** - 16 Channel Thermocouple Electronics module (individually isolated channels).

The Electronics Module houses the following two printed circuit assemblies:

Logic Board (LTH) 5X00595 contains the following attributes:

- I/O Bus Interface
- Electronic ID circuits
- Circuits to drive the power supplies
- Circuits to synchronize the power drive and communication to the A/D converter of Field Interface Board, and
- The FPGA for control
- Data storage and manipulation

Refer to Logic board block diagram (HDTI) (see page 439).

Field Interface Board (FTH) 5X00596 contains the following attributes:

- Used to conduct the control and data signals plus power (+5V, +3.3V) between the two boards.
- There are sixteen identical individually isolated channels on the field interface board.
- An active “clamp” circuit protects the A/D converter inputs from over-voltage signals.
- Provides an open thermocouple detection mechanism that forces the channel to a very negative level if the thermocouple is open that will result in the module returning “attention” when the Open thermocouple channel is read.

Refer to Field board block diagram (HDTI) (see page 440).

25.3 Personality module (HDTI)

- **1C31116G05** 13 Bit Analog Input Personality Module

25.4 Valid module combinations (HDTI)

16 Channel Thermocouple valid module combinations (16-bit) ¹

RANGE	CHANNELS	ELECTRONIC S MODULE	PERSONALITY MODULE
+/-20mV, +/-50mV, +/-100mV	16	5X00594G01	1C31116G05
¹ This module configuration is CE Mark compliant.			

25.5 Terminal block wiring information (HDTI)

Terminal block connection assignments:

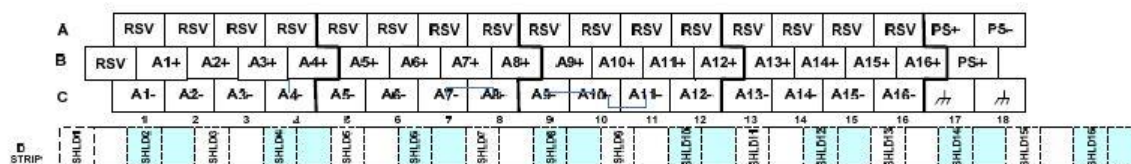


Figure 100: Terminal block connections

Note: For ungrounded Thermocouples (typical case) – The shield should be terminated at the D strip. The thermocouple wires terminate to the A+ and A- connections.

For Remotely grounded thermocouples – the shield and the thermocouple are grounded at the sensor site. The shield must not be terminated at the module.

25.6 Terminal block pin assignments for the Thermocouple Emod (HDTI)

The 53 Position compression-style terminal block arranged in 3 rows.

- Row A is the highest relative to the base, has 18 positions.
- Row B is the middle row and has 17 positions.
- Row C is nearest to the base has 18 positions.

Maximum Wire Size is 12 AWG - 22 AWG single wire. Two 14 AWG (max.) wires/terminal.

Each Analog input point consists of three signals: the (+) input, the (-) input, and a shield.

A shielded twisted pair cable is required for best performance, maximum noise rejection and CE mark compliance.

Refer to Terminal block wiring information (HDTI) (see page 436) for a pictorial diagram of the terminal block pin assignments.

Refer to Field connection wiring information (HDTI) (see page 437) and Field connection wiring information (HDTI) (see page 438) for diagrams of the different wiring connections from terminal block to Electronics Module.

Terminal Block Pin Assignments for the Thermocouple Electronics module

ROW A PIN #	SIGNAL NAME	ROW B PIN #	SIGNAL NAME	ROW C PIN #	SIGNAL NAME
1	RESERVED	1	RESERVED	1	AI1(-)
2	RESERVED	2	AI1(+)	2	AI2(-)
3	RESERVED	3	AI2(+)	3	AI3(-)
4	RESERVED	4	AI3(+)	4	AI4(-)

Row A PIN #	SIGNAL NAME	Row B PIN #	SIGNAL NAME	Row C PIN #	SIGNAL NAME
5	RESERVED	5	AI4(+)	5	AI5(-)
6	RESERVED	6	AI5(+)	6	AI6(-)
7	RESERVED	7	AI6(+)	7	AI7(-)
8	RESERVED	8	AI7(+)	8	AI8(-)
9	RESERVED	9	AI8(+)	9	AI9(-)
10	RESERVED	10	AI9(+)	10	AI10(-)
11	RESERVED	11	AI10(+)	11	AI11(-)
12	RESERVED	12	AI11(+)	12	AI12(-)
13	RESERVED	13	AI12(+)	13	AI13(-)
14	RESERVED	14	AI13(+)	14	AI14(-)
15	RESERVED	15	AI14(+)	15	AI15(-)
16	RESERVED	16	AI15(+)	16	AI16(-)
17	PS+	17	AI16(+)	17	Earth Ground
18	PS+	18	PS+	18	Earth Ground

25.7 Field connection wiring information (HDTI)

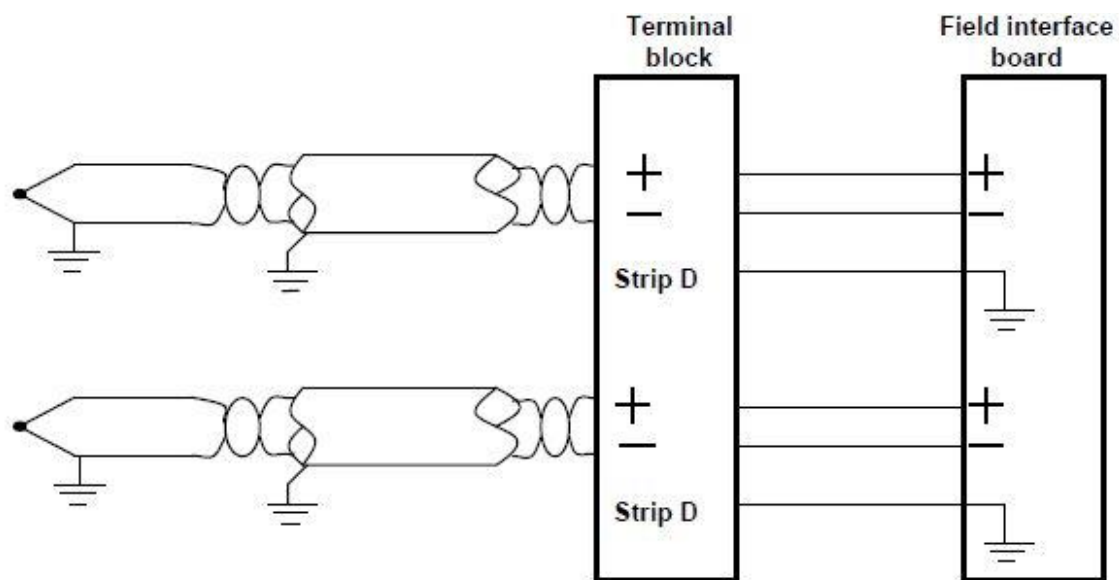


Figure 101: A - Field grounding diagram

25.8 Field connection wiring information (HDTI)

The following diagram illustrates the Local grounding

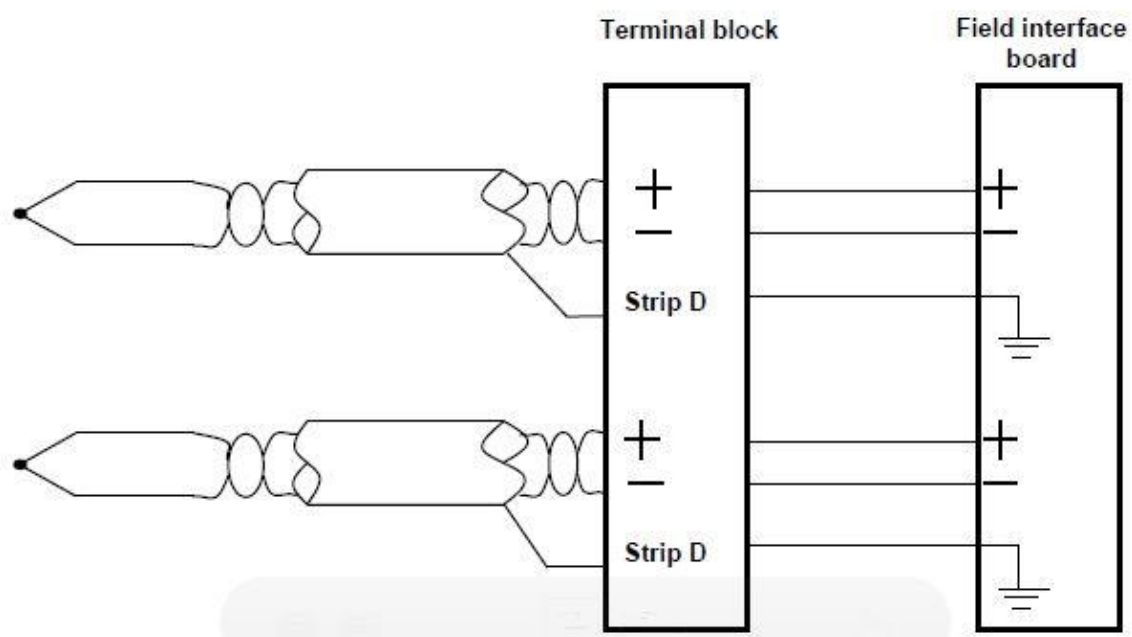


Figure 102: B - Local grounding diagram

25.9 Logic board block diagram (HDTI)

The following figure illustrates the HDTI Logic board.

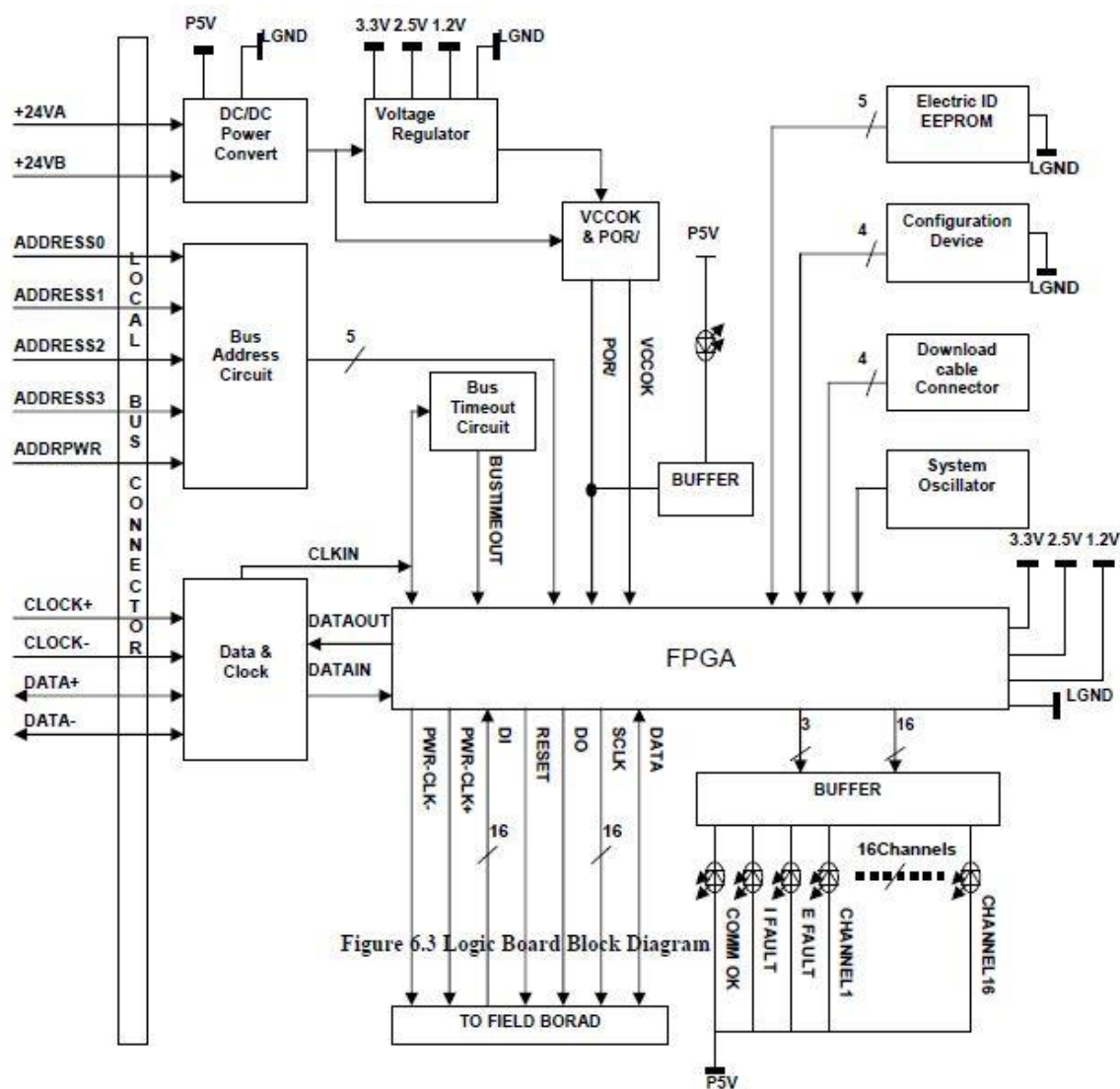


Figure 103: Logic board block diagram

25.10 Field board block diagram (HDTI)

The following figure illustrates a HDTI Field board.

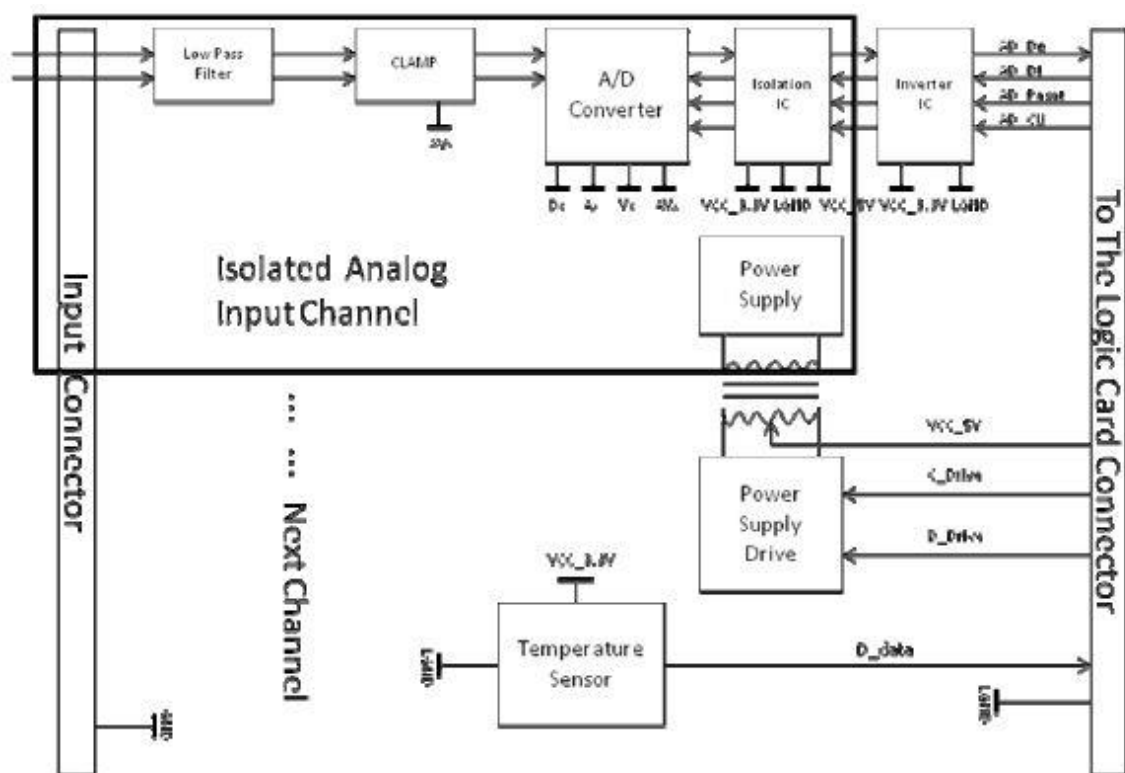


Figure 104: Field board block diagram

25.11 Point Quality Register (HDTI)

Read Register #12 (C in Hex) is used to report the point quality of the eight input channels.

The definition of the bits in this register is listed in the following table.

Point quality register output data format (read)

BIT	DESCRIPTION
0	1 = Channel Fault on Channel 1 exists. 0 = No Channel Fault on Channel 1 exists.
1	1 = Channel Fault on Channel 2 exists. 0 = No Channel Fault on Channel 2 exists.
2	1 = Channel Fault on Channel 3 exists. 0 = No Channel Fault on Channel 3 exists.

BIT	DESCRIPTION
3	1 = Channel Fault on Channel 4 exists. 0 = No Channel Fault on Channel 4 exists.
4	1 = Channel Fault on Channel 5 exists. 0 = No Channel Fault on Channel 5 exists.
5	1 = Channel Fault on Channel 6 exists. 0 = No Channel Fault on Channel 6 exists.
6	1 = Channel Fault on Channel 7 exists. 0 = No Channel Fault on Channel 7 exists.
7	1 = Channel Fault on Channel 8 exists. 0 = No Channel Fault on Channel 8 exists.
8	1 = Channel Fault on Channel 9 exists. 0 = No Channel Fault on Channel 9 exists.
9	1 = Channel Fault on Channel 10 exists. 0 = No Channel Fault on Channel 10 exists.
10	1 = Channel Fault on Channel 11 exists. 0 = No Channel Fault on Channel 11 exists.
11	1 = Channel Fault on Channel 12 exists. 0 = No Channel Fault on Channel 12 exists.
12	1 = Channel Fault on Channel 13 exists. 0 = No Channel Fault on Channel 13 exists.
13	1 = Channel Fault on Channel 14 exists. 0 = No Channel Fault on Channel 14 exists.
14	1 = Channel Fault on Channel 15 exists. 0 = No Channel Fault on Channel 15 exists.
15	1 = Channel Fault on Channel 16 exists. 0 = No Channel Fault on Channel 16 exists.

25.12 Mask Register (HDTI)

Write/read Register #14 (E in Hex) The Mask register can be written on a per point basis to prevent an unused channel from reporting a fault. A read of a masked channel will report attention status. This register can be read back as well. The initial power up state is 0xFFFF. Bit definitions in this register are listed in the following table.

Mask Register

BIT	DESCRIPTION
0	1 = Channel 1 is used. 0 = Channel 1 is not used.
1	1 = Channel 2 is used. 0 = Channel 2 is not used.
2	1 = Channel 3 is used. 0 = Channel 3 is not used.
3	1 = Channel 4 is used. 0 = Channel 4 is not used.
4	1 = Channel 5 is used. 0 = Channel 5 is not used.
5	1 = Channel 6 is used. 0 = Channel 6 is not used.
6	1 = Channel 7 is used. 0 = Channel 7 is not used.
7	1 = Channel 8 is used. 0 = Channel 8 is not used.
8	1 = Channel 9 is used. 0 = Channel 9 is not used.
9	1 = Channel 10 is used. 0 = Channel 10 is not used.
10	1 = Channel 11 is used. 0 = Channel 11 is not used.
11	1 = Channel 12 is used. 0 = Channel 12 is not used.
12	1 = Channel 13 is used. 0 = Channel 13 is not used.
13	1 = Channel 14 is used. 0 = Channel 14 is not used.
14	1 = Channel 15 is used. 0 = Channel 15 is not used.

BIT	DESCRIPTION
15	1 = Channel 16 is used. 0 = Channel 16 is not used.

25.13 Configuration/Status Register information (HDTI)

Register 13 (0xD) is used for both module configuration and module status. The Module Status Register has both, status and diagnostic information. Bit information contained within these words is shown in the following table.

Note: Configuration changes are reflected in the status register only after the action required by the configuration change has been processed by the hardware. An example would be a range change or range initialization.

These status words are only updated once per input channel sampling period, therefore, any Controller action based on changing the configuration (writing to register 13) must take this delay into account.

Data format for the Configuration / Module Status Register

BITS	DESCRIPTION CONFIGURATION REGISTER (WRITE)	DESCRIPTION MODULE STATUS REGISTER (READ)
0	1 = Configure Module 0 = Unconfigured module, causing an attention status.	1 = Configured 0 = Not configured
1	1 = Force an attention status to be read by the Controller. 0 = No forced error	1 = Forced error set by the Controller. 0 = No forced error.
2	Not defined.	0 = (Reserved for factory test).
3	Not defined.	0 = (Reserved for factory test).
4	Not defined.	0 = (Reserved for factory test).
5	Not defined.	Warm up.
6	Not defined.	1 = Not calibrated. 0 = Calibrated.
7	mV Range 0**	mV Range 0.
8	mV Range 1**	mV Range 1.
9	Not defined.	Always 1.
10	Do not set. 0 = (Reserved for factory test).	0 = (Reserved for factory test).
11	Do not set. 0 = (Reserved for factory test).	0 = (Reserved for factory test).
12	Not defined.	0 = (Reserved for factory test).
13	Not defined.	0 = (Reserved for factory test).

BITS	DESCRIPTION CONFIGURATION REGISTER (WRITE)	DESCRIPTION MODULE STATUS REGISTER (READ)
14	Do not set. 0 = (Reserved for factory test).	0 = (Reserved for factory test).
15	Not defined.	1 = A/D conversion fault detected. 0 = NO A/D conversion faults.
**Bits 7 and 8 = 00 -> 20mV = 01 -> 50mV = 10 -> 100mV = 11 -> unused		
Note: Changing the range will result in a reconfiguration of the A/D converter. This process takes about 2 seconds. During this time, the analog channels will hold their last value. An un-calibrated module defaults to the unused range (11). A calibrated module defaults to the 20 mV range (00). Initial status for an un-calibrated module - 0x3C0. Initial status for a calibrated module - 0x200. Configuration/Status bits in bold are for factory calibration only. During online operation, factory calibration configuration bits should be set to 0 and status bits will be read as 0.		

Configuration/Status Register bit definitions:

Bit 0: Configures the module (write) or indicates the configuration state of the module (read). A "1" indicates that the module is configured. Note that until the module is configured, reading from addresses #0 through #11 (B in Hex) will produce an attention status.

Bit 1: (write "1") Forces the module into the error state, resulting in the error LED being lit. The read of bit "1" indicates that there is an internal module error, or the controller has forced the module into the error state. The state of this bit is always reflected by the module's Internal Error LED. Whenever this bit is set, an attention status is returned to the controller when addresses #0 through #11 (B in Hex) are read.

Bits 2 , 3 and 4: (Reserved for factory test).

Bit 5: Set for about 8 seconds during power up. The module will return "no response" status during this time.

Bit 6: Used for calibration status.

Bits 7 and 8: These bits configure the voltage input range for the module

Bit 9: Always 1

Bit 10: (Reserved for factory test).

Bit 11: (Reserved for factory test).

Bit 12: (Reserved for factory test).

Bit 13: (Reserved for factory test).

Bit 14: (Reserved for factory test).

Bit 15: Indicates an AD conversion fault of the module. The particular channel that has the fault will be reported in register 0xC. This bit will also be set if there is a detected error of the temperature sensor. In addition, all bits of register 0xC will be set.

25.14 Diagnostic LEDs (HDTI)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module. Lit when not timed out.
E	This LED location is not used for this module.
I (Red)	Internal Error LED. Lit whenever there is any type of error with the module except for a loss of power. Possible causes are: ▪ Module initialization is in progress. ▪ I/O Bus timeout has occurred (>1.6 seconds). ▪ Register, static RAM or FLASH checksum error. ▪ Module reset. ▪ Module is uncalibrated. ▪ Forced error has been received from the Controller. ▪ Communication between the Field and Logic boards failed.
1 - 16 (Red)	Channel error. Lit whenever there is an error associated with a channel or channels. Possible causes are: ▪ Positive overrange: Input voltage greater than +121% of full scale value (for modules configured as voltage input). ▪ Negative overrange: Input voltage less than -121% of full scale value (for modules configured as voltage input). ▪ Self calibration readings are out of range. ▪ Open Thermocouple detected.

25.15 Specifications (HDTI)

Thermocouple Input (16 Channel) specifications

DESCRIPTION	VALUE
Number of channels	16
Input signal range	±20mv, ±50mv, ±100mv
Resolution	13 bits plus sign.
Point sampling (Rate/Second)	20 - When configured for 60Hz rejection 20 - When configured for 50Hz rejection
Input Channel sample rate	50 milliseconds when configured for 50 Hz systems. 50 milliseconds when configured for 60 Hz systems.

DESCRIPTION	VALUE
Input Channel setting time to a Full Scale Step	50.822 msec worst case.
Continuous	An over voltage of $\pm 120\text{Vdc}$ or 120VAC RMS (50/60 Hz) will not damage the input channels. Sustained over range input can affect subsequent readings for several minutes following its removal.
Input Peak (AC) Voltage	For specified accuracy and normal mode rejection, the peak-to-peak AC component of the input signal is not to exceed 50% of the full-scale value for both Groups.
Dielectric Withstand Voltage	Maximum $\pm 1000\text{ VDC}$ for one minute, channel to channel, and channel to logic.
Temperature coefficient	$\pm 0.24\%$ +/- $24\mu\text{V}$ of the full scale value over 0 to 60°C . - When configured for 50 or 60 cycle rejection. Note: Temperature characteristics of the channels are determined mainly by the characteristics of the voltage reference IC.
Bus Communication Timer	Occurs after a nominal 1.6 seconds. The Communication OK LED turns OFF and the Internal Error LED turns ON.
Open Thermocouple Detection	Included
Output Code	13-bits plus sign (two's complement) plus an error indicator bit (IMOK).
Point Quality	Set to 1 for good quality. Point quality for an individual channel is reflected in bit 15. Bad quality is the result of the following conditions: Input ranges - When an over range input of $\pm 121\%$ of the full-scale value is read. When the thermocouple is open.
Normal Mode Rejection	60 dB (typical) @ $50\text{Hz} \pm 1\text{Hz}$ (The Module must be configured for the proper frequency) 60 dB (typical) @ $60\text{Hz} \pm 1\text{Hz}$ (The Module must be configured for the proper frequency)
Common Mode Rejection	120 dB @DC and at the nominal (50/60 Hz) power line frequency $\pm 1/2\%$, and its harmonics (The Module must be configured for the proper frequency.) 100 dB @DC and at the nominal (50/60 Hz) power line frequency $\pm 5\%$, and its harmonics (The Module must be configured for the proper frequency.)
Input impedance	3.3 M ohms, 70 k ohms in overload or power-down conditions.
Diagnostics	Internal module operating faults. Open thermocouple detection circuit.

DESCRIPTION	VALUE
Power Requirements	Power supply voltage: Primary and optional Backup: ▪ Minimum 21.0V ▪ Nominal 24.0V ▪ Maximum 25.0V Current: ▪ 0.1A Nominal ▪ 0.125A Maximum
Temperature Sensor	The field interface board provides a temperature input as and additional channel with the following specifications: ▪ Temperature Range: -55°C to 125°C ▪ Sampling Rate: 750 msec maximum ▪ Resolution: +/- 1/2°C ▪ Accuracy: +/- 1/2°C over - 10°C to +/- 85°C range. ▪ Output Code: 8 bit, two's complement, plus sign with error indication.
Operating temperature range	0 to 60°C (32°F to 140°F).
Storage temperature range	-40°C to 85°C (-40°F to 185°F).
Temperature stability	Maximum change +/- 10°C per hour of operation.
Humidity (non-condensing)	0 to 95% with a maximum wet bulb temperature not over 35°C (95°F)
Vibration	Will withstand a 0.15mm displacement from 10 to 57 Hz and 2 G's from 57 to 500 Hz, per IEC 68-2-6, when attached to a DIN rail in the typical vertical and horizontal configurations.
Shock	Will remain operational and reliable after being subjected to testing defined in IEC 68-2-27 over the following curve: 15 G's for 11mSec and ½ sine wave.

SECTION 26

DC Digital Output module 24V (32 Channel)

IN THIS SECTION

<i>32 Channel 24 VDC Digital Output module overview</i>	<i>450</i>
<i>Electronics modules (Emod) - 32 Channel 24V DC Digital Output</i>	<i>450</i>
<i>Personality modules (Pmod) - 32 Channel 24V DC Digital Output</i>	<i>450</i>
<i>Valid module combinations - 32 Channel 24V DC Digital Output</i>	<i>450</i>
<i>Terminal block wiring information - 32 Channel 24V DC Digital Output</i>	<i>451</i>
<i>Field connection wiring diagram - 32 Channel 24V DC Digital Output</i>	<i>452</i>
<i>Configuration/Status Register information - 32 Channel 24V DC Digital Output</i>	<i>452</i>
<i>Diagnostics - 32 Channel 24V DC Digital Output</i>	<i>455</i>
<i>Specifications - 32 Channel 24V DC Digital Output</i>	<i>455</i>

26.1 32 Channel 24 VDC Digital Output module overview

The Ovation 32 Channel 24 VDC Digital Output module contains 32 24-volt single-ended digital output channels. Each digital output channel is capable of sourcing up to 500 mA of output current with a 2A maximum total output current limit per module.

Note: The Ovation 32 Channel 24 VDC Digital Output module is only available for Ovation software releases 3.4 and later.

The digital output module switches high-side 24 VDC power to 32 external loads. Switched power for all 32 digital output channels is derived from the Ovation 24 VDC Auxiliary Power Supply. All 32 digital output channels share a common return with the Auxiliary 24 VDC power supply.

Note: The 32 Channel 24 VDC Digital Output requires the use of an Ovation 4-slot I/O base (5X00497G01) which provides additional wire terminations to support the 32 channels. The 32 Channel 24 VDC Digital Output cannot be used with the standard I/O Bases (1B30035H01, 1X00014H01, or 5X00334G01).

The I/O Module General Information (see page 17) section contains environmental, installation, wiring, and fuse information for I/O modules.

26.2 Electronics modules (Emod) - 32 Channel 24V DC Digital Output

5X00500G01 - provides 32 Channels of 24V DC High-Side single-ended Digital Output switching

26.3 Personality modules (Pmod) - 32 Channel 24V DC Digital Output

1X00691H01 - The 32 Channel 24V DC single-ended Digital Output module does not require a Pmod for any electrical connections to field terminals. A cavity insert is used in the Pmod location to cover the unused Pmod connector and provide terminal wiring information.

26.4 Valid module combinations - 32 Channel 24V DC Digital Output

32 Channel 24V DC Digital Output valid module combinations

DESCRIPTION	CHANNELS	ELECTRONICS MODULE OR PANEL KIT	PERSONALITY MODULE
32 Channel 24V DC High-Side, single-ended Digital Output	32	5X00500G01	1X00691H01
This module configuration is CE Mark certified.			

Note: The 32 Channel 24V DC single-ended Digital Output requires the use of an Ovation 4-slot I/O Base (5X00497G01) which provides additional wire terminations to support the 32 channels.

The 32 Channel 24V DC single-ended Digital Output cannot be used with the standard I/O Bases (1B30035H01, 1X00014H01, or 5X00334G01).

26.5 Terminal block wiring information - 32 Channel 24V DC Digital Output

The terminal block wiring diagram for the 32 Channel 24V DC single-ended Digital Output module is illustrated in the following figure. The following table lists and defines abbreviations used in the diagram.

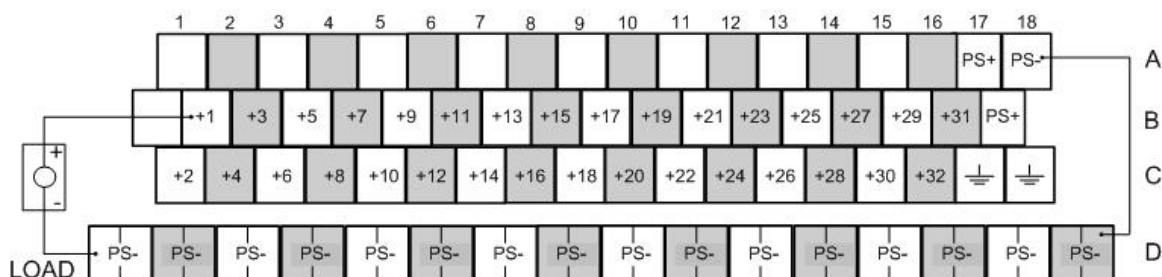


Figure 105: Terminal block connections for the 32 Channel single-ended Digital Output module

Abbreviations used in wiring diagrams

ABBREVIATION	DEFINITION
	Earth ground terminals.
+1 through +32	Digital Output Positive terminal connection
PS-	Auxiliary 24V DC Power Supply Return. All PS- terminals are tied together internally on the Digital Output module/base. Two (2) terminal connections per terminal strip screw are used to support 32 channels.
PS+ / PS-	Auxiliary 24V DC Power Supply Terminals. No external connections are required when using Ovation +24V DC Auxiliary Power Supply. Ovation Aux Supply provided to module through branch.
	Reserved terminal. No connection allowed on these unmarked terminals.
+24V DC Auxiliary power enters module through an internal branch connection or terminal block connection (PS+/PS-). Power is fused on the module then delivered to each channel's power switch. The high-side power is switched to each channels' positive output terminal (+1 through +32) for connection to the field device positive terminal. Each field device return signal is tied to the PS- connection on the base terminal strip. All PS- connections are tied together at the base terminal strip and connected to PS- of the Auxiliary Power Supply.	

26.6 Field connection wiring diagram - 32 Channel 24V DC Digital Output

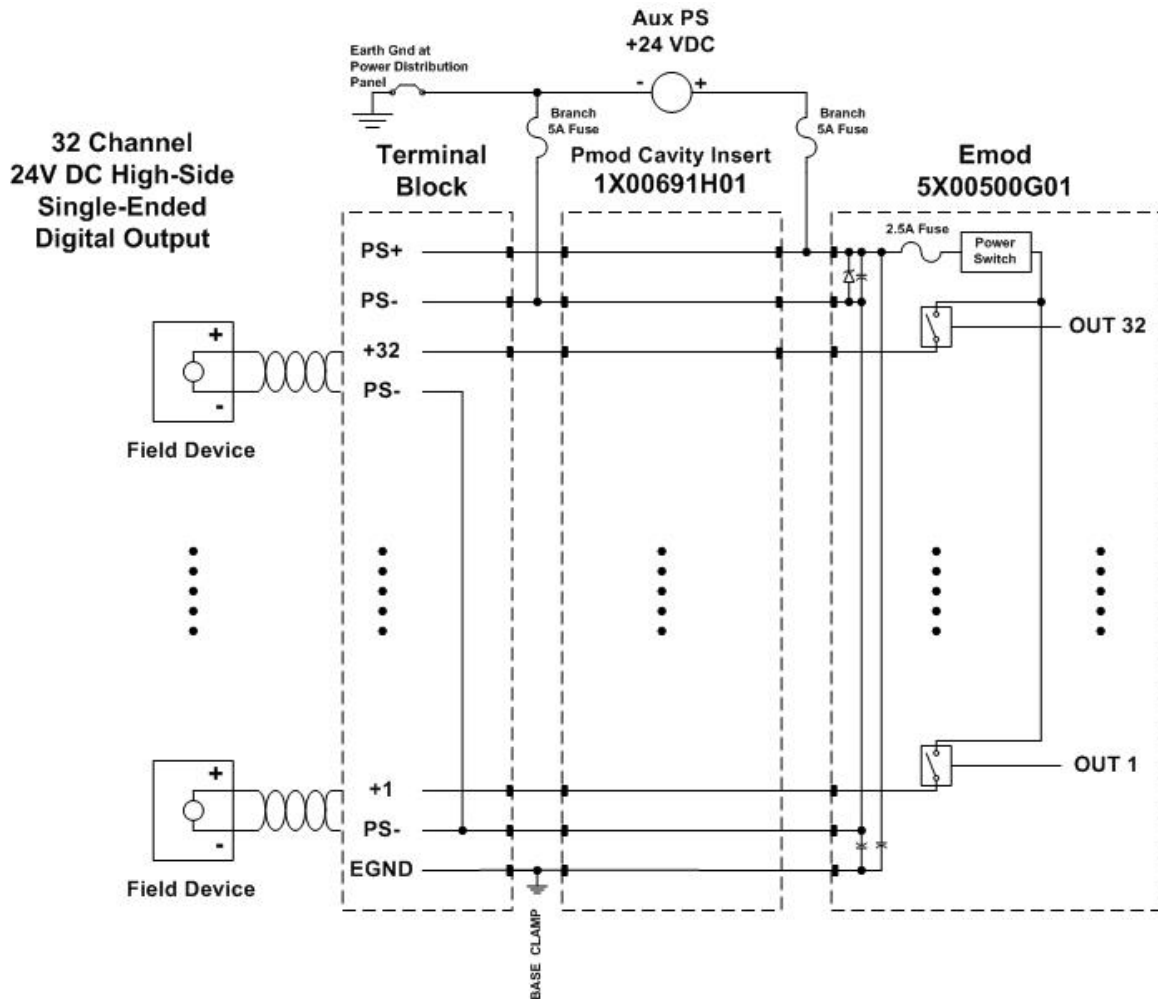


Figure 106: Wiring diagram - 32 Channel 24V DC single-ended Digital Output module

26.7 Configuration/Status Register information - 32 Channel 24V DC Digital Output

The Module Configuration / Status Register is module I/O register 13 (0xD) and is a write register.

32 Channel single-ended Digital Output Configuration/Status (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
0	1 = configured 0 = not configured	1 = configured* 0 = not configured
1	1 = forced error 0 = no forced error	1 = forced error set by Controller 0 = no forced error*
2 - 4	Timer Bit 0 - 2	Timer Bit 0 - 2

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)
5	1 = Hold Outputs on Timeout 0 = Reset Outputs on Timeout	1 = Outputs held on Timeout 0 = Outputs reset on Timeout
6	Not defined	Not defined. 0 = permanent value
7	Not defined	1 = Blown fuse detected 0 = Fuse OK*
8 - 14	Not defined	Not defined. 0 = permanent value
15	Not defined	1 = Channel fault exists (see registers 0xB and 0xC for fault) 0 = No channel faults exist
* Default value		

26.7.1 Channel Status Register - 32 Channel 24V DC Digital Output

Word addresses 11 (0xB in Hex) and 12 (0xC in Hex) are used to report fault status of the individual digital output channels. A reported fault may indicate channel short-circuit, overload condition, or switch IC case temperature above limit.

Channel Status Register (Address 11 - 0xB in Hex)

BIT	DESCRIPTION (READ ONLY)
0	1 = Channel 1 Fault Exists 0 = No Fault Reported on Channel 1
1	1 = Channel 2 Fault Exists 0 = No Fault Reported on Channel 2
2	1 = Channel 3 Fault Exists 0 = No Fault Reported on Channel 3
3	1 = Channel 4 Fault Exists 0 = No Fault Reported on Channel 4
4	1 = Channel 5 Fault Exists 0 = No Fault Reported on Channel 5
5	1 = Channel 6 Fault Exists 0 = No Fault Reported on Channel 6
6	1 = Channel 7 Fault Exists 0 = No Fault Reported on Channel 7
7	1 = Channel 8 Fault Exists 0 = No Fault Reported on Channel 8
8	1 = Channel 9 Fault Exists 0 = No Fault Reported on Channel 9
9	1 = Channel 10 Fault Exists 0 = No Fault Reported on Channel 10
10	1 = Channel 11 Fault Exists 0 = No Fault Reported on Channel 11
11	1 = Channel 12 Fault Exists 0 = No Fault Reported on Channel 12

BIT	DESCRIPTION (READ ONLY)
12	1 = Channel 13 Fault Exists 0 = No Fault Reported on Channel 13
13	1 = Channel 14 Fault Exists 0 = No Fault Reported on Channel 14
14	1 = Channel 15 Fault Exists 0 = No Fault Reported on Channel 15
15	1 = Channel 16 Fault Exists 0 = No Fault Reported on Channel 16

Channel Status Register (Address 12 - 0xC in Hex)

BIT	DESCRIPTION (READ ONLY)
0	1 = Channel 17 Fault Exists 0 = No Fault Reported on Channel 17
1	1 = Channel 18 Fault Exists 0 = No Fault Reported on Channel 18
2	1 = Channel 19 Fault Exists 0 = No Fault Reported on Channel 19
3	1 = Channel 20 Fault Exists 0 = No Fault Reported on Channel 20
4	1 = Channel 21 Fault Exists 0 = No Fault Reported on Channel 21
5	1 = Channel 22 Fault Exists 0 = No Fault Reported on Channel 22
6	1 = Channel 23 Fault Exists 0 = No Fault Reported on Channel 23
7	1 = Channel 24 Fault Exists 0 = No Fault Reported on Channel 24
8	1 = Channel 25 Fault Exists 0 = No Fault Reported on Channel 25
9	1 = Channel 26 Fault Exists 0 = No Fault Reported on Channel 26
10	1 = Channel 27 Fault Exists 0 = No Fault Reported on Channel 27
11	1 = Channel 28 Fault Exists 0 = No Fault Reported on Channel 28
12	1 = Channel 29 Fault Exists 0 = No Fault Reported on Channel 29
13	1 = Channel 30 Fault Exists 0 = No Fault Reported on Channel 30
14	1 = Channel 31 Fault Exists 0 = No Fault Reported on Channel 31
15	1 = Channel 32 Fault Exists 0 = No Fault Reported on Channel 32

26.8 Diagnostics - 32 Channel 24V DC Digital Output

Diagnostic logic card LED's indications

LED	DESCRIPTION
P (green)	The Power OK LED is lit when the module main power is OK.
C (green)	The Communication OK LED is lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED is lit to indicate Auxiliary 24V DC field power is not present, is below threshold, or the Auxiliary 24V DC fuse is blown.
I (Red)	The Internal Fault LED is lit under the following conditions: ▪ The Force Error bit (Bit-1) of the Configuration Register is set. ▪ The Ovation Controller is not communicating with the module. ▪ A Channel Fault exists.
1 - 32 (Green)	Each of the 32 channel LEDs represent the states of the Channel 1 through Channel 32 power switches.

Note: 24V Auxiliary Fuse Rating: 2.5A, 250V Fast-acting Fuse 5X20 mm

26.9 Specifications - 32 Channel 24V DC Digital Output

32 Channel 24V DC single-ended Digital Output module specifications

DESCRIPTION	VALUE																																				
Number of channels	32																																				
Output Type	IEC 61131-2 - protected output current sourcing DC output																																				
Output Current per Channel Output Short Circuit to Supply Common Current Limit	500 mA Max, but not more than 2A maximum for total 32 channels. 1.2 typ - 1.7A max per channel																																				
Maximum On Voltage	20V																																				
Maximum Off Leakage Current	5uA per channel																																				
Output Delay Time	29.2us Typ, 40us Max (Off to On) - no load 336us Typ, 400us Max (On to Off) - no load																																				
Bus I/O Communications Watchdog Timer	<table><tr><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Time Out Period</td></tr><tr><td>0</td><td>0</td><td>0</td><td>16.777 seconds +/- 10%</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4.194 seconds +/- 10%</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2.097 seconds +/- 10%</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1.049 seconds +/- 10%</td></tr><tr><td>1</td><td>0</td><td>0</td><td>524 milliseconds +/- 10%</td></tr><tr><td>1</td><td>0</td><td>1</td><td>262 milliseconds +/- 10%</td></tr><tr><td>1</td><td>1</td><td>0</td><td>131 milliseconds +/- 10%</td></tr><tr><td>1</td><td>1</td><td>1</td><td>65 milliseconds +/- 10%</td></tr></table>	Bit 4	Bit 3	Bit 2	Time Out Period	0	0	0	16.777 seconds +/- 10%	0	0	1	4.194 seconds +/- 10%	0	1	0	2.097 seconds +/- 10%	0	1	1	1.049 seconds +/- 10%	1	0	0	524 milliseconds +/- 10%	1	0	1	262 milliseconds +/- 10%	1	1	0	131 milliseconds +/- 10%	1	1	1	65 milliseconds +/- 10%
Bit 4	Bit 3	Bit 2	Time Out Period																																		
0	0	0	16.777 seconds +/- 10%																																		
0	0	1	4.194 seconds +/- 10%																																		
0	1	0	2.097 seconds +/- 10%																																		
0	1	1	1.049 seconds +/- 10%																																		
1	0	0	524 milliseconds +/- 10%																																		
1	0	1	262 milliseconds +/- 10%																																		
1	1	0	131 milliseconds +/- 10%																																		
1	1	1	65 milliseconds +/- 10%																																		
Diagnostics	Blown fuse detection																																				

DESCRIPTION	VALUE
Module power	Drawn from Main: 2.35W typ; 2.7W maximum (all channels on) Drawn from Auxiliary: 1.2W typ; 1.4W maximum (all channels on) 47.6W typ; 57.5W max (all channels on @ 2A limit) Power Dissipation within module: 3.53W typ; 4.05W maximum (all channels on)
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
Inductive Kick Protection	Zener Diode -14V maximum for 16.5ms with KUEP-3D15-24 relay

SECTION 27

Digital Output module (DO) (16 Channel)

IN THIS SECTION

<i>16 Channel Digital Output module overview - (DO)</i>	458
<i>Electronics modules (Emod) - (DO)</i>	458
<i>Personality modules (Pmod) - (DO)</i>	458
<i>Valid module combinations - (DO)</i>	458
<i>External power supply information - (DO)</i>	459
<i>Relay Panels - (DO)</i>	460
<i>Solid State Relay module for DIN Rail Layout (5A22410H01 / 5A22410H02) - (DO)</i>	462
<i>Solid State Relay module Terminations (5A22410H01 / 5A22410H02) - (DO)</i>	463
<i>Specifications - (LI)</i>	464
<i>G2R Style Relay module for DIN Rail Layout (5A22411H01) - (DO)</i>	468
<i>Blown Fuse Detection Circuit - (DO)</i>	469
<i>G2R Style Relay module terminations (5A22411H01) - (DO)</i>	470
<i>KUEP Style Relay module for DIN Rail Layout (5A22412G01 / 5A22412G02) - (DO)</i> ...	471
<i>KUEP (2 Form C) Relay module Terminations (5A22412G01) - (DO)</i>	472
<i>KUEP (Form X) Relay module terminations (5A22412G02) - (DO)</i>	473
<i>Terminal block wiring information - (DO)</i>	474
<i>Field connection wiring diagram - (DO)</i>	475
<i>Field connection wiring diagram (Group 1) (CE Mark) - (DO)</i>	476
<i>Wiring diagram to relay module (G2R or Solid State) locally powered - (DO)</i>	477
<i>Wiring diagram to relay module (G2R or Solid State) - (DO)</i>	478
<i>Wiring diagram to relay module (KUEP Style) locally powered (CE Mark) - (DO)</i>	479
<i>Wiring diagram to relay module (KUEP style remotely powered (CE Mark) - (DO)</i>	480
<i>Relay panel application diagrams - (DO)</i>	481
<i>Configuration/Status Register information - (DO)</i>	484
<i>Diagnostic Logic card LEDs - (DO)</i>	485
<i>Specifications - (DO)</i>	486

27.1 16 Channel Digital Output module overview - (DO)

The Ovation Digital Output module provides a means to switch up to 60 VDC at moderate currents (for example, relay coils and lamps). The Digital Output module contains 16 current sinking transistor outputs capable of switching 60 VDC loads at up to 500mA.

The Digital Output module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Digital Output module is a CE Mark certified module.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

27.2 Electronics modules (Emod) - (DO)

- **1C31122G01** provides for switching 60 VDC loads.

27.3 Personality modules (Pmod) - (DO)

- **1C31125G01** is used to interface the digital output module to the field through the terminal blocks.
- **1C31125G02** is used to interface the digital output module to the relay modules when power is supplied locally (from the I/O backplane auxiliary power supply). It can also be used to interface the digital output module to the field through the terminal blocks.
- **1C31125G03** is used to interface the digital output module to the relay modules when power is supplied remotely (from the relay modules). It can also be used to interface the digital output module to the field through the terminal blocks.

CAUTION: When 1C31125G03 is used, the returns for the remote power supply and the local power supply are connected together. Therefore, to avoid problems with differences in earth ground potentials, ensure that the power supply return lines are earth grounded at only ONE point.

27.4 Valid module combinations - (DO)

Digital Output valid module combinations ¹

DESCRIPTION ¹	CHANNELS	ELECTRONICS MODULE OR PANEL KIT	PERSONALITY MODULE
5-60 VDC Single-ended Direct	16	1C31122G01	1C31125G01
Relay Panel Interface:			
Local Power Supply	16	1C31122G01	1C31125G02
Field Power Supply	16	1C31122G01	1C31125G03
Relay Panels: Solid State Relay Panel (AC)	16	5A22410G01	
Solid State Relay Panel (DC)	16	5A22410G02	
G2R Relay Panel (Low Power Electro-mechanical)	16	5A22411G01	
KU Relay Panel ² (High Power Electro-mechanical)	16	5A22412G01 - G03	
¹ All configurations listed in the table are CE Mark certified, unless they use AC/DC solid state relay panels.			
² Two panels (8 relays each) are included in the KU Relay Panel kit 5A22412G01, G02, and G03.			

27.5 External power supply information - (DO)

The Digital Output module may obtain voltage from the internal auxiliary power supply (backplane) or from an external power supply.

If an external power supply is used, *Using an External Power Supply* (see page 635) contains steps to be undertaken before connecting the external power supply to the Digital Output module base unit terminal block. The external power supply DC output voltage level depends on the Digital Output module application.

27.6 Relay Panels - (DO)

Relay panels are used to switch high currents and high voltages as required by various field devices. The Digital Output module interfaces to the relay modules through Groups 2 and 3 of the Personality modules and a standard cable.

The following table provides information about the three standard relay modules.

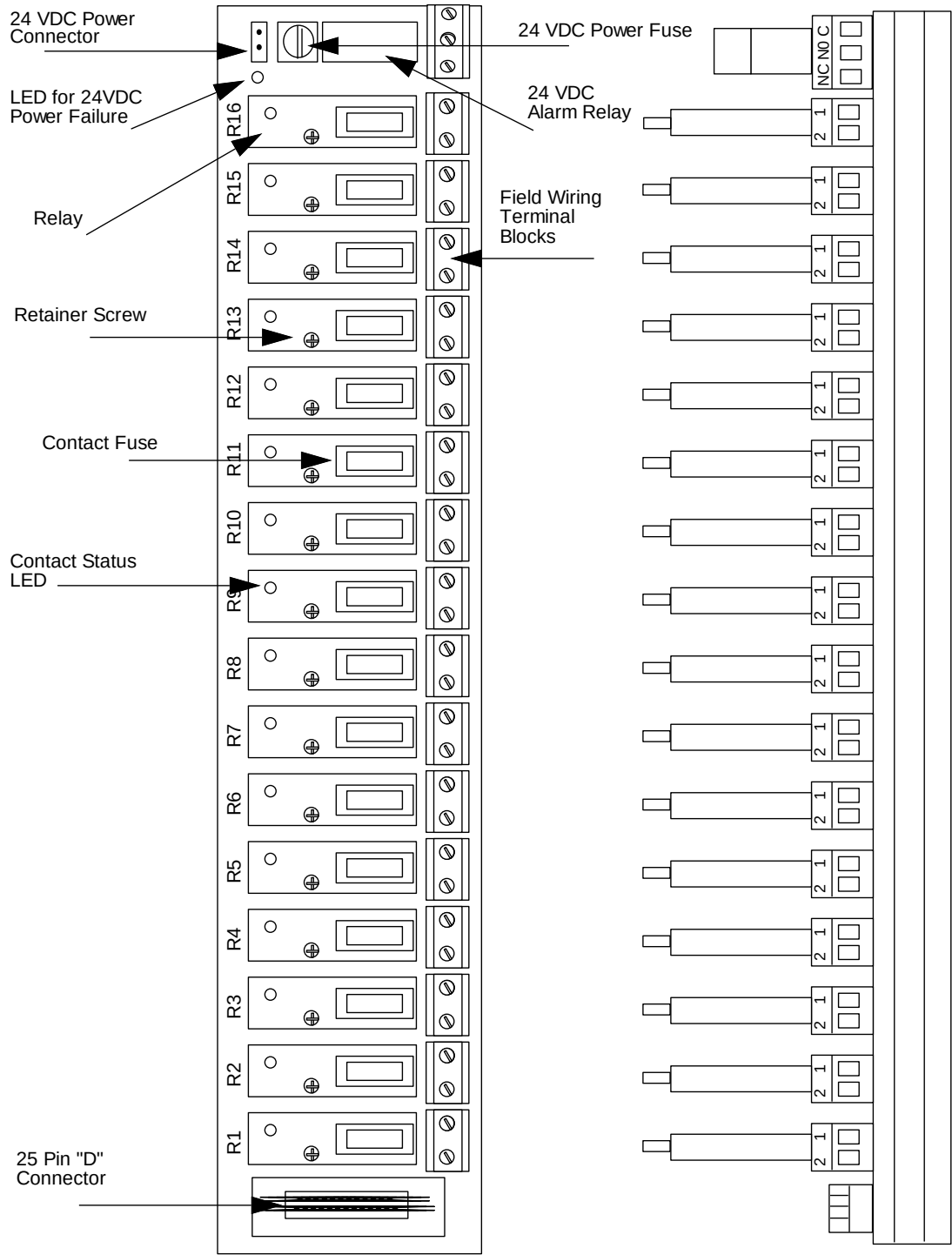
Relay contact ratings must be adhered to when utilizing the Digital Output Relay Panel assemblies. The application must include external current limiting protection for the Digital Output Relay Panel assemblies.

Digital Output relay panels

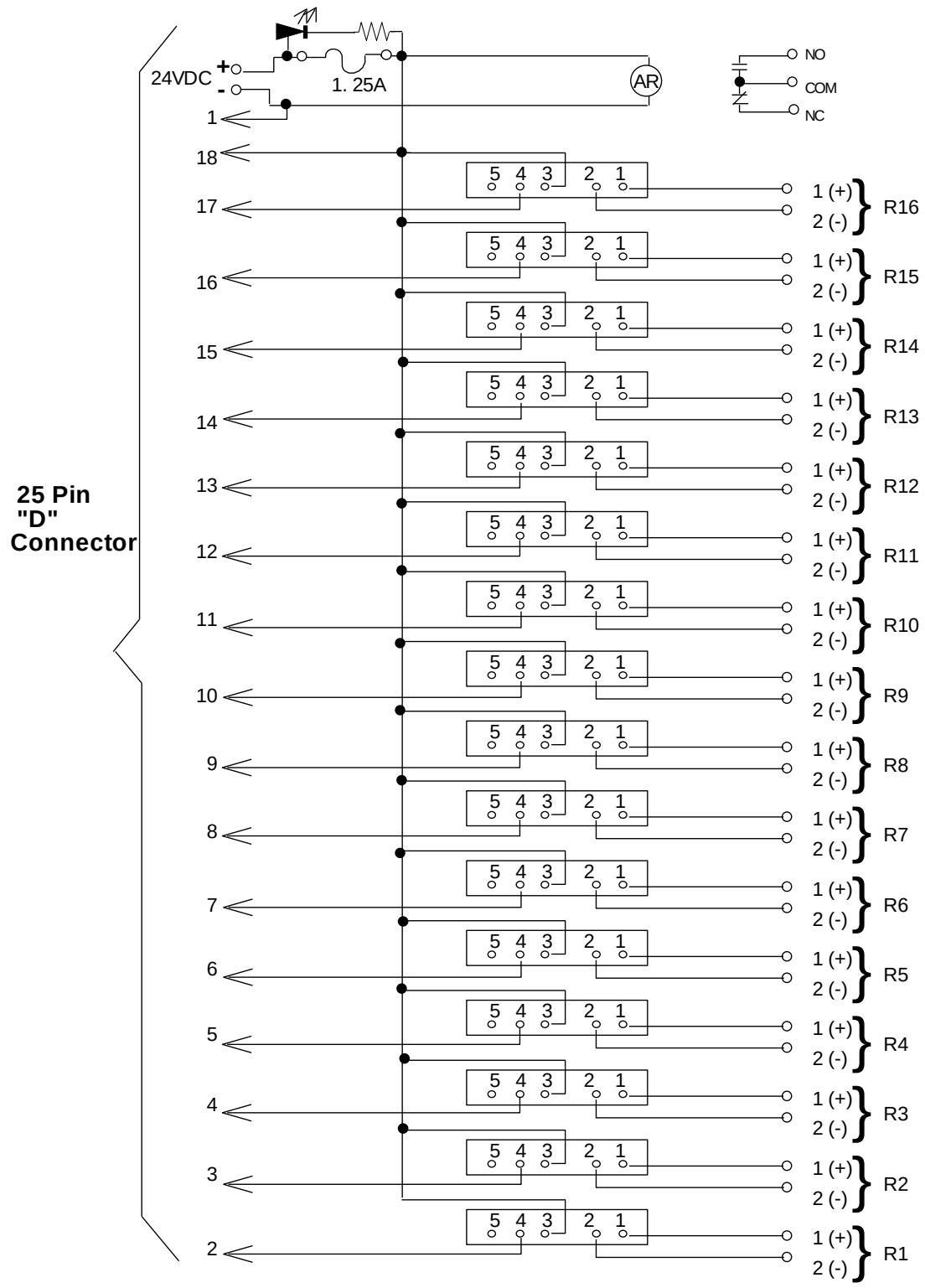
RELAY MODULE	CE Mk	SIZE	CHANNELS	CONTACT TYPE	CONTACT RATING	INPUT POWER	CONNECT CABLE
5A22410G01 Solid State	No	35.86 cm L (14.12 in) 7.75 cm W (3.05 in) 10.46 cm H (4.12 in)	16	Solid State (1 normally open)	3.5 amps @250 VAC at 25 °C 1.65 amps @250 VAC at 60 °C	246mA typ 310mA Max @26.4V	5A26148
5A22410G02 Solid State	No	35.86 cm L (14.12 in) 7.75 cm W (3.05 in) 10.46 cm H (4.12 in)	16	Solid State (1 normally open)	1.0 amps @200 VDC at 60 °C	246mA typ 310mA Max @26.4V	5A26148
5A22411G01 G2R Style (Low Power Electro- mechanical)	Yes	45.09 cm L (17.75 in) 7.75 cm W (3.05 in) 6.05 cm H (2.38 in)	16	Mechanical (1 Form C)	10 amps @250 VAC 10 amps @30 VDC	453mA typ 610mA Max @26.4V	5A26148
5A22412G01 ¹ KUEP Style (High Power Electro- mechanical) Contains two 5A22412H01 panels and 16 4960A71H16 relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Mechanical (2 Form C)	10 amps @240 VAC, PF = 0.8 3 amps @150 VDC	1.32A typ 1.8A Max @26.4V (for 2 relay panels) ²	5A26149

RELAY MODULE	CE Mk	SIZE	CHANNELS	CONTACT TYPE	CONTACT RATING	INPUT POWER	CONNECT CABLE
5A22412G02 ¹ KUEP Style (High Power Electro-mechanical) Contains two 5A22412H01 panels and 16 4960A71H05 relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Mechanical (Form X)	10 amps @240 VAC, PF = 0.8 10 amps @150 VDC	940mA typ 1.27A Max @26.4V (for 2 relay panels) ²	5A26149
5A22412G03 ¹ KUEP Style (High Power Electro-mechanical) Contains two 5A22412H01 panels and up to 16 project specific relays.	Yes	49.5 cm L (19.5 in) 7.75 cm W (3.05 in) 9.53 cm H (3.75 in)	16 (using two panels)	Project Specific	Project Specific	Project Specific	5A26149
¹ Two panels required for 16 outputs. ² If one panel is used, half the power is needed.							

27.7 Solid State Relay module for DIN Rail Layout (5A22410H01 / 5A22410H02) - (DO)



27.8 Solid State Relay module Terminations (5A22410H01 / 5A22410H02) - (DO)



27.9 Specifications - (LI)

- Electronics module (1C31174)
- Personality module (1C31177)

The following tables provide specifications for the Loop Interface module:

- General Specifications
- Analog input
- Analog output
- Digital input
- Digital output.

Loop Interface General Specifications

DESCRIPTION	VALUE
Module power	Main: 2.7 W typical; 3.5 W Maximum Aux (when used): Digital Inputs: 0.13W (24V) typical 0.27 W (48V) typical Digital Outputs: (power-dependent on loads for 2 outputs @ 100mA each) 4.8 W (24V) typical 9.6 W (48V) typical Analog Inputs: (2 inputs @ 20mA each) 0.96 W (24V) typical
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%

Loop Interface Analog Input module Specifications

DESCRIPTION	VALUE
Number of analog input points	2
Input range	0 to +10 V (G01) 0 to +5 V (G02) 4 to 20 mA (G03 - G04) AI1 and AI2 current inputs must be terminated (even if not used) to prevent point fault generation.
Resolution	13-Bits (including polarity)
Guaranteed accuracy (@25°C) ¹	±0.10% of upper range value ±10µV ±1/2LSB @99.7% confidence
Temperature coefficient	±0.24% of the upper range value ±24µV over 0 to 60°C.

DESCRIPTION	VALUE
Input impedance: 0 to 10V groups 0 to 5V groups, and 4 to 20mA groups	2 M ohm σ 1 M OHM Σ
Sampling rate	10 samples per second under normal conditions. 8 samples per second during auto calibration.
Offset and gain temperature drift compensation	Automatic
Diagnostics	Internal module operating faults. Out of range detection. Open loop/blown fuse detection for current loops.
Dielectric isolation: Channel to channel Channel to logic	1000 V AC/DC 1000 V AC/DC
Normal mode rejection	60 dB at 50 Hz $\pm$ 1/2% or 60 Hz $\pm$ 1/2% 30 dB (typical) at 50 Hz $\pm$ 5% or 60 Hz $\pm$ 5%
Common mode rejection	120 dB at DC; power line frequency and its harmonics $\pm$ 1/2% without line frequency tracking. 100 dB (typical) for nominal line frequency $\pm$ 5% and harmonics without line frequency tracking.
¹ See additional information for CE Mark certified systems.	

Loop Interface Analog Output module Specifications

DESCRIPTION	VALUE
Number of points	1 - Analog output is not present for Group 4 (electric drive) modules. AO current outputs in G03 - G04 must be terminated (even if not used) to prevent point fault generation.
Maximum update time	2 mSec
Output range	0 - 10 V@ minimum 1 K ohms load impedance (10mA Maximum load) (G01 - G02) 4 - 20 mA @ Maximum 750 Ohms load impedance (0 Ohms minimum) (G03)
Resolution	12 bits
Guaranteed accuracy (@25°C $\pm$ 1°C) ¹	$\pm$ 0.10% of span
Temperature coefficient	0 to 10 V groups: 30 ppm/°C 4 to 20mA groups: 45 ppm/°C
User loop voltage	Power for current loop output is supplied by module.
Diagnostics	Internal module operating faults ▪ Overcurrent ▪ Undercurrent
Dielectric isolation: Channel ground to channel ground Channel ground to logic ground	Maximum $\pm$ 1000 V AC/DC Maximum $\pm$ 1000 V AC/DC

DESCRIPTION	VALUE
Output loading	0 - 10 V@ minimum 1 K ohms load impedance (10mA Maximum load) 4 - 20 mA @ Maximum 750 ohms load impedance (0 ohms minimum)
¹ See additional information for CE Mark certified systems (see page 621).	

Loop Interface Digital Input module Specifications

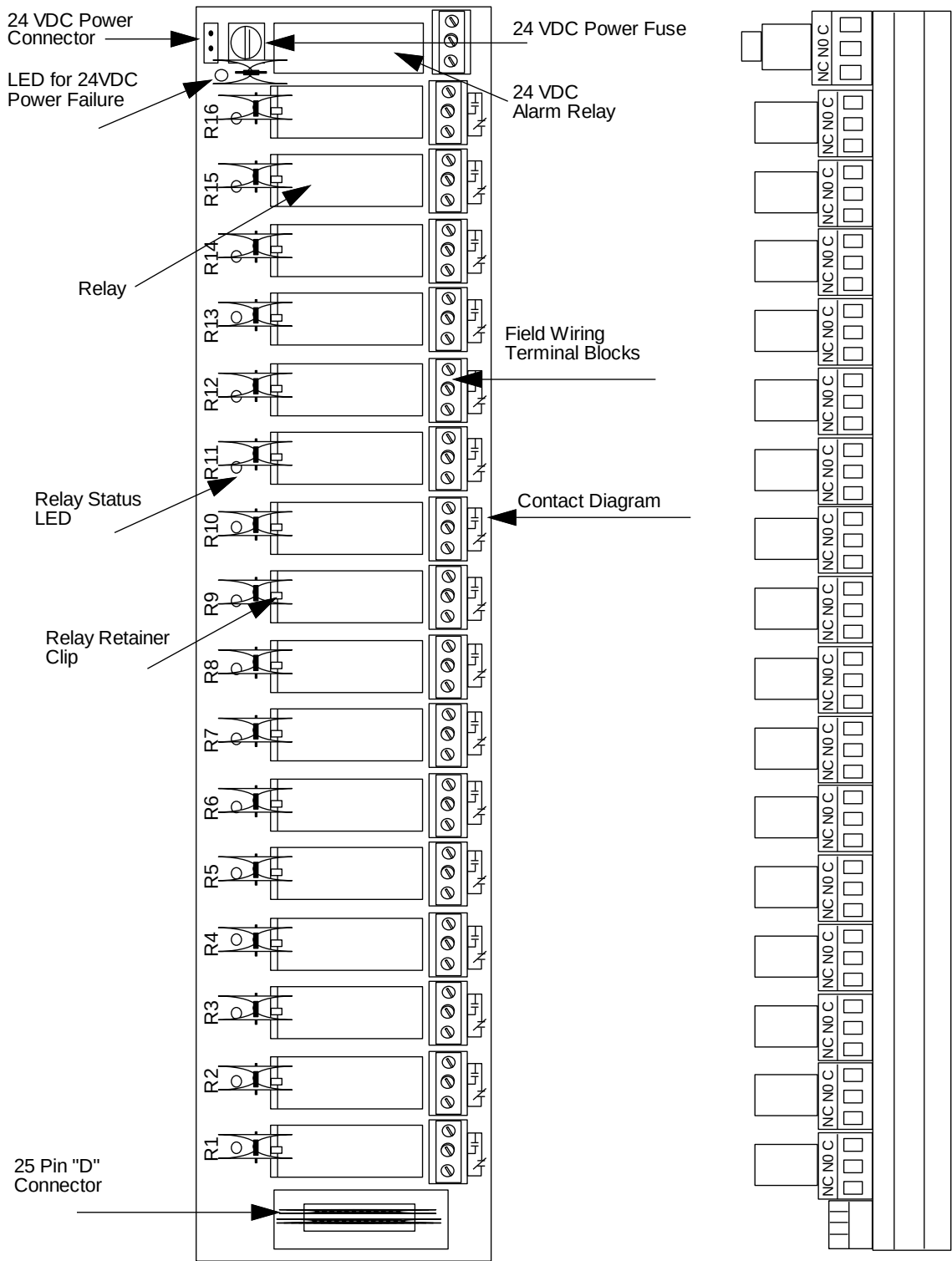
DESCRIPTION	VALUE
Number of points	Two digital inputs dedicated as priority raise and lower inputs. If priority raise and lower inputs are not desired, shorting wires should be placed across the inputs (+1 to -1 and +2 to -2) to eliminate possible false turn on from noise.
Input range	24V or 48V typ 18 -60 VDC
Propagation delay of contact change of state	1.9 mSec minimum; 35.0 mSec Maximum
Cable length (quality is 50pF/ft or better)	1000 feet Maximum
Diagnostics	Internal module operating faults ▪ Auxiliary power supply blown fuse detection (enabled/disabled) ▪ Priority raise and lower error, also referred to as runbacks, (both raise and lower active)
Dielectric isolation: Channel ground to channel ground Channel ground to logic ground	Maximum 1000V AC/DC Maximum 1000V AC/DC
External (auxiliary) power supply	If desired, the digital input auxiliary supply voltage may be the same voltage as that used for the digital outputs. This voltage is provided as an output between terminals Vf+ and V-. This fused voltage (Vf+) is monitored as an additional digital input. Input characteristics are identical to the other two digital inputs.

Loop Interface Digital Output module Specifications

DESCRIPTION	VALUE
Number of points	2
Output voltage Off voltage (Maximum) On voltage (Maximum)	5 VDC minimum, 60 VDC maximum (auxiliary power supply) 1.0 VDC @ 500mA
Output current Off current (Maximum) On current for individual output (Maximum) On current for two outputs combined (Maximum)	25μA @ Tamb = 25°C, VDS = 60 VDC 250μA @ Tamb = 60°C, VDS = 60 VDC 500 mA 880 mA limited by fuse rating

DESCRIPTION	VALUE
External (auxiliary) supply voltage	Voltage = 5 VDC minimum, 60 VDC Maximum The return line and auxiliary power supply voltage is common to both points but is galvanically isolated from logic ground. This auxiliary supply voltage originates from the terminal block (on inputs V+ and V-) and is fused on the personality module. The fused voltage is distributed back out to the terminal blocks as +1, +2 for the digital outputs and Vf+ for the digital inputs. Each digital output is diode clamped to this fused auxiliary supply voltage to prevent damage from inductive load surges. The fused auxiliary supply voltage is monitored as an additional digital input. Input characteristics are identical to the digital inputs.
Diagnostics	Internal module operation faults Auxiliary supply blown fuse detection (enabled/disabled)
Maximum propagation time	14.5 mSec for Rload = 500W This time is comprised of the microprocessor firmware digital output update rate, which is once per loop, or approximately every 12 ms, plus the delay time for the output, which is 2.5 ms Max at Rload = 500 W.
Dielectric isolation: Channel ground to logic ground	Maximum ± 1000 V AC/DC

27.10G2R Style Relay module for DIN Rail Layout (5A22411H01) - (DO)



27.11 Blown Fuse Detection Circuit - (DO)

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it also gives a visual indication of the status via the “EXTERNAL ERROR” LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 15VDC and 60VDC, the circuit indicates that the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates that the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

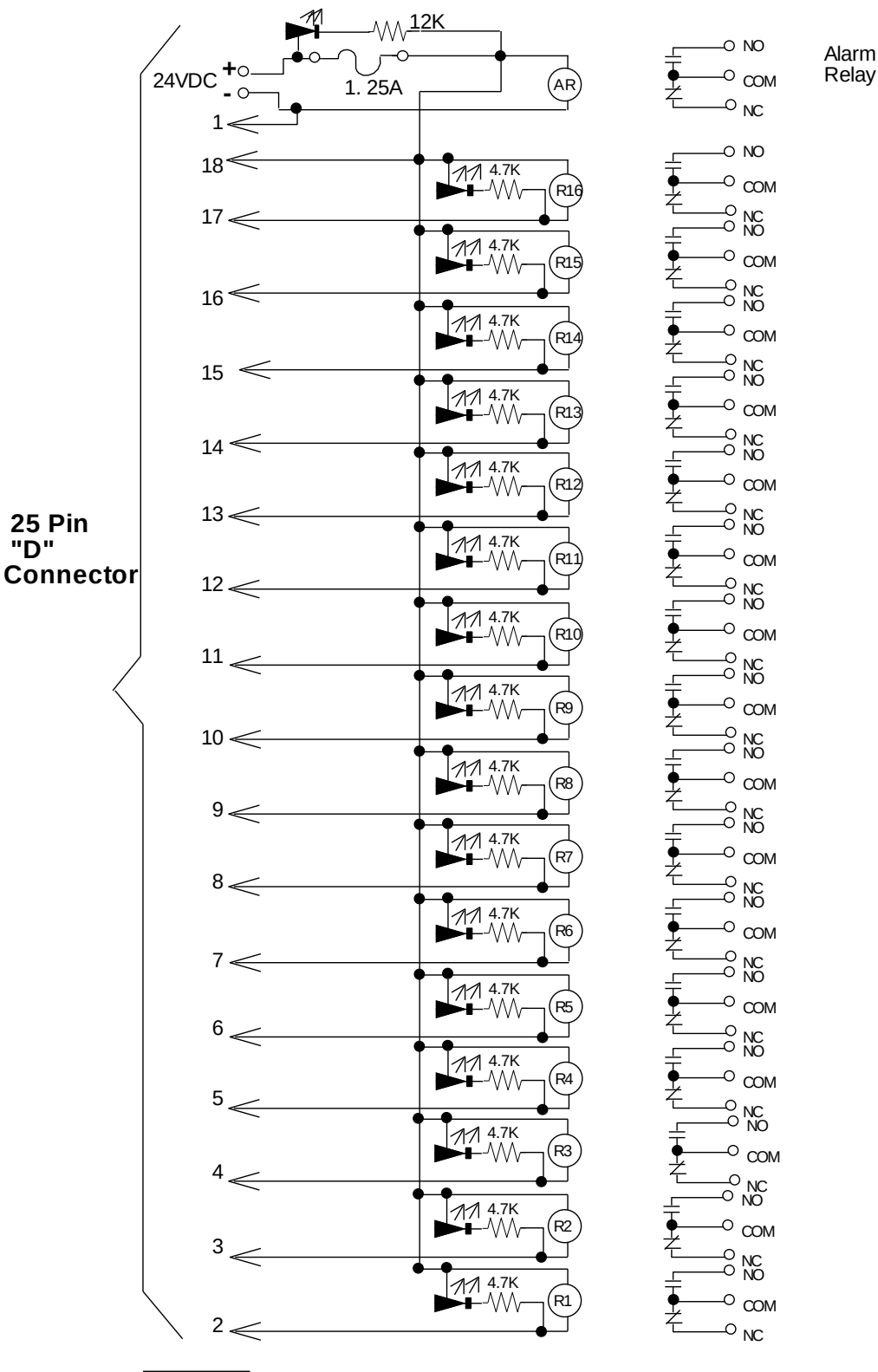
If the card is operated with a field supply voltage less than 15V, the output circuit continues to operate properly. However, the blown fuse detection may not give an accurate indication of the fuse state. In this case, the Controller has the capability to disable the detection circuit by writing a “0” to Bit 7 of the configuration register. When Bit 7 is a “0” the “EXTERNAL ERROR” LED is turned OFF and the blown fuse status bit (Bit 6 of the status register) is cleared which indicates the fuse is OK.

In summary, this feature is specified to operate as follows:

- $15\text{VDC} \leq \text{Field supply voltage} \leq 60\text{VDC}$ = Fuse is OK
- $0.4\text{VDC} < \text{Field supply voltage} < 15\text{VDC}$ = UNDEFINED
- $\text{Field supply voltage} \leq 0.4\text{VDC}$ = Fuse is blown

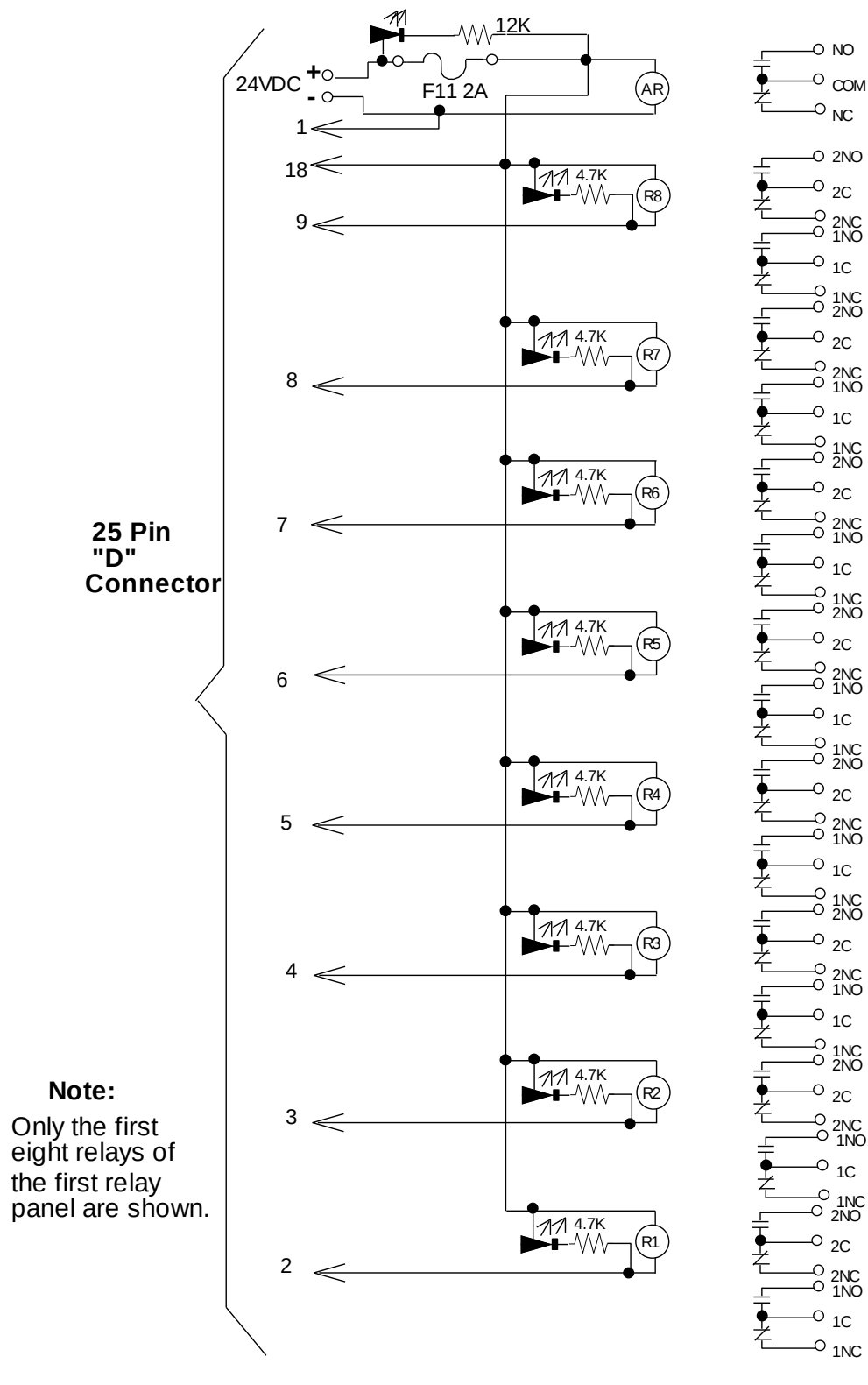
After a power-on reset the blown fuse detection circuit is disabled.

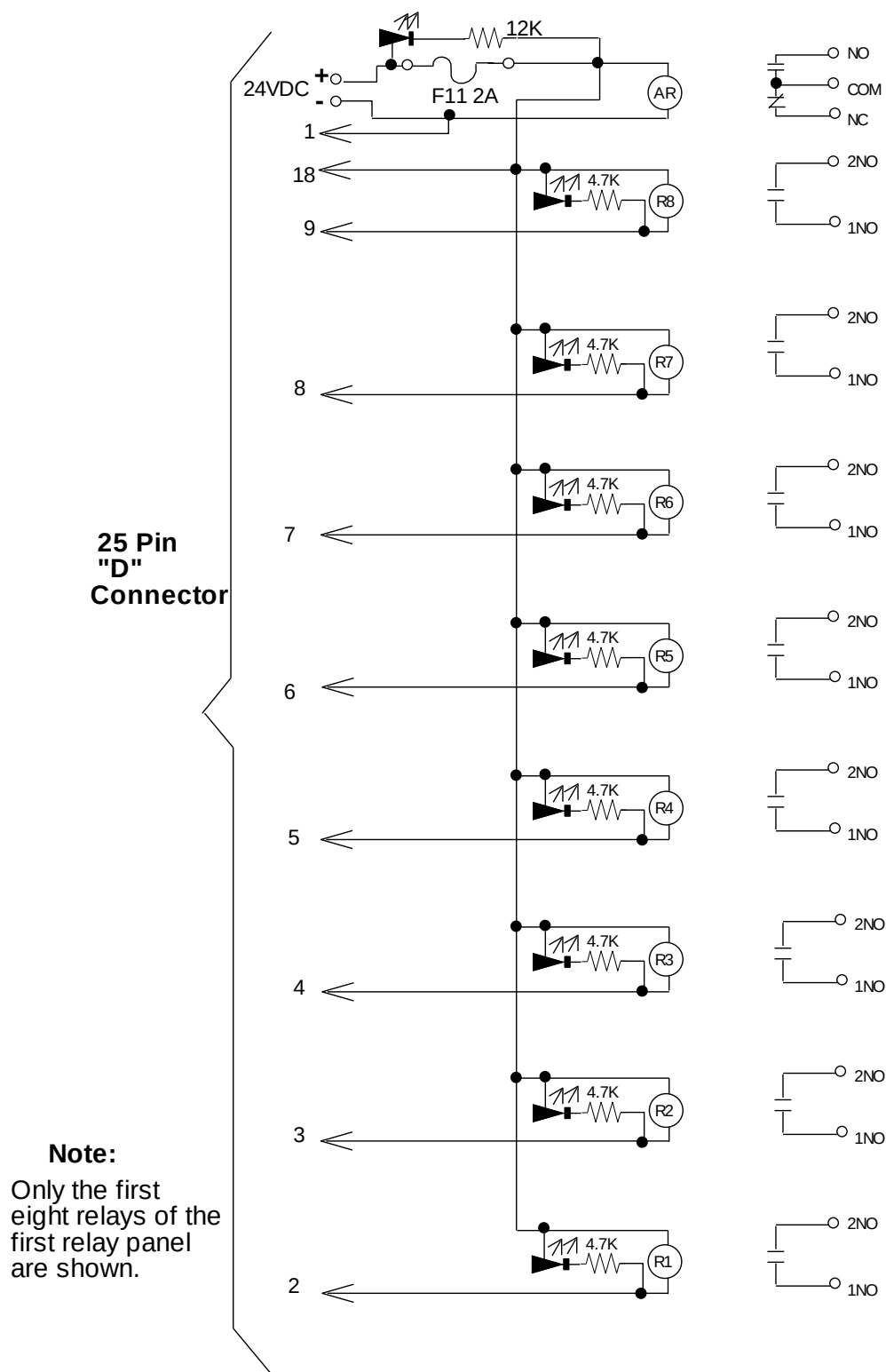
27.12 G2R Style Relay module terminations (5A22411H01) - (DO)





27.14 KUEP (2 Form C) Relay module Terminations (5A22412G01) - (DO)



27.15 KUEP (Form X) Relay module terminations (5A22412G02) - (DO)

27.16 Terminal block wiring information - (DO)

Each Personality module has a simplified wiring diagram label on its side, which appears above the terminal block. This diagram indicates how to connect the wiring from the field to the terminal block in the base unit. The diagram for the Digital Output personality module is shown in the following figure. The following table lists and defines the abbreviations used in that diagram.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

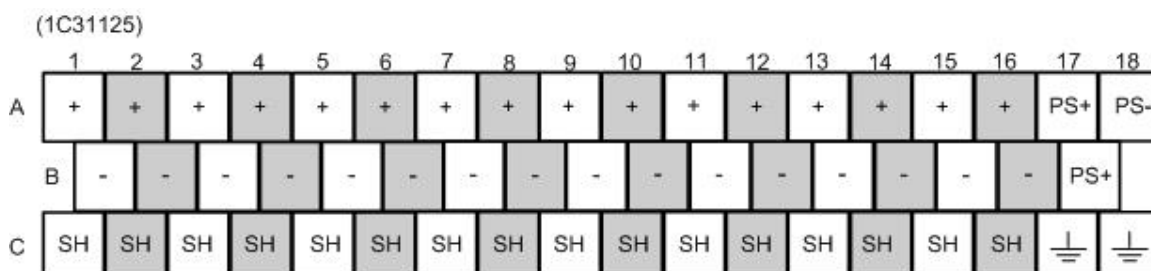


Figure 107: Terminal Block Connections for the Digital Output Personality Modules

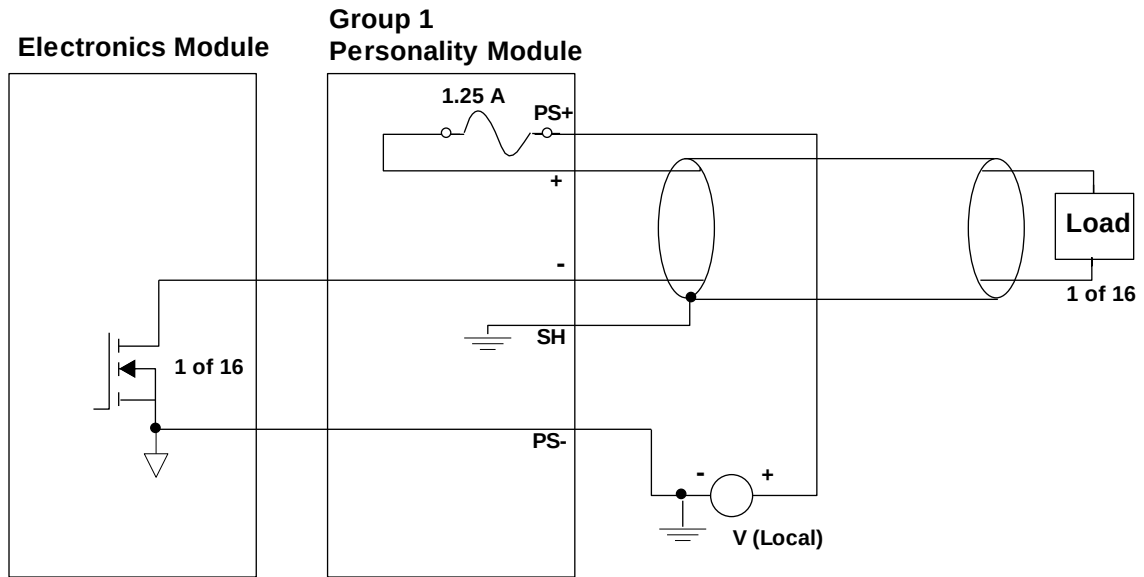
Abbreviations Used in Wiring Diagrams

ABBREVIATION	DEFINITION
	Earth Ground terminals.
+	Digital output positive terminal connections.
-	Digital output negative terminal connections.
PS+, PS-	Auxiliary power supply terminals.
SH	Shield.

Note: Do **not** use unmarked terminal block locations.
Shield terminals (SH) are **not** connected in CE Mark systems.

You should always adhere to channel specifications and polarity when connecting load devices to the digital output module. This ensures proper operation of the digital output module and avoids potential damage to either the digital output module or load device.

27.17 Field connection wiring diagram - (DO)

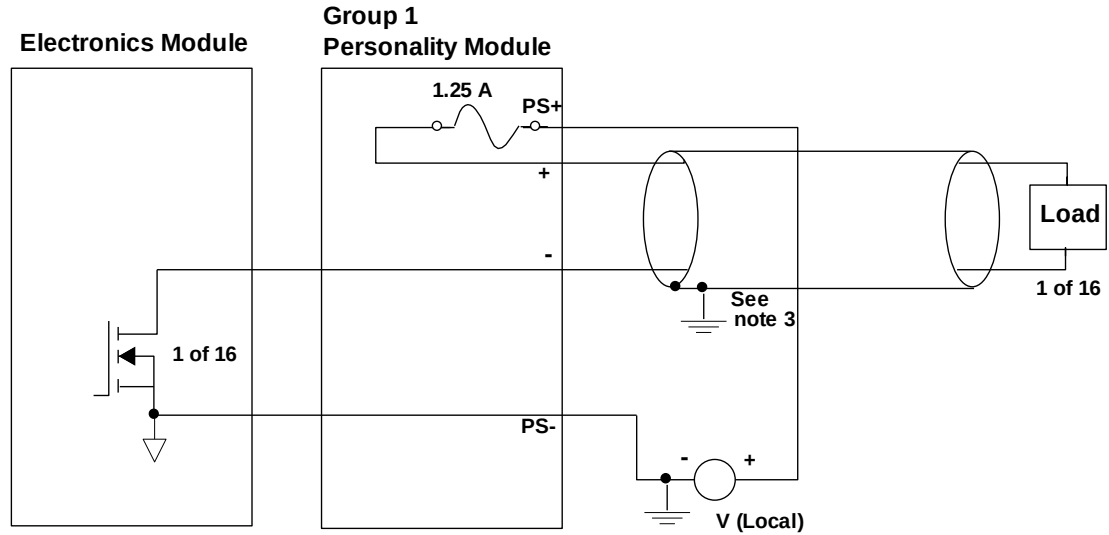


Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.

Figure 108: Field Connection for the Digital Output Personality Module (Group 1) (Non-CE Mark Certified Systems)

27.18 Field connection wiring diagram (Group 1) (CE Mark) - (DO)

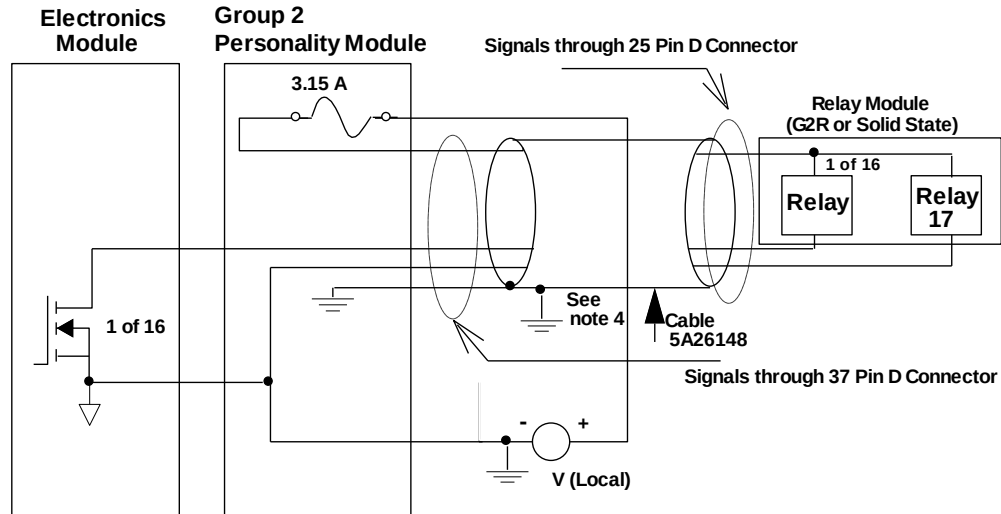


Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.
3. All field wiring must be braid shielded and grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).

Figure 109: Field Connection for the Digital Output Personality Module (Group 1) (CE Mark Certified System)

27.19 Wiring diagram to relay module (G2R or Solid State) locally powered - (DO)

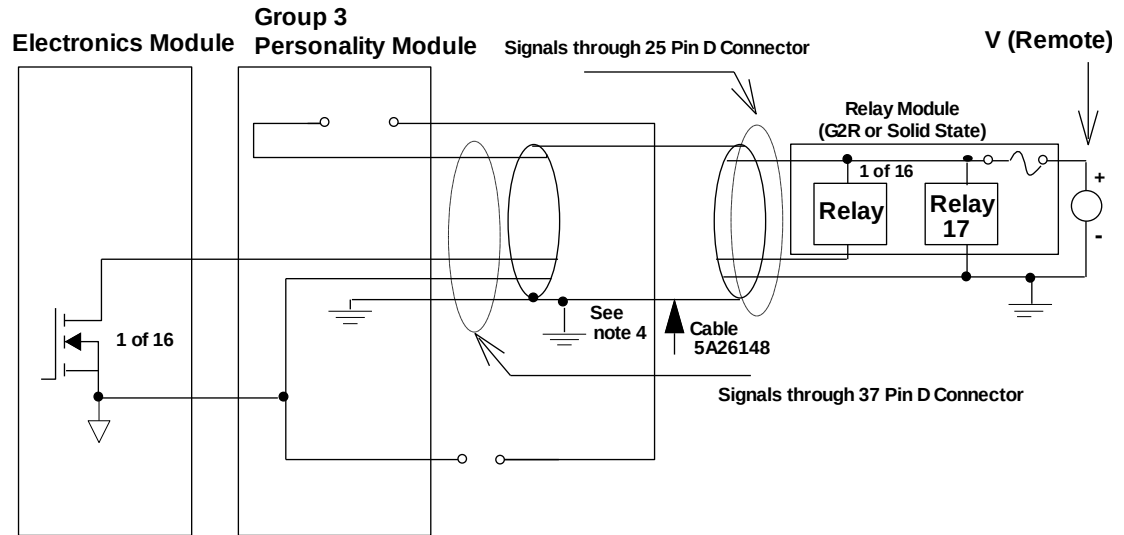


Notes

1. V (Local) is the I/O backplane auxiliary power supply.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 17 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26148 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware(see the appropriate "Cable Guidelines" information for your system).
5. Solid State Relay Configurations not CE Mark Certified.

Figure 110: Digital Output Module to Relay Module (G2R or Solid State) Locally Powered

27.20 Wiring diagram to relay module (G2R or Solid State) - (DO)



Notes

1. V (Remote) is a supply provided via the relay module.
2. Shielded cables are required for IEC 801-5 compliance.
3. Relay 17 is used to indicate the status of the power supply.
4. For CE Mark certified systems where cable 5A26148 exits the cabinet or a suited set of EMC cabinets: The cable shield must be grounded at the entry point of the cabinet using the recommended hardware (see the appropriate "Cable Guidelines" information for your system).
5. Solid State Relay Configurations not CE Mark Certified.

Figure 111: Digital Output Module to Relay Module (G2R or Solid State)

27.21 Wiring diagram to relay module (KUEP Style) locally powered (CE Mark) - (DO)

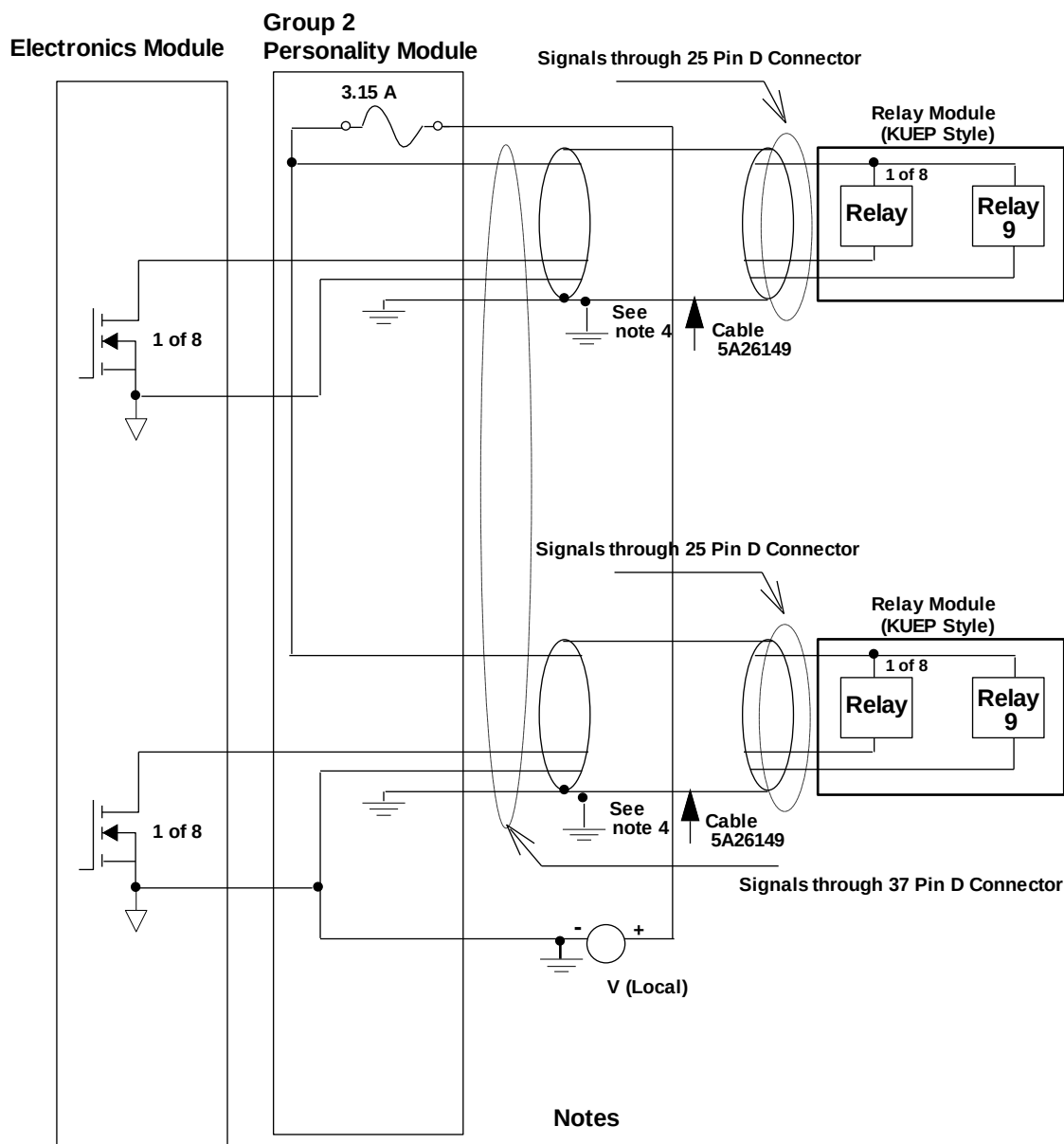


Figure 112: Digital Output Module to Relay Module (KUEP Style) Locally Powered (Non-CE and CE Mark)

27.22 Wiring diagram to relay module (KUEP style remotely powered (CE Mark) - (DO)

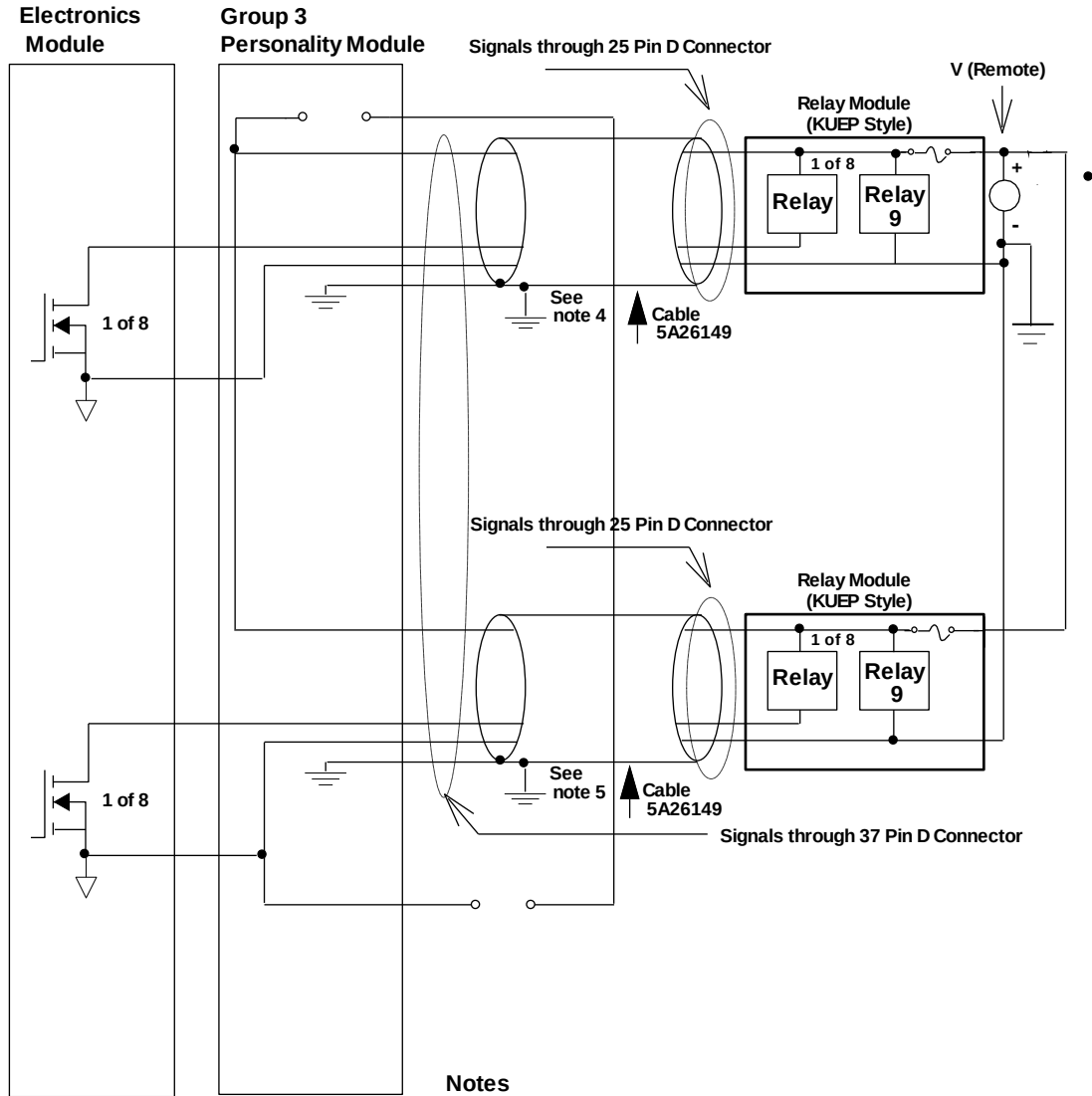


Figure 113: Digital Output Module to Relay Module (KUEP Style) Remotely Powered (Non-CE and CE Mark)

27.23 Relay panel application diagrams - (DO)

The following figures illustrate three types of applications for relay panels.

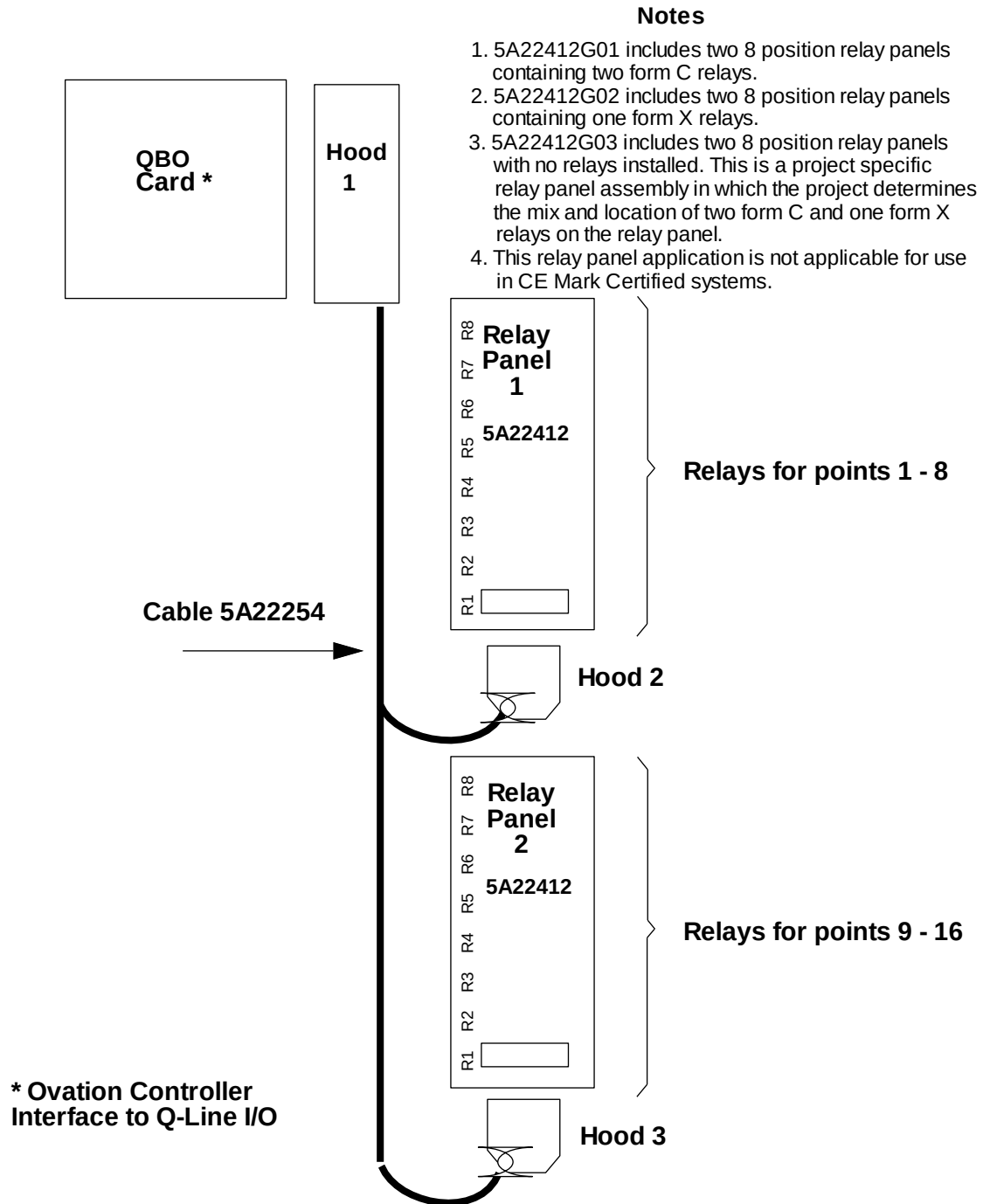


Figure 114: Relay Panels to Q-Line (QBO Card)

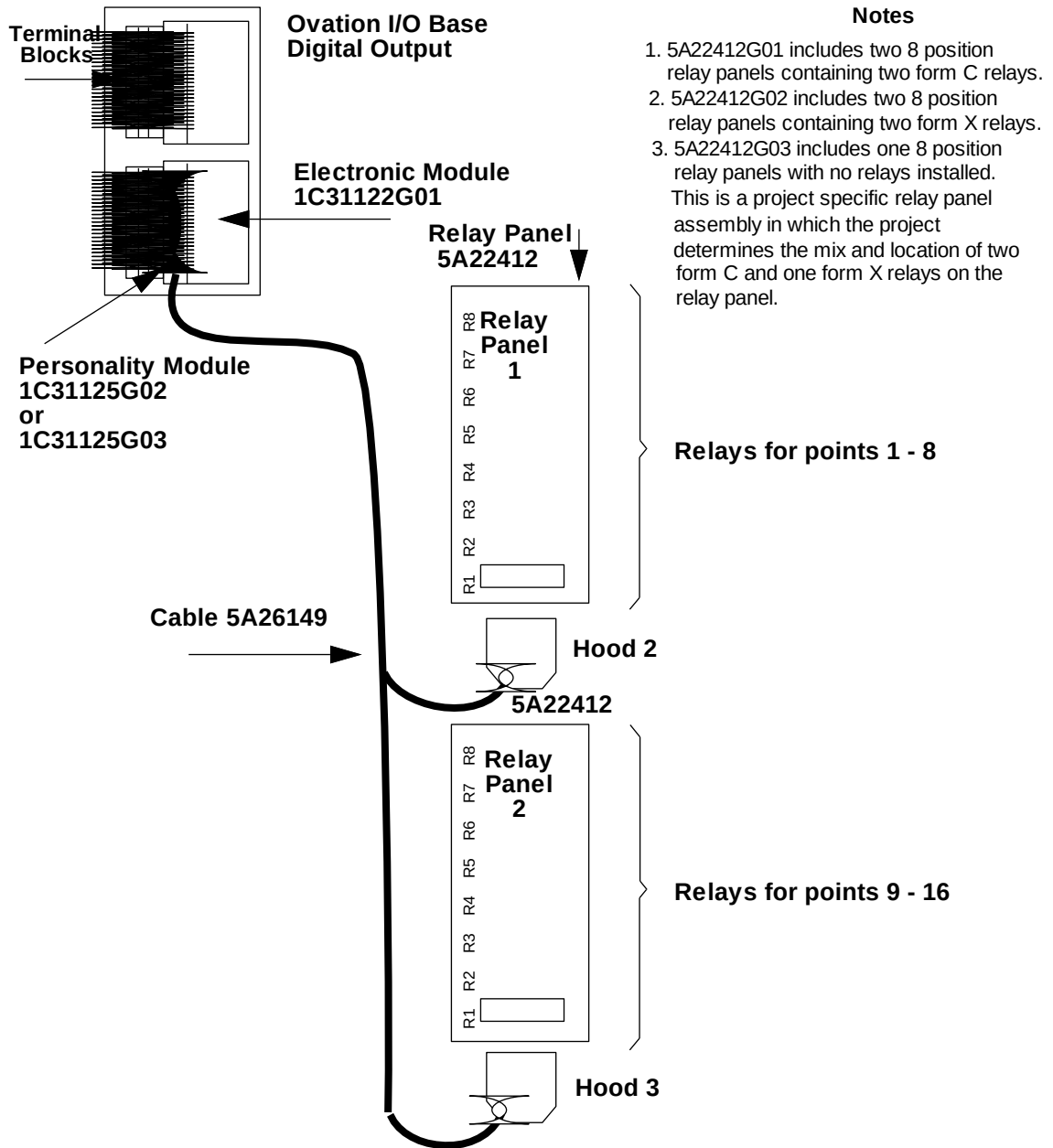


Figure 115: KUEP Relay Panels to Ovation I/O Base

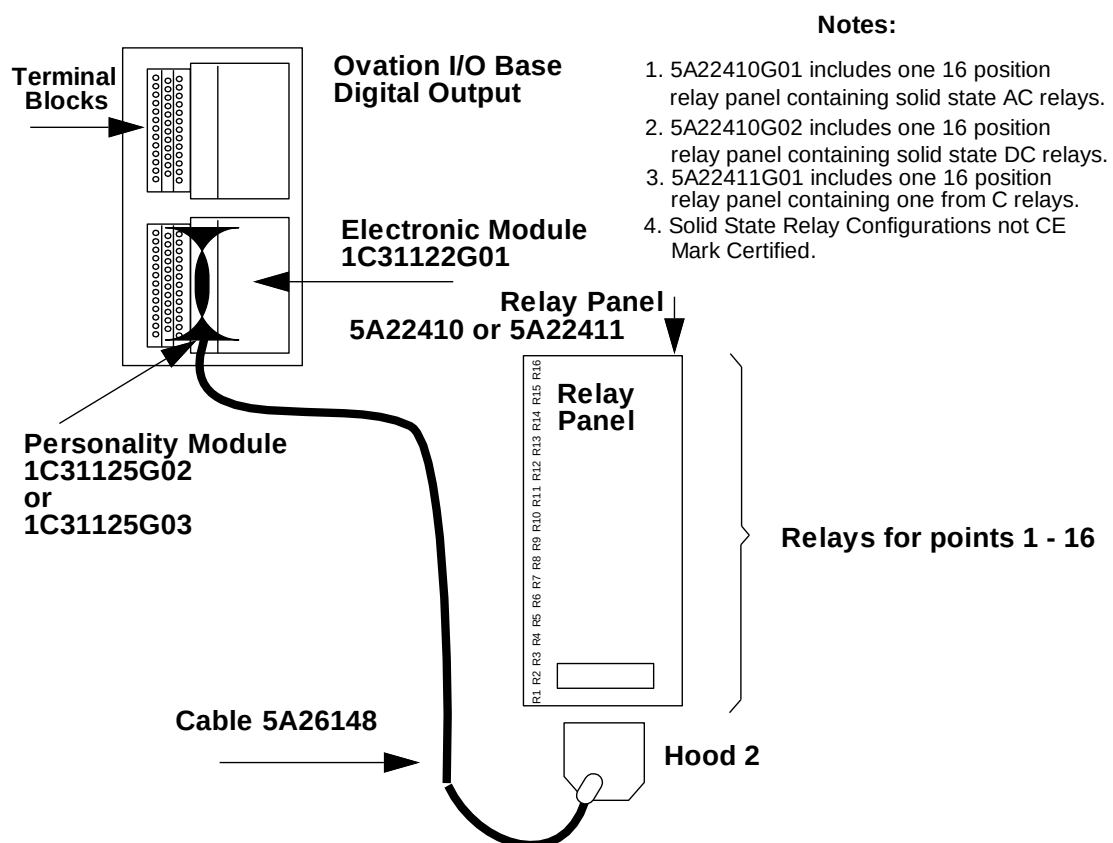


Figure 116: Solid State or G2R Relay Panels to Ovation I/O Base

27.24 Configuration/Status Register information - (DO)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). (See the *Ovation Operator Station User Guide*.)

Digital Output Configuration/Status Register (Address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)																																																																								
0	Configured (active high)	Configured (active high) (1=configured; 0=unconfigured)																																																																								
1	Forced Error (active high)	Forced Error (active high) (1=forced error; 0=no forced error)																																																																								
2- 4	Communications Timeout Setting ¹ <table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisecs</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisecs</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisecs</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisecs</td></tr></table> The tolerance on the timeout period is +/- 35%.	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisecs	1	0	1	250 millisecs	1	1	0	125 millisecs	1	1	1	62.5 millisecs	Communications Timeout Setting ¹ <table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisecs</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisecs</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisecs</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisecs</td></tr></table> The tolerance on the timeout period is +/- 35%.	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisecs	1	0	1	250 millisecs	1	1	0	125 millisecs	1	1	1	62.5 millisecs
BIT 4	BIT 3	BIT 2	TIMEOUT																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisecs																																																																							
1	0	1	250 millisecs																																																																							
1	1	0	125 millisecs																																																																							
1	1	1	62.5 millisecs																																																																							
BIT 4	BIT 3	BIT 2	TIMEOUT																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisecs																																																																							
1	0	1	250 millisecs																																																																							
1	1	0	125 millisecs																																																																							
1	1	1	62.5 millisecs																																																																							
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)																																																																								
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)																																																																								
7	Enable blown detection circuit (active high)	Enable blown detection circuit (active high)																																																																								

¹ The tolerance on the timeout period is +/- 35%.

Bit definitions for this register are encoded as shown in the above table and described below:

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a "1" to bit 0 of the configuration register. Once configured, it remains configured until a power up/down reset is generated. After a power-up condition, the configuration register is cleared.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit (see page 469). When Bit 6 of the status register is set, the field supply fuse is blown.

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

CAUTION: This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system.

Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

27.25 Diagnostic Logic card LEDs - (DO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 484) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 484)) is active, or the Controller stops communicating with the module.
1 - 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

27.26 Specifications - (DO)

Digital Output (16 Channel) specifications

DESCRIPTION	VALUE
Number of channels	16
Output voltage Off voltage (Maximum) On voltage (Maximum)	60 VDC 1.0 V @ 500mA 0.2 V @ 100mA
Output current Off Current (Maximum) On current for all 16 outputs combined (Max) Personality module Group 1 Personality module Group 2 ¹ Personality module Group 3 ¹ On current for individual output (Max)	25µA @ TA = 25°C, VDS = 60 VDC 250µA @ TA = 60°C, VDS = 60 VDC Limited by fuse rating 890mA Maximum for all 16 outputs 2.2A Maximum for all 16 outputs Limited by the fuse located on the relay module 500 mA
Blown fuse detection ² Operating voltage range	15V ≤ field supply voltage ≤ 60V
Maximum propagation time	2.5 mSec for Rload=500Ω
Dielectric isolation: ³ Channel to logic	1000V AC/DC
Module power	Main: 2.2 W typical, 3.3 W Maximum Aux used with no relay panels: 8 outputs on @ 100mA each 19.2 W (24V) typical 38.4 W (48V) typical Aux used with the following relay panels: Solid State panel with 16 relays: 5.9 W (24V) typical G2R panel with 16 relays: 10.87 W (24V) typical KUEP panel with 8 Form C relays: 15.84 W (24V) typical 2 KUEP panels with 16 Form C relays: 31.68 W (24V) typical KUEP panel with 8 Form X relays: 11.28 W (24V) typical 2 KUEP panels with 16 Form X relays: 22.56 W (24V) typical
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
Inductive Kick Protection method	Diode ⁴
¹ The personality module Groups 2 and 3 are used to interface with the relay modules (see page 460). ² You can configure the card to disable the blown fuse detection function. ³ All 16 channels have a common return which is galvanically isolated from the logic ground. ⁴ Inductive kick diode located on the personality module. Diode is specified to protect the MOSFET when connected to loads within the digital output channel specifications (Off voltage = 60VDC and On current = 500mA).	

Note: *The output channels maintain proper operation when subjected to IEC 61131-2, second edition, 2003-02 Section 9.12 Voltage Drops and Interruptions Immunity testing (condition tested with the standard Ovation power supply providing both the main and auxiliary power to the Digital Output Module).*

SECTION 28

High Side Digital Output (24 VDC) module - (HSDO) (16 Channel)

IN THIS SECTION

<i>16 Channel High Side Digital Output (24 VDC) module overview - (HSDO)</i>	490
<i>Electronics modules (Emod) - (HSDO)</i>	490
<i>Personality modules (Pmod) - (HSDO)</i>	490
<i>Valid module combinations - (HSDO)</i>	491
<i>Module block diagram - (HSDO)</i>	491
<i>Redundant module interconnection - (HSDO)</i>	492
<i>Field signal wiring information - (HSDO)</i>	493
<i>Field power wiring information for module base unit terminal blocks - (HSDO)</i>	494
<i>Module cables for High Side Digital Output 24VDC - (HSDO)</i>	495
<i>HSDO to HSDO Cable Assembly Routing Information Redundant Configuration - (HSDO)</i>	495
<i>Module channel fault register - (HSDO)</i>	496
<i>Field power shutoff - (HSDO)</i>	496
<i>Configuration/Status Register information - (HSDO)</i>	497
<i>Diagnostic logic card LED's - (HSDO)</i>	501
<i>Specifications - (HSDO)</i>	503

28.1 16 Channel High Side Digital Output (24 VDC) module overview - (HSDO)

The Ovation High Side Digital Output 24VDC (HSDO) module is an intelligent microcontroller-based digital output module and is available for systems with Windows Ovation 3.0.4 and above.

The HSDO consists of two modules, (electronics and personality), that are inserted into an Ovation I/O module base unit. The HSDO module contains sixteen optically isolated digital output channels. Each digital output channel is capable of sourcing up to 500 mA of output current.

These sixteen optically isolated digital output channels share a common 24VDC power source. Power for all sixteen digital output channels is supplied from either of the following power sources:

- Ovation power supply AUX output. *(Maximum total output current limited to 2A per module when 24V Aux. power is used.)*

OR

- External 24VDC power source. *(Maximum total output current limited to 4A per module.)*

Each digital output channel has an intelligent power switch which contains a high-side power MOSFET switch used to switch 24VDC power to an external load. Each intelligent power switch has built-in current limiting feature that limits the maximum switch output current to provide short circuit protection.

Series isolation diodes are located between each intelligent power switch output pin and the output terminals of all sixteen digital output channels. The presence of these isolation diodes permit the 24VDC HSDO module to operate in either of the following two modes:

- Single/simplex mode (independent of any other module).

OR

- Redundant mode (connected in parallel with another 24VDC HSDO module).

When the 24VDC HSDO module operates in redundant mode, a cable assembly is necessary to link together the personality modules of the two redundant 24VDC HSDO modules. Refer to the *HSDO to HSDO Cable Assembly Routing Information - Redundant Configuration (see page 495)*.

Note: *When this cable assembly is installed, customer field signal wiring only needs to be connected to one base unit terminal block.*

28.2 Electronics modules (Emod) - (HSDO)

- **5X00270G01** provides 24VDC 500 mA output switching capability.

28.3 Personality modules (Pmod) - (HSDO)

- **5X00273G01** provides voltage suppression networks for each digital output channel, 24VDC field power filtering and connectors to permit redundant mode operation.

28.4 Valid module combinations - (HSDO)

High Side Digital Output (24VDC) valid module combinations

RANGE	CHANNELS	ELECTRONICS MODULE	PERSONALITY MODULE
24VDC	16	5X00270G01	5X00273G01

28.5 Module block diagram - (HSDO)

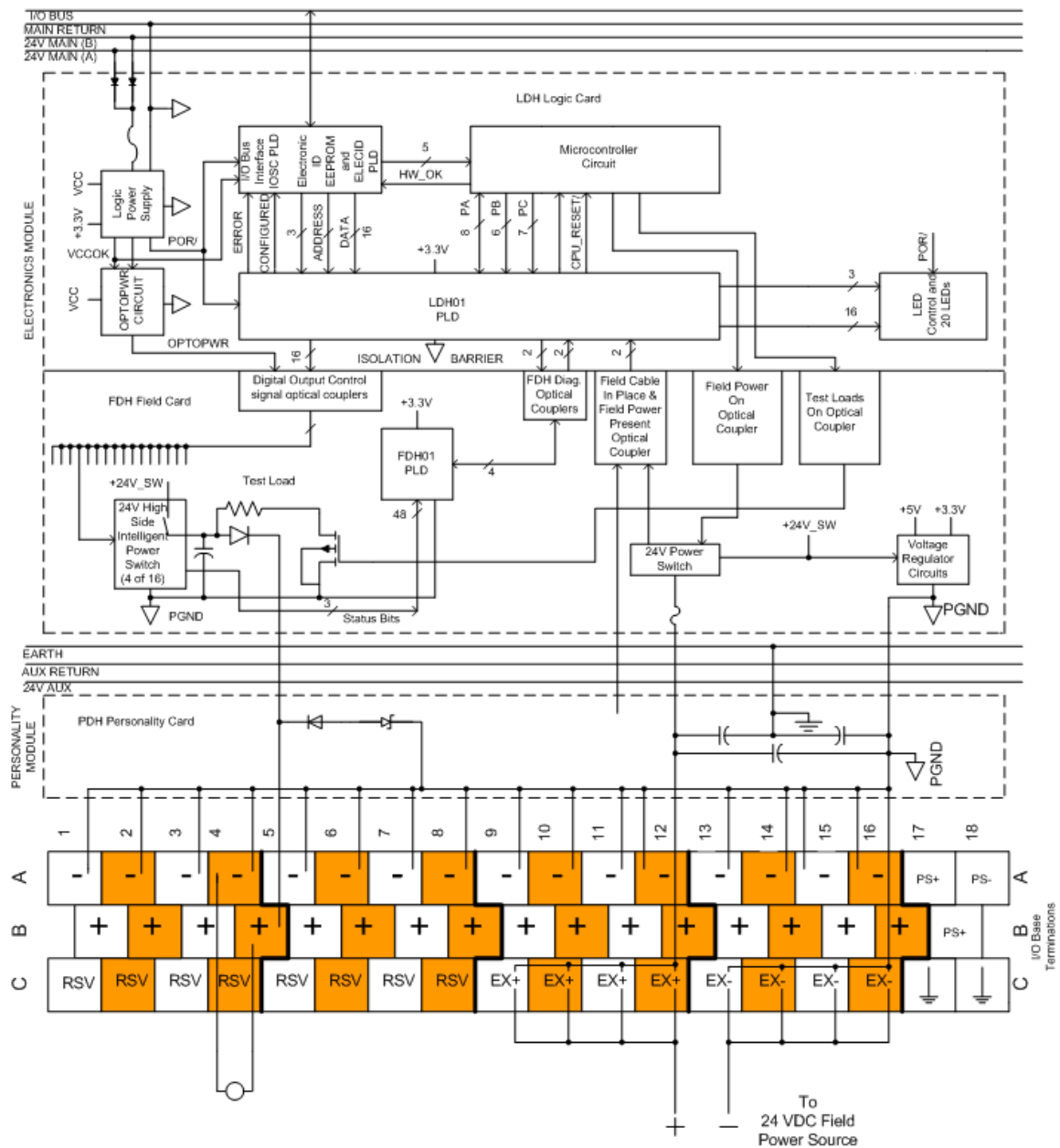


Figure 117: 24 VDC High Side Digital Output Module Block Diagram

28.6 Redundant module interconnection - (HSDO)

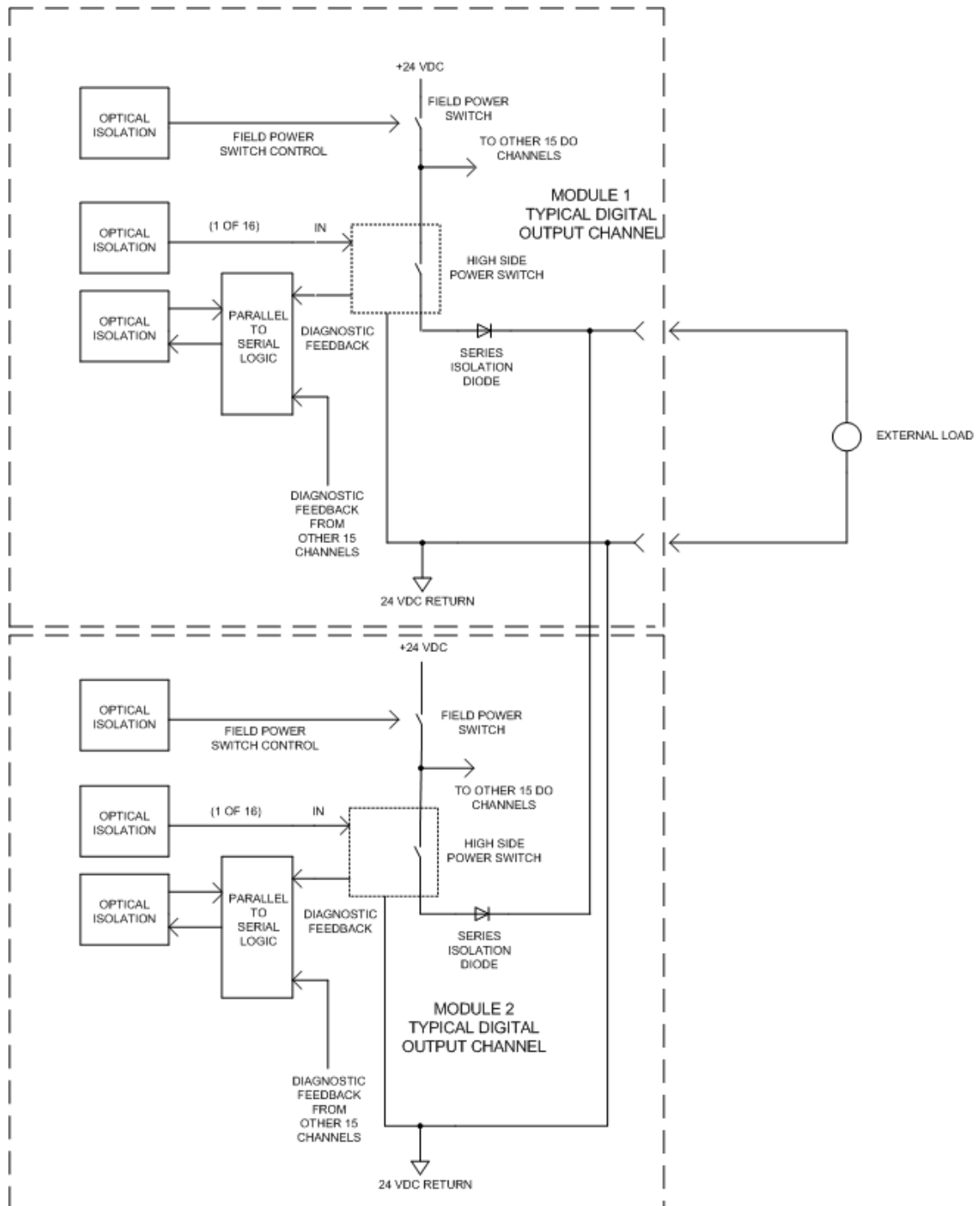


Figure 118: Redundant Module Interconnection for the 24VDC HSDO Module

28.7 Field signal wiring information - (HSDO)

Each Personality module has a simplified wiring diagram label affixed to its side; this label appears above the base unit terminal block. This diagram indicates how the wiring from external field loads is to be connected to the HSDO module's base unit terminal block.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshaling Base Unit (see page 30) for more information.

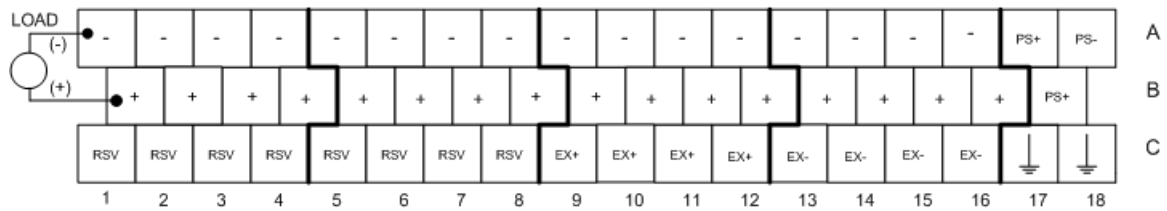


Figure 119: Field Signal Terminal Connections for the HSDO Module Base Unit

Abbreviations used in diagram

ABBREVIATION/SYMBOL	DEFINITION
	Earth ground terminals.
+	Digital output positive terminal connection.
-	Digital output negative terminal connection.
RSV	Reserved terminal. No connections allowed on these terminals.
EX+, EX-	24VDC Field Power input terminals.
PS+, PS-	Cabinet Auxiliary 24VDC power source terminals.

Note: Do **not** make connections to any base unit terminal labeled RSV.

- When HSDO modules are operated in redundant pairs, field wiring is only connected to the base unit terminals of one HSDO module in the redundant pair.

28.8 Field power wiring information for module base unit terminal blocks - (HSDO)

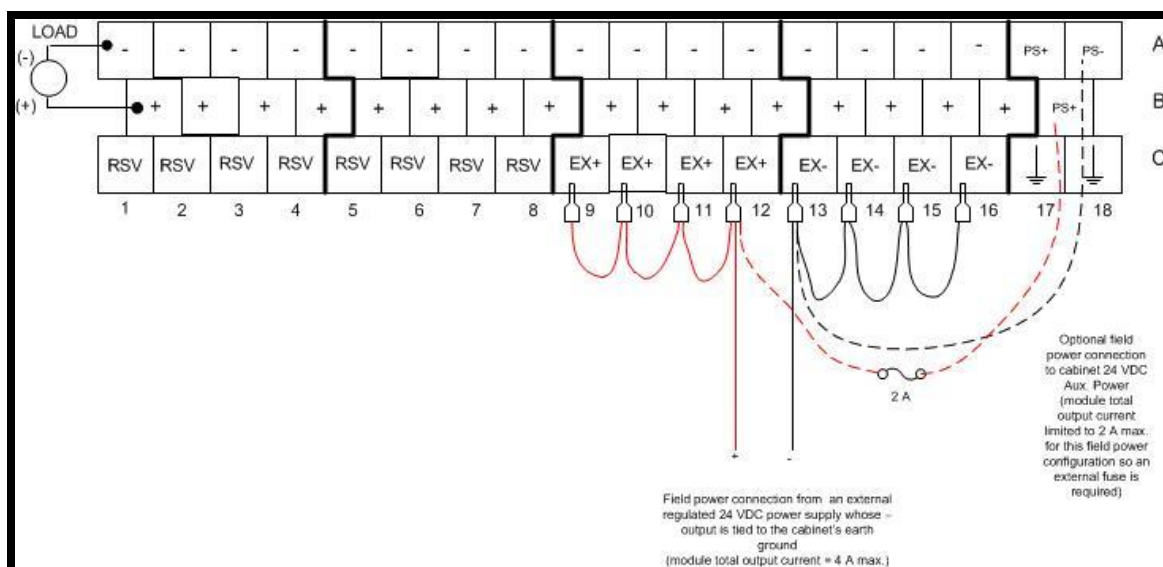


Figure 120: Field Power Terminal Connections for the HSDO Module Base Unit

Note: HSDO module field power connections must be made to both redundant HSDO modules' base unit terminal blocks.

Using an external regulated 24VDC field power source:

- Connect the external 24VDC field power source positive to all four of the base unit EX+ terminals.
- Connect the external 24VDC field power source return to all four of the base unit EX- terminals.
- Connect the external 24VDC field power source return output to the cabinet's earth ground.

Using the cabinet Auxiliary 24VDC power source:

- Connect one of the two base unit PS+ terminals to all four base unit EX+ terminals. This connection must be fused using a 2A IEC 60127-2 quick-acting fuse.
- Connect the base unit PS- terminal to all four base unit EX- terminals.

Note: For the cabinet Auxiliary 24 VDC field power scheme, the Maximum HSDO module digital output current is limited to a Maximum of 2A due to current capacity limitations of the Ovation Base Unit block terminals.

28.9 Module cables for High Side Digital Output 24VDC - (HSDO)

The following power cable/wire assemblies are used for the 24VDC HSDO module.

PART NUMBER	DESCRIPTION
1X00392G01	HSDO to HSDO interface cable assembly (used only for redundant mode operations).
1X00395G01	HSDO field power wire assembly - 24VDC Return.
1X00395G02	HSDO field power wire assembly - 24VDC.

28.10 HSDO to HSDO Cable Assembly Routing Information Redundant Configuration - (HSDO)

An HSDO to HSDO cable assembly (1X00392G01), is required for redundant HSDO module configurations. The diagram below illustrates redundant HSDO module placement and the routing configuration of the HSDO to HSDO cable assembly.

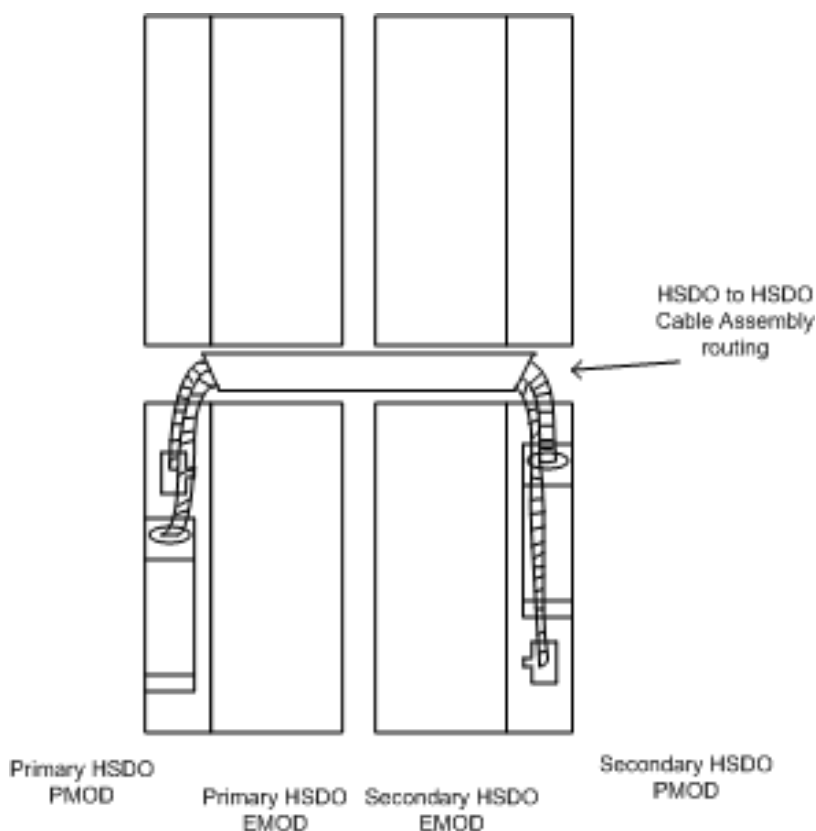


Figure 121: HSDO to HSDO Cable Assembly Routing - Redundant Configuration

Note: The 1X00392G01 cable assembly is not required for HSDO modules operating in single/simplex mode configurations.

28.11 Module channel fault register - (HSDO)

The Module Channel Fault Register is module I/O register 12 (0xC in Hex). Word address 12 (0xC in Hex) serves as a channel fault register. Each module digital output channel is assigned a bit in this register. Each channel's fault bit is cleared if no digital output faults have been detected for that channel. If the module's microcontroller detects a channel digital output fault, then a register fault bit is set for that channel.

The Module Status register Bit 14, Digital Output fault, is the logical OR of all sixteen Module Channel fault register fault bits.

Module channel fault register bit assignments (address 12 or 0xC).

BIT	READ DEFINITION
0 - 15	Channel 1 - 16 Digital Output Fault

28.12 Field power shutoff - (HSDO)

An HSDO module shuts off its field power for one of the two following scenarios:

All the following conditions must be true:

- ☐ Module detects a power switch output short circuit to +24V fault.
- ☐ Module is configured for redundant mode operation.
- ☐ Module observes that its partner HSDO module is alive.
- ☐ Module observes that the partner HSDO module is healthy.

OR WHEN

All of the following conditions must be true:

- ☐ The HSDO module was configured with redundant operation enabled, but then becomes unconfigured for at least three seconds.
- ☐ Module observes that its partner HSDO module is alive.
- ☐ Module observes that the partner HSDO module is healthy.

28.13 Configuration/Status Register information - (HSDO)

The Module Configuration/Module Status register is module I/O register 13 (0xD). Word address 13 (0xD in Hex) is used to configure the HSDO module and to provide status information to the Controller. The Module Status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern Field on the Hardware Tab). (Refer to the *Ovation Operator Station User Guide*.) The Module Configuration/Module Status register assignments are defined in the following table:

Module configuration/module status register low byte bit assignments (address 13 or 0xD in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE DEFINITION)	DATA DESCRIPTION - STATUS REGISTER (READ DEFINITION)																																																																								
0	Configure module - (1 = configure).	Module Configured (1 = configured). (0 = unconfigured).																																																																								
1	Force Error (1 = force internal error).	Forced Error (1 = forced error). (0 = no forced error).																																																																								
2	I/O Bus Communications Timeout Bit 0.	I/O Bus Communications Timeout Bit 0.																																																																								
	<table><tr><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Timeout period</td></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisecs</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisecs</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisecs</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisecs</td></tr></table>	Bit 4	Bit 3	Bit 2	Timeout period	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisecs	1	0	1	250 millisecs	1	1	0	125 millisecs	1	1	1	62.5 millisecs	<table><tr><td>Bit 4</td><td>Bit 3</td><td>Bit 2</td><td>Timeout period</td></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisecs</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisecs</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisecs</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisecs</td></tr></table>	Bit 4	Bit 3	Bit 2	Timeout period	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisecs	1	0	1	250 millisecs	1	1	0	125 millisecs	1	1	1	62.5 millisecs
	Bit 4	Bit 3	Bit 2	Timeout period																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 millisecs																																																																						
	1	0	1	250 millisecs																																																																						
	1	1	0	125 millisecs																																																																						
1	1	1	62.5 millisecs																																																																							
Bit 4	Bit 3	Bit 2	Timeout period																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisecs																																																																							
1	0	1	250 millisecs																																																																							
1	1	0	125 millisecs																																																																							
1	1	1	62.5 millisecs																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
3	I/O Bus Communications Timeout Bit 1.	I/O Bus Communications Timeout Bit 1.																																																																								
4	I/O Bus Communications Timeout Bit 2.	I/O Bus Communications Timeout Bit 2.																																																																								
5	I/O Bus Communications Timeout Action. 1 = Digital Outputs hold their state upon an I/O Bus Communications timeout. I/O Bus Communications Timeout. 0 = Digital Outputs reset upon an I/O Bus Communications Timeout.	I/O Bus Communications Timeout Action selection.																																																																								
6	Not Used.	Not Used.																																																																								
7	Field card power status handling. 1 = Module External Error if no 24 VDC field power present.	Field card power status handling section.																																																																								

Bit definitions for this registers low byte are encoded as shown in the previous table and described below:

Bit 0: When Bit 0 is set, the module is configured. The module digital outputs cannot be controlled until the Controller has set Module Configuration register bit 0.

Bit 1: Bit 1 is the Force-Error Bit. When Bit 1 is set, the modules Internal Error LED is illuminated. The module goes into Attention status.

Bits 2 - 4: These three Bits select the I/O Bus Communication Timeout period.

Bit 5: I/O Bus Communications Timeout Action Bit.

Bit 5 is set: When no communications between the Controller and the HSDO module occur during a time period specified by bits by Bits 4, 3, and 2, the following happens:

- Module digital outputs hold their last value.
- Communications OK LED is off and the Internal Error LED is illuminated.

Bit 5 is cleared: When no communications between the Controller and module takes place during a time period defined by Bits 4, 3, and 2, the following happens:

- Module digital outputs are turned off.
- Communications OK LED is off and the Internal Error LED is illuminated.

Bit 6: This bit is not used.

Bit 7: This bit is the Field Card Power Status Handling Bit.

Bit 7 is set: If the module's external 24VDC power supply voltage is not present, the following happens:

- External Error LED is illuminated.
- Module goes into Attention status.

Bit 7 is cleared: If the module's external 24VDC power supply voltage is not present, the following happens:

- External LED is not illuminated.
- Module does not go into Attention status. With no field power present, the module digital outputs do not function.

Module Configuration/Module Status Register High Byte Bit Assignments (Address 13 or 0xD in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE DEFINITION)				DATA DESCRIPTION - STATUS REGISTER (READ DEFINITION)
8	Dynamic Digital Output Test Time Interval Bit 0.				Field_Cable_Absent 1 = Field interface cable absent in redundant mode. 0 = Field interface cable present or single mode operation.
	Bit 10	Bit 9	Bit 8	Dynamic Digital Output Test Interval	
	0	0	0	24 hours	
	0	0	1	12 hours	
	0	1	0	8 hours	
	0	1	1	4 hours	
	1	0	0	2 hours	
	1	0	1	1 hour	
	1	1	0	30 minutes	
1	1	1	15 minutes		
9	Dynamic Digital Output Test Time Interval Bit 1.				Cross_Cable_Absent 1 = Cross connect cable absent in redundant mode. 0 = Cross connect cable present or single mode operation.
10	Dynamic Digital Output Test Time Interval Bit 2.				Partner Not Responding Absent 1 = Partner not responding in redundant mode. 0 = Partner responding or single mode operation.
11	Not Used.				Application Code Invalid 1 = Application code stored in internal module memory is not valid.
12	Not Used.				Internal Logic Card fault.
13	Not Used.				No Field Power
14	Digital Output Fault Handling Method Selection: 1 = Alarm only upon Digital Output fault. 0 = Alarm and shut off field power upon Digital Output fault.				Digital Output fault.
15	Redundant/Single operation mode selection: 1 = Select Redundant mode operation. 0 = Select Single mode operation.				Redundant/Single operating mode selection: 1 = Redundant mode operation selected. 0 = Single mode operation selected.

Bit definitions for this registers high byte are encoded as shown in the above table and described below:

Bits 8 - 10: These three Configuration Register Bits select the Dynamic Digital Output Test Time Interval.

Bit 11: When Status Register Bit 11 is set, the module microcontroller application firmware stored in internal memory is not valid.

Bit 12: When Status Register Bit 12 is set, at least one of three internal logic card faults are detected by the modules internal microcontroller's self tests: Microcontroller Register fault, Microcontroller RAM Fault, Boot Loader Firmware Code Checksum error.

Bit 13: When Status Register Bit 13 is set, there is no 24VDC field power present to power the modules intelligent power switches.

Bit 14: Bit 14 is the Digital Output fault Handling Bit.

Bit 14 is set: The module never shuts off its power in the event of a digital output fault.

Bit 14 is cleared: Module field power shuts off for a digital output fault if all of the following conditions are true:

- Digital Output is a power switch short circuit to 24V.
- Module is operating in redundant mode.
- Partner HSDO module is alive.
- Partner HSDO module is healthy.

Bit 14 Digital Output Fault - This Status Register bit is set for one of the following conditions:

- Digital output fault.
- Internal logic fault.
- Application code invalid.

Bit 15: Single or Redundant mode selection bit.

CAUTION: This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system.

Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

28.14 Diagnostic logic card LED's - (HSDO)

For both stand-alone and redundant High Side Digital Output module configurations, power switch diagnostic bits are accessed every 25 milliseconds. If a digital output fault is detected on a channel, the corresponding Module Channel Fault register fault bit is set. When any bit in the Module Channel Fault register is set, the Module Status register (register 0xD) Digital Output fault bit (Bit 14) is also set.

These digital output fault conditions can be detected and reported:

- Power switch output short circuit to ground.
- Power switch output short circuit to +24V (switch cannot be turned off).
- Power switch power supply under-voltage.
- Power switch open circuit (switch cannot be turned on).

When HSDO modules operate in a redundant module configuration, a dynamic power switch turn-off test is performed periodically. By communicating over the cross-connect cable serial link, the two HSDO modules coordinate their dynamic power switch turn-off testing so that both modules do not shut off their power switch outputs at the same time.

Upon module insertion, after communication between modules is established, and after 12 additional seconds have elapsed, the HSDO module performs the dynamic power switch turn-off test. The HSDO module will then performs test periodically at a time interval ranging from 15 minutes to 24 hours. This time interval is selected by the values of Module Configuration register bits 10, 9 and 8.

The Ovation 24VDC High Side Digital Output LDH logic card contains 20 LEDs to display module status. The following figure illustrates the LED array:

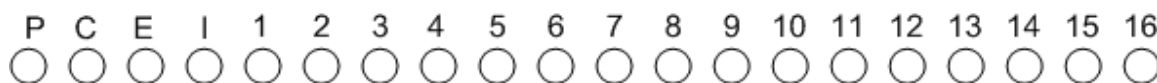


Figure 122: LED Configuration for the 24VDC High Side Digital Output Electronics Module

The following table lists the module LEDs and describes what each indicates.

Diagnostic logic card LED's

LED	DESCRIPTION
P - (green)	Power OK LED. This LED is lit when the Electronics module card 5VDC power is okay.
C - (green)	Communications OK LED, which is lit when the Controller is communicating with the module.
E - (red)	External Error LED - This LED is lit when both of the following conditions are true: Field power is absent ▪ Module Configuration register Bit 7 is set.
I - (red)	Internal Error LED - This LED is lit when one or more of the following conditions are true: Controller is not communicating with the module. Internal microcontroller sets its internal error bit. ▪ Module Configuration Error Bit 1 is set.
1 - 16 (green)	Channel 1 - 16 Status - Lit when the Channel 1 power switch is turned on and not lit when the Channel 1 - 16 power switch is turned off.

Note: All switches are turned off when dynamic testing occurs. The **LEDs** which were on, indicate that the output switch is active, and blink off for 25 mSec, or 50 mSec during the test.

28.15 Specifications - (HSDO)

High Side Digital Output 24 VDC specifications

DESCRIPTION	VALUE
Number of Digital Output Channels.	16
Output Voltage	
On Voltage (Minimum)	22.5VDC @ 500mA (VS = 24VDC)
Off Voltage (Maximum)	0.6VDC
Output Current	
On current for individual output (Maximum).	500 mA
On current for individual output (Minimum).	6 mA (minimum load current required for proper diagnostic operation).
Off current for individual output (Maximum).	100 uA
On current for all 16 outputs combined (Maximum).	4 A (2A if field power source equals auxiliary power).
Output Short Circuit to Supply Common Minimum current limit Maximum current limit	750 mA 1.5 A Note: After a channel output short circuit to supply common short circuit fault is cleared, the channel resumes normal operation. Multiple digital output channels can handle output short circuit to supply common faults until the total module field supply current exceeds 4A, which is the rating of the Electronics module's 4A quick acting IEC 60127-2 fuse.
Field Power Operating Voltage Range: Minimum: Maximum:	21.6 VDC 26.4 VDC
Field Circuit Current	4 A Maximum (2 A Maximum if 24 VDC Aux. power is used) Actual field current is dependent on the number of ON digital output channels and the external load impedances.
Output State Transition Time (I/O Bus access to Output state change) OFF to ON, nominal ON to OFF, nominal	100 microseconds 200 microseconds
Dielectric Isolation	1,000 VDC for one minute, field to logic 500 VAC RMS for one minute, field to logic
Module Main Power (Nominal) (Maximum)	2.16 W 3 W
Module Field Power	48 W (VS=24V, 8 Channels on @ 250mA / channel) typical 105.6W (VS = 26.4V) Maximum
Operating Temperature Range	0° to 60° C (32° to 140° F)
Storage Temperature Range	-40° to 85° C (-40° to 185° F)

DESCRIPTION	VALUE
Humidity (non-condensing)	0 to 95% relative humidity non-condensing
Note: All 16 digital output channels have a common return which is the field power supply common.	

SECTION 29

Relay Output module (HROE) (32 Channel)

IN THIS SECTION

<i>32 Channel Relay Output module overview (HROE)</i>	505
<i>Electronics module (HROE)</i>	506
<i>Base assemblies (HROE)</i>	506
<i>Valid Emod and base combinations (HROE)</i>	506
<i>32 Channel Relay Output Electronics module block diagram (HROE)</i>	507
<i>Single channel illustration (HROE)</i>	508
<i>Terminal block wiring information (HROE)</i>	508
<i>32 Channel non-fused relay base field wiring information (HROE)</i>	509
<i>32 Channel fused relay base field wiring information (HROE)</i>	509
<i>Power supply requirement for the 32 Channel Relay output module (HROE)</i>	510
<i>Configuration register information (HROE)</i>	511
<i>Status register information (HROE)</i>	512
<i>Channel Relay Output Emod Addressing</i>	512
<i>Channel Relay Output Emod Register (HROE)</i>	513
<i>Communication timeout (HROE)</i>	513
<i>Blown fuse detection circuit (HROE)</i>	514
<i>Diagnostic LEDs (HROE)</i>	514
<i>Specifications (HROE)</i>	515

29.1 32 Channel Relay Output module overview (HROE)

The Ovation 32 Channel Non Fused & Fused Relay Output assemblies provide a means to switch high current and voltage devices located in the field. The 32 relays are SLIM-line style which are utilized within the control and PLC markets for resistive loads and light inductive loads such as interposing relay coils and auxiliary contacts on external controllers.

The Ovation 32 Channel Relay Base Subsystem consists of a 32 Channel Non Fused Relay Base assembly or 32 Channel Fused Relay Base assembly, a 32 Channel Relay Output Electronics Module, and 32 - 1 FORM C SLIM-line style medium power electromechanical relays for switching field devices.

The 32 Channel Relay Output Electronics Module consists of 32 relay channel driver circuits, employing the use of the standard main Ovation +24V power supply. The 32 Channel Relay Output Electronics Module provides thirty-two output relay output driver circuits which interface with the SLIM line relays located on the Ovation 32 Channel Non Fused Relay Base Assembly and the 32 Channel Fused Relay Base Assembly.

The 32 Channel Non Fused Relay Base Assembly is capable of driving 5A, 250 VAC resistive loads (PF=1). The 32 Channel Fused Relay Base Assembly is capable of driving 3.15A, 250 VAC resistive loads (PF=1) which is fuse limited with an integral 3.15A Type T fuse. The relays are also capable of driving small inductive loads such as interposing relay coils at AC 15 load type.

29.2 Electronics module (HROE)

5X00583G01 - 32 Channel Relay Output electronics module.

There is one group of the 32 Channel Relay Output Electronics Module which provides the interface to the 32 Channel Low Power Relay Base providing 32 relay output capability respectively.

29.3 Base assemblies (HROE)

5X00623G01 - 32 Channel Fused Relay Base assembly.

There are two groups of the 32 Channel Fused Relay Base assembly which accommodates 32 low power relays:

- ☐ G01 = SLIM Line Relays installed.
- ☐ G02 = No SLIM Line Relays installed.

Capable of driving 3.15A, 250 VAC resistive loads (PF=1)

Each channel has a series 3.15A field side fuse and a blown fuse detection LED circuit.

5X00584G01 - 32 Channel Non-Fused Relay Base assembly.

There are two groups of the 32 Channel Non-Fused Power Relay Base assembly which accommodates 32 low power relays:

- ☐ G01 = SLIM Line Relays installed.
- ☐ G02 = No SLIM Line Relays installed.

Capable of driving 5A, 250 VAC resistive loads (PF=1).

29.4 Valid Emod and base combinations (HROE)

The following table depicts a clear definition of the valid electronics module and the base module:

MODULE DESCRIPTION	EMOD STYLE	BASE MODULE STYLE
32 Channel Relay Output Electronics Module with the 32 Channel Fused Relay Base assembly which accommodates 32 low power relays. G01 = SLIM Line Relays installed. G02 = No SLIM Line Relays installed.	5X00583G01	5X00623G01 5X00623G02
32 Channel Relay Output Electronics Module with the 32 Channel Non-Fused Power Relay Base assembly which accommodates 32 low power relays. G01 Base = SLIM Line Relays installed. G02 Base = No SLIM Line Relays installed.	5X00583G01	5X00584G01 5X00584G02

29.5 32 Channel Relay Output Electronics module block diagram (HROE)

The following is a diagram of the 32 Channel Relay Output Emod.

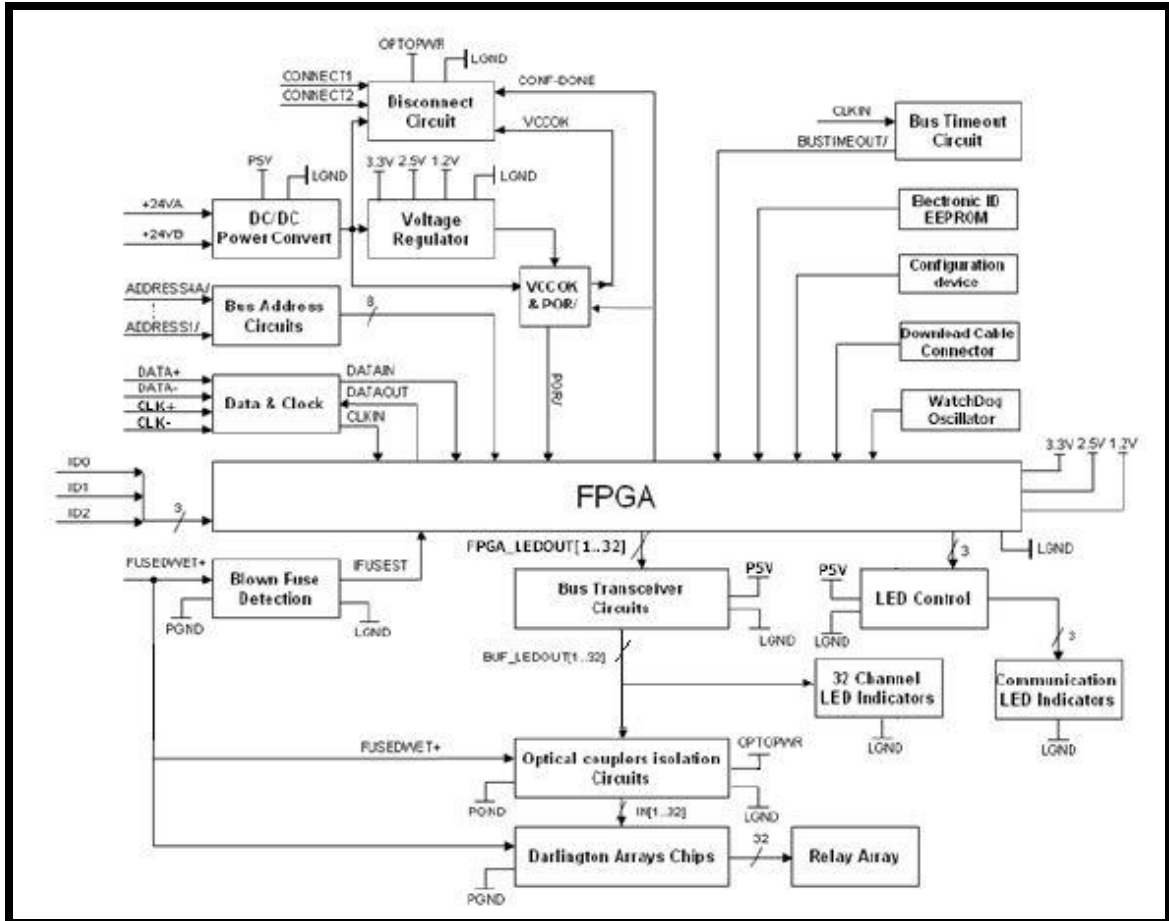


Figure 123: 32 Channel Relay Output Electronics module block diagram

29.6 Single channel illustration (HROE)

The following illustration is a diagram of a single channel.

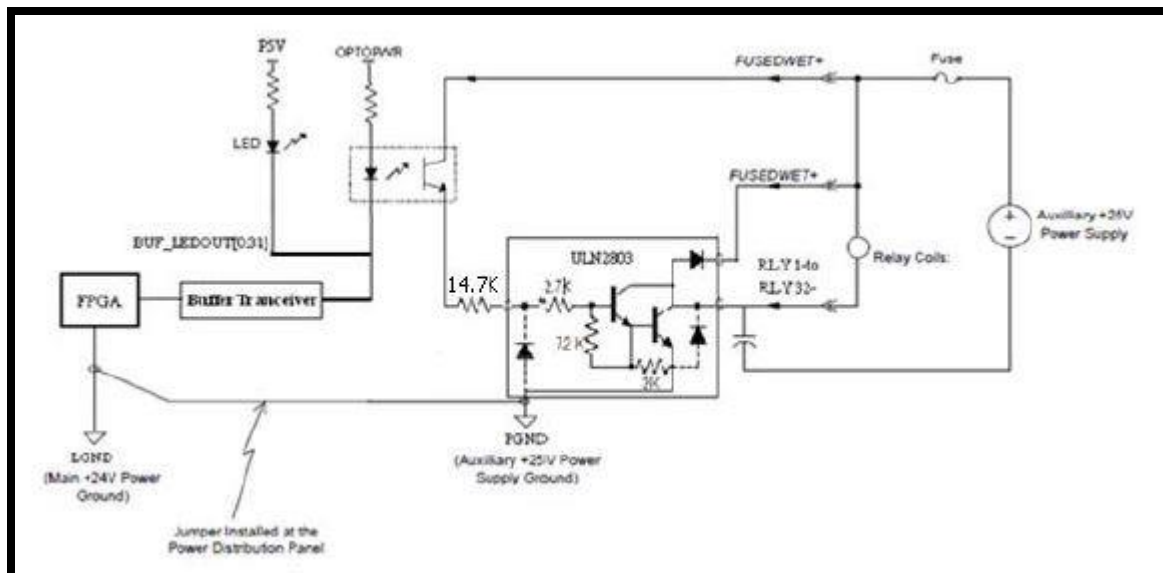


Figure 124: Single channel illustration

29.7 Terminal block wiring information (HROE)

Each relay base assembly employs terminal blocks which are permanently marked with appropriate relay contact designations at each position. The terminal block marking indicates how field wiring is connected to each terminal block position in the respective relay base assemblies.

The following diagram illustrates the terminal block pin assignments for fused and non-fused 32 Channel Relay Base assemblies:

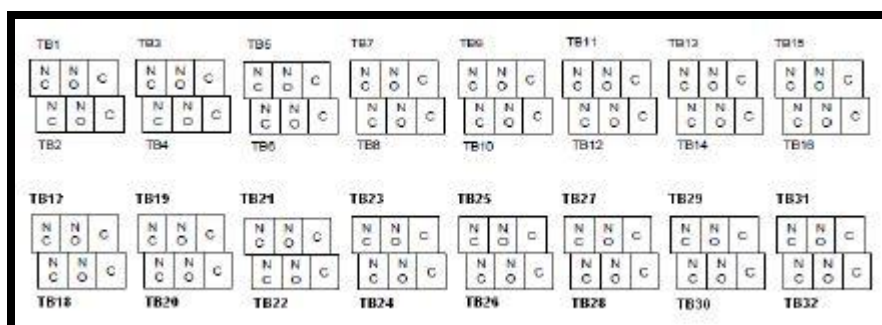


Figure 125: 32 Channel Relay Base assembly terminal block pin assignments

29.8 32 Channel non-fused relay base field wiring information (HROE)

The following figure illustrates field wiring for the 32 Channel non-fused relay base.

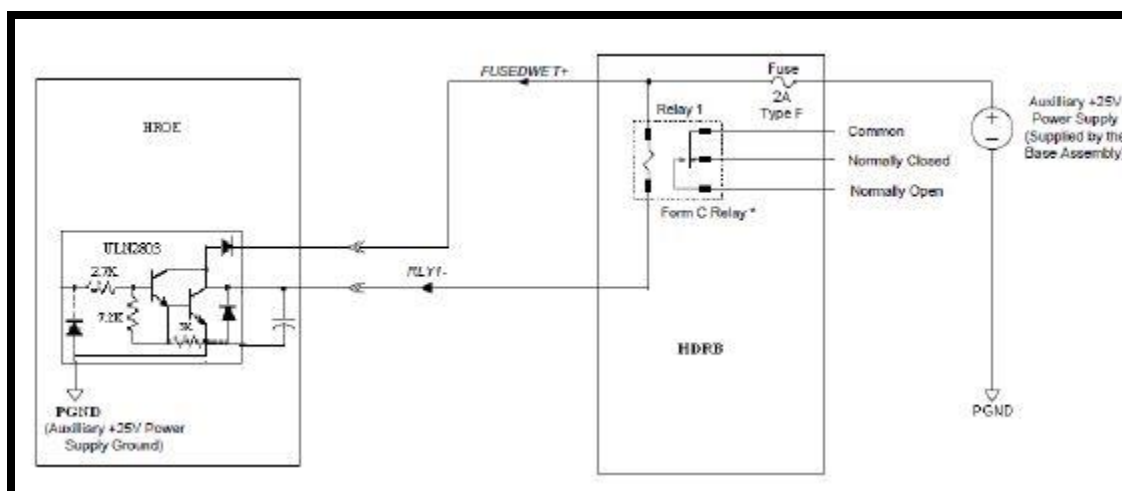


Figure 126: 32 Channel non-fused relay base assembly field wiring

29.9 32 Channel fused relay base field wiring information (HROE)

The following illustration is a field wiring diagram for the 32 Channel fused relay base.

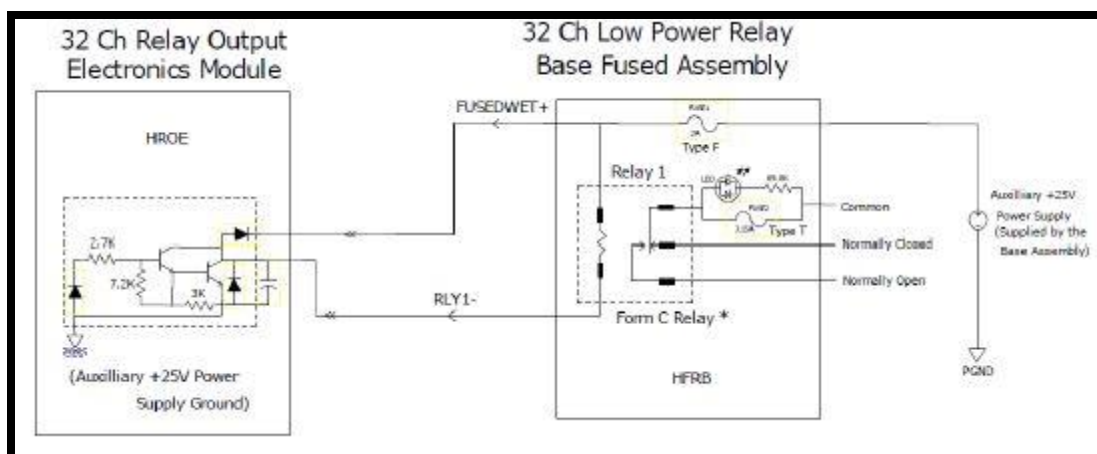


Figure 127: 32 Channel fused relay base field wiring information (HDROE)

29.10 Power supply requirement for the 32 Channel Relay output module (HROE)

The 32 Channel Relay Output Electronics module uses the standard main Ovation +24V power supply to energize the 32 Channel Relay Output Electronics Module.

The relay coils are energized by the standard Ovation +24V auxiliary power supply which is distributed throughout the standard Ovation bases as well as the 32 Channel Non-Fused Relay Base assemblies or the 32 Channel Fused Relay Base assemblies.

Main power to the 32 Channel Relay Output Electronics Module is fused with a holder on the 32 Channel Relay Output Electronics Module and is not user serviceable. Auxiliary power supplied to all 32 coils is fused on either the 32 Channel Non-Fused Relay Base assembly or the 32 Channel Fused Relay Base assembly by an integral cartridge fuse holder.

29.10.1 Voltage requirements

32 Channel Relay Output Electronics Module Voltage Requirements (+24V Main Power):

- Primary Voltage: 21V to 25V
- Back-up Voltage: 21V to 25V

SLIM Line Relays:

- Absolute Maximum Coil Supply Voltage = 28.8 VDC @ 20 degrees Celsius.

29.10.2 Power requirements

32 Channel Relay Output Electronics Module (5X00583G01)

- ☐ Main Input Power (maximum) : 102 mA @ 25.5 VDC, 2.6 W
- ☐ Main Input Power (all channels on) : 82 mA @ 24VDC, 2 W
- ☐ Auxiliary Input Power (maximum): 58 mA @ 25.5 VDC, 1.5 W
- ☐ Auxiliary Input Power (typical): 41 mA @ 24 VDC, 1.0 W

32 Channel Relay Base Non Fused Assembly (5X00584G01) - 32 1 Form C Relays included

- ☐ Input Power (maximum) : 588 mA @ 25.5 VDC, 15 W
- ☐ Input Power (typical) : 470 mA @ 24 VDC, 11.3 W

32 Channel Relay Base Fused Assembly (5X00623G01) - 32 1 Form C Relays included

- ☐ Input Power (maximum) : 588 mA @ 25.5 VDC, 15 W
- ☐ Input Power (typical) : 470 mA @ 24 VDC, 11.3 W

One Form C Relay: Panasonic APF30224 –SLIM Line Relay

- ☐ Input Power (maximum): 8.75 mA @ 25.5 VDC, 0.223 W
- ☐ Input Power (typical): 7 mA @ 24 VDC, 0.168 W

29.11 Configuration register information (HROE)

The controller writes the module configuration to a register located at address offset DH. The bits are defined as follows:

- Bit 0: Configured (active high)
- Bit 1: Forced Error (active high)
- Bit 2: Communication Timeout Bit 0
- Bit 3: Communication Timeout Bit 1
- Bit 4: Communication Timeout Bit 2
- Bit 5: Don't reset outputs on a communications timeout (active high)
- Bit 6: Not Used
- Bit 7: Enable blown fuse detection circuit (active high)
- Bit 8-15: Not Used

The controller configures the module by writing a "1" to bit 0 of the configuration register. Once configured, it remains configured until a power up/down reset is generated. After a power up condition the configuration register is cleared.

When bit 0 is set, the module is configured and registers may be accessed and properly return correct data values.

When bit 0 is not set, the module is not configured and any accesses to registers with offsets less than 0CH will result in data being returned as all 1's within each register (Attention). Registers with offsets 0CH-0FH respond normally when accessed.

When bit 1 is set, the internal error LED is turned on and data registers with offsets less than 0CH can be written but not properly read. This is because accesses to registers with offset 0CH and less will result in data being returned as all 1's within each register when this bit is set (Attention).

Bits 2, 3, and 4 are used to select the communication timeout period.

When bit 5 is set, the relay outputs hold their last state on a communications watchdog timeout.

When bit 5 is cleared, the relay outputs are cleared (output transistor is shut off and the relays are de-energized) on a communications watchdog timeout.

When bit 7 is set the blown fuse detection circuitry is enabled.

29.12 Status register information (HROE)

The controller reads the module status from a 16 bit status register located at address offset DH. The bits are defined as follows:

- Bit 0: Configured (active high)
- Bit 1: Forced Error (active high)
- Bit 2: Communication Timeout Bit 0
- Bit 3: Communication Timeout Bit 1
- Bit 4: Communication Timeout Bit 2
- Bit 5: Do not reset outputs on a communications timeout (active high)
- Bit 6: Indicates the status of the blown fuse detection circuit. (high => Aux supply fuse is blown).
- Bit 7: Enable blown fuse detection circuit bit (active high)

Additionally, the 32 Channel Non Fused Relay Output Base Assembly (HDRB) & 32 Channel Fused Relay Output Base Assembly straps three bits in hardware to identify a high density base assembly which uniquely distinguishes the high density assemblies from other existing relay base assemblies.

The status can be read from bits 8, 9, and 10 at the register located at offset DH. The remaining bits 11-15 are not used by the module but the FPGA assigns them to a 0 state.

Bits 8 through 10

	BITS 8	BIT 9	BIT 10
Base Type	Base ID0	Base ID1	Base ID2
HDRV / HFRB	1	0	1

29.13 Channel Relay Output Emod Addressing

The 32 Channel Relay Output Electronics Module is addressed as follows with PE not active (low).

OFFSET	WRITE	READ
0H	Relay Output Status (0-15)	Relay Output Status
1H	Relay Output Status (16-32)	Relay Output Status
2H-CH	Not used	Not used
DH	Module Configuration	Module Status
EH	Not used	Not used
FH	Not used	Electronics ID

- With PE active (high), the controller can program the Electronic ID. .
- The 32 channel relay output electronics module will also respond to several group write addresses which are used to read the Electronic ID from EEPROM.

Operation is defined in the Ovation Backplane Interface Design Specification (16DS033).

29.14 Channel Relay Output Emod Register (HROE)

The controller writes the desired relay output value to a 16 bit register located at offset 00H and 01H. The bit positions are defined as follows:

REGISTER 00H (RELAY OUTPUT 1 - 16)	REGISTER 01H (RELAY OUTPUT 17 - 32)
Bit 15 : Relay Output 16	Bit 15 : Relay Output 32
Bit 14 : Relay Output 15	Bit 14 : Relay Output 31
Bit 13 : Relay Output 14	Bit 13 : Relay Output 30
Bit 12 : Relay Output 13	Bit 12 : Relay Output 29
Bit 11 : Relay Output 12	Bit 11 : Relay Output 28
Bit 10 : Relay Output 11	Bit 10 : Relay Output 27
Bit 9 : Relay Output 10	Bit 9 : Relay Output 26
Bit 8 : Relay Output 9	Bit 8 : Relay Output 25
Bit 7 : Relay Output 8	Bit 7 : Relay Output 24
Bit 6 : Relay Output 7	Bit 6 : Relay Output 23
Bit 5 : Relay Output 6	Bit 5 : Relay Output 22
Bit 4 : Relay Output 5	Bit 4 : Relay Output 21
Bit 3 : Relay Output 4	Bit 3 : Relay Output 20
Bit 2 : Relay Output 3	Bit 2 : Relay Output 19
Bit 1 : Relay Output 2	Bit 1 : Relay Output 18
Bit 0 : Relay Output 1	Bit 0 : Relay Output 17

A "1" written to one of the bit positions turns ON the corresponding output transistor; therefore, the output relay is energized along with the status LED. Writing a "0" to one of the bit positions turns OFF the corresponding output transistor and therefore de-energizes the output relay along with the status LED.

The controller can also read the status of this register at offset 00H and 01H to verify the current state of the outputs.

29.15 Communication timeout (HROE)

The controller selects the communications timeout period by writing to bits 2-4 of the configuration register (offset DH). The bit status and the corresponding timeout periods are listed below:

Communication Timeout Settings

TIMEOUT BIT 2	TIMEOUT BIT 1	TIMEOUT BIT 0	TIMEOUT PERIOD
0	0	0	16 seconds
0	0	1	4 seconds
0	1	0	2 seconds
0	1	1	1 second

TIMEOUT BIT 2	TIMEOUT BIT 1	TIMEOUT BIT 0	TIMEOUT PERIOD
1	0	0	500 milliseconds
1	0	1	250 milliseconds
1	1	0	125 milliseconds
1	1	1	62.5 milliseconds
Time-outs have a tolerance of +/- 35%. The default after a power-up is 16 seconds.			

Note: After a power up condition the 16 second timeout period is automatically selected. The communications timer is reset on either a read or a write from/to the relay output module.

29.16 Blown fuse detection circuit (HROE)

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it gives a visual indication of the status via the EXTERNAL ERROR LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 18VDC and 25.5VDC, the circuit indicates the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register.

If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

In summary, this feature is specified to operate as follows:

- $18\text{ VDC} \leq \text{Field supply voltage} \leq 25.5\text{VDC}$ = Fuse is OK
- $0.4\text{ VDC} < \text{Field supply voltage} < 18\text{VDC}$ = UNDEFINED
- $\text{Field supply voltage} \leq 0.4\text{VDC}$ = Fuse is blown

Note: After a powering reset, the blown fuse detection circuit is disabled. System level configuration software must set the respective configuration bit if blown fuse detection is desired.

29.17 Diagnostic LEDs (HROE)

Diagnostic logic card LED's (for fused and non fused assemblies)

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the communication watchdog timer is not timed out.
E (Red)	External Fault LED. Lit when the auxiliary supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register) is active (high) or when the watchdog timer is timed out.

LED	DESCRIPTION
1 - 32 (Green) Emod LEDs	Each output has an associated green LED on the Emod that indicates the state of the output. (24V Main power.) ▪ If the LED is lit, this indicates that the output is in the ON state. (Output relay is energized.) ▪ If the LED is not lit, this indicates that the output is in the OFF state.
1 - 32 (Red) Relay Base Coil state	Indicates the state of the relay coil. Located on the Relay Base assembly, each relay coil has an associated red LED. ▪ If the LED is lit, this indicates that the output is in the ON state. (Output relay is energized.) ▪ If the LED is not lit, this indicates that the relay coil is in the OFF state.
1 - 32 (Red) Relay Base Blown fuse detection	Indicates the status of the channel fuse. (24V Auxiliary power.) ▪ If the LED is lit, this indicates that the channel fuse is blown. (Output relay is energized.) ▪ If the LED is not lit, this indicates that the output channel is operational and is operating normally. The channel fuse is in series with the common or "C" terminal connection on each channel.

29.18 Specifications (HROE)

Relay Output Electronics module specifications (5X00583)

DESCRIPTION	VALUE
Number of channels	32
Blown fuse detection ¹ Operating voltage range	18 VDC ≤ Auxiliary supply voltage ≤ 25.5 VDC Max, Fuse is OK 0.4 VDC < Auxiliary supply voltage < 18 VDC, UNDEFINED Auxiliary supply voltage ≤ 0.4 VDC, Fuse is blown <i>Note: After a power-on reset, the blown fuse detection circuit is disabled. System level configuration software must set the respective configuration bit if blown fuse detection is desired.</i>
Module power	Main: 1.88 W typical, 2.5 W Maximum Auxiliary: 0.3 W typical, 0.35 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ You can configure the module to enable/disable the blown fuse detection function.	

Non-fused Relay Output Base Specifications (5X00584) and Fused (5X00623)

DESCRIPTION	VALUE
Number of relays	32
Relay Type	G2R electromechanical style with 1 Form C contact style

DESCRIPTION	VALUE
Relay contact ratings ³	10 amps @250 VAC, PF=1 10 amps @30 VDC
Maximum propagation time	Operate time: 15 mSec, bounce approximately = 3 mSec Release time: 10 mSec, bounce approximately = 8 mSec
Dielectric isolation: Channel to Channel Relay contacts to logic	2200 Vrms Dielectric withstand for 1 min, Relay contacts to logic. 2200 Vrms Dielectric withstand for 1 min, Relay channel to Relay channel. 1000 Vrms Dielectric withstand for 1 min, between individual channel traces on any given channel. 500 Vrms for 1 minute 32 Channel Relay Base (aux. power to logic).
Surge withstand capability	ANSI/IEEE C37.90.1-2002 Surge Withstand Capability (At the relay contacts). -ANSI/IEEE C37.90.1-2002 specifies two different waveforms. The first is the oscillatory waveform and the second is the fast transient waveform. - IEC 61000-4-4 Electromagnetic compatibility (EMC) –Electrical Fast Transient/Burst Immunity Test (1000V). - IEC 61000-4-5-2004 Electromagnetic compatibility (EMC) –Surge Withstand Immunity Test (1000V).
Relay base power	Auxiliary power: 9.1 W typical, 11.68 W Maximum
Auxiliary power supply ¹	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum@60°C
Operating temperature range ²	0 to 60°C (32°F to 140°F)
Storage temperature range	-40 to 85°C (-40°F to 185°F)
Operating temperature	40 to 85°C (-40°F to 185°F) @ 25.5 VDC max
SLIM-Line Relays Operating temperature	-40 to 85°C (-40°F to 185°F) @ 25.5 VDC max
SLIM-Line Storage Relays temperature	-40 to 85°C (-40°F to 185°F)
Power Supply voltage Main and Auxiliary	Minimum 21.0 Nominal 24.0 Maximum 25.0
Vibration	0.15mm displacement from 10 to 57 Hz and 2G's from 57 to 500 Hz
Shock	15 G's for 11 millisecond and 1/2 sine wave.
Humidity (non-condensing)	0 to 95% with a maximum wet bulb not over 35 degrees C (95 degrees F)
¹ Use of the internal Ovation auxiliary power supply is recommended for relay output modules. ² See additional application derating (see page 546) information. ³ 1A @240 VAC 300,000 operations IEC 61131-2 applications. No DC ratings considered.	

SECTION 30

Relay Output module - (RO)

IN THIS SECTION

<i>Relay Output overview - (RO)</i>	518
<i>Electronics modules (Emod) - (RO)</i>	518
<i>Base assemblies - (RO)</i>	518
<i>Panel kits - (RO)</i>	519
<i>External power supply information (RO)</i>	519
<i>Using bases (RO)</i>	520
<i>Terminal block wiring information (RO)</i>	521
<i>Base unit layouts - (RO)</i>	522
<i>Field connection wiring diagrams for the Relay Output module</i>	524
<i>Field connection wiring diagrams (CE Mark) - (RO)</i>	525
<i>Configuration/Status Register information - (RO)</i>	526
<i>Blown fuse detection circuit (RO)</i>	528
<i>Diagnostic Logic card LEDs (RO)</i>	528
<i>Specifications - (RO)</i>	528

30.1 Relay Output overview - (RO)

An Ovation Relay Output module consists of an Electronics module, a base assembly, and relays. The Relay Output module provides a means to switch high AC voltages at high currents to field devices. There are two versions of the Relay Output base assembly which contain either 12 or 16 relays within each base. The 12 Relay Output base assembly provides the additional advantage of being able to switch larger DC voltages at high currents.

Each Relay Output base assembly incorporates an integral Relay Output Electronics module to interface between the relays and the Ovation I/O Controller. The Relay Output Electronics module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Relay Output module is a CE Mark certified module.

Note: I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.

30.2 Electronics modules (Emod) - (RO)

- **1C31219G01** provides an interface between the Ovation Controller and the mechanical relays that are used to switch high AC voltages at high currents. This module plugs into the Relay Output base assembly.

Note: The Relay Output base assembly does not incorporate a Personality module.

30.3 Base assemblies - (RO)

There are two different styles of Relay Output with Contact Monitoring base assemblies:

- **5X00564G01** is configured with 16 Form C (G2R style) relays which switch high AC voltages at high currents. Each relay contains one Form C contact arrangement which is brought to terminal blocks for user connections.
- **5X00564G02** is configured at the project level with either 12 Form C (KUEP style) or 12 Form X (KUEP style) relays which switch high AC and DC voltages at high currents.

In the case of the Form C relay, only one of the contact pairs within the relay is available at the terminal blocks for user connection. The KUEP style relay bases (1C31222G01) have the advantage of being able to switch larger DC voltages at higher currents than the G2R style relay bases (1C31223G01).

Relay contact ratings must be adhered to when utilizing the Relay Output module Assemblies. The application must include external current limiting protection for the Relay Output module Assemblies.

30.4 Panel kits - (RO)

There are several different styles of Relay Output panel kits:

- **5A26457G01** contains a Relay Output Electronics module a relay output base assembly, and 16 Form C relays (G2R style).
- **5A26458G01** contains a Relay Output Electronics module, a relay output base assembly, and 12 Form C relays (KUEP style).
- **5A26458G02** contains a Relay Output Electronics module, a relay output base assembly, and 12 Form X relays (KUEP style).
- **5A26458G03** contains a Relay Output Electronics module, and a relay output base assembly. This is a project-specific base assembly in which the project determines the mix of the Form C and Form X relays on a panel. The KUEP Form C relay is 4960A71H16 and the KUEP Form X relay is 4960A71H05.
- **5A26458G04** contains a Relay Output Electronics module, a relay output base assembly, and 12 Form C relays (KUEP style) and labeled with the country of assembly.
- **5A26458G05** contains a Relay Output Electronics module, a relay output base assembly, and 12 Form X relays (KUEP style) and labeled with the country of assembly.

CAUTION! When using the Relay Output Base Assemblies, the Power Distribution Module (5X00489G01) must have the Main GND and AUX GND referenced together. Therefore, ensure that the Main grounding bar (J10) and AUX grounding bar (J11) are installed and referenced to earth on the Power Distribution Module.

Relay Output bases must be installed only on I/O branches containing +24V typical Aux power (before auctioneering diode drop within Ovation auxiliary power supply).

Do NOT install Relay Output modules/bases on the same branch with Ovation bases with different voltage wired as Aux power (for example, DI modules using 125V AC).

30.5 External power supply information (RO)

Emerson recommends that the Relay Output base assembly obtain relay coil voltage from the internal Ovation auxiliary power supplies. These supplies distribute power through the Controller backplane and ROP panel to base assemblies. Use of external power supplies for relay coil power is **NOT** recommended.

30.6 Using bases (RO)

Proper relay operation is temperature dependent and is determined by the following:

- Temperature rise of the coil after being energized for extended periods.
- Temperature rise of the coil due to large relay contact currents.
- Ambient temperature.

The following table provides general user guidelines which can be referenced when configuring cabinets with Relay Output bases.

Operating Temperature Summary for Relay Output Bases

CABINET TYPE	AMBIENT CABINET OPERATING TEMPERATURE	RELAY BASE STYLE
Controller	0 to 50°C (32 to 122°F)	G2R
Extended I/O	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W Maximum	G2R
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W Maximum	G2R
Controller	0 to 50°C (32 to 122°F)	KUEP Form X
Extended I/O	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W Maximum	KUEP Form X
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W Maximum	KUEP Form X
Controller	0 to 40°C (32 to 104°F)	KUEP Form C
Extended I/O	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Ventilated)	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Sealed)	0 to 35°C (32 to 95°F) @ 175 W Maximum	KUEP Form C
Remote I/O (Sealed)	0 to 25°C (32 to 77°F) @ 225 W Maximum	KUEP Form C

30.7 Terminal block wiring information (RO)

Each relay base assembly employs terminal blocks which are permanently marked with appropriate relay contact designations at each position. The terminal block marking indicates how field wiring is connected to each terminal block position in the respective relay base assemblies.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

The terminal block markings for the G2R style Relay Output base assembly and for the KUEP style Relay Output base assemblies are illustrated below. The following table lists and defines the abbreviations used in those diagrams.

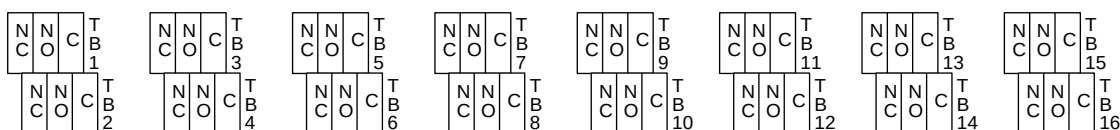
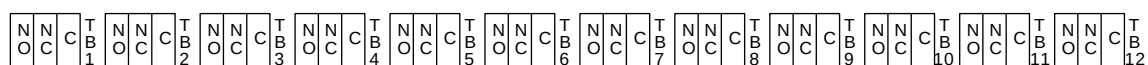
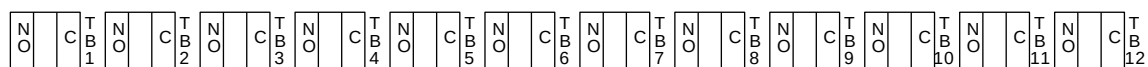


Figure 128: Terminal Block Connections for the G2R Relay Output Base Assembly



Form C Relays Installed



Form X Relays Installed

Figure 129: Terminal Block Connections for the KUEP Relay Output Base Assembly

Abbreviations Used in Wiring Diagrams

ABBREVIATION	DEFINITION
NC ¹	Normally Closed contact connection
NO	Normally Open contact connection
C	Common contact connection
¹ Do NOT use the NC terminal position when using the KUEP style base assembly with a Form X style relay inserted. The terminal position should remain unconnected.	

30.8 Base unit layouts - (RO)

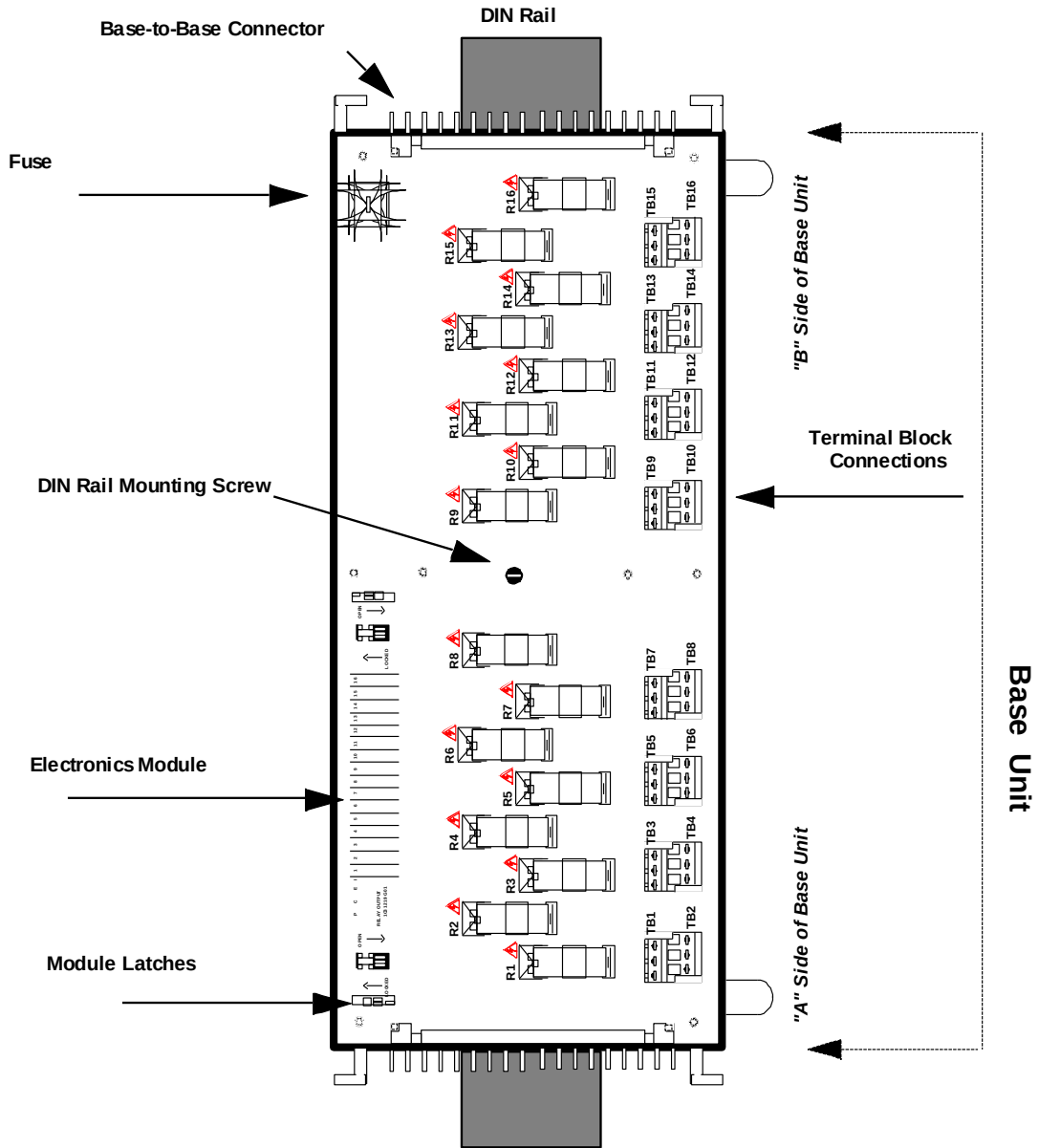


Figure 130: Relay Output Panel G2R

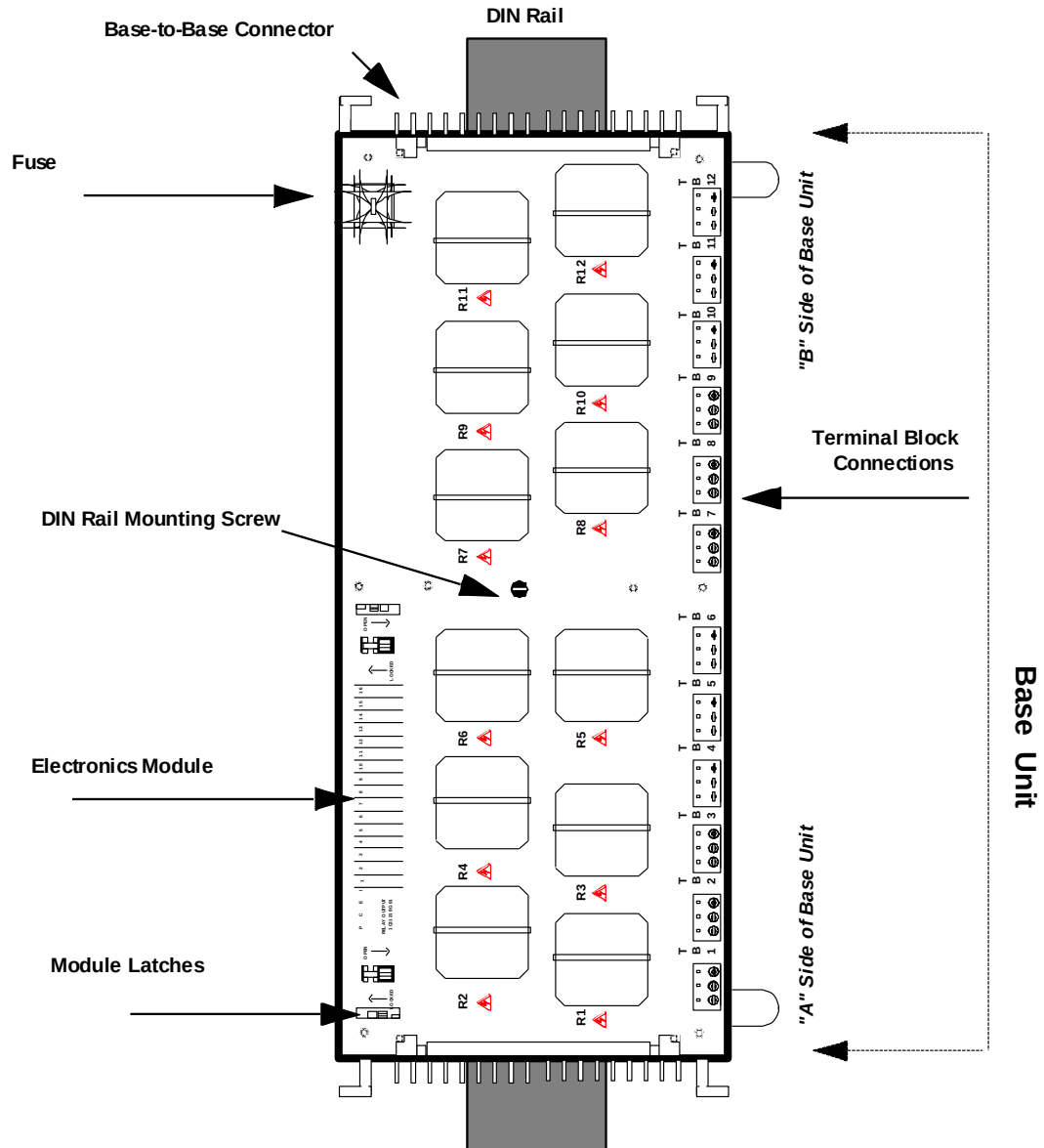


Figure 131: Relay Output KUEP

30.9 Field connection wiring diagrams for the Relay Output module

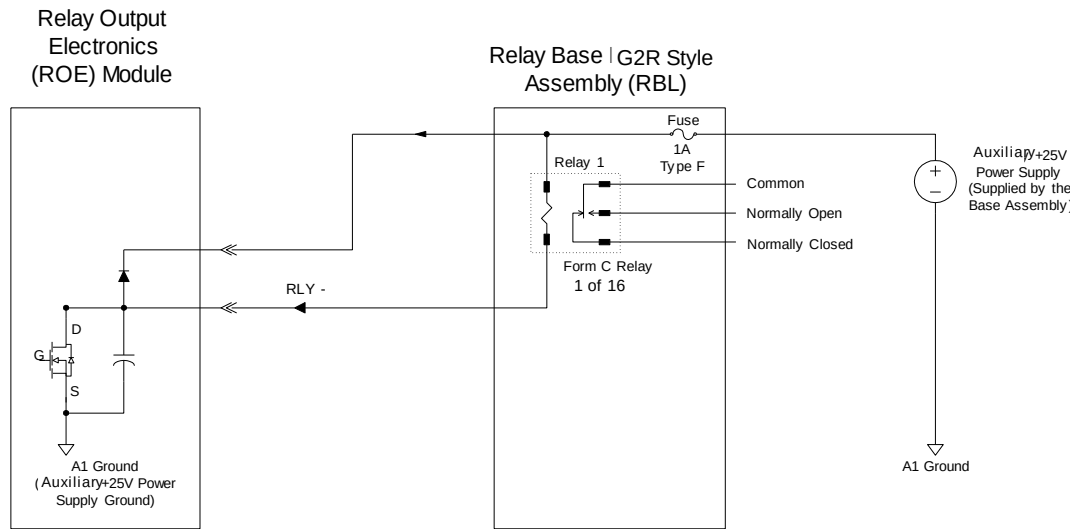


Figure 132: Relay Base G2R Style Assembly Field Wiring

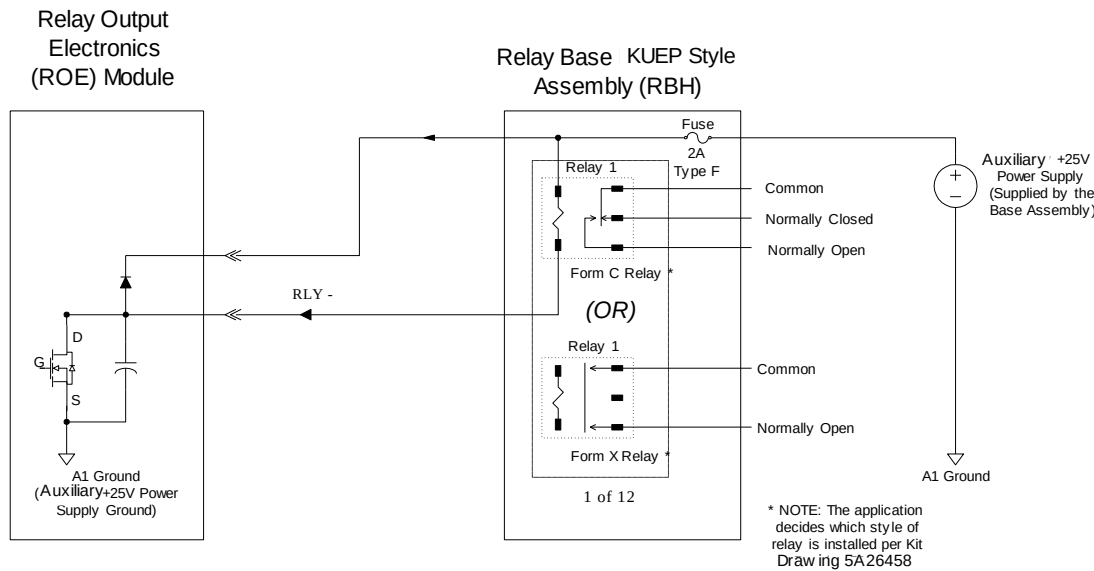


Figure 133: Relay Base KUEP Style Assembly Field Wiring

30.10 Field connection wiring diagrams (CE Mark) - (RO)

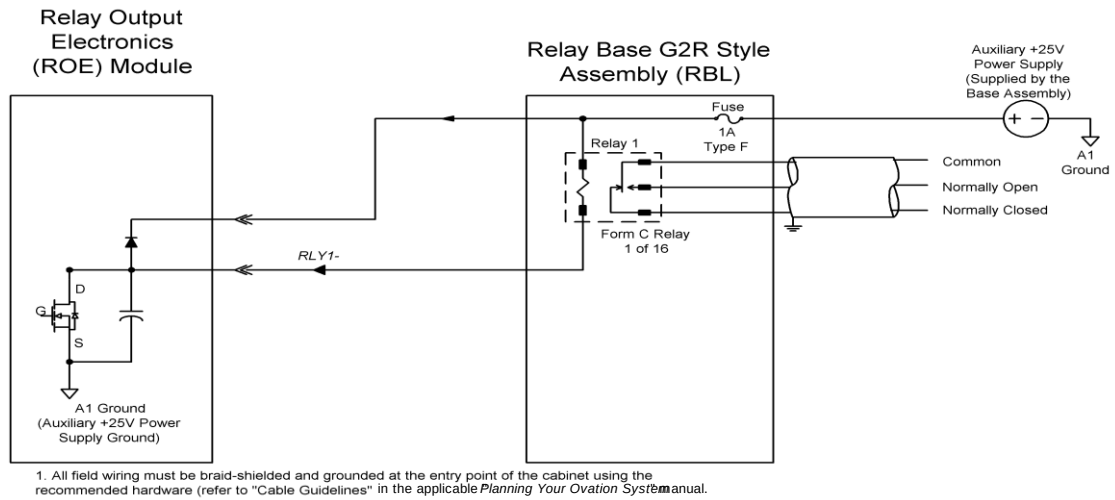


Figure 134: Relay Base G2R Style Assembly Field Wiring (CE Mark)

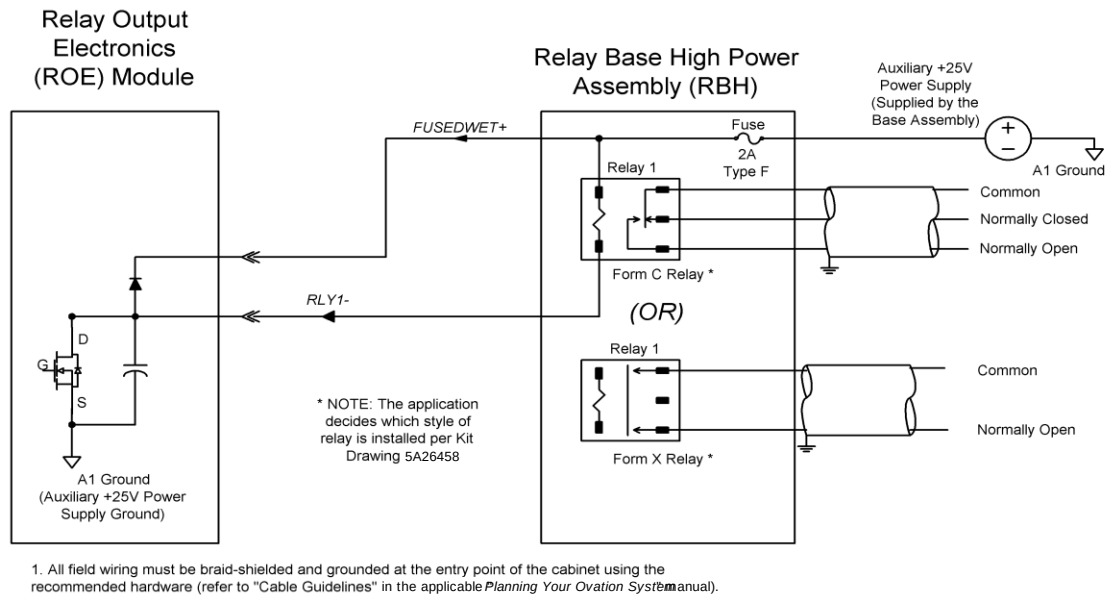


Figure 135: Relay Base KUEP Style Assembly Field Wiring (CE Mark)

30.11 Configuration/Status Register information - (RO)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). Refer to the *(Ovation Operator Station User Guide.)*

Relay Output configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)																																																																								
0	Configured (active high)	Configured (active high) (1 = configured; 0 = unconfigured)																																																																								
1	Forced Error (active high)	Forced Error (active high) (1 = forced error; 0 = no forced error)																																																																								
2 - 4	Communications Timeout Setting ¹	Communications Timeout Setting ¹																																																																								
	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec.</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec.</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec.</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec.</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec.	1	0	1	250 millisec.	1	1	0	125 millisec.	1	1	1	62.5 millisec.	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec	1	0	1	250 millisec	1	1	0	125 millisec	1	1	1	62.5 millisec
	BIT 4	BIT 3	BIT 2	TIMEOUT																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 millisec.																																																																						
	1	0	1	250 millisec.																																																																						
	1	1	0	125 millisec.																																																																						
1	1	1	62.5 millisec.																																																																							
BIT 4	BIT 3	BIT 2	TIMEOUT																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisec																																																																							
1	0	1	250 millisec																																																																							
1	1	0	125 millisec																																																																							
1	1	1	62.5 millisec																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)																																																																								
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)																																																																								
7	Enable blown fuse detection circuit (active high)	Enable blown fuse detection circuit (active high)																																																																								
8	Not used	Base ID0 Bit ² (Set by the Base Assembly)																																																																								
9	Not used	Base ID1 Bit ² (Set by the Base Assembly)																																																																								
10	Not used	Base ID2 Bit ² (Set by the Base Assembly)																																																																								
11 - 15	Not used	Not used																																																																								

¹ The tolerance on the timeout period is +/- 35%.

² Refer to the following table for Base ID values.

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a “1” to Bit 0 of the configuration register. Once configured, it remains configured until a power-up/down reset is generated. After a power-up condition, the configuration register clears.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit. When Bit 6 of the status register is set, the field supply fuse is blown.

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

Bits 8-10: The Base Assembly (KUEP or G2R style) straps three bits in hardware which identify which type of base the ROE is plugged into. The type of base can therefore be determined from reading these bits.

Bits 11-15: Not used.

CAUTION! This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system.

Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

Relay Output Base ID Bits

BIT 10 (BASE ID2)	BIT 9 (BASE ID1)	BIT 8 (BASE ID0)	BASE TYPE
0	0	0	KUEP Style
0	0	1	G2R Style
All others	All others	All others	Reserved for Future Use

30.12 Blown fuse detection circuit (RO)

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it gives a visual indication of the status via the EXTERNAL ERROR LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 18VDC and 25.5VDC, the circuit indicates the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

In summary, this feature is specified to operate as follows:

- $18\text{ VDC} \leq \text{Field supply voltage} \leq 25.5\text{VDC}$ = Fuse is OK
- $0.4\text{ VDC} < \text{Field supply voltage} < 18\text{VDC}$ = UNDEFINED
- $\text{Field supply voltage} \leq 0.4\text{VDC}$ = Fuse is blown

Note: After a powering reset, the blown fuse detection circuit is disabled. System level configuration software must set the respective configuration bit if blown fuse detection is desired.

30.13 Diagnostic Logic card LEDs (RO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 526) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 526)) is active or the Controller stops communicating with the module.
1 - 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

30.14 Specifications - (RO)

Relay Output Electronics module specifications (1C31219G01)

DESCRIPTION	VALUE
Number of channels	16
Blown fuse detection ¹ Operating voltage range	$18\text{V} \leq \text{auxiliary supply voltage} \leq 25.5\text{V}$

DESCRIPTION	VALUE
Module power	Main: 1.88 W typical, 2.5 W Maximum Auxiliary: 0.3 W typical, 0.35 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ You can configure the module to enable/disable the blown fuse detection function.	

Relay Output Base Specifications (1C31223G01, G2R Style)

DESCRIPTION	VALUE
Number of relays	16
Relay Type	G2R electromechanical style with 1 Form C contact style
Relay contact ratings ³	10 amps @250 VAC, PF=1 10 amps @30 VDC
Maximum propagation time	Operate time: 15 mSec, bounce approximately = 3 mSec Release time: 10 mSec, bounce approximately = 8 mSec
Dielectric isolation: Channel to Channel Relay contacts to logic	2300 VAC 2200 VAC
Relay base power	Auxiliary power: 9.1 W typical, 11.68 W Maximum
Auxiliary power supply ¹	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum@60°C
Operating temperature range ²	0 to 60°C (32°F to 140°F)
Storage temperature range	-40 to 70°C (-40°F to 158°F)
Humidity (non-condensing)	35 - 85%
¹ Use of the internal Ovation auxiliary power supply is recommended for relay output modules.	
² See additional application derating (see page 546) information.	
³ 1A @240 VAC 300,000 operations IEC 61131-2 applications. No DC ratings considered.	

Relay Output Base Assembly Specifications (1C31222G01, KUEP Style)

DESCRIPTION	VALUE
Number of channels	12
Relay Type	KUEP electromechanical style: 5A26458G01 Kit - 1 Form C contact type 5A26458G02 Kit - 1 Form X contact type 5A26458G03 Kit - Project specific

DESCRIPTION	VALUE
Relay contact ratings ³	Form C relays: 10 amps @240 VAC, PF=0.8 3 amps @150 VDC Form X relays: 10 amps @240 VAC, PF=0.8 10 amps @150 VDC
Typical propagation time	Operate time: 15 mSec, excluding bounce Release time: 10 mSec, excluding bounce
Dielectric isolation: Channel to Channel Relay contacts to logic	2300V AC 2200 VAC
Relay base power	Auxiliary power: 23.45 W typical, 30.1 W Maximum (5A26458G01 Kit - Form C relays) 15.9 W typical, 20.41 W Maximum (5A26458G02 Kit - Form X relays)
Auxiliary power supply ¹	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum @42°C (108°F) (Form C relays) 25.5V Maximum @60°C (140°F) (Form X relays)
Operating temperature range ²	0 to 45°C (32°F to 113°F) (5A26458G01 Kit - Form C relays) 0 to 60°C (32°F to 140°F) (5A26458G02 Kit - Form X relays)
Storage temperature range	KUEP X: -40 to 70°C (-40°F to 158°F) KUEP C: -40 to 50°C (-40°F to 122°F)
¹ Use of internal Ovation auxiliary power supply is recommended for Relay Output modules. ² See additional application derating information contained in <i>Using Relay Output Bases</i> (see page 546). ³ 1A @240 VAC 100,000 operations IEC 61131-2 applications. No DC ratings considered.	

SECTION 31

Relay Output with Contact Monitoring - (ROCM)

IN THIS SECTION

<i>Relay Output with Contact Monitoring module overview - (ROCM).....</i>	<i>532</i>
<i>Electronics modules (Emod) - (ROCM).....</i>	<i>532</i>
<i>Base assemblies - (ROCM)</i>	<i>532</i>
<i>Emod and base assembly combinations - (ROCM).....</i>	<i>533</i>
<i>External power supply information - (ROCM)</i>	<i>533</i>
<i>Operating temperature - (ROCM)</i>	<i>533</i>
<i>Configuration/Status Register information - (ROCM).....</i>	<i>534</i>
<i>Base unit layouts - (ROCM)</i>	<i>536</i>
<i>Blown fuse detection circuit - (ROCM)</i>	<i>537</i>
<i>Contact input monitoring circuits - (ROCM)</i>	<i>537</i>
<i>Terminal block wiring information - (ROCM)</i>	<i>539</i>
<i>Field connection wiring diagram - (ROCM)</i>	<i>540</i>
<i>Diagnostic Logic card LEDs - (ROCM)</i>	<i>540</i>
<i>Specifications - (ROCM)</i>	<i>540</i>

31.1 Relay Output with Contact Monitoring module overview - (ROCM)

An Ovation Relay Output with Contact Monitoring (ROCM) module consists of an Electronics module, a base assembly, and relays. The Relay Output module provides a means to switch high AC voltages at high currents to field devices. It provides a single FORM X relay contact to drive the field devices. In addition, the module has two monitoring circuits per channel, which provide a feedback to the standard Ovation Contact Input module or Digital Input Module to indicate the contact state of the relay.

Each Relay Output with Contact Monitoring base assembly incorporates an integral Relay Output Electronics module to interface between the relays and the Ovation I/O Controller. The Relay Output Electronics module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Relay Output with Contact Monitoring contains shorting jumpers to enable or disable both contact monitoring circuits on a per channel basis. The Relay Output with Contact Monitoring contains the field terminal headers, which accept pluggable terminal blocks in either right angle screw compression or vertical crimp pin styles. In addition, the Relay Output with Contact Monitoring Base contains the contact monitoring terminal headers, which accept pluggable terminal blocks. The pluggable terminal blocks contain a screw hold down to the terminal header for mechanical stability.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

31.2 Electronics modules (Emod) - (ROCM)

- **1C31219G01** provides an interface between the Ovation Controller and the mechanical relays that are used to switch high AC voltages at high currents. This module plugs into the Relay Output base assembly.

Note: *The Relay Output base assembly does not incorporate a Personality module.*

31.3 Base assemblies - (ROCM)

There are two different styles of Relay Output with Contact Monitoring base assemblies:

- **5X00564G01** contains eight (8) high power relays that are pre-installed with Form X relays in the base assembly. The G01 does not have Field output or Contact monitoring output terminal blocks installed. This group is used for marshalling configurations with pre-terminated pluggable cable assemblies.
- **5X00564G02** accommodates eight (8) high power relays that are pre-installed with Form X relays in the base assembly. The G02 has Field output and Contact Monitoring terminal blocks installed. This group is used for direct customer terminations.

You must adhere to relay contact ratings when utilizing the Relay Output with Contact Monitoring module assemblies. The application must include external current limiting protection for the Relay Output with Contact Monitoring module assemblies.

31.4 Emod and base assembly combinations - (ROCM)

The following table depicts a clear definition of the valid electronics module and the base module:

MODULE DESCRIPTION	EMOD STYLE	BASE MODULE STYLE
Relay Output with Contact Monitoring Assembly, KUEP Form X, Marshalling (No terminal blocks installed).	1C31219G01	5X00564G01
Relay Output with Contact Monitoring Assembly, KUEP Form X, Customer Termination(Terminal blocks installed).	1C31219G01	5X00564G02

31.5 External power supply information - (ROCM)

Emerson recommends that the Relay Output with Contact Monitoring base assembly obtain relay coil voltage from the internal Ovation auxiliary power supplies. These supplies distribute power through the Controller backplane and ROP panel to base assemblies. Use of external power supplies for relay coil power is **NOT** recommended.

31.6 Operating temperature - (ROCM)

Proper relay operation is temperature dependent and is determined by the following:

- Temperature rise of the coil after being energized for extended periods.
- Temperature rise of the coil due to large relay contact currents.
- Ambient temperature.

The following table provides general user guidelines which can be referenced when configuring cabinets with High Power Relay Output with Contact Monitoring bases:

Operating Temperature Summary for Relay Output Bases

CABINET TYPE	AMBIENT CABINET OPERATING TEMPERATURE	RELAY BASE STYLE
Controller	0 to 50°C (32 to 122°F)	Relay Output with Contact Monitoring
Extended I/O	0 to 60°C (32 to 140°F)	Relay Output with Contact Monitoring
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	Relay Output with Contact Monitoring
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W Maximum	Relay Output with Contact Monitoring
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W Maximum	Relay Output with Contact Monitoring

31.7 Configuration/Status Register information - (ROCM)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). Refer to the (*Ovation Operator Station User Guide*.)

Relay Output configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)																																																																								
0	Configured (active high)	Configured (active high) (1 = configured; 0 = unconfigured)																																																																								
1	Forced Error (active high)	Forced Error (active high) (1 = forced error; 0 = no forced error)																																																																								
2 - 4	Communications Timeout Setting ¹	Communications Timeout Setting ¹																																																																								
	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec	1	0	1	250 millisec	1	1	0	125 millisec	1	1	1	62.5 millisec	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec	1	0	1	250 millisec	1	1	0	125 millisec	1	1	1	62.5 millisec
	BIT 4	BIT 3	BIT 2	TIMEOUT																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 millisec																																																																						
	1	0	1	250 millisec																																																																						
	1	1	0	125 millisec																																																																						
	1	1	1	62.5 millisec																																																																						
BIT 4	BIT 3	BIT 2	TIMEOUT																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisec																																																																							
1	0	1	250 millisec																																																																							
1	1	0	125 millisec																																																																							
1	1	1	62.5 millisec																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)																																																																								
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)																																																																								
7	Enable blown fuse detection circuit (active high)	Enable blown fuse detection circuit (active high)																																																																								
8	Not used	Base ID0 Bit ² (Set by the Base Assembly)																																																																								
9	Not used	Base ID1 Bit ² (Set by the Base Assembly)																																																																								
10	Not used	Base ID2 Bit ² (Set by the Base Assembly)																																																																								
11 - 15	Not used	Not used																																																																								

¹ The tolerance on the timeout period is +/- 35%.

² Refer to the following table for Base ID values.

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a "1" to Bit 0 of the configuration register. Once configured, it remains configured until a power-up/down reset is generated. After a power-up condition, the configuration register clears.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit. When Bit 6 of the status register is set, the field supply fuse is blown.

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

Bits 8-10: The Base Assembly (RBHI) straps three bits in hardware which identify which type of base the ROE is plugged into. The type of base can therefore be determined from reading these bits.

Bits 11-15: Not used.

CAUTION! This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system.

Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indicating a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any effect that change may have on the system. Under some conditions, a different timeout may cause the module to go into its respective fail-safe mode.

Relay Output Base ID Bits

BIT 10 (BASE ID2)	BIT 9 (BASE ID1)	BIT 8 (BASE ID0)	BASE TYPE
1	0	0	RBHI

31.8 Base unit layouts - (ROCM)

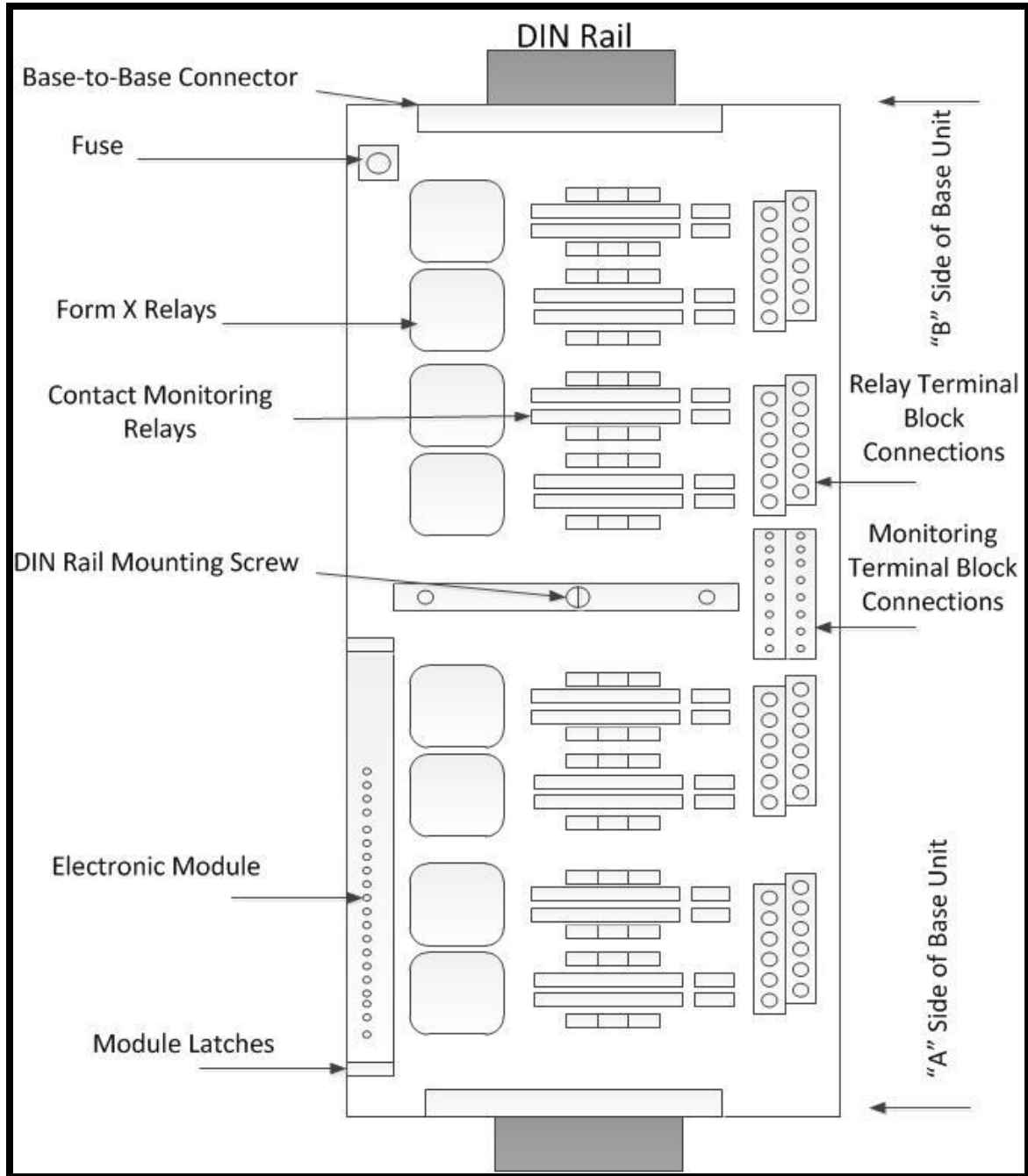


Figure 136: Relay Output with Contact Monitoring Panel

31.9 Blown fuse detection circuit - (ROCM)

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it gives a visual indication of the status through the EXTERNAL ERROR LED (see page 540).

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 18VDC and 25.5VDC, the circuit indicates the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

In summary, this feature is specified to operate as follows:

- $18\text{ VDC} \leq \text{Field supply voltage} \leq 25.5\text{VDC}$ = Fuse is OK
- $0.4\text{ VDC} < \text{Field supply voltage} < 18\text{VDC}$ = UNDEFINED
- $\text{Field supply voltage} \leq 0.4\text{VDC}$ = Fuse is blown

Note: After a powering reset, the blown fuse detection circuit is disabled. System level configuration software must set the respective configuration bit if blown fuse detection is desired.

31.10 Contact input monitoring circuits - (ROCM)

The High Power Relay Output with Contact Monitoring contains two monitor circuits that allow the Ovation system to detect the actual state of the relay output contact utilized to drive the connected field device. The two monitoring circuits are:

- Equipment Power Fail (EQPF): contains a 1 FORM A (NO) relay, which is closed when equipment power for that channel is present.
- Field Contact Monitor (CMON): contains a 1 FORM A (NO) relay, which is closed when the field circuit is open.

Both the EQPF and CMON circuits contain common mode surge capacitors and a normal mode Metal Oxide Varistor (MOV) to protect the channels against fast transients and surges. The normal mode MOV also provides protection against inductive kicks associated from inductive loads, which are driven by the field contacts.

Monitoring Circuit State Definitions

MONITOR CIRCUIT	MONITORING RELAY LOGIC STATE
EQPF	Monitor Relay Closed = Equipment Power Present Monitor Relay Open = Equipment Power Present , (<20 V)
CMON	Monitor Relay Closed = Field Contact Open Monitor Relay Open = Field Contact Closed

The channel off state is determined by the voltage drop of the monitor relay coil. The voltage drop resistance is specified at 6V or less for the drop out state. The lower operating limit for the channel monitoring circuits is 100 VAC or 100 VDC and the upper operating limit is 140VAC or 140 VDC.

Monitoring Circuit Operating Ranges

MONITOR CIRCUIT	THRESHOLD VALUE	CONDITION
EQPF	Voltage < 6VAC, VDC	Guaranteed Drop Off
CMON	100 < Voltage < or = 140 VAC, VDC	Proper operating range

When the Relay output is the de-energized state, the field contact monitor circuit generates a small leakage current through the load device. The operational load threshold value should be greater than the maximum value of the monitor circuit leakage. This condition should be verified before using the device to ensure proper operation.

Contact Monitoring Leakage Current

MONITOR CIRCUIT	THRESHOLD VALUE	CONDITION
CMON	I leakage = 8mA @ 140Vrms	Maximum
	I leakage = 5mA @ 140VDC	Maximum

The field contact monitor circuit detects current flow through the field device in its OFF state. Therefore, a small voltage drop occurs across the field device when this current flows. The field device is normally a low impedance device and there is a small impact on the voltage threshold to the monitor circuitry. However, there is a maximum allowable device loading specification to ensure proper monitor operation over the assembly operational parameters.

Contact Monitoring Load Specification

MONITOR CIRCUIT	THRESHOLD VALUE	CONDITION
CMON	Load Impedance = 500 ohms @ 100Vrms	Maximum
	Load Resistance = 3.5 Kohms @ 100VDC	Maximum

31.11 Terminal block wiring information - (ROCM)

Each relay base assembly employs terminal blocks which are permanently marked with appropriate relay contact designations at each position. The terminal block marking indicates how field wiring is connected to each terminal block position in the respective relay base assemblies.

The terminal block markings for the Relay Output with Contact Monitoring base assembly are illustrated below. The following tables list and define the abbreviations used in those diagrams.

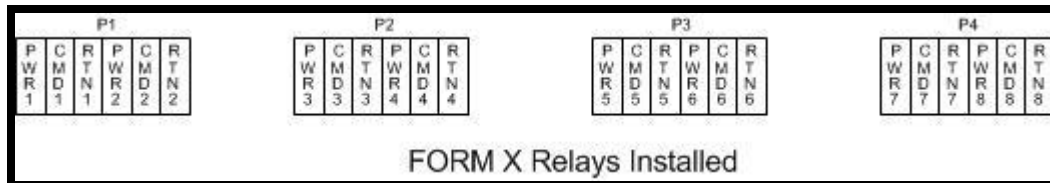


Figure 137: Terminal Block Connection for the Form X Relay Output with Contact Monitoring

Abbreviations Used in Wiring Diagrams

ABBREVIATION	DEFINITION
PWR	Equipment Power
CMD	Equipment Command
RTN	Equipment Power Return

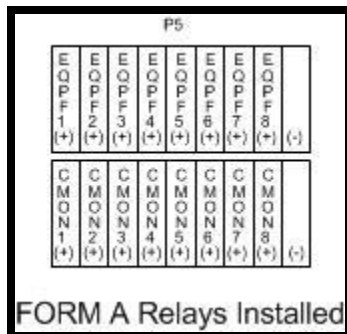


Figure 138: Terminal Block Connection for the Form A Relay Output with Contact Monitoring

Abbreviations Used in Wiring Diagrams

ABBREVIATION	DEFINITION
EQPF (+)	Equipment Power Fail signal (ON = Power Ok, OFF = Power Fail)
CMON (+)	Contact Monitor signal (ON = Form X Contact Open, OFF = Form X Contact Closed)
(-)	Return

31.12 Field connection wiring diagram - (ROCM)

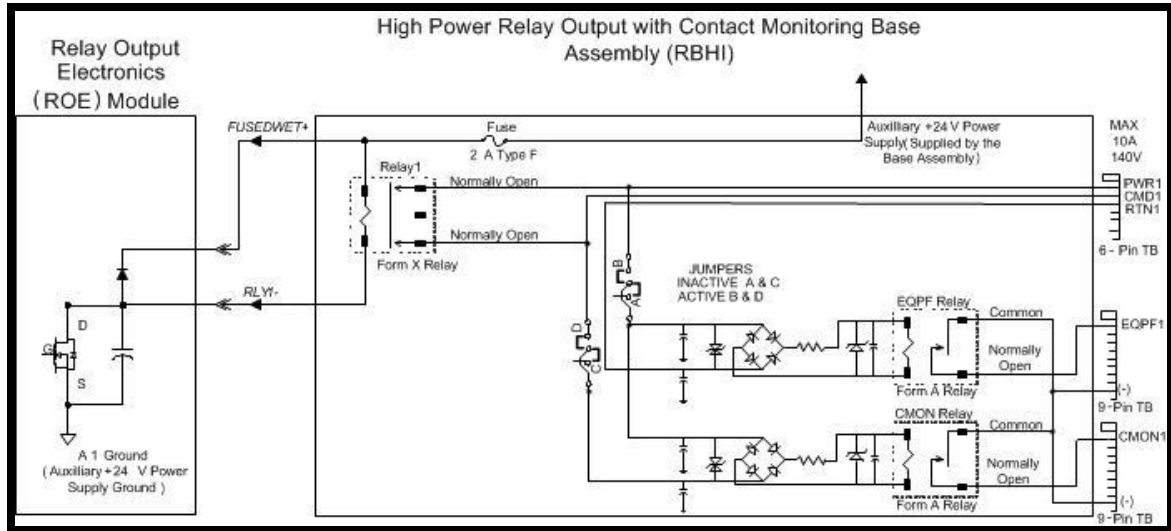


Figure 139: Relay Output with Contact Monitoring with Field Wiring

31.13 Diagnostic Logic card LEDs - (ROCM)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 534) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 534)) is active or the Controller stops communicating with the module.
1 - 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

31.14 Specifications - (ROCM)

Relay Output Electronics module specifications (1C31219G01)

DESCRIPTION	VALUE
Number of channels	16
Blown fuse detection ¹ Operating voltage range	$18V \leq \text{auxiliary supply voltage} \leq 25.5V$

DESCRIPTION	VALUE
Module power	Main: 1.88 W typical, 2.5 W Maximum Auxiliary: 0.3 W typical, 0.35 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ You can configure the module to enable/disable the blown fuse detection function.	

Relay Output Base Specifications (5X00564G01/5X00564G02)

DESCRIPTION	VALUE
Number of relays	8
Relay Type	KUEP Form X
Maximum propagation time	Operate time: 15 mSec, bounce approximately = 3 mSec Release time: 10 mSec, bounce approximately = 8 mSec
Dielectric isolation: Channel to Channel Relay contacts to logic	1350 VAC 1400 VAC
Relay base power	Auxiliary power: 10.2 W typical, 13.5 W Maximum
Auxiliary power supply ¹	24V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum@60°C
Operating temperature range ²	0 to 60°C (32°F to 140°F)
Storage temperature range	-40 to 70°C (-40°F to 158°F)
Humidity (non-condensing)	35 - 85%
¹ Use of the internal Ovation auxiliary power supply is recommended for relay output with contact monitoring module.	
² See additional application derating (see page 546) information.	

SECTION 32

Relay Output with Contact Monitoring (Fused) - (FRO)

IN THIS SECTION

<i>Fused Relay Output module overview - (FRO)</i>	544
<i>Electronics modules (Emod) - (RO)</i>	544
<i>Base assemblies - (FRO)</i>	545
<i>External power supply information - (FRO)</i>	545
<i>Using bases - (FRO)</i>	546
<i>Terminal block wiring information - (FRO)</i>	547
<i>Base unit layouts - (FRO)</i>	548
<i>Field connection wiring diagrams - (FRO)</i>	549
<i>Configuration/Status Register information - (FRO)</i>	550
<i>Blown fuse detection circuit - (FRO)</i>	552
<i>Diagnostic Logic card LEDs - (FRO)</i>	552
<i>Specifications - (FRO)</i>	552

32.1 Fused Relay Output module overview - (FRO)

The Ovation Fused Relay Output Assembly provides a means to switch high current and voltage devices located in the field. You have a choice between a fused low power relay output assembly and a fused high power relay output assembly for differing applications. The Fused Low Power Relay Output Assembly employs a 1 FORM C contact arrangement for driving field devices. The Fused High Power Relay Output Assembly allows a choice between a 1 FORM C or a 1 FORM X relay contact arrangement depending upon which KUEP form factor relay is installed.

The Fused Relay Output Bases provide the capability to provide contact wetting power from a common external wetting source or optionally isolate contact wetting on an individual channel basis. Additionally, the Fused Relay Output Bases incorporate individual channel fusing eliminating the need for additional external fusing. The Fused Relay Output Bases incorporate headers which accept pluggable terminal blocks in either right angle screw compression or vertical crimp pin styles.

A Ovation Fused Relay Output module consists of an Electronics module, a base assembly containing fuses and relays. The module provides a means to switch high AC voltages at high currents to field devices. There are two versions of the Fused Relay Output base assembly which contain either 12 or 16 relays within each base. The 12 Fused Relay Output base assembly provides the additional advantage of being able to switch DC voltages at high currents.

Each Fused Relay Output base assembly incorporates an integral Fused Relay Output Electronics module to interface between the relays and the Ovation I/O Controller. The Fused Relay Output Electronics module provides configurable communication timeout periods and LEDs to indicate the status of each output.

The Fused Relay Output Assembly incorporates a backward compatible addressing scheme so that it is compatible with existing I/O bases.

Note: *I/O Module General Information (see page 17) contains environmental, installation, wiring, and fuse information for I/O modules.*

Integral fusing elements are provided for the protection of the Fused Relay Output module assembly. The project shall ensure proper application of the panel with respect to applied powering scheme and integral fusing. Any additional components required for the installation shall be provided at the project level.

32.2 Electronics modules (Emod) - (RO)

- **1C31219G01** provides an interface between the Ovation Controller and the mechanical relays that are used to switch high AC voltages at high currents. This module plugs into the Relay Output base assembly.

Note: *The Relay Output base assembly does not incorporate a Personality module.*

32.3 Base assemblies - (FRO)

There are several different styles of Relay Output base assemblies:

- **5X00430G01** Fused High Power Relay Base Assembly, 12 Form C Relays included, No Output Termination Blocks Pre-Installed.
- **5X00430G02** Fused High Power Relay Base Assembly, 12 Form X Relays included, No Output Termination Blocks Pre-Installed.
- **5X00430G03** Fused High Power Relay Base Assembly, 12 Form C Relays included, Output Termination Blocks Pre-Installed.
- **5X00430G04** Fused High Power Relay Base Assembly, 12 Form X Relays included, Output Termination Blocks Pre-Installed.
- **5X00431G01** Fused Low Power Relay Base Assembly, 16 Form C Relays included, No Output Termination Blocks Pre-Installed.
- **5X00431G02** Fused Low Power Relay Base Assembly, 16 Form C Relays included, Output Termination Blocks Pre-Installed.

Fused Relay Output module Valid module combinations ¹

DESCRIPTION	RELAYS	ELECTRONICS MODULE	BASE UNIT ¹
Low power, Marshaling	16	1C31219G01	5X00431G01
Low power, blocks installed	16	1C31219G01	5X00431G02
High power, Form C, Marshaling	12	1C31219G01	5X00430G01
High power, Form X, Marshaling	12	1C31219G01	5X00430G02
High power, Form C, blocks installed	12	1C31219G01	5X00430G03
High power, Form X, blocks installed	12	1C31219G01	5X00430G04
¹ Relay Outputs do not use standard Ovation I/O bases. Use the listed base units for Relay Output applications. Also note that the Relay Output module does not use a Personality module.			

32.4 External power supply information - (FRO)

It is recommended that the Relay Output base assembly obtain relay coil voltage from the internal Ovation auxiliary power supplies. These supplies distribute power through the Controller backplane and ROP panel to base assemblies. Use of external power supplies for relay coil power is **NOT** recommended.

32.5 Using bases - (FRO)

Proper relay operation is temperature dependent and is determined by the following:

- Temperature rise of the coil after being energized for extended periods.
- Temperature rise of the coil due to large relay contact currents.
- Ambient temperature.

The following table provides general user guidelines which can be referenced when configuring cabinets with Relay Output bases.

Operating Temperature Summary for Relay Output Bases

CABINET TYPE	AMBIENT CABINET OPERATING TEMPERATURE	RELAY BASE STYLE
Controller	0 to 50°C (32 to 122°F)	G2R
Extended I/O	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	G2R
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W Maximum	G2R
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W Maximum	G2R
Controller	0 to 50°C (32 to 122°F)	KUEP Form X
Extended I/O	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Ventilated)	0 to 60°C (32 to 140°F)	KUEP Form X
Remote I/O (Sealed)	0 to 50°C (32 to 122°F) @ 175 W Maximum	KUEP Form X
Remote I/O (Sealed)	0 to 40°C (32 to 104°F) @ 225 W Maximum	KUEP Form X
Controller	0 to 40°C (32 to 104°F)	KUEP Form C
Extended I/O	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Ventilated)	0 to 45°C (32 to 113°F)	KUEP Form C
Remote I/O (Sealed)	0 to 35°C (32 to 95°F) @ 175 W Maximum	KUEP Form C
Remote I/O (Sealed)	0 to 25°C (32 to 77°F) @ 225 W Maximum	KUEP Form C

32.6 Terminal block wiring information - (FRO)

Each relay base assembly employs terminal blocks which are permanently marked with appropriate relay contact designations at each position. The terminal block marking indicates how field wiring is connected to each terminal block position in the respective relay base assemblies.

Note: For the Standard I/O Marshalling Base Unit, field terminations are located on the half shells and connected to the base. See Marshalling Base Unit (see page 30) for more information.

The terminal block markings for the G2R style Relay Output base assembly and for the KUEP style Relay Output base assemblies are illustrated below. The following table lists and defines the abbreviations used in those diagrams.

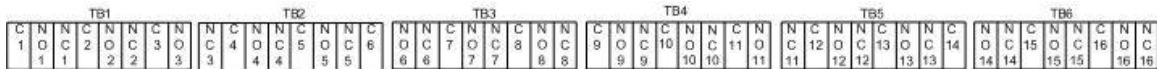


Figure 140: Terminal Block Connections for the Fixed Low Power Relay Output Base Assembly

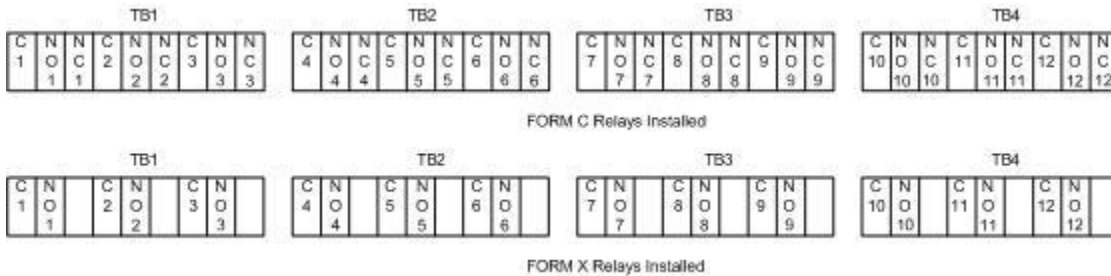
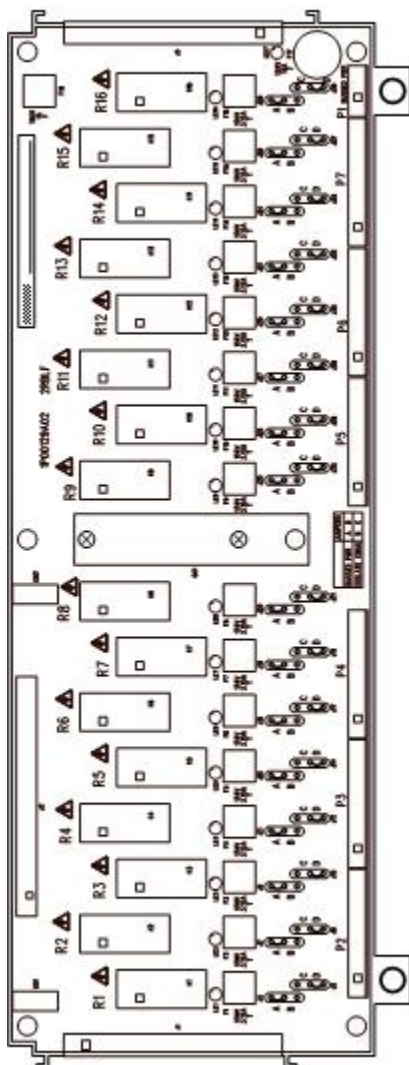


Figure 141: Terminal Block Connections for the Fixed High Power Relay Output Base Assembly

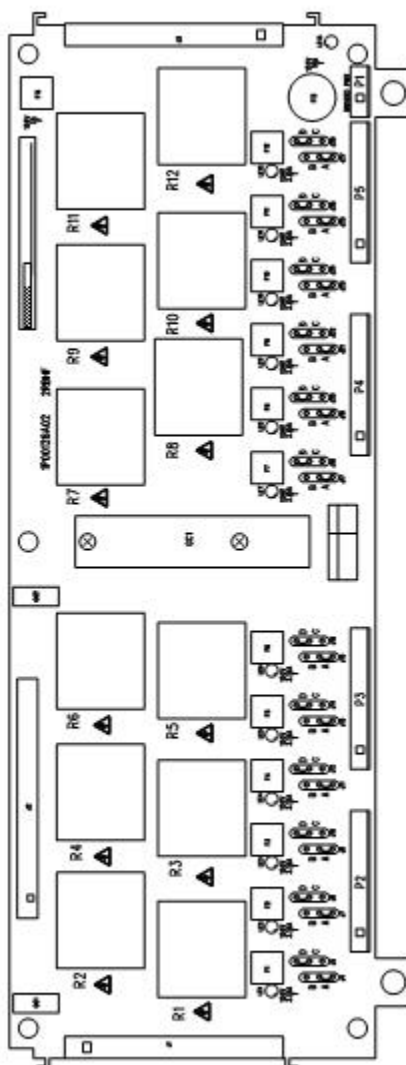
Abbreviations Used in Wiring Diagrams

ABBREVIATION	DEFINITION
NC ¹	Normally Closed contact connection
NO	Normally Open contact connection
C	Common contact connection
¹ Do NOT use the NC terminal position when using the KUEP style base assembly with a Form X style relay inserted. The terminal position should remain unconnected.	

32.7 Base unit layouts - (FRO)



G2R Style



KUEP Style

32.8 Field connection wiring diagrams - (FRO)

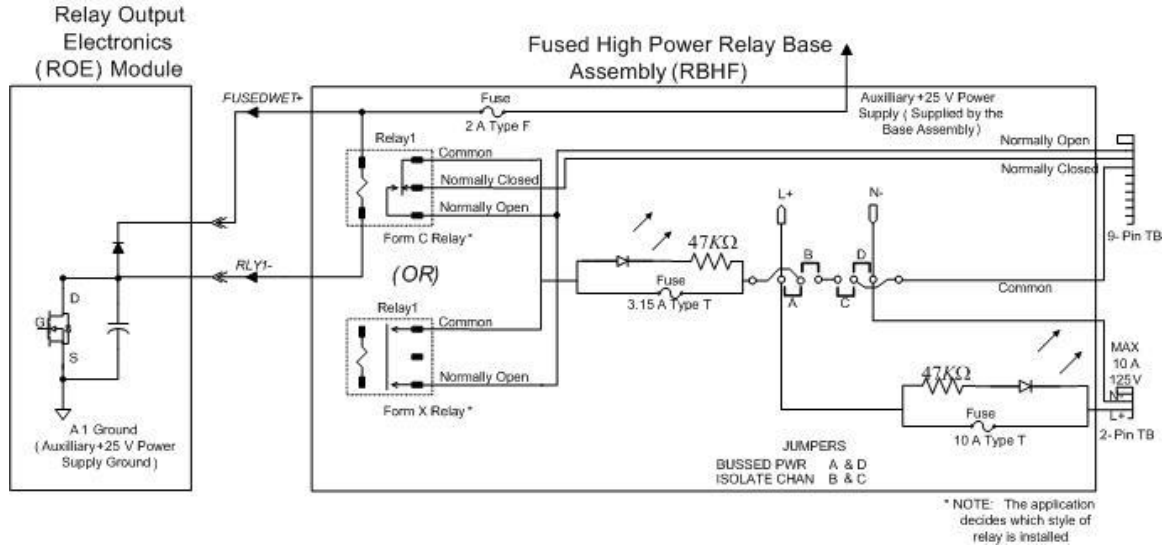


Figure 142: Fused high power relay output field wiring

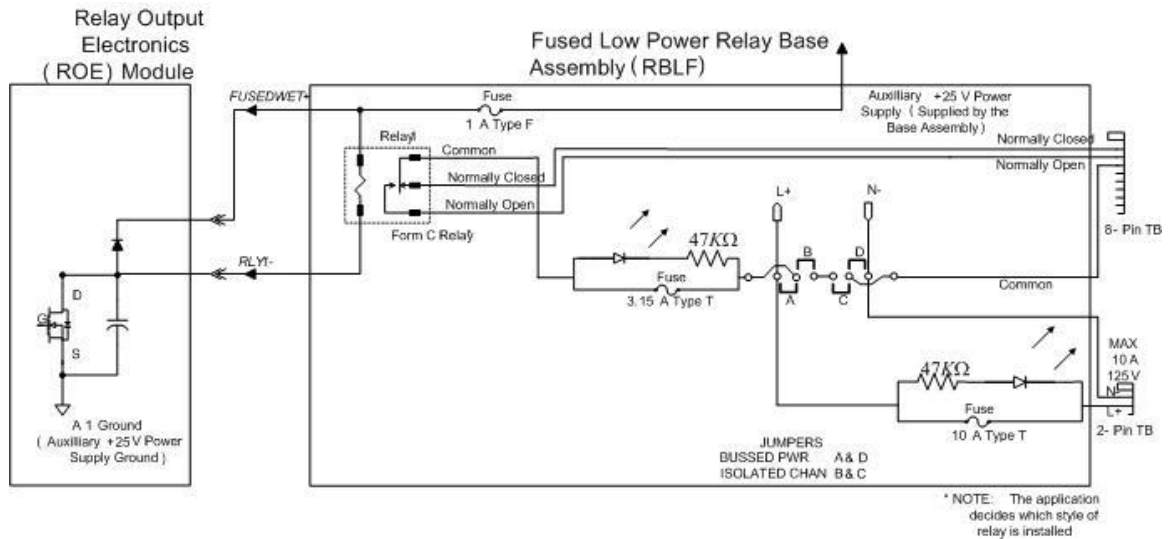


Figure 143: Fused low power relay output field wiring

32.9 Configuration/Status Register information - (FRO)

Word address 13 (D in Hex) is used to configure the module and provide status information to the Controller. The status register can be read by using the Point Information window at an Operator Station (see the Bit Pattern field on the Hardware tab). Refer to the (*Ovation Operator Station User Guide*.)

Relay Output configuration/status register (address 13 or D in Hex)

BIT	DATA DESCRIPTION - CONFIGURATION REGISTER (WRITE)	DATA DESCRIPTION - STATUS REGISTER (READ)																																																																								
0	Configured (active high)	Configured (active high) (1 = configured; 0 = unconfigured)																																																																								
1	Forced Error (active high)	Forced Error (active high) (1 = forced error; 0 = no forced error)																																																																								
2 - 4	Communications Timeout Setting ¹	Communications Timeout Setting ¹																																																																								
	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec	1	0	1	250 millisec	1	1	0	125 millisec	1	1	1	62.5 millisec	<table><tr><th>BIT 4</th><th>BIT 3</th><th>BIT 2</th><th>TIMEOUT</th></tr><tr><td>0</td><td>0</td><td>0</td><td>16 seconds</td></tr><tr><td>0</td><td>0</td><td>1</td><td>4 seconds</td></tr><tr><td>0</td><td>1</td><td>0</td><td>2 seconds</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1 seconds</td></tr><tr><td>1</td><td>0</td><td>0</td><td>500 millisec</td></tr><tr><td>1</td><td>0</td><td>1</td><td>250 millisec</td></tr><tr><td>1</td><td>1</td><td>0</td><td>125 millisec</td></tr><tr><td>1</td><td>1</td><td>1</td><td>62.5 millisec</td></tr></table>	BIT 4	BIT 3	BIT 2	TIMEOUT	0	0	0	16 seconds	0	0	1	4 seconds	0	1	0	2 seconds	0	1	1	1 seconds	1	0	0	500 millisec	1	0	1	250 millisec	1	1	0	125 millisec	1	1	1	62.5 millisec
	BIT 4	BIT 3	BIT 2	TIMEOUT																																																																						
	0	0	0	16 seconds																																																																						
	0	0	1	4 seconds																																																																						
	0	1	0	2 seconds																																																																						
	0	1	1	1 seconds																																																																						
	1	0	0	500 millisec																																																																						
	1	0	1	250 millisec																																																																						
	1	1	0	125 millisec																																																																						
	1	1	1	62.5 millisec																																																																						
BIT 4	BIT 3	BIT 2	TIMEOUT																																																																							
0	0	0	16 seconds																																																																							
0	0	1	4 seconds																																																																							
0	1	0	2 seconds																																																																							
0	1	1	1 seconds																																																																							
1	0	0	500 millisec																																																																							
1	0	1	250 millisec																																																																							
1	1	0	125 millisec																																																																							
1	1	1	62.5 millisec																																																																							
The tolerance on the timeout period is +/- 35%.		The tolerance on the timeout period is +/- 35%.																																																																								
5	Outputs hold their state on communications timeout (active high)	Outputs hold their state on communications timeout (active high)																																																																								
6	Not used	Indicates the status of the blown fuse detection circuit (high = field supply fuse is blown)																																																																								
7	Enable blown fuse detection circuit (active high)	Enable blown fuse detection circuit (active high)																																																																								
8	Not used	Base ID0 Bit ² (Set by the Base Assembly)																																																																								
9	Not used	Base ID1 Bit ² (Set by the Base Assembly)																																																																								
10	Not used	Base ID2 Bit ² (Set by the Base Assembly)																																																																								
11 - 15	Not used	Not used																																																																								

¹ The tolerance on the timeout period is +/- 35%.
² Refer to the following table for Base ID values.

Bit 0: When Bit 0 is set, the module is configured. The Controller configures the module by writing a "1" to Bit 0 of the configuration register. Once configured, it remains configured until a power-up/down reset is generated. After a power-up condition, the configuration register clears.

Bit 1: When Bit 1 is set, the internal error LED is turned on and data registers can be written but not read.

Bits 2-4: These bits are used to select the communication timeout period.

Bit 5: When Bit 5 is set, the digital outputs hold their last state on a communications watchdog timeout. When Bit 5 is cleared, the digital outputs are cleared (output transistor is shut off) on a communications watchdog timeout.

Bit 6: This bit indicates the status of the blown fuse detection circuit. When Bit 6 of the status register is set, the field supply fuse is blown.

Bit 7: When Bit 7 is set, the blown fuse detection circuit is enabled.

Bits 8-10: The Base Assembly (KUEP or G2R style) straps three bits in hardware which identify which type of base the ROE is plugged into. The type of base can therefore be determined from reading these bits.

Bits 11-15: Not used.

CAUTION: This module contains Communications Timeout Settings (Timeout Action and Timeout Selection) that are initially configured in the Developer Studio.

The default Timeout Selection is 16 seconds, with the Timeout Action set to LATCH.

These settings are normally adjusted by a Project Engineer or an Emerson Field Service Engineer after determining the affects the setting will have on the system.

Any Timeout Selection change made while the module is in the LATCH Timeout Action, will have no effect on the system (with the exception of the system indication a Communication Error.)

The Timeout Action must be changed to RESET in the Developer Studio before any new Timeout Selection has an effect on the system.

It is recommended that before you make any changes to the Timeout Selection, you conduct a thorough evaluation of any affect that change may have on the system. Under some conditions a different timeout may cause the module to go into its respective fail-safe mode.

Fused Relay Output Base ID Bits

BIT 10 (BASE ID2)	BIT 9 (BASE ID1)	BIT 8 (BASE ID0)	BASE TYPE
0	1	0	RBHF
0	1	1	RBLF

32.10 Blown fuse detection circuit - (FRO)

Bit 6 in the status register enables the Controller to monitor the status of the field supply fuse, and it gives a visual indication of the status via the EXTERNAL ERROR LED.

The Controller enables this feature by writing a “1” to Bit 7 of the configuration register. If enabled and the field supply voltage is between 18VDC and 25.5VDC, the circuit indicates the field supply fuse is OK by turning OFF the “EXTERNAL ERROR” LED and clearing Bit 6 of the module status register. If enabled and the field supply voltage is less than 0.4VDC, the circuit indicates the field supply fuse is blown by turning ON the “EXTERNAL ERROR” LED and setting Bit 6 of the module status register.

In summary, this feature is specified to operate as follows:

- $18\text{ VDC} \leq \text{Field supply voltage} \leq 25.5\text{VDC}$ = Fuse is OK
- $0.4\text{ VDC} < \text{Field supply voltage} < 18\text{VDC}$ = UNDEFINED
- $\text{Field supply voltage} \leq 0.4\text{VDC}$ = Fuse is blown

Note: After a powering reset, the blown fuse detection circuit is disabled. System level configuration software must set the respective configuration bit if blown fuse detection is desired.

32.11 Diagnostic Logic card LEDs - (FRO)

Diagnostic logic card LED's

LED	DESCRIPTION
P (green)	Power OK LED. Lit when the +5V power is OK.
C (green)	Communication OK LED. Lit when the Ovation Controller is communicating with the module.
E (Red)	External Fault LED. Lit when the field supply fuse is blown and the blown fuse detection circuit is enabled. Blown Fuse bit (Bit 7) of the Configuration Register (see page 526) enables or disables the fuse detection circuit (high = enabled).
I (Red)	Internal Fault LED. Lit whenever the Force Error bit (Bit 1 of the Configuration Register (see page 526)) is active or the Controller stops communicating with the module.
1 - 16 (Green)	If the LED is lit, this indicates that the output is in the ON state. If the LED is not lit, this indicates that the output is in the OFF state.

32.12 Specifications - (FRO)

Relay Output Electronics module specifications (1C31219G01)

DESCRIPTION	VALUE
Number of channels	16
Blown fuse detection ¹ Operating voltage range	$18\text{V} \leq \text{auxiliary supply voltage} \leq 25.5\text{V}$

DESCRIPTION	VALUE
Module power	Main: 1.88 W typical, 2.5 W Maximum Auxiliary: 0.3 W typical, 0.35 W Maximum
Operating temperature range	0 to 60°C (32°F to 140°F)
Storage temperature range	-40°C to 85°C (-40°F to 185°F)
Humidity (non-condensing)	0 to 95%
¹ You can configure the module to enable/disable the blown fuse detection function.	

Fused Low Power Relay Output Base Specifications (5X00431G01 - G02) (G2R)

DESCRIPTION	VALUE
Number of relays	16
Relay Type	Form C
Maximum propagation time	Operate time: 15 mSec, bounce approximately = 3 mSec Release time: 10 mSec, bounce approximately = 8 mSec
Dielectric isolation: Relay contacts to logic	1500 VAC
Relay base auxiliary power	9.1 W typical, 11.68 W Maximum
Auxiliary power supply ¹	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum@60°C
Channel ratings ³	3.15A @ 150VAC
Bus power ratings ⁴	10A @ 150 VAC
Operating temperature range ²	0 to 60°C (32°F to 140°F)
Storage temperature range	-40 to 70°C (-40°F to 158°F)
Humidity (non-condensing)	35 - 85%
¹ Use of the internal Ovation auxiliary power supply is recommended for relay output modules. ² See additional application derating (see page 546) information. ³ Channel rating is limited to 3.15A by the internal channel fuse. Standard fuse carry current derating apply. (0.5%/°C above 30°C) ⁴ Bus rating is limited to 10A by the internal channel fuse. Standard fuse carry current derating apply. (0.5%/°C above 30°C)	

Fused High Power Relay Output Base Assembly Specifications (5X00430G01 - G04) (KUEP)

DESCRIPTION	VALUE
Number of channels	12
Relay Type	5X00430G02-G04 - Form C 5X00430G01-G03 - Form X
Typical propagation time	Operate time: 15 mSec, excluding bounce Release time: 10 mSec, excluding bounce

DESCRIPTION	VALUE
Dielectric isolation: Relay contacts to logic	1500 VAC
Relay base auxiliary power	Auxiliary power: 23.45 W typical, 30.1 W Maximum (Form C relays) 15.9 W typical, 20.41 W Maximum (Form X relays)
Auxiliary power supply ¹	25V typical (before output auctioneering diode drop within Ovation auxiliary power supply) 25.5V Maximum @42°C (108°F) (Form C relays) 25.5V Maximum @60°C (140°F) (Form X relays)
Operating temperature range ²	0 to 45°C (32°F to 113°F) (Form C relays) 0 to 60°C (32°F to 140°F) (Form X relays)
Channel ratings ³	3.15A @ 150VAC ⁵
Bus power ratings ⁴	10A @ 150 VAC ⁵
Storage temperature range	KUEP C: -40 to 50°C (-40°F to 122°F) KUEP X: -40 to 70°C (-40°F to 158°F)
¹ Use of internal Ovation auxiliary power supply is recommended for Relay Output modules. ² See additional application derating information contained in <i>Using Relay Output Bases (see page 546)</i> . ³ Channel rating is limited to 3.15A by the internal channel fuse. Standard fuse carry current derating apply. (0.5%/°C above 30°C) ⁴ Bus rating is limited to 10A by the internal channel fuse. Standard fuse carry current derating apply. (0.5%/°C above 30°C) ⁵ The panel is designed to 150VDC. However, the power source must have the return ("-") lead referenced to earth. Projects must review the power scheme to determine applicability.	

SECTION 33

Noise minimization and causes

IN THIS SECTION

<i>Electrical noise and causes</i>	555
<i>Noise discrimination</i>	556
<i>Noise energy level</i>	556
<i>Noise frequency</i>	557
<i>Signal and noise sources</i>	557
<i>Noise sources</i>	558
<i>Noise classes</i>	558
<i>Noise rejection for digital signals</i>	559
<i>Analog signal noise rejection</i>	559
<i>Output signal noise rejection</i>	559
<i>Noise-sensitive circuit noise rejection</i>	560
<i>Analog signal shielding techniques</i>	562
<i>Common input considerations</i>	564

33.1 Electrical noise and causes

A wide variety of analog and/or digital circuits are associated with the Ovation System's installation. There are low-level voltage circuits, high-level voltage circuits, circuits that transfer information, and circuits that transfer power. These circuits are placed into two categories: noise-producing circuits and noise-sensitive circuits.

Noise problems typically occur when transmitting analog (voltage, current, and other measured values) or digital information (on/off conditions, pulse trains or similar data) via inter-connected or wired circuits. The information carried by signals in such circuits may become distorted during transfer and errors may result from this distortion.

The difference between the signal of transmitted information and the signal of that information as received is called **noise** (see the figures in Energy Level (see page 556) and Frequency (see page 557)). The noise minimization techniques briefly described in this section focus on preventing errors by either eliminating the noise, or when elimination is not possible, performing steps to lessen its impact.

The following topics discuss the causes of electrical noise in your Ovation system and the recommended techniques for eliminating or reducing that noise.

- Noise discrimination (see page 556).
- Noise sources (see page 557).
- Noise classes (see page 558).
- Noise rejection.
- Analog signal shielding techniques (see page 562).
- Common input considerations (see page 564).

33.2 Noise discrimination

Natural signal properties (such as the peaks of a digital signal) or conditions created during signal transmission (such as the voltage of the analog signal) are used to make the desired information in the signal appear different from the noise. The recovery of correct information from a noisy signal therefore depends upon the ability to subtract the noise from the desired information.

Three components of a signal that can be used to separate the desired information from a noisy signal are:

- Energy Level (see page 556).
- Frequency (see page 557).
- Noise Sources (see page 557) (of both Signal and Noise).

The following information explains how each of these components can be applied to minimize errors that may occur because of a noisy signal.

33.3 Noise energy level

The energy level is the total energy for the signal plus any induced noise. If there is a significant difference between the signal and the noise, then the noise is rejected easily by thresholding techniques (as identified as Desirable in the following figure). If there is not a significant difference between the signal and the noise, then the noise is not easily rejected (as identified as Undesirable in the following figure).

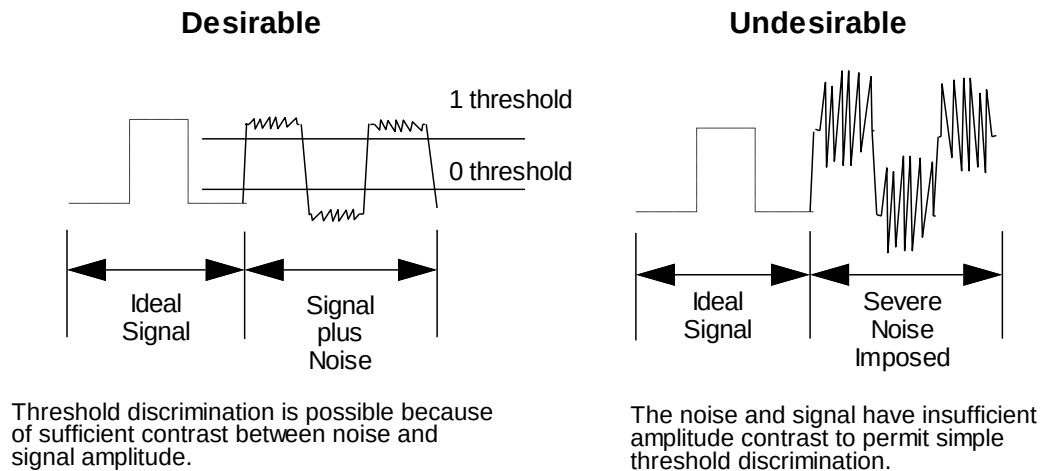
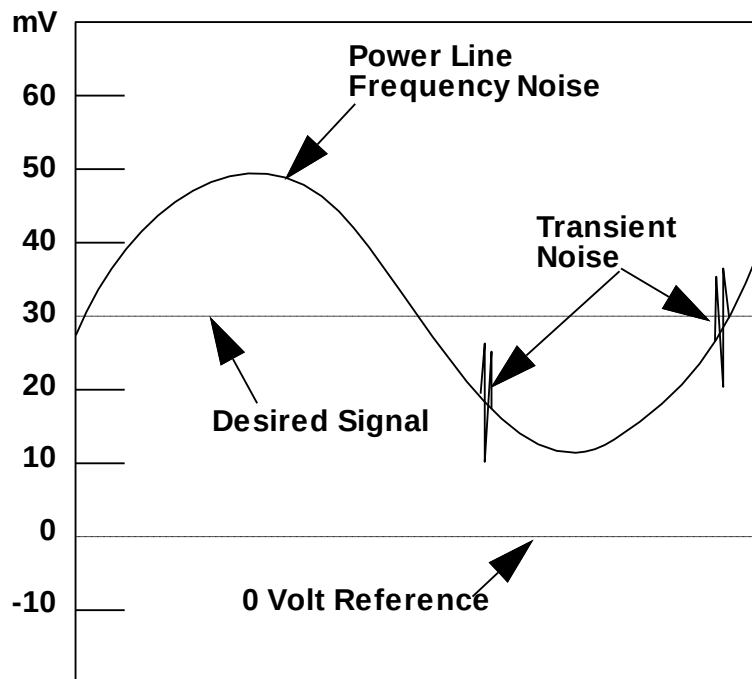


Figure 144: Amplitude discrimination example

33.4 Noise frequency

Most noise commonly encountered in industrial plants is related either to **switching transients**, or to **power line frequency** and its low harmonics. The analog signals are usually lower in frequency than one cycle per second, while the digital signals between plant and Controller appear from zero to millions of cycles per second.

Both analog and digital signals can be discriminated easily by eliminating frequency content from external noise sources, such as switching transients, since the transients do not contain appreciable energy below 0.5 MHz frequency. Low pass filtering is useful in recovering analog signals from either power line or transient noise and for recovering digital signals from transient noise. The following figure shows an example of these two types of noise.



The signal above is shown at a 30mV level with both 14 mV RMS (60 Hz) and transient noise.

Figure 145: Typical noisy signal

33.5 Signal and noise sources

When signals are originally generated, most are relatively noise-free. The bulk of the noise present on a received signal has been added to the signal during its transmission. Isolation and segregation of signal sources and wiring from noise sources is highly effective as a recovery means. This technique, as well as the low-pass filtering previously mentioned, serves to reduce the recovery problem to one of amplitude or energy level discrimination.

33.6 Noise sources

The following devices and circuits are common sources of noise:

- Inductive devices, such as relays and solenoids.
- AC and DC power circuits, and wiring.
- Switch-gear.
- Fast-rise-time sources: thyristors and certain solid-state switching circuits.
- Variable-frequency or variable current devices.

33.7 Noise classes

Signal and power circuits, wiring, and cables are classified as high-level or low-level sources of noise and interference. See *Planning Your Ovation System*. A definition of each class of noise is given in the following table.

Noise class definitions

NOISE CLASS	LEVEL	DEFINITION
H	High	Includes AC/DC signals: a. 110VAC, 115VAC under 15A except brakes and fields. b. Up to 100A, 500VDC or 440VAC including brakes and fields. c. Over 100A, 500VDC, 440VAC. d. 2.3kV and over.
M	Medium	Includes digital I/O signals greater than 48V.
L	Low	Includes 24/48V digital I/O signals, and contact input.
Q	Very Low	Includes analog I/O signals as well as digital pulse inputs to high-speed counting circuits and data links.

33.8 Noise rejection for digital signals

The Ovation system employs three specific noise rejection measures for digital signal plant interconnections:

- Low pass filtering.
- Substantial signal levels (48 VDC or 115 VAC).
- Galvanically isolated.

Low pass filtering and the use of large signal level techniques provide frequency and energy level discrimination, respectively.

Galvanic isolation of the digital signal receiver from ground is important as a means for rejecting noise which causes both wires in a signal pair to change voltage-to-ground potentials. An example of this type of isolation is a signal source (transmitter) which is grounded at a point remote from the receiver, where transmitter and receiver grounds are not at the same voltage. In this case, ground potential difference appears as a voltage on both wires of the corresponding signal pair.

Another example in which galvanic isolation may be required to reject ground potential difference noise would be in circuits where coupling exists between signal wires, inducing a potential in both wires. Induced potentials can occur when signal wires are present in environments with changing electromagnetic or electrostatic fields. Isolation may be required in this case.

An optical isolator (also known as an opto-isolator) may be used to bring digital signals into the receiver. No receiver response to noise can occur unless signal line noise current flows. Low frequency current, which may flow as a result of equal noise voltage-to-ground potentials on both wires of the signal pair, is eliminated if the signal wires are not grounded at more than one point. This is called the **common-mode voltage**.

Note: High frequency noise currents can flow using stray capacitance as part of their path. This requires the use of low pass filtering in addition to the galvanic isolation.

33.9 Analog signal noise rejection

Analog signal isolation is provided for the same reasons that are discussed for digital signals (see page 559). However, since analog signals are typically low level, filtering and isolation noise rejection techniques are more critical for analog signals than for digital signals.

Analog signal filtering is achieved by averaging applied signals for one cycle (or an integer multiple of cycles) of the AC power line frequency. Power line related noise, at the power line frequency and its harmonics, has exactly zero average value when the average is taken over exactly one cycle and is filtered out of the signal by this technique.

Transient noise (high frequency damped ringing) has zero average value for averages taken over time periods much longer than the duration of the transients.

33.10 Output signal noise rejection

Digital output signals from the Ovation System to the plant are electromechanical or semiconductor outputs which are galvanically isolated from the Controller. Analog output signals from the Ovation system to the plant are either voltage or current outputs which are also galvanically isolated from the Controller.

33.11 Noise-sensitive circuit noise rejection

All transmitting, low-level analog and digital circuits must be assumed to be noise-sensitive and to require special protection against noise. Field signals from process transducers (thermocouples, RTDs, and so forth) are especially susceptible to noise. Noise can be coupled into these sensitive circuits in three ways:

- Electrostatic coupling via distributed capacitances.
- Electromagnetic coupling via distributed inductances.
- Conductive coupling, such as circuits sharing a common return.

Noise suppression for these noise sensitive circuits involves one or more of the following basic measures:

- Physical separation (see page 560) between noise-producing and noise-sensitive circuits.
- Twisted-pair wiring (see page 560) for signal connection within plant.
- Proper grounding (see page 561), especially avoiding multiple grounding of cable shields and proper shielding, especially cable shielding.
- Surge protection (see page 561) to IEEE and ANSI standards.

33.11.1 Physical circuit separation

Circuit separation is a simple and effective means of electrostatic and electromagnetic field induced noise control. This is because electrostatic and electromagnetic fields decay with increasing distance, producing lower amplitude noise and maintaining a good signal-to-noise ratio.

33.11.2 Twisted-pair wiring

Twisted-pair wiring suppresses noise by acting to eliminate circuit loops which are sensitive to stray electromagnetic fields. For this reason, it is recommended that all analog signal circuit connections should be made with twisted-pair wire. Digital signal connections should carry a group return (or common) wired in the same cable as the signal wires.

Twisted pairs are also recommended in digital circuits where unusually noisy environments exist. Twisting of the signal wire and its return conductor becomes increasingly important as the length of the two becomes greater, and as the distance from noise sources becomes less. In twisted pairs or small cables (less than 1/2 inch outer conductor circle diameter), a twist rate of at least one to two twists per foot is recommended.

33.11.3 Proper grounding and shielding

Proper grounding, along with shielding, causes noise-induced currents to flow in the shield, and from the shield to ground, rather than in the corresponding signal conductors. Shielding itself is useful in avoiding capacitively coupled noise. The shield's sole function is to decrease effective capacitance from conductors inside the shield to conductors outside. To accomplish this, the shield should be as continuous as possible and equipped with a "drain wire" for secure single-point grounding.

Conductors and corresponding returns may be grouped within a shield only if capacitive coupling between them is acceptable. Avoid the grouping of low-level and high-level analog inputs, contact inputs, and contact outputs within a single shield. Shields are used as current-carrying conductors on some systems. To be effective, shields are grounded at the same point as the signals within, except as otherwise noted within this document.

33.11.4 Surge protection

Surge protection to IEEE C37.90.1 -1989 (Reference ANSI C37.90.1-1989) standards is provided on most Ovation I/O modules. Check individual module descriptions for availability or possible additional conditions.

Ovation I/O modules, designated as being CE Mark compliant, have surge protection as shown in the following table when installed in CE Mark certified cabinets:

Surge Protection Levels

SPECIFICATION	LEVEL
EN 61000-4-3 (Radiated Field Immunity)	10 V/m
EN 61000-4-4 (Electrical Fast Transient Immunity)	1 Kv
EN 61000-4-5 (Surge Immunity)	1 Kv
EN 61000-4-6 (Conducted Radio Frequency Immunity)	*10 V rms
*The HART Analog Input and HART Analog Output modules meet a reduced level of 3V rms.	

33.12 Analog signal shielding techniques

For noise suppression purposes, analog signals of less than one volt is considered low-level and (as is the case with all analog signals), require shielding. Individually twisted and shielded pairs should be used for all analog input signal wiring. Multi-pair cable can be used if each twisted pair in the cable has its own insulated shield. Use the following guidelines to shield signals:

- Ground the analog signal shield.
- Ground the shield at one end only, preferably to a single point at the signal source, except as otherwise noted in this document.
- Connect the low side of the signal to the shield at the signal source. If the shield cannot be conveniently grounded at or near the signal source, ground it at the Controller. An ideal analog signal field connection is shown in the following figure
- Run the shield (unbroken) from the transducer to the shield terminal of the Analog to Digital (A/D) front-end at the Analog Input module. (See *Planning Your Ovation System*.) Maintain shield continuity at junction boxes when they are used.

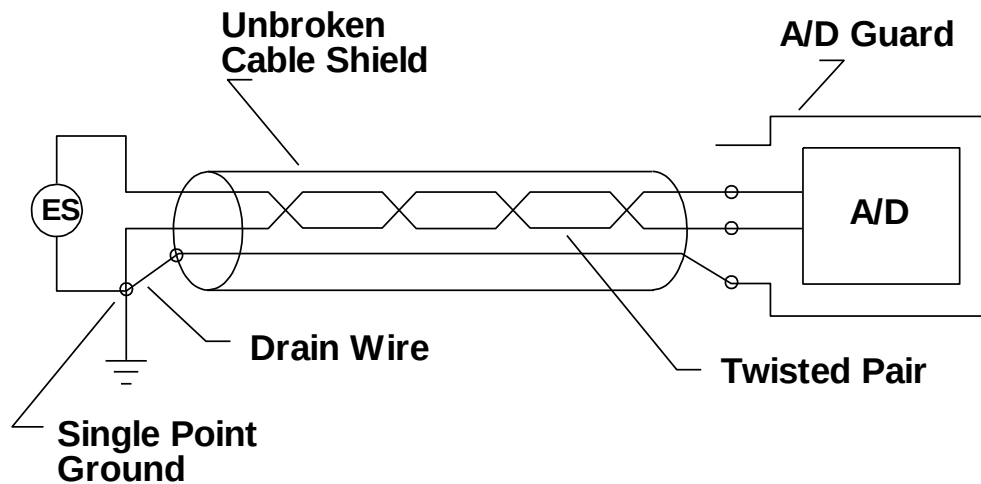
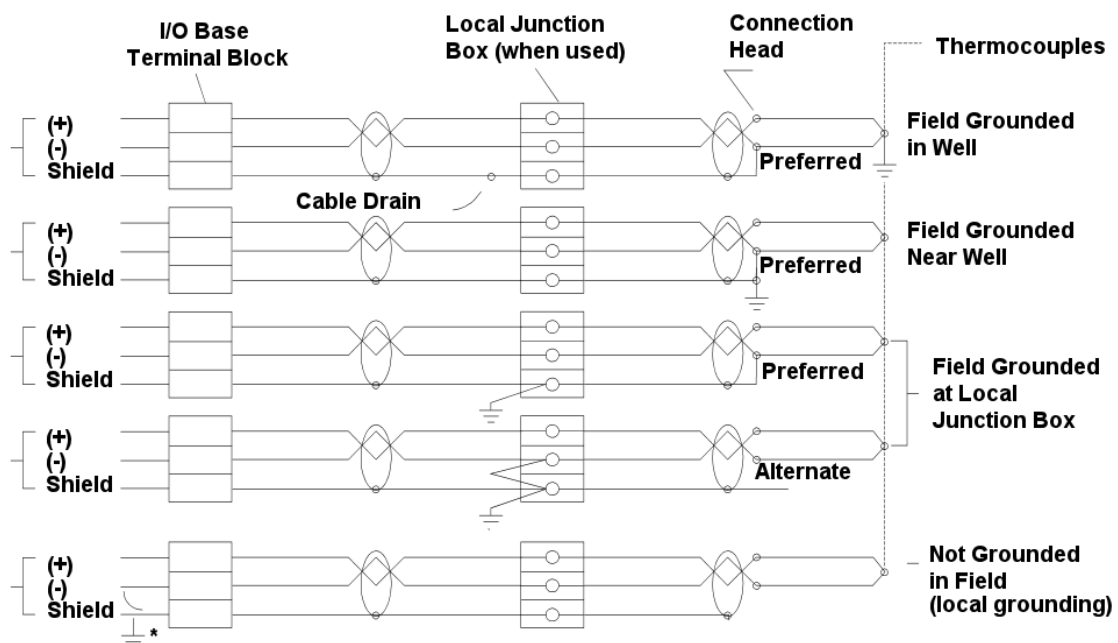


Figure 146: Ideal Analog Signal Field Connection

The following figure shows the typical recommended thermocouple analog signal wiring and the next figure shows the recommended sensor analog signal wiring.

Note: See *Personality Module Jumpers* (see page 25) for details on how to access the jumpers.



* Grounding is set through jumpers within the Personality module. The default setting for the module has the jumpers installed for local grounding. To configure for field grounding, the jumpers must be removed.

Figure 147: Typical Thermocouple Analog Signal Wiring by User

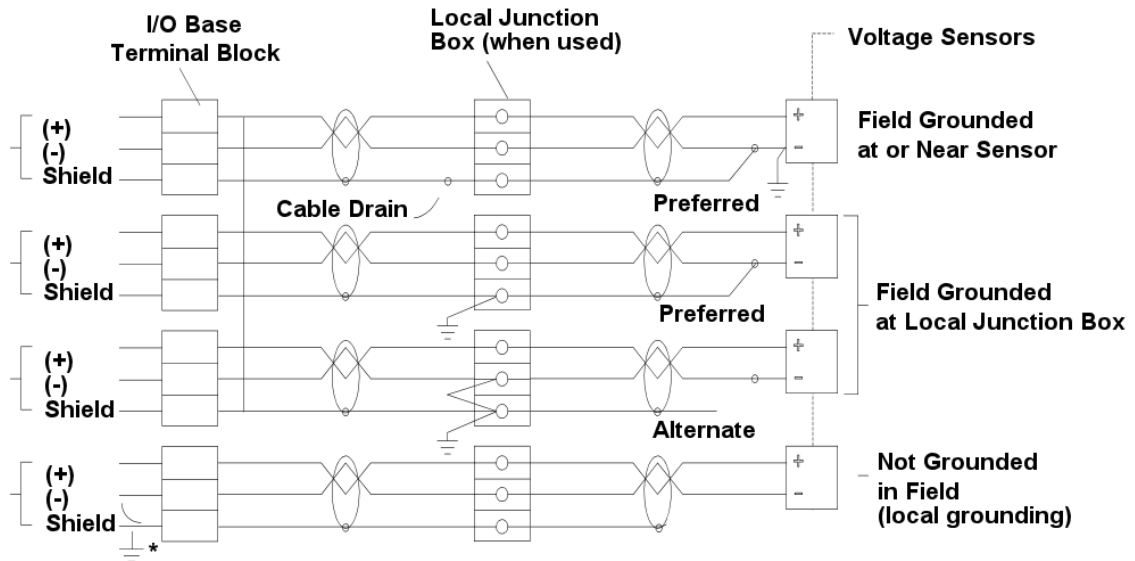


Figure 148: Typical Sensor Analog Signal Wiring by User

33.13 Common input considerations

4 to 20 mA signal considerations

When sufficient separation from noise sources exists, this standard class of control signal does not require shielded cables. However, it is strongly recommended for surge protection. Use of twisted-pair cables is recommended.

Digital signal considerations

The Ovation System's digital I/O circuits used in data transmission do not require individual twisted or shielded pair conductors. A multi-conductor cable, in which one conductor serves as a common return and with a single overall cable shield, is sufficient for most Ovation digital signal applications.

Contact closure signal considerations

- Outputs (CCO) - These circuits usually require no shielding.
- Inputs (CCI) - These circuits require no shielding if the net current in the cable is zero.

CE Mark considerations

For CE Mark certified systems, all field wiring must be braid-shielded and grounded at the entry point of the cabinet using the recommended hardware. (See [Planning Your Ovation System](#).)

SECTION 34

Defining and addressing the I/O for the Controllers

IN THIS SECTION

<i>What is the process for planning the I/O for your system?</i>	<i>566</i>
<i>What are the Ovation I/O module base types?</i>	<i>567</i>
<i>What is an Ovation I/O module address?</i>	<i>568</i>
<i>What are the Ovation Controller I/O interfaces?</i>	<i>575</i>
<i>Common cabinet components (Controller, remote node, and extended cabinet)</i>	<i>578</i>
<i>Common cabinet configurations.....</i>	<i>585</i>
<i>Local I/O.....</i>	<i>586</i>
<i>Remote I/O.....</i>	<i>588</i>
<i>Extended I/O cabinet components.....</i>	<i>591</i>
<i>Remote node cabinet components</i>	<i>594</i>
<i>Selecting the I/O interface cards.....</i>	<i>601</i>
<i>What changes can you make to an I/O device?</i>	<i>601</i>
<i>General requirements for I/O cable.....</i>	<i>601</i>
<i>Power distribution scheme.....</i>	<i>605</i>

34.1 What is the process for planning the I/O for your system?

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. This system consists of a configurable mix of functional input/output (I/O) modules that communicate on the I/O bus to the Ovation Controller.

I/O modules provide an interface between the Ovation Controller and the processes in the plant. Ovation I/O modules are “plug-in” components with built-in fault tolerance and diagnostics. They are able to operate on a wide range of signals and perform a multitude of functions.

The Developer Studio I/O (input/output) Devices folder contains tools used to define the I/O modules for the Ovation system. The I/O Device folders contain Setup Wizards and dialog boxes that provide visual representation of the I/O devices for an Ovation system.

Before the I/O devices folder can be used to define the I/O hardware, you need to secure the I/O plan for your Ovation system.

After securing the plan, the information is entered into the I/O Devices portion of the system hierarchy to define the I/O for your Ovation system. I/O Devices are defined individually for each drop.

During configuration, the following elements are assigned point names by the system to identify the elements to the Ovation database:

- Each **remote node** is assigned a Node (RN) record type point name. The RN record type is used because it contains bits that are used to monitor the node power supply.
- Each **Ovation I/O module** is given a Module (RM) record type point name. The RM point is used to configure the I/O module and to provide status/alarm information about the I/O module. Points can then be assigned to each module by using the Hardware tab in the Points folder. Refer to the *Ovation Record Types Reference Manual* for additional information.

34.2 What are the Ovation I/O module base types?

Ovation I/O bases house the Ovation I/O modules and provide a mechanism for you to run field wiring and connect field signals to the Ovation I/O. Series of bases can be connected together to form a “branch” of Ovation I/O.

The Ovation system supports two different types of bases:

- Standard I/O base.
- Relay Output base.

Bases can be mixed within a given I/O branch and cabinet. There are restrictions as to how these bases can be mixed. (See *Planning Your Ovation System*.)

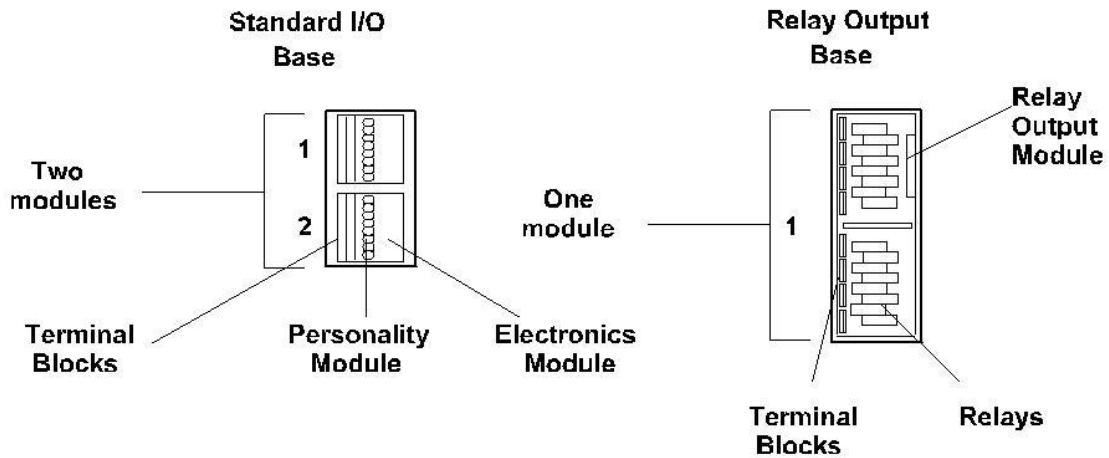


Figure 149: Standard I/O and relay output bases

34.2.1 What is a standard I/O module base?

A standard Ovation I/O base houses up to two standard Ovation I/O modules. Standard Ovation I/O modules are designed to fit securely into the standard I/O bases.

Each standard I/O module is assigned a logical address. Since each standard I/O base can house two Ovation I/O modules, a standard I/O base occupies **two** logical module addresses.

34.2.2 What is a relay output module base?

The relay output base houses one module and requires **one** I/O address. Although the relay output base only contains one module, it is **1.5 times longer** than the standard I/O module base to allow additional space to house the relays.

34.3 What is an Ovation I/O module address?

The Ovation System assigns an address to each Ovation module defined by the Ovation Developer Studio. This address is based on the logical location of the module with respect to the Ovation Controller and is used by the Ovation Developer Studio to configure the hardware information for a point.

A standard I/O base consists of two logical modules; and a relay output base has one logical module.

34.3.1 What are the guidelines for positioning I/O modules in cabinets?

When selecting module positions, observe the following guidelines:

- The position of the module in the cabinet determines the address of the module.
- Placement of I/O modules are from **top to bottom** on the left side of a cabinet and from **bottom to top** on the right side of a cabinet.
- If Relay Output modules are mixed with standard I/O modules on the same branch, **always** start the standard I/O module base in an odd-numbered module position on the branch (positions 1/2, 3/4, 5/6, or 7/8).

Relay Output modules can be placed in odd or even numbered positions. For example, modules can begin in 1, 2, 3, 4, 5, 6, 7, or 8 slots.

- Physical cabinet size and branch power requirements may limit the number of modules that can be configured in a branch.

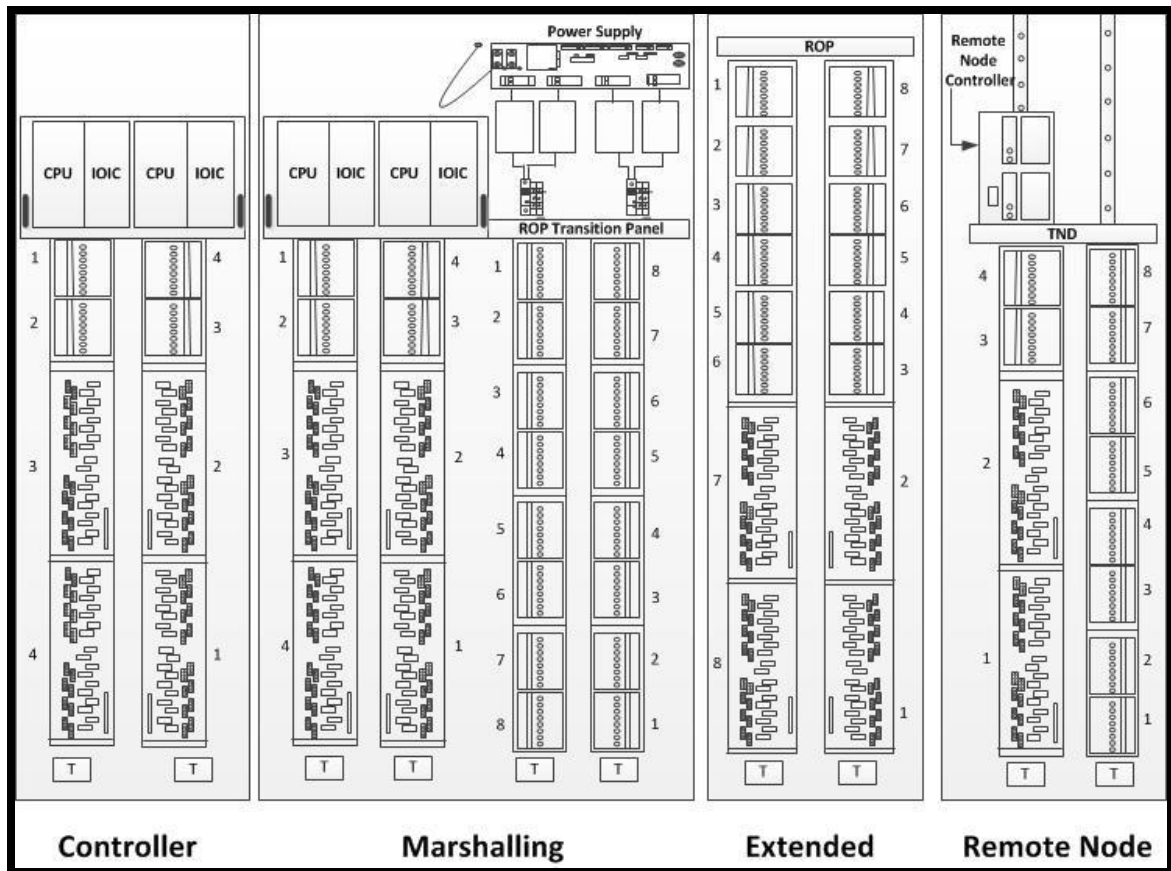


Figure 150: Examples of cabinet with standard I/O and relay modules

34.3.2 What is the addressing format for I/O modules?

The logical I/O address is composed of three numbers (four when remote I/O is used) separated by decimals and in the following format:

- D.N.B.S** where:

D = Device number assigned to the Controller's IOIC

N = Node (only used in Remote I/O; 1 through 8).

B = Branch (1 through 8).

S = Slot where module is located (1 through 8 for Ovation I/O). (1 through 12 for Q-Line I/O).

■ Standard I/O base assemblies

The I/O addressing for the Ovation database is determined from the positions of the bases installed in the cabinets. Installation of standard I/O bases requires at least two I/O module addresses on a branch. Their I/O module position must **always** start on odd positions.

I/O modules should always be installed in the left-most branch of each side of a cabinet from the TOP down to the BOTTOM. I/O modules in the right-most branch of each side of a cabinet are addressed from the BOTTOM up to the TOP.

Emerson Process Management recommends that all bases (typically four) be installed in the right side of a cabinet, even if the bases are not all filled with I/O modules. This prevents disruption of the database if additional I/O modules are installed in the future.

■ Relay output base assemblies

Relay Output bases can be located before or after standard I/O bases. Installation of relay output bases requires one I/O module address on a branch and can begin on an **odd** or **even** position.

Note: Physical cabinet space may limit the maximum number of bases in a given cabinet style.

When a relay output base is used before a standard I/O base, an even number of relay output bases must be used so the I/O base starts at an odd position. If a standard I/O base follows an odd number of relay output bases, the configuration is incorrect and does **not** work (see the following figure for examples).

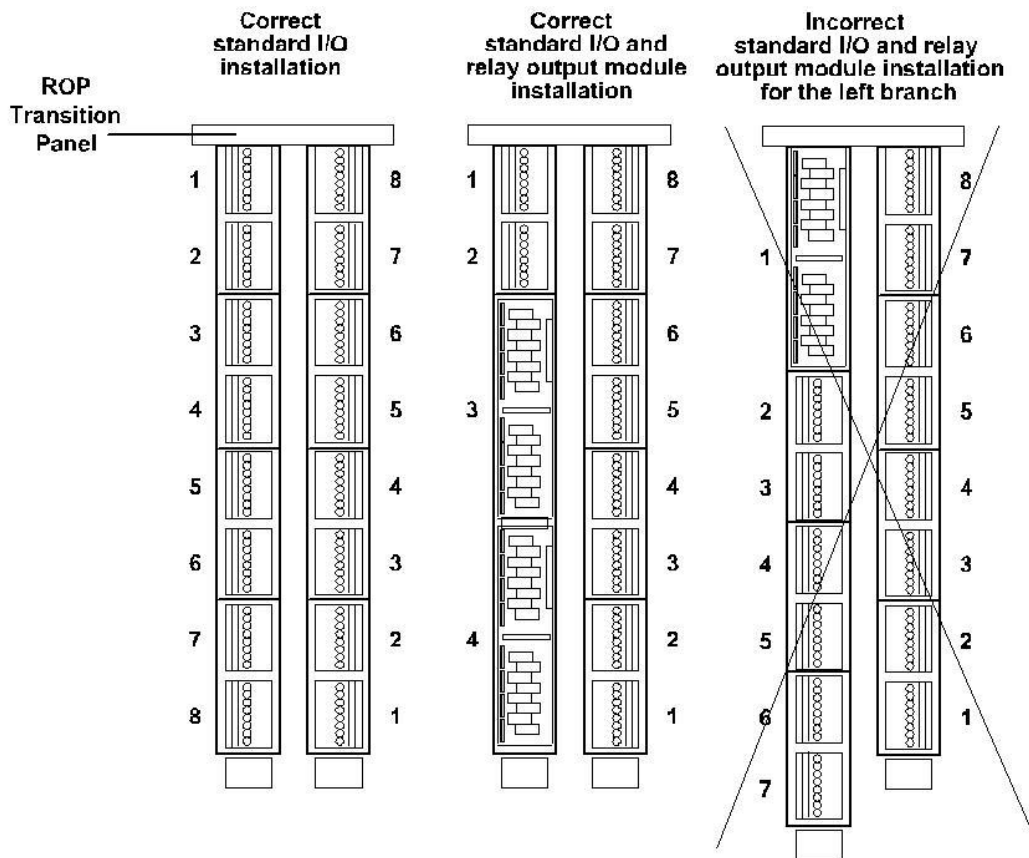


Figure 151: I/O and Relay Output module configuration examples

34.3.3 Examples of Controller cabinet I/O module addresses

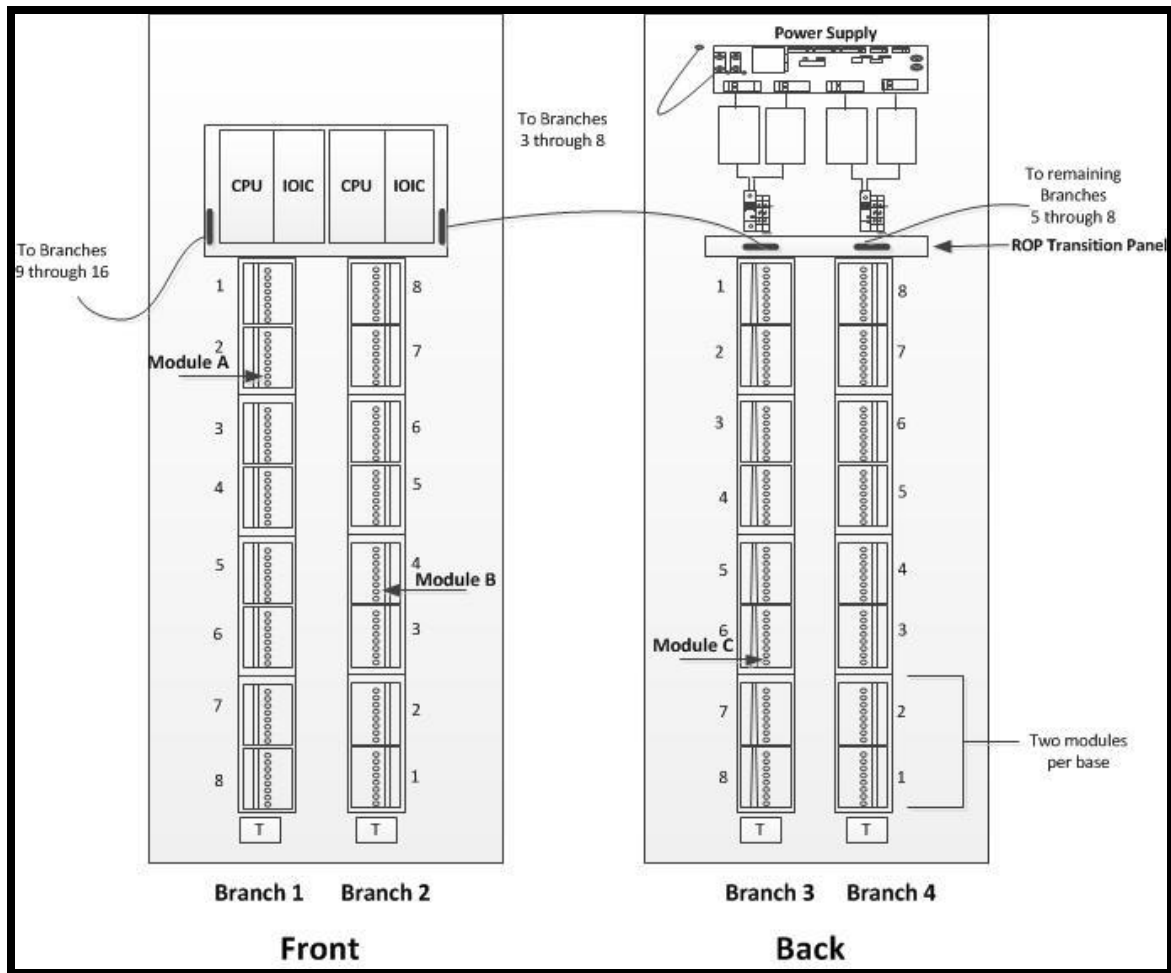


Figure 152: IO Address examples, modules A, B, C (Controller cabinet)

- Module A address = 1.1.2.
- Module B address = 1.2.4.
- Module C address = 1.3.6.

34.3.4 Examples of extended I/O cabinet module addresses

Note: ROP transition panel is used when configuring cabinets (front of cabinet).

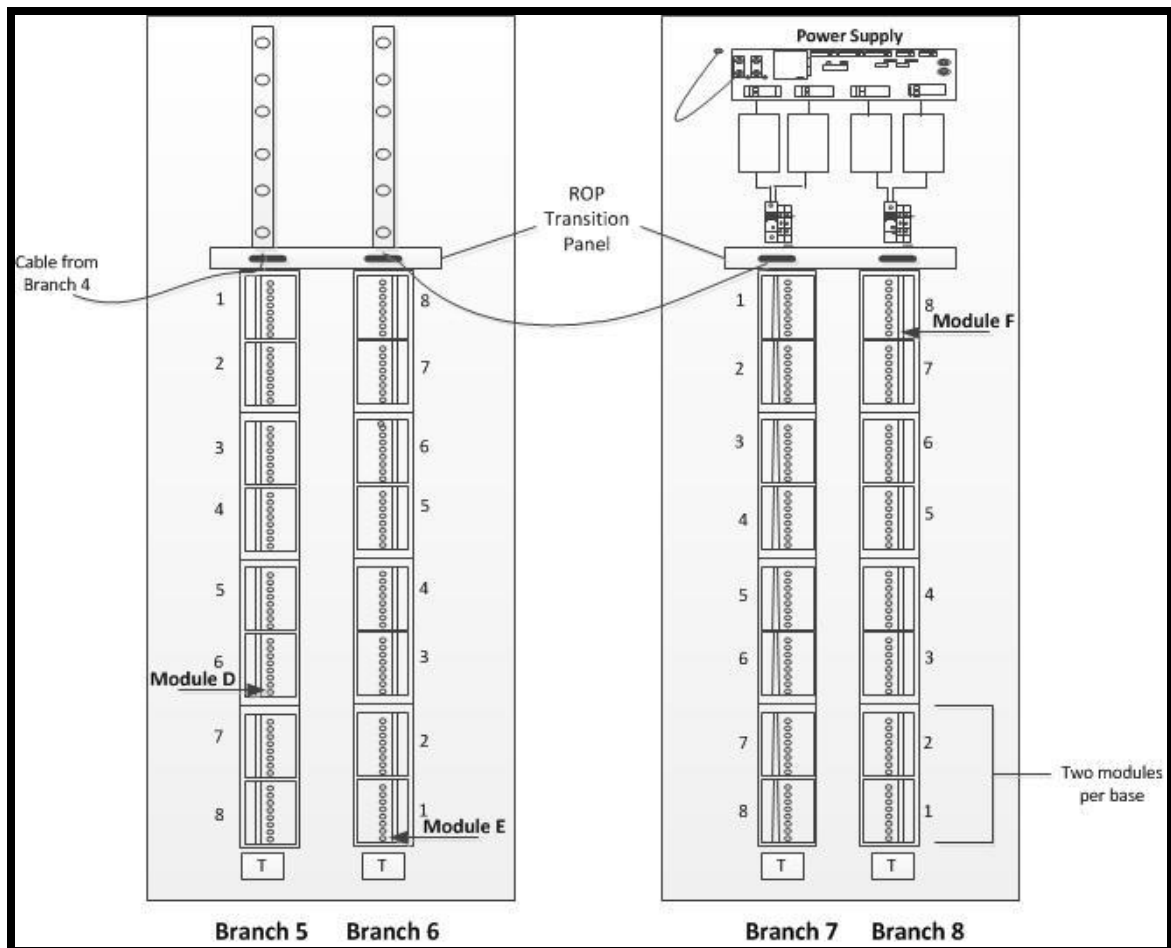
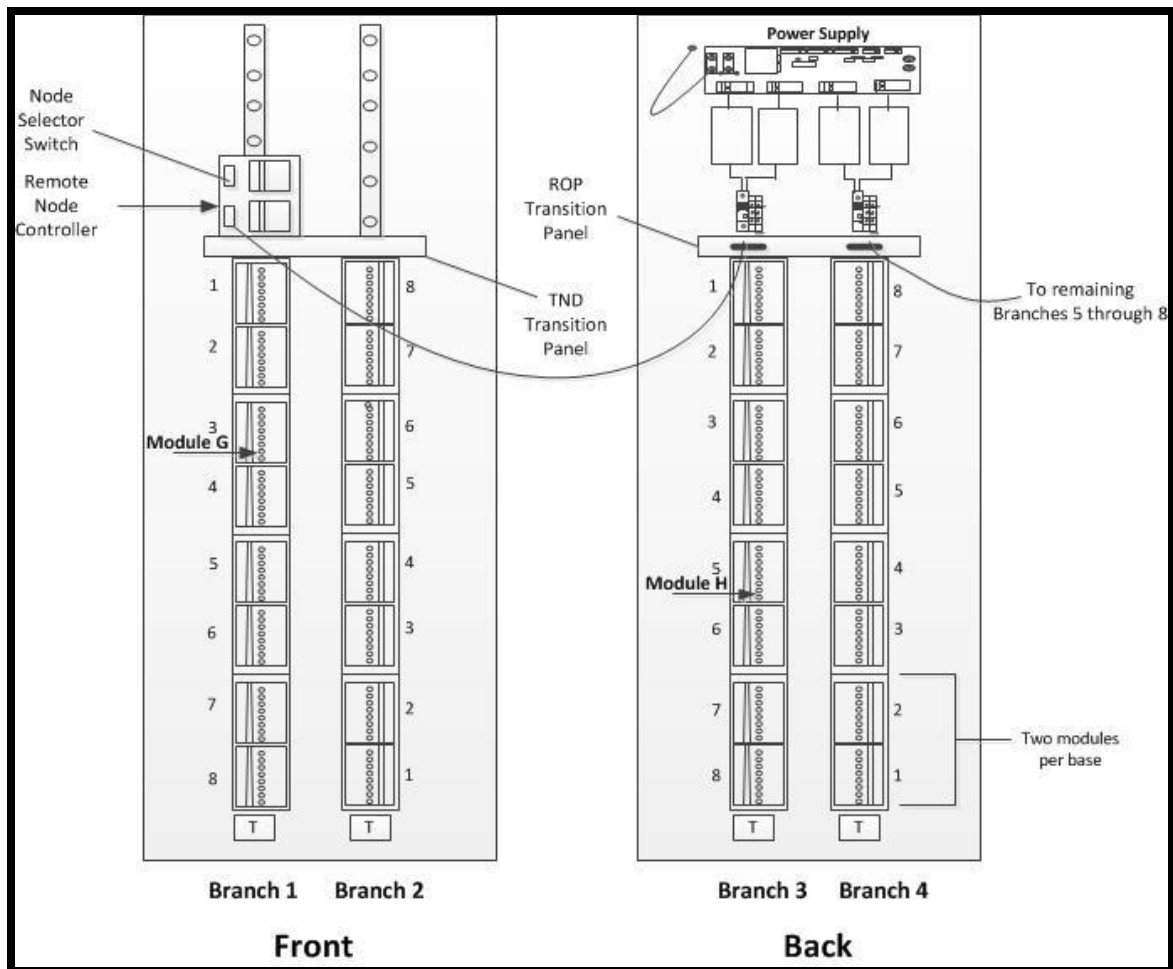


Figure 153: I/O Address examples, modules D, E, F (extended I/O cabinet)

- Module D address = 1.5.6.
- Module E address = 1.6.1.
- Module F address = 1.8.8.

34.3.5 Examples of remote node I/O cabinet module addresses



The Node address (1 through 8) for Ovation remote I/O is determined by where the node is connected to the MAU Attachment Unit (located in the Controller cabinet). The Node Selector Switch in the Remote Node Cabinet is then set to match the connection position. See the [Ovation I/O module addressing](#) (see page 568) section of the [Ovation I/O Reference Manual](#) for details about addresses for remote nodes.

The Node is in MAU position 1 for the following examples:

- Module G address = 1.1.1.3.
- Module H address = 1.1.3.5.

34.3.6 Examples of Relay Output module addresses

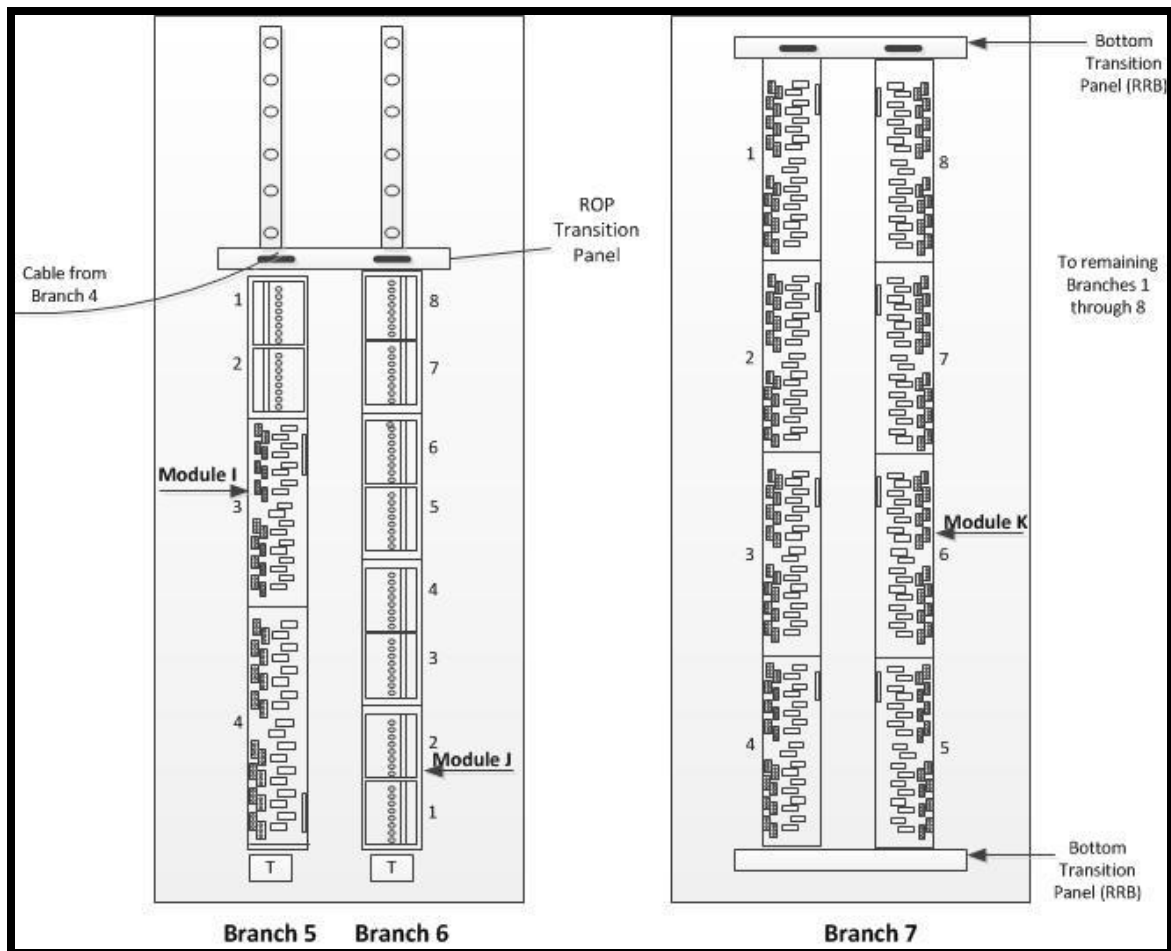


Figure 154: I/O address examples, modules I, J, K (Relay Output modules)

Note: ROP transition panel is used when configuring cabinets (front of cabinet). Branch 7 (back of cabinet) is composed solely of relay panels using RRP and RRB transition panels. (See *Ovation I/O Reference Manual*.)

IOIC module for the Controller.

- Module I address = 1.5.3.
- Module J address = 1.6.2.
- Module K address = 1.7.6.

Note: The back of the extended cabinet contains only one branch of Relay Output modules due to physical limitations.

The Relay Output modules can also be used with the RRP and RRB transition panels (instead of the ROP or TND panel). Using the RRP and RRB transition panel allows one “branch” of up to eight relay bases to be housed in a single side of an Ovation ventilated extended cabinet in two columns of four bases.

34.3.7 Q-Line I/O module addressing

The address for Ovation modules is determined by the location of the module in the I/O cabinet. However, the address for a Q-Line card is determined by the jumper settings on the actual Q-Line card. A visual inspection of the card should be performed to determine the jumper settings. (Refer to the *Q-Line Installation Manual*.)

Q-Line QBO modules are used to perform DIOB testing. The QBO card is addressed by entering it in hexadecimal format into a dialog box. The box appears when a Q-Line module is defined and configured through the Developer Studio.

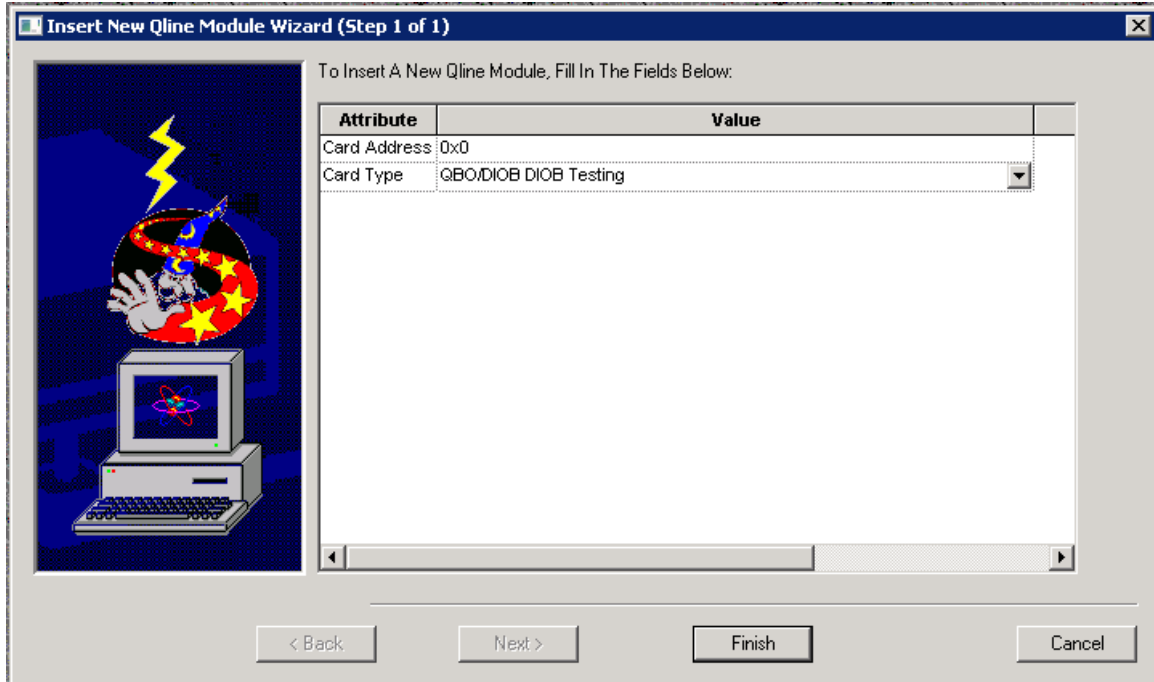


Figure 155: Insert New Q-Line Module Wizard

34.4 What are the Ovation Controller I/O interfaces?

Ovation Controllers provide various types of interfaces to communicate with the Ovation system and other devices. These interfaces include:

- Ovation network
- Dedicated backup
- I/O devices

34.4.1 Network Interface ports

The OCR1100 Ovation Controller has the following NIC port options:

- G01 - Four RJ45 connections.
- G02 - One RJ45 and three SFP Fiber connections.

The Ovation Controller's processor module provides four network interface ports, labeled N1, N2, N3, and N4. These ports are located at the top of the module housing.

Network interface ports

PORT	SUPPORTS
N1	Used for third-party devices. This is an additional Ethernet interface for other uses, such as third-party links, if necessary.
N2	Typically used for single attached networking to the Ovation network.
N3	Provides an additional Ethernet interface for dual attached networking.
N4	This is the default Ethernet interface for dedicated control synchronization or third-party device.

Note: When using direct connection (Port N4 to N4) control synchronization, make sure both Controllers have control synchronization enabled and that the cable is attached before performing a download, reboot, and load.

If a pair of redundant Controllers has been running with control synchronization enabled and control synchronization is then disabled, disconnect the dedicated cable from the Controllers before rebooting the Controllers with the new configuration.

Conversely, if a pair of redundant Controllers has been running with control synchronization disabled and control synchronization is then enabled, connect the dedicated cable between the Controllers after they have been running with the new configuration.

Note:

OCR400 Controllers are available in the following two groups:

G01 (64MB) implements N1, N2, N3, and N4 as the RJ-45 connectors.

G02 (128 MB) implements N1, N2, N3, and N4 as the RJ-45 connectors.

OCR1100 Controllers are available in the following two groups:

G01 (128 MB) implements N1, N2, N3, and N4 as the RJ-45 connectors.

G02 (128 MB) implements N1, N2, and N3 as the Small Form Factor Pluggable (SFP) transceivers and N4 as a RJ-45 connector.

Only approved SFPs can be installed in the OCR1100 G02. Approved SFPs are listed in the following Ovation drawing - 1X00832.

34.4.2 I/O interface ports

The Controller's I/O interface module supports up to 16 branches of local Ovation I/O, using ports L1 and L2, physically located on the Controller Base Assembly, below the Controller. The Controller also provides three RJ-45 interface ports to support additional local and remote I/O. These ports are located at the top of the module housing and are labeled Q5, R4, and R3. The port labeled Q5 supports up to four crates of local Q-Line I/O. Ports R3 and R4 are configured as a pair. They can support three different options:

- Remote Ovation (R3/R4)
- Remote Q-Line (R3/R4)
- Local Q-Line (R4 only)

When configured for Ovation I/O, up to four nodes of remote Ovation I/O can be supported on each port. Local Ovation I/O is not supported on either port.

When ports R3/R4 are configured for remote Q-Line, each port can support up to four nodes each with four crates per node.

When configured for local Q-Line, R4 can support up to four crates (1 node) of local Q-Line, but R3 must be unoccupied.

Note: Ports R3 and R4 can be configured as a pair to support either Ovation I/O or Q-Line I/O, but not a mixture of the two. Port Q5 supports only local Q-Line I/O. Ports L1 and L2 only support local Ovation I/O.

The following list shows the configuration options:

- **Port L1** supports up to 8 local branches of local Ovation I/O.
- **Port L2** supports up to 8 local branches of local Ovation I/O.
- **Port Q5** supports up to 4 crates of local Q-Line I/O (1 node).
- **Port R3** supports one of the following:
 - ☐ Up to 4 nodes of remote Ovation I/O.
 - ☐ Up to 4 nodes of remote Q-Line I/O.
- **Port R4** supports one of the following:
 - ☐ Up to 4 nodes of remote Ovation I/O.
 - ☐ Up to 4 nodes of remote Q-Line I/O.
 - ☐ 1 node of local Q-Line I/O.

(Refer to the [Q-Line Installation Manual](#) and the Q-Line card types section in the [Ovation I/O Reference Manual](#) for information about Q-Line modules.)

34.4.3 What are Small Form-factor Pluggable transceivers (SFPs)?

Small Form-factor Pluggable transceivers (SFPs) are compact pluggable transceivers used for telecommunication and data communications. SFPs are used on the G02 OCR1100 Controller. SFPs are inserted into designated Ethernet ports on the OCR1100 Controller.

There are 3 SFP Ethernet ports on the G02 OCR1100 Controller and one copper RJ45 port, this Controller option has a temperature rating of 0-50 deg. C or 32-122 deg. F.

Currently, there is only one approved SFP 100Base-FX unit. Refer to 1X00832 for additional information on approved SFPs.

Note: *Use of non-approved SFPs is not permitted on the Ovation system.*

The OCR1100 G02 Controller ports are protected by factory installed dust covers. Dust covers are removed prior to usage.

Replacement dust covers can be ordered as a separate item using the following part numbers:

- SFP dust cover - 1X00828H04
- RJ45 dust cover - 5A26371H95

34.5 Common cabinet components (Controller, remote node, and extended cabinet)

The following figures illustrate components that may be contained in both Controller cabinets, remote node cabinets and extended cabinets:

34.5.1 Ovation Power Distribution Module (PDM)

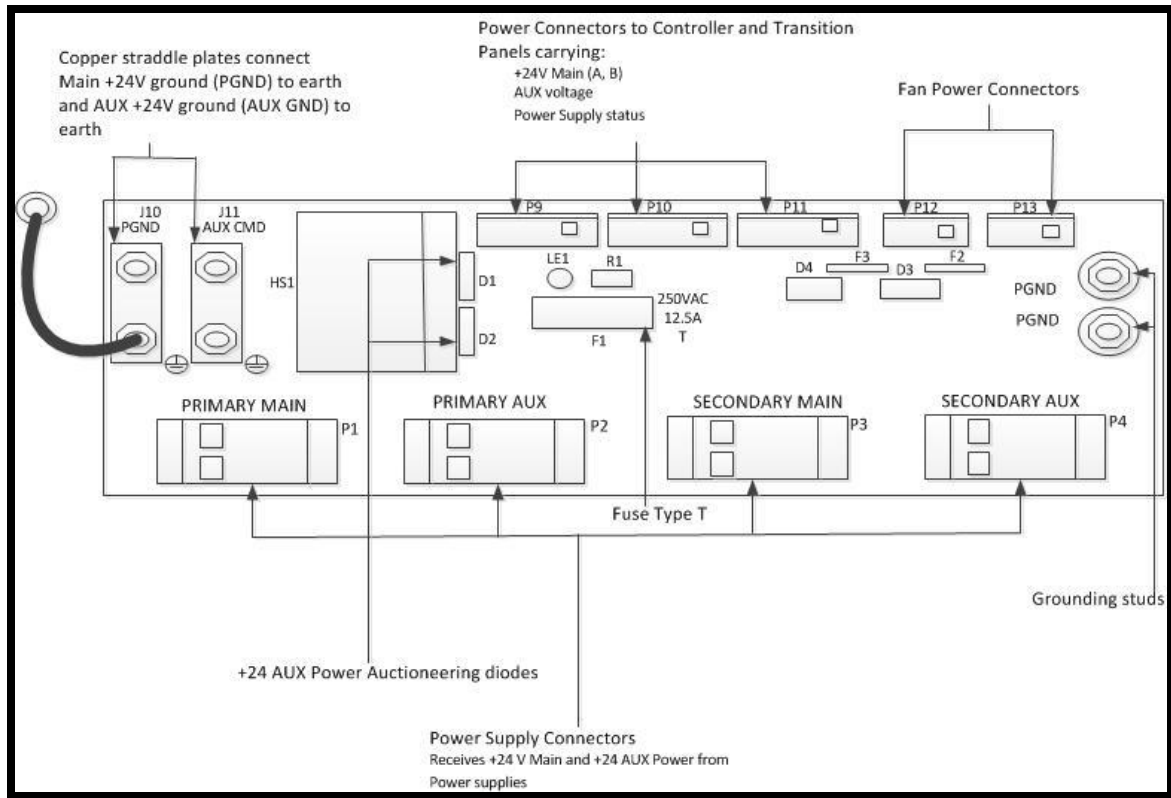


Figure 156: Ovation Power Distribution Module (PDM)

34.5.2 Ovation Standard I/O Modules and Base Units

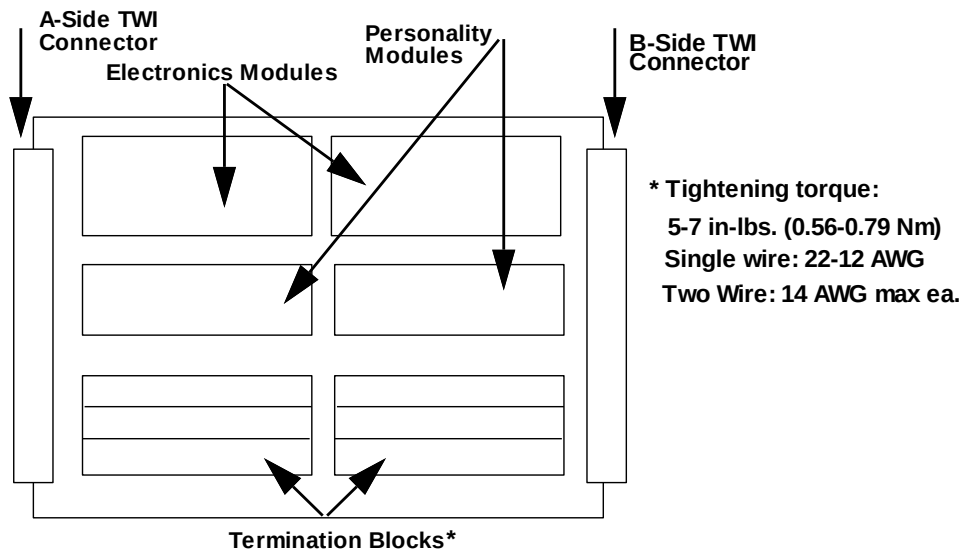


Figure 157: Ovation Standard I/O Modules and Base Units

34.5.3 Relay Output Modules and Bases

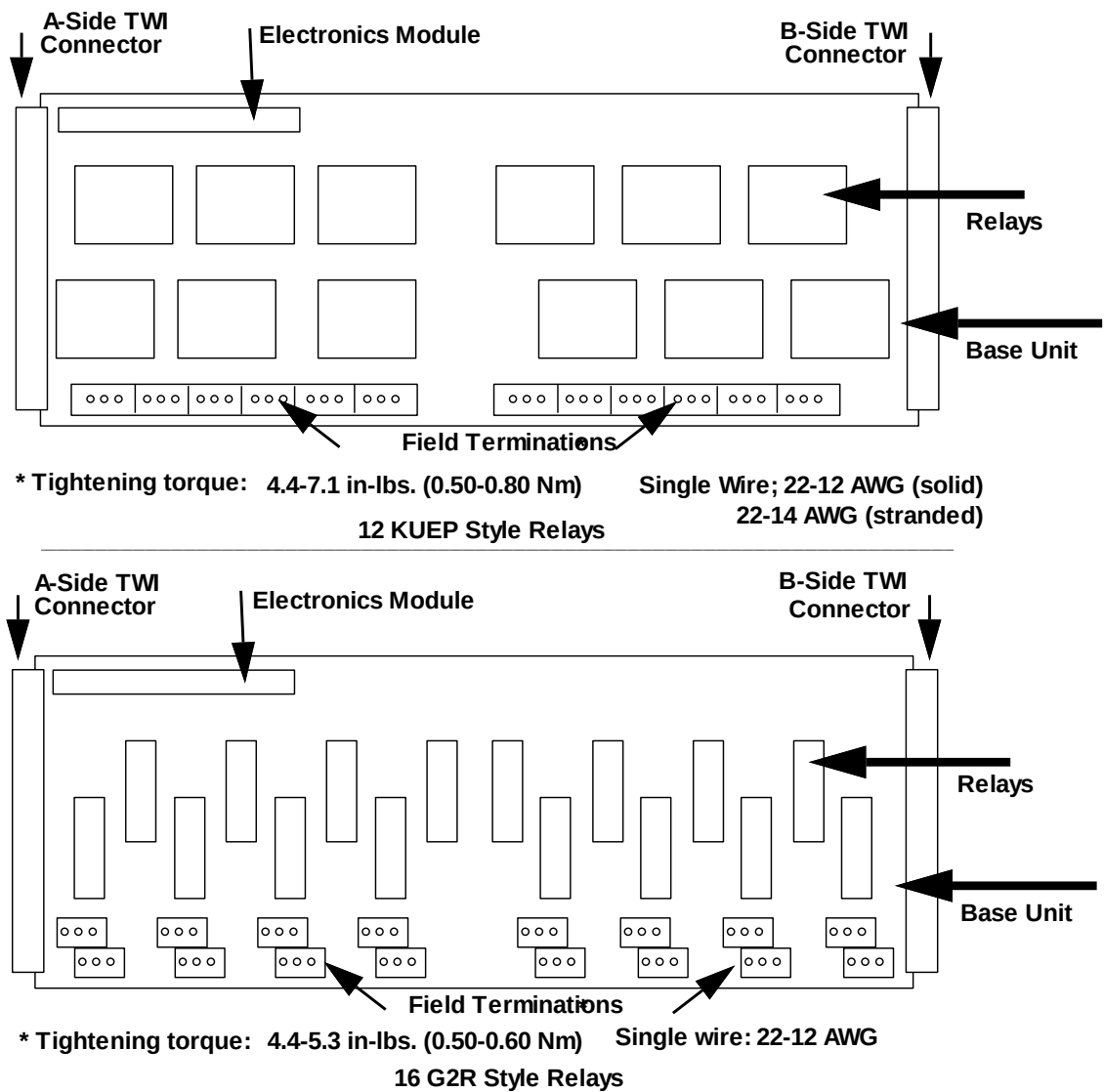


Figure 158: Relay Output Modules and Bases

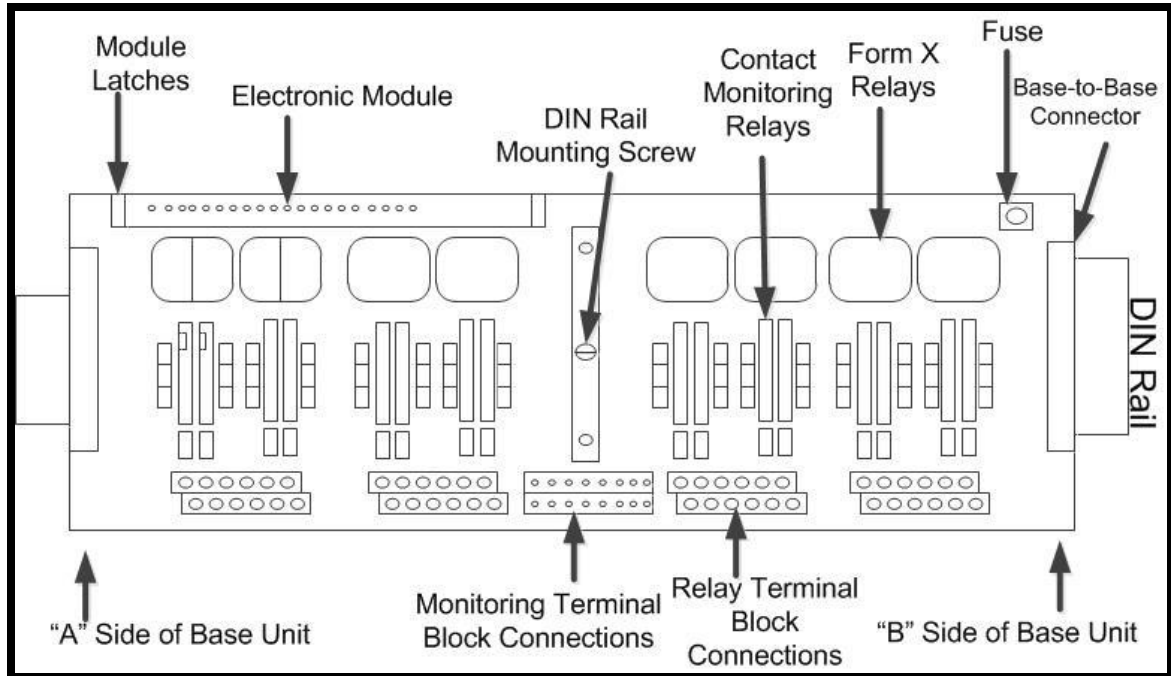


Figure 159: Relay Ooutput with Contact Monitoring Modules and Bases

34.5.4 I/O Dual Branch Transition Panel (ROP)

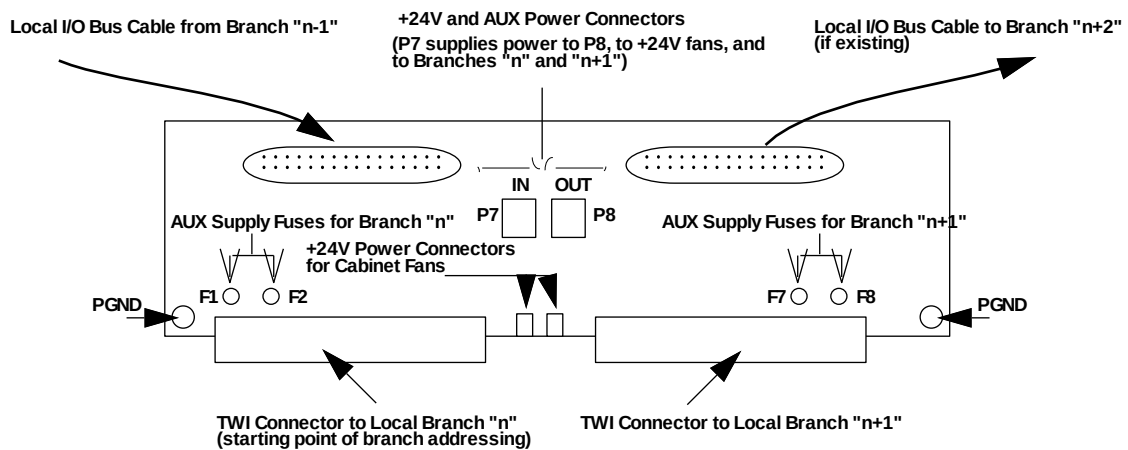
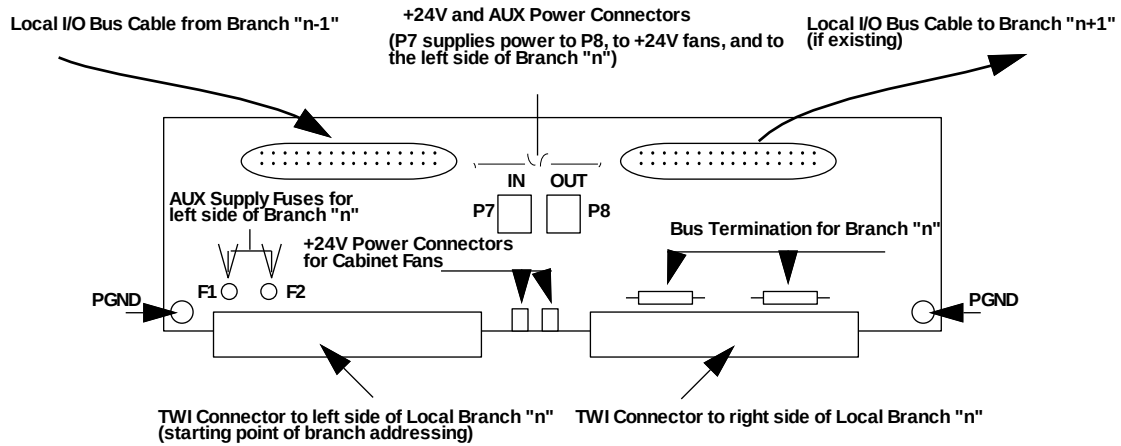


Figure 160: I/O Dual Branch Transition Panel (ROP)

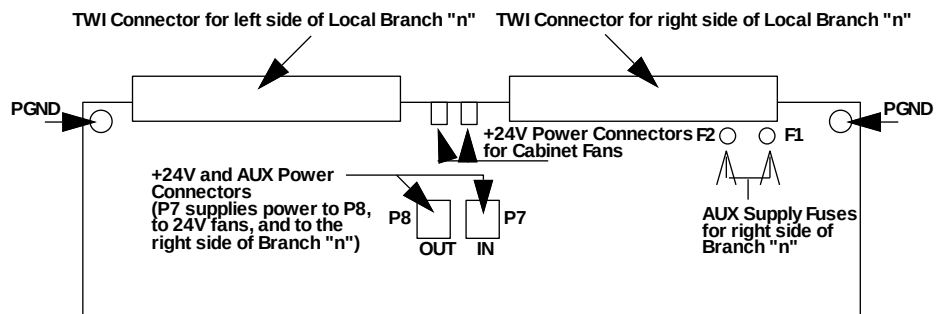
34.5.5 Ovation I/O Single Branch Transition Panels



Note

The RRP is typically used in conjunction with the RRB.

Transition Panel (RRP at top of branch)



Notes

1. The RRP is typically used in conjunction with the RRB.
2. I/O module addresses continue from the left side TWI connector to the right side TWI connector.

Transition Panel (RRB at bottom of branch)

Figure 161: Ovation I/O Single Branch Transition Panels

34.5.6 Remote Node Controller (RNC)

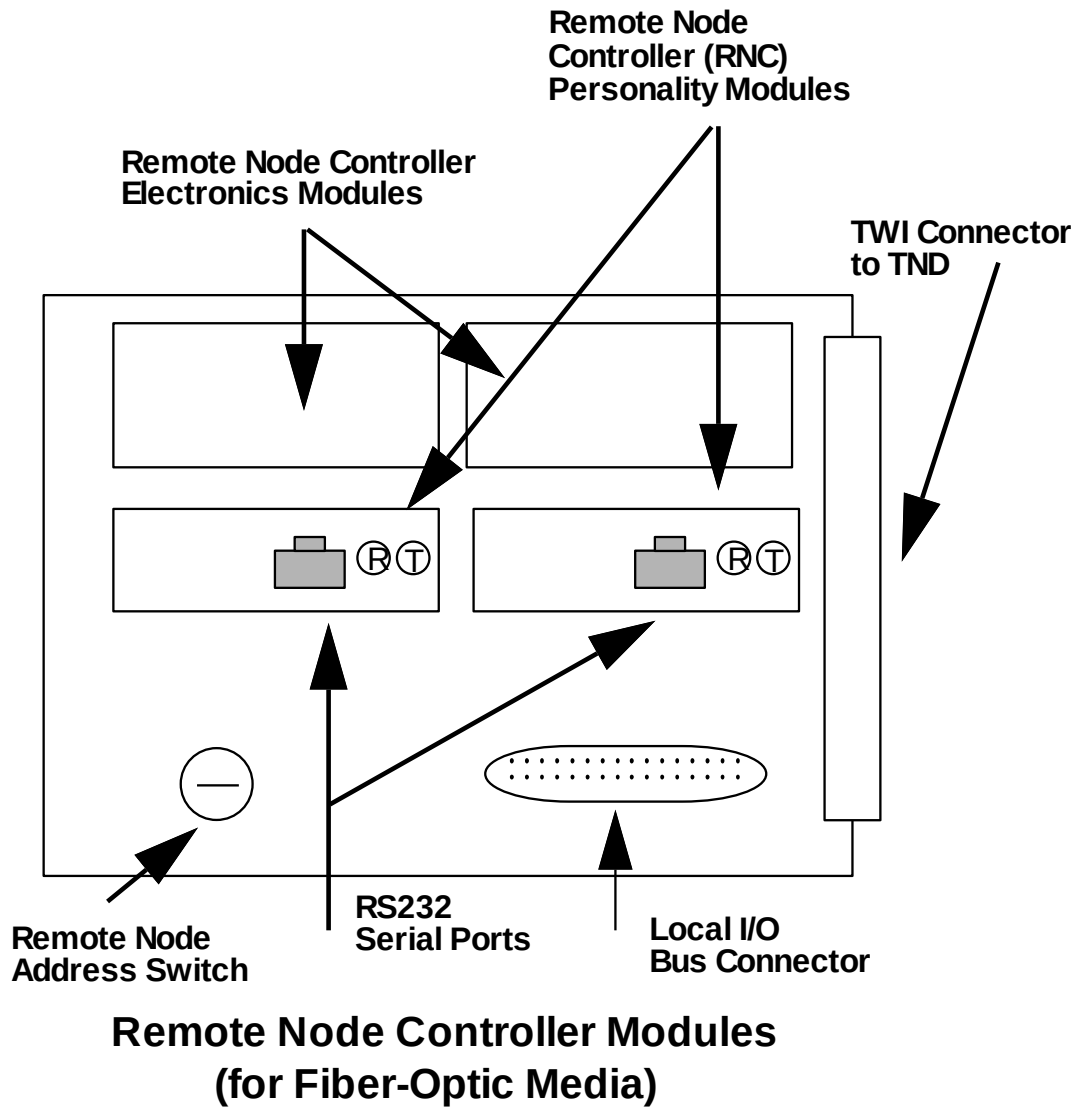


Figure 162: Remote Node Controller (RNC)

34.5.7 Remote Node Transition Panel (TND)

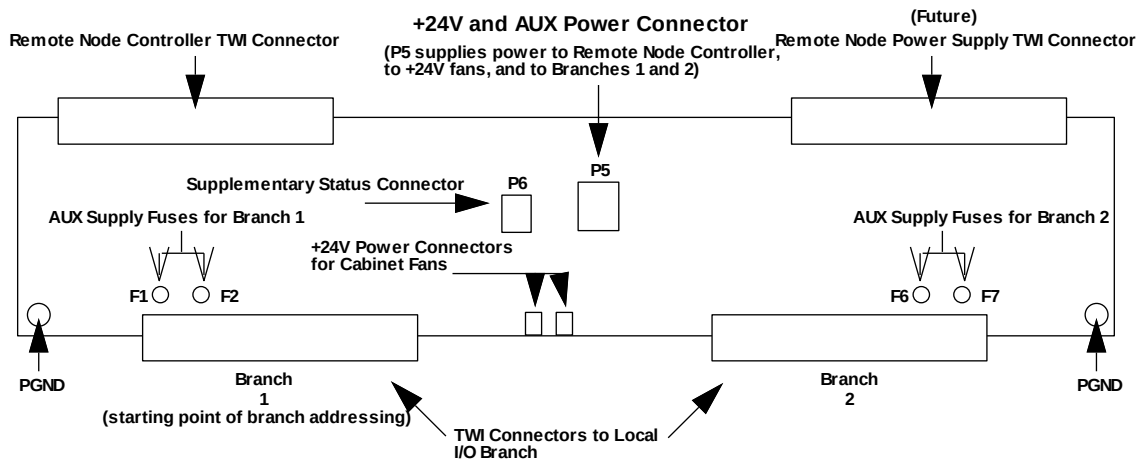


Figure 163: Remote Node Transition Panel (TND)

34.5.8 MAU with typical fiber-optic connector pairs (OCR400 Controller and OCR1100 Controller)

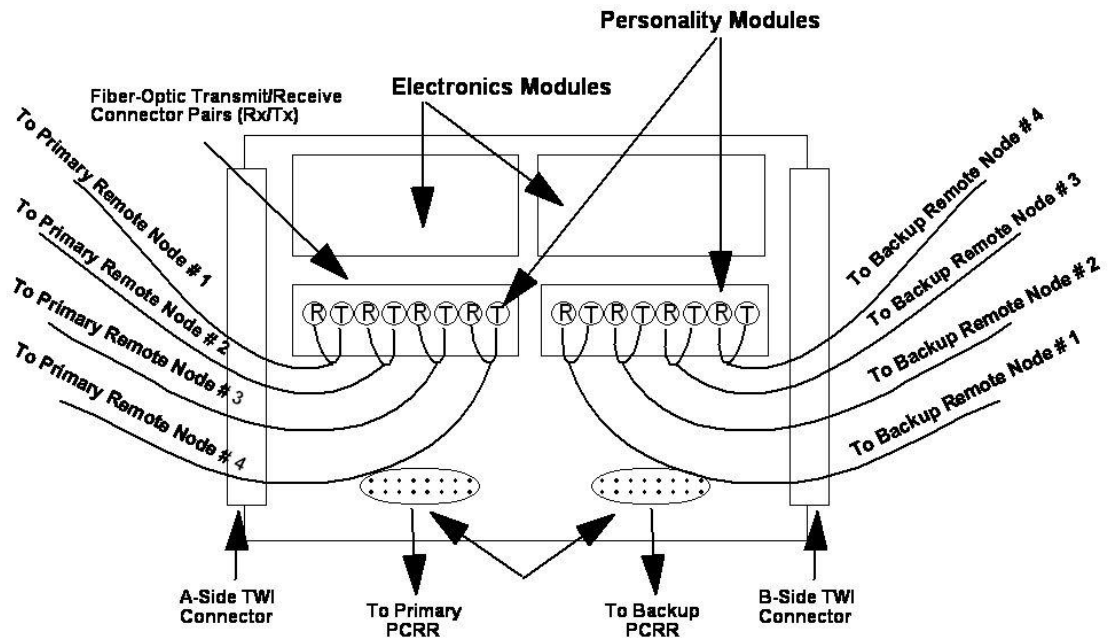


Figure 164: MAU with Typical Fiber-Optic Connector Pairs (OCR400 Controller)

34.6 Common cabinet configurations

34.6.1 Controller cabinet components and cabling (local and remote I/O) (OCR400 Controller)

Note: For the power distribution scheme, refer to the Power distribution scheme for Ovation 3.5 (see page 605) section.

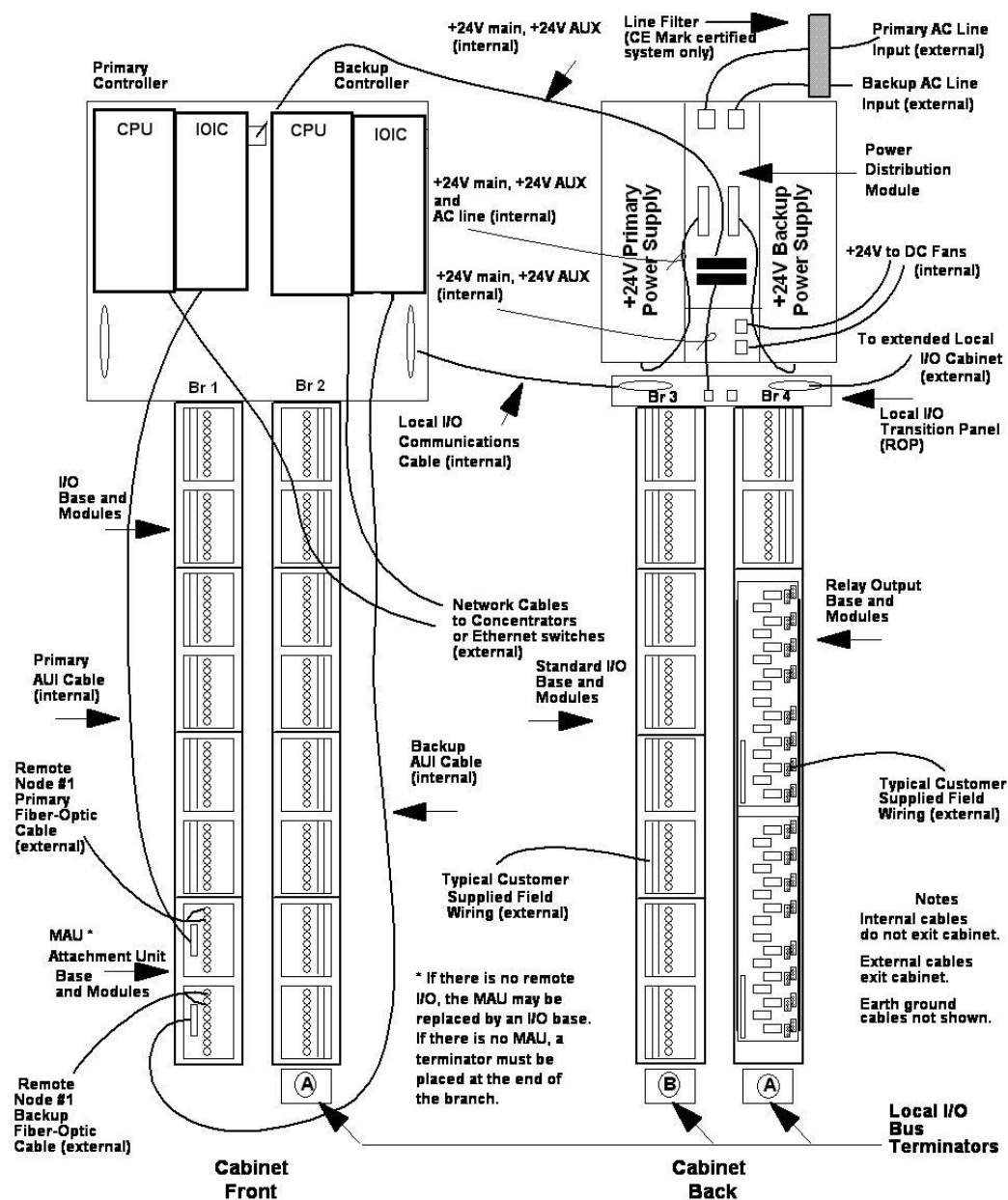


Figure 165: Controller Cabinet Components and Cabling (local and remote I/O) (OCR400 Controller)

34.7 Local I/O

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. The local Ovation I/O consists of a mix of functional I/O units (modules) that communicate on the I/O bus to the Controller in the Controller's cabinet or in close proximity (9.1 meters (30 ft)).

Note: *Ovation local I/O is applicable for use in CE Mark certified systems except where noted.*

Ovation I/O also provides for remote I/O functions.

Typically, the Ovation local I/O subsystem contains:

- Controller cabinet with the redundant Ovation Controller, applicable IOIC, power supplies, and I/O modules.
- Extended I/O cabinet with additional I/O modules and power supplies.
- Appropriate cable and connections (see page 601) between the cabinets (See *Planning Your Ovation System.*)
- Interface support of existing Q-Line I/O using the IOIC.

Note: *Optional Ovation Marshalling cabinet configurations are also available, which provide for halfshell wiring terminations. (See *Planning Your Ovation System.*)*

34.7.1 Local I/O system configuration for the OCR400 Controller and OCR1100 Controller

The OCR400 and OCR1100 Ovation Controllers use an Ovation I/O Interface Card to communicate with Ovation I/O. Refer to the applicable [Ovation Controller User Guide](#) for additional information on the I/O configuration.

The Ovation OCR400 and OCR1100 Controllers contain one IOIC module. This module provides ports that connect to and support the following I/O module locations:

- **Local Ovation I/O** connects through ports L1 and L2.
- **Remote Ovation I/O** connects through IOIC ports R3 (nodes 0 through 3) and R4 (nodes 4 through 7).
- **Local Q-line I/O** connects through IOIC ports Q5 (DIOB 0) and R4 (DIOB 1).
- **Remote Q-line I/O** connects through IOIC ports R3 (nodes 0 through 3) and R4 (nodes 4 through 7).

Each OCR400 or OCR1100 Controller can support the following I/O modules in various combinations:

- Maximum of **128 local** Ovation I/O modules.
- Maximum of **512 remote** Ovation I/O modules.
- Maximum of **96 local** Q-line I/O cards.
- Maximum of **384 remote** Q-line I/O cards.

Observe the following combination rules:

- If you connect to remote Q-line I/O, you cannot connect to remote Ovation I/O. You can connect to local Q-line through port Q5 (DIOB 0).
- If you connect to remote Ovation I/O, you cannot connect to remote Q-line I/O. You can connect to local Q-line through port Q5 (DIOB 0).
- If you use both ports Q5 and R4 to connect to local Q-line I/O, you cannot connect to any remote I/O.

Connection to local Ovation I/O is always available.

34.8 Remote I/O

Note: *Ovation remote I/O is applicable for use in CE Mark certified systems except where noted.*

The Ovation Distributed Control System provides modulating control, sequential control, and data acquisition for a variety of system applications. Although using local I/O is typically the most practical control solution, a remote process might need to be controlled.

Remote I/O is typically used where a process requires that I/O modules be located near the process, even though the Controller is not. The remote I/O modules are connected to the Controller through long distance, serial media, such as fiber-optic cables.

Typically, the Ovation remote I/O subsystem contains:

- Controller cabinet containing the redundant Ovation Controller, applicable I/O Interface Controller (IOIC) or PCI cards, power supplies, and I/O modules.
- Remote Node cabinet(s) (see page 594) containing the redundant Remote Node Controller module, as well as I/O cards.
- Extended I/O cabinet (see page 591) containing additional I/O modules and power supplies.
- Appropriate cable and connections between cabinets (See [*Planning Your Ovation System.*](#))

Note: *An optional Ovation Marshalling cabinet is also available. The rear of this 32 inch wide cabinet provides for halfshell wiring terminations, but has the same mechanical and electrical performance as the standard Ovation cabinet. (See [*Planning Your Ovation System.*](#))*

34.8.1 Remote I/O features (OCR400 Controller and OCR1100 Controller)

The Ovation remote I/O subsystem has the following features:

- Maximum number of Remote Nodes: **8 nodes**, redundant Controller.
- Maximum number of I/O modules per remote node: **64**¹ (eight branches with eight modules for each branch).
- Maximum number of I/O modules per Controller: **512**¹.
- Remote I/O Bus configuration: 10 BASE-FL Ethernet physical layer with a proprietary protocol.
- Remote I/O cycle time: **<100** microseconds (no repeaters²), double byte word master/slave access as seen by the IOIC.
- Cyclic redundancy checking on all outbound and inbound messages. Retries on failed messages.
- Standard Remote communications media offered: **Fiber-optic**
- Maximum cable length for 850 nm fiber-optic media: **2 km**
- Maximum cable length for 1300 nm fiber-optic media: **4 km**
- Remote communication diagnostics can be performed in the Primary and Backup system without affecting I/O modules. The diagnostics available are:
 1. Simulation of all types of bus cycles (such as local I/O including statuses, bit corruption, message length faults, collision faults, and no response).
 2. Loopback of all messages from IOIC through the MAU.
 3. Connection check of AUI cable and remote node link.
- Status LEDs: Available on IOIC, MAU, and RNC modules.
- Interface support of existing Q-Line I/O using Q-Line QOR card.
- Redundancy provided through independent MAU and RNC modules as well as communication media. The primary Controller has sole access to the remote I/O. The backup can perform diagnostic tests of the backup remote I/O link and RNC.

¹ These numbers represent hardware capabilities. Controller software limitations are not implied.

² Repeater are third-party Ethernet devices that must be endorsed by Emerson design engineers.

34.8.2 Controller cabinet components (Remote I/O) (OCR400 Controller and OCR1100 Controller)

The Ovation Remote I/O Controller cabinet contains the following:

- Redundant Controller Chassis - This rack in the Controller cabinet provides the backplane for two separate Controllers. For each Controller, the backplane interconnects the following components:
 - ☐ CPU module. Includes Fast Ethernet network interface.
 - ☐ IOIC module - I/O interface Controller module serving as the master of the remote I/O bus. Refer to the *Q-Line Installation Manual* for remote Q-Line I/O installation information (only 850 nm optics, with 2 km Maximum length, are available for remote Q-Line applications).

An IOIC module has two Attachment Unit Interface (AUI) ports each of which may connect to an Attachment Unit module using an AUI cable. Together, the two ports typically serve as the primary I/O bus master with another IOIC providing the redundant pair.

The IOIC module provides local power for itself and the CPU module.

- **Power Supply - DIN Rail Mounted.** Generates +24V to power the electronics in the I/O Controller Cabinet, as well as +24V auxiliary power. Two are required for redundancy. An optional separate +48V auxiliary power supply is also available.
- **Power Distribution module (5X000489G01)** - Provides connectors for cables used to distribute +24V to the Redundant Controller Chassis, and +24V and auxiliary power to branches of local I/O.
- **Standard I/O modules and bases (see page 579)** - Standard Ovation I/O modules which interface to field devices.
- **Relay Output module and bases (see page 580)** - Relay module base, 1.5 times larger than a standard I/O base unit, containing Electronics module and relays to control field devices).
- **I/O Dual Branch Transition Panel (see page 581) (ROP - 4D33922)** - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary power, and the local I/O communications bus.

Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches Maximum may be daisy-chained together).

- **I/O Branch Terminator (see page 582) (1B30023)** - Connects to the A or B-side of a standard I/O base at the end of a branch having no Attachment Unit module to terminate the local I/O bus.

CAUTION! The I/O addressing for the Ovation database is determined from the positions of the bases installed in the cabinets.

Emerson recommends that all possible bases (typically four) be installed in the right-most branch of each side of a cabinet, even if they are not all filled with I/O modules. This prevents disruption of the database if additional I/O modules are installed in the future.

I/O modules should be installed in the right-most branch of each side of a cabinet from the BOTTOM UP. I/O modules should be installed in the left-most branch of each side of a cabinet from the TOP DOWN.

If Relay Output modules are mixed with Standard I/O modules on the same branch, the Standard I/O module base must always start in an odd-numbered position on the branch (positions 1/2, 3/4, 5/6, or 7/8).

- **Media Attachment Unit (MAU)** - This module provides a point of attachment for fiber optic cables used to transfer messages over long distances between the IOIC and up to four remote nodes. The module directs messages between the IOIC and one of the four remote nodes at a time as selected, converting signals readable by the IOIC to signals compatible with the fiber optic media and vice versa. The following components comprise the MAU:
 - ☐ **Electronics module (1C31179)** - Houses the Attachment Unit Logic Board (LAU) which provides power for the module and displays LED indication that the fiber optic cables are connected and the Remote Node Controller module has power.
 - ☐ **Personality module (1C31181)** - Houses the Attachment Unit Personality Board (PAU) which translates signals between the PCRR and the fiber optic media and provides connectors for the fiber optic cables.

MAU valid module combinations

ELECTRONICS MODULE	PERSONALITY MODULE	LENGTH OF OPTICAL LINK ¹	CHANNELS	OPTICS
1C31179G01	1C31181G01	Up to 2 kilometers (6,560 ft)	2	850 nm
1C31179G02	1C31181G02	Up to 2 kilometers (6,560 ft)	4	850 nm
1C31179G01	1C31181G03	Up to 4 kilometers (13,120 ft)	2	1300 nm
1C31179G02	1C31181G04	Up to 4 kilometers (13,120 ft)	4	1300 nm
¹ In order not to be required to select extended IOIC time-out periods, it is recommended that you do NOT exceed an optical length of 3.7 km. ² An Ovation Controller cabinet MAU MUST use the same type of optics (850 nm or 1300 nm) for each of the remote nodes that it interfaces. An MAU cannot interface both 850 nm remote nodes (using 1C1204G01 Personality modules) and 1300 nm remote nodes (using 1C31204G03 Personality modules.)				

- ☐ Media Attachment Unit Base (**1C31206**) - This base holds a Maximum of two modules and provides a connector for the AUI Cable which interconnects the IOIC and Attachment Unit module. The backplane routes +24V to the Attachment Unit modules for power. It also provides local I/O bus termination.

Therefore, I/O branch terminator boards are not required at the end of branches where Media Attachment Unit modules are placed.

34.9 Extended I/O cabinet components

The Ovation I/O Extended cabinet contains the following:

Note: Refer to the *Planning Your Ovation System Manual* for additional cabinet and cable information.

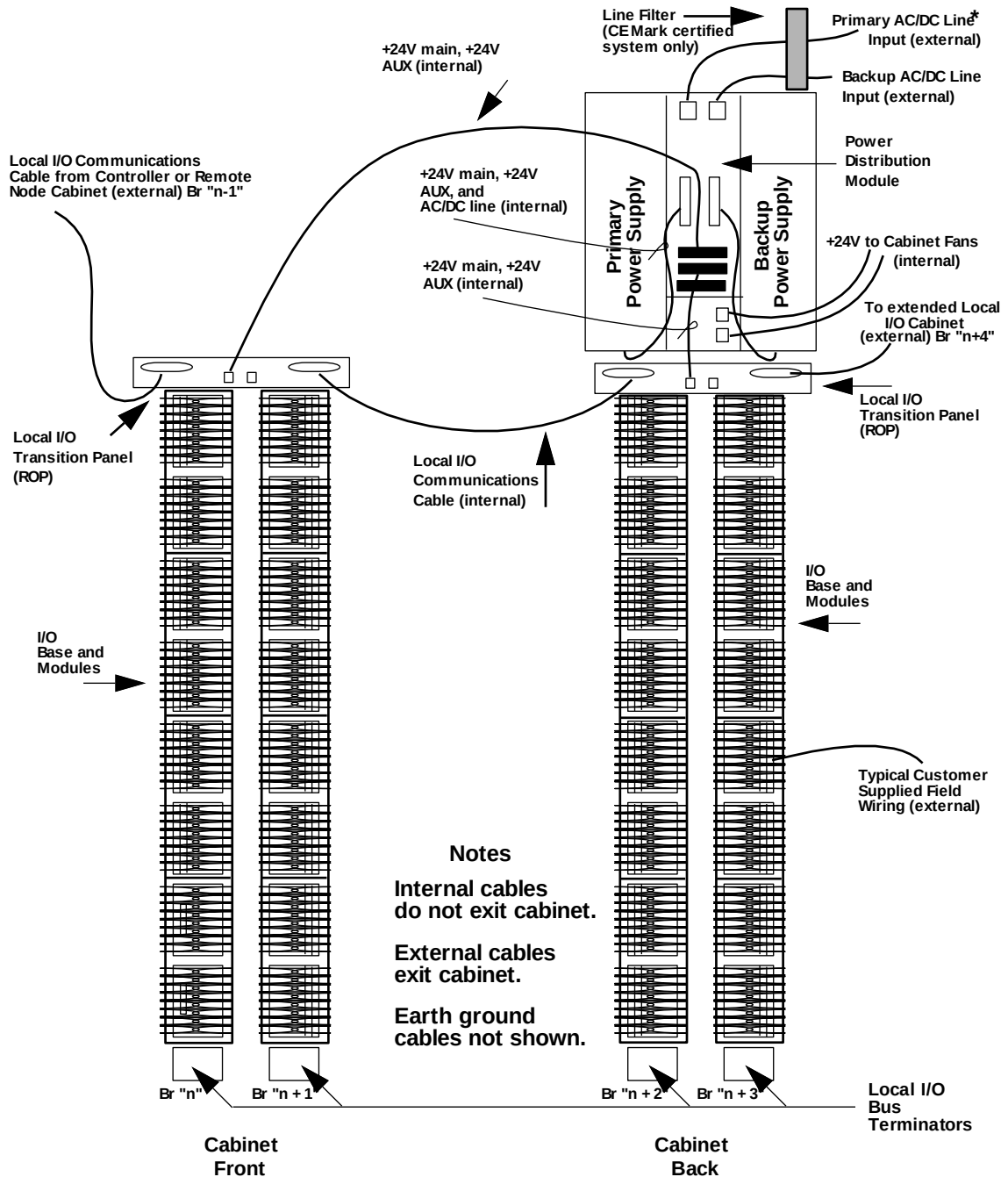
- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the I/O Controller Cabinet, as well as +24V auxiliary power. Two are required for redundancy.
- Power Distribution module (5X000489G01) - Provides connectors for cables used to distribute +24V to branches of local I/O, and in the Redundant RNC in remote cabinets.
- Standard I/O modules and Base (see page 579) - Standard Ovation I/O modules which interface to field devices.
- Relay Output module and Base (see page 580) - Relay module base, 1.5 times larger than a standard I/O base unit, containing Electronics module and relays to control field devices.
- I/O Dual Branch Transition Panel (see page 581) (ROP - 4D33922) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary supplies, and the local I/O communications bus.

Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches Maximum may be daisy-chained together).

- I/O Single Branch Transition Panels (see page 582) (Top - RRP 3A99252; Bottom - RRB 3A99253) - Used with Relay Output modules for a single I/O branch of up to eight relay bases.

Supplies +24V redundant power, auxiliary power, and local communications bus to the branch. Mounted at the top/bottom of the extended cabinet. Only one I/O branch is used and remaining branches are passed on.

Note: For the power distribution scheme, refer to the Power distribution scheme for Ovation 3.5 (see page 605) section.



* DC Power Supplies are not applicable to CEMark Certified systems.

Figure 166: Ovation Extended I/O Cabinet (illustrating cables and Standard I/O)

34.10 Remote node cabinet components

The Ovation Remote Node (see page 596) cabinet, located remotely from the Controller cabinet contains the following:

- Power Supply - DIN Rail Mounted. Generates +24V to power the electronics in the Remote Node Cabinet, as well as +24V auxiliary power. Two are required for redundancy.
- Remote Node Controller (RNC) module (see page 583) - Provides a point of attachment for remote I/O media used to transfer messages between the remote node and the MAU. There are only two Remote Node Controller modules per remote node (one primary, one backup), regardless of the number of cabinets at the node. The module translates messages from the remote I/O bus into local I/O bus cycles that can be directed to as many as eight branches of local I/O modules.

The following components comprise the Remote Node Controller module:

- ☐ Remote Node Electronics module (**1C31203**) - Prepares messages received from the remote I/O Controller for the local I/O modules at the remote node. When an I/O module responds to the message, the module prepares the response to be sent back to the Controller over the fiber-optic media.
- ☐ Remote Node Personality module (**1C31204G01 for 850 nm optics/1C31204G03 for 1300 nm optics**) - Houses the Remote Node Personality Board (PAU) which provides connectors for the media used to transmit and receive remote messages between the Controller and remote node. Group 1 modules provide fiber-optic connections; (future plans are that group 2 modules provide an AUI port used to connect to third-party transceivers). Power supply monitoring circuitry of the +24V redundant supplies is located on this module and is reported back to the Electronics module to flag failure of the primary or backup supply.
- ☐ Remote Node Controller Base (**1C31205**) - This unique base holds a Maximum of two Remote Node modules and interfaces directly to two I/O branches. It provides a rotary switch for node addressing and a D-connector for interfacing to as many as six additional I/O branches using a local I/O communications cable. The RNC base unit is connected to the Remote Node Transition Panel described below.
- Remote Node Transition Panel (**see page 584**) (**TND - 4D33924**) - Interconnects the RNC base, Remote Power Supply module (if used), and the branches of local I/O in a single Remote Node cabinet. The Remote Node Transition Panel (TND) also provides connectors for DIN Rail Mounted +24V Supplies or auxiliary supplies to be wired into the remote node.
- Power Distribution module (**PDM - 5X000489G01**) - Provides connectors for cables used to distribute +24V to the Redundant RNC, and +24V and auxiliary power to the branches of I/O.
- Standard I/O modules and Base (see page 579) - Standard Ovation I/O modules which interface to remote field devices when placed in the Remote Node cabinet.
- Relay Output module and Base (see page 580) - Relay Output I/O modules which interface to remote field devices when placed in the Remote Node cabinet.
- I/O Dual Branch Transition Panel (see page 581) (**ROP - 4D33922**) - Connects to two branches of I/O, providing a point to bring in +24V redundant power, auxiliary power, and the local I/O communications bus.

Connections are provided on the I/O Transition Panel to daisy-chain the local I/O communications bus from one ROP to the next (up to eight I/O branches **Maximum** may be daisy-chained (see page 598) together.

- I/O Single Branch Transition Panels (see page 582) (**Top - RRP 3A99252; Bottom - RRB 3A99253**) - Used with Relay Output modules for a single I/O branch of up to eight relay bases.

Supplies +24V redundant power, auxiliary power, and local communications bus to the branch. Mounted at the top/bottom of the extended cabinet (see page 582). Only one I/O branch is used and branches 2 through 8 are passed on.

- I/O Branch Terminator Board A or B (**1B30023**) - Connects to the A/B-side of a standard I/O base (see page 596) at the end of a branch to terminate the I/O bus.

34.10.1 Typical Remote Node Cabinet

Note: For the distribution scheme, refer to the Power distribution scheme for Ovation 3.5 (see page 605) section.

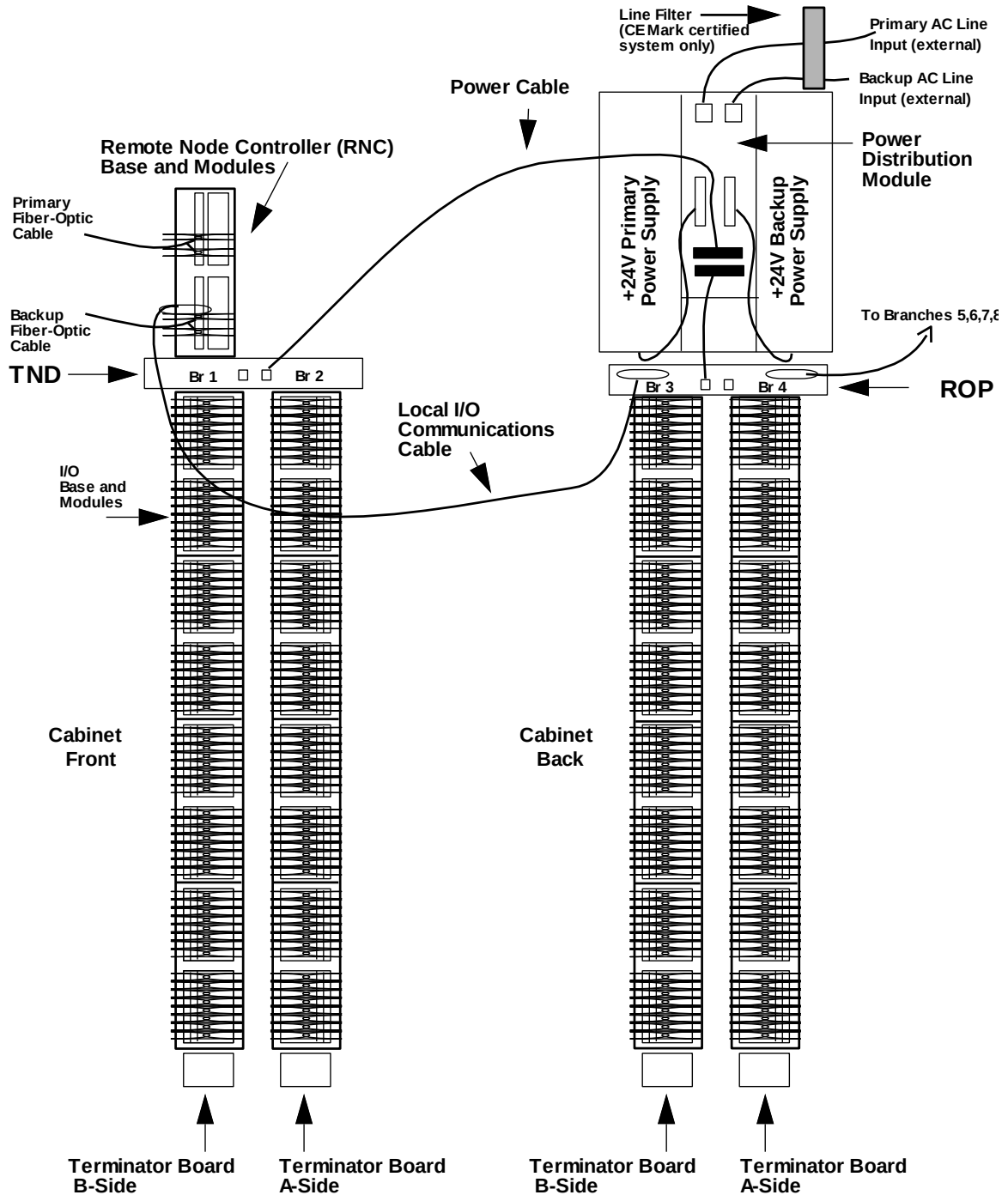


Figure 167: Typical Remote Node Cabinet

34.10.2 Placing the MAU module

The MAU module is located in an Ovation Controller cabinet or in a migrated WDPF DPU cabinet. The MAU plugs into a special base unit which can accommodate up to two modules per base. The base unit clamps onto the DIN rail, the same way as standard I/O module bases are attached to the DIN rail.

MAU 1 and MAU 2 are two separate MAU modules which may be located anywhere in the Controller cabinet. One AUI cable connects MAU 1 to P1 on the PCRR, and a second AUI cable connects MAU 2 to P2 on the PCRR.

Note: *If you migrate a WDPF Q-Line remote I/O system to Ovation, a QOR card replaces the QRC card in the WDPF Remote Node. Be sure to connect the MAU **TX** ports to the QOR **RX** ports, and connect the MAU **RX** ports to the QOR **TX** ports.*

Refer to the applicable Remote Q-Line Installation Manual for your system for information on remote Q-Line and the QOR card (only 850 nm optics, with 2 km Maximum length, are available for remote Q-Line applications).

The A-side and B-side of the MAU base unit terminates the local I/O bus, so the base must always be at the end of a branch when local I/O modules are located on the same branch.

The B-side of the MAU base also initiates base addressing for a branch of local I/O. If desired, multiple MAU base units may be connected together on a single branch. Since the MAU base unit terminates the local I/O bus, I/O Bus Termination cards are not required on the end of a branch that has an MAU.

Duplex fiber optic cables (see page 598) must be hooked between the MAU channels and their corresponding remote nodes with specific switch settings.

34.10.3 Remote node addressing switch

A Controller PCRR card can control up to eight remote nodes. A 10-position rotary switch (located on an RNC backplane or on a QOR card) is used to assign a node address to the remote node.

Note: Each remote Q-Line node is assigned all 244 possible DIOB addresses (08H through FBH).

Positions 0-7 on the switch assign the lowest-to-highest order remote node from an addressing standpoint. Selecting position 8 or 9 on the switch is the same as assigning position 0 or 1, respectively, to a remote node.

The remote node must be connected to a specific channel of the Controller cabinet's MAU so that the PCRR communication signals can be directed to the proper node. Similarly, the AUI cable connecting the MAU to the PCRR must be connected to a specific port on the PCRR. The following table lists the control path for a PCRR controlling eight remote nodes through two MAUs.

Remote Node Addressing Switch

REMOTE NODE	PCRR PORT FOR AUI CABLE	MAU CHANNEL	REMOTE NODE'S ROTARY SWITCH SETTING
1	P1	MAU 1 - channel 1	0
2	P1	MAU 1 - channel 2	1
3	P1	MAU 1 - channel 3	2
4	P1	MAU 1 - channel 4	3
5 ¹	P2	MAU 2 - channel 1	4
6 ¹	P2	MAU 2 - channel 2	5
7 ¹	P2	MAU 2 - channel 3	6
8 ¹	P2	MAU 2 - channel 4	7
Do not use.			8 or 9
¹ Optional for migration projects.			

34.10.4 Daisy-Chain Control of I/O Branches

Only one cabinet at a remote node contains redundant RNC modules which connect to two branches of I/O through the TND.

To control additional branches of I/O (up to six more branches), the local I/O bus (beginning at the RNC transition panel) is daisy chained to up to three ROPs. The ROPs may or may not be located in the same cabinet as the RNC. Note that each branch of I/O must be terminated with the proper I/O Branch Terminator Board (A or B). See Power Supply (see page 599) for a typical configuration of a remote node cabinet using daisy-chain control.

34.10.5 Power Supply

A +24V Power Supply is used to supply power to the Remote Node cabinet. The Power Supply is mounted on DIN Rails in the Remote Node cabinet. It is wired to the TND to provide power to the RNC and to the local I/O branches that are connected to the TND.

Note: For the distribution scheme, refer to the Power distribution scheme for Ovation 3.5 (see page 605) section.

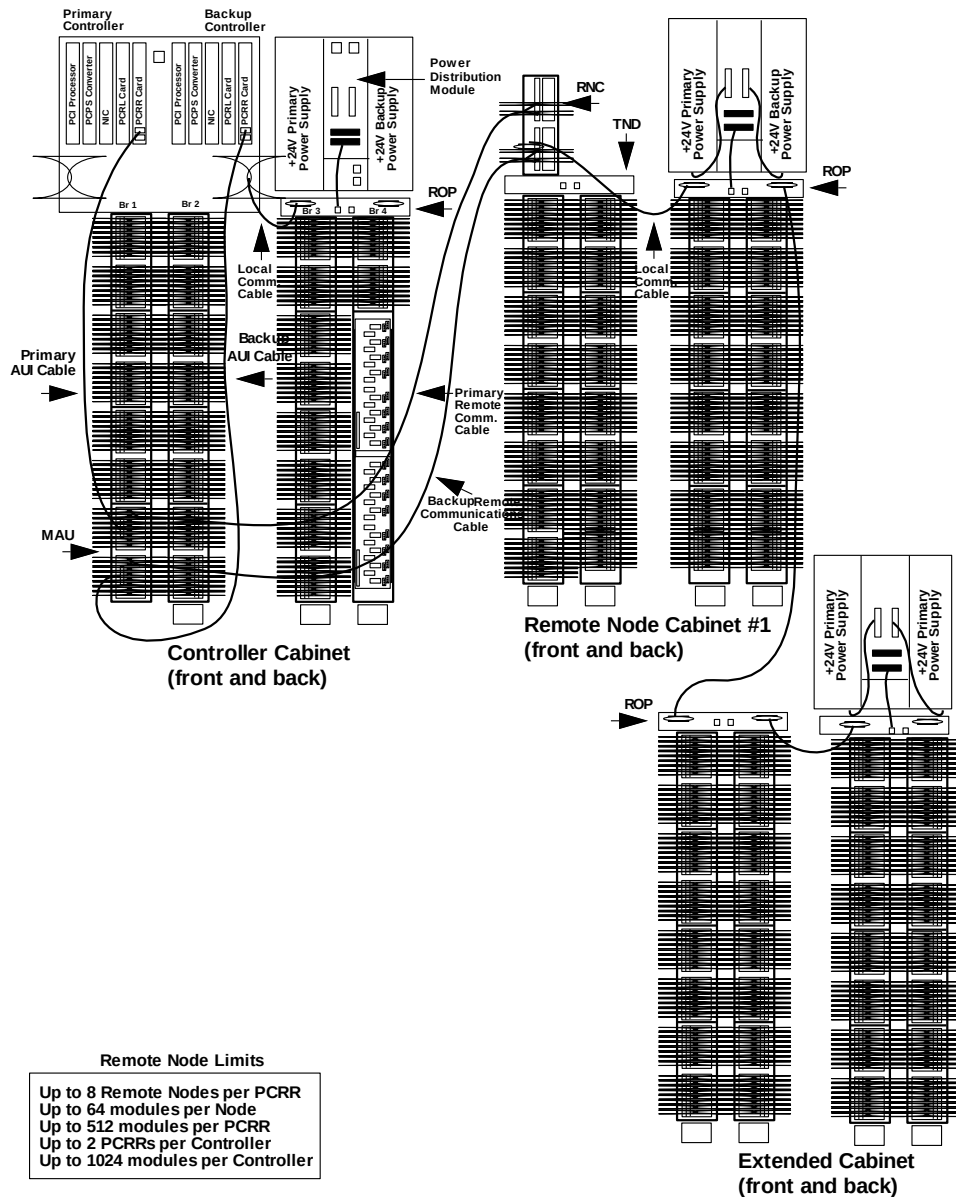


Figure 168: Example of Remote I/O Daisy-Chain Connections

34.10.6 Example of typical MAU cable connections to Remote Nodes (OCR400 Controller)

Note: For the distribution scheme, refer to the Power distribution scheme for Ovation 3.5 (see page 605) section.

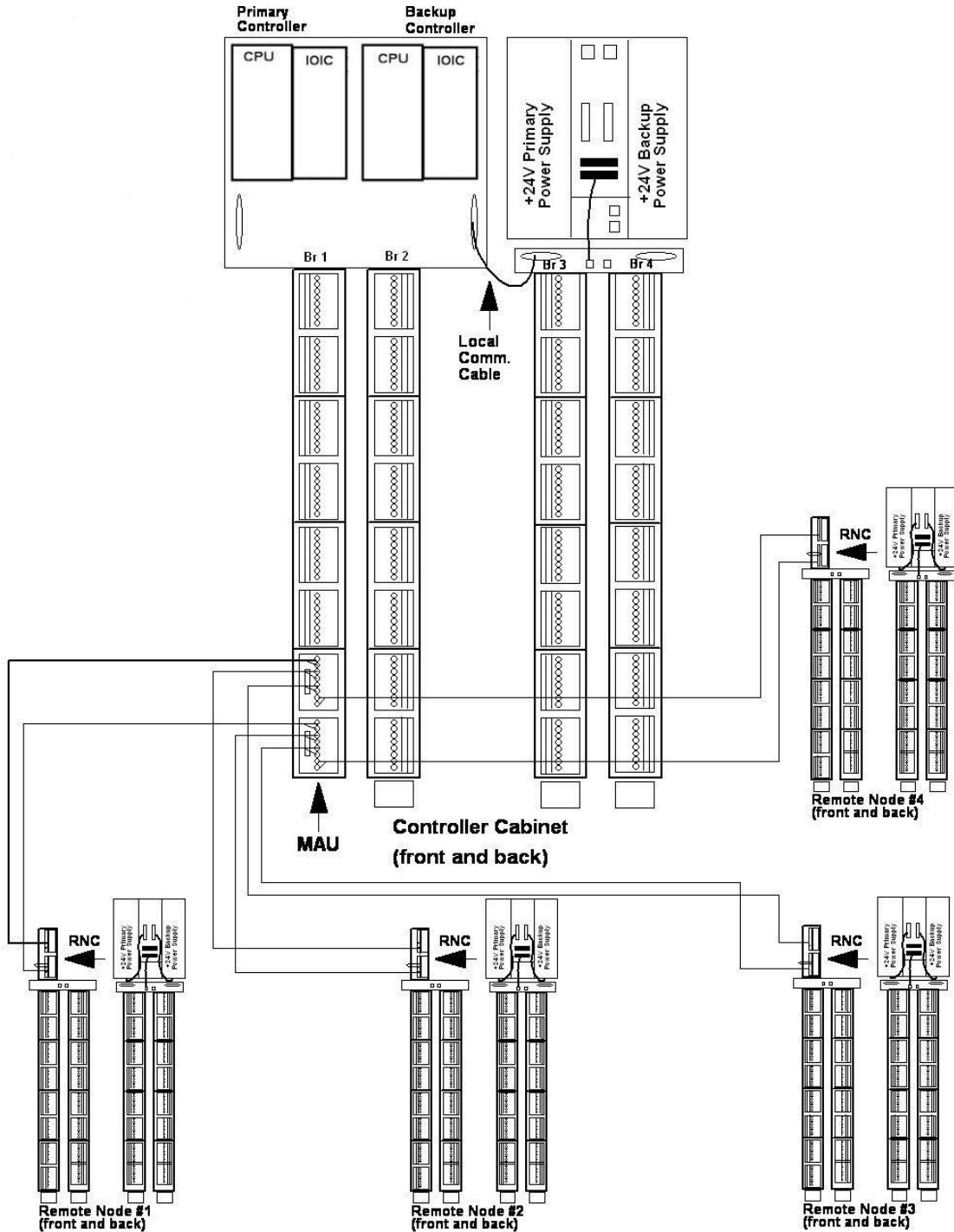


Figure 169: Example of Typical MAU Cable Connections to Remote Nodes (OCR400 Controller)

34.11 Selecting the I/O interface cards

For the OCR400 and OCR1100, the IOIC module handles interface for all of the I/O cards (see [What are the Ovation Controller I/O interfaces?](#) (see page 575)).

34.12 What changes can you make to an I/O device?

After an I/O device has been created and loaded to the target drop, it may be necessary to make changes.

You can make changes to the following:

- I/O devices (see page 601).
- External network devices (see page 601).

34.12.1 To modify an I/O device

After an I/O device has been created and loaded to the target drop, it may be necessary to make changes.

1. Launch the Ovation Developer Studio.
2. Use the system tree to navigate to the **I/O Devices** folder:
Systems > Networks > Units > Drops > I/O Devices
3. Right-click the appropriate item.
4. Select **Open**.
5. Make necessary changes in the dialog box and select **Ok** or **Apply**.

34.12.2 To modify an external Ovation networks device

For external networks modification information, see [Ovation Multiple Networks User Guide](#).

34.13 General requirements for I/O cable

The following cables are used for various I/O cable requirements:

34.13.1 I/O communications cable (5A26141)

This cable allows you to expand local I/O to additional branches by daisy-chaining connections between either the Controller backplane or Remote Node Controller Transition panel and additional local I/O Transition panels.

Length: 9.1 meters Maximum (30 ft).

34.13.2 **AUI Cable (5A26147)**

The PCRR and Media Attachment module are connected via an AUI cable. This cable meets the electrical specifications stated in the ANSI/IEEE 802.3 standard for local area networks. The cable should be long enough to reach the length of the cabinet.

Length: Approximately 1.5 meters (5 ft).

34.13.3 **Fiber-Optic Cable (3A98763 - Green) (3A98764 - Yellow)**

The standard configuration of the Ovation Remote I/O Subsystem requires fiber-optic cables (with ST connectors) to connect the MAU to a remote node.

For 850 nm optics, distances of up to 2 km are supported between the remote node and the Controller.

For 1300 nm optics, distances of up to 4 km are supported between the remote node and the Controller.

34.13.4 **Ovation Remote I/O Acceptable Optical Link Power Loss Budget**

The Optical Power Budget (OPB) is the maximum power loss that can occur between the transmitter and the receiver. The OPB is the difference between the coupled optical power (dBm) available from the transmitter and the coupled optical power required by the receiver. The OPB must be greater than or equal to the sum of Optical Power Margin (OPM) and losses that account for optical fiber attenuation, optical fiber slice losses, and optical connector to connector coupling losses. The OPM accounts for any decrease in the transmitted power or received power over the optical link's lifetime. An OPM of 2 dB is used.

Ovation Remote I/O 850 nm Optical Links

Minimum Optical Transmitter power = -16 dBm (~25 uW)

Minimum Optical power required by the optical receiver = -28 dBm (~1.6uW)

Optical Power Budget = 12 dB

Optical Power Margin = 2 dB

Allowable optical link loss = 10 dB maximum (sum of cable attenuation, slice losses, and connector coupling losses)

Ovation Remote I/O 1300 nm Optical Links

Minimum Optical Transmitter power = -17.5 dBm (~17.8 uW)

Minimum Optical power required by the optical receiver = -29.5 dBm (~1.12 uW)

Optical Power Budget = 12 dB

Optical Power Margin = 2 dB

Allowable optical link loss = 10 dB maximum (sum of cable attenuation, splice losses, and connector coupling losses)

The 62.5/125 micron multi-mode graded index optical fiber used by Ovation Remote I/O is compatible with both 850 nm and 1300 nm optical devices. However, the 62.5/125 micron multi-mode graded index optical fiber exhibits power losses at 1300 nm that is approximately 1/3 to 1/2 of the power losses experienced at 850 nm.

Note: The Optical Power is measured in linear units of milliwatts (mW), nanowatts (nW), and decibels (dB).

The dB is a ratio of two powers, for example, the loss in a fiber optical cable. When power is measured in the linear units (mW, uW, or nW), the dB is calculated on a log scale using the following formula:

$$\text{power (dB)} = 10 \log (\text{power1}/\text{power 2})$$

If absolute power levels are measured (the measurement is generally referenced to 1 milliwatt (mW) and is expressed as dB), the dBm is calculated using the following formula:

$$\text{power (dBm)} = 10 \log (\text{power}/1 \text{ mW})$$

Therefore, 1mW = 0 dBm, 1uW = -30 dBm, and 1nW = -60 dBm.

Adding Ovation Controllers to WDPF Q-Line I/O

When OCR1100 Controllers are added to a WDPF control system using Q-Line I/O, two QOL cards, one connected to each Controller, are necessary to provide the connections previously done by the QBE or the QOR card. QOL cards typically occupy the QBE slot or the 13th slot in the upper and lower Q-crates in a WDPF A or extended A cabinet.

QOL cards are typically used when Ovation Controllers are installed and utilize Q-line I/O. Refer to drawing number 5X00252 for additional information.

The Ovation Controller treats local Q-Line as if it were remote Q-Line without the conversion to fiber-optic media. The 13V power supply voltages are not directly connected to the Ovation Controller. QOL cards replace the first and last QBE cards in the Q-Crates.

The QOL monitors the 13V power supplies and provides a status bit to the Controller. This is similar to the way Remote Q-Line and the QOR card provide status for remote Q-Line. Both provide status bits in board registers which are read by the Controller.

Remember that the QOL is really making local Q-Line into remote Q-Line but only providing a short distance copper connection instead of fiber optic so the Controller does not notice this minor difference.

The migration kit wiring diagram 4D33960 shows a 2-connector cable connected to the PCQL module which was where the 13V power was monitored and status provided for the Controller. The I/O interface on the Ovation Controller does not have this 13V connection capability so instead the status is read from the QOL.

Two QOL cards 5X00230 are used for local Q Line I/O.

- QOL combines MAU and QOR functionality while eliminating the FO cable that is "Local Remote" Q-Line.
- Replaces QBEs in Q1 and Q4 Q-Crate 13th slots.
- For single Q-crate applications, both QOL's are housed in the same Q-crate.

34.14 Power distribution scheme

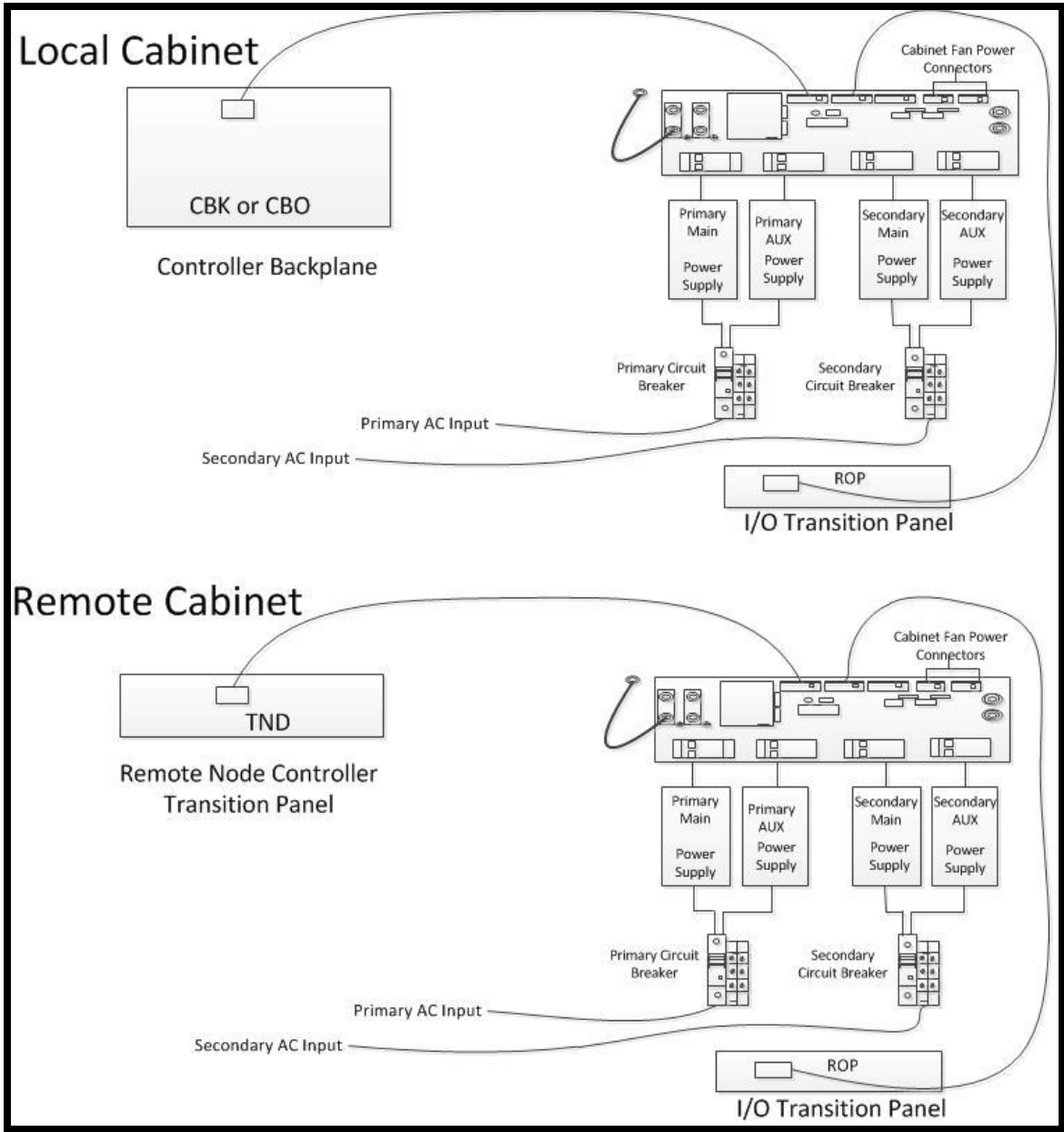


Figure 170: Power distribution scheme

SECTION 35

I/O system status and diagnostic LEDs

IN THIS SECTION

Status LEDs for the Controller processor module..... 608
Diagnostic LEDs..... 609
MAU Module..... 610
RNC Module..... 611

35.1 Status LEDs for the Controller processor module

The Controller processor module (left side of Controller) provides nine indicator LEDs that display status information about the interface between the Controller and the Ovation network.

There is a green power indicator (labeled P) and a pair of green and amber LEDs for each Ethernet port (labeled N1, N2, N3, and N4). The green power indicator lights when the Processor module is powered. Each Ethernet network port has two indicator LEDs (green and amber).

The green indicator is the Link Integrity/Power LED and lights when the port is receiving power and flashes slowly when the module is linked with the network through that port.

The amber indicator displays Link Activity status and flashes when the module is receiving or transmitting data on that port.

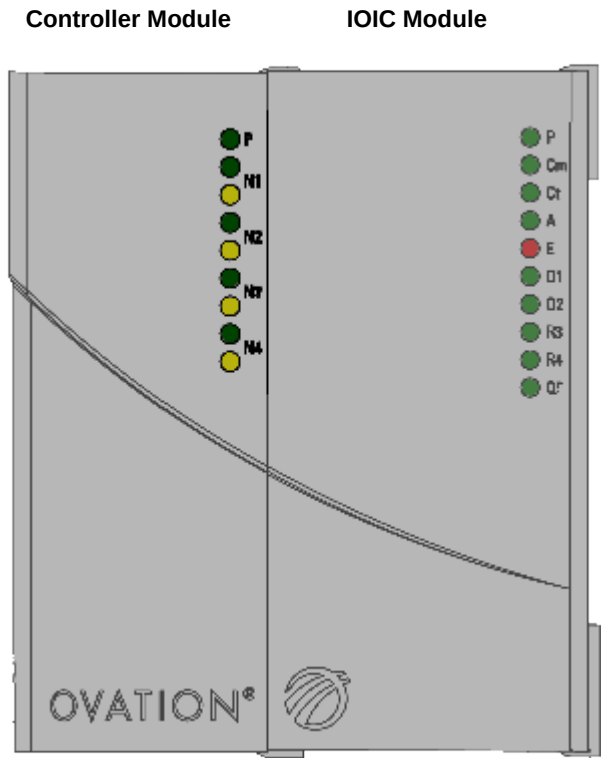


Figure 171: Processor module status LEDs

Processor module status LEDs

LED	MEANING	ON	OFF	BLINKING
P	Power	Lights green when module is powered.	Unlit when module is not powered.	N/A
N1	Ethernet port green LED (Link Integrity/Power LED)	Port is receiving power.	Port is not receiving power.	Module is linked to network through the port.

LED	MEANING	ON	OFF	BLINKING
	Ethernet port amber LED (Link activity status)	N/A	N/A	Module is receiving or transmitting data on the port.
N2	Ethernet port green LED (Link Integrity/Power LED)	Port is receiving power.	Port is not receiving power.	Module is linked to network through the port.
	Ethernet port amber LED (Link activity status)	N/A	N/A	Module is receiving or transmitting data on the port.
N3	Ethernet port green LED (Link Integrity/Power LED)	Port is receiving power.	Port is not receiving power.	Module is linked to network through the port.
	Ethernet port amber LED (Link activity status)	N/A	N/A	Module is receiving or transmitting data on the port.
N4	Ethernet port green LED (Link Integrity/Power LED)	Port is receiving power.	Port is not receiving power.	Module is linked to network through the port.
	Ethernet port amber LED (Link activity status)	N/A	N/A	Module is receiving or transmitting data on the port.

35.2 Diagnostic LEDs

Three Controller modules used in the Ovation Remote I/O subsystem are equipped with LEDs that provide diagnostic displays. The modules are the PCRR, MAU, and the RNC.

35.3 MAU Module

The MAU Electronics Module front panel has LEDs to display the status of the MAU on-board power supply and the fiber-optic links between the MAU and each remote node.

The four LINK OK LEDs correspond with the four remote nodes connected to the MAU.

Note: G01 MAU contains only two remote node connections and does have Link 3 and Link 4 LEDs.

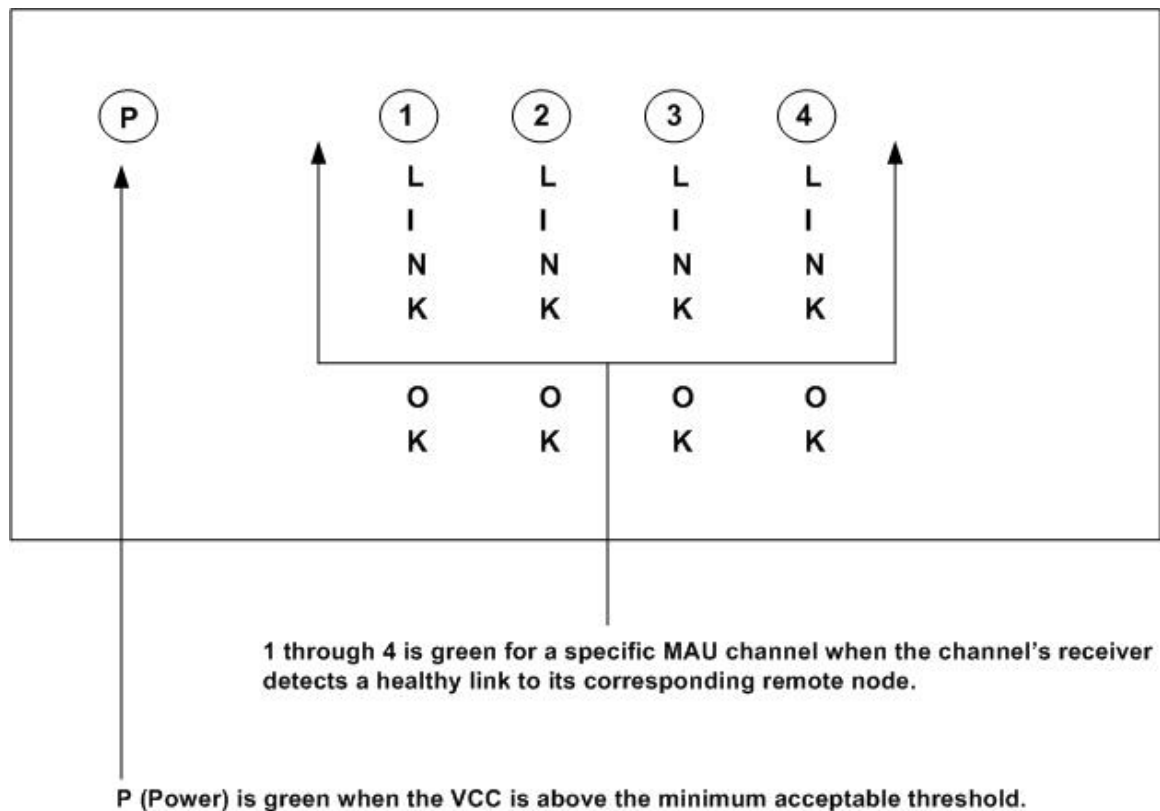


Figure 172: MAU LED Indicators

A healthy link between an MAU channel and a remote node is established when the transmitter of a powered-up remote node Controller is connected through a fiber-optic link to the receiver of its corresponding channel on the MAU. The transmitted signal received by the MAU must be strong enough to overcome low-light conditions to be seen as healthy by the MAU.

35.4 RNC Module

The RNC Electronics Module front panel has four LEDs to display statuses specific to the RNC and 16 LEDs to display statuses specific to the eight branches controlled by the RNC.

The LED states are defined in the following figure and table.

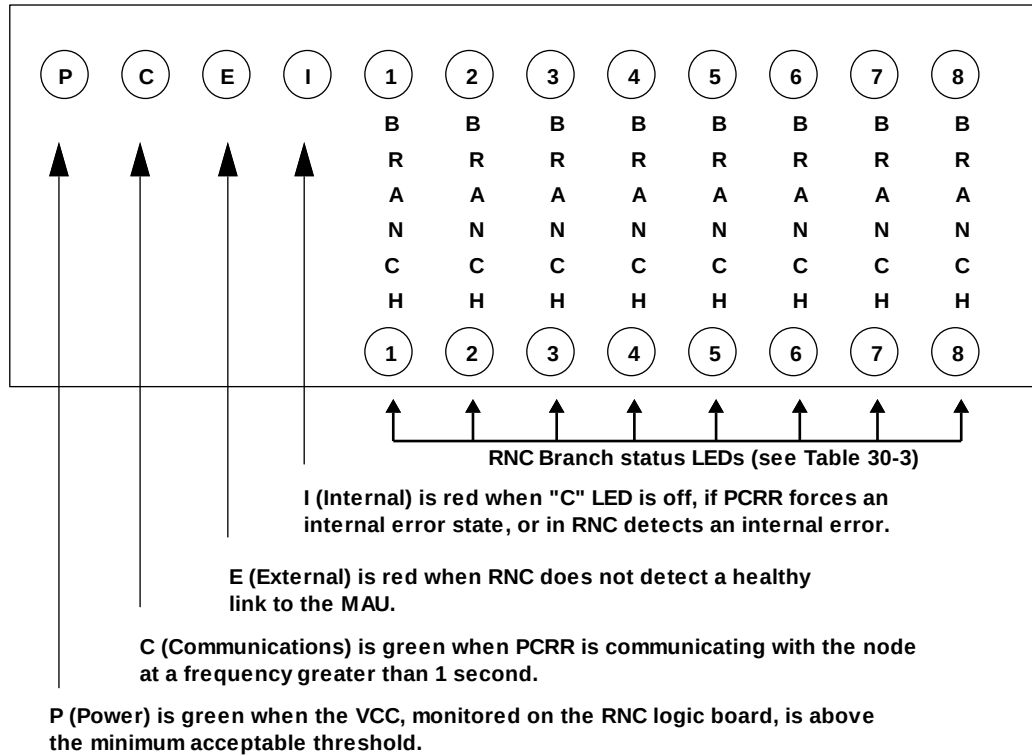


Figure 173: RNC LED Indicators

RNC Branch Status LED States

GREEN LED	RED LED	REMOTE NODE BRANCH STATUS
On	Off	All I/O cycles to the branch are succeeding.
On	On	Mixture of failing and succeeding I/O cycles to the branch.
Off	On	All I/O cycles to the branch are failing.
Off	Off	Branch is not being accessed.

SECTION 36

Ovation Electronic ID

IN THIS SECTION

<i>Electronic ID (EID).....</i>	<i>613</i>
<i>Serial number</i>	<i>613</i>
<i>Index number</i>	<i>615</i>
<i>I/O Module EID programming format</i>	<i>617</i>
<i>Bar code label</i>	<i>619</i>

36.1 Electronic ID (EID)

The Ovation I/O modules, I/O controllers, and processors are capable of storing a unique identifier in the on-board and non-volatile memory. This identifier is known as the Electronic ID (EID). The EID consists of the following two distinct pieces of information:

- Serial number (see page 613)
- Index number (see page 615)

36.2 Serial number

The serial number provides a method for identifying and date coding the Ovation I/O module. This number is a single 10-digit decimal number representing when and where the module was manufactured.

The serial number provides a method for identifying and date coding the Ovation I/O module. This number is a single 10-digit decimaling numbessentprer r

The serial number has two different formats, depending on whether or not it is associated with the OCR400CPU processor.

Format A

Format A applies to all products *except* the OCR400CPU processor.

The format used for the serial number is **DDDYYPNNNN** and is described in the following table

EID Serial Number for all products except OCR400CPU processor

CODE	DESCRIPTION	RANGE
DDD	Day of the year	001 - 366
YY	Year	00 - 99
P	Label printstation	0 - 9*

CODE	DESCRIPTION	RANGE
NNNN	1 - 9999 roll-over counter Increments by one and rolls back to 0001 after reaching 9999.	0001 - 9999

For example, if a module was module 8322, manufactured at print station 7, on day 43 of 2013, the serial number would be: **0430378322**,

where:

043 is the day of the year

13 is the year

7 is the label station

2 identifies that this module is the 8322 module labeled at station 7 for that day.

Format B

Format B applies to the OCR400CPU.

The format used for the serial number is **NNNNNPWWYY** and is described in the following table

EID Serial Number for the OCR400CPU processor

CODE	DESCRIPTION	RANGE
NNNNN	Ethernet MAC Address	00029 - 65535
P	Label printstation	8*
WW	Week of the year	01 - 52
YY	Year	00 00

The Ethernet MAC Address does not roll back to 00029 after reaching 65535

For example, if a module was module 8322, manufactured at printstation 7, on day 43 of 2013, the serial number would be: **0430378322**,

where:

043 is the day of the year

13 is the year

7 is the label station

2 identifies that this module is the 8322 module labeled at station 7 for that day.

36.3 Index number

The index number provides a description of the types and revisions of the two cards (Logic and Field) that make up an Ovation Electronics module. This number is a series of eight decimal numbers (separated by dots) that identifies the type of module and the revisions of the cards.

The format used by Ovation Electronics module for the index number is

MFC.MG.MR.LA.LR.FA.FR.CC.

EID index number (Ovation I/O modules)

CODE	DESCRIPTION	RANGE	NUMBER OF BITS
MFC	Module Function Code ¹	001 - 254	8
MG	Module Assembly Group	01 - 63	6
MR	Module Assembly Revision	00 - 63	6
LA	Logic Card Artwork	00 - 31	5
LR	Logic Card Assembly Revision	00 - 63	6
FA	Field Card Artwork	00 - 31	5
FR	Field Card Assembly Revision	00 - 63	6
CC	Compatibility Code	00 - 63	6
¹ Refer to the following table for each Ovation I/O module.			

The format used by the I/O Controller cards (PCRL, PCRR, PCQL and QOR) for the index number is **MFC.MG.CR.CA** and is described in below:

EID index number (Ovation I/O Controller modules)

CODE	DESCRIPTION	RANGE	NUMBER OF BITS
MFC	Module Function Code ¹	001 - 254	8
CG	Controller Group	01 - 63	6
CR	Controller Assembly Revision	00 - 63	6
CA	Controller Artwork	00 - 31	5
¹ Refer to the following table for function codes for each Ovation I/O Controller module.			

Module function codes

MODULE ASSEMBLY	MODULE TYPE	CATEGORY	FUNCTION CODE
1C31113	Analog Input (AI)	I/O module	001
1C31129	Analog Output (AO)	I/O module	002
1C31107	Digital Input (DI)	I/O module	003

MODULE ASSEMBLY	MODULE TYPE	CATEGORY	FUNCTION CODE
1C31122	Digital Output (DO)	I/O module	004
1C31142	Contact Input (CI)	I/O module	005
1C31157	Sequence of Events (SE)	I/O module	006
1C31147	Pulse Accumulator (PA)	I/O module	007
1C31166	Link Controller (LC)	I/O module	008
1C31199	Servo Driver (SR)	I/O module	009
1C31194	Valve Positioner (VP)	I/O module	010
1C31189	Speed Detector (SD)	I/O module	011
1C31203	Remote Node Controller (ND)	I/O module	012
1C31179	Media Attachment Unit (AU) ¹	I/O module	013
1C31161	RTD Input (RT)	I/O module	014
1C31174	Loop Interface Controller (LI)	I/O module	015
1C31219	Relay Output Electronics (ROE)	I/O module	016
1C31232	Compact Digital Input (DI)	I/O module	017
1C31234	Compact Contact Input (CI)	I/O module	018
1C31233	Compact Sequence of Events (SE)	I/O module	019
1C31224	14-bit Analog Input (AI14)	I/O module	020
5X00058	HART Analog Input (HAI)	I/O module	021
5X00062	HART Analog Output (HAO)	I/O module	022
5X00070	High-Speed Analog Input (HSAI)	I/O module	023
5X00106	HART High Performance Analog Input (IAH)	I/O module	024
5X00119	8-Channel RTD Input (RTD)	I/O module	025
5X00167	HART High Performance Analog Output (OAH)	I/O module	026
5X00270	High-Side Digital Output (HSDO)	I/O module	027
5X00300	Profibus (PBUS)	I/O module	028
5X00301	Fieldbus (FBUS)	I/O module	029
5X00376	DeviceNet (DNET)	I/O module	030
5X00357	Enhanced Compact Sequence of Events (ECSE)	I/O module	031
5X00419	Ethernet Link Controller	I/O module	032
5X00411	Redundant Digital Input (RDI)	I/O module	033
5X00501	16 Channel 4-20mA Analog Input	I/O module	034
5X00499	32 Channel 24V DC single-ended Digital Input	I/O module	035
5X00500	32 Channel 24V DC single-ended Digital Output	I/O module	036

MODULE ASSEMBLY	MODULE TYPE	CATEGORY	FUNCTION CODE
5X00597	Redundant Control with SLIM (RCS)	I/O Module	037
5X00594	16-Channel T/C Input (HDTI)	I/O Module	038
5X00606	8-Channel Compact T/C Input (CTI)	I/O Module	039
5X00622	16-Channel RTD Input (HDRTD)	I/O Module	040
5X00621	8-Channel Compact RTD Input (CRTD)	I/O Module	041
5X00583	32-Channel Relay Output (HDROE)	I/O Module	042
5X00481	OCR1100 CPU (OCR1100)	Processor	245
5X00467	Numalogic PC700 Remote I/O	I/O Controller	246
5X00241	OCR400 CPU (OCR400CPU)	Processor	247
5X00230	Q-Line Local Node Controller (QOL)	I/O Controller	248
5X00226	OCR400 I/O Interface (IOIC)	I/O Controller	249
3A99257	Q-line Remote Node Controller (QOR)	I/O Controller	250
3A99229	PCI to GBUS Interface (PGI)	PGI	251
3A99190	Remote Ovation I/O Interface (PCRR)	I/O Controller	252
3A99158	Local Ovation I/O Interface (PCRL)	I/O Controller	253
3A99141	Local Q-line I/O Interface (PCQL)	I/O Controller	254
¹ No onboard EID. Bar code label only.			

36.4 I/O Module EID programming format

The EID is represented in the Electronics card of an I/O module as **five** 16-bit integers (words). These words are programmed into the card after it has been manufactured and tested.

36.4.1 Serial number

The entire 10-digit serial number is written as one number into two 16-bit words. The serial number is contained in the MH field of the module (RM) record type and the Node (RN) record type (See the *Ovation Record Types Reference Manual*.)

36.4.2 Index number

The 17-digit index number is packed into three 16-bit words. The index number is contained in the M6, M7, and M8 fields of the module (RM) Record Type and the Node (RN) Record Type (See *Ovation Record Types Reference Manual*.)

INDEX HIGH WORD: INDEX # 3: M8 FIELD (OFFSET D)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MF C	MF C	MF C	MF C	MF C	MF C	MFC	MFC	MG	MG	MG	MG	MG	MG	MR	MR
INDEX MIDDLE WORD: INDEX # 2: M7 FIELD (OFFSET C)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
MR	MR	MR	MR	LA	LA	LA	LA	LA	LR	LR	LR	LR	LR	LR	FA
INDEX LOW WORD: INDEX # 1: M6 FIELD (OFFSET B)															
bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
FA	FA	FA	FA	FR	FR	FR	FR	FR	FR	CC	CC	CC	CC	CC	CC

36.5 Bar code label

The following figures contain examples of bar code labels. These labels are typically placed on the bottom of a manufactured Ovation Electronics I/O module or I/O Controller board after it has been successfully tested.

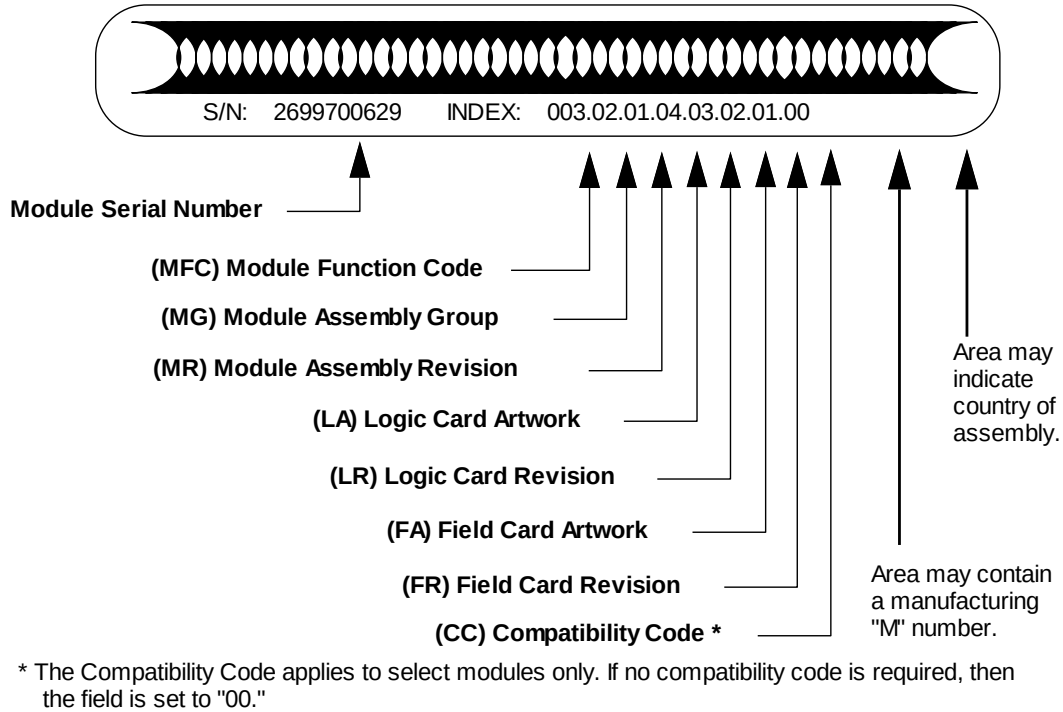
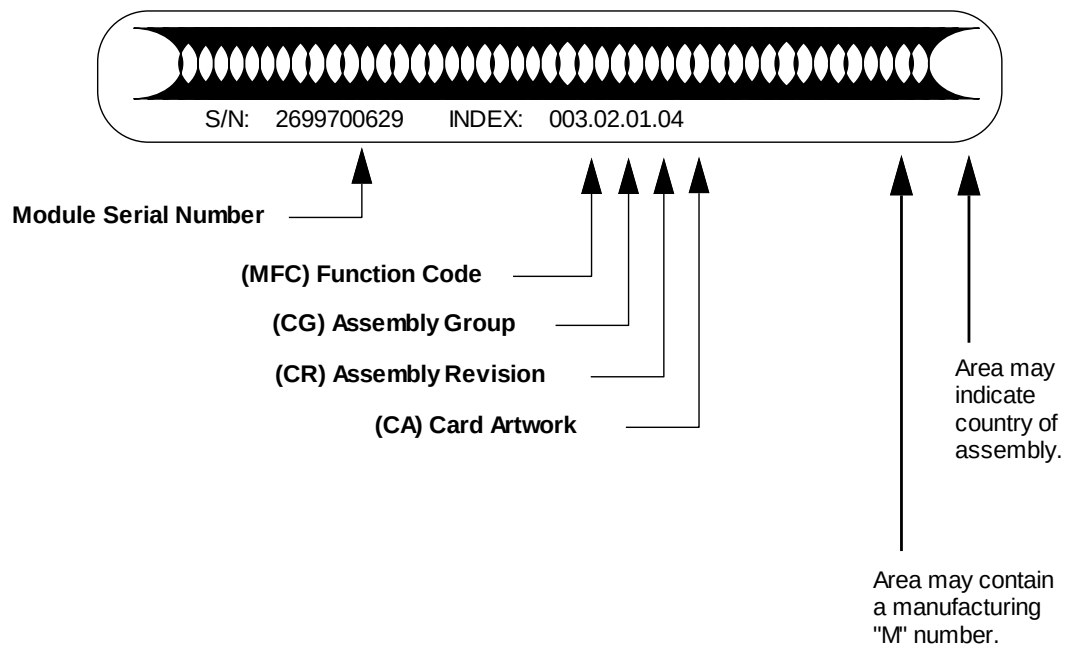


Figure 174: Bar code example for I/O module



* The Compatibility Code applies to select modules only. If no compatibility code is required, then the field is set to "00."

Figure 175: Bar Code Example for I/O Controller Board

SECTION 37

Compliance standards

IN THIS SECTION

<i>CE Mark Certified systems.....</i>	<i>621</i>
<i>KC Compliance mark</i>	<i>622</i>

37.1 CE Mark Certified systems

CE Mark certification on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety, and environmental protection legislation. CE Mark on a product indicates to governmental officials that the product may be legally placed on the market in their country and ensures the free movement of the product within the European Free Trade Association (EFTA) & European Union (EU) single market.

Non-EMC cabinet approach

A CE Mark Certified system is constructed with non-EMC cabinets. This is accomplished by utilizing a Non-EMC cabinet approach in which baseline testing was performed on the standard Ovation cabinet style 5X00127H02.

The CE Mark Certified Ovation Controller cabinet assembly, Extended I/O cabinet assembly, and Remote I/O cabinet assembly are certified for operation in the Industrial Environment as documented in the EMC Technical Construction File for Ovation (5X00423) and the Low Voltage Safety Technical File for Ovation (5X00394).

This approach utilizes requirements on field wiring shield termination to ensure compliance with the specific European Electromagnetic Emissions/Immunity and low voltage directive safety requirements.

The baseline cabinet assemblies utilized for the Non EMC Cabinet approach testing are 5X00127H02 (ventilated cabinet assembly) or 5X00046H03 (sealed cabinet assembly). Alternate models shall be considered ongoing based upon equivalency and may include criteria such as welded steel frame construction, gauge of metal side panels, overlapping door seams, internal ground straps connecting all panels to the mounting plate or equivalent, and a grounding stud for tying the EMC ground.

The specific requirements for the Non EMC Cabinet CE Mark approach are discussed throughout this document and are also in the following:

- **Drawing 5X00424** – This drawing contains a baseline listing of all components applicable for the Non EMC Cabinet CE Mark Certified System approach.
- **Drawing 5A26370** – This drawing contains a baseline listing of workstation and peripheral components applicable for the CE Mark Certified System.
- **Drawing 5X00475** – This drawing contains a baseline listing of third party workstation and peripheral components applicable for the CE Mark Certified System.

37.1.1 CE Mark accuracy considerations

EMC Technical Construction File and 5X00423 references various temporary electromagnetic interferences that the Ovation system must operate through. During these conditions, the accuracy of all Ovation analog points shall be derated to $\pm 2.5\%$.

37.2 IEC61131-2 system

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes international standards for all electrical, electronic, and related technologies. These serve as a basis for national standardization and as references when drafting international business agreements and contracts.

An Ovation IEC61131-2 certified system is a system whose components are compliant with the standards described in IEC61131-2. The Ovation Controllers and a subset of the Ovation I/O modules comply with these standards.

The specific requirements for IEC61131-2 certified systems are discussed in the following:

- Technical File **5X00394**.
- Drawing **5X00393** - This drawing contains a baseline listing of all Ovation components applicable for the IEC Certified System.

37.3 KC Compliance mark

The KC compliance mark indicates that a product has been manufactured to comply with Korean Radio Act standards.

In accordance with the KC compliance mark the manufacturer's name, address, and contact number are as follows:

Emerson Process Management, Power & Water Solutions Inc.
200 Beta Drive
Pittsburgh, Pennsylvania 15238 (USA)
(412) 963-4000

SECTION 38

Ovation power supply information

IN THIS SECTION

Power supply front view 623

Power supply wiring illustration 626

Power supply wiring connections 627

Functional diagram..... 628

Power supply locking mechanism..... 629

Power supply specifications..... 629

38.1 Power supply front view

The Ovation 24VDC power supply is a CE Mark certified power supply available in two styles:

- 1X00781H01L - 24VDC 10A
- 1X00781H02L - 24VDC 10A, Wide DC input

The following illustration shows the front view of the Ovation power supply and its associated attributes.



Figure 176: Ovation Power supply

ITEM	DESCRIPTION
+	Output terminal - Positive output. Quick-connect spring clamp terminals, two pins per pole.
-	Output terminal - Negative (return) output. Quick-connect spring clamp terminals, two pins per pole.
13 and 14 DC ok	The DC ok relay contact is synchronized with the DC ok LED. Quick-connect spring clamp terminals.
24 - 28 V	Output Voltage Potentiometer - Open the flap to adjust the output voltage.
DC ok	Green LED - Illuminates when the output voltage is >90% of the adjusted output voltage.
Overload	Red LED - Illuminates when the voltage in the output terminals is <90% of the adjusted output voltage, or in case of a short circuit in the output. Input voltage is required. LED flashes when the unit has switched off due to over-temperature.
N	N - Neutral input terminal. Quick-connect spring clamp terminals. (DC Return)
L	L - Line input terminal. Quick-connect spring clamp terminals. (+DC Input)
GND	PE (Protective Earth input). Quick-connect spring clamp terminals.

38.1.1 Diagnostic power supply LEDs

Diagnostic LEDs

LED INDICATORS	OVERLOAD LED	DC OK LED	DC OK CONTACT
Normal mode	OFF	ON	Closed
During Bonus Power	OFF	ON	Closed
Overload (Volt < 90%)	ON	OFF	Open
Output short circuit	ON	OFF	Open
Temperature Shutdown	Intermittent	OFF	Open
No input power	OFF	OFF	Open
Note: All parameters are specified at 24 V, 10 A, 230 VAC, 25 °C, 77 °F ambient and after five minutes run-in time unless otherwise noted.			

38.2 Power supply wiring illustration

The following figure illustrates the power supply wiring from the front view of the power supply:



Figure 177: Power supply wiring illustration

38.3 Power supply wiring connections

The following diagram illustrates how wires are connected and disconnected into the power supply terminal block.

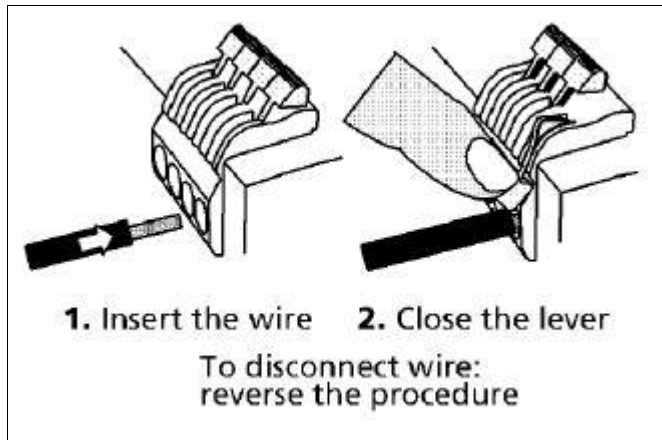


Figure 178: Power supply wire connection

CAUTION!

1. Follow all national and local installation codes and installation regulations.
2. Make sure you use appropriate copper cables and wires and that all strands of a stranded wire enter the terminal connection.
3. Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
4. Do not use the unit without the PE connection.
5. Unused terminal compartments should be securely tightened.

Terminals and wiring

WIRE	INPUT	OUTPUT	DC-OK SIGNAL
	spring-clamp terminals	spring-clamp terminals	spring-clamp terminals
Solid wire	0.5-6mm ²	0.5-6mm ²	0.5-6mm ²
Stranded wire	0.5-4mm ²	0.5-4mm ²	0.5-4mm ²
American Wire Gauge	20 - 10 AWG	20 - 10 AWG	20 - 10 AWG

38.4 Functional diagram

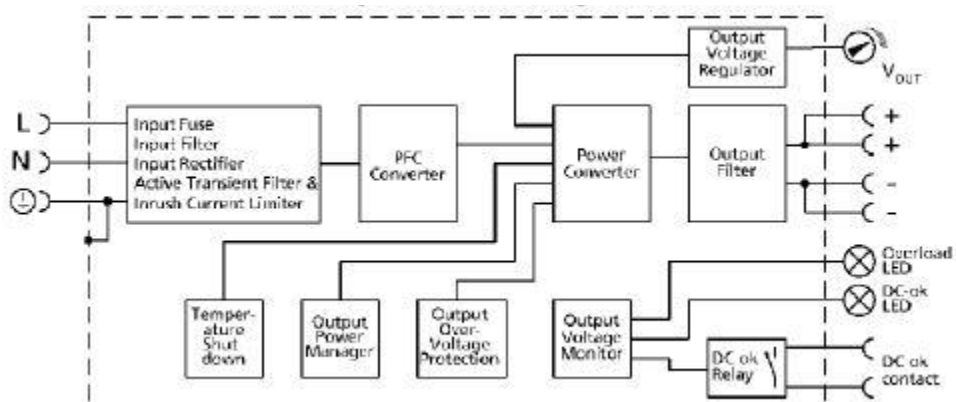


Figure 179: Functional diagram

38.5 Power supply locking mechanism

A locking mechanism, located at the bottom on the power supply, holds the power supply firmly to the DIN rail. Use a slotted head screwdriver to pull down the lever arm to release the power supply from the rail assembly. Lift the unit from the rail assembly while the lever arm is pulled down.

To re-attach the power supply, engage the top the power supply to the rail and push the bottom of the power supply onto the rail.

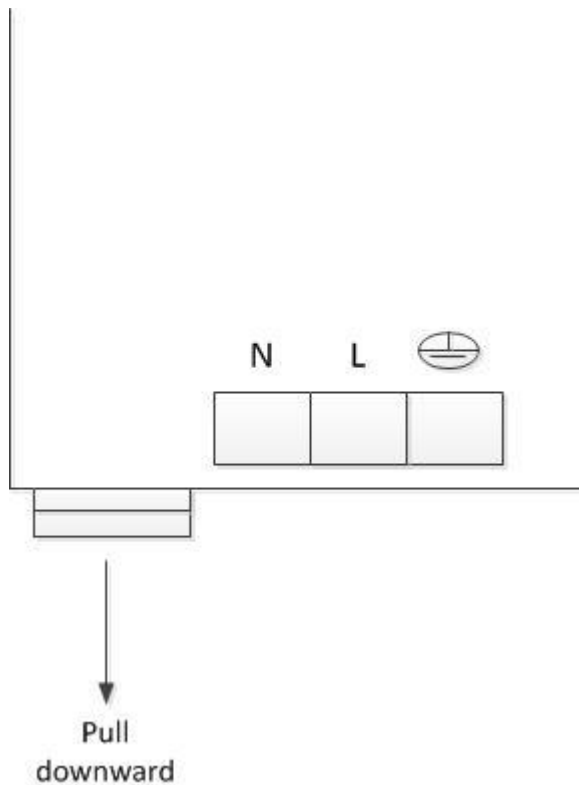


Figure 180: Power supply locking mechanism

38.6 Power supply specifications

The following table lists specifications for the 24VDC power supply.

ITEM	SPECS.	COMMENTS
AC input	nominal AC 100 - 240V	
AC input range	minimum 85 - 276VAC minimum 60 - 85VAC minimum 276 - 300VAC	Continuous operation Full power for 200ms, no damage between 0 and 85 VAC < 500ms

ITEM	SPECS.	COMMENTS		
Input current	Typical	AC 100V 2.65A	AC 120V 2.22A	AC 230V 1.22A at 24V, 10A
Power factor	Typical	AC 100V 0.99	AC 120V 0.98	AC 230V 0.92 at 24V, 10A <i>Note: The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.</i>
AC input allowed voltage L or N to earth	maximum 300VAC			
Input frequency	nominal 50 - 60Hz	+/- 6%		
Inrush current	maximum typical	AC 100V 10A peak 5A peak	AC 120V 10A peak 4A peak	AC 230V 10A peak 7A peak Values are over entire temperature range.
Turn-on voltage	typical 81 VAC	Steady-state value		
Shut-down voltage	typical 63 VAC	Steady-state value		
DC input - H01L DC input range DC input current	nominal 110-150V minimum 88-187VDC typical 2.37A	-20%/+25% Continuous operation 110 VDC, at 24V, 10A		
DC input - H02L DC input range DC input current	nominal 110-300 V minimum 88-375 VDC typical 2.37/ 0.85 A	-20%/+25% Continuous operation 110/300 VDC, at 24V, 10A		
Turn-on voltage	typical - 80 VDC	Steady state value		
Shut-down voltage	typical - 55 VDC	Steady state value		
Output voltage	nominal 24V typical 24.1			
Output current	nominal 10A	Continuously available at 24V		
Hold-up time	typical typical	AC 100V 51ms 26ms	AC 120V 53ms 27ms	AC 230V 55ms at 24V, 5A 28ms at 24V, 10A
Terminals and Wiring		Spring-clamp terminals.		
Operational temperature	-13 ⁰ F to 158 ⁰ F or (25 ⁰ C to +70 ⁰ C)	Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.		
Storage Temperature	-40 ⁰ F to 185 ⁰ F or (-40 ⁰ C to +85 ⁰ C)	For storage and transportation.		
Humidity	5 to 95% r.H.	Do not energize while condensation is present.		

ITEM	SPECS.	COMMENTS
Altitude	0 to 2000m (0 to 6560 ft.) 2000 to 6000m (6560 to 20000 ft.)	Without restrictions. Reduce output power or ambient temperature.
Dimensions	Length/Height - 4.9 inches Width - 2.4 inches Depth - 4.6 inches	
Weight	2 lbs.	
Note: All parameters are specified at 24 V, 10 A, 230 VAC, 25 °C, 77 °F ambient and after five minutes run-in time unless otherwise noted.		

SECTION 39

Replacing power supplies

IN THIS SECTION

Power supply replacement cautions 633

39.1 Power supply replacement cautions

CAUTION! Emerson recommends that a certified electrical technician performs the replacement procedure when you are replacing power supplies while your system is powered and online.

When replacing both primary and secondary power supply units, begin by replacing the secondary power supplies first. After the secondary unit is re-installed and turned ON, indicator lights illuminate indicating that you have power-on the secondary power supplies. Make sure the secondary power supply units are online before removal of the primary units.

Proceed by turning the power OFF at the primary power supplies. The primary power supplies fail over to the secondary power supplies, allowing replacement of both power supplies to be accomplished without taking the system offline. Install the replacement power supplies and reapply power to the primary power supply unit.

Both primary and secondary power supply units can be replaced by using the following procedure:

- *To replace redundant power supplies (see page 633).*

39.1.1 To replace redundant power supplies

Use the following steps to replace the redundant power supplies:

1. Turn the power OFF at the power supply by switching the circuit breaker on the DIN rail to the **OFF** position.
2. Remove the power cable from the bottom of the power supply by releasing the terminal block levers. Then, pull the cable downward from the power supply terminal block. Repeat this step for the output cable.
3. Loosen the power supply locking mechanism that is located at the bottom of the power supply (see *Power Supply Locking Mechanism* (see page 629)).

Note: *A medium size slotted head screwdriver is necessary to loosen the locking mechanism.*

4. After the locking mechanism has been loosened, lift the power supply from the rail assembly.
5. Install the replacement power supply on the power supply DIN rail.

6. Make sure the replacement power supply is fitted securely on the DIN rail assembly by checking that the locking mechanism is engaged.
7. Make sure the circuit breaker is in the **OFF** position before attaching power cabling to the power supply.
8. Re-attach the power cables by inserting the power supply cables into the connector terminals of the power supply.

Note: *Ensure that the color coding is maintained on the power supplies. Refer to the redundant power supplies for color coding.*

9. Make sure that the cable connector secures the cables from falling out of the terminals. In addition, make sure that lever arms are engaged.
10. If all wires are tight, you can re-apply power by switching the circuit breaker of the power supply to the **ON** position. This step completes the power supply replacement process.

SECTION 40

Using an external power supply

IN THIS SECTION

What is an external supply?..... 635

40.1 What is an external supply?

Some Ovation I/O modules require an auxiliary power supply. Auxiliary power may be obtained either from the internal auxiliary power supply (backplane), or from an external power supply.

The auxiliary power is bussed along an entire branch of I/O modules. All I/O modules within a branch **MUST** use the same auxiliary power voltage for proper operation. External auxiliary power can be applied to each branch individually.

If an Ovation I/O module is to be connected to an external power supply, perform the following procedure **BEFORE** connecting the power supply to the Ovation module and powering it up.

Note: *Using external auxiliary power with the Relay Output module is not recommend. Instead, use the Ovation internal auxiliary supply for relay coil power.*

40.1.1 To prepare for connecting an external power supply

CAUTION! Using an external power supply may introduce dangerous voltages to an I/O cabinet. Do NOT apply external power to a cabinet until the appropriate internal auxiliary power supply fuses have been removed and the required fuse covers have been installed.

1. Identify the specific I/O branch to which the Ovation I/O module is assigned and the back panel (CBO) or transition panel (ROP or TND) associated with the I/O branch (see the following figures for panel locations).

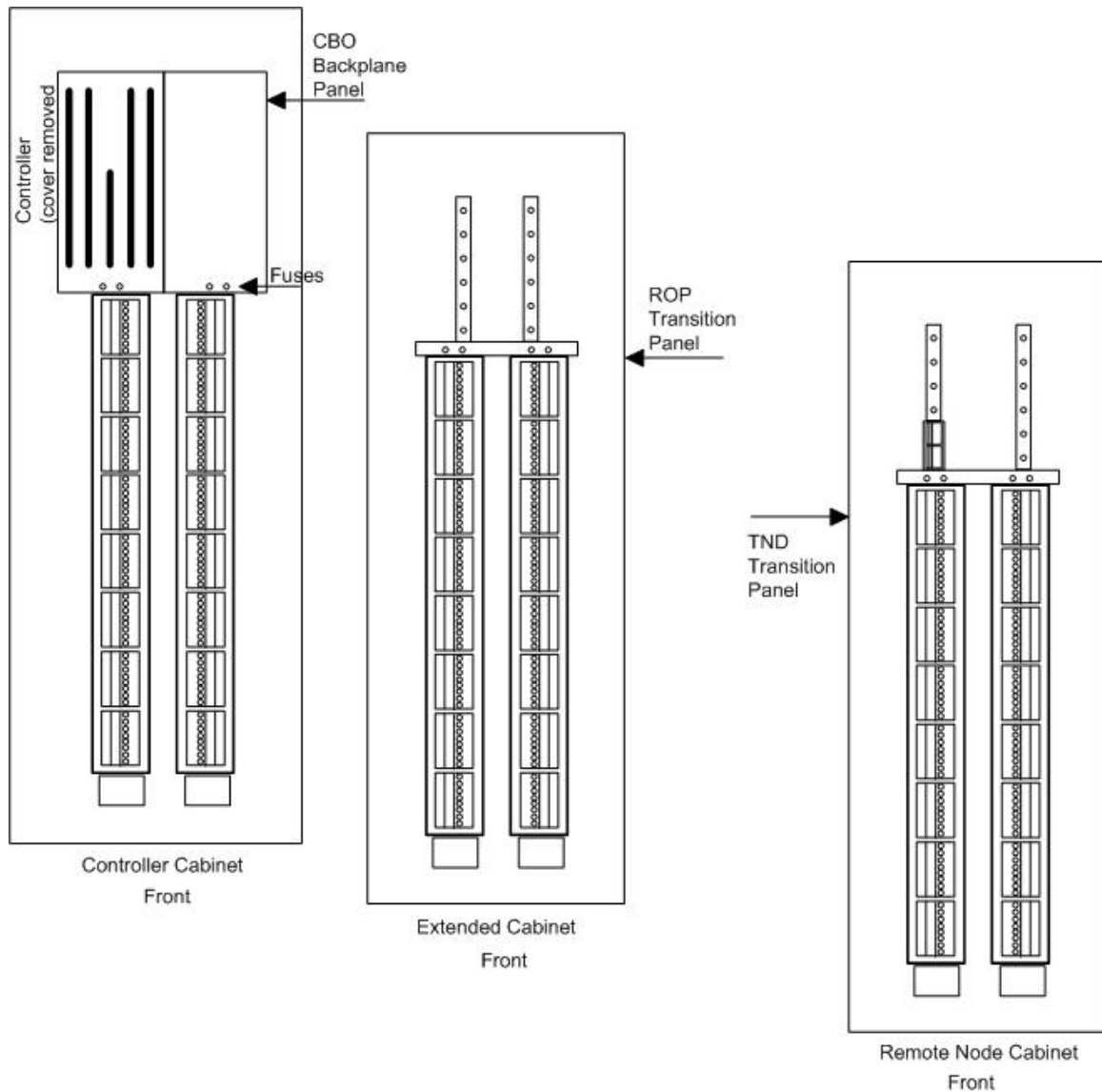


Figure 181: Locations of CBO, ROP, and TND cabinet panels

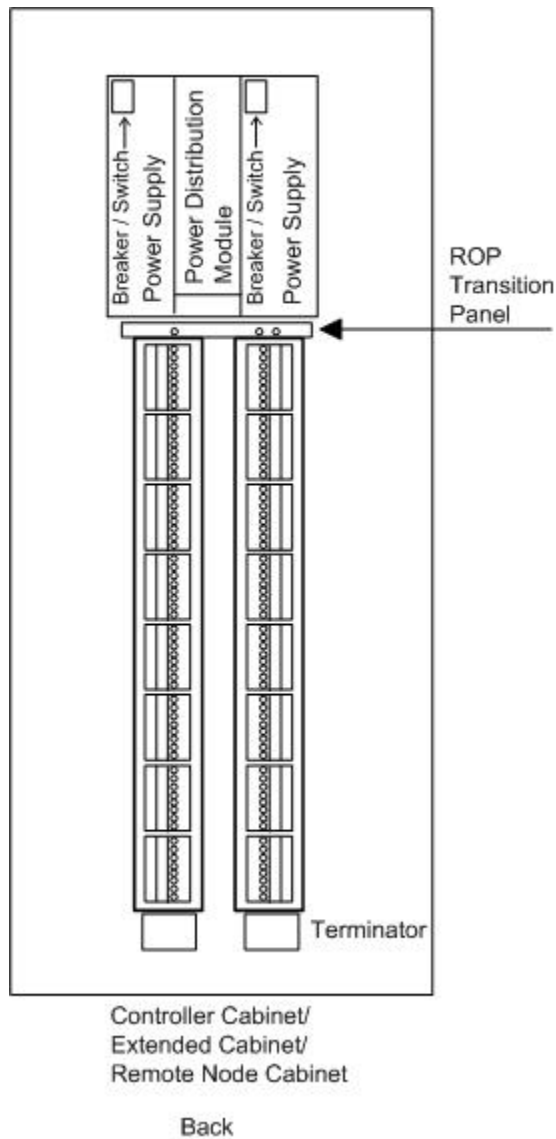
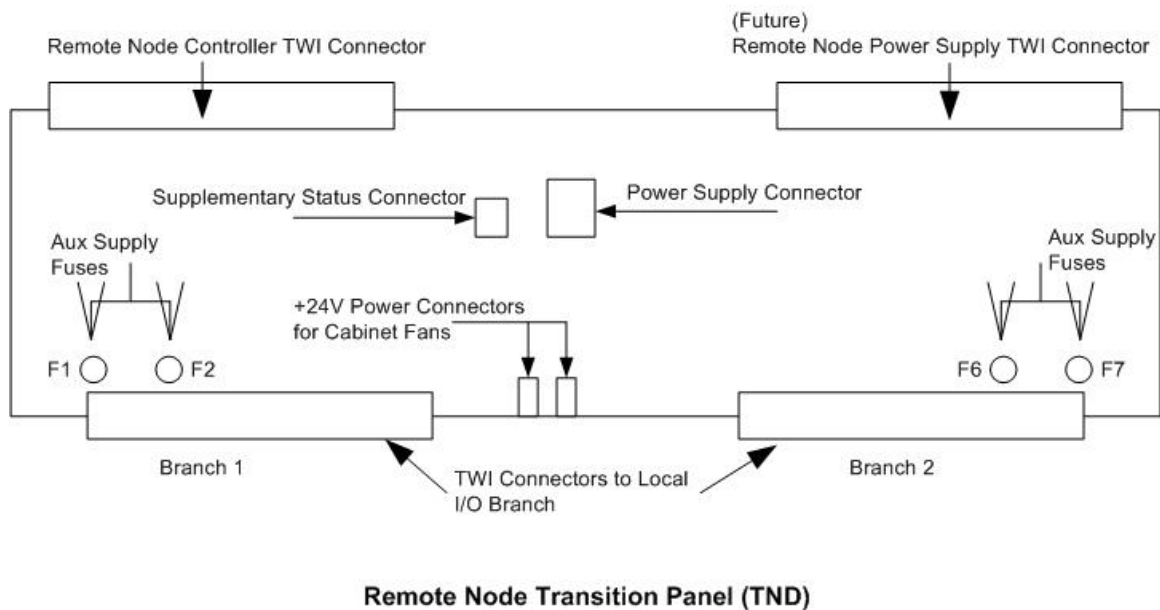
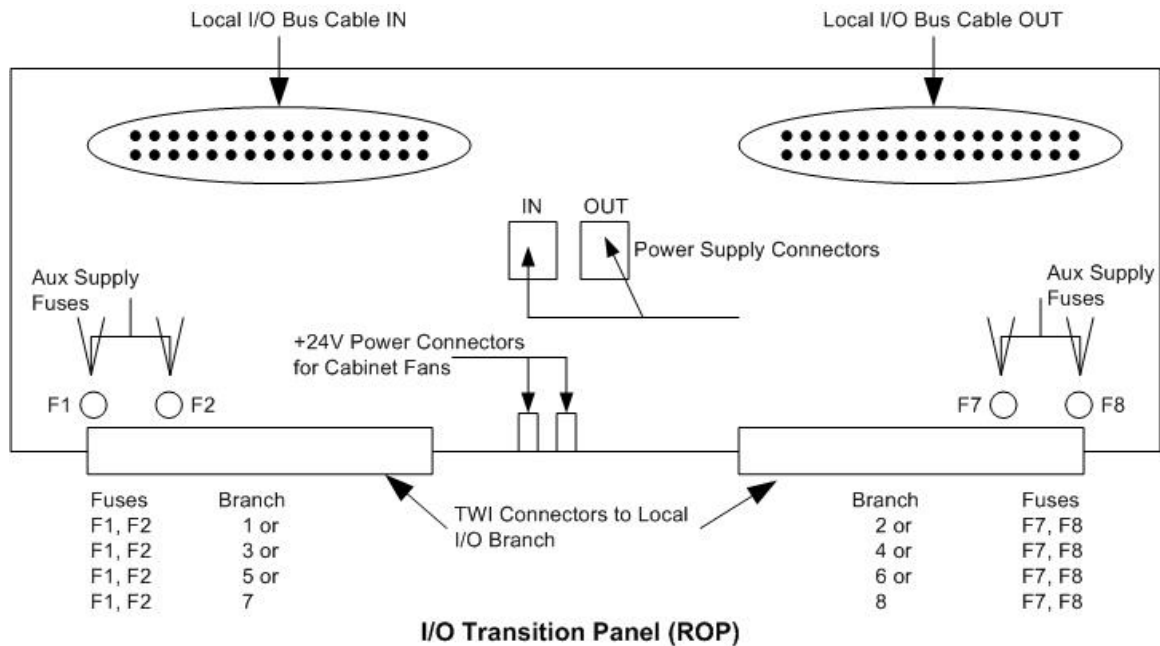


Figure 182: Location of ROP panel in cabinet backs

2. If the I/O branch is associated with a transition panel, perform the following:
 - a) If the transition panel has a cover, remove it to expose the fuses.
 - b) Remove the pair of round plug-in fuses located nearest the I/O branch that you identified in Step 1.
 - c) Replace the transition panel cover (where applicable) after the fuses are removed. A fuse cover kit is not required for transition panels that have a cover. However, if the transition panel does not have a cover, then fuse cover caps (5A26371H20) are required.

Note: Fuse cover caps are required **only** if the external power supply output voltage is greater than 60 VDC, 42 VAC peak or 30 VAC rms.



Note
Covers are not shown.

Figure 183: Auxiliary power supply fuse locations for ROP and TND panels

3. If the I/O branch is associated with a back-plane (CBO), perform the following:
 - a) Identify the artwork level of the backplane.

- b) Determine what fuse cover kit is needed for the backplane:
 - 1C31213G01 for artwork level 3CBO and earlier.
 - 1C31213G02 for artwork level 5CBO and later.
- c) Remove the pair of round plug-in fuses located nearest the I/O branch that you identified in Step 1.
- d) Install the appropriate fuse cover kit over the fuse sockets from where the fuses were removed.

Note: The fuse cover kit is required **only** if the external power supply output voltage is greater than 60 VDC, 42 VAC peak or 30 VAC rms.

4. After the fuse covers are securely installed, connect the external voltage power supply positive (+) and negative (-) outputs to the Ovation I/O module base unit terminal block PS+ (A17 or B17) and PS- (A18) terminals. Once the external power supply is connected to the base unit terminal block and is powered up, the entire I/O branch has access to the external power supply voltage.

Note: Base unit terminal block locations A17 (PS+) and B17 (PS+) are connected to the same potential within the base unit.

Index

1

- 16 Channel 4-20mA Analog Input module overview • 47
- 16 Channel Compact Contact Digital Input module overview - (CCDI) • 254
- 16 Channel Compact Digital Input module overview - (CompactDI) • 219
- 16 Channel Contact Digital Input module overview - (ContactDI) • 242
- 16 Channel Digital Input module overview - (DI) • 209
- 16 Channel Digital Output module overview - (DO) • 460
- 16 Channel Enhanced Compact Sequence of Events Digital Input module overview - (ECISOEDI) • 324
- 16 Channel High Side Digital Output (24 VDC) module overview - (HSDO) • 492
- 16 Channel Redundant Digital Input module overview - (RDI) • 400
- 16 Channel Sequence of Events Compact Digital Input Field Interface module 1 overview - (SOECompactDI) • 292
- 16 Channel Sequence of Events Contact Digital Input Field Interface module overview - (SOEContactDI) • 282
- 16 Channel Sequence of Events Digital Input module overview - (SOEDI) • 268
- 16 Channel Thermocouple Input module overview (HDTI) • 436

3

- 32 Channel 24 VDC Digital Input module overview • 203
- 32 Channel 24 VDC Digital Output module overview • 452
- 32 Channel Contact Input Sequence of Events module overview (HDSOE) • 418
- 32 Channel fused relay base field wiring information (HROE) • 511
- 32 Channel non-fused relay base field wiring information (HROE) • 511
- 32 Channel Relay Output Electronics module block diagram (HROE) • 509
- 32 Channel Relay Output module overview (HROE) • 507

4

- 4 Channel Analog Output module overview - (AO) • 163
- 4 Channel HART High Performance Analog Output module overview - (HHPAO) • 189
- 4 Channel RTD Input module overview - (RTD-4) • 143

8

- 8 Channel Analog Input high speed module overview (14-Bit) - (HSAI) • 59
- 8 Channel Analog Input module overview (13-Bit) - (AI-13) • 97
- 8 Channel Analog Input module overview (14-Bit) - (AI-14) • 85
- 8 Channel HART Analog Input module overview - (HAI) • 113
- 8 Channel HART Analog Output module overview - (HAO) • 175
- 8 Channel HART High Performance Analog Input module overview - (HHPAI) • 127
- 8 Channel RTD Input module overview - (RTD-8) • 153

A

- Adding Ovation Controllers to WDPF Q-Line I/O • 606
- Analog Input high speed module (14-Bit) - (HSAI) (8 Channel) • 59
- Analog Input module (13-Bit) - (8 Channel) (AI-13) • 97
- Analog Input module (14-Bit) - (8 Channel) (AI-14) • 85
- Analog Input module 4-20 mA (16 Channel) • 47
- Analog Input modules • 37
- Analog Output module - (AO) (4 Channel) • 163
- Analog Output modules • 39
- Analog signal noise rejection • 561
- Analog signal shielding techniques • 564
- AUI Cable (5A26147) • 604

B

- Bar code label • 621
- Base assemblies - (FRO) • 547
- Base assemblies - (RO) • 520
- Base assemblies - (ROCM) • 534
- Base assemblies (HROE) • 508

Base unit layouts - (FRO) • 550
Base unit layouts - (RO) • 524
Base unit layouts - (ROCM) • 538
Blown Fuse Detection - (RDI) • 413
Blown Fuse Detection Circuit - (DO) • 471
Blown fuse detection circuit - (FRO) • 554
Blown fuse detection circuit - (ROCM) • 539
Blown fuse detection circuit (HROE) • 516
Blown fuse detection circuit (RO) • 530
Bus interface modules • 45

C

Cable impedances in field wiring - (CCDI) • 258
Cable impedances in field wiring - (ContactDI) • 247
CE Mark accuracy considerations • 624
CE Mark Certified systems • 623
Channel Enable/Mask Register - 16 Channel 4-20mA Analog Input • 54
Channel Relay Output Emod Addressing • 514
Channel Relay Output Emod Register (HROE) • 515
Channel Status Register - 16 Channel 4-20mA Analog Input • 55
Channel Status Register - 32 Channel 24V DC Digital Output • 455
Common cabinet components (Controller, remote node, and extended cabinet) • 580
Common cabinet configurations • 587
Common input considerations • 566
Communication timeout (HROE) • 515
Compact Digital Input module - (CompactDI) (16 Channel) • 219
Compliance standards • 623
Configuration register information (HROE) • 513
Configuration/Status Register Command Data information (HDSOE) • 428
Configuration/Status Register information - (AI-13) • 108
Configuration/status register information - (AI-14) • 91
Configuration/Status Register information - (AO) • 169
Configuration/Status Register information - (CompactDI) • 238
Configuration/Status Register information - (ContactDI) & (CCDI) • 250, 263
Configuration/Status Register information - (DI) • 216
Configuration/Status Register information - (DO) • 486
Configuration/Status Register information - (ECISOEDI) • 392
Configuration/Status Register information - (FRO) • 552
Configuration/Status Register information - (HAI) • 123
Configuration/Status Register information - (HAO) • 183
Configuration/Status Register information - (HHPAI) • 137
Configuration/Status Register information - (HHPAO) • 198
Configuration/Status Register information - (HSDO) • 499
Configuration/Status Register information - (RDI) • 411
Configuration/Status Register information - (RO) • 528
Configuration/Status Register information - (ROCM) • 536
Configuration/Status Register information - (RTD-4) • 150
Configuration/Status Register information - (RTD-8) • 159
Configuration/Status Register information - (SOECompactDI) • 317
Configuration/Status Register information - (SOEDI) • 277
Configuration/Status Register information - 16 Channel 4-20mA Analog Input • 52
Configuration/Status Register information - 32 Channel 24V DC Digital Input • 206
Configuration/Status Register information - 32 Channel 24V DC Digital Output • 454
Configuration/Status Register information (HDTI) • 445
Configuration/Status Register Reply Data information (HDSOE) • 430
Contact Digital Input module (Compact) - (CCDI) (16 Channel) • 253
Contact Digital Input module overview - (ContactDI) (16 Channel) • 241
Contact Input channel diagram (HDSOE) • 422
Contact Input field wiring with 1 return line (HDSOE) • 425
Contact Input field wiring with 32 return lines (HDSOE) • 425
Contact input monitoring circuits - (ROCM) • 539
Contact Input Sequence of Events module (HDSOE) (32 Channel) • 417
Controller cabinet components (Remote I/O) (OCR400 Controller and OCR1100 Controller) • 591
Controller cabinet components and cabling (local and remote I/O) (OCR400 Controller) • 587
Copyright Notice • 2

Cross Cable in Place circuit - (RDI) • 414

D

Daisy-Chain Control of I/O Branches • 600
 DC Digital Output module 24V (32 Channel) • 451
 Defining and addressing the I/O for the Controllers • 567
 Diagnostic LEDs • 612
 Diagnostic LEDs - 16 Channel 4-20mA Analog Input • 56
 Diagnostic LEDs - 32 Channel 24V DC Digital Input • 206
 Diagnostic LEDs (HDSOE) • 433
 Diagnostic LEDs (HDTI) • 447
 Diagnostic LEDs (HROE) • 516
 Diagnostic logic card LEDs - (AI-13, AI-14 & HSAI) • 82, 93, 110
 Diagnostic Logic card LEDs - (AO) • 172
 Diagnostic Logic card LEDs - (CCDI) • 265
 Diagnostic Logic card LEDs - (CompactDI) • 239
 Diagnostic Logic card LEDs - (ContactDI) • 252
 Diagnostic Logic card LEDs - (DI) • 217
 Diagnostic Logic card LEDs - (DO) • 487
 Diagnostic Logic card LEDs - (ECISOEDI) • 396
 Diagnostic Logic card LEDs - (FRO) • 554
 Diagnostic Logic card LEDs - (HAI) • 125
 Diagnostic Logic card LEDs - (HAO) • 186
 Diagnostic Logic card LEDs - (HHPAI) • 140
 Diagnostic Logic card LEDs - (HHPAO) • 201
 Diagnostic logic card LED's - (HSDO) • 503
 Diagnostic Logic card LEDs - (RDI) • 414
 Diagnostic Logic card LEDs - (ROCM) • 542
 Diagnostic Logic card LEDs - (RTD-4) • 151
 Diagnostic Logic card LEDs - (RTD-8) • 160
 Diagnostic Logic card LEDs - (SOECompactDI) • 319
 Diagnostic Logic card LEDs - (SOEDI) - (SECompactDI) • 278, 289
 Diagnostic Logic card LEDs (RO) • 530
 Diagnostic power supply LEDs • 627
 Diagnostics - 32 Channel 24V DC Digital Output • 457
 Digital Input module - (DI) (16 Channel) • 209
 Digital Input module 24 VDC (32 Channel) • 203
 Digital Input modules • 40
 Digital Output module (DO) (16 Channel) • 459
 Digital Output modules • 42

E

Electrical noise and causes • 557
 Electronic ID (EID) • 615
 Electronics module (HDSOE) • 418
 Electronics module (HDTI) • 437
 Electronics module (HROE) • 508
 Electronics module fuses • 25
 Electronics modules (Emod) - (AI-13) • 97
 Electronics modules (Emod) - (AI-14) • 85
 Electronics modules (Emod) - (AO) • 163
 Electronics modules (Emod) - (CCDI) • 254
 Electronics modules (Emod) - (CompactDI) • 220
 Electronics modules (Emod) - (ContactDI) • 242
 Electronics modules (Emod) - (DI) • 210
 Electronics modules (Emod) - (DO) • 460
 Electronics modules (Emod) - (ECISOEDI) • 325
 Electronics modules (Emod) - (HAI) • 114
 Electronics modules (Emod) - (HAO) • 176
 Electronics modules (Emod) - (HHPAI) • 128
 Electronics modules (Emod) - (HHPAO) • 189
 Electronics modules (Emod) - (HSAI) • 60
 Electronics modules (Emod) - (HSDO) • 492
 Electronics modules (Emod) - (RDI) • 401
 Electronics modules (Emod) - (RO) • 520, 546
 Electronics modules (Emod) - (ROCM) • 534
 Electronics modules (Emod) - (RTD-4) • 143
 Electronics modules (Emod) - (RTD-8) • 154
 Electronics modules (Emod) - (SEContactDI) • 282
 Electronics modules (Emod) - (SOECompactDI) • 293
 Electronics modules (Emod) - (SOEDI) • 269
 Electronics modules (Emod) - 16 Channel 4-20mA Analog Input • 48
 Electronics modules (Emod) - 32 Channel 24V DC Digital Input • 203
 Electronics modules (Emod) - 32 Channel 24V DC Digital Output • 452
 Emod and base assembly combinations - (ROCM) • 535
 Enhanced Compact Sequence of Events
 Digital Input module - (ECISOEDI) (16 Channel) • 323
 Enhanced Compact Sequence of Events
 Digital Input module (5X00357G01) (FDJ) - (ECISOEDI) • 328
 Enhanced Compact Sequence of Events
 Digital Input module (5X00357G02) (FDI) - (ECISOEDI) • 339

Enhanced Compact Sequence of Events
Digital Input module (5X00357G03) (FDI) -
(ECISOEDI) • 354

Enhanced Compact Sequence of Events
Digital Input module (5X00357G04) (FCI) -
(ECISOEDI) • 367

Enhanced Compact Sequence of Events
Digital Input module (5X00357G05)
(FDW) - (ECISOEDI) • 379

Environmental Specifications - (ECISOEDI) •
398

Event buffer read procedure - (ECISOEDI) •
391

Example of typical MAU cable connections
to Remote Nodes (OCR400 Controller) •
602

Examples of Controller cabinet I/O module
addresses • 573

Examples of extended I/O cabinet module
addresses • 574

Examples of Relay Output module
addresses • 576

Examples of remote node I/O cabinet
module addresses • 575

Extended I/O cabinet components • 593

External power supplies - (AI-14) • 86

External power supply information - (AI-13) •
99

External Power Supply information -
(CompactDI) • 221

External power supply information - (DO) •
461

External power supply information - (FRO) •
547

External power supply information - (HAI) •
116

External power supply information - (HAO) •
178

External power supply information - (HSAI) •
61

External power supply information - (ROCM)
• 535

External power supply information -
(SOECompactDI) • 294

External power supply information - (SOEDI)
• 269

External power supply information
(5X00357G01 - G05) - (ECISOEDIG01,
G02, G03, G05) • 335, 351, 364, 388

External power supply information (RO) •
521

External power supply information
differential (front end) - (DI) • 212

External power supply information single-
ended (front end) - (DI) • 211

External power supply usage • 637

F

Fiber-Optic Cable (3A98763 - Green)
(3A98764 - Yellow) • 604

Field board block diagram (HDTI) • 442

Field card block diagram (HDSOE) • 421

Field connection diagrams - (HSAI) • 68

Field connection wiring - 5X00357G01 • 331

Field connection wiring (5X00357G02) -
(ECISOEDI) • 343

Field connection wiring (5X00357G03) -
(ECISOEDI) • 358

Field connection wiring (5X00357G04) -
(ECISOEDI) • 372

Field connection wiring (5X00357G05) -
(ECISOEDI) • 383

Field connection wiring diagram - 32

Channel 24V DC Digital Output • 454

Field connection wiring diagram - (DO) • 477

Field connection wiring diagram - (ROCM) •
542

Field connection wiring diagram (CE Mark)
(G04) - (SOECompactDI) • 315

Field connection wiring diagram (G04) -
(SOECompactDI) • 313

Field connection wiring diagram (Group 1)
(CE Mark) - (DO) • 478

Field connection wiring diagrams - (HAO) •
180

Field connection wiring diagrams - (AI-13) •
102

Field connection wiring diagrams - (AI-14) •
88, 89

Field connection wiring diagrams -
(CompactDI) • 224

Field connection wiring diagrams -
(ContactDI) • 248

Field connection wiring diagrams - (DI) • 214

Field connection wiring diagrams - (FRO) •
551

Field connection wiring diagrams - (HAI) •
118

Field connection wiring diagrams - (HHPAI) •
133

Field connection wiring diagrams - (RDI) •
403

Field connection wiring diagrams -
(SEContactDI) • 287

Field connection wiring diagrams - (SOEDI) •
275

Field connection wiring diagrams - 16

Channel 4-20mA Analog Input (2-Wire) •
51

Field connection wiring diagrams - 16

Channel 4-20mA Analog Input (4-Wire) •
52

- Field connection wiring diagrams - 32
- Channel 24V DC Digital Input • 205
- Field connection wiring diagrams (CE Mark)
 - (AI-13) • 103
- Field connection wiring diagrams (CE Mark)
 - (AI-14) • 90
- Field connection wiring diagrams (CE Mark)
 - (CCDI) • 261
- Field connection wiring diagrams (CE Mark)
 - (CompactDI) • 231
- Field connection wiring diagrams (CE Mark)
 - (ContactDI) • 249
- Field connection wiring diagrams (CE Mark)
 - (DI) • 215
- Field connection wiring diagrams (CE Mark)
 - (HAI) • 119
- Field connection wiring diagrams (CE Mark)
 - (HAO) • 181
- Field connection wiring diagrams (CE Mark)
 - (HHPAI) • 135
- Field Connection wiring diagrams (CE Mark)
 - (HHPAO) • 195
- Field connection wiring diagrams (CE Mark)
 - (RO) • 527
- Field connection wiring diagrams (CE Mark)
 - (SEContactDI) • 288
- Field connection wiring diagrams (CE Mark)
 - (SOEDI) • 276
- Field connection wiring diagrams (CE Mark)
 - (G01-3) - (SOECompactDI) • 306
- Field connection wiring diagrams (CE Mark)
 - (simplex) - (AO) • 167
- Field Connection wiring diagrams (Emod) - (HHPAO) • 194
- Field connection wiring diagrams (front end)
 - (ContactDI) • 246
- Field connection wiring diagrams (Pmod 1C31116) - (HSAI) • 71
- Field connection wiring diagrams (Pmod 1C31227) - (HSAI) • 69
- Field connection wiring diagrams (Pmod 1C31227) (CE Mark) - (HSAI) • 70
- Field Connection wiring diagrams (Pmod 5X00211G03) - (HHPAO) • 196
- Field Connection wiring diagrams (Pmod 5X00211G03) (CE Mark) - (HHPAO) • 197
- Field connection wiring diagrams
 - (Redundant) - (AO) • 168
- Field connection wiring diagrams (simplex) - (AO) • 166
- Field connection wiring diagrams Field Interface module (G01-3) - (SOECompactDI) • 299
- Field connection wiring diagrams for the Relay Output module • 526
- Field connection wiring diagrams, Pmod (Pmod 1C31116) (CE Mark) - (HSAI) • 72
- Field connection wiring Individually Fused (5X00357G02) - (ECISOEDI) • 346
- Field connection wiring Individually Fused (5X00357G03) - (ECISOEDI) • 361
- Field connection wiring information (HDTI) • 439, 440
- Field interface - (SOECompactDI) • 295
- Field interface - (SOEDI) • 270
- Field power shutoff - (HSDO) • 498
- Field power wiring information for module base unit terminal blocks - (HSDO) • 496
- Field signal wiring information - (HSDO) • 495
- Field wiring (5X00357G01) - (ECISOEDI) • 330
- Field wiring (5X00357G02) - (ECISOEDI) • 342
- Field wiring (5X00357G03) - (ECISOEDI) • 357
- Field wiring (5X00357G04) - (ECISOEDI) • 369
- Field wiring (5X00357G04) (contact) - (ECISOEDI) • 370
- Field wiring (5X00357G05) - (ECISOEDI) • 382
- Field wiring cable impedances (HDSOE) • 426
- Field wiring cable lengths - (CCDI) • 257
- Field wiring cable lengths - (ContactDI) • 244
- Field wiring cable lengths - (SEContactDI) • 285
- Field wiring cable lengths (G04) - (SOECompactDI) • 296
- Field wiring cable requirements - (HAI) • 120
- Field wiring cable requirements - (HAO) • 182
- Field wiring cable requirements - (HHPAI) • 133
- Field wiring cable requirements - (HHPAO) • 198
- Field wiring configuration considerations - (DI) • 214
- Field wiring configuration considerations - (SOEDI) • 272
- Field wiring considerations - (CompactDI) • 223
- Field wiring diagram - (HHPAI) • 129
- Field wiring diagram (CE Mark) - (HHPAI) • 130
- Field wiring diagrams - (CCDI) • 259
- Field wiring diagrams - (SEContactDI) • 284
- Field wiring diagrams configuration - (SOEDI) • 273
- Field wiring diagrams configuration (Front end) (G04) - (SOECompactDI) • 295
- Field wiring diagrams for (Pmod 1C31164G01) - (RTD-4) • 146

Field wiring diagrams for (Pmod 1C31164G02) - (RTD-4) • 147
 Field wiring diagrams for (Pmod 1C31164G02) (CE Mark) - (RTD-4) • 148
 Field wiring field interface restrictions (G01-G03) - (SOECompactDI) • 296
 Field wiring restrictions - (CCDI) • 256
 Field wiring restrictions - (ContactDI) • 244
 Field wiring restrictions - (SEContactDI) • 283
 Field wiring restrictions (G04) - (SOECompactDI) • 297
 Functional block diagram - (RDI) • 406
 Functional diagram • 630
 Fused Relay Output module overview - (FRO) • 546

G

G2R Style Relay module for DIN Rail Layout (5A22411H01) - (DO) • 470
 G2R Style Relay module terminations (5A22411H01) - (DO) • 472
 General requirements for I/O cable • 603
 Ground fault detection on Contact Input diagram (HDSOE) • 423

H

HART Analog Input module - (HAI) (8 Channel) • 113
 HART Analog Output module - (HAO) (8 Channel) • 175
 HART High Performance Analog Input module - (HHPAI) (8 Channel) • 127
 HART High Performance Analog Output module - (HHPAO) (4 Channel) • 189
 High Side Digital Output (24 VDC) module - (HSDO) (16 Channel) • 491
 HSDO to HSDO Cable Assembly Routing Information Redundant Configuration - (HSDO) • 497

I

I/O address and Buffer control register command data information (HDSOE) • 429
 I/O address and Buffer control register reply data information (HDSOE) • 431
 I/O communications cable (5A26141) • 603
 I/O Dual Branch Transition Panel (ROP) • 583
 I/O environmental specifications • 28
 I/O interface ports • 579
 I/O Module configurations • 37
 I/O Module EID programming format • 619
 I/O module features • 20
 I/O Module general information • 19

I/O reference terminology • 20
 I/O system status and diagnostic LEDs • 609
 Index number • 617, 620
 Input address locations (Group 1) - (HSAI) • 73
 Input address locations (Group 2) - (HSAI) • 75
 Input address locations (Group 3) - (HSAI) • 77
 Input address locations (Group 4) - (HSAI) • 79
 Installing Ovation modules • 24

K

KC Compliance mark • 624
 KUEP (2 Form C) Relay module
 Terminations (5A22412G01) - (DO) • 474
 KUEP (Form X) Relay module terminations (5A22412G02) - (DO) • 475
 KUEP Style Relay module for DIN Rail Layout (5A22412G01 / 5A22412G02) - (DO) • 473

L

Local I/O • 588
 Local I/O system configuration for the OCR400 Controller and OCR1100 Controller • 589
 Logic board block diagram (HDSOE) • 420
 Logic board block diagram (HDTI) • 441
 Logic Card Digital Debounce Filter Propagation Delay - (RDI) • 411
 LSH Logic function block diagram (HDSOE) • 424

M

Marshalling base unit • 32
 Mask Register (HDTI) • 444
 MAU Module • 612
 MAU with typical fiber-optic connector pairs (OCR400 Controller and OCR1100 Controller) • 586
 Maximum cable lengths (HDSOE) • 427
 Module and field connection wiring - (RTD-8) • 155
 Module and field connection wiring (CE Mark) - (RTD-8) • 157
 Module block diagram - (AI-14) • 91
 Module block diagram - (HSAI) • 66
 Module block diagram - (HSDO) • 493
 Module block diagram information - (HAI) • 115
 Module block diagrams - (HAO) • 177
 Module Block Diagrams - (HHPAO) • 191
 Module block diagrams - (RDI) • 405

Module cables for High Side Digital Output
24VDC - (HSDO) • 497
Module channel fault register - (HSDO) • 498
Module register information - (HSAI) • 81
Module-base unit interconnection
(5X00357G02) - (ECISOEDI) • 340
Module-base unit interconnection
(5X00357G03) - (ECISOEDI) • 355
Module-base unit interconnection
(5X00357G04) - (ECISOEDI) • 368
Module-base unit interconnection
(5X00357G05) - (ECISOEDI) • 380
Module-base unit interconnection
(5X00357G05) (individually fused) -
(ECISOEDI) • 381
Module-base unit interconnection
(Individually Fused) (5X00357G02) -
(ECISOEDI) • 341
Module-base unit interconnection diagram
(5X00357G01) - (ECISOEDI) • 329
Module-base unit interconnection
individually Fused (5X00357G03) -
(ECISOEDI) • 356

N

Network Interface ports • 577
Noise classes • 560
Noise discrimination • 558
Noise energy level • 558
Noise frequency • 559
Noise minimization and causes • 557
Noise rejection for digital signals • 561
Noise sources • 560
Noise-sensitive circuit noise rejection • 562

O

One shot function - (ECISOEDI) • 327
Open loop detect register - (HAO) • 182
Operating temperature - (ROCM) • 535
Output signal noise rejection • 561
Ovation cabinet fuses • 27
Ovation Electronic ID • 615
Ovation I/O Single Branch Transition Panels
• 584
Ovation module configuration and status •
24
Ovation module diagnostic LEDs • 25
Ovation Power Distribution Module (PDM) •
581
Ovation power supply information • 625
Ovation Remote I/O 1300 nm Optical Links •
605
Ovation Remote I/O 850 nm Optical Links •
604
Ovation Remote I/O Acceptable Optical Link
Power Loss Budget • 604

Ovation Standard I/O Modules and Base
Units • 581
Overview • 19

P

Panel kits - (RO) • 521
Personality Jumper Information - (HHPAI) •
137
Personality module (HDSOE) • 418
Personality module (HDTI) • 437
Personality Module (Pmod) - (CCDI) • 255
Personality module fuses • 26
Personality module jumpers • 27
Personality modules (Emod) -
(SEContactDI) • 282
Personality modules (Pmod) - (AI-14) • 85
Personality modules (Pmod) - (AO) • 164
Personality modules (Pmod) - (CompactDI) •
220
Personality modules (Pmod) - (ContactDI) •
242
Personality modules (Pmod) - (DI) • 210
Personality modules (Pmod) - (DO) • 460
Personality modules (Pmod) - (ECISOEDI) •
325
Personality modules (Pmod) - (HAI) • 114
Personality modules (Pmod) - (HAO) • 176
Personality modules (Pmod) - (HHPAI) • 128
Personality modules (Pmod) - (HHPAO) •
190
Personality modules (Pmod) - (HSAI) • 60
Personality modules (Pmod) - (HSDO) • 492
Personality modules (Pmod) - (RDI) • 401
Personality modules (Pmod) - (RTD-4) • 143
Personality modules (Pmod) - (RTD-8) • 154
Personality modules (Pmod) -
(SOECompactDI) • 293
Personality modules (Pmod) - (SOEDI) • 269
Personality modules (Pmod) - 16 Channel 4-
20mA Analog Input • 48
Personality modules (Pmod) - 32 Channel
24V DC Digital Input • 203
Personality modules (Pmod) - 32 Channel
24V DC Digital Output • 452
Personality modules and jumper settings
(Pmod) - (AI-13) • 98
Physical circuit separation • 562
Placing the MAU module • 599
Point Quality Register (HDTI) • 442
Power checking (ContactDI - CCDI) • 251,
264
Power distribution scheme • 607
Power requirements • 512
Power Supply • 601
Power supply front view • 626
Power supply information - (HHPAI) • 131
Power supply locking mechanism • 631

Power supply replacement cautions • 635
Power supply requirement for the 32
Channel Relay output module (HROE) •
512
Power supply specifications • 631
Power supply wiring connections • 629
Power supply wiring illustration • 628
Proper grounding and shielding • 563

Q

Q-Line I/O module addressing • 577

R

Ranges - (RTD-8) • 158
Redundant Digital Input module - (RDI) (16
Channel) • 399
Redundant interface cable assembly routing
- (RDI) • 404
Redundant interface cable assembly routing
configuration (Redundant) - (AO) • 169
Redundant module interconnection -
(HSDO) • 494
Relay module components • 33
Relay Output module - (RO) • 519
Relay Output module (HROE) (32 Channel)
• 507
Relay Output Modules and Bases • 582
Relay Output overview - (RO) • 520
Relay Output with Contact Monitoring -
(ROCM) • 533
Relay Output with Contact Monitoring
(Fused) - (FRO) • 545
Relay Output with Contact Monitoring
module overview - (ROCM) • 534
Relay panel application diagrams - (DO) •
483
Relay Panels - (DO) • 462
Remote I/O • 590
Remote I/O features (OCR400 Controller
and OCR1100 Controller) • 591
Remote node addressing switch • 600
Remote node cabinet components • 596
Remote Node Controller (RNC) • 585
Remote Node Transition Panel (TND) • 586
Replacement of user serviceable fuses • 25
Replacing power supplies • 635
RNC Module • 613
RTD Input module - (RTD-4) (4 Channel) •
143
RTD Input module - (RTD-8) (8 Channel) •
153
RTD ranges - (RTD-4) • 149

S

Selecting the I/O interface cards • 603

Sequence of Events Compact Digital Input
Field Interface module 1 -
(SOECompactDI) (16 Channel) • 291
Sequence of Events Contact Digital Input
Field Interface module - (SOEContactDI)
(16 Channel) • 281
Sequence of Events Digital Input module -
(SOEDI) (16 Channel) • 267
Serial number • 615, 619
Signal and noise sources • 559
Signal propagation delay - (RDI) • 408
Single channel illustration (HROE) • 510
Solid State Relay module for DIN Rail
Layout (5A22410H01 / 5A22410H02) -
(DO) • 464
Solid State Relay module Terminations
(5A22410H01 / 5A22410H02) - (DO) • 465
Specialty I/O modules • 43
Specifications - (AI-13) • 111
Specifications - (AI-14) • 94
Specifications - (AO) • 172
Specifications - (CCDI) • 265
Specifications - (CompactDI) • 239
Specifications - (ContactDI) • 252
Specifications - (DI) • 217
Specifications - (DO) • 488
Specifications - (FRO) • 554
Specifications - (HAI) • 126
Specifications - (HAO) • 186
Specifications - (HHPAI) • 141
Specifications - (HHPAO) • 202
Specifications - (HSAI) • 82
Specifications - (HSDO) • 505
Specifications - (LI) • 466
Specifications - (RO) • 530
Specifications - (ROCM) • 542
Specifications - (RTD-4) • 151
Specifications - (RTD-8) • 161
Specifications - (SEContactDI) • 289
Specifications - (SOEDI) • 278
Specifications - 16 Channel 4-20mA Analog
Input • 56
Specifications - 32 Channel 24V DC Digital
Input • 207
Specifications - 32 Channel 24V DC Digital
Output • 457
Specifications (5X00357G01) - (ECSOEDI) •
337
Specifications (5X00357G02) - (ECSOEDI) •
352
Specifications (5X00357G03) - (ECSOEDI) •
365
Specifications (5X00357G04) - (ECSOEDI) •
377
Specifications (5X00357G05) - (ECSOEDI) •
390
Specifications (HDSOE) • 433

Specifications (HDTI) • 448
 Specifications (HROE) • 517
 Specifications -(RDI) • 415
 Specifications and ranges (G01-3) -
 (SOECompactDI) • 320
 Specifications and ranges (G04) -
 (SOECompactDI) • 321
 Standard module components • 29
 Status LEDs for the Controller processor
 module • 610
 Status register information (HROE) • 514
 Summary of Changes • 3
 Surge protection • 563
 Switching Input Voltage Current Curve -
 (RDI) • 410

T

Temperature sensor Personality module
 (1C31116G04) - (HSAI) • 65
 Terminal block pin assignments for the
 Thermocouple Emod (HDTI) • 438
 Terminal block wiring information - (AI-13) •
 100
 Terminal block wiring information - (AI-14) •
 86
 Terminal block wiring information - (AO) •
 165
 Terminal block wiring information - (CCDI) •
 255
 Terminal block wiring information -
 (CompactDI) • 222
 Terminal block wiring information -
 (ContactDI) • 243
 Terminal block wiring information - (DI) • 213
 Terminal block wiring information - (DO) •
 476
 Terminal block wiring information - (FRO) •
 549
 Terminal block wiring information - (HAI) •
 117
 Terminal block wiring information - (HAO) •
 179
 Terminal block wiring information - (HHPAI) •
 132
 Terminal block wiring information - (HHPAO)
 • 193
 Terminal block wiring information - (HSAI) •
 67
 Terminal block wiring information - (RDI) •
 402
 Terminal block wiring information - (ROCM) •
 541
 Terminal block wiring information -
 (SEContactDI) • 286
 Terminal block wiring information -
 (SOECompactDI) • 298

Terminal block wiring information - (SOEDI)
 • 271
 Terminal block wiring information - 16
 Channel Analog Input 4-20mA (4-Wire) •
 50
 Terminal block wiring information - 32
 Channel 24V DC Digital Input • 204
 Terminal block wiring information - 32
 Channel 24V DC Digital Output • 453
 Terminal block wiring information (HDSOE) •
 419
 Terminal block wiring information (HDTI) •
 438
 Terminal block wiring information (HROE) •
 510
 Terminal block wiring information (Pmod
 1C31164G01) - (RTD-4) • 144
 Terminal block wiring information (Pmod
 1C31164G02) - (RTD-4) • 145
 Terminal block wiring information (Pmod
 5X00121G01) - (RTD-8) • 154
 Terminal block wiring information (RO) • 523
 Terminal block wiring information 16
 Channel 4-20mA Analog Input (2-Wire) •
 48
 Thermocouple Input module (16 Channel)
 (HDTI) • 435
 Thermocouple Personality module
 functionality & coefficients - (AI-13) &
 (HSAI) • 61, 104
 Thermocouple types and coefficients - (AI-
 13) & (HSAI) • 62, 105
 To modify an external Ovation networks
 device • 603
 To modify an I/O device • 603
 To prepare for connecting an external power
 supply • 638
 To replace redundant power supplies • 635
 Twisted-pair wiring • 562
 Typical Remote Node Cabinet • 598

U

Using bases - (FRO) • 548
 Using bases (RO) • 522

V

Valid Emod and base combinations (HROE)
 • 508
 Valid module combinations - (AI-13) • 98
 Valid module combinations - (AI-14) • 86
 Valid module combinations - (AO) • 164
 Valid module combinations - (CCDI) • 255
 Valid module combinations - (CompactDI) •
 220
 Valid module combinations - (ContactDI) •
 243
 Valid module combinations - (DI) • 210

- Valid module combinations - (DO) • 461
- Valid module combinations - (ECISOEDI) • 326
- Valid module combinations - (HAI) • 114
- Valid module combinations - (HAO) • 176
- Valid module combinations - (HHPAI) • 128
- Valid module combinations - (HHPAO) • 190
- Valid module combinations - (HSAI) • 60
- Valid module combinations - (HSDO) • 493
- Valid module combinations - (RDI) • 401
- Valid module combinations - (RTD-4) • 144
- Valid module combinations - (RTD-8) • 154
- Valid module combinations - (SEContactDI) • 282
- Valid module combinations - (SOECompactDI) • 294
- Valid module combinations - (SOEDI) • 269
- Valid module combinations - 16 Channel 4-20mA Analog Input • 48
- Valid module combinations - 32 Channel 24V DC Digital Input • 204
- Valid module combinations - 32 Channel 24V DC Digital Output • 452
- Valid module combinations (HDSOE) • 418
- Valid module combinations (HDTI) • 437
- Voltage requirements • 512
- Voltage-current curve - (RDI) • 409
- Voltage-current curve (5X00357G01) - (ECISOEDI) • 336
- Voltage-current curve (5X00357G02) - (ECISOEDI) • 351
- Voltage-current curve (5X00357G03) - (ECISOEDI) • 364
- Voltage-current curve (5X00357G05) - (ECISOEDI) • 389

W

- What are Small Form-factor Pluggable transceivers (SFPs)? • 580
- What are the guidelines for positioning I/O modules in cabinets? • 570
- What are the Ovation Controller I/O interfaces? • 577
- What are the Ovation I/O module base types? • 569
- What changes can you make to an I/O device? • 603
- What is a relay output module base? • 569
- What is a standard I/O module base? • 569
- What is an external supply? • 637
- What is an Ovation I/O module address? • 570
- What is the addressing format for I/O modules? • 571
- What is the process for planning the I/O for your system? • 568

- Wire break detect function - (ECISOEDI) • 327
- Wiring diagram to relay module (G2R or Solid State) - (DO) • 480
- Wiring diagram to relay module (G2R or Solid State) locally powered - (DO) • 479
- Wiring diagram to relay module (KUEP style remotely powered (CE Mark) - (DO) • 482
- Wiring diagram to relay module (KUEP Style) locally powered (CE Mark) - (DO) • 481
- Wiring information - (SOECompactDI) • 294
- Wiring information - (SOEDI) • 269