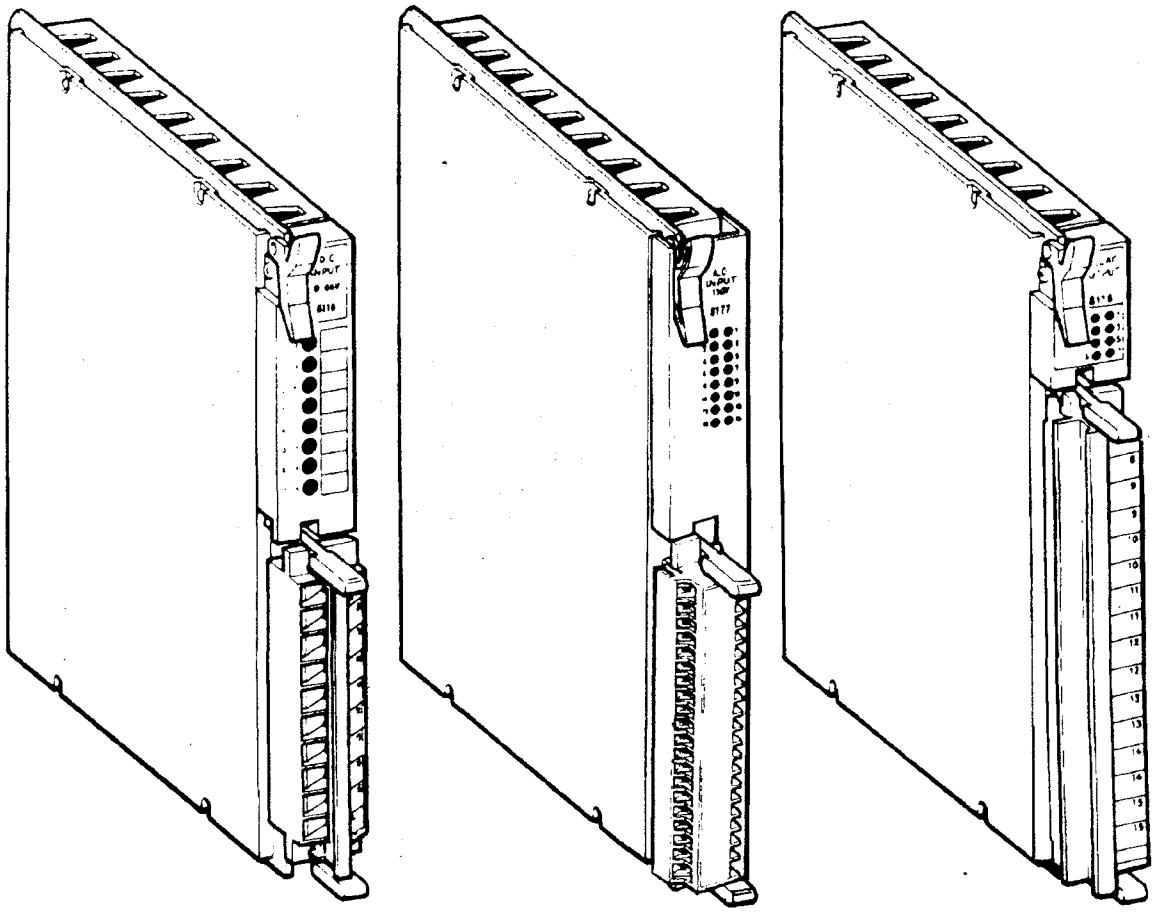
CEGELEC

COMPACT I/O MODULES (DIGITAL)



GEM80 USER INFORMATION

CONTENTS

1. INTRODUCTION

1.1 Product Overview

Control signals associated with equipment such as lamps, pushbuttons, solenoids, limit switches, relays contactors, TTL, CMOS, relay outputs, etc. may be input to or output from GEM80 controllers via the range of digital Compact I/O modules.

This range handles various plant side supplies, a.c. or d.c. voltages from 24Va.c. to 220Va.c., 50 or 60 Hz and from 5Vd.c to 100Vd.c., Relay output modules with volt-free contacts are also available.

The modules provide a robust interface between the electrically noisy plant signals and the controller, and interfaces with the controller through the Basic I/O highway.

Compact modules plug into subracks including 12 slot Compact I/O subracks and several GEM80 controller subracks which provide slots prepared to take Basic I/O modules.

Optical isolation (or in the case of the Relay Output Modules, the relays themselves) separates the plant signals from the GEM80 controller, so two power sources are required, one on the plant side of the optical isolation (i.e. the plant side power supply) and the other on the GEM80 controller side of the optical isolation. This is provided by a +15V supply, drawn from the host controller through the Basic I/O highway ribbon cable (see Section 4 for further details).

The output modules are suitable for connection to inductive loads, for further information, refer to Section 7.2.

1.2 Installation, Operation and Maintenance

WARNING: Failure to comply with any of the general requirements for installation, operation and maintenance provided in the appropriate technical manuals and/or the additional instructions below will significantly increase the risk of maloperation, fire and electrical shock.

1.2.1 Hazardous Voltages

Hazardous voltages and energy levels can exist on plant wiring to I/O modules. Ensure that plant supplies are disconnected before fitting, removing or wiring to plant connectors. Also ensure that any shrouds provided are securely replaced.

1.2.2 Rating of Plant Wiring

In general, any plant wiring should have current and voltage ratings that exceed the module's maximum continuous ratings. All plant wiring should be protected by suitably rated fuses.

1.2.3 Module Fuses

Should a module's internal fuses require replacement, ensure that only the same or equivalent type, as defined in the GEM80 Fuses User information Leaflet T437, are fitted.

1.2.4 Plant Wiring

Due to the high concentration of plant wiring and terminations that may occur in a typical GEM80 system:

a) all terminations to screw terminals should be terminated using boot lace ferrules

b) all plant wiring must be suitably supported and restrained

c) all plant wiring must be routed and segregated from other wiring categories as described in Controller Technical Manuals

2. SPECIFICATION

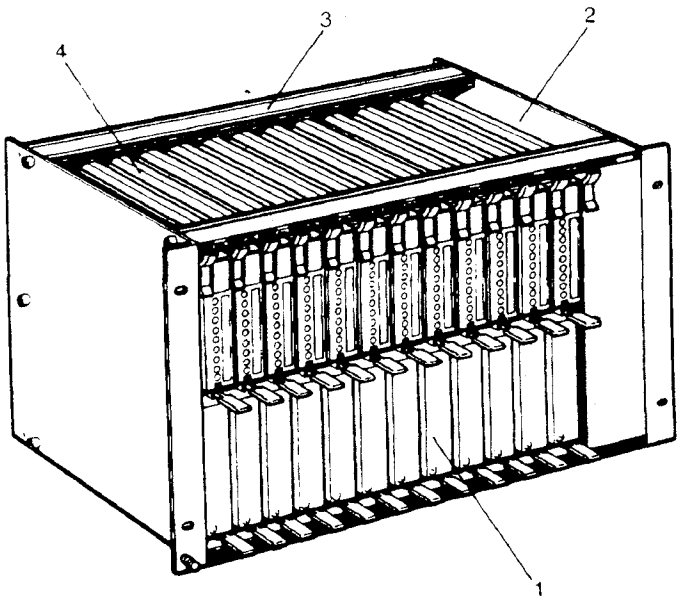
See Product Data Sheets

3. HARDWARE LAYOUT

3.1 Subracks

Figure 1 shows a subrack with twelve Compact I/O modules fitted. The modules slide along guide rails and plug into the backplane at the rear of the subrack.

Each module is mechanically coded to ensure that only input modules are fitted in spaces allocated to input modules and output modules are fitted in spaces allocated to output modules. Section 6 details this mechanical coding.



1. Compact Module
2. Subrack
3. Backplane
4. Guide Rails

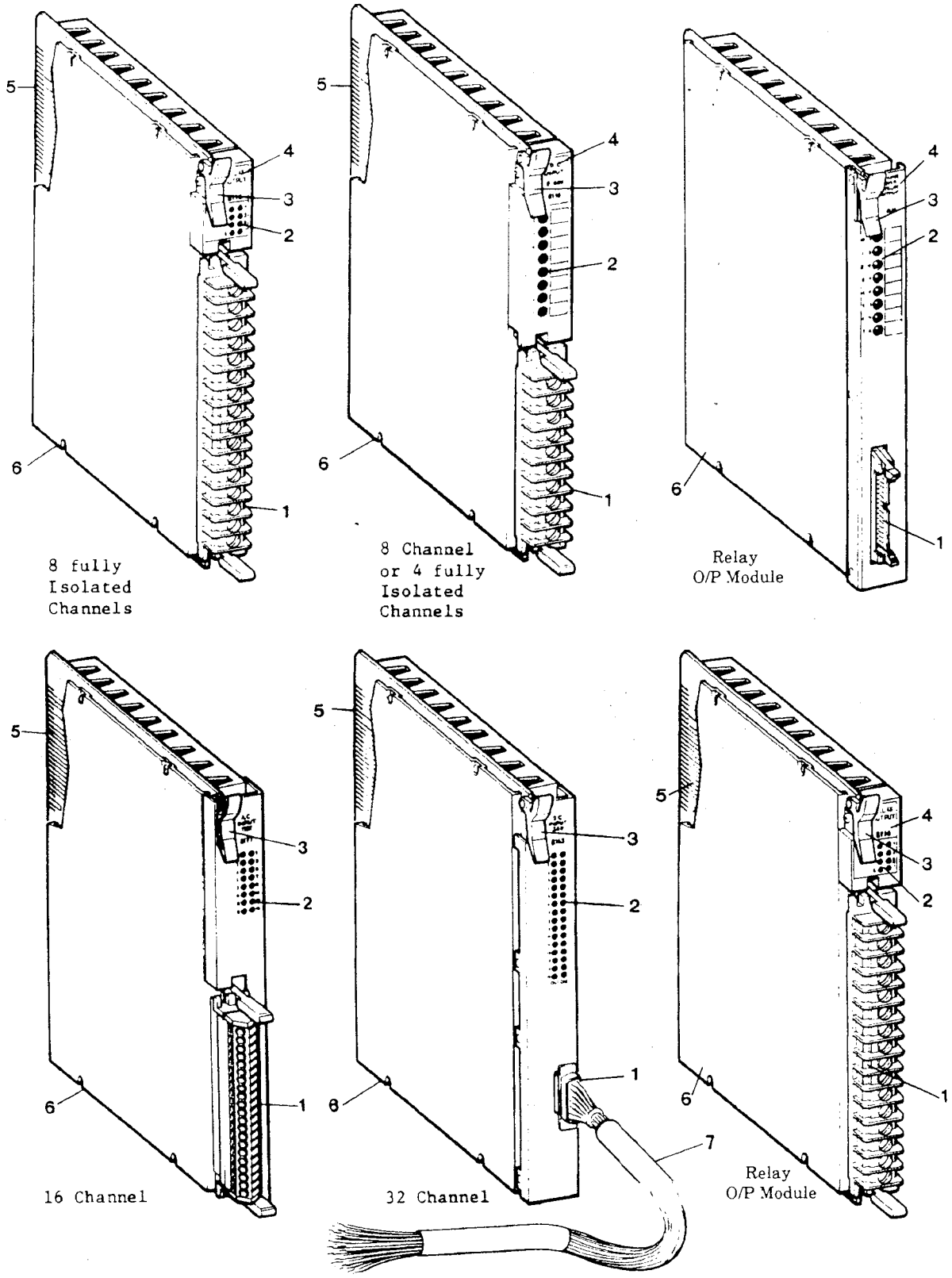
Figure 1 - 8869 Subrack fitted with Compact Modules

3.2 Modules

Figure 2 shows typical 4, 8, 16 and 32 channel Compact I/O Modules. Also shown are the 8130 and 8143 Relay Output modules. The rugged design includes moulded side covers. Indicator lamps are provided to show the state of each input or output and where a fuse is fitted (on output modules and TTL/CMOS Input 8138) a lamp is provided to indicate if the fuse has blown (see Section 8 for details).

At the front of the module is a removable plant connector and Section 6 details how connections are made to this.

At the rear of the module is the edge connector for mating with the subrack backplane (see Section 5 for details).



1. Connector for plant wiring
2. Indicator lamps for state indication of each input
3. Ejection handle
4. Colour code and type number
5. Edge connector (mating with subrack backplane)
6. Moulded side cover
7. Wiring harness

Figure 2 - 4, 8, 16 and 32 Channel Compact I/O Modules

4. POWER CONSUMPTION FROM HOST CONTROLLER

A +15V supply is provided by the host controller via the Basic I/o highway ribbon cable. Table 1 shows the current drawn in milliamps from the host controller for each module type. The table shows the current drawn in two extreme states, this is when all the channels are ON and when all the channels are OFF.

Table 1 - Power Consumption From Host Controller

Module	Maximum +15V current (mA) drawn from Host controller			Module	Maximum +15V current (mA) drawn from Host controller	
	All channels				All channels	
	ON	OFF			ON	OFF
8110	8.4	4.8		8152	8.4	4.8
8111	6.5	4.8		8153	60	12
8112	6.5	4.8		8162	57	1
8113	57	1		8163	148	–
8114	81	1		8164+	320	30
8115	81	1		8167	30	6
8116	60*	0.5		8168	6.8	4.8
8117	81	1		8171	81	1
8118	6.8	4.8		8177	16	14
8119	57	1		8178+	205	40
8120	8.4	4.8		8179+	57	1
8121	57	1		8180+	57	1
8123	6.5	4.8		8181+	60	12
8124	81	1		8182+	81	1
8125	6.5	4.8		8183+	81	1
8126	81	1		8184+	81	1
8130	10 + (25 per relay energised) 210 maximum	0.5		8185+	81	1
8138	8.4	4.8		8188	6.5	4.8
8139	60	12		8197	148	–
8140	60	12		8198	320	30
8143	190	15		9513	70	45
8147	8.4	4.8		9514	205	40
8148	6.8	4.8		9543	190	15
8149	57	1				

* 180mA for 10 ms, all outputs changing state

+ These modules have an enable circuit which requires an additional 10mA when the power is taken from the host controller.

5. FITTING MODULES IN THE SUBRACK

5.1 Introduction

The edge connector at the rear of the Compact I/O module is a mechanically coded connector. This mechanical coding ensures that input modules can only be fitted in subrack locations allocated to output modules.

The subracks are supplied with coding pegs fitted in place of the connector fingers in positions 5, 10, 12 and 31 as shown in Figure 3.

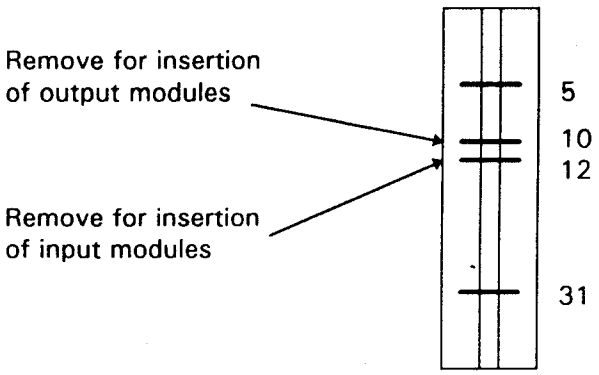


Figure 3 - Mechanical Coding in Subrack Edge Connector

5.2 Fitting Input Modules

Input modules are supplied with cut-outs corresponding to subrack connector positions 5,10 and 31 as shown in Figure 4a.

To fit an input module in the subrack, the coding peg fitted in the subrack edge connector at position 12 should be removed with a pair of long nose pliers.

5.3 Fitting Output Modules

Output modules are supplied with cut-outs corresponding to subrack connector positions 5,12 and 31 as shown in Figure 4b.

To fit an output module in the subrack, the coding peg fitted in the subrack edge connector at position 10 should be removed with a pair of long nose pliers.

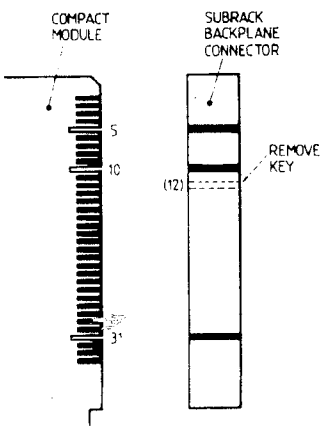


Figure 4a - Input Module Mechanical Coding Cutouts

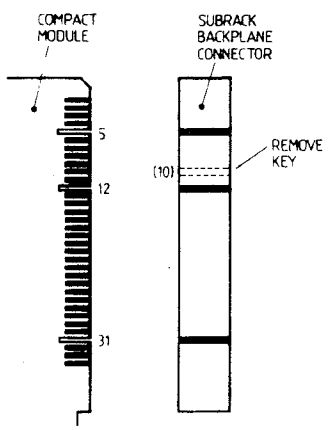


Figure 4b - Input Module Mechanical Coding Cutouts

6. PLANT CONNECTIONS

6.1 4, 8 and 16 Channel Modules

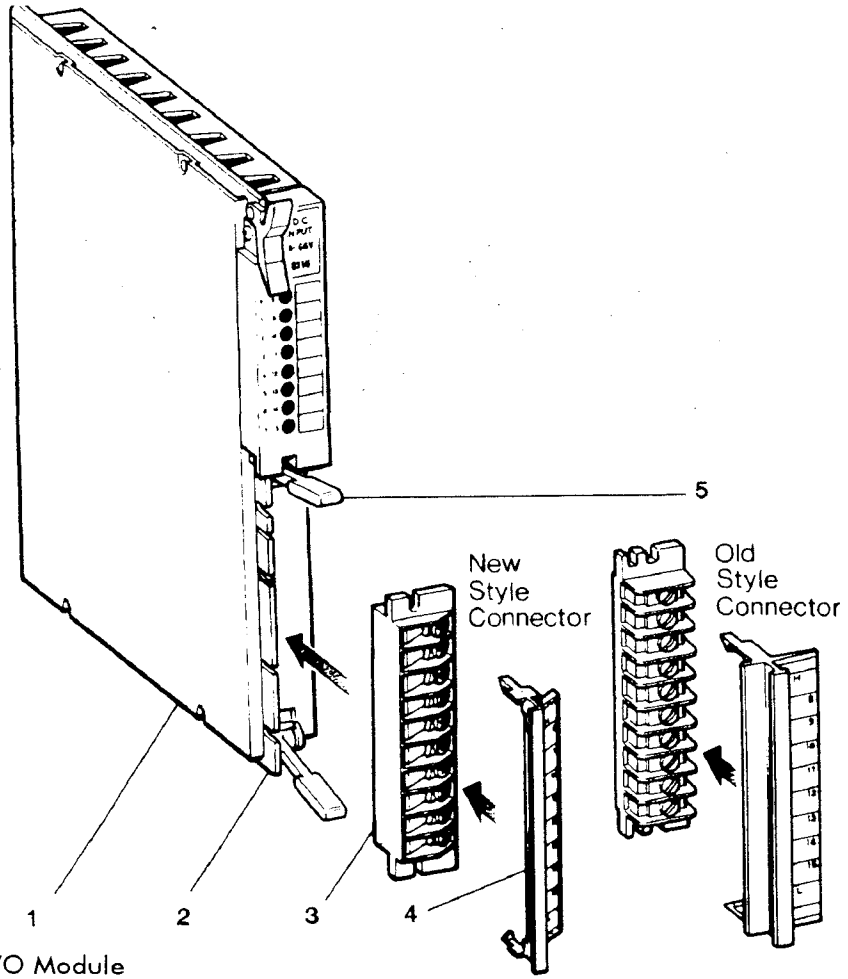
6.1.1 Introduction

Plant wiring is terminated onto screw terminals of an edge connector. This edge connector then push fits onto the front of the module and a shroud clips over the top of the whole assembly. Figure 5 shows this assembly for a typical 8 channel module.

The screw terminals of the plant edge connector accept wiring with a conductor size up to 1.5mm^2 and these access from the left hand side of the connector as shown in Figure 6. Enough slack should be left in the cable form to allow removal of the connector and then removal of the module from the subrack.

The plant connector retaining clips also act as ejection levers to aid connector removal.

The protective shroud carries a label for terminal identification, and also has space for the user to add function details if required.



1. Compact I/O Module
2. Printed Circuit Board edge connector
3. Plant connector with screw terminals for plant wiring
4. Shroud with label for terminal identification
5. Retaining/ejection clips for plant connector

Figure 5 - Plant Connection, 8 Channel I/O Module

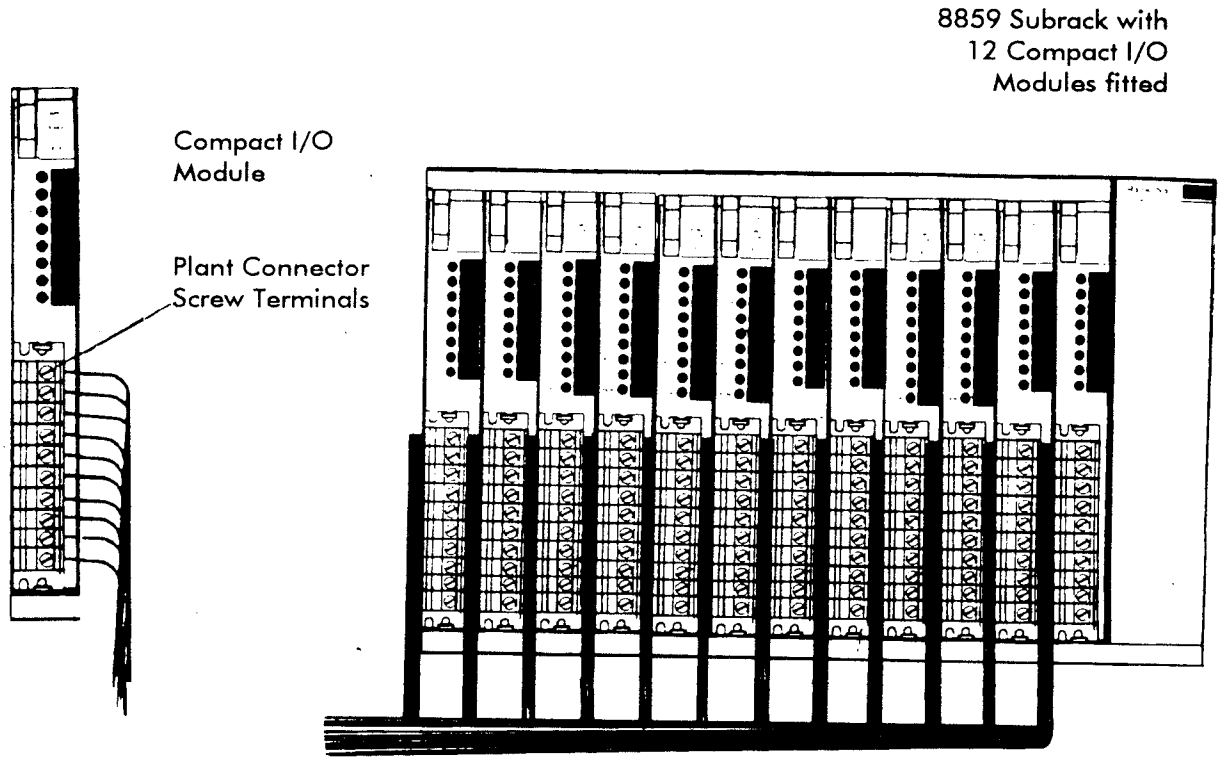


Figure 6 - Terminating Plant Wiring

6.1.2 Mechanical Coding of Plant Connector

Two plastic coding keys are supplied as part of the plant connector kit. These fit into the plant edge connector in such a way as to correspond with the cut outs on the mating PCB edge connector. The location of the coding keys are different for each module type. Figure 7 shows an example of the coding as fitted for an 8124 module. It should be noted that some modules have connectors larger than 10 way so that coding key positions higher than 10 may be indicated. Table 2 details the coding position for the other Compact I/O Modules.

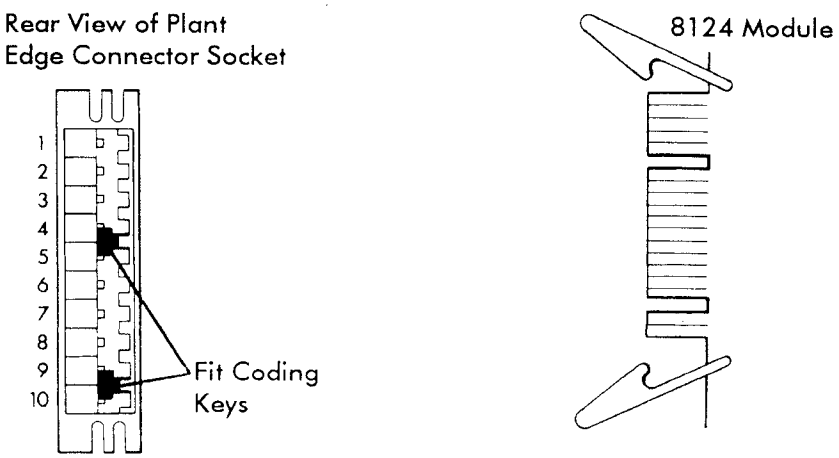


Figure 7 - Example of mechanical coding for 8124 module

Table 2 - Mechanical Coding Positions of Plant Connector

Module Type Number	Position for Coding Key 1	Position for Coding Key 2		Module Type Number	Position for Coding Key 1	Position for Coding Key 2
8110	1 & 2	3 & 4		8148	1 & 2	8 & 9
8111	2 & 3	4 & 5		8149	3 & 4	8 & 9
8112	2 & 3	5 & 6		8152	1 & 2	7 & 8
8113	3 & 4	5 & 6		8153	3 & 4	4 & 5
8114	4 & 5	6 & 7		8162	3 & 4	9 & 10
8115	4 & 5	7 & 8		8167	4 & 5	8 & 9
8116	1 & 2	3 & 4		8168	1 & 2	7 & 8
8117	4 & 5	8 & 9		8171	4 & 5	7 & 8
8118	1 & 2	9 & 10		8177	2 & 3	8 & 9
8119	3 & 4	7 & 8		8178	2 & 3	9 & 10
8120	1 & 2	4 & 5		8179	3 & 4	5 & 6
8121	3 & 4	6 & 7		8180	3 & 4	6 & 7
8123	2 & 3	6 & 7		8181	3 & 4	4 & 5
8124	4 & 5	9 & 10		8182	4 & 5	9 & 10
8125	2 & 3	7 & 8		8183	5 & 6	6 & 7
8126	5 & 6	6 & 7		8184	4 & 5	6 & 7
8138	1 & 2	5 & 6		8185	4 & 5	7 & 8
8139	6 & 7	7 & 8		8188	1 & 2	10 & 11
8140	3 & 4	5 & 6		9513	2 & 3	11 & 12
8143	1 & 2	5 & 6		9514	2 & 3	12 & 13
8147	1 & 2	6 & 7		9543	1 & 2	5 & 6

6.2 8 Channel Input Modules

6.2.1 8 Channel Input Modules 8110, 8111, 8112, 8118, 8123, 8125, 8138 and 8152

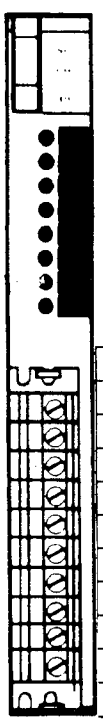


Figure 8 shows the plant connections for the ten screw terminals. Plant side power supply connections are screw terminal numbers 1 and 10. The eight input channel connections are screw terminals 2 to 9.

Screw Terminal Number	Function
1	Plant Side Power High
2	Channel 0
3	Channel 1
4	Channel 2
5	Channel 3
6	Channel 4
7	Channel 5
8	Channel 6
9	Channel 7
10	Plant Side Power Low

Figure 8 - Plant Connections for 8 Channel Compact I/O Modules

The internal electrical equivalent circuit (plant side of the opto isolation) is shown in Figure 9 (Figure 10 for 8138 TTL-CMOS module). This shows that all eight channels are tied to one common return terminal (screw terminal 10 "Low"). A single terminal is available for each input channel.

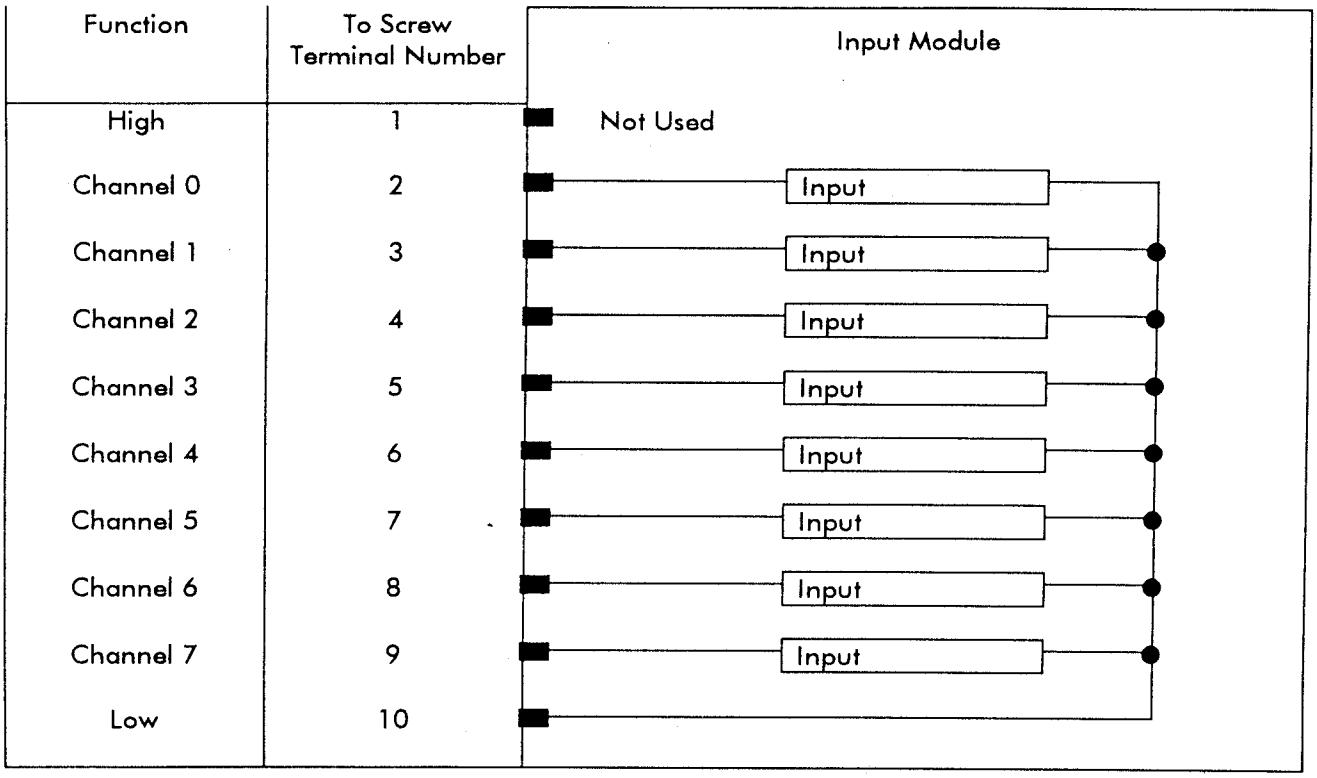


Figure 9 - Internal Equivalent Circuit of 8 Channel Input Modules (plant side of opto isolation)

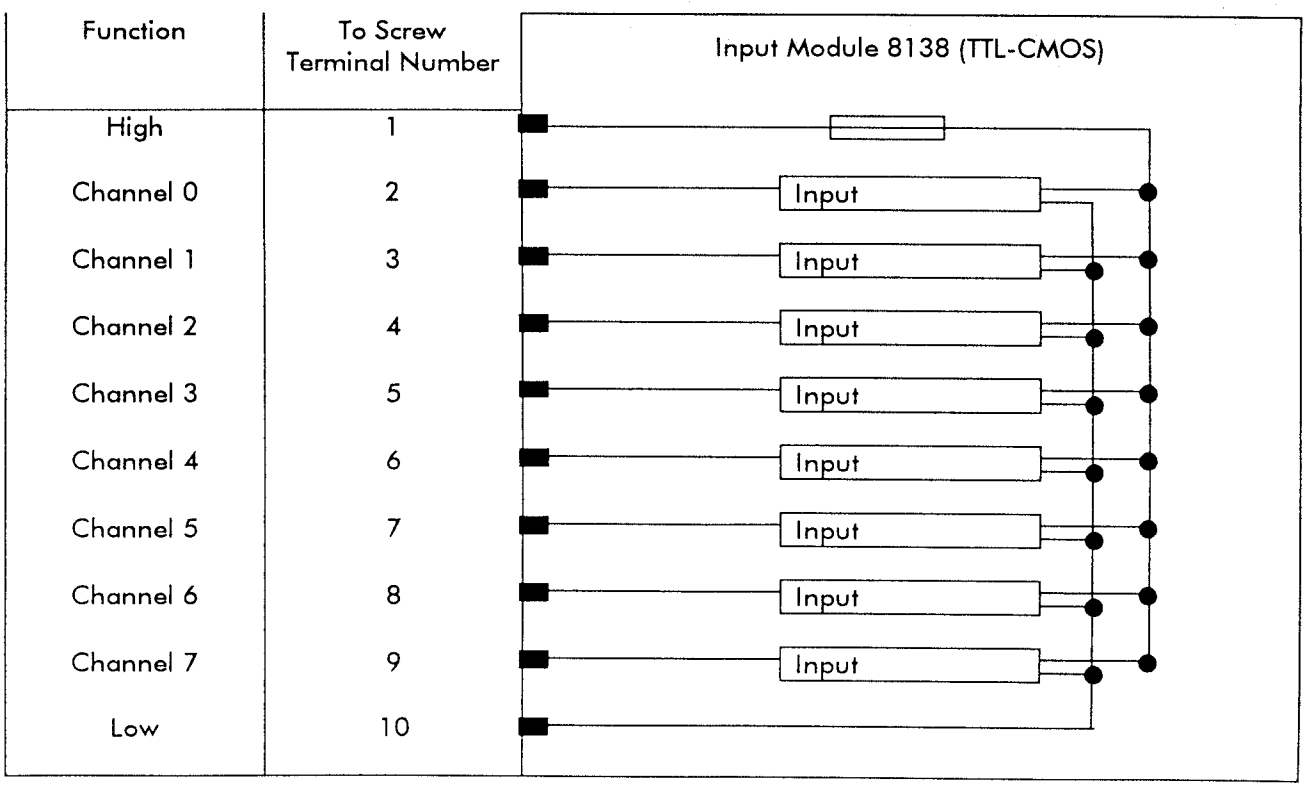


Figure 10 - Internal Electrical Equivalent Circuit of 8138 TTL-CMOS Input Module (plant side of opto isolator)

6.2.2 8 Channel Inverted Input Modules 8120 and 8148

Figure 8 shows the plant connections for the ten screw terminals. Plant side power connections are screw terminals 1 and 10. The eight channels are screw terminals 2 to 9.

The internal equivalent circuit is as shown in Figure 11.

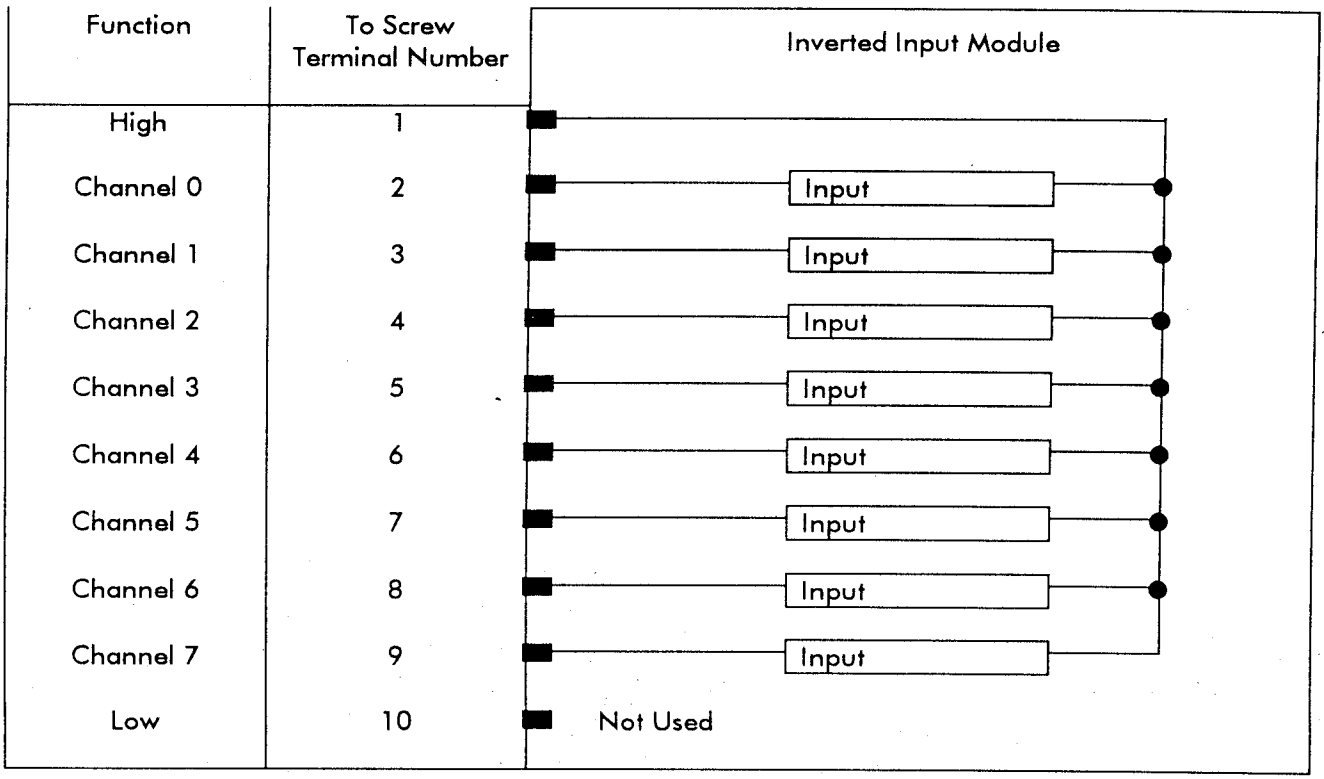


Figure 11 - Internal Equivalent Circuit of 8120 and 8148 Inverted Input Modules (plant side of opto isolator)

6.2.3 8 Channel Isolated Input Modules 8147, 8168 and 8188

Figure 12 shows the plant connections for the sixteen screw terminals. Each adjacent pair of terminals is for each channel. The internal equivalent circuit (plant side of opto isolation) is shown in Figure 13. This shows that each channel is electrically independent.

Screw Terminal Number		Channel Number
1	High	0
2	Low	
3	High	1
4	Low	
5	High	2
6	Low	
7	High	3
8	Low	
9	High	4
10	Low	
11	High	5
12	Low	
13	High	6
14	Low	
15	High	7
16	Low	

Figure 12 - Plant Connection for 8 Channel Isolated Input Modules

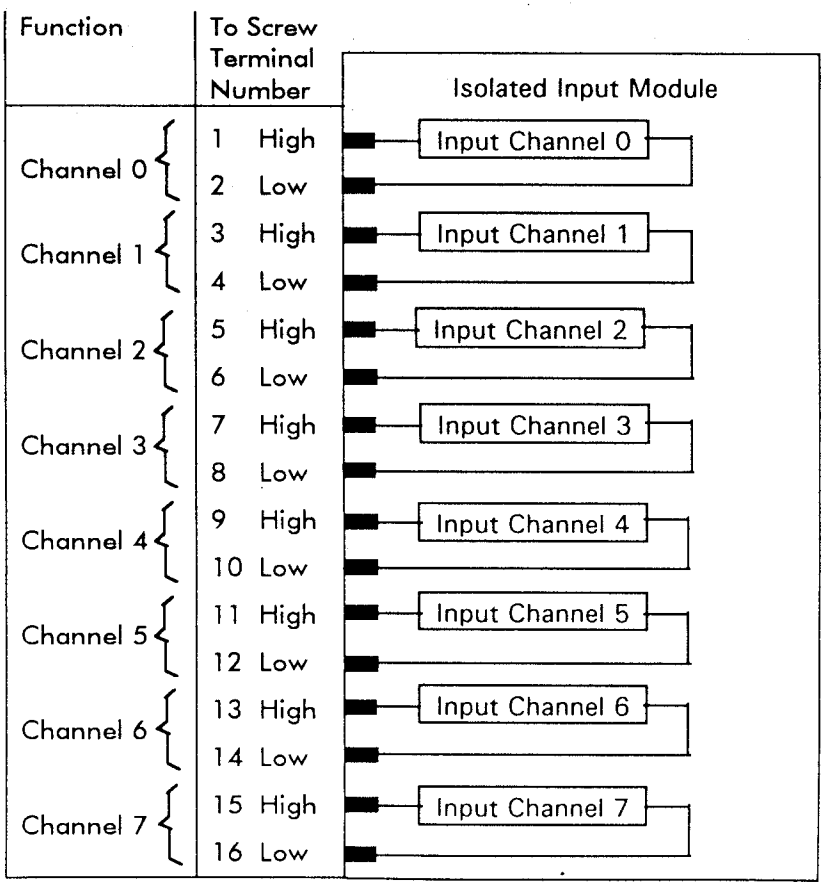


Figure 13 - Internal Electrical Equivalent Circuit of Isolated Input Module (plant side of opto isolation)

6.3 8 Channel Output Modules

6.3.1 8 Channel Output Modules 8113, 8114, 8115, 8119, 8124, 8126, 8139, 8140, 8153, 8162, 8171, 8179, 8181, 8182, 8183, 8184 and 8185

Figure 8, as before, shows the plant connections for the ten screw terminals. Plant side power supply connections are "High" at the top, (screw terminal number 1) and "Low" at the bottom (screw terminal number 10). The eight output channel connections are screw terminals 2 to 9. The internal electrical equivalent circuit (plant side of opto isolation) is shown in Figure 14 (Figure 15 for 8139 TTL-CMOS module). This shows that all eight channels are tied to one common return terminal (screw terminal 1 "High"). A single terminal is available for each output channel.

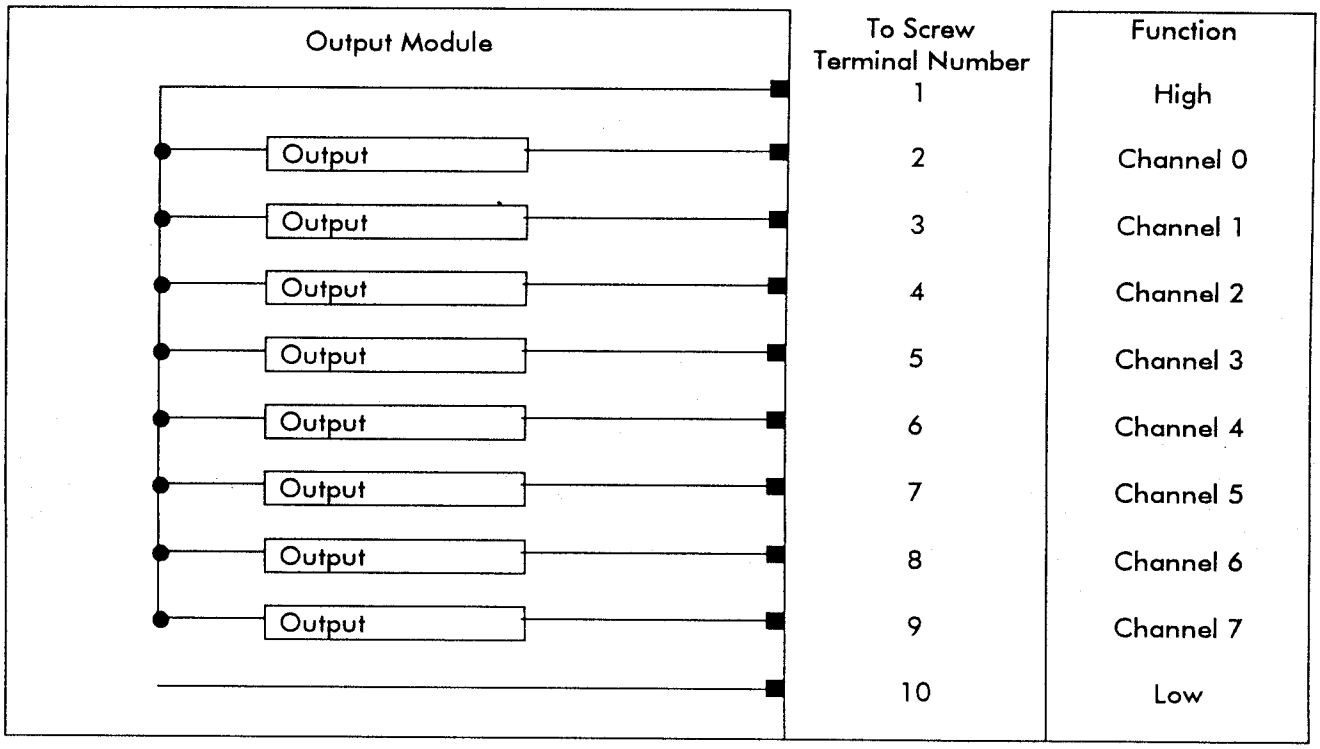


Figure 14 - Internal equivalent circuit of Output Modules for 8113, 8114, 8115, 8119, 8124, 8126, 8140, 8153, 8162, 8179, 8181, 8182, 8183, 8184 and 8185

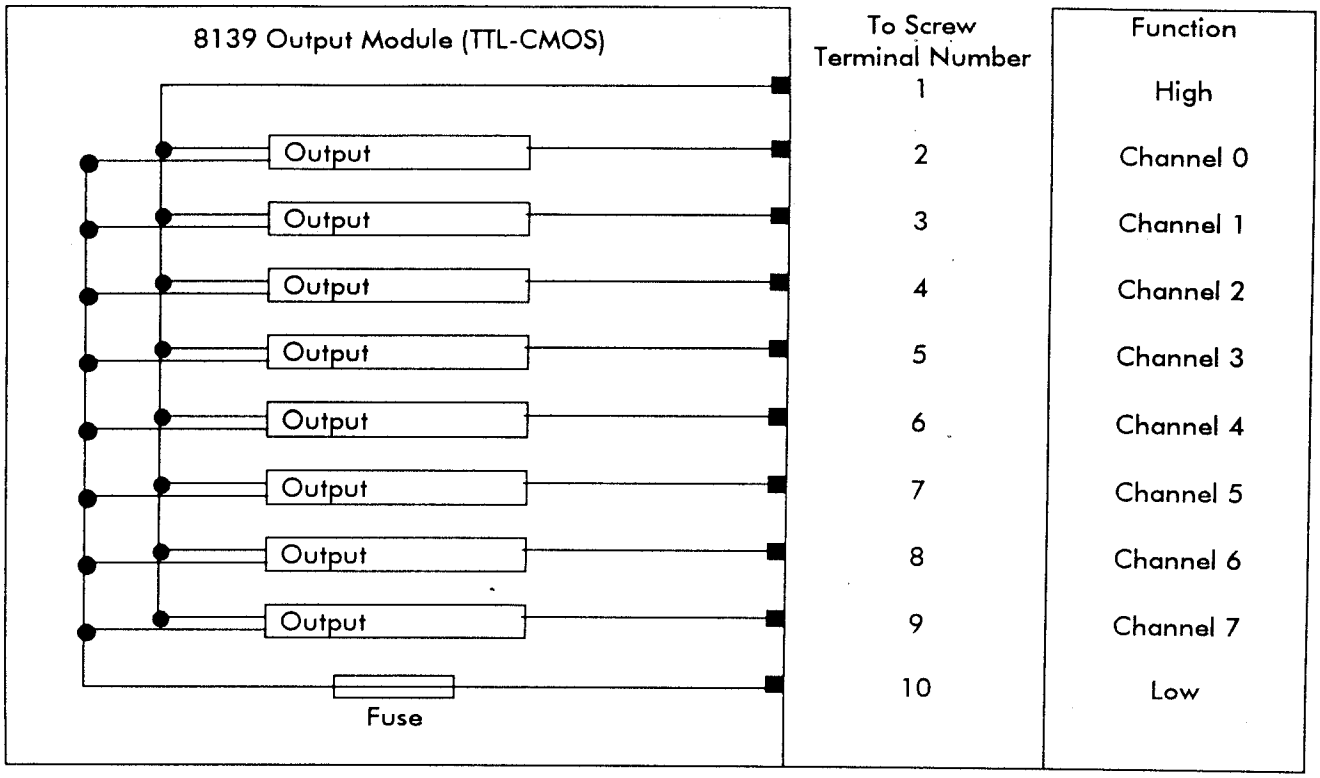


Figure 15 - Internal equivalent circuit of 8139 TTL-CMOS Output Module

6.3.2 8-Channel Inverted Output Modules 8121, 8149 and 8180

The internal electrical equivalent circuit (plant side of opto isolation) is shown in Figure 16 (see Figure 8 for plant connections).

This shows that all eight channels are tied to one common return terminal (screw terminal 10 "Low"). A single terminal is available for each output channel. Plant side power supply "high" is connected to terminal 1.

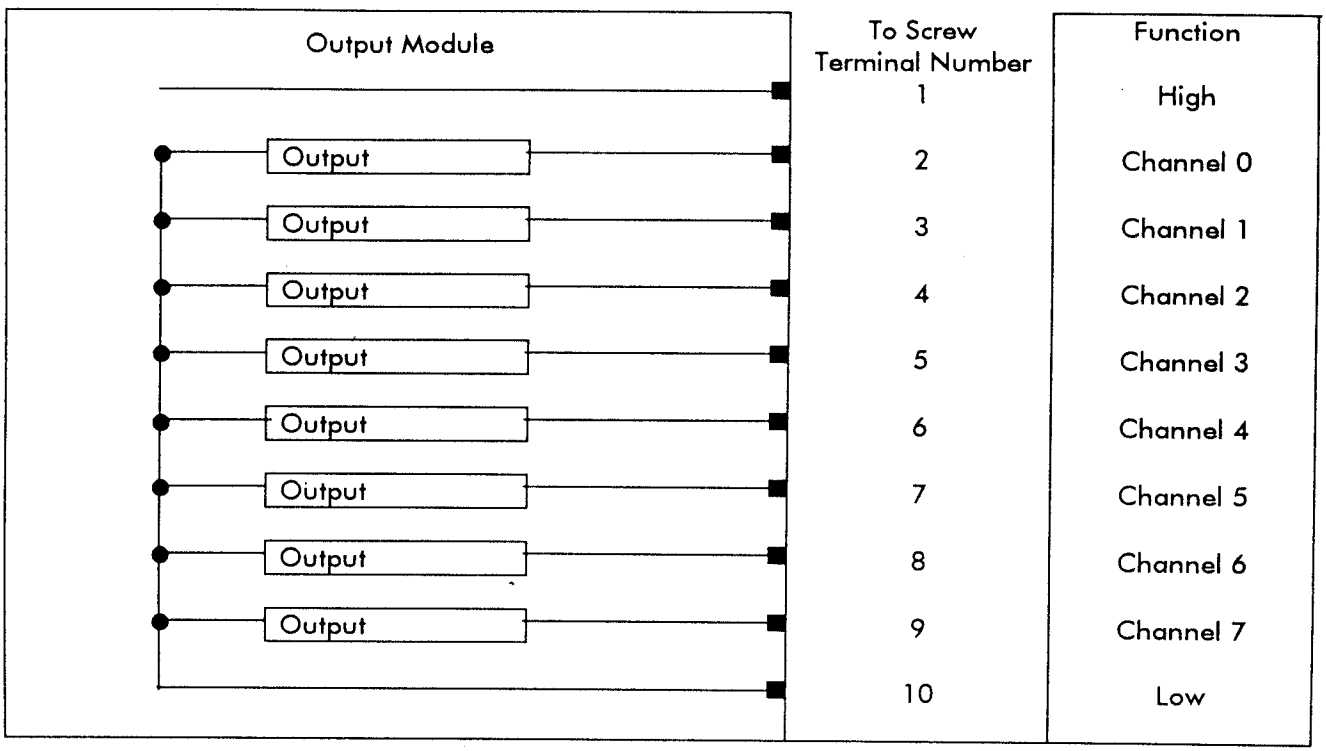


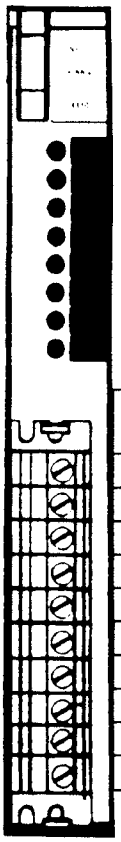
Figure 16 - Internal Equivalent Circuit of 8121, 8149 and 8180 Inverted Output Modules

6.4 4 - Channel Isolated Output Modules 8117 and 8167

The 8117 provides four isolated AC output channels while the 8167 provides four isolated channels with an external enable input.

The output enable ensures that the output channels are inhibited until the output enable is activated. See Section 7.6.4 in Typical Circuits for details.

Figure 17 shows the plant connections for the screw terminals. The four channels are output on terminals 1 to 8 while 9 and 10 are unused on the 8117 and are the external enable terminals on the 8167. Figure 18 shows the internal electrical equivalent circuit.



Screw Terminal Number		Function
1	High	Channel 0
2	Output	
3	High	Channel 1
4	Output	
5	High	Channel 2
6	Output	
7	High	Channel 3
8	Output	
9	+	8167 output enable
10	–	8117 unused

Figure 17 - Plant Connection for 8117 and 8167

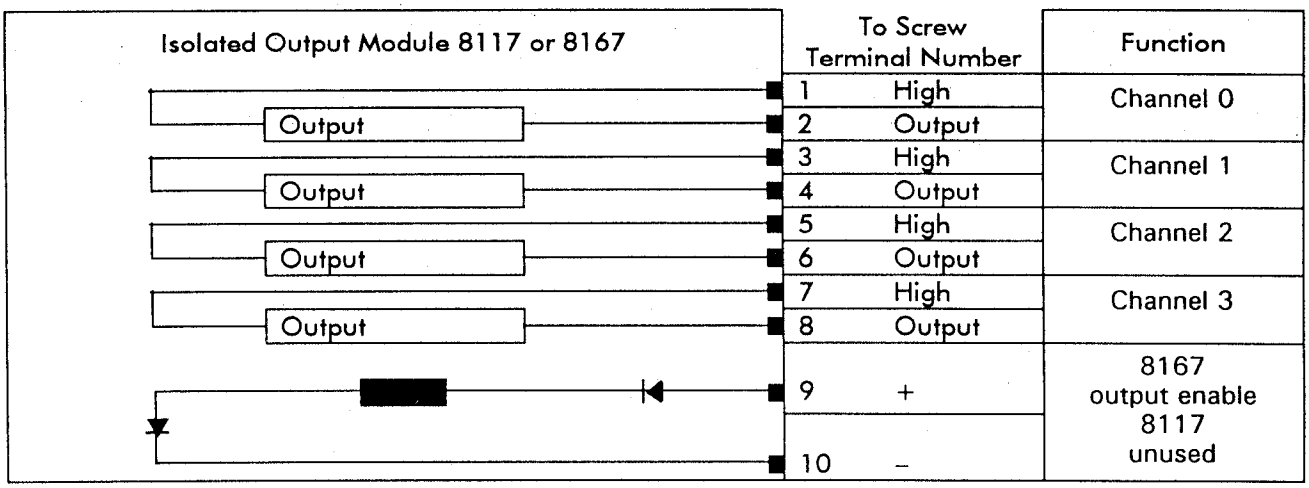


Figure 18 - Internal Equivalent Circuit of Output Modules 8117 and 8167 (plant side of opto isolator)

6.5 8-Channel Relay Output Modules 8116, 8130, 8143 and 9543

Figure 19a shows the plant connections for the sixteen screw terminals on the 8116, 8143 and 9543 Relay Output Modules. Each adjacent pair of terminals is for each channel. Figure 19b shows the plant connections for the plug connector on the 8130 Relay Output Module.

The internal equivalent circuits (plant side of isolation) are shown in Figures 20a, 20b and 20c. These show that each channel is electrically independent.

6.5.1 8130 Relay Output Module Plant Connections

The plant connections for the 8130 are made by using a wiring harness, 8891-4082, which comprises a socket connector and 3 metre cable.

A blanking pin must be inserted in position 3 of the socket connector on the wiring harness to provide mechanical coding. This will then match the plug connector mounted on the front panel of the module which will have pin 3 removed.

Screw Terminal Number	Channel Number
1	0
2	
3	1
4	
5	2
6	
7	3
8	
9	4
10	
11	5
12	
13	6
14	
15	7
16	

Figure 19a - Screw Terminals for Relay Output Modules 8116 and 8143

CHANNEL		WIRE COLOUR	CONNECTOR PIN NUMBER
Not Used			1 2
Not Used			4 5 6
Not Used			7 8 9 10
0	(N/C (COMMON (N/O	GREY BLACK/WHITE BLACK	13 12 11
1	(N/C (COMMON (N/O	GREY BLACK/WHITE BROWN	16 15 14
2	(N/C (COMMON (N/O	GREY BLACK/WHITE RED	19 18 17
3	(N/C (COMMON (N/O	GREY BLACK/WHITE ORANGE	22 21 20
4	(N/C (COMMON (N/O	GREY BLACK/WHITE YELLOW	25 24 23
5	(N/C (COMMON (N/O	GREY BLACK/WHITE GREEN	28 27 26
6	(N/C (COMMON (N/O	GREY BLACK/WHITE BLUE	31 30 29
7	(N/C (COMMON (N/O	GREY BLACK/WHITE VIOLET	34 33 32

Figure 19b - Wire Colour Code for Plug Connector on 8130 Relay Output Module

6.5.2 Transient Suppression

Care must be taken to protect output contacts from damage by high inrush, inductive, and capacitance discharge loads. Under switching or transient conditions, the specified switching values must not be exceeded.

High inrush currents caused by a capacitive load charging or discharging through the contact may be limited by the addition of series resistance.

DC inductive loads may be suppressed by the addition of a suitably rated peak inverse voltage diode in parallel with the load (cathode of the diode being connected to the positive potential).

AC inductive loads should have a network in parallel with the load, consisting of a capacitor and resistor in series. The values of the network are a function of the resistance and inductance of the load.

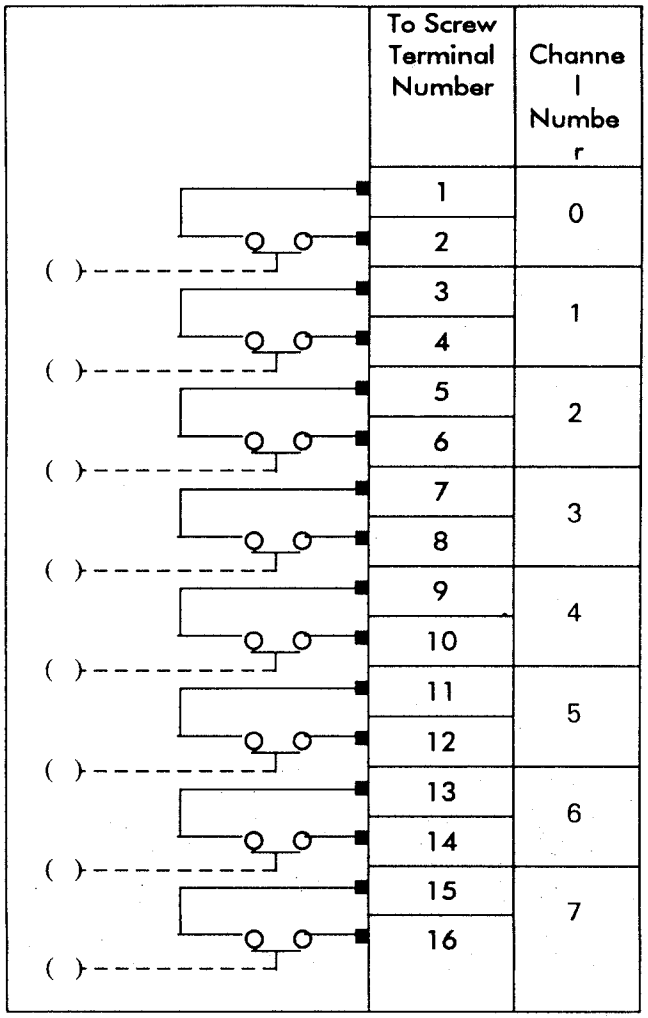


Figure 20a - Internal Equivalent Circuit (plant side) for 8116, 8143-4002 and 9543 Relay Output Modules

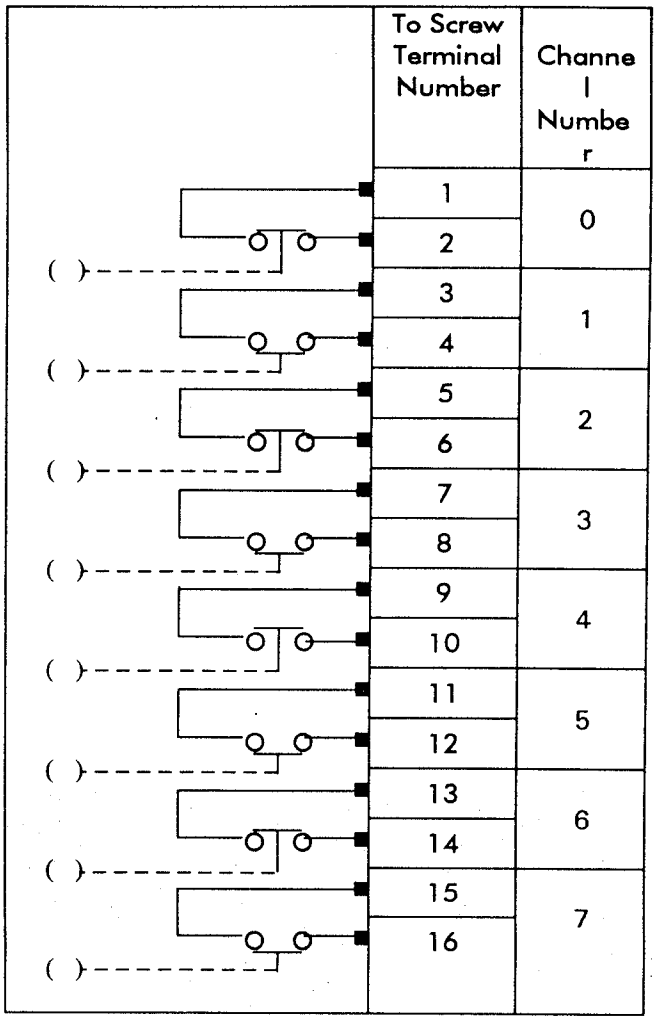


Figure 20b - Internal Equivalent Circuit (plant side) for 8143-4006 Relay Output Module (4 normally closed, 4 normally open contacts)

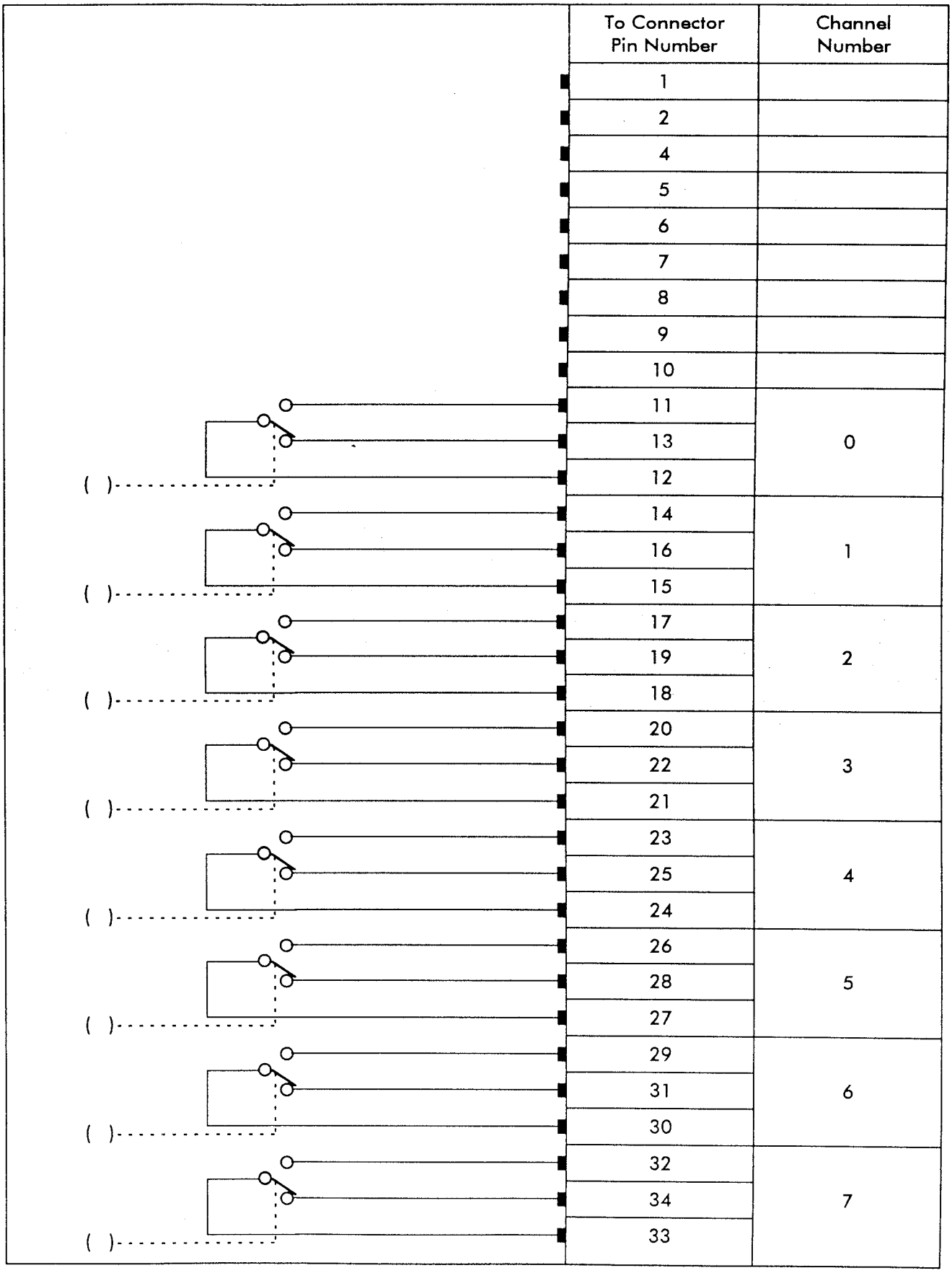


Figure 20c - Internal Electrical Equivalent Circuit (plant side) for 8130 Relay Output Module

6.6 16-Channel and 32-Channel I/O Modules

6.6.1 16-Channel Input Modules 8177 & 9513

Figure 21 shows the plant connections for the twenty screw terminals. Plant-side power supply connections are screw terminals 19 and 20 "Low". The sixteen input channel connections are screw terminals 3 to 18. Screw terminals 1 and 2 are unused, but common within the module.

Screw Terminal Number	Channel Number
1	NOT USED
2	NOT USED
3	0
4	1
5	2
6	3
7	4
8	5
9	6
10	7
11	8
12	9
13	10
14	11
15	12
16	13
17	14
18	15
19	LOW
20	LOW

Figure 21 - 8177 16 Channel Input Module

The internal electrical equivalent circuit is shown in Figure 22. This shows that all sixteen channels are tied to one common return terminal (screw terminals 19 and 20, "Low"), and that there is one terminal for each channel.

Function	To Screw Terminal Number
Not Used	1
Not Used	2
Channel 0	3
Channel 1	4
Channel 2	5
Channel 3	6
Channel 4	7
Channel 5	8
Channel 6	9
Channel 7	10
Channel 8	11
Channel 9	12
Channel 10	13
Channel 11	14
Channel 12	15
Channel 13	16
Channel 14	17
Channel 15	18
Low	19
Low	20

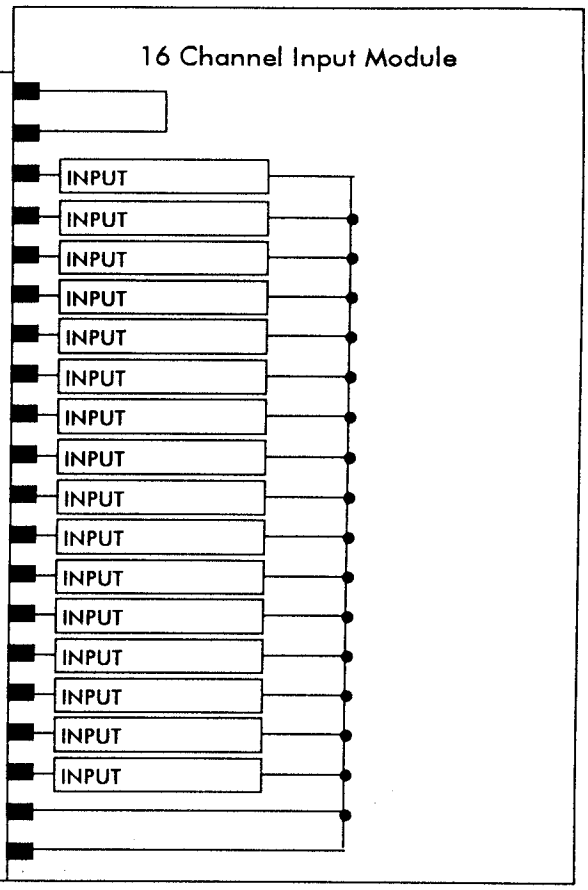
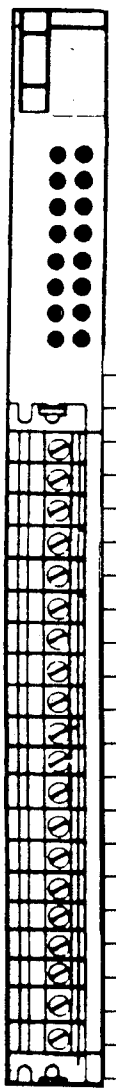


Figure 22 - Internal equivalent Circuit of Sixteen-Channel Input Modules

6.6.2 16-Channel Output Module 8178 and 9514

Figure 23 shows the plant connections for the twenty screw terminals. Plant-side power supply connections are screw terminals 1 and 2, and 19 and 20. The sixteen output channel connections are screw terminals 3 to 18.



Screw Terminal Number	Channel Number
1	HIGH
2	HIGH
3	0
4	1
5	2
6	3
7	4
8	5
9	6
10	7
11	8
12	9
13	10
14	11
15	12
16	13
17	14
18	15
19	LOW
20	LOW

Figure 23 - 8178 16 Channel Output Module

The internal equivalent circuit is shown in Figure 24. This shows that all sixteen channels are tied to one common return terminal (screw terminals 1 and 2, "High"), and that there is one terminal for each channel.

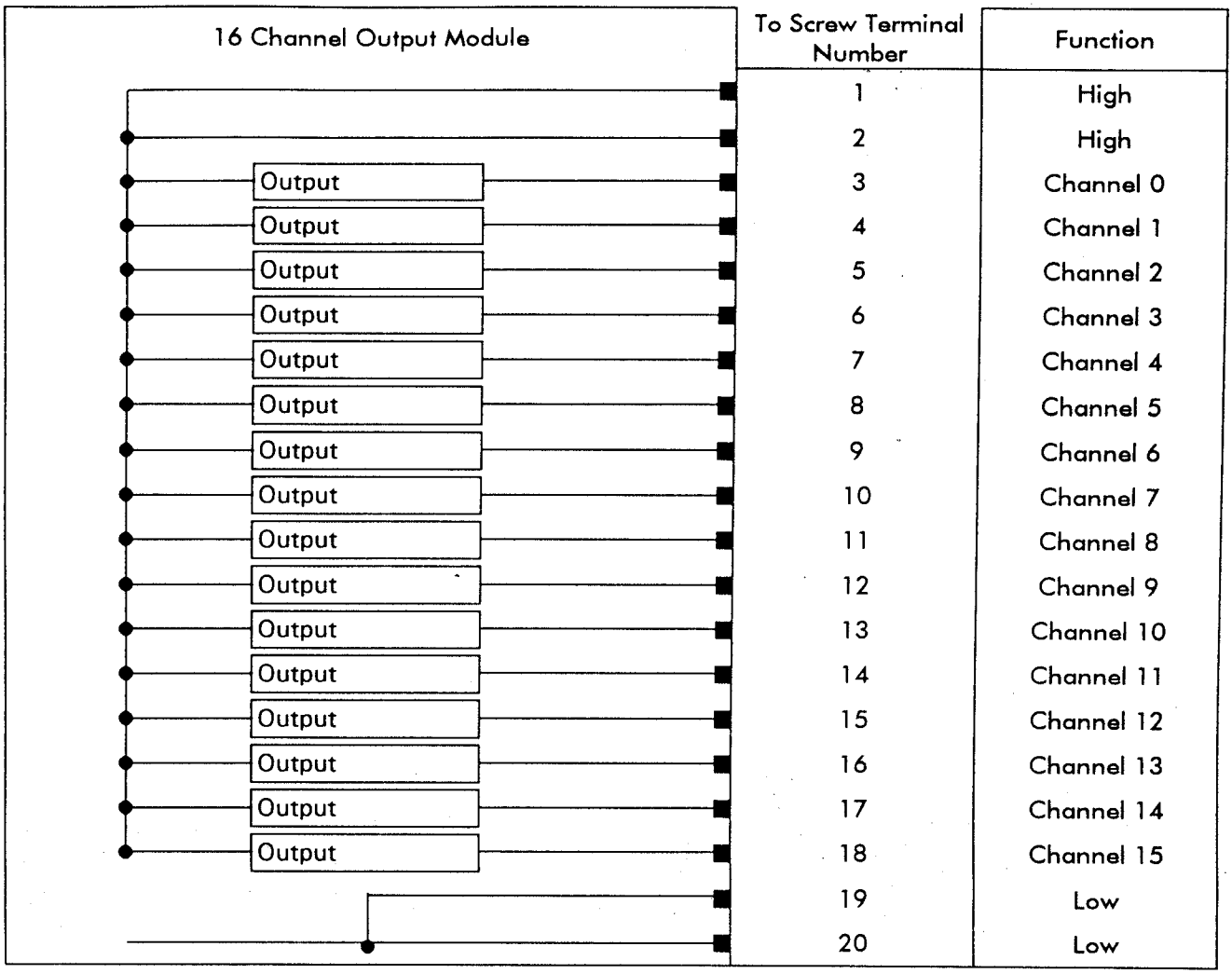


Figure 24 - Internal Equivalent Circuit of 16-Channel Output Modules

6.6.3 32-Channel Input Modules 8163 and 8197

Plant connections are made via the "D" Type connector on the front of the module. A cable harness with plug is optionally available for this purpose. The 32-Channel Input Module inputs data to two consecutive 16-bit data table words, word 1 and word 2. The exact address of these words depends on the position of the module in the subrack and the address decoder switch settings. See 8859 User Information, Publication T1504.

Each group of eight input channels is tied to a separate common. This is shown in Figure 25 for channels 0 to 7, word 1. The complete pin-out is shown in Figure 26.

Common 1 is used for channels 0 to 7 word 1
Common 2 is used for channels 8 to 15 word 1
Common 3 is used for channels 0 to 7 word 2
Common 4 is used for channels 8 to 15 word 2

Note: The "D" Type connector is mechanically coded to ensure connection to a 32-way input module only by the removal of pin 20.

Sufficient slack should be left when wiring the connector to allow the connector to be unplugged and moved clear of the module to allow module removal.

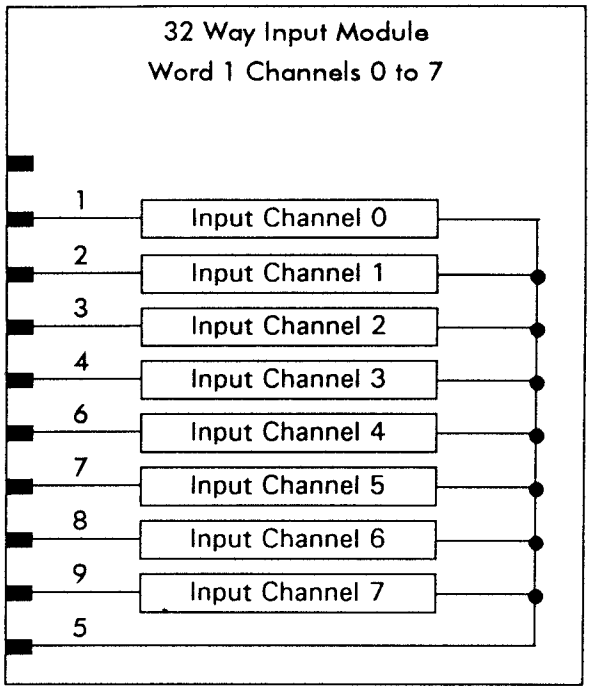


Figure 25 - 32-Channel Input Module Circuit
Word 1 Channels 0 to 7

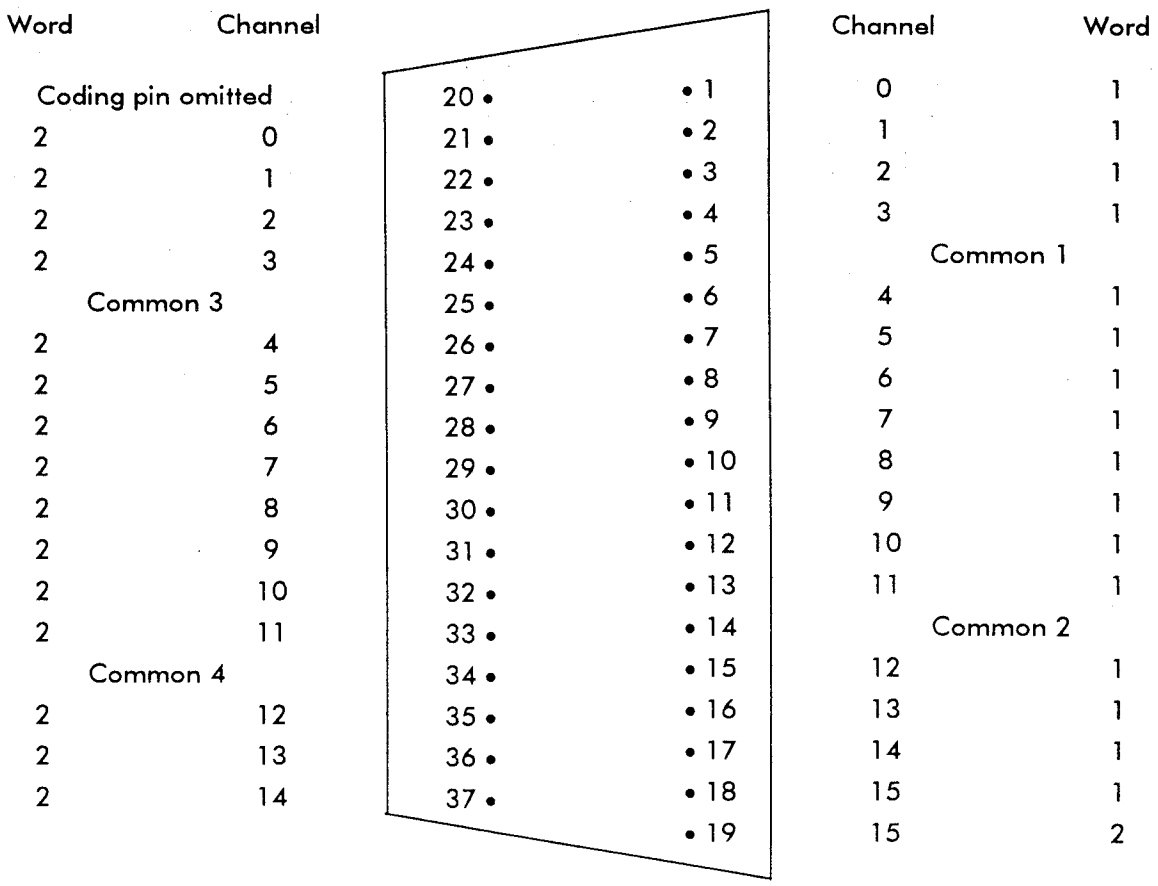


Figure 26 - "D" Connector Pin Out: 32 Channel Input Module

6.6.4 32-Channel Output Modules 8164 and 8198

Plant connections are made via the "D" Type connector on the front of the module. A cable harness with plug is optionally available for this purpose. The 32 Channel Output Module outputs data to two consecutive 16 bit data table words, word 1 and word 2. The exact address of these words depends on the position of the module in the subrack and the address decoder switch settings. See 8859 User Information, Publication T1504.

Each group of eight output channels is tied to the high (+24V) power supply rail. To allow current sharing, the three pins provided on the "D" Type connector (5, 14 and 25) are commoned within the module. The high (+24V) should be connected to all three pins for maximum output capability of the module.

A single low (0V) terminal is provided for connecting the plant supply 0V.

Figure 27 shows these connections for channels 0 to 7, word 2. The complete pin-out is shown in Figure 28.

Note: The "D" Type connector is mechanically coded to ensure connection to a 32-way output module only by the removal of pin 19.

Sufficient slack should be left when wiring the connector to allow the connector to be unplugged and moved clear of the module to allow module removal.

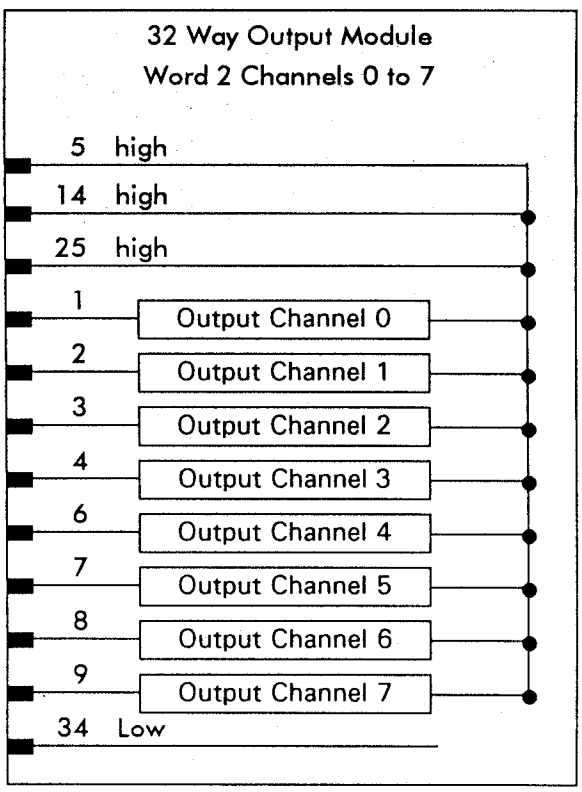


Figure 27 - 32-Channel Output Module Circuit Word 2 Channels 0 to 7

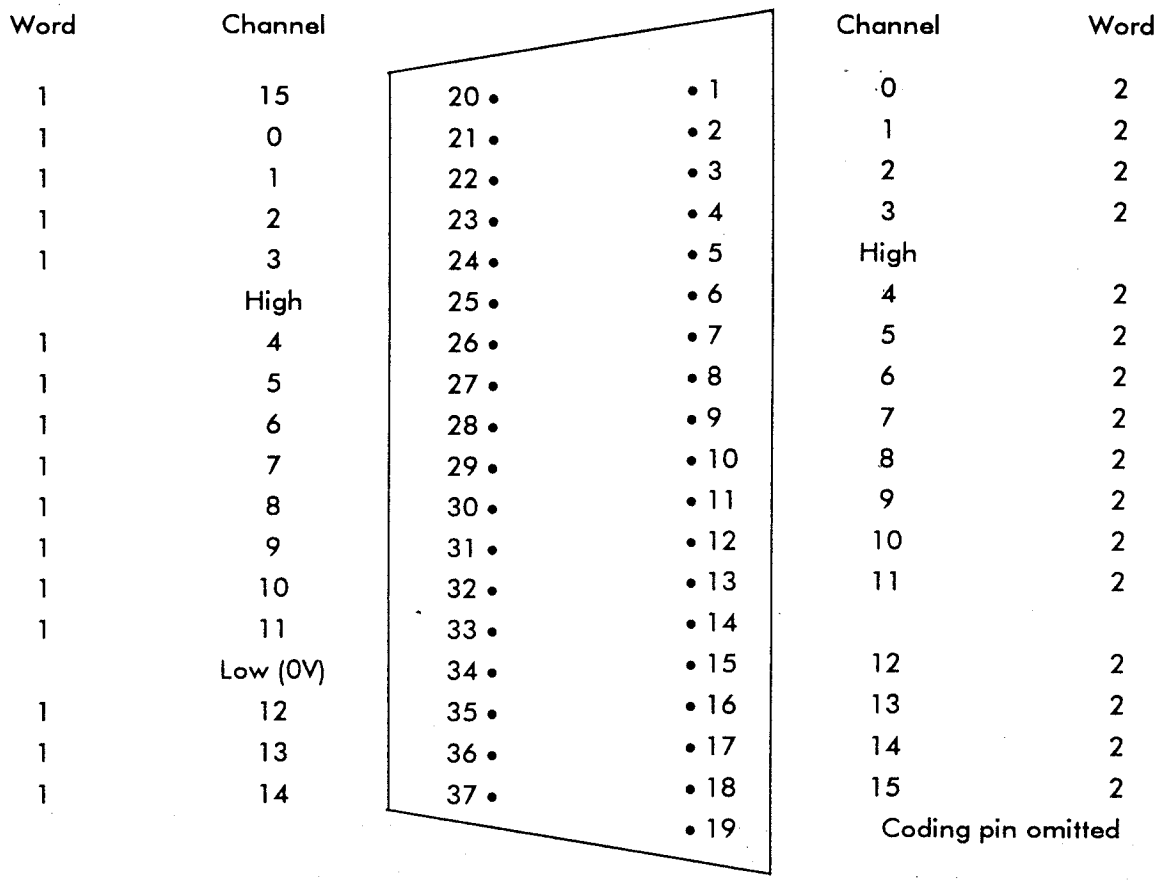


Figure 28 - "D" Connector Pin Out: 32 Channel Output Module

6.6.5 Plant Connection for 32-Channel Modules

A 3-metre harness, order number 8891-4395 (8163 and 8197), 8891-4399 (8164 and 8198) is optionally available. It is supplied complete with "D" Type connector at one end for connection to the module front panel. Figures 29a and 29b show which wire colour is connected to which pin of the "D" Type connector.

"D" Type Connector Pin Number	Wire Colour	Cable Wire Number	Terminal Number	Terminal Legend	Channel	
			1			
			2			
			3			
1	RED	1	4	000	0	
2	BLUE	2	5	001	1	
3	GREEN	3	6	002	2	
4	YELLOW	4	7	003	3	
			8			
5	WHITE	5	9	CM1	COMMON	
6	BLACK	6	10	004	4	
7	BROWN	7	11	005	5	
8	VIOLET	8	12	006	6	
9	ORANGE	9	13	007	7	
			14			WORD 1
			15			
10	PINK	10	16	008	8	
11	TURQUOISE	11	17	009	9	
12	GREY	12	18	010	10	
13	RED/BLUE	13	19	011	11	
14	GREEN/RED	14	20	CM2	COMMON	
			21			
15	YELLOW/RED	15	22	012	12	
16	WHITE/RED	16	23	013	13	
17	RED/BLACK	17	24	014	14	
18	RED/BROWN	18	25	015	15	
19	YELLOW/BLUE	19	27	115	15	
20	NOT CONNECTED					
21	WHITE/BLUE	20	28	100	0	
22	BLUE/BLACK	21	29	101	1	
23	ORANGE/BLUE	22	30	102	2	
24	GREEN/BLUE	23	31	103	3	
			32			
			33			
25	GREY/BLUE	24	34	CM3	COMMON	
26	BLUE/PINK	25	35	104	4	
27	WHITE/GREEN	26	36	105	5	
28	GREEN/BLACK	27	37	106	6	
			38			WORD 2
29	ORANGE/GREEN	28	39	107	7	
30	GREY/GREEN	29	40	108	8	
31	YELLOW/BROWN	30	41	109	9	
32	WHITE/BROWN	31	42	110	10	
			43			
33	BROWN/BLACK	32	44	111	11	
34	GREY/BROWN	33	45	CM4	COMMON	
35	YELLOW/VIOLET	34	46	112	12	
36	VIOLET/BLACK	35	47	113	13	
37	WHITE/VIOLET	36	48	114	14	

Figure 29a - Wire Colour for 'D' Type Connector on 8163 Module

"D" Type Connector Pin Number	Wire Colour	Cable Wire Number	Terminal Number	Terminal Legend	Channel	
			1			
			2			
			3			
1	RED	1	4	100	0	
2	BLUE	2	5	101	1	
3	GREEN	3	6	102	2	
4	YELLOW	4	7	103	3	
			8			
5	WHITE	5	9	24V	COMMON	
6	BLACK	6	10	104	4	
7	BROWN	7	11	105	5	
8	VIOLET	8	12	106	6	
9	ORANGE	9	13	107	7	
			14			WORD 2
			15			
10	PINK	10	16	108	8	
11	TURQUOISE	11	17	109	9	
12	GREY	12	18	110	10	
13	RED/BLUE	13	19	111	11	
14	GREEN/RED	14	20	24V	COMMON	
			21			
15	YELLOW/RED	15	22	112	12	
16	WHITE/RED	16	23	113	13	
17	RED/BLACK	17	24	114	14	
18	RED/BROWN	18	25	115	15	
19	NOT CONNECTED		26			
20	YELLOW/BLUE	19	27	015	15	
21	WHITE/BLUE	20	28	000	0	
22	BLUE/BLACK	21	29	001	1	
23	ORANGE/BLUE	22	30	002	2	
24	GREEN/BLUE	23	31	003	3	
			32			
			33			
25	GREY/BLUE	24	34	24V	COMMON	
26	BLUE/PINK	25	35	004	4	
27	WHITE/GREEN	26	36	005	5	
28	GREEN/BLACK	27	37	006	6	
			38			WORD 1
29	ORANGE/GREEN	28	39	007	7	
30	GREY/GREEN	29	40	008	8	
31	YELLOW/BROWN	30	41	009	9	
32	WHITE/BROWN	31	42	010	10	
			43			
33	BROWN/BLACK	32	44	011	11	
34	GREY/BROWN	33	45	0V	COMMON	
35	YELLOW/VIOLET	34	46	012	12	
36	VIOLET/BLACK	35	47	013	13	
37	WHITE/VIOLET	36	48	014	14	

Figure 29b - Wire Colour for 'D' Type Connector on 8164 Module

The 8891-4395 and 8891-4399 wiring harnesses have a blanking pin provided which must be inserted in the 'D' Type connector to provide mechanical coding. When connecting an 8891-4395 to an Input Module, the blanking pin must be inserted in pin 20 of the 'D' Type connector on the harness. When connecting an 8891-4935 to an Output Module, the blanking pin must be inserted in pin 19 of the 'D' Type connector on the harness.

7. TYPICAL CIRCUITS

7.1 DC and AC Input Modules 8110, 8111, 8112, 8118, 8123, 8125, 8138, 8152, 8163, 8177 and 8197.

These typical examples show, for simplicity, connections to channel 0 and/or 1. Any of the other channels could have been used. 8-, 16- and 32-channel modules are referred to.

Note: Some 16- and 32-channel modules may have more than one 'HIGH' and 'LOW' terminal.

7.1.1 Connecting Single or Series Chains of Contacts

Figure 30 shows a typical example of these connections. AC input modules accept a.c. powered circuits, DC input modules accept d.c. powered circuits.

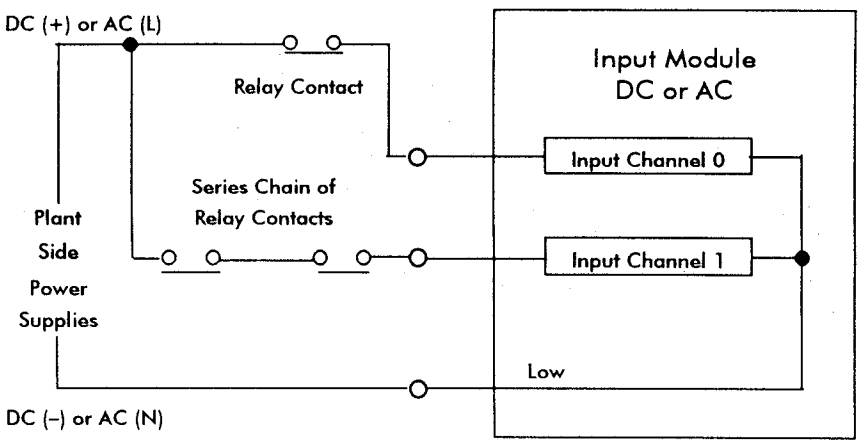


Figure 30 - Typical Example of Connecting a Single or Series Chain of Contacts to an Input Module

7.1.2 Connecting a Solid State Switch

Figure 31 shows connection of an a.c. input module, fed by a.c. plant-side power. Figure 32 shows connection of a d.c. input module fed by d.c. plant-side power.

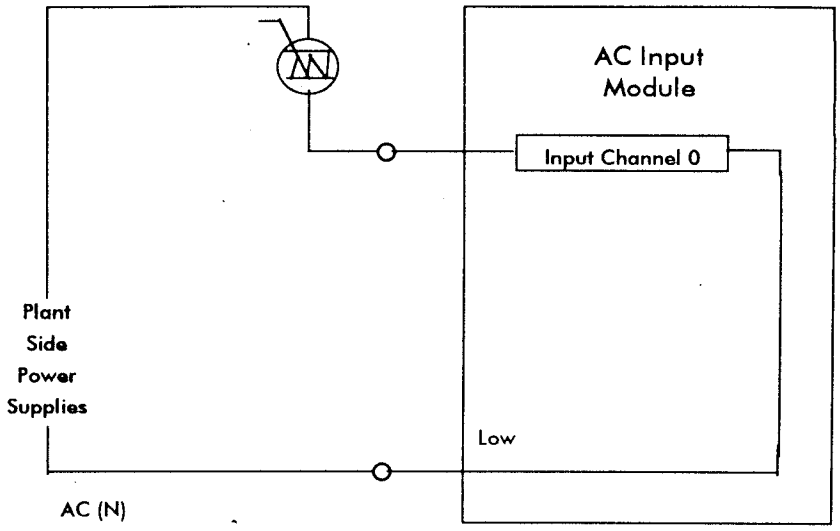


Figure 31 - Typical Example of Connecting a Solid State Switch (a.c. mode)

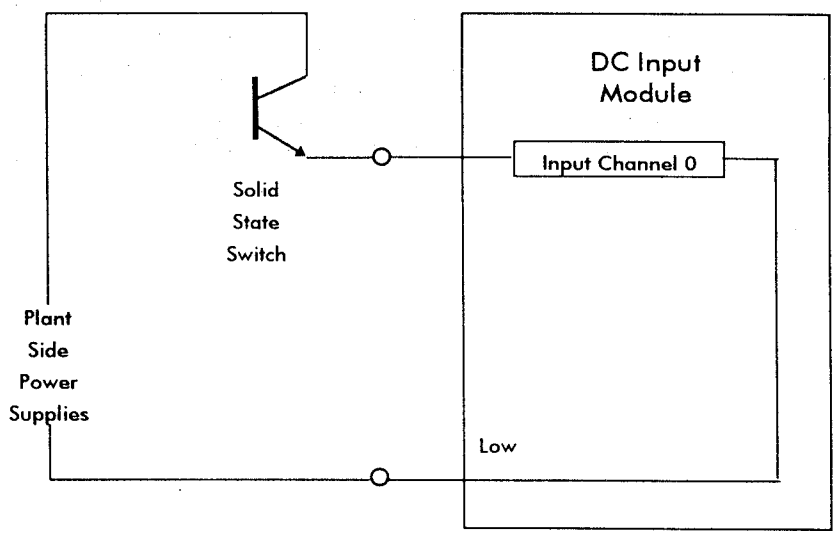


Figure 32 - Typical Example of Connecting a Solid State Switch (d.c. mode)

7.1.3 Power Supply Sensing

Figure 33 shows connections for a power supply. AC input modules accept a.c. supplies, DC input modules accept d.c. supplies.

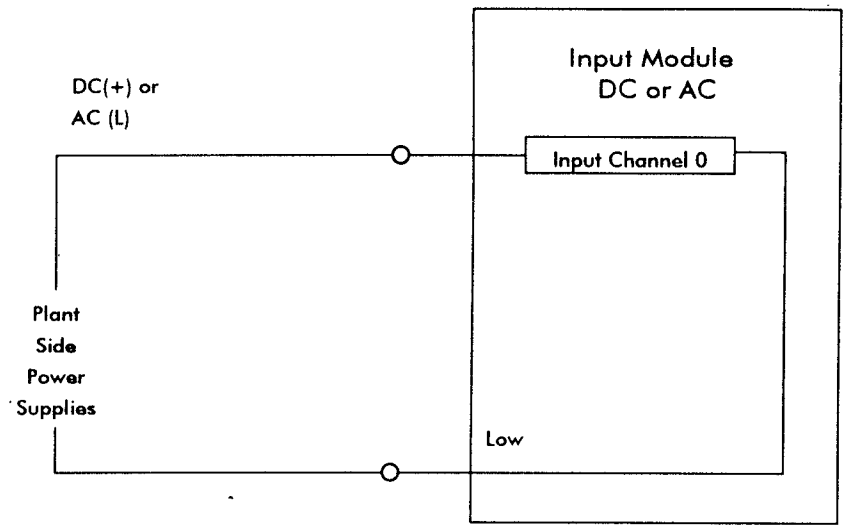


Figure 33 - Typical Example of Power Supply Sensing

7.1.4 Connecting an 8138 Input Module to TTL or CMOS

Figure 34 shows the connection of an 8138 Input Module to TTL or CMOS circuitry. Figure 35 shows the connection of an 8138 input module to open collector TTL or CMOS circuitry.

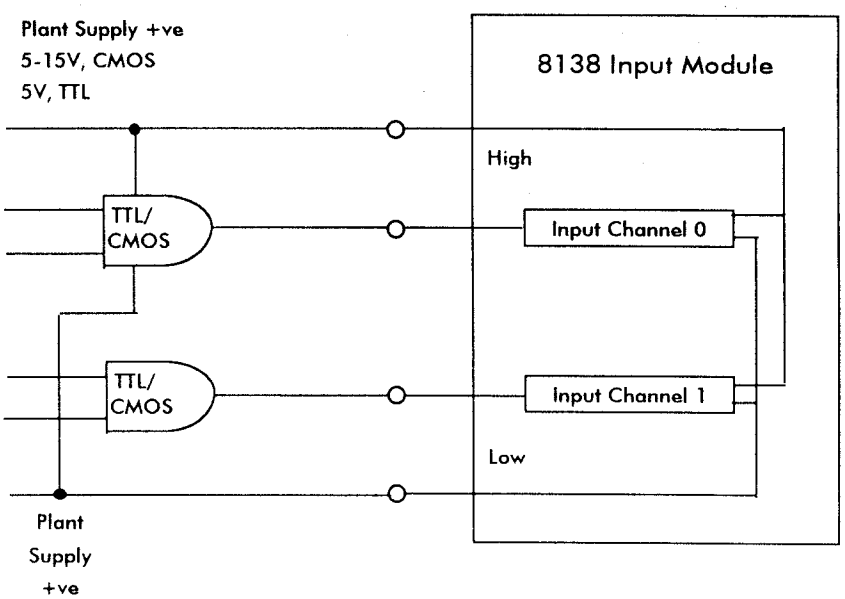


Figure 34 - Typical Example of Connection of TTL or CMOS Gate Outputs to an 8138 Input Module

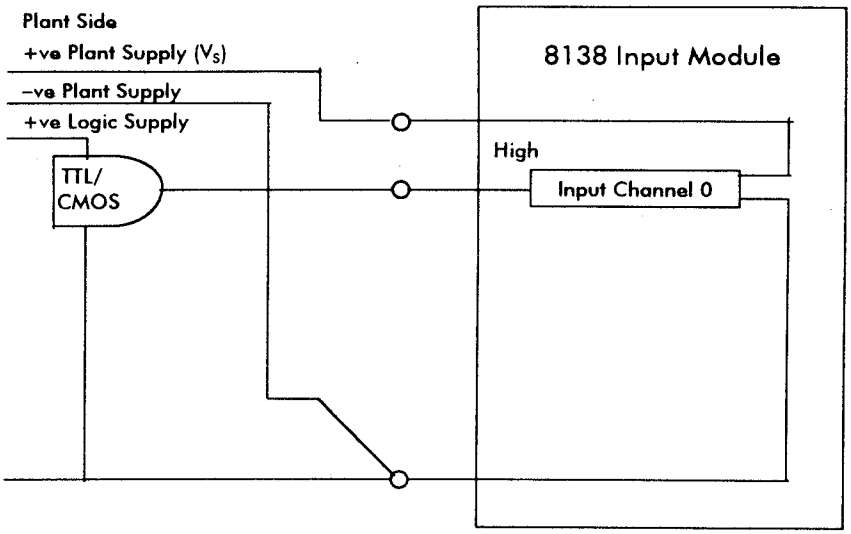


Figure 35 - Typical Example of Connecting Open Collector Gate Output to an 8138 Input Module

7.2 8 Channel Inverted Input modules 8120 and 8148

These typical circuits show, for simplicity, connections to channels 0 and/or 1. Any of the other channels could have been used.

7.2.1 Connecting Single or Series Chains of Contacts

Figure 36 shows a typical example of these connections.

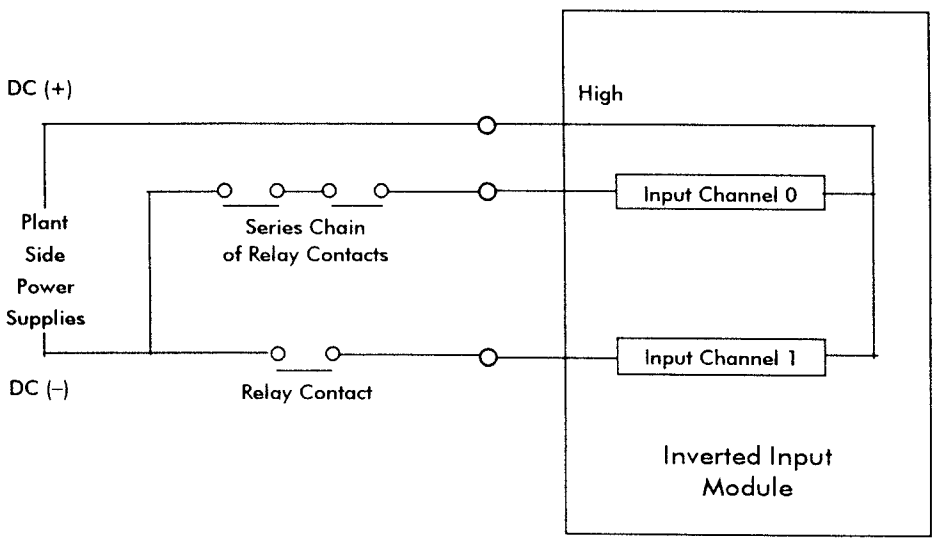


Figure 36 - Typical Example of Connecting a Single or Series Chain of Contacts to Inverted Input Modules 8120 and 8148

7.2.2 Connecting a Solid State Switch

Figure 37 shows a typical example of these connections.

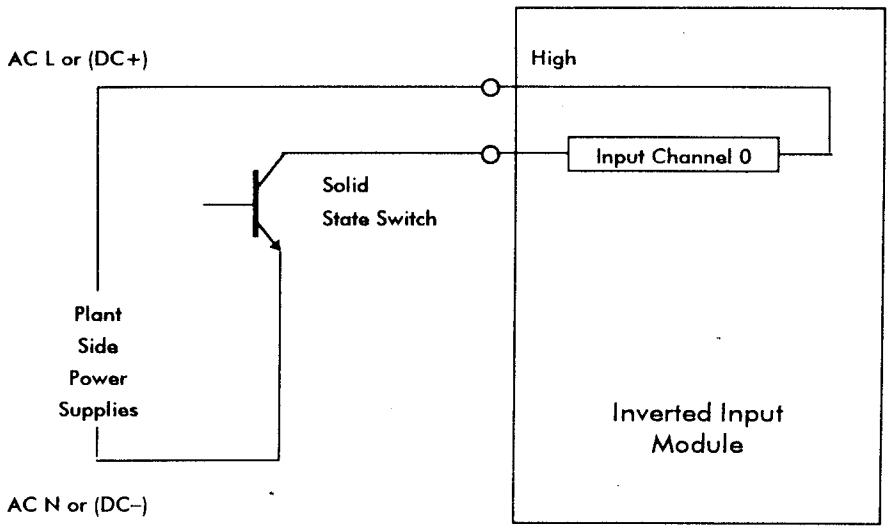


Figure 37 - Connecting a Solid State Switch to Inverted Input Modules 8120 and 8148

7.2.3 DC Power Supply Sensing

Figure 38 shows a typical example of this connection.

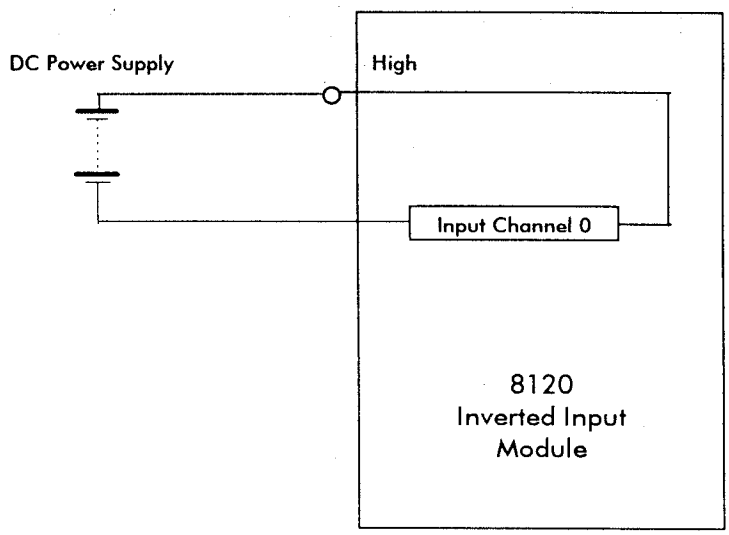


Figure 38 - Typical Example of Connecting DC Power Supply Sensing to 8120 Inverted Input Module

7.3 8-Channel Isolated Input Modules 8147, 8168 and 8188

These typical circuits show, for simplicity, connection of Channel 0 and/or 1. Any of the other channels could have been used.

7.3.1 Connecting Single or Series Chains of Contacts

Figure 39 shows a typical example of these connections.

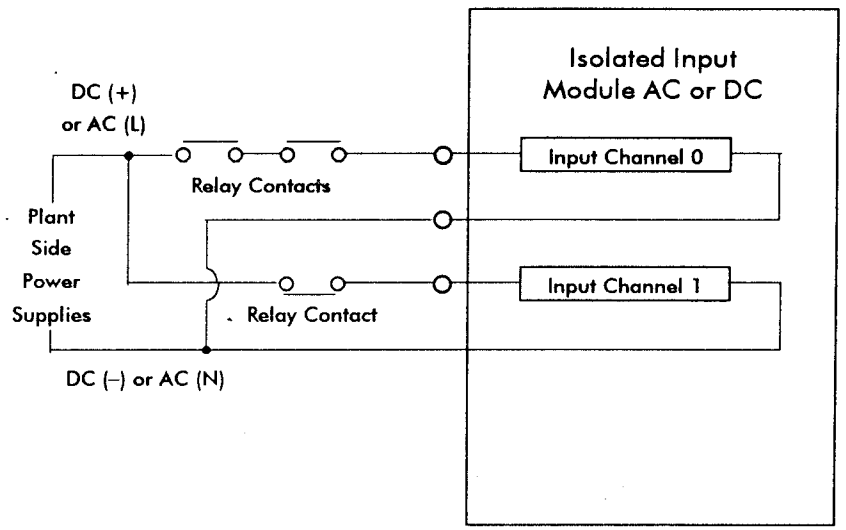


Figure 39 - Connecting Single or Series Chain of Relay Contacts to an Isolated Input Module

7.3.2 Connecting a Solid State Switch

Figure 40 shows a typical example of these connections.

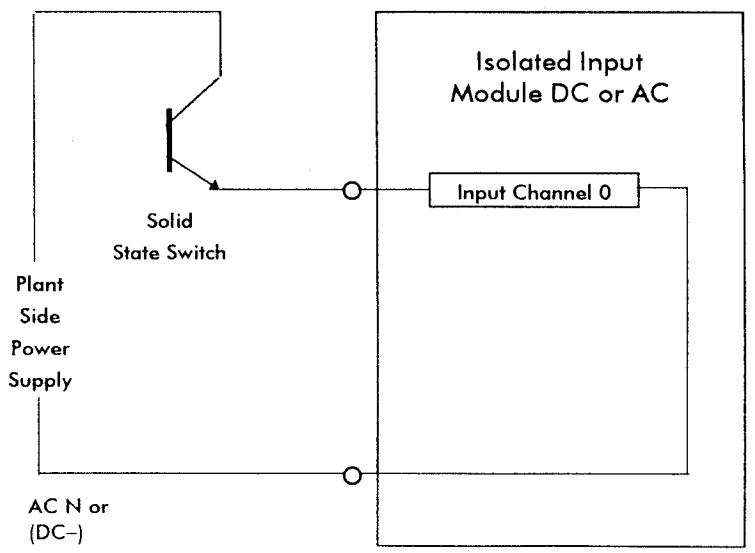


Figure 40 - Connecting a Solid State Switch to an Isolated Input Module

7.3.3 Connections for Sensing an Input Signal with an Offset Voltage

Figure 41 shows a typical example of these connections.

Note... V1 and V2 must not exceed 66V dc
(V3 + V1) must not exceed 2kV (peak), (V3 + V2) must not exceed 2kV (peak).

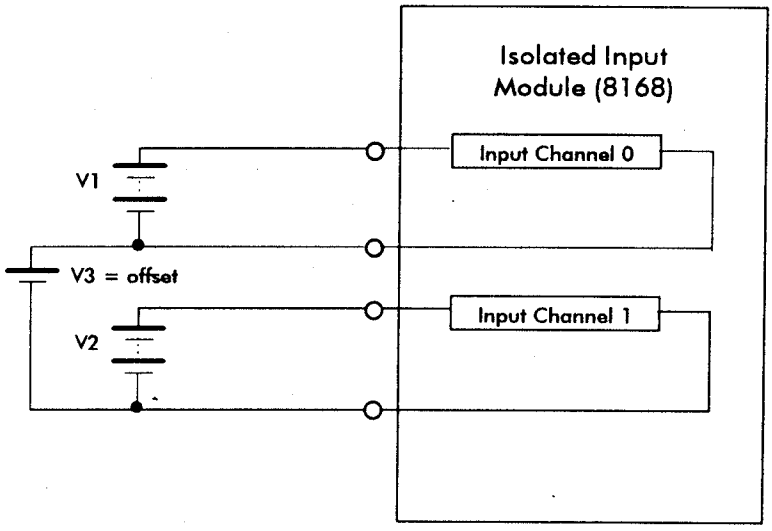


Figure 41 - Connections for Sensing an Input Signal with an Offset Voltage

7.4 DC and AC Output Modules 8113, 8114, 8115, 8119, 8124, 8126, 8139, 8140, 8153, 8162, 8164, 8171, 8178, 8179, 8181, 8182, 8183, 8184, 8185 and 8198

Typical circuits below show, for simplicity, connection of Channels 0 and 1. Any of the other Channels could be substituted. 4-, 8-, and 32-channel modules are referred to.

Note... Some 16- and 32-channel modules may have more than one "HIGH" and "LOW" terminal.

7.4.1 Load and Load Circuit Requirements

(i) Minimum Load (AC Modules Only)

Note... In the specifications for the modules there is a minimum load current quoted as well as a maximum. If a load is connected which takes less than 50mA, then the following could occur:

-Misfiring of the output Triac and distorted output waveforms, due to inadequate holding current through the Triac.

-High residual voltage across the load, due to the current through the snubber circuit in the OFF condition.

To avoid these conditions when the current application is below 50mA, use modules whose minimum current is 25mA. For even lower current applications, Relay Output Modules should be used.

(ii) Inductive Loads (AC Modules Only)

When driving loads consisting of coils rated at less than 10VA using the AC Output Modules, problems can sometimes occur due to the snubber circuits. Snubber circuits are protection circuits built into the modules to protect the switching devices from damage due to voltage spikes. Coupled with the load inductance, the snubber capacitance can sometimes produce a resonant circuit whose resonant frequency is close to the plant-side power supply frequency. When this happens the load may not de-energise when the switching device turns off.

If this does not occur, the resonance can be damped out by connecting a resistor in parallel with the load. The values generally recommended are:

Up to 110V 10K Ohms 2W
Up to 220V 20K Ohms 5W

As different loads will have different inductance characteristics, these values may need to be reduced for some types of load.

When adding damping resistors, consideration must be given to the extra heat dissipation. Fitting the resistors within the output module itself could raise the internal ambient temperature unacceptably.

(iii) Design of Load Circuit

Care should be taken in arranging load circuits to avoid "sneak" circuits. For example, the circuit of Figure 42 should not be used since, while in the manual mode, the GEM80 may be running and channels 0 and 1 may be "ON". In these circumstances, if PB1 is pressed, both RL1 and RL2 will energise.

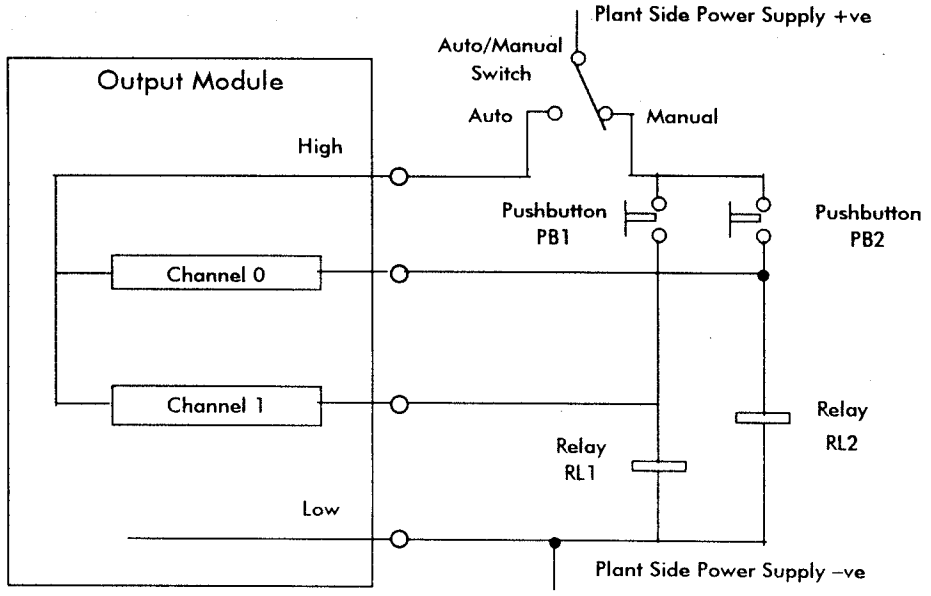


Figure 42 - THIS CIRCUIT WILL NOT WORK and is an example of a "sneak" circuit

(iv) Watchdog Circuit

For safety, plant-side power supplies should be interlocked with the watchdog contacts in such a way that when the controller is halted, plant-side power is prevented from powering the output circuits such as shown in Figure 43.

(v) Internal Suppression Connection

The return side of loads and plant-side power –ve must be connected to the "Low" terminal of the output module. This is because the suppression circuits inside the output module will not be connected unless the "Low" terminal is connected. The example in figure 43 shows the connection correctly made to the low terminal.

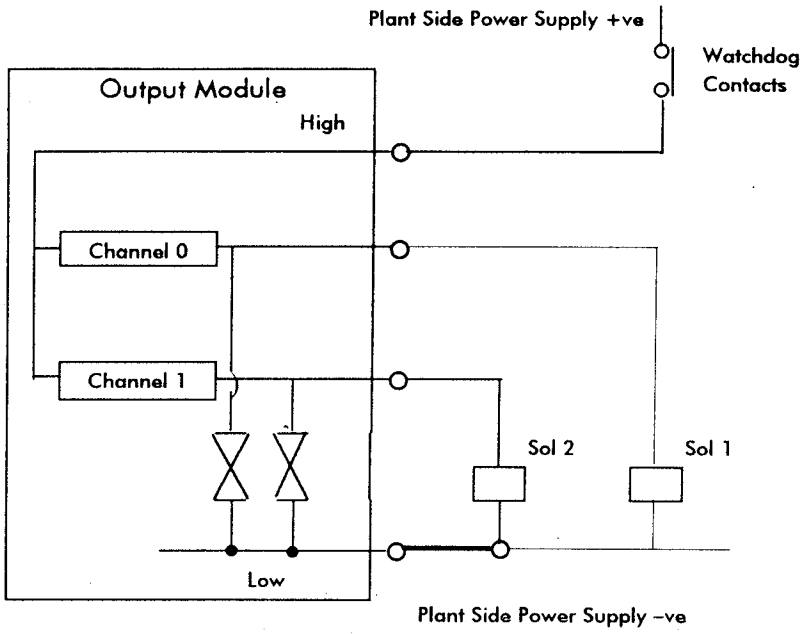


Figure 43 - Internal Suppression Circuit

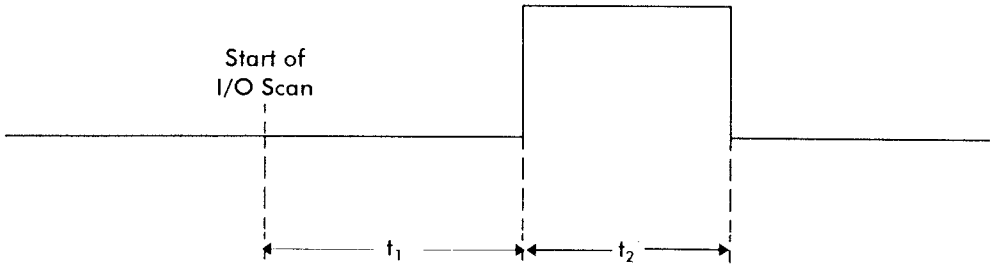
(vi) 8140 Strobe Output Modules

The 8140 has a strobed output facility on each channel. Once an output channel has been set "ON", GEM80 I/O scans will produce a delayed strobed output.

Strobed outputs only occur as a result of GEM80 I/O scans. If these scans cease, no strobed outputs will be produced. A memory within the module records which channel has been set "ON" or "OFF", and when I/O scans resume, the correct strobed outputs will be produced.

If the GEM80 controller is powered down, all the outputs on the 8140 will be switched "OFF". On power up, the output states are indeterminate, so one set of strobed outputs could be produced before I/O scanning begins.

The strobed output for each I/O scan when a channel is set "ON" is shown below:



Where: t_1 = Delay from setting bit "ON" to output changing
t_2 = Period for which output pulse is present
t_1 = 11.7 to 18.4ms
t_2 = 10.0 to 15.8ms

7.4.2 Connecting Contactors or Solenoids

Figure 44 shows a typical example of these connections. AC Output Modules accept a.c. power circuits. DC Output Modules accept d.c. power circuits.

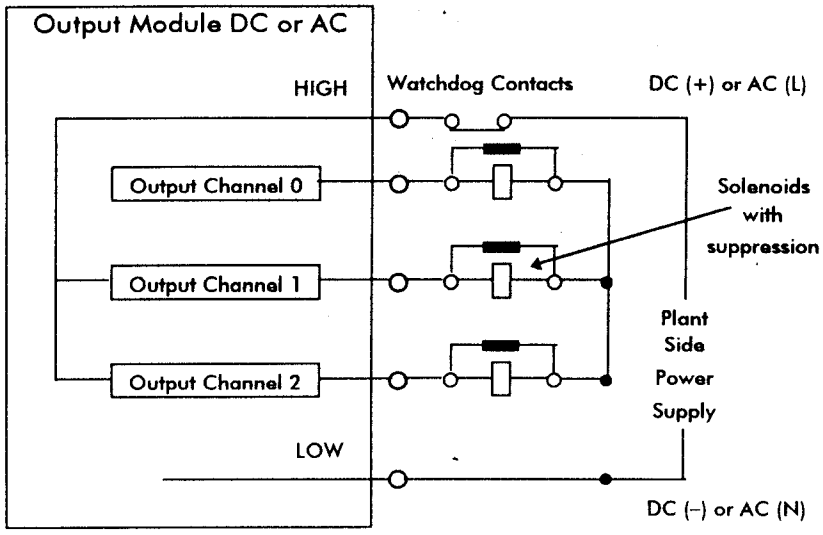


Figure 44 - Typical Example of Connecting Solenoids or Contactors to an Output Module

Where local pushbuttons or contacts are required, these can be fitted as shown in Figure 45. This circuit is very similar to that shown in Figure 42. However, in this circuit, the power supply is taken to the pushbuttons and the module after the watchdog contacts.

If the supply for the pushbuttons and the module had been taken before the watchdog contacts, and if channel 0 and 1 were both on and PB1 was pushed, both RL1 and RL2 would energise. Therefore, the supply must always be taken after the watchdog contacts.

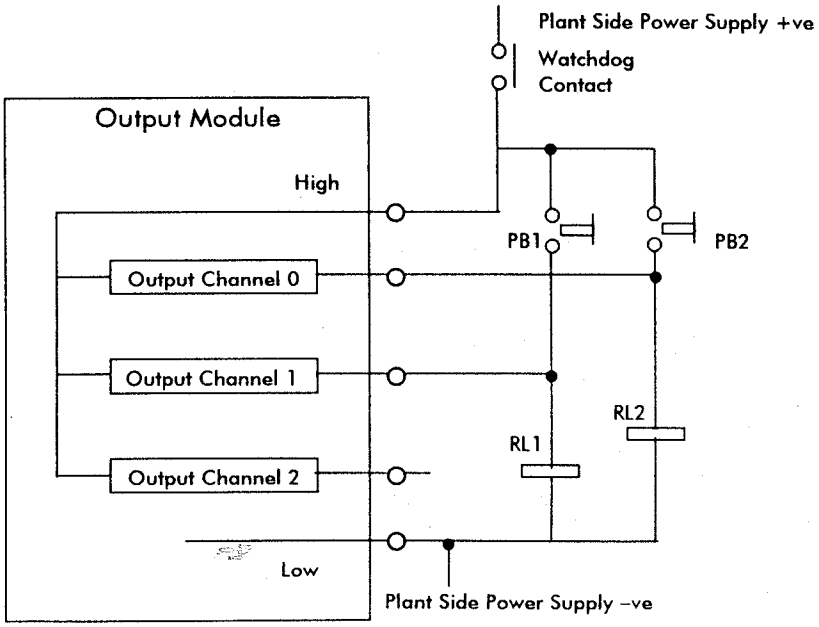


Figure 45 - Typical Example of Connecting Solenoids or Contactors with Local Pushbuttons to an Output Module

7.4.3 Connecting TTL or CMOS to an 8139 Output Module

Connection of TTL or CMOS gates to an 8139 Output Module is shown in Figure 46.

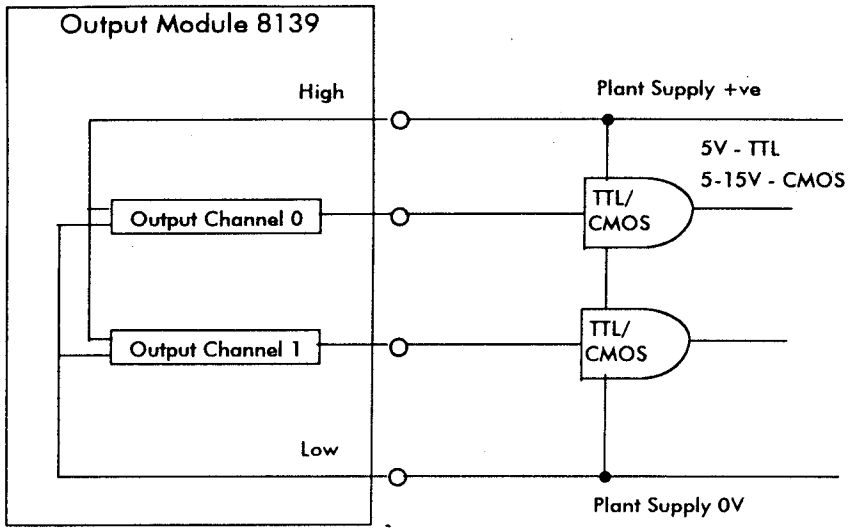


Figure 46 - Connecting TTL or CMOS Gates to an 8139 Output Module

7.5 8-Channel Inverted Output module 8121, 8149 and 8180

7.5.1 Load and Load Circuit Requirements

See section 7.4.1 Load and Load Circuit Requirements.

7.5.2 Connection of Solenoids or Contactors

Figure 47 shows a typical example of these circuits.

Where local pushbutton or contacts are required, these can be fitted as shown in Figure 48.

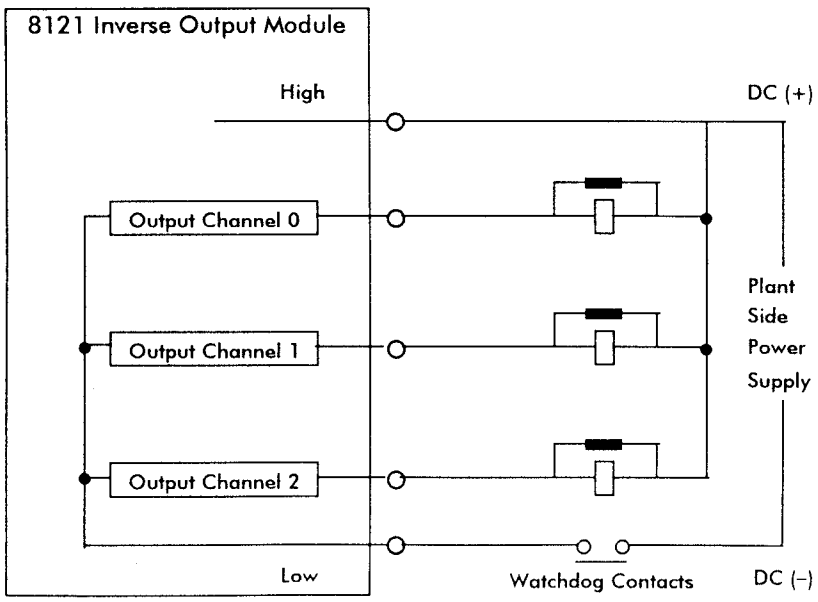


Figure 47 - Typical Example of Connecting Solenoids or Contactors to an 8121 Inverse Output Module

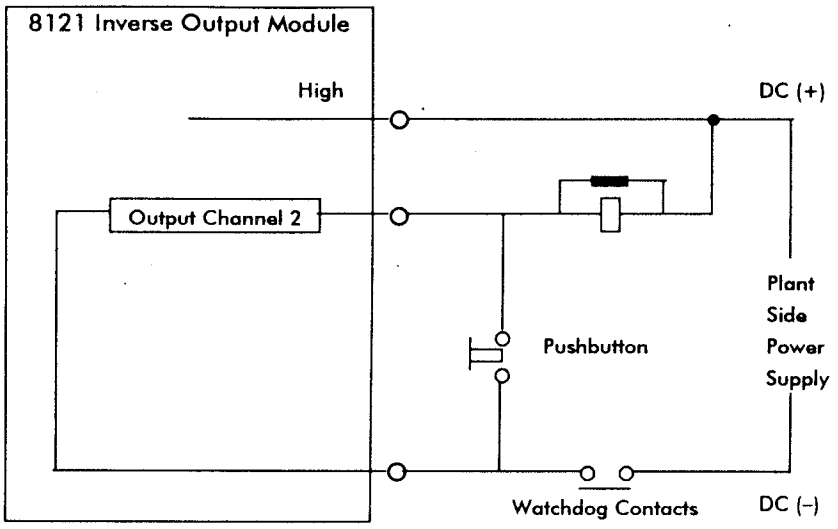


Figure 48 - Typical Example of Connecting Solenoid or Contactors with Local Pushbutton to an 8121 Inverse Output Module

7.6 4-Channel Isolated Output Modules 8117 and 8167

7.6.1 Load and Load Circuit Requirements

See Section 7.4.1 Load and Load Circuit Requirements.

(i) Load Noise Suppression

Transient voltages developed across inductive loads such as solenoids and relays can cause electrical interference, especially when operated with series contacts.

The effects of this interference can be minimised by the addition of an RC suppression network between the output of the module and the plant supply neutral, as shown in Figure 49.

A suitable RC network is the "Rifa" PMR 2026.0-1+22 or equivalent.

If discrete components are used, the resistor must be of the solid carbon type to withstand current surges and must be rated at 0.5W minimum, e.g. Allen Bradley EB2205 or equivalent.

The capacitor must be a Class Y type suitable for operation at the maximum rated supply voltage, e.g. Mullard type 330-00104 or equivalent.

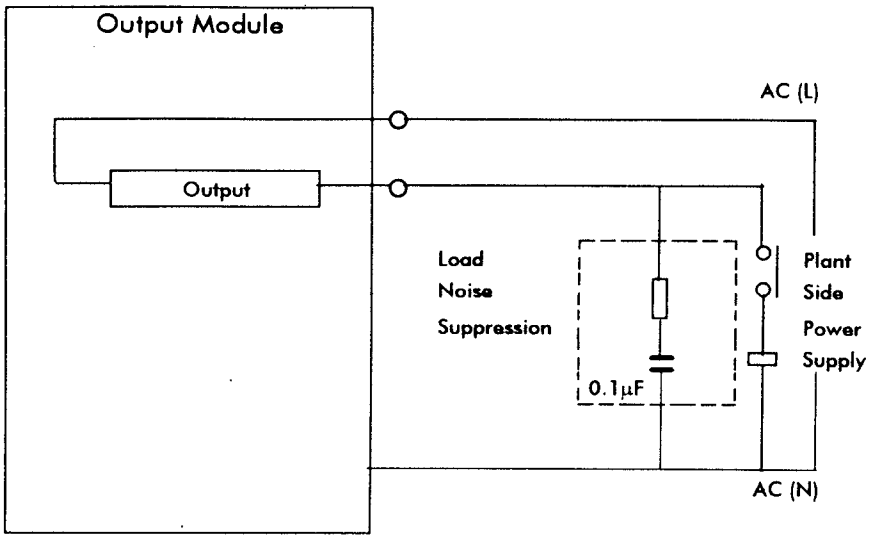


Figure 49 - Load Noise Suppression

7.6.2 Connection of Solenoids or Contactors

Figure 50 shows a typical example of connection of a solenoid or contactor with individual isolation.

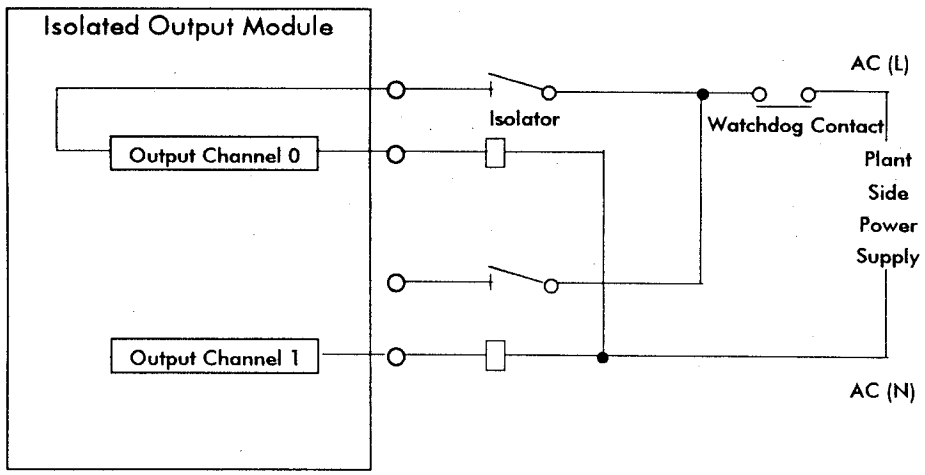


Figure 50 - Connection of Individually Isolated Solenoids or Contactors to an Isolated Output Module

Figure 51 shows a typical example of connection of solenoids or contactors with separate power supplies.

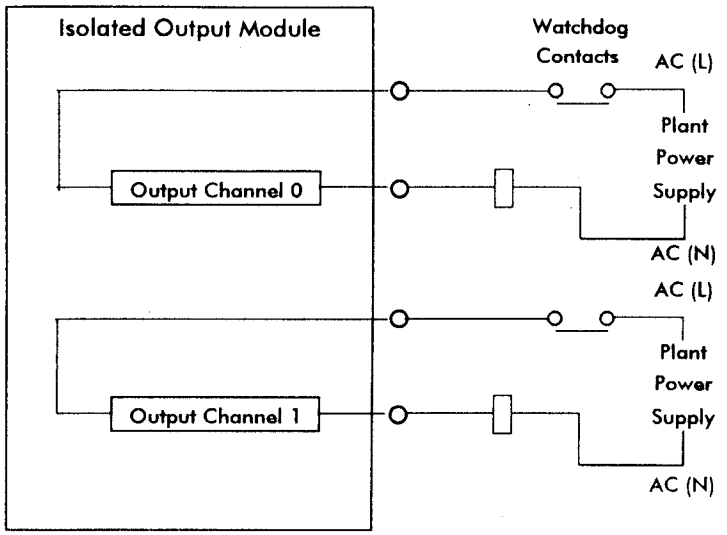


Figure 51 - Connection of Solenoids or Contactors to Isolated Output modules from Separate Plant Side Power Supplies

7.6.3 Connecting a Series "AND" Circuit

Figure 52 shows a typical example of series "AND" operation of outputs.

In this circuit, in the event of failure of either output fuse, the fuse blown lamp will light, however, because of the voltage sharing nature of the circuit, fuse blown indication is not possible if both fuses blow.

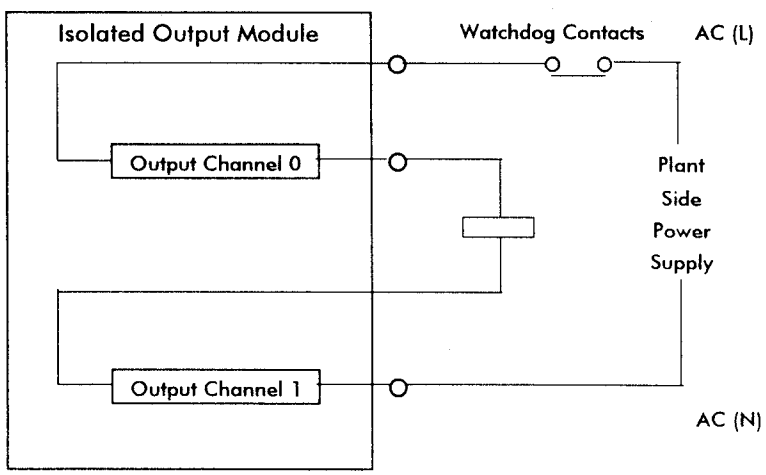


Figure 52 - Typical Example of Series "AND" Operation of Output Modules

7.6.4 Connecting an Output Enable to an 8167

The enable signal would normally be provided from the watchdog relay so that the outputs are inhibited on initial power switch-on and when the watchdog circuit opens. See Figure 53.

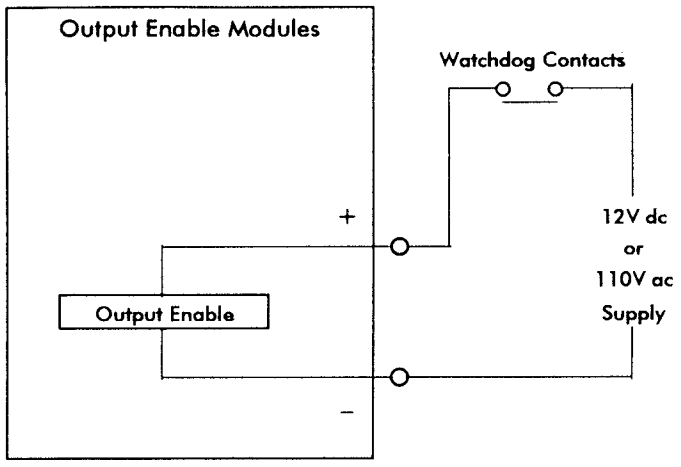


Figure 53 - Connection of output Enable to an 8167

7.7 Output enable Modules (other than 8167)

This feature ensures that all contacts are held in the "OFF" state until:

a) An enable signal at +15V dc ±10% is present;

and

b) The GEM80 controller initiates the output "ON".

The enable signal is applied at the I/O subrack and will enable all modules which possess the Output Enable feature contained in the subrack.

The enable signal of +15V dc is provided by the user supplied equipment. Figures 54a, 54b and 54c show the position of this enable signal in relation to the watchdog contacts and the subrack backplane. Output would be inhibited on initial power switch-on and at other times when the watchdog contacts open.

Subracks which have facilities to accept the enable signal are:

8866-4002	4-slot I/O subrack
8869-4002	12-slot I/O subrack
8869-4003	12-slot I/O subrack
8859-4003	12-slot I/O subrack
8884-4008	8-slot I/O in GEM80/100 controller subrack
8884-4009	8-slot I/O in GEM80/100 controller subrack
8884-4010	8-slot I/O in GEM80/100 controller subrack
8884-4017	8-slot I/O in GEM80/100 controller subrack
8884-4018	8-slot I/O in GEM80/100 controller subrack
8884-4019	8-slot I/O in GEM80/100 controller subrack
8885-4009	8-slot I/O in GEM80/130 controller subrack
8884-4010	8-slot I/O in GEM80/130 controller subrack
8884-4018	8-slot I/O in GEM80/130 controller subrack
8884-4019	8-slot I/O in GEM80/130 controller subrack

8870-416x	6-slot I/O in GEM80/141 and 142 controller subracks
8870-426x	6-slot I/O in GEM80/141 and 142 controller subracks
8870-418x	6-slot I/O in GEM80/163 controller subrack
8867-4004	8-slot I/O in a power supply subrack
8867-4006	8-slot I/O in a power supply subrack
8857-4004	8-slot I/O in a power supply subrack
8863-4003	Remote I/O Interface subrack
8853-4003	Remote I/O Interface subrack

On the above range of subracks, the modules must be enabled from a +15V supply external to the I/O subracks themselves. Push-on terminals are provided on the backplanes of these subracks for connection of the +15V enable signal (see Section 7.7.1).

On later subracks the modules are permanently enabled from the GEM80 +15V supply rails via links on the subrack backplane. This presents an additional load on the GEM80 +15V supply of approximately 10mA per module. However, it is still possible to enable the modules from a remote +15V supply by removing the links, and connecting the remote +15V signal via terminal blocks on the backplane.

Subracks having this feature include:

8859-4003	12 Slot I/O subrack
8857-4021	GEM80/131 controller subrack
8857-4020	GEM80/400 controller subrack
8855-4007	GEM80/400 Enhanced AC controller subrack
8855-4008	GEM80/400 Enhanced DC controller subrack
8857-4005	Remote I/O Outstation subrack

It is not possible to use modules with the Output Enable feature in subracks which do not have the facilities to accept the enable signal (apart from the 8167, which differs from all other Output Enable Modules in that the enable signal is input via the front connector of the module itself).

Subracks which will not accept the enable signal are:

8874-4001	8-slot I/O in Basic I/O Changeover subrack
8866-4001	4-slot I/O subrack*
8869-4001	12-slot I/O subrack*
8884-4001	8-slot I/O in GEM80/100 controller subrack*
8884-4003	8-slot I/O in GEM80/100 controller subrack*
8884-4005	8-slot I/O in GEM80/100 controller subrack*
8885-4001	8-slot I/O in GEM80/130 controller subrack
8885-4003	8-slot I/O in GEM80/130 controller subrack

*These items are no longer supplied with new equipment ordered

7.7.1 Output Enable

Figures 54a to 54d show the connection of an enable signal to various controller subracks. Both remote +15V power supplies and GEM80 +15V power supplies are dealt with as the source of the enable signal.

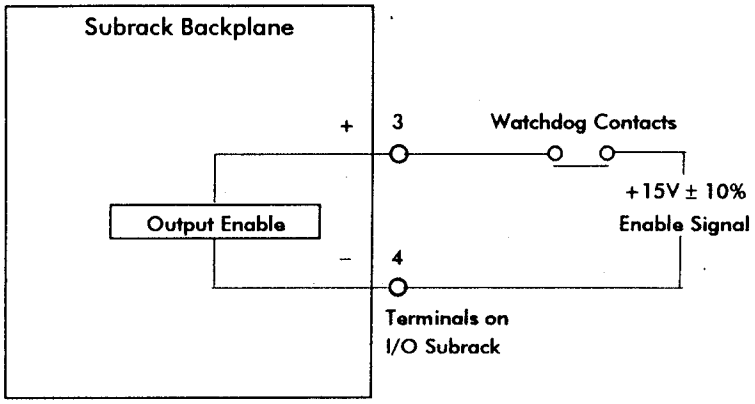


Figure 54a - Connection of Output Enable Signal to 4- and 12-slot I/O Subracks

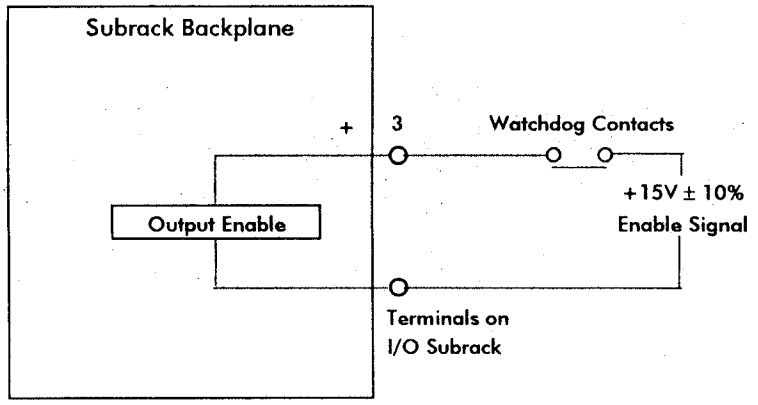


Figure 54b - Connection of Output Enable Signal to GEM80/100, /130, /141 and /142 Controller Subracks, 8-slot subracks and PSU

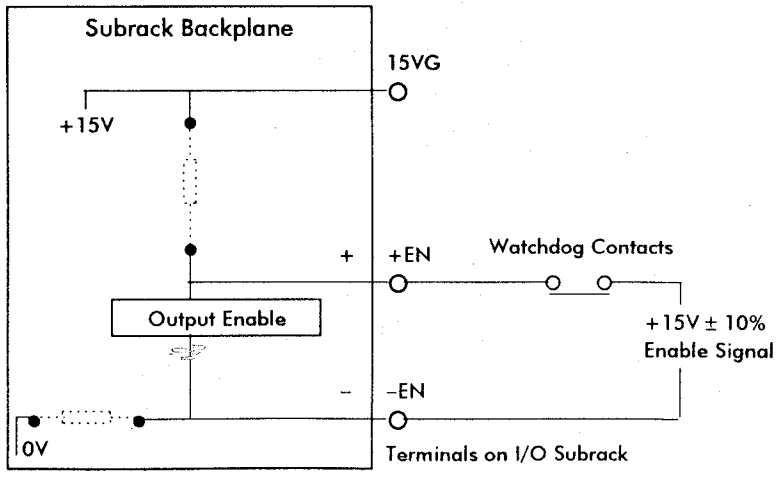


Figure 54c - Connection of Output Enable Signal Using an External Power Supply (Later Subracks Only)

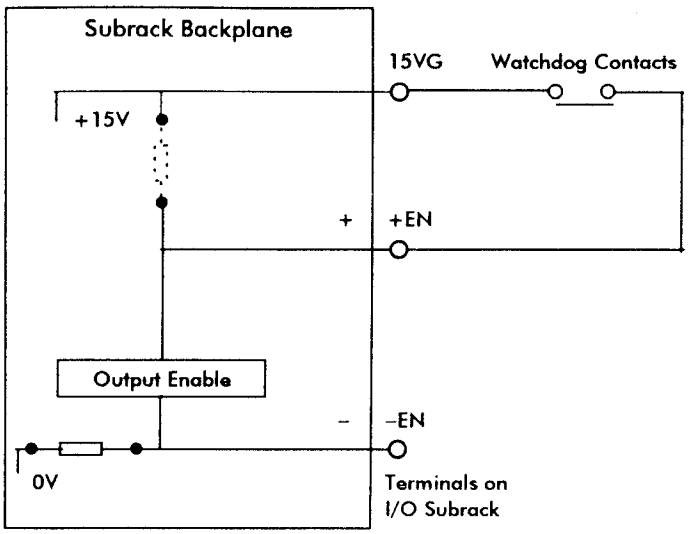


Figure 54d - Connection of Output Enable Signal Using the GEM80 Power Supply (Later Subracks Only)

7.2.2 Wiring Segregation

Wiring is said to be either "Clean" or "Dirty" depending on how much interference or noise is present. Interference can be caused by switching circuits, such as contactors or relays, and also by motors. Wiring for these types of plant connections are said to be "Dirty" and are opto-isolated from the GEM80.

"Clean" wiring, such as analog wiring, can tolerate some interference because of the way the signal is decoded. "Very Clean" wiring such as Basic I/O ribbon cables must be free of all noise or interference. Both the "Clean" and "Very Clean" wiring are opto isolated from the plant-side connections which are considered to be "Dirty".

It is essential that these different types of wiring are not run alongside one another, but are kept separate.

If an output enable signal is derived from a remote power supply, it is considered to be "Dirty" and so should be run alongside other plant-side connections. It must not be run alongside "Clean" or "Very Clean" wiring.

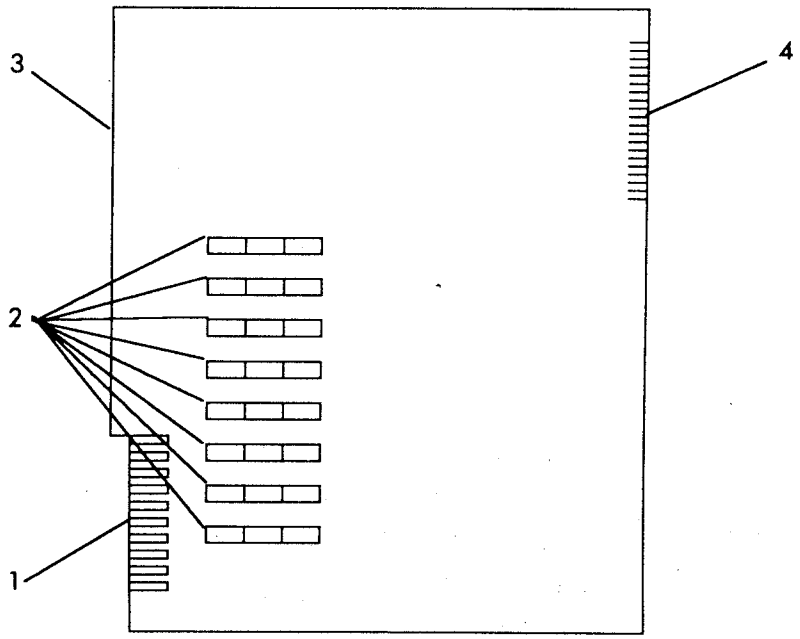
If, however, an output enable signal is derived from the internal GEM80 +15V supply, then it is considered to be "Very Clean", and must be run separated from any "Dirty" plant-side wiring.

Refer to Technical Manuals for further information on wiring segregation.

8. SHORT CIRCUIT PROTECTION ON AC AND DC OUTPUT MODULES AND 8138

A fuse is fitted for short circuit protection on AC and DC Output Modules and also the 8138. An indicator lamp on the fuse panel indicates if a fuse has blown. To replace the fuse, the moulded side covers must first be removed by removing the four screws and then the pcb mounted clip-in fuses will be revealed. See Figure 55 for a typical example.

The type of fuse which should be used for replacement is detailed in GEM80 Fuses User Information.



1. Plant Connector
2. Clip in Fuses
3. Front Panel
4. Subrack Connector

Figure 55 - 8113 Compact Module with Side Covers removed to show fuses

Note... The 8178 16 way 110V AC Output Module may have soldered in fuses. Modules should be returned for repair. On later versions, fuses are socket mounted.

9. ORDERING CODES

9.1 Digital Compact I/O Modules — XXXX-4001

Where XXXX is the module number. Each of the 8-channel and 16-channel modules is supplied with a plant-side connector having screw terminals. The 32-channel modules are supplied with a 32-way 'D' type connector and cable.

9.2 Spares

9.2.1 Module Without Connector — XXXX-4002

9.2.2 Plant Connector Kits

Consisting of one plant connector, one connector shroud, and two coding keys.

Input Modules	8110, 8111, 8112, 8118, 8120, 8123, 8125, 8138, 8148, 8152	8890-4147
Output Modules	8113, 8114, 8115, 8119, 8121, 8124, 8126, 8139, 8140, 8149, 8153, 8162, 8171, 8179, 8180, 8181, 8182, 8183, 8184,8185	8890-4147
Isolated Input Modules	8147, 8168,8188	8890-4600
Isolated Output Module	8117	8890-4155
Isolated Output Module	8167	8890-4141
Relay Output Modules	8116, 8143, 9543	8890-4600
16-Channel Modules	8177, 8178, 9513,9514	8890-4144

9.2.3 Wiring Harness Kits

Consisting of a wiring harness terminated in a connector appropriate to the module for which it has been ordered.

Relay Output Module 8130	8891-4082
32-Channel Input Module 8163 and 8197	8891-4395
32-Channel Output Module 8164 and 8198	8891-4399

9.2.4 Fuses

See GEM80 Fuses User Information, Publication No. T437

9.2.5 Terminal Rails

8163 and 8197 Input Modules	8891-4030
8164 and 8198 Output Modules	8891-4031

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