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Digital Input/Output Module (DIO) 13

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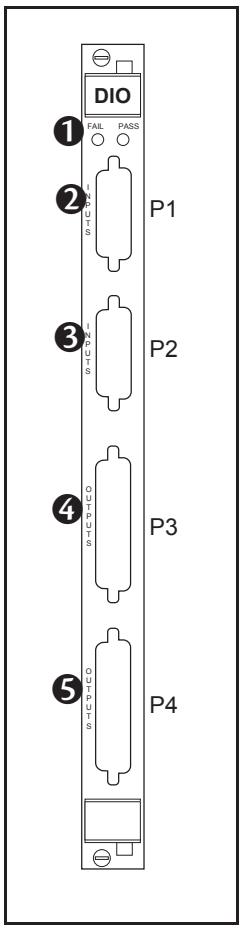
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13.1 Introduction

The Adept Digital I/O module is an opto-isolated 64-channel digital I/O module with 32 input channels and 32 output channels. It is a 6U VME slave module designed in full conformance with the ANSI/IEEE specification. See the optional *V+ Language User's Guide* for information on digital I/O.

There is also digital I/O capability on the SIO module: 12 input and 8 output channels. See section 7.6 on page 85 for details.

13.2 Connections and Indicators



1. þPass/Fail LED's. The green Pass LED indicates the module has passed start-up checks and is ready to operate. The red Fail LED indicates a system failure has been asserted.
2. **P1 Input** connector, for 16 Group 1 and Group 2 digital input signals.
3. **P2 Input** connector, for 16 Group 3 and Group 4 digital input signals.
4. **P3 Output** connector, for 16 Group 1 and Group 2 digital output signals.
5. **P4 Output** connector, for 16 Group 3 and Group 4 digital output signals.

13.3 Inputs

The 32 input channels are arranged in four groups of eight. Each group is electrically opto-isolated from the other groups and from the VMEbus circuitry. The eight inputs within each group share a common ground.

The inputs are accessed through the two 26-pin D-sub Input connectors on the front of the module. Each connector provides access to two input groups. Each group requires 10 pins: 8 Input signals and 2 Ground references. An input is turned on by providing a positive potential on its input pin relative to the ground pin of its group. This type of input is considered "sinking", that is, to turn it on, current must flow into the input pin.

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Table 13-1. DIO Input Circuit Specifications

Operational voltage range	–35 VDC≤ V_{in} ≤ +35 VDC
"Off" state voltage range	–35 VDC ≤ V_{in} ≤ +3 VDC
"On" state voltage range	+10 VDC ≤ V_{in} ≤ +35 VDC
Typical threshold voltage	V_{in} = +6 VDC
Operational current range	0 ≤ I_{in} ≤ 14 mA
"Off" state current range	0 ≤ I_{in} ≤ 400 µA
"On" state current range	2.3 mA ≤ I_{in} ≤ 14 mA
Typical threshold current	I_{in} = 1.1 mA
Impedance (V_{in}/I_{in})	2.5 K Ω minimum
Current at V_{in} = +35 VDC	I_{in} ≤ 14 mA
Current at –35 VDC ≤ V_{in} ≤ 0	I_{in} ≤–50 µA
Turn on response time (hardware) Software scan rate/response time	30 µsec maximum 16 ms scan cycle/ 32 ms max response time
Turn off response time (hardware) Software scan rate/response time	175 µsec maximum 16 ms scan cycle/ 32 ms max response time

The input current specifications are provided for reference, voltage sources are typically used to drive the inputs.

Note that the "off" state current range encompasses the leakage current of the outputs. This guarantees that the inputs will not be turned on by the leakage current from the outputs. This is useful in situations where the inputs are connected to the outputs to monitor the state of the outputs.

13.4 Outputs

The 32 output channels are arranged in four groups of eight. Each group is electrically opto-isolated from the other groups and from the VMEbus circuitry. The eight outputs within each group share a common power supply and a common ground.

The outputs are accessed through the two 44-pin D-sub Output connectors on the front of the module. Each connector provides access to two output groups. Each group requires 19 pins: 8 output signals, 1 test signal, 9 power supply (all tied together), and 1 power supply ground reference. When an output is on, current will flow in through the power supply pins and out of the output pins. This type of output is considered "sourcing," that is, in the on condition, current flows out of the output pin.

Each output channel (circuit) should be connected to only one output device.

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Testing Outputs and Fuses

Like many solid-state I/O systems, when an output is off, a small leakage current will try to flow out of the output. This will raise the potential of the output to the power supply voltage level if there is no load. With a load connected, the output will function normally. However, if you need to test the output with a voltmeter with a load disconnected, you will get a false reading. The test signal provides a bias which can be used as a pulldown resistor for system-level debugging. When this is connected to an output, the output will assume the ground potential when it is off.

The test signal can also be used to test the state of the power fuse for that particular group. If the resistance between the test and ground pins is less than 10 K ¾, then the fuse is OK. If the reading is greater than 10K ¾ then the fuse is blown and needs to be replaced. Call Adept Customer Service for information on replacement.

Output Power Supply Voltage Jumpers

Each group of signals (1 through 4) has a jumper associated with it to select the power supply voltage range. The two ranges are 15 to 30 VDC and 10 to 15 VDC. The jumpers are located on the DIO PC board. Each jumper has a clip that can be placed in either position A or position B. See the table below for the jumper numbers for each group.

The DIO modules are normally shipped with the ranges set to 15 to 30 VDC. You should verify this before connecting I/O lines and equipment for the first time.

Table 13-2. DIO Output Voltage Range Settings

Signal Group Number	Jumper Number	Voltage output in Position A	Voltage output in Position B
1	J4	15 to 30 V	10 to 15 V
2	J3	15 to 30 V	10 to 15 V
3	J5	15 to 30 V	10 to 15 V
4	J6	15 to 30 V	10 to 15 V



CAUTION: The power supply voltage should not go below the selected range because this could cause the output transistors to operate in the linear state and dissipate excessive power. Likewise, the power supply voltage should not exceed the selected range because this could blow the fuse for that group.

There is no requirement to provide specific power sequencing between the output power supplies and the VME power supply. The design of the output section is such that the outputs will not turn on during module power up.

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Output Power Supply Current Selection

The 9 power pins for each group are connected together on the board, and the current supplied from the output pins is drawn from these power pins. The number of power pins used in a particular application depends on the total current supplied through that group's outputs.

The supply current should be limited to a maximum of one amp per power pin. Use this limitation to select the number of power pins you need. For example, each output can source up to 400 mA, giving a maximum total current (for a group of 8 outputs) of 3.2 A that will be required from the power supply. In this case, a minimum of 4 power pins should be used. A total of 9 power pins are provided to allow for more wire connections to decrease the voltage drop across the power supply wires. If you experience an excessive voltage drop, make connections to additional power pins (to a maximum of 9).

The ground connection should connect to the power supply directly, not the ground connection of the load. This will isolate the module from any voltage drop across the load ground wires.

Table 13-3. Digital Output Circuit Specifications

Parameter	Value
Low power supply range	$10\ VDC \le V_{sup} \le 15\ VDC$
High power supply range	$15\ VDC \le V_{sup} \le 30\ VDC$
Power supply ground current	$I_g \le 35\ mA$
Operational current range, per channel	$I_{out} \le 400\ mA$
V_{out}, output on, $I_{out} = 400\ mA$	$V_{sup} - 0.8 \le V_{out} \le V_{sup}$
Output off leakage current	$I_{out} \le 400\ \mu A$
Turn on response time	10 µsec maximum
Turn off response time	120 µsec maximum



CAUTION: The above specs apply only to the output channels on the DIO module. See Chapter 7 on the SIO Module for specs on the digital output channels on that module.

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13.5 Typical DIO Wiring

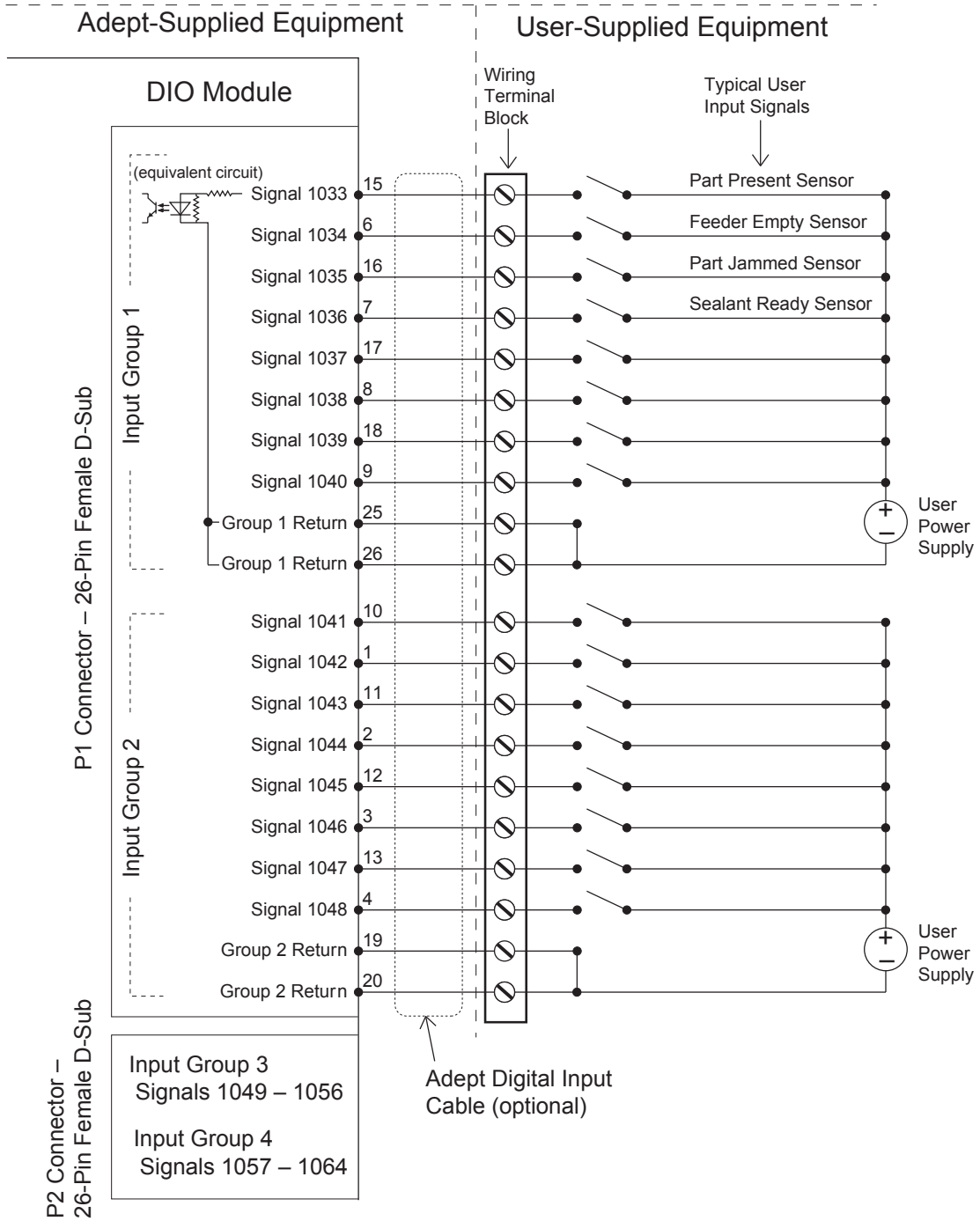


Figure 13-1. Typical Digital Input Setup

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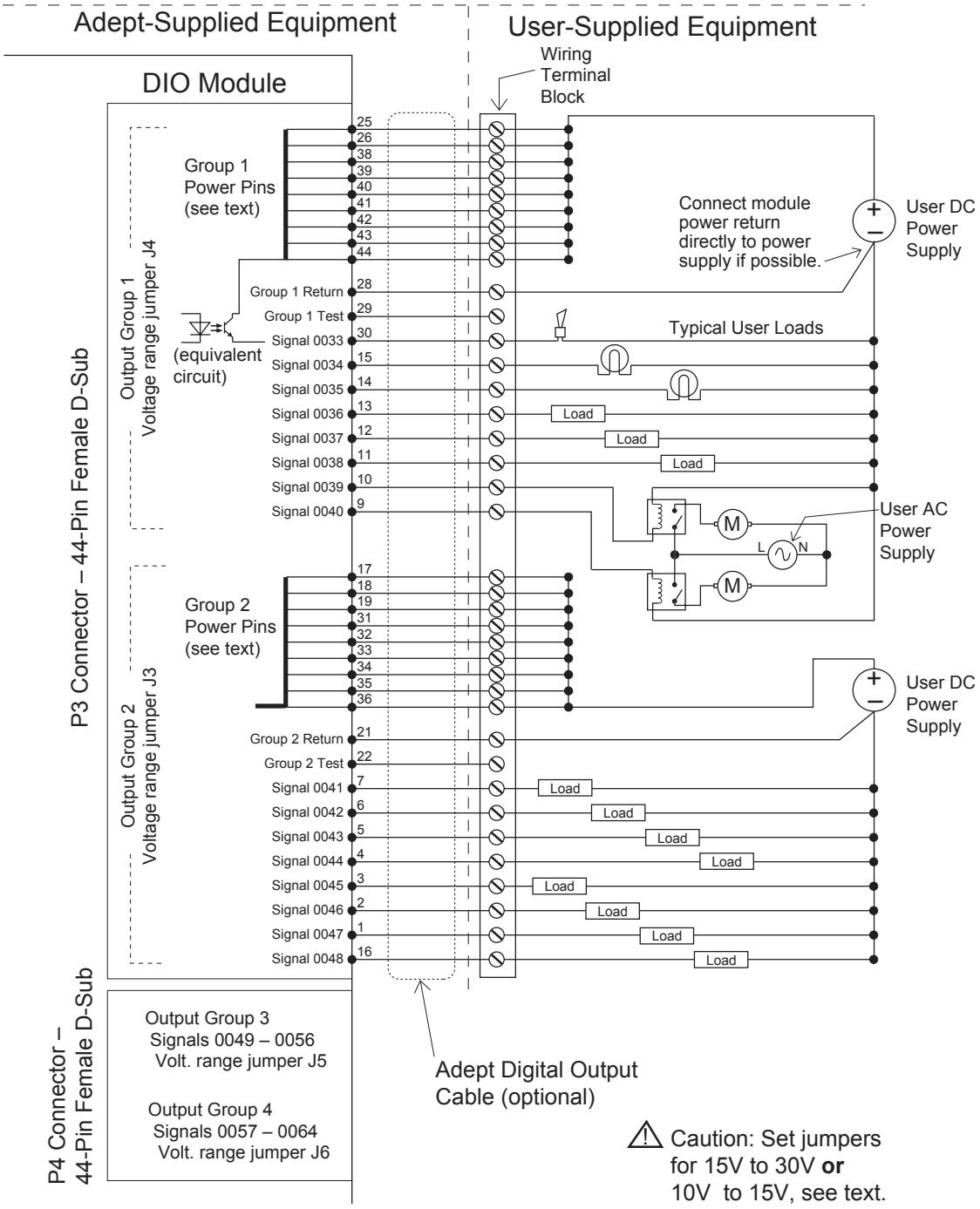


Figure 13-2. Typical Digital Output Setup

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13.6 Optional DIO Cables

The cables to connect to the Input and Output connectors on the DIO module can be ordered as a set of four cables: two input cables and two output cables. These cables have a mating plug on one end and unterminated flying leads on the other end. The wire size of the Adept cables is 0.18 mm^2 (24AWG). You can use these cables to connect to the digital inputs/outputs in your system or to a wiring block.

To comply with IEC 1131, if you choose to supply a wiring block, it should be capable of accepting wire in the range of 0.18 mm^2 (24 AWG) to 2.0 mm^2 (14 AWG).

Labeling Cables

The P1 and P2 input connectors on the front of the module are similar except that P1 handles the Group 1 and 2 input signals and P2 handles the Group 3 and 4 input signals. The optional digital input cables can be connected to either P1 or P2. Make sure to clearly label the cables once you have completed your installation so that the cables do not get swapped by mistake; see the Warning below.

The P3 and P4 output connectors are also similar except that P3 handles the Group 1 and 2 output signals and P4 handles the Group 3 and 4 output signals. The optional digital output cables can be connected to either P3 or P4. Make sure to clearly label the cables once you have completed your installation so that the cables do not get swapped by mistake; see the Warning below.



WARNING: Make sure to clearly label the P1 to P4 digital I/O cables so that they are always plugged into the correct connector. Swapping the P1 and P2 or P3 and P4 cables could cause damage to your equipment. Depending on the installation, this could potentially cause injury to personnel in the area. Also, if you have more than one DIO module, make sure each set of cables is clearly labeled so they don't get plugged into the wrong module by mistake.

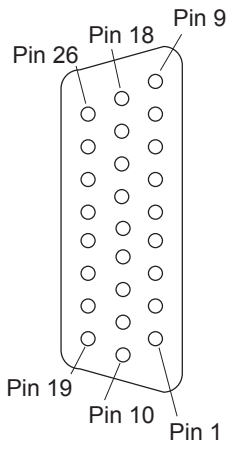
Input and Output Cable Wiring Information

The pinouts, signal names, and wire color information for the input and output cables are shown in the next four tables.

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Table 13-4. DIO P1 Input Cable Pin Assignments

Pin Number	Signal Group	Module #1 Signal[a]	Wire Color	Pin Locations
P1–15	1	1033	red/white	
P1–6	1	1034	orange	
P1–16	1	1035	green/white	
P1–7	1	1036	blue	
P1–17	1	1037	blue/white	
P1–8	1	1038	white/black	
P1–18	1	1039	black/red	
P1–9	1	1040	red/black	
P1–25	1	group 1 return	blue/red	
P1–26	1	group 1 return	red/green	
P1–10	2	1041	green/black	
P1–1	2	1042	black	
P1–11	2	1043	orange/black	
P1–2	2	1044	white	
P1–12	2	1045	blue/black	
P1–3	2	1046	red	
P1–13	2	1047	black/white	
P1–4	2	1048	green	
P1–19	2	group 2 return	white/red	
P1–20	2	group 2 return	orange/red	



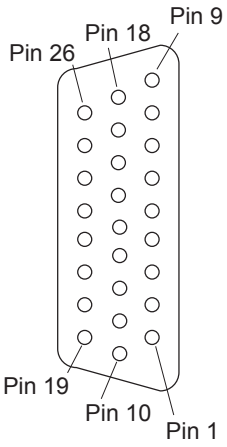
P1 26-Pin Female Input Connector on DIO Module Front Panel

[a] The signal numbers for modules 2 –7 increase by 32 for each additional module; see Table 13-8.

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Table 13-5. DIO P2 Input Cable Pin Assignments

Pin Number	Signal Group	Module #1 Signal[a]	Wire color	Pin Locations
P2–15	3	1049	red/white	
P2–6	3	1050	orange	
P2–16	3	1051	green/white	
P2–7	3	1052	blue	
P2–17	3	1053	blue/white	
P2–8	3	1054	white/black	
P2–18	3	1055	black/red	
P2–9	3	1056	red/black	
P2–25	3	group 3 return	blue/red	
P2–26	3	group 3 return	red/green	
P2–10	4	1057	green/black	
P2–1	4	1058	black	
P2–11	4	1059	orange/black	
P2–2	4	1060	white	
P2–12	4	1061	blue/black	
P2–3	4	1062	red	
P2–13	4	1063	black/white	
P2–4	4	1064	green	
P2–19	4	group 4 return	white/red	
P2–20	4	group 4 return	orange/red	



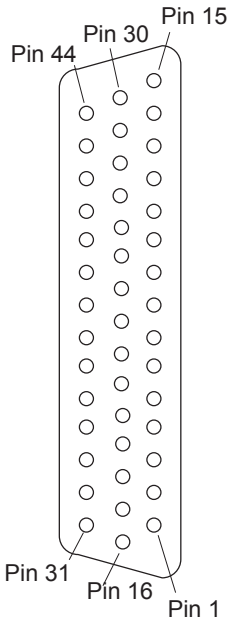
P2 26-Pin Female Input Connector on DIO Module Front Panel

[a] The signal numbers for modules 2 –7 increase by 32 for each additional module; see Table 13-8.

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Table 13-6. DIO P3 Output Cable Pin Assignments

Pin Number	Group Number	Module #1 Signal name[a]	Wire Color	Pin Locations
P3–30	1	0033	green/black/white	
P3–15	1	0034	green/white	
P3–14	1	0035	red/white	
P3–13	1	0036	black/white	
P3–12	1	0037	blue/black	
P3–11	1	0038	orange/black	
P3–10	1	0039	green/black	
P3–9	1	0040	red/black	
P3–25	1	power	orange/green	
P3–26	1	power	black/white/red	
P3–38	1	power	orange/black/green	
P3–39	1	power	blue/white/orange	
P3–40	1	power	black/white/orange	
P3–41	1	power	white/red/orange	
P3–42	1	power	orange/white/blue	
P3–43	1	power	white/red/blue	
P3–44	1	power	black/white/green	
P3–28	1	group 1 return	white/black/red	
P3–29	1	group 1 test	red/black/white	
P3–7	2	0041	white/black	
P3–6	2	0042	blue	
P3–5	2	0043	orange	
P3–4	2	0044	green	
P3–3	2	0045	red	
P3–2	2	0046	white	
P3–1	2	0047	black	
P3–16	2	0048	blue/white	
P3–17	2	power	black/red	
P3–18	2	power	white/red	
P3–19	2	power	orange/red	
P3–31	2	power	orange/black/white	
P3–32	2	power	blue/black/white	
P3–33	2	power	black/red/green	
P3–34	2	power	white/red green	
P3–35	2	power	red/black/green	
P3–36	2	power	green/black/orange	
P3–21	2	group 2 return	blue/red	
P3–22	2	group 2 test	red/green	



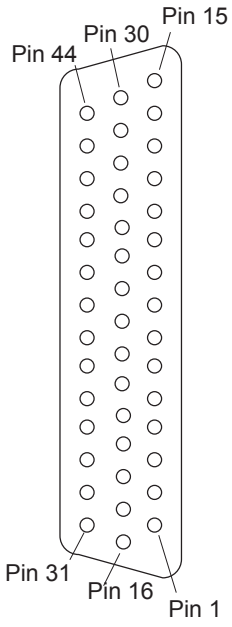
P3 44-Pin Female Output Connector on DIO Module Front Panel

[a] The signal numbers for 2 –7 increase by 32 for each additional module; see Table 13-8.

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Table 13-7. DIO P4 Output Cable Pin Assignments

Pin Number	Group Number	Module #1 Signal name[a]	Wire Color	Pin Locations
P4–30	3	0049	green/black/white	
P4–15	3	0050	green/white	
P4–14	3	0051	red/white	
P4–13	3	0052	black/white	
P4–12	3	0053	blue/black	
P4–11	3	0054	orange/black	
P4–10	3	0055	green/black	
P4–9	3	0056	red/black	
P4–25	3	power	orange/green	
P4–26	3	power	black/white/red	
P4–38	3	power	orange/black/green	
P4–39	3	power	blue/white/orange	
P4–40	3	power	black/white/orange	
P4–41	3	power	white/red/orange	
P4–42	3	power	orange/white/blue	
P4–43	3	power	white/red/blue	
P4–44	3	power	black/white/green	
P4–28	3	group 3 return	white/black/red	
P4–29	3	group 3 test	red/black/white	
P4–7	4	0057	white/black	
P4–6	4	0058	blue	
P4–5	4	0059	orange	
P4–4	4	0060	green	
P4–3	4	0061	red	
P4–2	4	0062	white	
P4–1	4	0063	black	
P4–16	4	0064	blue/white	
P4–17	4	power	black/red	
P4–18	4	power	white/red	
P4–19	4	power	orange/red	
P4–31	4	power	orange/black/white	
P4–32	4	power	blue/black/white	
P4–33	4	power	black/red/green	
P4–34	4	power	white/red green	
P4–35	4	power	red/black/green	
P4–36	4	power	green/black/orange	
P4–21	4	group 4 return	blue/red	
P4–22	4	group 4 test	red/green	



P4 44-Pin Female Output Connector on DIO Module Front Panel

[a] The signal numbers for 2 –7 increase by 32 for each additional module; see Table 13-8.

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13.7 Additional DIO Modules

Setting the Module Address

Additional DIO modules can be installed in an Adept MV controller, up to a maximum of 8 modules per controller, depending on slot availability. The total digital I/O channels available, including the channels on the SIO modules are:

- maximum digital input channels = 268
- maximum digital output channels = 264

Each module that is added must have a unique VMEbus address so the controller can recognize it properly. The address is set at DIP switch S1 on the DIO PC board. The switch settings are shown below. See Figure 13-3 for the location of S1.

Table 13-8. Switch Settings for S1 on DIO Module

8-Position DIP Switch S1 on DIO PC board								
Switch positions 1 to 6 – to select bus address for DIO modules								
DIO Module Number	**Input Signals**	**Output Signals**	**Switch position**					
			6	**5**	**4**	**3**	**2**	**1**
1	1033 – 1064	33 – 64	closed	closed	closed	closed	closed	closed
2	1065 – 1096	65 – 96	closed	closed	closed	closed	closed	**Open**
3	1097 – 1128	97 – 128	closed	closed	closed	closed	**Open**	closed
4	1129 – 1160	129 – 160	closed	closed	closed	closed	**Open**	**Open**
5	1161 – 1192	161 – 192	closed	closed	closed	**Open**	closed	closed
6	1193 – 1224	193 – 224	closed	closed	closed	**Open**	closed	**Open**
7	1225 – 1256	225 – 256	closed	closed	closed	**Open**	**Open**	closed
8	1257 – 1288	257 – 288	closed	closed	closed	**Open**	**Open**	**Open**
Switch position 7 – required setting is closed								
Switch position 8 – required setting is open								

Labeling Sets of Cables

The optional Adept input and output cables for the DIO modules are the same for each additional module you that add to a controller. Make sure to clearly label each set of four cables so that they are identified with a specific DIO module. Also see the warning on page 148 about swapping the two input cables or the two output cables with each other.

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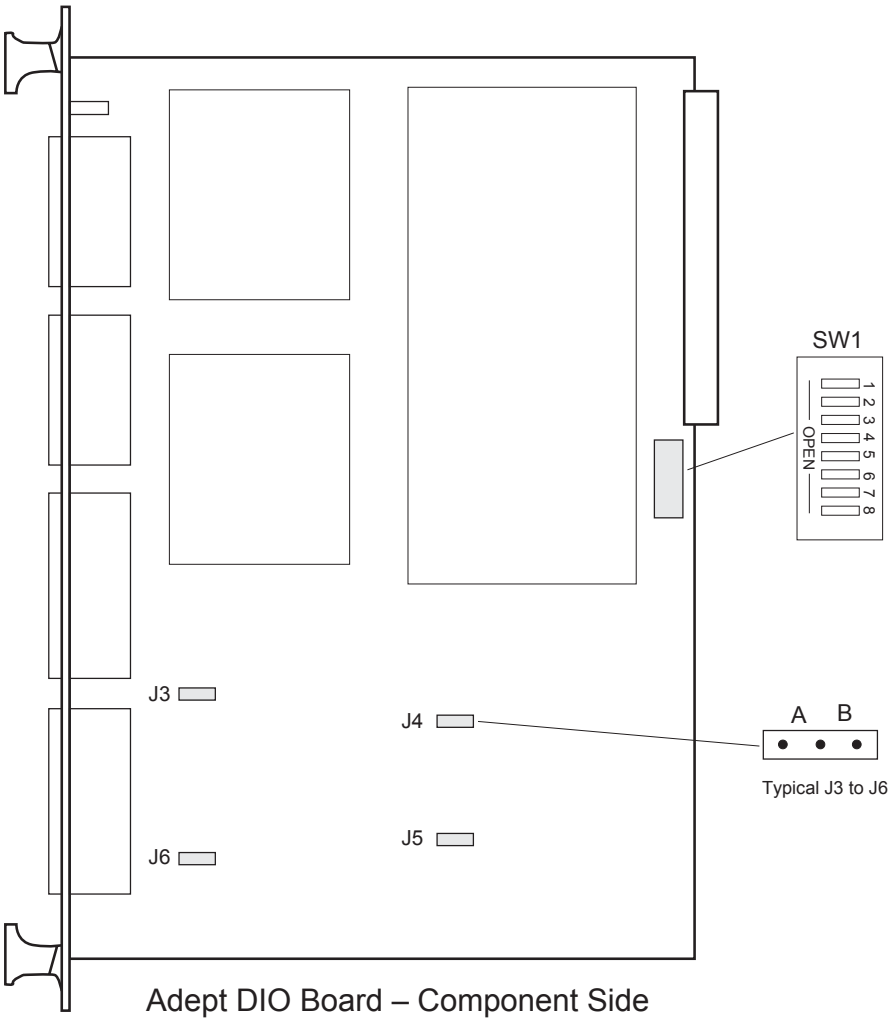


Figure 13-3. Switch and Jumper Locations on DIO PC Board

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13.8 DIO Module Specifications

Table 13-9. DIO Technical Specifications[a]

Electrical Power Consumption	5 VDC 1.0 A typical 5 VDC 1.2 A max +12 VDC none –12 VDC none
Width	Occupies one backplane slot
Inputs (see Table 13-1 for Input circuit specifications)	
Number of channels	32 (4 groups of 8)
Isolation - any I/O group to any I/O group - any I/O group to VMEbus	300 VDC 1000 VDC
Outputs (see Table 13-3 for Output circuit specifications)	
Number of channels	32 (4 groups of 8)
Output configuration	Current sourcing outputs
Power supply voltage	10 to 15 or 15 to 30 VDC, jumper selectable
Output transient protection	Reverse voltage protection and transient suppression provided.

[a] Specifications subject to change.

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