

Applying the 5B Series Backplanes and Mounting Cards

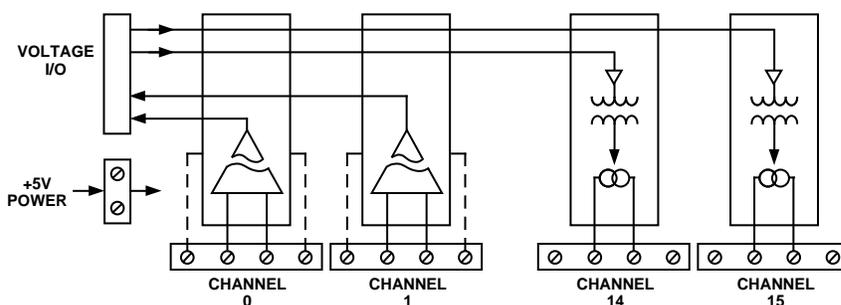


Figure 1. 5B01 Functional Block Diagram

INTRODUCTION

The 5B Series includes a number of multichannel backplanes and mounting cards that provide a complete signal conditioning solution. Four backplanes currently available, the 16-channel 5B01 and 5B02 and the 8-channel 5B08 and 5B08-MUX, provide different system configuration options for the user. Models 5B01 and 5B08 I/O signals are independently available, while model 5B02 and 5B08-MUX I/O signals are controlled via an on-board multiplexer providing a bus for input signals and a separate bus for output signals. With all backplanes, 5B Series modules can be mixed or matched and may be changed without disturbing field wiring or system power. The 5B03 and 5B04, one- and two-channel mounting cards, allow an economical means to handle a few remote signals. A single-channel mounting card, AC1360, is available for ease of complete 5B Series module evaluation.

Both 16-channel backplanes can be mounted in a 19" x 3.5" panel space, such as the rack mount kit, model AC1393. The 8-channel backplanes can also be mounted in the AC1393. The one- and two-channel mounting cards, models 5B03, 5B04 and AC1360, are DIN rail compatible using available hardware. All backplanes and mounting cards provide individual channel screw terminals for field connections. These connections satisfy all transducer inputs and process current outputs and provide sensor excitation when necessary. A cold junction temperature sensor, model AC1361, is supplied on each channel to accommodate thermocouple modules (5B37 or 5B47). All backplanes and mounting cards require an external regulated +5 V dc power supply.

MODEL 5B01 BACKPLANE

The 5B01, diagrammed in Figure 1, is a 16-channel backplane that provides single-ended, high level analog input/output pins on the system connector. It is pin compatible with Analog Devices' 3B Series applications. (Note, however, that 5B Series modules provide a ± 5 V output swing rather than the ± 10 V swing provided by 3B Series modules.)

Model 5B01 System Connectors

Signal connections between the 5B01 backplane and the associated measurement and control system are made at P1 and P2. These connectors are identical electrically. The redundant connectors may be useful if a 5B01 is used for both analog input and analog output and the data acquisition system has separate input and output connectors. Figure 2 is a diagram of the voltage I/O provided on the P1 and P2 connectors of the 5B01 backplane.

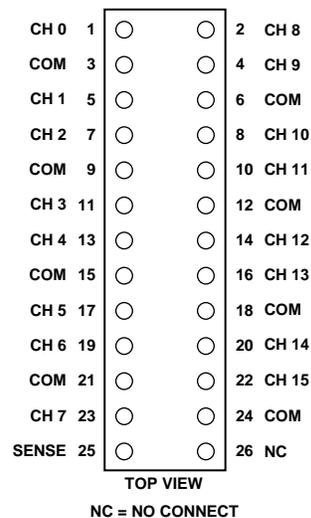


Figure 2. 5B01 and 5B08 System Connector Pinout

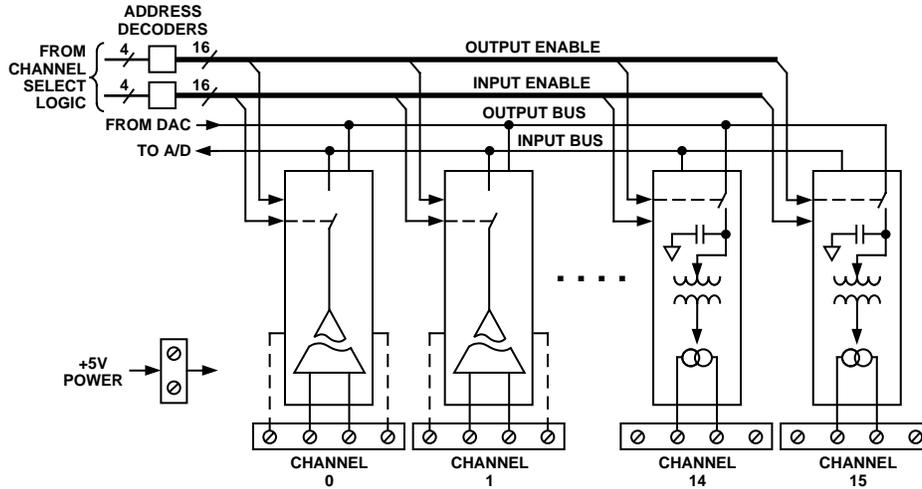


Figure 3. 5B02 Functional Block Diagram

A signal path is provided for each channel and, in addition, a number of grounding pins are present in the connector pinout to provide interchannel shield conductors in the ribbon cable. In some cases, discussed below, the ground conductors will not provide an accurate signal reference, so a SENSE pin is also provided in the pinout. Several jumper and component options on the backplane provide optimum ground connections for various circumstances.

Model 5B01 Grounding

Each 5B01 backplane is factory configured with Jumpers W1, W3 and W4 installed. Jumper W1 grounds the shield wires in the ribbon cable (Pins 3, 6, 12, 15, 18, 21 and 24) at the 5B01 backplane. This will usually be the primary ground connection between the 5B01 and the measurement system. This connection is required if output modules will be used on the backplane. It is also required if there is no high impedance sense input (input Low of a differential or pseudo-differential system) available on the measurement system. Jumper W3 connects the sense input, if available, to Pin 25 so that the 5B01's ground is read. It can be left in place at all times. Jumper W4 connects +5 V dc power common to input/output common (backplane measurement ground). A connection between power common and input/output common is important for the 5B Series modules to function properly; however, if this connection is made elsewhere in your system (the best place is usually near the A/D or D/A converters), W4 should be cut, since a ground loop could result.

Model 5B01 Interchannel Bridge Jumpers

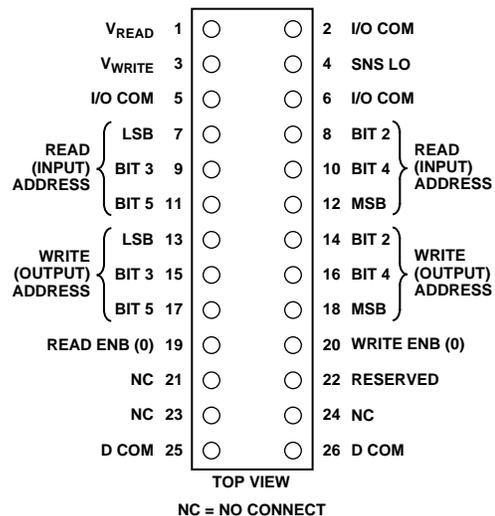
The 5B01 gives the user the capability of directing the voltage output of any input module to an adjacent output module (e.g., Model 5B39) simply by placing a jumper between the pins of the two modules (input to channel n, output from channel n + 1). This feature can be used to provide an isolated current output from an isolated input module, giving two levels of 1500 V rms isolation. Model AC1344 provides ten jumpers.

MODEL 5B02 BACKPLANE

The 5B02, diagrammed in Figure 3, is a 16-channel backplane. It incorporates input and output buses that take advantage of the internal series output switches in the input modules and the track-and-hold in the output module. Designers integrating the 5B02 into a measurement and control system do not need external multiplexers and can use a single digital-to-analog converter to serve numerous output channels. Digital outputs from the host data acquisition system are used to address the 5B Series modules and designate inputs and outputs. Only one analog input, one analog output, and a number of digital outputs are required to address up to 64 analog input/output channels.

Model 5B02 System Connectors

Signal connections between the 5B02 backplane and the associated measurement or control system are made at P1. The pinout of this connector is illustrated in Figure 4.



V_{READ} IS THE ANALOG OUTPUT OF INPUT MODULES
 V_{WRITE} IS THE ANALOG INPUT OF OUTPUT MODULES
 MATING CONNECTOR AMP PN746290-6 OR EQUIVALENT

Figure 4. 5B02 System Connector Pinout

One signal path is provided for inputs and one for outputs. Input and output modules are independently addressed by two sets of six address pins and an enable pin. In addition, a number of grounded pins are present in the connector pinout to provide shield conductors in the ribbon cable. In some cases, discussed below, the ground conductors will not provide an accurate signal reference, so a SENSE pin is also provided in the pinout. Several jumper and component options in the backplane provide optimum ground connections for various circumstances.

Model 5B02 Grounding

Each 5B02 backplane is factory configured with Jumpers W1, W2 and W4 installed. Jumper W1 grounds the shield wires in the ribbon cable (Pins 2, 5 and 6) at the 5B02 backplane. This will usually be the primary ground connection between the 5B02 and the measurement system. This connection is required if output modules will be used on the backplane. It is also required if there is no high impedance sense input (input low of a differential or pseudo-differential system) available on the measurement system. Jumper W2 connects the sense input, if available, to Pin 25 so that the 5B02's ground is read. It can be left in place at all times. Jumper W4 connects +5 V dc power common to input/output common (backplane measurement ground). A connection between power common and input/output common is important for the 5B Series modules to function properly; however, if this connection is made elsewhere in your system (the best place is usually near the A/D or D/A converters), W4 should be cut since a ground loop could result.

Model 5B02 Address Selection Jumpers

The 5B02 backplane can hold 16 modules in any combination of inputs or outputs. Address decoders on the backplane (separate decoders are provided for inputs and outputs) determine which module is read (inputs) or driven (outputs). To permit system expansion, up to four backplanes can be daisy-chained on the system I/O ribbon cable for a total of 64 channels. Jumpers on each backplane (labeled SH1-5 and SH6-10) determine the block of 16 addresses assigned to each backplane. Input (read) and output (write) addressing are completely independent; in all cases, Jumpers 1–5 control inputs and 6–10 control outputs. Independent addressing might be used, for example, to update output modules without interrupting the monitoring of input modules.

Backplanes are factory configured with jumpers at Positions 1 and 6; Figure 5 shows the address jumpers in the factory configured positions. This sets up the backplane as a stand-alone 16-channel system; the two highest-order address bits in the read and write addresses are

ignored. Moving the jumpers to any other position in the two blocks enables decoding of the full six address bits; the exact position of the jumper determines address position for the backplane as shown in Table I. To use multiple backplanes in this manner, connect the corresponding I/O connector pins of each backplane in parallel. CAB-01 is a ribbon cable with three 26-pin connectors designed for this purpose.

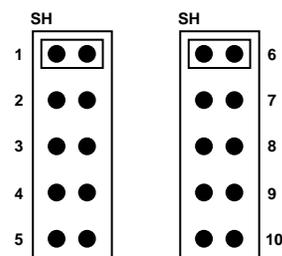


Figure 5. 5B02 Address Selection Pins Shown with Factory Default Jumpers

Table I. 5B02 Address Selection Jumpers

Input Jumper	Output Jumper	Address Range
2	7	48–63
3	8	32–47
4	9	16–31
5	10	0–15

MODEL 5B08 BACKPLANE

Model 5B08 System Connectors

Signal connections between the 5B08 and the associated measurement and control system are made with two identical 26-pin connectors (P1 and P2), similar to the 16-channel model 5B01 backplane. Reference to these connectors is electrically identical and may be useful if a 5B08 is used for both analog input and analog output and the data acquisition system has separate input or output connectors. Figure 2, shown with model 5B01, illustrates the pin assignments for P1 and P2.

The I/O connectors provide a signal path for each channel and, in addition, a number of grounding pins are available to provide interchannel shield conductors in the ribbon cable. In some cases, discussed below, the ground conductors will not provide an accurate signal reference, so a SENSE pin is also provided in the connectors. Several jumper and component options on the 5B08 provide optimum ground connections for various applications. These are discussed in the following sections.

Model 5B08 Output Channel Selection

To configure Model 5B08 I/O for different system needs, on-board jumpers are provided. A family of eight 3-pin jumpers, J8 through J15, allows the user to assign the 5B08 I/O to either the upper eight I/O pins (CH0, CH1, CH2, CH3, CH4, CH5, CH6, CH7) or to the lower eight I/O pins (CH8, CH9, CH10, CH11, CH12, CH13, CH14, CH15). This capability allows two 8-channel 5B08 backplanes to be used in a 16-channel configuration, with all I/O assigned to the 16 unique I/O pins, CH0–CH15. Table II illustrates the channel assignments for each of the eight jumpers, J8 through J15.

Table II. 5B08 Output Channel Assignments

Jumper	Jumper Position	Connects	To V/I Channel
J8	LO HI	Channel 0	0 8
J9	LO HI	Channel 1	1 9
J10	LO HI	Channel 2	2 10
J11	LO HI	Channel 3	3 11
J12	LO HI	Channel 4	4 12
J13	LO HI	Channel 5	5 13
J14	LO HI	Channel 6	6 14
J15	LO HI	Channel 7	7 15

Model 5B08 Interchannel Jumpers

The 5B08 offers the user the ability to easily connect the voltage output of any 5B Series input module directly to the voltage input of an adjacent output module (e.g., Model 5B39) by placing a jumper over two pins J1, J2, J3, J4, J5, J6 or J7. This feature can be used to provide an isolated current output from an isolated input module. This results in both isolated voltage and isolated current outputs from a single sensor input signal. A kit of ten jumpers is available as Model AC1344. Table III shows the channel assignments when Jumpers J1–J7 are used. Additional configuration flexibility is provided when the output jumper selections (J8–J15) are combined with the interchannel jumper selections (J1–J7). Table III provides the resulting signal assignments for each of the various jumper selections.

Table III. 5B08 Interchannel Jumpers

Jumper	Connects
J1	Channel 0 to V_{OUT} to Channel 1 V_{IN}
J2	Channel 1 to V_{OUT} to Channel 2 V_{IN}
J3	Channel 2 to V_{OUT} to Channel 3 V_{IN}
J4	Channel 3 to V_{OUT} to Channel 4 V_{IN}
J5	Channel 4 to V_{OUT} to Channel 5 V_{IN}
J6	Channel 5 to V_{OUT} to Channel 6 V_{IN}
J7	Channel 6 to V_{OUT} to Channel 7 V_{IN}

Table IV. 5B08 Channel Assignments Using Output and Interchannel Jumpers

Jumper Closed	Output Jumper	Channel Setting	Connects	Connects V/I Channels
J1	J8 LO J8 HI J8 LO J8 HI	J9 LO J9 LO J9 HI J9 HI	Channel 0 to Channel 1	0 to 1 8 to 1 0 to 9 8 to 9
J2	J9 LO J9 HI J9 LO J9 HI	J10 LO J10 LO J10 HI J10 HI	Channel 1 to Channel 2	1 to 2 9 to 2 1 to 10 9 to 10
J3	J10 LO J10 HI J10 LO J10 HI	J11 LO J11 LO J11 HI J11 HI	Channel 2 to Channel 3	2 to 3 10 to 3 2 to 11 10 to 11
J4	J11 LO J11 HI J11 LO J11 HI	J12 LO J12 LO J12 HI J12 HI	Channel 3 to Channel 4	3 to 4 11 to 4 3 to 12 11 to 12
J5	J12 LO J12 HI J12 LO J12 HI	J13 LO J13 LO J13 HI J13 HI	Channel 4 to Channel 5	4 to 5 12 to 5 4 to 13 12 to 13
J6	J13 LO J13 HI J13 LO J13 HI	J14 LO J14 LO J14 HI J14 HI	Channel 5 to Channel 6	5 to 6 13 to 6 5 to 14 13 to 14
J7	J14 LO J14 HI J14 LO J14 HI	J15 LO J15 LO J15 HI J15 HI	Channel 6 to Channel 7	6 to 7 14 to 7 6 to 15 14 to 15

Model 5B08 Grounding

Model 5B08 is supplied with three grounding jumpers: W1, W3 and W4. These three jumpers are installed at the factory, but can be changed to accommodate user system configuration needs. Jumper W1 connects the P1 and P2 shield pins 3, 6, 9, 12, 15, 18, 21 and 24) to the 5B08 I/O common (backplane measurement ground). This will usually be the primary ground connection between the 5B08 backplane and the measurement system. This connection is required if output modules are used on the 5B08. It is also required if there is no high impedance sense input (input LOW of a differential (or pseudo-differential system) available on the measurement system. Jumper W3 connects the sense input, if available on Pin 25, to the 5B08 I/O common, so it can be read directly. W3 can be left in place at all times. Jumper W4 connects the 5B08 I/O common to the +5 V dc power common. A connection between power common and I/O common is important for the 5B Series modules to function properly; however, if this connection is made elsewhere in your system (the best place is usually near the A/D or D/A converters), W4 should be cut since a ground loop could result.

MODEL 5B08-MUX BACKPLANE

The 5B08-MUX incorporates input and output buses that take advantage of the internal series output switches in the 5B Series input modules as well as the track-and-hold circuit in the output modules. Designers integrating the 5B08-MUX into a measurement and control system do not need external multiplexers and can use a single digital-to-analog converter to serve numerous output channels. Refer to Figure 6 for a functional block diagram of model 5B08-MUX. Digital outputs from the host data acquisition system are used to address the 5B Series modules and designate inputs and outputs. Only one analog input, one analog output and a number of digital outputs are required to address up to 64 analog input/output channels using eight 5B08-MUX backplanes.

Model 5B08-MUX System Connectors

Signal connections between the 5B08-MUX and the associated measurement or control system are made at P1, a 26-pin connector, similar to the 5B02 backplane. The pinout of P1 is shown in Figure 4.

One signal path is provided for inputs and one for outputs. Input and output modules are independently addressed by two sets of six address pins and an enable pin. In addition, a number of grounded pins are present in the connector pinout to provide shield conductors in the ribbon cable. In some cases, discussed below, the ground conductors will not provide an accurate signal reference, so a SENSE pin (SNS LO) is also provided in the pinout. Several jumper and component options on the backplane provide optimum ground connections for various circumstances.

Model 5B08-MUX Grounding

Model 5B08-MUX is supplied with three grounding jumpers: W1, W2 and W4. These three jumpers are installed at the factory, but can be changed to accommodate user system configuration needs. Jumper W1 connects the P1 shield pins (Pins 2, 5 and 6) to the 5B08-MUX backplane common (backplane measurement ground). This will usually be the primary ground connection between the 5B08-MUX backplane and the measurement system. This connection is required if output modules are used on the 5B08-MUX. It is also required if there is no high impedance sense input (input LO of a differential or pseudo-differential system) available on the measurement system. Jumper W2 connects the sense input from the measurement system, if available on Pin 4, to the 5B08-MUX backplane common, so it can be read directly. W2 can be left in place at all times. Jumper W4 connects the 5B08-MUX backplane common to the +5 V dc power common. A connection between power common and I/O common is important for the 5B Series modules to function properly; however, if

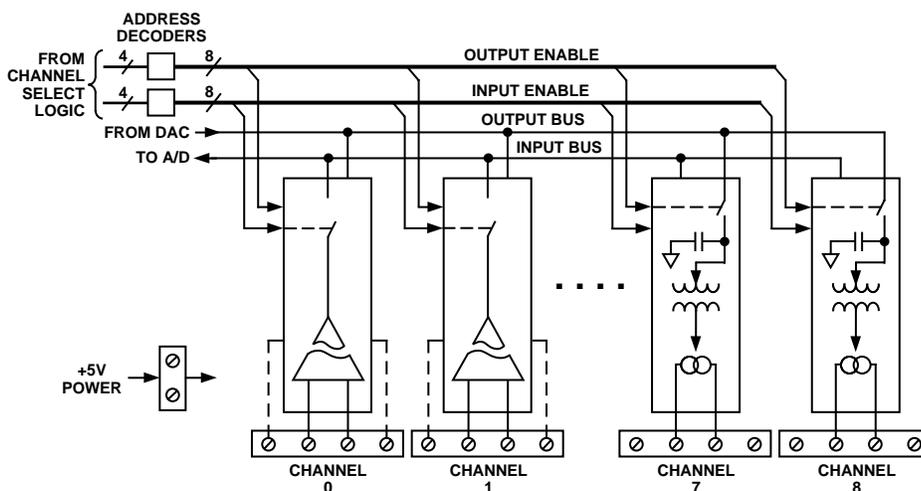


Figure 6. 5B08-MUX Functional Block Diagram

this connection is made elsewhere in your system (the best place is usually near the A/D or D/A converters), W4 should be cut since a ground loop could result.

Model 5B08-MUX Address Jumpers

5B08-MUX backplane can hold eight 5B Series modules in any combination of inputs or outputs. Address decoders on the backplane determine which module is read (input type) or driven (output type). Separate decoders are provided for inputs and outputs. To permit system expansion, up to eight 5B08-MUX backplanes can be daisy-chained on the system I/O ribbon cable for a total of 64 channels. Jumpers on each backplane (labeled J1–J9 and J10–J18) determine the block of eight addresses assigned to each backplane. Input (read) and output (write) addressing are completely independent; in all cases, Jumpers J1–J9 control inputs and J10–J18 control outputs. Independent addressing might be used, for example, to update output modules without interrupting the monitoring of input modules.

Table V. 5B08-MUX Address Jumpers

Input Jumper	Output Jumper	Address Range
J2	J11	56–63
J3	J12	48–55
J4	J13	40–47
J5	J14	32–39
J6	J15	24–31
J7	J16	16–23
J8	J17	8–15
J9	J18	0–7

5B08-MUX Factory Jumper Settings

5B08-MUX backplanes are factory configured with jumpers at Positions J1 and J10. This sets up the 5B08-MUX backplane as a stand-alone 8-channel system. Moving the jumpers to any other position in the two blocks of jumpers enables decoding of the full six address bits; the exact position of the jumper determines address position for the 5B08-MUX backplane as shown in Table V. To use multiple 5B08-MUX backplanes in this manner, connect the corresponding I/O connector pins of each backplane in parallel. Model CAB-01 cable is a ribbon cable with three 26-pin connectors designed for this purpose.

MODEL 5B01, 5B02, 5B08 AND 5B08-MUX GROUND STUDS

The 5B Series modules meet transient voltage protection standard ANSI/IEEE C37.90.1-1989, thereby preventing harm to the connected system even when a very large, fast transient strikes all field I/O lines at the same time. However, proper grounding of the backplane is essential to get full protection since in such cases currents on the order of an ampere with rise times on the order of one microsecond must be diverted to ground. Both the resistance and the inductance of the ground path are critical. In applications where hazards of this magnitude exist, the large (#10-32) ground studs provided at each end of the 5B01, 5B02, 5B08 and 5B08-MUX backplanes should be connected to system ground by the shortest practical length of large-diameter wire.

The surge withstand capability can be tested with not less than fifty 2.5 kV bursts per second. A test duration of two seconds is widely accepted. A rise time of 20 kV/μs is specified, and each module could see a surge current on the order of 1 ampere.

When a safety ground is used, the connection of backplane measurement ground to system measurement ground via the shield wires in the ribbon cable could result in a ground loop. If the application involves only input modules and a sense input is used on the measurement system, W1 should be cut to prevent a ground loop.

Caution: *W1 is required if output modules are used or there is no high impedance sense input on the measurement system. In these cases, the best defense against ground loop effects is to minimize the distance between the backplane and the associated system and to route any large currents carefully so as to minimize ground differences.*

MODELS 5B01, 5B02, 5B08 AND 5B08-MUX FUSING AND SUPPLY VOLTAGE

All 5B Series backplanes require external +5 V dc regulated power. This is connected directly to the designated supply input screw terminals. The power supply is bused to all signal conditioners on the backplane. The total subsystem power requirement is a function of the modules that are used. Since reversing the polarity of the connected +5 V dc power source could destroy installed modules, the 5B01, 5B02, 5B08 and 5B08-MUX backplanes incorporate polarity reversal protection in the form of a shunt diode. A series fuse will be blown by the diode current if the supply is reversed. If the fuse is blown, replacement with the proper type (Littelfuse® type 252 004) is essential.

MODELS 5B03 AND 5B04 MOUNTING CARDS

The 5B03 card holds one 5B Series module, the 5B04 holds two modules. These cards may be clustered for larger groups of modules.

Refer to Figures 7 and 8 for the wiring diagrams for the 5B03 and 5B04.

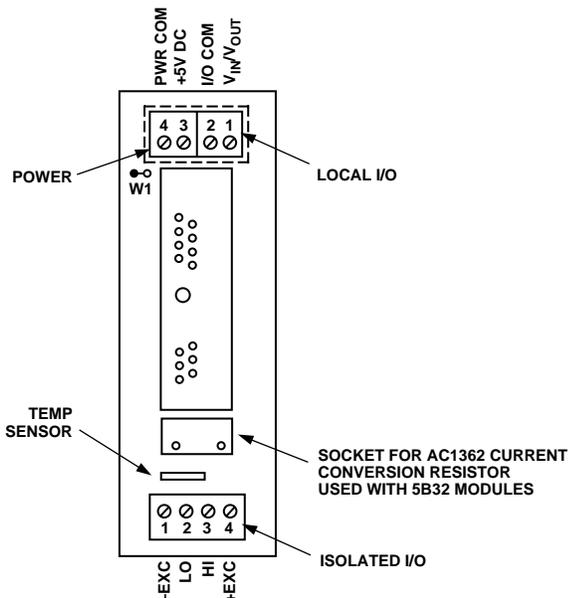


Figure 7. Model 5B03 Wiring Diagram

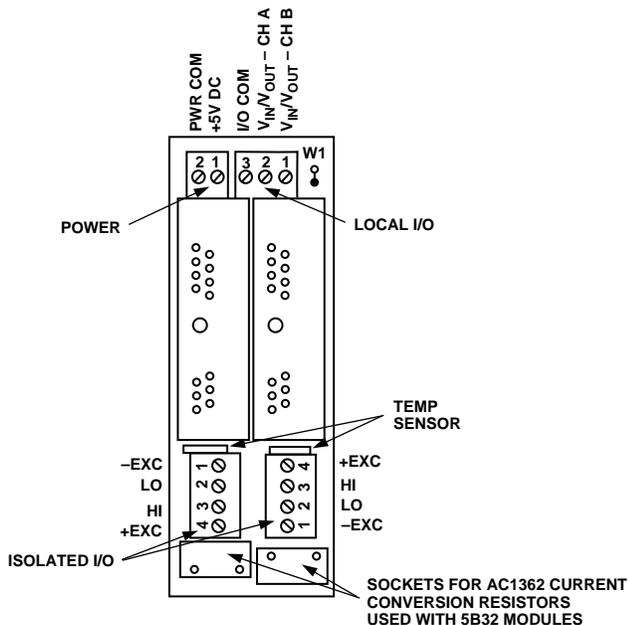


Figure 8. Model 5B04 Wiring Diagram

Models 5B03 and 5B04 Grounding

Jumper W1 connects +5 V dc power common to input/output common (backplane measurement ground). A connection between power common and input/output is important for the 5B Series modules to function properly; however, if this connection is made elsewhere in your system (the best place is usually near the D/A or A/D converters), W1 should be cut since a ground loop could result.

Models 5B03 and 5B04 DIN Rail Mounting

Individual mounting cards are DIN rail compatible using Phoenix Universal Mounting UM modules. Two or more cards can be mounted in wider UM assemblies. The snap foot elements will fit DIN EN 50022, DIN EN 50035, and DIN EN 50045 rails.

Mounting a single 5B03 or 5B04 would require the Phoenix parts listed in Table VI.

Table VI. 5B03 and 5B04 Phoenix DIN Rail Mounting Parts

Phoenix Model	Description	Qty.
UM-BEFE	Base Element with Snap Foot	1
UM-SE	Side Element	2

Mounting two or more 5B03 or 5B04 cards would require the parts listed in Table VII. The (#) is the total number of 5B03 and 5B04 mounting cards to be DIN rail mounted.

Table VII. Phoenix DIN Rail Mounting Parts For Multiple 5B03 and 5B04

Phoenix Model	Description	Qty.
UM-BEFE	Base Element with Snap Foot	2
UM-SE	Side Element	2
UM-BE	Base Element	(#) - 2
UM-VS	Connection Pins	(4 × (#)) - 4

Power Connection

The 5B03 and 5B04 are powered with a single +5 V dc supply, applied to terminals +5 V and +PWR COM.

Caution: The 5B03 and 5B04 are not protected against reversed power supply connections. A reversal may destroy the installed modules.

MODEL AC1360 MOUNTING CARD

The AC1360 is a 1-channel test or evaluation mounting card for the 5B Series modules. Screw terminals are provided for all of the module's input, output, control and power connections. In addition, the AC1361 cold

junction temperature sensor is installed for thermocouple applications, and a pair of sockets permits installation of the AC1362 current sensing resistor used with the 5B32 current input module.

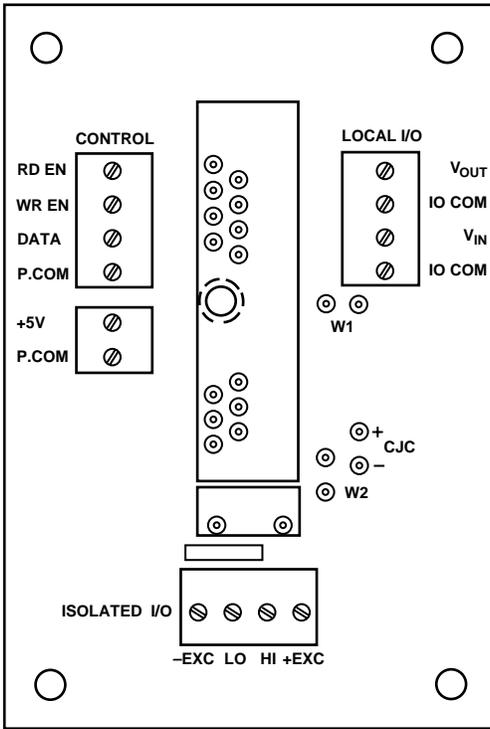


Figure 9. AC1360 Mounting Card

Model AC1360 DIN Rail Mounting

The AC1360 is DIN rail mountable, using Phoenix Universal Module UM elements. To mount a single AC1360 would require the following Phoenix parts:

Table VIII. Phoenix DIN Rail Mounting Parts For Model AC1360

Phoenix Model	Description	Qty.
UM-BEFE	Base Element with Snap Foot	2
UM-SE	Side Element	2
UM-VS	Connection Pins	4

Standoffs are included with each AC1360 for bench top use or wall mounting.

Model AC1360 Configuration Jumpers

The AC1360 includes two configuration jumpers. The first, labeled W1, is factory installed and provides a convenient point for providing the required current return path from I/O common on the nonisolated (system side) of the modules to the +5 V supply common. In general, this is not the best place to have such a connection. In most applications, there will already be a suitable path

resulting from a connection at another point so that W1 will result in a ground loop. Virtually any contact between supply common and analog measurement common in the surrounding system is sufficient; the two grounds can be several volts apart and can have a resistance of up to 10 kΩ between them without affecting 5B Series module operation. W1 should be cut if such a contact exists.

Jumper W2 is also factory installed and only affects the operation of thermocouple input modules. W2 connects the AC1361 temperature sensor in its normal manner when a thermocouple input module is installed in the module socket. For applications involving connection of thermocouple wire to the HI and LOW screw terminals, this results in normal correction in the module for the thermal effects of the connections. If, however, a 5B37 or 5B47 thermocouple module is to be operated without thermocouple wire at the screw terminals—as, for example, in a test fixture using a millivolt source—the temperature sensor must be disabled and a suitable voltage to simulate operation at a chosen terminal temperature must be substituted. This is accomplished by opening jumper W2 and connecting a voltage source to the terminals labeled CJC (Cold Junction Compensation). The required polarity of the applied voltage is indicated at the terminals. It is absolutely essential that the source of the voltage floats with respect to anything connected to the HI and LOW input terminals (or the ±EXC screws, which are not normally used in thermocouple applications). Most bench top calibration sources have the necessary isolation to work properly. In these applications, a CJC voltage of 510.0 mV will simulate sensor operation at a terminal temperature of +25°C. Since there are no parasitic thermocouples at the screw terminals to correct, all output readings will appear to be 25°C higher than would be implied by the input voltage. With the 25°C shift taken into account, however, module operation is close to normal conditions for test or evaluation purposes. Alternatively, a CJC voltage of 572.5 mV can be applied, simulating operation at a terminal temperature of 0°C. Millivolt inputs can then be read directly from thermocouple tables without any temperature shift. At 572.5 mV, however, since the module's cold junction correction circuitry is operating far from its design center, its errors will be larger than would be the case in normal operation.

Power Connection.

The AC1360 is powered with a single +5 V dc supply, applied to terminals +5 V and P.COM.

Caution: The AC1360 is not protected against reversed power supply connections. A reversal may destroy the installed module.