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The 5B Series User's Manual

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June, 98

5B Series
New Product Information

Data Sheets for the following New 5B Series products are attached:

5B08/5B08-MUX
8-Channel Backplanes

5B35
4-Wire RTD input module

5B36
Potentiometer/Resistor input module

5B42
4-to-20 mA Process Current input module

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5B Series
8-Channel Backplanes

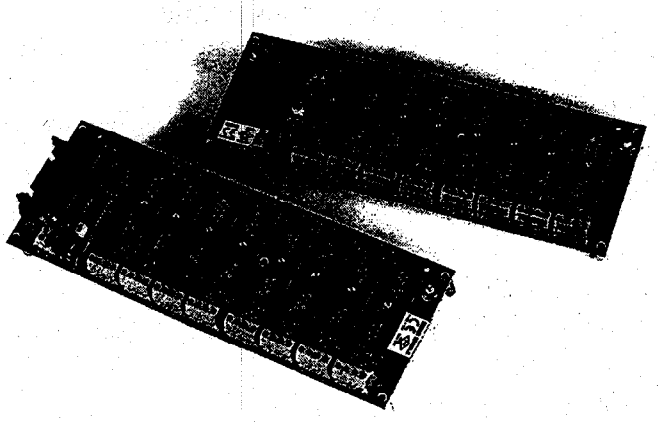
5B08/5B08-MUX

FEATURES

- 8-Channel, Industry Standard 5B Series Compatibility
- Two Backplane Selections
  - 5B08: Eight Independent I/O Channels
  - 5B08-MUX: Eight I/O Channels Multiplexed onto One Bus
- Mix and Match 5B Series I/O Module Capability
  - Thermocouple, RTD, mV, V, Frequency, mA, Strain Gage, Loop-Powered mA, Potentiometer, Slidewire
- –25°C to +85°C Temperature Range
- 1500 V rms Chan/Chan and Input/Output Isolation
- FM Approved
  - Approved for Use in Class I, Division 2, Groups A, B, C and D Locations
- CE Approved
  - EMC Directive In Heavy Industrial Applications

APPLICATIONS

- Front-End Data Acquisition Systems
- Process Control and Monitoring
- Product Test



GENERAL DESCRIPTION

The 5B08 and 5B08-MUX backplanes accept up to eight 5B Series input/output modules, providing direct screw terminal interfacing to sensors and transducers, as well as a 26-pin connector I/O interface to a measurement and control system (refer to Figures 2 and 3 for functional block diagrams). Model 5B08 backplane I/O signals are independently available, while Model 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. 5B Series modules can be mixed or matched and may be changed without disturbing field wiring. Each channel has a cold junction temperature sensor (Model AC1361) to accommodate thermocouple modules (5B37 or 5B47). Both backplanes require an external +5 V dc regulated power supply. Reverse power supply protection is provided as well as a replaceable 4-ampere fuse and a power ON green LED indicator.

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 1 illustrates the pin assignments for P1 and P2.

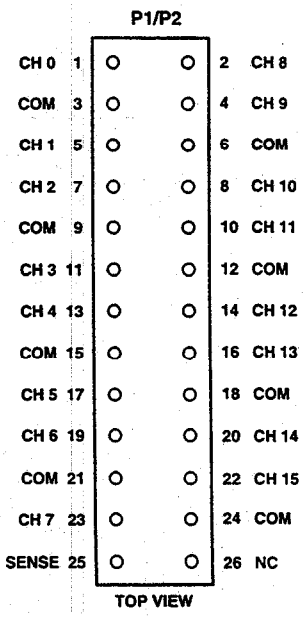


Figure 1. 5B08 System Connector Pinout

REV. A

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5B08/5B08-MUX–SPECIFICATIONS (typical @ +25°C and +5 V dc unless otherwise noted)

Model	5B08	5B08-MUX
CHANNELS	8	*
DIMENSION—WITH 5B SERIES MODULES	3.5" × 10.0" × 3.2" (88.9 mm × 254.0 mm × 81.3 mm)	* *
WEIGHT	7 oz (200 g)	*
MOUNTING STANDOFFS	5	*
COLD JUNCTION TEMPERATURE SENSORS (Provided On Backplane) Accuracy @ +25°C Over +5°C to +45°C	 8, Model AC1361 ±0.25°C (±0.75°C max) ±0.5°C (±0.0125°C/°C)	 * * *
SYSTEM CONNECTOR 26-Pin Male Mating	 Amp 746290-6	 *
ADDRESS SELECTION INPUTS Max Logic "0" Min Logic "1" Max Logic "1"	 N/A N/A N/A	 +0.8 V +2.0 V +7.0 V
POWER SUPPLY Voltage: Operating Voltage: Max Safe Limit—With Modules Current—Without Modules Fuse (F1)	 +5 V dc ± 5% +6.0 V dc max 13 mA 4 Ampere Littelfuse® Type 252 004	 * * 40 mA *
TEMPERATURE RANGE Rated Performance Storage Relative Humidity	 –25°C to +85°C –40°C to +85°C 0 to 95% @ +60°C Noncondensing	 * * *

*Specifications same as Model 5B08.

Specifications subject to change without notice.

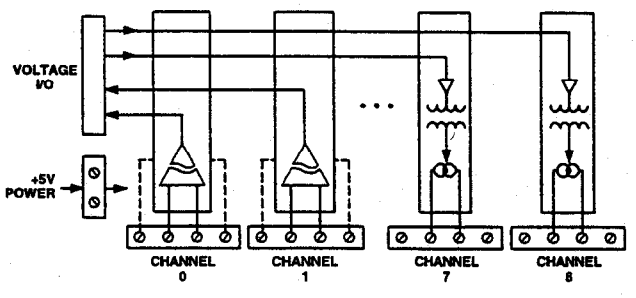


Figure 2. 5B08 Functional Block Diagram

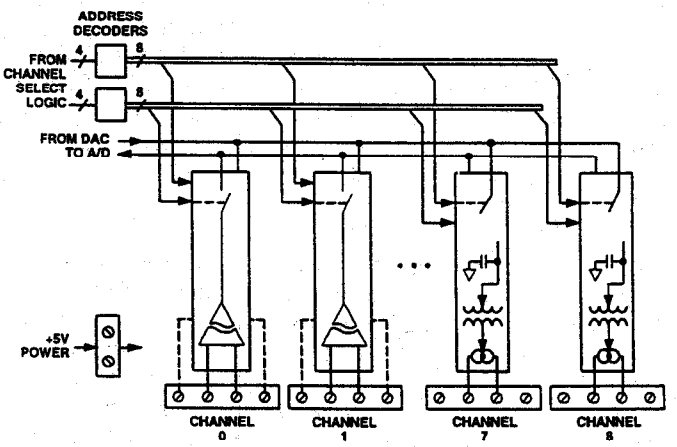


Figure 3. 5B08-MUX Functional Block Diagram

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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.

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 I illustrates the channel assignments for each of the eight jumpers, J8 through J15.

Table I. 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

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 II 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 inter-channel jumper selections (J1–J7). Table III provides the resulting signal assignments for each of the various jumper selections.

Table II. 5B08 Interchannel Jumpers

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

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

Jumper Closed	Output Channel Jumper 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 HI J13 LO J13 HI J13 LO	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 HI J14 LO J14 HI J14 LO	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

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5B08 GROUND JUMPERS

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 (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 LO 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 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.

5B08 ADDITIONAL INFORMATION

See the "5B08/5B08-MUX" sections of this data sheet for additional information on Model 5B08.

5B08-MUX DESCRIPTION

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 3 for a functional block diagram and Figure 6 for a schematic 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 CONNECTOR

Signal connections between the 5B08-MUX and the associated measurement or control system are made at P1, a 26-pin connector. 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 in the backplane provide optimum ground connections for various circumstances.

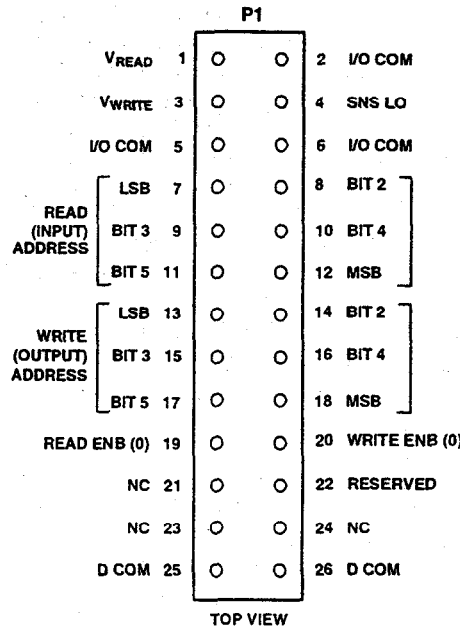


Figure 4. 5B08-MUX System Connector Pinout

5B08-MUX GROUND JUMPERS

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 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.

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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 IV. 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 IV. 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.

5B08/5B08-MUX FUSING AND POLARITY REVERSAL

Since reversing the polarity of the +5 V dc power source could destroy installed modules, the 5B08/5B08-MUX incorporate polarity reversal protection in the form of a shunt diode. A 4-ampere socketed fuse will open by the diode current if the supply is reversed. If the fuse is open, replacement with the proper type (Littelfuse Type 252 004) is essential.

5B08/5B08-MUX GROUND STUDS

The 5B Series modules meet transient voltage protection standard ANSI/IEEE C37.90.1-1989.

The 5B Series modules can prevent damage to the connected system even when a very large, fast transient strikes all eight field I/O lines at the same time. However, proper grounding of the backplane is essential to ensure full protection since, in such cases, currents on the order of an ampere, with rise times on the order of one microsecond, must be delivered 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 stud provided at each end of the 5B08 backplane (at one end of the 5B08-MUX backplane) 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.

5B08/5B08-MUX 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 errors is to minimize the distance between the backplane and the associated system and to route any large currents carefully to minimize ground differences.

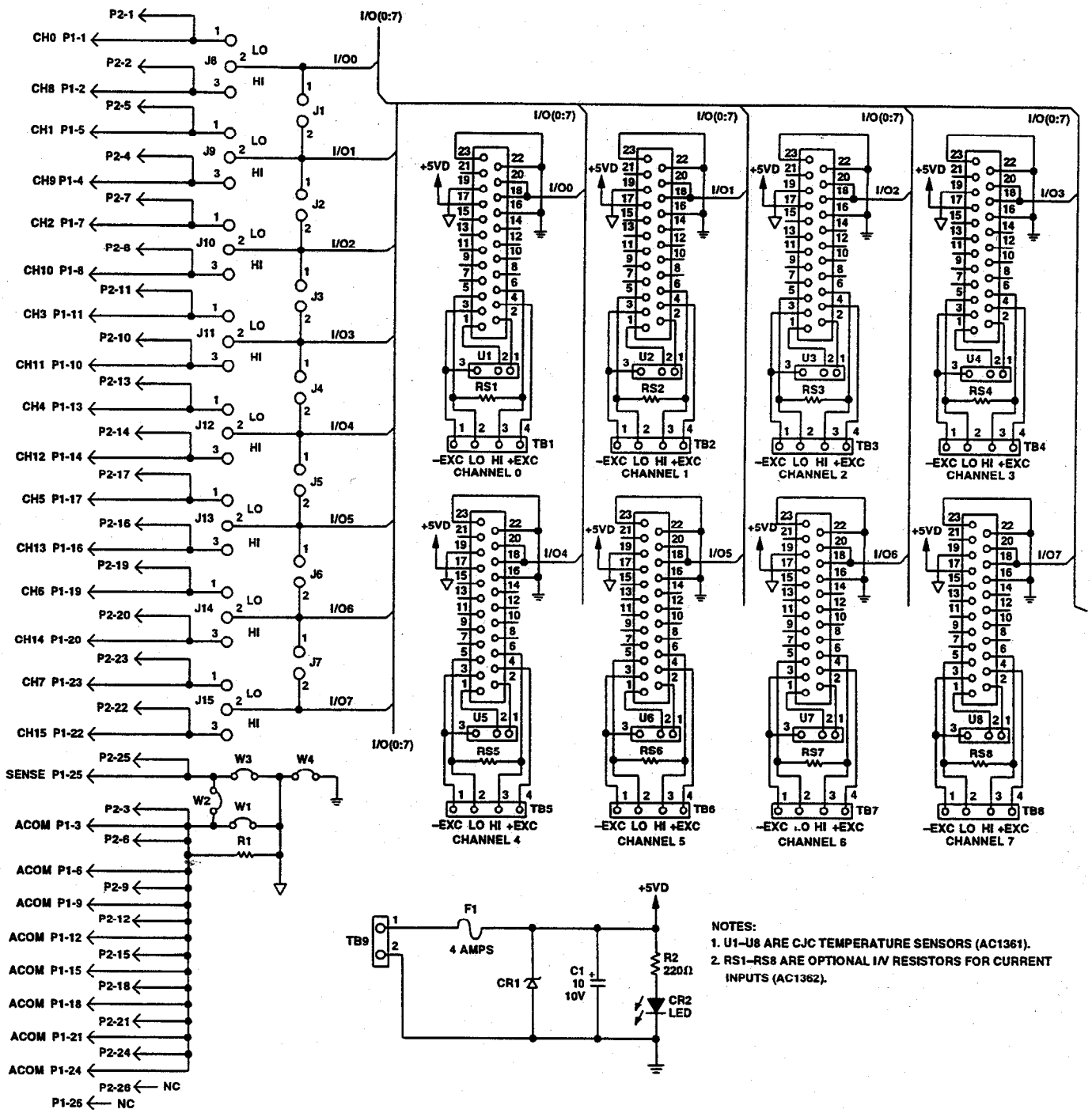
5B08/5B08-MUX INPUT FIELD CONNECTIONS

All field sensor and transducer connections to the 5B08 and 5B08-MUX are made to 4-screw terminal connectors associated with each channel. Figure 7 illustrates the specific field connections for each of the various 5B Series modules.

5B SERIES MODULES

The 5B Series provides a selection of over 14 module types, covering sensors signals such as mV, V, thermocouple, potentiometer, RTD, mA, frequency and strain. Both standard input/output ranges are available as well as custom ranges. The 5B-Custom program diskette, a Windows®-based program, is available from Analog Devices to assist the user both in selecting a standard module range and/or verifying if a custom range is available. Additionally, a 5B Series User manual is available to provide detailed specifications on all 5B Series modules and application information in using both modules and backplanes.

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NOTES:
1. U1–U8 ARE CJC TEMPERATURE SENSORS (AC1361).
2. RS1–RS8 ARE OPTIONAL I/V RESISTORS FOR CURRENT INPUTS (AC1362).

Figure 5. 5B08 Schematic Diagram

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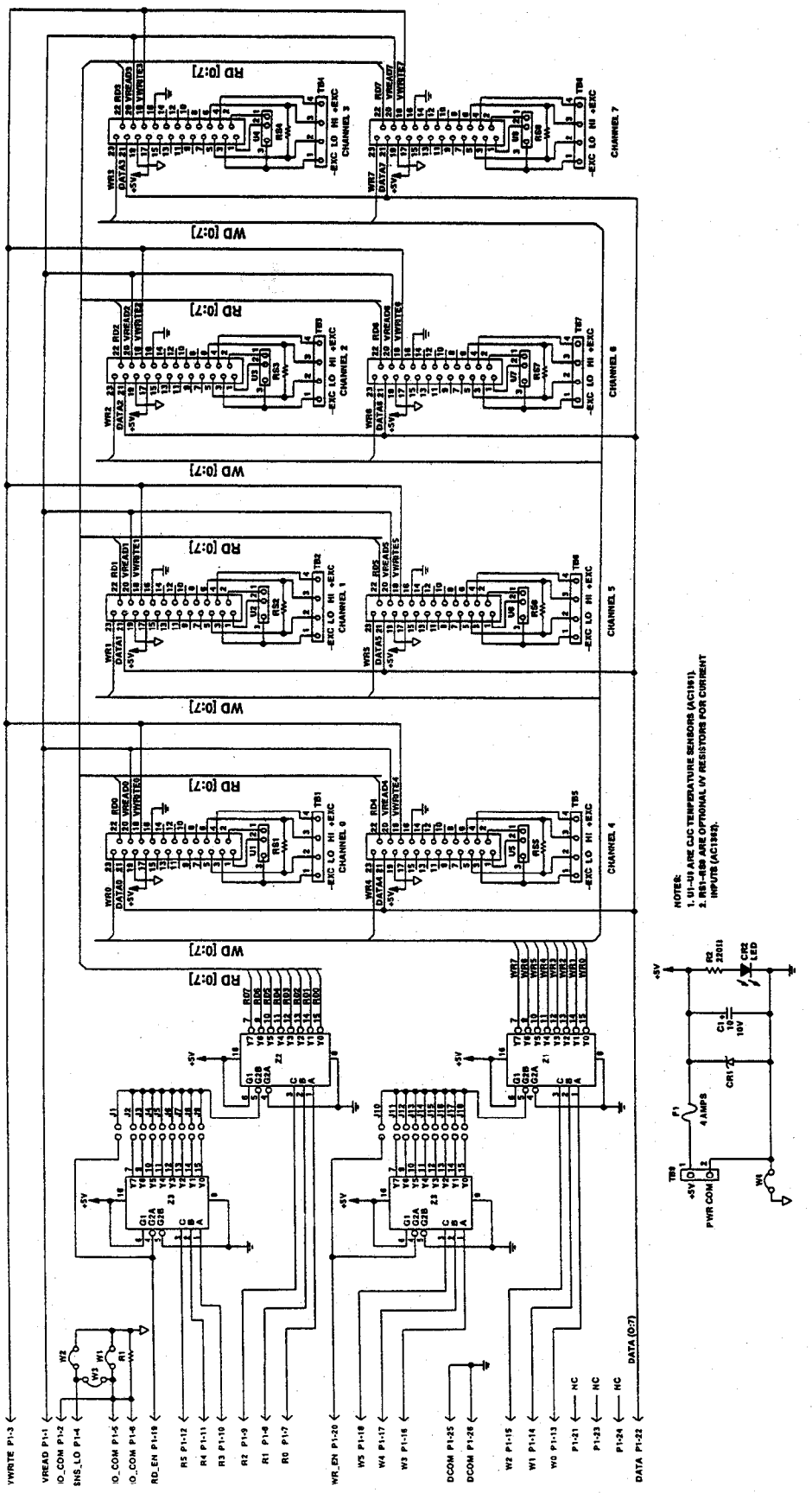


Figure 6. 5B08-MUX Schematic Diagram

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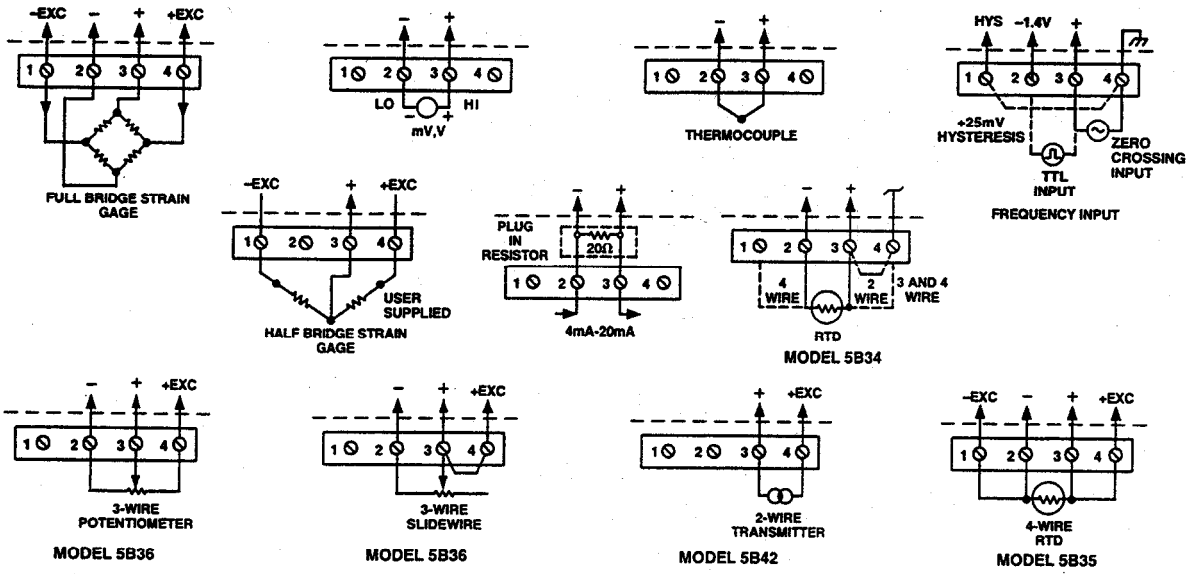
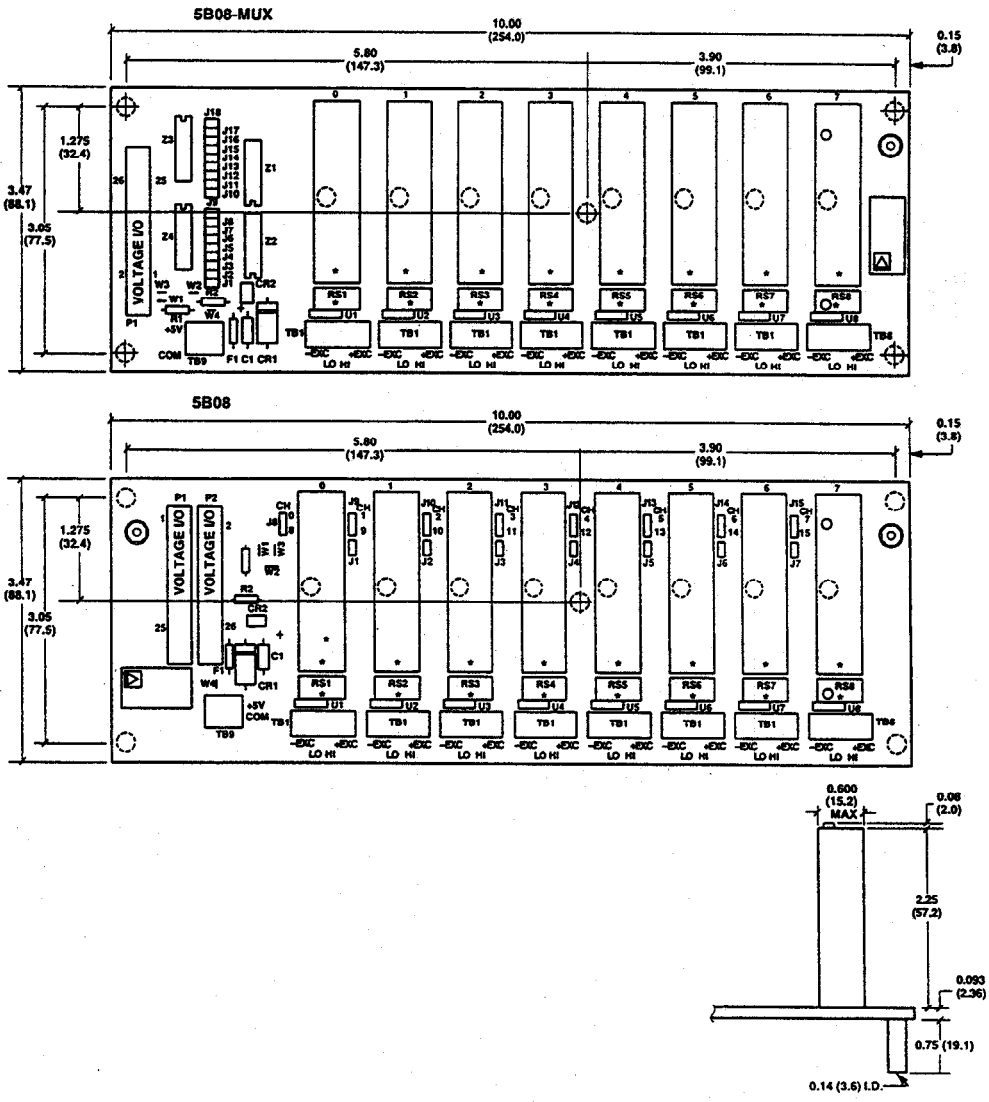


Figure 7. Field Input Connections

OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



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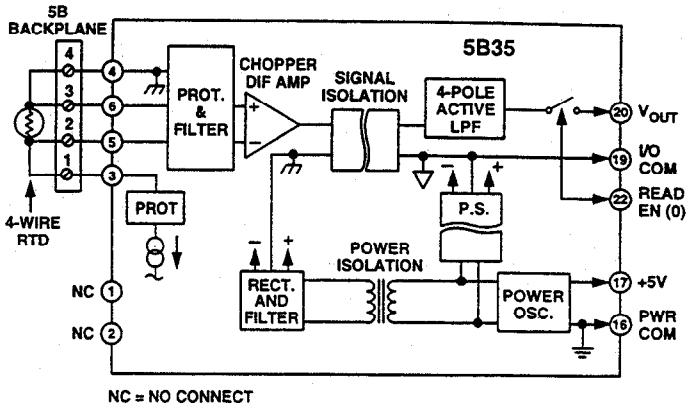
Linearized 4-Wire RTD Input Module

MODEL 5B35

FEATURES

Accepts a Variety of RTD Types
100 Ω Platinum, 10 Ω Copper, 120 Ω Nickel
Linearizes RTD Signal
1500 V rms Input/Output and Input/Power Isolation
250 V rms Output/Power Isolation
240 V rms Field Wiring Protection
4-Wire Lead Resistance Compensation
190 dB CMRR
116 dB NMR @ 60 Hz, 108 dB @ 50 Hz
Low Drift:
Input Offset ±0.01°C/°C
Gain ±30 ppm/°C
Low Output Noise:
0.3 mV p-p @ 100 kHz BW
6 mV p-p @ 5 MHz BW
Low Power Consumption: +5 V dc @ 15 mA
ANSI/IEEE C37.90.1-1989 Transient Protection
CSA, FM and CE Approvals

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

Model 5B35 converts the input from a wide variety of RTD types to a linearized, high accuracy output of 0 V to +5 V. The module provides transformer isolation, RTD excitation, RTD lead-resistance compensation, signal filtering and input protection against line voltage connection. A series output switch eliminates the need for external multiplexing. The industry standard 5B Series encapsulated plug-in modular package is compatible with all 5B backplanes. Modules are powered by +5 V dc, ±5%.

Signal isolation is provided by transformer coupling using a proprietary technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the input signal, which is filtered and buffered to provide an accurate, low impedance, low noise output.

True three-port isolation includes common-mode voltage of: 1500 V rms between input and output, and between input and power; 250 V rms between output and power.

The modules provide RTD excitation from a precision current source. A low drift, chopper stabilized, differential amplifier design allows for the use of very low RTD excitation currents to minimize accuracy losses from self-heating of the RTD. The low input offset drift of ±0.01°C/°C and gain drift of ±30 ppm/°C assure that accuracy is maintained over a wide operating temperature range.

The four-wire configuration of the 5B35 supplies the RTD excitation current through two leads that are not the signal input leads. Because there is no excitation current in the signal input leads, the lead lengths or resistances have no effect on the RTD measurement.

An optimized five-pole Butterworth filter (with 4 Hz bandwidth) provides 116 dB of normal-mode rejection at 60 Hz and 108 dB at 50 Hz. Output noise is an exceptionally low 0.3 mV p-p at 100 kHz bandwidth and 6 mV p-p at 5 MHz bandwidth.

The input circuit is protected against accidental application of voltages, such as an ac power line, up to 240 V rms continuous.

A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. When the output switch is not used, ground the enable input to I/O common to turn on the switch.

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MODEL 5B35–SPECIFICATIONS (typical @ +25°C and V_S = +5 V dc)

Model	5B35
INPUT	
Standard Ranges	See Table I
Custom Range Limits	(See Table II for More Information)
100 Ω Pt	-200°C to +850°C
120 Ω Ni	-80°C to +320°C
10 Ω Cu	-100°C to +260°C
Impedance	
Normal (Power On)	>1000 MΩ
Power Off	200 kΩ
Overload	200 kΩ
Normal-Mode Rejection (NMR)	116 dB (60 Hz); 108 dB (50 Hz)
Protection	
Continuous	240 V rms max
Transient	ANSI/IEEE C37.90.1-1989
SENSOR EXCITATION CURRENT	
100 Ω Pt, 120 Ω Ni	0.25 mA
10 Ω Cu	1.0 mA
LEAD RESISTANCE EFFECT	
100 Ω Pt, 120 Ω Ni	±0.00001°C/Ω
10 Ω Cu	±0.0001°C/Ω
COMMON-MODE VOLTAGE (CMV)	
Input-to-Output, Continuous	1500 V rms, max
Input-to-Power, Continuous	1500 V rms, max
Power-to-Output, Continuous[1]	250 V rms, max
COMMON-MODE REJECTION (CMR), 50/60 Hz[2]	190 dB
ACCURACY	
Initial @ +25°C[3]	See Table I
Conformity Error	±0.05% Span
Stability vs. Temperature (-40°C to +85°C)	
Input Offset	±0.01°C/°C
Output Offset	±20 µV/°C
Gain	±30 ppm of Reading/°C
OUTPUT	
Range	0 V to +5 V
Resistance	25 Ω
Bandwidth	4 Hz
Step Response Time (10% to 90% range)	100 ms
Noise	
Input, 0.1 Hz to 10 Hz	0.2 µV rms
Output, 100 kHz Bandwidth	100 µV rms 0.3 mV p-p
Output, 1 MHz Bandwidth	1.5 mV p-p
Output, 5 MHz Bandwidth	6 mV p-p
Protection	Continuous Short to Ground
Current Limit	±9 mA
Enable Time (C Load = 0 pF to 2000 pF)	6 µs to ±1 mV of V_{OUT}
Enable Control	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+100 V
Input Current "0," "1"	0.5 µA
POWER SUPPLY	
Voltage, Rated Performance	+5 V dc ± 5%
Current	15 mA
Sensitivity (100 Ω Pt, 120 Ω Ni, 10 Ω Cu)	±0.2°C/V
CASE SIZE, Maximum	2.275" × 2.325" × 0.595" (57.8 mm × 59.1 mm × 15.1 mm)
WEIGHT	70 grams
ENVIRONMENTAL	
Temperature Range, Rated Performance	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Relative Humidity	0% to 93% @ +40°C, Noncondensing
RFI Susceptibility	±0.5% Span Error @ 400 MHz, 5 W, 3'

NOTES
[1]The user's board layout must separate Power Ground from I/O Common and when the 5B35 output switch is not used, ground the enable input to I/O Common. Power-to-Output CMV is not available when the 5B35 is installed on a 5 B Series backplane.
[2]CMR for Model 5B35-04 is 180 dB.
[3]Includes the combined effects of repeatability, hysteresis and conformity.

Specifications subject to change without notice.

Table I. Standard Model Input/Output Ranges*

Model	Input Range	Accuracy
100 Ω Platinum, α = 0.00385*		
5B35-01	-100°C to +100°C (-148°F to +212°F)	±0.26°C
5B35-02	0°C to +100°C (+32°F to +212°F)	±0.13°C
5B35-03	0°C to +200°C (+32°F to +392°F)	±0.26°C
5B35-04	0°C to +600°C (+32°F to +1112°F)	±0.78°C
5B35-05	-100°C to +200°C (-148°F to +392°F)	±0.60°C
10 Ω Copper, α = 0.004274		
5B35-C-01	0°C to +120°C (10 Ω at 0°C) (+32°F to +248°F)	±0.23°C
5B35-C-02	0°C to +120°C (10 Ω at +25°C) (+32°F to +248°F)	±0.23°C
120 Ω Nickel, α = 0.00672		
5B35-N-01	0°C to +300°C (+32°F to +572°F)	±0.40°C

*Standard output range for all models is 0 V to +5 V. Custom input/output ranges are available, including versions for the 100 Ω Platinum (α = 0.003916) RTD. See Table II.

Table II. Custom Model Ordering Guide

Order Model: **5B35-CUSTOM*** plus Customer Specified Information

Customer Specified Information:

Sensor Type	Input Range		Output Range	
Available Sensor Types	*Low Limit*	*High Limit*	*Low Limit*	*High Limit*
100 Ω Pt α = 0.00385	-200°C	+850°C	0 V	+5 V
100 Ω Pt α = 0.003916	-200°C	+850°C	0 V	+5 V
10 Ω Cu α = 0.004274	Consult Factory		0 V	+5 V
120 Ω Ni α = 0.00672	Consult Factory		0 V	+5 V

*For copper (Cu) RTD sensor inputs, order 5B35-C-CUSTOM.
For nickel (Ni) RTD sensor inputs, order 5B35-N-CUSTOM.

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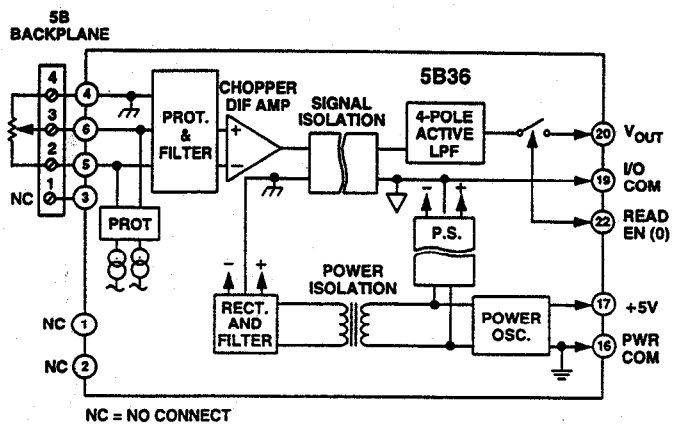
Potentiometer Input Module

MODEL 5B36

FEATURES

Accepts Potentiometers up to 10,000 Ω
High Level 0 V to +5 V Output
1500 V rms Input/Output and Input/Power Isolation
250 V rms Output/Power Isolation
240 V rms Field Wiring Protection
170 dB CMRR
116 dB NMR @ 60 Hz, 108 dB @ 50 Hz
Low Gain Drift: ±30 ppm/°C
Low Output Noise:
0.3 mV p-p @ 100 kHz BW
6 mV p-p @ 5 MHz BW
Low Power Consumption: +5 V dc @ 15 mA
ANSI/IEEE C37.90.1–1989 Transient Protection
CSA, FM and CE Approvals

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

Model 5B36 converts the input from a variety of potentiometers and variable resistors to a high level output of 0 V to +5 V. The module provides transformer isolation, potentiometer excitation, signal filtering and input protection against line voltage connection. The series output switch eliminates the need for external multiplexing. The industry standard 5B Series encapsulated plug-in modular package is compatible with all 5B backplanes. Modules are powered by +5 V dc, ± 5%.

Signal isolation is provided by transformer coupling using a proprietary technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the input signal, which is filtered and buffered to provide an accurate, low impedance, low noise output.

True three-port isolation includes common-mode voltage of: 1500 V rms between input and output, and between input and power; 250 V rms between output and power.

The modules provide potentiometer excitation from a precision current source. A low drift, chopper stabilized, differential amplifier design allows for the use of very low excitation currents to minimize accuracy losses from self-heating of the potentiometer. The low gain drift of ±30 ppm/°C and low offset drift assure that accuracy is maintained over a wide operating temperature range.

The 5B36 supplies equal excitation currents to three-wire potentiometers to cancel the effects of lead resistance.

An optimized five-pole Butterworth filter (with 4 Hz bandwidth) provides 116 dB of normal-mode rejection at 60 Hz and 108 dB at 50 Hz. Output noise is an exceptionally low 0.3 mV p-p at 100 kHz bandwidth and 6 mV p-p at 5 MHz bandwidth.

The input circuit is protected against accidental application of voltages, such as an ac power line, up to 240 V rms continuous.

A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. When the output switch is not used, ground the enable input to I/O common to turn on the switch.

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MODEL 5B36–SPECIFICATIONS (typical @ +25°C and V_S = +5 V dc)

Model	5B36
INPUT	
Standard Ranges	See Table I
Custom Range Limits	See Table II
Impedance	
Normal (Power On)	>1000 MΩ
Power Off	200 kΩ
Overload	200 kΩ
Normal Mode Rejection (NMR)	116 dB (60 Hz); 108 dB (50 Hz)
Protection	
Continuous	240 V rms max
Transient	ANSI/IEEE C37.90.1–1989
SENSOR EXCITATION CURRENT	
100 Ω, 500 Ω, 1 kΩ Sensors	0.25 mA
10 kΩ Sensor	0.1 mA
LEAD RESISTANCE EFFECT	
100 Ω, 500 Ω, 1 kΩ Sensors	±0.005 Ω/Ω
10 kΩ Sensor	±0.01 Ω/Ω
COMMON-MODE VOLTAGE (CMV)	
Input-to-Output, Continuous	1500 V rms, max
Input-to-Power, Continuous	1500 V rms, max
Power-to-Output, Continuous[1]	250 V rms, max
COMMON-MODE REJECTION (CMR) 50 Hz/60 Hz	170 dB
ACCURACY	
Initial @ +25°C[2]	±0.08% Span
Stability vs. Temperature (–40°C to +85°C)	
Input Offset	
100 Ω, 500 Ω, 1 kΩ Sensors	±0.004 Ω/°C
10 kΩ Sensor	±0.010 Ω/°C
Output Offset	±20 µV/°C
Gain	±30 ppm of Reading/°C
OUTPUT	
Range	0 V to +5 V
Resistance	25 Ω
Bandwidth, –3 dB	4 Hz
Step Response Time (10% to 90% Range)	100 ms
Noise	
Input, 0.1 Hz to 10 Hz	0.2 µV rms RTI[3]
Output, 100 kHz Bandwidth	100 µV rms
	0.3 mV p-p
Output, 1 MHz Bandwidth	1.5 mV p-p
Output, 5 MHz Bandwidth	6 mV p-p
Protection	Continuous Short to Ground
Current Limit	±9 mA
Enable Time (C Load = 0 pF to 2000 pF)	6 µs to ±1 mV of V_{OUT}
Enable Control	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+100 V
Input Current "0," "1"	0.5 µA
POWER SUPPLY	
Voltage, Rated Performance	+5 V dc ± 5%
Current	15 mA
Sensitivity	±2 µV/% RTI[3]
CASE SIZE, Maximum	2.275" × 2.325" × 0.595" (57.8 mm × 59.1 mm × 15.1 mm)
WEIGHT	70 grams
ENVIRONMENTAL	
Temperature Range, Rated Performance	–40°C to +85°C
Storage Temperature	–40°C to +85°C
Relative Humidity	0% to 93% @ +40°C, Noncondensing
RFI Susceptibility	±0.5% Span Error @ 400 MHz, 5 W, 3'

NOTES
[1]The user's board layout must separate Power Ground from I/O Common and when the 5B36 output switch is not used, ground the enable input to I/O Common. Power-to-Output CMV is not available when the 5B36 is installed on a 5B Series backplane.
[2]Includes the combined effects of repeatability, hysteresis and nonlinearity.
[3]Referenced to input.

Specifications subject to change without notice.

Table I. Standard Model Input/Output Ranges*

Model	Input Range	Output Range
5B36-01	0 Ω to 100 Ω	0 V to +5 V
5B36-02	0 Ω to 500 Ω	0 V to +5 V
5B36-03	0 Ω to 1 kΩ	0 V to +5 V
5B36-04	0 Ω to 10 kΩ	0 V to +5 V

NOTE
*Custom input/output ranges are available. See Table II.

Table II. Custom Model Ordering Guide

Order Model: **5B36-CUSTOM**	
Plus Customer Specified Information	
Input Range	
Zero Suppression (= Low); *specify*	
Minimum	0 Ω
Maximum	150 Ω
High; *specify*	
Minimum	25 Ω + Zero Suppression
Maximum	10 kΩ + Zero Suppression
Output Range	
Low; *fixed*	0 V
High; *specify*	+5 V max

Examples:
Smallest Input Range with No Zero Suppression
Specify 0 Ω to 25 Ω Input Range
Smallest Input Range with Highest Zero Suppression
Specify 150 Ω to 175 Ω Input Range
Largest Input Range with No Zero Suppression
Specify 0 Ω to 10 kΩ Input Range
Largest Input Range with Highest Zero Suppression
Specify 150 Ω to 10.150 kΩ Input Range

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Process Current Input Module

MODEL 5B42

FEATURES

Accepts 4-to-20 mA Process Current Input Signal
Provides Isolation and Regulated 20 V DC Loop Power for Nonisolated 2-Wire Transmitters
+1 V to +5 V or +2 V to +10 V Output
1500 V rms Input/Output and Input/Power Isolation
250 V rms Output/Power Isolation
140 dB Common-Mode Rejection
100 Hz Signal Bandwidth
Accuracy: ±0.05%
Linearity: ±0.01%
240 V rms Field Wiring Protection
Protected Internal Current Sense Resistor
ANSI/IEEE C37.90.1-1989 Transient Protection
CSA, FM and CE Approvals

GENERAL DESCRIPTION

Model 5B42 interfaces with 2-wire transmitters to convert their 4-to-20 mA process current signal into a high accuracy output of +1 V to +5 V or +2 V to +10 V. The module provides 1500 V isolation with 140 dB CMR, 20 V regulated loop power (at a 4-to-20 mA loop current), signal filtering, and input protection against accidental line voltage connection. The industry standard 5B Series encapsulated plug-in modular package is compatible with all 5B backplanes. Modules are powered by +5 V dc, ±5%.

Signal isolation is provided by transformer coupling using a proprietary technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the input signal, which is filtered and buffered to provide an accurate, low impedance, low noise output.

True three-port isolation includes common-mode voltage of: 1500 V rms between input and output, and between input and power; 250 V rms between output and power.

Accurate performance is maintained over a wide -40°C to +85°C operating temperature range. The 5B42's low drift design achieves an output offset drift of only ±5 µV/°C and gain drift of ±25 ppm/°C.

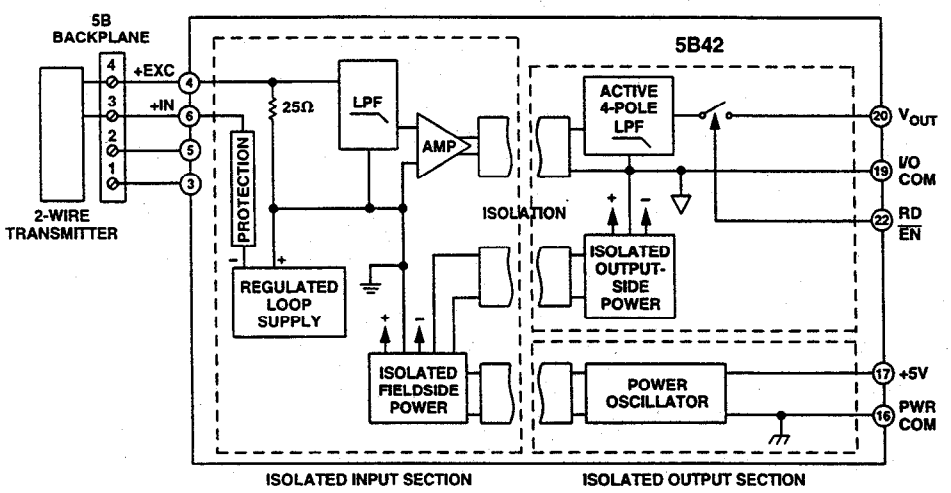
The 5B42 offers significant advantages over signal conditioners that require an external current sense resistor. An external resistor is not protected from accidental connection to ac line voltages, and its error tolerance must be added to the conditioner's specified errors.

The 5B42 is trimmed and specified including its internal 25 Ω current-sense input resistor. The 5B42 signal input, loop supply and the sense resistor are all protected against accidental application of voltages, such as an ac power line, up to 240 V rms continuous. There is no need to install an external resistor on the backplane, but if one is installed, it has no effect on the 5B42 performance.

The module has a -3 dB bandwidth of 100 Hz, an optimized 5-pole signal filter with low overshoot and exceptional output noise performance of 200 µV peak-to-peak at 100 kHz bandwidth.

The 5B42 logic-controlled series output switch eliminates the need for external multiplexing in many applications. This low output resistance switch is controlled by an active low enable input. When the output switch is not used, ground the enable input to I/O common to turn on the switch.

FUNCTIONAL BLOCK DIAGRAM



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MODEL 5B42–SPECIFICATIONS (typical @ +25°C and V_S = +5 V dc)

Model	5B42
INPUT	
Standard Ranges	4 mA to 20 mA (See Table I)
Custom Range Limits	0 mA to 20 mA (See Table II)
Input Resistor[1]	25 Ω
Loop Supply Voltage	20 V @ 4 mA to 20 mA
Normal-Mode Rejection (NMR)	
-3 dB @ 100 Hz	90 dB Per Decade Above 100 Hz
Input/Excitation/Sense Resistor Protection	
Continuous	240 V rms max
Transient	ANSI/IEEE C37.90.1-1989
COMMON-MODE VOLTAGE (CMV)	
Input-to-Output, Continuous	1500 V rms, max
Input-to-Power, Continuous	1500 V rms, max
Power-to-Output, Continuous[2]	250 V rms, max
COMMON-MODE REJECTION (CMR) 50 Hz/60 Hz[3]	140 dB
ACCURACY	
Initial @ +25°C[4]	±0.05% Span ±4 µA RTI[5]
Nonlinearity	±0.01% Span
Stability vs. Temperature (-40°C to +85°C)	
Input Offset	±0.5 µV/°C
Output Offset	±5 µV/°C
Gain	±25 ppm of Reading/°C
OUTPUT	
Range (See Tables I and II)	
5B42-01	+1 V to + 5 V
5B42-02	+2 V to +10 V
Resistance	25 Ω
Bandwidth, -3 dB	100 Hz
Step Response Time (90% Span)	4 ms
Noise	
Input, 0.1 Hz to 10 Hz	10 nA rms
Output, 100 kHz	200 µV pk-pk
Protection	Continuous Short to Ground
Current Limit	±20 mA
Enable Time (C Load = 0 pF to 2000 pF)	6 µs to ±1 mV of V_{OUT}
Enable Control	
Max Logic "0"	+0.8 V
Min Logic "1"	+2.4 V
Max Logic "1"	+36 V
Input Current "0," "1"	0.5 µA
POWER SUPPLY	
Voltage, Rated Performance	+5 V dc ± 5%
Current	
@ Transmiter Load of 20 mA	200 mA
@ Transmitter Load of 4 mA	100 mA
Sensitivity	±1 µV/% RTI[5]
CASE SIZE, Maximum	2.275" x 2.325" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
WEIGHT	70 grams
ENVIRONMENTAL	
Temperature Range, Rated Performance	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Relative Humidity	0% to 93% @ +40°C, Noncondensing
RFI Susceptibility	±0.5% Span Error @ 400 MHz, 5 W, 3'

NOTES

[1]A precision 25 Ω current-sense input resistor is internal to the 5B42.

[2]The user's board layout must separate Power Ground from I/O Common and when the 5B42 output switch is not used, ground the enable input to I/O Common. Power-to-Output CMV is not available when the 5B42 is installed on a 5B Series backplane.

[3]The use of shielded cable from the signal source to the 5B42 inputs is recommended to maintain CMR performance.

[4]Includes the combined effects of repeatability, hysteresis and nonlinearity.

[5]Referenced to Input.

Specifications subject to change without notice.

Table I. Standard Model Input/Output Ranges*

Model	Input Range	Output Range
5B42-01	4 mA to 20 mA	+1 V to +5 V
5B42-02	4 mA to 20 mA	+2 V to +10 V

*Custom input/output ranges are available. See Table II.

Table II. Custom Model Ordering Guide

Order Model: **5B42-CUSTOM** plus Customer Specified Information

Customer Specified Information:

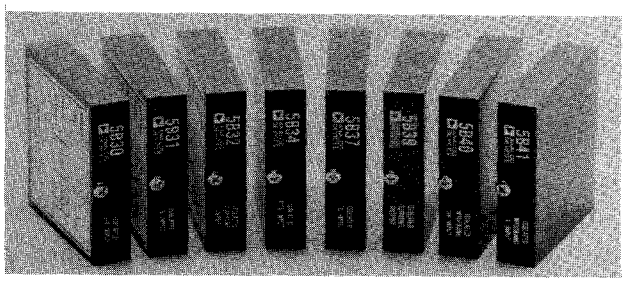
Input Range	Output Range	
Available Range	*Low Limit*	*High Limit*
0 mA to 20 mA*	0 V	10 V

*There is no loop power supplied by the 5B42 at 0 mA input.

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Chapter 1
Introduction

This manual serves as a guide to both designers of systems using 5B Series Modular Signal Conditioners and to users of a 5B Series Signal Conditioning Subsystem solution. Module functions and specifications are described in Chapter 2. The proper configuration and operation of the 5B Series Subsystem are discussed in Chapter 3, and system design issues are addressed in Chapter 4. Appendixes are devoted to available accessories, drill templates, and product notes.



General Description

The 5B Series modules are low cost, high performance plug-in signal conditioners. Designed for industrial applications, these modules incorporate a circuit design utilizing transformer-based isolation and automated surface mount manufacturing technology. This allows for long term stability and channel to channel isolation. They are compact, economical components whose performance exceeds that available from more expensive devices. Combining 1500 Vrms continuous CMV isolation, ±0.05% calibrated accuracy, small size and low cost, the 5B Series is an attractive alternative to expensive signal conditioners and in-house designs.

All modules are hard potted and identical in pinout and size (2.25″ x 2.25″ x 0.60″). They can be mixed and matched on one backplane, permitting users to address their exact needs, and may be changed without disturbing field wiring. The isolated input modules provide 0 to +5 V or –5 V to +5 V outputs (depending on model type) and accept J, K, T, E, R, S, N, and B thermocouples; 100 Ω platinum, 10 Ω copper and 120 Ω nickel RTDs; strain gages; mV, V, 4-20 mA or 0-20 mA, frequency (0 to 250 kHz), and wide bandwidth (10 kHz) mV and V signals. These modules feature complete signal conditioning functions including 240 Vrms input protection, filtering, chopper stabilized low drift (±1 µV/°C), amplification, 1500 Vrms isolation, linearization for RTD and thermocouple inputs, and sensor excitation when required. The output module converts a 0 to +5 V or ±5 V input to an isolated 4-20 mA or 0-20 mA process current signal. All modules feature excellent common mode rejection and meet IEEE-STD 472 (SWC). These modules incorporate a laser trimmed resistor network, obviating the need for potentiometer adjustments and constant calibration.

The 5B Series provides system designers with an easy to use solution for analog I/O in a minimum of board space. The modules' standard pinout and easy installation simplify design. There are also a number of backplanes, which provide a complete signal conditioning solution for end users. Each backplane incorporates screw terminals for field wiring inputs and outputs and cold junction

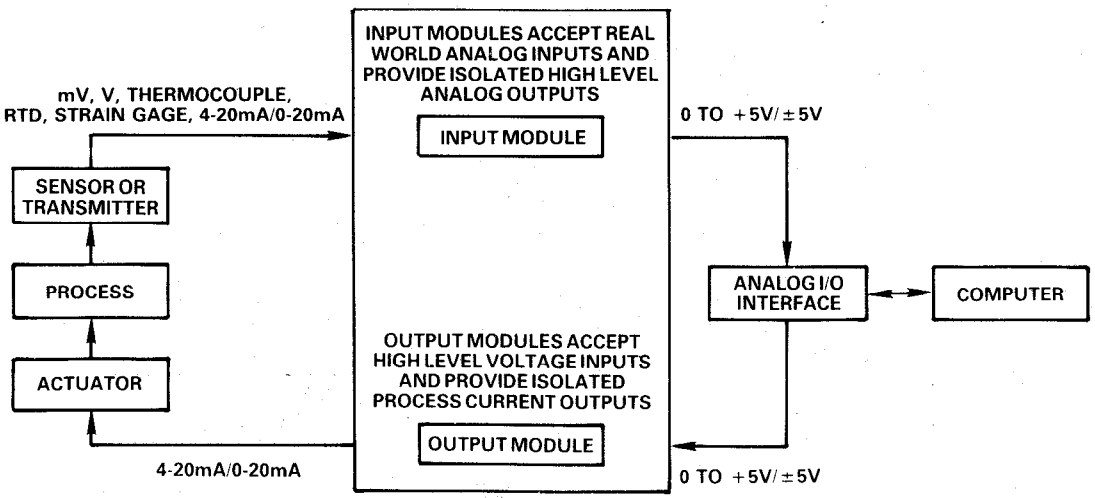


Figure 1.1. Block Diagram of a General Measurement and Control Application Using the 5B Series

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compensation sensors for thermocouple applications. 19″ relay rack compatible backplanes that can hold up to sixteen modules are available, as well as DIN rail compatible one and two channel backplanes.

Applications

The 5B Series provides an easy and convenient solution to signal conditioning problems of both designers and end users with measurement and control applications. Typical uses include mini and microcomputer based measurement systems, standard data acquisition systems, programmable controllers, analog recorders, and dedicated control systems. These modules are ideally suited to applications where monitoring and control of temperature, pressure, flow, and other analog signals are required. A general 5B Series measurement and control application is diagrammed in Figure 1.1.

FM and CSA Approvals

The 5B Series modules and backplanes are approved by Factory Mutual (FM) and 5B Series modules by the Canadian Standards Association (CSA) for use in Class I, Division 2, Groups A, B, C, and D Hazardous Locations. These approvals certify that the 5B Series is suitable for use in locations where a hazardous concentration of flammable gas may exist under fault conditions of operation. Electrical equipment of this category is classified as being "Nonincendive."

5B Series Modules

The 5B Series includes a growing family of isolated input and output modules. All are identical in size (2.25″ x 2.25″ x 0.60″) and pinout. The choice of specific modules depends on the signals involved in a particular application. The transfer function provided by each input module is:

Input: specified sensor measurement range
Output: 0 to +5 V or –5 V to +5 V

The transfer function provided by each output module is:

Input: 0 to +5 V or –5 V to +5 V
Output: 4-20 mA or 0-20 mA

The available functions are listed in Table 1.1. Many standard configurations of each module are available and factory laser trimmed custom units can be supplied. Wide zero suppression capability allows a user to map any portion of the input signal into the full output span, permitting improved system resolution within a selected measurement range.

Existing, conditioned signals can be connected into the 5B Series backplane through the AC1367 Switch Input Module.

Table 1.1. Available 5B Series Modules

Module	Function	Output
5B30	Isolated mV Input	0 to +5 V or –5 V to +5 V
5B31	Isolated V Input	0 to +5 V or –5 V to +5 V
5B32	Isolated Current Input	0 to +5 V
5B34	Isolated 2, 3, or 4 Wire* RTD Input – 100 Ω Pt, 10 Ω Cu, or 120 Ω Ni	0 to +5 V
5B37	Isolated Thermocouple Input – Type J, K, T, E, R, S, or B	0 to +5 V
5B38	Isolated Strain Gage Input for Full Bridge or Half Bridge	–5 V to +5 V
5B39	Isolated Current Output	4-20 mA or 0-20 mA
5B40	Isolated Wide Bandwidth mV Input	0 to +5 V or –5 V to +5 V
5B41	Isolated Wide Bandwidth V Input	0 to +5 V or –5 V to +5 V
5B45	Isolated Frequency Input 0 to 10 kHz Input	0 to +5 V or –5 V to +5 V
5B46	Isolated Frequency Input 0 to 250 kHz Input	0 to +5 V or –5 V to +5 V
5B47	Isolated Linearized Thermocouple Input – Type J, K, T, E, R, S, or B	0 to +5 V

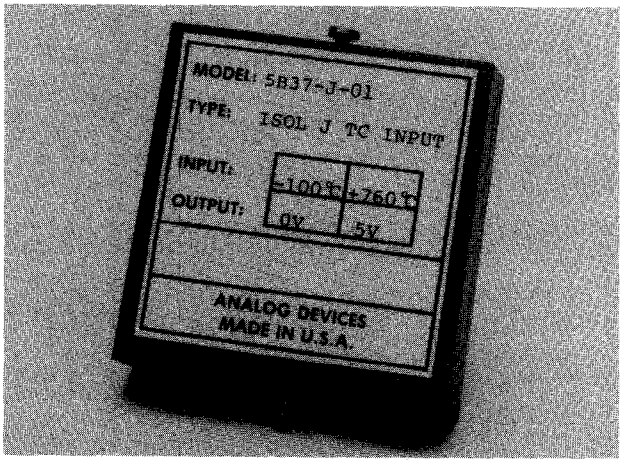
*The 5B34 RTD input module provides 3 wire lead resistance compensation and can be connected to 2, 3, or 4 wire RTDs.

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Chapter 2
Module Specifications

Features

- **Compact, Low Cost Signal Conditioners**
- **Analog Input Modules for Direct Interface to Sensors: Thermocouples, RTDs, and Strain Gages**
  Millivolt and Voltage Sources
  Process Current Inputs
- **Analog Output Module**
  4-20 mA or 0-20 mA Process Current Output
- **Complete Signal Conditioning Function**
  240 Vrms Field Wiring Protection, Filtering, Amplification, 1500 Vrms CMV Isolation, High Noise Rejection, RFI/EMI Immunity, and Wide Range Zero Suppression
- **High Accuracy: ±0.05%**
- **Low Drift: ±1 µV/°C**
- **–25°C to +85°C Rated Temperature Range**
- **Mix and Match Module Capability**
- **No Potentiometer Adjustments**
- **Custom Ranges Available**



Module Description

The 5B Series modules were designed for harsh industrial environments, with modules hard potted for durability. They incorporate a circuit design utilizing transformer based isolation and automated surface mount manufacturing technology, which yields devices that are small, low-cost, and highly reliable. All modules operate from a single +5 V supply.

Performance

The 5B Series provides excellent signal conditioning performance. Each unit is laser trimmed for high calibrated accuracy. Typical calibrated accuracy is comprised of ±0.05% span ±10 µV RTI ±0.05 Vz (Vz the input voltage that results in a 0 V output). Refer to the specific module data page for more detailed information. Chopper-stabilized amplification provides low drift and outstanding long term stability without the need for potentiometer adjustments. 1500 Vrms transformer isolation for the signal and power sections eliminates ground loops, guards against transients, prevents common mode voltage problems, and ensures channel to channel isolation. 160 dB common mode rejection, 90 dB normal mode rejection, and RFI/EMI immunity maintain signal integrity.

Evaluation and Test

A single channel socket, AC1360, is available for module evaluation. It is discussed in Chapter 4.

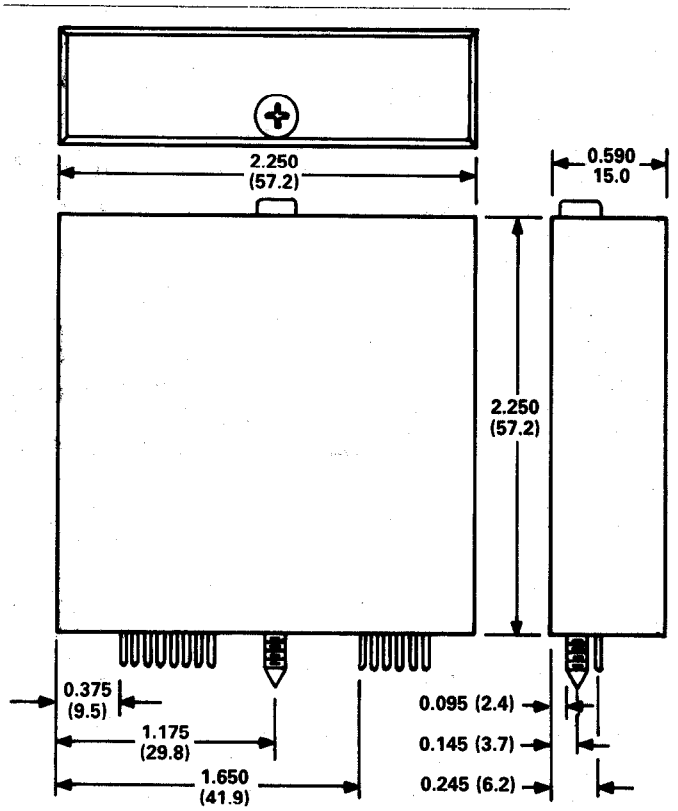
Protection

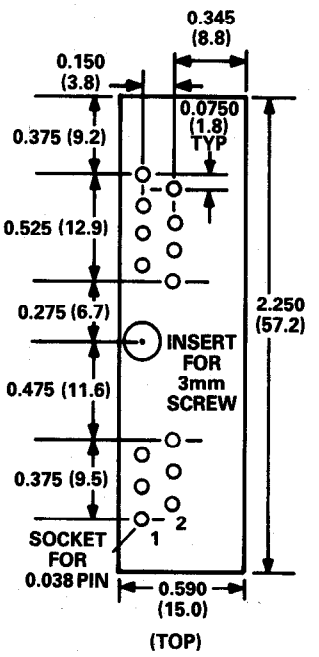
All field wired terminations, including sensor inputs, excitation circuitry, and current outputs, are protected against the inadvertent application of 240 Vrms line voltage. The 5B Series modules have also been designed to meet the IEEE standard for transient voltage protection (IEEE-STD 472 (SWC)).

Physical Characteristics

All 5B Series modules are identical in pinout and size (Figure 2.1), and they can therefore be mixed and matched on a backplane, permitting users to address their exact needs. The modules are hard potted, typically weigh 2.25 ounces (64 grams), and have sturdy 40 mil gold plated pins. The module cases are made from a thermoplastic resin, which has a fire retardent rating of 94 V-O and is designed for use from –55°C to +85°C. The modules are secured in the backplane by means of a tapered screw also serving as a guide for insertion. For ready identification, the isolated input modules are labeled with white lettering on a black background, the isolated output modules are labeled with white letters on a red background, and the nonisolated switch inputs are labeled with black lettering on a white background.

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PIN DESIGNATIONS

WRITE EN (0)	23	22	READ EN (0)
RESERVED	21	20	V_{OUT}
I/O COM	19	18	V_{IN}
+5V	17	16	POWER COM
		6	IN HI
IN LO	5	4	+EXC
−EXC	3	2	SENSOR +
SENSOR −	1		

Figure 2.1. 5B Series Module Outline and Pin Designations (dimensions in inches and (mm))

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Input Modules

- **Variety of Signal Source Inputs**
  - **Sensors: Thermocouples, RTDs, Tachometers, Flow Meters, and Strain Gages**
  - **Millivolt and Voltage Sources**
  - **4-20 mA or 0-20 mA Process Current Inputs**
- **Mix and Match Input Capability**
- **High Level Voltage Output: –5 V to +5 V or 0 to +5 V**
- **High Accuracy: ±0.05%**
- **Low Drift: ±1 µV/°C**
- **Reliable Transformer Isolation: 1500 Vrms CMV, 160 dB CMR, Meets IEEE-STD 472: Transient Protection (SWC)**
- **Input Protection: 240 Vrms Continuous**
- **Factory Ranged and Trimmed, Custom Ranges Available**

The 5B Series input modules are galvanically isolated, single channel, plug-in signal conditioners that provide input protection, amplification and filtering, and a high level, series-switched analog output, which can eliminate the need for external multiplexers. Key specifications include: 1500 Vrms isolation, calibrated accuracy of ±0.05%, ±0.02% span nonlinearity, and low drift of ±1 µV/°C.

5B Series input modules, listed in Table 2.1, are selected to meet the requirements of each application. The transfer function provided by each module is:

Input: specified sensor measurement range
Output: 0 to +5 V or –5 V to +5 V

Input modules are available to accept millivolt, volt, process current, thermocouple, RTD, and strain gage inputs. Each module is available in a number of standard ranges to meet most applications. Special 5B Series input module ranges can be ordered from the factory. A wide zero suppression capability allows any portion of the input signal to be mapped into the full output span permitting improved system resolution within a selected measurement range.

Output Module

- **High Level Voltage Inputs: 0 to +5 V or –5 V to +5 V**
- **Process Current Output: 4-20 mA or 0-20 mA**
- **High Accuracy: ±0.05%**
- **Reliable Transformer Isolation: 1500 Vrms CMV, CMR=90 dB**
- **Meets IEEE-STD 472: Transient Protection (SWC)**
- **Output Protection: 240 Vrms continuous**
- **Internal Track and Hold Amplifier**

The 5B39 current output module accepts a high level analog signal at its input and provides a galvanically isolated 4-20 mA or 0-20 mA process current signal at its output. The module features high accuracy of ±0.05%, ±0.02% nonlinearity, and 1500 Vrms common mode voltage isolation protection.

The transfer function provided by this module is:

Input: 0 to +5 V or –5 V to +5 V
Output: 4-20 mA or 0-20 mA

Voltage Switch Input Module

Conditioned signals can be brought into the 5B backplane with the AC1367 Voltage Switch Input Module. This is a nonisolated, zero gain module incorporating a selectable output switch.

Table 2.1. 5B Series Input Modules

Module	Function	Output
5B30	Isolated mV Input	0 to +5 V or –5 V to +5 V
5B31	Isolated V Input	0 to +5 V or –5 V to +5 V
5B32	Isolated Current Input	0 to +5 V
5B34	Isolated 2, 3 or 4 Wire* RTD Input – 100 Ω Pt, 10 Ω Cu, or 120 Ω Ni	0 to +5 V
5B37	Isolated Thermocouple Input – Type J, K, T, E, R, S, N, or B	0 to +5 V
5B38	Isolated Strain Gage Input – Full Bridge and Half Bridge	–5 V to +5 V
5B40	Isolated Wide Bandwidth mV Input	0 to +5 V or –5 V to +5 V
5B41	Isolated Wide Bandwidth V Input	0 to +5 V or –5 V to +5 V
5B45	Isolated Frequency Input – 0 to 10 kHz Input	0 to +5 V or –5 V to +5 V
5B46	Isolated Frequency Input – 0 to 250 kHz Input	0 to +5 V or –5 V to +5 V
5B47	Isolated Linearized Thermocouple Input – Type J, K, T, E, R, S, or B	0 to +5 V

*The 5B34 RTD input module provides 3 wire lead resistance compensation and can be connected to 2, 3, or 4 wire RTDs.

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5B30 and 5B31 Millivolt and Voltage Input Modules

The 5B30 millivolt input module accepts ±5 to ±500 millivolt input signals and provides either a –5 V to +5 V or 0 to +5 V output. The 5B31 voltage input module accepts ±0.5 V to ±10 V input signals and provides either a –5 V to +5 V or 0 to +5 V output.

Figure 2.2 is a functional block diagram for the 5B30 and 5B31. A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input screw terminals, and, in the 5B31, the input signal is attenuated by a factor of 20 at this point. A three-pole filter with a 4 Hz cutoff provides 60 dB of normal-mode rejection and CMR enhancement at 60 Hz. (One pole of this filter is located at the module input, while the other two poles are in the output stage for optimum noise performance.) A chopper-stabilized input amplifier provides all of the module's gain and assures low drift. This amplifier operates on the input signal after subtraction of a stable, laser-trimmed voltage, which sets the zero-scale input value. It is, therefore, possible to suppress a zero-scale input that is many times the total span to provide precise expanded scale measurements.

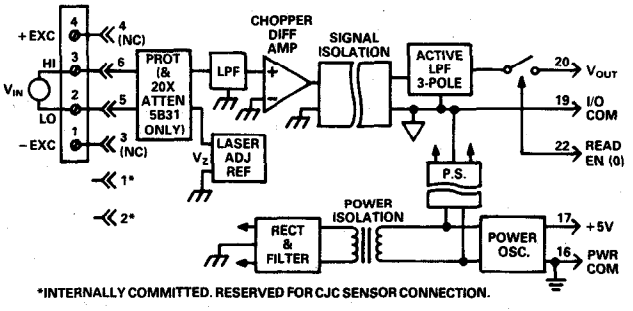


Figure 2.2. 5B30 and 5B31 Functional Block Diagram

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

5B30 and 5B31 Ordering Information

Input Range	Output Range	Model
–10 mV to +10 mV	–5 V to +5 V	5B30-01
–50 mV to +50 mV	–5 V to +5 V	5B30-02
–100 mV to +100 mV	–5 V to +5 V	5B30-03
–10 mV to +10 mV	0 to +5 V	5B30-04
–50 mV to +50 mV	0 to +5 V	5B30-05
–100 mV to +100 mV	0 to +5 V	5B30-06
–1 V to +1 V	–5 V to +5 V	5B31-01
–5 V to +5 V	–5 V to +5 V	5B31-02
–10 V to +10 V	–5 V to +5 V	5B31-03
–1 V to +1 V	0 to +5 V	5B31-04
–5 V to +5 V	0 to +5 V	5B31-05
–10 V to +10 V	0 to +5 V	5B31-06

NOTE: The -04, -05, and -06 ranges of models 5B30 and 5B31 map bipolar input ranges into unipolar output ranges; 0 maps to +2.5 V.

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5B30 and 5B31 Specifications (typical @ 25°C and +5 V Power)

	5B30	5B31
Input Span Limits	±5 mV to ±0.5 V	±0.5 V to ±10 V
Output Ranges	–5 V to +5 V or 0 to +5 V	*
Accuracy[1]	±0.05% span ±10 µV RTI ±0.05% (Vz†)	±0.05% span ±0.2 mV RTI ±0.05%(Vz†)
Nonlinearity	±0.02% span	*
Stability vs. Ambient Temperature		
Input Offset	±1 µV/°C	±20 µV/°C
Output Offset	±20 µV/°C	*
Gain	±25 ppm of reading/°C	±50 ppm of reading/°C
Input Bias Current	±3 nA	±0.2 nA
Input Resistance		
Normal	5 MΩ	650 kΩ
Power Off	40 kΩ	650 kΩ
Overload	40 kΩ	650 kΩ
Noise		
Input, 0.1-10 Hz	0.2 µVrms RTI	2 µVrms RTI
Output, 100 kHz	200 µVrms RTO	*
Bandwidth, –3 dB	4 Hz	*
Rise Time, 10% to 90% Span	0.2 s	*
CMV, Input to Output		
Continuous	1500 Vrms max	*
Transient	meets IEEE-STD 472 (SWC)	*
CMR (50 or 60 Hz) 1 kΩ in Either or Both Input Leads	160 dB (all ranges)	160 dB (span <±2 V) 150 dB (span =±10 V)
NMR (50 or 60 Hz)	60 dB	*
Input Protection		
Continuous	240 Vrms max continuous	*
Transient	meets IEEE-STD 472 (SWC)	*
Output Resistance[2]	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs	*
Output Selection Input		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Sensitivity	±2 µV/Vs% (RTI)	±0.4 mV/Vs% (RTI)
Power Consumption	150 mW (30 mA)	*
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)	*
Environmental		
Temperature Range, Rated Performance	–25°C to +85°C	*
Temperature Range, Operating	–40°C to +85°C	*
Temperature Range, Storage	–40°C to +85°C	*
Relative Humidity (MIL 202)	0 to 95% @ 60°C noncondensing	*
RFI Susceptibility	±0.5% span error @ 400 MHz, 5 W, 3'	*

*Specifications same as 5B30.

†Vz is the nominal input voltage that results in a 0 V output.

[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes very high load resistance.

[2]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.

Specifications subject to change without notice.

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5B32 Current Input Module

The 5B32 current input module measures a 4-20 mA or 0-20 mA process current input signal by reading the voltage across a precision 20 Ω resistor. It provides a 0 to +5 V output signal.

Figure 2.3 is a functional block diagram for the 5B32. Since the resistor cannot be protected against destruction in the event of an inadvertent connection of the power line, it is provided in the form of a separate pluggable resistor carrier assembly. Extra current conversion resistors are available as accessories (model number AC1362 – see Note 2). A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input screw terminals. A three-pole filter with a 4 Hz cutoff provides 60 dB of normal-mode rejection and CMR enhancement at 60 Hz. (One pole of this filter is located at the module input, while the other two poles are in the output stage for optimum noise performance.) A chopper-stabilized input amplifier provides all of the module's gain and assures low drift. This amplifier operates on the input signal after subtraction of a stable, laser trimmed voltage, which sets the zero-scale input value for the 4-20 mA range. The laser trim process can also be used to customize units to meet special requirements.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

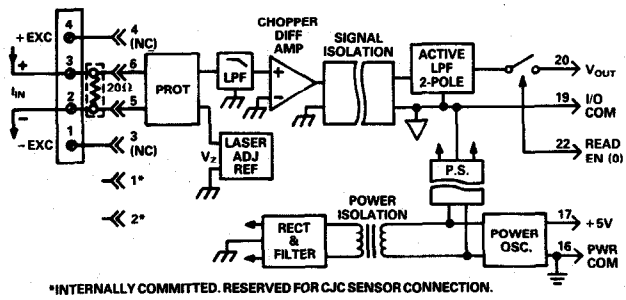


Figure 2.3. 5B32 Functional Block Diagram

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

Notes:

(1) A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

(2) The AC1362 is a 20 Ω, 0.1% (typical), 1/4 watt, 20 ppm/°C resistor which is fully encapsulated. The resistor tolerance will directly affect the performance of the data acquisition system and should be included in the worst case analysis of the system. The AC1362 is shipped with the 5B32 module. Spares may be ordered as part number AC1362.

5B32 Ordering Information

Input Range	Output Range	Model
4-20 mA	0 to +5 V	5B32-01
0-20 mA	0 to +5 V	5B32-02

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5B32 Specifications (typical @ 25°C and +5V Power)

Input Ranges	0 to 20 mA, 4 to 20 mA
Output Range	0 to +5 V
Accuracy[1]	±0.05% span ±0.05% (Iz†)
Input Resistor[2]	
Value	20.00 Ω
Accuracy	±0.1%
Nonlinearity	±0.02% span
Stability vs. Ambient Temperature	
Module Offset	±0.0025%/°C of Iz†
Module Gain	±0.0025%/°C of reading/°C
Stability of Supplied Input Resistor	±0.001%/°C
Noise	
Input, 0.1-10 Hz	10 nArms RTI
Output, 100 kHz	200 µVrms RTO
Bandwidth, –3 dB	4 Hz
Rise Time, 10% to 90% Span	0.2 s
CMV, Input to Output	
Continuous	1500 Vrms max
Transient	meets IEEE-STD 472 (SWC)
CMR (50 or 60 Hz)	
1 kΩ in Either or Both Input Leads	160 dB (all ranges)
NMR (50 or 60 Hz)	60 dB
Input Protection	
Continuous	240 Vrms max continuous
Transient	meets IEEE-STD 472 (SWC)
Output Resistance[3]	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs
Output Selection Input	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Power Supply Voltage	+5 V ±5%
Power Supply Sensitivity	±2 µV/Vs% (RTI)
Power Consumption	150 mW (30 mA)
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)
Environmental	
Temperature Range, Rated Performance	–25°C to +85°C
Temperature Range, Operating	–40°C to +85°C
Temperature Range, Storage	–40°C to +85°C
Relative Humidity (MIL 202)	0 to 95% @ 60°C noncondensing
RFI Susceptibility	±0.5% span error @ 400 MHz, 5W, 3'

†Iz is the nominal value of input current which results in an output of 0 V.
[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes very high load resistance. Does not include input resistor error.
[2]The current-to-voltage conversion resistor (AC1362) is supplied as a plug-in component for mounting external to the module.
[3]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.
Specifications subject to change without notice.

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5B34 RTD Input Module

The 5B34 RTD input module accepts a wide variety of RTD types as inputs and provides a linearized output of 0 to +5 V.

Figure 2.4 is a functional block diagram of the 5B34. Excitation for the RTD is provided by a current source, with an identical current taken through the third RTD lead in such a way as to cancel the effects of (equal) lead resistances. The second current also flows in Rz, which is laser-trimmed to the value of the RTD at the temperature that is to result in a module output of zero volts. Thus the input seen by the differential amplifier will be zero at that scale point. Since both current sources are connected to input screw terminals, they are protected against accidental application of voltages up to 240 Vrms. A pair of protection networks serves the same function for the amplifier, and input filtering is provided at the same points.

The differential amplifier is a chopper-stabilized design featuring exceptionally low drift. This makes possible the use of very low RTD excitation currents to minimize self-heating without incurring any loss of accuracy. A feedback linearizer is laser-trimmed along with the module's gain and zero settings. The laser trim process can also be used to customize units to meet special requirements.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many

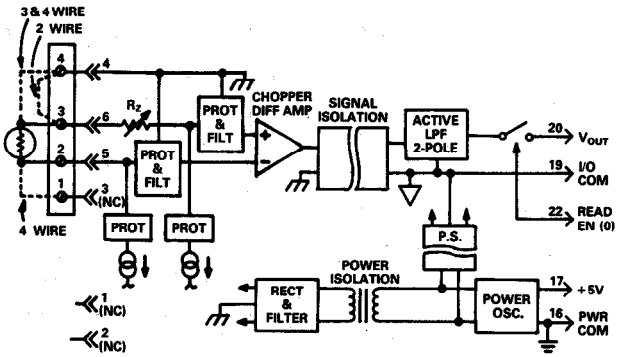


Figure 2.4. 5B34 Functional Block Diagram

applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

5B34 Ordering Information

Input Range	Output Range	Model
100 Ω Pt, α = 0.00385*		
–100°C to +100°C (–148°F to +212°F)	0 to +5 V	5B34-01
0 to +100°C (+32°F to 212°F)	0 to +5 V	5B34-02
0 to +200°C (+32°F to 392°F)	0 to +5 V	5B34-03
0 to +600°C (+32°F to 1112°F)	0 to +5 V	5B34-04
10 Ω Cu		
0 to +120°C (10 Ω @ 0°C) (+32°F to +248°F)	0 to +5 V	5B34-C-01
0 to +120°C (10 Ω @ 25°C) (+32°F to +248°F)	0 to +5 V	5B34-C-02
120 Ω Ni		
0 to +300°C (+32°F to +572°F)	0 to +5 V	5B34-N-01

*The "-CUSTOM" version of the 5B34, 100 Ω Platinum may be ordered with an alpha of 0.00397.

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5B34 Specifications (typical @ 25°C and +5 V Power)

Input Span Limits	25°C to 1070°C (100 Ω Pt)
Output Range	0 to +5 V
Accuracy[1]	±0.05% span ±0.04 Ω* ±0.05% (Rz†)
Conformity Error[2]	±0.05% span
Stability vs. Ambient Temperature Input Offset Output Offset Gain	 ±0.02°C/°C ±20 µV/°C ±50 ppm of reading/°C
Input Bias Current	±3 nA
Input Resistance Normal Power Off Overload	 5 MΩ 40 kΩ 40 kΩ
Noise Input, 0.1-10 Hz Output, 100 kHz	 0.2 µVrms RTI 200 µVrms RTO
Bandwidth, –3 dB	4 Hz
Rise Time, 10% to 90% Span	0.2 s
CMV, Input to Output Continuous Transient	 1500 Vrms max meets IEEE-STD 472 (SWC)
CMR (50 or 60 Hz) 1 kΩ in Either or Both Input Leads	 160 dB (all ranges)
NMR (50 or 60 Hz)	60 dB
Sensor Excitation Current 100 Ω Pt, 120 Ω Ni 10 Ω Cu	 0.25 mA 1.0 mA
Lead Resistance Effect 100 Ω Pt, 120 Ω Ni 10 Ω Cu	 ±0.02°C/Ω ±0.2°C/Ω
Input Protection Continuous	 240 rms max continuous
Output Resistance[3]	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time (C_L = o to 2,000 pF)	6 µs
Output Selection Input Max Logic "0" Min Logic "1" Max Logic "1" Input Current "0"	 +1 V +2.5 V +36 V 0.4 mA
Power Supply Voltage	+5 V ±5%
Power Supply Sensitivity 100 Ω Pt, 120 Ω Ni 10 Ω Cu	 0.05°C/V 0.5°C/V
Power Consumption	150 mW (30 mA)
Size	2.25″ x 2.25″ x 0.60″ (52 mm x 52 mm x 15 mm)
Environmental Temperature Range, Rated Performance Temperature Range, Operating Temperature Range, Storage Relative Humidity (MIL 202)	 –25°C to +85°C –40°C to +85°C –40°C to +85°C 0 to 95% @ 60°C noncondensing

*±0.025 Ω for Cu RTD's
±0.1 Ω for Ni RTD's.

†Rz is the value of the RTD resistance at the lowest point of the measurement range.

[1]Includes the combined effects of repeatability, hysteresis, and linearity and assumes very high load resistance. Does not include sensor or signal source error.

[2]For Pt RTDs only; other types may vary.

[3]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.

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5B37 Thermocouple Input Module

The 5B37 thermocouple input module accepts input signals from types J, K, T, E, R, S, and B thermocouples and provides a 0 to +5 V output. Figure 2.5 is a functional block diagram for the 5B37. Cold junction compensation circuitry corrects for the effects of the parasitic thermocouples formed by thermocouple wire connections to the input screw terminals. The compensator provides an accuracy of ±0.5°C over the +5°C to +45°C ambient temperature range. A bias current supplied through resistor Roc gives a predictable upscale response to an open thermocouple. (Downscale open thermocouple detection can be provided by installing a 50 MΩ resistor across screw terminals 1 and 3. This resistor could be a 0.25 W carbon composition; ±20% tolerance is suitable.)

A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input screw terminals. A three-pole filter with a 4 Hz cutoff provides 60 dB of normal-mode rejection and CMR enhancement at 60 Hz. (One pole of this filter is located at the module input, while the other two poles are in the output stage for optimum noise performance.) A chopper-stabilized input amplifier provides all of the module's gain and assures low drift. This amplifier operates on the input signal after subtraction of a stable, laser-trimmed voltage, which sets the zero-scale input value. It is, therefore, possible to suppress a zero-scale input that is many times the total span to provide precise expanded scale measurements.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases

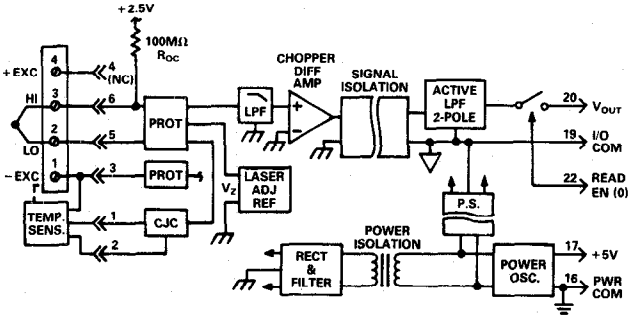


Figure 2.5. 5B37 Functional Block Diagram

where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

To determine the output voltage of the 5B37 module, refer to Appendix D. The 5B37 transfer function is given for each model (e.g., 5B37-N-08).

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

Caution:

When evaluating 5B37 modules with a mV source, the cold junction temperature sensor will introduce errors. See the AC1360 discussion in Chapter 4.

5B37 Ordering Information

Input Type	Range	Output Range	Model
Type J	–100°C to +760°C (–148°F to +1400°F)	0 to +5 V	5B37-J-01
Type K	–100°C to +1350°C (–148°F to +2462°F)	0 to +5 V	5B37-K-02
Type T	–100°C to +400°C (–148°F to +752°F)	0 to +5 V	5B37-T-03
Type E	0 to +900°C (+32°F to +1652°F)	0 to +5 V	5B37-E-04
Type R	0 to +1750°C (+32°F to +3182°F)	0 to +5 V	5B37-R-05
Type S	0 to +1750°C (+32°F to +3182°F)	0 to +5 V	5B37-S-05
Type B	0 to +1800°C (+32°F to +3272°F)	0 to +5 V	5B37-B-06
Type N	0 to +1300°C (+32°F to +2372°F)	0 to +5 V	5B37-N-08

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5B37 Specifications (typical @ 25°C and +5 V Power)

Input Span Limits	±5 mV to ±0.5 V
Output Range	0 to +5 V
Accuracy[1]	±0.05% span ±10 µV RTI ±0.05% (Vz†) + CJC Sensor, if applicable
Nonlinearity	±0.02% span
Stability vs. Ambient Temperature	
Input Offset	1 µV/°C
Output Offset	±20 µV/°C
Gain	±25 ppm of reading/°C
Input Bias Current	–25 nA
Input Resistance	
Normal	5 MΩ
Power Off	40 kΩ
Overload	40 kΩ
Noise	
Input, 0.1/10 Hz	0.2 µVrms RTI
Output, 100 kHz	200 µVrms RTO
Bandwidth, –3 dB	4 Hz
Rise Time, 10% to 90% Span	0.2 s
CMV, Input to Output	
Continuous	1500 Vrms max
Transient	meets IEEE-STD 472 (SWC)
CMR (50 or 60 Hz)	
1 kΩ in Either or Both Input Leads	160 dB (all ranges)
NMR (50 or 60 Hz)	60 dB
Input Protection	
Continuous	240 Vrms max continuous
Output Resistance[2]	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs
Output Selection Input	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA
Open Input Response	upscale
Open Input Detection Time	10 s
Cold Junction Compensation	
Initial Accuracy @ +25°C[3]	±0.25°C (±0.75°C max)
Over +5°C to +45°C	±0.5°C (±0.0125°C/°C)
Power Supply Voltage	+5 V ±5%
Power Supply Sensitivity	±2 µV/Vs% (RTI)
Power Consumption	150 mW (30 mA)
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)
Environmental	
Temperature Range, Rated Performance	–25°C to +85°C
Temperature Range, Storage	–40°C to +85°C
Temperature Range, Operating	–40°C to +85°C
Relative Humidity (MIL 202)	0 to 95% @ 60°C noncondensing
RFI Susceptibility	±0.5% span error @ 400 MHz, 5 W, 3'

†Vz is the nominal input voltage that results in a 0 V output.

[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes very high load resistance.

[2]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.

[3]When used with AC1361 CJC sensor (see Chapter 4), which is provided on each channel of 5B Series backplanes and on the AC1360.

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5B38 Strain Gage Input Module

The 5B38 wide bandwidth strain gage input module accepts signals from full bridge and half bridge 300 Ω to 10 kΩ transducers. The 5B38 provides +10 V excitation and produces an output of –5 V to +5 V. This module features a bandwidth of 10 kHz.

Figure 2.6 is a functional block diagram of the 5B38. A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input screw terminals. The excitation section provides +10 V. Since the excitation lines are not sensed at the strain gage, care should be taken to minimize any IR loss in these wires. This can be accomplished by the use of heavy gage wires or the shortest length of wire possible. A one pole anti-aliasing filter is located at the module's input, while a three pole low pass filter in the output stage sets the bandwidth and yields optimum noise performance. A low drift amplifier provides the module's gain.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is fully floating. In addition, the output section acts as a third floating port, eliminating

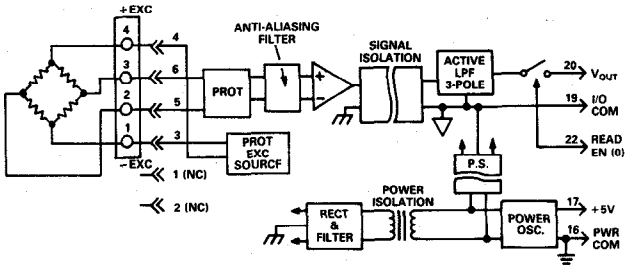


Figure 2.6. 5B38 Functional Block Diagram

many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

The 5B38 can be used with half-bridge transducers since the module contains bridge completion circuitry. The module can be factory configured for wide input ranges to accommodate the DC offset created by mismatches in the transducer. There is no provision for use with quarter or three-quarter-bridge strain gages. However, the user may complete the bridge to the half or full-bridge level external to the module and use the 5B38 module.

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

5B38 Ordering Information

Input Bridge	Range and Excitation	Output Range	Model
Full Bridge	10.0 V excitation, @ 3 mV/V Sensitivity, 300 Ω to 10 kΩ	–5 V to +5 V	5B38-02
Half Bridge	10.0 V excitation, @ 3 mV/V Sensitivity, 300 Ω to 10 kΩ	–5 V to +5 V	5B38-04
Full Bridge	10.0 V excitation, @ 2 mV/V Sensitivity, 300 Ω to 10 kΩ	–5 V to +5 V	5B38-05

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5B38 Specifications (typical @ 25°C and +5 V Power)

	Full Bridge	Half Bridge
Models	5B38-02, 5B38-05	5B38-04
Input Span Limits	±30 mV @ 3 mV/V Sensitivity ±20 mV @ 2 mV/V Sensitivity	±30 mV @ 3 mV/V Sensitivity
Output Range	–5 V to +5 V	*
Accuracy[1]	±0.08% span ±10 µV RTI	±0.08% span ± 1 mV RTI
Nonlinearity	±0.02% span	*
Excitation Output[2]	+10 V ± 3 mV	*
Excitation Load Regulation	±5 ppm/mA	*
Half Bridge Voltage Level	N/A	(Excitation Voltage/2) ±1 mV
Stability vs. Ambient Temperature		
Input Offset	1 µV/°C	*
Output Offset	±40 µV/°C	*
Gain	±25 ppm of reading/°C	*
Excitation Voltage	±15 ppm/°C	*
Half Bridge	N/A	±15 ppm/°C
Input Bias Current	±3 nA	*
Input Resistance		
Normal	20 MΩ minimum	*
Power Off	40 kΩ minimum	*
Overload	40 kΩ minimum	*
Noise		
Input, bandwidth = 10 Hz	0.4 µVrms RTI	±2 µVrms RTI
Input, bandwidth = 10 kHz	±70 nV/√Hz RTI	±250 nV/√Hz RTI
Output, bandwidth = 100 kHz	10 mV p-p RTO	*
Bandwidth, –3 dB	10 kHz	*
Rise Time, 10% to 90% Span	40 µs	*
Settling Time (to 0.1%)	250 µsec	7 msec
CMV, Input to Output		
Continuous	1500 Vrms max	*
Transient	meets IEEE-STD 472 (SWC)	*
CMR (50 or 60 Hz) 1 kΩ in Either or Both Input Leads	100 dB	*
Input Protection		
Continuous	240 Vrms max continuous	*
Output Resistance	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs	*
Output Selection Input		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Sensitivity	25 ppm reading/% ± 2.5 µV RTI/%	*
Power Consumption	1 W full load, .6 W no load	*
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)	*
Environmental		
Temperature Range, Rated Performance	–25°C to +85°C	*
Temperature Range, Storage	–40°C to +85°C	*
Temperature Range, Operating	–40°C to +85°C	*
Relative Humidity (MIL 202)	0 to 95% @ 60°C noncondensing	*
RFI Susceptibility	±0.5% span error @ 400 MHz, 5W, 3'	*

[1]Includes the combined effects of gain, offset and excitation errors, repeatability, hysteresis, and nonlinearity.
[2]At full load (300 Ω).
*Same as full-bridge versions.

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5B39 Current Output Module

The 5B39 current output module accepts a high level analog signal at its input and provides a galvanically isolated 4-20 mA or 0-20 mA process current signal at its output. The module features high accuracy of ±0.05%, ±0.02% nonlinearity and 1500 Vrms common mode voltage isolation protection.

Figure 2.7 is a functional block diagram of the 5B39 current output module. The voltage input, usually from a digital-to-analog converter, is buffered and a quarter scale offset is added if a 4-20 mA output is specified.

The signal is latched in a track and hold circuit. This track-and-hold allows one DAC to serve numerous output channels. The output droop rate is 80 µA/s, which corresponds to a refresh interval of 25 ms for 0.01% FS droop. The track-and-hold is controlled by an active-low enable input. On power-up, the output of the 5B39 remains at 0 mA for approximately 100 ms, allowing the user to initialize the track-and-hold.

In conventional applications where one DAC is used per channel and the track-and-hold is not used, the enable input should be grounded to power common, as it is on the 5B01 backplane. This keeps the module in tracking mode.

The signal is sent through an isolation barrier to the current output (V-to-I converter) stage. Signal isolation is provided by transformer coupling using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and converted to a current output. Output protection allows safe operation even in the event of a 240 Vrms power line being connected to the signal terminals.

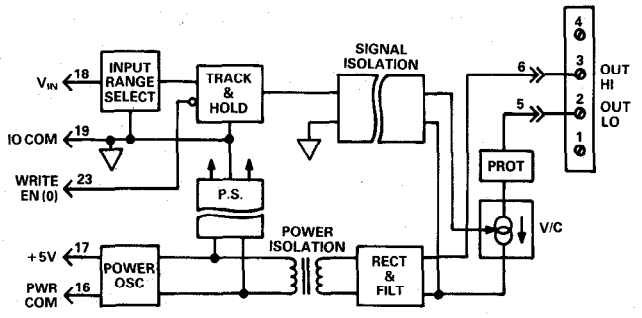


Figure 2.7. 5B39 Functional Block Diagram

A single +5 V supply powers a clock oscillator, which drives power transformers for the input circuit and the output's high-compliance, current loop supply. The output current loop is, of course, fully floating. In addition, the input section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the input circuit is limited; however, input common must be kept within ±1 V of power common.

Notes:

(1) A current path must exist between input common and power common at some point for proper operation of the module. See Chapter 4 for details.

(2) The 0 to 20 mA output of a 5B39-04 can be converted to a 0 to 10 V output by dropping a 500 Ω resistor across the output terminals.

This voltage output should be used cautiously. Since it is not a true voltage source, the tolerance of the resistor and load impedances that are not large relative to the conversion resistor will introduce errors. A load impedance >500 kΩ would contribute <0.1% error.

5B39 Ordering Information

Input Range	Output Range	Model
0 to +5 V	4-20 mA	5B39-01
–5 V to +5 V	4-20 mA	5B39-02
0 to +5 V	0-20 mA	5B39-03
–5 V to +5 V	0-20 mA	5B39-04

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5B39 Specifications (typical @25°C and +5 V Power)

Standard Input Ranges	0 to +5 V or –5 V to +5 V
Standard Output Ranges	4-20 mA or 0-20 mA
Load Resistance Range[1]	0 to 650 Ω
Accuracy[2]	±0.05% span
Nonlinearity	±0.02% span
Stability vs. Ambient Temperature Zero Span	 ±0.5 µA/°C ±20 ppm of reading/°C
Output Ripple, 100 Hz bandwidth	30 µA peak-peak
Common Mode Voltage Output to Input and Power Supply	 1500 Vrms continuous
Common Mode Rejection	90 dB
Normal Mode Output Protection	240 Vrms continuous
Output Transient Protection	Meets IEEE-STD 472 (SWC)
Sample & Hold: Output Droop Rate Acquisition Time	 80 µA/s 50 µs
Overrange Capability	10%
Maximum Output Under Fault	26 mA
Input Resistance	10 MΩ
Bandwidth, –3 dB	400 Hz
Rise Time, 10% to 90% Span	2 ms
Track-and-Hold Enable Max Logic "0" Min Logic "1" Max Logic "1" Input Current "0"	 +1 V +2.5 V +36 V 1.5 mA
Power Supply	+5 V dc ±5%
Power Supply Sensitivity	±0.25 µA/Vs%
Power Consumption	0.85 W (170 mA)
Maximum Input Voltage Without Damage	–10 V to +10 V
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)
Environmental Temperature Range, Rated Performance Temperature Range, Operating Temperature Range, Storage Relative Humidity (MIL 202) RFI Susceptibility	 –25°C to +85°C –40°C to +85°C –40°C to +85°C 0 to 95% @ 60°C noncondensing ±0.5% span error @ 400 MHz, 5W, 3'

[1]With a minimum power supply voltage of 4.95 V, R_L can be up to 750 Ω.
[2]Includes the combined effects of repeatability, hysteresis, and nonlinearity.
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5B40 and 5B41 Wide Bandwidth Millivolt and Voltage Input Modules

The 5B40 wide bandwidth millivolt input module accepts ±5 to ±500 millivolt input signals and provides either a –5 V to +5 V or 0 to +5 V output. The 5B41 wide bandwidth voltage input module accepts ±0.5 V to ±10 V input signals and provides either a –5 V to +5 V or 0 to +5 V output. Both modules feature a 10 kHz bandwidth.

Figure 2.8 is a functional block diagram of the 5B40 and 5B41. A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input , and, in the 5B41, the signal is attenuated by a factor of 20 at this point. A one pole anti-aliasing filter is located at the module's input, while a thre- pole, low-pass filter in the output stage sets the bandwidth and yields optimum noise performance. A low drift input amplifier provides all of the module's gain. This amplifier operates on the input signal after subtraction of a stable, laser-trimmed voltage, which sets the zero-scale input value. It is, therefore, possible to suppress a zero-scale input that is many times the total span to provide precise expanded scale measurements.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases

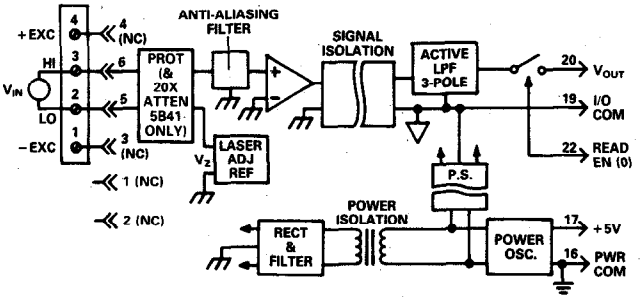


Figure 2.8. 5B40 and 5B41 Functional Block Diagram

where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

A single +5 V supply powers a clock oscillator which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common-mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

5B40 and 5B41 Ordering Information

Input Range	Output Range	Model
–10 mV to +10 mV	–5 V to +5 V	5B40-01
–50 mV to +50 mV	–5 V to +5 V	5B40-02
–100 mV to +100 mV	–5 V to +5 V	5B40-03
–10 mV to +10 mV	0 to +5 V	5B40-04
–50 mV to +50 mV	0 to +5 V	5B40-05
–100 mV to +100 mV	0 to +5 V	5B40-06
–1 V to +1 V	–5 V to +5 V	5B41-01
–5 V to +5 V	–5 V to +5 V	5B41-02
–10 V to +10 V	–5 V to +5 V	5B41-03
–1 V to +1 V	0 to +5 V	5B41-04
–5 V to +5 V	0 to +5 V	5B41-05
–10 V to +10 V	0 to +5 V	5B41-06

NOTE:
The -04, -05, and -06 ranges of models 5B40 and 5B41 map bipolar input ranges into unipolar output ranges; 0 maps to +2.5 V.

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5B40 and 5B41 Specifications (typical @ 25°C)

	5B40	5B41
Input Span Limits	±5 mV to ±0.5 V	±0.5 V to ±10 V
Output Ranges	–5 V to +5 V or 0 to +5 V	*
Accuracy[1]	±0.05% span ±10 µV RTI ±0.05% (Vz†)	±0.05% span ±0.05% (Vz†)
Nonlinearity	±0.02% span	*
Stability vs. Ambient Temperature		
Input Offset	±1 µV/°C	±20 µV/°C
Output Offset	±40 µV/°C	*
Gain	±25 ppm of reading/°C	±50 ppm of reading/°C
Input Bias Current	±3 nA	±0.2 nA
Input Resistance		
Normal	200 MΩ	650 kΩ
Power Off	40 kΩ	650 kΩ
Overload	40 kΩ	650 kΩ
Noise		
Input, 0.1/10 Hz	0.4 µVrms RTI	2 µVrms RTI
Output		
Vi=±FS	20 mV, peak-peak	*
Vi=0	10 mV, peak-peak	*
Bandwidth, –3 dB	10 kHz	*
Rise Time, 10% - 90% span	35 µs	*
CMV, Input to Output		
Continuous	1500 Vrms	*
Transient	meets IEEE-STD 472 (SWC)	*
CMR (50 or 60 Hz)		
1 k Ω source unbalance	100 dB (all ranges)	90 dB
Input Protection		
Continuous	240 Vrms	*
Transient	meets IEEE-STD 472 (SWC)	*
Output Resistance[2]	50 Ω	*
Voltage Output Protection	Continuous Short to Ground	*
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs	*
Output Selection Input		
Max Logic "0"	+1 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Current "0"	0.4 mA	*
Power Supply Voltage	+5 V ±5%	*
Power Supply Sensitivity	±2 µV/Vs% (RTI)	±0.4 mV/Vs% (RTI)
Power Consumption	150 mW (30 mA)	*
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)	*
Environmental		
Temperature Range, Rated Performance	–25°C to +85°C	*
Temperature Range, Operating	–40°C to +85°C	*
Temperature Range, Storage	–40°C to +85°C	*
Relative Humidity (MIL 202)	0 to 95% @ 60°C noncondensing	*
RFI Susceptibility	±0.5% span error @ 400 MHz, 5 W, 3'	*

*Specifications same as 5B40.

†Vz is the input voltage that results in a 0 V output.

[1]Includes the combined effects of repeatability, hysteresis and nonlinearity and assumes very high load resistance.

[2]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.

Specifications subject to change without notice.

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5B45 and 5B46 Frequency Input Modules

The 5B45 is an isolated frequency input module that accepts full scale input frequency signals ranging from 500 Hz to 20 kHz. Model 5B46 is an isolated frequency input module that accepts full scale input signals ranging from 20 kHz to 275 kHz. Both modules have a user selectable threshold of either 0 V or +1.4 V, and a user selectable hysteresis of either ±25 mV or ±400 mV.

Circuit Description: Figure 2.9 shows a functional block diagram for models 5B45 and 5B46. Input protection of up to 240 Vrms is provided on the four input screw terminals. The input signal is compared to the selected threshold (V_T) and hysteresis (V_H). Signals of virtually any waveshape which exceed the combined threshold and hysteresis levels ($V_T \pm V_H$), will trigger the comparator. The comparator's output frequency is transmitted across a proprietary isolation barrier and converted into a high level analog signal. The signal is then filtered by a two-pole low pass butterworth filter and buffered to provide a clean, low impedance output signal.

Output Switch: A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance (50 ohms) and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn the switch ON, as it is done on the 5B01 Backplane.

Threshold Selection: The threshold is determined by user wiring on the input backplane screw terminals. If the input signal is a zero crossing voltage input, the input signal should be connected to the backplane screw terminals 4 and 3 to implement a 0 V threshold. When the input signal is connected to screw terminals 3 and 2, the threshold is +1.4 V (see Figure 2.9).

Hysteresis Selection: Hysteresis is set at ±400 mV for signals connected to either terminals 3 & 4 or 3 & 2. However, the user can change the hysteresis to ±25 mV by the addition of a jumper between screw terminals 1 and 4. (see Figure 2.9)

Response Time: Response time is a function of the input frequency range and the module bandwidth. The table below indicates the output rise/fall time and settling time for a step change input over the rated input ranges of the 5B45 and 5B46. Other ranges would have response times in between these values.

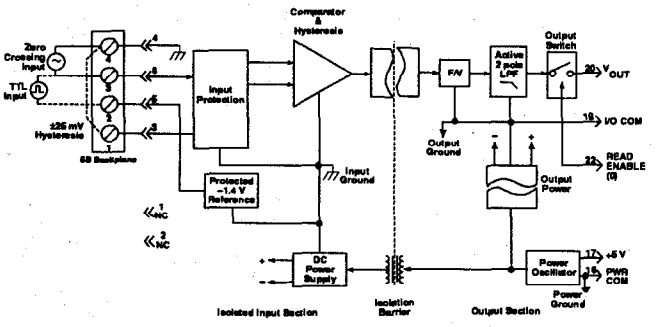


Figure 2.9 5B45 and 5B46 Functional Block Diagram

5B45 and 5B46 Response Time

Model	Rise/Fall Time 10% to 90% ms	Step Response to ±0.1% ms
5B45-01	80	150
5B45-02	60	140
5B45-03	50	130
5B45-04	50	130
5B45-05	50	130
5B46-01	15	44
5B46-02	7	22
5B46-03	4	12
5B46-04	4	9

Output Common Connection: The single +5 V supply powers a clock oscillator, which drives power transformers for both the input and output circuits. The input circuit is fully floating and isolated from the output common and the power common. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and power supply noise. The common mode range of the output circuit is limited and the output common must be kept within ±3 V of power common.

Note: A current path must exist between power common (Pin 16) and output common (Pin 19) for proper operation of the output switch. See Chapter 4 for details.

5B45 and 5B46 Ordering Information

Model	Input Range	Output Range
5B45-01	0 to 500 Hz	0 to +5 V
5B45-02	0 to 1 kHz	0 to +5 V
5B45-03	0 to 2.5 kHz	0 to +5 V
5B45-04	0 to 5 kHz	0 to +5 V
5B45-05	0 to 10 kHz	0 to +5 V
5B46-01	0 to 25 kHz	0 to +5 V
5B46-02	0 to 50 kHz	0 to +5 V
5B46-03	0 to 100 kHz	0 to +5 V
5B46-04	0 to 250 kHz	0 to +5 V

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5B45 and 5B46 Specifications (typical @ +25°C and Vs = +5 V dc)

MODEL	5B45	5B46
FREQUENCY INPUT		
Frequency Ranges - Standard Ranges	*See Ordering Guide*	*See Ordering Guide*
Span Limits - Custom Input Ranges[1]	500 Hz, min - 20 kHz, max	20 kHz, min - 275 kHz, max
Overrange	20% of span	*
Voltage Range	70 mV rms, min - 240 V rms, max	*
Waveforms	Sine, Square, Triangle, Pulse Train	*
Pulse Width (Pulse Train Inputs)	2 µsec, min	*
Protection		
Continuous	240 V rms, max continuous	*
Threshold Options	0 V or +1.4 V	*
TTL Input, Low (–40°C to +85°C)	0.8 V, max	*
TTL Input, High (–40°C to +85°C)	2.0 V, min	*
Hysteresis Options[2]	±25 mV or ±400 mV	*
Impedance		
Small Signal, Vin <5 V, p-p	5 MΩ	*
Large Signal, Vin >5 V, p-p	40 kΩ ‖330 pF	*
Power Off	40 kΩ ‖330 pF	*
Bias Current, Vin <5 V, p-p	±100 µA	*
COMMON-MODE VOLTAGE (CMV)		
Input-to-Output, Continuous	1500 V rms, min	*
Transient	Meets IEEE STD 472 (SWC)	*
COMMON-MODE REJECTION (CMR)		
1 kΩ source imbalance, 50/60 Hz	120 dB	*
ACCURACY		
Initial @ +25°C[3]	±0.05% span (±0.1% span max)	*
Nonlinearity	±0.005% span (±0.015% span max)	*
Gain vs Temperature (–40°C to +85°C)	±20 ppm/°C	*
Offset vs. Temperature (–40°C to +85°C)	±20 uV/°C	*
OUTPUT		
Range (RL > 50 kΩ)[4]	–5V to +5V; 0 to +5 V	*
vs. Supply Voltage	±0.005% of Span /% Vs	*
Resistance	50 Ω	*
Protection	Continuous Short to Ground	*
Enable Time (C load = 0 to 2000 pF)	6 µsec	*
Enable Control		
Max Logic "0"	+1.0 V	*
Min Logic "1"	+2.5 V	*
Max Logic "1"	+36 V	*
Input Currrent "0"	400 µA	*
Bandwidth[5], –3 dB	10 Hz	190 Hz
Step Response Time	*See Table 1*	*See Table 1*
Ripple	10 mV, p-p @ 10% of (F_{-FS} +F_{SPAN})	*
Noise		
100 kHz Bandwidth	0.7 mV, p-p	*
5 MHz Bandwidth	7 mV, p-p	*
POWER SUPPLY		
Voltage, Rated Performance	+5 V dc ±5%	*
Current	70 mA	*
CASE SIZE	2.25" x 2.25" x 0.6"	*
WEIGHT	70 grams	*
ENVIRONMENTAL		
Temperature Range		
Rated Performance	–40°C to +85°C	*
Storage	–40°C to +85°C	*
Relative Humidity	0 to 93% @ +40°C, noncondensing	*
RFI Susceptability	±0.5% span error @ 400 MHz, 5 W. 3"	*

*Specifications same as 5B45
[1]Custom Input Ranges, with zero supression, available as model 5B45-custom and 5B46-custom
[2]Jumper selectable. See Functional Block Diagram.
[3]Warm-up time, 10 seconds. Includes the combined effects of repeatability, hysteresis and nonlinearity .... R_L >50 k Ω.
[4]–5 V to +5 V Output Range available as custom ranged model 5B45-Custom or 5B46-Custom
[5]Bandwidth is specified for 2-pole Butterworth output filter.
Specifications subject to change without notice.

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5B47 Linearized Thermocouple Input Module

The 5B47 thermocouple input module accepts input signals from types J, K, T, E, R, S, and B thermocouples and provides a 0 to +5 V output. The input signal is internally linearized to provide an output that is linear with temperature.

Figure 2.10 is a functional block diagram for the 5B47. Cold junction compensation circuitry corrects for the effects of the parasitic thermocouples formed by thermocouple wire connections to the input screw terminals. The compensator provides an accuracy of ±0.5°C over the +5°C to +45°C ambient temperature range. A bias current supplied through resistor Roc gives a predictable upscale response to an open thermocouple. (Downscale open thermocouple detection can be provided by installing a 50 MΩ resistor across screw terminals 1 and 3. This resistor could be a 0.25 W carbon composition; ±20% tolerance is suitable.)

A protection circuit assures safe operation even if a 240 Vrms power line is connected to the input screw terminals. A three-pole filter with a 4 Hz cutoff provides 60 dB of normal-mode rejection and CMR enhancement at 60 Hz. (One pole of this filter is located at the module input, while the other two poles are in the output stage for optimum noise performance.) A chopper-stabilized input amplifier provides all of the module's gain and assures low drift. This amplifier operates on the input signal after subtraction of a stable, laser-trimmed voltage, which sets the zero-scale input value. It is, therefore, possible to suppress a zero-scale input that is many times the total span to provide precise expanded scale measurements.

Signal isolation is provided by transformer coupling, using a proprietary modulation technique for linear, stable performance. A demodulator on the output side of the signal transformer recovers the original signal, which is

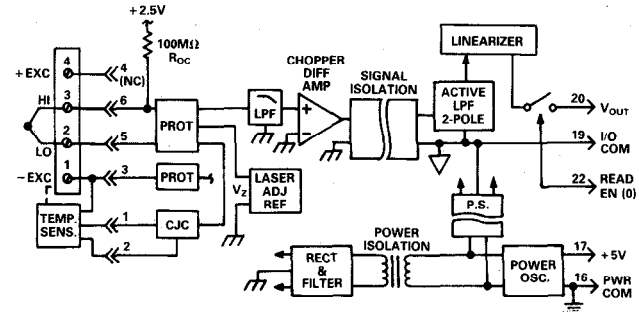


Figure 2.10. 5B47 Functional Block Diagram

then filtered and buffered to provide a clean, low-impedance output. A series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

The single +5 V supply powers a clock oscillator, which drives power transformers for the input and output circuits. The input circuit is, of course, fully floating. In addition, the output section acts as a third floating port, eliminating many problems that might be created by ground loops and supply noise. The common mode range of the output circuit is limited; however, output common must be kept within ±3 V of power common.

Note:

A current path must exist between power common and output common for proper operation of the demodulator and output switch. See Chapter 4 for details.

Caution:

When evaluating 5B47 modules with a mV source, the cold junction temperature sensor will introduce errors. See the AC1360 discussion in Chapter 4.

5B47 Ordering Information

Input Type	Range	Output Range	Model	Accuracy[1](typ)
Type J	0 to +760°C (+32°F to +1400°F)	0 to +5 V	5B47-J-01	±1.1°C
Type J	–100°C to +300°C (–148°F to +572°F)	0 to +5 V	5B47-J-02	±0.5°C
Type J	0 to +500°C (+32°F to +932°F)	0 to +5 V	5B47-J-03	±0.6°C
Type K	0 to +1000°C (+32°F to +1832°F)	0 to +5 V	5B47-K-04	±1.3°C
Type K	0 to +500°C (+32°F to +932°F)	0 to +5 V	5B47-K-05	±0.6°C
Type T	–100°C to +400°C (–148°F to +752°F)	0 to +5 V	5B47-T-06	±1.4°C
Type T	0 to +200°C (+32°F to +392°F)	0 to +5 V	5B47-T-07	±0.5°C
Type E	0 to +1000°C (+32°F to +1832°F)	0 to +5 V	5B47-E-08	±1.7°C
Type R	+500°C to +1750°C (+932°F to +3182°F)	0 to +5 V	5B47-R-09	±2.5°C
Type S	+500°C to +1750°C (+932°F to +3182°F)	0 to +5 V	5B47-S-10	±2.4°C
Type B	+500°C to +1800°C (+932°F to +3272°F)	0 to +5 V	5B47-B-11	±5.1°C

[1]The CJC sensor accuracy should be added to the module accuracy for a system accuracy, if applicable.

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5B47 Specifications (typical @ 25°C and +5 V Power)

Input Span Limits	±5 mV to ±0.5 V
Output Range	0 to +5 V
Accuracy[1]	See Ordering Information
Stability vs. Ambient Temperature Input Offset[2] Gain	 ±1 µV/°C ±25 ppm of reading/°C
Input Bias Current	–25 nA
Input Resistance Normal Power Off Overload	 5 MΩ 40 kΩ 40 kΩ
Output Noise, 100 kHz	500 µVrms RTO
Bandwidth, –3 dB	4 Hz
Rise Time, 10% to 90% Span	0.2 s
CMV, Input to Output Continuous Transient	 1500 Vrms max meets IEEE-STD 472 (SWC)
CMR (50 or 60 Hz) 1 kΩ in Either or Both Input Leads	 160 dB (all ranges)
NMR (50 or 60 Hz)	60 dB
Input Protection Continuous	 240 Vrms max continuous
Output Resistance[3]	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs
Output Selection Input Max Logic "0" Min Logic "1" Max Logic "1" Input Current ("0")	 +1 V +2.5 V +36 V 0.4 mA
Open Input Response	upscale
Open Input Detection Time	10 s
Cold Junction Compensation Initial Accuracy @ +25°C[4] Over +5°C to +45°C	 ±0.25°C (±0.75°C max) ±0.5°C (±0.0125°C/°C)
Power Supply Voltage	+5 V ±5%
Power Supply Sensitivity	±2 µV/Vs% (RTI)
Power Consumption	150 mW (30 mA)
Size	2.25″ x 2.25″ x 0.60″ (52 mm x 52 mm x 15 mm)
Environmental Temperature Range, Rated Performance Temperature Range, Operating Temperature Range, Storage Relative Humidity (MIL 202) RFI Susceptibility	 –25°C to +85°C –40°C to +85°C –40°C to +85°C 0 to 95% @ 60°C noncondensing ±0.5% span error @ 400 MHz, 5 W, 3′

[1]Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes very high load resistance.
[2]±1 µV/°C is equivalent to .020°C/°C for Type J thermocouples and .025°C/°C for Type K and T thermocouples.
[3]The output resistance value can be used to determine gain error when the module is driving a resistive load. Note, however, that loads heavier than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.
[4]When used with AC1361 CJC sensor (see Chapter 4), which is provided on each channel of 5B Series backplanes and on the AC1360.
Specifications subject to change without notice.

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AC1367 Voltage Switch Input Module

The AC1367 voltage switch input module allows the 5B user to connect an existing, conditioned signal into the 5B Series backplane. This module accepts a –5 V to +5 V input and provides a –5 V to +5 V output. The module is not isolated and there is no gain or attenuation of the signal.

Figure 2.11 is a functional block diagram of the AC1367. This module is protected for continuous inputs of ±10 V and will withstand ±20 V for 10 seconds. Above these limits, a nonreplaceable fuse within the module may blow. The resistance between the input and the output is 250 Ω when the module is enabled. As with all 5B Series modules, a series output switch is included to eliminate the need for external multiplexing in many applications. This switch has a low output resistance and is controlled by an active-low enable input. In cases where the output switch is not used, the enable input should be grounded to power common to turn on the switch, as it is on the 5B01 backplane.

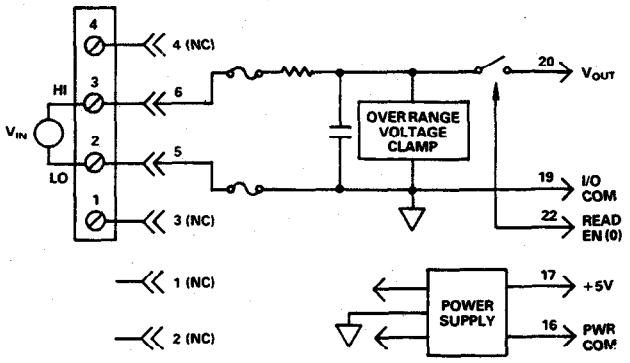


Figure 2.11. AC1367 Functional Block Diagram

AC1367 Specifications (typical @ 25°C and +5 V Power)

Input Span Limits	–5 V to +5 V
Output Range	–5 V to +5 V
Input-to-Output Resistance, when enabled	250 Ω
Input Resistance Normal Power Off Overrange	 10 MΩ 200 Ω 200 Ω
Output Noise	300 µV peak to peak
Bandwidth	500 kHz
Rise Time, 10% to 90% Span	500 ns
Input Protection	±10 V continuous, ±20 V for 10 seconds
Maximum Voltage at Input Low[1]	0.0 V
Maximum Current into Input Low[2]	±20 mA
Maximum Current into Input High[2]	±20 mA
Maximum Output When Input is Overranged	±10 V
Feedthrough, Input to Output @ 1 kHz, R_L = 50 Ω	–100 dB
Output Resistance	Input Source Resistance + 250 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time (C_L = 0 to 2,000 pF)	6 µs
Output Selection Input Max Logic "0" Min Logic "1" Max Logic "1" Input Current "0"	 +1 V +2.5 V +36 V 0.4 mA
Power Supply Voltage	+5 V±5%
Power Consumption	35 mW (6.5 mA)
Size	2.25" x 2.25" x 0.60" (52 mm x 52 mm x 15 mm)
Environmental Temperature Range, Rated Performance Temperature Range, Operating Temperature Range, Storage Relative Humidity (MIL 202) RFI Susceptibility	 –25°C to +85°C –40°C to +85°C –40°C to +85°C 0 to 95% @ 60°C noncondensing +0.5% span error @ 400 MHz, 5 W, 3'

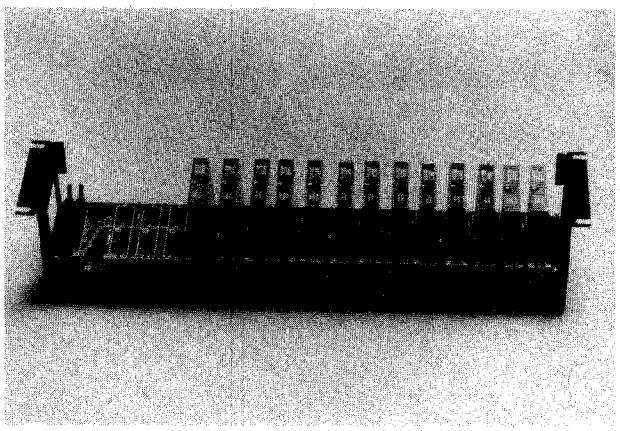
Note:
Input voltages above those specified may cause permanent damage to the module.

[1]Input Low is internally connected to I/O Com.
[2]Input High and Input Low are internally fused; the fuse is nonreplaceable.
Specifications subject to change without notice.

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Chapter 3
5B Series Subsystem Solutions

The 5B Series includes a number of backplanes which provide a complete signal conditioning solution. The two 5B Series 16-channel backplanes currently available, the 5B01 and 5B02, provide different system configuration options. The 5B03 and 5B04, one and two channel backplanes, allow an economical means to handle a few remote signals. A single-channel socket, AC1360, is available for module evaluation. It is discussed in Chapter 4.



Both 16 channel 5B Series backplanes can be mounted in a 19″ x 3.5″ panel space. The one and two channel backplanes are DIN rail compatible. Each channel has four screw terminals for field connections. These connections satisfy all transducer inputs and process current outputs and provide sensor excitation when necessary. A cold junction sensor is supplied on each channel to accommodate thermocouple modules. All backplanes require an external +5 V power supply.

This chapter describes the backplanes and how they are used. Common topics – power requirements, field terminations, installation, and interface accessories – follow the backplane discussions.

5B01 Backplane

The 5B01, diagrammed in Figure 3.1, 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.) Figure 3.2 is a schematic of the 5B01 backplane.

Connector Pin Usage

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 connector 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 3.3 is a diagram of the voltage I/O provided on the P1 and P2 connectors of the 5B01 backplane.

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 in the backplane provide optimum ground connections for various circumstances.

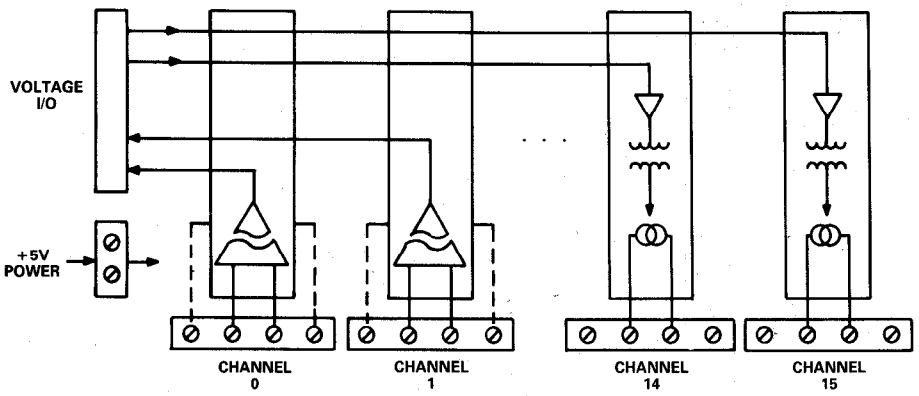


Figure 3.1. 5B01 Diagram

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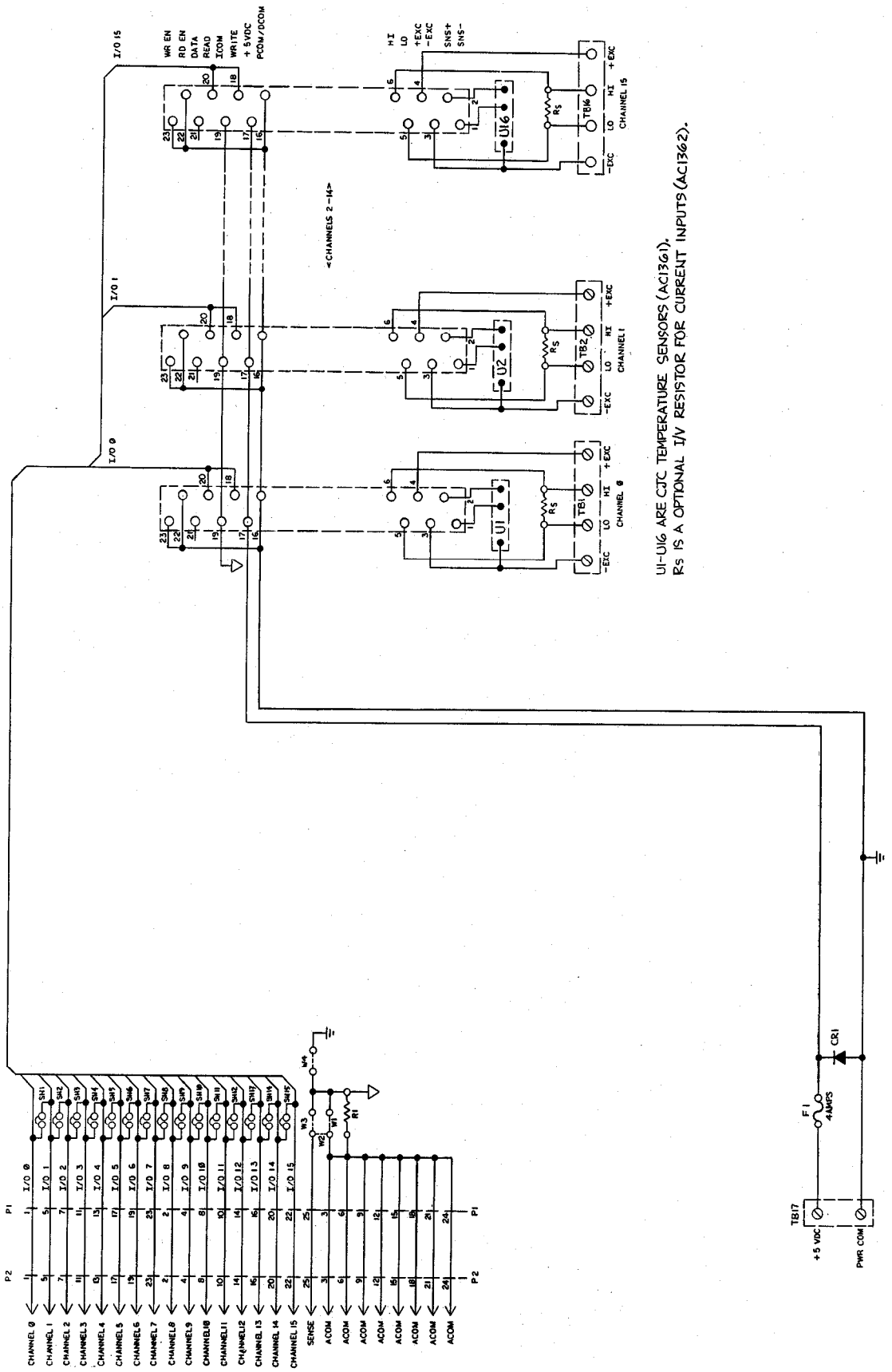


Figure 3.2. 5B01 Schematic

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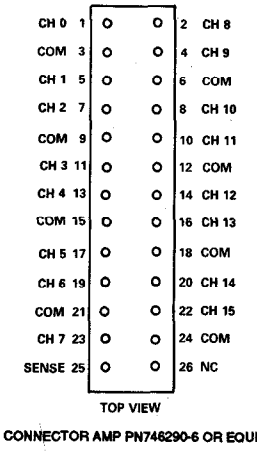


Figure 3.3. 5B01 System Connector Pinout

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 Lo 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 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.

The 5B Series modules can prevent harm to the connected system even when a very large, fast transient strikes all 16 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 backplane 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 50 2.5 kV bursts per second. A test duration of 2 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 A.

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 errors 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.

Fusing and Polarity Reversal

Since reversing the polarity of the connected +5 V power source could destroy installed modules, the 5B01 incorporates 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.

Interchannel Bridge Jumpers

The 5B01 gives the user the capability of directing the voltage output of any input module to an adjacent output module by simply 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 Vrms isolation. Model AC1344 provides 10 jumpers.

5B02 Backplane

The 5B02, diagrammed in Figure 3.4, is also 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-holds in the output modules. 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. A schematic of the 5B02 is shown in Figure 3.6. 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.

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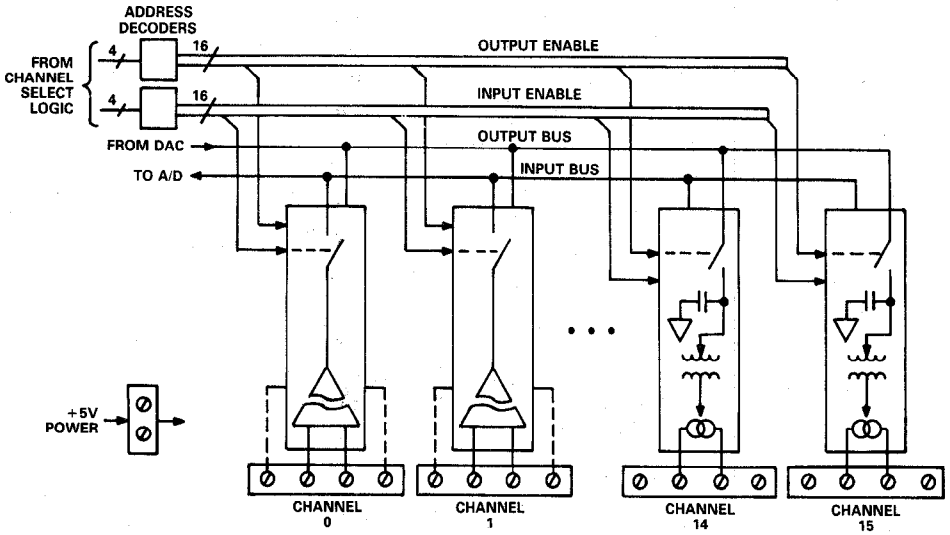


Figure 3.4. 5B02 Diagram

Connector Pin Usage

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 3.5.

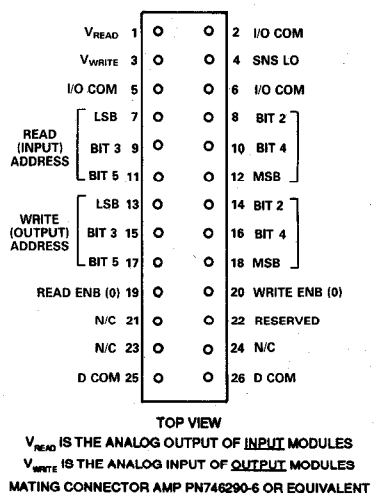


Figure 3.5. 5B02 System Connector Pinout

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.

Grounding

Each 5B02 backplane is factory configured with jumpers W1, W2, and W4 installed.

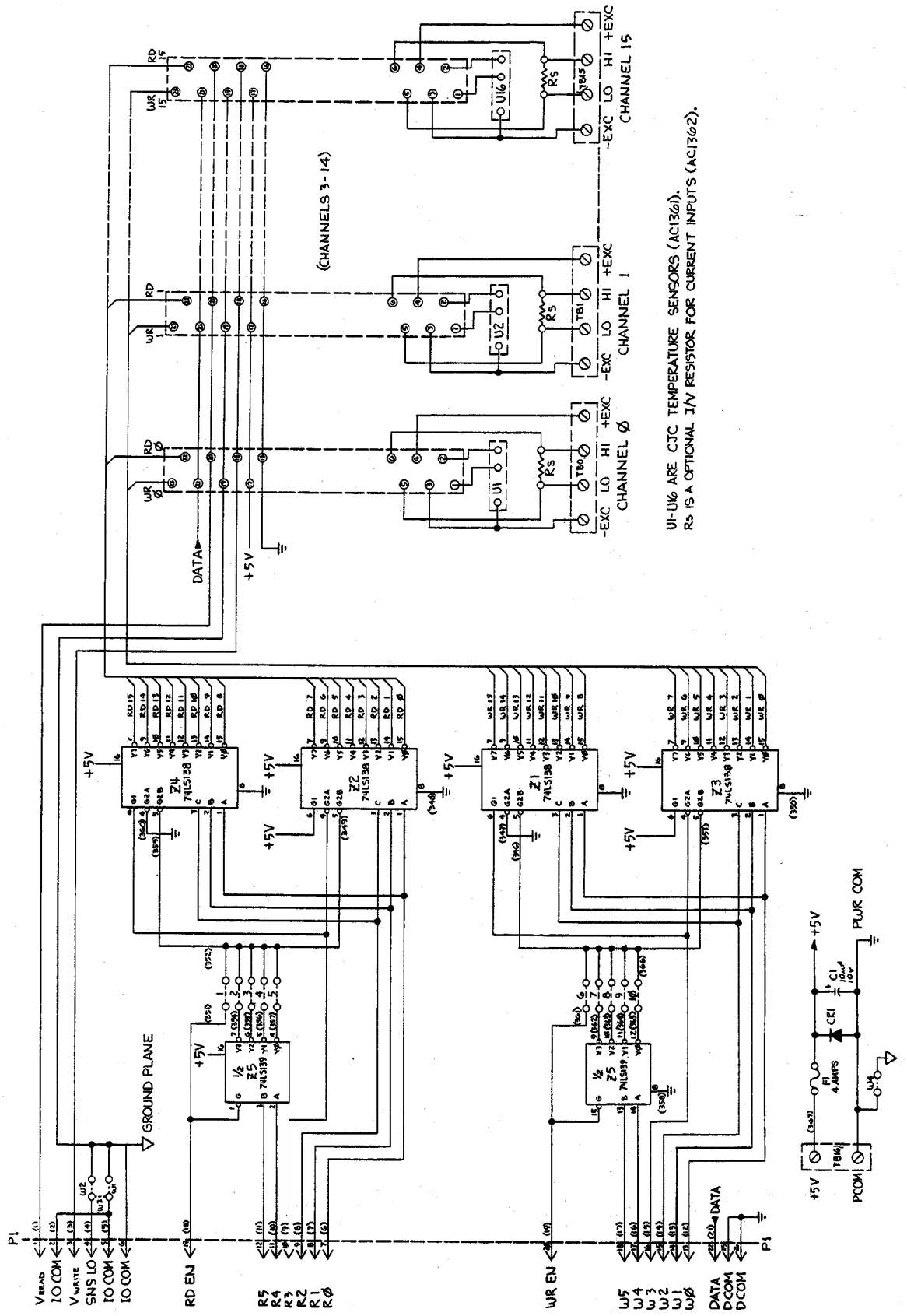
Jumper W1 grounds the shield wires in the ribbon cable (pins 2, 5, and 6) at the 5B02 backplane. This will usually be the primary ground connection between the 5B02 and the measurement system. This connection is required if output modules will be used on the backplane. It is also required if there is no high-impedance sense input (input Lo 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 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.

The 5B Series modules can prevent harm to the connected system even when a very large, fast transient strikes all 16 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 stud provided at one end of the 5B02 backplane should be connected to system ground by the shortest practical length of large diameter wire.

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NOTE:

For information on configuring multiple 5B02 backplanes, see Appendix C.

Figure 3.6. 5B02 Schematic

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The surge withstand capability can be tested with not less than 50 2.5 kV bursts per second. A test duration of 2 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 A.

When such 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 errors 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.

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 3.7 shows the address jumpers in the factory configured positions. This sets up the backplane as a standalone 16-channel system; the two

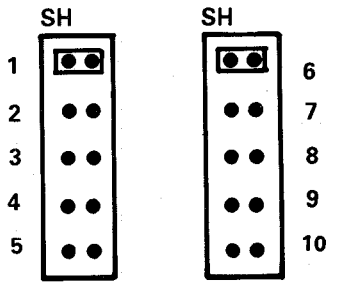


Figure 3.7. Address Selection Pins Default Jumpers

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 3.1. 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.

Table 3.1. 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

Fusing and Polarity Reversal

Since reversing the polarity of the connected +5 V power source could destroy installed modules, the 5B02 incorporates 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.

5B01 and 5B02 Backplane Specifications

	5B01	5B02
Channels	16	*
Physical Size (with modules)	3.5″ x 17.4″ x 3.2″ (88.9 mm x 442 mm x 81.3 mm)	*
Weight	11.25 oz. (305 g)	*
Address Selection Inputs		
Max Logic "0"	N/A	0.8 V
Min Logic "1"	N/A	2.0 V
Max Logic "1"	N/A	7.0 V
Power Supply	+5 V dc ±5%	*
Power Consumption	N/A	0.16 W (32 mA) TYP

*Specifications same as 5B01.

Specifications subject to change without notice.

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5B03 and 5B04 Backplanes

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

Figures 3.8 and 3.9 are the wiring diagrams for the 5B03 and 5B04. CAUTION! The 5B03 and 5B04 are not protected against reversed power supply connections. A reversal may destroy the installed modules.

Jumper W1 connects +5 V 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.

Individual backplanes are DIN rail compatible using Phoenix Universal Mounting UM modules. Two or more backplanes can be mounted in wider UM assemblies.

Mounting a single 5B03 or 5B04 would require the following Phoenix parts:

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

Mounting 2 or more backplanes would require:

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 x (#)) - 4

where (#) is the total number of 5B03 and 5B04 backplanes to be DIN rail mounted.

The snap foot elements will fit DIN EN 50022, DIN EN 50035, and DIN EN 50045 rails.

5B03 and 5B04 Backplane

	5B03	5B04
Channels	1	2
Physical Size (with modules)	4.25″ x 1.365″ (105 mm x 34.7 mm)	*
Weight	.85 oz (24.0 g)	1.06 oz (30.2 g)
Power Supply	+5 V dc ±5%	*

*Specifications same as 5B03.

Specifications subject to change without notice.

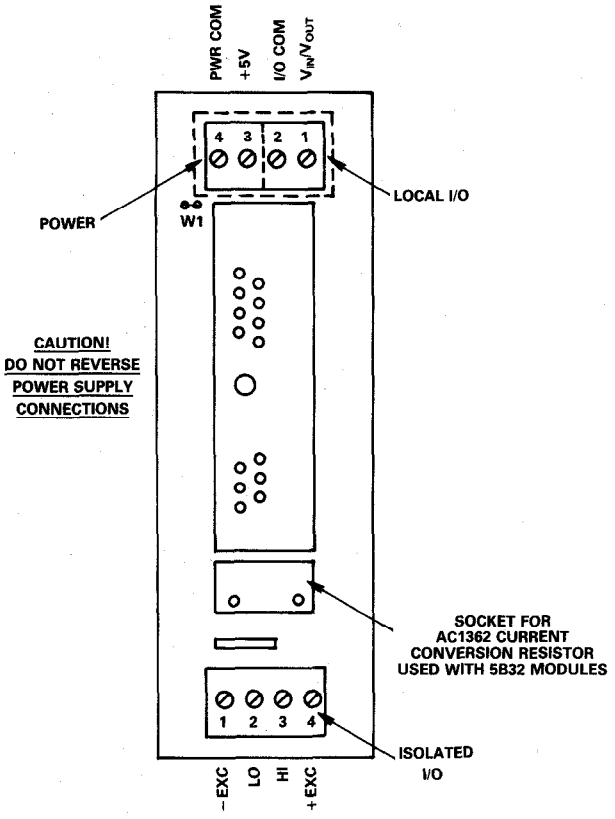


Figure 3.8. 5B03 Wiring Diagram

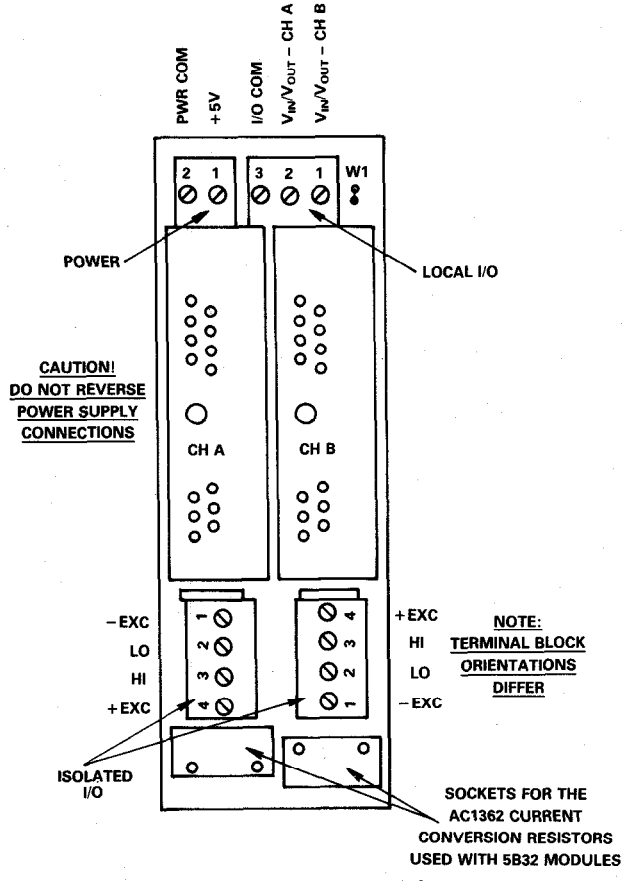


Figure 3.9. 5B04 Wiring

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Power Requirements

All 5B Series backplanes require external +5 V power. This is connected to TB17 on the 5B01 and TB16 on the 5B02.

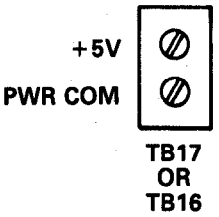


Figure 3.10. Power Connection – Terminal Block 17 (5B01), Terminal Block 16 (5B02)

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. Module power requirements are listed in Table 3.2. A chassis mounting 1 A (model 955) +5 V power supply is available.

Table 3.2. Module Power Requirements

Model	Current
5B30	30 mA
5B31	30 mA
5B32	30 mA
5B34	30 mA
5B37	30 mA
5B38	200 mA
5B39	170 mA*
5B40	30 mA
5B41	30 mA
5B45	70 mA
5B46	70 mA
5B47	30 mA

*Maximum output load resistance is 750 Ω.

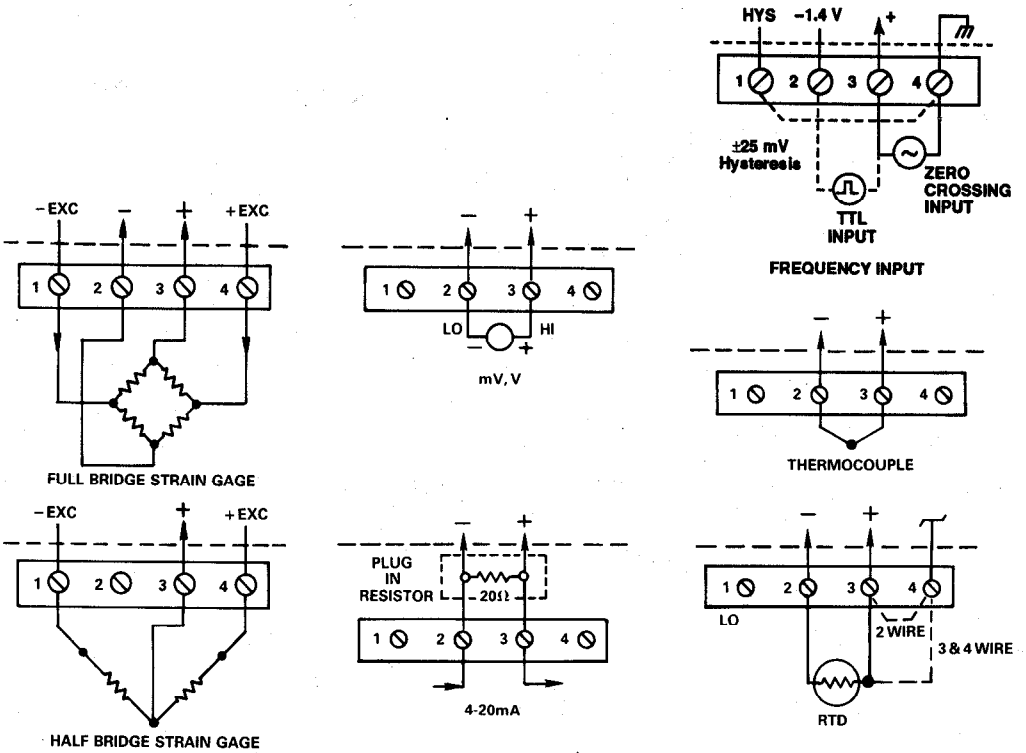


Figure 3.11. Input Field Connections

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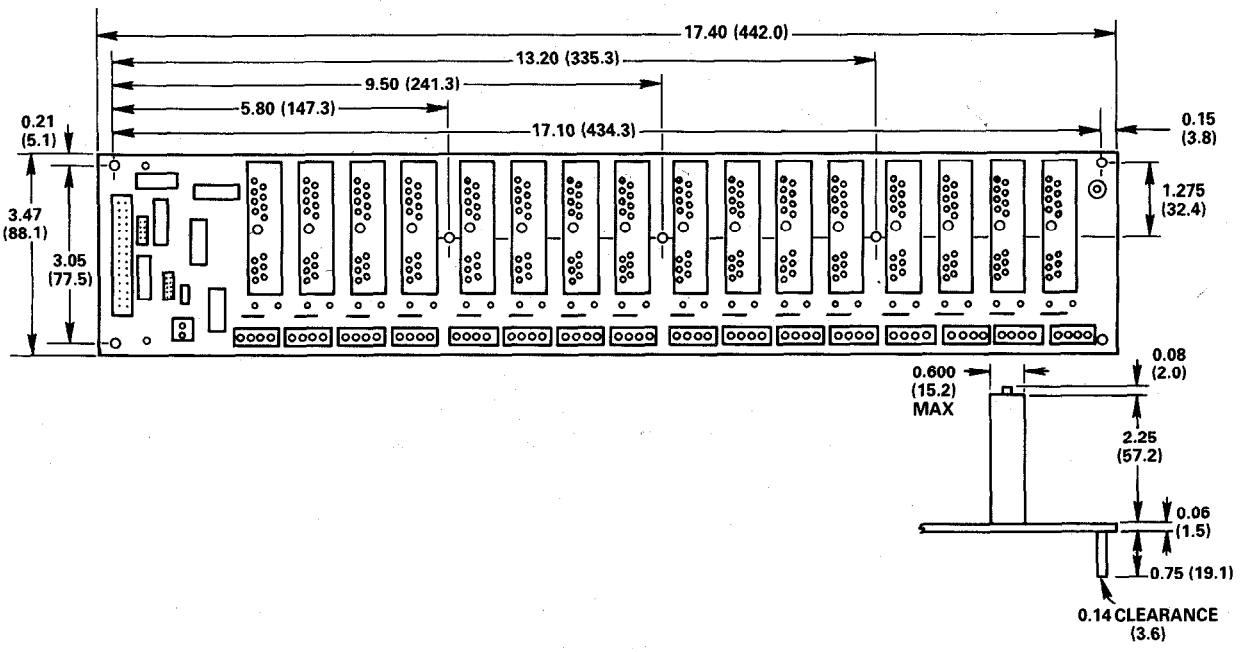


Figure 3.12. 5B01 and 5B02 Backplane Mounting Dimensions in Inches and (mm)

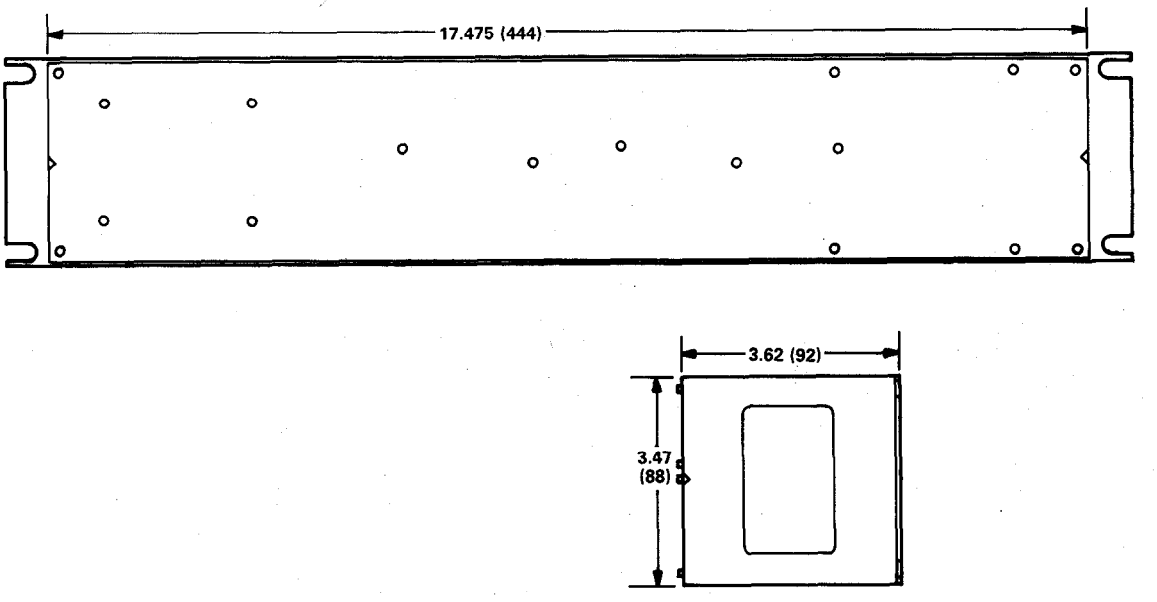


Figure 3.13. AC1363 Rack Mount Diagram (dimensions in inches and (mm))

Field Terminations

All field terminations are made at terminal blocks 1-16 of the 5B01 and terminal blocks 1-17 on the 5B02. Input screw terminal connections are indicated in Figure 3.11; the input screw terminals in the figure are numbered 1, 2, 3, and 4 to correspond to the markings on each backplane.

Output screw terminal connections are:

OUT LO	terminal 2
OUT HI	terminal 3

14-22 AWG wire may be used with these terminal blocks.

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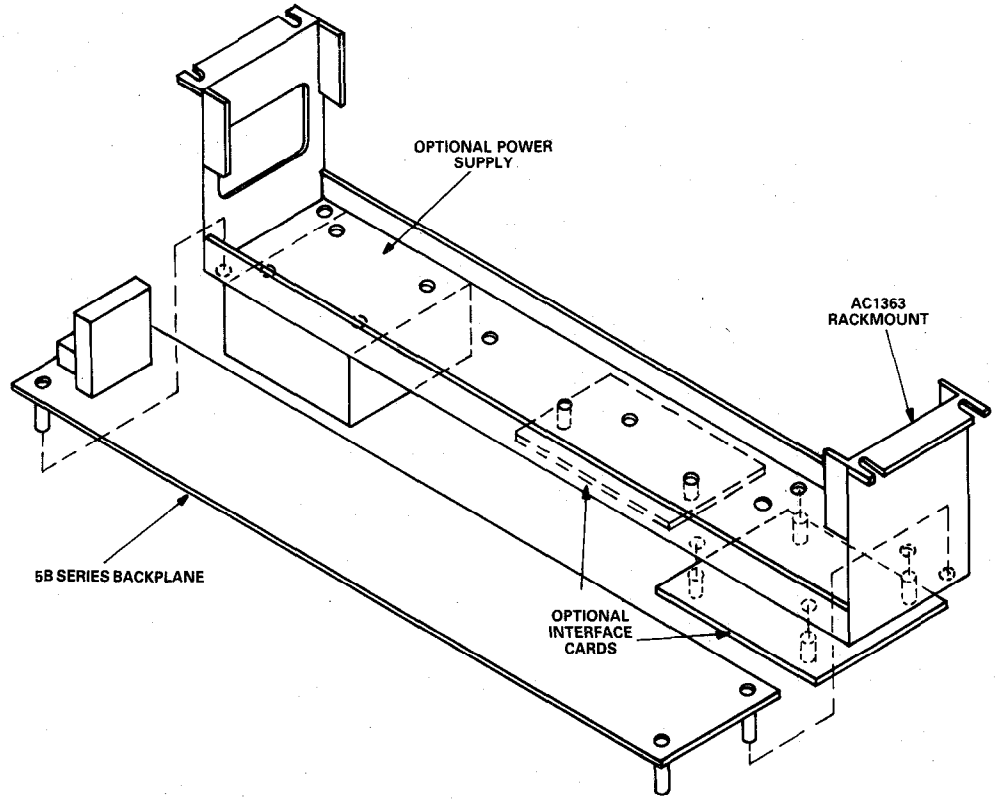


Figure 3.14. Rack Mount Assembly Drawing

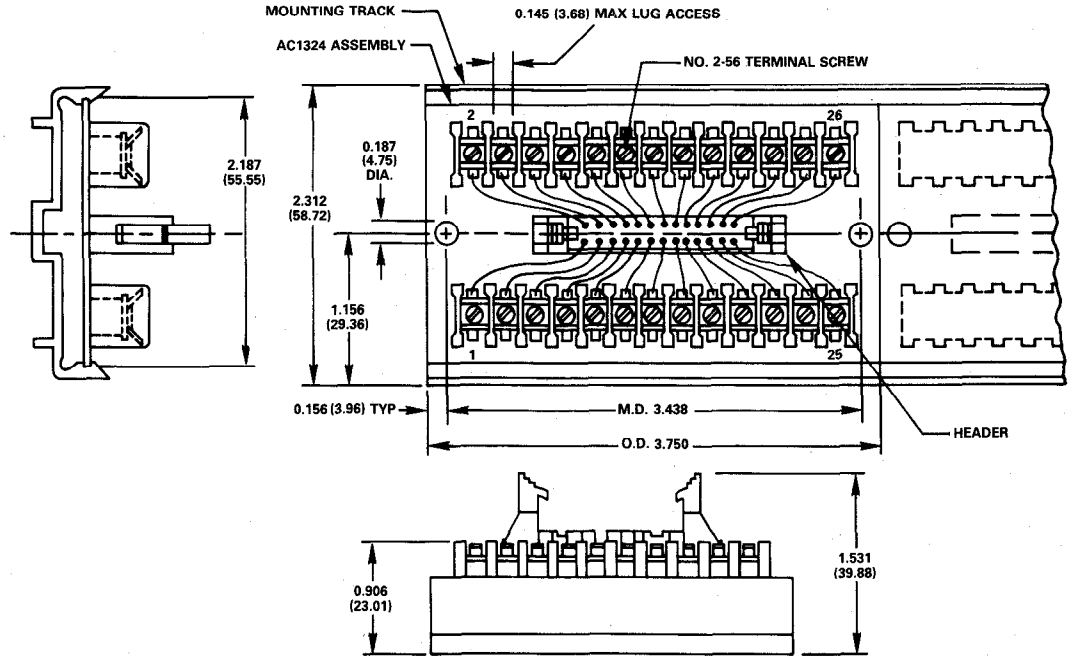


Figure 3.15. AC1324 Diagram (dimensions in inches and (mm))
NOTE: Mounting rack is not provided with AC1324

Installation

The 5B Series Signal Conditioning Subsystem is designed for installation in any convenient location suitable for general purpose electronic equipment. Operating ambient temperature should be between –25°C and +85°C (–13°F and +185°F) for rated performance. If the equipment will be used in a harsh or unfavorable environment, it may be necessary to install it inside a protective enclosure. It is recommended that the backplane be mounted and wired before the modules are installed.

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Each 5B Series 16-channel backplane has seven standoffs – one at each corner and three along the centerline – and is supplied with seven 3 mm screws for mounting purposes. Figure 3.10 is a diagram of the mounting dimensions for these backplanes. A drill template is included in Appendix B.

The AC1363 is a single piece metal chassis for mounting a 5B01 or 5B02 backplane in a 19″ rack. It has seven 3 mm threaded inserts for mounting a 5B01 or 5B02, six additional threaded inserts to allow mounting of an adaptor board on the back of the rack mount kit, and holes that allow a 955 or 976 power supply to be mounted on the back of the rack. Screws are also included. The backplane fits readily in the rack by sliding it in from the side under the end flanges. The AC1363 weighs 1.70 lb (775 g). Figure 3.13 is a diagram of the AC1363 rack-mount kit, and Figure 3.14 is a rack mount assembly drawing.

Interface Accessories

A number of accessories are available, which complete the 5B Series Signal Conditioning Subsystem solution by providing an interface to a host system. The AC1315 is a 2′ (60 cm) 26-pin cable with two connectors that can be connected to either the 5B01 or the 5B02 backplane. The CAB-01 is a 26-pin cable with three connectors for daisy-chaining 5B02 backplanes. The number of CAB-01 cables needed is equal to the total number of 5B02 backplanes minus one.

The AC1324 accepts the AC1315 or CAB-01 from a 5B Series backplane and provides 26 screw terminals for interconnecting to any analog I/O subsystem. This interface board might be used with programmable controllers, for example, and is diagrammed in Figure 3.15. It can be mounted in snap track, if desired, or may be mounted to the AC1363 Rack-Mount Kit. Standoffs are included with the AC1324 and should be used if it is to be mounted on the back of the AC1363.

The AC1366 is an interface board that will convert high-level logic control signals into the TTL levels necessary for the 5B02 backplane. An application requiring this board can occur with programmable controllers that may use up to 24 V logic.

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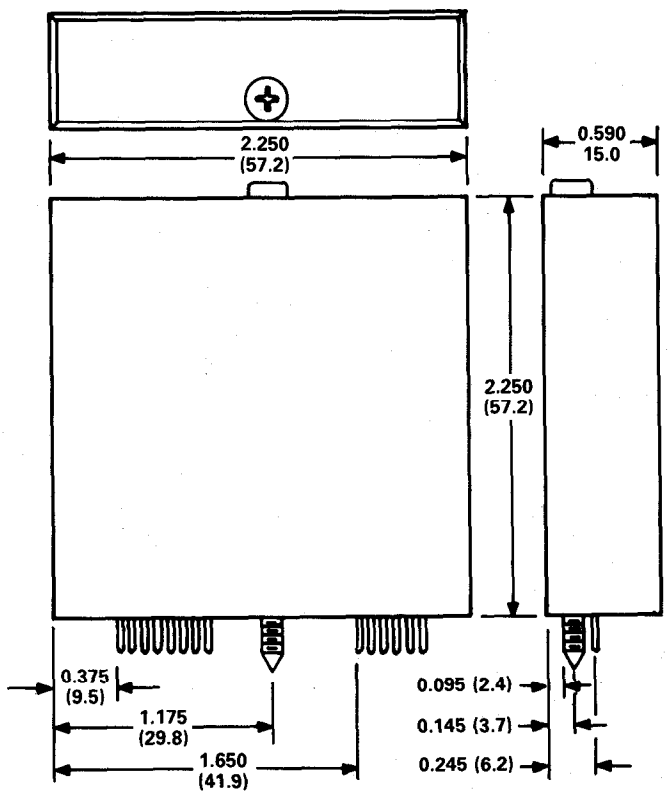
Chapter 4
System Design Considerations

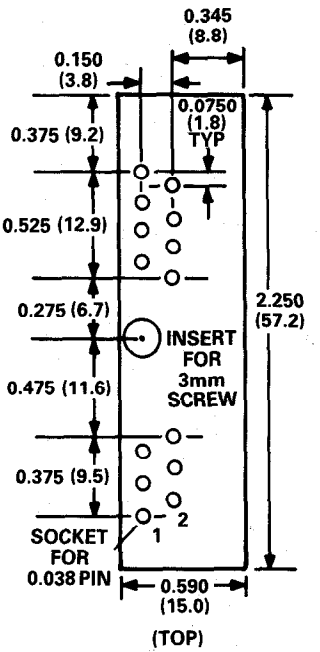
It is simple to incorporate the functionally complete 5B Series modules in your own circuit board or backplane. This chapter discusses some of the important considerations in integrating the 5B Series into your design. Physical, process side, and system side design issues are presented in turn. Miscellaneous topics are grouped at the end of the chapter.

Physical Design Issues

The 5B Series modules are identical in size and pinout. This makes designing a system with a variety of sensor inputs and/or process outputs very simple. Figure 4.1 shows the module outline and pinout. Figure 4.2 shows a single channel of a 5B01 backplane as an example of the factors to consider in a design. You may want to refer to this figure throughout this chapter.

The modules' 40 mil pins fit into widely available sockets such as AMP Inc.'s 645502-1, and the modules are secured with self-contained, metric mounting screws and 3 mm inserts, such as PEM's (Penn Engineering and Manufacturing Corp.) KFS2-M3.





PIN DESIGNATIONS

WRITE EN (0)	23	22	READ EN (0)
RESERVED	21	20	VOUT
I/O COM	19	18	VIN
+5 V	17	16	POWER COM
		6	IN HI
IN LO	5	4	+EXC
-EXC	3	2	SENSOR+
SENSOR-	1		

Figure 4.1. 5B Series Input Module Outline and Pin Designations

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HOLE	INSTALL
a	AMP SOCKET – P/N 645500-1
b	3MM SWAGE INSERT – PEM KFS2-M3
c	025 SQ PIN ASSY – SAMTEK
d	CJC SOLDERED IN
e	TERM BOARD SOLDERED IN

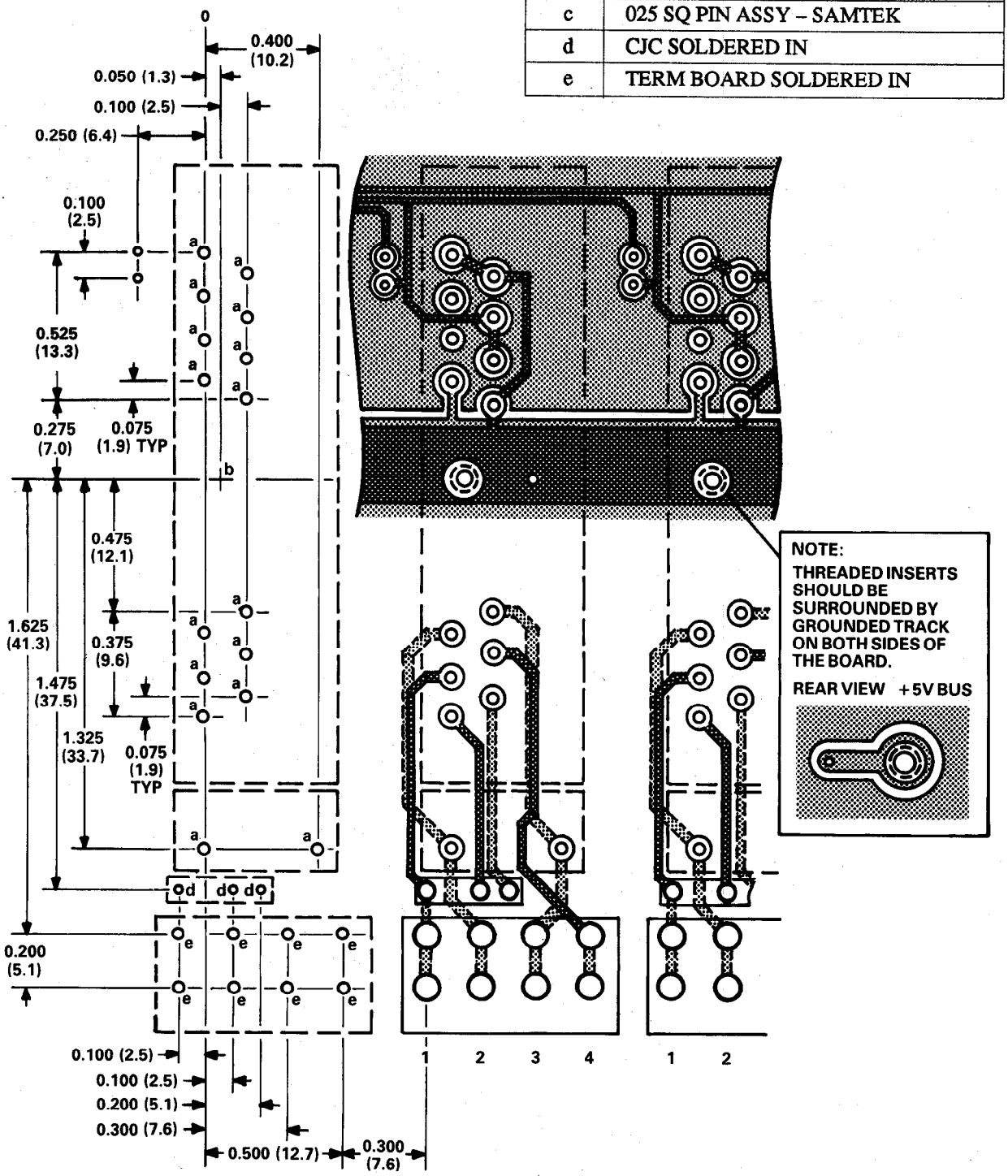


Figure 4.2. 5B01 Backplane Channel

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Process Side Issues

This section addresses board design issues related to the process side of the isolation barrier.

Field Terminations

Screw terminals will usually be required for connecting field wiring to the modules. Each module will use a minimum of two terminals and a maximum of four (2 signal, 2 excitation).

AC1361 Cold Junction Temperature Sensor

Where thermocouple wires connect to copper terminals, a correction for the thermoelectric potential of that junction must be made. In the 5B Series modules, this is accomplished by measuring the temperature at the screw terminals and applying a correction signal in the module. The AC1361 temperature sensor was designed specifically for this purpose. It is a cold junction temperature sensor optimized for operation in the temperature range from +5°C to +45°C and is intended to be used exclusively with 5B Series thermocouple input modules.

Installing sensors in every channel provides maximum system flexibility. When a system is configured in this way, no advance knowledge of which channels will be assigned to thermocouple inputs or whether a particular channel will be an input or an output is required. The design of the AC1361 makes this possible in two ways:

- Connection of the AC1361 to the associated module will not affect the operation of any non- thermocouple module in any way (see Figure 4.3).
- The calibration of the AC1361 is independent of the thermocouple module with which it is used.

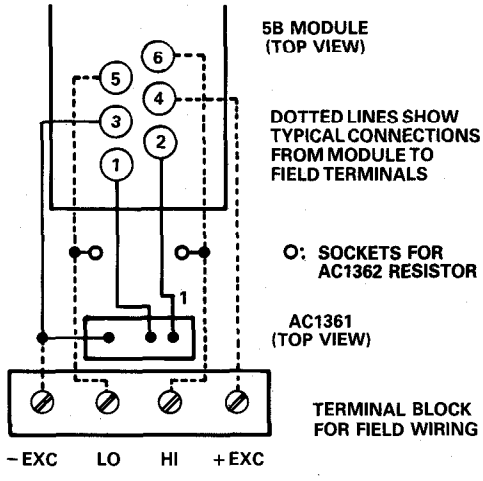


Figure 4.3. AC1361 Connection

Thus there is no need to keep a sensor associated with a specific module or to dedicate channels exclusively for thermocouple use.

Figure 4.4 shows the limits of the outline of the AC1361 sensor package. This sensor should be placed as close to the field wiring terminations as possible. It is not necessary for the body of the sensor to touch the terminal block – the thermal path to the sensor is primarily through its leads. It is important , whenever thermocouples are connected to a system, to minimize thermal gradients in the neighborhood of the field terminals. Heat sources should be placed as far from the screw terminals as possible.

Electrical specifications of the sensor (Table 4.1) are

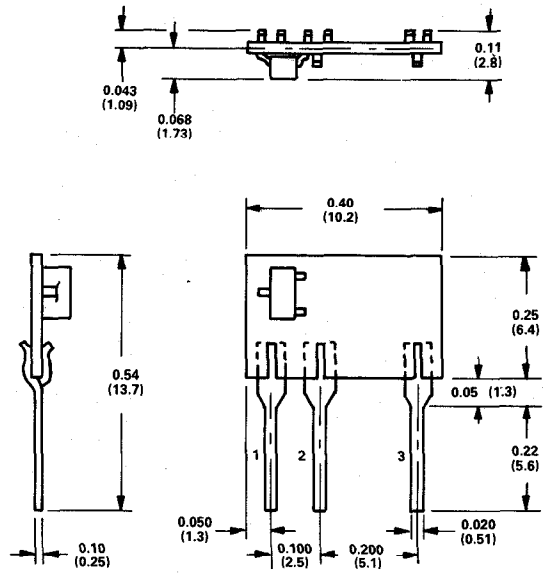


Figure 4.4. AC1361 Outline

provided only to facilitate inspection; the accuracy specifications of 5B Series thermocouple modules include the effects of a worst-case sensor. The test circuit for the AC1361 is shown in Figure 4.5.

Current Conversion Resistor

Parameter	Value	Test Conditions
V_S at +25.0°C	(510 ±0.75) mV	+25.0°C
Avg. Δ V_S with T	–(2.500 ±0.04) mV/°C	+5°C to +45°C

Table 4.1. AC1361 Electrical Specifications

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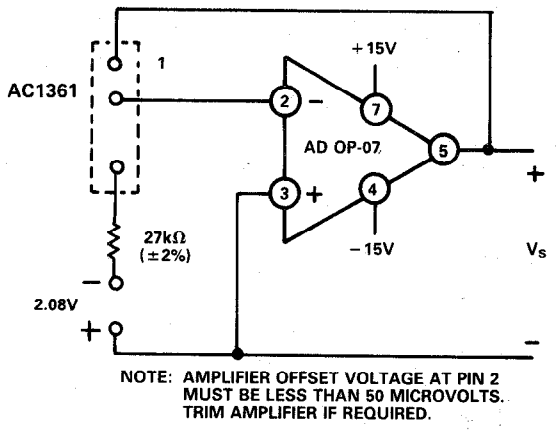


Figure 4.5. AC1361 Test Circuit

Current Conversion Resistor

The 5B32 current input module measures process current signals by reading the voltage developed across a precision 20 Ω resistor. This resistor is supplied in the form of a separate pluggable resistor carrier assembly since it can not be protected against destruction in the event of an inadvertent connection of the power line. (Extra current conversion resistors are available as accessories, model number AC1362.)

If the power line is inadvertently connected across the high and low signal terminals, large currents will flow, causing the resistor to fuse internally. To protect your board, the tracks from signal high and low to the resistor should be wide – 50 mil conductor widths in 1 or 2 ounce copper are appropriate.

The AC1362 is shown in Figure 4.6. Space must be provided for the AC1362 in any applications that might include current inputs. Accommodation of this resistor carrier in a 5B Series backplane is illustrated in Figure 4.2.

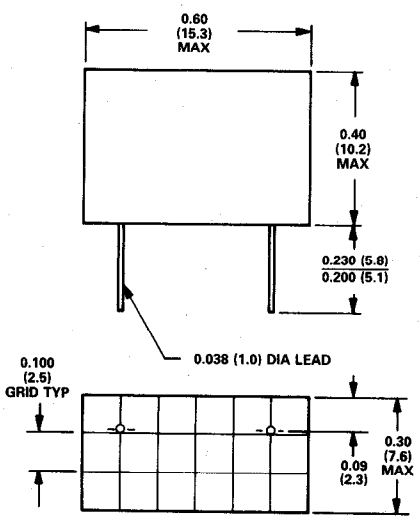


Figure 4.6. AC1362 Outline

Protection

The 5B Series modules can withstand application of 240 V to any combination of I/O field terminations. To protect your board from being harmed by such an occurrence, a 50 mil spacing should be maintained between conductors associated with the field wiring screw terminals. For spacing purposes, track from pins 1 and 2 of the AC1361 can be taken as equivalent to IN LO.

The 5B Series modules can also prevent harm to the connected system when a very large, fast transient strikes all field I/O lines at the same time. However, proper grounding of your board is essential to get full protection since, in some 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. On our 5B Series backplanes, large ground studs are provided and, when hazards of this magnitude exist, are connected to ground by the shortest practical length of large diameter wire.

The surge withstand capability can be tested with not less than 50 2.5 kV bursts per second. A test duration of 2 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 A.

When a safety ground is connected, care must taken to insure measurement accuracy. Refer to the grounding sections on the 5B01 or 5B02 backplanes in Chapter 3 for a discussion of provisions made in our 5B Series backplanes.

Safety

Because leakage currents from high common mode voltages could reach the hold-down screw, the screw insert should preferably be grounded to power common or at least surrounded by guard rings on both sides of the printed circuit board.

It is good practice to put all track connected to the HI and LO field wiring terminals on the back of the board to prevent a hazard when high common mode voltages are present.

Isolation

The 5B Series modules provide 1500 Vrms CMV isolation. The modules' pinout sets an upper bound of 0.300″ between input and output track (assuming a metal screw insert grounded to system common). Care should be taken in placing I/O tracks to maintain this spacing between the input and output conductors. Consult Figure 4.2 for an example of how the tracks are laid out on our 5B01 backplane so as to maintain this spacing. You should also be aware that safety standards may place requirements on track spacings.

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Board design issues related to the system side of the isolation barrier are discussed in this section.

Grounding

A current path must exist between power common and output common (input common and power common in output modules) at some point for proper operation of the module. This path can be resistive; anything less than 10 kΩ is sufficient. The connection does not need to be near the module; distances up to 6 feet are acceptable.

Using the Input Modules' Output Switch

The low-resistance (<50 Ω) series output switch (active-low) in each input module can provide a self-multiplexed output controlled by an enable input that is compatible with MOS and LSTTL levels. Turning on a channel results in a settled output to a 1000 pf bus load (equivalent to roughly 30 modules) in less than 5 microseconds.

If you do not wish to use the output switch present in each 5B Series input module, simply ground the read enable input to power common.

Effects of the Output Switch

The output switch has a typical resistance of 50 Ω and a maximum resistance of 100 Ω. The effect of this resistance is twofold.

First, in analog bus applications, the bus capacitive load interacts with the switch resistance to determine the output selection time. The specified 6 µs settling time is valid for capacitive loads up to 2,000 pF. Since the output capacitance, switch off, of a module is only 25 pF, this will not usually be a limitation, even in combination with typical backplane tracks. Larger loads will result in longer settling times.

Second, an error voltage is developed across the switch when it is resistively loaded. In addition to the expected effect on gain error, load resistances less than 20 kΩ will also degrade nonlinearity and gain temperature coefficient.

Using the Track-and-Hold Feature

Each output module includes a track-and-hold circuit which allows one DAC to serve numerous output channels. The output droop rate is 80 µA/s which corresponds to a refresh interval of 25 ms for 0.01% full-scale droop. The track-and-hold is controlled by an active-low enable input which is compatible with CMOS and LSTTL signals.

If you do not wish to use the track-and-hold present in each output module, simply ground the write enable input to power common.

Miscellaneous Topics

Other system design considerations are grouped in this section.

AC1360 Evaluation Socket

The AC1360 is a test or evaluation socket for 5B Series modules. Screw terminals are provided for all of the module's input, output, control, and power connections. In addition, an 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.

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

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

The snap foot elements will fit DIN EN 50022, DIN EN 50035, and DIN EN 50045 rails.

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

Configuration Options

The AC1360, shown in Figure 4.7, includes only two

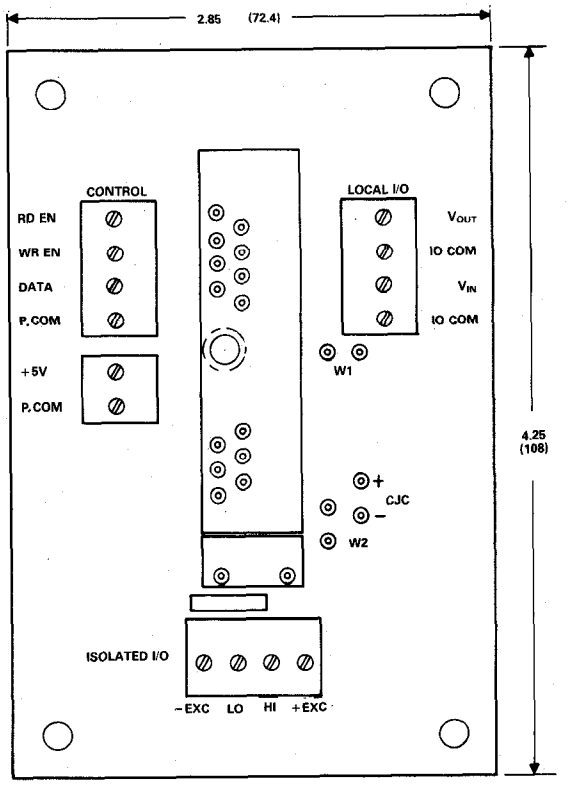


Figure 4.7. AC1360.

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The first, labeled W1, 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 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 LO 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. 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 LO input terminals (or the ±EXC screws, which are not normally used in thermocouple applications). Most benchtop 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.

Caution: The AC 1360 is not protected against reversed power supply connections. A reversal may destroy the installed module.

Double Isolation Protection

A board using the 5B Series modules can be configured to provide a double isolation barrier, as shown in Figure 4.8.

A common mode voltage at the input would have to break down the barrier in the input module and raise local common (ground) enough to break down the barrier in the output module before it could affect the output circuit.

Use with Two-Wire Transmitters

The 5B Series can be used in a system to interface with two-wire transmitters in either of two ways. A configuration with a current loop input from a loop-powered transmitter (2-wire) is illustrated in Figure 4.9. A configuration with a current loop input from a locally powered source, or 3/4 wire transmitter, is illustrated in Figure 4.10.

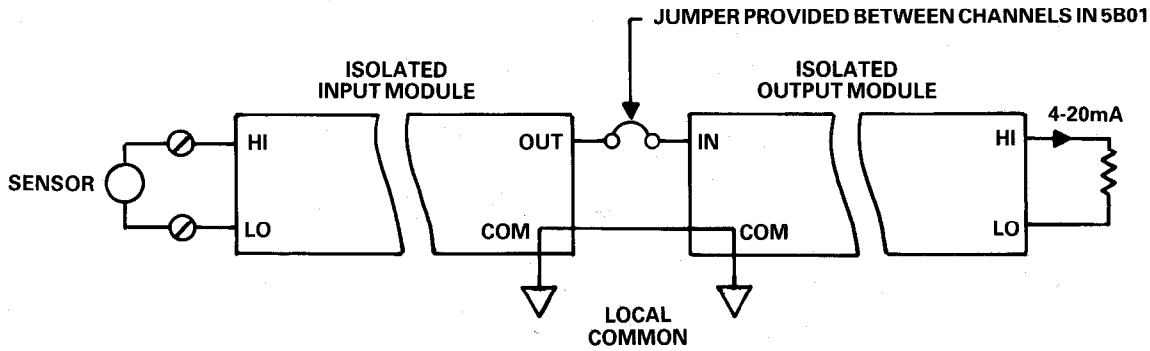


Figure 4.8. Double Isolation Protection

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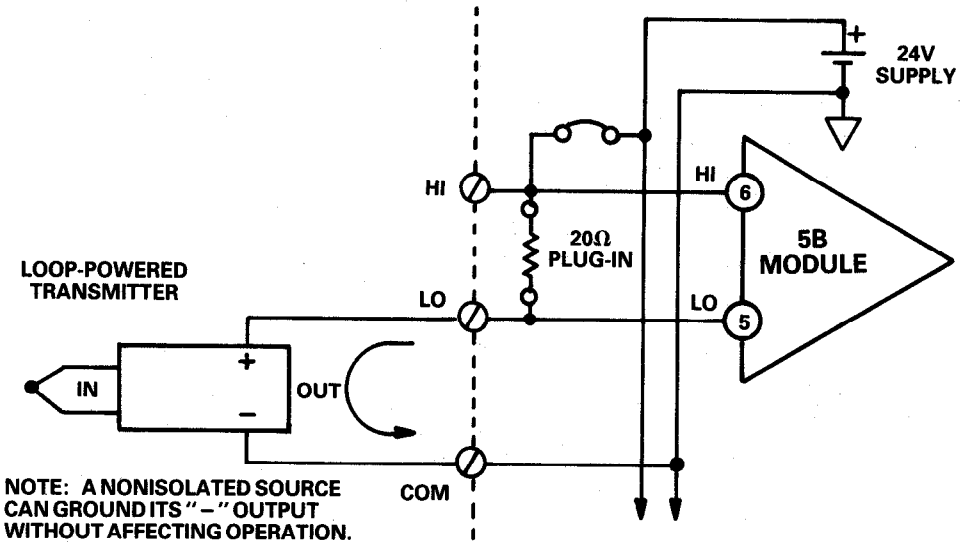


Figure 4.9. Current Loop Input from Loop-Powered Transmitter (2-Wire)

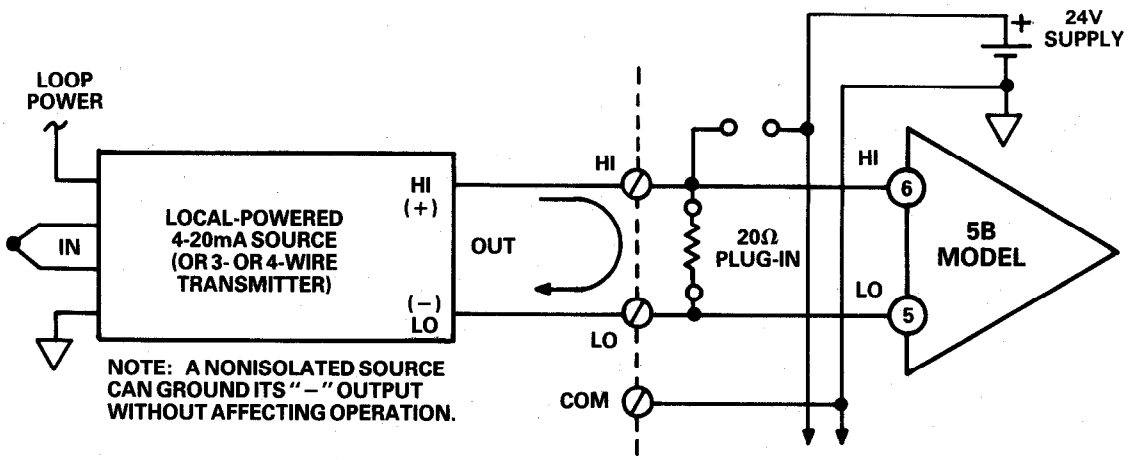


Figure 4.10. Current Loop Input from Locally-Powered Source (or 3/4 Wire Transmitter)

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Appendix A
Accessories

To ease the board design process and to complete the 5B Series subsystem solution, the following accessories are available.

AC1315
The AC1315 is a 2′ (60 cm) 26-pin cable with 2 connectors

AC1324
The AC1324 is a universal interface board with a 26-pin connector in and 26 screw terminals out. A diagram of the AC1324 is included in the Interface Accessories section of Chapter 3, page 3-11.

AC1344
The AC1344 is a package of 10 jumpers for providing two levels of isolation protection on the 5B01 backplane or replacing the address selection jumpers on the 5B02 backplane.

AC1360
The AC1360 is a single channel evaluation and test socket with screw terminals and a cold junction sensor. The operation of this socket is discussed in Chapter 4, page 4-5. A diagram is included.

AC1361
The AC1361 temperature sensor provides cold junction temperature measurement for thermocouple applications on user-designed backplanes. This sensor is described in detail in Chapter 4, page 4-3. They are provided on each channel of 5B Series backplane.

AC1362
Supplied with each 5B32 Current input Module, the AC1362 is a replacement pluggable resistor (20 Ω) assembly.

AC1363
The AC1363 is a single-piece metal chassis for mounting 5B Series backplanes in a 19″ rack.

AC1364
The AC1364 is this *5B Series User's Manual.*

AC1365
The AC1365 is a module case and mounting screw.

AC1366
The AC1366 is an interface board used to convert high-level control signals to the TTL logic levels used on the 5B02 backplane. This board can be mounted on the backside of the metal chassis (AC1363).

AC1367
The AC1367 voltage switch input is a nonisolated, unity gain module, allowing a preconditioned signal to be connected into the 5B backplane. A detailed discussion of this module is included in Chapter 2, page 2-20.

CAB-01
The CAB-01 is a 26-pin cable with 3 connectors used to daisy-chain 5B02 backplanes. The number of CAB-01 cables needed is equal to the number of 5B02 backplanes to be connected together minus one. A maximum of four 5B02 backplanes can be chained together, requiring three CAB-01 cables and one AC1315 cable (or similar cable) to connect to an interface board or control system.

955
The 955 is a chassis mounted 1 A @ 5 V power supply. See Table 3.2 in order to determine the power requirements for each system.

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Appendix B
Drill Template

Figure B.1 is a drill template for mounting a 5B01 or 5B02 backplane.

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Appendix C
5B02 Jumper Configurations

The 5B02 backplane was designed to address multiple backplane configurations with a minimum of external circuitry. This is accomplished by implementing analog input and output buses and taking advantage of output enable and track-and-hold circuits built into the modules. Using the address and control lines on the 5B02, up to 64 analog input/output channels can be accessed.

The following tables describe the jumper configurations required on the 5B02 backplanes for one, two, three, or four 5B02 combinations.

5B02 Logic Table – Single Board Application

In this appliction, the jumpers on the board should be in positions 1 and 6. All other jumpers should be left open. In the single-board application, R4, R5, W4, and W5 should be tied high or low; it's best not to let them float. Also note that N.C. means NO CHANNEL SELECTED and X means DON'T CARE.

RD EN	R5	R4	R3	R2	R1	R0	READ	WR EN	W5	W4	W3	W2	W1	W0	WRITE
1	X	X	X	X	X	X	N.C.	1	X	X	X	X	X	X	N.C.
0	X	X	0	0	0	0	CH0	0	X	X	0	0	0	0	CH0
0	X	X	0	0	0	1	CH1	0	X	X	0	0	0	1	CH1
0	X	X	0	0	1	0	CH2	0	X	X	0	0	1	0	CH2
0	X	X	0	0	1	1	CH3	0	X	X	0	0	1	1	CH3
0	X	X	0	1	0	0	CH4	0	X	X	0	1	0	0	CH4
0	X	X	0	1	0	1	CH5	0	X	X	0	1	0	1	CH5
0	X	X	0	1	1	0	CH6	0	X	X	0	1	1	0	CH6
0	X	X	0	1	1	1	CH7	0	X	X	0	1	1	1	CH7
0	X	X	1	0	0	0	CH8	0	X	X	1	0	0	0	CH8
0	X	X	1	0	0	1	CH9	0	X	X	1	0	0	1	CH9
0	X	X	1	0	1	0	CH10	0	X	X	1	0	1	0	CH10
0	X	X	1	0	1	1	CH11	0	X	X	1	0	1	1	CH11
0	X	X	1	1	0	0	CH12	0	X	X	1	1	0	0	CH12
0	X	X	1	1	0	1	CH13	0	X	X	1	1	0	1	CH13
0	X	X	1	1	1	0	CH14	0	X	X	1	1	1	0	CH14
0	X	X	1	1	1	1	CH15	0	X	X	1	1	1	1	CH15

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5B02 Logic Table – Dual-Board Application

In this appliction, the first board will be called "A" and the second board will be called "B."

Board A will have the jumpers in positions 5 and 10.
Board B will have the jumpers in positions 4 and 9.

RD EN	R5	R4	R3	R2	R1	R0	READ/ CHANNEL	WR EN	W5	W4	W3	W2	W1	W0	WRITE/ CHANNEL
1	X	X	X	X	X	X	N.C.	1	X	X	X	X	X	X	N.C.
X	1	X	X	X	X	X	N.C.	X	1	X	X	X	X	X	N.C.
0	0	0	0	0	0	0	CH0/A	0	0	0	0	0	0	0	CH0/A
0	0	0	0	0	0	1	CH1/A	0	0	0	0	0	0	1	CH1/A
0	0	0	0	0	1	0	CH2/A	0	0	0	0	0	1	0	CH2/A
0	0	0	0	0	1	1	CH3/A	0	0	0	0	0	1	1	CH3/A
0	0	0	0	1	0	0	CH4/A	0	0	0	0	1	0	0	CH4/A
0	0	0	0	1	0	1	CH5/A	0	0	0	0	1	0	1	CH5/A
0	0	0	0	1	1	0	CH6/A	0	0	0	0	1	1	0	CH6/A
0	0	0	0	1	1	1	CH7/A	0	0	0	0	1	1	1	CH7/A
0	0	0	1	0	0	0	CH8/A	0	0	0	1	0	0	0	CH8/A
0	0	0	1	0	0	1	CH9/A	0	0	0	1	0	0	1	CH9/A
0	0	0	1	0	1	0	CH10/A	0	0	0	1	0	1	0	CH10/A
0	0	0	1	0	1	1	CH11/A	0	0	0	1	0	1	1	CH11/A
0	0	0	1	1	1	0	CH12/A	0	0	0	1	1	1	0	CH12/A
0	0	0	1	1	0	1	CH13/A	0	0	0	1	1	0	1	CH13/A
0	0	0	1	1	1	0	CH14/A	0	0	0	1	1	1	0	CH14/A
0	0	0	1	1	1	1	CH15/A	0	0	0	1	1	1	1	CH15/A
0	0	1	0	0	0	0	CH0/B	0	0	1	0	0	0	0	CH0/B
0	0	1	0	0	0	1	CH1/B	0	0	1	0	0	0	1	CH1/B
0	0	1	0	0	1	0	CH2/B	0	0	1	0	0	1	0	CH2/B
0	0	1	0	0	1	1	CH3/B	0	0	1	0	0	1	1	CH3/B
0	0	1	0	1	0	0	CH4/B	0	0	1	0	1	0	0	CH4/B
0	0	1	0	1	0	1	CH5/B	0	0	1	0	1	0	1	CH5/B
0	0	1	0	1	1	0	CH6/B	0	0	1	0	1	1	0	CH6/B
0	0	1	0	1	1	1	CH7/B	0	0	1	0	1	1	1	CH7/B
0	0	1	1	0	0	0	CH8/B	0	0	1	1	0	0	0	CH8/B
0	0	1	1	0	0	1	CH9/B	0	0	1	1	0	0	1	CH9/B
0	0	1	1	0	1	0	CH10/B	0	0	1	1	0	1	0	CH10/B
0	0	1	1	0	1	1	CH11/B	0	0	1	1	0	1	1	CH11/B
0	0	1	1	1	1	0	CH12/B	0	0	1	1	1	1	0	CH12/B
0	0	1	1	1	0	1	CH13/B	0	0	1	1	1	0	1	CH13/B
0	0	1	1	1	1	0	CH14/B	0	0	1	1	1	1	0	CH14/B
0	0	1	1	1	1	1	CH15/B	0	0	1	1	1	1	1	CH15/B

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5B02 Logic Table – Triple-Board Application

A third board can be added to a dual application, and this will be called board "C." This board will have jumpers in location 3 and 8.

RD EN	R5	R4	R3	R2	R1	R0	READ/ CHANNEL	WR EN	W5	W4	W3	W2	W1	W0	WRITE/ CHANNEL
1	X	X	X	X	X	X	N.C.	1	X	X	X	X	X	X	N.C.
X	1	1	X	X	X	X	N.C.	X	1	1	X	X	X	X	N.C.
0	1	0	0	0	0	0	CH0/C	0	1	0	0	0	0	0	CH0/C
0	1	0	0	0	0	1	CH1/C	0	1	0	0	0	0	1	CH1/C
0	1	0	0	0	1	0	CH2/C	0	1	0	0	0	1	0	CH2/C
0	1	0	0	0	1	1	CH3/C	0	1	0	0	0	1	1	CH3/C
0	1	0	0	1	0	0	CH4/C	0	1	0	0	1	0	0	CH4/C
0	1	0	0	1	0	1	CH5/C	0	1	0	0	1	0	1	CH5/C
0	1	0	0	1	1	0	CH6/C	0	1	0	0	1	1	0	CH6/C
0	1	0	0	1	1	1	CH7/C	0	1	0	0	1	1	1	CH7/C
0	1	0	1	0	0	0	CH8/C	0	1	0	1	0	0	0	CH8/C
0	1	0	1	0	0	1	CH9/C	0	1	0	1	0	0	1	CH9/C
0	1	0	1	0	1	0	CH10/C	0	1	0	1	0	1	0	CH10/C
0	1	0	1	0	1	1	CH11/C	0	1	0	1	0	1	1	CH11/C
0	1	0	1	1	0	0	CH12/C	0	1	0	1	1	0	0	CH12/C
0	1	0	1	1	0	1	CH13/C	0	1	0	1	1	0	1	CH13/C
0	1	0	1	1	1	0	CH14/C	0	1	0	1	1	1	0	CH14/C
0	1	0	1	1	1	1	CH15/C	0	1	0	1	1	1	1	CH15/C

5B02 Logic Table – Addition of Fourth Board

The addition of the fourth board (board "D") will utilize jumper positions 2 and 7.

RD EN	R5	R4	R3	R2	R1	R0	READ/ CHANNEL	WR EN	W5	W4	W3	W2	W1	W0	WRITE/ CHANNEL
1	X	X	X	X	X	X	N.C.	1	X	X	X	X	X	X	N.C.
0	1	1	0	0	0	0	CH0/D	0	1	1	0	0	0	0	CH0/D
0	1	1	0	0	0	1	CH1/D	0	1	1	0	0	0	1	CH1/D
0	1	1	0	0	1	0	CH2/D	0	1	1	0	0	1	0	CH2/D
0	1	1	0	0	1	1	CH3/D	0	1	1	0	0	1	1	CH3/D
0	1	1	0	1	0	0	CH4/D	0	1	1	0	1	0	0	CH4/D
0	1	1	0	1	0	1	CH5/D	0	1	1	0	1	0	1	CH5/D
0	1	1	0	1	1	0	CH6/D	0	1	1	0	1	1	0	CH6/D
0	1	1	0	1	1	1	CH7/D	0	1	1	0	1	1	1	CH7/D
0	1	1	1	0	0	0	CH8/D	0	1	1	1	0	0	0	CH8/D
0	1	1	1	0	0	1	CH9/D	0	1	1	1	0	0	1	CH9/D
0	1	1	1	0	1	0	CH10/D	0	1	1	1	0	1	0	CH10/D
0	1	1	1	0	1	1	CH11/D	0	1	1	1	0	1	1	CH11/D
0	1	1	1	1	0	0	CH12/D	0	1	1	1	1	0	0	CH12/D
0	1	1	1	1	0	1	CH13/D	0	1	1	1	1	0	1	CH13/D
0	1	1	1	1	1	0	CH14/D	0	1	1	1	1	1	0	CH14/D
0	1	1	1	1	1	1	CH15/D	0	1	1	1	1	1	1	CH15/D

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Appendix D
5B37 Transfer Function

Calculating the Output Voltage of a 5B37

The output voltage of a 5B37 thermocouple signal conditioner can be calculated by knowing: (a) the thermocouple input voltage at the measurement temperature; (b) the thermocouple input signal at the minimum point of the 5B37 module temperature range; and (c) the 5B37 gain.

Transfer Equation for 5B37

To determine the output voltage from a 5B37 module, use the following equation:

$$V_{OUT} = [\text{ T.C. Output} - V_{ZERO}] * \text{GAIN}$$

where,

1 – V_{OUT} is the 5B37 module output (in volts)

2 – T.C. Output is the thermocouple output voltage (in mV) at the temperature being measured

3 – V_{ZERO} is the thermocouple output voltage (in mV) at the minimum temperature span specified for the 5B37 module

4 – GAIN is the throughput gain (in V/mV) of the 5B37 module

The table show below provides the thermocouple output voltage at the minimum temperature span of each 5B37 module (V_{ZERO}) and the 5B37 gain.

Sensors Software Program

For assistance in determining a specific thermocouple output voltage at any temperature, you may contact the Analog Devices, Inc. Technical Support Group and request a copy of the SENSORS software program. This Windows software program provides a convenient reference to lookup tables of temperature sensing devices, including thermocouples, RTD's (Platinum, Nickel, and Copper), as well as thermistors. Functions are implemented in both directions (i.e., temperature to mV and mV to temperature), as well as in both °C and °F.

5B37 Model	J-01	K-02	T-03	E-04	R-05	S-05	B-06	N-08
Temp (C) lo	–100	–100	–100	0	0	0	0	0
Range hi	760	1350	400	900	1750	1750	1800	1300
Vout (V) lo	0	0	0	0	0	0	0	0
Range hi	5	5	5	5	5	5	5	5
Vin (mV) lo	–4.632	–3.553	–3.378	0	0	0	0	0
Range hi	42.922	54.125	20.869	68.783	20.878	18.504	13.585	47.502
Vin span	47.554	57.678	24.247	68.783	20.878	18.504	13.585	47.502
Gain (V/mV)	0.105143	0.086688	0.206211	0.072692	0.239486	0.270211	0.368052	0.105258
Vzero (mV)	–4.632	–3.553	–3.378	0	0	0	0	0

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Important Information

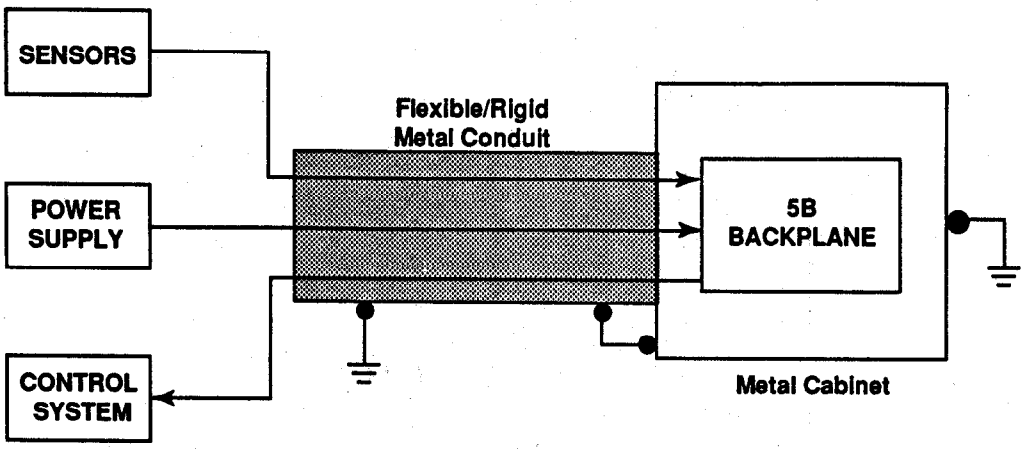
for use of the
5B Series Signal Conditioning Subsystems
in RFI/EMI fields.

The 5B Series Signal Conditioning Subsystem has been tested and passed the stringent "heavy industrial" requirements of the European Union's electromagnetic compatibility (EMC) directive. The 5B Series modules have the CE (Communité Européenne) mark on their label indicating their approval. Only products that comply with these directives can have the CE mark affixed. Only CE marked products can be sold in the EU starting on January 1, 1996.

In order to comply with the European Standards in a typical heavy industrial application we recommend the following setup:

1. The modules must be mounted on a standard ***iomation*** 5B backplane.
2. The 5B backplane must be mounted inside a standard metal cabinet which fully encloses the modules on all sides. The cabinet must be earth grounded at a convenient point and good electrical contact between all side panels must be assured.
3. All wiring must be routed through a metal conduit or wire chase (flexible or rigid).
4. The conduit must be earth grounded and electrically connected to the cabinet.
5. Due to the low input levels, it is recommended that all input, output and power lines be shielded. The wiring must be connected as described in Chapter 3 of this manual.

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General Wiring Configuration

CE CERTIFICATION TESTS

The 5B Series modules have been tested and certified according to the rigorous electromagnetic constrains of the EN50082-2 and EN50081-2 European Standards.

The tests performed in accordance with these standards were:

- Radiated RF Immunity - 80 MHz to 1000 MHz.
- Pulsed RF Immunity - 900 MHz, 50% Duty Cycle, 200 Hz.
- Conducted RF Immunity - 150 KHz to 80 MHz.
- Magnetic Field Immunity - 50 Hz.
- Fast Transient Immunity.
- ESD Immunity, Contact Method.
- ESD Immunity, Air Discharge Method.
- Voltage Surge Immunity.
- Emissions.

When used according to these installation directions, any errors caused by EMI/RFI interference will be less than 0.1% of the full scale 5B measurement range (typical @ 25°C), for field strengths up to 10 V/M and frequencies up to 1 GHz.

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Statement of Warranty

Analog Devices warrants that the Products furnished under this Agreement will be free from material defects for a period of one year from the date of shipment. The Customer shall provide notice to Analog Devices of such defect within one week after the Customer's discovery of such defect. The sole obligation and liability of Analog Devices under this warranty shall be to repair or replace, at its option, without cost to the Customer, the product or part which is so defective and as to which such notice is given.

Upon request by Analog Devices, the product or part claimed to be defective shall immediately be returned at the Customer's expense to Analog Devices. Replaced or repaired products or parts will be shipped to the Customer at the expense of Analog Devices.

There shall be no warranty or liability for any products or parts which have been subject to misuse, accident, negligence, failure of electric power or modification by the Customer without Analog Devices' approval. Final determination of warranty eligibility shall be made by Analog Devices. If a warranty claim is considered invalid for any reason, the Customer will be charged for services performed and expenses incurred by Analog Devices in handling and shipping the returned item.

As to replacement parts supplied or repairs made during the original warranty period, the warranty period of the replacement or repaired part shall terminate with the termination of the warranty period with respect to the original product or part.

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