Acromag®

Series A5B
Signal Conditioning Modules

USER'S MANUAL

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Manual No. 8500-299

IMPORTANT SAFETY CONSIDERATIONS

It is very important for the user to consider the possible adverse effects of power, wiring, component, sensor, or software failures in the design of any type of control or monitoring system. This is especially important where economic property loss or human life is involved. It is important that the user employ redundancy, and comprehensive failure analysis to insure a safe and satisfactory overall system design. It is agreed between the Buyer and Acromag, that this is the Buyer's responsibility.

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1.0 INTRODUCTION

This manual is intended to provide the user of Acromag A5B signal conditioning modules and products with application information and detailed specifications on each module type. Chapter 2 provides detailed electrical and mechanical specifications on all A5B analog I/O modules and all accessories. Chapter 3 covers the digital I/O modules and accessories. Chapter 4 contains application notes specific to individual A5B products. Appendix A contains a Series A5B Selection and Ordering Guide.

General Description

The Acromag A5B signal conditioning modules provide analog and digital input/output interfacing for moderate industrial environments. Utilizing optical and transformer isolation, the A5B product line offers a high level of safety when interfacing expensive computer systems to industrial processes.

These signal conditioning modules are essential components of safe data acquisition system design. Isolation barriers in each module help prevent damage to expensive control room equipment from hazardous voltages and lightning surges usually present in industrial applications. Isolation also prevents troublesome ground loops which disrupt the measured signal. Filter circuits on the input modules eliminate electrical noise in the measured signal. Overall, the A5B product line of analog and digital signal conditioning modules and accessories create a more cost effective and manageable method for system design, expansion, and repair.

Both the digital and analog modules are manufactured to the highest industry standards. They are assembled from the highest quality components, encased in a thermally conductive hard potting material, and subjected to stringent testing and quality control. Further, they each meet industry standard pinouts for convenient system expansion and repair.

Analog Modules

The A5B analog input/output modules can interface to a wide range of signal input and output requirements. The input modules can accept signals from thermocouple, RTD, strain-gage, millivolt, volt, and current sources. The output modules can provide a 4-20mA or 0-20mA current for a variety of control applications. All modules are transformer isolated to 1500Vrms.

Digital Modules

The digital input/output modules provide the user with a safe interface to harsh industrial measurement and control applications. Input modules can interface to a range of AC and DC voltages from TTL levels to 280 volts. The output modules can switch any variety of 3 Amp loads up to 280VAC. All modules are optically isolated to 4000Vrms.

2.0 ISOLATED ANALOG I/O MODULES AND ACCESSORIES

2.1 A5B ANALOG I/O MODULE GENERAL SPECIFICATIONS

Key Features

* Millivolt, Voltage, Current, Thermocouple, Strain Gage, and RTD Signals are Supported
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* A5B Types Can be Mixed and Matched on a Backpanel

The Acromag A5B series of analog input/output modules provides a highly reliable and safe interface to harsh industrial measurement and control applications. Each A5B module provides a single channel of isolated analog input or output. Input modules interface to all types of external sensors, then filter, isolate, amplify, (some models also linearize), and convert the input to a high-level analog voltage output. The output modules accept a high-level analog voltage signal from a host system, then buffer, isolate, and amplify, before providing a process current output to field devices. Almost 60 different A5B modules are available and encompass a wide selection of isolated analog input and output functions; including voltage and current in low and high bandwidth, thermocouple, RTD, and strain-gage models. Custom I/O ranges are also available; please consult the factory.

Input Modules

The A5B input modules can accept signals from a variety of signal sources: thermocouple, RTD, strain-gage, millivolt, voltage, and current inputs. They all have the same industry standard pinout and footprint which allows mixing and matching of input types on the same backpanel. All input modules provide transformer isolation with key specifications of 1500V rms Common Mode Voltage (CMV) protection, 160dB Common Mode Rejection (CMR) and ANSI/IEEE C37.90.1-1989 (Formerly IEEE-472) transient protection.

Output Modules

The A5B39 output module can provide either a 4-20mA, or 0-20mA output signal, for use in a variety of control applications. It has the same 1500 VAC rms isolation rating as the input modules.

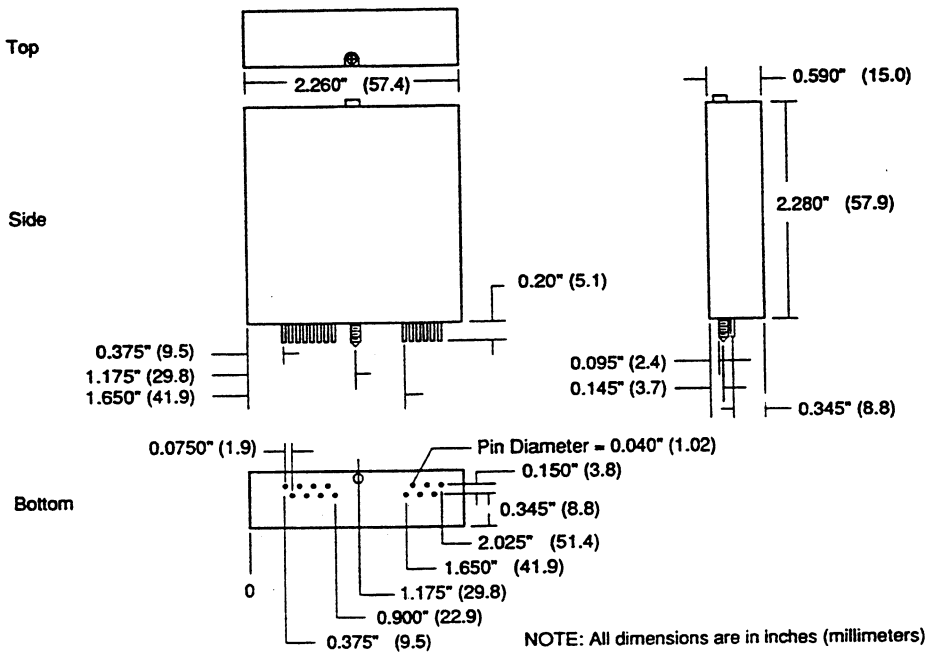
Analog I/O Accesories

A full line of accessory products is offered to provide a complete solution to the end user's specific control applications. Two 16-position backpanels, and both a single and dual position DIN rail panel, provide mounting capability for any mixture of the analog modules. Additional accessories include interface cables, 19-inch mounting rack, fuses, barrier-strip jumpers, test adapters, and power supplies (see Section 2.4).

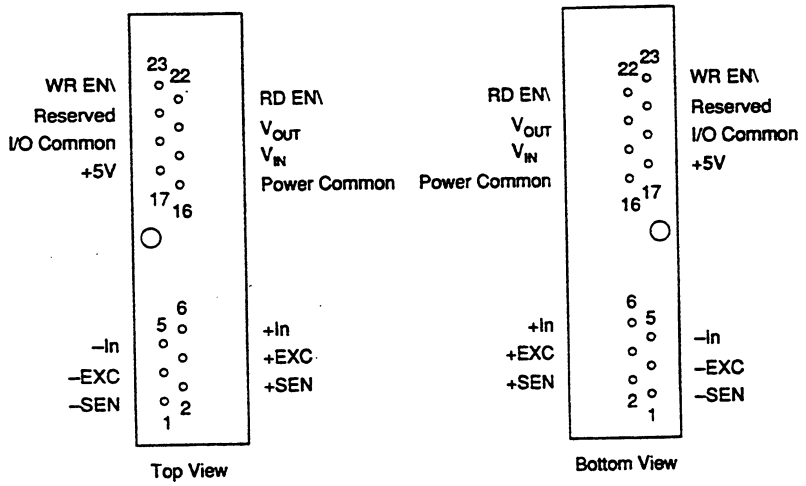
Mechanical Drawings

The following mechanical drawing is useful if designing circuit boards to mount the A5B modules. Many sockets are available which accept the mounting pins. As an example, AMP Incorporated provides a socket with part number 1-331892-4. The captive nut for the 3mm mounting screw can be obtained from PEM (Penn Engineering and Manufacturing), part number KFS2-M3.

A5B Analog Module Mechanical Dimensions [inches(mm)]



A5B Analog Module PIN Assignments



2.2 ANALOG INPUT MODULES

2.2.1 A5B30 & A5B31 Voltage Input Modules

Features
* Accepts Millivolt and Voltage Level Signals
* High Level Voltage Output, +/-5V or 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 160dB CMR
* 95dB NMR at 60Hz, 90dB AT 50Hz
* +/-0.05% Accuracy
* +/-0.02% Linearity
* +/-1 uV/^{o}C Drift

Each A5B30 and A5B31 voltage input module provides a single channel of analog input which is filtered, isolated, amplified, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

Signal filtering is accomplished with a six-pole filter which provides 95dB of Normal-Mode-Rejection at 60Hz, and 90dB at 50Hz. Two poles of this filter are on the field side of the isolation barrier and the other four are in the output stage.

After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%.

A special input circuit on the A5B30 and A5B31 modules provides protection up to 240VAC against accidental connection of power-line voltages.

The A5B30 millivolt input module accepts +/-10mV to +/-100mV input signals, and provides a +/-5V, or 0 to +5V output. The A5B31 voltage input module accepts +/-1V to +/-10V input signals, and provides a +/-5V, or 0 to +5V output.

A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

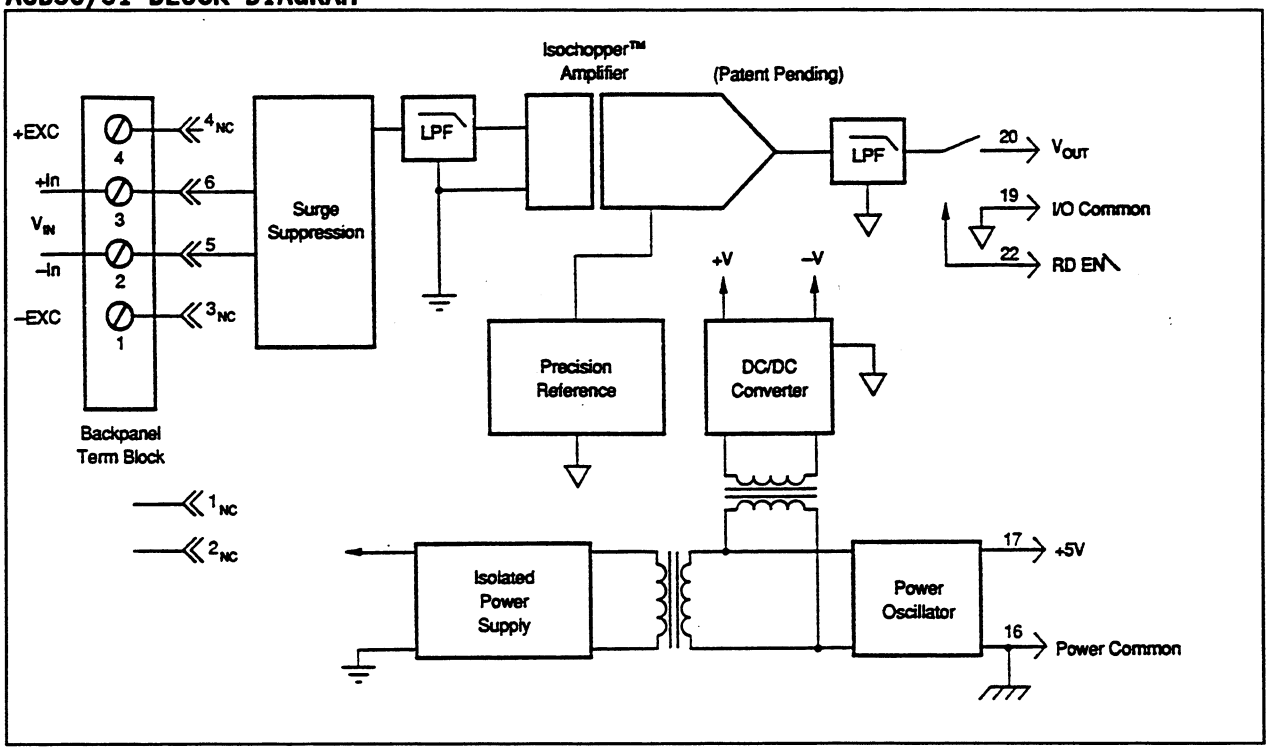
A5B30/31 SPECIFICATIONS (Typical @ 25C, +5V Power, '*' = same spec as A5B30):

Module	A5B30	A5B31
Input Range	±10mV to ±100mV	±1V to ±10V
Input Bias Current	±0.5nA	±0.05nA
Input Resistance		
Normal	50MΩ	650KΩ
Power Off	40KΩ	650KΩ
Overload	40KΩ	650KΩ
Input Protection		
Continuous	240Vrms max	*
Transient	ANSI/IEEE C37.90.1-1989(former IEEE-472)	*
CMV, Input to Output		
Continuous	1500V rms max	*
Transient	ANSI/IEEE C37.90.1-1989(former IEEE-472)	*
CMR (50 or 60Hz)	160dB	*
NMR	95dB @ 60Hz, 90dB @ 50Hz	*
Accuracy	±.05%(.08% Max) Sp ±10uV RTI ±.05%(Vz)[1]	±.05%(.08% Max) Sp ±0.2mV RTI ±.05%(Vz)[1]
Nonlinearity	±0.02% Span (±.035% Max)	*
Stability:		
Input Offset	± 1uV/°C (± 2uV/°C Max)	±20uV/°C (±25uV/°C Max)
Output Offset	±20uV/°C (±30uV/°C Max)	*
Gain	±25ppm/°C (±50ppm/°C Max)	±50ppm/°C (±70ppm/°C Max)
Noise:		
Input, 0.1 to 10Hz	0.2uV rms (0.6uV rms Max)	2uV rms (3uV rms Max)
Output, 100KHz	200uV rms (400uV rms, 800uVp-p Max)	*
Bandwidth, -3dB	4Hz	*
Response Time, 90% span	0.2s	*
Output Range	±5V or 0 to +5V	*
Output Resistance	50 ohm	*
Output Protection	Continuous Short to Gnd	*
Output Selection Time:		
(to +/-1mV of Vout)	2.5uS @ 200pF, 3.5uS @ 500pF	*
	4.0uS @ 1000pF, 6.0uS @ 2000pF	*
Output Enable Control:		
Max Logic "0"	+0.8V	*
Min Logic "1"	+2.4V	*
Max Logic "1"	+36V	*
Input Current, "0,1"	0.5uA	*
Pwr Supply Voltage	+5VDC ±5%	*
Pwr Supply Current	30mA Max	*
Pwr Supply Sensitivity	±2uV/% (RTI)	±200uV/% (RTI)
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)	*
Environmental:		
Operating Temp. Range	-25°C to +85°C	*
Storage Temp. Range	-40°C to +85°C	*
Relative Humidity	0 to 95% noncondensing	*
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3 ft	*

Notes:

1. Vz is the input voltage that results in 0V output. RTI is Referred To Input. Sp is Span.
2. Sample error calculation - To calculate maximum inaccuracy at 25°C for an A5B30-01 module (Input: -10mV to +10mV, Output: -5V to 5V), combine the error specifications for Accuracy and Nonlinearity as follows: ±0.08% of span ±0.035% Nonlinearity ±10uV RTI[1] ±0.05% of V_Z[1]. This is equivalent to ±0.0008*(10V) ±0.00035*(10V) ±0.00001V*(10V/0.02V) ±0.0005*(0V), or ±16.5mV at the output. Error for other A5B30/31 models is calculated in a similar fashion.

A5B30/31 BLOCK DIAGRAM



A5B30/31 ORDERING INFORMATION

MODEL	INPUT RANGE	OUTPUT RANGE
A5B30-01	- 10mV to + 10mV	-5V to +5V
A5B30-02	- 50mV to + 50mV	-5V to +5V
A5B30-03	-100mV to +100mV	-5V to +5V
A5B30-04	- 10mV to + 10mV	0V to +5V
A5B30-05	- 50mV to + 50mV	0V to +5V
A5B30-06	-100mV to +100mV	0V to +5V
A5B31-01	- 1V to + 1V	-5V to +5V
A5B31-02	- 5V to + 5V	-5V to +5V
A5B31-03	-10V to +10V	-5V to +5V
A5B31-04	- 1V to + 1V	0V to +5V
A5B31-05	- 5V to + 5V	0V to +5V
A5B31-06	-10V to +10V	0V to +5V

2.2.2 A5B32 Current Input Module

FEATURES
* Accepts milliAmp Level Signals
* High Level Voltage Output, 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 160dB CMR
* 95dB NMR at 60Hz, 90dB AT 50Hz
* +/-0.05% Accuracy
* +/-0.02% Linearity
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B32 current input module provides a single channel of analog input which is filtered, isolated, amplified, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

A precision 20 ohm current conversion resistor is supplied with the A5B32 module. Sockets are provided on the APB01/02 backpanels to allow installation of this resistor. Extra resistors are available under part number AXR1 (see Section 2.4.8).

Signal filtering is accomplished with a six-pole filter which provides 95dB of Normal Mode Rejection at 60Hz, and 90dB at 50Hz. Two poles of this filter are on the field side of the isolation barrier, and the other four are in the output stage.

After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%.

A special input circuit on the A5B32 module provides protection up to 240VAC against accidental connection of power-line voltages.

The A5B32 current input module accepts 4 to 20mA, or 0 to 20mA input signals, and provides a 0 to +5V output.

A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

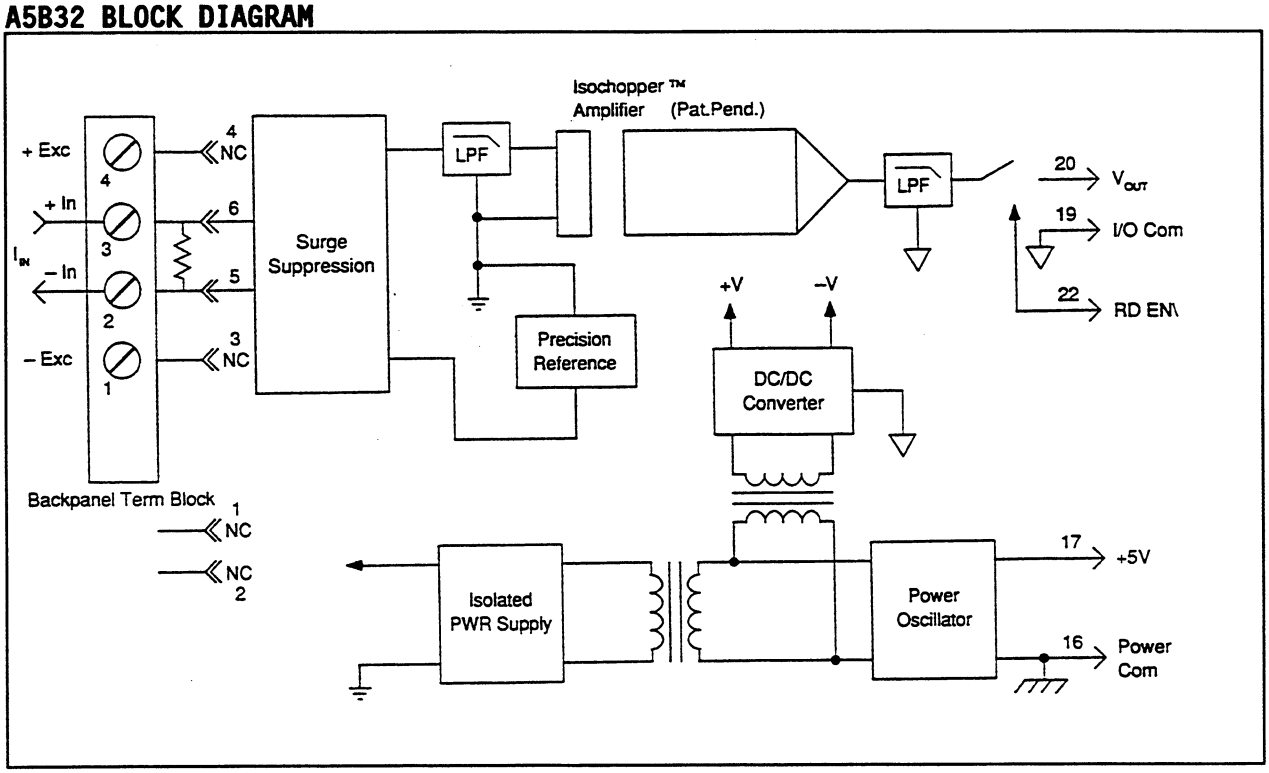
A5B32 SPECIFICATIONS (Typical @ 25C, +5V Power):

Input Range	0 to 20mA or 4 to 20mA
Input Resistor (Current Sense Resistor):	
Value	20.00Ω
Accuracy	±0.1%
Stability	±10ppm/°C
Input Protection:	
Continuous	240V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMV, Input to Output:	
Continuous	1500V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMR (50 or 60Hz)	160dB
NMR	95dB @ 60Hz, 90dB @ 50Hz
Accuracy	±0.05% Span (±.08% Max) ±0.05%(Iz)[1]
Nonlinearity	±0.02% Span (±.035% Max)
Stability:	
Input Offset	±1uV/°C (±2uV/°C Max) ±25ppm/°C of Iz
Output Offset	±20uV/C (±30uV/°C Max)
Gain	±25ppm/C (±50ppm/°C Max) of reading ±10ppm for Resistor
Noise:	
Input, 0.1 to 10Hz	10nA rms (20nA rms Max)
Output, 100KHz	200uV rms (400uV rms, 800uVp-p Max)
Bandwidth, -3dB	4Hz
Response Time, 90% span	0.2S
Output Range	0 to +5V
Output Resistance	50 ohm
Output Protection	Continuous short to gnd
Output Selection Time (to +/-1mV of Vout)	2.5uS @ 200pF, 3.5uS @ 500pF 4.0uS @ 1000pF, 6.0uS @ 2000pF
Output Enable Control:	
Max Logic "0"	+0.8V
Min Logic "1"	+2.4V
Max Logic "1"	+36V
Input Current, "0,1"	0.5uA
Power Supply Voltage	+5VDC ±5%
Power Supply Current	30mA Max
Power Supply Sensitivity	±2uV/% (RTI)
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)
Environmental:	
Operating Temp. Range	-25°C to +85°C
Storage Temp. Range	-40°C to +85°C
Relative Humidity	0 to 95% noncondensing
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3 ft

Notes:

1. Iz is the input current that results in 0V output.
2. RTI is Referred To Input.
3. Sample error calculation - To calculate maximum inaccuracy at 25°C for an A5B32-01 module [Input: 4 to 20mA (80 to 400mV into 20Ω), Output: 0 to 5V], combine the error specifications for Accuracy and Nonlinearity as follows: ±0.08% of span ±0.035% Nonlinearity ±0.05% of I_z[1]. This is equivalent to ±0.0008*(5V) ±0.00035*(5V) ±0.0005*(0.08V), or ±5.8mV at the output. Error for an A5B32-02 module is calculated in a similar fashion.

A5B32 BLOCK DIAGRAM



A5B32 ORDERING INFORMATION

MODEL	INPUT RANGE	OUTPUT RANGE
A5B32-01	4 to 20 mA	0V to +5V
A5B32-02	0 to 20 mA	0V to +5V

2.2.3 A5B34 RTD Input Modules

FEATURES

* Interfaces with 100 ohm Platinum, 10 ohm Copper, or 120 ohm Nickel RTD's in 2, 3, or 4-wire configurations
* Linearizes RTD Signal
* High Level Voltage Output, 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 160dB CMR
* 95dB NMR at 60Hz, 90dB AT 50Hz
* +/-0.05% Accuracy
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B34 RTD input module provides a single channel of RTD input which is filtered, isolated, amplified, linearized, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

RTD excitation is provided from the module by two matched current sources. When using a three-wire RTD, this method allows an equal current to flow in each RTD lead, which cancels the effects of lead resistances. The excitation currents are very small (0.25mA for 100 ohm Pt and 120 ohm Ni, 1mA for Cu) which minimizes self-heating of the RTD.

Signal filtering is accomplished with a six-pole filter which provides 95dB of Normal-Mode-Rejection at 60Hz, and 90dB at 50Hz. Two poles of this filter are on the field side of the isolation barrier, and the other four are in the output stage. After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%.

A special input circuit on the A5B34 module provides protection up to 240VAC against accidental connection of power-line voltages.

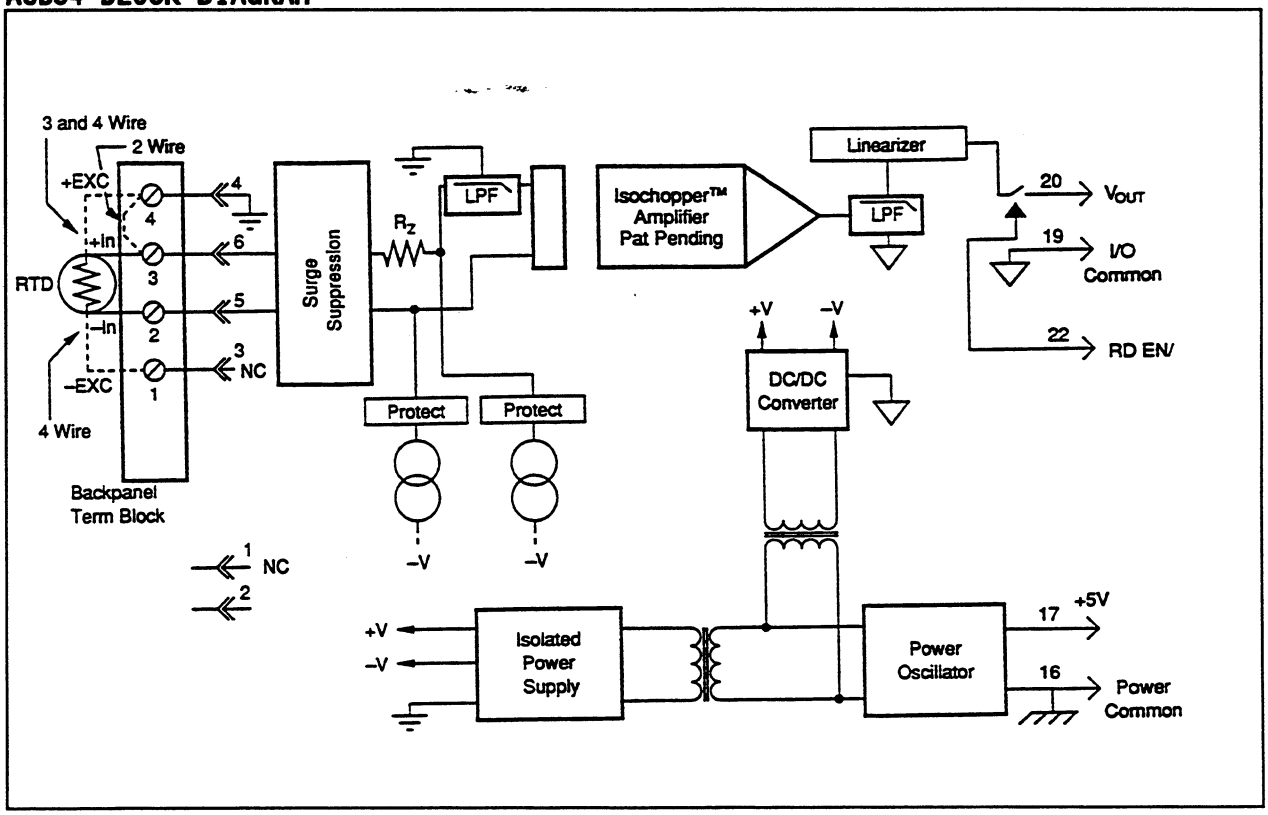
A5B34 SPECIFICATIONS (Typical @25C, +5V Power):

Input Range	-200°C to +850°C (100Ω Pt)
Input Resistance:	
Normal	50MΩ
Power Off	40KΩ
Overload	40KΩ
Input Protection:	
Continuous	240V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
Sensor Excitation Current:	
100Ω Pt, 120Ω Ni	0.25mA
10Ω Cu	1.0mA
Lead Resistance Effect:	
100Ω Pt, 120Ω Ni	±0.02°C/Ω
10Ω Cu	±0.2°C/Ω
CMV, Input to Output:	
Continuous	1500V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMR (50 or 60Hz)	160dB
NMR	95dB @ 60Hz, 90dB @ 50Hz
Accuracy	±0.05% span (±.08% Max) ±0.1Ω[1] ±0.05%R_Z[2] (±.08%R_Z[2] Max)
Conformity Error	±0.05% span
Stability:	
Input Offset	±0.02°C/°C (±.04°C/°C Max)
Output Offset	±20uV/°C (±30uV/°C Max)
Gain	±50ppm of reading/°C Max
Noise:	
Input, 0.1 to 10Hz	0.2uV rms RTI (0.6uV rms Max)[3]
Output, 100KHz	200uV rms RTO (400uV rms, 800uVp-p Max)[3]
Bandwidth, -3dB	4Hz
Response Time, 90% span	0.2s
Output Range	0 to +5V
Output Resistance	50Ω
Output Protection	Continuous Short to Ground
Output Selection Time (to +/-1mV of Vout):	2.5uS @ 200pF, 3.5uS @ 500pF 4.0uS @ 1000pF, 6.0uS @ 2000pF
Output Enable Control:	
Max Logic "0"	+0.8V
Min Logic "1"	+2.4V
Max Logic "1"	+36V
Input Current, "0,1"	0.5uA
Power Supply Voltage	+5VDC ±5%
Power Supply Current	30mA (33mA Max)
Power Supply Sensitivity	
100Ω Pt, 120Ω Ni	0.05 °C/V
10Ω Cu	0.5 °C/V
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)
Environmental:	
Operating Temp. Range	-25°C to +85°C
Storage Temp. Range	-40°C to +85°C
Relative Humidity	0 to 95% noncondensing
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3ft

Notes:

1. Use ±0.025Ω when using Cu RTDs.
2. R_Z is the value of RTD resistance at the lowest point of measurement range.
3. RTI is Referred To Input. RTO is Referred To Output.
4. Sample error calculation - To determine the maximum inaccuracy at 25°C for an A5B34-01 module (Pt Input: -100 to +100°C, Output: 0 to 5V), calculate the following: ±0.08% of span ±0.1Ω[1] ±0.08% of R_Z ±0.05% of span (conformity error). The zero for this module occurs at 60.25Ω, midpoint at 100.00Ω, and full-scale at 138.50Ω. The span is 78.25Ω. This is equivalent to (±0.0008*78.25Ω ±0.1Ω ±0.0008*60.25Ω) * (5V/78.25Ω) ±0.0005*5V, or ±16.0mV at the output. Error for other A5B34 models is calculated in a similar fashion.

A5B34 BLOCK DIAGRAM



A5B34 ORDERING INFORMATION

MODEL	INPUT RANGE	OUT RANGE	ACCURACY
100 OHM Pt, alpha = 0.00385			
A5B34-01	-100 to +100°C(-148 to +212°F)	0 to +5V	+/-0.43°C
A5B34-02	0 to +100°C(+ 32 to 212°F)	0 to +5V	+/-0.44°C
A5B34-03	0 to +200°C(+ 32 to 392°F)	0 to +5V	+/-0.50°C
A5B34-04	0 to +600°C(+ 32 to 1112°F)	0 to +5V	+/-0.72°C
10 OHM Cu			
A5B34C-01	0 to +120°C(+ 32 to +248°F), 10 ohms @0C	0 to +5V	+/-0.82°C
A5B34C-02	0 to +120°C(+ 32 to +248°F), 10 ohms @25C	0 to +5V	+/-0.84°C
120 OHM Ni			
A5B34N-01	0 to +300°C(+ 32 to +572°F)	0 to +5V	+/-0.30°C

2.2.4 A5B37 Thermocouple Input Module

FEATURES
* Interfaces to Types J, K, T, E, R, S, and B Thermocouples
* High Level Voltage Output, 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 160dB CMR
* 95dB NMR at 60Hz, 90dB AT 50Hz
* +/-0.05% Accuracy
* +/-0.02% Linearity
* +/-1uV/^{o}C Drift
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B37 thermocouple input module provides a single channel of thermocouple input which is filtered, isolated, amplified, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

The A5B37 can interface to seven industry standard thermocouples; type J, K, T, E, R, S, and B. Its corresponding output signal operates over a 0 to +5V range. The application information of Section 4.1 provides a detailed explanation of how to convert the A5B37 output voltage back to temperature. Each module is cold junction compensated to correct for parasitic thermocouples formed by the thermocouple wire and the screw terminals on the mounting backpanel. Upscale open thermocouple detect is provided by an internal pull-up resistor.

Signal filtering is accomplished with a six-pole filter which provides 95dB of Normal-Mode-Rejection at 60Hz and 90dB at 50Hz. Two poles of this filter are on the field side of the isolation barrier and the other four are in the output stage.

After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%. A special input circuit on the A5B37 module provides protection up to 240VAC against accidental connection of power-line voltages. A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

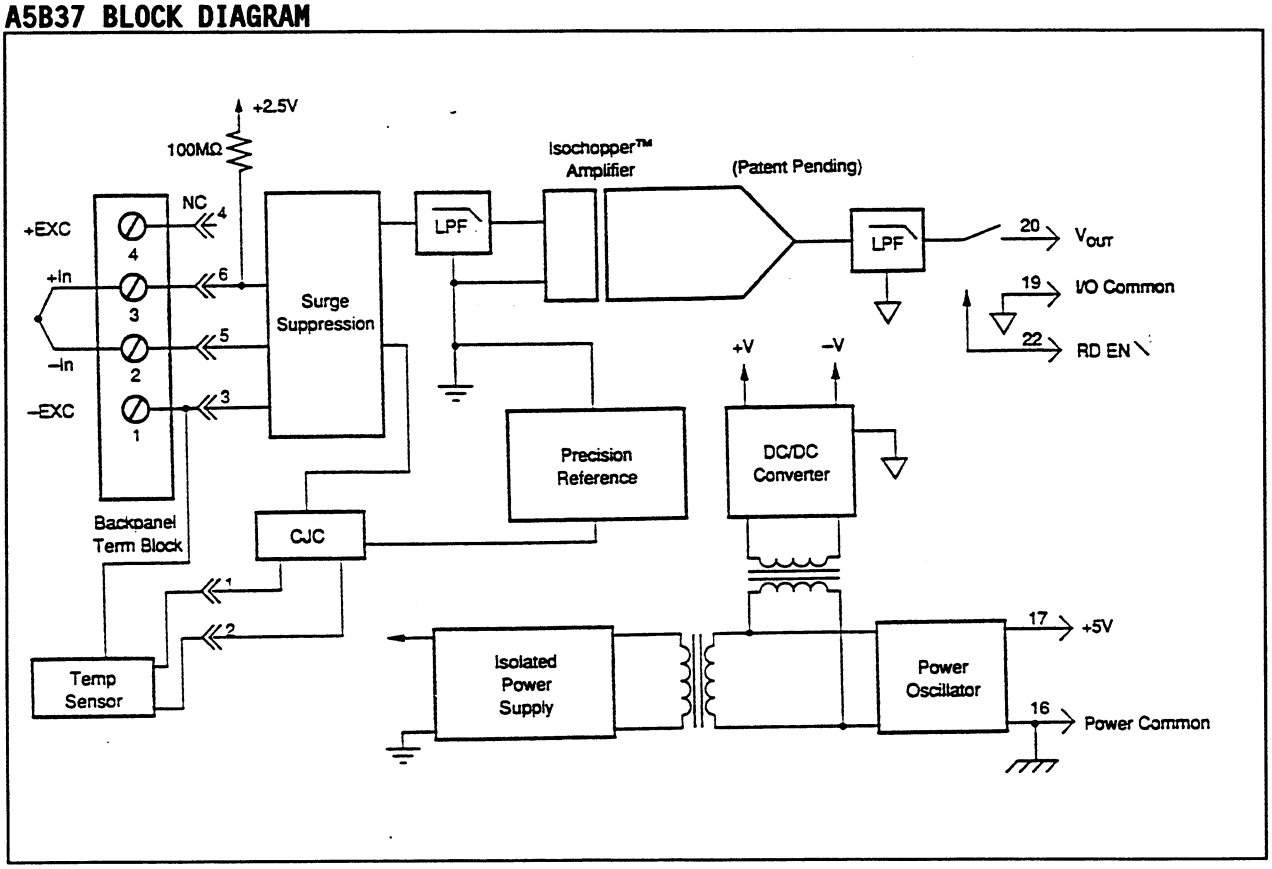
A5B37 SPECIFICATIONS (Typical @ 25C, +5V Power):

Input Range	±5mV to ±0.5V
Input Bias Current	-25nA
Input Resistance:	
Normal	50MΩ
Power Off	40KΩ
Overload	40KΩ
Input Protection:	
Continuous	240V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMV, Input to Output:	
Continuous	1500V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMR (50 or 60Hz)	160dB
NMR	95dB @ 60Hz, 90dB @ 50Hz
Accuracy	±0.05% span (±.08% Max) ±10uV RTI ±0.05%(V_Z[1])
Nonlinearity	±0.02% span (±.035% Max)
Stability:	
Input Offset	± 1uV/°C (± 2uV/°C Max)
Output Offset	±20uV/°C (±30uV/°C Max)
Gain	±25ppm/°C (±50ppm/°C Max)
Noise:	
Input, 0.1 to 10Hz	0.2uV rms (0.6uV rms Max)
Output, 100KHz	200uV rms (400uV rms, 800uVp-p Max)
Bandwidth, -3dB	4Hz
Response Time, 90% span	0.2S
Output Range	0 to +5V
Output Resistance	50Ω
Output Protection	Continuous Short to Ground
Output Selection Time (to ±1mV of Vout):	2.5uS @ 200pF, 3.5uS @ 500pF 4.0uS @ 1000pF, 6.0uS @ 2000pF
Output Enable Control:	
Max Logic "0"	+0.8V
Min Logic "1"	+2.4V
Max Logic "1"	+36V
Input Current, "0,1"	0.5uA
Open Input Response	Upscale
Open Input Detection Time	10S
Cold Junction Compensation:	
Accuracy, 25C	±0.25°C
Accuracy, +5C to +45C	±0.5°C
Power Supply Voltage	+5VDC ±5%
Power Supply Current	30mA Max
Power Supply Sensitivity	±2uV/% (RTI)
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)
Environmental:	
Operating Temp. Range	-25°C to +85°C
Storage Temp. Range	-40°C to +85°C
Relative Humidity	0 to 95% noncondensing
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3ft

Notes:

1. Vz is the input voltage that results in 0V output.
2. RTI is Referred To Input.
3. Sample error calculation - To calculate the maximum inaccuracy at 25°C for an A5B37J module (Non-Linearized J TC In: -100 to + 760°C, Out: 0 to 5V), combine the error specifications for Accuracy and Nonlinearity as follows: ±0.08% of span ±0.035% Nonlinearity ±10uV RTI[2] ±0.05% of V_Z[1] ±CJC error. The zero for this module occurs at -4.632mV, midpoint at 19.145mV, and full-scale at 42.922mV. The Seebeck coefficient is 51uV/°C, CJC error is 0.4°C, and the span is 47.554mV. This is equivalent to ±0.00115*(5V) ± 10uV*(5V/0.047554V) ±0.0005*(-4.632mV) ±0.4°C*(51uV/°C)*(5V/0.047554V), or ±8.9mV at the output. Error for other A5B37 models is calculated in a similar fashion.
4. Cold Junction Compensation accuracy over the full temperature range of -25°C to +85°C is ±1.0°C typical, ±1.5°C maximum.

A5B37 BLOCK DIAGRAM



A5B37 ORDERING INFORMATION

MODEL	INPUT TYPE AND RANGE	OUTPUT RANGE
A5B37J	TYPE J, -100 to + 760 °C (-148 to +1400 °F)	0V to +5V
A5B37K	TYPE K, -100 to +1350 °C (-148 to +2462 °F)	0V to +5V
A5B37T	TYPE T, -100 to + 400 °C (-148 to + 752 °F)	0V to +5V
A5B37E	TYPE E, 0 to + 900 °C (+ 32 to +1652 °F)	0V to +5V
A5B37R	TYPE R, 0 to +1750 °C (+ 32 to +3182 °F)	0V to +5V
A5B37S	TYPE S, 0 to +1750 °C (+ 32 to +3182 °F)	0V to +5V
A5B37B	TYPE B, 0 to +1800 °C (+ 32 to +3272 °F)	0V to +5V

2.2.5 A5B38 Strain-Gage Input Module

FEATURES

* Interfaces to 300 ohm through 10K ohm, Full or Half-Bridge Strain Gages
* High Level Voltage Output, -5V to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 100dB CMR
* 10KHz Signal Bandwidth
* +/-0.08% Accuracy
* +/-0.02% Linearity
* +/- 1uV/^{O}C Drift
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B38 Strain-Gage input module provides a single channel of strain-gage input which is filtered, isolated, amplified, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2.

The A5B38 can interface to full-bridge or half-bridge transducers that have a resistance range from 300 ohms to 10K ohms. A matched pair of bridge-completion resistors (to +/-1mV) allows the use of low cost half-bridge transducers. The 10KHz bandwidth allows measurement of high speed processes, such as vibration analysis.

Strain-gage excitation is provided from the module by a very stable 10V source. Full-scale sensitivities of 2mV/V or 3mV/V are offered as standard. With 10V excitation, this results in +/-20mV, or +/-30mV full-scale input ranges, producing +/-5V full scale output.

Signal filtering is accomplished with an anti-aliasing filter on the field side of the isolation barrier, and a four-pole filter in the output stage. After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%. A special input circuit on the A5B38 module provides protection up to 240VAC against accidental connection of power-line voltages. A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

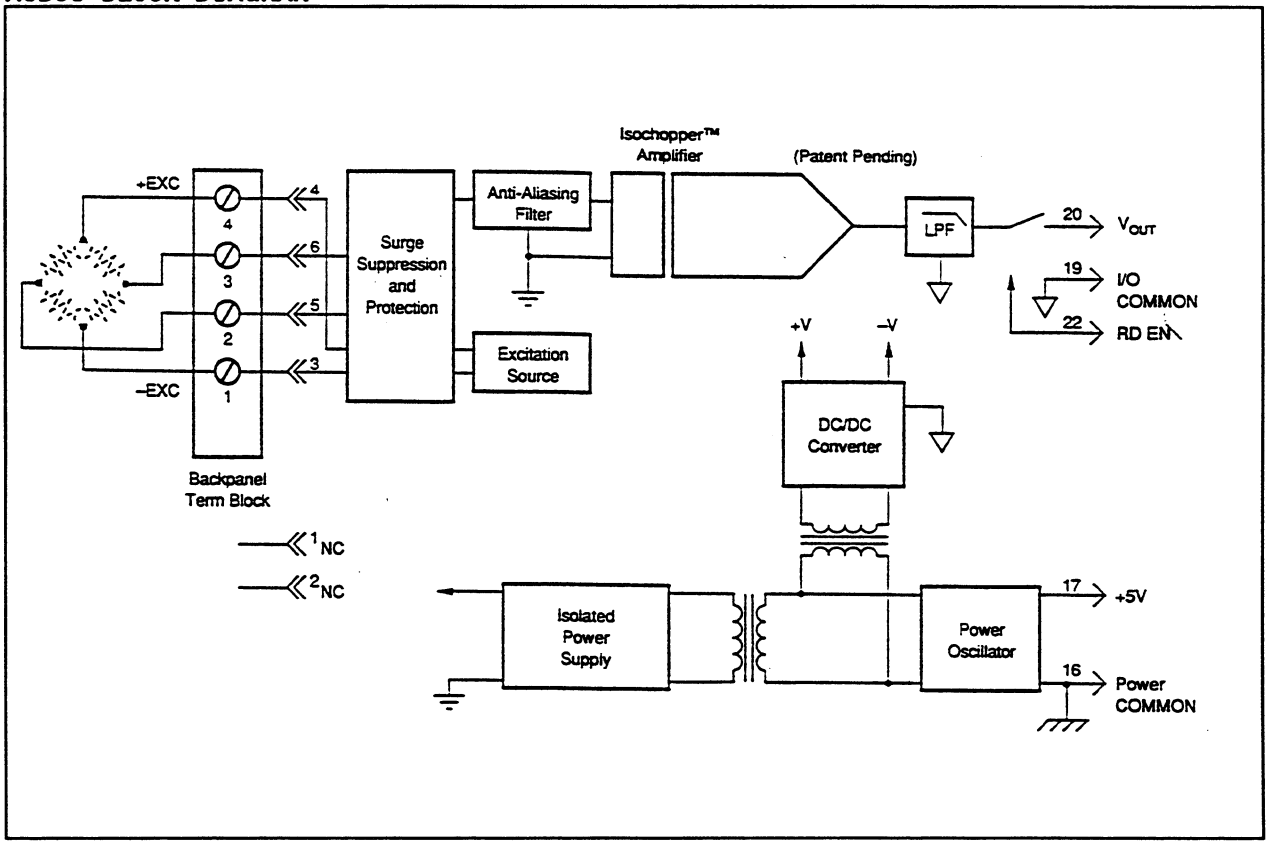
A5B38 SPECIFICATIONS (Typical @25C, +5V Power, '*' = same specification):

	Full Bridge	Half Bridge
Module	A5B38-02,-05	A5B38-04
Input Range	±30mV @ 3mV/V Sensitivity ±20mV @ 2mV/V Sensitivity	±30mV @ 3mV/V Sensitivity
Input Bias Current	±0.3nA	*
Input Resistance:		
Normal	50MΩ	*
Power Off	40KΩ	*
Overload	40KΩ	*
Input Protection:		
Continuous	240V rms Max	*
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)	*
Excitation Output V, 300Ω load	+10V ±3mV	*
Excitation Load Regulation	±5ppm/mA	*
Excitation Stability	±15ppm/°C	*
Half Bridge Voltage Level	N/A	(Excitation V/2) ± 1mV
CMV, Input to Output:		
Continuous	1500V rms Max	*
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)	*
CMR (50 or 60Hz)	100dB	*
NMR (-3dB at 10KHz)	120dB per decade (frequency > 10KHz)	*
Accuracy	±0.08% Span ±10uV RTI	±0.08% span ±1mV RTI
Nonlinearity	±0.02% Span	*
Stability:		
Input Offset	±1uV/°C	*
Output Offset	±40uV/°C	*
Gain	±25ppm of reading/°C	*
Noise:		
Input, 10Hz	0.4uV rms	2uV rms
Input, 10KHz	±70nV/√Hz RTI	±250nV/√Hz RTI
Output, 100KHz	10mVp-p	*
Bandwidth, -3dB	10KHz	*
Rise time, 10 to 90% span	40uS	*
Settling Time, to 0.1%	250uS	7mS
Output Range	+/-5V	*
Output Resistance	50Ω	*
Output Protection	Continuous short to ground	*
Output Selection Time		
(to +/-1mV of Vout)	2.5uS @ 200pF, 3.5uS @ 500pF 4.0uS @ 1000pF, 6.0uS @ 2000pF	* *
Output Enable Control:		
Max Logic "0"	+0.8V	*
Min Logic "1"	+2.4V	*
Max Logic "1"	+36V	*
Input Current, "0,1"	0.5uA	*
Power Supply Voltage	+5VDC ±5%	*
Power Supply Current	200mA full load, 120mA no load	*
Power Supply Sensitivity	25ppm reading/% ±2uV(RTI)/%	*
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)	*
Environmental:		
Operating Temp. Range	-25°C to +85°C	*
Storage Temp. Range	-40°C to +85°C	*
Relative Humidity	0 to 95% non-condensing	*
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3 ft	*

Notes:

1. RTI is Referred To Input.
2. Sample error calculation - To determine the maximum inaccuracy at 25°C for an A5B38-02 module (Full Bridge, Input: 300 to 10KΩ, Output: -5 to +5V), calculate the following: ±0.08% of span ±0.02% Non-linearity ±10uV RTI. The zero for this module occurs at -30mV, midpoint at 0mV, and full-scale at +30mV. The input span is 60mV. This is equivalent to ±(0.0008+0.0002)*(0.06V) ±0.00001V, or ±0.070mV RTI. Thus, 10V * ±0.070mV/(60mV) = ±11.6mV at the output. Error for other A5B38 models is calculated in a similar fashion.

A5B38 BLOCK DIAGRAM



A5B38 ORDERING INFORMATION

MODEL	BRIDGE TYPE	INPUT RANGE	EXCITATION	OUTPUT
A5B38-02	FULL BRIDGE	300 to 10K ohms	10.0V at 3mV/V Sensitivity	-5V TO +5V
A5B38-05	FULL BRIDGE	300 to 10K ohms	10.0V at 2mV/V Sensitivity	-5V TO +5V
A5B38-04	HALF BRIDGE	300 to 10K ohms	10.0V at 3mV/V Sensitivity	-5V TO +5V

2.2.6 A5B40 Wide-Bandwidth Voltage Input Modules

FEATURES
* Accepts milliVoltage and Voltage Level Signals
* High Level Voltage Output, +/-5V or 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 100dB CMR
* 10KHz Signal Bandwidth
* +/-0.05% Accuracy
* +/-0.02% Linearity
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B40 and A5B41 wide bandwidth voltage input module provides a single channel of analog input which is amplified, isolated, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus, without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

The input signal is processed through a pre-amplifier on the field side of the isolation barrier. This pre-amplifier has a gain-bandwidth product of 5MHz and is bandwidth limited to 10KHz. After amplification, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%.

A special input circuit on the A5B40 and A5B41 modules provides protection up to 240VAC against accidental connection of power-line voltages.

The A5B40 millivolt input module accepts +/-10mv to +/-100mv input signals and provides a +/-5V or 0 to +5V output. The A5B41 voltage input module accepts +/- 1V to +/-10V input signals and provides a +/-5V or 0 to +5V output.

A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

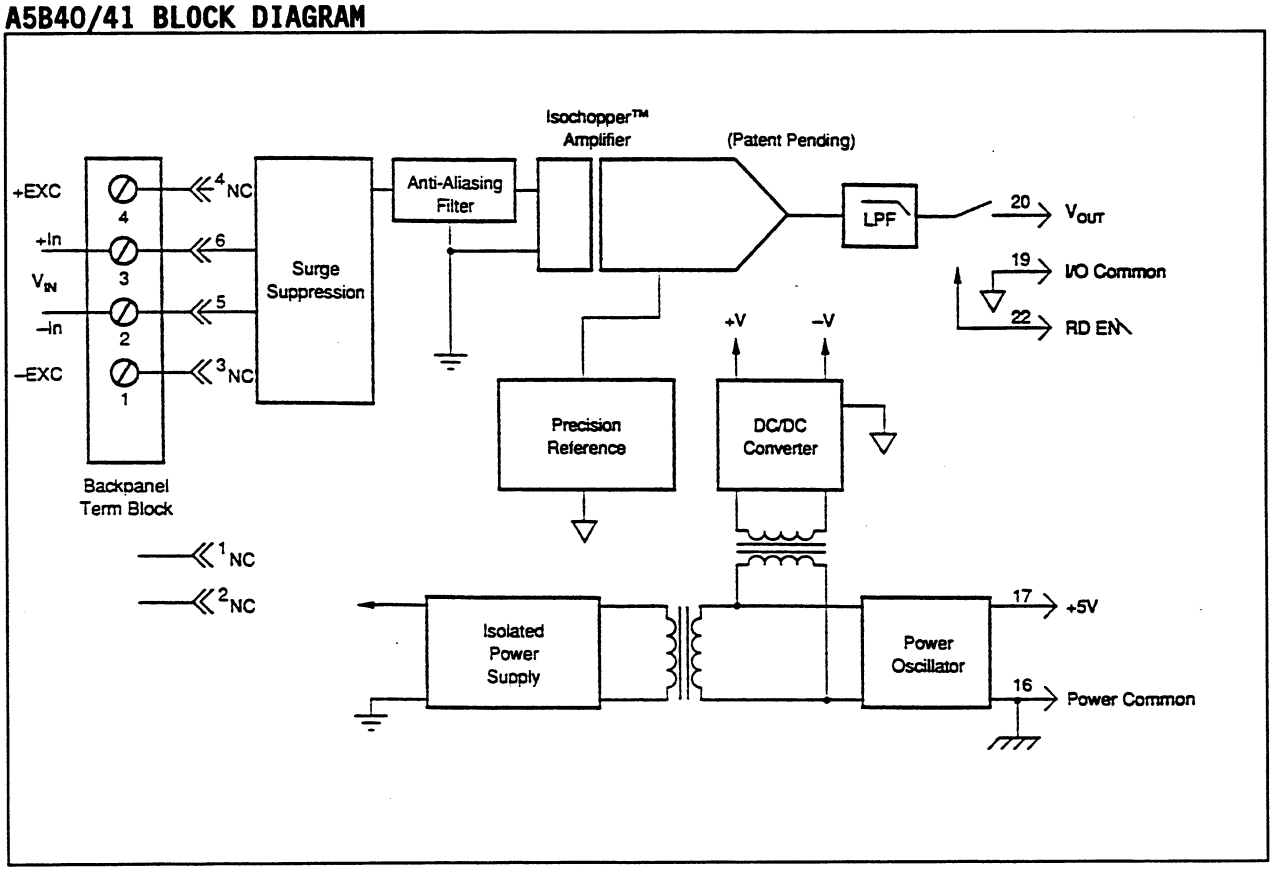
A5B40/41 SPECIFICATIONS (Typical @25C, +5V Power, '*'= same spec as A5B40):

Module	A5B40	A5B41
Input Range	±10mV to +/-100mV	±1V to ±10V
Input Bias Current	±0.5nA	±0.05nA
Input Resistance:		
Normal	200MΩ	650KΩ
Power Off	40KΩ	650KΩ
Overload	40KΩ	650KΩ
Input Protection:		
Continuous	240V rms max	*
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)	*
CMV, Input to Output:		
Continuous	1500V rms max	*
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)	*
CMR (50 or 60Hz)	100dB	90dB
NMR (-3dB at 10KHz)	120dB per decade above 10KHz	*
Accuracy	±.05% Span (±.08% Max) ±10uV RTI ±0.05%(Vz)[1]	±.05% Span (±.08% Max) ±0.05%(Vz)[1]
Nonlinearity	±0.02% Span (±0.035% Max)	*
Stability:		
Input Offset	± 1uV/°C (± 2uV/°C Max)	±20uV/°C (±25uV/°C Max)
Output Offset	±40uV/°C (±50uV/°C Max)	*
Gain	±25ppm/°C (±50ppm/°C Max)	±50ppm/°C (±70ppm/°C Max)
Noise:		
Input, 0.1 to 10Hz	0.4uV rms (1uV rms Max)	2uV rms (4uV rms Max)
Output, Vin=+/-FS	20 mVp-p Max	30 mVp-p Max
Vin=0	10 mVp-p	*
Bandwidth, -3dB	10KHz	*
Rise time, 10 to 90% Span	35uS	*
Output Range	±5V or 0 to +5V	*
Output Resistance	50 ohm	*
Output Protection	Continuous Short to Ground	*
Output Selection Time		
(to +/-1mV of Vout)	2.5uS @ 200pF, 3.5uS @ 500pF	*
	4.0uS @ 1000pF, 6.0uS @ 2000pF	*
Output Enable Control:		
Max Logic "0"	+0.8V	*
Min Logic "1"	+2.4V	*
Max Logic "1"	+36V	*
Input Current, "0,1"	0.5uA	*
Power Supply Voltage	+5VDC ±5%	*
Power Supply Current	30mA (33mA Max)	*
Power Supply Sensitivity	±2uV/% (RTI)	±200uV/% (RTI)
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)	*
Environmental:		
Operating Temp. Range	-25°C to +85°C	*
Storage Temp. Range	-40°C to +85°C	*
Relative Humidity	0 to 95% noncondensing	*
RFI Susceptibility	±0.5% Span error @ 400MHz, 5W, 3 ft	*

Notes:

1. Vz is the input voltage that results in 0V output.
2. RTI is Referred To Input.
3. Sample error calculation - To calculate the maximum inaccuracy at 25°C for an A5B40-01 module (Input: -10mV to +10mV, Output: -5V to 5V), combine the error specifications for Accuracy and Nonlinearity as follows: ±0.08% of span ±0.035% Nonlinearity ±10uV RTI ±0.05% of V_z[1]. This is equivalent to ±0.0008*(10V) ±0.00035*(10V) ±0.00001V*(10V/0.02V) ±0.0005*(0V), or ±16.5mV at the output. Error for other A5B40/41 models is calculated in a similar fashion.

A5B40/41 BLOCK DIAGRAM



A5B40/41 ORDERING INFORMATION

MODEL	INPUT RANGE	OUTPUT RANGE
A5B40-01	- 10mV to + 10mV	-5V to +5V
A5B40-02	- 50mV to + 50mV	-5V to +5V
A5B40-03	-100mV to +100mV	-5V to +5V
A5B40-04	- 10mV to + 10mV	0V to +5V
A5B40-05	- 50mV to + 50mV	0V to +5V
A5B40-06	-100mV to +100mV	0V to +5V
A5B41-01	- 1V to + 1V	-5V to +5V
A5B41-02	- 5V to + 5V	-5V to +5V
A5B41-03	-10V to +10V	-5V to +5V
A5B41-04	- 1V to + 1V	0V to +5V
A5B41-05	- 5V to + 5V	0V to +5V
A5B41-06	-10V to +10V	0V to +5V

2.2.7 A5B47 Linearized Thermocouple Input Modules

FEATURES
* Interfaces to Types J, K, T, E, R, S, and B Thermocouples
* Linearizes Thermocouple Signal
* High Level Voltage Output, 0 to +5V
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 160dB CMR
* 95dB NMR at 60Hz, 90dB AT 50Hz
* +/- 1uV/^{o}C Drift
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B47 thermocouple input module provides a single channel of thermocouple input which is filtered, isolated, amplified, linearized, and converted to a high level analog voltage output. This voltage output is logic switch controlled, which allows these modules to share a common analog bus without the requirement of external multiplexers. If desired, the output switch can be turned on continuously by simply grounding the Read-Enable pin 22. **IMPORTANT:** For proper operation of the output switch, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

The A5B47 can interface to seven industry standard thermocouples; types J, K, T, E, R, S, and B. Its corresponding output signal operates over a 0 to +5V range. Each module is cold junction compensated to correct for parasitic thermocouples formed by the thermocouple wire and the screw terminals on the mounting backpanel. Upscale open thermocouple detect is provided by an internal pull-up resistor.

Signal filtering is accomplished with a six-pole filter which provides 95dB of Normal-Mode-Rejection at 60Hz, and 90dB at 50Hz. Two poles of this filter are on the field side of the isolation barrier, and the other four are in the output stage.

After the initial field-side filtering, the input signal is chopped by a proprietary chopper circuit. Isolation is provided by transformer coupling, again using a proprietary technique to suppress transmission of common mode spikes or surges. The module is powered from +5VDC, +/-5%.

A special input circuit on the A5B47 module provides protection up to 240VAC against the accidental connection of power-line voltages. A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

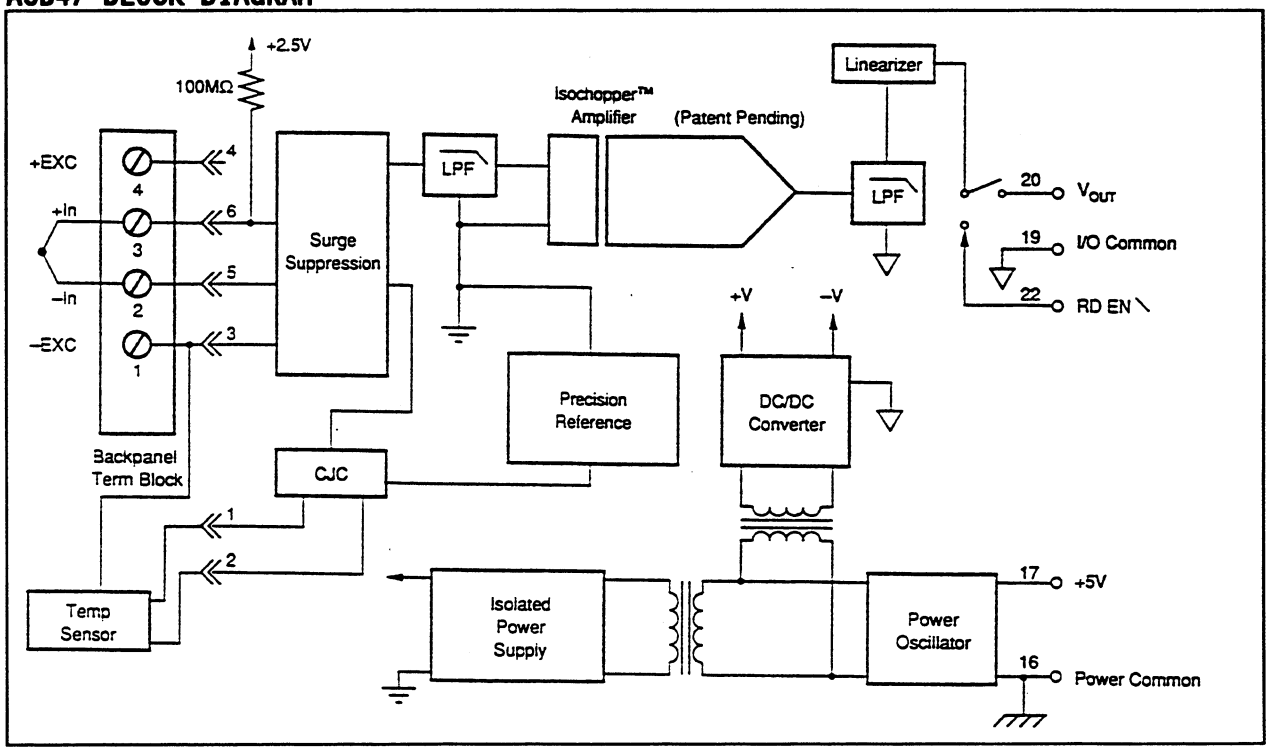
A5B47 SPECIFICATIONS (Typical @ 25C, +5V Power):

Input Range	±5mV to ±0.5V
Input Bias Current	-25nA
Input Resistance:	
Normal	50MΩ
Power Off	40KΩ
Overload	40KΩ
Input Protection:	
Continuous	240V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMV, Input to Output:	
Continuous	1500V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMR (50 or 60Hz)	160dB
NMR	95dB @ 60Hz, 90dB @ 50Hz
Accuracy/Conformity	See Ordering Information...
Stability:	
Input Offset	±1uV/°C[1] (± 2uV/°C Max)
Output Offset	±20uV/°C (±30uV/°C Max)
Gain	±25ppm/°C (±50ppm/°C Max)
Noise:	
Input, 0.1 to 10Hz	0.2uV rms (0.6uV rms Max)
Output, 100KHz	150uV rms, 300uV p-p (400uV rms, 800uVp-p Max)
Bandwidth, -3dB	4Hz
Response Time, 90% span	0.2S
Output Range	0 to +5V
Output Resistance	50Ω
Output Protection	Continuous Short to Ground
Output Selection Time (to +/-1mV of Vout):	2.5uS @ 200pF, 3.5uS @ 500pF 4.0uS @ 1000pF, 6.0uS @ 2000pF
Output Enable Control:	
Max Logic "0"	+0.8V
Min Logic "1"	+2.4V
Max Logic "1"	+36V
Input Current, "0,1"	0.5uA
Open Input Response	Upscale
Open Input Detection Time	10S
Cold Junction Compensation:	
Accuracy, 25C	±0.25°C
Accuracy, +5C to +45C	±0.5°C
Power Supply Voltage	+5VDC ±5%
Power Supply Current	30mA (33mA Max)
Power Supply Sensitivity	±2uV/% (RTI)
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)
Environmental:	
Operating Temp. Range	-25°C to +85°C
Storage Temp. Range	-40°C to +85°C
Relative Humidity	0 to 95% Non-Condensing
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3ft

Notes:

1. This is equivalent to °C as follows: Type J; 0.020 °C/°C, Types K & T; 0.025 °C/°C, Type E; 0.016 °C/°C, Types R & S; 0.168 °C/°C.
2. Sample error calculation - To determine the maximum output inaccuracy at 25°C for an A5B47J-01 module (Linearized J TC Input: 0 to + 760°C, Output: 0 to 5V), errors are combined as follows: ±°C (accuracy from table of next page) ±CJC error. The accuracy for this module is ±1°C, the Seebeck coefficient is 51uV/°C, CJC error is 0.4°C, and the span is 42.922mV. Thus, maximum error is calculated as (5V/760°C)*1°C ±(0.4°C)*(51uV/°C)*(5V/0.042922V), or ±8.95mV at the output. Error for other A5B47 models is calculated in a similar fashion.
3. Cold Junction Compensation accuracy over the full temperature range of -25°C to +85°C is ±1.0°C typical, ±1.5°C maximum.

A5B47 BLOCK DIAGRAM



A5B47 ORDERING INFORMATION

MODEL	INPUT TYPE AND RANGE	OUTPUT RANGE	ACCURACY
A5B47J-01	TYPE J, 0 to + 760C (+ 32 to +1400F)	0V to +5V	+, 76C
A5B47J-02	TYPE J, -100 to + 300C (-148 to + 572F)	0V to +5V	+/-u.40C
A5B47J-03	TYPE J, 0 to + 500C (+ 32 to + 932F)	0V to +5V	+/-0.36C
A5B47K-04	TYPE K, 0 to +1000C (+ 32 to +1832F)	0V to +5V	+/-1.0 C
A5B47K-05	TYPE K, 0 to + 500C (+ 32 to + 932F)	0V to +5V	+/-0.38C
A5B47T-06	TYPE T, -100 to + 400C (-148 to + 752F)	0V to +5V	+/-1.1 C
A5B47T-07	TYPE T, 0 to + 200C (+ 32 to + 392F)	0V to +5V	+/-0.30C
A5B47E-08	TYPE E, 0 to +1000C (+ 32 to +1832F)	0V to +5V	+/-1.5 C
A5B47R-09	TYPE R, +500 to +1750C (+932 to +3182F)	0V to +5V	+/-1.6 C
A5B47S-10	TYPE S, +500 to +1750C (+932 to +3182F)	0V to +5V	+/-1.5 C
A5B47B-11	TYPE B, +500 to +1800C (+932 to +3272F)	0V to +5V	+/-3.3 C

2.3 ANALOG OUTPUT MODULES

2.3.1 A5B39 Current Output Modules

FEATURES
* Accepts High-Level Voltage Input, +/-5V or 0 to +5V
* High Level Current Output, 4 to 20mA or 0 to 20mA
* 1500 Volt Transformer Isolation
* IEEE-472 Transient Protection
* Input Protected to 240VAC Continuous
* 110dB CMR
* 400Hz Signal Bandwidth
* +/-0.05% Accuracy
* +/-0.02% Linearity
* A5B Types Can be Mixed and Matched on a Backpanel

Each A5B39 current output module provides a single channel of analog output. The track-and-hold circuit in the input stage can be operated in a hold mode where one DAC can supply many output modules, or a track mode where one DAC is dedicated to each module. In addition to the track-and-hold circuit, each module provides signal buffering, isolation, filtering, and conversion to a high level current output.

Setting of the track or hold mode is controlled by the logic state of WR EN\, pin 23 of the module. When pin 23 is low, the track mode is enabled. If pin 23 is open or high, the hold mode is enabled. For a low state, pin 23 must be connected to pin 16, Power Common. This connection is made automatically on the APB01 backpanel. The APB02 backpanel allows host computer control of the WR EN\ control line, which allows multiplexing of one host DAC to up to 64 A5B39 output modules. During power up, the output remains at 0mA for 100ms, which allows the track-and-hold circuit to be initialized.

IMPORTANT: For proper operation of the track-and-hold circuit, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This connection can be easily established on the APB01/02 backpanels. Consult Section 2.4.1 or 2.4.2 (APB01 or APB02 Backpanels), or Application Information of Section 4.2 for more details.

A special circuit in the output stage of the module provides protection up to 240VAC against accidental connection of power-line voltages.

A full accessory line is offered; including interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4).

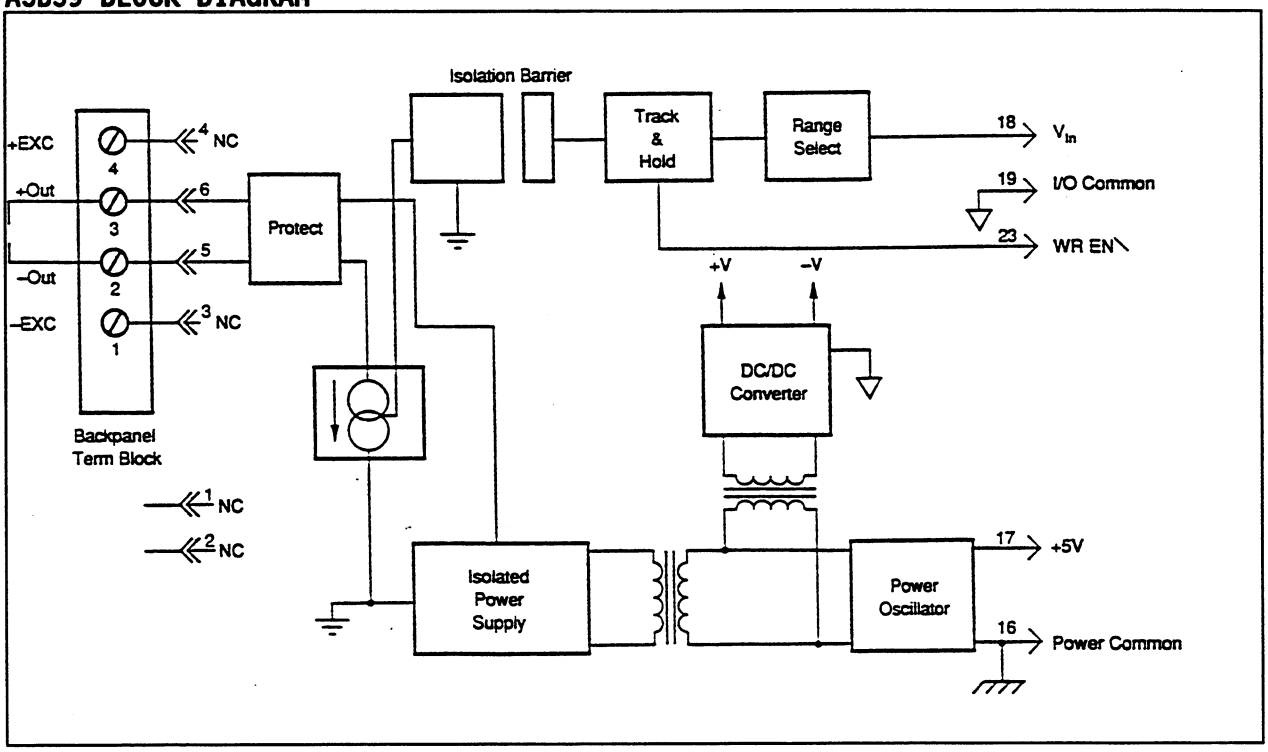
A5B39 SPECIFICATIONS (Typical @25C, +5V Power):

Input Voltage Range	±5V, or 0 to +5V
Input Voltage Maximum	±36V (No Damage)
Input Resistance	50MΩ
Output Current Range	0 to 20mA or 4 to 20mA
Over Range Capability	10%
Load Resistance Range	0 to 650Ω (0 to 750Ω for Supply Voltage greater than 4.95VDC)
Output I Under Fault, Max	26mA
Output Protection:	
Continuous	240V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMV, Output to Input:	
Continuous	1500V rms max
Transient	ANSI/IEEE C37.90.1-1989 (formerly IEEE-472)
CMR (50 or 60Hz)	110dB
Accuracy	±0.05% span (±0.08% Max)
Nonlinearity	±0.02% span (±0.035% Max)
Stability:	
Zero	±0.5uA/°C (±1uA/°C Max)
Span	±20ppm/°C (±40ppm/°C Max)
Noise:	
Output Ripple, 100Hz bandwidth	10uAp-p (20uAp-p Max)
Bandwidth, -3dB	400Hz
Sample and Hold:	
Output Droop Rate	40uA/S
Acquisition Time	50uS
Track-and-Hold Enable Control:	
Max Logic "0"	+1V
Min Logic "1"	+2.5V
Max Logic "1"	+36V
Input Current, "0"	1.5mA
Power Supply Voltage	+5VDC ±5%
Power Supply Current	170mA Max
Power Supply Sensitivity	±0.25uA/%
Mechanical Dimensions	2.28"x2.26"x0.60" (58mmx57mmx15mm)
Environmental:	
Operating Temp. Range	-25°C to +85°C
Storage Temp. Range	-40°C to +85°C
Relative Humidity	0 to 95% noncondensing
RFI Susceptibility	±0.5% span error @ 400MHz, 5W, 3ft

Notes:

1. Sample error calculation - To calculate the maximum output inaccuracy at 25°C for an A5B39-01 module (Input: 0 to 5V, Output: 4 to 20mA), combine the error specifications for Accuracy and Nonlinearity as follows: ±0.08% of span ±0.035% Nonlinearity. This is equivalent to ±0.0008*(0.016*500Ω) ±0.00035*(0.016*500Ω), or ±9.2mV at the output into a 500Ω load. The error for other A5B39 models is calculated in a similar fashion.

A5B39 BLOCK DIAGRAM



A5B39 ORDERING INFORMATION

MODEL	INPUT RANGE	OUTPUT RANGE
A5B39-01	0 to +5V	4 to 20mA
A5B39-02	-5V to +5V	4 to 20mA
A5B39-03	0 to +5V	0 to 20mA
A5B39-04	-5V to +5V	0 to 20mA

2.4 A5B ANALOG MODULE ACCESSORIES

PRODUCT SUMMARY

* 16 Position Backpanels
* Single or Dual Position Backpanels, DIN Rail Mounted
* 19-Inch Mounting Rack for Backpanels
* Interface Cables
* Module Evaluation Board
* Cable-to-Screw-Terminal Interface Board
* VME Board Interface Adaptor
* Fuses
* Jumpers
* Power Supplies
* Current Conversion Resistor

A full accessory line is offered for the Acromag A5B analog signal conditioning product line. Accessories include backpanels, mounting racks, interface cables, fuses, barrier-strip jumpers, test modules, and power supplies (see Section 2.4). The following sections describe each of these items in detail.

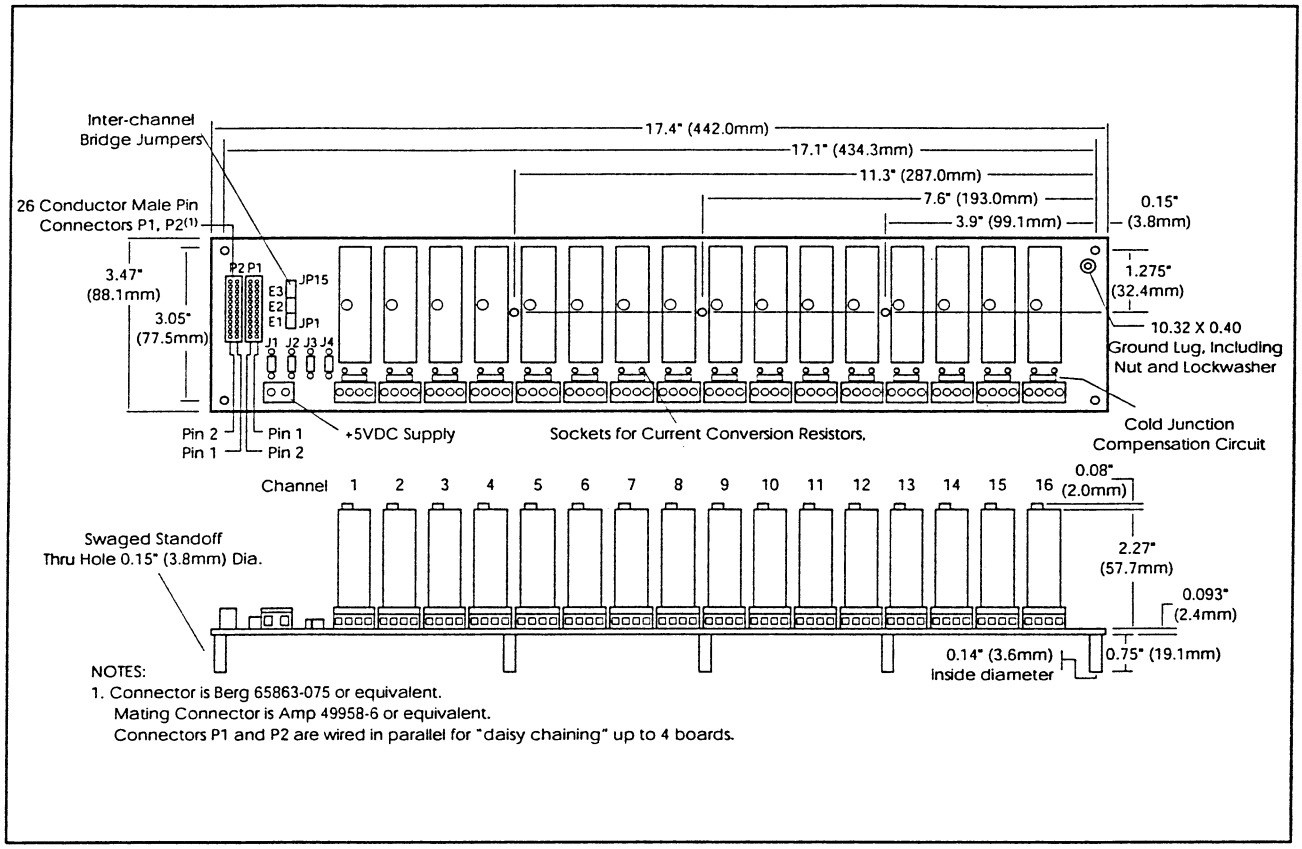
2.4.1 APB01 16-Position Analog Backpanel, Non-Multiplexed

The APB01 16 channel backpanel can accept any of the A5B analog modules in any mixture. It can be mounted on the AXRK-002 19-inch metal rack. The APB01 has 16 non-addressable analog I/O signal channels which provides each module with its own analog bus. The module output switch is continuously "on" when using this backpanel. A temperature sensor is mounted at each channel position to provide cold junction compensation for thermocouple modules. Field connections are terminated with four screw terminals at each module site. Use system interface cable AXCA004-XX for connection to the host system. This system can also be mated with Acromag analog input VME boards (see Section 2.4.6).

APB01 SPECIFICATIONS:

Operating Temperature:	-25 to +85 ^{o}C, 95% Relative Humidity, Non-Condensing
Interface Connector:	
Field	High Density Screw Clamp, 14 AWG Max
Logic	26-pin, Male Header Connector

APB01 DIMENSIONS



APB01 ELECTRICAL
(See page 33 and 34 for APB01 Schematic)

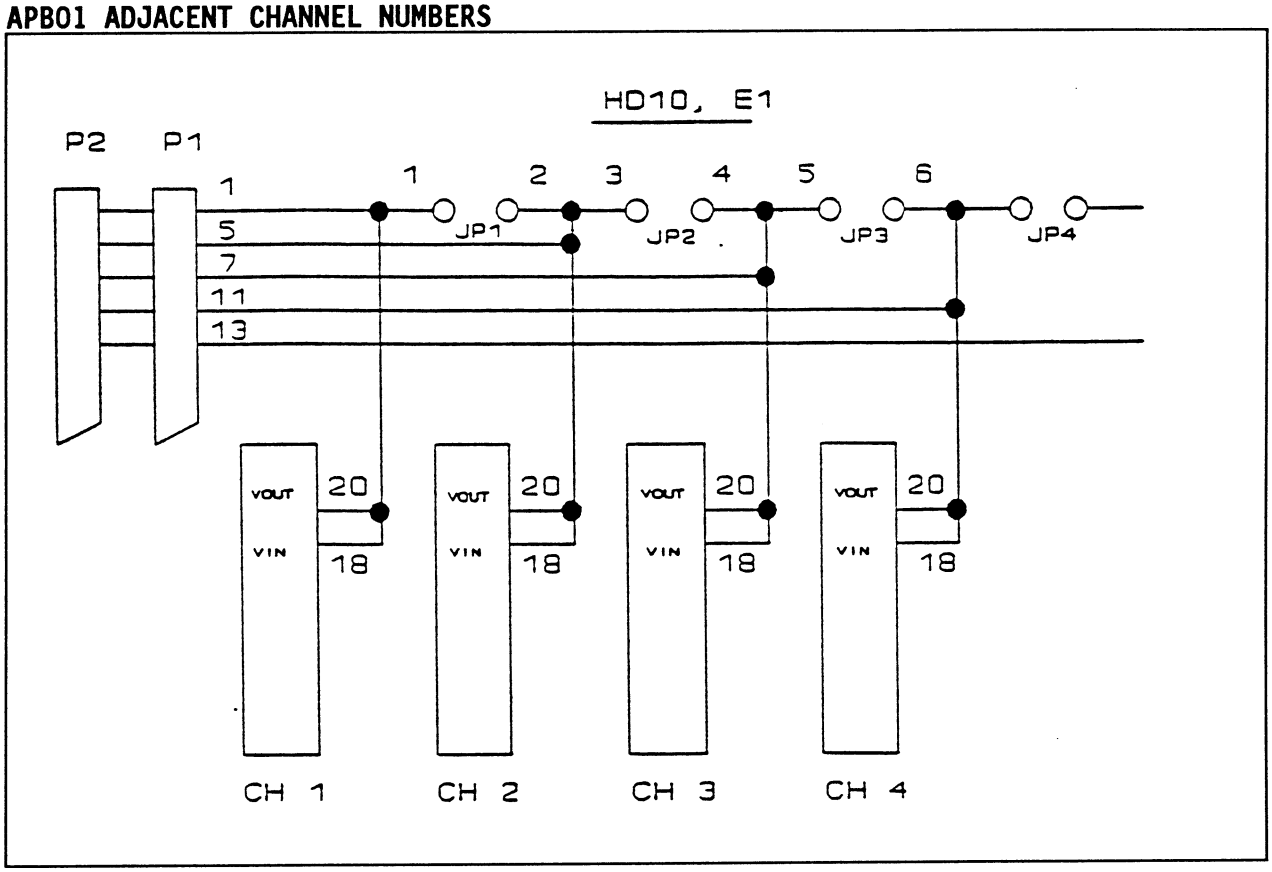
P1 AND P2 CONNECTOR: Connection to the host system is made at connectors P1 and P2. These connectors are electrically equivalent. Two connectors are provided to allow both analog input and analog output from host systems having individual input and output connectors. See Section 2.4.8 for available Interface Cables.

ADJACENT CHANNEL JUMPERS: Adjacent channels may be connected together to provide an isolated output signal from an isolated input module, providing two levels of 1500V isolation. This capability is provided with the 15 jumpers labeled JP1 through JP15 on headers E1, E2, and E3. A simplified drawing of the APB01 schematic for Channel 1 through 4 is shown on the following page.

Example: Assume an A5B30 input module is installed in channel 1 position, and an A5B39 output module is installed in channel 2 position. If JP1 is installed, the output of channel 1 is connected to the input of channel 2, which provides two levels of 1500V isolation.

APB01 ELECTRICAL

APB01 ADJACENT CHANNEL NUMBERS



POWER: The APB01 backpanel requires external +5VDC +/-5% power. The chassis mounted AXPRE-003 or AXPRT-003 power supplies have adequate capacity to power any combination of modules.

FUSING: The APB01 backpanel power is fuse protected through F1. This is a Littelfuse type 252004, 4 amp fuse. Zener diode DZ1 provides extra protection by clamping the input power voltage to +5.6V. If the input supply voltage connection is reversed, this zener diode will be forward biased and fuse F1 will be blown.

GROUNDING (see figure in following pages): The diagram of the following page details the optional ground jumper configuration available on the APB01 backpanel. Jumpers J1, J3, and J4 are factory installed.

APB01 ELECTRICAL

Jumper J1 connects the AGND shield wires (pins 3, 6, 9, 12, 15, 18, 21, and 24) to the backpanel signal ground. This provides a ground connection between the host system and backpanel. Jumper J1 is required if output modules (A5B39) are used, or if there is no high impedance sense input (input low of a differential or pseudo-differential system) on the host measurement system.

Jumper J3 connects the SENSE line (pin 25) to the backpanel signal ground. If the host system has the capability, this allows measuring the APB01 ground potential.

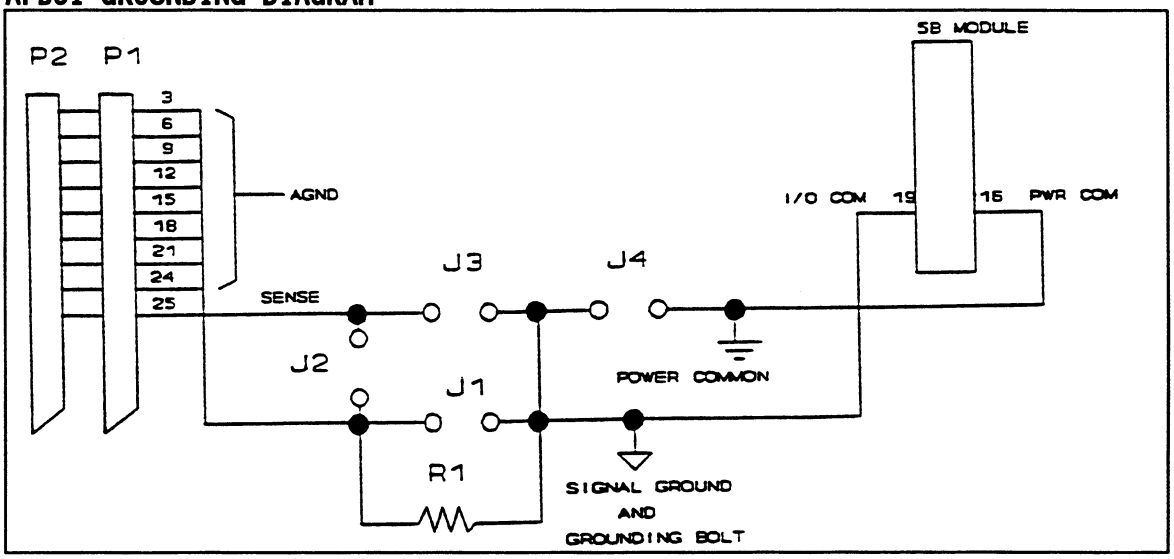
For proper operation of the output switch or track-and-hold circuit on the A5B modules, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This path can be established on the APB01 via jumper J4. If this connection exists elsewhere in the system, jumper J4 should be removed since possible ground loops could exist. Other connections of power ground and signal ground usually occur at the A/D or D/A converter of the host measurement system. More information on grounding can be found in Application Information of Section 4.2 .

If the connection of power common and AGND shield wires exist in the host measurement system, an optional resistive connection between AGND and the backpanel signal ground can be made via R1. R1 can be as large as 10K ohms; 100 ohms is a recommended value. Jumper J2 can be used to connect the SENSE line to R1 when this ground configuration is used.

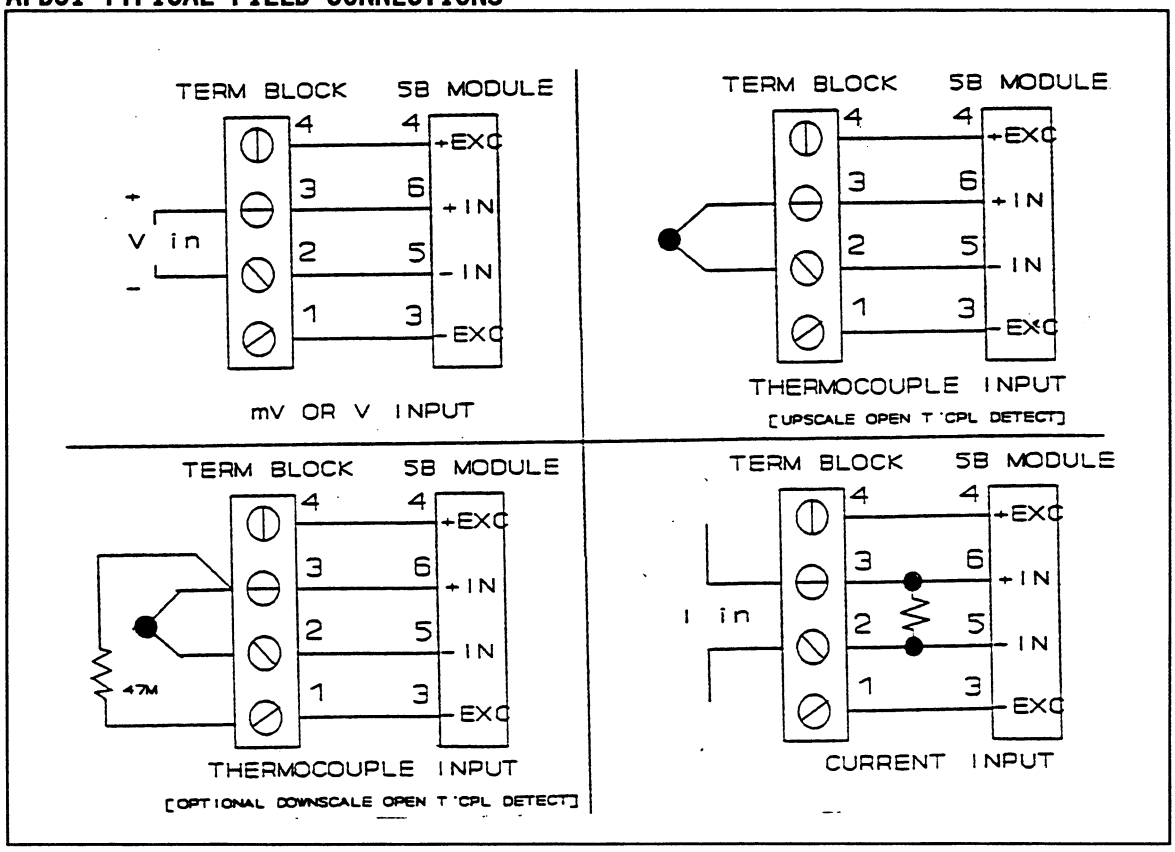
For full protection against large electrical disturbances on the field-side of the A5B modules, a #10-32 ground stud is provided on the backpanel. An electrical connection between this ground stud and system ground should be provided with a large gauge wire of the shortest possible length. When this connection is made, a possible ground loop could result through the AGND shield wires and backpanel signal ground. If the application involves only input modules and a differential input is used by the host measurement system, J1 should be removed. Remember that J1 is required if output modules are used or if the host system does not have differential inputs.

FIELD CONNECTIONS (see figure on next page): All field wiring is terminated at the 16, four position, high density connectors labled TB1 thru TB16. Some typical field connections are shown in the figure below. The screw terminals in the figure are labeled 1 thru 4 and correspond with the markings on the APB01 backpanel.

APB01 GROUNDING DIAGRAM

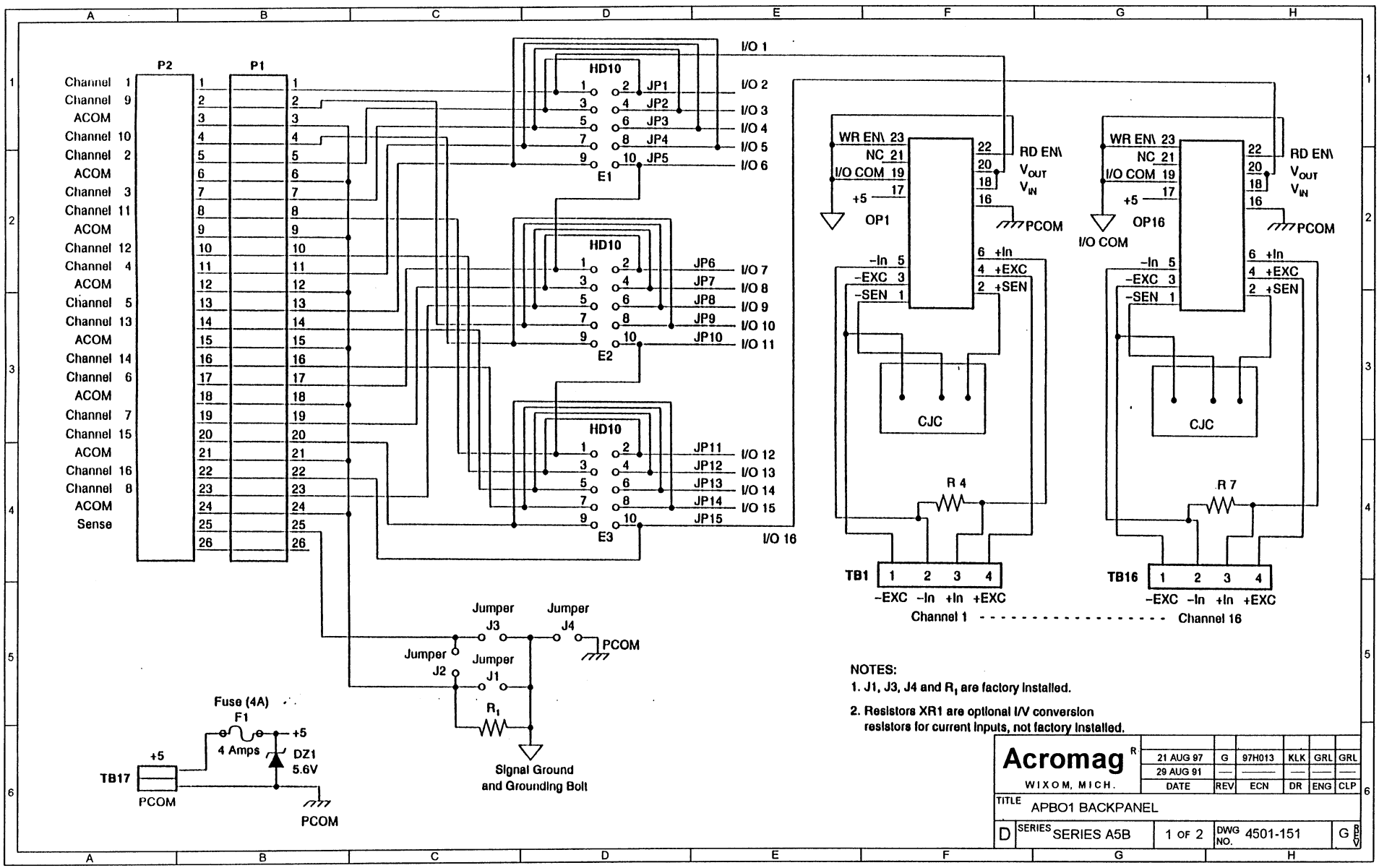


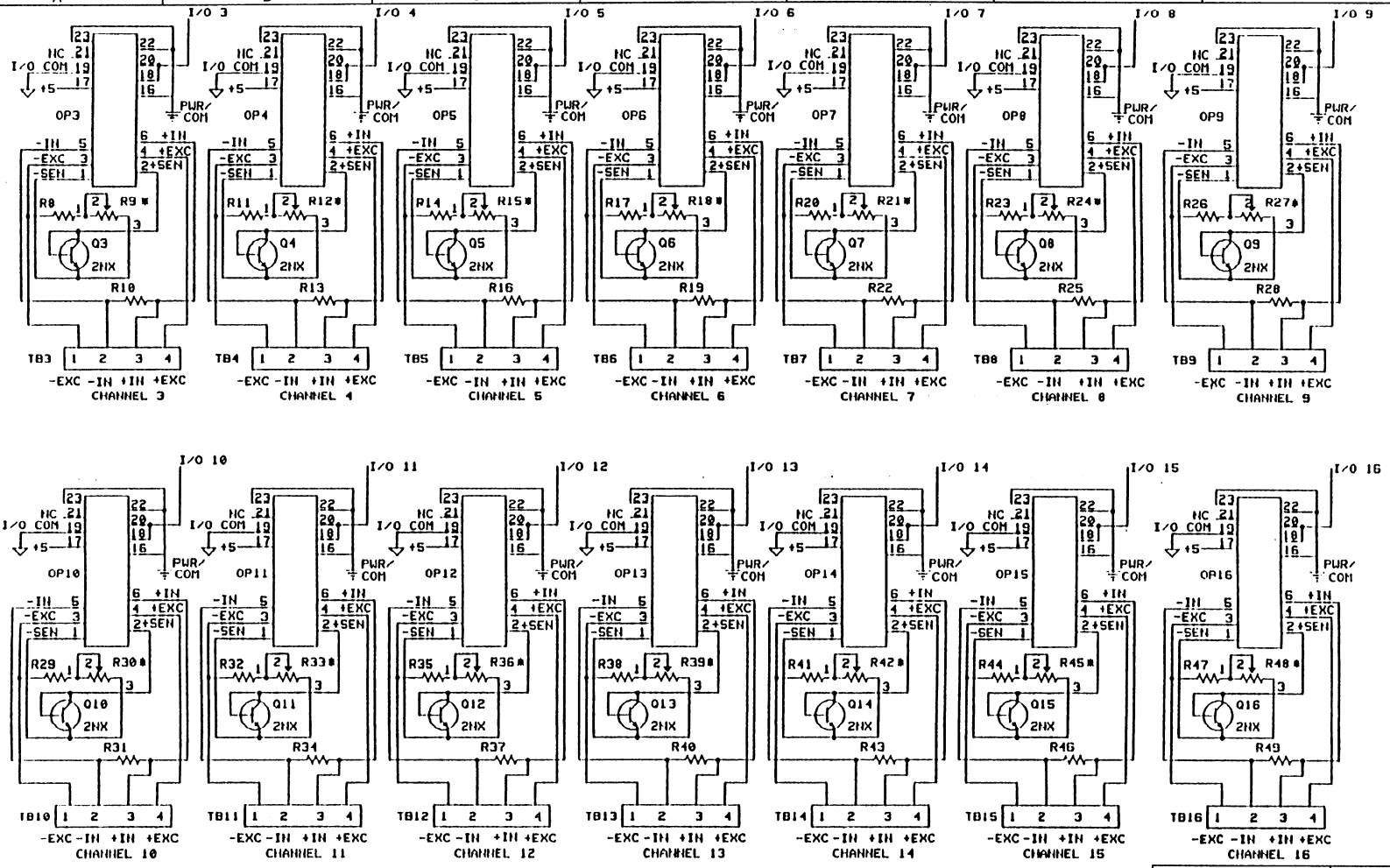
APB01 TYPICAL FIELD CONNECTIONS



APB01 ORDERING INFORMATION

MODEL	DESCRIPTION
APB01	16 channel Analog Backpanel, Non-Multiplexed


P2
P1
Channel 1
Channel 9
ACOM
Channel 10
Channel 2
ACOM
Channel 3
Channel 11
ACOM
Channel 12
Channel 4
ACOM
Channel 5
Channel 13
ACOM
Channel 14
Channel 6
ACOM
Channel 7
Channel 15
ACOM
Channel 16
Channel 8
ACOM
Sense
HD10
JP1
JP2
JP3
JP4
JP5
E1
JP6
JP7
JP8
JP9
JP10
E2
JP11
JP12
JP13
JP14
JP15
E3
I/O 1
I/O 2
I/O 3
I/O 4
I/O 5
I/O 6
I/O 7
I/O 8
I/O 9
I/O 10
I/O 11
I/O 12
I/O 13
I/O 14
I/O 15
I/O 16
WR EN\
NC
I/O COM
+5
OP1
RD EN\
VOUT
VIN
PCOM
-In
-EXC
-SEN
+In
+EXC
+SEN
CJC
R 4
R 7
OP16
I/O COM
TB1
TB16
-EXC -In +In +EXC
Channel 1
Channel 16
Jumper
J3
J4
J2
J1
PCOM
R1
Signal Ground
and Grounding Bolt
Fuse (4A)
F1
4 Amps
DZ1
5.6V
TB17
NOTES:
1. J1, J3, J4 and R1 are factory installed.
2. Resistors XR1 are optional I/V conversion resistors for current inputs, not factory installed.
Acromag
WIXOM, MICH.
21 AUG 97
29 AUG 91
DATE
REV
ECN
DR
ENG
CLP
TITLE
APBO1 BACKPANEL
SERIES A5B
1 OF 2
DWG NO. 4501-151



NOTES:

1. Q1-Q16 ARE CJC TEMPERATURE SENSORS.
2. R4,7,10,13,16,19,22,25,28,31,34,37,40,43,46,49 ARE OPTIONAL I/V RESISTORS FOR CURRENT INPUTS, NOT FACTORY INSTALLED.
3. TEN MINI-LINKS FOR E1, E2, E3 ARE STORED ON E1, E2, E3 HEADERS. CUSTOMER MUST INSTALL TO SUIT HIS SPECIFIC MODULE CONFIGURATION.
4. * FACTORY ADJUSTED.

Acromag® WIXOM, MICH.	DATE	REV	ECN	DR	ENG	CLP
	21 AUG 97	G	97H013	KLK	GRL	GRL
	29 AUG 91	—	———	—	—	—

TITLE: APB01 BACKPANEL

SIZE	SERIES		DWG NO.	REV
D	SERIES A5B	2 OF 2	4501-151	G

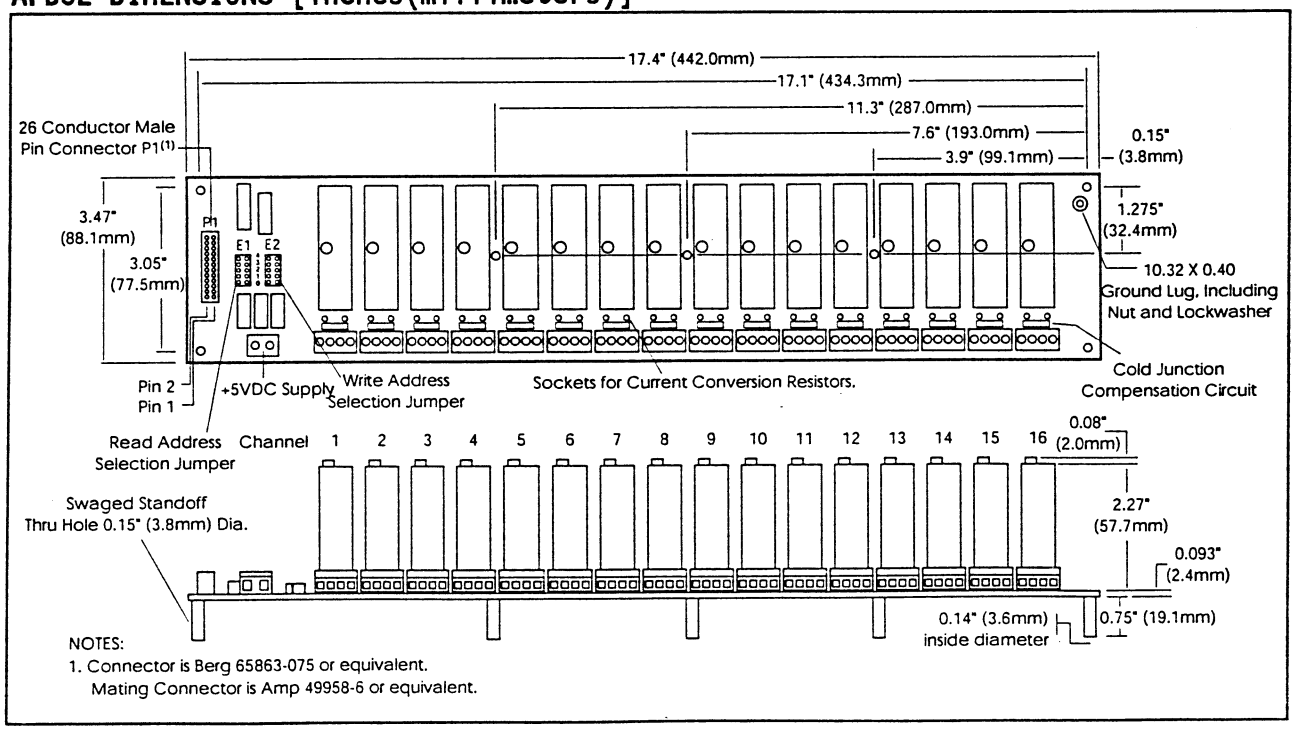
2.4.2 APB02 16-Position Analog Backpanel, Multiplexed

The APB02 16 channel backpanel can accept any of the A5B analog modules in any mixture. It can be mounted on the AXRK-002 19-inch metal rack. The APB02 has two analog buses; one for analog input and one for analog output. This two-bus configuration takes advantage of the switch controlled outputs on the input modules and the track-and-hold inputs on the output modules. A temperature sensor is mounted on each channel to provide cold junction compensation for thermocouple modules. Field connections are terminated with four screw terminals at each module site. Up to four APB02 backpanels may be daisy-chained. Use the AXCA005 cable for daisy chaining and the AXCA004-XX cable for connection to the host system.

APB02 SPECIFICATIONS:

Operating Temperature:	-25 to +85 ^{o}C, 95% relative humidity, Non-Condensing
Interface Connector:	Field - High Density Screw Clamp, 14 AWG Max Logic - 26-pin, Male Header Connector
Address Input Logic:	Max Logic "0" = 0.8V Min Logic "1" = 2.0V

APB02 DIMENSIONS [inches(millimeters)]



APB02 ELECTRICAL
(See Page 39 and 40 for a Schematic Drawing of the APB02 Backpanel)

P1 CONNECTOR: The 26-pin P1 connector provides the signal interface between the APB02 backpanel and the host measurement system. Two separate analog bus connections are provided; one for analog input signals, and one for analog output signals. Two sets of six address lines and an enable pin allow input and output modules to be independently multiplexed onto their respective analog signal bus. R0 thru R5, and RDENAB are used for input modules, and W0 thru W5, and WRENAB are used for output modules. See Section 2.4.8 for available interface cables.

ADDRESS SELECTION: The APB02 backpanel has address decoding circuitry to allow multiplexing any combination of up to 16 input or output modules. Capability is also provided in the address decode circuitry to expand the system to 64 channels (four APB02 backpanels) of multiplexed input or output. Jumpers on HD10 header, E1 and E2 group, select which set of 16 addresses are assigned to a particular backpanel. The E1 group assigns a set of 16 addresses for input modules, and the E2 group assigns a set of 16 addresses for output modules. The table below shows the correlation of jumper position to address range.

E1 JUMPER POS	E2 JUMPER POS	ADDRESS RANGE/MODE
1-2	1-2	0-15, STAND ALONE
9-10	9-10	0-15, EXPANDED
7-8	7-8	16-31, EXPANDED
5-6	5-6	32-47, EXPANDED
3-4	3-4	48-63, EXPANDED

To connect multiple APB02 backpanels in this expanded configuration, use interconnect cable AXCA005.

POWER: The APB02 backpanel requires external +5VDC +/-5% power. The chassis mounted AXPRE-003 or AXPRT-003 power supplies have adequate capacity to power any combination of modules.

FUSING: The APB02 backpanel power is fuse protected through F1. This is a Littelfuse type 252004, 4 amp fuse. Zener diode DZ1 provides extra protection by clamping the input power voltage to +5.6V. If the input supply voltage connection is reversed, this zener diode will be forward biased and fuse F1 will be blown.

APB02 ELECTRICAL

GROUNDING: The figure of the following page details the optional ground jumper configuration available on the APB02 backpanel. Jumpers J1, J2, and J4 are factory installed.

Jumper J1 connects the SIG COM shield wires (pins 2, 5, and 6) to the backpanel signal ground. This provides a ground connection between the host system and backpanel. Jumper J1 is required if output modules (A5B39) are used, or if there is no high impedance sense input (input low of a differential or pseudo-differential system) on the host measurement system.

Jumper J2 connects the SNS LO line (pin 4) to the backpanel signal ground. If the host system has the capability, this allows measuring the APB02 ground potential.

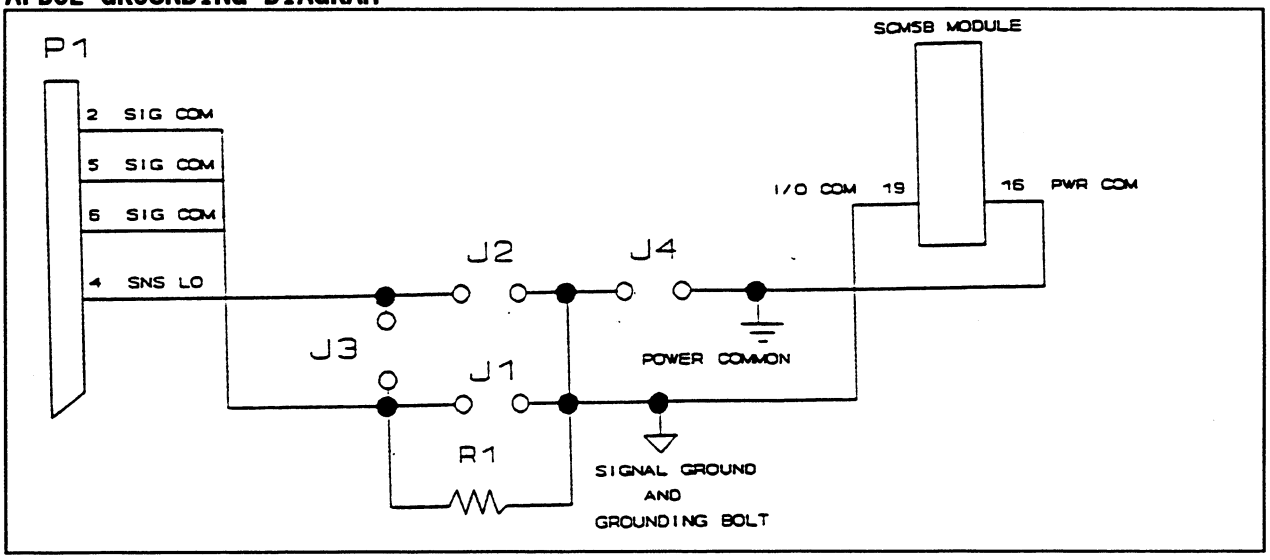
For proper operation of the output switch or track-and-hold circuit on the A5B modules, a current path must exist between the host control logic power common and module I/O Common (module pin 19). This path can be established on the APB02 via jumper J4. If this connection exists elsewhere in the system, jumper J4 should be removed since possible ground loops could exist. Other connections of power ground and signal ground usually occur at the A/D or D/A converter of the host measurement system. More information on grounding can be found in the Application Information of Section 4.2.

If the connection of power common and SIG COM shield wires exist in the host measurement system, a resistive connection between SIG COM and the backpanel signal ground can be made via R1. R1 can be as large as 10K ohms; 100 ohms is a recommended value. Jumper J3 can be used to connect the SNS LO line to R1 when this ground configuration is used.

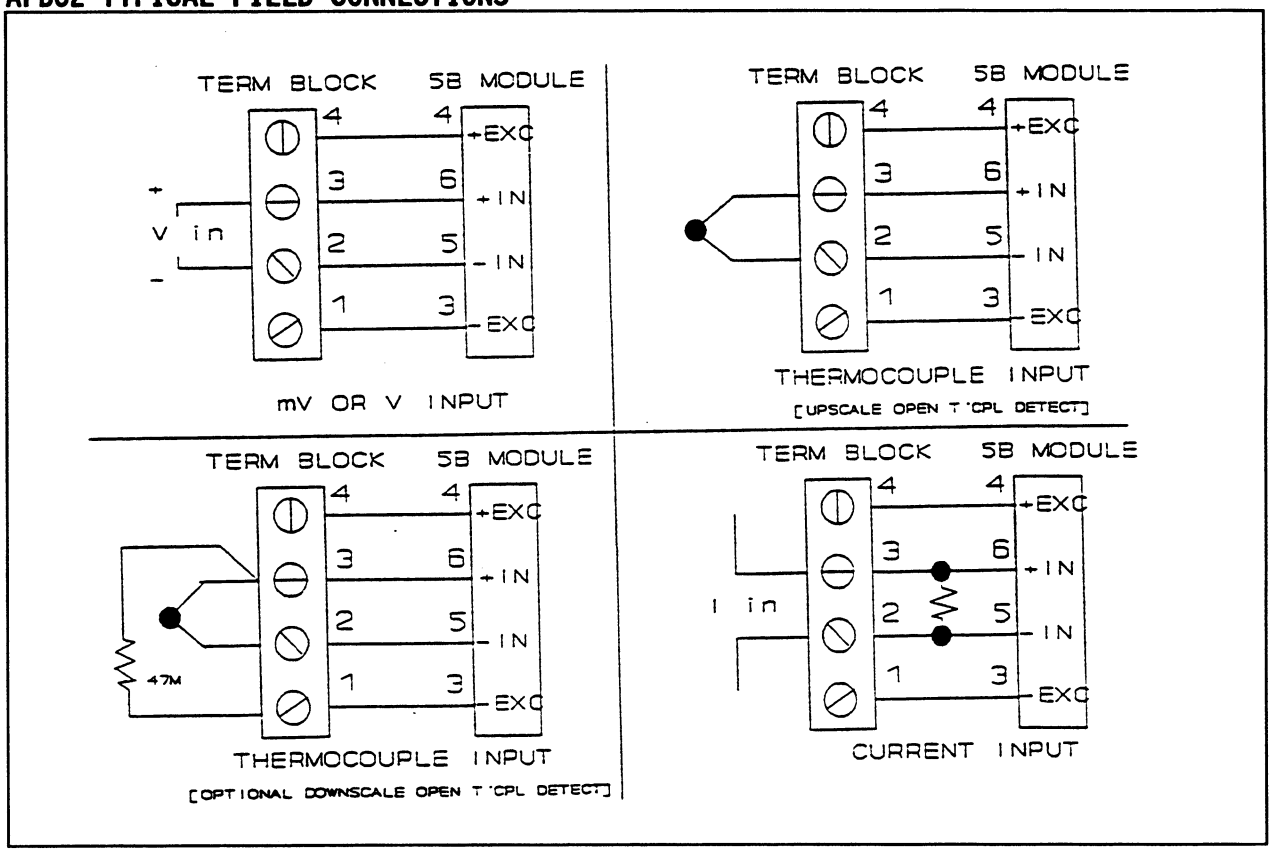
For full protection against large electrical disturbances on the field-side of the A5B modules, a #10-32 ground stud is provided on the backpanel. An electrical connection between this ground stud and system ground should be provided with a large gauge wire of the shortest possible length. When this connection is made, a possible ground loop could result through the SIG COM shield wires and backpanel signal ground. If the application involves only input modules, and a differential input is used by the host measurement system, J1 should be removed. Remember that J1 is required if output modules are used or if the host system does not have differential inputs.

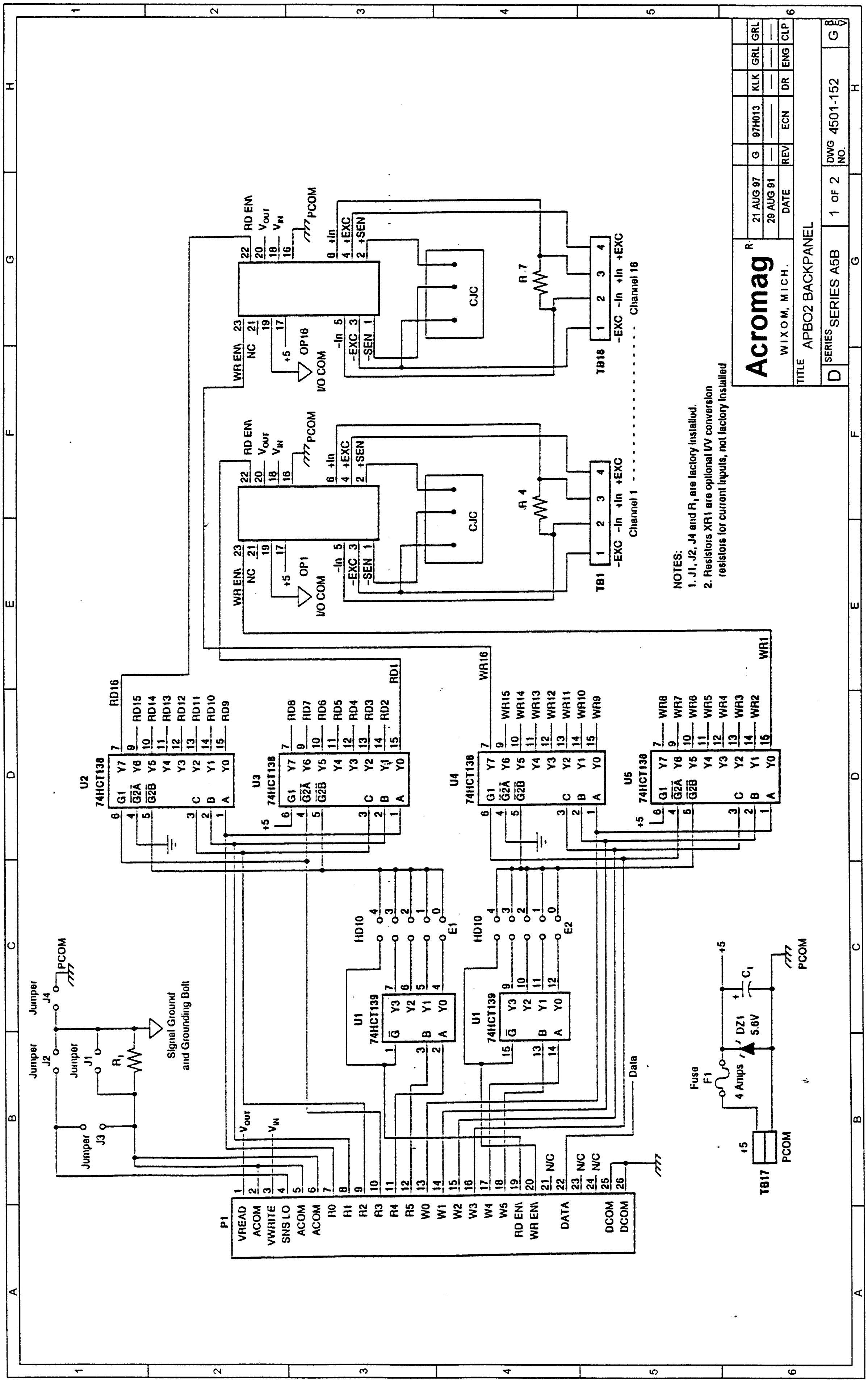
FIELD CONNECTIONS: All field wiring is terminated at the 16, four position high density connectors labled TB1 thru TB16. Some typical field connections are shown in the figure of the following page. The screw terminals in the figure are labeled 1 through 4 and correspond to the markings on the APB02 backpanel.

APB02 GROUNDING DIAGRAM

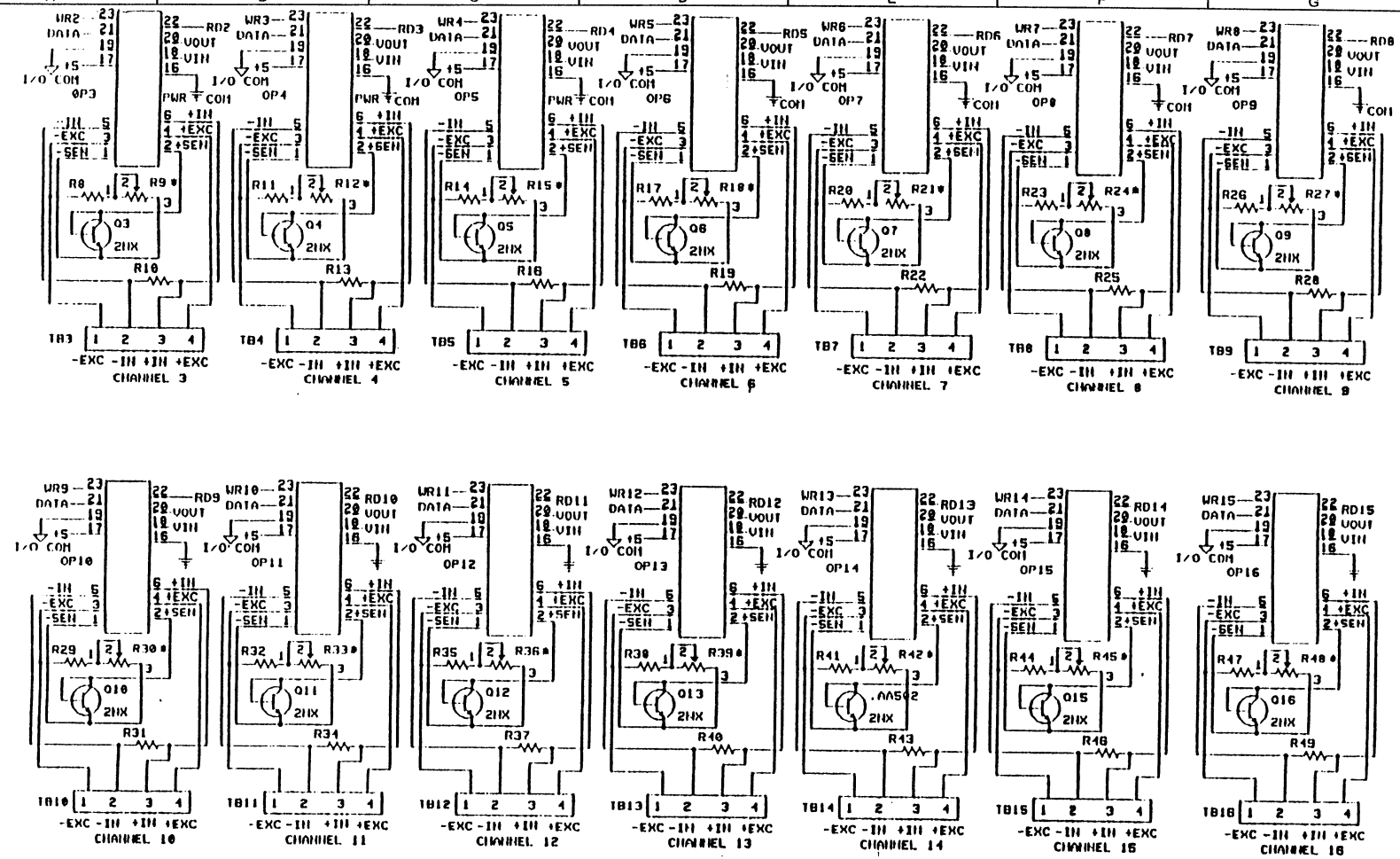


APB02 TYPICAL FIELD CONNECTIONS





Acromag
WIXOM, MICH.
TITLE APBO2 BACKPANEL
SERIES A5B
D
1 OF 2
DWG NO. 4501-152
G
21 AUG 97
29 AUG 91
DATE
REV
ECN
DR
ENG
CLP
97H013
KLK
GRL
NOTES:
1. J1, J2, J4 and R1 are factory installed.
2. Resistors XR1 are optional I/V conversion resistors for current inputs, not factory installed.
P1
VREAD
ACOM
VWRITE
SNS LO
R0
R1
R2
R3
R4
R5
W0
W1
W2
W3
W4
W5
RD EN\
WR EN\
DATA
DCOM
N/C
Jumper J2
Jumper J1
Jumper J3
Jumper J4
PCOM
Signal Ground and Grounding Bolt
Data
U1 74HCT139
HD10
E1
E2
U2 74HCT138
U3 74HCT138
U4 74HCT138
U5 74HCT138
RD16
RD1
WR16
WR1
OP1
OP16
I/O COM
CJC
TB1
TB16
-EXC -In +In +EXC
Channel 1
Channel 16
Fuse F1
4 Amps
DZ1 5.6V
TB17



NOTES:

1. Q1-Q18 ARE CJC TEMPERATURE SENSORS.
2. R4,7,10,13,16,19,22,25,28,31,34,37,40,43,46,49 ARE OPTIONAL I/V RESISTORS FOR CURRENT INPUTS, NOT FACTORY INSTALLED.
3. * FACTORY ADJUSTED.

Acromag WIXOM, MICH.	21 AUG 97	G	97H013	KLK	GRL	GRL
	29 AUG 91	—	———	—	—	—
	DATE	REV	ECN	DR	ENG	CLP
TITLE APBO2 BACKPANEL						
D SERIES SERIES A5B	2 OF 2	DWG NO. 4501-152			G REV	

2.4.3 APB03 & APB04 One/Two Position Analog Backpanels

The APB03 is a single channel mounting panel for the A5B modules. The APB04 is a dual channel mounting panel for the A5B modules. They both are DIN rail compatible. Phoenix brand Universal Module (UM) elements may be used to mount these products and are pictured in Section 2.4.7.

APB03/APB04 SPECIFICATIONS:

Operating Temperature	-25 to +85°C, 95% Relative Humidity, Non-Condensing
Interface Connector	Field - High Density Screw Clamp, 14 AWG Max
	Logic - High Density Screw Clamp, 14 AWG Max

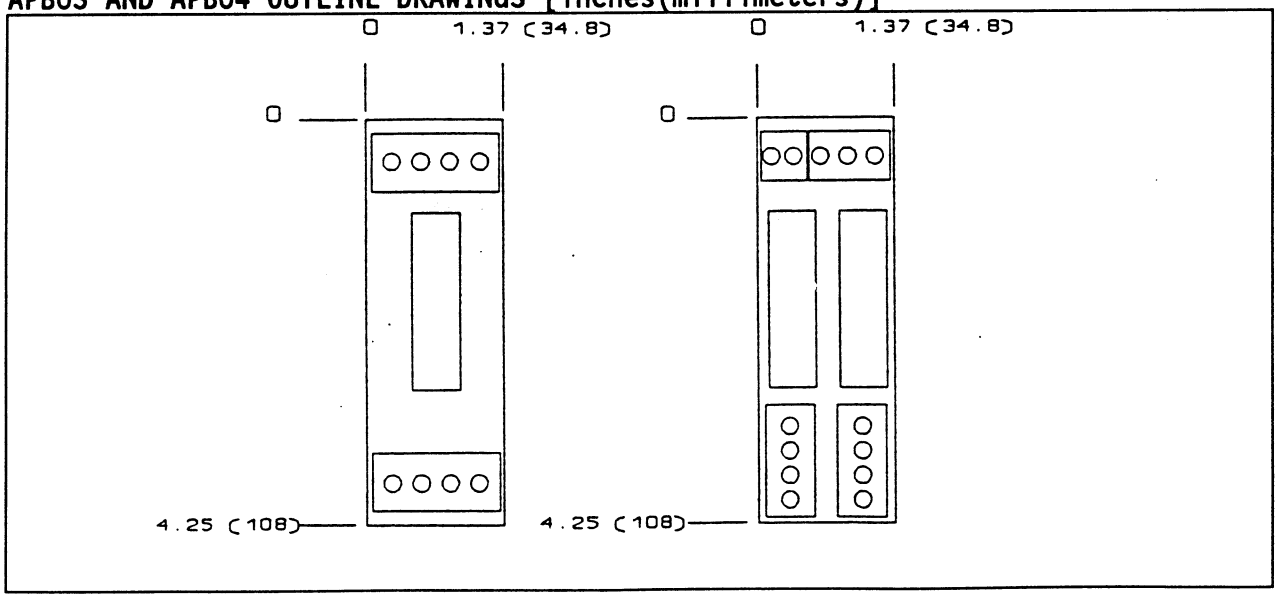
The following parts are available from Phoenix or can be ordered from Acromag and are required for mounting one APB03/04 panel (these parts are pictured in Section 2.4.7):

Qty	Model	Acromag Part	Description
1	UM-BEFE-35	1043-110	Base Element with snap foot
2	UM-SE	1043-112	Side Element

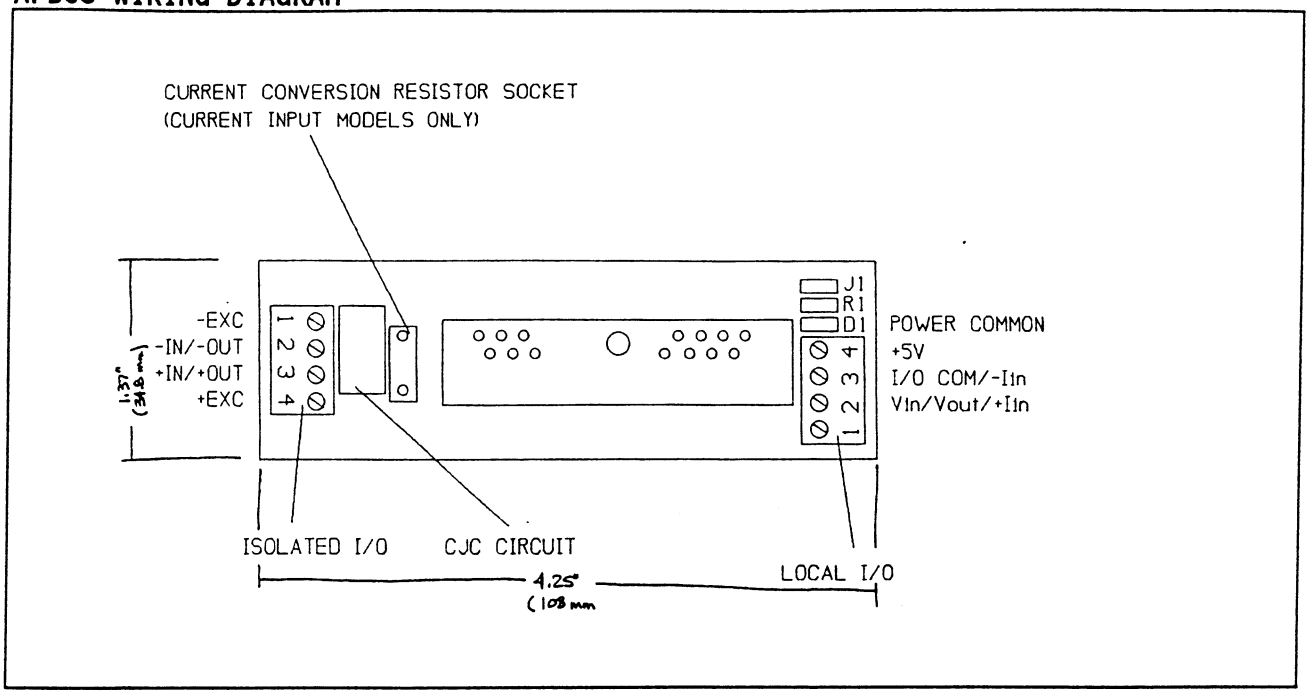
The following parts are available from Phoenix or can be ordered from Acromag and are required for mounting two or more APB03/04 panels (these parts are pictured in Section 2.4.7):

Qty	Model	Acromag Part	Description
2	UM-BEFE-35	1043-110	Base Element with snap foot
2	UM-SE	1043-112	Side Element
(# panels)-2	UM-BE-35	1043-111	Base Element without snap foot
(4 x (# panels))-4	UM-VS	1043-113	Connection pins

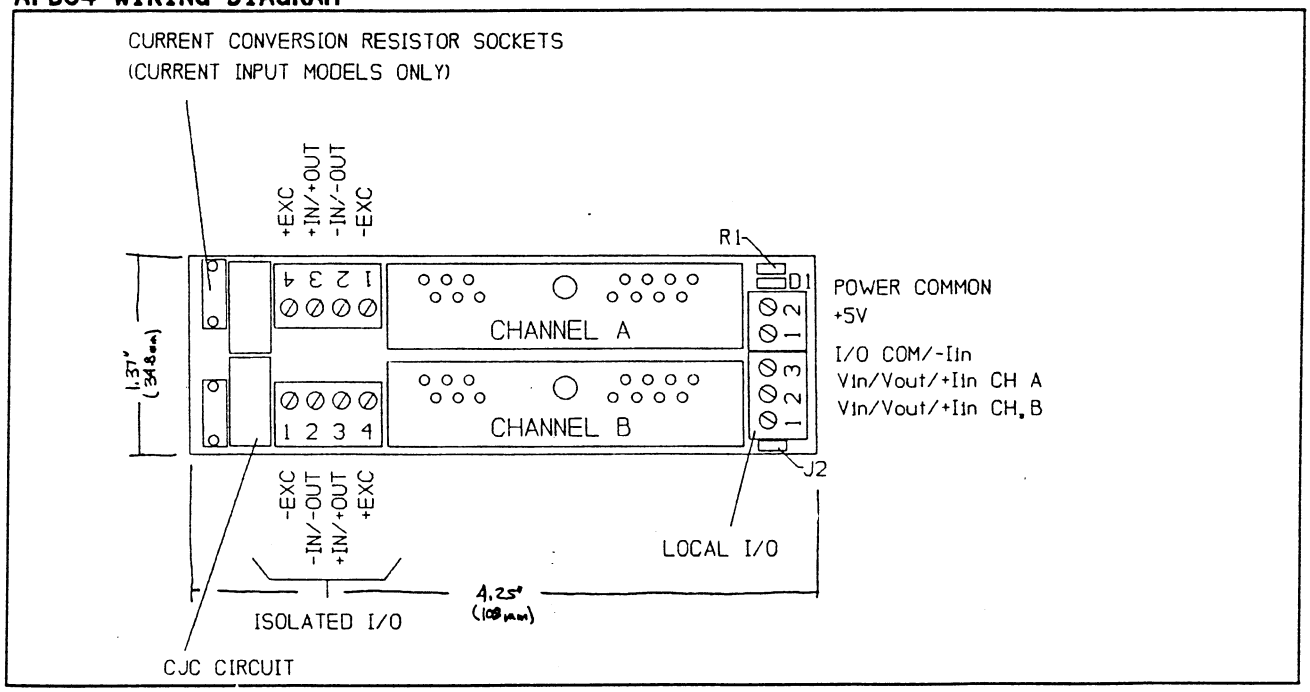
APB03 AND APB04 OUTLINE DRAWINGS [inches(millimeters)]



APB03 WIRING DIAGRAM



APB04 WIRING DIAGRAM



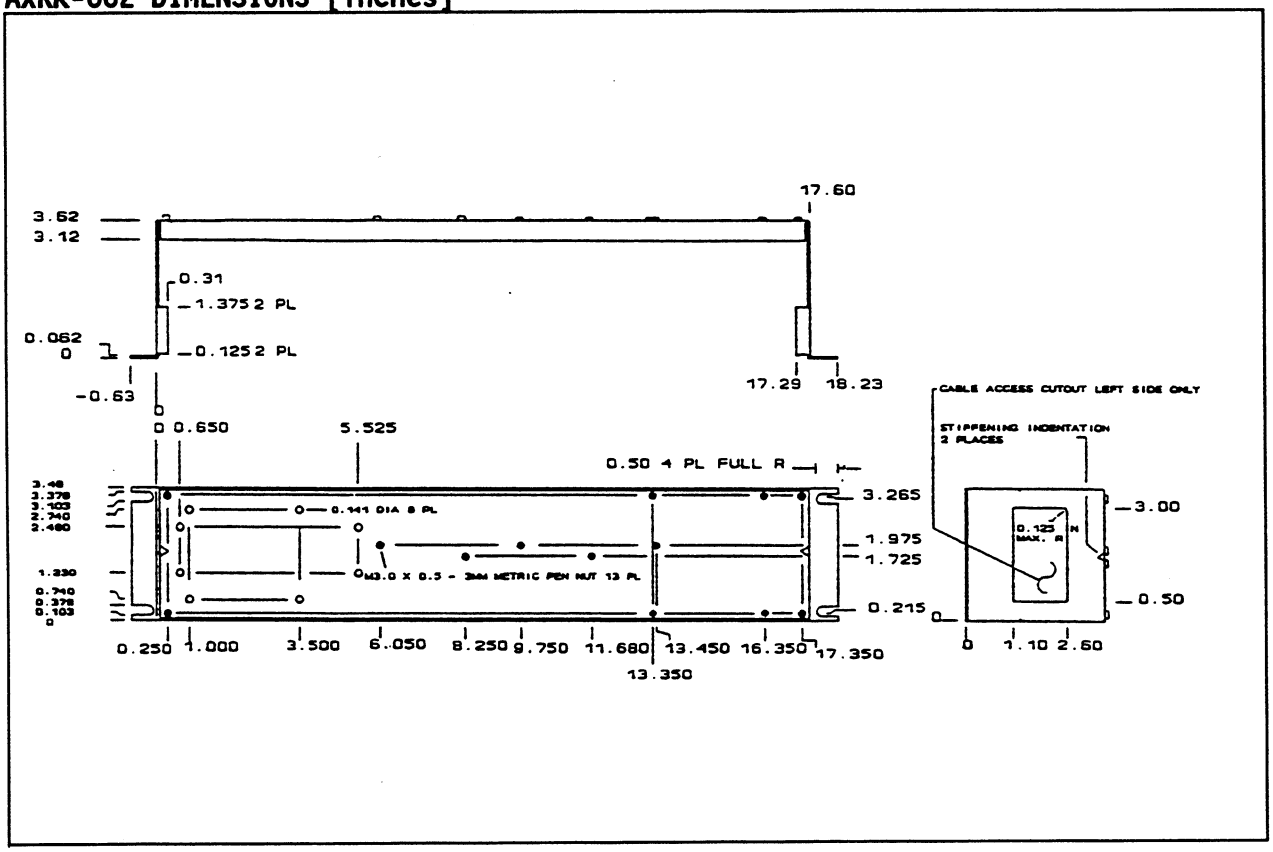
APB03/APB04 ORDERING INFORMATION

MODEL	DESCRIPTION
APB03	Single Channel Mounting Panel for A5B Modules
APB04	Dual Channel Mounting Panel for A5B Modules

2.4.4 AXRK-002 19-Inch Mounting Rack

The AXRK-002 is a 19-inch metal rack for mounting the APB01 or APB02 backpanel. It also provides the capability to mount the AXPRT-003 or AXPRE-003 power supplies, and the AXIF interface board.

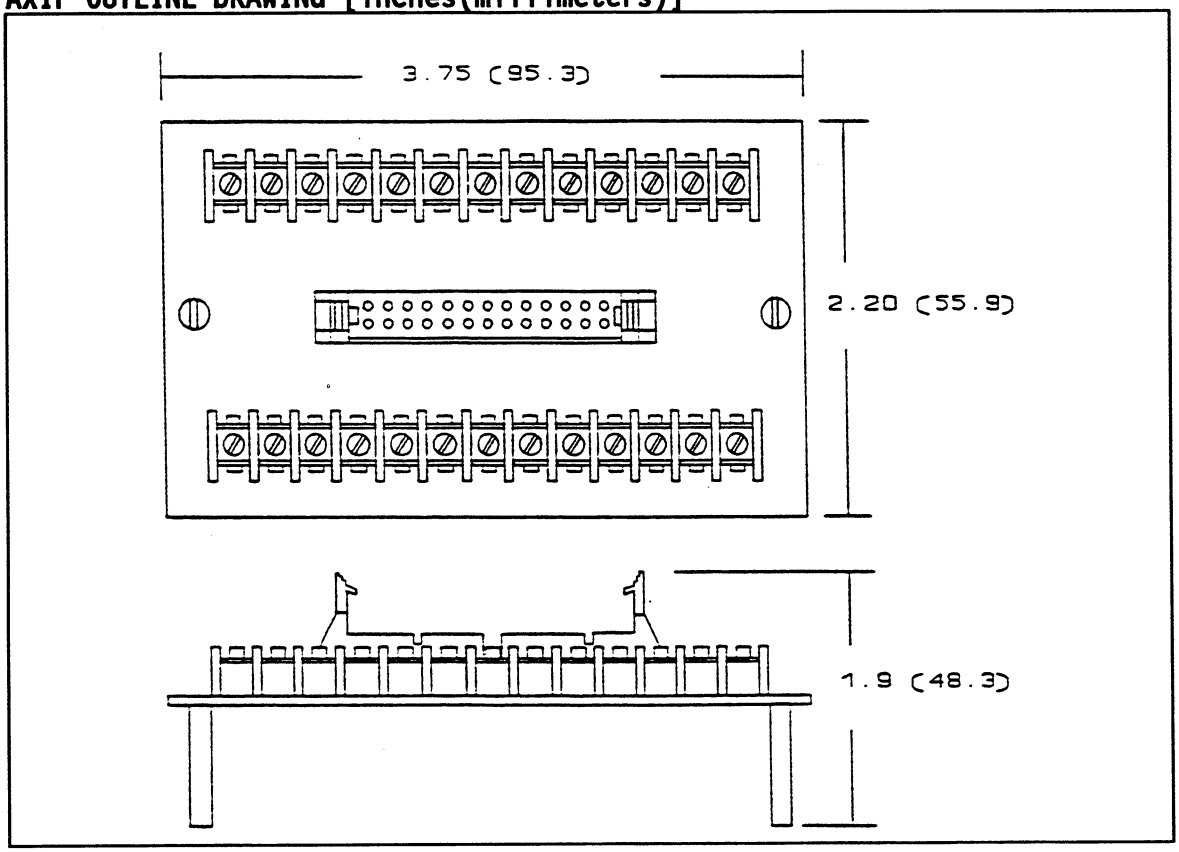
AXRK-002 DIMENSIONS [inches]



2.4.5 AXIF Universal Interface Board

The AXIF is a universal interface board which converts a 26-pin ribbon cable input to 26 screw terminals for individual wiring. It can be mounted on the back of the AXRK-002 mounting rack; standoffs and mounting hardware are included. Use the AXCA004 cable with this product (see Section 2.4.8).

AXIF OUTLINE DRAWING [inches(millimeters)]

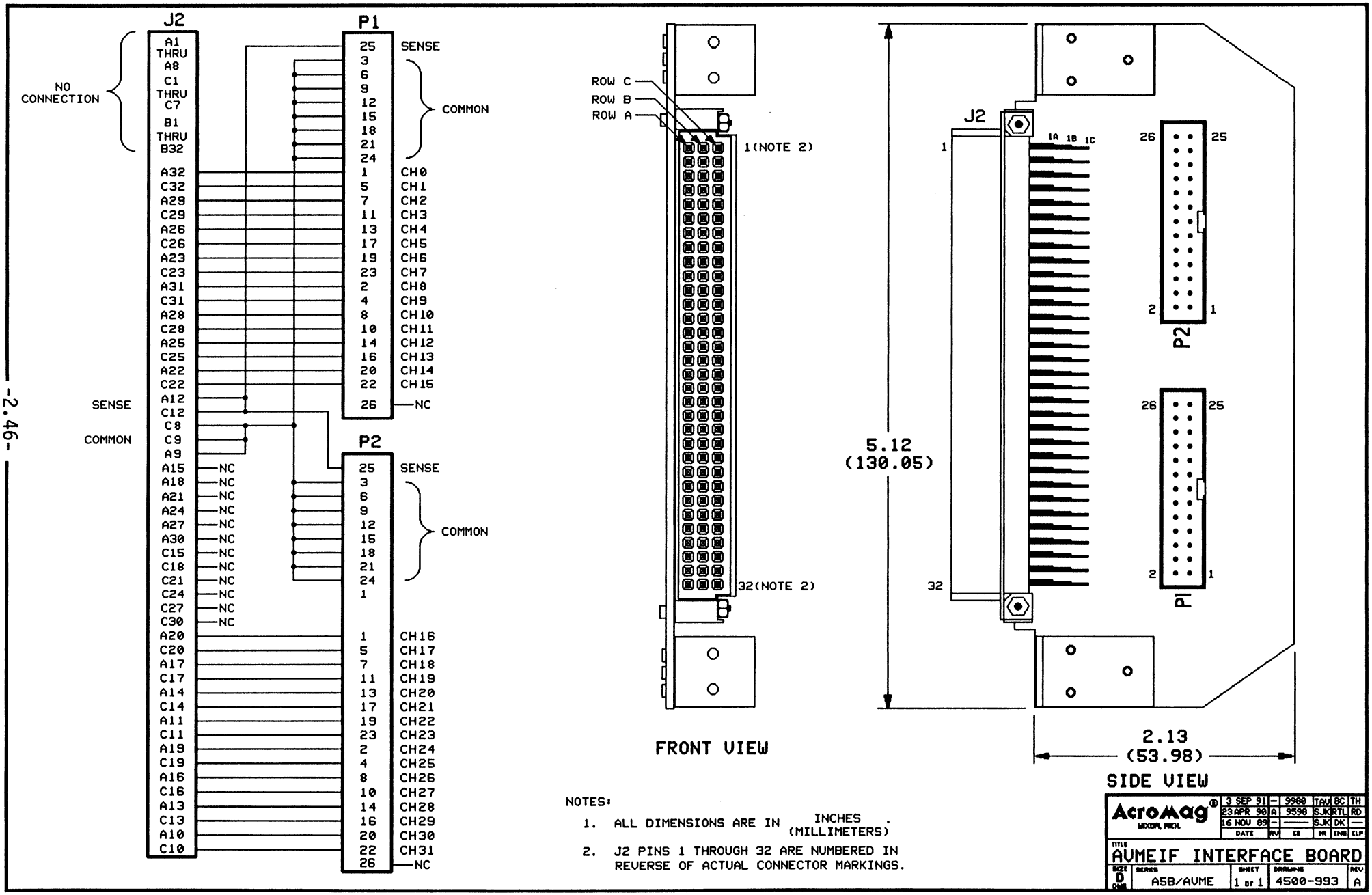


2.4.6 AVMEIF VME Interface Board

The AVMEIF is a plug-in interface board which allows up to two APB01 Backpanels to connect to Acromag's Analog Input VME boards (the Series 9325 for example). The AVMEIF is used to mate the 96-pin VME connector (P2) to the 26-conductor ribbon cables of the APB01 I/O panels (see Section 2.4.8 for information on cables). The AVMEIF is normally connected directly to the P2 connector of AVME boards and mounted to the back of the VME cage.

AVMEIF SPECIFICATIONS:

Operating Temperature:	-25°C to +85°C
Electrical Connections:	See Drawing 4500-993 of the following page
Printed Circuit Board:	Military grade FR-4 epoxy glass circuit board coated with a fungus resistant acrylic conformal coat.
Terminals:	
Input Connector (J2)	Female, 96 pin x 3 rows, right angle. Body is Glass Reinforced Thermoplastic UL 94V-O. Contacts are Phosphor Bronze with 30 uinches Gold over 75 uinches Nickel.
Output Connector (P1,P2)	Female, 26 pin x 2 rows. Body is Glass Filled Polyester. Contacts are Phosphor Bronze with 30 uinches Gold over 50 uinches Nickel.



NOTES:

1. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).
2. J2 PINS 1 THROUGH 32 ARE NUMBERED IN REVERSE OF ACTUAL CONNECTOR MARKINGS.

Acromag® WIXOM, MICH.	DATE	REV	DR	ENG	CLP
	3 SEP 91	–	9980	TAV	BC	TH
	23 APR 98	A	9598	SJK	RTL	RD
	16 NOV 89	–	——	SJK	DK	—

TITLE: AVMEIF INTERFACE BOARD

SIZE	SERIES	SHEET	DRAWING	REV
D	A5B/AVME	1 of 1	4500-993	A

2.4.7 AXEV Single Channel Analog Module Evaluation Board

The AXEV is a single channel analog board with a test socket for A5B modules and is typically used for module evaluation. All signal input/output, control, and power connections are connected to terminal blocks for ease of user access. A cold junction temperature sensor circuit is included for evaluation of thermocouple modules.

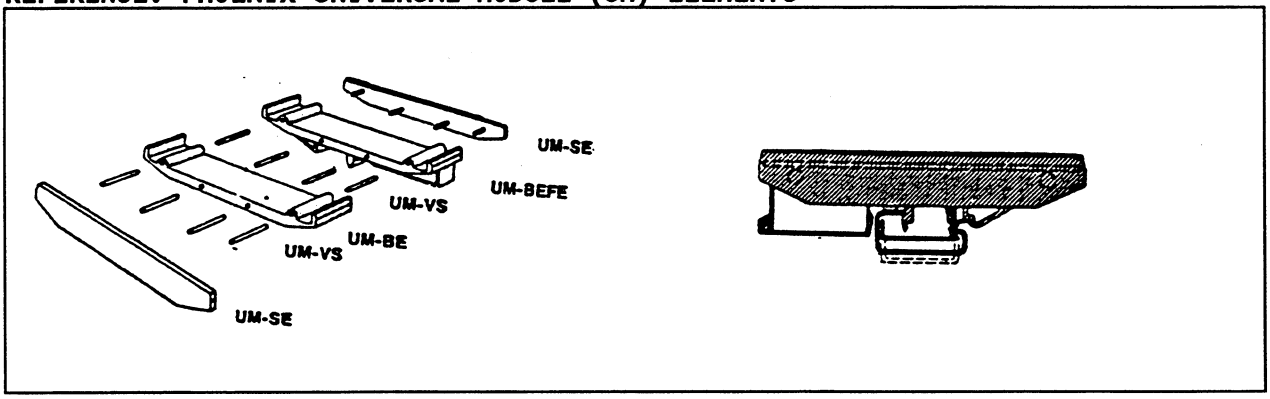
The AXEV is mechanically compatible with DIN rail mounting. Phoenix brand Universal Module (UM) elements may be used to mount this product. The following parts are available from Phoenix or can be ordered from Acromag and can be used to mount <u>one</u> AXEV (see Figure Below):

2, Phoenix UM-BEFE-35 Base Elements with snap foot (Acromag 1043-110)
2, Phoenix UM-SE Side Elements (Acromag 1043-112)
4, Phoenix UM-VS connection pins (Acromag 1043-113)

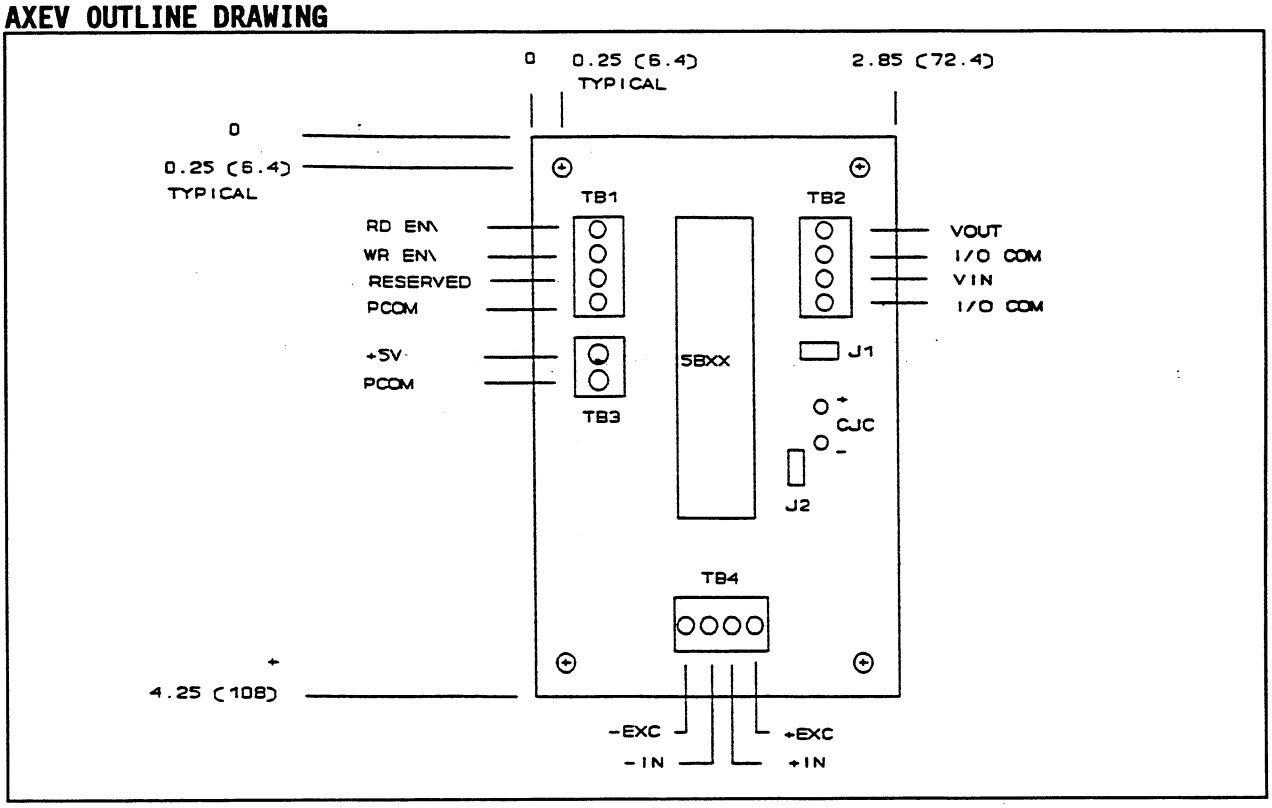
Two jumpers are provided for customer use. The first, J1, provides a current path between +5V Power Common (module pin 16) and I/O Common (module pin 19). A path must exist between the host control logic power common and module I/O common for proper operation of the module output switch or track-and-hold circuit. If this connection exists elsewhere in the system, jumper J1 should be removed since possible ground loops could exist. Other connections of power ground and signal ground usually occur at the A/D or D/A converter of the host measurement system.

Jumper J2 is used in the Cold Junction Compensation circuit. If it is installed, the compensation circuit is enabled and will provide the proper compensation voltage to correct for the thermoelectric effect at the (+IN) and (-IN) screw terminals. If an external simulation voltage is desired for Cold Junction Compensation, J2 is removed. The external voltage is applied at the sockets labled (CJC +) and (CJC -). An external voltage of 510.0mV corresponds to an ambient temperature of +25°C. The transfer function of the on board compensation circuit is -2.500 mV/°C. The external voltage (EXT) is calculated as follows: EXTmV = 510mV - 2.500 mV/°C * (Temp°C - 25°C). The circuit diagram of the AXEV is shown on the following page.

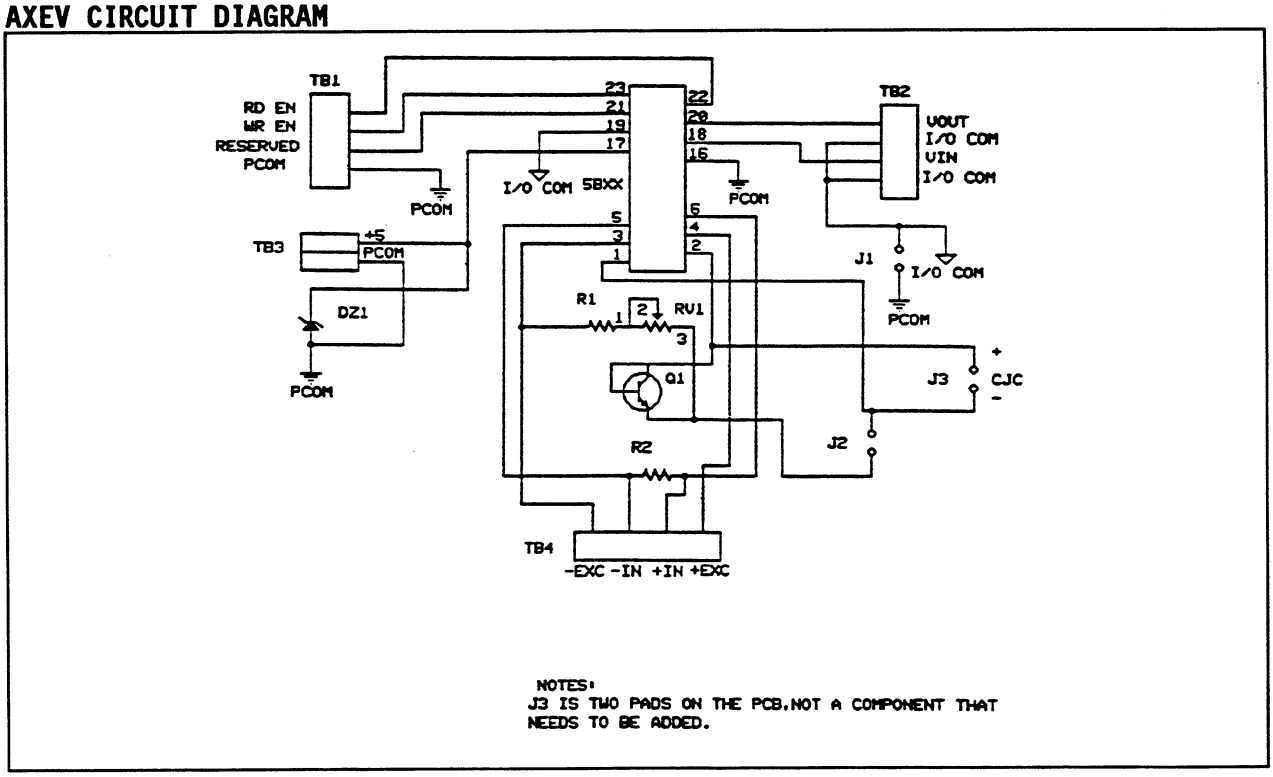
REFERENCE: PHOENIX UNIVERSAL MODULE (UM) ELEMENTS



AXEV OUTLINE DRAWING



AXEV CIRCUIT DIAGRAM



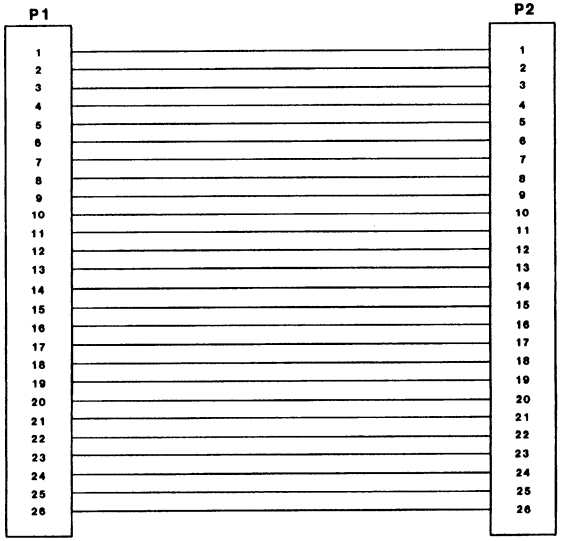
2.4.8 AXCA004 & AXCA005 Interface Cables

AXCA004-XX CABLE:

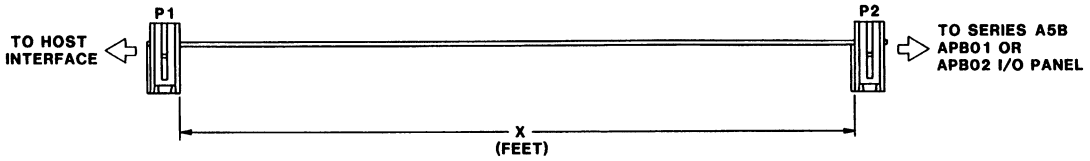
The AXCA004-XX is a system interface cable for the APB01 and APB02 backpanels. This is a 26-conductor ribbon cable with a mass-terminated socket connector installed on each end. It can be ordered in any length (the -XX of the model number denotes the required length in feet). See schematic 4501-153 of the following page.

AXCA005 CABLE:

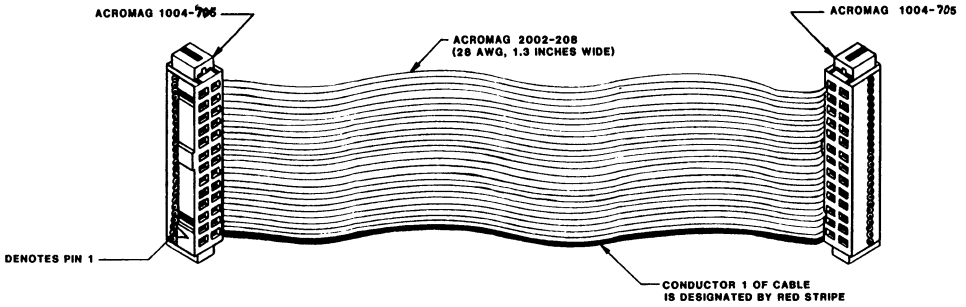
The AXCA005 is a daisy-chain cable for interfacing to more than one APB02 backpanels in a daisy chain fashion. The AXCA005 is 3 feet long and provides interconnection between a maximum of four APB02 backpanels. See schematic 4501-154 of the second following page.



MODEL AXCA004-XX SCHEMATIC



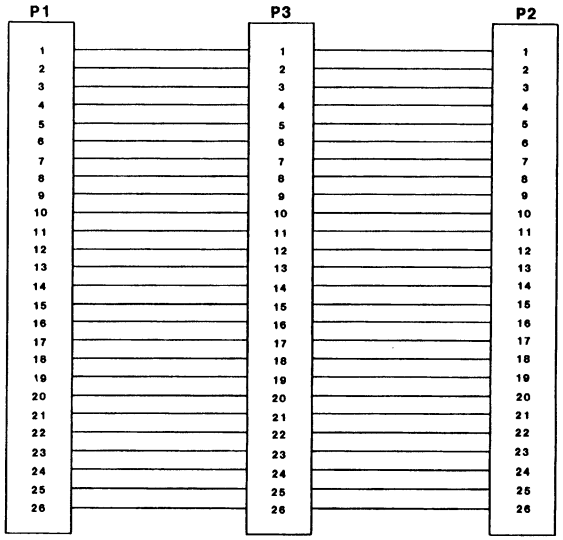
SIDE VIEW



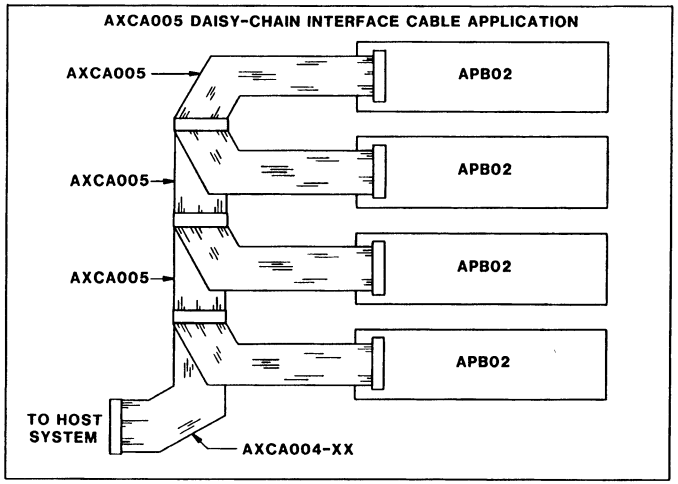
MODEL AXCA004-XX INTERFACE CABLE
(NOTE: -XX OF MODEL NUMBER DENOTES LENGTH IN FEET).

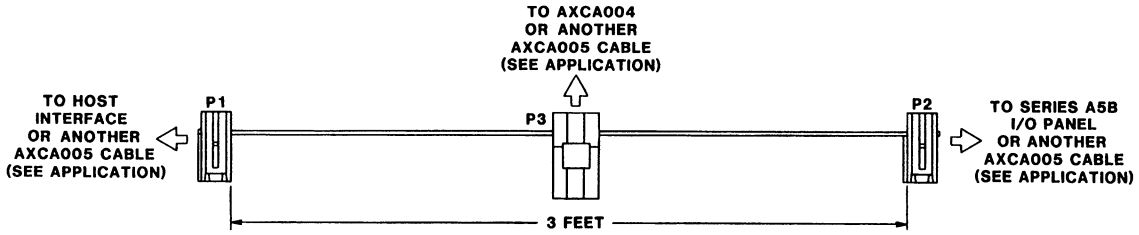
FRONT VIEW

Acromag WIXOM, MICH.		28 OCT 91	—	—	PV	SC
		DATE	REV	CO	DR	ENG
TITLE: CABLE: MODEL AXCA004-XX						
SIZE D	SERIES A5B	SHEET 1 OF 1	DRAWING 4501-153			REV

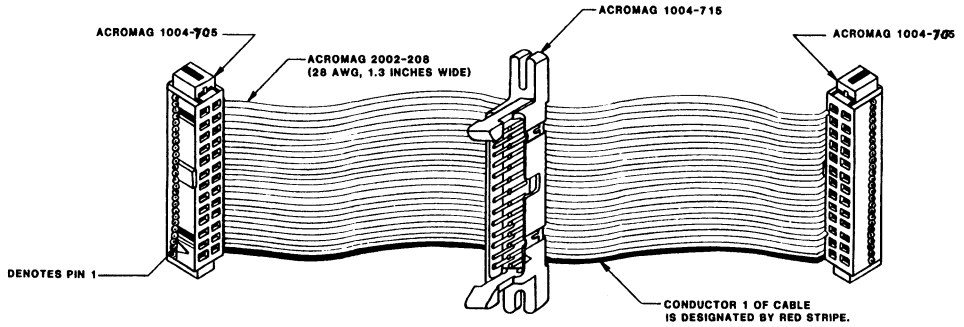


MODEL AXCA005 SCHEMATIC





SIDE VIEW



MODEL AXCA005 INTERFACE CABLE

FRONT VIEW

Acromag WIXOM, MICH.					
28 OCT 91 DATE	REV	CO	DR	ENG	CLP
TITLE: CABLE: MODEL AXCA005					
SIZE D DWG	SERIES A5B	SHEET 1 OF 1	DRAWING 4501-154		REV

2.4.9 AXFS-003 Fuse, AXJP-003 Jumper Strap, AXCS Blank Module Case, & AXR1 Current Conversion Resistor

AXFS-003 Fuse:

Package of 10 replacement fuses for use on the APB01 or APB02 backpanel. This is equivalent to a Littelfuse 252004. This is a series fuse in the five volt power line rated for 4 amps and 125 volts. It provides protection against inadvertent reverse connection of five volt power.

AXJP-003 Jumper Strap:

Package of 10 jumpers for connecting adjacent input/output modules on the APB01 backpanel. This connection is made if it is desired to direct the output of any input module to the adjacent output module. The jumpers can also be used for configuring I/O addresses on the APB02 backpanel.

AXCS Blank Module Case:

This is a blank A5B module case and mounting screw. For case dimensions, refer to Section 2.1.

AXR1 Current Sense Resistor:

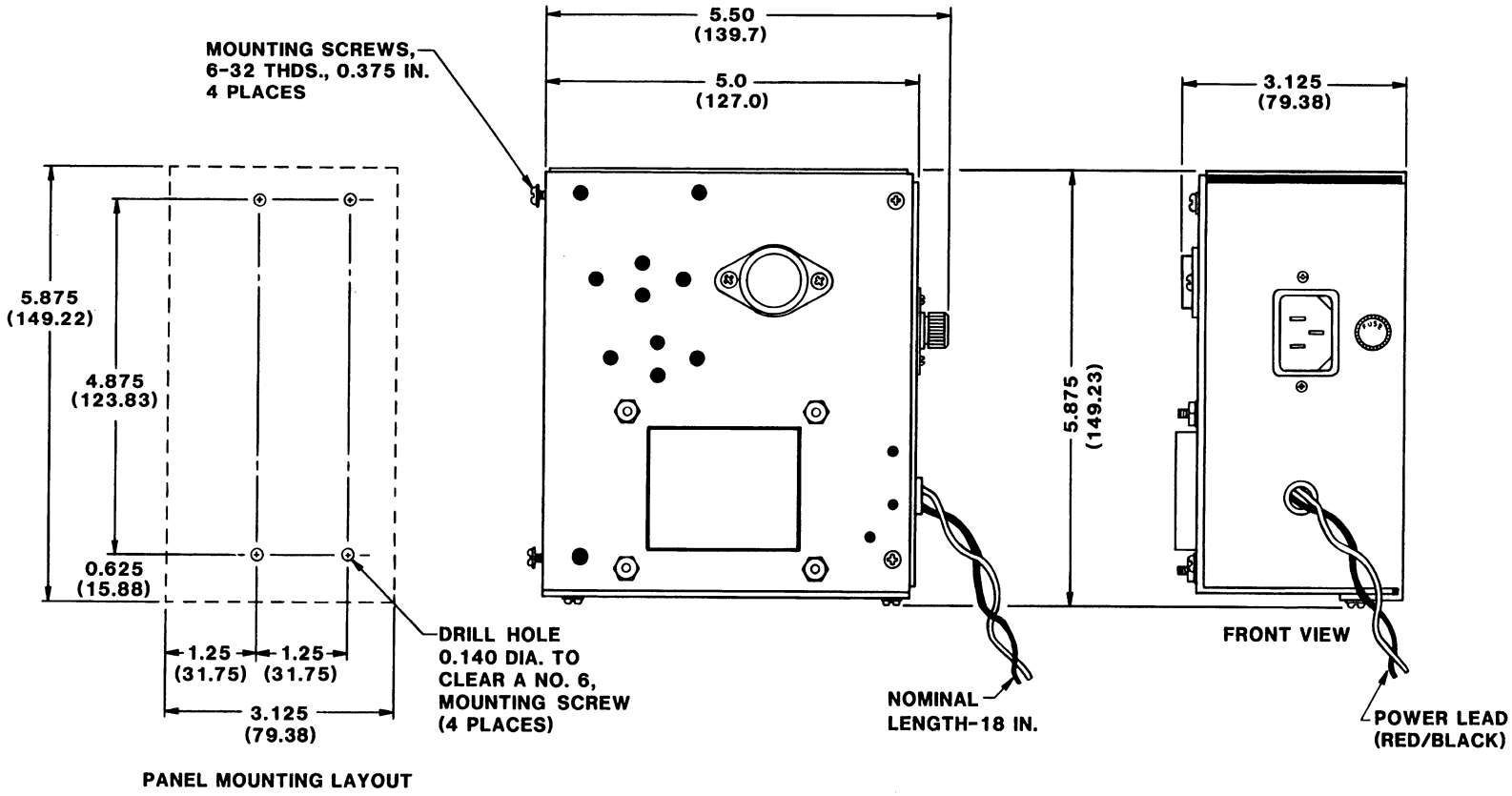
A precision 20 ohm, 0.1%, T2 grade resistor with plug-terminals attached. It is used with the A5B32 current input module. Sockets are provided on the APB01/02 backpanels to allow installation of this resistor. One AXR1 is shipped with each A5B32 module.

2.4.10 AXPRT-003 & AXPRE-003 Power Supplies

Two power supplies are offered for the analog backpanels. These supplies are available in 120VAC or 220VAC input. They have sufficient output current capacity to supply any combination of A5B modules. The AXRK-002 metal rack provides mounting capability for the AXPRT/AXPRE-003 power supplies.

AXPRT/AXPRE SPECIFICATIONS:	AXPRT-003	AXPRE-003
Input Voltage Range	104-132 VAC	207-265 VAC
Output Voltage	5 VDC	5 VDC
Output Current (at +70C)	3 Amp	3 Amp
Operating Temperature	0 to +70 ^{o}C	0 to +70 ^{o}C
Dielectric Withstand Voltage (Input to Ground)	3750 VAC	3750 VAC
Line Regulation (10% Line Change)	+/- 0.05%	+/- 0.05%
Load Regulation (50% Load Change)	+/- 0.05%	+/- 0.05%
Output Ripple (Max)	5 mVp-p	5 mVp-p
Overvoltage Protection (Factory Set)	6.2 V +/- 0.4V	6.2 V +/- 0.4V
Mechanical Dimensions	See Drawing 4501-140 of following page.	

Note: Both supplies are tested and certified by TUV to VDE 0806 and IEC 380. They are UL Recognized (File Number E55974) and CSA Certified (CSA File Number LR38879).



MOUNTING AND CLEARANCE DIMENSIONS
MODEL AXPRT-003(115V) AND
MODEL AXPRE-003(230V)

ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).

Acromag® WIXOM, MICH.						
4 SEP 91	—	—	TV	SC	—	
DATE	REV	CO	DR	ENG	CLP	
TITLE: AXPRT/AXPRE-003 POWER SUPPLY						
SIZE C DWG	SERIES A5B	SHEET 1 OF 1	DRAWING 4501-140	REV		

3600-025

3.0 ISOLATED DIGITAL I/O MODULES AND ACCESSORIES

This series of digital input/output modules provides the user with a highly reliable and safe interface to harsh industrial measurement and control applications. These electrically isolated, optically coupled relays provide a means to interface AC/DC signals and perform output power control. All of these I/O modules isolate the computer or logic side from electrical transients, accidental short circuits, and excessive voltages. They offer high reliability and a wide variety of input and output ranges. Their solid state design provides both shock and vibration resistance.

This family of digital I/O modules is designed to mount in the Model 4TPH-16SSR-ST Termination Panel or equivalent (see Section 3.3.1). This panel, with Solid State Relays installed, is then connected to the host backpanel or digital port using the 4TPH-HH-2 or 4TPH-HH-6 cable (see Section 3.3.2).

The following general specifications cover the digital input/output modules listed below:

MODEL	DESCRIPTION
IAC5	AC Input: 90 to 140V AC or DC
IAC5-A	AC Input: 90 to 280V AC or DC
IDC5	DC Input: 4 to 32VDC
IDC5-F	DC Input: 4 to 32VDC, Fast Acting
OAC5-A	AC Output: 24 to 280VAC
ODC5	DC Output: 5 to 60VDC
ODC5R	Output : SPST Dry Contact

DIGITAL I/O MODULES GENERAL SPECIFICATIONS (All Models):

Physical Characteristics

Shipping Weight	0.15 pounds (0.07 Kg) packed
Mounting	Each module, single screw mounting

Operating Conditions

Operating Temperature Range	-25 to +70 °C (-13 to 158 °F)
Storage Temperature Range	-25 to +85 °C (-13 to 185 °F)
Relative Humidity	0 to 95% Relative Humidity (Non-Condensing), up to 40°C (104°F)
Power	+5V DC
Isolation	All modules provide Input/Output optical isolation. When mounted in a termination panel, the modules are rated at 250 Volts RMS (354V DC) continuous. Will withstand 1500V AC dielectric strength test for 1 minute without breakdown. Complies with test requirements outlined in ANSI C39.5-1974 for the voltage rating specified.

General Reference Data

Radio Frequency Interference	Capability of withstanding an RFI field strength of up to 10 volts per meter at 27 MHZ, 151 MHz, and 467 MHz with no digital effect.
Line Noise Effects	Field terminals capable of withstanding ANSI/IEEE C37.90-1978 Surge Withstanding Capability (SWC) Test with no component failures. Unit is tested to a standardized test waveform that is representative of surges (high frequency transient electrical interference) observed in actual installations.

The following specifications are limited to the field side of the digital I/O module. These modules are specified for use with the Model 4TPH-16SSR-ST Termination Panel (Section 3.3.1), the logic side of the module meets the needs of the application and is not specified.

3.1 DIGITAL INPUT MODULES

FEATURES
* Optical Isolation
* UL, CSA Approvals
* Industry Standard Pinout and Footprint
* Can be Mixed and Matched on a Backpanel
* Color Coded by Function
* Input Filtering for Transient Free Switching
* Full Accessory Line
* 100% Tested to Published Specifications

APPLICATIONS
* Rugged Design for Industrial Plant Environments
* Reduces Wiring Costs
* Reduces Electrical Noise in Measured Signals
* Convenient System Expansion and Repair
* Ideal Relay Replacement
* An Ideal Interface to a Variety of Switch Sources; Proximity, Limit, Selector, Push-Button, Toggle, Photoelectric, or TTL Devices

This series of digital input modules provides a highly reliable and safe interface to harsh industrial measurement and control applications. Each module provides 4000 Vrms of optical isolation. By installing these signal conditioning modules near individual field sensors, a reliable isolation barrier is provided between the field and computer system. Other benefits include reduction of field wiring costs and the establishment of a cost effective and manageable method for system expansion and repair. The input modules are designed with filtering on the input and a hysteresis amplifier for high noise rejection and transient free switching.

The following sections cover the digital input models listed:

- IAC5, AC Input, 90 to 140V AC or DC
- IAC5-A, AC Input, 180 to 280V AC or DC
- IDC5, DC Input, 4 to 32VDC
- IDC5-F, DC Input, 4 to 32VDC, Fast Acting

3.1.1 IAC5 & IAC5-A Digital AC Input Modules

AC input modules are used for sensing ON/OFF alternating current (AC) or DC voltage levels in the ranges of 90-140V and 180-280V, AC or DC. They are protected from damage due to high-voltage transients on the input signal. All AC input modules are designed with filtering on the input and a hysteresis amplifier for high noise rejection and transient free switching. Typical uses and applications include sensing the presence or absence of voltage or sensing contact closures. A yellow case color denotes these two models.

IAC5/IAC5-A SPECIFICATIONS ('*' = same specification as IAC5):

	IAC5	IAC5-A
Input AC Voltage Range	90-140 VAC	90-280 VAC
Input DC Voltage Range	90-140 VDC	90-280 VDC
Input Current @ Rated Voltage	10mA rms	*
Input Allowed for No Output	3mA at 50 VAC/VDC	2mA at 50 VAC/VDC
Line Frequency Range	47 to 63 Hz	*
Turn On Time	20mSec	*
Turn Off Time	30mSec	*
Input Resistance (R1 in Schematic Diagram)	13KΩ	26KΩ
Logic Supply Voltage Range	4.5 to 6 VDC	*
Nominal Logic Supply Voltage	5 VDC	*
Logic Supply Current @ 5VDC	12mA	*
Control Resistance (Rc in Schematic Diagram)	220Ω	*
Module Color Code	Yellow	*
Electrical Connections	Drawing 4500-845	*
Mechanical Dimensions	Drawing 4500-845	*

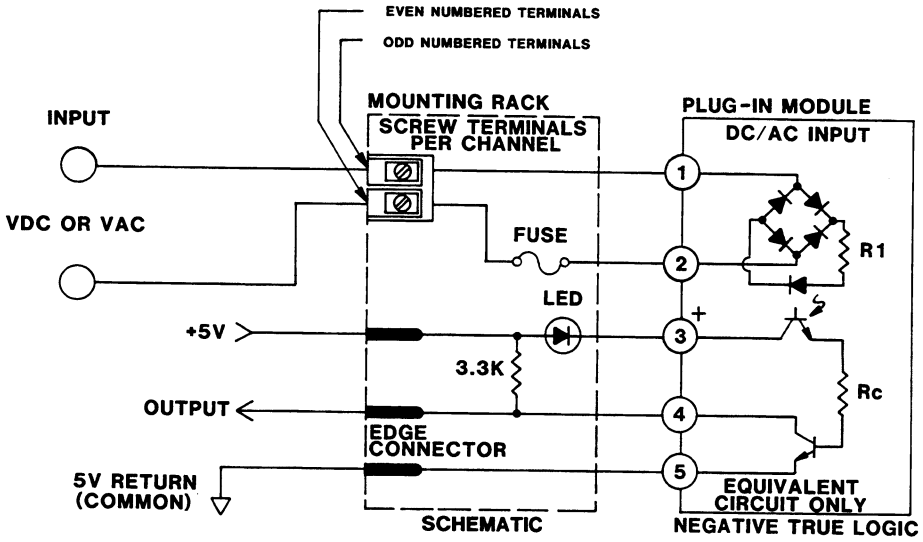
IAC5/IAC5-A ORDERING INFORMATION

MODEL	DESCRIPTION
IAC5	90-140V AC or DC Input
IAC5-A	90-280V AC or DC Input

Model: IAC5 / IAC5-A

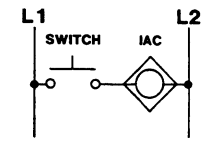
MODULE CONNECTIONS, MECHANICAL DIMENSIONS

AC Input

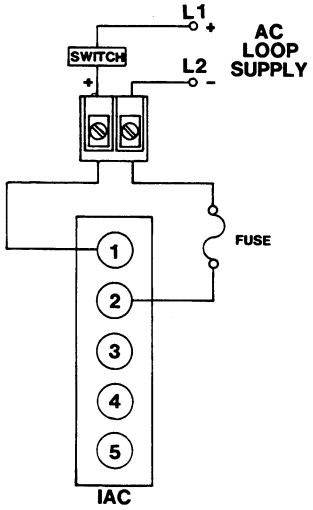


TRUTH TABLE

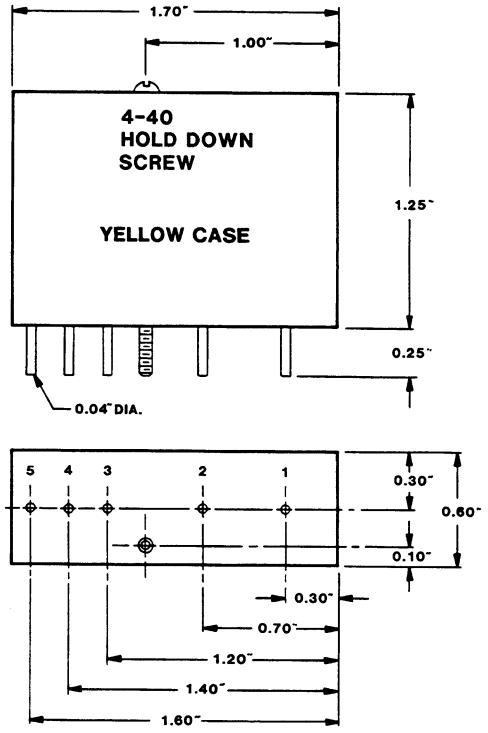
INPUT	OUTPUT
ON	0V (0)
OFF	5V (1)



LINE SYMBOL



ELECTRICAL CONNECTIONS



DIMENSIONS

Acromag WIXOM, MICH.
TITLE: MODULE DIMENSIONS AND ELECTRICAL CONNECTIONS
SIZE C DWG | SERIES IAC5/IAC5-A | SHEET 1 OF 1 | DRAWING 4500-845 | REV A
24 NOV 87 A 8912 | 4 SEPT 87 — | DATE REV CO DR ENG CLR

3600-025

3.1.2 IDC5 & IDC5-F Digital DC Input Modules

DC input modules are used for sensing ON/OFF DC voltage levels. The IDC5 can be used to sense voltages of 4-32 VDC. The IDC5-F is designed for low voltage DC input in the range of 4-32 VDC, with high speed turn-on/off times. The IDC5 is designed with filtering on the input and a hysteresis amplifier for high noise rejection and transient free switching. The IDC5-F module is a fast switching input module for signals produced by photoelectric switches, encoders, DC proximity switches, or TTL level devices. These two models have a white case color.

IDC5/IDC5B SPECIFICATIONS ('*' = same specification as IDC5):

	IDC5	IDC5-F
DC Input Line Voltage Range	4 to 32 VDC	*
Input Current at 32VDC	34mA	68mA
Input Allowed for No Output	1.5mA Maximum at 2VDC	*
Turn On Time	5mSec Maximum	50 uSec Maximum
Turn Off Time	5mSec Maximum	100uSec Maximum
Input Resistance (R1 in Schematic Diagram)	1KΩ	500Ω
Logic: Supply Voltage Range	4.5 to 6 VDC	*
Nominal Logic Supply Voltage	5VDC	*
Logic Supply Current at +5V	12mA DC	*
Control Resistance (Rc in Schematic Diagram)	220Ω	*
Module Color Code	White	*
Electrical Connections	Drawing 4500-844	*
Mechanical Dimensions	Drawing 4500-844	*

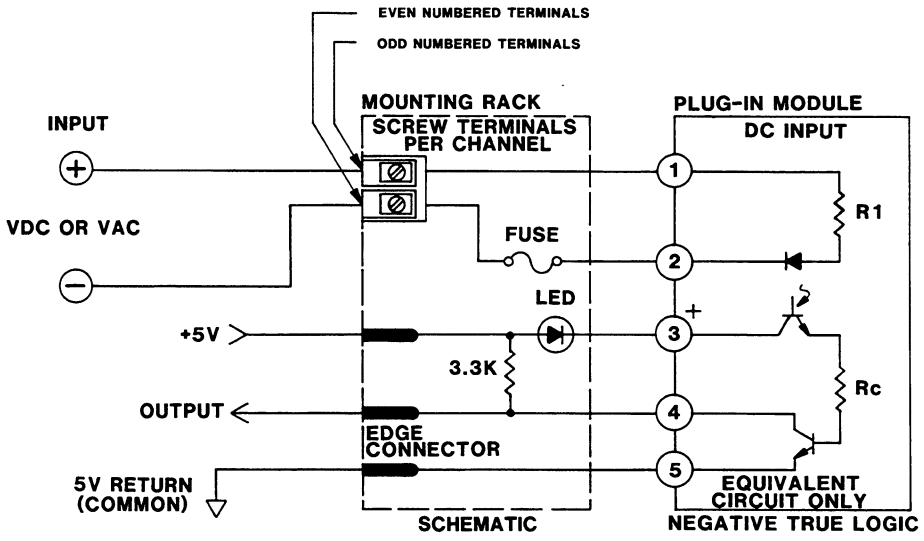
IDC5/IDC5-F ORDERING INFORMATION

MODEL	DESCRIPTION
IDC5	4 to 32VDC Input
IDC5-F	4 to 32VDC Input, Fast Acting

Model: IDC5 / IDC5-F

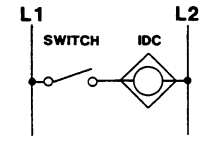
MODULE CONNECTIONS, MECHANICAL DIMENSIONS

DC Input

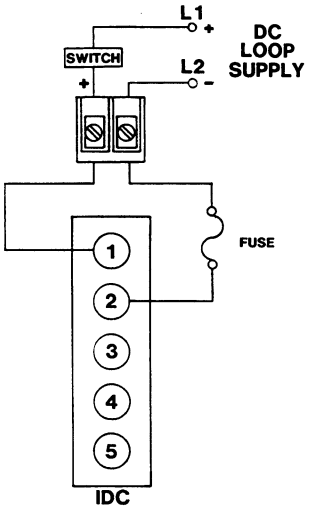


TRUTH TABLE

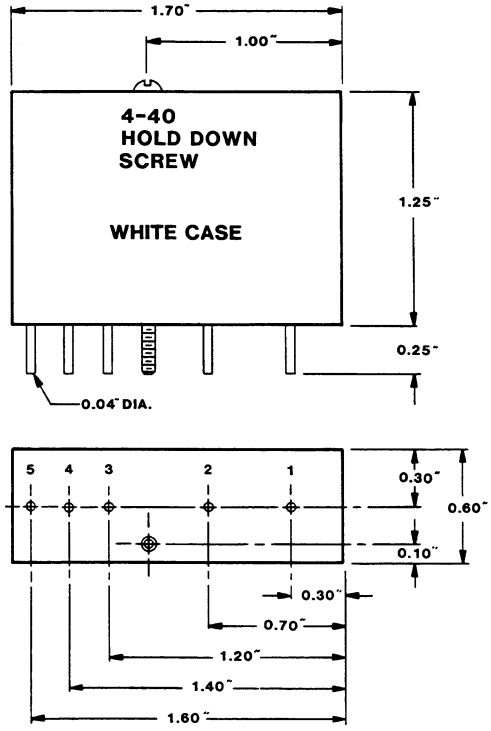
INPUT	OUTPUT
ON	0V (0)
OFF	5V (1)



LINE SYMBOL



ELECTRICAL CONNECTIONS



DIMENSIONS

3.2 DIGITAL OUTPUT MODULES

FEATURES
* Optical Isolation
* UL, CSA Approvals
* 3A Current Rating
* Industry Standard Pinout and Footprint
* Can be Mixed and Matched on a Backpanel
* Color Coded by Function
* Full Accessory Line
* 100% Tested to Published Specifications

APPLICATIONS
* Rugged Design for Industrial Plant Environments
* Reduces Wiring Costs
* Convenient System Expansion and Repair
* Ideal Relay Replacement

This series of digital output modules provides a highly reliable and safe interface to harsh industrial measurement and control applications. By installing these output modules near individual field loads, a reliable isolation barrier is provided between the field and computer system. Other benefits include the reduction of field wiring costs, and the establishment of a cost effective and manageable method for system expansion and repair.

The following sections cover the digital I/O models listed:

- OAC5-A, AC Output, 24 to 280VAC
- ODC5, DC Output, 5 to 60VDC
- ODC5R, DC Output, SPST Dry Contact

NOTE: Acromag digital output modules can be operated directly with microcomputer PIA type ICs (6821, 6522, and 8255A are typical) and TTL logic families (74, 74LS, and 74S are typical), without buffering. For an output "ON" condition, the interface chip is required to sink 12ma. These chips do not usually specify the ability to sink 12ma because Vsat must be maintained at 0.7 volts or less. They will sink 12ma if Vsat is allowed to be more than 0.7 volts. The Acromag output modules can operate with an interface chip Vsat of 1.5 volts.

3.2.1 OAC5-A Digital AC Output Module

The OAC5-A AC output module is used for controlling or switching AC loads, such as; relays, solenoids, contactors, heaters, motor starters, or indicator lamps. This module provides up to 4000 Vrms of optical isolation between the field device and the control logic. It has a continuous load current rating of 3 amps at 45°C ambient. The module is equivalent to a Single Pole, Single Throw, Normally Open contact (FORM A, SPST-NO, Make) and features zero voltage turn-on, zero current turn-off, and an RC snubber circuit which allows switching heavy inductive loads. Functionality is denoted by the black case color.

OAC5-A SPECIFICATIONS:

	OAC5-A
Nominal Line Voltage	240VAC rms
Operating Voltage Range	24 to 280VAC rms
One Cycle Surge Current Rating	100 Amps Peak
AC Current Rating:	3.50A AC, 40°C (104°F) 1.76A AC, 70°C (158°F)
Maximum Off-State Voltage	400 Volts Peak
Maximum Off-State Leakage	3mA rms
Minimum Load Current	50mA
Line Frequency Range	47 to 63Hz
Turn-On Time	16.6mS Maximum, 60Hz
Turn-Off Time	16.6mS Maximum, 60Hz
DV/DT-Off-State	200 Volts/uSec
DV/DT-Commutating	Snubbed for 0.5 Power Factor Load
Output Voltage Drop Max.	1.6 Volts
Logic: Supply Voltage Range	4.5 to 6VDC
Nominal Supply Voltage	5 VDC
Supply Current at +5VDC	20 mA
Control Resistance (Rc in Schematic Diagram)	220 Ohms
Module Color Code	Black
Electrical Connections	Drawing 4500-847
Mechanical Dimensions	Drawing 4500-847

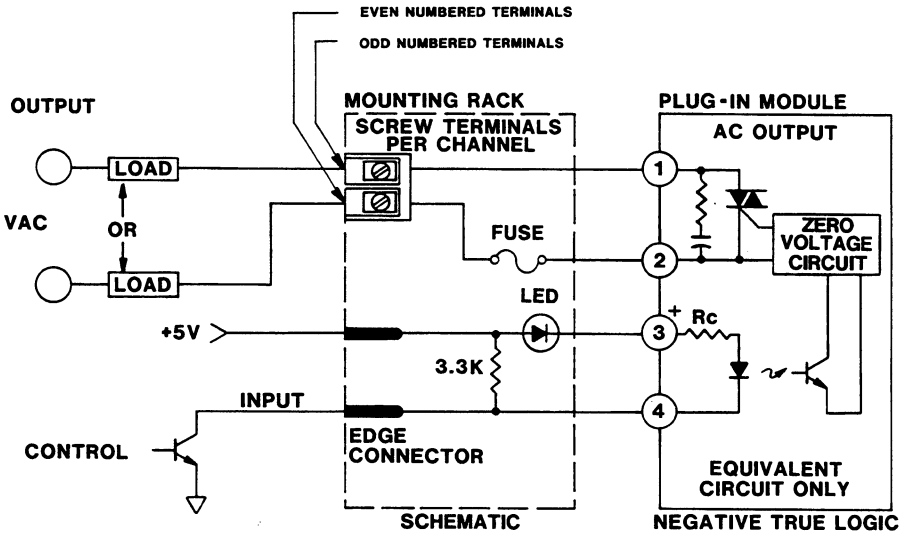
OAC5-A ORDERING INFORMATION

MODEL	DESCRIPTION
OAC5-A	24 to 280VAC Output

Model: OAC5-A

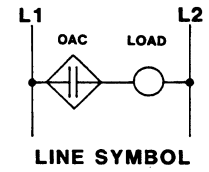
MODULE CONNECTIONS, MECHANICAL DIMENSIONS

AC Output

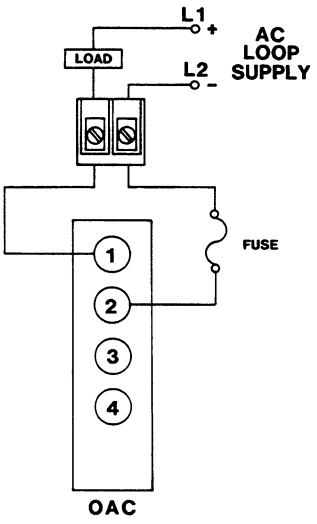


TRUTH TABLE

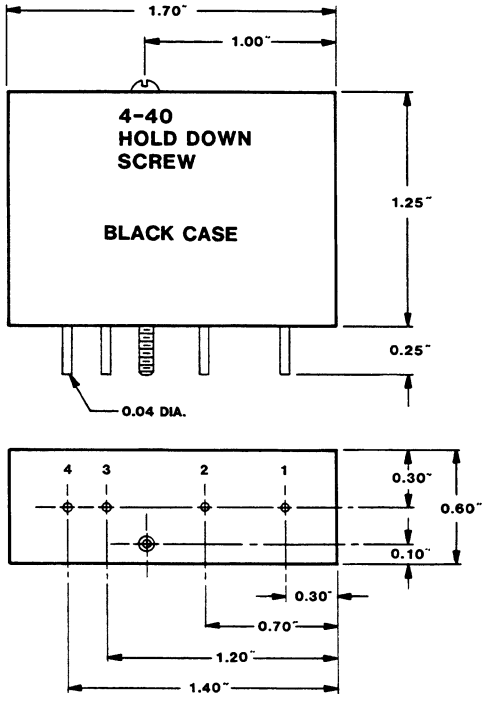
INPUT	OUTPUT
0V (0)	ON
5V (1)	OFF



LINE SYMBOL



ELECTRICAL CONNECTIONS



DIMENSIONS

3.2.2 ODC5 Digital DC Output Module

Digital DC output modules are used for controlling or switching DC loads. This module is equivalent to a Single Pole, Single Throw, Normally Open contact (FORM A, SPST-NO, Make). Typical uses and applications for DC output modules include switching the following loads: DC Relays, DC Solenoids, DC Motor Starters, and DC Lamps or Indicators.

ODC5 SPECIFICATIONS:

	ODC5
Operating Voltage Range	5-60 VDC
Current Rating	3.0A DC, 40°C (104°F) 1.1A DC, 70°C (158°F)
One-Second Surge	5A DC
Off-State Leakage	0.5mA at 60VDC
Turn-On Time	100 uSec
Turn-Off Time	750 uSec
Output Voltage Drop Max	1.5 Volts
Logic: Supply Voltage Range	4.5 to 6 VDC
Nominal Supply Voltage	5VDC
Supply Current at 5VDC	18mA DC
Control Resistance (Rc)	250Ω
Module Color Code	Red
Electrical Connections	Drawing 4500-846
Mechanical Dimensions	Drawing 4500-846

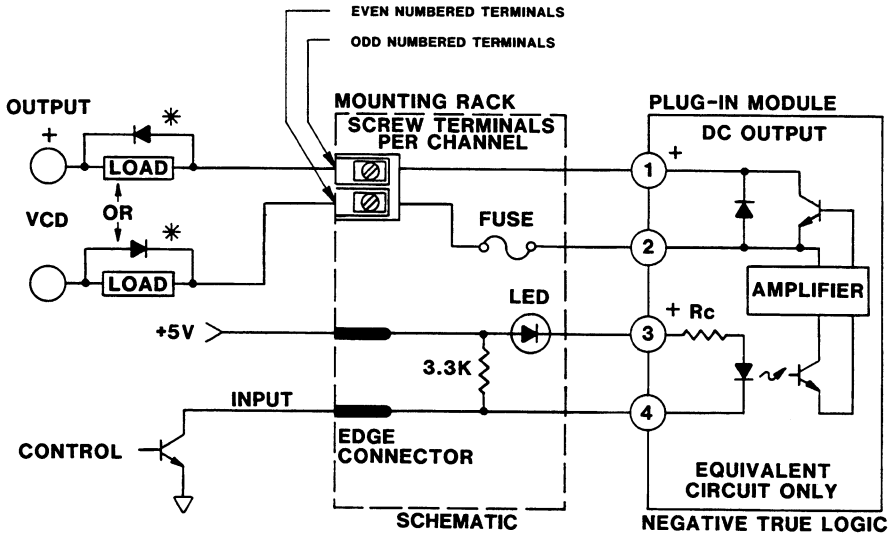
ODC5 ORDERING INFORMATION

MODEL	DESCRIPTION
ODC5	5 to 60VDC Output

Model: ODC5

MODULE CONNECTIONS, MECHANICAL DIMENSIONS

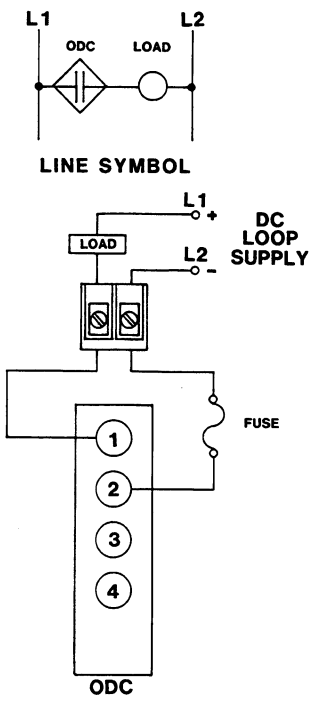
DC Output



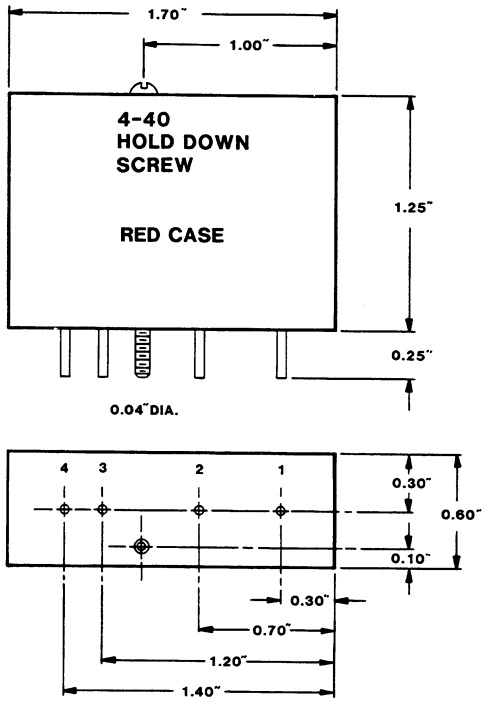
✳ COMMUTATING DIODE MUST BE USED ON INDUCTIVE LOADS.

TRUTH TABLE

INPUT	OUTPUT
0V(0)	ON
5V(1)	OFF



ELECTRICAL CONNECTIONS



DIMENSIONS

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TITLE: MODULE DIMENSIONS AND ELECTRICAL CONNECTIONS

SIZE C | SERIES ODC5 | SHEET 1 OF 1 | DRAWING 4500-846 | REV B

3600-025

3.2.3 ODC5R Digital DC Output Module, Dry Contact

The ODC5R is a Form A, mechanical relay output module. The ODC5R is ideal for applications requiring a dry-contact closure. These applications include multiplexing of communication lines and others where a low contact resistance is needed.

ODC5R SPECIFICATIONS:

	ODC5R
Contact Form	Form A, SPST - Normally Open, Dry-Contact
Contact Rating	10 VA
Switching Volts	100 VDC (130 VAC Maximum)
Switching Current	0.5 Amps Maximum
Carry Current	1.5 Amps Maximum
Contact On-Resistance	200 milliohms
Turn On Time	500 uSec
Turn Off-Time	500 uSec
Contact Bounce	200 uSec
Mechanical Life	5 Million Cycles
Isolation Voltage	1500 VDC
Logic Voltage Range	4.8-6.0 VDC
Logic Pick-Up Voltage	2.5 VDC at +5VDC logic voltage
Logic Drop-Out Voltage	0.8 VDC at +5VDC logic voltage
Logic Input Current	14mA DC at +5VDC logic voltage
Electrical Connections	Drawing 4500-856
Mechanical Dimensions	Drawing 4500-856

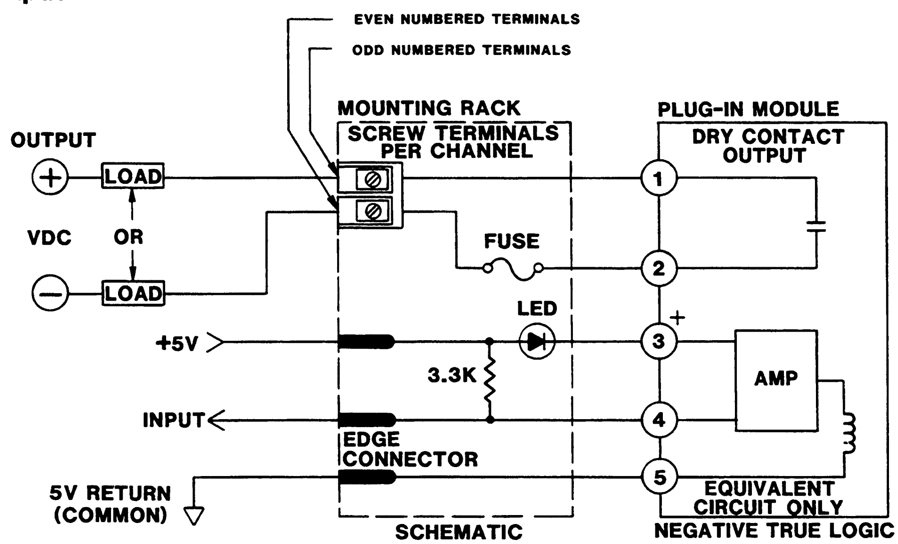
ODC5R ORDERING INFORMATION

MODEL	DESCRIPTION
ODC5R	Relay, Dry Contact

Model: ODC5R DRY CONTACT OUTPUT MODULE

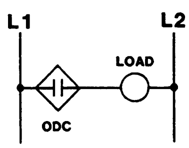
MODULE CONNECTIONS, MECHANICAL DIMENSIONS

DC Output

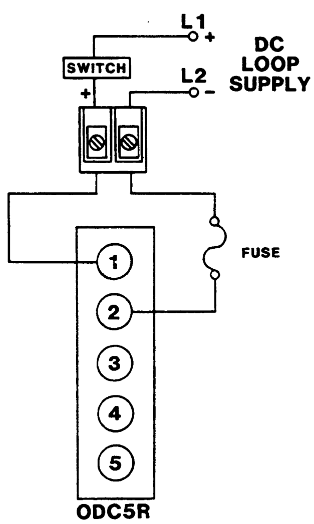


TRUTH TABLE

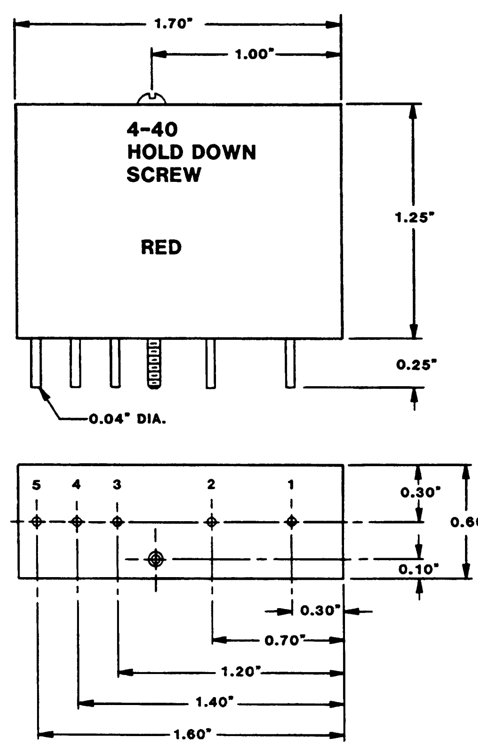
OUTPUT	INPUT
ON	0V (0)
OFF	5V (1)



LINE SYMBOL



ELECTRICAL CONNECTIONS



DIMENSIONS

Acromag® WIXOM, MICH. | DATE 22 SEP 89 | TITLE MODULE DIMENSIONS AND ELECTRICAL CONNECTIONS | SIZE C | SERIES ODC5R | SHEET 1 OF 1 | DRAWING 4500-856 | REV -

3.3 DIGITAL I/O MODULE ACCESSORIES

3.3.1 4TPH-16SSR-ST Digital Expansion Panel For Digital I/O Solid State Relays (SSR)

The Model 4TPH-16SSR-ST termination panel can accommodate up to 16 single channel digital I/O modules (Solid State Relays) in any combination. A 50-pin header connector is used on the termination panel for easy interface to computer parallel I/O ports via a 50-conductor ribbon cable.

4TPH-16SSR-ST SPECIFICATIONS:

Performance

Digital I/O Channels	16, any mix. Compatible with the following isolated modules: Digital Input Modules : IAC5, IAC5-A, IDC5, IDC5-B Digital Output Modules: OAC5, OAC5-A, ODC5, ODC5-A, ODC5R
Status Indicators	One LED (red) per channel. Input Module : LED is ON when there is an input signal to the module. Output Module: LED is ON when there is a signal for the output to be ON.
Fuse	5 Amp, Littlefuse part #255-005, one per channel. Each digital panel is supplied with an individual 5 Amp fuse for each position. The fuse is installed in a pair of sockets and may be removed with needle-nose pliers.
Field Wiring Connections	See Drawing 4500-909. NOTE: Each I/O Module is connected to two barrier strip terminals. When connecting DC loads or inputs, the LOWER-NUMBERED position is always MORE POSITIVE.
Sockets	For Repair or Replacement. Large Socket: Amp part #50871-8 Small Socket: Amp part #50863-8

Physical Characteristics

Shipping Weight	1.25 pounds (0.6 Kg) packed.
Mounting	Surface Mounting. Leave sufficient space around the digital I/O panel for wiring.
Mounting Hardware	The digital I/O panel is supplied with 3/4 inch standoffs. All standoffs should be secured using No. 6 hardware to provide maximum physical strength.

4TPH-16SSR-ST SPECIFICATIONS...continued:

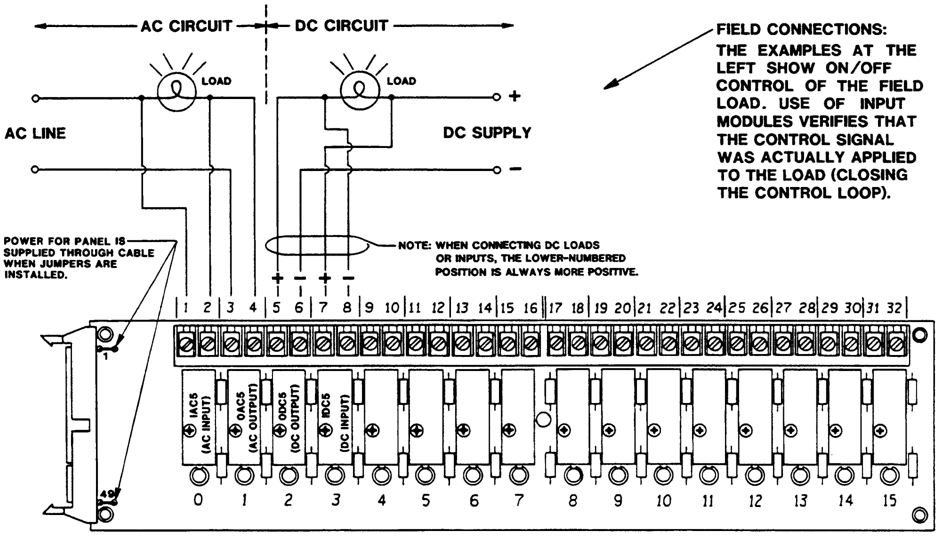
Field Wiring Connectors	Barrier-type terminal strip using No. 6 screws and clamp plates. Wire 12-18 AWG.
Logic Wiring Connector	50 pin/socket connector with keying. Mates with 3M, 50 wire cable connector, Part 3425-6600 or equivalent, with Strain Relief option, 3M Part 3448-3050 or equivalent, on connector. Use cable Model 4TPH-HH-2 or 4TPH-HH-6. It is desirable to keep the cable short to reduce the effects of electrical noise. Route the cable away from power cables.
Dimensions	See Drawing 4500-909 for Mounting and Clearance Dimensions.
Electrical Connections	See Drawing 4500-909
Connection Examples	See Drawing 4500-909
Printed Circuit Board	Military grade FR-4 epoxy glass circuit board. Thickness: 0.063 inches.

Operating Conditions

Operating Temperature Range	-25 to 70 ^{o}C (-13 to 158 ^{o}F)
Storage Temperature Range	-25 to +85 ^{o}C (-13 to 185 ^{o}F)
Relative Humidity (RH)	10 to 95 percent RH (Non-Condensing), up to 40^{o}C (104^{o}F)
Power	+5V DC power for panel is supplied by the I/O Station through the 50 wire ribbon cable. Jumpers, connecting Pins 1 and 49 to the circuit, must be installed (standard).

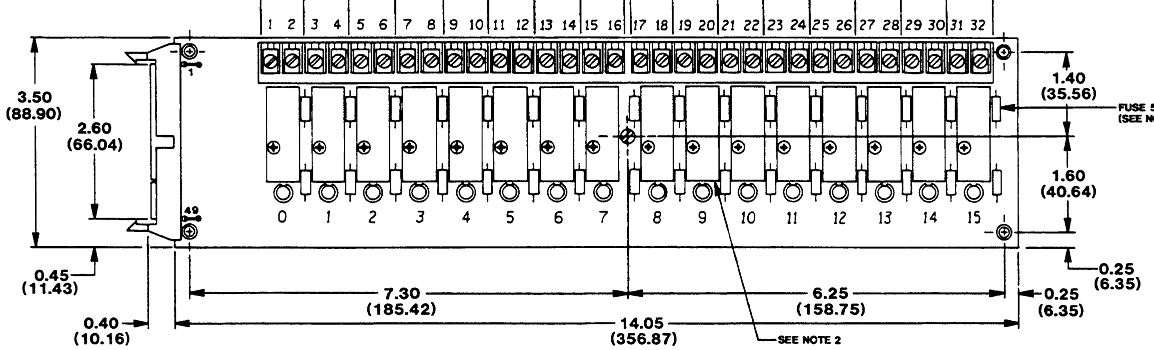
General Reference Data

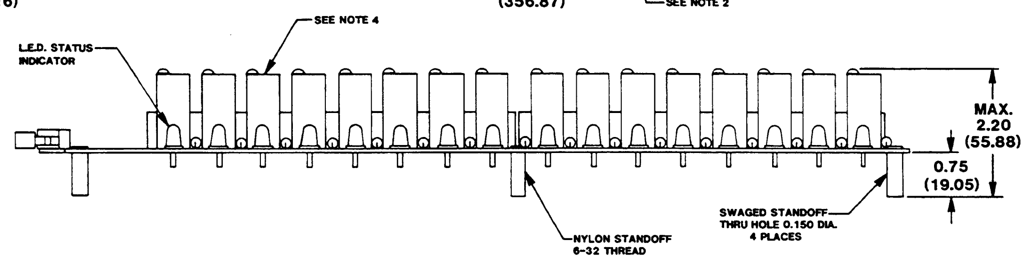
Radio Frequency Interference	Capability of withstanding an RFI field strength of 10 volts per meter at 27 MHZ, 151 MHz, and 467 MHz with no digital effect, per SAMA PMC 33.1 test procedures.
Line Noise Effects	Field terminals capable of withstanding ANSI/IEEE C37.90-1978 Surge Withstanding Capability (SWC) Test with no component failures. Unit is tested to a standardized test waveform that is representative of surges (high frequency transient electrical interference) observed in actual installations.



FIELD WIRING EXAMPLE

I/O STATION CHANNEL NUMBERS (SEE NOTE 1)	DECIMAL	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	HEX-ASCII	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20
DIGITAL PANEL CHANNEL NUMBER		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15





NOTES:

1. CHANNEL NUMBERS; I/O STATION COMMANDS USE THE ASSIGNED HEX-ASCII NUMBERS TO IDENTIFY THE CHANNEL AS SHOWN.
2. DIGITAL INPUT/OUTPUT MODULES-ANY MIX. SEE USERS' MANUAL FOR MODULE MODEL NUMBERS SUPPORTED AND PERFORMANCE DETAILS.
3. FUSE: EACH POSITION IS SUPPLIED WITH AN INDIVIDUAL 5 AMPERE FUSE. THE FUSE IS INSTALLED IN A PAIR OF SOCKETS, AND MAY BE REMOVED WITH A NEEDLE-NOSE PLIERS. REPLACEMENT FUSES ARE AVAILABLE FROM LITTLEFUSE DISTRIBUTORS (P.N. 255-005, 5 AMP).
4. INPUT/OUTPUT MODULES ARE SHOWN FOR REFERENCE ONLY AND ARE NOT INCLUDED WITH THE 4TPH-16SSR-ST TERMINATION PANEL.
5. ALL DIMENSIONS ARE IN INCHES (MILLIMETERS).
6. TOLERANCES: ±0.020 INCHES ±0.5 MILLIMETERS
7. WHEN CONNECTING DC LOADS OR INPUTS, THE LOWER NUMBERED POSITION IS ALWAYS MORE POSITIVE.

DIGITAL I/O PANEL
MODEL: 4TPH-16SSR-ST
MOUNTING AND CLEARANCE
ELECTRICAL CONNECTIONS

Acromag® WIXOM, MICH.
MOUNTING & CLEARANCE ELECTRICAL CONNECTIONS
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3.3.2 4TPC-HH-2 & 4TPC-HH-6 Digital I/O Cables 50-wire Ribbon Cable, Header to Header

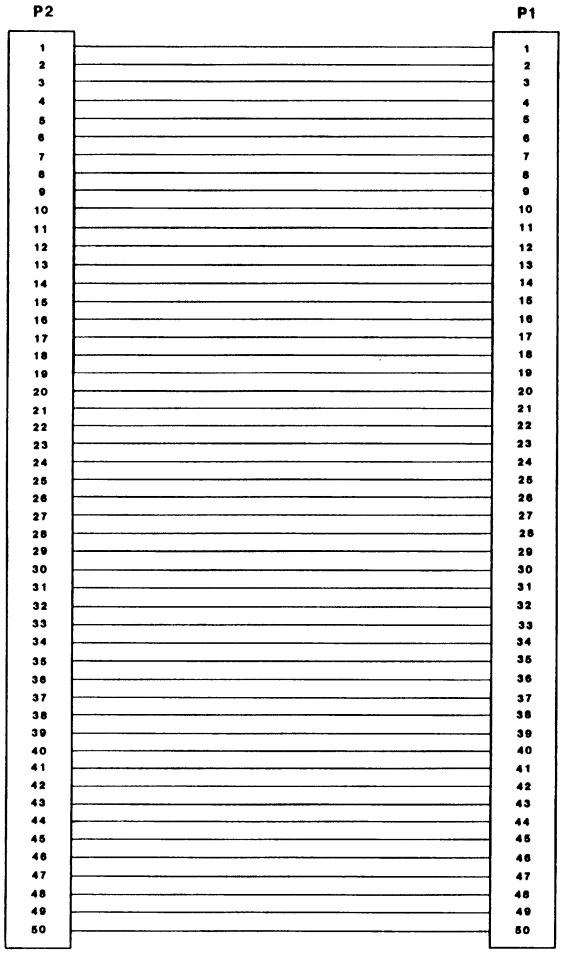
This cable is used to connect to the 50-pin header interface of the digital I/O termination panel 4TPH-16SSR-ST (Section 3.3.1). The '-2' and '-6' model number suffix is used to denote the length in feet. To minimize noise pickup, it is recommended that this length be kept to a minimum and that this cable be routed away from power cables.

4TPC-HH-x SPECIFICATIONS:

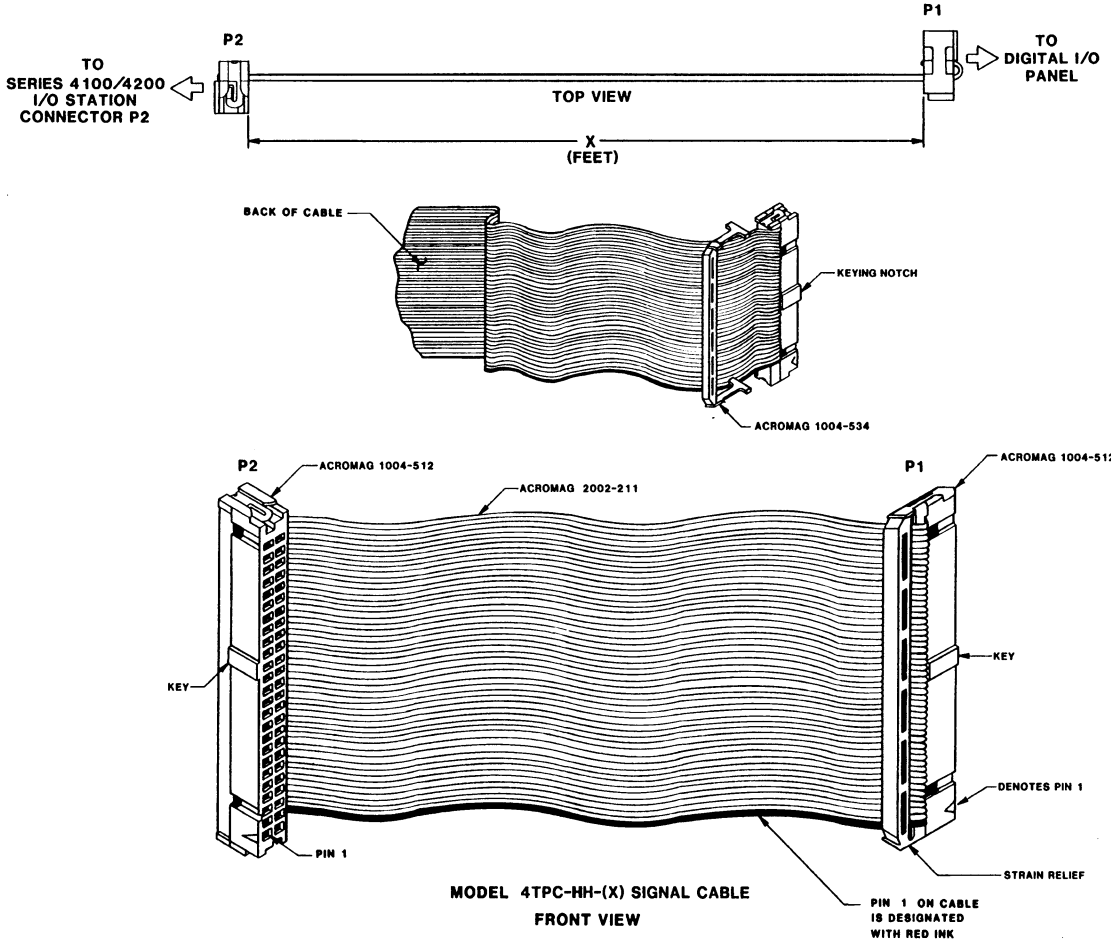
Cable	50-wire flat ribbon cable, 28 gauge. Acromag Part 2002-211 (3M Part C3365/50, or equivalent).
Length	4TPC-HH-2 is 2 feet, 4TPC-HH-6 is 6 feet.
Header (Host Side)	50-pin Header, female, no strain relief. Acromag Part 1004-512 (3M Part 3425-6600, or equivalent).
Header (I/O Panel Side)	50-pin Header, female, with strain relief. Header: Acromag Part 1004-512 (3M Part 3425-6600, or equivalent). Strain Relief: Acromag Part 1004-534 (3M Part 3448-3050, or equivalent).
Keying	Headers, both sides have polarizing key to prevent improper installation.
Schematic & Mechanical Dimensions	Drawing 4500-899
Shipping Weight	1.0 pounds (0.5 Kg) packed.

4TPC-HH-x ORDERING INFORMATION

MODEL	DESCRIPTION
4TPC-HH-2	Digital I/O Cable, 2 feet long
4TPC-HH-6	Digital I/O Cable, 6 feet long



MODEL 4TPC-HH-(X)
SCHEMATIC



MODEL 4TPC-HH-(X) SIGNAL CABLE
FRONT VIEW

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	DATE	REV	CO	DR	ENG	CLP	
TITLE: CABLE: MODEL 4TPC-HH-(X)							
SIZE D DWG	SERIES	SHEET 1 OF 1	DRAWING 4500-899	REV			

4.0 A5B APPLICATION INFORMATION

These topics are covered in the following sections:

- A5B37 Thermocouple Voltage-to-Temperature Conversion Method
- Ground Connections and Host System Interface for A5B Modules
- A5B Failure Rate Calculation and Prediction
- Interpreting Drift Specifications

4.1 A5B37 THERMOCOUPLE VOLTAGE-TO-TEMPERATURE CONVERSION METHOD

When the A5B37 thermocouple modules are used to measure temperature, the measured output voltage must often be converted back to temperature. This is readily done with the A5B37 series of modules, because cold junction compensation is incorporated into the module and the APB01/02 Backpanels. For example:

A Type K thermocouple is to be used with the A5B37K.

A5B37K input and output ranges:

Temperature Input	Vout
- 100 °C	0 VDC
+1350 °C	+5 VDC

From the Type K thermocouple tables we find the following voltages:

-100 °C = -3.553 mV
1350 °C = 54.125 mV

The A5B37K module gain (G), is given by:

G = Vout full-scale range / Thermocouple full-scale range in volts

Therefore: G = 5 / [0.054125 - (-0.003553)] = 86.69 V/V

Calculate the effective thermocouple input voltage (V_t) from the measured output voltage (Vout) by the following formula:

V_t = (Vout measured / G) + (Thermocouple neg. full scale in volts)

Therefore: V_t = (Vout / 86.69) + (-0.003553)

Finally, find the value of the field temperature being measured by crossing V_t to thermocouple temperature in your application program's thermocouple lookup table.

Gains for other A5B37 Thermocouple modules are shown in the following table:

Module	Range	Module Gain (G)	Thermocouple Negative Full Scale
A5B37J	-100 to 760 °C	105.14 V/V	-4.632 mV
A5B37K	-100 to 1350 °C	86.69 V/V	-3.553 mV
A5B37T	-100 to 400 °C	206.21 V/V	-3.378 mV
A5B37E	0 to 900 °C	72.69 V/V	0.0 mV
A5B37R	0 to 1750 °C	239.49 V/V	0.0 mV
A5B37S	0 to 1750 °C	270.21 V/V	0.0 mV
A5B37B	0 to 1800 °C	368.05 V/V	0.0 mV

For example, the following formula and values would be used for a Type J thermocouple:

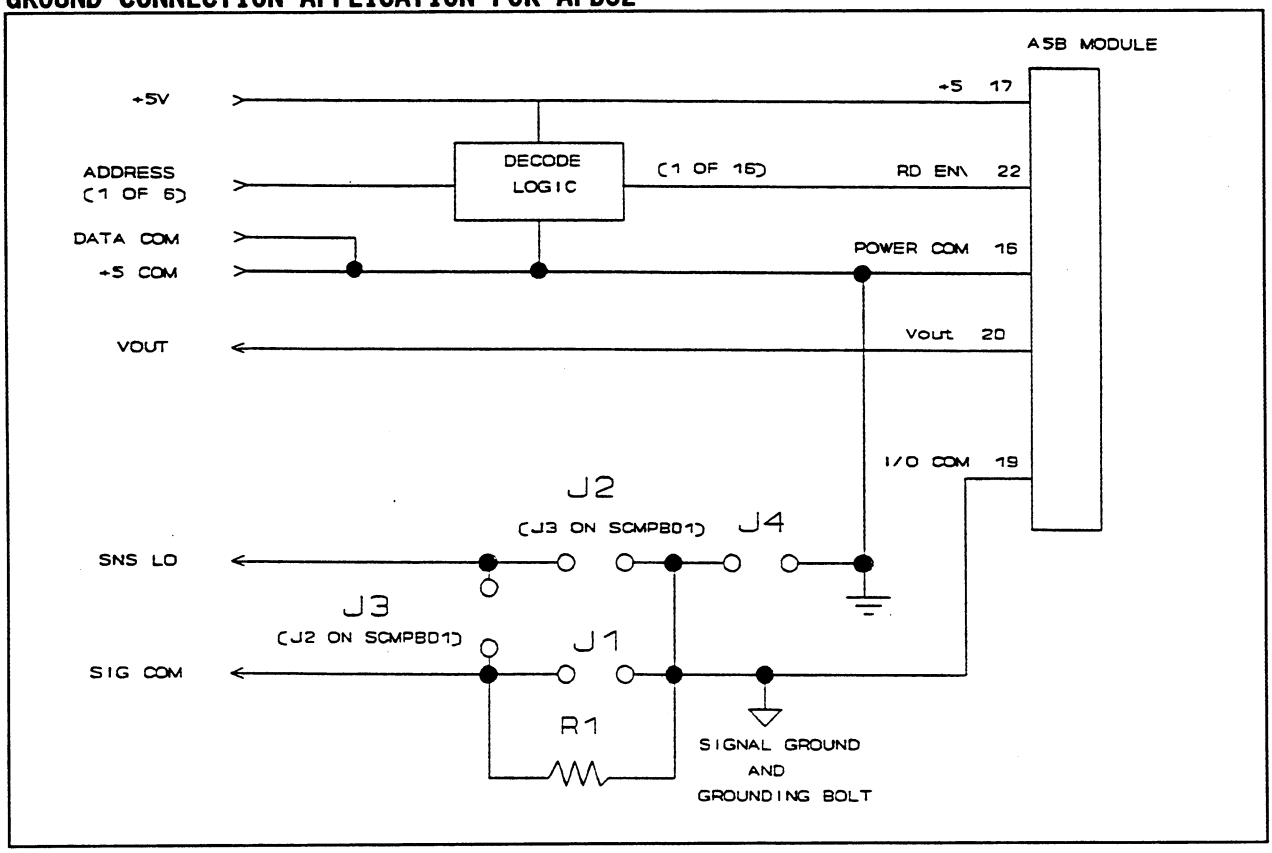
V_t = (Vout / 105.14) - 0.004632.

Where Vout is the module output voltage in volts, and V_t is the thermocouple voltage referenced to a 0°C cold junction (i.e. the voltage given in published tables).

4.2 GROUND CONNECTIONS AND HOST SYSTEM INTERFACE FOR A5B MODULES

Use of the ground jumper arrangement on the APB01 and APB02 backpanels depends on the particular host Analog-to-Digital Converter (ADC) system connected to the backpanels and A5B modules. This application note details four common system interface schemes; more than these could exist. The APB02 multiplexing backpanel is used for our example, rather than the APB01, because the APB02 has more logic circuitry which depends on proper interface schemes. However, most of the following notes are applicable to both.

GROUND CONNECTION APPLICATION FOR APB02



CASE 1 (Factory Configuration):
J1, J2, & J4 installed, J3 & R1 out...

This is a general purpose configuration which may be used with single-ended or differential ADC systems. For single-ended ADC systems, connect the ADC positive input to VOUT, and ADC signal common and any shield line to SNS LO. Multiple APB02 backpanels are connected together using SIG COM.

For differential ADC systems, connect the ADC positive input to VOUT, and negative input and shields to SNS LO. Multiple backpanels are connected together using SIG COM. Note that in this case, SIG COM and SNS LO are shorted together and may be used interchangeably.

CASE 2 (Remote Digital and Analog Common Connection):
J1 & J2 installed, J3, J4, & R1 out...

Data common and analog common are usually connected at only one point in the system. This eliminates the possibility of a ground loop. Normally, the best single point to connect grounds is close to the ADC. Many systems absolutely require this connection be made as close to the ADC as possible. In this case, J4 is removed in order to allow DATA COM and SIG COM to be connected remotely. SIG COM should be connected to the ADC signal common and to the SIG COM of other APB02 backpanels. SNS LO is then connected to the ADC systems negative input. For differential multiplexers, SNS LO should be the multiplexed negative input.

CASE 3 (Psuedo Ground for Offset Adjustment):
J3, J4, & R1 installed, J1 & J2 out...

In this case, R1 is used as a voltage dropping resistor to create the possibility of an offset voltage for the ADC system. DATA COM and I/O COM should be within 0.2 volts of each other to allow the read select logic (RD EN\) to operate correctly. This assumes the read select logic of the system is referenced to power common. The A5B modules are transformer isolated between PWR COM and I/O COM (50 volts maximum). However, RD EN\ is referenced to I/O COM. For this reason I/O COM should be within 0.2 volts of the system digital common. This 0.2 volts could be exceeded, but noise margin is reduced accordingly. R1 will allow this small offset voltage to exist. The recommended value of R1 is 100 ohms. Values up to 10K ohm may be used in quiet electromagnetic conditions.

CASE 4 (Ground Loop Break):
J2, J4, & R1 installed, J1 & J3 out...

In some systems, it may be desired to break the signal common ground loop of multiple backplanes with resistances. R1 may be used for this. A recommended value is 100 ohms. SNS LO should be multiplexed into the ADC negative input.

4.3 A5B MTBF FAILURE RATE CALCULATION AND PREDICTION

Failure rate calculations for the A5B modules are derived from the MIL-HDBK-217E specification. They are as follows for the listed models:

A5B30/31/37-xx 1.54 failures per 10^6 hours (650,000 hours MTBF)
A5B40/41-xx 1.46 failures per 10^6 hours (680,000 hours MTBF)

Estimated actual failure rates are predicted to be much lower due to 100% powered burn-in at elevated temperature. The estimated actual failure rate for the above listed models is 0.67 failures per 10^6 hours (1,500,000 hours MTBF).

4.4 INTEPRETING DRIFT SPECIFICATIONS

I. A5B30-XX, A5B31-XX, A5B40-XX and A5B41-XX Modules

Read the drift specifications under the "Stability" heading on the appropriate spec sheet. Then Determine the overall gain of the module by dividing the ouput range by the input range.

1. Calculating Offset Drift:

   Multiply the input offset drift specification by the module gain and add the output offset drift specification.

2. Calculating Gain Drift:

   Multiply the gain drift spec by the output range of the module.

   * For worst case analysis, the module is operated at plus or minus full scale output.

3. Calculating Total Drift:

   Total Drift = Offset Drift + Gain Drift

   * For worst case analysis, drift numbers are additive. Therefore, all terms carry the same sign.

   To determine the drift in volts at a given temperature (^{o}C), subtract 25^{o}C (ambient) from the temperature, then multiply by the offset drift, gain drift or total drift calculated above.

   EXAMPLE 1: A5B30-03 Input Offset..... +/- 1uV/^{o}C
   Output Offset..... +/-20uV/^{o}C
   Gain..... +/-25ppm/^{o}C

   Module Gain = (+5V - -5V) / (+100mV - -100mV) = 50

   Offset Drift = (+/-1uV/^{o}C)(50V/V) + (20uV/^{o}C) = +/- 70uV/^{o}C
   Gain Drift = (+/-25ppm/^{o}C)(10V) = +/-250uV/^{o}C
   Total Drift = +/-70uV/^{o}C + +/-250uV/^{o}C = +/-320uV/^{o}C

   Worst case drift at 85^{o}C:

   Offset Drift (85^{o}C) = (+/- 70uV/^{o}C)(85 - 25^{o}C) = +/- 4.2mV
   Gain Drift (85^{o}C) = (+/-250uV/^{o}C)(85 - 25^{o}C) = +/-15.0mV
   Total Drift (85^{o}C) = (+/-320uV/^{o}C)(85 - 25^{o}C) = +/-19.2mV

II. A5B37X and A5B47X-XX Modules

Read the drift specifications under the "Stability" heading and the Cold Junction Compensation accuracy from the appropriate spec sheet. Using thermocouple tables to convert the input range to volts, determine the module gain (V/V) by dividing the output range by the input range. Look up the Seebeck Coefficient for the thermocouple Type under consideration.

The procedure for calculating drift is the same as in Section I, with the exception of adding in the CJC accuracy.

1. Calculating CJC Accuracy

For $T_{ambient}$ = 25°C, multiply the accuracy (+/-0.25°C) by the Seebeck Coefficient and the module gain.

For 5°C < $T_{ambient}$ < 45°C, multiply the accuracy (+/-0.25°C +/-0.5°C) by the Seebeck Coefficient and the module gain.

Add this term to the Offset Drift as calculated in Section I.

EXAMPLE 2: A5B37K

Input Offset..... +/- 1uV/°C
Output Offset..... +/-20uV/°C
Gain..... +/-25ppm/°C
CJC Accuracy..... +/-0.25°C @ 25°C
+/-0.50°C 5°C to 45°C

Type K Thermocouple

- 100°C --> -3.553 mV
+1350°C --> +54.125 mV
Seebeck Coefficient = 40.44uV/°C

Module Gain = (+5 - 0V)/(54.125 - -3.553mV) = 86.69 V/V

Offset Drift = (+/-1uV/°C)(86.69)+(20uV/°C)
+/-0.75°C(40.44uV/°C)(86.69) =
= +/-106.7uV/°C +/-2.63mV

Gain Drift = (+/-25ppm/°C)(5V)
= +/-125uV/°C

Total Drift = +/-106.7uV/°C +/-125uV/°C +/-2.63mV =
= +/-231.7uV/°C +/-2.63mV

III. A5B32-XX

The procedure for calculating drift is the same as in Section I, with the exception of adding the drift of the supplied input resistor.

Add the following terms to the Offset Drift:

1. (+/-10ppm/^{o}C)(20 ohms)(Iz*)(Gain)
2. (+/-25ppm/^{o}C)(Iz)(20 ohms)(Gain)

Add the following term to the Gain Drift:

1. (+/-10ppm/^{o}C)(20 ohms)($I_{full\ scale}$)(Gain)

* Iz is the input current which result in zero output.

APPENDIX A: Series A5B Selection and Ordering Guide

SERIES A5B ANALOG INPUT MODULES

Isolated Voltage Input Modules

Model	Description
A5B30-01	In:- 10 to + 10mV, Out: -5 to +5V
A5B30-02	In:- 50 to + 50mV, Out: -5 to +5V
A5B30-03	In:-100 to +100mV, Out: -5 to +5V
A5B30-04	In:- 10 to + 10mV, Out: 0 to 5V
A5B30-05	In:- 50 to + 50mV, Out: 0 to 5V
A5B30-06	In:-100 to +100mV, Out: 0 to 5V
A5B31-01	In:- 1 to + 1V, Out: -5 to +5V
A5B31-02	In:- 5 to + 5V, Out: -5 to +5V
A5B31-03	In:-10 to +10V, Out: -5 to +5V
A5B31-04	In:- 1 to + 1V, Out: 0 to 5V
A5B31-05	In:- 5 to + 5V, Out: 0 to 5V
A5B31-06	In:-10 to +10V, Out: 0 to 5V

Isolated Current Input Modules

Model	Description
A5B32-01	In: 4 to 20mA, Out: 0 to 5V
A5B32-02	In: 0 to 20mA, Out: 0 to 5V

Isolated RTD Input Modules

Model	Description
...100 ohm Pt, alpha = 0.00385	
A5B34-01	In:-100 to +100°C, Out: 0 to 5V
A5B34-02	In: 0 to +100°C, Out: 0 to 5V
A5B34-03	In: 0 to +200°C, Out: 0 to 5V
A5B34-04	In: 0 to +600°C, Out: 0 to 5V
...10 ohm Cu	
A5B34C-01	In: 0 to +120°C(10Ω/ 0°C), Out:0 to 5V
A5B34C-02	In: 0 to +120°C(10Ω/25°C), Out:0 to 5V
...120 ohm Ni	
A5B34N-01	In: 0 to +300°C, Out: 0 to 5V

Isolated Thermocouple Input (Non-Linearized)

Model	Description
A5B37J	Type J, In:-100 to + 760°C, Out:0 to 5V
A5B37K	Type K, In:-100 to +1350°C, Out:0 to 5V
A5B37T	Type T, In:-100 to + 400°C, Out:0 to 5V
A5B37E	Type E, In: 0 to + 900°C, Out:0 to 5V
A5B37R	Type R, In: 0 to +1750°C, Out:0 to 5V
A5B37S	Type S, In: 0 to +1750°C, Out:0 to 5V
A5B37B	Type B, In: 0 to +1800°C, Out:0 to 5V

Isolated Thermocouple Input Modules (Linearized)

Model	Description
A5B47J-01	Type J, In: 0 to + 760°C, Out: 0 to 5V
A5B47J-02	Type J, In:-100 to + 300°C, Out: 0 to 5V
A5B47J-03	Type J, In: 0 to + 500°C, Out: 0 to 5V
A5B47K-04	Type K, In: 0 to +1000°C, Out: 0 to 5V
A5B47K-05	Type K, In: 0 to + 500°C, Out: 0 to 5V
A5B47T-06	Type T, In:-100 to + 400°C, Out: 0 to 5V
A5B47T-07	Type T, In: 0 to + 200°C, Out: 0 to 5V
A5B47E-08	Type E, In: 0 to +1000°C, Out: 0 to 5V
A5B47R-09	Type R, In: 500 to +1750°C, Out: 0 to 5V
A5B47S-10	Type S, In: 500 to +1750°C, Out: 0 to 5V
A5B47B-11	Type B, In: 500 to +1800°C, Out: 0 to 5V

Isolated Strain-Gage Input Modules

Model	Description
A5B38-02	Full-bridge, In: 300 to 10KΩ, Out: -5 to +5V Excitation: 10.0V at 3mV/V Sensitivity
A5B38-04	Half-bridge, In: 300 to 10KΩ, Out: -5 to +5V Excitation: 10.0V at 3mV/V Sensitivity
A5B38-05	Full-bridge, In: 300 to 10KΩ, Out: -5 to +5V Excitation: 10.0V at 2mV/V Sensitivity

Isolated Wide-Bandwidth Voltage Input Modules

Model	Description
A5B40-01	In: - 10 to + 10mV, Out: -5 to +5V
A5B40-02	In: - 50 to + 50mV, Out: -5 to +5V
A5B40-03	In: -100 to +100mV, Out: -5 to +5V
A5B40-04	In: - 10 to + 10mV, Out: 0 to 5V
A5B40-05	In: - 50 to + 50mV, Out: 0 to 5V
A5B40-06	In: -100 to +100mV, Out: 0 to 5V
A5B41-01	In: - 1 to + 1V, Out: -5 to +5V
A5B41-02	In: - 5 to + 5V, Out: -5 to +5V
A5B41-03	In: -10 to +10V, Out: -5 to +5V
A5B41-04	In: - 1 to + 1V, Out: 0 to 5V
A5B41-05	In: - 5 to + 5V, Out: 0 to 5V
A5B41-06	In: -10 to +10V, Out: 0 to 5V

ISOLATED CURRENT OUTPUT MODULES

Model	Description
A5B39-01	In: 0 to 5V, Out: 4 to 20mA
A5B39-02	In: -5 to +5V, Out: 4 to 20mA
A5B39-03	In: 0 to 5V, Out: 0 to 20mA
A5B39-04	In: -5 to +5V, Out: 0 to 20mA

APPENDIX A: Series A5B Selection and Ordering Guide

ANALOG I/O BACKPANELS

Model	Description
APB01	16 channel, Non-Multiplexed
APB02	16 channel, Multiplexed
APB03	Single channel mounting panel[1]
APB04	Dual channel mounting panel[1]

Note 1. The following parts are available from Phoenix or Acromag and are required for the DIN rail mounting of one APB03/04 panel:

Qty	Model	Acromag#	Description
1	UM-BEFE-35	1043-110	Base Element w/foot
2	UM-SE	1043-112	Side Element

For mounting two or more APB03/04 panels, order:

Qty	Model	Acromag#	Description
2	UM-BEFE-35	1043-110	Base Element w/foot
2	UM-SE	1043-112	Side Element
*	UM-BE-35	1043-111	Base Element wo/foot
		*(Order Qty = # panels - 2)	
*	UM-VS	1043-113	Connection Pins
		(Order Qty = [4(# panels) - 4]	

ACCESSORIES

Model	Description
AXPRT-003	Power supply: 120VAC input
AXPRE-003	Power supply: 220VAC
AXIF	Universal interface board
AVMEIF	VME Interface Board for connecting the APB01 or APB02 backpanel to Acromag VME Boards.
AXCA-004-xx	Interface cable for host system connection. Specify length (-xx) in feet when ordering.
AXCA-005	Daisy chain cable
AXRK-002	19-inch metal mounting rack
AXFS-003	4A Fuses (package of 10)
AXJP-003	Jumper strap (package of 10)
AXCS	Blank module case
AXR1	Current conversion resistor
AXEV	Analog module evaluation board[2].
8500-299	Series A5B User's Manual

Note 2. The following parts are available from Phoenix or Acromag and are required for the DIN rail mounting of one AXEV board:

Qty	Model	Acromag#	Description
2	UM-BEFE-35	1043-110	Base Element w/foot
2	UM-SE	1043-112	Side Element
4	UM-VS	1043-113	Connection Pins

DIGITAL I/O MODULES

Model	Description
IAC5	Type: AC IN, Range:90 to 140V AC or DC
IAC5-A	Type: AC IN, Range:90 to 280V AC or DC
IDC5	Type: DC IN, Range: 4 to 32VDC
IDC5-F	Type: DC IN, Range: 4 to 32VDC Fast Acting
OAC5-A	Type: AC OUT, Range: 24 to 280VAC
ODC5	Type: DC OUT, Range: 5 to 60VDC

DIGITAL I/O ACCESSORIES (Order Separately)

Model	Description
4TPH-16SSR-ST	Digital I/O Panel, 16 channel
4TPC-HH-2	Digital I/O Cable, 2 feet
4TPC-HH-6	Digital I/O Cable, 6 feet