



Technologies/Applications

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5B47 Isolated, Linearized Thermocouple Input

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Functional Description

The 5B47 is a single-channel signal conditioning module that interfaces, amplifies and filters J, K, T, E, R, S, and B-type thermocouple. The module provides an isolated and protected precision output of 0 to +5 V.

The 5B47 internally linearizes its input signal to provide an output that is linear with temperature. Accuracy for each type of sensor is specified in the 5B47 model [table](#). (See Model [5B37](#) for non-linearized conditioning of thermocouple signals.)

Accurate and System-Ready

Internal cold-junction compensation largely corrects errors arising from parasitic thermocouples formed by thermocouple connection to the input screw terminals, providing an accuracy of $\pm 0.25^{\circ}\text{C}$ @ $+25^{\circ}\text{C}$ ambient temperature. The module generates a predictable upscale signal to indicate an open thermocouple; for a downscale response, connect a $20\text{ M}\Omega$, 0.25 W resistor across screw terminals 1 and 3.

The 5B47 protects the computer side from damage due to field-side overvoltage faults. All models withstand 240 V rms at their input terminals without damage, thereby shielding computer-side circuitry from field-side overvoltage conditions. Further, the 5B47 is mix-and-match and hot-swappable with other 5B Series modules, so can be inserted or removed from any socket in the same [backplane](#) without disrupting system power.

Inside the 5B47 Module



A chopper-stabilized input amplifier provides low drift and stable gain. At the amplifier input, a stable, laser-trimmed zero-scale input voltage is subtracted from the input signal to set the zero-scale value. For user convenience, the zero can be optionally factory-set to meet custom needs. This allows suppression of a zero-scale input value many times larger than the total span for precise expanded-scale measurements.

Internal multi-pole lowpass filtering with a four-Hz cutoff (-3 dB) provides 60 dB of normal-mode rejection (noise on signal) and enhancement of common-mode rejection (noise on signal return) at 60 Hz, enabling accurate measurement of small signals in high electrical noise.

Signal isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. The differential input circuit on the field side is fully floating, eliminating the need for any input grounding. A demodulator on the computer side of the signal transformer recovers the original signal, which is then filtered and buffered to provide a low-noise, low-impedance output signal. The output common must be kept within ± 3 V of power common.

Convenience Features

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. The enable input should be grounded to power common if the output need not be switched, as on the 5B01 and 5B08 [backplanes](#).

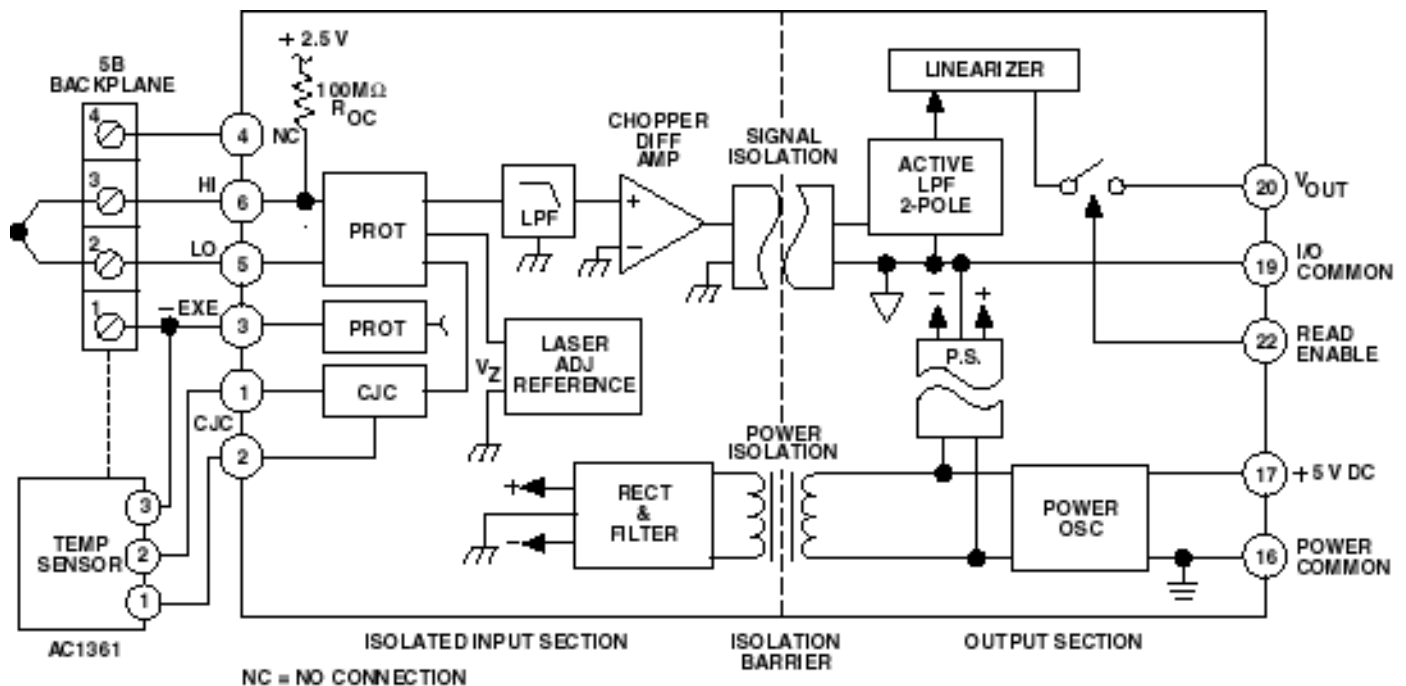


Figure 1. 5B47 Functional Block Diagram

Input Types

- Thermocouple Types:
J, K, T, E, R, S, B

Output Ranges

- 0 to +5 V
(+1 V to +5 V - custom)

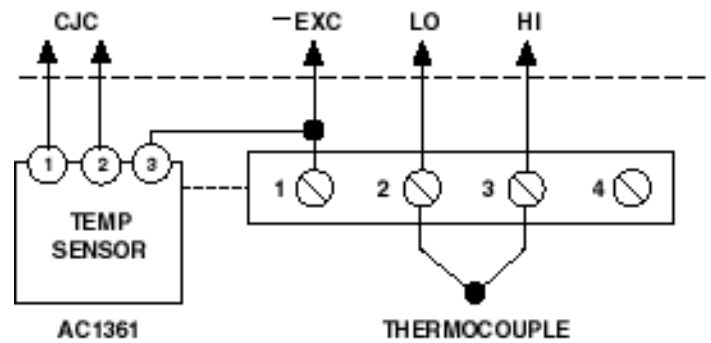


Figure 2. 5B47 Input Field Connections

5B47 Models Available

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

¹The CJC sensor accuracy should be added to the module accuracy for a system accuracy.

* Custom Input/Output ranges are available. Refer to [ordering guide](#).

5B47 Specifications

Description	Model 5B47
Input Ranges	
Standard Ranges	Refer to Model Table
Custom Ranges	±5 mV to ±500 mV
Output Ranges ($R_L > 50\text{ k}\Omega$)	+1 V to +5 V or 0 V to +5 V
Accuracy¹	
Initial @ +25°C	See Model Table

Input Offset vs. Temperature ²	$\pm 1 \mu\text{V}/^\circ\text{C}$
Output Offset vs. Temperature	$\pm 20 \mu\text{V}/^\circ\text{C}$
Gain vs. Temperature	$\pm 0.0025\%$ of Reading/ $^\circ\text{C}$
Cold Junction Compensation	
Initial Accuracy @ $+25^\circ\text{C}$ ³	$\pm 0.25^\circ\text{C}$ ($\pm 0.75^\circ\text{C}$, maximum)
Accuracy, $+5^\circ\text{C}$ to $+45^\circ\text{C}$	$\pm 0.5^\circ\text{C}$ ($\pm 0.0125^\circ\text{C}/^\circ\text{C}$)
Input Bias Current	-25 nA
Input Resistance	
Power On	5 M Ω
Power Off	40 k Ω
Overload	40 k Ω
Noise	
Input, 0.1 Hz to 10 Hz Bandwidth	0.2 μV rms
Output, 100 kHz Bandwidth	500 μV rms
Bandwidth, -3 dB	4 Hz
Output Rise Time, 10% to 90% Span	200 ms
Common-Mode Voltage (CMV)	
Input-to-Output, Continuous	1500 V rms, maximum
Output-to-Power, Continuous ⁴	± 3 V, maximum
Transient	ANSI/IEEE C37.90.1-1989
Common Mode Rejection (CMR)	
1 k Ω Source Imbalance, 50/60 Hz	160 dB
Normal Mode Rejection (NMR), 50/60 Hz	60 dB
Input Protection	
Continuous	240 V rms, maximum
Transient	ANSI/IEEE C37.90.1-1989
Output Resistance	50 Ω
Voltage Output Protection	Continuous Short to Ground
Output Selection Time	6 μs @ $C_{\text{load}} = 0$ to 2,000 pF
Output Enable Control	
Max Logic "0"	+1 V
Min Logic "1"	+2.5 V
Max Logic "1"	+36 V
Input Current "0"	0.4 mA

Open Input Response	Upscale
Open Input Response Time	10 seconds
Power Supply Voltage	+5 V $\pm 5\%$
Power Supply Current	30 mA
Power Supply Sensitivity, RTI	$\pm 2 \mu\text{V}/\%$ of V_s
Mechanical Dimensions	2.275" x 2.375" x 0.595" (57.8 mm x 59.1 mm x 15.1 mm)
Environmental	
Temperature Range	
Rated Performance	-25°C to +85°C
Operating	-40°C to +85°C
Storage	-40°C to +85°C
Relative Humidity	0 to 93% @ +40°C noncondensing
RFI Susceptibility	$\pm 0.5\%$ Span error @ 400 MHz, 5 Watt, 3 ft

Includes the combined effects of repeatability, hysteresis, and nonlinearity and assumes $R_L > 50 \text{ k}\Omega$. Loads heavier than $50 \text{ k}\Omega$ will degrade nonlinearity and gain temperature coefficient.

² $\pm 1 \mu\text{V}/^\circ\text{C}$ is equivalent to $0.02^\circ\text{C}/^\circ\text{C}$ for Type J thermocouples; $0.025^\circ\text{C}/^\circ\text{C}$ for Type K and T thermocouples; $0.016^\circ\text{C}/^\circ\text{C}$ for Type E thermocouples; $0.168^\circ\text{C}/^\circ\text{C}$ for Type R and S thermocouples.

³When used with the model AC1361 CJC sensor (see [Accessories](#) section), which is provided on each channel of [5B Series backplanes and mounting cards](#).

⁴The output common must be kept within $\pm 3 \text{ V}$ of power common.

Specifications subject to change without notice.

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