

### FEATURES

**Single-channel signal conditioning module that Amplifies, Protects, Filters, and Isolates Analog Input.**

**Isolates and protects a wide variety of four-wire RTDs.**

**Generates an linearized, highly accurate output of 0 to +5V.**

**Module circuitry can withstand 240v rms at the input screw-terminals.**

**All 5B35 series modules are mix-and-match and Hot Swappable.**

### APPLICATIONS

**Industrial signal conditioning**

**Industrial signal isolation**

**Industrial signal filtering**

**Signal Linearization**

### PRODUCT OVERVIEW

The 5B Series represents an innovative generation of low cost, high performance plug-in signal conditioners. Designed for industrial applications, these modules incorporate highly reliable transformer-based isolation and automated surface-mount manufacturing technology. They are compact, economical components whose performance exceeds that available from more expensive devices. Combining 1500 V rms continuous isolation, +0.05% calibrated accuracy, small size and low cost, the 5B Series is an attractive alternative to expensive signal conditioners and in-house designs

All modules are potted and identical in pin-out and size (2.27" x 2.32" x 0.595"). They can be mixed and matched, permitting users to address their exact needs, and may be "hot swapped" without disturbing field wiring or power. The isolated input modules provide 0 to +5V or +5V outputs and accept J, K, T, E, R, S, N, or B type thermocouples.

These modules feature complete signal conditioning functions including 240 V rms input protection, filtering, chopper stabilized low drift +1 uV/oC amplification, 1500 V rms isolation, and sensor excitation when required.

All modules feature excellent common mode rejection and meet industrial transient surge withstand specifications.

#### Rev. 0

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### FUNCTIONAL BLOCK DIAGRAM

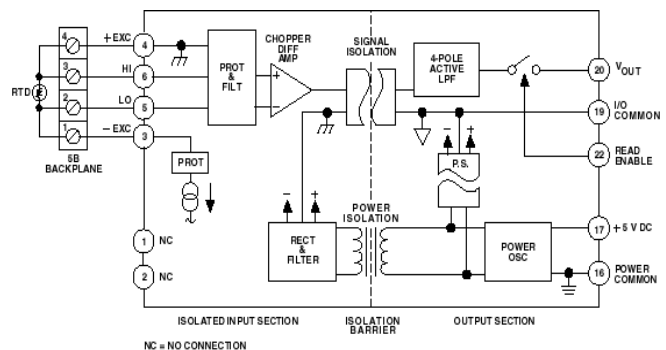


Figure 1. 5B35 Functional Block Diagram

There are also a number of backplanes and mounting sockets which provide a complete signal conditioning solution for end users. Each backplane incorporates screw terminals for field wiring inputs and outputs and cold junction sensors for thermocouple applications.

These signal conditioners are designed to provide an easy and convenient solution to signal conditioning problems of both designers and end users in measurement and control applications. Typical uses include microcomputer-based measurement systems, standard data acquisition systems, programmable controllers, analog recorders and dedicated control systems. The 5 B series modules are ideally suited to applications where monitoring and control of temperature, pressure, flow, rotation and other analog signals are required.

The 5B Series modules and backplanes are approved by Factory Mutual (FM) and the 5B Series modules are approved by the Canadian Standards Association (CSA) for use in Class 1, Division 2, Groups A, B, C, and D locations. These approvals certify that the 5B Series is suitable for use in locations where a hazardous concentration of flammable gas may exist only under fault conditions of operation. Equipment of this category is called "nonincendive" and they need no special enclosures or other physical safeguards. The 5B series modules and backplanes have been tested and passed the stringent heavy industrial requirements of the EU's electromagnetic compatibility (EMC) directive – EN50082-1 and EN50081-2. When used according to installation directions (refer to 5B series User Manual), any errors caused by EMI/RFI interference will be less than 0.1% of the full scale 5B measurement range for field strengths up to 10 V/M and frequencies up to 1 GHz.

## GENERAL DESCRIPTION

The 5B35 is a single-channel signal conditioning module that amplifies, filters, isolates and protects a wide variety of four-wire RTDs. The module provides a linearized, highly accurate output of 0 to +5V.

**Accurate and Stable Performance** – The four-wire configuration of the 5B35 supplies RTD excitation from a precision, protected current source: two RTD wires carry the excitation current and two wires serve as signal-input leads that measure the voltage across the RTD. Because no excitation current flows through the signal input leads, the length or resistance of the leads creates little or no RTD measurement error. A low-drift chopper-stabilized differential amplifier allows use of very low excitation current to minimize error due to RTD self heating. The amplifies low input offset drift of  $\pm 0.01^{\circ}\text{C}/^{\circ}\text{C}$  and gain drift of  $\pm 30\text{ppm}/^{\circ}\text{C}$ . Assure accuracy over the full operating temperature range.

**True Three-Port Isolation** – The floating, differential input circuit on the field side eliminates the need for any input grounding. Signal and power isolation by transformer coupling uses a proprietary modulation technique for linear, stable and reliable performance. 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. True three-port isolation (Input-Output-Power)

includes common-mode rating of: 1500V rms between input and output and input and power; 250V rms between power and output – no return path is required between the power and signal output commons.

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

The 5B35 protects the computer side from damage due to field-side over-voltage faults. The module withstands 240V rms at the input terminals without damage, thereby shielding the internal computer-side circuitry from field-side over-voltage conditions. In addition, the 5B35 is mix-and-match and hot swappable with all other 5B Series modules, so can be inserted or removed from any socket in the same backplane without disrupting system power.

A series output switch eliminates the need for external multiplexing in many applications. The switch is turned on by an active-low enable input. If the switch is to be on at all times, the enable-input should be grounded to power common as it is on the 5B01 and 5B08 backplanes.



Figure 2

## 5B35 Models Available

| Model                | Input Range                                                                                                                 | Output Range | Accuracy                 |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------|
| <b>5B35-01</b>       | <b>100 <math>\Omega</math> Platinum, <math>\alpha = 0.00385^*</math></b><br>-100°C to +100°C (-148°F to +212°F)             | 0 V to +5 V  | $\pm 0.26^\circ\text{C}$ |
| <b>5B35-02</b>       | 0°C to +100°C (+32°F to +212°F)                                                                                             | 0 V to +5 V  | $\pm 0.13^\circ\text{C}$ |
| <b>5B35-03</b>       | 0°C to +200°C (+32°F to +392°F)                                                                                             | 0 V to +5 V  | $\pm 0.26^\circ\text{C}$ |
| <b>5B35-04</b>       | 0°C to +600°C (+32°F to +1112°F)                                                                                            | 0 V to +5 V  | $\pm 0.78^\circ\text{C}$ |
| <b>5B35-05</b>       | -100°C to +200°C (-148°F to +392°F)                                                                                         | 0 V to +5 V  | $\pm 0.60^\circ\text{C}$ |
| <b>5B35-C-01</b>     | <b>10 <math>\Omega</math> Copper, <math>\alpha = 0.004274</math></b><br>0°C to +120°C (10 $\Omega$ @ 0°C) (+32°F to +248°F) | 0 V to +5 V  | $\pm 0.23^\circ\text{C}$ |
| <b>5B35-C-02</b>     | 0°C to +120°C (10 $\Omega$ @ 25°C)(+32°F to +248°F)                                                                         | 0 V to +5 V  | $\pm 0.23^\circ\text{C}$ |
| <b>5B35-N-01</b>     | <b>120 <math>\Omega</math> Nickel, <math>\alpha = 0.00672</math></b><br>0°C to +300°C (+32°F to +572°F)                     | 0 V to +5 V  | $\pm 0.40^\circ\text{C}$ |
| <b>5B35-Custom</b>   | *                                                                                                                           | *            |                          |
| <b>5B35-C-Custom</b> | *                                                                                                                           | *            |                          |
| <b>5B35-N-Custom</b> | *                                                                                                                           | *            |                          |

\* Custom Input/Output ranges are available including versions for the 100  $\Omega$  Platinum RTD with  $\alpha = 0.003916$ . Refer to configuration guide.

## 5B35 Specifications

(typical @ +25°C and  $V_s = +5$  V dc)

| Description                                                         | Model 5B35                                                                                                                                                                                 |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                     | <b>Input Ranges</b>                                                                                                                                                                        |
| Standard Ranges                                                     | Refer to Model Table                                                                                                                                                                       |
| Custom Ranges                                                       | -200°C to +850°C (100 $\Omega$ Platinum, $\alpha = 0.00385$ )<br>-80°C to +320°C (120 $\Omega$ Nickel, $\alpha = 0.00672$ )<br>-100°C to +260°C (10 $\Omega$ Copper, $\alpha = 0.004274$ ) |
| <b>Output Range (<math>R_L &gt; 50</math> k<math>\Omega</math>)</b> | 0 V to +5 V                                                                                                                                                                                |
|                                                                     | <b>Accuracy<sup>1</sup></b>                                                                                                                                                                |
| Initial @ +25°C                                                     | Refer to Model Table                                                                                                                                                                       |
| Conformity Error                                                    | $\pm 0.05\%$ Span                                                                                                                                                                          |
| Input Offset vs. Temperature                                        | $\pm 0.01^\circ\text{C}/^\circ\text{C}$                                                                                                                                                    |
| Output Offset vs. Temperature                                       | $\pm 20$ $\mu\text{V}/^\circ\text{C}$                                                                                                                                                      |
| Gain vs. Temperature                                                | $\pm 0.003\%$ of Reading/ $^\circ\text{C}$                                                                                                                                                 |
|                                                                     | <b>Input Resistance</b>                                                                                                                                                                    |
| Power On                                                            | > 1000 M $\Omega$                                                                                                                                                                          |
| Power Off                                                           | 200 k $\Omega$                                                                                                                                                                             |
| Overload                                                            | 200 k $\Omega$                                                                                                                                                                             |
|                                                                     | <b>Noise</b>                                                                                                                                                                               |
| Input, 0.1 Hz to 10 Hz Bandwidth                                    | 0.2 $\mu\text{V}$ rms                                                                                                                                                                      |

|                                          |                                                                                 |
|------------------------------------------|---------------------------------------------------------------------------------|
| Output, 100 kHz Bandwidth                | 100 $\mu$ V rms (0.3 mV peak-peak)                                              |
| Output, 1 MHz Bandwidth                  | 1.5 mV peak-peak                                                                |
| Output, 5 MHz Bandwidth                  | 6 mV peak-peak                                                                  |
| <b>Bandwidth, -3 dB</b>                  | 4 Hz                                                                            |
| <b>Output Rise Time, 10% to 90% Span</b> | 100 ms                                                                          |
| <b>Common-Mode Voltage (CMV)</b>         |                                                                                 |
| Input-to-Output, Continuous              | 1500 V rms, maximum                                                             |
| Input-to-Power, Continuous               | 1500 V rms, maximum                                                             |
| Output-to-Power, Continuous <sup>2</sup> | 250 V rms, maximum                                                              |
| Transient                                | ANSI/IEEE C37.90.1-1989                                                         |
| <b>Common Mode Rejection (CMR)</b>       |                                                                                 |
| 1 k $\Omega$ Source Imbalance, 50/60 Hz  | 190 dB (180 dB, Model 5B35-04)                                                  |
| <b>Normal Mode Rejection (NMR)</b>       | 116 dB @ 60 Hz; 108 dB @ 50 Hz                                                  |
| <b>Sensor Excitation Current</b>         |                                                                                 |
| 100 $\Omega$ Pt, 120 $\Omega$ Ni         | 0.25 mA                                                                         |
| 10 $\Omega$ Cu                           | 1.0 mA                                                                          |
| <b>Lead Resistance Effect</b>            |                                                                                 |
| 100 $\Omega$ Pt, 120 $\Omega$ Ni         | $\pm 0.00001^{\circ}\text{C}/\Omega$                                            |
| 10 $\Omega$ Cu                           | $\pm 0.0001^{\circ}\text{C}/\Omega$                                             |
| <b>Input Protection</b>                  |                                                                                 |
| Continuous                               | 240 V rms, maximum                                                              |
| Transient                                | ANSI/IEEE C37.90.1-1989                                                         |
| <b>Output Resistance</b>                 | 25 $\Omega$                                                                     |
| <b>Voltage Output Protection</b>         | Continuous Short to Ground                                                      |
| Output Current Limit                     | $\pm 9$ mA                                                                      |
| <b>Output Selection Time</b>             | 6 $\mu$ s to $\pm 1$ mV of $V_{\text{out}}$ @ $C_{\text{load}} = 0$ to 2,000 pF |
| <b>Output Enable Control<sup>2</sup></b> |                                                                                 |
| Max Logic "0"                            | +0.8 V                                                                          |
| Min Logic "1"                            | +2.4 V                                                                          |
| Max Logic "1"                            | +100 V                                                                          |
| Input Current "0", "1"                   | 0.5 $\mu$ A                                                                     |
| <b>Power Supply Voltage</b>              | +5 V dc $\pm 5\%$                                                               |
| <b>Power Supply Current</b>              | 15 mA                                                                           |
| <b>Power Supply Sensitivity, RTI</b>     | $\pm 0.2^{\circ}\text{C}/\%$ of $V_s$                                           |
| <b>Mechanical Dimensions</b>             | 2.275" x 2.375" x 0.595"<br>(57.8 mm x 59.1 mm x 15.1 mm)                       |
| <b>Environmental</b>                     |                                                                                 |
| <b>Temperature Range</b>                 |                                                                                 |
| Rated Performance                        | -40°C to +85°C                                                                  |

|                    |                                          |
|--------------------|------------------------------------------|
| Operating          | -40°C to +85°C                           |
| Storage            | -40°C to +85°C                           |
| Relative Humidity  | 0 to 93% @ +40°C non-condensing          |
| RFI Susceptibility | ±0.5% Span error @ 400 MHz, 5 Watt, 3 ft |

<sup>1</sup>Includes the combined effects of repeatability, hysteresis, and conformity error. Loads heavier than 50 kΩ will degrade conformity and gain temperature coefficient.

<sup>2</sup>The user's board layout must separate Power Common from Output Common. When the output switch is not used, connect the Enable Input to the Output Common. Output Common is connected to power common when the 5B35 is installed on a 5B Series backplane.

*Specifications subject to change without notice.*

## PIN CONFIGURATIONS AND FUNCTIONAL DESCRIPTIONS

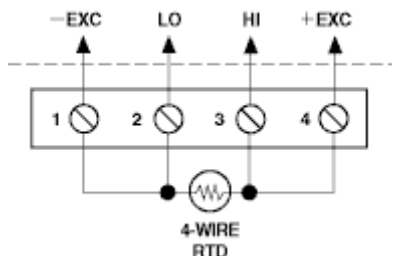


Figure 3 5B35 Input Field Connections

Table 1. Pin Function Descriptions—

| Pin No. | Description |
|---------|-------------|
| 1       | -EXC        |
| 2       | LO          |
| 3       | HI          |
| 4       | +EXC        |

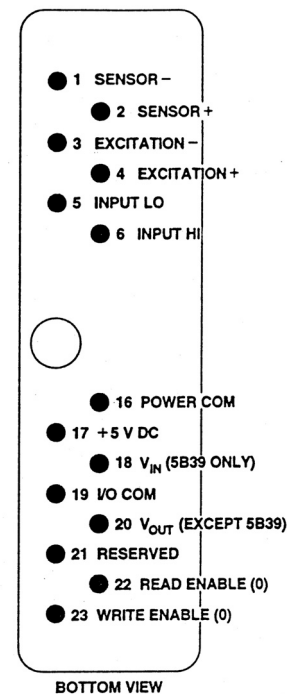
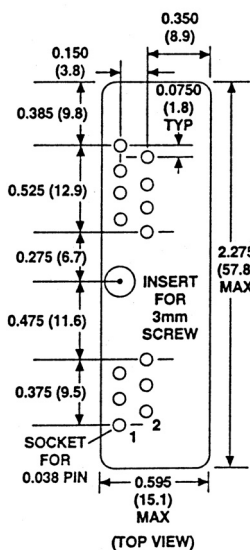


Figure 4 . Model 5B Series Module, with pin-out assignments.

### ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



## OUTLINE DIMENSIONS

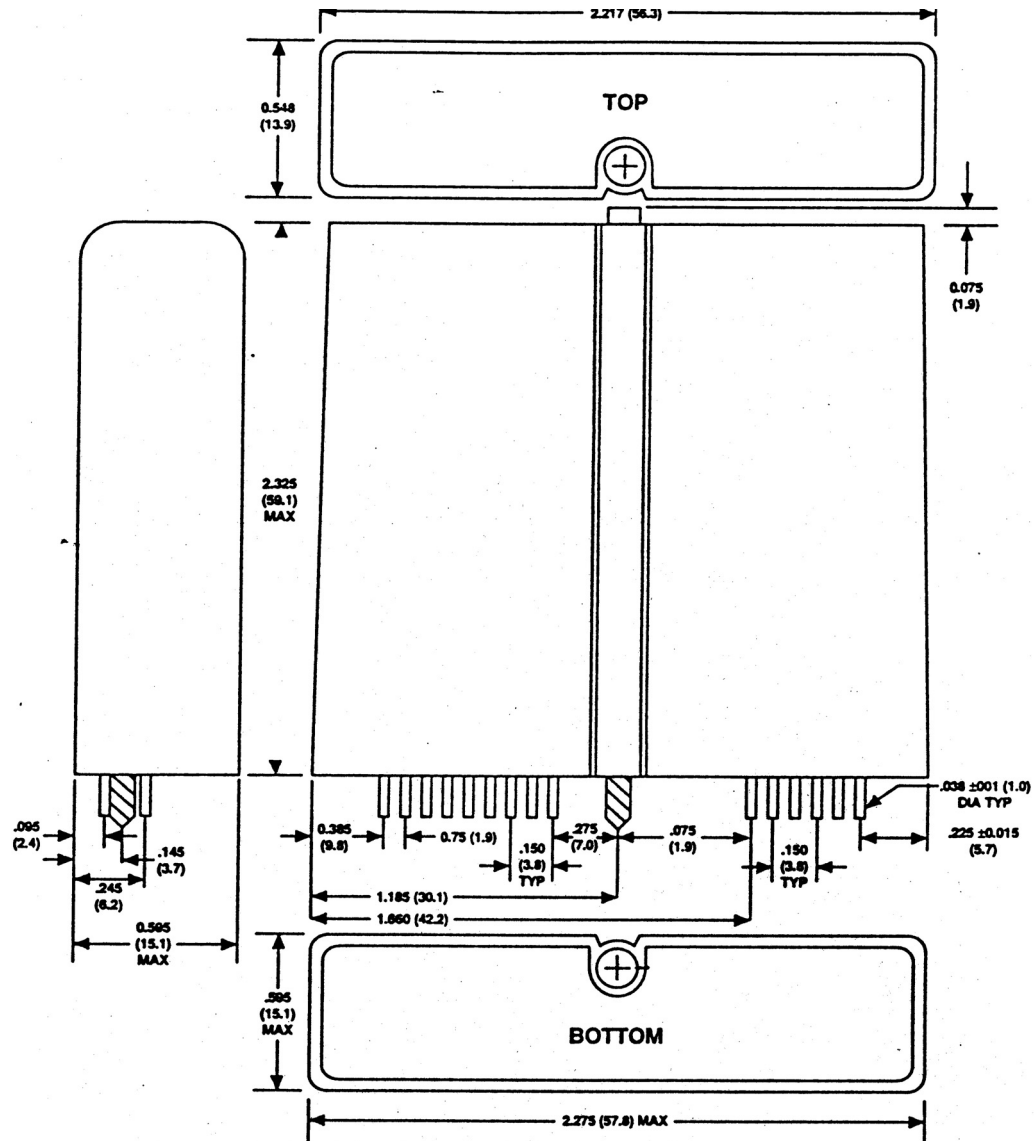


Figure 5. Outline Dimensions

**NOTES**



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