



# Linearized 4-Wire RTD Input Module

## MODEL 5B35

### FEATURES

#### Accepts a Variety of RTD Types

100  $\Omega$  Platinum, 10  $\Omega$  Copper, 120  $\Omega$  Nickel

#### Linearizes RTD Signal

1500 V rms Input/Output and Input/Power Isolation

250 V rms Output/Power Isolation

240 V rms Field Wiring Protection

4-Wire Lead Resistance Compensation

190 dB CMRR

116 dB NMR @ 60 Hz, 108 dB @ 50 Hz

#### Low Drift:

Input Offset  $\pm 0.01^\circ\text{C}/^\circ\text{C}$

Gain  $\pm 30$  ppm/ $^\circ\text{C}$

#### Low Output Noise:

0.3 mV p-p @ 100 kHz BW

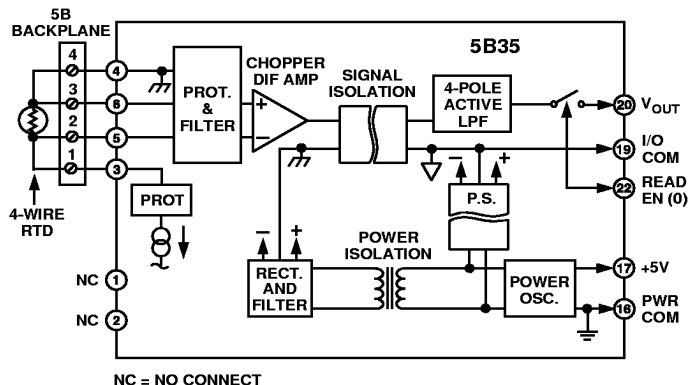
6 mV p-p @ 5 MHz BW

Low Power Consumption: +5 V dc @ 15 mA

ANSI/IEEE C37.90.1-1989 Transient Protection

CSA, FM and CE Approvals

### FUNCTIONAL BLOCK DIAGRAM



### GENERAL DESCRIPTION

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

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

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

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

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

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

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

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

### REV. 0

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# MODEL 5B35—SPECIFICATIONS (typical @ +25°C and $V_S = +5\text{ V dc}$ )

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

## NOTES

<sup>1</sup>The user's board layout must separate Power Ground from I/O Common and when the 5B35 output switch is not used, ground the enable input to I/O Common. Power-to-Output CMV is not available when the 5B35 is installed on a 5 B Series backplane.

<sup>2</sup>CMR for Model 5B35-04 is 180 dB.

<sup>3</sup>Includes the combined effects of repeatability, hysteresis and conformity.

Specifications subject to change without notice.

**Table I. Standard Model Input/Output Ranges\***

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

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

**Table II. Custom Model Ordering Guide**

Order Model: 5B35-CUSTOM* plus Customer Specified Information				
<b>Customer Specified Information:</b>				
Sensor Type	Input Range		Output Range	
Available Sensor Types	Low Limit	High Limit	Low Limit	High Limit
100 $\Omega$ Pt $\alpha = 0.00385$	-200°C	+850°C	0 V	+5 V
100 $\Omega$ Pt $\alpha = 0.003916$	-200°C	+850°C	0 V	+5 V
10 $\Omega$ Cu $\alpha = 0.004274$	Consult Factory		0 V	+5 V
120 $\Omega$ Ni $\alpha = 0.00672$	Consult Factory		0 V	+5 V

\*For copper (Cu) RTD sensor inputs, order

5B35-C-CUSTOM.

For nickel (Ni) RTD sensor inputs, order

5B35-N-CUSTOM.