Low Cost, Modular Process Control Signal Conditioners

7B Series

FEATURES

- **Accepts Process Control Input Signals: Thermocouples, RTDs, Current, Millivolt and Voltage Inputs**
- **Powered Current Input Provides Isolated +24 V for a Transmitter**
- **Analog Current Output Module**
- **Complete Signal Conditioning Function: 120 V RMS Field Wiring Protection, Filtering, Amplification, 1500 V RMS Transformer Based Isolation**
- **Operates From +14 V DC to +35 V DC Power**
- **Factory Calibrated Accuracy**
- **Mix and Match Modularity**

GENERAL DESCRIPTION

The 7B Series of signal conditioners represents a new level of price versus performance for the process control industry. These modular, plug-in conditioners accept inputs from the most common process control transducers and signals and provide a high level isolated output voltage. Galvanic isolation of 1500 volts rms is achieved by transformer based circuitry. Both the signal path and the power supply are isolated enabling true channel-to-channel isolation.

The modules accept a nominal power supply input of +24 volts dc with a range of +14 volts to +35 volts. The small size of 1.7″ × 2.1″ × 0.60″ allows large point count applications without taking up a lot of space. All specifications are valid over −40°C to +85°C.

Isolated input modules are available for J, K, T, E, R, S and B thermocouples; platinum RTDs; and current, voltage and millivolt signals. The isolated powered loop input module provides +24 volts for a transmitter and accepts a 4–20 mA current input. All input modules provide a high level 1–5 volt output signal, with additional output ranges available. An isolated current output module provides a 0–20 mA or 4–20 mA signal to the field for control applications. A compact sensor for cold junction compensation reduces the space required on the backplane.

A variety of backplanes are available to provide a complete solution for the end user or systems integrator. Each backplane contains screw terminals for the field wiring connections. A cold junction compensation thermistor is installed under the terminal blocks on each channel. Only the thermocouple input module receives this input signal. This flexibility allows any module type, input or output, to be used in any channel on the backplane. A 25-pin D style connector is used for system hookup. Provisions are made for redundant power connections as well as an LED to indicate power on. Nineteen-inch rack mount kits are available.

APPLICATIONS

The 7B Series of signal conditioners is designed to provide an easy and cost effective solution to interfacing to transducers in process monitoring and control systems. These modules can be designed into a system as a component or used with Analog Devices' backplanes to provide a higher level solution. The +24 volt power supply requirement and a simple pinout eases the integration of the 7B Series into a user designed backplane. Applications requiring monitoring and control of large numbers of analog signals are a perfect fit for the 7B Series.

7B Series—SPECIFICATIONS

Input Modules (All specifications are at +25°C, +24 V power.)

Model	7B30/7B31	7B32	7B33	7B34	7B35	7B37
Input Ranges	DC mV/DC V	Current	dc V	RTD	Current	Thermocouples
Output Ranges	1–5 V, 0–10 V	1–5 V, 2–10 V	1–5 V, 2–10 V	*	1–5 V, 2–10 V	*
Accuracy[1]	±0.1% Span max	*	*	±0.13%–±0.25% Span max[2]	*	±0.10% Span max[2]
Nonlinearity	±0.02% max	*	*	±0.05% Span Conformance	*	*
Stability vs. Ambient Temperature						
Span	±35 ppm/°C ±55 ppm/°C	±35 ppm/°C	±15 ppm/°C	±60 ppm/°C	±40 ppm/°C	±35 ppm/°C
Output Offset	±0.002% Span/°C	*	*	*	*	*
Input Offset	1 μV/°C	*	NA	*	NA	*
CMV, Input to Output	1500 V RMS Continuous	*	*	*	*	*
CMR @ 50 or 60 Hz, 1 kΩ, Source Unbalance	160 dB/120 dB	105 dB min	105 dB min	160 dB min	105 dB	160 dB
NMR @ 60 Hz	60 dB	NA	NA	*	NA	*
NMR @ 50 Hz	56 dB	NA	NA	*	NA	*
Input Protection, Continuous	120 V AC Continuous	*	*	*	*	*
Voltage Output Protection	Continuous Short to Gnd	*	*	*	*	*
Input Transient Protection	Meets IEEE-STD472	*	*	*	*	*
Input Resistance	10 MΩ/100 kΩ	2 MΩ	2 MΩ	NA	NA	10 MΩ
Bandwidth	3 Hz	100 Hz	100 Hz	3 Hz	100 Hz	3 Hz
Response Time, 0 to 90%	200 ms	10 ms	10 ms	500 ms	10 ms	200 ms
Minimum Output Voltage	−1.2 V[3]/−30 V[4]	*	*	*	*	*
Maximum Output Voltage	+7.4 V[3]/+13.5 V[4]	*	*	*	*	*
Open Input Response	NA	Downscale	Downscale	Upscale	Downscale	Upscale
Open Input Detection Time	NA	2 s max	2 s max	10 s max	2 s max	10 s max
Power Supply	+14 V to +35 V	*	*	*	+18 V to +30 V	*
Power Supply Sensitivity	±0.01% Span/V	*	*	*	±0.025% Span/°C	*
Power Consumption	25 mA	*	*	*	60 mA max	*
Size (H)(W)(D)	2.13"×1.705"×0.605", max	*	*	*	*	
Environmental						
Rated Temperature Range	−40°C to +85°C	*	*	*	*	*
Operating Temperature Range	−40°C to +85°C	*	*	*	*	*
Storage Temperature Range	−40°C to +85°C	*	*	*	*	*
Relative Humidity	0 to 90%, Noncondensing	*	*	*	*	*

NOTES
[1]Accuracy specification includes the combined effects of repeatability, hysteresis and linearity and does not include sensor or signal source error.
[2]Accuracy specification is dependent on input range, consult factory.
[3]1–5 V output.
[4]0–10 V output.

*Specifications same as 7B30.

Specifications subject to change without notice.

Table I. Input Selection

Input Type / Span	Output	Model
VOLTAGE		
mV DC: 0–10 mV, ±10 mV, ±100 mV, 0–100 mV	1–5 V, 0–10 V	7B30
V DC: 0–1 V, 0–5 V, 1–5 V	1–5 V, 0–10 V	7B30
V DC: 0–10 V, ±10 V, ±5 V	1–5 V, 0–10 V	7B31
V: 1–5 V	1–5 V	7B33
PROCESS CURRENT		
4–20 mA	1–5 V	7B32
4–20 mA, External 250 Ω Resistor	1–5 V	7B33
0–20 mA dc/4–20 mA dc, External 250 Ω Resistor	1–5 V, 0–10 V	7B31
4–20 mA Powered Loop Current	1–5 V	7B35
RTDs		
100 Ω Pt	1–5 V, 0–10 V	7B34
THERMOCOUPLES		
J, K, T, E, R, S, B	1–5 V, 0–10 V	7B37

PIN DESIGNATIONS

I/O & POWER COM	5
V_{OUT}	4
+24 VOLTS	3
INPUT LOW	2
INPUT HIGH	1
SENSOR	0

NOTE
Pin 0 is only used on the 7B34 the 7B34 RTD Input and the 7B37 Thermocouple Input Modules.

This information applies to a product under development. Its characteristics and specifications are subject to change without notice. Analog Devices assumes no obligation regarding future manufacture unless otherwise agreed to in writing.

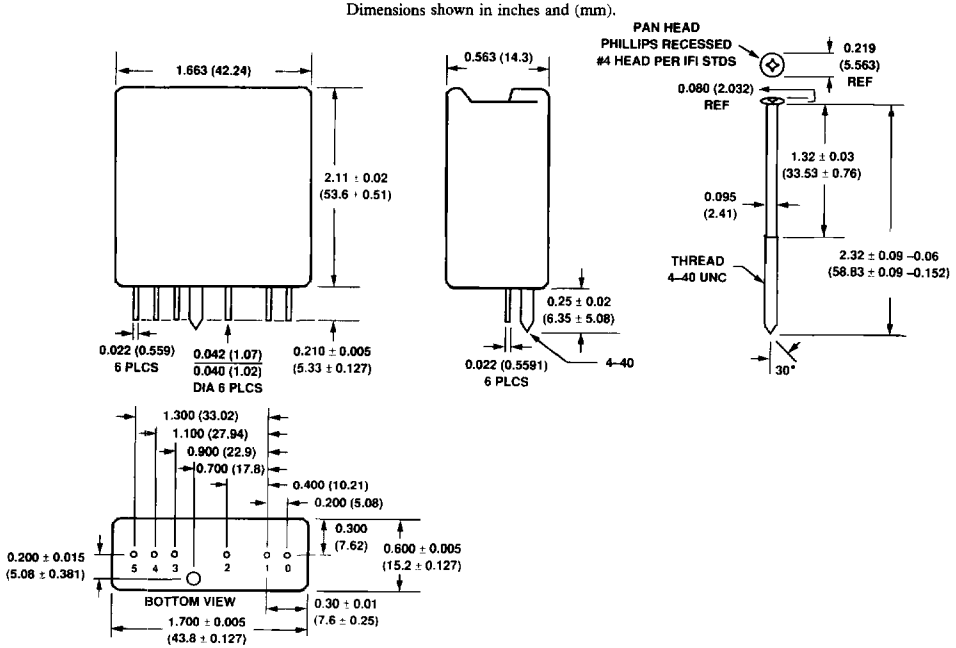
Output Module (All specifications are at +25°C, +24 V power.)

Model	7B39
Input Range	1–5 V, 0–10 V
Output Range	4–20 mA, 0–20 mA
Load Resistance Range	0 to 850 Ω
Accuracy[1]	±0.1% max
Nonlinearity	±0.02% max
Stability vs. Ambient Temperature	±0.01%/°C
CMV, Input To Output	1500 V RMS Continuous
Output Protection	120 V RMS Continuous
Output Transient Protection	Meets IEEE-STD472 (SWC)
Input Resistance	10 MΩ
Response Time 0 to 90%	10 ms
Output Range	
Minimum Output Current	0 mA
Maximum Output Current	32 mA
Bandwidth	100 Hz
Power Supply	+14 V dc to +35 V dc
Power Supply Sensitivity	±0.0[illegible]%/V
Power Consumption	65 mA
Size	2.13"×1.705"×0.6[illegible]" max
Environmental	
Rated Temperature Range	−40°C to +85°C
Operating Temperature Range	−40°C to +85°C
Storage Temperature Range	−40°C to +85°C
Relative Humidity	0 to 90% Noncondensing

NOTES
[1]Accuracy specification includes the combined effects of repeatability, hysteresis and linearity. Does not include signal source error.
Specifications subject to change without notice.

7B SERIES MODULE OUTLINE

Dimensions shown in inches and (mm).



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SYSTEM DESIGN FEATURES

- **Power Supply Range of +14 Volts to +35 Volts**
- **Single Threaded Insert for Module Hold Down**
- **Accepts Thermistor for Cold Junction Compensation**

SYSTEM DESIGN INFORMATION

The 7B Series was designed to be easily integrated into a process control system. The pins and the hold down screw fit into the same sockets as those used with solid-state relays. The thermistor recommended for cold junction compensation is commercially available. The pins are 0.022″ in diameter and 0.210″ extending from the bottom of the case. The millivolt, volt and current input modules and the current output module have five pins and the thermocouple and RTD modules have six pins each. The RTD module requires three field wiring connections, all others need two.

BASIC DESIGN GUIDELINES

Modules may be mounted in any position and will normally be placed next to the screw terminals connecting to the associated field wiring. The temperature sensor is used only by the thermocouple modules; but if it is installed in each channel, then modules can be inserted in any channel depending upon the application. The operation of the non-thermocouple modules is not affected by the temperature sensor. This sensor must be physically close to the terminals where the thermocouple wire connects to copper. Because the low power dissipation of the 7B Series modules minimizes temperature gradients on the backplane, no special precautions are needed to get accurate temperature sensing.

Provisions must be made for a current sense resistor if there are current inputs and the 7B32 with the internal sense resistor is not being used. The screw terminals for the field wiring connections are large enough for a resistor to be connected directly on the terminals. Provisions can also be made to use the pluggable current sense resistor offered as an accessory.

The width of the modules permits installation on 0.625″ centers where required, but consideration must be given in each application to the required distance between backplane conductors where large interchannel voltages exist or code requirements apply. The isolation specification may be downrated due to the module spacings.

MODULE DESCRIPTIONS

7B30 and 7B31: Isolated Millivolt and Voltage Input

The 7B30 and 7B31 accept millivolt and volt signals, respectively. They each provide an isolated +1 to +5 volt or 0 to +10 volt output signal. Both modules have standard ranges from ±10mV up to ±10 V. The 7B31 can be used with a current sense resistor to provide a 0 to +10 volt output. These modules have a 3 Hz bandwidth.

Figure 1 shows a block diagram of the 7B30/7B31. The high and low input terminals are protected for up to 120 V rms. The high level signals of the 7B31 are attenuated and both modules have a one pole low pass filter on the input. A low drift amplifier provides the gain of the module. The signal is modulated and passed across a transformer supplying 1500 volts of isolation. The signal is then demodulated so the original signal is recovered. The two pole output filter and buffer ensure a clean low noise signal on the output. The power supply section of the module is also isolated allowing channel-to-channel isolation.

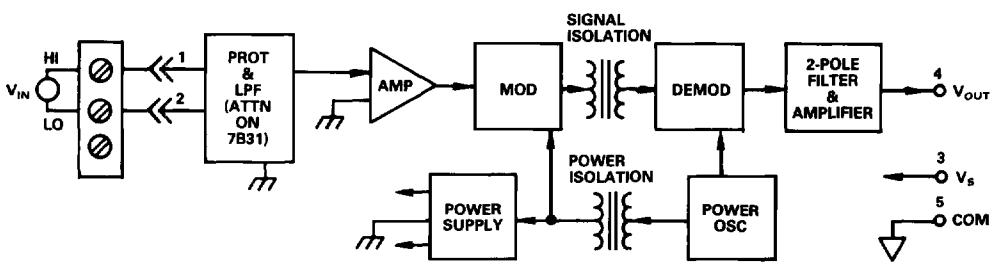

Figure 1. 7B30/7B31 Block Diagram

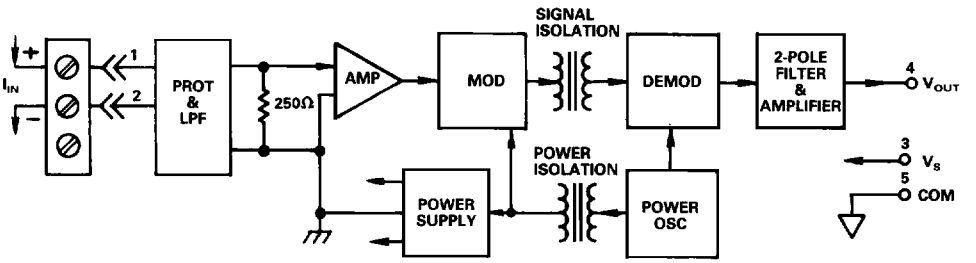

Figure 2. 7B32 Block Diagram

7B32: Isolated Current Input

The 7B32 accepts a 4–20 mA current input and provides a +1 to +5 volt output. The 7B32 incorporates an internal protected current conversion resistor allowing the process current to be directly connected to the module without compromising system integrity. The internal resistor allows the module calibration to include the current sense resistor. Downscale open input detection and a bandwidth of 100 Hz is featured.

Figure 2 is a functional block diagram of the 7B32. The module features input protection of 120 V rms in addition to a low pass filter on the input. The input current is converted to a voltage signal and then modulated to pass across the transformer barrier. The isolated signal is then demodulated and buffered and filtered to provide a clean output voltage proportional to the input current.

The 7B32 is available with a +1 to +5 volt output. If a current input module with a 0 to +10 volt output is desired, a standard 7B31 with a +1 to + 5 volt input and a 250 Ω current conversion resistor can be used. In applications where an external current sense resistor is preferred, the 7B33 voltage input module and the current sense resistor can be used to allow a +1 to +5 volt output.

7B33: Isolated High Level Voltage Input

The 7B33 accepts a +1 to +5 volt input signal and provides a +1 to +5 volt output with a signal bandwidth of 100 Hz.

Figure 3 is a functional block diagram of the 7B33. The two input terminals are protected for the hookup of 120 V rms. A 2.2 MΩ resistor on the input provides downscale open input detection within 2 seconds of a break on the input. A low pass filter combined with a low drift amplifier insure a clean signal into the modulator stage. The signal is modulated and passed across the transformer to provide 1500 V rms common mode isolation. The signal is recovered by the demodulator and fed through a 2-pole filter and buffered to provide a clean, low impedance output signal.

The +24 volt power input to the 7B33 provides power for the output stage and is passed across a second transformer in order to provide isolated power for the input circuitry. This ensures channel-to-channel isolation of the modules.

The 7B33 is available with a +1 to +5 volt input and a +1 to +5 volt output, this module has no provisions for gain or attenuation. The 7B30 and 7B31 mV and V input modules should be used for different input or output ranges.

The 7B33 can be used with a 250 Ω resistor as a current input module. This external current sense resistor allows the current loop to be maintained if the module has to be removed.

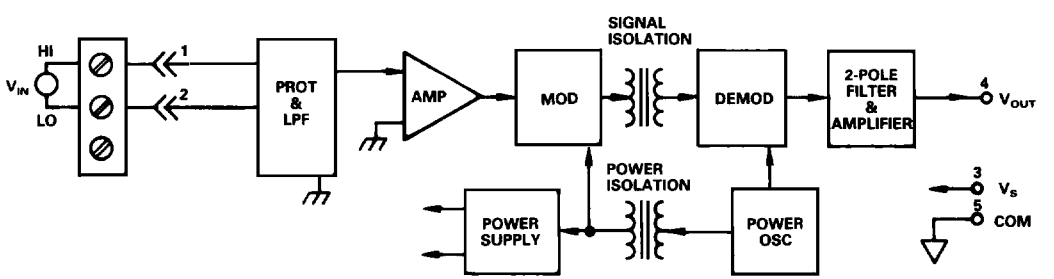

Figure 3. 7B33 Block Diagram

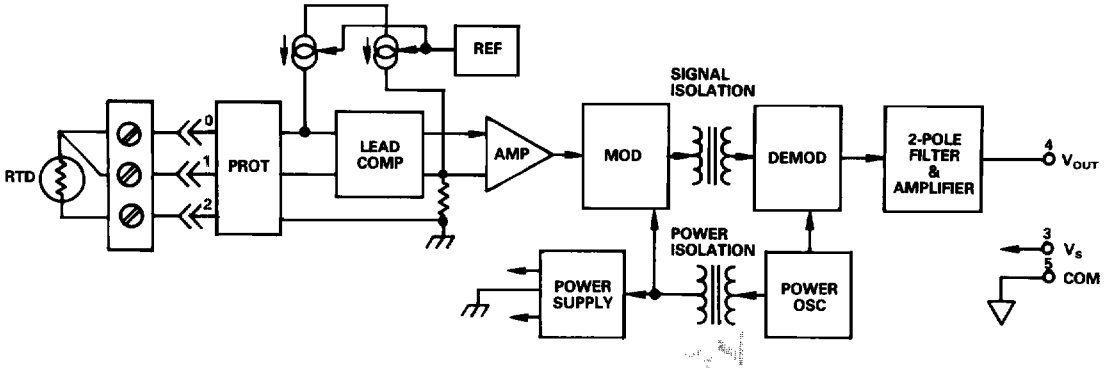

Figure 4. 7B34 Functional Block Diagram

7B34: Isolated Linearized RTD Input

The 7B34 accepts inputs from 100 Ω platinum RTDs and provides a linear voltage output. The 7B34 is available with a +1 to +5 volt or a 0 to +10 volt output range, all ranges feature a 3 Hz bandwidth. Three wire lead compensation is provided, and 2, 3 or 4 wire RTDs may be used. Upscale open input protection is provided on the signal leads.

Figure 4 is a functional block diagram of the 7B34. The 7B34 uses three pins for the RTD input, two for the sensor and a third for the excitation. All three input terminals are protected for up to 120 V rms. Low drift sensor excitation current of 0.25 mA is provided for platinum RTDs. A current source identical to the excitation current source is connected to the third lead of the RTD to cancel the effects of lead resistance. This current also flows through Rz, chosen to represent the RTD value of the zero output to voltage of the module. This signal is then amplified and modulated to be passed across the isolation barrier. The original signal is recovered in the demodulator stage. A two pole filter and a buffer ensure a clean low noise output voltage is provided.

The +24 volt power is also isolated by transformer coupling to provide channel-to-channel isolation and signal to power isolation. The 7B34 will accept power supply inputs from +14 volts to +35 volts.

7B35: Isolated Powered Current Loop Input

The 7B35 accepts a 4–20 mA current input and provides the loop power for a transmitter. This module features downscale open input detection and a bandwidth of 100 Hz. The module incorporates a protected 200 Ω current sense resistor eliminating the need for external resistors. A +1 to +5 volt output range is standard.

The functional block diagram is shown in Figure 5. The two input terminals are protected for 120 V rms. A one-pole input filter eliminates high frequency noise. A 200 Ω current conversion resistor converts the signal to a voltage to be amplified. The signal is then modulated and passed across the galvanic isolation of the transformer to provide 1500 volts of common mode isolation. The demodulator reclaims the original signal, which is filtered and buffered to give a clean, low noise output voltage.

The power supply for the module is also isolated and the module will accept power inputs from +18 volts to +30 volts.

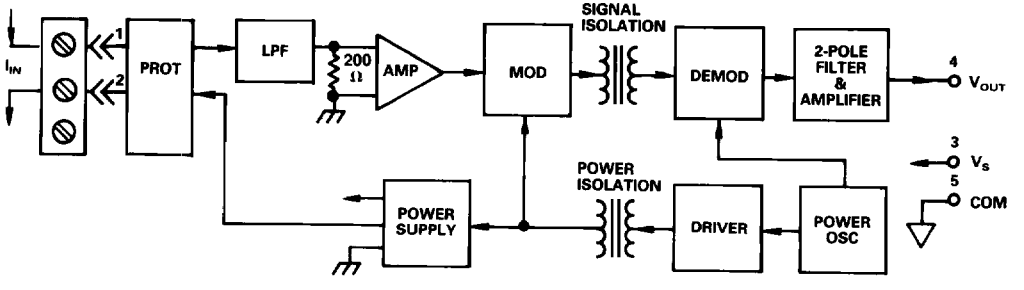

Figure 5. 7B35 Functional Block Diagram

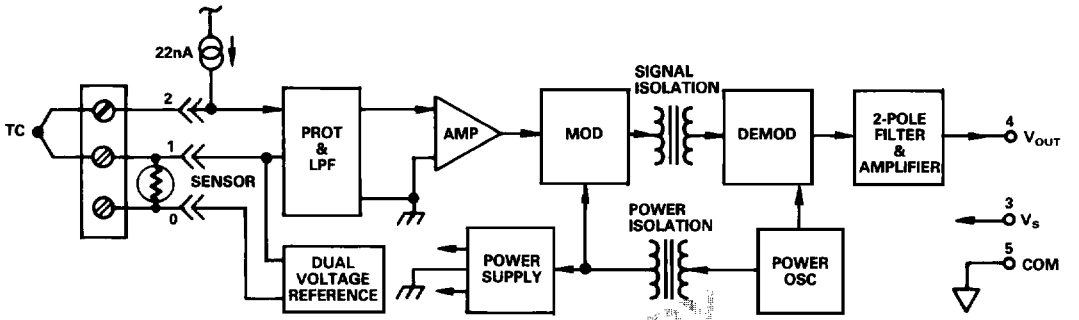

Figure 6. 7B37 Block Diagram

7B37: Isolated Thermocouple Input

The 7B37 accepts inputs from J, K, T, E, R, S and B type thermocouples and provides a nonlinearized +1 to +5 volt or 0 to +10 volt output. Upscale open thermocouple detection is featured within 10 seconds of a break in in the thermocouple wiring. This module is designed to accept cold junction compensation from a thermistor mounted on the backplane adjacent to the field wiring terminals. There are standard ranges available for each thermocouple type.

Figure 6 is a functional block diagram of the 7B37. In order to accommodate the CJC input, the 7B37 uses three input pins. Cold junction compensation circuitry corrects for the effects of connecting the thermocouple wires to the screw terminals on the backplane. Upscale open input detection is provided through the 22 nA current source. The input terminals are protected for the inadvertent connection of 120 V rms. A one-pole low pass filter on the input rejects high frequency noise. The input signal is offset to set the zero scale input value. A low drift amplifier provides a stable signal into the modulator; 1500 volt signal isolation is provided by transformer coupling. A demodulator on the output side recovers the original, which is buffered and filtered to provide a clean output signal.

7B39: Isolated Current Output

This module accepts a +1 to +5 volt or 0 to +10 volt input from the user's system and provides a galvanically isolated 4–20 mA or 0–20 mA current output to the field wiring capable of driving a 750 Ω load at +24 volt power. The bandwidth is 100 Hz.

The functional block diagram is shown in Figure 7. The module accepts its input signal from the user's system, typically a D/A. The signal is buffered and then modulated to be passed across the transformer isolation barrier. After the signal is demodulated, it is converted to an output current. The output current loop is floating. The output terminals are protected even if a 120 V rms signal is connected.

A single +24 volt power supply drives the module's power transformer and the clock oscillator. The power is isolated from the input signal.

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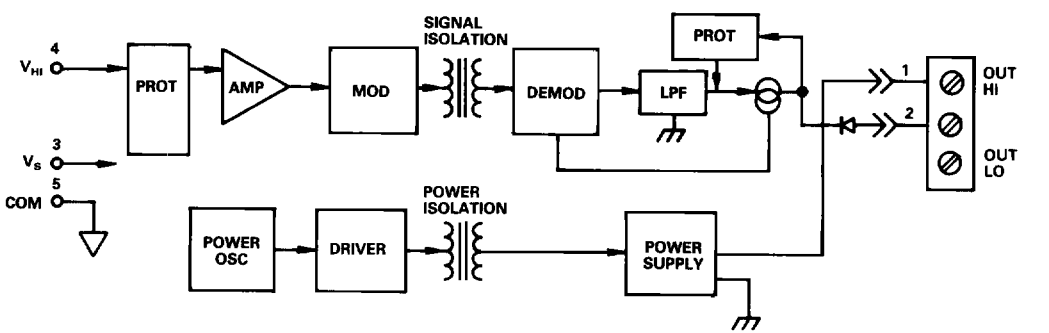

Figure 7. 7B39 Functional Block Diagram

BACKPLANE FUNCTIONAL DESCRIPTION

The 7B Series includes a variety of backplanes to address end user and evaluation needs. Backplanes are available in 16-, 8- and 4-channel sizes. The 16- and 8-channel backplanes can be mounted in a 19" by 3.5" panel space. The 4-channel backplane is ideal for evaluation purposes or small point count applications.

Each backplane channel has three screw terminals for field connections. The field connections accept transducer or signal inputs and provide excitation and current outputs when needed. A cold junction compensation sensor is mounted underneath the screw terminal block on each channel to accommodate thermocouple modules. Each I/O channel has six pin sockets to ensure interchangeability of the modules. A standard D type 25-pin connector is used for system interface on the 16-channel backplane. The connector provides 16 single ended input and/or output signals.

All 7B Series backplanes have three power supply connections. The modules can accept power supply levels from +14 to +35 volts. Two connections are used for a primary +24 volt power input and a backup power supply. A series diode is used to sense the power supply. If one supply fails, the other supply can take over. The diode also provides reverse power connection protection. The third power connection can be used for a +15 volt power supply since there is no diode drop in the line to affect the power supply level. A LED on each backplane indicates the power status.

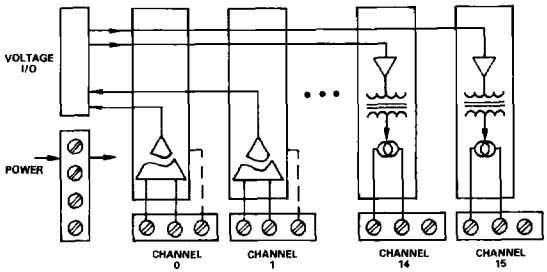

Figure 8. 7BP16 Block Diagram

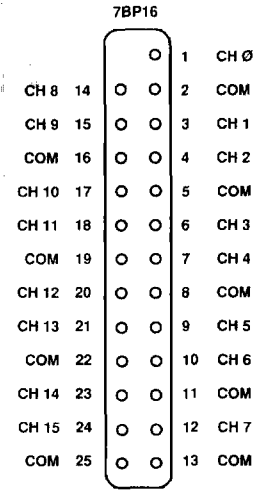

Figure 9. System Connection Pinout (Bottom View)

BACKPLANE SPECIFICATIONS

	7BP16	7BP08	7BP04
Channels	16	8	4
External Power Requirement	+14 V to +35 V	*	*
Cold Junction Sensor	On Each Channel	*	*
Size	3.5" × 17.4" (88.9 × 441.96 mm)	3.5" × 10" (88.9 × 254 mm)	3.5" × 6" (88.9 × 152.4 mm)

*Specifications same as 7BP16

ACCESSORIES

To facilitate system design with the 7B Series the following accessories are available:

Current Conversion Resistor. This encapsulated, precision 250 Ω resistor can be used with the 7B33 Isolated Voltage Input Module to convert a 4–20 mA current input to the 1–5 volt input for the module.

Rack Mount. A single piece metal chassis for mounting a 7B Series backplane in a 19" rack. Model number AC1363.

Cables. A 2 foot cable with a 25-pin D type connector and a 26-pin connector is available to connect the 7B Series backplane to systems compatible with the 3B and 5B Series families.

User's Manual. A complete manual is available to instruct the user on how to design and install systems using the 7B Series.