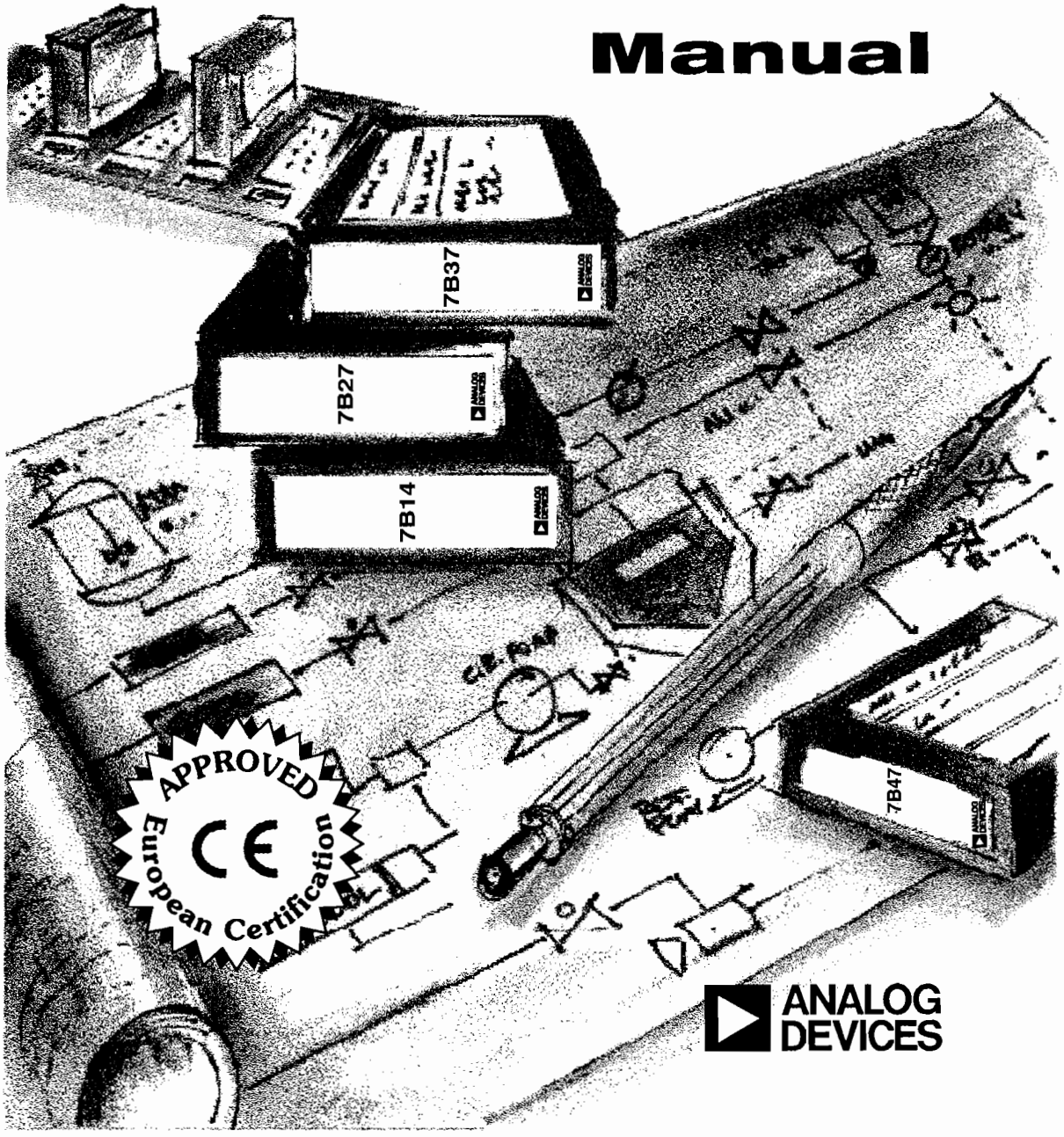
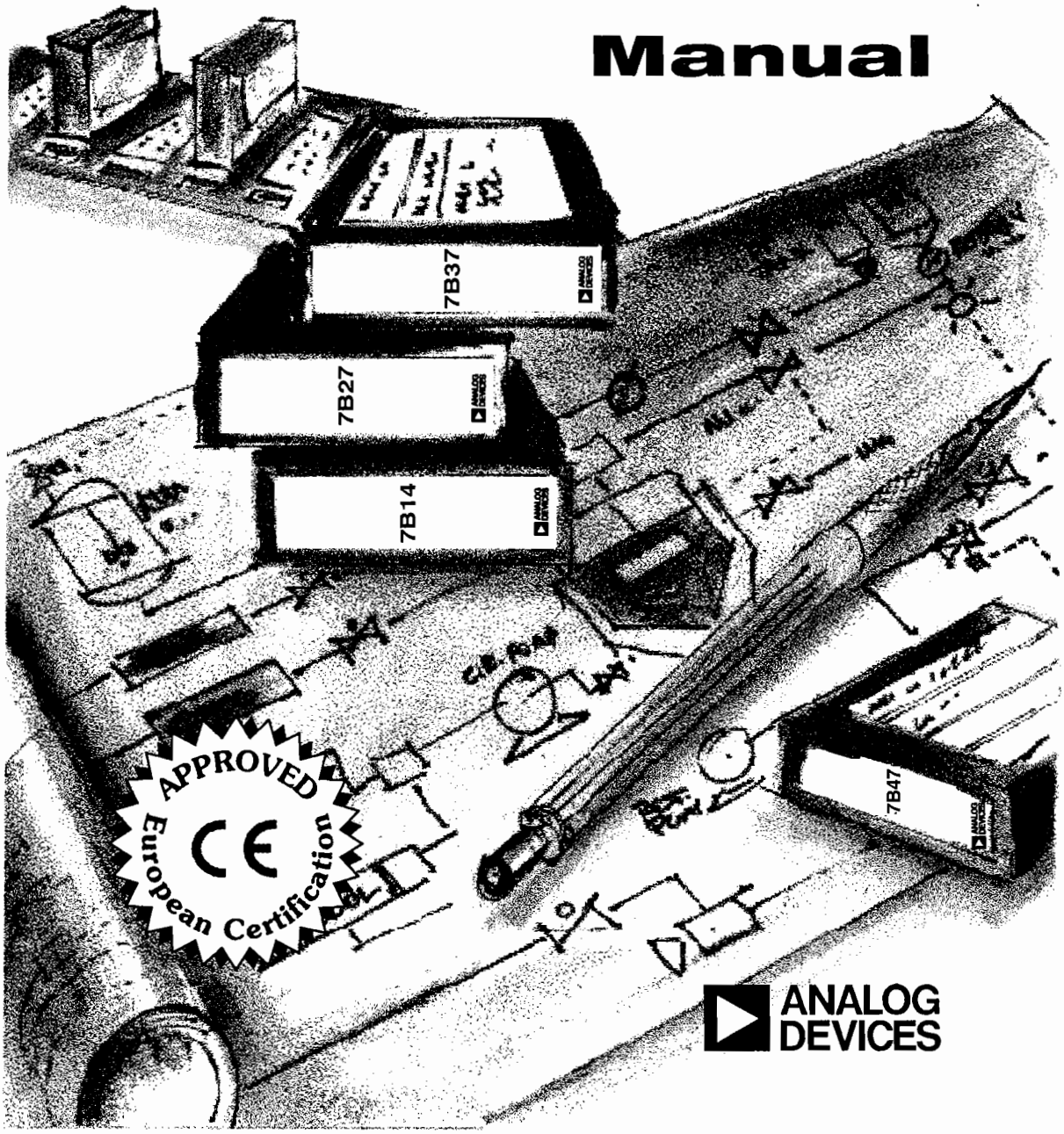
7B Series User's Manual



ANALOG DEVICES

7B Series User's Manual



7B Series User's Manual
98-1435902
AC1399

Contents

Contents

List of Tables

Preface

The *7B Series User's Manual* provides all the information required to set up a 7B Series system, using either a backplane supplied by Analog Devices or a user-designed backplane. It is intended for system designers responsible for building data acquisition systems. These users should be familiar with measurement and control principles and with their particular application; a technical background is not required.

The *7B Series User's Manual* is organized as follows:

- Chapter 1 provides an overview of the features of the 7B Series modules and 7B Series backplanes.
- Chapter 2 provides the information needed to unpack modules and backplanes, install modules in a backplane, mount a backplane, connect a power supply to a backplane, wire signals to a backplane, and connect a backplane to a process control system.
- Chapter 3 provides the information needed to design a backplane for 7B Series modules.
- Appendix A contains the specifications for 7B Series modules and 7B Series backplanes.
- Appendix B contains the transfer functions of the 7B27 and the 7B37.
- Appendix C contains the pin assignments for 7B Series modules and for the I/O connector on the 7B Series backplane.
- Appendix D contains a summary of specific model numbers for 7B Series modules.

- Appendix E contains information on where to obtain accessory items associated with a 7B Series system, as well as components used on the 7B backplane.
- Appendix F contains special considerations to keep in mind when using solid-state relay modules in a 7B Series system.
- Appendix G contains a component layout of the 7BP16-1 backplane.
- Appendix H contains the schematics of the 7BP04-1, 7BP08-1, and 7BP16-1.

An index completes this manual.

Note that when the instructions in this manual refer specifically to one of the backplanes available from Analog Devices, the term 7B Series backplane is used. If you are using a custom-designed backplane, you must adapt the instructions to meet your needs.

1 Overview

The 7B Series Signal Conditioners are isolated, high-performance, analog input and analog output signal conditioning modules. The 7B Series modules are designed to plug into sockets on either a 7B Series backplane, available from Analog Devices, or a user-designed backplane.

Analog input modules accept real-world analog signals and provide high-level output voltages to a process control system. Analog output modules accept high-level voltage inputs from the process control system and provide process current and voltage outputs to the process.

This chapter describes the features of the 7B Series signal conditioning modules and the 7B Series backplanes. Refer to Chapter 3 for information on designing your own backplanes for 7B Series modules.

7B Series Modules

The 7B Series analog input modules accept inputs from thermocouples, resistance temperature detectors (RTDs), millivolt and voltage sources, and process current signals. The 7B Series input modules provide high-level voltages that range from either 1 to 5 V or 0 to 10 V, depending on the specific module.

The 7B Series analog output modules accept high-level analog signals and provide either 4 to 20 mA, 0 to 20 mA, or ±10 V process signals, depending on the specific model.

Table 1-1 lists the input modules available; Table 1-2 lists the output modules available. Refer to Appendix A for a complete list of specifications for each module.

Table 1-1. 7B Series Input Modules

Module	Input Range	Isolation	Output Range
7B14	100 Ω Platinum Non-Isolated RTD 120 Ω Nickel Non-Isolated RTD 10 Ω Copper Non-Isolated RTD	None	1-5 V, 0-10 V
7B21	±10 V	1500 V rms	±10 V
7B27	J, K, T, E, R, S, and B Low-Isolated Thermocouple	100 V rms	1-5 V or 0-10 V
7B30	0-10 mV, ±10 mV, 0-100 mV, ±100 mV, 0-1 V, ±1 V, or 1-5 V	1500 V rms	1-5 V or 0-10 V
7B31	0-10 V, ±10 V, 0-5 V, or ±5 V	1500 V rms	1-5 V or 0-10 V
7B32	4-20 mA or 0-20 mA	1500 V rms	1-5 V or 0-10 V
7B33	1-5 V or 0-5 V[1]	1500 V rms	1-5 V or 0-10 V
7B34	100 Ω Platinum RTDs 120 Ω Nickel RTDs	1500 V rms	1-5 V or 0-10 V
7B35	4-20 mA[2] + Loop Power	1500 V rms	1-5 V or 2-10 V
7B37	J, K, T, E, R, S, and B Isolated Thermocouple	1500 V rms	1-5 V or 0-10 V
7B47	J, K, T, E, R, S, B, and N Isolated Thermocouple	1500 V rms	1-5 V or 0-10 V

Note

[1]Model 7B33 may be used to measure a process current input (4-20 mA or 0-20 mA) by installing a 250 Ω current sensing resistor, such as model AC1391, on the backplane. With this resistor installed, the current loop is maintained even when the module is removed from the backplane.

[2]Contains an isolated +24 V dc power supply to drive a 4-20 mA current loop. Allows you to connect a loop-powered (2-wire) transmitter without using a separate power supply. Maintains channel-to-channel isolation between transmitters.

Table 1-2. 7B Series Output Modules

Module	Output Range	Isolation	Input Range
7B22	±10 V	1500 V rms	±10 V
7B39	0-20 mA or 4-20 mA	1500 V rms	1-5 V or 0-10 V

Each 7B Series module is available in several versions, each with a specific input or output range. For example, the version of the 7B30 module with an input range of ±100 mV and an output range of 1 to 5 V is model number 7B30-07-1. Refer to Appendix D for a complete list of specific model numbers.

All 7B Series modules are identical in size. A module is shown in Figure 1-1.

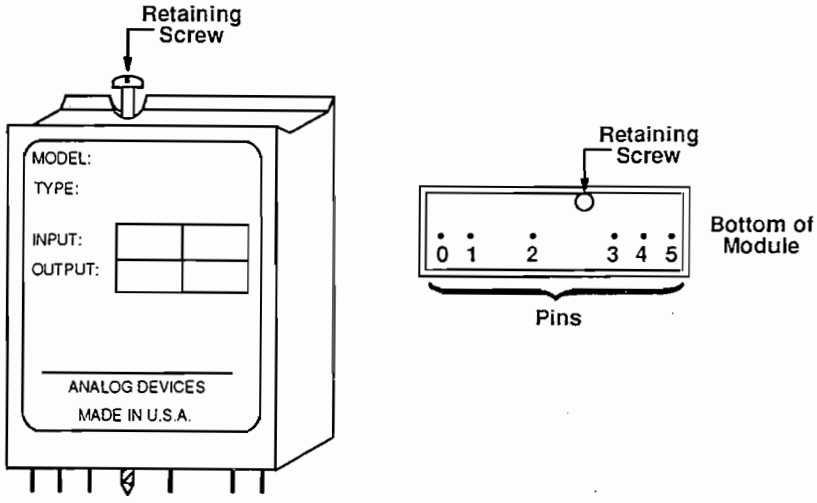


Figure 1-1. 7B Series Module

The voltage input modules (7B21, 7B30, 7B31, and 7B33), the current input modules (7B32 and 7B35), and the output modules (7B22 and 7B39) contain five pins. The RTD input modules (7B14 and 7B34) and the thermocouple input modules (7B27, 7B37, and 7B47) contain six pins. The pins are located at the bottom of the module, as shown in Figure 1-1. The pin assignments of a 7B Series module are listed in Table 1-3.

Table 1-3. 7B Series Module Pin Assignments

Pin	Input Module Function	Output Module Function
0[1]	Sensor Input	Not Used
1	Input High	Output High
2	Input Low	Output Low
3	Power Supply (dc)	Power Supply (dc)
4	Output Voltage	Input Voltage
5	Output and Power Common	Input and Power Common

Note

[1]This pin is found only on RTD input and thermocouple input modules.

The labels on the tops of the modules are color-coded to differentiate input modules from output modules, as follows:

- **Input** - White lettering on a black background.
- **Output** - White lettering on a red background.

Each module is packaged in a durable plastic shell and is designed to operate in the extended –40°C to +85°C temperature range.

The modules are calibrated in the factory to an accuracy of ±0.1%; they are not user-adjustable.

CSA Approval

7B Series modules are approved by the Canadian Standards Association (CSA) for use in Class I, Division 2, Groups A, B, C, and D Hazardous Locations. These approvals certify that the 7B Series is suitable for use in locations where a hazardous concentration of flammable gas may exist under fault conditions of operation. Equipment of this category is classified as being "Nonincendive" and needs no special enclosure or other physical safeguards.

7B Series Backplanes

The 7B Series product family includes the following backplanes, available from Analog Devices:

- **7BP04-1** - A 4-channel backplane.
- **7BP08-1** - An 8-channel backplane.
- **7BP16-1** - A 16-channel backplane.

A 7B Series backplane is shown in Figure 1-2.

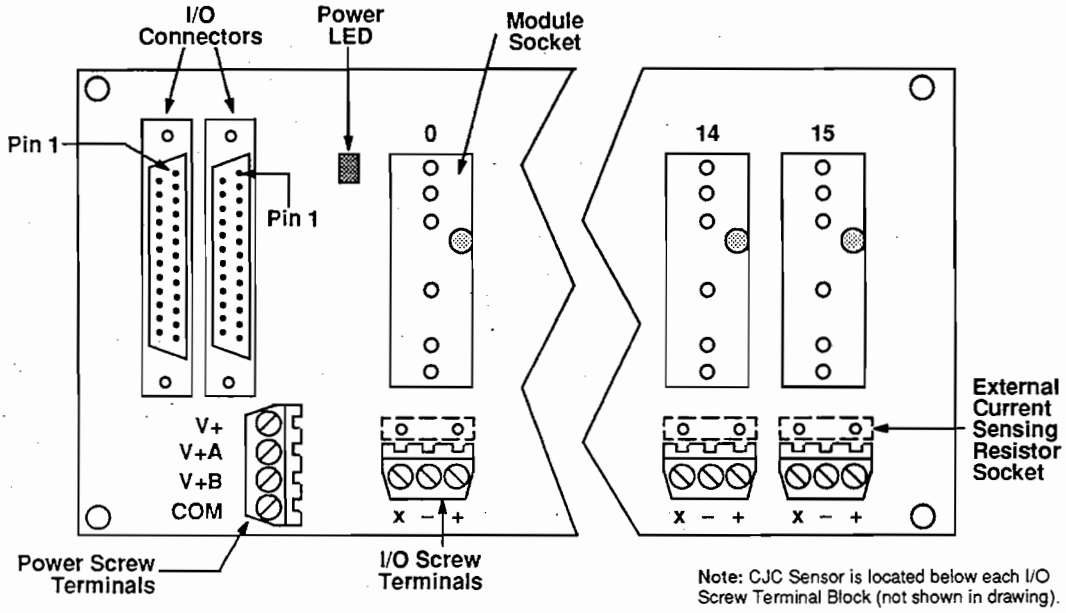


Figure 1-2. 7B Series Backplane

Each 7B Series backplane contains the following:

- Sockets for 7B Series modules (4, 8, or 16, depending on the backplane).
- Sockets for external current sensing resistors; the resistors allow you to use the 7B33 voltage input module for process current input.
- Three I/O screw terminals for each channel.
- Two identical 25-pin I/O connectors to provide high-level voltage I/O for all channels. The two connectors allow you to provide separate input and output connections when using analog input modules and analog output modules on the same 7B Series backplane.

- CJC thermistor for each channel to accommodate thermocouple modules; the thermistors measure the temperature of the screw terminals and apply a correction factor to the thermocouple reading. The thermistors are embedded in the circuitry under the I/O screw terminal blocks and are not visible on the backplane.
- Four power screw terminals for connecting external power.
- One LED that indicates whether power is present. (If power is present, the LED is lit.)

You can mount 7B Series backplanes either in a 19″ rack using rack-mount kit AC1363, available from Analog Devices, or directly to a wall using standoffs and mounting screws included with the rack-mount kit. Refer to Mounting a Backplane in Chapter 2 for more information.

2 Setting Up a 7B Series System

This chapter provides the information needed to set up a 7B Series system. It includes information about unpacking 7B Series modules and backplanes, installing 7B Series modules in a 7B Series backplane, mounting a 7B Series backplane, connecting a power supply to a 7B Series backplane, wiring signals to a 7B Series backplane, and connecting a 7B Series backplane to a process control system.

Unpacking Modules and Backplanes

Caution: To adhere to strict electrostatic discharge (ESD) procedures, it is recommended that you use wrist strap grounds when handling any electronic devices or products. Failure to eliminate electrostatic discharge may damage components in your 7B Series system.

7B Series modules and backplanes are packaged in antistatic bags to avoid damage to sensitive components. Before removing a module or backplane from its shipping bag, hold the bag and touch it to local ground to discharge any built-up static electricity. This is particularly important in dry or low-humidity climates.

After grounding has been established, remove the module or backplane and inspect it for signs of damage and loose components. If the module or backplane appears damaged in any way, immediately contact your local Analog Devices sales office. Do not attempt to use a damaged module or backplane.

Store unused modules and backplanes in the antistatic bags in which they were shipped.

Installing 7B Series Modules

You can install any 7B Series module in any socket on a 7B Series backplane. To install a module, perform the following steps:

1. Align the module's retaining screw (provided with the module) and connector pins with the holes in the backplane.
2. Gently insert the module into position.
3. Tighten the retaining screw. Refer to Figure 2-1.

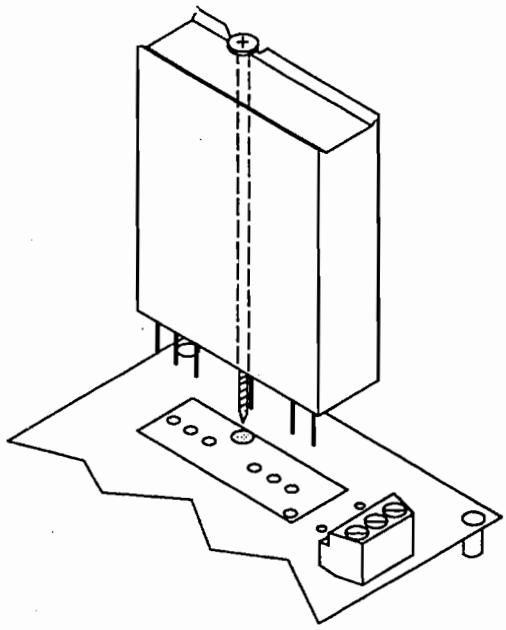


Figure 2-1. Installing a Module

Note: You can remove and install 7B Series modules even when power is present on the backplane.

Mounting a Backplane

You can mount 7BP04-1, 7BP08-1, and 7BP16-1 backplanes on a wall or in a 19″ rack using rack-mount kit AC1363 (Figure 2-2). The mounting procedures are described in the following sections.

Wall Mounting

To mount a 7B Series backplane on a wall, perform the following steps:

1. Mark the location of the mounting holes used to support the backplane, as shown in Figure 2-3. Note that the dimensions are given both in inches and in millimeters (shown in parentheses).

   The four corner mounting holes are sufficient for most applications; however, if you require additional rigidity for the 7BP08-1 or 7BP16-1 backplane, mark the optional mounting holes provided on these backplanes.

2. Drill and tap the marked mounting holes for the 6-32 x 1″ screws.

3. Mount the backplane by inserting the 6-32 x1″ screws through the standoffs in the backplane and into the wall or panel. If you can access the other side of the wall/panel, attach a nut and lockwasher to each screw.

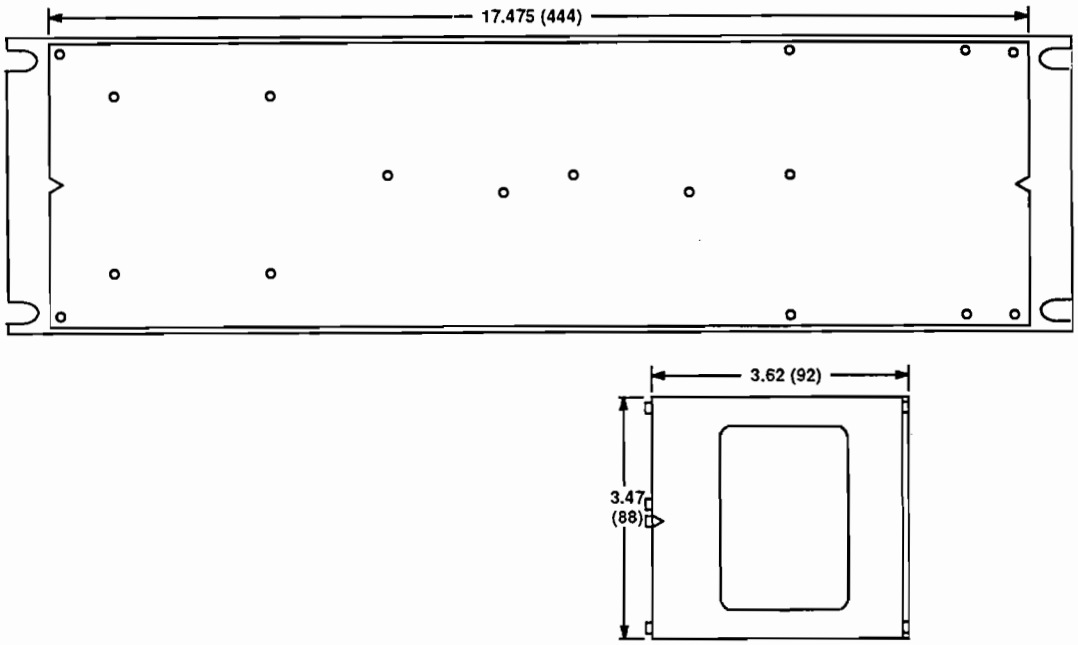
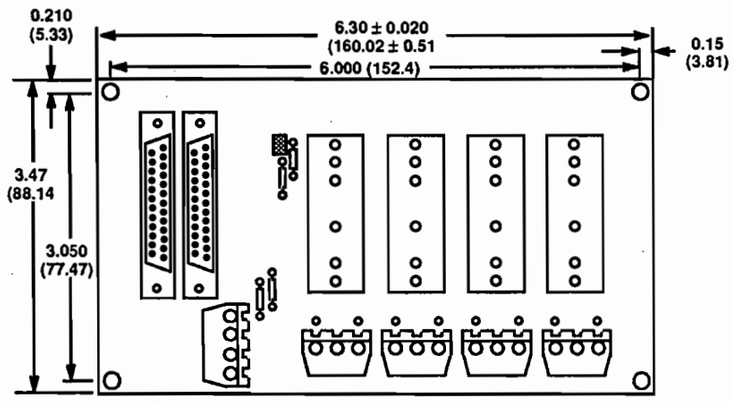
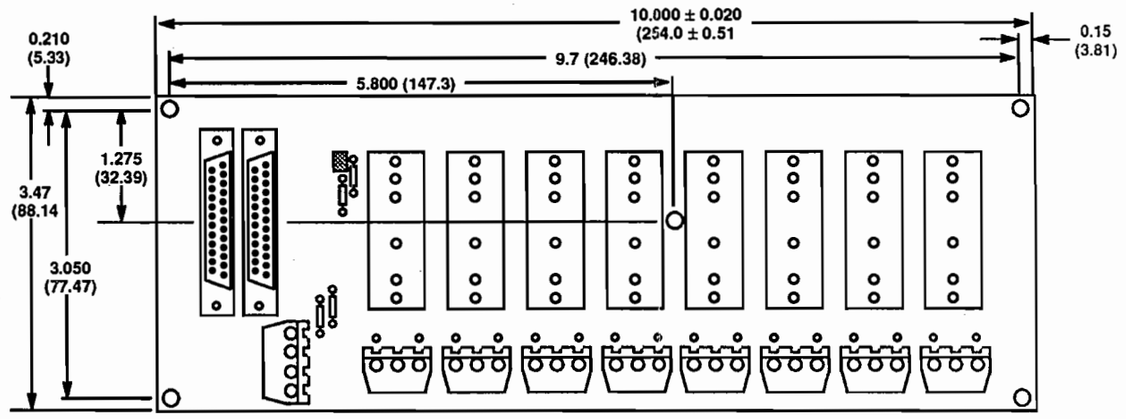


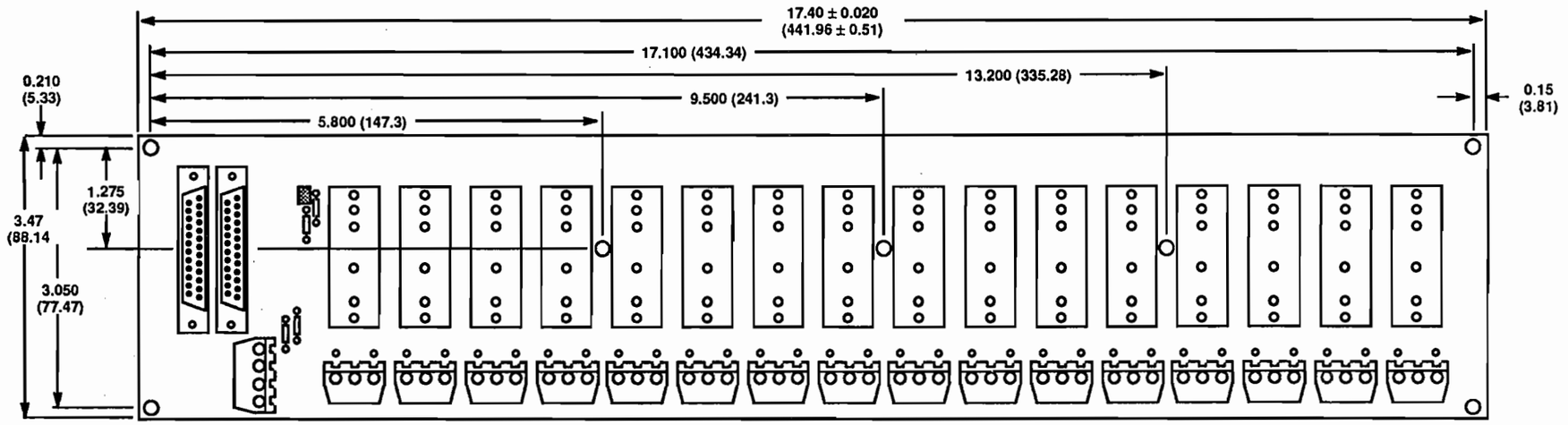
Figure 2-2. AC1363 Rack Mount Diagram
(dimensions in inches and (mm))



7BP04-1



7BP08-1



7BP16-1

Figure 2-3. Location of Mounting Holes

Rack Mounting

To mount a 7B Series backplane in a rack using rack-mount kit AC1363, perform the following steps:

1. Place the rack-mount panel on a flat surface and slide the backplane into the rack-mount panel from the side.
2. Insert four 6-32 x 1″ screws, shipped with the 7B Series backplane, through the standoffs in the four corners of the backplane and into the threaded inserts on the rack-mount panel. Refer to Figure 2-4.

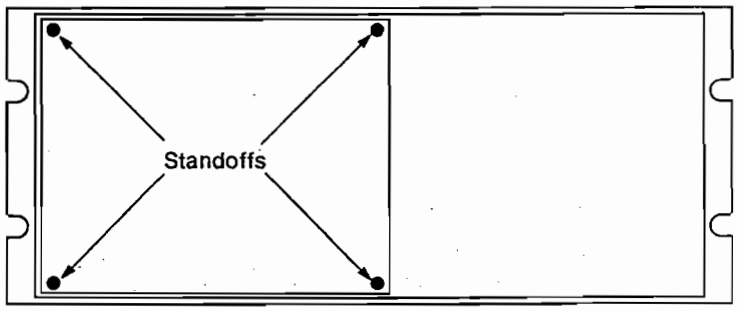


Figure 2-4. Attaching the 7B Series Backplane to the Rack-Mount Panel

Four screws are sufficient for most applications; however, if you require additional rigidity for the 7BP08-1 or 7BP16-1 backplane, insert additional 6-32 x 1″ screws through the optional standoffs provided on these backplanes.

3. With a Phillips-head screwdriver, tighten the screws.
4. Push the four self-retaining fasteners, supplied with the rack-mount kit, onto the rails inside the rack. The fasteners must be located four inches vertically from one another. See Figure 2-5.

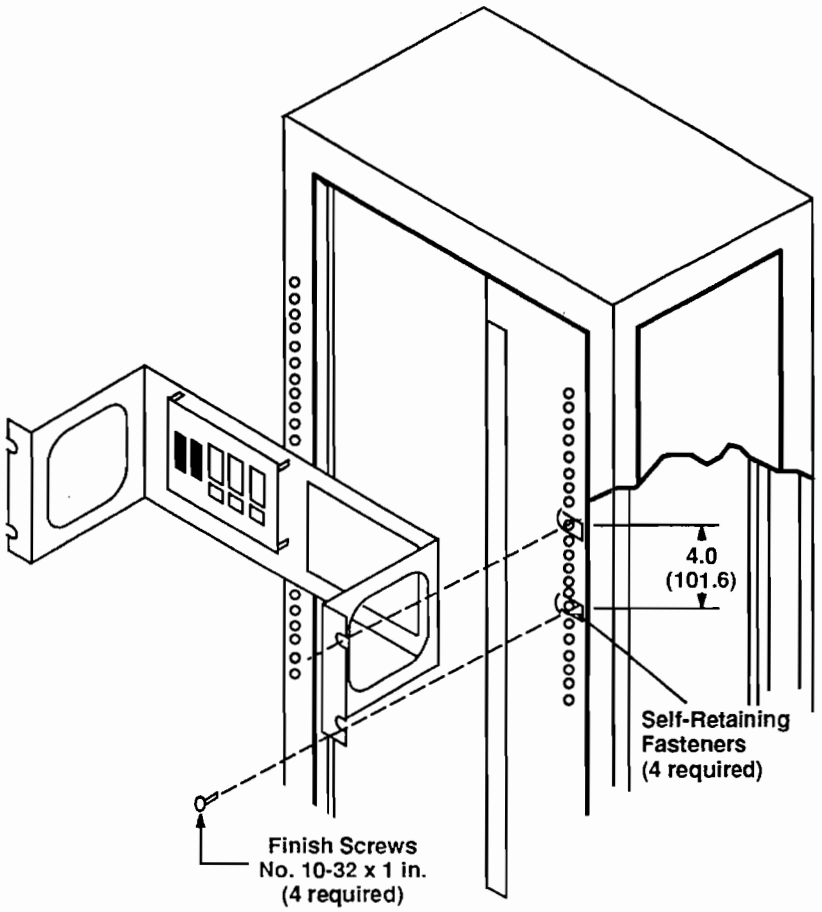


Figure 2-5. Attaching the Rack-Mount Panel to the Rack

5. Align the rack-mount panel with the self-retaining fasteners and attach with four #10-32 x 1″ finish screws, supplied with the rack-mount kit.
6. With a Phillips-head screwdriver, tighten the screws.

Connecting a Power Supply

To power a 7B Series backplane (including any installed modules), use a single, unregulated, external power supply that provides +24 V dc.

To determine the correct current rating for the +24 V dc power supply, add the current requirements for all the modules on the backplane. The current requirements are listed in Table 2-1. (Note that no additional current is required for a 7B Series backplane.)

Table 2-1. Current Requirements

Module	Current Requirement	Module	Current Requirement
7B14	25 mA	7B32	20 mA
7B21	35 mA	7B33	20 mA
7B22	20 mA	7B34	25 mA
7B27	25 mA	7B35	60 mA
7B30	25 mA	7B37	25 mA
7B31	25 mA	7B39	60 mA
		7B47	25 mA

Note: To reduce high-frequency line noise that may be transmitted through the 7B Series modules, it is recommended that you use a +24 V dc linear power supply.

One LED on the backplane indicates whether power is present. (If power is present, the LED is lit.) Refer to Figure 1-2 for the location of the LED.

You can provide power to a 7B Series backplane in one of the following ways:

- **Normal Power Connection** - Under normal operating conditions, you provide power to a 7B Series backplane by connecting a single +24 V dc power supply to the backplane. A diode located on the power input line provides protection from reverse polarity connections.

  Attach the power supply to one of the power supply screw terminals (V+A or V+B) on the 7B Series backplane. Refer to Figure 2-6.

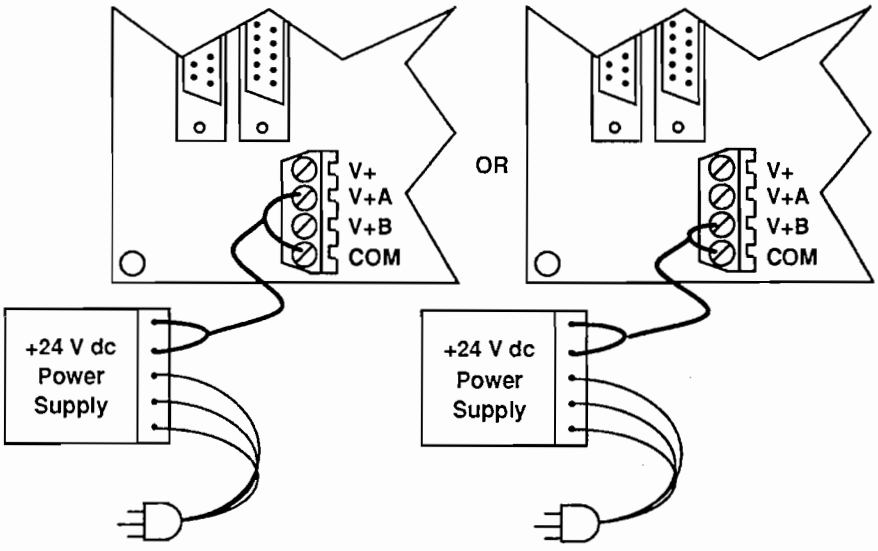


Figure 2-6. Attaching a Single Power Supply

- **Redundant Power Connection** - To guard against disruptions in operation, you can provide redundant power to a 7B Series backplane by connecting two +24 V dc power supplies to the backplane. Diodes located on the two power input lines allow switching if one of the power supplies fails. The diodes also provide protection from reverse polarity connections.

  Attach one power supply to power supply screw terminal V+A on the 7B Series backplane and the other power supply to power supply screw terminal V+B. Refer to Figure 2-7.

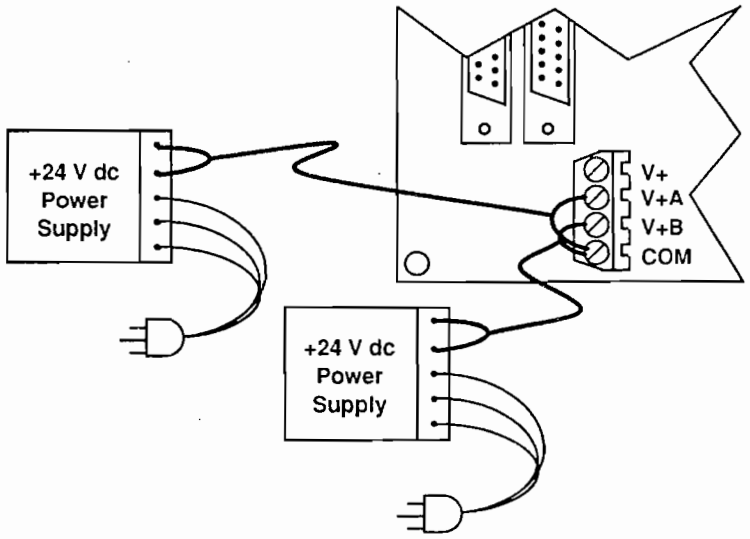


Figure 2-7. Attaching Two Power Supplies

- **Low-Voltage Power Connection** - If you are already using a low-voltage, +15 V dc power supply in an existing installation, you can avoid the voltage drop found across the diodes by using the low-voltage power connection provided on the 7B Series backplane.

Attach the +15 V dc power supply to power supply screw terminal V+ on the 7B Series backplane. Refer to Figure 2-8.

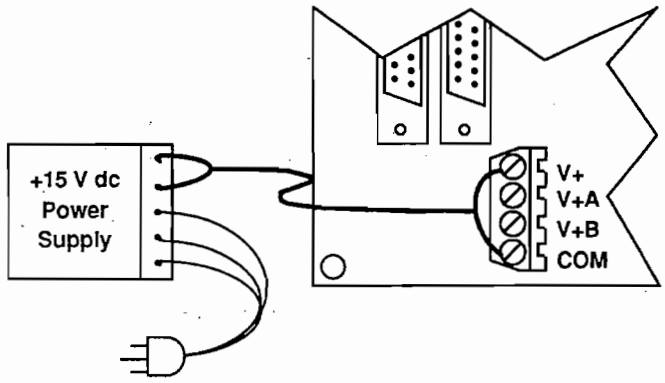


Figure 2-8. Attaching a Low-Voltage Power Supply

Note: A 7B Series backplane does not provide protection from reverse polarity connections when a low-voltage power supply is attached to power supply screw terminal V+.

Wiring Signals to a Backplane

Attach analog input and output signals to a 7B Series backplane through I/O screw terminals associated with each 7B Series module (labeled ×, –, and +). The functions of the screw terminals vary depending on the analog input or output type. Refer to Figure 1-2 for the location of the I/O screw terminals on a 7B Series backplane.

It is recommended that you use 14-20 AWG wire to connect signals to a backplane.

It is also recommended that you shield low-level analog signals, such as those found when using thermocouples and RTDs, to ensure the integrity of the analog signal. With shielding, the measurement device does not pick up common-mode voltage that may be present in the environment. Terminate the shield wire at only one point. Tie the shield wire to the – screw terminal for all input modules except the 7B34; tie the shield wire to the + screw terminal for the 7B34. Alternately, the shield may be tied to ground. Figure 2-9 illustrates the shielding of an RTD input (using the 7B34 module) and the shielding of a thermocouple input.

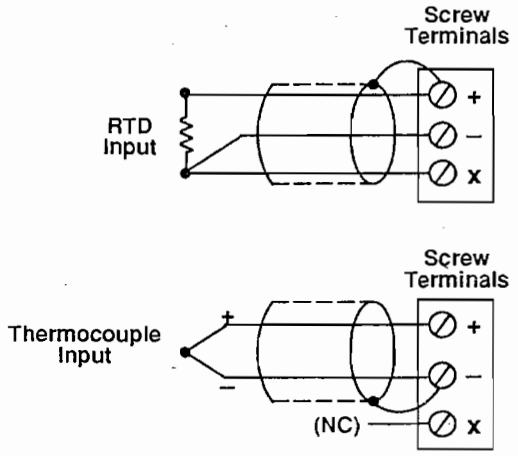


Figure 2-9. Shielding Signals

Attach analog input and analog output signals to a backplane as follows:

- **Process Current Input** - Examples of wiring process current input signals to 7B32 and 7B35 modules are shown in Figure 2-10.

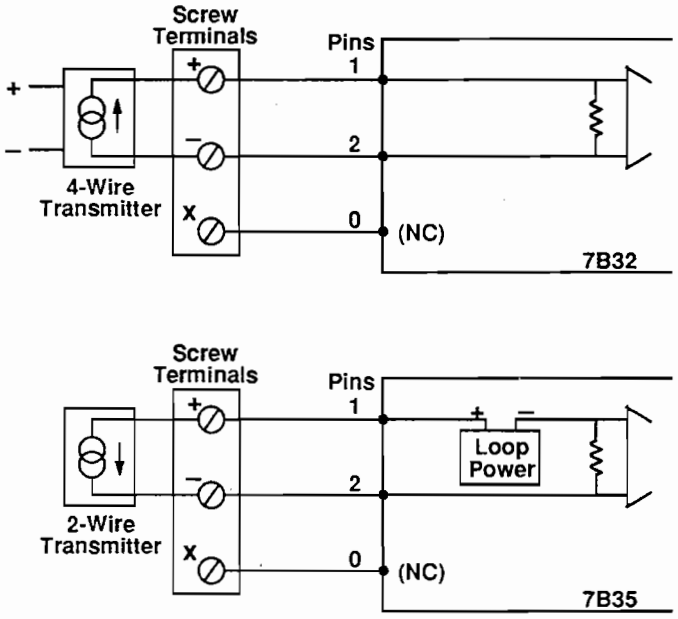


Figure 2-10. Process Current Input

To use the 7B33 voltage input module for process current input, install a 250 Ω current sensing resistor, such as the AC1391 from Analog Devices, on the backplane. With the resistor installed, the current loop is maintained even when the module is removed from the circuit. Install the AC1391 in the appropriate external current sense resistor socket on the 7B Series backplane. Refer to Figures 2-11 and 2-12.

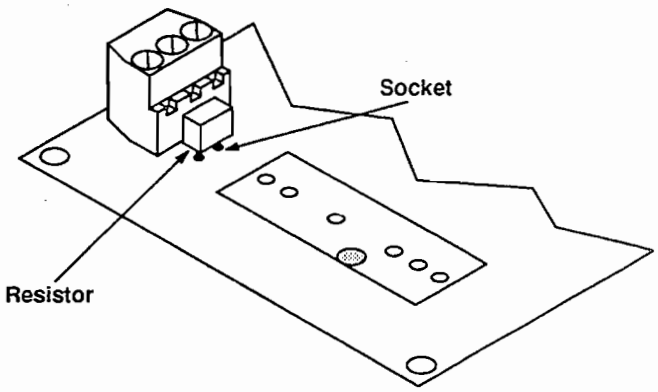


Figure 2-11. Installing the External 250 Ω Current Sensing Resistor (AC1391)

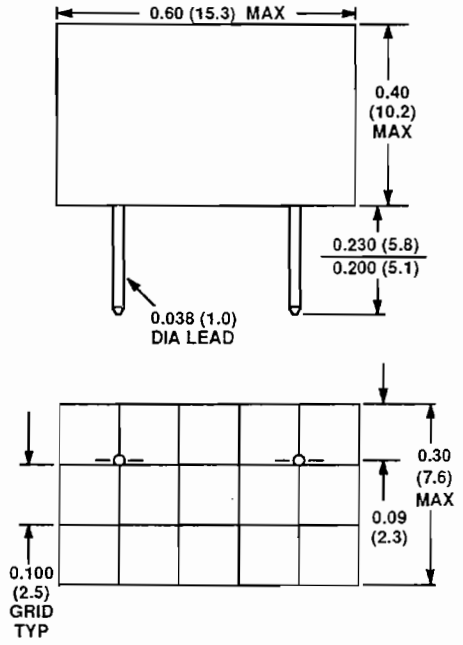


Figure 2-12. AC1391 Resistor Outline Drawing
(Dimensions shown in inches and (mm)).

- **Thermocouple Input** - An example of wiring a thermocouple input signal to a 7B27, 7B37, or 7B47 module is shown in Figure 2-13.

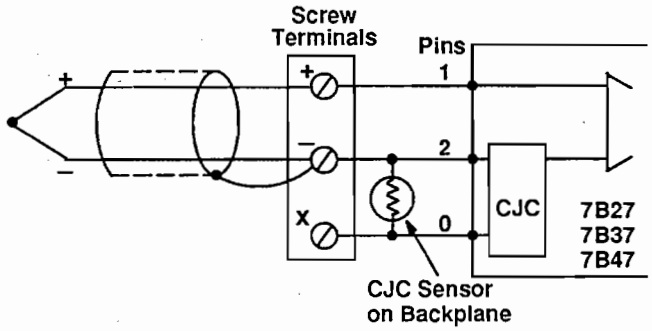


Figure 2-13. Thermocouple Input

Note: If an open circuit is detected at the input to a 7B27, 7B37, or 7B47 module, the output of the modules goes to full scale.

- **RTD Input** - An example of wiring an RTD input signal to a 7B14 or 7B34 module is shown in Figure 2-14.

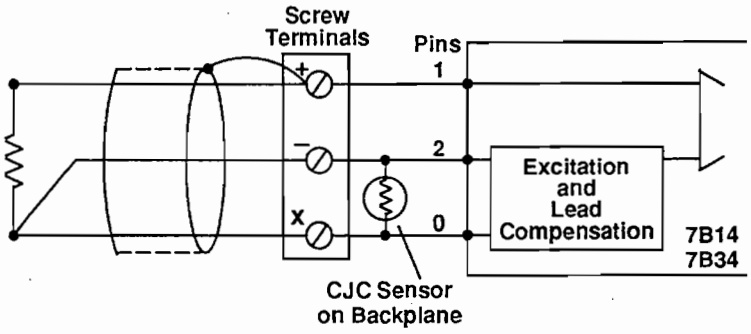


Figure 2-14. RTD Input

Notes: The CJC sensors on the 7B Series backplane do not affect the RTD measurement.

If an open circuit is detected at the input to a 7B14 or 7B34 module, the output of the module goes to full scale.

- **Millivolt and Voltage Input** - An example of wiring a millivolt or voltage input signal to a 7B21, 7B30, 7B31, or 7B33 module is shown in Figure 2-15.

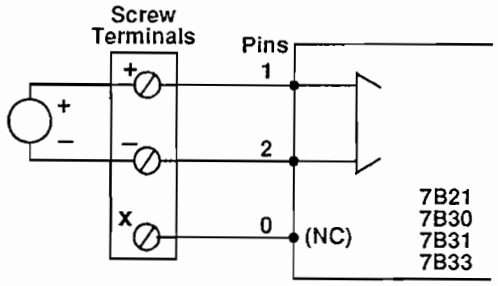


Figure 2-15. Millivolt and Voltage Input

- **Process Current Output** - An example of wiring a process current output signal to a 7B39 module is shown in Figure 2-16.

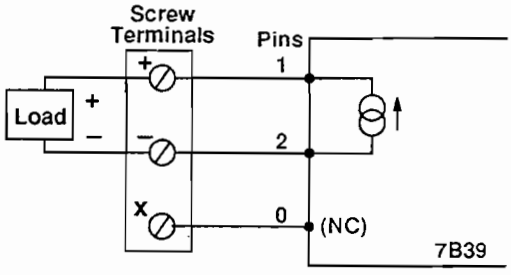


Figure 2-16. Process Current Output

- **Voltage Output** - An example of wiring a voltage output signal to a 7B22 module is shown in Figure 2-17.

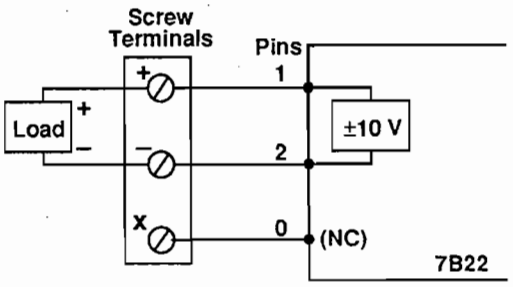


Figure 2-17. Voltage Output

Connecting to the Process Control System

To connect a 7B Series backplane to a process control system, use the two 25-pin, I/O connectors on the backplane. The two I/O connectors are completely interchangeable, allowing you to wire input and output signals or analog and digital signals to the same backplane.

Figure 2-18 illustrates the pin assignments for the two I/O connectors. Refer to Figure 1-2 for the location of the connectors on the backplane.

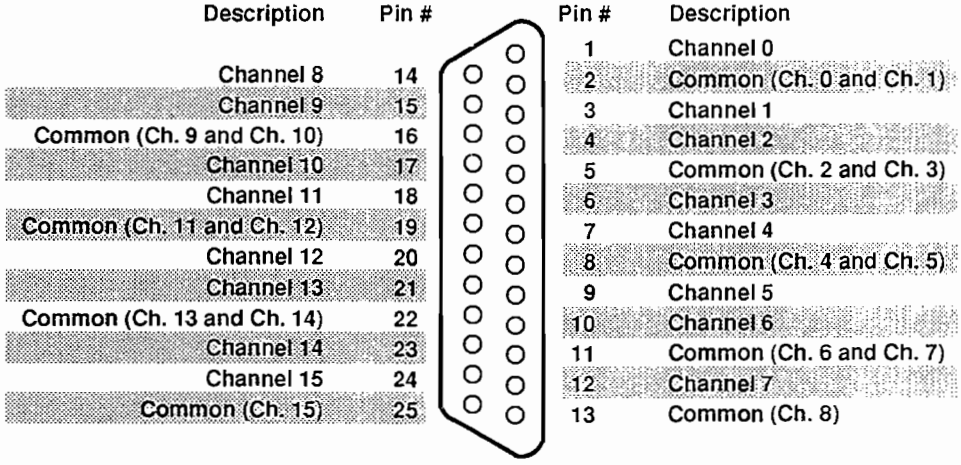


Figure 2-18. I/O Connector and Pin Assignments (Top View)

You can attach a 7B Series backplane to the following:

- An analog input or analog output board installed in either a host computer or a programmable controller. An example of such a board is the RTI-815® analog I/O board, which is available from Analog Devices and is installed in an IBM personal computer.

- A screw termination board, which converts the pins on the I/O connector to screw terminals. When using input modules on the 7B Series backplane, you can wire point-to-point from the screw termination board to your control system. When using output modules on the 7B Series backplane, you can wire point-to-point from your control system to the screw termination board. An example of a screw termination board is the AC1324, available from Analog Devices.

Connections to an RTI-815 analog I/O board and to an AC1324 screw termination board are described in the following sections. If you are using a different board, refer to the documentation supplied with the board and adapt these instructions to meet your needs.

Connecting to an RTI-815 Analog I/O Board

To connect a 7B Series backplane to an RTI-815 analog I/O board installed in a host computer, perform the following steps:

1. Make sure that you have the AC1393 adapter cable and a 50-pin to 26-pin cable, such as the AC1335. Both the AC1393 and the AC1335 are available from Analog Devices.
2. Attach the 25-pin female connector on the AC1393 adapter cable to one of the I/O connectors on the 7B Series backplane.
3. Attach the 26-pin male connector on the AC1393 adapter cable to the 26-pin female connector on the AC1335 cable.
4. Attach the 50-pin female connector on the AC1335 cable to the J2 connector on the RTI-815 board. The AC1335 cable automatically routes the signals from the 7B Series backplane to the appropriate pins on the J2 connector.

Figure 2-19 illustrates the connection of a 7B Series backplane to an RTI-815 board. The thermocouple input to the 7B37 module in channel 0 is converted by the RTI-815 board. A program running on the host computer reads the value and displays it on the screen.

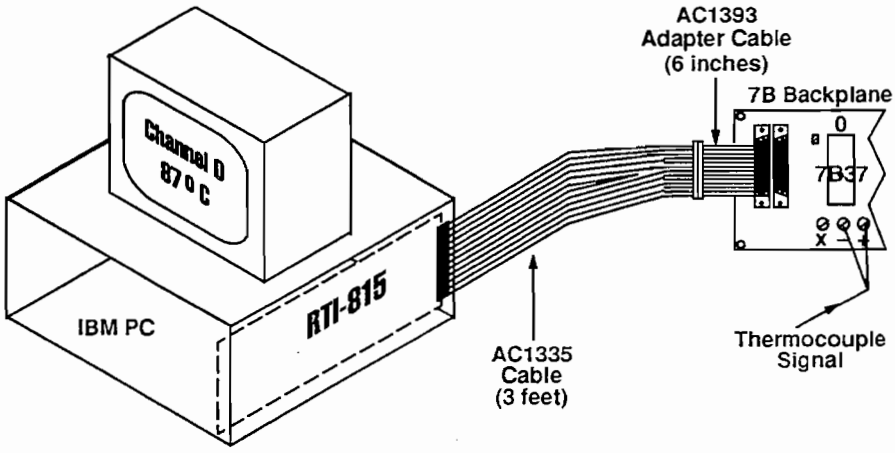


Figure 2-19. Connecting a 7B Series Backplane to an RTI-815

Notes: If you are using another RTI board from Analog Devices, use the AC1393 adapter cable and the same RTI board cable that connects a 3B Series or 5B Series backplane to the analog input or analog output board. Refer to your board documentation for more information.

If you are not using an RTI board from Analog Devices, make sure that you use an appropriate cable. One end of the cable should have a 25-pin female connector compatible with the pin assignments of the I/O connector on the 7B Series backplane; refer to Figure 2-18. The other end of the cable should have a connector appropriate for the analog input or analog output board.

Connecting to an AC1324 Screw Termination Board

To connect a 7B Series backplane to an AC1324 screw termination board, perform the following steps:

1. Make sure that you have the AC1393 adapter cable and a 26-pin to 26-pin cable, such as the AC1315. Both the AC1393 and the AC1315 are available from Analog Devices.
2. Attach the 25-pin female connector on the AC1393 adapter cable to one of the I/O connectors on the 7B Series backplane.
3. Attach the 26-pin male connector on the AC1393 adapter cable to a 26-pin female connector on the AC1315 cable.
4. Attach the other 26-pin female connector on the AC1315 cable to the connector on the AC1324 screw termination board. The AC1315 cable automatically routes the signals from the 7B Series backplane to the appropriate pins on the AC1324 connector. Refer to Table 2-2.

Figure 2-20 illustrates the connection of a 7B Series backplane to an AC1324 screw termination board. The voltage input signal connected to screw terminals 1 and 3 on the AC1324 is sent through the I/O connector on the 7B Series backplane and out to the device connected to the 7B22 module in channel 0.

Table 2-2. 7B Backplane I/O Pinouts in Relation to AC1324 Pinouts

7B Pinouts	Nomenclaure	AC1324 Pinouts
1	Channel 0	1
2	Common (Ch. 0 and Ch. 1)	3
3	Channel 1	5
4	Channel 2	7
5	Common (Ch. 2 and Ch. 3)	9
6	Channel 3	11
7	Channel 4	13
8	Common (Ch. 4 and Ch. 5)	15
9	Channel 5	17
10	Channel 6	19
11	Common (Ch. 6 and Ch. 7)	21
12	Channel 7	23
13	Common (Ch. 8)	25
14	Channel 8	2
15	Channel 9	4
16	Common (Ch. 9 and Ch. 10)	6
17	Channel 10	8
18	Channel 11	10
19	Common (Ch. 11 and Ch. 12)	12
20	Channel 12	14
21	Channel 13	16
22	Common (Ch. 13 and Ch. 14)	18
23	Channel 14	20
24	Channel 15	22
25	Common (Ch. 15)	24
N/A	Unused	26

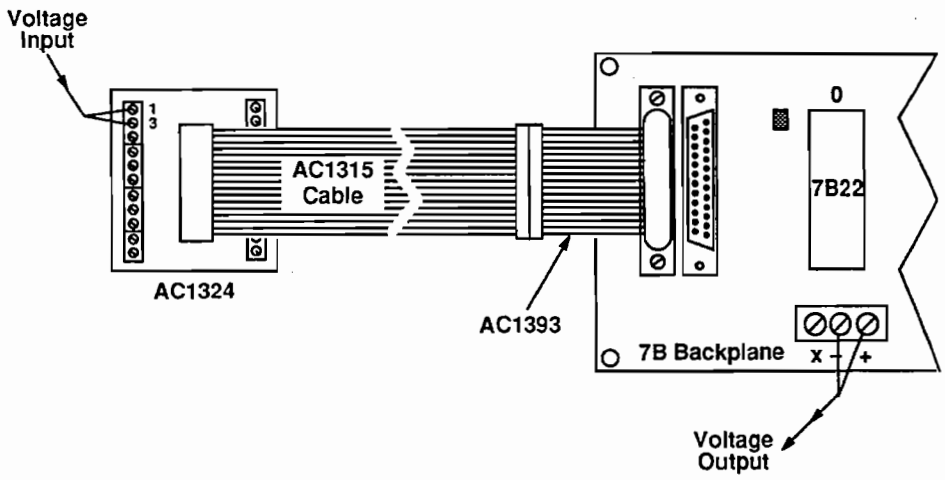


Figure 2-20. Connecting a 7B Series Backplane to an AC1324

Note: If you are not using an AC1324 screw termination board from Analog Devices, make sure that you use an appropriate cable. One end of the cable should have a 25-pin female connector compatible with the pin assignments of the I/O connector on the 7B Series backplane; refer to Figure 2-18. The other end of the cable should have a connector appropriate for the screw termination board.

3 Designing Your Own Backplane

This chapter provides the information required to design your own backplane for 7B Series modules. For your convenience, Appendix F contains the component layout of the 16-channel backplane provided by Analog Devices. Refer to Appendix E for a list of components that you can use when designing your own backplane.

The dimensions of a 7B Series module are shown in Figure 3-1. Note that the dimensions are given both in inches and in millimeters (shown in parentheses).

The pins of a 7B Series module are 0.039″ (0.55 mm) in diameter and 0.21″ (5.3 mm) in length; all pins are gold-plated and are designed to be inserted into miniature spring sockets. The voltage input and output modules and the process current input and output modules contain five pins; the RTD input and thermocouple input modules contain six pins.

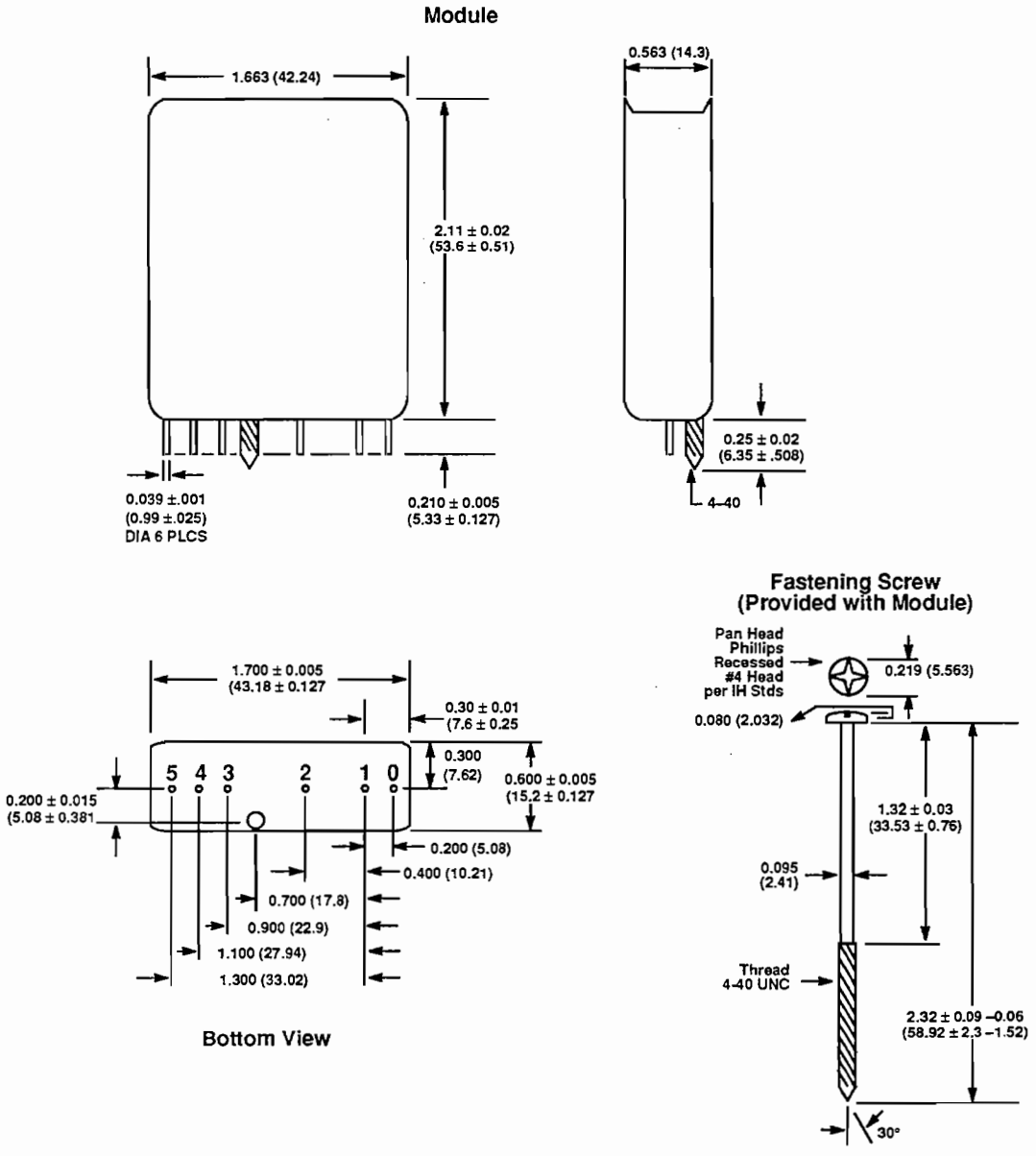


Figure 3-1. 7B Series Module Dimensions

When designing your own backplane, keep the following considerations in mind:

- If you are planning to use thermocouple input modules, it is recommended that you provide a space for CJC temperature sensors.

  A CJC sensor should be placed across pins 0 and 2, as close as possible to the point where the thermocouple wire connects to the screw terminal. You can provide CJC sensors for every channel, if desired; only the thermocouple modules receive the compensated signal.

- If you are planning to use voltage input modules for process current inputs, provide a space on the backplane for current sensing resistors across module pins 1 and 2.

  Alternatively, a current sensing resistor can be placed directly across the screw terminals, + and –. Make sure that the screw terminals are large enough to mount the resistors directly on the terminals.

- Although the width of 7B Series modules permits installation on 0.625" (16 mm) centers, since large interchannel voltages may exist, make sure that you provide an adequate distance between backplane conductors. Make sure that isolated and nonisolated tracks on the backplane are separated enough to support the required isolation voltage system's performance. The appropriate distance between tracks varies, depending on the application and the locale. Consult one of the standards agencies that has set minimum spacings as requirements for accreditation.

- In situations where the +24 V dc power voltage may exceed the maximum rating of the 7B Series module (+29 V dc for the 7B21 and 7B22, +35 V dc for all others), it is recommended that you use a diode transient absorber (transzorb) rather than a varistor. A transzorb is a unipolar device that functions as a diode, where a varistor is a bipolar device. Refer to Appendix E for the name of a suggested manufacturer of transzorbs.

  Since the transzorb may not protect the 7B Series modules from negative voltages (–0.8 V or greater) that can damage the modules, it is also recommended that you place decoupling capacitors across the power supply voltage lines to act as bypass capacitors on all transients.

  In addition, it is recommended that you place a series diode in the positive leg of the power supply to protect the 7B Series modules if the power supply leads are connected in reverse. Place the decoupling capacitors after (on the module side of) the diode. Refer to Figure 3-2.

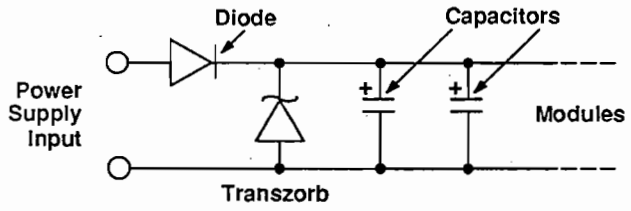


Figure 3-2. Protecting 7B Series Modules from Power Supply Transients

A Specifications

Tables A-1 through A-15 contain the specifications for the 7B Series modules; the modules are presented in numerical order. Table A-15 contains the specifications for the 7B Series backplanes. Unless otherwise noted, specifications are typical, based on a temperature of +23°C and a +24 V dc power supply voltage.

Table A-1. 7B14 Non-Isolated Linearized RTD Input Module

Feature	Specification
Input Range[1]	
7B14-01-X	–100°C to +100°C (–148°F to +212°F)
7B14-02-X	0°C to +100°C (+32°F to +212°F)
7B14-03-X	0°C to +200°C (+32°F to +392°F)
7B14-04-X	0°C to +600°C (+32°F to +1112°F)
7B14-05-X	–50°C to +350°C (–58°F to +662°F)
7B14-N-01-X	0°C to +300°C (+32°F to +573°F)
7B14-N-02-X	0°C to +200°C (+32°F to +392°F)
7B14-C-02-X	0°C to +120°C (+32°F to +248°F)
Output range options[1,2]	1-5 V, 0-10 V

Table A-1. 7B14 Non-Isolated Linearized RTD Input Module (cont.)

Feature	Specification
Accuracy[3]	
7B14-01-X	±0.15% span maximum
7B14-02-X	±0.2% span maximum
7B14-03-X	±0.15% span maximum
7B14-04-X	±0.1% span maximum
7B14-05-X	±0.1% span maximum
7B14-N-01-X	±0.03% span maximum
7B14-N-02-X	±0.03% span maximum
7B14-C-02-X	±1.0% span maximum
Nonlinearity[4]	
7B14-01-X, 02-X, 03-X, 04-X, 05-X	±0.05% span maximum
7B14-N-01-X	±0.12% span maximum
7B14-N-02-X	±0.14% span maximum
7B14-C-02-X	±0.05% span maximum
Stability vs. temperature, –40°C to +85°C	
Span	±60 ppm/°C
Input Offset	±1 µV/°C
Zero Suppression	±0.002% (R_Z/R_{SPAN})[5]/°C
Output Offset	±0.002% span/°C
Lead resistance effect	±0.02°C/Ω
Output resistance	less than 1 Ω
Noise	
Peak @ 5 MHz B/W	1 mV
RMS @ 10 Hz to 100 KHz B/W	0.4 mV
Peak @ 0.1 Hz to 10 Hz B.W	0.6 µV
Supply sensitivity	±0.0001%/% Vs
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	250 ms

Table A-1. 7B14 Non-Isolated Linearized RTD Input Module (cont.)

Feature	Specification
Normal-Mode Rejection Input-to-output and power @ 50/60 Hz	60 dB
Input protection	±30 V dc continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4 Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5W @ 400 MHz @ 3′
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	45 grams

Notes

[1]The X in the 7B14 model number designations is used to identify the output voltage range option. If X = 1, then the 7B14 is factory configured for a 1-5 V output. If X = 2, then the 7B14 is factory configured for a 0-10 V output. The standard range 7B14's (i.e., 7B14-01-X, 02-X, 03-X, 04-X, and 05-X) are configured for a 100 Ω Platinum RTD with the DIN standard α of 0.000385. The 7B14-N series is configured for a 120 Ω Nickel RTD. The 7B14-C series is configured for a 10 Ω Copper RTD.

[2]Into 2 k Ω minimum load.

[3]Includes effects of repeatability, hysteresis, and linearity.

[4]Calculated using best straight line.

[5]R_Z is the value of the RTD resistance at the lowest measurement point. R_{SPAN} is the change in resistance over the measurement span.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-2. 7B21 Isolated Voltage Input Module

Feature	Specification
Input range	±10 V
Output range[1]	±10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset[4] Output offset	 ±35 ppm/°C N/A ±0.001% span/°C
Input resistance[5]	2 MΩ
Input bias current	3 nA
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 6 mV 1.5 mV 6 μV
Supply sensitivity	±0.0002%/% V_S
Nominal 3 dB B/W	300 Hz
Response time (0 to 90%)	1 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 100 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II

Table A-2. 7B21 Isolated Voltage Input Module (cont.)

Feature	Specification
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'
Supply voltage	+19 to +29 V dc
Supply current	35 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Into 2 k Ω minimum load.

[2]Includes effects of repeatability, hysteresis, and linearity.

[3]Calculated using best straight line.

[4]Included in output offset specification.

[5]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-3. 7B22 Isolated Voltage Output Module

Feature	Specification
Output range	±10 V
Input range	±10 V
Accuracy[1]	±0.1% span maximum
Nonlinearity[2]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C span	±35 ppm/°C
Output offset	±0.001% span/°C
Maximum output	±14 V dc maximum
Load resistance[3]	5 k Ω minimum
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 70 mV 3 mV 6 μV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	400 Hz
Response time (0 to 90%)	1 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Output-to-input and power @ 50/60 Hz	 100 dB
Output protection	±35 V dc
Input protection	±35 V dc
Output transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'

Table A-3. 7B22 Isolated Voltage Output Module (cont.)

Feature	Specification
Supply voltage	+19 to +29 V dc
Supply current	20 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Includes effects of repeatability, hysteresis, and linearity.

[2]Calculated using best straight line.

[3]Depends on power supply voltage.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-4. 7B27 Low-Isolated Thermocouple Input Module

Feature	Specification
Input range	J, K, T, E, R, S, and B thermocouples
Output range options[1]	1-5 V, 0-10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C	
Span	±35 ppm/°C
Input offset	±0.5 µV/°C
Zero Suppression	±0.005% V_Z/°C[4]
Output offset	±0.002% span/°C
Input resistance[5]	10 MΩ
Input bias current	25 nA
Output resistance	less than 1 Ω
Noise	
Peak @ 5 MHz B/W	6 mV
RMS @ 10 Hz to 100 kHz B/W	0.4 mV
Peak @ 0.1 Hz to 10 Hz B/W	0.6 µV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	150 ms
Common-Mode voltage	100 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	160 dB
Normal Mode Rejection Input-to-output and power @ 50/60 Hz	60 dB
Input protection	±30 V dc continuous
Output protection	Continuous short to ground

Table A-4. 7B27 Low-Isolated Thermocouple Input Module (cont.)

Feature	Specification
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3′
CJC accuracy	±1.0°C maximum over the +5°C to +45°C ambient temperature range
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	45 grams

Notes

[1]Into 2 k Ω minimum load. Refer to Appendix B for information on the transfer function of Model 7B27.

[2]Includes effects of repeatability, hysteresis, and linearity. The CJC sensor accuracy should be added to the 7B27 module accuracy to compute the overall measurement accuracy.

[3]Calculated using best straight line.

[4]V_Z is the nominal input voltage that results in a 0 V output.

[5]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-5. 7B30 Isolated Millivolt/Voltage Input Module

Feature	Specification
Input range[1]	±10 mV to ±1 V
Output range options[2]	1-5 V, 0-10 V
Accuracy[3]	±0.1% span maximum
Nonlinearity[4]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset Zero Suppression Output offset	 ±35 ppm/°C ±0.5 μV/°C ±0.005% V_Z/°C[5] ±0.002% span/°C
Input resistance[6]	10 MΩ
Input bias current	1 nA
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 6 mV 0.4 mV 0.6 μV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	150 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	160 dB
Normal Mode Rejection Input-to-output and power @ 50/60 Hz	60 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground

Table A-5. 7B30 Isolated Millivolt/Voltage Input Module (cont.)

Feature	Specification
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3′
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Model 7B30 may be used to measure a process current input by installing a 250 Ω current sensing resistor, such as Model AC1391, on the backplane. With this resistor installed, the current loop is maintained even when the module is removed from the backplane.

[2]Into 2 k Ω minimum load.

[3]Includes effects of repeatability, hysteresis, and linearity.

[4]Calculated using best straight line.

[5]V_Z is the nominal input voltage that results in a 0 V output.

[6]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-6. 7B31 Isolated Voltage Input Module

Feature	Specification
Input range	±1 V to ±10 V
Output range options[1]	1-5 V, 0-10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C	
Span	±55 ppm/°C
Input offset	±5 µV/°C
Zero Suppression	±0.005% V_Z/°C[4]
Output offset	±0.002% span/°C
Input resistance[5]	100 k Ω
Input bias current	0.2 nA
Output resistance	less than 1 Ω
Noise	
Peak @ 5 MHz B/W	6 mV
RMS @ 10 Hz to 100 kHz B/W	0.4 mV
Peak @ 0.1 Hz to 10 Hz B/W	3 µV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	150 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	120 dB
Normal Mode Rejection Input-to-output and power @ 50/60 Hz	60 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground

Table A-6. 7B31 Isolated Voltage Input Module (cont.)

Feature	Specification
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3′
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Into 2 k Ω minimum load.

[2]Includes effects of repeatability, hysteresis, and linearity.

[3]Calculated using best straight line.

[4]V_Z is the nominal input voltage that results in a 0 V output.

[5]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-7. 7B32 Isolated Process Current Input Module

Feature	Specification
Input range	4-20 mA, 0-20 mA
Output range options[1]	1-5 V, 0-10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset[4] Output offset	 ±35 ppm/°C N/A ±0.003% span/°C
Input resistance[5]	200 Ω
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 6 mV 0.4 mV 4 µV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	100 Hz
Response time (0 to 90%)	10 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 105 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'

Table A-7. 7B32 Isolated Process Current Input Module (cont.)

Feature	Specification
Supply voltage	+14 to +35 V dc
Supply current	20 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Into 2 k Ω minimum load.

[2]Includes effects of repeatability, hysteresis, and linearity.

[3]Calculated using best straight line.

[4]Included in output offset specification.

[5]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc

Specifications subject to change without notice.

Table A-8. 7B33 Isolated Voltage Input Module

Feature	Specification
Input range[1]	1-5 V, 0-5 V
Output range options[2]	1-5 V, 0-10 V
Accuracy[3]	±0.1% span maximum
Nonlinearity[4]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset[5] Output offset	 ±15 ppm/°C N/A ±0.003% span/°C
Input resistance[6]	2 MΩ
Input bias current	0.1 nA
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 6 mV 0.4 mV 4 μV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	100 Hz
Response time (0 to 90%)	10 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 105 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3′

Table A-8. 7B33 Isolated Voltage Input Module (cont.)

Feature	Specification
Supply voltage	+14 to +35 V dc
Supply current	20 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Model 7B33 may be used to measure a process current input by installing a 250 Ω current sensing resistor, such as Model AC1391, on the backplane. With this resistor installed, the current loop is maintained even when the module is removed from the backplane.

[2]Into 2 k Ω minimum load.

[3]Includes effects of repeatability, hysteresis, and linearity.

[4]Calculated using best straight line.

[5]Included in output offset specification.

[6]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-9. 7B34 Isolated Linearized RTD Input Module

Feature	Specification
Input range[1]	
7B34-01-X	-100°C to +100°C (-148°F to +212°F)
7B34-02-X	0°C to +100 °C (+32°F to +212°F)
7B34-03-X	0°C to +200 °C (+32°F to +392°F)
7B34-04-X	0°C to +600°C (+32°F to +1112°F)
7B34-05-X	-50°C to +350°C (-58°F to +662°F)
7B34-N-01-X	0°C to +300°C (+32°F to +573°F)
7B34-N-02-X	0°C to +200°C (+32°F to +392°F)
Output range options[2]	1-5 V, 0-10 V
Accuracy[3]	
7B34-01-X	±0.15% span maximum
7B34-02-X	±0.2% span maximum
7B34-03-X	±0.15% span maximum
7B34-04-X	±0.1% span maximum
7B34-05-X	±0.1% span maximum
7B34-N-01-X	±0.3% span maximum
7B34-N-02-X	±0.3% span maximum
Nonlinearity[4] 7B34-01-X, 02-X, 03-X, 04-X, 05-X	±0.05% span maximum
7B34-N-01-X	±0.12% span maximum
7B34-N-02-X	±0.14% span maximum
Stability vs. temperature, -40°C to +85°C	
Span	±60 ppm/°C
Input offset	±1 µV/°C
Zero Suppression	±0.002% (R_Z/R_{SPAN})[5]/°C
Output offset	±0.002% span/°C

Table A-9. 7B34 Isolated Linearized RTD Input Module (cont.)

Feature	Specification
Lead resistance effect	±0.02°C/Ω
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 10 mV 0.4 mV 0.6 μV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	250 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 160 dB
Normal-Mode Rejection Input-to-output and power @ 50/60 Hz	 60 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'
Supply voltage	+14 to +35 V dc

Table A-9. 7B34 Isolated Linearized RTD Input Module (cont.)

Feature	Specification
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]The X in the 7B34 model number designations is used to identify the output voltage range option. If X = 1, then the 7B34 is factory configured for a 1-5 V output. If X = 2, then the 7B34 is factory configured for a 0-10 V output. The standard range 7B34's (i.e., 7B34-01-X, 02-X, 03-X, 04-X, and 05-X) are configured for a 100 Ω Platinum RTD with the DIN standard α of 0.000385. The 7B34-N series is configured for a 120 Ω Nickel RTD.

[2]Into 2 k Ω minimum load.

[3]Includes effects of repeatability, hysteresis, and linearity.

[4]Calculated using best straight line.

[5]R_Z is the value of the RTD resistance at the lowest measurement point. R_{SPAN} is the change in resistance over the measurement span.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-10. 7B35 Isolated Process Current Input Module

Feature	Specification
Input range	4-20 mA
Loop Supply Voltage	*See Figure A-1, p. A-22*
Output range options[1]	1-5 V, 2-10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset[4] Output offset	 ±40 ppm/°C N/A ±0.003% span/°C
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 60 mV 0.9 mV 4 μV
Supply sensitivity	±0.003%/% V_S
Nominal 3 dB B/W	100 Hz
Response time (0 to 90%)	5 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 105 dB
Input protection	±35 V dc continuous, 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3′

Table A-10. 7B35 Isolated Process Current Input Module (cont.)

Feature	Specification
Supply voltage	+18 to +35 V dc
Supply current	60 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Into 2 k Ω minimum load.

[2]Includes effects of repeatability, hysteresis, and linearity.

[3]Calculated using best straight line.

[4]Included in output offset specification.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

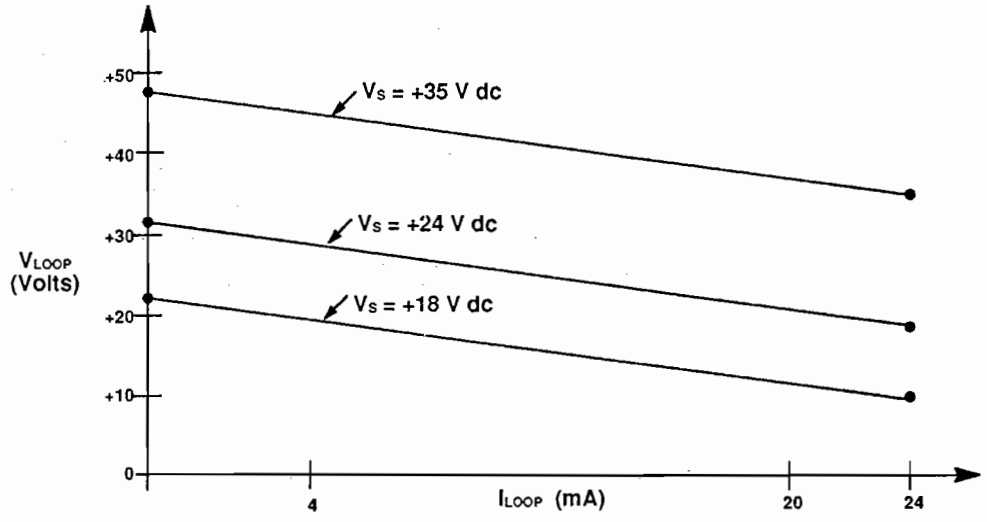


Figure A-1. 7B35 Isolated Loop Voltage

Table A-11. 7B37 Isolated Thermocouple Input Module

Feature	Specification
Input range	J, K, T, E, R, S, and B thermocouples
Output range options[1]	1-5 V, 0-10 V
Accuracy[2]	±0.1% span maximum
Nonlinearity[3]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C Span Input offset Zero Suppression Output offset	 ±35 ppm/°C ±0.5 µV/°C ±0.005% V_Z[4]/°C ±0.002% span/°C
Input resistance[5]	10 MΩ
Input bias current	25 nA
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 6 mV 0.4 mV 0.6 µV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	150 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output and power @ 50/60 Hz	 160 dB
Normal-Mode Rejection Input-to-output and power @ 50/60 Hz	 60 dB
Input protection	±35 V dc continuous, 120 V rms continuous

Table A-11. 7B37 Isolated Thermocouple Input Module (cont.)

Feature	Specification
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'
CJC accuracy	±1.0°C maximum over the +5°C to +45°C ambient temperature range
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Into 2 k Ω minimum load. Refer to *Appendix B* for information on the transfer function of Model 7B37.

[2]Includes effects of repeatability, hysteresis, and linearity. The CJC sensor accuracy should be added to the 7B37 module accuracy to compute the overall measurement accuracy.

[3]Calculated using best straight line.

[4]V_Z is the nominal input voltage that results in a 0 V output.

[5]Specified for power ON; for power OFF, input resistance is 30 k Ω minimum.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-12. 7B39 Isolated Process Current Output Module

Feature	Specification
Output range options	0-20 mA, 4-20 mA
Input range	0-10 V, 1-5 V
Accuracy[1]	±0.1% span maximum
Nonlinearity[2]	±0.02% span maximum
Stability vs. temperature, –40°C to +85°C span	±25 ppm/°C
Input Resistance 7B39-01 7B39-02	 2.2 MΩ 40 KΩ
Output offset	±0.0035% span/°C
Maximum output	30 mA
Load resistance[3]	0 Ω to 850 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 kHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 160 µA 4 µA 25 nA
Supply sensitivity	±0.006%/% V_S
Nominal 3 dB B/W	100 Hz
Response time (0 to 90%)	3 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Output-to-input and power @ 50/60 Hz	 110 dB
Output protection	±35 V dc, 120 V rms
Input protection	±35 V dc
Output transient	IEEE-STD 472 IEC 255-4, Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5 W @ 400 MHz @ 3'

Table A-12. 7B39 Isolated Process Current Output Module (cont.)

Feature	Specification
Supply voltage	+14 to +35 V dc
Supply current	60 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

Notes

[1]Includes effects of repeatability, hysteresis, and linearity.
[2]Calculated using best straight line.
[3]Depends on power supply voltage. *See Figure A-2.*
All specifications are at +23°C ± 5°C and V_S = +24 V dc.
Specifications subject to change without notice.

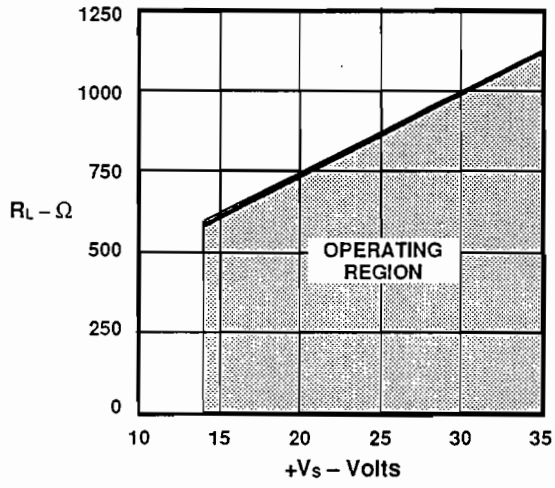


Figure A-2. Load Resistance vs. Supply Voltage

Table A-13. 7B47 Linearized Isolated Thermocouple Input Module

Feature	Specification
Input range	J, K, T, E, R, S, N, and B thermocouples
Output range options[1]	1-5 V, 0-10 V
Accuracy[2]	*Refer to Table A-14*
Nonlinearity	N/A
Stability vs. temperature –40°C to +85°C Span Input offset Zero suppression Output offset	 ±40 ppm/°C ±0.5 µV/5°C ±0.005% (R_Z/R_{SPAN}/°C[5] ±0.002% span/°C
Input resistance[3]	10 M Ω
Input bias current	25 nA
Output resistance	less than 1 Ω
Noise Peak @ 5 MHz B/W RMS @ 10 Hz to 100 KHz B/W Peak @ 0.1 Hz to 10 Hz B/W	 7 mV 1 mV 0.5 µV
Supply sensitivity	±0.0001%/% V_S
Nominal 3 dB B/W	3 Hz
Response time (0 to 90%)	150 ms
Common-Mode voltage	1500 V rms continuous
Common-Mode Rejection Input-to-output power @ 50/60 Hz	 160 dB
Normal-Mode Rejection Input-to-output power @ 50/60 Hz	 60 dB

Table A-13. 7B47 Linearized Isolated Thermocouple Input Module (cont.)

Feature	Specification
Input protection	±35 V dc continuous 120 V rms continuous
Output protection	Continuous short to ground
Input transient	IEEE-STD 472 IEC 255-4 Class II
ESD	IEC 801-2, Level 2
RFI/EMI susceptibility	0.5% span, 5W @ 400 MHz @ 3'
CJC accuracy	±1.0°C maximum over the +5°C to +45°C ambient temperature range
Supply voltage	+14 to +35 V dc
Supply current	25 mA maximum
Operating range	–40°C to +85°C
Storage range	–40°C to +85°C
Humidity, 24 hours	90% noncondensing
Weight	60 grams

NOTE

[1]Into 2 k Ω minimum load.

[2]Includes effects of repeatability, hysteresis, and linearity. The CJC sensor accuracy should be added to the 7B47 module accuracy to compute the overall measurement accuracy.

[3]Specified for Power ON; for power OFF, input impedence is 30 k Ω minimum

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-14. Accuracy for the 7B47 Linearized Thermocouple Input Module

Model	Input Range	Accuracy[1,2] (Typical)	Accuracy[1,2] (Maximum)
7B47-J-01-1	0°C to +760°C (32°F to 1400°F)	±0.15% Span	±0.38% Span
7B47-J-01-2	0°C to +760°C (32°F to 1400°F)	±0.13% Span	±0.32% Span
7B47-J-02-1	–100°C to +300°C (–148°F to 572°F)	±0.16% Span	±0.35% Span
7B47-J-02-2	–100°C to +300°C (–148°F to 572°F)	±0.14% Span	±0.30% Span
7B47-K-03-1	0°C to +1300°C (32°F to 2372°F)	±0.15% Span	±0.35% Span
7B47-K-03-2	0°C to +1300°C (32°F to 2372°F)	±0.15% Span	±0.32% Span
7B47-K-04-1	0°C to +600°C (32°F to 1112°F)	±0.09% Span	±0.20% Span
7B47-K-04-2	0°C to +600°C (32°F to 1112°F)	±0.08% Span	±0.18% Span
7B47-T-05-1	0°C to +400°C (32°F to 752°F)	±0.24% Span	±0.50% Span
7B47-T-05-2	0°C to +400°C (32°F to 752°F)	±0.19% Span	±0.38% Span
7B47-T-06-1	–100°C to +200°C (–148°F to 392°F)	±0.29% Span	±0.57% Span
7B47-T-06-2	–100°C to +200°C (–148°F to 392°F)	±0.25% Span	±0.47% Span
7B47-E-07-1	0°C to +900°C (32°F to 1652°F)	±0.18% Span	±0.41% Span
7B47-E-07-2	0°C to +900°C (32°F to 1652°F)	±0.15% Span	±0.34% Span

Table A-14. Accuracy for the 7B47 Linearized Thermocouple Input Module (cont.)

Model	Input Range	Accuracy[1,2] (Typical)	Accuracy[1,2] (Maximum)
7B47-R-08-1	+500°C to +1750°C (932°F to 3182°F)	±0.15% Span	±0.36% Span
7B47-R-08-2	+500°C to +1750°C (932°F to 3182°F)	±0.13% Span	±0.30% Span
7B47-S-09-1	+700°C to +1750°C (1292°F to 3182°F)	±0.13% Span	±0.31% Span
7B47-S-09-2	+700°C to +1750°C (1292°F to 3182°F)	±0.11% Span	±0.25% Span
7B47-B-10-1	+800°C to +1800°C (1472°F to 3272°F)	±0.19% Span	±0.41% Span
7B47-B-10-2	+800°C to +1800°C (1472°F to 3272°F)	±0.17% Span	±0.35% Span
7B47-N-11-1	+200°C to +1300°C (392°F to 2372°F)	±0.14% Span	±0.31% Span
7B47-N-11-2	+200°C to +1300°C (392°F to 2372°F)	±0.09% Span	±0.27% Span

NOTES

[1]The CJC sensor accuracy should be added to the 7B47 module accuracy listed in this table in order to compute the overall measurement accuracy.

[2]Accuracy includes the effects of repeatability, hysteresis and conformity.

All specifications are at +23°C ± 5°C and V_S = +24 V dc.

Specifications subject to change without notice.

Table A-15. 7B Series Backplanes

Feature	Specification
Number of channels	
7BP04-1	4
7BP08-1	8
7BP16-1	16
Size	
7BP04-1	3.47″ x 6.3″
7BP08-1	3.47″ x 10″
7BP16-1	3.47″ x 17.4″

NOTE:
Mounting hardware is not provided with backplanes. Mounting hardware is provided with the Rack-Mount Kit, Model AC1363

Errata

Appendix B : 7B27 and 7B37 Transfer Functions

Page B-1

Transfer Equation should read:

Vout = [T.C. Output - Vzero] X [GAIN] + V_{OL}

V_{OL} = Low-End of the Output Voltage Range (in Volts)

Examples:
For a 7B Series module with an output range of 1 V to 5 V, V_{OL} =1
For a 7B Series module with an output range of 0 to 10 V, V_{OL} = 0

Page B-2

The GAIN (V/mV) for the following models is as follows:

Model	*Gain (V/mV)*
7B27-J-01-1	0.0841149
7B27-J-10-1	0.371161
7B27-J-11-1	0.183099
7B27-J-12-1	0.120861
7B27-J-13-1	0.238507
7B27-K-02-1	0.069351
7B27-K-20-1	0.327681
7B27-K-21-1	0.160630
7B27-K-22-1	0.081921
7B27-K-23-1	0.167182
7B27-T-03-1	0.163787
7B27-E-04-1	0.058154
7B27-R-05-1	0.191589
7B27-S-06-1	0.216169
7B27-B-05-1	0.294442

Page B-3

The GAIN (V/mV) for the following models is as follows:

Model	*Gain (V/mV)*
7B37-J-01-1	0.0841149
7B37-J-10-1	0.371161
7B37-J-11-1	0.183099
7B37-J-12-1	0.120861
7B37-J-13-1	0.238507
7B37-K-01-1	0.069351
7B37-K-20-1	0.327681
7B37-K-21-1	0.160630
7B37-K-23-1	0.081921
7B37-K-23-1	0.167182
7B37-T-03-1	0.163787
7B37-E-04-1	0.058154
7B37-R-05-1	0.191589
7B37-S-06-1	0.216169
7B37-B-05-1	0.294442

B 7B27 and 7B37 Transfer Functions

Calculating the Output Voltage

The output voltage of a 7B27 and 7B37 thermocouple signal conditioner can be calculated by knowing: (a) the thermocouple input voltage at the measurement temperature; (b) the thermocouple input signal at the minimum point of the 7B27 and 7B37 module temperature range; and (c) the 7B27 and 7B37 gain.

Transfer Equation

To determine the output voltage from a 7B27 and 7B37 module, use the following equation:

$$V_{OUT} = [\text{ T.C. Output} - V_{ZERO}] * [\text{ GAIN }]$$

where,

- **V_{OUT}** is the 7B27 and 7B37 module output (in volts)
- **T.C. Output** is the thermocouple output voltage (in mV) at the temperature being measured
- **V_{ZERO}** is the thermocouple output voltage (in mV) at the minimum temperature span specified for the 7B27 and 7B37 module
- **GAIN** is the throughput gain (in V/mV) of the 7B27 and 7B37 module

V_{ZERO} and Gain are listed for each 7B27 and 7B37 model in Table B-1 (7B27) and Table B-2 (7B37).

Transfer Functions

Table B-1. 7B27 Transfer Functions

7B27 Non-Isolated	Input Range	Output Range	V_{IN} Range (mV)	Span (mV)	Gain (V/mV)	V_{ZERO} (mV)
7B27-J-01-1	–100°C to +760°C	1 V to 5 V	–4.632 to +42.922	47.554	0.105144	–4.632
7B27-J-01-2	–100°C to +760°C	0 V to 10 V	–4.632 to +42.922	47.554	0.210287	–4.632
7B27-J-10-1	0°C to +200°C	1 V to 5 V	0 to +10.777	10.777	0.463951	0
7B27-J-10-2	0°C to +200°C	0 V to 10 V	0 to +10.777	10.777	0.927902	0
7B27-J-11-1	0°C to +400°C	1 V to 5 V	0 to +21.846	21.846	0.228875	0
7B27-J-11-2	0°C to +400°C	0 V to 10 V	0 to +21.846	21.846	0.457750	0
7B27-J-12-1	0°C to +600°C	1 V to 5 V	0 to +33.096	33.096	0.151076	0
7B27-J-12-2	0°C to +600°C	0 V to 10 V	0 to +33.096	33.096	0.302151	0
7B27-J-13-1	+300°C to +600°C	1 V to 5 V	+16.325 to +33.096	49.421	0.101172	16.325
7B27-J-13-2	+300°C to +600°C	0 V to 10 V	+16.325 to +33.096	49.421	0.202343	16.325
7B27-K-02-1	–100°C to +1350°C	1 V to 5 V	–3.553 to +54.125	57.678	0.086688	–3.553
7B27-K-02-2	–100°C to +1350°C	0 V to 10 V	–3.553 to +54.125	57.678	0.173376	–3.553
7B27-K-20-1	0°C to +300°C	1 V to 5 V	0 to +12.207	12.207	0.409601	0
7B27-K-20-2	0°C to +300°C	0 V to 10 V	0 to +12.207	12.207	0.819202	0
7B27-K-21-1	0°C to +600°C	1 V to 5 V	0 to +24.902	24.902	0.200787	0
7B27-K-21-2	0°C to +600°C	0 V to 10 V	0 to +24.902	24.902	0.401574	0
7B27-K-22-1	0°C to +1200°C	1 V to 5 V	0 to +48.828	48.828	0.102400	0
7B27-K-22-2	0°C to +1200°C	0 V to 10 V	0 to +48.828	48.828	0.204801	0
7B27-K-23-1	+600°C to +1200°C	1 V to 5 V	+24.902 to +48.828	73.730	0.067815	24.902
7B27-K-23-2	+600°C to +1200°C	0 V to 10 V	+24.902 to +48.828	73.730	0.135630	24.902
7B27-T-03-1	–100°C to +400°C	1 V to 5 V	–3.553 to +20.869	24.247	0.206211	–3.553
7B27-T-03-2	–100°C to +400°C	0 V to 10 V	–3.553 to +20.869	24.247	0.412422	–3.553
7B27-E-04-1	0°C to +900°C	1 V to 5 V	0 to +68.783	68.783	0.072692	0
7B27-E-04-2	0°C to +900°C	0 V to 10 V	0 to +68.783	68.783	0.145385	0
7B27-R-05-1	0°C to +1750°C	1 V to 5 V	0 to +20.878	20.878	0.239487	0
7B27-R-05-2	0°C to +1750°C	0 V to 10 V	0 to +20.878	20.878	0.478973	0
7B27-S-06-1	0°C to +1750°C	1 V to 5 V	0 to +18.504	18.504	0.270212	0
7B27-S-06-2	0°C to +1750°C	0 V to 10 V	0 to +18.504	18.504	0.540424	0
7B27-B-05-1	0°C to +1800°C	1 V to 5 V	0 to +13.585	13.585	0.368053	0
7B27-B-05-2	0°C to +1800°C	0 V to 10 V	0 to +13.585	13.585	0.736106	0

Table B-2. 7B37 Transfer Functions

7B37 Non-Isolated	Input Range	Output Range	V_{IN} Range (mV)	Span (mV)	Gain (V/mV)	V_{ZERO} (mV)
7B37-J-01-1	–100°C to +760°C	1 V to 5 V	–4.632 to +42.922	47.554	0.105144	–4.632
7B37-J-01-2	–100°C to +760°C	0 V to 10 V	–4.632 to +42.922	47.554	0.210287	–4.632
7B37-J-10-1	0°C to +200°C	1 V to 5 V	0 to +10.777	10.777	0.463951	0
7B37-J-10-2	0°C to +200°C	0 V to 10 V	0 to +10.777	10.777	0.927902	0
7B37-J-11-1	0°C to +400°C	1 V to 5 V	0 to +21.846	21.846	0.228875	0
7B37-J-11-2	0°C to +400°C	0 V to 10 V	0 to +21.846	21.846	0.457750	0
7B37-J-12-1	0°C to +600°C	1 V to 5 V	0 to +33.096	33.096	0.151076	0
7B37-J-12-2	0°C to +600°C	0 V to 10 V	0 to +33.096	33.096	0.302151	0
7B37-J-13-1	+300°C to +600°C	1 V to 5 V	+16.325 to +33.096	49.421	0.101172	16.325
7B37-J-13-2	+300°C to +600°C	0 V to 10 V	+16.325 to +33.096	49.421	0.202343	16.325
7B37-K-02-1	–100°C to +1350°C	1 V to 5 V	–3.553 to +54.125	57.678	0.086688	–3.553
7B37-K-02-2	–100°C to +1350°C	0 V to 10 V	–3.553 to +54.125	57.678	0.173376	–3.553
7B37-K-20-1	0°C to +300°C	1 V to 5 V	0 to +12.207	12.207	0.409601	0
7B37-K-20-2	0°C to +300°C	0 V to 10 V	0 to +12.207	12.207	0.819202	0
7B37-K-21-1	0°C to +600°C	1 V to 5 V	0 to +24.902	24.902	0.200787	0
7B37-K-21-2	0°C to +600°C	0 V to 10 V	0 to +24.902	24.902	0.401574	0
7B37-K-22-1	0°C to +1200°C	1 V to 5 V	0 to +48.828	48.828	0.102400	0
7B37-K-22-2	0°C to +1200°C	0 V to 10 V	0 to +48.828	48.828	0.204801	0
7B37-K-23-1	+600°C to +1200°C	1 V to 5 V	+24.902 to +48.828	73.730	0.067815	24.902
7B37-K-23-2	+600°C to +1200°C	0 V to 10 V	+24.902 to +48.828	73.730	0.135630	24.902
7B37-T-03-1	–100°C to +400°C	1 V to 5 V	–3.553 to +20.869	24.247	0.206211	–3.553
7B37-T-03-2	–100°C to +400°C	0 V to 10 V	–3.553 to +20.869	24.247	0.412422	–3.553
7B37-E-04-1	0°C to +900°C	1 V to 5 V	0 to +68.783	68.783	0.072692	0
7B37-E-04-2	0°C to +900°C	0 V to 10 V	0 to +68.783	68.783	0.145385	0
7B37-R-05-1	0°C to +1750°C	1 V to 5 V	0 to +20.878	20.878	0.239487	0
7B37-R-05-2	0°C to +1750°C	0 V to 10 V	0 to +20.878	20.878	0.478973	0
7B37-S-06-1	0°C to +1750°C	1 V to 5 V	0 to +18.504	18.504	0.270212	0
7B37-S-06-2	0°C to +1750°C	0 V to 10 V	0 to +18.504	18.504	0.540424	0
7B37-B-05-1	0°C to +1800°C	1 V to 5 V	0 to +13.585	13.585	0.368053	0
7B37-B-05-2	0°C to +1800°C	0 V to 10 V	0 to +13.585	13.585	0.736106	0

C Pin Assignments

Table C-1 lists the pin assignments for 7B Series input and output modules. Table C-2 lists the pin assignments for the I/O connector.

Table C-1. 7B Series Module Pin Assignments

Pin	Input Module Function	Output Module Function
0[1]	Sensor Input	Not Used
1	Input High	Output High
2	Input Low	Output Low
3	Power Supply (dc)	Power Supply (dc)
4	Output Voltage	Input Voltage
5	Output and Power Common	Input and Power Common

Note

[1]This pin is found only on RTD input and thermocouple input modules.

Table C-2. Backplane I/O Connector Pin Assignments

Pin	Function
1	Channel 0
2	Common (Ch. 0 and Ch.1)
3	Channel 1
4	Channel 2
5	Common (Ch. 2 and Ch. 3)
6	Channel 3
7	Channel 4
8	Common (Ch. 4 and Ch. 5)
9	Channel 5
10	Channel 6
11	Common (Ch. 6 and Ch.7)
12	Channel 7
13	Common (Ch. 8)
14	Channel 8
15	Channel 9
16	Common (Ch. 9 and Ch. 10)
17	Channel 10
18	Channel 11
19	Common (Ch. 11 and Ch. 12)
20	Channel 12
21	Channel 13
22	Common (Ch. 13 and Ch. 14)
23	Channel 14
24	Channel 15
25	Common (Ch. 15)

D

Summary of Model Numbers

Table D-1 contains a list of the specific model numbers for 7B Series input modules; Table D-2 contains a list of the specific model numbers for 7B Series output modules.

Table D-1. 7B Series Input Module Model Numbers

Description	Model Number	Input Range	Output Range
Millivolts Isolated Unipolar	7B30-01-1	0 mV – 10 mV	1 V – 5 V
	7B30-01-2	0 mV – 10 mV	0 V – 10 V
	7B30-02-1	0 mV – 100 mV	1 V – 5 V
	7B30-02-2	0 mV – 100 mV	0 V – 10 V
Millivolts Isolated Bipolar	7B30-06-1	±10 mV	1 V – 5 V
	7B30-06-2	±10 mV	0 V – 10 V
	7B30-07-1	±100 mV	1 V – 5 V
	7B30-07-2	±100 mV	0 V – 10 V
Voltage Isolated Unipolar	7B30-03-1	0 V – 1 V	1 V – 5 V
	7B30-03-2	0 V – 1 V	0 V – 10 V
	7B31-04-1	0 V – 5 V	1 V – 5 V
	7B31-04-2	0 V – 5 V	0 V – 10 V
	7B30-05-1	1 V – 5 V	1 V – 5 V
	7B30-05-2	1 V – 5 V	0 V – 10 V
	7B31-01-1	0 V – 10 V	1 V – 5 V
	7B31-01-2	0 V – 10 V	0 V – 10 V
Voltage Isolated Bipolar	7B30-08-1	±1 V	1 V – 5 V
	7B30-08-2	±1 V	0 V – 10 V
	7B31-02-1	±5 V	1 V – 5 V
	7B31-02-2	±5 V	0 V – 10 V
	7B31-03-1	±10 V	1 V – 5 V
	7B31-03-2	±10 V	0 V – 10 V
	7B21	±10 V	±10 V

Summary of Model Numbers

Table D-1. 7B Series Input Module Model Numbers

Description	Model Number	Input Range	Output Range
Voltage Isolated	7B33-01-1 7B33-01-2	1 V – 5 V 0 V – 5 V	1 V – 5 V 0 V – 10 V
Current Isolated	7B32-01-1 7B32-01-2	4 mA – 20 mA 0 mA – 20 mA	1 V – 5 V 0 V – 10 V
	7B30-05-1 7B30-05-2	4 mA – 20 mA[1] 4 mA – 20 mA[1]	1 V – 5 V 0 V – 10 V
	7B33-01-1 7B33-01-2	4 mA – 20 mA[1] 0 mA – 20 mA[1]	1 V – 5 V 0 V – 10 V
2-Wire Transmitter Isolated with Loop Power (w/Sense Resistor)	7B35-01-1[2] 7B35-01-2[2]	4 mA – 20 mA 4 mA – 20 mA	1 V – 5 V 2 V – 10 V
RTD Non-Isolated (Linearized, 100 Ω Platinum, 2- or 3-Wire, α = 0.00385)	7B14-01-1 7B14-01-2	–100°C to +100°C –100°C to +100°C	1 V – 5 V 0 V – 10 V
	7B14-02-1 7B14-02-2	0°C to +100°C 0°C to +100°C	1 V – 5 V 0 V – 10 V
	7B14-03-1 7B14-03-2	0°C to +200°C 0°C to +200°C	1 V – 5 V 0 V – 10 V
	7B14-04-1 7B14-04-2	0°C to +600°C 0°C to +600°C	1 V – 5 V 0 V – 10 V
	7B14-05-1 7B14-05-2	–50°C to +350°C –50°C to +350°C	1 V – 5 V 0 V – 10 V
RTD Isolated (Linearized, 100 Ω Platinum, 2- or 3-Wire, α = 0.00385)	7B34-01-1 7B34-01-2	–100°C to +100°C –100°C to +100°C	1 V – 5 V 0 V – 10 V
	7B34-02-1 7B34-02-2	0°C to +100°C 0°C to +100°C	1 V – 5 V 0 V – 10 V
	7B34-03-1 7B34-03-2	0°C to +200°C 0°C to +200°C	1 V – 5 V 0 V – 10 V
	7B34-04-1 7B34-04-2	0°C to +600°C 0°C to +600°C	1 V – 5 V 0 V – 10 V
	7B34-05-1 7B34-05-2	–50°C to +350°C –50°C to +350°C	1 V – 5 V 0 V – 10 V

Table D-1. 7B Series Input Module Model Numbers

Description	Model Number	Input Range	Output Range
RTD Non-Isolated (Linearized, 120 Ω Nickel, 2- or 3-Wire)	7B14-N-01-1	0°C to +300°C	1 V – 5 V
	7B14-N-01-2	0°C to +300°C	0 V – 10 V
	7B14-N-02-1	0°C to +200°C	1 V – 5 V
	7B14-N-02-2	0°C to +200°C	0 V – 10 V
RTD Isolated (Linearized, 120 Ω Nickel, 2- or 3-Wire)	7B34-N-01-1	0°C to +300°C	1 V – 5 V
	7B34-N-01-2	0°C to +300°C	0 V – 10 V
	7B34-N-02-1	0°C to +200°C	1 V – 5 V
	7B34-N-02-2	0°C to +200°C	0 V – 10 V
RTD Non-Isolated (Linearized, 10 Ω Copper, 2- or 3-Wire)	7B14-C-01-1	0°C to +120°C	1 V – 5 V
	7B14-C-01-2	0°C to +120°C	0 V – 10 V
Thermocouple Non-Isolated Type J	7B27-J-01-1	100°C to +760°C	1 V – 5 V
	7B27-J-01-1	100°C to +760°C	0 V – 10 V
	7B27-J-10-1	0°C to +200°C	1 V – 5 V
	7B27-J-10-2	0°C to +200°C	0 V – 10 V
	7B27-J-11-1	0°C to +400°C	1 V – 5 V
	7B27-J-11-2	0°C to +400°C	0 V – 10 V
	7B27-J-12-1	0°C to +600°C	1 V – 5 V
	7B27-J-12-2	0°C to +600°C	0 V – 10 V
	7B27-J-13-1	300°C to +600°C	1 V – 5 V
	7B27-J-13-2	3005C to +600°C	0 V – 10 V
Type K	7B27-K-02-1	100°C to +1350°C	1 V – 5 V
	7B27-K-02-2	100°C to +1350°C	0 V – 10 V
	7B27-K-20-1	0°C to +300°C	1 V – 5 V
	7B27-K-20-2	0°C to +300°C	0 V – 10 V
	7B27-K-21-1	0°C to +600°C	1 V – 5 V
	7B27-K-21-2	0°C to +600°C	0 V – 10 V
	7B27-K-22-1	0°C to +1200°C	1 V – 5 V
	7B27-K-22-2	0°C to +1200°C	0 V – 10 V
	7B27-K-23-1	+600°C to +1200°C	1 V – 5 V
	7B27-K-23-2	+600°C to +1200°C	0 V – 10 V
Type T	7B27-T-03-1	100°C to +400°C	1 V – 5 V
	7B27-T-03-2	100°C to +400°C	0 V – 10 V

Summary of Model Numbers

Table D-1. 7B Series Input Module Model Numbers

Description	Model Number	Input Range	Output Range
Thermocouple Type E	7B27-E-04-1	0°C to +900°C	1 V – 5 V
	7B27-E-04-2	0°C to +900°C	0 V – 10 V
Type R	7B27-R-05-1	0°C to +1750°C	1 V – 5 V
	7B27-R-05-2	0°C to +1750°C	0 V – 10 V
Type S	7B27-S-06-1	0°C to +1750°C	1 V – 5 V
	7B27-S-06-2	0°C to +1750°C	0 V – 10 V
Type B	7B27-B-07-1	0°C to +1800°C	1 V – 5 V
	7B27-B-07-2	0°C to +1800°C	0 V – 10 V
Thermocouple Isolated	7B37-J-01-1	–100°C to +760°C	1 V – 5 V
	7B37-J-01-1	–100°C to +760°C	0 V – 10 V
Type J	7B37-J-10-1	0°C to +200°C	1 V – 5 V
	7B37-J-10-2	0°C to +200°C	0 V – 10 V
	7B37-J-11-1	0°C to +400°C	1 V – 5 V
	7B37-J-11-2	0°C to +400°C	0 V – 10 V
	7B37-J-12-1	0°C to +600°C	1 V – 5 V
	7B37-J-12-2	0°C to +600°C	0 V – 10 V
	7B37-J-13-1	+300°C to +600°C	1 V – 5 V
	7B37-J-13-2	+3005C to +600°C	0 V – 10 V
Type K	7B37-K-02-1	–100°C to +1350°C	1 V – 5 V
	7B37-K-02-2	–100°C to +1350°C	0 V – 10 V
	7B37-K-20-1	0°C to +300°C	1 V – 5 V
	7B37-K-20-2	0°C to +300°C	0 V – 10 V
	7B37-K-21-1	0°C to +600°C	1 V – 5 V
	7B37-K-21-2	0°C to +600°C	0 V – 10 V
	7B37-K-22-1	0°C to +1200°C	1 V – 5 V
	7B37-K-22-2	0°C to +1200°C	0 V – 10 V
	7B37-K-23-1	+600°C to +1200°C	1 V – 5 V
	7B37-K-23-2	+600°C to +1200°C	0 V – 10 V
Type T	7B37-T-03-1	–100°C to +400°C	1 V – 5 V
	7B37-T-03-2	–100°C to +400°C	0 V – 10 V
Type E	7B37-E-04-1	0°C to +900°C	1 V – 5 V
	7B37-E-04-2	0°C to +900°C	0 V – 10 V
Type R	7B37-R-05-1	0°C to +1750°C	1 V – 5 V
	7B37-R-05-2	0°C to +1750°C	0 V – 10 V

Table D-1. 7B Series Input Module Model Numbers (cont.)

Description	Model Number	Input Range	Output Range
Thermocouple Type S	7B37-S-06-1	0°C to +1750°C	1 V – 5 V
	7B37-S-06-2	0°C to +1750°C	0 V – 10 V
Type B	7B37-B-07-1	0°C to +1800°C	1 V – 5 V
	7B37-B-07-2	0°C to +1800°C	0 V – 10 V
Thermocouple Linearized Isolated Type J	7B47-J-01-1	0°C to +760°C	1 V – 5 V
	7B47-J-01-2	0°C to +760°C	0 V – 10 V
	7B47-J-02-1	–100°C to +300°C	1 V – 5 V
	7B47-J-02-2	–100°C to +300°C	0 V – 10 V
Type K	7B47-K-03-1	0°C to +1300°C	1 V – 5 V
	7B47-K-03-2	0°C to +1300°C	0 V – 10 V
	7B47-K-04-1	0°C to +600°C	1 V – 5 V
	7B47-K-04-2	0°C to +600°C	0 V – 10 V
Type T	7B47-T-05-1	0°C to +400°C	1 V – 5 V
	7B47-T-05-2	0°C to +400°C	0 V – 10 V
	7B47-T-06-1	–100°C to +200°C	1 V – 5 V
	7B47-T-06-2	–100°C to +2005C	0 V – 10 V
Type E	7B47-E-07-1	0°C to +900°C	1 V – 5 V
	7B47-E-07-2	0°C to +900°C	0 V – 10 V
Type R	7B47-R-08-1	+500°C to +1750°C	1 V – 5 V
	7B47-R-08-2	+500°C to +1750°C	0 V – 10 V
Type S	7B47-S-09-1	+700°C to +1750°C	1 V – 5 V
	7B47-S-09-2	+700°C to +1750°C	0 V – 10 V
Type B	7B47-B-10-1	+800°C to +1800°C	1 V – 5 V
	7B47-B-10-2	+800°C to +1800°C	0 V – 10 V
Type N	7B47-N-11-1	+200°C to +1300°C	1 V– 5 V
	7B47-N-11-2	+200°C to +1300°C	0 V – 10 V

NOTES:

[1]Model 7B30 and 7B33 may be used to measure a process current input by installing a 250 Ω current sensing resistor, such as Model AC1391, on the backplane. With this resistor installed, the current loop is maintained even when the module is removed from the backplane.

[2]Provides isolated loop power.

Summary of Model Numbers

Table D-2. 7B Series Output Module Model Numbers

Output Signal	Model Number	Output Range	Input Range
Current Isolated	7B39-01	4 mA to 20 mA	1 V to 5 V
	7B39-02	0 mA to 20 mA	0 V to 10 V
Voltage Isolated, Bipolar	7B22	±10 V	±10 V

E Accessories and Backplane Components

Table E-1 contains a list of the accessories that are available for use with your 7B Series system, along with the manufacturer's part number and address information. Table E-2 contains a list of components you may use when designing your custom 7B backplane. Analog Devices, Inc. makes no claims about the availability and quality of parts purchased through vendors other than Analog Devices. This information is listed for your convenience only.

Table E-1. Accessories

Part Description	Part Number	Manufacturer
Cables		
6-inch, 26-pin male to 25-pin female adapter cable; used to connect 7B backplane to Analog Devices boards	AC1393	Analog Devices, Inc. (800) 426-2564
3-foot, 25-pin male to 25-pin female cable; used to connect 7B backplane to host computer	AC1394	Analog Devices, Inc. (800) 426-2564
2-foot, 26-pin female to 26-pin female cable; used to connect 7B backplane to AC1324 screw termination board	AC1315	Analog Devices, Inc. (800) 426-2564
External 250 Ω current sensing resistor (0.1%, 10 ppm/°C)	AC1391	Analog Devices, Inc. (800) 426-2564

Table E-1. Accessories (cont.)

Part Description	Part Number	Manufacturer
Mating connector (female) to I/O connector on 7B Series backplane (used for custom-designed cables)	745078-5	AMP Incorporated Harrisburg, PA 17105 (800) 522-6752
Module case and hold-down screw (used for custom-designed circuitry)	AC1397	Analog Devices, Inc. (800) 426-2564
19" Rack-mount kit for Backplanes (includes mounting hardware)	AC1363	Analog Devices, Inc. (800) 426-2564
Screw termination board (26-pin connector, 26 screw terminals)	AC1324	Analog Devices, Inc. (800) 426-2564

Table E-2. Backplane Component List

Part Description	Part Number	Manufacturer
Miniature Spring Sockets For 7B Module Pins *(Require 6 per 7B module)*	645980-2	AMP Incorporated Harrisburg, PA 17105 800-522-6752
Miniature Spring Sockets For Plug-in I/V Resistor *(Require 2 per 7B module)*	645500-1	AMP Incorporated Harrisburg, PA 17105 800-522-6752
CJC Thermistor *(Require 1 per 7B27, 7B37 or 7B47 module)*	100K6A1	Betatherm Corp. 910 Turnpike Road Shrewsbury, MA 01545 508-842-0516
Threaded Insert Fastner For 7B Module Screw *(Require 1 per 7B module)*	KFS2-440	PEM Corp. P.O. Box 1000 Danboro, PA 18916-1000 215-766-8853
Diode Protect against reverse polarity. *(Require 2 per backplane)*	1N4005	Various Motorola, etc.
Resistor Current limit – used with LED *(Require 1 per backplane)*	1.3K, 5% 1/4 Watt	Various Allen Bradley, etc.
Diode Used to protect against power supply transients *(Require 1 per backplane)*	SA40A	General Instruments Power Semiconductor Division 10 Mellville Park Road Melville, NY 11747 (516) 847-3000
LED For Power-On Indicator *(Require 1 per backplane)*	MV54124 Green	Quality Technologies 610 North Maryave Sunnyvale, CA 94086
Connector – D Type, Male 25-pin – Used for Signal Output *(Require 2 per backplane)*	745073-3	AMP Incorporated Harrisburg, PA 17105 800-522-6752

Table E-2. Backplane Component List

Part Description	Part Number	Manufacturer
Terminal – 3 position Used for Sensor Input *(Require 1 per 7B module)*	MKDS5/3-6.35	Phoenix Contact P.O. Box 4100 Harrisburg, PA 17111 717-944-1300
Terminal – 4 position Used for Power Input *(Require 1 per backplane)*	MKDS5/4-6.35	Phoenix Contact P.O. Box 4100 Harrisburg, PA 17111 717-944-1300

F

Using Solid-State Relay Modules in a 7B Series System

The 7B Series modules are compatible with the industry-standard, solid-state relay (SSR) footprint. It is recommended that you use analog 7B Series modules and discrete SSR modules on separate backplanes. However, you can use SSR modules on a 7B Series backplane, if desired.

Notes: Do not use 7B Series modules on a backplane made by an SSR module vendor.

Use only SSR modules that are powered by +24 V dc.

When considering the use of both 7B Series analog modules and discrete SSR modules on the same 7B Series backplane, keep the following in mind:

- When SSR input modules are in the closed (ON) state, a current of approximately 18 mA flows through the ground pins onto the ground track. This 18 mA generates 100 μV near channel 0, increasing linearly to 200 μV at channel 15. If a 16-channel backplane contains one 7B Series module and 15 SSR input modules that are all ON, a ground voltage of 2.2 mV is generated.

If you anticipate that this ground voltage will create a problem in your application, it is recommended that you use differential measurements rather than single-ended measurements. For single-ended measurements, all signals are referred to a common ground. For differential measurements, the output of each channel (+ side) is referred to its appropriate common (– side). Figure F-1 illustrates the difference between single-ended and differential modes.

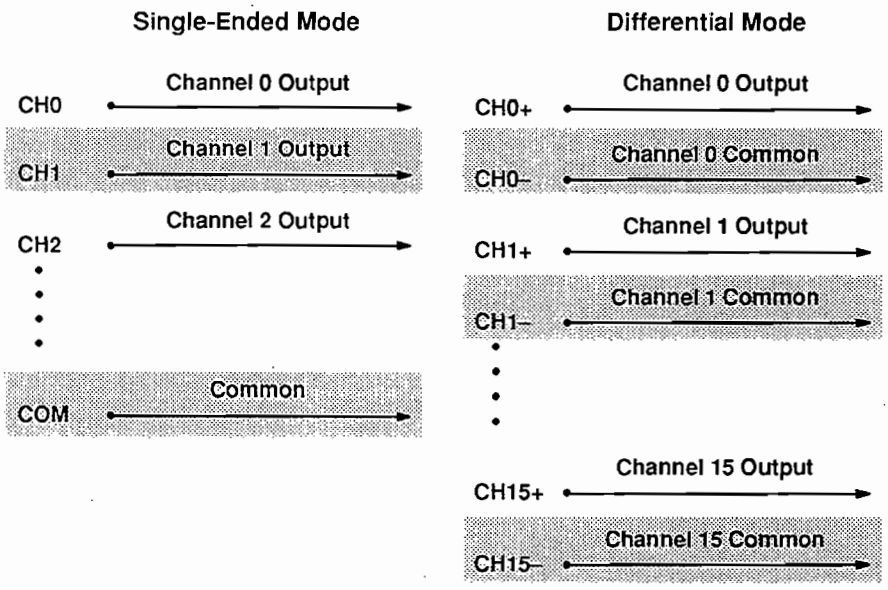


Figure F-1. Single-Ended and Differential Modes

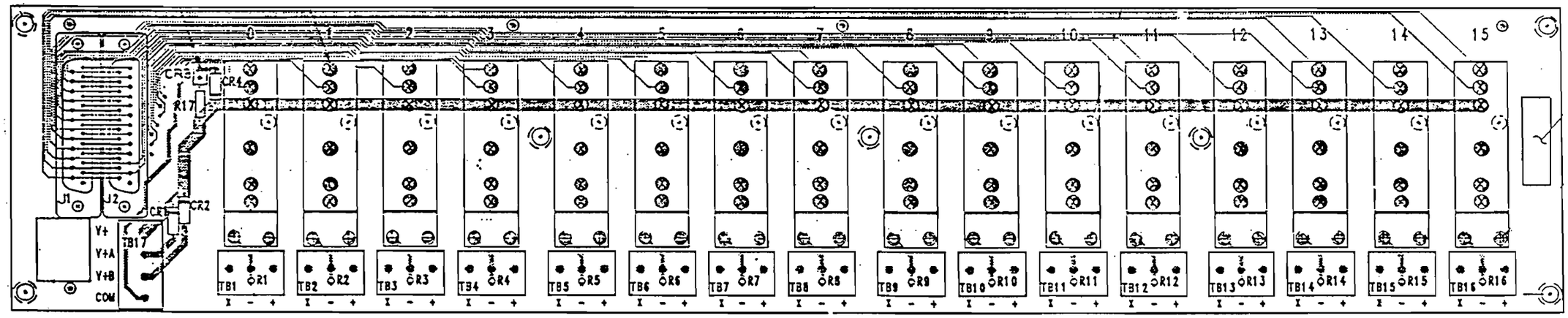
Note: SSR output modules also generate 18 mA when in the closed (ON) state. However, this current does not affect any other modules, since the current flows through the channel's I/O line.

- When the state of an SSR output module changes from OFF to ON or from ON to OFF, the module generates an impulse on the output of the 7B Series modules. Since the capacitance coupling of adjacent I/O lines can range from 4 pF between channels 0 and 1 to 24 pF between channels 14 and 15, the value of the impulse varies, depending on the position of the channel on the backplane. The speed of the SSR output module also affects the value of the impulse. For example, if an SSR output module has a rise time of 200 V/µs, a 24 pF capacitance generates 250 mV/µs; faster modules generate higher voltages with slower durations.

  This impulse can create a problem with a fast sample-and-hold (S/H) circuit in front of a successive approximation analog-to-digital converter (ADC). Therefore, it is recommended that you either use an integrating ADC (to average out any potential impulses) or synchronize the S/H circuit with the SSR output switch (to inhibit the switching of SSR output modules while the S/H circuit is acquiring the signal).

G Component Layout

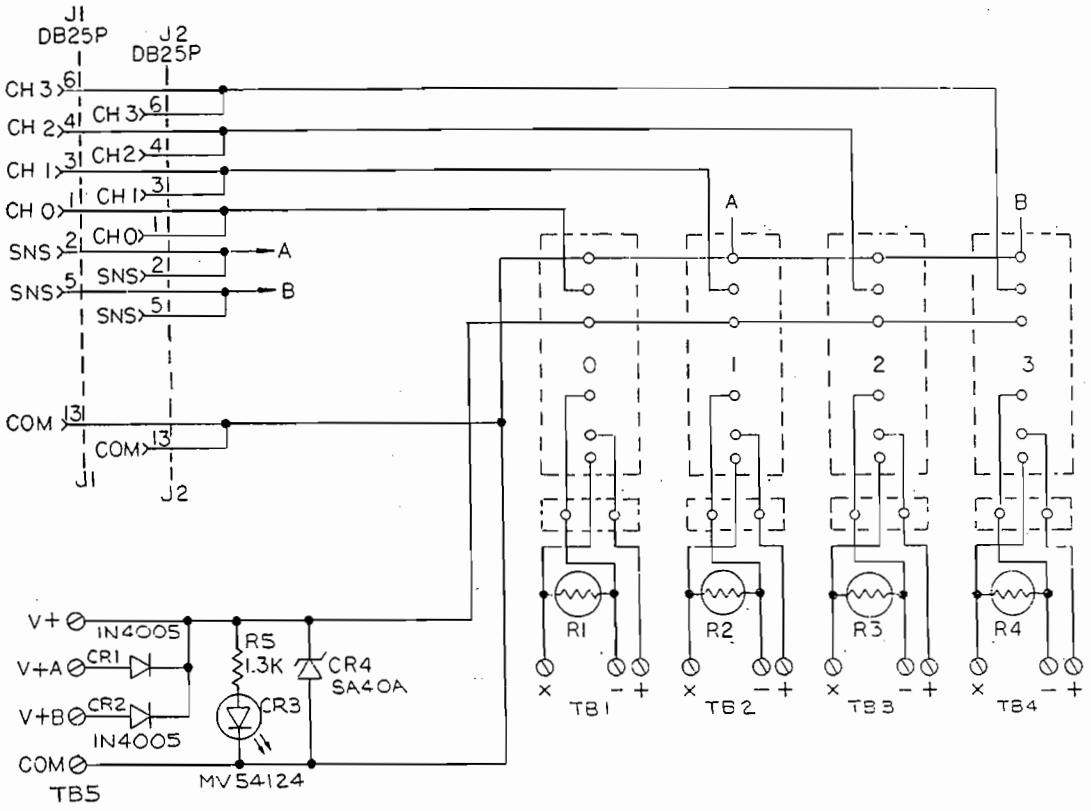
Appendix G contains a component layout of a 7BP16-1 backplane; you might find it helpful if you are designing your own backplane.



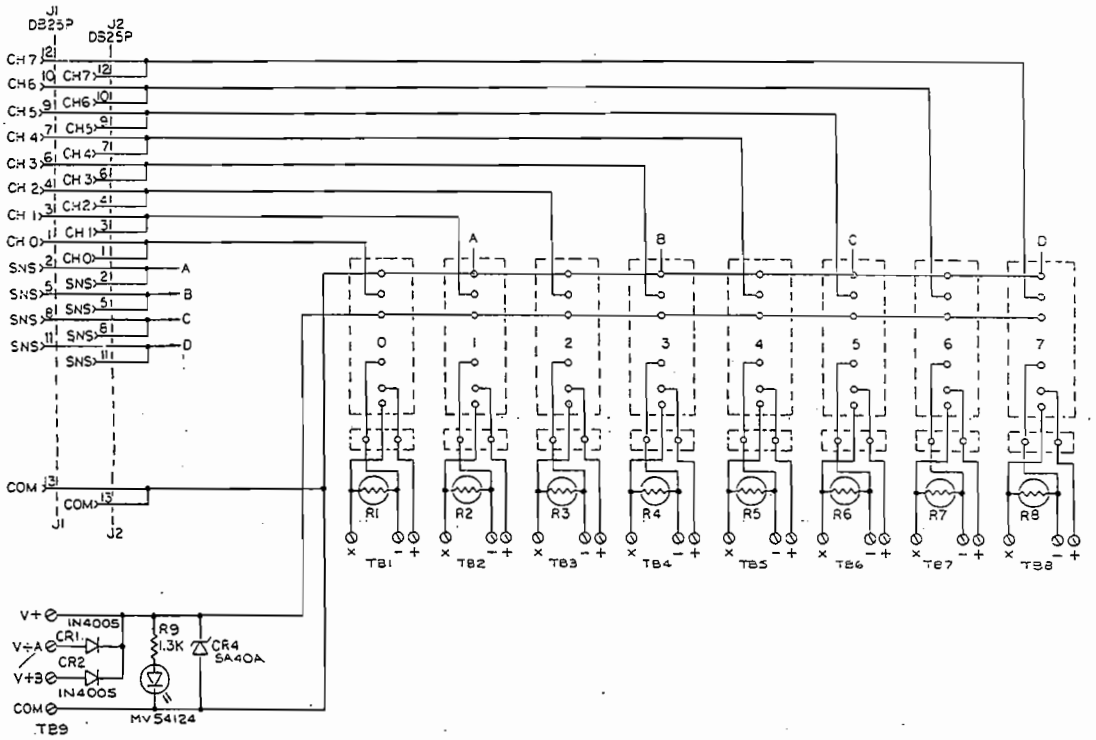
Component Layout of the 7BP16-1

H Schematics

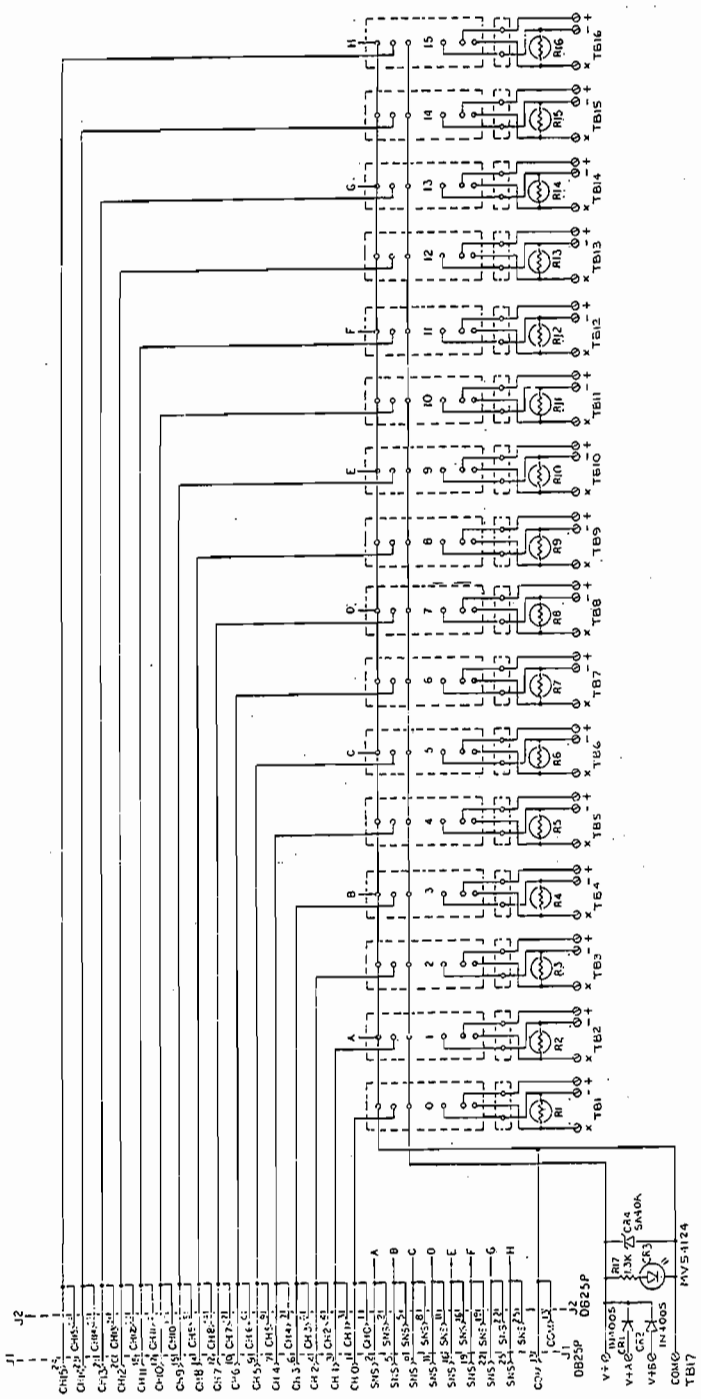
Appendix H contains the schematic diagrams of the 7BP04-1, 7BP08-1, and 7BP16-1 backplanes.



7BP04 Backplane



7BP08 Backplane



7BP16 Backplane

Index

A

B

C

D

E

H

I

L

M

N

O

P

R

S

T

U

V

W

Statement of Warranty

Analog Devices warrants that the Products furnished under this Agreement will be free from material defects for a period of one year from the date of shipment. The Customer shall provide notice to Analog Devices of such defect within one week after the Customer's discovery of such defect. The sole obligation and liability of Analog Devices under this warranty shall be to repair or replace, at its option, without cost to the Customer, the product or part which is so defective and as to which such notice is given.

Upon request by Analog Devices, the product or part claimed to be defective shall immediately be returned at the Customer's expense to Analog Devices. Replaced or repaired products or parts will be shipped to the Customer at the expense of Analog Devices.

There shall be no warranty or liability for any products or parts which have been subject to misuse, accident, negligence, failure of electric power or modification by the Customer without Analog Devices' approval. Final determination of warranty eligibility shall be made by Analog Devices. If a warranty claim is considered invalid for any reason, the Customer will be charged for services performed and expenses incurred by Analog Devices in handling and shipping the returned item.

As to replacement parts supplied or repairs made during the original warranty period, the warranty period of the replacement or repaired part shall terminate with the termination of the warranty period with respect to the original product or part.

THE FOREGOING WARRANTY CONSTITUTES ANALOG DEVICES' SOLE LIABILITY AND THE CUSTOMER'S SOLE REMEDY WITH RESPECT TO THE PRODUCTS AND IS IN LIEU OF ALL OTHER WARRANTIES, LIABILITIES AND REMEDIES. EXCEPT AS THUS PROVIDED, ANALOG DEVICES DISCLAIMS ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

98-1435903
AC1399

One Technology Way
Norwood, MA 02062