ANALOG DEVICES

6B SERIES USER'S MANUAL

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6B SERIES USER'S MANUAL

6B Series User's Manual
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Preface

The *6B Series User's Manual* provides all the information required to install, configure, calibrate, read data from, and write data to 6B Series modules and the 6B50 digital I/O board. It is intended for system designers responsible for building data acquisition systems.

The *6B Series User's Manual is* organized as follows:

- Chapter 1 provides an overview of the features of 6B Series modules, 6B Series backplanes, and 6B50 digital I/O boards.
- Chapter 2 provides guidelines to follow when setting up and installing a 6B Series system.
- Chapter 3 provides the background information needed to use the 6B Series Command Set. It is intended for users who are writing their own application programs to configure, calibrate, read data from, or write data to 6B Series modules and 6B50 digital I/O boards.
- Chapter 4 presents the 6B Series commands in alphabetical order, describing the syntax and usage for each.
- Chapter 5 provides technical information about the hardware structure of the 6B Series system. It is intended for those users who are interested in more technical detail than provided in Chapter 1.
- Appendix A provides a brief description of the 6B Series Utility/Demo software package. It is intended for those users who want to configure, calibrate, read data from, or write data to 6B Series modules and 6B50 digital I/O boards without writing their own application programs.

- Appendix B contains examples of each of the data formats for each input and output range.
- Appendix C contains instructions for calibrating analog I/O modules.
- Appendix D contains the information needed to troubleshoot a 6B Series system.
- Appendix E contains a summary of 6B Series commands arranged by syntax and by the particular module/board supported.
- Appendix F contains sample programs for reference when writing individual application programs.
- Appendix G contains information on where to obtain common parts and accessory items associated with a 6B Series system.
- Appendix H contains diagrams of the layouts and mechanical dimensions of 6B Series modules, boards, backplanes, and accessories.
- Appendix I contains tables illustrating the overall 6B Series Communication rates as a function of the configuration settings.
- Appendix J contains a discussion on RS-232C and RS-485 communication, as they are implemented in a 6B series system.
- Appendix K contains important information for using of the 6B Series Signal Conditioning Subsystem to comply with the European Union EMC Directive.
- Appendix L contains information about Dynamic Data Exchange (DDE) and a software driver that allows any Microsoft Windows application that supports DDE to exchange data with the 6B Series.

1 Description

The 6B Series product family consists of modules, boards, and backplanes, which provide a direct interface between your host computer and a variety of analog input, analog output, and digital I/O applications. This chapter describes the features of the 6B Series analog input and analog output modules, the 6B Series backplanes, and the 6B50 digital I/O board. If you require more technical information, refer to Chapter 5.

6B Series Modules

The 6B Series product family includes analog input and analog output modules that provide an interface between your host computer and real-world signals.

All 6B Series modules are identical in size and pin configur- ation. You install modules into one of a variety of 6B Series backplanes; these backplanes are described later in this chapter. A 6B Series module is shown in Figure 1-1.

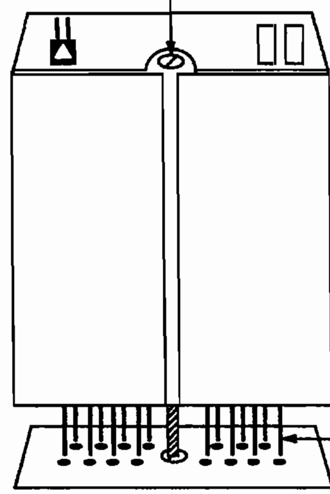

Figure 1-1. 6B Series Module

The 6B Series modules are described in more detail in the following sections.

Analog Input Modules

The 6B Series analog input modules are low-cost, digitizing, signal conditioning modules that offer transformer-based isolation, ranging, analog-to-digital (A/D) conversion, and digital communication. Input modules accept input from thermocouples, resistance temperature detectors (RTDs), millivolt and voltage signals, and process current signals. The modules convert these signals and then transmit the data serially through an RS-485 connector. The backplane closest to the host computer converts the RS-485 signals to RS-232C signals to send to the host. Each input module provides input-to-output accuracy of ±0.05% or better for all millivolt and voltage input ranges.

Modules Available

The following input modules are available:

- **6B11 Module** - The 6B11 module accepts input from J, K, T, E, R, S, and B thermocouples, millivolt inputs from ±15 mV to ±500 mV, voltage inputs from ±1 V to ±5 V, and process current inputs. It returns data in engineering units, such as °C, V, or mA, as percent of full-scale range (FSR), or in twos complement hexadecimal format.
- **6B12 Module** - The 6B12 module accepts millivolt inputs from ±150 mV to ±500 mV, voltage inputs from ±1 V to ±50 V, and process current inputs. It returns data in engineering units, such as mV, V, or mA, as percent of FSR, or in twos complement hexadecimal format.
- **6B13 Module** - The 6B13 module accepts input from platinum, nickel, and copper RTDs and returns linearized data in engineering units, such as °C or Ω, as percent of FSR, or in twos complement hexadecimal format.
- **6B11HV, 6B12HV, 6B13HV Modules** - These modules are identical to the 6B11, 6B12 and 6B13 modules, except for a higher Input-to-Output Isolation rating of 2500 V rms (vs. the "non-HV" rating of 1500 V rms). All 6B11, 6B12 and 6B13 information in this manual is applicable to the 6B11HV, 6B12HV and 6B13HV respectively, unless specifically stated otherwise.

Programming Modules

Software is used to configure analog input modules for address, input range, baud rate, data format, checksum status, and/or integration time. All programmable parameters are stored in nonvolatile memory on the module.

All analog input modules can be calibrated to correct for gain errors and the 6B13 module can be calibrated to correct for offset errors.

For applications that require the synchronized sampling of more than one input signal, all 6B11 analog input modules, all 6B12 analog input modules, and all 6B50 digital I/O boards can be programmed to simultaneously sample their input values. The synchronized data can be read back later.

Refer to Chapters 3 and 4 for more information on programming analog input modules.

6B21 Analog Output Module

The 6B21 analog output module provides digitally controlled, isolated current loop output to a resolution of 12 bits. Select an output range of either 0 to 20 mA or 4 to 20 mA.

Software is used to configure 6B21 modules for address, output range, baud rate, data format, checksum status, slew rate, and start-up output value. All programmable parameters are stored in nonvolatile memory on the module.

Express the output value either in engineering units, as percent of span, or in hexadecimal format. The slew rate is the rate at which the output signal rises or falls as it reaches the desired output value. The start-up output value is used whenever the module is powered up.

6B21 analog output modules can be calculated to 4 mA and 20 mA.

The host can check a 6B21 analog output module by reading back either the last programmed output value or the measured value of the current actually flowing through the current loop.

Refer to Chapters 3 and 4 for more information on programming analog output modules.

6B50 Digital I/O Board

The 6B50 digital I/O board allows data to be read from and written to 24 digital I/O channels on three 8-bit ports (A, B, and C). Access the three digital I/O ports with industry standard digital I/O panels, such as the STB-50A Screw Termination Board, the DB-16 Digital I/O Backplane, and the DB-24 Digital I/O Backplane. Connect the digital I/O panel through the 50-pin connector (J2) on the 6B50 board. Refer to Application Wiring in Chapter 2 for more information.

Each channel on a 6B50 board is bidirectional. Use each channel as either an input channel or an output channel. The logic level associated with each channel is provided either by an external device, such as a switch whose contact closure state is being monitored, or by the on-board output signal, which is used when writing a value to a channel. The output transistor is active-low. A logic 1 indicates that the output signal is ON and the voltage is low. A logic 0 indicates that the output signal is OFF and the voltage is high. When powering up or resetting a 6B50 digital I/O board, all on-board output signals are turned OFF. When writing a value to a channel, the output signal is automatically turned ON. The host can read either the state of an external device connected to a channel or the last value written to a channel.

The input signals are individually buffered and software debouncing is provided. The 6B50 board samples the inputs every 1 ms; however, the software does not register a change of state unless the input remains in the same state for five consecutive readings (a minimum of 4 ms). The output signals are latched and remain in the same state unless the state is changed by executing a write (Digital Data Out) command.

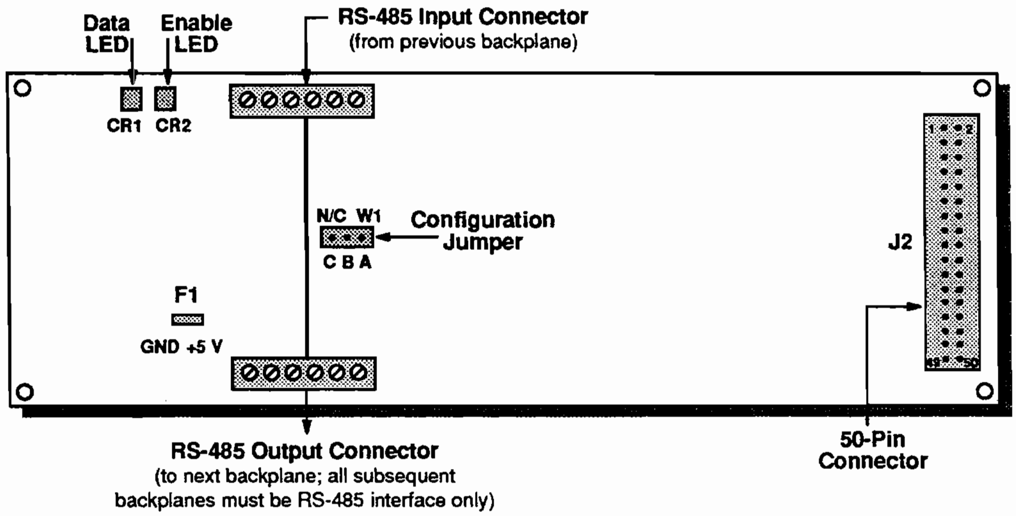

Figure 1-2. 6B50-1 Board

Boards Available

Two types of 6B50 digital I/O boards are available. The 6B50-1 board, shown in Figure 1-2, has two RS-485 connectors, one for connecting to the previous 6B50 board or 6B Series backplane in a network and one for connecting to the next board or backplane in the network.

The 6B50-2 board, shown in Figure 1-3, has an RS-485 output connector for connecting to the next 6B50 board or 6B Series backplane in a network and an RS-232C connector for connecting to a host computer. It also has an RS-232C-to-RS-485 converter that allows the board to communicate with the host.

Note: The 6B50-1 INPUT connectors and OUTPUT connectors (shown in Figure 1-2) may be interchanged when wiring a 6B Series system... both INPUT and OUTPUT connectors are tied in parallel on the 6B50-1 board.

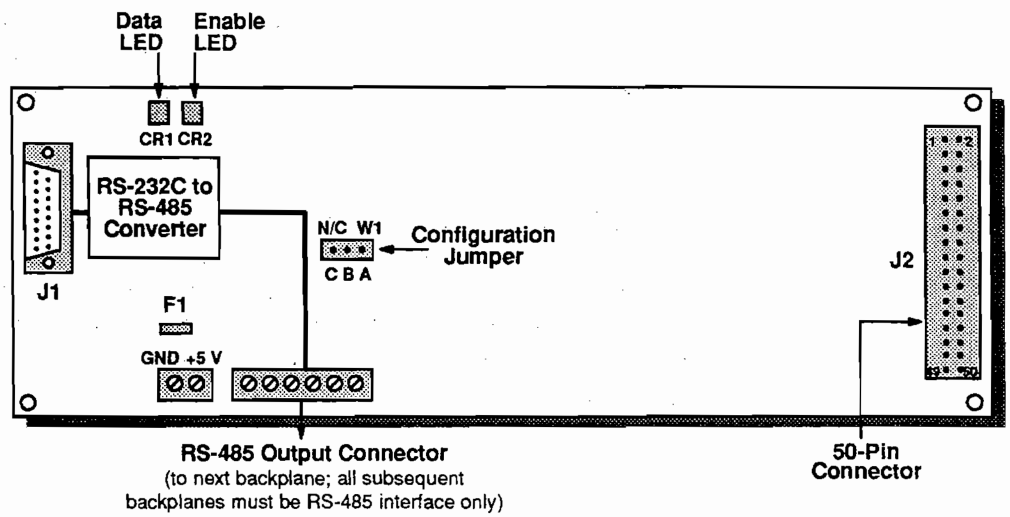

Figure 1-3. 6B50-2 Board

The mechanical dimensions of the 6B50-1 and 6B50-2 boards are shown in Appendix H.

Configuration Jumper

Each 6B50 digital I/O board contains a configuration jumper (W1), which allows you to verify the configuration of a 6B50 board by forcing the board into a known state. The configuration jumper contains three posts (A, B, and C). If the configuration jumper is installed in position AB on *power-up,* the board is forced into a known address (00H), baud rate (9600), and checksum status (disabled). You can then address the board to verify its configuration.

You must use the configuration jumper to establish or alter the address, baud rate, and checksum status. All other programmable parameters – such as input range, data format, and integration time – may be changed without the use of the configuration jumper.

The configuration jumper is intended strictly for verification and configuration; install the jumper in position BC during normal operation. For more information on the configuration jumper, refer to Appendix A.

Power Supply

Each 6B50 digital I/O board requires an external +5 V power supply, which you connect to the +5 V and GND screw terminals on the board. A shunt diode provides polarity reversal protection to the board. A fuse (F1) protects the board from damage caused by short circuits. Refer to Providing Power to Backplanes and Boards in Chapter 2 for more information.

Networking

You can connect multiple 6B50 digital I/O boards and 6B Series backplanes in an RS-485 network. Two LEDs (labeled CR1 and CR2) indicate the status of the communication lines. Refer to Connecting Multiple Backplanes and Boards in Chapter 2 for more information.

Programming Boards

You use software to configure 6B50 digital I/O boards for address, baud rate, and checksum status. All programmable parameters are stored in nonvolatile memory on the board.

For applications that require the synchronized sampling of more than one input signal, you can program all 6B11 analog input modules, all 6B12 analog input modules, and all 6B50 digital I/O boards to sample their input values simultaneously. You can read the synchronized data back later.

Refer to Chapters 3 and 4 for more information on programming 6B50 digital I/O boards.

6B Series Backplanes

The following 6B Series backplanes are available for use with 6B Series modules:

- **6BP01-1 Backplane** - The 6BP01-1 backplane, shown in Figure 1-4, is a single-channel backplane. It has one RS-485 input connector for connecting to the previous 6B Series backplane or 6B50 digital I/O board in a network. (Note that since the 6BP01-1 backplane does not contain an RS-485 output connector, you cannot connect the 6BP01-1 to any backplanes or boards farther in the network.)

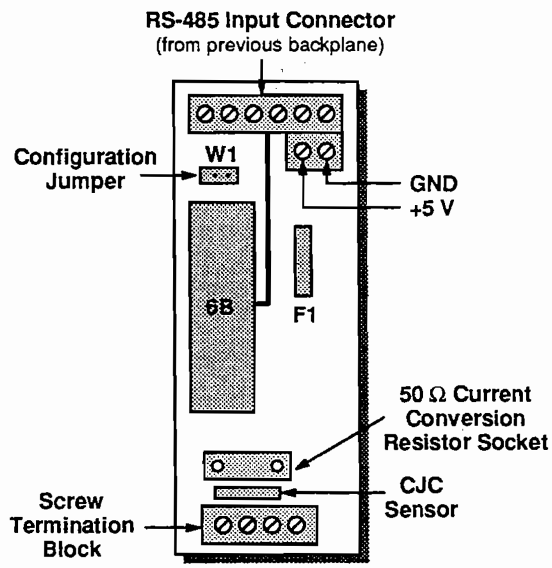

Figure 1-4. 6BP01-1 Backplane

- **6BP01-2 Backplane** - The 6BP01-2 backplane, shown in Figure 1-5, is a single-channel backplane. It has an RS-485 output connector for connecting to the next 6B Series backplane or 6B50 board in a network and an RS-232C connector for connecting to a host computer. It also has an RS-232C-to-RS-485 converter that allows the 6B modules to communicate with the host.

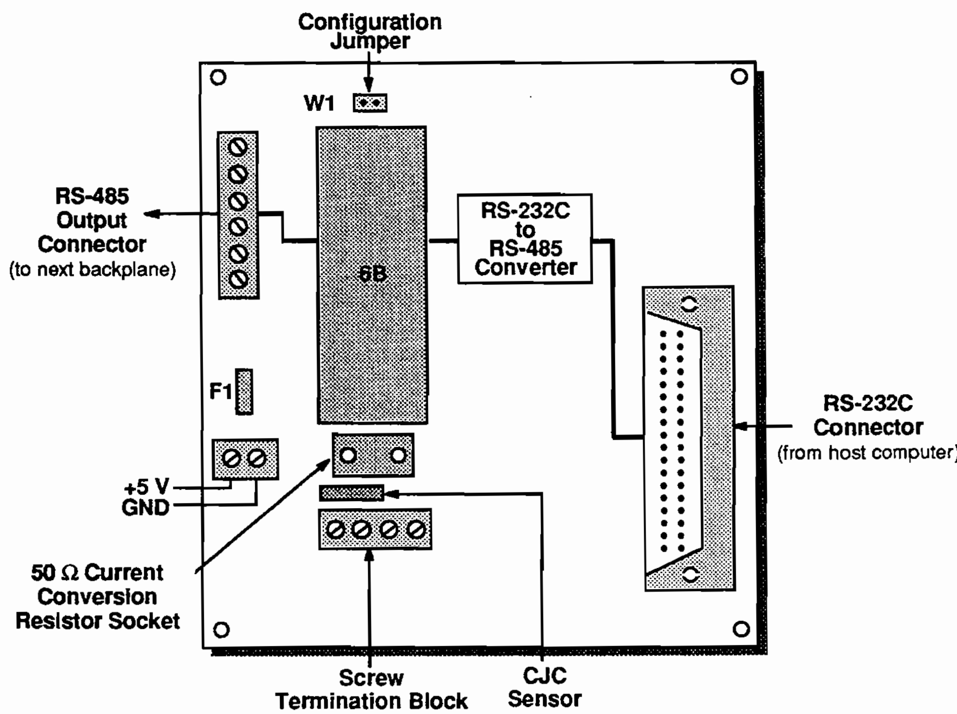

Figure 1-5. 6BP01-2 Backplane

- **6BP04-1 Backplane** - The 6BP04-1 backplane, shown in Figure 1-6, is a 4-channel backplane. It has two RS-485 connectors, one for connecting to the previous 6B Series backplane or 6B50 digital I/O board in a network and one for connecting to the next backplane or board in the network. It also has an RS-485 repeater that allows you to connect the backplane to another backplane or board at a distance of up to 4000 feet.

Note: The 6BP04-1 INPUT and OUTPUT connections (shown in Figure 1-6), may NOT be interchanged when wiring a 6B Series system... in the event they are interchanged, the 6BP04-1 and subsequent 6B backplane boards will not respond – however, no damage will occur to the boards.

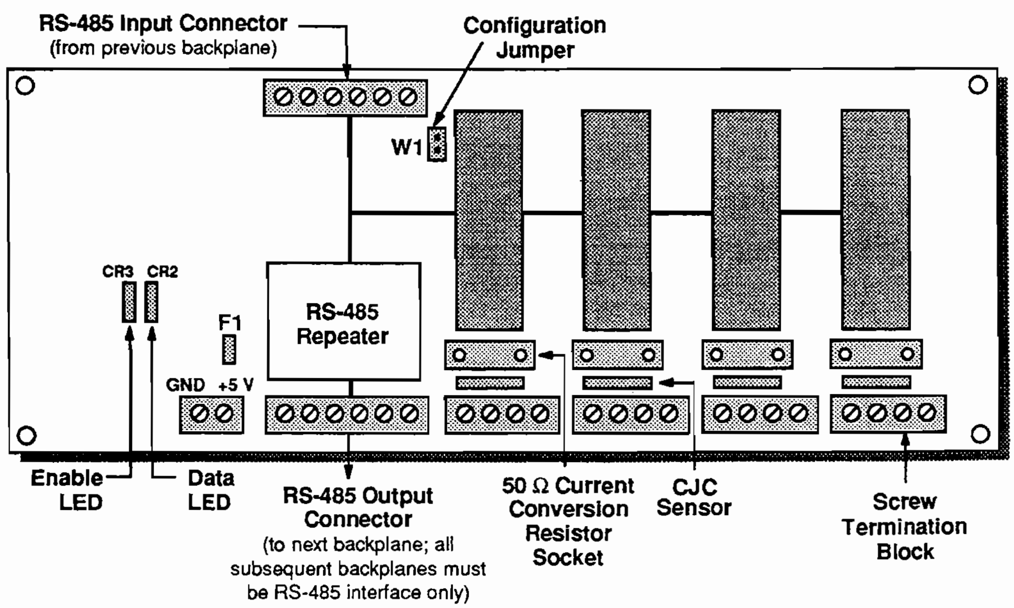

Figure 1-6. 6BP04-1 Backplane

- **6BP04-2 Backplane** - The 6BP04-2 backplane, shown in Figure 1-7, is a 4-channel backplane. It has an RS-485 output connector for connecting to the next 6B Series backplane or 6B50 digital I/O board in a network and an RS-232C connector for connecting to a host computer. It also has an RS-232C-to-RS-485 converter that allows the 6B modules to communicate with the host, and an RS-485 repeater that allows the backplane to to be connected to another backplane or board at a distance of up to 4000 feet.

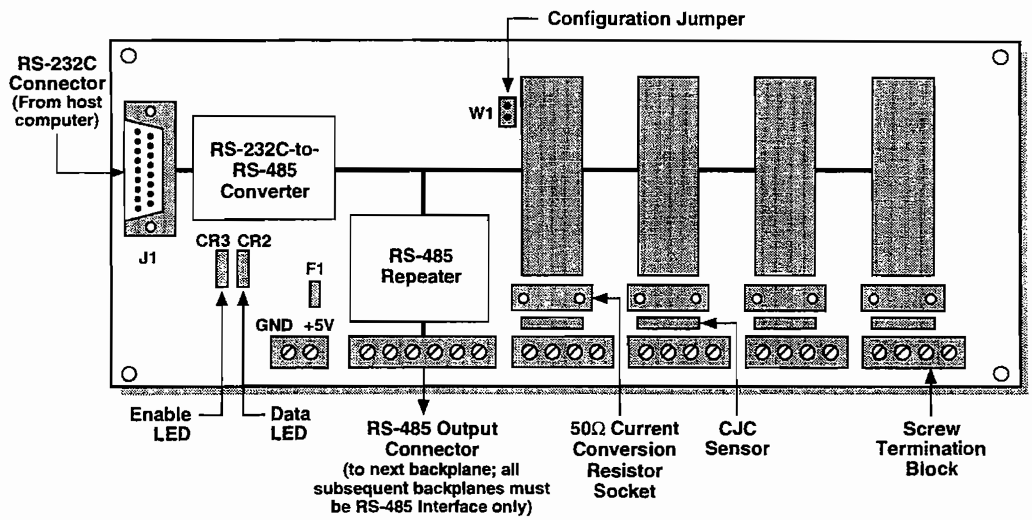

Figure 1-7. 6BP04-2 Backplane

- **6BP04HV-1, 6BP04HV-2 Backplanes** - The 6BP04HV-1 and 6BP04HV-2 backplanes are the same as the 6BP04-1 and 6BP04-2 backplanes respectively, with the following additional characteristics: the input-to-output and channel-to-channel isolation voltage is rated at 2500 V rms (vs. 1500 V rms for the 6BP04-1 and 6BP04-2); the 6BP04HV-1 and 6BP04HV-2 provide power supply Overvoltage Protection for voltages greater than 6.5 V dc (the 6BP04-1 and 6BP04-2 do not have this feature); The I/O connections accept 18-22 AWG wire (vs. 14-22 AWG for 6BP04-1 and 6BP04-2).

- **6BP16-1 Backplane** - The 6BP16-1 backplane, shown in Figure 1-8, is a 16-channel backplane. It has two RS-485 connectors, one for connecting to the previous 6B Series backplane or 6B50 digital I/O board in a network and one for connecting to the next backplane or board in the network. It also has an RS-485 repeater that allows you to connect the backplane to another backplane or board at a distance of up to 4000 feet.

Note: The 6BP16-1 INPUT and OUTPUT connections (shown in Figure 1-8), may NOT be interchanged when wiring a 6B Series system… in the event they are interchanged, the 6BP16-1 and subsequent 6B backplane boards will not respond – however, no damage will occur to the boards.

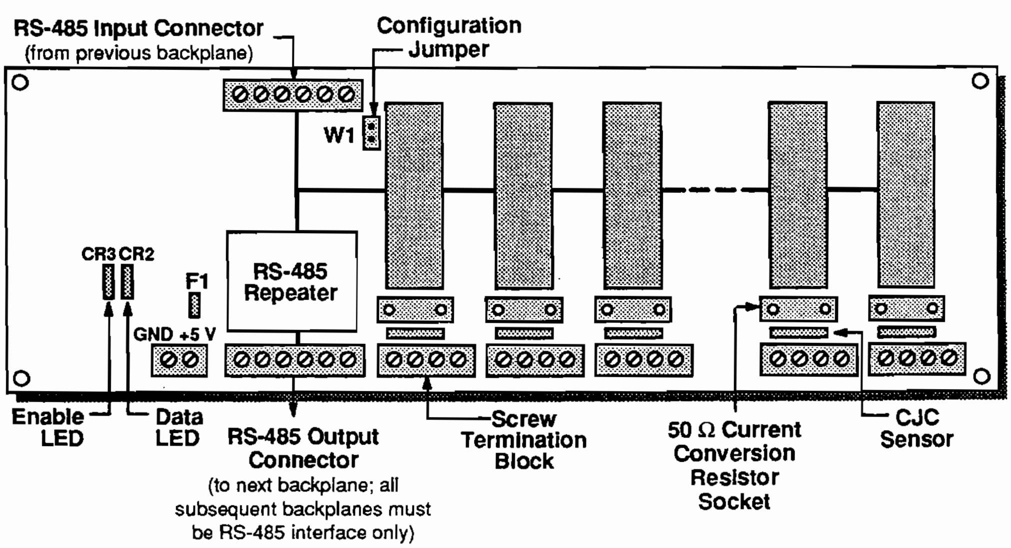

Figure 1-8. 6BP16-1 Backplane

- **6BP16-2 Backplane** - The 6BP16-2 backplane, shown in Figure 1-9, is a 16-channel backplane. It has an RS-485 output connector for connecting to the next 6B Series backplane or 6B50 digital I/O board in a network and an RS-232C connector for connecting to a host computer. It also has an RS-232C-to-RS-485 converter that allows the 6B module to communicate with the host and an RS-485 repeater that allows you to connect the backplane to another backplane or board at a distance of up to 4000 feet.

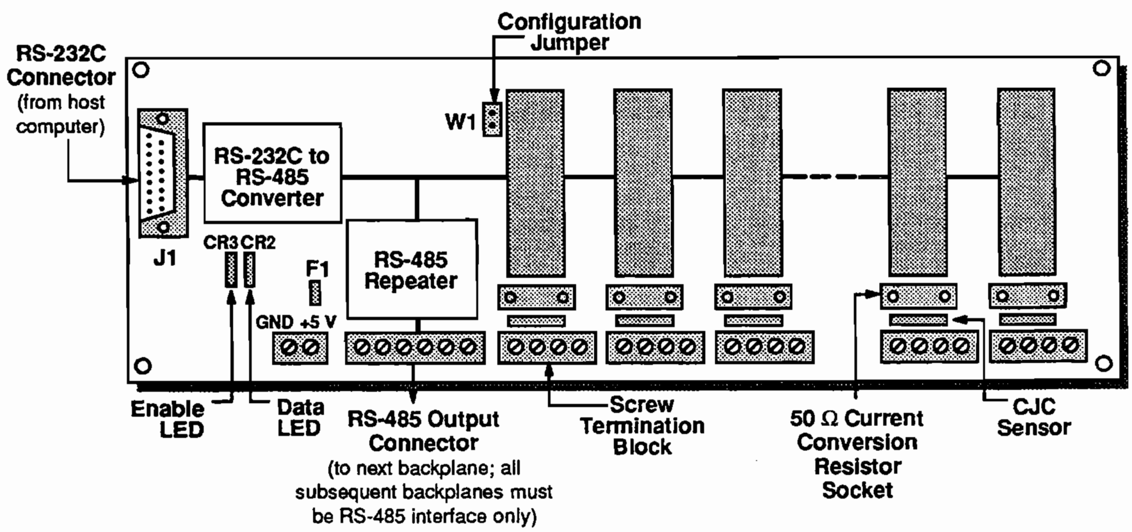

Figure 1-9. 6BP16-2 Backplane

The mechanical dimensions of the 6B Series backplanes are shown in Appendix H.

Features

Besides the RS-485 connector(s), RS-232C connector, RS-232C-to-RS-485 converter, and RS-485 repeater, each 6B Series backplane contains the following:

- **Screw Termination Block** - Each channel on a 6B Series backplane has a screw termination block with four screw terminals for connecting applications. These screw terminals satisfy all transducer inputs and process current outputs, and they provide excitation when necessary.
- **CJC Sensors** - A CJC (cold junction compensation) sensor is permanently installed for each channel on a 6B Series backplane to accommodate the 6B11 module. When thermocouple wires are connected to the screw terminals, the CJC sensor measures the temperature of the screw terminals and applies a correction term to the thermocouple reading. The CJC sensor operates optimally in a temperature range from +5°C to +45°C. The mechanical dimensions of the CJC sensor are shown in Appendix H.

Notes: You can leave the CJC sensor in place, even if an input other than a thermocouple is attached to the channel. In addition, the calibration of the CJC sensor is independent of the particular thermocouple input used.

If you are building your own backplane, you can order CJC sensors (AC1361) for thermocouple inputs. Refer to Appendix G for more information.

- **Configuration Jumper -** The configuration jumper (W1) allows verification of the configuration of a module by forcing the module into a known state. The configuration jumper is connected to the leftmost module position on a 6B Series backplane. If a module is installed in this leftmost position and if the configuration jumper is installed, on power-up the module is forced into a known address (00H), baud rate (9600), and checksum status (disabled). The module can be addressed to verify and change its configuration.

  The configuration jumper must be used to establish or alter the address, baud rate and checksum status for a 6B Series module.

  The configuration jumper is intended strictly for verification and configuration; *do not use this jumper during normal operation.* For more information on the configuration jumper, refer to Appendix A.

- **Power Supply Screw Terminals -** All 6B Series backplanes require an external +5 V power supply, which is connected to the +5 V and GND screw terminals on the backplane. Refer to Providing Power to Backplanes and Boards in Chapter 2 for more information.

AC1381

- **50 Ω Current Conversion Resistor Socket -** To use a 6B11 or 6B12 analog input module to measure process current inputs, a 50 Ω current conversion resistor (AC1381) is needed to read the voltage. For each channel that reads a current input, the resistor must be inserted into the appropriate 50 Ω current conversion resistor socket on the 6B Series backplane. The AC1381 is a fully encapsulated 50 Ω, 0.1% (max), 1/8 watt, 10 ppm/°C (max) resistor. The resistor tolerance will directly affect the accuracy of the data acquisition system and should be included in the worst case analysis of the system. The mechanical dimensions of the resistor are shown in Appendix H.

Caution: If the power lines across the high and low signal screw terminals are accidentally connected while a current conversion resistor is connected, the resistor will open circuit internally.

- **Shunt Diode -** A shunt diode on each 6B Series backplane provides polarity reversal protection to the backplane.
- **Fuse -** A fuse (F1) on each 6B Series backplane protects the backplane from damage caused by short circuits or by the failure of one of the modules on the backplane. Refer to Replacing the Fuse in Chapter 2 for information on replacing the fuse.
- **Status Indicators -** Two LEDs (labeled CR3 and CR2) indicate the status of the communication lines. Refer to Communication Status in Chapter 2 for more information.

Networking

Multiple backplanes and 6B50 digital I/O boards can be connected in an RS-485 network. Refer to Connecting Multiple Backplanes and Boards in Chapter 2 for more information.

Mounting Backplanes

6BP04, 6B04HV and 6BP16 backplanes can be mounted in a 19" rack or flush to a panel; a 6BP01-2 backplane can be mounted on DIN rails or flush to a panel; a 6BP01-1 backplane can be mounted on DIN rails. Refer to Mounting a Backplane or Board in Chapter 2 for more information.

European Union Requirements

For companies designing equipment to sell to the nations of the European Union (EU – 15 Countries), Analog Devices 6B modules have been tested and approved to meet requirements for electromagnetic compatibility – EMC Directive 89/336/EEC, which became effective January 1, 1996. To indicate approval, all 6B Series modules have the CE (Communité Européenne) mark on their label. Satisfying these requirements indicates that each 6B module will neither create noise which will cause interference with other products in its environment, nor be susceptible to noise created by equipment in that environment.

Please refer to Appendix K for additional details on the EMC tests as well as the setup information when applying the 6B Series Modules to comply to the EMC Directive in heavy industrial applications.

2 Setup and Installation

A 6B Series system consists of backplanes, modules, boards, a host computer, and I/O applications in an arrangement appropriate for your installation. This chapter provides guidelines to follow when setting up and installing a 6B Series system. As you set up your system, keep the following considerations in mind:

- Carefully plan the layout and configuration of your system before you begin.
- You do not have to set up your system in any particular sequence. For example, you may want to configure your modules and boards in a laboratory setting and then bring them to your installation later, or you may want to install one backplane and several modules immediately and then install additional backplanes, modules, and boards later.

Warning: High voltages may be present at the backplane's screw terminals and pin sockets even if the backplane power is turned off. If you cannot disconnect the applications connected to the backplanes, use extreme caution to avoid potential shock.

Hardware and Software Requirements

The following equipment is required to set up a 6B Series system:

- Host computer, such as an IBM® PC™, IBM PC/XT™, or IBM PC AT™-compatible, with an accessible RS-232C serial communication port.
- RS-232C male-to-female DB-25 cable (AC1382), RS-232C male-to-female DB-9 cable (AC1385), or other compatible cable (up to 50 feet).
- +5 V power supply for each 6B Series backplane or 6B50 digital I/O board; refer to Providing Power to 6B Series Backplanes and Boards in this chapter for more information.
- 6B Series modules, as needed.
- One 6B Series backplane or 6B50 digital I/O board with an RS-232C connector.
- 6B Series backplanes and 6B50 digital I/O boards with RS-485 connectors, as needed.
- 6B Series Utility/Demo disk.

Unpacking

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 6B Series system.

6B Series modules, backplanes, and boards are packaged in antistatic bags to avoid damage to sensitive components. Before removing a module, backplane, or board 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, backplane, or board and inspect it for signs of damage and loose components. If the module, backplane, or board appears damaged in any way, contact your local Analog Devices sales office. Do not attempt to use a damaged module, backplane, or board.

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

Installing Modules

To install a 6B Series module into its permanent socket on the 6B Series backplane, perform the following steps:

1. Make sure that no power is being applied to the backplane.

   Note: It is recommended that you turn power OFF before removing or installing modules.

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

Configuring Modules and Boards

The following parameters of 6B Series modules and boards are user-configurable:

- Address (all modules and boards)
- Baud rate (all modules and boards)
- Checksum status (all modules and boards)
- Input range (6B11, 6B12, 6B13 only)
- Output range (6B21 only)
- Data format (6B11, 6B12, 6B13, 6B21 only)
- Integration time (6B11, 6B12, 6B13 only)
- Slew rate (6B21 only)

Notes: Changing the Address, Baud Rate, and Checksum status *requires the use of the W1 jumper on the backplane*. These parameters are typicaly only changed during initial setup of a 6B series system.

Input Range, output range, data format, integration time and slew rate *do not require the use of the W1 jumper*. They may be changed at any time, during initial system setup, or during field operation.

Factory Configuration

Analog Devices ships 6B Series modules and boards with the factory configuration shown in Table 2-1.

Note: Address 00H should be reserved only for modules and boards configured at the factory. The user should reconfigure all modules and boards to an address other than 00H, during initial setup.

Table 2-1 Factory Configuration of 6B Series Modules and Boards

Module	Parameter	Factory Configuration
6B11 and 6B11HV	Address	00H
	Baud rate	9600
	Checksum status	Disabled
	Input range	±5 V
	Data format	Engineering units
	Integration time	50 ms (60 Hz)
	Slew rate	Not applicable
6B12 and 6B12HV	Address	00H
	Baud rate	9600
	Checksum status	Disabled
	Input range	±5 V
	Data format	Engineering units
	Integration time	50 ms (60 Hz)
	Slew rate	Not applicable
6B13 and 6B13HV	Address	00H
	Checksum status	Disabled
	Input range	Platinum RTD, ±100°C, α= 0.00385
	Data format	Engineering units
	Integration time	50 ms (60 Hz)
	Slew rate	Not applicable
6B21	Address	00H
	Baud rate	9600
	Checksum status	Disable
	Output range	0 to 20 mA
	Data format	Engineering units
	Integration time	Not applicable
	Slew rate	Immediate change
6B50	Address	00H
	Baud rate	9600
	Checksum status	Disabled
	Input/Output range	Not applicable
	Data format	Not applicable
	Integration time	Not applicable
	Slew rate	Not applicable

You must reconfigure all factory-default parameters that are not appropriate to your application using either the 6B Series Utility/Demo software or a user-written application program. For information on the 6B Series Utility/Demo software, refer to Appendix A or the READ.ME file on the 6B Series Utility/Demo disk. For information on the 6B Series command set, which is required for user-written application programs, refer to Chapters 3 and 4.

Note: Since all 6B Series modules and boards are shipped with address 00H and no two modules or boards can have the same address, you must change the factory-default address for every module and board in the system.

When you finish configuring a module, write the range and the address of the module on the label in the space provided. This allows you to easily identify the module later.

Configuring Baud Rate or Checksum

When you configure or reconfigure a 6B Series module or 6B50 digital I/O board for address, baud rate or checksum status, you must perform the following steps:

1. Make sure that the system (or host) baud rate is set to 9600 baud.
2. Turn the power off to the backplane whose module you are configuring or to the 6B50 board that you are configuring.
3. If you are configuring a module, insert the module into the leftmost socket on the 6B Series backplane. If you are configuring a 6B50 board, omit this step.
4. If you are configuring a module, make sure that the configuration jumper (W1) is installed. If you are configuring a 6B50 board, make sure that the configuration jumper (W1) is installed in position AB.
5. Apply power to the backplane or board.

6. If you are using the 6B Series Utility/Demo software, search for the module or 6B50 board using the *Search* option.
7. Change the baud rate or checksum status for the module or 6B50 board.
8. Turn the power off to the backplane or board.
9. If you are configuring a module, install the module in the destination socket on the 6B Series backplane and remove the configuration jumper. If you are configuring a 6B50 board, install the configuration jumper in position BC.
10. Apply power to the backplane or board.

Note: Whenever you configure or reconfigure a 6B Series module or 6B50 digital I/O board for baud rate or checksum status, you must recycle the power to the backplane or board before the configuration change takes effect.

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11. Make sure that the system (or host) board rate is set to the appropriate baud rate for normal operation.
12. If you are using the 6B Series Utility/Demo software, update the system map using the *Search* option.

Mounting a Backplane or Board

The following sections describe the methods you can use to mount a 6B Series backplane or 6B50 digital I/O board.

Rack Mount: AC1380

Two 6BP04 backplanes (6B04-1, 6B04-2, 6B04HV-1 or 6B04HV-2), one 6BP16-1 or 6BP16-2 backplane, or two 6B50-1 or 6B50-2 digital I/O boards can also be mounted in a 19" rack using a rack-mount kit (AC1380). An Analog Devices 955, 977 or PWR-01 power supply can also be mounted in the rack mount. The rack mount weighs 1.7 pounds (775 grams). Dimensions are shown in Appendix H.

Install the backplane or board in the rack mount, as shown in Figure 2-1.

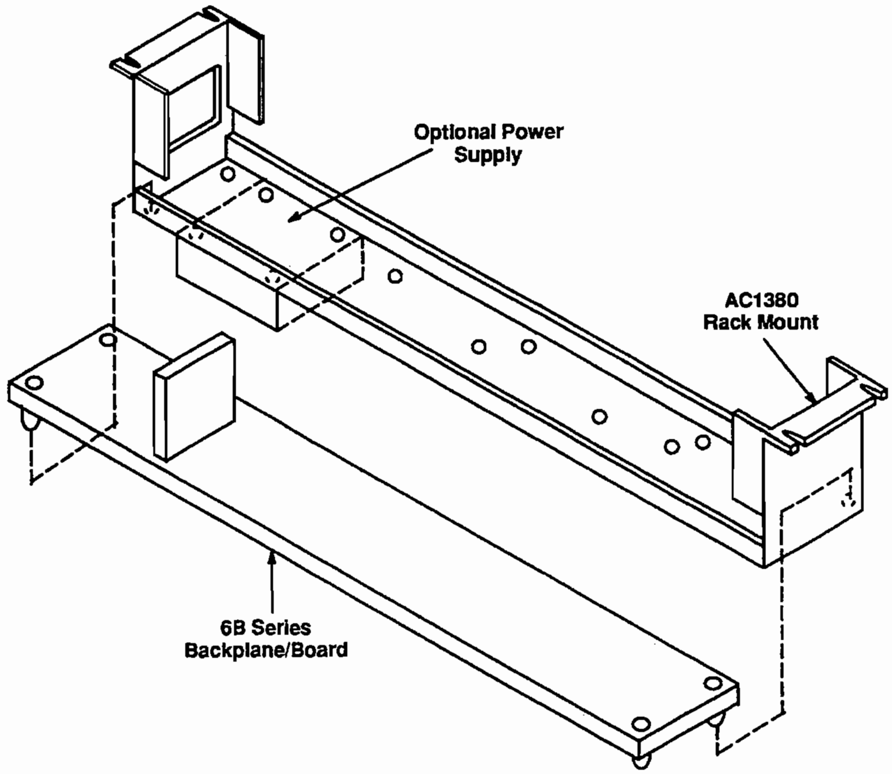


Figure 2-1. Installing a Backplane or Board into the AC1380 Rack Mount

Mounting Screw Kit

To install the backplane or board or power supply in the AC1380 rackmount, use the mounting screws that are provided with the AC1380. Two sets of screws are provided: (1) Set of 4, # 4-40 × 3/16 inch screws; (2) Set of 7, fillister head Phillips Drive M3 × 30 metric screws.

Mounting Power Supplies

Models 955 and 977 modular power supplies are provided with four threaded inserts, #4-40 × 0.15 inch deep. To mount these supplies in the AC1380, use the 4, # 4-40 × 3/16 inch screws inserted through the 0.147 inch diameter holes located in the left corner of the AC1380. Refer to Figure 2-1.

Mounting Backplanes

The 6B backplanes have pre-mounted standoffs. The AC1380 has a total of nine metric inserts, type M-3. To mount any of the backplanes or boards in the AC1380, use the 7 fillister head Phillips Drive M3 × 30 metric screws. Refer to Figure 2-1.

Rail Mount

The 6BP01-1 and 6BP01-2 backplanes can be mounted on DIN rails using Phoenix Universal Mounting (UM) assemblies. These assemblies include base elements with and without snap feet, side elements and connection pins.

One base element with snap foot and two side elements are required to mount a single 6BP01 backplane. Refer to Figure 2-2.

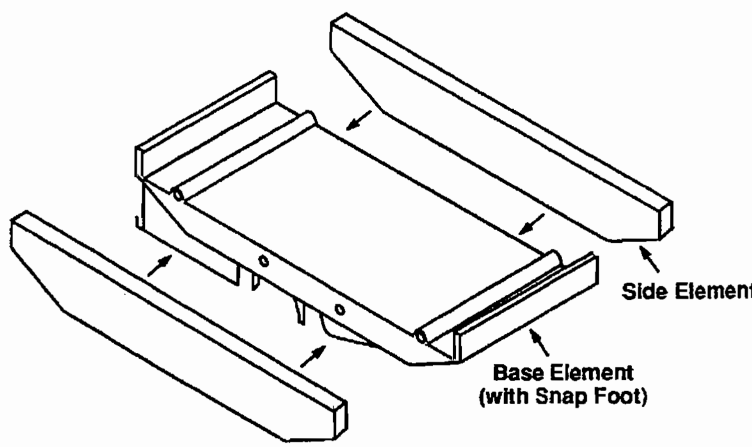


Figure 2-2. Rail Mounting a Single Backplane

To mount two or more 6BP01 backplanes requires two base elements with snap feet to support the outer two backplanes, two side elements, enough base elements without snap feet to support any additional backplanes, and connection pins to connect the base elements. Refer to Figure 2-3.

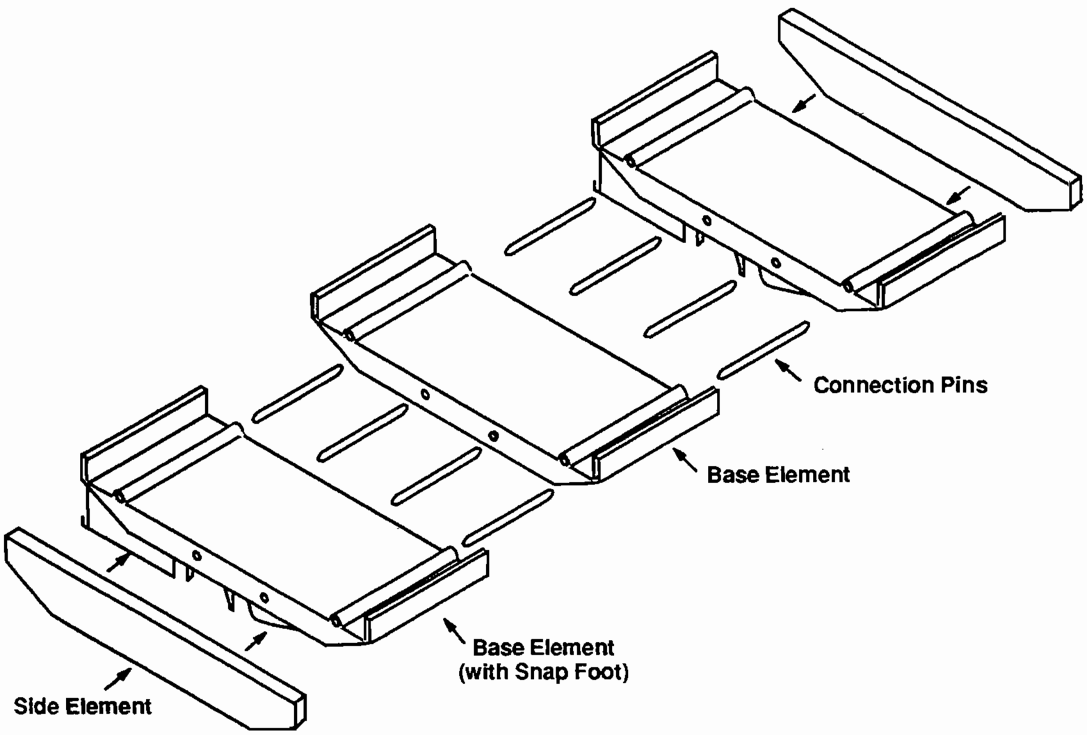


Figure 2-3. Rail Mounting Multiple Backplanes

The base elements with snap feet fit DIN EN 50022, DIN EN 50035, and DIN EN 50045 rails.

For information on ordering UM assemblies, refer to Appendix G.

Flush Mount

You can mount all backplanes and boards except the 6BP01-1 flush to a panel. Drill holes in the panel corresponding to the backplane or board standoffs. Refer to Appendix H for the dimensions of the backplane or board and the locations of the standoffs.

Connecting Multiple Backplane and Boards

Link multiple 6B Series backplanes and 6B50 digital I/O boards together by using the RS-485 connector and dual, twisted/shielded wire pairs, see Figure 2-8. In the RS-485 network, each 6B Series module counts as one load and each 6B50 digital I/O board counts as one load. Individual backplanes, without 6B modules, do not act as a load to the RS-485 network.

The maximum length of the network, and the maximum number of loads supported in a 6B series system, depends on the number of RS-485 repeaters in the network. Table 2-2 indicates which backplanes and boards contain repeaters. Also shown in Table 2-2 are the total loads each fully populated 6B backplane or board presents to the RS-485 network.

Table 2-2. Backplanes and Boards Containing Repeaters

Backplane/ Board	Repeater	Number[1] of Loads
6BP01-1	No	1
6BP01-2	Yes	1
6BP04-1	Yes	4
6BP04HV-1	Yes	4
6BP04-2	Yes	4
6BP04HV-2	Yes	4
6BP16-1	Yes	16
6BP16-2	Yes	16
6B50-1	No	1
6B50-2	Yes	1

[1]When backplane/board is fully populated (i.e., 16 modules for 6BP16-1)

Limits

The maximum length of the interconnecting wire between two repeaters is 4000 feet, and the maximum number of loads between one repeater and another repeater is 32. (Note that the loads on the backplane containing the first repeater come "before" the first repeater and do not count as part of the maximum of 32 loads for the second repeater.) The maximum number of loads in an entire network is 256. Figure 2-4 illustrates a sample configuration.

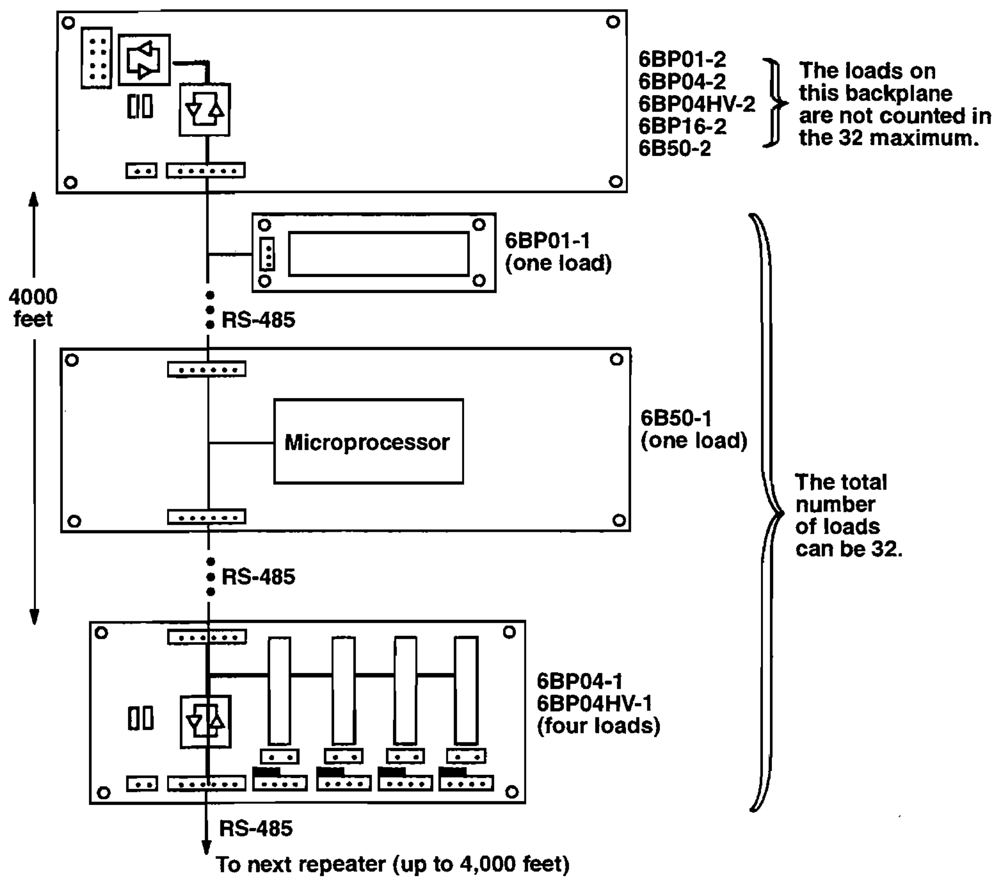


Figure 2-4. Sample Configuration

Each network can include only one backplane or one board that contains both an RS-232C connector and an RS-485 connector. This RS-232C/RS-485 backplane or board (6BP01-2, 6BP04-2, 6BP04HV-2, 6BP16-2, or 6B50-2) must be connected to an "RS-485 only" backplane or board (6BP01-1, 6BP04-1, 6BP04HV-1, 6BP16-1, or 6B50-1).

Types of Configurations

Multiple 6B Series backplanes and boards can be linked in a variety of configurations. These configurations are described in the following sections.

Daisy-Chain Configuration

In a daisy-chain configuration, connect the RS-485 output connector of one backplane or board to the RS-485 input connector of another backplane or board. An example of a daisy-chain configuration is shown in Figure 2-5.

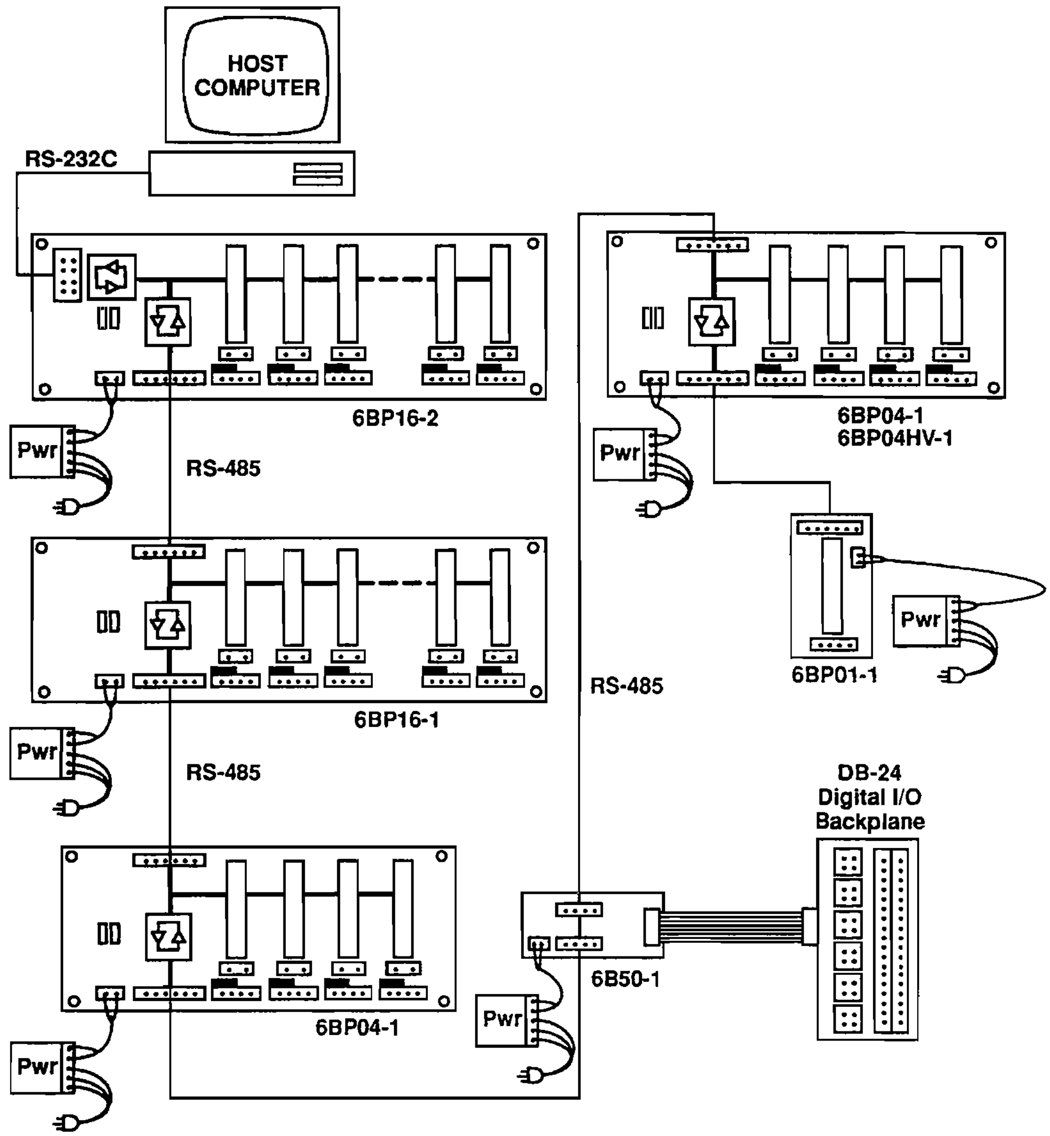
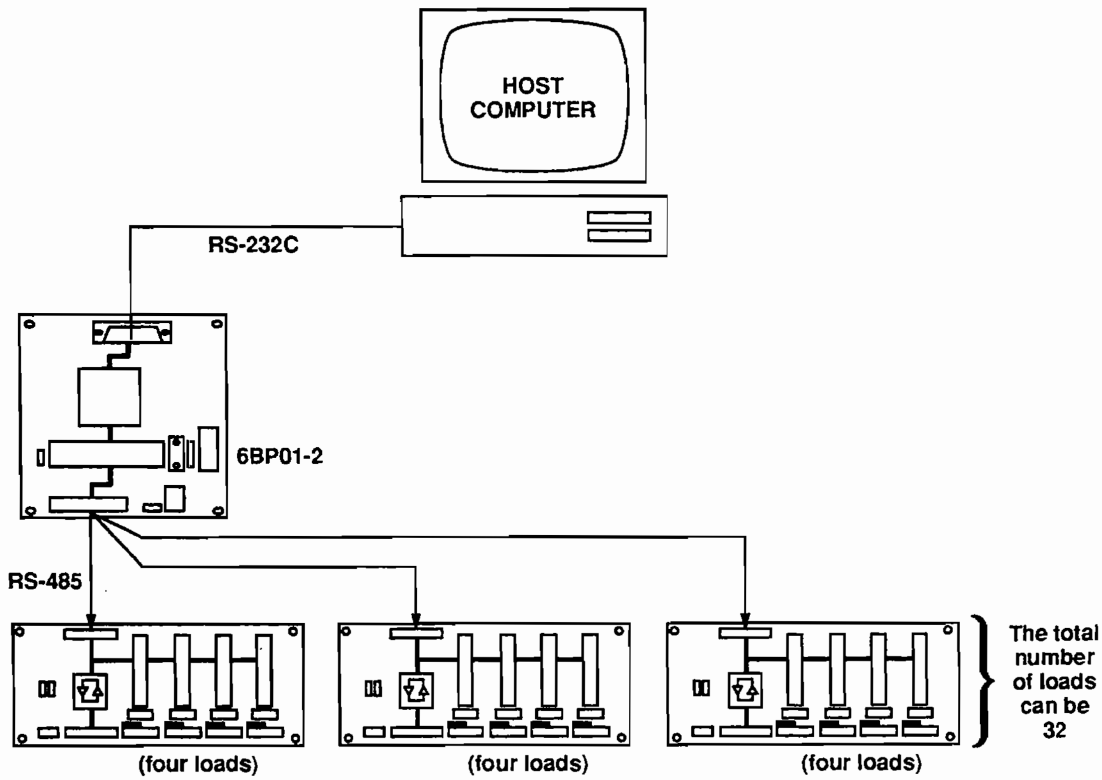


Figure 2-5. Daisy-Chain Configuration

Multidrop Configuration

In a multidrop configuration, you can connect multiple backplanes and boards (up to 32 loads) to the RS-485 output connector of a single backplane or board. An example of a multidrop configuration is shown in Figure 2-6.



NOTE: Power supplies for 6B backplanes are not shown.

Figure 2-6. Multidrop Configuration

Maintenance Configuration

If your physical arrangement requires that your 6B Series system is far from the host computer, you can attach a 6BP01-2 backplane close to the host. Instead of installing a module in the 6BP01-2, you can use the 6BP01-2 socket as a maintenance socket to configure modules during initial installation and start-up and to test or reconfigure modules once the 6B Series system is up and running. An example of a maintenance configuration is shown in Figure 2-7.

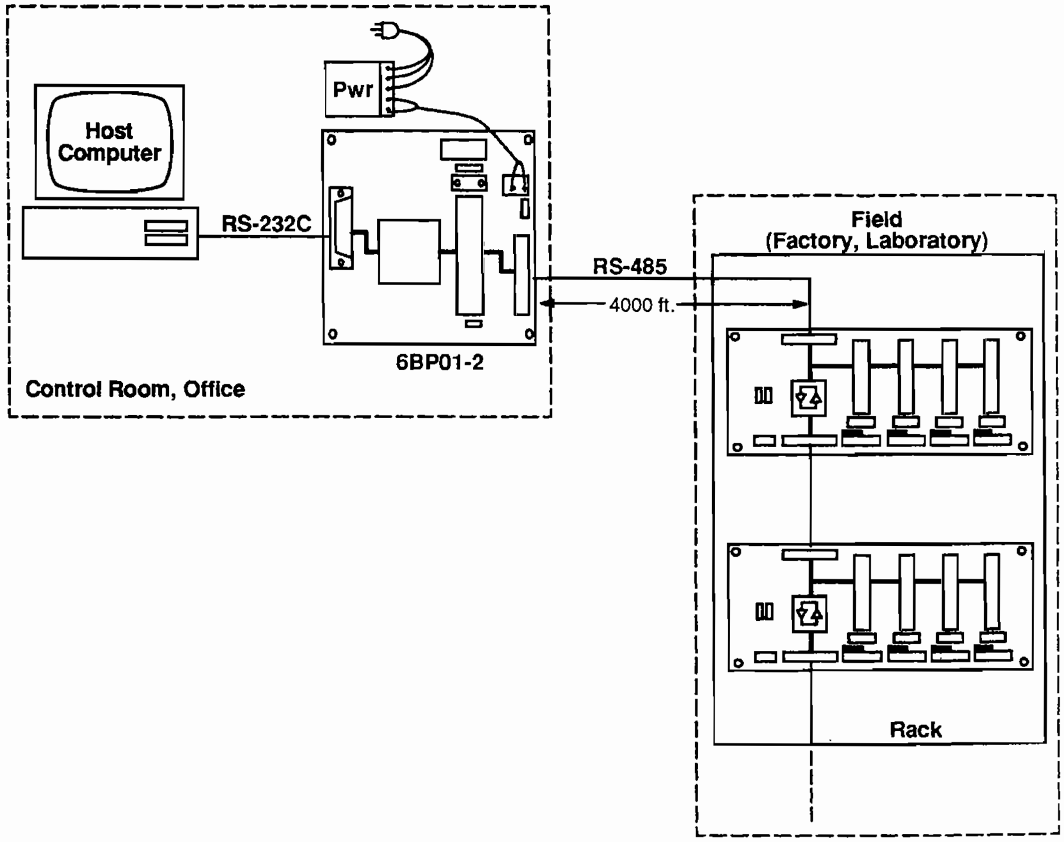


Figure 2-7. Maintenance Configuration

Recommended Wiring

It is recommended that the Belden 9842 cable (or equivalent) be used to connect two backplanes/boards using the RS-485 connector. This cable contains two twisted pairs of foil-shielded wire bundled together. Connect the two pairs and the individual shields to the terminal block as shown in Figure 2-8. Note: Z_C = 120 Ω for Belden 9842.

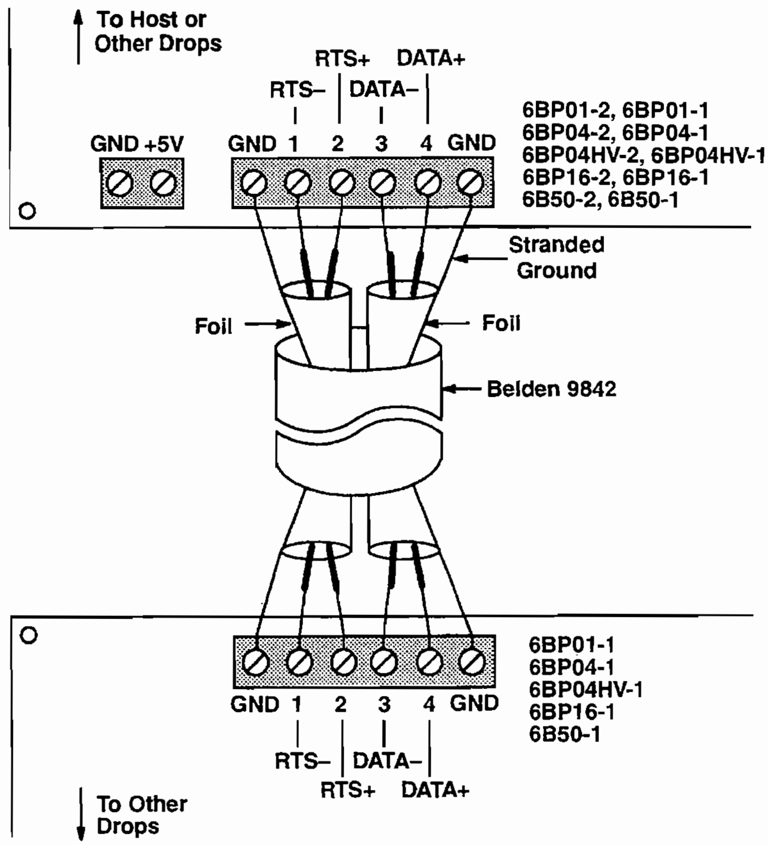


Figure 2-8. RS-485 Connection

Providing Power to Backplanes and Boards

You must connect a +5 V power supply to each 6B Series backplane or 6B50 digital I/O board. Power is bussed to all modules on a backplane.

Current Requirements

To calculate the total current requirement for each backplane or board, keep the following current requirements in mind:

- 100 mA for each analog input module.
- 250 mA for each analog output module.
- 200 mA for a 6B Series backplane.
- 225 mA for a 6B50 digital I/O board.

Selecting a Power Supply

Caution: *Power supply voltages greater than +6.5 V can cause permanent damage to 6B Series modules and boards. Make sure that the power supply voltage does not exceed +6.5 V.*

Analog Devices provides the following power supplies for use with 6B Series products:

- 1 A power supply (Model 955), suitable for a 6B50 digital I/O board or a 6B Series backplane and up to six modules.
- 5 A power supplies (Models 977 and PWR-01), suitable for a 6B50 digital I/O board or two 6B Series backplanes, and up to 32 input modules or 18 output modules.

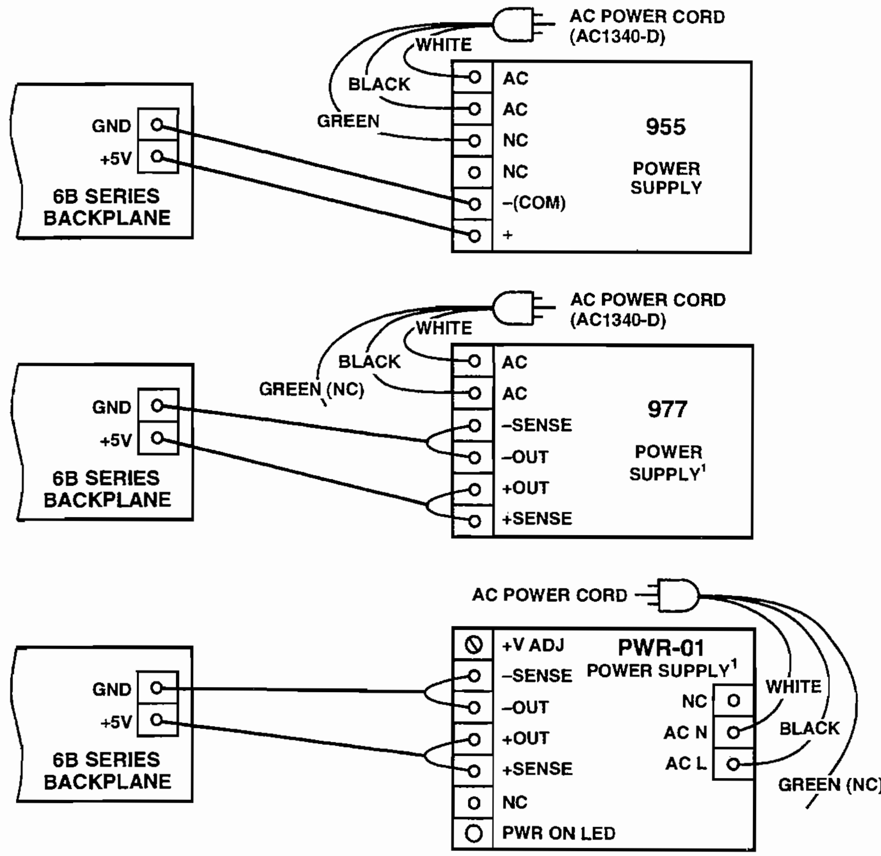
Refer to Appendix H for the dimensions of the Analog Devices power supplies.

Use any +5 V ±5% dc power supply that can supply 100 mA for each analog input module, 250 mA for each analog output module, 200 mA for each 6B Series backplane, and 225 mA for each 6B50 board. However, if an Analog Devices power supply is not used, keep the following in mind:

- The power supply used must have a rise time and fall time (10% to 90% of rated voltage) of less than 150 ms. If not, modules and boards may be incorrectly initialized, resulting in erratic operation.
- In applications where power supply voltage is not well regulated, or where power line transients can occur, use voltage clamp protection networks between the +5 V power supply and the 6B Series system.

Connecting the Power Supply

Connect the +5 V and ground on the power supply to the screw terminals on the backplane or board marked +5 V and GND. Connect an ac line cord (AC1340-D) to the ac screw terminals on the Analog Devices power supplies. Refer to Figure 2-9. (Note that screw terminals labeled NC on Analog Devices power supplies are not internally connected to the power supplies.)



NOTE
[1]MODELS 977 AND PWR-01 ARE SHIPPED WITH SHORTING BARS ACROSS –SENSE/–OUT AND +SENSE/+OUT TERMINALS

Figure 2-9. Connecting the Power Supply

Replacing the Fuse

The backplanes and boards incorporate polarity reversal protection in the form of a shunt diode and fuse (F1). If the +5 V and GND wires from the power supply are reversed, the fuse will blow and the green LED will go off. Should this happen, replace the fuse with one of the following:

- Littelfuse® 251.500, 1/2 A fuse (for single-module 6B Series backplanes).

- Littelfuse 251.005, 5 A fuse (for multiple-module 6B Series backplanes).
- Littelfuse 251.01.5, $1^1/_2$ A fuse (for the 6B50 digital I/O board).

Mounting

You can mount a power supply using one of the following:

- **Rack Mount** - Install the power supply under the rack mount, using the screws provided.
- **Flush Mount** - Install the power supply on a separate platform next to the backplane or board.

Attaching the Host Computer

You connect a 6BP01-2, 6BP04-2, or 6BP16-2 backplane or a 6B50-2 digital I/O board to a host computer using a RS-232C cables, such as the AC1382 or AC1385 available from Analog Devices. The AC1382 cable, shown in Figure 2-10a, is a 10-foot, DB-25 male-to-female cable. The AC1385 cable, shown in Figure 2-10b, is a 10-foot, DB-25 male to DB-9 female cable.

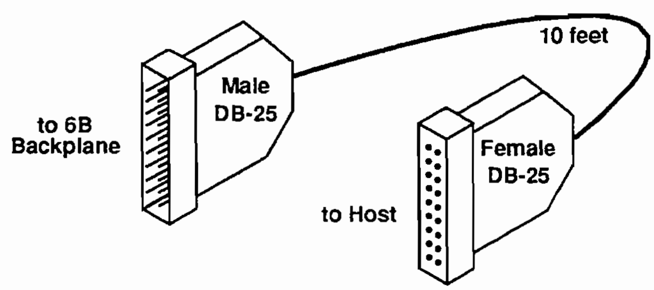


Figure 2-10a. AC1382 Cable

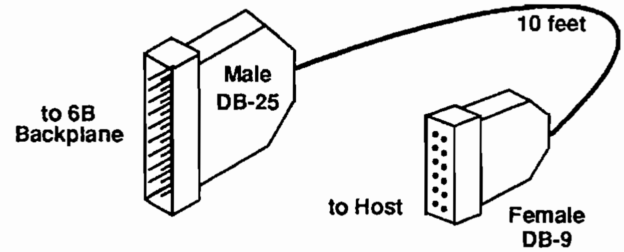


Figure 2-10b. AC1385 Cable

Notes: Use any RS-232C cable up to 50 feet in length. Since 6B Series backplanes and boards are not DTE (Data Terminal Equipment) devices, do not use a null-modem cable. If your IBM computer is equipped with a 9-pin D connector for the serial port, use AC1385 cable; however, some serial ports do not use the same connector pin assignments as IBM. Refer to the technical documentation for your specific computer for the appropriate pin assignments.

The 6BP01-2, 6BP04-2, 6BP04HV-2, 6BP16-2, or 6B50-2 must be the backplane/board closest to the host computer. Attach the female end of the RS-232C cable to the COM1 or COM2 port (asynchronous serial communication adapter) on the host computer. Attach the male end of the RS-232C cable to the RS-232C connector on the backplane or board. Only pins 1, 2, 3 and 7 of the AC1382 cable are to be connected, as shown in Figure 2-11. Communication is not affected if using a cable with additional pins. Only pins 2, 3 and 7 are connected with the AC1385 cable. See Figure 2-11b.

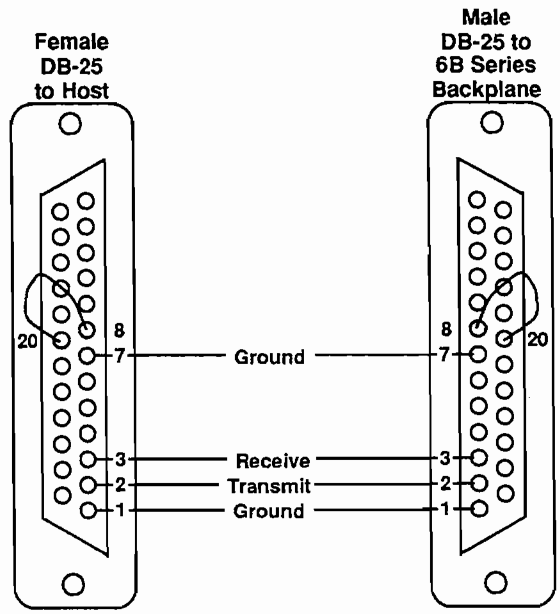


Figure 2-11a. AC1382 Cable Connections

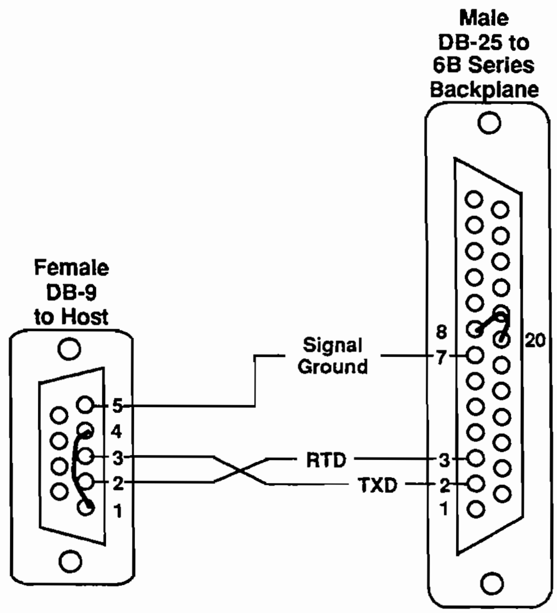


Figure 2-11b. AC1385 Cable Connections

Notes: On the AC1382 cable, pin 8 (Data Carrier Detect) and pin 20 (Data Terminal Ready) are connected. Since 6B Series modules and boards do not support handshaking, the connection of pins 8 and 20 simulates handshaking for software that requires handshaking but cannot disable handshaking. For all other software, the connection of pins 8 and 20 is insignificant.

Pin 6 is wired on the 6B Series backplanes and boards to provide for future enhancements. Since pin 6 is not used at this time, the AC1382 cable provides no connection for pin 6.

Communicating with the Host

All characters received by a 6B Series module or 6B50 digital I/O board from the host or transmitted by a 6B Series module or 6B50 digital I/O board to the host are asynchronous ASCII codes consisting of one start bit, eight data bits, and one stop bit. Since only the printable ASCII subset is used, the most significant bit (MSB) of each transmitted character is always 0 (and ignored), and the MSB of each received character is ignored.

To ensure compatibility with 6B Series modules and 6B50 boards, you must configure the host to transmit data in the following format:

- Eight data bits
- One stop bit
- No parity

The 6B Series modules and 6B50 boards do not support software handshaking. Therefore, the modules and boards do not send XOFF and XON characters to control the transmission of data.

Communication Status

Each backplane/board has the following LEDs, which indicate the status of the communication lines:

- **Data LED** - The green LED (CR2 on 6B Series backplanes, CR1 on the 6B50 digital I/O board) indicates the state of the data lines to and from the host computer. When the data lines are in the idling state, the green LED is on. When the data lines are in the space state during data communication to or from the host, the green LED is off. (Note that at high data rates, the green LED may appear to get dim rather than to go off completely.)

- **Enable LED** - The yellow LED (CR3 on 6B Series backplanes, CR2 on the 6B50 digital I/O board) indicates whether the repeaters are enabled and whether any modules or boards are sending data to the host. When any module on this 6B Series backplane (or on any backplane farther in the network) or when this 6B50 board (or any 6B50 board farther in the network) is responding to an addressed command from the host, the yellow LED is on. When the communication lines are in the idling state, the yellow LED is off.

Using RS-485 Communication

Use half-duplex RS-485 communication to connect the host directly to a 6BP01-1, 6BP04-1, 6BP04HV-1, or 6BP16-1 backplane or 6B50-1 board in the following situations:

- If a longer distance is required between the host computer and the first 6B Series backplane or board than the 50 feet provided by your RS-232C cable.
- If isolation is required when operating in an electrically noisy environment.

To use half-duplex RS-485 communication, the host must contain an RS-485 communication card. It is recommended that the following be used: National Instruments' AT-485 Serial Interface Card, National Instruments' PCMCIA-485 Serial Interface Card, or Control and Data Technologies' PLCP0054 Opto Isolated Serial Card. Refer to Appendix G for more information.

Note: The following steps must be taken when using National Instruments' AT-485 and PCMCIA-485 Serial Interface cards.

1. Tie the RXD+ line to the TDX+ line (AT-485 pins 4 and 8, respectively)
2. Tie the RXD– line to the TDX– line (AT-485 pins 5 and 9, respectively)
3. Connect the RXD+ and TDX+ to pin 4 of the 6B backplane (XCV+)

4. Connect the RXD– and TDX– to pin 3 of the 6B backplane (XCV–)
5. Be sure to configure the AT-485 board to operate in two-wire mode: TXRDY auto control.

Using a Modem

A modem is used to communicate with a 6B Series system at a remote location. The format of the characters sent and received through a modem is the same as the format of the characters sent and received through a host computer. Refer to Communicating with the Host in this section for more information.

Figure 2-12 illustrates the cable connections that are required when using a modem. Note that when attaching the modem to the 6B Series backplane or 6B50 board, only pins 1, 2, 3, and 7 must be connected; communication is not affected if you use a cable with additional pins.

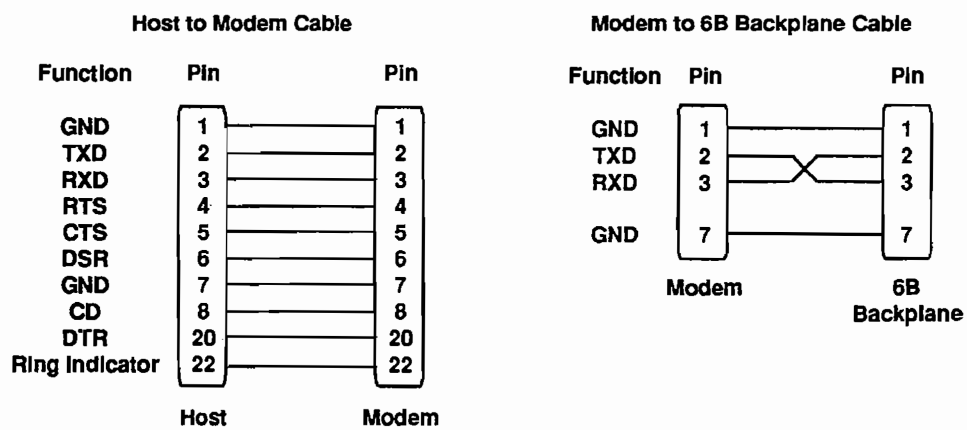


Figure 2-12. Modem Cable Connections

Examples of recommended modems are the Microcom AX/9624c™ MNP® Class 6 modem attached to the host computer and the Microcom SX2400™ modem attached to the RS-232C connector of a 6BP01-2, 6BP04-2, 6BP04HV-2, or 6BP16-2 backplane or 6B50-2 board. Table 2-3 lists the appropriate switch settings when using these modems.

Table 2-3. Modem Switch Settings

Modem	Switch	Position	Meaning
Microcom AX/9624c Front Switch Settings	1	Up	Respond to DTR
	2	Down	Command set
	3	Down	Show result codes
	4	Down	Command echo on
	5	Up	Auto-answer on
	6	Up	Carrier follows remote system
	7	Up	Long form result codes
	8	Down	Smart mode
	9	Up	Rack mount modem support only
	10	Up	Asynchronous operation
Microcom AX/9624c Rear Switch Settings	1	Up	No flow control
	2	Up	
	3	Down	Auto-reliable mode
	4	Up	
	5	Up	Do not use MNP extended result codes
	6	Up	Restore configuration stored on reset or power-up
	7	Down	Read switches on reset or power-up
	8	–	Not used
Microcom SX/2400 Front Switch Settings	1	Down	DTR always considered on
	2	Up	Asynchronous operation
	3	Up	Not used
	4	Down	Local test mode disabled
	5	Up	No preselected value for inactivity timer
	6	Up	No automatic baud rate adjust
	7	Up	DSR and CTS are always on
	8	Down	Reinitialize on power-up or reset
Microcom SX/2400 Rear Switch Settings	1	Down	Preset both serial port and modem port for no flow control
	2	Up	
	3	Down	Preset auto-answer to on and modem to normal mode
	4	Up	
	5	Up	Not used
	6	Down	Preset baud rate to 2400 baud
	7	Up	
	8	Down	

Refer to Appendix F for a sample program to try when using a 6B Series system with a modem.

Application Wiring

The following sections contain information on attaching various types of analog I/O and digital I/O applications to 6B Series backplanes and 6B50 digital I/O boards.

Analog I/O Applications

Attach analog I/O applications to a 6B Series backplane through the four screw terminals on the screw termination block associated with each 6B module. It is recommended that 14-22 AWG wire (18-22 AWG on the 6BP04HV-1 and 6BP04HV-2) be used to connect applications and that applications are placed as close to the screw terminals as possible. The following sections contain special considerations for attaching each analog input and analog output type.

Millivolt, Voltage and Thermocouple Inputs

As shown in Figure 2-13, screw terminal 2 is the negative input and terminal 3 is the positive input for all thermocouple, millivolt, and voltage inputs.

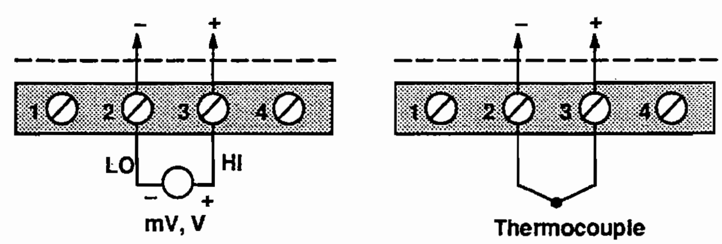


Figure 2-13. Millivolt, Voltage and Thermocouple Inputs

Each set of four screw terminals has a CJC sensor installed next to it for accurate measurement of the screw termination block temperature. To minimize thermal gradients, make sure that there is proper ventilation around the backplane.

Process Current Inputs

Figure 2-14 shows the wiring for process current inputs.

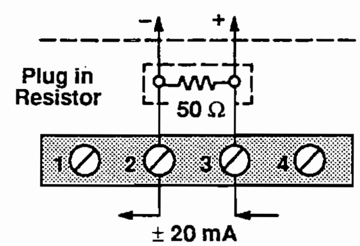


Figure 2-14. Process Current Inputs

You need a precision 50 Ω current conversion resistor (AC1381) to convert the 20 mA current signal to a 1 V signal that the 6B11 or 6B12 can read. Plug the resistor into the socket on the appropriate backplane channel. Keep in mind that since the module's inputs are bipolar, a negative value results if you reverse the high and low inputs on the screw terminal.

RTD Inputs

Figure 2-15 shows 2-wire, 3-wire, and 4-wire connections for RTDs.

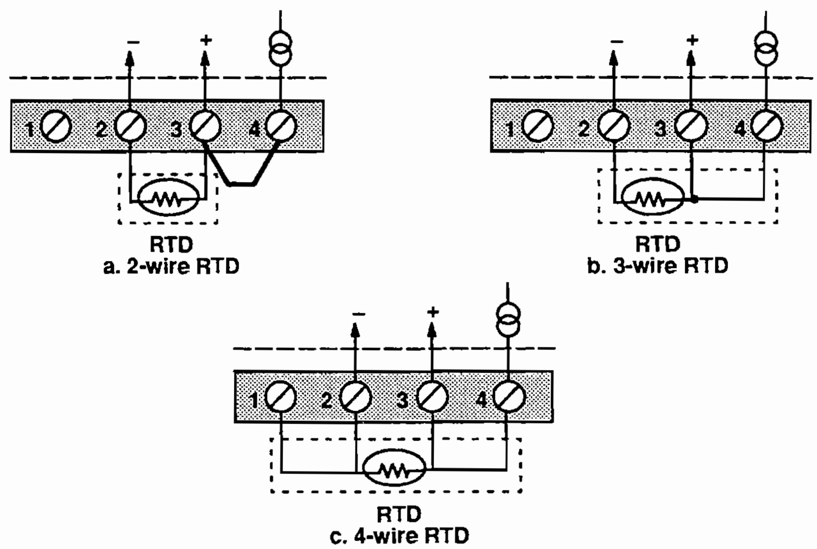


Figure 2-15. RTD Inputs

For 2-wire connections, you must jumper screw terminals 3 and 4 to provide excitation current to the application. For 3-wire connections, use screw terminals 2, 3, and 4; screw terminal 3 is the sense input, screw terminal 4 provides the current output, and screw terminal 2 provides the return paths. For 4-wire connections, connect the fourth wire to screw terminal 1, which is not internally connected to the module.

Note: The 6B13 uses a 3-wire technique for sensing and compensating for lead resistance. This technique assumes that the lengths and resistances of all leads attached to the screw terminals are equal. Differences between the leads are not properly compensated for.

Current Outputs

Figure 2-16 shows the wiring for current outputs.

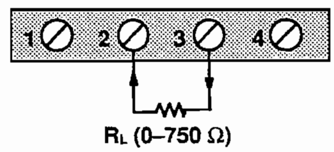


Figure 2-16. Current Outputs

Digital I/O Applications

You attach digital I/O applications to the three ports on the 6B50 digital I/O board using an STB-50A Screw Termination Board, DB-16 Digital I/O Backplane, or DB-24 Digital I/O Backplane. You access the digital I/O panel through the on-board, 50-pin connector (J2), shown in Figure 2-17. The location of the connector on the 6B50 board is shown in Figures 1-2 and 1-3. The pin assignments of the connector are listed in Table 2-4 in Attaching Digital I/O Applications later in this chapter.

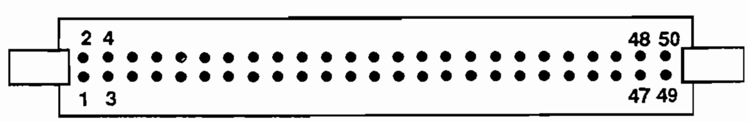


Figure 2-17. 50-Pin Connector (J2)

STB-50A Screw Termination Board

Use the STB-50A Screw Termination Board, shown in Figure 2-18, to measure and control low-level, TTL-compatible digital I/O signals.

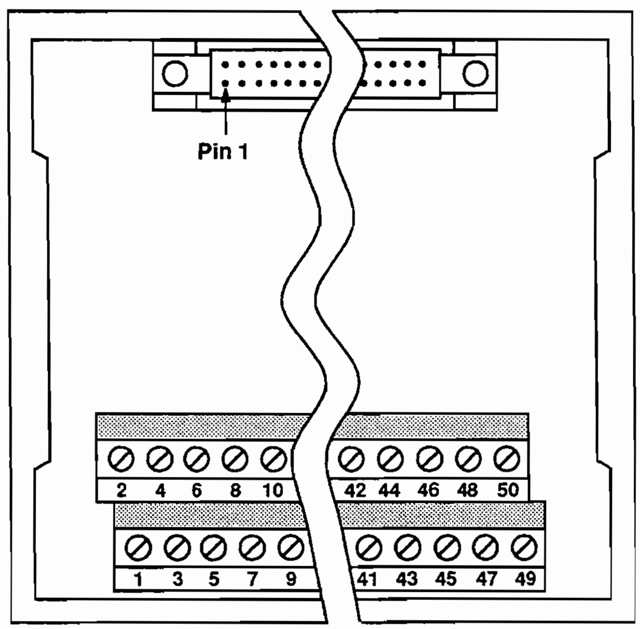


Figure 2-18. STB-50A Screw Termination Board

To attach a 6B50 board to an STB-50A board, use the 3-foot, 50-pin CAB-02 ribbon cable shipped with the panel. Attach one end of the cable to the 50-pin connector (J2) on the 6B50, and attach the other end of the cable to the digital I/O connector on the STB-50A board. Make sure that pin 1 on the cable corresponds to pin 1 on the connector. Refer to Figure 2-19.

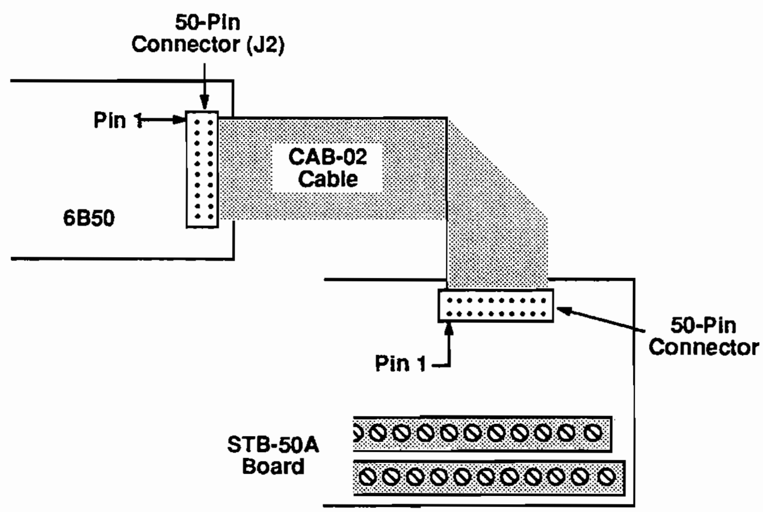
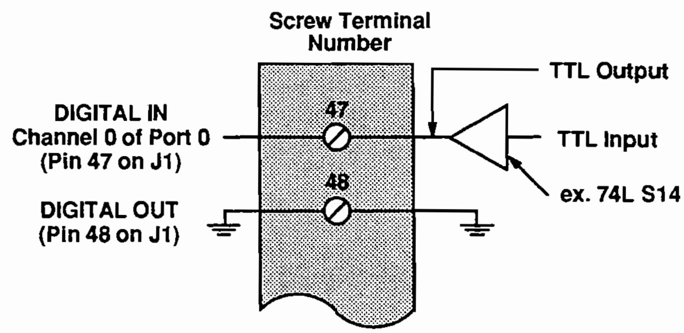


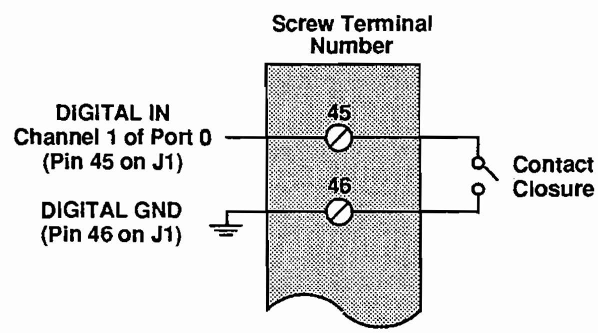
Figure 2-19. Attaching the STB-50A Screw Termination Board

The STB-50A board does not require a power source. You connect applications to the STB-50A through the screw terminal barrier strip, which contains standard slot-head screw terminals. The STB-50A provides 50 screw terminals, numbered from 1 to 50. The 6B50 channels accessed through the STB-50A board are listed in Table 2-4 in Attaching Digital I/O Applications later in this chapter.

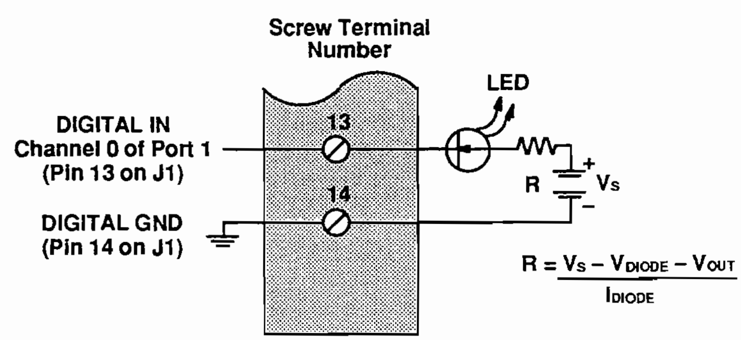
Figure 2-20 illustrates low-level, digital input and output wiring using the STB-50A Screw Termination Board.



a. TTL Input Example



b. Contact Closure Input Example



c. Digital Output Example

Figure 2-20. Typical Low-Level Digital I/O Wiring

DB-16 Digital I/O Backplane

Use the DB-16 Digital I/O Backplane, shown in Figure 2-21, and its associated ac and dc I/O modules to measure and/or control high-level ac and dc signals or if isolation of the digital I/O is required.

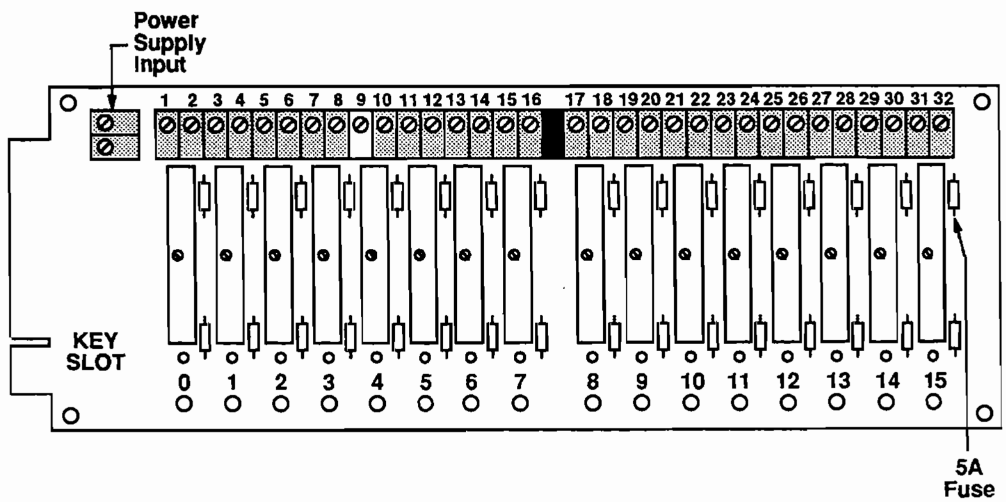


Figure 2-21. DB-16 Digital I/O Backplane

The DB-16 backplane supports the installation of up to 16 single-channel, solid-state relay modules, which provide 2500 V of isolation. You should install the modules in their appropriate positions in the backplane and secure them with one screw each.

To attach a 6B50 board to a DB-16 backplane, use the 5-foot, 50-pin CAB-03 ribbon cable. Attach one end of the cable to the 50-pin connector (J2) on the 6B50, and attach the other end of the cable to the digital I/O connector on the DB-16 backplane. Make sure that pin 1 on the cable corresponds to pin 1 on the connector. Refer to Figure 2-22.

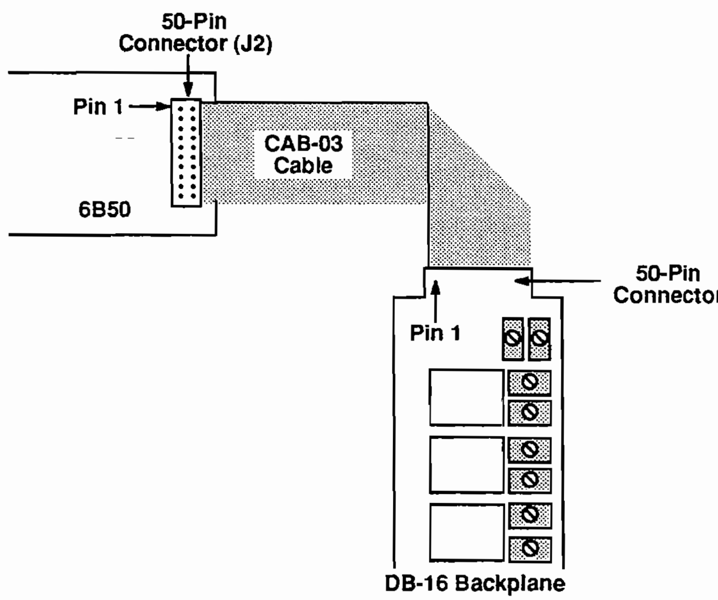
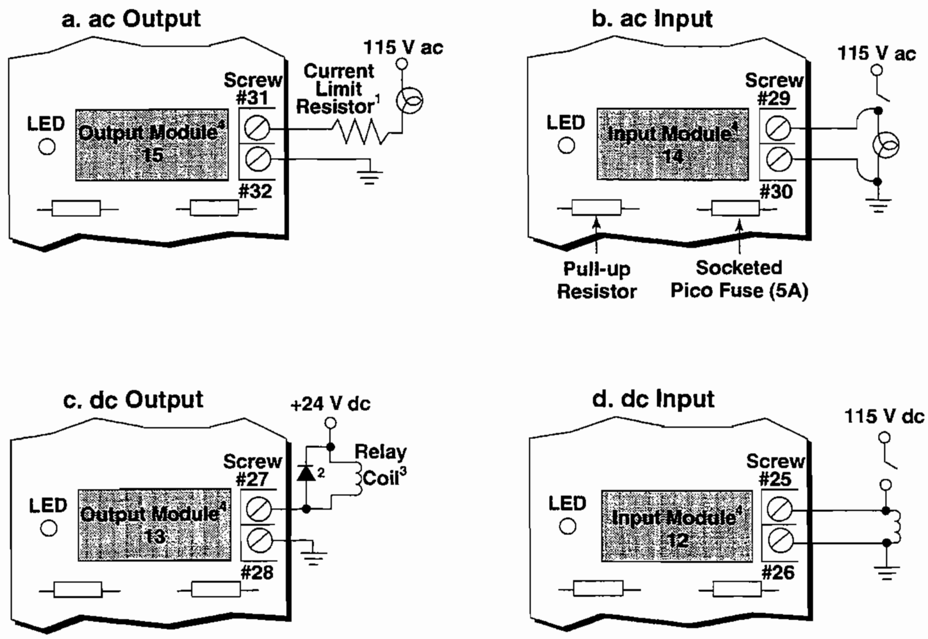


Figure 2-22. Attaching the DB-16 Digital I/O Backplane

The DB-16 backplane is powered through an external +5 V power supply. You connect applications to the DB-16 backplane through the screw terminal barrier strip, which contains 32 standard slot-head screw terminals (screw terminals 1 and 2 are associated with channel 0 on the backplane, screw terminals 3 and 4 are associated with channel 1 on the backplane, and so on). Use the odd-numbered screw terminal for the high input; use the even-numbered screw terminal for the low input.

Figure 2-23 illustrates high-level ac and dc digital wiring using input and output modules on the DB-16 backplane. *Example a* illustrates turning a lamp on and off, *example b* illustrates monitoring whether the lamp is on or off, *example c* illustrates turning a relay coil on and off, and *example d* illustrates monitoring whether or not the relay coil is being energized.



Notes

[1]Should not exceed 3A.

[2]User supplied diode necessary for inductive spike damping.

[3]Relay coil amperage should not exceed output module rating.

[4]Modules are color coded: ac Input – Yellow
ac Output – Black
dc Input – White
dc Output – Red

Figure 2-23. Typical High-Level Digital I/O Wiring Examples Using the DB-16 Backplane

DB-24 Digital I/O Backplane

Use the DB-24 Digital I/O Backplane, shown in Figure 2-24, and its associated ac and dc I/O modules to measure and/or control high-level ac and dc signals or if isolation of the digital I/O is required.

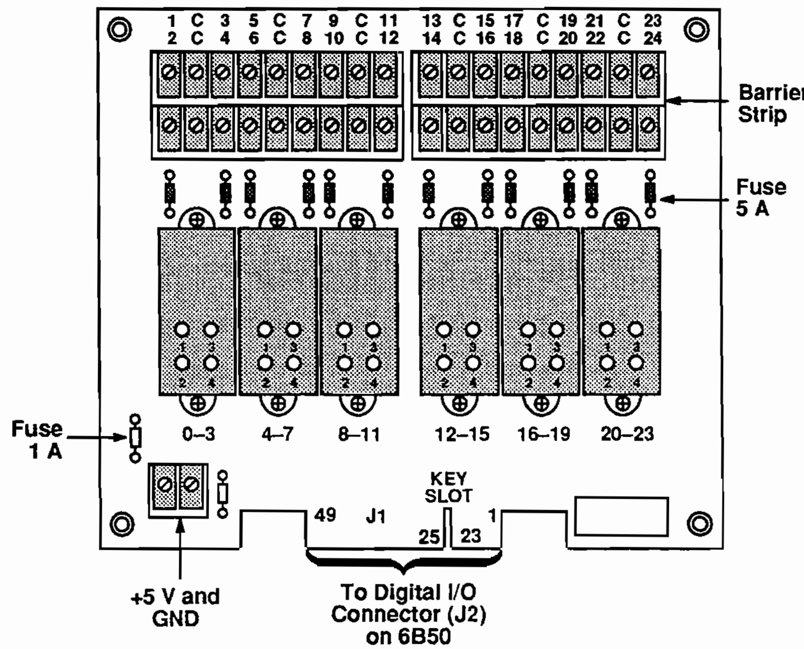


Figure 2-24. DB-24 Digital I/O Backplane

The DB-24 backplane supports the installation of up to six 4-channel, high-density modules, which provide 4000 V of isolation. You should install the modules in their appropriate positions in the backplane and secure them with two screws each.

To attach a 6B50 board to a DB-24 backplane, use the 5-foot, 50-pin CAB-03 ribbon cable. Attach one end of the cable to the 50-pin connector (J2) on the 6B50, and attach the other end of the cable to the digital I/O connector on the DB-24 backplane. Make sure that pin 1 on the cable corresponds to pin 1 on the connector. Refer to Figure 2-25.

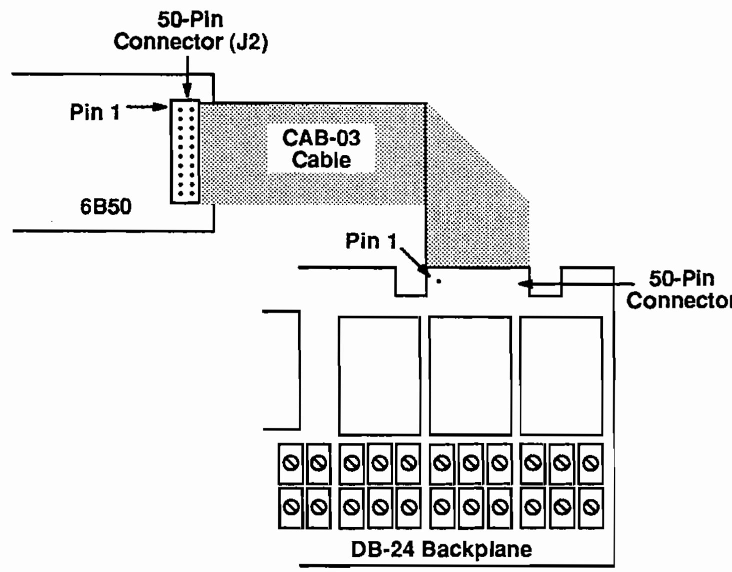


Figure 2-25. Attaching the DB-24 Digital I/O Backplane

The DB-24 backplane is powered through an external +5 V power supply. You connect applications to the DB-24 backplane through the screw terminal barrier strip, which contains standard slot-head screw terminals. The DB-24 provides six screws for each 4-channel module, with two channels sharing the same common.

The two common connections for each module on a DB-24 are connected to one another. Therefore, each of the four individual channels on the module can use either of its two common connections. Since the commons are connected, you must make sure that all the applications attached to the 4-channel module share the same common voltage reference. If two applications use different common voltage references, you must attach the applications to two different modules. Figure 2-26 illustrates how the channels and their commons are connected.

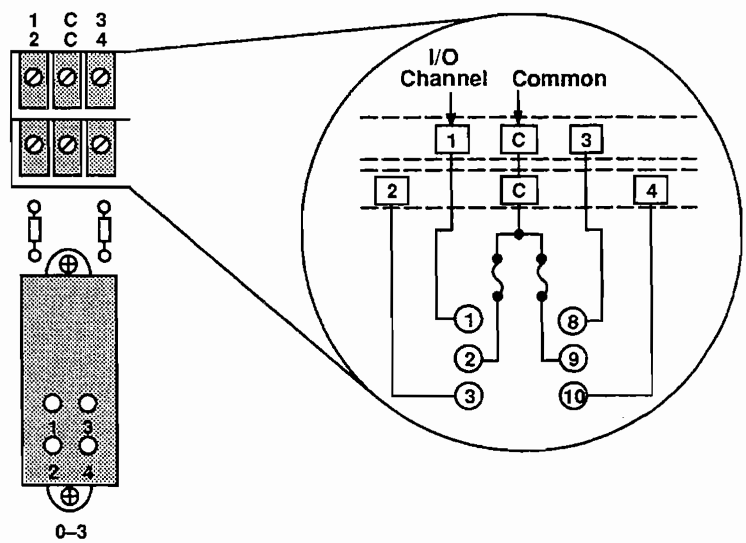
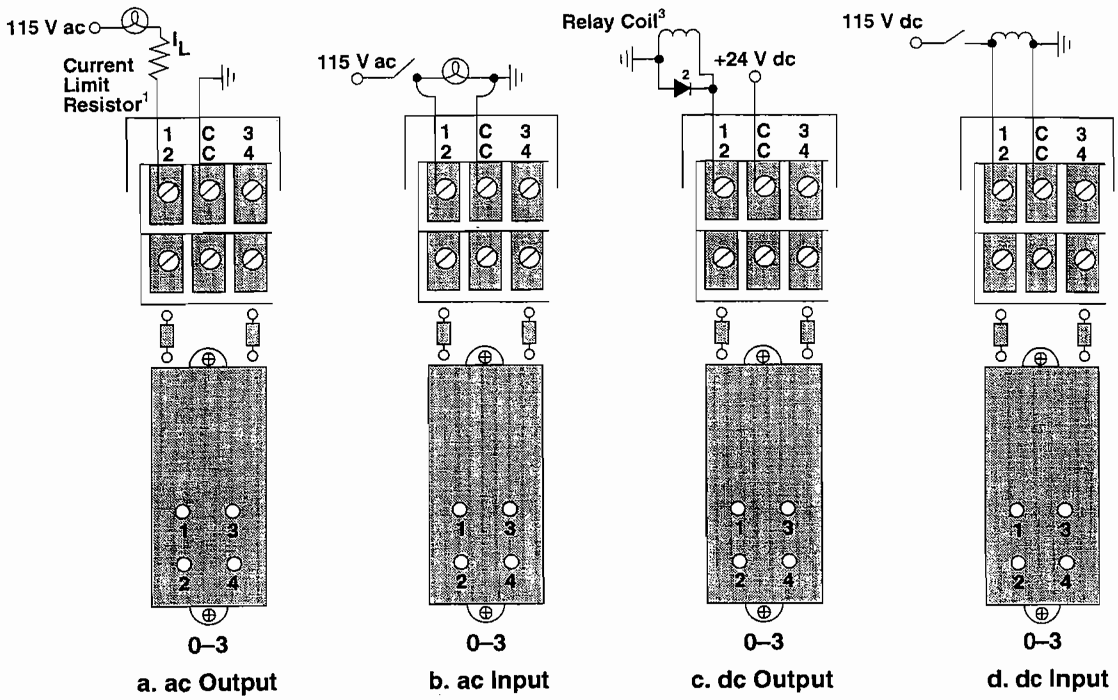


Figure 2-26. DB-24 Backplane Common Connections

Figure 2-27 illustrates high-level ac and dc digital wiring using input and output modules on the DB-24 backplane. *Example a* illustrates turning a lamp on and off, *example b* illustrates monitoring whether the lamp is on or off, *example c* illustrates turning a relay coil on and off, and *example d* illustrates monitoring whether or not the relay coil is being energized.



Notes

[1]Should not exceed 3A.

[2]User supplied diode necessary for inductive spike damping.

[3]Relay coil amperage should not exceed output module rating.

[4]Modules are color coded:

ac Input	– Yellow
ac Output	– Black
dc Input	– White
dc Output	– Red

Figure 2-27. Typical High-Level Digital I/O Wiring Examples Using the DB-24 Backplane

Attaching Digital I/O Applications

To attach applications to a digital I/O panel, use 22-14 AWG twisted-pair wire and strip the wire back approximately $^{1}/_{4}$ inch (6.3 mm).

The 6B50 channels accessed through the STB-50A, DB-16, and DB-24 panels, as well as the associated pin on the 50-pin (J2) connector, are listed in Table 2-4.

Table 2-4. Accessing Digital I/O Channels

6B50 Channel	STB-50A Screw Terminal	DB-16 Screw Terminals	DB-24 Screw Terminals	J2 Connector pin[2]
Port A, Bit 0	47	1, 2	1, C	47
Port A, Bit 1	45	3, 4	2, C	45
Port A, Bit 2	43	5, 6	3, C	43
Port A, Bit 3	41	7, 8	4, C	41
Port A, Bit 4	39	9, 10	5, C	39
Port A, Bit 5	37	11, 12	6, C	37
Port A, Bit 6	35	13, 14	7, C	35
Port A, Bit 7	33	15, 16	8, C	33
Port B, Bit 0	31	17, 18	9, C	31
Port B, Bit 1	29	19, 20	10, C	29
Port B, Bit 2	27	21, 22	11, C	27
Port B, Bit 3	25	23, 24	12, C	25
Port B, Bit 4	23	25, 26	13, C	23
Port B, Bit 5	21	27, 28	14, C	21
Port B, Bit 6	19	29, 30	15, C	19
Port B, Bit 7	17	31, 32	16, C	17
Port C, Bit 0	15	N/A	17, C	15
Port C, Bit 1	13	N/A	18, C	13
Port C, Bit 2	11	N/A	19, C	11
Port C, Bit 3	9	N/A	20, C	9
Port C, Bit 4	7	N/A	21, C	7
Port C, Bit 5	5	N/A	22, C	5
Port C, Bit 6	3	N/A	23, C	3
Port C, Bit 7	1	N/A	24, C	1

Notes

[1]All even-numbered screw terminals are connected to digital ground.
[2]All even-numbered pins are connected to digital ground. Pin 49 is connected to +5 V power.

3 Using the 6B Series Command Set

This chapter is intended for those who are using the 6B Series command set to write application programs that configure, calibrate, read data from, or write data to 6B Series modules and 6B50 digital I/O boards. It provides background information needed to use analog input commands, analog output commands, and digital I/O commands. For more detailed information, including the command syntax and examples, refer to Chapter 4.

Analog Input Commands

The 6B Series command set provides analog input commands that allow you to configure analog input modules, read data from analog input modules, calibrate analog input modules, and return the status of analog input modules.

Configuring an Analog Input Module

The Configuration command allows you to set the address, input range, baud rate, data format, checksum status, and/or integration time for an analog input module. Normally, the Configuration command is used only when a module is installed.

The Configuration command parameters are described in more detail in the following subsections.

Address

The address for each analog input module is a unique hexadecimal number between 00 and FF. All modules are shipped with address 00H. Since no two 6B Series modules or 6B50 digital I/O boards can have the same address, you must reconfigure the address of each analog input module when setting up your 6B Series system. It is recommended that you reserve address 00H for configuration and diagnostic purposes.

Input Range

Table 3-1 lists the input ranges that you can configure for an analog input module.

Table 3-1. Input Ranges

Module	Input Ranges
6B11 and 6B11HV	±15 mV
	±50 mV
	±100 mV
	±500 mV
	±1 V
	±5 V
	±20 mA[1]
	Type J thermocouple, 0°C to 760°C
	Type K thermocouple, 0°C to 1000°C
	Type T thermocouple, –100°C to 400°C
	Type E thermocouple, 0°C to 1000°C
	Type R thermocouple, 500°C to 1750°C
	Type S thermocouple, 500°C to 1750°C
	Type B thermocouple, 500°C to 1800°C
6B12 and 6B12HV	±50 V
	±10 V
	±5 V
	±1 V
	±500 mV
	±150 mV
	±20 mA[1]

Table 3-1. Input Ranges

Module	Input Ranges
6B13	Platinum RTD, –100°C to 100°C, α = 0.00385
and	Platinum RTD, 0°C to 100°C, α = 0.00385
6B13HV	Platinum RTD, 0°C to 200°C, α = 0.00385
	Platinum RTD, 0°C to 600°C, α = 0.00385
	Platinum RTD, –100°C to 100°C, α = 0.003916
	Platinum RTD, 0°C to 100°C, α = 0.003916
	Platinum RTD, 0°C to 200°C, α = 0.003916
	Platinum RTD, 0°C to 600°C, α = 0.003916
	Nickel RTD, –80°C to 100°C
	Nickel RTD, 0°C to 100°C
	Copper RTD (10 Ω @ 25°C), 0°C to 120°C
	Copper RTD (10 Ω @ 0°C), 0°C to 120°C

Note
[1]This input range requires the use of a 50 Ω current conversion resistor (AC1381).

Baud Rate

You can configure the baud rate of analog input modules as 300, 600, 1200, 2400, 4800, 9600 or 19,200 baud.

Note that not all serial ports support a baud rate of 19,200. Make sure that the system is capable of this speed before configuring an analog input module with this baud rate. All 6B Series modules and 6B50 boards in a system must operate at the same baud rate.

Data Format

An analog input module can be configured to transmit data to the host in one of the following data formats:

- **Engineering Units -** The engineering units format presents data in natural units, such as volts, millivolts, milliamps and degrees. Since the total data string length, including sign, digits and decimal point, is fixed at seven characters, most computer languages can easily parse this format.

The engineering units format consists of a "+" or "–" sign, followed by five decimal digits and a decimal point; the resolution (position of the decimal point) depends on the configured input range, as follows:

- *±15 mV, ±50 mV input range* - Resolution is 1 µV (three decimal places).
- *±100 mV, ±150 mV, ±500 mV input range* - Resolution is 10 µV (two decimal places).
- *±1 V, ±5 V input range* - Resolution is 100 µV (four decimal places).
- *±10 V, ±50 V input range* - Resolution is 1 mV (three decimal places).
- *±20 mA input range* - Resolution is 1 µA (three decimal places).
- *Type T thermocouple input range* - Resolution is 0.01°C (two decimal places).
- *Type J, K, E, R, S, and B thermocouple input range* - Resolution is 0.1°C (one decimal place).
- *RTD input range* - Resolution is 0.01°C (two decimal places)

For example, if an analog input module is configured for a ±5 V range and the input value is –3.45 V, the value returned is –3.4500. As another example, if an analog input module is configured for a type T thermocouple (–100°C to 400°C) and the input value is 243.5°C, the value returned is +243.50.

The analog input modules provide an overrange capability when configured for the engineering units data format. For example, if an analog input module is configured for a ±5 V range and the input value is +5.763 V, the value returned is +5.7630.

However, keep in mind that only readings within the input range are fully accurate and linear. Readings between ±100% and ±115% of FSR are not guaranteed to be accurate, but are typically linear. Readings beyond these limits are neither linear nor accurate.

- **Percent of FSR** - The percent of FSR format presents data as the value of the input signal relative to the calibrated full-scale range of the input (percent of full-scale range).

  The percent of FSR format consists of a "+" or "–" sign, followed by five decimal digits and a decimal point. The decimal point is fixed, and the maximum resolution is ±0.01%.

  For example, if an analog input module is configured for a ±5 V range and the input value is +2.0 V, the value returned is +040.00, indicating that the input was at +40% of full-scale range. As another example, if an analog input module is configured for a type J thermocouple (0°C to 760°C) and the input value is 645.3°C, the value returned is +084.90, indicating that 645.3°C is 84.9% of 760°C.

  Since all voltage input ranges are bipolar, the full calibrated voltage range spans from –100% to +100%. For example, when using a ±5 V input range on a 6B11 module, +5 V corresponds to +100% and –5 V corresponds to –100%.

  For thermocouple input ranges, it is assumed that the input range is bipolar and symmetric about zero, even if the specified range of operation does not extend over the entire implied range. For example, when using a type J thermocouple (0°C to 760°C), 760°C corresponds to +100% and 0°C corresponds to 0%. If a thermocouple is not specified to zero, it is assumed that it is capable of reading to zero. For example, when using a type B thermocouple, which is specified for operation from +500°C to +1800°C, +1800°C corresponds to +100% and 500°C corresponds to +27.77%.

For RTD input ranges (whether they are specified to zero or below zero), the percentage is based on the actual span of the specified range. For example, when using a nickel RTD specified for –80°C to +100°C, +100°C corresponds to +100% and –80°C corresponds to 0%.

The 6B Series analog input modules provide an overrange capability when configured for the percent of FSR data format. For example, if an analog input module is configured for a ±5 V range and the input value is +5.5 V, the value returned is +110.00.

However, keep in mind that only readings within the input range are fully accurate and linear. Readings between ±100% and ±115% of FSR are not guaranteed to be accurate, but are typically linear. Readings beyond these limits are neither linear nor accurate.

- **Twos complement hexadecimal** - The twos complement hexadecimal format is the ASCII hexadecimal representation of the data. It is compact and provides fast communication, excellent resolution, and easy conversion to computer-compatible integer format.

  The twos complement hexadecimal format consists of a 4-character hexadecimal string, representing a 16-bit twos complement binary value. Resolution is one least significant bit (LSB) of 16 bits. Positive full scale is represented as 7FFF (+32,767) and negative full scale is represented as 8000 (–32,768).

  For example, if an analog input module is configured for a ±5 V range and the input value is –1.234 V, the value returned is E069, corresponding to the signed integer –8087.

  For voltage and milliamp input ranges, the full calibrated voltage range spans from 8000 to 7FFF. For example, when using a ±5 V input range on a 6B11 module, +5 V corresponds to 7FFFH and –5 V corresponds to 8000H.

For thermocouple input ranges (whether the thermocouple is specified to zero, below zero, or above zero), it is assumed that the input range is bipolar and symmetric about zero. For example, when using a type J thermocouple (0°C to 760°C), 760°C corresponds to 7FFFH and 0°C corresponds to 0000H (–760°C, if valid, would correspond to 8000). When using a type T thermocouple (–100°C to 400°C), +400°C corresponds to 7FFF, 0°C corresponds to 0000H, and –100°C corresponds to CCCCH (–400°C, if valid, would correspond to 8000). When using a type R thermocouple (500°C to 1750°C), +1750°C corresponds to 7FFFH and +500°C corresponds to 2492H (0°C, if valid, would correspond to 0000H and –1750°C, if valid, would correspond to 8000H).

For RTD input ranges (whether they are specified to zero or below zero), the twos complement hexadecimal value is based on the actual span of the specified range. For example, when using a nickel RTD specified for –80°C to +100°C, +100°C corresponds to 7FFFH and –80°C corresponds to 8000H.

No overrange capability is provided when a module is configured for the twos complement hexadecimal data format.

- **Ohms** - The ohms format is only valid for 6B13 analog input modules. It allows you to read the value of the RTD resistance in ohms. It consists of a "+" or "–" sign, followed by five decimal digits and a decimal point; the resolution (position of the decimal point) depends on the RTD, as follows:
  - *Platinum, Nickel RTDs* - Resolution is 10 mΩ (two decimal places).
  - *Copper RTDs* - Resolution is 1 mΩ (three decimal places).

For example, for a 100 Ω platinum RTD specified for –100°C to +100°C, +100°C corresponds to +138.50 Ω and –100°C corresponds to +060.60 Ω.

Integration Time

You can configure an analog input module for one of the following integration times:

- **50 ms (60 Hz operation)** - Used in the United States, or in any location with 60 Hz power. This integration time results in an input conversion rate of approximately 9 conversions per second and a normal mode rejection of 60 Hz interference.
- **60 ms (50 Hz operation)** - Used in Europe, or in any location with 50 Hz power. This integration time results in an input conversion rate of approximately 8.33 conversions per second and a normal mode rejection of 50 Hz interference.

There is no distinction in performance (other than throughput rate) between the 50 ms and 60 ms integration times. If power line interference is not a problem, you can select either integration time without penalty. If power line interference is a problem, you should select the appropriate integration time to obtain the specified normal mode rejection ratio.

Note: After changing the integration time from 50 ms to 60 ms (or 60 ms to 50 ms), the Analog Input Data will not be valid for a period of approximately 2 sec.

Checksum

You can configure an analog input module to incorporate checksum generation and checking into all commands. A checksum helps you detect errors in commands to the module from the host and responses from the module to the host. It does, however, reduce throughput by adding two characters to the command and two characters to the response.

When the checksum feature is enabled, all commands to the module and all responses from the module contain a checksum. The checksum is expressed in a 2-character ASCII hexadecimal format and is transmitted just before the carriage return. The checksum is the modulo-256 sum of all the ASCII values of all the characters in the command preceding the checksum.

If the checksum is missing or incorrect in a command in which the checksum feature is enabled, the module does not respond.

Note: When configuring a 6B series system, all 6B modules and boards must be set to an identical checksum setting (i.e., enabled or disabled).

Reading Data from an Analog Input Module

The 6B Series command set provides the following commands for reading data from an analog input module:

- **Analog Data In Command** - Returns the input value from a specified analog input module in the currently configured data format.
- **Synchronized Sampling Command** - Instructs all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards to sample their input values immediately and simultaneously and then store these values in a special register.
- **Read Synchronized Data Command** - Returns the value stored by a specified module during the Synchronized Sampling command.

Calibrating an Analog Input Module

The 6B Series command set provides the following commands for calibrating an analog input module:

- **Span Calibration Command** - Allows you to calibrate an analog input module to correct for gain errors.
- **Offset Calibration Command** - Allows you to calibrate a 6B13 analog input module to correct for offset errors.

The Span Calibration and Offset Calibration commands are generally used only when a module is installed.

Returning Status

The 6B Series command set provides the following commands for returning the status of an analog input module:

- **Configuration Status Command** - Allows you to read the configuration of a specified analog input module.
- **CJC Status Command** - Allows you to read the value of the CJC sensor for a specified 6B11 analog input module.

Analog Output Commands

The 6B Series command set provides analog output commands that allow you to configure analog output modules, specify output values for analog output modules, calibrate analog output modules, and return the status of analog output modules.

Configuring an Analog Output Module

The Start-up Output Current Configuration command allows you to store the output value of a specified analog output module; this value is used as the start-up current whenever the module is powered up.

The Configuration command allows you to set the address, output range, baud rate, data format, slew rate, and/or checksum status for an analog output module; normally, the Configuration command is used only when a module is installed.

The Configuration command parameters are described in more detail in the following subsections.

Address

The address for each analog output module is a unique hexadecimal number between 00 and FF. All modules are shipped with address 00. Since no two 6B Series modules or 6B50 boards can have the same address, you must reconfigure the address of each 6B21 analog output module when setting up your 6B Series system. It is recommended that you reserve address 00 for configuration and diagnostic purposes.

Output Range

You can configure the output range of a 6B21 analog output module as either 0 to 20 mA or 4 to 20 mA.

Baud Rate

You can configure the baud rate of analog output modules as 300, 600, 1200, 2400, 4800, 9600, or 19,200 baud.

Note that not all serial ports support a baud rate of 19,200. Make sure that your system is capable of this speed before configuring a 6B21 analog output module with this baud rate. All 6B Series modules and 6B50 boards in a system must operate at the same baud rate.

Data Format

You can configure a 6B21 analog output module to use data in one of the following data formats:

- **Engineering Units** - The engineering units format presents data in natural units, such as milliamps. Since the total data string length, including digits and decimal point, is fixed at six characters, most computer languages can easily parse this format.

  The engineering units format consists of two decimal digits, a decimal point, and three decimal digits; the resolution is 1.5 μA.

  For example, if an analog output module is configured for a 0 to 20 mA range and the desired output value is +4.762 mA, the value specified is 04.762.

  The analog output modules provide an overrange capability when configured for the engineering units data format. However, keep in mind that only values within the output range are fully accurate and linear. Values between 20 and 22 mA are not guaranteed to be accurate, but are typically linear.

- **Percent of Span** - The percent of span format presents data as the value of the output signal relative to the span of the output (percent of span).

  The percent of span format consists of a "+" or "–" sign, three decimal digits, a decimal point, and two decimal digits. The decimal point is fixed, and the maximum resolution is 0.01% of span (2 μA for the 0 to 20 mA output range and 1.6 μA for the 4 to 20 mA output range).

  For example, if an analog output module is configured for a 0 to 20 mA output range and the desired output value is 10 mA, the value specified is +050.00, indicating that the output is at 50% of span.

The analog output modules provide an overrange capability when configured for the percent of span data format. However, keep in mind that only values within the output range are fully accurate and linear. Values between 100% and 110% (for the 0 to 20 mA output range) and between 100% and 112.5% (for the 4 to 20 mA output range) are not guaranteed to be accurate, but are typically linear.

- **Hexadecimal** - The hexadecimal format is the ASCII hexadecimal representation of the data. It is compact and provides fast communication, excellent resolution, and easy conversion to computer-compatible integer format.

  The hexadecimal format consists of a 3-character hexadecimal string, representing a 12-bit binary value. For the 0 to 20 mA output range, the resolution is 0.025% of span or 5 μA; 000 corresponds to 0 mA and FFF corresponds to 20 mA. For the 4 to 20 mA output range, the resolution is 0.025% of span or 4 μA; 000 corresponds to 4 mA and FFF corresponds to 20 mA.

  No overrange capability is provided when a module is configured for the hexadecimal data format.

Slew Rate

You can configure a 6B21 analog output module with a slew rate. The slew rate is the number of milliamps per second that the output current should rise or fall from the present output current to the desired output current. You can configure the output value to change immediately or at one of the following slew rates:

- 0.125 mA/second
- 0.250 mA/second
- 0.500 mA/second
- 1.0 mA/second
- 2.0 mA/second

- 4.0 mA/second
- 8.0 mA/second
- 16.0 mA/second
- 32.0 mA/second
- 64.0 mA/second
- 128.0 mA/second

Checksum

You can configure a 6B21 analog output module to incorporate checksum generation and checking into all commands. A checksum helps you detect errors in commands to the module from the host and responses from the module to the host. It does, however, reduce throughput by adding two characters to the command and two characters to the response.

When the checksum feature is enabled, all commands to the module and all responses from the module contain a checksum. The checksum is expressed in a 2-character ASCII hexadecimal format and is transmitted just before the carriage return. The checksum is the modulo-256 sum of all the ASCII values of all the characters in the command preceding the checksum.

If the checksum is missing or incorrect in a command in which the checksum feature is enabled, the module does not respond.

Specifying an Analog Output Value

Use the Analog Data Out command to specify an output value to be used by a specified 6B21 analog output module.

Calibrating an Analog Output Module

The 6B Series command set provides the following commands for calibrating a 6B21 analog output module:

- **Trim Calibration Command**
- **4 mA Calibration Command**
- **20 mA Calibration Command**

The three calibration commands are used together to calibrate an analog output module; they are generally used only when a module is installed.

Returning Status

The 6B Series command set provides the following commands for returning the status of an analog output module:

- **Configuration Status Command** - Allows you to read the configuration of a specified analog output module.
- **Last Value Readback Command** - Returns either the last value sent to a specified analog output module by the Analog Data Out command or the start-up output current.
- **Current Readback Command** - Returns the measured value of the current flowing through the current loop.
- **Reset Status Command** - Indicates whether a specified analog output module was reset since the last time you executed this command.

Digital I/O Commands

The 6B Series command set provides digital I/O commands that allow you to configure 6B50 digital I/O boards, read data from 6B50 digital I/O boards, write data to 6B50 digital I/O boards, and return the status of 6B50 digital I/O boards.

Configuring a Digital I/O Board

The Configuration command allows you to set the address, baud rate, and/or checksum status for a 6B50 digital I/O board. Normally, the Configuration command is used only when a board is installed.

The Configuration command parameters are described in more detail in the following subsections.

Address

The address for each 6B50 digital I/O board is a unique hexadecimal number between 00 and FF. All boards are shipped with address 00H. Since no two 6B Series modules or 6B50 boards can have the same address, you must reconfigure the address of each 6B50 digital I/O board when setting up your 6B Series system. It is recommended that you reserve address 00H for configuration and diagnostic purposes.

Baud Rate

You can configure the baud rate of 6B50 digital I/O boards as 300, 600, 1200, 2400, 4800, 9600, or 19,200 baud.

Note that not all serial ports support a baud rate of 19,200. Make sure that your system is capable of this speed before configuring a 6B50 board with this baud rate. All 6B modules and boards in a system must operate at the same baud rate.

Checksum

You can configure a 6B50 digital I/O board to incorporate checksum generation and checking into all commands. A checksum helps you detect errors in commands to the board from the host and responses from the board to the host. It does, however, reduce throughput by adding two characters to the command and two characters to the response.

When the checksum feature is enabled, all commands to the board and all responses from the board contain a checksum. The checksum is expressed in a 2-character ASCII hexadecimal format and is transmitted just before the carriage return. The checksum is the modulo-256 sum of all the ASCII values of all the characters in the command preceding the checksum.

If the checksum is missing or incorrect in a command in which the checksum feature is enabled, the board does not respond.

Reading Data from a Digital I/O Board

The 6B Series command set provides the following commands for reading data from a 6B50 digital I/O board:

- **Digital Data In Command** - Returns the input value from ports A, B, and C on a specified 6B50 digital I/O board.
- **Synchronized Sampling Command** - Instructs all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards to sample their input values immediately and simultaneously and then store these values in a special register.
- **Read Synchronized Data Command** - Returns the value stored by a specified module during the Synchronized Sampling command.

Writing Data to a Digital I/O Board

Use the Digital Data Out command to write a specified output value to a port, or a channel within a port, on a specified 6B50 digital I/O board.

Returning Status

The 6B Series command set provides the following commands for returning the status of a 6B50 digital I/O board:

- **Configuration Status Command** - Allows you to read the configuration of a specified 6B50 digital I/O board.
- **Reset Status Command** - Indicates whether a specified 6B50 digital I/O board was reset since the last time you executed this command.

4 Command Reference Guide

This chapter describes the commands included in the 6B Series command set. The commands are listed in alphabetical order and are labeled according to the operation they perform: analog input, analog output, and digital I/O. It is recommended that you refer to Chapter 3 for background information before reading this chapter.

The 6B Series commands are listed in Table 4-1 according to the operation they perform.

NOTE: 6B11HV, 6B12HV, 6B13HV Modules - These modules are identical to the 6B11, 6B12 and 6B13 modules, except for a higher Input-to-Output Isolation rating of 2500 V rms (vs. the "non-HV" rating of 1500 V rms). All 6B11, 6B12 and 6B13 information in this manual is applicable to the 6B11HV, 6B12HV and 6B13HV respectively, unless specifically stated otherwise.

Table 4-1. 6B Series Commands

Operation	Commands
Analog Input	Configuration – Analog Input
	Analog Data In
	Offset Calibration
	Span Calibration
	Synchronized Sampling
	Read Synchronized Data - Analog Input
	Configuration Status
	CJC Status
Analog Output	Configuration - Analog Output
	Analog Data Out
	Start-up Output Current Configuration
	Trim Calibration
	4 mA Calibration
	20 mA Calibration
	Configuration Status
	Last Value Readback
	Current Readback
	Reset Status
Digital I/O	Configuration - Digital I/O
	Digital Data In
	Digital Data Out
	Synchronized Sampling
	Read Synchronized Data - Digital I/O
	Configuration Status
	Reset Status

Notes: In some cases, more than one command use the same command syntax. Make sure that the address you use in a command is correct. If you use the wrong address, the results will be unpredictable.

You must always use uppercase letters in 6B Series commands.

PURPOSE

The Analog Data In command returns the input value from the specified analog input module in the currently configured data format.

COMMAND SYNTAX

`#AA(cr)`

COMMAND ARGUMENTS

is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module whose value you want to return. Values for *AA* range from 00 to FF.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`>(data)(cr)`

RESPONSE ARGUMENTS

> is the delimiter character.

(data) represents the input value in the configured data format. The configured data format is either engineering units, percent of FSR, twos complement hexadecimal, or ohms. Refer to Analog Input Commands in Chapter 3 for more information.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `#23(cr)`
Response: `>+4.7653(cr)`

The input value at the module at address 23H is +4.7653 V. (The data format is engineering units.)

Command: `#E5(cr)`
Response: `>FF5D(cr)`

The input value at the module at address E5H is FF5D twos complement hexadecimal. (The data format is twos complement.)

Command: `#1A(cr)`
Response: `>+066.66(cr)`

The input value at the module at address 1AH is 66.66% of FSR. (The data format is percent of FSR.)

Command: `#0588(cr)`
Response: `>+3.56719D(cr)`

The checksum feature is enabled. The input value at the module at address 05H is +3.5671 V. (The data format is engineering units.) The command checksum (88H) is the sum of the ASCII values of the following characters: #, 0, and 5. The response checksum (9DH) is the sum of the ASCII values of the following characters: >, +, 3, ., 5, 6, 7, and 1.

PURPOSE

The Analog Data Out command specifies the output value used by the specified analog output module.

COMMAND SYNTAX

`#AA(data)(cr)`

COMMAND ARGUMENTS

is the delimiter character.

AA represents the 2-character hexadecimal address of the analog output module whose output value you want to specify. Values for *AA* range from 00 to FF.

(data) represents the desired output value. The range of values depends on the configured data format (either engineering units, percent of span, or hexadecimal). Refer to Analog Output Commands in Chapter 3 for more information.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`>(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an out-of-range value. (Note that although the module returns an error, it does attempt to use a value as close to the specified value as possible.)*

RESPONSE ARGUMENTS

> is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `#2120.000(cr)`
Response: `>(cr)`

The output value for the module at address 21H is 20 mA. (The data format is engineering units.)

Command: `#09+050.00(cr)`
Response: `>(cr)`

The module at address 09H is configured for a 4 to 20 mA output range and a percent of span data format. (The span of the output range is 16 mA.) The output value is 12 mA or 50% of span (4 mA + (0.50 x 16 mA) = 12 mA).

Command: `#347FF(cr)`
Response: `>(cr)`

The module at address 34H is configured for a 0 to 20 mA output range and a hexadecimal data format. (The span of the output range is 20 mA.) The output value is 10 mA ((7FFH / FFFH) x 20 mA = 10 mA).

PURPOSE

The CJC Status command allows you to read the value of the CJC sensor for the specified 6B11 analog input module. The value is returned in degrees C.

COMMAND SYNTAX

`$AA3(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module whose CJC sensor you want to read. Values for *AA* range from 00 to FF.

3 indicates the CJC Status command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`>(data)(c)`	*if the command is valid.*
`?AA(cr)`	*if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

> is a delimiter character indicating a valid command.

? is the delimiter character indicating an error.

(data) represents the value of the CJC sensor in °C. The format consists of a "+" or "–" sign, followed by five decimal digits and a decimal point. The decimal point is fixed; the resolution is 0.1°C.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$233(cr)`
Response: `>+0024.9(cr)`

The value of the CJC sensor for the module at address 23H is 24.9°C.

PURPOSE

The Configuration - Analog Input command allows you to set the address, input range, baud rate, data format, checksum status, and/or integration time for an analog input module. The configuration information is stored in nonvolatile memory.

COMMAND SYNTAX

`%AANNTTCCFF(cr)`

COMMAND ARGUMENTS

% is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module you want to configure. Values for *AA* range from 00 to FF.

NN represents the new hexadecimal address of the module. Values for *NN* range from 00 to FF.

TT represents the hexadecimal type code. The type code indicates the input range. Table 4-2 lists the type codes for analog input modules.

Table 4-2. Type Codes for Analog Input Modules

Module	Type Code (TT)	Input Ranges
6B11 and 6B11HV	00	±15 mV
	01	±50 mV
	02	±100 mV
	03	±500 mV
	04	±1 V
	05	±5 V
	06	±20 mA[1]
	0E	Type J thermocouple, 0°C to 760°C
	0F	Type K thermocouple, 0°C to 1000°C
	10	Type T thermocouple, –100°C to 400°C
	11	Type E thermocouple, 0°C to 1000°C
	12	Type R thermocouple, 500°C to 1750°C
	13	Type S thermocouple, 500°C to 1750°C
	14	Type B thermocouple, 500°C to 1800°C
6B12 and 6B12HV	07	±50 V
	08	±10 V
	09	±5 V
	0A	±1 V
	0B	±500 mV
	0C	±150 mV
	0D	±20 mA[1]
6B13 and 6B13HV	20	Platinum, –100°C to 100°C, $\alpha = 0.00385$
	21	Platinum, 0°C to 100°C, $\alpha = 0.00385$
	22	Platinum, 0°C to 200 °C, $\alpha = 0.00385$
	23	Platinum, 0°C to 600°C, $\alpha = 0.00385$
	24	Platinum, –100°C to 100°C, $\alpha = 0.003916$
	25	Platinum, 0°C to 100°C, $\alpha = 0.003916$
	26	Platinum, 0°C to 200°C, a = 0.003916
	27	Platinum, 0°C to 600°C, $\alpha = 0.003916$
	28	Nickel, –80°C to 100°C
	29	Nickel, 0°C to 100°C
	2A	Copper (10 Ω @ 25°C), 0°C to 120°C
	2B	Copper (10 Ω @ 0°C), 0°C to 120°C

Note
[1]This input range requires the use of a 50 Ω current conversion resistor (AC1381).

CC represents the hexadecimal baud rate code. Table 4-3 lists the baud rate codes.

Table 4-3. Baud Rate Codes

Baud Rate Code (CC)	Baud Rate
01	300 baud
02	600 baud
03	1200 baud
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud

FF is the hexadecimal equivalent of the 8-bit parameter that represents the data format, checksum status, and integration time. The structure of the data format/checksum status/integration time parameter is shown in Figure 4-1. Note that bits 2 through 5 are not used and must be set to 0.

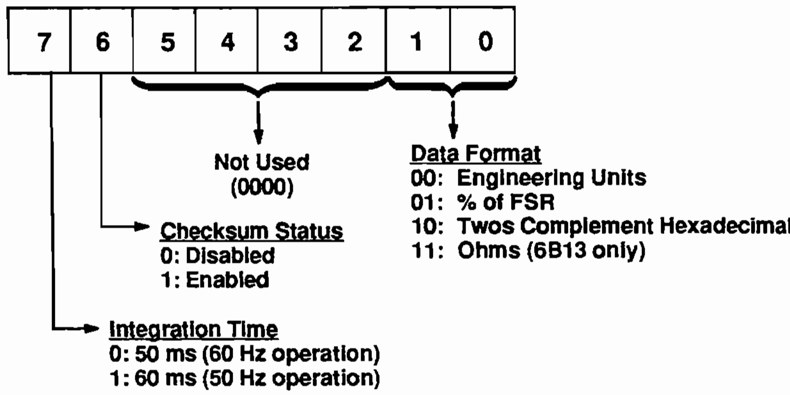


Figure 4-1. Data Format/Checksum/Integration Time Parameter

Refer to Analog Input Commands in Chapter 3 for more information about configuring data formats, checksums, and integration times for analog input modules.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation, or if you did not install the configuration jumper before changing the baud rate or checksum.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

If you are configuring a module for the first time, *AA* = 00 and *NN* equals the new address. If you are reconfiguring a module and changing the address, input range, data format, or integration time, *AA* equals the currently configured address and *NN* equals the current or new address. If you are reconfiguring a module and changing the baud rate or checksum status, you must install the configuration jumper, forcing the module to address 00H; while the configuration jumper is installed, *AA* = 00 and *NN* equals the current or new address.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `%2324050600(cr)`
Response: `!24(cr)`

The 6B Series analog input module at address 23H is configured to a new address of 24H, an input range of ±5 V, a baud rate of 9600, an integration time of 50 ms (60 Hz), engineering units data format, and no checksum checking or generation. The response indicates that the command was accepted and the module was reconfigured.

Command: `%2424050500(cr)`
Response: `?24(cr)`

An attempt was made to reconfigure the 6B Series analog input module at address 23H to address 24H with a new baud rate of 4800. The command was not accepted because the configuration jumper was not installed.

Command: `%FDFD000502(cr)`
Response: `?FD(cr)`

An attempt was made to configure the 6B13 analog input module at address FDH to an input range of ±15 mV, a baud rate of 4800, an integration time of 50 ms (60 Hz), twos complement hexadecimal data format, and no checksum checking or generation. The response indicates that the command was not accepted because invalid data was entered (±15 mV is not a valid input range for a 6B13 analog input module).

PURPOSE

The Configuration – Analog Output command allows you to set the address, output range, baud rate, data format, slew rate, and/or checksum status for an analog output module. The configuration information is stored in nonvolatile memory.

COMMAND SYNTAX

`%AANNTTCCFF(cr)`

COMMAND ARGUMENTS

% is the delimiter character.

AA represents the 2-character hexadecimal address of the analog output module you want to configure. Values for *AA* range from 00 to FF.

NN represents the new hexadecimal address of the module. Values for *NN* range from 00 to FF.

TT represents the hexadecimal type code. The type code indicates the output range. Table 4-4 lists the type codes for the 6B21 module.

Table 4-4. Type Codes for the 6B21 Module

Type Code (TT)	Output Range
30	0 to 20 mA
31	4 to 20 mA

CC represents the hexadecimal baud rate code. Table 4-5 lists the baud rate codes.

Table 4-5. Baud Rate Codes

Baud Rate Code (CC)	Baud Rate
01	300 baud
02	600 baud
03	1200 baud
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud

FF is the hexadecimal equivalent of the 8-bit parameter that represents the data format, slew rate, and checksum status. The structure of the data format/slew rate/checksum parameter is shown in Figure 4-2. Note that bit 7 is not used and must be set to 0.

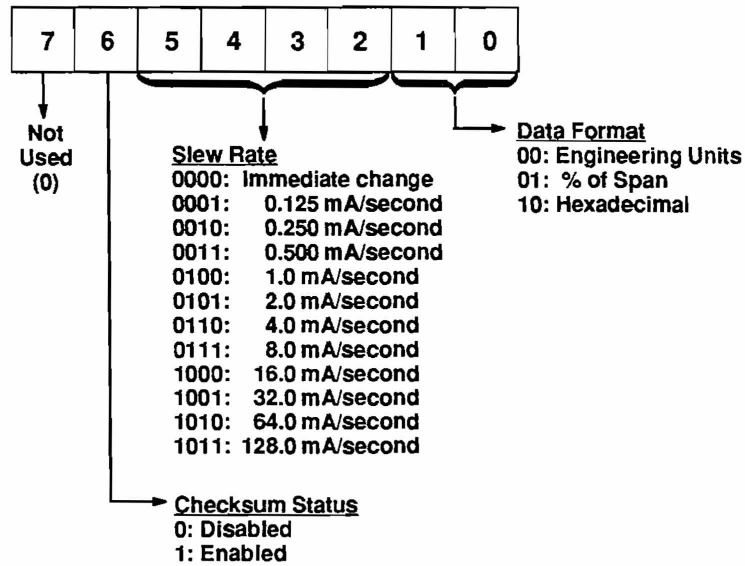


Figure 4-2. Data Format/Slew Rate/Checksum Parameter

Refer to Analog Output Commands in Chapter 3 for more information about configuring data formats, slew rates, and checksums for analog output modules.

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation, or if you did not install the configuration jumper before changing the baud rate or checksum.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

If you are configuring a module for the first time, *AA* = 00 and *NN* equals the new address. If you are reconfiguring a module and changing the address, output range, data format, or slew rate, *AA* equals the currently configured address and *NN* equals the current or new address. If you are reconfiguring a module and changing the baud rate or checksum status, you must install the configuration jumper, forcing the module to address 00H; while the configuration jumper is installed, *AA* = 00 and *NN* equals the current or new address.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `%0015310610(cr)`
Response: `!15(cr)`

The 6B21 analog output module at address 00H is configured to a new address of 15H, an output range of 4 to 20 mA, a baud rate of 9600, engineering units data format, a slew rate of 1 mA per second, and no checksum checking or generation.

PURPOSE

The Configuration - Digital I/O command allows you to set the address, baud rate, and/or checksum status for a 6B50 digital I/O board. The configuration information is stored in nonvolatile memory.

COMMAND SYNTAX

`%AANNTTCCFF(cr)`

COMMAND ARGUMENTS

% is the delimiter character.

AA represents the 2-character hexadecimal address of the 6B50 board you want to configure. Values for *AA* range from 00 to FF.

NN represents the new hexadecimal address of the board. Values for *NN* range from 00 to FF.

TT represents the hexadecimal type code. For a 6B50 digital I/O board, *TT* must equal 40H.

CC represents the hexadecimal baud rate code. Table 4-6 lists the baud rate codes.

Table 4-6. Baud Rate Codes

Baud Rate Code (CC)	Baud Rate
01	300 baud
02	600 baud
03	1200 baud
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud

FF is the hexadecimal equivalent of the 8-bit parameter that represents the checksum status. The structure of the checksum parameter is shown in Figure 4-3. Note that bits 0 through 5 and bit 7 are not used and must be set to 0.

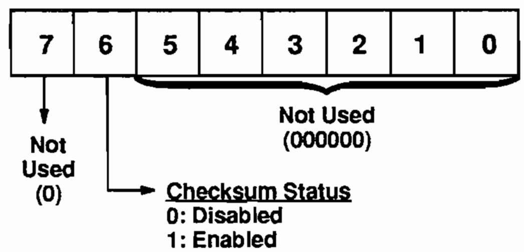


Figure 4-3. Checksum Parameter

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation, or if you did not install the configuration jumper in position AB before changing the baud rate or checksum.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the board.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

If you are configuring a board for the first time, *AA* = 00 and *NN* equals the new address. If you are reconfiguring a board and changing the address, *AA* equals the currently configured address and *NN* equals the current or new address. If you are reconfiguring a board and changing the baud rate or checksum status, you must install the configuration jumper in position AB, forcing the module to address 00H; while the configuration jumper is installed in position AB, *AA* = 00 and *NN* equals the current or new address.

The 6B50 board does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `%0003400540(cr)`
Response: `!03(cr)`

The 6B50 digital I/O board configured for address 03H is reconfigured to a baud rate of 4800 with checksum checking and generation enabled. Although you already configured the board for address 03H, when you install the configuration jumper in position AB to change the baud rate and/or checksum status, the address of the board automatically becomes 00H.

Configuration Status

6B11, 6B12, 6B13, 6B21, 6B50
Analog Input, Analog Output, Digital I/O

PURPOSE

The Configuration Status command allows you to read the configuration of the specified analog input module, analog output module, or 6B50 digital I/O board.

COMMAND SYNTAX

`$AA2(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the module or board whose configuration you want to read. Values for *AA* range from 00 to FF.

2 indicates the Configuration Status command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AATTCCFF(cr)`

RESPONSE ARGUMENTS

! is a delimiter character.

AA represents the 2-character hexadecimal address of the module.

TT represents the type code. Table 4-7 lists the meanings of the type codes for 6B Series modules and boards.

Table 4-7. Type Codes for 6B Series Modules and Boards

Module/ Board	Type Code (TT)	Input/Output Range
6B11 and 6B11HV	00	±15 mV
	01	±50 mV
	02	±100 mV
	03	±500 mV
	04	±1 V
	05	±5 V
	06	±20 mA
	0E	Type J thermocouple, 0°C to 760°C
	0F	Type K thermocouple, 0°C to 1000°C
	10	Type T thermocouple, -100°C to 400°C
	11	Type E thermocouple, 0°C to 1000°C
	12	Type R thermocouple, 500°C to 1750°C
	13	Type S thermocouple, 500°C to 1750°C
	14	Type B thermocouple, 500°C to 1800°C
6B12 and 6B12HV	07	±50 V
	08	±10 V
	09	±5 V
	0A	±1 V
	0B	±500 mV
	0C	±150 mV
	0D	±20 mA

Table 4-7. Type Codes for 6B Series Modules and Boards (Cont.)

Module/ Board	Type Code (TT)	Input/Output Range
6B13 and 6B13HV	20	Platinum, –100°C to 100°C, α = 0.00385
	21	Platinum, 0°C to 100°C, α = 0.00385
	22	Platinum, 0°C to 200°C, α = 0.00385
	23	Platinum, 0°C to 600°C, α = 0.00385
	24	Platinum, –100°C to 100°C, α = 0.003916
	25	Platinum, 0°C to 100°C, α = 0.003916
	26	Platinum, 0°C to 200°C, α = 0.003916
	27	Platinum, 0°C to 600°C, α = 0.003916
	28	Nickel, –80°C to 100°C
	29	Nickel, 0°C to 100°C
	2A	Copper (10 Ω @ 25°C), 0°C to 120°C
	2B	Copper (10 Ω @ 0°C), 0°C to 120°C
6B21	30	0 to 20 mA
	32	4 to 20 mA
6B50	40	N/A

CC represents the baud rate code. Table 4-8 lists the meanings of the baud rate codes for 6B Series modules and boards.

Table 4-8. Baud Rate Codes

Baud Rate Code (CC)	Baud Rate
01	300 baud
02	600 baud
03	1200 baud
04	2400 baud
05	4800 baud
06	9600 baud
07	19200 baud

FF is the hexadecimal equivalent of the 8-bit parameter that represents additional attributes of the module or board, such as data format, integration time, slew rate, and checksum status. Refer to the appropriate Configuration command for more information on the meaning of this parameter.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `$232(cr)`
Response: `!23050600(cr)`

The 6B Series analog input module at address 23H is configured for an input range of ±5 V, a baud rate of 9600, an integration time of 50 ms (60 HZ), engineering units data format, and no checksum checking or generation.

Command: `$012(cr)`
Response: `!01300614(cr)`

The 6B21 analog output module at address 01H is configured with a 0 to 20 mA output range, a 9600 baud rate, engineering units data format, a slew rate of 2 mA per second, and no checksum checking or generation.

Command: `$022(cr)`
Response: `!02400600(cr)`

The 6B50 digital I/O board at address 02H is configured with a 9600 baud rate and no checksum checking or generation.

PURPOSE

The Current Readback command directs a specified 6B Series analog output module to measure the current flowing through its current loop and to return the output value. Note that the value returned is a rough measurement and may not be the precise value.

COMMAND SYNTAX

`$AA8(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the analog output module whose current you want to measure. Values for *AA* range from 00 to FF.

8 indicates the Current Readback command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(data)(cr)`	*if the command is valid.*
`?AA(cr)`	*if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is a delimiter character.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(data) represents the actual value of the current flowing through the current loop in the configured data format. The configured data format is either engineering units, percent of span, or hexadecimal. Refer to Analog Output Commands in Chapter 3 for more information.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$058(cr)`
Response: `!0519.387(cr)`

The value of the current flowing through the current loop of the analog output module at address 05H is approximately 19.387 mA.

PURPOSE

The Digital Data In command returns the input value from ports A, B, and C on a specified 6B50 board.

COMMAND SYNTAX

`$AA6(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the 6B50 board whose values you want to return. Values for *AA* range from 00 to FF.

6 indicates the Digital Data In command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!(dataA)(dataB)(dataC)(cr)`	*if the command is valid.*
`?AA(cr)`	*if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the board.

(dataA) represents the 2-character hexadecimal input value read from port A.

(dataB) represents the 2-character hexadecimal input value read from port B.

(dataC) represents the 2-character hexadecimal input value read from port C.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

Each bit in the 2-character hexadecimal value returned represents the value of a channel in the port, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, and so on. A value of 1 indicates that the voltage at the channel is low; a value of 0 indicates that the voltage at the channel is high. For example, if *(dataA)* = 24 (00100100), the voltage at channels 2 and 5 is low and the voltage at channels 0, 1, 3, 4, 6, and 7 is high.

If an external device is attached to a channel, make sure that the on-board output signal is OFF before you attempt to execute a Digital Data In command. If you don't, the results will be unpredictable. To turn the on-board output signal OFF, if necessary, execute a Digital Data Out command with an output value of 0.

If an external device is attached to a channel, the value returned represents the state of the external device. If no external device is attached to a channel, the value returned represents the last output value you wrote to the channel.

The board does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$336(cr)`
Response: `!05F000(cr)`

The input value of Port A on the 6B50 digital I/O board at address 33H is 05H (00000101), meaning that the voltage at channels 0 and 2 is low and the voltage at channels 1, 3, 4, 5, 6, and 7 is high. The input value of Port B is F0H (11110000), meaning that the voltage at channels 4, 5, 6, and 7 is low and the voltage at channels 0, 1, 2, and 3 is high. The input value at Port C is 00H, meaning that the voltage at all channels is high.

Digital Data Out

6B50

Digital I/O

PURPOSE

The Digital Data Out command writes a specified output value to a port, or a channel within a port, on a specified 6B50 board.

COMMAND SYNTAX

`#AABB(data)(cr)`

COMMAND ARGUMENTS

is the delimiter character.

AA represents the 2-character hexadecimal address of the 6B50 board whose port you want to write to. Values for *AA* range from 00 to FF.

BB represents the port, or the channel within the port, to write to. To write an entire byte to an output port, the first character of *BB* is 0, and the second character of *BB* is the appropriate port (A, B, or C). To write one bit to a single output channel, the first character of *BB* is the appropriate port, and the second character of *BB* is the appropriate channel within the port.

(data) represents the data to write in 2-character hexadecimal format. Each bit represents the value to write to a specific channel in the port, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, and so on. A value of 1 indicates that the output is low; a value of 0 indicates that the output is high. If you are writing an entire byte to an output port, values for *(data)* range from 00 to FF. If you are writing one bit to a single output channel, values for *(data)* are either 00 or 01.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`>(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter.*

RESPONSE ARGUMENTS

> is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

You can execute the Digital Data Out command for only one port at a time. To write the same value to all three ports, you must execute the command three times.

The board does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `#140B05(cr)`
Response: `>(cr)`

An output value of 05H (00000101) is sent to Port B on the 6B50 digital I/O board at address 14H. The voltage at channels 0 and 2 is forced low and the voltage at channels 1, 3, 4, 5, 6, and 7 is forced high.

Command: `#15A701(cr)`
Response: `>(cr)`

An output value of 1 is sent to Port A, channel 7, on the 6B50 digital I/O board at address 15H. The voltage at that channel is forced low.

PURPOSE

When calibrating a 6B21 analog output module, the 4 mA Calibration command indicates that the output current is exactly 4 mA. The 4 mA Calibration command is one of three commands you use to calibrate a 6B21 analog output module; you must also execute the Trim Calibration command and the 20 mA Calibration command.

COMMAND SYNTAX

`$AA0(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the analog output module you want to calibrate. Values for *AA* range from 00 to FF.

0 indicates the 4 mA Calibration command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

It is assumed that either a milliammeter or a resistor and voltmeter is connected to the module's outputs both before and during the execution of this command. Refer to Appendix C for more information on the procedures to follow when performing an analog output module calibration.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

Last Value Readback

6B21
Analog Output

PURPOSE

The Last Value Readback command returns the last output value sent to the specified module by the Analog Data Out command; refer to the Analog Data Out Command for more information. If the 6B21 module was just powered up or reset, the Last Value Readback command returns the start-up output value; refer to the Start-up Output Current Configuration command for more information.

COMMAND SYNTAX

`$AA6(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the analog output module whose value you want to return. Values for *AA* range from 00 to FF.

6 indicates the Last Value Readback command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(data)(cr)`

RESPONSE ARGUMENTS

! is a delimiter character.

AA represents the 2-character hexadecimal address of the module.

(data) represents the output value in the configured data format. The configured data format is either engineering units, percent of span, or hexadecimal. Refer to Analog Output Commands in Chapter 3 for more information.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$056(cr)`
Response: `!0520.000(cr)`

The last output value sent to the analog output module at address 05H was 20 mA. (The data format is engineering units.)

Offset Calibration

6B13
Analog Input

PURPOSE

The Offset Calibration command allows you to calibrate a 6B13 analog input module to correct for offset errors.

COMMAND SYNTAX

`$AA1(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module you want to calibrate. Values for *AA* range from 00 to FF.

1 indicates the Offset Calibration command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

Use the Span Calibration command to correct for gain errors. Refer to Appendix C for more information on the procedures to follow when performing an analog input module calibration.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

Read Synchronized Data – Analog Input

6B11, 6B12
Analog Input

PURPOSE

The Read Synchronized Data - Analog Input command returns the value stored by the specified 6B11 or 6B12 analog input module during the last Synchronized Sampling command.

COMMAND SYNTAX

`$AA4(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module whose value you want to return. Values for *AA* range from 00 to FF.

4 indicates the Read Synchronized Data - Analog Input command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(status)(data)(cr)`	*if the command is valid.*
`?AA(cr)`	*if you entered an invalid parameter or invalid operation, if the module has not received a Synchronized Sampling command since the last power-up, if the conversions are not yet complete, or if the specified module does not support the Synchronized Sampling command.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(status) represents the 1-character value indicating whether the data sampled by the module during the last Synchronized *Sampling* command was returned previously. If *(status)* = 1, the data from the last Synchronized Sampling command is being returned for the first time. If *(status)* = 0, the module returned data from the last Synchronized Sampling command at least once before.

(data) represents the value stored by the specified module during the last Synchronized Sampling command. The module returns the value in the configured data format. The configured data format is either engineering units, percent of FSR, twos complement hexadecimal, or ohms. Refer to Analog Input Commands in Chapter 3 for more information on data formats.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

Because of the time required to perform the conversions and normalize the data, it is recommended that you wait a minimum of 70 ms between executing the Synchronized Sampling command and executing the Read Synchronized Data - Analog Input command. If you execute the Read Synchronized Data - Analog Input command before the conversions are complete, the software returns an error.

The module does not respond if it detects a communication error, if the command is invalid, or if the specified address does not exist.

EXAMPLES

Command: `$054(cr)`
Response: `!051+48.347(cr)`

You waited at least 70 ms after executing a Synchronized Sampling command to all appropriate modules and boards in the 6B Series system. The input value stored by the analog input module at address 05H during the last Synchronized Sampling command was +48.347 V. (The data format is engineering units.) This is the first time the data has been returned.

Command: `$054(cr)`
Response: `!050+48.347(cr)`

You waited at least 70 ms after executing a Synchronized Sampling command to all appropriate modules and boards in the 6B Series system. The input value stored by the analog input module at address 05H during the last Synchronized Sampling command was +48.347 V. (The data format is engineering units.) The module returned this data at least once before; this may indicate that a subsequent Synchronized Sampling command was not received by the module.

PURPOSE

The Read Synchronized Data - Digital I/O command returns the value stored by the specified 6B50 digital I/O board during the last Synchronized Sampling command.

COMMAND SYNTAX

`$AA4(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the 6B50 board whose values you want to read. Values for *AA* range from 00 to FF.

4 indicates the Read Synchronized Data - Digital I/O command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!(status)(dataA)(dataB)(dataC)(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation, if the board did not receive a Synchronized Sampling command since the last power-up, if the conversions are not complete, or if the specified board does not support the Synchronized Sampling command.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the board.

(status) represents the 1-character value indicating whether the data stored by the 6B50 digital I/O board during the last Synchronized Sampling command was returned previously. If *(status)* = 1, the data from the last Synchronized Sampling command is being returned for the first time . If *(status)* = 0, the board returned data from the last Synchronized Sampling command at least once before.

(dataA) represents the 2-character hexadecimal input value read from port A.

(dataB) represents the 2-character hexadecimal input value read from port B.

(dataC) represents the 2-character hexadecimal input value read from port C.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

Because of the time required to perform the conversions and normalize the data, it is recommended that you wait a minimum of 1 ms between executing the Synchronized Sampling command and executing the Read Synchronized Data - Digital I/O command. If you execute the Read Synchronized Data - Digital I/O command before the conversions are complete, the software returns an error.

Each bit in the 2-character hexadecimal value returned represents the value of a channel in the port, where bit 0 corresponds to channel 0, bit 1 corresponds to channel 1, and so on. A value of 1 indicates that the voltage at the channel is low; a value of 0 indicates that the voltage at the channel is high. For example, if *(dataA)* = 24 (00100100), the voltage at channels 2 and 5 is low and the voltage at channels 0, 1, 3, 4, 6, and 7 is high.

If an external device is attached to a channel, the value returned represents the state of the external device. If no external device is attached to a channel, the value returned represents the last output value that you wrote to the channel.

The module does not respond if it detects a communication error, if the command is invalid, or if the specified address does not exist.

EXAMPLES

Command: `$054(cr)`
Response: `!105F000(cr)`

You waited at least 1 ms after executing a Synchronized Sampling command to all appropriate modules and boards in the 6B Series system. The input value stored by the 6B50 digital I/O board at address 05H during the last Synchronized Sampling command was 05H (00000101) for Port A, F0H (11110000) for Port B, and 00H for Port C. This is the first time the data has been returned.

Command: `$054(cr)`
Response: `!005F000(cr)`

You waited at least 1 ms after executing a Synchronized Sampling command to all appropriate modules and boards in the 6B Series system. The input value stored by the 6B50 digital I/O board at address 05H during the last Synchronized Sampling command was 05H (00000101) for Port A, F0H (11110000) for Port B, and 00H for Port C. The module returned this data at least once before; this may indicate that a subsequent Synchronized Sampling command was not received by the module.

Reset Status

6B21, 6B50
Analog Output, Digital I/O

PURPOSE

The Reset Status command returns a bit indicating whether the specified analog output module or 6B50 digital I/O board was reset after you last executed this command.

COMMAND SYNTAX

`$AA5(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the module or board you are checking. Values for *AA* range from 00 to FF.

5 indicates the Reset Status command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AAS(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is a delimiter character.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module or board.

S represents the reset status of the module or board. If *S* = 1, the module or board was reset after you last executed this command; if *S* = 0, the module or board was not reset after you last executed this command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module or board does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLES

Command: `$155(cr)`
Response: `!151(cr)`

The 6B50 digital I/O board at address 15H was reset or powered up after you last executed a Reset Status command. If you execute the command again without resetting the board, the response will be as follows:

```
!150(cr)
```

Span Calibration

6B11, 6B12, 6B13
Analog Input

PURPOSE

The Span Calibration command allows you to calibrate the specified analog input module to correct for gain errors.

COMMAND SYNTAX

`$AA0(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the analog input module you want to calibrate. Values for *AA* range from 00 to FF.

0 indicates the Span Calibration command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The Span Calibration command performs an electronic nonvolatile calibration of the input range of a specified module. The module is calibrated to the input range for which it is configured; therefore, it is assumed that the proper calibration signal is connected to the module's inputs both before and during the execution of the Span Calibration command. Refer to Appendix C for more information on the procedures to follow when performing an analog input module calibration.

For the 6B13 analog input module, use the Offset Calibration command to correct for offset errors.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

Start-up Output Current Configuration

6B21
Analog Output

PURPOSE

The Start-up Output Current Configuration command allows you to store the present value of the output current of the specified analog output module in the module's nonvolatile memory. The module uses this value as the default start-up current whenever the module is powered up or after a brownout condition occurs.

COMMAND SYNTAX

`$AA4(cr)`

COMMAND ARGUMENTS

$ is the delimiter character.

AA represents the 2-character hexadecimal address of the analog output module whose output current you want to store. Values for *AA* range from 00 to FF.

4 indicates the Start-up Output Current Configuration command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$034(cr)`
Response: `!03(cr)`

The present output value of the 6B21 analog output module at address 03H is 6.5 mA. This command stores this 6.5 mA value in memory. Whenever the module is reset or powered up, the output value is set to 6.5 mA.

Synchronized Sampling

6B11, 6B12, 6B50
Analog Input, Digital I/O

PURPOSE

The Synchronized Sampling command instructs all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards in the 6B Series system to sample their input values immediately and simultaneously. Each 6B11 and 6B12 module and each 6B50 board stores the data in a separate register in the module's or board's memory and then resumes normal operation. You can return the data later by executing the Read Synchronized Data - Analog Input command or the Read Synchronized Data - Digital I/O command.

COMMAND SYNTAX

#**

COMMAND ARGUMENTS

is the delimiter character.

** indicates the Synchronized Sampling command.

REMARKS

A carriage return is not required.

Do not use checksum characters, even if the checksum feature is enabled.

The 6B11 and 6B12 modules and the 6B50 digital I/O board do not respond to the Synchronized Sampling command. You must execute the Read Synchronized Data - Analog Input command or the Read Synchronized Data - Digital I/O command after you execute the Synchronized Sampling command to retrieve the data. Refer to the appropriate Read Synchronized Data command for more information.

The 6B11 and 6B12 analog input modules require a maximum of 70 ms to perform conversions and normalize the data. Therefore, you should not execute any additional commands on a 6B11 or 6B12 module until at least 70 ms have elapsed. If you execute another command too soon, the software returns an error.

The 6B50 digital I/O board requires a maximum of 1 ms to perform conversions and normalize the data. Therefore, you should not execute any additional commands on a 6B50 board until at least 1 ms has elapsed. If you execute another command too soon, the software returns an error.

Trim Calibration

6B21
Analog Output

PURPOSE

When calibrating a 6B21 analog output module, the Trim Calibration command adjusts the output current. The Trim Calibration command is one of three commands you use to calibrate a 6B21 analog output module; you must also execute the 4 mA Calibration command and the 20 mA Calibration command.

COMMAND SYNTAX

`$AA3(number of counts)(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the analog output module you want to calibrate. Values for *AA* range from 00 to FF.

3 indicates the Trim Calibration command.

(number of counts) is the 2-character twos complement hexadecimal value representing the number of counts to increase or decrease the output current. Each count is equal to approximately 1.5 µA. Values range from 00 to FF, where 00 represents 0 counts, 7F represents +127 counts, 80 represents –128 counts, and FF represents –1 counts. A negative number decreases the output current by the specified number of counts; a positive number increases the output current by the specified number of counts.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX `!AA(cr)`

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

It is assumed that either a milliammeter or a resistor and voltmeter is connected to the module's outputs both before and during the execution of this command. Refer to Appendix C for more information on the procedures to follow when performing an analog output module calibration.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

EXAMPLE

Command: `$03332(cr)`
Response: `!03(cr)`

This command increases the present output value of the analog output module at address 03H by 50 counts (about 75 μA).

20 mA Calibration

6B21
Analog Output

PURPOSE

When calibrating a 6B21 analog output module, the 20 mA Calibration command indicates that the output current is exactly 20 mA. The 20 mA Calibration command is one of three commands you use to calibrate a 6B21 analog output module; you must also execute the 4 mA Calibration command and the Trim Calibration command.

COMMAND SYNTAX

`$AA1(cr)`

COMMAND ARGUMENTS

$ is a delimiter character.

AA represents the 2-character hexadecimal address of the analog output module you want to calibrate. Values for *AA* range from 00 to FF.

1 indicates the 20 mA Calibration command.

(cr) represents the 1-character terminating character (carriage return, 0DH).

RESPONSE SYNTAX

`!AA(cr)` *if the command is valid.*

`?AA(cr)` *if you entered an invalid parameter or invalid operation.*

RESPONSE ARGUMENTS

! is the delimiter character indicating a valid command.

? is the delimiter character indicating an error.

AA represents the 2-character hexadecimal address of the module.

(cr) represents the 1-character terminating character (carriage return, 0DH).

REMARKS

It is assumed that either a milliammeter or a resistor and voltmeter is connected to the module's outputs both before and during the execution of this command. Refer to Appendix C for more information on the procedures to follow when performing an analog output module calibration.

The module does not respond if it detects a syntax error or communication error or if the specified address does not exist.

5 Technical Reference

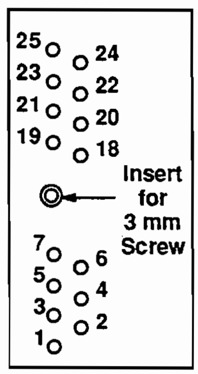
This chapter provides a technical description of the 6B Series modules, the 6B50 digital I/O board, the communication and networking capabilities of a 6B Series system, and the synchronized sampling of data from all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards in the system. It also includes the specifications of 6B Series modules and the 6B50 digital I/O board.

The 6B Series modules offer signal conditioning, galvanic transformer-based isolation, scaling, analog-to-digital (A/D) or digital-to-analog (D/A) conversion, and digital communication. The embedded microcontroller provides ranging, autocalibration, linearization and compensation for internal sources of error, including ambient temperature changes. 1500 V rms (2500 V rms for "HV" models) isolation for both signal and power eliminates ground loops, guards against transients, prevents common mode voltage (CMV) problems and ensures channel-to-channel input isolation.

6B Series modules are designed to meet the IEEE standard for CMV transient voltage protection (ANSI/IEEE C37.90.1-1989). All field-wired terminations, including sensor inputs, excitation circuitry and current outputs, are protected against accidental application of 240 V rms line voltage.

NOTE: 6B11HV, 6B12HV, 6B13HV Modules - These modules are identical to the 6B11, 6B12 and 6B13 modules, except for a higher Input-to-Output Isolation rating of 2500 V rms (vs. the "non-HV" rating of 1500 V rms). All 6B11, 6B12 and 6B13 information in this manual is applicable to the 6B11HV, 6B12HV and 6B13HV respectively, unless specifically stated otherwise.

All 6B Series modules are identical in size and can be mixed and matched on a 6B Series backplane. The modules are hard-potted and have sturdy 40 mil gold-plated pins. The socket layout and pin designations for each of the modules are shown in Figure 5-1.



Socket Layout

N/C 25	24 XCV+
XCV– 23	22 RTS+
RTS– 21	20 +5 V PWR
PWR COM 19	18 CONFIG
IN LO 7	6 IN HI
–EXC 5	4 +EXC
CJC EXC 3	2 +SNS
–SNS 1	

Pin Designations (6B11, 6B12)

N/C 25	24 XCV+
XCV– 23	22 RTS+
RTS– 21	20 +5 V PWR
PWR COM 19	18 CONFIG
RTD COM 7	6 +SNS
N/C 5	4 +SRC
N/C 3	2 N/C
N/C 1	

Pin Designations (6B13)

N/C 25	24 XCV+
XCV– 23	22 RTS+
RTS– 21	20 +5 V PWR
PWR COM 19	18 CONFIG
LO 7	6 HI
5	4
3	2
1	

Pin Designations (6B21)

Figure 5-1. Socket Layout and Pin Designations

The module cases are made from a thermoplastic resin, which has a fire-retardant rating of 94V-O and is designed to withstand storage temperatures of -40°C to +85°C. Secure the modules in the backplane with a tapered captive screw. The modules contain labels on which to indicate the input/output range and address. The mechanical dimensions of a 6B Series module and socket are shown in Appendix H.

The 6B Series analog input and output modules are shipped from the factory fully calibrated, and the calibration coefficients are stored in nonvolatile EEPROM (Electrically Erasable Programmable Read-Only Memory). The modules should not require any recalibration; to recalibrate a module, refer to Appendix C.

Analog Input Modules

On the 6B Series analog input modules, the analog input (V_{IN}), an internal reference voltage (V_{REF}), and an internal zero (ground) are multiplexed with the CJC signal and a local temperature sensor into a programmable gain amplifier (PGA). Determining the actual value of the analog input requires a stable reference that can be calibrated. As long as V_{REF} (nominally 6.4 V) is stable, its absolute value is not critical. In calibrating a module at the factory, both a precisely known analog input and V_{REF} are converted. Their ratio is stored in 1024-bit, serial in/serial out EEPROM and used as a correction factor in subsequent calculations.

A voltage-to-frequency (V/F), charge-balancing converter takes the conditioned signal and converts it into a serial output that is passed through a transformer and across the isolation barrier. The pulse-transformer signal goes directly into a custom gate array, which provides counting and frequency-to-binary number conversion. The gate array has a crystal-controlled clock oscillator and two counters, which produce counts of the V/F signal and the period of the reference clock. The count values are converted from fixed-point binary to single-precision floating point in the microcontroller. The gate array also provides a driver for the isolated front-end power.

The 80C52 microcontroller contains the entire executable program memory and performs scaling, ranging, calibration, internal temperature correction, and linearization. Linearization is needed for accurate temperature readings. The digitized analog input value points to a specific entry in a look-up table, where linearization slope (*m*) and intercept (*b*) values are stored. These values are combined with the raw value in a standard $y = mx + b$ calculation to produce a linearized value.

The data in the microcontroller is formatted for transmission to the RS-485 interface according to the programmable parameters stored in EEPROM. (Refer to Chapters 3 and 4 for more information on programming a 6B Series module.)

A low voltage reset monitor ensures reliable rest of the module when the supply voltage drops below 4.4 volts.

A block diagram of the 6B11 and 6B12 analog input modules is shown in Figure 5-2. A block diagram of the 6B13 analog input module is shown in Figure 5-3.

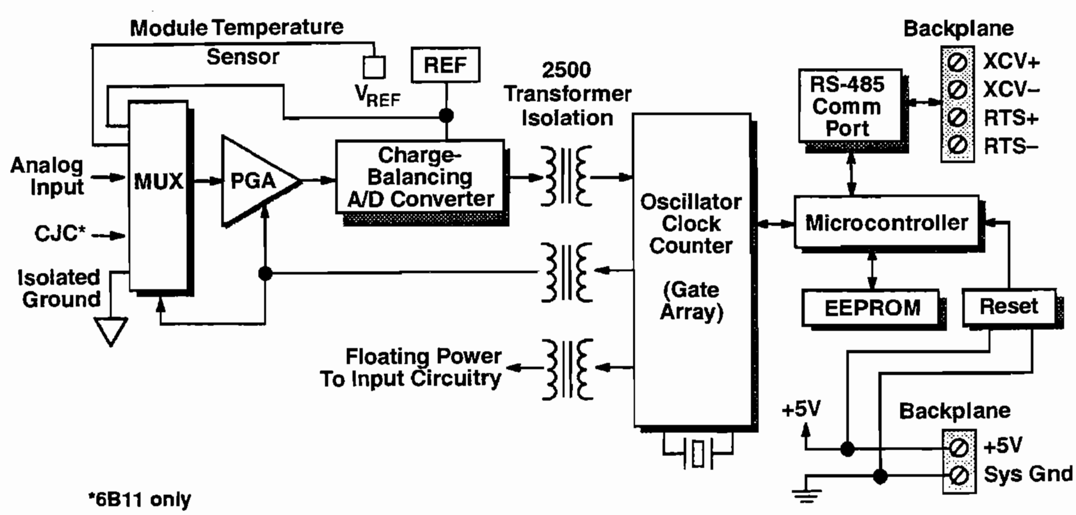


Figure 5-2. 6B11 and 6B12 Module Block Diagram

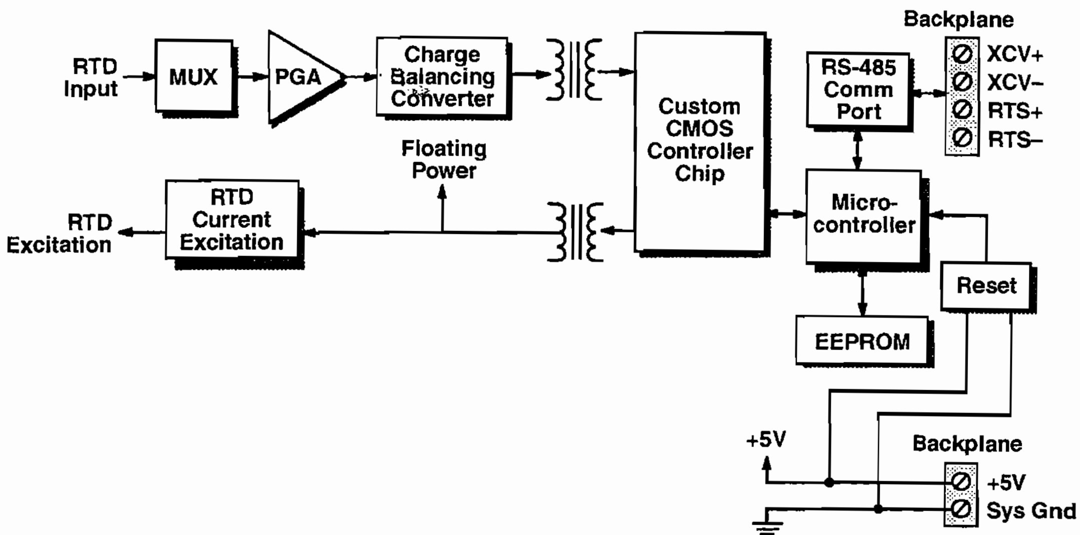


Figure 5-3. 6B13 Module Block Diagram

The 6B13 uses a unique design to measure RTD inputs. The 3-wire RTD interface, shown in Figure 5-4, compares the ratio of the RTD resistance to that of an internal resistor, as measured by voltage drops.

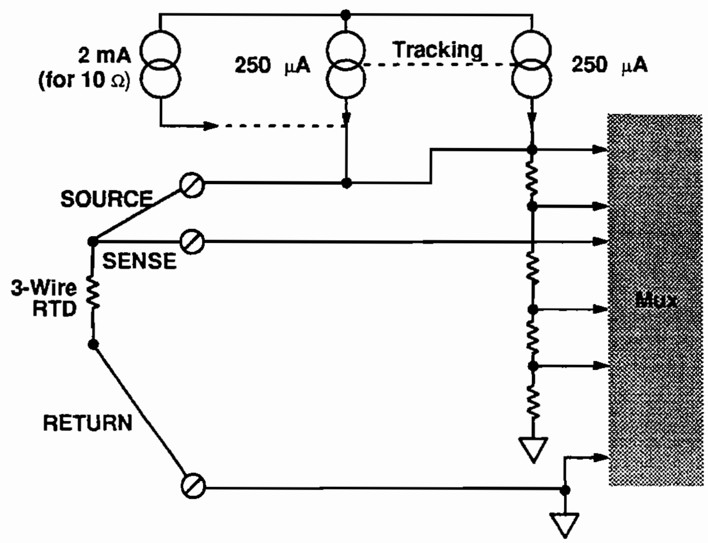


Figure 5-4. RTD Input Structure

An internal resistor string provides ranging for different types and ranges of RTDs. Excitation for the RTD and the internal resistors is furnished by a tracking pair of 250 µA current sources.

The input reading must provide lead-wire compensation, since any voltage drop in the wires to the RTD itself would otherwise be interpreted as resistance (and temperature changes) in the RTD. In the 6B13, this compensation is performed digitally. Since no current flows into the SENSE lead input, the voltage difference between the SOURCE and SENSE inputs is due entirely to IR drop in the SOURCE lead. The software subtracts twice the measured value to compensate for SOURCE plus (similar) RETURN lead resistance.

For the 10 Ω copper RTD, the 250 μA source current is too low to provide adequate drop across the RTD. Rather than change both current sources (or the multiplexer range resistors), a tracking 2 mA source is connected in parallel with the 250 μA RTD source. The known ratio between the RTD current source and the multiplexed resistor current source is used in the calculations.

Analog Output Modules

The 6B21 analog output module receives a command from the host through an RS-485 interface and converts this command into an isolated process current output. The 80C52 microcontroller controls the 12-bit digital-to-analog converter (DAC) through an optically isolated serial interface. The DAC drives the current loop through a protected voltage-to-current (V/I) converter. The output monitor is a V/F converter whose frequency is proportional to the loop current. This variable signal frequency is fed back to the microcontroller through an optical isolator. The microcontroller then scales the frequency signal and returns the value to the host on command. A dc-to-dc converter generates 25 V @ 25 mA to power the current loop and output circuitry from the +5 V power supply. A reset monitor ensures the reliable reset of the module when the voltage drops below 4.7 V, independent of the power supply rise and fall times. A block diagram of the 6B21 analog output module is shown in Figure 5-5.

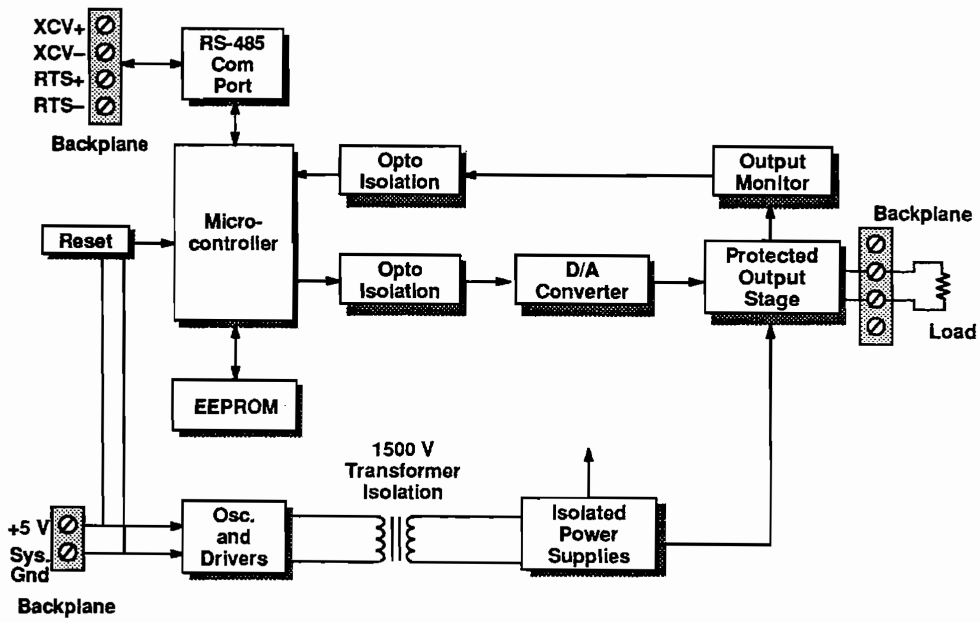


Figure 5-5. 6B21 Module Block Diagram

6B50 Digital I/O Board

On the 6B50 digital I/O boards, the microcontroller communicates with the host to exchange command and status information. The output drivers are open collector darlington transistor arrays with 47 kΩ pull-up resistors, each capable of sinking 500 mA of current. A reset monitor ensures the reliable reset of the module when the voltage drops below 4.7 V, independent of the power supply rise and fall times. The reset circuitry is connected to the 24 output latches. When the 6B50 board is powered up, all output latches are cleared and all output drivers are turned off. You must execute a Digital Data Out command to activate the output drivers. (The Digital Data Out command is described in Chapter 4.) A block diagram of the 6B50 digital I/O board is shown in Figure 5-6.

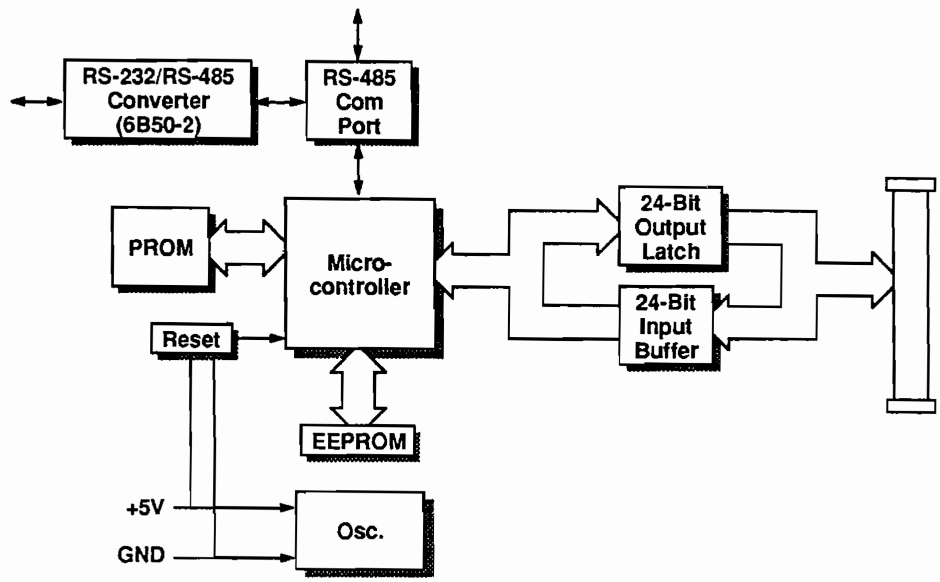


Figure 5-6. 6B50 Block Diagram

Communication and Networking

A 6B Series backplane or 6B50 digital I/O board can be part of a network of backplanes and boards all with a common host. The microcontroller on the backplane or board interfaces to communication lines using a pair of RS-485 line driver and receiver integrated circuits. Figure 5-7 shows how the bidirectional, half-duplex scheme is wired.

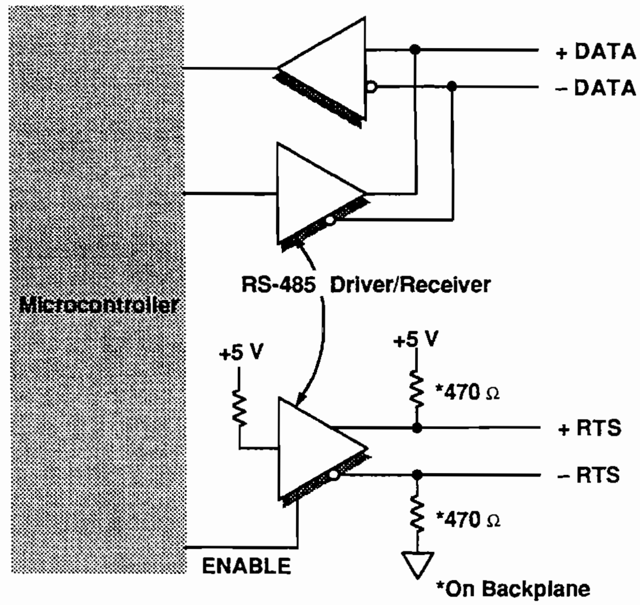


Figure 5-7. Serial Communication Circuitry

One wire pair represents incoming/outgoing differential data, and the other pair is a differential line for RTS (Request to Send). The RTS driver input is wired high, and the driver ENABLE is controlled by the microcontroller; the differential outputs of the driver have 470 Ω pull-up (and pull-down) resistors located on the backplane or board.

Note: A 6B Series system does not use RTS in the way RTS is typically used in RS-232C communication. On a 6B Series system, RTS is not used by the host computer and no handshaking occurs.

To avoid conflicts that occur when several modules and boards try to send data at the same time, a simple command/response protocol is used. When the modules and boards are not transmitting, they are in a listen mode. Only the host can initiate a command/response sequence. When a module or board recognizes its address in a command message from the host, the module or board asserts the RTS line; this reverses the direction of any repeaters between the module or board and the host. The module or board then proceeds to transmit its response to the host without sending a handshake signal. When the module or board completes the transmission of the response, it relinquishes the RTS line. The host can then initiate a new transaction.

The networking capabilities of 6B Series backplanes and 6B50 boards include the following:

- **RS-232C Connector** - The RS-232C connector allows a backplane or board to communicate with a host computer. RS-232C is an EIA standard intended for serial data transmission over distances of up to 50 feet and speeds of up to 19,200 bits per second. It is designed to act as an interface between a single communicating device and a host computer. On 6B Series backplanes and 6B50 digital I/O boards, RS-232C is a 4-wire interface (TX, RX, and two ground connections) that can be used with most computers containing a serial port.

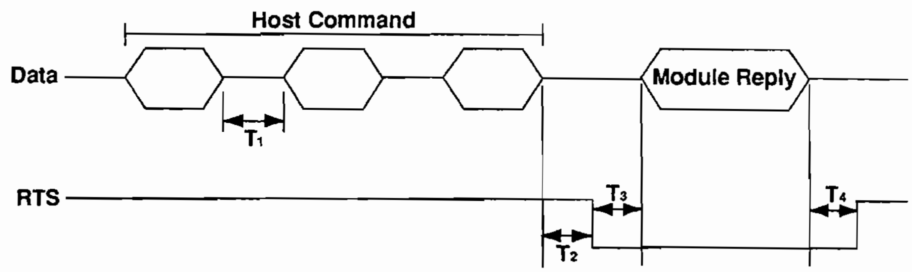
  The RS-232C-to-RS-485 converter, shown in Figures 1-3, 1-5, 1-7, and 1-9, transforms the host signal from a full-duplex RS-232C signal (which operates on separate transmit/receive paths) to a half-duplex RS-485 signal (which operates over a bidirectional bus). Communication is always sequential rather than concurrent. A module or board does not respond to the host until the complete command is received and does not accept a new command until the previous response is complete. Note that a 6B21 analog output module that is in the process of "slewing" to a programmed output current can accept a new command.

- **RS-485 Connector -** The RS-485 connector allows connection of one backplane or board to another backplane or board in either a daisy-chain or a multidrop configuration. The network of backplanes and boards connected to a single RS-232C port can contain up to 256 loads, where each analog I/O module counts as one load and each 6B50 digital I/O board counts as one load.

  RS-485 is an EIA standard for multidropped systems, intended for serial data transmission over long distances. RS- 485 receivers have a common mode input range of –7 V to +12 V; this provides good noise rejection. On 6B Series backplanes and 6B50 digital I/O boards, RS-485 uses two twisted/shielded wire pairs, one for differential data and the other for differential control (RTS). The RTS signal functions as a transceiver control line when connecting multidropped RS-485 devices to RS-232C and controls the direction of RS-485 repeaters.

- **RS-485 Repeater -** The RS-485 repeater can extend the distance a signal can be transmitted and increase the number of loads on a network. Each 6BP01-2, 6BP04- 1, 6BP04HV-1, 6BP04-2, 6BP04HV-2, 6BP16-1, and 6BP16-2 backplane contains an RS-485 repeater. These repeaters are shown in Figures 1-4 through 1-7. The distance between each repeater can be up to 4000 feet.

A timing diagram for communication between the host computer and an analog input module is shown in Figure 5-8. Note that an asterisk (*) indicates that the value is the same as the value in the previous column.



	Fast Reply Commands	Slow Reply Commands
T1	20 char times @ current baud rate, maximum	*
T2	100 µs, typical	*
T3	1 ms + 1 char time @ current baud rate, typical	200 ms, typical
T4	100 µs, typical	*

Fast Reply Commands	Slow Reply Commands
Analog Data In	Configuration
Configuration Status	CJC Status
	Span Calibration
	Offset Calibration

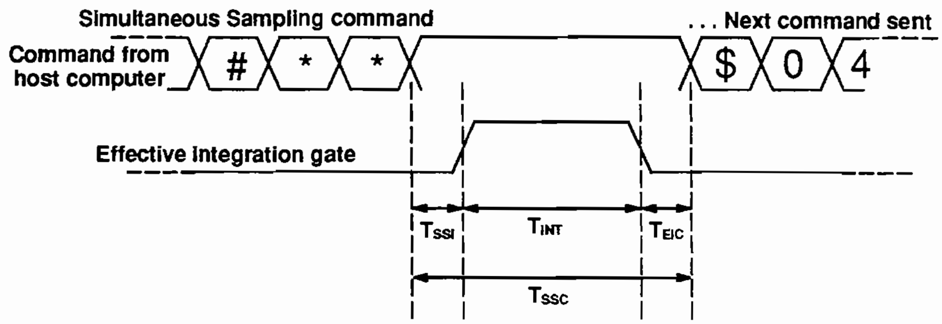
Figure 5-8. Timing Diagram for Host Communication

All communication is performed by sending ASCII string commands; the complete command string is transmitted in a single word. Therefore, you cannot use a "dumb" terminal that sends one character at a time, since the module or board would timeout before it received a command.

Synchronized Sampling

The firmware of the 6B11 analog input module, 6B12 analog input module, and 6B50 digital I/O board allows you to sample data from all 6B11s, 6B12s, and 6B50s simultaneously. Each module or board stores the data in a separate register within its microcontroller and can access the data with a separate command.

The 6B11 and 6B12 require a maximum of 70 ms to perform conversions and normalize the data; the 6B50 requires a maximum of 1 ms to perform conversions and normalize the data. This time period includes the delay between the receipt of the Synchronized Sampling command and the onset of the integration period, the integration period itself, and the time required for linearization and/or scaling operations. A timing diagram is shown in Figure 5-9.



Timing Parameter	Description	Minimum	Typical	Maximum
T_{SSI}	End of simultaneous sampling command to start of integration period	---	0.2 ms	9 ms
T_{INT}	Integration period	---	50 ms/ 60 ms (depending on configuration)	51 ms/ 61 ms
T_{EIC}	End of integration period to start of communication	10 ms	---	---
T_{SSC}	End of simultaneous sampling command to start of next command	70 ms	---	---

Figure 5-9. Timing Diagram for Synchronized Sampling

Specifications

Table 5-1 contains the specifications for the 6B Series analog input modules. Table 5-2 contains the specifications for the 6B21 analog output module. Table 5-3 contains the specifications for the 6B50 digital I/O board. Unless otherwise noted, specifications are based on a typical temperature of +25°C and a +5 V power supply voltage. *Specifications are subject to change without notice.*

Table 5-1. 6B Series Analog Input Module Specifications

Feature	Specification
Input Ranges 6B11 6B12 6B13	 Thermocouple, mV, V, mA mV, V, mA Pt, Ni, Cu RTDs
Output	RS-485
Accuracy[1] 6B11[2], 6B12 6B13	 ±0.05% or better ±0.03°C (Pt, Ni)
Zero Drift 6B11, 6B12 6B13[3]	 ±0.3 μV/°C ±0.005°C/°C
Span Drift 6B11 6B12 6B13[3]	 ±3 ppm/°C typical, ±25 ppm/°C maximum ±10 ppm/°C typical, ±50 ppm/°C maximum ±0.005°C/°C
Common-Mode Voltage, input-to-output 6B11, 6B12, 6B13 6B11HV, 6B12HV, 6B13HV	 1500 V rms continuous 2500 V rms continuous
Common-Mode Rejection at 50 Hz or 60 Hz, 1 kΩ source imbalance 6B11, 6B13 6B12	 160 dB 108 dB
Normal-Mode Rejection at 50 Hz or 60 Hz, 1 kΩ source imbalance 6B11, 6B13 6B12	 58 dB 56 dB
Sensor Excitation Current (6B13 only) 100 Ω Pt, 120 Ω Ni 10 Ω Cu	 0.25 mA 2.25 mA
Lead Wire Resistance in Each Lead (6B13 only)	10 Ω maximum

Table 5-1. 6B Series Analog Input Module Specifications (cont.)

Feature	Specification
Lead Resistance Effect (6B13 only) 100 Ω Pt, 120 Ω Ni 10 Ω Cu	 0.0007°C/Ω 0.01°C/Ω
Cold Junction Compensation[5] Accuracy @ +25°C Over +5°C to +45°C Ambient	 ±0.25°C (±0.75°C maximum) ±0.5°C (±0.0125°C/°C)
Differential Input Protection	240 V rms continuous
Differential Input Transient Protection	ANSI/IEEE C37.90.1-1989
Input Resistance 6B11 6B12 6B13	 100 MΩ 1 MΩ N/A
Bandwidth	4 Hz
Conversion Rate	9 samples/second
Power Supply Requirements Voltage[5] (operating) Voltage (max. safe limit) Current Fuse (F1)	 +5 V dc ±5% +6.5 V dc 100 mA @ +5 V dc Littelfuse 251.500, 1/2 A (for single-channel) 6B Series backplanes), Littelfuse 251.005, 5 A (for multiple-channel) 6B Series backplanes),
Dimensions	2.3″ (58.4 mm) x 3.1″ (78.8 mm) x 0.75″ (19.1 mm)
Temperature Range Rated Performance Storage	 –25°C to +85°C –40°C to +85°C
Relative Humidiy	0 to 93% at 40°C Noncondensing

Table 5-1. 6B Series Analog Input Module Specifications (cont.)

Notes

[1]Accuracy depends on the configured input range. Refer to Tables 5-4 through 5-6 for specific accuracy by input range.

[2]6B11 and 6B11HV modules only. When measuring thermocouple signals, the CJC sensor accuracy should be added to the 6B11 and 6B11HV module accuracy to compute the overall system accuracy.

[3]Combined effect of zero drift and span drift.

[4]CJC sensor accuracy refers to the AC1361 sensor mounted on 6B series backplanes.

[5]Voltage rise time and fall time (10% to 90% of rated voltage) must be less than 150 ms.

Table 5-2. 6B21 Analog Output Module Specifications

Feature	Specification
Range	0 to 20 mA, 4 to 20 mA
Overrange	+2 mA ±200 µA
Initial Accuracy Output Offset Span Output Offset Readback Span Readback	 ±5 µA typical, ±15 µA maximum ±0.02% FSR typical, ±0.05% FSR maximum ±100 µA ±0.5% FSR
Accuracy vs Temperature (Temperature Coefficient) Output Offset Gain Output Offset Readback Gain Readback	 ±1 µA/°C ±50 ppm/°C ±5 µA/°C ±200 ppm/°C
Resolution Output Performance Readback Performance	 ±0.02% FSR ±0.5% FSR
Nonlinearity Output Performance Readback Performance	 ±0.02% FSR ±0.5% FSR
Bandwidth	100 samples/second
Settling Time	1 ms to 0.1% FSR
Noise (100 Hz bandwidth)	1 µA P-P
Load Resistor	0 to 750 Ω
Normal Mode Output Protection	240 V rms
Slew Rate	0.125 mA to 128.0 mA per second, in 11 binary ranges
Common Mode Voltage, input-to-output	1500 V rms continuous
Common Mode Rejection @ 60 Hz	90 dB minimum

Table 5-2. 6B21 Analog Output Module Specifications (cont.)

Feature	Specification
Differential Input Transient Protection	ANSI/IEEE C37.90.1-1989
Power Supply Requirements Voltage[1] (operating) Voltage (max. safe limit) Current Consumption Fuse (F1)	 +5 V dc ±5% +6.5 V dc 250 mA @ 5V 1.2 W Littelfuse 251.500 1/2 A (for single-channel 6B Series backplanes) Littelfuse 251.005, 5 A (for multiple-channel 6B Series backplanes)
Dimensions	2.3″ (58.4 mm) x 3.1″ (78.8 mm) x 0.75″ (19.1 mm)
Temperature Range Rated Performance Storage	 -25°C to +85°C -40°C to +85°C
Relative Humidiy (MIL-STD-883C, Method 1004.4)	0 to 95% at 60°C

Note

[1]Voltage rise-time and fall-time (10% to 90% of rated voltage) must be less than 150 ms.

Table 5-3. 6B50 Digital I/O Board Specifications

Feature	Specification
Number of I/O Channels	24 (configurable as input or output)
I/O Circuit Configuration	Open collector outputs with 47 kΩ pull-ups to +5 V
Inputs High-Level Low-Level	 3.5 V minimum, 5.25 V maximum 0.8 V maximum
Outputs High-Level Current Low-Level Current High-Level Voltage	 50 µA @ +5 V 100 mA @ 1.1 V +5.25 V maximum
Communication RS-232C and RS-485 Baud Rates RS-232C Maximum Distance RS-485 Maximum Distance	 300, 600, 1200, 2400, 4800, 9600, 19.2K 50 feet 4000 feet
Power Supply Requirements Voltage, Operating Voltage (max. safe limit) Current, Quiescent Fuse (F1)	 +5 Vdc ±5% +6.5 V dc 225 mA @ 5 V (excluding load current) Littelfuse 251.01.5, 1 1/2 A
Temperature Range Rated Performance Storage	 0°C to +70°C –40°C to +85°C
Relative Humidity	0 to 95%
Dimensions	3.47″ x 6.5″ (90.68 mm x 165.1 mm)

Table 5-4 contains the specific accuracy for each 6B11 input range. Table 5-5 contains the specific accuracy for each 6B12 input range. Table 5-6 contains the specific accuracy for each 6B13 input range.

Table 5-4. Range Accuracy for 6B11, 6B11HV Modules

Input Range Code (Hex)	Input Range	Typical Accuracy	Maximum Error	Peak-To-Peak Noise	Units
00	±15 mV	±0.03	±0.06	±0.02	% of FSR
01	±50 mV	±0.015	±0.04	±0.01	% of FSR
02	±100 mV	±0.0055	±0.03	±0.00	% of FSR
03	±500 mV	±0.005	±0.03	±0.002	% of FSR
04	±1 V	±0.005	±0.03	±0.005	% of FSR
05	±5 V	±0.005	±0.03	±0.0015	% of FSR
06	±20 mA[1]	±0.008	±0.03	±0.005	% of FSR
0E	J thermocouple[2] 0 to 760°C	±0.4	±0.75	±0.14	°C
0F	K thermocouple[2] 0 to 1000°C	±0.5	±0.75	±0.22	°C
10	T thermocouple[2] -100 to 400°C	±0.5	±0.75	±0.2	°C
11	E thermocouple[2] 0 to 1000°C	±0.5	±0.75	±0.2	°C
12	R thermocouple[2] 500 to 1750°C	±0.63	±1.5	±0.3	°C
13	S thermocouple[2] 500 to 1750°C	±0.62	±1.5	±0.4	°C
14	B thermocouple[2] 500 to 1800°C	±1.2	±2.0	±0.7	°C

Notes

[1]Excluding error contribution from current conversion resistor.

[2]Includes effects of repeatability, hysteresis, and linearity. The CJC sensor accuracy should be added to the 6B11 and 6B11HV module accuracy to compute the overall measurement accuracy.

Table 5-5. Range Accuracy for 6B12, 6B12HV Modules

Input Range Code (Hex)	Input Range	Typical Accuracy	Maximum Error	Peak-To-Peak Noise	Units
07	±50 V	±0.006	±0.03	±0.004	% of FSR
08	±10 V	±0.006	±0.03	±0.005	% of FSR
09	±5 V	±0.006	±0.03	±0.006	% of FSR
0A	±1 V	±0.006	±0.03	±0.007	% of FSR
0B	±500 mV	±0.01	±0.04	±0.008	% of FSR
0C	±150 mV	±0.03	±0.06	±0.02	% of FSR
0D	±20 mA[1]	±0.006	±0.03	±0.007	% of FSR

Note

[1]Excluding error contribution from current conversion resistor.

Table 5-6. Range Accuracy for 6B13, 6B13HV Modules

Input Range Code (Hex)	Input Range	Typical Accuracy	Maximum Error	Peak-To-Peak Noise	Units
20	Pt, –100°C to 100°C, α = 0.00385	0.02	0.15	0.03	°C
21	Pt, 0°C to 100°C, α = 0.00385	0.03	0.15	0.04	°C
22	Pt, 0°C to 200°C, α = 0.00385	0.03	0.15	0.04	°C
23	Pt, 0°C to 600°C, α = 0.00385	0.05	0.15	0.05	°C
24	Pt, –100°C to 100°C, α = 0.003916	0.03	0.15	0.03	°C
25	Pt, 0°C to 100°C, α = 0.003916	0.05	0.15	0.03	°C
26	Pt, 0°C to 200°C, α = 0.003916	0.03	0.15	0.04	°C
27	Pt, 0°C to 600°C, α = 0.003916	0.04	0.15	0.05	°C
28	Ni, –80°C to 100°C	0.05	0.15	0.02	°C
29	Ni, 0°C to 100°C	0.03	0.15	0.02	°C
2A	Cu (10 Ω @ 25°C) 0°C to 120°C	0.13	1.4	0.04	°C
2B	Cu (10 Ω @ 0°C) 0°C to 120°C	0.11	1.4	0.04	°C

Table 5-7. Power Supply Specifications

(typical @ +25°C, 115 V ac, 60 Hz, unless otherwise noted)

Feature	Model 955	Model 977	PWR-01
Input Voltage Range	105 V ac to 125 V ac	100 V ac to 130 V ac	85 V ac to 265 V ac
Frequency	50 Hz to 250 Hz	47 Hz to 400 Hz	47 Hz to 63 Hz
Output Voltage	5 V dc	5 V dc	5 V dc
Short Circuit Protection	Current Limited	Current Limited	Current Limited
Overvoltage Protection[1]	+6.2 V dc	+6.2 V dc	+6.0 V dc
Output Current	1000 mA	5000 mA	5000 mA
Voltage Accuracy	±2% maximum	±2% maximum	±1%, adjustable ±3%
Temperature Coefficient	±0.02%/°C	±0.02%/°C	±0.05%/°C
Line Regulation	±0.05%	±0.05%	±0.1%
Load Regulation	±0.15%	±0.1%	±0.5%
Ripple & Noise	2 mV rms, maximum	100 mV pk-pk	50 mV pk-pk maximum
Breakdown Voltage	2500 V ac rms, minimum	900 V ac rms, minimum	5300 V dc one-minute
Switching Frequency	N/A	25 kHz	65 kHz
Operating Temperature Range	–25°C to +71°C	–25°C to +71°C	0°C to +70°C
Storage Temperature Range	–25°C to +85°C	–25°C to +85°C	–40°C to +85°C
Derating	40 mA/°C above 50°C	15 mA/°C above 50°C	100 mA/°C above 50°C
Cooling	Free Air Convection	Free Air Convection	Free Air Convection

Note

[1]Substantial overload can be withstood, including direct short. Prolonged operation should be avoided since excessive temperature rises will occur.

Table 5-8. 6BP01 Backplane Specifications

Feature	6BP01-1	6BP01-2
Channels	1	1
Interface[1]	RS-485	RS-232C
Isolation	2500 V rms	2500 V rms
Power Supply		
Voltage		
Operating	Passive	+5 V dc ±5%
Max. Safe Limit	N/A	+6.5 V dc
Current	N/A	200 mA
Fuse	Littelfuse® 251.500 1/2 A	Littelfuse® 251.005 5 A
Dimensions	4.25″ x 1.37″	4.25″ x 2.85″
Temperature Range		
Rated Performance	–25°C to +85°C	–25°C to +85°C
Storage	–40°C to +85°C	–40°C to +85°C
Relative Humidity	0 to 95% @ 60°C	0 to 95% @ 60°C

Note

[1]All backplanes have the RS-485, half duplex, interface.

Table 5-9. 6BP04 Backplane Specifications

Feature	6BP04-1	6BP04-2	6BP04HV-1	6BP04HV-2
Channels	4	4	4	4
Interface[1]	RS-485	RS-232C	RS-485	RS-232C
Isolation[2]	1500 V rms	1500 V rms	2500 V rms	2500 V rms
Power Supply				
Voltage				
Operating	+5 V dc ±5%	+5 V dc ±5%	+5 V dc ±5%	+5 V dc ±5%
Max Safe Limit	+6.5 V dc	+6.5 V dc	+35 V dc	+35 V dc
Overvoltage Protection[3]	N/A	N/A	>+6.5 V dc	>+6.5 V dc
Current	200 mA	200 mA	200 mA	200 mA
Fuse	Littelfuse® 251.005 5 A	Littelfuse® 251.005 5 A	Littelfuse® 251.005 5 A	Littelfuse® 251.005 5 A
Dimensions	3.47″ x 6.5″	3.47″ x 6.5″	3.47″ x 6.5″	3.47″ x 6.5″
Temperature Range				
Rated Performance	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C	–25°C to +85°C
Storage	–40°C to +85°C	–40°C to +85°C	–40°C to +85°C	–40°C to +85°C
Relative Humidity	0 to 93% @ 40°C Noncondensing	0 to 93% @ 40°C Noncondensing	0 to 93% @ 40°C Noncondensing	0 to 93% @ 40°C Noncondensing

Notes

[1]All backplanes have the RS-485, half duplex, interface.
[2]Input-to-output and channel-to-channel.
[3]Overvoltage Protection is provided by an SCR crowbar. Power must be recycled to reset.

Table 5-10. 6BP16 Backplane Specifications

Feature	6BP16-1	6BP16-2
Channels	16	16
Isolation[2]	1500 V rms	1500 V rms
Power Supply Voltage Operating Max. Safe Limit Current Fuse	 +5 V dc ±5% +6.5 V dc 200 mA Littelfuse® 251.005 5 A	 +5 V dc ±5% +6.5 V dc 200 mA Littelfuse® 251.005 5 A
Temperature Range Rated Performance Storage	 –25°C to +85°C –40°C to +85°C	 –25°C to +85°C –40°C to +85°C
Relative Humidity	0 to 93% @ 40°C Noncondensing	0 to 93% @ 40°C Noncondensing

Notes

[1]All backplanes have the RS-485, half duplex, interface.
[2]Input-to-output and channel-to-channel.

A Utility/Demo Software

This appendix contains a brief description of the 6B Series Utility/Demo software. It is intended for those users who want to configure, calibrate, read data from, or write data to 6B Series modules and 6B50 digital I/O boards without writing their own application programs.

The 6B Series Utility/Demo software is a menu-driven program provided by Analog Devices. It is shipped on a disk with your manual. You should copy the 6B Series Utility/Demo software into an appropriate directory on your hard drive. For more detailed information than that provided in this appendix, read the various on-line Help screens or refer to Chapters 3 and 4.

Note: For multispeed host computers, you must copy the 6B Series Utility/Demo software into an appropriate directory on your hard drive to assure proper operation.

SIXBCCD for DOS Installation Instructions

1. Insert the 6B Series Configuration/Utilities Disk into your computer's 3.5" floppy drive.
2. Create a SIXBCCD sub-directory on your hard disk.
3. Copy all the files located in A:\SIXBCCD, or B:\SIXBCCD if your 3.5" disk drive happens to be drive B: to C:\SIXBCCD.
4. From the C:\SIXBCCD directory, type "sixbccd" to run the program.

6BWIN for Windows® 3.1 & NT 3.51 Installation Instructions

1. Start Microsoft® Windows
2. Insert the 6B Series Configuration/Utilities Disk into your computer's 3.5" floppy drive.
3. From the Program Manager™ choose **Run** . . . from the File Menu.
4. In the Command Line box, type "a:\setup," or "b:\setup" if your 3.5" disk drive happens to be drive B:, and click OK.
5. 6B-WIN Setup will ask for a path name, where 6B-WIN executable files and data files should be kept. If you would like Setup to create a directory for you, type in the directory name, or click on [OK] to select the default directory, "c:\6bwin."

Please refer to the 6B-WIN Help file for further information.

6BWIN for Windows® 95 & NT 4.0 Installation Instructions

1. Start Microsoft Windows.
2. Insert the 6B Series Configuration/Utilities Disk into your computer's 3.5" floppy drive.
3. Choose Run . . . from the Start Menu.
4. In the Open box, type "a:\setup" or "b:\setup" if your 3.5" disk drive happens to be drive B: and click OK.
5. 6BWIN Setup will ask for a path name, where 6BWIN executable files and data files should be kept. If you would like Setup to create a directory for you, type in the directory name, or click on [OK] to select the default directory, "c:\6bwin."

Please refer to the 6BWIN Help file for further information.

To use the 6B Series Utility/Demo software, perform the following steps:

1. From the appropriate directory in DOS, enter the following:

   ```
   sixbccd [-m]
   ```

   (*-m* forces the 6B utility to use a monochrome display)

2. From the copyright screen, press <Escape> to display the Main Menu.

3. Use the arrow keys to highlight the appropriate option and press <Enter> to select the option.

The Main Menu options are described on the following pages. Note that when you are instructed to select an option, use the arrow keys to highlight the option and then press <Enter>.

- **Help** - Select this option to display additional information.
- **Quit** - Select this option to return to DOS.
- **Comport** - Select this option to configure the host communication port. The *Comport* options are described as follows:
  - *Port* - Select this option to indicate the serial port on the host to which the 6B Series system is connected.
  - *Baud Rate* - Select this option to specify the baud rate.
- **Map** - Select this option to retrieve the current configuration data for 6B Series modules and 6B50 digital I/O boards and save the configuration data either in memory, on a disk, or on a printed page. The *Map* options are described as follows:
  - *Search* - Select this option to poll all modules and boards on the 6B Series system and store the current configuration data for all the modules and boards in memory.
  - *Save* - Select this option to save the current configuration data for all the modules and boards to disk. Note that you must poll the modules and boards using the *Search* option before you can save the configuration data.

- *Print* - Select this option to poll all modules and boards on the 6B Series system and print the current configuration data for all the modules and boards on a specified printer.
- *Quit* - Select this option to return to the Main Menu.
- *Help* - Select this option to display additional information.

Note: The system asks you to indicate the highest address to poll. If you do not enter a number, the system defaults to 255 and polls all possible addresses. To save time, you can enter the lowest appropriate address instead.

- **Config** - Select this option to configure a 6B Series module or 6B50 digital I/O board. Select the appropriate module or board, select the parameter you want to configure, and then select the appropriate setting.

Note: You can only access the parameters appropriate to the type of module or board you are configuring. The other parameters are shaded and cannot be accessed. For example, when configuring a 6B21 analog output module, the *T(int)* parameter is shaded because you cannot configure an integration time for an output module.

The *Config* parameters are described as follows:

- *Format* - Select this option to specify the data format. For more information on data formats, refer to the appropriate Data Format section in Chapter 3.
- *Range* - Select this option to specify the input or output range.
- *Baud* - Select this option to specify the baud rate. All modules and boards in a system must operate at the same baud rate.

Note: If you are specifying the baud rate for a module, the module must be installed in the socket nearest the configuration jumper (W1) with the configuration jumper installed. If you are specifying the baud rate for a 6B50 digital I/O board, the configuration jumper (W1) must be installed in position AB on the board. Refer to Configuring Modules and Boards in Chapter 2 for more information on configuring the baud rate.

- *Checksum* - Select this option to enable or disable the checksum feature. For more information on the checksum feature, refer to the appropriate Checksum section in Chapter 3.

Note: If enabling or disabling the checksum feature for a module, the module must be installed in the socket nearest the configuration jumper (W1) with the configuration jumper installed. If you are enabling or disabling the checksum feature for a 6B50 digital I/O board, the configuration jumper (W1) must be installed in position AB on the board. Refer to Configuring Modules and Boards in Chapter 2 for more information on configuring the checksum status.

- *T(int)* - Select this option to specify the integration time. For more information on integration time, refer to Integration Time in Chapter 3.
- *Address* - Select this option to specify the address of a module or board. Enter a decimal number between 0 and 255.
- *Slew Rate* - Select this option to specify the slew rate. For more information on slew rates, refer to Slew Rate in Chapter 3.
- *Execute* - After entering all appropriate data, select this option to store the new configuration in the module or board and update the system map.

– *Quit* - Select this option to return to the Main Menu without storing the new configuration in the module or board.

– *Help* - Select this option to display additional information.

Configuration Notes

Before the system allows you to configure any modules or boards, it must poll all the modules and boards to determine which are configurable. If appropriate, the system asks you to indicate the highest address to poll. If you do not enter a number, the system defaults to 255 and polls all possible addresses. To save time, instead enter the lowest appropriate address.

Since all modules and boards are shipped with address 00H and *no two modules or boards can have the same address, you* must initially configure the system with only one unconfigured module or board installed at a time. Once you have changed the address of a module or board from 00H, you can leave the module or board installed.

In a network of 6B Series backplanes and 6B50 digital I/O boards, make sure that only one backplane or board has the configuration jumper (W1) installed at any one time.

After making a physical change, such as turning the power on or off, inserting or extracting the configuration jumper (W1), or removing or inserting a module or board, you must use the *Search* option to remap the system.

- **Calibrate** - Select this option to calibrate an analog I/O module. Select the appropriate module.

  For analog input modules, apply the appropriate voltage/ resistance (as indicated on the screen), and press <Enter>.

  For analog output modules, use the arrow keys to increase or decrease the output current. Press <F1> when the output current is exactly 4 mA. Press <F2> when the output current is exactly 20 mA.

  Press <Escape> to return to the Main Menu.

Note: Before the system allows you to calibrate any modules, it must poll all the modules and boards to determine which are available for calibration. If appropriate, the system asks you to indicate the highest address to poll. If you do not enter a number, the system defaults to 255 and polls all possible addresses. To save time, you can enter the lowest appropriate address instead.

- **Browse** - Select this option to display a list of all currently configured modules and boards. For each module or board, the system displays the address, the type code (Range), a description of the module or board, and the model number of the module or board. Press <Enter> or <Escape> to return to the Main Menu.
- **InData** - Select this option to display the input value for each currently configured analog I/O module or digital I/O board. For each module or board, the system displays the address, the model number of the module or board (Type), the present input value (Data), the units in which the data is displayed, and the type of application (Sensor).

Note: For each analog output module, the value displayed is the actual value of the current flowing through the current loop. For each digital I/O channel, the value displayed is either the state of an external device or, if no external device is attached to a channel, the last output value written to the channel.

Whenever the modules and boards are reading data, instruct all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards to simultaneously sample their input values. Press <S> to initiate the synchronized sampling of data. The modules and boards simultaneously sample their input values and the software displays the data on the screen. The software displays the message *SYNCHRONIZED DATA SAMPLE* at the bottom of the screen to indicate that you are no longer in continuous sampling mode. Note that for modules and boards that do not support the synchronized sampling of data, the software displays the message COMM ERR instead of a value.

As the user moves from screen to screen to read data from other modules and boards, the software displays a pound sign (#) next to modules and boards whose data has already been read.

Press <S> to initiate another synchronized sampling of data. Press <C> to return to continuous sampling mode. Press <Escape> to return to the Main Menu.

- **OutData** - Select this option to specify an output value for an analog output module or a digital I/O board.

  For analog output modules, use the arrow keys to increase or decrease the output value (Setpoint) until you reach the desired output value. (Note that the readback value is the actual value of the current flowing through the current loop.) Press <F1> to store the setpoint value in the module's memory to be used as the start-up current whenever the module is powered up or reset. Press <Escape> to return to the Main Menu.

  For digital I/O boards, use the left and right arrow keys to highlight the bit to which you want to assign a value. Use the up arrow key to set the highlighted bit; use the down arrow key to clear the highlighted bit. (Note that the readback value is either the state of an external device or, if no external device is attached to a channel, the last output value written to the channel.)

B

Input/Output Ranges and Data Formats

This appendix contains examples of each of the data formats for each input and output range.

Range Code (hex)	Input Range Description	Data Formats	+F.S.	Zero	–F.S.	Displayed Resolution
00	±15 mV	Engineering Units	+15.000	±00.000	–15.000	1 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
01	±50 mV	Engineering Units	+50.000	±00.000	–50.000	1 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
02	±100 mV	Engineering Units	+100.00	±000.00	–100.00	10 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
03	±500 mV	Engineering Units	+500.00	±000.00	–500.00	10 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
04	±1 V	Engineering Units	+1.0000	±0.0000	–1.0000	100 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
05	±5 V	Engineering Units	+5.0000	±0.0000	–5.0000	100 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]

Data Formats

Range Code (hex)	Input Range Description	Data Formats	+F.S.	Zero	–F.S.	Displayed Resolution
06	±20 mA	Engineering Units	+20.000	±00.000	–20.000	1 µA
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
07	±50 V	Engineering Units	+50.000	±00.000	–50.000	1 mV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
08	±10 V	Engineering Units	+10.000	±00.000	–10.000	1 mV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
09	±5 V	Engineering Units	+5.0000	±0.0000	–5.0000	100 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
0A	±1 V	Engineering Units	+1.0000	±0.0000	–1.0000	100 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
0B	±500 mV	Engineering Units	+500.00	±000.00	–500.00	10 µA
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
0C	±150 mV	Engineering Units	+150.00	±000.00	–150.00	10 µV
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]
0D	±20 mA	Engineering Units	+20.000	±00.000	–20.000	1 µA
		% of FSR	+100.00	±000.00	–100.00	0.01%
		Twos Complement	7FFF	0000	8000	1 LSB[1]

Range Code (hex)	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
0E	Type J Thermocouple 0°C to 760°C	Engineering Units	+760.00	+000.00	0.1°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	0000	1 LSB[1]
0F	Type K Thermocouple 0°C to 1000°C	Engineering Units	+1000.0	+0000.0	0.1°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	0000	1 LSB[1]
10	Type T Thermocouple –100°C to 400°C	Engineering Units	+400.00	–100.00	0.01°C
		% of FSR	+100.00	–025.00	0.01%
		Twos Complement	7FFF	CCCC	1 LSB[1]
11	Type E Thermocouple 0°C to 1000°C	Engineering Units	+1000.0	+0000.0	0.1°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	0000	1 LSB[1]
12	Type R Thermocouple 500°C to 1750°C	Engineering Units	+1750.0	+0500.0	0.1°C
		% of FSR	+100.00	+028.57	0.01%
		Twos Complement	7FFF	2492	1 LSB[1]
13	Type S Thermocouple 500°C to 1750°C	Engineering Units	+1750.0	+0500.0	0.1°C
		% of FSR	+100.00	+028.57	0.01%
		Twos Complement	7FFF	2492	1 LSB[1]
14	Type B Thermocouple 500°C to 1800°C	Engineering Units	+1800.0	+0500.0	0.1°C
		% of FSR	+100.00	+027.77	0.01%
		Twos Complement	7FFF	238E	1 LSB[1]
20	100 Ω Platinum RTD α = .00385 –100°C to 100°C	Engineering Units	+100.00	–100.00	0.01°C
		% of FSR	+100.00	+100.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+138.50	+060.60	10 mΩ
21	100 Ω Platinum RTD α = .00385 0°C to 100°C	Engineering Units	+100.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+138.50	+100.00	10 mΩ

Range Code (hex)	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
22	100 Ω Platinum RTD α = .00385 0°C to 200°C	Engineering Units	+200.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+175.84	+100.00	10 mΩ
23	100 Ω Platinum RTD α = .00385 0°C to 600°C	Engineering Units	+600.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+313.59	+100.00	10 mΩ
24	100 Ω Platinum RTD α = .00392 –100°C to 100°C	Engineering Units	+100.00	–100.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+139.16	+060.60	10 mΩ
25	100 Ω Platinum RTD α = .00392 0°C to 100°C	Engineering Units	+100.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+139.16	+100.00	10 mΩ
26	100 Ω Platinum RTD α = .00392 0°C to 200°C	Engineering Units	+200.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+177.13	+100.00	10 mΩ
27	100 Ω Platinum RTD α = .00392 0°C to 600°C	Engineering Units	+600.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+317.28	+100.00	10 mΩ
28	120 Ω Nickel RTD –80°C to 100°C	Engineering Units	+100.00	–080.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+200.64	+066.60	10 mΩ

Range Code (Hex)	Input Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Displayed Resolution
29	120 Ω Nickel RTD 0°C to 100°C	Engineering Units	+100.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+200.64	+120.00	10 mΩ
2A	Copper RTD 10 Ω @ 25°C 0°C to 120°C	Engineering Units	+120.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+13.665	+09.043	1 mΩ
2B	Copper RTD 10 Ω @ 0°C 0°C to 120°C	Engineering Units	+120.00	+000.00	0.01°C
		% of FSR	+100.00	+000.00	0.01%
		Twos Complement	7FFF	8000	1 LSB[1]
		Ohms	+15.050	+10.000	1 mΩ

Note

[1]Resolution is one LSB of 16 bits.

Range Code (Hex)	Output Range Description	Data Formats	Maximum Specified Signal	Minimum Specified Signal	Output Resolution
30	0 to 20 mA	Engineering Units	22.000	00.000	1.5 µA
		% of FSR	+110.00	+000.00	2 µA
		Hexadecimal Binary	FFF	000	5 µA
31	4 to 20 mA	Engineering Units	22.000	00.000	1.5 µA
		% of FSR	+112.50	–025.00	1.6 µA
		Hexadecimal Binary	FFF	000	4 µA

C Calibration Procedure

All 6B Series analog input and output modules are calibrated at the factory and generally do not need any recalibration. If recalibration is required, follow the analog input module or analog output module calibration procedures described in this appendix.

NOTE: 6B11HV, 6B12HV, 6B13HV Modules - These modules are identical to the 6B11, 6B12 and 6B13 modules, except for a higher Input-to-Output Isolation rating of 2500 V rms (vs. the "non-HV" rating of 1500 V rms). All 6B11, 6B12 and 6B13 information in this manual is applicable to the 6B11HV, 6B12HV and 6B13HV respectively, unless specifically stated otherwise.

Analog Input Module Calibration

To Calibrate an analog input module, perform the following steps.

1. Make sure that the module being calibrated is installed in a 6B series backplane.
2. Apply power to the backplane using a +5 V dc power supply, and let the module warm up for 30 minutes. Ambient temperature should be approximately +25°C.
3. If required, configure the module for the input range you are calibrating it to.

4a. For 6B11 and 6B12 modules, apply the appropriate calibration voltage to the screw terminals on the +IN and –IN inputs, as shown in Figure C-1.

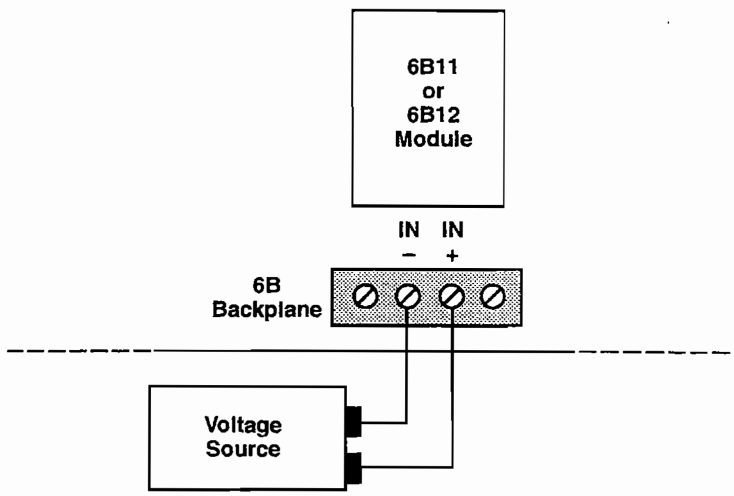


Figure C-1. Applying Calibration Voltage

Table C-1 lists calibration voltages for all input ranges.

Table C-1. Calibration Voltage

Module	Input Range Code (Hex)	Input Range	Calibration Voltage
6B11 and 6B11HV	00	±15 mV	+15 mV
	01	±50 mV	+50 mV
	02	±100 mV	+100 mV
	03	±500 mV	+500 mV
	04	±1 V	+1 V
	05	±5 V	+5 V
	06	±20 mA	+20 mA[1]
	0E	J thermocouple 0 to 760°C	+50 mV

Table C-1. Calibration Voltage (cont.)

Module	Input Range Code (Hex)	Input Range	Calibration Voltage
6B11 and 6B11HV (cont.)	0F	K thermocouple 0 to 1000°C	+50 mV
	10	T thermocouple –100 to +400°C	+22 mV
	11	E thermocouple 0 to 1000°C	+80 mV
	12	R thermocouple 500 to 1750°C	+22 mV
	13	S thermocouple 500 to 1750°C	+22 mV
	14	B thermocouple 500 to 1800°C	+15 mV
6B12 and 6B12HV	07	±50 V	+50 V
	08	±10 V	+10 V
	09	±5 V	+5 V
	0A	±1 V	+1 V
	0B	±500 mV	+500 mV
	0C	±150 mV	+150 mV
	0D	±20 mA	+20 mA[1]

Note
[1]You can substitute +1 V for +20 mA if you remove the current conversion resistor for that channel. However, the calibration accuracy will be limited to 0.1%, due to the resistor's tolerance.

Use a low noise precision voltage source, such as a Data Precision® Model 8200 or equivalent. Since cold junction compensation is handled separately, and the CJC sensor is permanently calibrated at the factory, monometallic connections must be used when calibrating voltage and thermocouple ranges.

4b. For 6B13 modules, apply the appropriate span calibration resistance to the screw terminals using a 3-wire connection, as shown in Figure C-2.

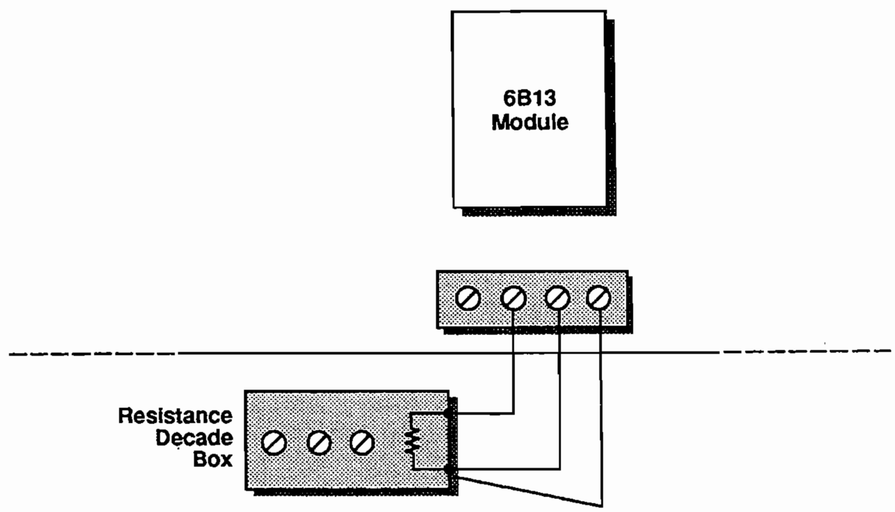


Figure C-2. Applying Calibration Resistance

Table C-2 lists span calibration resistances for all input ranges.

Table C-2. Calibration Resistance

Input Range Code (Hex)	Input Range	Span Calibration Resistance	Offset Calibration Resistance
20	Pt, –100°C to 100°C α = 0.00385	140 Ω	60 Ω
21	Pt, 0°C to 100°C α = 0.00385	140 Ω	60 Ω
22	Pt, 0°C to 200°C α = 0.00385	200 Ω	60 Ω
23	Pt, 0°C to 600°C α = 0.00385	440 Ω	60 Ω
24	Pt, –100°C to 100°C α = 0.003916	140 Ω	60 Ω
25	Pt, 0°C to 100°C α = 0.003916	140 Ω	60 Ω
26	Pt, 0°C to 200°C α = 0.003916	200 Ω	60 Ω
27	Pt, 0°C to 600°C α = 0.003916	440 Ω	60 Ω
28	Ni, –80°C to 100°C	200 Ω	60 Ω
29	Ni, 0°C to 100°C	200 Ω	60 Ω
2A	Cu (10 Ω @ 25°C) 0°C to 120°C	15 Ω	10 Ω
2B	Cu (10 Ω @ 0°C) 0°C to 120°C	15 Ω	10 Ω

Use a precision resistance decade box or discrete precision resistors with these values: 10 Ω, 15 Ω, 60 Ω, 140 Ω, 200 Ω, and 440 Ω. The accuracy of calibration depends on the absolute accuracy of the resistor.

Note: You must apply the voltage/resistance for at least 1 s before issuing the Span Calibration command, and you should hold it until the module acknowledges the command; this typically takes 150 ms.

5. Execute the Span Calibration command. Refer to the Span Calibration command in Chapter 4 for more information.
6. For 6B13 modules, apply the appropriate offset calibration resistance to the screw terminals using a 3-wire connection, as shown in Figure C-2. Refer to Table C-2 for a list of offset calibration resistances for all input ranges.

Note: You must apply the resistance for at least 1 s before issuing the Offset Calibration command, and you should hold it until the module acknowledges the command; this typically takes 150 ms.

7. Execute the Offset Calibration command. Refer to the Offset Calibration command in Chapter 4 for more information.

Analog Output Module Calibration

To calibrate an analog output module, perform the following steps:

1. Make sure that the module that you are calibrating is installed in a 6B Series backplane.
2. Apply power to the backplane using a +5 V dc power supply, and let the module warm up for 30 minutes. Ambient temperature should be approximately +25°C.

3. Attach either a 5-digit milliammeter or a 5-digit voltmeter with a shunt resistor (250 Ω, 0.01%, 10 ppm) to the appropriate module. Refer to Figure C-3.

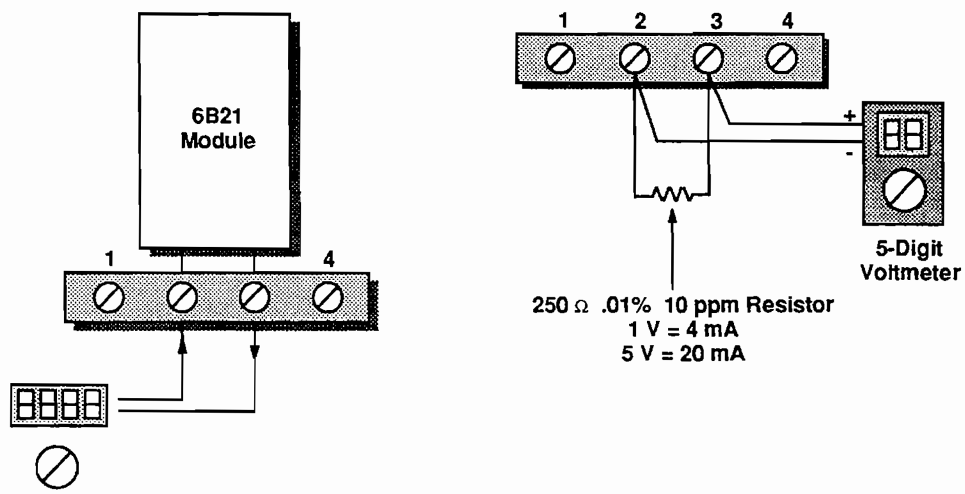


Figure C-3. Attaching Meter to Analog Output Module

4. Execute an Analog Data Out command with an output value of 4 mA. The module's output will be approximately 4 mA.
5. Execute the Trim Calibration command as often as necessary until the output current is equal to exactly 4 mA.
6. Execute the 4 mA Calibration command to indicate that the present output current is exactly 4 mA.
7. Execute an Analog Data Out command with an output value of 20 mA. The module's output will be approximately 20 mA.

8. Execute the Trim Calibration command as often as necessary until the output current is equal to exactly 20 mA.
9. Execute the 20 mA Calibration command to indicate that the present output current is exactly 20 mA.

Note: Make sure that you perform the entire procedure. You must calibrate both the 4 mA output current and the 20 mA output current.

D Troubleshooting

This appendix contains general troubleshooting information and a procedure to follow if you have difficulty communicating with a 6B Series module or 6B50 digital I/O board.

General Troubleshooting

Table D-1 lists general symptoms and possible solutions for problems you may have when using 6B Series modules and 6B50 digital I/O boards. If, after checking out the following troubleshooting information, the module or board still fails to operate properly, contact your local Analog Devices sales office.

Table D-1. Troubleshooting a 6B Series System

Symptom	Possible Cause	Possible Solution
Module or board does not respond to host.	The RS-485 cable may be loose or not connected properly.	Check the cable connection. Refer to Connecting Multiple Backplanes and Boards in Chapter 2 for more information.
	The external power supply is not attached or is not supplying power.	Check the power supply. Refer to Connecting the Power Supply in Chapter 2 for more information.
	You are sending a command to a module or board whose address does not exist.	Check the syntax of the command and the configuration of the module or board. Refer to Chapters 3 and 4 for more information.
	You are using an incorrect baud rate.	Verify that the baud rate is the same for the module or board and the host computer.

Table D-1. Troubleshooting a 6B Series System (cont.)

Symptom	Possible Cause	Possible Solution
Module or board is not operating properly.	The module or board is damaged or malfunctioning.	Contact your local Analog Devices sales office.
	Vibration or loose connections.	Cushion the source of vibration and tighten connections.
	Incorrect wiring.	Check wiring. Refer to Chapter 2 for more information.
	Missing or broken wires or cables.	Replace cables and wires.
	Overheating.	Control temperature; the ambient temperature should be less than 60°C.
	Electrical noise.	Control electromagnetic interference through better cable shielding and planned ground connections.
	High line resistance.	Use larger cable size (within 22-14 AWG range).
Erroneous data.	Application is not attached correctly.	Rewire application. Refer to Application Wiring in Chapter 2 for more information.
	A module is out of calibration.	Perform the calibration procedure. Refer to Appendix C for more information. (Note that the 20 mA input range of a 6B11 analog input module uses an AC1381 shunt resistor module to convert the 20 mA input signal to a ±1 V input signal. Since each shunt resistor module has a tolerance of ±0.1%, you could experience a span error of up to that amount, even though the ±1 V range is precisely calibrated. If the ±0.1% of span error is too large for your application, calibrate the module and resistor as a mated pair.)

Table D-1. Troubleshooting a 6B Series System (cont.)

Symptom	Possible Cause	Possible Solution
Yellow LED and green LED on 6B Series backplane or 6B50 board is continually on.	The 6B50 board or one or more of the modules on the 6B Series backplane may be faulty.	Remove the 6B50 board and the modules one at a time to locate the faulty one. Begin testing on the last backplane or board with both LEDs on.
Green LED goes off.	You may have blown fuse F1.	Replace with Littelfuse 251.500, $^1/_2$ A (for single-channel 6B Series backplanes), Littelfuse 251.005, 5 A (for multiple-channel 6B Series backplanes), or Littelfuse 251.01.5, 1 $^1/_2$ A (for 6B50 digital I/O boards).
6B21 analog output module responds to all commands, but readback indicates that no current is flowing.	The current loop is open.	Check wiring.
When using the *Search* option on the 6B Series Utility/ Demo software, the software doesn't recognize any of the modules or boards.	On some multispeed host computers, you cannot access the 6B utility from a diskette.	Copy the 6B utility into an appropriate directory on your hard disk and access the 6B utility from there.
A TIMEOUT error occurs when using the 6B Series Utility/ Demo software.	Memory-resident programs may be interfering with communication to the 6B Series modules and boards.	Remove the memory-resident programs and try again.
	Communication interfaces, such as modems, may not be working properly with the 6B Series modules and boards because the 6B Series Utility/Demo software's timeout period is not long enough.	Use the 6B Series Utility/Demo software without the communication interfaces, or try other software.

Troubleshooting Communications

If your host computer is having difficulty communicating with a 6B Series module or 6B50 board, you can perform the following procedure with one module or board, and then continue with additional modules and boards you may have:

Note: This procedure uses DEBUG, which is normally included with the DOS operating system. It is assumed that DEBUG is located in the DOS directory and that an appropriate path is provided. For more information on DEBUG, refer to your DOS documentation.

---

1. From the DOS prompt, enter the following:

   ```
   DEBUG <Enter>
   ```

   The system displays a hyphen (-), which is the DEBUG prompt.

2. At the DEBUG prompt, enter the following:

   ```
   D 40:0 L 4 <Enter>
   ```

   The system displays one of the following messages:

`0040:0000 F8 03 00 00`	Indicates that you have one serial communication port set up as COM1. If this is correct, go to step 3. If this is incorrect, check the configuration of your communication ports; refer to Attaching the Host Computer in Chapter 2.

`0040:0000 F8 03 F8 02`	Indicates that you have two serial communication ports set up as COM1 and COM2. If this is correct, go to step 3. If this is incorrect, check the configuration of your communication ports; refer to Attaching the Host Computer in Chapter 2.
`0040:0000 F8 02 00 00`	Indicates that you have one serial communication port set up as COM2. If you are using only one serial communication port, it must be set up as COM1. Check the configuration of your communication ports, and reconfigure, if necessary; refer to Attaching the Host Computer in Chapter 2.

Note: If you are using serial communication ports other than COM1 and COM2, the messages displayed may be different. Before continuing, verify that you are using your serial communication ports correctly.

3. Disconnect the RS-232C cable from the 6B Series backplane or board, and short pins 2 and 3 on the male connector together.
4. Enter the following to return to the DOS prompt:

```
Q <Enter>
```

5. At the DOS prompt, enter the following BASIC program:

```
10 OPEN "COM1:9600,N,8,1,cd,ds,cs,rs" FOR RANDOM AS 1
20 INPUT "Input address of module (hex AA) ";b$
30 IF b$ = "-1" THEN GOTO 100
40 A$ = "#" + b$
50 PRINT A$
60 PRINT #1, A$
70 INPUT #1, C$
80 PRINT C$
90 GOTO 20
100 END
```

Note: This program assumes you are using COM1. If you are using COM2, change *COM1* in line 10 to *COM2*.

6. Run the BASIC program.

   The system displays the following prompt:

   ```
   Input address of module (hex AA)
   ```

7. Enter any character at the prompt.

   The character you entered should be displayed on the screen. If not, press <Control/Break> to exit the program, and check the cable and serial communication port for any problems.

8. Disconnect the short between pins 2 and 3 on the male connector, and reconnect the RS-232C cable to the 6B Series backplane or board.

9. If you are testing a 6B Series module, install the module in the leftmost position on a backplane and install the configuration jumper (W1).

   If you are testing a 6B50 board, install the configuration jumper (W1) in position AB.

10. Run the BASIC program again, entering *00* at the prompt (*00* indicates module address 00H).

    The response from the module or board should be displayed on the screen. If the module or board does not respond, a wire may be crossed within the RS-232C cable, the module or board may be powered incorrectly, or the module or board may be defective.

E Summary of Commands

Table E-1 contains a list of all commands in the 6B Series command set arranged by syntax. Table E-2 contains a list of all commands in the 6B Series command set arranged by module/board. Refer to Chapters 3 and 4 for a detailed description of these commands.

Table E-1. Summary of Commands (by Syntax)

Command Syntax	Command Name	Modules/Boards Used
#**	Synchronized Sampling	6B11 analog input module 6B12 analog input module 6B50 digital I/O board
#AA	Analog Data In	Analog input modules
#AA(data)	Analog Data Out	Analog output modules
#AABB(data)	Digital Data Out	6B50 digital I/O board
$AA0	Span Calibration 4 mA Calibration	Analog input modules Analog output modules
$AA1	Offset Calibration 20 mA Calibration	Analog input modules Analog output modules
$AA2	Configuration Status	Analog input modules Analog output modules 6B50 digital I/O board
$AA3	CJC Status	Analog input modules
$AA3(# of counts)	Trim Calibration	Analog output modules

Table E-1. Summary of Commands (by Syntax) (cont.)

Command Syntax	Command Name	Modules/Boards Used
$AA4	Read Synchronized Data	6B11 analog input module 6B12 analog input module 6B50 digital I/O board
	Start-up Output Current Configuration	Analog output modules
$AA5	Reset Status	Analog output modules 6B50 digital I/O board
$AA6	Last Value Readback	Analog output modules
	Digital Data In	6B50 digital I/O board
$AA8	Current Readback	Analog output modules
%AANNTTCCFF	Configuration	Analog input modules Analog output modules 6B50 digital I/O board

Table E-2. Summary of Commands (by Module/Board)

Module/Board	Command Syntax	Command Name	Description
Analog Input Modules	#AA	Analog Data In	Returns the input value from a specified analog input module in the currently configured data format.
	%AANNTTCCFF	Configuration	Allows you to set the address, input range, baud rate, data format, checksum status, and/ or integration time for an analog input module.
	$AA0	Span Calibration	Allows you to calibrate an analog input module to correct for gain errors.
	$AA1	Offset Calibration	Allows you to calibrate a 6B13 analog input module to correct for offset errors.
	#**	Synchronized Sampling	Instructs all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards to sample their input values immediately and simultaneously and then store these values in a special register.
	$AA4	Read Synchronized Data	Returns the value stored by a specified module during the Synchronized Sampling command.
	$AA2	Configuration Status	Allows you to read the configuration of a specified analog input module.
	$AA3	CJC Status	Allows you to read the value of the CJC sensor for a specified 6B11 analog input module.

Table E-2. Summary of Commands (by Module/Board) (cont.)

Module/Board	Command Syntax	Command Name	Description
Analog Output Modules	#AA(data)	Analog Data Out	Specifies an output value to be used by a specified analog output module.
	%AANNTTCCFF	Configuration	Allows you to set the address, output range, baud rate, data format, slew rate, and/or checksum status for an analog output module.
	$AA4	Start-up Output Current Configuration	Allows you to store the output value of a specified analog output module; the value is used as the start-up current whenever the module is powered up.
	$AA3	Trim Calibration	Used with the 4 mA Calibration command and 20 mA Calibration command to calibrate a specified analog output module.
	$AA0	4 mA Calibration	Used with the Trim Calibration command and 20 mA Calibration command to calibrate a specified analog output module.
	$AA1	20 mA Calibration	Used with the Trim Calibration command and 4 mA Calibration command to calibrate a specified analog output module.
	$AA2	Configuration Status	Allows you to read the configuration of a specified analog output module.
	$AA6	Last Value Readback	Returns either the last value sent to a specified analog output module by the Analog Data Out command or the start-up output current.

Table E-2. Summary of Commands (by Module/Board) (cont.)

Module/Board	Command Syntax	Command Name	Description
Analog Output Modules (cont.)	$AA8	Current Readback	Returns the measured value of the current flowing through the current loop.
	$AA5	Reset Status	Indicates whether a specified analog output module was reset after you last executed this command.
Digital I/O	$AA6	Digital Data In	Returns the input value from ports A, B, and C on a specified 6B50 digital I/O board.
	#AABB(data)	Digital Data Out	Writes a specified output value to a port, or a channel within a port, on a specified 6B50 digital I/O board.
	AANNTTCCFF	Configuration	Allows you to set the address, baud rate, and/or checksum status for a 6B50 digital I/O board.
	#**	Synchronized Sampling	Instructs all 6B11 analog input modules, 6B12 analog input modules, and 6B50 digital I/O boards to sample their input values immediately and simultaneously and then store these values in a special register.
	$AA4	Read Synchronized Data	Returns the value stored by a specified 6B50 digital I/O board during the Synchronized Sampling command.
	$AA2	Configuration Status	Allows you to read the configuration of a specified 6B50 digital I/O board.
	$AA5	Reset Status	Indicates whether a specified 6B50 digital I/O board was reset after you last executed this command.

F Sample Programs

This appendix contains sample programs that you can refer to when developing programs for communication to any 6B Series product.

Additional 6B sample programs (i.e., Visual Basic Program, using Custom Controls) are available from the Bulletin Board System (BBS). They may be obtained by dialing 617-461-4361 (8 Data Bits; 1 Stop Bit; No Parity; 1200/2400/4800/9600/14.2 K Baud.)

Reading Input Data

The program in this section is written in BASIC and uses a command/response routine to monitor 20 6B11, 6B12, and 6B13 modules and report the present input value of each.

You can change any of the 6B command parameters in the program to accommodate other commands or 6B devices, as described in Chapters 3 and 4. In addition, you can change the file numbers, communication ports, and baud rate. However, for successful communication to occur, do not change the parameters in the "OPEN COM" statement (n,8,1,cs,ds,rs,cd).

Use only uppercase characters when sending commands containing characters. Uppercase and lowercase characters differ in their ASCII equivalent codes, and 6B modules and boards respond only to the proper arrangement of ASCII codes, as described in Chapter 4.

```
 20 CLS:KEY OFF:KEY (10) ON:ON KEY (10) GOSUB 250: ON ERROR GOTO 280
 30 LOCATE 25,1:PRINT "Press F10 to QUIT";:
 35 'Set up the com port as COM1: and baud rate as 9600
 40 PORT$="com1:":BAUD$="9600"
 50 '
 60 LOCATE 1,10:PRINT "Module      HEX       Module"
 70 LOCATE 2,10:PRINT "Number      Address   Reply"
 80 '
 85 'Open file #1 as the com port and set communication parameters
 90 OPEN PORT$+BAUD$+",n,8,1,cs,rs,cd,ds" FOR RANDOM AS #1
100 FOR MODNUM=0 TO 19
105 'Convert the module address to a HEX value and assure the address
    has 2 characters
110 MODNUM$=HEX$(MODNUM):IF LEN(MODNUM$)<2 THEN MODNUM$="0"+MODNUM$
115 'Assemble a DATA command for the current module address
120 CMD$="#"+MODNUM$
125 'Output the command to 6B via the com port as a string value
130 PRINT #1,CMD$
140 '
150 TIMOUT=TIMOUT+1
155 'If no data appears in the com port buffer and the timeout counter
    is less than 100, go back and wait again; if data has appeared or
    if the timeout counter limit is met, then proceed
160 IF EOF(1) AND TIMOUT<100 THEN GOTO 150 ELSE TIMOUT=0
165 'If no data has been returned then set reply to a "blank" string;
    otherwise go and get the data value from the comport buffer
170 IF EOF(1) THEN REPLY$=" -                    " ELSE INPUT #1,REPLY$
180 '
190 LOCATE (MODNUM+4),10:PRINT USING "####";MODNUM;:
200 PRINT SPC(8) MODNUM$;:
205 'Print the reply
210 PRINT SPC(14); REPLY$
220 NEXT MODNUM
230 '
240 GOTO 100
250 CLOSE #1
260 LOCATE 25,1:PRINT SPC(40);
270 END
275 'Simple error handling routine; if error occurs, restart program
280 RUN
```

Using a Modem

The program in this section is written in Microsoft QuickBASIC® version 4.5 and demonstrates the acquisition of data from four 6B11 modules that accept input from J type thermocouples.

```
    CLS
    DIM A$(4)
    A$(0) = "#01": A$(1) = "#02": A$(2) = "#03": A$(3) = "#04"
    OPEN "COM1: 2400,n,8" FOR RANDOM AS #1
    LOCATE 5, 35: COLOR 14: PRINT "DIALING"
    PRINT #1, "ATDT9,123-4567" :REM USE APPROPRIATE TELEPHONE NUMBER
    INPUT #1, B$: INPUT #1, B$
    CLS : COLOR 15
    LOCATE 10, 20
    PRINT B$: COLOR 2
    FOR I = 1 TO 20000: NEXT I
    CLS : COLOR 14
    LOCATE 2, 32: PRINT "6B SUBSYSTEM"
    LOCATE 12, 16: PRINT "CH1": LOCATE 12, 31: PRINT "CH2"
    LOCATE 12, 45: PRINT "CH3": LOCATE 12, 59: PRINT "CH4"
    COLOR 11
START:
    LOCATE 13, 14
    FOR X = 0 TO 3
    Z$ = INKEY$
    PRINT #1, A$(X)
    INPUT #1, C$
    C$ = MID$(C$, 2, 7)
    PRINT C$; ,
    IF (Z$ = "S" or Z$ = "s") GOTO ABORT
    NEXT
    GOTO START
ABORT:
    FOR W = 1 TO 20000: NEXT W
    PRINT #1, "+++"; : FOR W = 1 TO 20000: NEXT W
    PRINT #1, "ATH"
    CLS : COLOR 7: END
```

G Source for Common Parts and Accessories

This appendix provides information on where to find some of the most common parts and accessory items associated with a 6B Series system. Table G-1 lists the parts and the manufacturers' part numbers. Analog Devices, Inc. makes no claims about the availability and quality of parts purchased through the vendors listed below. This information is listed for your convenience only.

Table G-1. Common Parts and Accessories for the 6B Series System

Part Description	Part Number	Company
Cables		
RS-232C cables (6B backplane/board to host computer)	AC1382 AC1385	Analog Devices, Inc. (800) 426-2564
6B backplane/board to STB-50A Screw Termination Board	CAB-02	
6B backplane/board to DB-16 or DB-24 Digital I/O Backplane	CAB-03	
CJC sensor	AC1361	Analog Devices, Inc. (800) 426-2564
Fuses		
1/2 A pico-fuse	251.500	Littelfuse, Inc. 800 E. Northwest Highway
5 A pico-fuse	251.005	Des Plaines, IL 60016 (708) 824-1188
1 1/2 A pico-fuse	251.01.5	

Table G-1. Common Parts and Accessories for the 6B Series System (cont.)

Part Description	Part Number	Company
Jumper clips Package of 10 jumper clips (0.1 inch)	AC1344	Analog Devices Inc. (800) 426-2564
Jumper clip (0.1 inch)	531-220-2	Amp Incorporated (800) 522-6752)
Power line cord	AC1340-D	Analog Devices, Inc. (800) 426-2564
Power Supplies 1 A power supply 5 A power supply 5 A power supply	 Model 955 Model PWR-01 Model 977	 Analog Devices, Inc. (800) 426-2564
Rack-mount kit	AC1380	Analog Devices, Inc. (800) 426-2564
Rail mounting assemblies Base element with snap foot	UM-BEFE #29 55 56 4	Phoenix Terminal Blocks, Inc. P.O. Box 4100 Harrisburg, PA 17111-0100 (717) 944-1300
Side element	UM-SE #29 55 59 3	
Base element	UM-BE #29 55 57 7	
Connections pins	UM-VS #29 55 58 0	
Resistors 50 Ω current conversion resistor	AC1381	Analog Devices, Inc. (800) 426-2564
RS-485 communication cards (Optically-isolated)	PLCP0054	Control and Data Technologies 327 South Walnut Street Beaver, PA 15009 (412) 775-3456
RS-485 communication cards for ISA for PCMCIA	 AT-485 PCMCIA-485	National Instruments 6504 Bridge Point Parkway Austin, TX 78730-5039 (512) 794-0100

Table G-1. Common Parts and Accessories for the 6B Series System (cont.)

Part Description	Part Number	Company
Software packages	LabVIEW LabWindows LabWindows/CVI BridgeVIEW	National Instruments 6504 Bridge Point Parkway Austin, TX78730-5039 (512) 794-0100
	Genesis Control Series Winworks	Iconic, Inc. 100 Foxborough Boulevard Foxborough, MA 02035 (508) 543-8600
	Paragon TNT	Intec Controls Corp. 55 West Street Walpole, MA 02081 (508) 660-1221
	FIX-DMACS FIX-MMI	Intellution One Edgewater Drive Norwood, MA 02062 (617) 769-8878
	Notebook NotebookPro Control ControlPro	Labtech 400 Research Drive Wilmington, MA 01887 (508) 657-5400
	AIMAX-PLUS AIMAX-WIN	TA Engineering Co., Inc. 1150 Moraga Way Moraga, CA 94556 (510) 376-850009
	FlexPro	Geitmann GmbH Froendenberger Strasse 115 58706 Menden GERMANY (49 2) 373 5093
	DDE-AD6B (Dynamic Data Exchange)	KEPware, Inc. 25 Bridge Street Yarmouth, ME 04096 (207) 846-5881

H Technical Diagrams

This appendix contains diagrams of the layouts and mechanical dimensions of 6B Series modules, backplanes, boards, and accessories. Note that the dimensions are given in inches first, followed by millimeters in parentheses.

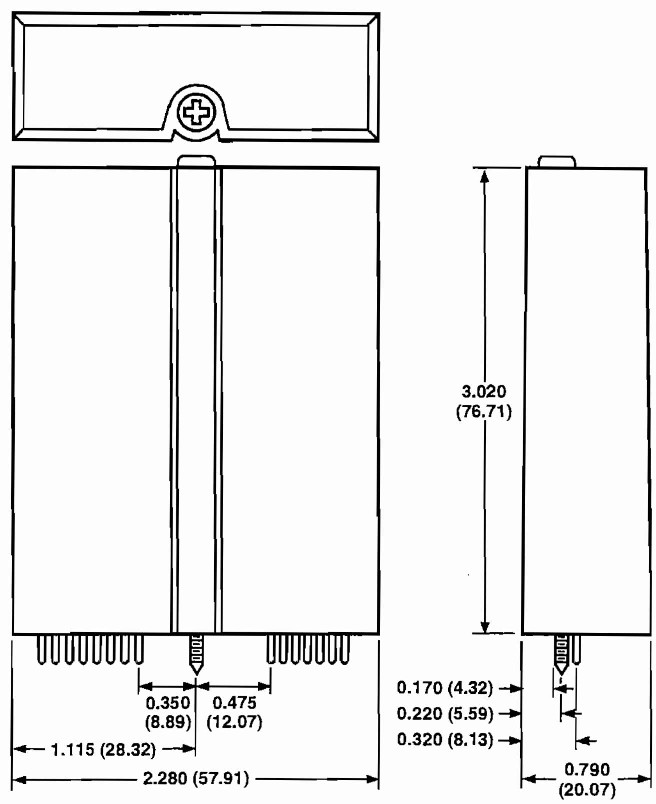


Figure H-1. Mechanical Dimensions of the 6B Series Module

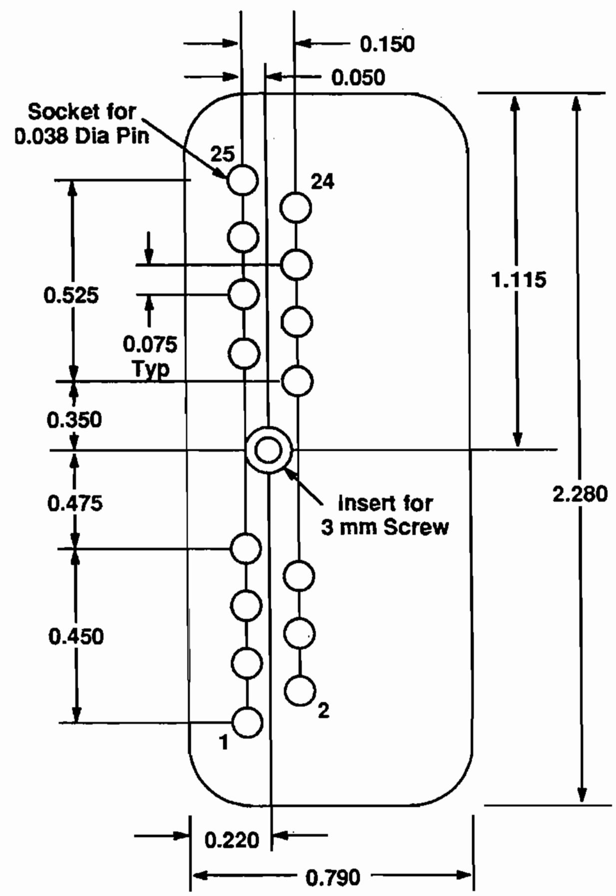


Figure H-2. Mechanical Dimensions of the 6B Series Module, showing location of socket pins and hold down screw

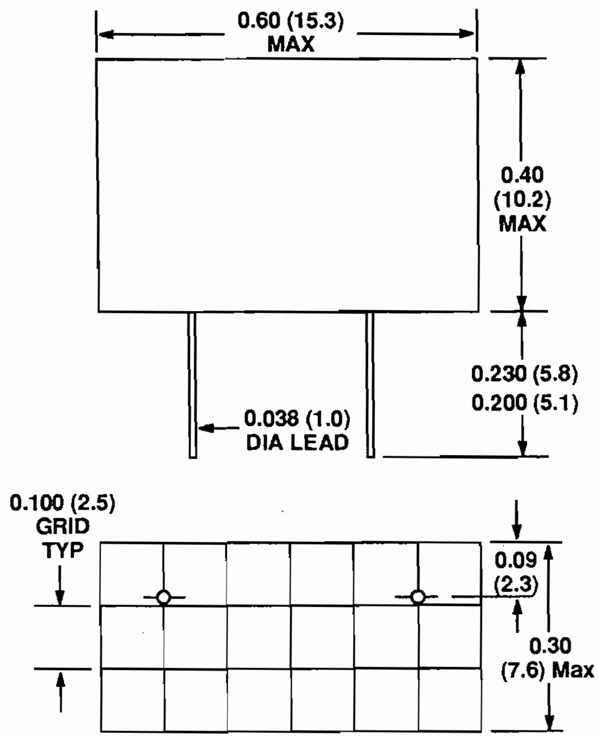


Figure H-3. Mechanical Dimensions of the 50 Ω Current Conversion Resistor, Model AC1381

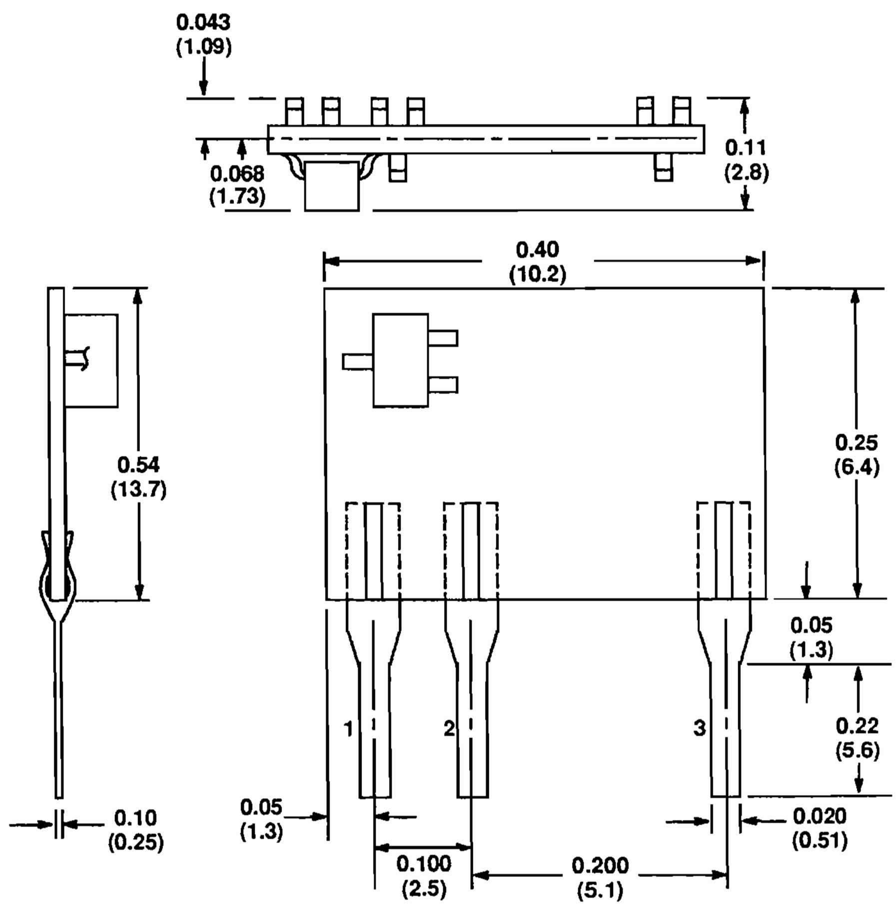
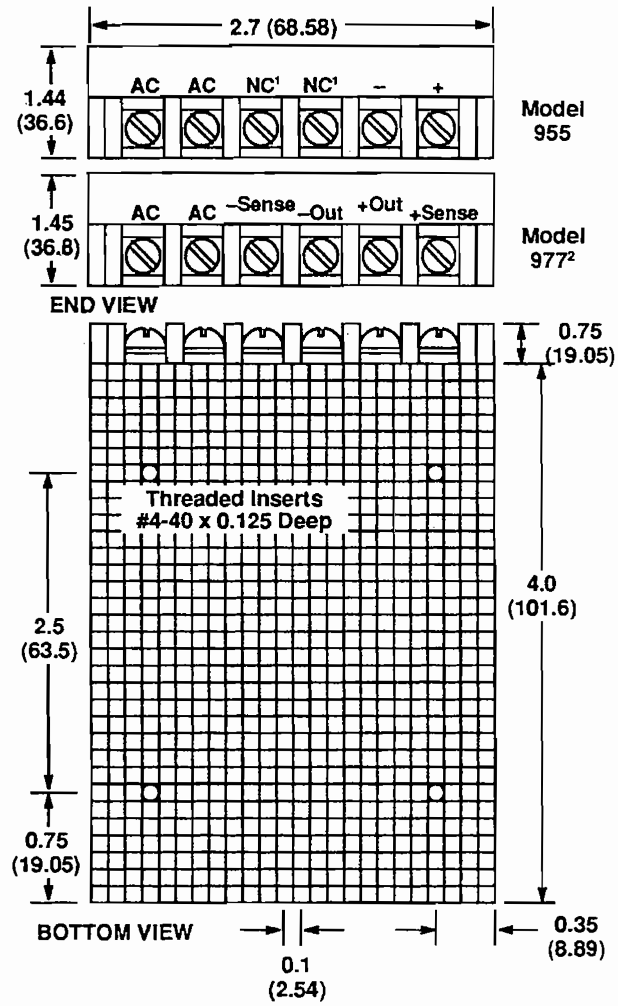


Figure H-4. Mechanical Dimensions of the CJC Sensor, Model AC1361

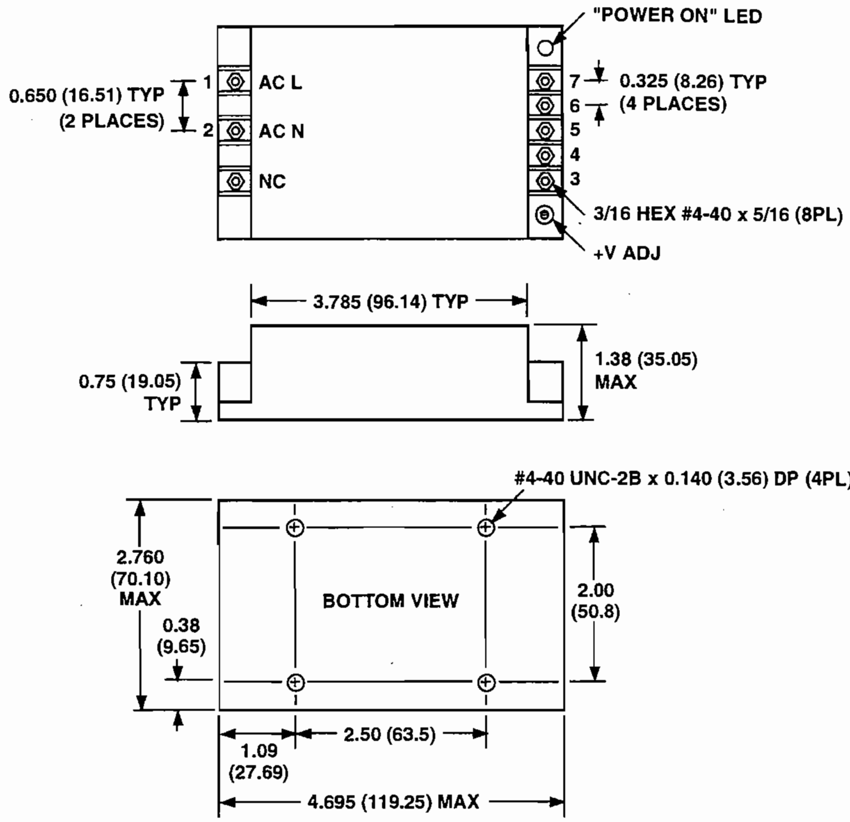


Notes

[1]NC indicates that the screw terminal is not internally connected to the power supply.

[2]Model 977 is shipped with shorting bars between +out/+sense terminals and –out/–sense terminals. These must be in place for normal operation.

Figure H-5. Mechanical Dimensions of Models 955 and 977 Power Supplies



PIN	PIN-OUT
1	AC LINE
2	AC NEUTRAL
3	–SENSE
4	+5V RETURN
5	+5V OUT
6	+SENSE
7	NC

NOTE:
1. DIMENSIONS ARE SHOWN IN INCHES AND (mm)
2. MODEL PWR-01 IS SHIPPED WITH SHORTING BARS ACROSS –SENSE/+5V RETURN TERMINALS AND +SENSE/+5V OUT TERMINALS.

Figure H-6. Mechanical Dimensions of Model PWR-01 Power Supply

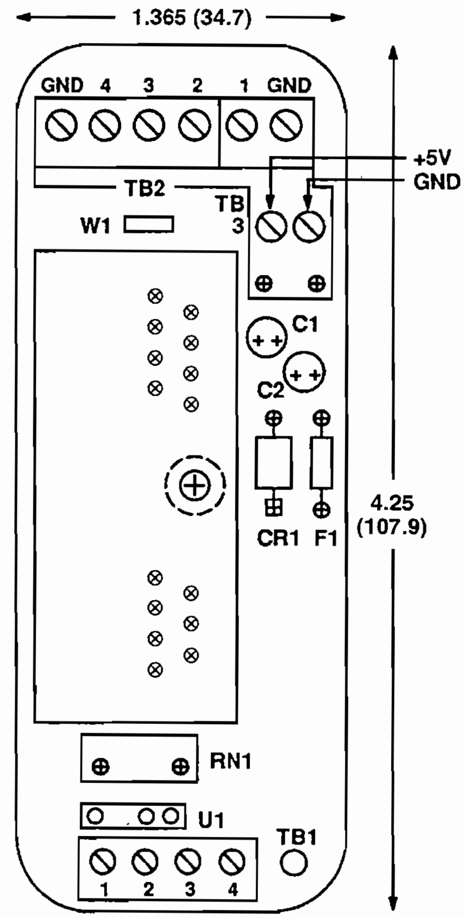


Figure H-7. 6BP01-1 Backplane Layout

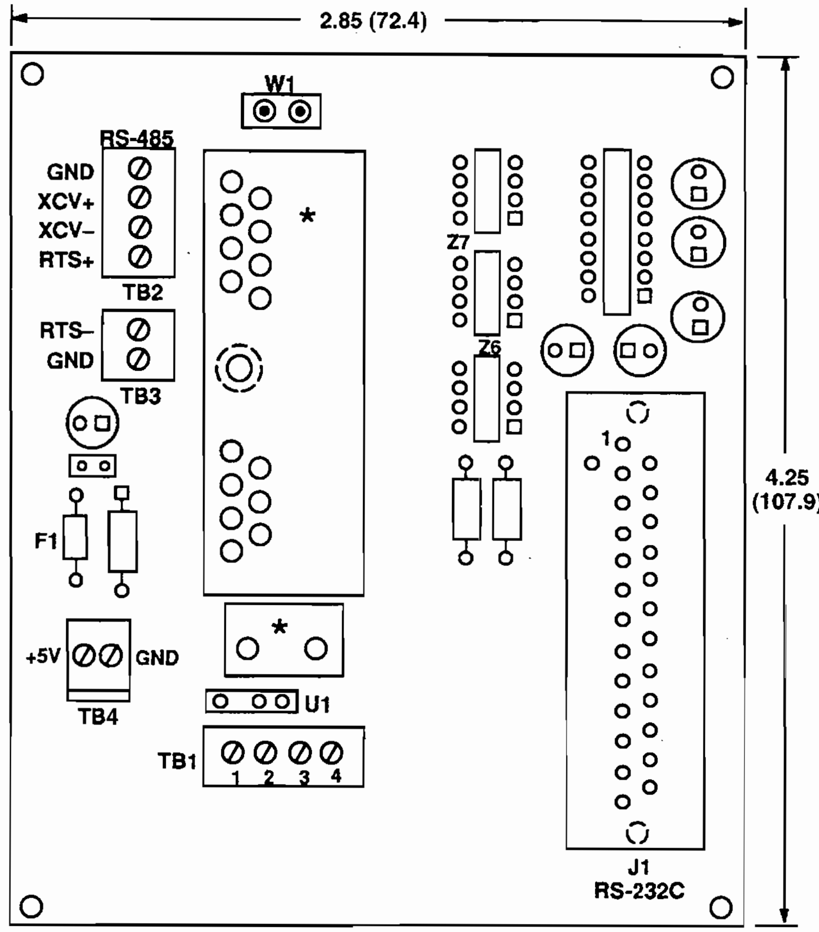


Figure H-8. 6BP01-2 Backplane Layout

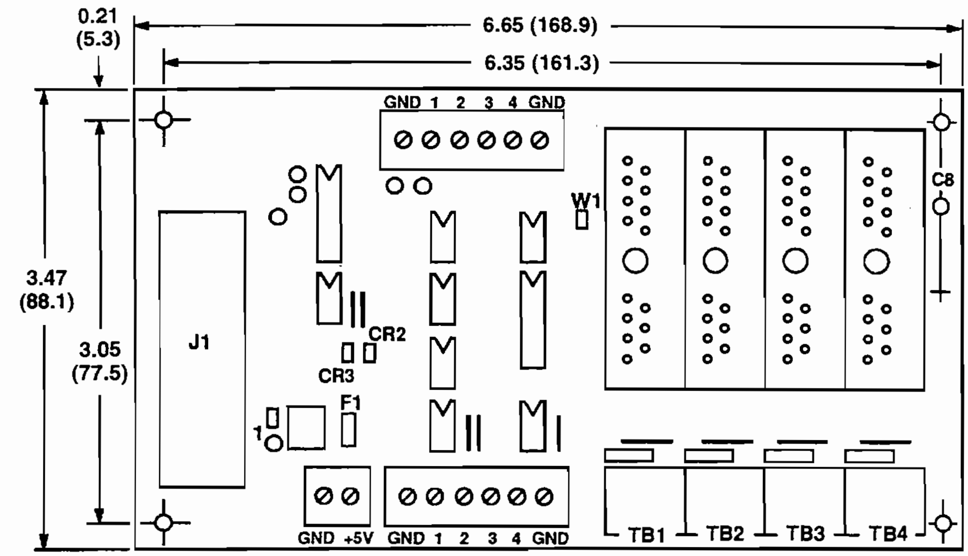


Figure H-9. 6BP04-1, 6B04HV-1, 6BP04-2 and 6BP04HV-2 Backplane Layout

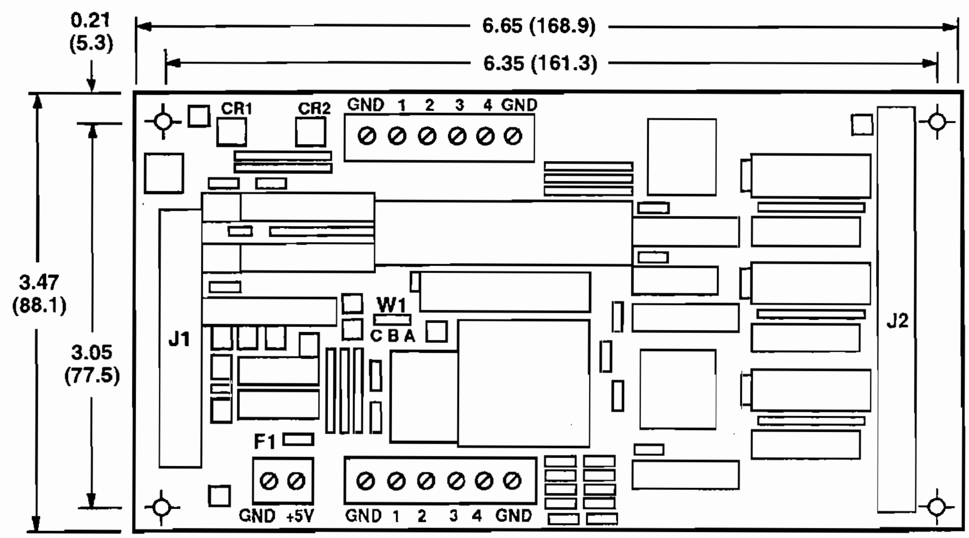


Figure H-10. 6B50-1 and 6B50-2 Board Layout

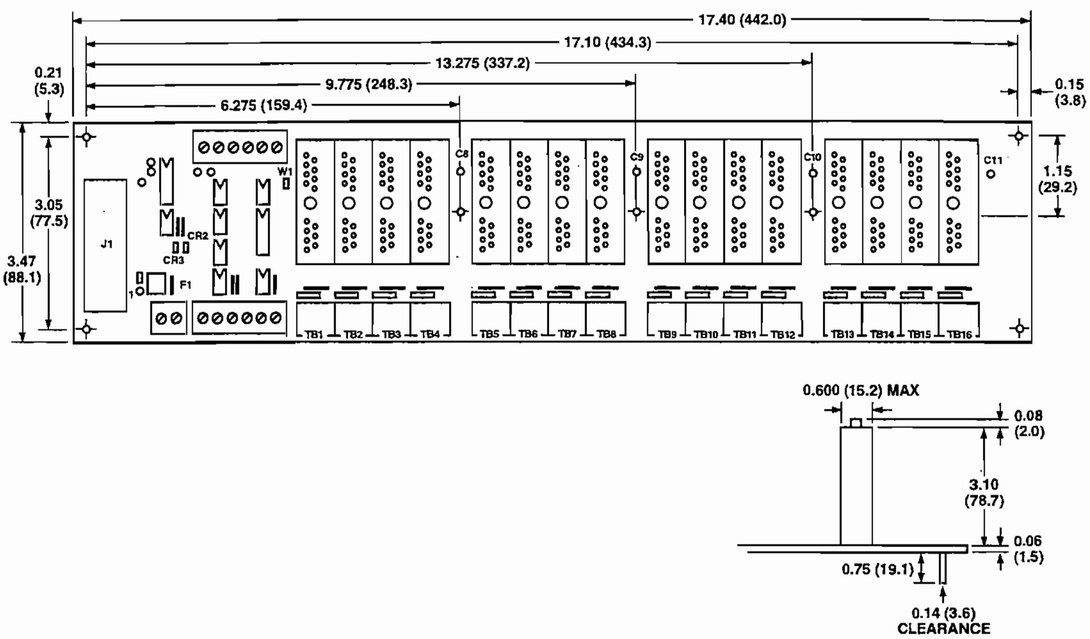


Figure H-11. 6BP16-1 and 6BP16-2 Backplane Layout

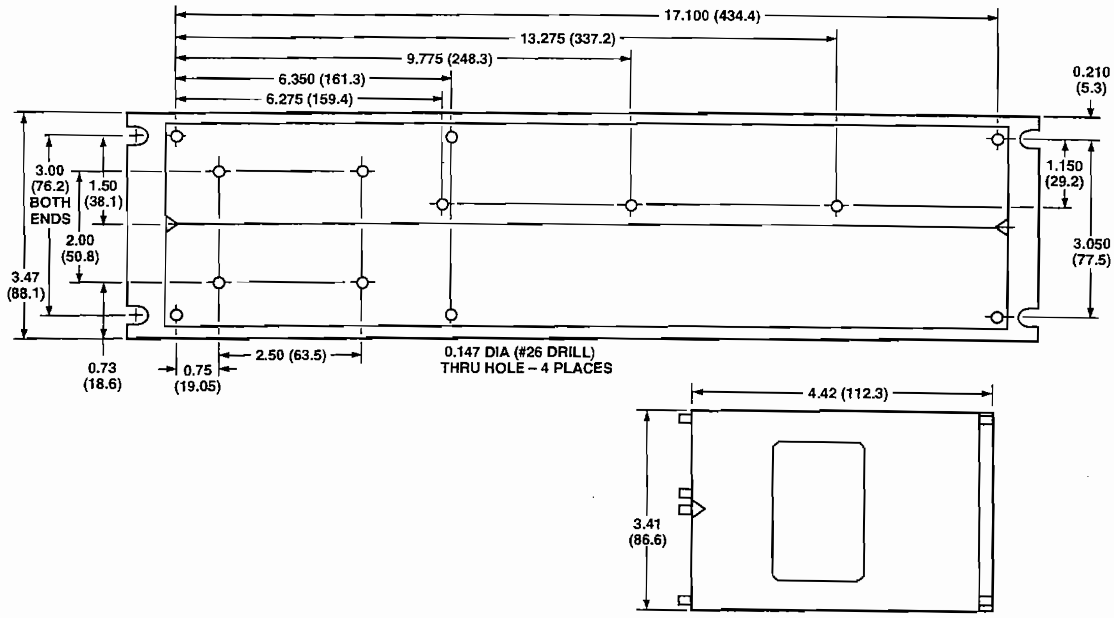


Figure H-12. AC1380 Rack Mount Dimensions

I

Channel Scanning Rates

The overall speed of communications between the host computer and a 6B Series system, will depend upon three selectable settings; (1) Baud Rate, (2) Checksum, (3) Output Data Format. In general, the fastest communication – 179 channels per second – will be achieved if checksum is disabled, baud rate is set at 19.2 K baud and twos complement format is selected. To determine the specific communication rate for other settings, refer to Tables I-1 through I-4.

Checksum Disabled

Table I-1 lists the time for one command/response (in ms) as a function of Baud Rate and Data Format/Command. Table I-2 lists the overall channel scanning rate (in channels per second), also as a function of the Baud Rate and Data Format/Command.

Checksum Enabled

Table I-3 lists the time for one command/response (in ms) as a function of Baud Rate and Data Format/Command. Table I-4 lists the overall channel scanning rate (in channels per second), also as a function of the Baud Rate and Data Format/Command.

Channel Scanning Rates

			Time for One Command/Response (ms)						
			Baud Rate						
Command	Output Format	Total Characters	300	600	1200	2400	4800	9600	19200
Data	Eng. Units	13	374	188	94	48	24	13	7
Data	Twos Comp.	10	294	148	74	38	19	10	6
Data	% of FS	13	374	188	94	48	24	13	7
Configuration	n/a	16	627	413	307	253	227	213	207
Calibration	n/a	9	440	320	260	230	215	208	204
Status	n/a	15	428	214	108	54	28	14	8
CJC Data	Eng. Units	14	573	387	293	247	223	212	206

Table I-1. Time for One Command/Response, with Checksum Disabled.

			Scan Rate – Channels per Second						
			Baud Rate						
Command	Output Format	Total Characters	300	600	1200	2400	4800	9600	19200
Data	Eng. Units	13	3	5	11	21	41	79	146
Data	Twos Comp.	10	3	7	13	27	52	98	179
Data	% of FS	13	3	5	11	21	41	79	146
Configuration	n/a	16	2	2	3	4	4	5	5
Calibration	n/a	9	2	3	4	4	5	5	5
Status	n/a	15	2	5	9	18	36	70	130
CJC Data	Eng. Units	14	2	3	3	4	4	5	5

Table I-2. Channel Scanning Rate, with Checksum Disabled.

Command	Output Format	Total Characters	Time for One Command/Response (ms) Baud Rate 300	600	1200	2400	4800	9600	19200
Data	Eng. Units	17	481	241	121	61	31	16	9
Data	Twos Comp.	14	401	201	101	51	26	14	7
Data	% of FS	17	481	241	121	61	31	16	9
Configuration	n/a	20	733	467	333	267	233	217	208
Calibration	n/a	13	547	373	287	243	222	211	205
Status	n/a	19	534	268	134	68	34	18	9
CJC Data	Eng. Units	18	680	440	320	260	230	215	208

Table I-3. Time for One Command/Response, with Checksum Enabled.

Command	Output Format	Total Characters	Scan Rate – Channels per Second Baud Rate 300	600	1200	2400	4800	9600	19200
Data	Eng. Units	17	2	4	8	16	32	62	118
Data	Twos Comp.	14	2	5	10	20	38	74	138
Data	% of FS	17	2	4	8	16	32	62	118
Configuration	n/a	20	1	2	3	4	4	5	5
Calibration	n/a	13	2	3	3	4	5	5	5
Status	n/a	19	2	4	7	15	29	57	107
CJC Data	Eng. Units	18	1	2	3	4	4	5	5

Table I-4. Channel Scanning Rates, with Checksum Enabled.

J RS-232/RS-485 Primer

RS-232-C Interface

RS-232-C is an EIA standard for low speed serial data commu nications. It is intended for relatively short distances (50 feet or less) and relatively low speed (19,200 bits per second or less). It is designed to interface a single communicating device to a host computer, and does not support multi-party connections

6B Implementation of RS-232-C

The 6B Series implementation is a simple three wire interface and will work with most computers with a serial port. The interface with the backplane utillizes only Pin 2 (Transmit) and Pin 3 (Receive), which must be connected one-to-one (not crossed) with the host interface. The only other connection required is ground, and Pin 7 is recommended for this purpose.

RS-485 Interface

RS-485 is an EIA standard developed in 1983 for multidropped systems, and is an upgraded version of RS-422-A. It is designed for a data transmission over long distances in noisy enviornments using a twisted pair cable.

RS-485 is similar to the RS-422 standard in that it utilizes a balanced, differential pair for data transmission. It differs from RS-422 by sharing one differential pair of wires for both transmitting and receiving. Since a RS-485 system cannot transmit and receive at the same time it is inherently half-duplex. RS-485 receivers have a common mode input range of – 7 V to 12 V, which give them good noise rejection.

6B Implementation of RS-485

The RS-485 standard implemented with the 6B Series utilizes two twisted pair: one for differential data and the other for differential handshake (Request to Send).

Although the use of the RTS signal means that the RS-485 has two wire pairs instead of one, it solves two problems. First, it functions as a transceiver control line when connecting multidropped RS-485 units to RS-232, a standard that does not support multidrop operation. It also controls the direction of bckplane repeaters which extend the signal distance beyond the 4000 ft. limit to another 4000 ft.; and allows more than 32 nodes to be mulltidropped (which is an RS-485 limitation). The alternative method of internal timing is dependent on baud rate and affected by delays.

6B Repeater Operation

All transactions on the network are initiated by the host (master), and respond to by the 6B module (slave) that is addressed. When the 6B modules are not transmitting, bias resistors enable the repeater transceivers (on the backplanes) away from the master, allowing the master to transmit to all slaves. When a 6B module recognizes its address in the command message, it asserts the RTS lines, which reverses the direction of all repeaters between it and the host. It can then go ahead and transmit the response which flows back to the host.

After the module has completed transmission of its reply it relinquishes the RTS lines and a new transaction can then be initiated by the host.

K

Using 6B Series Modules to meet European Union Requirements

EMC Compatibility

The 6B Series Signal Conditioning Subsystem has been tested and has passed the stringent "heavy industrial" requirements of the European Union's electromagnetic compatibility (EMC) directive.

In order to comply with the European Standards in a typical heavy industrial application we recommend the following setup:

1. The modules must be mounted on a standard 6B Series backplane.
2. The 6B backplane must be mounted inside a standard metal cabinet that fully encloses the modules on all sides. The cabinet must be earth grounded at a convenient point and good electrical contact between all side panels must be assured.
3. All wiring must be routed through a metal conduit or wire chase (flexible or rigid).
4. The conduit must be earth grounded and electrically connected to the cabinet.
5. Due to the low input levels, it is recommended that all input, output and power lines be shielded. The shields must be connected as described in Section 2 of this manual (Setup and Installation).

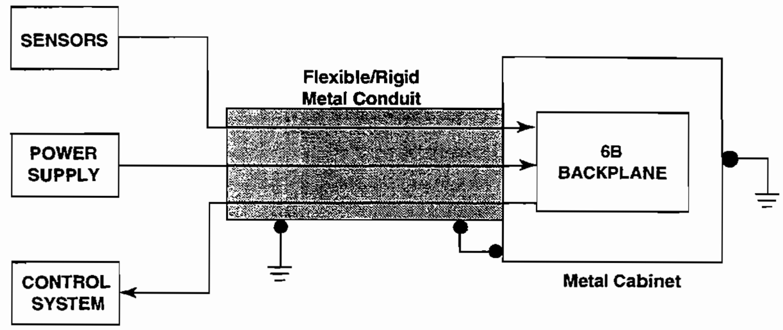


Figure K-1. General Wiring Configuration

CE Certification Tests

The 6B Series modules have been tested and certified according to the rigorous electromagnetic constraints of the EN50081-2 and EN50082-2 European Standards. A description of each test is given below, followed by Table K-1 listing the standards for each test. Table K-2 presents a summary of the actual test results.

Test Description

In conformance with EN50081-2 and EN50082-2 standards, the following tests were conducted to comply with the requirements for CE certification.

1. Radiated RF Immunity The units were subject to a RF field using a log-periodic antenna, maintained at 10 V/m by an amplifier placed outside the RF chamber. The field was swept from a frequency of 80 MHz to 1 GHz, with a 1 KHz modulation. The frequency increment size was 0.2% of the current frequency and the settling time at each frequency was 2 seconds. The field strength was supervised by a RF field monitor located next to the cabinet holding the units. The amplifier was adjusted accordingly to maintain the 10 V/m field strength. The antenna was placed exactly 1 m from the units. Readings were taken for both horizontal and vertical polarizations. The outputs of the units under test were acquired at every frequency through a crosspoint

matrix scanner and a precision digital voltmeter. By subtracting the baseline reading taken with no RF field, the change was obtained and then expressed and stored as a percentage of span change. This test simulated the effect of system operation in an environment that is exposed to strong (heavy industrial) radiated electromagnetic waves.

2. Conducted RF Immunity The units were subject to conducted EMI via a RF generated signal resistively injected into the conductive layer of a standard flexible wire chase housing the wires from the system backplane. The point of contact was approximately 20 cm from the units. The field was swept from a frequency of 150 KHz to 80 MHz, with a 1 KHz modulation. The frequency increment size was 1% of the current frequency and the settling time at each frequency was two seconds. Ferrite beads were placed outside the RF chamber on the wires to ensure that the disturbance was not reflected to the test measurement instrumentation. As in the radiated RF immunity tests, the outputs of the units were scanned in and the percentage of span change was stored.

3. Fast Transient Immunity All field wires external to the system console are subjected to and must withstand transients occurring within the normal environment of operation. The test configuration, routing field wires through a single wire chase, requires transient testing be applied to the wire chase; thus the conduit carrying the wires were placed in a metal enclosure for testing. Positive and negative polarities of 0.5 KV, 1 KV and 2 KV with 5 ns/50 ns rise/fall times were capacitively injected into the conduit. The outputs were scanned before and after the transients and the percent of span change was calculated and stored. (The test instrumentation and supporting test equipment were removed from the proximity of the wires during the application of the transients to avoid damage to the test equipment.)

4. Pulsed RF Immunity The units were subjected to radiated RF at 900 MHz, 10 V/m, 100% square wave modulated at 200 Hz inside the RF chamber using a log-periodic. About 180 readings were taken with a settling time of two seconds for each reading. Both vertical and horizontal polarizations were tested. Once again, the percentage of span change was calculated and stored.

5. Magnetic Field Immunity The units were placed within two coils carrying current to generate a magnetic field of 30 A/m @, 50 Hz. The field strength was measured using a loop antenna and an oscilloscope. The units were placed in three configurations, X, Y and Z. relative to the magnetic field. The outputs of the units were scanned and the percentage of change calculated. This tested the units' behavior under stray magnetic fields.

6. ESD – Contact The units were subjected to the contact method following the human model by an ESD gun four times, using positive and negative polarities at 4 KV. The ESD was applied to the units' cases, mounting screws and the DB25 connector backshell. After exposure, the units were retested to ensure proper functionality.

7. ESD – Air The units were subjected to the air discharge method following the human model by an ESD gun eight times, using positive and negative polarities at 2 KV, 4 KV, 6 KV and 8 KV. The ESD was applied to the units' cases, mounting screws and the DB25 connector backshell. After exposure, the units were retested to ensure proper functionality.

8. Voltage Surges Immunity Five positive and five negative 2 KV pulses with 1.2 µs/50 µs rise/fall times, each lasting 1 minute, were applied directly onto the shields at the input end of the field wiring. A capacitor was connected from shield to ground near the module end of the field wiring. When a particular shield was under test, it was ensured that its shield did not contact any other shields, forcing the surge to enter the unit. The units were retested after exposure to ensure proper functionality.

9. Emissions The units were tested for radiated and conducted emissions. The units were biased at maximum output and readings of field strength from 30 MHz to 1000 MHz in both vertical and horizontal polarization were taken. Readings from the AC main of the DC power supply from 50 KHz to 30 MHz were also taken.

Table K-1. List of Tests

No.	Test	Test Specification	Basic Standard	Test Setup	Criteria
1	Radiated RF Immunity	80-1000 MHz 10 V rms Modulated, 1 KHz, 80%	ENV 50140	ENV 50140	A
2	Conducted RF Immunity	0.15 to 80 MHz 10 V rms 80% AM (1KHz)	ENV 50141	ENV 50141	A
3	Fast Transient Immunity	1 KV, 2 KV	IEC 801-4	IEC 801-4	B
4	Pulsed RF Immunity	900 MHz 50% Duty Cycle, 200 Hz	ENV 50140	ENV 50140	A
5	Magnetic Field Immunity	50 Hz 30 A/m	EN 61000-4-8	EN 61000-4-8	A
6	ESD Immunity Contact	4 Contact	EN 61000-4-2	EN 61000-4-2	B
7	ESD Immunity Air	8 Air Discharge	EN 61000-4-2	EN 61000-4-2	B
8	Voltage Surge Immunity	2 KV, 5 positive, 5 negative			B
9	Emissions	Radiated & Conducted			

Table K-2. Summary of Tests

No.	Test	Method	Criteria	Average Error*
1	Radiated RF Immunity	Modulated, vertical Modulated, horizontal	A A	0.006% of span 0.015% of span
2	Conducted RF Immunity		A	0.002% of span
3	Fast Transient Immunity		B	Less than published specifications
4	Pulsed RF Immunity	Horizontal Vertical	A A	0.002% of span 0.002% of span
5	Magnetic Field Immunity	X, Y, and Z direction	A	0.003% of span
6	ESD Immunity Contact	Contact	B	Less than published specifications
7	ESD Immunity Air	Air	B	Less than published specifications
8	Voltage Surge Immunity		B	Less than published specifications
9	Emissions			Less than EN50082-2 limits

*Average result shows the average error among all tested modules.

L

Understanding Dynamic Data Exchange

Dynamic Data Exchange is a feature of Windows that allows two programs to share data commands with each other. DDE can be thought of as a direct link between two application programs. In most cases, one application is providing some form of data (either text or graphics) to another application. The application that is the source of the data is called the "server" and the application that is receiving the data is called the "client".

A 32-Bit DDE Server (KEPDDE) software product with support for the 6B-Series of signal conditioning products is available from:

KEPware, Inc.
25 Bridge Street
Yarmouth, Maine 04096 USA
TEL: (207) 846-5881
FAX: (207) 846-5947
http://www.kepware.com

32-Bit DDE Server

KEPware's DDE Server (KEPDDE) allows any Microsoft Windows application that supports DDE to exchange data with PLCs or other industrial devices such as the 6B Series. Tag names are assigned to data locations in each external device. A link is established by sending the tag address and device specific data from the DDE client to KEPDDE via the "Application|Topic!Item" syntax used in DDE client/server applications. From then on the link for that item will automatically be updated when the data changes.

KEPDDE Features

Supports multiple device networks through a single interface using installable device drivers.
Supports AdvancedDDE, FastDDE, XL_Table and CF_Text data formats.
Supports NetDDE.
Supports concurrent serial port and PC card configurations.
Supports up to eight serial port connections simultaneously.
Dynamic client to device tag assignment capability.
Programmable scan times for each item.
Data transmission to client applications only if it has changed since the last update.
Channel connections displayed graphically.
Real-time reporting of DDE conversation status.
Configuration wizards speed device and channel configuration.
On-line help provided.
Includes simulator driver and demo project to help get you started.
No hardware lock.

KEPware's 32-Bit Analog Devices 6B Series Driver

Driver System Requirements
IBM Compatible PC running Windows 95 or Windows NT.
KEPware Part #: DDE-AD6B32

Driver Features

The 6B Series driver works in conjunction with KEPware's (KEPDDE) to provide data exchange between DDE clients and Analog Devices 6B Series modules.

Data update to the server only if it has changed since the previous update.
Supports synchronous data acquisition.
Supports communications through eight serial ports simultaneously.
Includes wizards for easy device and communications configuration.
Includes online help.

Supported Features

6B11, 6B11HV, 6B12, 6B12HV, 6B13 and 6B13HV Analog Input Modules
6B21 Analog Output Modules
6B50 Digital I/O Modules

Driver System Requirements

IBM Compatible PC running Windows 95 or Windows NT and KEPDDE.

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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.

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