

### ANALOG I/O FEATURES

- Sensor-to-Computer Conditioning and Digitizing
- Inputs/Outputs: Thermocouples, RTDs, Millivolt, Volt, Process Current
- Communication Interface: RS-485  
Backplane Option of RS-232 or RS-485
- Field Configurable via Software
  - 6B11: J, K, T, E, R, S and B Thermocouple,  $\pm 15$  mV to  $\pm 5$  V, 4-20 mA, 0-20 mA
  - 6B12:  $\pm 150$  mV to  $\pm 50$  V, 4-20 mA, 0-20 mA
  - 6B13: 100  $\Omega$  Pt, 120  $\Omega$  Ni and 10  $\Omega$  Cu
  - 6B21: 0-20 mA or 4-20 mA Output
- Configurable Parameters Stored in Module's EEPROM
- Autocalibrating, High Performance Integrating Converter, No Potentiometers Required
- Linearized Outputs in Engineering Units
- Input to Output Isolation: 1500 V rms  
Meets IEEE Standard for CMV Transient Voltage Protection (IEEE-STD 472)

- Small Package: 2.3" x 3.1" x 0.75"  
Modules Plug into Backplane for High Channel Density
- Specifications Valid Over the  $-25^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  Temperature Range

### DIGITAL I/O FEATURES

- 24 Channels of Digital I/O
- Interfaces with Industry Standard Solid-State Relay Panels
- Readback for Output Monitoring
- Bit or Byte Addressable
- Communication Compatible with Analog I/O Backplanes

### APPLICATIONS

- Distributed Data Acquisition and Control
- Test Stand Automation
- Machine Monitoring
- Material Testing
- Energy Management

This eight-page data summary contains key specifications to speed your selections of the proper solution for your application. Additional information on this product can be obtained by from your local sales office.

## GENERAL DESCRIPTION

The 6B Series of modules and boards provide the hardware needed to implement a flexible, distributed monitoring and control application. By selecting only the modules and interfaces needed and connecting them via RS-485, the data acquisition and control strategy can be designed for optimum location of the I/O as well as minimizing sensor runs. The modularity and configurability of the 6B Series also makes them very cost effective.

### Analog I/O

The 6B Series analog I/O modules represent a complete sensor-to-RS-485 solution. Each module performs signal conditioning, isolation, ranging, A/D or D/A conversion and digital communications. The sensors and inputs supported include thermocouples, RTDs, millivolt, volt and current signals. The output module can drive 0-20 mA or 4-20 mA interface valves or actuators. All calibration, address and linearizing parameters are stored in nonvolatile memory in the module.

Designed for industrial applications, the 6B Series modules incorporate transformer based isolation with automated surface mount manufacturing technology for increased reliability at low cost. These compact, rugged modules can be mixed and matched on a 16 channel backplane for high density, remote data acquisition and control.

Unlike conventional signal conditioners, each 6B module is a complete microcomputer based data acquisition system. A big advantage of an onboard microcontroller is the ability to reconfigure each module for various sensor types and input ranges. This reduces the number of different models that have to be used in a given application and carried in inventory. Also, by distributing the processing needs down to the node level, the host is off-loaded for supervisory and higher level control functions.

Interconnection between modules is via an RS-485 bidirectional serial bus standard. Communications between modules and host is in ASCII over an RS-232 or RS-485 link. Interface circuitry to convert RS-232 to RS-485 is built into the backplane. Baud rates are software programmable, and speeds up to 19.2 K baud can be selected.

All modules are fully encapsulated and identical in pinout and size (2.3"×3.1"×0.75"). The 6B Series is fully specified over the industrial temperature range of -25°C to +85°C.

### Digital I/O

Digital signals can be monitored and controlled in a 6B Series RS-485 network by a 24-channel digital I/O interface board. This subsystem is completely compatible with the 6B Series protocol. Connections to 16 and 24 channel solid-state relay backplanes is via a 50 conductor ribbon cable. This allows interfacing with inputs and outputs from 4 to 240 V. Power control modules are also available that can switch up to three amps and come with a variety of ratings for low voltage dc to 280 V ac.

Similar to the analog modules, the digital I/O subsystem has an onboard microcontroller as well as nonvolatile memory. All the digital channels are addressable on a byte or bit-by-bit basis. In addition, the board can easily be configured for its address, baud rate and checksum status.

## DESIGN FEATURES AND USER BENEFITS

**Digitizing and Conditioning:** By combining the signal conditioning and isolation functions with the A/D or D/A converter, the task of designing a computer based data acquisition system is greatly simplified. Since the RS-485 standard is a party line configuration, multiple 6B modules can be daisy chained onto the same bus.

**Configurable:** Each 6B Series module is configurable through software for many parameters including sensor type, output format, baud rate and checksum status. This can be very useful in pilot plant environments where the temperature ranges are not known beforehand. An additional benefit is that inventory can be greatly reduced for an application.

**High Performance:** The high quality signal conditioning combined with a precision A/D or D/A converter delivers  $\pm 0.05\%$  accuracy including all temperature effects. For input modules, the auto-zeroing feature of the A/D converter assure excellent zero drift and long term stability.

**Small Size and Remotely Mountable:** A 16-channel backplane can be mounted on a 19" rack and occupies only 3.5" of rack space. Each backplane has a RS-485 interface on screw terminals and an optional converter to RS-232. This allows easy hookup to a computer over distances up to 4000 ft (RS-485).

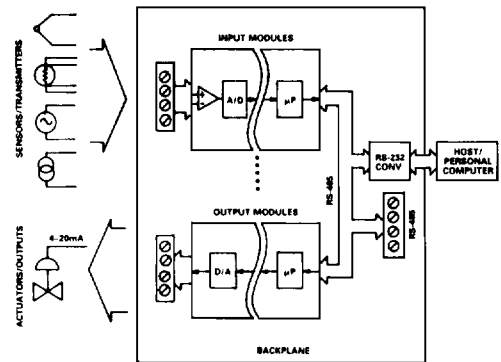


Figure 1. 6B Series Analog I/O Block Diagram

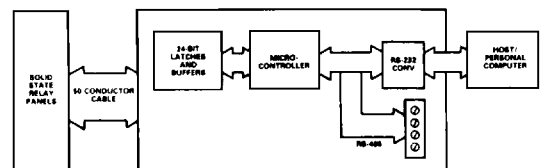
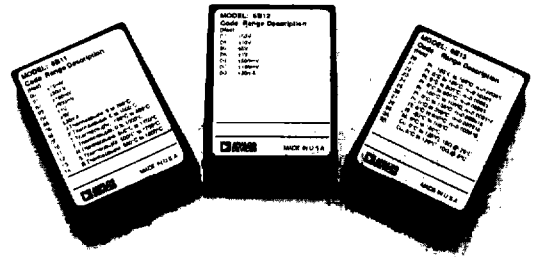


Figure 2. 6B Series Digital I/O Block Diagram

## Analog I/O Modules – 6B Series

### FEATURES

- Variety of Signal Source Inputs
  - Sensors: Thermocouples and RTDs
  - Millivolt and Voltage Sources
  - 4-20 mA and 0-20 mA Process Current Inputs
- RS-485 Output
- Software Configurable for Ranges and Sensors
- All Configurable Parameters Stored in EEPROM
- Linearized Output in Engineering Units
- Mix and Match Input Capability
- Reliable Transformer Isolation: 1500 V CMV, 160 dB CMR, Meets IEEE-472: CMV Transient Protection
- Input Protection: 240 V rms Continuous



### DESCRIPTION

The 6B Series input modules cover all signal ranges from  $\pm 15$  mV to  $\pm 50$  V and all thermocouple and RTD types. The input signal is conditioned and scaled by the programmable gain amplifier and digitized by a 16-bit integrating converter under microprocessor control. The conversion rate is 9 samples/sec which gives a Nyquist bandwidth of 4.5 Hz.

The digitized value is passed serially across a magnetically isolated barrier (1500 V rms) and clocked in by a custom controller chip. The onboard microcontroller then converts the data into engineering units as determined by the channel parameters, i.e., whether the input signal was from a thermocouple, an RTD or a process current. In between conversions the microcontroller auto-zeros the offset and gain by monitoring the onboard temperature and reference drift. CJC compensation is also performed at this stage.

The 6B11 linearizes and compensates J, K, T, E, R, S and B thermocouples and digitizes millivolt and volt ranges from  $\pm 15$  mV to  $\pm 5$  V. The 6B12 interfaces with high level signals ranging from  $\pm 150$  mV to  $\pm 50$  V and the 6B13 linearizes 100  $\Omega$  Pt (alphas of 0.00385 and 0.003916), 120  $\Omega$  Ni RTDs and 10  $\Omega$  Cu RTDs.

The 6B Series modules have a simple master-slave relationship with the host and respond only when spoken to. Each module has a unique ID number stored in nonvolatile memory for ad-

ressing. The format is ASCII, and all standard baud rates up to 19.2 K baud are possible. Refer to the communication section of the data sheet for a summary of the command set.

Each 6B Series module can be recalibrated in the field or lab to an external reference. Similarly it can be reconfigured in the field for a different transfer function. All user configured parameters are stored in the nonvolatile memory (EEPROM) of the module.

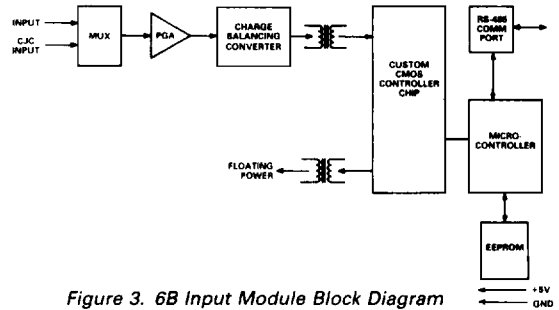


Figure 3. 6B Input Module Block Diagram

**FEATURES**

- Digitally Controlled Current Loop Output (12-Bits)**
- Programmable Output Ranges: 0-20 mA or 4-20 mA**
- Active Current Output; External Loop Power Supply Not Required**
- Common Mode Isolation: 1500 V**
- Meets IEEE-Std 472 for CMV Transient Protection**
- Normal Mode Output Protection: 240 V rms**
- Programmable Slew Rate Limiting**
- Output Monitoring and Readback for Fault Detection**

**APPLICATIONS**

- Distributed Data Acquisition and Control**
- Industrial Pilot Plant Control**
- Machine Control**
- Energy Management**

**GENERAL DESCRIPTION**

The 6B21 is an output module in the 6B Series that provides 0-20 mA or 4-20 mA process currents. It is electrically and mechanically compatible with the existing modules and backplanes. It takes a command from the host and converts it into an isolated process current suitable for interfacing with valves and actuators. The 6B21 was designed with fault protection as a key objective. In addition, the actual current flowing in the current loop can be read back by an on-board isolated A/D converter. The module will revert to a preset output stored in EEPROM in case of a brown-out.

The block diagram for the 6B21 is shown in Figure 4. An on-board microprocessor communicates with the host through a RS-485 port to exchange command and status information. An EEPROM is used to store calibration constants as well as config-

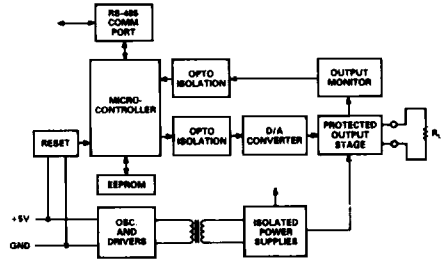


Figure 4. 6B21 Block Diagram

uration information. The microprocessor also controls the output DAC through an optically isolated serial interface. The D/A converter drives the current loop through a protected 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 microprocessor through an optical isolator. The microprocessor then scales the frequency signal and returns the current readback data to the host. A DC/DC converter generates 25 V @ 25 mA to power the current loop and output circuitry from the +5 V power supply.

The 6B21 is encapsulated and packaged in a 2.3"×3.1"×0.75" module. It is fully specified over the industrial (-25°C to +85°C) temperature range.

**Output Module Specifications** (typical @ 25°C and +5 V power unless otherwise noted)

Model	6B21
<b>OUTPUT SPECIFICATIONS</b>	
Range	0-20 mA + 10% Overrange 4-20 mA +10% Overrange
Initial Accuracy	
Output Offset	± 5 µA (+15 µA max)
Span	±0.02% FSR (±0.05% FSR max)
Accuracy vs. Temperature	
Output Offset TC	± 1 µA/°C
Gain TC	±50 ppm/°C
Resolution	± 0.02% FSR
Nonlinearity	± 0.02% FSR
Bandwidth	100 samples/sec
Settling Time	1 ms to 0.1% FSR
Noise (100 Hz Bandwidth)	1 µA pk-pk
Load Resistor	0 to 750 Ω
Normal Mode Protection	240 V rms
Slew Rate	Step Response Plus 0.125 - 128 mA/sec in Eleven Binary Ranges
<b>READBACK SPECIFICATIONS</b>	
Initial Accuracy	
Output Offset	± 100 µA
Span	± 0.5% FSR
Accuracy vs. Temperature	
Output Offset TC	± 5 µA/°C
Gain TC	± 200 ppm/°C
Resolution	0.5% FSR
Nonlinearity	0.5% FSR
<b>ISOLATION SPECIFICATIONS</b>	
Common Mode Voltage Input to Output	1500 V rms
CMR @ 60 Hz	90 dB min
Transient Protection	IEEE-Std 472 (SWC)
<b>POWER CONSUMPTION</b>	<b>1.2 W</b>

**NOTES**

- † See table for specific accuracy by range.
- \* Specifications same as 6B11.
- Specifications subject to change without notice.

# Digital I/O – 6B Series

## FEATURES

- 24 Channels of Digital I/O
- Interfaces with Industry Standard Digital I/O Panels
- High Output Current Capability
- RS-232 Interface to Host (6B50-2)
- RS-485 Interface to Other 6B Series Backplanes
- Instruction Set Compatible with 6B Series
- Readback for Output Monitoring

## APPLICATIONS

- Distributed Data Acquisition and Control
- Industrial Pilot Plant Control
- Machine Control
- Energy Management

## GENERAL DESCRIPTION

The 6B50 is a digital I/O board that is compatible with the 6B Series at the network level. It takes a command from the host and converts it into logic levels suitable for interfacing with industry standard optoisolated digital I/O panels. All I/O channels can be configured for input or output, using bit or byte addressing. In addition, the status of the port can be read back by the host to confirm the I/O configuration.

The block diagram for the 6B50 is shown below. An onboard microprocessor communicates with the host to exchange command and status information. An EEPROM is used to store system parameters (address, baud rate, etc.) as well as I/O configuration information. The microcontroller is interfaced to 8-bit latches and buffers for a maximum of 24 digital I/O channels. Each channel can be set individually as an input or output.

Similar to other 6B Series backplanes, the 6B50 is available with only an RS-485 interface (6B50-1), or with an additional RS-485/RS-232 converter (6B50-2). The 6B50 is a 3.47" × 6.5" open board that can be panel or rack mounted. It is fully specified over the commercial (0 to +70°C) temperature range.

## INTERFACING

The 6B50 interfaces with industry standard single and quad solid-state relay modules. These are available for use with inputs and outputs from 4 V to 240 V. Power control modules can switch up to three amps and are available in a variety of ratings for low voltage dc to 280 V ac. Analog Devices also supplies 16- and 24-channel digital subsystems (DB-16 and DB-24) that interface with the 6B50 through a 50 conductor flat ribbon cable.

The single channel modules listed below plug into the DB-16 board.

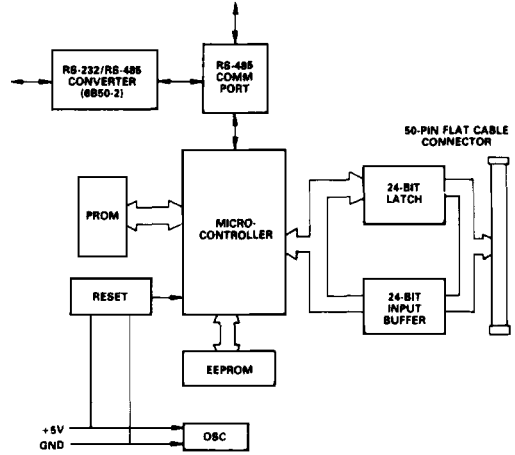


Figure 5. 6B50 Block Diagram

Model	Range
IA140A	AC Input, 140 V
IA280A	AC Input, 280 V
OA140A	AC Output, 140 V
OA280A	AC Output, 280 V
ID016	DC Input, 16 V
ID032	DC Input, 32 V
OD060	DC Output, 60 V
OD200	DC Output, 200 V

The quad modules listed below plug into the DB-24 board.

Model	Range
OA240QA	4 Channels Output, 120 V/240 V AC
OD60Q	4 Channels Output, 60 V DC
IA120QA	Input, 120 V AC
IA240QA	4 Channels Input, 240 V AC or DC
ID32Q	4 Channels Input, 10–32 V DC
ID16FQ	4 Channels Fast Input, 16 V DC
	50 μs Turn-on Time, 100 μs Turn-off Time

## BACKPLANES

### Backplane Description

The 6B Series backplanes, combined with modules, provide a complete data acquisition system for end users. Each backplane incorporates screw terminals for field wiring inputs and outputs and cold junction compensation for thermocouple applications. The communication interface is RS-232 or RS-485 depending on the option.

For flexibility in application, one, four and sixteen channel backplanes are provided. These can be ordered either with the standard RS-485 interface, or with the optional RS-485 to RS-232 converter. The RS-232 interface allows easy hookup to most serial ports, while the standard RS-485 interface can be used for daisy chaining additional backplanes. The RS-485 interface can drive a twisted pair cable up to a maximum of 4000 ft.

### BACKPLANE SPECIFICATIONS

	Channels	Interface <sup>1</sup>	Dimensions	Power Consumption
6BP01-1	1	RS-485	4.25"×1.37"	Passive
6BP01-2	1	RS-232	4.25"×2.85"	200 mA
6BP04-1	4	RS-485	3.47"×6.5"	200 mA
6BP04-2	4	RS-232	3.47"×6.5"	200 mA
6BP16-1	16	RS-485	3.47"×17.4"	200 mA
6BP16-2	16	RS-232	3.47"×17.4"	200 mA

<sup>1</sup>All backplanes have the RS-485 interface.

All 6B Series backplanes require a +5 V ± 5% power supply for the backplane circuitry as well as the modules. Backplanes and power supplies can be easily mounted on a rack mount kit described below.

## SOFTWARE SUPPORT

**Utility Disk:** A test program to evaluate the 6B Series is part of the *6B Series User's Manual*. This allows for functionality of the modules to be tested on the bench as well as for programming all parameters, i.e., address, range, output format, checksum enable, etc.

**Drivers:** Drivers for popular software packages are also available as accessories. These drivers provide transparent access to the 6B Series modules from the serial port, and maintain a user friendly interface. Drivers are currently available for: Control EG\*, LABTECH NOTEBOOK<sup>†</sup> and THE FIX<sup>‡</sup>.

**LABTECH<sup>†</sup> ACQUIRE:** Bundled with every 6B Series order at no extra charge, ACQUIRE is a basic software package that simplifies the data acquisition and recording process. It provides a menu driven software interface for the 6B Series and is very easy to learn. ACQUIRE features data logging and triggering options, as well as several ways to display data graphically.

\*Control EG is a trademark of Quinn-Curtis.

<sup>†</sup>LABTECH and LABTECH NOTEBOOK are registered trademarks of Laboratory Technologies Corporation.

<sup>‡</sup>THE FIX is a registered trademark of Intellution, Inc.

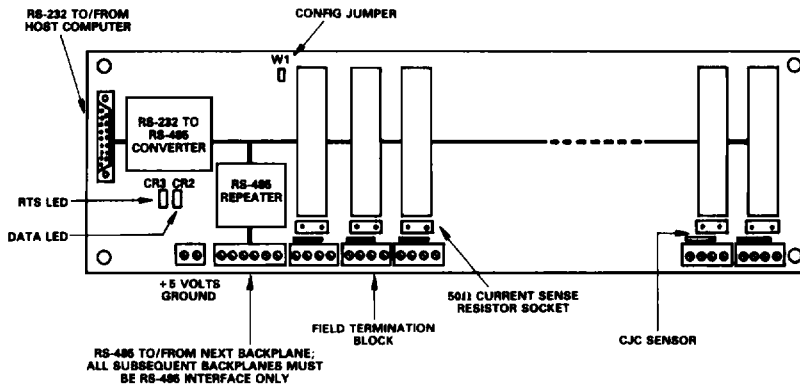


Figure 6. 6BP16-2 Block Diagram

**Input Module Specifications** (typical @ 25°C and +5 V power)

Model	6B11	6B12	6B13
Input Ranges	Thermocouple, mV, V, mA	mV, V, mA	Pt, Ni, Cu RTD
Output	RS-485	*	*
Accuracy†	±0.05% or better <sup>1</sup>	*	±0.03°C (Pt, Ni)
Zero Drift	±0.3 μV/°C	*	
Span Drift	±25 ppm/°C max	±50 ppm/°C max	} Combined Effect: ±0.005°C/°C
Common Mode Voltage, Input to Output	1500 V rms Continuous	*	
Common Mode Rejection (at 50 Hz or 60 Hz 1 kΩ Source Imbalance)	160 dB	108 dB	*
Normal Mode Rejection (at 50 Hz or 60 Hz)	58 dB	56 dB	*
Differential Input Protection	240 V rms Continuous	*	*
Input Transient Protection (CMV)	IEEE-Std 472 (SWC)	*	*
Input Resistance	100 MΩ	1 MΩ	N/A
Bandwidth	4 Hz	*	*
Conversion Rate	9 samples/sec	*	*
Power Consumption	1.2 W	*	*

**Range Accuracy** (typical @ 25°C and +5 V power)

Hex Code	Range Description	Typical Accuracy	Maximum Error	Peak-to-Peak Noise	Units
<b>6B11</b>					
00	±15 mV	±0.03	±0.06	±0.02	% of FS
01	±50 mV	±0.015	±0.04	±0.01	% of FS
02	±100 mV	±0.0055	±0.03	±0.005	% of FS
03	±500 mV	±0.005	±0.03	±0.002	% of FS
04	±1 V	±0.005	±0.03	±0.005	% of FS
05	±5 V	±0.005	±0.03	±0.0015	% of FS
06	±20 mA <sup>1</sup>	±0.008	±0.03	±0.005	% of FS
0E	J Thermocouple, 0 to 760°C	±0.4	±0.75	±0.14	°C
0F	K Thermocouple, 0 to 1000°C	±0.5	±0.75	±0.22	°C
10	T Thermocouple, -100°C to 400°C	±0.5	±0.75	±0.2	°C
11	E Thermocouple, 0 to 1000°C	±0.5	±0.75	±0.2	°C
12	R Thermocouple, 500°C to 1750°C	±0.63	±1.5	±0.3	°C
13	S Thermocouple, 500°C to 1750°C	±0.62	±1.5	±0.4	°C
14	B Thermocouple, 500°C to 1800°C	±1.2	±2.0	±0.7	°C
<b>6B12</b>					
07	±50 V	±0.006	+0.03	±0.004	% of FS
08	±10 V	±0.006	+0.03	±0.005	% of FS
09	±5 V	±0.006	+0.03	±0.006	% of FS
0A	±1 V	+0.006	+0.03	±0.007	% of FS
0B	±500 mV	±0.01	+0.04	±0.008	% of FS
0C	±150 mV	±0.03	+0.06	±0.02	% of FS
0D	±20 mA <sup>1</sup>	±0.006	+0.03	±0.007	% of FS
<b>6B13</b>					
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, 0°C to +120°C, -0 Ω (at 25°C)	0.13	0.5	0.04	°C
2B	Cu, 0°C to +120°C, 10 Ω (at 25°C)	0.11	0.5	0.04	°C

NOTE  
<sup>1</sup>Excluding error contribution from current sense resistor.

**Common Module Specifications**

<b>POWER SUPPLY</b>	
Voltage, Operating	+5 V ± 5%
<b>ENVIRONMENTAL</b>	
Temperature Range	
Rated Performance	-25°C to +85°C
Storage	-40°C to +85°C
Relative Humidity (MIL Spec 202)	0 to 95% (at 60°C)

# Digital I/O Specifications (typical @ 25°C and +5 V power unless otherwise noted)

<b>Model</b>	6B50
<b>DIGITAL I/O</b>	
Number of I/O	24 (Configurable for Input or Output)
I/O Circuit Configuration	Open Collector Outputs with 47 kΩ Pullups to +5 V
<b>Digital Inputs</b>	
High Level Input	3.5 V min, 5.25 V max
Low Level Input	0.8 V max
<b>Digital Outputs</b>	
High Level Output Current	50 μA @ 5 V
Low Level Output Current	100 mA @ 1.1 V
High Level Output Voltage	5.25 V max
<b>COMMUNICATIONS</b>	
<b>RS-232C</b>	
Baud Rates	300, 600, 1200, 2400, 4800, 9600, 19.2 K
Maximum Distance	50 ft
<b>RS-485</b>	
Baud Rates	300, 600, 1200, 2400, 4800, 9600, 19.2 K
Maximum Distance	4000 ft
<b>POWER SUPPLY</b>	
Voltage, Operating	+5 V ± 5%
Current, Quiescent	225 mA <sup>1</sup>
<b>SIZE</b>	3.47" × 6.5" (90.68 mm × 165.1 mm)
<b>ENVIRONMENTAL</b>	
Temperature Range	
Rated Performance	0 to +70°C
Storage	-40°C to +85°C
Relative Humidity	0 to 90% Noncondensing

**NOTE**

<sup>1</sup>Excluding load current.  
Specifications subject to change without notice.

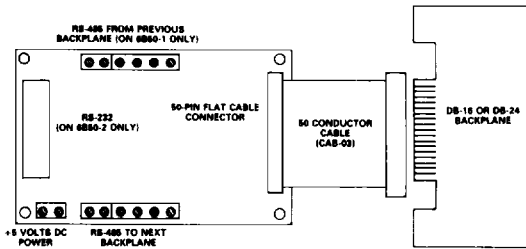


Figure 7. 6B50 Digital I/O Board Block Diagram

### Input Module Pin Designations

N/C	26	24	XCV+
XCV-	23	22	RTB+
RTS-	21	20	+5V PWR
PWR COM	19	18	CONFIG
IN LO	7		
-EXC	6	8	IN HI
CJC EXC	3	4	+EXC
-SNS	1	2	+SNS

### Output Module Pin Designations

N/C	26	24	XCV+
XCV-	23	22	RTB+
RTS-	21	20	+5V PWR
PWR COM	19	18	CONFIG
LO	7	6	HI
N/C	5	4	N/C
N/C	3	2	N/C
N/C	1		

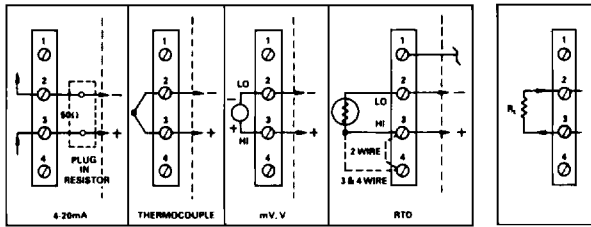


Figure 8. 6B Series Connections

### 6B Module Outline

