GE
Measurement & Control

Validation

Netpac®

User's Manual

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M4402-4 Rev. A
April 2012

Netpac®

Remote Modules for Conditioning and Measurement

User's Manual

M4402-4 Rev. A
April 2012

http://www.ge-mcs.com/en/validation-and-environmental-monitoring.html

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Chapter 1. Overview

Chapter 2. Installation

Chapter 4. Netpac with GE Hosts

Appendix A. System Specifications

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Chapter 1. Overview

1.1 Introduction

This user's guide describes Netpac installation and programming for system engineers and includes these chapters:

- Chapter 1, *Overview*, describes Netpac's capabilities, module configurations, Netpac models, and card layouts.
- Chapter 2, *Installation*, explains how to mount Netpac and covers power connections, control and I/O card settings, and wiring.
- Chapter 3, *Communications Protocol*, presents Netpac commands, formats, responses, and examples.
- Chapter 4, *Netpac with Kaye Hosts*, supplements information for Kaye datalogger user's guides.
- Appendix A - *System Specifications*
- *Hardware Warranty and Return Policy*

1.1.1 Distributed I/O Network

Netpac remote modules condition, measure, linearize and send input signals to the host on command. You can link modules together to form a distributed I/O network, located up to 16,000 feet from the host. Netpac modules communicate over an RS-485 bus using a single twisted pair cable.

Netpac modules provide direct connection to a variety of sensors and transducers, including voltage, current, thermocouple, RTD, pulse, frequency, and status inputs. Netpac also provides contact and analog outputs.

1.1.2 Remote Scanner and On-Board Signal Processor

Netpac performs both remote scanning and on-board signal processing. This includes analog-to-digital conversion, linearization to engineering units, and thermocouple ice-point compensation. A Netpac channel stores the resulting data (actual volts, degrees, percentages, contact status, period, frequency, etc.).

The host sends instructions to Netpac and requests data. From the host, you send outputs to your process using Netpac. The host can be a computer or one of the following Kaye dataloggers: AutoGraph™, AutoLink™, AutoCalc™, or Ten/60™.

1.2 Module Configurations

A Netpac module consists of an analog or digital control card with its associated I/O card set(s) and a power supply. Netpac modules are available in both single and multi-module configurations. A single module holds one control card (analog or digital) and one I/O card set. A multi-module consists of either one analog or digital control card and up to five I/O card sets, or one analog and one digital card set with up to six I/O card sets.

A control card directs the multiplexing/demultiplexing of the signals, performs engineering units conversion, stores data in a channel, and is the communication link between the Netpac module and the host.

1.2.1 Multi-Drop Configuration

In a multi-drop configuration, you can address up to 16 Netpac control cards for each port on the host. Each control card is housed in a single or multi-module. The number of ports and total number of inputs and outputs depends on the host.

1.2.2 Single Module

Supports one control card, either analog or digital, and one input or output card set with up to 20 channels of I/O. Three models are available: *NEMA 2* or *NEMA 4* enclosure, and *Open Style*. You can order the *Open Style* ready to mount in your own enclosure. See Figure 1 on page 3 for models, and Figure 3 on page 6 for card layout.

Table 1 below outlines the available models and the number of channels supported by each type of Netpac.

Table 1: Types of Single Module Netpacs

Model	Description	Channel
Voltage/TC/Current*/Contact Input	2-wire inputs	20
	3-wire inputs	20
High Voltage Input	0-150 VDC, 2-wire	20
	0-150 VDC, 3-wire	20
RTD Input	3-wire 100Ω Pt	20
	3-wire 10Ω Cu	20
	4-wire 100Ω Pt	10
Frequency/Period/Status/Totalize (f/p/s/t)	Dry contact for f/p/s/t	10
	TTL/CMOS input, 5-15V for f/p/s/t	10
	Isolated input, 80-150V for f <5 KHz/p/s/t	10
	Isolated AC/DC detector, 80-150V, s/ only	10
	15mV AC input for f/p/t	10
Analog Output	0-10V, 0-5V, 4-20mA, 1-5mA	5
Contact Output	2A at 30 VDC, 0.6A at 125 VAC	20
*25Ω shunt resistor required for each current input.		

1.2.2 Single Module (cont.)

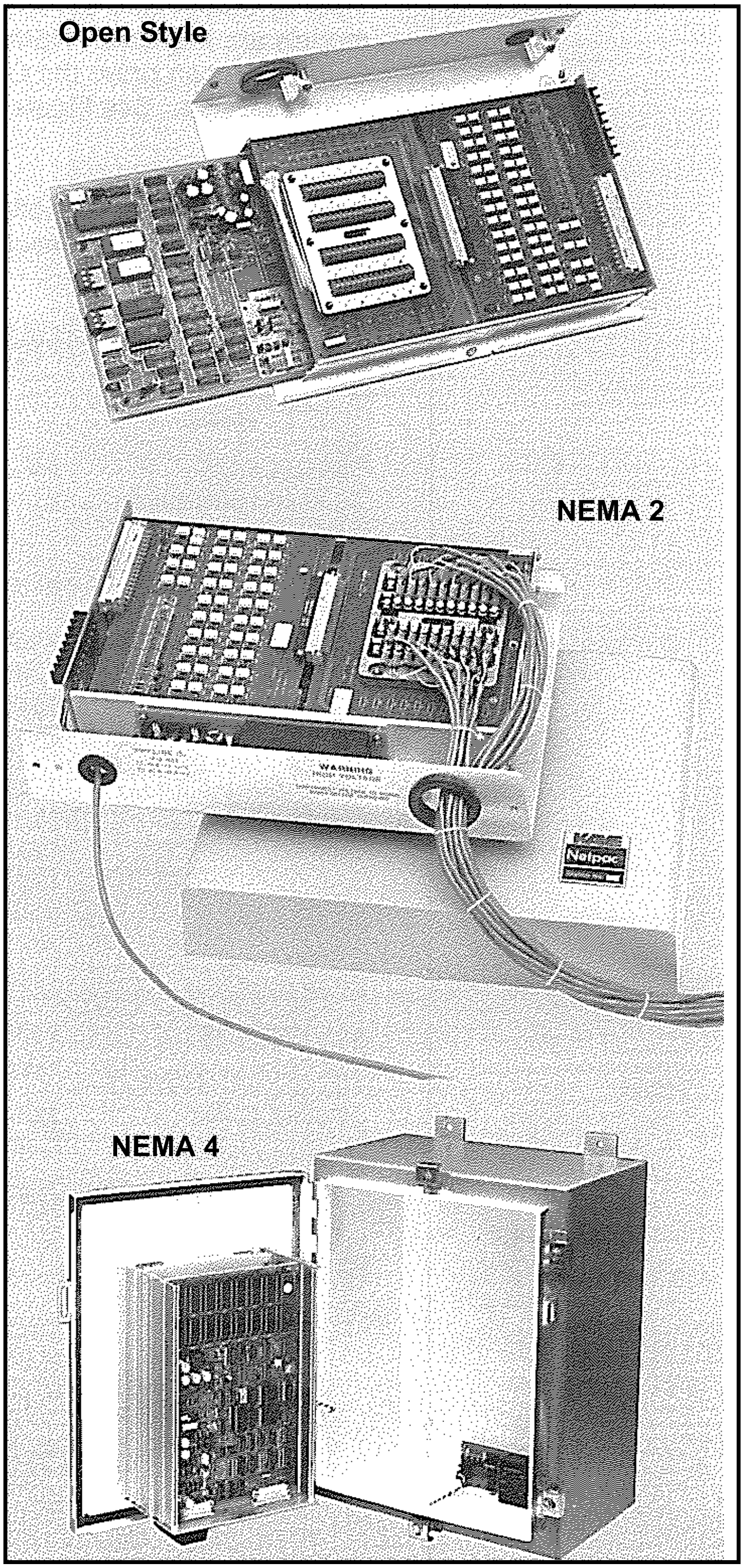


Figure 1: Single Module Nepac Models

1.2.3 Multi-Module

A multi-module can contain one or two modules (see *Module Configurations* on page 1). Three models of multi-module Netpacs are available: *Open Style*, *NEMA 4*, and *Rack Mount* (see Figure 2 on page 5).

The analog control card supports up to five analog card sets and one hundred channels of I/O. The digital control card supports up to five digital card sets and fifty channels of I/O. Each control card or card set occupies one slot in the multi-module Netpac chassis.

Two slots are available for the control cards (one analog and one digital) and six slots for the I/O card sets. See Figure 3 on page 6, Figure 4 on page 6 and Figure 5 on page 7 for card layouts. The multi-module NEMA 4 incorporates the Open Style card rack.

Channels associated with analog control cards are numbered in groups of 20 according to placement of the I/O card in relation to the control card.

Card Number	Channel Number
0	00-19
1	20-39
2	40-59
3	60-79
4	80-99

Channels associated with digital control cards are numbered in groups of 10 according to the I/O card number.

Card Number	Channel Number
0	00-09
1	10-19
2	20-29
3	30-39
4	40-49

Most of the host-to-Netpac command formats reference the card number and then channel (see Chapter 3, *Command Protocol*). A few reference only the channel (for example, the *resolution* command).

1.2.3 Multi-Module (cont.)

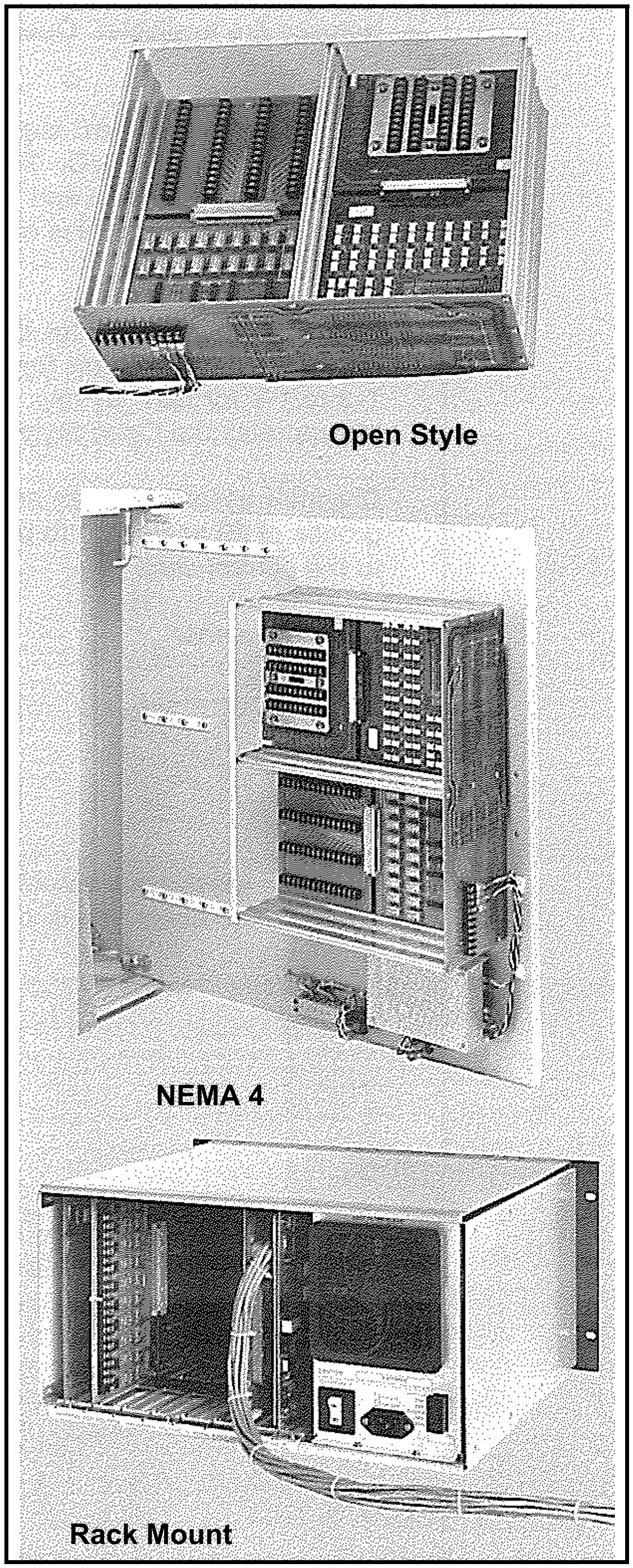


Figure 2: Multi-Module Netpac Models

1.2.4 Card Layouts

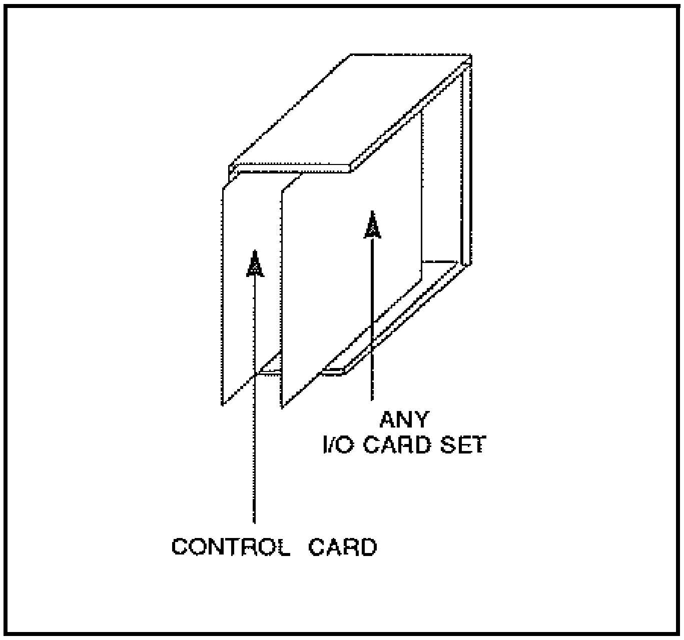


Figure 3: Card Layout, Single Module Open Style

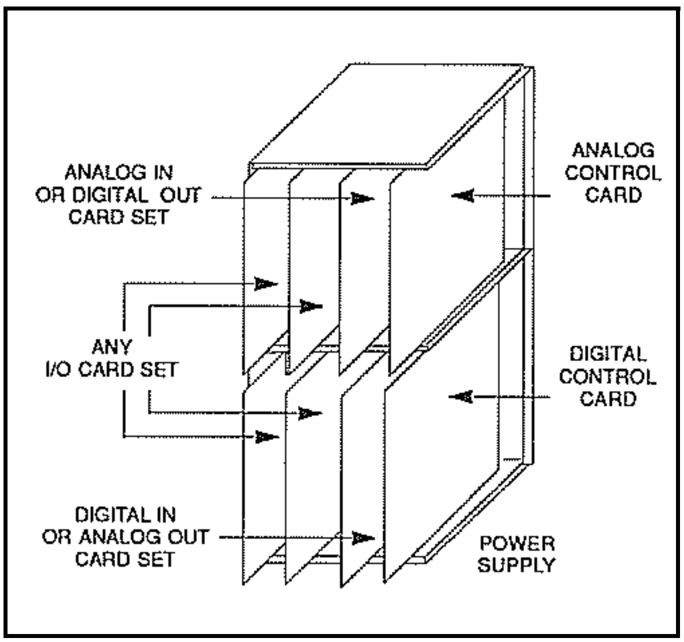


Figure 4: Card Layout, Multi-Module Open Style

1.2.4 Card Layouts (cont.)

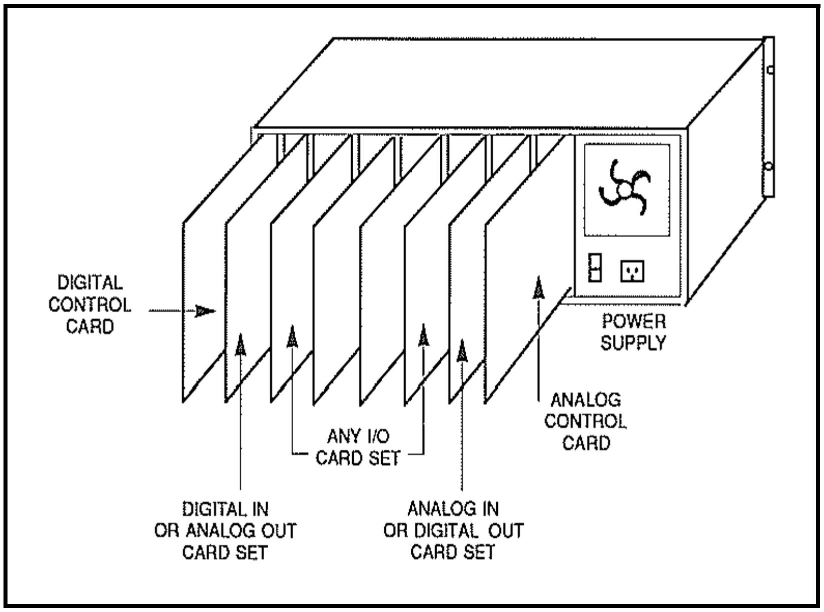


Figure 5: Card Layout, Multi-Module Rack Mount

The factory supplies a variety of multi-module card sets to accommodate most common industrial applications. Table 2 below lists card sets supported by the analog control card, and Table 3 on page 8 lists those supported by the digital control card.

1.3 Analog Control Card

The analog control card converts analog signals from thermocouples, RTD's, etc. to a digital representation and sends the signals to the host. It also processes commands from the host and opens or closes contacts on a contact output card.

Table 2: Card Sets Supported by Analog Control Card

Model	Description	Channel
Voltage/TC/Current*/Contact Input	2-wire inputs	20
	3-wire inputs	20
High Voltage Input	0-150 VDC, 2-wire	20
	0-150 VDC, 3-wire	20
RTD Input	3-wire 100Ω platinum	20
	3-wire 10Ω copper	20
	4-wire 100Ω platinum	10
Contact Output	2A at 30 VDC, 0.6A at 125 VAC	20
*25Ω shunt resistor required for each current input.		

1.4 Digital Control Card

The digital control card sets the range, resolution and operating mode of the *Frequency/Period/Status/Totalize* card, stores the digital value from each pulse input, and sends the data to the host. The digital control card also drives the analog output card.

Table 3: Card Sets Supported by Digital Control Card

Model	Description	Channel
Frequency/Period/Status/Totalize (f/p/s/t)	Dry contact for f/p/s/t	10
	TTL/CMOS input, 5-15V for f/p/s/t	10
	Isolated input, 80-150V for f <5 KHz/p/s/t	10
	Isolated AC/DC detector, 80-150V, s/ only	10
	15mV AC input for f/p/t	10
Analog Output	0-10V, 0-5V, 4-20mA, 1-5mA	5

Chapter 2. Installation

2.1 Introduction

This chapter of the user's guide describes how to install each type of Netpac single and multi-module. It includes:

- Mounting instructions
- Power connections and power source selection
- Analog and digital control card settings
- I/O card settings
- Interface converter connections

Figures 6 through 10 show physical dimensions and card layout.

2.2 Mounting Single Modules

2.2.1 NEMA 2

The base plate has three original mounting holes located under the card sets and four mounting holes located in the four corners of the baseplate for easy access. In either case, you must supply the mounting hardware (mounting standoff, etc.)

Follow the mounting instructions for either the three hole mounting or the four hole mounting as indicated below.

2.2.1a Three Hole Mounting Instructions

Access the holes by loosening the card retainers at the rear of the assembly and then sliding the card sets and control card from the card cage. Once the cards are removed, place the baseplate on the mounting surface and use it as a template to mark the mounting holes. Mount the modules so that dust and moisture cannot enter the enclosure through the mounting holes.

2.2.1b Four Hole Mounting Instructions

Place the Netpac baseplate on the mounting surface and use it as a template to mark the four mounting holes. Mount the modules so that dust and moisture cannot enter the enclosure through the mounting holes. Refer to Figure 6 on page 10.

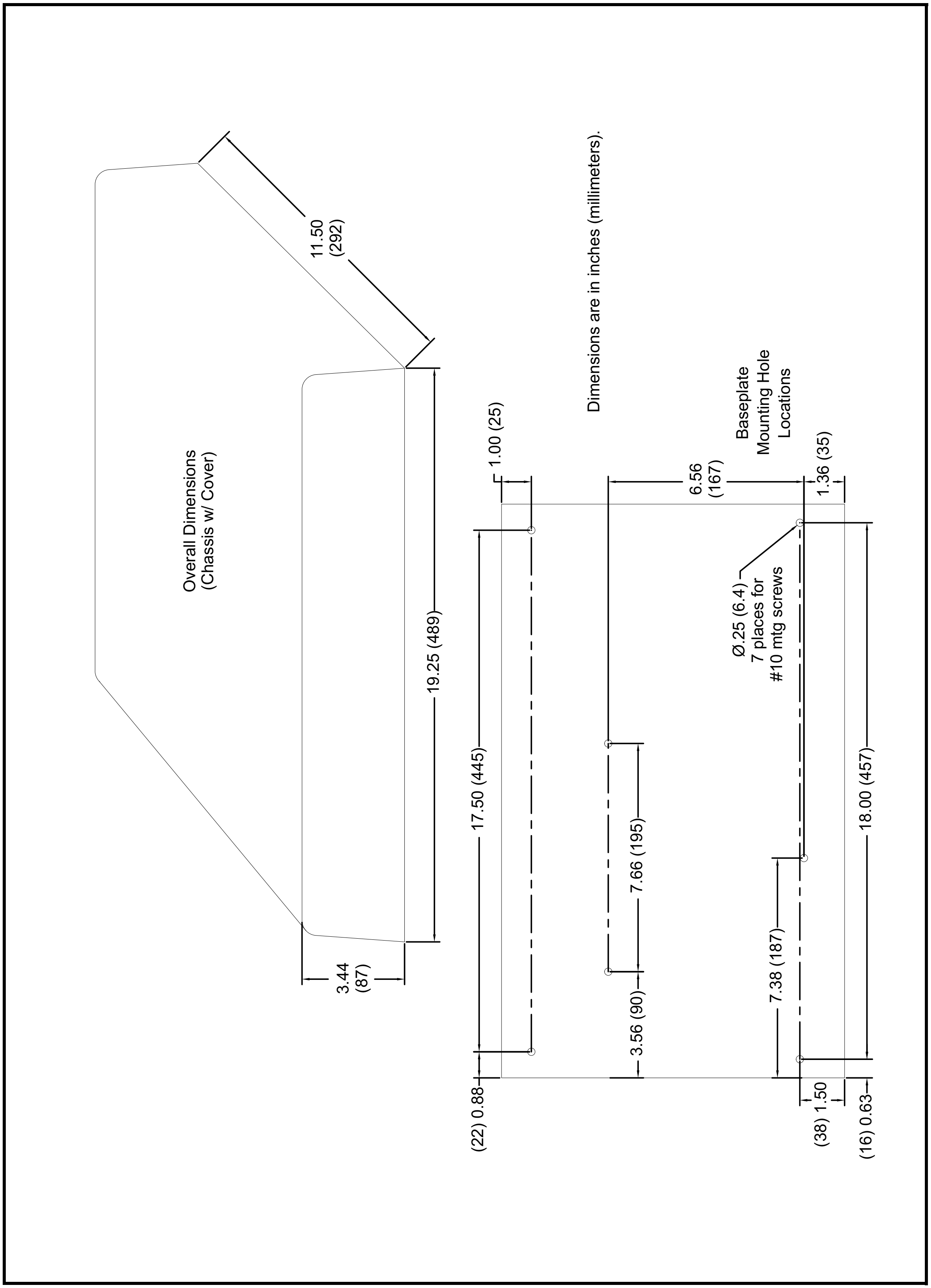


Figure 6: NEMA 2 Single Module Dimensions

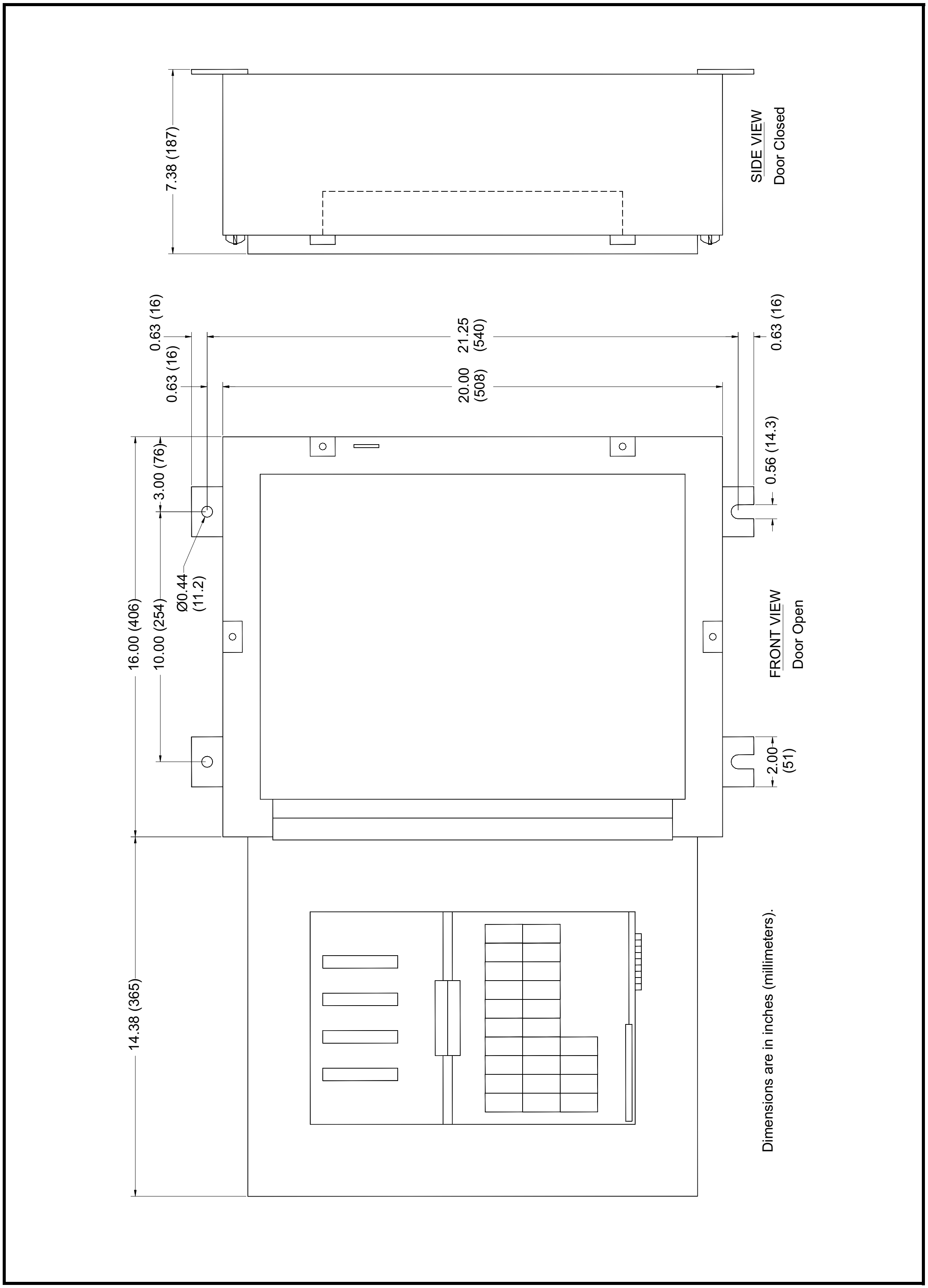


Figure 7: NEMA 4 Single Module Dimensions

2.2.2 NEMA 4

Recommended when the operating environment is highly moist, dusty or corrosive. The NEMA 4 single module is also designed for wall mounting, and requires conduit fittings for communications and signal wiring. See Figure 7 on page 11.

2.2.3 Open Style

Single modules are shipped in a card cage for mounting in your own enclosure. The module is secured to a shipping plate that you can use for mounting. Or, you can detach the module from the plate and mount it in your own card cage. Mounting the *Open Style* is similar to the NEMA 2 except there is no cover. See the mounting pattern in Figure 6 on page 10 for dimensions.

2.3 Mounting Multi-Modules

2.3.1 NEMA 4

A conduit plate is mounted on the bottom. Determine the hole size required for conduit fittings, remove the plate and install the fittings before you wire the unit.

You can rotate the inner tray that holds the card cage by rotating the enclosure 180° so that the wiring entry is at the top. Remove the spring-loaded locking pins and washers that serve as a hinge for the inner tray. Locate the washers and hinge pins on the opposite side. See Figure 8 on page 13.

WARNING! **The door and inner tray of the multi-module are heavy and have tight clearances. Prevent them from slamming closed while wiring or servicing the equipment or severe personal injury could result.**

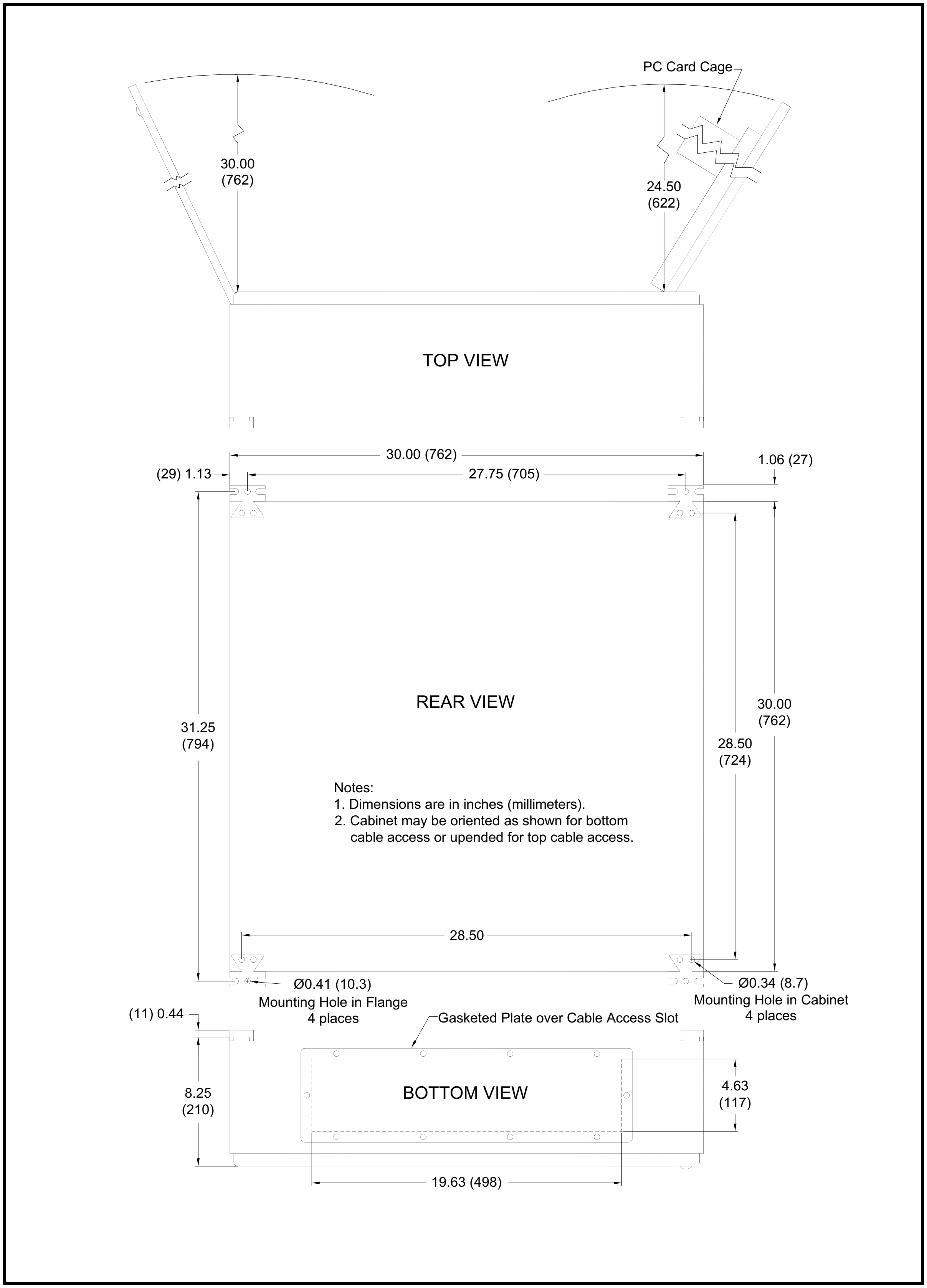


Figure 8: NEMA 4 Multi-Module Dimensions

2.3.2 Rack Mount

Fits into a standard 19-inch rack (see Figure 9 below). An integral power supply, powered from 115 or 230 VAC, 50 or 60 Hz, provides operating voltages for any mix of control cards and input/output card sets.

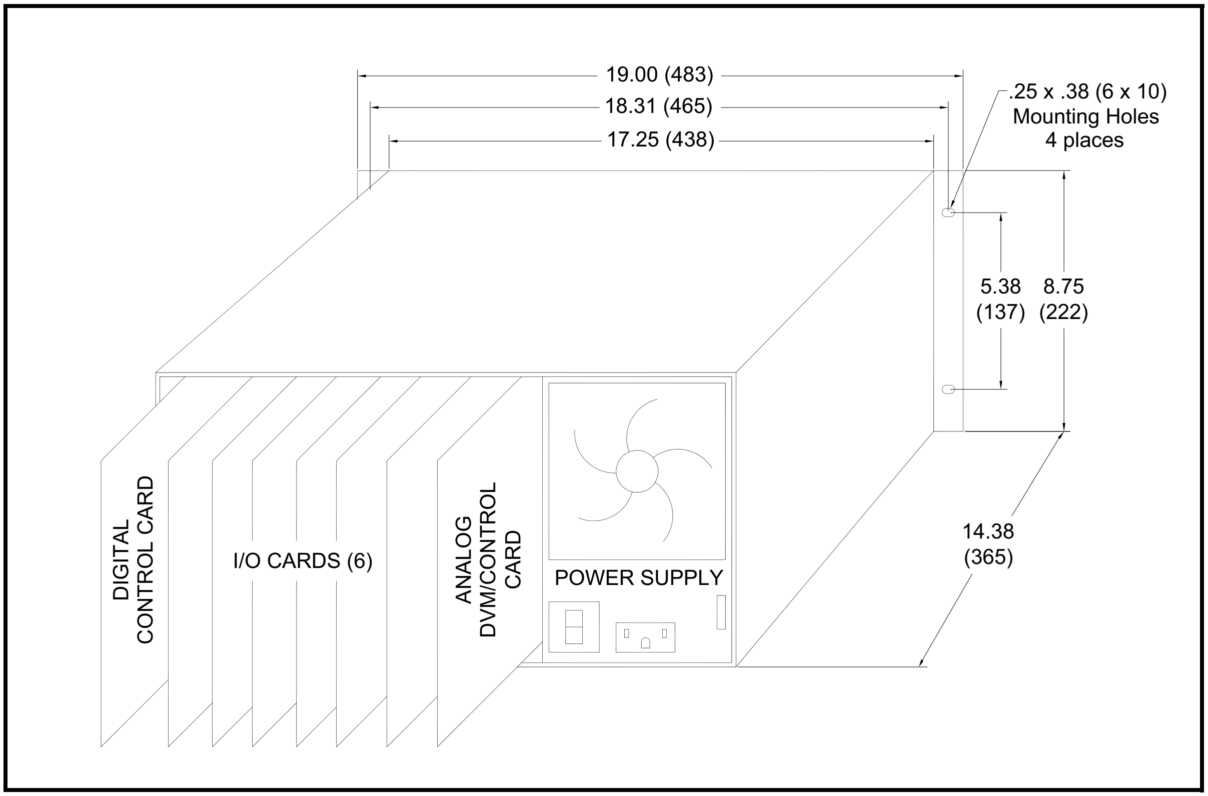


Figure 9: Rack Mount Multi-Module Dimensions

2.3.3 Open Style

Designed for a laboratory quality environment, or for use in customer housings, the *Open Style* multi-module is packaged with the card cage portion mounted on a shipping plate (see Figure 10 below).

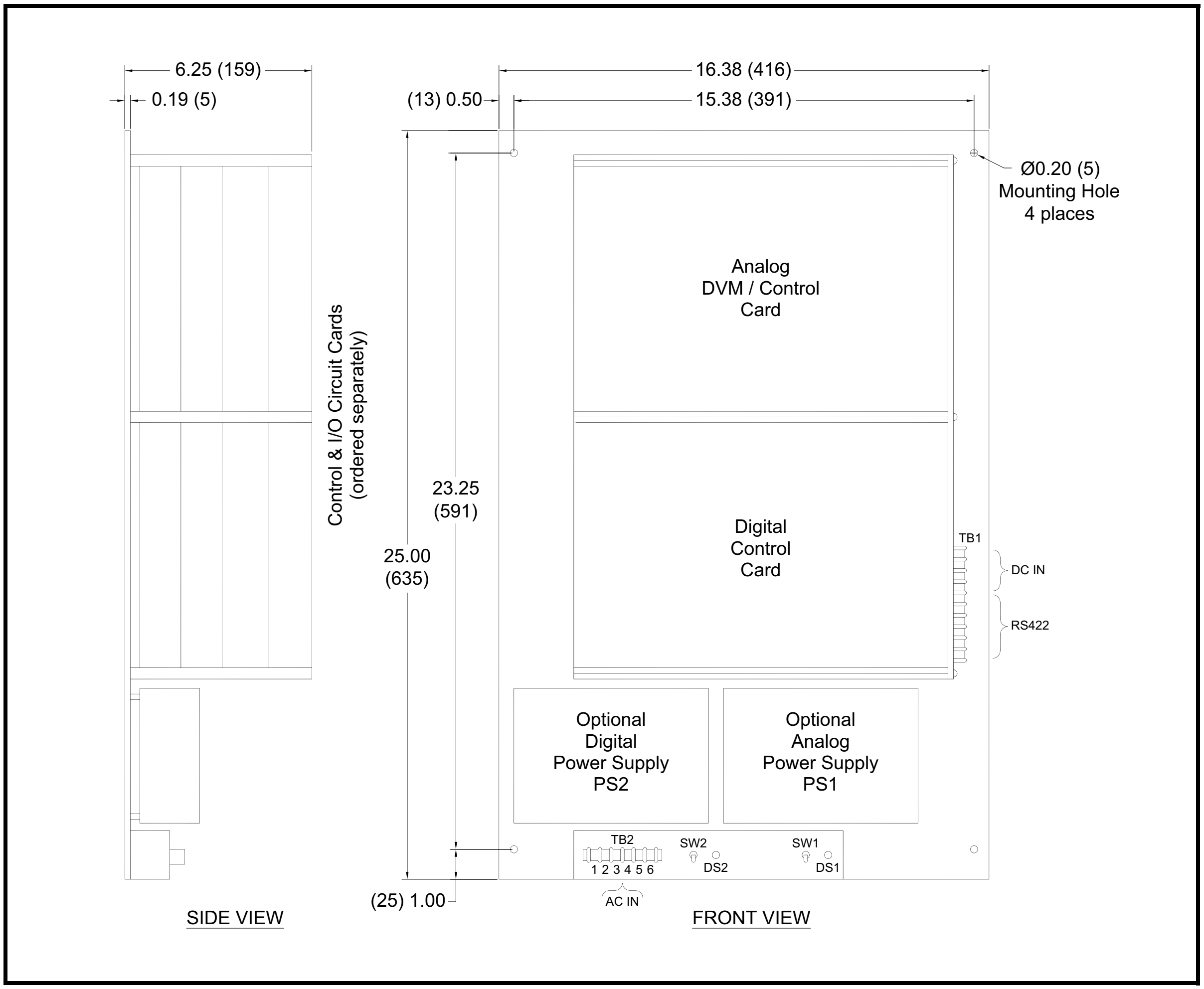


Figure 10: Open Style Multi-Module Dimensions

2.4 Power Connections

Netpac modules require an operating voltage of either +12 VDC or +24 VDC. The operating voltage can come from the factory installed power supply that operates from a source of 115 or 230 VAC, 50 or 60 Hz, or from your own DC source.

2.4.1 Factory Installed Power Supply

Set the power selection jumper (P5 on the analog control card and not designated on the digital control card) according to the following paragraphs. See Figure 14 on page 19 and Figure 33 on page 38 for the location of the power select jumper on the control cards. The fuse located on the control card is rated 2A.

If the power supply is factory installed, the following applies:
The *Open Style* and *NEMA 4* modules have a 24V power supply and the jumper is always set at +24V. The *Rack Mount* module and the single Netpac *NEMA 2* have a 12V power supply and the jumper is set to 12V.

If you have more than one control card in a *NEMA 4* or *Open Style* multi-module Netpac, a second power supply is required. One supply provides operating power to the analog bus and the other to the digital bus. This configuration prevents ground loops and provides adequate power to both buses.

All Rack Mount multi-modules include a 12V power supply which is sufficient for two control cards.

In the multi-module, the AC power is installed below the module on the inner frame of *NEMA 4* or *Open Style* models. The AC input is routed to the power supply using a switch, also mounted on the inner frame. An LED indicates when power is on.

In the single module, the AC input is routed to the power supply using a terminal strip located next to the power supply.

With the *NEMA 4* enclosure, the switch and LED face you when the frame is closed. If you must open the frame for servicing, make sure the switch is OFF and the LED is not lighted. When two power supplies are required, both have a power input switch and LED.

WARNING! The sensor wiring that connects the input modules can float at hazardous voltage levels even after power is removed.

See Figure 11 below for the power terminal strip.

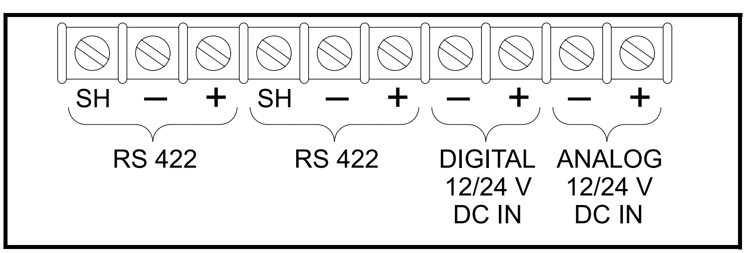


Figure 11: Power Terminal Strip

2.4.2 Customer Installed Power Supply

When using your own DC power, GE recommends a +24 VDC power source with the single Netpac module. This accommodates voltage sags of greater than 10% without affecting the accuracy of the data. A single module dissipates approximately 11W (12.6W at power-up) and a fully loaded multi-module dissipates approximately 34W.

Connect the 115V AC input to TB2, pins 4, 5, and 6, and connect the 24V output to the Netpac power terminal strip. If you are installing two power supplies, connect the AC to screws 1, 2, and 3; screw 1 is grounded.

WARNING! **Do not connect the 115 or 230 VAC cord to the terminal strip or damage will result. See Figure 12 below and Figure 13 on page 18, Netpac Wiring Diagrams.**

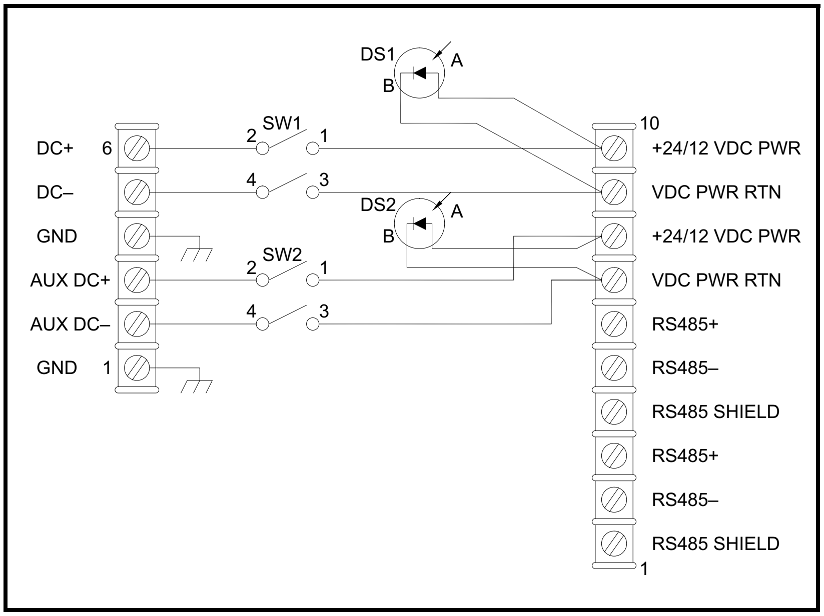


Figure 12: Wiring for Internal Power Supply

If your power supply is external to Netpac, connect the power supply to the DC terminal strip, screws 4, 5, and 6; screw 4 is grounded. If you have two external supplies, connect the second to screws 1, 2 and 3 (see Figure 13 on page 18).

2.4.2 Customer Installed Power Supply (cont.)

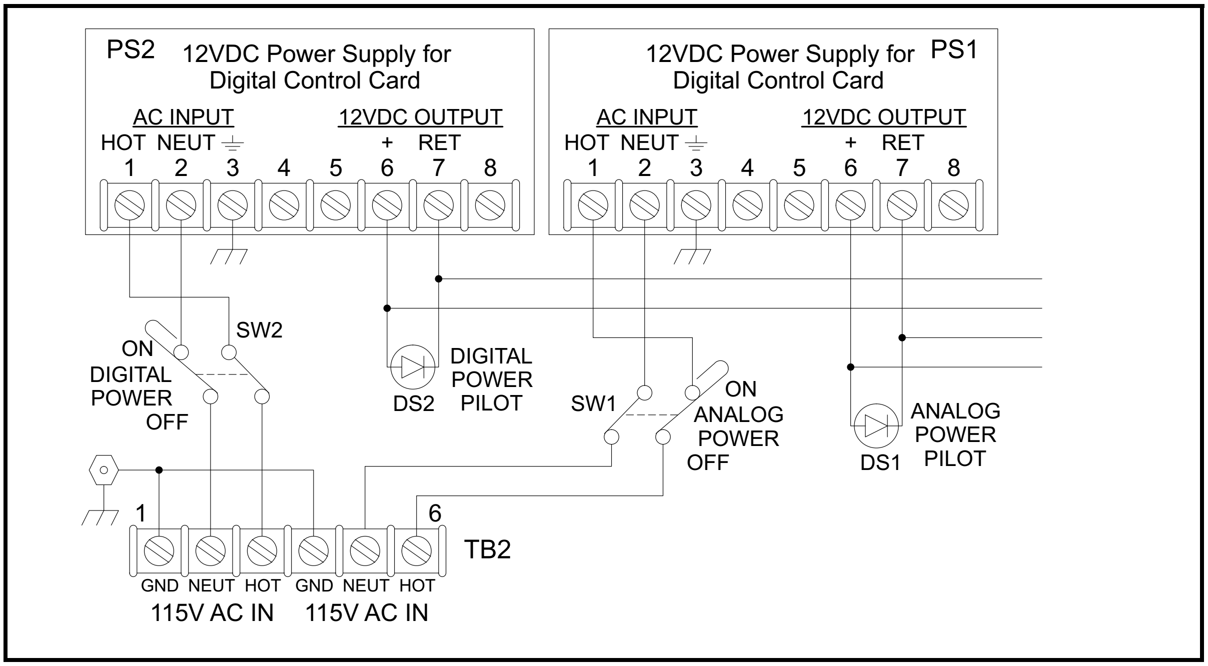


Figure 13: Wiring for External Power Supply

2.4.3 Power Frequency Jumper

The power frequency jumper (P15) sets the timing for analog to digital conversion and indicates how much normal mode noise is integrated out of the data conversion. It reflects the AC power used by surrounding equipment.

PI5 is located at the right rear corner of the analog control card. Install the jumper across the pins that reflect your typical source, 50 Hz or 60 Hz (see Figure 14 on page 19 for the jumper location).

2.4.4 Analog Control Card

The analog control card converts analog signals from thermocouples, RTD's, voltage, and current to a digital representation and transmits the signal to the host. It also processes commands from the host and opens or closes contacts on a contact output card and at TBI on the control card.

This subsection describes how to set the following switch and jumpers on the analog control card, shown in Figure 14 below:

- DIP switch S1
- Power selection jumper (P5)
- Power frequency jumper (P15)
- Baud rate jumper (P14)
- Default resolution jumper (P16)

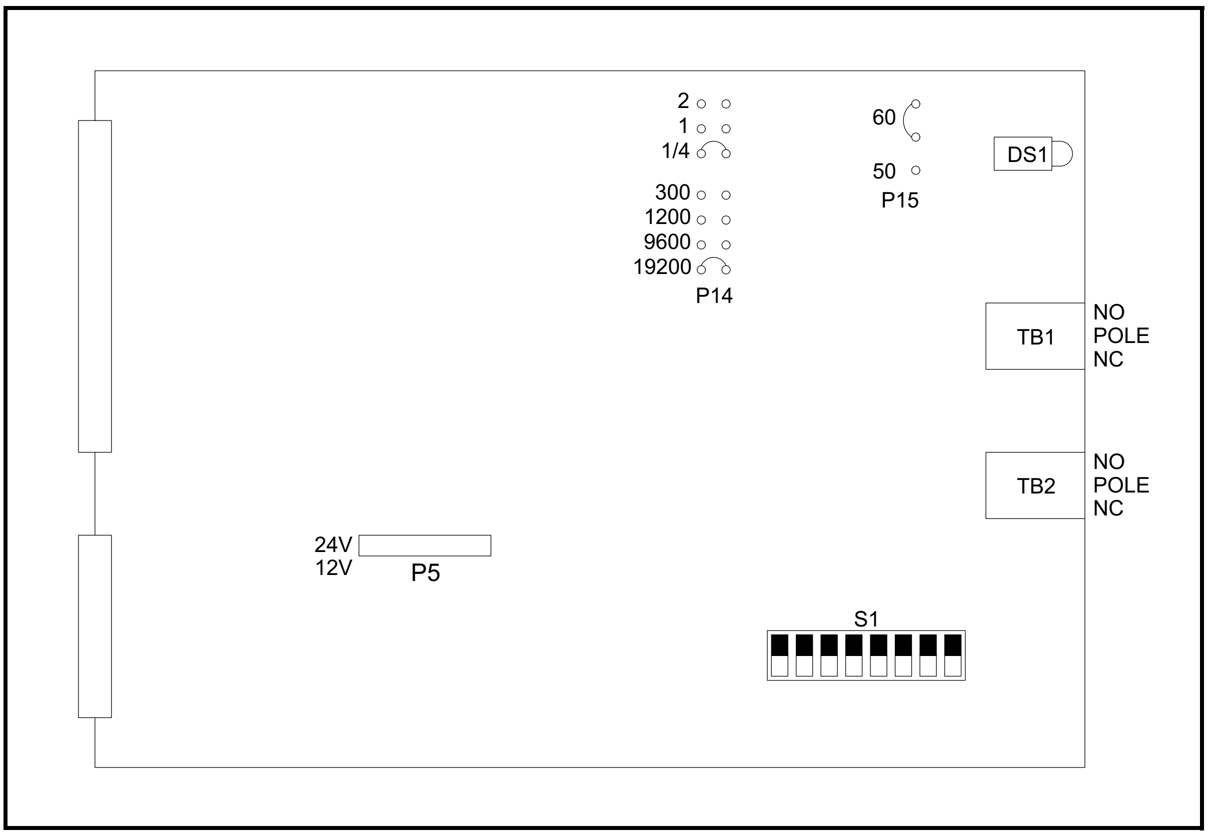


Figure 14: Analog Control Card Components

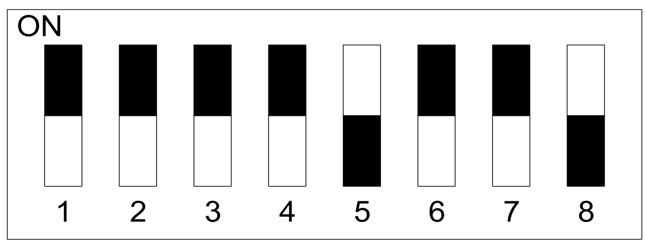
TB1 is a contact output on the analog control card, and TB2 is the watchdog timer. See *DIP Switch S1* on page 20, *Contact Output* on page 34, and the *Contact Actuate <X>* command on page 67, for information.

2.4.5 Dip Switch S1

DIP switch S1 on the analog control card controls the following functions:

Feature	Slide
Netpac module address	1-4
Auto Scan/Calibrate	5
CPU or measurement failure mode for watchdog timer	6
Reset contact outputs at power-up	7
Checksum	8

Sample settings of DIP switch S1 are shown in Figure 15 below. "ON" relates to the imprint on the switch. The blackened areas show switch positions.



Slide	Purpose	Set to
1-4	Module Address	0 0
5	Auto Scan/Calibrate	Continuous Scan
6	Watch Dog Relay	CPU failure mode
7	Contact Output	Latched position
8	Checksum	Enable

Figure 15: DIP Switch S1, Analog Cont. Card, Sample Settings

2.4.5 Dip Switch S1 (cont.)

Module Address: To set a unique address (00-15) for each Netpac module refer to Table 4 below.

Table 4: Setting Module Address for Analog Control Card

Module Address	Slide 1	Slide 2	Slide 3	Slide 4
00	ON	ON	ON	ON
01	OFF	ON	ON	ON
02	ON	OFF	ON	ON
03	OFF	OFF	ON	ON
04	ON	ON	OFF	ON
05	OFF	ON	OFF	ON
06	ON	OFF	OFF	ON
07	OFF	OFF	OFF	ON
08	ON	ON	ON	OFF
09	OFF	ON	ON	OFF
10	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF
12	ON	ON	OFF	OFF
13	OFF	ON	OFF	OFF
14	ON	OFF	OFF	OFF
15	OFF	OFF	OFF	OFF

Auto Scan/Calibrate Slide 5. When enabled, this feature continuously scans all channels and performs a calibration every 25-30 seconds. Scanning consists of measuring, converting and storing the data at each channel. The interval depends on the number of channels programmed, the resolution selected for each channel, and other system activities, such as communications and command processing. GE recommends that you enable Auto Scan/Calibrate by setting slide 5 to OFF.

Auto Scan/Calibrate is supported by the analog control card with firmware revision 1.10 or higher.

2.4.5 Dip Switch S1 (cont.)

Watchdog Timer (TB2) Slide 6. Configures the watchdog timer (WDT) at TB2 on the control card to reset on CPU failure or measurement failure.

CPU failure mode monitors on-board processor malfunctions. To enable CPU failure mode, set slide 6 to ON. If CPU failure mode is selected and a CPU failure occurs, the WDT relay automatically resets the CPU and continues to do so every six seconds unless the CPU responds by clearing the WDT.

Measurement failure mode determines if Netpac is processing measurements. To enable measurement mode failure, set slide 6 to OFF. If you select measurement failure mode with a scan interval greater than six seconds, the WDT relay is de-energized.

With closure, the scan can stop, Netpac failure can occur, or a network cable break or host failure can be the problem.

The watchdog timer is energized at power-up and the normally open (NO) contact TB2 is closed. If the CPU fails or a measurement is not taken, TB2 returns to the open position after six seconds, depending on the mode you selected.

Note: *The WDT relay is de-energized at power loss.*

Contact Output Reset (TB1) Slide 7. Specifies what happens at power-up to the contact outputs on the contact output cards as well as to local contact output at TBI (the contact output on the analog control card).

If you set slide 7 to OFF, all contact outputs, including TBI, reset to their normally open, normally closed positions at power-up.

If you set slide 7 to ON, all contact outputs, including TBI, remain at the position they were in at the time of power loss.

Checksum Slide 8. To enable checksum, set slide 8 to OFF; to disable it, set it to ON. You must enable checksum if you are using Netpac with a GE datalogger or KVIEW.

2.4.6 Power Selection

See *Factory Installed Power Supply* on page 16 for information on setting the power selection jumper.

2.4.7 Baud Rate Jumper

The baud rate jumper (P14) is located to the right of center on the control card. Install the jumper next to the baud rate you want (300, 1,200, 9,600 or 19,200).

2.4.8 Default Resolution Jumper

The default resolution jumper (P16) is located above the baud rate jumper. It sets the default resolution for all input channels associated with the analog control card. Higher resolutions require more processing time for greater accuracy and yield fewer samples per interval time.

Select the appropriate setting:

Jumper Setting	Bits Plus Sign	Default Resolution
2 line cycles	14	High
1 line cycle	13	Medium
¼ line cycle	11	Low

When you program individual channels, you can override the jumper-selected resolution on a channel-by-channel basis. Channels that are not programmed for a resolution assume the jumper setting as a default.

2.4.9 I/O Cards for Analog Control Card

The I/O cards associated with the analog control card do not require any jumper or switch settings.

2.4.10 Voltage

Normal Mode. Refers to the difference in potential between the high (+) and low (–) input terminals of the input module. You are usually measuring the sensor voltage, such as a thermocouple or RTD.

In Figure 16 on page 24, normal mode voltage is the 1.5V output of the battery. Noise picked up by your sensor or cables increases or decreases the sensor normal mode voltage at the moment the reading is taken.

Common Mode. (AC or DC) Refers to identical voltage going to both terminals. Frequently caused by large currents flowing in the ground path between your sensor and the measuring device, common mode voltage decreases reading accuracy. Check your sensors to assure that common mode voltage cannot occur.

For example, if you connect a grounded thermocouple to the field windings of a 115 VAC motor to measure winding temperature, you could apply a common mode voltage of 115 RMS (about 162V peak). Since the system is guarded, it rejects common mode voltages, both AC and DC, and measures only the sensor voltage. Using the AC motor as an example, you do not usually find errors in the temperature measurement, even though the AC common mode voltage is many times greater than the thermocouple normal mode voltage.

WARNING! Since sensors can be floated at hazardous voltage levels, disconnect all power prior to handling any sensor leads. Failure to heed this warning could result in personal injury.

In Figure 16 below, common mode voltage equally raises the absolute voltage at the high and low terminals.

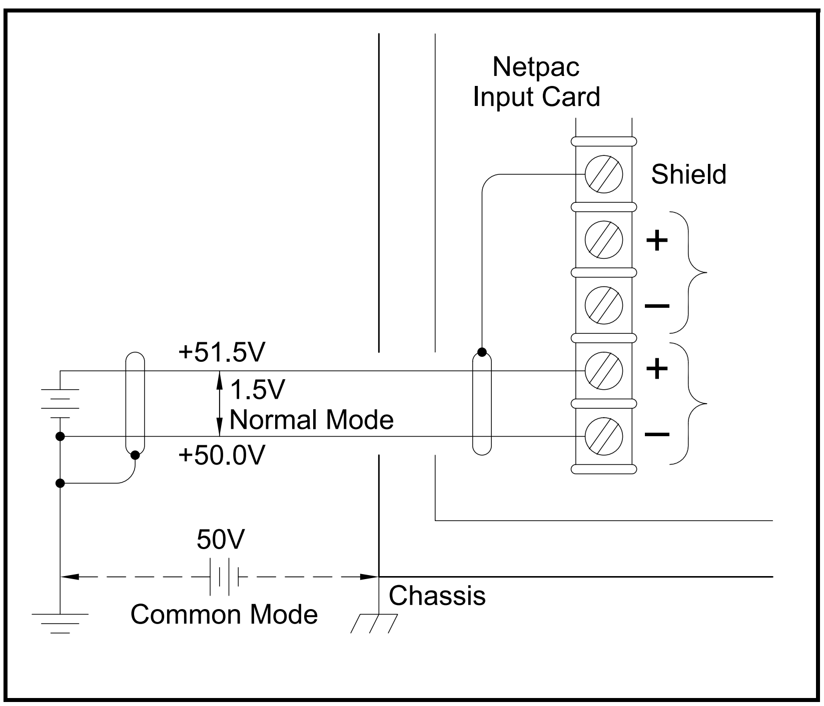


Figure 16: Normal/Common Mode Voltages

2.4.10 Voltage (cont.)

Limitations. To prevent damage to your signal input mode, GE recommends you follow this rule:

CAUTION! Never apply a voltage greater than 115V peak between any two input leads (high, low, or shield). The maximum difference in common mode voltage between any two channels on a card must not exceed 250V peak, and from card to card or card to ground frame must not exceed 350V. Failure to heed this caution could result in permanent damage to the input modules.

Connections. See Figure 17 on page 26 for voltage connection diagrams. Use the two-wire multi-purpose input card whenever the input signal is 10 VDC or less. Connect the sensor lead with the more positive potential to the (+) terminal and the lead with the less positive potential to the (–) terminal. If you reverse these leads, the system measures the Input signal indicating the opposite polarity.

WARNING! To protect yourself and the equipment, always disconnect sensor voltages before handling signal cables. The sensors can be floating at some high potential. Failure to heed this warning could result in personal injury.

The two-wire Netpac is fully shielded. However, the shield is not switched as channels are accessed. Give careful consideration to the connection of the source to the input card. Improper connection can generate ground loops, cause inaccurate readings, or be harmful to the equipment.

- Two-Wire, Unshielded. If you are using two-wire, unshielded cable to connect the source to the input card, connect the more positive lead to the (+) terminal and the less positive lead to the (–) terminal. Leave the shield terminal of the input card unconnected.
- Two-Wire, Individually Shielded. If the sources are at the same common mode potential, connect the shield of one source to the less positive lead as close to the source as possible. Leave the other shields unconnected at the source end. At the input card, connect all shields together and then make a common connection to the shield (SH) terminal.

If the sources are at different common mode potential, connect the shield to the (–) terminal of the channel at the input card. At the source, do not leave a shield terminal unconnected. Alternatively, reverse this configuration by connecting the shield to the source, but do not connect it at the input card.

CAUTION! In either of the previous cases, never connect both ends of the shield at the same time.

- Two-Wire, Shielded Wire Bundles. If you are using 20 twisted wire pairs within a single shield, the same rules apply as for two-wire, individually shielded cable.
- Three-Wire, Individually Shielded. The three-wire input card has a switched shield connection for each channel. When the common mode source has a high impedance, connect the shield to the low side as close to the source as possible. This allows most of the common mode current to flow in the shield leg and bypass input.

When the common mode source has a low impedance to the high input, connect the shield to the high side at the source. If you are not using a remote guard connection, connect the jumper at the shield to the low input. Do not allow the shield to float.

2.4.10 Voltage (cont.)

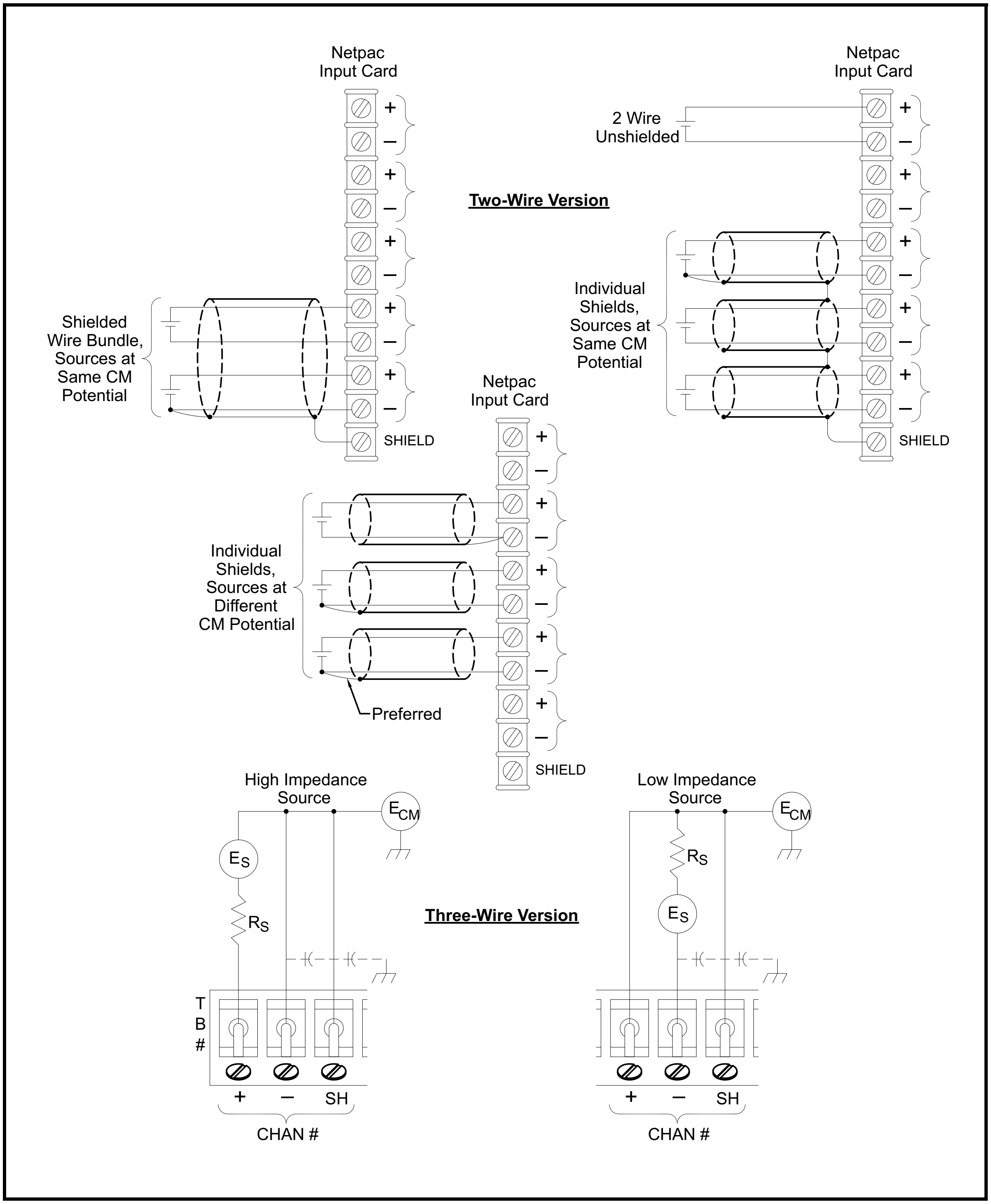


Figure 17: Voltage Connections

2.4.10 Voltage (cont.)

Connections (cont.).

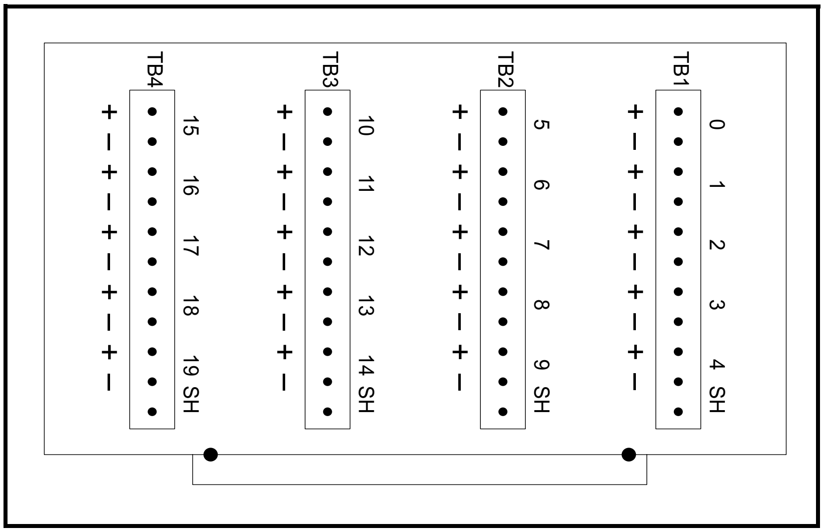


Figure 18: 2-Wire Volts - Thermocouple Input Card

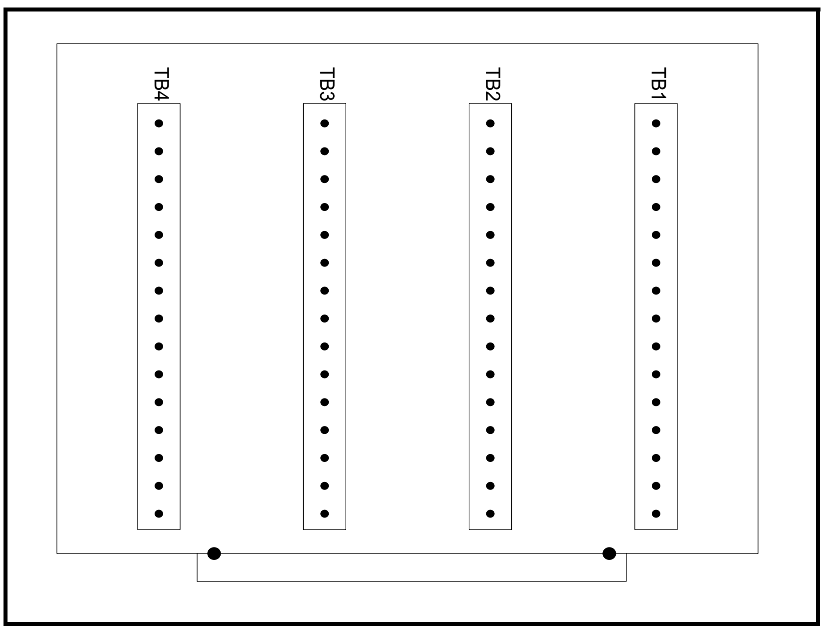


Figure 19: 3-Wire Volts - Thermocouple Input Card

2.4.11 High Voltage Input

If the input card is configured for high voltage inputs, the factory removes jumper JUI on the input card and places a 150:1 resistive divider network in series with the input signal. The system measures the lower voltage, multiplies the result by 150, and transmits the data in engineering units that reflect the actual input.

To adjust the driver network, apply a known voltage to a single channel, access that channel in a continuous mode, and adjust potentiometer R22 for the known input voltage.

Note: *When jumper JU1 is removed and the divider installed, all input channels are subject to the divider action. Low and high level signals cannot be mixed on the same input card.*

2.4.12 Thermocouples

You can intermix thermocouple types on a single input card. Figure 20 below shows thermocouple connections. Table 5 and Table 6 on page 29 show the material, color code, and polarity of the common thermocouple types. See Appendix A for thermocouple specifications.

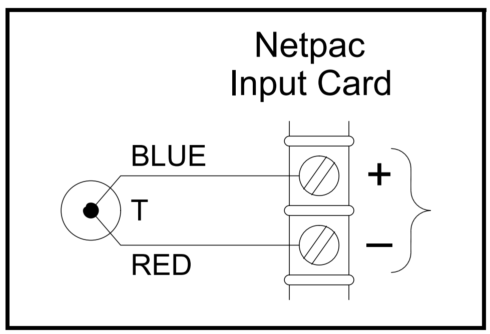


Figure 20: Thermocouple Connection

Calibration. lnput card calibration compensates for the temperature of the uniform temperature plane (UTP) at the input termination. When measuring the input from the thermocouple, the system first measures the temperature of the UTP and stores the result. It then measures the thermocouple input, subtracts the offset, and converts the remainder to engineering units.

The adjustment is factory set, but to check or calibrate the input card, place one thermocouple from each input card into an ice bath until the temperature stabilizes. Access the channel in a continuous mode for a 0°C or 32°F reading on that channel. Repeat this procedure for each input card.

2.4.12 Thermocouples (cont.)

Table 5: Thermocouple Color Code

ANSI Symbol	Material	Color	Polarity
J	Iron	White	+
	Constantan	Red	–
K	Chromel	Yellow	+
	Alumel	Red	–
T	Copper	Blue	+
	Constantan	Red	–
E	Chromel	Purple	+
	Constantan	Red	–
R	Platinum	Red	+
	10% Rh/Pt	Black	–
S	Platinum	Red	+
	13% Rh/Pt	Black	–
B	Platinum 6% Rh	Red	+
	Platinum 30% Rh	Black	–

Table 6: Thermocouple Extension Wire Color Code

ANSI Symbol	Material	Color		Polarity
		Single	Duplex	
JX	Iron	White	White	+
	Constantan	Red-White	Red	–
KX	Chromel	Yellow	Yellow	+
	Alumel	Red-Yellow	Red	–
TX	Copper	Blue	Blue	+
	Constantan	Red-Blue	Red	–
EX	Chromel	Purple	Purple	+
	Constantan	Red-Purple	Red	–
SX	Copper	Black	Black	+
	Alloy/ 16 11	Red-Black	Red	–

2.4.13 RTD's

RTD's are typically made from copper or platinum and have nominal resistances of 10 or 100 Ω. See Appendix A for RTD specifications.

The three-wire RTD has terminal connections for only the high (+), low (–), and shield on a per-channel basis. The input card contains precision completion resistors for three legs of a bridge circuit (the fourth leg is the RTD) and has a precision voltage source to supply excitation current. See Figure 22 below for a typical connection diagram. Lead length compensation is provided if both signal leads are the same length.

A 4-wire RTD input has a constant current source to provide excitation to the RTD. Signal high (+) and low (–) and positive and negative excitation are switched using photovoltaic relays on a per-channel basis. The 4-wire configuration provides the highest accuracy by eliminating the lead resistance effect.

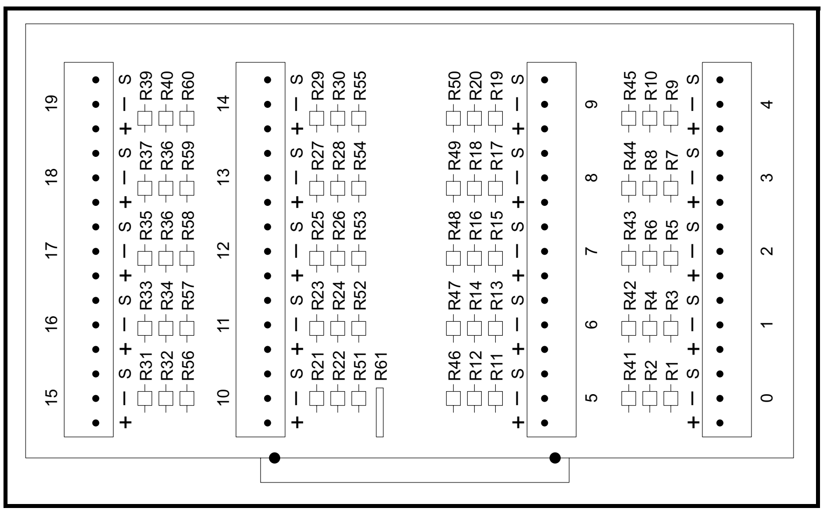


Figure 21: 3-Wire RTD Input Card

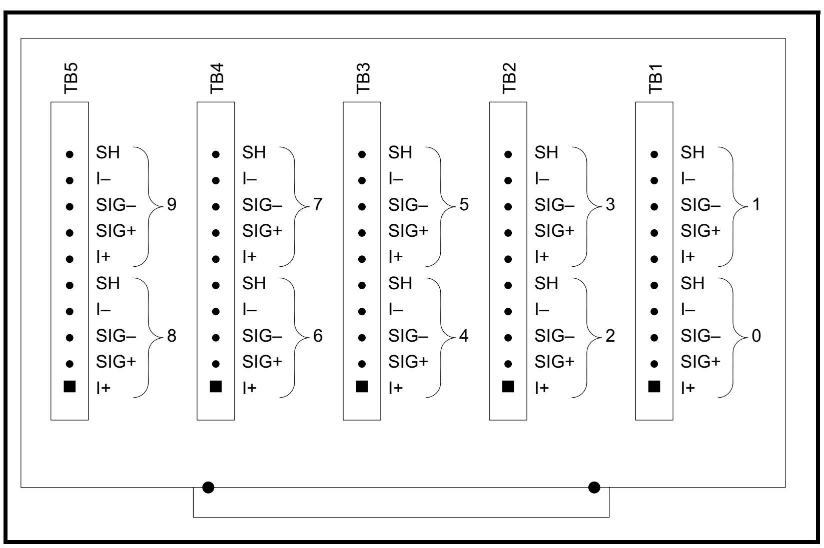


Figure 22: 4-Wire RTD Input Card

2.4.13 RTD's (cont.)

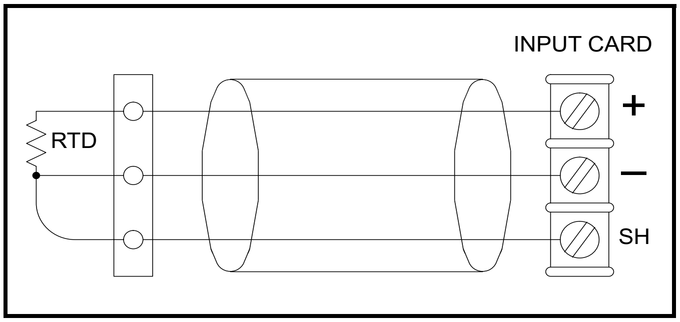


Figure 23: Typical RTD Connection

If your RTD is a two- or three-wire plus shield, connect the RTD as shown in the alternate connection diagram, Figure 24 below. In a three-wire configuration, the shield must connect to the minus (–) signal lead at the RTD. The third wire connects to the shield terminal of the input card. Do not leave the shield lead unconnected in either the two- or three-wire configuration.

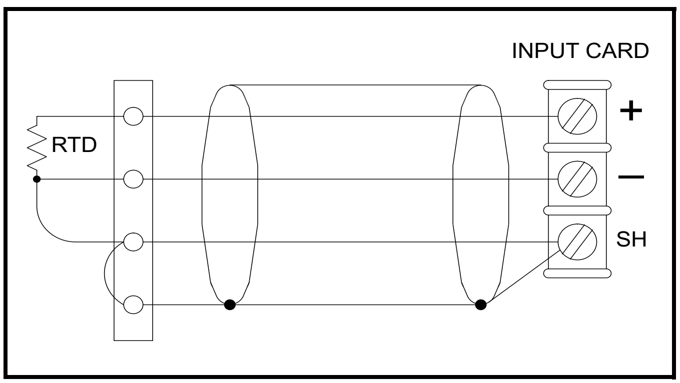


Figure 24: Alternate RTD Connection

The following paragraphs describe how to connect 2-, 3-, or 4-wire RTD's to a 4-wire input card.

The leads of most 3-lead RTD's are labeled A, B, and C. If your RTD is labeled this way, connect the two common leads to terminals (–) and (1–). Connect the other lead to (+). Add a fourth lead, and connect it to the single lead, as close to the RTD as possible. Connect the added lead to (1+) terminal. Since the current source is referenced to shield, connect the RTD sheath or shield to the (SH) terminal, as shown in Figure 25 on page 32, and terminate it at the source.

2.4.13 RTD's (cont.)

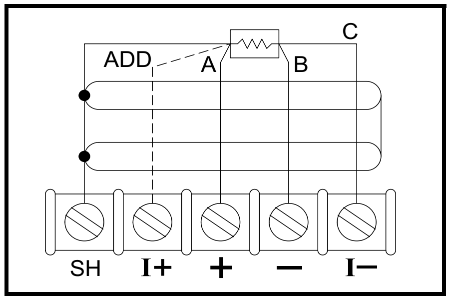


Figure 25: 3-Wire RTD to 4-Wire Input Card

For a four-lead RTD, you must connect the two leads at one end to (+) and (I+). Connect the other two lines to (–) and (I–) Connect the sheath or shield to the (SH) terminal as shown in Figure 26 below.

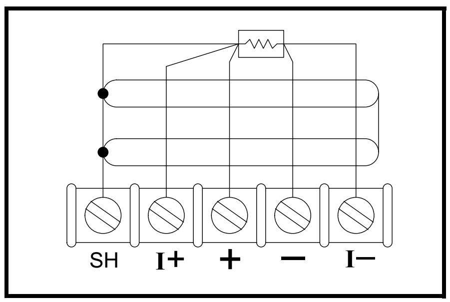


Figure 26: 4-Wire RTD to 4-Wire Input Card

For a two-lead RTD, you must connect an extra lead to both sides of the RTD (create a 4-lead RTD), and connect as shown in Figure 27.

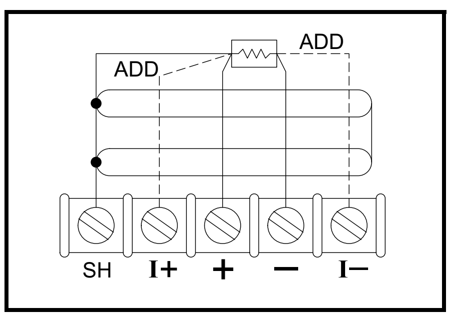


Figure 27: 2-Wire RTD to 4-Wire Input Card

When using either of the three-wire input cards, RTD measurements occur when you electrically place the RTD into a bridge circuit as one-quarter of the bridge. Excitation is supplied to the bridge and any changes to the resistive device are recorded as changes in temperature using resident software routines.

A constant current source provides excitation to the RTD, eliminating any line drops caused by lead resistance. Signal high (+) and low (–) and positive and negative excitation are switched using photovoltaic relays on a per-channel basis. The 4-wire configuration provides the highest accuracy by eliminating the lead resistance effect.

2.4.13 RTD's (cont.)

Calibrate the standard accuracy input and multiplex card by connecting a precision resistor equal to the ohmic value of the RTD (for 0°C) across the plus, minus, and shield terminals of the input module. Access the assigned channel in a continuous mode and adjust Rl for a reading of 0°C or 32°F.

The full bridge per channel, high accuracy input and multiplex cards are made with precision resistors and require no calibration. Higher accuracy is obtained without switches in the bridge circuit when a bridge-per-channel configuration is used.

The four-wire constant current input and multiplex pair are factory calibrated. However, R1 on the input card is provided in the event calibration is necessary.

2.4.14 Current Transmitters

A current transmitter is a signal conditioner that converts the output from a sensor to a proportional current. Most current transmitters produce an output of 4-20 mA, 10-50 mA or 0-1 mA. The manufacturer usually provides calibration controls on the transmitter for setting zero (4 or 10 mA) and full scale (20 or 50 mA).

The input card provides the resistive terminations for use with either current transmitter. This termination is a 25-ohm, 0.05 percent resistor. These resistors are labeled R0 (channel zero) through R19 (channel 19). Refer to Figure 24 on page 31 and insert them as required.

Data readout from a current transmitter is recorded as percent of full scale. If you use a 4-20 mA current transmitter, the readout is 70 percent, the amount of current is actually 15.2 mA (0.7 times the range of 16 mA, plus the offset of 4 mA). As shown in Figure 24 on page 31, two terminals, usually labeled (+) and (–), are provided on the current transmitter for connection to a DC power supply when placed in series with the measuring device.

In this system, the input module is considered the measuring device. Use a power supply recommended by the current transmitter manufacturer. Connect the transmitter, DC power supply, and input module.

Shielded cables are not usually required with current transmitters. Connect the jumper at the shield terminal to either the (+) or the (–) terminal on the input module.

2.4.14 Current Transmitters (cont.)

If you have a current input coming into a channel, install and solder a 25-ohm shunt resistor to the card at the resistive ("R") termination for the corresponding channel. The current transmitter supplies a proportional current and the system measures the voltage drop across the resistor. (If you expect to reconfigure the channel and do not want to solder the resistor, install the resistor under the channel screw terminals, between the plus and minus screw terminals.) Figure 28 below illustrates a resistor soldered at R4 for channel 4 input.

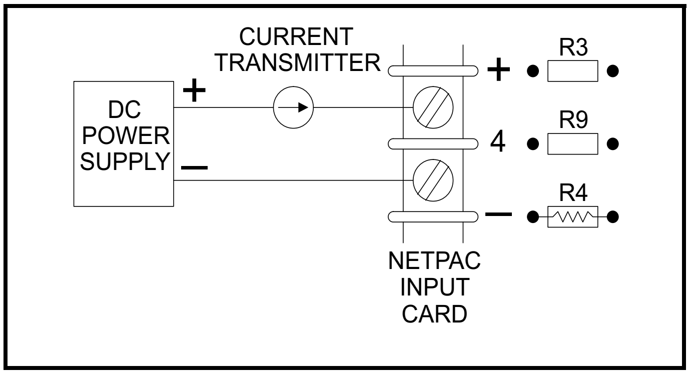


Figure 28: Current Transmitter Connection w/ 25Ω Shunt Resistor Soldered at R4

2.4.15 Contact Input

Connect the leads directly to the contact input terminals as shown in Figure 29 below. External power is not used to monitor the status.

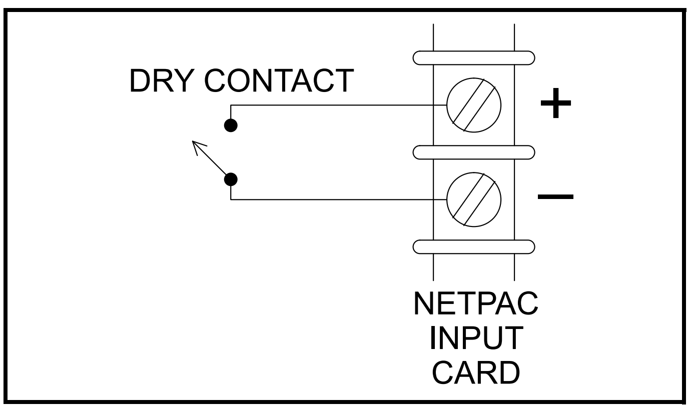


Figure 29: Contact Status Input Connection

2.4.16 Contact Output

The contact output on the analog control card is called TB1. A Watch Dog Timer contact, also on the analog control card, is called TB2. With the analog control card, you can add contact output cards.

TBl is activated based on whether you select measurement or CPU failure at DIP Switch S1, Slide 6 (see *DIP Switch S1* on page 20) or use the <X> command for contact actuate (see Chapter 3, *Command Protocol*).

2.4.16 Contact Output (cont.)

Contact output cards are the same physical size as standard input cards and consist of a two-card set. The card with the output wiring terminal strips is a Contact Output card, while the other is a Contact Select card. Each Contact Output card accommodates up to 20 channels.

Each channel on the Contact Output card has three terminals that connect internally to a form C relay rated 2A at 30 VDC and 0.6A at 125 VAC resistive load. These relays are mechanically latched. Consider the characteristics of the load before you connect the relays.

- If the load is resistive and within the specifications of the relays, no additional components are required.
- If the load is inductive and within the specifications of the relays, follow the instructions below.
- If the load exceeds the relay specifications, an intermediate relay is required. Verify that the contacts at the intermediate relay support the load. Apply the design rules discussed below to protect the output of the intermediate relay.

The intermediate relay coil presents an inductive load to the Contact Output card. Follow the instructions below for hooking up an inductive load. We recommend that you use DC to drive the load. It produces less noise than AC.

Also, make sure you keep control wiring and power wiring separate. Never put them in the same conduit. Use the maximum separation allowable.

After you connect the relay outputs, always test the system under full load to make sure that there is no interference to the rest of the system. Symptoms of interference include jumpy or intermittent analog inputs.

2.4.16 Contact Output (cont.)

AC Voltage --Inductive Load. Place a shunt across the load at the source of the noise, but never across the terminals of the contact output card. See Figure 30.

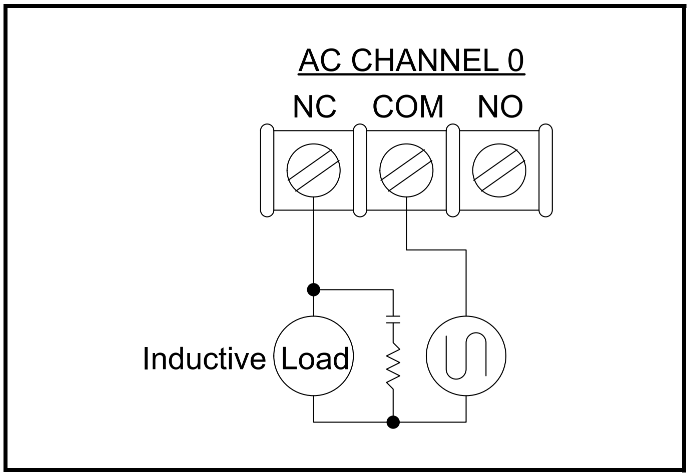


Figure 30: AC Voltage Connection

Use this guide to help you select the values of C and R:
R is 0.5 to 1Ω per 1V contact voltage
C is 0.5 to 1µF per 1A contact current

The capacitor acts to suppress the discharge the moment the contact opens. The resistor limits the current at the next power-up. Use AC type capacitors.

DC Voltage -Inductive Load. Place a diode (D) across the load at the source of the noise but never across the terminals of the contact output card. See Figure 31.

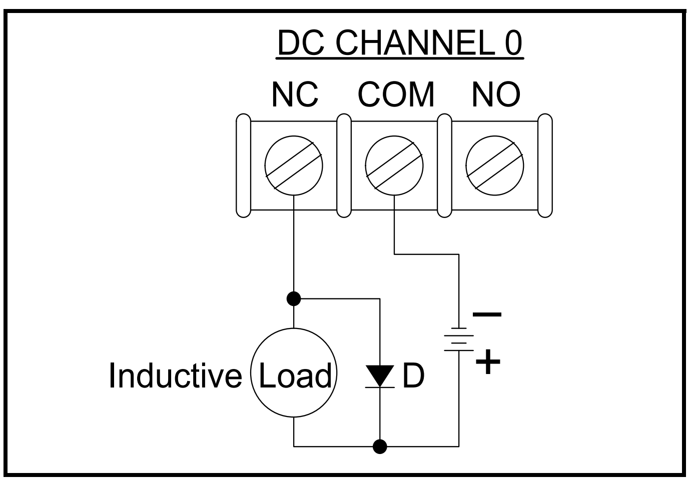


Figure 31: DC Voltage Connection

The diode, that is connected in parallel, causes the energy stored in the load to dissipate as joule heat in the resistance component of the inductive load.

2.4.16 Contact Output (cont.)

Acknowledged Contact. When you program a contact output from a GE datalogger, you can select either an acknowledged or non-acknowledged contact.

If you select acknowledge, the contact actuates whenever the programmed alarm condition occurs. Press <ACK> on the datalogger front panel (or from the computer for an AutoLink host) to silence the audible alarm and deactivate any such contact closure in alarm. If the alarm condition still exists at the next scan, the contact does not actuate and only reactuates on a new alarm condition.

Non-Acknowledged Contact. If you select non-acknowledge, the contact actuates whenever the programmed alarm condition occurs, and deactivates only when the alarm condition clears.

DIP Switch S1, slide 7, on the analog control card, affects the contact outputs. Refer to *Analog Control Card* on page 19.

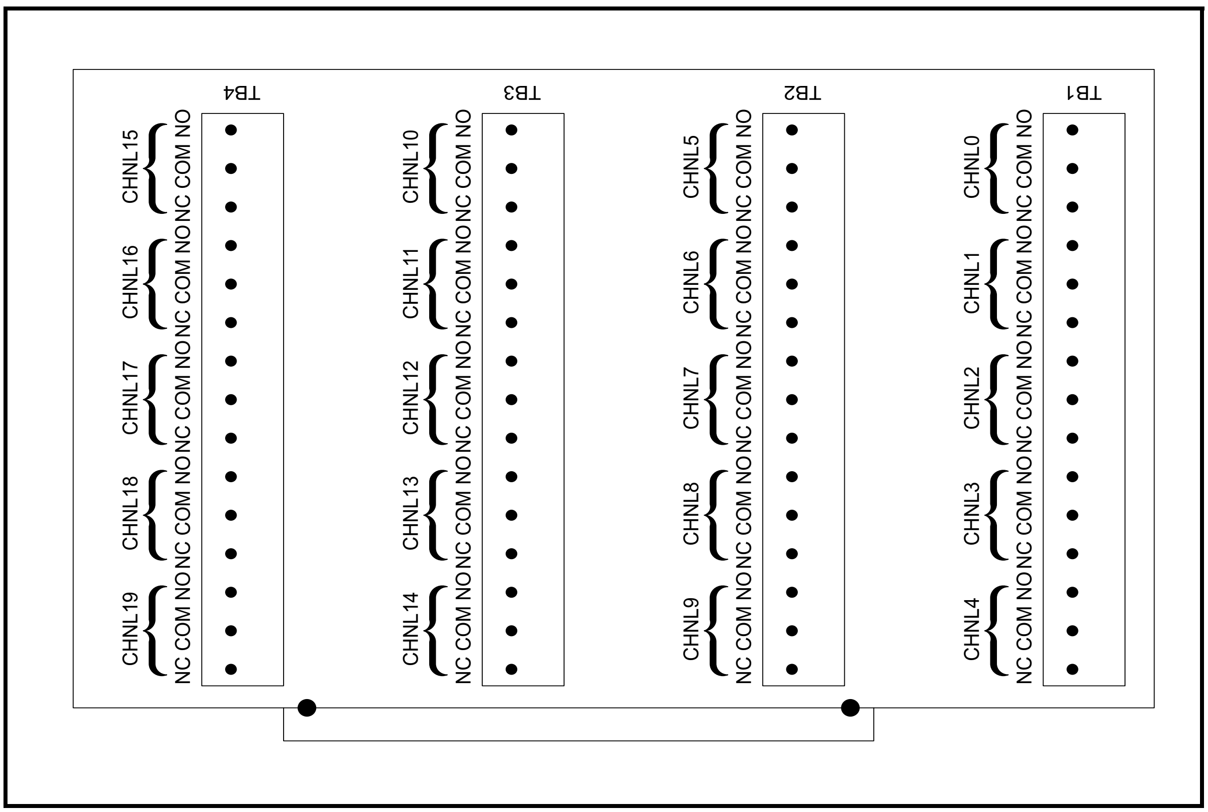


Figure 32: Contact Output Card Components

2.5 Digital Control Card

A digital control card supports up to five digital input/analog output cards with up to 50 channels of I/O.

This subsection describes how to set the following switches and jumpers on the digital control card, shown in Figure 33 below:

- DIP switch S1
- Power selection jumper
- Baud rate (JU5)

Settings for I/O cards associated with the digital control card are also given in this subsection.

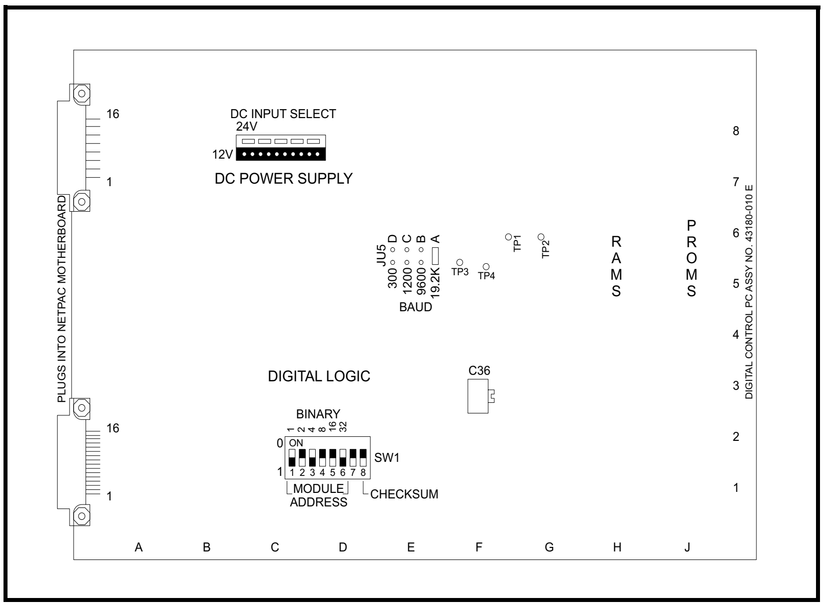


Figure 33: Digital Control Card

2.5.1 DIP Switch S1

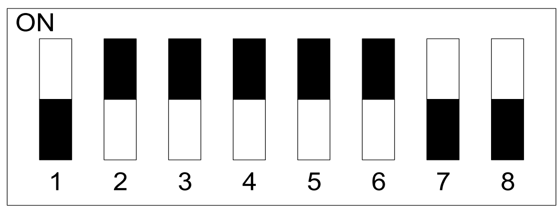
The eight-position DIP switch S1, located on the digital control card, sets the module address and controls checksum.

Module Address. Set the module address at slides 1 to 6 of DIP Switch S1. You have 64 (00-63) addresses available. Table 4 on page 21 shows how to set the module address for the analog control card. You set the module address for the digital control card in the same manner, except there are two additional slides (5 and 6) to access modules 16-63.

Note: *Slide 7 is not used.*

Checksum - Slide 8. To enable checksum, set slide 8 to OFF; to disable, set it to ON. You must enable checksum if you are using Netpac with a GE datalogger or with KVIEW.

Sample settings of DIP switch S1 are shown in Figure 34 below. "ON" relates to the imprint on the switch.



Slide	Purpose	Set to
1-6	Module Address	Module 01
7	Not Used	--
8	Checksum	Enable

Figure 34: Dip Switch S1 with Sample Settings

2.5.2 Power Selection

See *Factory-Installed Power Supply* on page 16 for information on selecting the jumper setting, and Figure 33 on page 38 for location of the jumper, labeled "DC Input Select."

2.5.3 Baud Rate

The baud rate jumper, JU5, is located near the center of the digital control card. Install the jumper at the position setting you want:

A = 19,200 B = 9600 C = 1200 E = 300

2.5.4 I/O Cards

This is the digital input card used with the digital control card. To make input connections to the 10-channel card, connect the high and low leads from the source to the plus (+) and minus (–) terminals of a selected input channel.

Circuit Configurations: The F/P/S/T card is configured at the factory for one of the five types of circuit configurations listed in Appendix A, *Specifications*. Configurations are shown in Figure 30 on page 36. The output of F/P/S/T is normalized to provide a signal of close to +5 volts.

At the slide switch on this card, shown in Figure 36 on page 42, set the card address, frequency range code, and period range code.

Card Address: Set the address at slide 5, 6, and 7. In a single module, always set the I/O card to 0.

Address	Slide 5	Slide 6	Slide 7
0	ON	ON	ON
1	OFF	ON	ON
2	ON	OFF	ON
3	OFF	OFF	ON
4	ON	ON	OFF

Frequency Range: Set the range at slides 1 and 2 of the eight-slide switch.

Slide 1	Slide 2	Resolution	Range Code
ON	OFF	1 Hz	0-65535 Hz
OFF	ON	0.1 Hz	0-6553.5 Hz
ON	ON	0.01 Hz	0-655.35 Hz

Period Range: Set the range at slide 3 and 4.

Slide 3	Slide 4	Period	Netpac Range
ON	ON	1 ms	1-65535 ms
OFF	ON	0.1 ms	0.1-6553.5 ms
ON	OFF	0.01 ms	0.01-655.35 ms
OFF	OFF	0.001 ms	0.001-65.535 ms

See Appendix A, *Specifications*, for maximum time to measure for frequency and period.

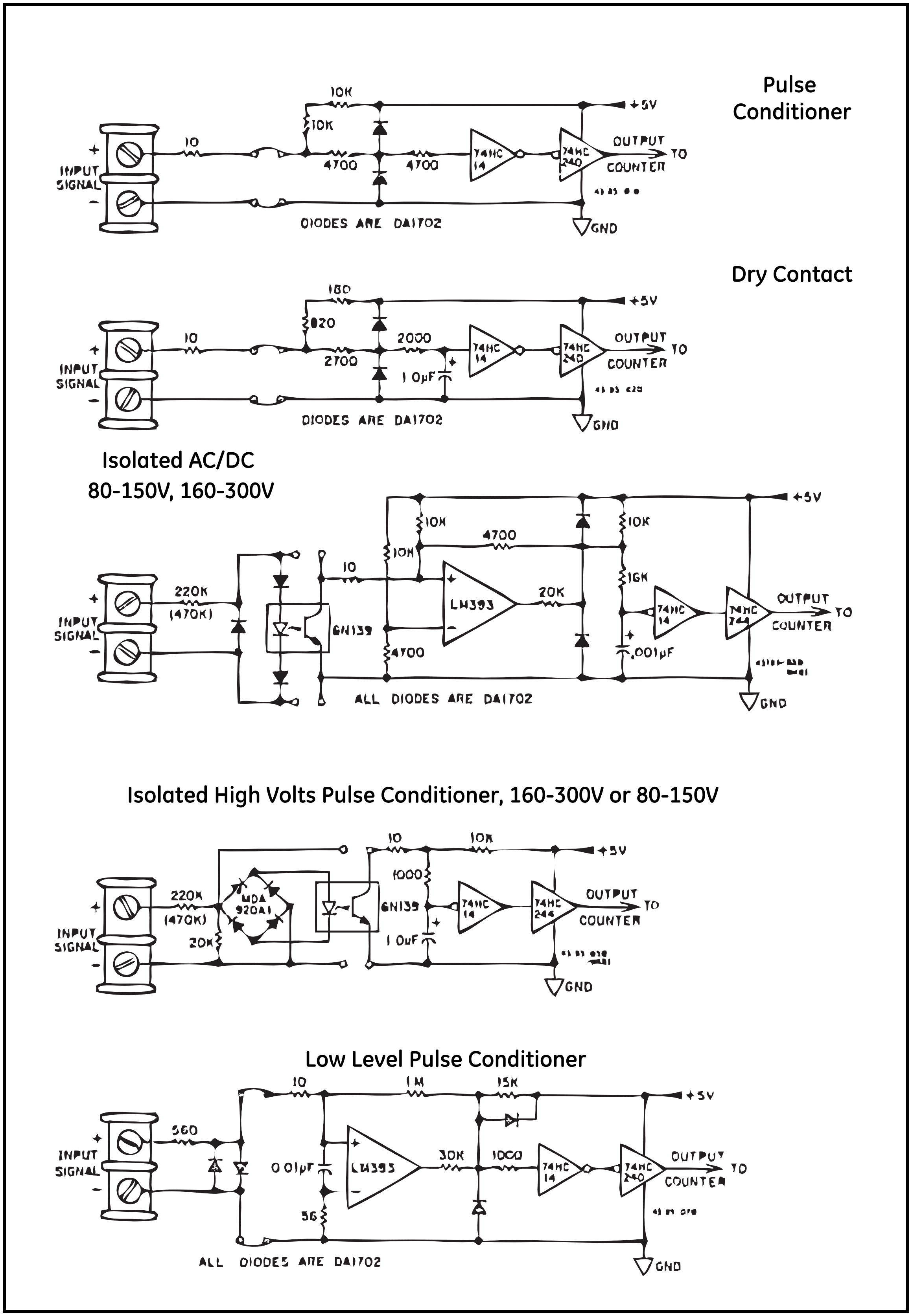


Figure 35: Frequency/Period/Status/Totalize Card Configurations

2.5.4 I/O Cards (cont.)

The Frequency/Period/Status/Totalize card set is made up of two cards. The pulse conditioner card takes the inputs, and the pulse counter card holds the DIP switch.

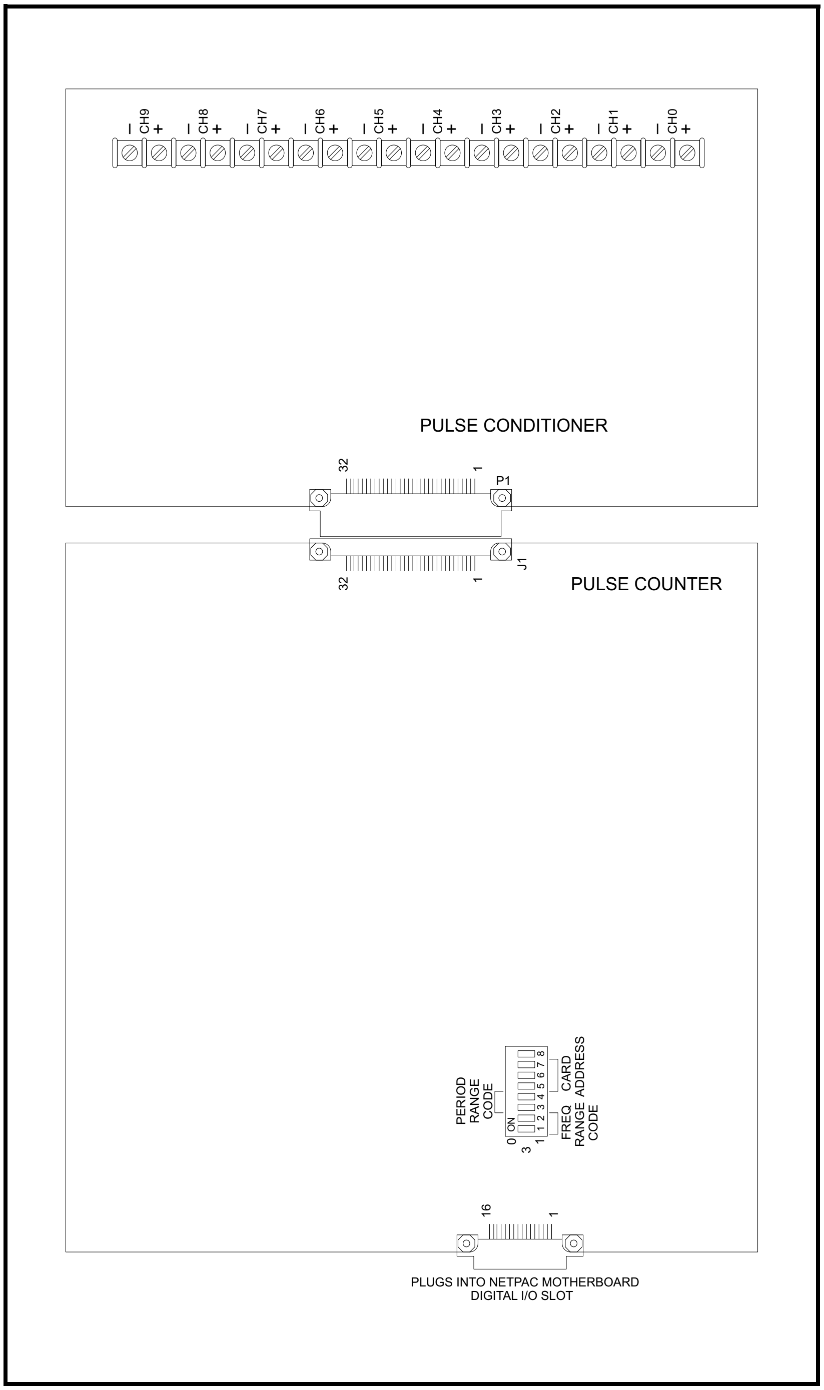


Figure 36: Frequency/Period/Status/Totalize Card

2.5.5 Analog Output

Each card supports five analog channels (0-4), and has a selectable card number (0-4). It provides four individually isolated current or voltage outputs: 0-5V, 0-10V, 1-5mA, and 4-20mA (see Figure 37 below).

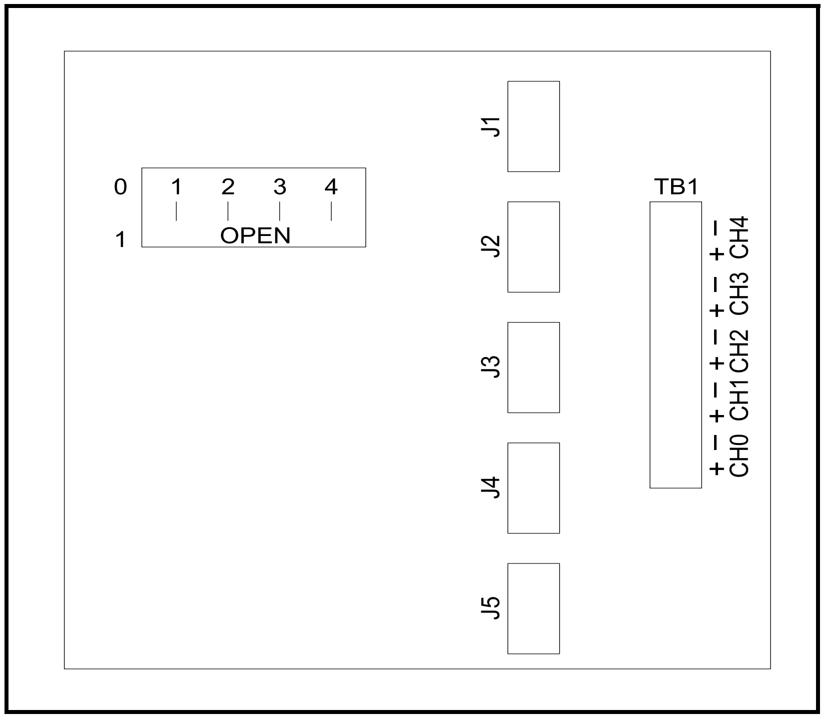


Figure 37: Analog Output Card

Card Address: Set the address at slides 1 to 3 of the four-position switch S1. Slide 4 is not used. In a single module, always set the address to 0.

Address	Slide 1	Slide 2	Slide 3
0	OPEN	OPEN	OPEN
1	CLOSED	OPEN	OPEN
2	OPEN	CLOSED	OPEN
3	CLOSED	CLOSED	OPEN
4	OPEN	OPEN	CLOSED

Connector TB1: Wire the analog output device to the 10-pin plug provided with the connector, and reconnect the plug to pins. Leads include output device (+) and ground (–). Figure 37 above shows the connector with a wired plug.

Voltage or Current: Set the ranges for each of the five channels on jumpers J1 to J5: 0-5V, 0-10V, 1-5mA, and 4-20mA.

Output is set as a percentage of the selected range. See Figure 38 on page 44 for Analog Output jumper ranges.

2.5.5 Analog Output (cont.)

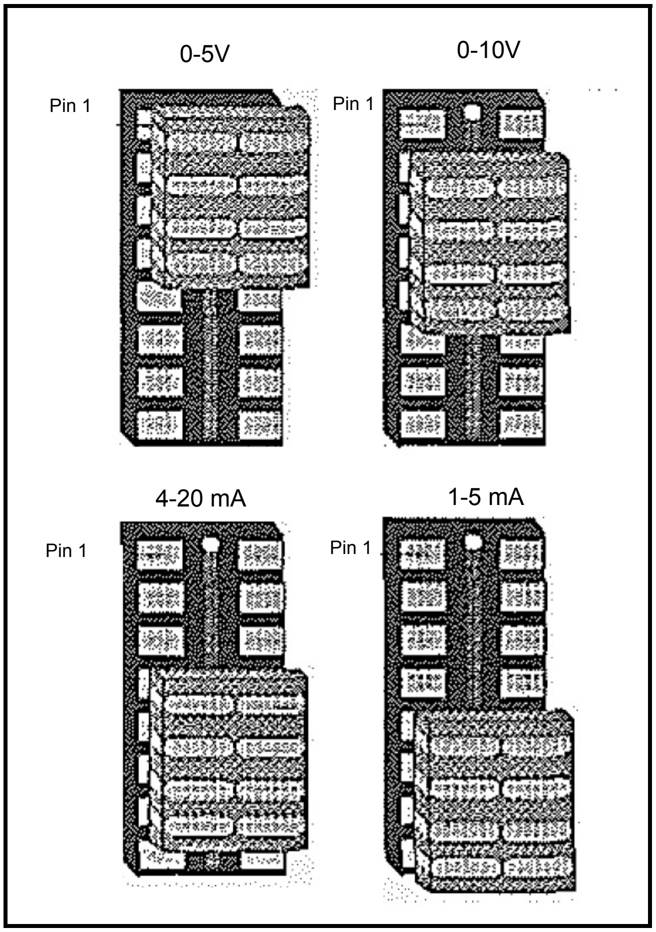


Figure 38: Analog Output Jumper - Setting Voltage/Current

Initialization: When you first apply power, the digital control card checks for installation of an analog output card before setting all channels to their minimum output value.

Calibration: As shown in Table 7 below, each analog output channel has a full scale SPAN and OFFSET adjustment, and a full scale jumper. When adjusting the voltage output, use only the SPAN potentiometer. To adjust the span, install the full scale jumper, adjacent to the potentiometer, and set to full scale using the SPAN adjustment. To set the offset, remove the jumper and rotate the OFFSET potentiometer until you find the proper offset.

Table 7: Analog Output Card Configuration

Channel	Pulse	Span	Offset	+Pin	–Pin	RS Jumper
0	F5	R94	R93	1	2	JU26
1	F4	R76	R75	3	4	JU21
2	F3	R58	R57	5	6	JU16
3	F2	R40	R39	7	8	JU11
4	F1	R22	R21	9	10	JU6

2.6 System Cabling

Netpac modules use a shielded, single twisted pair of wires to communicate to the host computer or GE datalogger. Communication is in engineering units.

Note: *Proper operation of the system requires that termination of the resistor match the characteristic impedance of the cable. An external terminator is not required at the host end when the Ten/60 is the host. The terminator is built into the interface assembly.*

Establish communication between the host and Netpac modules with a modified, half-duplex RS-485 serial interface on a two-wire bus. (Older versions of the Netpac backplane are silk screened with 422– and 422+. The new version is silk screened with 485A and 485B.) Figure 2-34 shows the power terminal strip that is mounted on the backplane of the single and multi-module.

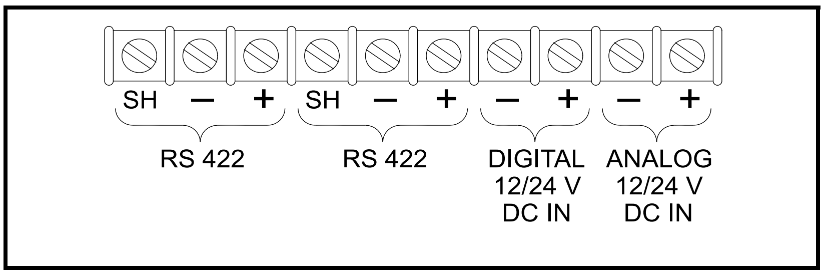


Figure 39: Power Terminal Strip

2.6.1 Host Connections

If you are connecting the host to either a single or multi-module, connect the RS-485 input to the three connectors (+, –, SH). If you are connecting the host to a group of modules, connect the cable from the host to one set of terminals, and then connect the next module in the series to the other set of communications terminals. Continue this wiring method until all modules are connected.

If your host is not RS-485 compatible, you must use the RS-232 to RS-422/485 converter. See *Interface Converter* below.

If you are connecting to a Ten/60, connect the cable directly to J1 (port 1), J2 (port 2) or J3 (port 3) of the host interface that is mounted in one of the option slots.

CAUTION! The shield conductor should be connected to chassis ground at only one location in the system, due to possible ground potential differences at different locations.

2.6.2 Interface Converter

To permit communication between Netpac units and hosts that use an RS-232 interface, an interface converter must be installed at each port. For more information about the Communication interface converter (model V5000), contact the factory.

[no content intended for this page]

Chapter 3. Communication Protocol

3.1 Introduction

This section describes the communication interface between Netpac and a computer. It gives you all the commands you need to communicate with Netpac, as well as examples of their use, format, and responses.

In this section, command characters appear within these bracket symbols: < >

Netpac modules use an asynchronous serial transmission format with eight data bits plus one start bit and one stop bit.

You can set the baud rate at 19,200, 9,600, 1,200, and 300. See Chapter 2, *Installation*, to set the baud rate.

Every character you send on the communications line (transferred or received by Netpac) is expressed as the ASCII equivalent of the character.

The host controls all communications to and from Netpac. If Netpac is in the Talk mode, it returns status messages to the host after it receives and acts on each command. If Netpac is in the Untalk mode, it receives and acts on commands but does not return status messages except after certain commands.

3.1.1 Autoscan

When AutoScan is enabled, Netpac continuously scans all channels and performs a calibration every 25 seconds. GE recommends you use the AutoScan feature. You enable or disable this feature on the analog control card at DIP Switch S1 (see Chapter 2, *Installation*). If you disable AutoScan, a delay of several seconds occurs while the scan takes place, and you must send the <Q> (calibrate) command. AutoScan does not apply to the digital control card.

3.1.2 I/O Cards

Most of the commands for I/O cards reference the card number and then the channel. A few commands (for example, resolution) reference just the channel. You need to know the number of inputs on the card to designate the channel. See Chapter I, *Overview*, for information on card layout.

3.2 Command Format

The commands you send from the host to Netpac must always begin with a colon and terminate with a carriage return. The colon should not appear under any other circumstances during transmission. The system ignores any character in a command that precedes the colon or follows the carriage return.

The command format is: address< >csCr where:

Address lead-in	= **:**
Address characters	= see below
Command character and arguments	= **< >**
Checksum	= **cs** (2 digits)
Carriage return	= **Cr**

3.2 Command Format (cont.)

Address characters are:

Char.	Hex	Address
?	3F	All modules (broadcast)
mm	00-0F	Module (analog)
	00-3F	Module (digital)
mmc		Module and card number; “c” is I/O card 0-4. When no card number is assigned, the default card number is zero.

All characters are sent as ASCII equivalents. For example, if the command to the Netpac is:02E1403csCr, see Table 9 on page 51 to determine the following ASCII equivalents of the characters:

:	(address lead-in)	3A
02	(module number)	30 32
E	(EU command)	45
14	(channel)	31 34
03	(EU of 55mV)	30 33
cs	(checksum)	41 39
Cr	(carriage return)	0D

3.2.1 Response Messages

The three types of response messages are: data, status, and contact out echo.

Data Message: Transmits messages from Netpac to the host in either ASCII (<H0>) or Floating Point Numerical (<H1>) format, depending on which format you select with <D> (see Data <D> in *Command Descriptions* on page 56).

The message format is :@(channel data)csCr where:

: = Address lead-in
@ = Message for host only
cs = Checksum
Cr = Carriage return

Message protocol:

- A short data message responds to an <S> (Scan) or single channel <D> (Data), and consists of the sign, six digits, and a floating decimal point for a single channel. An example of a short message:
  :@–.7352 cs Cr
- A long data message responds to these commands: <B> (Block), <G> (Go) followed by <cD> in the Talk mode, or <I> followed by <cD> in Untalk mode. They are sent in a series of 20 data messages without separating carriage returns and originate from the same module. Channel zero is sent first and channel 19 last. See Figure 40 on page 56 for an example of a long data message.

Status Message: A module returns a status message to the host when, for example, it:

- Is talk-enabled and receives a command or communications error.
- Receives <I> and the previous command was not <S>, <G7, or <K> (Contact Assign).
- Receives a command that does not require immediate action by the selected module.

The message format is: @*ss where:

: = Address lead-in
@ = Message for host only
* = Message with only status information, not a data value.
ss = 2-digit module status message (see Table 8 on page 50).

3.2.1 Response Messages (cont.)

Table 8: Module Status Messages

00	= No errors, no new command received
01	= Command received, no errors to report
02	= Programming error
03	= Power-up flag not set
04	= Serial Framing error
10	= PROM check error
11	= RAM check error
12	= VCO check error
40	= Channel number out of range
41	= Card number not installed
42	= EU is not 40 for <V> (Value)
43	= Value out of range
44	= Overrange
45	= Power failure
50-65	= Checksum error for modules 00-15, where 50 = module 00.

For example:

If you address module 04, and a status message of:@*54 is returned, you know by checking Table 8 above that a checksum error occurred. If the selected module detects an error while Talk-enabled, it returns a message to the host. If the module is not Talk-enabled and does not respond to <I>, a transmission error has occurred with the <I> command. See *Transmission Errors* on page 53.

Contact Out Echo (COE) Message: Checks for Netpac receipt of the contact output commands before they are actuated. (See the Contact Assign <K> command.)

3.2.2 Checksum

GE highly recommends you use checksum at all times to determine errors in commands sent to Netpac or messages returned to the host. (See DIP switch S1 in Chapter 2, *Installation*).

The transmitter of a command adds the ASCII-Hex representation of all characters in the response or command, and then inserts the ASCII representation of the two low order digits following the command or response. (See Table 9 below.)

Table 9: ASCII–Hex Codes

20	SP	41	A	51	Q
2A	*	42	B	52	R
2F	/	43	C	53	S
30	0	44	D	54	T
31	1	45	E	55	U
32	2	46	F	56	V
33	3	47	G	57	W
34	4	48	H	58	X
35	5	49	I	59	Y
36	6	4A	J	5A	Z
37	7	4B	K	5F	–
38	8	4C	L		
39	9	4D	M		
3A	:	4E	N		
3F	?	4F	O		

The receiver of the command or response does the same: it adds the characters and checks that the two low order digits are equal to the received checksum.

3.2.2 Checksum (cont.)

For example, suppose the host tells the module to set the 55mV range on module 02, channel 14 (:02E1403). By adding the ASCII value of these characters, Hex 1A9 is produced:

Hex	
:	= 3A
0	= 30
2	= 32
E	= 45
1	= 31
4	= 34
0	= 30
3	= 33
	1A9

Since only the two low order digits are used, Hex A9 (A=41, 9=39) is included in the command. If the receiver computes any other value, a “checksum error” status message is sent to the host and the command is ignored.

3.2.3 Transmission Errors

Error conditions occur when a bad serial stream or improper command sequence is sent to the Netpac module. Netpac does not act on a command if it detects an error. The host must implement a time-out when waiting for a response from a module.

For example, when a module is in the Untalk mode (see <U> command), it cannot respond to an <I> command that is in error. A subsequently correct <I> returns the status describing the nature of the previous error. A transmission error can corrupt characters while Netpac is oblivious to that error.

The following rules apply to module responses for overall data and network integrity:

A checksum error is reported in a status message that indicates the address of the module. Check this address against the Netpac module address you specified in the command to make sure it matches.

Send a message only once. Additional <I> commands result in a “Status 0” message. A module in the Untalk mode cannot respond to <I> if it has not first received the <S> (Scan) command. A “Status 0” message informs the host that the most recent <S> command was not received.

Table 10 below outlines the format and response for each command. A detailed description of the commands with examples follows the table.

The following abbreviations are used in the commands:

mm	= Module address
c	= Card number
C	= One channel (0-4)
CC	= One channel (00-99)
ff	= First channel in a block
nn	= Number of channels
nnn	= 3-digit Hex-bit number; each bit corresponds to one channel
nnnnn	= 5-digit Hex-bit number; each bit corresponds to one channel
SS	= Status (see Table 8 on page 50)

Table 10: Command Summary

Command	Description	Format	Response	Comment
A	Status	:mmA	:@*SS	Analog Ctrl only
B	Block Scan	:mmBffnn	:@Csddddddd/ (not last) :@Csddddddd (last)	Analog Ctrl only
C	Contact Input-10	:mmcC	:@nnn	Digital Ctrl only

Table 10: Command Summary (Continued)

Command	Description	Format	Response	Comment
D	Read Analog Data	:mmD	20 analog input channels (0-19)	
		:mmcD	20 analog input channels (20*c)-(20*c + 19)	
		:mmDCC	1 analog input channel (00-99)	
		:mmcDC	1 analog output channel (0-4); channels 8 and 9 give status of analog output card	
E	Engineering Unit	:mmECCEU	:@*SS	Skip is default
F	Temperature Unit			Ignored-Digital
	Degrees C	:mmF0	:@*SS	
	Degrees F (default)	:mmF1	:@*SS	
G	Go Scan all channels in module	:mmG	:@*SS	
H	Delta Format			
	ASCII (default)	:mmH0	:@*SS	
	Floating point	:mmH1	:@*SS	
I	Interogate	:mm1	After S - One data message After D - 20 channel message After K - COE message Any other - Status message	
J	Block Temperature	:mmJ :mmcJ	:@*SS :@*SS	Ignored-Digital
K	Contact Assign	:mmKnnnnn :mmKnnnnnX :mmcKnnnnn :mmcKnnnnnX	:@nnnnn :@*SS :@nnnnn :@*SS	Analog Ctrl only
M	Last channel measured			
	Voltage	:mmM0	:@Csddddddd	
	Last EU	:mmM1	:@EXX	

Table 10: Command Summary (Continued)

Command	Description	Format	Response	Comment
Q	Calibrate	:mmQ :mmcQ	:@*SS	Ignored-Digital
R	Resolution	:mmRCCx	:@*SS	Analog Ctrl only x = L, M, H or D
S	Scan	:mmSCC	Data if Talk enabled	
T	Talk (default)	:mmT	:@*SS	
U	Untalk	:mmU	Response only with B, D or I commands	
V	Analog Output	:mmVcCxxx.xx	:@*SS	Digital Ctrl only
X	Contact Actuate	:mmX :mmcX :mmXCC	:@*SS :@*SS :@*SS	Ignored-Digital
Z	Zero	:mmZ :mmcZ	:@*SS :@*SS	Ignored-Digital

mm	= Module address
c	= Card number
C	= One channel (0-4)
CC	= One channel (00-99)
ff	= First channel in a block
nn	= Number of channels
nnn	= 3-digit Hex-bit number; each bit corresponds to one channel
nnnnn	= 5-digit Hex-bit number; each bit corresponds to one channel
SS	= Status (see Table 8 on page 50)

3.2.4 Command Descriptions

Checksums and carriage returns are not included in the examples in this section. Assume they are part of the commands.

3.2.5 Status <A>

Send once at the beginning of a command string or at the beginning of a programming session for module status. Refer to Table 8 on page 50 for a complete list of status messages. A sampling of responses is given below.

The command format is: mmA

Command	Response	Message
:00A	:@*00	No errors, no new command received
	:@*01	Command received, no errors
	:@*02	Programming Error

3.2.6 Block Scan <B>

lnstructs Netpac to scan the block of channels specified in the argument and to return the data immediately, even if the module is in the Untalk mode. (The <S> command scans only one channel.)

With Block Scan, the processing time of the previous channel is overlapped with the integration time of the current channel, resulting in increased channel throughput. If AutoScan is not enabled, a delay of several seconds can occur. The command format is :mmBffnn

For example:

:00B0020	Instructs module 0 to scan and return 20 channels of data (0-19)

The data format is :@Csddddddcs/

where:	
C	= Channel number (0-9)
sdddddd d	s = sign (+) or (–), and d = data characters
cs	= Checksum
/	= More to come in a group

Figure 40 below is a sample of ASCII data returned from multichannels that are programmed for 10V inputs.

```
:@0-.7259   1C/1-.0635   9A/2-.0779   9A/3+.0011   8E/4-.0635/   9D/5-.0790
A0/   6-.0657   A3/7-.0791   A3/8-.0791   A4/9-.0768/   A9/0+.0735   98/1-.0579
A1/   2-.0534   99/3+.1202   91/4+1859/   A4/5+.2383   9E6+.1169   A0/7+.0134
99/   8-.0301   97/9-.0334   9E
```

Figure 40: Sample ASCII Channel Data for <B>

3.2.7 Contact Input Channel <C>

Requests contact input status for all 10 inputs. (Use <C> only with a digital control card.) <C> requires both a module and card address. The addressed Netpac returns a three-character data string that reflects the contact input status of all 10 inputs. The command format is :mmcC

For example:

:001C	Returns data from module 0, card 1 (channels 20-39)

The return data string indicates the status in Hex format.
Example:

	ASCII Equivalent of Bits
:@000	All contacts open (00 0000 0000)
:@001	Channel 0 closed (00 0000 0001)
:@00A	Channels 3 and 1 closed (00 0000 1010)
:@3FF	All channels closed (11 1111 1111)

3.2.8 Data <D>

Reads analog data. If a selected module is Talk-enabled or has received an <I> or <B> command, a data message is returned with the value that is stored in memory for that channel or channel block.

Use this command to read analog input or output data for one channel or 20 channels, card 0 or another card.

The command formats are:

:mmD	Reads data from channels 0-19 (by default).
:mmcD	Reads a 20-channel group; the number preceding the <D> indicates the card.
:mmDCC	Reads data for one analog input channel (00-99).
:mmcDC	Reads the current value of one analog output channel (0-4), expressed as percentage of the range. The status message is in Hex format, shown in Table 11 on the next page. If you enter channel 8 or 9, a status byte for the card is returned. Channel 8 returns overrange status, and channel 9 returns power failure status.

Examples for each of the above commands:

:03D	Reads analog input data from module 03 (channels 0-19). (See Figure 41 on the next page.)
:031D	Reads data from module 03, card 1, channels 20-39. (See Figure 41 on the next page.)
:04D88	Reads analog input data from module 04 (card 4), channel 88. (See *Response Messages* on page 49.)
:043D2	Reads percentage range at module 04, card 3, channel 2

3.2.8 Data <D> (cont.)

Table 11: Status Messages for <D>

Bits	Status
7	Card installed (0 if installed)
6	Not used (always 0)
5	Not used (always 0)
4	Overrange/power fail, channel 4 (0 if no fault)
3	Overrange/power fail, channel 3 (0 if no fault)
2	Overrange/power fail, channel 2 (0 if no fault)
1	Overrange/power fail, channel 1 (0 if no fault)
0	Overrange/power fail, channel 0 (0 if no fault)

```
:@0-.7259  .0635  .0779  .0011  .0635  .0790  .0657  .0791  .0791
.0768/  .0735  .0579  .0534  .1202  1859  .2383  .1169  .0134
.0301  .0334
```

Figure 41: Sample ASCII Channel Data for <D>

3.2.9 Engineering Unit <E>

Programs a channel for a specific EU.

The command format is :mmECCEU

Table 12 on page 59 lists EU codes, card types, formats for decimal placement, and significant digits used in the measurements of all EU's. For example:

:02E1403   Programs module 02, channel 14 for an EU of 55 mV.

Current and analog output values (EU 20-22 and 40) are always represented by a percentage of full scale (0-100 percent). Any value out of that range results in status message 43 (refer to Table 8 on page 50).When programming voltage ranges or skipping channels, assign Autorange (EU 02) if you are not sure of the range. This prevents overrange conditions. The Autorange measurements shown in Table 8 conform to a format that is different from other EU’s.

3.2.9 Engineering Unit <E> (cont.)

Table 12: Engineering Units

Code	EU	Card Type	Format
01	Skip	--	--
02	Autorange:		
	55mV	--	±.######
	100mV	--	±.######
	1V	--	±#.#####
	10V	--	±##.####
03	55mV	Volts DC/TC	±##.###
04	100mV	Volts DC/TC	±###.###
05	1V	Volts DC/TC	±#.#####
06	10V	Volts DC/TC	±##.####
07	T/C J	Volts DC/TC	±#####.#
08	T/C K	Volts DC/TC	±#####.#
09	T/C T	Volts DC/TC	±#####.#
10	T/C E	Volts DC/TC	±#####.#
11	T/C S	Volts DC/TC	±#####.#
12	T/C R	Volts DC/TC	±#####.#
13	T/C B	Volts DC/TC	±#####.#
14	RTD 100Ω Pt (**a**=0.003925)	RTD	±#####.#
15	RTD 100Ω Pt (**a**=0.00385)	RTD	±#####.#
16	RTD 10Ω Cu	RTD	±#####.#
20	Current, 10-50mA (0-100% of range	Volts DC/TC	±###.##
21	Current, 4-20mA (0-100% of range	Volts DC/TC	±###.##
22	Current, 0-1mA (0-100% of range)	Volts DC/TC	±###.##
23	0-150V	High Volts	±###.##
24	Contact In (20) (0=closed; 1=open)	Volts DC/TC	0.000 or 1.000
35	Frequency:	F/P/S/T	
	10Hz		±#####0.
	1 Hz		±#####.
	0.1 Hz		±####.#
	0.01 Hz		±###.##
36	Period:	F/P/S/T	
	1 ms		±#####.
	0.1 ms		±####.#
37	Contact In (10)	F/P/S/T	See <C> cmd.
38	Total Pulses	F/P/S/T	±#####.
40	Analog Output (0-100% of range)	Analog Out	+xxx.xx
01	Contact Output	Contact Out	See <K> cmd.

3.2.10 Degrees <F0> or <F1>

Programs the selected module to return data in degrees Celsius or Fahrenheit. Select <F0> for Celsius or <F1> for Fahrenheit (default).

The command format is :mmF0 or :mmF1

For example:

:03F0	Programs module 03 to return data in degrees Celsius.

3.2.11 Go <G>

Scans the selected module once for channels with a programmed EU. If AutoScan is enabled, you do not need to send this command for a scan. If AutoScan is not enabled, the scan takes several seconds to complete.

If the module is Talk-enabled, it returns a status message when the task is completed. If the module is not Talk-enabled, data is held in memory until it receives an <I> or the data is written over in response to another <G>.

The command format is :mmG

For example:

:04G	Scans all channels of each card in module 04 once.

The second form of this command is <GQ>. This results in zero, calibrate, thermal block measurements, as well as a scan of all channels (see *Calibrate/Zero/Thermal Block Measurement <Q>* on page 65).

3.2.12 Data Format <H0> or <H1>

Formats response messages in ASCII (default) or floating point format. See *Response Messages* on page 49 for information. Enter <HO> for ASCII and <HI> for floating point.

The command format is :mmH0 or :mmH1

For example:

:01H1	Formats module 01 for floating point.

3.2.12 Data Format <H0> or <H1> (cont.)

ASCII Format <HO>: Data in this format consists of the sign, six data digits, and decimal point. The format includes trailing zeros, and leading zeros are converted to spaces.

These error messages are returned for channel data:

*SKIP	Skipped channel
*OVRRNGE	Out of range
*OPEN TC	Open thermocouple
*PARITY	Parity error
*COM.ERR	Communication error
*MATH.ER	Math error

If a measurement that uses a non-linear EU (thermocouple and RTD) is out of range of the linearization routines, overrange data results.

Floating Point Numerical Format <H1>: Returns data in ASCII-Hex floating point format.

Program Netpac for the <H1> mode to communicate with hosts that require the floating point format shown in Figure 42 below. In this format, the most significant bit (bit 31) indicates the sign of the mantissa, while bit 30 indicates the sign of the exponent. The next six bits form the exponent and the remaining 24 bits form the mantissa.

The mantissa is expressed as a 24-bit (fractional) value. The exponent is expressed as a two's complement 7-bit value having a range of –64 to +63. The most significant bit is the sign of the mantissa (0 = positive, 1 = negative), for a total of 32 bits. The binary point is to the left of the most significant mantissa bit (bit 23). All floating point data values are normalized. Bit 23 must be equal to 1, except for the value zero (represented by all zeros) or when an error condition exists.

For example, (84A00000) is equal to –10.0000.

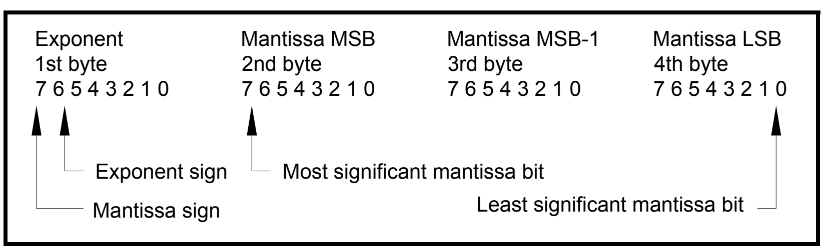


Figure 42: Floating Point Format

Channel errors are reflected by a code in the most significant mantissa byte (second byte, bits 23-16):

01	= Skip channel
02	= Overrange
03	= Open thermocouple
04	= Parity error
05	= Communication error
06	= Math error

3.2.13 Interrogate <I>

Returns data or status messages to the host regardless of the module's Talk or Untalk state.

The command format is :mmI

For example:

:03I	Requests status of module 03.

The module's response is dictated by the command received prior to <I>.

Prior Command	Response to <I>
Scan <S>	One short data message
Data <D>	20-channel data message
Contact Assign <K>	COE (contact output echo) message
Any other command	Status message

Note: *Netpac is double-buffered for commands. If you want a response from an Untalk module after it has completed the first command, send a separate <I> immediately after any other command.*

3.2.14 Thermal Block Measurement <J>

The thermocouple input module uses a nickel resistor in the Uniform Temperature Plane (UTP) with a reference bridge source applied to it. In response to <J>, the module reads the voltage across the resistor, which corresponds to the thermocouple reference junction temperature, and places this value in memory. When you request temperature data, this value compensates the actual reference junction temperature with an ice point reference junction.

The command formats are :mmJ and :mmcJ

For example:

:03J	Takes thermal block measurement (TBM) of module 03, card 0.
:033J	Takes TBM of multi-module 03, card 3. (Use this format for multi-modules.)

3.2.15 Contact Assign <K>

Sends contact status for all 20 channels of a contact output card.

The command formats are
:mmKnnnnn
:mmKnnnnnX
:mmcKnnnnn
:mmcKnnnnnX

nnnnn is a 20-bit number represented by a 5-digit Hex-bit number expressed as an ASCII value, with each bit corresponding to one channel.

If X is included in the command, the contacts are actuated immediately. If X is not included, the assignment is placed in memory and a Contact Out Echo (COE) message is sent to the host. (See *Response Messages* on page 49.)

For example:

:03K00001	Assigns contacts at module 03, card 0.
:024K00001	Assigns contacts at module 02, card 4.
:033K00001X	Assigns and actuates contacts at module 03, card 3.
:04K2AC1F	Closes the contact at module 04, card 0, channels 0, 1, 2, 3, 4, 10, 11, 13, 15, and 17.

3.2.15 Contact Assign <K> (cont.)

Table 13 below illustrates how we determined the hexadecimal value 2AC1F. First, you determine which contacts are closed and then, using that binary number, convert each digit to its hexadecimal equivalent.

Table 13: Example for Determining Hexadecimal Value

Digits	5	4	3	2	1
Channels	19 18 17 16	15 14 13 12	11 10 9 8	7 6 5 4	3 2 1 0
Contact Status	0 0 1 0	1 0 1 0	1 1 0 0	0 0 0 1	1 1 1 1
HEX	2	A	C	1	F

Following a <K> command and when an X is not present, Netpac returns a Contact Out Echo (COE) message to the host to confirm that the module received the command before actuating the contacts.

The data format is :@nnnnn

See the <K> command format above for a description of (nnnnn). Each bit corresponds to one channel. A (1) indicates a closed state and (0) indicates an open state.

3.2.16 Measured Data <M>

Retrieves the raw voltage or engineering unit number of the last processed channel at the analog control card. This command gives meaningful information only when AutoScan is disabled.

In the case of thermocouples, the raw voltage is expressed as compensated millivolts. Other measurements could be either volts or millivolts.

The command format is :mmM0 or :mmM1

<MO> returns the voltage from the most recently measured channel; the message format is :@Csddddddd.

<MI> returns the EU number assigned to the most recently measured channel; the message format is: @Em.

3.2.17 Calibrate/Zero/Thermal Block Measurement <Q>

Performs a zero offset (refer to <Z> on page 68) plus a 10V calibration and a thermal block measurement (TBM) (refer to <J> on page 63). The calibration measurement scales the full-scale VCO (Voltage Contact Oscillator) count to a precise 10.000V reference. The measurement is stored in memory and later used as a reference to scale all calculations to EU's.

The command formats are :mmQ and :mmcQ

For example:

:04Q	Performs zero offset, calibration, and TBM on module 04, card 0.
:042Q	Performs zero offset, calibration, and TBM on multi-module 04, card 2.

To scan all channels on all cards in a module, use <GQ>, referenced under the GO command on page 60.

3.2.18 Resolution <R>

Sets resolution on a per-channel basis. (See *Default Resolution Jumper* on page 23.) The three resolutions, high, medium and low, equate to integration periods of two line cycles, one line cycle, or ¼ line cycle. You set the default resolution at jumper-selected (P16) on the analog control card.

The command format is :mmRCCx, where x = L, M, H, or D

For example:

:00R01L	Sets module 0, channel 1 to Low.
:02R21M	Sets module 2, channel 21 to Medium.
:04R39H	Sets module 4, channel 39 to High.
:03R50D	Sets module 3, channel 50 to Default.

3.2.19 Scan <S>

Measures a single channel or returns a calibration value. If the module is Talk-enabled, it returns a data message as soon as data is available. <S> momentarily prevents the module from responding to other commands until the accumulated data is stored. If you send a second command, it is stored and acted on when the module is free.

The command formats are :mmSCC and :mmScC

For example:

:02S18 Accesses module 02, which is in Untalk mode, scans channel 18 and places the data in memory.

Use <S> in the format :mmScC to store the zero offset value of each range, the calibration voltage, and the thermocouple block value. To obtain the zero offset value for the 55mV, 100mV, IV, or 10V ranges, indicate the range in the channel (C) digit of the command format using these alpha characters.

A	= 55mV
B	= 100mV
C	= 1V
D	= 10V
E	= Calibrate
F	= Thermocouple block offset value

For example:

:03S0B Accesses module 03, card 0, and places in memory the zero offset value for the 100mV range (B).

Note: *You can retrieve the zero, calibrate, and thermocouple block values in memory and use them in later calculations with <I> when you use it immediately after <S>. Zero and calibrate values are returned as VCO counts, block values are in millivolts.*

3.2.20 Talk <T>

Enables Netpac to respond to every command with a Status message, and is the default until an Untalk command is sent.

The command format is :mmT

For example:

:03T <T> enables Netpac module 03 and requests a Status message.

3.2.21 Untalk <U>

Prevents Netpac from sending a Status message in response to host-initiated commands, except when <I> is sent, or if a communication error is detected with this command and then you send <T>.

The command format is :mmU

For example:

:03U	Disables Netpac response to commands. (Netpac accepts and acts on commands sent while in Untalk mode).

3.2.22 Value <V>

Sets a specific output channel on an analog output card to a value.

The command format is :mmVcCxxx.xx

xxx.xx represents between 0 and 100% of the range selected at the card jumper. When the command is executed, the value is placed in the channel table and the output is adjusted accordingly. The control card checks for an overrange or power fail and returns a status message.

For example:

:01V23100.00	Sets module 01, card 2, channel 3 at 100% output value for the jumper-selected range.

3.2.23 Contact Actuate <X>

Closes or opens the contacts of the designated module according to criteria specified by <K>.

The command formats are
:mmX
:mmcX
:mmXCCx

x indicates the open (0) or closed (1) state of the contact.

For example:

:04X	Actuates all contacts at module 04, (card 0).
:021X	Actuates all contacts at module 02, card 1 (channels 20-39).
:03X801	Closes contact on channel 80 (indicated by 1). Contact closure is immediate (X).

If you use Netpac command protocol to activate or deactivate the contact at TB1 and channel 99, use the following commands and arguments:

:00X991	Closes TB1 and contact at channel 99.
:00X990	Opens TB1 and contact at channel 99.

See *Analog Control Card* on page 19 for information on TB1.

3.2.24 Zero <Z>

Measures the zero offset on all four ranges and stores this value in memory for future calculations.

The command formats are :mmZ and :mmcZ

For example:

:03Z	Measures module 03 (card 0).
:033Z	Measures module 03, card 3 (channels 60-79).

Chapter 4. Netpac with GE Hosts

4.1 Overview

Netpac operates with GE dataloggers or with hosts that run KVIEW™, The FIX™, or FIX DMACS™.

This section supplements the following GE datalogger user's guides: AutoGraph, AutoCalc, AutoLink, and the Ten/60.

To program Netpac from a Ten/60 or Auto family datalogger (except AutoCalc), you use the front panel of the datalogger. With AutoCalc, Netpac is programmed at a computer.

If your host is running KVIEW, the menu-driven configuration program is KVCONFIG, described in the Netpac subsection of the *GE I/O Supplement* in the *KVIEW* or *Mini-Kview User's Guide*.

If your host is running The FIX or FIX DMACS, use the menu-driven configuration program described in the *GE I/O Supplement*.

The FIX and FIX DMACS are tradenames of lntellution Corporation.

4.2 Netpac and Auto Family

Auto family dataloggers communicate with Netpac using:

- Port 1, if you install an analog control card in the mainframe.
- Port 1 or 2 over a two-wire, RS-485 bus, if the control card is installed in an external module.

Up to 512 channels of local and remote I/O are available.

Interface the datalogger channel to Netpac using a module address (port, module number, and channel number). This occurs when you answer the query, "NETPAC LOC."

Assign the engineering unit to the Netpac channel when you answer the query, "EU?" Once the Netpac location and engineering units are assigned, the Auto family datalogger sets up the channel table in memory and downloads this data to Netpac.

4.2.1 Power-Up Sequence

When power is applied, the Auto family datalogger and the Netpac control card perform several tasks, including:

- Running internal and Netpac diagnostic test and reporting any RAM or PROM failures.
- Checking for non-response error messages from Netpac and noting which modules are enabled
- Reprogramming EU's for all enabled Netpacs

4.2.2 Operation Sequence

Communication between the Auto family datalogger and the Netpac control card consists of a constant series of commands to talk to Netpac, initiate the scan sequence, read data, etc. These are some of the more important features of this communication:

- If Netpac sends a power-fail message, the host automatically programs all engineering units and resolution when power is reapplied.
- If power is removed from Netpac for any reason, the host makes five attempts to establish the communication link before displaying the message, “Netpac module does not respond” (Error 53). The host tries to establish the communication link every five seconds during the operation sequence. If a Netpac responds, the host programs it to ensure proper operation.
- Netpac disregards skipped channels. If a Skip message is returned, the host assumes an error and automatically programs all Netpac channels.

4.2.3 Netpac and the Ten/60

The Ten/60 issues commands to Netpac modules to: program engineering units (EU’s), scan all channels, retrieve data, set status contacts, and retrieve status data. Up to 1,000 channels of local and remote I/O are available.

If Netpac modules are used with the Ten/60, you can designate specific Ten/60 channels or groups of channels as external.

The Ten/60 stores all address information (port, module, and channel number), EU’s, and status for all Netpac modules in internal memory.

The Ten/60 communicates with Netpac modules using the Netpac Interface Option (model U5040). The card occupies one option slot at the rear of the Ten/60 and provides three Netpac ports.

If any module loses its programmed state (due to power failure or any other cause), the interface automatically programs the module at power-up. The interface also handles any communication errors (see *Error Codes* on page 75).

4.2.4 Baud Rate Selection

The Netpac and the Ten/60 interface must both transmit and receive at the same baud rate.

The interface's three input/output ports operate at baud rates compatible with Netpac modules on the same port. DIP Switch S1 on the interface card controls these baud rates. Slides 1 and 2 control port 1, slides 3 and 4 control port 2, and slides 5 and 6 control port 3. See Table 1 on page 14 for slide positions and rates.

To set Netpac baud rates, see *Analog Control Card* on page 12 and *Digital Control Card* on page 32.

Table 14: Baud Rate Selection, Ten/60 Interface Card

		Baud Rate			
Port	**Switch**	**300**	**1,200**	**9,600**	**19,200**
1	1, 2	0, 0	1, 0	0, 1	1, 1
2	3, 4	0, 0	1, 0	0, 1	1, 1
3	5, 6	0, 0	1, 0	0, 1	1, 1

4.2.5 Power Selection

The interface card is automatically powered from the +5 VDC supplied on the Ten/60 system bus. The Netpac module derives operating power in one of three ways: (1) +24 VDC supplied from the Ten/60 system bus, (2) an external DC source connected to the DC input terminal board on the Netpac backplane, or (3) a DC source connected to DC input terminals located on the Ten/60 interface card.

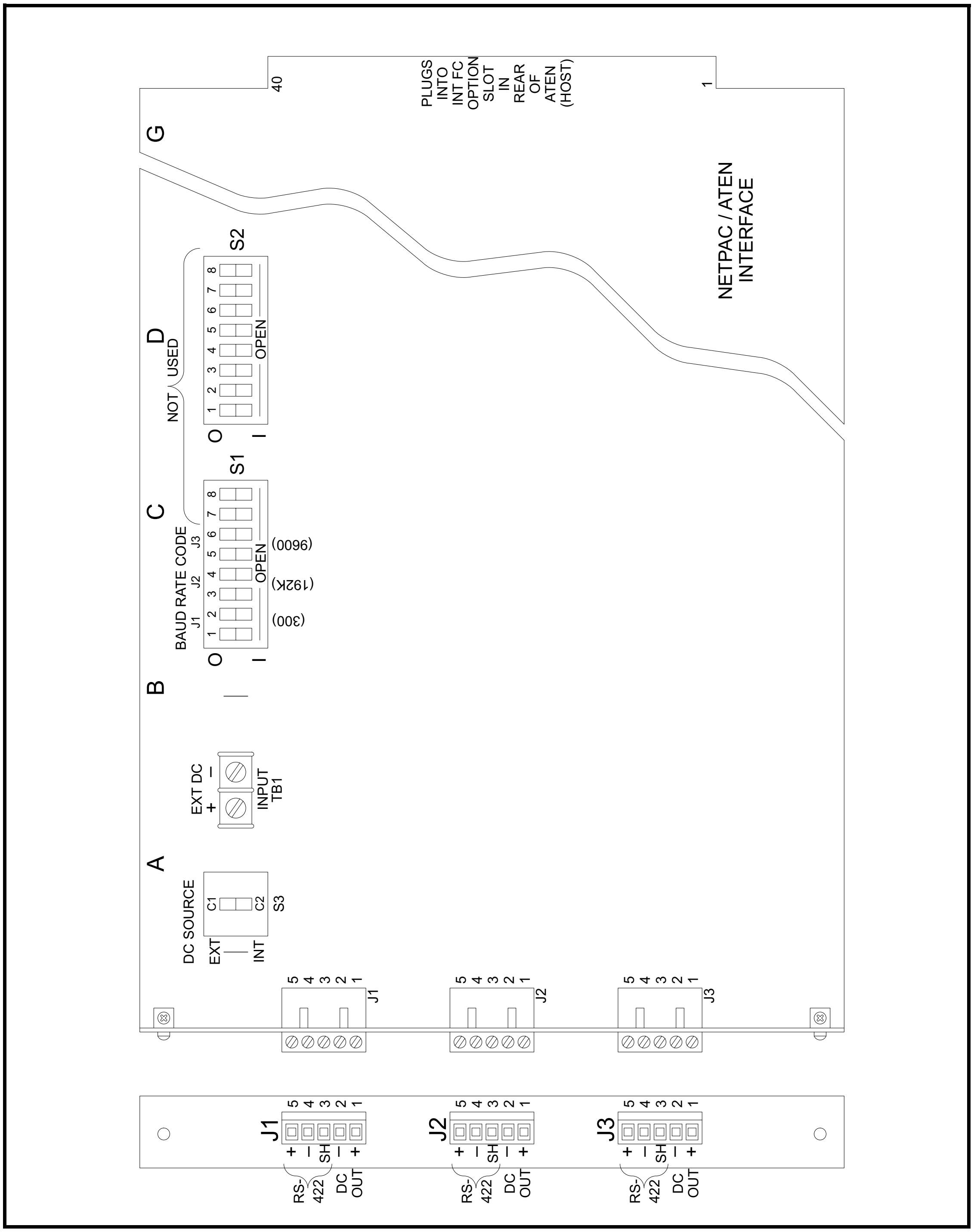


Figure 43: Ten/60 Interface Card

4.2.6 Internal Power Supply

If the operating power for a Netpac module is derived from the Ten/60 power supply using the system bus, a major constraint is imposed. Since the single Netpac module draws approximately 0.5A per card, the Ten/60 can power only one or two single modules, depending on the number of additional options connected to the system.

If you use this method, make sure that S3 is set to the C2 position and that the connector from the appropriate port has five wires connected as shown in Table 15 below.

Table 15: Port Connectors

Pin	Description
5	RS-485 (+)
4	RS-485 (–)
3	RS-485 (SH)
2	24 VDC (–)
1	24 VDC (+)

4.2.7 External Power Supply

If you use an external DC source to power the Netpac module, connect it to the power input terminal of each module. Set S3 to the C1 (EXT) position.

You can connect external power directly to binding posts on the Ten/60 interface. This routes power to each module using the port wiring shown in Table 15 above. Connect the high side of the +24V to the post marked EXT DC+ (located near the upper left corner of the interface), and the low side to the post marked EXT DC–. Make sure S3 is set to the C1 (EXT) position.

Note: *You must select either 50 or 60 Hz at jumper (P15) on the Netpac control card to set the timing for the analog-to-digital converter, even if your instrument is DC powered.*

4.2.8 Diagnostic Error Accumulation

To enable or disable the diagnostic error accumulation mode, use positions 7 and 8 of DIP Switch S1, with channels 190 through 198 the recipients of the error count. Specific assignments for each of these channels are given below:

190	=	Number of received characters
191	=	Number of transmitted characters
192	=	Receiver transmit errors
193	=	Receiver checksum errors
194	=	Receiver framing errors
195	=	Receiver wrong response
196	=	Transmitter framing error
197	=	Transmitter checksum error
198	=	Transmitter wrong command

Diagnostic error accumulation is enabled whenever slides 7 and 8 are set opposite each other, and disabled whenever the slides are set identically.

Scan and program datalogger channels 190-198 with a dummy argument. Use a Netpac assignment that is not included in your system. For instance, if you have six 20-channel Netpacs assigned to port 1, you can use an assignment for a seventh Netpac as your dummy argument. Use EU 54 and a Netpac location of 1,7,0,6. This corresponds to port 1, module 7, channel 0, and a range of six. (If you use a range of 6, ignore the V returned after accumulation.)

If you use the diagnostic error accumulation as a troubleshooting tool, set a short interval such as 20 seconds. This allows you to monitor the count prior to its clearance at the beginning of the next scan.

To accumulate total counts over many scan periods, use an additional group of inactive channels and perform a math function.

For example, use channels 190-198 as the error channels and 200-208 as total accumulation channels. Program 190-198 as described, and program 200-208 as math channels. The expression for channel 200 is C190, C200, and the expression for channel 201 is C191, C201, and so on. The algebraic expression is A + B. Include all channels in the scan cycle. Totals of channels 200-208 are reset when the scan is restarted.

4.2.9 Operation Sequence

At power on, a Ten/60 initiates a programming sequence with Netpac modules to:

- Send status messages to the host
- Test all RAM and PROM located on the Netpac modules, and report errors to the Ten/60
- Set all module channels at programmed EU's and resolutions, or the default (jumper-selected) resolution.

“NETPAC” is displayed on the CRT. The keyboard remains locked until programming is complete.

If you request a scan of Ten/60 channels that includes Netpac modules, the channel data is sent to the Ten/60 for display or recording.

4.2.10 Error Codes

All error codes that apply to the Ten/60 also apply to Netpac. The following error codes are associated with Netpac modules exclusively:

Error 49	Improper response from interface board
Error 50	Improper command sent to interface board
Error 51	Feature is not included in Netpac
Error 52	Netpac module is not using checksums
Error 53	Netpac module does not respond
Error 54	Netpac module failed diagnostic tests

Error 53, a temporary error, is generated if a previously programmed module loses communication or power. If the module later resumes operation, it is reincorporated into the cycle and the error is canceled.

Error 54 is a permanent error. The only way to re-establish the system routine is to reapply power to the host after the faulty module is removed from the scan sequence.

4.2.11 Netpac Programs

When a host scan is initiated at standard intervals or triggered by a logic condition, use program Page 24 to initiate a scan of Netpac modules. (See the *Ten/60 User's Guide* for information on program Pages.)

Note: *The Ten/60 must have GE firmware revision 1.00 or later for Netpac operation.*

Program Page 24 initiates a scan cycle of all Netpac modules.

Program Page 05 designates Netpac as the source of a datalogger channel as follows:

1. Enter a single channel or a group of channels as inactive (that is, not in use for data input). On the EU line, enter EU 54 if the Netpac channel is the data source, EU 55 if the Netpac channel is a contact output channel (acknowledge), or EU 56 for contact output (non-acknowledge). (EU's 54-56 are dedicated to Netpac.)
2. Address the Netpac channel in this format on the ASN line:

   NET (Port, Module, Channel, EU, New or Old data) where:

NET	Defines a Netpac channel; formula must be in parentheses ( ).
Port	Specifies the port based on the connector at the rear of the interface card, J1 = 1, J2 = 2, J3 = 3
Module	Defines the module number (0-15) set on the Netpac DIP switches.
Channel	Defines the Netpac channel as the data source or the first channel of a group of channels. Limits are 0-99.
EU	Defines the engineering unit at the Netpac. See Table 3-5 on page 12 for a list of EU's.
New or Old	Enter an asterisk (*) if you want new data, or leave blank if you want the data previously stored in memory. Define the EU; and then define if you want to return data residing in memory or initiate a new scan of that particular channel. On the ASN line, enter a formula that is similar to that used for contacts.

Contact Outputs: When you program a contact output with the Ten/60, you can select either an acknowledged or non-acknowledged contact (see *Contact Output* on page 27). A Netpac contact output card closes a contact as a result of a measured value, calculated value, or a logic value.

Use program Page 05 to assign a single channel in the datalogger sequence, and then enter EU 55 to designate it as an acknowledged contact output, or EU 56 as a non-acknowledged contact output.

On the ASN line, enter the address. Enter the remaining argument for the contact closure, first and last channel(s) and limit(s), and close the parentheses.

4.2.11 Netpac Programs (cont.)

Contact Outputs: (cont.) For example, if datalogger channel 74 is an acknowledged contact output located at port 2, module 07, channel 3, and you want a contact closure whenever channel 40 exceeds limit 1 or limit 3, enter the following on the ASN line:

NET (2, 7, 3, C40, C40, 1, 3)

With this program, whenever datalogger channel 40 exceeds limit 1 or 3 (C40 is the first and last channel), a contact is closed at module 07, channel 3, and remains closed until acknowledged.

Local Contact Output, TB1: Program the local contact output at TB1 to either close or open using the same protocol as standard contact outputs, program Page 05. Channel 99 is designated for this contact. For example, when using a Ten/60, the following program actuates the contact whenever the value of limit 1 is exceeded:

```
CHANNEL 1, EU25, E(1.0), LIMITS (01/00/00/00)
CHANNEL 2, EU31, NETPAC LOC (1/00/99),
    E(CON(C1 ,C1 ,L1))
LIMIT 1 = 1.5H
```

If TB1 is normally closed, it remains closed when channel 1 evaluates to less than 1.5 (L1 or the limit setting is greater than 1.0 (Cl)).

If channel 1 evaluates to greater than 1.5, or the limit is reduced below the value of channel 1, the contact at TB1 is activated, the normally closed contacts open, and the normally open contacts close.

If you also have a contact output card (designated as channel 99) installed in a Netpac multi-module, it operates in parallel with the contact at TB1.

Linear Equations: To assign data from a Netpac module to a linear equation, use an inactive channel (that is, not in use for data input) and a mathematical equation.

Assign EU 46 to the inactive channel. EU 46 converts the Netpac data according to the algebraic expression that you define on program Page 16. On the ASN line, assign your expression name (II to WW) followed by your variables in parentheses. Precede channel numbers with the letter C, and place numerical data in decimal fraction or scientific notation.

You can use up to eight variables. For a linear equation, only two variables are typically used: the channel used for the input and the multiplication factor. A third variable is the offset.

The following example is an MX + B equation:

ASN II(150,C001,-200)

The name of the expression (MX + B) that you define on program Page 16 is II. Netpac input data (X) is read at the Ten/60 channel 001. Assume the input data is from a flow transducer where 2-10mV represents a flow rate of 100-1300 GPM.

4.2.11 Netpac Programs (cont.)

Linear Equations:(cont.). The M value is the change in Y divided by the change in X. In this example, M is 150.

M = 1300–100/10–2 = 150

The B value is Y_1 – MX,. In this example, B is -200.

B = 100-150(2) = -200

Next, access channel 001 and designate it as the Netpac channel (X) by entering EU 54. Define the port (1), module (0), channel (1), and Netpac EU (03) on the ASN line.

ASN NET(1,0,1,03,*)

Finally, access program Page 16 and enter the algebraic expression A*B+C (for MX + B).

The following example is for the math equation:

((C*B) t A) + D.

The expression name is VR. Channel 7 is variable A, channel 14 is variable B, 4.2 is variable C, and 10.0 is variable D.

VR (C7,C14,4.2,10.0)

Use program Page 16 to enter the expression name and define it as algebraic. On the definition line, enter how you want the variables computed. If you want to multiply 4.2 times channel 14, add channel 7 to this number and divide by 10.

4.2.12 Logic Triggered Scans

Various methods of achieving logic-triggered scans are discussed in the Ten/60 User's Guide on program Page 18 and 19. These methods operate in the same manner for Netpac channels. The only difference is that the first and last channels are designated for scanning when the trigger channel exceeds a preset limit. You can also designate them as Netpac channels by using EU 54, 55, or 56 and entering the formula on the ASN line.

Appendix A. System Specifications

A.1 Netpac Models

Single Module: Open Style
NEMA 2
NEMA 4

Multi-Module: Open Style
NEMA 4
Rack Mount

A.2 Inputs

Voltage:. ±55mV, ±100mV, ±1V, ±10V

Current:. 0-1mA, 4-20mA, 10-50mA

Measurement Range	Measurement Accuracy
55mV	±0.03% of input voltage
100mV	±0.03% of input voltage
1V	±0.03% of input voltage
10V	±0.03% of input voltage
0 to 1mA	±0.08% of input current
4 to 20mA	±0.08% of input current
10 to 50mA	±0.08% of input current

Thermocouples:. J, K, T, R, S, E, B (includes cold junction compensation and linearization)

A.2 Inputs (cont.)

Thermocouple Type	Measurement Range (°C)	Measurement Accuracy °C	°F
J	–200 to –150	±0.7	±1.3
	–150 to –50	±0.6	±1.1
	–50 to 100	±0.5	±0.9
	100 to 400	±0.6	±1.0
	400 to 760	±0.7	±1.3
K	–200 to –150	±0.7	±1.3
	–150 to –50	±0.6	±1.1
	–50 to 100	±0.5	±0.9
	100 to 400	±0.6	±1.1
	400 to 760	±0.7	±1.3
	760 to 1000	±0.8	±1.4
T	–200 to –150	±0.7	±1.3
	–150 to –50	±0.6	±1.1
	–50 to 100	±0.5	±0.9
	100 to 400	±0.6	±1.1
E	–200 to –150	±0.7	±1.3
	–150 to –50	±0.6	±1.1
	–50 to 100	±0.5	±0.9
	100 to 400	±0.6	±1.1
	400 to 760	±0.7	±1.3
R, S	0 to 100	±1.2	±2.2
	100 to 200	±1.0	±1.8
	100 to 1665	±0.9	±1.6
B	200 to 400	±1.8	±3.2
	400 to 760	±0.7	±1.3
	760 to 1800	±0.6	±1.1

Dry Contact: Open, closed

Status: AC/DC

High Volts: 0 to ±150 VDC

A.2 Inputs (cont.)

RTD's:. 100Ω platinum (alpha 0.00385, 0.003925), 10Ω copper

The accuracy specifications apply at 25°C with relative humidity less than 95%, non-condensing, high resolution.

100 Ω platinum RTD accuracy specifications:

Measurement Range (°C)	3-Wire Std.		3-Wire Brg./Ch.		4-Wire	
	°C	°F	°C	°F	°C	°F
–200 to 0	±0.8	±1.4	±0.5	±0.9	±0.4	±0.7
0 to 250	±0.7	±1.3	±0.4	±0.7	±0.3	±0.5
250 to 500	±0.9	±1.5	±0.5	±0.9	±0.4	±0.7
500 to 850	±1.0	±1.8	±0.6	±1.1	±0.5	±0.9

10 Ω copper RTD accuracy specifications:

Measurement Range (°C)	3-Wire Standard		3-Wire Bridge/Ch.	
	°C	°F	°C	°F
–50 to 50	±5.0	±9.0	±0.5	±0.9
50 to 150	±5.1	±9.2	±0.5	±0.9

Pulse Counting: 0-65,000 counts (only when host is Auto series, Ten/60, or installed software; operates synchronously with Netpacs; not supported by KVIEW, Mini-KVIEW or THE FIX).

Frequency: 65 KHz max.

Period: 65 seconds max.

Function	Range Code Switch	Resolution	Range	Max. Time to Measure
Frequency	10	1 Hz	0-65535 Hz	3 sec
	01	0.1 Hz	0-6553.5 Hz	30 sec
	00	0.01 Hz	0-655.35 Hz	300 sec
Period	00	1ms	1-65535ms	3xperiod
	01	0.1ms	0.1-6553.5	3xperiod
	10	0.01ms	0.01-655.35	3xperiod
	11	0.001ms	0.001-65.535	3xperiod
Contact Status	--	open/close	open/close	1ms
Total Pulses	--	1 count	0-65535 counts	1ms

Multiplexer: Photovoltaic, solid state, indefinite life

A.3 Outputs

Contact Out. 2A at 30 VDC, 0.6A at 125 VAC

Analog Out. Ranges of 0-5V, 0-10V, 1-5mA, 4-20mA

A.4 Environmental

Temperature: 32° to 140°F (0° to 60°C)

Humidity: 0-95% non-condensing

Operating Altitude: 10,000 ft.

A.5 Voltage Measurement

Resolution/Integration period (selectable by channel):

High 14 bits plus sign, 2 line cycles
Medium 13 bits plus sign, 1 line cycle
Low 11 bits plus sign, ¼ line cycle

Measurement Accuracy: ±(0.03% of input + 2 counts)

Normal Mode Rejection: 70-dB at 60 Hz ±0.01% at high resolution

Repeatability: 1 in 16,384 of span

Max. Normal Mode: ±250V peak

Common Mode Rejection:

	2-Wire	3-Wire
@ 50/60 Hz	140dB	160dB
@ DC	120dB	150dB

Max. Common Mode. 250V peak channel to channel within input card;
350V peak channel to ground, input card to input card

A.6 Communications

Type: Two-wire serial with voltage levels conforming to EIA RS-485

Option: RS-232 to RS-422/485 interface converter

Baud Rates: 300, 1,200, 9,600, 19,200; user selectable

Protocol: ASCII, with checksum in ASCII for error detection

Max. Dist. from Host: Up to 16,000 ft. (5,000m)

Addressability: From 1 to 16 Netpacs on one port (single twinax line)

A.6.1 Maximum Channel Capacity - Single Port

Host Computer with RS-232/485 Converter: 1600 channels

Maximum Network Throughput: 125 channels/sec

A.6.2 Power Requirements

Input Power: 12 VDC, 24 VDC, 115 VAC or 230 VAC

DC Power Line Variation: –10% to +17% of nominal input voltage

AC Power Surge Withstand: Meets requirements of IEEE std. 472-1974 (ANSI C37.90a-1974); Surge withstand capability tests

Single and multi-modules with volts, currents, thermocouples, dry contact status, RTD's, high volts or contact output: 11W maximum for any number of channels

Pulse counting (10 channels) or analog output (5 channels): 14W

A.7 Diagnostics

Software self-diagnostics are run on power-up and during operation. Error indication is communicated to host upon interrogation.

Status LED provides indication of system state.

A.8 Dimensions

Single Module:

	Height	Width	Depth	Weight
Open Style	3 1/4"	14 1/8"	11"	5 lbs 7 oz
NEMA 2	3 1/4"	15 1/4"	11 1/2"	10 lbs 15 oz
NEMA 4	20"	16"	6"	29 lbs

Multi-Module:

	Height	Width	Depth	Weight
NEMA 4	20"	16"	6"	29 lbs
Rack Mount	8 3/4"	19"	14 3/8"	18 lbs
Open Style	25"	16 5/8"	6 1/2"	14 lbs

A.9 Input Conditioning Types for Digital Control Card

TTL/CMOS

Input low voltage	>0.0 volt and <0.8 volt
Input high voltage	>3.5 volts and <12.0 volts
Input voltage	>–0.5 volts min. and <15.0 volts max.
Input resistance	>3,000Ω
Input frequency	<800 KHz
Input pulse width	>625 nsec

A.9.1 Dry Contact

Input closed resistance	<150Ω
Input open resistance	>2,500Ω
Input frequency	<10 Hz
Input pulse width	>50 msec
Input Low pass cut-off freq.	approx. 100 Hz
Input load resistance	approx. 1,000Ω (shunt to +5 volts)

A.9.2 Isolated AC, 80 to 150 Volts

Input low voltage	<3 volts
Input high voltage	>80 volts
Input voltage	<150 volts RMS
Input resistance	>200 KΩ
Input frequency	<1,000 Hz
Input pulse width	>250 μ s
Isolation leakage current	<1 μA at 3,000 VDC, 25°C, 45% RH

A.9.3 Isolated High Volts, 80 to 150 Volts

Input off voltage	<15 volts
Input on voltage	>80 volts
Input voltage	<150 volts RMS
Input resistance	>200 K Ω
Input frequency	<10 KHz
Input pulse width	>50 μ s
Conditioner OFF to ON propagation delay	<1ms (0.7ms typical)
Conditioner ON to OFF propagation delay	<10ms (7ms typical)
Isolation leakage current	<1 μA at 3,000 VDC, 25°C, 45%RH

A.9.4 Low Level, 15m VAC

Input low voltage	<–15 mV
Input high voltage	>15 mV
Input voltage	<10 volts RMS (max. over-voltage)
Input resistance	>500 KW for input voltage <200 mV RMS
Input frequency	<10 KHz
Input pulse width	>50 μ s

[no content intended for this page]

A

B

C

D

E

G

Warranty

Each instrument manufactured by GE Sensing is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of GE Sensing. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If GE Sensing determines that the equipment was defective, the warranty period is:

- one year from delivery for electronic or mechanical failures
- one year from delivery for sensor shelf life

If GE Sensing determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by GE Sensing, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties or merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a GE Sensing instrument malfunctions within the warranty period, the following procedure must be completed:

1. Notify GE Sensing, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, GE Sensing will issue a RETURN AUTHORIZATION NUMBER (RAN), and shipping instructions for the return of the instrument to a service center will be provided.
2. If GE Sensing instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.
3. Upon receipt, GE Sensing will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

- If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.
- If GE Sensing determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

[no content intended for this page]

Customer Support Centers

U.S.A.
For Sales and Services (Repair/Calibration):
GE Measurement & Control
St Marys Center
967 Windfall Road
St Marys, Pennsylvania 15857
U.S.A.
T: 814-834-9140
F: 814-781-7969
stmaryscc@ge.com

U.S.A.
For Technical Support:
The Boston Center
1100 Technology Park Drive
Billerica, MA 01821
U.S.A.
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