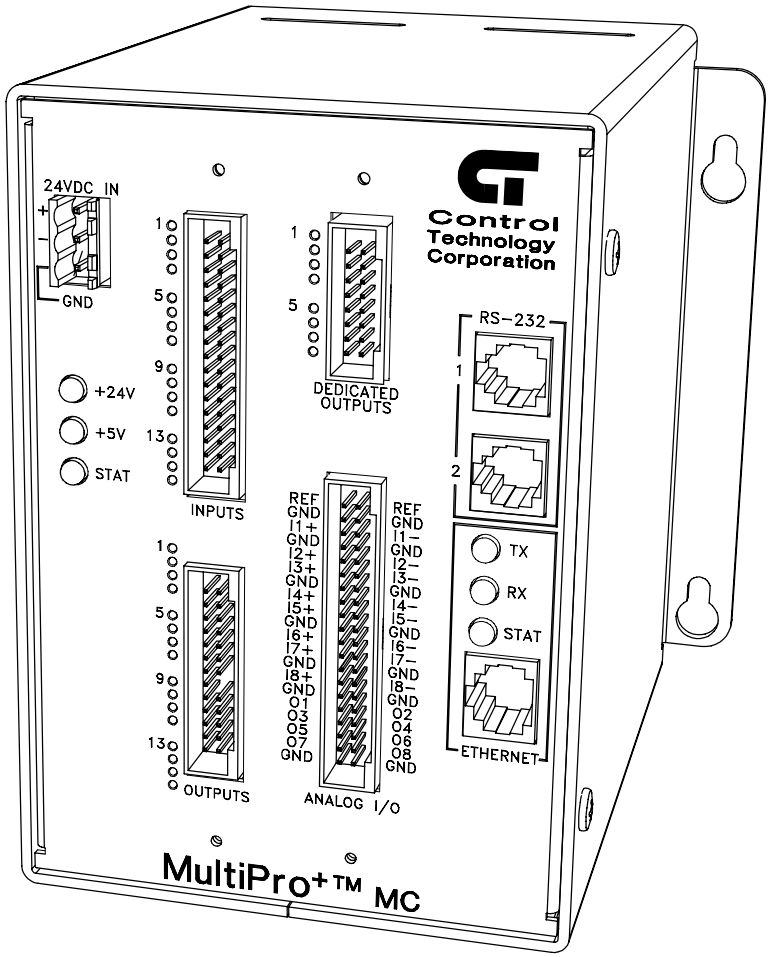
Model 2644 MultiPro+™ MC
Installation Guide



Doc. No. 2644IG
Revision B
October 2001

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Contents

2 Application Notes

Notes to Readers

The *Model 2644 Installation Guide* provides the following information:

- Dimensions and Mounting Considerations -- mounting dimensions and precautions on mounting the MultiPro.
- Description and Connection Diagrams -- an overview of the MultiPro's basic functions; pinout diagrams for all connectors.
- Specifications -- general, digital I/O, and analog I/O specifications; hardware and firmware revisions for the 2644 controller.
- Power Connections -- connecting power to the MultiPro.
- Status Lights -- how the status light functions.
- I/O Connections -- connecting digital inputs and outputs; connecting analog inputs and outputs; connecting dedicated outputs.
- Controller Communications -- describes the controller's RS-232 ports and Ethernet port and how they function.
- Application Notes -- programming analog inputs and outputs.

Related Documents

The following documents contain additional information:

- For information on Quickstep, refer to the *Quickstep™ Language and Programming Guide* or the *Quickstep™ User Guide.*
- For information on the registers in your controller, refer to the *Register Reference Guide* (available at www.ctc-control.com).
- For information on Microsoft Windows or your PC, refer to the manuals provided by the vendor.

Formatting Conventions

The following conventions are used in this book:

ALL CAPS BOLDFACE	Identifies DOS, Windows, and installation program names.
Boldface	Indicates information you must enter, an action you must perform, or a selection you can make on a dialog box or menu.
Italics	Indicates a word requiring an appropriate substitution. For example, replace *filename* with an actual file name.
Text_Connected_With_Underlines	Indicates symbolic names used in Quickstep programs. Step Names are ALL_CAPITALS. Other symbolic names can be Initial_Capitals or lower_case.
SMALL CAPS	Identifies the name of Quickstep instructions in text.
`Courier font`	Identifies step names, comments, output changes, and Quickstep instructions appearing in the Quickstep editor.
Art Code 2217F1	Identifies the file name of a particular graphic image.

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Getting Started

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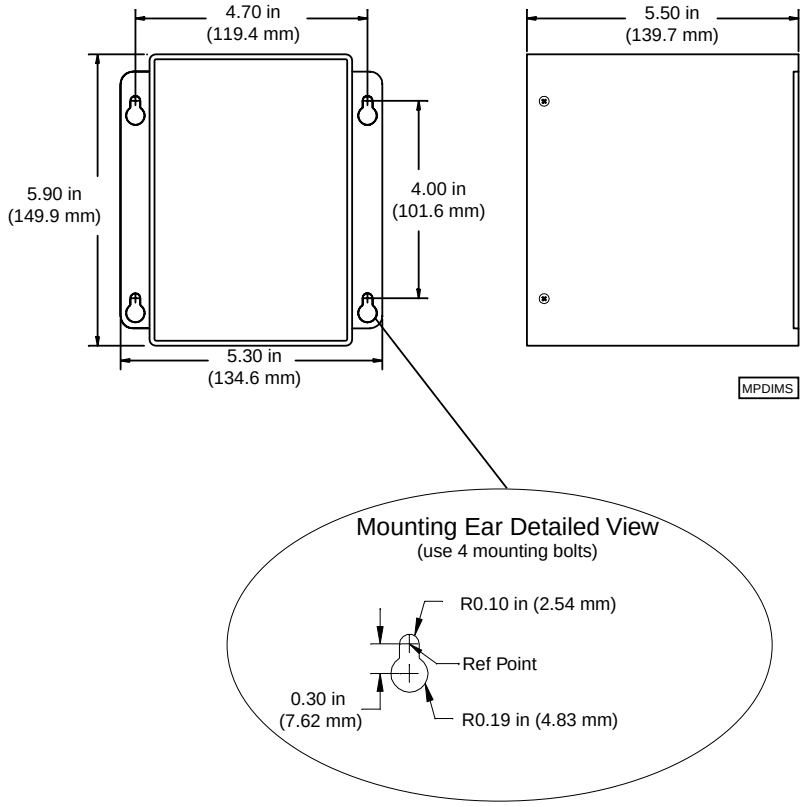
Dimensions and Mounting Considerations

All MultiPro controllers have mounting ears that allow easy mounting to flat surfaces such as a NEMA-rated electrical enclosure. Figure 1–1 provides mounting ear details and MultiPro dimensions.

Select a mounting location that protects against the environmental hazards listed below:

- Avoid flying metal chips that may result from installation or subsequent machine construction. You should also avoid conductive dusts, liquids, or condensing humidity. If any of these conditions exist, mount the MultiPro in a NEMA 4 or NEMA 12 rated enclosure.
- Do not mount the MultiPro in an environment that requires explosion proof practices.
- Avoid mounting locations that are in close proximity to devices that produce electromagnetic interference (EMI) or radio frequency interference (RFI). Devices such as motor starters, relays, large power transformers, and ultrasonic welding apparatus fall into this category.

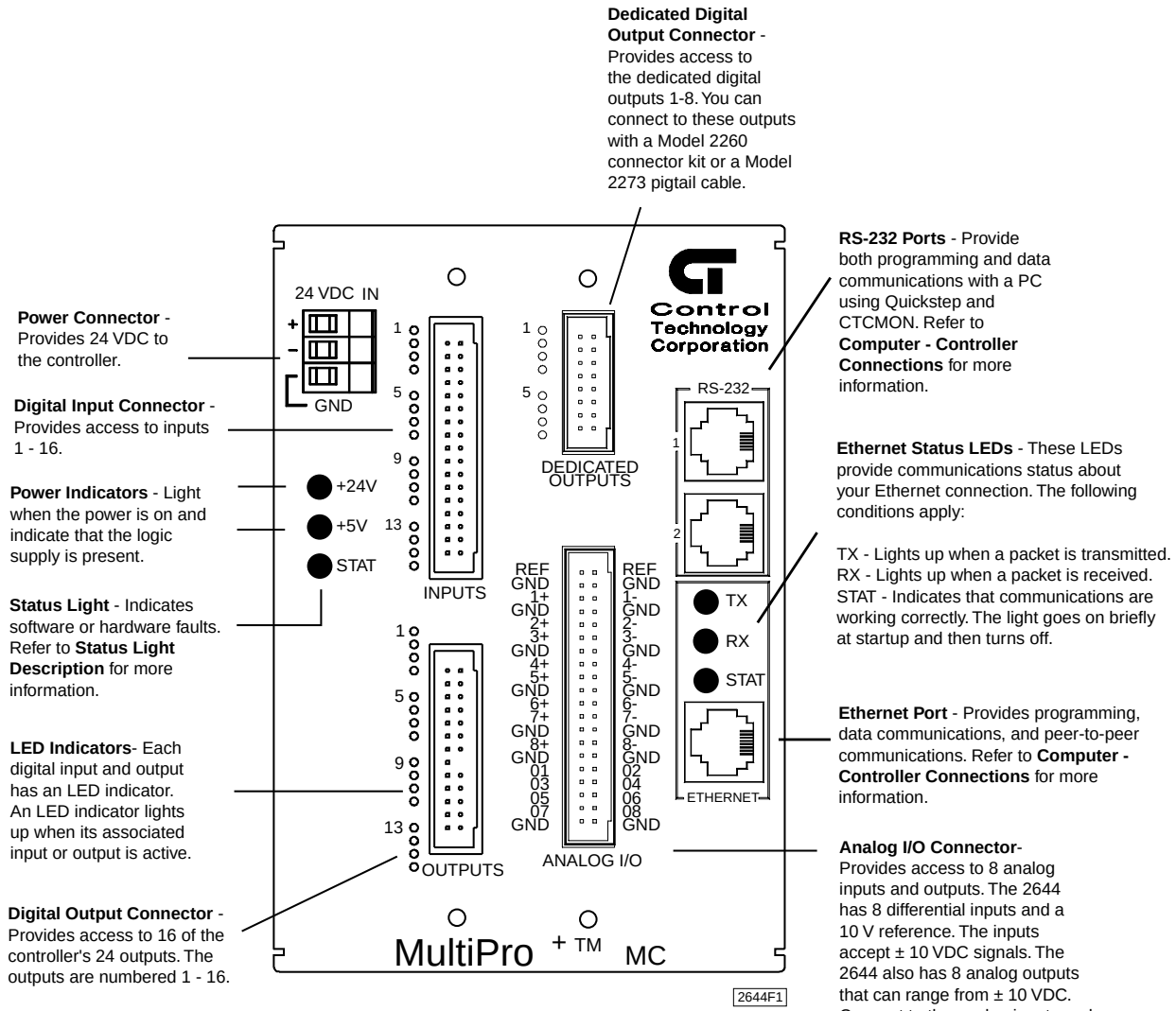
Figure 1–1. MultiPro Dimensions and Mounting Ear Details



2644 Description

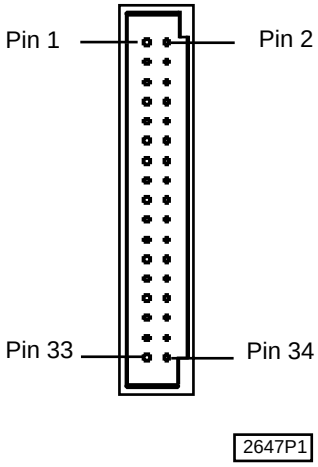
Figure 1–1 shows the 2644's faceplate and describes its different features.

Figure 1–1. 2644 Faceplate and Features



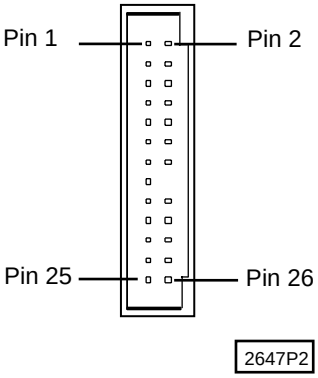
Connectors and Pinout Diagrams

Table 1–1. Connection Diagram - Digital Input Connector



Digital Input Connector	Pin #	Signal	Pin #	Signal
	1	D Input 1	2	Return
	3	D Input 2	4	Return
	5	D Input 3	6	Return
	7	D Input 4	8	Return
	9	D Input 5	10	Return
	11	D Input 6	12	Return
	13	D Input 7	14	Return
	15	D Input 8	16	Return
	17	D Input 9	18	Return
	19	D Input 10	20	Return
	21	D Input 11	22	Return
	23	D Input 12	24	Return
	25	D Input 13	26	Return
	27	D Input 14	28	Return
	29	D Input 15	30	Return
	31	D Input 16	32	Return
	33	+24 VDC	34	Return

Table 1–2. Connection Diagram - Digital Output Connector



Digital Output Connector	Pin #	Signal	Pin #	Signal
	1	D Output 1	2	D Output 14
	3	D Output 2	4	D Output 15
	5	D Output 3	6	D Output 16
	7	D Output 4	8	Return
	9	D Output 5	10	Return
	11	D Output 6	12	Return
	13	D Output 7	14	Return
	15	D Output 8	16	No pin
	17	D Output 9	18	+24 VDC
	19	D Output 10	20	+24 VDC
	21	D Output 11	22	+24 VDC
	23	D Output 12	24	+24 VDC
	25	D Output 13	26	NC

Table 1–3. Connection Diagram - Dedicated Digital Output Connector

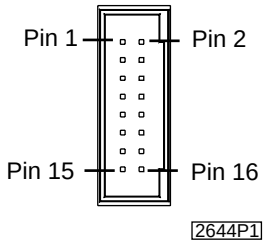
Dedicated Digital Output Connector	Pin #	Signal	Pin #	Signal
	1	D Output 1	2	D Output 2
	3	D Output 3	4	D Output 4
	5	D Output 5	6	D Output 6
	7	D Output 7	8	D Output 8
	9	Return	10	Return
	11	Return	12	Return
	13	+ 24 VDC	14	+ 24 VDC
	15	+ 24 VDC	16	+ 24 VDC

Table 1–4. Connection Diagram - Analog Input / Output Connector

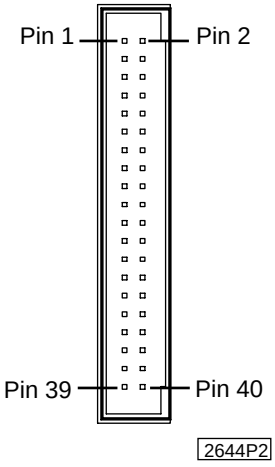
Analog I/O Connector	Pin #	Signal	Pin #	Signal
	1	10 V Ref.	2	10 V Ref.
	3	Return	4	Return
	5	A Input 1+	6	A Input 1-
	7	Return	8	Return
	9	A Input 2+	10	A Input 2-
	11	A Input 3+	12	A Input 3-
	13	Return	14	Return
	15	A Input 4+	16	A Input 4-
	17	A Input 5+	18	A Input 5-
	19	Return	20	Return
	21	A Input 6+	22	A Input 6-
	23	A Input 7+	24	A Input 7-
	25	Return	26	Return
	27	A Input 8+	28	A Input 8-
	29	Return	30	Return
	31	A Output 1	32	A Output 2
	33	A Output 3	34	A Output 4
	35	A Output 5	36	A Output 6
	37	A Output 7	38	A Output 8
	39	Return	40	Return

Table 1–5. Connection Diagram - RS-232 Connector

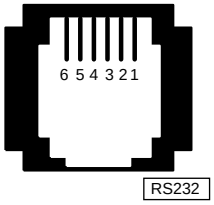
RS-232 Connector	Pin #	Signal
	1	NC (+5 VDC on Channel 1)
	2	TxD Outbound
	3	Common
	4	Common
	5	RxD Inbound
	6	NC (+5 VDC Return on Channel 1)

Table 1–6. Ethernet Connector

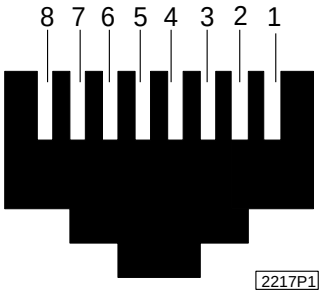
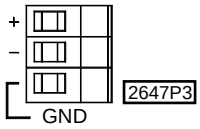
10Base-T Connector	Pin #	Signal
	1	TX0+
	2	TX0-
	3	RX1+
	4	NC
	5	NC
	6	RX1-
	7	NC
	8	NC

Table 1–7. Connection Diagram - Power Connector

Power Connector	Pin #	Signal
	1	+24 VDC
	2	+24 V Return
	3	Ground

Specifications

Table 1–8. General Specifications

Description	Min.	Typical	Max.	Units
Absolute Maximum Ratings				
Ambient Temperature				
Operating	0		+50	°C
Storage	-20		+80	°C
Controller Characteristics				
Voltage range	22.0	24.0	27.0	VDC
Current requirements at 24 VDC		.4	.6	A
User memory capacity (11 year lithium-cell RAM)		32K		Bytes
The main CPU is an Hitachi SH2 processor running at 24.576 MHz.				
Controller Performance Specifications [1]				
Controller CPU clock speed		24.576		MHz
Sense input, jump to new step, change output		0.5		ms
Perform multiplication (between volatile registers)		0.3		ms
Time delay duration, 10 ms programmed		10.08		ms
Time delay duration, 1 s programmed		1.001		s
Internal count rate		750		Hz
Communications Characteristics				
RS-232 transmitters		± 9	± 12	VDC
RS-232 receivers	± 3		± 12	VDC
Ethernet transceivers (10 Megabits/s) [2]			1.5	VAC PP

1. Performance specifications shown are with one task running. RS-232 communications may degrade the count by up to 10%.
2. This conforms to IEEE Standard 802.3.
3. This value is derived with high communications priority active or when one task is running.
4. Specifications are at 25°C unless otherwise specified.

Table 1–8. General Specifications (Continued)

Description	Min.	Typical	Max.	Units
Network Performance Specifications [3]				
Host communications				
Single-register transaction from controller		2		ms
16-register read from controller		12-15		ms
50-register read from controller		13-16		ms
Peer-to-peer communications				
Single-register transaction from controller		10-13		ms
Controller Resource Summary				
Multi-tasking (tasks)			56	
Volatile registers (32-bit)			490	
Non-volatile registers (32-bit)			500	
Data table elements (16-bit, non-volatile)			8000	
Input-linkable counters			16	
Flags			32	
Program steps			1280	

1. Performance specifications shown are with one task running. RS-232 communications may degrade the count by up to 10%.
2. This conforms to IEEE Standard 802.3.
3. This value is derived with high communications priority active or when one task is running.
4. Specifications are at 25°C unless otherwise specified.

Table 1–9. Digital I/O Specifications

Description	Min.	Typical	Max.	Units
Absolute Maximum Ratings				
Applied input voltage [1]	0		27.0	VDC
Applied output voltage [2]	0		24.0	VDC
Output current				
Single output			500	mA DC
Total limit			5	A
Operating Characteristics				
Output on voltage (I_o = 500 mA)		0.8	1.8	VDC
Output off leakage (applied voltage = 24V) [3]		0.01	0.75	µA
Input off voltage (I_i = 0 mA)		24.0	26.4	VDC
Input on current (V_i = 0 V)		-2.10	-2.85	mA
Input on current threshold (V_i = 8 V typical)		-1.0	-1.85	mA
Input off current (typical leakage current allowable)			-250	µA

1. Under normal operation, no external input voltage is applied. Inputs should be externally switched to the input common.
2. An on-board protection diode returns to +24 V from each output.
3. In the off state, unconnected outputs are internally pulled to +5 V through a diode and an LED indicator.
4. Specifications are at 25°C unless otherwise specified.

Table 1–10. Analog I/O Specifications

Description	Min.	Typical	Max.	Units
Absolute Maximum Ratings				
Maximum analog input voltage			± 15	VDC
Minimum analog output load resistance	2.0			kΩ
Maximum output current				
Precision +10 V reference output			25	mA
Digital outputs (per output)			500	mA
Analog isolation - voltage withstand (one minute duration maximum)			1500	V
Operating Characteristics - Analog Inputs				
Differential input range	-10.000000		+10.000000	VDC
Common mode voltage range	-10		+10	VDC
Input resistance		10		kΩ
Input resolution (15-bit)		.00305		%FS
Input accuracy (25°C, 8-sample filtering)		.00305		%FS

1. All digital outputs have short-circuit and overcurrent protection.
2. Specifications are at 25°C, unless otherwise specified.

Table 1–10. Analog I/O Specifications (Continued)

Description	Min.	Typical	Max.	Units
Input conversion time (asynchronous)		2.083		ms
Input filter settings (default = 1 sample)	2.083		533.248	ms
Threshold triggering response (analog input to digital output response)		2.25		ms
Operating Characteristics - Analog Outputs				
Output voltage range	-10.000		+10.000	VDC
Output resolution		2.44		mV
Output settling time				
-10.000 to +10.000 V		0.2		ms
0 to 5.000 V		0.1		ms
Dedicated Digital Output Specifications				
On voltage (I_o = 500 mA)		.6	1.2	VDC
Off leakage (applied voltage = 24 VDC)		1	100	µA DC
Maximum output current [1]			500	mA DC

1. All digital outputs have short-circuit and overcurrent protection.
2. Specifications are at 25°C, unless otherwise specified.

Table 1–11. Hardware / Firmware Revision Levels

Model Numbers	Hardware Revision Level	Firmware Revision Level [1] [2]
All	0	2.18

1. You can confirm firmware revision levels by doing a register read in Quickstep's monitor program. Use register 13003 to confirm the firmware revision in a MultiPro controller.
2. Firmware revision levels are not equivalent to standard decimal numbers. For example, firmware revision level 2.10 translates to:

   Major Revision Level 2
   Minor Revision Level 10

   If this value changes to 2.20, it translates to:

   Major Revision Level 2
   Minor Revision Level 20 (not revision level 2)

Power Connections

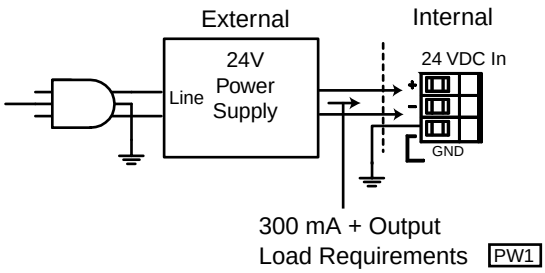
This section describes how to connect power to the MultiPro.

Connecting DC Power

The MultiPro requires an externally supplied voltage of +24 VDC for proper operation (Figure 1–2). Power is connected through the connector located on top of the MultiPro.

+24 VDC supplies power to all the I/O circuitry and also to a DC/DC converter. This conversion circuit creates an isolated +5 VDC supply that provides power to the MultiPro's logic circuitry.

Figure 1–2. 24 Volt Power Supply



The Importance of Proper Grounding

The MultiPro's ground should follow a direct, low-impedance path to the plant's power source that is not shared by any machinery that injects a large amount of electrical noise onto the line.

Note

For more information on noise protection, refer to CTC Technical Note No. 26, *Reducing Noise Susceptibility*. This document is available in the Customer Support area of our Web site at www.ctc-control.com.

Status Light Description

The status light (STAT) is located on the MultiPro's front left panel and is used to indicate a software or hardware fault. These faults are described below.

Note

After the MultiPro is turned ON, the light is steady and red during the first second of operation.

Software Fault

Quickstep programs may produce software faults that are indicated by a periodic flashing light. These faults occur when the MultiPro is unable to execute because an application problem exists within the Quickstep program. You can view the fault type by viewing the program status in Quickstep's monitoring utility, CTCMon. Once a software fault occurs, the MultiPro is idle and all resources that can be set (outputs, etc.) remain in the state they were in before the fault occurred.

Note

You can program register 13009 to turn off a specific output when a software fault occurs. Refer to the *Quick Reference Register Guide* at www.ctc-control.com for more information.

Hardware Fault

Hardware faults are displayed as a steady red light and indicate that the internal watchdog timer has disabled the MultiPro's CPU. When this occurs, the MultiPro's outputs are also disabled.

Try clearing a hardware fault by cycling the power and/or downloading the same Quickstep program. If the fault doesn't clear, your MultiPro controller may require repair. Contact our Technical Support representative for assistance.

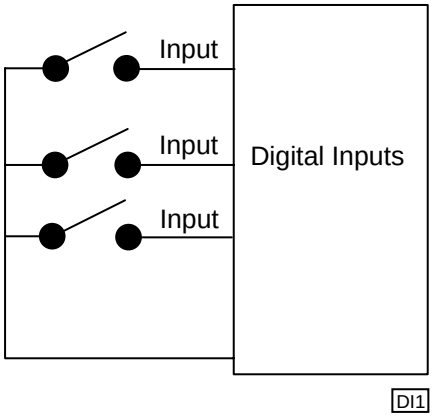
Connecting Digital Inputs

This section describes the digital inputs and how to connect devices to these inputs.

Activating a Digital Input

The Model 2644 has 16 digital inputs that you can activate with a switch closure (Figure 1–3) to **Return**, which is the common for the controller's 24 V supply. Each input is opto-isolated from the MultiPro's logic circuitry and is internally self-powered by the 24 V supply through a current-limiting resistor.

Figure 1–3. Digital Input Activation



The MultiPro senses when an input is pulled down to **Return** by a switch closure. A `MONITOR` instruction or any other programmed instruction referring to a general purpose input can use this information.

Using Solid-State Sensors

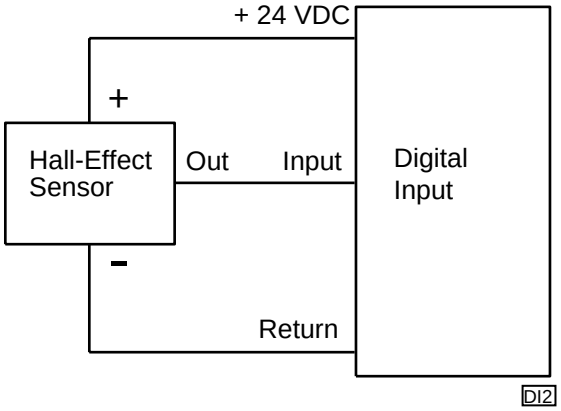
You can connect many types of electronic sensors such as three-wire Hall-effect sensors, proximity sensors, and phototransistors to the inputs without any additional circuitry. These devices must have sinking type open-collector outputs (NPN) and must be able to withstand at least +24 V on their output terminals when they are in the OFF state. The sensor must also be able to sink the required input current (i.e.- 2.1 mA) when ON.

Note

Do not use two-wire, solid-state sensors.

Electronic sensors have internal circuitry that generally requires an external power source. Figure 1–4 shows how to connect a solid-state sensor.

Figure 1–4. Connecting a Solid-State Sensor to a Digital Input



Connecting Digital Outputs

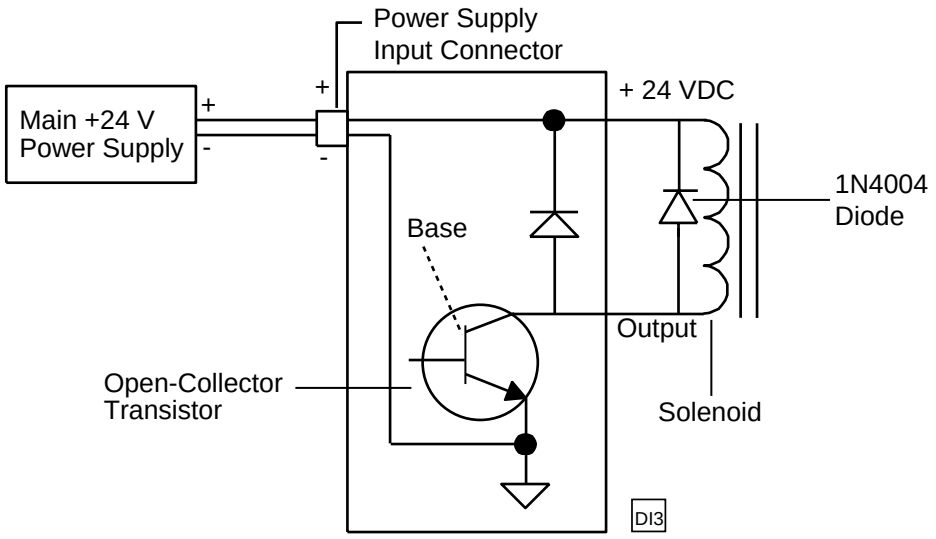
This section describes the digital outputs and how to connect devices to these inputs.

Using Open-Collector Outputs

The Model 2644 has 24 outputs for driving external loads such as solenoid valves, indicators, solid-state relays and other low-power DC loads. These outputs are configured as open-collector transistors that can switch loads up to 0.5 Amps DC. Open-collector outputs are transistors whose collector terminal is left unconnected to allow greater flexibility in its use.

An open-collector output, which is shown in Figure 1–5, performs roughly the same function as a switch contact with one side of the switch connected to ground. When the output is turned OFF, no current can flow through the transistor. This is equivalent to an open switch contact because the device being controlled is turned OFF.

Figure 1–5. Open-Collector Output



When the output is turned on, current flows through the transistor, which is equivalent to a closed switch contact. The controlled device turns on in response to the flow of current.

Connect a device to an open-collector output by connecting one of the device's terminals to the output and the other terminal to the positive side of the power supply. If the device is polarized, connect its negative [-] terminal to the output.

Note

Control Tech recommends that you place a suppression diode across inductive loads. Use a 1N4004 diode or its equivalent. Locate the diode as close to the load as possible. Refer to Figure 1–5 for more information.

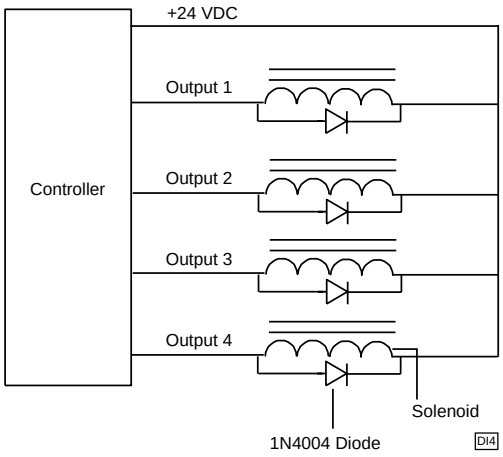
Caution

Do not exceed the rated current of the power supply in use. When you calculate your system's current requirements, you need to consider the maximum number of output devices that will be turned on simultaneously. Include 0.45 A for the MultiPro in your calculation.

Connecting Multiple Devices

It is possible to supply power to multiple devices from the same power source. One lead of each device is attached to an independent output and the other lead is connected to the positive [+] terminal of the power source. Figure 1–6 shows four solenoid valves that are controlled by Outputs 1-4. Power is supplied to each output from the MultiPro's power supply.

Figure 1–6. Multiple Device Connection Diagram



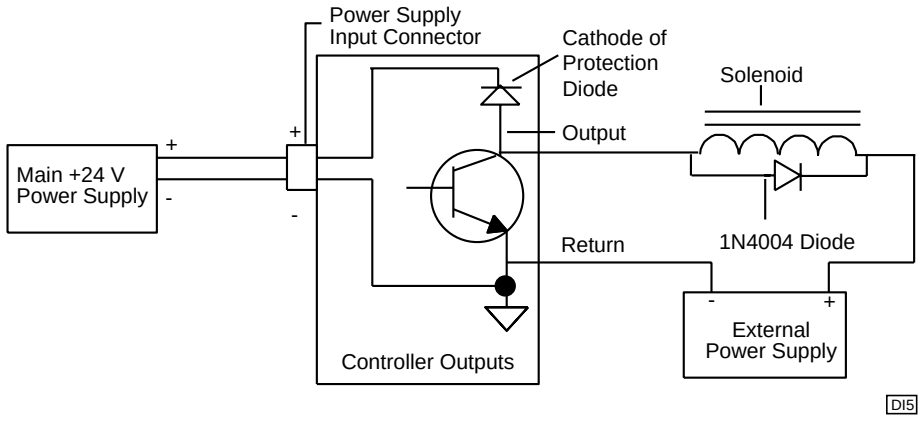
Connecting to a Second External Supply

Multiple devices can also derive their power source from a secondary external power supply. Some devices use this external supply while others use the controller's power supply. If you use this option, connect each device to the positive [+] terminal of the appropriate power supply. Figure 1–7 illustrates this setup.

Note

If you decide to use an external power supply, do not tie the positive terminals of the two supplies together by direct means or indirect means.

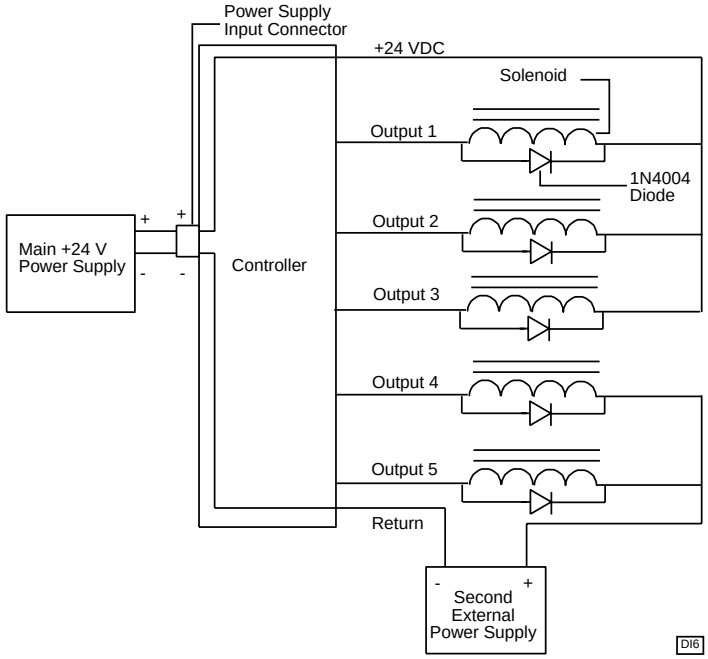
Figure 1–7. External Power Supply Connection Diagram



Caution

Each output has a protection diode with its cathode connected to the +24 VDC power supply through the input connector. This diode prevents damage to the output when it is connected to an inductive load. If you use an external supply as shown in Figure 1–7, a current path exists between the two supplies through the devices being controlled. Under normal circumstances, this practice is acceptable. However, some power supplies offer low impedance with respect to the power supply return when you turn them OFF. For example, in Figure 1–7, the main supply is turned OFF and the external supply is ON. Current from the external supply can energize the device connected to the output and turn it ON.To prevent this situation, make sure that both supplies are turned ON and OFF at the same time. Refer to Figure 1–8 for an alternative way to connect an external power supply.

Figure 1–8. Alternative Wiring Diagram for an External Power Supply



Note

Do not use an external power supply with an output voltage that exceeds the voltage rating of the MultiPro's outputs.

Caution

Do not connect the positive [+] terminals of the power supplies together! Damage to one of the supplies may result. Figure 1–8 shows the connection between the external supply's negative terminal and the output connector's return terminal. This provides a complete path for the current traveling through the device being controlled.

Connecting Analog Inputs

The MultiPro's analog inputs are opto-isolated from the controller's CPU logic circuitry. This reduces ground-looping and increases noise immunity. Figures 1–9 through 1–11 show wiring configurations for a differential signal, a single-ended signal, and a potentiometer.

Figure 1–9. Connecting a Differential Signal

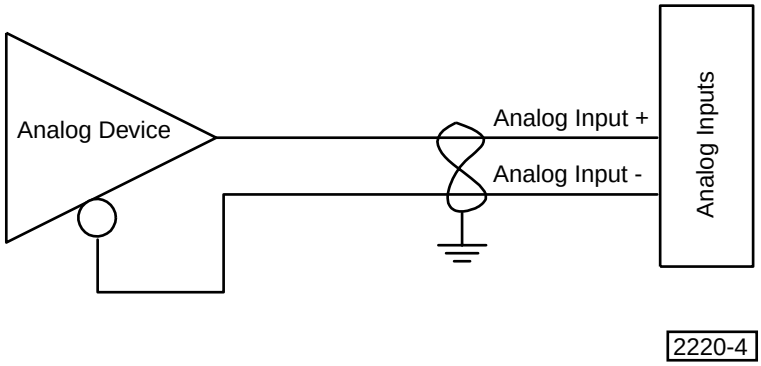


Figure 1–10. Connecting a Single-Ended Signal

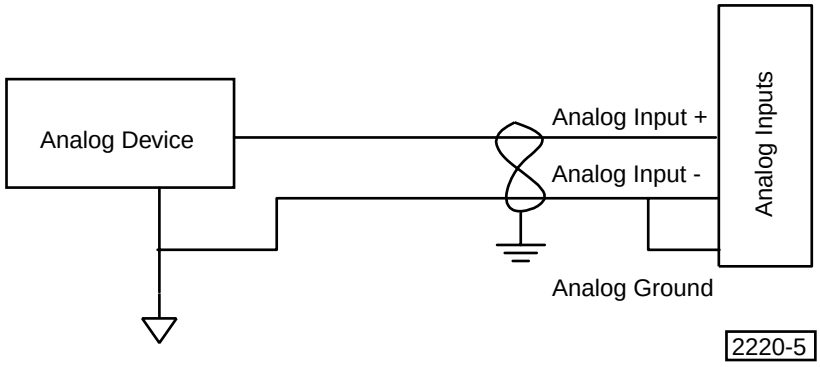
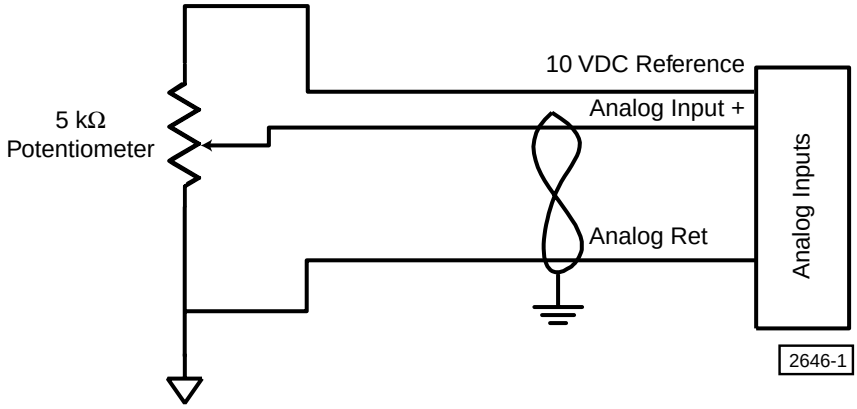


Figure 1–11. Connecting to a Potentiometer



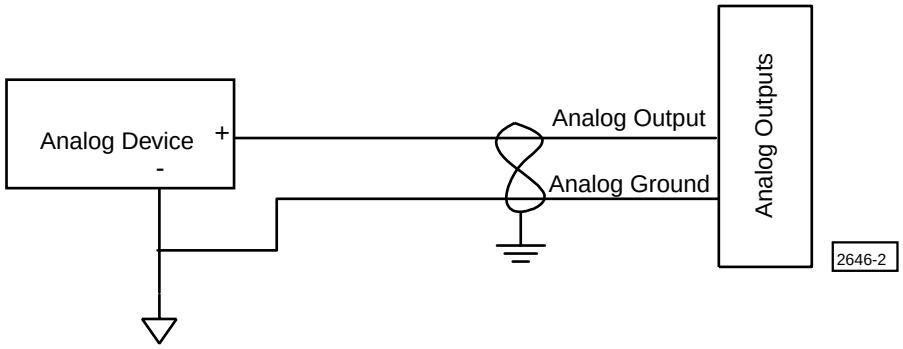
Connecting Analog Outputs

This section discusses analog output connections and describes how to gain access to these outputs.

Connecting Analog Outputs

The MultiPro has 8 bipolar (±10 V) analog outputs with 13-bit resolution. Figure 1–12 shows an analog output's wiring configuration.

Figure 1–12. Wiring Configuration - Analog Output



Note

All shields, which are part of a cable, are connected to ground on the controller end (side) of the cable.

Computer - Controller Connections

The MultiPro's RS-232 ports provide a way to download Quickstep programs and also support data communications. The MultiPro also has a 10Base-T connector for communicating over Ethernet networks.

RS-232 Protocols

Built-in protocols allow the following activities:

- **Direct communications between a PC and the MultiPro's RS-232 ports** - This feature enables you to directly interact with all the MultiPro's resources such as registers, inputs, outputs, and flags without modifying the MultiPro's program.
- **Monitoring** - You can monitor a controller's activity through an RS-232 port with CTCMON.

Note

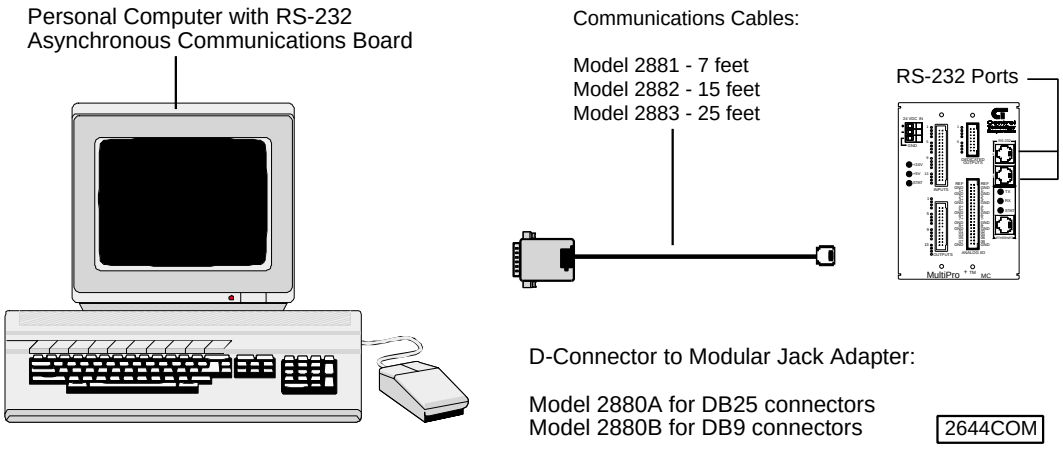
The protocols mentioned above are described in the *CTC 32-Bit Data Communications Functions Reference Guide,* which is available in the Customer Support area of our web site at www.ctc-control.com.

RS-232 Connections

Connect to one of the RS-232 ports through the modular jack (labeled 1 and 2) on the MultiPro's front panel. This jack carries the receive and transmit signals and two commons (ground). Refer to Table 1–5 on page 11 for connection information on this jack.

Standard Control Technology cables are available for connecting to this jack (Figure 1–13). As an alternative, many commonly available telephone cables may be substituted.

Figure 1–13. Communication Cables and Connectors



Connecting to a D Connector

RS-232 ports on computers are usually configured through 25-pin (DB25) or 9-pin (DB9) D-type connectors. Most PC manufacturers use standard wiring on these connector types. Control Technology has adapters available that connect directly to a male DB25 (Model 2880A) or DB9 (Model 2880B) connector. These adapters have a modular jack that is wired for compatibility with the COMM port. To ensure full compatibility with these adapters, you should wire the computer's communications port as a DTE (Data Terminating Equipment) device.

Note

Do not connect the MultiPro to a telephone line.

Figures 1–14 and 1–15 show computer-controller connections using an RS-232 connection and DB25 and DB9 connectors.

Figure 1–14. DB9 Connections

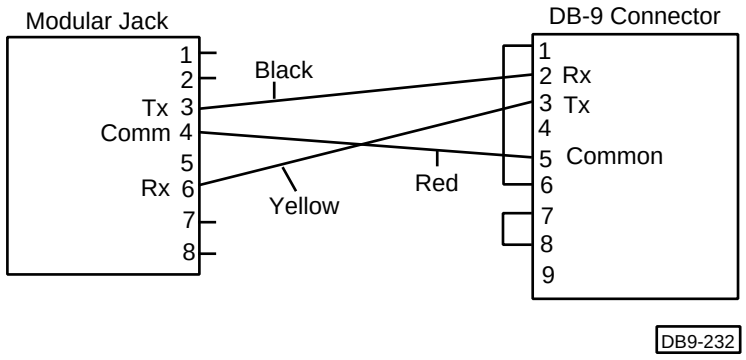
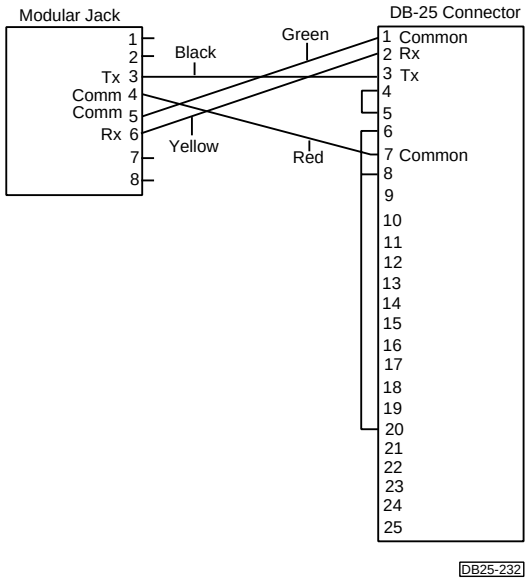


Figure 1–15. DB25 Connections



Ethernet Connections

The 2644 has a 10Base-T connector that conforms to IEEE standard 802.3. This section discusses the Ethernet protocol and illustrates a typical network connection diagram. Wiring information for the Ethernet connector is listed in Table 1–6 and performance specifications are listed in Table 1–8.

Ethernet Protocol

Ethernet is the most widely used local area network (LAN) access method. Data packets are transmitted over coaxial cable using the carrier sense multiple access with collision detection (CSMA/CD) algorithm until they arrive at their destination without any collisions. Ethernet nodes on a segment share the bandwidth, which is 10 MBps (Ethernet). The 2644 has an Ethernet port that allows it to communicate over an Ethernet network using a 10Base-T connections.

10Base-T

This connection type uses unshielded twisted pair (UTP) cabling and standard RJ-45 connectors. 10Base-T uses Category 3 (or higher) cables. Higher category numbers provide greater protection from outside electrical interference. CTC recommends using Category 5 UTP cable, connectors, and wiring techniques.

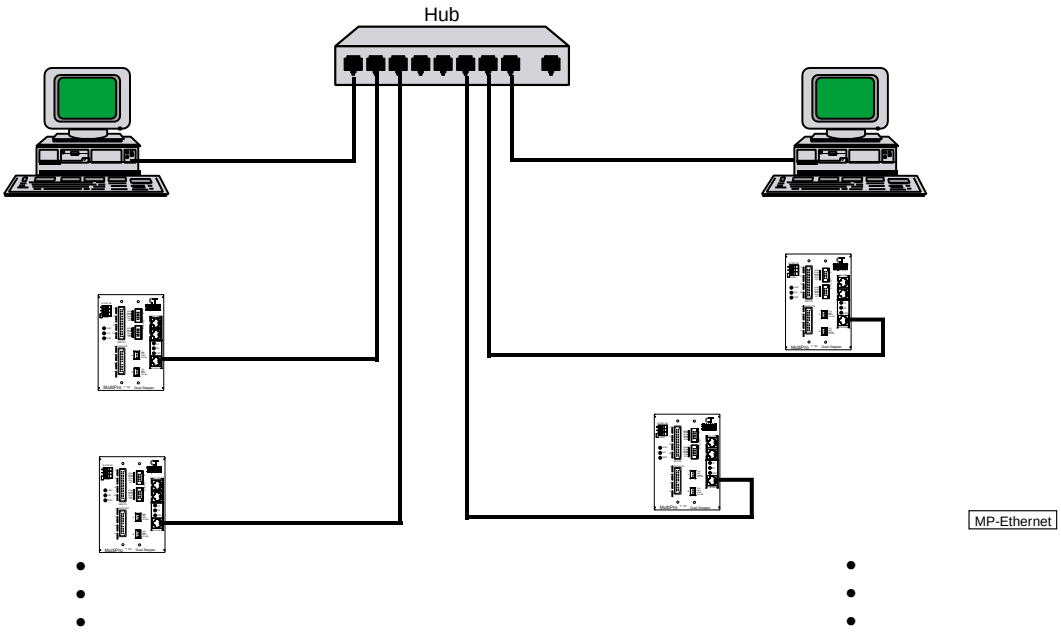
Network Specifications

Node and cable specifications for 10Base-T connections are listed below. Termination for 10Base-T is provided by a hub. The total nodes per hub are determined by the hub size.

Total number of nodes supported:	32767
Maximum number of nodes per segment:	1024
Maximum cable length per segment:	100 meters
Maximum cable length per network:	500 meters (10Base-T)

Figure 1–16 shows computer-controller connections using an Ethernet network. It represents one segment out of 5 possible segments on the network. The total cable length between all devices and the hub must not exceed 100 meters or the rule is violated.

Figure 1–16. Ethernet Network with one Segment



Controllers and other devices can be added to this segment provided that you don't exceed 100 meters of cable.

Host Communications

The MultiPro's networking capabilities includes host communications, peer-to-peer communications offering indirect node access, built-in error checking, and network access from any controller's RS-232 port. A host computer can interrogate the area network continuously while local computers or operator interface terminals can access the network port using conventional communications protocols from any controller's RS-232 port. For fast data retrieval, the controller supports both block area transfer from a single command request both locally and over the network.

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Application Notes

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Programming Analog Inputs

This section provides programming information for the MultiPro's analog inputs.

Specifying Digital Filter Length

Use registers 18501-18508 to specify the digital filter length for the MultiPro's analog inputs. Enter a value in one of these registers to specify the total number of samples processed by the MultiPro. These samples are continuously averaged for use in your Quickstep program. The default value is 1, or unfiltered. A single sample period for an analog conversion is 2.0833 ms. CTC recommends that you set the filter length value to 8 (2.0833 * 8 = 16.67 ms, or a 60 Hz rate). If the value is set to 8 or a multiple of 8, it helps reject any 60 Hz noise that may be present on your system.

Note

The analog inputs are designed to operate asynchronously. This allows you to specify larger filter lengths without affecting the controller's performance.

Setting Up Input Thresholds

You can configure each analog input to control an associated digital output that is based on reaching pre-defined setpoints. The digital outputs are mapped one-to-one with the analog inputs. When an analog input reaches a pre-defined setpoint value, the controller turns the associated digital output ON or OFF.

You can dynamically adjust the setpoints from your Quickstep program by using CTCMON or with an operator interface. The dedicated digital outputs are configured as open-collector transistors that are available for driving DC loads. Each output can handle up to 0.5 A and provides overcurrent and short-circuit protection.

Registers 19001-19008 and 19501-19508 set the threshold setpoints for the dedicated digital outputs. The way they are used depends on how you want to control the output. For example, Figure 2–1 shows that the first output remains OFF until the voltage level on analog input 1 meets or exceeds 6 VDC. If the voltage falls below 4 VDC, the output turns back OFF. In this example, the hysteresis area ranges between 4-6 VDC to prevent the output from toggling ON or OFF when the voltage reaches the edge of the setpoint.

Figure 2–1. Input Threshold with rising voltage turning input ON

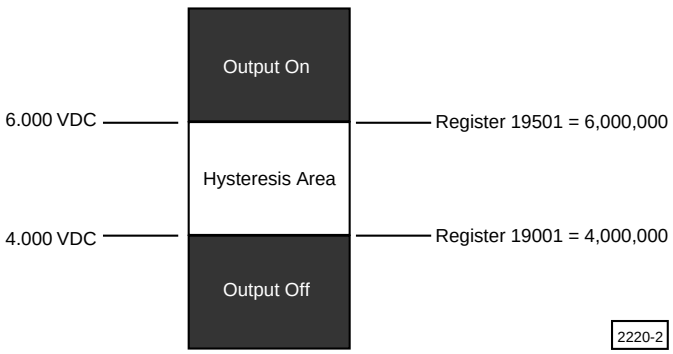
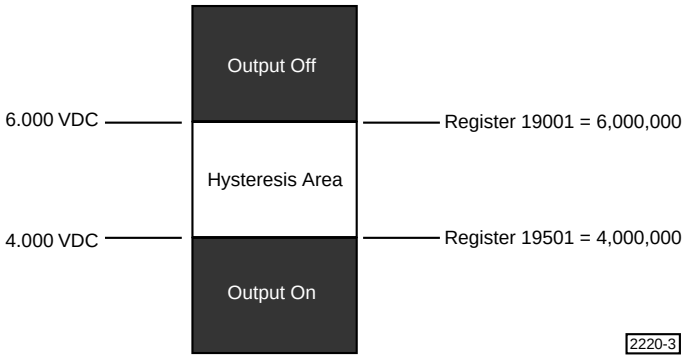


Figure 2–2 shows that the first output remains ON until the voltage level on analog input 1 meets or exceeds 6 VDC. If the voltage falls below 4 VDC, the output turns back ON. In this example, the hysteresis area ranges between 4-6 VDC to prevent the output from toggling ON or OFF when the voltage reaches the edge of the setpoint.

Figure 2–2. Input Threshold with falling voltage turning input ON



The program sample below configures analog input 1. When the value exceeds 3 VDC, digital output 1 turns ON. When the value falls below 2.5 VDC, the output turns OFF. This process is handled locally and does not affect the Quickstep program's execution time.

```
[10] DIGITAL_OUTPUT_THRESHOLDS
    ;;;
    ;;; Register 19001 sets the minimum threshold for analog
    ;;; input 1 as 2.500000. Register 19501 sets the maximum
    ;;; threshold for analog input 1 as 3.000000.
    ;;;
----------------------------------------
    <NO CHANGE IN DIGITAL OUTPUTS>
----------------------------------------
    store 2500000 to Reg_19001
    store 3000000 to Reg_19501
    goto next
```

Your Quickstep program can check the status of an output at any time. The dedicated outputs are accessed through registers 18001-18008, which have read/write capability. A value of 0 indicates that the output is OFF and a 1 means it is ON. You can use an `IF` instruction to determine the output's ON/OFF state. You can also toggle the output ON or OFF by storing a 0 or 1 to the appropriate register.

In the following example, the program jumps to the next step when dedicated output 1 is ON.

```
[56] CHECK_DEDICATED_OUTPUT
    ;;;
   ----------------------------------------
    <NO CHANGE IN DIGITAL OUTPUTS>
   ----------------------------------------
    if Reg_18001=1 goto next
```

This program sample turns on dedicated output 3 and turns off output 8.

```
[446] CHANGE_DEDICATED_OUTPUTS
    ;;;
    ————————————————————————————————-
    <NO CHANGE IN DIGITAL OUTPUTS>
    ————————————————————————————————-
    store 1 to Reg_18004
    store 0 to Reg_18008
    goto next
```

Disabling the Thresholding Feature

You can disable the thresholding feature in one of the following ways:

1. Store a number greater than 10,000,000 to register 19501 (for analog input 1) or to register 19508 (for analog input 128).

2. Store a number less than -10,000,000 to register 19001 (for analog input 1) or to register 19008 (for analog input 128).

Alternate Access to Analog Inputs

Registers 8501-8508 provide alternate access to the analog inputs. All values are expressed in millivolts and can range from -10,000,000 to +10,000,000 (-10 to +10 VDC). The following example checks the value on an analog input and proceeds to the next step if the value is greater than 9.150000 VDC:

```
if Reg_8504>9150000 goto next
```

Setting Analog Input Range

Register 13010 sets the range of all analog inputs as 0 – 10,000 (normal range on the inputs is 0 to ± 10,000,000). Store 1 to this register at the beginning of your program to automatically set the range of all analog inputs as 0 – 10,000.

Programming Analog Outputs

This section provides program samples when you access the MultiPro's analog outputs.

Access to Analog Outputs

You can use a STORE instruction to directly change an analog output's value.

```
store 4500 to Reg_8006
```

Registers 8001-8008 provide alternate access to the analog outputs. The following examples check the value on an analog output and change the value of an output. All values are expressed in millivolts.

This example checks the value of analog output 1 and proceeds to the next step when the value is reached:

```
if Reg_8001 > 1259 goto TURN_OFF_VALVE
```

This example instructs the controller to send 4.500 VDC out analog output 6.

```
store 4500 to AOUT_8006
```