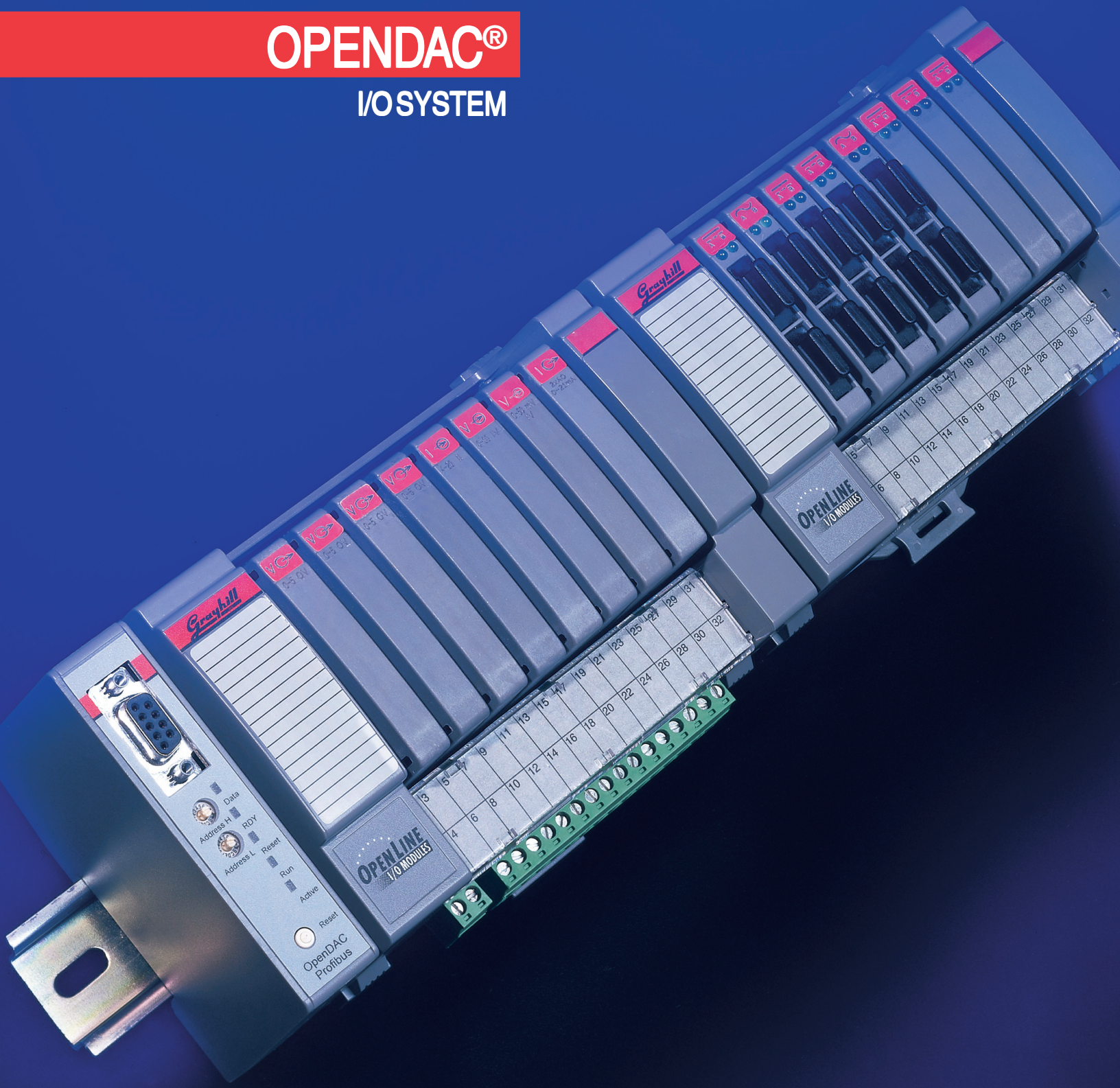


# OPENDAC<sup>®</sup>

## I/O SYSTEM



## OPENDAC® I/O SYSTEM

*Low Cost Remote I/O System*

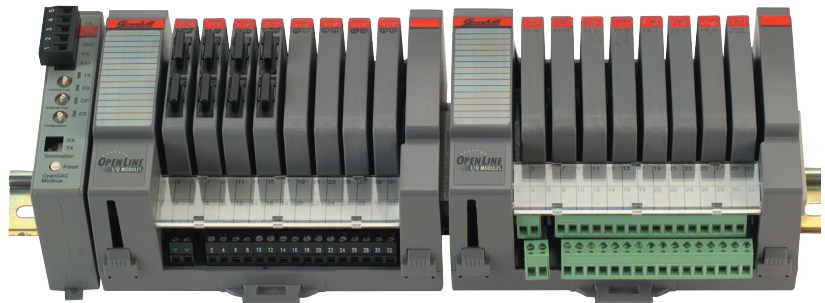
### FEATURES

- Compatible with Present Systems
- Communicates within third party hardware and software
- Ethernet Version

	Page
Network Interfaces	
OpenDAC® for Ethernet .....	2
OpenDAC® for Modbus .....	4
OpenLT (Optomux) .....	6
OpenDAC® for Profibus .....	8
Racks	
16 Channel .....	10

### OpenDAC® I/O System

The OpenDAC® family is a compact, low cost and flexible I/O system that is used for remote data requisition and control. Each network interface is capable of interfacing with one or two OpenDAC® I/O racks that allow a maximum of 32 channels of OpenLine® I/O modules. With the exception of the OpenLT™, they do not have the capability of running embedded control programs (ECPS). If this is a requirement, please review the OpenLine® Control System. OpenDAC® I/O racks are not compatible with the OpenLine® Controllers.



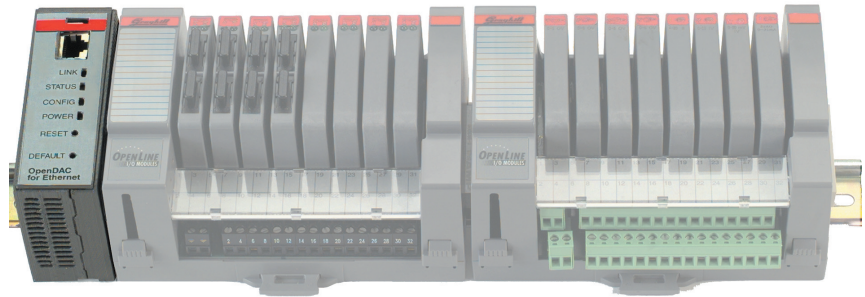
## NETWORK INTERFACES

### OpenDAC® for Ethernet



#### FEATURES

- Use Ethernet to Control/Monitor up to 32 Analog and/or Digital I/O Channels using OpenLine® I/O Modules
- Network Multiple OpenDACs®
- 10Base-T and 100Base-TX Support
- Extremely Fast Response Times over Network
- Support Modbus/TCP Protocol and HTTP
- Use Web Browser for Configuration, Monitoring and Control of I/O modules
- Diagnostic LEDs
- CE Certified
- DIN Rail Mounting
- Modbus TCP



ETHERNET UNIT ON OPENDAC® SYSTEM

#### APPLICATIONS

Stand Alone Control
Local Control & I/O
Remote I/O
Distributed I/O
SCADA
RTU

#### GENERAL DESCRIPTION

The OpenDAC® for Ethernet network interface is a remote slave that responds to Modbus/TCP commands that it receives over the network. The status and configuration of up to 32 OpenLine® analog or digital I/O channels is stored and constantly refreshed. OpenDAC® for Ethernet is self-configuring. On power up, the controller will identify the types of I/O modules present. The unit will then continuously scan and update the digital and analog modules. Digital input channels can be setup for latching operation. The OpenDAC® for Ethernet supports the OpenLine® Smart Module Protocol (SMP) that allows field calibration and parameter setup of I/O modules.

Each OpenDAC® or third party device on the network is assigned a unique IP address. There are three methods of assigning the internet protocol address -BOOTP, DHCP, and a static method. The controller is shipped with the default IP address of 128.0.0.1. The IP address can be changed using a web browser. The web browser can also be used to select BOOTP or DHCP to assign the IP address. Communication data rates are either 10 Mbps or 100 Mbps. OpenDAC® automatically detects whether it is connected to a 10Base-T or 100Base-TX network, eliminating switch settings and simplifying set up. Network and controller status can be monitored by status LEDs.

Each OpenDAC® incorporates a communication watchdog timer that monitors communication from the Modbus/TCP master. When the watchdog is enabled and the slave does not receive a valid Modbus/TCP message within a specified time, the OpenDAC® will set all output modules to the stored fault-state values. Should a valid message be received, the timer is reset and communication resumes. All configuration parameters are displayed and modified using a web browser. The configuration parameters are password protected to provide security against unauthorized access.

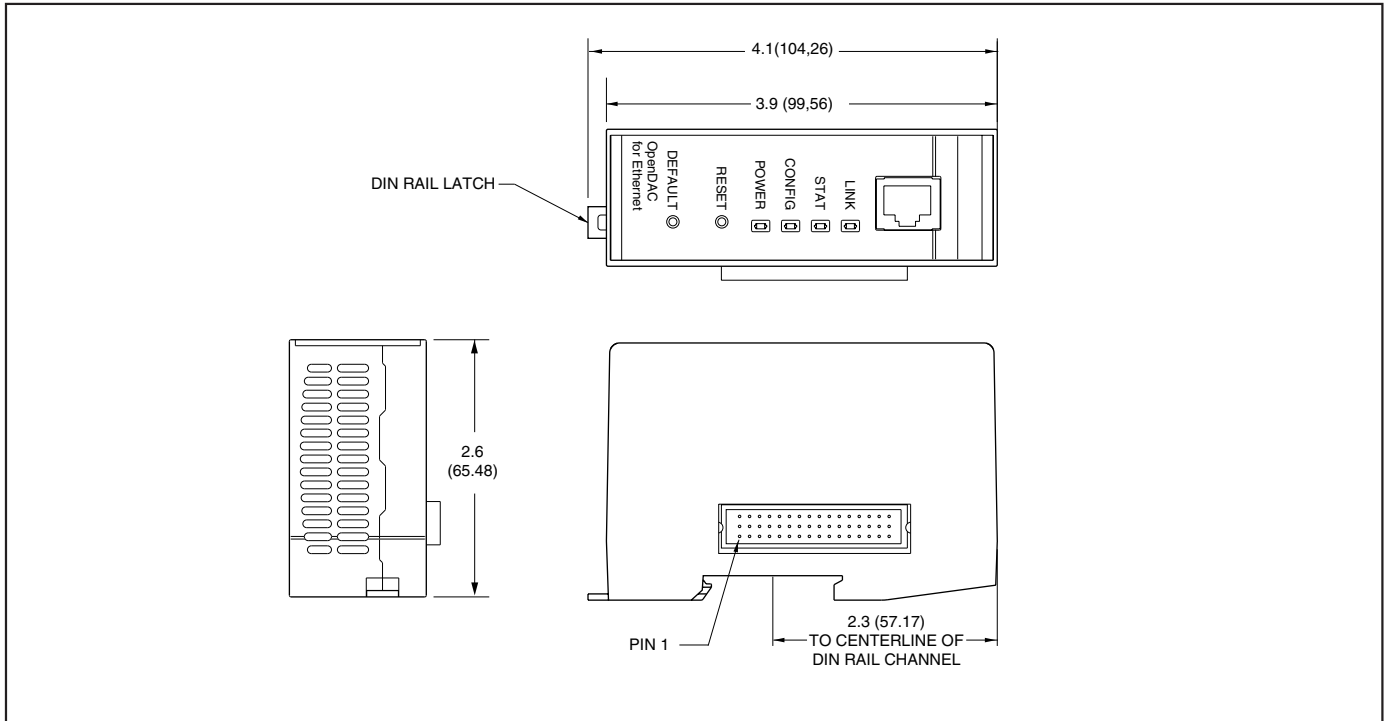
#### ANALOG & DIGITAL I/O MODULES

OpenDAC® for Ethernet connects directly to one or two 16 channel racks. Any combination of analog and digital I/O modules may be used. On power up, the OpenDAC® scans and stores the I/O configuration and makes the information available to the master.

In addition to simple On/Off instructions, the OpenDAC® allows you to:

- Read linearized thermocouple and RTD temperature values
- Detect rising or falling edges
- Latch momentary input events
- Set the level of analog outputs

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

- Supply Voltage:** 4.80 to 5.25 Vdc
- Supply Current (less modules):** 1.0 amp max.
- Operating Temperature:** -40 to 85°C
- Humidity:** 5-95% non-condensing
- Housing Material:** ABS/Polycarbonate blend
- CPU:** Net+ARM 40
- Connections:**
  - Network:** RJ-45
  - Passive Rack:** 48-Pin Euro DIN (male)
  - Range of Network (without repeaters):** 100 meters with CAT 5 UTP

**ORDERING INFORMATION**

Part Number	Description
<b>Ethernet Network Interface</b>	
72-ETH-T000	Analog/Digital OpenDAC® for Ethernet
<b>Ethernet User's Manual and Software</b>	
72-UM-OETH	OpenDAC® for Ethernet user's manual
72-UM-ETH	OpenLine® for Ethernet user's manual
72-UOL	OpenLine®/OpenDAC® configuration and product data
72-UME-DLL32	Ethernet/Modbus DLL for Windows 95/98/NT
<b>Compatible Components</b>	
OpenDAC® I/O Racks	Analog OpenLine® I/O Modules
Digital OpenLine® I/O Modules	Power Supply

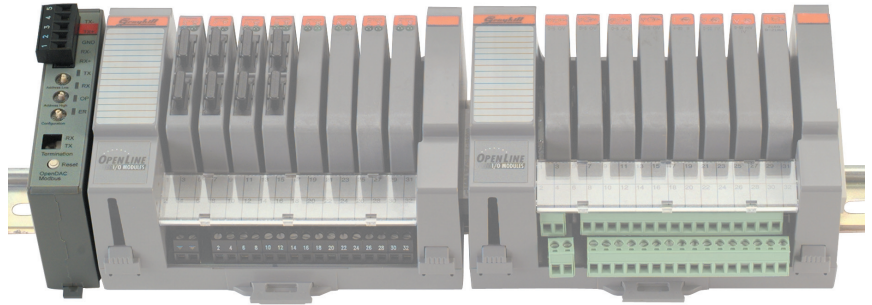
**Available from your local authorized Grayhill Distributor.** For prices and discounts, contact your local sales office, an authorized Distributor or Grayhill.

OpenDAC® I/O System

## NETWORK INTERFACES OpenDAC® for Modbus

### FEATURES

- Each Unit Controls/Monitors up to 32 Analog and/or Digital I/O using OpenLine® Modules
- Network up to 247 OpenDACs® per Host PC, Each Separated by as much as 4,000 Feet
- Communicate Over RS-422/485 at Speeds from 9600 Baud to 56.7 KB
- 100% Modbus ASCII or Modbus RTU Compatible
- CE Certified
- DIN Rail or Panel Mount



MODBUS UNIT ON OPENDAC® SYSTEM

### APPLICATIONS

Stand Alone Control
Local Control & I/O
<b>Remote I/O</b>
Distributed I/O
SCADA
RTU

### GENERAL DESCRIPTION

OpenDAC® for Modbus is an inexpensive, flexible interface to 32 analog or digital OpenLine® I/O. As one of 247 slave devices on a Modbus network, OpenDAC® for Modbus constantly scans and stores the current status of each I/O. Upon command from the host device, the controller will change the status of an output or return the value of an input. The slave address is switch selectable. Diagnostic LEDs provide troubleshooting assistance.

### ANALOG & DIGITAL I/O

OpenDAC® for Modbus connects directly to two 16 channel racks. Any combination of analog and digital I/O modules may be used. On power up, the OpenDAC® scans and stores the I/O configuration and makes the information available to the master for query.

In addition to simple On/Off instructions, Modbus commands allow you to:

- Read linearized thermocouple and RTD temperature values
- Count pulses at frequencies up to 1000Hz
- Detect rising or falling edges
- Latch momentary input events
- Set the level of analog outputs

### COMMUNICATIONS

The host computer and OpenDAC® for Modbus communicate serially over one or two pair of twisted wires per RS-422/485 in a multi-drop configuration. They use Modbus ASCII or RTU

format to code the command and the response messages. Application programs running on the host computer issue commands and then await responses from the OpenDAC®. The communications speed is switch selectable between 9600 and 56700 baud. The entire network can span 4000 feet.

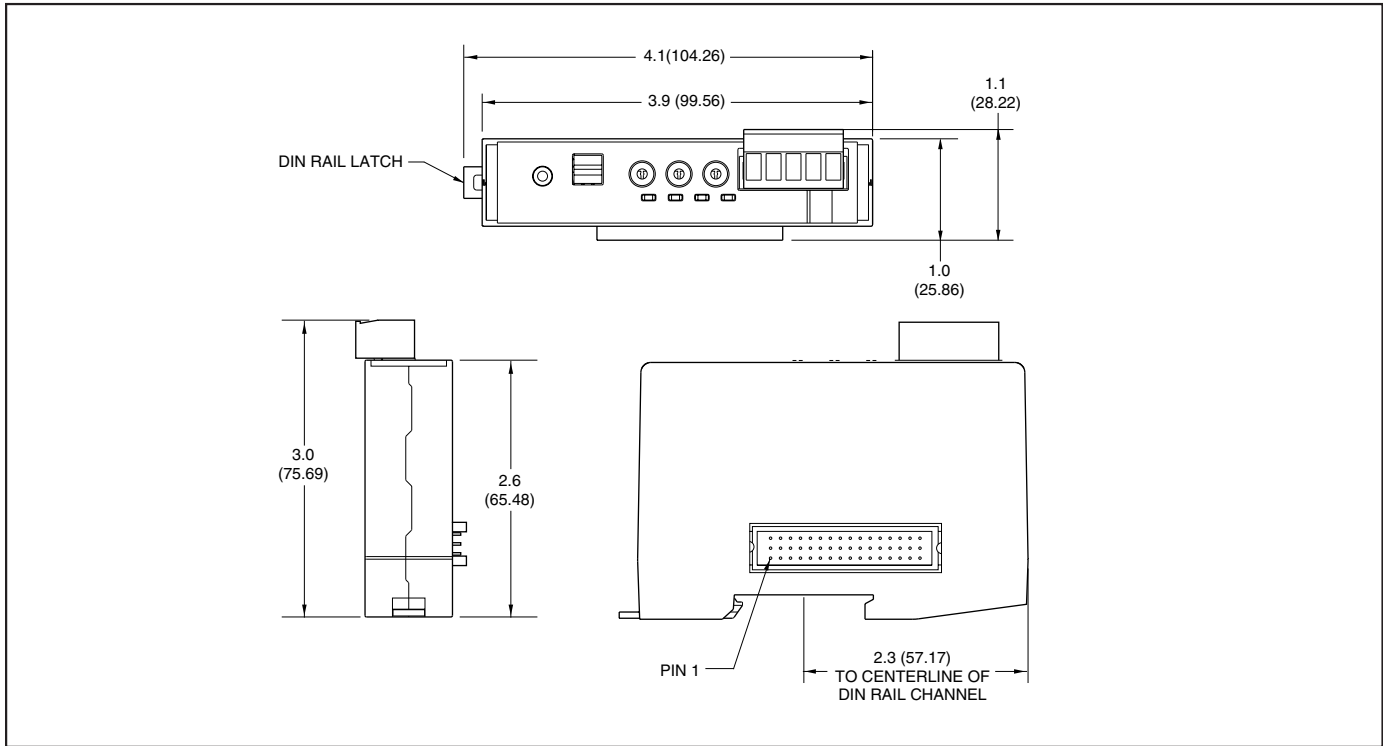
### FAULT TOLERANCE

Each OpenDAC® for Modbus has an internal communications watchdog timer to minimize the impact of a broken Modbus link between the controller and the master device. If activated, the timer must be reset by an incoming message within the prescribed period of time. If not, the controller will force it's outputs into a default state.

### SOFTWARE

Software drivers are available which simplify the task of interfacing host programs written in Visual Basic or C to the Modbus network. Sample programs, set-up and debug utilities are included on the disk with the drivers. Interface drivers for most third party software packages are available through their distributors. Our DLL will assist you in building custom Man-Machine Interfaces using Visual Basic, Visual C/C++, or Borland compilers running on Windows 95, 98 or NT.

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

**Power Supply:** 4.75 to 5.25 Vdc  
**Supply Current (less modules):** 1 amp @ 5 Vdc max.  
**Operating Temperature:** 0 to 60°C  
**Humidity:** 95% non-condensing  
**Microprocessor:** V25 @ 10 MHz  
**Housing Material:** ABS/Polycarbonate blend  
**Connections:**  
 RS-422/485: 5 position depluggable connector  
 Passive Rack: 48-pin Euro DIN (male)  
**Serial Data:**  
 Format: 10 Bit ASCII: 1 Start, 1 Stop, 8 Data  
 Integrity: Message Checksum  
**Range of Network:** Compliant with EIA/TIA RS485-A (1 standard load per controller). Operates in multi-drop mode. 247 DIP switch selectable addresses. May require RS485 repeaters for lengths over 4000 feet or more than 32 controllers. Consult factory for special configurations.

**ORDERING INFORMATION**

Part Number	Description
<b>OpenDAC® Network Interface</b>	
<b>72-MOD-4000</b>	Analog/Digital OpenDAC® for Modbus
<b>OpenDAC® User's Manual and Software</b>	
<b>72-UM-OMOD</b>	OpenDAC® for Modbus user's manual
<b>72-UME-DLL32</b>	Ethernet/Modbus DLL for Windows 95/98/NT
<b>72-UOL</b>	OpenLine® configuration and product data
<b>Compatible Components</b>	
OpenDAC® I/O Racks Digital OpenLine® I/O Modules Analog OpenLine® I/O Modules Power Supply	

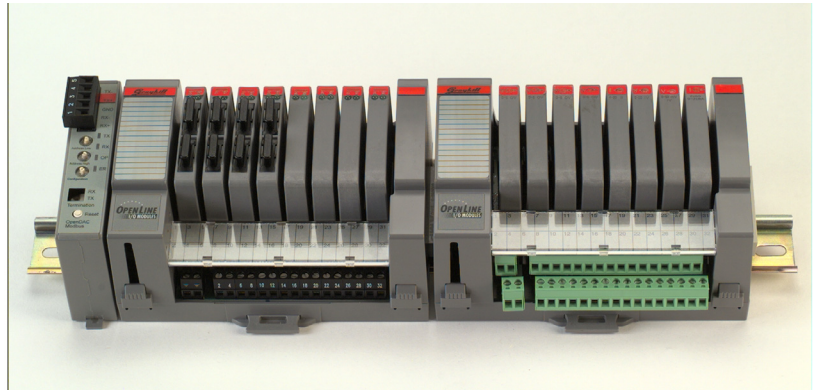
**Available from your local authorized Grayhill Distributor.** For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

## NETWORK INTERFACES

### OpenLT™ (Optomux)

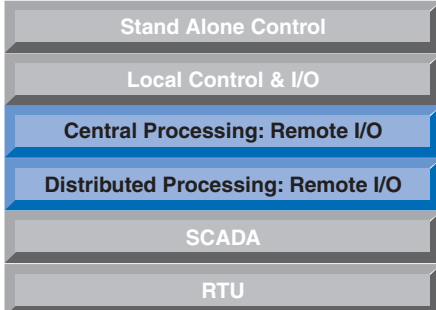
#### FEATURES

- Each Unit Controls/Monitors up to 32 Analog and/or Digital I/O using OpenLine® Modules
- Executes On-Board Programs Created With Borland C
- Network up to 64 OpenLTs per Host Serial Port, Spanning as Much as 4000 Feet
- Communicate Over RS422 /485 at Speeds from 9600 Baud to 115.2 KB
- 100% Optomux Compatible, With Expanded Command Set
- I/O Update Rates of 500 µSec per 32 Digital I/O, and 2 mS per Analog Input or 2 Analog Outputs
- 64-Bit Floating Point Math
- DIN Rail or Panel Mountable
- CE Certified



OPENLT® UNIT ON OPENDAC® SYSTEM

#### APPLICATIONS



#### GENERAL DESCRIPTION

The OpenLT™ Optomux™ controller is a remote slave that responds to Optomux™ commands from the master or host PC. The 72-OPT-4100 version has memory for Embedded Control Programs (ECPs) which are control or data acquisition routines which run locally on the OpenLT™ and off-load some responsibilities from the host. ECP routines written for MicroDAC can be easily transferred to OpenLT™ and vice versa. By combining MicroDAC, OpenLT™ and ProMux® the cost/performance of a distributed control or data acquisition network is optimized for price and performance.

#### ANALOG & DIGITAL I/O

OpenLT® connects directly to one or two OpenLine® racks (part number 70LRCK16-48). Any combination of OpenLine® analog and digital I/O modules may be used. OpenLTs™ can be networked to a host PC which execute programs that monitor the input signals and control the outputs. In addition to simple ON/OFF instructions, commands are included which permit you to:

- Sample analog signals at 2 mS per input
- Flag values above or below prescribed levels
- Capture min/max values
- Calculate the average input signal levels
- Provide linearized thermocouple and RTD temperature values
- Determine the width of input pulses
- Count pulses at frequencies up to 1000Hz
- Detect rising or falling edges
- Latch momentary input events
- Set the level of analog outputs
- Provide delayed-on or delayed-off outputs

#### COMMUNICATIONS

The host computer and OpenLT(s)™ communicate serially over one or two pair of twisted wires per RS-422/485 in a multi-drop configuration. They use Optomux™ ASCII format to code the command and the response messages. Application programs running on the host computer issue commands and then await responses from the OpenLT™. The communications speed is selectable between 9.6 and 115.2 KBaud. Each controller on the network is assigned a unique base address. The entire network can span 4000 feet. Diagnostic LEDs show traffic on the network.

#### EMBEDDED CONTROL PROGRAMS

By specifying OpenLT(s)® with the optional 64 KB of flash memory, you can develop and download C language programs to any of the networked controllers.

Even while an ECP is running on OpenLT®, any Optomux™ command it receives from the host will be processed as usual, which allows you to delegate some or all of the control and data acquisition responsibility from the host computer. This reduces communications time and improves system response.

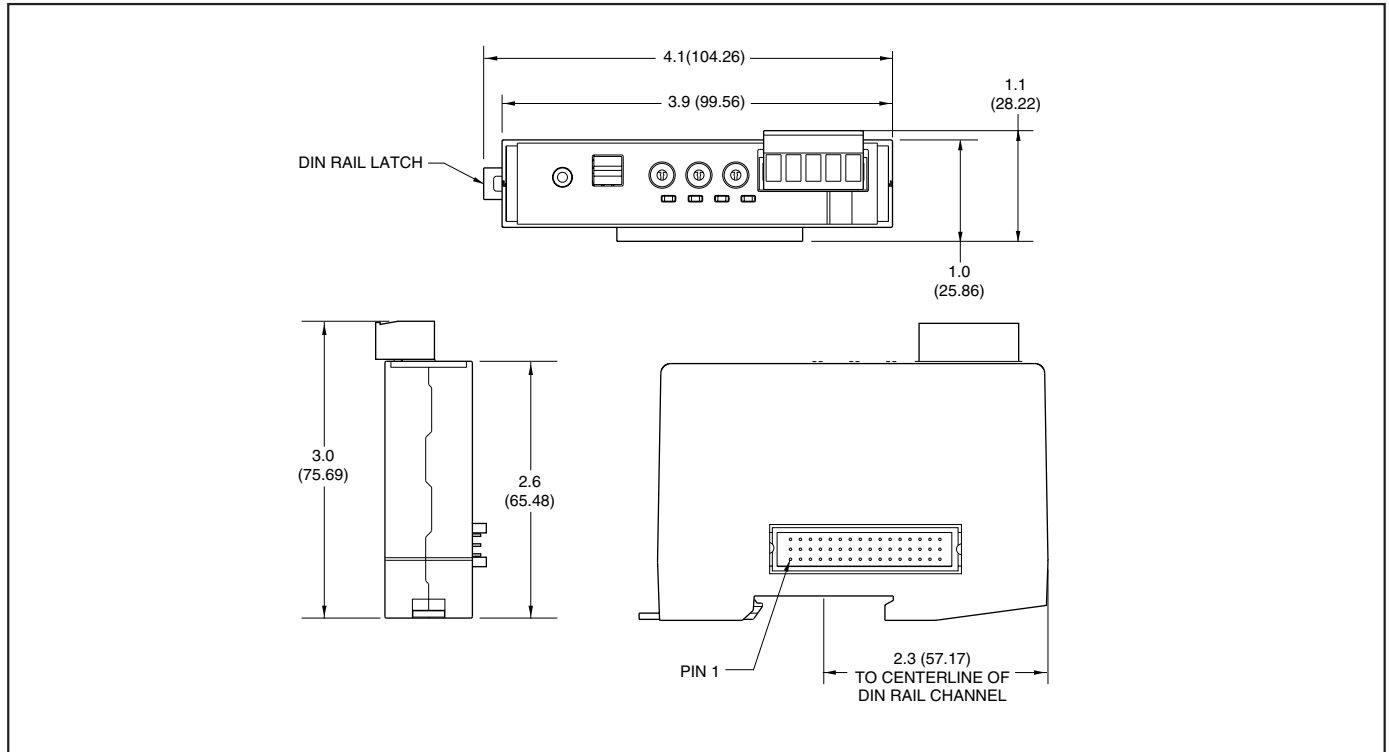
For embedded or stand-alone applications, downloaded ECP routines can be initiated on power-up.

Libraries and the appropriate download utility are included with the ECP Programmers Manual.

#### SOFTWARE

Software drivers are available which simplify the task of interfacing host programs written in Visual Basic or C to the Optomux network. Sample programs, set-up and debug utilities are included on the disk with the drivers. Interface drivers for most third party software packages are available through their distributors. Our Optomux DDE Server dramatically simplifies data sharing between OpenLTs™ and Windows applications, such as Microsoft EXCEL (see Controller Software). Our DLL will assist you in building custom Windows Man-Machine Interfaces using Visual Basic, Visual C/C++, or Borland compilers.

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

**Power Supply:** 4.75 to 5.25 Vdc  
**Supply Current (less modules):** 300 mA max.  
**Operating Temperature:** 0 to 60°C  
**Humidity:** 95% non-condensing  
**Microprocessor:** V25 @ 10 MHz  
**Housing Material:** ABS/Polycarbonate blend  
**Connections:**  
 RS-422/485: 5 position pluggable terminal block  
 Rack: 48-pin Euro DIN (male)  
**Serial Data:**  
 Format: 10-Bit ASCII, 1 Start, 1 Stop, 8 Data  
 Integrity: Message Checksum or 4 Pass + CS  
**Range of Network:** Compliant with EIA/TIA RS485-A (1 standard load per controller). Operates in multi-drop mode. 64 DIP switch selectable addresses. May require RS485 repeaters for lengths over 4000 feet or more than 32 controllers. Consult factory for special configurations.

**ORDERING INFORMATION**

Part Number	Description
<b>OpenLT® Network Interface</b>	
<b>72-OPT-4000</b>	Analog/Digital OpenLT®
<b>72-OPT-4100</b>	Analog/Digital OpenLT® with 64K flash for C ECP storage
<b>OpenLT® User's Manuals and Software</b>	
<b>72-UMM-D</b>	Driver development and protocol definition (includes driver source code)
<b>72-UMM-DDE</b>	Optomux DDE server for Windows 3.1
<b>72-UMM-DLL</b>	Optomux DLL for Windows 3.1
<b>72-UMM-DLL32</b>	Optomux DLL for Windows 95/98/NT
<b>72-UMM-E</b>	C language ECP manual with libraries
<b>72-UMM-H</b>	Programmer's manual with Basic and C host drivers and examples
<b>72-UM-OOPT</b>	Hardware installation and setup. Includes setup and debug programs
<b>72-UOL</b>	OpenLine® configuration and product data
<b>7W-UM-MDL32</b>	Windows ECP download Utility
<b>Compatible Components</b>	
OpenDAC® I/O Racks Digital OpenLine® I/O Modules Analog OpenLine® I/O Modules Power Supplies	

**Available from your local authorized Grayhill Distributor.** For prices and discounts, contact your local sales office, an authorized Distributor or Grayhill.

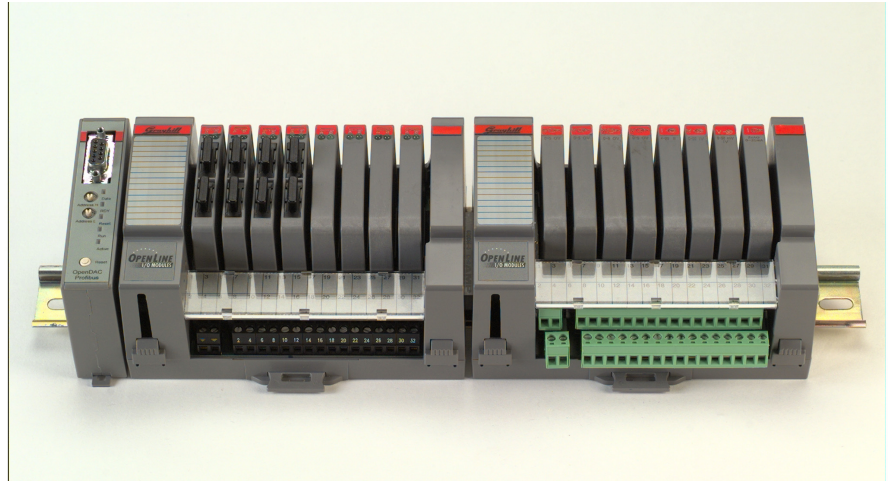
OpenDAC® I/O System



## NETWORK INTERFACES OpenDAC® for Profibus

### FEATURES

- Each Unit Controls/Monitors up to 32 Analog and/or Digital I/O using OpenLine® Modules
- Network up to 127 OpenDACs® per Host PC
- Communicate at Speeds Up to 12 MB
- Auto Baud Rate Detect
- 100% Profibus DP Compatible (PTO Tested and Approved)
- I/O Update Rates of 500 µSec per 32 Digital and 1 mS per Analog Module (2 Channels)
- Diagnostic LEDs
- CE Certified
- DIN Rail Mount



PROFIBUS UNIT ON OPENDAC® SYSTEM

### APPLICATIONS

Stand Alone Control
Local Control & I/O
<b>Remote I/O</b>
Distributed I/O
SCADA
RTU

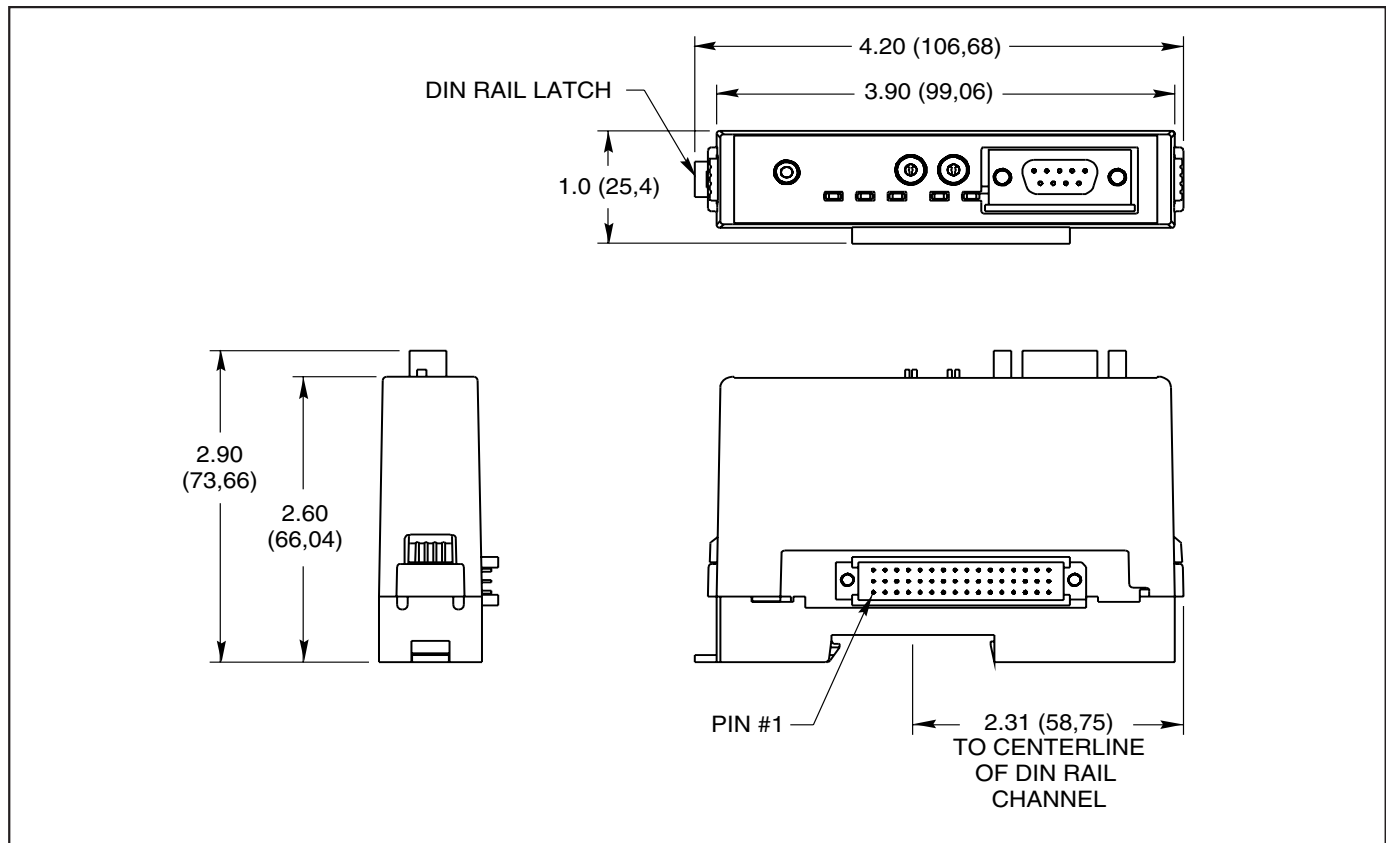
### GENERAL DESCRIPTION

The OpenDAC® for Profibus network interface is a remote slave that responds to Profibus DP commands that it receives over the network. The status and configuration of up to 32 OpenLine® analog or digital I/O channels is stored and constantly refreshed.

OpenDAC® for Profibus is self-configuring. On power up, the controller will read the ID of each I/O module and build an internal database. During the master configuration the controller will compare this configuration with the stored configuration. If there is a match, the master will allow exchange of information to occur.

Each OpenDAC® or third party device on the network will occupy 1 of 127 unique addresses. Communication between the master and slave devices takes place at baud rates from 50 KB to 12 MB. OpenDACs® automatically detect the baud rate, eliminating switch settings and simplifying set up. Network traffic and controller status can be monitored by status LEDs on the controllers. Diagnostic information is routinely exchanged between master and slave devices.

Each OpenDAC® incorporates a communication watchdog timer that monitors communication from the Profibus master. When the watchdog is enabled and the slave does not receive a valid Profibus message within 100mS, the OpenDAC® will set all output values to zero. Should a valid message be received, the timer is reset and communication resumes.

**DIMENSIONS** In inches (and millimeters)

**SPECIFICATIONS**

**Supply Voltage:** 4.75 to 5.25 Vdc

**Supply Current (less modules):** 0.5A max.

**Operating Temperature:** -40 to 85°C

**Humidity:** 5-95% non-condensing

**Housing Material:** ABS/Polycarbonate blend

**CPU:** AM 188ES @ 24 MHz

**Connections:**

Profibus: 9-Pin D-Sub (female)

Passive Rack: 48-Pin Euro DIN (male)

**Serial Data:**

Format: 11 bits: 1 start, 1 stop, 1 parity (even), 8 data

Integrity: Frame checksum

**Range of Network (without repeaters):**

1200 meters for entire network below 93 KB;

600 meters at 187.5 KB; 200 meters at 500 KB

**ORDERING INFORMATION**

Part Number	Description
<b>Profibus Network Interfacer</b>	
<b>72-PRO-4000</b>	Analog/Digital OpenDAC® for Profibus DP
<b>Profibus User's Manual and Software</b>	
<b>72-UM-PRO</b>	OpenDAC® for Profibus DP user's manual
<b>72-UOL</b>	OpenLine® configuration and product data

**Available from your local authorized Grayhill Distributor.**

For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

## RACKS 16 Channel

### FEATURES

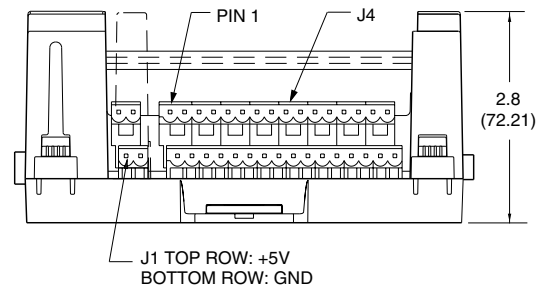
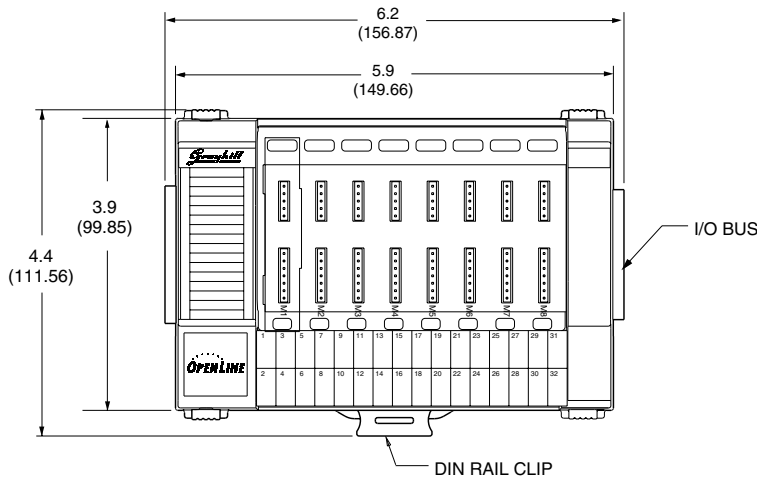
- Automatically Detects OpenLine® I/O Module Types
- Provides Direct Interface for the I/O to OpenDAC® Network Interfaces
- Multiple Termination Options
- Stack up to Two Racks for the 32 I/O channels
- Small Footprint
- DIN Rail Mount
- UL, CSA, CE (See Engineering Info, p. L-6)



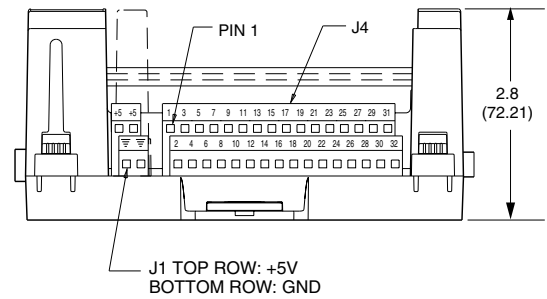
### 16 CHANNEL RACK: OpenDAC® Rack

**Part No. 70LRCK16-48**

Dimensions are shown in inches (and millimeters).  
All tolerances are  $\pm 0.010$  (0,25) unless otherwise specified.

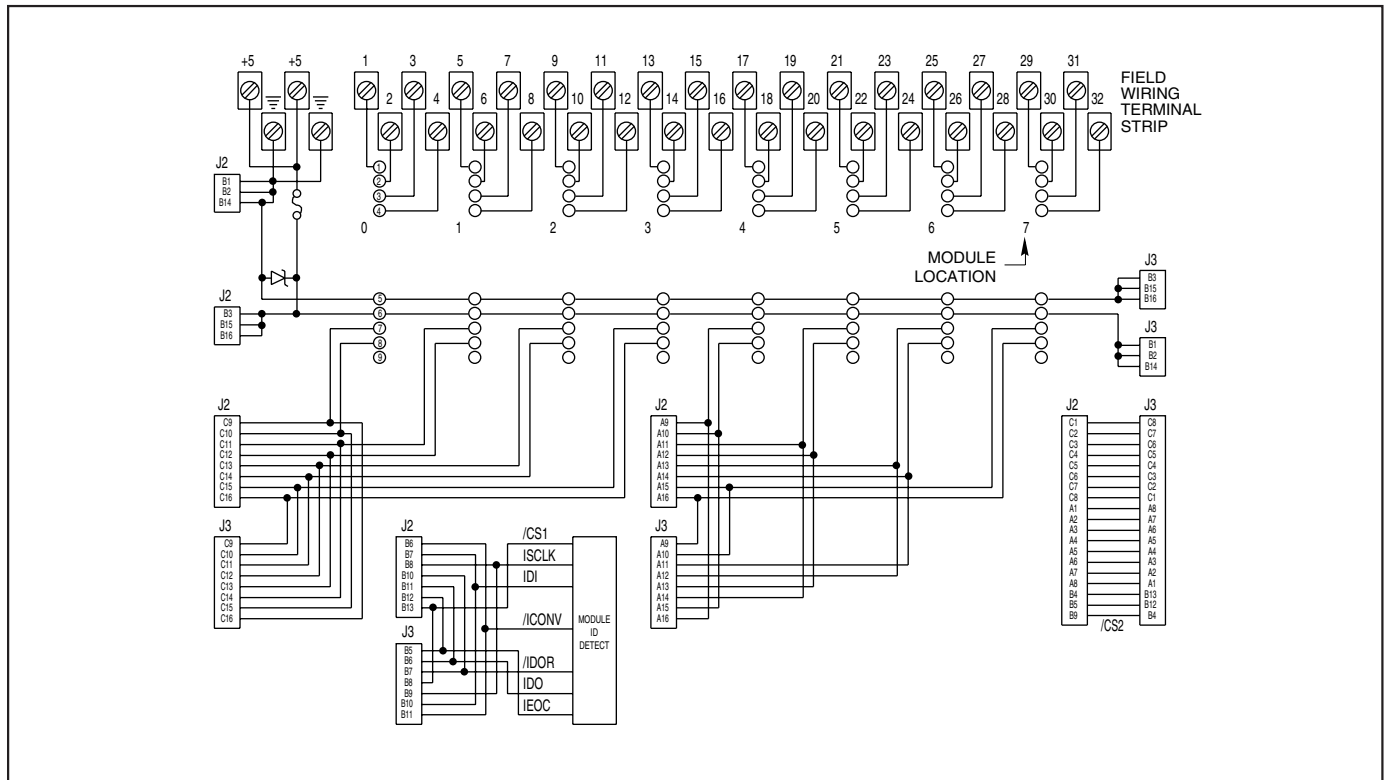


**70LRCK16-48P** (WP VERSION SOLD WITH PLUGS)



**70LRCK16-48**

**SCHEMATIC: Part No. 70LRCK16-48**



**ORDERING INFORMATION (MODULES ORDERED SEPARATELY)**

Part Number	I/O	Description	UL	CSA	Style
<b>16 Channel Racks</b>					
<b>70LRCK16-48</b>	16	48-pin Euro DIN logic signal connector. DIN rail mount.	X	X	OpenDAC®
<b>70LRCK16-48C</b>	16	48-pin Euro DIN logic signal connector. DIN rail mount with cage clamp style terminal blocks	X	X	OpenDAC®
<b>70LRCK16-48P</b>	16	48-pin Euro DIN logic signal connector. DIN rail mount with pluggable terminal blocks	X	X	OpenDAC®
<b>70LRCK16-48WP</b>	16	48-pin Euro DIN logic signal connector. DIN rail mount with pluggable terminal blocks, plug included	X	X	OpenDAC®

**Available from your local Grayhill Distributor.** For prices and discounts, contact a local Sales Office, an authorized local Distributor or Grayhill.

OpenDAC® I/O System

# SYSTEM 50



- SYSTEM 50
- MicroDAC
- MicroDAC LT
- Promux
- Microlon
- Various I/O Racks

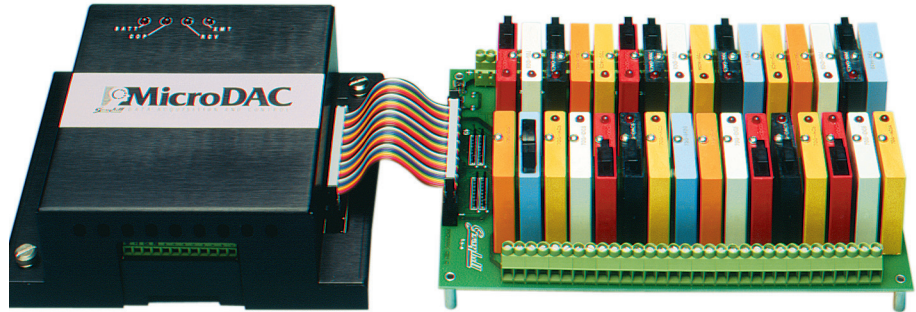
	Page
SYSTEM 50 RACKS OVERVIEW .....	3
Racks	
4 Channel .....	4
8 Channel .....	6
16 Channel .....	11
24 Channel (In-Line) .....	18
24 Channel .....	22
32 Channel .....	25
32 Channel Parallel Controller Board for 72-PMX-32D .....	27
Controllers	
MicroDAC (Optomux) .....	29
MicroDAC LT (Optomux) .....	31
Network Interfaces	
Promux (Optomux) .....	33
Parallel Bus Interface .....	35
Communication Converters .....	37
Accessories .....	38

System 50

## CONTROLLERS MicroDAC (Optomux)

### FEATURES

- Each Unit Controls/Monitors up to 32 Analog (G5 Only) and/or Digital I/O Modules
- Executes On-Board Programs Created With Borland C
- Network up to 64 MicroDACs per Host Serial Port, Each Separated by as Much as 4000 Feet
- Communicate Over RS-422/485 at Speeds From 1200 Bd to 115.2 KB
- 100% Optomux™ Compatible, With Expanded Command Set
- I/O Update Rates of 500 μSec per 32 Digital I/O, and 10 mS per Analog Input or 2 Analog Outputs
- BASIC and C Drivers for the PC
- DIN Rail or Panel Mountable Metal Enclosure
- Hardware Expansion With SBX Port
- Real Time Clock Option (Y2K Compliant)



### APPLICATIONS

Stand Alone Control
Local Control & I/O
Remote I/O
Distributed I/O
SCADA
RTU

### ANALOG & DIGITAL I/O

A 50 conductor ribbon cable is supplied to connect MicroDACs to any 8,16,24, or 32 module mounting rack. If connected to a G5 rack, any combination of analog and digital I/O modules may be used. OpenLine®, standard and mini racks permit only a combination of digital modules. MicroDACs can be networked to a PC which runs programs that monitor the input signals and control the outputs. In addition to simple ON/OFF instructions, commands are included which permit you to:

- Sample analog signals at 10 mS per input
- Flag values above or below prescribed levels
- Capture min/max values
- Calculate the average input signal levels
- Provide linearized thermocouple and RTD temperature values
- Determine the width of input pulses
- Count pulses at frequencies up to 1000 Hz
- Detect rising or falling edges
- Latch momentary input events
- Set the level of analog outputs
- Provide delayed-on or delayed-off outputs

### COMMUNICATIONS

The host PC and MicroDAC(s) communicate serially over one or two pair of twisted wires per RS-422/485 in either a multi-drop or repeat configuration. They use Optomux™ ASCII format to code the command and the response messages. Application programs running on the host PC issue commands and then await responses from the MicroDAC. The communications speed is selectable between 1.2 and 115.2 KBaud. Each controller on the network is assigned a unique base address. You can separate units from one another by as much as 4,000 feet.

### EMBEDDED CONTROL PROGRAMS

By specifying MicroDAC(s) with the optional 64KB of flash memory, you can develop and download C language programs to any of the networked controllers.

Even while an Embedded Control Program (ECP) is running on MicroDAC, any Optomux™ command it receives from the host will be processed as usual, which allows you to delegate some or all of the control and data acquisition responsibility from the host PC. This reduces communications time and improves system response.

For embedded or stand-alone applications, downloaded ECP routines can be initiated on power-up. Where redundant control or process shutdown procedures are vital, ECP initiation can be tied to the communications watchdog timer. In the event the host computer goes off line, the ECP automatically begins executing.

Libraries and the appropriate download utility are included with the ECP Programmers Manual.

### SOFTWARE

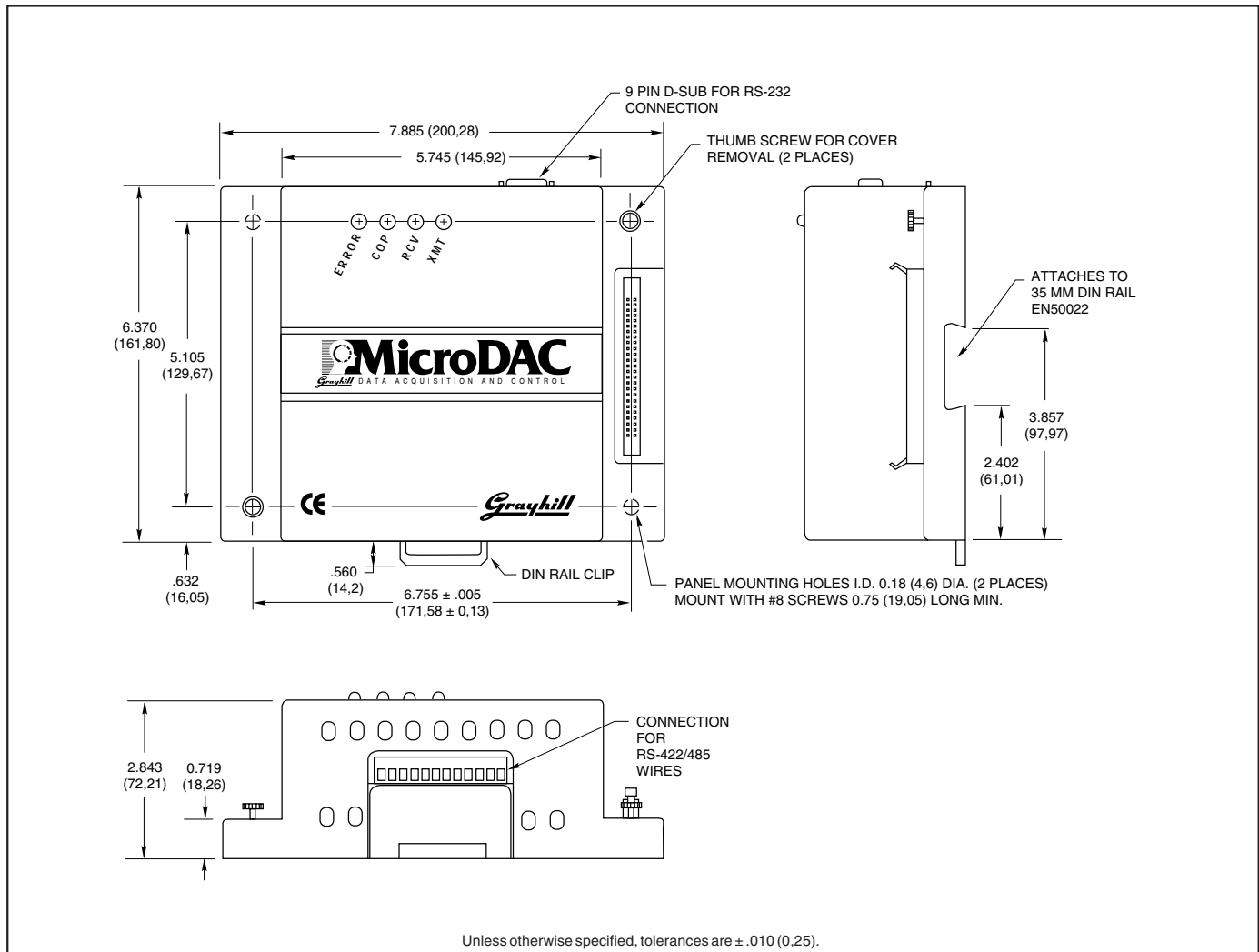
Software drivers are available which simplify the task of interfacing host programs written in Visual Basic or C. Sample programs, set-up and debug utilities are included on the disk with the drivers. Interface drivers for most third party software packages are available through their distributors. Our MicroDAC DDE Server dramatically simplifies data sharing between MicroDACs and Windows applications, such as Microsoft Excel (see Optomux Software). Our DLL will assist you in building custom Windows Man-Machine Interfaces or control programs using Visual Basic, Visual C/C++, or Borland compilers.

### OTHER FEATURES/OPTIONS

The RS-232 serial port provides a connection for remote RS-232 devices. You can use this port to read information from input devices such as bar code readers or keyboards or to write information to output devices such as operator interfaces, intelligent displays or printers.

The optional real time clock permits ECP routines to be executed based on date or time of day. It also allows data that is collected to be time stamped and stored in battery backed RAM memory.

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

**Power Supply:** 4.75 to 5.25 Vdc  
**Supply Current (less modules):** 1A maximum  
**Operating Temperature:** 0 to 60°C  
**Humidity:** 95% non-condensing  
**Housing Material:** Anodized Aluminum  
**Microprocessor:** V25 @ 10 MHz  
**Connections:**  
 RS-422/485: 12 position terminal block  
 RS-232 (DCE or DTE): 9-pin D-Sub (male)  
 SBX: 36-pin dual row (female)  
 Rack: 50-pin male header  
**Serial Data:**  
 Format: 10-Bit ASCII, 1 Start, 1 Stop, 8 Data  
 Integrity: Message Checksum or 4 Pass + CS  
**Range of Network:** Compliant with EIA/TIA RS-485-A (1 standard load per controller). Operates in multi-drop or repeat mode. 64 DIP switch selectable addresses. May require RS485 repeaters for lengths over 4,000 feet or more than 32 controllers in multi-drop mode. Consult factory for special configurations.

**ORDERING INFORMATION**

Part Number	Description
<b>MicroDAC Controllers</b>	
<b>72-MDC-32ADC</b>	Analog/Digital MicroDAC with RS-232 and SBX ports, 64K batt. backed RAM, 64K flash for C ECP storage, and real time clock.
<b>MicroDAC User's Manuals and Software</b>	
<b>72-UMM</b>	Introduction to MicroDAC
<b>72-UMM-D</b>	Driver development and protocol definition. Includes driver source code
<b>72-UMM-DDE</b>	Optomux DDE Server for Windows 3.1
<b>72-UMM-DLL</b>	Optomux DLL for Windows 3.1
<b>72-UMM-DLL32</b>	Optomux DLL for Windows 95/98/NT
<b>72-UMM-E</b>	C language ECP manual with libraries
<b>72-UMM-H</b>	Programmers manual with Basic and C host drivers & examples
<b>72-UMM-IL</b>	Hardware installation and set-up. Includes set-up and debug programs.
<b>7W-UM-MDL32</b>	Windows ECP download Utility

**Available from your local authorized Grayhill Distributor.** For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

System 50

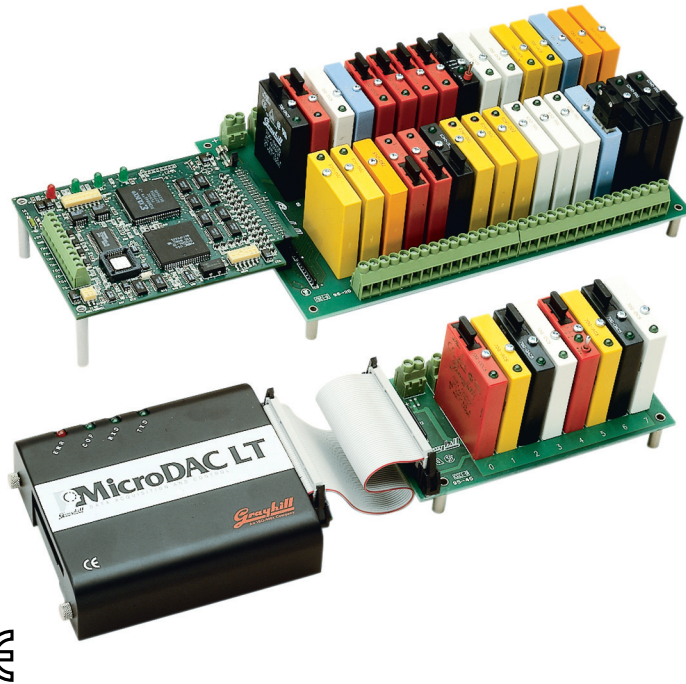


## CONTROLLERS

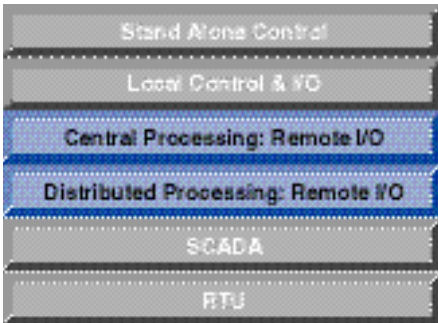
### MicroDAC LT (Optomux)

#### FEATURES

- Each Unit Controls/Monitors up to 32 Analog (G5 Only) and/or Digital I/O Modules
- Executes On-Board Programs Created With Borland C
- Network up to 64 MicroDAC LTs per Host Serial Port, Spanning as Much as 4000 Feet
- Communicate Over RS-422 /485 at Speeds From 1200 Baud to 115.2 KB
- 100% Optomux Compatible, With Expanded Command Set
- I/O Update Rates of 500  $\mu$ Sec per 32 Digital I/O, and 10 mS per Analog Input or 2 Analog Outputs
- 64-Bit Floating Point Math



#### APPLICATIONS



#### GENERAL DESCRIPTION

MicroDAC LT is a low cost version of MicroDAC for customers who don't need all of the features of MicroDAC. Missing are the battery back-up for the RAM memory, real-time clock, RS-232, and SBX ports. The DIN Rail Mountable metal enclosure is optional. ECP routines written for MicroDAC can be easily transferred to MicroDAC LT and vice versa. By combining MicroDAC, MicroDAC LT and ProMux the cost/performance of a distributed control or data acquisition network is optimized for price and performance.

#### ANALOG & DIGITAL I/O

MicroDAC LT connects directly to any 8,16,24, or 32 module mounting rack with a 50-pin header. If connected to a G5 rack, any combination of analog and digital I/O modules may be used. Standard and Mini racks permit only a combination of digital modules. MicroDAC LTs can be networked to a host PC which execute programs that monitor the input signals

and control the outputs. In addition to simple ON/OFF instructions, commands are included which permit you to:

- Sample analog signals at 10 mS per input
- Flag values above or below prescribed levels
- Capture min/max values
- Calculate the average input signal levels
- Provide linearized thermocouple and RTD temperature values
- Determine the width of input pulses
- Count pulses at frequencies up to 1000Hz
- Detect rising or falling edges
- Latch momentary input events
- Set the level of analog outputs
- Provide delayed-on or delayed-off outputs

#### COMMUNICATIONS

The host computer and MicroDAC LT(s) communicate serially over one or two pair of twisted wires per RS-422/485 in a multi-drop configuration. They use Optomux™ ASCII format to code the command and the response messages. Application programs running on the host computer issue commands and then await responses from the MicroDAC. The communications speed is selectable between 1.2 and 115.2 KBaud. Each controller on the network is assigned a unique base address. The entire network can span 4000 feet.

#### EMBEDDED CONTROL PROGRAMS

By specifying MicroDAC LT(s) with the optional 64KB of flash memory, you can develop and download C language programs to any of the networked controllers.

Even while an Embedded Control Program (ECP) is running on MicroDAC LT, any Optomux™ command it receives from the host will be processed as usual, which allows you to delegate some or all of the control and data acquisition responsibility from the host computer. This reduces communications time and improves system response.

For embedded or stand-alone applications, downloaded ECP routines can be initiated on power-up.

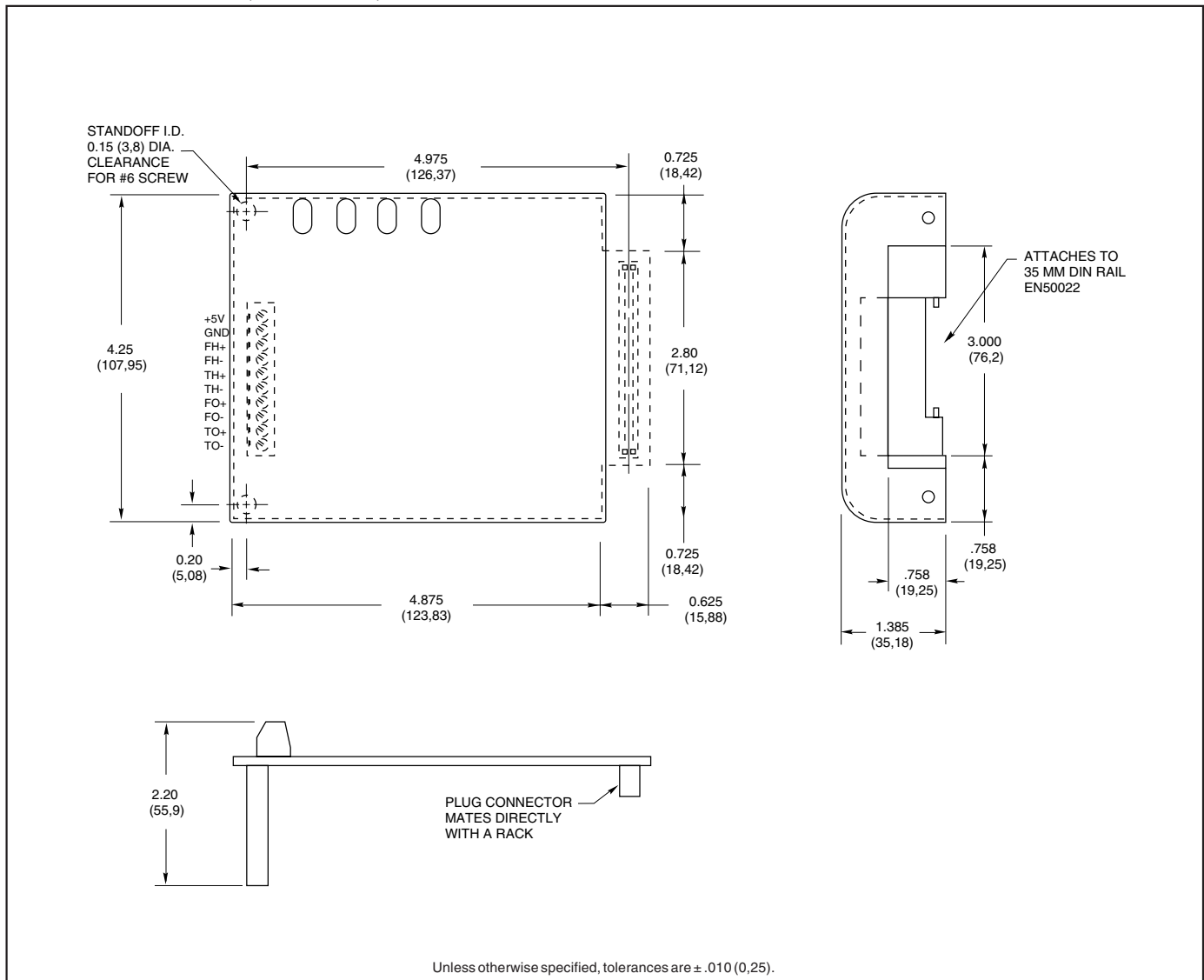
Libraries and the appropriate download utility are included with the ECP Programmers Manual.

#### SOFTWARE

Software drivers are available which simplify the task of interfacing host programs written in Visual Basic or C to the MicroDAC network. Sample programs, set-up and debug utilities are included on the disk with the drivers. Interface drivers for most third party software packages are available through their distributors. Our MicroDAC DDE Server dramatically simplifies data sharing between MicroDACs and Windows applications, such as Microsoft Excel (see Controller Software). Our DLL will assist you in building custom Windows Man-Machine Interfaces or control programs using Visual Basic, Visual C/C++, or Borland compilers.

<sup>1</sup>With optional enclosure.

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

**Power Supply:** 4.75 to 5.25 Vdc  
**Supply Current (less modules):** 300 mA  
**Operating Temperature:** 0 to 70°C  
**Humidity:** 95% non-condensing  
**Microprocessor:** V25 @ 10 MHz  
**Housing Material:** Painted steel  
**Connections:**  
 RS-422/485: 10 position terminal block  
 Rack: 50-pin female plug  
**Serial Data:**  
 Format: 10-Bit ASCII, 1 Start, 1 Stop, 8 Data  
 Integrity: Message Checksum or 4 Pass + CS  
**Range of Network:** Compliant with EIA/TIA RS485-A (1 standard load per controller). Operates in multi-drop mode. 64 DIP switch selectable addresses. May require RS485 repeaters for lengths over 4000 feet or more than 32 controllers. Consult factory for special configurations.

**ORDERING INFORMATION**

Part Number	Description
<b>MicroDAC LT Controllers</b>	
<b>72-MDL-32ADC</b>	Analog/Digital with 64K flash for C ECP storage
<b>MicroDAC LT User's Manuals and Software</b>	
<b>72-UMM</b>	Introduction to MicroDAC
<b>72-UMM-D</b>	Driver development and protocol definition. Includes driver source code
<b>72-UMM-DDE</b>	Optomux DDE Server for Windows 3.1
<b>72-UMM-DLL</b>	Optomux DLL for Windows 3.1
<b>72-UMM-DLL32</b>	Optomux DLL for Windows 95/98/NT
<b>72-UMM-E</b>	C language ECP manual with libraries
<b>72-UMM-H</b>	Programmers manual with Basic and C host drivers & examples
<b>72-UMM-IL</b>	Hardware installation and set-up. Includes set-up and debug programs

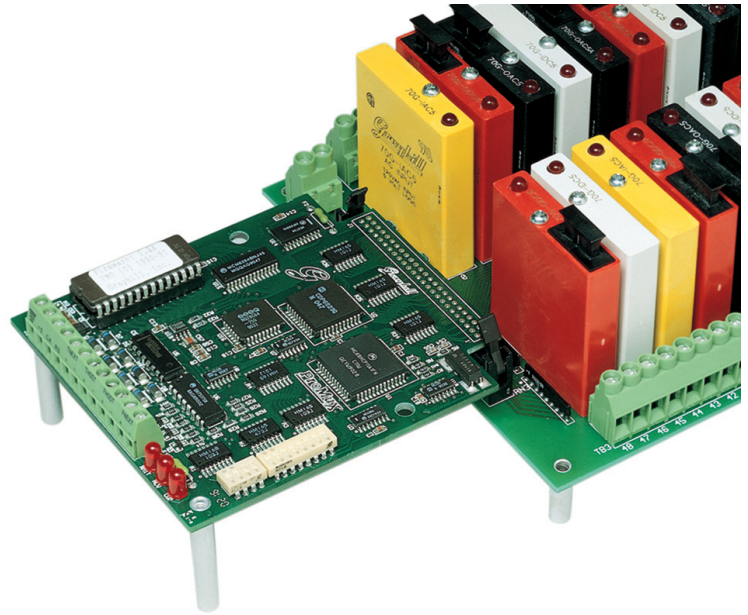
Available from your local authorized Grayhill Distributor.

For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

## NETWORK INTERFACES ProMux® (Optomux)

### FEATURES

- Each Board Controls Up to 24 Standard, Mini, G5 or OpenLine® Digital Modules
- Up to 256 Addressable ProMux® Boards Separated by 4,000 Feet
- 100% Optomux Compatible, Plus Extra Commands
- Communications at Speeds From 300 Baud to 38.4 Kbaud.
- Transient Protection on Communications Lines
- Direct Plug-In or Ribbon Cable Interconnection
- BASIC and C Drivers for the PC



### APPLICATIONS

Stand Alone Control
Local Control & I/O
<b>Remote I/O</b>
Distributed I/O
SCADA
RTU

### DIGITAL INPUTS/OUTPUTS

The ProMux® network interface mates with any of our 8, 16, or 24 digital module racks. Plug Grayhill OpenLine®, standard, miniature, or G5 digital I/O modules into the racks. They can be mixed in any combination. Connect the ProMux® boards serially to a host computer and then issue commands to monitor the inputs or control the outputs. Commands are included which permit you to:

- Read the ON/OFF status of inputs
- Determine the width of input pulses

- Count pulses at frequencies up to 400Hz
- Detect rising or falling edges
- Latch momentary input events
- Turn outputs ON or OFF individually or in groups
- Pulse-width modulate outputs
- Provide delayed-on or delayed-off outputs
- Generate pulses or squarewaves

### COMMUNICATIONS

The host computer and ProMux® boards communicate serially over two pair of twisted wires per RS-422/485 in either a multi-drop or repeat configuration. They use an industry standard ASCII string format to code the command and response messages. Application programs running on the host computer issue commands and then await responses from the ProMux® boards. The communications speed is selectable between 300 baud and 38.4 Kbaud. Each controller on the network is assigned a unique base address from 0 to 255. You can separate boards from one another by as much as 4,000 feet.

### SOFTWARE

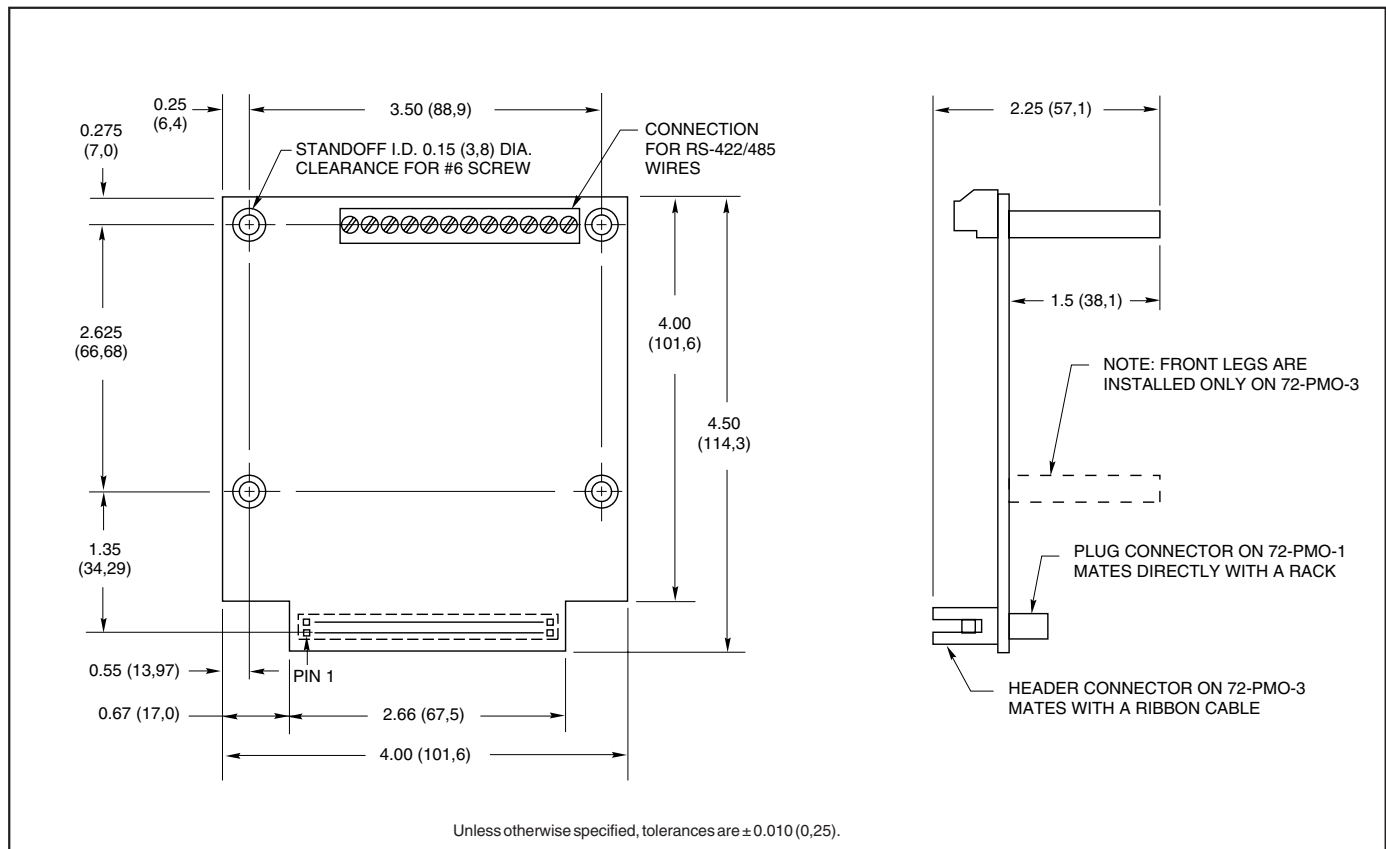
Software drivers are available which simplify the task of interfacing programs written in Visual Basic or C to the ProMux® network. Sample programs and the set-up and debug utilities are included on the disk with the drivers. Interface drivers for most third party software packages are available through their distributors.

### OTHER FEATURES

All ProMux® boards are thoroughly tested and shipped in static proof boxes.

Because space inside your enclosure can be limited, we offer numerous rack plug-in configuration options. For applications requiring even more mounting flexibility, the ProMux® boards can be connected to racks with a ribbon cable up to six feet long.

If you do not have an RS-422 or RS-485 serial port on your PC, we offer a variety of RS-232 to RS-422/485 converters.

**DIMENSIONS** In inches (and millimeters)

**SPECIFICATIONS**

**Supply Voltage:** 4.5 to 5.5 Vdc

**Supply Current (less modules):** 300 mA max.

**Operating Temperature:** 0° to 70°C

**Humidity:** 95% non-condensing

**Microprocessor:** 68HC11 @ 7.4 MHz

**Connections:**

RS-422/485: 12 position terminal block

Rack: 50-pin female plug connector or 50-pin male header connector

**Serial Data:**

Format: 10-Bit ASCII, 1 Start, 1 Stop, 8 Data

Integrity: Message Checksum or 4 Pass + CS

**Range of Network:** Compliant with EIA/TIA

RS485-A (1 standard load per controller).

Operates in multi-drop or repeat mode. 256

DIP switch selectable addresses. May require

RS485 repeaters for lengths over 4,000 feet or

more than 32 controllers in multi-drop mode.

Consult factory for special configurations.

**ORDERING INFORMATION**

Part Number	Description
<b>Network Interfaces</b>	
<b>72-PMO-1</b>	Plug connector for direct rack connection
<b>72-PMO-3</b>	Header connector for ribbon cable to rack connection
<b>User's Manuals and Software</b>	
<b>72-UMO</b>	Manual with no software, for evaluating boards for purchase
<b>72-UMO-C</b>	Manual with Basic and C software drivers and utilities
<b>72-UMM-DDE</b>	Optomux DDE server for Windows 3.1
<b>72-UMM-DLL</b>	Optomux DLL for Windows 3.1
<b>72-UMM-DLL32</b>	Optomux DLL for Windows 95/98/NT

**Available from your local authorized Grayhill Distributor.**

For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

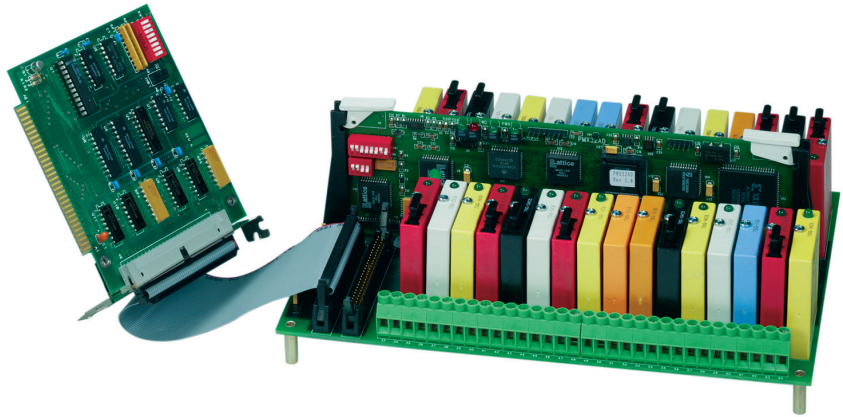
## NETWORK INTERFACES

### Parallel Bus



#### FEATURES

- Each Board Controls Up to 24 or 32 I/O Modules
- Scans 512 Digital I/O Points in Less Than 200  $\mu$ Sec.
- Compatible With Parallel Controller Boards From Other Manufacturers
- DIP Switch Selectable Address and Options
- Up to 32 Addressable Boards Over 500 Feet
- On-Board Terminating Resistors
- On-Board Communications Watchdog Timer



#### APPLICATIONS

Stand Alone Control
Local Control & I/O
Remote I/O
Distributed I/O
SCADA
RTU

#### DIGITAL INPUTS/OUTPUTS

The 72-PMX-24D controller board mates with any of our 8, 16, or 24 digital module racks. The 72-PMX-32D or 72-PMX-32AD controller board mates with special rack part number 70GRCP32-HL which accepts up to 32 G5 analog or digital I/O modules. Connections are made between the PC (or other type of host) parallel port and the controller boards via a 50 pin flat ribbon cable. The cable can be up to 500 feet in length. The cable from the host is connected to the first controller board on the bus and then daisy chained to additional controller boards. Up to 32 controller boards with 16 module racks (or 16 controller boards with 24 or 32 module racks) can be added anywhere along the cable. The maximum number of I/O per parallel port is 512.

#### SPEED

The parallel bus is high speed. The host PC can read or write eight digital I/O modules in less than 3 microseconds which means that 512 digital I/O modules can be scanned in less than 200 microseconds! Each group of eight I/O modules are accessed through a separate I/O port register on the host PC or controller. In assembly language, an **IN** or **OUT** instruction is used to read or write this information. In C language, an **inp** or **outp** function call is used. In BASIC, an **INP** or **OUTP** instruction is used.

#### WATCHDOG TIMER

Each controller board has an on-board communications watchdog timer which monitors communications between the host and controller board. A timer value between 0.5 seconds and 12 seconds is selected for each board. On power up, the timer begins counting down. Whenever a message from the host is received, the timer is restarted. Should the timer time out, all of the output modules being controlled by the board will be set to one of four DIP switch selectable conditions (ie. all off).

#### OTHER FEATURES

One of the control lines on the parallel bus is called RESET. The RESET line can be used to simultaneously turn off all of the output modules being controlled by each of the boards on the bus.

Three LEDs on the controller boards assist in troubleshooting problems. They indicate when power is being applied, when messages are being received, and when the watchdog timer has timed out.

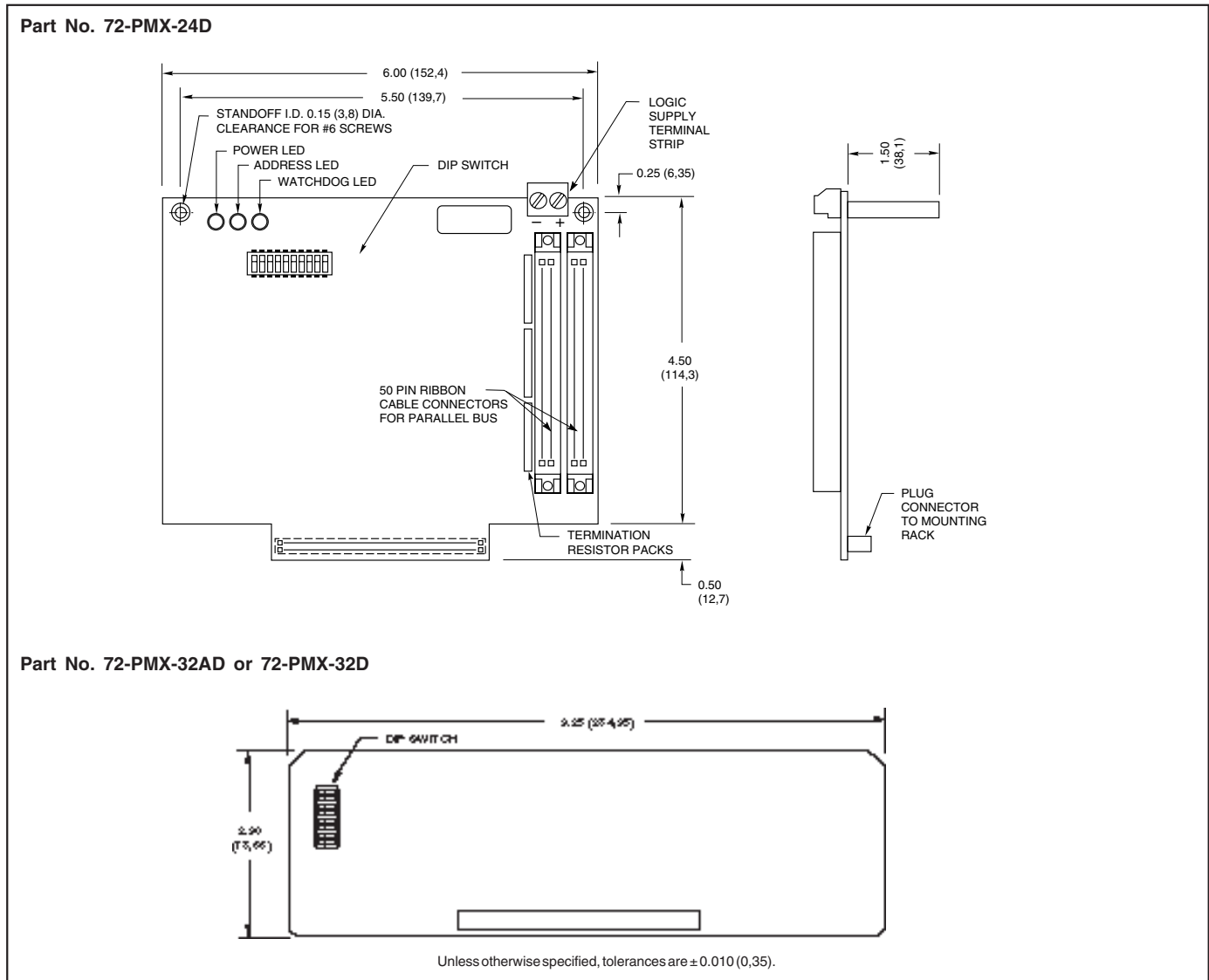
#### THE 72-PC28 ADAPTER CARD

In applications where the host computer is a PC, the 72-PC28 adapter card is an IBM PC/XT/AT bus to parallel bus interface which occupies a single half slot in the computer. The bus ribbon cable plugs into its 50-pin male header connector. Each adapter card can drive up to thirty two 72-PMX-24D controller boards, sixteen 72-PMX-32D controller boards or sixteen 72-PMX-32AD controller boards over a total distance of 500 feet. Up to four 72-PC28 adapter cards can be installed in one PC. The base address for the card and wait states are DIP switch selectable.

Each 72-PC28 includes a complete User's Manual and a software setup/test utility program. This program graphically shows you dip switch, jumper and termination resistor settings for the system configuration you decided. You can then use the program to configure and manipulate any I/O on the parallel bus.

All controller boards are thoroughly tested prior to shipment.

**DIMENSIONS** In inches (and millimeters)



**SPECIFICATIONS**

**Supply Voltage:** 4.9 to 5.1 Vdc  
**Supply Current (board only):** 1.5A maximum  
**Operating Temperature:** 0° to 60°C  
**Humidity:** 95% non-condensing  
**Connections (72-PMX-24D):**  
 Parallel bus: Two 50-pin male header connectors  
 Rack: 50-pin female plug connector  
**Connections (72-PMX-32D or 72-PMX-32AD):**  
 Parallel bus: Two 50-pin male header connectors located on rack 70GRCP32-HL  
 Rack: 70-pin female plug connector  
**Parallel Data:**  
 Format: 8-Bit Parallel  
**Range of Network:**  
 Multi-drop: Up to 500 feet total cable length, with (32) 72-PMX-24D or (16) 72-PMX-32D or 72-PMX-32AD boards maximum

**ORDERING INFORMATION**

Part Number	Description
<b>Controller Board</b>	
72-PMX-24D	Parallel controller board for up to 24 digital I/O modules
72-PMX-32AD	Parallel controller board for 32 G5 analog or digital I/O modules
72-PMX-32D	Parallel controller board for 32 G5 digital I/O modules
<b>Adapter Card</b>	
72-PC28	IBM PC parallel port plug-in board, includes 72-UMP manual
<b>User's Manual</b>	
72-UMP	Manual with utility software and sample programs

For finished ribbon cable assemblies, see "Controller Accessories"

**Available from your local authorized Grayhill Distributor.**

For prices and discounts, contact your local sales office, an authorized Distributor, or Grayhill.

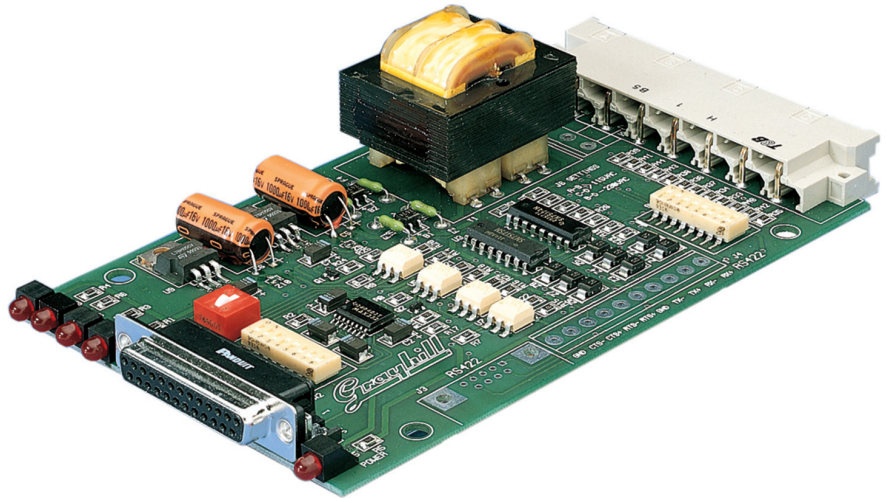
## COMMUNICATION CONVERTERS RS-232 to RS-422/485

### FEATURES

- Selectable RTS operation for 2 wire applications
- Transient Protection on the RS-422/485 Lines
- On-Board Power Supply With Jumper Selectable 110/220 Vac Operation
- Optical Isolation Between RS-232 and RS422/485
- DIP Switch Selectable DTE/DCE Setting
- Multiple Mounting and Connector Options

### GENERAL DESCRIPTION

The 72-CNV-XX family of converters offer a flexible and reliable solution to the challenge of interfacing devices conforming to different serial communication standards. Grayhill converter products are designed for industrial environments. All communication lines have transient protection which other commercially available converters lack. The converters allow an RS-232 device (ie. PCs, PLCs, Embedded Controllers) to communicate reliably over long distances to multiple devices utilizing the RS-422/485 standard. Reliability is an inherent benefit of the differential mode communication of RS-422/485. Noise introduced onto the RS-422/485 link affects both the positive and negative side equally, preserving the integrity of the differential signal between them. Long distances and multiple slave devices are supported by the converters. In half-duplex (2-wire) RS-485 mode,



handshaking can be controlled from either end of the communication link. Typical applications involve connecting a host computer to remotely located serial devices such as printers, control equipment, or data acquisition devices distributed throughout an office or factory.

The multiple mounting and connector options allow for many installation possibilities. All three versions conform to a Eurocard 3U size (160 mm x 100 mm). 72-CNV-10 will mount in a DIN 41494 card cage. AC power and the RS-422 signals are brought out to a DIN standard 41612 15-pin connector (Harting p/n 09061152911 or equivalent). 72-CNV-11 has standoffs to facilitate panel mounting. AC power comes in to a screw-

type terminal strip. RS-422 signals are on a separate terminal strip or a female DB-9 connector. 72-CNV-12 has a DIN rail card carrier which permits the assembly to snap on a DIN rail. AC power and RS-422 signals are brought in to two screw-type terminal strips. A female DB-25 connector transfers the RS-232 signals for all three versions.

### SPECIFICATIONS

- Supply Voltage Range ( $V_{ps}$ ):** 110/220 Vac (jumper selectable)
- Maximum Supply Current ( $I_{ps}$ ):** 120 mA
- Isolation Voltage:** 4000 Vac
- Transmission Rate:** 300 to 115,200 Baud
- Operating Temperature Range:** 0 to 60°C
- 95% relative humidity, non-condensing
- Indicators:** TX, RX, CTS, RTS and Power

### ORDERING INFORMATION

Part Number	Description
<b>72-CNV-10</b>	RS-232 to RS-422/485 converter for DIN card cage (Pictured)
<b>72-CNV-11</b>	RS-232 to RS-422 converter for panel mount
<b>72-CNV-12</b>	RS-232 to RS-422/485 converter for DIN rail mounting

### 72-CNV-2, 72-CNV-4 AND 72-CNV-5



72-CNV-4 and 72-CNV-5 convert serial communications from RS-232 to RS-485 in both directions. The converter simply plugs into any male RS-232 DB-25 connector and converts the transmit and receive signals to RS-485 (RS-422) levels at speeds to 115.2 KB. The converters are configured for DTE (default) or DCE operation.

The 72-CNV-2 is similar to the 72-CNV-4 except that it provides optical isolation and

operates only in an RS-422 mode at a maximum rate of 19.2 KB.

- Supply Voltage:**
  - +8 to +15 Vdc (-2 and -4 versions)
  - +5Vdc (-5 version)
- Supply Current:**
  - 62 mA plus output load (-2 version)
  - 30 mA plus output load (-4 and -5 version)
- Operating Temperature Range:** 0-60°C

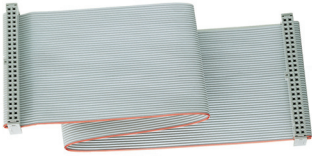
### ORDERING INFORMATION

Part Number	Description
<b>72-CNV-2</b>	RS-232 to RS-422 converter with optical isolation
<b>72-CNV-4</b>	RS-232 to RS-422/485 converter with 8 to 15V operation
<b>72-CNV-5</b>	RS-232 to RS-422/485 converter with 5V operation

Available from your local Grayhill Distributor. For prices and discounts, contact a local Sales Office, an authorized Distributor, or Grayhill.

## ACCESSORIES

### CABLE ASSEMBLIES



Several standard cable assemblies to connect controllers to our I/O module mounting racks may be ordered. The 72-CHH cable has a 50-pin header connector on each end to mate with those on mounting racks. The 72-CHE cable has a 50-pin header connector on one end and a 50-pin edge card connector on the other.

### TEST MODULES



Modules for use in system set up and testing may be ordered. Modules 70M-ISW1 and 70G-ISW1 simulates an input; 70M-OSW1 switch simulates an output.

### ORDERING INFORMATION

Part Number	Description
<b>Cable Assemblies</b>	
72-CHH-1	Ribbon cable assembly, header to header, 1 foot long
72-CHH-2	Ribbon cable assembly, header to header, 2 feet long
72-CHH-4	Ribbon cable assembly, header to header, 4 feet long
72-CHH-6	Ribbon cable assembly, header to header, 6 feet long
72-CHE-2	Ribbon cable assembly, header to edge card, 2 feet long
72-CHE-4	Ribbon cable assembly, header to edge card, 4 feet long
72-CHE-6	Ribbon cable assembly, header to edge card, 6 feet long
<b>Test Modules</b>	
70L-ISW	Input module test switch, OpenLine® package
70G-ISW1	Input module test switch, G5 package
70M-ISW1	Input module test switch, mini package
70M-OSW1	Output module test switch, 3 amp, mini package
<b>Fuses</b>	
70-FUSE-3AC	Fuse, 3.15A, 5x20mm, used on all AC Digital Output Modules
70-FUSE-3DC	Fuse, 3.15A, 5x20mm, used on all Solid State OpenLine® DC Digital Output Modules
70-FUSE-H	Fuse holder for Output Modules, used on all Digital Output Modules

### FUSE KITS

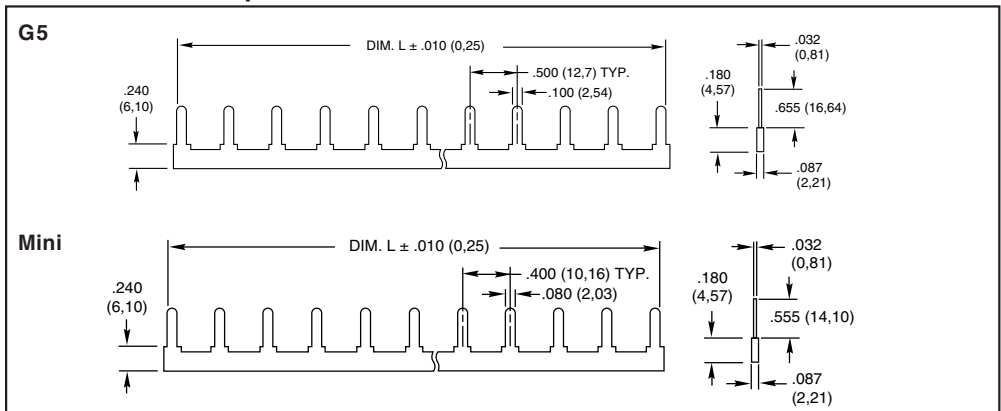
Fuse and fuse holder Replacement kits of 10 can be ordered directly from Grayhill.

**Controller Boards, I/O Modules, Module Racks, and Accessories are available through Authorized Grayhill Industrial Distributors.** For prices and discounts, contact your local sales office, an authorized Industrial Distributor, or Grayhill.

### SYSTEM 50 JUMPER BARS

Grayhill jumper bars are available for applications that require common terminals to be bussed together on digital I/O mounting racks. Jumper bars are available for both our Mini and G5 racks. Grayhill jumper bars are made from .032" thick tin-plated brass. The jumper bars are insulated with a molded sleeve for excellent dielectric properties.

### DIMENSIONS: Jumper Bars



### ORDERING INFORMATION: Jumper Bars for Grayhill G5 and Mini Series I/O Racks

Part Number	Description	Dimension "L" in. (mm)	Use on Grayhill I/O Rack
70G-JUMP8	8 position jumper for G5 I/O racks	3.60 (91,44)	70GRCK8-HL, 70GRCK16-HL, 70GRCM32-HL, 70GRCP32-HL, 70GRCK16I, 70GRCK16T
70G-JUMP12	12 position jumper for G5 I/O racks	5.60 (142,24)	70GRCK16I, 70GRCK16T
70M-JUMP6	6 position jumper for Mini I/O racks	2.08 (52,83)	70MRCQ24-HL
70M-JUMP8	8 position jumper for Mini I/O racks	2.88 (73,15)	70MRCQ24-HL