



- **System Configuration, Installation and Troubleshooting Manual**



**Complete wiring, dimensional, and operational specifications for the I/O modules, I/O mounting racks, and accessories can be found in Grayhill Catalog #7**

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or our Bulletin Board Service:

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Other MicroDAC User's Manuals Available:

<b>Part Number</b>	<b>Description</b>
72-UMM-D	Driver development and protocol definition manual Includes source code for Grayhill drivers.
72-UMM-DDE	MircODAC's Dynamic Data Exchange server for Windows. Manual includes DDE software.
72-UMM-E	Programmer's manual for developing and downloading C language ECPs. Includes sample C libraries.
72-UMM-H	Programmer's manual with complete explanation of the Grayhill drivers and their use. Includes Basic, C, and Pascal drivers along with example programs.

72-UMM-IL  
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## Introduction

The MicroDAC family of controllers are important components in a data acquisition and/or control project. The term “controllers” will refer to both units, MicroDAC and MicroDAC LT, unless otherwise specified. Their versatility gives you the option of serial communications over great distances for master/slave type control or running as a stand-alone controller or a combination of both.

In many applications the sensory and actuating devices are located over a wide area. Installing a MicroDAC, MicroDAC LT or a combination of both (up to 64 units), with I/O modules, near the remote input and output devices allows you to bring I/O status and data back to the host computer via a twisted pair serial network. MicroDAC is connected to an I/O module mounting rack with a 50 pin ribbon cable, while MicroDAC LT is plugged directly into the I/O module rack through a mating 50 pin female header. The racks are available in sizes of 8, 16, 24, and 32 I/O points. Analog or digital modules, input or output can be plugged into each location on the rack. The maximum number of I/O that can be serviced by each controller network is 2048 (64 controllers x 32 I/O points). The MicroDAC unit has an SBX port that allows control of an additional 48 points of digital only I/O; therefore, maximum number of I/O that can be serviced on a purely MicroDAC network is 3072 digital only points and 2048 mixed I/O points for a total of 5120 I/O points.

Using the Optomux<sup>1</sup> ASCII character protocol, the host computer sends commands to the controller to determine the status of its various process inputs or to change the status of its outputs. The commands are transmitted over a single pair of twisted wires (RS-485) or two pair of twisted wires (RS-422) at speeds from 1200 baud to 115.2 Kbaud. The addressed controller decodes the commands and returns the appropriate response. If your host computer is an IBM PC<sup>2</sup> or compatible, inexpensive interface driver software is available for the BASIC and C programming languages. This software dramatically simplifies sending and receiving these messages. If you prefer, you can use an off-the-shelf graphics based data acquisition and control software package. Many of these packages already offer an OptoMux/MicroDAC compatible driver. The following is a listing of some of the packages that currently support the Optomux protocol:

In-Touch\*      Wonderware Software Development Corporation  
100 Technology Drive  
Irvine, CA 92718  
(714) 727-3200

ViewPoint      Tele-Denken Resources, Inc.  
7702 FM 1960 East  
Humble, TX 77346  
(713) 852-5366

<sup>1</sup> Optomux is a registered trademark of Opto 22.

<sup>2</sup> IBM PC is a registered trademark of International Business Machines Corp.

Amax Plus T.A. Engineering Company, Inc.  
105 School Street  
Moraga, CA 94556  
(415) 376-8500

Notebook Labtech  
400 Research Drive  
Wilmington, MA 01887  
(508) 657-5400

The Fix Intelution, Inc.  
315 Norwood Park South  
Norwood, MA 02062-4633  
(617) 769-8878

Paragon 550 Intec Controls Corporation  
55 West Street  
Walpole, MA 02081  
(508) 660-1221

Genesis Iconics, Inc.  
100 Foxborough Boulevard  
Foxborough, MA 02035  
(508) 543-8600

Factory Link United States Data Corporation  
1551 Glenville Drive  
Richardson, TX 75081-2499  
(214) 680-9700

**\* Driver supports the extended commands and functionality of the MicroDAC**

When a large number of controllers are networked to a single host, the time required for the host to process all of the I/O information it is receiving can significantly slow the entire system response. To alleviate this problem, the controllers can store and run programs independent of the host (embedded control capability is dependent upon model selected). This decision sharing capability allows you to determine which control decisions will be made by the host computer and which the controller can make on its own. This capability can free the host to spend more time performing supervisory functions (ie: screen graphics, report generation, and monitoring over-all system performance) while the controller is making decisions, comparing values, solving equations and collecting data.

# System Configuration Considerations

## System Hardware Selection

A minimum controller system consists of a controller from the MicroDAC family, I/O mounting racks and single point I/O modules. There are several versions of the controller, each with a unique combination of features and selling price. You need to understand the differences between controller versions and select the appropriate model number(s).

### Controller Selection

Number	Description
72-MDC-32D	Digital only MicroDAC with RS-232 and SBX ports.
72-MDC-32AD	Analog/Digital MicroDAC with RS-232 and SBX ports.
72-MDC-32DC	Digital only MicroDAC with RS-232 and SBX ports, 128 Kbytes of battery backed RAM, 64 Kbytes Flash for ECP storage, and real time clock.
72-MDC-32ADC	Analog/Digital MicroDAC with RS-232 and SBX ports, 128 Kbytes of battery backed RAM, 64 Kbytes Flash for ECP storage and real time clock.
72-MDL-32AD	Analog/Digital MicroDAC LT
72-MDL-32ADC	Analog/Digital MicroDAC LT with 64 Kbytes of flash memory for embedded control program storage.

### Rack and I/O Selection

The rack you select is based on the types of I/O you are going to use in your system.

Analog I/O	G5 Series I/O only (70G and 73G)—to mix I/O types (analog and digital) you must use the G5 series products; Analog I/O are not available in mini and standard.
Digital Only	G5, mini, or standard I/O and racks

In all cases, the controllers are only compatible with 5 volt logic modules. The ribbon cable provided with the MicroDAC is compatible with the racks that have an “-HL” suffix. The MicroDAC LT is best used with the racks that also have the “-HL” suffix.

Also, note that different controller model numbers may be mixed on the same serial link. For example, if an application has a mixture of analog and digital I/O in one location and all digital I/O at another location, the most economical solution would be to use a 72-MDC-32AD or 72-MDC-32ADC at the first location and a 72-MDC-32D or 72-MDL-32AD at the second. Additional savings can be realized by substituting a 72-PMO-1 ProMux controller board for any MicroDAC controller, if the I/O is purely digital. The ProMux, MicroDAC and MicroDAC LT are all network compatible. It is important to note the I/O quantities, scan rates, baud rates and etc. when designing your network.

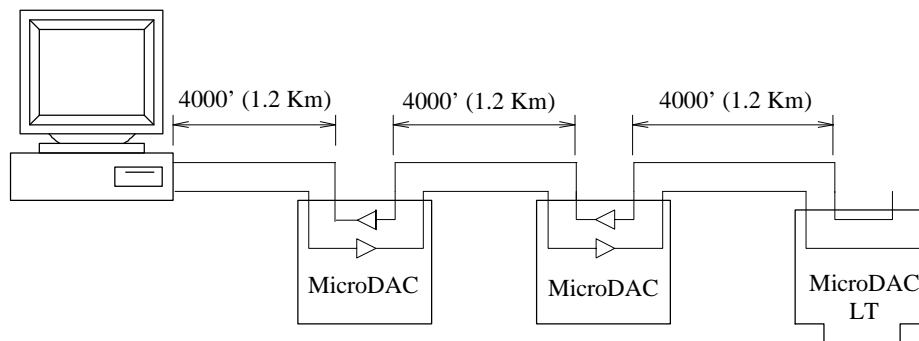
## Hardware Differences between MicroDAC & MicroDAC LT

Feature	MicroDAC	MicroDAC LT
Real time clock	Yes	No
RS-232 port	Yes	No
SBX port	Yes	No
64K flask for user programs (ECP's)	Model dependent	Model dependent
Communication Mode(s)	Repeat & Multidrop	Repeat Only
Battery backed RAM	Model dependent	No

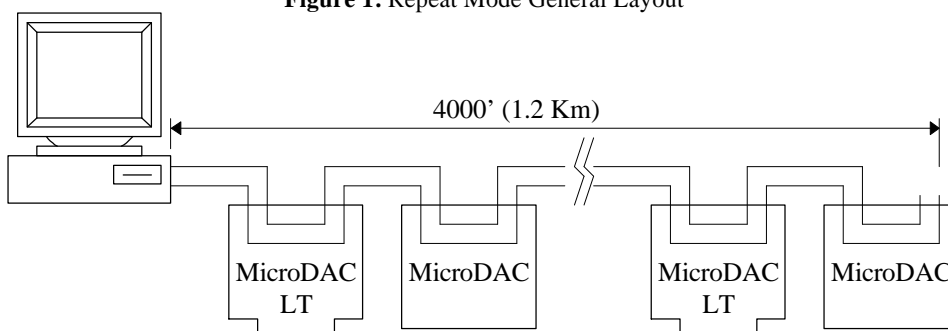
**Table 1:** Hardware differences between the MicroDAC family of controllers

## Repeat vs. Multidrop Communications Configuration

A shielded cable with one (RS-485) or two (RS-422) twisted pair of wires link the host to a network of controllers. An important consideration for your system wiring is whether to configure the network in a “repeat” or “multidrop” configuration. The tradeoff is one of distance between nodes versus communications integrity. Figures 1 and 2 show the general layouts. Later in the manual, you will find the complete wiring diagram and DIP switch settings for the repeat and multidrop configurations.



**Figure 1:** Repeat Mode General Layout



**Figure 2:** Multidrop Mode General Layout

In the repeat configuration, each MicroDAC has active circuits (transmitters and receivers) that take the line signal, “boost” it to full strength, and re-transmit the signal back onto the network. This “boosting” enables distances of up to 4000’ (1.2 Km) between nodes. The drawback is that if any node experiences a loss of power or a system failure then any node downstream is no longer accessible. Note that the MicroDAC LT’s do not have the active ‘boost’ circuitry in them, so on a mixed network in repeat mode, MicroDAC LT’s can be located only after the last MicroDAC and no further than 4000 feet away.

When the controllers are in a multidrop configuration it is essentially on a “parallel” network. Should any controller on the network fail there are no active circuits to impede the network signal, making the network less susceptible to complete failures. The lack of “boosting,” as seen in the repeat mode, limits the entire network to a total cable length of 4000 feet.

### **Addressing and Module Arrangement**

The Optomux protocol only permits sixteen I/O of one type (analog or digital) to be located at one address. The MicroDAC family is capable of monitoring or controlling any combination of 32 analog or digital modules. Therefore, each controller must occupy four addresses. The base address is DIP switch selectable. It is the address used to monitor or control the digital I/O modules in rack locations 0 through 15. The controller automatically reserves the next 3 sequential addresses for the rest of the I/O modules. Digital modules in rack locations 16 through 31 are located at the base address + 1, analog modules in rack locations 0 through 15 are located at the base address + 2, and analog modules in rack locations 16 through 31 are located at the base address + 3.

**All versions of the controllers occupy four addresses, even if a smaller I/O rack is used or only digital modules are used.**

You need to take this addressing scheme into consideration when determining which I/O modules to install in each location on the I/O rack. I/O at different addresses cannot be affected by a single command from the host. You will want to group the I/O so that inputs or outputs which need to be read or actuated simultaneously are located at the same address. This will reduce the number of commands that need to be issued and thereby improve system response time.

A second consideration in determining I/O module locations is cross-talk and electrical noise. When mixing analog and digital modules on a rack, care must be taken not to route the field wiring for sensitive analog input signals (especially millivolt or thermocouple types) close to digital output wiring. Load switching can generate noise spikes. If I/O wiring from these loads is not properly routed or shielded, the noise signals can be coupled into adjacent I/O wires. In the case of analog inputs, this can result in erroneous readings by the controller. A common practice for minimizing the probability of this occurring is shown in Figure 3. By

using dual row G5 I/O racks, the “noisy” I/O can be wired to one half of the rack, and the sensitive I/O wired to the other.

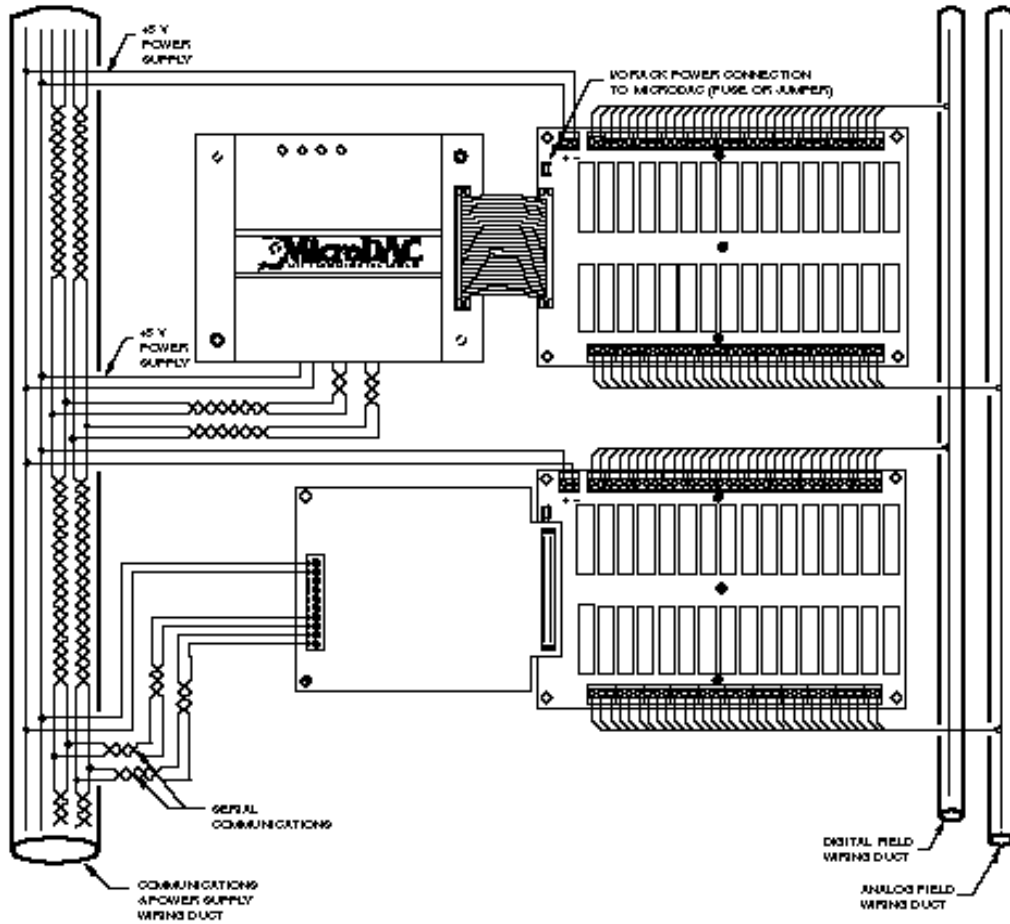


Figure 3: Typical MicroDAC Wiring Diagram

## Installation

### Unpacking

The MicroDAC family of controllers contains numerous static sensitive devices. Therefore, it is shipped in antistatic conductive package. When unpacking the controllers, use care to ensure these devices are not damaged by static electricity. The following handling procedures are recommended:

- 1) When transporting or storing, leave the controller in its antistatic box.
- 2) When handling, all work benches and operators should be grounded, using antistatic mats and wrist straps.

Included with each MicroDAC is a six inch ribbon cable assembly for connecting the unit with an I/O rack. Additional Cable lengths are available. Contact you local Grayhill Distributor for pricing and availability.

*Note: The cable length between the MicroDAC and the I/O rack should be kept to a minimum and must not exceed six feet.*

### Mounting

The controller and its accompanying I/O rack can be mounted horizontally or vertically in any orientation. We recommend mounting them horizontally with the controller to the left of the I/O rack and with the rack in a vertical plane. This provides the best use of natural air flow to cool the controller and I/O modules.

Figure 4 is a complete dimensional drawing of MicroDAC (complete I/O rack dimensional drawings can be found in Grayhill Catalog #7). To panel mount the unit, first remove its cover by loosening the two thumb screws. The unit is anchored to the panel through two 0.18 inch (4,6 mm) holes in opposite corners from the thumb screws. This size hole will accommodate a #6 or #8 screw.

MicroDAC will mount to shallow (35 x 7.5 mm) or deep (35 x 15 mm) “top hat” DIN rails which meet the dimensional requirements of DIN EN 50 022. The unit snaps onto the DIN rail by first engaging the spring loaded DIN rail clip on MicroDAC with the bottom of the rail and then pushing up on the bottom of the unit until rail brackets grab the top lip of the rail. To remove the unit from the rail, use a screwdriver to pry the DIN rail clip away from the bottom of the unit. Then lift the unit off of the DIN rail.

*Note: DIN rail mounting MicroDAC to a surface that is grounded does not ensure the base and cover will also be grounded.*

Figure 5 is a complete dimensional drawing of the MicroDAC LT (complete I/O rack dimensional drawings can be found in Grayhill Catalog #7). The unit is anchored to the panel through two 0.15 inch (3,6 mm) in the adjacent corners of the MicroDAC LT unit opposite the ribbon cable header. This size hole will accommodate a #6 screw.

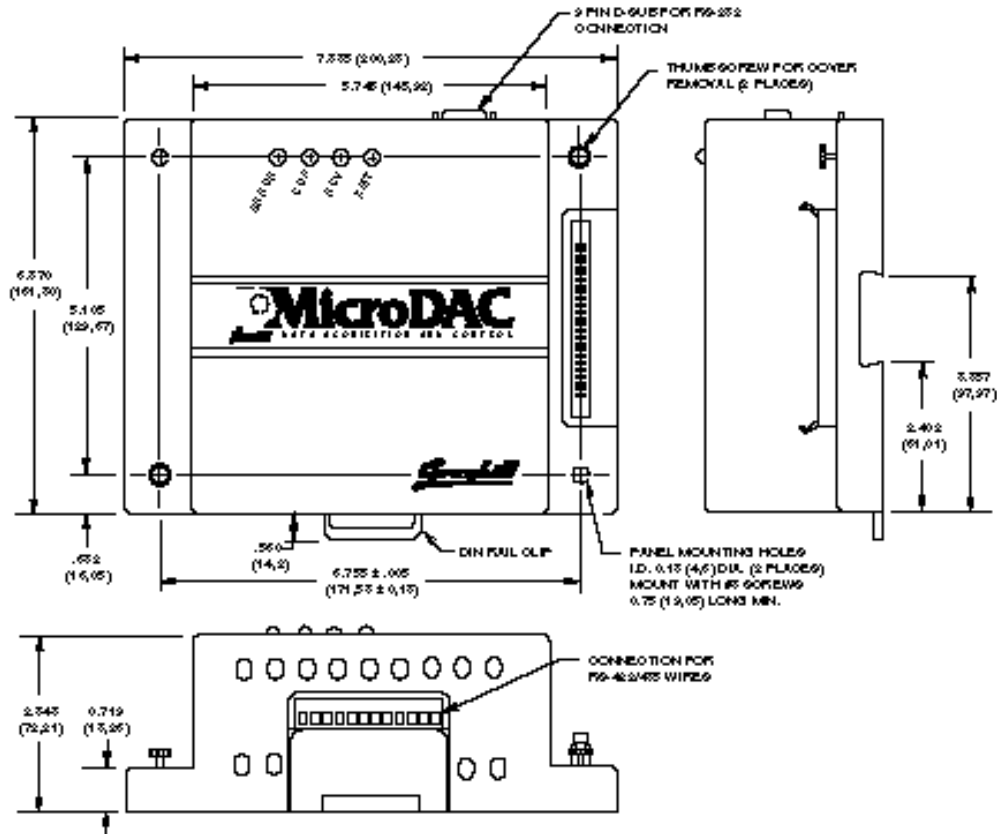


Figure 4: MicroDAC Dimensional Drawing

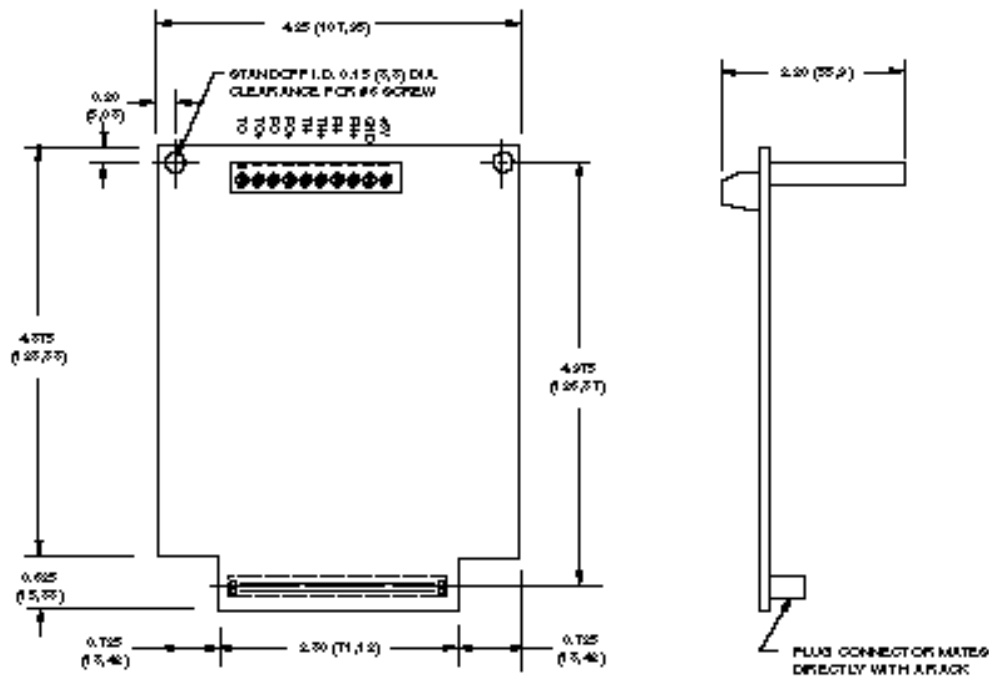


Figure 5: MicroDAC LT Dimensional Drawing

## Power Supply Wiring

The controller and the I/O modules installed in the adjoining I/O rack require a regulated +5 Vdc power supply. You must power both the controller and the I/O rack with a single power supply as shown in the following figures. You must also install a fuse jumper wire between the '+' terminal on the 2 position terminal strip and pin 49 of the 50 pin header connector (see Figure 6). The controller and I/O rack *must* not be powered separately, see the following warning.

**WARNING—Output modules (AC and DC) will activate if power (+5 Vdc) is applied to the I/O rack but not to the controller.**

**To ensure the output modules will turn off in the above situation:**

- Verify that the fuse or jumper between the "+" terminal and pin 49 on the I/O rack is installed, and
- Use one power supply to power I/O rack and MicroDAC as shown in Figure 6.

**Check polarities of all power supply connections before applying power to MicroDAC. Incorrect polarity may cause damage to the controller.**

MicroDAC is protected by a socketed 2 amp fuse (F1), while the MicroDAC LT is protected by a socketed 1 amp fuse at the terminal strip (F2), and the ribbon cable (F1).

The table below should be used to size the power supply. It lists the conservative worst case current draw for each of the components in the MicroDAC system. By multiplying the quantity of I/Os per rack by the values listed in the table, you can calculate the worst case current draw for each of the I/O racks in your system. A conservative value for the current required for each controller is: 800 mA for the MicroDAC, and 300 mA for the MicroDAC LT.

Worst Case I/O Type	Current Draw Per Module
Digital Inputs	0.02 A
Digital Output	0.02 A
Analog Input	0.15 A
Analog Voltage Output	0.15 A
Analog Current Output	0.25 A

**Example:** For a given application, a MicroDAC is connected to a 32 point I/O rack populated with eight Digital Inputs, eight Digital Outputs, eight Analog Inputs, and eight Analog Voltage Outputs. What is the minimum current rating for the power supply which will power the entire system?

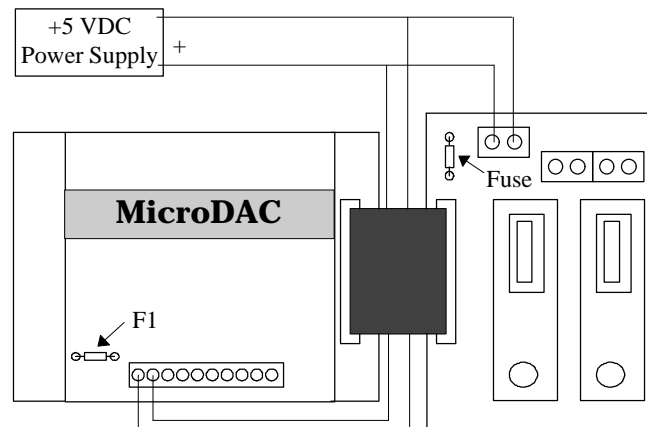
$$I_{\text{POWER SUPPLY}} = (8 \times \text{DI}) + (8 \times \text{DO}) + (8 \times \text{AI}) + (8 \times \text{AO}) + I_{\text{controller, or}}$$

$$I_{\text{POWER SUPPLY}} = (0.16) + (0.16) + (1.2) + (1.2) + .800 = 3.52 \text{ Amps}$$

When the controllers are powered and operating correctly, the COP indicator LED will flash at a rate near 1 Hertz.

## Controller to I/O Rack Connection

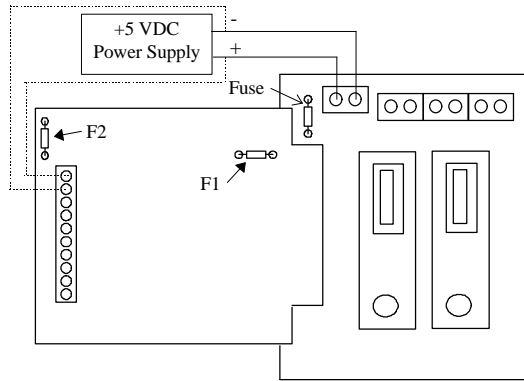
**MicroDAC:** The connection between MicroDAC and the I/O rack is made using a 50 conductor ribbon cable assembly. A finished six inch ribbon cable is included with each MicroDAC. Longer ribbon cable assemblies are available from Grayhill (see **Accessories**). The maximum ribbon cable length is six feet. In equipment where a high level of electrical noise is present, it may be necessary to use a shielded ribbon cable. In this case, the shield should be connected to the same ground as the MicroDAC case. The 50 pin header connectors on both the MicroDAC and Grayhill I/O racks with an “-HL” suffix mate with Molex connectors part number 15-29-8504 or equivalent.



**Figure 6:** MicroDAC Power Supply Wiring

**MicroDAC LT:** The connection between the MicroDAC LT and the rack is done by matching 50 pin ribbon cable headers as shown in the following figure. The MicroDAC LT has an advantage in that it can be powered directly from the rack if the correct fuses and jumpers are installed. The dotted wiring is optional if the rack and the MicroDAC LT have all the fuses installed as shown in the figure.

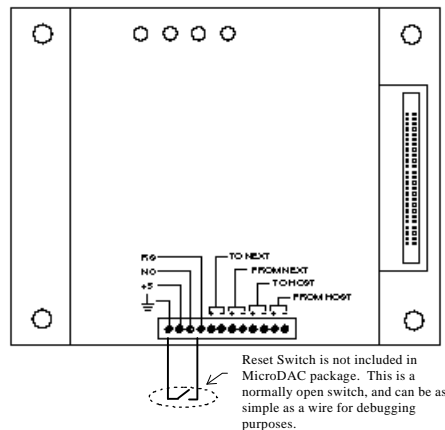
- To ensure the output modules will turn off in the above situation:
- Verify that the fuse or jumper between the "+" terminal and pin 49 on the I/O rack is installed, and
  - Verify that the fuse (F1) on the MicroDAC LT controller is installed.
  - OR install the dotted wiring.



**Figure 7:** MicroDAC LT Power Supply Wiring

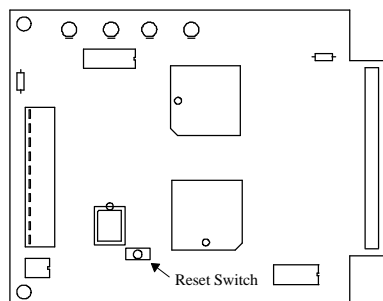
### Hardware Reset Terminal

The MicroDAC and MicroDAC LT provide a hardware reset function. On the MicroDAC the RS connection on the twelve-position terminal strip, J2, is commonly used during set up and debug. RS allows a hardware reset to be performed without toggling power to the unit. When the RS pin is momentarily pulled to ground, the board performs its initialization routines. Wiring to the RS pin should be removed after installation and debugging, to prevent the MicroDAC to reset unnecessarily in EMI noisy environments.



**Figure 8:** MicroDAC Reset switch wiring

The ECP capable version of MicroDAC LT (72-MDL-32ADC) has a built in reset switch and can be found in the following figure.



**Figure 9:** MicroDAC LT Reset Switch location

### Component Layouts

The following two figures will be referenced in the following sections. The figures show the component layout of each board. These layouts will help the user find the component needed to accomplish the desired settings.

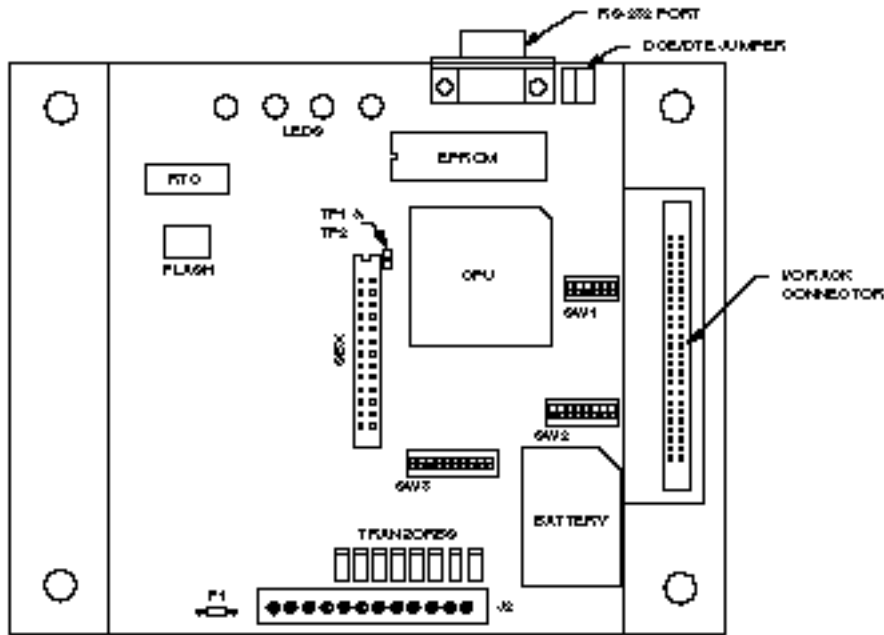


Figure 10: MicroDAC Component Layout

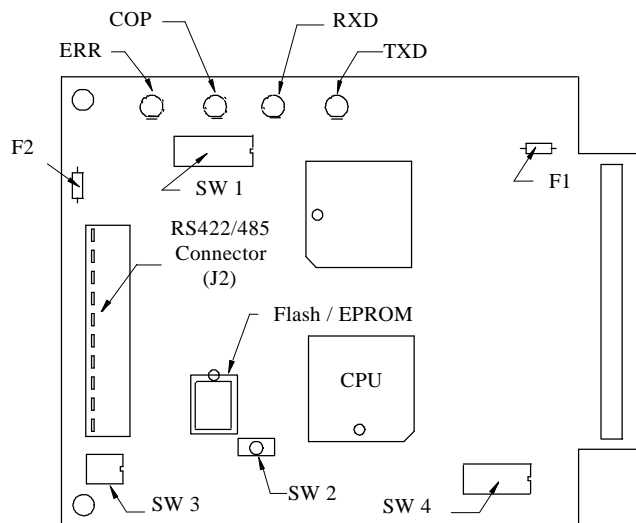


Figure 11: MicroDAC LT Component Layout

## DIP Switch Settings

**MicroDAC:** The 6 position DIP switch, SW1, is used to select the communications protocol (2 pass or 4 pass), the communications baud rate, and to clear the Autostart ECP bit. The 8 position DIP switch, SW2, is used to select the base address for the unit. The 10 position DIP switch, SW3, is used to direct messages received on the serial port to the correct circuitry dependent upon whether a multidrop or repeat communications wiring scheme is being used, and to set end-of-line communications termination.

**MicroDAC LT:** The 8 position DIP switch, SW1, is used to select the base address for the unit. The pushbutton switch, SW2, is the hardware reset switch. The 2 position dip switch, SW3, is for switching in the network termination resistors. The 6 position DIP switch, SW4, is used to select the communications protocol (2 pass or 4 pass), the communications baud rate, and to clear the Autostart ECP bit.

*Note:* The controllers only read the DIP switch settings during their initialization routine. Therefore, in order for a controller to recognize a DIP switch setting change, you must toggle power to the unit, ground the “RS” pin (MicroDAC), depress the reset switch (LT), or send it the “Board Reset” (+01) command.

## Setting the Base Address

The 8 position DIP switch; (SW2 on the MicroDAC, SW1 on the MicroDAC LT), is used to assign four unique addresses between 0 and 252 (0 and FC in hex) to each controller in the network. These addresses are used by the host to send commands to individual controllers. The DIP switch selection sets the Base Address for the unit. Commands which impact digital I/O modules in rack locations 0 through 15 are sent to the Base Address, while commands that impact digital I/O in rack locations 16 through 31 are sent to the Base Address + 1. Commands which impact analog I/O in rack locations 0 through 15 are sent to the Base Address + 2, and commands which impact analog I/O in rack locations 16 through 31 are sent to the Base Address + 3.

Address	I/O Type	Rack Position
Base*	Digital	0 - 15
Base + 1	Digital	16 - 31
Base + 2	Analog	0 - 15
Base + 3	Analog	16 - 31

**Table 2:** Firmware Generated Addresses

\*DIP switch selectable

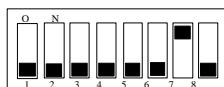
*Note:* MicroDAC and MircoDAC LT automatically assign the three offset addresses regardless of the size rack used or type of modules in each location. Therefore, when setting the address DIP switch, care must be taken not to conflict with the addresses being used by another MicroDAC. A good practice is to assign the Base Addresses in increments of four (0, 4, 8, 12, 16, etc).

Switch Position								Base Address	
1	2	3	4	5	6	7	8	Decimal	Hex
0	0	0	0	0	0	0	0	0	00
0	0	0	0	0	0	0	1	1	01
0	0	0	0	0	0	1	0	2	02
0	0	0	0	0	0	1	1	3	03
0	0	0	0	0	1	0	0	4	04
0	0	0	0	0	1	0	1	5	05
0	0	0	0	0	1	1	0	6	06
0	0	0	0	0	1	1	1	7	07
0	0	0	0	1	0	0	0	8	08
0	0	0	0	1	0	0	1	9	09
0	0	0	0	1	0	1	0	10	0A
0	0	0	0	1	0	1	1	11	0B
0	0	0	0	1	1	0	0	12	0C
			.					.	.
			.					.	.
			.					.	.
1	1	1	1	0	1	0	0	244	F4
1	1	1	1	0	1	0	1	245	F5
1	1	1	1	0	1	1	0	246	F6
1	1	1	1	0	1	1	1	247	F7
1	1	1	1	1	0	0	0	248	F8
1	1	1	1	1	0	0	1	249	F9
1	1	1	1	1	0	1	0	250	FA
1	1	1	1	1	0	1	1	251	FB
1	1	1	1	1	1	0	0	252	FC
1	1	1	1	1	1	0	1	253	FD
1	1	1	1	1	1	1	0	254	FE
1	1	1	1	1	1	1	1	255	FF

Table 3: Switch Setting & Base Address

1 = Switch On  
 0 = Switch Off

**Example**



Set for base address 02 (0000 0010)

## Setting the Autostart ECP Bit, 2/4-Pass Mode, and Baud Rate

The 6 position DIP switch (SW2 on MicroDAC, SW4 on MicroDAC LT) is located as shown in the figures. The following table shows how each switch affects the controller.

Position	MicroDAC (SW2)		MicroDAC LT (SW4)	
	On	Off	On	Off
1	Auto Start Off	Auto Start On	N/A	
2	N/A		Auto Start Off	Auto Start On
3	4 Pass Comm.	2 Pass Comm.	4 Pass Comm.	2 Pass Comm.
4	Baud Rate		Baud Rate	
5	Baud Rate		Baud Rate	
6	Baud Rate		Baud Rate	

**Table 4:** Position Functions

Switch position 1 on the MicroDAC (Switch position 2 on the MicroDAC LT) is used to clear the Autostart ECP bit within memory. When in the ON position, and the controller is reset the Autostart ECP bit is cleared. When in the OFF position, the clearing of the Autostart ECP bit is disabled. Changing the switch during operation will not stop the ECP during the current session; it will only prevent the ECP from restarting on a power-up.

Switch position 3 (for both controllers) is used to select 2 Pass or 4 Pass communications. The phrase **2 Pass** means that one communications cycle requires two events on the serial link; a command and a response. This is the typical mode of communications used on the controller network because it yields the fastest system response. The other choice is 4 Pass communications or Echo mode. The phrase 4 Pass means that one communications cycle requires four events; a command, an echo of the command, an execute command, and a response. This is obviously a longer cycle than the 2 Pass mode. However, using only checksum to assure communications integrity leaves a slight potential for errors to occur. The 4 Pass mode adds an extra margin of communications integrity.

Switch positions 4 through 6 are used to select the baud rate of the serial network. The baud rate of all MicroDACs in the system should match the baud rate of the host and any other devices on the network. The network baud rate is typically set to maximum operating baud rate of the slowest device on the network. Table 5 shows the switch setting to choose the desired and available baud rates.

Switch Position			Baud Rate
4	5	6	(baud)
Off	Off	Off	1200
Off	Off	On	2400
Off	On	Off	9600
Off	On	On	19.2K
On	Off	Off	38.4K
On	Off	On	57.6K
On	On	Off	115.2K
On	Off	On	307 K

Table 5: Baud Rate Settings

### Serial Communications Wiring

Before communications wiring can begin, two decisions must be made. The first is whether two wire RS-485 or four wire RS-422 communications will be used and the second is whether the multidrop or repeat configuration will be used.

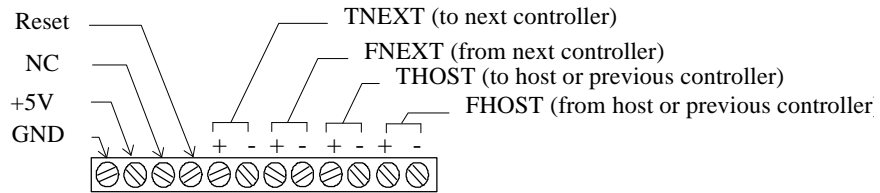
The advantages and disadvantages of multidrop and repeat configuration were discussed earlier in this manual (see **System Configuration Considerations**). Both configurations are wired the same. However, switch positions 1 and 7 through 10 (or switch positions 1 and 2 on the MicroDAC LT) on DIP switch SW3 must be set accordingly. Remember MicroDAC LT can exist only at the end of the line in a repeat mode network. The proper DIP switch settings for SW3 are shown with each of the following wiring diagrams.

The controller network types—multidrop or repeat, RS422 or RS485—must have an end-of-line network termination. End-of-line termination means that the last controller in the network must be terminated with a 120 Ω resistor. Each controller has the terminating resistor built-in, and are switched in or out via DIP switch SW3. See chart below for the correct settings for DIP switch SW3. The termination resistors are switched in using SW3 on the MicroDAC LT, and positions 2, 3, and 6 on the MicroDAC. The MicroDAC allows the user to switch 4.7 KΩ biasing resistors into the RS422 network. This is done by switching positions 7 through 10 to the “ON” position.

Mode	MicroDAC		MicroDAC LT	
	Normal	Last Board	Normal	Last Board
Multidrop				
Repeat (RS-422 Only)			N/A	

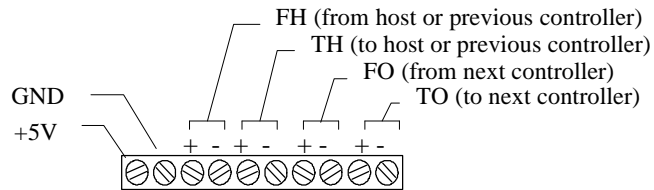
To wire the communications connections, remove the MicroDAC cover and locate the twelve position terminal block (J2). The function of each terminal is shown in

Figure 12. The “To Next”, “From Next”, “To Host”, and “From Host” terminals are used for communications.



**Figure 12:** MicroDAC Terminal Strip Layout

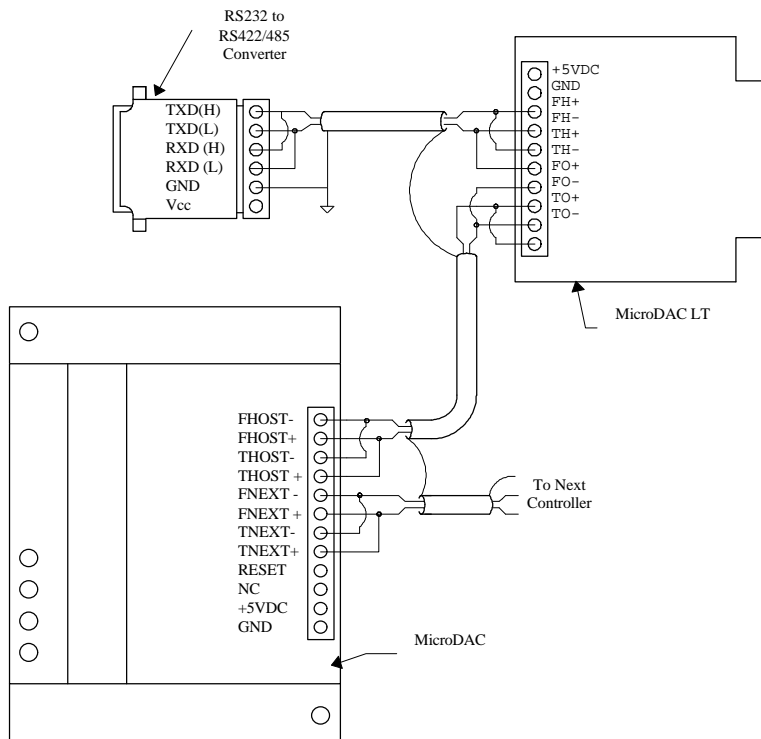
On the MicroDAC LT locate the 10 position terminal block (J2). The function of each terminal is shown in Figure 13. The “To Other”, “From Other”, “From Host” and “To Host” are used for communications.



**Figure 13:** MicroDAC LT Terminal Strip Layout

## RS-485 Wiring (2 Wire, Multidrop Mode Only)

Using two wire RS-485 communications, messages are transmitted and received on the same pair of shielded, twisted wires (Belden part number 9841, 9341, or equivalent). Care must be taken to turn the host driver IC on when sending messages and off when receiving messages. This can be accomplished using software or hardware. Only multidrop wiring configuration is possible when RS-485 is used.



**Figure 14:** RS-485 Wiring

**Note:** The shield grounds should be connected to system ground at one point only. This practice will eliminate the possibility of ground loops causing erroneous operation.

## RS-422 Wiring (4 Wire, Repeat or Multidrop Modes)

Using four wire RS-422, messages are transmitted on one pair of shielded, twisted wires and received on another (Belden part number 9729, 9829, or equivalent). Both multidrop and repeat configurations are possible when RS-422 is used.

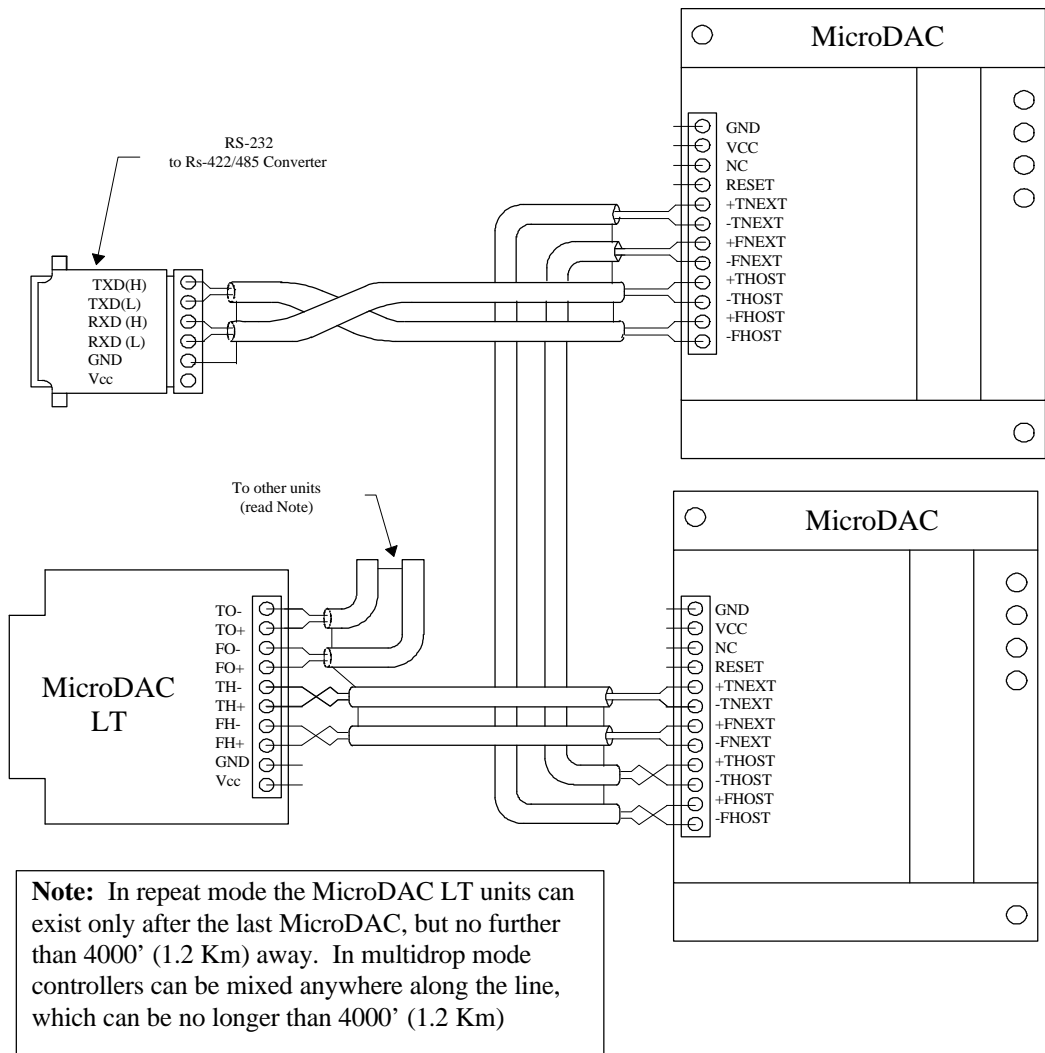
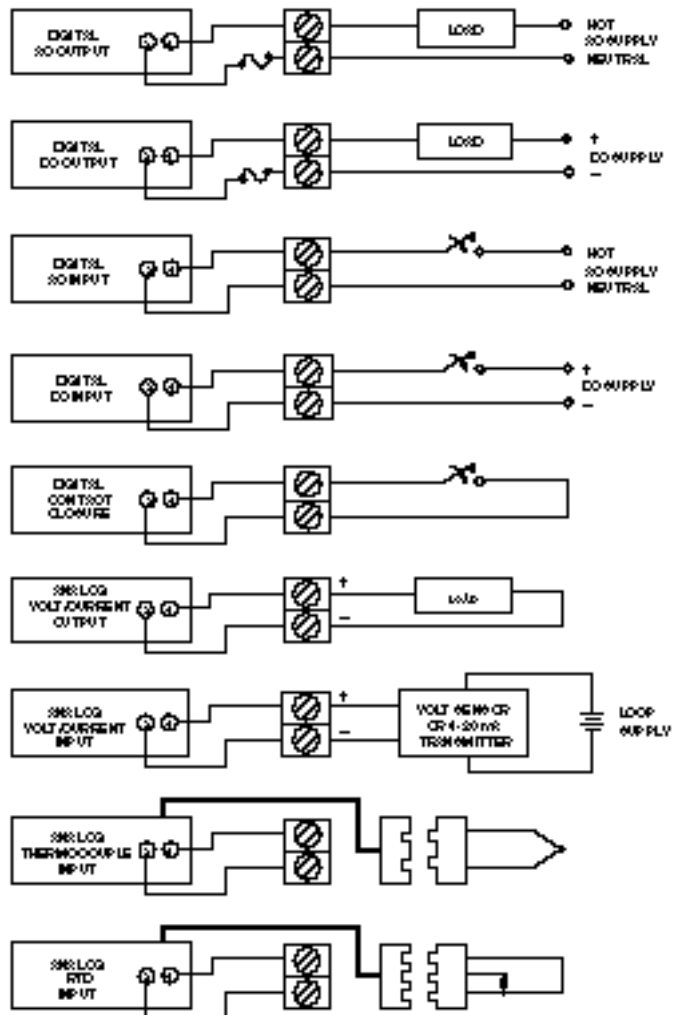


Figure 15: RS-422 Wiring

**Note:** The shield grounds should be connected to system ground at one point only. This practice will eliminate the possibility of ground loops causing erroneous operation.

## I/O Module Wiring

Analog and digital modules can be placed at any I/O rack location, however, to minimize the possibility of crosstalk and noise pickup it is a good practice to group similar module types together. Shown below are the wiring diagrams for each I/O module type. 14 or 16 gauge wire is recommended to wire the field devices to the I/O rack terminal block. The wiring and operation of the modules can be verified by issuing the appropriate Configure, Read, and/or Write commands from the GH-TALK utility program (see next section). **Modules should never be installed or removed while power is applied to the I/O rack or MicroDAC.**



## Installing SBX Boards (MicroDAC Only)

MicroDAC's capabilities can be enhanced by adding a Grayhill or third party expander board on the SBX port located on the top of the MicroDAC CPU board.

SBX is an IEEE 959-1987 standard originated by Intel. Manufacturers adhering to the standard have two board sizes—"single-wide" (2.85" x 3.7") and "double-wide" (2.85 x 7.5"). The MicroDAC supports the "single-wide" versions due to space restriction under the cover of the MicroDAC. This is true regardless of whether or not the cover is installed. An SBX board can be installed by removing the MicroDAC cover and plugging it into the 36 pin dual row female connector (light blue) on the CPU board.

If you are looking at the MicroDAC with the power and network terminal block to the bottom and the RS-232 local port to the top you will notice a hole in the CPU board approximately 2" to the left of the SBX connector. This hole is for the support stand-off supplied with each SBX board. This stand-off is typically one of two forms—screw down or snap fit—and should only be used if made of a non-conductive material. If the stand-off is a screw down type then you will be required to use the following steps to properly install the stand-off:

1. Remove the stand-off from the SBX board.
2. Attach the stand-off to the MicroDAC CPU by inserting the screw through the stand-off hole, holding the screw with your finger, and screwing the stand-off onto the screw.
3. Install the SBX board into the MicroDAC and insert the final screw through the top of the SBX board into the installed stand-off.

If a snap-in type is supplied then you simply snap the stand-off into the bottom side (same side as the male SBX connector) of the SBX board, install the SBX board and snap the end of the stand-off into the MicroDAC CPU board.

**Note:** *Give consideration to the type of stand-off you use in your application; the snap-in style of stand-off may release under high vibration conditions.*

Following is a list of interface boards available through Grayhill, as well as, third party SBX boards that have been tested and are known to be compatible with the MicroDAC:

<b>Manufacturer</b>	<b>Part Number</b>	<b>Description</b>
Grayhill	72-SBX-48PIO	48 bi-directional parallel I/O
	72-SBX-ARCCBX	Coaxial cable ARCNET SBX board
	72-PCCXB-ARC	Coaxial cable PC interface card
	72-SBX-ARCCXB	Coaxial cable installation kit
	72-TERM93	Coaxial cable terminator
	72-SBX-ARCFO	Fiber-optic cable ARCNET board
SBX	72-PCFO-ARC	Fiber-optic PC interface card
	72-SBX_ARCFO	Fiber-optic installation kit
	72-SBX-ARC485	Twisted pair cable ARCNET SBX board
	72-PC485-ARC	Twisted pair PC interface card
	72-SBX-ARC485	Twisted pair installation kit
	Bulletin #638	ARCNET Brochure (No Cost)

<b>Manufacturer</b>	<b>Model Number</b>	<b>Description</b>
Computer Dynamics		(803) 877-7471
	CDX-AD816	12-bit A/D converter, 8 differential/16 single ended
	CDX-P48	48 bi-directional parallel I/O
Contemporary Controls		(708) 963-7070
	SBX20-485	Arcnet RS-485 interface
	SBX20-FOG-ST	Arcnet Fiber Optic Interface
Intel Corporation		(408) 978-8080
	iSBX-354	Dual-channel serial port, selectable RS-232/RS-422
Technology 80 Inc.		(800) 545-2980
	4324	Quadrature encoder input (.333 Mhz) or high speed counter input (1.25 MHz)
Ziatech Corporation		(508) 541-0488
	ZSBX-CT31	48 bi-directional parallel I/O

**Note:** For the MicroDAC to communicate with the installed SBX board, you will have to create and compile 'C' or QuickBASIC code and link it to your ECP program or use the prewritten ProWare commands.

## Supported SBX Signal Lines

MicroDAC does not make connection to all of the pins on the SBX connector. You must make sure that the SBX card you select only requires those that are supported.

Supported	Not Supported
MDO-MD7	MDRQT
IORD/,IOWRT/	MDACK/
MAO-MA2	OPT 0 - OPT 1
RESET	TDMA
MCSO/, MCS1	MINTR1
MWAIT	MPST/
MINTRO	+12 V, -12 V*
MCLK	
+5V, all grounds	

\* +12 V and -12 V are not supplied by the MicroDAC. Connections for the +12 V and -12 V are provided for by two .025" square terminals on .100" centers. The terminals are labeled TP1 (+12 V) and TP2 (-12 V) as shown in Figure 10. They mate with Molex connector 50-57-9002 or equivalent.

## Local RS-232 Port (MicroDAC Only)

The local RS-232 port on MicroDAC can be used to input or output information from/to remote RS-232 devices. A set of jumpers (see Figure 10) permit the port to be configured for DCE or DTE operation.

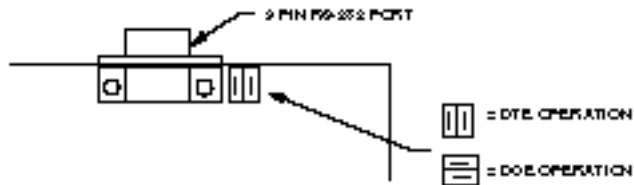


Figure 16: RS-232 Jumper Locations and Settings

The RS-232 connections are made to the 9 pin D-sub male connector on the top of MicroDAC. The pin-out for the connector is shown in Figure 17.

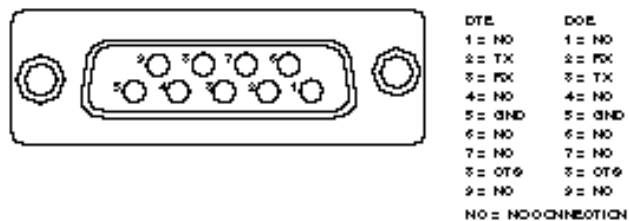


Figure 17: Local RS-232 Pin-outs

---

GH-TALK.EXE is a DOS based utility program supplied on the enclosed disk. The program provides a means for sending any of the ProWare ASCII commands to the Grayhill controllers. Commands are constructed by making selections in various menus and windows. Once the complete command string is built, it can be sent to any of the controllers on the network. The response received from the controller is displayed on the screen.

GH-TALK is used during system installation to verify the host and controller(s) are wired and communicating. By issuing Read and Write commands, the I/O wiring can also be checked. GH-TALK demonstrates the exact sequence of a command and/or to debug portions of an application program.

In this section we will discuss the conventions used to move around through GH-TALK and how to send commands to the network using GH-TALK.

To execute GH-TALK from the DOS prompt, type:

C>GH-TALK and press Enter  
*or*  
A>GH-TALK and press Enter

*Note: GH-TALK only supports RS-422 4 wire network wiring.*

## Main Menu

The [Main Menu] is displayed at the start of GH-TALK. Pressing **ESC** once or twice from any menu level will return GH-TALK to the [Main Menu] screen shown below:

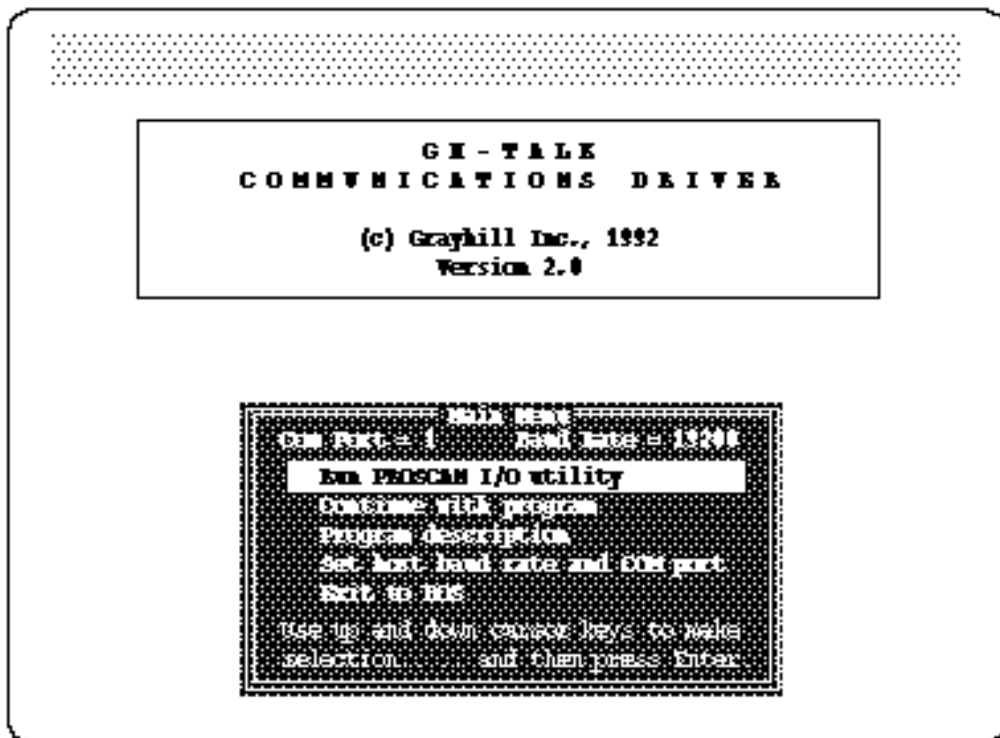


Figure 18

There are five categories to choose from on the [Main Menu]. During your first session, you will want to check that the communications port and baud rate being used by GH-TALK matches your system configuration. These parameters are modified using the [Set host baud rate and COM port] menu and are saved to a file named GH-TALK.PRM. After they have been properly set, you don't need to access this screen again unless you modify your system. The [Program description] selection is a help screen which repeats much of the information provided in this chapter. The [Exit to DOS] selection is used to quit GH-TALK and returns you to DOS.

The current default Com Port and Baud Rate are displayed at the top of the Main Menu window. If they are correct, select menu options [Run PROSCAN I/O utility] or [Continue with program] by using the up or down arrow keys and press Enter. Then refer to the "Proscan Utility" or "Sending Command Strings" section.

## Setting Com Port

If the Com Port or Baud rate is not appropriate for your system configuration, move the highlight bar to [Set host baud rate and COM port] and press **Enter**. The [Communications Port] screen below will appear.

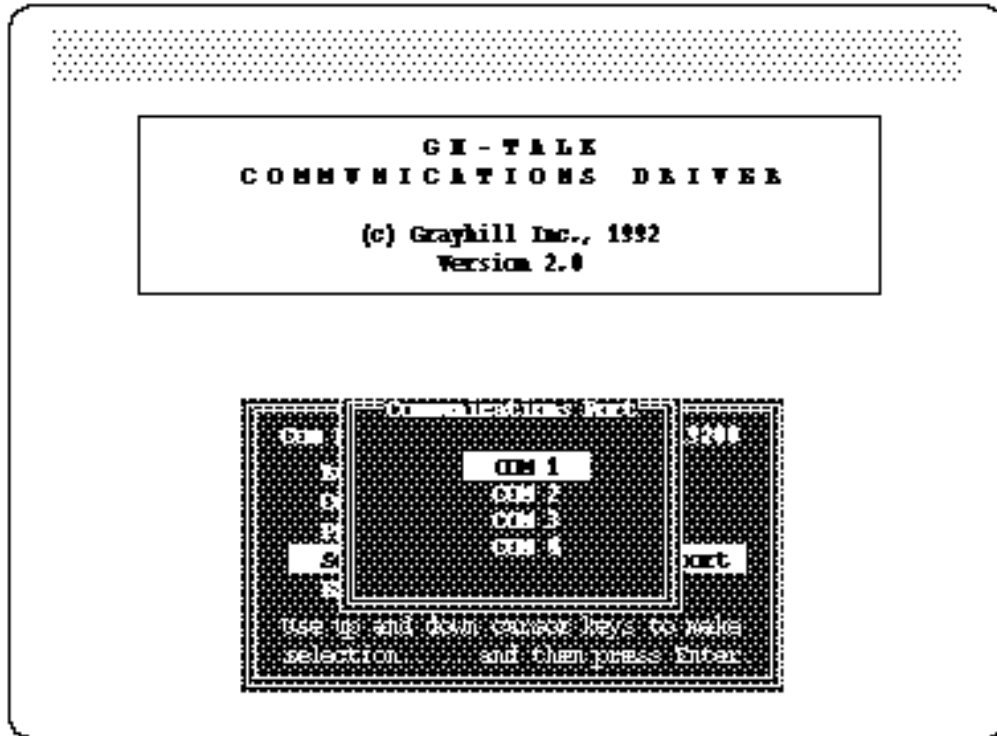


Figure 19

Use the up or down arrow keys to select the appropriate Com Port setting and press **Enter**. This will save the new Com Port setting and cause the [Baud Rate] screen to appear. Use the up or down arrow keys to select the baud rate that matches the MicroDAC controller DIP switch setting, and press **Enter**. If you are unsure of the Baud Rate, press **Enter** to save the Com Port setting and refer to the “ProScan Utility” section for explanation on how to find the board you want to address.

Pressing **ESC** will return you to the [Main Menu] without saving the new values.

## ProScan Utility

ProScan is a utility that allows you to access your network and find, monitor and/or manipulate controller boards on the network.

When you initially select [Run PROSCAN I/O utility] you will see the screen shown in Figure 17. This screen consists of three columns of data and a row listing the function key definitions. The first column displays current system information, help information, and communications status. The second column (currently blank) is used to display I/O information when in the SCAN mode. The third column will display the controller boards found on the network after the FIND function has been executed.

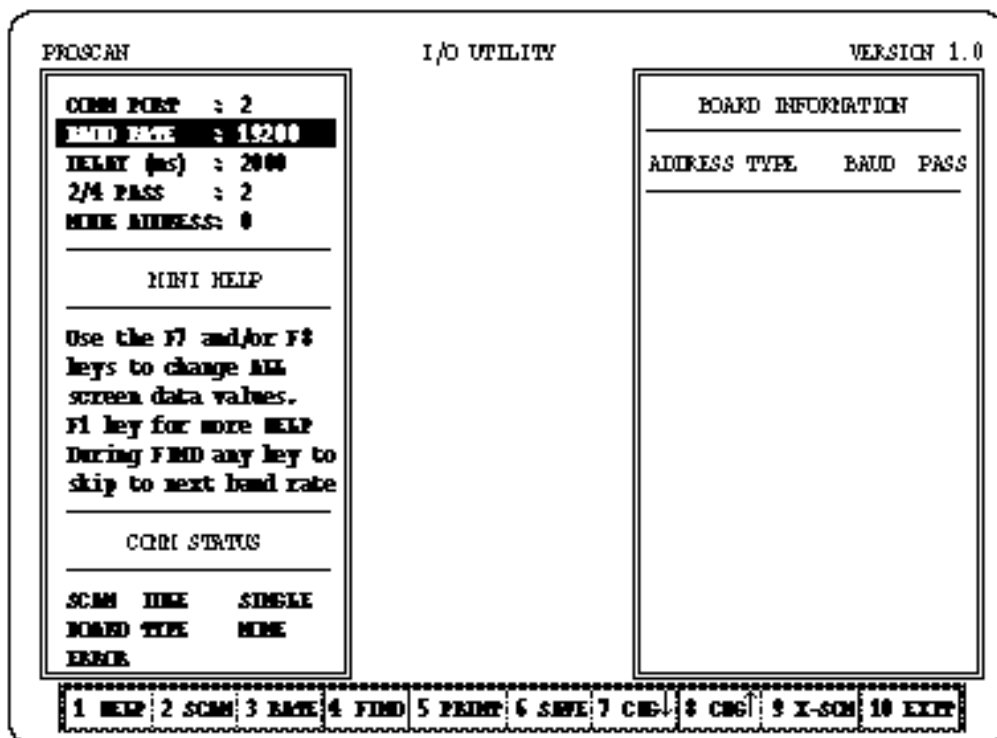


Figure 20

## FIND

The FIND function lets you go out onto the network and search for controller boards that are attached to the network. To initiate FIND you press the F4 function key. ProScan will begin searching the network at 300 baud. You can force the baud rate to increment to the next higher level by pressing the SPACE bar. You will notice that ProScan will increment the "NODE ADDRESS" much quicker at the higher baud rates.

Once FIND has gone through all the baud rates (up to 115,200), ProScan will display any controller boards found on the network. The example in Figure 18 shows two controllers in the network, one at base address 1, and the other at base address 10. If no controller boards were found on the network then either the Com Port selected is incorrect or there is some other hardware problem such as incorrect RS422/485 network wiring, defective serial port, or controller board problems.

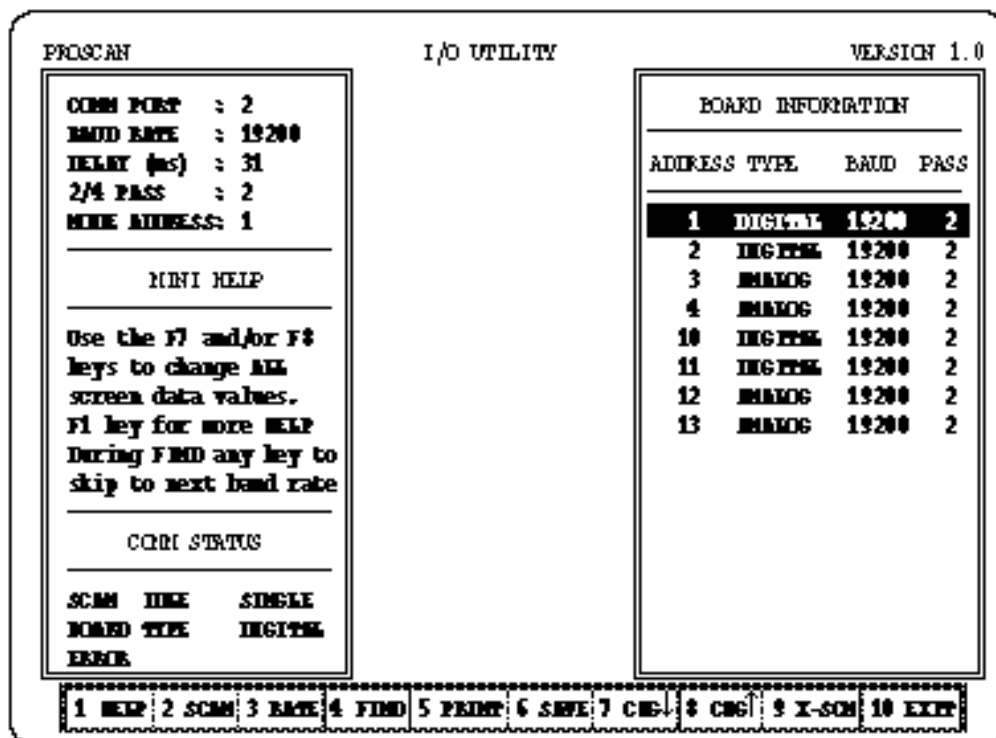


Figure 21

The data shown in the BOARD INFORMATION column gives you information on all the controllers found on the network. This information consists of the node address, the controller board type, the baud rate, and the protocol mode (2 pass or 4 pass). Pressing the right arrow key will move the highlight bar to the first node in the BOARD INFORMATION column. With the up or down arrow keys, you can select the node you want to use or communicate with. After making your selection you can either press ESC and return to the main menu with the baud rate set to communicate with the selected controller, or you can press SCAN ( F2) to monitor or manipulate I/O from within ProScan.

## SCAN

After selecting a controller board from the BOARD INFORMATION column as previously described in the “FIND” section of the manual, you can start the SCAN mode. SCAN lets you configure, monitor, and manipulate each I/O point on the selected controller. You enter the SCAN function by pressing the F2 key. After pressing SCAN the center column will appear as shown in Figure 19.

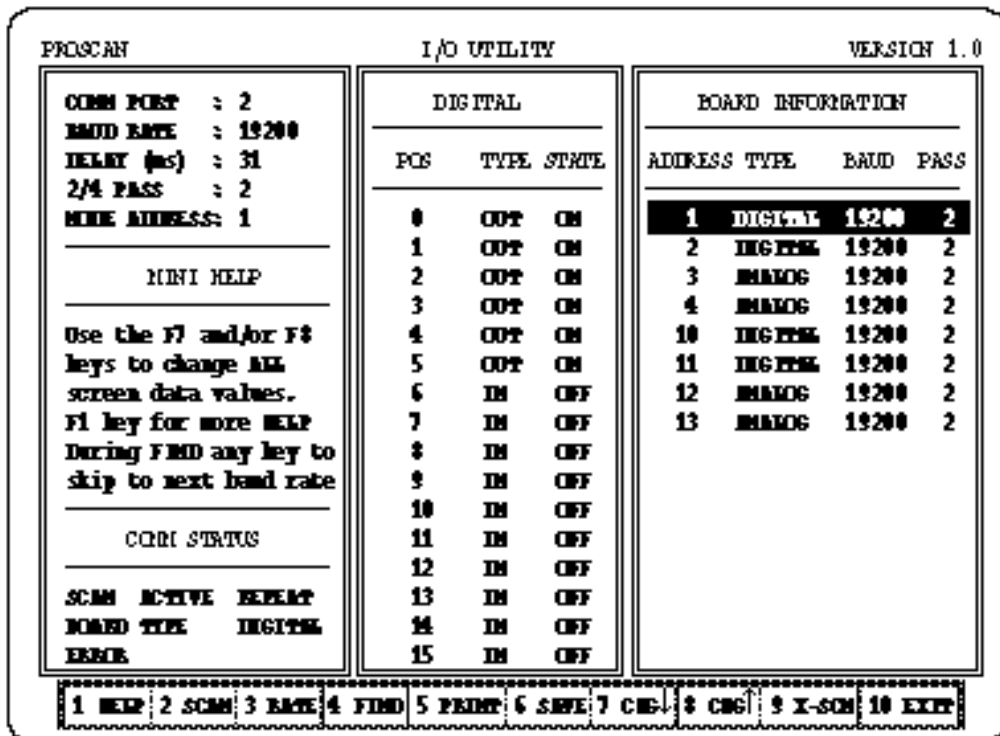


Figure 22

There are two modes to the SCAN function: SINGLE and REPEAT. These modes are selected by alternately pressing the RATE (F3) key. In the SINGLE mode the I/O status is only read once for every time the SCAN key is pressed. In the REPEAT mode the I/O is continuously monitored at the rate listed under DELAY in column one.

Using the left and right arrow keys, you can alternate between the TYPE and STATE columns. When in the TYPE column you can use the F7 or F8 key to change the configuration of the highlighted I/O point (IN = input, OUT = output). The STATE column reflects the status (ON or OFF) of the I/O. When in the STATE column and if the I/O point is of type OUT, then you can toggle the state of the selected I/O point by pressing the F7 or F8 key. If the I/O point is of type IN then the state cannot be altered.

To access another controller board on the network press F9 (X-SCN) and use the up or down arrow keys to select another controller board. In Figure 22 we have selected the analog controller at node address 3 and have started the SCAN function.

*Note:* Do not press F10 (EXIT) to exit the current SCAN and select another board to SCAN. Doing so will take you back to the main menu and require you to run the FIND function again in order to select another controller board.

PROSCAN	I/O UTILITY	VERSION 1.0																																																																																							
COMM PORT : 2 BAUD RATE : 19200 DELAY (ms) : 31 2/4 PASS : 2 HOME ADDRESS: 6 <hr/> MINI HELP <hr/> Use the F7 and/or F8 keys to change ALL screen data values. F1 key for more HELP During FIND any key to skip to next baud rate <hr/> COMM STATUS <hr/> SCAN ACTIVE REPEAT BOARD TYPE ANALOG ERROR	ANALOG <hr/> <table border="1"> <thead> <tr> <th>POS</th> <th>TYPE</th> <th>VALUE</th> </tr> </thead> <tbody> <tr><td>0</td><td>IN</td><td>3085</td></tr> <tr><td>1</td><td>IN</td><td>3085</td></tr> <tr><td>2</td><td>IN</td><td>3085</td></tr> <tr><td>3</td><td>IN</td><td>3085</td></tr> <tr><td>4</td><td>IN</td><td>3085</td></tr> <tr><td>5</td><td>IN</td><td>3085</td></tr> <tr><td>6</td><td>IN</td><td>3085</td></tr> <tr><td>7</td><td>IN</td><td>3085</td></tr> <tr><td>8</td><td>IN</td><td>3085</td></tr> <tr><td>9</td><td>IN</td><td>3085</td></tr> <tr><td>10</td><td>IN</td><td>3085</td></tr> <tr><td>11</td><td>IN</td><td>3085</td></tr> <tr><td>12</td><td>IN</td><td>816</td></tr> <tr><td>13</td><td>IN</td><td>1086</td></tr> <tr><td>14</td><td>IN</td><td>0</td></tr> <tr><td>15</td><td>IN</td><td>0</td></tr> </tbody> </table>	POS	TYPE	VALUE	0	IN	3085	1	IN	3085	2	IN	3085	3	IN	3085	4	IN	3085	5	IN	3085	6	IN	3085	7	IN	3085	8	IN	3085	9	IN	3085	10	IN	3085	11	IN	3085	12	IN	816	13	IN	1086	14	IN	0	15	IN	0	BOARD INFORMATION <hr/> <table border="1"> <thead> <tr> <th>ADDRESS</th> <th>TYPE</th> <th>BAUD</th> <th>PASS</th> </tr> </thead> <tbody> <tr><td>1</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>2</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>3</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>4</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>10</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>11</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>12</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> <tr><td>13</td><td>DIGITAL</td><td>19200</td><td>2</td></tr> </tbody> </table>	ADDRESS	TYPE	BAUD	PASS	1	DIGITAL	19200	2	2	DIGITAL	19200	2	3	DIGITAL	19200	2	4	DIGITAL	19200	2	10	DIGITAL	19200	2	11	DIGITAL	19200	2	12	DIGITAL	19200	2	13	DIGITAL	19200	2
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1 HELP 2 SCAN 3 RATE 4 FIND 5 PRINT 6 SAVE 7 CHG 8 CHG 9 X-SCAN 10 EXIT																																																																																									

Figure 22

When the controller is an analog controller board, ProScan in the SCAN mode will display the center column as shown in Figure 18. All the positions with values of 30856 (out-of-range) either have no modules present or the module is not an analog module. The other positions will show the current raw analog value in a range of from 0 to 4095.

To exit ProScan you can press ESC or F10 to return to the main menu. The baud rate will be set at that of the last controller board you addressed in ProScan.

## Sending Command Strings

To build and send command strings, select [Continue with program] from the main menu and press Enter. The [Command/Response] screen will appear and you will be prompted for the MicroDAC controller address. See Figure 23.

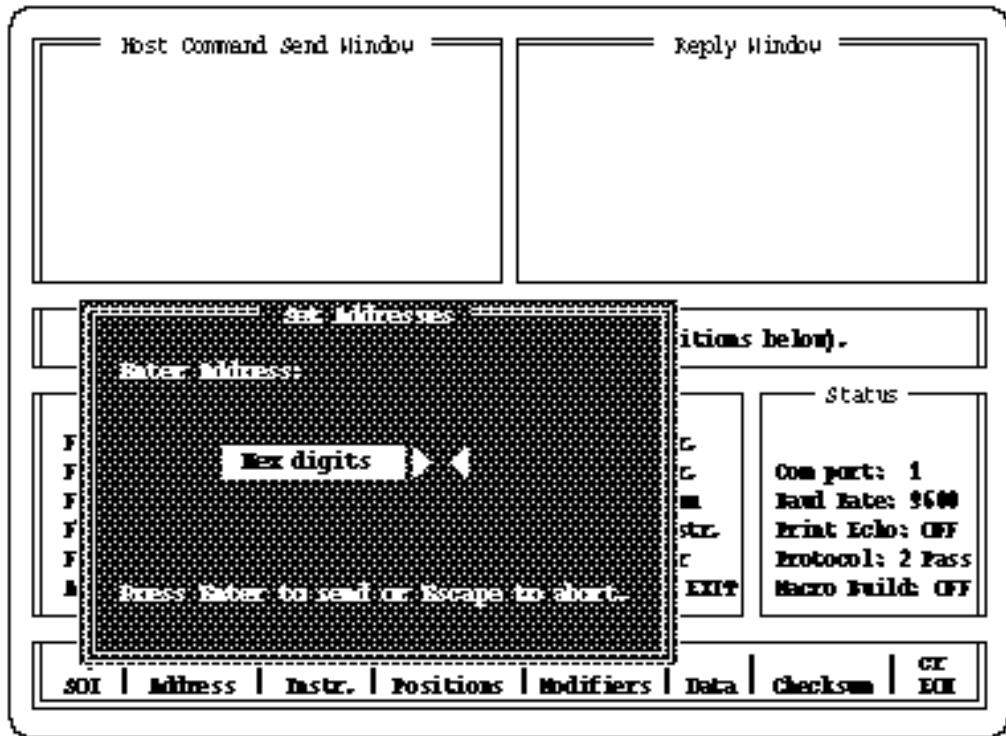


Figure 23

The [Command/Response] screen is used to construct a command, send it to the specified MicroDAC controller, and display its response.

A complete description of the structure of the controller commands is given in the Driver Development Manual (72-UMM-D). The necessary ingredients are displayed across the bottom of the screen. They are the start of instruction character (>), followed by the controller's address, instruction, positions, modifiers, data, checksum and a carriage return. Positions, modifiers, and data are optional. GH-TALK provides a pop-up window to select the instruction. Function keys will calculate and append the appropriate checksum value, convert decimal data to hexadecimal, and send out the command. The F1 key is used throughout to provide help if more details are required.

To continue, you must type in the address of the MicroDAC controller you will be communicating with and then press Enter.

You are now ready to begin communicating with controller. The address window should disappear, revealing your choices as shown below:

Host Command Send Window		Reply Window													
User Prompt															
<b>Please press an active key (see key definitions below).</b>															
Active Keys		Status													
F1: context help	ENTER: start new instr.	Com port: 1													
F3: set addresses	F2: resend last instr.	Baud Rate: 9600													
F5: manual instr. entry	F6: macro control menu	Print Echo: OFF													
F7: show addresses	Alt-F6: send macro instr.	Protocol: 2 Pass													
F9: response help	F8: hex/dec converter	Macro Build: OFF													
Alt-F9: toggle printer echo	F10: set baud rate or EXIT														
Host Command Format															
>	SOI		Address		Instr.		Positions		Modifiers		Data		Checksum		CR
															BDI

Figure 24

You may choose to construct your messages manually or automatically. Pressing F5 starts the manual process. The Manual Command Window will appear in the middle of the screen:

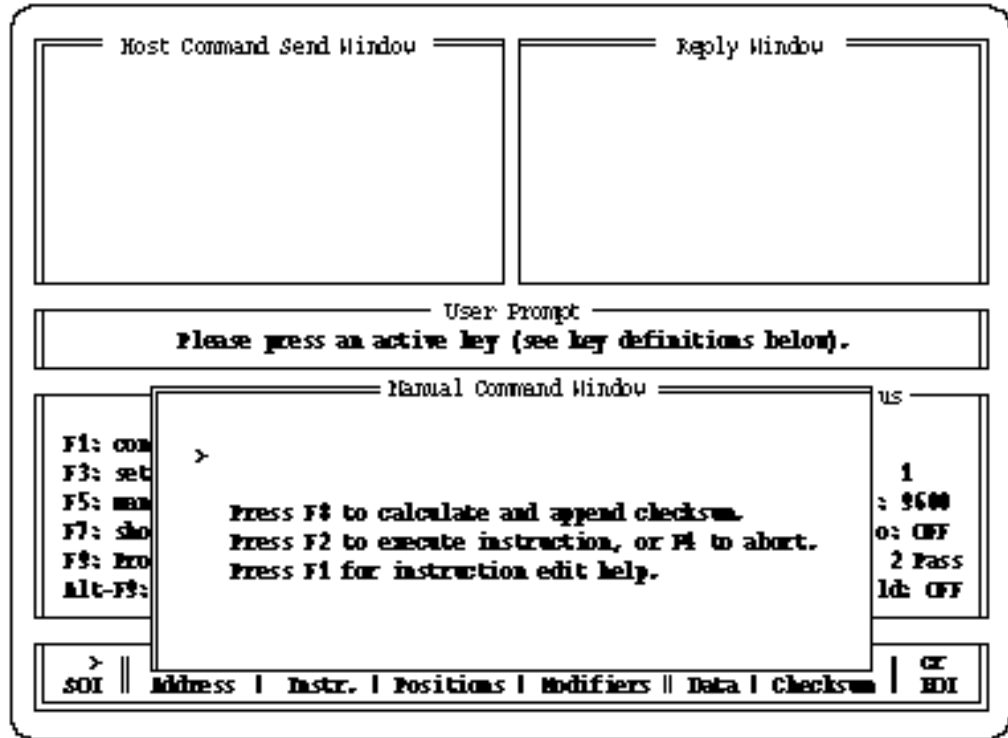


Figure 25

As you enter the command, it will be displayed in the window. When complete, press F8 to calculate and append the checksum value. Then press F2 to send the instruction to the controller. The command sequence will now be displayed in the Host Command Send Window. Directly across from it in the Reply Window will be the corresponding response from the controller. If the response begins with "A", the command was correctly interpreted and carried out. If data was requested from the controller, it too will be displayed. If the response begins with "N", an error occurred in communications or interpretation of the command. The Error Code definitions are shown under "Error Codes" at the end of this manual.

To automatically construct a command, press Enter from the [Command/Response] screen. The Instruction Type window will appear as shown below:

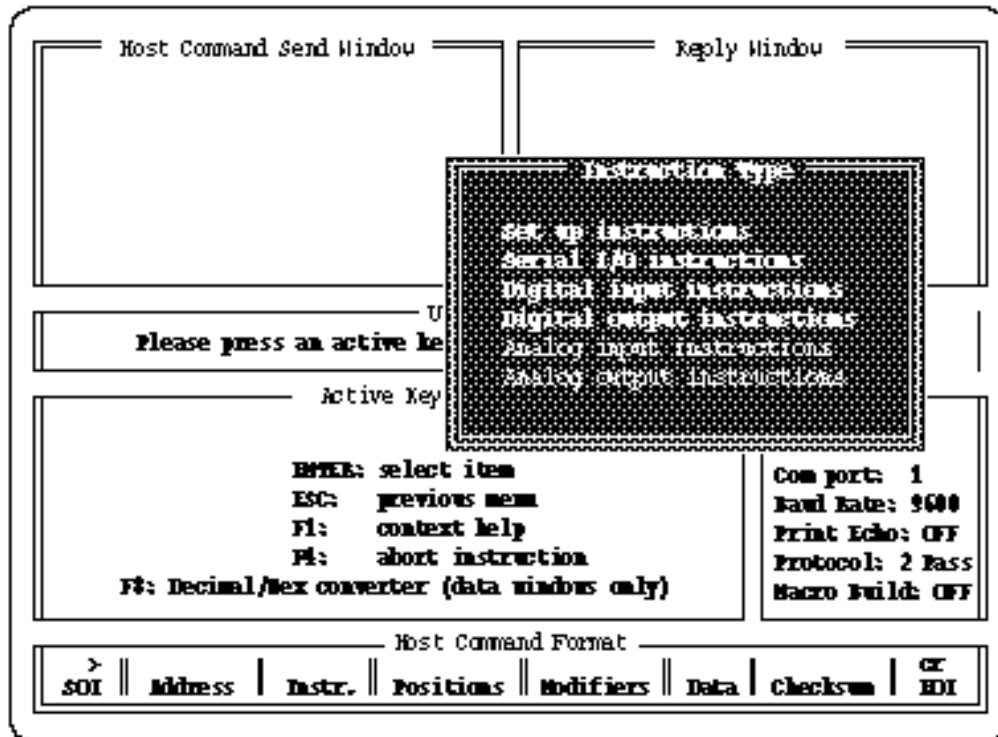


Figure 26

Use the up and down arrow keys to select the type of command you wish to send (Set up, Serial I/O, Digital Input, or Digital Output). Pressing Enter will cause an Instructions window to appear which lists all of the commands for the selected type. Move the highlight bar to the command which you wish to send, and press Enter. Complete the instruction as outlined on the previous page, and send it to the controller.

## GH-Talk Example

GH-TALK is often used to verify that your network is wired and configured correctly. It also serves as a rudimentary demonstration of how controllers work. If you are a first time user, you may want to try the following example to gain confidence that your host and controllers are connected properly. The example shows the steps to follow to turn on an output module in position 0 and read the status of an input module in position 1 using GH-TALK.

The example requires the following:

- 1) Any controller from the MicroDAC family unpacked, powered up, and the DIP switches set for 9600 baud and a base address of 01.
- 2) The host PC wired to controller is in RS-422 configuration and running DOS.
- 3) An output module is in position 0, and a Grayhill input switch test module is in position 1 of the I/O mounting rack as shown below. The switch module only comes in mini or G5 module styles.

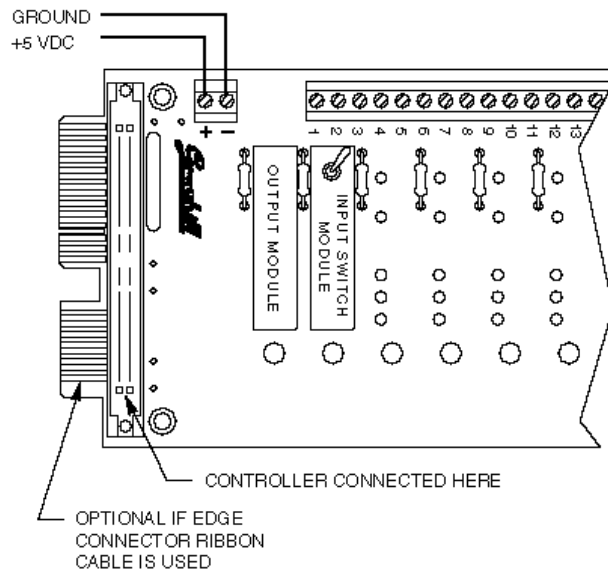


Figure 27

Use the [Baud Rate] screen to select 9600 and the [Communications Port] screen to select the correct port as described earlier. Continue on with the [Command/Response] screen as you did earlier in this chapter and press F5 to get into the Manual Command Window. The screen should appear as shown below:

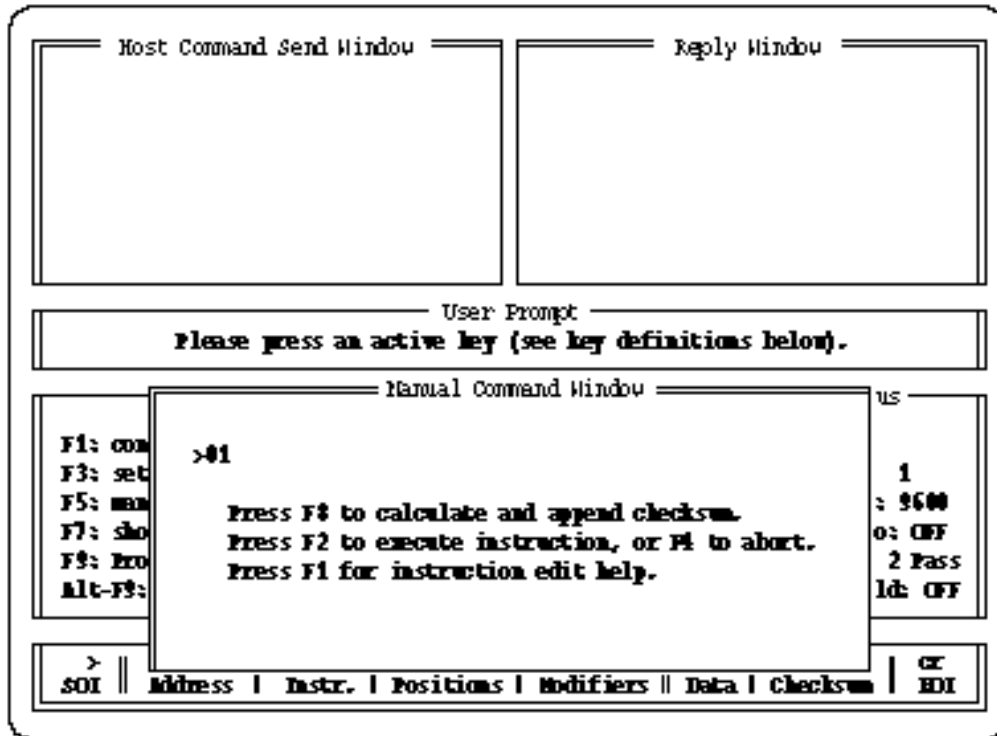


Figure 28

To construct a command you must always begin the command with the board address of the controller to be affected. In this example you will first send the controller a Power Up Clear command; this example assumes the board was just powered up. You do this by first typing "01" (the address) and then an "A" (Power Up Clear command). Next press F8 to calculate the checksum. Now the message will read ">01AA2". Press F2 to send the message. The RCV and XMT LEDs on the controller should flash briefly to indicate that it received and responded to the message. The response message will now be displayed in the Reply Window. If the response is an "A", then your setup is correct. If the response begins with an "N", then an error occurred and you will need to troubleshoot before continuing.

One of the commands for turning on outputs is the Write Digital Outputs command. This command turns on all outputs specified in the command string and turns off all outputs not specified. Inputs are not affected.

Before you can send this command, however, you must first configure position 0 as an output. This is done by executing the “Configure as Outputs” (I) command. To configure position 0, type in the message “01I001” as shown below:

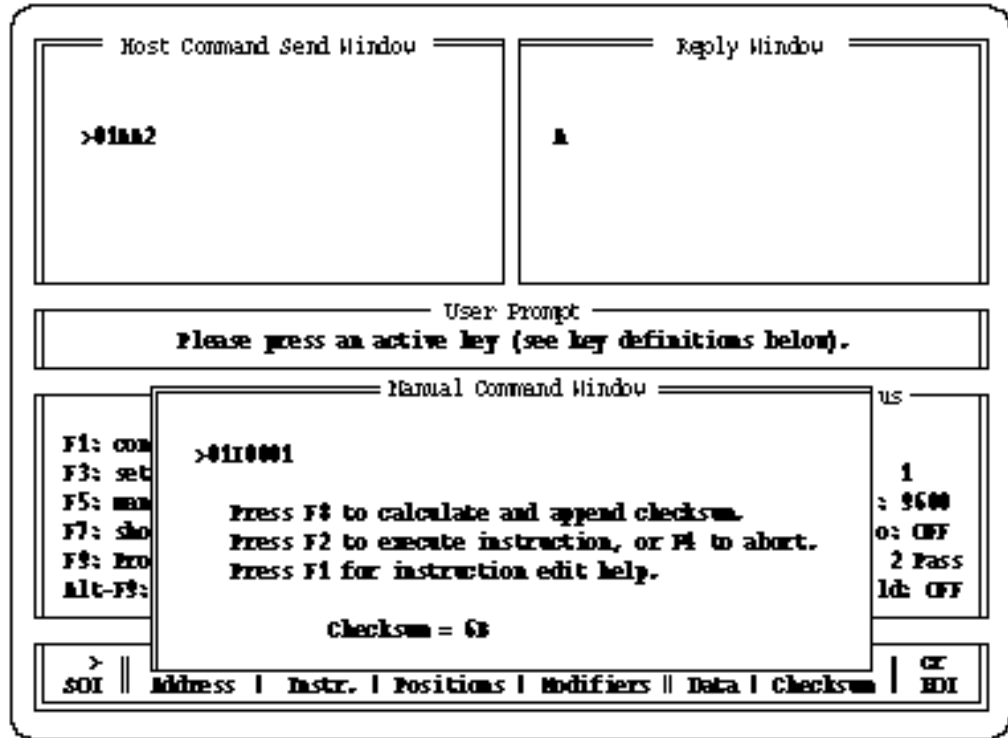


Figure 29

Press F8 for checksum, then F2 to send the message. You will receive an acknowledge “A” reply once again.

The Write Digital Outputs command “J” can now be sent to address 1. To turn on position 0 type “01J0001”, press F8 to append the checksum, and then F2 to send the message. The rack LED corresponding to position 0 will turn on and stay on. Since no other positions were configured as outputs, none of the other positions are affected. A third acknowledgment will appear in the Reply Window.

Next, you can read the status of the input module in position 1. You would use the Read Digital I/O command to do this. This command is signified by the letter “M”. The command string you would type is “01M” as shown below:

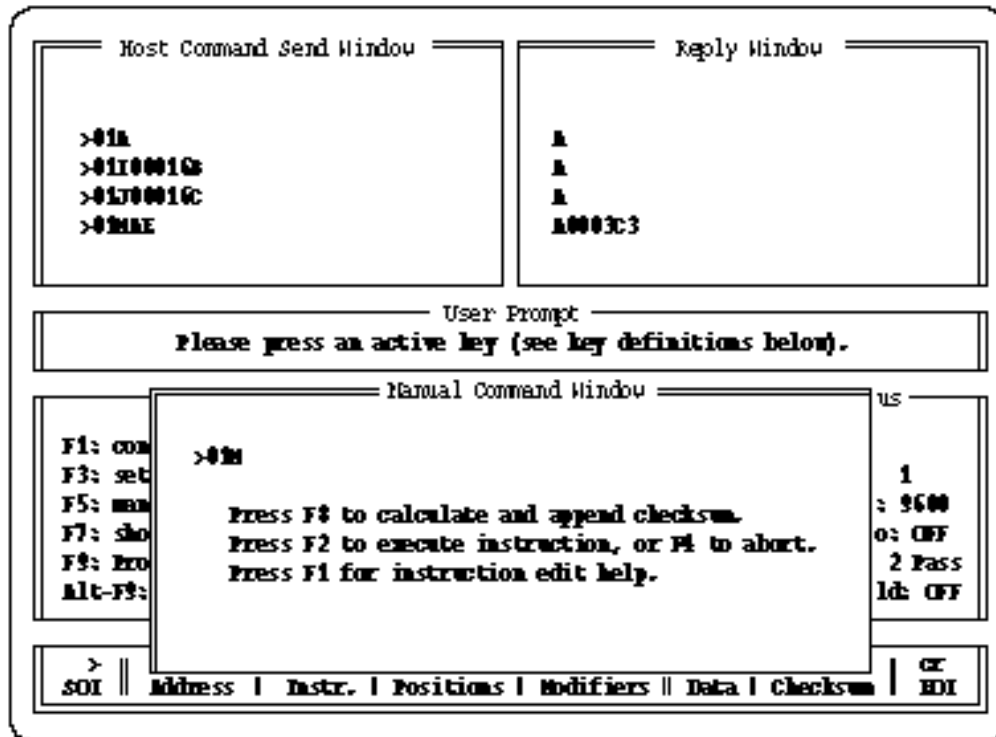


Figure 30

Complete the message by pressing F8 to add the checksum. The message will read “>01MAE”. Now press F2 to send the command and the reply will be:

A0003C3 if the module is on, or

A0001C1 if the module is off.

The “0003” signifies that positions 0 and 1 are on. A “0001” signifies that only position 0 is on. Because of our previous example, position 0 should read as on.

Through practice you will become proficient at the use of this program. It can save valuable programming and troubleshooting time.

## Troubleshooting Hardware Problems

### Status LEDs

On power-up, the MicroDAC controllers perform a self test. While the test is being performed, the LEDs are turned on in sequence from the XMT LED to the ERROR LED. When the self test is complete, the COP LED begins flashing at a 1 Hz rate and the other LEDs are turned off, if the controller is functioning properly. If a problem is found, the LEDs will illuminate in one of four problem codes:

Error	LED Status			Condition	Cure
	COP	RCV	XMT		
Off	F	C	C	Normal Operation	
On	Off	Off	On	Non Maskable Interrupt	X
On	Off	On	Off	Code Execute Out of Bounds or Illegal Integer	Y
On	F	F	F	Diagnostic/Memory Error	X
On	F	C	C	Battery Failure	Z

F = Flashing On/Off

C = Flash On/Off During Communications

X = Hardware Failure or a Read/Write Command was Issued to a Protected Memory Location. Review Software. Toggle Power. If Problem Persists, Contact Grayhill.

Y = ECP Programming Problem. Review ECP for Addresses Outside the System Memory Map or Illegal Integers.

Z = Battery Back up for RAM Memory and Real Time Clock is Low or has Failed. Contact Grayhill for Replacement. (MicroDAC Only)

Common Problems	Possible Remedies
<i>Host sends message and controllers' RCV LED flashes, but the XMT LED never flashes.</i>	<p>The fact that the RCV LED flashed on the controller indicates that data, in some form, made it from the host onto the network. There are several causes for this problem:</p> <ol style="list-style-type: none"> <li>1. Check Address DIP switch to make sure the address matches the address you are trying to communicate to from the host.</li> <li>2. Check Baud Rate DIP switch to make sure the baud rate is set to the same baud rate as the host.</li> <li>3. Check the wiring to make sure the polarity is not reversed on the FHOST lines (the LED will still flash with the polarity reversed)</li> <li>4. Check that you have from 4.75 to 5.25 Vdc at the controllers power termination.</li> <li>5. If the COP LED is ON solid (not flashing), then turn OFF switch #2 on DIP switch SW1.</li> <li>6. Check wiring to ensure that all connections</li> </ol>

are solid. Make sure terminal strip clamp is not clamped down on the wire insulation.

7. Make certain that there is not a significant (greater than 1 V) difference in the ground potentials between controllers and/or host.

Common Problems	Possible Remedies
<i>Host sends an Activate or Write Outputs command to the controller. It responds with and Acknowledge, but the output does not turn on.</i>	<p>As factory default, the controller powers up with all module positions configured as digital inputs. Check for the following conditions:</p> <ol style="list-style-type: none"> <li>1. Check that the modules are configured as outputs. You can do this by exiting your program and using GH-TALK to either read the current configuration or to reconfigure to board. Use GH-TALK to manually activate outputs. If the outputs turn ON, then you need to add code to your program to monitor for an N00 error response. When this response occurs your program must re-initialize the controller.</li> <li>2. Confirm that you are using 5 Vdc logic I/O modules. I/O modules are available in 5, 15, and 24 logic versions. The MicroDAC controller family is only compatible with 5 Vdc logic (70G-OAC5, 70G-IAC5, etc.)</li> <li>3. Check that you are using the correct rack with the controller. Grayhill has three styles of 32 point racks: 70MRCQ32-XX, 70GRCQ32-XX and 70GRCM32-XX. <b>Only the 70GRCM32-HL is compatible.</b></li> <li>4. Check that the ribbon cable from the MicroDAC to the rack is fully seated to both devices, or that the LT controller is fully seated and centered onto the header connectors of the I/O rack.</li> <li>5. Check the I/O scan rate settings. The controllers have configurable scan rates for both the digital and analog I/O. One of the choices is turning the scan OFF. If the scan is OFF the I/O module will not be updated. Use the EC.EXE program included with the 72-UMM-IL and 72-UMM-E diskettes to check and reconfigure the scan rates.</li> </ol>
Common Problems	Possible Remedies

*The output LED is ON, but the load is not.*

The LEDs on the racks (in the case of the 70 and 70M series) and the LEDs on the 70G output modules only indicate that the logic has been activated. If the load is not activating then:

1. *Check the fuse on the rack or the module. If open, replace.*
2. *Check that the load is meeting the minimum load requirement as noted in the #7 Catalog.*
3. *Check that the voltage is present at the module terminals (the outputs DO NOT generate a voltage, only switch a voltage present at the terminal blocks.*
4. *Replace the module.*

*Excessive checksum errors (N02 or -3 if using ProWare) are received during communications.*

Some environments are extremely noisy. Precautions must be taken to make sure the network is properly wired and terminated. Some environments are so noisy that the only solution is to lower the baud rate used on the system.

1. *Make sure you are using individually shielded twisted pair cable with an overall shield. The twist should be at least 1/2 twists per inch.*
2. *The shield should be grounded at one end only to prevent potential ground loops.*
3. *Check that the terminations on DIP switch SW3 are properly set for your network type and board location (ie: last board). (See **Serial Communications Wiring** section for correct settings).*
4. *Make certain that there is not a significant (greater than 1 V) difference in the ground potentials between controllers and/or host.*

## Error Codes

Controller Responses	Error Description
N00	<b>Power Up Clear Command Expected.</b> The first command after powering MicroDAC controller should be the Power Up Clear command. If another command is sent first, or for some reason, the controller processor has reset, this error is returned. <b>If this error message is returned, it implies that controller has reset all of its configuration information to their default values. It will be necessary to reconfigure the MicroDAC controller.</b>
N01	<b>Undefined Command.</b> The command received does not correspond to a valid controller command.
N02	<b>Checksum Error.</b> The checksum calculated for the command by the controller does not match the transmitted value.
N03	<b>Receive Buffer Overflow.</b> The command received contained more than 16 characters.
N04	<b>Non-Printable ASCII Character Received.</b> Only values from 21 Hex to 7F Hex are valid command characters.
N05	<b>Insufficient Data.</b> Not enough data characters were included for the command as received by the controller. Perhaps POSN or INFO data was overlooked.
N06	<b>Communications Watchdog Timeout.</b> The watchdog timer on MicroDAC controller timed out (no commands were received within the prescribed timeout period). If the timeout needs to be modified, use the Set Watchdog Delay command. <b>If this error code is received, the outputs have been forced to their fault conditions or an ECP has been initiated.</b>
N07	<b>Invalid Data.</b> The data field(s) received by controller contained values which were too large for the specified command.
N??	<b>Response Checksum Error</b> —The checksum calculated for message by GH-TALK does not match the checksum value returned by the controller.
N??	<b>Turn Around Delay Timeout</b> —The controller did not respond to the command. Check communications wiring, power supply connections, and DIP switch settings.

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## Accessories

The following section lists MicroDAC controller accessories available from Grayhill. Complete specifications for these devices can be found in the Grayhill Catalog #7.

### RS-232 to RS-422/485 Converters

Grayhill offers two series of serial communications converters which convert bi-directionally between RS-232 and RS-422 or RS-485.

The first series is the 72-CNV-1, 72-CNV-2, and 72-CNV-3. This series of converters plug into any male RS-232 DB25 connector (or with a DB9 connector if a DB25 to DB9 converter is used). The 72-CNV-1 and 72-CNV-3 are non-isolated converters that can convert RS-232 to RS-422 or RS-485 and can handle baud rates of up to 115.2 KBaud. The 72-CNV-1 requires an external +8 to +15 Vdc power supply whereas the 72-CNV-3 requires a regulated external +5 Vdc power supply. The 72-CNV-2 is an optically isolated converter that converts RS-232 to RS-422 **only** and can handle baud rates of up to 19.2 KBaud. The 72-CNV-2 requires an unregulated +8 to +15 Vdc power supply for the RS-422 side and, in some cases, may require a 5 to 10 Vac power supply for the RS-232 side. All three converters are factory preset for DTE operation, but can be reconfigured (via internal jumper) for DCE operation.

The second series of converters are the 72-CNV-10, 72-CNV-11, and 72-CNV-12. These converters require no external supply; they can be powered directly by 120 or 240 Vac (jumper selectable) . All three converters are optically isolated between the RS-232 and the RS-422/485 lines, have transient protection on the RS-422/485 lines, and have status LEDs for TX, RX, CTS, RTS, and power. They also can operate up to baud rates of 115.2K.

The difference in the three converters is mounting configuration. The 72-CNV-10 is a DIN 41494 card cage mount, the 72-CNV-11 has standoffs for panel mounting, and the 72-CNV-12 has a DIN rail carrier mount.

### Cable Assemblies

Grayhill supplies several standard cable assembly lengths to interconnect MicroDAC controller and I/O racks. Cable part numbers beginning with 72-CHH have 50 pin header connectors at each end to do this.

### Switch Input Simulation Modules

Part numbers 70M-ISW1 and 70G-ISW1 have toggle switches built-in to simulate a digital input event. These modules are used during software debugging and system installation. 70M-ISW1 modules plug into standard or mini I/O racks; 70G-ISW1 modules plug into G5 I/O racks.