

## OVERVIEW

Welcome to Grayhill's family of controllers and I/O systems. Regardless of your application, we likely have the ideal solution for you. All of our systems are designed to meet the worldwide demand for flexible, reliable, entry-level PC based industrial controls and data acquisition. Since today's world of PC based control is changing and evolving at a fast pace, our products are intended to be completely open and adhere to the emerging open standards.

In practice, there are numerous ways of deploying a PC based control and/or data acquisition system—Stand Alone Control, Local Control and I/O, Centralized Processing with Remote I/O, Distributed Processing with Remote I/O, Supervisory Control and Data Acquisition (SCADA) and Remote Terminal Units (RTUs). To determine which approach is best for your application, several factors must be considered:

1. The rate at which information needs to be gathered.
2. Where the information needs to be disseminated.
3. The allowable system response time.
4. How wide an area the I/O are spread over.
5. The total cost of implementing the project.

## Control and Data Acquisition Architectures

There are two distinct yet related control systems: OpenLine® and OpenDAC®. An OpenLine® system is comprised of a controller, I/O base(s), I/O modules, and (optionally) a power supply. The OpenLine® controller is an embedded, industrialized PC capable of executing complex algorithms at high speeds. OpenLine® I/O bases are the interface between the controllers and the I/O modules. The bases scan the I/O at very fast intervals and pass I/O information with the controller through dual-port memory at extremely high speeds. For applications that require redundancy, the bus permits two controllers to monitor the I/O status.

OpenDAC® systems include a network interface, I/O rack(s), the same I/O modules used in OpenLine® systems, and (optionally) a power supply. The network interface provides access to the I/O modules using the popular industrial networking protocols. The access to the I/O is direct. The I/O rack does not perform any module scanning (different from the OpenLine® I/O base). The network interfaces are not capable of executing programs or algorithms locally.

The OpenLT™ product is an exception to the two systems listed above. The OpenLT™ uses OpenDAC® I/O racks but has the capability of running local programs. The OpenLT™ provides a migration path for MicroDAC and MicroDAC LT users that wish to update their systems and use existing local programs and the communication interface.

## HOW TO USE THIS SECTION

On each of the product pages in this Section, you will see the following list of applications. The highlighted category(s) (in color as below) indicate the type of applications that the product(s) on that page are appropriate.

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

## DEFINITION OF TERMS

**Module:** a single potted I/O device which contains one or two channels [to four channels] of a specific type of I/O.

**Position:** the location in a I/O rack or I/O base system in which a module can reside.

**Channel:** a single interface termination to the potted electronics within an I/O module. Each Module has one [two] or two [four] channels depending on module type and will consume one or two positions.

**I/O Point:** input/output point. Equivalent to a single channel on an I/O module.

**I/O Rack:** provide field wiring terminals for I/O.

**I/O Base:** provide field wiring terminals, processor scan engine and dual port memory for OpenLine I/O.

**Field Connection:** the side of the I/O isolation barrier that connects between the I/O rack or base and the field devices.

**Logic Connection:** the side of the I/O isolation barrier that connects between the I/O module to the network interface, controller, or I/O base brain board.

**I/O System:** system using I/O modules with a Network Interface that does not have local control (Embedded Control Programs or ECP's).

**Network Interface:** a unit that has a minimum of a network interface and an I/O interface but cannot run a local control program or ECP.

**Controller:** a unit that has a minimum of a network interface, an I/O interface, and can run a local control program or ECP. The unit may have other features such as an auxiliary serial port, real time clock, expansion bus, or expansion memory.

**Control System:** system using I/O modules with a Controller that can have local control and processing of events (ECP's).

**System 50:** Grayhill's 50-pin connector family of I/O racks, controllers and network interfaces.

**OpenLine:** Grayhill's modular control system comprised of controllers, I/O bases, I/O modules and power supplies. The system supports ethernet and modbus protocols.

**OpenDAC:** Grayhill's modular I/O system comprised of network interfaces, I/O racks and I/O modules. The system supports ethernet, modbus, optomux and profibus protocols.

## CONTROL SYSTEMS TABLE

	OpenLine® Control System	OpenDAC® I/O System	I/O System 50
<b>Applications</b>	Distributed control and data acquisition-high speed	Low-cost remote I/O	Distributed control and data acquisition and remote control
<b>Network Interfaces &amp; Controllers (Controllers have embedded control capability)</b>	OpenLine® Ethernet 586 OpenLine® Serial Modbus 586	OpenDAC® for Ethernet OpenDAC® for Modbus OpenDAC® for Profibus OpenLT™ (Optomux)	MicroDAC (Optomux) MicroDAC LT (Optomux) ProMux (Optomux)
<b>I/O Module Families</b>	OpenLine® analog and digital	OpenLine® analog and digital	OpenLine® digital only G5-analog and digital Mini-digital only Standard-digital only
<b>Maximum I/O per Network Interface or Controller</b>	128 (can be expanded)	32	MicroDAC (LT) = 32 ProMux = 24
<b>Compatible with I/O mounting Racks and Bases</b>	OpenLine® I/O bases	OpenDAC® I/O racks	OpenLine® green I/O racks G5 I/O racks Mini I/O racks Standard I/O racks
<b>Available I/O Rack or Base Sizes</b>	16 (stackable)	16 (stackable)	4, 8, 16, 24 or 32

## STAND ALONE I/O SYSTEMS

“Stand alone” or “embedded control” is typically used in machine control applications where all of the I/O points are physically located within 50 feet of the controller. The control program is downloaded to the controller and run locally. An operator interface panel can be connected to the controller to display the machine status and allow the user to change machine settings or parameters. In stand alone applications with less than 32 I/O, OpenLT™ or MicroDAC controllers can be programmed in C to do the job. For I/O counts up to 128, the OpenLine® controllers can be programmed in C, Flow Chart, Ladder Logic, Sequential Function Chart, or Function Block Diagrams. With expansion cards, the I/O counts may be increased.

## LOCAL I/O SYSTEMS

If your application requires high speed (microsecond) processing of I/O information by a PC, our PAMUX™ or PC5 system is the best choice. Typical applications where these systems are being used today include high speed dispensing, filling, printing and palletizing. Using the PAMUX™ system, up to 512 analog or digital I/O can be ribbon cabled back to a PC controller card. The PC5 card plugs directly into the PC and ribbon cables to a rack of 8, 16, or 24 digital I/O.

## REMOTE I/O SYSTEMS

The most popular approach to collecting I/O information from sensors and actuators spread over a wide area is to run a serial bus from the PC to remote locations. The PC is then used to process the I/O data, make the control decisions, and display graphical information to the user. Material handling, power management, modular machinery, alarm monitoring, and batch control are common applications which utilize our controllers in remote I/O applications. Depending upon the number of I/O to be scanned, this approach normally yields response times between 5 and 500 milliseconds. We support many “open” serial buses for remote I/O:

- Ethernet (Q4 2000)
- Modbus ASCII and Modbus RTU
- Optomux™
- Profibus DP™

The connection between the PC and multiple remote nodes is made by running the appropriate serial cable or, in the case of Modbus and Optomux, a wireless link using our EZCom® Spread Spectrum Radio. By adhering to open standards, third party hardware and software can be easily integrated with our controllers.

Modbus RTU, Modbus ASCII and Optomux™ devices are connected over twisted pair RS422/485 cables at distances up to 4,000 feet (1,250 meters) at speeds up to 115.2 KB. Up to 4,096 I/O points can be monitored or controlled over an Optomux or Modbus network using MicroDAC, ProMux®, OpenDAC® for Modbus, or OpenLT™ controllers.

Our Microlon® controller combines the power of LonWorks™ technology with our analog and digital I/O modules. Communications occur using a high speed (78 KB or 1.25 MB) peer-to-peer network and the LonTalk protocol. Up to 32,385 Microlons or other LonTalk compatible products can be networked together.

Profibus DP has the fastest transmission data rate of the remote buses, running at speeds up to 12 MB. Each OpenDAC® for Profibus controller interfaces 32 analog or digital I/O points to the network.

## DISTRIBUTED I/O SYSTEMS

A distributed control architecture is used to overcome some of the shortcomings of centralized processing scheme. Using distributed processing, each controller actually executes a portion of the overall control strategy. This improves response times (typically 1 to 10 milliseconds) and provides more options should the system need to be modified or experience a malfunction. Using centralized processing, the entire system shuts down if the PC fails. With distributed processing, portions or all of the system can continue to function even though the host PC fails. Likewise, a broken network cable in a centralized processing system results in all of the outputs downstream of the break freezing in a predetermined state. In a distributed processing scheme, the I/O control could continue or a safe shut down program could be initiated. Distributed control is common on assembly lines, batch processing, end of line testing, and food processing.

We currently support distributed processing with our OpenLine® family of controllers. Either Ethernet or Modbus can be used to network these controllers to one another and PCs. If you prefer Optomux™, our MicroDAC and OpenLT™ controllers can also be programmed to execute local programs.

## SCADA SYSTEMS

Supervisory Control and Data Acquisition (SCADA) systems are very similar to the distributed processing—remote I/O scheme, except that the host PC or “supervisor” does not actively participate in executing the local control strategy. Instead, the supervisor monitors the results of the individual stand alone “islands of automation” and takes them off line when problems arise. While monitoring the system for problems, the supervisor is actively monitoring and logging data from the remote controllers. SCADA systems are typically deployed in applications where the I/O are spread over a large geography such as fresh water supply, waste water treatment, distribution of electricity, natural gas distribution and flood control applications. The OpenLine® controllers are ideal for SCADA applications. Leased or dedicated phone lines connect the controller to the “supervisor”. EZCom® radios are commonly used in SCADA systems to eliminate the difficulties of hard wiring the remote controllers.

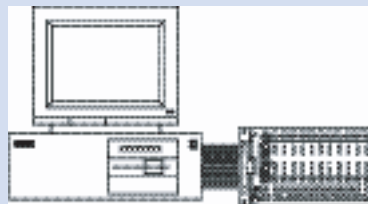
## RTU SYSTEMS

A Remote Terminal Unit (RTU) periodically scans and stores information about the process it is monitoring. The RTU data is typically accessed using phone lines by the host control system. The RTU is a self contained control system that usually includes battery backup and redundant controllers. RTUs can be located in hard to get to remote locations which are powered by solar panels and use RF to transfer information. Because of the redundancy built into the OpenLine® system, it's low power consumption and wide operating temperature range, the OpenLine® family is ideal for many RTU applications.

### Stand Alone Control



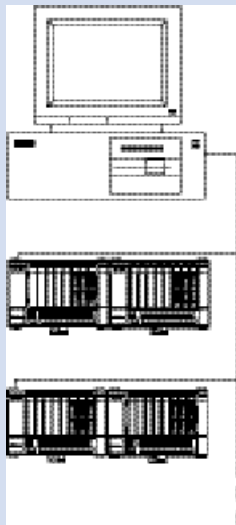
### Local Control & I/O



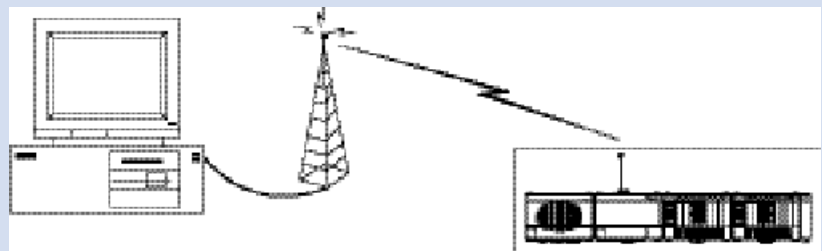
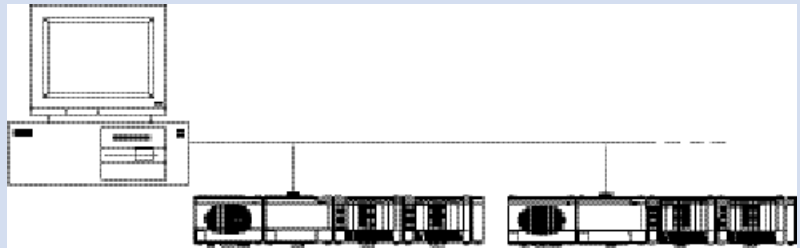
REMOTE I/O SYSTEMS				
System	Protocol	I/O Points	Compatible I/O	Network Type
OpenDAC® Ethernet	Modbus TCP running on Ethernet TCP/IP	32	OpenLine® Digital and Analog	10/100 Mbps 10Base-T/100Base TX
OpenDAC® Profibus	Profibus DP	32	OpenLine® Digital and Analog	12 Mbps/RS-422/485
OpenDAC® Modbus	Modbus RTU or ASCII	32	OpenLine® Digital and Analog	56.6 kbps/RS-422/485
OpenLT™	Optomux	32	OpenLine® Digital and Analog	115 kbps/RS-422/485
MicroDAC LT	Optomux	32	All Digital Families, G5 Analog	115 kbps/RS-422/485
Promux	Optomux	32	All Digital Families	38.4 kbps/RS-422/485

DISTRIBUTED I/O SYSTEMS					
System	Protocol	I/O Points	Programming Method	Features	Network Type
OpenLine® Ethernet	Modbus TCP running on Ethernet TCP/IP	128	C or ISaGRAF IEC61131-3	PC104, RS-232, RTC, Flash Drive Redundancy	10/100 Mbps 10Base T/100Base TX
OpenLine® Serial	Modbus RTU or ASCII	128	C or ISaGRAF IEC61131-3	PC104, RS-232, RTC, Flash Drive Redundancy	56.6 kbps/RS-422/485
MicroDAC	Optomux +	32	C	SBX, RS-232, RTC, BB SRAM	56.6 kbps/RS-422/485
MicroDAC LT	Optomux +	32	C	Lower Cost	115 kbps/RS-422/485
OpenLT™	Optomux +	32	C	Lowest Cost	115 kbps/RS-422/485

Remote I/O



Distributed I/O






**PROPER I/O RACK AND CONTROLLER BOARD COMBINATIONS**

	Standard Racks			Mini Racks				G5 Racks					OpenLine/OpenDAC® Racks				
	70RCK8-HL	70RCK16-HL	70RCK24-HL	70MRCK8-HL	70MRCK16-HL	70MRCK24-HL	70MRCQ24-HL	70GRCK8-HL	70GRCK16-HL	70GRCK24-HL	70GRCK32-HL	70GRCP32-HL	70LRCK8-HL	70LRCK16-HL	70LRCK24-HL	70LRCK16-48	7SLIOB16
72-PC5-24D	d	d	d	d	d	d	d	d	d	d			d	d	d		
72-PMX-24D	d	d	d	d	d	d	d	d	d	d			d	d	d		
72-PMX-32D or 32AD												x					
72-PMO-1	d	d	d	d	d	d	d	d	d	d			d	d	d		
72-PMO-3	d	d	d	d	d	d	d	d	d	d			d	d	d		
72-MDC-32AD	d	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-MDC-32ADC	d	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-MDL-32AD	dx	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-MDL-32ADC	dx	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-MDLE-32AD	dx	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-MDLE-32ADC	dx	dx	dx	dx	dx	x	x	x	x	x	x		d	d	d		
72-ETH-T000																x	
72-OPT-4000																x	
72-PRO-4000																x	
72-MOD-4000																x	
72-MOD-L500-8																	x
72-MOD-L500-16																	x
72-ETH-L500-8																	x
72-ETH-L500-16																	x

“x” denotes proper controller board and I/O rack combinations, using both analog and digital modules.

“d” denotes proper controller board and I/O rack combinations, digital I/O only.

 OPENDAC®
 OPENLINE®
 SYSTEM 50