G4LC32ISA-LT USER'S GUIDE

Form 735-990421 — April, 1999

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Opto 22 warrants all of its products to be free from defects in material or workmanship for 30 months from the manufacturing date code. This warranty is limited to the original cost of the unit only and does not cover installation, labor, or any other contingent costs. Opto 22 I/O modules and solid-state relays with date codes of 1/96 or later are guaranteed for life. This lifetime warranty excludes reed relay, SNAP serial communication modules, SNAP PID modules, and modules that contain mechanical contacts or switches. Opto 22 does not warrant any product, components, or parts not manufactured by Opto 22; for these items, the warranty from the original manufacturer applies. These products include, but are not limited to, the OptoTerminal-G70, OptoTerminal-G75, and Sony Ericsson GT-48; see the product data sheet for specific warranty information. Refer to Opto 22 form number 1042 for complete warranty information.

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WELCOME

ABOUT THE G4LC32ISA-LT

Thank you for purchasing a G4LC32ISA-LT. The G4LC32ISA-LT is a low-cost, general purpose controller that mounts in an ISA backplane. This flexible microprocessor handles all of the logic required for your application, using only power from the PC. Compatible with Opto 22's graphical control languages (OptoControl and Cyrano) and man-machine interfaces (OptoDisplay and MMI), the G4LC32ISA-LT can be programmed to suit many types of industrial control applications. In addition, the G4LC32ISA-LT has two serial ports, configurable as either RS-232 or RS-485, which may be used to communicate to other serial devices or to I/O units (up to 4,096 points per port.)

ABOUT THIS MANUAL

This reference manual provides complete specifications and instructions to set up and install a G4LC32ISA-LT controller.

In this manual you'll find:

- **Chapter 1: Introduction** — General information about the G4LC32ISA-LT, its possible applications, basic architecture, and hardware diagrams.
- **Chapter 2: Quick Start** — A brief explanation of how to quickly get the G4LC32ISA-LT up and running.
- **Chapter 3: Installation and Setup** — Descriptions of jumper settings, communication connections, and installation procedures.
- **Chapter 4: Software and Firmware** — General software and firmware overviews and communication procedures.
- **Appendix A: Troubleshooting** — Tips for resolving problems you may encounter.
- **Appendix B: Cable and Connector Specifications** — A list of recommended communication cables and connectors.
- **Appendix C: Product Specifications** — A list of specifications for the G4LC32ISA-LT.
- **Appendix D: Address Jumpers** — Jumper settings for all addresses.
- **Appendix E: Product Support** — Details on how to reach Opto 22 Product Support.

DOCUMENT CONVENTIONS

- **Bold** typeface indicates text to be typed. Unless otherwise noted, such text may be entered in upper or lower case. (Example: "At the DOS prompt, type **cd \windows**.")
- *Italic* typeface indicates emphasis and is used for book titles. (Example: "See the *OptoControl User's Guide* for details.")
- File names appear in all capital letters. (Example: "Open the file TEST1.TXT.")
- Key names appear in small capital letters. (Example: "Press SHIFT.")
- Key press combinations are indicated by plus signs between two or more key names. For example, SHIFT+F1 is the result of holding down the SHIFT key, then pressing and releasing the F1 key. Similarly, CTRL+ALT+DELETE is the result of pressing and holding the CTRL and ALT keys, then pressing and releasing the DELETE key.
- "Press" (or "click") means press and release when used in reference to a mouse button.
- Menu commands are sometimes referred to with the Menu➡Command convention. For example, "Select File➡Run" means to select the Run command from the File menu.
- Numbered lists indicate procedures to be followed sequentially. Bulleted lists (such as this one) provide general information.

CHAPTER 1

INTRODUCTION

OVERVIEW

The G4LC32ISA-LT processor is a low-cost, general purpose, industrial microcomputer that's mounted on a standard IBM PC ISA bus card. Its low cost, size, and flexibility make it ideal for original equipment manufacturers, machine control, test stations, laboratory automation, and various data concentrator and collector applications. The result is an innovative hardware/software solution that includes intelligent I/O and OptoControl — an advanced software control language. This tightly-integrated package allows you to quickly and easily implement your industrial control applications.

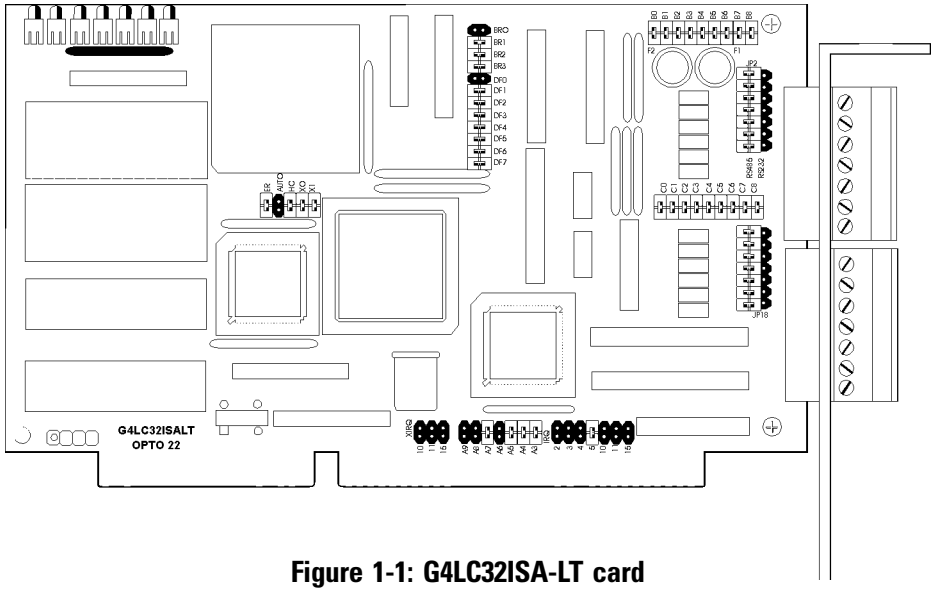


Figure 1-1: G4LC32ISA-LT card

The G4LC32ISA-LT shrinks the "Two Box" Computer Integrated Manufacturing (CIM) control architecture into a "One Box" package. While still maintaining the performance of a two-tier processor architecture, the industrial PC, in conjunction with the G4LC32ISA-LT, can operate a complete system of highly intelligent I/O modules in real-time, while simultaneously providing CIM functions such as operator interfacing, maintenance diagnostics, SPC, SQC, CFM, logistical tracking, data entry, historical logging, trending, and host interfacing. Compatible with Opto 22's real-time control languages (OptoControl and Cyrano), and man-machine interfaces (OptoDisplay and Mistic MMI), the G4LC32ISA-LT can be programmed to suit many types of industrial control applications.

The G4LC32ISA-LT is operated as a slave co-processor and may be mounted in either an active or passive ISA backplane. Multiple slave-configured G4LC32ISA-LT processors, each with their own I/O, may be installed in a single PC. As a slave, the only resource the G4LC32ISA-LT needs from the ISA bus to run is power. Thus, you may reset the PC, and the G4LC32ISA-LT will continue to operate.

The G4LC32ISA-LT comes standard with 256 KB of battery-backed RAM and 256 KB of flash memory. The RAM can be used to store a user's control program and data. The flash memory stores a downloadable operating system (kernel) and can also be used to store a user's control program permanently. The use of flash technology allows a user to remotely download new kernels offered by Opto 22. This avoids the need to go to the actual G4LC32ISA-LT location to download a new kernel that offers features required for a given application.

Two serial ports are on the G4LC32ISA-LT and each may be configured for RS-232 or RS-485/422 communication. The RS-485/422 port may be used for I/O expansion using Opto 22 I/O units. The RS-232 port may be used to connect to other serial devices, such as barcode readers or modems.

I/O Units

The G4LC32ISA-LT processor not only handles all the logic necessary to run your application programs, but it also communicates with I/O units remote. I/O units are connected to the G4LC32ISA-LT through its RS-485/422 serial link. You can serially connect up to 32 (256 with repeaters) I/O units over a span of 3,000 feet (further distances with repeaters).

The I/O link is a twisted-pair serial interface (RS-485/422) communicating up to 115.2 KBd. You can mix both digital and analog I/O units as needed and select the I/O unit size for your application. Typical I/O units accommodate 16 I/O modules, while some have an I/O density as high as 32 points. The G4LC32ISA-LT can control up to 4,096 I/O points per RS-485/422 communication link.

CRC 16-error detection is included in every message transaction between the G4LC32ISA-LT and the connected I/O units, ensuring safe, reliable operation. Diagnostic LEDs are also provided on the G4LC32ISA-LT to simplify debugging.

Software

The G4LC32ISA-LT is programmed using one of Opto 22's PC-based graphical flowchart languages, like OptoControl. Combined with Opto 22's OptoDisplay and OptoServer software, the G4LC32ISA-LT can handle many industrial control applications.

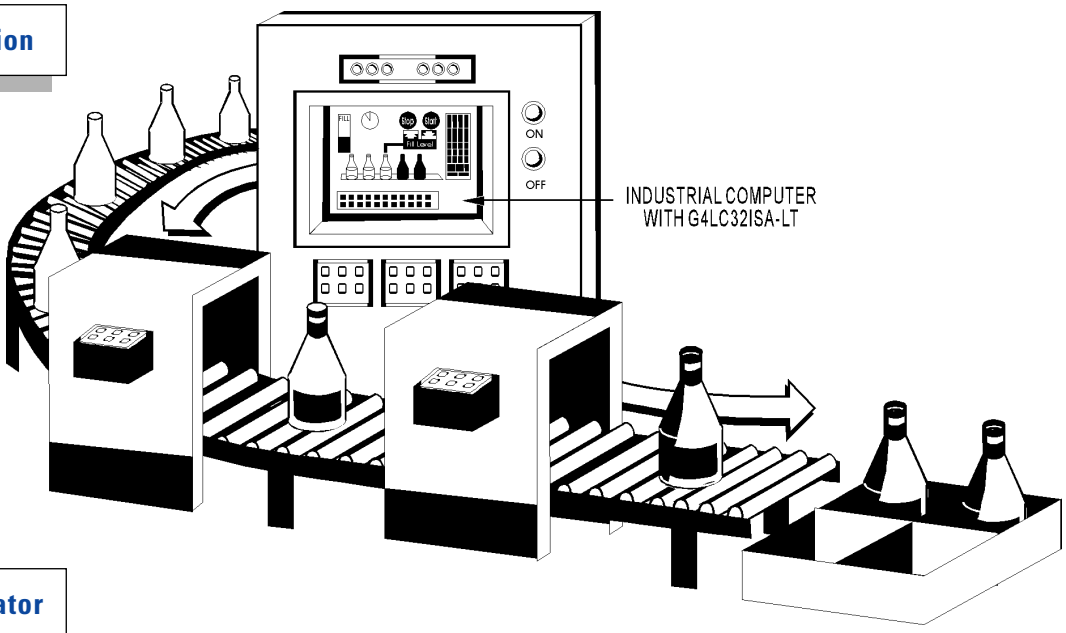
The G4LC32ISA-LT configuration and program development are performed through OptoControl on a PC workstation. After your application is complete, you can download your control strategy to the G4LC32ISA-LT either locally or remotely. You can then debug the program using the OptoControl debug mode, again either locally or remotely.

OptoDisplay, a graphical user interface, uses the tag name database generated by OptoControl to easily develop the tagnames used in the graphical display of your I/O process. Along with OptoServer, you can develop client/server architectures supporting any DDE-aware application (such as Microsoft Excel). In addition, rather than being limited to using Opto 22 software, the G4LC32ISA-LT can be used with any third-party software package featuring an Opto 22 driver or custom user code incorporating Opto 22's Host Words.

POSSIBLE APPLICATIONS

The following diagrams depict common applications for the G4LC32ISA-LT: a stand-alone OEM application, a data concentrator, laboratory automation testing, and a test station.

OEM Application



Data Concentrator

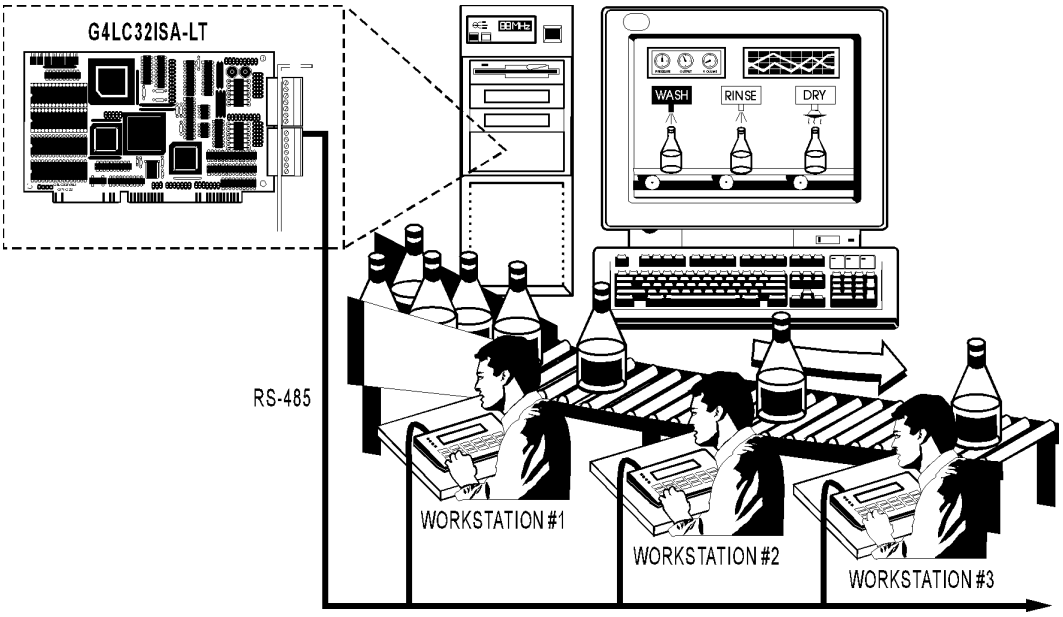
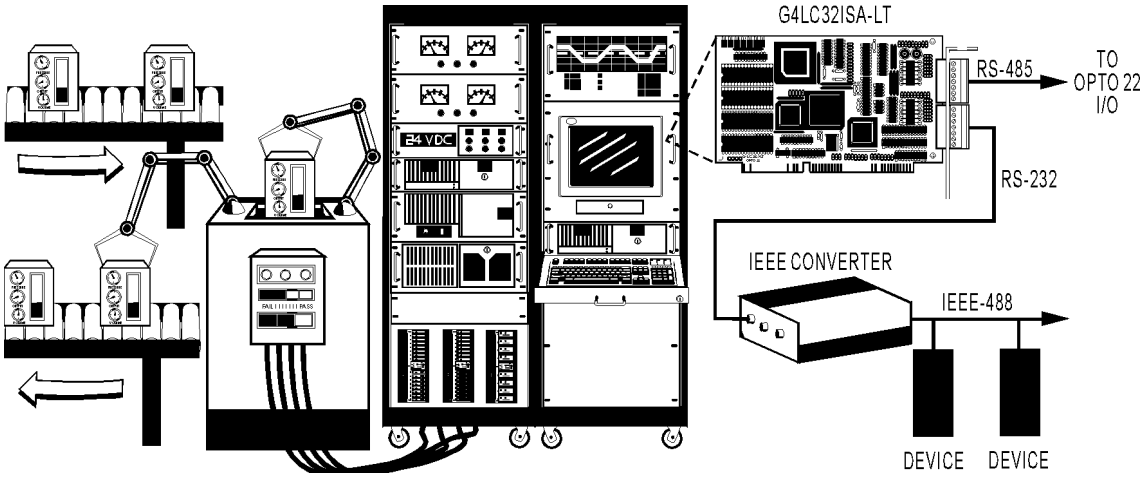


Figure 1-3: Examples of G4LC32ISA-LT applications

Laboratory Testing



Test Station

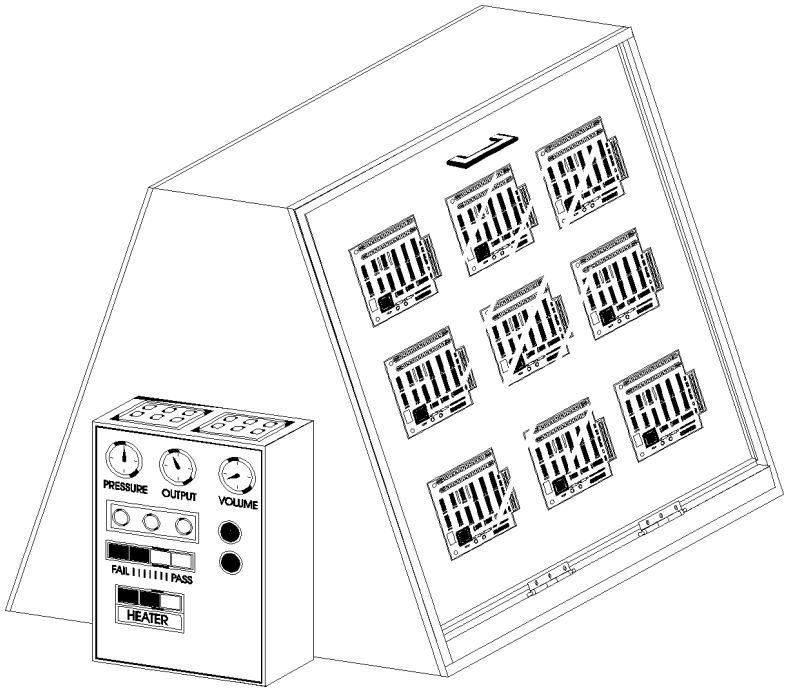


Figure 1-4: More examples of G4LC32ISA-LT applications

BASIC ARCHITECTURE

Program control and host communications are handled by a powerful 32-bit 68020 microprocessor. The G4LC32ISA-LT processor's 256 KB of battery-backed RAM and 256 KB flash EEPROM allow you to execute control applications with moderate data collection requirements. The processor is mounted on an ISA bus card and can be plugged into a PC.

A block diagram of the G4LC32ISA-LT is shown in Figure 1-5:

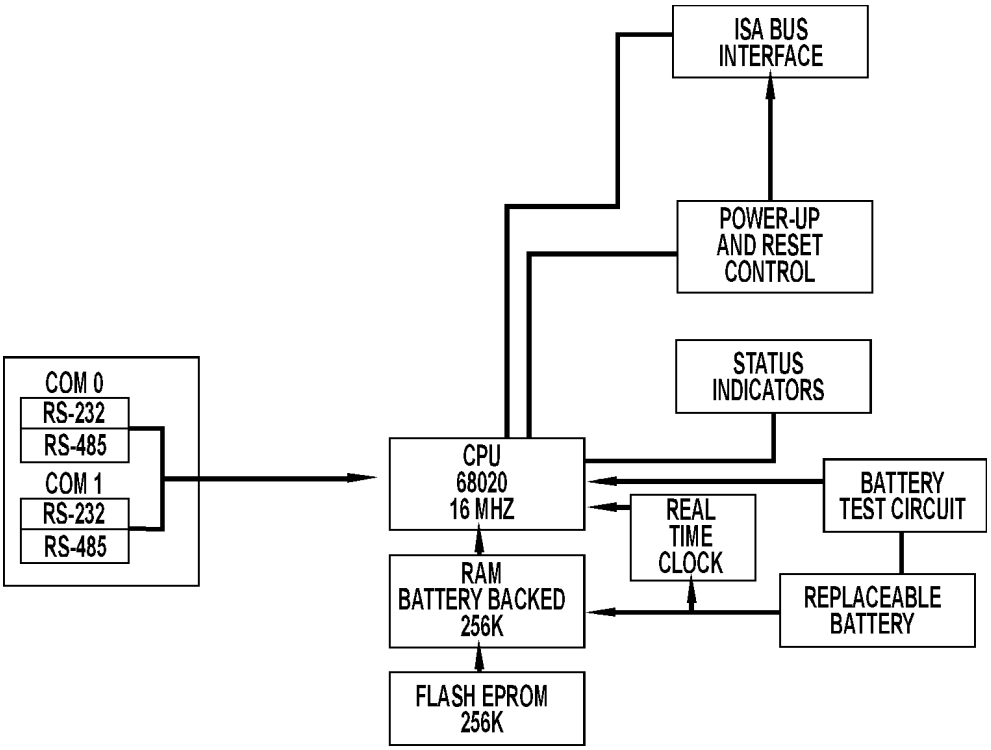


Figure 1-5: Block diagram of G4LC32ISA-LT

HARDWARE DIAGRAM

G4LC32ISA-LT Card Overview

Figure 1-6 shows the basic components of the G4LC32ISA-LT as viewed from the front.

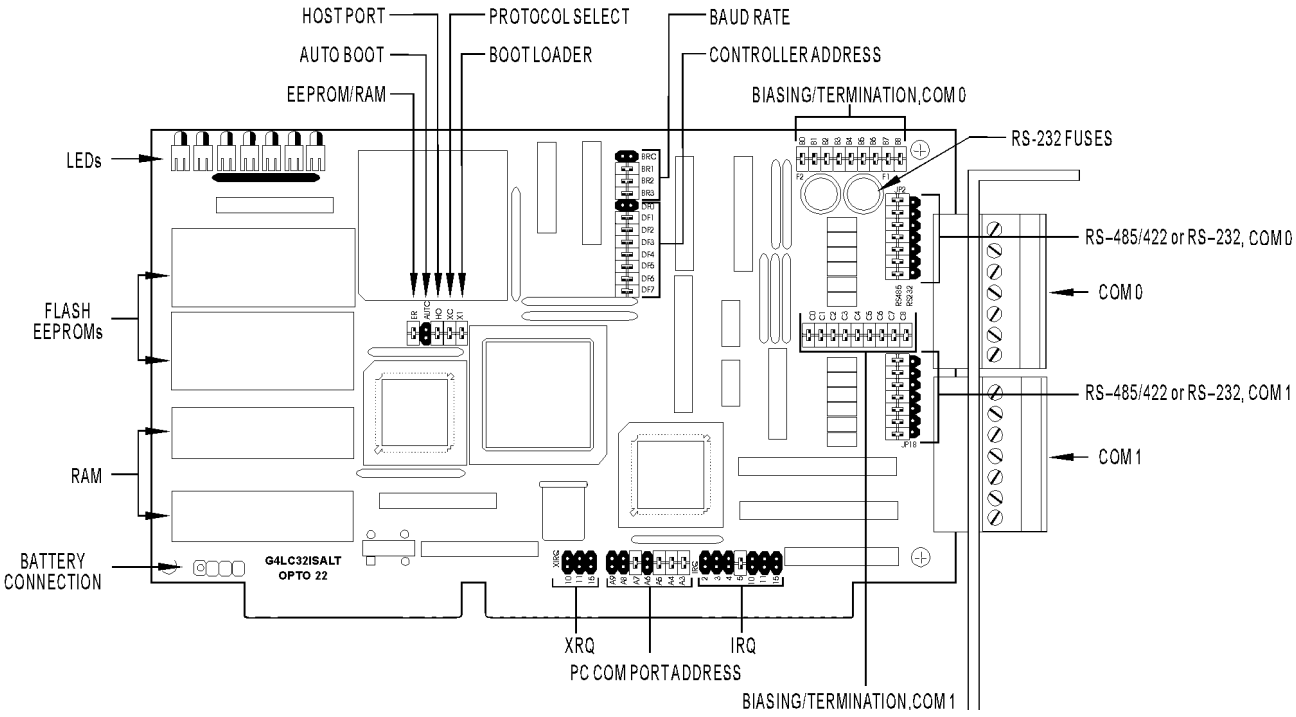


Figure 1-6: G4LC32ISA-LT as viewed from the front

CHAPTER 2

QUICK START

OVERVIEW

This chapter provides a brief explanation of how to get the G4LC32ISA-LT up and running on a PC using a hard-wired RS-485 host port connection to I/O units. If you are installing the G4LC32ISA-LT in an environment that is networked, uses multiple hosts, or uses modems, refer to Chapter 3 for detailed instructions.

A quick start installation consists of the following steps:

1. Unpack the G4LC32ISA-LT
2. Check the configuration jumpers
3. Connect the battery
4. Install into a host PC
5. Verify the G4LC32ISA-LT is communicating properly

PACKING LIST

When removing the G4LC32ISA-LT from its packaging, make sure the following components are included:

Component	Use
Extra jumpers	Can be installed as G4LC32ISA-LT configuration jumpers
Two RS-232/RS-485 seven-position connectors	Connect wiring to serial ports COM 0 and COM1
Connector key disk, containing six connector keys	Prevents non-keyed connectrors from plugging into the serial port
G4BATT32 battery	RAM backup battery
Battery replacement label	Record the battery's installation date
Four floppy disks 1. Cyrano Kernels and Firmware Utility (P/N 8885) 2. OptoKernels (P/N 8884) 3. & 4. Two OptoUtilities disks (P/N 8848)	 1. Contains Cyrano-compatible firmware and DOS download utility 2. Contains OptoControl-compatible firmware 3. & 4. Contains Win 95/NT download utility
Note: If any of the above items are missing or damaged, contact Opto 22 Product Support immediately at 1-800-835-6786 (or 909/695-3080).	

CHECKING CONFIGURATION JUMPERS

The G4LC32ISA-LT is configured by the factory for connection to a host PC's ISA bus. Its two serial ports are default-configured for RS-485 communication at 115.2 KBd, and are biased and terminated. The G4LC32ISA-LT's default address is 1 and the default communication mode is binary. Refer to Figure 2-1 for the default configuration of all jumpers.

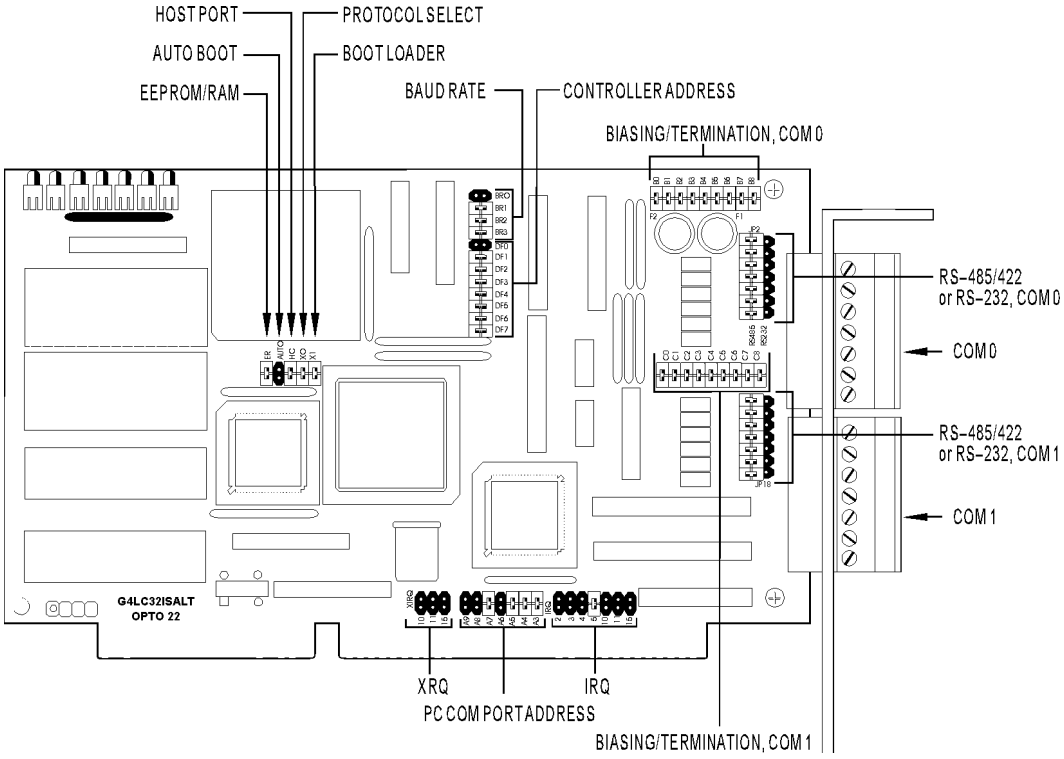


Figure 2-1: G4LC32ISA-LT configuration jumpers

For a complete explanation of all configuration jumpers, see "Setting Configuration Jumpers" in Chapter 3. For a chart of address jumper configurations, see Appendix D.

CONNECTING THE BATTERY

To save battery power, the G4LC32ISA-LT backup battery is not connected at the factory. Refer to Figure 2-2 to determine a suggested battery location and its connection to the G4LC32ISA-LT. For detailed information on connecting the battery, see Chapter 3, "Connecting the Backup Battery."

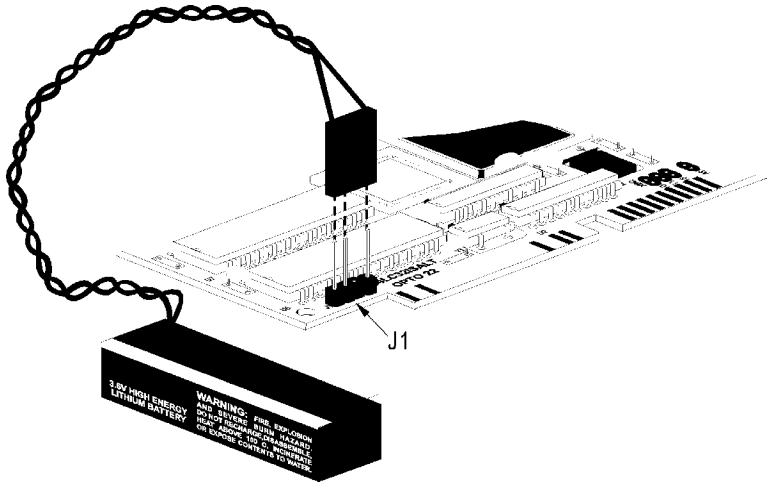


Figure 2-2: Location of backup battery on G4LC32ISA-LT

INSTALLING THE G4LC32ISA-LT

1. Find an unoccupied 16-bit ISA expansion slot in the computer.
2. Remove the expansion slot cover if one is installed.
3. Discharge any static charge that you may have by touching the computer's metal chassis.
4. Install the card by orienting the card edge connector toward the expansion slot, and the mounting bracket toward the access port.
5. Attach the G4BATT32 battery to a convenient location in the computer.

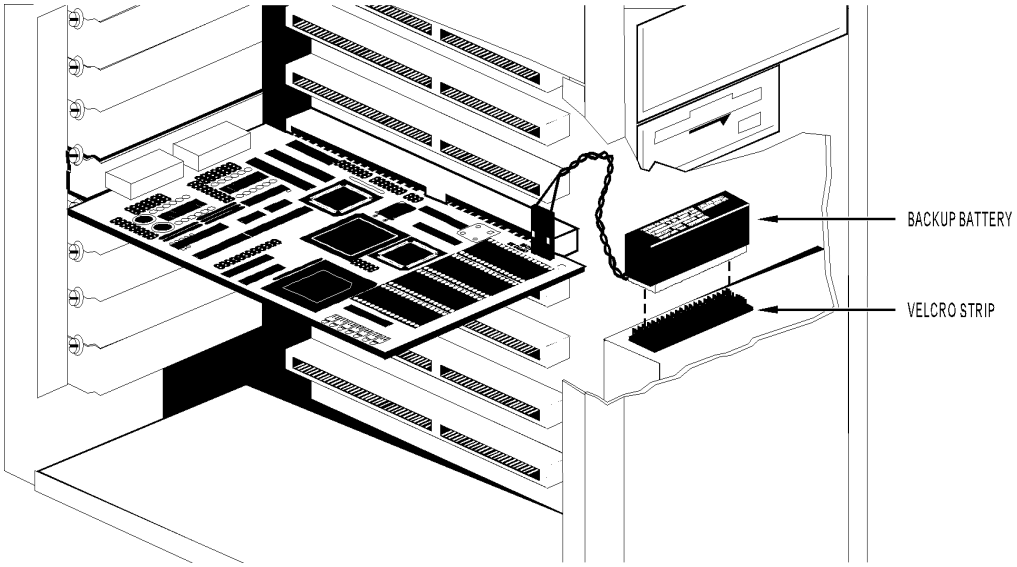


Figure 2-3: Installing the G4LC32ISA-LT into a computer

COMMUNICATION TO A HOST PC

Communication between the host PC and the G4LC32ISA-LT can be configured and verified using the PC-based graphical flowchart language OptoControl, or the OptoTerm utility, which must be installed on the PC. For details, consult the *OptoControl User's Guide* (Opto 22 form 724).

CHAPTER 3

INSTALLATION AND SETUP

OVERVIEW

This chapter expands upon the quick start information in Chapter 2 with detailed instructions on installing and configuring the G4LC32ISA-LT.

After unpacking the G4LC32ISA-LT, review the packing list in Chapter 2 to ensure that all components are included. You may then proceed through the installation procedures below, as detailed in this chapter:

1. Setting configuration jumpers
2. Connecting the backup battery
3. Installing the G4LC32ISA-LT
4. Connecting to a host PC, modem, or other serial device
5. Connecting to remote I/O units

For your reference, Figure 3-1 provides a view of the G4LC32ISA-LT, with components clearly labeled.

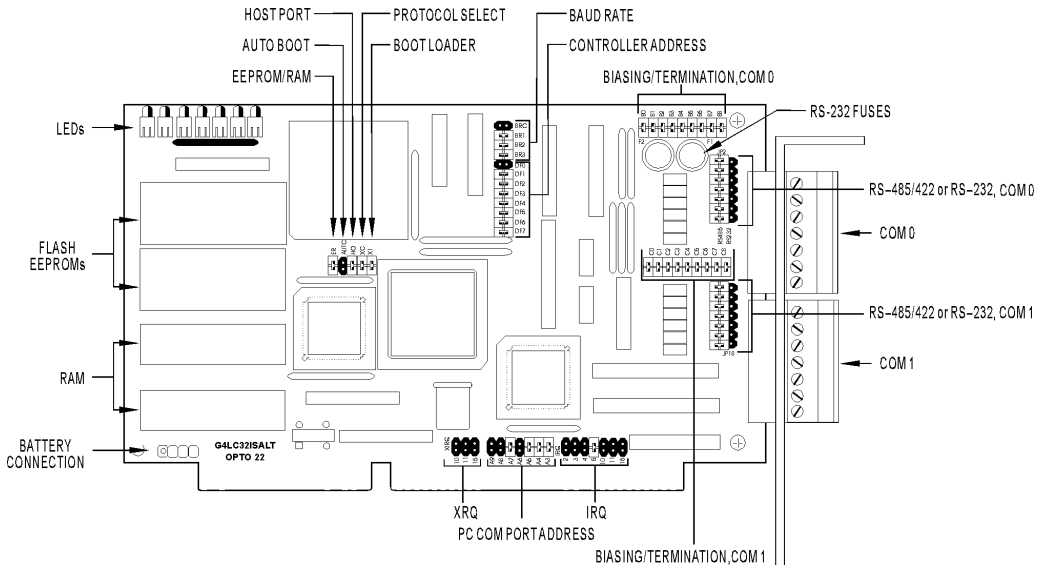


Figure 3-1: G4LC32ISA-LT Controller

SETTING CONFIGURATION JUMPERS

The G4LC32ISA-LT includes jumpers that allow you to configure the G4LC32ISA-LT based on your individual application requirements. This section describes these configuration jumpers.

Refer to Figure 3-1 for the location of the G4LC32ISA-LT jumpers. Table 3-1 describes the use and default settings of most jumpers. "In" means a jumper is installed and "out" means a jumper is **not** installed.

Each jumper is described in detail below.

EEPROM/RAM Jumper (E/R)

Use this jumper to choose the source of the G4LC32ISA-LT's control program. When the jumper is in (the default), the control program will run from RAM; when the jumper is out, the control program is copied from flash EEPROM into RAM and run from RAM.

Normally, application programs are downloaded from your PC workstation to battery-backed CMOS RAM in the G4LC32ISA-LT. The programs are then executed from RAM. Unless application programs are stored in flash EEPROM, the E/R jumper should be installed to allow the control program in RAM to run.

Autoboot Jumper (AUTO)

Use this jumper to determine whether autoboot mode will be enabled (jumper in) or disabled (jumper out, the default).

When autoboot mode is enabled, at power-up the G4LC32ISA-LT automatically executes the resident user program (RAM or flash). Otherwise, it waits to receive a command from the host computer or from OptoControl to run the resident program.

Protocol Select Jumper (X0)

Use this jumper to select whether communication between the host computer and the controller will be in binary mode (jumper in, the default) or ASCII mode (jumper out).

Boot Loader Jumper (X1)

Use this jumper to set the controller to either boot to the downloaded kernel (jumper in, the default) or boot to the kernel loader (jumper out). This jumper should always remain in place for normal operations. For more information, see Appendix *A, Troubleshooting*.

Host Port Jumpers (H0)

Use this jumper to determine the primary host port used by the G4LC32ISA-LT upon power up or reset. Select from the ISA bus (jumper in, the default), or COM0 (jumper out).

Baud Rate Jumpers (BR0–BR3)

Use these jumpers to set the baud rate for COM0 on Power up or reset. Select the appropriate

jumper settings based on the baud rates in Table 3-1. The default baud rate is 115.2 KBd. This baud rate may be changed in software.

Controller Address Jumpers (ADDRESS DF0–DF7)

Use these jumpers to select an 8-bit address (from 1 to 255) for the controller. The factory default is address 1 (jumper DF0 out, all others in). DF7 represents the most significant bit and DF0 represents the least significant bit. Address 0 is reserved and should not be used as a controller address. A jumper that isn't installed in a jumper position equals a logical 1. A jumper that is installed in a jumper position represents a logical 0.

Table 3-1 (on the previous page) shows the incremental address value added by taking out each of the jumpers. For example, if jumpers are out for bits 0, 3, and 6, the address would be 1 + 8 + 64 = 73.

To set the jumpers based on a predetermined address, refer to the chart in Appendix D. Alternatively, you can convert the address into binary format, then set jumpers based on the binary digits in reverse order. For example, to set an address of 118 (76 hex), use a scientific calculator to convert the number to binary: 01110110. The final digit is 0, so bit 0 will be in (jumper installed); the second-to-last digit is 1, so bit 1 will be out (jumper not installed); the third-to-last digit is 1, so bit 2 will be out; and so forth. The result is that jumpers will not be installed on bits 1, 2, 4, 5, and 6. Checking the results by referring to Table 3-1, an address of 2 + 4 + 16 + 32 + 64 = 118 is determined. Figure 3-2 displays the jumper configuration for an address of 118.

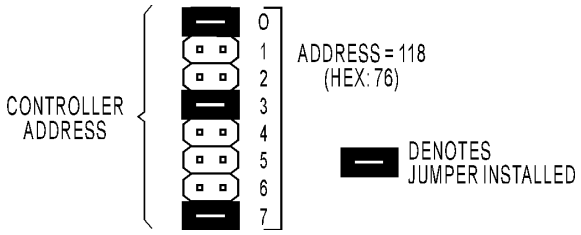


Figure 3-2: Jumper settings for address 118

RS–485/422 and RS–232 Jumpers

The COM0 and COM1 ports may be configured for either RS-485/422 or RS-232 communication. Jumper group JP2 configures COM0, and jumper group JP18 configures COM1. Refer to Figure 3-3 for the communication jumper settings. Figure 3-3 shows COM0 configured for RS-485/422 communication, and COM1 configured for RS-232 communication.

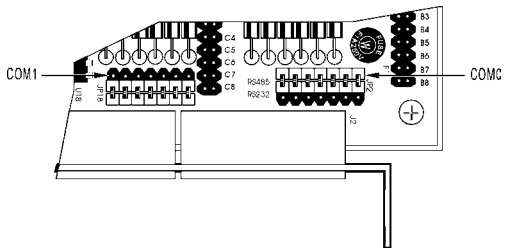


Figure 3-3: RS-485/422 and RS-232 communication selection jumpers

Table 3-1: G4LC32ISA-LT Configuration Jumpers (factory defaults are highlighted below)

Jumper(s)	Description	Position				Setting
E/R	EEPROM/RAM	**In**				**Run from RAM**
		Out				Run from EEPROM
Auto	Autoboot	**In**				**Autoboot enabled**
		Out				Autoboot disabled
X0	Communication	**In**				**Binary**
		Out				ASCII
X1	Boot Loader	**In**				**Boot to kernel**
		Out				Boot to loader
H0	Host Port	**In**				**ISA bus port**
		Out				Com 0
Baud	Baud Rate	BR0	BR1	BR2	BR3	
		Out	**In**	**In**	**In**	**115.2 KBd**
		In	Out	In	In	76.8 KBd
		Out	Out	In	In	57.6 KBd
		In	In	Out	In	38.4 KBd
		Out	In	Out	In	19.2 KBd
		In	Out	Out	In	9600 Bd
		Out	Out	Out	In	4800 Bd
		In	In	In	Out	2400 Bd
		Out	In	In	Out	1200 Bd
		In	Out	In	Out	600 Bd
		Out	Out	In	Out	300 Bd
Address DF0-DF7	Address Bits	**Jumper DF0 Out**				**1**
		Jumper DF1 Out				2
		Jumper DF2 Out				4
		Jumper DF3 Out				8
		Jumper DF4 Out				16
		Jumper DF5 Out				32
		Jumper DF6 Out				64
		Jumper DF7 Out				128

Biasing and Termination Jumpers (B0–B8 and C0–C8)

If COM0 or COM1 is configured for RS-485 communication, use Jumpers B0 through B8 for biasing and terminating COM0, and jumpers C0 through C8 for biasing and terminating COM1. RS-485/422 lines require proper termination and biasing for reliable operation. Communication lines require termination at the physical beginning and end of an RS-485/422 link, and require biasing at one location anywhere in the link. Table 3-2 describes each jumper's function and Figure 3-4 shows how jumper settings affect the RS-485/422 electrical schematic.

If COM0 or COM1 is configured for RS-232 communication, jumpers B0–B8 for COM0, or jumpers C0–C8 for COM1. These must be installed for proper operation.

Table 3-2: Biasing and Termination Jumpers

Jumper	Description
B0 or C0	Pull-up for TX/RX+ (BIAS)
B1 or C1	Terminator for TX/RX
B2 or C2	Pull-down for TX/RX- (BIAS)
B3 or C3	Pull-up for RX+ (BIAS)
B4 or C4	Terminator for RX line
B5 or C5	Pull-down for RX- line (BIAS)
B6 or C6	Pull-up for IRQ+
B7 or C7	Terminator for IRQ
B8 or C8	Pull-down for IRQ-

B jumpers are for COM0; C jumpers are for COM1

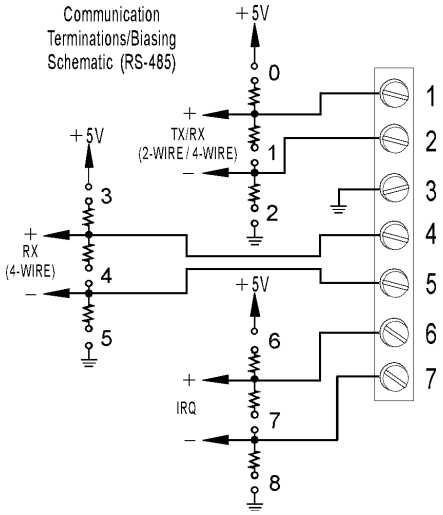


Figure 3-4: Biasing and termination jumpers schematic

The G4LC32ISA-LT is shipped from the factory with all B and C group jumpers installed. This setting is for a G4LC32ISA-LT in a 2-wire or 4-wire RS-485/422 communication link located at the beginning of the physical link. These jumpers bias and terminate the TX/RX± 2-wire, RX± 4-wire, and IRQ communication lines. Refer to Figure 3-5 for other jumper settings.

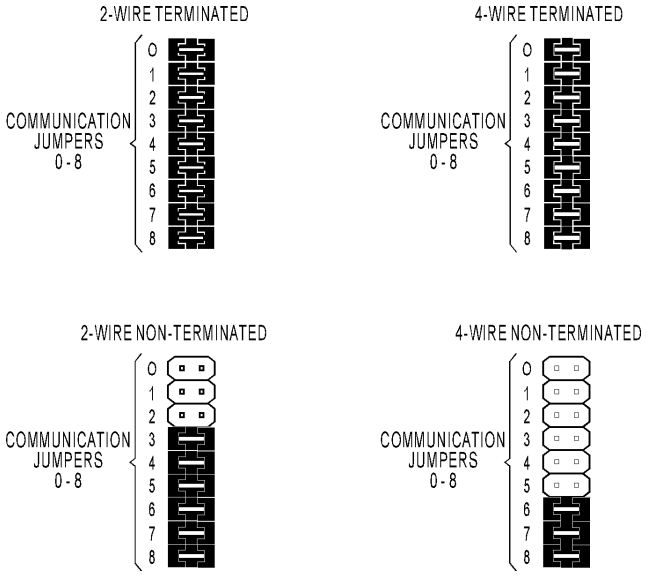


Figure 3-5: COMM jumper settings

2-wire Communication

If the G4LC32ISA-LT is the first controller in an RS-485/422 2-wire communication link, install all jumpers. If it is the last controller in a 2-wire communication link, install jumpers 1, 3, 4, and 5. If it is not the first or last controller, install jumpers 3, 4, and 5.

If the IRQ lines are not used, install jumpers 6, 7, and 8. If the IRQ lines are used and the controller is the first controller in the communication link, install jumpers 6, 7, and 8. If the IRQ lines are used and the controller is the last controller in the communication link, install jumper 7.

4-wire Communication

If the G4LC32ISA-LT is the first controller in an RS-485/422 4-wire communication link, install all jumpers. If the G4LC32ISA-LT is the last controller in a 4-wire communication link, install jumpers 1 and 4.

If the IRQ lines are not used, install jumpers 6, 7, and 8. If the IRQ lines are used and the controller is the first controller in the communication link, install jumpers 6, 7, and 8. If the IRQ lines are used and the controller is the last controller in the communication link, install jumper 7.

COM Port Address and IRQ Jumpers

The COM Port address and IRQ jumpers are used to select the base I/O address and interrupt line of the G4LC32ISA-LT's host port in the computer. Refer to Table 3-3 for the recommended address and IRQ settings. The default is COM4, address 340, IRQ 5.

Table 3-3: Computer Port Address and IRQ Jumpers

Port	Hex Address	A9	A8	A7	A6	A5	A4	A3	IRQ #
COM 1	3F8	Out	Out	Out	Out	Out	Out	Out	4
COM 2	2F8	Out	In	Out	Out	Out	Out	Out	3
*OPTO COM3	348	Out	Out	In	Out	In	In	Out	2
*OPTO COM4	340	Out	Out	In	Out	In	In	In	5
COM 5	248	Out	In	In	Out	In	In	Out	10
COM 6	240	Out	In	In	Out	In	In	In	11

*Note: These settings are different than the Windows default settings for COM3 & COM4.

CONNECTING THE BACKUP BATTERY

The G4LC32ISA-LT uses a RAM backup battery. This 3.6-volt lithium battery features a shelf life of up to 10 years and an operational life of two to five years.

To maintain operational life, the battery is not connected at the factory. Attach the battery connector to the battery terminal labeled J1. The connection is keyed and will attach in one direction only, with the red wire connecting to the positive lead. Refer to Figure 3-6 for the battery connection locations. (Execute the following steps only after setting the configuration jumpers. Refer to the next section on the following page for G4LC32ISA-LT installation instructions.) After installing the G4LC32ISA-LT in the PC, attach the Velcro strip to a convenient location inside the computer. Secure the battery to the Velcro strip.

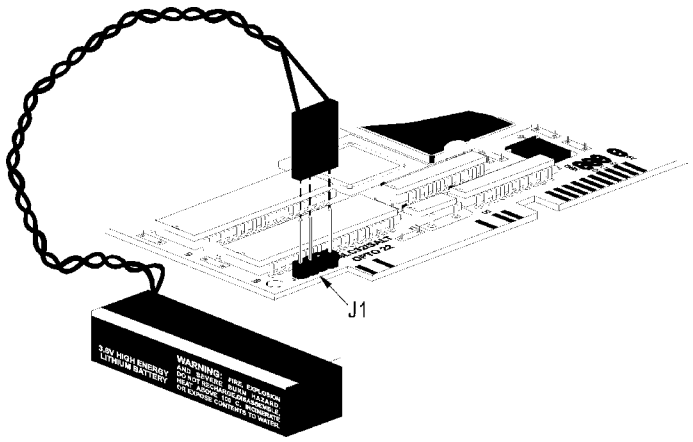


Figure 3-6: G4LC32ISA-LT Backup Battery

The Battery Service Record stamp should be placed in a convenient place in the computer. It includes the Opto 22 part number of the battery (G4BATT32), the date the battery was installed, and the date the battery should be replaced (five years after installation). If the G4LC32ISA-LT is subjected to temperature extremes, the battery may require replacement after as little as two years.

INSTALLING THE G4LC32ISA-LT

Refer to the owner's manual of your computer for information on opening and removing the computer's cover.

Note: *Be sure to configure the jumpers and connect the G4BATT32 before installing the card.*

The general procedure for installing the G4LC32ISA-LT card is as follows:

1. Find an unoccupied 16-bit ISA expansion slot in the computer.
2. Remove the expansion slot cover if one is installed.
3. Discharge any static electricity you may have by touching the computer's metal chassis.
4. Install the card by orienting the card edge connector facing the expansion slot and the mounting bracket facing the access port as shown in Figure 3-7:

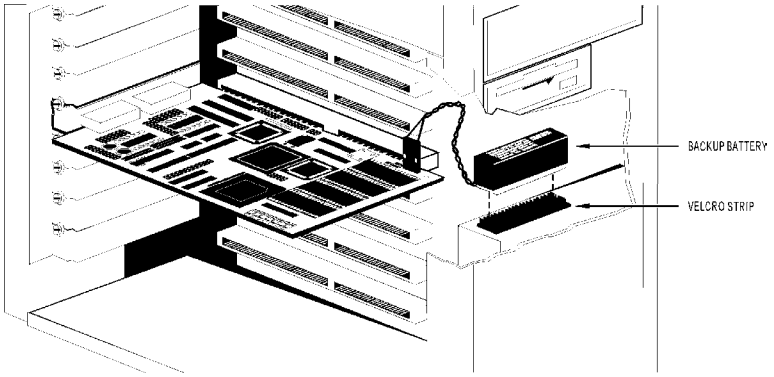


Figure 3-7: Installing the G4LC32ISA-LT

5. Attach the G4BATT32 battery to a convenient location in the computer.

CONNECTING TO A HOST PC, MODEM, OR OTHER DEVICE

The G4LC32ISA-LT features an ISA bus and two built-in serial ports: COM0 and COM1. Both serial ports are RS-232- or RS-485/422-configurable, and have a data transfer rate of 300 Bd to 115.2 KBd. They may be used to communicate to I/O units, intelligent serial devices, or function as generic communication ports.

Either the ISA bus or COM0 may be used as a primary host port. COM1 may only be used as an alternate host port. (An alternate host port is an additional host port besides the primary host port. This could allow, for example, a modem connection from an offsite terminal to dial-up and view the local process.) The typical G4LC32ISA-LT application uses the ISA port as its host port. A G4LC32ISA-LT may also be part of a multi-dropped network of controllers in which its COM0 is connected to a host PC with an AC37.

RS-232 COM0 and COM1 configured ports allow modems, intelligent serial devices, and multiple G4LC32ISA-LT host ports to be used. Both ports can be programmed and controlled through OptoControl, and can be configured to provide +5 VDC for devices with low current demands, such as barcode readers.

RS-485/422 COM0 and COM1 configured ports may be used as a serial link to connect to Opto 22 I/O units. The G4LC32ISA-LT can be separated by up to 3,000 ft. from I/O units or controllers. (An AC38 repeater enables even longer separation distances.) This is accomplished via a single shielded twisted-pair cable that provides communication over an RS-485/422 serial data bus. Up to 32 remote I/O units (256 with repeaters) can be attached on a single serial link.

Fusing for RS–232 +5 VDC

A +5 VDC fused source is available on pin 1 from both the COM0 and COM1 ports. A maximum 0.5A load can be drawn through the 1A-rated fuse. The replacement part number for this fuse is Opto 22 P/N FUSE01G4 (Wickman P/N 19373A). Keep in mind that any power drawn should be figured into the load on the PC's power supply.

Figure 3-8 shows the location of these fuses:

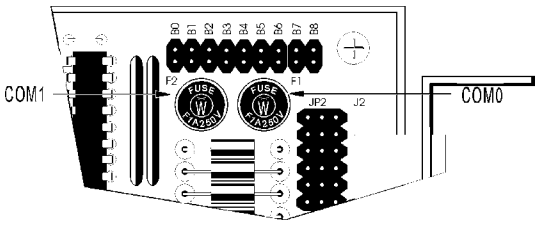


Figure 3-8: Location of +5V fuses on the G4LC32ISA-LT

Wiring

Important: *Serial port connectors wired for other controllers may not be compatible with the G4LC32ISA-LT. Use the G4LC32ISA-LT connectors provided and refer to the configuration label for wiring information.*

The following sections describe wiring for the serial ports found on the G4LC32ISA-LT. Use Tables 3-4 and 3-5 as references for wiring the pluggable, 7-terminal, serial port connectors shown in Figure 3-9:

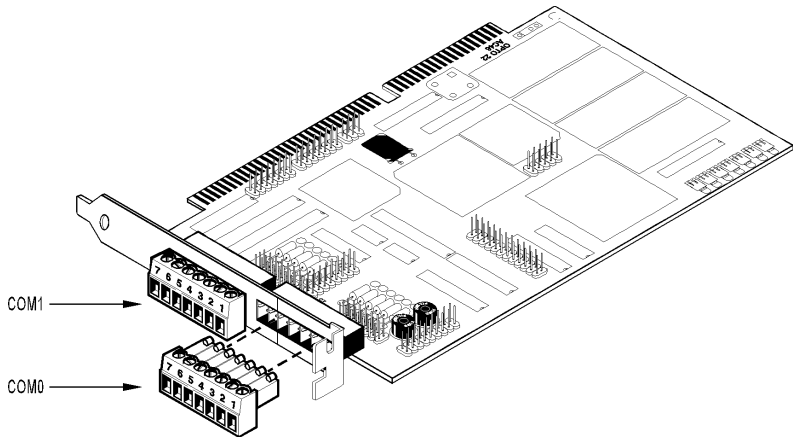


Figure 3-9: Terminal serial port connectors

RS–232 COM0 and COM1 Pin Connections

The G4LC32ISA-LT has two built-in serial ports. For RS-232 communication, jumpers **must** be installed on B0 through B8 for COM0, or C0 through C8 for COM1. The following table contains descriptions for each pin.

Important: *If RTS and CTS are not used, they should be disabled (default) and not enabled by software. Remember to install the port's RS-232 communication jumpers. See Figure-3-3.*

Table 3-4: Pin Descriptions for the RS-232 Serial Ports

Pin	COM0 and COM1
1	+5 VDC[1]
2	Transmit (TX)
3	Receive (RX)
4	Request-to-Send (RTS)
5	Clear-to-Send (CTS)
6	Data Terminal Ready (DTR)
7	Ground (GND)

[1] The +5 VDC may be used to power devices with low current demands.

RS–485/422 COM0 and COM1 Pin Connections

COM0 and COM1 may also function as RS-422/485 ports. Table 3-5 contains descriptions for each COM0 and COM1 pin for both 2-wire and 4-wire modes.

Note that the interrupt lines can be used to add interrupt capability to Opto 22 remote I/O units connected to a G4LC32ISA-LT via an RS-485 serial link.

Table 3-5: Pin Descriptions for the RS-485 Serial Ports

Pin	2-Wire	4-Wire
1	Transmit/Receive Plus (TX/RX-)	Transmit Plus (TX+)
2	Transmit/Receive Minus (TX/RX-)	Transmit Minus (TX-)
3	Common Ground (GND)	Common Ground (GND)
4	No Connection (NC)	Receive Plus (RX+)
5	No Connection (NC)	Receive Minus (RX-)
6	Interrupt Plus (IRQ+)	Interrupt Plus (IRQ+)
7	Interrupt Minus (IRQ-)	Interrupt Minus (IRQ-)

Wiring to a Host PC

This section provides information on wiring connections between a G4LC32ISA-LT's COM0 port and a host PC. This type of connection is used when multiple G4LC32ISA-LTs are multidropped over an RS-485 network. Examples show connections to a standard PC serial port and an Opto 22 AC37.

Be sure to use cabling that is appropriate for your application. See Appendix B for a list of recommended cables and connectors.

RS-232 COM0 and COM1

Figure 3-10 presents an example of RS-232 wiring between a host PC and the COM0 or COM1 port of an G4LC32ISA-LT. Verify that the pin connections on your host PC are the same as those called out in the diagram.

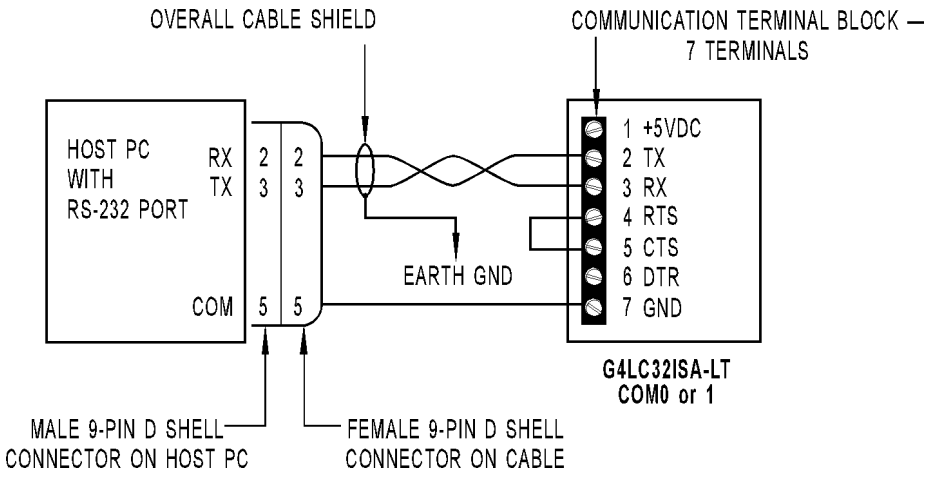


Figure 3-10: RS-232 wiring to a host PC

RS-485/422 COM0 and COM1

4-Wire Mode Using an AC37

If you are using an Opto 22 AC37, refer to Figure 3-11 for wiring details.

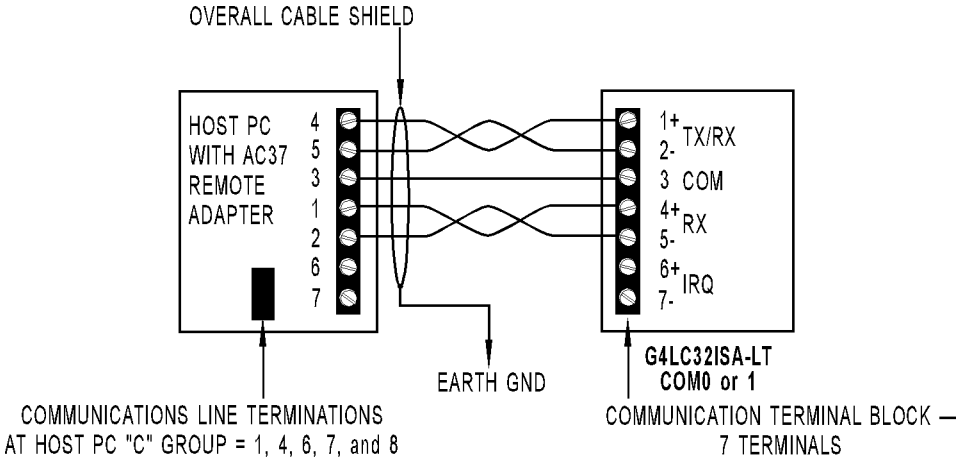


Figure 3-11: RS-485/422 Wiring to an AC37 using 4-wire mode

2-Wire Mode Using an AC37

The AC37 also supports a 2-wire RS-485/422 connection. Refer to Figure 3-12 for wiring.

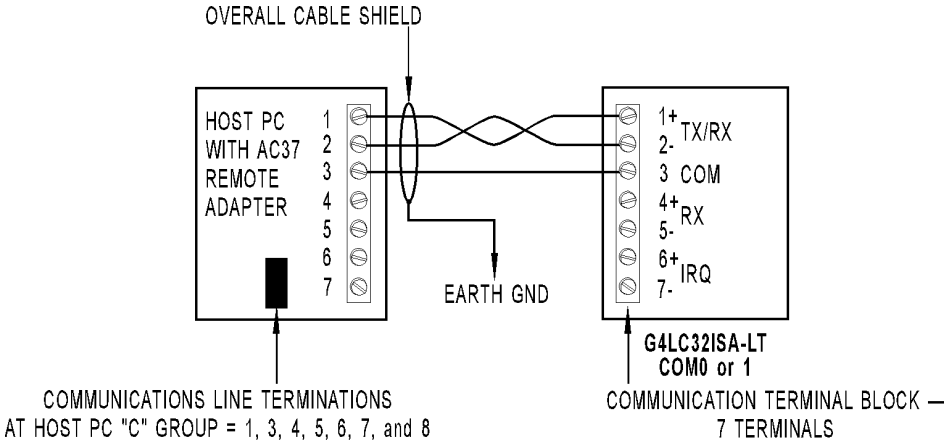


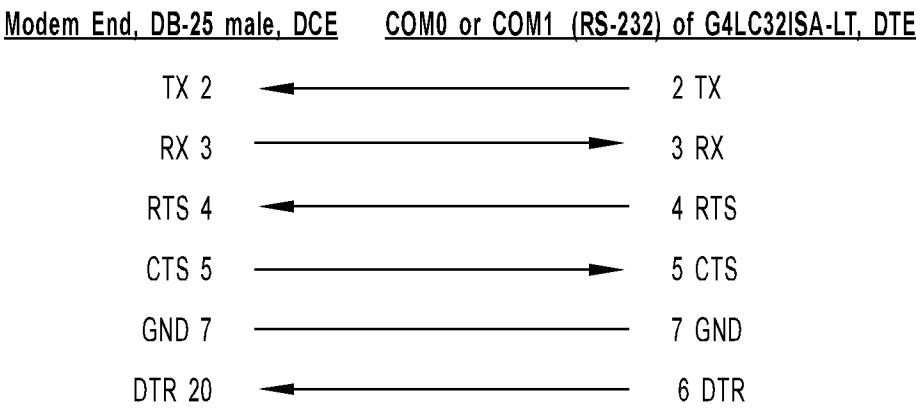
Figure 3-12: RS-485 Wiring to an AC37 using 2-wire mode

Wiring to a Modem (A DCE Device)

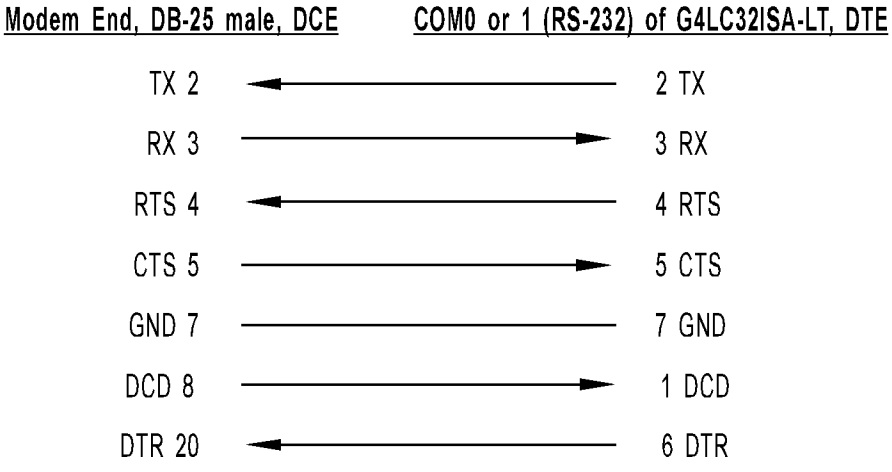
Refer to your modem documentation for detailed wiring information, possible jumper configuration, and initialization setup. You may also wish to refer to Opto 22's communication application notes, available through Opto 22's Bulletin Board Service (see Appendix E for details).

Most standard external PC modems can be usd with the G4LC32ISA-LT. However, a custom (or special) communications cable must be used between the modem and the G4LC32ISA-LT. Wiring diagrams for this cable are shown below:

Suggested Modem to G4LC32ISA-LT Cable (without carrier detect):



Suggested Modem to G4LC32ISA-LT Cable (with carrier detect):



CONNECTING TO I/O UNITS

The built-in RS-485/422 COM0 or COM1 port can be used as a serial link to communicate with digital or analog remote I/O units. One method for doing this is to use an Opto 22 P/N G4IOR I/O remote interface as illustrated in Figure 3-14. This method allows the use of Opto 22 standard I/O equipment (G4 panels, cables, etc.). Refer to the *Mistic Installation Guide* (Opto 22 form 595) for more details.

Figure 3-14 shows a 2-wire RS-485 shielded connection from COM0 on the G4LC32ISA-LT to the G4IOR Remote Interface block. Connect pin 1 (TX/RX+) to G4IOR "TH+," pin 2 (TX/RX-) to G4IOR "TH-," and pin 3 to "COM." If you are using the interrupt lines, connect pin 6 to "IRQ+" and pin 7 to "IRQ-."

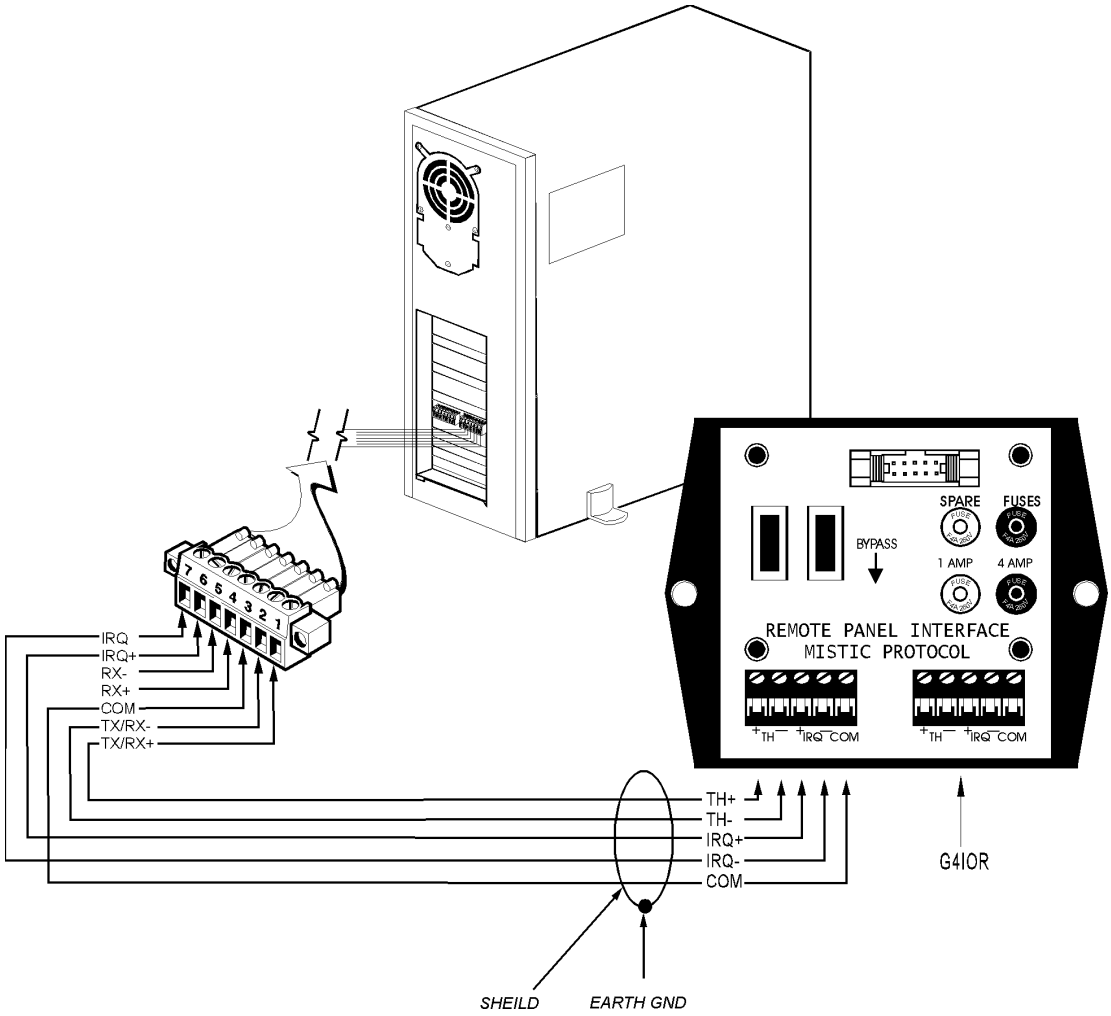


Figure 3-14: Communication to a remote interface

Another method for using the RS-485/422 COM0 or COM1 port as a serial link (remote) is to use an Opto 22 P/N SBTA to install I/O units. This allows you to accommodate your own installation practices, application requirements, and cables. Simply mount your I/O units throughout your installation and daisy chain the communication cable between them. Refer to the *Mistic Installation Guide* (Opto 22 form 595) for more SBTA wiring details.

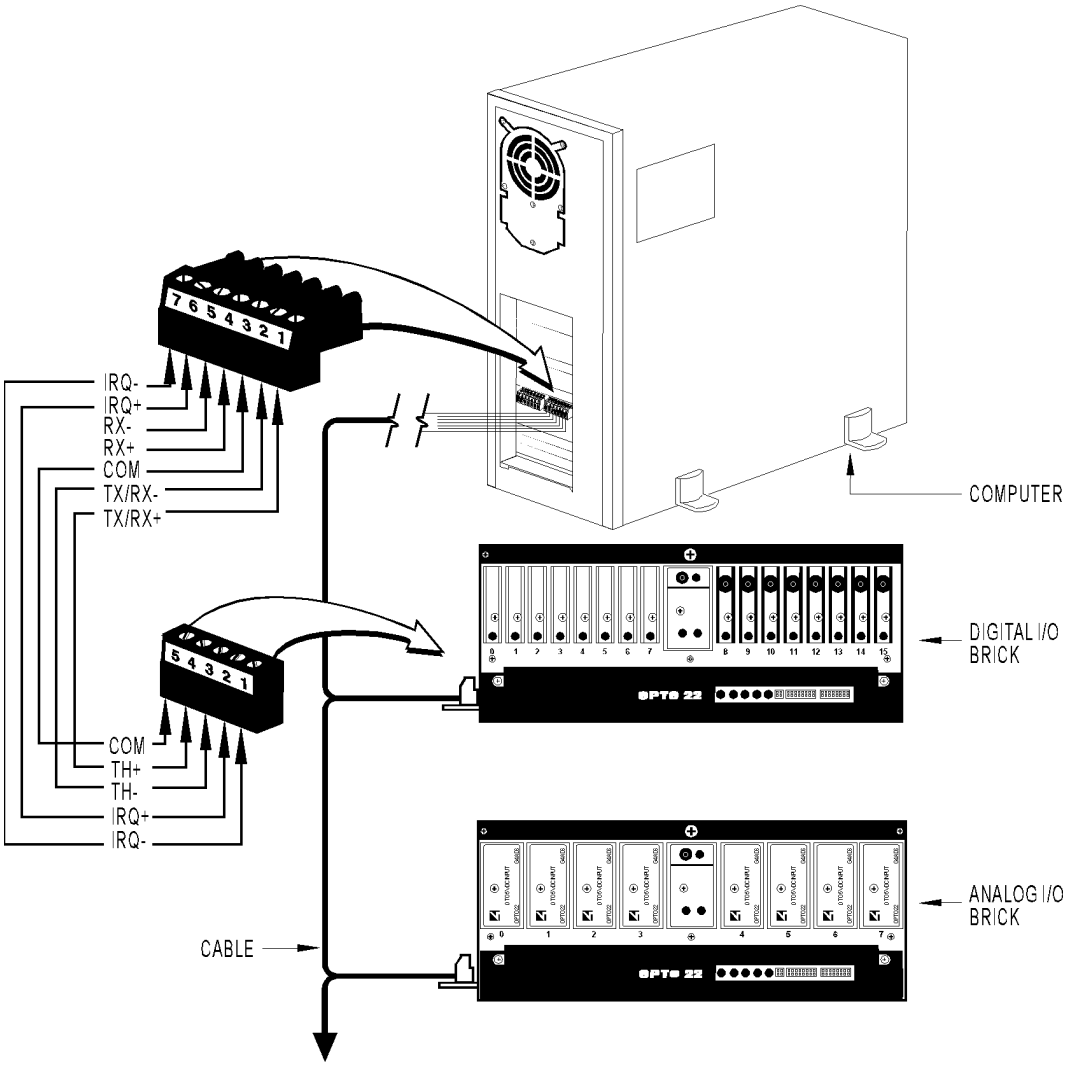


Figure 3-15: Remote I/O units installed with SBTA

LED INDICATORS

Seven LEDs are located on the G4LC32ISA-LT (Figure 3-16) and perform the functions displayed in Table 3-6.

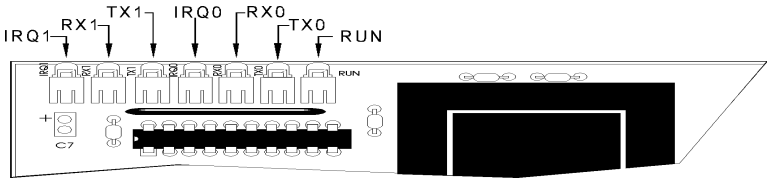


Figure 3-16: LED indicators on the G4LC32ISA-LT

Table 3-6: LED Functions

LED	Indication
RUN (Processor status)	This indicator shows processor status. When the processor is functioning normally, the light stays on. When the processor is powered down, the light goes off. If the light begins to blink, it could indicate a processor malfunction or low power supply voltage.
TX0 (COM0 transmit)	This indicator illuminates whenever COM0 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle, a wiring problem exists, or CTS is inactive.
RX0 (COM0 receive)	This indicator illuminates whenever COM0 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
IRQ0 (COM0 interrupt)	This indicator illuminates when an interrupt is generated by an I/O unit on the COM0 RS-485/422 remote link. If the LED is not illuminated, it indicates an interrupt request has not been generated by an I/O unit, or a wiring problem exists.
TX1 (COM1 transmit)	This indicator illuminates whenever COM1 is transmitting serial data. If the LED fails to illuminate, it could indicate that the port is idle, a wiring problem exists, or CTS is inactive.
RX1 (COM1 receive)	This indicator illuminates whenever COM1 is receiving serial data. If the LED fails to illuminate, it could indicate that the port is idle or a wiring problem exists.
IRQ1 (COM1 interrupt)	This indicator illuminates when an interrupt is generated by an I/O unit on the COM1 RS-485/422 remote link. If the LED is not illuminated, it indicates an interrupt request has not been generated by an I/O unit, or a wiring problem exists.

CHAPTER 4

SOFTWARE AND FIRMWARE

OVERVIEW

This chapter provides information about the OptoControl, OptoDisplay, and OptoServer Windows 95 and Windows NT software products which may be used with the G4LC32ISA-LT. It also provides information on updating the processor firmware.

OptoControl is used to program and debug G4LC32ISA-LT control strategies. OptoDisplay is used to create and display G4LC32ISA-LT process operator interfaces running on the PC. OptoServer allows the user to construct complex client/server architectures running multiple OptoDisplay sessions, DDE-aware applications (such as Microsoft Excel), or third-party software packages with OptoServer driver capability.

Besides generating a downloadable strategy to be executed on the G4LC32ISA-LT, OptoControl generates a database of tag names for items such as I/O points and variables. This single database is shared by OptoDisplay and eliminates the need for multiple tag data bases. OptoDisplay uses the database to dynamically animate the various screen objects making up the operator interface: valves, pumps, gauges, and so forth.

The tight integration between OptoControl, OptoDisplay, and OptoServer not only makes all three software packages easy to use, but it also prevents multiple database entry errors, allows tag name validation, and takes full advantage of the G4LC32ISA-LT's hardware capabilities.

The sophisticated firmware of the G4LC32ISA-LT processor, along with flash technology, enables a user to update the G4LC32ISA-LT remotely with a new operating system, or "kernel".

DOS PLATFORMS

Also available from Opto 22 are the DOS-compatible Cyrano, Mistic MMI, and MDS software packages which fully support the G4LC32ISA-LT. For more information about Cyrano, refer to the *Cyrano User's Guide* (Opto 22 form 702); for Mistic MMI, refer to the *MMI User's Guide* (Opto 22 form 626); and for MDS, refer to the *MDS User's Guide* (Opto 22 form 691).

OPTOCONTROL SOFTWARE

This section gives a general explanation of how communication is set up between OptoControl and the G4LC32ISA-LT, how I/O for the G4LC32ISA-LT is configured, and how an OptoControl strategy is stored into flash memory.

Configuring Communications to the G4LC32ISA-LT

To download OptoControl strategies to the G4LC32ISA-LT and debug them, you must first configure the communication link between the host PC and the G4LC32ISA-LT. Begin by deciding which type of physical communication link will be used (ISA bus, RS-485/422, or RS-232). Then install and configure communication hardware between the host PC and the G4LC32ISA-LT. (Refer to Chapter 3 and your PC documentation for communication hardware installation details.)

Once the hardware has been installed, OptoControl must be configured to communicate over the physical communication link. For more details regarding OptoControl, refer to the *OptoControl User's Guide* (Opto 22 form 724).

Configuring I/O for the G4LC32ISA-LT

Before writing OptoControl strategies for the G4LC32ISA-LT, you must inform OptoControl about the I/O connected to the G4LC32ISA-LT. This means you will first need to decide how many I/O points of each type (digital and analog) are required for your application.

OptoControl must know how the I/O units are connected to a controller (e.g., RS-485 remote serial link) as well as what type of module will be installed into each I/O channel on each unit. Once OptoControl has this information, you may use the assigned I/O tag names to reference the I/O within an OptoControl strategy.

Having decided the amount and type of I/O to be used, configure each channel by following the configuration procedures outlined in the *OptoControl User's Guide*.

STORING USER STRATEGIES INTO G4LC32ISA-LT FLASH EEPROM

OptoControl strategies may be stored into flash memory instead of residing in RAM backed up by a battery. Flash memory has the same long-term reliability as an EEPROM. Strategies may be developed for the G4LC32ISA-LT in RAM, downloaded and debugged, and then stored in flash memory. If the G4LC32ISA-LT has been set up to boot automatically from flash memory, the OptoControl strategy stored in flash will be executed upon power up.

Refer to the *OptoControl User's Guide* for instructions on storing an OptoControl strategy into flash memory.

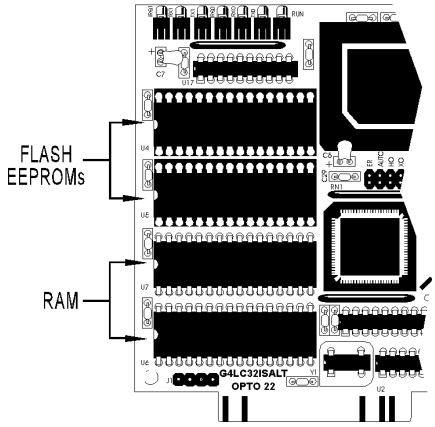


Figure 4-1: EEPROM and RAM chip locations on the G4LC32ISA-LT

OPTODISPLAY AND OPTOSERVER SOFTWARE

Both OptoDisplay and OptoServer share the database generated by OptoControl. This database contains information for communicating to the G4LC32ISA-LT and references data items such as variables, I/O, PIDs, and event/reactions. This information is used by OptoDisplay to animate a graphic and is also used by OptoServer to collect information from a G4LC32ISA-LT and other Opto 22 controllers.

To attach OptoDisplay and OptoServer to a G4LC32ISA-LT and other Opto 22 controllers, follow the standard procedures outlined in the OptoDisplay and OptoServer manuals. In short, you will be telling OptoDisplay and OptoServer which OptoControl database to open to access the communication information and strategy data items.

For more details regarding OptoDisplay and OptoServer, refer to the *OptoDisplay User's Guide* (Opto 22 form 723) and *OptoServer User's Guide* (Opto 22 form 722).

UPDATING THE G4LC32ISA-LT FIRMWARE

The G4LC32ISA-LT uses a real-time, event-driven operating system, or "kernel". The processor's kernel executes the strategy created in OptoControl. The G4LC32ISA-LT comes loaded with the most current Opto 22 kernel. The G4LC32ISA-LT also comes with a disk containing the current kernel as well as the OptoTerm Utility program for updating the stored kernel. The latest kernels are also available on Opto 22's Bulletin Board System.

Note to Cyrano users: Cyrano is not compatible with the factory-loaded OptoKernel. The flash firmware utility disk included with the G4LC32ISA-LT contains the current Cyrano kernel as well as the Flash 200 Utility Program for downloading the firmware. OptoTerm may also be used to download a Cyrano kernel.

Each processor has a boot loader permanently stored into a non-erasable portion of its flash memory. This boot loader enables a user to download a new kernel as Opto 22 makes new kernels available, even if the existing kernel has been lost.

To update a kernel, use the OptoTerm utility included with FactoryFloor. For details on using the OptoTerm utility, consult OptoTerm's on-line help, or the *OptoControl User's Guide*.

The boot loader currently supports only the ISA bus and COM0 as primary host ports for kernel updating.

APPENDIX A

TROUBLESHOOTING

Table A-1: G4LC32ISA-LT Troubleshooting Chart

Indication	Condition/Problem	Action
RUN LED is off.	Power not applied to processor or voltage is too low.	Check power supply connections.
RUN LED flashes after a power failure occurred during EEPROM firmware installation.	Kernel is corrupted or processor has malfunctioned.	Remove Boot Loader jumper so that G4LC32ISA-LT boots to loader. Download flash kernel, then reinstall Boot Loader jumper.
Run LED is blinking.	Controller is malfunctioning.	Call Opto 22 Product Support.
TX0 (COM0 transmit) LED stays off.	Port is not transmitting.	Cycle power to unit. Check CTS connection (for RS-232); must be connected to RTS or disabled if it is not used. Check jumper settings and/or OptoControl communication setup.
RX0 (COM0 receive) LED stays off.	Port is idle. Wire or connection is bad.	Check wiring from the host and connections at the G4LC32ISA-LT terminals.
Host does not receive a response from the G4LC32ISA-LT and RX0 or RX1 (COM0 or COM1 receive) LED flashes during program download.	Incorrect setup in OptoControl. PC to G4LC32ISA-LT connections are incorrect.	Check OptoControl communication setup, specifically rate, address, and binary/ASCII settings. Check wiring connections forcorrect polarity and wire integrity.
TX1 (COM1 transmit) LED stays off.	Port is not transmitting.	Cycle power to unit. Check CTS connection (for RS-232); must be connected to RTS or disabled if it is not used. Check jumper settings and/or OptoControl communication setup.
RX1 (COM1 receive) LED stays off.	Port is idle. Wire or connection is bad.	Check wiring for reverse polarity.Check connections at terminals.
G4LC32ISA-LT controller cannot transmit to PC.	Configuration jumpers were changed without cycling power. Wiring to serial port is incorrect.	Cycle power and retry transmission. Check wiring for reverse polarity.

APPENDIX B

CABLE AND CONNECTOR SPECIFICATIONS

SERIAL COMMUNICATION CABLES

The following cables are recommended for both RS-232 and RS-485/422 serial communication. Although you may elect to use other cables, keep in mind that low capacitance (less than 15 pF/ft.) is important for high-speed digital communication links.The cables listed below are all 24-gauge, 7x32 stranded, with 100-ohm nominal impedance and a capacitance of 12.5 pF/ft.

Select from the following two-, three-, and four-pair cables, depending on your application needs. All will yield satisfactory results. It is recommended that you choose a cable with one more pair than your application requires. Use one of the extra wires, not the shield, as the common.

Two-Pair:

- Belden P/N 8102 (with overall shield)
- Belden P/N 9729 (individually shielded)
- Belden P/N 8162 (individually shielded with overall shield)
- Manhattan P/N M3475 (individually shielded with overall shield)
- Manhattan P/N M39249 (individually shielded with overall shield)

Three-Pair:

- Belden P/N 8103 (with overall shield)
- Belden P/N 9730 (individually shielded)
- Belden P/N 8163 (individually shielded with overall shield)
- Manhattan P/N M3476 (individually shielded with overall shield)
- Manhattan P/N M39250 (individually shielded with overall shield)

Four-Pair:

- Belden P/N 8104 (with overall shield)
- Belden P/N 9728 (individually shielded)
- Belden P/N 8164 (individually shielded with overall shield)
- Manhattan P/N M3477 (individually shielded with overall shield)
- Manhattan P/N M39251 (individually shielded with overall shield)

G4LC32ISA-LT CONNECTORS

The following connector is used for the two serial ports on the G4LC32ISA-LT:

Green Pluggable 7-Position Terminal Mini-Plug

- Used for RS-232 and RS-485/422 connections from the G4LC32ISA-LT (COM0 and COM1)
- Manufactured by Phoenix Contact (P/N MC1,5/7-ST-3,81)

APPENDIX C

PRODUCT SPECIFICATIONS

Table C-1: G4LC32ISA-LT Product Specifications

Item	Specification
CPU	32-bit Motorola 68020 processor
CPU clock frequency	16.67 MHz
Memory: RAM Flash EEPROM on controller	 256 KB with battery backup (user programs and data) 256 KB (Firmware and user programs)
RAM/clock battery	3.6-volt lithium, non-rechargeable
Communication: COM0 COM1 RS-232 RS-485/422	 RS-485/422 or RS-232 RS-485/422 or RS-232 TX, RX, RTS, CTS, +5V, DTR, GND 2-wire, half-duplex 4-wire, half- or full-duplex
Real-time clock	Clock/calendar, Epson 72421A with battery backup
Power requirements	5 VDC at 1.5 A (maximum)
Typical operating temperature	-20° C to 70° C
Storage temperature	-40° C to 85° C
Humidity	5% to 95% relative humidity, non-condensing
Software	OptoControl, OptoDisplay, OptoServer, Cyrano, Mistic MMI, MDS
System monitors: Host communications Watchdog timers RAM battery backup low	 Detect communication errors from processor Detect main power supply operation Detects program corruption (checksum RAM test)

APPENDIX D

ADDRESS JUMPERS

The G4LC32ISA-LT includes eight address jumpers. To set the jumpers based on a predetermined address, refer to the chart below.

Note: *Address 0 is reserved and should not be used.*

For details on accessing and setting these jumpers, see Chapter 3.

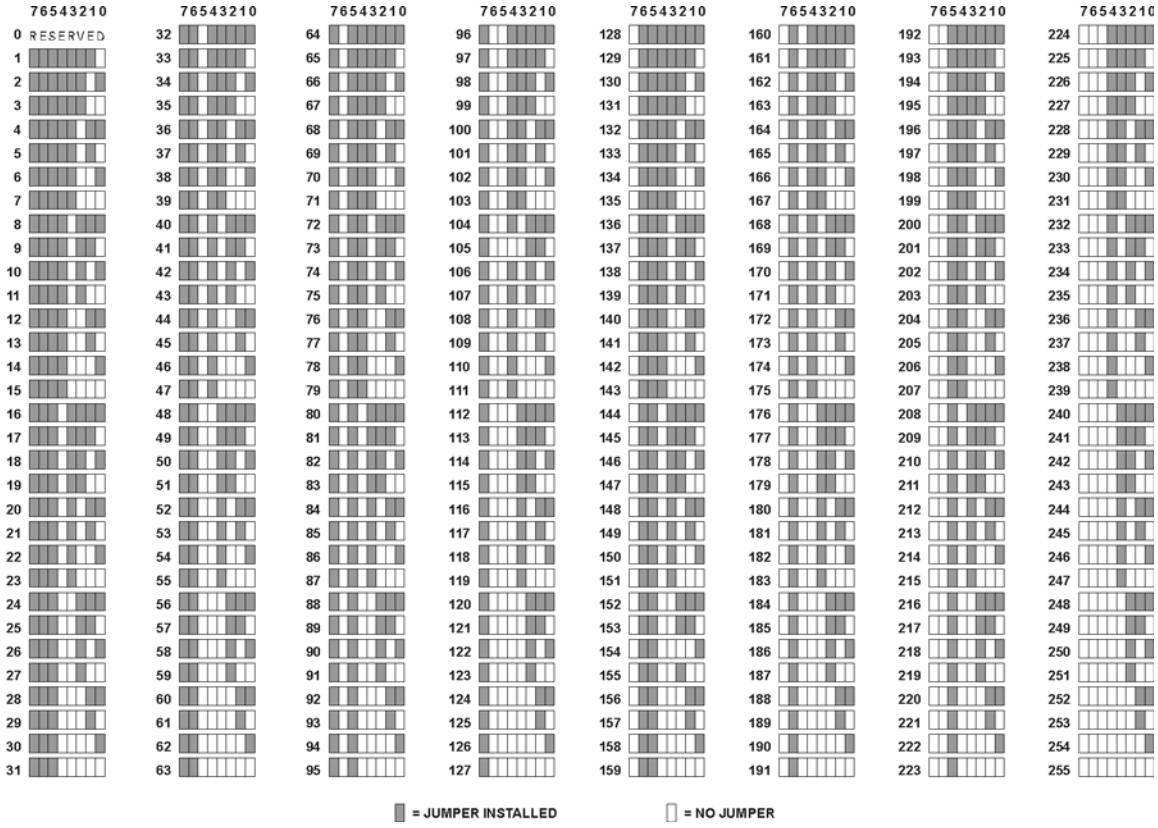


Figure D-1: G4LC32ISA-LT address jumper configurations

APPENDIX E

PRODUCT SUPPORT

If you have any questions about this product, contact Opto 22 Product Support Monday through Friday, 8 a.m. to 5 p.m. Pacific Time.

Phone:	800-TEK-OPTO (835-6786) 951-695-3080
Fax:	951-695-3017
E-mail:	support@opto22.com
Opto 22 Web site:	www.opto22.com

When calling for technical support, be prepared to provide the following information about your system to the Product Support engineer:

- Software and version being used
- Controller firmware version
- PC configuration
- A complete description of your hardware and operating systems, including:
  — jumper configuration
  — accessories installed (such as expansion daughter cards)
  — type of power supply
  — types of I/O units installed
  — third-party devices installed (e.g., barcode readers)
- Specific error messages seen

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