G4EB2 BRAIN

Features

- Upgrades older serial-based G4 and Quad Pak I/O to Ethernet-based I/O
- Equipped with two switched Ethernet network interfaces
- Multi-protocol communications and I/O processor
- Handles a mix of digital input and output modules in any position on one mounting rack
- No changes required to I/O and field wiring
- Multidrop capability

G4D32EB2

DESCRIPTION

The G4EB2 replaces a 32-channel digital brain in a serial or Pamux system with an Ethernet-based 32-channel digital brain that uses the OptoMMP protocol.

The G4EB2 provides physical compatibility, I/O module compatibility, and field-wiring compatibility with the older system. However, this brain uses a different protocol—OptoMMP instead of *mistic* or Pamux—and different commands. If you replace an older brain with the new part, you will need to change your program in order to communicate with the unit.

The G4EB2 brains are designed for extended or new applications and provide the option of using Ethernet and the OptoMMP protocol without disturbing I/O and field wiring.

G4D32EB2-UPG—Replaces a G4RS brain board on a G4D32RS *mistic* digital rack. This part number includes a G4EB2 brain and a metal cover designed to fit the brain's Ethernet connections.

G4D32EB2—A complete Ethernet version of the G4D32RS *mistic* digital rack. Includes a G4EB2 brain, a G4 module mounting rack, a G4REG onboard regulator, and a metal cover.

The G4D32EB2 is for new applications. For example, if you have a design that includes a G4D32RS, you could use the G4D32EB2 instead. It has the same footprint as the G4D32RS and the same field wiring.

G4EB2—Brain board only. Replaces a B4 brain board on a G4PB32H or PB32HQ rack. Can be used to replace a G4RS brain, but the old cover will not fit; part number G4D32EB2-UPG with the new cover is recommended.

NOTE: Remove the existing communication cable on the rack (RS-485 or ribbon); it might cause electronic interference.

Like the SNAP-PAC-EB2, the G4EB2 brain is a powerful and versatile I/O and network communications processor for your SNAP PAC System™. It is designed primarily to work in distributed systems controlled by a SNAP PAC programmable automation controller, but it can also be used as intelligent remote I/O in an Allen-Bradley® RSLogix®-based PLC system or as PC-based I/O.

Part Numbers

Part	Description
G4D32EB2	Ethernet I/O 32-Channel G4 Digital OptoMMP Brain, Rack, and Cover
G4D32EB2-UPG	Ethernet I/O Upgrade for G4D32RS Digital Rack
G4EB2	Ethernet I/O Upgrade for B4 Brain

The G4EB2 provides local intelligence that frees the controller for supervisory tasks. For example, each brain independently handles functions such as latching, watchdog timers, TPO, digital totalizing, and pulse generation. These functions continue to work on the brain even if communication with the controller is lost.

G4EB2 brains can also be used independently for standalone I/O processing and communication. They communicate over a standard 10/100 Mbps Ethernet network. Like the SNAP-PAC-EB2, the G4EB2 does not offer high-speed digital functions. For a complete list of brain features, see page 3.

Each G4EB2 brain is equipped with two switched Ethernet network interfaces. These interfaces support Auto MDI-X, which means you can use a standard straight-through Ethernet cable; a crossover cable is not needed for direct connection to a PC.

Because these interfaces share a single IP address and act just like an Ethernet switch, G4EB2 brains can be installed not only in a standard star configuration, but also in a daisy chain configuration, extending the control network without the expense of additional Ethernet network hardware.

The functionality, configuration, and commissioning of the G4EB2 brain board is similar to the SNAP-PAC-EB2 brain except that no analog I/O functionality is available. For point configuration, see the *PAC Manager User's Guide* (form 1704). For more information about the SNAP-PAC-EB2 brain, see the *SNAP-PAC Brains Users Guide (*form1690), and the *SNAP-PAC Brains Data Sheet (*form1689).

Multiple Protocol Support on Ethernet

In addition to I/O processing, G4EB2 brains support communication using multiple protocols running simultaneously over Ethernet, including EtherNet/IP™, Modbus®/TCP, SNMP for network management, FTP for the brain's built-in file system, SMTP (email client), and Opto 22's open memory-mapped OptoMMP protocol. Communication with OPC 2.0-compliant clients is available through OptoOPCServer (see Software, below).

Upgrading Existing Hardware

Use the following table to determine which part number you need to upgrade your existing hardware:

If you have this:	Order this part number:
G4RS brain board on a G4D32RS *mistic* digital brick	G4D32EB2-UPG
B4 brain board on a G4PB32H or PB32HQ rack	G4EB2

Note that the G4EB2 brain does not use either the *mistic* or Pamux protocols. If you are considering using it to replace a B4, be aware that performance is different; contact Product Support with any questions.

Software

G4EB2 brains are primarily designed for use with a SNAP PAC programmable automation controller. The controller runs a control program built with PAC Project™ software. (PAC Project version 9.2b or higher is required for use with the G4EB2.) The PAC Project software suite comes in two forms, Basic and Professional.

- **PAC Project Basic**, which is included in the purchase of a SNAP PAC controller, consists of control programming, human-machine interface (HMI) development and runtime, and configuration software.
- **PAC Project Professional** is available for purchase and adds SoftPAC, a software controller for PC-based control, OptoOPCServer™ for OPC connectivity, OptoDataLink™ for database communications, and additional features.

In addition to using a SNAP PAC controller with PAC Project software, you can communicate with G4EB2 brains using the open and documented OptoMMP protocol. Two OptoMMP toolkits are available on our website, www.opto22.com:

- The OptoMMP Communication Toolkit includes ActiveX components and C++ classes, so you can use programming tools such as Visual Basic or Visual C++ to communicate with the brains. See form 1465, the *OptoMMP Protocol Guide*, for more information.
- The .NET OptoMMP Messaging Toolkit is a 100% managed DLL which can be added to a C#, Visual Basic, or a CLR-enabled C++ project. You can use programming tools such as Visual Studio 2005, 2008, or 2010 to communicate with the brains. See form 1955, the *SNAP PAC .NET OptoMMP Messaging Toolkit Technical Note*, for more information.

Ethernet brains can also communicate with Allen-Bradley RSLogix® systems using EtherNet/IP (see Opto 22 form 1770, the *EtherNet/IP for SNAP PAC Protocol Guide*, on our website).

In addition, Ethernet brains communicate using Modbus/TCP; see Opto 22 form 1678, the *Modbus/TCP Protocol Guide*, for more information.

G4EB2 FEATURES

Ethernet networking: Two switched Ethernet wired network interfaces (one IP address)	
Ethernet network security (IP filtering, port access)	
I/O modules supported	Digital input and output modules
Digital I/O point features	Input latching
	Watchdog timer
	On/off status
	TPO (time-proportional output)
	Pulse generation (N pulses, continuous square wave, on-pulse, and off-pulse)
	Digital totalizing
Maximum number of modules: Any mixture of digital input and output modules up to 32 for G4 modules and up to 8 for 4-channel Quad Pak modules	
Scratch Pad area for peer-to-peer data (bits, floats, integers, strings)	
Realtime clock (RTC)	
OPC driver support	
OptoMMP memory-mapped protocol	
EtherNet/IP™ (Allen-Bradley® Logix systems and others)	
Modbus®/TCP	
SNMP (network management)	
FTP server, file system	
Email (SMTP client)	
UDP Streaming	
Digital events, Alarm events, Serial events	
Event messaging	
Data logging in the brain	
I/O point data mirroring	
Memory map data copying	

SPECIFICATIONS

G4EB2 Specifications

Input Power on G4D32RS with G4REG (no I/O)	24 VDC at 275 mA maximum (does not include module power requirements)
Input Power on G4PB32H or PB32HQ (no I/O)	5.0–5.2 VDC at 550 mA maximum (does not include module power requirements)
Memory	16 MB RAM
Wired Ethernet Network Interfaces	IEEE 802.3 network, 10Base-T and 100Base-TX. Automatic MDC/MDI-X crossover (Ethernet crossover cable not required for direct connection to PC). Two switched interfaces, allowing multi-drop (daisy-chain) or standard star network configuration.
Maximum Ethernet Segment Length	100 meters with Category 5 or superior UTP. For 100 Mbps at this distance, use Category 5 or superior solid UTP.
Backup battery for real-time clock	User replaceable BR2032 coin cell provides 10 years power off backup for system clock
Operating Temperature	0 to 70 °C
Storage Temperature	-40 to 85 °C
Humidity	0–95% humidity, non-condensing
Agency certifications	G4EB2 & G4D32EB2-UPG: CE, RoHS, DFARS; UKCA G4D32EB2: CE, RoHS, DFARS
Warranty	30 months from date of manufacture

Additional Specifications for G4D32EB2 Brick Base

Operating Temperature	0 to 70 °C 95% humidity, non-condensing
Interface Connectors Field Control Power	 Screw-type terminal strip accommodates up to 10 AWG wire Boxed header accepts a G4EB2 brain board Screw-type terminals accommodate up to 10 AWG wire

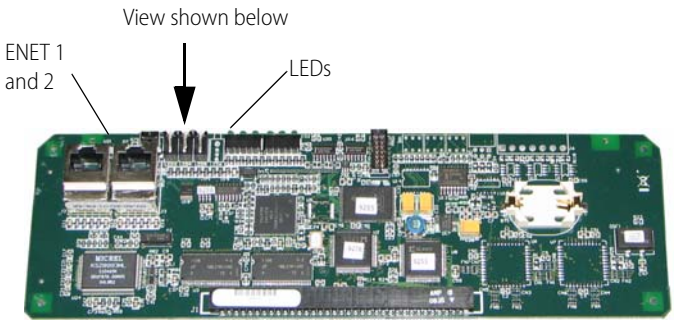
Switched Ethernet Network Interfaces

G4EB2 brains can be networked in a daisy-chain configuration or in a standard star configuration using either Ethernet interface. Both interfaces use the same IP address.

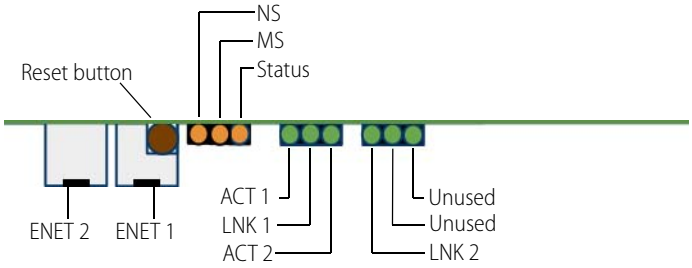
NOTE: When using a daisy-chain configuration, be aware that if power to a brain is lost, all brains beyond it on the network will also lose communication. Firmware on daisy-chained brains must be updated one at a time.

G4EB2 LEDS AND NETWORK INTERFACES

This diagram applies to part numbers G4EB2, G4D32EB2, and G4D32EB2-UPG.



LEDs: Location



LEDs: Purpose

LED	Indicates
LNK1	Link established with Ethernet network on ENET 1
LNK2	Link established with Ethernet network on ENET 2
ACT1	Activity on Ethernet network on ENET 1
ACT2	Activity on Ethernet network on ENET 2
Status	Brain status
NS	EtherNet/IP Network Status
MS	EtherNet/IP Module Status
Unused	Reserved for future use

LED Blink Codes

LEDs on the G4EB2 brain use blink codes to indicate operation and status. Blink codes provide useful information during operation and in troubleshooting.

Self-Test LED Sequence at Startup

When you first turn on the brain, you'll see the following LED sequence. This is a self test.

Duration (seconds)	MS LED	NS LED
0.25	Green	Off
0.25	Red	Off
0.25	Green	Green
0.25	Green	Red
0.25	Off	Off
0.25	On	Flash On

Normal LED Behavior: MS and NS LEDs

Once the self-test is finished, normal LED behavior is as shown in the following tables.

MS LED—Applies only when using EtherNet/IP

LED	Description
Steady Off	No power
Steady Green	Operational. Device has been configured and can operate normally.
Flashing Green	Standby. Device does not have a valid IP configuration.
Flashing Red	Minor fault. A recoverable fault has occurred.
Steady Red	Major fault. A non-recoverable fault has occurred.

NS LED

LED	Description
Steady Off	The device does not have a valid IP address or has no power.
Flashing Green	EtherNet/IP only: No connections
Steady Green	EtherNet/IP only: Connected
Flashing Red	EtherNet/IP only: Connection Timeout

STAT LED—Green

If the STAT LED is on and remains green, the brain has an IP address and is operating normally.

If the STAT LED blinks green when the brain starts up, it indicates the following:

Number of Blinks	Speed of Blinks	Means
2	fast	Normal; the brain's firmware is starting up.
5	fast	Default settings have been successfully restored.
7	fast	Entering failsafe bootloader mode. (See "Resetting the Brain" on page 7 for more information.)

STAT LED—Orange

On an G4EB2 brain, if the STAT LED blinks orange about four times a second, the device is attempting to obtain an IP address by sending BootP requests.

If the STAT LED blinks orange fast and continuously after you pushed the RESET button, the device is in hardware test mode. See "Resetting the Brain" on page 7 for more information.

STAT LED—Red and Green

If the STAT LED blinks red and green alternately, it indicates that the brain is in failsafe bootloader mode. See "Resetting the Brain" on page 7 for more information.

STAT LED—Red

If the STAT LED blinks red, it indicates the following:

Number of Blinks	Speed of Blinks	Means	Problem and Workaround
4	slow	Invalid MAC address or hardware revision	Contact Product Support.
5	slow	Fatal error	Firmware or hardware problem. Check the power supply and connections before restarting. Call Product Support if the error is repeated.
6	slow	RAM error	Contact Product Support.
7	slow	Ethernet switch failure	Contact Product Support.
11	slow	Ethernet loopback test failure	Contact Product Support.
13	slow	Real-time clock failure	Contact Product Support.
16	slow	Serial flash failure	Contact Product Support.
20	slow	Digital failure	Contact Product Support.
21	slow	Bus failure	Contact Product Support.

Resetting the Brain

1. Carefully push the Reset button. (See the LEDs diagram on page 5 for the button's location.)
2. Depending on the type of reset you need, press and hold down the Reset button as described below. DO NOT hold the button down too long.

NOTE: Do not reset the brain to hardware test mode unless Opto 22 Product Support tells you to.

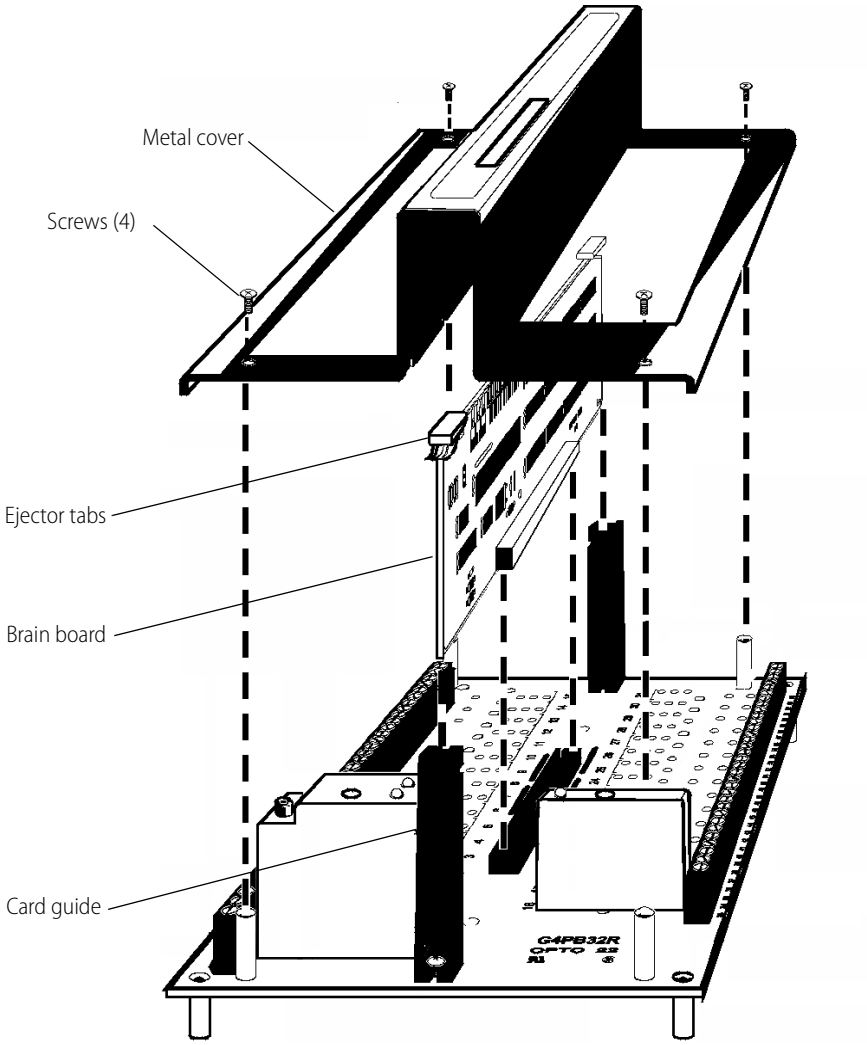
Reset type	How to use the reset button	What happens	Notes
Simple reset	Press and release immediately	Brain restarts. Files in RAM are erased. Files in flash memory are untouched.	
Restore factory defaults	Press just until STAT LED turns solid green (1-2 sec)	Brain restarts. Files in RAM and flash memory are erased. I/O configuration in flash is erased. IP address is reset to 0.0.0.0 and subnet mask to 255.255.255.0.	You have to reassign the IP address and subnet mask.
Failsafe bootloader mode	Press and wait until LED turns solid green. Release when LED starts to blink (2-5 sec)	Brain restarts. Files in RAM are erased. Files in flash memory are untouched.	Cycle power to recover. Result is the same as a simple reset.
Hardware test mode	Press and hold until LED starts blinking orange rapidly and continuously (> 5 sec)	Brain restarts. Files in RAM and flash memory are erased. I/O configuration in flash is erased. IP address is reset to 0.0.0.0 and subnet mask to 255.255.255.0.	Cycle power to recover. Result is the same as restoring to factory defaults. You have to reassign the IP address and subnet mask.

INSTALLING THE BRAIN BOARD AND METAL COVER IN A G4D32RS

Follow these steps to install the components of the G4D32EB2-UPG upgrade kit in an G4D32RS *mistic* digital brick. The components include a G4EB2 brain board and new metal cover.

1. Turn off power to the unit.
2. Unscrew the four screws securing the old metal cover. Save the screws.
3. Remove the old metal cover from the G4D32RS, and do not reinstall it. The old metal cover is not compatible with the G4EB2 brain board.
4. Using the ejector tabs, remove the *mistic* G4RS brain board from the G4D32RS.
5. Insert the G4EB2 brain into the card guides in place of the *mistic* brain board.
6. Install the new metal cover and secure it in place with the four screws.

Configuring and commissioning the G4EB2 is similar to the SNAP-PAC-EB2. For more information about the SNAP-PAC-EB2 brain, see the *SNAP PAC Brains Users Guide (*form1690), and the *SNAP PAC Brains Data Sheet (*form1689). *To add I/O points when not using a SNAP PAC controller, see the special section for the G4EB2 in chapter 2 of the PAC Manager User's Guide (form 1704).*

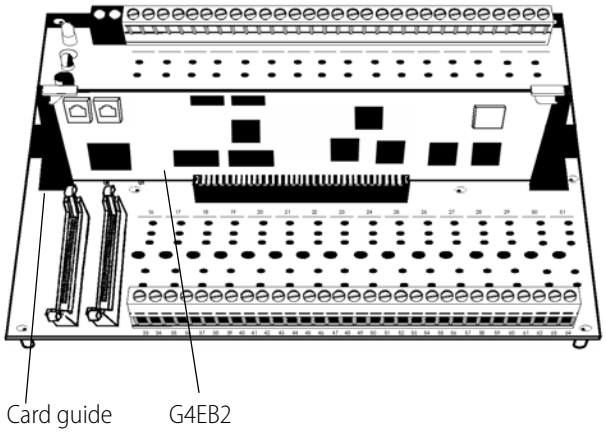


CONNECTING A G4EB2 BRAIN BOARD TO A G4PB32H OR PB32HQ RACK

The G4EB2 brain board plugs into a box connector on a G4PB32R, G4PB32H or PB32HQ I/O mounting rack and is secured by vertical card guides.

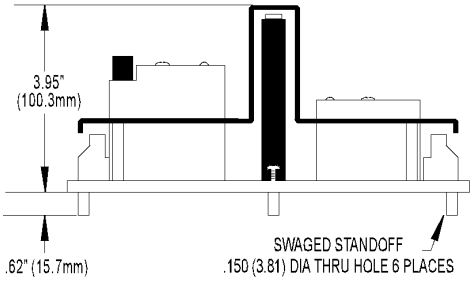
NOTE: The existing ribbon cable might cause electronic interference and should be removed.

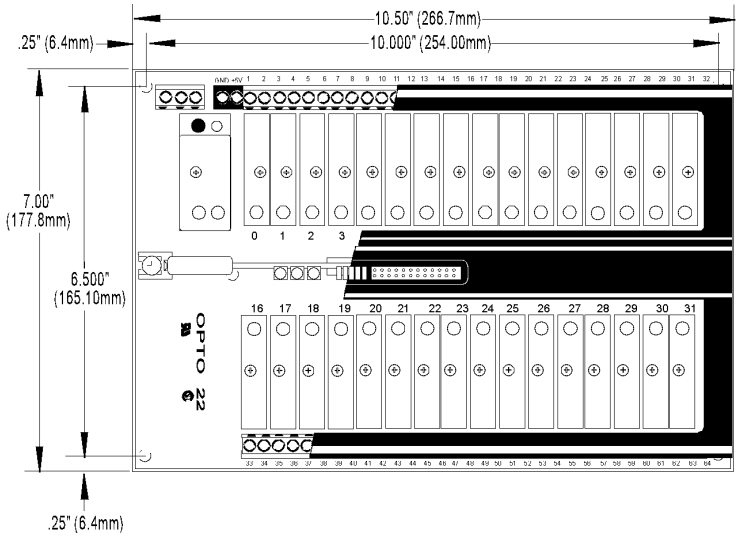
1. Turn off power to the unit.
2. Using the ejector tabs, remove the *mistic* B4 brain board from the G4D32RS.
3. Insert the G4EB2 brain into the card guides in place of the *mistic* brain board.



MOUNTING THE G4D32EB2

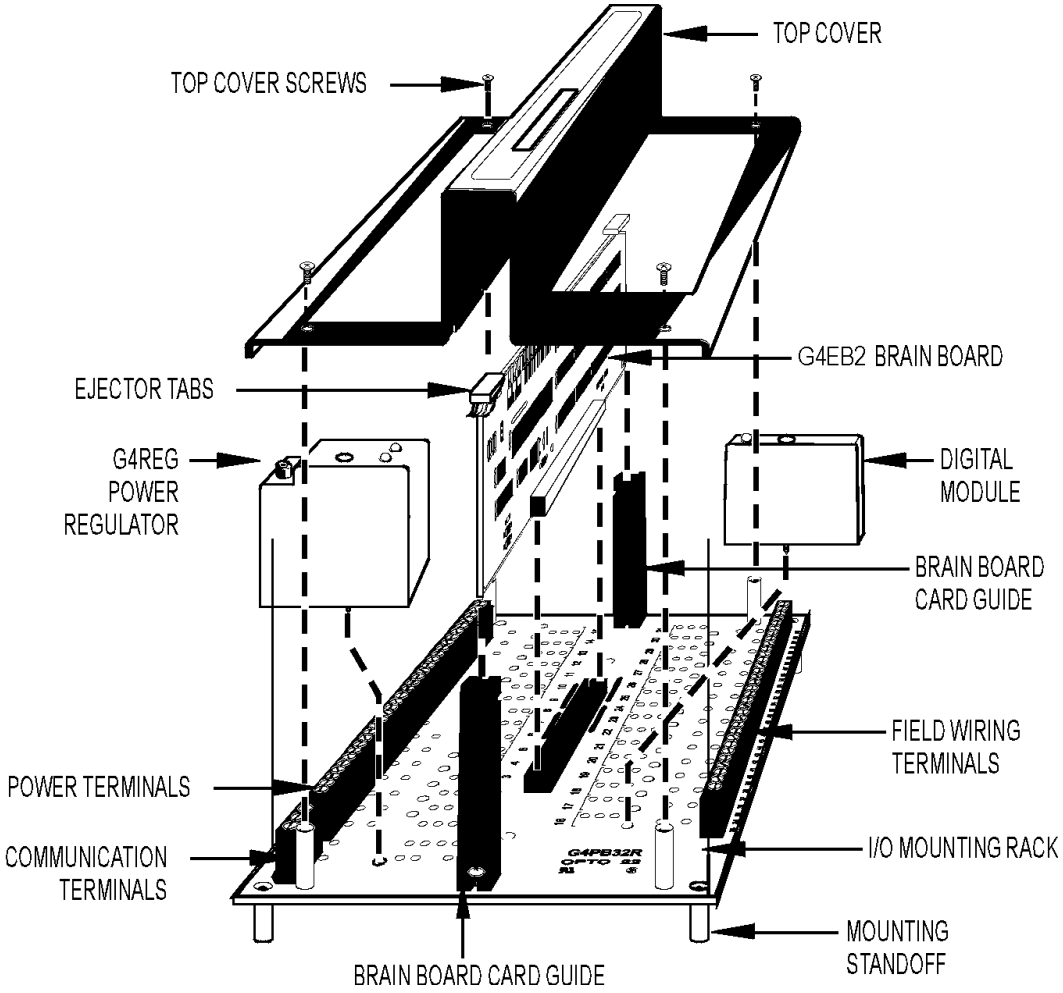
1. Remove the four top cover screws and lift off the top cover.
2. Affix the G4D32EB2 to an enclosure or panel, using the mounting standoffs shown here.
3. Connect power, field, and communication wiring. Refer to the appropriate sections in this document for instructions.
4. Replace the top cover and secure to the mounting rack with the top cover screws.





ASSEMBLING THE G4D32EB2

The G4D32EB2 is a high-I/O-capacity digital unit for the PAC family of PC-based control products. Each unit offers single-point on/off control and latching for up to 32 digital I/O points.

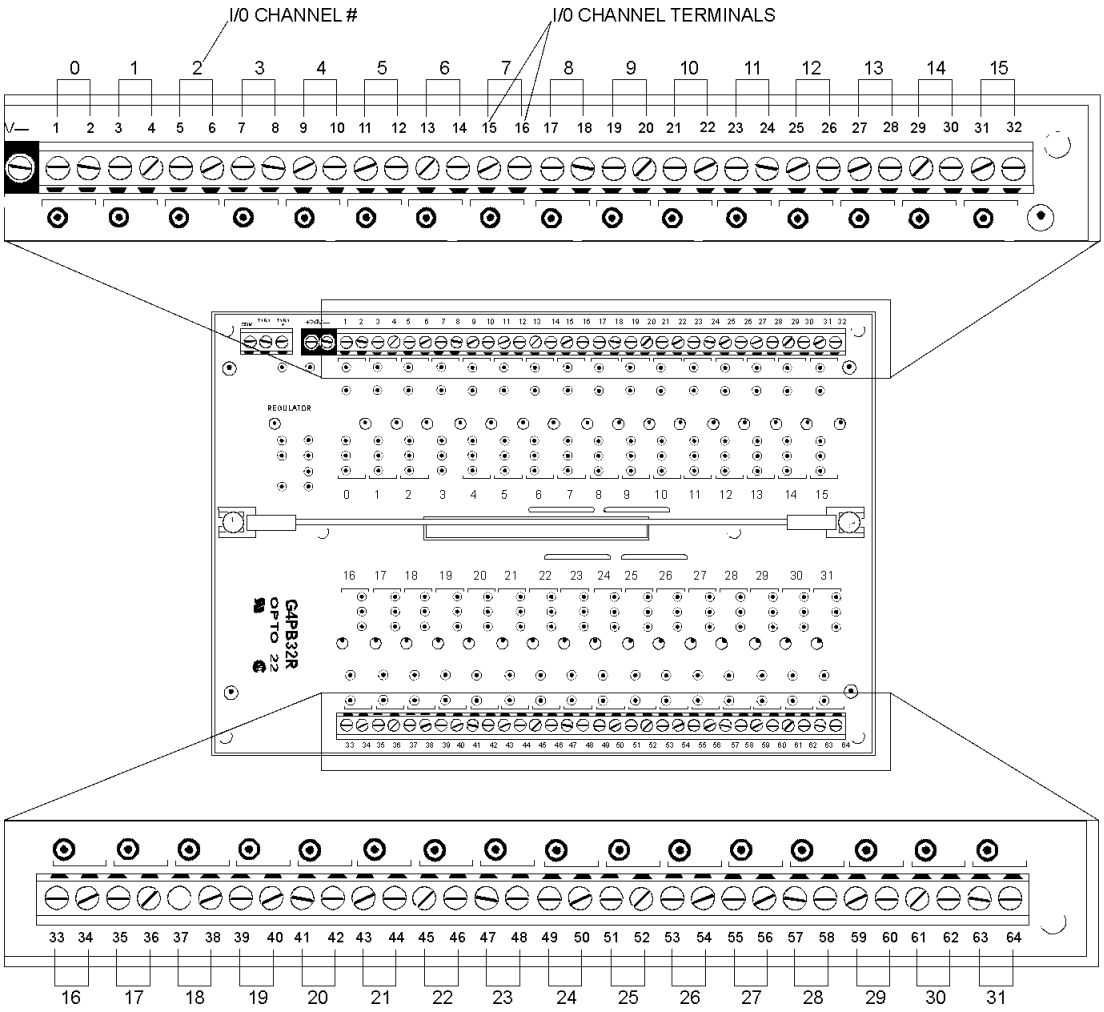


CONNECTING FIELD WIRING TO THE G4D32EB2

***CAUTION**: **Turn off power** to the G4D32EB2 before connecting or removing field wiring.*

The following illustration shows the location of the field wiring terminals on the G4D32RS and the layout of the terminal points as they correspond to each channel. Field wiring terminals accept up to 10 AWG wire.

Each channel has a positive (+), odd numbered terminal and a negative (–), even numbered terminal. Connect the positive wire from your field device to the channel's positive terminal, and then connect the negative wire to the negative terminal. The table on page 12 lists the channel numbers and their respective field terminals.



CHANNEL POSITIONS AND FIELD TERMINALS ON THE G4D32EB2

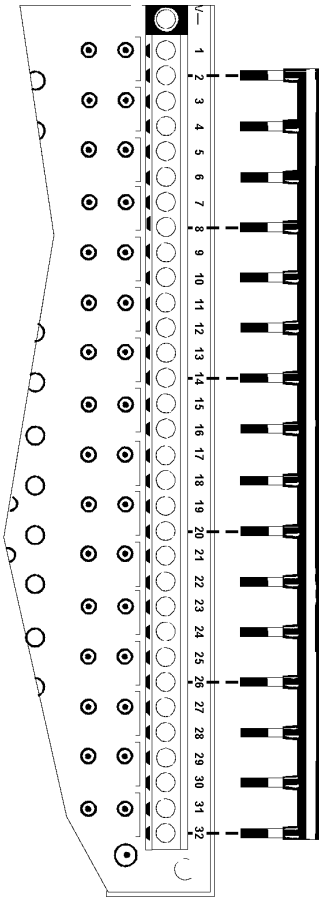
This table shows the channel numbers and their respective field terminals on the G4D32EB2. See "Connecting a G4EB2 Brain Board to a G4PB32H or PB32HQ Rack" on page 9.

Module Position	Field (Terminal Strip) + and -
0	1 and 2
1	3 and 4
2	5 and 6
3	7 and 8
4	9 and 10
5	11 and 12
6	13 and 14
7	15 and 16
8	17 and 18
9	19 and 20
10	21 and 22
11	23 and 24
12	25 and 26
13	27 and 28
14	29 and 30
15	31 and 32
16	33 and 34
17	35 and 36
18	37 and 38
19	39 and 40
20	41 and 42
21	43 and 44
22	45 and 46
23	47 and 48
24	49 and 50
25	51 and 52
26	53 and 54
27	55 and 56
28	57 and 58
29	59 and 60
30	61 and 62
31	63 and 64

BUSSING POINTS TOGETHER ON THE G4D32EB2

Several field terminals may be bussed together by using Opto 22 part number G4STRAP. One G4STRAP may jumper up to 16 positions.

It may also be trimmed to jumper fewer points together. The following example shows how the G4STRAP is used on the G4D32EB2.



G4EB2 DIMENSIONS

More about Opto 22

OPTO 22

PRODUCTS

Opto 22 develops and manufactures reliable, easy-to-use, open standards-based hardware and software products. Industrial automation, process control, remote monitoring, data acquisition, and industrial internet of things (IIoT) applications worldwide all rely on Opto 22.

groov RIO®

groov RIO edge I/O offers a single, compact, PoE-powered industrial package with web-based configuration and IIoT software built in, support for multiple OT and IT protocols, and security features like a device firewall, data encryption, and user account control.

Standing alone, *groov* RIO connects to sensors, equipment, and legacy systems, collecting and securely publishing data from field to cloud. Choose a universal I/O model with thousands of possible field I/O configurations, with or without Ignition from Inductive Automation®, or a RIO EMU energy monitoring unit that reports 64 energy data values from 3-phase loads up to 600 VAC, Delta or Wye.

You can also use *groov* RIO with a Modbus/TCP master or as remote I/O for a *groov* EPIC system.

groov EPIC® System

Opto 22's *groov* Edge Programmable Industrial Controller (EPIC) system gives you industrially hardened control with a flexible Linux®-based processor with gateway functions, guaranteed-for-life I/O, and software for your automation and IIoT applications.

groov EPIC Processor

The heart of the system is the *groov* EPIC processor. It handles a wide range of digital, analog, and serial functions for data collection, remote monitoring, process control, and discrete and hybrid manufacturing.

In addition, the EPIC provides secure data communications among physical assets, control systems, software applications, and online services, both on premises and in the cloud. No industrial PC needed.

Configuring and troubleshooting I/O and networking is easier with the EPIC's integrated high-resolution color touchscreen. Authorized users can manage the system locally on the touchscreen, on a monitor connected via the HDMI or USB ports, or on a PC or mobile device with a web browser.

groov EPIC I/O

groov I/O connects locally to sensors and equipment. Modules have a spring-clamp terminal strip, integrated wireway, swing-away cover, and LEDs indicating module health and discrete channel status. *groov* I/O is hot swappable, UL Hazardous Locations approved, and ATEX compliant.

groov EPIC Software

The *groov* EPIC processor comes ready to run the software you need:

- Programming: Choose flowchart-based PAC Control, CODESYS Development System for IEC61131-3 compliant programs, or secure shell access (SSH) to the Linux OS for custom applications
- Node-RED for creating simple IIoT logic flows from pre-built nodes
- Efficient MQTT data communications with string or Sparkplug data formats
- HMI: *groov* View to build your own HMI viewable on touchscreen, PCs, and mobile devices; PAC Display for a Windows HMI; Node-RED dashboard UI
- Ignition or Ignition Edge® from Inductive Automation (requires license purchase) with OPC-UA drivers to Allen-Bradley®, Siemens®, and other control systems, and MQTT communications

Older products

From solid state relays, to world-famous G4 and SNAP I/O, to SNAP PAC controllers, older Opto 22 products are still supported and working hard at thousands of installations worldwide. You can count on us for the reliability and service you expect, now and in the future.

QUALITY

Founded in 1974, Opto 22 has established a worldwide reputation for high-quality products. All are made in the U.S.A. at our manufacturing facility in Temecula, California.

Because we test each product twice before it leaves our factory rather than testing a sample of each batch, we can afford to guarantee most solid-state relays and optically isolated I/O modules for life.

FREE PRODUCT SUPPORT

Opto 22's California-based Product Support Group offers free technical support for Opto 22 products from engineers with decades of training and experience. Support is available in English and Spanish by phone or email, Monday–Friday, 7 a.m. to 5 p.m. PST.

Support is always available on our website, including free online training at OptoU, how-to videos, user's guides, the Opto 22 KnowledgeBase, and OptoForums.

PURCHASING OPTO 22 PRODUCTS

Opto 22 products are sold directly and through a worldwide network of distributors, partners, and system integrators. For more information, contact Opto 22 headquarters at **800-321-6786** (toll-free in the U.S. and Canada) or **+1-951-695-3000**, or visit our website at www.opto22.com.

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