

# OPTO 22

## DATA SHEET

Form 463-050728

# BRAIN BOARDS CLASSIC ANALOG AND DIGITAL

page 1/10

Part Number	Description
B1	16-Channel Digital Optomux Protocol Brain Board
B2	16-Channel Analog Optomux Protocol Brain Board

### Description

Opto 22 **B1** (digital) and **B2** (analog) Optomux® brain boards are intelligent digital processors that operate as slave devices to a host computer. Each brain board contains a microprocessor that provides the necessary intelligence to communicate with a host computer and also perform control functions at each channel of I/O.

The B1 and B2 brain boards are designed to mount on most Opto 22 I/O mounting racks that have header connectors. I/O mounting racks that accept single-channel standard and G4 I/O modules, Quad Pak™ I/O modules, or SNAP I/O™ modules—and racks that have built-in integrated I/O circuitry—are all available.

### Networking

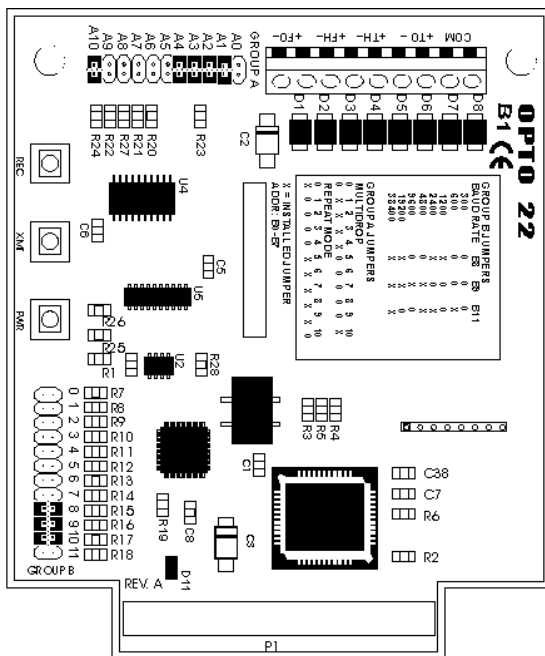
B1s and B2s communicate with a host computer via an RS-

422/485 serial link using twisted-pair cable that connects to each Optomux unit (brain board plus rack). The serial data link operates at selectable baud rates from 300 baud to 38.4 Kbaud.

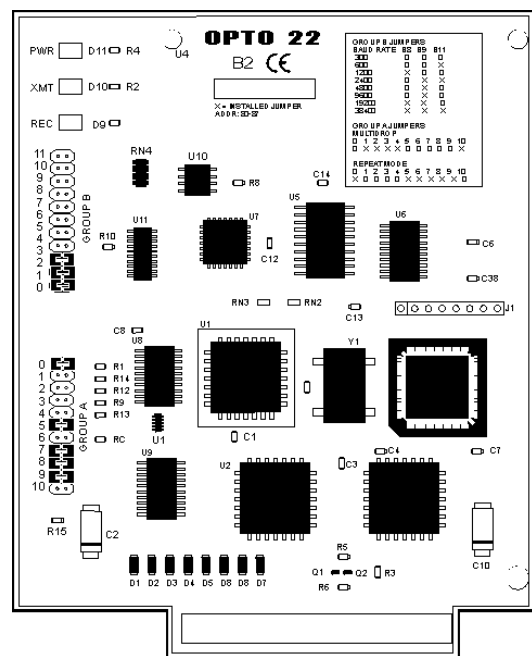
Optomux units can be configured for either multidrop or repeat mode operation. In multidrop mode, up to 32 Optomux units can be networked over a total line length of up to 5,000 feet. Additional units can be added by using a repeater. In repeat mode operation, up to 256 Optomux units can be networked with up to 5,000 feet between units.

To use Optomux I/O on an Ethernet network, use Opto 22's E1 or E2 brain boards. These boards can use both serial and Ethernet networks simultaneously, and are drop-in replacements for B1s and B2s. See the E1 and E2 data sheet (Opto 22 form 1546) for information.

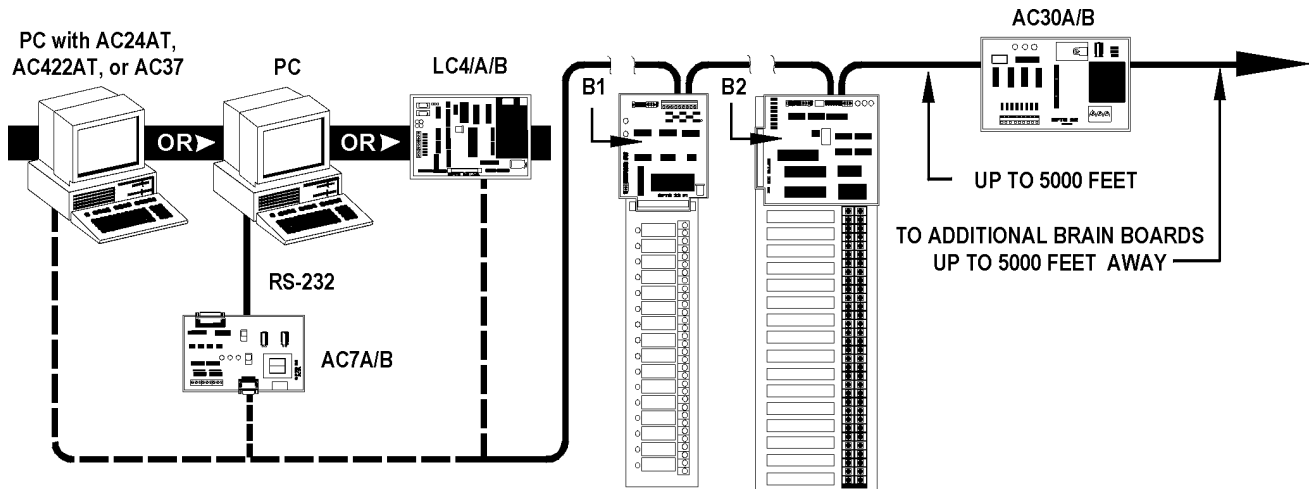
**B1 Digital Brain Board**



**B2 Analog Brain Board**



### System Architecture



### Functions

#### B1 (Digital) Functions

- Read Point
- Write Point
- Latch Point
- Count
- Pulse Duration
- Time Delay
- Pulse Generation

#### B2 (Analog) Functions

- Read Point
- Write Point
- Input Averaging
- Min/Max (peak and valley) Recording
- Gain and Offset Calculation
- Waveform Generation

For complete information on supported Optomux commands, see Opto 22 form #1572.

### Specifications

B1 Power Requirements	5 VDC $\pm$ 0.1 V @ 0.5 amps (includes digital module requirements)
B2 Power Requirements	5 VDC $\pm$ 0.1 V @ 0.5 amps (excludes analog module requirements*)
Operating Temperature	0° C to 70° C 95% humidity, non-condensing
Interface	RS-422/485 communications 50-pin female header connector to I/O mounting rack
Data Rates	300, 600, 1200, 2400, 4800, 9600, 19200, and 38400 baud
Range: Multidrop Repeat Mode	Up to 5,000 feet total length with up to 32 Optomux stations maximum. ** Up to 5,000 feet between stations with up to 256 Optomux stations maximum.
Communications	Full duplex, two twisted pairs, a signal common wire, and a shield
LEDs	Power, receive, and transmit
Jumper-selectable Options	Address (0 to 255) Baud rate Multidrop or repeat mode 2- or 4-pass protocol

\*\*  $\pm$ 15 VDC  $\pm$  0.25 V required for the analog modules. Current depends on the number and type of modules installed. A 24 VDC power supply is required for analog modules that need a current loop source.

\* Extend line length and/or number of OPTOMUX stations with the AC30A/B network adapter.

### Compatible I/O Racks

	B1 (Digital)	B2 (Analog)
<b>SNAP</b>	SNAP-D4M, SNAP-D4MC, SNAP-D4MC-P	none
<b>G4</b>	G4PB8H, G4PB16H, G4PB16HC	none
<b>Quad</b>	PB16HQ	none
<b>Standard</b>	PB4H, PB8H, PB16H, PB16HC	PB4AH, PB8AH, PB16AH
<b>Integral I/O Racks</b>	PB16J/K/L, PB16J/K/L	none

## Installation and Wiring

### Power Requirements

The B1 and B2 brain boards require +5 volts DC ( $\pm 0.1$  VDC) at 0.5 amps.

Although it is possible to distribute DC from a common power supply to several locations, better noise immunity is obtained by having separate power supplies at each physical location where a rack/brain board unit is installed. The +5 VDC power supply is connected to the I/O mounting rack beneath the removable brain board portion of the digital Optomux unit.

Analog racks also require +15 VDC and -15 VDC ( $\pm 0.25$  VDC) to power the analog I/O modules. The amount of power required depends on the type and number of analog I/O modules that are plugged into the Optomux unit. See the data sheets for your modules; power requirements for each module are included in the module specifications.

Analog racks also provide terminals for a separate +24 volt supply that can be used for powering a 4–20 mA current loop using 4–20 mA analog I/O modules. For this type of application, the +24 volt supply is required in addition to the supplies mentioned

above. Refer to the module's data sheet for information on wiring 4–20 mA modules with a loop supply.

The current requirements given for the output modules are only for the modules. To determine what size power supply is needed, add the load requirements for each module to determine total power supply requirements.

NOTE: Use only isolated supplies with Optomux products. Isolated supplies reduce the risk of ground loops in the communication wiring. Do not connect the power supply's DC common to earth ground. Linear power supplies are recommended.

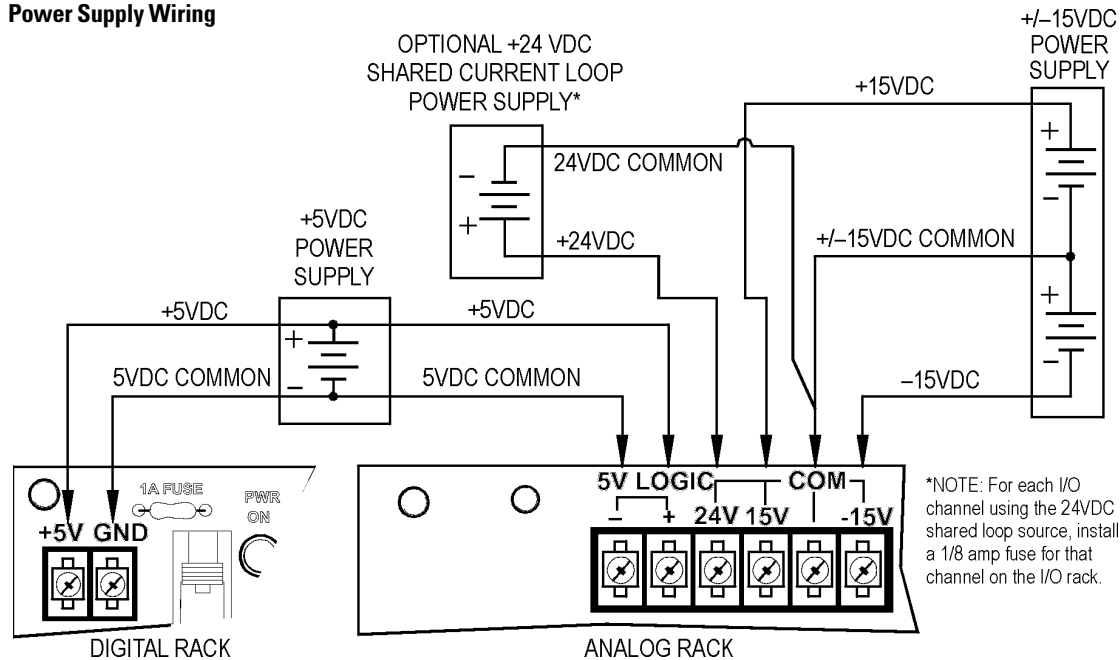
### Connecting the Power Supply

The diagram below shows how to connect the power supply.

Connect 5-volt power to the barrier strip connectors marked "+5V" and "GND" on the mounting rack. If the +5-volt supply is used by more than one unit or by other devices, make sure the voltage at each rack is 5 VDC ( $\pm 0.1$  V).

The +5-volt and  $\pm 15$ -volt wires should be routed away from any high-voltage field wires. There should only be one "earth"

### Power Supply Wiring



### Installation and Wiring (continued)

ground connection per network, typically at the host site. If the ground connection is at the host site, make sure none of the power supplies is grounded. This method prevents ground loop problems due to offset voltages appearing between multiple ground points.

If an Opto 22 PBSA/B/C power supply is used with the digital racks, the +5VDC logic connection is made by the supply when it is screwed to the rack. In this case, the only connection required is the 120 VAC (220 VAC or 10–28 VDC depending on supply type) connection to the PBSA (or PBSB or PBSC) supply.

Separate or combined +5 VDC ( $\pm 0.1$  VDC) and  $\pm 15$  VDC ( $\pm 0.25$  VDC) supplies can be used to provide power to analog racks. When using a multiple-output supply, make sure that the 5 VDC RETURN line is separate from the 15-volt COMMON line. Otherwise, the analog modules will not be isolated.

**CAUTION:** Check polarities of all power supply connections before applying power. Incorrect polarity will damage the brain board and I/O modules.

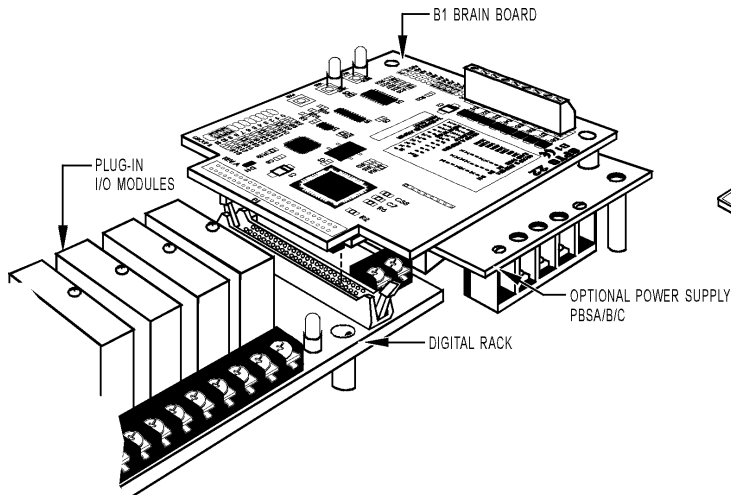
Use a consistent color code from the power supply to all brain boards to prevent wiring errors. Size 18 AWG or larger is recommended for power supply wiring.

The high cost of electrical wiring and the susceptibility of analog signals to noise make it desirable to place the brain board as close as possible to the controlled device.

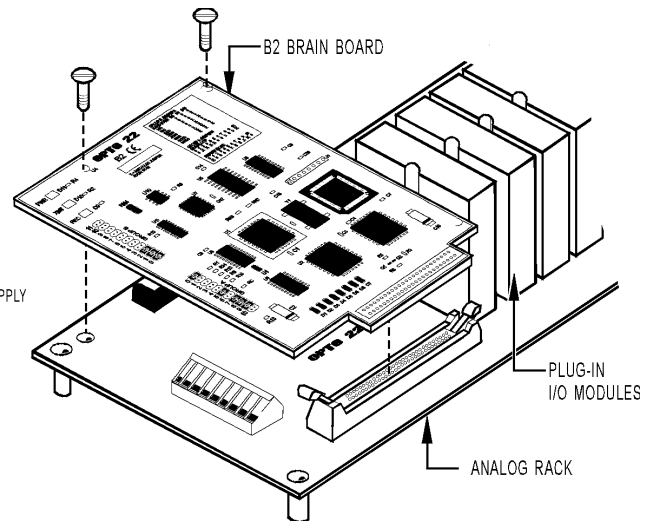
The default communication mode for the B1 and B2 brain boards is multidrop. When wiring a multidrop communications cable, keep in mind that the cable is a high-speed data-transmission line. To reduce reflections, make sure the line is terminated properly at both ends and that all stubs are less than three inches long.

Repeat mode is a jumper-selectable option. In this configuration, each brain board acts as a repeater, allowing up to 5,000 feet between units. Since a power failure at any unit breaks the communications link, battery backup is recommended. Note that you cannot mix units operating in repeat mode and units operating in multidrop mode on the same network.

**B1 Brain Board with Digital Mounting Rack**



**B2 Brain Board with Analog Mounting Rack**



## Installation and Wiring (continued)

### Installing the Brain Board on the Mounting Rack

The B1 or B2 brain board plugs into the mounting rack using the 50-pin connector. The figures on the previous page show how to install the brain board on the mounting rack. When properly installed, the B1 (digital) brain board extends away from the rack, while the B2 (analog) brain board covers up the communications and power wiring on the rack.

The unit can be mounted in any attitude on any flat surface. Both the mounting rack and the brain board are supplied with permanently attached standoffs. All the standoffs should be secured for maximum physical strength. Be sure to leave sufficient space between adjacent units for the I/O wiring.

### Installing I/O Modules

**CAUTION!** Be sure that all power to unit and to the controlled devices is removed before installing or removing I/O modules.

Input and output modules can be installed in any rack position. For specifications and wiring information on modules, see the module's data sheet.

### Communication Cables

The following cables are recommended for RS-485/422 serial communications. 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 four-, three-, and two-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, rather than the shield, for the common.

#### 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)

#### 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)

#### 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)

### Wiring Diagrams

A complete connection at each brain board consists of 10 wires: two twisted pairs and a common coming from the computer or previous brain board, and two twisted pairs and a common going to the next brain board.

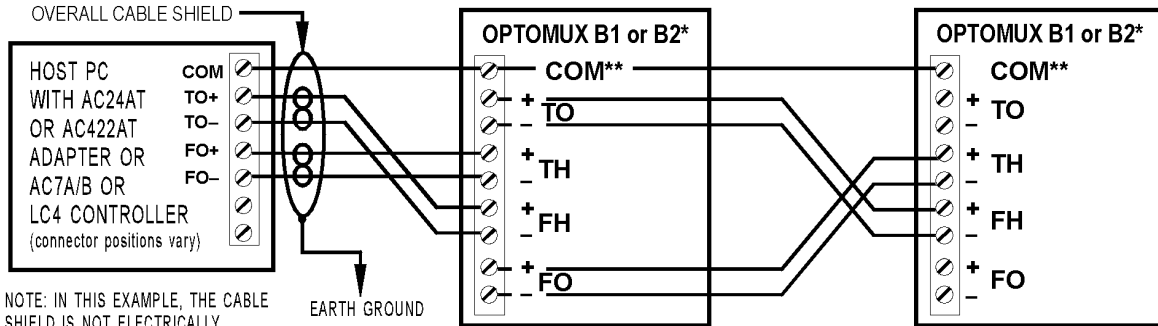
The following page shows standard and alternate wiring diagrams. It also shows jumper settings for repeat and multidrop modes and for proper termination and biasing. When wiring a series of Optomux units, always think of the previous Optomux unit as the host.

To ensure reliable communications, we recommend the following:

- Use shielded twisted-pair wires for the communications wiring. (See recommended cables on this page.)
- Route the communication and DC power wiring separately from any high-voltage field wiring or AC power wiring.
- Make sure the communications COM terminals on each rack are connected.

Form 463-050728

### STANDARD CONFIGURATION

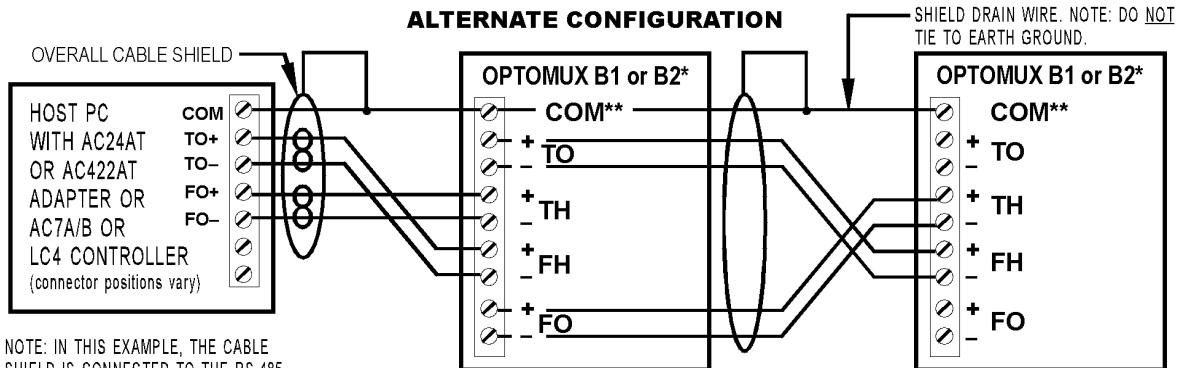


NOTE: IN THIS EXAMPLE, THE CABLE SHIELD IS NOT ELECTRICALLY CONNECTED TO THE RS-485 COM (COMMON) TERMINALS

TO = TO OPTOMUX  
FO = FROM OPTOMUX  
TH = TO HOST  
FH = FROM HOST

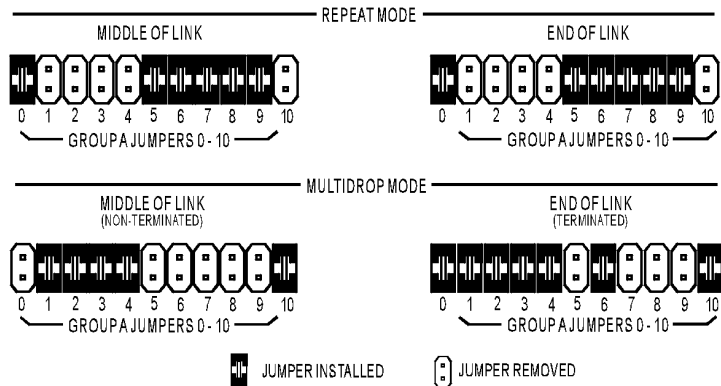
\*B2 COMMUNICATIONS WIRING CONNECTIONS ARE MADE TO THE RACK, NOT TO THE BRAIN BOARD. ON THE RACK, THE COM CONNECTOR IS AT THE OTHER END OF THE CONNECTOR STRIP.  
\*\*DO NOT CONNECT ANY COM POINT TO EARTH GROUND.

### ALTERNATE CONFIGURATION



NOTE: IN THIS EXAMPLE, THE CABLE SHIELD IS CONNECTED TO THE RS-485 COM (COMMON) TERMINALS, BUT THE SHIELD IS NOT EARTH GROUNDED.

IN ORDER TO MEET PUBLISHED SPECIFICATIONS, THE RS-485 SERIAL LINK REQUIRES TWO TERMINATIONS, ONE AT EACH END OF THE SERIAL LINK. STAR CONFIGURATION IS NOT ALLOWED. IN ORDER TO USE A STAR CONFIGURATION, USE OPTO 22 PART NUMBER AC30A/B.





### Specifications: Jumpers

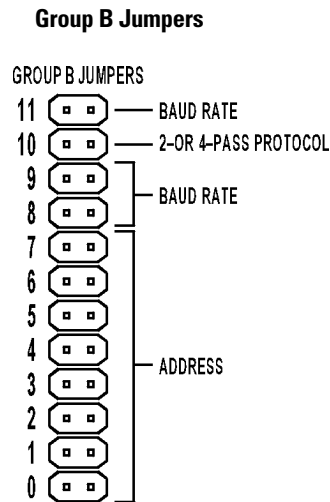
The two groups of jumpers on the B1 and B2 brain boards are labeled Group A and Group B.

**Jumpers in Group A** route wiring for repeat or multidrop mode communications and also provide proper termination and biasing. All brain boards on the same network must operate in the same mode. Jumper settings for Group A are shown with the wiring diagrams on page 7.

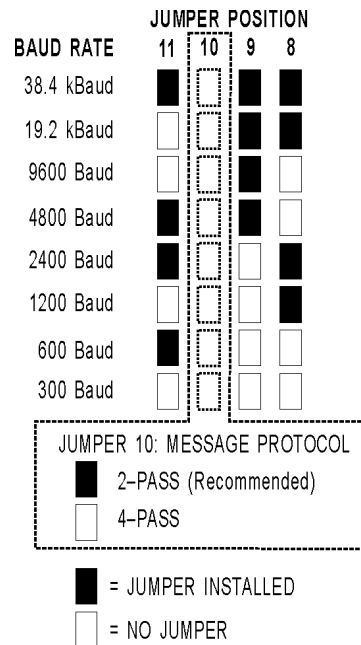
**Jumpers in Group B** set the address and baud rate and also determine the message protocol. See the following page for address jumper settings.

Select the baud rate using jumpers 8, 9, and 11 in Group B, according to the diagram below. All units on the same network should be set for the same baud rate.

The message protocol can be set as 2-pass or 4-pass. Use 2-pass for normal operation. The 4-pass protocol may be useful during troubleshooting, because it allows the host to examine and display the command message the brain board received before the command is executed. See the diagram below for jumper settings on message protocol.



### Baud Rate and Message Protocol Jumpers





### Address Jumpers

Set the Address jumpers (Group B, jumpers 0–7) according to the following chart. Each brain board on the same network must have a unique address. Addresses do not need to be sequential.

7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0	7 6 5 4 3 2 1 0
0 ■■■■■■■■	43 ■■■■■■■■	86 ■■■■■■■■	129 ■■■■■■■■	172 ■■■■■■■■	214 ■■■■■■■■
1 ■■■■■■■■	44 ■■■■■■■■	87 ■■■■■■■■	130 ■■■■■■■■	173 ■■■■■■■■	215 ■■■■■■■■
2 ■■■■■■■■	45 ■■■■■■■■	88 ■■■■■■■■	131 ■■■■■■■■	174 ■■■■■■■■	216 ■■■■■■■■
3 ■■■■■■■■	46 ■■■■■■■■	89 ■■■■■■■■	132 ■■■■■■■■	175 ■■■■■■■■	217 ■■■■■■■■
4 ■■■■■■■■	47 ■■■■■■■■	90 ■■■■■■■■	133 ■■■■■■■■	176 ■■■■■■■■	218 ■■■■■■■■
5 ■■■■■■■■	48 ■■■■■■■■	91 ■■■■■■■■	134 ■■■■■■■■	177 ■■■■■■■■	219 ■■■■■■■■
6 ■■■■■■■■	49 ■■■■■■■■	92 ■■■■■■■■	135 ■■■■■■■■	178 ■■■■■■■■	220 ■■■■■■■■
7 ■■■■■■■■	50 ■■■■■■■■	93 ■■■■■■■■	136 ■■■■■■■■	179 ■■■■■■■■	221 ■■■■■■■■
8 ■■■■■■■■	51 ■■■■■■■■	94 ■■■■■■■■	137 ■■■■■■■■	180 ■■■■■■■■	222 ■■■■■■■■
9 ■■■■■■■■	52 ■■■■■■■■	95 ■■■■■■■■	138 ■■■■■■■■	181 ■■■■■■■■	223 ■■■■■■■■
10 ■■■■■■■■	53 ■■■■■■■■	96 ■■■■■■■■	139 ■■■■■■■■	182 ■■■■■■■■	224 ■■■■■■■■
11 ■■■■■■■■	54 ■■■■■■■■	97 ■■■■■■■■	140 ■■■■■■■■	183 ■■■■■■■■	225 ■■■■■■■■
12 ■■■■■■■■	55 ■■■■■■■■	98 ■■■■■■■■	141 ■■■■■■■■	184 ■■■■■■■■	226 ■■■■■■■■
13 ■■■■■■■■	56 ■■■■■■■■	99 ■■■■■■■■	142 ■■■■■■■■	185 ■■■■■■■■	227 ■■■■■■■■
14 ■■■■■■■■	57 ■■■■■■■■	100 ■■■■■■■■	143 ■■■■■■■■	186 ■■■■■■■■	228 ■■■■■■■■
15 ■■■■■■■■	58 ■■■■■■■■	101 ■■■■■■■■	144 ■■■■■■■■	187 ■■■■■■■■	229 ■■■■■■■■
16 ■■■■■■■■	59 ■■■■■■■■	102 ■■■■■■■■	145 ■■■■■■■■	188 ■■■■■■■■	230 ■■■■■■■■
17 ■■■■■■■■	60 ■■■■■■■■	103 ■■■■■■■■	146 ■■■■■■■■	189 ■■■■■■■■	231 ■■■■■■■■
18 ■■■■■■■■	61 ■■■■■■■■	104 ■■■■■■■■	147 ■■■■■■■■	190 ■■■■■■■■	232 ■■■■■■■■
19 ■■■■■■■■	62 ■■■■■■■■	105 ■■■■■■■■	148 ■■■■■■■■	191 ■■■■■■■■	233 ■■■■■■■■
20 ■■■■■■■■	63 ■■■■■■■■	106 ■■■■■■■■	149 ■■■■■■■■	192 ■■■■■■■■	234 ■■■■■■■■
21 ■■■■■■■■	64 ■■■■■■■■	107 ■■■■■■■■	150 ■■■■■■■■	193 ■■■■■■■■	235 ■■■■■■■■
22 ■■■■■■■■	65 ■■■■■■■■	108 ■■■■■■■■	151 ■■■■■■■■	194 ■■■■■■■■	236 ■■■■■■■■
23 ■■■■■■■■	66 ■■■■■■■■	109 ■■■■■■■■	152 ■■■■■■■■	195 ■■■■■■■■	237 ■■■■■■■■
24 ■■■■■■■■	67 ■■■■■■■■	110 ■■■■■■■■	153 ■■■■■■■■	196 ■■■■■■■■	238 ■■■■■■■■
25 ■■■■■■■■	68 ■■■■■■■■	111 ■■■■■■■■	154 ■■■■■■■■	197 ■■■■■■■■	239 ■■■■■■■■
26 ■■■■■■■■	69 ■■■■■■■■	112 ■■■■■■■■	155 ■■■■■■■■	198 ■■■■■■■■	240 ■■■■■■■■
27 ■■■■■■■■	70 ■■■■■■■■	113 ■■■■■■■■	156 ■■■■■■■■	199 ■■■■■■■■	241 ■■■■■■■■
28 ■■■■■■■■	71 ■■■■■■■■	114 ■■■■■■■■	157 ■■■■■■■■	200 ■■■■■■■■	242 ■■■■■■■■
29 ■■■■■■■■	72 ■■■■■■■■	115 ■■■■■■■■	158 ■■■■■■■■	201 ■■■■■■■■	243 ■■■■■■■■
30 ■■■■■■■■	73 ■■■■■■■■	116 ■■■■■■■■	159 ■■■■■■■■	202 ■■■■■■■■	244 ■■■■■■■■
31 ■■■■■■■■	74 ■■■■■■■■	117 ■■■■■■■■	160 ■■■■■■■■	203 ■■■■■■■■	245 ■■■■■■■■
32 ■■■■■■■■	75 ■■■■■■■■	118 ■■■■■■■■	161 ■■■■■■■■	204 ■■■■■■■■	246 ■■■■■■■■
33 ■■■■■■■■	76 ■■■■■■■■	119 ■■■■■■■■	162 ■■■■■■■■	205 ■■■■■■■■	247 ■■■■■■■■
34 ■■■■■■■■	77 ■■■■■■■■	120 ■■■■■■■■	163 ■■■■■■■■	206 ■■■■■■■■	248 ■■■■■■■■
35 ■■■■■■■■	78 ■■■■■■■■	121 ■■■■■■■■	164 ■■■■■■■■	207 ■■■■■■■■	249 ■■■■■■■■
36 ■■■■■■■■	79 ■■■■■■■■	122 ■■■■■■■■	165 ■■■■■■■■	208 ■■■■■■■■	250 ■■■■■■■■
37 ■■■■■■■■	80 ■■■■■■■■	123 ■■■■■■■■	166 ■■■■■■■■	209 ■■■■■■■■	251 ■■■■■■■■
38 ■■■■■■■■	81 ■■■■■■■■	124 ■■■■■■■■	167 ■■■■■■■■	210 ■■■■■■■■	252 ■■■■■■■■
39 ■■■■■■■■	82 ■■■■■■■■	125 ■■■■■■■■	168 ■■■■■■■■	211 ■■■■■■■■	253 ■■■■■■■■
40 ■■■■■■■■	83 ■■■■■■■■	126 ■■■■■■■■	169 ■■■■■■■■	212 ■■■■■■■■	254 ■■■■■■■■
41 ■■■■■■■■	84 ■■■■■■■■	127 ■■■■■■■■	170 ■■■■■■■■	213 ■■■■■■■■	255 ■■■■■■■■
42 ■■■■■■■■	85 ■■■■■■■■	128 ■■■■■■■■	171 ■■■■■■■■		

■ = JUMPER INSTALLED    □ = NO JUMPER

### Products

Opto 22 produces a broad array of reliable, flexible hardware and software products for industrial automation, remote monitoring, enterprise data acquisition, and machine-to-machine (M2M) applications.

### SNAP Ethernet Systems

Based on the Internet Protocol (IP), SNAP Ethernet systems offer flexibility in their network connectivity and in the software applications they work with. The physical network may be a wired Ethernet network, a cellular wireless network, or a modem. A wide variety of software applications can exchange data with SNAP Ethernet systems, including:

- Opto 22's own ioProject™ suite of control and HMI software
- Manufacturing resource planning (MRP), enterprise management, and other enterprise systems
- Human-machine interfaces (HMIs)
- Databases
- Email systems
- OPC client software
- Custom applications
- Modbus/TCP software and hardware.



SNAP Ethernet system hardware consists of controllers and I/O units. Controllers provide central control and data distribution. I/O units provide local connection to sensors and equipment.

### SNAP OEM Systems

Opto 22 SNAP OEM I/O systems are highly configurable, programmable processors intended for OEMs, IT professionals, and others who need to use custom software with Opto 22 SNAP I/O modules.

Linux® applications running on these systems can read and write to analog, simple digital, and serial I/O points on SNAP I/O modules using easily implemented file-based operations. Applications can be developed using several common development tools and environments, including C or C++, Java, and shell scripts.



### M2M Systems

Machine-to-machine (M2M) systems connect your business computer systems to the machines, devices, and environments you want to monitor, control, or collect data from. M2M systems often use wireless cellular communications to link remote facilities to central systems over the Internet, or to provide monitoring and control capability via a cellular phone.

Opto 22's Nvio™ systems include everything you need for M2M—interface and communications hardware, data service plan, and Web portal—in one easy-to-use package. Visit [nvio.opto22.com](http://nvio.opto22.com) for more information.

### Opto 22 Software

Opto 22's ioProject and FactoryFloor® software suites provide full-featured and cost-effective control, HMI, and OPC software to power your Opto 22 hardware. These software applications help you develop control automation solutions, build easy-to-use operator interfaces, and expand your manufacturing systems' connectivity.



### Quality

In delivering hardware and software solutions for worldwide device management and control, Opto 22 retains the highest commitment to quality. We do no statistical testing; each product is made in the U.S.A. and is tested twice before leaving our 160,000 square-foot manufacturing facility in Temecula, California. That's why we can guarantee solid-state relays and optically-isolated I/O modules *for life*.

### Product Support

Opto 22's Product Support Group offers comprehensive technical support for Opto 22 products. The staff of support engineers represents years of training and experience, and can assist with a variety of project implementation questions. Product support is available in English and Spanish from Monday through Friday, 7 a.m. to 5 p.m. PST.

### Opto 22 Web Sites

- [www.opto22.com](http://www.opto22.com)
- [nvio.opto22.com](http://nvio.opto22.com)
- [www.internetio.com](http://www.internetio.com) (live Internet I/O demo)

### Other Resources

- OptoInfo CDs
- Custom integration and development
- Hands-on customer training classes.



### About Opto 22

Opto 22 manufactures and develops hardware and software products for industrial automation, remote monitoring, enterprise data acquisition, and machine-to-machine (M2M) applications. Using standard, commercially available Internet, networking, and computer technologies, Opto 22's input/output and control systems allow customers to monitor, control, and acquire data from all of the mechanical, electrical, and electronic assets that are key to their business operations. Opto 22's products and services support automation end users, OEMs, and information technology and operations personnel.

Founded in 1974 and with over 85 million Opto 22-connected devices deployed worldwide, the company has an established reputation for quality and reliability.