

B3000-B SERIAL BRAIN USER'S GUIDE

Form 1781-170202—February 2017

OPTO 22
Automation made simple.

43044 Business Park Drive • Temecula • CA 92590-3614
Phone: 800-321-OPTO (6786) or 951-695-3000
Fax: 800-832-OPTO (6786) or 951-695-2712
www.opto22.com

Product Support Services

800-TEK-OPTO (835-6786) or 951-695-3080
Fax: 951-695-3017
Email: support@opto22.com
Web: support.opto22.com

B3000-B Serial Brain User's Guide
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For Help

If you have problems installing or using SNAP PAC brains and cannot find the help you need in this guide or on our website, contact Opto 22 Product Support.

Phone: 800-TEK-OPTO (800-835-6786
toll-free in the U.S. and Canada)
951-695-3080
Monday through Friday,
7 a.m. to 5 p.m. Pacific Time

NOTE: Email messages and phone calls to Opto 22 Product Support are grouped together and answered in the order received.

Fax: 951-695-3017

Email: support@opto22.com

Opto 22 website: 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
- Brain and controller firmware version (as applicable)
- PC configuration (type of processor, speed, memory, and operating system)
- A complete description of your hardware and operating systems, including:
 - loader and firmware versions for the brain, and date code
 - for an Ethernet network, IP addresses and subnet masks for devices on the system
 - for a serial network, addressing and communication parameters
 - type of power supply
 - third-party devices installed (for example, barcode readers)
- Specific error messages seen

2: Configuration and Communication

This chapter describes the B3000-B serial port, how to set up serial networking, how to set the address and communications options for the brain, and how the brain addresses the I/O.

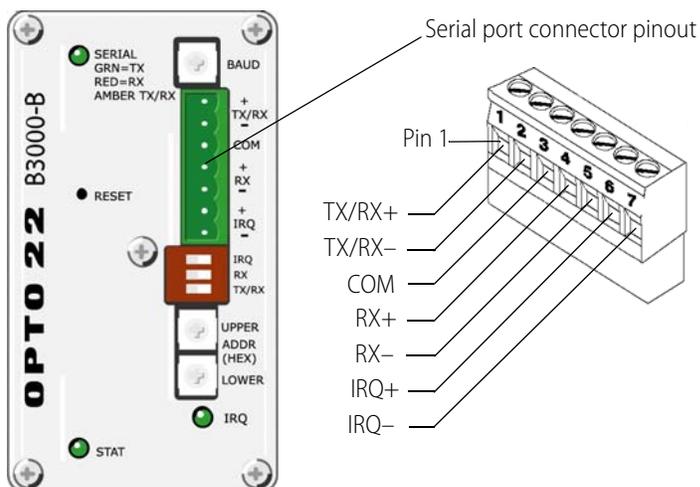
Serial Port	(below)
Setting Up Serial Networking	page 4
Setting the Address and Communication Options	page 5
Addressing I/O	page 8

Serial Port

The communications port on a B3000-B is RS-485, either 2-wire or 4-wire. Baud rate, termination, and address are set using the switches on the brain's top cover. To configure the B3000-B, see the next section, "[Setting Up Serial Networking.](#)"

For serial cable recommendations and wiring, see [Chapter 3: Wiring.](#)

Wiring of IRQ + and IRQ - (pins 6 and 7) is optional and is only needed when using *mistic* interrupts.

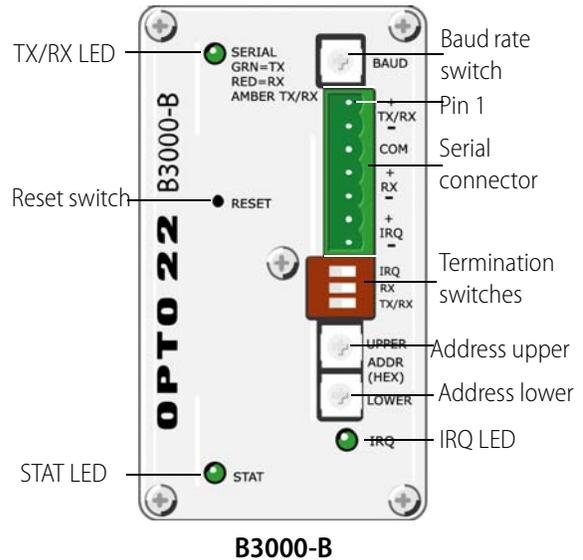


Setting Up Serial Networking

The B3000-B brain can be connected to a SNAP PAC S-series or *mistic* controller, or to a PC equipped with an Opto 22 PCI-AC48 adapter card, which provides an RS-485 port.

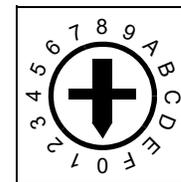
Follow these steps to set up serial networking:

1. Attach an RS-485 serial cable to the serial port. (See [Chapter 3: Wiring](#) for cable recommendations).
2. Follow the wiring diagrams beginning on [page 12](#) for the serial network.
3. Rotate the baud rate switch to set the desired baud rate, as follows:



Baud rate	Switch position
(Reserved)	F
* 230400 bps	E
115200 bps	D
76800 bps	C
57600 bps	B
38400 bps	A
19200 bps	9
9600 bps	8

Baud rate	Switch position
4800 bps	7
2400 bps	6
1200 bps	5
600 bps	4
300 bps	3
(Reserved)	2
(Reserved)	1
(Reserved)	0

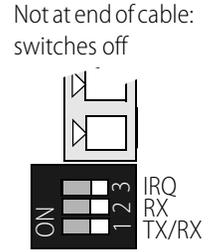


Baud Rate Switch

* Older Opto 22 controllers do not support this setting. It is supported by SNAP PAC S1's and S2's.

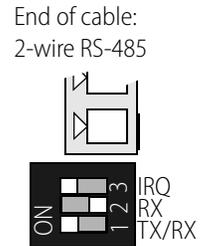
NOTE: Due to timing tolerances, some baud rates may not work with some compatible devices.

4. Use the three termination switches to set termination as follows:
 - For all B3000-B units that are *not* at the physical end of the cable, set all three of the termination switches to the OFF position.
 - For the B3000-B at the physical end of the cable, set as follows:
 - If using 2-wire RS-485, set IRQ and TX/RX ON, and set RX OFF.
 - If using 4-wire RS-485, set all three of the termination switches ON.



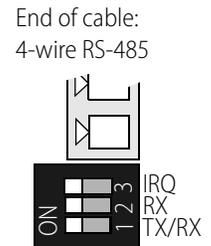
NOTE: If your system has a controller or computer at one end of the cable, you only need to terminate the one B3000-B at the other end of the cable.

However, if you have B3000-B units at both ends of the cable with the controller or computer somewhere in-between, you need to terminate the B3000-B units at both ends of the cable and turn off the termination at the controller or computer.



NOTE: Biasing is required at one location only. It can be applied anywhere on the link, however, it is normally applied at the controller or computer. Because of this, the B3000-B does not offer biasing switches.

5. Use the two rotary address switches to set the unit's address as described in the next section.



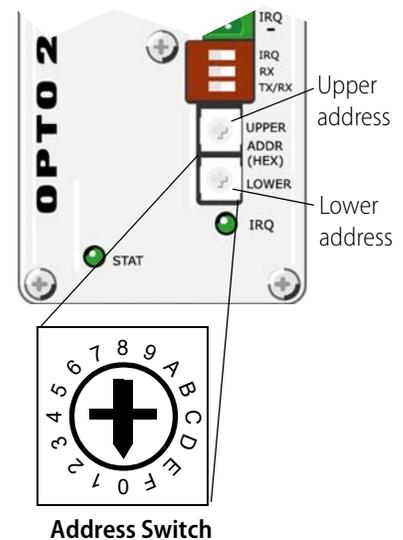
Setting the Address and Communication Options

The brain's address and other communication options are set using the two 16-position rotary switches on the top of the brain—an upper address switch and a lower address switch. Each B3000-B contains four addresses consisting of the base address, base +1, base +2, and base +3. The base address is an even multiple of 4.

NOTE: The normal communication options are Binary and CRC.

The following tables show switch settings for each address.

- For Binary or ASCII, CRC16, see [page 6](#)
- For Binary or ASCII, Checksum, see [page 7](#)



Binary Mode with CRC16

This mode is supported by PAC Control and Opto Control.

	Base Address	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
Upper address switch	Upper Address	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3
Lower address switch	Lower Address	0	4	8	C	0	4	8	C	0	4	8	C	0	4	8	C

Base Address	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124
Upper Address	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7
Lower Address	0	4	8	C	0	4	8	C	0	4	8	C	0	4	8	C

Base Address	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188
Upper Address	8	8	8	8	9	9	9	9	A	A	A	A	B	B	B	B
Lower Address	0	4	8	C	0	4	8	C	0	4	8	C	0	4	8	C

Base Address	192	196	200	204	208	212	216	220	224	228	232	236	240	244	248	252
Upper Address	C	C	C	C	D	D	D	D	E	E	E	E	F	F	F	F
Lower Address	0	4	8	C	0	4	8	C	0	4	8	C	0	4	8	C

ASCII Mode with CRC16

This mode is supported by PAC Control and Opto Control.

	Base Address	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
Upper address switch	Upper Address	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3
Lower address switch	Lower Address	1	5	9	D	1	5	9	D	1	5	9	D	1	5	9	D

Base Address	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124
Upper Address	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7
Lower Address	1	5	9	D	1	5	9	D	1	5	9	D	1	5	9	D

Base Address	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188
Upper Address	8	8	8	8	9	9	9	9	A	A	A	A	B	B	B	B
Lower Address	1	5	9	D	1	5	9	D	1	5	9	D	1	5	9	D

Base Address	192	196	200	204	208	212	216	220	224	228	232	236	240	244	248	252
Upper Address	C	C	C	C	D	D	D	D	E	E	E	E	F	F	F	F
Lower Address	1	5	9	D	1	5	9	D	1	5	9	D	1	5	9	D

Binary Mode with Checksum

This mode is *not* supported by PAC Control and Opto Control.

	Base Address	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
Upper address switch	Upper Address	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3
Lower address switch	Lower Address	2	6	A	E	2	6	A	E	2	6	A	E	2	6	A	E

Base Address	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124
Upper Address	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7
Lower Address	2	6	A	E	2	6	A	E	2	6	A	E	2	6	A	E

Base Address	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188
Upper Address	8	8	8	8	9	9	9	9	A	A	A	A	B	B	B	B
Lower Address	2	6	A	E	2	6	A	E	2	6	A	E	2	6	A	E

Base Address	192	196	200	204	208	212	216	220	224	228	232	236	240	244	248	252
Upper Address	C	C	C	C	D	D	D	D	E	E	E	E	F	F	F	F
Lower Address	2	6	A	E	2	6	A	E	2	6	A	E	2	6	A	E

ASCII Mode with Checksum

This mode is *not* supported by PAC Control and Opto Control.

	Base Address	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
Upper address switch	Upper Address	0	0	0	0	1	1	1	1	2	2	2	2	3	3	3	3
Lower address switch	Lower Address	3	7	B	F	3	7	B	F	3	7	B	F	3	7	B	F

Base Address	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124
Upper Address	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	7
Lower Address	3	7	B	F	3	7	B	F	3	7	B	F	3	7	B	F

Base Address	128	132	136	140	144	148	152	156	160	164	168	172	176	180	184	188
Upper Address	8	8	8	8	9	9	9	9	A	A	A	A	B	B	B	B
Lower Address	3	7	B	F	3	7	B	F	3	7	B	F	3	7	B	F

Base Address	192	196	200	204	208	212	216	220	224	228	232	236	240	244	248	252
Upper Address	C	C	C	C	D	D	D	D	E	E	E	E	F	F	F	F
Lower Address	3	7	B	F	3	7	B	F	3	7	B	F	3	7	B	F

Addressing I/O

The B3000-B is connected to a SNAP B-series I/O rack, which can hold either 8, 12, or 16 SNAP modules. Digital modules (either input or output) contain four channels of I/O. Analog input modules contain two channels and analog output modules contain one or two channels. Both analog and digital modules can be on the same rack.

NOTE: Some SNAP modules cannot be used with the B3000-B. For example, analog modules with four or more points cannot be used; high-density digital modules cannot be used. Also, some newer modules require different processing and cannot be used with the B3000-B. Consult the module's data sheet for compatibility information.

A B3000-B is capable of addressing a maximum of 32 channels of digital I/O and 32 channels of analog I/O. However, the I/O mounting racks will not accommodate 32 channels of both digital and analog. The actual number of channels available depends on the combination of modules you choose. For example, the SNAP-B16M rack can mount 16 modules. Up to eight of these modules can be digital, providing 32 channels of digital I/O. The remaining eight module positions can be analog, providing up to 16 channels of analog I/O. However, if all 16 modules are analog (no digital modules at all), up to 32 channels of analog I/O are available.

I/O on the B3000-B is divided into four addresses (two digital I/O and two analog I/O). The digital addresses are base+0 and base+1. The analog addresses are base+2 and base+3. Therefore, if the brain is configured at address 12, the digital addresses would be 12 and 13 and the analog would be 14 and 15. See the following page for an illustration of the rack with digital and analog modules, showing their addresses.

First Four Module Positions (0-3)—As you see in the illustration on the following page, each of the first four module positions on the rack can hold either a digital or an analog module. These first four positions can be all analog, all digital, or any mix of both.

These four positions constitute the 16 digital channels of digital address base+0, and the first eight analog channels of analog address base+2.

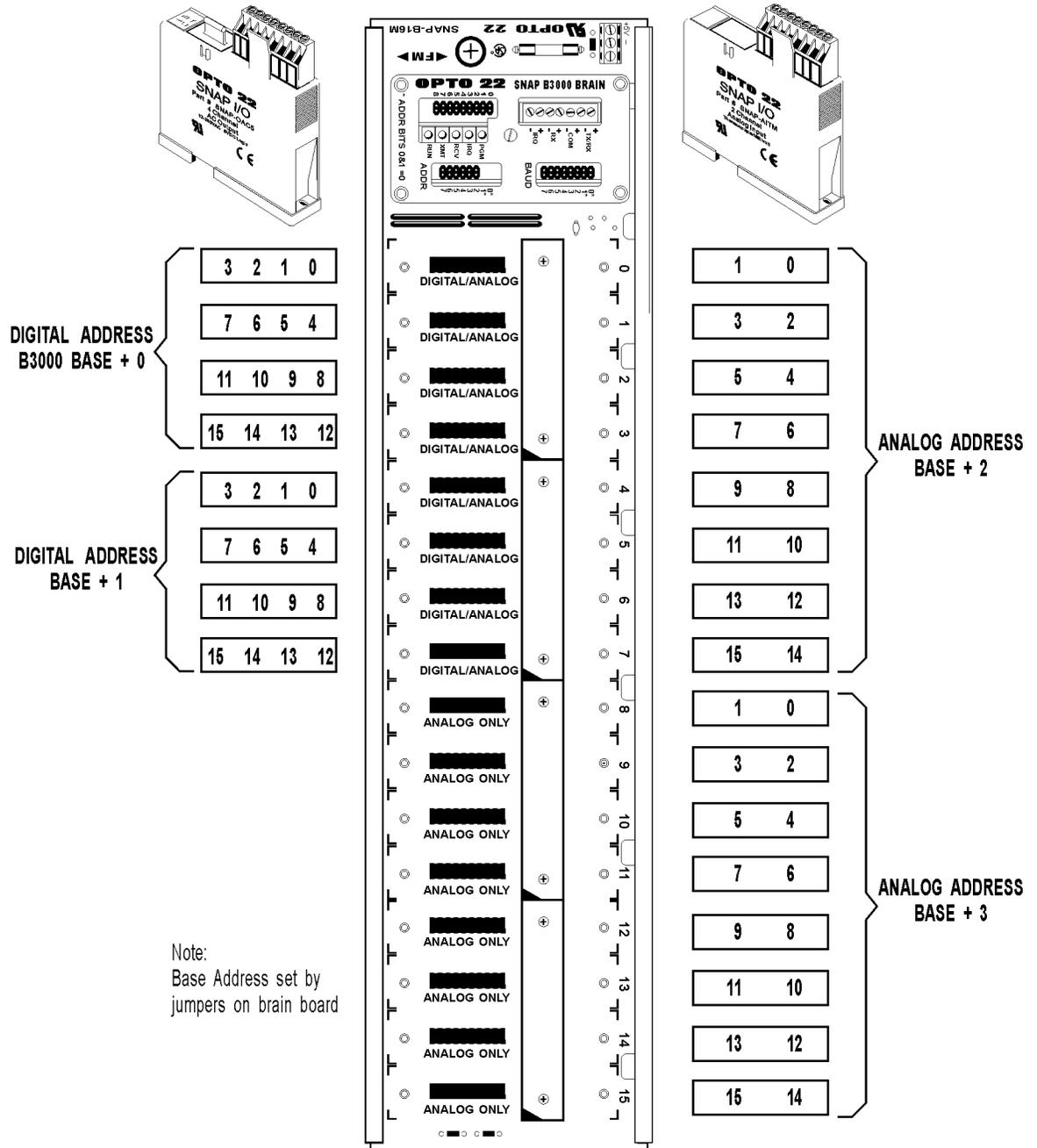
Second Four Module Positions (4-7)—Like the first four module positions, each position in the second group of four can hold either a digital or an analog module. They can be all analog, all digital or any mix of both.

These four positions constitute the 16 digital channels of digital address base+1, or the second eight analog channels of analog address base+2.

Last Eight Module Positions (8-15)—These positions hold analog modules only. These eight positions constitute the 16 analog channels of analog address base+3.

Digital and Analog I/O Addressing

See explanation on the previous page.



3: Wiring

See the section below for communication cables recommended for use with the B3000-B. See [page 12](#) for wiring diagrams that show how to connect a B3000-B brain to a SNAP PAC S-series controller.

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 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, rather than the shield, for 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)
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)
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)

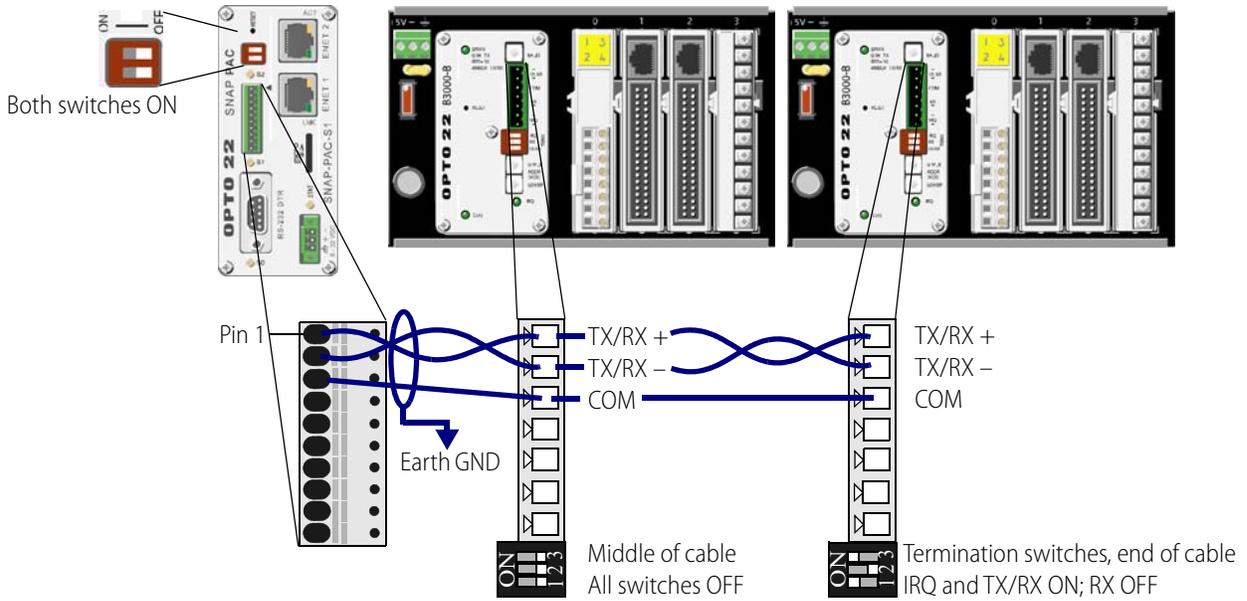
See belden.com and www.manhattanwire.com.

Wiring Diagrams

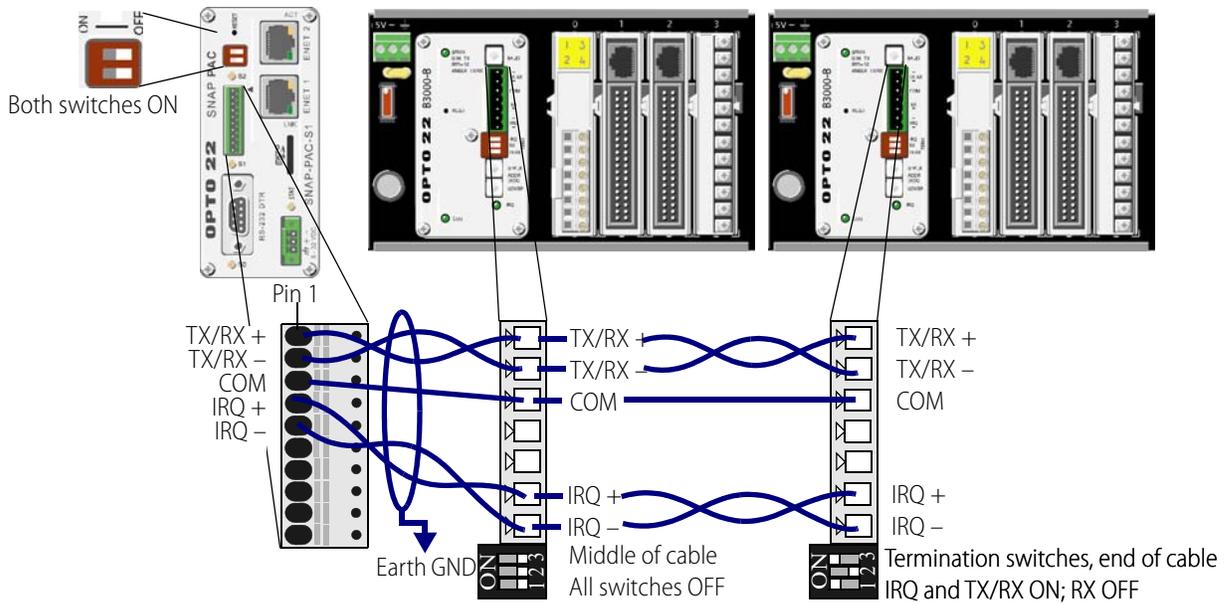
Wiring to a SNAP-PAC-S1 Controller

NOTE: The SNAP-PAC-S1 controller only supports 2-wire RS-485.

Two-wire



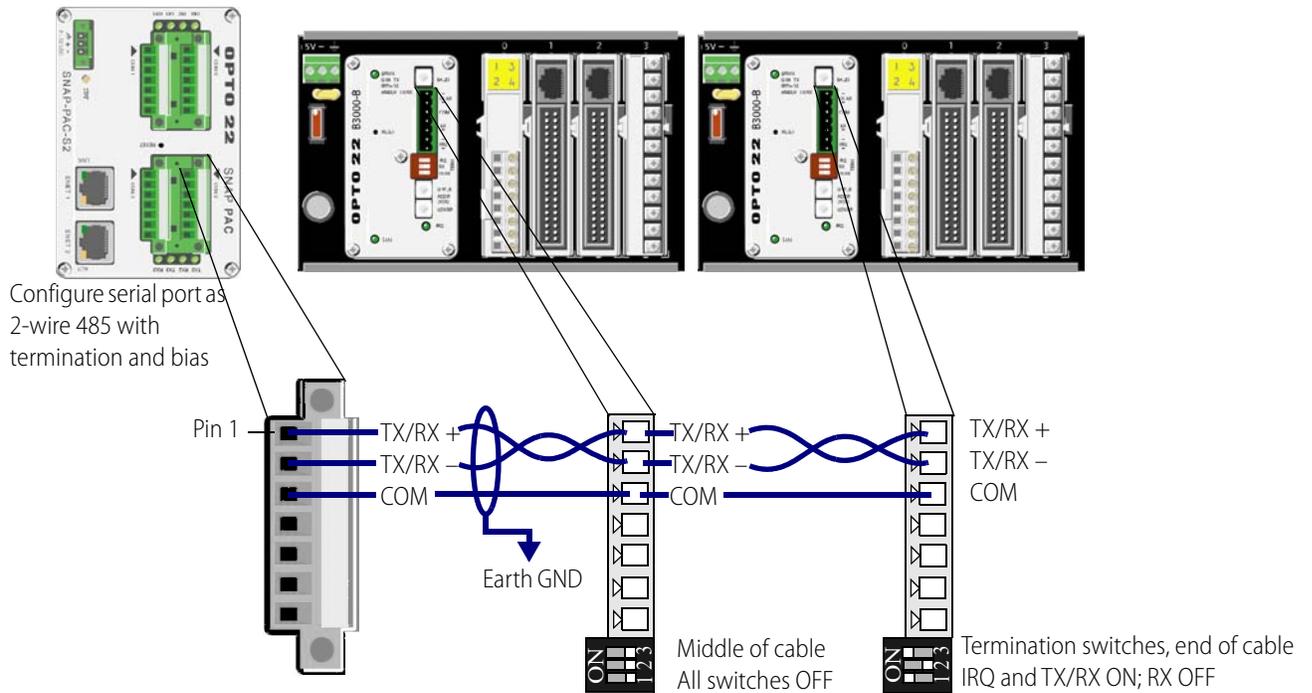
Two-wire with interrupt line



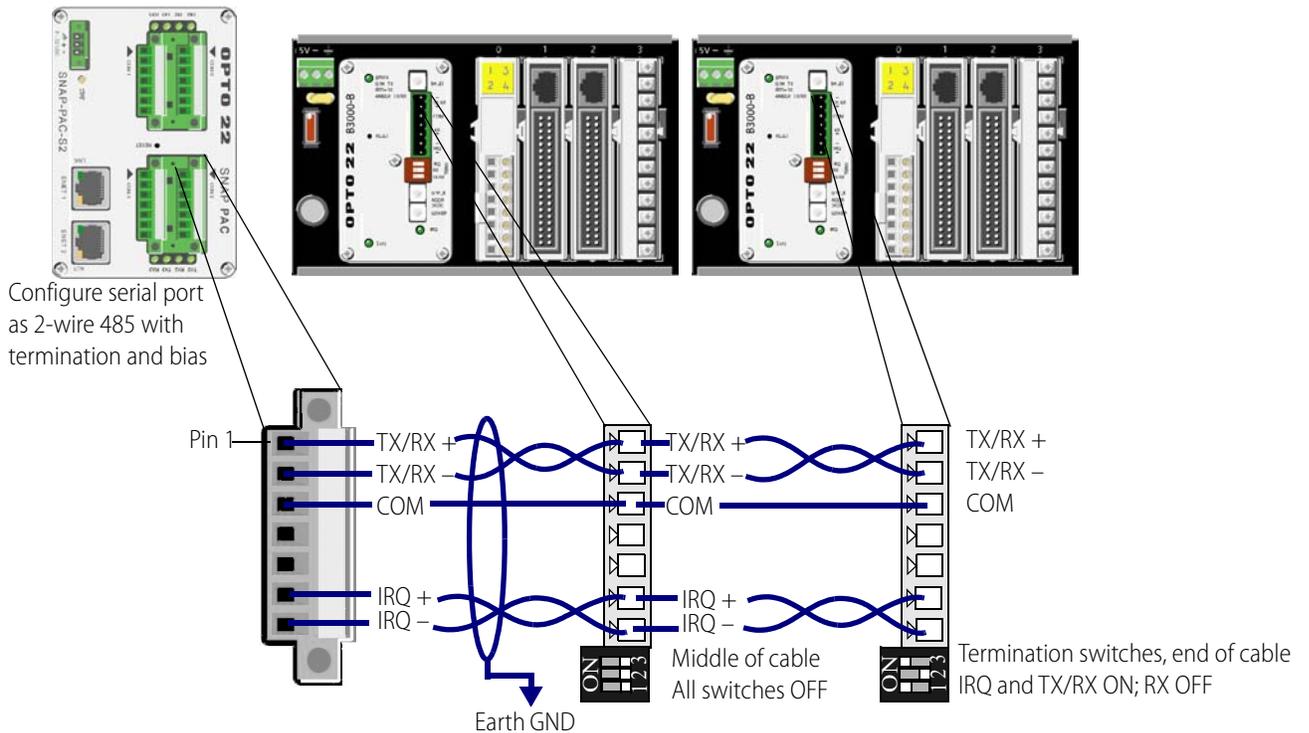
Wiring to a SNAP-PAC-S2 Controller

NOTE: The SNAP-PAC-S2 supports both two-wire and four-wire RS-485. Use PAC Manager to configure the serial ports. For details, see form 1704, the PAC Manager User's Guide.

Two-wire



Two-wire with interrupt line

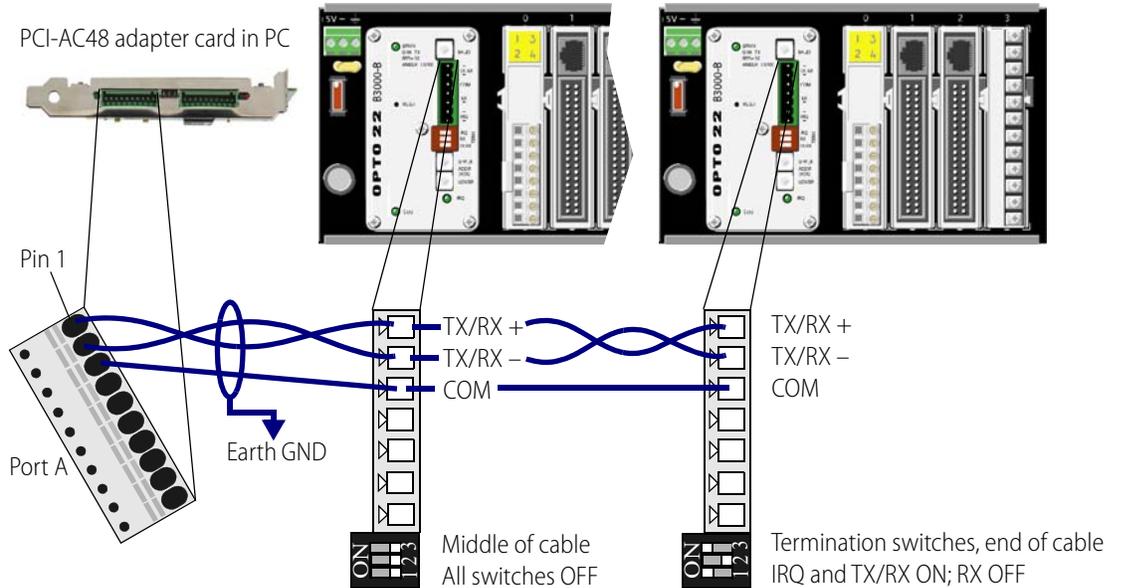


Wiring to a PCI-AC48 Adapter Card in a PC

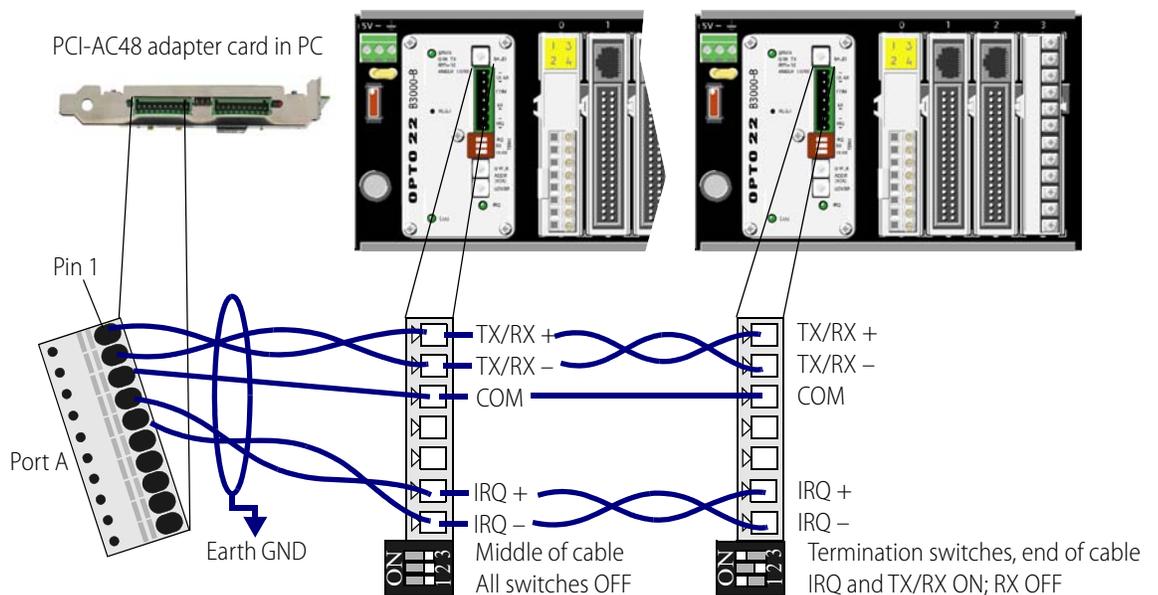
NOTE: Check the default termination and bias on the PCI-AC48 and make certain they are set appropriately for the network. Termination should be at each end of the RS-485 cable, and biasing should be at one location only, typically at the host device, which would be the PCI-AC48 in this case.

NOTE: For system architecture drawings using a PCI-AC48 adapter card in a PC, see form 787, the B3000 Brain Data Sheet.

Two-wire

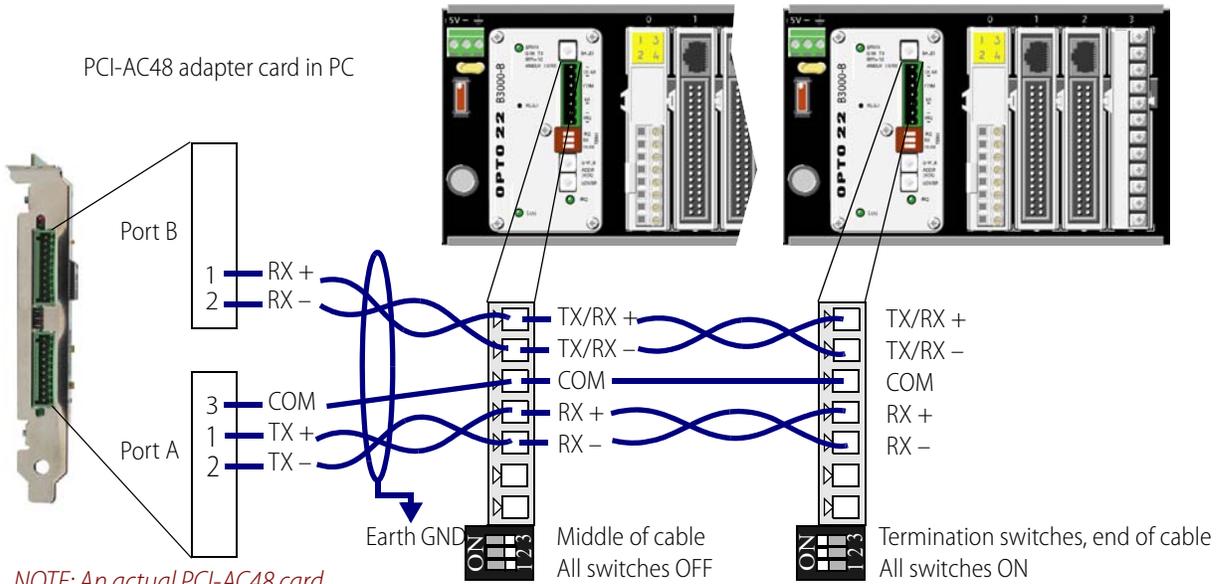


Two-wire with interrupt line



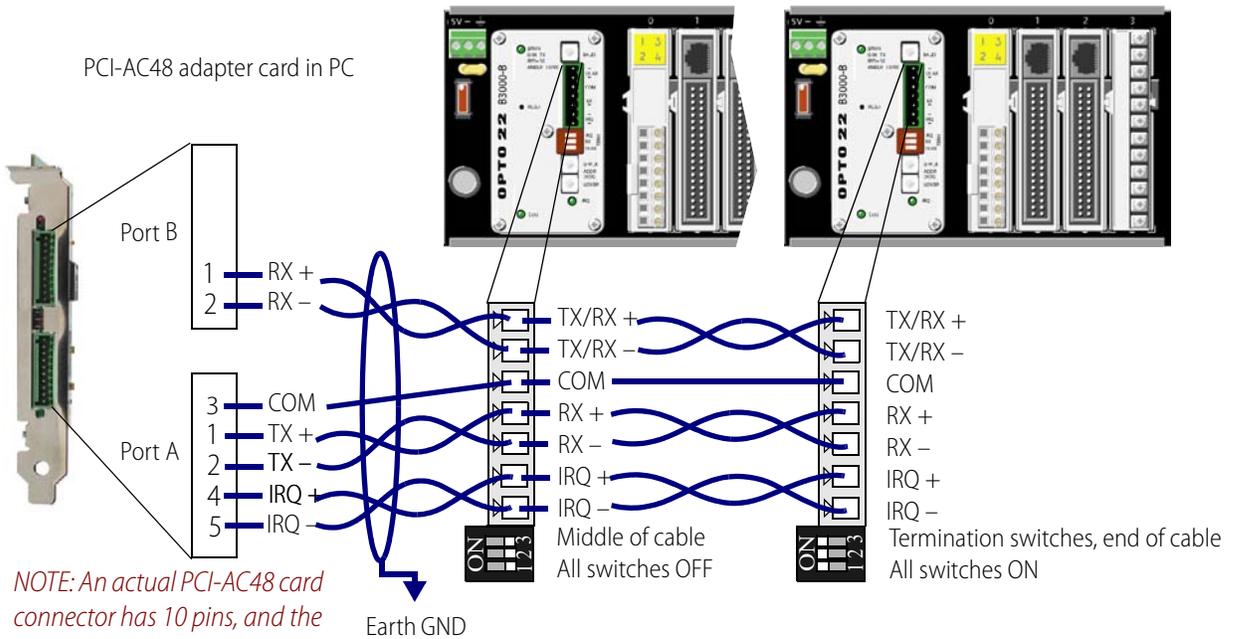
Wiring to a PCI-AC48 Adapter Card in a PC (continued)

Four-wire



NOTE: An actual PCI-AC48 card connector has 10 pins, and the pins are in a different order than shown here.

Four-wire with interrupt line



NOTE: An actual PCI-AC48 card connector has 10 pins, and the pins are in a different order than shown here.

4: Maintenance and Troubleshooting

This chapter includes the following maintenance and troubleshooting information:

Maintenance

Loading New Firmware	page 17
Resetting the Brain	page 21
LED Indicators and STAT LED Blink Codes	page 21

Troubleshooting

Troubleshooting Checklist	page 22
Making Sure the Brain is in Normal Mode	page 23

Maintaining the B3000-B Serial Brain

Loading New Firmware

A B3000-B brain contains firmware (sometimes referred to as the *kernel*), which is similar to an operating system. If the firmware should become damaged, or if a new version of the firmware is released, you can load new firmware to the brain using the software utility PAC Manager. PAC Manager is on the CD that came with the brain and is also available as a free download from our website, www.opto22.com.

Follow these steps to replace the firmware.

1. Make sure you have the following before beginning:
 - Internet access to obtain new firmware from our website.
 - PAC Manager (from the CD that came with the brain or from our website) installed on your PC. If the brain is attached to a SNAP PAC S-series controller, the PC must be on the same Ethernet network as the controller. If not, you need a PCI-AC48 adapter card and an RS-232 to RS-485 adapter cable to connect directly from the PC to the brain.
 - Address information for the controller(s) and/or brain(s) that will receive the new firmware.
2. Make sure the brain is in Binary CRC16 mode.

For more information, see [“Setting the Address and Communication Options”](#) on page 5. ASCII and Checksum are not supported in PAC Manager.

3. Restart the device in failsafe bootloader mode, and then watch for the blink code to make sure the device is in this mode. See [“Resetting the Brain”](#) on page 21.
4. Attach the PC with PAC Manager to the brain using either *Ethernet Pass-Through* or *Serial Direct* as follows:
 - For Ethernet Pass-Through, connect via Ethernet through a SNAP PAC S-series controller.
 - For Serial Direct, connect directly from the PC using a serial cable and a PCI-AC48 adapter card.

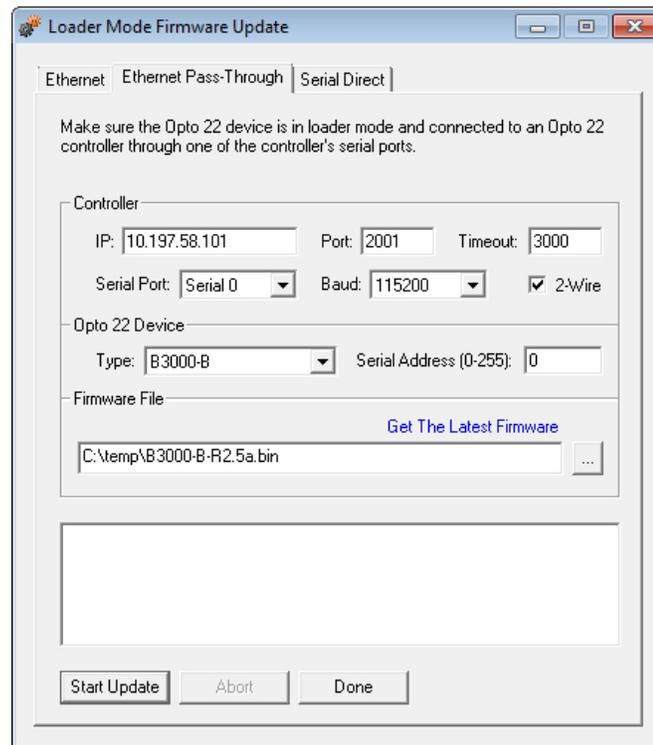
For more information on connections, see [Chapter 3: Wiring](#).

5. Choose Start > Programs > Opto 22 > PAC Project Software > PAC Manager.
6. In the PAC Manager main window, choose Tools > Install Firmware via Failsafe Bootloader Mode. Click OK at the message about products it can be used with.
7. (Ethernet Pass-Through only) If the brain is connected through an S-series controller, click the Ethernet Pass-Through tab, and do the following. For Serial Direct, skip to [step 8](#).

NOTE: Before proceeding, make sure the strategy on the controller is stopped.

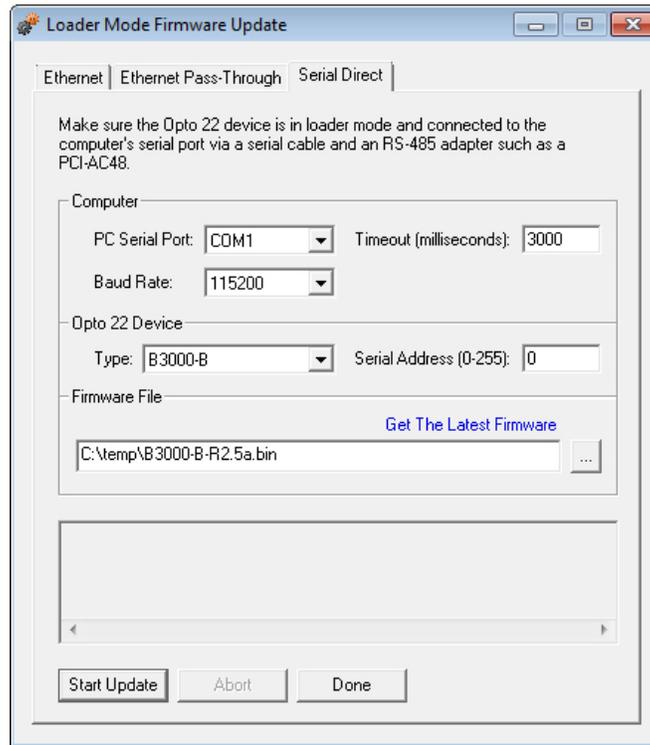
- a. In the Controller section of the Loader Mode Firmware Update dialog box:
 - Enter the IP address of the controller.
 - Leave the Port at 2001 unless you have changed it on the controller.
 - Choose the serial port on the controller that the brain is connected to.
 - Make sure the baud rate matches that on the brain.
 - If you are using a 2-wire connection, check 2-Wire.
- b. In the Opto 22 Device section:
 - Select B3000-B as the type.

- Select the brain's serial address.



- Skip to [step 9](#).
- 8.** (Serial Direct only) If the brain is connected directly to a PC, click the Serial Direct tab, and do the following.
- In the Computer section:
 - Choose the COM port the brain is connected to.
 - Make sure the baud rate matches that on the brain.
 - In the Opto 22 Device section:
 - Choose B3000-B as the type.

- Enter the brain's serial address.



9. Click the blue Get Latest Firmware link.
The link opens your browser and takes you to the Firmware Downloads section of our website, www.opto22.com.
10. Choose the firmware for your part number from the list and download it to your PC.
If you have any difficulty obtaining or loading new firmware, contact Opto 22 Product Support.
11. Click the browse button  and locate the firmware file you just downloaded. Double-click the filename.
The path and filename appear in the Filename field.
12. When all the fields are correct, click Start Update.
Progress is shown in the lower part of the window. When the process is complete, either repeat from [step 7](#) or [step 8](#) for another device, or click Done.
The device is now ready to use.

Resetting the Brain

1. Carefully insert a straightened paperclip or stiff wire into the small hole labeled RESET.
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.

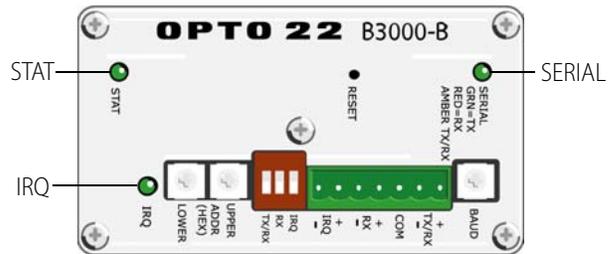
NOTE: Do not reset the brain to hardware test mode unless Opto 22 Product Support tells you to.

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.	
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.	Cycle power to recover. Result is the same as restoring to factory defaults.

LED Indicators and STAT LED Blink Codes

Three LEDs on the top of the B3000-B brain (STAT, SERIAL, and IRQ) indicate status conditions.

LED	Indicates
STAT	Brain status
SERIAL	Green = Transmit
	Red = Receive
	Amber = Transmit/Receive
IRQ	<i>mistic</i> interrupt currently active.



The STAT LED color and blink pattern provides useful information during operation and in troubleshooting as follows:

Green

If the STAT LED is on and remains green, the brain 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 21 for more information.)

Orange

If the STAT LED blinks orange fast and continuously after you pushed the RESET button, the device is in hardware test mode (see [page 21](#)).

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 21](#) for more information.

Red

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

Number of Blinks	Speed of Blinks	Means	Problem and Workaround
4	slow	Incorrect serial settings. Invalid hardware revision	Check serial settings (See page 4 .) 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.
16	slow	Serial flash failure	Contact Product Support.
20	slow	Digital failure	Contact Product Support.
21	slow	Bus failure	Contact Product Support.

Troubleshooting a B3000-B Brain

Troubleshooting Checklist

If you are having trouble communicating with a B3000-B brain, check the following:

- Make sure the brain’s hold-down screw has been tightened so that it is snug. (Do not overtighten.)
- Make sure the brain has been turned on and that the STAT LED is lit (green). If the STAT LED is not green, the brain may not be in normal mode. See below, [“Making Sure the Brain is in Normal Mode.”](#)
- Make sure that power to the brain is sufficient. Each brain should have its own power supply. The brain needs 5.00 to 5.20 VDC, measured downstream of the fuse on the rack.
- If you’re accessing the brain through a SNAP PAC S-series controller, make sure you can communicate with the controller over Ethernet. For help, see the controller user’s guide (form 1592).
- Check physical connections between the controller or PC and the brain.
- Verify that the following serial parameters on the controller or PC and the brain correspond: baud rate, address, 2-wire or 4-wire connections.
- Make sure termination switches are set correctly for all brains on the serial network.

Making Sure the Brain is in Normal Mode

If you are having trouble communicating with the brain, it might be in *failsafe bootloader mode* or *hardware test mode*. The brain restarts in one of these modes if you hold down the RESET button longer than the time needed to restore default settings. For more information on using the RESET button, see [“Resetting the Brain” on page 21](#).

- *Failsafe bootloader mode* is used to update firmware. It is also used for troubleshooting a problem with Opto 22 Product Support. You know the brain is in this mode if the STAT LED is blinking red and green alternately. If your brain restarts in failsafe bootloader mode, simply cycle power to the device. This action performs a simple restart and allows you to communicate with the brain.
- The brain enters *hardware test mode* if you hold down the RESET button for more than five seconds. This mode puts the brain into a continuous testing loop. If your brain is in hardware test mode, cycle power to it, and it will restart as if you had reset it to factory defaults.

