Using microSD with Older Controller Firmware

Introduction

SNAP PAC controllers manufactured in November 2008 and later have a microSD card slot in the top of the controller's case. On a controller with a microSD card slot, the STAT LED blinks briefly about once every five seconds, indicating that the controller is checking to see if a card is in place.

IMPORTANT: Behavior for the microSD card has changed since the first release. This document describes behavior with controller firmware versions older than 9.0. If you are running controller firmware 9.0 or newer, use instructions in the controller user's guide; do not use this technical note.

To determine firmware version, see *.*

Opto 22 Product Support recommends that you update controller firmware to the latest version if you are going to use a microSD card. Later firmware versions have added significant functionality and fixed problems. To download the latest firmware, go to www.opto22.com/site/downloads and filter by Firmware. If you need a newer loader version or have other problems, contact Product Support. Contact information is on *.*

Card Type and Format

Use only cards with the microSD logo (shown above right) with 2 GB or smaller capacity. Cards with more than 2 GB capacity may fit in the slot, but the controller will not recognize them. **Do not** use microSDHC cards.

When you buy microSD cards, they come properly formatted with FAT16. If you ever need to reformat a card, make sure to use a utility specifically designed to format SD cards, and use FAT16.

Since long filenames are not supported, all files you store on the card must be named with a maximum of eight characters in the name plus three characters in the extension (8 dot 3 format), for example: `datafile.txt`

Using the microSD card with FTP, you can read the card at 380 kB/s and write to it at 231 kB/s.

MicroSD Card Uses

The microSD card can be used for several purposes:

*   To store data or files, which you can access using PAC Control commands or an FTP client. (PAC Manager cannot be used to access data, because it cannot see the card's directory.)
*   To update firmware on the controller; or, for a SNAP PAC R-series controller, to update firmware on a serial communication module on the controller's rack.

The card provides a convenient way to update firmware on non-networked controllers. It's also useful if PAC Manager is not available to update firmware.

- To temporarily boot the controller from firmware on the microSD card rather than from the firmware in the controller, for example to test new firmware.

- To update, run, or test new PAC Control strategies if the controller is not on the network, if PAC Control isn't available, or if you want to test a new strategy without erasing the existing one.

The following table summarizes how to use the card; see the page in the last column for steps.

| To do this	When	Put card in...	Use this method	See pg
Store/access data	Anytime	Controller	Automate data storage and retrieval in PAC Control logic: Use PAC Control commands and file communication handles. Or use PAC Control FTP communication handles.	3
		Controller[1]	From a PC, use an FTP client.	
		PC with card reader	Use Windows Explorer.	
Try out controller firmware without replacing current firmware	In advance	Controller[1] or PC with card reader	Use Windows Explorer or FTP client to copy new firmware to card.	6
	To use	Controller	Insert prepared card into controller and cycle power. Controller runs firmware on card. To go back to older firmware, remove card and cycle power again.	
Try out new strategy without replacing current strategy	In advance	Controller[1] or PC with card reader	Use PAC Control to make controller download (.cdf) file; then use Windows Explorer or FTP client to put .cdf file on the card.	8
	To use	Controller	Insert prepared card into controller and cycle power. Controller runs strategy from card. To go back to older strategy, remove card and cycle power again.	
Update non-networked controller with new firmware	In advance	PC with card reader	Create command file; copy it and the firmware file to card.	4
	To use	Controller	Insert card into controller. Controller runs firmware from card and saves it to flash memory.	
Update non-networked controller with new strategy	In advance	PC with card reader	Use PAC Control to make controller download (.cdf) file; then use Windows Explorer to copy .cdf file to the card.	8
	To use	Controller	Insert card into controller and cycle power. (Firmware older than 9.0a) Controller runs new strategy from card and saves it to flash if box is checked.	

1 Controller must be on same network segment as PC.

Storing and Accessing Data or Files

When inserted into the controller and accessed from a PC using FTP or PAC Control, the card appears as a directory in the controller's file system named: `sdcard0` Just like a PC might show a thumb drive as a directory named Removable Disk (E:), for example, the controller shows the card as a directory named sdcard0.

IMPORTANT: *Do NOT try to create this directory. When you look at the card in the controller, the card appears as a directory named sdcard0. When you look at the card in a card reader attached to your PC, you see the card reader's directory instead. When the card is in a card reader, you are already in the root of the card (that is, you are already inside the sdcard0 directory).*

For example, suppose you are looking at a microSD card in a SNAP PAC controller with IP address 10.192.54.241. You can see that this controller has three files in its regular file system, plus the microSD card:

Files in PAC's file system   microSD card
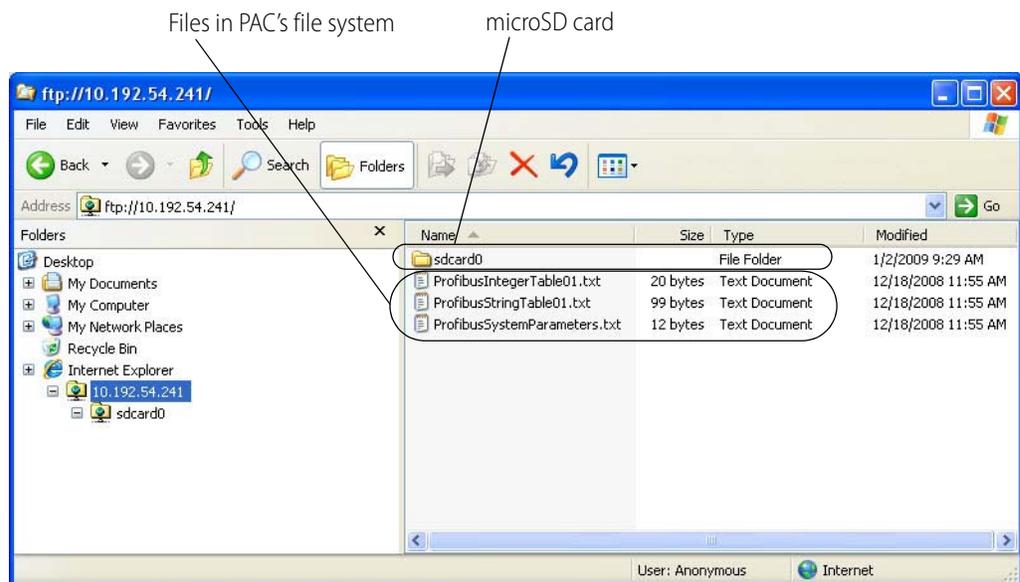
Within the `sdcard0` directory on the controller (or the root if the card is in a card reader), you can create other directories and create or add files, up to a maximum of 512 files and directories. In subdirectories of sdcard0, however, you can include many more files. The total number of files and directories on the microSD card cannot exceed 65,500.

Remember that all files must be named with a maximum of eight characters in the name plus three characters in the extension (8 dot 3 format), for example: `datafile.txt`

When the card is in the controller, you can access files on the card through PAC Control commands and from a PC using FTP.

Use PAC Control commands just as you would with any other file in the controller's file system. See the section "Using the Control Engine's File System" in Chapter 10 of the *PAC Control User's Guide* (form #1700) for help. Remember to include the card's directory name in the path in the file communication handle, for example: `file:a,/sdcard0/VoltLog.txt`
Note that the path separator is a forward slash (/), not a backward slash (\).

You can also use the FTP communication handle in PAC Control to manipulate files. See the section "Moving Files via FTP," also in Chapter 10 of the *PAC Control User's Guide*.

To move files to or from a PC, use any standard FTP software. (Don't use PAC Manager as the FTP client, because it cannot see directories within the controller's file system). Remember to include the card's directory name, for example: `ftp://192.168.1.1/sdcard0/`

NOTE: If you access the card when it is not in the controller (for example, in a card reader), the sdcard0 *directory does not appear. Do NOT create it. The controller treats the card as a folder in the controller's file system.*

Displaying Free Space on the Card

(Requires firmware 8.5a or newer.) If you need to know how many free bytes are left on a microSD card, you can use PAC Control or PAC Manager to read this data from an address in the controller's memory map. In a PAC Control strategy, for example, you could notify an operator if the card needs replacing, based on the number of bytes still unused.

1. Make sure the card is in the controller.
2. In PAC Control, use the command Read Number from I/O Unit Memory Map to read memory map address F7002204. Use Integer 32 Variable in Argument 2.

   For more information, see "I/O Unit—Memory Map Commands" in Chapter 10 of the *PAC Control User's Guide,* and see "Read Number from I/O Unit Memory Map" in the *Command Reference* or Help.)

3. In PAC Manager, open the Inspect window for the controller. Click Other and choose Generic Read/Write from the popup menu. In the Address field, type F7002204. From the Type dropdown list, choose 32-bit Integer. Leave the Length as 1. Click Refresh.

   The number of bytes appears in the Value column.

Updating Firmware

The card can also be used to update firmware if the controller is not on the network, or if PAC Manager isn't available. The card can update both controller firmware and, on an R-series controller, firmware for a serial communication module on the same rack.

NOTE: The controller must have firmware version R8.4a or higher and loader version 5.1b or higher to use the microSD card in this way. To check versions, see page 10.

1. Obtain the correct firmware file from our website, www.opto22.com. If you are using Secure Strategy Distribution (SSD), the firmware must have the correct signature.
2. Rename the firmware file to fit the 8 dot 3 filename format (see "Card Type and Format" on page 1).

The original file extension does not have to be retained. To make sure the file is clearly identified, we recommend a name such as the following: `PPP-TMM.mmb` where:

PPP   = controller type (R1, R2)
T   = R for release (or B for beta)
MM   = major revision number
mm   = minor revision number
b   = build letter

Example of an original firmware filename: `snap-pac-r2-R9.0a.bin`
Example of the same firmware file, renamed: `R2-R9.0a`

3. Copy the renamed firmware file to a blank microSD card. If you don't have a blank card, delete the following directories and their contents if they appear on the card:

   /sdcard0/strategy
   /sdcard0/boot
   /sdcard0/opto22/config

   You can write to the card in one of two ways: either use your PC to FTP files to the card in the controller, or use a card reader with your PC and simply copy files with Windows Explorer.

4. In the root directory of the card, create a command file named `command` (If you are looking at the card in a card reader, go to the root directory. If you are looking at the card in the controller, go to the directory named `sdcard0`).

5. In the `command` file, include the following commands as needed, all in the same file. All commands are CASE SENSITIVE.

To do this	Use command	Details
Install serial communication module firmware	`ModKrn <file>, <modpos>`	<file> is the firmware path and file as the microSD card sees it, so do not include *sdcard0* directory in the path. The firmware file can be compressed in gzip format or uncompressed. * <modpos> is the position of the module on the rack. NOTE: If this file exists, it will be installed. Firmware checking is impossible on serial modules. **CAUTION:** Installing the wrong firmware on a serial module will make the module unusable. Make sure you have the correct firmware!
Install controller firmware	`Krn <file>`	<file> is the firmware path and filename as the microSD card sees it, so do not include *sdcard0* directory in the path. The firmware file can be compressed in gzip format or uncompressed.* If you're using Secure Strategy Distribution, <file> must include a valid signature. NOTE: If installing both module and controller firmware, make sure the ModKrn command comes before the Krn command, as Krn resets the controller. NOTE: Controller firmware will be installed only if it differs from the current firmware.
* To gzip a file on Windows, use the utility at http://gnuwin32.sourceforge.net/packages/gzip.htm. SNAP PAC cannot decompress files that were compressed with WinZip		

The following sample command file updates firmware on the controller.

```
Krn R2-R9.0a
```

The following sample command file updates firmware on the controller and on two serial modules. The update commands for the serial modules must be listed first. This file updates version R2.0a on an RS-232 serial module in slot 3, firmware version R1.3c on a motion control module (a special type of serial module) in slot 6, and firmware version R9.0a on a SNAP-PAC-R2 controller. Note that the motion control firmware is located in a directory named `motion.` It doesn't have to be in its own directory; module and controller firmware files can be in the same directory or in separate directories, as you choose. If you show a path in the command file, note that you must use a forward slash (/), not a backward slash (\).

```
ModKrn SCM-R2.0a, 3
ModKrn motion/MOT-R1.3c, 6
Krn R2-R9.0a
```

6. In Windows Explorer, right-click the command file filename and choose Properties. In the General tab, click to put a checkmark in the Read-only box. Then click OK.

7. To update firmware, insert the card in the controller's card slot.

The controller reads the command file, updates firmware, and saves firmware to flash memory. When finished, it places a file named `response` in the root directory of the card; this file indicates the success or failure of each command. Then the controller restarts..

8. Wait until the STAT LED blinks only once every five seconds, and then remove the card.

Booting from Firmware on the Card

You can also boot the controller from firmware on the card, rather than from the firmware in flash memory, for example to test new firmware before updating it on the controller.

You can write to the card in one of two ways: either use your PC to FTP files to the card in the controller, or use a card reader with your PC and simply copy files with Windows Explorer.

NOTE: Wired controllers must have loader version 5.1b or newer. Wired+Wireless controllers must have loader version 6.0a or newer. Controllers configured for Secure Strategy Distribution (SSD) cannot boot from the card.

1. Locate the firmware file you wish to boot from and rename it to fit the 8 dot 3 filename format (see "Getting Firmware Version Information" on page 10).

Recommended naming scheme: `PPP-TMM.mmb` where:

PPP = controller type (R1, R2)
T = R for release (or B for beta)
MM = major revision number
mm = minor revision number
b = build letter

Example of an original firmware filename: `snap-pac-r2-R9.0a.bin`
Example of the same firmware file, renamed: `R2-R9.0a`

2. Create a directory on the card in the root and name it: `boot`

Remember, if you are looking at the card *in the controller*, you create the `boot` directory in the `sdcard0` directory. If you are looking at the card *in a card reader*, create the `boot` directory at the top level. The controller's file system treats the card as a directory named sdcard0.

3. Copy the renamed firmware file to the `sdcard0/boot` directory on the microSD card.

Here's how it might appear if you are looking at the card in the controller:
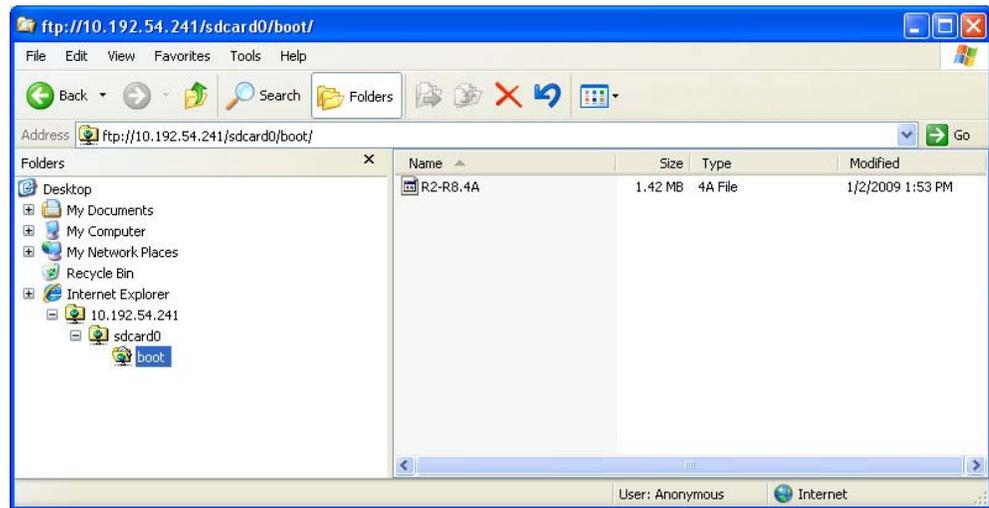
IMPORTANT: *The boot directory must contain only one firmware file. If it contains more than one, the wrong firmware may be loaded.*

4. If the card contains a command file or any other firmware files, delete them.

5. To boot the controller from firmware on the card, turn the controller off and insert the card in the controller's card slot. Turn the controller back on. (Or insert the card and then quickly push and release the controller's Reset button.)

If the boot directory exists on the card, the STAT LED blinks green three times, quickly. Firmware is loaded. If the STAT LED blinks red, see "Blink Codes" in the controller's user's guide to determine the problem.

If the STAT LED blinks green two times, either the boot directory is not present, the firmware file is invalid or does not match the controller, or the controller is an SSD controller.

When the STAT LED no longer blinks steadily, but blinks only once every five seconds, you can remove the card. When the card is removed, the controller continues running the firmware on the card until power is cycled or the controller is reset. If you need to know whether the controller booted from the card or from flash memory, use PAC Manager's Inspect window to check the Status Read area. See the *PAC Manager User's Guide* for instructions.

Updating, Running, or Testing a Strategy

The card can also be used to update, run, or test a PAC Control strategy. This ability is useful when the controller is not on the network or PAC Control isn't available. Both regular strategies and Secure Strategy Distribution (SSD) strategies can be used.

You can write to the card in one of two ways: either use your PC to FTP files to the card in the controller, or use a card reader with your PC and copy files with Windows Explorer.

IMPORTANT: *The controller must have firmware version R8.4a or higher and loader version 5.1b or higher. To check the version on your controller, see page 10.*

1. In PAC Control Configure mode, choose File→Strategy Options. Click the Download tab.
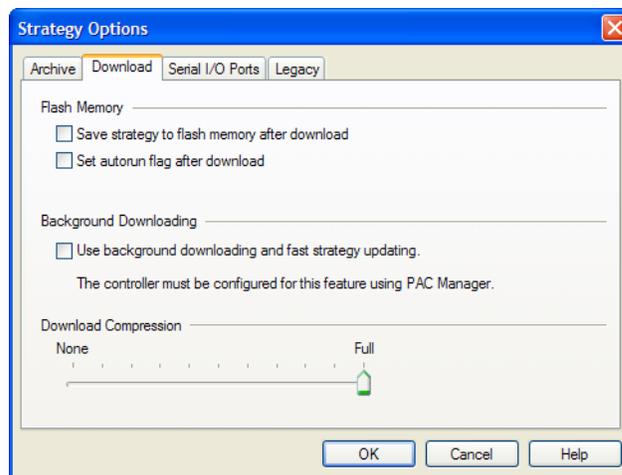
2. If you want the strategy saved to flash memory, check the box Save strategy to flash memory after download.

3. For all firmware versions 8.4a or newer, if you want to set the strategy to autorun, check the box Set autorun flag after download.

Autorun works if you insert the card and then turn on the controller; it has no effect if you insert the card when the controller is already turned on. (If the controller is already turned on, the new strategy follows the status of the existing strategy: if the existing strategy was running when the card was inserted, the new strategy will run; otherwise, it will not.)

If you use background downloading, the controller will switch to the new strategy when the card is inserted.

4. Click OK.

5. Choose one of the following:

a. If you're using Secure Strategy Distribution, follow steps in form #1762, the *PAC Terminal SSD Technical Note*, to create a download file with the file extension .ssd.

b. Otherwise, compile the strategy as a Control Engine Download file (.cdf) by right-clicking the name of the control engine in the Strategy Tree and choosing Compile Control Engine Download File from the pop-up menu.

The file is created in the same folder as the strategy, with a .cdf extension and a filename consisting of the strategy's name and the control engine's name (for example, MyStrategy.MyEngine.cdf).

6. Rename the .cdf or .ssd strategy file to fit the 8 dot 3 filename format for the microSD card (see "Card Type and Format" on page 1).

> **IMPORTANT:** *You must retain the correct file extension (.cdf or .ssd).*

7. Create a directory on the card in the root and name it: `strategy`

Remember, if you are looking at the card *in the controller*, you create the `strategy` directory in the `sdcard0` directory. If you are looking at the card *in a card reader*, create the `strategy` directory at the top level. The controller's file system treats the card as a directory named sdcard0.

8. Copy the renamed strategy file to the `sdcard0/strategy` directory on the microSD card.

Here's an example of a strategy file in the strategy directory, looking at the card in the controller:
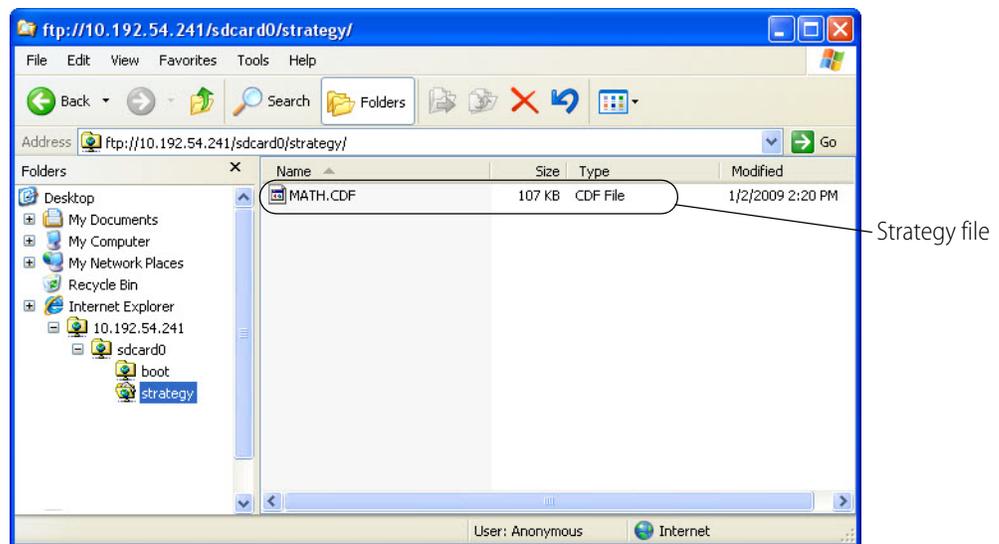
Strategy file

9. Choose how you want to use the card with the controller:

– **Turn off the controller, put the card in, and turn the controller back on.** The controller will load the strategy from the card (verifying the signature if it is an .ssd file), switch to the new strategy if you're using background downloading, and run the new strategy if you set it to autorun. If it's not set to autorun, you have to start the strategy manually using PAC Control or PAC Terminal. If you checked the Save to flash memory box, the strategy is saved to flash.

– **Put the card in while the controller is running.** The controller will check that the strategy differs from the existing one, verify signature on an .ssd file, load the strategy, switch to the new strategy if you're using background downloading, and then run the strategy only if the existing strategy was running when you put the card in. If the existing

strategy was stopped, the new one will not run; you must start it manually. If you checked the Save to flash memory box, the strategy is saved to flash.

In either case, the STAT LED will blink steadily while the strategy is loading and then blink two sets of three blinks—green to indicate success, or red to indicate failure. When the STAT LED no longer blinks steadily, but blinks only once every five seconds, it has finished.

10. Wait until the STAT LED blinks only once every five seconds, and then remove the card.

## Disabling Firmware and Strategy Updates Via the Card

If you do not want anyone to be able to update firmware or strategies using a microSD card, you can disable this feature in the controller. (Enabled is the default.)

1. In PAC Manager, open the Inspect window for the controller.

2. Click Other and choose Generic Read/Write from the popup menu.

3. In the Address field, type F7002200. Choose 32-bit Integer as the Type.

4. To disable firmware/strategy updates: In the Value column next to the address, type 0 (zero). Click Apply.

5. To enable firmware/strategy updates: In the Value column, type any value other than zero and click Apply.

For Help

Getting Firmware Version Information

1. Choose Start→Programs→Opto 22→PAC Project→PAC Manager.

2. In the PAC Manager main window, click the Inspect button 🔍.

3. In the Device Name field, type the controller's name or IP address. Click Status Read.
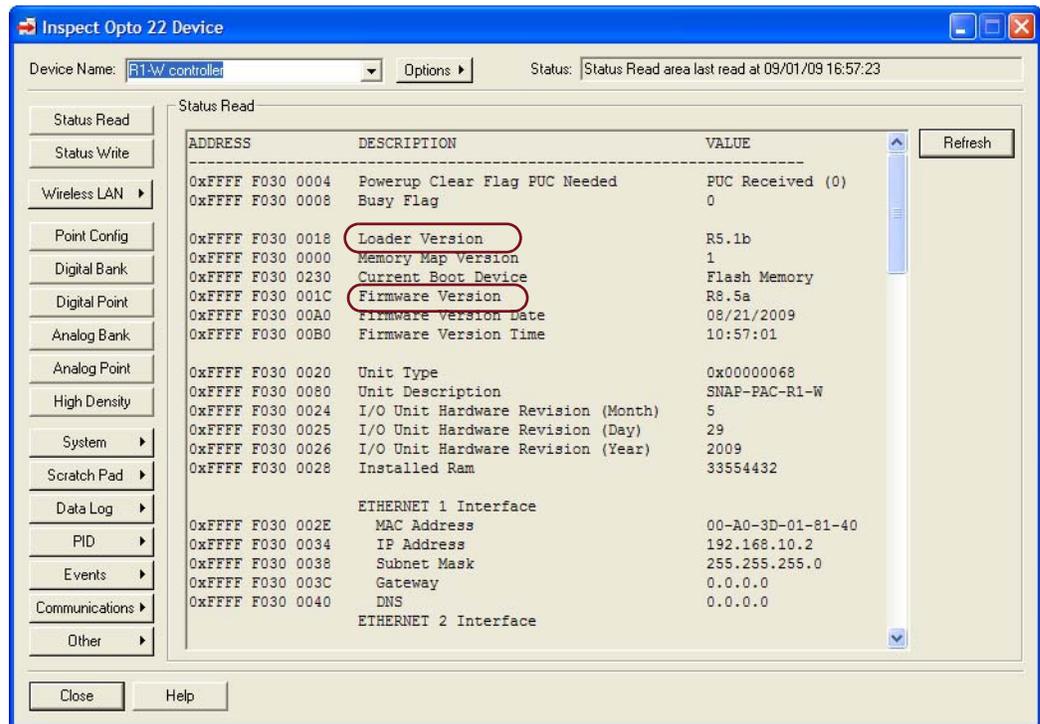
Loader and firmware versions are shown.

Contacting Opto 22 Product Support

If you need a newer loader version, have trouble downloading firmware, or experience other problems using the microSD card slot, and you cannot find the answer in this document or in the controller's user's guide, please contact Opto 22 Product Support.

Phone: 800-TEK-OPTO (835-6786)
951-695-3080
(Hours are Monday through Friday,
7 a.m. to 5 p.m. Pacific Time)

Fax: 951-695-3017

Email: support@opto22.com

Opto 22 website: www.opto22.com

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