Spacelab VxWorks Software Update

Vulnerability Mitigation

UVSL (91367, 91369, 91370, and 91387) Software Version 2.03.14

077-0480-01 Rev A

CUSTOMER SERVICE NOTES

Product Covered: UVSL, 91367, 91369, 91370, and 91387.

Purpose: VxWorks Software Update – Vulnerability Mitigation.

Description:
An enterprise security firm identified vulnerability (URGENT/11) in the VxWorks operating System software version 6.6 distributed by Wind River, which is used in certain Spacelabs products. For additional information, please visit https://www.spacelabshealthcare.com/products/security/. The VxWorks vulnerability can allow a remote user to access a product and potentially disrupt patient monitoring.

Authorized Spacelabs Healthcare Service Personnel should install VxWorks patch software per standard operating procedures.

To mitigate the identified vulnerability and ensure device security is optimized, Healthcare service personnel can also install the VxWorks patch software via the following instruction set.

Dependencies:
The following process and procedures are dependent on monitor model and software version. Spacelabs has outlined a specific update procedure to follow based on which monitor type and software versions installed. See flow chart below to assist with determining the appropriate update procedure based on monitor model and software version.

- 2.03.14 is downward compatibly with all hardware configurations.

Important Considerations:
Clinical Nursing Education may be necessary if updating existing software versions from 2.03.13 or older (training materials will be provided).

Additional Command Module upgrades may be required for full features with newer monitoring software. For additional help contact Technical Support at 1-800-522-7025.

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Overview

Order of Operations:

The following are steps necessary to pre-plan an upgrade and to determine a suitable update procedure.

1. Register with Spacelabs Healthcare Security user group. Registration may take up to 48 hours for access approval so plan accordingly. Once registered, software, installation, and post installation instructions will be accessible. Once registered you will receive an email with user name and password along with a download password to download the software zip. The zip file contains this CSN, VxWorks software and all related forms.
2. Obtain VxWorks patch software and all available documentation from https://www.spacelabshealthcare.com/products/security/. Software and instructions should be downloaded to USB drive or service laptop that will be used for updating monitor software.
3. Install MD5Summer and validate the .md5 hash files. See Appendix D.
4. Install FileZilla FTP server. See appendix C for installation and configuration.
5. Determine update process for software update via flow chart
6. See Appendix B for information on how to connect the Service Computer to the monitor.
7. Record the monitor's configuration per worksheet, Document 091-1197-01 Rev A and Document 091-1198-01 Rev A.
8. Update software via selected procedure
9. Test monitor for full functionality after update is completed.
10. Repeat steps as necessary to update all affected monitors

Tools Required:

1. Laptop with Windows 7 or Windows 10. Must have USB and Ethernet port available.
2. Ethernet crossover cable.
3. Ethernet patch cable
4. USB mouse (optional)
5. Small 4 or 6 port L2 switch
6. USB thumb drive (FAT32 formatted). USB Flash drives larger than 32GB have not been tested.
7. FileZilla server on the designated laptop (Appendix C).
8. Monitor software and MIR sheet.

How to Register with Spacelabs to Obtain Software:

Using your browser navigate to https://www.spacelabshealthcare.com/products/security/ and register as New User, or enter user name and password if you already have a valid login. New user registration may take 24 to 48 hours for authentication.

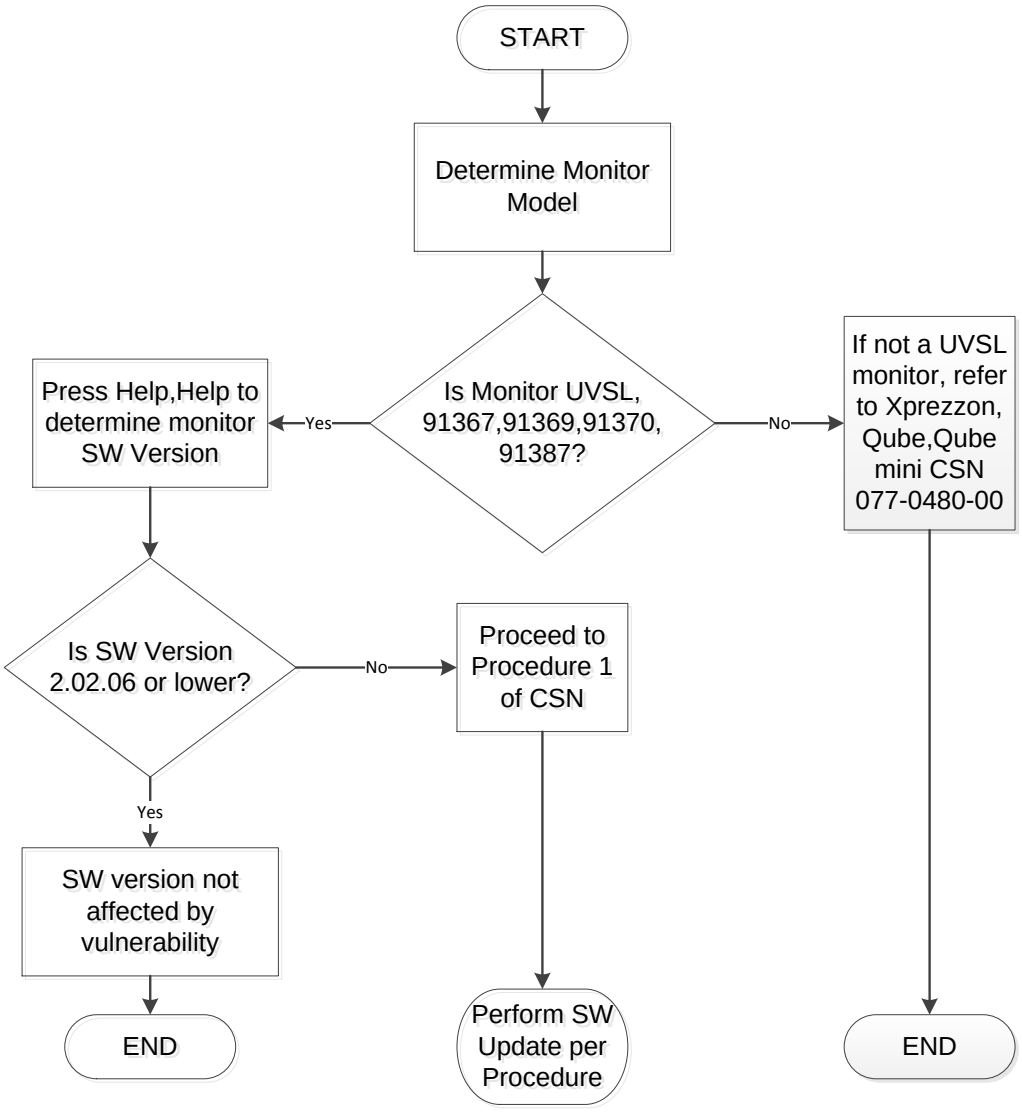
Once registered navigate to VxWorks software update folder and download designated software and instructions. At the completion of software updates, fill out the MIR and email to installedbase@spacelabs.com. MIR may contain multiple entries.

FTP Server Instructions

Download FileZilla Server from https://filezilla-project.org/ Follow configuration instructions via Appendix C.

Determining SW Update Procedure:
To assist with determining which model type and SW version are currently in place, follow the diagram below, then proceed to the appropriate update Procedure. UVSL model numbers include (**91367, 91369, 91370, and 91387)**

UVSL SW version 2.02.06 or below is not affected by vulnerability.



VxWorks UVSL SW Update Process

Overview

The Ultraview SL (UVSL) product line consists of:

- 91367 (SL2200)
- 91369 (SL2400)
- 91370 (SL2600)
- 91387 (SL2700, SL2800, SL2900, SL3800, and SL3900)

Programming of UVSL monitors consists of these six steps:

1. Download and verify the software distribution files from https://www.spacelabshealthcare.com/wp-login.php?redirect_to=https%3A%2F%2Fwww.spacelabshealthcare.com%2Fproducts%2Fsecurity%2Fsecurity-advisories-and-archives%2Fvxworks-software-updates-for-spacelabs-devices%2F (must be registered user)
2. Connecting the Service Computer to the target monitor via a network connection (see Appendix B).
3. Program the boot-sector of the monitor CPU Flash ROM.
4. Program the application-sector of the monitor CPU Flash ROM.
5. Zero the NVRAM on the CPU board.
6. Verify monitor configuration settings.

The NVRAM on the monitor CPU board must be zeroed after any software update.

Prior to version 2.03.07, only Spacelabs Field Service Engineers could program UVSL monitors. This is because the Sysgen datakey had to be attached to the monitor serial port in order to zero the NVRAM. This effectively returns the monitor backend configurations, including the option string (Sysgen), back to factory defaults.

*Beginning with software version **2.03.07**, the NVRAM can be safely zeroed without the datakey attached. This allows Healthcare Service Personnel to update the UVSL monitors as well. Network settings and most backend configuration settings are retained. The monitor options (Sysgen) are also retained.*

On Service Computer (Laptop)

1. Download the Software Files from the following link:

   https://www.spacelabshealthcare.com/wp-login.php?redirect_to=https%3A%2F%2Fwww.spacelabshealthcare.com%2Fproducts%2Fsecurity%2Fsecurity-advisories-and-archives%2Fvxworks-software-updates-for-spacelabs-devices%2F (must be a registered user).

2. On your service laptop, copy the rocket folder from the downloaded zip file (in the folder 2.03.14 SW) onto the C drive.

3. The results should be similar as shown in Figure 1.

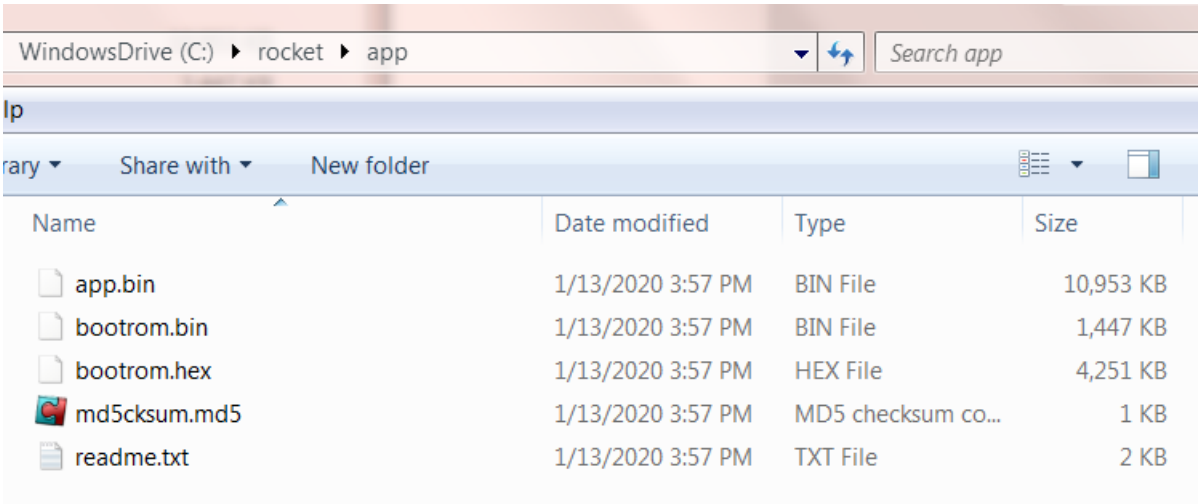


Figure 1: Example Rocket History Folder Content

Important Note: Be sure to Install MD5 Summer and configure per Appendix D. Double click on the .md5 files in the folders. Make sure app.bin, bootrom.bin and FD_image.bin or FD_image_c.bin all indicate OK before loading them into the monitor, see Figures 2.

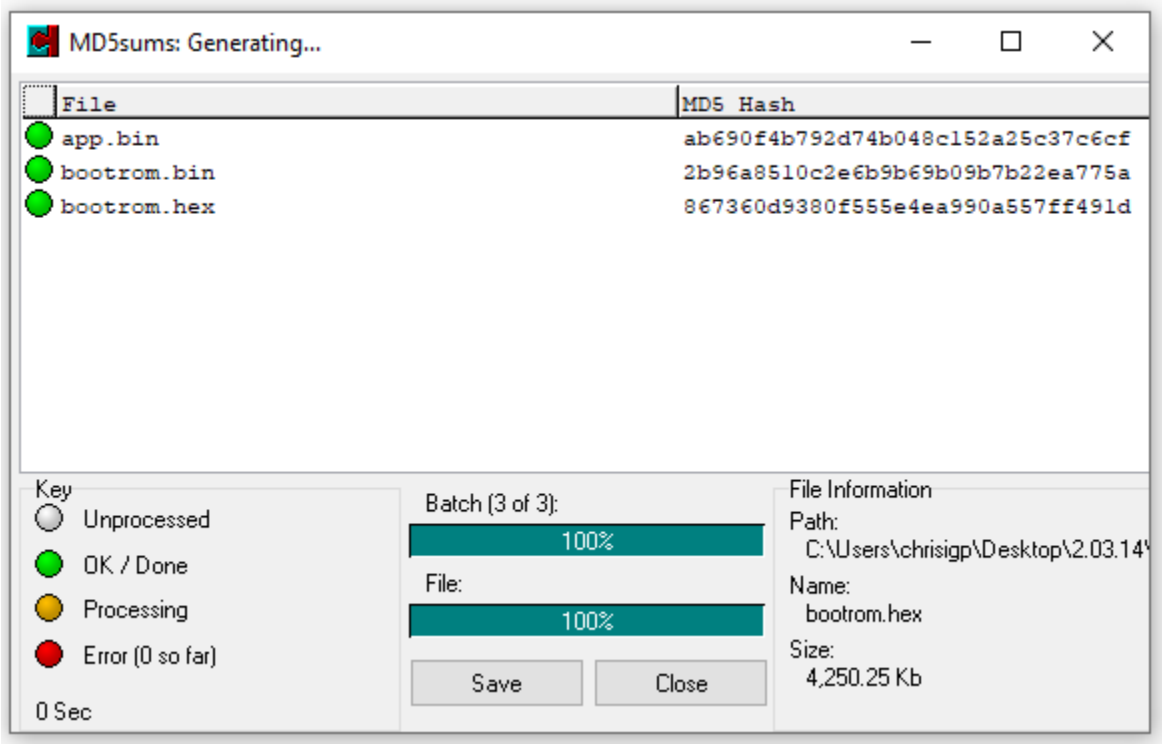


Figure 2: Verifying File Integrity

Please review all steps for clarity and order before proceeding with SW update.

Avoid programming any monitor while it is actively monitoring patients. Although rare, programming failures may render the monitor inoperative. Work with the hospital staff to provide backup monitoring while you program the monitor.

Programming the UVSL monitors will result in loss of patient data. Again, work with the hospital staff in saving any patient data they may need.

The monitor configuration memory (NVRAM) must be zeroed after programming. You must document all target monitor Sysgen (FSE Only), Biomed, and Clinical-menu settings before starting the programming procedure.

Important Note: Complete documents 091-1197-00 Rev A and 091-1198-00 Rev A to record the Biomed, Clinical, and Network menu settings prior to the software update.

Refer to Appendix C for installation and configuration of FileZilla server. By default, UVSL monitors expect the Service Computer's IP Address to be 164.90.254.66/ 255.255.255.0. If the monitor is not on the same IP network, document its current IP configuration, and then change the address to 164.90.254.10/ 255.255.255.0.

UVSL Monitor Pre-Steps

1. In the Biomed Menu, document the current Network Setup/TCP/IP settings, and then make the following changes:
    a. If DHCP is enabled (the key is blue) disable it by touching the DHCP key.
    b. IP Address: 164.90.254.10
    c. Subnet Mask: 255.255.255.0
    d. Gateway Address: nothing (clear the field)
    e. Touch Save and reset the monitor

2. Access the Extended Diagnostics menu. Cycle power on the monitor. During the 4-3-2-1 countdown, touch the lower-left corner of the touchscreen, and then touch the lower-right corner. Do not touch both corners at the same time. If using a mouse, press both mouse buttons simultaneously during the countdown. See Figures 6-8.

3. From the Main Menu, choose **p – print boot params**. Verify the settings are the same as below(See Figure 3):
   a. Ensure the file name is **\rocket\app\app**
   b. Ensure no gateway is listed

```
->
boot device          : motfcc
unit number          : 0
processor number     : 0
host name            : stymie
file name            : \rocket\app\app
inet on ethernet (e) : 164.90.254.10:ffffff00
host inet (h)        : 164.90.254.66
user (u)             : target
ftp password (pw)    : passwd1
flags (f)            : 0x0

Press key to continue...
->
```

Figure 3: UVSL Boot Parameters

- If any entry is wrong, choose **c – change boot params** from the Main Menu.
- If the displayed parameter value is correct, touch ENTER to go to the next parameter.
- If the displayed parameter value is incorrect, use the DELETE key to erase the entry up to the ->, and then enter the correct value. Touch ENTER to go to the next parameter.
- Continue until you return to the Main Menu. Choose **p – print boot params** again to verify the settings are the same as shown in Figure 3.

Refer to *Appendix C* for installation and configuration of the FileZilla FTP server. By default, UVSL monitors expect the Service Computer's IP Address to be 164.90.254.66/ 255.255.255.0. If the monitor is not on the same IP network, document its current IP configuration, and then change the address to 164.90.254.10/ 255.255.255.0

Procedure: Updating UVSL Monitors to SW 2.03.14

1. UVSL monitors expect to find the required software files in the *c:\rocket**app*** folder on the Service Computer.
2. Ensure that the required software files are in *c:\rocket**app.*** See Figure 1.
3. Take note of the checksum values for the bootrom.bin and app.bin files located in the readme.txt file. The following is the app.bin and bootrom.bin checkum values for software version 2.03.14:

   app.bin 0x3806e391
   bootrom.bin 0x071d1280

   The checksum values will be different for every software release. See Figure 4.

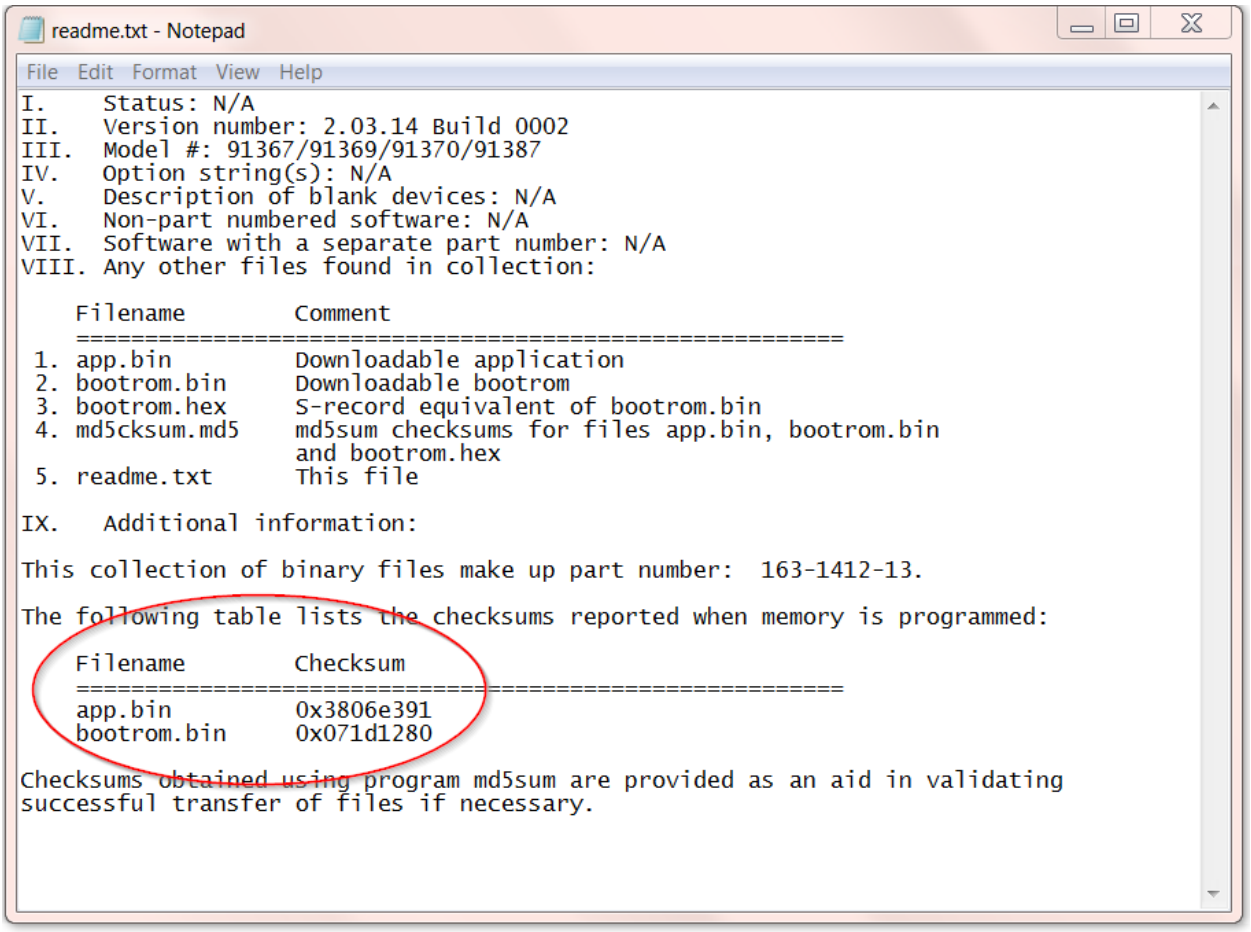


Figure 4: Example of Checksum Values for UVSL monitors in the readme.txt file

4. Power-on the target monitor, and allow it to fully boot. Connect the Service Computer to the monitor using a direct (crossover) network connection. See Appendix B for information on how to connect the Service Computer to the monitor.
5. Start the FileZilla application, Figure 5. Refer to Appendix C for installation and configuration of the FileZilla server if needed.

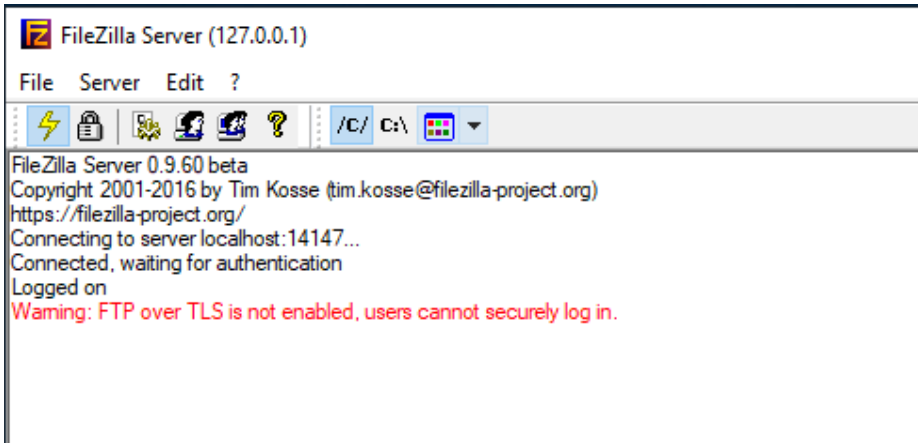


Figure 5: FileZilla Application Running

6. Cycle power on the target monitor. During the 4-3-2-1 countdown, Figure 6, touch the lower-left corner of the touchscreen, and then touch the lower-right corner to enter Extended Diagnostics, Figure 7 and 8. Do not touch both corners at the same time. If using a mouse, press both mouse buttons simultaneously during the countdown.

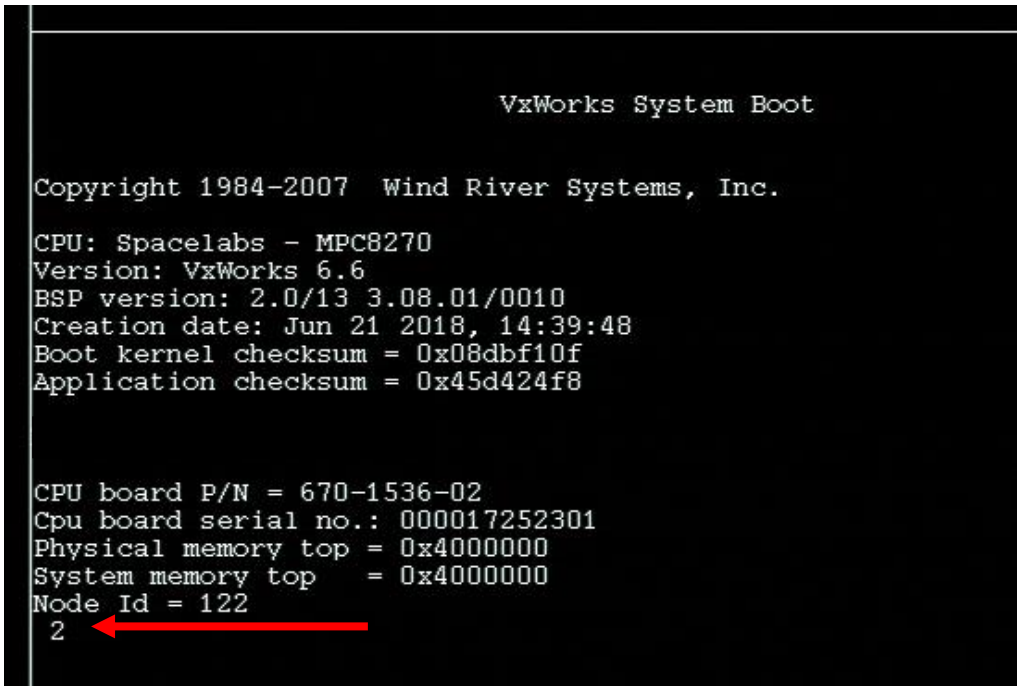


Figure 6: Touch the screen or click the mouse buttons before this countdown gets to zero.

Figure 7: Touch the lower-left corner of the touchscreen, then touch the lower-right corner. Do not touch both corners at the same time.

Figure 8: Extended Diagnostics, Main Menu

7. From the Extended Diagnostics main menu, select the **b - burn flash…** key. The burn flash menu appears, Figure 9.

Figure 9: UVSL Burn Flash Menu (v2.03.14)

8. **Always burn the boot image first**. Select the **b - boot image** key. Watch the FileZilla window and verify the target monitor made the connection to the FTP server, Figure 10.

If the monitor returns an ftpXfer error, go to the troubleshooting section Appendix A.

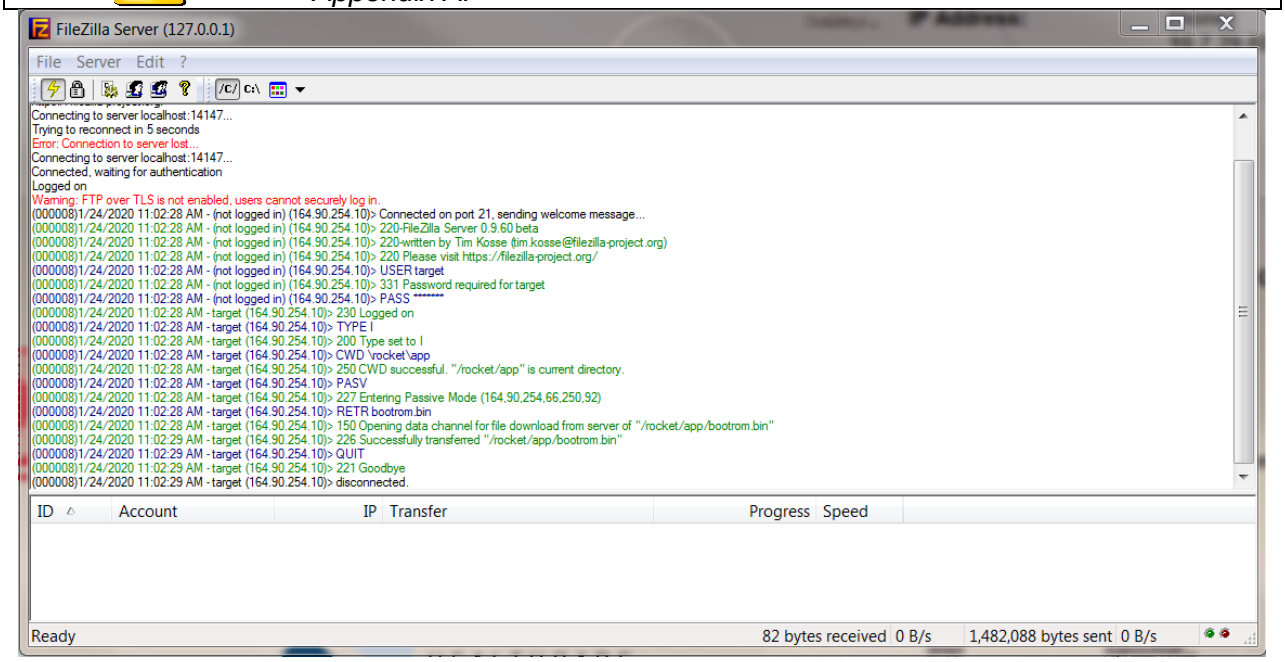


Figure 10: Target monitor logged in to the FTP Server. (bootrom.bin successful)

9. The monitor will show a series of dots progressing across the bottom of the screen. After programming is complete (less than two minutes), the monitor will display the following:

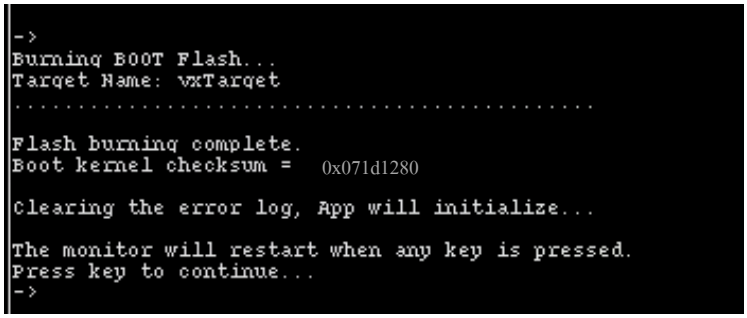


Figure 11: UVSL monitors boot image flash burn complete

THIS STEP IS CRUCIAL, DO NOT SKIP IT!

10. Verify the boot kernel checksum displayed on the monitor is the same as the *bootrom.bin* checksum value specified in the *readme.txt* file. The following is the and bootrom.bin checkum value for software version 2.03.14:

    bootrom.bin 0x071d1280

    a. If the checksum values match (a successful load), go to the next step.

    b. If the values do not match, (an unsuccessful load) select the **Continue…** key and repeat steps 7 through 10 again. See the troubleshooting section Appendix A if the subsequent attempts continue to fail.

11. Select the **Continue…** key. Enter Extended Diagnostics again. Do not allow the monitor fully to boot.

NOTE	*Beginning with software version 2.03.11, the monitor will automatically re-enter Extended Diagnostics when the **Continue…** key is selected.*

12. From the Extended Diagnostics main menu, select the **b - burn flash** key. The burn flash menu appears.
13. Select the **a - application image** key. Watch the WFTPD window and verify the target monitor made the connection to the FTP server:
14. The monitor will again show a series of dots progressing across the bottom of the screen. After programming is completed (about one to three minutes), the monitor will display the following:

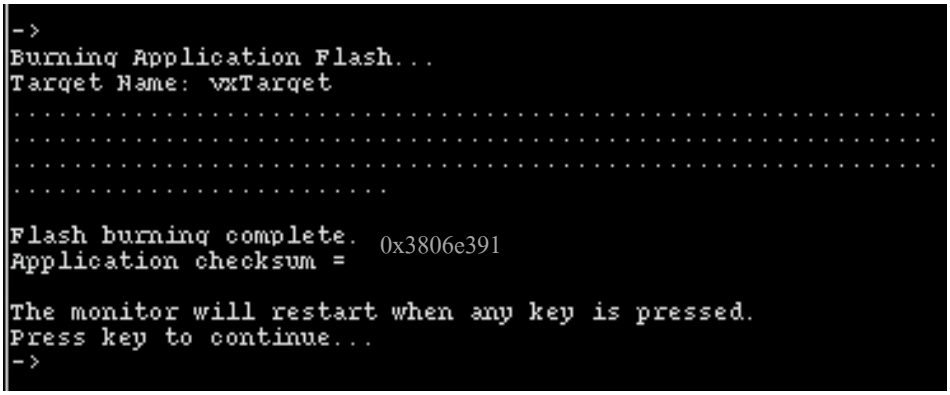


Figure 12: UVSL Application Image flash burn complete

THIS STEP IS CRUCIAL, DO NOT SKIP IT!

15. Verify the Application checksum displayed on the monitor is the same as the *app.bin* checksum value specified in the *readme.txt* file. The following is the app.bin checkum value for software version 2.03.14:

    app.bin 0x3806e391

    a. If the checksum values match (a successful load), go to the next step.

    b. If the values do not match, (an unsuccessful load) repeat steps 12 through 15 again. See the troubleshooting section Appendix A if the subsequent attempts continue to fail.

16. Select the **Continue… key**. Enter Extended Diagnostics once again. Do not allow the monitor to fully boot.
17. The NVRAM must be zeroed after programming *app.bin*.

NOTE	*Beginning with **2.03.07**, the NVRAM can be zeroed from Extended Diagnostics without a Sysgen datakey attached to the monitor serial port.*

18. From the Extended Diagnostics main menu, select the **z – zero NV ram** key.

    a. If the Sysgen datakey is present on the monitor serial port, the NVRAM will be

zeroed completely, immediately. All configurations, including the Option string will be set to Factory Defaults.

b. If the datakey is **not** installed, you must first confirm clearing of the NVRAM. Network configurations and the option-string will be retained.

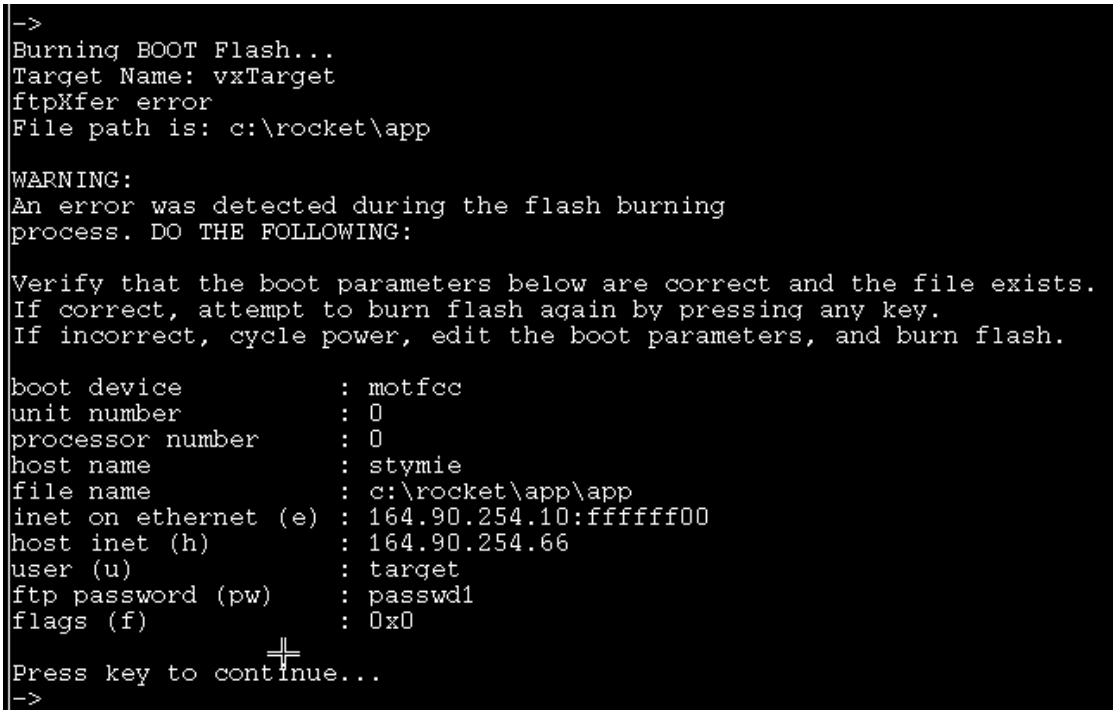
Figure 13: Confirm Clearing of NVRAM without datakey

19. From the Extended Diagnostics main menu, select the **D – run diagnostics…** key, and then the **R - Reset monitor (cold boot)** key. Allow the monitor to fully boot into the user interface.
20. Programming of the UVSL monitor is complete. Be sure to follow any additional procedures specified in this CSN.
21. Be sure to configure the monitor settings back to their original values, especially if you changed the monitor IP Address, or zeroed the NVRAM back to factory defaults.
22. Complete the MIR after each monitor update.
23. Submit the completed MIR with all updated monitors to installedbase@spacelabs.com

IF YOU EXPERIENCE ANY PROBLEMS DURING THIS PROCEDURE, REFER TO APPENDIX A FOR TROUBLESHOOTING.

Appendix A: Troubleshooting UVSL Monitor Programming Issues

Monitor returns an ftpXfer error when initializing flash burn:



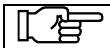
The *ftpXfer error* can be caused by a number of things:

1. The FileZilla Server application is not running on the Service Computer.
2. The required files (*bootrom.bin, app.bin*) are not in the expected folder (*c:\rocket**app***) on the Service Computer.
3. Incorrect connection between Service Computer and target monitor.
    - Allow the target monitor to fully boot.
    - Ping the target monitor from the Service Computer.
        - If Ping is successful, check the boot parameters settings in the target monitor.
        - If Ping fails, troubleshoot the network connections and verify IP Addresses of the monitor and Service Computer. Temporarily turn OFF any firewalls that are enabled on the Service Computer, and retry ping again.
4. The Service Computer is not on the expected IP address of 164.90.254.66.
    - From the Command Prompt, type *ipconfig/all*. Verify the network connection you are using is set for 164.90.254.66.

5. The boot parameters on the target computer are incorrect.

   - Enter Extended Diagnostics. Select **p - print boot** parameters. Compare the settings with the factory-default settings below.

`boot device : motfcc`
`unit number : 0`
`processor number : 0`
`host name : stymie`
`file name : c:\rocket\app\app`
`inet on ethernet (e) : 164.90.254.10:ffffff00`
`host inet (h) : 164.90.254.66`
`gateway inet (g) : 164.90.254.1`
`user (u) : target`
`ftp password (pw) : passwd1`
`flags (f) : 0x0`
	Path to the *bootrom.bin* and *app.bin* files. Notice it is a backslash (\) not forward slash (/)
	Default IP Address & Subnet Mask of the monitor. Actual address may be different.
	Service Computer's IP Address
	Default Gateway. **See note below**
	
	0x0=static IP; 0x40=DHCP



NOTE *A gateway is not specified by factory default. If a gateway is defined, but not actually present, the monitor will return an* ftpXfer error.

   - If a gateway address is listed, make note of the address, and then use the change boot parameters utility in the Extended Diagnostics main menu to delete the gateway entry. Then retry programming the monitor.

   - Be sure to re-enter the gateway address via the Biomed→Network Config menu.

Unit appears to program correctly, but the CHECKSUM fails:

Verify the *readme.txt*, *bootrom.bin*, and *app.bin* files are from the same software version distribution being installed. Download all files again from https://www.spacelabshealthcare.com/products/security/ site if necessary.
If the checksums still do not match after a Flash burn, the CPU board will need to be replaced.

Appendix B: Service Computer Connections

Overview

An Ethernet network connection using the TCP/IP protocol is used for programming Spacelabs Healthcare patient monitors. An Ethernet – TCP\IP network connection is also required for programming physiological patient modules via a patient monitor. The patient monitors that are compatible with the module-programming process include:

All Ultraview SL patient monitors. 91367 (SL2200), 91369 (SL2400), and 91387 (SL2700, SL2800, SL2900, SL3800, and SL3900). 91390 Qube, 91389, Qube mini, 91393 XPREZZON.

Ethernet Hardware Network Connection

A simple RJ45 Ethernet cable connected between the monitor network port and the Service Computer network port is all that is needed.

However, Spacelabs patient monitors, and some early computer NIC adapters, do not auto-detect the connection (MDI-X). In those cases, use a crossover network cable, or use a network switch.

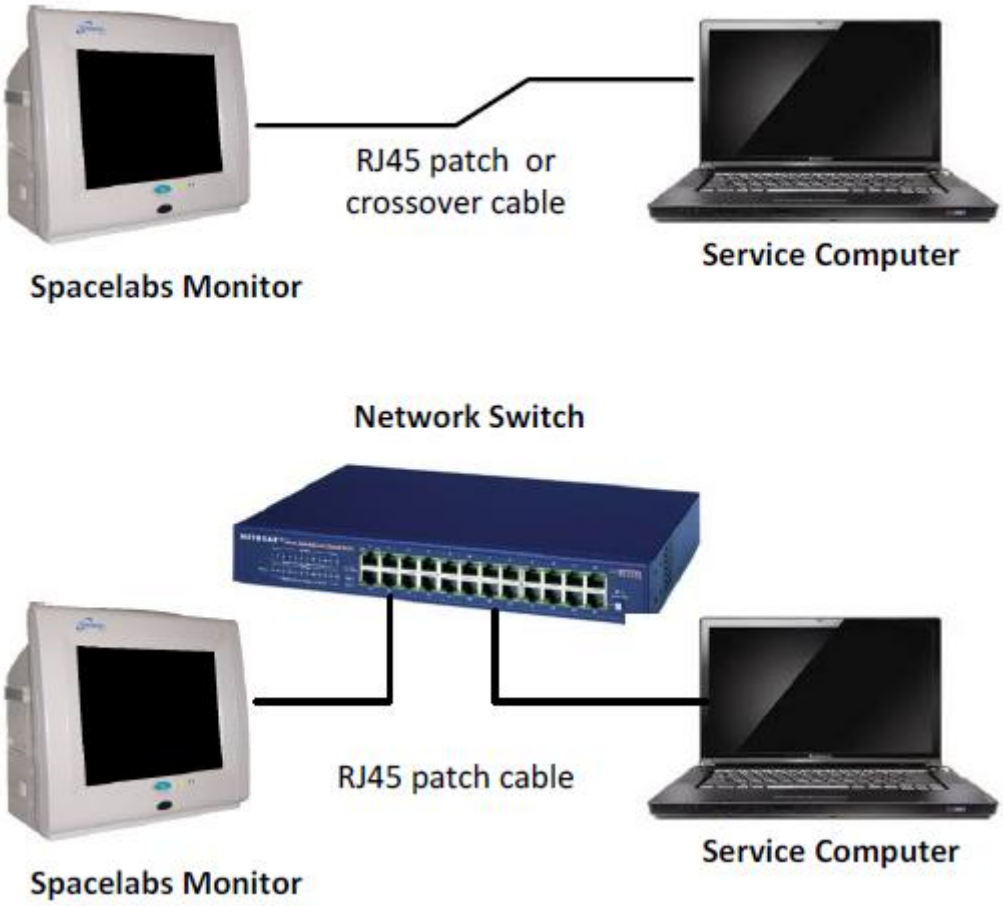


Figure 15: Service Computer network connections

TCP/IP Settings

Service Computer By default, all Spacelabs patient monitors expect the Service Computer's IP address to be 164.90.254.66, with a subnet mask of 255.255.255.0. How to change the IP address on the Service Computer is OS-version dependent. Use Windows Help (click on the desktop, then F1) if you need help in changing the network settings on the Service Computer.

Patient Monitors The default IP network address for Spacelabs Healthcare patient monitors is 164.90.254.0/ 255.255.255.0. The actual *factory-default* host address of the monitor depends on the "family" to which it belongs:

- UVSL 164.90.254.10/ 255.255.255.0
- XPREZZON /Qube /Qube mini 164.90.254.10/ 255.255.255.0.

If the monitor is using the Spacelabs default-addressing scheme, there is no need to change its IP address.
However, in most cases, the IP address of the patient monitor to be updated will have a private IP address assigned to it by the hospital IT Department. In those cases, it is best to first document the monitor existing IP configuration, and then change it to the factory-default settings. Of course once the monitor software update is completed, you must return the settings to their original values.

Verifying the Connection

Once the proper Ethernet connections and IP settings are made, test the connection from the Service Computer by using the PING command from the CMD Prompt. See Figure 13.

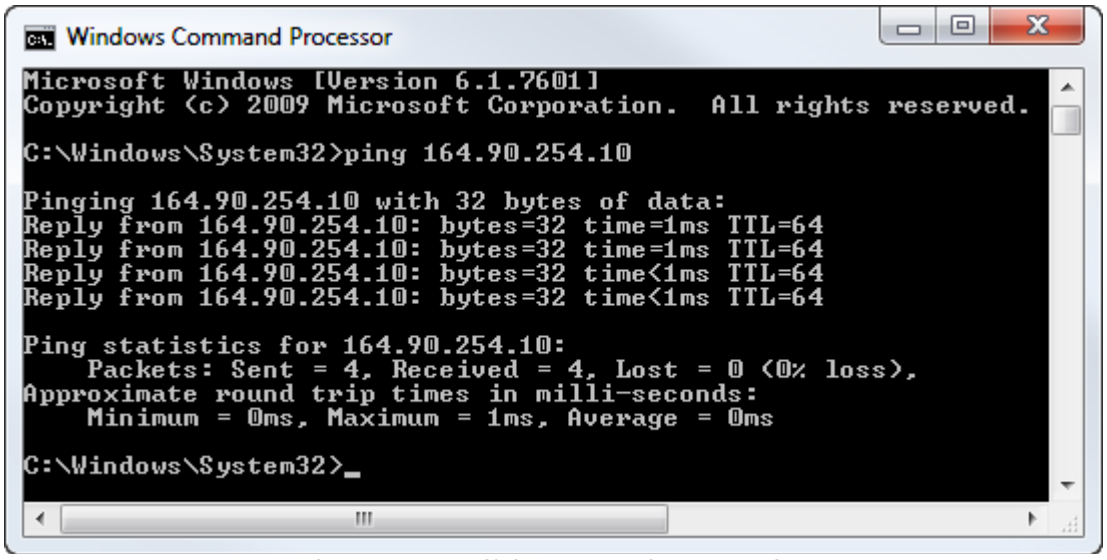


Figure 16: Verifying network connection

Alternately, UVSL, XPREZZON, Qube and Qube mini monitors have a PING utility in their Extended Diagnostics menu. By default the PING function will ping the Service Computer's IP address of 164.90.254.66.

If PING fails, try these steps:

1. If a gateway is defined in the monitor, but not actually present, the PING command will fail. Remove the gateway entry from the monitor, and retry PING again.
2. Temporarily turn off the Windows Firewall, or whatever firewall is installed.

Appendix C: Installing FileZilla File Transfer Protocol

Update the software in Spacelabs Healthcare patient monitors via an Ethernet network using the (TCP/IP) File Transfer Protocol (FTP). The patient monitor is the FTP client; the FTP server is on the Service Computer.

FileZilla is an FTP Server for Windows and is compatible with Spacelabs software load procedures.

Download the FTP Server Application

FileZilla is a free FTP solution. It is open source software distributed free of charge under the terms of the GNU General Public License. To download the application, open your web browser and go to https://filezilla-project.org/, only the standard server product is required. Click on the download button for the FileZilla Windows FTP Server. Save the .zip file to any temporary folder on the Service Computer

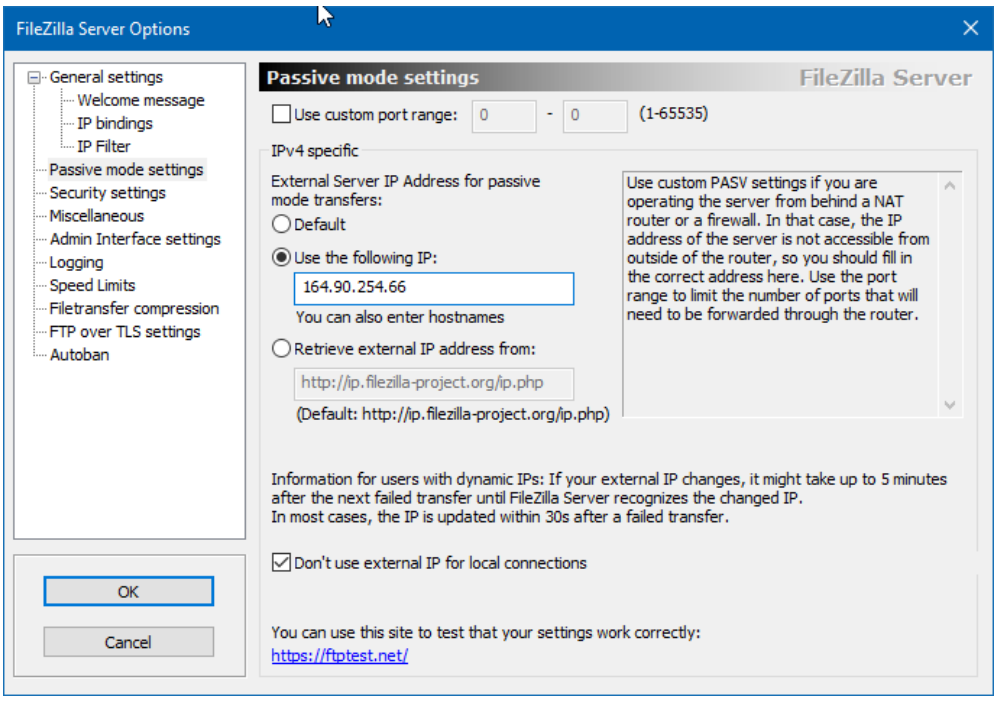
Once downloaded, install FileZilla using default settings on the Service Computer (laptop used to install monitor software.)

Configuring the FileZilla FTP Server Application

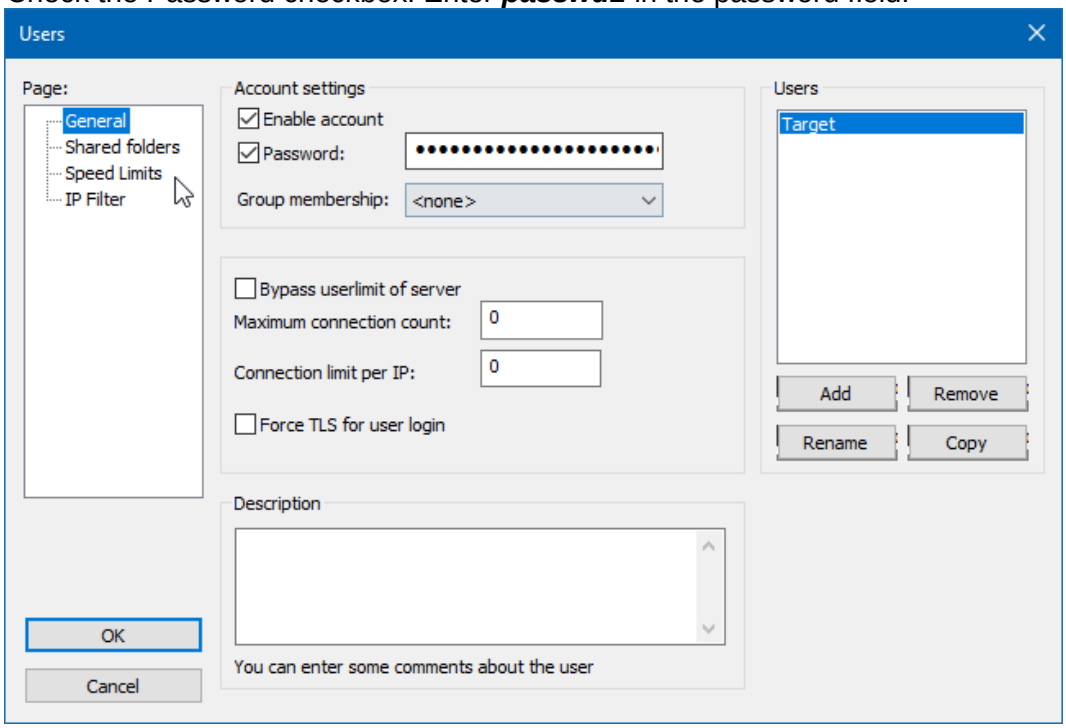
After installation the administrative interface will start. Connect using localhost on port 14147. No password.

The default settings for FileZilla Server are not immediately compatible with Spacelabs monitors. To configure FileZilla Server follow these instructions:

1. From the *Edit* menu select *Settings*
2. Choose *Passive mode settings*.
3. Choose *Use the following IP* and enter *164.90.254.66*. This is the IP address of the Service computer itself.
4. Click OK.

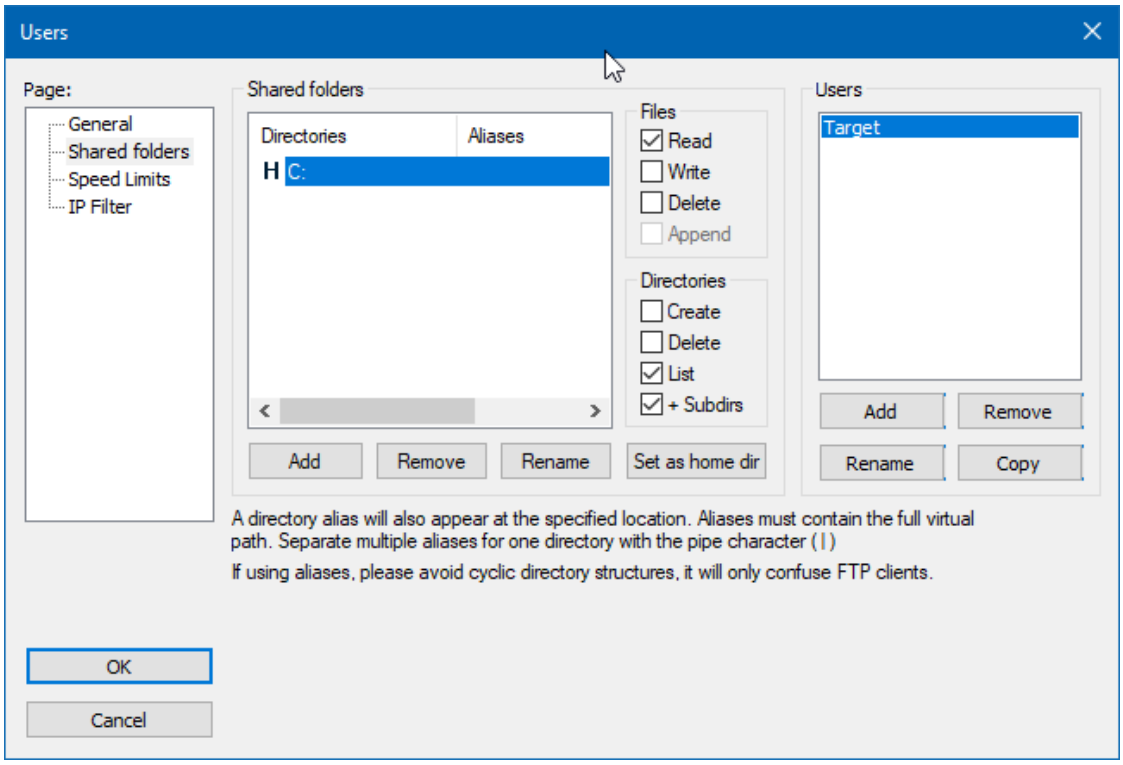


5. From the *Edit* menu choose *Users*.
6. Select the *General* page.
7. Under the *Users* list, select *Add*. Enter ***Target*** as the user name, and then click OK.
8. Check the *Enable account* checkbox
9. Check the Password checkbox. Enter ***passwd1*** in the password field.



10. Select the *Shared folders* page.

11. Under the Shared folders list, click *Add*
12. Browse to and select C:\.
13. Under *Files*, make sure only the *Read* checkbox is checked
14. Under *Directories*, make sure only the *List* and + *Subdirs* checkboxes are checked.
15. Click OK.



Appendix D: Configuring MD5summer to validate .md5 hash files

You must have administrator rights to do this procedure.

Windows 10:

1. Create a folder named *MD5 Summer* in the root of the C:\ drive. (**C:\MD5 Summer**)
2. Copy the *md5summer.exe* and *md5summer.md5* files to the C:\MD5 Summer folder
3. Double-click on the *md5summer.md5* file. Windows will prompt you for an app to open the file.
4. Choose *More Apps*, scroll down the list, and then click *Look for another app on this PC*.
5. Browse to **C:\MD5 Summer** folder, and then choose *md5summer.exe*.
6. If you receive an information window stating that MD5summer failed to set file associations, click OK and close all associated windows.
7. Right-click on *md5summer.exe*, and then choose *Run as Administrator*. Choose YES in the UAC window. Close the md5summer window.
8. File association for any .md5 file is now permanently set to open with *md5summer.exe*.
9. In the 3.08.03 software folder, double click any MD5 file to verify integrity.

Windows 7:

1. Create a folder named *MD5 Summer* in the root of the C:\ drive. (**C:\MD5 Summer**)
2. Copy the *md5summer.exe* and *md5summer.md5* files to the C:\MD5 Summer folder
3. Double-click on the *md5summer.md5* file. Windows will prompt you for a program to open the file.
4. Choose *Select a Program from a list of installed programs*, and then click OK.
5. Click the *Browse* button, and browse to the **C:\MD5 Summer** folder, and then choose *md5summer.exe*.
6. Make sure the *Always use the selected program to open this kind of file* checkbox is checked, and then click OK.
7. If you receive an information window stating that MD5summer failed to set file associations, click OK and close all associated windows.
8. Right-click on *md5summer.exe*, and then choose *Run as Administrator*. Choose YES in the UAC window. Close the md5summer window.
9. File association for any .md5 file is now permanently set to open with *md5summer.exe*.
10. In the 3.08.03 software folder, double click any MD5 file to verify integrity.