

Santa Barbara Scientific
SM-1 PRO Seeing Monitor

Installation and Operation

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Santa Barbara Scientific SM-1 PRO Seeing Monitor
Installation and Operating Manual
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1. Introduction

Santa Barbara Scientific's SM-1 PRO Seeing Monitor consists of a Raspberry Pi computer resident in the seeing monitor enclosure that captures exposures from the ST-I Camera, and processes the information locally. It is called the "Server". It communicates to a program running on the user's PC that is called the "Client". Use of this server-client system offers the user several advantages. First of all, the cable between Seeing Monitor and PC can now be of any length, since it is an internet connection, and a USB extension does not have to be employed. Secondly, the client application is a Java application, and will run on a PC, Mac, or Linux Platform. Lastly, the client application requires low overhead on the part of the PC and does not interfere with other programs. This manual describes how to install and operate the seeing monitor with this computer upgrade.

Connections: the Raspberry Pi is shown in Figure 1. It is connected to the ST-I through a short USB cable.

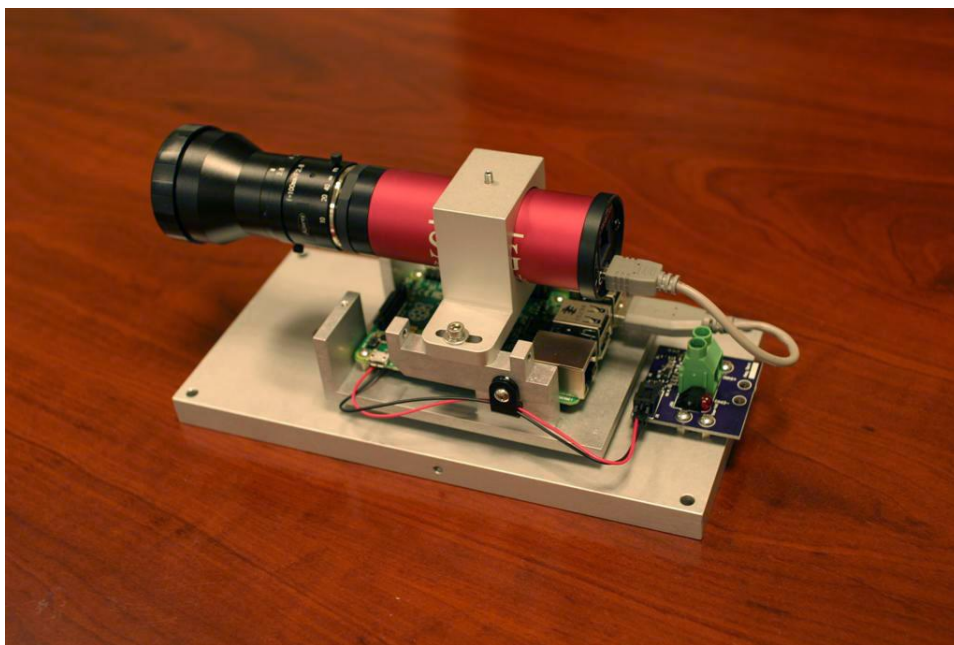


Figure 1: Raspberry Pi installed in Seeing Monitor Structure

We also provide a 25 foot (7.5 meter) power cable that has a USB connection to a 5 volt power supply. ***Note that even though the connection to the power supply is a USB style connector the device pulls too much current to run off of a computer PC, and the pinouts are NOT compatible. Do NOT plug the power connection into a PC just because the connector fits – always a bad idea! The power module is designed for 100 to 240 volt operation.*** A plug adapter may be required outside of the USA. The power module is designed for 100 to 240 volt operation. A plug adapter may be required outside of the USA.

The power module, like any electronics, must be protected from the rain and kept dry. Make SURE when installing the power cable that the red lead is connected to the Plus (right) side of the power daughter board. The other cable required is an Ethernet cable. It connects from the Raspberry Pi to a router. SB Scientific does not provide the router but it is assumed the user has one to which the PC is also connected. The diagram in Figure 2 shows all these connections. When you have all connections made it is a good idea to secure the cables to your stand so that if you trip over the cables in the dark you do not rip connectors off of boards. Also, cables moving in the wind could perturb the seeing measurement.

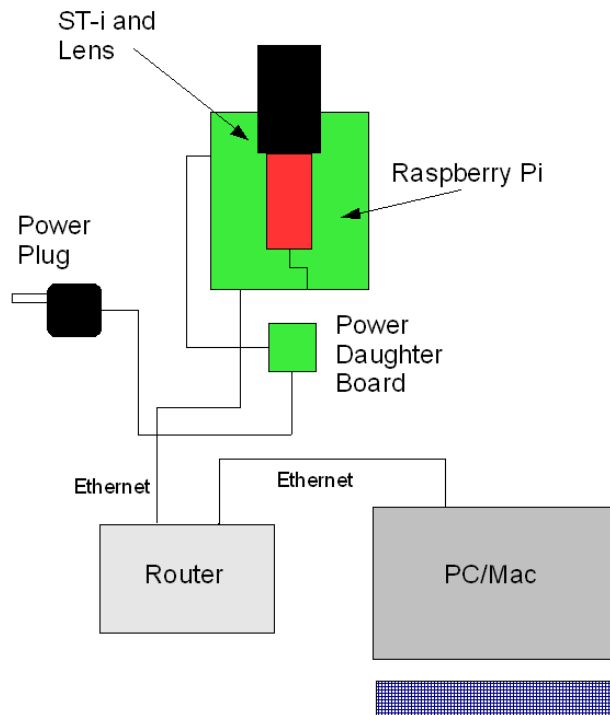


Figure Two: Connections

2. Installing the Software

The Raspberry Pi (RP) is a small computer that actually is a lot like a PC – you can connect a monitor and keyboard up to it and run programs, like a web browser. However, these instructions stick to the seeing monitor application. The version SMSrv_1_68_0000.jar server software comes preinstalled on the RP. The client software is Java, so before you run it you must have Java installed on your computer. Go to www.java.com to download the latest version. Note that Windows XP support is becoming problematic and you may be forced to use Windows 7, 8 or 10. Sorry! It's not us that created this problem! Once you have installed Java, go to our web site, www.sbscientific.com, and download the Seeing Monitor client software, SMCI_1_68_0000.jar. You can copy this file to any directory and run it from there by double-clicking it.

3. Running the Software and Connecting

When the client software initializes you should see the screen shown in Figure Three.

Seeing Monitor Client, ver. 1.54.0000

Connection Camera Graph Update About

Setup

Latitude 49 : 55 Longitude 14 : 47 E

Time Zone America/Los_Angeles Set Time Zone

Daily Start 20 : 0 Daily End 5 : 0

Focal Length 100.0 [mm] Aperture 36.0 [mm] Pixel 7.4 [um] Default Kowa Lens

Avg. Polaris Counts 20000 Polaris Detection Threshold 25 [%] Search Zone +/- 3 [pixel]

Save File Path

Seeing Data Auto Save File Path

Seeing Graph Auto Save Graph Path

Camera Screenshot Screenshot Path

Connection

Host IP Address Find Hosts Port 50001 Reset CCD Camera Connect

0% Device LST 13:46:22 Seeing

Solar Elevation

Figure Three: Connection Page of Client Software

You can move between the Connection, Camera, Graph, Update, and About tabs at any time by clicking the desired tab. To begin, initialize the settings on the Connections page EXCEPT for the time zone. Enter your latitude, longitude, daily start time (local time), daily end time (local time), focal length (100 mm for our standard unit), aperture (36 mm for our standard unit), and pixel size (7.4 microns for our standard unit). For average Polaris counts, enter 70,000, and for the Polaris Detection Threshold enter 25%. For the search zone enter +/- 3 pixels. Our upcoming Southern Hemisphere Seeing monitor uses a larger telescope so we had to make many of these settings user selectable. The latitude and longitude is used to calculate the sun's depression below the horizon, and also for locating the target star in the Southern Hemisphere.

About that time zone setting: the time zone referred to is the one set in the Raspberry Pi, and you can't set it until you are connected to it. We will do this in a later step.

For the Seeing Data, Seeing Graph, and Camera Screenshot file paths just click the path buttons on the right, which select the C:\users directory on a PC. You can change these paths if you wish. Select

AUTOSAVE if you wish for the information to be updated throughout the night. There is no good reason to save the Camera Screenshot throughout the night except for troubleshooting purposes, but the data and graph data sets are good to keep for the record.

Now you are ready to connect to the RP server unit. Power up the seeing monitor, and wait about 1 minute for the Raspberry Pi to finish booting. Then, select FIND HOSTS. This command will take about 10 seconds to look for a connected seeing monitor, and will respond with its IP address. If it reports that the RP was found, then click the CONNECT button. The client should find the RP in about 10 more seconds and report that it is connected in the text box below.

This step is likely to be the most problematic for the user. If no connection is made, even though the IP address was detected, try a few more times. As a last resort, unplug the Seeing Monitor power supply, plug it back in, wait one minute and try again. Contact us if this step fails again. We also have had some trouble with the unit's IP address being detected. If you know how to interrogate the router and ask it for the IP address of all connected units, then you can see the RP and manually type its address into the Host IP address field. We have limited user data on the reliability of this step. On most of our machines here at SB Scientific it works fine. But, a few have trouble. . If you experience problems contact info@sbscientific.com.

Once the unit is connected you are ready to select the time zone in the dialog box on the left side of the screen (the nomenclature is a bit odd – we are in the America/Los Angeles zone). Then click the SET TIME ZONE button. You will get a message that the time zone has been set, but you need to reboot the RP server. Reboot it, wait at least a minute, and try to connect again. If you cannot connect once again cycle the power on the seeing monitor, wait one minute, and try again. The time LST that is displayed on a few screens refers to the Local Sidereal Time.

Once you are connected and initialized the rest is easy!

4. Camera Functions

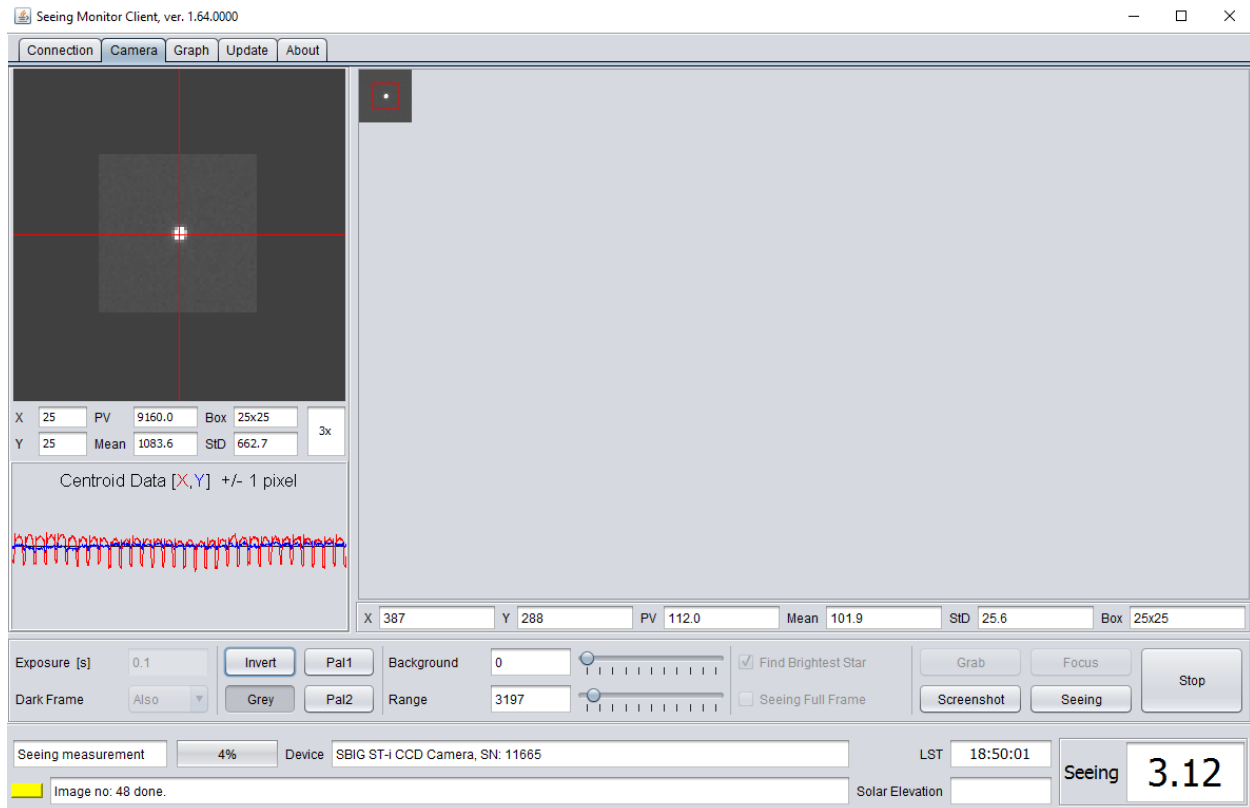


Figure 4: CAMERA page functions

This page allows control of the camera. Start by finding and focusing on Polaris. First set an exposure of about 1 second in the Exposure field, and select ALSO for dark frame, and click the FOCUS button on the right. The unit will start taking exposures. Set the background slider to zero, and the range to 2000, and you should be able to see the image clearly. Adjust the sliders to optimize the appearance of the display. Next, find Polaris and center the North Celestial pole as described in the Seeing Monitor manual. By the way, if this proves to be difficult place a laser pointer along the side of the unit and direct it at Polaris to get close.

Focus the star carefully. When you have Polaris well positioned click the STOP button. To start the seeing measurement click the SEEING button. The unit will start taking and displaying 0.01 second images of Polaris after 3 frames to verify the star position. It does this every time, so that is normal. Once again optimize the appearance of the display with the sliders, and Select FIND BRIGHTEST STAR to just see a portion of the whole frame and speed up the measurement. Only select SEEING FULL FRAME for troubleshooting purposes. This selection downloads the whole frame for each image but slows down the throughput unnecessarily.

Note that the centroid data for each axis shown in Figure 4 was captured using an artificial star being dithered by mechanical means to check the math, and that is why it shows periodicity. The seeing numbers were within 10% of the expected numbers based on the artificial star movement. Note – only star motion horizontally is used for the seeing calculation. If you are concerned that vertical motion may be worse for your site then it is a simple matter to rotate the ST-I by 90 degrees to see if that makes a difference. One can glance at the centroid data and quickly see any significant difference between the axes, though.

5. Graph Functions

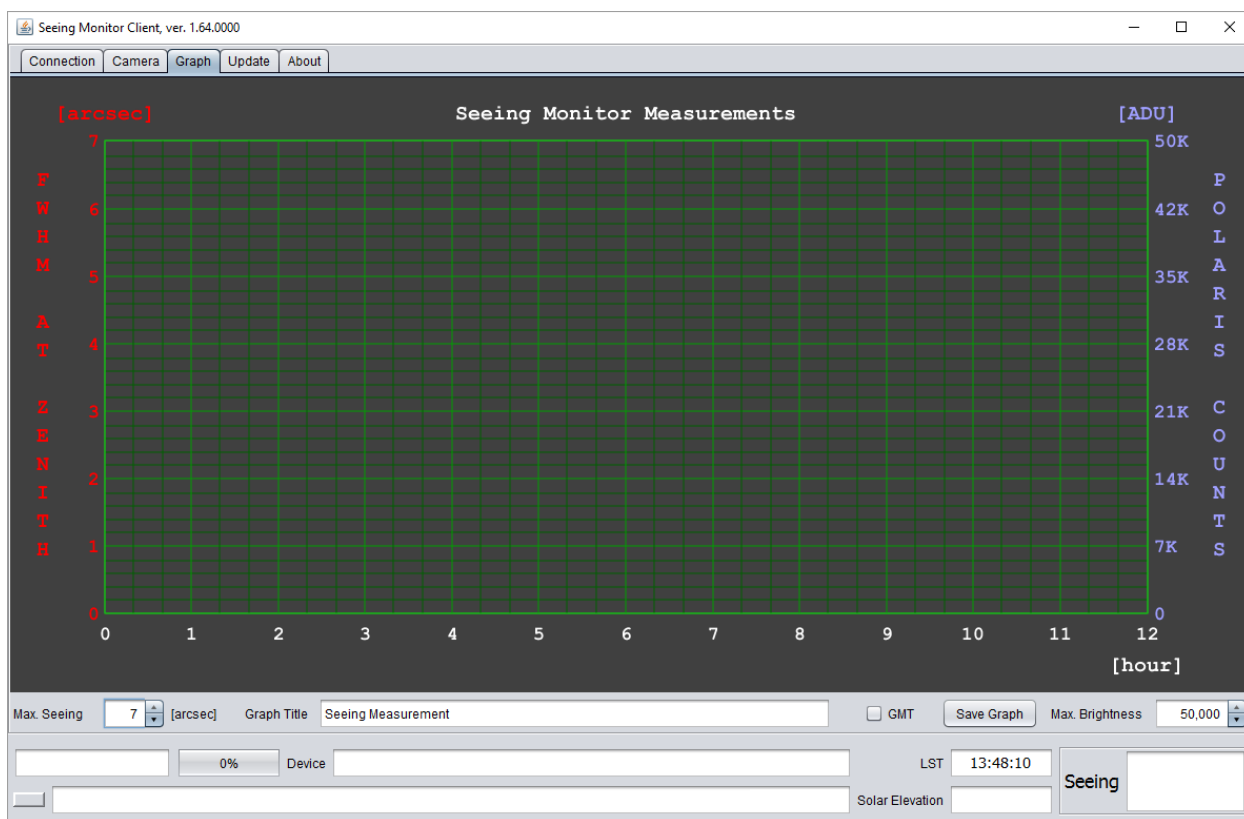


Figure Five: GRAPH page functions

On the GRAPH page you can see the results of the seeing measurements. A control below the FWHM seeing scale, and the Polaris Counts scale allows you to set the range of each axis. Both seeing and Polaris Counts are displayed to give you a quick look at the quality of the night. The graph requires a few cycles of measurements before data is displayed. 1000 looks at Polaris are analyzed for each measurement. You can select GMT to display the seeing relative to Greenwich Mean Time, if you wish, and you can also save the graph if you don't want to use the AUTOSAVE feature of the program. You should use AUTOSAVE since otherwise the next morning the data may no longer be shown.

6. Updating the Software

The seeing monitor software will be upgraded to a new version from time to time. This process is a little tricky since both the firmware in the server and the client software have to be upgraded at the same time. Here is a step by step description of the process.

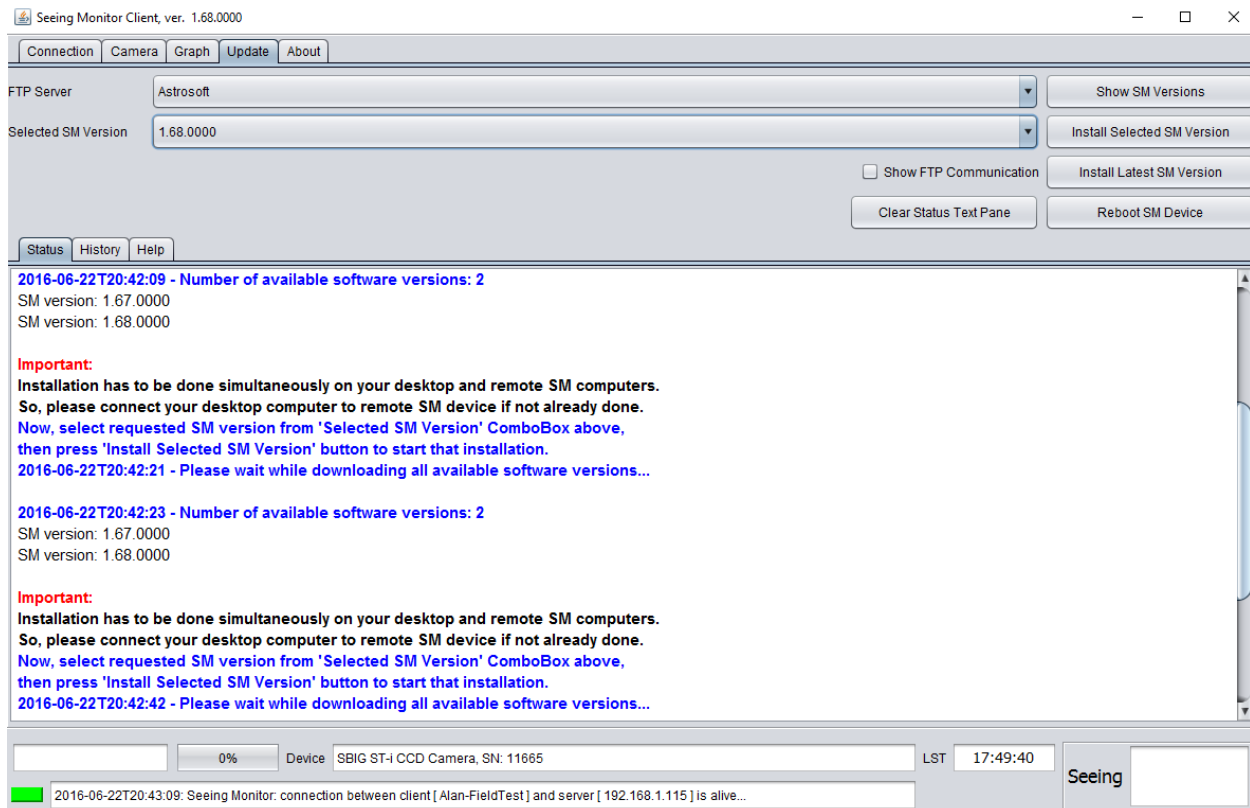


Figure Six: Update Screen

Refer to Figure Seven, below, for the location of the functions described in the following Steps.

Step 1: Connect to your server from the client, as described earlier. Select the Update tab. Note: on my computer I have to turn off the MacAfee firewall for 15 minutes for this process to work. I recommend you do the same. Make sure your connection to the server is active, as evidenced by the green box and dialog in the bottom text box shown in Figure Seven.

Step 2: Select an FTP server from which to download an update. Currently the Astrosoft server is the only active one, but we will add a Santa Barbara Scientific site soon.

Step 3: Press “Show SM Version” button to see all of the available updates. The results are shown inside the Status pane.

Step 4: All updates are seen in Status pane. Example shows two updates 1.67 & 1.68.

Step 5: Select the version you would like to install. We recommend the latest version, but, if there is a problem, you can revert to an earlier version.

Step 6: Click 'Install Selected SM Version' button to download and install it. This is done automatically on both machines, your PC running the SM client and your RPI running the SM server. This action is done automatically without any user interaction and may take several seconds (5 - 10) on my site, but this may differ from site to site. You cannot cancel an installation process!

When you click “Install Selected SM Version” or an “Install Latest SM Version” button, a dialog will pop up. Installation will only continue when the “Yes” button is clicked.

Step 7: The progress of software download and installation is shown in this area.

Step 8: here, a user is informed about the copying of the SmSrv application to his RPI. For example, the client PC copies say, a SmSrv_1_68_0000.jar file to the RPI. If that copy was successfully done, the RPI will create another working copy of that file, named SmSrv.jar, which is automatically launched when the RPI is rebooted. Otherwise the current SmSrv.jar would be executed again. Note: You can also only update the SM client site without updating your RPI. This ability is useful in the case of some software installation problems, such as if SmSrv was not updated for some reason, while SmCli was updated. So, a user may downgrade his PC's SmCli back to his previous version, which is still running on his RPI. The whole Update process will stop on message 8. But, normally the update is done on both sites automatically.

Step 9: when you see this message, both client and server sites have been updated successfully.

Step 10: at this point, you need to reboot the RPI by clicking the “Reboot SM Device” button. After that, you may also close your current client application and start the new version. The new version will be saved in the C:\users directory, and will be named “SmCli.jar”. Put it in the directory you want and execute it next time you reconnect to the server. Remember that it takes the server around a minute to reboot.

Step 11: same as Step 6 but installs the latest version instead of selected version

Step 12: clears the dialog box

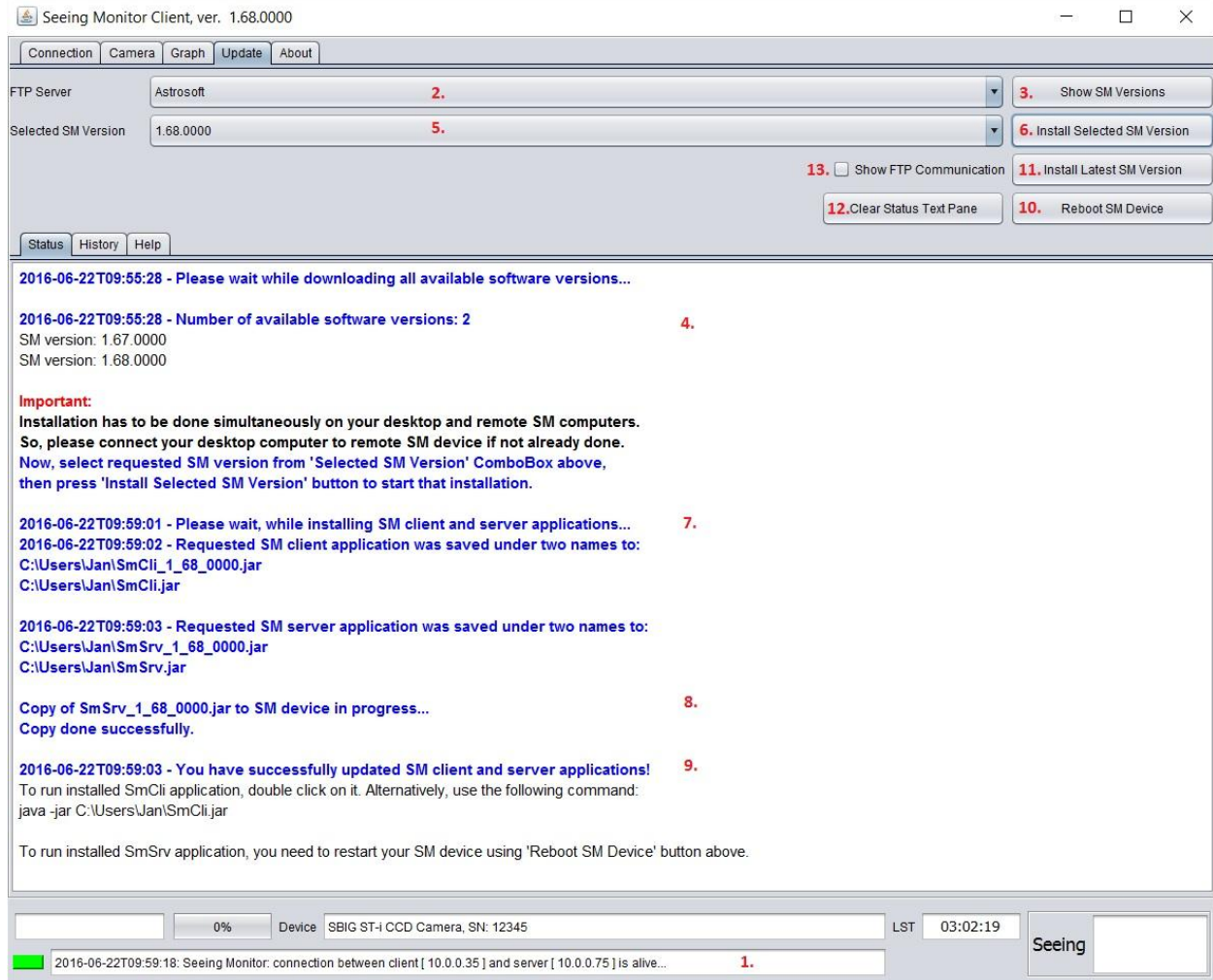


Figure Seven: Update screen dialog

Step 13: show FTP communication – if this box is checked, some additional I/O messages received from the FTP server will be displayed. This can be useful in the case of connection problems with the remote FTP site.

7. About Tab - Support

The About tab shows how to get in touch with Santa Barbara Scientific, Cloudland Instruments (the equipment developer), or Astrosoft (the software developer).

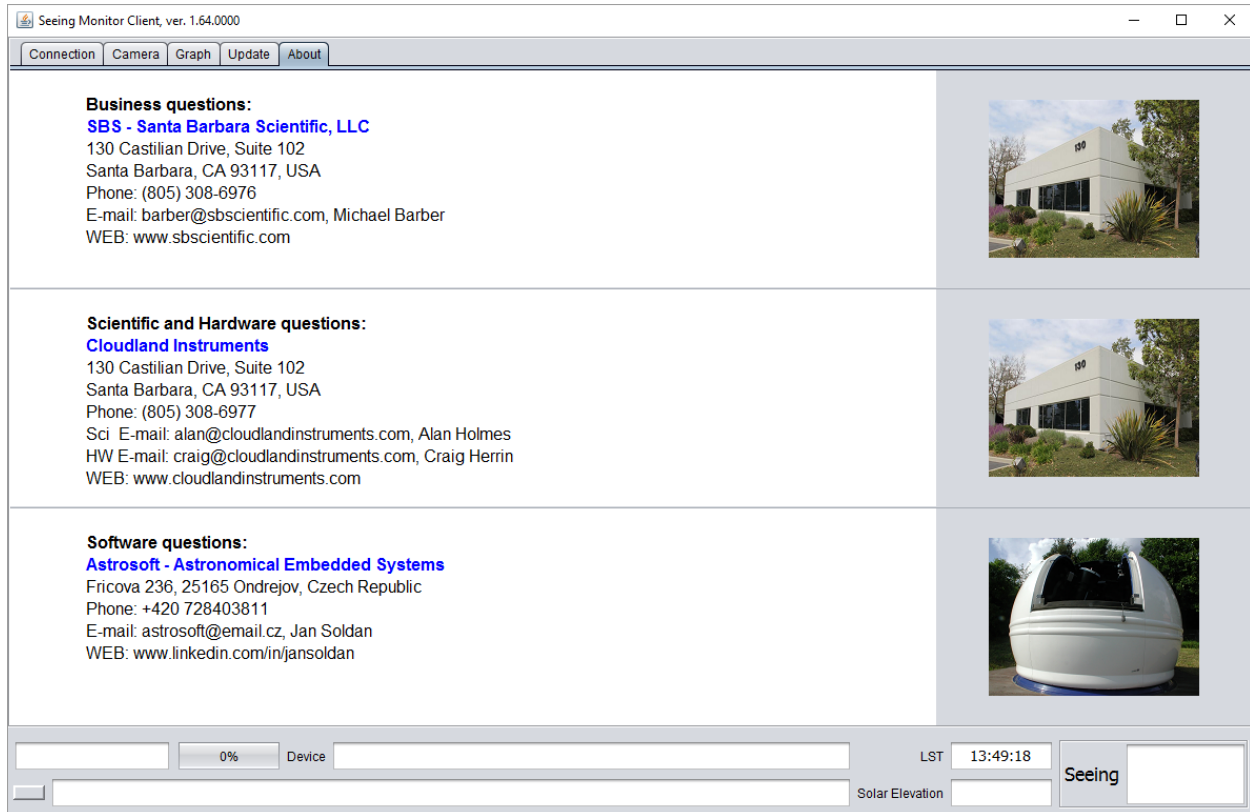


Figure Eight: About Screen Dialog

Appendix A – Installing the Raspberry Pi and Power Boards

1. Remove four socket head screws holding cover on SM-1 (Fig. 1)
2. Remove two socket head screws holding ST-I adjustable bracket. Lift off and set aside. (Fig. 2)
NOTE: Your SM-1 MAY already have a flat plate attached under the ST-I (See Fig. 6). If so, remove it and set it aside. You will reinstall it in Step 6.
3. Locate eight threaded holes on the inside of the base plate for insertion of stand-offs (provided). Screw in the eight standoffs as shown in Fig. 3 using a 3/16th socket driver. If you do not have a 3/16th socket wrench you can also thread the standoffs in by hand and LIGHTLY tighten with a pair of pliers.
NOTE: Your SM-1 MAY already have these standoffs installed. If so, skip this step and go to Step 4.
4. Attach the two PC boards to the standoffs as shown in Fig. 4. Each board uses four Philips head screws (provided).
5. Plug the connecting wires from the main board into the mating socket on the power board as shown in Fig. 5. Use the retaining clip provided to secure any slack in the wire to avoid pinching it when you replace the cover, also shown in Fig. 5.
6. Place the flat rectangular shaped metal shield over the Raspberry Pi and secure with two Philips head screws as shown in Fig. 6.
7. Replace the bracket holding the ST-I that you removed in Step 2. (You can also do this after attaching the power cord in the next step if it is easier to access the connector screws).
NOTE: Check that the ST-I aperture is set to f/2.8 before closing up the cover. Setting an aperture that is too small will adversely affect the ability of the ST-I to capture images of Polaris at the high frame rates used during operation
8. Attach the power cord as shown in Fig. 8. The cord is color coded with a red sleeve on the POSITIVE wire. This must be connected to the POSITIVE terminal in the attachment block. The power board is printed with the polarity of the block terminals so be sure to attach the RED wire to the terminal labeled +5VDC as shown in Fig. 8.
9. Attach the short USB cable between the ST-I camera and the Raspberry Pi as shown in Fig. 9
10. The other end of the long power cord has a connector that looks like a USB connector. However, as cautioned in the manual, you should NOT plug this connector into a USB outlet on your computer. The Raspberry Pi requires more current than a USB outlet will provide and the pinouts on this power cable are different than a typical USB connector. Plug this end ONLY into the power adapter provided as shown in Fig. 10. This power adapter is compatible with 100-240V, 50/60Hz outlets, although a user supplied plug adapter with the proper plug style may be needed outside North America.
11. Connect an Ethernet cable to the Raspberry Pi (user provided, not shown).

12. Replace the SM-1 cover taking care not to pinch the wires going to the Raspberry Pi and also taking care not to stress or bend the window frame. Replace the four socket head screws removed in Step 1.

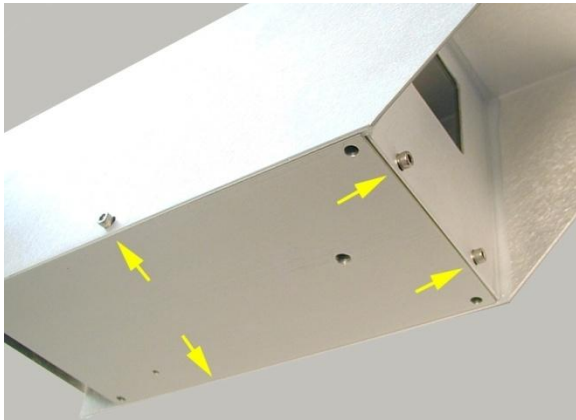


Fig.1

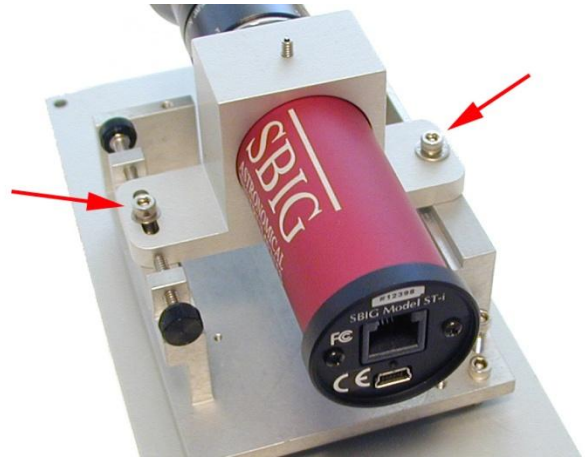


Fig 2

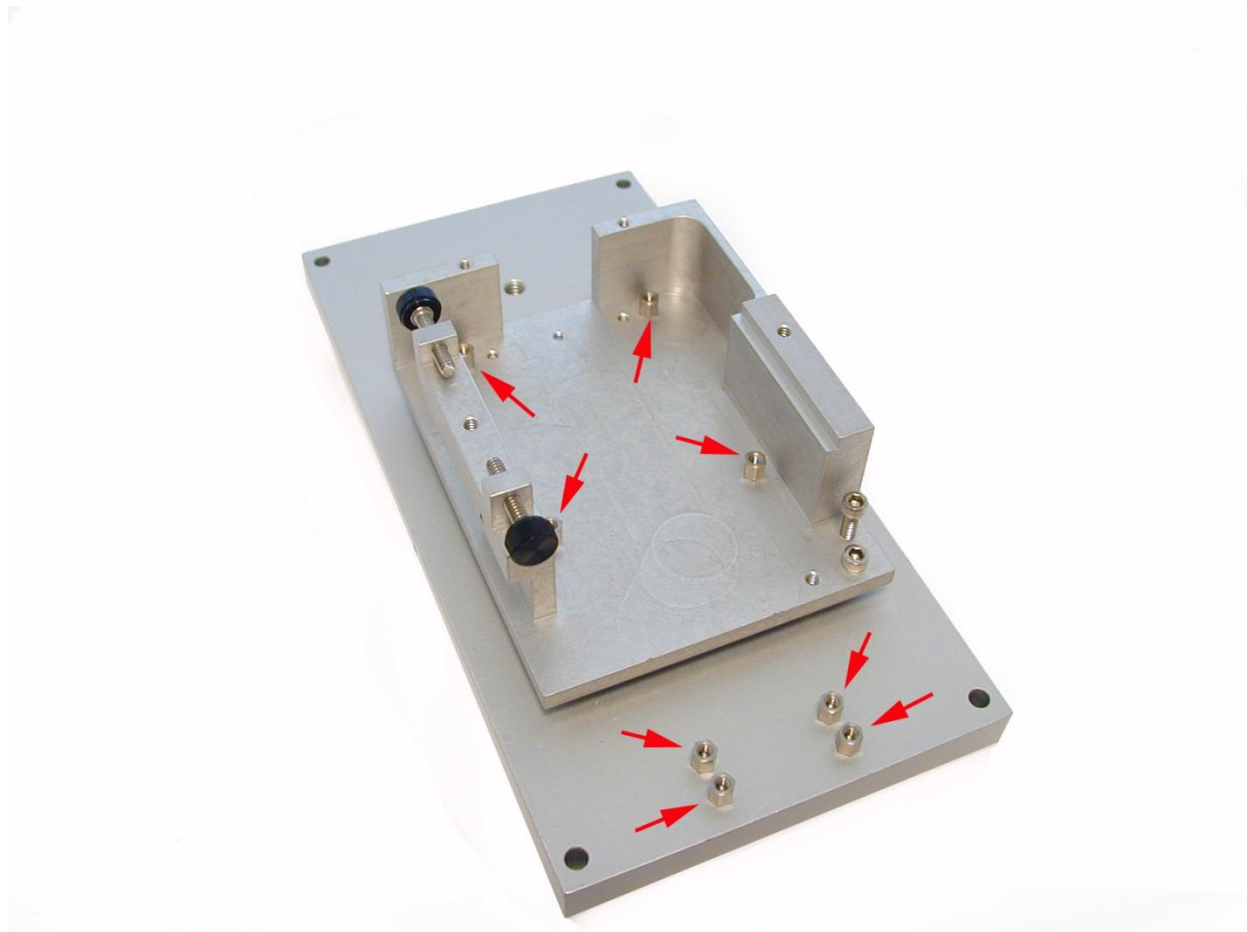


Fig. 3

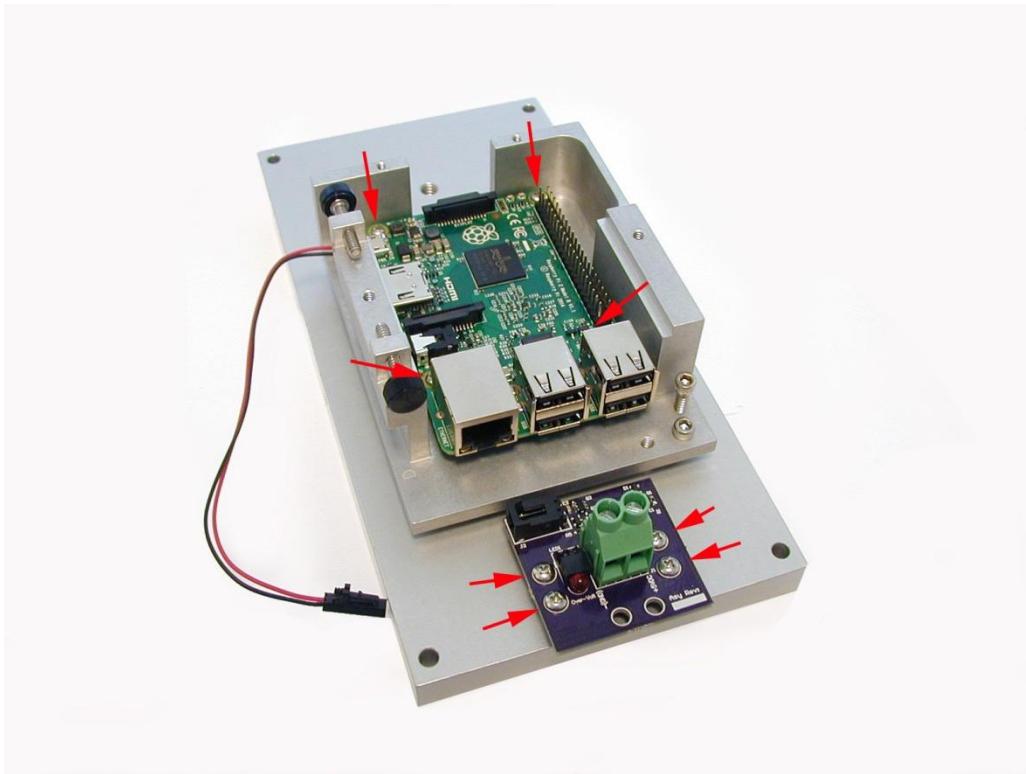


Fig 4

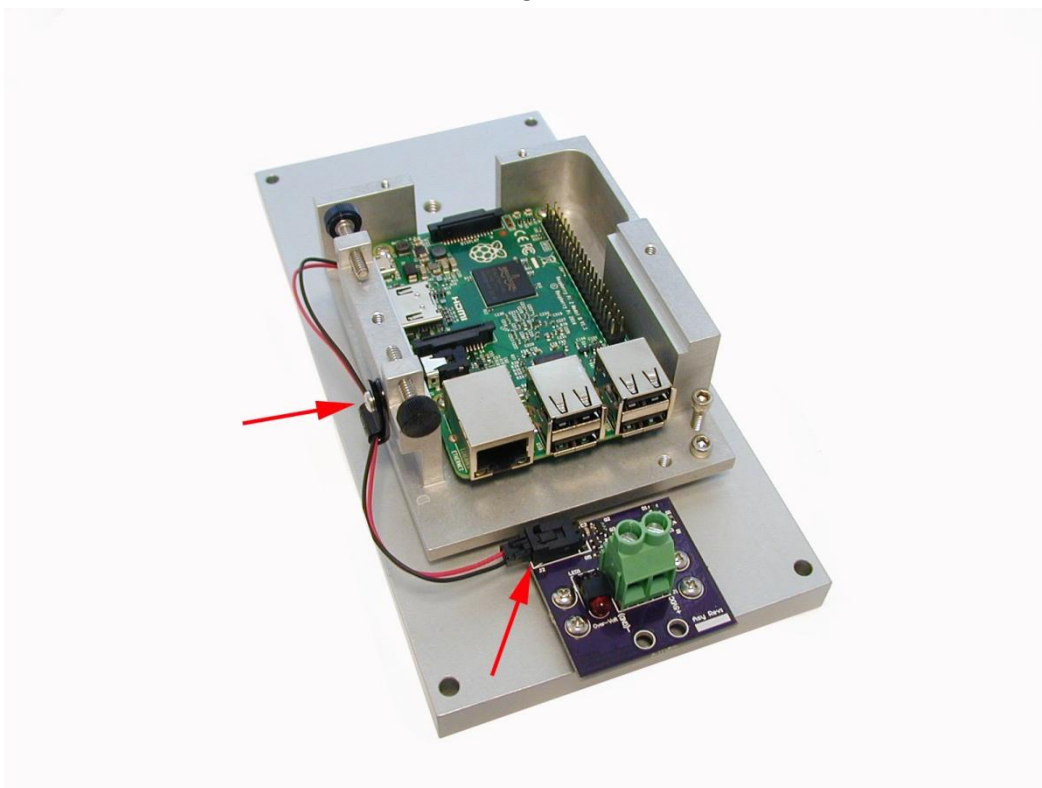


Fig 5



Fig. 6



Fig. 7

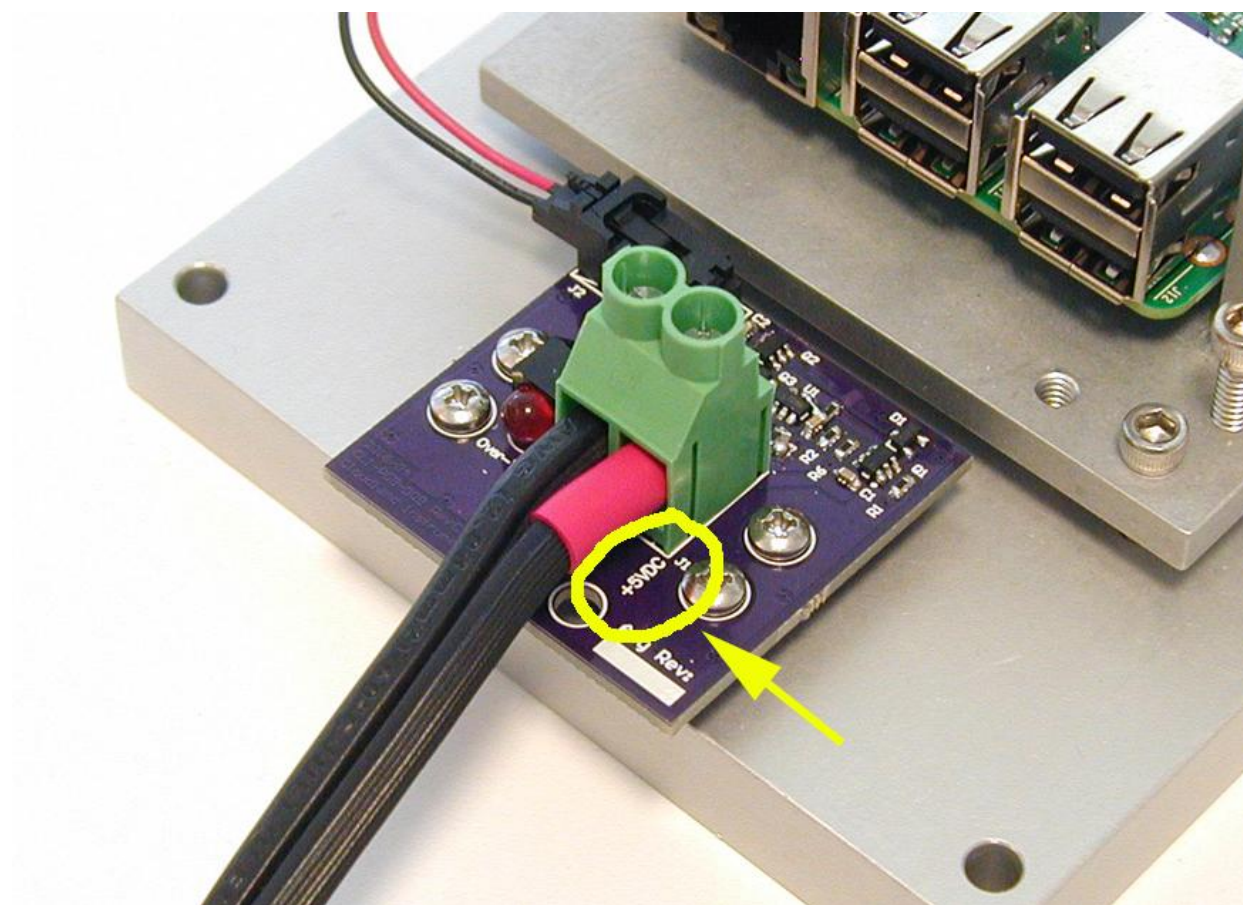


Fig 8

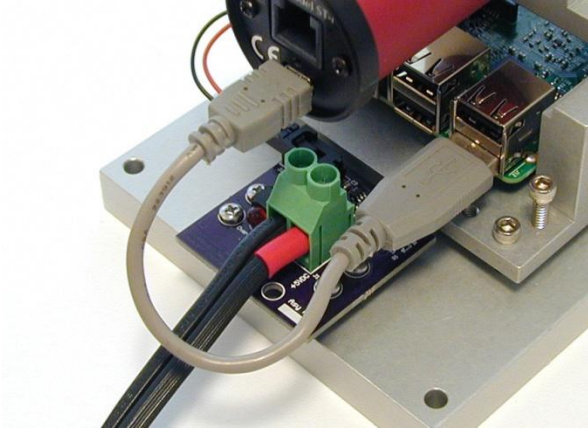


Fig. 9



Fig. 10