XAGYL Communications
USB Filter Wheel

Introduction

Thank you for purchasing a XAGYL Communications product ! The XAGYL FW5125V2 five position USB motorized filter wheel is aimed towards astronomical use and designed for visual and photographic observation of celestial objects.

It enables automated access to five industry standard 1.25" filters for astrophotography use. Its characteristics and thin dimensions make it an ideal accessory for ATIK, Starlight Xpress or Basler cameras.

Filter position is selectable with the ASCOM driver, a standalone utility is provided for diagnostic and manual filter selection, and the wheel can be used with any ASCOM Filter Wheel compatible commercial imaging software. The integrated firmware is field upgradeable as required using the included utilities.

The included ASCOM driver lets the user define each filter's name and back focus requirements in the event that the filters installed are not par-focal when coupled with a motorized focuser system (if available) for automatic refocusing.

Its numerous features, accessories, simplicity of use, finish and reliable operation make this a first class device at a very attractive price. The filter wheel is available as a stand alone product or bundled with a set of quality LRGB filters for color photography using a monochrome camera.

Warranty

XAGYL Communications warranties each Product will be exempt from material or manufacturing defects and will perform according to all published specifications under normal use for a period of twelve months. This warranty is valid only for use as a filter wheel for visual or astrophotography use with a telescope or astronomical binoculars. No other application is supported or advised by XAGYL Communications.

The warranty does not cover damages incurred during improper use or operation, through improper installation, accident, mishandling, fall, damage to any connectors or factory supplied USB cable, improper use of a non-approved USB cable, natural disaster, damage caused by electrical surges of natural and man made sources, damage caused by abnormal, extreme or ill-advised mechanical or environmental conditions, from dis-assembly by the user except as specified in this manual, from non-authorized repair or modification from any and all equipment supplied by XAGYL Communications.

To help resolve any mechanical, software or installation problems, contact your local distributor for prompt assistance or return authorization number if required.

Content

Figure 1

1. 10' USB Cable
2. Filter Wheel
3. C Mount to T2 Adapter
4. T2 Male to Male Adapter
5. T2 to 1.25" Nosepiece Adapter
6. Dark Filter for unattended dark frame capture

WARNING : Please note that version 1 of the FW5125 uses a custom cable which integrates USB to Serial conversion in the cable itself and should not be replaced with a standard USB cable. However, it is possible to add a USB A male to female extension cable if required. Version 2 of the filter wheel uses a standard USB cable.

As an option, the filter wheel may be purchased with a set of 1.25" LRGB filters:

Figure 2

Filters transmission graph :
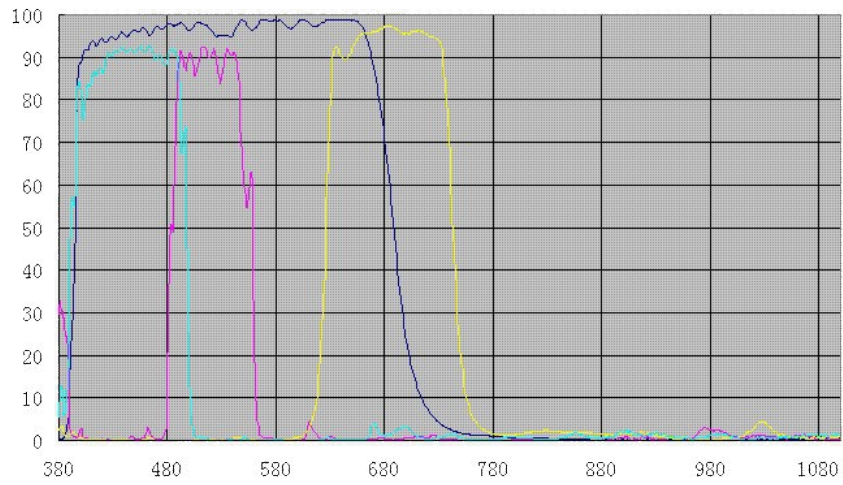
Figure 3

Filter Installation

Installation of the filters may be difficult if attempted through the T2 opening. We recommend instead to remove the top cover plate to give better access to the filter carousel. This is accomplished by removing the 8 screws securing the cover plate to the wheel body as outlined in the image below.

Figure 4

Care should be used when reinstalling the cover as to not damage the threads in the body's casting.

In the factory configuration, the carousel is installed to accept filters with a maximum cell height of 8mm and thread length of 3mm. In the event that your filters exceed this thread length, it is possible to invert the carousel in order to provide a maximum of 4mm thread length.

The following procedure should be followed to accomplish this:

1. Remove the top cover as indicated above.
2. Remove the carousel, main gear and belt as a single assembly.
3. Remove the five magnets from the carousel and set aside.

> Please note that the index magnet is identified by the pan head screw holding it in place and is located opposite filter position #1. All other magnets are held using a flat, tapered head screw which are not placement critical.

4. Using pliers and gentle force, remove the center hub by rotating it counterclockwise.
5. Reinstall the hub on the reverse side of the carousel – excessive force is not required and will mark the hub.
6. Reinstall the magnets on the new side, taking care to install the index magnet in the hole directly opposite the filter hole #1.

> Use minimal force when tightening the screws as the rare earth magnets are somewhat brittle and can shatter under excessive stress.

7. Install the reconfigured carousel and gear into the filter wheel body.
8. Install filters as required.

It is recommended to perform a new calibration routine for each filter after changing the carousel orientation.

Adapter Installation

In order to achieve such a thin format, custom adapters must be utilized. You will note that each adapter if manufactured with very short T2 threads on one side. It is particularly important to note this on the T2 to T2 adapter. Installation of this adapter with the longer threads into the filter wheel will cause it to bind into the filters and result in damage to the filter cells. Always use the included adapters and ensure free movement of the carousel after adapter installation.

With the top cover facing you, note the filter position marks near the carousel's center. This filter wheel side should be mounted towards the optical train. Install the desired adapter – either the 1.25" nosepiece adapter or the T2 to T2 if required (parts 4 and 5 in figure 1). On the camera side, install the C Mount adapter or the T2 to T2 (parts 3 and 4 in figure 1), if not used on the telescope side, as required by the camera or imaging chain. Again, excessive force will damage the threads on the filter wheel, so use only the force necessary to securely seat the adapter to the wheel.

It is recommended to manually verify proper rotation of the carousel before inserting the USB cable into the wheel to ensure that none of the filters make direct contact with the adapters.

Installation

All drivers are available for download on XAGYL's website. Obtain either the 32 bit or 64 bit drivers as required by your operating system. Download and unzip the appropriate drivers to your desktop for later use.

The drivers consist of the FTDI hardware driver and ASCOM platform driver. Windows 7 will detect and install the FTDI driver automatically. Older generation operating systems will require manual installation of the driver.

1. ASCOM driver installation

On the first hookup of the filter wheel, Windows may request the driver installation if not already loaded by a previous component. If this is the case, Click "Cancel" to halt the automatic installation of the driver. From the downloaded drivers, run the FTDI driver installation package CDM20814_WHQL_Certified_32bit.zip or CDM20814_WHQL_Certified_64bit.zip as required by your operating system.

At this point, it may be useful to document your existing COM port devices in order to identify which port will be added and occupied by the filter wheel. The ports will be listed in the Device Manager under Ports (COM & LPT).
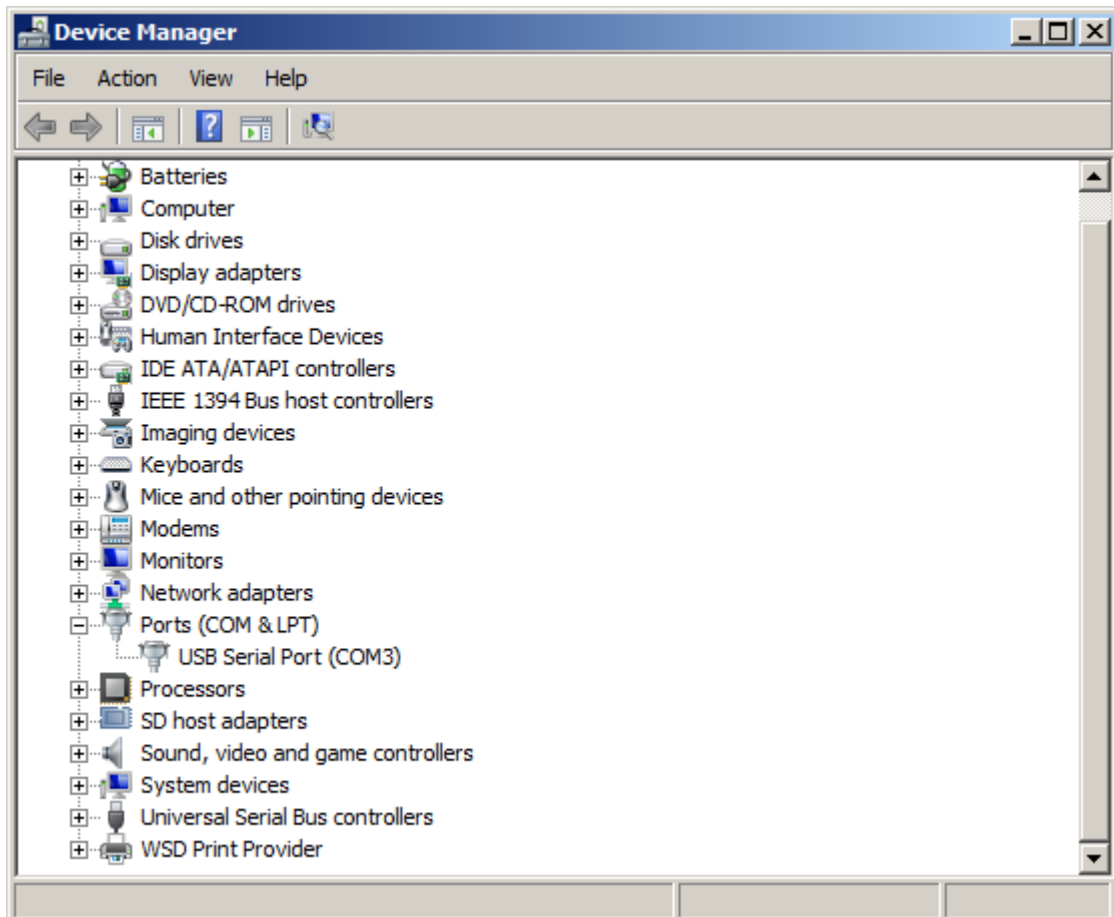

Figure 5

Plug in the filter wheel into any free USB ports on your computer or USB hub and allow Windows to detect and install the appropriate drivers. This operation may take some time to complete depending on your computer's configuration. Once complete, you will note a new entry in the Ports section of the Device Manager. This is the COM port number which will be used later in the installation procedure of the ASCOM driver.

If desired, the latest FTDI driver is available for download from the following location:

http://www.ftdichip.com/Drivers/VCP.htm

2. Software and ASCOM driver installation

Please ensure that .NET 4.0 and ASCOM platform V6 are installed prior to the installation of the XAGYL ASCOM driver. These packages may be obtained from the following locations:

http://download.ascom-standards.org/ASCOMPlatform6SP1.exe

and

http://www.microsoft.com/en-us/download/details.aspx?id=30653

Once the .NET framework and ASCOM platform are up to date, proceed with the installation of the XAGYL ASCOM driver by extracting and running the Xagyl_Filterwheel_ASCOM_Driver-X.X.X.zip file downloaded earlier.

> **Warning : If you were using an older version of ASCOM such as 5 or 5.5, if is highly recommended to uninstall it first, and remove all references and folders associated with the older version. The folders will contain ASCOM in their name and will be found in various areas of your hard drive.**

In the **"Start"** menu, you will now find a new item labeled **"Xagyl Filter Wheel"** which contains two utilities for testing and manual control of the filter wheel. The item labeled **"ASCOM FilterWheel Tester"** uses the ASCOM platform to access the wheel, whereas the "**Xagyl FilterWheel Tester (Non-ASCOM)"** utility will access the hardware directly without the requirement for ASCOM.

3. Verification

Once the filter wheel is plugged in, the carousel will begin its rotation and stop automatically on filter position 1. Take care not to obstruct the carousel; it must be able to turn freely when powered.

Launch the **"ASCOM FilterWheel Tester"** utility. The following ASCOM window will appear:
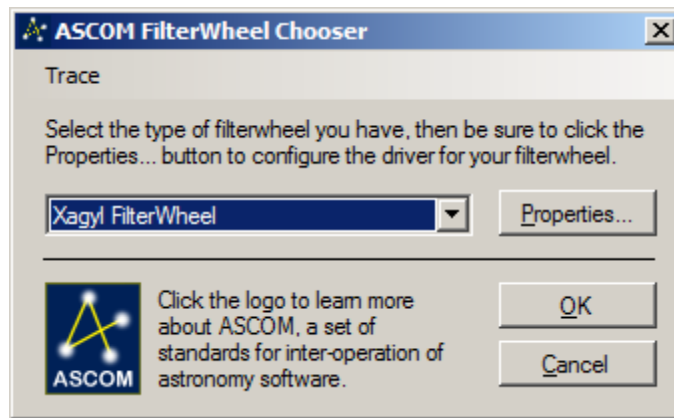

Figure 6

In the drop down box, select **"Xagyl FilterWheel"**. Then, click on **"Properties"** to configure access to the wheel. The following configuration panel appears:
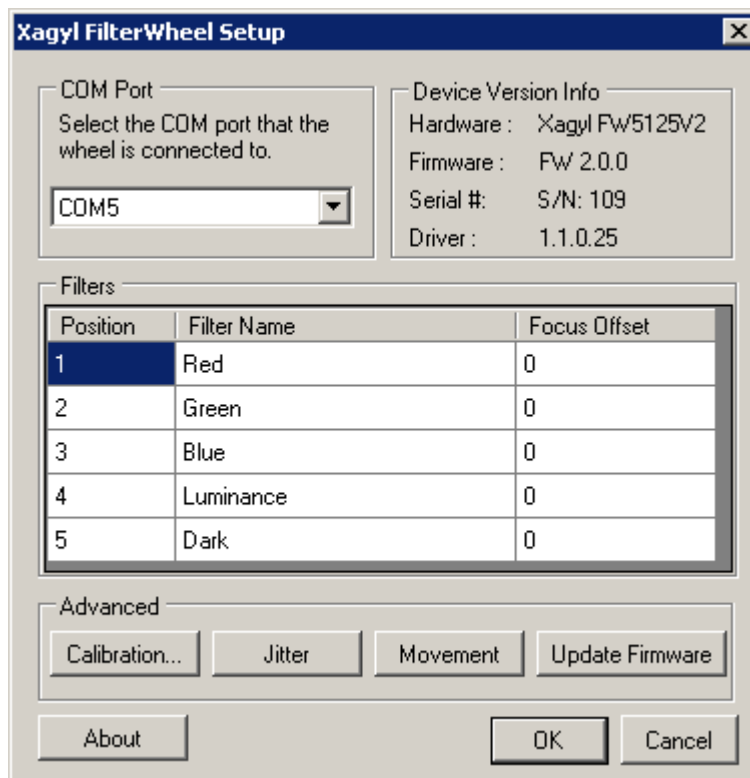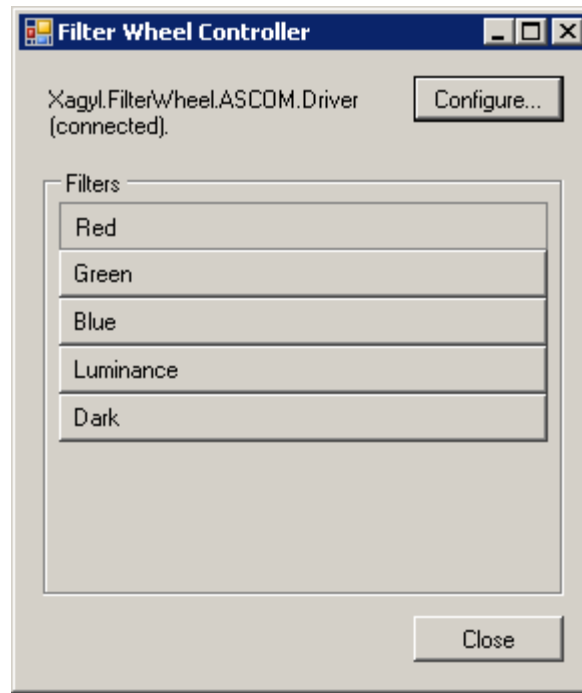

Figure 7

4. Filter wheel configuration

The main configuration windows allows the selection of the COM onto which the wheel is located. This should be set to the port detected in step 1. Once the proper port is selected, the Device Version Info box will be populated with the information contained in your filter wheel. In the event of incorrect port selection, the information will instead show "Not Detected".

For each filter installed, the "Filters" table can be populated with the associated parameters: Filter Name and Focus Offset for use with automatic focusers. Focus offset will be available from

the filter manufacturer. For each filter position, the information entered must match the filter installed in the wheel.

Once the configuration is complete, click on the **"OK"** button to close the configuration windows, and again click on the **"OK"** button to close the ASCOM Chooser to launch the test utility.

Figure 8

Clicking on the corresponding filter buttons will initiate a movement to position the filter in the optical path. Do not block the rotation with fingers or tools as this may cause damage to the equipment.

The intelligent position system will re-center a filter if the carousel is accidentally moved while in operation.

Clicking on the **"Configure"** button, will once again display the configuration panel to configure the individual filter parameters.

The XAGYL Filter Wheel ASCOM driver is compatible with any software which supports ASCOM filter wheels, such as MaximDL, AstroArt, Prism, etc.

5. Advanced Configuration

The configuration panel offers several advanced configuration options to improve the overall performance.

Calibration

The **"Calibration"** button provides precise positioning of each filter in the optical path.
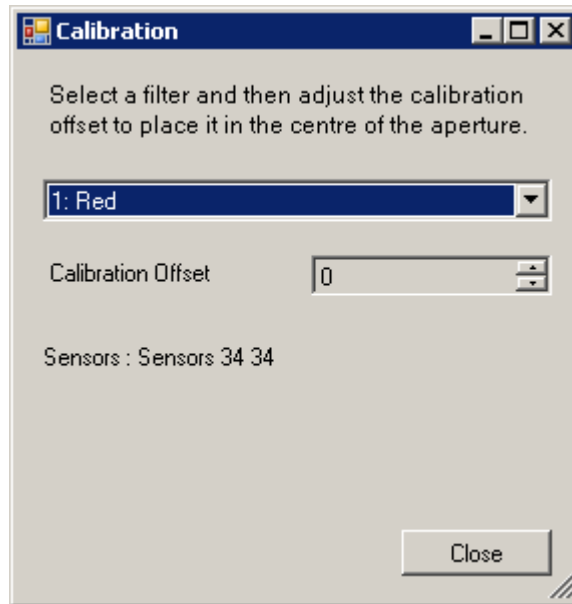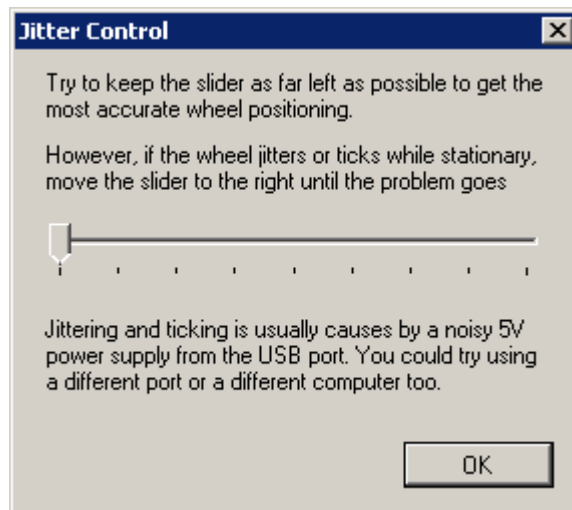

Figure 9

Adjusting the **"Calibration Offset"** value will move the carousel left or right as required. Each calibration offset is stored permanently in the filter wheel and will not be lost between uses.

Jitter

The positioning system can be sensitive to noisy power provided by the USB port. This will be reflected by very small movements of the carousel while in stationary mode. An audible click can also be heard.
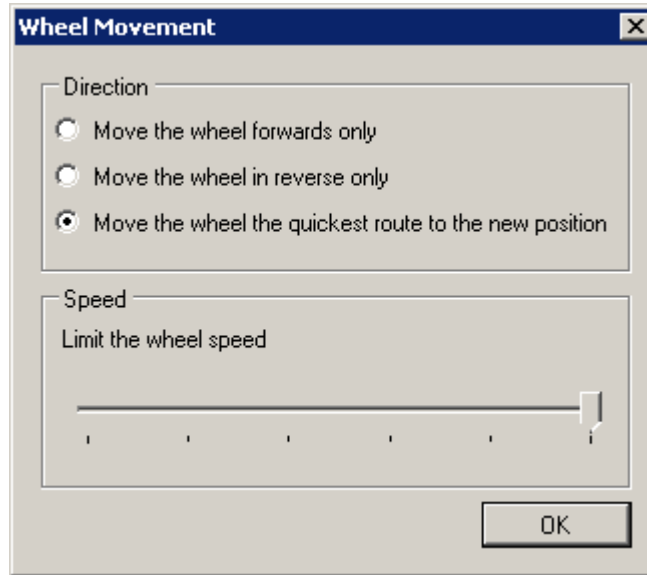

Figure 10

The jitter adjustment will compensate for these variations, but at the expense of fine positioning repeatability. We recommend using the lowest value at which jitter disappears as to maintain the highest positioning accuracy.

Movement

The **"Movement"** button provides access to the rotational direction of the carousel.

Figure 11

Move the wheel forwards only: the carousel rotates the filters in an incremental direction only.

Move the wheel in reverse only: the carousel rotates the filters in a decremental direction only.

Move the wheel the quickest route: the carousel rotates in whichever direction provides the quickest path to the selected filter. This is the quickest filter access method.

Firmware Update

The **"Update Firmware"** button provides a means of updating the integrated firmware installed in the filter wheel.
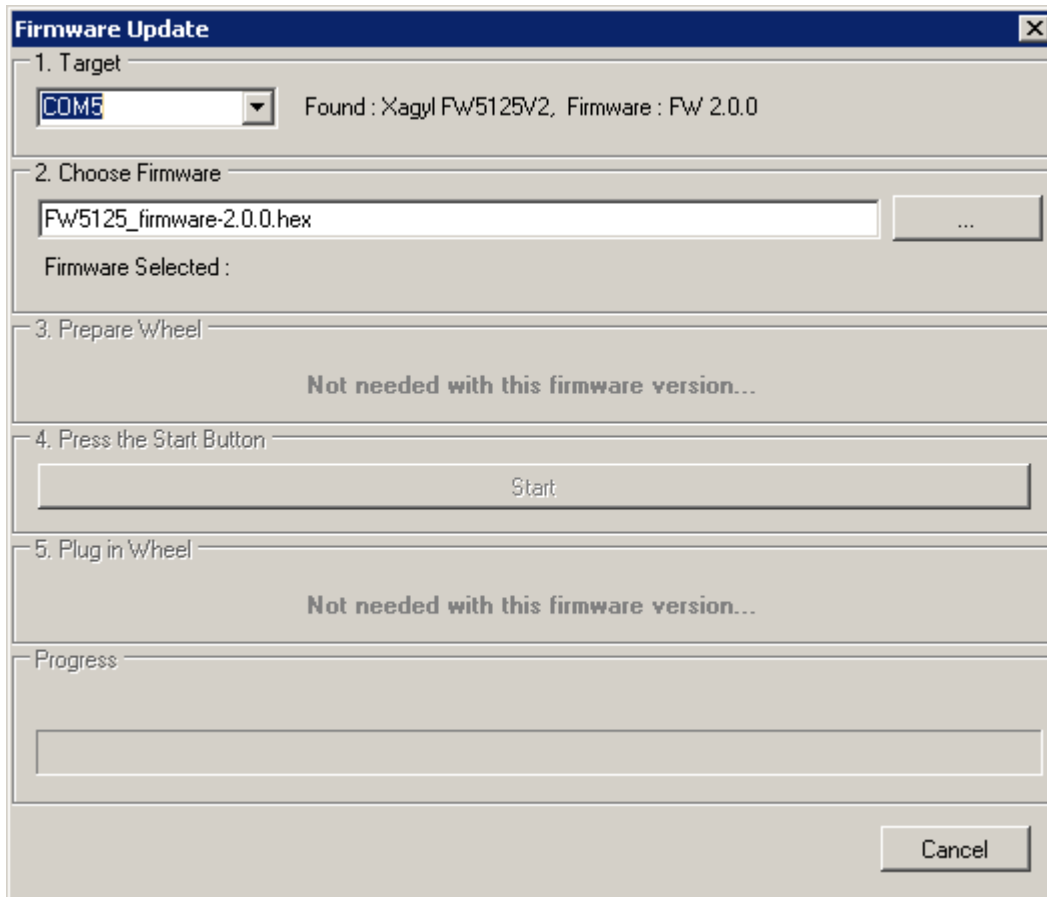

Figure 12

The latest firmware version is available for download for XAGYL's website in the Astronomy / Filter Wheel section.

https://www.xagyl.com/store_us/home.php?cat=6

The firmware update windows displays two selection boxes. The first is the COM port on which the upgrade utility expects to find the filter wheel. The second box holds the name and location of the firmware HEX file to be uploaded to the wheel.

File names will be in the format FW5125_firmware-X.X.X.hex where X.X.X represents the firmware version number. Click on the **"..."** button to search for a file to upload.

> Warning : If upgrading from version 1.X.X to version 2.X.X, interim firmware version 1.9.9 must first be installed to prepare the wheel for the new firmware format. Failure to do so will render the wheel inoperable and will require reinstallation of the firmware using a different, dedicated utility.

Click **"Start"** to initiate the upgrade process. This will take approximately 3 to 4 minutes. When complete, the filter wheel will perform a restart and position itself to filter number 1. Once the restart is complete and the carousel comes to a complete stop, press the **"Close"** button to complete the upgrade process and return to the configuration window. It is advised to perform a full calibration after any update since some incremental versions must erase the stored settings to perform correctly.

5. Care and maintenance

It is recommended to keep your filter wheel in a dry and dust free location when not in use. In the event of dust ingress, follow the filter installation procedure to open and remove the installed filters. Wipe and clean any contaminants using a clean soft dry cloth and / or use a manual air bulb to blow away any dust present.

6. Communication protocol

Version 1 of the filter wheel uses an integrated USB to Serial cable. Version 2 has a standard USB connection. The following pinout applies only to version 1.
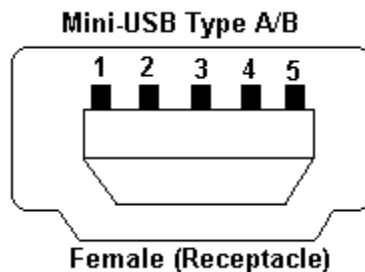
Figure 13

Mini USB A/B Connector Pinout:

Pin 1 - +5V Input, 500mA
Pin 2 - Tx (TTL Serial Out)
Pin 3 - Rx (TTL Serial In)
Pin 4 – Reserved – MUST REMAIN UNCONNECTED
Pin 5 – Ground

The filter wheel communicates with the computer using a standard serial protocol consisting of 2 characters: COMMAND VALUE. Communication occurs at 9600 baud, 8 bits, 1 stop bit, no parity. Direct communication is possible using any terminal software supporting COM port serial connections, such as Hyperterminal or PuTTY.

7. Command Set

The following commands may be used for diagnostic purposes or to provide information required for integration into an alternate operating system or driver such as MacOS or Linux.

As of firmware version 3.1.5, here are the current commands:

Serial = 9600, 8, n, 1
Command format = CV where C=command and V=value

"B", "b"
> Move backward Value number of filters - Value = 0 to F Hex (0 to 15 Decimal)

"C", "c"
> Deprecated – use "(" and ")"
> Removed from version 2.0.0
> Calibrate Value where Value is
> 1 - Shift the carousel counterclockwise
> 2 - Shift the carousel clockwise

"F", "f"
> Move forward Value number of filters - Value = 0 to F Hex (0 to 15 Decimal)

"G", "g"
> Move to Value position - Value = 1 to X, carousel will turn in direction of shortest path where X is the highest filter position

"I", "i"
> Inquire Value where Value is:
> 0 - Display product name "Xagyl FW5125VX"
> 1 - Display firmware version "FW3.1.5"
> 2 - Display current filter position - "PX"
> 3 - Display the serial number - "S/N: XXXXXX"
> 4 - Display the maximum rotation speed - "MaxSpeed XXX%"
> 5 - Display the jitter value - "Jitter XX"
> 6 - Display sensor position offset for current filter position - "PX Offset XX"
> 7 - Display filter position sensor threshold value - "Threshold XX"
> 8 - Display the number of available filter slots - "FilterSlots X"
> 9 - Display the Pulse Width value - "Pulse Width XXXXXuS"

"M", "m"
> Increase pulse width by 100uS
> Value is ignored
> Adjust the length of the "ON" pulse during the centering phase of a filter change. This may be required when the filter wheel is used in extreme cold where some binding can occur.
> Pulse width values range from 100uS to 10000uS. Default value is 1500uS.
> Displays "Pulse Width XXXXXuS"

"N", "n"

> Decrease pulse width by 100uS
>
> Value is ignored
>
> Adjust the length of the "ON" pulse during the centering phase of a filter change. This may be required when the filter wheel is used in extreme cold where some binding can occur.
>
> Pulse width values range from 100uS to 10000uS. Default value is 1500uS.
>
> Displays "Pulse Width XXXXXuS"

"O", "o"

> Display sensor position offset for filter position Value - "PX Offset XX"

"R", "r"

> Reset Value where Value is:
>
> 0 - Hard reboot
>
> 1 - Initialize - restarts and moves to filter position 1
>
> 2 - Reset all calibration values to 0, displays "Calibration Removed"
>
> 3 - Reset Jitter value to 1, displays "Jitter 1"
>
> 4 - Reset maximum carousel rotation speed to 100%, displays "MaxSpeed 100%"
>
> 5 - Reset Threshold value to 30, displays "Threshold 30"
>
> 6 - Calibrate - performs a sensor calibration and stores the results in flash

"S", "s"

> Set the maximum carousel rotation speed during normal operation at Value x 10 percent speed
>
> if Value >= A Hex (10 decimal) then maximum carousel rotation speed = 100%
>
> if Value = 0 then carousel rotation is stopped
>
> Displays "Speed=XXX%"

"T", "t"

> Test (Debug) Value where Value is:
>
> 0 - Display current sensor values, displays "Sensors LL RR" where LL is left sensor and RR is right sensor. Numbers are absolute deviations from Midrange value
>
> 1 - Display current sensor values, displays "Sensors LLL RRR" where LLL is left sensor and RRR is right sensor. Numbers are actual measured values
>
> 2 - Display median left sensor value, displays "MidRange XXX"
>
> 3 - Display right sensor calibration value, displays "RightCal XX" which is the hardware deviation between right and left sensor

"<"

> Runs motor backward at Value x 10 percent speed - if Value >= A Hex (10 decimal) then run at 100% speed
>
> if Value = 0 then carousel rotation is stopped
>
> Do "R1" to stop and reset to index position
>
> Displays "Backward XXX%"

">"

Runs motor forward at Value x 10 percent speed - if Value >= A Hex (10 decimal) then
     run at 100% speed
if Value = 0 then carousel rotation is stopped
Do "R1" to stop and reset to index position
Displays "Forward XXX%"

"["

Decrease jitter window by 1
Value is ignored
This feature is to compensate for noisy 5V power from the USB port
Jitter values range from 1 to 10 – use the smallest value which provides a jitter-free
     filter center position
Displays "Jitter X"

"]"

Increase jitter window by 1
Value is ignored
This feature is to compensate for noisy 5V power from the USB port
Jitter values range from 1 to 10 – use the smallest value which provides a jitter-free
     filter center position
Displays "Jitter X"

"("

Position calibration of current filter
Value is ignored
Shift the carousel counterclockwise
Displays "PX Offset XX"

")"

Position calibration of current filter
Value is ignored
Shift the carousel clockwise
Displays "PX Offset XX"

"{"

Decrease filter position threshold value
Value is ignored
Carousel will stop earlier in rotation and start fine positioning.
Too low of a value can cause carousel to stop prematurely when changing positions
Displays "Threshold XX"

"}"

Increase filter position threshold value
Value is ignored
Carousel will stop later in rotation and start fine positioning.
Too high of a value can cause the wheel to fail to recognize filter positions
Displays "Threshold XX"