

Applications Note

Supporting the CFW-6A or CFW-8 in Software

The CFW-6A and CFW-8 are motorized color filter wheels that can be controlled remotely through the Universal CPU used in the ST-4X, ST-5 and ST-6 cameras or thru the ST-7/8. The filter wheels plug into the Universal CPU's AUX port or the ST-7/8's Telescope Connector where they receive power and motor control signals. Operationally the filter wheels contain a closed-loop motor system that is pulse width driven. Supplying the filter wheel with pulses of varying widths from 500 μ s to 2200 μ s controls the angular position of the carousel. Rotational position is proportional to pulse width. Terminating the pulse sequence to the motor freezes the motor at its position.

From a software developer's standpoint there are several issues regarding the CFW-6A and CFW-8 highlighted in the table below and discussed further in sections below:

- A pulse_out command has been added to the CPU firmware to support the filter wheels¹.
- The CFW-8 is self calibrating, but the CFW-6A each require a unique calibration.
- The CFW-8 can have any combination of 5 filters and the CFW-6A can have any combination of 6 filters in the carousel.

Controlling the filter position with the Pulse Out command

Both the Universal CPU and the ST-7 Parallel Driver have Pulse Out commands that are used to control the filter wheel position. The commands are much the same with a few differences:

- The Universal CPU has a synchronous parameter that needs to be set TRUE for positioning the filter wheel. The parallel driver always generates synchronous pulses and does not have this parameter.
- The Universal CPU's unit of time keeping for generating pulse widths is 0.435 microseconds and the ST-7/8's unit of time keeping is a wider 1.0 microsecond. Therefore when specifying pulse_width and pulse_period parameters on the ST-7/8 the values are 0.435 times the value you would use with the Universal CPU to give similar pulse widths and pulse periods.

¹ The pulse_out command is supported by all ST-4X and ST-5 ROMS and by ST-6 systems with firmware versions 3.0 or greater.

When used in conjunction with the CFW-6A/CFW-8 you should set the `number_pulses` parameter to 60 and the `pulse_period` parameter to 42000 for the Universal CPU and 18270 ($42000 * 0.435$) for the ST-7/8 for a pulse rate of 55 Hz. The `pulse_width` parameter is a little more complicated and will be discussed below. After issuing the `pulse_out` command and receiving the CPU's ACK message you will not be able to talk to the CPU for 1.1 seconds while it is issuing a series of 60 pulses at a 55 Hz pulse rate.

The `pulse_width` parameter varies depending on the desired carousel position. For the CFW-8, `pulse_widths` on the Universal CPU of 1200, 1800, 2400, 3000 and 3600 (0.435 times these numbers for the ST-7/8) position the filter wheel at the one of the five different positions. On the CFW-6A the pulse widths required to exactly center the filter at a desired position will vary from unit to unit but be close to the values of 1200, 1800, 2400, 3000, 3600 and 4200 (again on the Universal CPU).

SBIG's CCDOPS software creates a configuration file named `FILTER.CFG` that retains the settings for a user's CFW-6A. The file contains the names of each of the six carousel positions as well as the required settings of the `pulse_width` parameter (on the Universal CPU) to position the carousel at the desired filter. Additionally the CCDOPS software allows the users to calibrate the CFW-6A filter wheel. As a software developer if at all possible we suggest you parse and maintain our configuration file so that the user can operate with either software without having to calibrate for each. While this may not be as easy as making your own configuration file it will be easier for the user.

The `FILTER.CFG` File

CCDOPS maintains a text file in the CCDOPS directory named `FILTER.CFG` that contains the setup and calibration data for the CFW-6A. The format of the file is lines of parameters and values in the format shown below:

Parameter = Value\n

The parameter order and a brief description of each parameter is as follows:

```
Filter_wheel = X
Filter_desired = X
Filter_1 = XXX
Filter_2 = XXX
Filter_3 = XXX
Filter_4 = XXX
Filter_5 = XXX
Filter_6 = XXX
Filter_pos_1 = XXX
Filter_pos_2 = XXX
Filter_pos_3 = XXX
Filter_pos_4 = XXX
Filter_pos_5 = XXX
Filter_pos_6 = XXX
```

`Filter_wheel` - This integer item is 0, 1, 2, or 3 depending on the type of filter wheel for which the user is configured. 0 = CFW-6, 1 = CFW-8, 2 = Manually Operated, 3 = None.

- Filter_desired - This integer item indicates the filter position selected when the user last ran the CCDOPS software.
- Filter_1 thru Filter_6 - These strings are the names of the filters. Each string can contain spaces but is limited to a maximum of 10 characters, terminated by the line's \n.
- Filter_pos_1 thru Filter_pos_6 - These integers are the required settings of the pulse_width parameter (on the Universal CPU) in the pulse_out command for each of the six possible carousel positions.

CFW-6A Calibration

The SBIG CCDOPS software allows the user to calibrate his /her individual CFW-6A. The calibration procedure steps through each of the six possible carousel positions and allows the user to fine tune the position. The results are then saved in the FILTER.CFG file. As a rough starting place you could start with pulse_width values of 1200, 1800, 2400, 3000, 3600 and 4200 (on the Universal CPU) for the six positions and allow the user to fine tune from there.