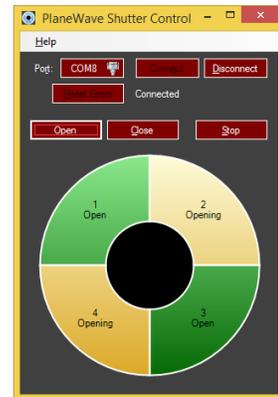


Automating the PlaneWave Primary Mirror Covers

The PlaneWave Primary Mirror Cover system is controlled using the PlaneWave Shutter Control application, otherwise known as PWS shutter.

The application features a user interface for manually controlling and monitoring the state of the mirror covers.

This application can also be commanded from other scripts and programs to control the mirror cover in an automated observatory setup. As of version 1.8.0, it can also be controlled via an ASCOM Driver.



This document describes commands supported by PWS shutter version 1.2.0 or later. The latest version is available on the PlaneWave website: <http://planewave.com/downloads/software/>

Methods for controlling PWS shutter

There are a variety of ways to interface with PWS shutter:

1. Load the ASCOM driver from a compatible ASCOM client that supports “CoverCalibrator” devices.
2. Run the batch files that are included with PWS shutter
3. Run the PWS shutter executable program (PWS shutter.exe) with a command line argument, and read the exit code from the program.
4. Send commands and receive responses via a TCP socket server hosted by PWS shutter.exe

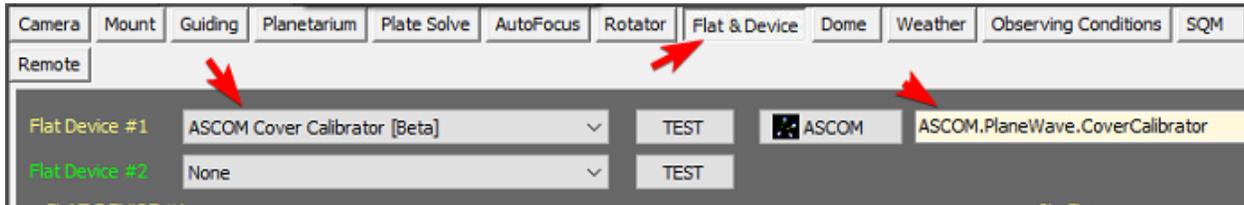
The various methods are useful in different circumstances. For example, it can be easier to call PWS shutter.exe or the included batch files from observatory startup scripts. On the other hand, it can be easier for custom observatory control software to maintain a long-running connection to the PWS shutter TCP server. Finally, if a client already supports ASCOM CoverCalibrator drivers, this driver can be used out of the box.

These methods are described in further detail below.

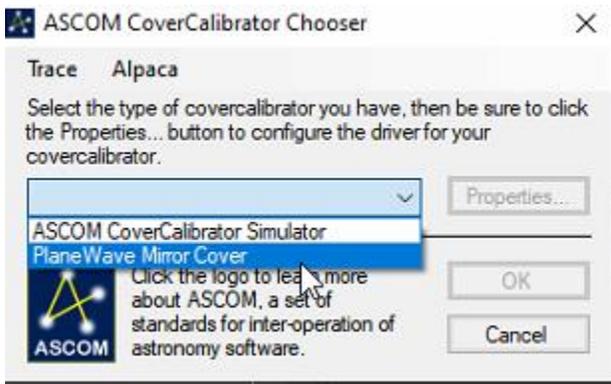
Using the ASCOM driver

As of PWS shutter 1.8.0, an ASCOM driver with the ProgID “ASCOM.PlaneWave.CoverCalibrator” is included with the installer. Some observatory control programs can be configured to talk to this driver. For example, in the Voyager automation program, the mirror cover can be configured as a “Flat Device”

by selecting “ASCOM Cover Calibrator” as the device, and then clicking the “ASCOM” button to choose the specific ASCOM driver.



When the ASCOM driver chooser window appears, select “PlaneWave Mirror Cover”.



Using the supplied batch files

As of version 1.8.0, PWShutter comes with a set of batch files that can be executed either by double-clicking on them or by calling them from an observatory startup script. These files are located under:

```
C:\Program Files (x86)\PlaneWave Instruments\PlaneWave Shutter Control\Scripts\
```

As of this writing there are three batch files:

open_shutter.bat

This script will connect to the mirror cover and begin opening. When the shutters are confirmed to be open, the script will print the text “Opened successfully” and the batch file will exit.

close_shutter.bat

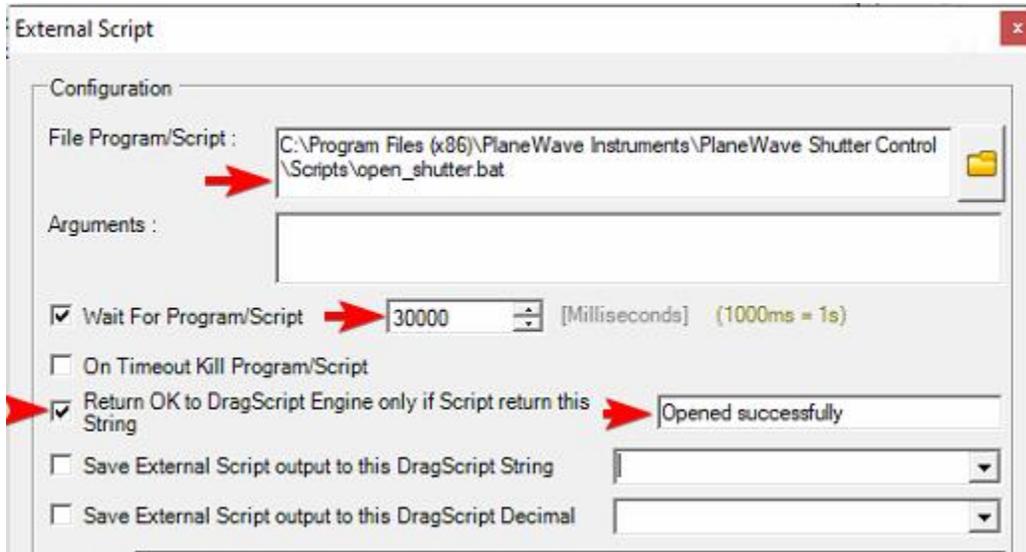
This script will connect to the mirror cover and begin closing. When the shutters are confirmed to be closed, the script will print the text “Closed successfully” and the batch file will exit.

shutter_status.bat

This script will query the mirror cover for its current state, and will either print “Open”, “Closed”, “Opening”, “Closing”, “PartlyOpen”, or “Error”.

Note that these files get replaced each time you reinstall or update PWShutter. If you wish to customize these scripts (for example, to change the exact wording that gets printed to the screen), please copy the scripts to a personal location first.

Many observatory automation programs allow you to run a custom script or batch file under various conditions. For example, the automation software Voyager includes a scripting mechanism called DragScript. The “External Script” command can be configured as shown below to call open_shutter.bat and wait until it prints “Opened successfully”.



Using PWShutter.exe with command line arguments

By default, the PWShutter application is installed in the following location:

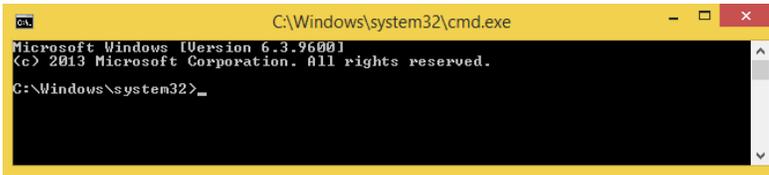
```
C:\Program Files (x86)\PlaneWave Instruments\PlaneWave Shutter Control\
```

The main program is PWShutter.exe. Running this program without any command line arguments will simply launch the GUI interface. Running this program with a command line argument will launch the GUI interface (if it is not already running), send the command to the program, and return the response as an exit code.

The available commands and responses are described later in this document.

You can experiment with these commands interactively using the Window Command Line interface. The example session below shows how you might launch PWShutter, connect to the controller, and open the shutters.

1. Run cmd.exe to bring up a Windows command line interface



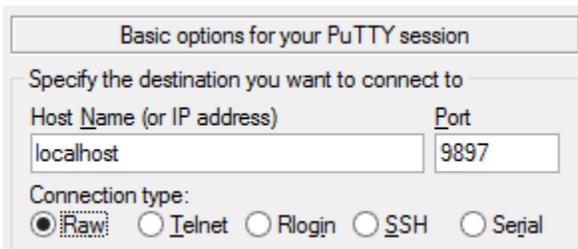
2. Change to the directory where PWS shutter.exe is located:
`cd\Program Files (x86)\PlaneWave Instruments\PlaneWave Shutter Control`
3. Run PWS shutter and try to connect. Using the syntax below, the program will wait until a connection has been established (or has failed) before returning to the command prompt. If the GUI is not already running, it will appear.
`start /wait pwshutter.exe connect`
4. Check the code that was returned by the program. In the case of the “connect” command, 0 indicates success and 255 indicates failure.
`echo %errorlevel%`

Using the PWS shutter TCP server

If PWS shutter.exe is running, you can establish a socket connection to a TCP server running on localhost, port 9897.

The example below shows how to connect to the TCP server using the popular PuTTY terminal program, available from <https://www.putty.org/>.

1. Launch PuTTY
2. Change “Connection type”, select “Raw”
Set “Host Name” to “localhost”
Set “Port” to “9897”



3. Click “Open”. If there is an error connecting, make sure that PWS shutter is running and no firewall rules are preventing the program from hosting a local server.
4. Type “isconnected” and press Enter. If PWS shutter is connected, you should see “0” as a response. If it is not connected, you should see “1”.
5. Type “connect” and press Enter. If PWS shutter was not already connected to the controller, you should see it establish a connection in the GUI. Eventually, the server should respond with a “0” to indicate success.

6. Type "open" and press Enter. The shutter should begin opening. Once the shutter is fully open, you should see a response of "0". If there is an error fully opening the shutters (for example, if you click the "Stop" button in the PWShutter GUI before the shutter can fully open), the server will respond with "255" followed by an error message.
7. Type "close" and press Enter. The shutter should begin closing. The server will respond with "0" on the shutter is closed, or "255" followed by an error message if there is an error.
8. Type "shutterstate" and press Enter. The server should respond with "1" to indicate that all shutters are closed.
9. Type "beginopen" and press Enter. The shutter should begin opening, and the server should respond with "0" very shortly after the command is sent.
10. While the shutter is opening, type "shutterstate" and press Enter. It should respond with "2" while the shutter is in the process of opening, or "0" once the shutter is fully open. If you stop the shutter before it is fully open, it will respond with "5".

After experimenting with these commands interactively, you can write a TCP client from the programming language of your choice to automate the mirror covers.

Commands

connect	<p>Attempt to connect PWShutter to the mirror cover controller.</p> <p>If PWShutter is running and already connected, nothing will happen.</p> <p>Returns: 0 if the program successfully established a connection 255 if there was an error establishing a connection</p>
isconnected	<p>Check if PWShutter is current connected to the controller.</p> <p>Returns: 0 if the program is connected to the controller 1 if the program is not connected to the controller 255 if there was an error running the command</p>
open	<p>Open the mirror covers, and wait until the covers are fully open or an error has occurred.</p> <p>PWShutter must already be connected to the mirror cover system before this command is sent. If the shutters are already open, nothing will happen.</p> <p>Returns: 0 if the covers were successfully opened 255 if an error occurred</p>
close	<p>Close the mirror covers, and wait until the covers are fully closed or an error has occurred.</p>

	<p>PWShutter must already be connected to the mirror cover system before this command is sent. If the shutters are already closed, nothing will happen.</p> <p>Returns: 0 if the covers were successfully closed 255 if an error occurred</p>
beginopen	<p>Begin opening the mirror covers, and return immediately.</p> <p>The state of the shutters can be monitored while they are moving using the “shutterstate” command.</p> <p>Returns: 0 if the covers successfully started opening 255 if an error occurred</p>
beginclose	<p>Begin closing the mirror covers, and return immediately.</p> <p>The state of the shutters can be monitored while they are moving using the “shutterstate” command.</p> <p>Returns: 0 if the covers successfully started closing 255 if an error occurred</p>
stop	<p>If the shutter is moving, bring it to a stop as soon as possible.</p> <p>Returns: 0 if the stop command was successfully executed 255 if an error occurred</p>
shutterstate	<p>Return the status of the shutter system.</p> <p>Returns: 0 if all shutters are open 1 if all shutters are closed 2 if shutters are in the process of opening 3 if shutters are in the process of closing 4 if at least one shutter is in an error state 5 if the shutters are stopped and not all closed 255 if there was an error retrieving the status (e.g. not connected)</p>

Sample code: batch file

The following batch file demonstrates how to connect PWShutter to the controller and open the shutters.

```
@ECHO OFF
```

```
SET PWSHUTTER="C:\Program Files (x86)\PlaneWave Instruments\PlaneWave Shutter Control\PWShutter.exe"
```

```
ECHO Checking connection
```

```

%PWSHUTTER% isconnected
IF %ERRORLEVEL% EQU 0 (
    ECHO Shutter is connected
) ELSE (
    ECHO Shutter is NOT connected
)

ECHO Trying to connect
%PWSHUTTER% connect
IF %ERRORLEVEL% EQU 0 (
    ECHO Connected successfully
) ELSE (
    ECHO ERROR: Connection failed
    EXIT /B
)

ECHO Opening
%PWSHUTTER% open
IF %ERRORLEVEL% EQU 0 (
    ECHO Opened successfully
) ELSE (
    ECHO ERROR while opening shutters
    EXIT /B
)

```

Sample code: Python 2.x TCP client

```

import socket
import StringIO
import time

def readline(sock):
    """
    Utility function for reading from a socket until a
    newline character is found
    """

    buf = StringIO.StringIO()
    while True:
        data = sock.recv(1)
        buf.write(data)
        if data == '\n':
            return buf.getvalue()

def sendreceive(sock, command):
    """
    Send a command to the server, and read the response.
    The response will be split into an integer error code and an optional error text message.
    Returns a tuple (code, error_text)
    """

    sock.send(command + "\n")
    response = readline(sock)

    # The response should consist of a numeric code, optionally
    # followed by some text if the code is 255 (error). Parse this out.

    fields = response.split(" ")
    response_code = int(fields[0])
    error_text = ""
    if len(fields) > 1:
        error_text = fields[1]
    return (response_code, error_text)

```

```

#### BEGIN SAMPLE SESSION ####

print "Connecting to PWS shutter TCP server..."
sock = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
sock.connect(("localhost", 9897))

print "Checking connection..."
(code, text) = sendreceive(sock, "isconnected")
if code == 0:
    print "PWS shutter is connected to the controller"
elif code == 1:
    print "PWS shutter is not connected to the controller"
else:
    print "ERROR:", code, text

print "Trying to connect to controller..."
(code, text) = sendreceive(sock, "connect")
if code == 0:
    print "Connection established"
else:
    print "ERROR:", code, text

print "Trying to begin opening the shutter..."
(code, text) = sendreceive(sock, "beginopen")
if code == 0:
    print "Shutter is starting to open"
else:
    print "ERROR:", code, text

print "Monitoring shutter status while opening..."
while True:
    (code, text) = sendreceive(sock, "shutterstate")
    if code == 0:
        print "Open"
    elif code == 1:
        print "Closed"
    elif code == 2:
        print "Opening"
    elif code == 3:
        print "Closing"
    elif code == 4:
        print "Error"
    elif code == 5:
        print "Partly open"
    else:
        print "ERROR:", code, text

    # Exit loop if we are in any state other than Opening
    if code != 2:
        break

    # Wait a bit before checking again
    time.sleep(1)

print "Done"

```