OFFICINASTELLARE
WORKSHOP OF THE STARS

SH-02
Primary Mirror Motorized Protection Shutter

Maintainance and installation manual

Revision: 02-140730

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Normal usage

Overview

The optional accessory motorized cover shutters consist of four motorized flaps controlled by an electronic unit. During normal use the flaps are fully open letting the light goes inside the telescope. When the telescope is not in use the flaps can be closed to protect primary mirror. The control of the shutters can be done in the following ways:

- Using the local control unit
- Using the local handset unit of the optional ATD-C
- Using the ATC-Remote PC program

For the first option continue to read here, for the last two options see the proper section in this manual.

The local control unit

The shutters local control unit comprise two backlight buttons and an internal status led.

The buttons, which are labelled “Open” and “Close”, when pressed open and close the shutters respectively.

When the two buttons are pressed together they change into backlight regulation mode. During this mode pressing the Close button will reduce the backlight intensity and pressing the Open button will augment it. Once done press again both buttons together to exit from backlight regulation mode.

The internal status led change its colour to signal current shutter status. Its meaning is the following:

- Blue: Shutters are open
- Green: Shutters are closed
- Half Red/Half Blue (or Purple): Shutters are opening
- Half Red/Half Blue (or Yellow): Shutters are closing
- Half Green/Half Blue (or Cyan): Control unit is in backlight regulation mode

Note: Since this unit is an optional accessory of the ATC-02 and so it drain power from the ATC-02 itself, this last one has to be turned on to be able to operate the shutters.

Maintenance options

Overview

The SH-2 shutter system is different from previous version. Main difference consist in the presence of intelligent electronic inside each of the four motors. Now, the electronic control unit does not directly control the motor anymore, instead it dialogues with each of the four motor controlled to query for the current status and to order to each of them to open or close themselves. This is achieved by the means of a serial communication realized through a bus topology: every motor control unit is connected in parallel with all the others and with the main control unit itself. Since they're connected in parallel, and so every command sent by the main control unit is received by all of the four motor control unit, every motor has its own unique id (a number which range is 1 to 4) so the main electronic unit can query for and command e specific motor control unit simply by using this unique id.

This explanation was needed to better understand the next chapter.

The other main difference between the old version and the SH-2 is how the electronic motor unit detect the run limit in the opening and in the closing movement. When a motor control unit is commanded open it start to move and it stops when it reach the fully open position. This position is automatically detected at every open movement and is achieved by an electronic system: when the flap reach a position which does not let to go beyond due to mechanical constraints the motor drawn current massively increases, the electronic circuit detect this condition and stops the motor immediately. In this way the opening limit switch has been remove thus reducing electromechanical components which may break soon or later.
When the shutter is fully open and it receives a close command it moves for a certain amount of steps which is individually setted for each shutter. In this way also the closing limit switch has been removed and it has been replaced by a software routine.

During maintenance, all operations are controlled through an hidden push buttons located inside the main control unit so, during maintenance operation, the main unit cover plate has to be removed. The internal push-button is a flat low profile button located on the printed circuit board, at the opposite short side in respect of the internal led.

One thing to be aware (and not to be scared of): each of the two main push buttons has a transparent plastic cylinder placed placed over it used as a push button finger extension. Normally the cover plate limit its movement to only the vertical axis, but during maintenance operations this cover is removed, so pressing it can put force sideways and it can detach from the underlying push button. This is normal and harmless. To fix it again on the push button simply make it rest over the push button, and applying a delicate force in the vertical axis rotate it until it will couple to the push button with a weak click sound.

Check motor control unit internal unique id

When the shutter motor units have to be replaced it is mandatory to mount them in the correct order, else they will open and close in the wrong order interfering each other. The correct order is based on the motor control unit's internal unique id. The correct order, looking directly into the primary mirror (reflecting yourself watching it) is:

1 = Left

2 = Right

3 = Top

4 = Bottom

To check the motor control unit do the following procedure:

1. Turn off the ATC-02
2. Connect the main control unit to one motor control unit, and connect this motor control unit to the following one. Do this last step until no more motor will be available. The last motor should remain with only one coupled connector and the other one should remain free.
3. Connect the SH-2 to ATC-02 through the flat cable
4. Turn on the ATC-02, this operation will supply power to the SH-2 unit
5. Press once the internal push button located inside the main control unit
6. Check all of the shutter control units. Each of them has a little hole in the black main cylinder, next to one of the two gray cylinder where the flap is attached. Through this hole you will see a light emitted from a led. Only one will have the led turned on.

   If you have difficulty to find it, turn off and on again the ATC-02, now all of the four shutter control units should have the led turned on. Once you've located where the hole is, do again this checklist from the start.
7. Once you've located which motor has the led turned on (only one among all) attach a piece of paper tape on the motor control unit body and write “1”. This is the motor control unit with internal unique id equals to one.
8. Press once the internal push button located inside the main control unit. The led located inside the motor control unit will turn off.
9. Press once the internal push button located inside the main control unit. The led located inside another motor control unit will turn on. This is the motor control unit number two. Place the paper tape and write “2” on the body of this motor control unit.
10. Repeat steps 8 and 9 for the motor control unit number three and four
11. Turn off ATC-02

Now you know what is the motor control unit internal unique id.

You can now proceed to mount them to the telescope in the correct order (from 1 to 4: left, right, top, bottom). If they were already mounted on the telescope check that they're mounted in the correct order.

Just a quick note: The motor control units are controlled by the main control unit in pair: the two horizontal motor control units are controlled (open and closed) in pair, and the vertical motor control units are controlled in pair. This means that if the motor control units are already installed and the left is swapped with the right one and/or the top is swapped with the bottom one, there should be no any problems.

For safe reason, first time the shutters are commanded open or close, please check that in opening motion they move horizontal ones first and vertical one later. In the closing motion it has to be the opposite: vertical ones first and horizontal one later.

Fine tune flaps closed position

As explained in the overview section, on the opening movement each motor control unit automatically stops the motor when the flap reach the fully opened position mechanical constraint.

For the closing movement the number of steps required to reach the correct fully closed position, starting from the fully open position must be manually set for each shutter.

To do so please follow this procedure:

1. Check that all the motors control unit are correctly mounted (refer to the previous section for the correct procedure). You can skip this step at your own risk if you're sure they're mounted correctly.
2. Turn off ATC-2, wait 5 seconds and turn it on again, this will reset the internal status of the main control unit.
3. Press the Open button on the main control unit and wait until the shutters are all opened.
4. Press the button inside the main control unit, motor number one's led will illuminate. Now it is in program mode and you can set the number of steps required to reach the fully closed position starting from the fully open position. To change the number of steps press the close button to decrease them by one step and press it open button to increase them by one step. By reference 5 steps are about one degree. The initial value of the steps should already be near to the correct value. The shutter flap stay still while you change the number of steps by means of the Open/Close button. Once you think to have set the correct amount of steps press again the internal push button button. This will have these effects:
    I. The set steps value is internally saved (i.e. you could even turn off power supply now)
    II. That single flap will close, thus you can control if it has reached the required position.
    Based on internal firmware version it may open before to start the closing movement.
    III. The led on the motor control unit will turn off and if the internal push button will be pressed again the next motor will enter in this program mode routine.

To summarize:

- Repeated pushing of the internal push button will cycle inside-outside program mode of every single motor control unit. The selected motor will have the internal led turned on.
- While in program mode, pressing Close button will reduce by one step for every single pushing while the Open open will increase it.
- The value of 5 steps is about 1 degree.
- The closing movement which will take the flap position to the closed position to check if the amount of steps enough or too much will start only when the motor control unit will exit from the program mode by pressing the main control unit internal push button.

Replacement of faulty motor

Overview

The shutters motor installation is normally made by Officina Stellare during telescope assembly. In case a motor unit is faulty an authorized technician can replace the faulty unit.

Four motors units and a control unit are mounted on the telescope. The motors are mounted in front of the primary mirror and each flap is mechanically connected to its motor. The controller is usually installed behind the halfway octagon.

Each motor has an unique address ranging from 1 to 4. It is mandatory to respect this positions for correct operation.

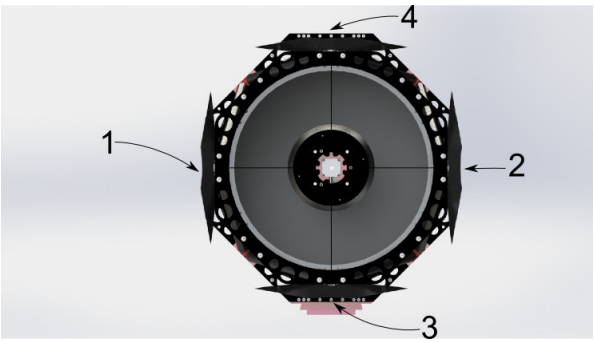

Fig. 1: Motors positions

The following standard positions are used to identify motors' addresses: looking at the telescope from the secondary mirror toward the primary mirror, with the telescope standing on its bottom side the addresses are:

1 = Left shutter

2 = Right shutter

3 = Bottom shutter

4 = Top shutter

Identify the faulty motor

Since some installation could differ from the standard one, please identify the address of the faulty motor by using the procedure described in the paragraph “Check motor control unit internal unique id” before to proceed with motor replacement to be sure to install the correct motor replacement unit.

Replacing a faulty motor

To replace a faulty motor please follow these steps:

- If possible open the shutters
- When the shutters are fully opened turn off the ATC power to remove power to the SH-02 controller too
- Identify the faulty motor (see Fig. 1)
- Disassemble the flap from the motor
- Remove the motor from the halfway octagon
- Mount the new motor in the correct place. Pay attention to use a motor with the same address as the faulty one
- Assemble the flap in the new motor

Opening the shutter

It is always recommended to open the shutter before to proceed to the motor replacement. This to avoid to move the flap unintentionally while replacing the motor and thus reducing the risk to break or to damage the motor's hood.

Remove the flap from the motor

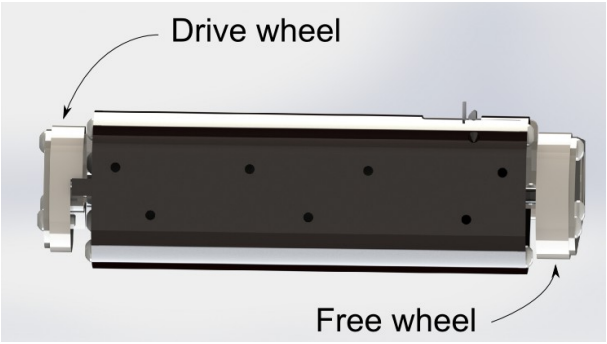

Fig. 2: Drive and free wheels

Removing the flap from the motor is useful to prevent hood damages.

To do so first unscrew the three bolts mounted on the free turning wheel as shown in figure 3.

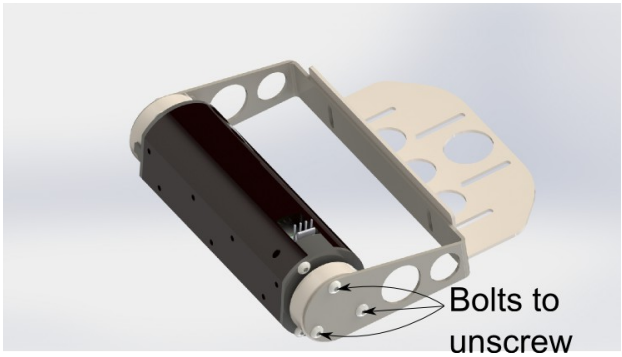

Fig. 3: The first bolts that need to be unscrewed are the ones in the free wheel

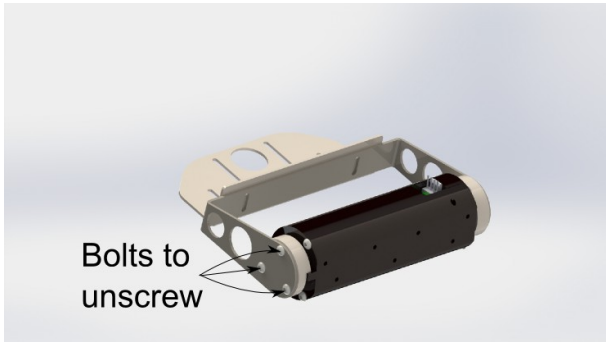

Fig. 4: The last bolts that need to be unscrewed are the ones in the drive wheel

Then unscrew the ones located in the drive wheel (Fig. 4) and gently pull the flap away from the telescope centre.

Remove the motor from the halfway octagon

Now that the flap is removed unscrew the four or five bolts (based on the telescope model) behind the halfway octagon that hold the faulty motor.

Mount the new motor in the correct position

It is now time to mount the new motor in the place of the old one. To do so simply place the new motor on the halfway octagon in the same position as the faulty one. Pay attention to make the cables run through the external side of the telescope and then screw the bolts.

Now that the motor is fasten on the telescope plug-in the connector. There is a unique way the connector can plug-in, so there is no risk of error doing this. Now turn on the ATC so that the SH-02 turn on too and perform a close-open cycle to check that everything is OK.

The shutter opening sequence is 1 and 2 together and then 3 and 4 together. The closing sequence is the opposite: 3 and 4 and then 1 and 2. If there is an error in the opening or closing sequence check all the connections and then check that the new shutter is the correct one for its position. Please check the sequence twice because in the first run the motors should synchronize themselves (e.g. when the new motor is in open state and all other motors are closed).

Attention: Controller unit start to move the motor number one and then it wait until the motor actually start to move before to command the next one. It does this procedure for each motor. So, if only some motor moves probably there are connection errors or the motors addresses are not correct.

Assemble the flap in the new motor

Now is time to open all shutter and mount the flap again. As before first screw the bolts in the drive wheel, then the ones in the free wheel.