# Standard Operating Procedure

## TIRCAM2

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## Scope

This document provides the standard operating procedure for the TIRCAM2 instrument on the 3.6m Devasthal Optical Telescope.

## Contents


**Figure 1:** The OFF and ON positions of the knob in AMOS-Panel-2.

# 1 Basic parameters of the Instrument

| ADFOSC parameters | |
|---|---|
| **Parameter** | **Values** |
| Type | Imaging |
| Mount position | Side port 1 |
| Wavelength range | 1 - 3.7 $\mu$m |
| Array size | 512 × 512 pixel$^2$ |
| Pixel size | 27 $\mu$ m |
| Pixel scale | 0″.17 |
| Field of view | 86″.5 X 86″.5 |
| Readout noise | 30 e$^-$ |
| Readout time | 3.3ms |
| Gain | 10 e$^-$/ADU |
| Minimum exposure | 0.1 s |
| Available filters | Broadbands: J, H, K<br>Narrow bands: BrG, K-cont, PAH, nbL |
| Limiting magnitude | 19, 18.8,18.0 mag with 10% photometric accuracy in J, H, K bands,<br>respectively, with effective 550s, 550s, and 1000s exposures. |

# 2 Starting the telescope

- **Powering on:** Go to the place near the lift on the ground floor and power on the telescope in three consecutive steps:

  1. Turn the knob of AMOS Panel-2 in **ON** position as shown in Fig. 1 .
  2. Turn the knob of AMOS Panel-1 in **ON** position as shown in 2.
  3. Turn the knob of the Power supply panel in **ON** position as shown in Fig. 3.

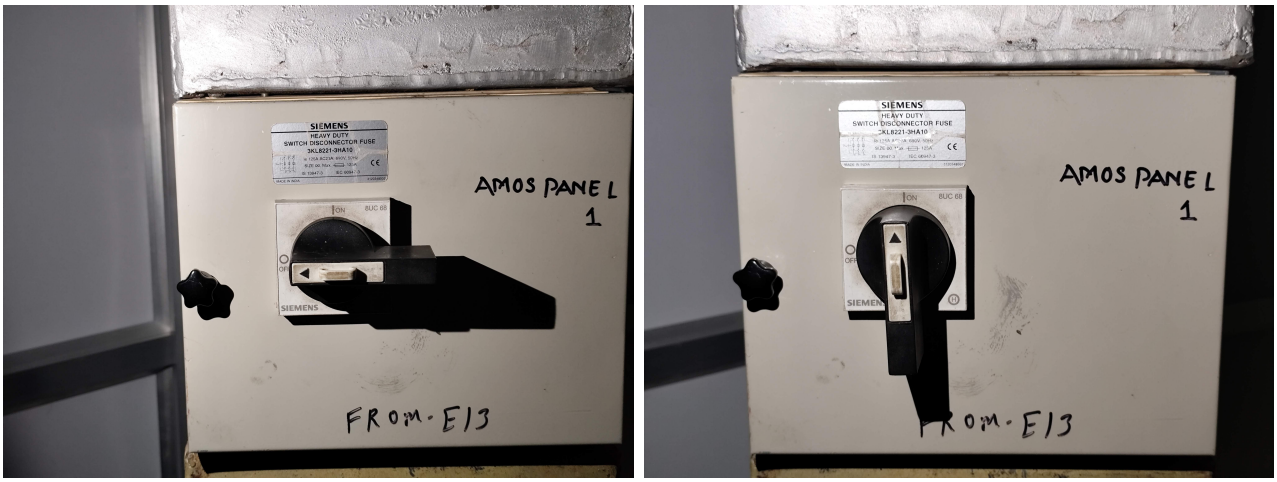


**Figure 2:** The OFF and ON positions of the knob in AMOS-Panel-1.


**Figure 3:** The OFF and ON positions of the knob in the power supply panel.


**Figure 4:** The TCS and AOS PCs in the cabinet of the control room.

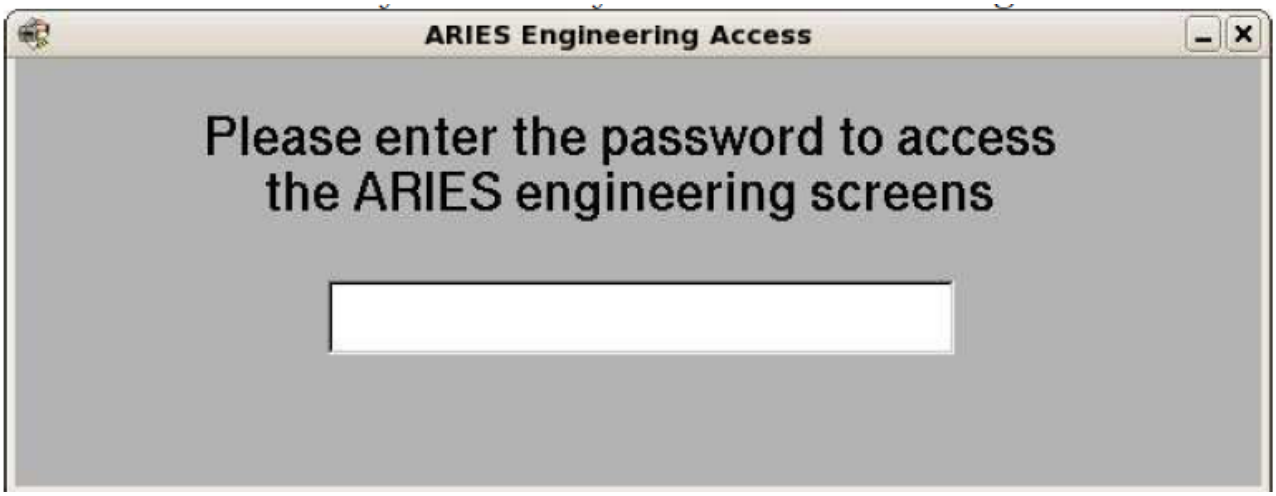


**Figure 5:** Engineering access screen.

- Now go to the control room and turn on the Telescope Control System (TCS) and Adaptive Optic System (AOS) PCs as shown 4.
- When the TCS gets powered on, generally the TCS engineering GUI and remote display open automatically; if not, then open them from the Desktop. The engineering window will ask for the access password as shown in the 5, give the password, and start the engineering window.
- Currently, the engineering window will show the status of the telescope as "Standby" as shown in Fig. 6. Now click the "Startup" button and the telescope will move to the "Running" status.
- Now rearm the telescope from the remote switch (black switch) which can be found near the TCS PC as shown in Fig. 7.
- Now open the remote display in the TCS PC. Several error messages will appear on the TCS display screen as shown in Fig. 8 and keep acknowledging them till they stop appearing.
- Now we have to initialize the telescope, which can be done in two ways:

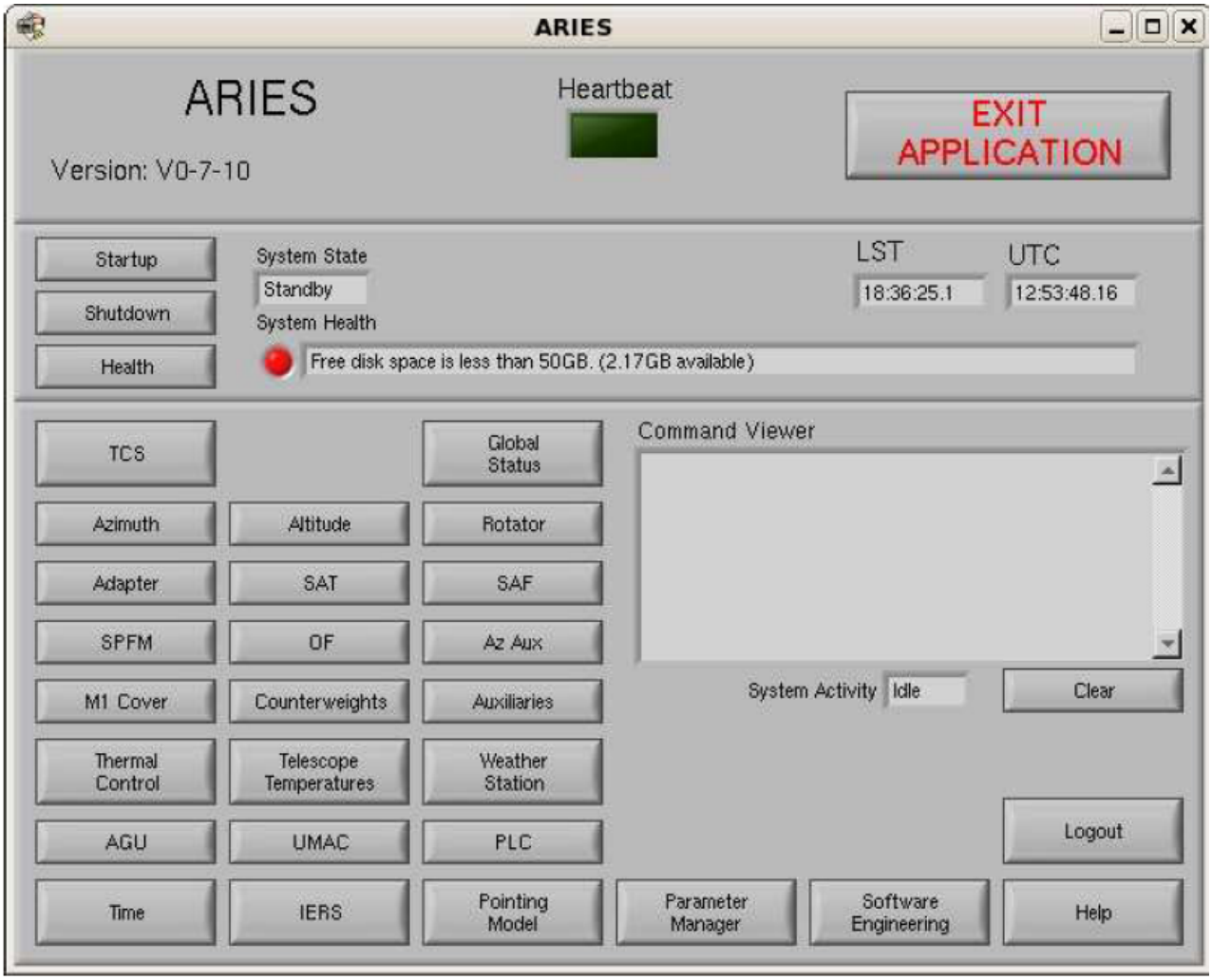


**Figure 6:** The initial display of the ARIES engineering screen.

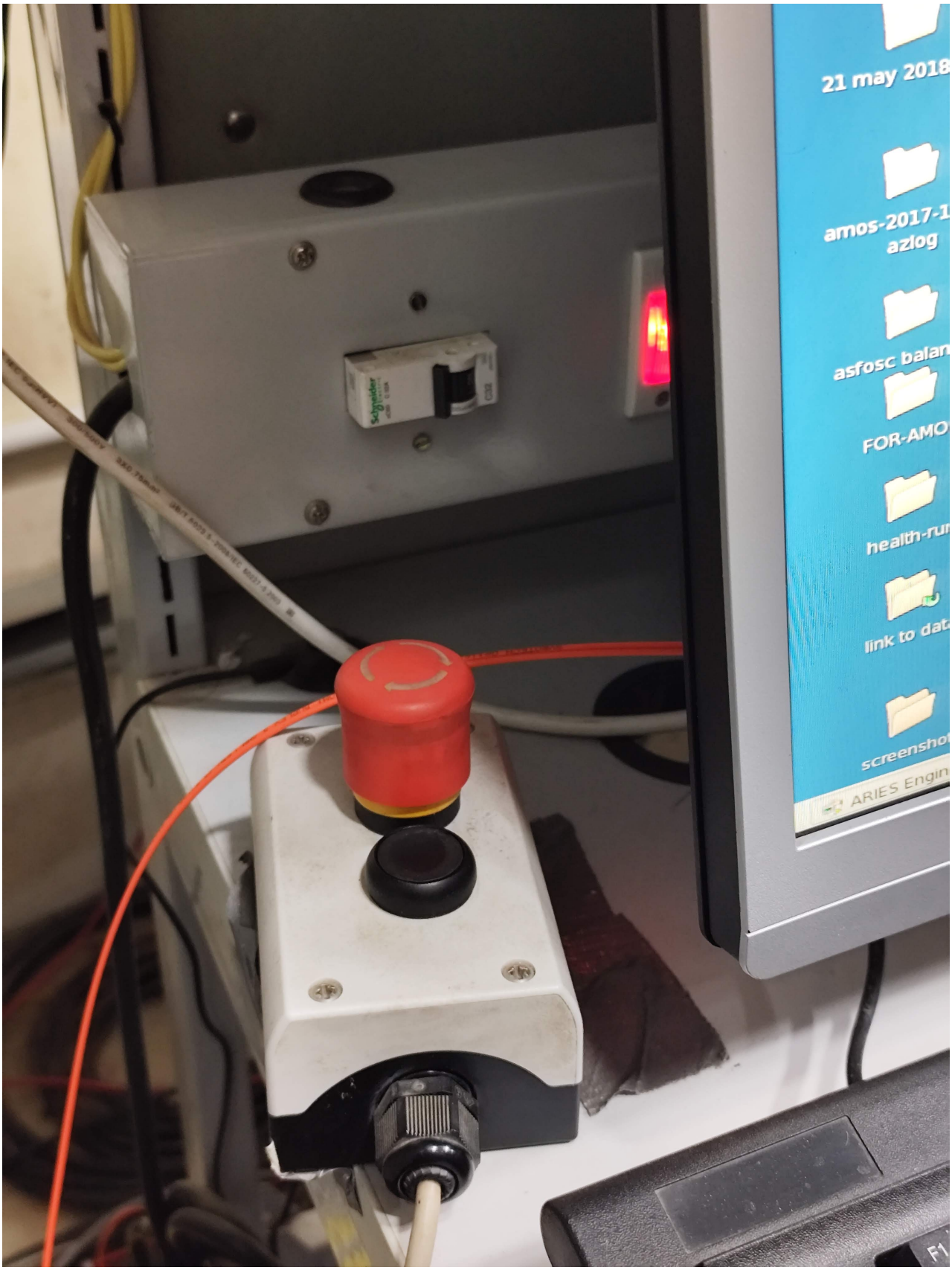


**Figure 7:** The black rearm button located near the TCS PC.


**Figure 8:** The error messages in the TCS screen.


**Figure 9:** The indicators showing the status of different components of the telescope.

1. In the TCS remote display, go to "System" under "Command Panel" and click the "Init" button as shown in Fig. 8 and monitor the motion of the telescope, and also check the status of the telescope axes and their positions. The indicator lights for all the axes in the TCS should turn green. The positions of the altitude, azimuth, and rotator axis should be at their datum positions, which are 78°, -45°, and 7° respectively.
2. Go to "Command Panel" and select "Main Axes". Now enable all three axes one by one and follow by clicking the "Datum" button, then check if all the axes reach their "Datum" positions as mentioned in the above point.

- ☐ Move the altitude axis to 90° by clicking the "Move" button of the "Altitude" axis in the "Main Axes" after giving a value of 90.
- ☐ Now open the AOS GUI and make sure that the telescope is at 90 deg and then click the "Startup" button. The completion of the process can be confirmed by all the green lights in the TCS GUI as shown in Fig. 9.
- ☐ After this process, the alt axis will be disabled, which needs to be enabled from the "Main Axes" Panel in TCS.
- ☐ Now the telescope is ready to use.

# 3 Starting the Dome

*(For the detailed pictorial explanation, refer to the manual for the Dome control)*

- ☐ Go to the technical room behind the main panel on the ground floor.
- ☐ Put the knob of the "dome drive panel" to UPS power.
- ☐ Go to the telescope floor.
- ☐ Switch ON the main switch of the "SLIT INCOMER".
- ☐ Put the knobs of "INTERLOCK CONTROL PANEL-E 27" in the "SLIT ON" and "DOME ON" positions.
- ☐ Push the green button on the "SLIT & WINDSCREEN DRIVE REMOTE PADDLE" to open the slit. The "white" and "black" buttons can be used to move the slit "up" and "down" sides respectively.
- ☐ Go to the "DOME DRIVE CONTROL PANEL - E 18" and :

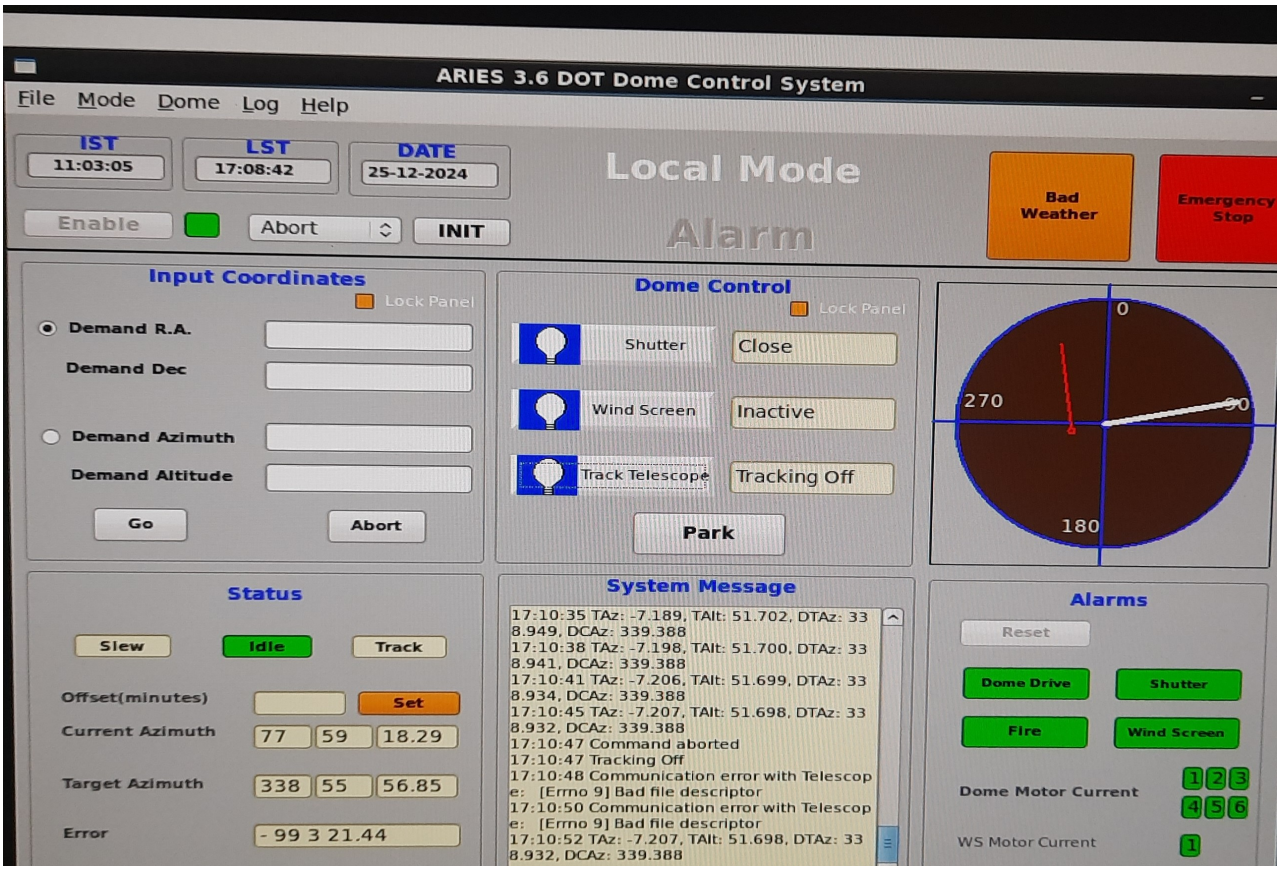


**Figure 10:** The Dome Control System GUI

1. Push the "MAIN CONT ON" (blue) button.
2. Select AUTO (A) mode with the help of A/M selector switch.
3. Select "DOME DRIVE" speed (L) mode.

- Go to the TCS control room.
- Switch ON the power supply of the microcontroller box.
- Turn on the Dome Control System (DOS) computer.
- Ping the TCS (192.168.0.100) and microcontroller (192.168.0.192) servers and delete the four *.ini files.
- Click the DomeControlSystem icon on the Desktop to open the DOS GUI. The DOS is shown in Fig. 10.
- Click the "Enable" button to "home" the dome. The completion of the homing process can be confirmed by the green color near the "Enable" button.
- Now the Dome is ready for the observations.

# 4 Observations using TIRCAM2

- Open the cover of the primary mirror. For this, go to the "390 - M1 Cover" section in "Command-Panel" and click the "Open" button as shown in Fig. 11.

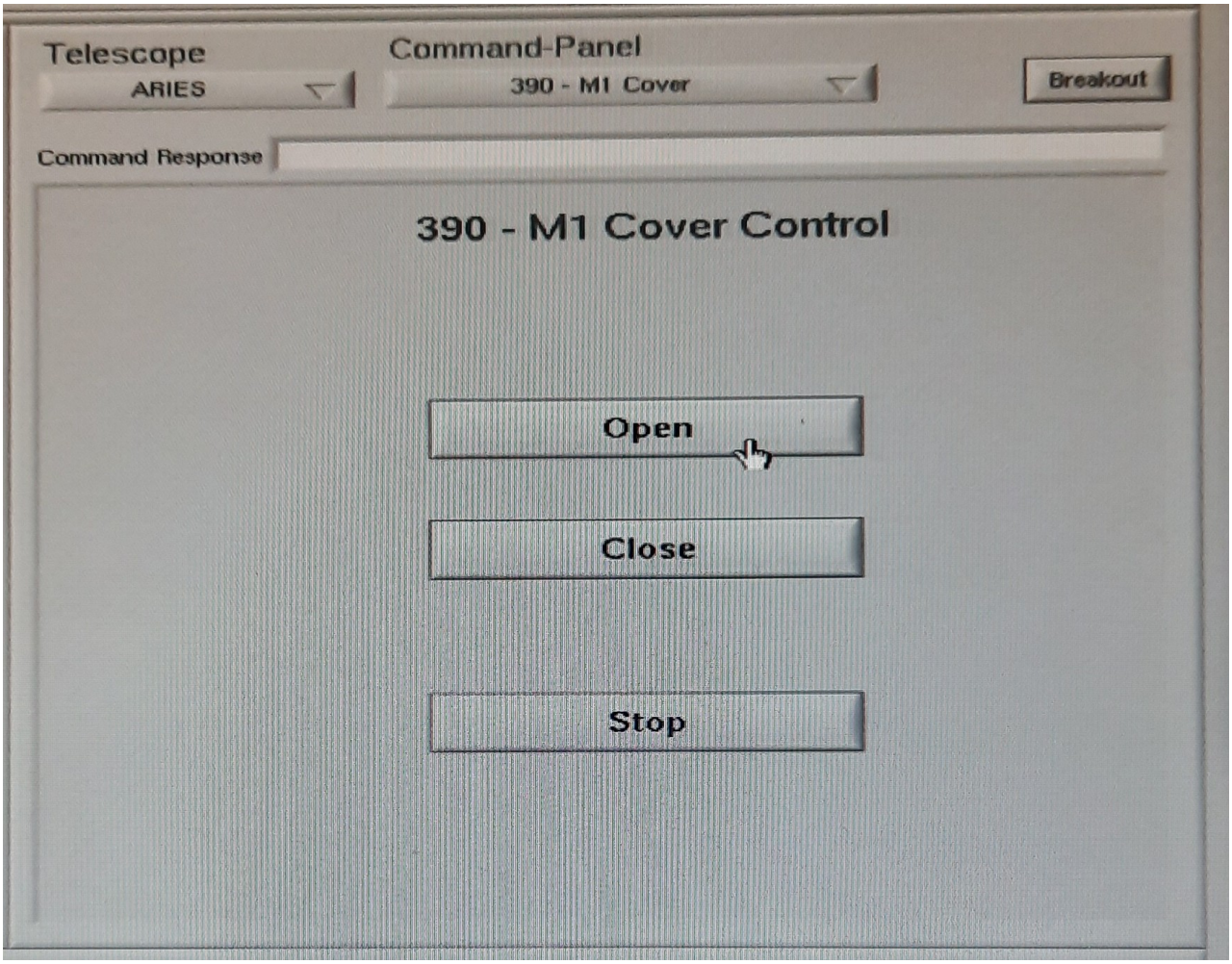


**Figure 11:** The controls for the primary mirror in TCS..

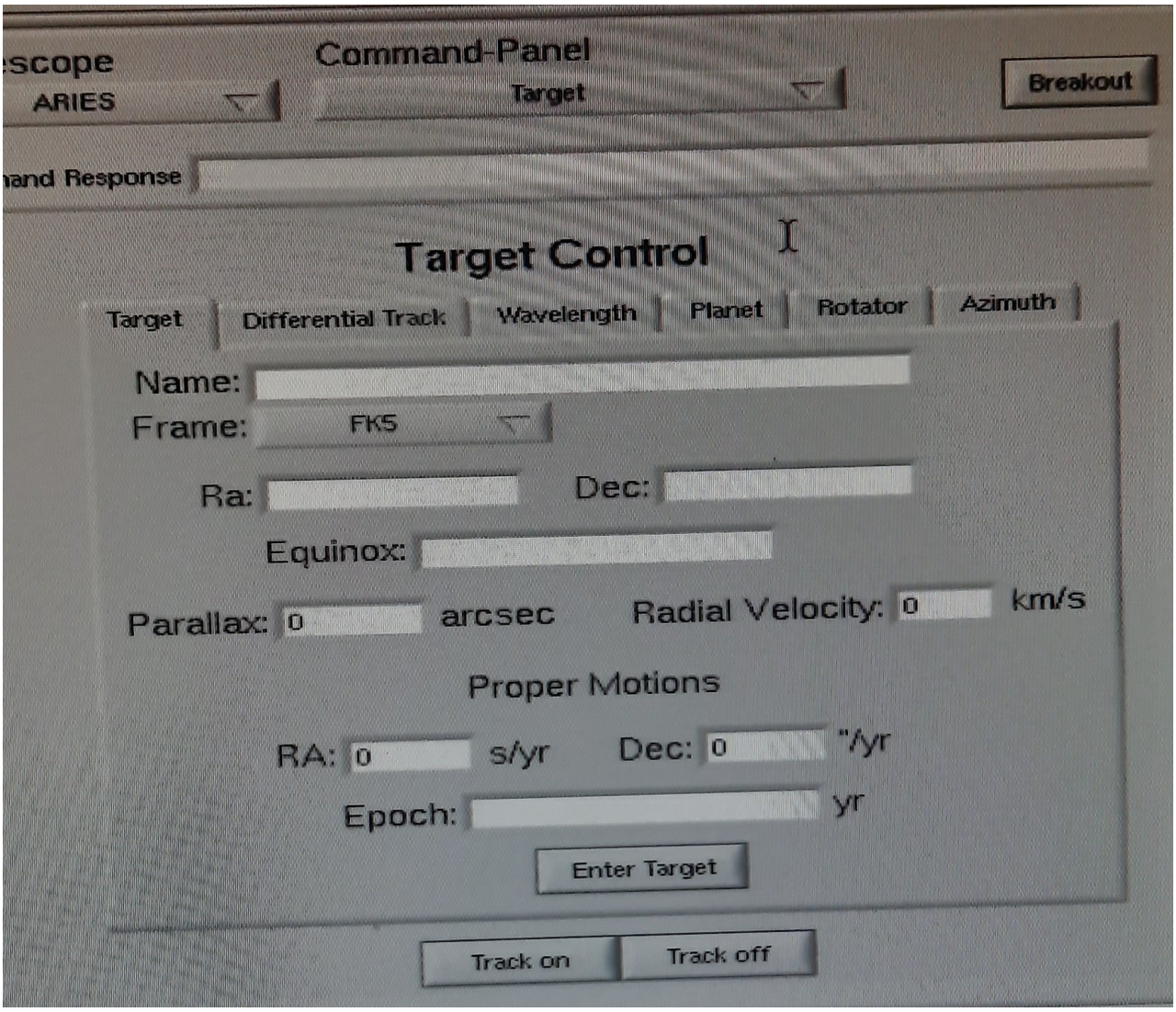


**Figure 12:** The target information can be entered here.

- Select the side port-1 in the TCS GUI and load the pointing model for TIRCAM2.
- Go to the "Target" in the "Command Panel" of TCS and insert the RA and DEC and name of the target to be observed, and then click the "Enter Target" button as shown in Fig. 12. Now, start tracking the telescope by clicking the "Track on" button.
- Go to the DOS window as shown in Fig. 10, either click the "Demand Azimuth" and "Demand Altitude" or click "Demand R.A." and "Demand Dec" options in the "Input coordinates" and click the "Go" button.
- The dome will slew to the telescope position and then click the "Track Telescope" button to start tracking.
- Open the remote desktop on the TIRCAM2 computer in the TCS room.
- Feed TIRCAM2 PC IP address 192.168.0.3 and click connect.
- Enter username as tircam and password as tircam.

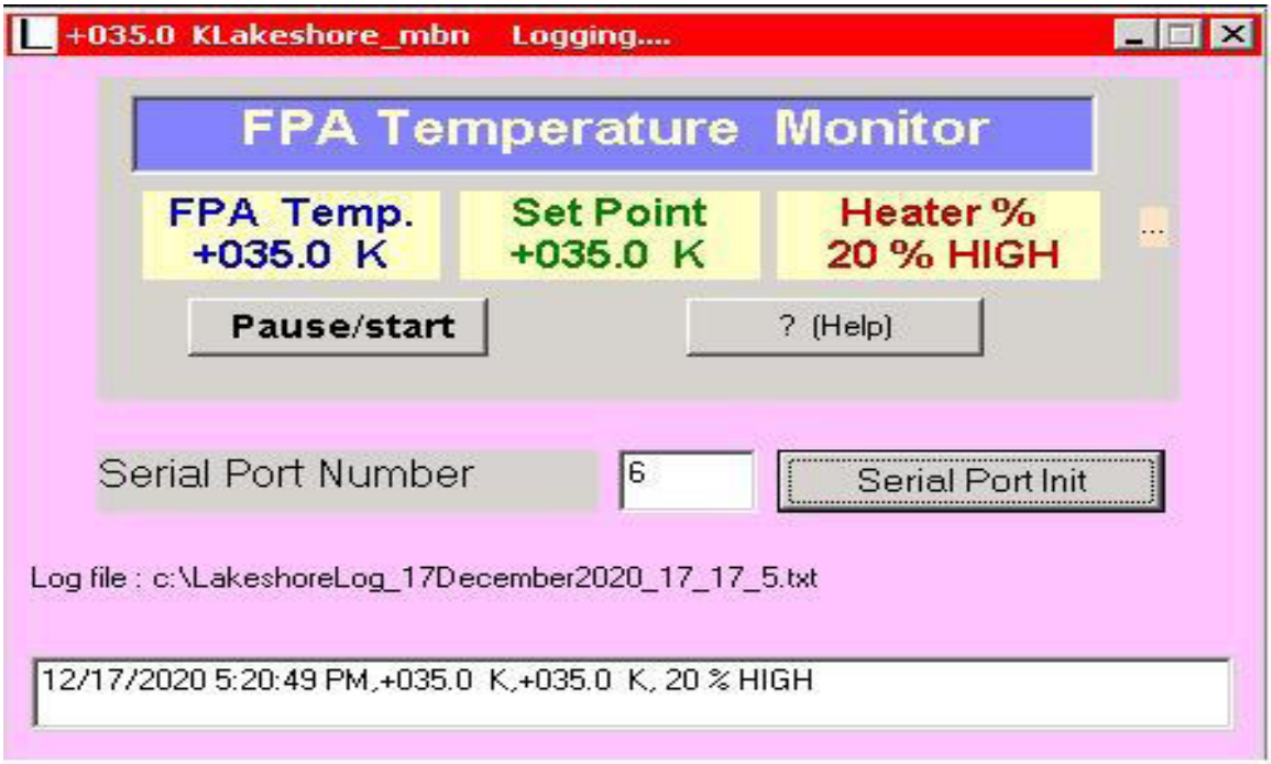


**Figure 13:** The lakeshore GUI showing the current and set temperature.

- Open the Lakeshore software and make sure the temperature is 35K as shown in Fig. 13. If the temperature is above 50K, don't turn on the camera.
- Make a folder in the TIRCAM2 computer to store the data of the observation night with the format YYMMDD. The path of this folder should be "$/D/Year\_cyclename/$"
- The schematic of the filter controller connections of TIRCAM2 is shown in the left panel of Fig. 14. Ensure that the connections are correctly done before powering on the filter controller. Now, power on the filter controller and check the COM port allotted to the filter controller Arduino Uno, e.g., COM14 as shown in the right panel of the Fig. 14
- Double click the filter calibration icon located on the desktop, it will open the GUI as shown in Fig. 15.
- Select the port number found in the above step and click the "InitSerial" button, followed by the "Calibrate" button, and wait till the status turns to "Calibration done".
- Open program "Tircam2ModeNormalSubarrSelection_ToDrive.exe" on the Desktop, the GUI will open as shown in Fig. 16.
- TIRCAM2 offers observations in two modes: Full frame mode and subarray mode. These can be selected from the "TIRCAM2 Mode Selection" GUI as shown in Fig. 16
- **FULL FRAME MODE:** To select the full frame mode, click "FULL FRAME MODE" button. It will open the "Voodoo" window as shown in Fig. 17. The "Full array mode covers a 512 × 512 pixel size, which corresponds to an 85.5 × 85.5 arcsec$^2$ field of view in the sky. The frame rate is 300 ms and can take a maximum of 7500 frames. In this mode, to complete 7500 frames of 0 sec exposure, TIRCAM2 takes 37 min 25 sec.

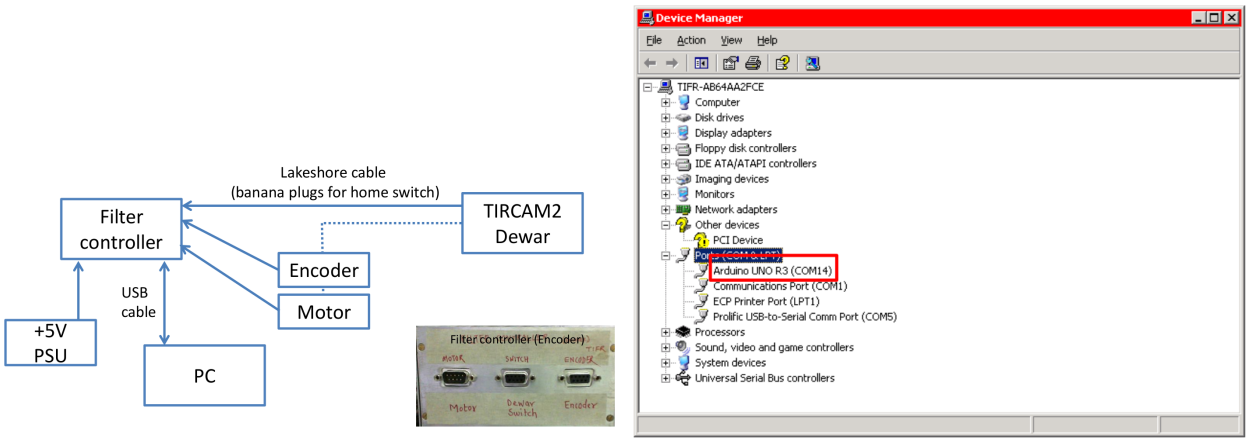


**Figure 14:** Left panel: Schematic of filter controller connections of TIRCAM2. Right panel: Information of the port allotted to the filter controller Arduino Uno

- In the Voodoo GUI, select the "setup" option and then load the "$Setup\_Fullframe\_5June2024.setup$" file and press the "Apply" button as shown in Fig. 18.
- The progress can be seen in the Voodoo window. When it shows "applied", close the window.
- Go to Set port and select the desired port number in the Voodoo window.
- Tick the "filter control" check box and then click "Next/prev". The filter window will pop open, tick "Enable Filter Buttons", select the desired filter, wait till the red circle comes on the desired filter, and then click "Quit". Repeat it for the next filter.
- The filter information will not be updated in the Voodoo window due to a software issue. To update it, tick the "Filter control" and click "NEXT"; the filter window will pop up. Now, click "Quit"; now the filter information will be updated.
- Write the path of the directory where the data will be saved in the "PATH" section.
- Select the type of image as "FITS".
- Write the name of the file. The format of the file should be "$object\_filter\_proposalID\_00.fits$".
- Set the exposure time and click the "Auto increment" button if required.
- Click the "Expose" button. Then the image will be exposed according to the desired exposure time."
- Check the image using DS9 after the exposure completes. Match the object with the sky map and check the focus. If the focus is okay, then go for further observation; otherwise, change the focus and repeat the exposure.

□ **SUBARRAY 10m MODE:** User can select the subarray mode by clicking the "SUBARRAY 10mS MODE" button. The specifications of the "SUBARRAY" mode with different binning sizes are mentioned in Table 1:

- Go to the "setup" option and load the setup file named "Subarr10ms_SetupLoadFile2020mbn_timcntsbrr.lod" as shown in Fig. 21.

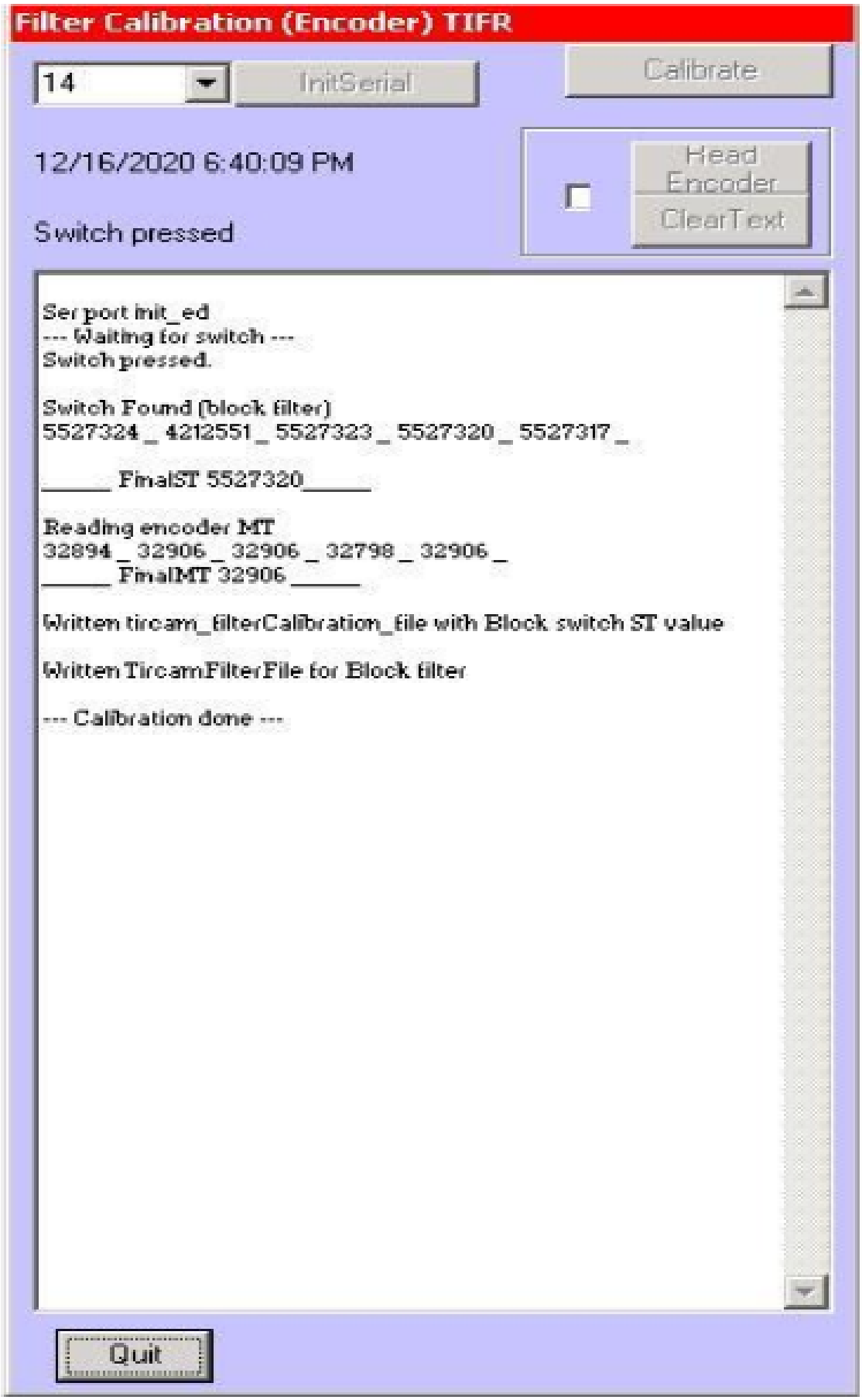


**Figure 15:** TIRCAM2 filter GUI.

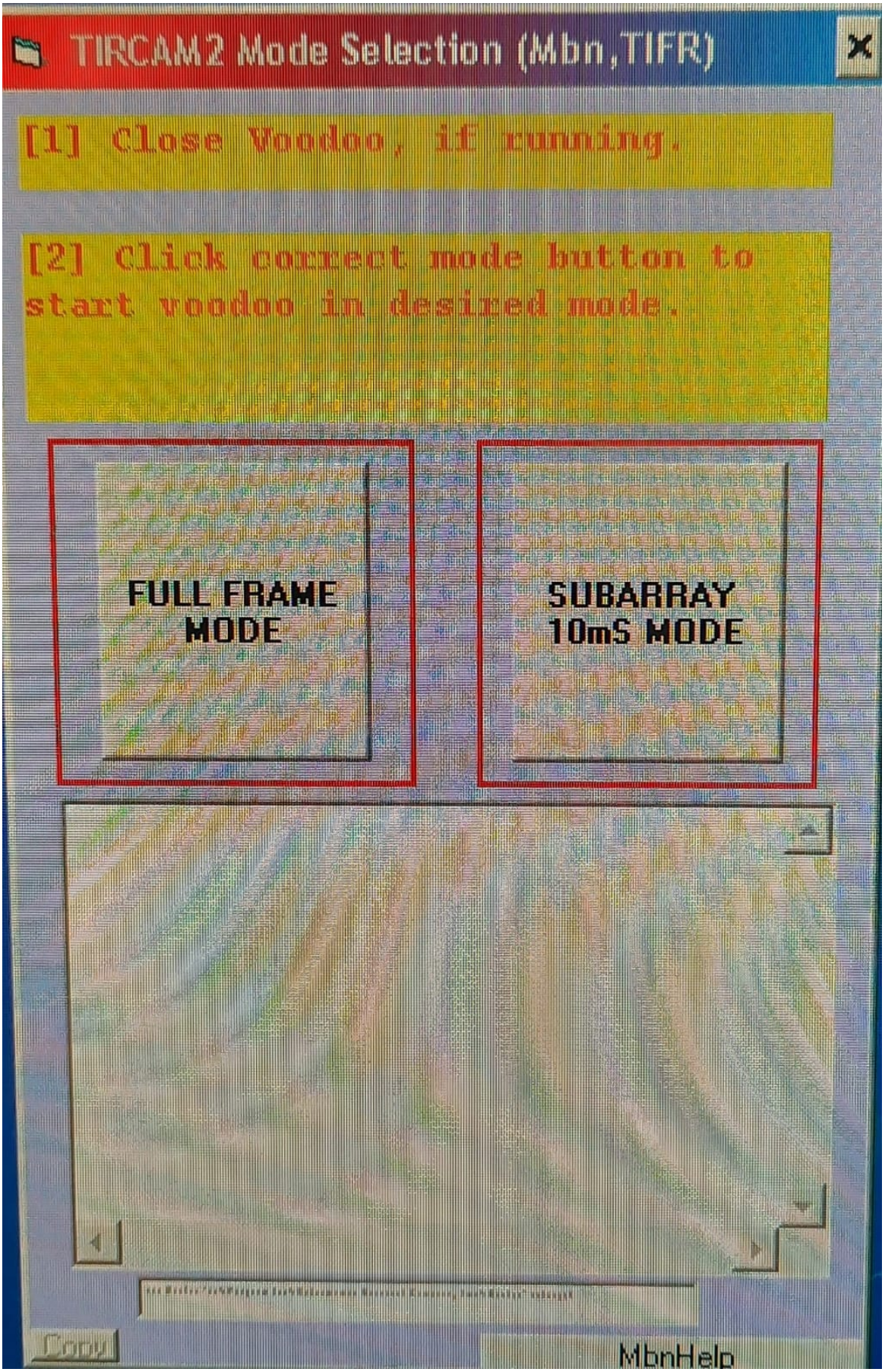


**Figure 16:** TIRCAM2 modes.

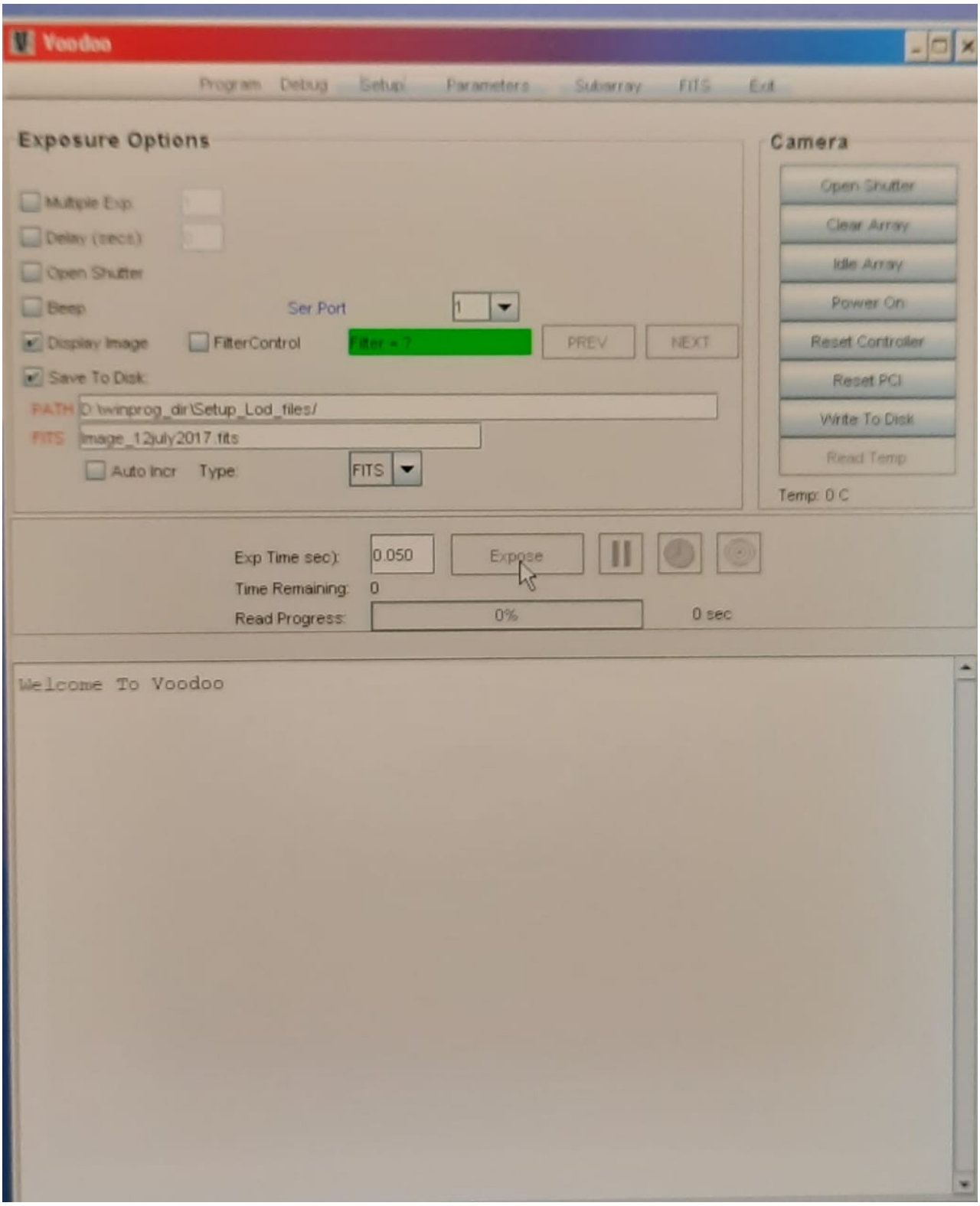


**Figure 17:** TIRCAM2 full frame mode.

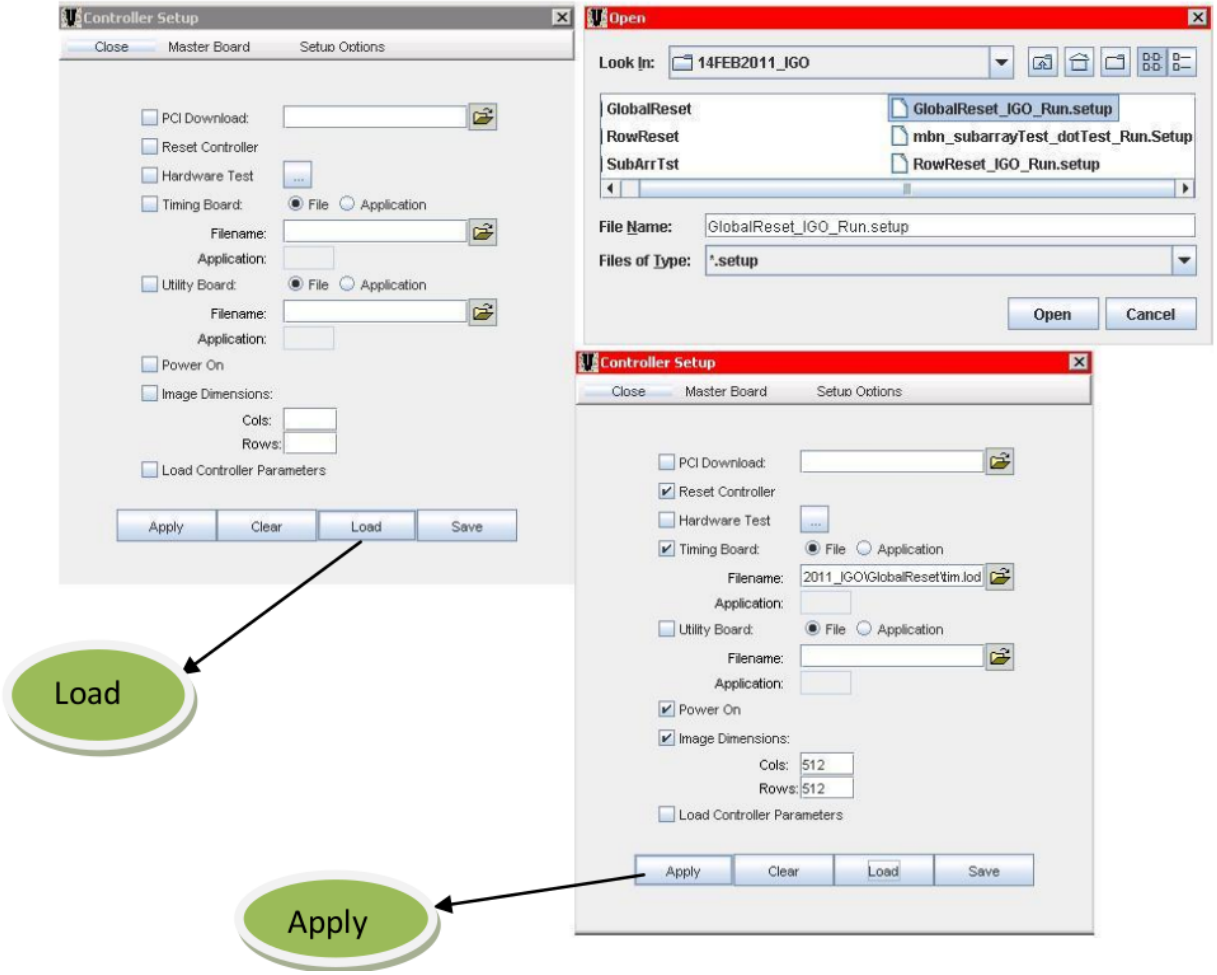


**Figure 18:** TIRCAM2 setup.

| Binning | FOV (arcsec square) | Frame rate (ms) | Max frame | Time to complete 0 sec exposure |
|---|---|---|---|---|
| 32 × 32 | 5.4 × 5.4 | 10 | 4000 | 40 sec |
| 64 × 64 | 10.7 × 10.7 | 14.8 | 1100 | 16.28 sec |
| 128 × 128 | 21.3 × 21.3 | 29.1 | 200 | 5.82 sec |

**Table 1:** The specifications of different subarray modes.

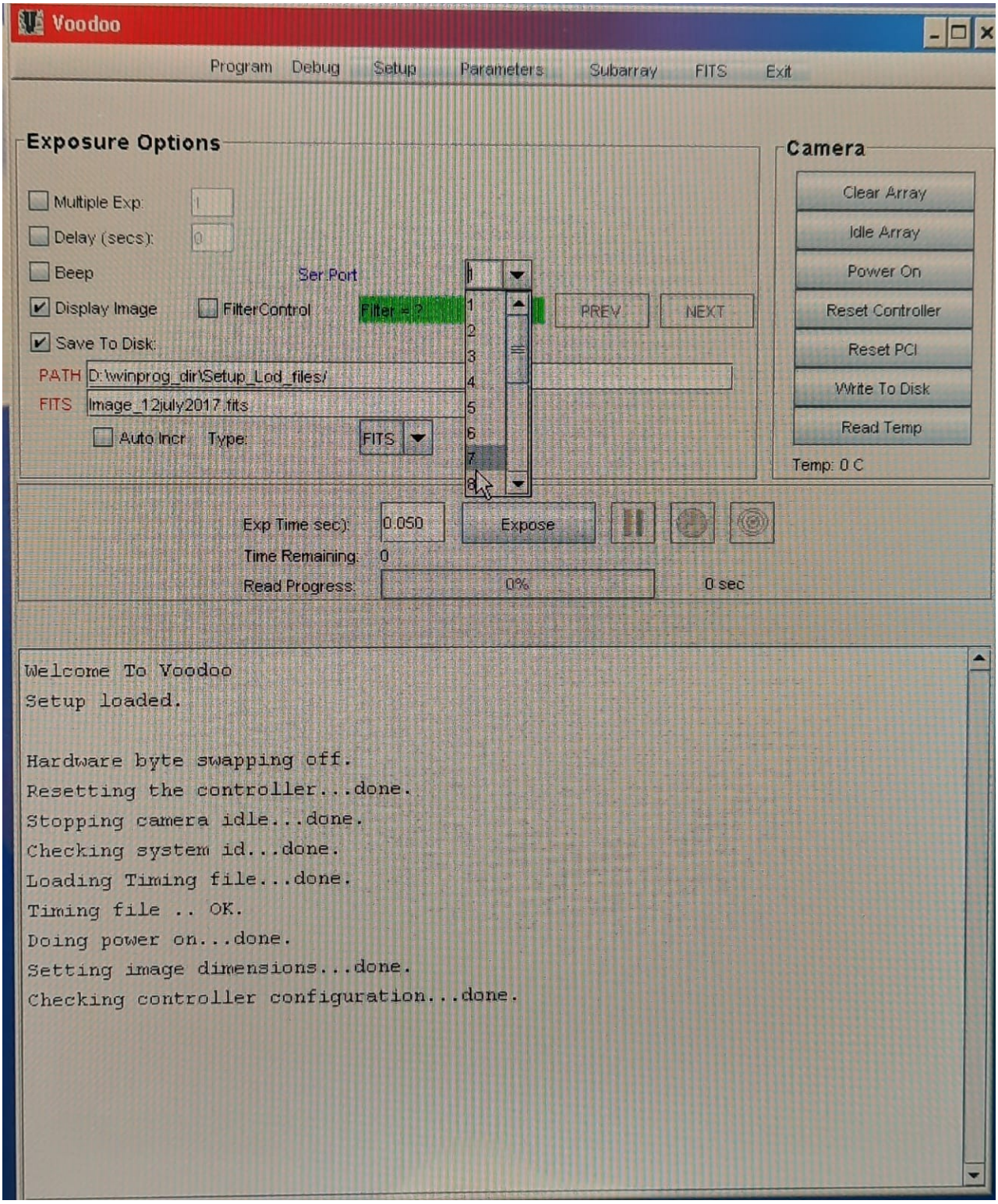


**Figure 19:** TIRCAM2 port selection.

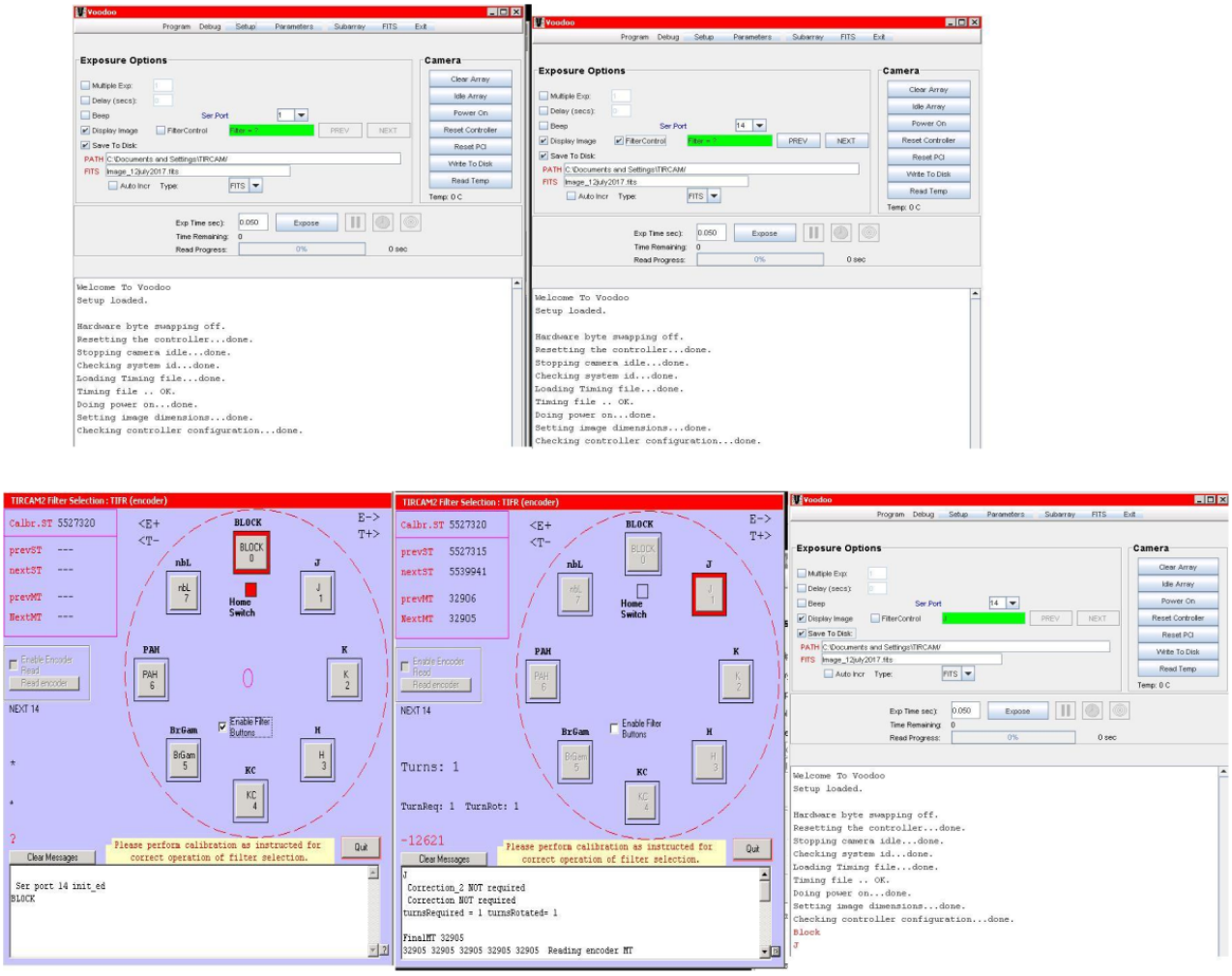


**Figure 20:** TIRCAM2 filter selection.

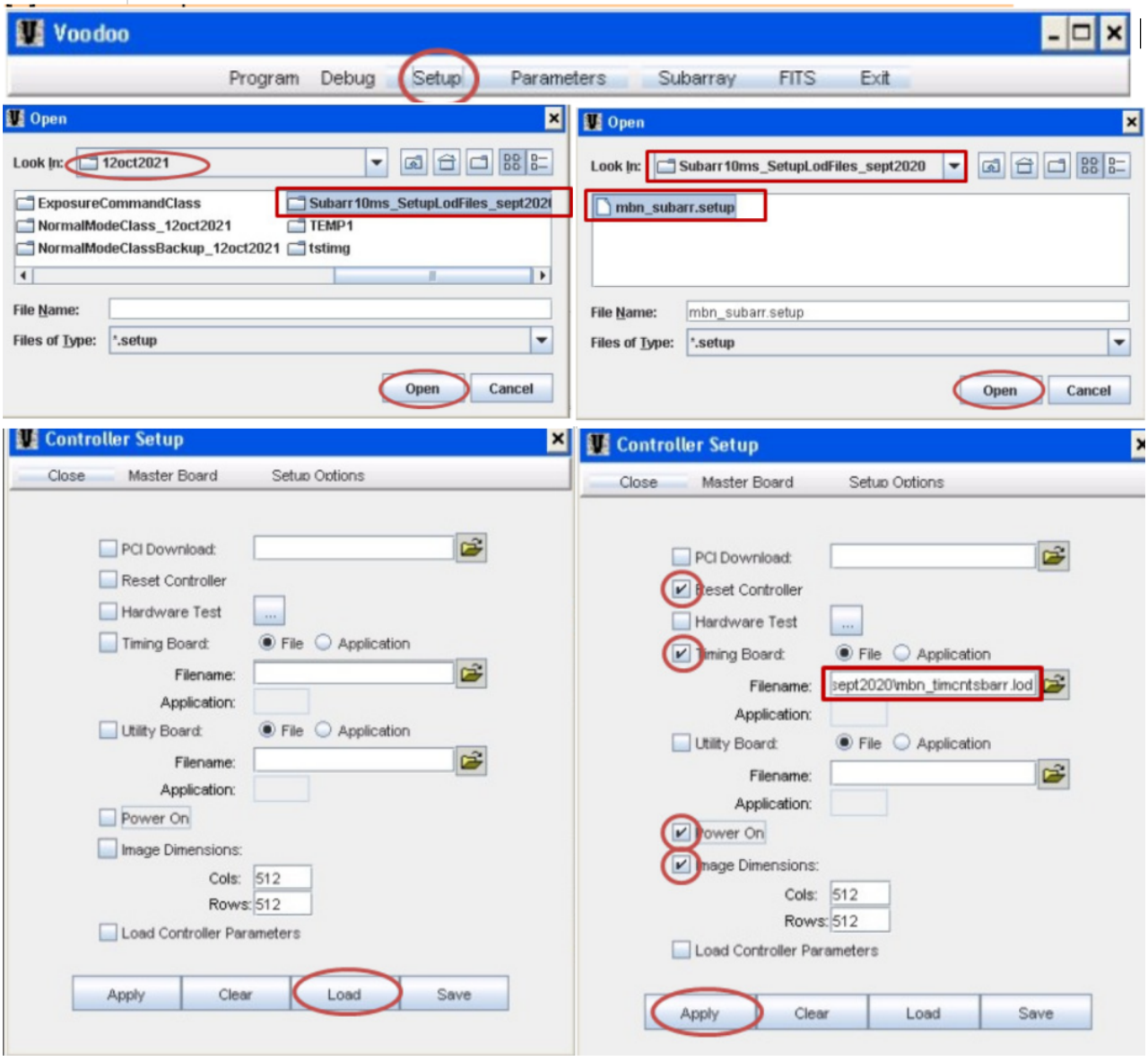


**Figure 21:** Setting up the sub-array mode.

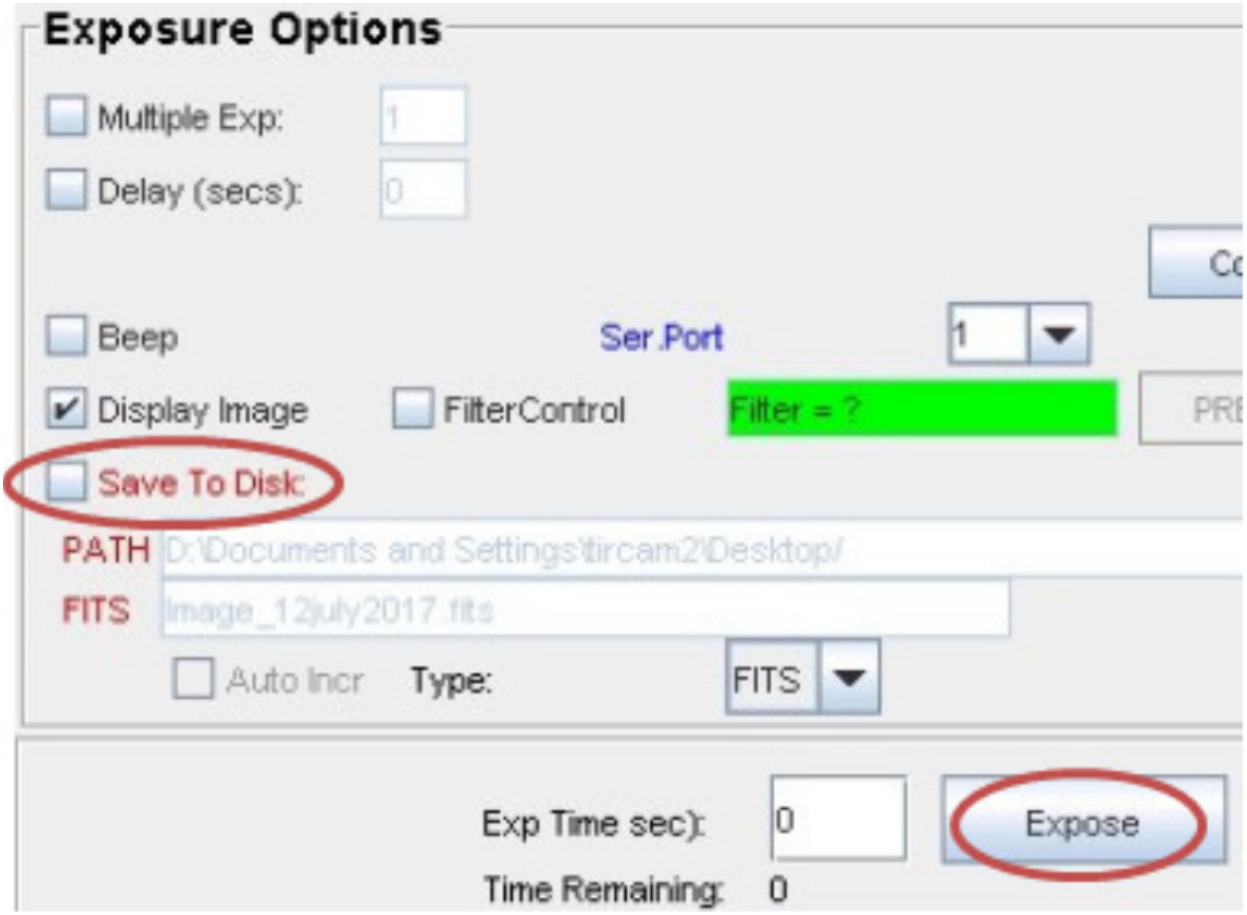


**Figure 22:** Dummy image with 0 s exposure.

- When the screen message displayed "configuration . . . done", close the "Controller setup" dialogue box.
- The process of controlling the filters is similar to the above-mentioned mode.
- Keep the "Save To Disk" unchecked and take a dummy image of 0 sec exposure time as shown in the Fig. 22.
- Enter the path to save the images as shown in Fig. 23.
- Go to "Subarray" option in Voodoo and fill in the desired box parameters, and click the "Apply" button as shown in Fig. 24. After showing "done" status close the dialog box.
- Select "Parameters" option in the Voodoo window and go for "Continous Readout" option. Tick the "continuous", "Write To Disk" and write "Number of Frames" as shown in the Fig. 25. Then select the "Apply" button and close the window.
- For this mode, unselect the "Display Image" option. Otherwise, it will keep opening every image. Now start the exposure.

□ The Status of all the processes can be seen in the lower window.

□ All the images can be checked by opening in DS9.

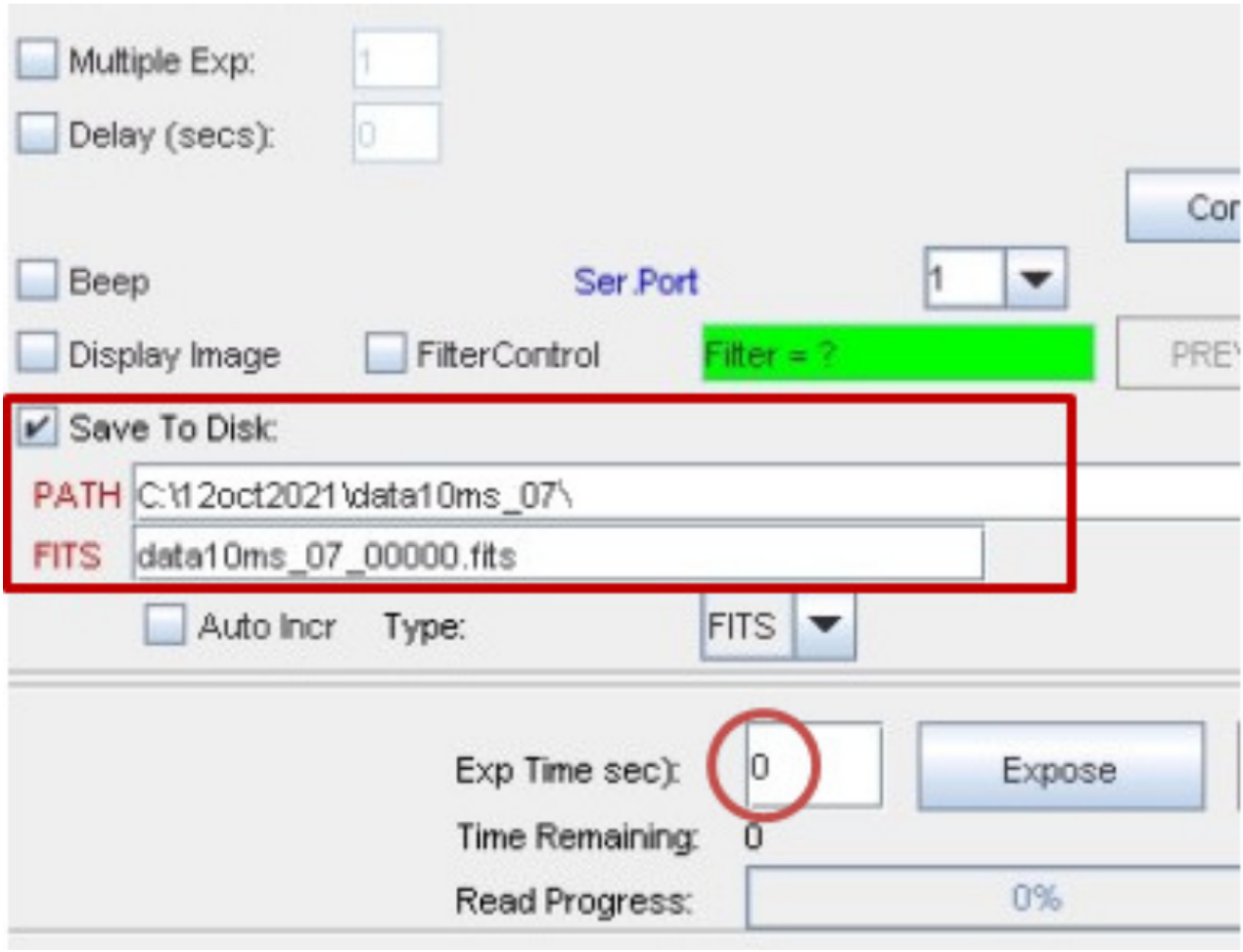


**Figure 23:** Setting up the path of images to be saved.

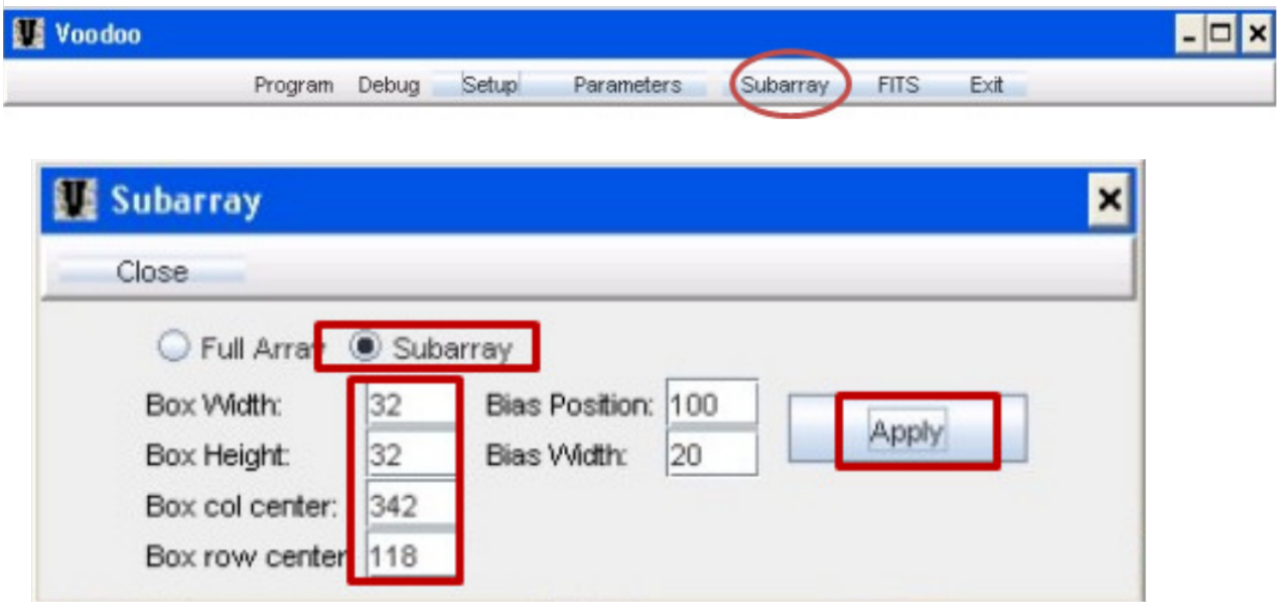


**Figure 24:** Setting up the subarray credentials.

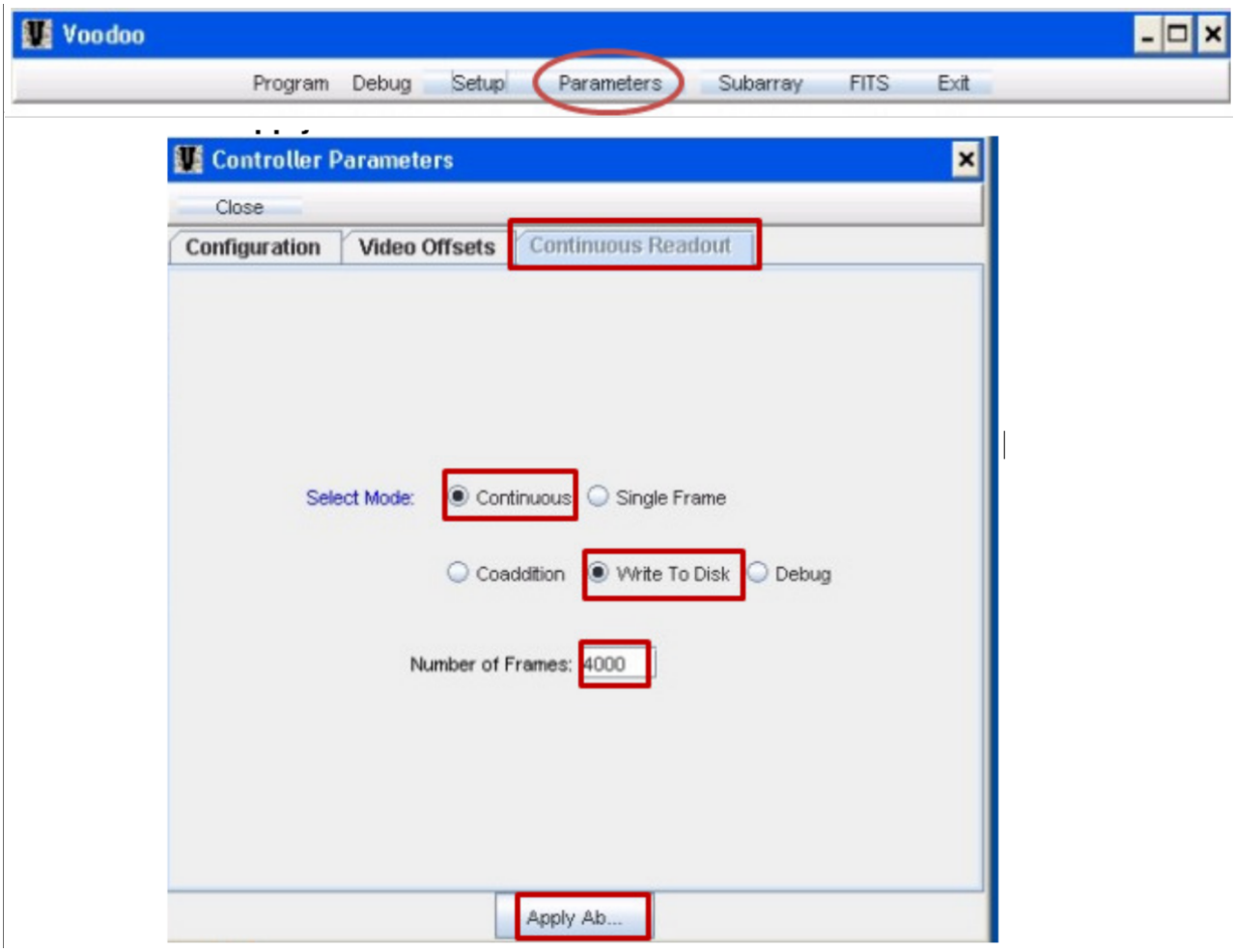


**Figure 25:** Setting up the parameters.

# 5 Turing off the instrument

# 6 Closing down the telescope

- ☐ Park the telescope by clicking the "Park" button in the TCS's "Command Panel".
- ☐ Close the TCS and AOS GUI.
- ☐ Turn off the Power supply.
- ☐ Turn off the knob in the AMOS panel-1.
- ☐ Turn off the knob in the AMOS panel-2.

# 7 Closing the dome

- ☐ Park the dome by clicking the "Park" button in DOS and then close it.
- ☐ Switch off the power supply of the Microcontroller from the TCS room.
- ☐ Go to the telescope floor and close the slit by pressing the close (Yellow) button in the "Slit & windscreen drive remote paddle".
- ☐ Switch off the "SLIT INCOMER" main switch.
- ☐ Put the knob of "dome drive" in "OFF" position.