VATT Control System

User manual

Supplier ProjectSoft®	ProjectSoft HK a.s. Eliščino nábřeží 375, 500 03 Hradec Králové Czech Republic tel.: +420 495 052 150 e-mail: info@projectsoft.cz
Investor 	Specola Vaticana Via della Conciliazione 54 00120 CITTÀ DEL VATICANO

Prepared Petr Langer	Checked	MPE Tomáš Turek	Revision 0	
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1. Document history

Revision 0 2023/03/15 First version of the document.

Revision 1 2024/06/04.Updated version

2. Abbreviations

- PLC - Programmable Logic Controller
- VATT – Vatican Advanced Technology Telescope
- EMI - Electromagnetic interference
- PCB - Printed Circuits Boards
- PCI - Peripheral Component Interconnect
- UDP - User datagram protocol
- SCADA - Supervisory Control and Data Acquisition

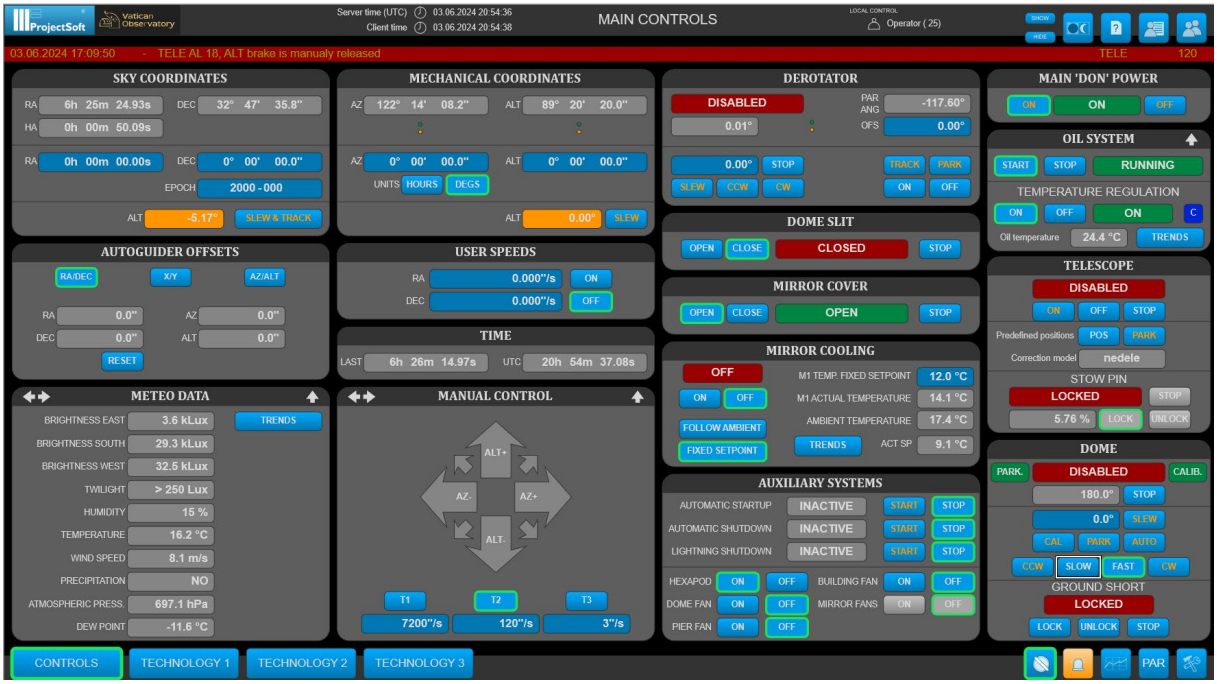
3. INTRODUCTION

These OPERATING INSTRUCTIONS provide basic information necessary to operate the control and visualization system of the telescope. Before starting any operation, the personnel assigned to operate the system must be trained and familiar with these INSTRUCTIONS.

4. OPERATING OF THE CONTROL COMPUTER

The visualization software is installed on the control computer (PC) with the Windows operating system. The control computer monitor displays the control process's actual status.

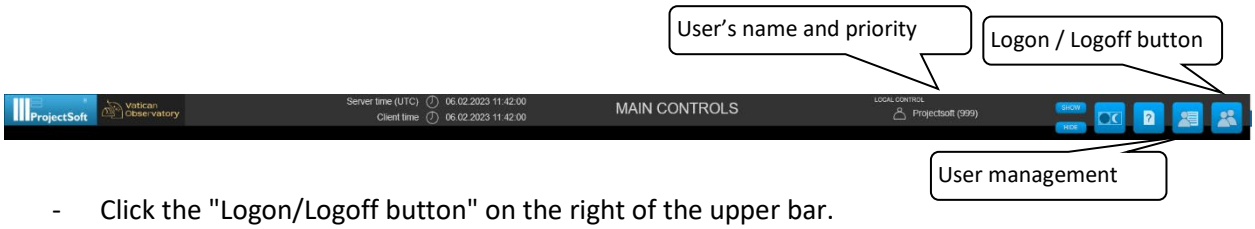
When the application starts, the main control screen is shown.



4.1 System controls

4.1.1 Logging on and off

Only authorized persons, logged on using their username and password can access the software.
Follow these steps to log on:



- Click the "Logon/Logoff button" on the right of the upper bar.
- The "Logon panel" will appear.

- Click inside the **Name** field and type in the user name.
- Then click inside the **Password** field, type in the required password and press Enter or click Logon to confirm. If the procedure was successful, the name of the logged user will appear in the upper bar. If the procedure was not successful, click on the Password field again and re-enter the password.
- **To log off**, press the **Logoff** button on this panel.

Individual authorized persons have the following access levels and corresponding restrictions to activities within the software (this can be modified on-site according to the specific needs of the customers):

- **PROJECTSOFT** priority 999, no restrictions
- **TECHNOLOGIST** priority 50, authorized to change selected set values and parameters
- **OPERATOR** priority 25, the basic level of operation, no authorization to change the above-mentioned parameters

After work completion, the user should log off to prevent unauthorized usage!

4.1.2 Screens - Overview

There are several groups, each group consists of one or more screens. Listed from left to right.

Group **CONTROLS**:

Screen **CONTROLS**

Screen **TECHNOLOGY**

Group **ALARMS**:

Screen **CURRENT ALARMS**

Screen **ALARM HISTORY**

Group **TRENDS**:

Screen **TRENDS**

Group **PARAMETERS**:

Screen **TELE PAR 1**

Screen **OTHER PAR 1**

Screen **OTHER PAR 2**

Screen **MODEL**

Group **SERVICE**:

Screen **GENERAL**

Screen **IO DEVICES**

4.1.3 Description of the upper and bottom bar

Each screen contains the appropriate drawing or scheme and the upper and bottom bars contain a set of control buttons and displayed information.

Upper bar

The following information can be found on the **upper bar:**

- the name of the screen
- the field showing the **name of the logged-on department and operator**
- the field showing the type of control – **LOCAL/REMOTE**
- the field showing server **date and time** (should be UTC)
- the field showing the client's **date and time**
- the lower red line displays information about the last active alarm

Buttons from the left:

- the **SHOW** button shows the application frame
- the **HIDE** button hides the application frame
- the **DAY/NIGHT** button reduces the brightness of a screen
- the **HELP** button opens this document
- the **USER LIST** button opens a dialogue where the user can edit user accounts
- the **USER LOGON** button

Bottom bar

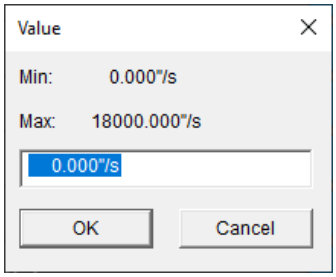
Buttons from the left:

- **BOOKMARKS** for switching between screens
- The button/indicator signals an **ALARM** in the system. In case when no alarm is active, the indicator is blue. If it is red-flashing, there is a non-acknowledged (non-confirmed) alarm in the system. If it is solid red, there is an acknowledged (confirmed) alarm in the system.
- The **TREND** button shows the screen with the graph of the selected technological variables
- The **PARAMETERS** button shows the screen with technical parameters.
- The **SERVICE** button shows the screen used to reach the documentation/ manual files and job termination.

4.1.4 Changing the value

- **Only authorized users with specified access levels can change** parameter values, alarm limits, etc.
- To change the value of a parameter move the mouse cursor to the **field of the variable value (light blue).**

  The field will be highlighted.
- Press **ENTER** or **click the left mouse button** to display the **"Value"** input window.

- Use the keyboard to enter the value and press **ENTER** to confirm.
- The value entered must be within the range set by the Min and Max values; values outside this range shall not be entered.

4.2 Alarm messages

Alarm messages notify the control system operator of existing non-standard conditions in the controlled technology such as drive failures, monitored variables outside working limits, stoppage of operation due to exceeding the control limits, etc.

- In case a new alarm occurs in the controlled technology, it is indicated by the **flashing indicator** in the Upper bar.

4.2.1 Actual alarms

- Select the **ALARM** button in the bottom bar and click to open the **"Actual alarms"** screen.
- **Actual alarms (i.e. new or persisting alarms) and so-called events** are displayed on this screen.

Individual columns of the table have the following meaning:

- date and time of the fault activation
- alarm status (A - active, + alarm activation, - alarm end)
- description of the fault
- location in the technology where the fault occurred
- value of the alarm variable

Lines are colour-coded according to their status:

- active non-acknowledged alarms: red
- active acknowledged alarms: orange
- inactive non-acknowledged alarms: yellow

If a new alarm is generated, operators must check the reason and acknowledge (confirm) it.

There are two possibilities to acknowledge alarms:

1. Acknowledge **all alarms in the system at one time** - click on the **"Acknowledge all"** button located on the bottom bar. The upper bar indicator will stop flashing and turn red, to indicate that acknowledged faults (operators are aware of them) are persisting in the system.

Remark: if the fault is resolved/removed indicator turns from red to blue.

2. **Acknowledge only selected alarms** - click on the appropriate alarm line.
   - **UP ARROW** and **DOWN ARROW** buttons in the middle of the bottom bar are used for navigation through the alarm list.
   - **LEFT ARROW** on the left of the lower bar is used to move back to the previous screen.
   - **RIGHT ARROW** on the left of the lower bar is used to move to the screen of alarm history.

4.2.2 Alarm history

- In the alarm history screen, all alarms and events can be displayed along with current alarms
- **An event** is an issue that **does not have the character of a fault** (log on of an operator, change of an important parameter, etc.) however, it is advisable to monitor it

Note: acknowledging is not possible in alarm history.

Lines are colour-coded according to their status:

- active non-acknowledged alarms: red
- active acknowledged alarms: orange
- inactive non-acknowledged alarms: yellow
- events: blue

4.2.3 Alarm recordings backup

All alarms are saved on the hard disk in the database file (SQLite database with .db extension) divided into weekly periods. This file is located in C:\Users\Public\Documents\TomPack\VATT\HistAlarms\. Generally, history is set to 10 years. After this time, the oldest recordings in the file are automatically deleted and replaced by the newer ones. **Therefore, if you want to archive data for a longer period, it is necessary to back up the file in a period shorter than the pre-set time of 10 years.**
If needed so, contact your IT department to solve the files backup.

4.3 Historical trends

The system of historical trends is used to archive measured technological values and display them in the chart.

There are two ways of displaying historical trends in TomPack:

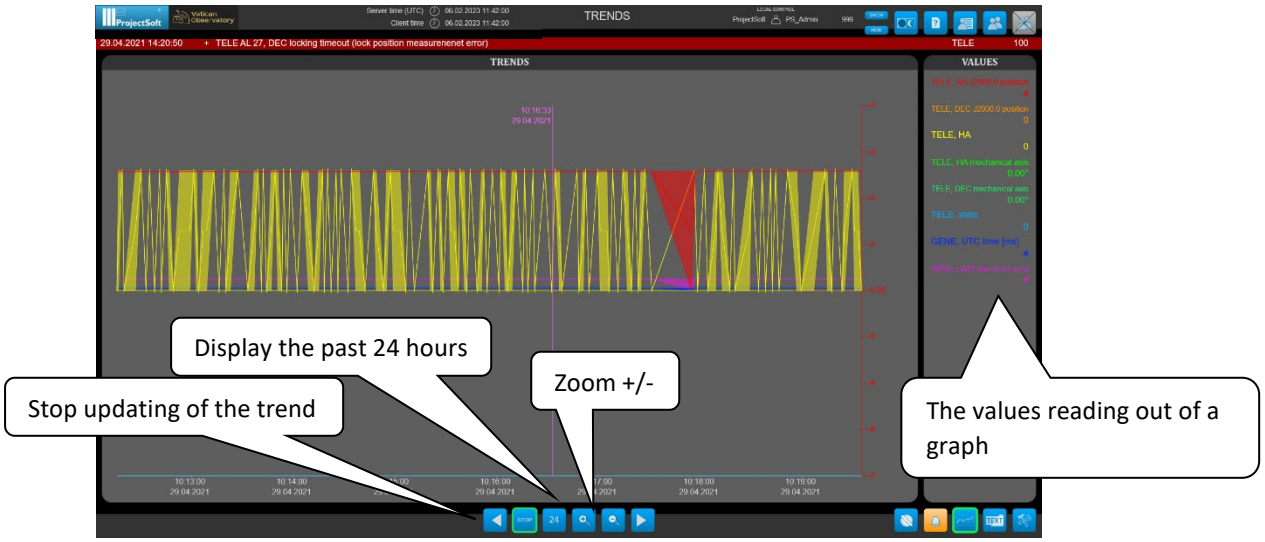
- To display the **trend of a specific measured variable**, click on the symbol of the controlled value (the left black section of the box).

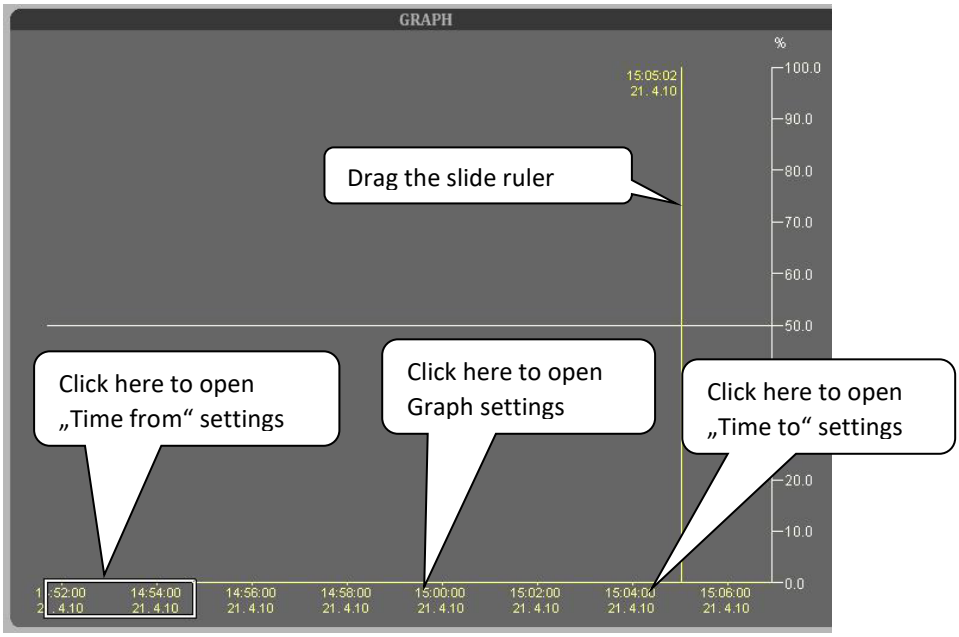
- To display the **summary trend of multiple measured inter-related variables**, click on the **TRENDS** button located on the bottom bar

- When the trend screen is opened for the first time, the **real-time trend** is always displayed, i.e. the course of the measured variable is continuously updated in real-time

4.3.1 Reading out of graph

- On the **right** side, next to the graph, **trend variable values are listed**; the value of each trend variable is updated accordingly to the slide ruler position.
- How to **read out values from the graph using the slide ruler**: position the mouse cursor to the "Y" axis, press the left mouse button, hold it, and drag it to the left (back in time).
- Date and time are displayed above the ruler and listed variable values are displayed on the right, as was already mentioned.





4.3.2 Movements in time

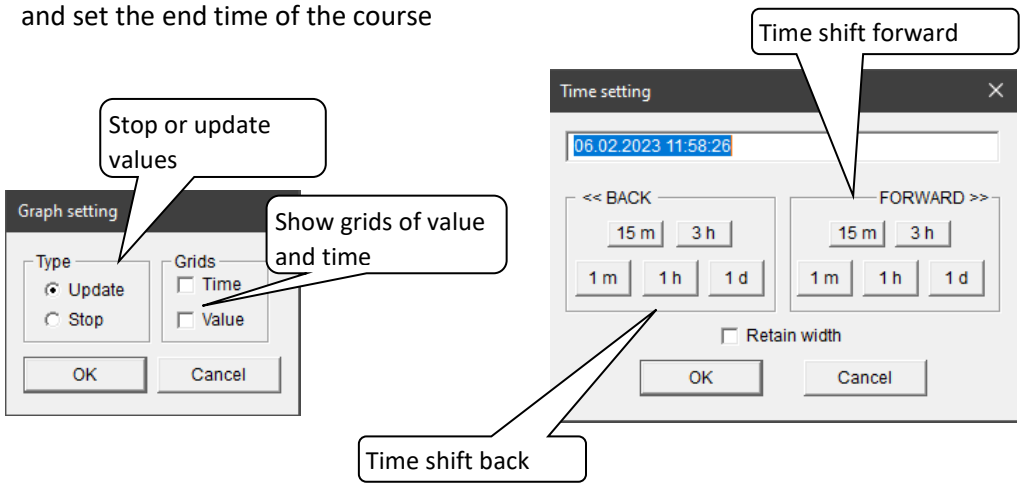
1. Viewing of real-time course

- If you want to change the time range of the displayed variable in real-time, you can use the following buttons located on the right of the graph:
- the **ZOOM+** button to enlarge the time range
- the **ZOOM-** button to reduce the time range
- the **24h** button to display the last 24 hours
- the **STOP OF TREND** button is used to stop updating the graph
- alternatively, the following steps can be used:
- click on the time axis, as shown in the picture, to open the **"Time from setting"** control panel for the time shift
- in this control panel, set the start time of the course either directly by filling in the date and time or by the usage of the buttons for shifting the time
- in this way, the graph will be extended from the current time to the past

2. Viewing the course in the past

- use the **STOP OF TREND** button to stop updating the graph
- as previously, click on the time axis, as shown in the picture, to open the **"Time from setting"** control panel for the time shift and set the start time of the course
- in this way, the graph will be extended to the past
- however, if you want to shift the course back in time while maintaining the same width of the graph, the **"Retain width"** box should be checked

- similarly, if the course has already been shifted to the past and you want to adjust its end, click on the time axis to open the **"Time to setting"** control panel for the time shift and set the end time of the course



4.3.3 Setting graph properties

- click on the time axis, as shown in the picture, to open the "**Graph setting**" control panel for changing graph properties
- in the left part "**Type**", graph updating can be stopped (the same function as the **STOP OF TREND** button)
- in the right part "**Grid**", an auxiliary grid can be displayed for both axes by marking the appropriate checkbox

4.3.4 Trend recordings backup

All trend-monitored variables are saved on the computer's hard disk, where the "TpServer2" application is running. The format is the same as for alarms archives and the location of the files is C:\Users\Public\Documents\TomPack\VATT\. **Files will be stored on the disk for the pre-set time. After this time, the oldest files will be overwritten automatically. Therefore, if you want to archive data for a longer period, it is necessary to back up the file in a period shorter than the pre-set time of 10000 days.**
If needed so, contact your IT department to solve the files backup.

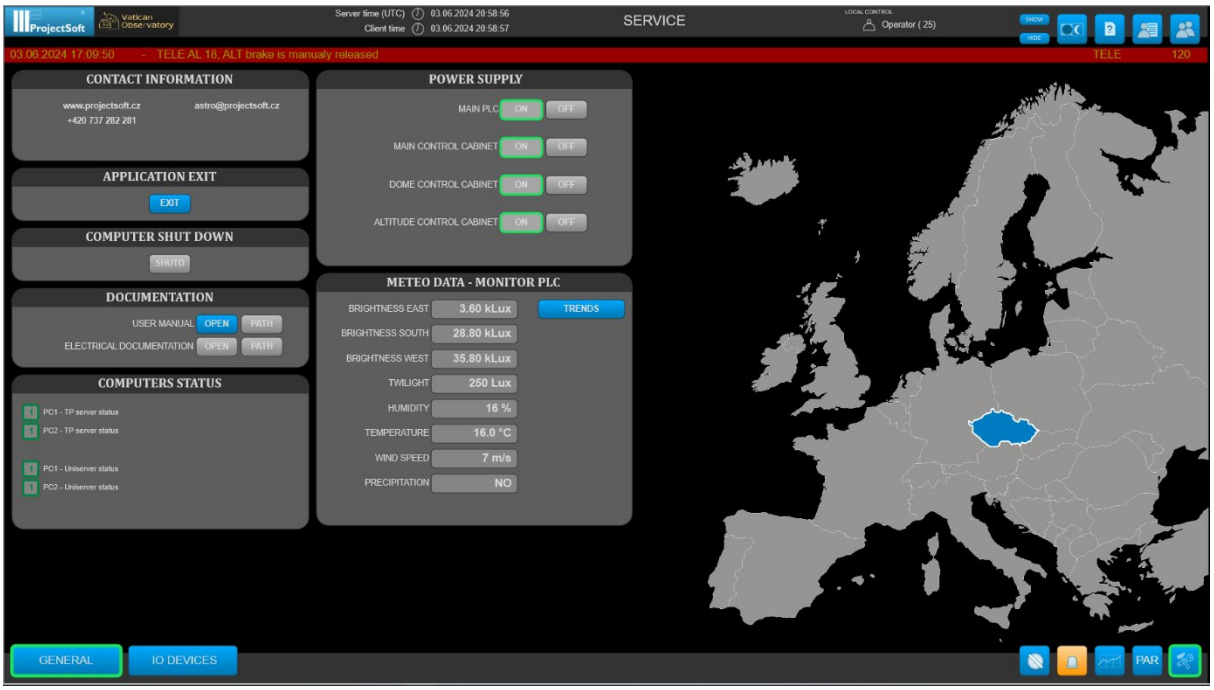
4.4 Service screen

To open the screen, click on the SERVICE button located on the bottom bar.

4.4.1 General screen

This screen consists of:

- Contact information
- Application exit
- Computer shutdown
- Documentation
- Computer status
- Power supply control
- Meteo data (from MonitorPLC)



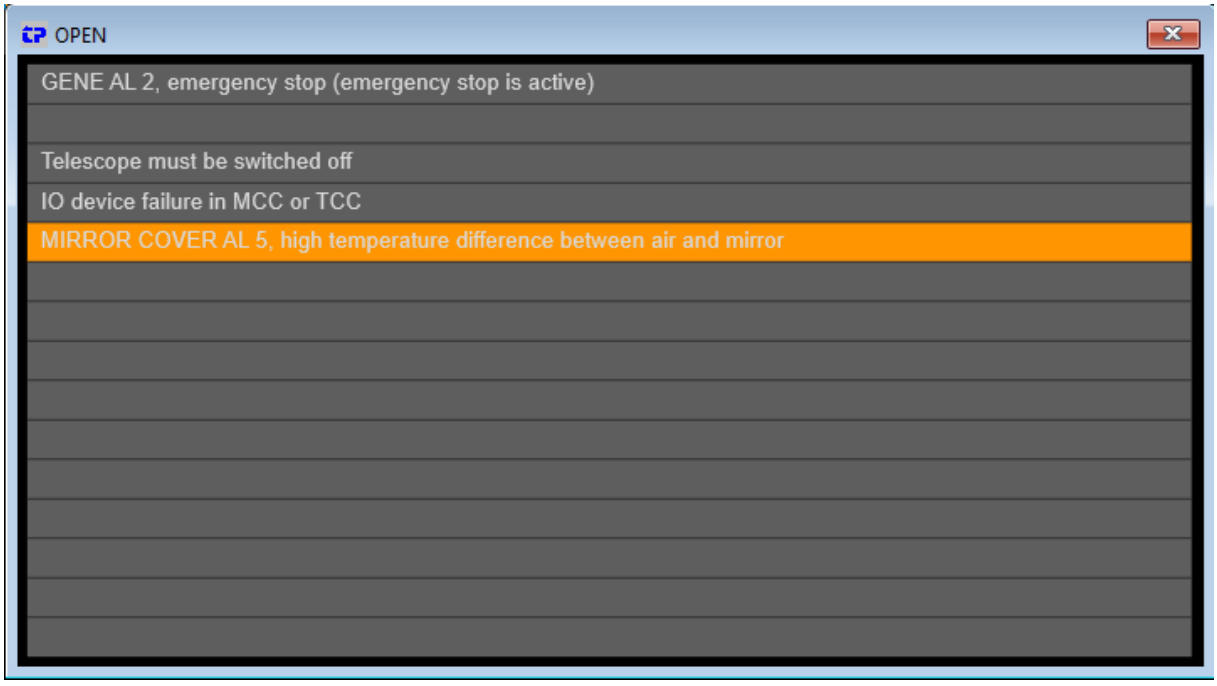
4.4.2 IO Devices screen

Screen with diagnostic data of PLCs and the status of each IO card and device.

4.4.3 Alarm signalization in the screen

When there is an active alarm assigned to a specific part of the system, the border around its state field is blinking orange. To check what is wrong, the user is supposed to open the alarm screen and check all active alarms.

When the color of the text on the button is orange, it means that not all conditions to proceed that action are met. The user can however click the button and a new window with all conditions will be shown. The condition that are highlighted are not met.

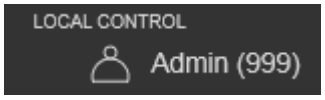


5. CONTROL

5.1 General control

There are two options to control the system. The LOCAL CONTROL mode and the REMOTE CONTROL mode. The mode is selected by the position of the switch on the control box in the control room.

The mode cannot be overridden by the software, so be sure to activate remote mode after leaving the building.



5.1.1 Local control

Main 'DON' power can be activated only by pressing a button on the box in the control room. This provides security protection from unwanted powering on the system.

5.1.2 Remote control

Normal operational mode. The control voltage can be activated from the visualization system. Opening any doors leading to the dome will turn the Main 'DON' power off in this mode.

Main 'DON' power is used for powering motors. Not all devices are without power if the Main 'DON' power is switched off. If you are going to work on the electric device, check if the voltage is off.

- **ON** button turns on the Main 'DON' power (only in Remote control).
- **OFF** button turns off the Main 'DON' power (only in Remote control).

5.2 Oil system

5.2.1 Oil system states

5.2.1.1 INACTIVE

The oil pumps are inactive.

5.2.1.2 TEMPERATURE CHECK

The system checks that the oil temperature is within the range for starting the oil system.

5.2.1.3 STARTING 1

The low pressure oil pump is activated and the system waits until the low pressure switch is activated.

5.2.1.4 STARTING 2

The high pressure oil pump is activated and the system waits until the oil pressure reaches required value for certain period of time.

5.2.1.5 STARTING 3

This state is used for restarting the oil system from the *STAND BY* state. The system is restarted right after the oil pressure reaches required value.

5.2.1.6 STAND BY

The oil pumps are turned off. The system is ready to perform faster start up sequence from this state. If the oil system is not restarted in the certain period of time, it is turned off.

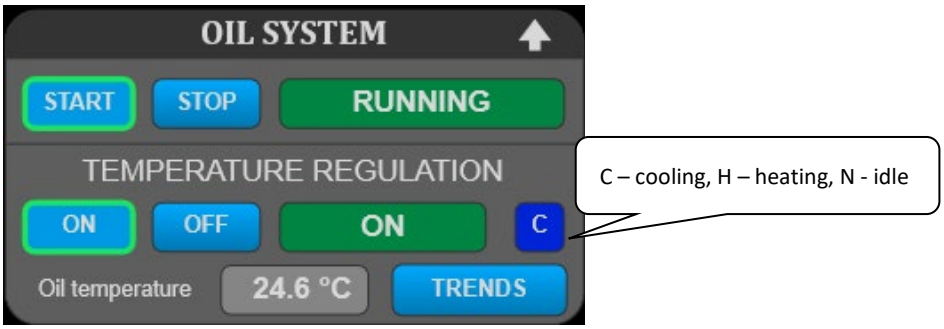
5.2.1.7 RUNNING

The oil system is running correctly and is ready for operating of the telescope.

5.2.1.8 CIRCULATION

The circulation pump is activated.

5.2.2 Description of controls



START button starts the oil system.

STOP button stops the oil system.

ON button starts the temperature regulation.

OFF button stops the temperature regulation.

5.3 STOW pin

The control of STOW pin is allowed only to the users with higher user level.

5.3.1 STOW pin states

5.3.1.1 STOPPED

The movement of the STOW pin is stopped and it is not in the locked or unlocked position.

5.3.1.2 LOCKING

The STOW pin is being locked.

5.3.1.3 LOCKED

The STOW pin is in a locked position.

5.3.1.4 UNLOCKING

The STOW pin is being unlocked.

5.3.1.5 UNLOCKED

The STOW pin is in unlocked position and the altitude axis is no longer secured by the STOW pin.

5.4 Telescope

5.4.1 Telescope states

5.4.1.1 DISABLED

The servo drives are switched off, meaning the motors stand still and are braked by the pneumatic brakes.

5.4.1.2 DISABLING

The telescope is halted and the servo drives are still powered on for a few seconds.

5.4.1.3 ENABLING

The power sources for the servo drives are turned on and the system is waiting a few seconds for their initialization.

5.4.1.4 ENABLED

The servo drives are powered on. The motors stand and are held in their actual position by control system regulators. The telescope can be moved using the manual movement function.

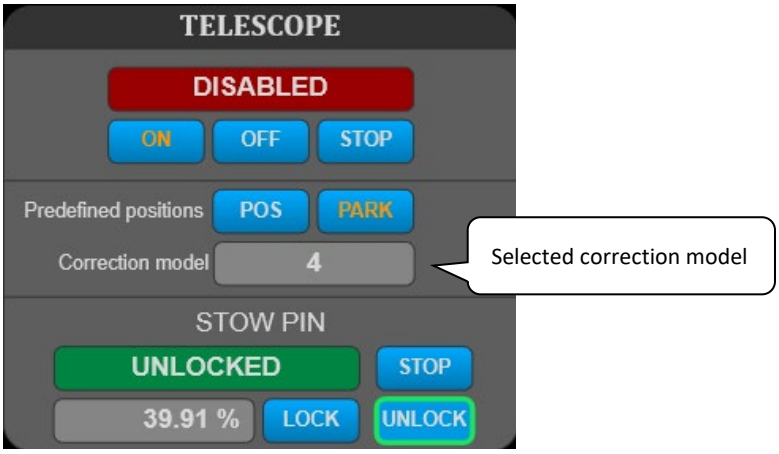
5.4.1.5 TRACKING

The control system uses actual Right Ascension and Declination as required position values and it calculates appropriate mechanical coordinates. This calculation is rectified by aberration, precession, nutation, refraction, and error model. The regulators maintain the telescope position in this requested position.

5.4.1.6 PARKING

The telescope moves to the specified mechanical parking position.

5.4.2 Description of controls



ON/OFF button enables/disables the telescope drives.

STOP button stops the movement of the telescope.

PARK button moves the telescope to the predefined parking position.

POS button opens the window with predefined positions of the telescope.

STOW pin

STOP button stops the movement of the STOW pin.

LOCK button starts the locking of the STOW pin.

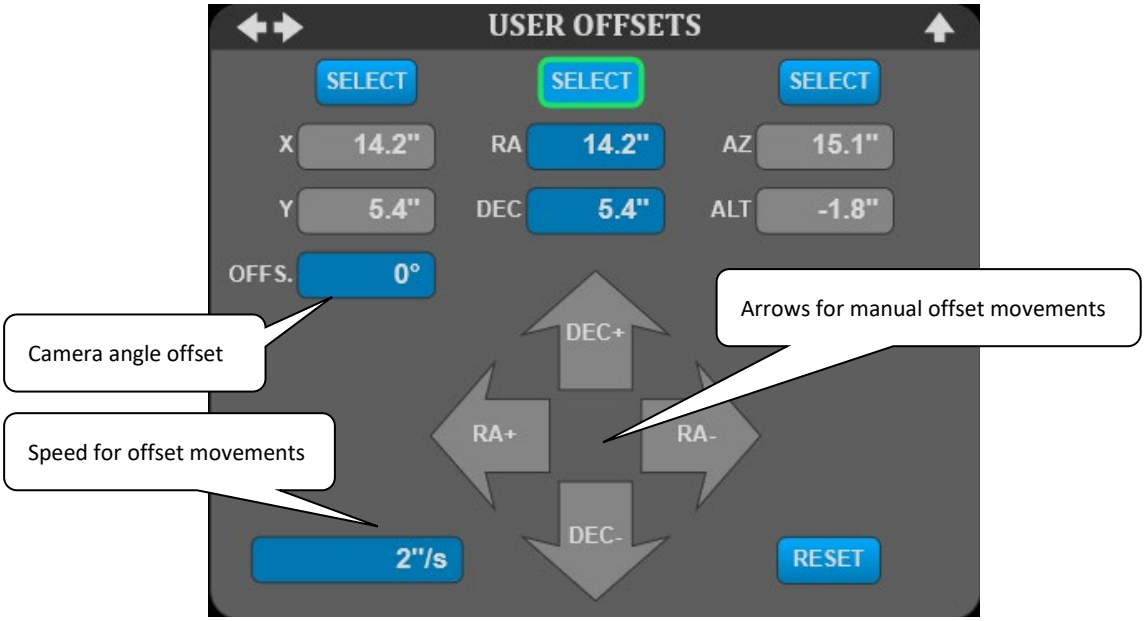
UNLOCK button starts the unlocking of the STOW pin.

5.4.3 Offsets

Offsets are used for compensation of an error, which is not removed by the correction model and must be corrected by the observer or autoguider.

5.4.3.1 User offsets

These offsets are entered manually by the observer. The observer hast to chose in what coordination system he wants to enter the offsets. After entering the offsets, the values are transformed to the mechanical coordinates.



- **RESET** button sets the offsets to zero.

5.4.3.2 Autoguider offsets

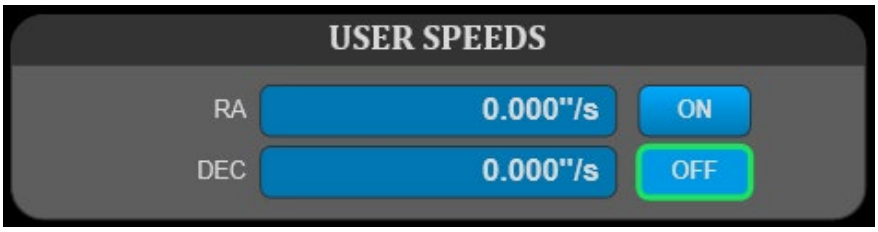
For the autoguider offsets, the observer has only to select in what coordinate system the autoguider sends the offsets.

- **RESET** button sets the offsets to zero.

5.4.4 User Speeds

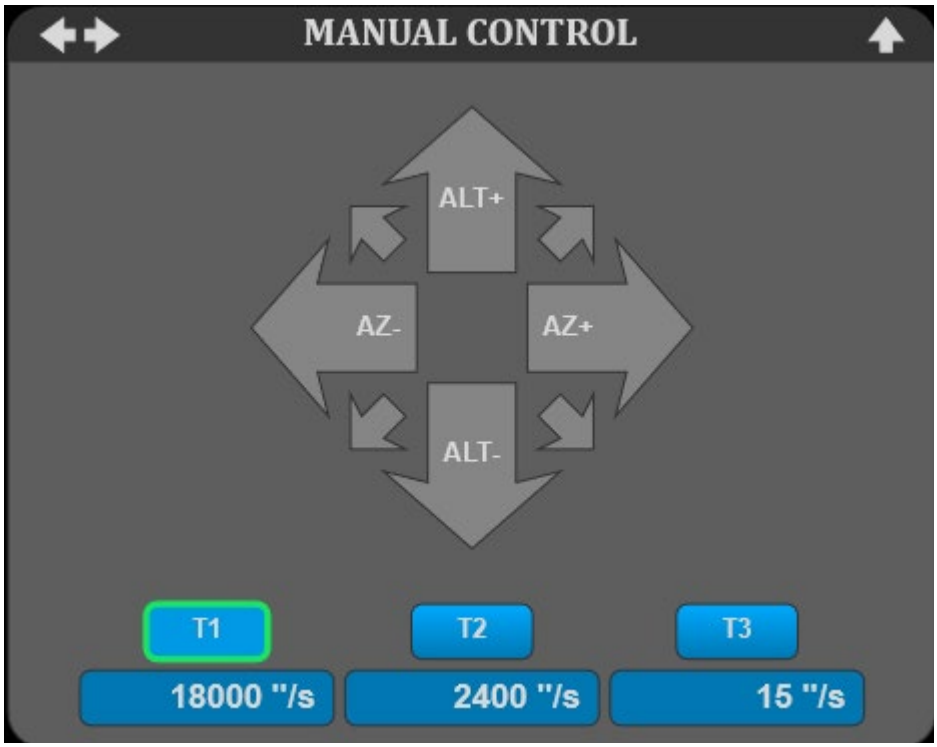
The user's speeds serve for moving of the telescope with the selected speed in **Track** mode. This function is useful for tracking comets and objects moving in the sky.

This function is switched on and off by buttons **ON** and **OFF**.



5.4.5 Manual movements

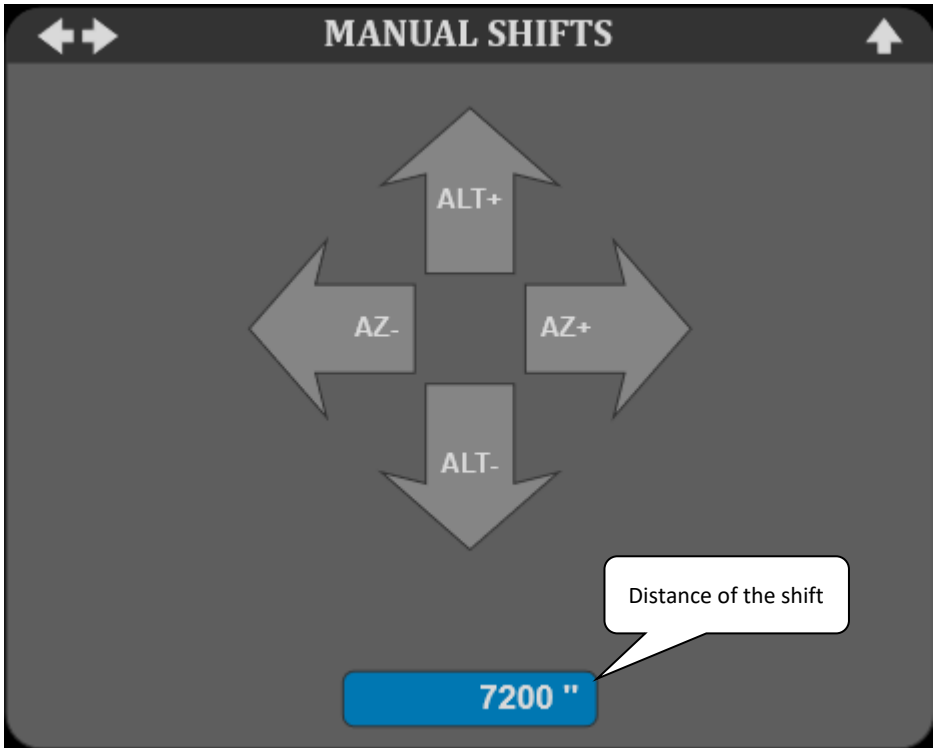
Used for movements of the telescope in the specific direction. May be used when the software alarm is on and the telescope needs to be moved to the safe position.



- **T1, T2, T3** button selects the speed for manual movement of the telescope.

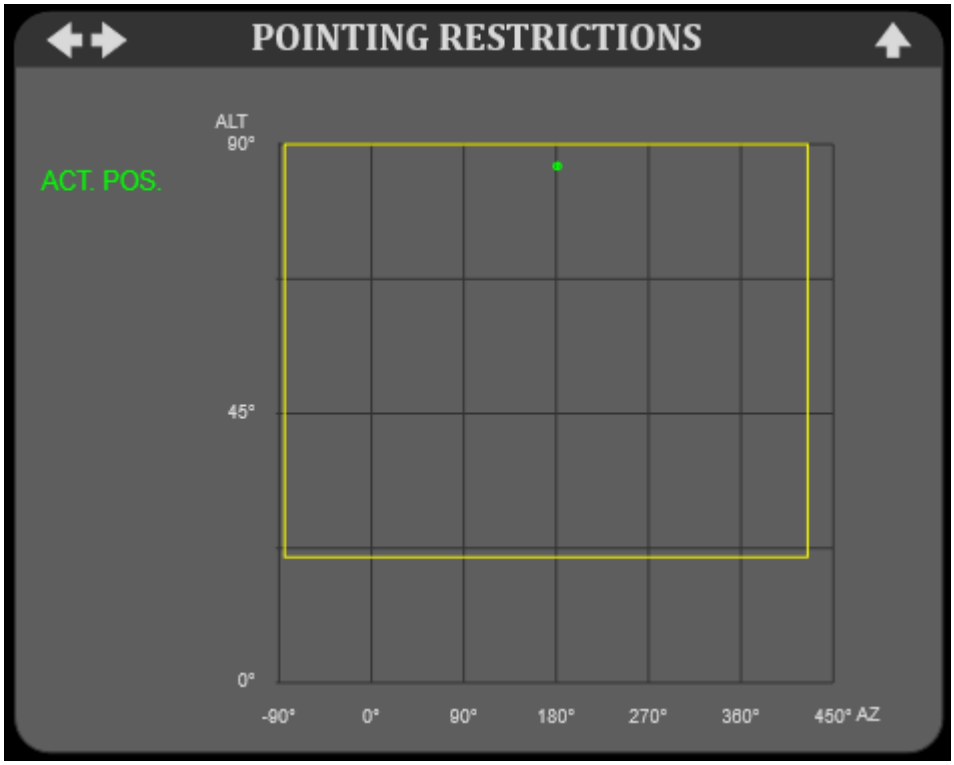
5.4.6 Manual shifts

Used for moving the telescope by the specified distance in selected direction.



5.4.7 Pointing restrictions

Used for monitoring of the telescope movement, its actual position, target position etc. Yellow border indicates telescope's pointing limits.



5.5 Correction model

5.5.1 Introduction

A couple of astronomical corrections are implemented in the PLC software. It is mainly annual aberration, precession and nutation when sky coordinates are used. Actual precession correction values depend on the epoch of coordinates entered.

The actual local apparent sidereal time is computed from actual UTC. To be able to use the UT1 time for more precise sidereal time, manually entered DUT1 correction is necessary regularly update.

Inaccuracies of the mount are corrected using these steps:

1. Measuring the inaccuracies

The user has to create a measurement database. It is accomplished by pointing the telescope to stars, fixing the telescope to the reference point of the camera and storing the actual difference in to text file. Both Main and Reverse positions should be used, but they will result in only one set of coefficients. To speed up data collection, part of the delivery is a star database, which includes uniformly selected stars of equal magnitude with the lowest amount of neighbourhood stars. There is also a screen where the user can enter the X/Y coordinates of the measured star on the CCD camera and the control system computes the required correction.

2. Computation of the coefficients

The next step is the computation of the coefficients, using the command line program TeleModel. It uses the least square fit of the measured data to compute the values of the coefficients. User can choose a text file with measured data and a set of computed coefficients. Selection of the coefficients is important for the correct and effective computation.

3. Transfer coefficient values into the control system

The next step is simple - the user fills in the parameter screen with computed coefficient values. It is possible to use 5 sets of parameters. The selection can be done by “1-5 Selection index” buttons. During obtaining the coefficients all other corrections must be switched on.

4. Test of the model

The last step should prove the validity of the data. The method is the same as step 1, but the necessary correction to reach the reference point of the camera should be in the expected range of the model.

There is possible to merge data from different measurements, but all conditions must be the same! Even a small change of the full optical or mechanical part disallows data merging.

The different measurement and coefficients computation has to be done for different optical configurations of the telescope. It is also common that different optical configurations have a different set of coefficients, not only different values.

It is suitable to perform the preliminary setting of the error model at the first step so that the deviations are measured for twenty objects only and the error model is used with these preliminary coefficients. The entire process is then repeated, as described in the preceding paragraph, with the preliminary error model turned on.

The following terms could be currently used:

1. Shift of the zero position in Azimuth axis, IA
2. Shift of the zero position in Altitude axis, IE
3. Nonperpendicularity between Azimuth and Altitude, NPAE
4. Colimation error, CA
5. Shift of the Azimuth axis towards North, AN
6. Shift of the Azimuth axis towards West, AW
7. Tube flexure, TFAA

Name	Azimuth axis influence	Altitude axis influence
IA	IA	0
IE	0	IE
NPAE	tan(alt)	0
CA	1/cos(alt)	0
AN	sin(az)*tan(alt)	cos(az)
AW	cos(az)*tan(alt)	cos(az)
TFAA	0	cos(alt)

5.5.2 The procedure for calculating the coefficients

5.5.2.1 Step 1 - Measuring of the inaccuracies, collecting data

The coordinates can be entered manually on the screen **CONTROL,** or the selected objects can be loaded from a text file, prepared in advance. The pathname of the file can be entered in the correction model window, usually c:\model\stars.dat

The line data format:

The first six characters represent the identification number

RA (hours, minutes, seconds, degrees, arc minutes, arc seconds)

Dec

RA proper motions (seconds and arc seconds per year)

Dec proper motions

Equinox

The file is terminated by the word "END".

Example:

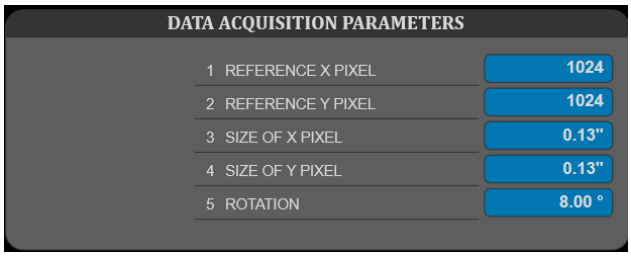
000001 01 33 13.030 -79 55 35.70 +.0126 +.011 2000.0

END

The procedure for data acquisition is following:

1. Switch the telescope to **STOPPED** mode.

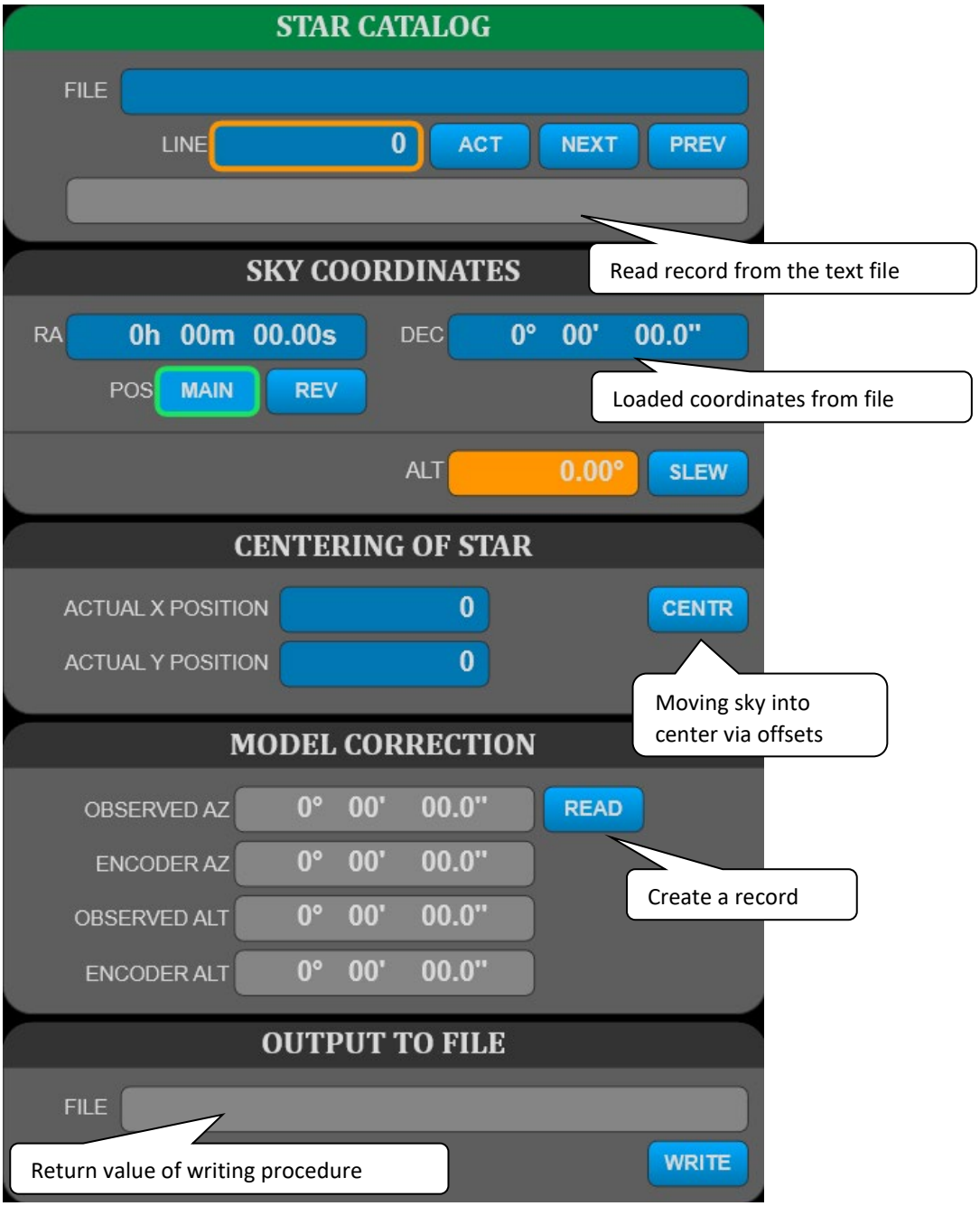
   Check or update the **DUT1** parameter value. This value can be obtained in IERS BULLETIN - A, for example here: https://www.iers.org/IERS/EN/Publications/Bulletins/bulletins.html, section Latest Version, column UT1-UTC, the value from the most recent date. The value can be also negative. Check also data acquisition parameters (on the parameter screen) for fast centring of the star.



2. Select the position of the telescope

3. Reset user offsets

4. Open the Data acquisition window (wrench button on Pointing model panel or DATA ACQ button on Pointing model screen)



- Enter the path to the file with the TeleModel database of stars.
- Start with line 1 (enter 1 into the column LINE).
- To read data from the selected line click the ACT button.
- To read data from the next line click the NEXT button. The line number will increase automatically.
- If the line is read successfully (green OK) then the coordinates and epoch of the star are transferred to Sky coordinates.
- If the coordinates of the star are above the horizon (ELEV. is not yellow) and are not covered by the shutter, click on the SLEW button.
- If the telescope is at the desired position, exposure.
- Align the camera using the derotator offset and select the RA/DEC user offsets mode.
- If the star is not at the reference pixel, enter the actual pixel position to the CENTERING OF STAR area and click on the button CENTR. Calculated corrections will be added to actual User corrections and the telescope will immediately change its position. Another possibility is to manually enter the desired correction into CORRECTION values or movement of the telescope using T3 speed and correction mode of the movement.
- Exposure an image.
- Repeat this procedure until the actual position of the star will correspond with the reference pixel. Sufficient accuracy is reached when the star is closer than approximately 1-2 arcs to the reference pixel.
- If the actual position of the star corresponds with the reference pixel click the READ button.
- If you have a centred sky and observed and encoder coordinates were read click WRITE to write data to the output file. The name of the file is generated automatically in the format model_YYYY_MM_DD.dat. Check if data were successfully written to the file.
- Repeat this procedure by pressing the button READ NEXT until all visible stars from the database are measured

Repeat the whole procedure (using the same stars) for the reverse position of the telescope

5.5.2.2 Step 2 - Computation of the coefficients

Command line program TeleModel.exe should be used for coefficients computation. Its first parameter is the name of the text file with measured data, next parameters are coefficient names to compute.

The result is split into two parts. The first part shows the measured data with the following columns:

AZ	Azimuth axis angle of a measured star
ALT	Altitude axis angle of a measured star
Input d_az	Measured difference in azimuth axis
Input d_alt	Measured difference in altitude axis
Input sqr	Total measured difference (magnitude of the error)
Result d_az	Resulted difference in azimuth axis
Result d_alt	Resulted difference in altitude axis

Result sqr Total result difference (the expected remaining error)

The second part includes coefficients:

Input RMS Root mean square of input data

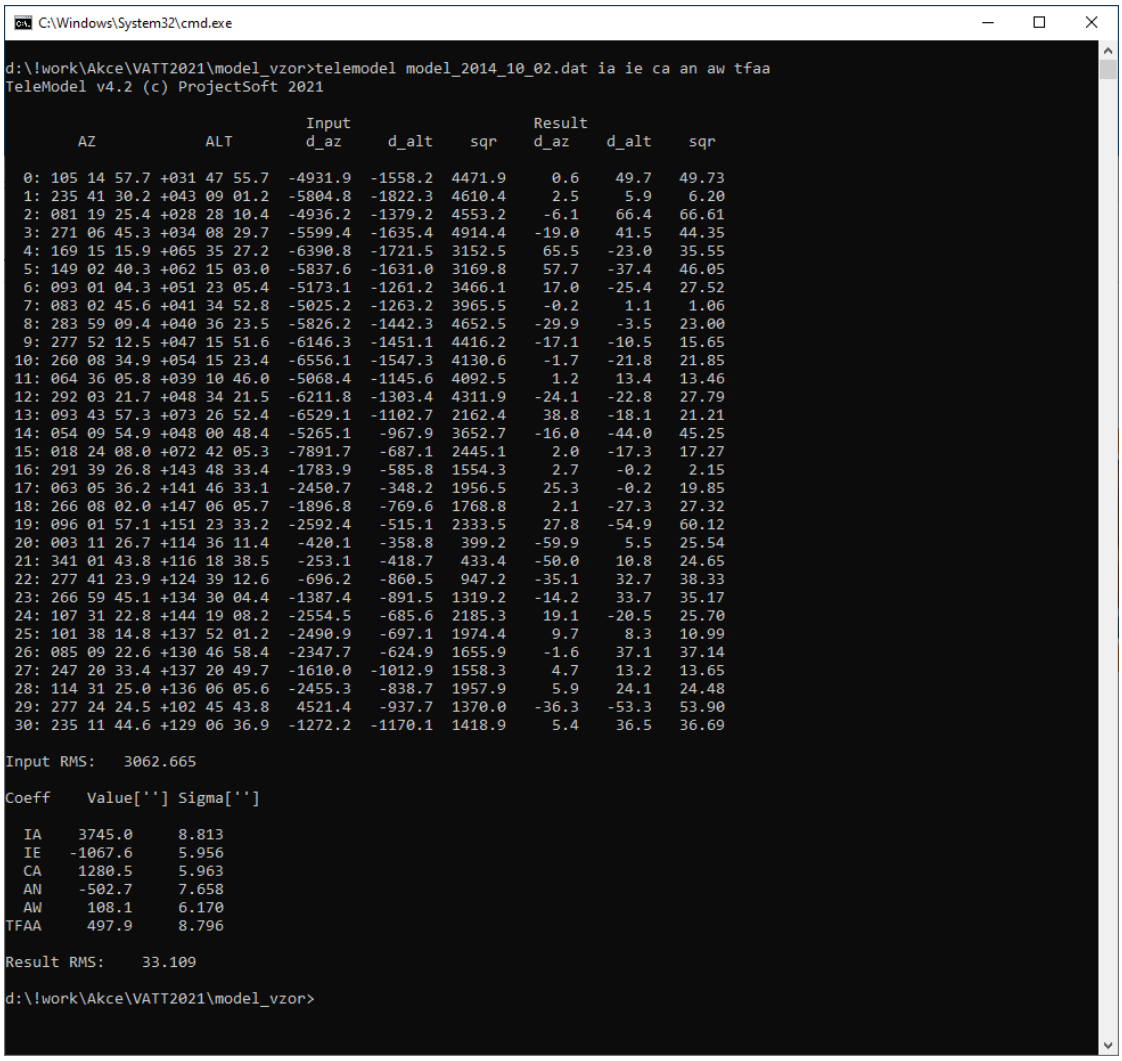
Coeff Coefficient name

Value Computed coefficient value

Sigma Deviation of coefficient value

Result RMS Root mean square of resulted remaining error

Example:



```
C:\Windows\System32\cmd.exe

d:\!work\Akce\VATT2021\model_vzor>telemodel model_2014_10_02.dat ia ie ca an aw tfaa
TeleModel v4.2 (c) ProjectSoft 2021

                                  Input                    Result
        AZ            ALT         d_az     d_alt    sqr     d_az    d_alt    sqr

  0: 105 14 57.7 +031 47 55.7  -4931.9  -1558.2  4471.9     0.6    49.7   49.73
  1: 235 41 30.2 +043 09 01.2  -5804.8  -1822.3  4610.4     2.5     5.9    6.20
  2: 081 19 25.4 +028 28 10.4  -4936.2  -1379.2  4553.2    -6.1    66.4   66.61
  3: 271 06 45.3 +034 08 29.7  -5599.4  -1635.4  4914.4   -19.0    41.5   44.35
  4: 169 15 15.9 +065 35 27.2  -6390.8  -1721.5  3152.5    65.5   -23.0   35.55
  5: 149 02 40.3 +062 15 03.0  -5837.6  -1631.0  3169.8    57.7   -37.4   46.05
  6: 093 01 04.3 +051 23 05.4  -5173.1  -1261.2  3466.1    17.0   -25.4   27.52
  7: 083 02 45.6 +041 34 52.8  -5025.2  -1263.2  3965.5    -0.2     1.1    1.06
  8: 283 59 09.4 +040 36 23.5  -5826.2  -1442.3  4652.5   -29.9    -3.5   23.00
  9: 277 52 12.5 +047 15 51.6  -6146.3  -1451.1  4416.2   -17.1   -10.5   15.65
 10: 260 08 34.9 +054 15 23.4  -6556.1  -1547.3  4130.6    -1.7   -21.8   21.85
 11: 064 36 05.8 +039 10 46.0  -5068.4  -1145.6  4092.5     1.2    13.4   13.46
 12: 292 03 21.7 +048 34 21.5  -6211.8  -1303.4  4311.9   -24.1   -22.8   27.79
 13: 093 43 57.3 +073 26 52.4  -6529.1  -1102.7  2162.4    38.8   -18.1   21.21
 14: 054 09 54.9 +048 00 48.4  -5265.1   -967.9  3652.7   -16.0   -44.0   45.25
 15: 018 24 08.0 +072 42 05.3  -7891.7   -687.1  2445.1     2.0   -17.3   17.27
 16: 291 39 26.8 +143 48 33.4  -1783.9   -585.8  1554.3     2.7    -0.2    2.15
 17: 063 05 36.2 +141 46 33.1  -2450.7   -348.2  1956.5    25.3    -0.2   19.85
 18: 266 08 02.0 +147 06 05.7  -1896.8   -769.6  1768.8     2.1   -27.3   27.32
 19: 096 01 57.1 +151 23 33.2  -2592.4   -515.1  2333.5    27.8   -54.9   60.12
 20: 003 11 26.7 +114 36 11.4   -420.1   -358.8   399.2   -59.9     5.5   25.54
 21: 341 01 43.8 +116 18 38.5   -253.1   -418.7   433.4   -50.0    10.8   24.65
 22: 277 41 23.9 +124 39 12.6   -696.2   -860.5   947.2   -35.1    32.7   38.33
 23: 266 59 45.1 +134 30 04.4  -1387.4   -891.5  1319.2   -14.2    33.7   35.17
 24: 107 31 22.8 +144 19 08.2  -2554.5   -685.6  2185.3    19.1   -20.5   25.70
 25: 101 38 14.8 +137 52 01.2  -2490.9   -697.1  1974.4     9.7     8.3   10.99
 26: 085 09 22.6 +130 46 58.4  -2347.7   -624.9  1655.9    -1.6    37.1   37.14
 27: 247 20 33.4 +137 20 49.7  -1610.0  -1012.9  1558.3     4.7    13.2   13.65
 28: 114 31 25.0 +136 06 05.6  -2455.3   -838.7  1957.9     5.9    24.1   24.48
 29: 277 24 24.5 +102 45 43.8   4521.4   -937.7  1370.0   -36.3   -53.3   53.90
 30: 235 11 44.6 +129 06 36.9  -1272.2  -1170.1  1418.9     5.4    36.5   36.69

Input RMS:   3062.665

Coeff    Value[''] Sigma['']

  IA    3745.0     8.813
  IE   -1067.6     5.956
  CA    1280.5     5.963
  AN    -502.7     7.658
  AW     108.1     6.170
TFAA     497.9     8.796

Result RMS:    33.109

d:\!work\Akce\VATT2021\model_vzor>
```

5.5.2.3 Step 3 – Transfer coefficient values into the control system

The resulted values should be then typed into corresponding boxes on the parameter screen. Unused coefficients have to be zeroed.

5.5.2.4 Step 4 – Test of the model

The last step should prove the validity of the data. The user should repeat the same method as in the case of collecting data for the model. However, the measured corrections should be approximately in the expected range of the model resulted RMS. The newly created database could be then also used for new computation of the coefficients.

5.6 Derotator

5.6.1 Derotator states

5.6.1.1 DISABLED

The servo drives are disabled, meaning the motors stand still and are not braked.

5.6.1.2 READY

The servo drives are enabled and the motors are held in their current position.

5.6.1.3 SLEW

The derotator is moving to a new position.

5.6.1.4 TRACK

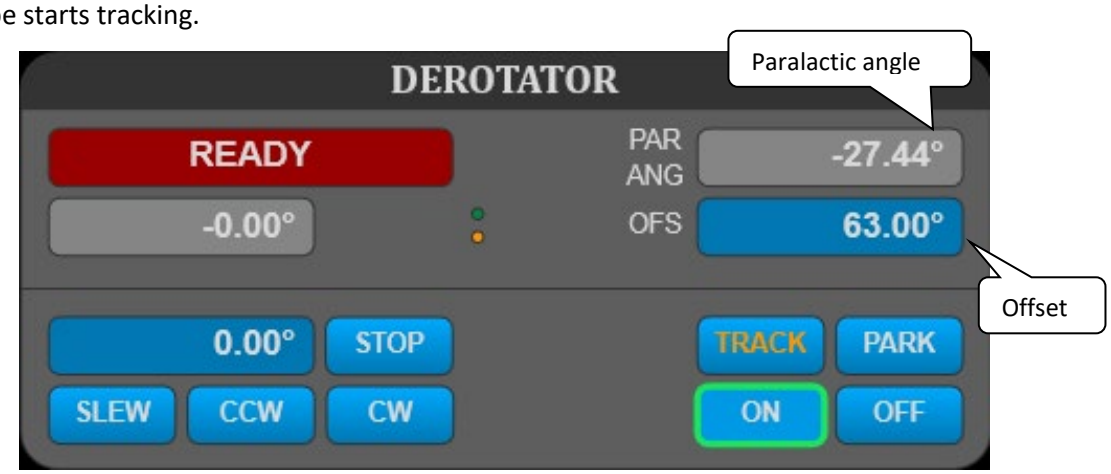
The derotator is tracking the telescope. It rotates to the angle that equals to the sum of paralactic angle and offset.

5.6.1.5 PARK

The derotator is moving to its parking position.

5.6.2 Description of controls

When the derotator is ready, it starts and stops tracking the telescope automatically, when the telescope starts tracking.



SLEW button slews the derotator to the required position.

CCW button moves the derotator counter clock wise.

CW button moves the derotator clock wise.

TRACK button makes the derotator to track the telescope.

PARK moves the derotator to its parking position.

STOP button stops the movement of the derotator.

5.7 Mirror Cover

5.7.1 Mirror cover states

5.7.1.1 STOPPED

The mirror cover is not moving and the position is not defined (the end position signal is not received).

5.7.1.2 OPENING, CLOSING

The mirror cover is opening/closing.

5.7.1.3 OPEN, CLOSED

The mirror cover is open/closed and not moving.

5.7.2 Description of controls

OPEN button starts opening the mirror cover.

CLOSE button starts closing the mirror cover.

STOP button stops mirror cover movement.

5.8 Dome

5.8.1 Dome states

5.8.1.1 DISABLED

The dome is not moving and is ready to receive control signals.

5.8.1.2 MANUAL CW, MANUAL CCW

The dome is moved manually.

5.8.1.3 AUTO

The dome is in automatic movement mode. The slit of the dome follows the telescope's position.

5.8.1.4 AUTO CW, AUTO CCW

The dome is moving automatically to a new position. The slit of the dome follows the telescope with a certain tolerance specified by the parameter.

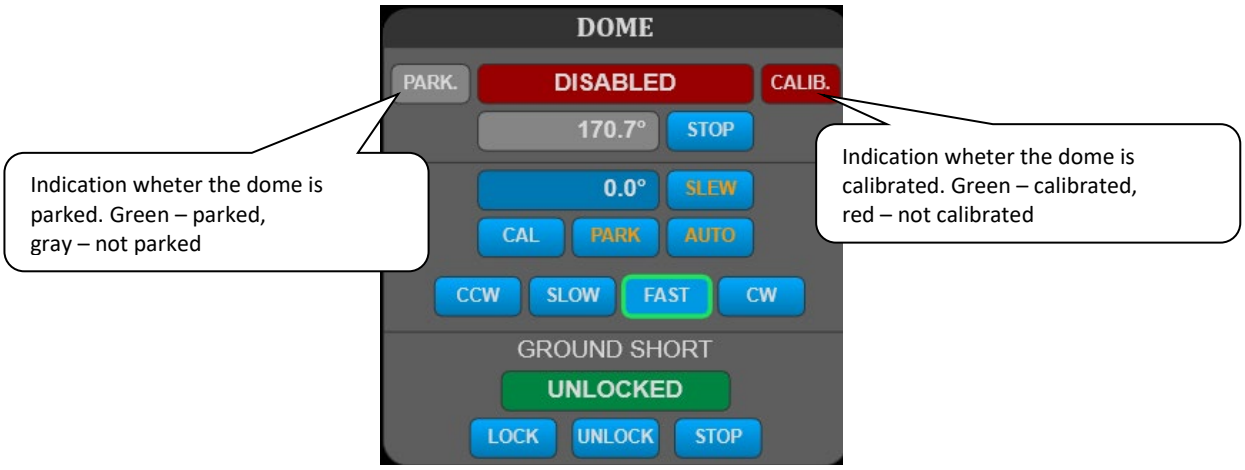
5.8.1.5 SLEW CW, SLEW CCW

The dome is moving to a new position, determined by the azimuth, set by the operator.

5.8.1.6 CALIBRATING

The dome is slewing until it slews over a calibrating sensor.

5.8.2 Description of control



SLEW button starts slewing the dome to the inserted position.

AUTO button turns on the AUTO mode.

PARK button starts slewing the dome to the parking position.

STOP button stops any movement of the dome.

SLOW, FAST buttons select the dome moving speed.

CCW, CW buttons move the dome manually.

Ground short

LOCK button locks the ground short.

UNLOCK button unlocks the ground short.

STOP button stops the movement of the ground short.

5.9 Dome slit

5.9.1 Dome slit states

5.9.1.1 UNKNOWN

The slit is not moving and is not open or closed.

5.9.1.2 OPENING, CLOSING

The slit is opening/closing.

5.9.1.3 OPEN, CLOSED

The slit is fully open/closed and not moving.

5.9.2 Description of control

OPEN button starts opening the slit.

CLOSE button starts closing the slit.

STOP button stops the movement of the slit.

5.10 Mirror cooling

ON button starts the mirror cooling system and mirror fans.

OFF button stops the mirror cooling system and morror fans.

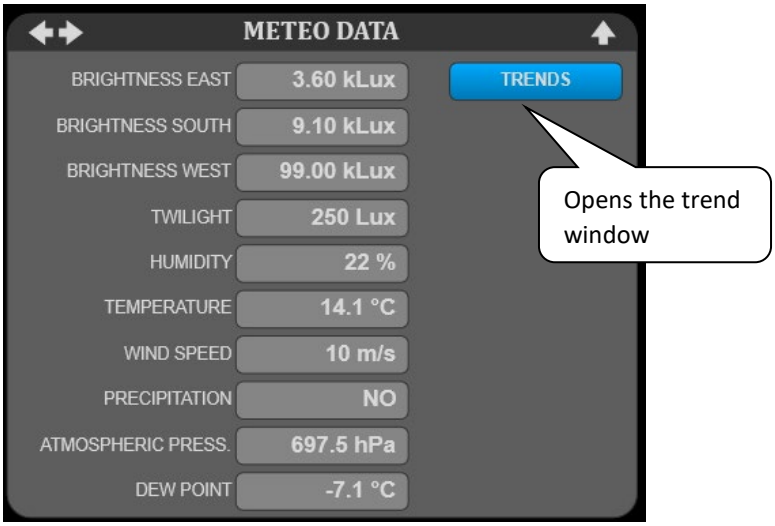
FIXED SETPOINT button selects the mode where the temperature setpoint is entered by user.

FOLLOW AMBIENT button selects the mode where the temperature setpoint equals ambient temperature.

The system checks that the temperature of the cooling fluid is above dew point and the difference between temperature of mirror and temperature of cooling fluid is not too high. The system adjusts the temperature setpoint automatically if it is needed.

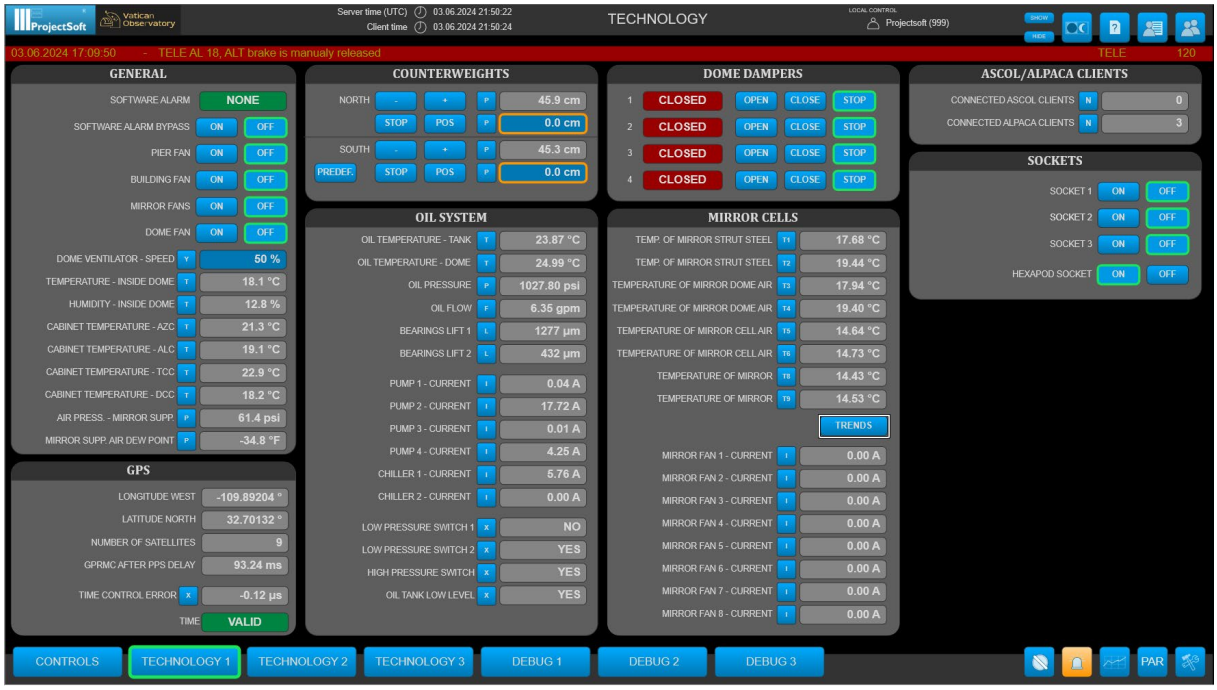
5.11 Meteorological data

Several meteorological values are measured and logged. Their actual values are shown in the Meteo data window.



5.12 TECHNOLOGY SCREEN

This screen is used for a more detailed view of some technology parts or to control less frequently used and less important systems.



5.12.1 Counterweights

POS button moves the counterweight to the desired position.

STOP button stops the counterweight movement.

+/- buttons move the counterweight manually.

5.12.2 Dome dampers

OPEN button starts opening the specific dome damper.

CLOSE button starts closing the specific dome damper.

STOP button stops any movement of the specific dome damper.