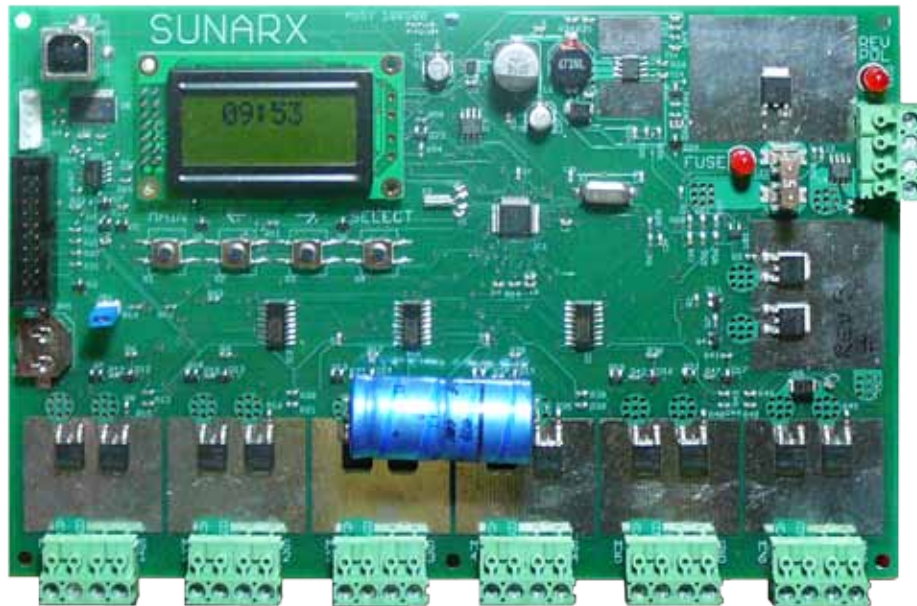


SunArx® C-6 Control Board Owner's Manual

rev. 201004226

applies to C-6 firmware version 1.23



NOTE: Wiring of solar panels and SunArx® power supply should only be done by qualified personnel.

Contents

Features	2
Installation	3
Quick Start	5
User Interface	7
Flow Chart	11
Calculating Mean Solar Time	12
Maintenance and Warranty	14

Introduction - SunArx® Tracker Movement Profile

Tracker movements are based on a 24 hour clock built into the C-6. Clock time is displayed in 24 hour “military” time, and the clock needs to be set to the local mean solar time, with 12:00 being noon, when the sun is directly to the South.

- At night, the trackers are in the mid position.
- At 04:00, the tracker will go to the East position. For installations with more than one tracker, the C-6 will move one tracker at a time, in sequence.
- At 09:05, the next tracking movement will occur, with the tracker moving a small amount to the West.
- Every 10 minutes after that another movement to the West will occur.
- At 14:55, the last movement of the day will occur, to the farthest West position.
- At 20:00, the tracker will go back to the night-time, mid position.

C-6 Features and Specifications

- Lithium battery backs up clock time
- Non-volatile memory stores tracker positions for fast recovery after power interruption
- If a battery based power system is used, voltage is monitored for intelligent shutdown before battery failure
- Maintenance mode allows any or all trackers to be parked in the mid position
- C-6 is protected against reverse polarity
- Weatherproof enclosure includes disconnect and fuse
- The following actuator errors are displayed if they occur
 1. OP Open - no motor connected or limit switch problem
 2. SH Short Circuit
 3. ST Stall - Excessive current during start of movement
 4. OC Overcurrent - Excessive current after movement starts
 5. SW Switch - sensor in the actuator is not working
- Max and Min temperature and supply voltage are stored and can be seen via menu
- Operating Temperature Range -25C to +85C
- Self consumption 70mA @ 24VDC, 50Wh per day (single tracker)
- Peak Load 1 amp @ 120VAC
- Operating voltage of C-6, actuator motor, and sensor 24VDC
- Power Supply 100W UL Class 2 double insulated or battery

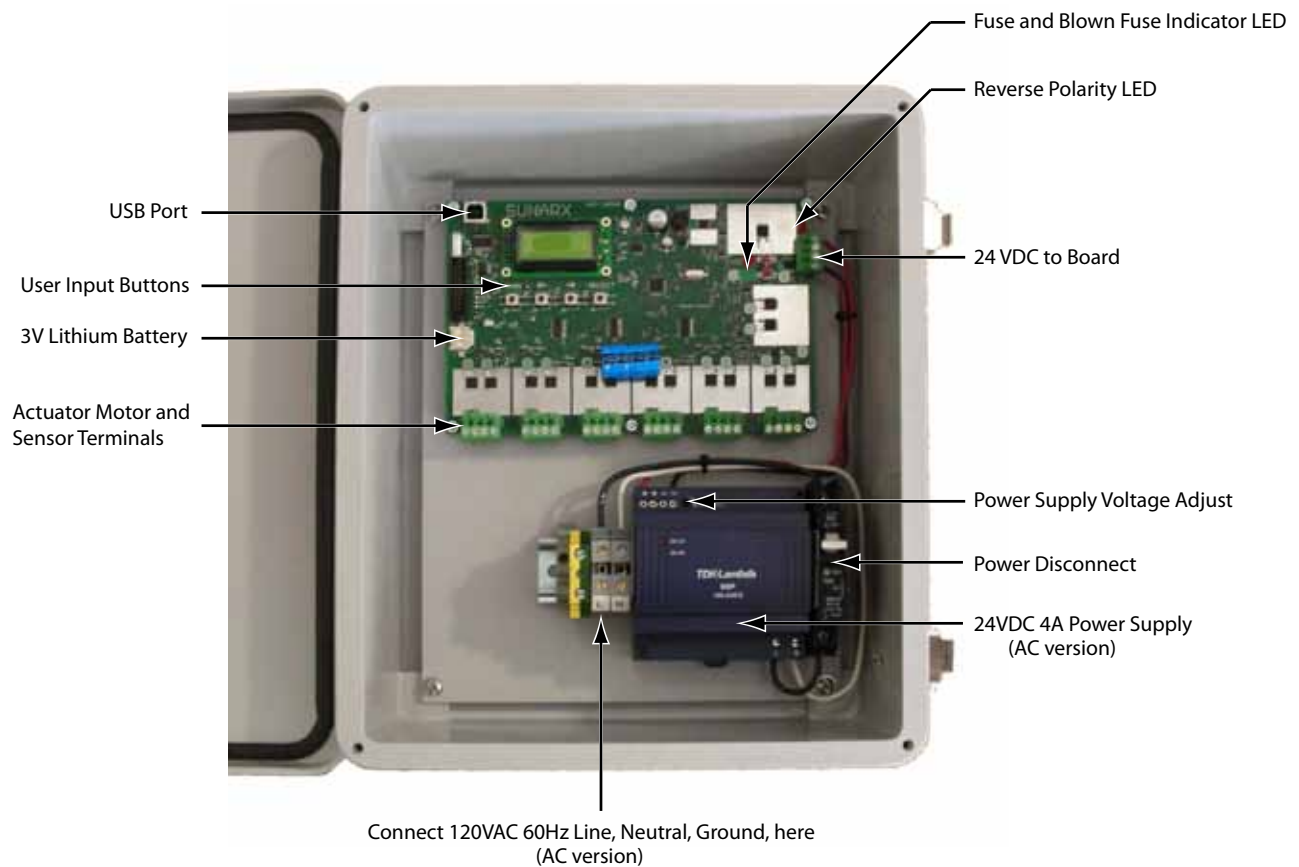


Fig. 1 Overview of C-6 Control Board with AC version power supply. DC version is similar except there is no power supply.

- Mount the C-6 enclosure where desired. 2 stainless steel straps are provided to mount the enclosure to a 6" pole. If using 14/4 actuator hookup wire, the maximum wire distance from the C-6 to an actuator is 150'.
- Complete the wiring to the actuators according to Figs. 2, 3, and 4. The recommended wire for actuator hookup is Olflex TC 14/4. The advantages of this wire include small overall diameter, fine stranding for flexibility, sunlight resistance, and ability to be direct buried.
- **Note** - Polarity of motor connections is important for correct operation. Polarity of *sensor* connections does not matter. Make sure to avoid connecting motor or power wires to sensor terminals in the actuator or the sensor will be damaged. Note the terms *sensor*, *reed sensor*, and *reed switch*, are used interchangeably and should not be confused with the *limit switches* which are also inside the actuator.
- **Note** - Make sure wiring in the actuator does not interfere with limit switch operation, note especially the brass plunger which extends into the area of the terminal block.
- Connect an appropriate power circuit to the terminal blocks in the C-6 enclosure. For 120VAC version, maximum power draw is 1 amp. The Power Supply V adjust should be adjusted at the factory to maximum so it operates around 24VDC. It can be changed with a very small philips screwdriver if necessary.
- Grounding the green and yellow terminal block on one side is sufficient grounding for the C-6. The power supply and circuit board have no additional ground connections.

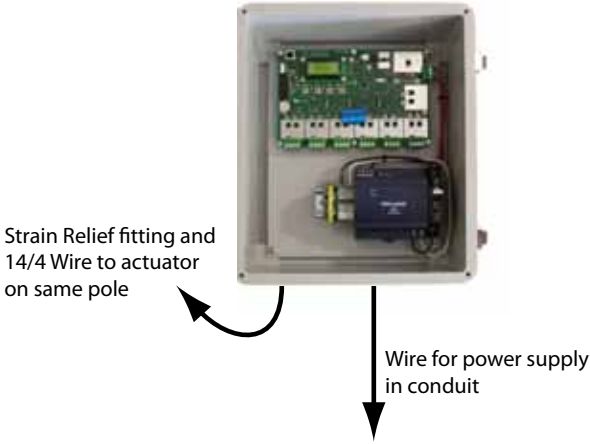


Fig. 2 Wiring to control box for single tracker.

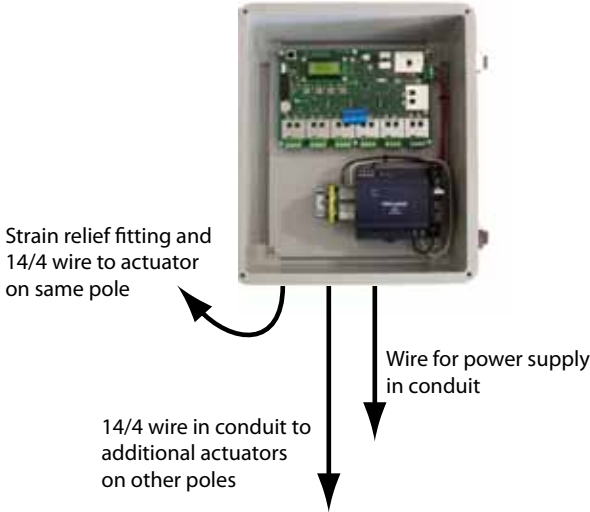


Fig. 3 Wiring to control box for multiple trackers. It is also possible to locate the control box remotely from the trackers.

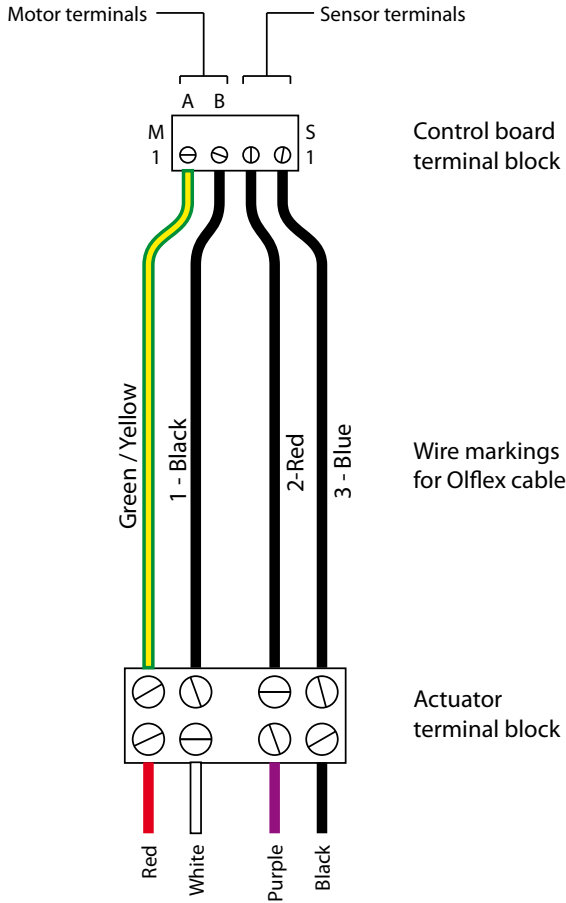


Fig. 4 Schematic of actuator motor and sensor connections.

System Startup

When all connections are complete and any obstructions are removed from the vicinity of the trackers, the system may be commissioned. Double check the actuator wiring and all mechanical connections on the trackers. All settings made during startup may be changed later so it is not necessary to set the time precisely now. It is also possible to start the system with any combination of actuators enabled, and enable additional actuators at any time.

The 4 buttons under the display are used to navigate the user interface:

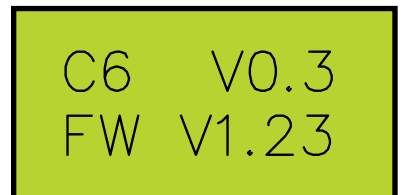
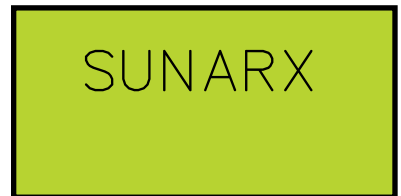
[MAIN] - Return to the main screen

[←] - Left arrow - move left or up in the menu, or move the cursor to the left.

[→] - Right arrow - move right or down in the menu, or move the cursor to the right.

[SELECT] - Enter a subscreen, or confirm a setting is correct.

1. Apply power to the control board, usually by turning on the circuit breaker in the control box.
2. The startup screen will be displayed, then after a few seconds the version number screen will be displayed, showing the hardware and firmware revision numbers.



3. After a few seconds, the "New Job" screen will be displayed. Press [→] to move the cursor under Y, then press [SELECT]. This clears all memory except clock time. This clears errors, maintenance mode settings, and enabled motors. If you do not select YES within 15 seconds, this will default to NO and assume the information in memory is correct. Leaving this set to NO could lead to unpredictable results with a brand new installation, so select YES the first time you start the system.



4. After New Job is selected, the SET TIME screen will appear. The time will be flashing, indicating you can adjust it. The time should be set to mean solar time, which you can enter if you have previously calculated it. For initial startup you can also use your local clock time, which will be close enough to get the system up and running. Use the [←] key to increase the hours, use the [→] key to increase the minutes. 24 hour military style time is used. After sensing no input for 15 seconds, the displayed time will be saved and the next screen will appear. You can also hit select to go to the next screen.



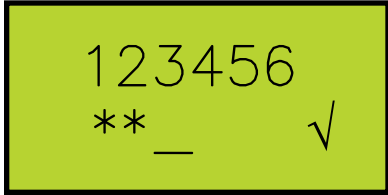
SET TIME
13:15

5. The ENABLE MOTORS screen will appear for a few seconds...



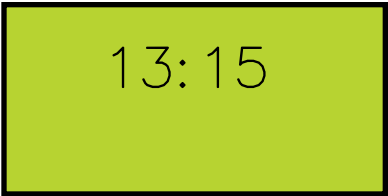
ENABLE
MOTORS

6. Followed by the Enable Motors input screen. Use the [←] and [→] keys to move the cursor under a motor you want to enable, then press [SELECT] to place a star under that motor. When you have starred all the motors you want to enable, use the [→] key to place the cursor under the check mark, and press [SELECT].



123456
** _ ✓

7. The normal main screen will appear, showing the time, and any errors. Depending on the number of motors and their positions, the control board may seem to do nothing for a few seconds while it checks the motors and sensors. Soon, the first actuator will retract to the West position to index it, followed by the other active actuators, one at a time. Then, the first actuator will move to the correct position based on the time, followed by the other active actuators, one at a time. The system is now in normal operation. If there are any errors they will be displayed under the time in the form of a flashing MOTOR X message, where X is the channel causing the error. The specific error may be seen via the STATUS menu, described below.



13:15

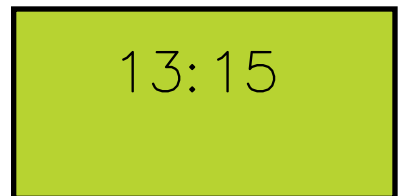
User Interface

Including the MAIN screen, there are 7 main menu screens which can be accessed using the [←] and [→] buttons:

1. MAIN - default screen, shows time and any motor errors
2. STATUS - accesses set of screens showing max and min temp and voltages and error details. The sub-screens allow resetting temp and voltage log and clearing motor errors
3. MAINTAIN - allows parking trackers in center position
4. SET TIME - allows adjusting the time
5. ENABLED - allows enabling or disabling motors
6. TEMP SET - allows choosing Celcius or Fahrenheit for display
7. RESTART - allows restarting the board

More details on each screen are provided below. If no button is pressed for 15 seconds the display will revert to the main screen. Or if at a subscreen, the display will revert to the parent screen.

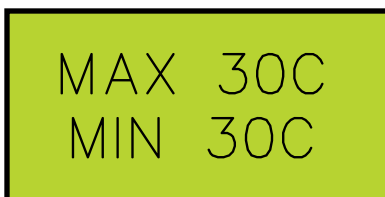
MAIN SCREEN - Normally shows only the time. If there are any motor errors they will be displayed alternating with the time. To see detail on motor errors or other status information, use the [→] to go to the STATUS screen. The main screen will also show a Low Volts message alternating with the time if a low voltage condition exists (supply voltage less than 21V).



STATUS SCREEN - Displays system information. Press [SELECT] to access subscreens or press [→] to go to the MAINTAIN screen.



Status subscreens:



Max/Min Temperature since last time memory was cleared. Press [→] to go to the next screen or press [SELECT] to reset the log.



Max/Min Voltage since last time memory was cleared. Press [→] to go to the next screen or press [SELECT] to reset the log.

Status subscreens, cont'd:



• • •



Motor Error. There are 6 of these screens, one for each motor. If there is a motor error it will be detailed on the second line of the display:

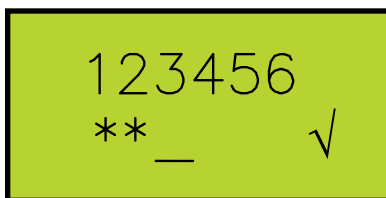
1. OP Open - no motor connected or limit switch problem
2. SH Short Circuit
3. ST Stall - Excessive current during start of movement
4. OC Overcurrent - Excessive current after movement starts
5. SW Switch - sensor in the actuator is not working

Investigate the source of the error. Press [SELECT] to clear the error or press [→] to go to the next screen.

MAINTAIN SCREEN - Allows parking active motors in middle position. Also shows any motors currently in Maintenance mode. Press [SELECT] to access subscreen or press [→] to go to the SET TIME screen.



Maintain subscreen:

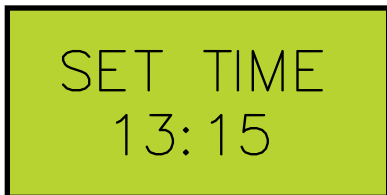


Use the [←] and [→] keys to move the cursor under a motor you want to park, then press [SELECT] to place a star under that motor. When you have starred all the motors you want to park, use the [→] key to place the cursor under the check mark, and press [SELECT].

SET TIME SCREEN - Allows changing the time. Press [SELECT] to access subscreen or press [→] to go to the ENABLED screen.



Set Time subscreen:

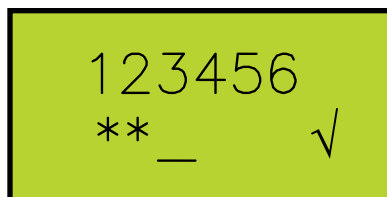


Use the [←] button to increase the hours and the [→] button to increase the minutes. Press [SELECT] when time is set as desired. See "How to Calculate your Mean Solar Time", below, or simply adjust until the tracker is pointed at the sun.

ENABLED SCREEN - Displays and allows changing which motors are active. Press [SELECT] to access subscreen or press [→] to go to the DEGREES screen.



Enabled subscreen:



Use the [←] and [→] keys to move the cursor under a motor you want to enable or disable, then press [SELECT] to place a star under that motor or to clear the star if disabling. When you have starred all the motors you want to enable, use the [→] key to place the cursor under the check mark, and press [SELECT].

New motors may be enabled without restarting the system. A new enabled motor will first go to the retracted position, then to the correct position based on the time.

Disabling and Re-enabling will also clear memory and errors for a motor.

TEMP SET SCREEN - Allows changing temperature display format. Press [SELECT] to access subscreen or press [→] to go to the RESTART screen.



Temp Set subscreen:



Use the [←] and [→] buttons to select fahrenheit or celcius degrees for temperature display. Press [SELECT] when set as desired.

RESTART SCREEN - Allows a restart of the control board. Press [SELECT] to access subscreen or press [→] to go to the STATUS screen. Restarting the control board has the same effect as power cycling the board. Restarting will bring up the same sequence of startup screens as described above in the Quick Start section. No settings or memory will be changed unless changed during the startup sequence. This default behavior also happens after power supply to the board is interrupted.

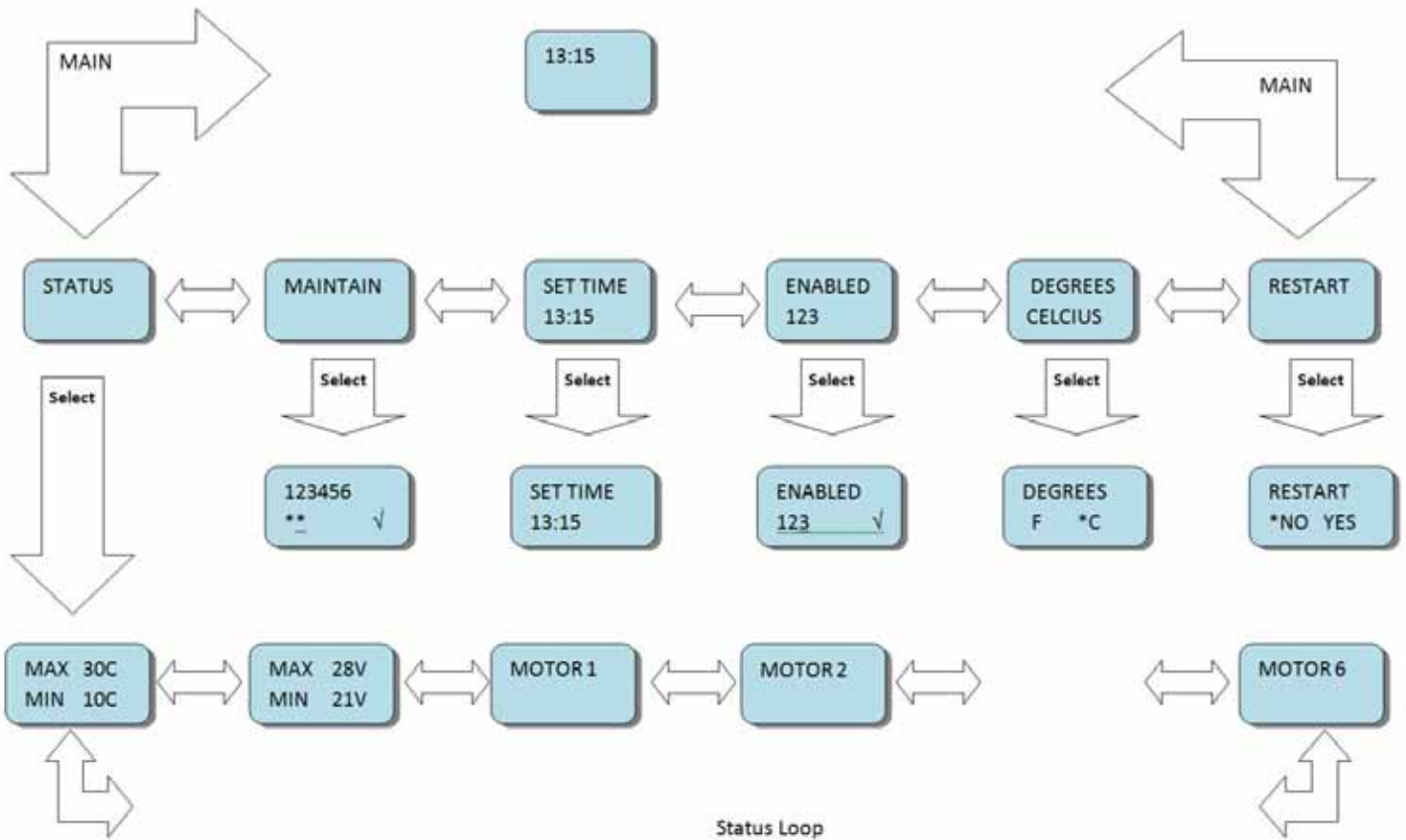


Restart subscreen:



Use the [←] and [→] buttons to move the star to your choice and press [SELECT] when set as desired.

Menu Flowchart



Support

Current Documentation:
www.sunarx.com/downloads.html

Technical Support
 email: info@sunarx.com
 phone: 970-984-3750
 forum: www.sunarx.com/forum

Determine your local mean solar time in a 24-hour format

“Solar Time” refers to a time system which is based on the position of the sun in the sky at a particular location. Noon solar time is when the sun is highest in the sky and due South (for the Northern hemisphere). Solar time varies from local clock time due to a location’s position in the time zone and daylight savings time. To set the C-6 to mean solar time, we need to correct for these factors. The instructions below explain how to calculate the difference between mean solar time and actual clock time in your location, so the C-6 can be set for clock time plus or minus this difference. It is not absolutely necessary to do the calculations; it also works well to simply adjust the C-6 clock until the solar panels point toward the sun (don’t look into the sun). As an aside, there is also some seasonal variation in solar time which we do not correct for; see Fig. 5.

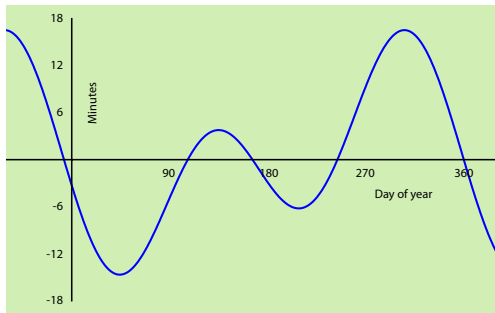


Fig. 5 The equation of time describes the difference between solar time at different times of year and mean solar time. The maximum error is a few degrees and does not significantly affect solar panel output.

1. Determine your time in local standard time:
 - A. If you are in Daylight Savings Time¹, subtract one hour from the local time.
 - B. If you are in Standard Time², use the local time.
2. Convert the local standard time to a 24-hour format:
 - A. The 24-hour format uses four digits to avoid duplication between AM and PM
 - B. Midnight (12:00 AM) is 00:00; noon (12:00 PM) is 12:00.
 - C. Between midnight and 12:59 AM, use “00” for the hour (i.e., 12:30 AM is 00:30).
 - D. Between 1:00 AM and 9:59 AM, add a “0” before the hour (i.e., 7:30 AM is 07:30).
 - E. Between 10:00 AM and 12:59 PM, use the time itself (i.e., 10:30 AM is 10:30 and 12:30 PM is 12:30).
 - F. Between 1:00 PM and 11:39 PM, add “12” to the hour (1:30 PM is 13:30 and 11:30 PM is 23:30).
3. Determine your longitude (in decimal format, in Degrees West):
 - A. One method is to use Google Maps (<http://maps.google.com>), and right click on your location, and select “What’s here?”. Latitude and Longitude will then be displayed in the search box. A portable GPS may also be used.
 - B. Degrees West may be displayed as a negative number; for this calculation make this a positive number.

¹ Daylight Saving Time begins each year at 2 a.m. on the second Sunday of March, when people “spring forward” one hour to start Daylight Saving Time.

² Standard Time begins each year at 2 a.m. on the first Sunday of November when people “fall back” one hour to resume Standard Time.

Calculating Mean Solar Time

4. Determine the longitude of your standard meridian (the center of your time zone):
 - A. Atlantic Time Zone – 60°W
 - B. Eastern Time Zone – 75°W
 - C. Central Time Zone – 90°W
 - D. Mountain Time Zone – 105°W
 - E. Pacific Time Zone – 120°W
 - F. Alaskan Time Zone - 135°W
 - G. Pacific Time Zone - 150°W
5. Calculate your “Degrees Offset” by subtracting your longitude from your standard meridian:
 - A. If your longitude is greater than your standard meridian, this will be a negative number. This means you are west of the center of your time zone, and the solar mean time you will calculate next will be earlier than the local standard time.
 - B. If your longitude is less than your standard meridian, this will be a positive number, meaning you are east of the center of your time zone, and the solar mean time you will calculate next will be later than the local standard time.
6. Calculate your “Time Offset” (in minutes) by multiplying the “Degrees Offset” (in degrees) by four (4).
 - A. Round the Time Offset up or down as appropriate to the nearest whole minute.
7. Calculate your local mean solar time:
 - A. If your Degrees Offset is positive, add the Time Offset to clock time to get mean solar time.
 - B. If your Degrees Offset is negative, subtract the Time Offset from clock time to get mean solar time.

Example 1: Calculate the Time Offset for a tracker in Chicago, IL at 2:20 in the afternoon in the summer:

1. Since it is summer, Chicago is in Daylight Savings Time so an hour is subtracted to get the Standard Time of 1:20, which is 13:20 in the 24-hour format.
2. The site longitude is 87.62°W.
3. As Chicago is in the Central Time Zone, the standard meridian is 90.00°W.
4. Subtracting the site longitude from the standard meridian yields a Degrees Offset of +2.38°.
5. Multiplying the Degrees Offset by four yields a Time Offset of +9.52 minutes, which is rounded up to +10 minutes.
6. Since the Time Offset is positive, it is added to the local standard time to get the local mean solar time of 13:30.

Example 2: Calculate the Time Offset for a tracker in New Castle, CO at 2:20 in the afternoon in the summer:

1. Since it is summer, New Castle is in Daylight Savings Time so an hour is subtracted to get the Standard Time of 1:20, which is 13:20 in the 24-hour format.
2. The site longitude is 107.55°W.
3. As New Castle is in the Mountain Time Zone, the standard meridian is 105.00°W.
4. Subtracting the site longitude from the standard meridian yields a Degrees Offset of -2.55°.
5. Multiplying the Degrees Offset by four yields a Time Offset of -10.20 minutes, which is rounded down to -10 minutes.
6. Since the Time Offset is negative, it is subtracted from the local standard time to get the local mean solar time of 13:10.

Battery Mode vs. AC Power Supply Mode

Upon startup the C-6 will assume it is running on an AC power supply. However if the supply voltage ever rises to 26.5V it will then assume it is running on a solar powered battery supply from then on. There is no display indication that the C-6 is in battery mode. If in battery mode, when a low volts condition (21V) occurs the C-6 will move all trackers to the middle position and leave them there until the voltage rises again to 26.5V, to allow the batteries to recover. At that time it will resume normal operation.

Maintenance

There is a 3V Lithium button-style battery on the control board to maintain settings during power outages. This battery should be replaced upon failure or every 10 years with type CR1220 CR1224 or CR1225. Failure is indicated if the control board loses power and does not retain the time or actuator position when power is restored.

SunArx® 10-Year Limited Warranty

SunArx® warrants to the original purchaser that the C-6 control board shall be free from defects in materials and workmanship for a period of ten (10) years from the date of purchase. SunArx® will repair, or replace at their option, any C-6 that is determined to be defective in material or workmanship under the following terms:

- The C-6 must have been installed in accordance with the installation instructions, including any electrical connections.
- The defective item must be received by SunArx® no later than one (1) week after the end of the warranty period.
- Return shipping is to be pre-paid by the original purchaser.
- The C-6 and/or its components must not be modified or altered in any way from original state unless modifications are made by an authorized source or have been previously authorized in writing by SunArx®.

This limited warranty does not cover:

- Accidental or intentional damage.
- Damage due to improper installation.
- Misuse, abuse, corrosion or neglect.
- Damage to product that occurs during its shipment, storage, or installation.
- Solar panels, equipment, materials, or supplies not manufactured by SunArx®.