



INSTALLATION & OPERATING INSTRUCTIONS

SOLAR TRACKER CONTROLLER



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CHAPTER 1: SAFETY INSTRUCTIONS

WARNING: Ignoring the following instructions can cause damage to the equipment or physical injury, or in some cases, death.

1.1 Pre-Installation Safety Measures

1. Before using the unit, read all the instructions and cautionary markings on the unit and all its appropriate sections.
2. The gross weight of the equipment is close to 5 Kg. Kindly lift the device carefully.
3. Please check the condition of the package and look for any sign of damage. Don't use the damaged or incomplete device.
4. Customers are NOT authorized to open the device or try to do any kind of modification, or repair, otherwise there is a danger of shock and loss of warranty.
5. To store the device, kindly follow instructions given in section 1.4.

1.2 Installation Safety Measures

1. Installation should be done in the presence of a professional technician. Safety equipment such as shoes, helmets, and gloves should be used by the technician.
2. Installation of the device should be carried out on a solar structure with proper ground clearance and specified nuts and bolts.
3. Install the device on metal or other non-flammable material, and keep it away from any combustible material.
4. The device should not be installed inside a closed chamber to ensure proper heat dissipation. Ignoring this will result in malfunctioning of the device and loss of warranty.
5. Before starting wiring connections, make sure PV panels, controller, and all other accessories are properly fitted in the designated place.
6. Ensure that the controller's and adjoining equipment are properly earthed to reduce electromagnetic emission and interference.
7. Make sure that earth conductors are adequately sized as required by safety regulations.
8. There must not be any loose connections. Make sure that all insulation are proper in order to prevent any damage/injury. Also, periodically inspect insulation in case of a bad weather.
9. Make sure that the earthing wire is connected with device. The wire diameter should be 4 sq. mm, and the color code is yellow-green or green.
10. Check whether the wiring is correct and firm; there should not be any short circuit in the peripheral equipment's circuit.
11. Ensure that the output of the device is turned off while setting all the required parameters.

12. Ensure that no unauthorized filter is connected to the output of the device. It may cause loss of warranty.
13. No magnetic switch or magnetic contactor should be connected to the output circuit of the device. When a device is in operation with load, magnetic switch or magnetic contactor can falsely trigger the over-current protection function, leading to malfunctioning of the system.
14. Install a suitable Lightning Arrester (LA) and earth it separately.

1.3 Safety during Operation

1. Do not operate or touch the device with wet hands.
2. Do not put any of your belongings like mobile etc. on the device.
3. It is mandatory to disconnect the input power before starting any maintenance work.
4. After the input is disconnected from the device, wait for at least five minutes to allow so as to allow the internal capacitors to get discharged for the safety of operation.
5. Do not conduct any insulation or voltage withstand tests on the device.
6. Untrained workers are banned to check the signals in the running stage.
7. The solar panel and device should be cleaned carefully once in a three months for the proper operation of the device.

1.4 Caution

Measures to be taken for storage:

1. The solar tracker controller should be kept in the shipping carton or crate before installation.
 2. Storage area should be clean, dry, and free from direct sunlight or corrosive fumes.
 3. Storage area has an ambient temperature range of -20 °C to 60 °C.
 4. Storage area has a relative humidity range of 0% to 90% and non-condensing environment.
 5. Storage area has an air pressure range of 85kPa to 107kPa.
- DO NOT store In an area with the rapid change in temperature (condensation and frost may be caused). In a place with lots of water leakage. In a place which has a high risk of fire ignition.

NOTE: If storage of the tracker controller is for more than 3 months, then ensure that temperature should not be more than 30 °C. Storage more than a year may reduce the lifespan of the device.

ATTENTION

1. If there is any abnormality, kindly contact our customer care.
2. Improper wiring and utilization or unauthorized alteration may result in damage to the device or other equipment, users will be responsible for the cause and there will be a loss of warranty.

CHAPTER 2 : INTRODUCTION

2.1 PRODUCT OVERVIEW

Shakti's Solar Tracker Controller is a dual axis solar tracker controller effectively designed, developed, and manufactured in India. It is a tracking system which is used to optimize solar panel positioning by constantly aligning with the sun's direction. This intelligent tracking system relies on the Solar Positioning Algorithm (SPA) to precisely calculate the sun's position based on the geographical location, time, and date, where it tracks the sun's rays, and its position is changed in such a way that the sun's rays are able to remain perpendicular with the solar panel to get the maximum power output. The tracker rotates on the both East-West and North-South axis. This product is designed for global installation with customizable settings for parameters based on location for optimal performance.



Fig. 2.1 Shakti Solar Tracker Controller

2.2 DUAL AXIS TRACKING

Dual-axis tracking significantly increases energy capture by allowing solar panels to follow the sun both horizontally and vertically. This system can boost energy efficiency by up to 40% compared to fixed or single-axis trackers, as it maintains optimal alignment with the sun throughout the day and across seasons. Additionally, dual-axis tracking maximizes power output. Therefore it is an ideal solution for achieving higher efficiency and greater energy yields.

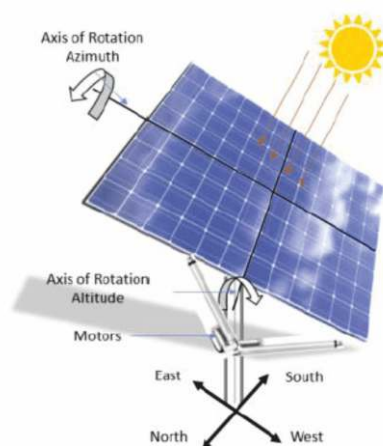
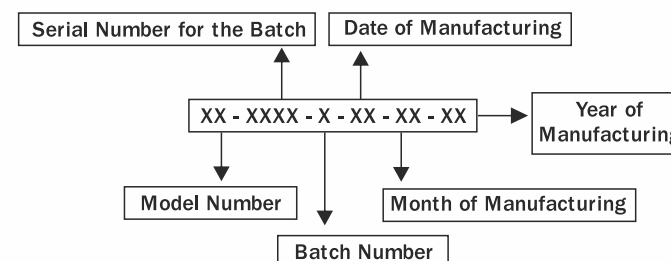


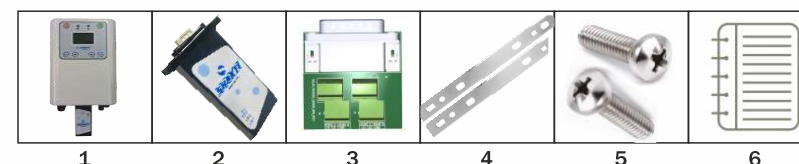
Fig. 2.2 Dual Axis tracking

2.3 RECEIVING AND INSPECTION:

2.3.1 Model Explanation-



2.3.2 Items inside the box-



S.No.	Description	Quantity
1	Shakti Solar Tracker Controller	1
2	Shakti RMS Dongle	1
3	Sensor Board & Cover	1
4	Mounting Clamp	2
5	Pan Head Philips Screw M4x10	6
6	User Manual	1

Table 2.1 Material Description

2.3.3 Output Connection -

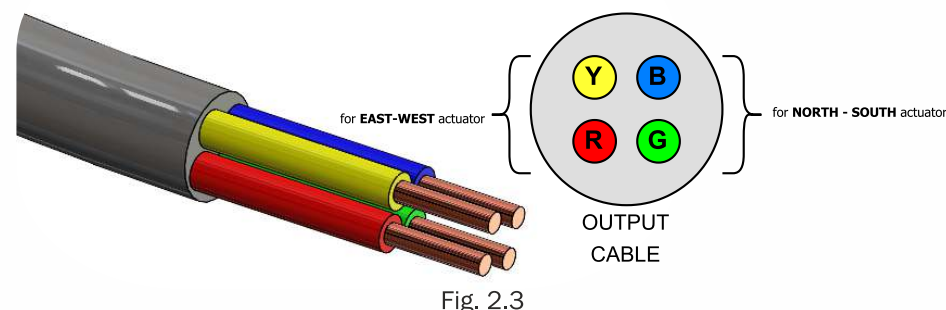


Fig. 2.3

North – South Actuator		East West Actuator	
+ve	-ve	+ve	-ve
Blue	Green	Red	Yellow

Table 2.2

2.3.4 WIFI/GPRS DB9 CONNECTOR

Connect IOT dongle to solar tracker controller via this port for acquiring date and time, which will be utilised in calculating the angles of SPA along with latitude and longitude for effective solar tracking. But if specific parameters are required to be observed, then connect RS232 to USB converter cable and data corresponding to a particular address according to the Modbus Address Table can be accessed.

NOTE: The Pins 1 & 5 of the DB9 Connector are the source pins of 5 V at few milliamperes current. These pins cannot be used as sink even for a single milliampere current.

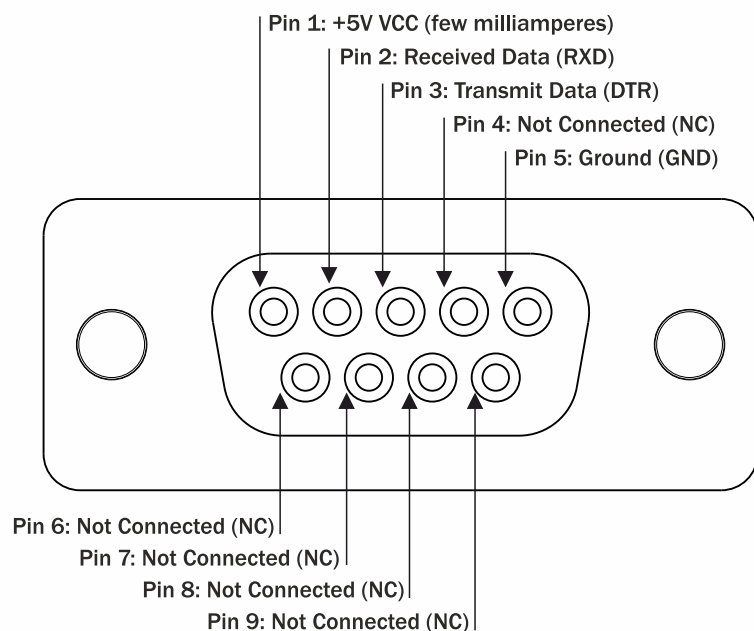
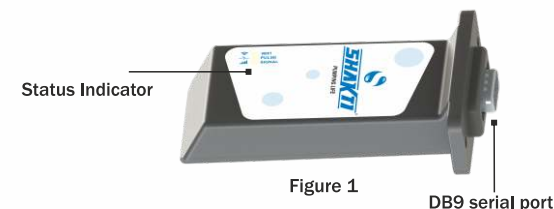


Fig. 2.4 RS232 Connector

2.3.5 SHAKTI RMS/IoT DONGLE

- Remote Monitoring and Control.
- In-built Data Logger & RTC.
- Compatible with GSM, WiFi & Bluetooth.



1. PRODUCT APPEARANCE :

Status Indicator:

Pulse LED (GREEN)	Constant ON/OFF Blink 1time in 2sec Blink in every second Blink 2 times in 1sec Blink 4 times in 1 sec	Abnormal ¹ No Sim detected ² Normal ¹ /No Internet ² Internet connected ² Data transfer in process ²
Signal LED (RED) ¹ GPS (RED) ²	ON Blink in every second OFF	Normal ¹ / GPS location fixed ² Getting GPS location ² Abnormal(Signal low) ¹ / GPS off ²
NETWORK LED (GREEN) ²	Constant ON Constant OFF	4G Connectivity ² 2G Connectivity ²
Wi-Fi LED (YELLOW) ¹	ON/Blink OFF	Normal ¹ No WiFi Network ¹

here 1 and 2 indicates 2G and 4G dongle respectively.

2. INSTALLATION AND CONNECTION:

For installing the SHAKTI IoT dongle.
Follow these steps :

Step1: Remove the cover and take out the motherboard.

Step2:
Insert SIM card as per the correct direction marked.

Step3:
Put the motherboard back into the enclosure.

Step 4:
Insert the dongle into DB9 port and use two M3x10 screws to fix the dongle along with gasket.

3. CONFIGURATION :

Step1: Connect the "Shakti IoT dongle" to the main device and check the "pulse LED" (green) blinking in every second.

Step2: If the sim card is present in the "Shakti lot dongle" and 2G or 4G network is available in that area, the Signal LED (RED)¹ will be ON for 2G dongle and Pulse LED (GREEN)² will blink in every second for 4G dongle.

Step3:

To configure the Wi-Fi in 2G dongle follow these steps:3.1)

Turn ON Wi-Fi on your Mobile and select "SHAKTI_DONGLE and connect it with the password "shakti123".

An HTML page will open in your browser otherwise browse <http://192.168.4.1>. You will get the HTML page like this:



Figure 5

3.2) Now "Configure Wi-Fi" now new page will open like this:

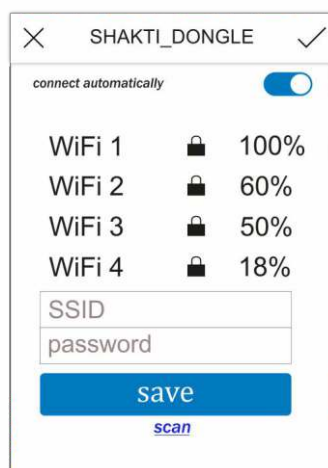


Figure 6

3.3) Select your preferred WiFi with proper password and then save. In case your WiFi network is not visible in the list scan again.

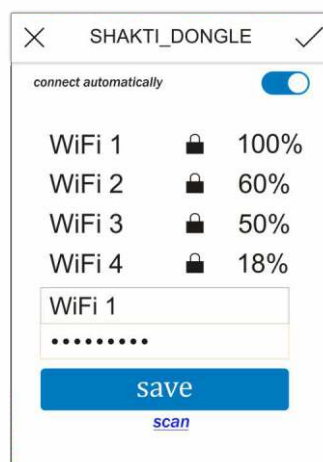


Figure 7

On successful configuration, WiFi LED (yellow) will be ON.

*** NOTE ***

- Shakti IoT Dongle is designed to work with GSM on priority, WiFi is always secondary.
- For using Wi-Fi remove SIM card then connect shakti dongle.
- On successful TCP connection WI-FI yellow LED will blink in every second.

4. TROUBLESHOOTING

- If Pulse LED is constantly ON/OFF, check main device power supply or restart the device.
- If signal LED not glowing, check sim card / signal strength.
- If Wi-Fi LED not glowing, check Wi-Fi network / reconfigure Wi-Fi settings.

5. Contact Shakti to integrate IoT Dongle to other products & solutions.

2.3.6 SPECIFICATION : SHAKTI SOLAR TRACKER CONTROLLER

Parameters	SHAKTI SOLAR TRACKER CONTROLLER
Tracking type	Dual – axis
Tracking Principle	Controls Azimuth angle and Zenith angle according to astronomical sun positioning
Tracking Accuracy	$\leq \pm 2^\circ$
Control modes	Auto / Manual
Supply Voltage	3 – Ph Supply : 380–460V 1 – Ph Supply : 190–270V
Rated Power	100W
Output Voltage to Actuators	$\pm 24V$
Output Current	1.6A (continuos)
Channels	2
Protections	1. Wind sensor failure detection. 2. Inclination sensor failure detection. 3. Strong Winds detection.
Inclination Sensor	
Measuring Range	$\pm 90^\circ$
Installation Method	Horizontal Down
Communication	RS485
DISPLAY & COMMUNICATION	
Display Type	Graphical LCD(128x64)
Status Indicator	LEDs
Serial Communication	RS232 & RS485 (MODBUS)
Communication (Wind Sensor)	RS485
Remote monitoring	YES(Optional)
PHYSICAL	
L X W X H	300mm x 218mm x 125 mm
Net wt. / Gross wt.	3 KG
OTHER INFO	
Pollution Degree	PD3
Over Voltage Category	Category II
Protection Class	Class I
Operating Temperature	-25 to 60 °C
Relative Humidity	0–95% RH(Non-condensing)
Altitude	3000 m (>2000m power derating)
IP Degree of Protection	IP 65

(The above specification are subject to change. Please refer sticker parameters for final value)

2.3.7 CONTROLLER FRAMES AND APPEARANCES

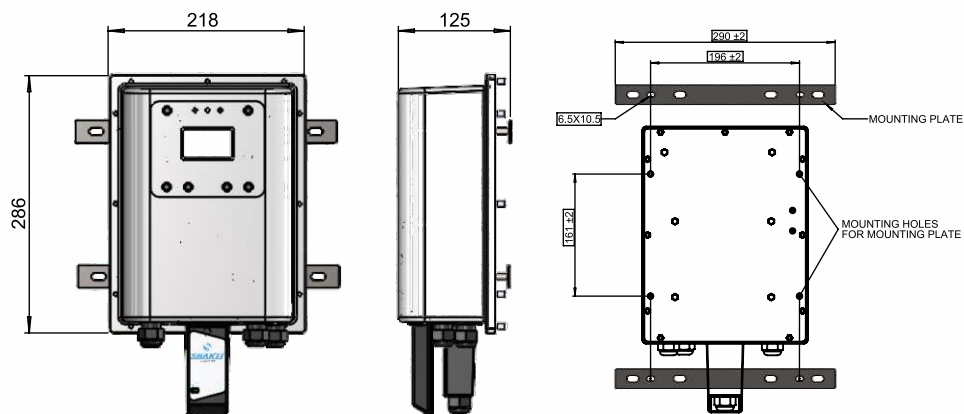


Fig. 2.5 Controller : top view, side view & back view

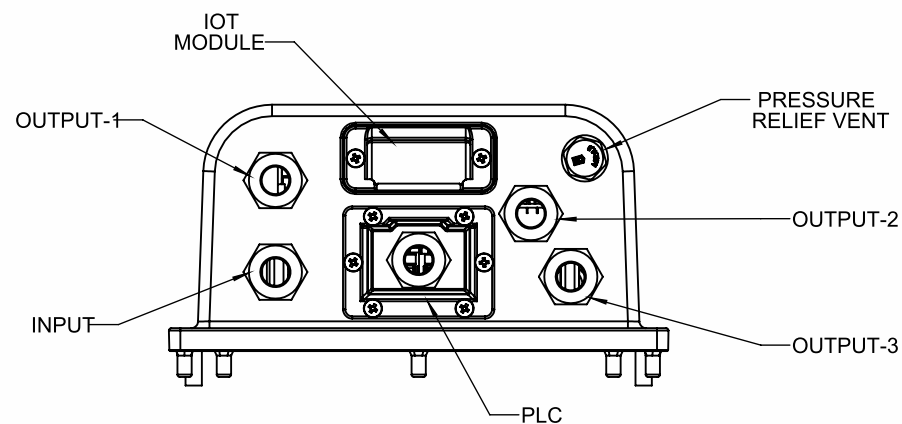


Fig. 2.6 Controller : front view

CHAPTER 3 : INSTALLATION AND WIRING

3.1 Guidelines for installation and wiring

1. The controller should be taken out of the packing box properly keeping in mind its weight.
2. Installation of controller should be carried out on solar structure with proper ground clearance and specified nuts and bolts.
3. Install it vertically on the pole (maximum inclination allowed is 15 degrees only).
4. Pay attention to the installing place to guarantee the effective heat dissipation.
5. Screw the nuts and bolts and make sure they are tightened properly. Connect the earthing wire at the bolting place.
6. Connect the AC input to the controller. Please refer labeled diagram of connector.
7. After that follow instructions given in chapter 4 of this manual.
8. Connect the output cables to the actuator.

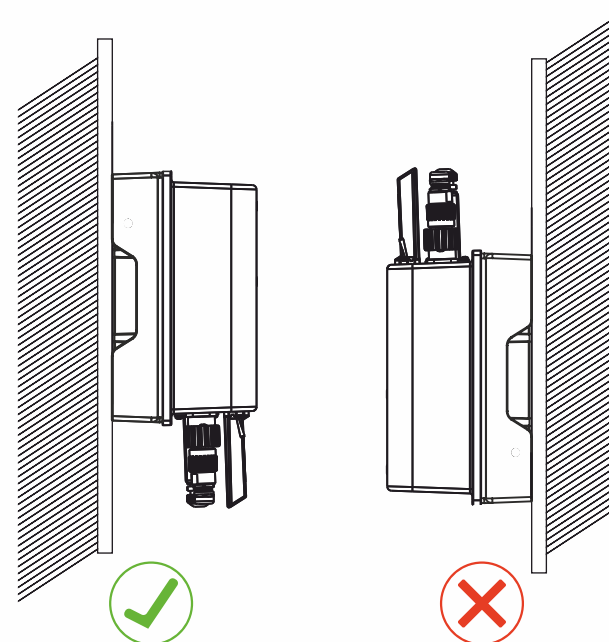


Fig. 3.1 Correct and Incorrect Installation of Controller

CHAPTER 4: BASIC OPERATION

4.1 Display Module Description

Following figure 4.1 indicates the outer look of display, it has four buttons, two LED indicators, one 126.5X105.5 mm LCD Display.

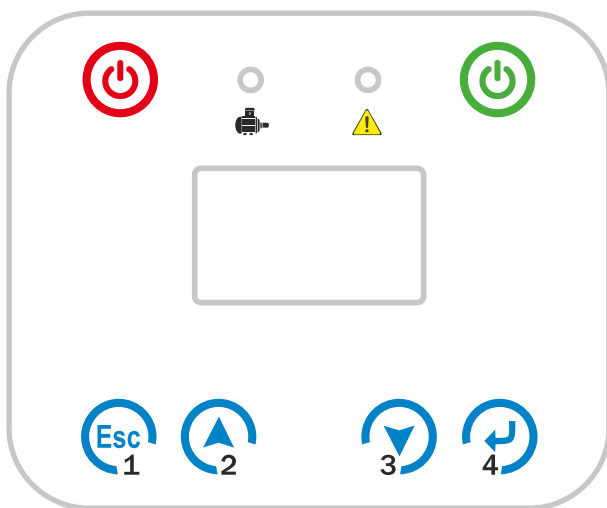


Fig. 4.1 LCD Module

4.2.Button Description and Operation

Button		Functionality
ESC		<ul style="list-style-type: none"> Previous Screen
UP Arrow		<ul style="list-style-type: none"> Used for Scrolling up For increasing the parameter values in Configuration menu
Down Arrow		<ul style="list-style-type: none"> Used for Scrolling down For decreasing the parameter values in Configuration menu
ENTER		<ul style="list-style-type: none"> Selection

4.3 LCD OPERATION

● **MAIN MENU** - In the main menu, users can access information or modify settings under different sections.

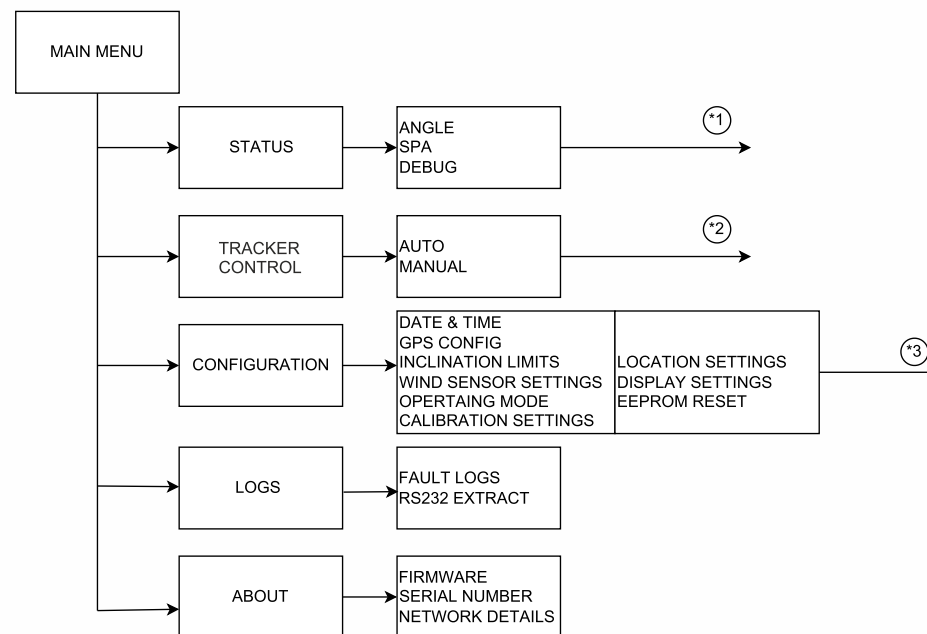


Fig. 4.2 Main Menu Tree

► STATUS

1)ANGLE:

This status section shows real-time values for various angles, including East-West angle, North-South angle, along with maximum limits for each direction i.e. (East limit, West limit, North limit, South limit), and reference angles for East-West and North-South directions which are further calculated through Solar Position Algorithm (SPA).

2)SPA:

The SPA status section shows the values of AZIMUTH ANGLE, ZENITH ANGLE and values which are calculated by Solar Position Algorithm (SPA) for E-W direction angle, N-S direction angle, Sunrise Time(SRT), and Sunset Time(SST).

3)DEBUG:

It includes essential data such as LATITUDE, LONGITUDE, present WIND SPEED, and the maximum value of wind speed achieved, i.e MAX SPEED . Apart from this all other parameters are for service team and installation purpose only.

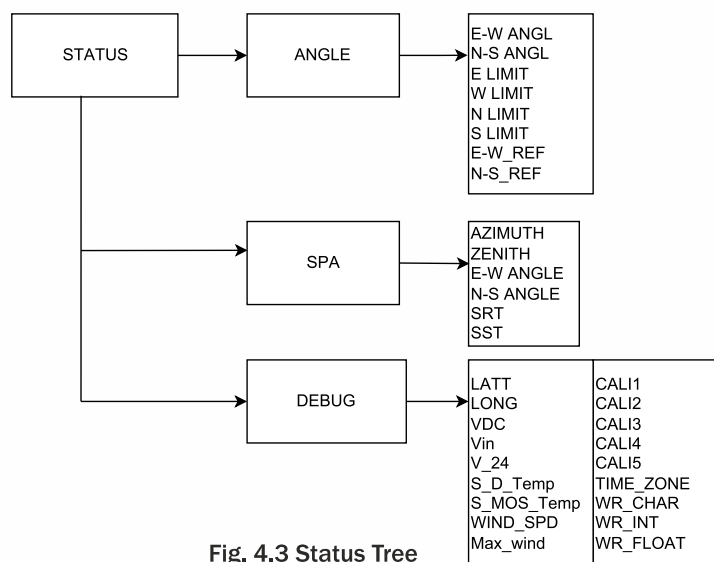


Fig. 4.3 Status Tree

► TRACKER CONTROL

Tracker Control section contains 2 modes of controlling the solar tracker. i.e. AUTO and MANUAL.

1) AUTO

In AUTO Mode, the tracker automatically adjusts its position based on the angles calculated by the Solar Position Algorithm (SPA), ensuring optimal alignment of the solar panels with the sun for efficient tracking throughout the day. After sunset ,the tracker returns to its home position.

2)MANUAL

When the manual mode is selected, users have the flexibility to adjust the tracker's position. Choosing STOP halts the tracker's movement entirely. Selections of NORTH, SOUTH, EAST, and WEST prompt the tracker to move in the corresponding direction until its limit is reached. This feature also facilitates the user to ensure the solar tracker's functionality. Selecting HOME returns the tracker to its home position.

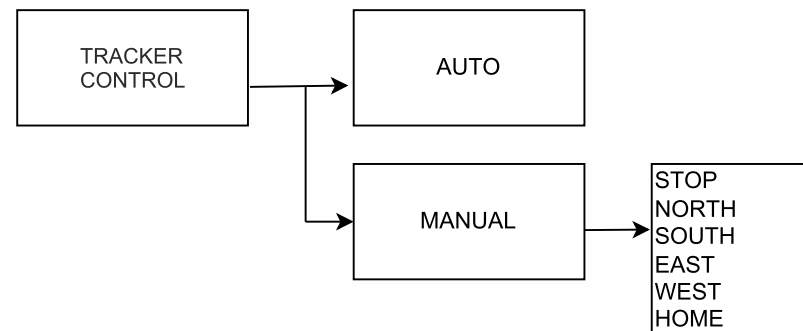


Fig. 4.4 Tracker Control Tree

● HOME POSITION

This feature automatically moves the solar tracker to a designated "HOME" position when it is not actively tracking the sun. This position is typically set to protect the panels during adverse weather conditions like high winds or storms. This feature ensures that the solar tracker remains efficient, durable, and well-protected during non-operational periods.

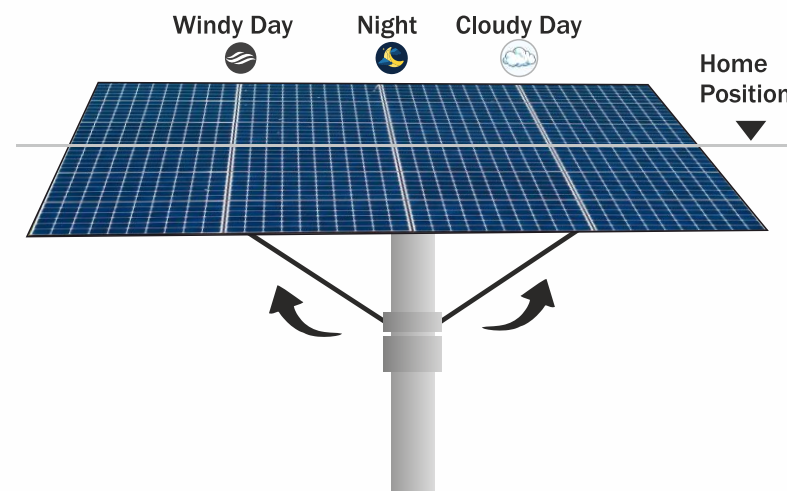


Fig. 4.5

► **CONFIGURATION :**

1) Date & Time:

Whenever dongle is connected to the tracker, it acquires date and time through server. Accurate date and time are necessary for correct operation of solar tracker. Otherwise in absence of dongle, user can manually set DATE and TIME as per requirements and after that time will get updated with the help of real time clock (RTC).

Note that inaccuracies in date and time settings can disturb the tracker's ability to accurately track the sun. Accurate date and time configuration are essential for the tracker's optimal operation.

2) GPS CONFIG

When GPS is enabled, the tracker automatically acquires latitude and longitude coordinates from the server, using GPS to determine the exact location of the solar panel. However, when GPS is disabled, users have the option to manually configure both latitude and longitude based on their current location.

3) INCLINATION LIMITS:

Inclination limits of each direction under EAST LIMIT, WEST LIMIT, NORTH, and SOUTH LIMIT can be set. These settings specify the allowable/maximum tilt angles of the panel in each respective direction.

4) WIND SENSOR SETTINGS:

a. WIND SENSOR MODE: If the Wind Sensor Mode is enabled, parameters such as WIND SPEED LIMIT, WIND SPD OBSERV TIME and WIND SPD RESET TIME can be configured. Additionally, if wind sensor doesn't work properly, warning triggering will occur in this enabled state. If it is disabled, access to these settings will be restricted, and no warning will be triggered.

b. WIND SPEED LIMIT: The maximum allowable wind speed can be set in this section. If the wind intensity exceeds this limit for the duration of Wind speed observ time, a warning will occur to protect the tracker from high-speed winds.

c. WIND SPD OBSERV TIME: This setting allows you to set the observation time for wind speed. It continuously monitors the Wind Speed Limit during this period, and if the wind speed remains at or above the set limit, a warning due to high speed winds will be triggered.

d. WIND SPD RESET TIME: If a warning due to high speed winds occurs, the tracker will automatically return to its desired position or angles calculated by the Solar Position Algorithm (SPA) after this specified Wind spd reset time. However, if the wind speed continues to exceed the wind speed limit, the warning will persist.

5) OPERATING MODE: Under this setting, operating mode of the solar tracker can be selected i.e. Soft start Mode & Contractor mode.

6) CALIBRATION SETTINGS:

a. CALIBRATION MODE: If the calibration mode is enabled, parameters such as CALIBRATE EAST TIME, CALIBRATE NORTH TIME and SUNTIME OFFSET can be configured.

b. CALIBRATE EAST TIME: This parameter determines the duration for which the solar tracker operates in the eastward direction before sunrise or during calibration process.

c. CALIBRATE NORTH TIME: This parameter determines the duration for which the solar tracker operates in the northward direction before sunrise or during calibration process.

d. SUNTIME OFFSET: This parameter plays a crucial role in determining the timing for the calibration process of the solar tracker. This also ensures that calibration process starts at the correct time with respect to the actual sunrise.

The calibration of the solar tracker is carried out before sunrise to ensure that the panels are oriented towards the north east direction when tracking begins. This process helps prevent delays and inaccuracies in aligning the panels with the sun, especially when multiple panels are operating simultaneously.

7) LOCATION SETTINGS:

Following parameters under location settings are necessary as they help in calculating the SPA angle, which significantly enhances tracking accuracy.

a. ELEVATION: The height of Solar panels above the ground level.

b. GMT +VE OFFSET: It indicates positive offset for countries where local time is ahead of Greenwich Mean Time.

c. GMT -VE OFFSET : It indicates negative offset for countries where local time is behind of Greenwich Mean Time.

GMT +VE OFFSET and GMT -VE OFFSET determine the time zone of a country, as the time zone is calculated by the difference of them.

Example:

● **For INDIA:**

India Standard Time (IST): IST is GMT+5:30. This means that the local time in India is 5 hours and 30 minutes ahead of GMT. So, when it is 12:00 noon GMT, it is 5:30 PM in India.

GMT +VE OFFSET	GMT -VE OFFSET	TIME ZONE
55	0	$(55/10) - 0 = 5.5$

● **For USA:**

The time zone of Washington, DC is GMT-4:00 during daylight saving time (Eastern Daylight Time, EDT). This means that the local time in Washington, DC is 4 hours behind Greenwich Mean Time (GMT). If it is 12:00 noon GMT, it will be 8:00 AM in Washington, DC.

GMT +VE OFFSET	GMT -VE OFFSET	TIME ZONE
0	40	$0 - (40/10) = -4$

To accurately represent the time zone, ensure that the values entered for GMT +VE OFFSET and GMT -VE OFFSET sum up correctly.

d. LOCAL PRESSURE: This refers to the annual average local pressure measured at a specific location, measured in millibars. Atmospheric pressure can effect how solar rays penetrate the atmosphere, affecting the efficiency of solar energy capture.

e. LOCAL TEMPERATURE: This is the annual average local temperature of a specific location, measured in °C.

f. DELTA UT1: This is a parameter that represents the difference between Universal Time (UT1) and Coordinated Universal Time (UTC). UT1 is based on the Earth's rotation, while UTC is a more stable time standard. Actual Delta UT1 is calculated by settable parameter "Delta UT1" i.e, DELTA UT1-1.

Here's a table format that explains how the values for Delta UT1 should be entered into the controller for different scenarios:

Desired Delta UT1	Delta UT1 set from Display	Actual Delta UT1
0	10000	$(10000/10000)-1 = 0.0$
1	20000	$(20000/10000)-1 = 1.0$
-0.5	5000	$(5000/10000)-1 = -0.5$

g. DELTA T: This parameter is the difference between the Earth's rotation time and Terrestrial time. SPA needs this parameters to account for changes in the earth's rotation.

h. SURFACE AZIMUTH MOVE: It is the angle in the horizontal plane, between the line due to south and the horizontal projections of the normal to the inclined plane surface.

i. SURFACE SLOPE: The angle at which the surface is inclined relative to the horizontal plane.

j. ATM REFRACTION: Atmospheric refraction is the bending of light as it passes through the Earth's atmosphere, especially noticeable at sunrise and sunset. This parameter adjusts for the deviation of light from a straight path, enhancing tracking precision. Actual ATM Refraction is calculated by settable parameter "ATM Refraction" i.e, ATM REFRACTION-5. Here's a table format that explains how the values for ATM Refraction should be entered into the controller for different

Desired ATM_REFRACT	ATM_REFRACT set from Display	Actual ATM_REFRACT
-5	0	$(000000/100000)-5 = -5$
5	100000	$(100000/100000)-5 = 5$
0	50000	$(50000/100000)-5 = 0$

8) DISPLAY SETTING:

In the display settings, user can customize the DISPLAY MODE, adjust CONTRAST, enable or disable AUTOROLL, and activate DISPLAY LOCK for protection purpose.

9) EEPROM RESET:

EEPROM can be reset only by authorized technician/ service personnel. Users are not allowed to reset the EEPROM, since it may cause malfunctioning of the unit.

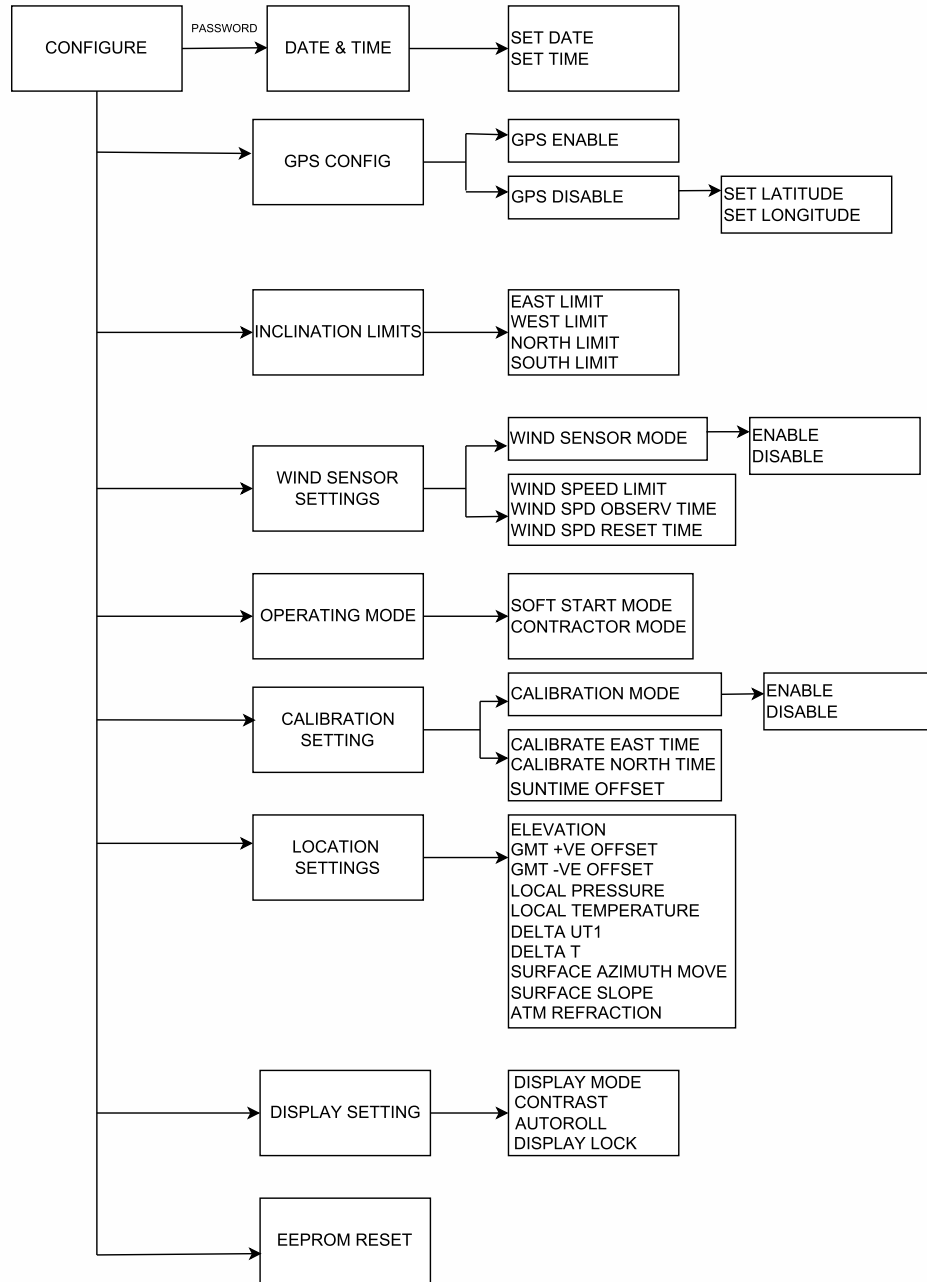


Fig. 4.6 CONFIGURATION TREE

CHAPTER 5 : NUMERICAL DISPLAY INFORMATION

The Shakti display features a unique capability where all pages can be distinctly identified using both words and numerals. The sequence of pages with respect to numerals follows a definite order, as described below:

Table 5.1 lists all parameters along with their corresponding display numbers. Numbers are not displayed for ROLLING PAGES and MENU. Once you enter the menu, all pages are numbered based on their sequential position within the menu. For example, TRACKER CONTROL is in the second position, so it is designated as 2. Any page within TRACKER CONTROL will start with 2. For example, the AUTO page is in the first position within TRACKER CONTROL, so its numeral designation is 21, where 2 corresponds to the TRACKER CONTROL page and 1 corresponds to the first page within page number 2.

Another example to understand the numeral location of LOCAL TEMPERATURE within LOCATION SETTING is given below:

3 CONFIGURATION >> 7 LOCATION SETTING >> 5 LOCAL TEMPERATURE.

Thus, the numeral designator for LOCAL TEMPERATURE within LOCATION SETTING is 375, as shown in Figure 5.1. This indicates that you should go to the 3rd page of the menu to reach CONFIGURATION, then to the 7th location within CONFIGURATION to reach LOCATION SETTING (page 37), and finally to the 5th location within LOCATION SETTING, which is LOCAL TEMPERATURE (page 375).

All parameters and pages are numbered according to the description above. However, when the location within a page exceeds 9, an underscore is added to the designator. For example, the 10th location within any page is designated as _10 i.e. the numeral designator for ATM REFRACTION is 37_10. To make it easier for customers to understand, page numbers are displayed at the top, and locations are shown in front of all the parameters.

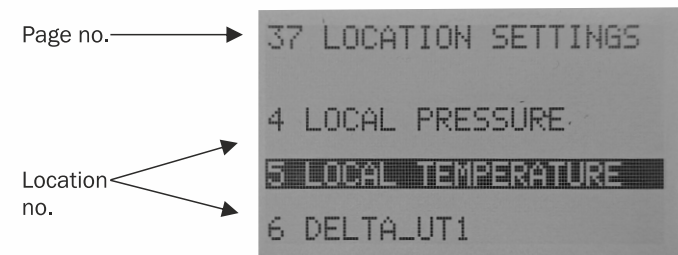


Fig. 5.1

0	MENU
1	STATUS
11	ANGLE
12	SPA
13	DEBUG
2	TRACKER CONTROL
21	AUTO
22	MANUAL
221	STOP
222	NORTH
223	SOUTH
224	EAST
225	WEST
226	HOME
3	CONFIGURATION
31	DATE & TIME
311	SET DATE
312	SET TIME
32	GPS CONFIG
321	GPS ENABLE
322	GPS DISABLE
3221	SET LATITUDE
3222	SET LONGITUDE
33	INCLINATION LIMITS
331	EAST LIMIT
332	WEST LIMIT
333	NORTH LIMIT
334	SOUTH LIMIT
34	WIND SENSOR SETTING
341	WIND SENSOR MODE
3411	WIND MODE ENABLE
3412	WIND MODE DISABLE
342	WIND SPEED LIMIT
343	WIND SPD OBSERV TIME
344	WIND SPD RESET TIME
35	OPERATING MODE
351	SOFT START MODE
352	CONTRACTOR MODE
36	CALIBRATION SETTING
361	CALIBRATION MODE
3611	ENABLE

3612	DISABLE
362	CALIBRATE EAST TIME
363	CALIBRATE NORTH TIME
364	SUNTIME OFFSET
37	LOCATION SETTING
371	ELEVATION
372	GMT +VE OFFSET
373	GMT -VE OFFSET
374	LOCAL PRESSURE
375	LOCAL TEMPERATURE
376	DELTA_UT1
377	DELTA_T
378	SURFACE AZIMUTH MOVE
379	SURFACE SLOPE
37_10	ATM REFRACTION
38	DISPLAY SETTINGS
381	DISPLAY MODE
3811	ROLLING PAGES
3812	SHAKTI SCREEN
382	CONTRAST
383	AUTOROLL
3831	YES
3832	NO
384	DISPLAY LOCK
3841	YES
3842	NO
385	CHANGE PASSWORD
39	EEPROM RESET
391	NO
392	YES
4	LOGS
41	FAULT LOGS
42	RS232 EXTRACT
421	FAULT DATA EXTRACT
5	ABOUT
51	FIRMWARE
52	SERIAL NUMBER
521	DRIVE SERIAL NO.
522	DONGLE SERIAL NO.
53	NETWORK DETAILS

Table 5.1

CHAPTER 6 : Warnings and Error Codes

This chapter outlines the tracker's warnings along with corresponding messages displayed on the LCD, the possible causes of these warnings, and their troubleshooting steps. Detailed warning information and descriptions are provided in the warning table below.

6.1 Warning Type

TYPE	TRACKER'S ACTION
INCLINOMETER FAILURE	<ul style="list-style-type: none"> Warning information will be displayed on the LCD screen. The tracker will fail to follow the sun's position and could behave unpredictably, possibly tilting in random direction.
WIND SENSOR FAILURE	<ul style="list-style-type: none"> Warning information will be displayed on the LCD screen. The tracker will not detect high speed winds during adverse weather conditions, but it will continue operating without stopping.
HOME POSITION DUE TO WIND	<ul style="list-style-type: none"> If high-speed winds are being detected by the wind sensor, the tracker initiates an automatic return to the home position to maintain its operational functionality and durability of structure.

Table 6.1

6.2 Warning Table

Warning Type	LCD Message Display	Possibility Reasons	Troubleshooting
Inclinometer Failure	01 INCLINOMETER FAILURE	1. Improper connection of the inclinometer with the device. 2. Breakage in the connecting wires. 3. Device is not able to receive angle data from the inclinometer.	1. Verify the proper connection of the inclination sensor. 2. Ensure that the connecting wires are properly connected at both ends. 3. Contact customer care.
Wind sensor failure	02 WIND SENSOR FAILURE	1. Improper connection of wind sensor with the device. 2. Breakage in the connecting wires. 3. Device is not able to receive wind speed from the wind sensor.	1. Verify the proper connection of the wind sensor. 2. Ensure that the connecting wires are properly connected at both ends. 3. Contact customer care.
Home position	03 HOME POSITION DUE TO WIND	1. If the wind speed is greater than the pre settable wind speed limit, then the tracker will move to its home position during this condition.	1. Monitor the weather conditions and wait for the high speed winds to pass. 2. Increase the value of Wind Speed limit parameter from Location Setting under Configuration.

Table 6.2

6.3 Parameter Validation and Error Codes

This table lists the various parameters used in the solar tracking system, their valid ranges, and the associated error codes that may be encountered if the values fall outside these ranges. Each parameter plays a crucial role in accurately calculating the Solar Position Algorithm (SPA).

Error Codes Table :

Parameters	Valid Range	Error code
year	-2000 to 6000	1
month	1 to 12	2
day	1 to 31	3
hour	0 to 24	4
minute	0 to 59	5
second	0 to <60	6
delta_t	< 8000 seconds	7
timezone	< 18 hours	8
longitude	< 180 °	9
latitude	< 90 °	10
elevation	> -6500000	11
pressure	0 to 5000	12
temperature	-273 to 6000 °C	13
slope	< 360 °	14
azimuth rotation	< 360 °	15
atmospheric refraction	< 5 °	16
delta_ut1	-1 to 1 second	17

Table 6.3

6.4 Sensor Troubleshooting

6.4.1 Inclination Sensor Troubleshooting:

If X-axis and Y-axis angles on the Rolling page are incorrect or not within range, then check connections from solar tracker sensor board to Inclination Sensor as below:

- The red wire (VDC) of the Inclinator should be connected to the +24V_ISO terminal of the Sensor Card.
- The black wire (Gnd) of the Inclinator should be connected to the CGND terminal of the Sensor Card.
- The white wire (Rx) of the Inclinator should be connected to the RS485_A terminal of the Sensor Card.
- The green wire (Tx) of the Inclinator should be connected to the RS485_B terminal of the Sensor Card.

Note: Proper connections ensure that the Inclination Sensor communicates effectively with the Sensor Card, allowing accurate display of the X-axis and Y-axis angles on the Rolling page.

6.4.2 Wind Sensor Troubleshooting:

If you find that the Wind speed on the Rolling page is incorrect or not within range, then check connections from solar tracker sensor board to Wind Sensor as below:

- The brown wire (VDC) of the Wind Sensor should be connected to the +24V_ISO terminal of the Sensor Card.
- The black wire (Gnd) of the Wind Sensor should be connected to the CGND terminal of the Sensor Card.
- The yellow wire (Tx) of the Wind Sensor should be connected to the RS485_A terminal of the Sensor Card.
- The blue wire (Rx) of the Wind Sensor should be connected to the RS485_B terminal of the Sensor Card.

Note: Proper connections ensure that the Wind Sensor communicates effectively with the Sensor Card, allowing accurate display of Wind speed on the Rolling page.

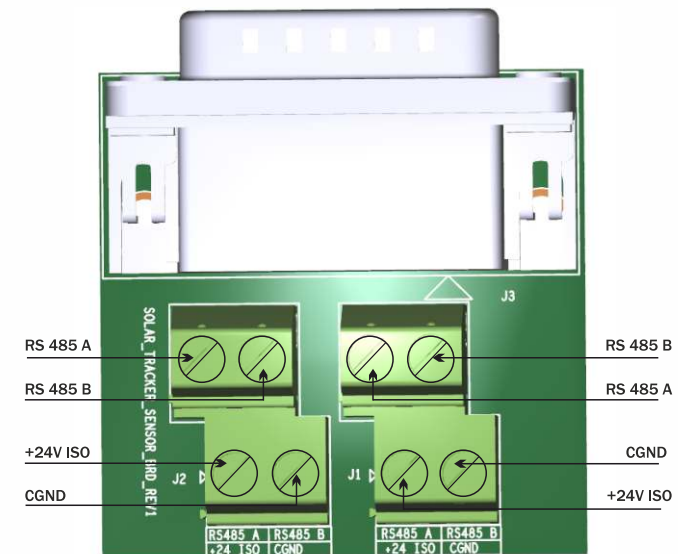


Fig. 6.1

CHAPTER 7 : MODBUS COMMUNICATION PROTOCOL

7.1 Com Port Setting :

- RS485 in half duplex mode
- Port Setting:- Baud Rate -9600, Data Bits-8, Stop Bits-1, Parity-None

7.2 RTU Frame Structure :

Slave address 0X01

Function field 0x03 :Read single parameter

0x06 : Write single parameter

Data field Data field includes address field and data load domain

CRC field 16bit CRC check value

7.2.1 Function Code : 0X03

This function code is used to read the contents of a contiguous block of registers.

Query-

Slave Address	Function Code	Register Address High	Register Address Low	High Register No	Low Register No	CRC Low	CRC High
0X01	0X03	—	—	0x00	0X01	—	—

Response-

Slave Address	Function Code	Byte Count	High bit	Low bit	CRC Low	CRC High
0X01	0X03	0X02	—	—	—	—

7.2.2 Function Code : 0X06

This function code is used to write the contents of a contiguous block of registers.

Query-

Slave Address	Function Code	Register Address High	Register Address Low	High Register No	Low Register No	CRC Low	CRC High
0X01	0X06	—	—	0x00	0X01	—	—

Response-

The response function code echoes the request function code

Slave Address	Function Code	Register Address High	Register Address Low	High Register No	Low Register No	CRC Low	CRC High
0X01	0X06	—	—	0x00	0X01	—	—

Note : If an error occurs, there will be no response from the drive.
 ·Minimum time interval between two request is 500ms.

S.No.	SOLAR TRACKER PARAMETERS	MODBUS ADDRESS (DEC)	OFFSET	Min	Max	Default	DVT Factor	Unit	Description
1	TRACKER CONTROL	8000	1	1	2	2	1	NA	1- AUTO, 2-MANUAL
2	MANUAL MODE	8001	1	1	6	1	1	NA	1-STOP, 2-NORTH, 3-SOUTH, 4-EAST, 5-WEST, 6-HOME
3	GPS CONFIG	8002	1	1	2	1	1	NA	1 : GPS ENABLE, 2 : GPS DISABLE
4	OPERATING MODE	8003	1	1	2	0	1	NA	1 : SOFT START MODE , 2 : CONTACTOR MODE
5	CALIBRATION MODE	8004	1	1	2	1	1	NA	1 : ENABLE , 2 : DISABLE
6	WIND SENSOR MODE	8005	1	1	2	1	1	NA	1 : ENABLE , 2 : DISABLE
7	EAST LIMIT	9000	2	400	899	455	10	deg	Structure Limit in EAST Direction.
8	WEST LIMIT	9002	2	905	1400	1345	10	deg	Structure Limit in WEST Direction.
9	NORTH LIMIT	9004	2	0	90	5	10	deg	Structure Limit in NORTH Direction.
10	SOUTH LIMIT	9006	2	10	500	445	10	deg	Structure Limit in SOUTH Direction.
11	ELEVATION	9008	2	0	9999	550	1	m	Observer's Elevation.
12	LOCAL PRESSURE	9010	2	0	5000	1012	1	mB	Annual Average Local PRESSURE.
13	LOCAL TEMPERATURE	9012	2	2	100	20	1	°C	Annual Average Local TEMPERATURE.
14	SURFACE AZIMUTH MOVE	9014	2	0	190	180	1	deg	Measured from South to projection of surface normal on horizontal plane, Negative East.
15	SURFACE SLOPE	9016	2	0	60	0	1	deg	Surface slope is measured from Horizontal Plane.
16	GMT POSITIVE OFFSET	9018	2	0	150	55	10	NA	Used to calculate the time zone of a country. TIME ZONE = GMT POSITIVE OFFSET – GMT NEGATIVE OFFSET.
17	WIND SPEED LIMIT	9020	2	10	150	25	1	Km/hr	If the Wind speed is more than the WIND SPEED LIMIT, then the tracker automatically moves to its home position.
18	CALIBRATION EAST TIME	9022	2	0	40	15	100	min	Total time in which the tracker performs calibration in EAST Direction.
19	WIND SPD OBSERV TIME	9024	2	0	99	10	100	NA	It is the time required to monitor the wind speed and move the tracker to its home position when the wind speed exceeds the wind speed limit.
20	WIND SPD RESET TIME	9026	2	1	60	3	1	NA	It is the time required to bring the tracker back to its desired position, if the wind speed becomes within the range.
21	SUN TIME OFFSET	9028	2	0	999	75	1	NA	It is the time required to perform CALIBRATION before or after the sunrise time.
22	CALIBRATION NORTH TIME	9030	2	0	40	15	100	min	Total time in which the tracker performs calibration in NORTH Direction.
23	GMT NEGATIVE OFFSET	9032	2	0	150	0	10	NA	Used to calculate the time zone of a country. TIME ZONE = GMT POSITIVE OFFSET – GMT NEGATIVE OFFSET.

S.No.	Float Parameters	MODBUS ADDRESS(DEC)	OFFSET	Min	Max	Default	DVT factor	Unit	Description
1	LATITUDE	5020	3	0	9999999	227195	10000	deg	Latitude is the angular distance of a place north or south of the earth's equator.
2	LONGITUDE	5024	3	0	9999999	758577	10000	deg	Longitude is the angular distance of a place east or west of the prime meridian.
3	DELTA UT1	5028	3	0	20001	10000	10000	NA	Fractional second difference between UTC and UT, which used to adjust earth's irregular rotational rate.
4	DELTA T	5032	3	0	16001	8069	10000	NA	Difference between Earth's rotational time and terrestrial time.
5	ATM REFRACTION	5036	3	0	100001	55667	10000	NA	Atmospheric refraction at sunrise and sunset.

S.No.	Configuration Parameters	MODBUS ADDRESS (DEC)	OFFSET	Min	Max	Default	DVT factor	Unit	Description
1	ROLLING PAGE ENABLE	262	1	1	2	1	1	NA	ROLLING_PAGE_ENABLE
2	LCD CONTRAST	263	1	27	39	33	1	%	LCD_CONTRAST
3	DISPLAY MODE	264	1	1	2	1	1	NA	DISPLAY_MODE_FLAG
4	RS232 BAUD RATE	275	1	1	6	2	1	NA	RS232_BAUD_RATE
5	RS485 BAUD RATE	276	1	1	6	2	1	NA	RS485_BAUD_RATE
6	MODBUS ADD RS232	277	2	1	99	1	1	NA	MODBUS_ADD_RS232
7	MODBUS ADD RS485	279	2	1	99	1	1	NA	MODBUS_ADD_RS485

CHAPTER 8 : RECYCLING AND DISPOSAL

Electrical and electronic waste should not be thrown out in open or buried or fired. They must never be treated as residential waste. A drive which has reached end of its life or is not needed any more should be returned to the dealer or to the company. A user may also act as per the government norms prevailing in the area.



WARRANTY CERTIFICATE

Dear Customer, Congratulation, for purchasing our product.

Controller is warranted against defects in workmanship and material under normal use, service & specified duty conditions. We provide one time warranty service for twelve months from the date of purchase by the first user.

Shakti Pumps (India) Limited warrants this product to be free from damage/ defects in material and workmanship under normal use and service for Twelve Months from the date of purchase by the first user. The user shall produce valid and original copy of invoice for availing warranty. The user shall carry defective Controller to nearest authorized service center .

This warranty does not cover any loss or damage/ defect of any nature resulting from wrong product selection/ improper installation or installation by unauthorized/ untrained person & improper use of the Controller. The warranty also does not cover consequential losses/ damages arising due to failure of Controller. No warranty will be provided on mechanical seal, rubber parts, fasteners & cables in Controller. Our obligation is limited to recycling or repairing or replacing product/ parts ex • factory. Equipment for repairs should be returned free of cost to us. The forgoing is subject to the provision that the user does not open the unit and make any change or repair without prior approval of authorized service center during the warranty period. This warranty excludes every condition whether statutory or otherwise, whatsoever not herein expressly set out.

WARRANTY CARD

Customer to fill following details

Name :
 Address :
 City/Village :
 District :
 State :
 Country :
 Pin Code :
 Mobile no. :
 Email id :

Information on Device:

Model no :
 Serial no. :
 Invoice no. :
 Commissioning date :
 Fault date and time :
 Message related to fault on display :
 Brief fault description and photo of display :
 Sign :
 Date :
 Place :

Installer to fill following details

Modules Used :
 Modules per string :
 Number of strings :
 Dealer license Number :
 Company :
 City/Village :
 State :
 Country :
 Pin Code :
 Mobile no. :
 Email id :
 Sign :
 Date :
 Place: :

INSTALLATION & OPERATING INSTRUCTIONS

BOOK-POST

To,
SHAKTI PUMPS (INDIA) LIMITED
Plot No. 401, 402, & 413, Industrial Area, Sector - 3, Pithampur - 454774,
Dist. - Dhar, (M.P.) - INDIA. Toll Free. 1800 103 5555
E-mail : info@shaktipumps.com, sales@shaktipumps.com
Visit us at : www.shaktipumps.com

Stamp

