USER MANUAL

SOLAR CONTROLLER
(Dual Option)

1 Hp – 3 Hp

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Scope:
- all models of dual solar controllers for capacity ranges of 1 HP to 3 HP

Refer the support section for any clarifications regarding this document

CONTENTS

This manual consists of installation, commissioning and troubleshooting process for Roto Energy Systems Limited solar product offering namely – dual solar controller.

The manual is intended for the use by technicians, contractors and other stakeholders that are involved in deployment and operation of Roto Energy Systems Limited products on field.

The following is covered in this document:

1. General information

Introduction

We wish to express our sincere thanks to you for choosing our product Dual Solar Controller, manufactured and supplied by ROTO ENERGY SYSTEMS LIMITED.

It is scientifically designed and built to give you long and dependable service. Carefully selection of material and manufacturing assures you a satisfactory performance as per the controller rating. The controller will give you years of trouble-free performance if it is handled with due care.

Roto Energy Systems Limited make energy efficient and environmentally friendly solar controllers are used with submersible positive displacement/centrifugal pumps which satisfies the requirement for handling clear cold and fresh water. It is designed for best in class efficiency which helps in solving the water problem for irrigation, houses, as well as for livestock or other water requirements.

'ROTO ENERGY SYSTEMS LIMITED' Dual Solar Controllers are easy to install, however detailed installation and operation manual is on following pages, for easy understanding and comprehensive first-hand information on these controllers.

Follow safety instructions carefully. Improper use and operation may cause lethal electrical shocks and/or damage to equipment.

Our products are meant for pumping water and they do not have any significant effect on environment during their use, if properly selected and used as per instructions given in the manual. Customers are advised to dispose off unusable components through appropriate disposal agencies to avoid the harmful impact (if any) on environment.

Instructions

Purchasers are cautioned to go through carefully the detailed instructions given for proper installation, use and servicing of the product and genuine spare parts as detailed in company's published literature, manuals, pamphlets or other official publications. Any deviation, if made by the customers, will void the warranty obligations and/or manufacturer's liability, if any, for any compensation consequential or otherwise. Use of trained mechanics will get you better results.

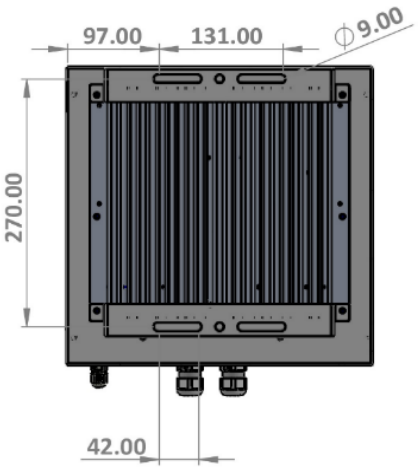
'ROTO ENERGY SYSTEMS LIMITED' Solar Controllers are assured to give delivery output as per the specifications. However, if the specifications and instructions are not followed correctly, the life of controller may reduce and also the performance of pump may get hampered.
The controllers are for pumps which in turn are for clear and cold fresh water for drinking purpose.
During installation and while starting the system, hand gloves should be worn for safety purposes.

All controller units are pre-configured with setting specific to a solar panel and motor combination. It is necessary to adhere to the requirements for correct operation.

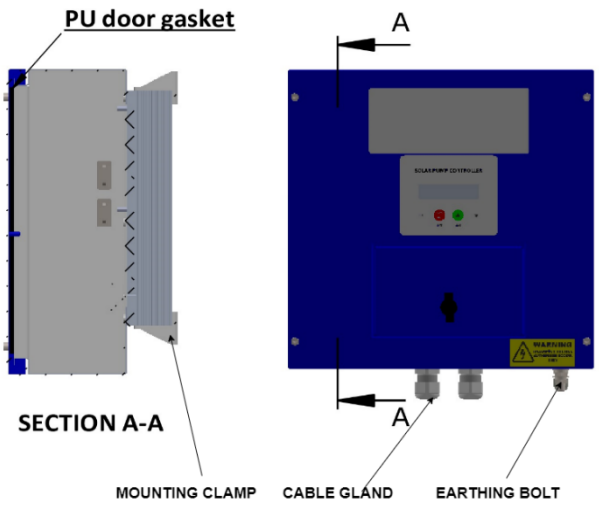
Warning
Always take help of a qualified mechanic/electrician while commissioning and starting the system for the first time.
Ensure that the pump is properly connected with the motor and the motor is properly connected with controller.
Ensure all electric joints as well as connections are water proof and covered.
Install controller with the pump set properly as per the rated head range.
Before going for any service of the system, disconnect the power supply.
Ensure that proper earthing is given to the controller.

2. Construction

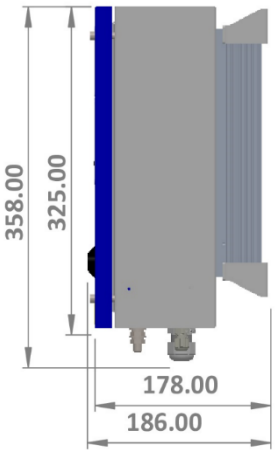
Dual Controller



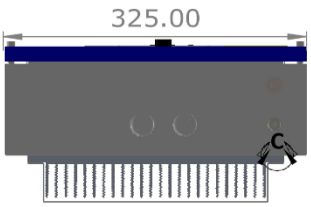
REAR VIEW



FRONT AND SECTION A-A VIEW



RIGHT VIEW



BOTTOM VIEW

The outer body of RESL Controllers is made with rugged, high Quality steel and is powder coated. The main external parts of the controller include:

- A LCD display with 4 press keys.
- Cable gland with DC supply wires with connectors and AC supply connection wires.
- Cable gland with motor connection wires
- Cable gland with water level sensor wires (for overhead tank and for dry run protection)
- MCB door know.
- Earthing bolt.
- Heat Sink.
- Mounting clamps.
- A branding sticker.
- A warning sticker.
- A product name plate sticker.

3. Technical specifications

The controllers are designed for the operation and speed control of a PMSM (DC) Motors. Input DC supply is through current regulated source such as SOLAR panels or SOLAR simulators. The dual controllers may receive power input from single-phase AC mains as well. The control strategy is based on sensor-less speed control of a permanent magnet synchronous motor (PMSM). The controller can also be configured to work in open loop V/F control mode for AC Induction motor control.

Application:

3-phase permanent magnet synchronous motors for pumping applications at river bed locations/Borewells/Agriculture/Sprinklers/Drip Irrigation/Rural & Urban water supply schemes/ High-rise building/ Livestock/ Fountains/ Fishery/ Ponds Water Circulation, etc.

Parameter	Dual Controller
Rating	
HP Rating	1 HP/2 HP/ 3 HP
Controller Input	
DC Power (Wp)	1000/2000/3000
Maximum PV Array/ DC Bus Voltage (V)	450
Max. Input DC Current (A)	15
Input AC Voltage (V)	230 (Single Phase 50/60 Hz)
MPPT Range (V)	70-200
Controller Output	
Maximum Three Phase Output Voltage (V rms)	300
Max. Output Current Rating (A)	15
Max. Output Fault/ Short Circuit Current (A)	25
Output Frequency (Hz)	0-300

Overload	150% for 1 minute
Motor types which can beused	PMSM (DC)/ Induction Motor

PROTECTIONS	
DC Input	Over/Under Voltage, Reverse Polarity
AC Input	Over/Under Voltage
Output	Output Short Circuit, Over Current
	Output Open Circuit
	Un-balance in the output
	Dry Run, dry-run-external
Temperature	Thermal Overload, Over Temperature
Operational	Water Level
PV input MCB	25A, 500V, 6kA
Grid input MCB	25A, 415V, 2 Pole
PV Input Surge Protection	20kA, 600V
Grid Input Surge Protection	20kA, 1-Phase, 320VAC
Communication and Interface	
Communication	TTL Rx and Tx signals available for RMU
	(RMU not included)
User interface	Two-line LCD, 4 Keys, Remote monitoring system(2G/4G)
OTHERS	
Operating AmbientTemperature	-20℃ to +50℃
Humidity Range	0 to 95% RH
Protection level	IP65
Cooling	Natural Cooling
Maximum Altitude	1000 m from Sea level
Suitability for wet locations	Suitable
Modes of Operation	1. MPPT mode
	2. KEYPAD mode

Frequency of operation	1. MPPT Mode: Minimum operating frequency – 20Hz, Base Frequency for Motor is programmable.
	2. KEYPAD Mode: Output frequency variable from 1Hz to Maximum frequency.
V/F curve pattern	Linear with Base Voltage at Base Frequency. Base Voltage, Base Frequency and Maximum Frequency are programmable
Start-up Sequence	1. Variable Frequency using Keypad for testing purposes.
	2. Based on the Input DC Voltage for Solar interface: Inverter will wait until the input DC Voltage reaches Open circuit voltage. There is a Start-up Delay time of 5 seconds and wait delay of 2 minutes in case of low intensity.
	3. Grid Presence: Max. speed.
Stop sequence	1. For both modes of Operation, inverter will stop if the input voltage is less than Minimum Input Voltage.
	2. For Keypad operation, the inverter will stop by pressing the BACK/ RESET key.
Restarting sequence	1. In KEYPAD mode, frequency is reset to minimum operating frequency of 1Hz. The User can increase or decrease the output frequency using display keypad interface.
	2. In MPPT mode, the will start when the input voltage is more than the Open Circuit Voltage and the Start-up delay is elapsed.

4. Installation

- Ensure that proper selection of the controller along with the solar modules and the pump set is done based on site conditions.

Unpacking:

- Open the controller's carton box. The contents of the box are packing materials and the controller itself. Take out the controller carefully.
- Check for physical damages. If there any visible damages to the unit, do not use it. Damages may have resulted in internal problems.
- Check and note the serial number of the controller. Verify that the specifications and material code are correct for the purposes of the installation.

Controller Mounting:

- Using the correct U clamps at the top and bottom of the controller to ensure a secure fit.
- If wall mounted, examine the wall's rigidity and construction details.
- Ensure proper earthing and Attach the drive's earthing system.

Controller connection with the Input Supply (DC and AC):

- Connect solar panel input connectors correctly. It has to be ensured that positive and negative marked MC4 connectors are connected to same respective polarities of the solar panels. Use multi-meter to verify the same.
- If solar input is connected and DC MCB is turned on (or single phase 50/60 Hz, 230 V AC supply is given and AC MCB is turned on) the controller's LCD should light up with rolling displays. If it doesn't recheck voltage and polarity of solar panels. Discard the unit if power input is correct and the system still doesn't turn on.

Controller connection with Motor-Pump Set:

- Verify that the motor name plate is compliant with controller name plate for correct operation.
- Before assembling the motor and pump, connect motor terminals to the output cables of the controller by matching the colour codes. It is advised to check the

resistance of all three phase of motor before the motor is connected. There should not be a variation of more than 5% per phase. The motor should otherwise be discarded.

- Connect motor cable terminals to the motor output cable of the controllers in correct R-Y-B sequence. Connecting in wrong sequence will lead to opposite rotation and may lead to damages in certain types of pumps.
- Ensure proper earthing for the controller and the motor.

Not connecting the earthing properly may lead to motor leakage current shocks to the user and also may damage the drive in the long run.

- In dual controller switch on the MCB (DC/AC) and operate the ON key which will give run command to the motor and display shows running.
- Ensure that the motor is running in the correct direction as per the arrow marked in the motor. (in case the motor runs in opposite direction interchange any 2 wires from controller output to motor)
- If the motor starts spinning without issues, ensure that it is turned off within 30 seconds. The unit may turn off the motor with Dry Run Fault on the LCD. This is normal.
- Check for current consumption when the motor was running. It should be well under the rated current limit.
- The motor and pump can now be coupled properly.
- The cable from the controller to be connected with cable from the motor using proper joining kit so that there is no short circuit.
- For overhead tank overflow protection yellow and black wire from the controller to be connected with suitable sensor. The sensor to be placed in a suitable position in the overhead tank. Do ensure that setting in the controller for the parameter 83 is kept as 000. 000 ensures the NO contact which is desired for overhead tank overflow protection.

- For dry run protection white and black wire from the controller to be connected with suitable sensor. The sensor to be placed at least 1 meter over the pump delivery nozzle. Do ensure that setting in the controller for the parameter 84 is kept as 001. 001 ensures the NC contact which is desired for dry run protection.

Fault Selection	Parameter	NO Connection	NC Connection	Wire used
Water Level 1 (Overhead Tank Overflow Protection)	83	000	001	BLACK and Yellow
Water Level 2 (Dry Run Protection)	84	000	001	BLACK and White

- The motor and pump can now be installed inside the bore.
- Turn on the system again to observe water output and proper operation.

In case the pump set fails to run properly or controller shows over current, it could be a controller tuning issue. Verify motor-controller configuration or Contact service.

5. Operation

For an end user, operating the system is quite straightforward.

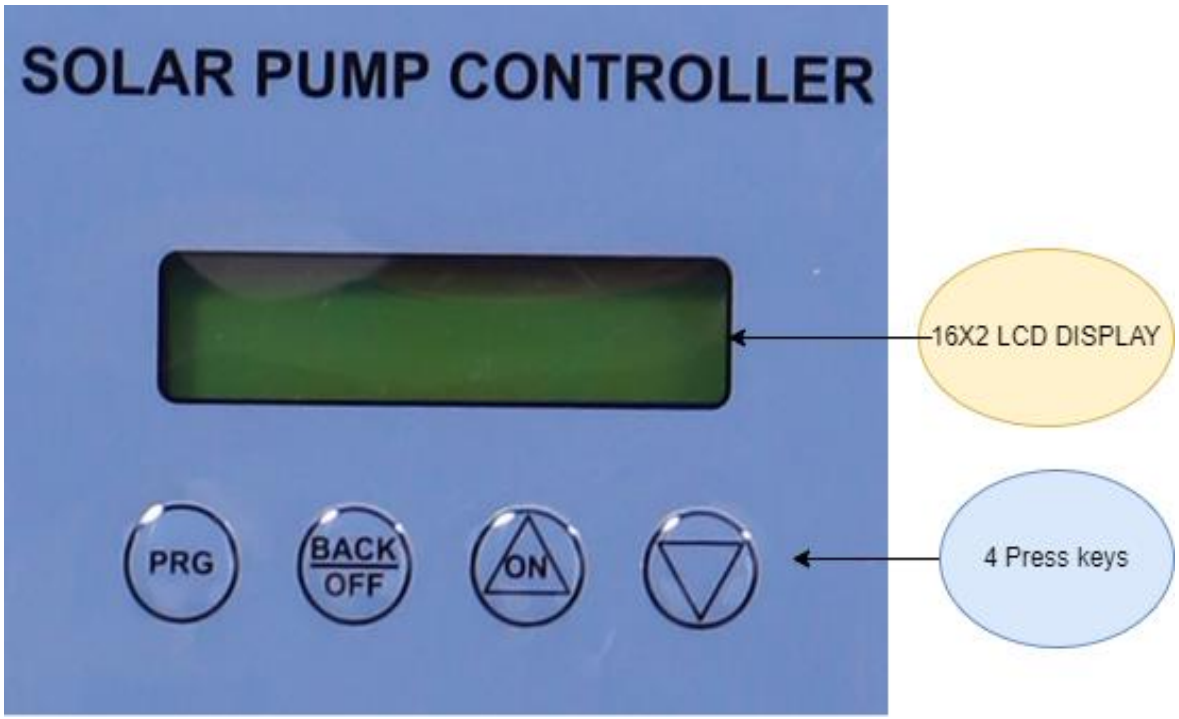
Following are the key points:

- Motor can be turned on or off by operating the MCB (DC/AC) in the controller or by pressing the on/off key in the controller.
- For the first time operation and if the controller is operated after a long time, ensure that load is connected to the controller after switching on the controller for 10 minutes.
- While, Roto Energy Systems Limited controller and submersible positive displacement pumps do not require day-to-day maintenance if properly selected and installed, it is a good practice to monitor the conditions and performance of the system. This diagnosis may be carried out by checking the maximum pressure (shut valve for a very short period) generated by the pump, and by checking the current drawn by the motor at standard duty flow rate. Both these

figures should be compared to pressures and current drawn recorded when the unit was initially installed. Any reduction in pressure may indicate wear in the pump, while any increase in motor current indicates a possible overload condition. Consult the pump service chart for further diagnosis of possible causes.

- If system fails to run, report the issue on the telephone number provided. Serial number and model of the controller, motor & pump along with the Invoice serial number should be kept handy while reporting the issue. If there is a fault on the LCD display of the controller, it should be noted down and reported on the call.
- Alternatively, end user may report the issue to their respective system integrators/dealer who in turn can report the issue to Roto Energy System Limited.

Understanding LCD Display and Keys



Display Sticker

The drive has an in-built LCD Display with 4 functional keys for monitoring and updating parameters. On start-up, controller enters READY mode if input voltages are sufficiently within the range as per the specification.

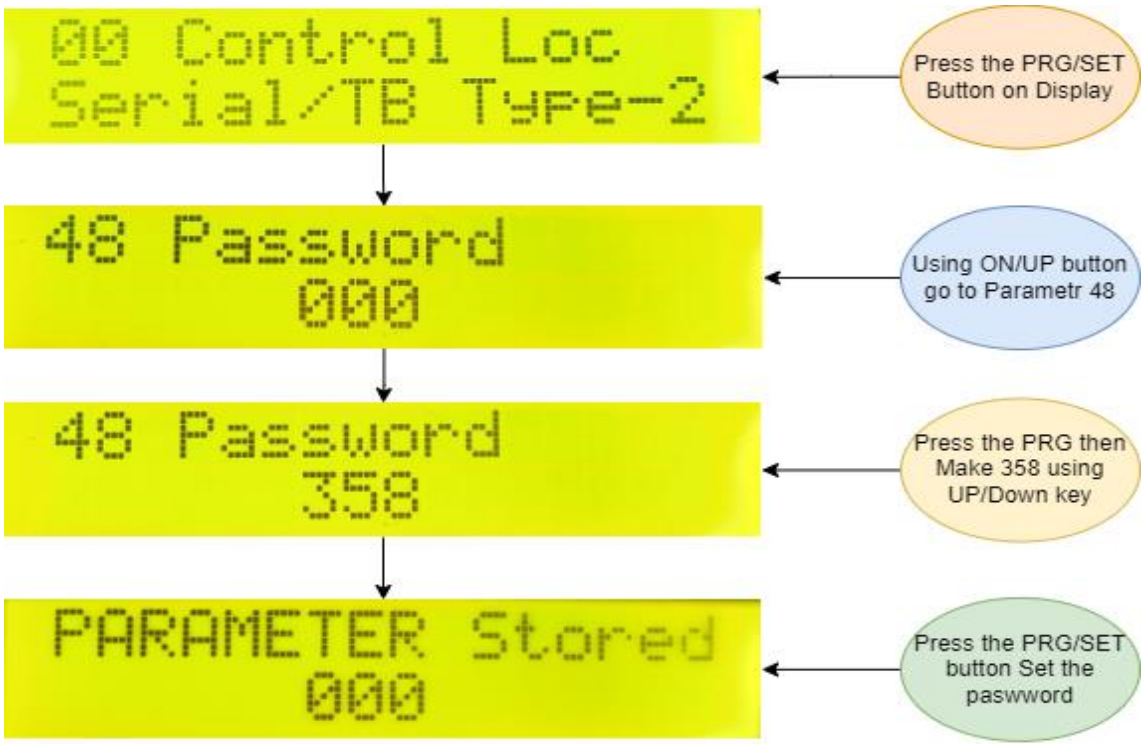
DISPLAYED MESSAGES	DESCRIPTION
IOUT= A	Indicates Motor Current
FREQ= Hz	Indicates output running frequency
DC= Volts	PV Voltage / DC Bus Voltage
IPV= Amps	PV Current for DC input only
IGBT= DegC	Device case temperature
VOUT= V	Output RMS Voltage
RPM=	Motor RPM
PWR= kW	DC Power in kW
FLOW= LPM	Estimated Water Flow in Liters per Minute
KWH=	Total Energy (Accumulated)
Signal=	In case of RMU along with SIM are installed, this indicates signalstrength available. Less than 10 can be considered as LOW and 0 indicates no Signal

After entering programming mode, pressing PRG key again will enable parameter updating. Pressing ▲/▼ keys in this mode will alter the parameters to the desired value. Press PRG for storing the new value to the parameter and pressing BACK will return to scrolling mode.

The parameter can be changed only after password is entered in the controller (default password setting is 358)

Keys	Description
PRG	Used as Program and Set Key • This Key is used to enter into Programming mode • When the drive is running, this key is used to scroll through monitoring parameters such as Output Voltage,Output real power, PF, etc • After modifying the parameters pressing this key for atleast 3sec will save the parameter value.

BACK/ OFF	Back Key is used as Return Key. • This may be used for returning to the previous menu. • Used for clearing the keypad resettable faults
▲	Used as UP key • When the Parameter “Mode Select” is from Keypad, UP key is used for increasing the reference frequency/ speed when the VFD is running in Motor mode of operation. • In programming mode, UP key is used to select parameter OR increment the data value for the selected Parameter.
▼	Used as DOWN key • When Parameter “Mode Select” is from Keypad, DOWN key is used for decreasing the reference frequency/ speed when the drive is running in Motor mode of operation. • In programming mode, DOWN key is used for selecting the Parameter OR decreasing the data value for the selected parameter.
ON	In MPPT mode pressing this key is START Command to the drive.
BACK/ OFF	In MPPT mode this key STOPs the motor.



Note:
After setting the password, select a parameter, press the PRG key, then use the UP/DOWN key to change the value in the parameter, Hold the PRG Key so that changed value is stored in that parameter.

List of Parameters:

Parameter	Parameter Name	Default	Settable Range
00	Control Loc	Serial/TB Type-2	• Serial Input • TB Input • Serial/TB Type-1 • Serial/TB Type-2 • S/TB Type2 Latch
01	Main Speed Ref	Remote	• Remote • Keypad
02	Freq Maximum	250.0 Hz	30 - 300Hz
03	Base Freq	50.0 Hz	30 - 300Hz
04	Rating	0.7 Kw	0.01 – 7.46Kw
05	Control Type	Sensor less PMSM	• V/F Control • Sensor less PMSM
06	Rated Current	12Amps	1.0 - 15Amps
07	Rated Voltage	70Volts	0.0 – 380Volts
08	Freq Minimum	1.00 Hz	1.0 - 240.0 Hz
09	Ramp Up Time	20.0 Sec	0.1 - 120.0 Sec
10	Ramp Down Time	05.0 Sec	0.1 - 120.0 Sec
11	Min DC Level	70.0 Volts	70.0 Volts -210.0 Volts
12	Low DC Limit	70.0 Volts	70.0 Volts -210.0 Volts
13	Torque Boost	002%	01 – 20%
14	Delta V Step	0.8 Volts	0.1 – 6.0 Volts
15	PM Control	00535	1 - 9999

16	O/P Cur Limit	130.0%	80 – 150.0%
17	OL Percent	110%	80 – 150.0%
18	RS 485 Time Out	0 Sec	0 – 60Sec
19	Pole Pairs	005	01 - 06
20	RS Resistance	0.50 Ohn	0.01 – 99.99 Ohm
21	Ld Inductance	0.80 mH	0.01 – 99.99 mH
22	Lq Inductance	1.09 mH	0.01 – 99.99 mH
23	Ke Constant	0.27 V. s/r	0.01 – 99.99 V.s/r
24	Kt Constant	0.28 Nm/A	0.01 – 99.99 Nm/A
25	Rotor Inertia	3.93 Kg CM^2	0.01 – 99.99 Kg CM^2
26	Speed Kp Gain	18208	0.01 – 99.99
27	Speed Ki Gain	23488	0 - 32767
28	D Cur Kp Gain	2703	0 - 32767
29	D Cur Ki Gain	18348	0 - 32767
30	Q Cur Ki Gain	2975	0 - 32767
31	Q Cur Ki Gain	641	0 - 32767
32	Current Calibration AC	7730	05730 - 09999
33	START Delay Cnt	1	01 - 024
34	PMSM PWR Calb	3187	2000 - 4000
35	DC CUR Calibration	1815	1000 - 4000
36	Closed Loop TO	40	001 - 400
37	DCV Calib	****	***
38	Start Up Current	060%	005 - 100%
39	FOC Start Ramp	20.0 Sec	01.0 – 120 Sec
40	Align Voltage	08.0	00.1 – 25.0
41	Min RPM PMSM	600 RPM	0 - 1000 RPM
42	FW Precent	99%	0 - 99%
43	Closed Loop BO	400 Hz	01 – 600Hz
44	Speed Damping	0.65	0.01-1.00

45	Current Frequency	180 Hz	080 – 600Hz
46	Current Damping	1.0	0.01 – 1.00
47	ID Run	000	0 - 002
48	Password	000	358
49	Max EMF Volts	68.0 Volts	0.01 – 380.0
50	Mode Select	000	0 - 001
51	Set Default	000	0 – 001
52	Motor Direction	Forward Direction	• Forward Direction • Reverse Direction
53	Fault Enable	14327	0 - 32767
54	MPPT Start Rate	04096	02048 - 32767
55	DC Stable Voltage	50 Volts	0 – 2000 Volts
56	Phase Loss dV	200	050 - 1000
57	DRY RUN Power	0.1kW	0 – 10.0 kW
58	DRY RUN Frequency	35.0 Hz	01.0 – 310.0
59	D Pul Kp Gain	19338	0.0 - 32767
60	D Pul KI Gain	22105	0.0 - 32767
61	Q Pul Kp Gain	18295	0.0 - 32767
62	Q Pul KI Gain	22324	0.0 - 32767
63	MPPT Method	009	0.0 - 32767
64	MPPT-P-Gain	19032	0.0 - 32767
65	MPPT-I-Gain	21105	0.0 – 32767.0
66	Dry Run Reset	900	0.0 – 3600sec
67	Rated Flow	1.9 m^3/h	0.0 – 350.0
68	Rated Head	70.0 m	0.0 – 999.9
69	Reset Counts	No Action	0 – No action 1 - Reset Total Flow

			2 - Reset Total kWH 3 - Reset Run hours
70	UP Link Time	120 Sec	0 – 9999 Sec
71	MPPT Interval	010	08 – 015.0
72	MPPT Min Power	005	0 - 9999
73	V/F Frequency - 1	25	0.0 – 85.0
74	V/F Voltage - 1	26	0 – 099.0
75	V/F Frequency - 2	42	0.0 – 85.0
76	V/F Voltage - 2	80	0 – 099.0
77	MPPT- On Level	090%	070 – 099%
78	MPPT-P-Gain1	18250	0.0 – 32767.0
79	MPPT-P-Gain2	24152	0.0 – 32767.0
80	MAINS SENSE	3500	0 – 5000.0
81	P Limit Value	06.0 kW	03.0 – 7.5kW
82	UV Level G	200	80.0 – 500.0
83	Switch -DI3	0	0 – 1.0 (set value is 0 then NO if set value is 1 then NC)
84	Switch -DI4	0	0 – 1.0 (set value is 0 then NO if set value is 1 then NC)
85	Start marge delay	16384	0.0– 32767.0

★ The parameter will change depending upon the HP Rating.

6. Precautions

Apart from the precautions mentioned in the rest of the sections, the following should be followed for correct and hassle-free operation:

- Handle the controller with care. Follow instructions on packaging carefully for correct handling.
- Do not stack for a more than 3 units in a column during storage or transport.
- In any case applied voltage should not exceed the permitted voltage range, it can harm the controller.
- Connect wires with standard connection procedures to avoid short circuits, voltage drops and other electrical problem. All connections should be properly done to avoid any sparking
- Ensure earthing is done correctly.
- Use correctly size cable gauges for DC, AC and earth connections
- Ensure that cabinet is not left open and that IP65 is not compromised due to damages of gaskets and the body.
- It is advisable to mount controller under the shadow of any object like solar panel.
- Do not cover the controller by any material like polythene, cloths etc. as it may cause over heating of the controller.
- The wiring work should be done by qualified electricians
- High voltages exist inside the enclosure. Wait for 10 minutes after disconnecting the power sources (PV Panel and AC mains inputs) before accessing the circuits. All Leds inside the controller should be off.

7. Faults

Sl. No.	LCD Display	Cause for the fault	Fault reset/ Clearing method	Fault reset time
1	DC UV Fault	Input DC < Rated	Input DC reaches rated value	Automatic
2	DC OV Fault	Input DC > Rated	Input DC reaches rated value	Automatic
3	!Over Temp!	Heatsink Temperature > 85℃	Heatsink Temperatureis less than 85℃	1 Min
4	!Water Level!	Fault set when “EXT Input Set”is set to Water level sensing and it is activated	Deactivating external fault inputs	Automatic
5	!Surge PV!	PV Surge Suppressor board failure/ improper wiring	Replace PV surge Suppressor / proper wiring	After 6 seconds
6	!DRY RUN!	When output power is less than set at Parameter “03NL Pwr Base”	Time based	After 1 hour
7	!DRYRun/EXT!	When parameter “FAULTInputSel”is chosen to be ACTHi or ACTLo, Internal DRYRUN measurement is disabled and drive trips for external signal input	When external input command clears	Automatic
8	!Unbalance!	Output motor cable open	Proper wiring	After 1hour
9	Inverse OL	Overload fault following an inverse curve with the limits 110% for 30min	Reducing the load within 110%	After 10minutes

		and 130% for 10sec		
10	OC in Acceln	When motor is locked or pump jammed	Clearing Lock or Jam	After 1 hour
11	OC in RUN	Current crosses rated value while running	Clearing the Lock or JAM Proper motor wiring	After 1 hour
12	!Output SC!	Output Short Circuit	Clear Short Circuit	Power recycles
13	!Door Open!	Module door is open	Door to be closed	1Minute
14	!Over Speed!	For PMSM only. Estimated speed is more than 3800rpm	Motor tuning parameters to be rechecked	After 1 hour
15	!OUTPUTOPEN!	For PMSM only. Motor is not connected	Check motor connection	After 1 hour
16	Motor Stall	Motor draws excessive current at lower speed than minimum speed	Mechanical assembly to be checked	After 1 hour
17	AC SURGE	AC Surge Suppressor fused	--	--

The warranty is void for the following conditions:

Sl No.	Conditions
1	Repair, modification or movement of the product or parts by buyer oranyone other than seller or its authorised representative or incorrect attachment to other products not provided by seller.
2	Damage resulting from Power Surges and acts of nature, including but not limited to storms, lightning, over voltage, fire, flood, pests, or other events outside the control of Seller.
3	Damage resulting from abuse, misuse, negligence, accident, action of third parties, improper or non-compliant use of operation including inadequate ventilation and circulation, improper installation, commissioning, and maintenance.

4	Damage resulting from improper start up, storage, excessive pollution,and dirt or dust intrusion into the product.
5	Installation in a highly corrosive environment.
6	Abnormal or unintended use.
7	Damage during transportation.
8	Damage resulting from the external connected equipment.
9	Damage resulting from failure to properly maintain the products.

8. Support

For sales related enquiry:
Visit www.rotoenergy.com

For service support:
Call Number: +91 (0) 120 2567946

If you are business customer:
To monitor and manage your systems, go to solarpump-manager.com and log in with the credentials provided to you.

For other queries:
Send an email to info@rotoenergy.com