

# SOLAR PUMP INVERTER- PRODUCT MANUAL

## 1. Introduction:

This Product manual describes about the Solar pump Inverter specification and its model identification. It also contains operating parameters and troubleshooting factors in case of any faults.

## 2. Solar Pump Inverter Model Description:

The following section describes about the solar pump inverter model and its model identification.

### 2.1 Solar Pump Inverter with IP65 Enclosure:

Designator identification for inverter with PV input as a source are listed in Table 1.

PV65L - 7H5 - B - 18A - R  
**A B C D E**

**Table 1:** Designator identification for inverter with PV input as a source

Section	Data	Description	
A	Inverter Series	PV65 – Solar MPPT Inverter - IP 65 L - Keypad type → L - LCD display/ D - LED display	
B	Motor HP	<b>HP</b>	<b>Symbol</b>
		1 HP	H1
		2 HP	H2
		3 HP	H3
		5 HP	H5
		7.5 HP	7H5
		10 HP	H10
		12.5 HP	12H5
		15 HP	H15

C	Class	Voltage Class	Input Solar DC Voltage	Output Voltage (3PH VAC)	MPPT Voltage (VDC)
		A	70 – 450V	0 – 260V	65 to 380
		B	400 – 800V	0 – 415V	380 to 680
D	Maximum Ampere	HP	Ampere (A)		
		1 to 5	12		
		7.5	14		
		10	22		
		12.5	25		
		15	30		
E	RMS	Part E is presents inverter has included with <b>Remote Monitoring System (RMS)</b> . If not exits, inverter doesn't have RMS facility.			

## 2.2 Solar Pump Inverter Both Solar PV and with GRID Input source:

Table 2 describes about Designator identification for inverter with Solar PV supply and Grid input as a source.

GPV65D-7H5 - B - 18A - R  
**A B C D E**

**Table 2:** Designator identification with PV source and GridInput.

Section	Data	Description	
A	Inverter Series	GPV65 – Solar MPPT Inverter supports both Grid Input and Solar PV DC Supply - IP 65 L - Keypad type → L - LCD display/ D - LED display	
B	Motor HP	HP	Symbol
		1 HP	H1
		2 HP	H2
		3 HP	H3
		5 HP	H5
		7.5 HP	7H5
		10 HP	H10

		12.5 HP	12H5		
		15 HP	H15		
C	Class	<b>Voltage Class</b>	<b>Input Voltage</b>	<b>Output Voltage (3PH VAC)</b>	<b>MPPT Voltage (VDC)</b>
		A	70 – 450 VDC / 230 VAC	0 – 260V	65 to 380
		B	400 - 800VDC / 415V/440VAC	0 – 415V	380 to 680
D	Maximum Ampere	<b>HP</b>	<b>Ampere (A)</b>		
		1 to 5	12		
		7.5	14		
		10	20		
		12.5	25		
		15	30		
E	RMS	Part E is presents inverter has included with <b>Remote Monitoring System (RMS)</b> . If not exits, inverter doesn't have RMS facility.			

### 3. Model Identification:

Solar PV Inverter models are listed in the following table.

**Table 3:**Solar PV Inverter model with Solar PV DC as only Source and LED keypad Display.

MODEL**	Rated Current	Pump Capacity	Input DC Voltage (VDC)	Output Voltage (VAC)	Recommended MPPT Voltage (VDC) *
PV65D-H1-A-12A	12A	1HP	70-300V	(0-140)VAC3PH	80 - 230 V
PV65D-H2-A-12A	12A	2HP	120-450 V	(0-180)VAC3PH	230 - 380 V
PV65D-H3-A-12A	12A	3HP	160-450 V	(0-230)VAC3PH	260 - 380 V
PV65D-H5-A-12A	12A	5HP	160-450 V	(0-260)VAC3PH	260 - 380 V

PV65D-H5-B-12A	12A	5HP	300-800V	(0-400)VAC 3PH	480 - 680 V
PV65D-7H5-B-14A	14A	7.5HP	300-800V	(0-400)VAC 3PH	480 - 680 V
PV65D-H10-B-22A	22A	10HP	300-800V	(0-400)VAC 3PH	480 - 680 V
PV65D-12H5-B-25A	25A	12.5HP	300-800V	(0-400)VAC 3PH	480 - 680 V
PV65D-H15-B-30A	30A	15HP	300-800V	(0-400)VAC 3PH	480 - 680 V

**Table 4:**Solar PV Inverter model (LED Keypad) with Input Source as a Solar PV DC and Grid Power supply.

MODEL**	Rated Current	Pump Capacity	Input Voltage (DC / AC)	Output Voltage (VAC)	Recommended MPPT Voltage (VDC) *
GPV65D - H1-A-12A	12A	1HP	(70-350) VDC / 230VAC	(0-140) VAC 3PH	80 - 230 V
GPV65D - H2-A-12A	12A	2HP	(120-450) VDC / 230VAC	(0-180) VAC 3PH	230 - 380 V
GPV65D - H3-A-12A	12A	3HP	(160-450) VDC / 230VAC	(0-230) VAC 3PH	260 - 380 V
GPV65D - H5-A-12A	12A	5HP	(160-450) VDC / 230VAC	(0-260) VAC 3PH	260 - 380 V
GPV65D - H5-B-12A	12A	5HP	(300-800) VDC OR 380VAC / 415 VAC	(0-400) VAC 3PH	480 - 680 V
GPV65D - 7H5-B-14A	14A	7.5HP	(300-800) VDC OR 380VAC / 415 VAC	(0-400) VAC 3PH	480 - 680 V
GPV65D - H10-B-22A	22A	10HP	(300-800) VDC OR 380VAC / 415 VAC	(0-400) VAC 3PH	480 - 680 V
GPV65D -12H5-B-25A	25A	12.5HP	(300-800) VDC OR 380VAC / 415 VAC	(0-400)VAC 3PH	480 - 680 V
GPV65D -H15-B-30A	30A	15HP	(300-800) VDC OR 380VAC / 415 VAC	(0-400)VAC 3PH	480 - 680 V

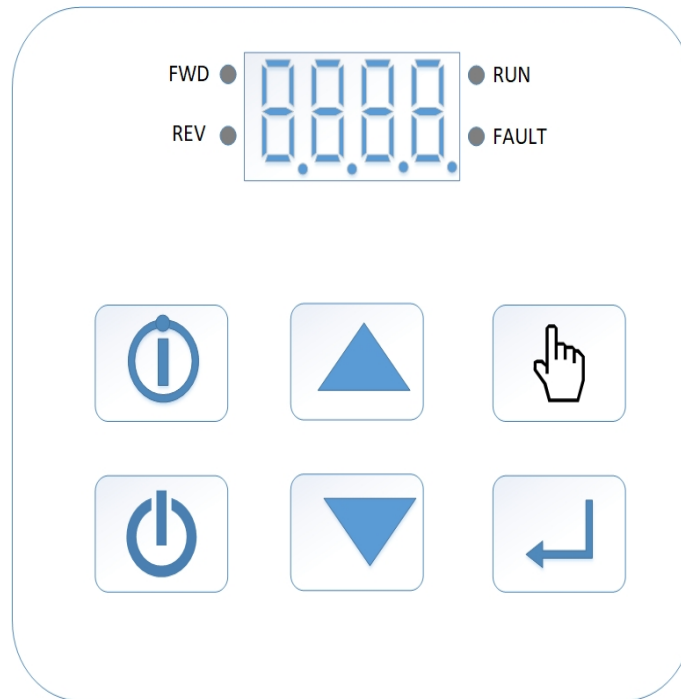
**Note:**

- 1) Part Number include **Part E section** denote the Inverter present Remote Monitoring system. If Part E section is not included inverter doesn't support Remote Monitoring system.
- 2) The total Solar power should be **at least bigger 1.3 times** than of rated power of pumps.
- 3) \* The recommended MPPT voltage is suggested only. It will not suitable for all motor, but user can calculate as per their requirement based on the motor parameters.

- 4) \*\* Customer has to mention the Keypad requirement, whether need of LED or LCD display based upon requirements.

## 4. Start Up and Operation

### 4.1 Keypad Description:



Button name	Function
Start	To run the controller in keypad control mode
Stop	In running mode, used for stop the controller In fault mode, used for reset the controller
Up	Linearly Increase the data code and function parameters
Down	Linearly Decrease the data code and function parameters
Program	Enter or exit to the program mode, parameter modification
Enter	To confirm the parameter value and also used to change the panel display parameters

## 4.2 Keypad operation process:

### Parameter setting:

Below example will show to set the parameter P-01 [Acceleration time].

To set the parameter, press the **Program** (hand symbol) key.

- Display shows P-00. Press **Up** key to change the parameter from P-00 to P-01.
- Display shows P-01. Press the **Enter** key, and then it shows the default value and using **Up** and **Down** key to change the value.
- Press **Enter** key to set and return to program P-01.
- Press **Program** key to return from programming mode.

### Fault reset:

After the controller in fault mode condition, display shows the relevant error code for corresponding error. To reset the controller, press “**Stop / Reset**” key. In case of some fault condition, it will auto restart the controller depend upon the Auto reset time. The controller can continue to run after the reset.

## 4.3 Running status display parameters:

Note: To use” **Enter**” key to switch the parameters

Display	Name	Description
H	Frequency	Controller output frequency
U	Output voltage	AC Input Voltage
A	Output current	AC Current
d	Input voltage	DC output Voltage
C	Input current	DC current
pdc	Input Power	Input DC Power in kW
t	Temperature	Heat sink temperature
rpn	RPM	Motor RPM

#### 4.4 User definable parameters:

Parameter	Description	Range	Factory Setting	MODBUS Address
P-00	Software Version	-	3.7	40257
P-01	Acceleration time	0.5 to 99.9 sec	5.0 sec	40258
P-02	Deceleration time	0.5 to 99.9 sec	0.5 sec	40259
P-03	Control mode 0 - Start mode in Keypad 1 - Start mode in Switch	0-1	1	40260
P-04	<b>Display selection monitoring</b> 0-Output Frequency 1-Output Voltage 2-Output Current 3-DC Bus voltage 4-DC CURRENT 5-Input Power 6-Temperature 7-MPPT 8- Auto Rotate	0 to 8	8	40261
P-05	<b>Motor Direction</b> 0-Forward 1-Reverse	0 to 1	0	40262
P-06	Motor Rated Current	Depend on HP	(Amps)	40263
<b>P-07</b>	Dry Run Current	Depend on motor	(Amps)	40264
P-08	Minimum output frequency	0 to 100 Hz	1.5 Hz	40265
P-09	Maximum output frequency	0 to 200 Hz	50 Hz	40266
P-10	Vector Control Over Modulation Gain	100 - 200 %	100%	40267
P-11	MPPT Search Time	0.1 - 10.0	1.0	40268
P-12	Reserved	-	-	40269
P-13	Reserved	-	-	40270
P-14	Reserved	-	-	40271
P-15	Reserved	-	-	40272
P-16	Reserved	-	-	40273
P-17	Reserved	-	-	40274
P-18	Reserved	--	-	40275
P-19	Frequency minimum	0 to 10 Hz	1.5 Hz	40276
P-20	Voltage minimum	0 to 40 V	18 V	40277
P-21	Mid frequency	0 to 25 Hz	3.0 Hz	40278
P-22	Mid voltage	0 to 200 V	30 V	40279
P-23	Maximum Frequency	0 to 60 Hz	50 Hz	40280
P-24	Maximum Voltage	0 to 260/440V	220/400V	40281
P-25	MPPT search Upper limit voltage	75% to 90%	85%	40282

P-26	Factory Reset to all Parameters	0 to 10	8 (reset)	40283
P-27	MPPT Search lower limit	70 -90%	75%	40284
P-28	Reserved	-	-	40285
P-29	Reserved	-	-	40286
P-30	LCD/LED Display Selection	0-LCD display 1-LED display	1	40287
P-31	Reserved	-	-	40288
P-32	Reserved	-	-	40289
P-33	Motor Power Limit in Watts	10 - 2200	800	40290
P-34	Reserved	-	-	40291
P-35	Motor poles	2 to 10	4	40292
P-36	Reserved	-	-	40293
P-37	Reserved	-	-	40294
P-38	<b>Control Mode</b> 0 - V/F Control Mode 1 - Vector Control (PMSM)	0 - 1	0	40295
P-39	Reserved	-	-	40296
P-40	Reserved	-	-	40297
P-41	DC Bus Filter Constant	100 - 3000	100 - Surface Pump 2000 - Other type of motor	40298
P-42	<b>MPPT Control Mode</b> 0 - Manual reference 1 - Algorithm-1, High Stability 2 - Constant Voltage Mode (As per P-25) 3 - Algorithm-2, High Efficiency 1 4 - Algorithm-3, High Efficiency 2	0 - 4	3	40299
P-43	Dry Run Enable /Disable 1-Enable 0-Disable	0 - 1	1	40300
P-44	Dry Run Detection Time	0-9999 sec	120 sec	40301
P-45	Dry Run Reset Time	0-999 min	30 min	40302
P-46	Minimum Power Protection	0.02 to 10.0 kW	0.2 kW	40303
P-47	Minimum Power Detection Time	0-9999sec	300 sec	40304
P-48	Minimum Power Reset Time	0-9999sec	600 sec	40305
P-49	Minimum Speed Protection	0 to 3000 RPM	500 RPM	40306
P-50	Minimum Speed Detection Time	0-9999sec	30 sec	40307
P-51	Minimum Speed Reset Time	0-9999sec	60 sec	40308
P-52	Error Auto Reset time	0 to 9999 se	180 second	40309
P-53		0 to 2	0 -- U phase	40310



	Phase current display selection		1 -- V phase 2 -- W phase	
P-54	Open Circuit Trip 0 - Disable 1 - Enable	0 to 1	1	40311
P-55	Phase Loss Trip 0 - Disable 1 - Enable	0 to 1	1	40312
P-56	Phase Loss Trip Delay Time	0.1 to 2.0 sec	1s	40313
P-57	Open Circuit Trip Delay Time	1.0 to 10.0 sec	5s	40314
P-58	Dc bus calibration	0 to 512	250	40315
P-59	Dc Current Calibration	75 to 125	100	40316
P-60	Slave Address	0-10	1	40317
P-61	Transmission Speed 0 - Baud rate 9600 bps 1 - Baud rate 19200 bps	0-1	0	40318
P-62	Power Curve 1	0.01-37.0 kW	0.5 kW	40319
P-63	Power Curve 2	0.01-37.0 kW	2.0 kW	40320
P-64	Power Curve 3	0.01-37.0 kW	3.0 kW	40321
P-65	Power Curve 4	0.01-37.0 kW	4.0 kW	40322
P-66	Power Curve 5	0.01-37.0 kW	5.0 kW	40323
P-67	Flow Curve 1	0.00-50.0LPS	0.1LPS	40324
P-68	Flow Curve 2	0.00-50.0LPS	0.5LPS	40325
P-69	Flow Curve 3	0.00-50.0LPS	1.0LPS	40326
P-70	Flow Curve 4	0.00-50.0LPS	1.5LPS	40327
P-71	Flow Curve 5	0.00-50.0LPS	2.0LPS	40328
P-72	Flow Gain	100%-200%	100%	40329
P-73	Reserved			40330
P-74	Speed Proportional Gain	500 to 8500	7499	40331
P-75	Speed Integral Gain	10 to 999	500	40332
P-76	Speed Differential Gain	10 to 999	100	40333
P-77	Torque Proportional Gain	500 to 8500	2499	40334
P-78	Torque Integral Gain	10 to 999	100	40335
P-79	Torque Differential Gain	10 to 999	10	40336
P-80	Flux Proportional Gain	500 to 8500	2499	40337
P-81	Flux Integral Gain	10 to 999	100	40338
P-82	Flux Differential Gain	10 to 999	10	40339
P-83	Motor Resistance in Ohm/phase	0.1 to 10.0	Upon HP	40340
P-84	Motor Inductance in mH/Phase	0.1 to 100.0	Upon HP	40341
P-85	Motor Back EMF in V/krpm	5 to 600	Upon HP	40342
P-86	Power Limit Enable 0 - Disable 1 - Enable	0 to 1	0 When Enable (1) - Frequency will be stop increase once Power	40343

			reached to the limit in the setting P-33	
P-87	Parking Current	0 - P-06	4.0	40344
P-88	Under Voltage Limit (%)	1-100%	50	40345
P-89	DC bus voltage stability Proportional gain	100 - 8500	2500	40346
P-90	DC bus voltage stability Integral gain	10 - 999	50	40347
P-91	Auto tuning	0 - 1	0	40348

## 4.5 MODBUS Communication Data:

Solar Pump Inverter supports for MODBUS data communication. The following table shows the RS-485 address along with its parameter.

### HMI/Controller Setting:

Baud Rate : 9600 / 19200pbs (Refer Parameter P-60 and P-61)  
 Data : 8 Bit  
 Start Bit : 1 Bit  
 Stop Bit : 1 Bit  
 Parity : None

S.No	Address	Function	Scaling
1	40001	Output Frequency	100
2	40002	Output Voltage	1
3	40003	Output Current	10
4	40004	DC Bus Voltage	1
5	40005	DC Current	10
6	40006	Instant Power	10
7	40007	Today Power	10
8	40008	Cumulative Power (MW)	1
9	40009	Cumulative Power (kW)	1
10	40010	Motor Speed	1
11	40011	Drive ON Hour	1
12	40012	Heat sink Temperature	1
13	40013	Motor Power	10
14	40014	Error Flag	1
15	40015	Today Flow	1

16	40016	Cumulative Flow(L)	1
17	40017	Cumulative Flow(H)	1
18	40018	Reference Frequency	100
19	40019	DC Open Circuit Voltage	1
20	40020	Flow Speed	1
21	40021	Maximum DC Voltage	1
22	40022	Maximum DC current	10
23	40023	Maximum Output Active Power	1
24	40024	Maximum Flow Speed	1
25	40025	Pump Today Run Hours	1
26	40257	Drive START/STOP Commands BIT 0: Drive Stop Command BIT 1: Drive Start Command	1

The following table describes about the 40014- Drive Error List and its corresponding bit Enable are listed below:

40014- Drive Error List				
Error code	Bit	Function	Bit status	
ER-00	0	Drive ON / OFF Status	0-OFF	1-ON
ER-01	1	Under Voltage	<b>0</b> - Error not occurred <b>1</b> - Error occurred	
ER-02	2	Over Voltage		
ER-03	3	Er-03		
ER-04	4	Over Load		
ER-05	5	Er-05		
ER-06	6	Minimum Power Protection		
ER-07	7	Minimum Speed Protection		
ER-08	8	Heat sink temperature		
ER-09	9	Output Short Circuit		
ER-10	10	Output Open Circuit		
ER-11	11	Output U Phase Loss		
ER-12	12	Output V Phase Loss		
ER-13	13	Output W Phase Loss		
ER-14	14	Dry Run Fault		

## 5. Fault diagnosis and Counter-measures of Solar PV Inverter:

The following chapter describes about possible faults and its counter-measures are listed below.

Fault Code	Fault Type	Possible Causes	Remedy Action
Error 1	Under Voltage	1) Input Power Supply Voltage is low.	1) Check the Input Power Supply. 2) Reduce the Motor Voltage setting in P-24.
Error 2	Over Voltage	1) Input Power supply voltage is higher than rated Value.	1) Check the Input Power Supply Voltage.

Error 4	Output Overload	<ol style="list-style-type: none"> <li>1) The load is too large or motor/Pump is blocked.</li> <li>2) The motor rated current setting is incorrect.</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the Output current.</li> <li>2) Check the parameter setting in P-06.</li> </ol>
Error 6	Minimum Power	<ol style="list-style-type: none"> <li>1) Input Power is Low.</li> <li>2) Minimum Power Protection setting P-46 is incorrect.</li> </ol>	<ol style="list-style-type: none"> <li>2) Set P-46 minimum power input protection for lower, P-47, P-48 for Detection time and Reset Time respectively.</li> </ol>
Error 7	Minimum Speed	<ol style="list-style-type: none"> <li>1) The sun light is weak or the solar cell panel configuration is insufficient.</li> <li>2) Minimum speed protection setting P-49 is incorrect.</li> </ol>	<ol style="list-style-type: none"> <li>1) The Inverter will automatically run when the light becomes strong. Check Solar Panel configuration.</li> <li>2) Set P-49 minimum speed protection for lower, P-50, P-51 for Detection time and Reset Time respectively.</li> </ol>
Error 8	Heat sink over temperature	<ol style="list-style-type: none"> <li>1) The ambient temperature is too high.</li> <li>2) IGBT module thermistor is damage.</li> <li>3) The inverter module is damaged.</li> </ol>	<ol style="list-style-type: none"> <li>1) Reduce the ambient temperature. Check the mounting position if drive is IP65.</li> <li>2) Contact Technical Team</li> <li>3) Contact Technical Team</li> </ol>
Error 9	Output terminal short circuit	<ol style="list-style-type: none"> <li>1) Output phase terminal is short.</li> <li>2) Motor load is too heavy.</li> <li>3) Motor Parameter (PMSM) setting is incorrect.</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the Motor terminal connections.</li> <li>2) Check the Output load</li> <li>3) Check Motor parameter P-24, P-38, P-83, P-84 and P-85.</li> </ol>
Error 10	Open Circuit Fault	<ol style="list-style-type: none"> <li>1) Output Load is not connected to inverter.</li> </ol>	<ol style="list-style-type: none"> <li>1) Connect Output Load</li> </ol>
Error 11	Phase Loss - U	<ol style="list-style-type: none"> <li>1) Output U phase connection is missing.</li> <li>2) U phase Output Current is too Low</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the U phase wiring.</li> <li>2) Check the motor three-phase winding is normal and troubleshooting</li> </ol>
Error 12	Phase Loss - V	<ol style="list-style-type: none"> <li>1) Output V phase connection is missing.</li> <li>2) V phase Output Current is too Low</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the V phase wiring.</li> <li>2) Check the motor three-phase winding is normal and troubleshooting</li> </ol>
Error 13	Phase Loss - W	<ol style="list-style-type: none"> <li>1) Output W phase connection is missing.</li> <li>2) W phase Output Current is too Low</li> </ol>	<ol style="list-style-type: none"> <li>1) Check the W phase wiring.</li> <li>2) Check the motor three-phase winding is normal and troubleshooting</li> </ol>

Error 14	Dry Run Protection	1) Reservoir is Empty 2) Dry Run Motor Ampere setting P-07 is incorrect.	1) Check Water Level 2) Set P-07 Low to disable if water level is fine.
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**Error 1 – Under Voltage Detection:**

Under Voltage of the specific inverter can be calculated as follows:

$$\text{Under Voltage} = 0.61 * P-24 * 1.414$$

Example: if P-24 = 380, then Under Voltage =  $0.61 * 380 * 1.414 = \underline{\underline{328VDC}}$ .

**Error 2 – Over Voltage Detection:**

The Following table shows the over voltage (DC) setting of the inverter:

Inverter Class	Over voltage
Class A	480VDC
Class B	820VDC

**Error 4 – Output Overload:**

Output Overload will be detected based upon the following factors as shown below:

100% of output current means that output current = P-06 parameter setting.

Output Current %	Detection Time in seconds
>100 - 124 %	180
>125 - 149 %	120
>150 - 179 %	10
>180 %	2

## **Error Auto Reset Functions:**

**Case 1:** The Following Error will be auto reset based upon the timing (in seconds) set in the parameter P-52.

- 1) Error 10
- 2) Error 11
- 3) Error 12
- 4) Error 13
- 5) Error 14

### **Case 2: Error 4 – Auto Reset:**

Error4 will be auto reset as the timing set in P-52. But Inverter tries again and again for 5 times. If it exceeds detection more than 5 times, Inverter will show same error. Check the remedy action.

### **Case 3: Error 9 – Auto Reset:**

Error 9 will be auto reset within 60 sec. But Inverter tries again and again for 5 times. If it exceeds detection more than 5 times, Inverter will show same error. Check the remedy action.

### **Case 4: Error 6, Error 7 – Auto Reset:**

For Error 6 and Error 7, the separate parameters are allocated for Detection and Auto reset as shown in table.

<b>Error</b>	<b>Detection time</b>	<b>Auto reset time</b>
Error 6	P-47	P-48
Error 7	P-50	P-51

### **Case 5: Error 8 – Auto Reset:**

If the temperature of the Inverter exceeds 90°C, Error 8 will be activated and it will clear when inverter case temperature falls to 80°C.

## 6. Auto Tuning:

### Steps to do auto tuning for PMSM Motor:

#### Step 1:

Verify, the PMSM (dc motor) parameters as mentioned below,

Parameter	Description	Range	Factory Setting	MODBUS Address
P-08	Minimum output frequency	0 to 100 Hz	10 Hz	40265
P-09	Maximum output frequency	0 to 200 Hz	110 Hz	40266
P-24	Maximum Voltage	0 to 260/440V	Rated motor voltage	40281
P-38	<b>Control Mode</b> 0 - V/F Control Mode 1 - Vector Control (PMSM)	0 - 1	1	40295

#### Step 2:

- Now, connect the motor wire (R Y B) to the drive output (R Y B) respectively without pump.
- Set parameter P-91 => 1
- Now, switch on the motor and wait for 3 minutes. After completion of tuning, motor will run automatically based upon the maximum frequency set in **P-09**.
- Switch off the motor, connect respective pump and run the motor in load before putting it inside the borewell and ensure the proper running condition.
- You can verify the tuned values in below mentioned parameter list.



<b>Parameter</b>	<b>Description</b>	<b>Range</b>	<b>Factory Setting</b>	<b>MODBUS Address</b>
P-83	Motor Resistance in Ohm/phase	0.1 to 10.0	Auto Tuned value	40340
P-84	Motor Inductance in mH /Phase	0.1 to 100	Auto Tuned value	40341
P-85	Motor Back EMF in V/krpm	5 to 600	Auto Tuned value	40342