M. B. Control & Systems Pvt. Ltd.
CIN : U67120WB1980PTC033012 | PAN : AABCM7980K | GST NO. : 19AABCM7980K1ZU
Registered & Corporate Office
31/1, Ahiripukur Road, Kolkata, West Bengal 700019 | +91 98313 30473, 98312 06454
+91 033 2287 0445 | enquiry@mbcontrol.com | www.mbcontrol.com
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ISO 9001 : 2015
IND/QMS/NAB-C1978/2658

Solar Irradiation Sensor (Modbus RS485 Output) - Operation and Installation Manual
Models –MBMet-501

Document Number: M4 050 040 040 01 (R4)
(Suitable for HW Version-101 and SW Version – 101)

Contents

For service support call us on +91 33 65651011 or mail us in service@mbcontrol.com

1. Warnings

- Installation at site should be done by skilled and qualified personal after taking required approvals.
- Use proper protection gear and tool while installing the device.
- Be aware of your surroundings while doing the installation work.
- Serious injury can occur if proper safety norms are not followed.
- Compliance with all utility and electrical safety codes regulations are mandatory.
- Read the manual and get acquainted with the senor connections and terminals before commencing installation activity.
- Before connecting the sensor system, read its label to confirm power supply requirements.
- All connections should be done only when power to the sensor is switched off.
- Improper installation and connections may damage the device and sensor connected to the same.
- Protect from overvoltage and static electricity.
- Physically damaged sensors should not be used or connected to main power.
- Use proper earth connection.
- **Use proper size screwdriver (tools) and cable for connection else the terminals might get damaged.**
- **The output cable and the sensor cables to be secured in such a way that water is not carried to the gland by the cable. The cable not to be secured elevated rather it should be lower than the plane of the sensor.**
- **Output Cable OD is to be maintained as per the below specification for proper waterproofing. Otherwise, water will seep into the junction box and will damage electronics.**
    - **Cable Type:**Unitronic robust c (tp) 2x2x0.14 screened halogen free cable.
    - **Cable dimensions:** Twisted Pair, Number of Conductors: 2 x 2, Conductor Diameter: 0.14mm², Outer Cable Diameter: 5.3mm,
    - Lapp Article No. 1032100

2. Technical Specifications Solar Irradiation Sensor

Features available in MBMet-501 will depend on its model.
Technical specifications for the Solar Irradiation sensor are provided in table-2.1 below.

Model/ Parameters	MBMet-501EB	MBMet-501FB
Solar Irradiation		
Sensor	Silicon	
Range	0-1500 W/m2	
Accuracy	±3 % of reading	
Resolution	1	
Response Time	2-3 seconds	
Stability	0.5% per annum	
Cell Temperature		
Range	-40 to 90^{0}C	
Accuracy	±0.3% FS	
Resolution	0.1	
Response Time	2-3 seconds	
External RTD Sensors (no sensor supplied)		
Number of Inputs	1	2
Sensor Type	RTD- PT100 / PT1000 (optional)	
Range	-30 to 150^{0}C	
Accuracy	±0.3% FS	
Resolution	0.1	
Response Time	3-5 seconds	
Analog Inputs (4-20mA)		
Number of Inputs	2	
Range	-1000.0 to +1000.0	
ADC Resolution	16 bits	
Resolution	0.1	
Digital Input		
Number of Inputs	1	
Input Frequency	0 – 200 Hz	
Isolation	Optical	
Sensor Input Types and Resolution	Status: ON/OFF Counter: 1 Rain Gauge: 0.1mm Wind speed: 0.1 mtrs/sec	
Wind Direction Input		
Number of Inputs	1	
Input Resistance	1K to 10K Ohms	
Measurement Range	0-360º	
Resolution	1º	

Power Supply	
Power Supply	9-32 VDC
Power Consumption	600mW
Communication	
Protocol	MODBUS RTU
Baud Rate	9600, 8bits, No parity

Table-2.1: Technical specifications

General specifications are provided in table 2.2 below:

Parameter	Specification
Irradiation Sensor Enclosure	Cast Aluminum
Ingress Protection	IP65
Irradiation Sensor Enclosure Size	125 (L) x 80 (W) x 57 (H) mm
Weight	350 grams (approx.)
Mounting clamp (suitable for mounting on PV module side)	SS 304
Cable terminals	1.5 sq. mm. copper
Cable glands (EMC protected)	M12x1.5mm
Ambient operating temperature	-30 to 70^{0}C
Ambient operating humidity	0 to 99% RH

Table -2.2: General specifications

Details of LED indicators provided on the device front are provided in table -2.3 below.

Sr. No	Led indication	Reference / Colour	Description	Led Status
1	Power Input LED	PWR / Green	Power not connected to the module	OFF
			Power connected to the module	ON
2	Health LED	HLT / Green	Device in normal operation	Slow Flash
			Device in calibration mode	Fast Flash
			Device operations fail	Steady
3	Digital Input status LED	DI1 / Green	Digital input 1 Pulse received	ON
4	RS485 Rx and Tx LED	RX / Green	Data received	ON
		TX / Green	Data transferred	ON

Table-2.3: Device LED indication details

3 Parts of Solar Irradiation Transducer

Details of parts shipped along with Solar Irradiation Transducer are provided in table 3.1 below.

Mark in Fig	Description	MBMet-501EB/ 501FB (Fig 3.1)
1	Transducer	1
2	Mounting Plate (SS-304)	1
3	M5 X 32mm SS Hex Screw	2
4	M5 SS Washer	4
5	M5 Spring Washer	4
6	M5 SS Nut	4
7	M5 X 20mm SS Round Screw	2

Table-3.1: Parts shipped with MBMet-501.

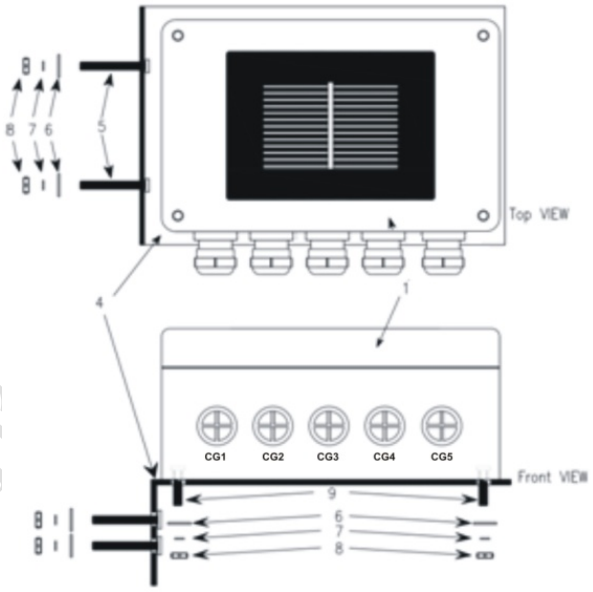


Fig-3.1: MBMet-501EB/FB Parts

4 Solar Irradiation Transducer– Installation

Use the sensor mounting clamp provided along with the sensor to install it at side of the PV module (or any other location). Care must be taken that the sensor inclination is same as PV Module.

Step – 1: Drill two holes (M6) at site where the Solar Irradiation sensor is intended to be installed according to the following figure 4.1.

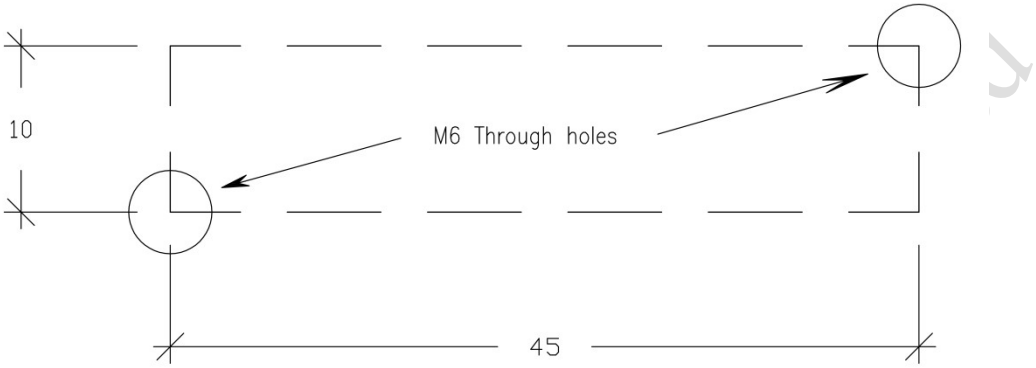


Fig – 4.1: Mounting holes' dimension

Step – 2: Install the sensor Mounting Clamp alongside the solar panel with the M5 x 32mm screws, nut, spring washer and washer provided as shown in the figure 4.2.

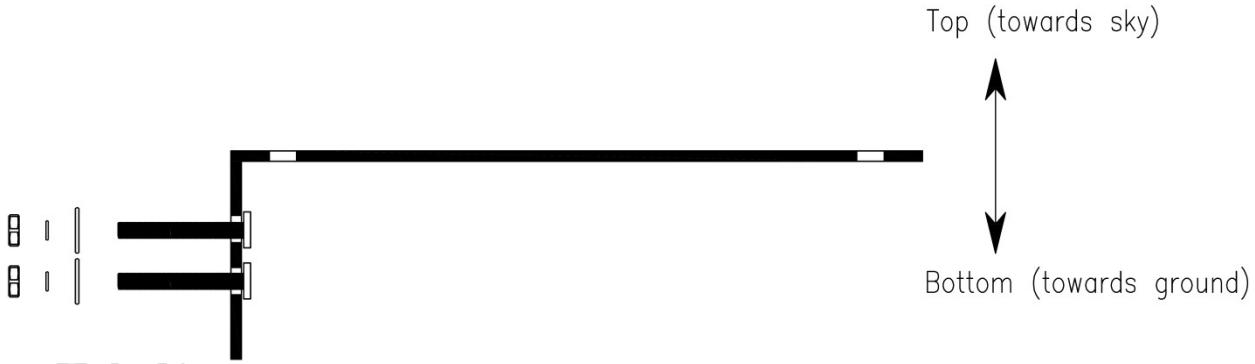


Fig – 4.2: Mounting clamp position

Step – 3: Open the cover of the sensor and mount the sensor to the clamp with the M5X20mm SS Round Head screws provided along with the sensor. The holes for mounting the sensor are shown in the figure 4.3.

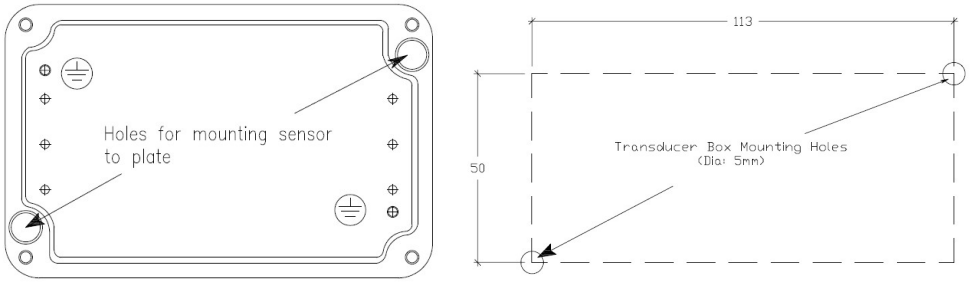


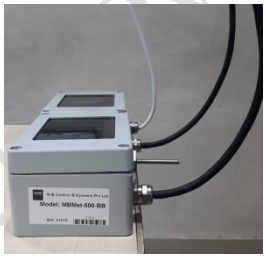
Fig – 4.3: Holes for fixing sensor to mounting plate.

Note: Keep the sensor cover with solar cell safely. Ensure that there is no scratch on the solar cell and it is not soiled.

Step – 4: Connect the interface cable according to the sensor specification. Connection details are given in Section 5 of this manual. After connection is done, close the cover and tighten the screws fully for retaining the IP protection.

Note: Cable should be matching the specification stated below for maintaining proper waterproofing. Otherwise, Gable gland will remain loose, and water will seep and damage the electronics inside.

Cable Type:cableunitronic robust c (tp) 2x2x0.14 screened halogen free cable.
Cable dimensions: Twisted Pair, Number of Conductors: 2 x 2, Conductor Diameter: 0.14mm², Outer Cable Diameter: 5.3mm,
Lapp Article No: 1032100



CORRECT WAY (the cables to be downwards) **WRONG WAY** (water can seep inside)

Fig-4.4: Proper way of securing the cables

5 Solar Irradiation Sensor– Connections

Care should be taken so that no components on the PCB are touched.
Terminal numbers on the sensor PCB are given in the figure 5.1 below.

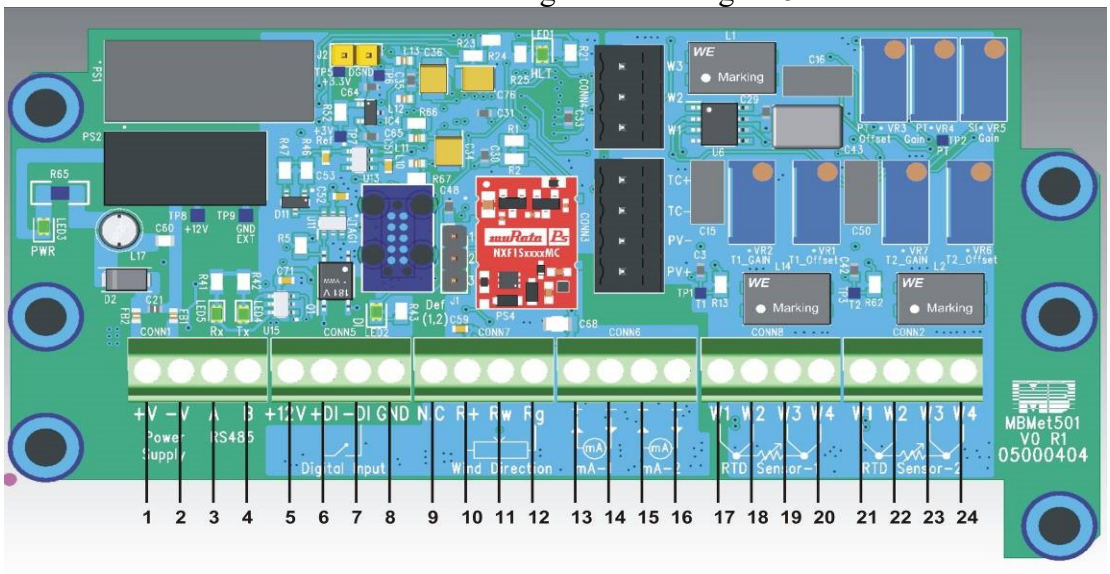


Fig – 5.1: Terminal Numbers

Connections for the terminals are provided in the table 5.1 below.

Terminal No.	Terminal notation	MBMet 501EB	MBMet 501FB
1	+V	9-32 VDC+	9-32 VDC+
2	-V	GND	GND
3	A	RS485 D+	RS485 D+
4	B	RS485 D-	RS485 D-
5	+12V	External Supply to DI Sensor 12V+	External Supply to DI Sensor 12V+
6	+DI	DI Sensor Input+	DI Sensor Input+
7	-DI	DI Sensor Input-	DI Sensor Input-
8	GND	External GND	External GND
9	N.C	No Connection	No Connection
10	R+	Wind direction potentiometer+	Wind direction potentiometer+
11	Rw	Wind direction potentiometer Wiper	Wind direction potentiometer Wiper
12	Rg	Wind direction potentiometer Gnd	Wind direction potentiometer Gnd
13	+	4-20mA+	4-20mA+
14	-	4-20mA-	4-20mA-
15	+	4-20mA+	4-20mA+
16	-	4-20mA-	4-20mA-
17	W1	RTD (A)	RTD (A)
18	W2	RTD (A)	RTD (A)
19	W3	RTD (B)	RTD (B)
20	W4	RTD (B)	RTD (B)
21	W1	NA	RTD (A)
22	W2	NA	RTD (A)
23	W3	NA	RTD (B)
24	W4	NA	RTD (B)

Table-5.1: MBMet-501 connections

5.1 Power Supply and RS485 Connections:

Power supply and RS485 external connection diagram are provided in Fig – 5.1.1

Note: Refer Technical Specification details provided in Table-2.1 for minimum and maximum external power rating.

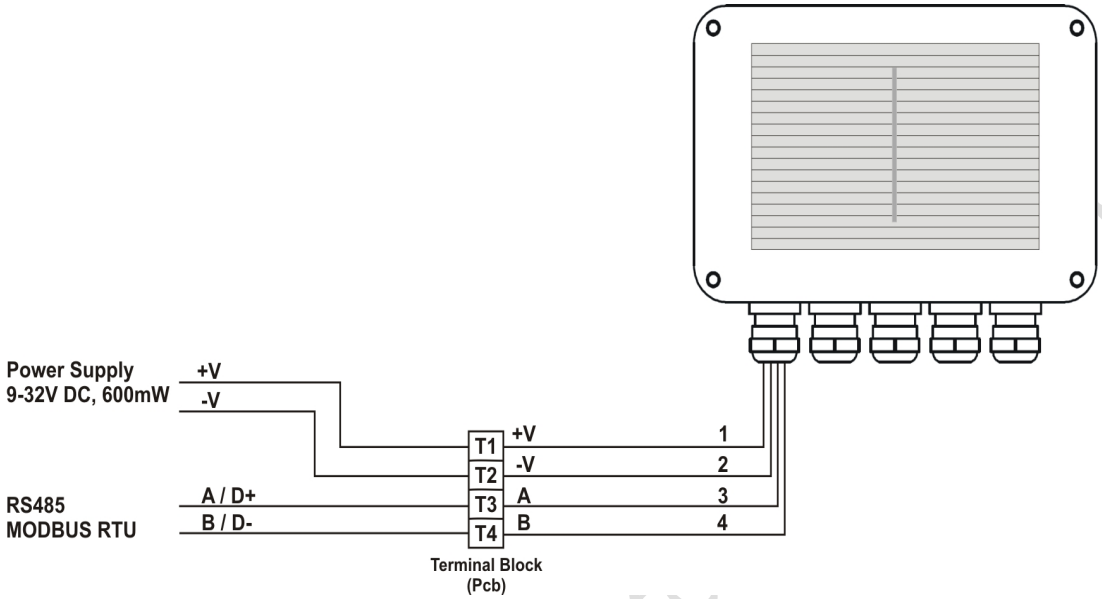


Fig – 5.1.1: Power Supply and RS485 Connection diagram

5.2 Digital Input Connections:

5.2.1 Digital Input Sink Connection

Digital Input Sink Connection diagram are provided in Fig – 5.2.1.1

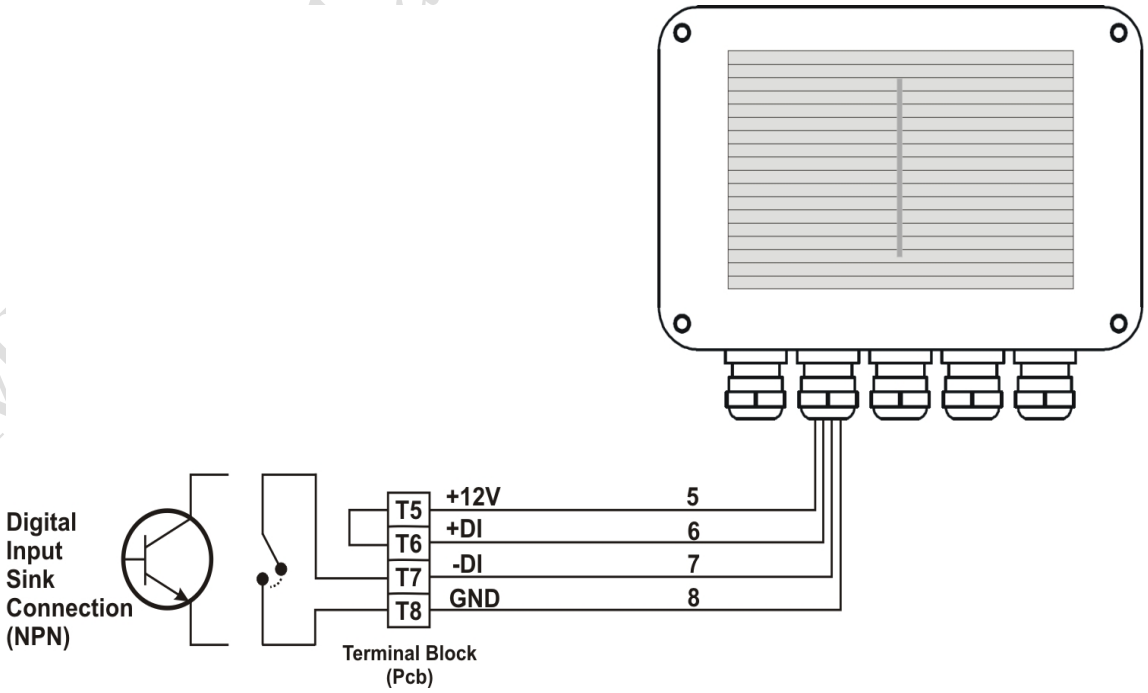


Fig – 5.2.1.1: Digital Input Sink Connection diagram

5.2.2 Digital Input Source Connection

Digital Input Source Connection diagram are provided in Fig – 5.2.2.1

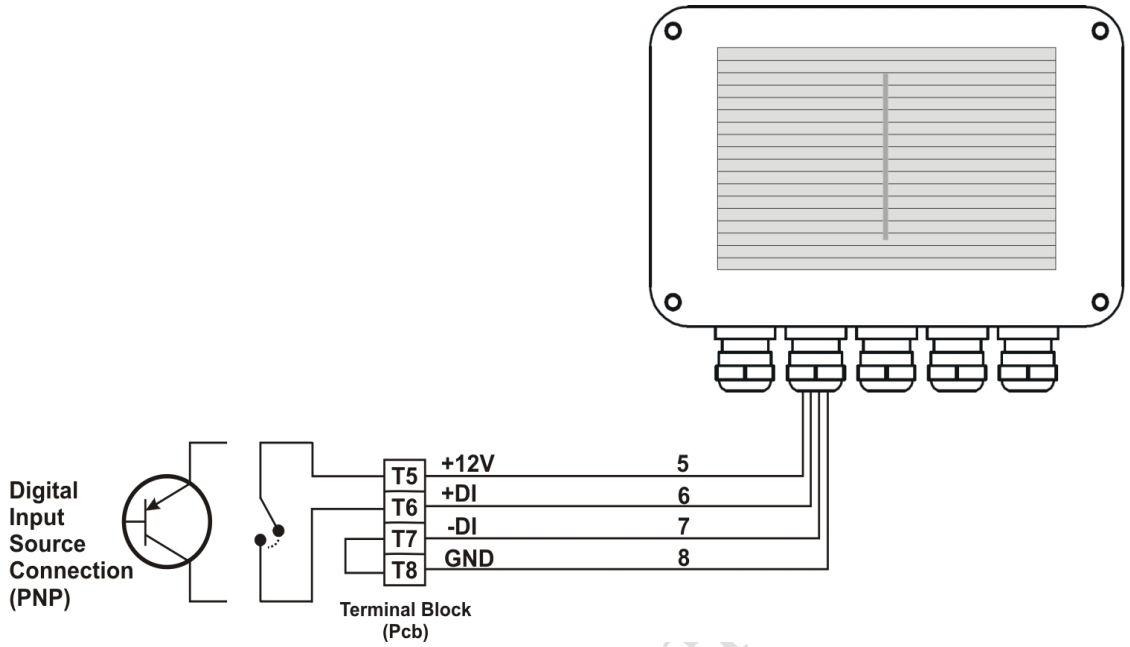


Fig – 5.2.2.1: Digital Input Source Connection diagram

5.3 Wind direction Connections:

Wind direction Input Connection diagram are provided in Fig – 5.3.1

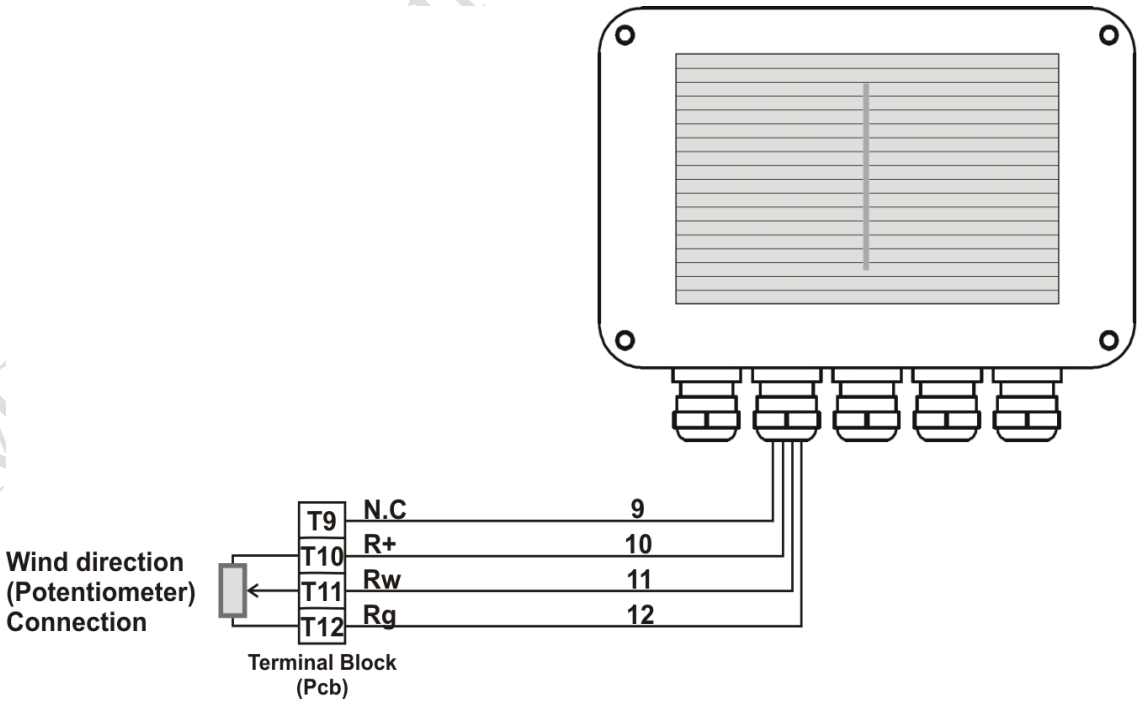


Fig – 5.3.1: Wind direction Input Connection diagram

5.4 Analog Input (4-20 mA) Connections:

Analog Input (4-20mA) for Channel-1 and Channel-2 connection diagram are provided in Fig – 5.4.1

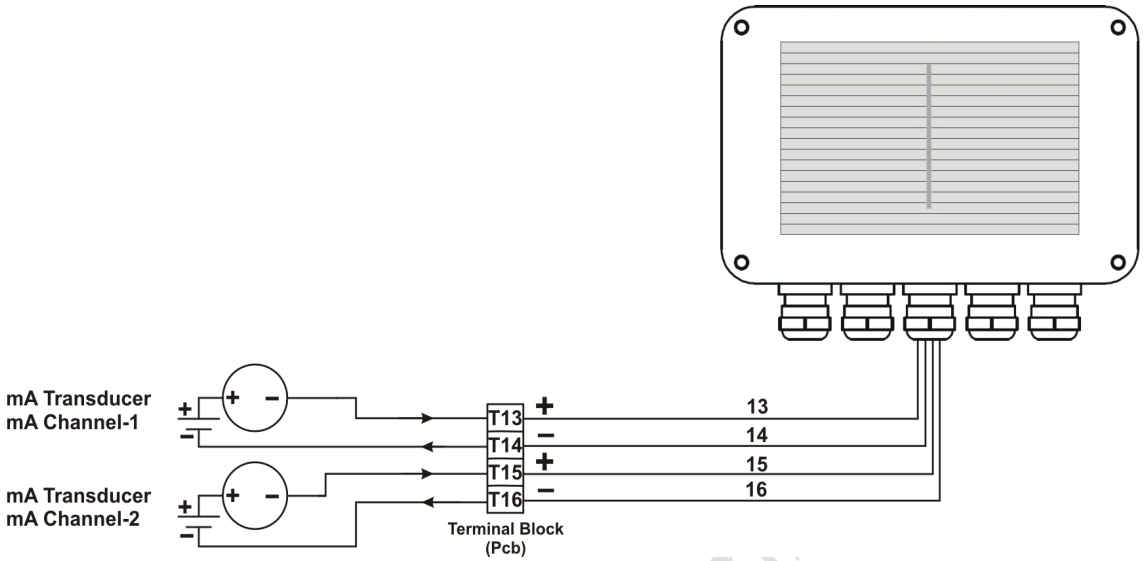


Fig – 5.4.1: Analog Input (4-20mA) Connection diagram

5.5 RTD Sensor Connections:

5.5.1 Three Wire RTD Sensor Connections:

Three wire RTD Sensor connection diagram for Channel-1 and Channel-2 are provided in Fig – 5.5.1.1

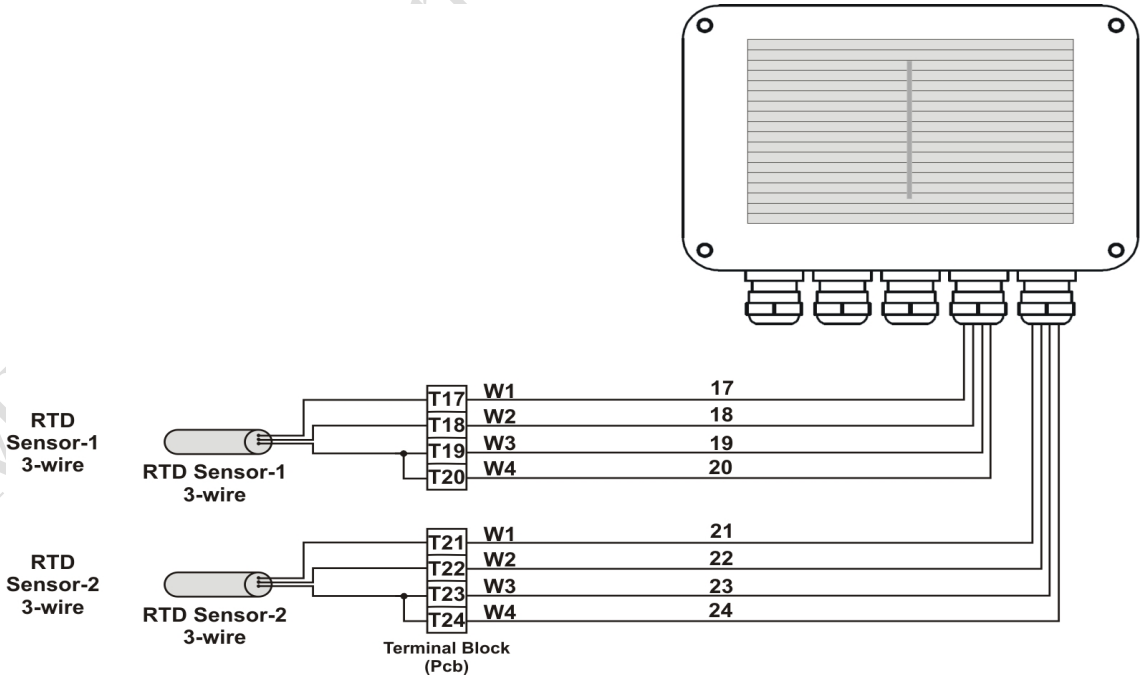


Fig – 5.5.1.1: Three wire RTD Sensor Connection diagram

5.5.2 Four Wire RTD Sensor Connections:

Four wire RTD Sensor connection diagram for Channel-1 and Channel-2 are provided in Fig – 5.5.2.1

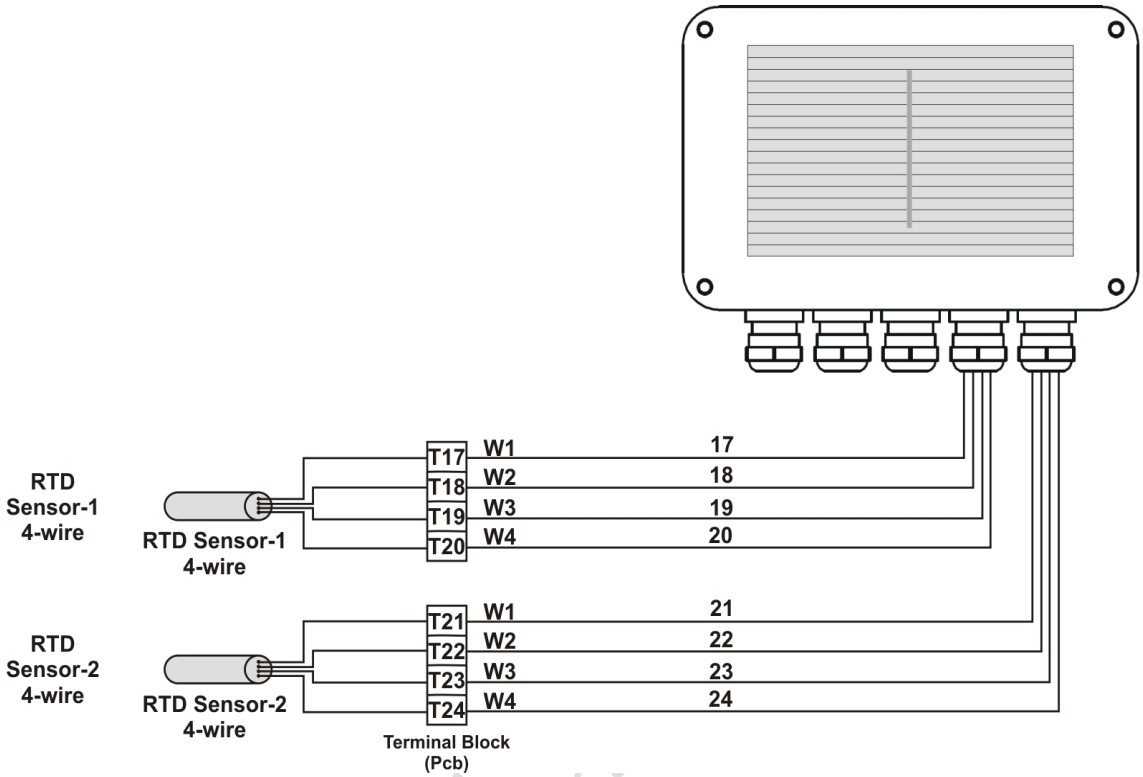


Fig – 5.5.2.1: Four wire RTD Sensor Connection diagram

6 MBMet-501: – Default Communication Parameters

Default configurations for solar irradiation sensor with RS485 output are shown in table-6 below.

Sr. No	Parameter	Default Setting
1	**Communication Parameters**	
1.1	Device MODBUS address	1
1.2	Baud rate	9,600
1.3	Parity	None
1.4	Stop bits	2
2	**RTD Channels**	
2.1	Temperature Unit	^{0}C

Table-6: Default communication parameters

7 MODBUS Registers

7.1 MODBUS Registers:

MODBUS registers are provided only for models with RS485 communication port. Parameter values shall be provided as per selected model. Un-supported values will be read as '0'.

Parameters from the sensor can be read via MODBUS RTU protocol in both signed integer and float data formats.

MODBUS Register Address	Parameter	Default Values	Length (bits)	Register Type	Parameters Type
Parameters Read Registers - Integer					
0	Solar Irradiation	-	16	Read only	Unsigned Integer
1	Cell Temperature (x10)	-	16	Read only	Signed Integer
2	RTD PT1000 temperature Sensor (x10) -1 (Ambient Temperature Module Temperature External Sensor-1)	-	16	Read only	Signed Integer
3	Analog Input -1 (x10) 4-20mA	-	16	Read only	Signed Integer
4	Analog Input -2 (x10) 4-20mA	-	16	Read only	Signed Integer
5	Digital Input Value (x10)	-	16	Read only	Signed Integer
6	Wind Direction (x1)	-	16	Read only	Signed Integer
7	RTD PT1000 temperature Sensor (x10) (External Sensor-2)	-	16	Read only	Signed Integer
Parameters Read Registers - Float					
20	Solar Irradiation	-	32	Read only	Float
22	Cell Temperature	-	32	Read only	Float
24	RTD PT1000 temperature Sensor -1 (x10) (Ambient Temperature Module Temperature External Sensor-1)	-	32	Read only	Float

26	Analog Input -1 (4-20mA)	-	32	Read only	Float
28	Analog Input -2 (4-20mA)	-	32	Read only	Float
30	Digital Input – value	-	32	Read only	Float
32	Wind Direction	-	32	Read only	Float
34	RTD PT1000 temperature Sensor (External Sensor-2)	-	16	Read only	Signed Integer
MODBUS Communication Parameters					
100	MODBUS ID(Default:1) 1<ID<247	1	16	Read/Write	Unsigned Integer
101	Baud rate (Default: 1) 0=4800; 1=9600; 2=19200	1	16	Read/Write	Unsigned Integer
102	Parity (Default: 0) 0=None; 1=Odd; 2=Even	0	16	Read/Write	Unsigned Integer
103	Stop bits. 1 (only stop bit 1 setting is allowed)	2	16	Read/Write	Unsigned Integer
104	Temperature Units 0 = °C; 1 = °K; 2 = °F	0	16	Read/Write	Unsigned Integer
105	Save configuration parameters *	1	16	Write only	Unsigned Integer
Device Manufacturing Details- Read only					
110	Device Model No: =4 - MBMet501-EB =5 - MBMet501-FB	-	16	Read only	Unsigned Integer
111	Hardware Version	-	16	Read only	Unsigned Integer
112	Software Version	-	16	Read only	Unsigned Integer
113	Manufacture Year	-	16	Read only	Unsigned Integer
114	Device Serial number	-	16	Read only	Unsigned Integer
Digital Input Channel – Wind Speed					
120	Signal input Type 0 = Not used, 1= Status 2= Counter 3= Rain Gauge 4= Wind Speed	4	16	Read/Write	Unsigned Integer

121	Rain Gauge Constant. Note: Constant x 100 Range: 0.01 to 10.00	20	16	Read/Write	Unsigned Integer
122	Wind Speed Constant. Note: Constant x 100 Range: 0.01 to 10.00	0	16	Read/Write	Signed Integer
123	Wind Speed Slope. Note: Slope x 1000 Range: 0.001 to 1.000	1612	16	Read/Write	Signed Integer
124	Save configuration DI Channel*	0	16	Write only	Unsigned Integer
Wind Direction					
125	Signal input 0 = Not used, 1= Used	1	16	Read/Write	Unsigned Integer
126	Enable filter. = 0 filter disabled =1 filter enabled (average of six samples)	0	16	Read/Write	Unsigned Integer
127	Save configuration Wind Direction Channel*	0	16	Write only	Unsigned Integer
RTD PT100 Sensor-1/ External RTD Sensor-1					
128	Input 0 = Not used, 1= Used	1	16	Read/Write	Unsigned Integer
129	Enable filter. = 0 filter disabled =1 filter enabled (average of six samples)	0	16	Read/Write	Unsigned Integer
130	Save configuration *	0	16	Write only	Unsigned Integer
External RTD Sensor-2					
131	Input 0 = Not used, 1= Used	1	16	Read/Write	Unsigned Integer
132	Enable filter. = 0 filter disabled =1 filter enabled (average of six samples)	0	16	Read/Write	Unsigned Integer
133	Save configuration *	0	16	Write only	Unsigned Integer
Analog Input (4-20mA) Channel-1					
134	Analog input status	0	16	Read/Write	Unsigned

	0= Not used 1 = Other Sensor				Integer
135	Enable filter. = 0 filter disabled =1 filter enabled (average of six samples)	0	16	Read/Write	Unsigned Integer
136	Signal low scaling range (x10)	-200	16	Read/Write	signed Integer
137	Signal high range range (x10)	800	16	Read/Write	signed Integer
138	Save configuration mA Channel 1*	1	16	Read/Write	Signed Integer
Analog Input (4-20mA) Channel-2					
139	Analog input status 0= Not used 1 = Other Sensor	0	16	Read/Write	Unsigned Integer
140	Enable filter. = 0 filter disabled =1 filter enabled (average of six samples)	0	16	Read/Write	Unsigned Integer
141	Signal low scaling range (x10)	-200	16	Read/Write	signed Integer
142	Signal high range range (x10)	800	16	Read/Write	signed Integer
143	Save configuration mA Channel 2*	1	16	Read/Write	Signed Integer

Table: 7.1 – MODBUS registers

Note:

* To save the communication parameters, write '1' in the register else the settings will not be saved.

7.2 Configuration of MODBUS Communication Parameters

Example is provided below for setting required communication parameters.

Modbus ID: 10
Baud rate: 19200
Parity: Even
Stop Bit: 2

Step-1: Connect the MBMet-501 to the Modbus Master Software with the default settings.

Step-2: Set the following in the MODBUS Master:
Function: Write Multiple Registers
Starting Address: 100

Number of registers: 5
Data Type: 16 bits Integer

Step-3: Set the communication parameters as per your requirement. (See example settings)

MODBUS Register Address	Parameter	Example settings
100	MODBUS ID	10 (Modbus ID=10)
101	Baud rate	2 (Baud Rate = 19200)
102	Parity	2 (Parity = Even)
103	Stop bits	2 (Stop Bit = 2)
104	Temperature Unit	0 (^{o}C)
105	Save	1 (Save)

Table No: 7.2 – Modbus communication parameter configuration

Notes:

i) To save the communication parameters, write 1 in register 105 else the settings will not be saved.

ii) Please note that writing single register is not allowed. All the registers are to be written in one MODBUS write command.

Step-4: After all the parameters are set in MODBUS Master, write the same to the sensor. The sensor will stop communication and restart again with modified parameters.

Step-5: Connect to sensor using the modified MODBUS communication parameters in the MODBUS Master that is set in Step-3. The Solar Irradiance sensor will start communicating.

Step-6: Configured communication parameters can be verified by reading the communication MODBUS registers (100 to 104) of the sensor.

7.3 Setting Default MODBUS Communication Parameters

Procedure for re-setting default communication parameters is as follows.

Step-1: Switch Off the power supply of the device.

Step-2: Locate the Jumper-1 on the PCB as shown in Fig – 7.3.1. The normal position of the jumper is shown in Fig 7.3.2

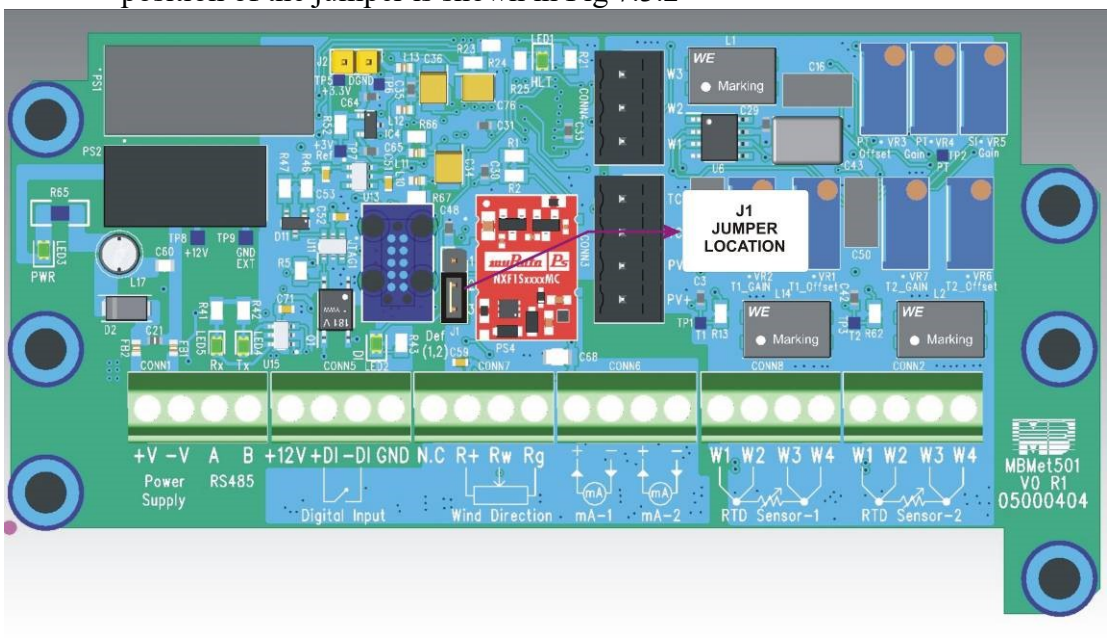


Fig – 7.3.1: Location of the Jumper 1

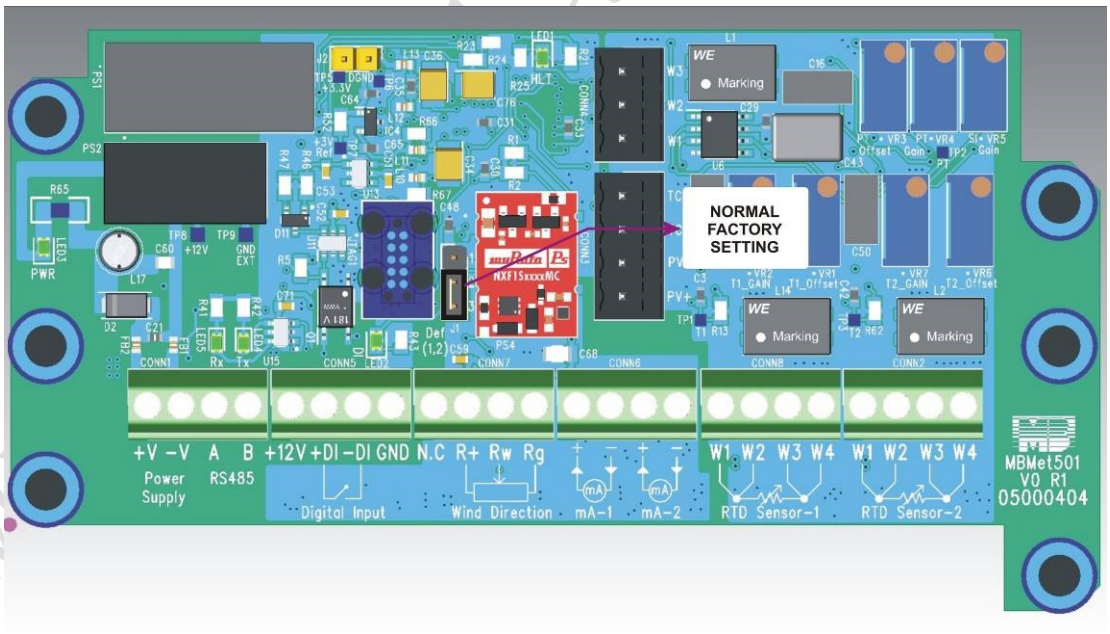


Fig – 7.3.2: Normal Position of Jumper-1 on board.

Step-3: Change the jumper position from Fig 7.3.2 to Fig 7.3.3

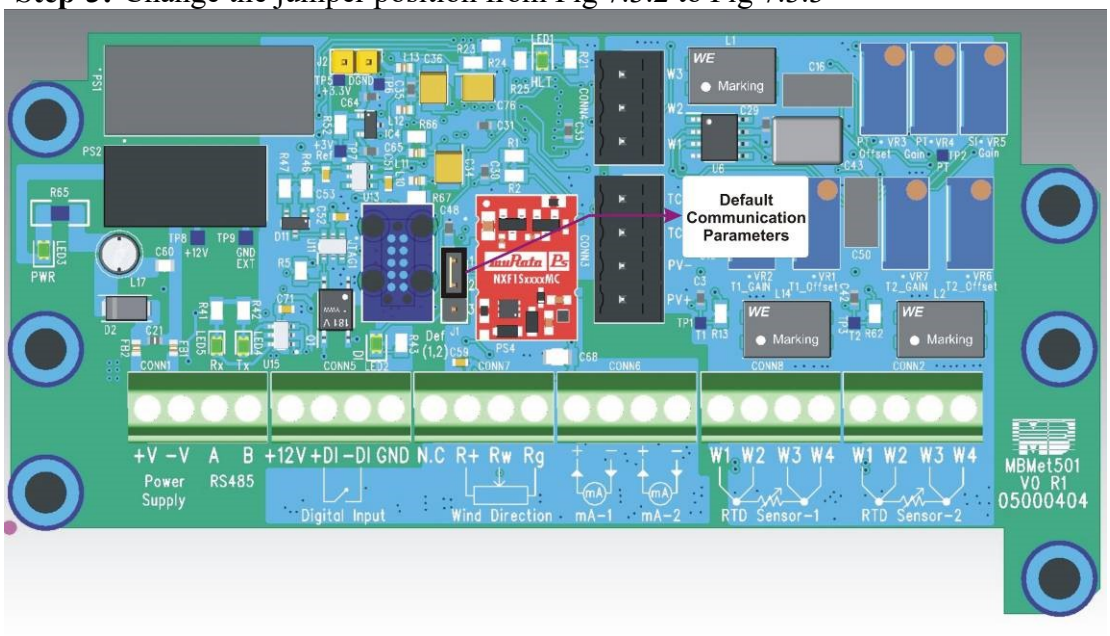


Fig – 7.3.3 Jumper position (for default resetting)

Step-4: Switch On power supply, wait for 30 sec and switch off the power supply
Step-5: Reconnect the jumper in the original factory position as in Fig 7.3.2

Communication parameters is reset to default settings. This will not change any other settings of the device.

8 General Maintenance

The most common type of maintenance required in panels is cleaning. Dirt and debris can collect on panels, especially during storms or extended periods without rainfall. So, cleaning of the panel should be regularly done every day in the morning to ensure the solar panels get the optimal amount of sunlight. Below cleaning procedures can be adopted for better performance of the panel.

General maintenance procedures:

i) Use **Plain water or a soft brush** to remove any grime, dirt, algae growth or bird dropping that has built up on the panels.

Note:

Good quality brushes without hard bristles need to be used for cleaning to prevent damaging the glass surface of modules. Do not make any scratches on the glass. This will produce wrong results.

ii) Clean solar panels when they are moist or wet so any dirt or residue that is stuck on them can be wiped off easily.

iii) Never use an abrasive sponge or soap for your panel cleaning as you may scratch the glass. The best way to clean panels by using a soft rag or biodegradable soap.

Ensure the maintenance of the panel happen every day or else ferrous metals may corrode, and salt laden atmospheres can increase the risk of corrosion.