

E-Dust

Soiling sensor
Entec Solar

User Manual

V.08062020



ENTEC



SOLAR

QPV
QualifyingPhotoVoltaics

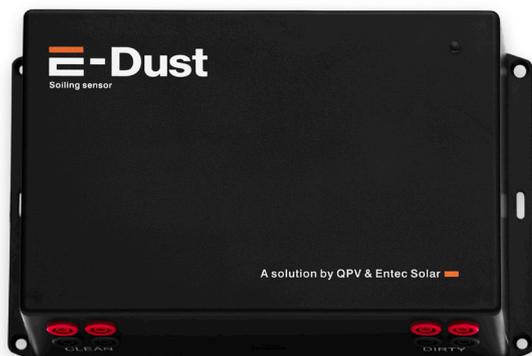
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1. Product specifications

Specifications	Value
Maximum input ¹ voltage	160V
Maximum input ² current	20A
Recommended maximum voltage @STC	125V
Maximum recommended current @STC	12A
Number of PV module inputs	2
Measurement accuracy	± 0.3% (V and I) & ± 0.5% (P)
Measurement resolution	2.5mV / 0.3mA
Measurement input	ModBus or Direct TCP/IP
Communication ports	RJ45
IP protection	IP 51
Power input	
-Voltage	12V / 24V DC
-Consumption	500mA @ 12V
Weight	1.0 kg
Dimensions	215 (244) x150x60,5mm (x-y-z)

Table 1: Main product characteristics.



2. External components

E-Dust has been designed for a simple installation, commissioning, and usability, minimizing the number of external components. It has the following components and connectors:

- 1 x LED: used to transmit basic information about the status of E-Dust operation.
- 1 x Jack: used to connect to the power supply between 8-28V (absolute voltage values).
- 1 x Reset button: used to reset the device to factory settings.
- 8 x female banana connectors: to conduct a four-point probe measurement of a photovoltaic module.
- 1 x RJ-45: for an Ethernet connection.



Figure 2: Reset button (left) and power connector (right). These are located on the left and right sides of the device, respectively.



Figure 3: Front peripherals, including: four banana socket connectors for the clean module, four others for the dirty module, and an RJ-45 connector for an Ethernet connection. The red connectors are for the positive pole and the black connectors for the negative pole.

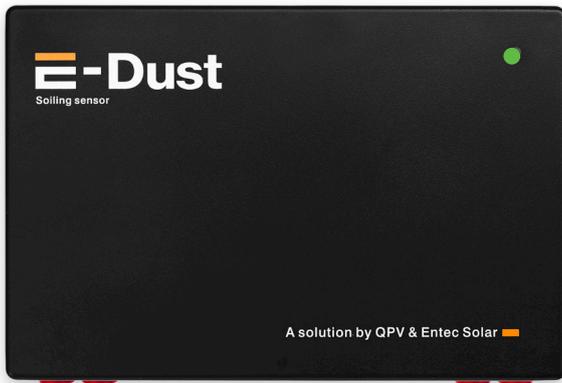


Figure 1: Frontal view, with the team logo and the LED in the upper right corner.

1 VERY IMPORTANT: maximum allowed voltage! On cold days this value can exceed the catalog value. Check the E-Dust maximum recommended voltage.

2 VERY IMPORTANT: maximum allowed current! On days with ample solar radiation this value can exceed the catalog value. Check the E-Dust maximum recommended current.

3. Starting E-Dust

Please complete the following steps to install and configure the E-Dust.

1. Firstly, configure E-Dust communications from a computer at a convenient location (i.e. office).
2. Install two photovoltaic modules of the same type as those which make up your PV plant in one or various places that are considered representative of the degree of contamination of the entire plant. One of the modules will be used as the dirty reference for the control unit and the other as the clean reference. See Figure 4.
3. Choose a location for the E-Dust installation relatively close to the installation of the two modules.
 - a. Since the E-Dust carries out a four-point probe measurement the distance between it and the modules does not introduce additional error in measurement. However, it is preferable to keep the distance as short as possible and avoid distances greater than 100 meters to minimize noise induced by the cables.
 - b. Make sure that on the chosen site there is a necessary power supply for the E-Dust (see Table 1) and that there is an Internet or local network connection.
 - c. Make sure the chosen site is covered and protected from dust and rain.
 - d. The E-Dust has four holes that allows it to be screwed directly to a wall. Make sure the screws do not extend beyond the wall so as not to affect the IP protection of the accommodation. If an installation that does not penetrate through the wall is impossible, protect the holes with silicone or attempt to stick the device directly to the wall with a strong adhesive.
4. The wiring from the modules to the E-Dust installation site, should be conducted using four 2.5mm² conductors required for each module. a. It is recommended to pass the four cables of each module through two independent corrugated tubes. b. It is recommended to install each tube in cable trenches.
5. Once the cables are passed through the corrugated tubes carry out the terminal connection. For each set of cables (one per module), on one side the two positive cables will be connected to a female MC4 connector (or alternatively to the existing connectors of the modules MC3, etc.) and on the other side two isolated, independent red male banana cables. For the negative set, on one side both cables will be connected to a negative MC4 and on the other side to two isolated, independent, black banana cables. Figure 5 shows an example of a four-point probe cable setup described here.
6. Connect each set of cables to both of the photovoltaic modules. **IMPORTANT:** before connecting the other end of the cables to the E-Dust, measure the terminal voltage with a multimeter to assure that it is within the device limits (see Table 1) and that the voltage matches that of the photovoltaic module tested.
7. Once the voltage is checked, connect the eight banana terminals to the E-Dust.
 - a. Be sure to consider the polarity.
 - b. The four cables on the clean module should be connected to the connectors on the left. After side of the E-Dust and the four cables from this sequence, which includes the the dirty module should be connected to the start-up and the measurement of the first I-V right side curve, E-Dust goes into continuous operation .
8. Connect the Ethernet cable to the RJ-45 during which the LED sequence is as follows: connector and to the local network switch.

9. Connect the power supply to the Jack. The E-Dust will start automatically.

10. Confirm that the device starts properly minute, indicating that an I-V curve is being according to the boot color code. See Section measured. While this light is on, E-Dust 4.

11. Confirm that the data is being received in adjustments are disabled. the QPV PVET servers or that the E-Dust can be accessed from a local SCADA.

12. If you cannot confirm points 10 and 11, contact QPV staff for technical assistance.



Figure 5: An example of an E-Dust attachment via screws to the wall of a control room at a PV plant.



Figure 4: An example of two installed modules, one as a dirty reference module and the other as a clean reference module.



Figure 6: An example of a (positive and negative) cable set for the four-point probe measurement. At one end, both cables connect to the MC-4 connector and at the other end each cable connects to an isolated male banana connector.

4. LED indicators color code

The E-Dust contains RGB LED indicators on its cover to visually transmit the status of the device.

For more advanced information on the device operation or configuration, the user should connect it to a computer via an Ethernet cable.

Upon start-up, the E-Dust shows the following set colors:

- 1 . Green for 1 second
- 2 . Blue for 1 second
- 3 . Red for 1 second
4. Solid green 5 seconds
- 5 . Red light steady for a few seconds

After this sequence, which includes the start-up and the measurement of the first I-V curve, E-Dust goes into continuous operation during which the LED sequence is as follows:

- 1 . Green flash every 5 seconds
- 2 . Red light steady for a few seconds every minute, indicating that an I-V curve is being measured. While this light is on, E-Dust communication and configuration adjustments are disabled.

5. Communication settings

The E-Dust offers a web platform for communication setup. The following steps outline how to access the platform and configure communication.

5.1 Factory reset.

This step is not necessary upon first use, nor if one knows the exact IP address to which to configure the device to.

IMPORTANT: If the current IP of the device is unknown or there are connectivity issues with the new device, the reset button must be pressed (located on the right side of the device) for a minimum of five seconds. The button should be pressed when the equipment is in its continuous operation state with the LED indicating the “on” state (see section 4)

5.2 E-Dust setup for Windows

The IP address of the PC from which the use is working should be modified. The steps are detailed below:

- 1 . Within the PC, access the Network and Sharing Center on Windows (Figure 6) or equivalent in Linux.
- 2 . Select “Local Area Connection”.
- 3 . Select “Properties”.
- 4 . Within the properties menu screen select “Internet Protocol Version 4 (TCP / IPv4 or the version used by your computer) and select “Properties” (figure 7).
- 5 . Within the screen that appears, configure the device to “Use the following IP address” (Figure 7).

6 . Change the following parameters:

a . **IMPORTANT:** before executing the following steps, write down the preliminary configuration values so that the original PC connection can be reestablished once the E-Dust setup is finished.

b . To establish a direct connection, input the following IP address 172.16.5.XXX (or the current IP address of the PC except for the last value) where X is any value between 1 and 254, except 155 and the original value. If you are trying to establish a connection within a local network, X also cannot coincide with the digits of any other device on the network.

c. Default gateway: 172.16.5.155 (or the current IP address of the computer).

d. Netmask: 255.255.255.0

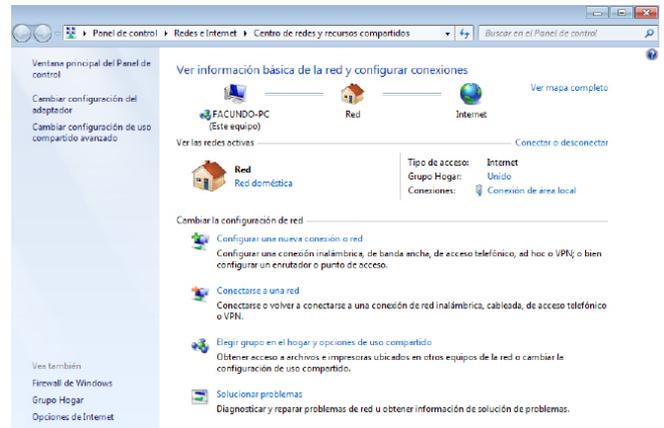


Figure 7: Network and Sharing Center menu for Windows setup.

3 This light indicates that the first measurement is being carried out and the duration depends on the time it takes to make the measurement, which is variable and in turn depends on the current and voltage of the module to be measured.

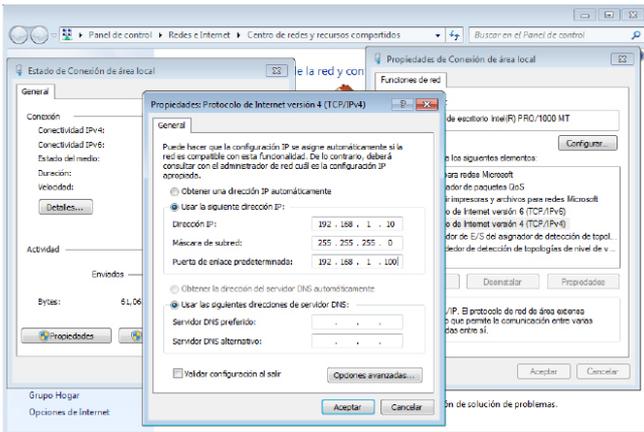


Figure 8: IP address and gateway configurations

5.3 E-Dust parameters setup

E-Dust parameters should be configured with the following steps:

1. Connect the E-Dust with a crossover RJ-45 cable to the Ethernet port of your computer. Usually all modern computers cross the wire automatically so any ethernet cable should do.
2. Open the browser (ex: Firefox, Chrome, Explorer) and enter the following address: <http://172.16.5.155>
3. The E-Dust web platform should appear as in figure 8.
4. Select one of the following communication protocols Modbus-TCP or a direct TCP-QPV Data Base connection. Before selecting a new mode make sure that the current mode of operation is in the "Now working as XXXXX" phrase. No change is necessary if the device is already functioning in the desired mode.
5. To save the following selection, enter the administrator password (admin_edust) and press the "Send" button.



Figure 9: E-Dust platform welcome screen.

6. Next, network parameters must be configured. To do this click on the tab "network config" and the screen shown in figure 9 will open.

7. Enter the desired network parameters of the E-Dust, the password (admin_edust) and press "send".

8. The E-Dust will reset itself with new changes in place.

9. Make sure that the correct LED color sequence appears at start-up and that the communication with the changed parameters works properly.

10. **IMPORTANT:** do not forget to reset your computer network settings to the original values.



Figure 10: E-Dust network configuration screen.

6. Appendix I: modbus registers map.

Below is the ModBus registers map. The 150 recorded voltage values of the “clean” curve 1 are stored sequentially in registers 0 to 149; the 150 recorded current values of the “clean” curve 1 are saved in registers 150 to 299.

For the “dirty” curve, the voltage registers range from 300 to 449 and current ones from 450 to 599. The measurement time is saved in POSIX format in registers 600 and 601. The device ID is stored in register 602.

eDust Modbus Map

Direction (decimal)	Direction (hexadecimal)	Variable	Units / Format
0	0x0	Vc0	V x 100
1	0x1	Vc1	V x 100
.....
149	0x95	Vc149	V x 100
150	0x96	lc0	mA
151	0x97	lc1	mA
.....
299	0x12B	lc149	mA
300	0x12C	Vd0	V x 100
301	0x12D	Vd1	V x 100
.....
449	0x1C1	Vd149	V x 100
450	0x1C2	ld0	mA
451	0x1C3	ld1	mA
.....
599	0x257	ld149	mA
600	0x258	DateTime.Hi	POSIXTime
601	0x259	DateTime.Lo	POSIX Time
602	0x25A	ID	-

Table 2: ModBus registers map.

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