Scuola Universitaria Professionale
della Svizzera Italiana

SUPSI

Dipartimento
Ambiente
Costruzioni e
Design

**Istituto
Sostenibilità
Applicata
Ambiente
Costruito**

MPPT 3000

User Manual

High Accuracy, Customizable
MULTIFUNCTION TESTING DEVICE FOR PHOTOVOLTAIC MODULES

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Important safety notice

Warning :

In all cases the assembly and installation must be done by qualified technicians, observing the national requirements and rules stipulated.

Opening the MPPT3000 or using it incorrectly will result in the immediate loss of the warranty, (unless for upgrades in agreement with manufacturer)

Warranty:

1 year.

Limitation of liability :

ISAAC - SUPSI cannot control the installation, use and maintenance of the MPPT3000.
Thus, we are not responsible for damages, costs or losses resulting from an installation which is not in accordance with the regulations or inappropriate use or maintenance.

The customer is always responsible for the use of the MPPT3000 and any other related additional device.
This device has not been designed nor warranted for use in any critical apparatus with potential risks of serious harm to people or to the environment.

ISAAC - SUPSI reserves the right to modify their products without previous notice.

Short description

The MPPT 3000 is a multifunction testing device for photovoltaic modules. A photovoltaic module, when connected to the MPPT 3000, is set to work in a MPP tracking mode. The MPPT 3000 also allows a customized I-V Tracer function. It is possible to connect RTD temperature sensors, pyranometers or other external sensors. The interaction with the MPPT is possible directly using its LCD and buttons or through a simple graphical user interface. The PV module energy is dissipated using an external resistor load with heat sink that must be always connected. This device has been developed for specific PV module testing at the ISAAC - SUPSI laboratory (TISO group).

- accurate MPP tracking: maximum 0.5 % error on P_{MPP} tracking
- wide voltage and current scalable ranges: up to 200V / 20A / max 250W
- optoisolated analog auxiliary outputs in order to measure, using an external measurement system, the PV module working condition and the auxiliary sensors
- built-in independent data logging: internal data storage allowing the use of the MPPT as datalogger
- transportable, compact, wide operating ambient temperature range (from -20°C to +40 °C)
- galvanically isolated RS-485 interface: dialog between PC master and one or more MPPTs
- I-V Tracer : use of the MPPT3000 as settable IV Tracer
- simultaneous Im and Vm measurement
- non isolated analog output (optional)
- run-time selectable ranges (automatic or manual)
- possibility to measure, thanks to a built-in micro-converter and independently from data loggers or external peripherals, the main meteorological parameters (T, G, …) by means of auxiliary sensors (sensors are not included)
- user friendly management software
- IP 20 case

Applications

This electrical equipment is extremely useful for anyone who needs to accurately test photovoltaic modules such school laboratories, module manufacturers or module providers, testing laboratories and so on.
Typical applications are:

- sc-Si, mc-Si, a-Si, thin-film accurate module testing
- I-V characterization
- Energy production test and comparison at outdoor real conditions
- Meteorological measurements during module test
- Comparison of an existing PV plant behaviour with respect to a reference PV module under test using the MPPT3000.

Technical specifications

General		
MPPT power supply	-	+24VDC / 8 W +/-10%
Operating ambient temperature	°C	from -20 to +40
Case protection grade	-	IP20
Load output resistor	Ω	from 18 to 47 (**Load must be always connected !**)
Dimensions	mm	194 x 221 x 162 without cableglands nor cables
Weight	kg	5
Photovoltaic module values		
P_{MAX} in	W	250 (continuous);
V_{MAX} @ 250W	V	150
$I_{SC\ MAX}$	A	5 / 10 / 20 (depends on the model)
$V_{m\ MIN}$	V	5
Measurements		
Voltage measurement ranges	V	200 / 100 / 50 / 25
Current measurement ranges	A	20A Model: 20 / 10 / 5 /2.5 10A Model: 10 / 5 / 2.5 /1.25 5A Model: 5 / 2.5 / 1.25 / 0.625
Accuracy	%	0.2
IV Tracer		
Scan rate	min	2 / 3 / 4 / 5 / 6
Points number	-	128 / 256 / 512
Sweep Time	s	1.0 to 3.0
IV tracing ad hoc available using the MPPT manager software.		
MPP Tracker		
Types	-	Full I-V curve search
		Fast MPP fine adjust
Control	-	Power and voltage
Customizable MPP adjust and Vm adjust available.		
Auxiliary opto-isolated analog outputs		
4 analog outputs (Vm, Im, RTD 1, RTD 2)	VDC	from 0 to 10 (proportional to the default represented input ranges)
Short circuit protected outputs. High impedance load required.		
Auxiliary analog measurement inputs		
Auxiliary input 1		RTD only (PT100)
Auxiliary input 2		RTD only (PT100)
Auxiliary input 3		voltage 0…1V max (autorange from 0..10mV to 0..1V)
Galvanically isolated RS-485 port		
Bit rate	bps	115200
Data length	bit	8
Stop bit	bit	1
Parity	-	Even
Flow control	-	None

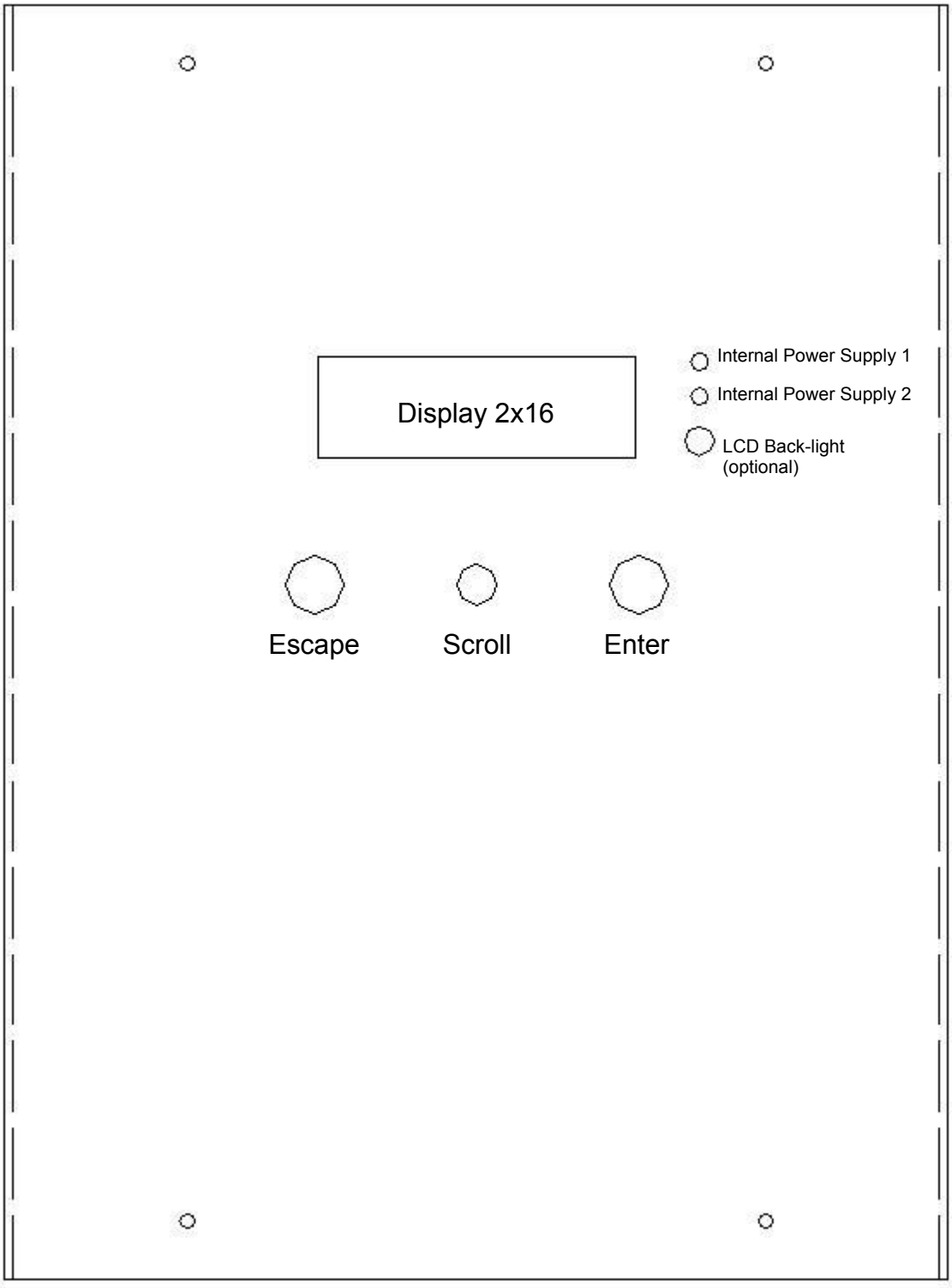
Performance

MPP Tracking		
Static MPP tracking efficiency	%	> 99.5
Dynamic MPP tracking efficiency	%	> 98.0
IV Tracer		
IV tracing difference	%	±0.2
DC / DC conversion		
Typ. Efficiency (Pout/Pin)	%	90.0

This performance test has been carried out at specific conditions, please see the specific data-book for details.

Box and connections

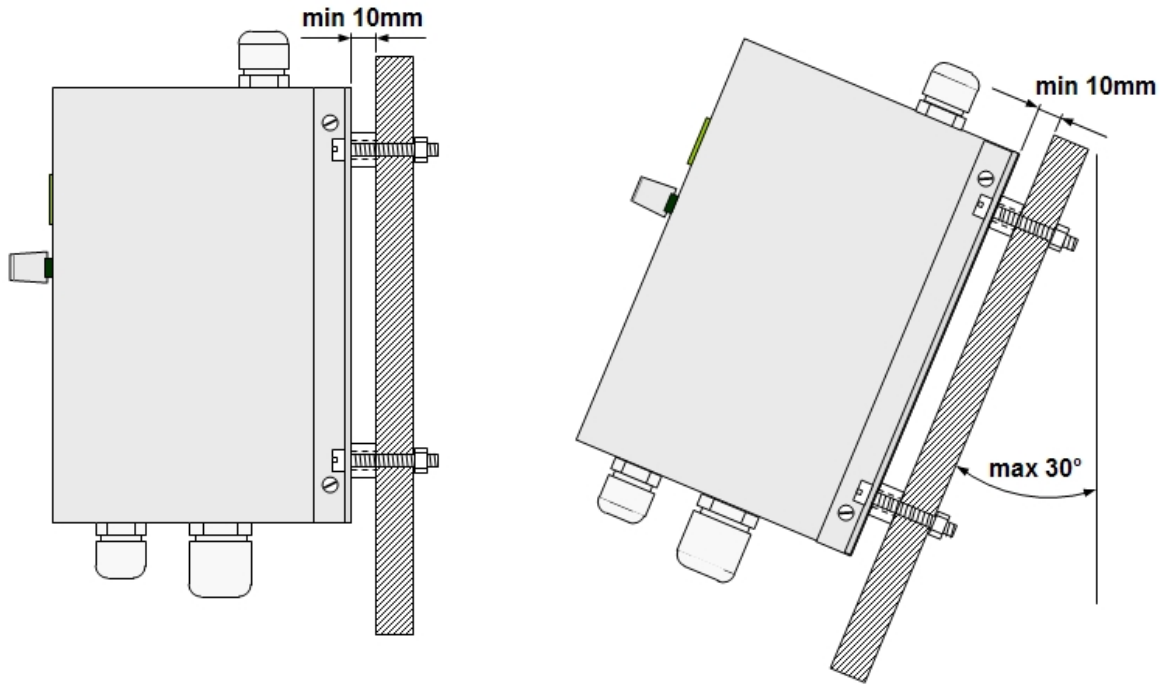
Front



The reset button of the main part (DSP) is placed on the left side of the box.
On the right side, there is the reset button of the auxiliary part (µController). When accessing a reset button, please use a non conductor stick.

Mounting the MPPT3000

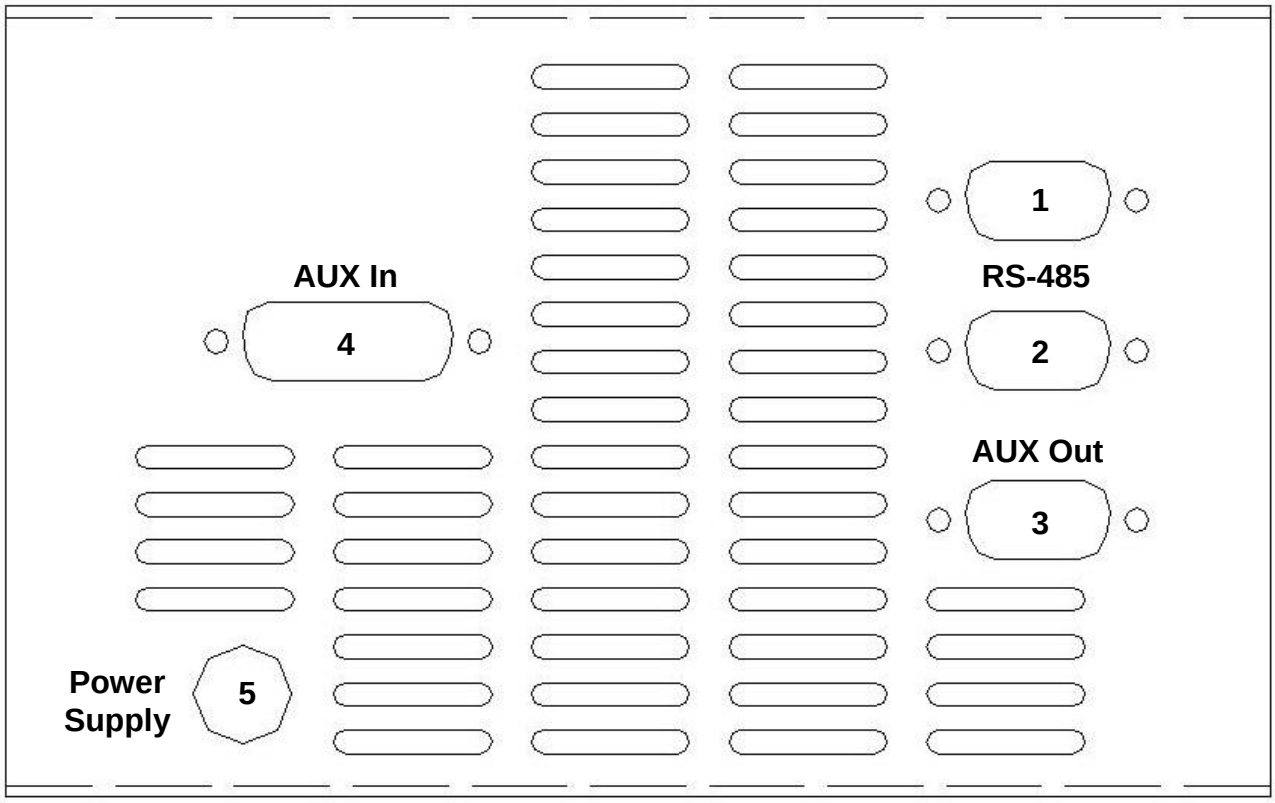
The MPPT3000 is provided with integrated heat sink for power dispersion.
In order to get maximum power dispersion the box must be mounted in vertical position or with a maximum tilt of 30° from vertical position , see also following schematics.
Moreover please allow 1 cm minimum gap from heat sink to mounting wall.



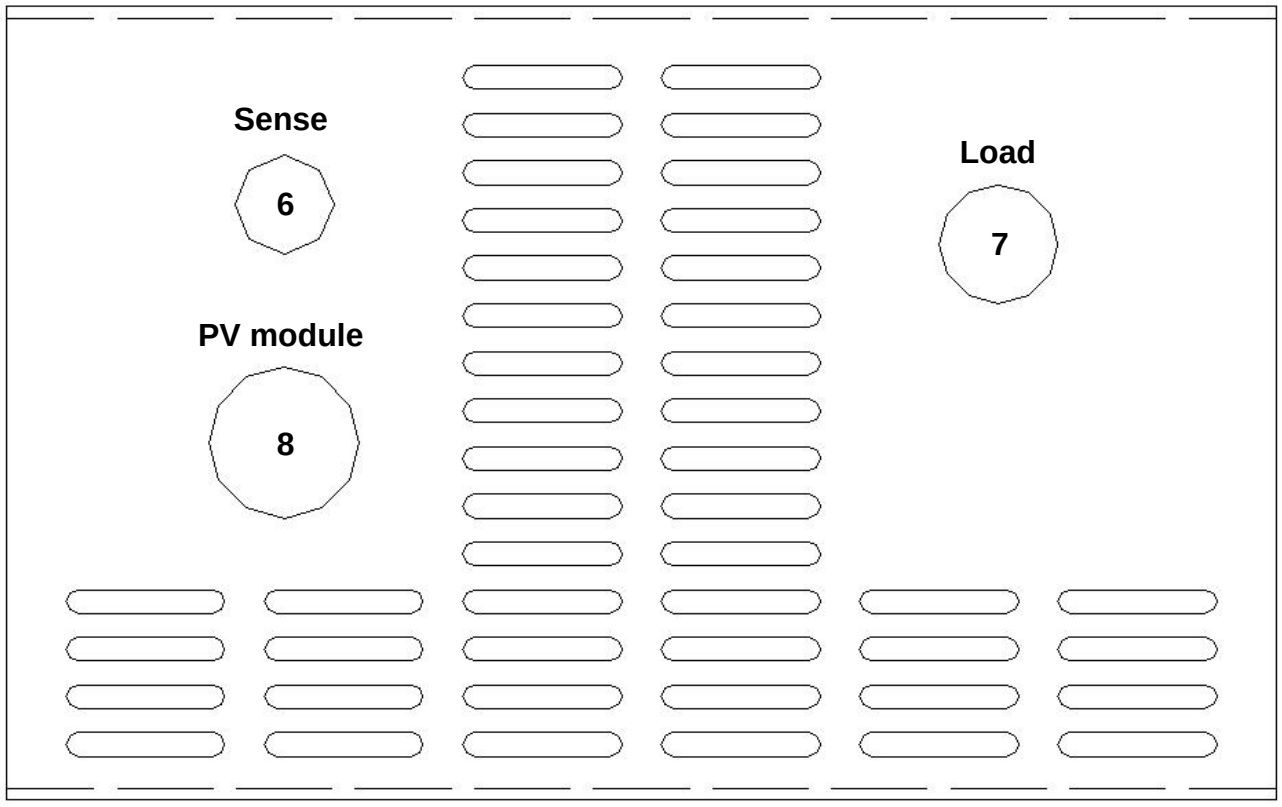
Mounting schematics

The electrical operating temperature of the MPPT goes from -20°C to +70°C but the ambiance temperature must not exceed 40°C at maximum power (250 W)

Top lateral



Bottom lateral



Wiring description

Connector	Description
1	RS-485 line, DB9 male
2	RS-485 line, DB9 female
3	Auxiliary analog outputs, DB9 female
4	Auxiliary input/output of auxiliary part (µController), DB15 male
5	Power supply of MPPT3000
6	Input for PV voltage sense measurement
7	Output power part (to the load resistor) **WARNING! THE LOAD RESISTOR MUST ALWAYS BE CONNECTED TO THE MPPT3000 ! Using the MPPT3000 without the load resistors leads to serious damages.**
8	Input for power connection PV module

Connector 1 and 2 :

See chapter **RS-485 line**.

Connector 3 :

1 Output AUX1 (0...10V represents 0...Ufull $_{scale}$)
2 Output AUX1 (GND)

3 Output AUX2 (0...10V represents 0...Ifull$_{-scale}$)
4 Output AUX2 (GND)

5 Output AUX3 (0...10V represents 0...AUX_Ch0_full $_{scale}$)
6 Output AUX3 (GND)

7 Output AUX4 (0...10V represents 0...AUX_Ch1_full $_{scale}$)
8 Output AUX4 (GND)

9 not connected

All auxiliary outputs are short circuit protected by means of a 2 kΩ series resistor.
Therefore to measure the output voltage value high impedance input instruments are required.

Connector 4 :

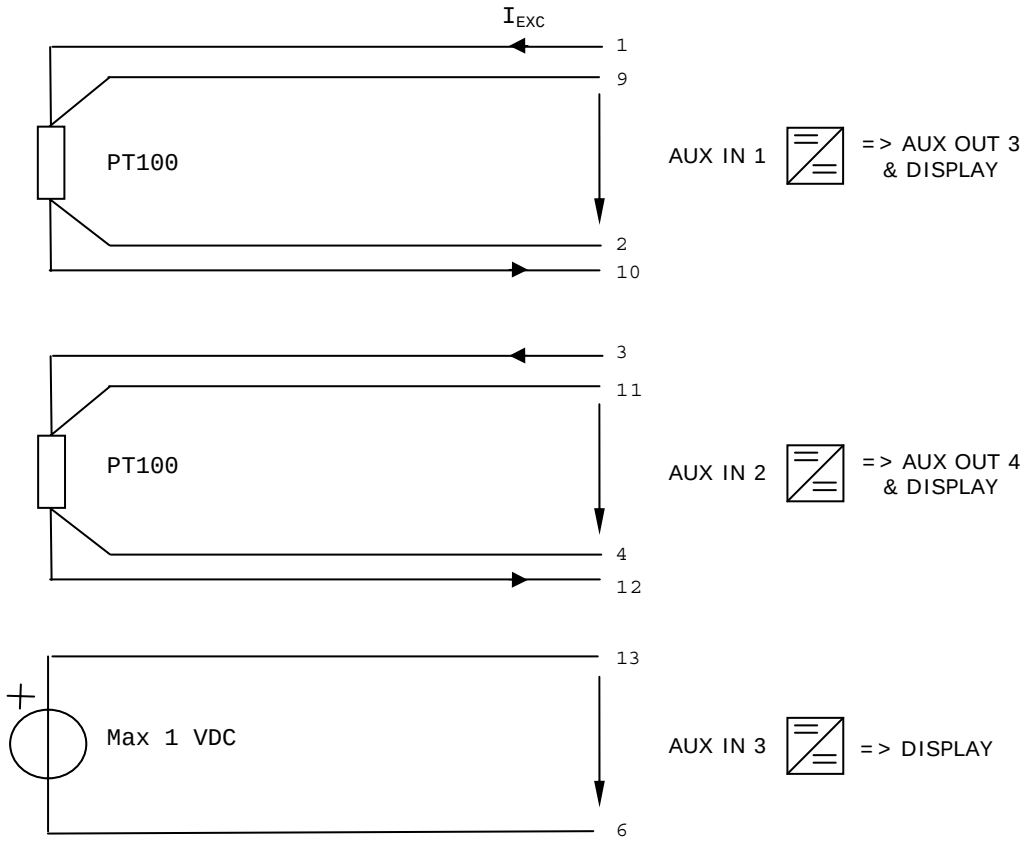
Auxiliary measurement part (µC) inputs. Configuration :

_ RTD on AUX IN 1 (AUX_Ch0)

_ RTD on AUX IN 2 (AUX_Ch1)

_ general voltage input on AUX IN 3

The next picture shows how to connect the RTDs and the general purpose voltage input (typically a pyranometer).

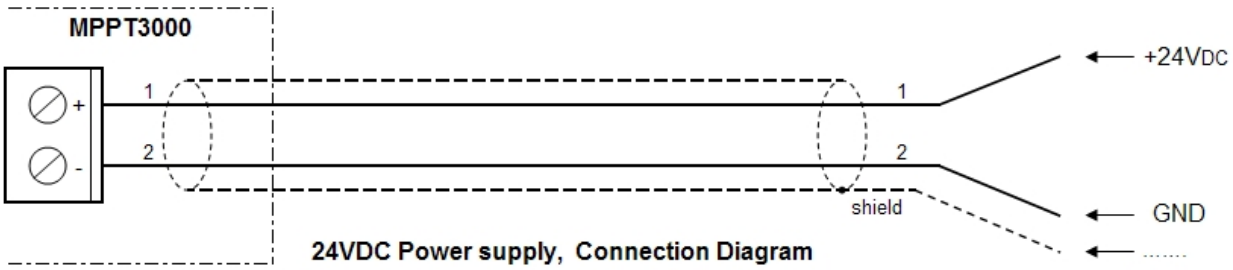


AUX IN 3:

The minimum voltage input range is 0..10 mV, the maximum voltage input range is 0..1V. The input range selection is automatic, just avoid to exceed 1 VDC. The voltage must be always positive (unipolar). The MPPT itself provides the excitation current for the RTDs.

Cable 5 : Power Supply (Input)

1	+24VDC
2	GND
Shield	Internally not connected



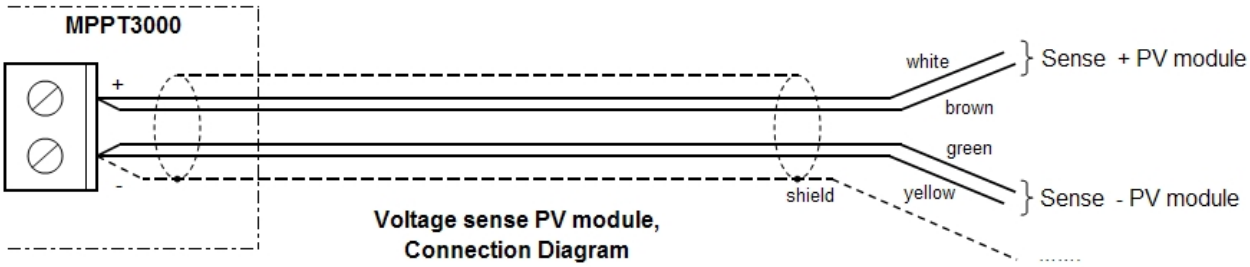
24VDC Power supply, Connection Diagram

Power supply connection :

Check the voltage and the polarity of the power supply.
The voltage and the polarity of the power supply should coincide with that mentioned above.
This connection should be done very carefully observing the polarity, any inappropriate voltage or polarity can damage the device.

Cable 6 : Voltage Sense (Input)

brown+white	Sense **+** PV module
green+yellow	Sense **–** PV module
Shield	Sense **–** PV module



Voltage sense PV module, Connection Diagram

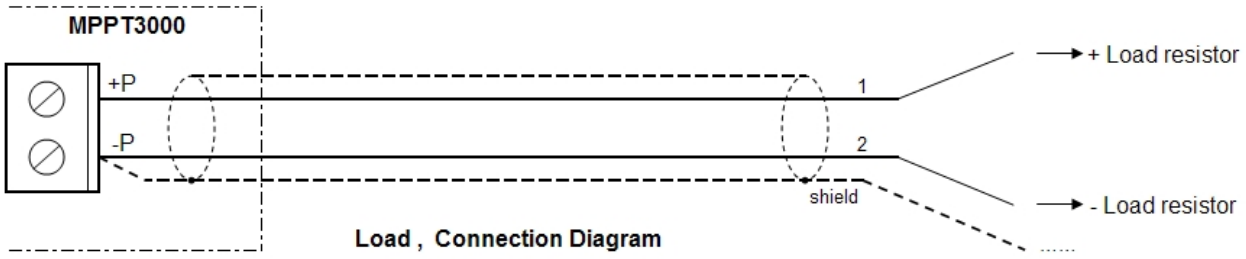
Voltage sense connection :

Check the voltage and the polarity of the photovoltaic module voltage sense input.
The value of the voltage sense input should in any case NOT exceed 200 VDC (Voc voltage).
This connection should be done properly, observing the polarity, any inappropriate voltage or polarity can damage the device.

Cable 7 : LOAD (Output)

!!!!!! IMPORTANT : THE LOAD MUST ALWAYS BE CONNECTED !!!!!!

1 + Load resistor
2+shield - Load resistor



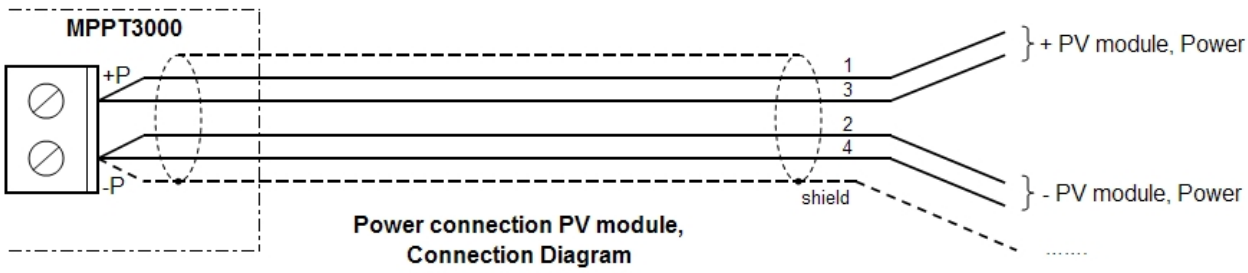
Load , Connection Diagram

Load connection :

The load MUST always be connected. Using the MPPT3000 without the load resistors leads to serious damages.

Cable 8 : PV Module power (Input)

1+3 **+** PV module
2+yellow/green(4) **–** PV module
Shield **–** PV module



Power connection PV module,
Connection Diagram

PV module power connections :

Check the voltage and the polarity of the photovoltaic module.
The voltage of the photovoltaic module should in any case NOT exceed the value of 200 VDC (Voc voltage)
This connection should be done very carefully observing the polarity, any inappropriate voltage or polarity can damage the device.

Choose of the load resistor

How to chose a load resistor

A load resistor must always be connected to the power output of the MPPT3000.
Please chose a resistor value between 18 and 47 Ω in order to :

_ **not to exceed I_{out} (I_{load}) < 3.5 A $_{DC}$**
_ **not to exceed V_{out} (V_{load}) < 108 V $_{DC}$**

according to the power output to disperse.

Example : Power of module = 250 W
Vmpp max > 5 V (ex : 17 V)
I mpp max < 20 A (ex : 14.7 A)

R load min = 250 / (3.5^2) = 20.4 Ω
R load max = (108^2) / 250 = 46.6 Ω

→ thus we choose for example 33 Ω / 250 W (or more powerfull)

→ check in the two charts below if the value of R load chosen is within required parameters

Example of resistor to use :

ARCOL

HS series heatsink mount resistors

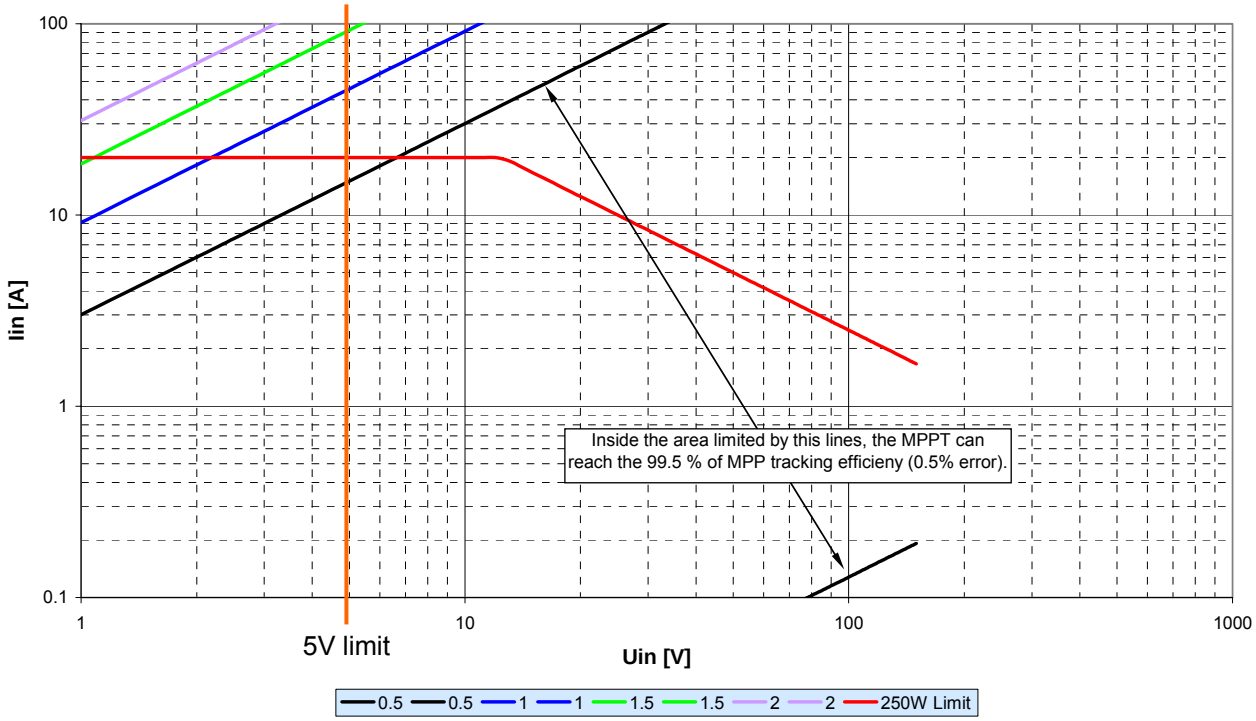
- Resistance range R005 to 100K Ohms
- To 600W
- Tolerance from 0.5%
- High power to volume ratio
- All welded construction
- Available in Non-Inductive Style (Type N)
- High pulse withstand capability
- Connection variation available

→ ***REMEMBER TO MOUNT LOAD RESISTORS ON A SUITABLE HEAT SINK***

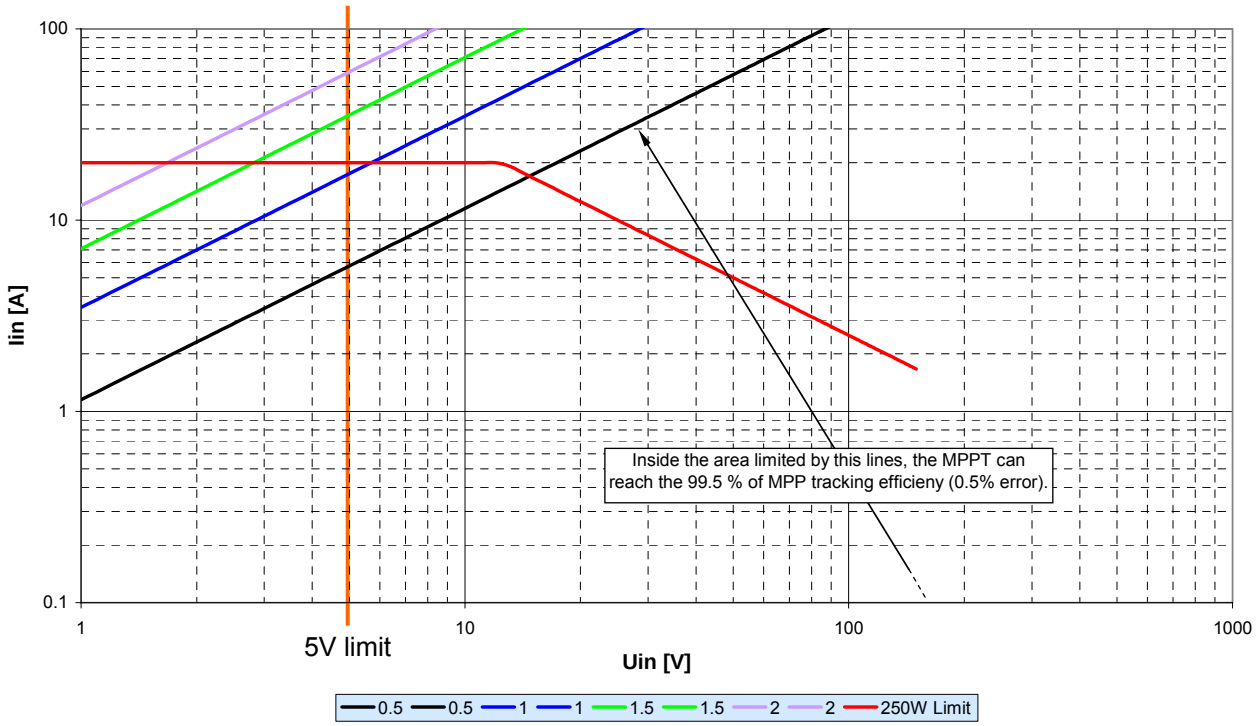
Reachable MPP tracking efficiency vs. output load resistor

The maximum power point tracking efficiency depends also on the chosen output load resistor.
As mentioned in the previous sub-chapter, the value of this resistor can vary between 18 and 47 Ω.
The following charts show the MPP tracking efficiency limits vs. output load resistor.

Iin = f(Uin) with maximum MPP tracking error percentage limits using 18 Ω output resistor



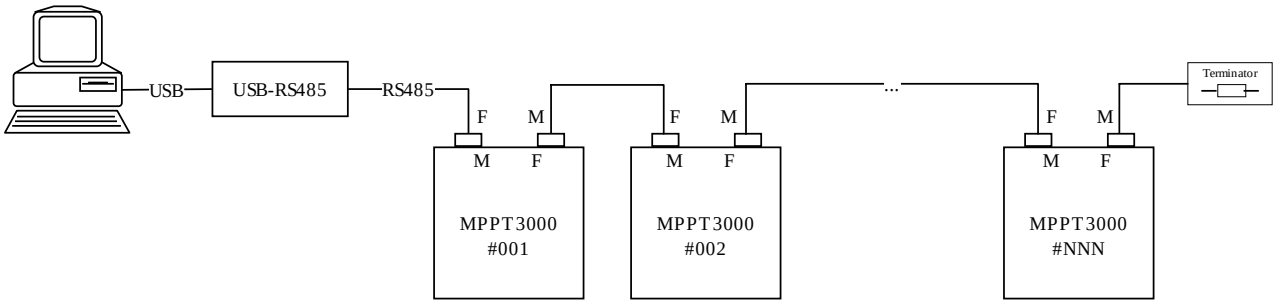
Iin = f(Uin) with maximum MPP tracking error percentage limits using 47 Ω output resistor



It can be seen that most of the working area is inside the by the black lines, which describe the 99.5 % efficiency limits. Only in extreme conditions the efficiency can go slightly below this limit. However, if the MPPT is used properly, the declared MPP tracking efficiency is respected, as it has been proved during the MPPT practical test.

RS485 network

The MPPT3000 devices can be connected to a master PC through a RS485 network. In this way it is possible to fully exploit the potential of the device using the specific user friendly management software. The following scheme shows the correct wiring of the MPPT3000 to the RS485 network.



At the end of the RS485 line there must be a terminal resistor, which can varies depending on the manufacturer of the USB/RS485 adapter and on the cables length. This terminal resistor must be wired between pin 1 (DATA+) and pin 9 (DATA–) of the DB9 connector.

Pin	DB9 for RS232 pinout[1]	DB9 for RS485 pinout[2]
1	Data Carrier Detect	DATA+
2	RxD	Not connected
3	TxD	Not connected
4	Data Terminal Ready	Not connected
5	Signal Ground	GND
6	Data Set Ready	V+
7	Request to Send	Not connected
8	Clear to Send	Not connected
9	Ring Indicator	DATA-

To dialog with one or more MPPTs use only the “MPPT Manager” software. This software allows the user to manage one or more MPPTs easily.

[1] Defined by the RS232 standard.
[2] Selected for the MPPT3000 project.

Turning on the MPPT3000

1. After wiring the device according to the manual specifications, unplug the PV module from the MPPT3000.
2. **Verify that the full-scale voltage ($U_{full\ scale}$) and the full-scale current ($I_{full\ scale}$) are never exceeded. Every time a PV module is replaced, verify again that the settings for $U_{full\ scale}$ and $I_{full\ scale}$ are correct.** If these requirements are met, go to 7.
3. Turn the device on and wait until the default writing appears on the display[3].
4. Set the $U_{full\ scale}$ and $I_{full\ scale}$ in order that the PV module never exceeds the chosen values. The set-up can be done directly on MPPT3000 or on the graphical interface of the provided software.
5. Save the settings for $U_{full\text{-}scale}$ and $I_{full\text{-}scale}$. Here again this can de done directly on the MPPT3000 or by the software.
6. Turn the MPPT3000 off.
7. Turn the device on and wait until the default writing appears on the display[4].
8. Verify that the settings for $U_{full\text{-}scale}$ and $I_{full\text{-}scale}$ have been loaded correctly.
9. Plug the PV module to the device.
10. At this stage, the MPPT is operating and can communicate with the master PC through the provided software, performing the requested instructions.

Turning off the MPPT3000

To switch the MPPT off is recommended to use the shutdown command, this command disables the data logging and prepares the MPPT to be switched off.

1. Open the MPPT Manager software.
2. Select the Terminal Folder.
3. Press the “Shutdown” button.
4. Wait the MPPT answer.

Now is safe to turn off the MPPT3000.

Note: After the shutdown command is sent, the data logging is disabled. To restore the normal function mode the MPPT must be restarted either switching off and re-switching on the power supply or using the reset button.

[3] The time necessary for starting (software load to the processor and initialization) may varies slightly but it is generally about 30 sec.
[4] See previous remark.

Menu

Introduction about the MPPT Menu

Three alphanumeric characters help the user to browse the menu.
The first character is used to define the level (Level 0 → no sign, Level 1 → single point, Level 2 → 2 points).
The second and the third characters show the position number of the selected lower level.

Examples:

1	2	0	'	0	2
2	2	0	'	0	2
2	2	1	"	0	1
3	0	0		0	3

This is an indicative representation, not a full representation.

Level 0 is the higher level, it represents the main groups.
Level 1 is the level used to browse and select the voices inside a main group.
Level 2 is the lower level, when the user is in this level he can modify the chosen voice. **Only the voices that are available in level 2 can be modified directly through the MPPT.**
Only the most important voices can be modified directly using the MPPT interface (buttons and scroll).
The other voices are only accessible using the MPPT Manager software, which also provides an easy access to all the features of the MPPT3000.

Menu Levels 0	1	2	Description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	ESC	Enter	Scroll
Default																						
0	0	0	Um, Pm (Normal functioning)	x	x	x	.	x	x		V		x	x	x	.	x		W	Next	Nothing	Next / Previous L0
			Im, Power part duty cycle	x	x	x	.	x	x		A		x	x	x	.	x		%			
0	0	0	Um, Pm (Power adjustment)	x	x	x	.	x	x		V	→	x	x	x	.	x		W	Next	Nothing	Next / Previous L0
			Im, Power part duty cycle	x	x	x	.	x	x		A		x	x	x	.	x		%			
0	0	0	Um, Pm (Voltage adjustment)	x	x	x	.	x	x		V	←	x	x	x	.	x		W	Next	Nothing	Next / Previous L0
			Im, Duty Cycle	x	x	x	.	x	x		A		x	x	x	.	x		%			
0	0	0	Um, Pm (MPP full search)	x	x	x	.	x	x		V	#	x	x	x	.	x		W	Next	Nothing	Next / Previous L0
			Im, Power part duty cycle	x	x	x	.	x	x		A	#	x	x	x	.	x		%			
0	1	0	Date, Week day	d	d	.	m	m	.	y	y		A	b	c					Next	Nothing	Next / Previous L0
			Hour	h	h	:	m	m	:	s	s											
0	2	0	E tot	E	t	x	x	x	x	x	x	x	x	.	x		W	h		Next	Nothing	Next / Previous L0
			E day	E	d	x	x	x	x	x	x	x	x	.	x		W	h				
0	3	0	PV module Type	M	o	d	u	l	e		T	y	p	e						Next	Nothing	Next / Previous L0
				a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p			
0	4	0	DSP Software version	D	S	P		S	W			a	b	c	d	e	f	g	h	Next	Nothing	Next / Previous L0
			uController Software version		u	C		S	W			a	b	c	d	e	f	g	h			

Low Refresh Info

1	99	0		Low Refresh Info (Setup1) 01	Level UP	Level DOWN	Next / Previous L0
1	0	0	RS485 network ID	MPPT ID '00 xxx	Level UP	Level DOWN	Next / Previous L1
1	0	1		Set MPPT ID "01 xxx	Level UP (don't load in RAM)	Enter	Change state
1	1	0	PV module manufacturer	Manufacturer '01 abcdefghijklmnop	Level UP	Nothing	Next / Previous L1
1	2	0	PV module type	Module Type '02 abcdefghijklmnop	Level UP	Nothing	Next / Previous L1
1	3	0	PV module serial number	Serial Nr '03 abcdefghijklmnop	Level UP	Nothing	Next / Previous L1
1	4	0	PV module database ID	Datab Mod ID '04 xxxxx	Level UP	Nothing	Next / Previous L1
1	5	0	PV module ID code	Mod ID Code '05 abcdefghijklmnop	Level UP	Nothing	Next / Previous L1
1	6	0	PV module position	Position '06 abcdefghijklmnop	Level UP	Nothing	Next / Previous L1
1	7	0	Auxiliary output 2 external datalogger associated channel	Ch Aux 2 '07 xxxxx	Level UP	Nothing	Next / Previous L1
1	8	0	Auxiliary output 3 external datalogger associated channel	Ch Aux 3 '08 xxxxx	Level UP	Nothing	Next / Previous L1
1	9	0	PV module MPP power @ STC.	Pm @ STC '09 xxx.xx W	Level UP	Nothing	Next / Previous L1
1	10	0	PV module MPP current @ STC.	Im @ STC '10 xxx.xx A	Level UP	Nothing	Next / Previous L1
1	11	0	PV module MPP voltage @ STC.	Vm @ STC '11 xxx.xx V	Level UP	Nothing	Next / Previous L1
1	12	0	PV module short circuit current @ STC	Isc @ STC '12 xxx.xx A	Level UP	Nothing	Next / Previous L1
1	13	0	PV module open circuit voltage @ STC	Voc @ STC '13 xxx.xx V	Level UP	Nothing	Next / Previous L1
1	14	0	PV module fill factor.	FF '14 xxx.xx %	Level UP	Nothing	Next / Previous L1
1	15	0	MPPT current mesuring shunt resistor.	Rshunt '15 xx mΩ	Level UP	Level DOWN	Next / Previous L1
1	15	1		Set Rshunt "01 xx mΩ	Level UP (don't load in RAM)	Enter	Change state
1	16	0	Default voltage range (Auxiliary output 0 refers to this value)	V Range '16 xxx.x V	Level UP	Level DOWN	Next / Previous L1
1	16	1		Set V Range "01 xxx.x V	Level UP (don't load in RAM)	Enter	Change state
1	17	0	Default current range (Auxiliary output 1 refers to this value)	I Range '17 xxx.xxx A	Level UP	Level DOWN	Next / Previous L1
1	17	1		Set I Range "01 xxx.xxx A	Level UP (don't load in RAM)	Enter	Change state
1	18	0	PV module cell area	Cell Area '18 xxx.x cm2	Level UP	Nothing	Next / Previous L1
1	19	0	PV module area	Module Area '19 xxx.xx m2	Level UP	Nothing	Next / Previous L1
1	20	0	PV module cells in serie	Cells in ser '20 xxxxx	Level UP	Nothing	Next / Previous L1
1	21	0	PV module cells in parallel	Cells in par '21 xxxxx	Level UP	Nothing	Next / Previous L1
1	22	0	Output resistor	Rout '22 xx Ω	Level UP	Level DOWN	Next / Previous L1

Setup

2	99	0		High Refresh Info (Setup 2) 02	Level UP	Level DOWN	Next / Previous L0
2	0	0	PWM duty cycle manual setting. (use this only for debug purposes)	Manual PWM '00	Level UP	Level DOWN	Next / Previous L1
2	0	1		xxx.xxxV xxx.xxW xxx.xxxA xxx.xx%	Level UP	Change Quad Encoder Step	Change Duty Cycle B
2	1	0	MPP full search.	MPP FS '01 ABC	Level UP	Level DOWN	Next / Previous L1
2	1	1		Set MPP FS "01 ABC	Level UP (don't load)	Load into RAM	Change state
2	2	0	MPP full search type	MPP FS Type '02 xx	Level UP	Level DOWN	Next / Previous L1
2	2	1		Set MPP FS "01 Type xx	Level UP (don't load)	Enter Load into RAM	Change state
2	3	0	MPP full search scan rate	MPP FS Scan '03 Rate xxx s	Level UP	Level DOWN	Next / Previous L1
2	3	1		Set MPP FS "01 Scan Rate xxx s	Level UP (don't load)	Enter Load into RAM	Change state
2	4	0	MPP full search sweep time	MPP FS '04 Sweep T xx.x s	Level UP	Level DOWN	Next / Previous L1
2	4	1		Set MPP FS "01 Sweep T xx.x s	Level UP (don't load)	Enter Load into RAM	Change state
2	5	0	MPP full fearch dead time	MPP FS '05 Dead T xx.xx s	Level UP	Level DOWN	Next / Previous L1
2	5	1		Set MPP FS "01 Dead T xx.xx s	Level UP (don't load)	Enter Load into RAM	Change state
2	6	0	MPP adjustement state (ON/OFF)	MPP Adj '06 ABC	Level UP	Level DOWN	Next / Previous L1
2	6	1		Set MPP Adj "01 ABC	Level UP (don't load)	Load into RAM	Change state
2	7	0	MPP adjustement start window	MPP Adj S Win '07 xxxxxxxxx	Level UP	Level DOWN	Next / Previous L1
2	7	1		Set MPP Adj "01 S Win xxxxxxxxx	Level UP (don't load)	Load into RAM	Change state
2	8	0	MPP adjustement end window	MPP Adj E Win '08 xxxxxxxxx	Level UP	Level DOWN	Next / Previous L1
2	8	1		Set MPP Adj "01 E Win xxxxxxxxx	Level UP (don't load)	Load into RAM	Change state
2	9	0	Voltage adjustement state (ON/OFF)	Vm Adj '09 ABC	Level UP	Level DOWN	Next / Previous L1
2	9	1		Set Vm Adj "01 ABC	Level UP (don't load)	Load into RAM	Change state
2	10	0	Voltage adjustement start window	Vm Adj S Win '10 xxxxxxx	Level UP	Level DOWN	Next / Previous L1
2	10	1		Set Vm Adj "01 S Win xxxxxxx	Level UP (don't load)	Load into RAM	Change state
2	11	0	Voltage adjustement end window	Vm Adj E Win '11 xxxxxxx	Level UP	Level DOWN	Next / Previous L1
2	11	1		Set Vm Adj "01 E Win xxxxxxx	Level UP (don't load)	Load into RAM	Change state
2	12	0	Automatic IV Tracer state (ON/OFF)	IV Tr State '12 ABC	Level UP	Level DOWN	Next / Previous L1
2	12	1		Set IV Tr "01 State ABC	Level UP (don't load)	Load into RAM	Change state
2	13	0	Automatic IV Tracer Scan Rate	IV Tr Scan '13 Rate xxh xxm	Level UP	Nothing	Next / Previous L1
2	14	0	Ad hoc IV Tracer points number (Automatic IV Tracer always has 256 pts)	IV Tr Points '14 xxx	Level UP	Nothing	Next / Previous L1
2	15	0	IV Tracer seweep time	IV Tr Sweep T '15 xx.x s	Level UP	Nothing	Next / Previous L1
2	16	0	Main datalogging scan rate	Data Logging '16 Rate xxm	Level UP	Level DOWN	Next / Previous L1
2	16	1		Set Data "01 Logging Ratexxm	Level UP (don't load)	Load into RAM	Change state
2	17	0	Autorange state (ON/OFF)	Autorange '17 ABC	Level UP	Level DOWN	Next / Previous L1
2	18	0	Restore default setup	Restore '20 Default Setup?	Level UP	Level DOWN	Next / Previous L1
2	18	1		Press Enter "01 to Restore Setup	Level UP (don't restore)	Restore default LRI into RAM	Nothing

Save/Load

3	99	0		Save/Load DSP Part 03	Level UP	Level DOWN	Next / Previous L0
3	0	0	Save Low Refresh Info (Setup1) into MPPT flash memory	Save LRI into Flash? '00 Abc	Level UP	Level DOWN	Next / Previous L1
3	0	1		Press Enter to Save LRI "01	Level UP (don't save)	Enter (Save)	Nothing
3	1	0	Load Low Refresh Info (Setup1) from flash memory to MPPT RAM	Load LRI into DSP RAM? '01 Abc	Level UP	Level DOWN	Next / Previous L1
3	1	1		Press Enter to Load LRI "01	Level UP (don't load)	Enter (Load)	Nothing
3	2	0	Save High Refresh Info (Setup2) into MPPT flash memory	Save Setup into Flash? '02	Level UP	Level DOWN	Next / Previous L1
3	2	1		Press Enter to Save Setup "01	Level UP (don't save)	Enter (Save)	Nothing
3	3	0	Load High Refresh Info (Setup2) from flash memory to MPPT RAM	Load Setup into DSP RAM? '03 Abc	Level UP	Level DOWN	Next / Previous L1
3	3	1		Press Enter to Load Setup "01	Level UP (don't load)	Enter (Load)	Nothing

uConverter

4	99	0		uConverter 04	Level UP	Level DOWN	Next / Previous L0
4	0	0	T ch0, T ch1 U ch3, T internal sensor	xxx.xx°C xxx.xx°C x.xxxV xxx.xx°C	Level UP	Nothing	Next / Previous L1

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