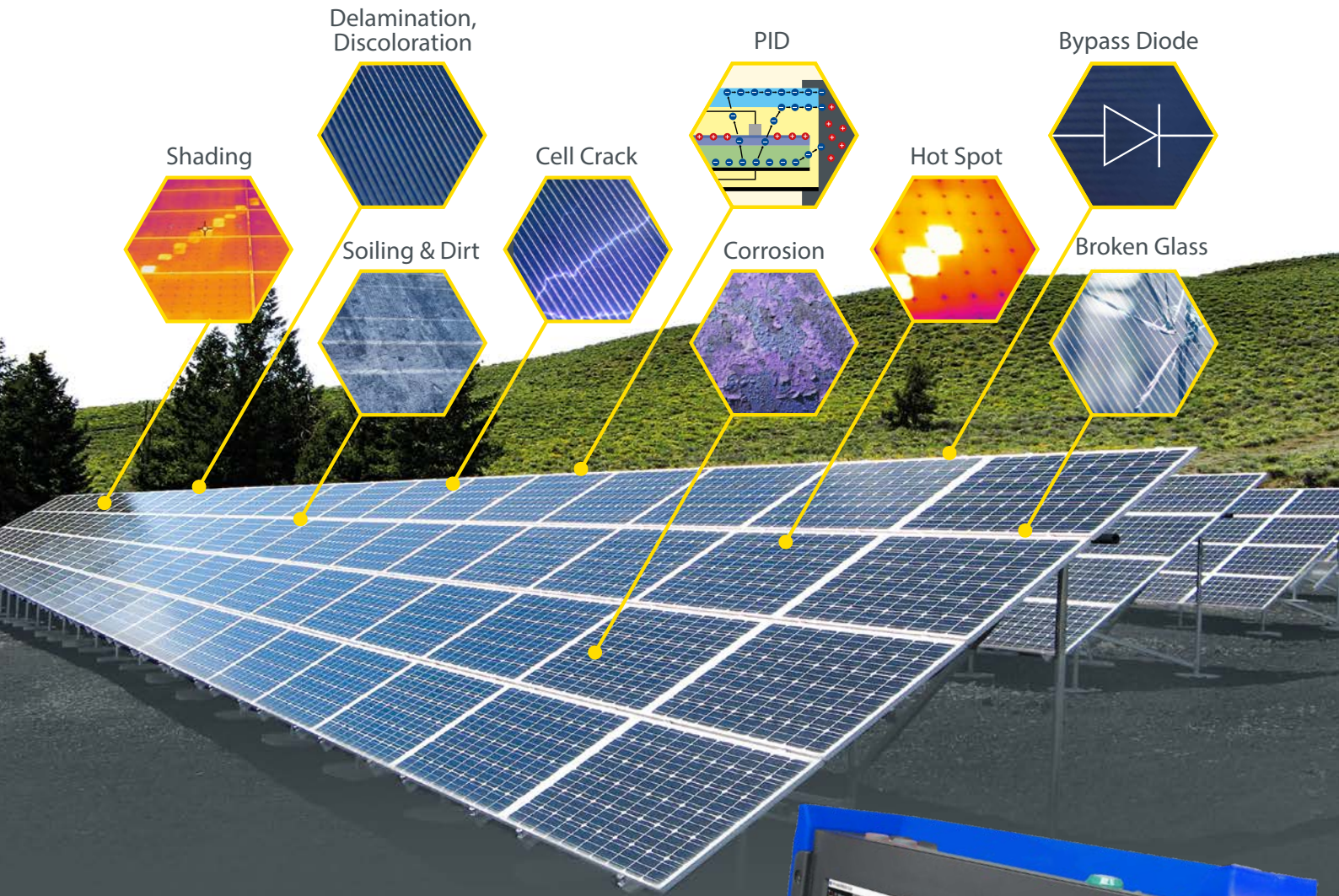




MULTI-CHANNEL IV CURVE TRACER

MESSTECHNIK

World's most versatile Solar Power Plant diagnostic system

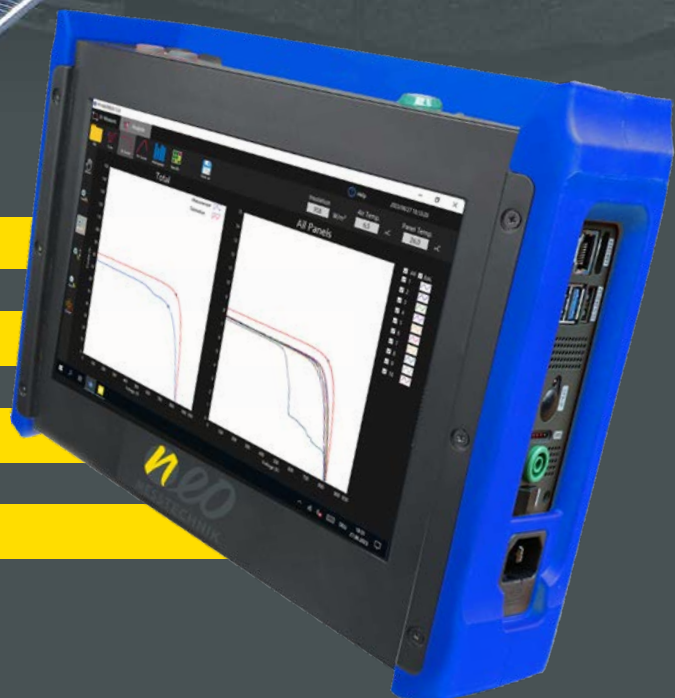


POWER PERFORMANCE

IV-CURVE-TRACING

DISTANCE-TO-FAULT

LEAKAGE MEASUREMENT



How does the PV Master unleash your solar power potential?

Performance: Testing ensures that PV modules, and other components perform as expected under various conditions. The PV Master assesses their efficiency, power output, and reliability.

Safety Compliance: Early fault detection through a combination of leakage current measurement and IV curve tracing.

Inspection methods

There are already a few methods to carry out PV inspections. The ones mainly used in the field are thermal imaging and electroluminescence but since they often need a lot of time and know how to use, they aren't flawless.

Diagnosis	Optical Inspection	Thermal Imaging	Electro-luminescence	1-Channel IV-Curve Tracing	Multichannel IV-Curve Tracing
Faults					
PID	×	△	✓	✓	✓
Bypass open	×	×	×	✓	✓
Bypass shorted	×	✓	✓	✓	✓
Hot Spots	×	✓	△	✓	✓
Cell Crack	×	△	✓	△	△
Disconnection	×	✓	-	✓	✓
Snail Trail	✓	△	-	✓	✓
parallel Mismatch	×	×	×	×	✓
Needed Time	-	High	High	High	Low

× no detection △ partly detection ✓ full detection

World's only instrument to detect parallel Mismatch-Losses

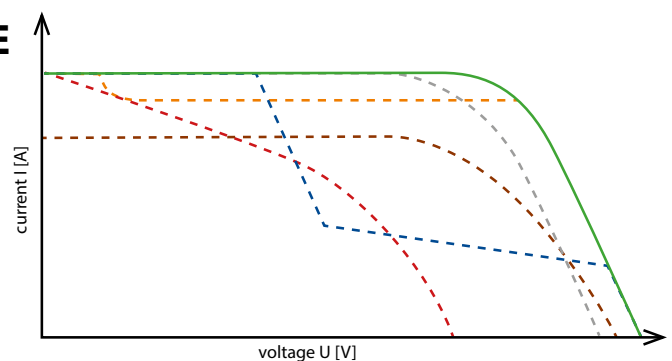
Exemplary faults detected by IV – CURVE

■ Standard Test Conditions
Expected curve when no damage or aging is present.

■ Hotspots
When solar cells within a module no longer supply current due to partial shading they heat up strongly due to the current of the other cells connected in series. In the worst case, a hot spot can lead to fires, but in any case, it results in a power reduction.

■ PID – Potential Induced Degradation
PID occurs when a voltage difference prevails between panel and ground. The primary circuit thereby produces a partial voltage discharge which then results in an output power reduction.

■ LID - Light Induced Degradation
The degradation of photovoltaic modules describes the reduction in performance due to aging effects. This mainly includes browning, cell bleaching blistering or cell corrosion.



■ Bypass-Diode Breakage
Bypass-Diodes can break due to production faults, thunderstorms, overheating, mechanical damage or continuous shading. When that happens the system voltage will be reduced leading to output power reduction.

■ Shading
Shaded modules do not only reduce the power output but also lead to bigger problems like Hotspots or breakage of the bypass diode.

Why is it the world's most versatile Solar Power Plant diagnostic system?

ADAPTIVE SWITCHING
Precise IV-Curve tracing for both - Single PV modules or full strings up to 1500 V beginning at 400 W/m² solar radiation.

IV CURVE TRACING
1500 V / 30 A
High Power Rating (optional 45 A)

LEAKAGE DETECTION & DISTANCE TO FAULT FUNCTION

DIAGNOSIS
Automatic detection of many types of performance-reducing faults, such as Mismatch, PID, Hotspots, Cell Cracks, BPD breakage and others.

EXTENSION BOX
For measuring up to 20 strings simultaneously - IV and Leakage measurement.

SENSOR BOX EXPERT
Bifacial PV module support. Exact temperature and irradiance measurement.

- Multimeter Mode (U, I, P)
- Mobile Operation up to 4 hours
- Easy Remote Connection (LAN, WLAN, UMTS)
- Direct Analysis on the Instrument using the 10.1 inch Multi-Touch-Screen

The best IV-Curve Tracer

Efficiency
Power & efficiency according to IEC62446-2

1 String

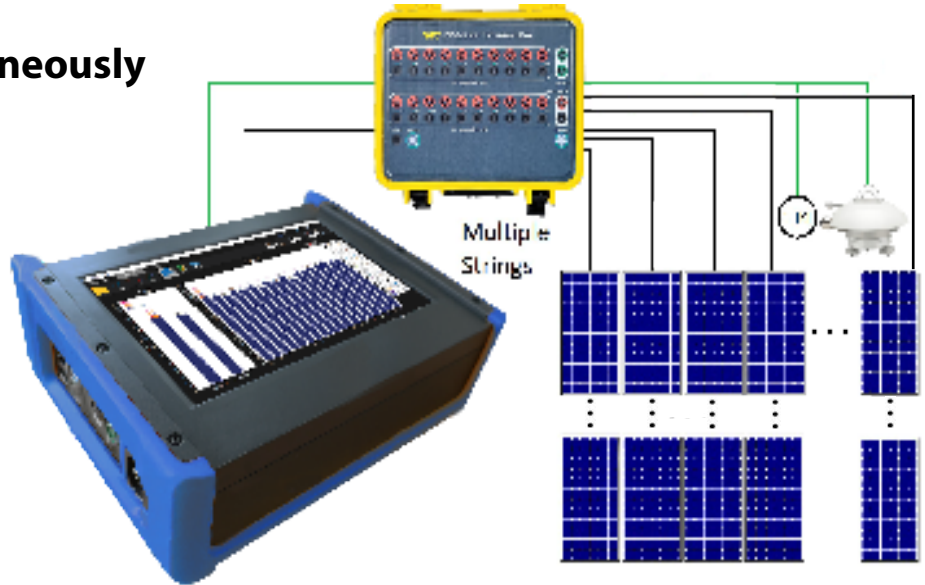
Sensor Box Options:

Sensor Box Lite
Integrated Class C Pyranometer, ambient and module temperature (PT100/PT1000)

Sensor Box Expert
- up to 2x Radiation (Pyra Class A, B or C)
- up to 5x Temperature (PT100/1000 or Thermocouple Typ K)
- wired or wireless (up to 100m)
- Touch-Screen Display and battery powered
- Bifacial Module support

Up to 20 strings simultaneously

The modular system of the PV Master series offers the best possible flexibility for the user. 1, 4, or 20 input channels can be connected to the device via an external switchbox.



PM-10: 1 Channel
Extension Box:
Option 1: 4 Channels
Option 2: 20 Channels

PV MASTER 10



1 Channel IV-curve tracing

Highly precise measurement diagnostics an report tool for PV systems.

up to 1500 V / 30 A

Designed for high-power applications (high voltage / high current)

20 CHANNEL EXTENSIONBOX



AUTOMATIC SWITCHING

Switches automatically through all connected Channels.

- 20x IV-curve measurement
- 20x Leakage measurement

PV MASTER 70



20 Channels with 1000 V / 30 A

PV MASTER 80



24 Channels with 1000 V / 30 A



8 Technical Data and Specifications

8.1 Accuracy and Signal Conditioning

ANALOG			HV	LV
Channel	Voltage		1	-
	Current		-	2
Input Range	Voltage		±1600Vp ±800Vp	-
	Current	Clamp	-	Low Voltage Input: ±10Vp MAX Internal Current Sensor: ±30A MAX
DC Accuracy			High Voltage Input: ±0.05%FS	Low Voltage Input: ±0.05%FS Internal Current Sensor: ±0.5%FS External Current Sensor: see datasheet
Gain Linearity			-	20ppm (MAX)
Gain Drift Range			-	20ppm/K (MAX)
Offset Drift			6mV/K (MAX)	26uV/K (MAX)
Input Resistance			10Mohm	10Mohm
ADC	Type		SAR	
	Data rate		1Msps(MAX)	
Filter	-3dB BW	Analog	510kHz 4th Order Butterworth	
		Digital (FIR)	241kHz@1Msps 160kHz@600ksps 121kHz@500ksps 70kHz@144ksps 68kHz@140ksps 11.5kHz@24ksps 9.6kHz@20ksps,140ksps	
Bandwidth	-0.1dB BW	Analog	160kHz 4th Order Butterworth	
		Digital (FIR)	220kHz@1Msps 153kHz@500ksps 110kHz@600ksp 68kHz@144ksps 66kHz@140ksps 11kHz@24ksps 9.2kHz@20ksps,140ksps	
Measuring BandWidth	-3dB		510 kHz	Low Voltage: 510 kHz Internal Current Sensor: 300 kHz
	-0.1dB		160 kHz	160 kHz
Typical SNR			90dB	
Typical CMRR			85dB	
Current Sensor Power Supply			-	Bipolar ±15V(1.3A), Unipolar +9V
TEDS	Current		-	1 TEDS for All CH
Isolation Type			CH-CH	CH-GND
Isolation Voltage			6kVp	CAT III 1000V



8.2 IV-Curve Specifications

Analogue			
Channel	I-V Curve		1 (Optional; max 20)
	Multimeter		Voltage 1 CH, Current 1 CH
	Environmental Sensor		Solar Irradiance
Temperature			Max. 5 CH
Input Range	I-V Curve	Voltage	± 1500 Vp MAX
		Current	± 30 Ap MAX
Communication for Environmental Sensor			RS485 / Wifi 802.11 b

Data points for IV-Curve Measurement

Sampling Rate	Data Points
100k	229
200k	457
300k	686
400k	914
500k	1143
800k	1828
1M	2285

8.3 Environment and Mechanical

Processor		Intel® Processor E3940 @ 1.6GHz
Storage		2x 256 GB Samsung SSD
Display		10.1" TFT LCD (Touch Screen), 1280x800
PC interface		2xUSB 3.0, 1xUSB 2.0, 1x HDMI
Battery (Li-ion)	Capacity	90 Wh
	Charging Time	About 4 hours 10 min.
	Operating Time	About 4hours 40 min. (Maximum)
Power supply		DC 12 VDC
Size (width x length x height)		298 x 225 x 95 mm
Temperature range	Operating	0°C ~ +60°C
	Storing	-20°C ~ +80°C