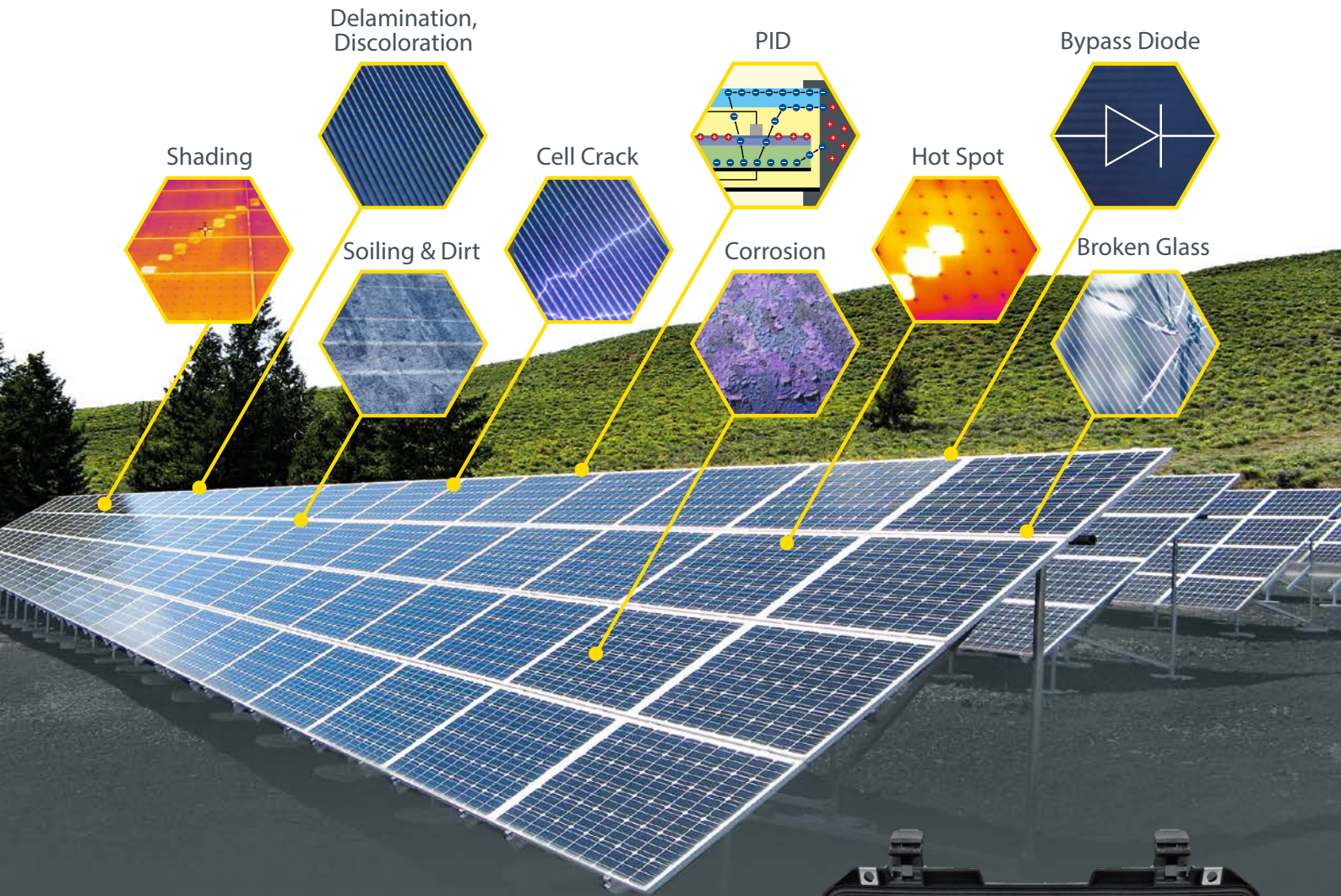




MULTI-CHANNEL IV CURVE TRACER

MESSTECHNIK

World's first Solar Power Plant diagnostic system



SAFETY TEST

LEAKAGE MEASUREMENT

PERFORMANCE TEST

FAULT DETECTION



SOLAR PHOTOVOLTAIC POWER PLANTS

The number of solar power plants has been steadily increasing over the past years. Photovoltaic systems are known for:

- Long Lifetime
- Low aging effects
- Low maintenance
- Low operating costs
- Easy Installation
- Robustness



Nevertheless, different kind of faults in PV systems can occur which lead to:



Performance losses of >10 % within 3 years are very common



Most faults are not detectable by visual inspection



Mismatch losses of PV strings are 10 to 100 times higher than defect panels

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 Faults	Optical Inspection	Thermal Imaging	Electro- Luminescence	1-Channel IV-Curve Tracing	Multichannel IV-Curve Tracing
PID	×	△	✓	✓	✓
Bypass Diode	△	✓	✓	✓	✓
Hot Spots	×	✓	△	✓	✓
Cell Crack	×	△	✓	△	△
Disconnection	×	✓	-	✓	✓
Snail Trail	✓	△	-	✓	✓
Mismatching	×	×	×	×	✓
Needed Time		High	High	High	Low
Know How		High	High	Average	Low

× no detection △ partly detection ✓ full detection

EXEMPLARY FAULTS DETECTED BY IV – CURVE

Standard Test Conditions

The standard test conditions designate a fixed set of conditions to be able to compare the performance of photovoltaic modules with each other.

Shading

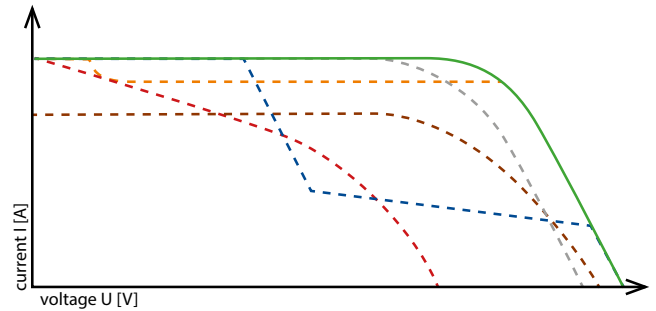
Shaded modules can be worse than expected for PV plants. Not only the power output will be reduced but it can also lead to bigger problems like Hotspots or breakage of the bypass diode.

Hotspots

Hotspots occur when individual solar cells within a solar module no longer supply current due to partial shading but heat up strongly due to the current of the other cells connected in series. In the worst case, a hot spot can lead to the destruction of the module, but in any case, it results in a reduction in yield.

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.

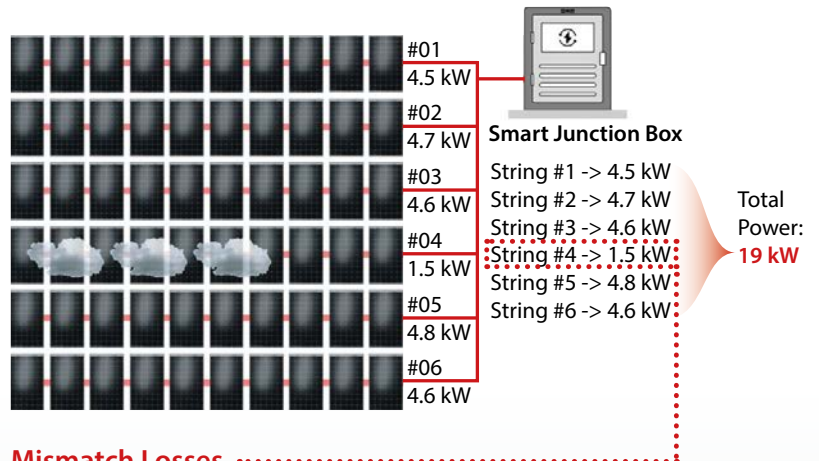
Bypass-Diode Breakage

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.

MISMATCH LOSSES

A mismatch is a power loss that can be caused by differences in the power, inclination or orientation of the PV modules or by the use of different module models.

These differences must always occur in one string. If, for example, modules with different power are connected in a row, the module with the lowest power also limits the power of the other connected modules.

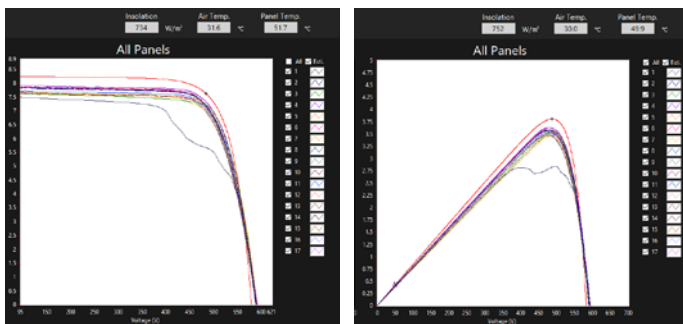


Mismatch Losses

Instead of only 3 kW power reduction, due to mismatch of strings, the reduction is **8 kW (30%)**

MULTI-CHANNEL IV CURVE TRACING

The Multi-channel PV Master instruments to detect the IV-Curve of up to 24 strings simultaneously. The only instrument worldwide to detect MISMATCH losses.



AUTOMATIC SYSTEM DIAGNOSTIC

An diagnostic system based on AI will detect and classify errors of individual strings automatically





Measurement of solar radiation, panel and ambient temperature and conversion to STC



AI (artificial intelligence) for automatic system diagnostic and performance



Safety
Measurement system for safety and performance check.



Leakage
Detection of leakage currents



Diagnosis
Automatic detection of Mismatch, Hotspot, PID, Shading, Bypass Diode, etc.



Efficiency
Power & efficiency according to IEC62446-2

PV MASTER 70



20 CHANNELS

Simultaneous measurement and diagnostics of up to 20 strings (channels) using Time-Sync technology.

up to 1600 V / 40 A

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

MOBILE OPERATION

The integrated battery pack allows an operating time of up to 4 hours.

SMART TOUCH

The 10.1 inch Smart Touch display responds immediately without any delay with intuitive operation like on a mobile phone.

PV MASTER 80



24 CHANNELS

Simultaneous measurement and diagnostics of up to 24 strings (channels) using Time-Sync technology.

1100 V / 40 A

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

RACK MOUNT

Ruggedized unit for both labortary and field tests.

SMART TOUCH

The 10.1 inch Smart Touch display responds immediately without any delay with intuitive operation like on a mobile phone.