IV PRO is the most advanced multifunction PV tester ever developed, being the combination of an **I-V curve tracer** meeting **IEC 60891**, and a commissioning tester meeting the **IEC 62446-1** standards.

IV PRO is a one-stop test solution to take category 1 and category 2 commissioning tests, to measure the performance and functionality, and to troubleshoot **single face** and **bifacial** modules in PV systems.

IV PRO: I-V curve tracing (performance/acceptance test)
IV PRO verifies the performance of PV strings in accordance with IEC 60891 by **tracing the I-V curve up to 1,500V and 40A**. Through the solar radiation and PV module temperature measurements (main unit wirelessly connected and/or synchronized to the remote unit SOLAR03), **IV PRO** extrapolates curves to the STC (Standard Test Conditions: 1000W/m^2, 25°C, AM 1.5) and compares them to the nominal values provided by the module manufacturer. The wide internal database already stores more than **40,000** modules, more modules can be added. Finally, **IV PRO** provides a positive or negative outcome (OK/NO).

IV PRO: Commissioning tests
IV PRO performs all tests required by the IEC 62446-1 to commission a photovoltaic installation **in automatic sequence**. Therefore, **by a single GO-key stroke** PVCHECKs-PRO measures and tests:

- continuity of protective earthing and/or equipotential bonding conductors, where fitted;
- polarity test;
- string open-circuit voltage test **up to 1500V**;
- string short-circuit current test **up to 40A**;
- insulation resistance of the DC circuits by generating **up to 1500V even on live circuits**.

As required by IEC 62446-1, **IV PRO** compares the just-measured values of string Voc and Isc to the previously measured strings composing the PV installation to prevent voltage and current mismatching.

Insulation resistance of DC circuits is performed according to IEC 62446-1 test method 1. Two tests are then performed: a first test between array negative and earth followed by a second test between array positive and earth, avoiding the use of any short-circuit switch box (*).

IV PRO: Functionality checks
IV PRO verifies the functionality of PV strings in accordance with IEC 62446 by measuring the open circuit voltage and short-circuit current under operating conditions **up to 1,500V and 40A**. According to the requirements of IEC 62446, **IV PRO** displays measures as well as their comparison to the previously tested PV strings. Through the solar radiation and PV module temperature measurements (main unit wirelessly connected and/or synchronized to the remote unit SOLAR03), IV 600 extrapolates measures to the STC (Standard Test Conditions: 1000W/m^2, 25°C, AM 1.5) and compares them to the nominal values provided by the module manufacturer. The wide internal database already stores more than **40,000** modules, more modules can be added. Finally, **IV PRO** provides a positive or negative outcome (OK/NO).

IV PRO: A green solution that never runs out of battery
To minimize battery consumption and allow battery recharging under any condition, IV PRO includes a revolutionary, **patent pending BMS** (**Battery Management System**) that automatically recovers energy from the test procedure to recharge the batteries. In addition, IV PRO is powered by the PV module/string under test that also recharges the instrument's batteries to never run out of power.

IV PRO: A smart aid making troubleshooting quick
Troubleshooting is a time consuming and costly activity. Any time an inverter shuts down because of lack of insulation, the quickest it is recovered it to normal operation, the quickest the installation returns to generating power and income. GFL is the new function **IV PRO** performs answering each technician's question: where is the fault? By this function **IV PRO** indicates the precise position of the lack of insulation, so the technician can go without fail to service the broken component.

(*) According to IEC 62446-1, insulation resistance test method 2 would require the use of a short-circuit switch box (incorporating a load break rated DC switch) to safely make and break the short circuit connection - after array cables have been safely connected into the device.

1. GENERAL FEATURES

Feature		Note
Ratings		CAT III 1500VDC
PV module type - all most common types of photovoltaic module	• Single face	✔
	• Bifacial	✔
I-V curve – voltage range		15V – 1500V DC
I-V curve – current range		0.1A – 40A DC
DMM (input voltages)		✔
Wireless environmental parameters measurement (free field; max 100m, bluetooth connection with SOLAR03 required)	• Irradiance	✔
	• Module temperature	✔
Commissioning tests @ OPC (OPerating Conditions)	• Open circuit voltage (Voc)	✔
	• Short circuit current (Isc)	✔
Commissioning tests @ STC (Standard Test Conditions) (free field; max 100m, bluetooth connection with SOLAR03 required)	• Open circuit voltage (Voc)	✔
	• Short circuit current (Isc)	✔
Performance/Acceptance tests @ OPC (OPerating Conditions) – I-V curve:		✔
Performance/Acceptance tests @ STC (Standard Test Conditions) (free field; max 100m, bluetooth connection with SOLAR03 required)	• I-V curve	✔
	• Outcome (OK/NO)	✔
Continuity of protective earthing and/or equipotential bonding conductors with 200mA test current		✔
Insulation measurement (DUAL mode and TIMER mode with test voltage 250V, 500V, 1000V, 1500V)	• Module	✔
	• Array/string	✔
	• Whole field	✔
GFL (Ground Fault Locator)		✔
PV module datasheet data base		> 40,000 internal
Memory		9999 Test
Data transfer / Communication port		USB-C and WiFi
Touch screen colour graphic LCD		800 x 600 pxl
Help on line		✔
Buzzer		✔
Power supply	• Internal batteries	✔ **with BMS**
	• Instrument inputs	✔ **with BMS**
	• External power supply	✔
Batteries	• 8 x 1.5V alkaline AA	✔
	• 8 x1.2V rechargeable AA	✔
Temperature range		-10°C – +50°C
Waterproof		IP67 (closed) – IP40 (open)

2. ELECTRICAL SPECIFICATIONS

Accuracy is calculated as ± [% readings + (no. of digits) * resolution] at 23 °C ± 5 °C, relative humidity <80%HR

2.1. DMM

DC Voltage

Range (V)	Resolution (V)	Uncertainty
3 ÷ 1500	1	± (1.0%rdg + 2dgt)

AC TRMS Voltage

Range (V)	Resolution (V)	Uncertainty
3 ÷ 1000	1	± (1.0%rdg + 3dgt)

Frequency range: 42.5 ÷ 69Hz ; Voltages zeroed for measured value <3V

2.2. PERFORMANCE TEST

IV TEST- DC Voltage @ OPC

Range (V)	Resolution (V)	Uncertainty
3.0 ÷ 1500.0	0.1	±(0.2%rdg+2dgt)

Minimum VPN voltage to start the test: 15V

IV TEST - DC Current @ OPC

Range (A)	Resolution (A)	Uncertainty
0.10 ÷ 40.00	0.01	±(0.2%rdg+2dgt)

PV module stray capacitance: max 30uF

IV TEST - DC Voltage @ STC

Range (V)	Resolution (V)	Uncertainty
3.0 ÷ 1500.0	0.1	±(4.0%rdg+2dgt)

IV TEST - DC Current @ STC

Range (A)	Resolution (A)	Uncertainty
0.10 ÷ 40.00	0.01	±(4.0%rdg+2dgt)

PV module stray capacitance: max 30uF

IV TEST - DC Power @ OPC

Range (W)	Resolution (W)	Uncertainty
50 ÷ 9999	1	±(1.0%rdg+6dgt)
10.00k ÷ 99.99k	0.01k	±(1.0%rdg+6dgt)

PV module stray capacitance: max 30uF

IV TEST - DC Power @ STC (ref. to 1 PV module)

Range (W)	Resolution (W)	Uncertainty
50 ÷ 9999	1	±(4.0%rdg+2dgt)

PV module stray capacitance: max 30uF

PV module type

All most common types of photovoltaic module, single face as well as **bifacial**

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Tel: +39-0546-621002 - Fax: +39-0546-621144
email: export@ht-instruments.com
web: http://www.ht-instruments.com

2.3. COMMISSIONING TEST

Continuity Test (RPE)

Range [Ω]	Resolution [Ω]	Uncertainty
0.00 ÷ 9.99	0.01	±(2.0%rdg+2dgt)
10.0 ÷ 99.9	0.1	
100 ÷ 1999	1	

Test current >200mA DC up to 2Ω (test leads included), Resolution 1mA, Test current uncertainty ±(5.0%rdg + 5dgt)
Open loop voltage 4 < V_0 < 10V

Insulation Test (MΩ) – Mode TIMER

Test voltage [V]	Range [MΩ]	Resolution [MΩ]	Uncertainty
250, 500, 1000, 1500	0.01 ÷ 9.99	0.01	±(5.0%rdg+ 5dgt)
	10.0 ÷ 99.9	0.1	

Open voltage: < 1.25 * nominal test voltage
Short circuit current: <15mA (peak) for all test voltages
Generated voltage Resolution 1V, uncertainty ±(5.0%rdg + 5dgt) @ Rmis> 0.5% FS
Test current > 1mA with load = 1kΩ x Vnom

Insulation Test (MΩ) – Mode DUAL

Test voltage DC [V]	Range [MΩ]	Resolution [MΩ]	Accuracy (*)
250, 500, 1000, 1500	0.1 ÷ 0.99	0.01	±(5.0%reading + 5digits)
	1.0 ÷ 19.9	0.1	
	20 ÷ 100	1	

Open voltage <1.25 x nominal test voltage
Short circuit current <15mA (peak) for each test voltage
Nominal measured current >1mA on R = 1kΩ x Vnom (with VPE, VNE= 0)
(*) For Accuracy the following constraints shall be considered:
Accuracy is indicated for VPN ≥240V, Rfault≥10Ω
Accuracy for Rp and R(+) is not declared if R(+)≥ 0.2MΩ and R(-) <0.2MΩ
Accuracy for Rp and R(-) is not declared if R(+) < 0.2MΩ and R(-) ≥0.2MΩ

2.4. FUNCTIONAL TEST

IV CHECK - DC Voltage @ OPC

Range (V)	Resolution (V)	Uncertainty
3.0 ÷ 1500.0	0.1	±(0.2%rdg + 2dgt)

Minimum VPN voltage to start the test: 15V

IV CHECK - DC Current @ OPC

Range (A)	Resolution (A)	Uncertainty
0.10 ÷ 40.00	0.01	±(0.2%rdg + 2dgt)

PV module stray capacitance: max 30uF

IV CHECK - DC Voltage @ STC

Range (V)	Resolution (V)	Uncertainty
3.0 ÷ 1500.0	0.1	±(4.0%rdg + 2dgt)

IV CHECK - DC Current @ STC

Range (A)	Resolution (A)	Uncertainty
0.10 ÷ 40.00	0.01	±(4.0%rdg + 2dgt)

PV module stray capacitance: max 30uF

3. GENERAL SPECIFICATIONS

DISPLAY AND MEMORY:	
Features:	Color graphic touch screen LCD 800x600
Memory:	max 9999 test, 3 levels of marker
Internal Data Base of PV module:	> 40,000

POWER SUPPLY:	
Internal:	8x1.5V type AA alkaline or 8x1.2V type AA NiMH rechargeable battery
External:	PV inputs (Vmin 40V) Power supply adapter A0061 (100-415V, CAT IV 300, CAT III 600V)
Battery life:	IV and IVCK: >1,000 tests

IV 600 battery life is also extended by BMS (**Battery Management System – patent pending**) that recovers energy absorbed while tracing the IV curve to recharge the batteries.

OUTPUT INTERFACE	
PC communication:	USB Type C and WiFi
SOLAR-03 communication:	BT communication (max distance 100m – outdoor free field)

MECHANICAL FEATURES	
Dimensions (L x W x H):	335 x 289 x 155mm; (13.1 x 11.4 x 6.1in)
Weight (batteries included):	7kg; (212 ounces)
Mechanical protection:	IP67 (case closed), IP40 (open)

ENVIRONMENTAL CONDITIONS:	
Reference temperature:	23°C ± 5°C ; (73°F ± 41°F)
Operating temperature:	-10°C ÷ 50°C ; (14°F ÷ 122°F)
Allowable relative humidity:	<80%RH
Storage temperature:	-20°C ÷ 60°C ; (-4°F ÷ 140°F)
Storage humidity:	<80%RH
Max. operating altitude:	2000m (6562ft)

GENERAL REFERENCE STANDARDS:	
Safety:	IEC/EN61010-1, 61010-2-030, 61010-2-034
EMC:	IEC/EN61326-1
Safety of measurement accessories:	IEC/EN61010-031
Measurements:	IEC 60891, IEC/EN62446-1 (PV performance, IVCK) IEC/EN 61557-1, 2, -4 (RPE, MΩ)
Technical documentation:	IEC EN 61187
Insulation:	double insulation
Pollution degree:	2
Overvoltage category:	CAT III 1500V to ground, Max 1500VDC among inputs
Max. operating altitude:	2000m (6562ft)

This instrument satisfies the requirements of Directives:
RED: Directive 2014/53/EU, LVD: Directive 2014/35/EU, EMCD: Directive 2014/30/EU
RoHS: Directive 2011/65/EU, WEEE: Directive 2012/19/EU