

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

SOLAR FARM PROPOSAL



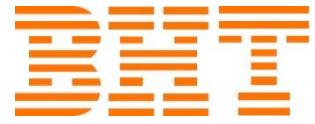
BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Solar Panel

AE SOLAR -1

این شرکت آلمانی یکی از شرکت های مطرح و قدرتمند تولید پنل خورشیدی است و در ایران هم شناخته شده است. اخیرا محصولات این شرکت در رده Tier1 در لیست Bloomberg منتشر میشود. از ویژگی های محصولات این شرکت گارانتی طولانی محصولات، بازده بالا و مناسب برای شرایط آب و هوایی سخت است.

Deutsche
Qualität
Garantiert

AE SOLAR
alternative energy

TIER 1
Bloomberg
NEW ENERGY FINANCE

132
HALF
CELLS

210
mm
CELL
SIZE

LID
RESISTANT

PID
RESISTANT

SALT CORROSION
RESISTANT

SAND
RESISTANT

NH₃
S
AMMONIA
RESISTANT

HIGHLY STABLE
AND TOUGH

AURORA
HIGH ENERGY YIELD
RELIABILITY
DURABILITY

30
years
Performance
Guarantee

15
years
Product
Warranty

MONO-CRYSTALLINE PV MODULES
HALF-CUT CELLS • MONO-FACIAL

640W-660W
AE ME-132 Series

ISO 9001:2015
ISO 14001
ISO 45001:2018
TÜV Rheinland
IEC 61215
IEC 61730
Regular Production Surveillance
Type Tested and Monitored
IEC 62716 (Ammonia corrosion)
IEC 61701 (Salt mist corrosion)
IEC 60068 (Sand and dust)
IEC 62804 (PID resistance)
Ariel Re
LLOYD'S
Underwriters
CE

www.ae-solar.com

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

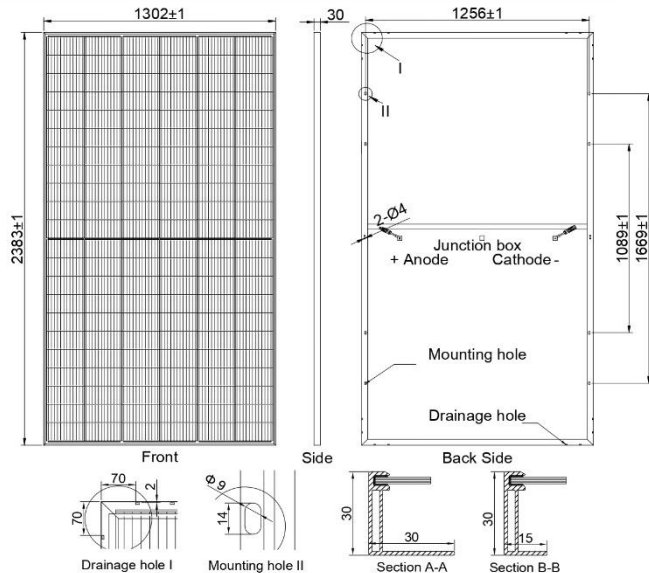


MONO-CRYSTALLINE PV MODULES
 HALF-CUT CELLS • MONO-FACIAL

AE ME-132 Series 640W-660W

Mechanical and design specification

| | |
|-----------------|--|
| Cell type | Gallium-doped Mono c-Si PERC, Half-cut cells, 210 mm |
| No. of cells | 132 |
| Glass | 3.2 mm, high transmission, AR coated, tempered |
| Encapsulation | EVA |
| Back cover | White backsheet |
| Junction box | IP 68 rated |
| Frame | 30 mm anodized Aluminium alloy |
| Cable | 1 x 4 mm ² , 350 mm length or customized |
| Connectors | MC 4 / MC 4 compatible |
| Dimension | 2383 mm x 1302 mm x 30 mm |
| Weight | 31.5 kg |
| Hail resistance | Max. Ø 25 mm at 23 m/s |
| Wind load | 2400 Pa/ 244 kg/ m ² |
| Mechanical load | 5400 Pa/ 550 kg/ m ² |

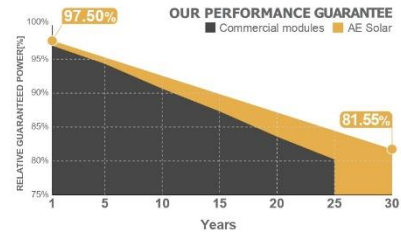
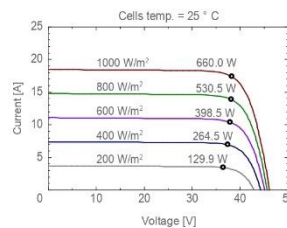


Packaging information

| | |
|-------------------------|---------------------------------------|
| Packaging configuration | 36 pcs / pallet |
| Loading capacity | 612 pcs / 40 HQ |
| Size / Pallet | 1350 mm x 1140 mm x 2500 mm (Upright) |
| Weight | 1167 kg / pallet |

Temperature ratings

| | | |
|--------------------------------------|--------|------------|
| Operating temperature | (°C) | -40 to +85 |
| Temp.coefficient of P _{max} | (%/°C) | -0.34 |
| Temp.coefficient of V _{oc} | (%/°C) | -0.25 |
| Temp.coefficient of I _{sc} | (%/°C) | 0.04 |
| Nom. operating temp. NOCT | (°C) | 43 ± 2 |



| Electrical specifications (STC*): | | AE640ME-132 | AE645ME-132 | AE650ME-132 | AE655ME-132 | AE660ME-132 |
|-----------------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|
| Nominal Max. Power | P _{max} (Wp) | 640 | 645 | 650 | 655 | 660 |
| Maximum operating voltage | V _{MPP} (V) | 37.00 | 37.20 | 37.40 | 37.60 | 37.80 |
| Maximum operating current | I _{MPP} (A) | 17.30 | 17.34 | 17.38 | 17.42 | 17.46 |
| Open-circuit voltage | V _{oc} (V) | 45.10 | 45.30 | 45.50 | 45.70 | 45.90 |
| Short-circuit current | I _{sc} (A) | 17.74 | 18.25 | 18.32 | 18.38 | 18.43 |
| Module efficiency | η (%) | 20.63 | 20.79 | 20.95 | 21.11 | 21.27 |
| Power tolerance | (W) | | | 0~+5 | | |
| Maximum system Voltage | (V) | | | 1500 | | |
| Maximum series fuse rating | (A) | | | 30 | | |

*STC: Standard test conditions (Irradiance 1000 W/m², Cell temperature 25°C and air mass of AM1.5)

| Electrical specifications (NMOT*): | | AE640ME-132 | AE645ME-132 | AE650ME-132 | AE655ME-132 | AE660ME-132 |
|------------------------------------|-----------------------|-------------|-------------|-------------|-------------|-------------|
| Nominal Max. Power | P _{max} (Wp) | 480 | 484 | 488 | 492 | 496 |
| Maximum operating voltage | V _{MPP} (V) | 34.70 | 34.90 | 35.10 | 35.30 | 35.50 |
| Maximum operating current | I _{MPP} (A) | 13.84 | 13.87 | 13.90 | 13.94 | 13.97 |
| Open-circuit voltage | V _{oc} (V) | 42.00 | 42.20 | 42.40 | 42.60 | 42.80 |
| Short-circuit current | I _{sc} (A) | 14.19 | 14.60 | 14.66 | 14.70 | 14.74 |

*NMOT: Normal Module Operating Temperature (Irradiance 800 W/m², Ambient temperature 20°C, air mass of AM1.5 and wind speed of 1 m/s)

The specifications and characteristics contained in this datasheet may deviate slightly from our actual products due to the product developments and uncertainty of measurement devices. The specifications included in the datasheet are subject to change without prior notice.

+49 8231 92 92 52 2
 sales@ae-solar.com
 www.ae-solar.com

Messerschmittring 54
 86343 Königsbrunn, Germany

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

این شرکت فرانسوی تنها تولید کننده پنل های خورشیدی در اروپا هست که در لیست Tier 1 Bloomberg وجود دارد.
این شرکت تا توان 600 وات و گارانتی 30 ساله پنل های با کیفیت و دارای تمام استانداردهای لازم را تولید میکند.

MONO CRYSTALLINE DOUBLE GLASS HALF-CUT BIFACIAL MODULE
585 / 590 / 595 / 600 Watts

Panther Series

Overview

Ground breaking technology; higher power output, improved system performance - the ideal solution for end users who want a fast turnaround on their investments. A fully certified premium quality and high efficiency module made with A Grade materials.

Key Benefits

- Certified by Independent Engineering Bodies
- Product Liability Insurance
- Ultra High Power Output
- 25 Years Limited Product Warranty
- Low Resistive Losses
- Low LCOE



Guaranteed mechanical resistance to severe weather conditions



Positive Tolerance

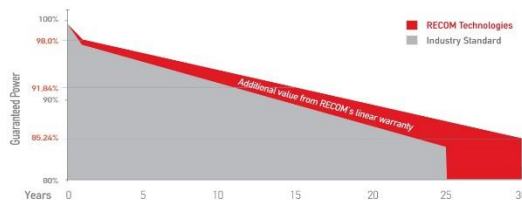


100 % electro-luminescence tested

Tests, Certifications and Warranties

| | |
|-----------------------------|---|
| Standard Tests | IEC 61215, IEC 61730 |
| Factory Quality Tests | ISO 9001: 2015, ISO 14001: 2015 |
| Certifications | Conformity to CE, PV CYCLE Fire safety Class C according to UL790 |
| Insurance | Third party liability insurance provided by Liberty Mutual |
| Wind and Snow Loads Testing | Module certified to withstand extreme wind (2400 Pascal) and snow loads (5400 Pascal) |
| Power Tolerance | Guaranteed +0/+5W (STC condition) |
| Warranties | <ul style="list-style-type: none">• 25-year limited product warranty• 15-year manufacturer warranty on 91.84% of the nominal performance• 30-year transferable linear power output warranty |

Linear Performance Warranty



First Year Output $\geq 98.0\%$ | 2-30 Year Decline $\leq 0.44\%$ | 30 Year Output $\geq 85.24\%$

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Panther

MONO CRYSTALLINE DOUBLE GLASS HALF-CUT BIFACIAL MODULE

RCM-xxx-8DBME (xxx=585-600)

Electrical Characteristics

| POWER CLASS ⁽¹⁾ | | | 585 | | 590 | | 595 | | 600 | |
|----------------------------|------------------|------|-----------|--------|-------|--------|-------|--------|-------|--------|
| Testing Condition | | | STC | NMOT | STC | NMOT | STC | NMOT | STC | NMOT |
| Maximum Power | P _{max} | [Wp] | 585 | 442,86 | 590 | 446,64 | 595 | 450,43 | 600 | 454,21 |
| Maximum Power Voltage | V _{mp} | [V] | 33.78 | 31.45 | 34.01 | 31.64 | 34.22 | 31.84 | 34.43 | 32.03 |
| Maximum Power Current | I _{mp} | [A] | 17.32 | 14.08 | 17.36 | 14.11 | 17.40 | 14.15 | 17.44 | 14.18 |
| Open Circuit Voltage | V _{oc} | [V] | 40.72 | 38.38 | 40.98 | 38.62 | 41.23 | 38.86 | 41.48 | 39.10 |
| Short Circuit Current | I _{sc} | [A] | 18.39 | 14.81 | 18.43 | 14.85 | 18.47 | 14.88 | 18.52 | 14.92 |
| Module Efficiency | Eff | [%] | 20.68 | | 20.85 | | 21.03 | | 21.21 | |
| Maximum Series Fuse | I _R | [A] | 30 | | | | | | | |
| Maximum System Voltage | V _{sys} | [V] | 1500 V DC | | | | | | | |

(1) Measurement Tolerances: P_{max} (± 3%), I_{sc} & V_{oc} (± 3%) - Power Classification 0/+5W

(2) STC (Standard Testing Condition): Irradiance 1000W/m², Cell Temperature 25°C, AM 1.5

(3) NMOT (Nominal Operating Module Temperature): Irradiance 800W/m², NMOT, Ambient Temperature 20°C, AM 1.5, Wind Speed 1m/s

Bi Facial Output (4)

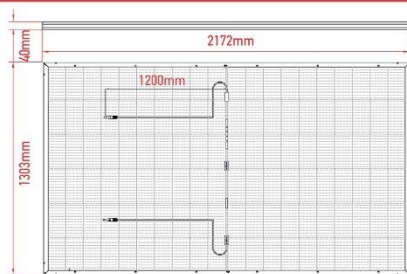
| POWER CLASS | | | 585 | | 590 | | 595 | | 600 | |
|--------------------------|-----|-----|-----------------------|---------|-----------------------|---------|-----------------------|---------|-----------------------|---------|
| | | | P _{max} [Wp] | Eff [%] | P _{max} [Wp] | Eff [%] | P _{max} [Wp] | Eff [%] | P _{max} [Wp] | Eff [%] |
| Power with Backside Gain | +5 | [%] | 614,3 | 21,8 | 619,5 | 21,9 | 624,8 | 22,1 | 630,0 | 22,3 |
| | +10 | [%] | 643,5 | 22,8 | 649,0 | 23,0 | 654,5 | 23,2 | 660,0 | 23,4 |
| | +15 | [%] | 672,8 | 23,8 | 678,5 | 24,0 | 684,3 | 24,2 | 690,0 | 24,4 |
| | +20 | [%] | 702,0 | 24,9 | 708,0 | 25,1 | 714,0 | 25,3 | 720,0 | 25,5 |
| | +25 | [%] | 731,3 | 25,9 | 737,5 | 26,1 | 743,8 | 26,3 | 750,0 | 26,6 |
| | +30 | [%] | 760,5 | 26,9 | 767,0 | 27,2 | 773,5 | 27,4 | 780,0 | 27,6 |

(4) Bifaciality Factor > 70% - Back-side power gain depends upon the specific project albedo - Efficiency is according to the surface of the module

Mechanical Data

| | |
|--------------|--|
| Dimensions | 2172mm x 1303mm x 40mm |
| Weight | 34,5 Kg |
| Cell Type | Mono Perc - 210mm x 105mm (2 x 60 Pcs) - G12 |
| Front Glass | 2.0 mm Tempered and low iron glass + ARC |
| Rear Side | 2.0 mm Tempered and low iron glass |
| Frame | Anodized Aluminium Alloy |
| Junction Box | IP68 - 3 Bypass diodes |
| Connector | EVO2 compatible |
| Output cable | 4mm ² - Length = 1200mm or customized |

Dimensions



RECOM assumes no liability or responsibility for any typographical error, layout error, misinformation, any other error, omission, contained herein.

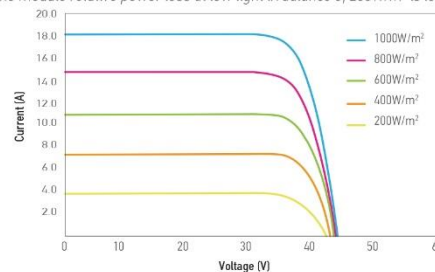
www.recom-tech.com

The specification and key features described in this datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, RECOM Technologies reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein. Please read the safety and installation instructions before using the modules.

© Copyright 2022, RECOM

I-V Curve

The module relative power loss at low light irradiance of 200W/m² is less than 3%.



Temperature Characteristics

| | |
|---|--------------|
| P _{max} Temperature Coefficient | -0.348% / °C |
| V _{oc} Temperature Coefficient | -0.282% / °C |
| I _{sc} Temperature Coefficient | +0.05% / °C |
| Operating Temperature | -40 ~ +85 °C |
| Nominal Operating Module Temperature (NMOT) | 42 ± 2 °C |

Packing Configuration

| | |
|-----------------------|---------------------|
| Container | 40' HC |
| Pieces per Pallet | 27 |
| Pallets per Container | 16 |
| Pieces per Container | (27+27+5)x8=472 pcs |

**Release: RCM-xxx-8DBME(XXX=585-600)-12-617-40-55-15V-008-2022-04-v2.0

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

Solar Inverter

SMA -1

این شرکت آلمان یکی از پیشرو ترین تولید کننده های اینورتر خورشیدی در جهان میباشد که سهم قابل توجهی از این محصول را در دنیا در اختیار دارد.

این شرکت اینورتر های خورشیدی را در رنج وسیعی از توان با بازدهی بالا تولید میکند. از محصولات شاخص این شرکت میتوان به اینورتر های مرکزی با توان های بالا اشاره کرد که بروشور اینورتر 2500 کیلوواتی این شرکت در ادامه آورده شده است.

PRELIMINARY SUNNY CENTRAL 2750 UP-US



Efficient

- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 150% is possible
- Full power at ambient temperatures of up to 25°C

Robust

- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible

- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turn-key solution, including medium-voltage block

Easy to Use

- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL 2750 UP-US

The new Sunny Central: more power per cubic meter

With an output of up to 2750 kVA and system voltages of 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

SUNNY CENTRAL 2750 UP-US

| Technical data* | SC 2750 UP-US |
|--|--|
| Input (DC) | |
| MPP voltage range V_{DC} (at 25 °C / at 50 °C) | 921 to 1325 V / 1100 V |
| Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, start}$ | 891 V / 1071 V |
| Max. input voltage $V_{DC, max}$ | 1500 V |
| Max. input current $I_{DC, max}$ | 3110 A |
| Max. short-circuit current $I_{DC, sc}$ | 6400 A |
| Number of DC inputs | 24 double pole fused (32 single pole fused) |
| Max. number of DC cables per DC input (for each polarity) | 2 x 800 kcmil, 2 x 400 mm ² |
| Integrated zone monitoring | ○ |
| Available DC fuse sizes (per input) | 200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A |
| Output (AC) | |
| Nominal AC power at $\cos \phi = 1$ (at 25 °C / at 50 °C) | 2750 kVA / 2500 kVA |
| Nominal AC power at $\cos \phi = 0.8$ (at 25 °C / at 50 °C) | 2200 kW / 2000 kW |
| Nominal AC current $I_{AC, nom}$ (at 25 °C / at 50 °C) | 2520 A / 2268 A |
| Max. total harmonic distortion | < 3% at nominal power |
| Nominal AC voltage / nominal AC voltage range ¹⁾⁸⁾ | 630 V / 504 V to 756 V |
| AC power frequency / range | 50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz |
| Min. short-circuit ratio at the AC terminals ⁹⁾ | > 2 |
| Power factor at rated power / displacement power factor adjustable ^{8) 10)} | 1 / 0.8 overexcited to 0.8 underexcited |
| Efficiency | |
| Max. efficiency ²⁾ / European efficiency ²⁾ / CEC efficiency ³⁾ | 98.7%* / 98.6%* / 98.5%* |
| Protective Devices | |
| Input-side disconnection point | DC load break switch |
| Output-side disconnection point | AC circuit breaker |
| DC overvoltage protection | Surge arrester, type I |
| AC overvoltage protection (optional) | Surge arrester, class I |
| Lightning protection (according to IEC 62305-1) | Lightning Protection Level III |
| Ground-fault monitoring / remote ground-fault monitoring | ○ / ○ |
| Insulation monitoring | ○ |
| Degree of protection | NEMA 3R |
| General Data | |
| Dimensions (W / H / D) | 2780 / 2318 / 1588 mm (109.4 / 91.3 / 62.5 inch) |
| Weight | < 4000 kg / < 8818.5 lb |
| Self-consumption (max. ⁴⁾ / partial load ⁵⁾ / average ⁶⁾) | < 8100 W / < 1800 W / < 2000 W |
| Self-consumption (standby) | < 370 W |
| Internal auxiliary power supply | ○ Integrated 8.4 kVA transformer |
| Operating temperature range ⁸⁾ | -25 °C to 60 °C / -13 °F to 140 °F |
| Noise emission ⁷⁾ | 67.0 dB(A)* |
| Temperature range (standby) | -40 °C to 60 °C / -40 °F to 140 °F |
| Temperature range (storage) | -40 °C to 70 °C / -40 °F to 158 °F |
| Max. permissible value for relative humidity (condensing / non-condensing) | 95% to 100% (2 month/year) / 0% to 95% |
| Maximum operating altitude above MSL ⁸⁾ 1000 m / 2000 m / 3000 m | ● / ○ / ○ (earlier temperature-dependent derating) |
| Fresh air consumption | 6500 m ³ /h |
| Features | |
| DC connection | Terminal lug on each input (without fuse) |
| AC connection | With busbar system (three busbars, one per line conductor) |
| Communication | Ethernet, Modbus Master, Modbus Slave |
| Communication with SMA string monitor (transmission medium) | Modbus TCP / Ethernet (FO MM, Cat-5) |
| Enclosure / roof color | RAL 9016 / RAL 7004 |
| Supply transformer for external loads | ○ (2.5 kVA) |
| Standards and directives complied with | UL 62109-1, UL 1741 (Chapter 31, CDR 61), UL 1741-SA, UL 1998, IEEE 1547, MIL-STD-810G |
| EMC standards | FCC Part 15 Class A |
| Quality standards and directives complied with | VDI/VDE 2862 page 2, DIN EN ISO 9001 |
| ● Standard features ○ Optional * preliminary | |

1) At nominal AC voltage, nominal AC power decreases in the same proportion
 2) Efficiency measured without internal power supply
 3) Efficiency measured with internal power supply
 4) Self-consumption at rated operation
 5) Self-consumption at < 75% Pn at 25 °C
 6) Self-consumption averaged out from 5% to 100% Pn at 25 °C

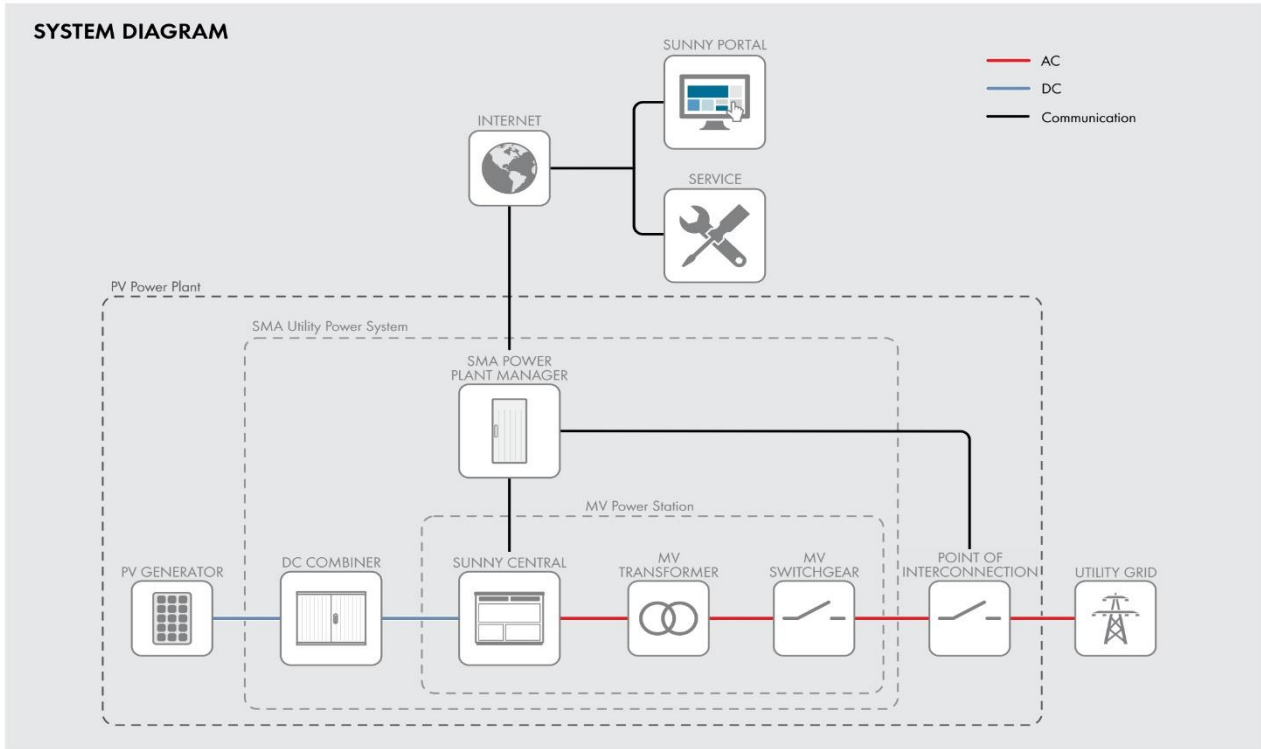
7) Sound pressure level at a distance of 10 m
 8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
 9) A short-circuit ratio of < 2 requires a special approval from SMA
 10) Depending on the DC voltage

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



SC275018US.PS-a.10 All products and services described and all technical data are subject to change, also for reasons of country-specific deviations, at any time without notice. SMA assumes no liability for typographical or other errors. For current information, please see www.SMA-Solar.com.

Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

بخش تولید اینورتر های این شرکت که اخیرا توسط Siemens خریداری شده است. تا ظرفیت 165 kw اینورتر خورشیدی تولید میکند. محصولات این برند طول عمر و بازدهی بالایی دارند و به علت کیفیت ساخت بالا معمولا خرابی کمی در طول عمر خود دارند. لازم به ذکر است اینورتر های با ظرفیت بالای این شرکت در سال های اخیر (2021&2023) رتبه Top در زمینه اینورتر های خورشیدی در اروپا را از موسسه EUOD Research دریافت کرده است.



blueplanet 155 + 165 TL3

String inverters for utility-scale solar power plants
up to multi-megawatt solar parks.



Pushing the limits.

Superior efficiencies and overload capacity through silicon carbide technology

Outstanding power density for easy logistics and installation

Decentralised design or 'Virtual Central' concept possible

Overvoltage protection AC/DC and for communication interfaces available

Lean commissioning and updates via remote services



www.kaco-newenergy.com

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

EN 500741-05-220216

Technical Data

| DC input data | 155 TL3 | 165 TL3 |
|---|---|--|
| Max. recommended PV generator power | 232 500 W | 247 500 W |
| MPP range | 875 – 1 300 V | 960 – 1 300 V |
| Operating range | 875 – 1 450 V | 960 – 1 450 V |
| Rated DC voltage / start voltage | 900 V / 1 000 V | 1000 V / 1 100 V |
| Max. no-load voltage | 1 500 V | 1 500 V |
| Max. input current | 183 A | 183 A |
| Max. short circuit current $I_{sc,max}$ | 300 A | 300 A |
| Number of MPP tracker | 1 | 1 |
| Connection per tracker | 1 - 2 | 1 - 2 |
| AC output data | | |
| Rated output | 155 000 VA | 165 000 VA |
| Max. power | 155 000 VA | 165 000 VA |
| Line voltage | 600 V (3P+PE) | 660 V (3P+PE) |
| Voltage range (Ph-Ph) | 480 – 690 V | 480 – 760 V |
| Rated frequency (range) | 50 Hz / 60 Hz (45 – 65 Hz) | 50 Hz / 60 Hz (45 – 65 Hz) |
| Rated current | 3 x 149.5 A | 3 x 144.5 A |
| Max. current | 3 x 152.0 A | 3 x 152.0 A |
| Reactive power / cos phi | | 0 – 100 % Snom / 0,30 ind. – 0,30 cap. |
| Max. total harmonic distortion (THD) | ≤ 3 % | ≤ 3 % |
| Number of grid phases | 3 | 3 |
| General data | | |
| Max. efficiency | 99.1 % | 99.1 % |
| Europ. efficiency | 98.9 % | 99.0 % |
| CEC efficiency | 98.9 % | 99.0 % |
| Standby consumption | < 10 W | < 10 W |
| Circuitry topology | transformerless | transformerless |
| Mechanical data | | |
| Display | LEDs | LEDs |
| Control units | webserver, supports mobile devices | webserver, supports mobile devices |
| Interfaces | Ethernet (Modbus TCP, Sunspec), RS485 (KACO-protocol), USB, optional: 4-DI | |
| Fault signalling relay | potential-free NOC max. 30 V / 1 A | potential-free NOC max. 30 V / 1 A |
| DC connection | cable lug, max. 240 mm ² (0.372 in ²) Cu or Al | |
| AC connection | cable lug, max. 240 mm ² (0.372 in ²) Cu or Al | |
| Ambient temperature | -25 °C – +60 °C ¹⁾ | -25 °C – +60 °C ¹⁾ |
| Humidity | 0 – 100 % | 0 – 100 % |
| Max. installation elevation (above MSL) | 3 000 m | 3 000 m |
| Min. distance from coast | 500 m | 500 m |
| Cooling | temperature controlled fan | temperature controlled fan |
| Protection class | IP66 / NEMA 4X | IP66 / NEMA 4X |
| Noise emission | 59.2 db (A) | 59.2 db (A) |
| H x W x D | 719 x 699 x 460 mm | 719 x 699 x 460 mm |
| Weight | 78.2 kg | 78.2 kg |
| Certifications | IEC 62109-1/-2, EN 61000-6-1/-2/-4, EN 61000-3-11/-12, EN 55011 group 1, class A, EN 62920 Emission class A / Immunity class A, UL62109-1, UL1741, CSA-C22.2 No.107.1, CSA-C22.2 No.62109-1, CSA-C22.2 No.62109-2 | |
| Safety | | |
| Grid connection rule | overview see homepage / download area | |

¹⁾ Power derating at high ambient temperatures

| Versions | S | XL |
|------------------------|------------|------------|
| Number of DC inputs | 1 - 2 | 1 - 2 |
| DC switch | - | ✓ |
| DC SPD | Type 1 + 2 | Type 1 + 2 |
| AC SPD | ○ | ○ |
| RS485 interface SPD | ○ | ○ |
| Ethernet interface SPD | ○ | ○ |
| PID Set | ○ | ○ |

standard = ✓ upgradeable = ○

The text and figures reflect the current technical state at the time of printing. Subject to technical changes. Errors and omissions excepted. This current version replaces all older versions. Download the most current version at: www.kaco-newenergy.com



KACO new energy GmbH | Werner-von-Siemens-Allee 1 | 74172 Neckarsulm | Germany

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

Weather Station

Lufft -1

این شرکت آلمانی یکی از معروفترین تولیدکنندگان سنسور های هواشناسی با دقت بالا در دنیا میباشد. یکی از محصولات منحصر به فرد این شرکت سنسورهای **All in one** هست که تمام سنسور های مورد نیاز در ایستگاه های هوا شناسی یک نیروگاه خورشیدی را در این محصول جمع آوری کرده است. در ادامه بروشور محصول **WS800** این شرکت آورده شده است.

Technical Data

WS800-UMB Smart Weather Sensor



First and only compact all-in-one weather sensor with detection of lightning strikes

- **Parameters measured**
temperature, relative humidity, air pressure, wind direction, wind speed, precipitation intensity, precipitation quantity, radiation, lightning strikes
- **Measurement technology**
Ultrasonic/Wind, NTC/T, Capacitive/RH/Pressure, Radar/Precipitation, radio wave emission/Lightning strikes
- **Product highlights**
Wind detection with birdproof construction. First and only compact all-in-one weather sensor with lightning detection, low power, heater, aspirated radiation shield, maintenance-free operation, open communication protocol.
- **Interfaces**
RS485 with supported protocols UMB-Binary, UMB-ASCII, Modbus-RTU, Modbus-ASCII, XDR and SDI-12
- **Article number**
8381.U01, 8381.U01-NA

From the WS product family of professional intelligent measurement transducers with digital interface for environmental applications. Integrated design with ventilated radiation protection for measuring: Air temperature, relative humidity, precipitation intensity, precipitation type, precipitation quantity, solar radiation, lightning detection, air pressure, wind direction and wind speed. One external temperature sensor is connectable.

Page 1

Technical modifications and errors excepted - Created 25/04/2023
G. Lufft Mess- und Regeltechnik GmbH Fellbach, Deutschland



Technical Data

WS800-UMB Smart Weather Sensor



General

| | |
|----------------------------|---|
| Dimensions | Ø approx. 150 mm, height approx. 317 mm |
| Weight | Approx. 1.5 kg |
| Interface | RS485, 2 - wire, half - duplex |
| Power supply | 11...32 VDC |
| Power supply | 5...11 VDC (electronics with limited precision of measurements) |
| Power supply | 24 VDC +/- 10% (heater) |
| Operating temperature | -50...60°C (with heater) |
| Operating rel. humidity | 0...100% RH |
| Cable length | 10 m |
| Protection level housing | IP66 |
| Standards/Regulations | Compliant to IEC 61724-1:2017 Class C |
| Mast mounting suitable for | Mast diameter 60 - 76 mm |

Lightning detection

| | |
|---------------------|----------------------------|
| Lightning detection | Number of lightning events |
| Coverage area | 5 - 10 km |

Air temperature

| | |
|-----------------|---|
| Principle | NTC |
| Measuring range | -50...60 °C |
| Unit | °C |
| Accuracy | ±0.2°C (-20...50°C), otherwise ±0.5 °C (> -30 °C) |

Relative humidity

| | |
|-----------------|----------------|
| Principle | Capacitive |
| Measuring range | 0 ... 100 % RH |
| Unit | % RH |
| Accuracy | ±2 % RH |

Air pressure

| | |
|-----------------|----------------------|
| Principle | MEMS capacitive |
| Measuring range | 300 ... 1200 hPa |
| Unit | hPa |
| Accuracy | ±0.5 hPa (0...40 °C) |

Wind direction

| | |
|-----------------|---------------------|
| Principle | Ultrasonic |
| Measuring range | 0 ... 359.9 ° |
| Unit | ° |
| Accuracy | < 3° RMSE > 1.0 m/s |
| Resolution | 0.1 |

Wind speed

| | |
|-----------------|------------|
| Principle | Ultrasonic |
| Measuring range | 0...75 m/s |

Page 2

Technical modifications and errors excepted - Created 25/04/2023
G. Lufft Mess- und Regeltechnik GmbH Fellbach, Deutschland



Technical Data

WS800-UMB Smart Weather Sensor



| | |
|------------|---|
| Unit | m/s |
| Accuracy | ± 0.3 m/s or ± 3 % (0...35 m/s) ± 5 % (>35 m/s) RMS |
| Resolution | 0.1 |

| Precipitation (liquid) | |
|------------------------|---|
| Droplet size | 0,3 ... 5 mm |
| Detection sensitivity | 0,01 mm/h |
| Particle velocity | 0.9 ... 15.5 m/s |
| Precipitation types | rain/ snow |
| Solid precipitation | 5.1 ... ~30 mm |
| Intensity range | 0...200mm/h |
| Intensity resolution | 0.01 mm/h |
| Amount resolution | 0.1 mm |
| Accuracy | 20 % under laboratory conditions |
| Reproducibility | Typical >90 % under laboratory conditions |

| Radiation | |
|---------------------|-----------------------|
| Unit | W/m ² |
| Accuracy | 5% |
| Response time (95%) | < 1s |
| Spectral range | 300 to 1100 nm |
| Measuring range | 1400 W/m ² |

این شرکت در زمینه طراحی و ساخت سنسورهای مورد نیاز در ایستگاه های هواشناسی و نیروگاه های خورشیدی فعالیت میکند.
یکی از معروفترین تولیدات این شرکت هلندی solar radiation measurement است.



SR22

Analogue Class A (secondary standard) pyranometer with quartz domes – extended spectral range

SR22 is a solar radiation sensor of the highest category in the ISO 9060 classification system: spectrally flat Class A. On top of the features and benefits of the successful SR20 pyranometer, SR22 has domes made of high-quality quartz, resulting in an extended spectral range. Covering the full solar spectrum, SR22's extended spectral range potentially offers lower measurement- and calibration uncertainties compared to pyranometers with glass domes. SR22 is typically used in high-accuracy reference stations.



Figure 1 SR22 Class A pyranometer.



Figure 2 SR22 sensor combined with VU01 ventilation unit.

Introduction

SR22 measures the solar radiation received by a plane surface, in W/m^2 , from a 180° field of view angle. This ISO 9060 secondary standard pyranometer enables users to attain the highest measurement accuracy and offers the widest spectral range commercially available. SR22 has an onboard temperature sensor. When using SR22, additional ventilation is recommended. SR22 is typically combined with ventilation unit VU01.

Extended spectral range

On top of the features and benefits of SR20 pyranometer, SR22 has an inner and outer dome made of high-quality quartz. This results in SR22's spectral range of 190 to $4000 \times 10^{-9} m$. SR22 covers the full solar spectrum, including the part between 3000 to $4000 \times 10^{-9} m$, which is not measured by pyranometers with glass domes.

Copyright by Hukseflux. Version 2209. We reserve the right to change specifications without prior notice
Page 1/4. For Hukseflux Thermal Sensors go to www.hukseflux.com or e-mail us: info@hukseflux.com



Measurement accuracy

In order to improve overall measurement accuracy, Hukseflux effectively targeted two major sources of measurement uncertainty: calibration and "zero offset a".

The initial calibration uncertainty is less than 1.7 %. The "zero offset a" specification of SR22 is 5 W/m² unventilated. Ventilated (with VU01) it is just 2.5 W/m².

Demanding applications

SR22's low temperature dependence makes it an ideal candidate for use under very cold and very hot conditions. The temperature dependence of every individual instrument is tested and supplied as a second degree polynomial. This information can be used for further reduction of temperature dependence during post-processing.

SR22 design

SR22 pyranometer uses a state-of-the-art thermopile sensor with black coated surface, two quartz domes of the highest quality and an anodised aluminium body. The connector, desiccant holder and sun screen fixation are very robust and designed for industrial use. All parts are specified for use across SR22's entire rated operating temperature range.

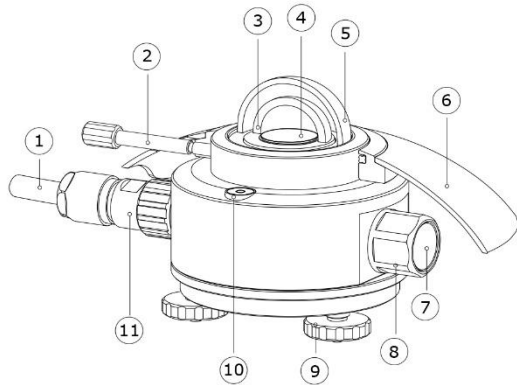


Figure 3 Overview of SR22:

(1) cable, (2) fixation of sun screen, (3) inner quartz dome, (4) thermal sensor with black coating, (5) outer quartz dome, (6) sun screen, (7) humidity indicator, (8) desiccant holder, (9) levelling feet, (10) bubble level, (11) connector.

Uncertainty evaluation

The uncertainty of a measurement under outdoor conditions depends on many factors. Guidelines for uncertainty evaluation according to the "Guide to Expression of Uncertainty in Measurement" (GUM) can be found in our manuals. We provide spreadsheets to assist in the process of uncertainty evaluation of your measurement.

Standards

Applicable instrument classification standards are ISO 9060 and WMO-No.8. Included in delivery as required by ISO 9060: test certificates for temperature response and directional response. Calibration is according to ISO 9847. PV related standards are ASTM E2848 and IEC 61724.



Figure 4 The inner and outer quartz domes of SR22 allow users to utilise SR22's extended spectral range.

Choosing the right instrument

Pyranometers are subject to classification in three classes according to ISO 9060. From Class C to Class B and from Class B to Class A, the achievable accuracy improves by a factor 2. Measurement accuracy does not only depend on instrument properties, but also on measurement conditions. A very accurate instrument will quickly underperform without a regular schedule of maintenance.

Our pyranometer [selection guide](#) assists you in choosing the right instrument.

Whatever your application is: Hukseflux offers the highest accuracy in every class at the most attractive price level.



Suggested use

- scientific climatological observations
- reference instrument for comparison
- extreme climates (tropical / polar)



Figure 5 SR22 side view.

See also

- **SR20** analogue Class A pyranometer
- **SR20-D2** digital Class A pyranometer with Modbus RTU and 4-20 mA output
- **SR25** Class A pyranometer with heating and sapphire dome
- **SR30** digital spectrally flat Class A pyranometer with heating and tilt sensor
- view our complete [product range of solar sensors](#)

SR22 specifications

| | |
|--|---|
| Measurand | hemispherical solar radiation |
| ISO classification ISO 9060:2018 | spectrally flat Class A pyranometer |
| ISO 9060:1990 | secondary standard pyranometer |
| Calibration uncertainty | < 1.7 % (k = 2) |
| Zero offset a | 5 W/m ² unventilated |
| Zero offset a | 2.5 W/m ² ventilated |
| Calibration traceability | to WRR |
| Spectral range | 190 to 4000 x 10 ⁻⁹ m |
| Spectral selectivity | < ± 2 % (0.35 to 1.5 x 10 ⁻⁶ m) |
| Sensitivity (nominal) | 15 x 10 ⁻⁶ V/(W/m ²) |
| Rated operating temperature range | -40 to +80 °C |
| Temperature response | < ± 1 % (-10 to +40 °C) < ± 0.4 % (-30 to +50 °C) with correction in dataprocessing report included |
| Temperature response test of individual instrument | report included to 95 ° |
| Directional response test of individual instrument | |
| Temperature sensor | Pt100 or 10 kΩ thermistor |
| Heater | 1.5 W at 12 VDC |
| Standard cable length | 5 m |

Options

- longer cable, in multiples of 5 metres
- ventilated with **VU01** ventilation unit

About Hukseflux

Hukseflux is the leading expert in measurement of energy transfer. We design and manufacture sensors and measuring systems that support the energy transition. We are market leaders in solar radiation- and heat flux measurement. Hukseflux products and services are offered worldwide via our office in Delft, the Netherlands and local distributors.

Interested in this product?
E-mail us at: info@hukseflux.com

SR22 Class A pyranometer – with quartz domes

This overview summarises the main features and benefits of SR22. Customers prefer Hukseflux pyranometers for their unsurpassed measurement accuracy and their lowest total cost of ownership.



Best measurement accuracy

- spectrally flat
- lowest zero offsets
- lowest calibration uncertainty
- best temperature dependence

Best paperwork

- only Hukseflux includes all ISO required reports with every individual sensor
 - temperature response testing from -30 to 50 °C
 - full directional response testing

Best connector

- interchangeable cables
- IP67 grade
- for industrial use

Best desiccant cartridge

- visible indicator of instrument health
- rugged aluminium design
- serviceable by user

Best sun screen

- sealed
- corrosion protection of body
- no dry-cooking of bubble level

Best humidity protection

- wrench-operated
- o-ring compressed to spec
- desiccant service interval > 2 years

© Copyright by Hukseflux . Version 2209. Page 4/4. For Hukseflux Thermal Sensors go to www.hukseflux.com or e-mail us: info@hukseflux.com

Solar DC Cable

HIS -1

این شرکت آلمانی تولید کننده انواع کابل های نیروگاهی به خصوص کابل های DC مربوط به نیروگاه های خورشیدی است. محصولات این شرکت کیفیت بالایی دارند و استاندارد های مربوطه از TUV آلمان را هم دارا میباشند

HIKRA®
solar cables
part of HIS CONNECT™

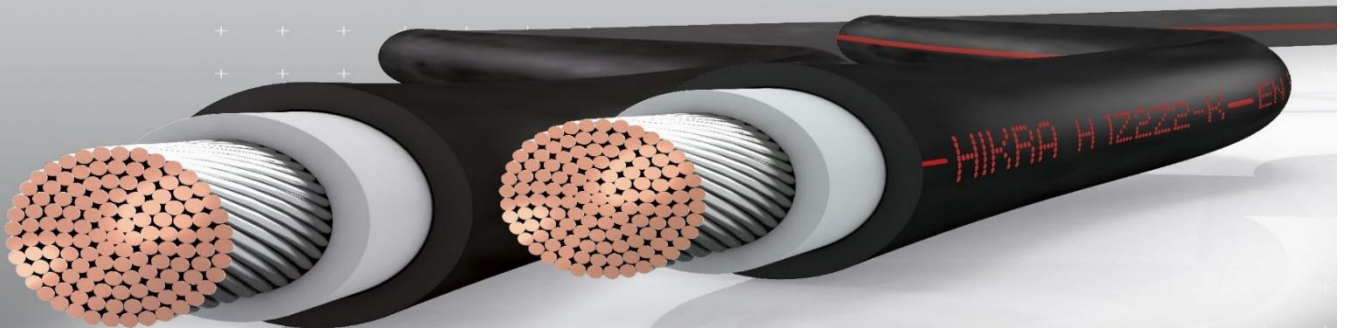
HIKRA® SOL

EN50618 (H1Z2Z2-K) IEC62930 (IEC 131)
TÜV 2 Pfg 2750 (PV 1500-WR)

DATA SHEET

IN FOCUS IS THE PLANT REVENUE IN OPERATION OUR SOLAR CABLES

- Higher water resistance and increased mechanical stability
- UV-stable and high resistance to external influences
- Additionally certified for floating PV according to TÜV 2 Pfg 2750 (PV 1500-WR)
- 25 years expected service life
- Continuous meter marking



HIS
we connect solar energy

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

HIKRA® SOL

TECHNICAL DATA



| Construction | |
|---------------------|---|
| Strand construction | Tin-plated copper strand (electrolytic copper), fine wire acc. IEC 60228 Class 5 |
| Insulation | Electron-beam cross-linked Polyolefin; Shore hardness D 32 |
| Outer Sheath | Electron-beam cross-linked special compound XLPO; Shore hardness D 36 |
| Colour | Sheath: black, red; Insulation: clear – naturally colored |
| Marking | HIKRA SOL1500V H1Z2Z2-K IEC62930 1x6,0 mm ² R 50408873 CE with meter marking |
| Standards | EN50618 (H1Z2Z2-K) TÜV R50363076; IEC62930 131 TÜV 50408873 |

| Technical characteristics | |
|--------------------------------------|---|
| Nominal voltage | 1,5kV DC and 1,0kV AC |
| Maximum permitted operating voltage: | 1,8kV DC (2,0 kV DC internal examination) |
| Voltage test on complete cable | 6,5kV AC / 15kV DC (5 minutes water bath, 20±5 °C) |
| Current carrying capacity | See document „Current rating – HIKRA® Solar Cable“ October 2020 |
| Short-circuit-temperature | 250 °C/5s |

| Material properties | |
|---|--|
| UV stability | Tensile strength and ultimate-elongation after 720 h (360 cycles) ≥ 70 % of initial values; EN 50289-4-17 acc. Method A; EN ISO 4892-1 (2000) and EN ISO 4892-2 (2006) |
| Ozone resistance | 72h, relative humidity 55±5 %, Temperature 40±2 °C (EN 50396 Method B; Ozone concentration (200±50)x10 ⁻⁶) |
| Insulation resistance | Insulation resistance in water bath, each 2h at +90 °C and 2h at 20 °C (Limit values acc. EN 50618 Table 1) |
| DC direct voltage test | Water bath, at +85 °C +5 °C, 240h, test voltage 1.8kV DC |
| Advanced DC dc voltage test | Water bath, at +85 °C +5 °C, 240h, test voltage 3.6kV DC (Floating PV TÜV 2 Pfg 2750) |
| Capacity measurement water storage | 14 days water storage at +90 ±5 °C; capacitance measurement after 1 day. After 14 days capacity measurement max. 10 %, resp. after 7 days 4 % higher than compared to capacity measurement after day 1 (Floating PV TÜV 2 Pfg 2750). |
| Dynamic penetration test | Spring-steel-needle through insulation or sheath (EN50618 Annex D) |
| Direct burial | Long-term water immersion at 90 °C, duration 12 weeks; Insulation resistance ≥ 3GΩ (internal examination acc. UL44 cl. 5.4 & UL2556 6.4.4.2.1) |
| Crushing- and impact-resistance | Impact-Resistance UL 854.23 and Crushing-Resistance UL 854.24 (internal examination) |
| Sheath resistance against acid and alkaline | 168h at 23 °C in N-Oxal acid and N-Sodium hydroxide (EN 60811-404); ammoniac-resistant |
| Behavior in case of fire | Flame-retardant acc. EN 60332-1-2 Annex A, low smoke emission (EN 61034,-2) |
| CPR-Performance | Dca; burning behavior acc. EN 50575:2014 |
| Halogen-free | EN 50525-1, Annex B |
| Cold impact test | EN 60811-506, EN 50618 Annex C.1 at -40 °C |
| Cold elongation test | Max. 30% elongation at -40±2 °C, 16h (EN 60811-505) |
| Damp heat test | Duration 1000h at 90 °C and min. 85 % relative humidity (EN 60068-2-78) |
| Minimum bending radius flexible / fixed | 10x cable diameter 4x cable diameter |

| Temperature Range | |
|--------------------------------------|---|
| Temperature | Ambient temperature: -40 °C to +90 °C; Maximum conductor temperature: +120 °C |
| Maximum storage temperature | +40 °C |
| Minimum temperature for installation | -25 °C |

| Order No. | Cross-section mm ² | Construction n x max. - Ø (mm) | Max. resistance (Ω/km) | External diameter (+/- 0,2 mm) | Copper Index kg/km | Approx. Weight kg/km |
|-----------|-------------------------------|--------------------------------|------------------------|--------------------------------|--------------------|----------------------|
| 739065 | 1 x 1.5 | 29 x 0.25 | 13.7 | 4.6 | 14.0 | 32.0 |
| 738609 | 1 x 2.5 | 47 x 0.25 | 8.21 | 5.0 | 24.0 | 41.0 |
| 738613 | 1 x 4.0 | 52 x 0.3 | 5.09 | 5.4 | 38.4 | 54.0 |
| 738615 | 1 x 6.0 | 78 x 0.3 | 3.39 | 6.0 | 57.6 | 73.0 |
| 738617 | 1 x 10.0 | 77 x 0.4 | 1.95 | 7.2 | 96.0 | 120.0 |
| 738619 | 1 x 16.0 | 126 x 0.4 | 1.24 | 8.7 | 153.6 | 189.0 |
| 739061 | 1 x 25.0 | 190 x 0.4 | 0.795 | 10.4 | 240.0 | 277.0 |

www.his-solar.com

Headquarter Germany

HIS Renewables GmbH
Siemensstraße 4D
64760 Oberzent
T +49 60689314400
E info@his-solar.de

France

HIS Renewables SARL
48 rue Claude Balbastre
34070 Montpellier
T +33 467276820
E info.fr@his-solar.com

Spain

HIS Soluciones de Sistemas Solares S.L.
Avenida de Brasil 17
Madrid 28020
T +34 916320493
E info.es@his-solar.com

Turkey

HIS Solar Sistemleri A.S.
Alsancak Mah. 1479 Sk. No.: 22/7
35220 Konak – Izmir
T +90 2324220931
E info.tr@his-solar.com

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Nexans -2

یکی از تولیدات شرکت فرانسوی Nexans تولید کابل های DC مخصوص نیروگاه خورشیدی با استاندارد های بین المللی است. کابل های تولیدی این شرکت تا ماکزیمم ولتاژ 1.8 KV DC عملکرد دارند و برای استفاده طولانی در محیط بیرون و شرایط سخت آب و هوایی مناسب هستند.

AmerSol Photovoltaic Cables



BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

37-712

AMERSOL 1/C PHOTOVOLTAIC CABLE

SINGLE CONDUCTOR: 2000V • UL 4703 • RATED 90°C



CONDUCTOR

19W Bare Coper - Standard.
 Also available with
 tinned copper conductor.

INSULATION

Black or Red Crosslinked
 Polyethylene (XLPE)

NEED LONG LENGTHS?

AmerSol is available
 up to 30,000 feet
 on 10 AWG.



Made in America



APPLICATIONS

Nexans AmerCable's Type PV is a single-conductor cable for applications such as connection to module junction boxes and required cable routing in balance-of-system (BOS) integration.

Nexans AmerCable is an ISO 9001:2015 certified manufacturer with 12+ years of solar cable manufacturing experience. Our uniquely manufactured AmerSol PV cables deliver consistent, reliable quality that meets your spec and lasts longer in the toughest operating environments.

RATINGS & APPROVALS

- UL 4703 listed as 2000V Type PV
- Suitable for continuous operating temperature of 90°C wet or dry
- UL listed as Sunlight Resistant
- Direct burial 2kV



APPLICATION SUPPORT

Nexans AmerCable leads the cable industry in customer technical support.

CABLE LEGEND:

AMERCABLE (YEAR) (SIZE) AWG 1/C 2000V (UL) PV WIRE 90C WET OR DRY -40C DIRECT BURIAL SUNLIGHT RESISTANT

| Part No. 37-712- | Size (AWG) | Number of Wires | Nominal Conductor Diameter (Inches) | Nominal Outer Diameter (Inches) | Approx. Weight (lbs/1000 ft) | Ampacity 90° C |
|---------------------|---------------|--------------------|--|--|------------------------------------|-------------------|
| 101 | 14 | 19 | 0.070 | 0.230 | 31 | 35 |
| 102 | 12 | 19 | 0.091 | 0.251 | 39 | 40 |
| 103 | 10 | 19 | 0.112 | 0.272 | 55 | 55 |
| 104 | 8 | 19 | 0.143 | 0.323 | 82 | 80 |

Cable diameters and weights are subject to +/- 5% manufacturing tolerance

**Compatible With
ALL Major
Connectors**

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Nexans AmerCable • email: solar.sales@nexans.com • (800) 643-1516 • (970) 862-4019

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

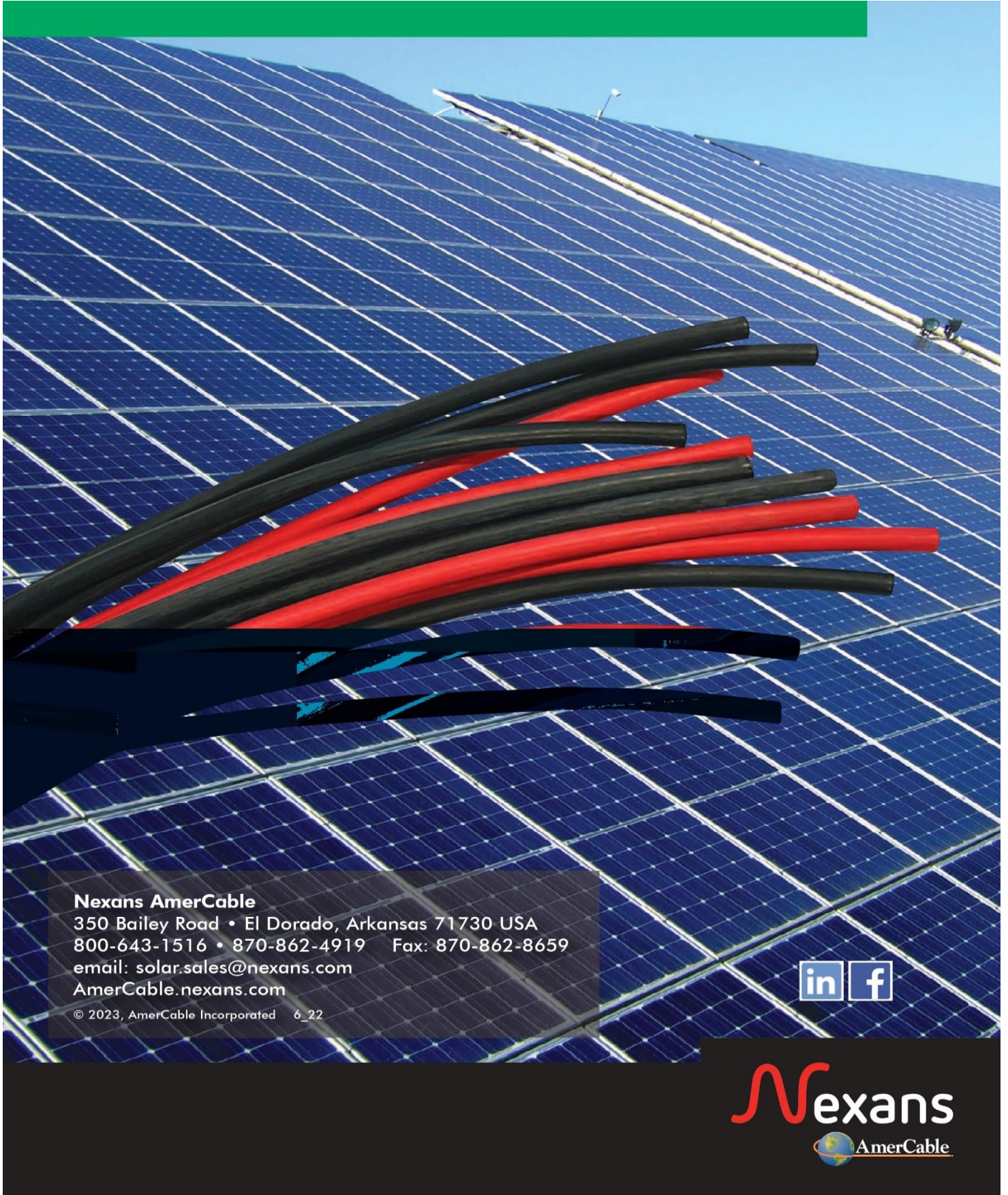
Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Nexans AmerCable

350 Bailey Road • El Dorado, Arkansas 71730 USA
800-643-1516 • 870-862-4919 Fax: 870-862-8659
email: solar.sales@nexans.com
AmerCable.nexans.com

© 2023, AmerCable Incorporated 6_22



BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

این شرکت آلمانی تاکنون بیش از 40 GW کابل تولید و به سراسر دنیا صادر کرده است.
کابل های مخصوص نیروگاه های خورشیدی تولیدی این شرکت تمام استانداردهای مورد نیاز از جمله TUV را دارا می باشد و تحمل ولتاژ تا 1800 ولت را دارد. همچنین برای شرایط آب و هوایی سخت نیز مناسب می باشد.

power in wire and cables

KBE
BERLIN

KBE SOLAR DB+



★ H1Z2Z2-K / EN 50618

★ IEC 131 / IEC 62930

★ TÜV 2 PFG 1169/10.19

1.500 V_{DC} / 1.800 V_{DC} max.

UV-Stabilität / UV-stability

erdverlegbar / direct burial

höhere Wasserbeständigkeit/
higher water resistance

Brandklasse D_{ca} nach BauPVO/
flammability class D_{ca} acc. CPR



MADE IN GERMANY



KBE Elektrotechnik GmbH • Symeonstraße 8 • 12279 Berlin • GERMANY

Tel: +49 (0)30 / 25 208-100 • Fax: +49 (0)30 / 25 208-140 • info@kbe-elektrotechnik.com • www.kbe-elektrotechnik.com

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

QUALITÄT / QUALITY Made in Germany

Die KBE Elektrotechnik GmbH ist Hersteller von Kabeln und Leitungen für die Automobil- und Hausgeräteindustrie sowie mit 40 GW installierter Leistung einer der führenden internationalen Anbieter von Solarleitungen.

Bei unserer verbesserten KBE Solar DB+ haben wir berücksichtigt, dass sich die Anforderungen in den letzten Jahren dramatisch erhöht haben. Aus diesem Grund ist die KBE Solar DB+ die erste 3-fach zertifizierte Solarleitung nach der europäischen Solarleitungsnorm EN 50618, sowie nach der internationalen Norm IEC 62930, als auch nach der TÜV Prüfnorm 2 PFG 1169/10.19 durch den TÜV zertifiziert.

Zusätzlich besitzt die KBE Solar DB+ Solarleitung eine ganze Reihe von Vorteilen gegenüber herkömmlichen Solarleitungen:

- TÜV Zertifizierung nach EN 50618 (H1Z2Z2-K)
- TÜV Zertifizierung nach IEC 62930 (62930 IEC 131)
- TÜV Zertifizierung nach 2 PFG 1169/10.19 (PV 1500-K)
- Ausgelegt für 1.500 V_{DC} (max. 1.800 V_{DC})
- fortlaufende Metermarkierung
- Erdverlegbarkeit durch hochwertige Isolationsmaterialien
- Höhere UV-Beständigkeit
- Höhere Wasserbeständigkeit
- Höherer Isolationswiderstand
- Höhere mechanische Stabilität
- Brandklasse D_{ca} nach BauPVO
- optimiert für Floating PV Anlagen (FPV)

Neben wettbewerbsfähigen Konditionen bietet KBE Ihnen:

- „Made in Germany“ mit Fertigung in Berlin
- Lieferung ab Lager, kurze Lieferzeit
- Kostengünstige Direktlieferung ins weltweite Ausland
- Hohe Qualität und lange Lebensdauer (25 Jahre nach EN 50618)
- Hohe Flexibilität und Biegegeschwindigkeit
- Kompatibilität zu allen gängigen Steckern
- Farben: Schwarz, Rot, Blau
- Aufmachung: 100m Ringe, 500m Spulen, 1.000m Spulen

KBE Elektrotechnik GmbH is manufacturer for wires and cables for the automotive and household appliance industry as well as one of the leading international suppliers of solar cables with 40 GW installed capacity.

The advanced KBE Solar DB+ features the latest, significantly increased, technical requirements for solar cables. As a consequence KBE Solar DB+ is the first triple certified solar cable, which is TÜV certified according to the European standard for solar cables EN 50618 and the international standard IEC 62930 as well as the new TÜV test standard 2 PFG 1169/10.19.

KBE Solar DB+ provides a number of additional advantages in comparison to conventional solar cables:

- TÜV certification acc. to EN 50618 (H1Z2Z2-K)
- TÜV certification acc. to IEC 62930 (62930 IEC 131)
- TÜV certification acc. to 2 PFG 1169/10.19 (PV 1500-K)
- Voltage rating 1.500 V_{DC} (max. 1.800 V_{DC})
- Consecutive meter marking
- Direct burial due to high quality insulation materials
- Higher UV-stability
- Higher water resistance
- Higher insulation resistance
- Higher mechanical stability
- flammability class D_{ca} acc. CPR
- optimized for floating PV systems (FPV)


























In addition to competitive conditions KBE offers:

- „Made in Germany“ with production in Berlin, Germany
- Delivery from stock, short lead time
- Worldwide deliveries at favourable terms
- High quality and long life time (25 years acc. to EN 50618)
- High flexibility and bending capability
- Compatibility to all common connectors
- Colors: black, red, blue
- Packaging: 100m rings, 500m spools, 1.000m spools







KBE Solar DB+ Datenblatt / Technical Data Sheet

Stand: 01.08.2020

| | | Anforderungsprofil - KBE Solar DB+ | Requirement Profile - KBE Solar DB+ |
|---|--|---|--|
|  | | Bezeichnung / Product name | KBE Solar DB+ |
|  | | Bauartkurzzeichen/ Leitungscode / Code designation | H1Z2Z2-K / 62930 IEC 131 / PV 1500-K |
|  | | Verfügbare Querschnitte / Cross sections available | 4,0 mm ² - 10 mm ² |
|  | | Normen / Approbationen / Standard / Approbations | DIN EN 50618; TÜV Zertifikat-Nr. R60147048; IEC 62930 2 PIG 1169/10.19 |
| | | Allgemeine Angaben | General Information |
|  | | Leiter / Conductor | E-Cu verzinkt nach IEC 60228 Klasse 5 |
|  | | Isolation / Insulation | Vernetztes Spezial Polyolefin |
|  | | Mantel / Sheathing | Vernetztes Spezial Polyolefin |
|  | | Bedruckung / Printing | KBE SOLAR DB+ X,XX mm ² H1Z2Z2-K 62930 IEC 131 PV 1500-K HALOGEN FREE LOW SMOKE R60147048 MADE IN GERMANY CE EAC |
|  | | Abstand der Bedruckung / Continuity of marks | ≤ 550 mm |
|  | | Mantelfarbe / Sheat colour | rot, blau, schwarz (Verwendung der Farbe mit sehr hoher Lichtechtheit (BWS 8) nach ISO 4892) |
|  | | Erwartete Gebrauchsdauer / Expected period of use | 25 Jahre |
| | | Elektrische Anforderungen | Electrical Specifications |
|  | Nennspannung / Rated Voltage U ₀ /U | 1,0/1,0 kV _{AC} 1,5/ 1,5 kV _{DC} | 1,0/1,0 kV _{AC} 1,5/ 1,5 kV _{DC} |
| | Höchstzulässige Betriebsspannung / Max. permissible operating voltage | 1,2/ 1,2 kV _{AC} 1,8/ 1,8 kV _{DC} (Leiter-Leiter, Leiter-Erde) | 1,2/ 1,2 kV _{AC} 1,8/ 1,8 kV _{DC} (conductor-conductor, conductor-ground) |
|  | | Strombelastbarkeit / Current carrying capacity | gemäß EN 50618, Tabelle A-3 |
|  | | Leiterwiderstand / Resistance of the conductor | EN 50395 Abschnitt 5 gemäß EN 50618, Tabelle 2 |
|  | | Spannungsprüfung AC / DC an der vollständigen Leitung / Voltage test on the complete cable with AC or DC | EN 50395 Abschnitt 6 (6,5 kV _{AC} oder 15 kV _{DC} ; 5 Minuten) |
|  | | Oberflächenwiderstand / Surface resistance | EN 50395 Abschnitt 11 |
|  | | Isolationswiderstand / Insulation resistance | EN 50395 Abschnitt 8.1 durchgeführt bei 20 °C & 90 °C in Wasser Ergebnisse gemäß EN 50618, Tabelle 1 2 PIG 1169/10.19 durchgeführt bei 20 °C & 90 °C in Wasser Ergebnisse gemäß 2 PIG 1169/10.19 mindestens: 1050 MΩ*km @ 20 °C 1,05MΩ*km @ 90 °C |
|  | | Durchlaufspannungsprüfung / Spark test | EN 62230, Anhang A |
|  | | Gleichspannungsbeständigkeit / Long term resistance of insulation to DC | EN 50395 Abschnitt 9 (10 Tage, 85 °C in NaCl 3 %, 1,8 kV _{DC}) |
| | | Mechanische Anforderungen | Mechanical Specifications |
|  | | Eigenschaften vor Alterung / Properties before ageing | EN 60811-1-1; EN 60811-1-2 (Zugfestigkeit Isolierung ≥ 8,0 N/mm ² Zugfestigkeit Mantel ≥ 8,0 N/mm ² Reißdehnung ≥ 125 %) |
|  | | Wärmedehnungsprüfung / Hot Set test | EN 60811-2-1 (200 °C; 15 Min. unter Last; 20 N/cm ² Belastung) |
|  | | Biegeradius / Bending radius | ≥ 4 x Aussendurchmesser |
|  | | Dynamische Durchdringungsprüfung / Dynamic penetration test | gemäß EN 50618 - Anhang D |
| | | Thermische Anforderungen | Thermal Specifications |
|  | | Umgebungstemperatur im Betrieb / Ambient temperature in operation | -40 °C bis +90 °C |
|  | | Tiefste, zulässige Umgebungstemperatur zur Installation / Min. ambient temperature for installation | -25 °C |
|  | | Tiefste, zulässige Umgebungstemperatur / Min. allowable ambient temperature | -40 °C |
|  | | Höchste Temperatur am Leiter / Max. temperature at conductor | 120 °C, basierend auf der EN 60216-1 (20.000 h; 50 % Restdehnung) |
|  | | Kurzschlussstemperatur / Short-circuit temperature | +250 °C (am Leiter max. 5 Sek.) |
|  | | Feuchte Wärme-Prüfung / Damp heat test | EN 60068-2-78 (1.000h bei 90 °C und 85 % Luftfeuchte) |
|  | | Schrumpfungsprüfung / Shrinkage test | EN 60811-503 (120°C, 1h, Schrumpfung <2,0%) |
|  | | Kältewickelprüfung / Cold bending test | EN 60811-504 (-40 °C, Vorkonditionierung: 16 h) |
|  | | Kältedehnungstest / Cold elongation test | DIN EN 60811-505 (-40 ± 2°C, Vorkonditionierung: 16 h) |
|  | | Kälteschlagprüfung / Cold impact test | EN 60811-506 und EN 50618, Anhang C (-40 °C; Masse des Fallgewichts 1.000 g) |

KBE Solar DB+ Datenblatt / Technical Data Sheet

Stand: 01.08.2020

| | | sicherheitsspezifische Anforderungen | specifications regarding safety |
|---|--|--|---|
| BauPVO Dca | Bauproduktenverordnung (BauPVO) / Construction Product Regulation (CPR) | Klasse D _{ca} in Übereinstimmung mit EN 50575:2014 | class D _{ca} in accordance with EN 50575:2014 |
| | Beständigkeit gegen Säuren und Laugen / Resistance against acid and alkaline solution | EN 60811-404 7 Tage; 23 °C (N-Oxalsäure; N-Natronlauge) | EN 60811-404 7 days; 23 °C (N-Oxalic-acid; N-Sodium hydroxide solution) |
| | Prüfung der Ozonbeständigkeit der vollständigen Leitung / Ozone resistance on completed cable | EN 50396 Abschnitt 8.1.3, Verfahren B | EN 50396 clause 8.1.3, method B |
|  | Bewitterung/UV-Prüfung am Mantel / Weathering/ UV-resistance on sheath | entspricht EN 50618, Anhang E EN 50289-4-17, Verfahren A (720h; 60 °C ± 3 °C; 50 ± 5 % Luftfeuchte) entspricht 2 PIG 1169/10.19 mit Test von 2.000h und damit deutlich höher als 720h nach EN 50618 | meets EN 50618, Annex E EN 50289-4-17, method A (720 h; 60 °C ± 3 °C; 50 ± 5 % relative humidity) meets 2 PIG 1169/10.19 test with 2.000h and exceeds significantly the test of 720h acc. EN 50618 |
| | Prüfung der vertikalen Flammenausbreitung an der vollständigen Leitung / Test for vertical flame propagation on complete cable | EN 60332-1-2 | EN 60332-1-2 |
| | Rauchentwicklung an der vollständigen Leitung / Smoke emission of complete cable | EN 61034-2 (Lichtdurchlässigkeit > 70 %) | EN 61034-2 (light transmittance > 70 %) |
| Prüfung auf Halogenfreiheit / Bestimmung von Halogenen - Elementarprüfung / Assessment of halogens / Determination of halogens - Elemental test | EN 50525-1, Anhang B | EN 50525-1, Annex B | |
| | | Zusätzliche interne Tests der KBE | Additional internal tests of KBE |
|  | Erdverlegbar / Direct burial | KBE-interne Prüfung gemäß UL 854: - Abschnitt 23: Impact-Resistance Test - Abschnitt 24: Crushing-Resistance Test | KBE internal test acc. To UL 854: -Section 23 Impact-resistance Test -Section 24 Crushing-Resistance Test |
| | Langzeitsolationswiderstand im Wasser / Long-term insulation resistance in water | KBE Test gemäß UL 44 Abschnitt 5.4 & UL 2556, Abschnitt 6.4: 90 °C ± 5 °C; 2000V (DC) ≥ 3 GΩ×m nach 12 Wochen Testergebnis KBE: > 50 GΩ×m nach 12 Wochen | KBE test acc. to UL 44 Section 5.4 & UL 2556, Section 6.4: 90 °C ± 5 °C; 2000V (DC) ≥ 3 GΩ×m after 12 weeks test result KBE: > 50GΩ×m after 12 weeks |
| | Eingruppierung in Kategorie AD8 / Classification to the category AD8 | in Anlehnung an die EN 50525-21 - Anhang E geprüft: - Spannungsprüfung im Wasser bei 1 kV AC, bei 50 °C über 100 Tage ohne Unterbrechung - Wasseraufnahme des Mantels nach 100 Tage Wasserlagerung bei 50 °C < 40 % - Isolationswiderstand von mindestens 10 ¹¹ Ω·cm | Tested acc. to EN 50525-21 - Annex E: - Voltage at 1 kV on cable in water at 50 °C during 100 days without any break - Water absorption on sheath after immersion 100 days at 50 °C less than 40 % - Insulation resistance tests with a minimum resistivity of 10 ¹¹ Ω·cm |
| | Langzeitsolationswiderstand in der Luft / Long-term insulation resistance in air | KBE Test gemäß UL 44, Abschnitt 5.5 & UL 2556, Abschnitt 6.4: 120 °C; 2000V (DC) ≥ 50 GΩ×m nach 12 Wochen | KBE test acc. to UL 44, Section 5.5 & UL 2556, Section 6.4: 120 °C; 2000V (DC) ≥ 50 GΩ×m after 12 weeks |
| | maximal zulässige Betriebsspannung mit KBE / Max. permissible operating voltage by KBE | 2,0/ 2,0 kV _{DC} | 2,0/ 2,0 kV _{DC} |
|  | Durchschlagsfestigkeit / Dielectrical strength | 12 kV 60 Min. Vergleich zur Anforderung von EN 50618: 6,5 kV; 5 Min. | 12 kV 60 min Comparison to Requirement of EN 50618: 6,5 kV; 5 min |
| | Widerstand gegen Salzwasser / Resistance against salt water | Lagerung bei 23 °C für 7 Tage in gesättigter Salzlösung Änderung der Zugfestigkeit < 5 % | storage at 23 °C for 7 days in saturated salt solution Change of tensile strength < 5 % |
| | Widerstand gegen Ammoniak / Resistance against Ammonia | 7 Tage bei 23 °C gesättigter Ammoniakatmosphäre (interner Test) | 7 days at 23 °C saturated ammonia atmosphere (int. Test) |
|  | Elektrische Kapazität und relative Dielektrizitätskonstante / Electrical capacitance and relative permittivity | KBE Test gemäß UL 44, Abschnitt 5.6 & UL 2556, Abschnitt 6.5: 90 °C ± 5 °C Wassertemperatur; Untertauchen für 14 Tage Relative Permittivität nach 1 Tag Untertauchen ≤ 6 % Kapazität nach 14 Tagen Untertauchen ≤ 10 % Kapazitätsunterschied von Tag 7 bis Tag 14 ± 4 % | KBE test acc. to UL 44, Section 5.6 & UL 2556, Section 6.5: 90 °C ± 5 °C water temperature; immersion for 14 days relative permittivity after 1 day immersion ≤ 6 % capacitance after 14 days immersion ≤ 10 % difference in capacitance from day 7 to day 14 ± 4 % |
| | Richtlinien & Zertifikate / Certificates & Guidelines | EN 50618, IEC 62930, 2 PIG 1169/10.19 TÜV Zertifikat-Nr. R60147048 RoHS 2011/65/EU + 2015/863/EU REACH 1907/2006 | EN 50618, IEC 62930, 2 PIG 1169/10.19 TÜV certificate-Nr. R60147048 RoHS 2011/65/EU + 2015/863/EU REACH 1907/2006 |

Bedruckung / Printing:

KBE SOLAR DB+ X,XX mm² H12Z2Z-K 62930 IEC 131 PV 1500-K HALOGEN FREE LOW SMOKE MADE IN GERMANY CE EAC

| Querschnitt / cross section | Leiterraufbau / conductor design | Widerstand / resistance | min. Wandstärke Isolation / min. insulation thickness | min. Wandstärke Mantel / min. jacket thickness | Außen Ø / outer Ø | Gewicht / weight | Aufmachung / packaging | KBE-Artikelnummer / KBE item no | | |
|-----------------------------|----------------------------------|-------------------------|---|--|-------------------|------------------|------------------------|---------------------------------|------------------|------------------|
| [mm ²] | n x max- Ø [mm] | Rmax. [mΩ/m] | [mm] | [mm] | [mm] | [kg/km] | [Meter] | ● schwarz / black | ● rot / red | ● blau / blue |
| 4,0 | 56 x 0,310 | 5,09 | 0,53 | 0,58 | 5,4 | 55 | 500 / 1.000 | 730400015060QUSW | 730400015060QURT | 730400015060QUBL |
| 4,0 | 56 x 0,310 | 5,09 | 0,53 | 0,58 | 5,4 | 55 | 100 Ring | 820400015060QUSW | 820400015060QURT | 820400015060QUBL |
| 6,0 | 80 x 0,310 | 3,39 | 0,53 | 0,58 | 6,0 | 75 | 500 / 1.000 | 730600015060QUSW | 730600015060QURT | 730600015060QUBL |
| 6,0 | 80 x 0,310 | 3,39 | 0,53 | 0,58 | 6,0 | 75 | 100 Ring | 820600015060QUSW | 820600015060QURT | 820600015060QUBL |
| 10,0 | 80 x 0,410 | 1,95 | 0,53 | 0,58 | 7,1 | 115 | 500 | 731000015060QUSW | 731000015060QURT | 731000015060QUBL |
| 10,0 | 80 x 0,410 | 1,95 | 0,53 | 0,58 | 7,1 | 115 | 100 Ring | 821000015060QUSW | 821000015060QURT | 821000015060QUBL |

power in wire and cables

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907, Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de, www.BHT-Online.de



Electric • Control • Mechanic

KBE Solar DB+ Zertifikate / certificates Stand: 01.08.2020

Zertifikat Certificate

Zertifikat Nr. Certificate No. Blatt Sheet
 R 60147048 0001

Ihr Zeichen Client Reference Unser Zeichen Our Reference Ausstellungsdatum Date of Issue
 1837/19 0010--60193773 002 03.03.2020 (day/month/yr)

Geschäftsinhaber License Holder Fertigungsstätte Manufacturing Plant
 KBE Elektrotechnik GmbH KBE Elektrotechnik GmbH
 Symeonstr. 8 Symeonstr. 8
 12279 Berlin 12279 Berlin
 Deutschland Deutschland

Prüfzeichen Test Mark Geprüft nach Tested acc. to
 EN 50618:2014

Zertifiziertes Produkt (Geräteidentifikation) Lizenzgebühr - Einheit License Fee - Unit
PV Components for BOS - electrical / PV cable

| | | |
|--------------------------------|---|----|
| Type Designation: | KBE Solar DB+ | 13 |
| Code designation: | H1222-K | |
| Cross section: | 4,0mm ² ; 6,0mm ² ; 10,0mm ² | |
| Rated voltage: | AC 10/10 ; 1,1kV ; 1,8kV | |
| max. voltage: | DC 1,8kV (conductor/conductor and conductor/earth) | |
| Ambient temperature range (a): | -40°C to +30°C | |
| max. temperature ac conductor: | + 120°C @ 20,000h | |
| Colour insulation: | white | |
| Colour sheath: | black | |
| Material insulation: | crosslinked Polyolefine | |
| Material sheath: | crosslinked Polyolefine | |

Remark:
 Sheath also in red and blue when requested

13

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es befreit die Kaufleute des Produktes mit dem oben genannten Standard und Prüfverfahren. Zusätzliche Anforderungen an Kunden, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich beachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

Zertifizierungsstelle

 TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg
 Tel: +49 221 806-3111 e-mail: cert-validity@de.tuv.com
 Fax: +49 221 806-3053 http://www.tuv.com/safety

Guido Volberg

Zertifikat Certificate

Zertifikat Nr. Certificate No. Blatt Sheet
 R 60147048 0002

Ihr Zeichen Client Reference Unser Zeichen Our Reference Ausstellungsdatum Date of Issue
 1837/19 0010--60193773 003 03.03.2020 (day/month/yr)

Geschäftsinhaber License Holder Fertigungsstätte Manufacturing Plant
 KBE Elektrotechnik GmbH KBE Elektrotechnik GmbH
 Symeonstr. 8 Symeonstr. 8
 12279 Berlin 12279 Berlin
 Deutschland Deutschland

Prüfzeichen Test Mark Geprüft nach Tested acc. to
 IEC 62930:2017

Zertifiziertes Produkt (Geräteidentifikation) Lizenzgebühr - Einheit License Fee - Unit
PV Components for BOS - electrical / PV cable

| | | |
|--------------------------------|---|---|
| Type Designation: | KBE Solar DB+ | 1 |
| Code designation: | 62930 IEC 131 | |
| Cross section: | 4,0mm ² ; 6,0mm ² ; 10,0mm ² | |
| Rated voltage: | AC 10/10 ; 1,1kV ; 1,8kV | |
| max. voltage: | DC 1,8kV (conductor/conductor and conductor/earth) | |
| Ambient temperature range (a): | -40°C to +30°C | |
| max. temperature ac conductor: | + 120°C @ 20,000h | |
| Colour insulation: | white | |
| Colour sheath: | black | |
| Material insulation: | crosslinked Polyolefine | |
| Material sheath: | crosslinked Polyolefine | |

Remark:
 Sheath also in red and blue when requested

1

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es befreit die Kaufleute des Produktes mit dem oben genannten Standard und Prüfverfahren. Zusätzliche Anforderungen an Kunden, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich beachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

Zertifizierungsstelle

 TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg
 Tel: +49 221 806-3111 e-mail: cert-validity@de.tuv.com
 Fax: +49 221 806-3053 http://www.tuv.com/safety

Guido Volberg

Declaration of Performance: DoP 0225
 According to Annex III of regulation (EU) no. 305/2011

KBE BERLIN

- Unique identification code of the product type: H1222-K
- Product name: KBE Solar DB+
- Usage: Cables for general applications in construction works subject to reaction to fire
- Manufacturer: KBE Elektrotechnik GmbH
 Symeonstraße 8
 12279 Berlin
- System of assessment and verification of consistency of performance: System 3
- Product certification body: ISSeP - Institut scientifi quo de service public No. 7859
- In case of declaration of performance concerning a construction product covered by a harmonized standard: The product certification body performed the type testing under system 3 subject to reaction to fire and issued:
 - Test report no. 0626-1 up to -4/2020
 - Test report no. 0627-3 up to -4/2020
 - Test report no. 0871-1 up to -2/2020
 - Classification report no. 1012/2020
- Declared performance:

| Essential characteristics | performance | Harmonized technical standard |
|---------------------------|-----------------|-------------------------------|
| - Reaction to fire | Dca-s2, dt2, A1 | EN 50575:2014 + A1:2016 |
| - Hazardous substances | NPD | |
- The performance of the product identified in points 1 & 2 is in conformity with the declared performance in point 8. This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

 Dr. Mike Szarmiesat
 Executive Director R & D KBE / DLB Group

Berlin, 29.05.2020
 (Place, Date)

power in wire and cables

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es befreit die Kaufleute des Produktes mit dem oben genannten Standard und Prüfverfahren. Zusätzliche Anforderungen an Kunden, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich beachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

Zertifizierungsstelle

 TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg
 Tel: +49 221 806-3111 e-mail: cert-validity@de.tuv.com
 Fax: +49 221 806-3053 http://www.tuv.com/safety

Guido Volberg

Zertifikat Certificate

Zertifikat Nr. Certificate No. Blatt Sheet
 R 60147048 0003

Ihr Zeichen Client Reference Unser Zeichen Our Reference Ausstellungsdatum Date of Issue
 448/20 0010--60193773 004 09.07.2020 (day/month/yr)

Geschäftsinhaber License Holder Fertigungsstätte Manufacturing Plant
 KBE Elektrotechnik GmbH KBE Elektrotechnik GmbH
 Symeonstr. 8 Symeonstr. 8
 12279 Berlin 12279 Berlin
 Deutschland Deutschland

Prüfzeichen Test Mark Geprüft nach Tested acc. to
 2 PEG 1152/10:19

Zertifiziertes Produkt (Geräteidentifikation) Lizenzgebühr - Einheit License Fee - Unit
PV Components for BOS - electrical / PV - Cables

as page 0061 - 0062/
 Supplement:
 Product complies also with the above mentioned standard.
 Additional Code designation: PV 1500-K

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es befreit die Kaufleute des Produktes mit dem oben genannten Standard und Prüfverfahren. Zusätzliche Anforderungen an Kunden, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich beachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
 This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

Zertifizierungsstelle

 TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg
 Tel: +49 221 806-3111 e-mail: cert-validity@de.tuv.com
 Fax: +49 221 806-3053 http://www.tuv.com/safety

Guido Volberg

power in wire and cables

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

power in wire and cables



>40 GW weltweit / >40 GW worldwide

KBE Elektrotechnik GmbH • Symeonstraße 8 • 12279 Berlin • GERMANY

Tel: +49 (0)30 / 25 208-100 • Fax: +49 (0)30 / 25 208-140 • info@kbe-elektrotechnik.com • www.kbe-elektrotechnik.com

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Solar Tracker

IDEEMATEC -1

این شرکت آلمانی یک شرکت پیشرو در زمینه ساخت Tracker های خورشیدی است. این شرکت تا کنون بیش از 4GW سیستم ترکر برای 25 کشور دنیا ارسال کرده است. از ویژگی های محصولات این شرکت سادگی نصب و راه اندازی و طول عمر بالا می باشد.

GENERAL MECHANICAL FEATURES

| | |
|--------------------------|---|
| Tracking type | Horizontal single axis tracker |
| Typical tracker size | Up to 240 m length |
| Ground cover ratio (GCR) | Configurable: typical 30-50% |
| Wind protection | Zero degree slow position |
| Corrosion protection | Galvanized steel C3 as standard C4 or C5 on request |
| Foundation | Sigma |
| Tracking range | 5° as standard Up to 60° upon request |
| Ground Clearance | 300 mm as standard Up to 500 mm on request |
| Inclination | Up to 36% |
| Cleaning | Verified by IDEEMATEC |

POWER AND CONTROL SYSTEM

| | |
|-----------------------|--|
| Software | Aurora™ by IDEEVATEC |
| Solar Tracking Method | Astronomical Algorithm 3D adaptive back-tracking |
| Communication | Full wired redundant data transfer & control flow through power cables eliminating need for additional cables |
| Control | One cluster control unit per 24 MW (250 trackers) - includes weather station, redundancy computer, SCADA ready |
| Power | AC power and self-powered solutions UPS available on request |
| Drive type | High accuracy slow gear disconnected |
| Motor type | 30 PE 400V 50Hz UL 480V 60Hz DC 24V |
| Operating temperature | -20°C up to +55°C |
| Warranty | 15 years System Warranty |

THE COMPLETE TRACKER PORTFOLIO

HORIZON L:TEC® 1P

GERMANY / Headquarters: germany@ideematec.com
 USA: usa@ideematec.com
 COLOMBIA: colombia@ideematec.com
 BRAZIL: brazil@ideematec.com
 CHILE: chile@ideematec.com
 MEXICO: mexico@ideematec.com

SPAIN: spain@ideematec.com
 AUSTRALIA: australia@ideematec.com
 CHINA: china@ideematec.com
 MENA: mena@ideematec.com

FRANCE: france@ideematec.com
 PORTUGAL: portugal@ideematec.com

Most advanced one-in-portrait tracker solution

The Horizon L:TEC® 1P tracker pairs our signature decoupled drive technology with the new innovative loading system for maximum stability. Designed especially for large systems.

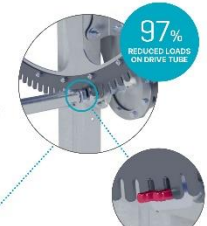
The Horizon L:TEC® is now available in both a one-in-portrait and a two-in-portrait option.



PATENTED JOCKS AND DECOUPLED DRIVE TECHNOLOGY

The decoupled drive technology is significantly more efficient than all traditional drives. The smart drive technology transfers the table loads directly into the foundations and creates that forces on the drive and reduces its absolute minimum.

This is why we can build the longest and most flexible trackers on the market.



POWERED BY JUST 1 DRIVE UNIT

- 3 times less drive units
- Higher availability
- Lower maintenance costs



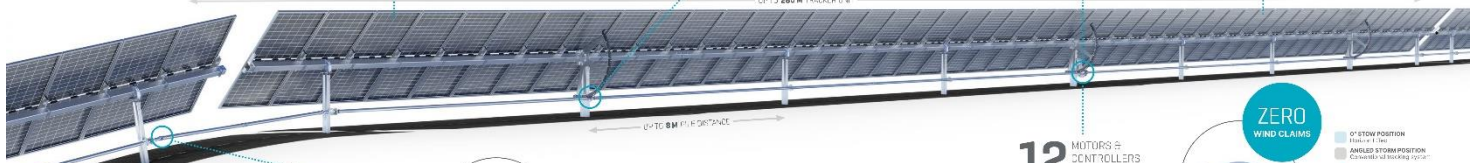
BEST LIFETIME VALUE AND OPTIMIZED LCOE

- Highest acid floor gains
- Optimizes overall yield
- Improves system lifetime

UP TO 240 MODULES PER TRACKER

UP TO 880 M TRACKER UNIT

UP TO 8 STRINGS PER TRACKER

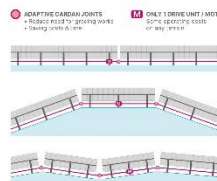


MAXIMUM DESIGN FLEXIBILITY UNLIKE ANY OTHER TRACKER

- Suits all module types: 72 Cells, 76 Cells, bifacial
- BOS optimized layout
- Modular tracker configuration

PATENTED CARBON JOINTS ADAPT TO ANY TERRAIN

- Each table can be installed at an angle of up to 36% from the previous table
- No need for complex grading works



12 MOTORS & CONTROLLERS PER MW

0° SLOW POSITION FOR 360° WIND PROTECTION

- Unique protection against extreme weather conditions
- 50% less stress with 0° slow
- Withstands winds of up to 180 km/h
- Higher energy during slowing
- Track-to-stop max. 6 minutes



BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

Zimmermann -2

این گروه آلمانی متشکل از چند شرکت زیر مجموعه در زمینه طراحی و ساخت سیستم های دنبال کننده خورشیدی، سازه های خورشیدی شناور روی آب و... میباشد. محصولات این شرکت نیز از کیفیت بالایی برخوردار است و از ویژگی های آن سرعت بالا در نصب و راه اندازی است.



ZIM Track

Horizontal single-axis tracker

- Strong and rigid construction, fully recyclable system components.
- Fast assembly, only bolted connections, no welding, cutting or drilling required.
- Patent pending for innovative module bracket with hooks for fast module installation.
- Integrated cable management.
- No expensive special tools required.
- Low maintenance system. Easy replacement of individual components including the gearbox without disassembly of the overall structure.

ZIM Track– Technical Data

| | |
|---|---------------------------------------|
| Design life | ▪ 25+ years |
| Max. inclination North-South | ▪ 15 % / 8.5° |
| Length of tracker | ▪ < 96 m |
| Turning angle | ▪ +/- 60° |
| Min. ground clearance inclined module | ▪ 200 mm |
| Average ground clearance inclined module | ▪ Client specific, between 400 -600mm |
| Max. height module edge | ▪ 2000 mm |

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



ZIM Track– Technical Data

| | |
|---------------------------------|--|
| Warranty statement | <ul style="list-style-type: none">▪ Tracker steel structure 10 years, control system 5 years with option to extend. |
| Tracking algorithm | <ul style="list-style-type: none">▪ Astronomical tracking algorithm with individual row backtracking. |
| Integration of Inverters | <ul style="list-style-type: none">▪ Weather protected inverter mounting possible, shelter from rain and overheating. |
| Drive system | <ul style="list-style-type: none">▪ Slewing drive, one unit per tracker row. |
| Cabling | <ul style="list-style-type: none">▪ Integrated cable management in main torque tube. |
| IP class | <ul style="list-style-type: none">▪ IP65 |
| Weather protection | <ul style="list-style-type: none">▪ Storm, snow and hail protection integrated in optimised algorithm. Threshold settings project specific configurable. |
| Cleaning position | <ul style="list-style-type: none">▪ Individual configurable. |
| Tests / Certification | <ul style="list-style-type: none">▪ VDE Confirmation of electrical concept.▪ Risk Assessment for health and safety for assembling and operation/maintenance.▪ Wind tunnel test.▪ Dynamic analysis for static calculation of substructure. |
| Monitoring | <ul style="list-style-type: none">▪ Remote monitoring and trouble shooting possible. |

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



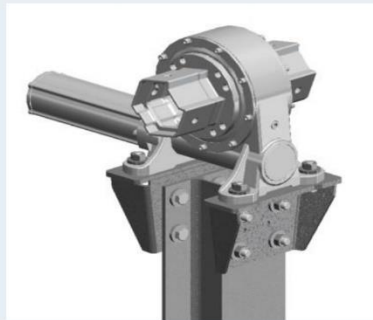
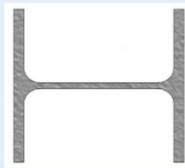
Electric • Control • Mechanic



ZIM Track – Main components

Main Components

- Centre HEA pile for drive unit
- Sigma piles for main tube bearings
- Maintenance free bearings
- Dampers



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



ZIM Track – Main components

Main Components

- Bifacial optimized module holder with integrated hooks for fast module installation
- Wireless control system with 3 power options:
 - i. Auxillary AC supply
 - ii. String powered
 - iii. String powered with optional battery add on



این شرکت آلمانی 24 سال سابقه تولید ترکر های خورشیدی با بالاترین رنج دریافت انرژی خورشیدی را دارد.
با استفاده از ترکر های این شرکت میتوان تا 42.9 درصد انرژی بیشتری نسبت به سازه های ثابت از خورشید دریافت کرد.



DEGER S100-PF-SR

DATA SHEET

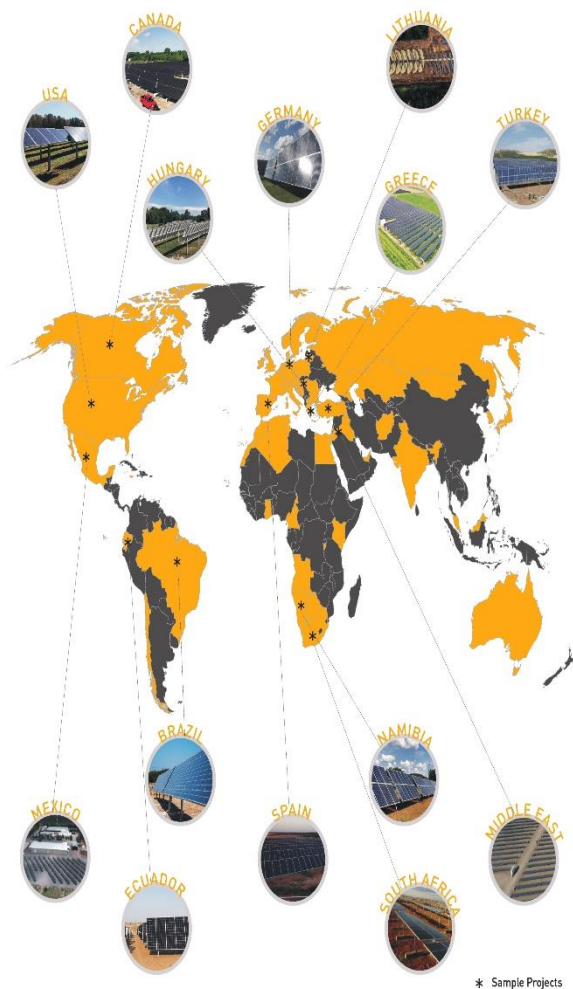
BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

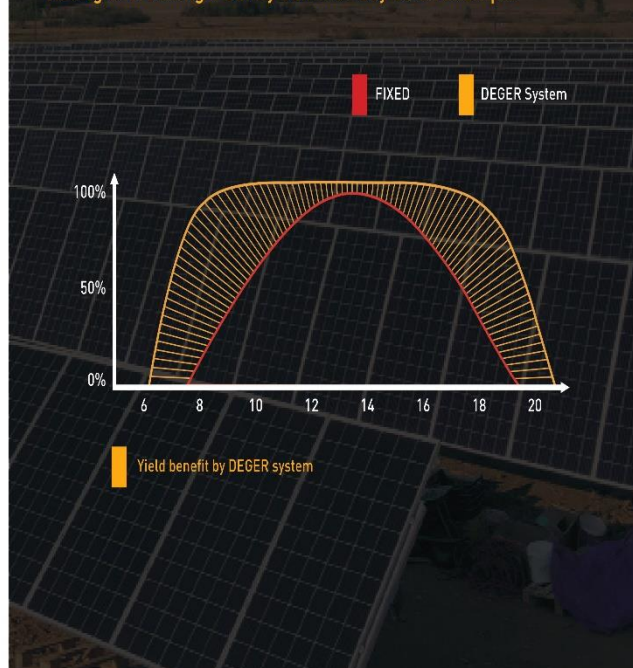
WE ARE AT YOUR SERVICE WORLDWIDE



Single-Axis Tracking System

Single-axis, active tracking systems from DEGER enable the optimal utilization of all the irradiation energy, suitable for all widely-sold solar modules. With the patented sensor-based MLD technology you can achieve yield increases of approx. 28.1% for all photovoltaic applications. An easy plug-and-play installation is realized by means of the stable supporting construction. The decentralized control enables maximum independence. DEGER systems are "designed in Germany"- and stand for quality and durability.

Rating chart using a sunny summer day as an example



BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

ADVANTAGES



Module carrier profiles made from aluminum



Availability of aluminum module carrier profiles in three different heights: 65mm, 85mm and 100mm.



Hot dipped galvanized steel



Wind speed stability for up to 140 km/h, for special areas 160 km/h is also available



Non-linked rows



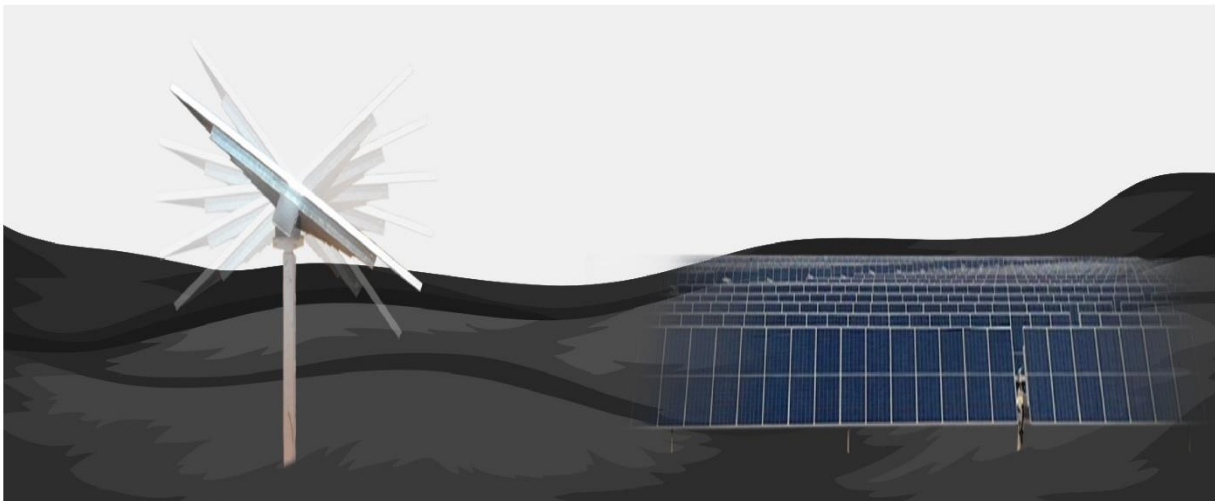
Low power consumption



Usage of IPE and HEA ramming profiles. Roll forming profiles are not used on any DEGER trackers.



Robust and reliable tracking systems with heavy duty dampers



Fast and simple plug-and-play installation



High functional reliability and low-maintenance operation



Fewer electronic parts required thanks to the management of two trackers by one EK S1 control panel



Tracking systems that can be designed with 1 to 84 solar modules

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

TECHNOLOGY



Intelligent Maximum Light Detection (MLD) system, up to 28.1 % yield increase with MLD technology.



Automatic reset to sunrise position overnight



Yield increase with snow sensor



Possibility of data collection every single second



Adjustable tracking system movement positions



Different cleaning positions



Adjustable wind speed limit for each solar tracking system (maximum 12 m/s)



Possibility of setting sunrise and sunset angles for shadow management via DEGER CTC software



Movement and wind/snow alarm data saved via Microsoft Excel



Possibility of individual tracking system management via DEGER CTC software



Wind protection with anemometer



Gearbox and DC motor technology

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de

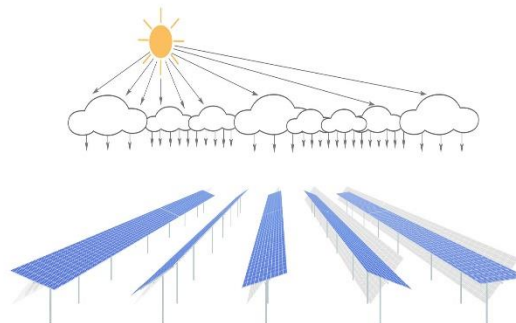


Electric • Control • Mechanic

MLD Technology

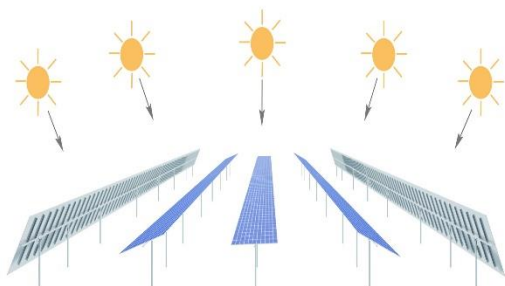
- Intelligent Maximum Light Detection (MLD) system, up to 28.1 % yield increase with MLD technology.

Technology that is proactive gets more out of the sun. The light irradiation's intensity is influenced by a number of factors – primarily clouds, of course. That is why it is crucial that a smart control is able to react to the conditions accordingly. The MLD principle takes on that task.

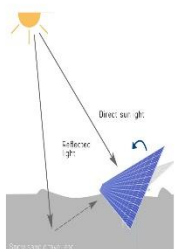


Varying light conditions:

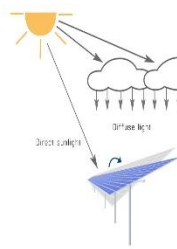
Because of different levels of cloudiness, the light conditions in solar park vary for each DEGER tracker. The individual control makes sure every DEGER system is optimally oriented to the brightest source of irradiation. This guarantees the highest energy yield possible.



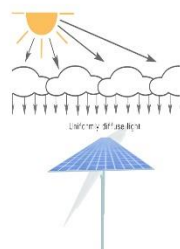
Sunshine: The DEGER system directly faces the sun all day.



Reflecting surface:
 The DEGER system uses direct solar irradiation as well as energy from reflected light.



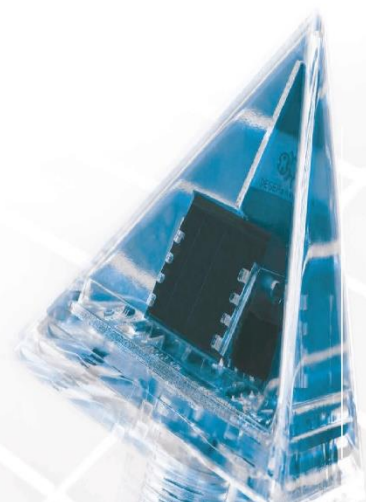
Partly clouded:
 In addition to the direct solar irradiation diffused light is also used to maximize the effect.



Overcast sky:
 The DEGER system catches all the diffused light by moving to horizontal position.



The MLD-Sensor – the critical component in the MLD principle of controlling tracking systems.



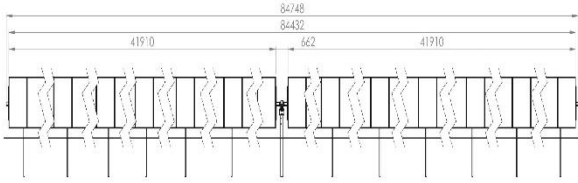
BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Technical Specification



DEGER S100-PF-SR
 With Driven Pile Foundation^[1]

BASIC DATA

| | |
|--------------------------------------|--------------------|
| Nominal output (depending on module) | Up to 38.000 Wp DC |
| Tracking type | 1-axis |
| Module surface (max.) | 170 m ² |
| Weight (total solar module weight) | Up to 2.601 kg |
| Approvals | CE, UL, CSA |

STRUCTURE

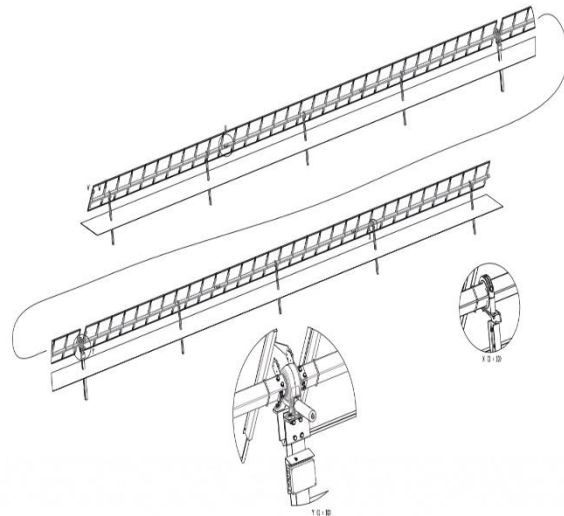
| | |
|-------------------|--|
| Materials | Hot-Dip galvanized steel, aluminum, synthetics |
| Galvanization | EN ISO 1461 or comparable |
| Bond-Type | Bolted connection, no welding on site |
| Certified statics | Yes |

DRIVE

| | |
|----------------------------|---|
| Principle | Rotary drive |
| East-West angle | +50° / -70° |
| Spin speed | 18°/min. |
| Sound level (without load) | At a distance of 10 meters: 20-40 Db(A) |
| Protection class | IP 67 |

ELECTRONICS & CONTROL

| | |
|---------------------|--|
| Operating voltage | 100 - 240 V AC / 100 - 380 V DC / 50 - 60 Hz |
| Rated input current | 0.8 A |
| Control | MLD-Technology |
| Protection class | IP 67 |



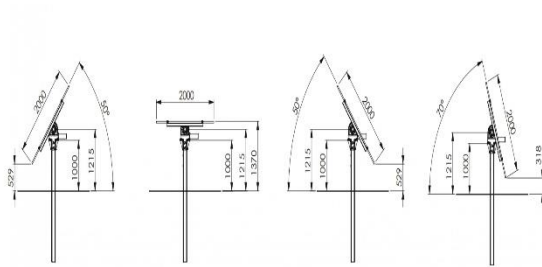
BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Technical Specification



DEGER S100-PF-SR
 With Driven Pile Foundation^[1]

POWER CONSUMPTION (APPROX)

| | |
|-------------------------------|--------------|
| Control mode | 1 W |
| With running actuator | 50 W - 336 W |
| Internal consumption per year | 6 kWh |

POWER OUTPUT

| | |
|-----------------------|---------|
| Output voltage | 24 V DC |
| Output current (max.) | 2.5 A |

CLIMATIC CONDITIONS

| | |
|---------------------------------|-------------------------------|
| Installation over sea level | max. 2000 m |
| Permissible ambient temperature | -20°C - +50°C |
| Humidity range | 5% - 95% |
| Permitted wind speed | Up to 140 km/h ^[2] |

GROUND CONDITIONS

| | |
|-------------------------------------|-----------------------|
| Max. ground inclination East-West | 10° |
| Max. ground inclination North-South | 10° ^[3] |
| Subsoil requirements | Soil survey necessary |

PILE DRIVING FLEXIBILITY

| | |
|----------------------------------|----------------|
| Ramming accuracy related to axis | max. +/- 20 mm |
| Axis twist angle | max. +/- 5° |
| Ramming accuracy in height | max. +/- 10 mm |

[1] The depth of the driven pile foundation must be statically calculated. Pictured dimensions can change depending on the module size and/or number of modules per tracking system

[2] With full occupancy - Laid out with Planning Tool

[3] Tracker axis installed parallel to the ground

SCOPE OF DELIVERY

Complete single-axis tracking systems, solar module carrier system made of steel or aluminium - matching the module type used, patented MLD control (Maximum Light Detection) with MLD sensor and assembly instructions.

OPTIONAL SERVICES

Assembly support, trainings and on-site service.

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

Comparative measurements: Up to 28.1% Yield Increase

In the comparative measurement four different systems for generating solar energy were examined in solar park Rexingen in southern Germany. The aim of the two-year study was to determine the efficiency and higher yield of the photovoltaic modules compared to fixed tilt installed, astronomic tracked and tracking by MLD sensors of single- and dual-axis systems.

CONDITIONS

The efficiency of solar panels depends on various factors such as temperature, air pressure and radiation values. So that the comparison measurements were carried out under the same conditions, all four systems were installed on the former landfill in Rexingen and equipped with the same modules and inverters. Measurement of yield was determined for two years and was carried out under the following parameters and performance

| | |
|-------------------|---|
| Installation site | 48° 26' 50" North, 8° 39' 48" East |
| Elevation N | 569 meters |
| Irradiation | 1,010 kWh/kWp (PVGIS) |
| Installed modules | Per unit 36 modules Sanyo HIP-215NKHE1 |
| Nominal power | 7.74 kWp |
| PV Inverter | Per unit one SMA SMC 8000TL |
| Nominal power | 8.0 kW |

SYSTEM 1

Fixed tilt installation 30° south-facing



SYSTEM 2

Single-axis DEGER tracking system with MLD sensor



SYSTEM 3

Dual axis astronomical controlled



SYSTEM 4

Dual-axis DEGER tracking system with MLD sensor



ANALYSIS PROCEDURES

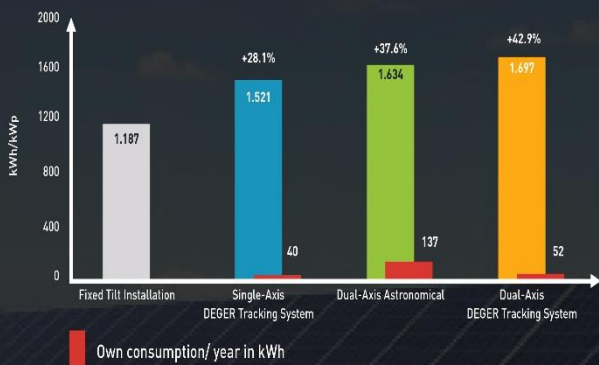
For the evaluation two different methods were used.

The normalization method, in which all performance variables such as cable length, actual module output, inverter efficiency and other similar variables are taken into account. By the evaluation with the standard method the yield takes into account a theoretical consideration of the cable losses resulting directly from the measured data without further corrective calculation.

Results

According to the one hundred percent availability of data in 2012 the following values are determined with the standard method:

COMPARATIVE MEASUREMENTS IN 2012 IN SOLAR PARK REXINGEN



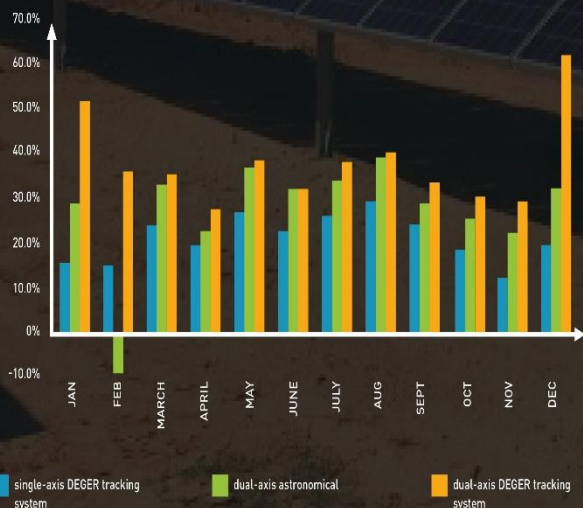
ADDITIONAL YIELD MONTHLY RESULTS IN 2012 COMPARED TO FIXED TILT SYSTEMS IN PERCENT

| | JAN | FEB | MAR | APR | MAY | JUNE | JULY | AUG | SEP | OCT | NOV | DEC |
|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| single-axis DEGER tracking system | 15.7% | 15.2% | 24.4% | 19.8% | 27.2% | 23.1% | 26.5% | 29.5% | 24.7% | 18.8% | 12.4% | 19.8% |
| dual-axis astronomical | 29.4% | -8.9% | 33.5% | 23.0% | 36.8% | 32.5% | 34.4% | 39.4% | 29.0% | 25.9% | 22.6% | 32.5% |
| dual-axis DEGER tracking system | 52.5% | 36.2% | 35.9% | 27.8% | 38.6% | 32.6% | 38.5% | 40.6% | 33.8% | 30.6% | 29.5% | 42.3% |

THE RESULT OF THE STUDY

- ◆ DEGER single axis tracking system are generating a 28.1% higher yield compared with static systems,
- ◆ DEGER dual axis tracking system are generating a 42.9% higher yield compared with static systems,
- ◆ DEGER tracking system are generating a 5.3% higher yield compared with astronomical controlled systems.
- ◆ DEGER tracking system have the lowest operating power consumption compared to the measured tracking systems in this study.
- ◆ During the winter, astronomically controlled units may not even outperform fixed systems when foggy or cloudy conditions are present. Only MLD technology senses that the diffuse irradiation is best captured with by presenting the most surface area possible.

ADDITIONAL YIELD MONTHLY RESULTS IN 2012 COMPARED TO FIXED TILT SYSTEMS



BHT Electric Control Mechanic GmbH & Co. KG

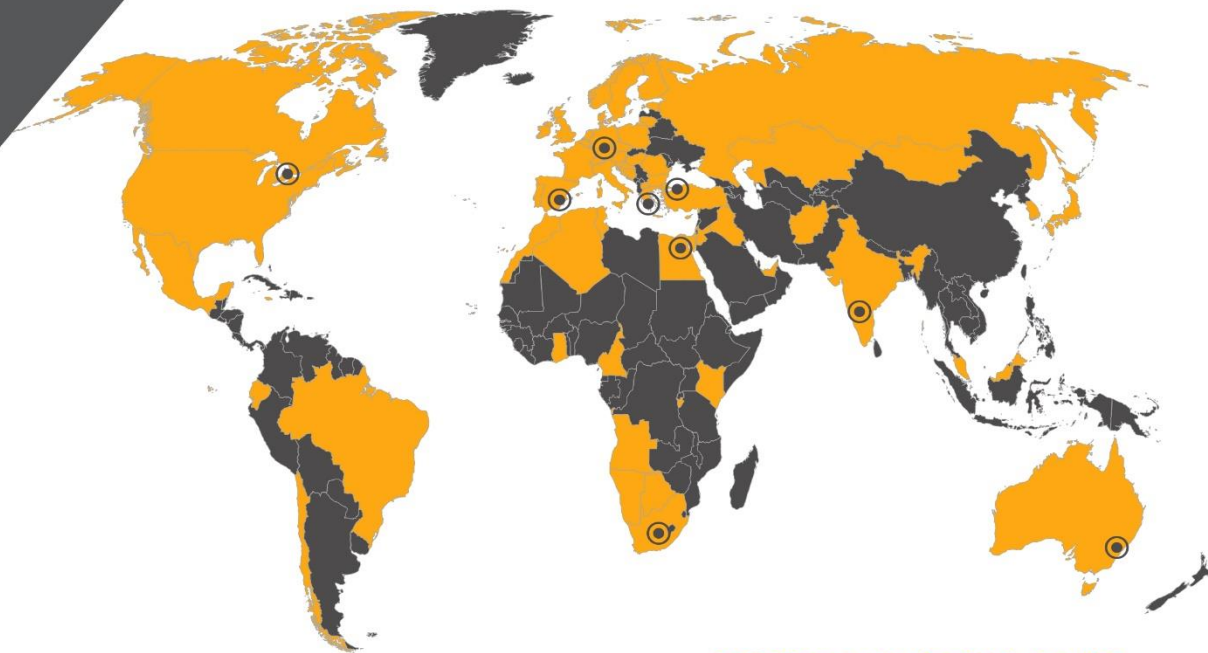
Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de





Electric • Control • Mechanic



WE ARE AT YOUR SERVICE WORLDWIDE



-  Sales and production locations
-  Installed DEGER systems

DEGERenergie GmbH & Co. KG

Hafnerstraße 50
72131 Ofterdingen
Germany
Phone: +49 7473 70218 41
E-Mail: info@DEGERenergie.com

BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

MC4 Connector

Staubli -1

شرکت سوئیسی Staubli اولین تولیدکننده سوکت های MC4 در دنیا بوده است. این شرکت هم اکنون مدل های مختلفی از این سوکت ها را با کیفیت بالا تولید و به بازار عرضه میکند.

FAST MOVING TECHNOLOGY



Cable coupler MC4 with barrel crimp contacts

Solarline | Connectors for renewable energy

EN



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



| Technical data | |
|--|---|
| Connector system | Ø 4 mm |
| Rated voltage | 1500 V DC (UL) 1000 V DC (CSA) |
| Rated current UL | 30 A (14 AWG) 35 A (12 AWG) 50 A (10 AWG) 70 A (8 AWG) 95 A (6 AWG) |
| Ambient temperature range | -40 °C ... +85 °C |
| Degree of protection, mated unmated | IP65, IP68 (1 h/1 m) IP2X |
| Overvoltage category/Pollution degree | CATIII/3 |
| Contact resistance of plug connectors | ≤ 0.25 mΩ |
| Safety class | 1500 V DC: 0 |
| Contact system | MULTILAM |
| Type of termination | Crimp (barrel crimp) |
| Contact material | Copper, tin plated |
| Insulation material | PC/PA |
| Locking system (UL) | Locking type, requiring tool |
| Flame class | UL94-V0 |
| Ammonia resistance (acc. to DLG) | yes |
| Salt mist spray test, degree of severity 6 | yes |
| UL recognized component, in accordance with UL 6703 | E343181 |
| CSA certified, in accordance with UL6703 (8 AWG version only) | 250725 |

Crimping pliers²⁾

PV-CZM...



PV-CZLX/6AWG



| Order No. | Type | Designation | Crimp range | Crimptype | | Assembly instruction |
|---------------|--------------|--------------------------------|---------------|-------------------|---------------------|----------------------|
| | | | AWG | Open crimp AWG | Barrel crimp AWG | |
| 32.6020-22100 | PV-CZM-22100 | Crimping pliers | 12; 10; 8 | 12; 10 | 8 | MA251 |
| 32.6020-23100 | PV-CZM-23100 | incl. locator and insert | 14; 12; 10; 8 | | 14; 12; 10; 8 | MA251 |
| 32.0349 | PV-CZLX/6AWG | Crimping pliers, incl. locator | 6 | | 6 | MA710 |

Individual parts for PV-CZM-...

| | | | | | | |
|---------------|-----------------|---------|---------------|--------|---------------|-------|
| 32.6021-22100 | PV-ES-CZM-22100 | Insert | 12; 10; 8 | 12; 10 | 8 | MA251 |
| 32.6021-23100 | PV-ES-CZM-23100 | Insert | 14; 12; 10; 8 | | 14; 12; 10; 8 | MA251 |
| 32.6055 | PV-LOC-B | Locator | 12; 10; 8 | 12; 10 | 8 | MA251 |
| 32.6074 | PV-LOC-D | Locator | 14; 12; 10; 8 | | 14; 12; 10; 8 | MA251 |

Individual parts for PV-CZLX/6AWG

| | | | | | | |
|---------|-----------------|---------|---|--|---|-------|
| 32.0350 | PV-CZL/6AWG-LOC | Locator | 6 | | 6 | MA710 |
|---------|-----------------|---------|---|--|---|-------|

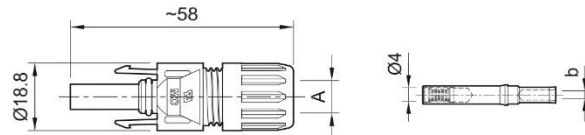
²⁾ Please contact us for information on pneumatic crimp station options.

Female and male cable coupler MC4

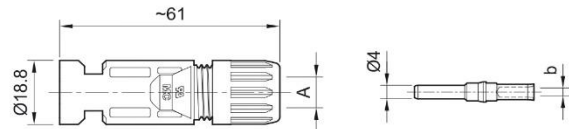
Female and male cable coupler as individual part with barrel crimp contacts (including insulating part)

- Snap-in lock
- In accordance with NEC 2020, requires a tool to open
- Proven MULTILAM technology with high long-term stability, which ensures consistently low performance loss throughout the entire service life of the plug connector
- Tried and tested plug connectors, over 15 years of experience in the field
- Available for assembly with cross-sections up to 6 AWG
- Also available as ready made leads
- Mating compatibility with the entire MC4 and MC4-Evo 2 families of connectors
- Leads made to customer's specifications available upon request

PV-KBT4...



PV-KST4...



| Female cable coupler | | Male cable coupler | | Ø range of cable gland ¹⁾ | | Conductor cross section | | | |
|----------------------|-----------------|--------------------|-----------------|--------------------------------------|------------|-------------------------|---|---|--|
| Order No. | Type | Order No. | Type | A (mm) | AWG | b (mm) | | | |
| 32.0094-UR | PV-KBT4/5I-UR | 32.0095-UR | PV-KST4/5I-UR | 4.83 – 6.2 | 14; 12; 10 | 3 | x | | |
| 32.0792-UR | PV-KBT4/5X-UR | 32.0793-UR | PV-KST4/5X-UR | 6.2 – 7.0 | 14; 12; 10 | 3 | x | | |
| 32.0096-UR | PV-KBT4/5II-UR | 32.0097-UR | PV-KST4/5II-UR | 7.0 – 8.60 | 14; 12; 10 | 3 | x | | |
| 32.0080-UR | PV-KBT4/8II-UR | 32.0081-UR | PV-KST4/8II-UR | 6.05 – 8.56 | 8 | 4.4 | x | x | |
| 32.0336-UR | PV-KBT4/13II-UR | 32.0337-UR | PV-KST4/13II-UR | 7.00 – 9.00 | 6 | 5 | x | | |

Accessories

| | | |
|---------|---------|--|
| 32.0716 | PV-BVK4 | Sealing cap, suitable for socket side |
| 32.0717 | PV-SVK4 | Sealing cap, suitable for plug side |
| 32.6024 | PV-MS | Open-end spanner set (consisting of 2 open-end spanners), plastics To tighten and unscrew the cable gland and to open the locking device of the connection. |



Assembly Instructions MA231, MA710

www.staubli.com/electrical

¹⁾ For more detailed information concerning the suitable cable gland range, please consult MA231 and MA710

2 MC4 with barrel crimp

Solar Testing Instruments

HT -1

شرکت HT Instruments ایتالیا تولید کننده انواع دستگاه های تست و دوربین های حرارتی برای نیروگاه های خورشیدی می باشد.
با استفاده از محصولات این شرکت میتوان از صحت عملکرد استرینگ های نیروگاه خورشیدی و کل نیروگاه اطمینان حاصل کرد.



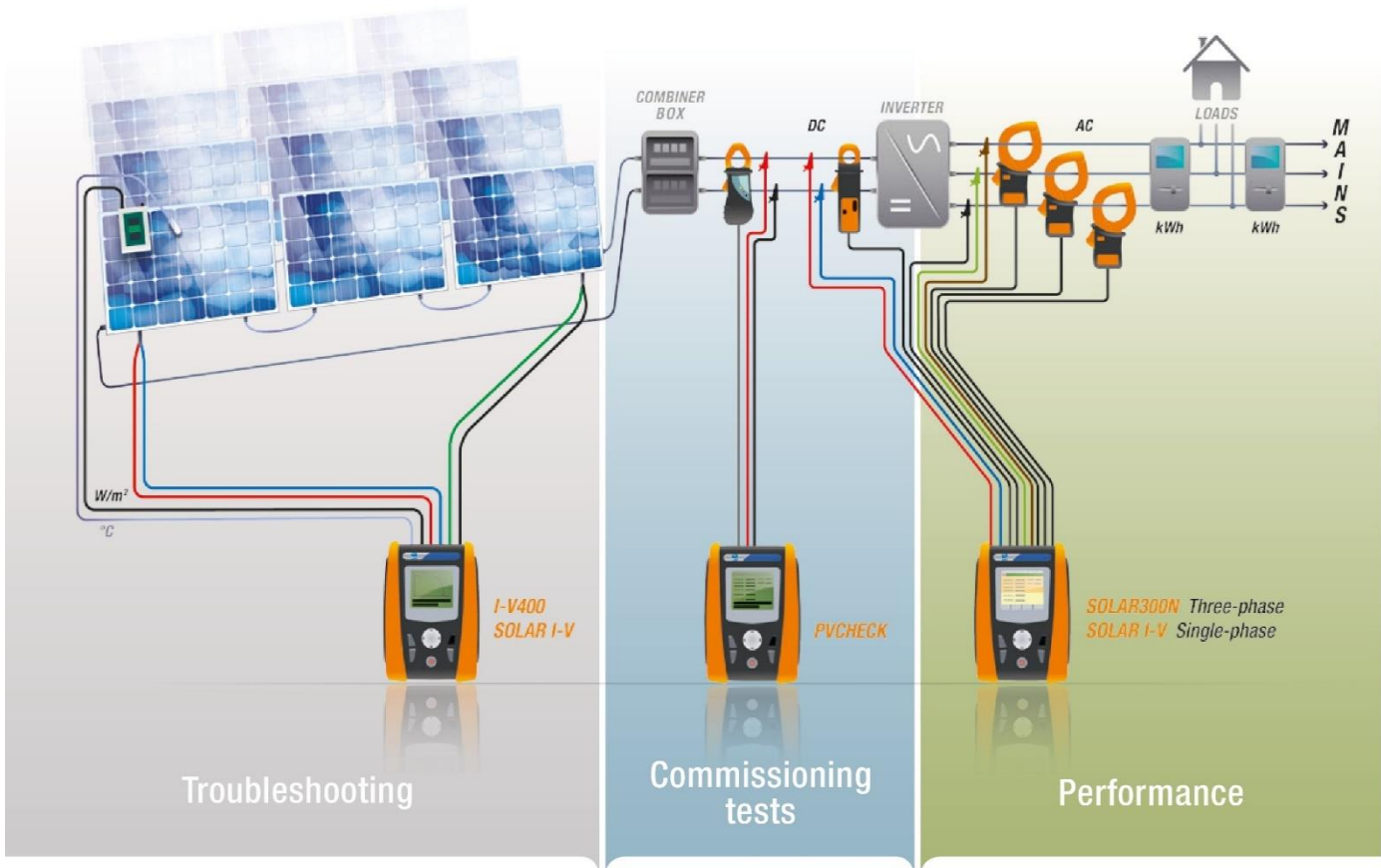
BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

H T S O L A R



BHT Electric Control Mechanic GmbH & Co. KG
Firmensitz: Köln Amtsgericht Köln HRA 13357
Ust-Id-Nr: DE 180758331
Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
Nüperling Beteiligungsgesellschaft mbH
Firmensitz: Köln
Registergericht Köln HRB 26389 Geschäftsführer:
Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
Sparkasse KölnBonn
(BLZ 370 501 98) Konto 192 996 8723
IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX



SOLAR PERFECTION

Photovoltaic installations: new HT solutions for commissioning tests, performance recording and troubleshooting.

Thanks to the decreasing cost of components, and considerable increase in related performance, installing PV systems on roofs or even on the ground has become more and more common. It is necessary, however, to consider problems of **installation safety, performance recording** and **maintenance** that may affect any PV installation.



Troubleshooting

- › It may happen that during the operation of a plant, some modules could fail compromising the performance of the whole system. When the efficiency of the system is lower than expected, it is necessary to troubleshoot the system to detect the broken modules, for further replacement. **SOLAR I-V** and **I-V 400** are the ideal solution for troubleshooting.

Commissioning tests

- › Commissioning tests are carried out to prove that the systems operate and perform to the safety specification. The standard IEC 62446 states the minimum testing and commissioning requirements to be carried out on PV installation each time they are connected to the grid. **PVCHECK** is the ideal solution for commissioning tests, as well as pre-start-up system checks.

Performance

- › Performance recording is a necessary pre-requisite to make maintenance programs effective. To monitor the performance of the system allows for detection of loss of production, to be corrected by troubleshooting and fixing the damage. **SOLAR300N**, **SOLAR I-V** and **MPP300** are the ideal solution for scheduled performance recording, as well as for loss of production investigation

H T S O L A R

SOLAR I-V

Multifunction instrument for **testing single-phase PV installations**.
(THREE-PHASE with accessory MPP300)

- › **Designed to meet any requirement of PV installation testers**
- › **Single phase efficiency measurement**
- › **I-V curve tracer**
- › **Voc and Isc measurement**
- › **Database of 30.000 PV modules curve types**

Easy identification of problems on systems which are not complying with the specifications declared by the manufacturer.

SOLAR I-V measures the **efficiency of single-phase PV systems** and also measures the **I-V characteristic both of a single module and of module strings on PV plants** (up to a maximum of 1000V and 10A).

Remote irradiation and temperature measurement

Irradiation and temperature measurements play an essential role for extrapolation of the I-V characteristic under standard test conditions. **SOLAR I-V carries out such measurements directly or under remote mode** through the unit **SOLAR-02, synchronized with main unit**. SOLAR I-V can effect measurements at the inverter, while **SOLAR-02 simultaneously detects environmental values close to modules without using long cable extensions**.

No more wasting time. It contemporarily carries out tests/recordings of 3 PV arrays.

SOLAR I-V can be interfaced with optional accessory **MPP300** capable of carrying out **simultaneously tests and recordings on max 3 separate arrays**, typical of multi-MPPT systems and multi-inverter systems (with MPP300).

Testing outcome: OK or NOT OK

SOLAR I-V compares the measured values with the values declared by the module manufacturer, **immediately providing the test result**.



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

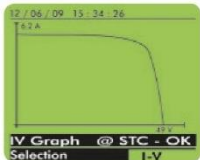
Functions

Maintenance of a PV plant

- Measurement of output voltage from module/string up to 1000V DC
- Measurement of output current from module/string up to 10A DC
- Measurement of solar irradiation [W/m²] with reference cell HT304N
- Measurement of temperature, automatic or by means of probe PT300N
- Measurement of output DC and nominal power from module/string
- I-V curve test with direct measurement of Irr/Temp parameters
- I-V curve test by using of SOLAR-02 unit
- Measurement of the resistance of photovoltaic module series
- Mechanical inclinometer to detect correct solar irradiation
- 4-terminal measuring method
- Comparison with standard conditions (STC: 1000 W/m², 25°C)
- Evaluation of testing result: OK / NO
- Management of up to 30 types of PV modules (30000 managed by PC software)
- Internal memory for data saving
- Recalling results on the display
- Optical/USB port for PC connection
- Online Help on the display

Performance of a PV plant

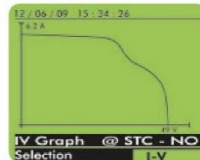
- DC/AC TRMS Voltage
- DC/AC TRMS Current
- DC power
- AC active power on single-phase systems
- Solar irradiation [W/m²] with reference cell
- Temperature environmental and module by means of probe PT300N
- Synchronization with remote unit SOLAR-02
- Display of real-time irradiation and temperature
- Use of relationship to correct DC efficiency through Temperature and Irradiance measuring
- Recording of parameters with programmable IP (5s – 60min)



REC. RUNNING
 Selection MPP I/A

| | | |
|------|-------|------------------|
| PRp | ---- | W/m ² |
| Irr | ---- | W/m ² |
| Pnom | 3.500 | kW |
| Tc | ---- | °C |
| Te | ---- | °C |
| Pdc | 3.125 | kW |
| Pac | 2.960 | kW |
| ndc | ---- | |
| ndc | 0.95 | |

Performance Analysis running.



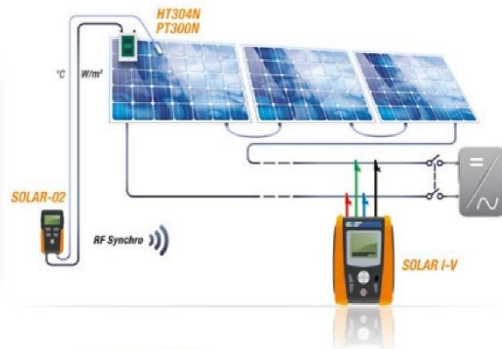
ANALYSIS RESULT
 Selection MPP I/A

| | | |
|------|-------|------------------|
| PRp | 0.815 | |
| Irr | 971 | W/m ² |
| Pnom | 3.500 | kW |
| Tc | 45.1 | °C |
| Te | 30.5 | °C |
| Pdc | 3.125 | kW |
| Pac | 2.960 | kW |
| ndc | 0.86 | |
| ndc | 0.95 | |

Performance outcome.

SOLAR I-V 1

Detection of IV characteristic on a string of PV modules through remote measurement of radiation and temperature



SOLAR I-V 2

Direct measurement of IV characteristic on a string of PV modules



SOLAR I-V 3

Testing of single-phase PV installation



H T S O L A R

I-V 400

Multifunction instrument for **I-V curve test** of PV strings and modules.



- › **I-V Curve tracer**
- › **Voc and Isc measurement**
- › **Database of 30.000 PV modules curve types**

Immediate recording of the I-V characteristic and of the characteristic parameters

I-V400 carries out the field measurement of the **I-V characteristic** and of the main characteristic parameters both of a **single module** and of **module strings on PV plants** (up to a maximum of 1000V and 10A).

Immediate compliance test result

The acquired data are then processed **to extrapolate the I-V characteristic** under standard test conditions (**STC**) in order to proceed comparing them with the rated data declared by the modules' manufacturer, thus immediately **determining whether or not the string or the module under test comply with the characteristics declared by the manufacturer**. On the other hand the analysis of **IV curve** permits to detect any fault condition on each single module composing the string under test.

Remote irradiation and temperature measurement

Irradiation and temperature measurements play an essential role for extrapolation of the I-V characteristic under standard test conditions. **I-V 400** carries out such measurements directly or under remote mode through the optional unit **SOLAR-02** **synchronized with main unit**. **I-V 400** can effect measurements at the inverter, while **SOLAR-02** simultaneously detects environmental values close to modules **without using long cable extensions**.

Friendly use with possibility of continuous updating of PV modules

I-V 400 manages a **database of PV modules**, which can be updated at any time both via the management software and directly on the instrument through the user interface.

Very accurate measurements even using cable extensions

Current and voltage measurements on modules or strings are effected with the 4-terminal method, which allows extending measuring cables without requiring any resistance compensation, so providing **accurate and precise measurements**.

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



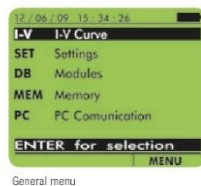
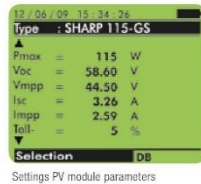
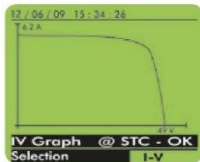
Electric • Control • Mechanic

Test outcome: OK or NOT OK

I-V 400 compares the measured values with the values declared by the module manufacturer, immediately providing the test result.

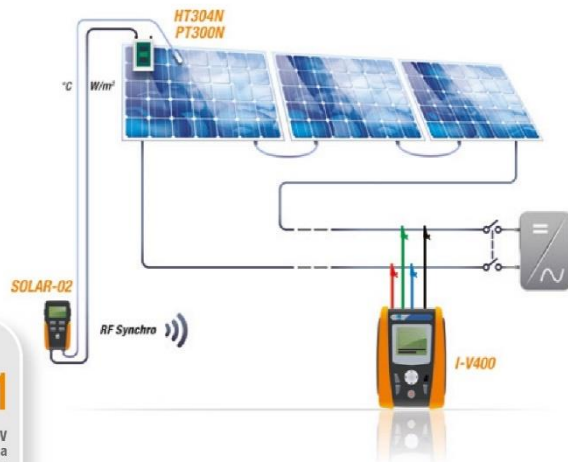
Functions

- Measurement of output voltage from module/string up to 1000V DC
- Measurement of output current from module/string up to 10A DC
- Measurement of solar irradiation [W/m²] with reference cell HT304N
- Measurement of temperature, automatic or by means of probe PT300N
- Measurement of output DC and nominal power from module/string
- Numerical and graphical display of I-V characteristic
- Measurement of the resistance of photovoltaic module series
- Mechanical inclinometer for incidence angle of solar irradiation
- 4-terminal measuring method
- Comparison with standard conditions (STC 1000 W/m², 25°C)
- Evaluation of testing result: OK / NO
- Management of up to 30 types of modules in the internal database
- Internal memory for data saving
- Recalling results on the display
- Optical/USB port for PC connection
- Help on line on the display



I-V 400 1

Detection of IV characteristic on a string of PV modules through remote measurement of radiation and temperature



I-V 400 2

Direct measurement of IV characteristic on a string of PV modules



BHT Electric Control Mechanic GmbH & Co. KG

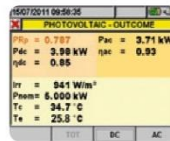
Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



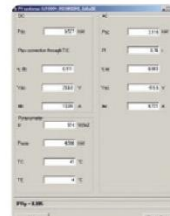
Electric • Control • Mechanic

Functions

- DC/AC TRMS (single-phase and three-phase) current measurement
- DC/AC (single-phase and three-phase) power measurement
- AC (single-phase and three-phase) energy measurement
- DC Measurement of power factor (cosphi) single-phase and three-phase
- Measurement of solar irradiation [W/m²] with reference cell HT304N
- Measurement of temperature by means of probe PT300N
- Recording of voltage and current harmonics up to the 49th order
- Recording of voltage anomalies (dips, peaks)
- Flicker analysis in compliance with standard EN50160
- Recording of inrush currents with a resolution of 10ms
- Recording of voltage fast transients (spikes) with a resolution of 5us
- Complete analysis of mains quality in compliance with standard EN50160
- Numerical and graphical display of each quantity
- Recalling results on the display
- TFT colour display with touch screen
- Power supply with rechargeable Li-ION battery
- Memory extension by means of compact flash (CF card)
- Data transfer to external USB memory (memory stick)
- USB port for PC connection
- Help on line at display

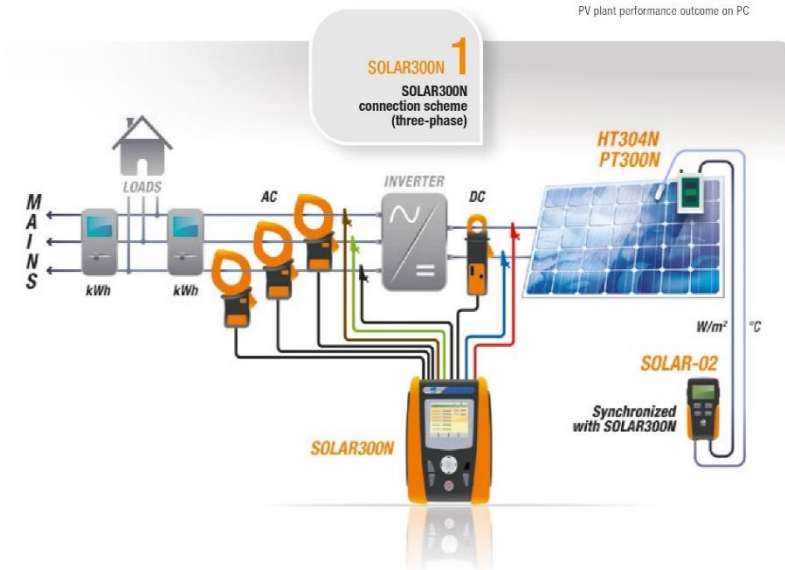


PV plant performance outcome on instrument display



PV plant performance outcome on PC

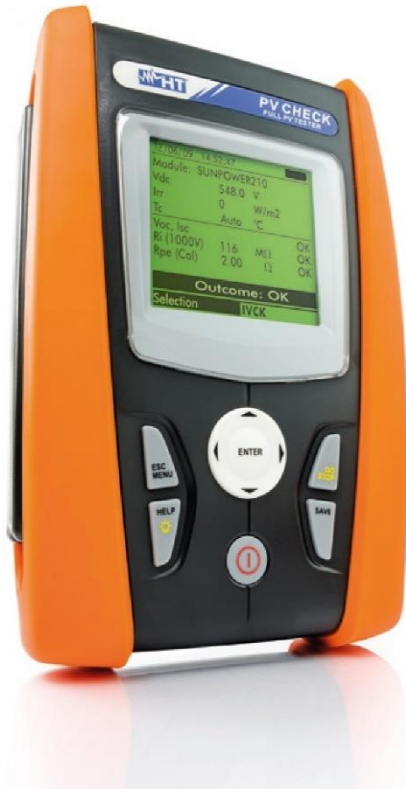
SOLAR300N is an advanced power and energy consumption analyzer



H T S (●) L A R

PV CHECK

Multifunction instrument to check **safety, parameters** and **performance** of a PV plant.



- › **Automatic test sequence (IVCK):**
 - › Insulation check
 - › Isc and Voc measurement
 - › Continuity check of protective conductor

The perfect check-up

- **Quick and safe testing** of electrical safety on a PV installation (DC section).
- Control on working of modules/strings in accordance with IEC/EN62446 guidelines.
- **PV CHECK** carries out insulation resistance measurement of active conductors of a module, a string or a PV array according to guidelines **without the need of using an external switch to short-circuit positive and negative terminals**.
- **PV CHECK** is provided with "IV Check" mode capable of evaluating **insulation**, values for **open circuit voltage Voc** and **short circuit current Isc** (both referred to **STC** through radiation measurement) as well as continuity of protective conductors on each string, with a single measurement.

Check of PV array performance under operating conditions

- **PV CHECK** carries out **performance analysis** of PV array (DC) under operating conditions (connected to the inverter) providing an indication of the power generated and **the efficiency of the PV field** depending on irradiation condition and temperature measured by the very instrument.

Testing outcome: OK or NOT OK

- **PV CHECK** compares test results with the values required by standards, so **granting immediate testing outcome**.

BHT Electric Control Mechanic GmbH & Co. KG

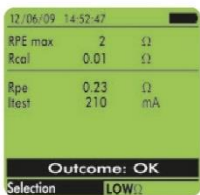
Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



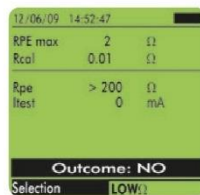
Electric • Control • Mechanic

Functions

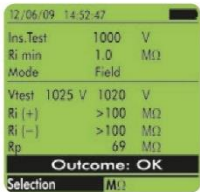
- Safety test of PV installation
- Continuity test on protective conductors with 200mA
- Insulation test with test voltage of 250, 500, 1000VDC
- DC voltage - DC current - DC Power
- Solar irradiation [W/m²] with reference cell HT304N
- Environmental and module temperature by means of PT300N probe
- SOLAR-02: remote unit for irradiance and temperature measurements (RF connection)
- Recording of PV plant parameters (DC side) with programmable IP (5s – 60min)
- Use of PDC compensation ratios according to environmental and module temperature
- Use of relationship to maximize the DC efficiency
- Outcome OK/NO
- Check of PV string's working
- Measurement of open circuit voltage up to 1000V DC
- Measurement of short circuit current up to 10A DC
- Measurement of temperature, automatic or by means of PT300N probe
- Mechanical inclinometer for the detection of solar radiation incidence angle
- Comparison with standard conditions (STC 1000 W/m², 25°C)
- Database to manage up to 30 types of photovoltaic modules (30000 managed by PC software)
- Internal memory for data saving
- Optical/USB port for PC connection
- Help on line on display



Continuity Test



Continuity Test

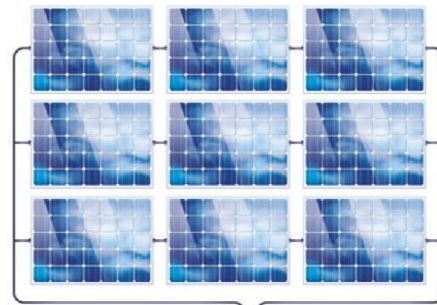


Insulation test



IVCK: automatic test sequence

PVCHECK 1 Insulation measurement in a PV field



PVCHECK 2 Measurement of DC efficiency on PV installations



H T S O L A R

MPP300

Accessory for **measuring and recording the efficiency** of **single-phase** and **three-phase multi-string** systems

- › **Simultaneous analysis of 3 strings**
- › **For connection with SOLAR300N and SOLAR I-V**
- › **Lowering of testing times**

MPP300 is an innovative accessory allowing **measuring and recording** the main parameters which characterize **single-phase and three-phase, single-string and multi-string** (up to three MPPTs) photovoltaic systems.

Provided with a practical **anti-shock hard carrying case**, its **light weight** and **small size** make it ideal for the field use.

MPP300 interfaces with **SOLAR300N** and **SOLAR I-V** for settings, to start/stop **recording electrical and environmental parameters** and to **enable the download of the recorded values**. The master instrument **SOLAR300N** or **SOLAR I-V** is only used in the initial and final phase of recording, and it does not play any active role while recording electrical and environmental parameters.

The remote unit **SOLAR-02** (synchronized with **MPP300**) is positioned next to the photovoltaic modules for measuring environmental parameters (irradiation and temperature). Thanks to the **synchronism**, it is **not necessary to lay long connection cables** between the environmental probes and the instrument, hampering the operator's movements, being a hindrance, etc., **nor to use a wireless connection** between the environmental probes and the instrument, usually impossible, because of signal attenuation due to the presence of floors, of reinforced concrete or metal structures, etc. The **synchronization between the two units** guarantees the necessary contemporaneity of measurements, the two separate and independent units **make measurements comfortable and safe under any condition**.

MPP300 finds its best partner in **SOLAR I-V**: while **MPP300** is recording the electrical and environmental parameters, it is possible to measure the **I-V characteristics** of strings and modules **with SOLAR I-V, saving time and money**.



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



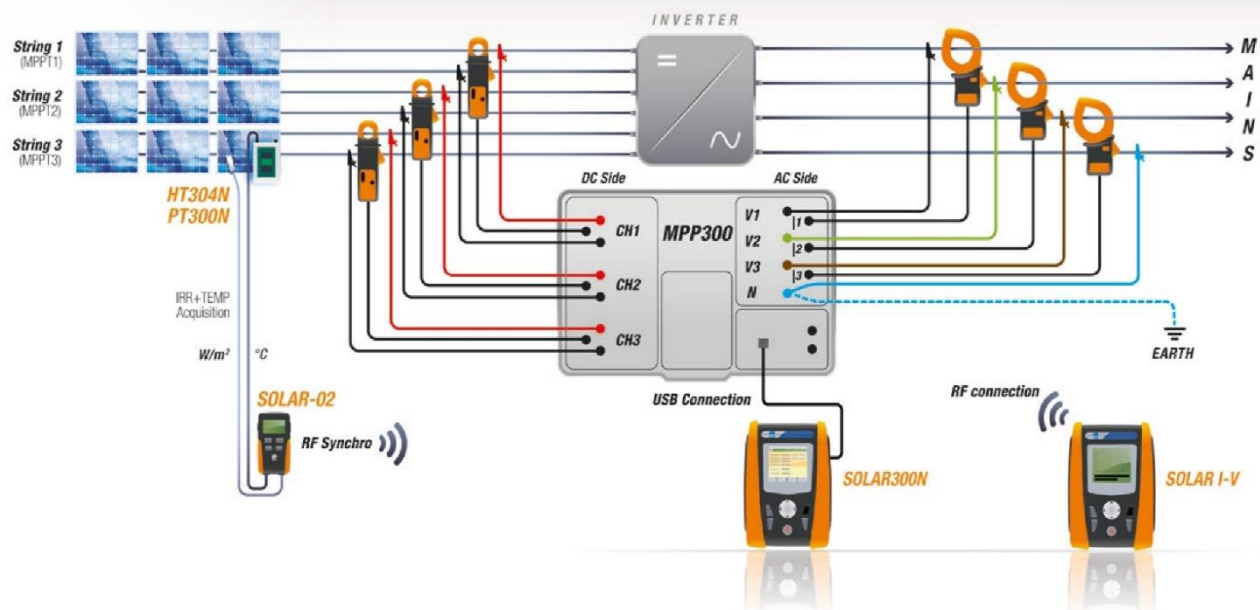
Electric • Control • Mechanic

Functions

- DC/AC TRMS voltage meas. (single-phase and three-phase)
- DC/AC TRMS current meas. (single-phase and three-phase)
- DC/AC power measurement (single-phase and three-phase)
- Simultaneous measurements up to 3 strings (max 3 MPPT)
- Connection with master unit: SOLAR300N and SOLAR I-V
- Power supply with rechargeable LI-ION battery and power adapter
- LED operating indications
- USB port for connection to unit SOLAR300N
- RF connection for connection to SOLAR-02 and SOLAR I-V
- Internal memory for saving recordings

MPP300 1

- Connection diagram
- MPP300 + SOLAR300N via USB connection
 - MPP300 + SOLAR I-V via RF connection



BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

H T S O L A R

THT 70 | 60 | 47

DIGITAL INFRARED CAMERAS

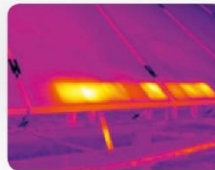


* THT70 and THT60 only. ** THT47 and THT60: 0,08 °C

- Light capacitive Touch Screen
- Optical Interchangeable* Lenses
- Laser Pointer*
- Visual image camera*
- Built-in Flash LED*
- Up to 3 independent cursors
- Areas with independent cursors
- 50 Hz**
High resolution even for moving elements
- 384x288**
160x120
pixel
High resolution for very clear pictures
- P.I.P. fusion overlay of thermal graphical + visual picture*
- Memory **micro**
- Connectivity **USB** **Bluetooth**
- Temperature Range **-20 → +400 °C**
- Automatic SPAN adjustment
- 0,06 °C**
Top thermal sensitivity**
- 2 rechargeable batteries + charger*
- IR video recording
- Audio notes recording
- Text notes
- Preset selection of material properties

Infrared cameras in PV installation testing and maintenance

The **new THT range** is based on a **highly innovative and reliable technology**. These cameras are headed to **different sectors** ranging from industrial to safety, building sector etc. Thanks to **innovative wide capacitive touch screen and icon display** as well as **high infrared resolution 384x288 pixel and 160x120pixel**, it is easier and more intuitive to detect problems which are not visible to the naked eye. New THT cameras are provided with **Flash LED, laser pointer, camera for visual and PIP pictures**, interchangeable optional lenses. Hundreds of photos can be taken as cameras are provided with 4 GB memory so enabling to draw up **reports complete with pictures, sound and text notes**. Thermal graphical analysis will be simple and fast from now on.



BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Tech specs

1. IMAGING PERFORMANCE

Thermal

| | THT 70 | THT 60 | THT 47 |
|------------------------|--------------------------------|--------------------------------|--------------------------------|
| Detector type | UFPA | UFPA | UFPA |
| Spectral range | 8 ±14µm | 8 ±14µm | 8 ±14µm |
| Resolution / Pxl size | 384 x 288 pxl / 25µm | 160 x 120 pxl / 25µm | 160 x 120 pxl / 25µm |
| Thermal sensitivity | <0.06 °C @ 30°C | <0.08 °C @ 30°C | <0.08 °C @ 30°C |
| Field of view (FOV) | 24.6° x 18.6° (22mm lens) | 29.8° x 22.6° (7.5 mm lens) | 29.8° x 22.6° (7.5 mm lens) |
| Minimum focal distance | 0.3m | 0.2m | 0.2m |
| IFOV (@1m) | 1.14mrad | 3.33mrad | 3.33mrad |
| Focusing | Manual on lens | Manual on lens | Manual on lens |
| Image frequency | 50Hz | 50Hz | 50Hz |
| Color palettes | 8 (Standard) + 10 (Customized) | 8 (Standard) + 10 (Customized) | 8 (Standard) + 10 (Customized) |

Visible

| | | | |
|-------------------|------------------------------------|------------------------------------|-------|
| Integrated camera | CMOS sensor 640x480 pxl, FOV 62.3° | CMOS sensor 640x480 pxl, FOV 62.3° | ----- |
|-------------------|------------------------------------|------------------------------------|-------|

2. IMAGING / IR VIDEO DISPLAY

| | THT 70 | THT 60 | THT 47 |
|------------------|--|--|--|
| Display type | 3.5" TFT color, capacitive touch-screen, high brightness | 3.5" TFT color, capacitive touch-screen, high brightness | 3.5" TFT color, capacitive touch-screen, high brightness |
| Infra PIP Fusion | IR image inside visible & visible image inside IR | IR image inside visible & visible image inside IR | ----- |
| IR Video | Recording and saving on Micro SD card MPEG4 file format | Recording and saving on Micro SD card MPEG4 file format | Recording and saving on Micro SD card MPEG4 file format |
| Video output | PAL / NTSC | PAL / NTSC | PAL / NTSC |
| Electronic zoom | x1 ÷ x20 in continuous way | x1 ÷ x20 in continuous way | x1 ÷ x20 in continuous way |
| Image rotation | 0° ÷ 360° in step of 1° | 0° ÷ 360° in step of 1° | 0° ÷ 360° in step of 1° |

3. MEASUREMENT

| | THT 70 | THT 60 | THT 47 |
|-----------------------|--|--|--|
| Temperature range | -20°C ÷ 400°C | -20°C ÷ 400°C | -20°C ÷ 400°C |
| Measurement unit | °C, °F, °K | °C, °F, °K | °C, °F, °K |
| Accuracy | ±2 % reading or ±2°C | ±2% reading or ±2°C | ±2% reading or ±2°C |
| Measurement cursors | 3 (selection temperature MIN, MAX, Customized position on image) | 3 (selection temperature MIN, MAX, Customized position on image) | 3 (selection temperature MIN, MAX, Customized position on image) |
| Laser pointer | Class 2 according to IEC 60825-1 | Class 2 according to IEC 60825-1 | ----- |
| Built-in illuminator | White light LED | White light LED | ----- |
| Measurement modes | Automatic / Manual / Histogram | Automatic / Manual / Histogram | Automatic / Manual / Histogram |
| Emissivity correction | 0.01 ÷ 1.00 + built-in table with common materials | 0.01 ÷ 1.00 + built-in table with common materials | 0.01 ÷ 1.00 + built-in table with common materials |
| Measurement features | Automatic correction based on distance, relative humidity, atmospheric temperature, offset | Automatic correction based on distance, relative humidity, atmospheric temperature, offset | Automatic correction based on distance, relative humidity, atmospheric temperature, offset |
| Advanced analysis | Spots (max 3), Lines (max 2), Areas (max 3), Isotherm | Spots (max 3), Lines (max 2), Areas (max 3), Isotherm | Spots (max 3), Lines (max 2), Areas (max 3), Isotherm |
| Alarm on temperature | Associated to measurements spots | Associated to measurements spots | Associated to measurements spots |

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

H T S () L A R

Tech specs



DISPLAY AND MEMORY

| | | | | | |
|--------------------------|---|---------------------------------------|---|-------------------------------|---------|
| Display Features | 128x128pxd LCD with backlight | 128x128pxd LCD with backlight | Graphic 64k color TFT touch screen with backlight and adjustable contrast | 128x128pxd LCD with backlight | ----- |
| Internal Memory capacity | 256 kbytes | 256 kbytes | 15MB | 256 kbytes | 2Mbytes |
| External memory | ----- | ----- | USB memory stick / CF Card | ----- | ----- |
| Saved data | Max 99 yield tests; 249 curves (I-V curve test), 999 IVCK | 249 curves (I-V curve test), 999 IVCK | 1 month @ IP=15min, 251 par | Max 999 tests | ----- |

POWER SUPPLY

| | | | | | |
|-----------------------------|---|--|---------------------------------------|--|--|
| Internal power supply | 6x1.5V alkaline batteries type LR6, AA, AM3, MN 1500 | 6x1.5V alkaline batteries type LR6, AA, AM3, MN 1500 | Li-ION, 3.7V rechargeable battery | 6x1.5V alkaline batteries type LR6, AA, AM3, MN 1500 | Li-ION, 3.7V rechargeable battery |
| External power supply | ----- | ----- | 110V/230V AC 50/60Hz to 5V DC adapter | ----- | 110V/230V AC 50/60Hz to 5V DC adapter |
| Battery duration | > 249 curves (I-V curve test), 999 IVCK tests, approx. 120 h (yield test) | > 249 curves (I-V curve test), 999 IVCK tests | > 6 hours | Approx. 120 hours (DC efficiency test) | > 3 hours |
| SOLAR-02 max recording time | Approx 1.5h (@ IP=5s) | Approx 1.5h (@ IP=5s) | Approx 1.5h (@ IP=5s) | Approx 1.5h (@ IP=5s) | Approx 1.5h (@ IP=5s); approx 8 days @ IP=600s |
| Auto power Off idleness | After 5 mins. | After 5 mins. | After 5 mins. (no external power) | After 5 mins. | ----- |

CHARACTERISTICS OF RADIO MODULE

| | | | | | |
|----------------------------|--------------------|--------------------|-------|--------------------|--------------------|
| Frequency range | 2.400 ÷ 2.4835 GHz | 2.400 ÷ 2.4835 GHz | ----- | 2.400 ÷ 2.4835 GHz | 2.400 ÷ 2.4835 GHz |
| R&TTE category | Class 1 | Class 1 | ----- | Class 1 | Class 1 |
| Max transmission power | 30µW | 30µW | ----- | 30µW | 30µW |
| Max RF connection distance | 1m | 1m | ----- | 1m | 1m |

OUTPUT INTERFACE

| | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--|
| PC communication port | Optical/USB | Optical/USB | USB | Optical/USB | ----- |
| Wireless RF interface (max distance 1m) | Connection with SOLAR-02 | Connection with SOLAR-02 | Connection with SOLAR-02 | Connection with SOLAR-02 | Connection with SOLAR I-V and SOLAR-02 |
| USB interface | ----- | ----- | For USB memory sticks | ----- | Connection with SOLAR300N |
| Integration Period (IP) | 5s to 60min | ----- | 1s to 60min | 5s to 60min | 5s to 60min |
| Operative system | ----- | ----- | Windows CE | ----- | ----- |

MECHANICAL FEATURES

| | | | | | |
|-----------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------------|
| Dimensions (L x W x H) and weight | 235 x165 x 75 mm - 1.2 kg | 235 x165 x 75 mm - 1.2 kg | 235 x165 x 75 mm - 1.0 kg | 235 x165 x 75 mm - 1.2 kg | 300 x265 x 140 mm - 2.3 kg |
| Encapsulation | IP40 | IP40 | IP40 | IP40 | IP65 |

ENVIRONMENTAL CONDITIONS

| | | | | | |
|---------------------------------------|------------|------------|------------|------------|------------|
| Reference temperature | 23°C ± 5°C | 23°C ± 5°C | 23°C ± 5°C | 23°C ± 5°C | 23°C ± 5°C |
| Working temperature | 0° ± 40°C | 0° ± 40°C | 0° ± 40°C | 0° ± 40°C | 0° ± 40°C |
| Working humidity | < 80% HR | < 80% HR | < 80% HR | < 80% HR | < 80% HR |
| Storage temperature (batt. not incl.) | -10 ÷ 60°C | -10 ÷ 60°C | -10 ÷ 60°C | -10 ÷ 60°C | -10 ÷ 60°C |
| Storage humidity | < 80% HR | < 80% HR | < 80% HR | < 80% HR | < 80% HR |

REFERENCE STANDARDS

| | | | | | |
|-----------------------------------|---|---|--|--|---|
| Safety | IEC/EN 61010-1 | IEC/EN 61010-1 | IEC/EN 61010-1 | IEC/EN 61010-1 | IEC/EN 61010-1 |
| Safety of measurement accessories | IEC/EN 61010-031 | IEC/EN 61010-031 | IEC/EN 61010-031, IEC/EN 61010-2-032 | IEC/EN 61010-031 | IEC/EN 61010-031 |
| Measurements | IEC/EN 60891 (I-V curve) IEC/EN 60904-5 (Temperature measurement) | IEC/EN 60891 (I-V curve) IEC/EN 60904-5 (Temperature measurement) | ----- | IEC/EN 62446 (IVCK) IEC/EN 60904-5 (Temperature measurement) IEC/EN 61557-1, -2, -4 (LOWV, MQ) | ----- |
| Insulation | Double insulation | Double insulation | Double insulation | Double insulation | Double insulation |
| Pollution degree | 2 | 2 | 2 | 2 | 2 |
| Overvoltage category | CAT II 1000V DC, CAT III 300V AC to ground Max 1000V between inputs P1, P2, C1, C2 | CAT II 1000V DC, CAT III 300V AC to ground Max 1000V between inputs P1, P2, C1, C2 | CAT IV 600V to ground, Max 1000V between inputs | CAT III 1000V DC, Max 1000V DC among inputs P, N, E, C | CAT III 1000V DC, Max 1000V between DC inputs CAT IV 300V AC to ground, Max 600V between AC inputs |
| Max altitude of use | 2000 m | 2000 m | 2000 m | 2000 m | 2000 m |
| Power quality | ----- | ----- | IEC/EN 61000-4-30 class B | ----- | ----- |
| Measurement performance | ----- | ----- | IEC/EN 61000-4-15, IEC/EN 50160 | ----- | ----- |
| Flicker | ----- | ----- | IEC/EN 61000-4-7, IEC/EN 50160 | ----- | ----- |
| Unbalance | ----- | ----- | ----- | ----- | ----- |

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Cross references

| | SOLAR I-V | I-V 400 | SOLAR300N | PV CHECK | MPP300 |
|--|---------------------------------|-----------------|------------------------------|--------------------|-------------|
| Continuity of protective conductors with 200mA | | | | • | |
| Insulation with test voltages of 50, 100, 250, 500, 1000V DC | | | | • (250, 500, 1000) | |
| String mode and field mode insulation | | | | • | |
| Phase sequence | | | • | | |
| DC/AC TRMS voltage/current on single-phase systems | • | | • | • (DC only) | • |
| DC/AC TRMS voltage/current on three-phase systems | | | • | • (DC only) | • |
| DC/AC powers on single-phase systems | • | | • | • (DC only) | • |
| DC/AC powers on three-phase systems | | | • | • (DC only) | • |
| Power factor (cos ϕ) on single-/three-phase systems | | | • | | |
| Energies on single-phase and three-phase systems | | | • | | |
| Recording of mains parameters with programmable IP | • (5s - 60m) | | • (1s-60m) | • (5s-60m) | |
| Maximum number of quantities contemporarily selectable | 9 | | 251 | 5 | |
| Harmonic analysis of voltages/currents up to the 49th order | | | • | | |
| Detection of voltage anomalies (dips, peaks) in 10ms | | | • | | |
| Complete analysis according to EN50160 | | | • | | |
| Inrush current of electric motors | | | • | | |
| Voltage fast transients (spikes) with a resolution of 5 μ s (200kHz) | | | • | | |
| Voltage unbalance (NEG%, ZERO%) and Flicker (Pst, Ptt) | | | • | | |
| Display of vector diagrams and waveforms of voltages/currents | | | • | | |
| Indication of recording autonomy | | | • | | |
| Default and customizable recordings | | | • | | |
| TFT touch-screen colour display | | | • | | |
| LCD custom backlight display | • | • | | • | |
| Power supply by rechargeable battery and by means of external power supplier | | | • | | • |
| Use of remote unit | • | • | • | • | • |
| Efficiency measurement/recording of single-string system | | • | | • (DC only) | • |
| Efficiency measurement/recording of multi-string system up to 3 MPPTs | • (with MPP300) | | • (with MPP300) | | • |
| Efficiency measurement/recording of single-phase system | • | | • | | • |
| Efficiency measurement/recording of three-phase system | • (with MPP300) | | • | | • |
| Irradiation measurement with reference solar cell | • | • | • | • | |
| Temperature measurement of modules and environment | • | • | • | • | |
| Detection of I-V curve of modules and strings | • (1000V, 10A) | • (1000V, 10A) | | | |
| Quick test mode | • (1000V, 10A) | • (1000V, 10A) | | • (1000V, 10A) | |
| Internal database of PV modules | • | • | • | • | |
| Measurement of modules and strings data (Voc, Vmpp, Imp, Isc, Pmax, FF, Dpmax) | • | • | • | • (Voc, Isc) | • |
| Auto power off | • | • | • | • | • |
| Memory capacity | > 200 curves 8 days @ Pt=10 min | > 200 curves | 1 month @ Pt=15 min, 251 par | 999 locations | 2 Mbyte |
| Extension of internal memory with external Compact Flash | | | • | | |
| USB port for connection of external memory sticks | | | • | | |
| PC interface with software for Windows | • (optical/USB) | • (optical/USB) | • (USB) | • (optical/USB) | |
| Context-sensitive help on the display | • | • | • | • | |
| Saving of recordings and instant values | • | • | • | • | |
| Dimensions (L x W x H) (mm) | 235x165x75 | 235x165x75 | 235x165x75 | 235x165x75 | 300x265x140 |
| Weight (batteries included) | 1,3 Kg | 1,2 Kg | 1 Kg | 1,2 Kg | 2,3 kg |
| Safety in compliance with IEC/EN61010-1 | • | • | • | • | • |

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
 Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
 E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic

H T S L A R

Accessories

| | SOLAR I-V | I-V 400 | SOLAR300N | PV CHECK | MPP300 |
|---|-----------|---------|-----------|----------|--------|
| PT300N PT1000 probe for cell temperature measurement | S | 0 | S | 0 | 0 |
| SOLAR-02 Remote unit for irradiance/temperature | S | 0 | S | 0 | 0 |
| KIT6SC4 Set 4 cables + 4 alligator clips | S | S | S | S | -- |
| KITPVMC3 Set of 2 adapters MC3 compliance | S | S | S | S | -- |
| KITPVMC4 Set of 2 adapters MC4 compliance | S | S | S | S | -- |
| KIT800 Set of 5 cables + 5 alligator clips | -- | -- | S | -- | -- |
| KITMPPACC Set of 4 alligator clips for AC voltage measure | -- | -- | -- | -- | S |
| KITMPPACW Set of 4 cables for AC voltage measurement, 2m | -- | -- | -- | -- | S |
| KITMPPDCC Set of 2 alligator clips for DC voltage, 3 pcs | -- | -- | -- | -- | S |
| KITMPPDCW Set of 2 cables for DC voltage measurement, 3 pcs | -- | -- | -- | -- | S |
| A0055 External adapter AC/DC recharging battery | -- | -- | S | -- | S |
| YABAT0003HT0 Li-ION rechargeable battery | -- | -- | S | -- | S |
| PT400 Stylus | -- | -- | S | -- | -- |
| HT304N Reference cell for radiation measurements | S | S | S | 0 | 0 |
| M304 Mechanical inclinometer | S | S | S | 0 | -- |
| HT4004N Transducer clamp 10-100A DC | S | -- | S | -- | 0 |
| HT4005K Transducer clamp for AC current up to 200A | S | -- | S | -- | 0 |
| TOPVIEW2006 Windows softw. + optical/USB cable C2006 | S | S | -- | S | -- |
| TOPVIEW2007 Windows softw. + optical/USB cable | -- | -- | S | -- | S |
| C2007 USB Cable | -- | -- | -- | -- | S |
| BORSA2051 Soft carrying bag | -- | -- | -- | S | -- |
| ISO9000 calibration certificate | S | S | S | S | S |
| User Manual | S | S | S | S | S |
| Quick reference guide | S | S | S | S | S |
| SP-0400 Set of straps for use of meter on neck | 0 | 0 | 0 | 0 | -- |
| KITPVEXT25M Set of 2 4mm banana cables, Green/Black, 25m l. | -- | 0 | -- | -- | -- |
| VA400 Hard carrying case | 0 | 0 | 0 | -- | -- |
| VA500 Hard carrying case | S | S | S | -- | -- |
| MPP300 Accessory for checks of SP/TP multi-string plants | 0 | -- | 0 | -- | -- |
| HT96U Standard clamp 1-100-1000A AC, diameter 54mm | 0 | -- | 0 | -- | 0 |
| HT97U Standard clamp 10-100-1000A AC, diameter 54mm | 0 | -- | 0 | -- | 0 |
| HT98U Standard clamp 1000A DC, diameter 50mm | 0 | -- | 0 | -- | 0 |
| HTFLEX33D Flex clamp 3000A, for use as analyzer only | -- | -- | -- | -- | 0 |
| HP30D1 Standard clamp with wide jaws up to 1000A DC | 0 | -- | 0 | -- | 0 |
| HP30C3 Standard clamp 3000A AC, diameter 70mm | -- | -- | 0 | -- | 0 |
| HP30C2 Standard clamp 200-2000A AC, diameter 70mm | -- | -- | 0 | -- | 0 |
| HT4004P Standard clamp 10-100A DC, only for use with MPP300 | 0 | -- | 0 | -- | 0 |
| HT903 Accessory for connection to external CTs | -- | -- | 0 | -- | -- |
| 606-IECN Connector with magnetic test lead | 0 | -- | 0 | -- | 0 |
| ACON3F4M Adapter for connection of DC clamps to MPP300 | 0 | -- | 0 | -- | 0 |
| HT4004 Standard clamp for DC current up to 100A | -- | -- | -- | S | -- |

S = STANDARD 0 = OPTIONAL

BHT Electric Control Mechanic GmbH & Co. KG
 Firmensitz: Köln Amtsgericht Köln HRA 13357
 Ust-Id-Nr: DE 180758331
 Geschäftsführer: Dipl.-Ing. Sasan M-Toussi

Haftende Komplementär GmbH:
 Nüperling Beteiligungsgesellschaft mbH
 Firmensitz: Köln
 Registergericht Köln HRB 26389 Geschäftsführer:
 Dipl.-Ing. Sasan M-Toussi

Bankverbindungen:
 Sparkasse KölnBonn
 (BLZ 370 501 98) Konto 192 996 8723
 IBAN: DE62 3705 0198 1929 9687 23 BIC: COLSDE33XXX

BHT Electric Control Mechanic GmbH & Co. KG

Hansaring 61, D-50670 Köln, Germany
Tel: +49/(0)221 1685 7907 , Fax: +49/(0)221 1685 6379
E-Mail: BHT@BHT-online.de , www.BHT-Online.de



Electric • Control • Mechanic



Accessories Standard & Optional

SOLAR-02



HT304N



VA400



M304



KITPVMC3 & KITPVMC4



HT4004



HP30C2



HT4004N



HT4005K



HT98U



HP3001



FT300N



606-IECN



HT98U

