ALBRIGHT
CONSULTING ENGINEERS

Address: PO BOX 4321, PALMERSTON, NT 0831
ABN: 44 600 817 463

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Email: admin@albrightsg.com.au

NORTHERN TERRITORY OF AUSTRALIA

STRUCTURAL ENGINEERING CERTIFICATE OF COMPLIANCE

ACE REFERENCE: 19-0710.02, REV 03

Date of Issue: 06 December 2019

SOLARWATT GMBH
Attention: Sascha Gotzsch
Mobile: 0477 245 584
Email: **sascha.gotzsch@solarwatt.com**

Introduction

Design Certification for the Solarwatt: Vision 60M: 315Wp & 320Wp and the Vision 60M Style: 300Wp, 305Wp, 310Wp, 315Wp & 320Wp, with support points at 800 mm & 1200 mm using the Clenergy PV-EZ Rack Solar Mounting System

This Certificate of Compliance verifies that the above mentioned Solarwatt Solar Panel Modules, **Vision 60M: 315Wp & 320Wp and the Vision 60M Style: 300Wp, 305Wp, 310Wp, 315Wp & 320Wp** (black anodised aluminium) can resist vertical loads with the corresponding support points as listed in Table 1.

Albright Consulting Engineers (ACE) Pty Ltd were engaged by Sascha Gotzsch from SOLARWATT GMBH to carry out and witness four individual mechanical load test (simulated static, wind load strength test). The test procedure followed was similar to the method outlined in AS4040.2, Static Strength Test Regime. The testing was performed on new panels supplied by the SOLARWATT GMBH.

The solar panel module(s) were mounted front side up and were free to deflect, this was to imitate a real-world situation. The electrical continuity or the cells themselves were not monitored during each of the tests. The load was applied by an airbag to the back of the panel and the centre deflection was monitored at 1kPa intervals as the load was applied by slowly inflating an air bag. A calibrated digital manometer was used to measure and track the design test pressures, while a calibrated digital deflection meter was used to measure and record the centre (vertical) deflection of the solar panel.

The tests were observed by Nicholas Kastellorizios on behalf of ACE on the 27th of November 2019 in Darwin, Northern Territory. A total of four individual panels were tested; two panels tested with supports at 800mm centres and the other two panels tested with supports at 1200mm centres; the tests were carried out once for each test case. The applied factor for variability (for 2 unit(s) tested per span or support centres) in accordance with AS/NZS 1170.0 Table B1 (when determining the allowable design capacity) is 1.38, (adopting a coefficient of variation of structural characteristics of 10%).

Table 1 outlines the Test Summary.

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Results & Observations

Test No.1, x2 SOLARWATT: Vision 60M Style, 300Wp Solar Panel Modules with Supports at 800mm Centres. Serial Numbers: 1M50046246 & 1M50046264

The solar panels **(1680mm x 990mm x 40mm)** were mounted to the test rig with support points at **800mm** centres apart on each side with a cantilever/ overhang of approximately **440mm** at each end (measured from centre of supports).

During the two individual tests, the solar panel modules were observed to be able to support an equivalent design test pressure of **9kPa**, with a centre deflection of approximately **60mm.** During both tests, it was observed that while in an attempt to increase the design test pressure, the solar panels shattered at approximately **9.5kPa** with vertical deflections exceeding **80mm**.These results were recorded just as the solar panel modules failed/buckled and shattered.

The cause of failure appeared to be consist during both tests, were is was observed that the glass panel had delaminated and had dislodged itself from right hand side of the aluminium frame. This is likely due to the shear capacity/ strength of the glue bonding panel to the frame. Other likely causes for this failure include: the structural integrity of the aluminium frames (i.e. grade of aluminium and frame connections) and or the thickness of the glass.

There were major visually obvious signs of buckling and permanent deflection to the aluminium frames and failure of the glass due to the excessive deflections.

Test No.1, x2 SOLARWATT: Vision 60M Style, 300Wp Solar Panel Modules with Supports at 1200mm Centres. Serial Numbers: 1M50046615 & 1M50046305

The solar panels **(1680mm x 990mm x 40mm)** were mounted to the test rig with support points at **1200mm** centres apart on each side with a cantilever/ overhang of approximately **240mm** at each end (measured from centre of supports).

During the two individual tests, the solar panel modules were observed to be able to support an equivalent design test pressure of **8.5kPa**, with a centre deflection of approximately **42mm.** During both tests, it was observed that while in an attempt to increase the design test pressure, the solar panels shattered at approximately **9kPa** with vertical deflections exceeding **55mm**.These results were recorded just as the solar panel modules failed/buckled and shattered.

The cause of failure appeared to be consist during both tests, were is was observed that the glass panel had delaminated and had dislodged itself from right hand side of the aluminium frame. This is likely due to the shear capacity/ strength of the glue bonding panel to the frame. Other likely causes for this failure include: the structural integrity of the aluminium frames (i.e. grade of aluminium and frame connections) and or the thickness of the glass.

There were major visually obvious signs of buckling and permanent deflection to the aluminium frames and failure of the glass due to the excessive deflections.

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Table 1: Test Summary: Recommended Ultimate Design Strength, Limit Design Capacity

Test	Panel Manufacturer, Model & Size (mm)	Support Points (mm)	Maximum Applied Load (kPa)	Material Variability Factor AS/NZS 1170.0 Table B1 – kt	Recommended Ultimate Design Strength Limit State Design Capacity (kPa)
No.1	SOLARWATT: Vision 60M Vision 60M Style, 300Wp, (1680mm x 990mm x 40mm): Serial Numbers Tested: 1M50046246 & 1M50046264	800	9	1.38	**6.52**
No.1	SOLARWATT: Vision 60M Style, 300Wp, (1680mm x 990mm x 40mm): Serial Numbers Tested: 1M50046615 & 1M50046305	1200	8.5	1.38	**6.16**

Vision 60M Style, Mechanical Properties:

Solar Cells	60 monocrystalline high power PERC solar cells
Cell Vendor	Data Not Provided
Cell Type	Monocrystalline high power PERC solar cells
Cell Dimensions	157 x 157
Dimensions (L x W x H)	1680 mm x 990 mm x 40 mm
Weight	22.8 kg
Connection technology	Cables 2 x 1.0 m/ 4.0mm2, Staubli Electrical MC4-connectors
Bypass diodes	3
IP rating	IP67
Module Technology	Glass-glass laminated; aluminium frame, black
Backing Material/ Substrate	Tempered glass, 2mm
Encapsulation	EVA-solar cells-EVA (ethylene vinyl acetate), transparent, Behind solar cells.
Covering Material/ Superstrate	Tempered solar glass with anti-reflective finish, 2mm
Frame	Black anodised aluminium

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Vision 60M, Mechanical Properties:

Solar Cells	60 monocrystalline high power PERC solar cells
Cell Vendor	Data Not Provided
Cell Type	Monocrystalline high power PERC solar cells
Cell Dimensions	157 x 157
Dimensions (L x W x H)	1680 mm x 990 mm x 40 mm
Weight	22.8 kg
Connection technology	Cables 2 x 1.0 m/ 4.0mm2, Staubli Electrical MC4-connectors
Bypass diodes	3
IP rating	IP67
Module Technology	Glass-glass laminated; aluminium frame, black
Backing Material/ Substrate	Tempered glass, 2mm
Encapsulation	EVA-solar cells-EVA (ethylene vinyl acetate), white Pigmented, behind solar cells.
Covering Material/ Superstrate	Tempered solar glass with anti-reflective finish, 2mm
Frame	Natural anodised aluminium

Summary

We recommended and certify that the **SOLARWATT: Vision 60M & Vision 60M Style** (Black Anodised Aluminium, 1680mm x 990mm x 40mm) Solar Panel Modules can resist the following vertical design loads, with a Recommended Ultimate Design Strength (Limit State Design Capacity), as listed for the following support conditions:

When supported on purlins and or battens at 800mm centres	**6.52 kPa**
When supported on purlins and or battens at 1200mm centres	**6.16 kPa**

This certificate of compliance has been prepared on behalf of and for the exclusive use of SOLARWATT GMBH and forms part of the A.I.P certificate of compliance.

Note that the above mentioned Limit State Design Capacities can apply to the **SOLARWATT: Vision 60M** Solar Panel Modules as they have been declared by the manufacturer that they mechanically identical to the **SOLARWATT: Vision 60M Style**. Refer to the Appendix A for Declaration of Conformity, data sheets for both **SOLARWATT: Vision 60M & Vision 60M Style**, as well as email, dated 02 December 2019.

The Limit State Design Capacities are only applicable for the panel size, model and support spacings as stated in this certificate. Additional power output models referenced are also covered under this certificate provided that they are mechanically & physically identical to the **SOLARWATT: Vision 60M Style, 300Wp** and that they are manufactured in the exact same way with the same materials as the **SOLARWATT: Vision 60M Style, 300Wp**.

This certificate is no longer valid if the any of the applicable Engineering and Mechanical Properties used in the manufacture of these solar panel modules or if the manufacturing processes or techniques is changed or altered in any way. It is the responsibility of the manufacturer to confirm if they are altered or changed as re-testing may be required.

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Please note: The panel fixing clamps; the support rails; their associated fixings or the fixings of the L Feet to the immediate supporting structure, although not found to be the failure mode in these test runs, may limit the structural design.

Company Name if certification issued on behalf of a corporation Albright Services Group Pty Ltd, Trading as Albright Consulting Engineers		**Company NT Registration Number** 215037ES	
I certify that reasonable care has been taken to ensure that the structural engineering aspects of the works as described above have been designed in accordance with the requirements of the Building Code of Australia and the Northern Territory Building Regulations			
Name **Nicholas Kastellorizios** Nominee for Albright Services Group Pty Ltd, Trading as Albright Consulting Engineers	**Nominee/Individual** **NT Registration Number** 196514ES	**Signature**	**Date** 06/12/ 2019

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Appendix A

SOLARWATT®
power to the people

SOLARWATT GmbH, Maria-Reiche-Str. 2a, 01109 Dresden, Germany

ALBRIGHT CONSULTING ENGINEERS

PO BOX 4321
PALMERSTON, NT 0831
Australia

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Maria-Reiche-Str. 2a
01109 Dresden

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Fax: +49-351-8895-100
Email: info@solarwatt.com
Web: www.solarwatt.de

Certified according to:
ISO 9001:2015
ISO14001:2015
BS OHSAS 18001:2007
ISO 50001:2011

From:	Direct dialing:	Email:	Date:
Norbert Betzl	+49-351-8895-347	norbert.betzl@solarwatt.com	12.11.2019

Declaration of conformity:
Identical mechanical strength between SOLARWATT Vision 60M style and Vision 60M

Dear Ladies and Gentlemen,

SOLARWATT glass-glass solar modules are produced under strictest quality requirements in our fully automated production facility in Dresden, Germany. The quality is tested according to IEC 61215:2016 and IEC 61730:2016 and approved by VDE with certificate 40049254.

Both SOLARWATT CEC listed glass-glass solar modules:

- Vision 60M style (300Wp, 305Wp, 310Wp, 315Wp and 320Wp) and
- Vision 60M (315Wp and 320Wp)

Are mechanically identical.

They only differ optically:

SOLARWATT glass-glass solar module	Frame color	Color of backside encapsulation
Vision 60M style	black	transparent
Vision 60M	silver	white

With best regards

Norbert Betzl
Director of Product Management Solar Modules

SOLARWATT®
SOLARWATT GmbH
Maria-Reiche-Straße 2a
01109 Dresden
Telefon 0351-8895-0, Fax: -100

Albright Services Group

From: Wald, Dietmar <Dietmar.Wald@solarwatt.com>
Sent: Monday, 2 December 2019 5:13 PM
To: Albright Services Group
Cc: Gotzsch, Sascha
Subject: WG: Cyclone Testing Australia at Albright: top result
Attachments: 19-0710.01 REV01 SOLARWATT VISION 60M STYLE 28.11.2019.pdf; Albright - Declaration of conformity - 2019_11_12.pdf; datasheet-60m-315-320-en-AUS.pdf; data-sheet-60m-style-en_1908.pdf

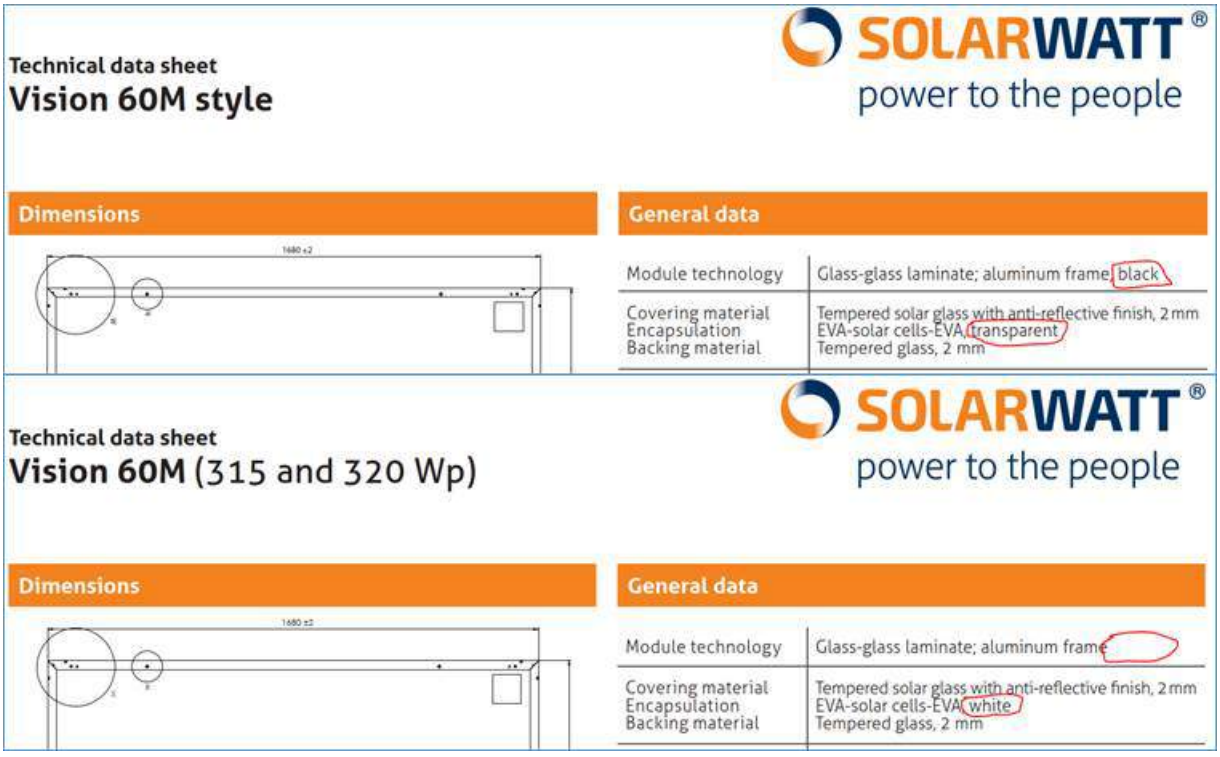
Follow Up Flag: Follow up
Flag Status: Completed

Hello Nick,

thank you for your feedback:
I made a screenshot of both datasheets and marked the optical differences in red.

- Vision 60M style:
  - **black** anodized aluminum (EN AW-6060 T66) frame
  - **transparent** EVA (ethylene vinyl acetate) behind the solar cells
- Vision 60M:
  - **natural** anodized aluminum (EN AW-6060 T66) frame
  - **white pigmented** EVA (ethylene vinyl acetate) behind the solar cells

The **black** and **natural** anodized aluminum (EN AW-6060 T66) frame comes from the same supplier.
Also the **transparent** and **white pigmented** EVA (ethylene vinyl acetate) comes from the same supplier.
Because of these two only optical differences, we declared the mechanical conformity between Vision 60M style and Vision 60M.
We do not use polycarbonate. We focus on producing solar modules with glass-EVA-glass-construction.
Please check if you can add Vision 60M 315Wp & 320Wp under this circumstances to your STRUCTURAL ENGINEERING CERTIFICATE OF COMPLIANCE.


Technical data sheet
Vision 60M style

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Dimensions

General data

Module technology	Glass-glass laminate; aluminum frame, black
Covering material	Tempered solar glass with anti-reflective finish, 2 mm
Encapsulation	EVA-solar cells-EVA, transparent
Backing material	Tempered glass, 2 mm

Technical data sheet
Vision 60M (315 and 320 Wp)

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Dimensions

General data

Module technology	Glass-glass laminate; aluminum frame
Covering material	Tempered solar glass with anti-reflective finish, 2 mm
Encapsulation	EVA-solar cells-EVA, white
Backing material	Tempered glass, 2 mm

Mit freundlichen Grüßen / Cordialement / Best regards
Dietmar Wald

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Technical data sheet

Vision 60M (315 and 320 Wp)

Glass-glass module
Solid quality with high performance

Thanks to their modern design SOLARWATT glass-glass modules deliver the highest long-term yields. They are robust and resilient, yet just as light as their glass-foil predecessors.

The high-performance PERC solar cells are embedded almost indestructibly in the glass-glass composite and thus optimally protected against all weather effects and mechanical stress. SOLARWATT can therefore offer a 30-year warranty on performance and product quality.

Product Quality

- **long-lasting and high-yield**
- **salt mist resistant**
- **100 % plus-sorting**
- **100 % PID protected**

premium quality MADE IN GERMANY since 1993

Service

30 Year Product Warranty
as per „Warranty conditions for SOLARWATT solar modules"

30 Year Performance Warranty
on 87 % of nominal power as per „Warranty conditions for SOLARWATT solar modules"

Country of origin
Quality made in Germany

Subject to change | Errors excepted
AZ-TDB-PMS-1707 | This data sheet fulfills the requirements listed in IEC 61215-1-1 | REV 000 | 09/2019 | EN-AUS

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Certified acc. to DIN EN ISO 9001, 14001, 50001 | BS OHSAS 18001:2007

Technical data sheet

Vision 60M (315 and 320 Wp)

SOLARWATT®
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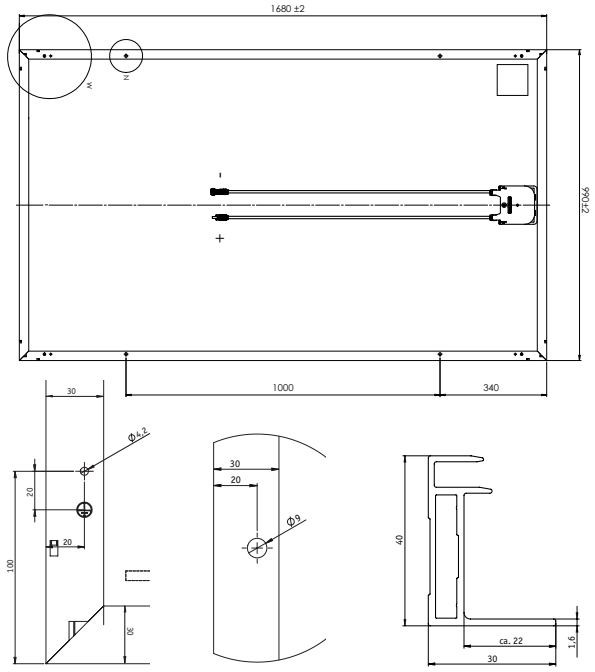
Dimensions



grounding bore hole | mounting bore hole | frame profile

General data

Module technology	Glass-glass laminate; aluminum frame
Covering material Encapsulation Backing material	Tempered solar glass with anti-reflective finish, 2 mm EVA-solar cells-EVA, white Tempered glass, 2 mm
Solar cells	60 monocrystalline high power solar cells
Cell dimensions	157 x 157 mm
L x W x H / Weight	$1{,}680^{\pm 2}$ x $990^{\pm 2}$ x $40^{\pm 0{,}3}$ mm / appr. 22,8 kg
Connection technology	Cables 2 x 1,0 m/4 mm² TE Connectivity PV4-S connectors
Bypass diodes	3
Max. system voltage	1,000 V
IP rating	IP67
Protection class	II (acc. to IEC 61140)
Fire class	C (acc. to IEC 61730), E (acc. to EN 13501)
Certified mechanical ratings as per IEC 61215	Suction load up to 2,400 Pa (test load 3,600 Pa) Pressure load up to 5,400 Pa (test load 8,100 Pa)
Recommended stress load as per Installation Instructions	Please refer to the specifications in the Installation Instructions and Warranty Conditions.
Qualifications	IEC 61215 | IEC 61730 | IEC 61701 | IEC 62804

Electrical data (STC)

STC (Standard Test Conditions): Irradiation intensity 1,000 W/m², spectral distribution AM 1,5 | Temperature 25±2 °C, in accordance to EN 60904-3

Nominal power P_{max}	315 Wp	320 Wp
Nominal voltage V_{MP}	32,5 V	32,7 V
Nominal current I_{MP}	9,78 A	9,87 A
Open circuit voltage V_{OC}	40,3 V	40,4 V
Short circuit current I_{SC}	10,31 A	10,4 A
Module efficiency	19,1 %	19,4 %

Measurement tolerances: Pmax ±5 %; Voc ±3 %; Isc ±5 %; Imp ±5 %
Reverse-current power rating Ir: 20 A, operating modules with an external power source is only permissible if using a phase fuse with a tripping current of ≤ 20 A.

Electrical data (NMOT and weak light)

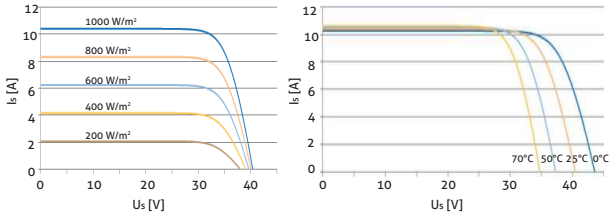
NMOT (Nominal Module Operation Temperature): Irradiation intensity 800 W/m², spectral distribution AM 1,5, Temperature 20 °C
Weak light conditions: Irradiation intensity 200 W/m², Temperature 25°C, Wind speed 1m/s, load operation

Nominal power $P_{max\ @NMOT}$	233 W	237 W
Nominal power $P_{max\ @200\ W/m^2}$	62,8 W	63,8 W

Measurement tolerances: Pmax ±5 %; Voc ±3 %; Isc ±5 %; Imp ±5 %
Reduction of module efficiency when irradiance is reduced from 1000 W/m² to 200 W/m² (at 25 °C): 4 ± 2 % (relative) / –0,6 ± 0,3 % (absolute).

Characteristic lines (Performance Class 320 Wp)

Voltage characteristic line at different temperatures and irradiations



Thermal Features

Operating temperature range	-40 ... +85 °C
Ambient temperature range	-40 ... +45 °C
Temperature coefficient P_{max}	-0,39 %/K
Temperature coefficient V_{OC}	-0,31 %/K
Temperature coefficient I_{SC}	0,05 %/K
NMOT	44 °C

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Technical data sheet

Vision 60M style

Glass-glass module
Eye catcher with highest yields

Thanks to their modern design SOLARWATT glass-glass modules deliver the highest long-term yields. They are robust and resilient, yet just as light as their glass-foil predecessors.

The high-performance PERC solar cells are embedded almost indestructibly in the glass-glass composite and thus optimally protected against all weather effects and mechanical stress. SOLARWATT can therefore offer a 30-year warranty on performance and product quality.

The SOLARWATT FullCoverage insurance is included for 5 years and free of charge. It insures almost all risks and takes effect even if the modules do not produce electricity or deliver less than expected in the event of damage.

Product Quality

- **ammonia resistant**
- **intensive hailstorm resistant**
- **salt mist resistant**
- **100 % plus-sorting**
- **100 % PID protected**
- **snow-load warranty**

premium quality MADE IN GERMANY since 1993

WE USE 100 % GREEN ENERGY for production and offices

Service

FullCoverage insurance
included (up to 1,000 kWp*)

Simple returns policy
as per „Delivery terms for SOLARWATT solar modules"

30 Year Product Warranty
as per „Warranty conditions for SOLARWATT solar modules"

30 Year Performance Warranty
on 87 % of nominal power as per „Warranty conditions for SOLARWATT solar modules"

* country-specific deviations apply

Subject to change | Errors excepted
AZ-TDB-PMS-0472 | This data sheet fulfills the requirements listed in IEC 61215-1-1 | REV 019 | 08/2019 | EN

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Certified acc. to DIN EN ISO 9001, 14001, 50001 | BS OHSAS 18001:2007

Technical data sheet
Vision 60M style

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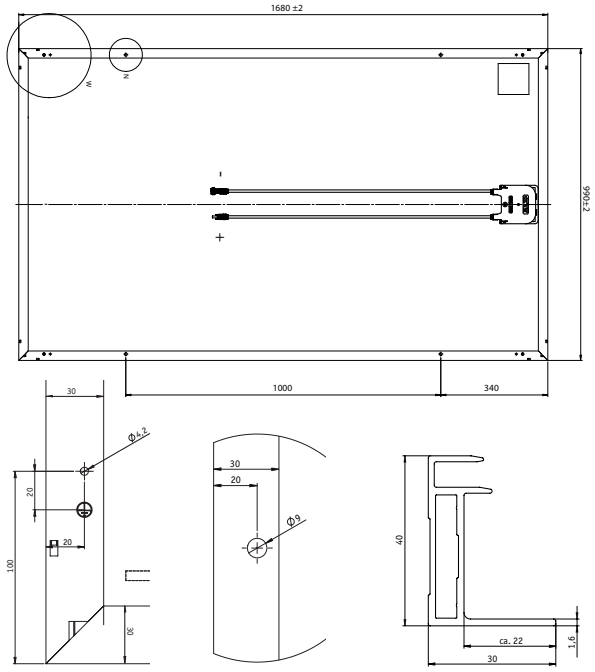
Dimensions



grounding bore hole | mounting bore hole | frame profile

General data

Module technology	Glass-glass laminate; aluminum frame, black
Covering material Encapsulation Backing material	Tempered solar glass with anti-reflective finish, 2 mm EVA-solar cells-EVA, transparent Tempered glass, 2 mm
Transparent areas	appr. 9,8 %
Solar cells	60 monocrystalline high power PERC solar cells
Cell dimensions	157 x 157 mm
L x W x H / Weight	$1{,}680^{\pm 2}$ x $990^{\pm 2}$ x $40^{\pm 0{,}3}$ mm / appr. 22,8 kg
Connection technology	Cables 2 x 1,0 m/4 mm² Stäubli Electrical MC4-connectors
Bypass diodes	3
Max. system voltage	1,000 V
IP rating	IP67
Protection class	II (acc. to IEC 61140)
Fire class	C (acc. to IEC 61730), E (acc. to EN 13501)
Certified mechanical ratings as per IEC 61215	Suction load up to 2,400 Pa (test load 3,600 Pa) Pressure load up to 5,400 Pa (test load 8,100 Pa)
Recommended stress load as per Installation Instructions	Please refer to the specifications in the Installation Instructions and Warranty Conditions.
Qualifications	IEC 61215 | IEC 61730 | IEC 61701 | IEC 62804

Electrical data (STC)

STC (Standard Test Conditions): Irradiation intensity 1,000 W/m², spectral distribution AM 1,5 | Temperature 25±2 °C, in accordance to EN 60904-3

Nominal power P_{max}	300 Wp	305 Wp	310 Wp	315 Wp	320 Wp
Nominal voltage V_{MP}	32,5 V	32,7 V	32,9 V	33,0 V	33,1 V
Nominal current I_{MP}	9,32 A	9,42 A	9,52 A	9,62 A	9,75 A
Open circuit voltage V_{OC}	39,9 V	40,1 V	40,3 V	40,4 V	40,5 V
Short circuit current I_{SC}	9,88 A	10,00 A	10,12 A	10,22 A	10,32 A
Module efficiency	18,2 %	18,5 %	18,8 %	19,1 %	19,4 %

Measurement tolerances: Pmax ±5 %; Voc ±10 %; Isc ±10 %, Imp ±10 %
Reverse-current power rating Ir: 20 A, operating modules with an external power source is only permissible if using a phase fuse with a tripping current of ≤ 20 A.

Electrical data (NMOT and weak light)

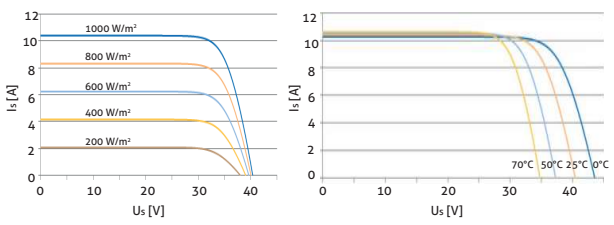
NMOT (Nominal Module Operation Temperature): Irradiation intensity 800 W/m², spectral distribution AM 1,5, Temperature 20 °C
Weak light conditions: Irradiation intensity 200 W/m², Temperature 25 °C, Wind speed 1m/s, load operation

Nominal power $P_{max\ @NMOT}$	222 W	226 W	230 W	233 W	237 W
Nominal power $P_{max\ @200\ W/m²}$	60,2 W	60,8 W	61,8 W	62,8 W	63,8 W

Measurement tolerances: Pmax ±5 %; Voc ±10 %; Isc ±10 %, Imp ±10 %
Reduction of module efficiency when irradiance is reduced from 1000 W/m² to 200 W/m² (at 25 °C): 4 ± 2 % (relative) / −0,6 ± 0,3 % (absolute).

Characteristic lines (Performance Class 320 Wp)

Voltage characteristic line at different temperatures and irradiations



Thermal Features

Operating temperature range	-40 ... +85 °C
Ambient temperature range	-40 ... +45 °C
Temperature coefficient P_{max}	-0,39 %/K
Temperature coefficient V_{OC}	-0,31 %/K
Temperature coefficient I_{SC}	0,05 %/K
NMOT	44 °C