Power Optimiser

For Australia
Module Add-On

P401 / P500 / P505

POWEROPTIMISER

PV power optimisation at the module-level

- Specifically designed to work with SolarEdge inverters
- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of modules mismatch-loss, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module level monitoring
- Module-level voltage shutdown for installer and firefighter safety

solaredge

/ Power Optimiser For Australia

Module Add-On

P401 / P500 / P505

Optimiser Model (Typical Module Compatibilty)	P401 (60&70 Cell modules)	P500 (for 96-cell modules)	P505 (for higher current modules)	
INPUT				
Rated Input DC Power[1]	400	500	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	60	80	83	Vdc
MPPT Operating Range	8 - 60	8 - 80	12.5-83	Vdc
Maximum Short Circuit Current (Isc)	11.75	10.1	14	Adc
Maximum Efficiency	99.5			%
Weighted Efficiency	98.8			%
Overvoltage Category	II			
OUTPUT DURING OPERATION (POWER OPTIMISER CONNECTED TO OPERATING SOLAREDGE INVERTER)				
Maximum Output Current	15			Adc
Maximum Output Voltage	60	60	85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMISER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)				
Safety Output Voltage per Power Optimiser	1 ± 0.1			Vdc
STANDARD COMPLIANCE				
EMC	FCC Part 15 Class B, IEC61000-6-2, IEC61000-6-3			
Safety	IEC62109-1 (class II safety), UL1741			
RoHS	Yes			
Fire Safety	VDE-AR-E 2100-712:2013-05			
INSTALLATION SPECIFICATIONS				
Maximum Allowed System Voltage	1000			Vdc
Dimensions (W x L x H)	129 x 153 x29.5	129 x 153 x 33.5	129 x 162 x 59	mm
Weight (including cables)	655	750	1064	gr
Input Connector[2]	MC4[2]	MC4[2]		
Input Wire Length	0.16 / 0.9[4]	0.16		m
Output Connector	MC4			
Output Wire Length	1.2			m
Operating Temperature Range	-40 to +85			˚C
Protection Rating	IP68 / NEMA6P			
Relative Humidity	0 - 100			%

(1) Rated power of the module at STC will not exceed the optimiser "Rated Input DC Power". Modules with up to +5% power tolerance are allowed
(2) For other connector types please contact SolarEdge
(3) Dual version for parallel connection of 2 modules; P/N: P485-4RMDMRM. In a case of odd number of PV modules in one string it is allowed to install one P485 dual version power optimiser connected to one PV module. When connecting a single module seal the unused input connectors with the supplied pair of seals
(4) Longer inputs wire length are available for use. For 0.9m input wire length order P401-xxxLxxx

PV System Design Using a Solaredge Inverter[5]		Single Phase HD-WAVE	Single Phase	Three Phase Residential	Three Phase Commercial	
Minimum String Length (Power Optimisers)	P401, P500	8		9	16	
	P505	6		8	14	
Maximum String Length (Power Optimisers)		25		25	50	
Maximum Nominal Power per String		5700[6] (6000 with SE8000H, SE10000H)	5250[6]	5625[6]	11250[7]	W
Parallel Strings of Different Lengths or Orientations		Yes				

(5) It is not allowed to mix P505 with P401/P500 in one string
(7) It is allowed to install up to 13,500W per string when the maximum power difference between each string is 2,000W
(6) If the inverters rated AC power ≤ maximum nominal power per string, then the maximum power per string will be able to reach up to the inverters maximum input DC power Refer to: https://www.solaredge.com/sites/default/files/se-single-string-power-optimizer-application-note-aus.pdf

CE RoHS

Application Note: SolarEdge Fixed String Voltage, Concept of Operation

Version History

- Version 1.1 (Feb. 2019) – Added note about M series power optimizers
- Version 1.0 (Sept. 2010) – Initial release

The SolarEdge system maintains a fixed string voltage regardless of string characteristics and environmental conditions. This application note details the concept of operation of the SolarEdge fixed string voltage and its benefits.

Concept of Operation

The SolarEdge power optimizer is a DC-DC power optimizer integrated into each module, replacing the junction box. The power optimizers, using an input control loop, perform per module MPPT and enable performance monitoring of each module. In an independent process, the power optimizers enable the inverter to automatically maintain a fixed string voltage, at the optimal point for DC-AC conversion by the inverter, regardless of string length and individual module performance.

The operating principles of the SolarEdge system are illustrated in the following example, which examines a system's behavior under varying conditions.

The example system consists of 10 200W modules. Each module has an integrated power optimizer, essentially a DC/DC buck-boost[1] converter with an MPPT controller. The power optimizers are serially-connected to form a string; multiple strings can be connected in parallel to the same input of the SolarEdge inverter. The SolarEdge inverter is a single stage current source – it continuously adapts the current it draws from the PV array in order to keep the input voltage constant.

The SolarEdge power optimizer is highly efficient, maintaining over 98% conversion efficiency over a wide range of conditions. However, for calculation simplicity, we assume 100% power optimizer efficiency in this example.

Scenario 1 – Ideal Conditions: Initially, we assume all the modules are exposed to full irradiance, each providing 200W of power. The power output of each solar module is maintained at the module's maximum power point by an input control loop within the corresponding power optimizer. This MPP loop dictates to the power optimizer an input current I_{in} and input voltage V_{in} that ensure the transfer of the entire 200W from the module to the DC bus. We assume an MPP voltage for each module (given perfectly matched modules for demonstration purposes) of V_{MPP} = 32V. This means the input voltage to the power optimizer is 32V, and the input current is 200W/32V = 6.25A. The input voltage to the inverter is controlled by a separate feedback loop. For simplicity, in this example the inverter requires a constant 400V. Since there are ten serially-connected modules, each providing 200W, the input current to the inverter is 2000W/400V = 5A. Thus, the DC bus current flowing through each of the power optimizers must be 5A. This means that each power optimizer in this example provides an output voltage of 200W/5A = 40V. In this case, the power optimizers are acting as up converters, converting the 32V input voltage to the target 40V output voltage. The various system currents and voltages in this case are illustrated in Figure 1.

[1] Applies to power optimizers from series PB, OP and P. M series power optimizers are buck only, however operate similarly.

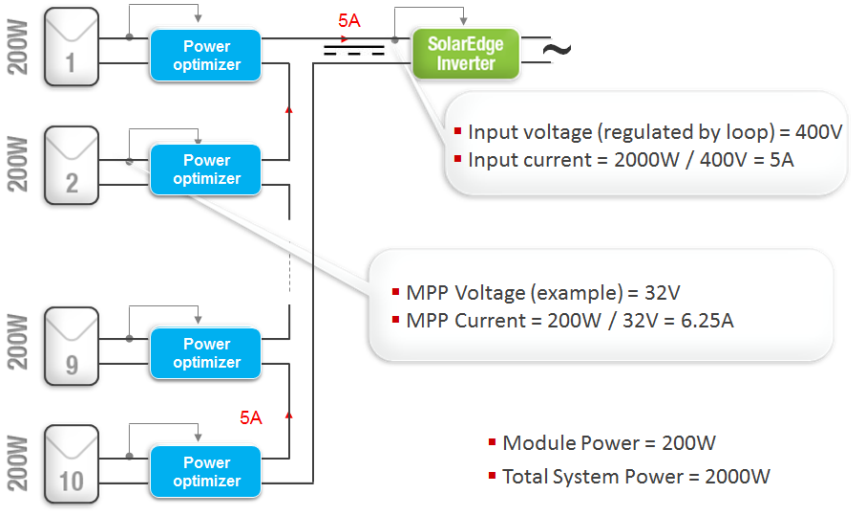


Figure 1: Operation under Ideal Conditions

Scenario 2 - Partial Shading: Next, we assume module #9 is shaded and consequently produces only 40W of power. The other 9 modules are not shaded and each still produces 200W of power. The power optimizer of the shaded module maintains that module at its maximum power point, which is now lowered due to the shading. Assuming V_{MPP} = 28V, the current is 40W/28V = 1.43A. The total power produced by the string is now 9x200W+40W = 1840W. Since the inverter still needs to maintain an input voltage of 400V, the input current to the inverter will now be 1840W/400V = 4.6A. This means that the DC bus current must be 4.6A. Therefore, the power optimizers of the 9 un-shaded modules will have an output of 200W/4.6A = 43.5V.

In contrast, the power optimizer attached to the shaded module will output 40W/4.6A = 8.7V. The input to the inverter can be obtained by summing 9 modules providing 43.5V and 1 module providing 8.7V, i.e. 9x43.5V+8.7V = 400V, as required by the inverter. In this case, the 9 power optimizers producing 200W each are essentially acting as up converters, converting the 32V input voltage to a 43.5V output voltage, whereas the power optimizer of module #9 is acting as a down converter, converting the 28V input voltage to an 8.7V output voltage.

The various system currents and voltages in this case are illustrated in Figure 2.

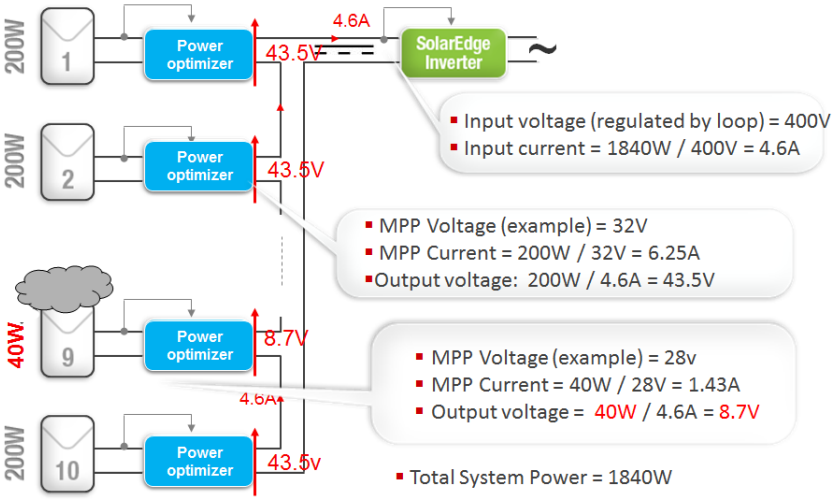


Figure 2: Operation with Partial Shading

As demonstrated by this example, each of the modules is operating at its maximum power point, regardless of operating conditions.

A comparison of the system operation in both cases can be seen in Figure 3. Note that both up and down DC/DC conversion are automatically used, depending on environmental conditions.

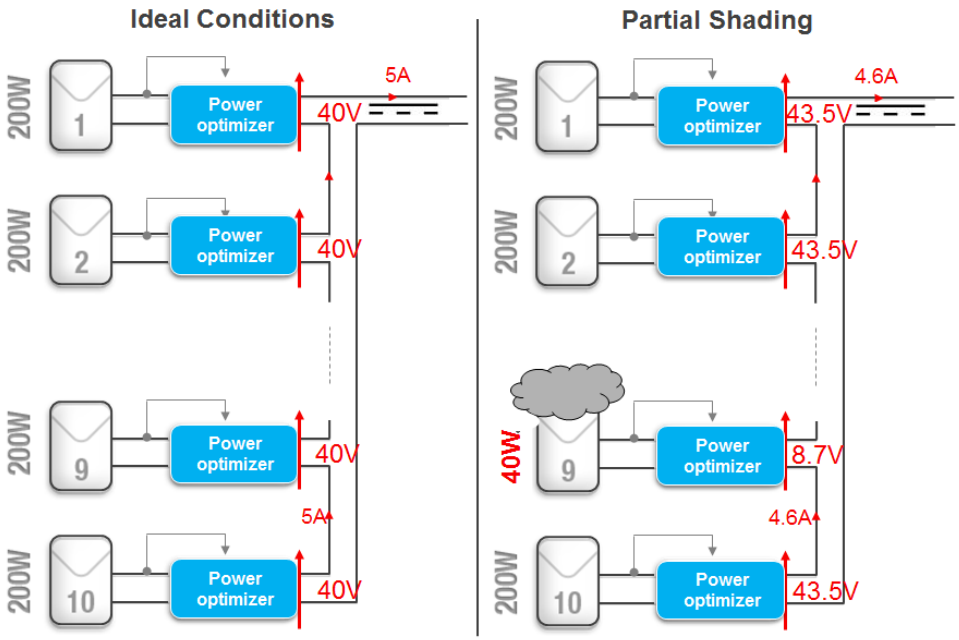


Figure 3: Case Comparison

Fixed String Voltage Benefits

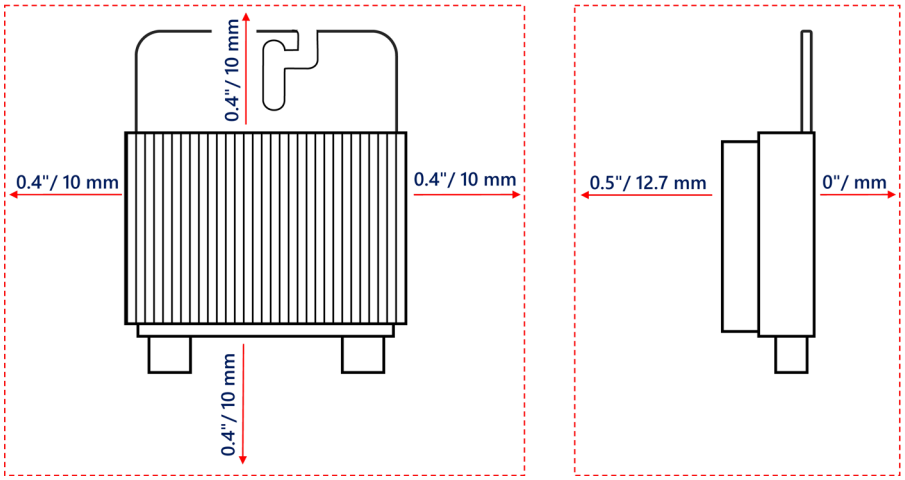
The fixed string voltage maintained by the SolarEdge power optimizers provides multiple benefits:

- **Flexible Design** – mismatched modules can be serially-connected in a string. The number of modules in a single string is not dependant on module output voltage and therefore a wide string length range is permitted.
- **High Inverter Efficiency and Reliability** – the SolarEdge inverter components work at a fixed voltage, operating under less stress. The inverter always operates at a voltage that enables optimal DC-AC inversion efficiency, independent of string length or environmental conditions.
- **Reduced Installation Cost** - longer strings lower BoS element count and installation cost and labor.
- **Temperature Indifference** - the SolarEdge fixed string voltage completely removes the temperature constraints which strongly limit string length in traditional systems.
- **Improved Safety** - all power optimizers start up in "safety 1V output" mode until the power optimizers are connected to a functioning SolarEdge inverter. Additionally, in the event of a grid power shutdown, the modules immediately stop producing power and revert to this mode.

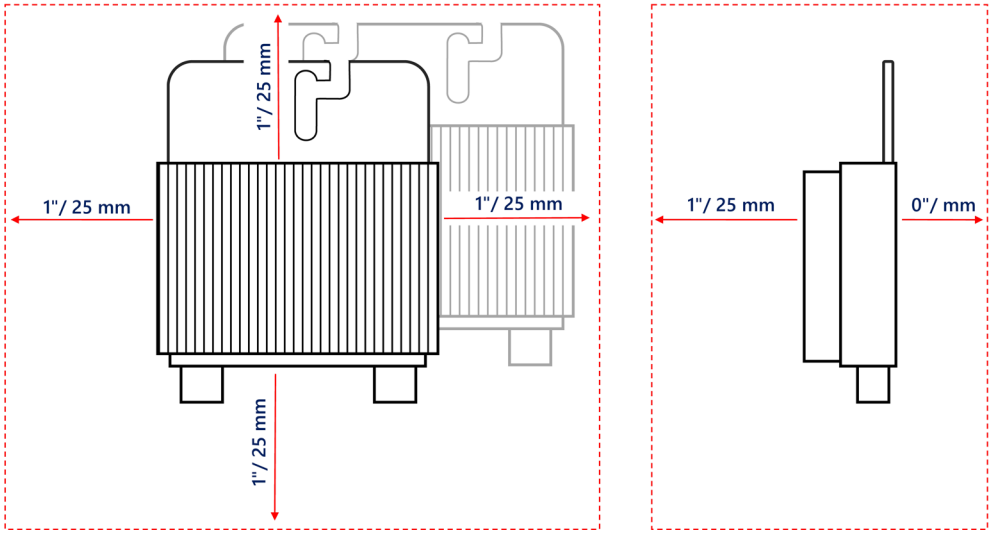
Application Note: Power Optimizer Clearance

Power optimizer clearance refers to the distance between any object (for example, railing system, module) and the power optimizer surface. To allow for heat dissipation, maintain clearance as specified below.

All power optimizers, except for the P860/P960 and M1600 power optimizers



P860/P960 and M1600 power optimizers



This application note overrides any conflicting power optimizer clearance instructions provided in other SolarEdge documents.

LIMITED PRODUCT WARRANTY

This SolarEdge Technologies Ltd. Limited Warranty covers defects in workmanship and materials of the below-listed products for the applicable Warranty Period set out below (the "Products"):

- **Power optimizers**: 25 years commencing on the earlier of: (i) 4 months from the date the power optimizers are shipped from SolarEdge; and (ii) the installation of the power optimizers, provided, however, that for the module embedded power optimizers (CSI and OPJ models), the Warranty Period shall not exceed the maximum of (1) the module product warranty and (2) the module power warranty periods provided by the applicable module manufacturer.
- **Inverters, Safety & Monitoring Interface (SMI), and Auto-transformer, Backup Interface**: 12* years commencing on the earlier of: (i) 4 months from the date the products are shipped from SolarEdge; and (ii) the installation of the products.
- **StorEdge Interface**: 10 years commencing on the earlier of: (i) 4 months from the date the Interfaces are shipped from SolarEdge; and (ii) the installation of the Interfaces.
- **ZigBee Gateway, Commercial Gateway, Firefighter Gateway, Smart Energy products, Cellular Communication products, RS485 Plug-in,Energy Meter, Smart EV Charger**: 5 years commencing on the earlier of: (i) 4 months from the date the product is shipped from SolarEdge; and (ii) the installation of the product. Warranty duration of wireless communication products is the same whether or not the product is pre-installed in the inverter.

* In some countries the inverter warranty is limited to 7 years. For a list of these countries please access http://www.solaredge.com/warranty_exceptions

The Limited Warranty does not apply to components which are separate from the Products, ancillary equipment and consumables, such as, for example, cables, cable holders, fuses, wires and connectors, whether supplied by SolarEdge or others. Some components may carry their own manufacturer warranty. See product datasheet for more details. In addition, for all power optimizers with a part number ending in C, the SolarEdge warranty does not apply to the input connector.

The Limited Warranty only applies to the buyer who has purchased the Products from an authorized seller of SolarEdge for use within the continent where SolarEdge originally sold the Products and in accordance with their intended purpose. The Limited Warranty may be transferred from buyer to any assignee, and will remain in effect for the time period remaining under the foregoing warranties, provided that the Products are not moved outside their original country of installation and any reinstallation is done in accordance with the installation directions and use guidelines accompany the Products (collectively the "Documentation").

If, during the applicable Warranty Period, buyer discovers any defect in workmanship and materials and seeks to activate the Limited Warranty, then buyer shall, promptly after such discovery, report the defect to SolarEdge. The report can be by sending an email to support@solaredge.net.au, or by contacting SolarEdge via the support portal on the SolarEdge website in the installer section https://www.solaredge.com/aus/service/support/, or via the phone at T:+61 1800 465 567 with the following information: (i) a short description of the defect, (ii) the Product's serial number, and (iii) a scanned copy of the purchase receipt or warranty certificate of the applicable Product.

Upon buyer's notification, SolarEdge shall determine whether the reported defect is eligible for coverage under the Limited
Warranty. The Product's serial number must be legible and properly attached to the Product in order to be eligible for Warranty coverage. If SolarEdge determines that the reported defect is not eligible for coverage under the Limited Warranty, SolarEdge will notify buyer accordingly and will explain the reason why such

coverage is not available. If SolarEdge determines that the reported defect is eligible for coverage under the Limited Warranty, SolarEdge will notify buyer accordingly, and SolarEdge may, in its sole discretion, take any of the following actions:

- repair the Product at SolarEdge's facilities or on-site; or
- issue a credit note for the defective Product in an amount up to its actual value at the time buyer notifies SolarEdge of the defect, as determined by SolarEdge, for use toward the purchase of a new Product; or
- provide Buyer with replacement units for the Product.

SolarEdge will determine whether the Product should be returned to SolarEdge and, if SolarEdge so determined, the Return
Merchandise Authorization ("RMA") Procedure (set out below) will be invoked. Where replacement Products are sent, SolarEdge generally sends such products within 48 hours. SolarEdge may use new, used or refurbished parts that are at least functionally equivalent to the original part when making warranty repairs. The repaired Product or replacement parts or Product, as applicable, shall continue to be covered under the Limited Warranty for the remainder of the then-current Warranty Period for the Product.

Where the RMA Procedure is invoked by SolarEdge, SolarEdge will instruct buyer how to package and ship the Product or part(s) to the designated location. SolarEdge will bear the cost of such shipment, upon receipt of the Product or part(s), SolarEdge will, at its expense and sole discretion, either repair or replace the Product or part(s).

SolarEdge will deliver the repaired or replaced Product or part(s) to buyer at buyer's designated location in countries where SolarEdge has an office and/or there is a significant PV market. For the specific list of countries to which such service is provided, please access https://www.solaredge.com/aus/shipping_cost_coverage_warranty#/. SolarEdge will bear the cost of such shipment, including shipping and customs (where applicable) and buyer shall bear any applicable value added tax. SolarEdge may elect to ship replacement Product and/or part(s) prior to receipt of the Product and/or part(s) to be returned to SolarEdge as per the above.

All costs, including, without limitation, labor, travel and boarding costs of SolarEdge service personnel or others that are incurred for labor relating to repairs, uninstalling and reinstalling of Products on-site, as well as costs related to buyer's employees and contractors repair or replacement activities, are not covered by the Limited Warranty and, unless otherwise agreed in writing in advance by SolarEdge, shall be borne by the buyer.

Warranty Exclusions: This Limited Warranty will not apply if (a) buyer is in default under the General Terms and Conditions of other Agreement governing the purchase of the Product, or (b) the Product or any part thereof is:

- damaged as a result of misuse, abuse, accident, negligence or failure to maintain the Product;
- damaged as a result of modifications, alterations or attachments thereto which were not pre-authorized in writing by SolarEdge;
- damaged due to the failure to observe the applicable safety regulations governing the proper use of the Product;
- installed or operated not in strict conformance with the Documentation, including without limitation, not ensuring sufficient ventilation for the Product as described in SolarEdge installation guide;

- opened, modified or disassembled in any way without SolarEdge's prior written consent;
- used in combination with equipment, items or materials not permitted by the Documentation or in violation of local codes and standards;
- damaged by software, interfacing, parts, supplies or other product not
- supplied by SolarEdge; damaged as a result of improper site preparation or maintenance or improper installation;
- damaged or rendered non-functional as a result of power surges, lightning, fire, flood, pest damage, accident, action of third parties, direct exposure to sea water or other events beyond SolarEdge's reasonable control or not arising from normal operating conditions; or
- damaged during or in connection with shipping or transport to or from buyer where buyer arranges such shipping or transport.

Additional exclusions from this Warranty:

- Any EV charger cable that is damaged due to: physical abuse and damage, commercial use, rust, water, damage, domestic wear and tear, use of car inlets which are incompatible with the smart EV Charger connector;
- Cellular Wireless Communication plans which are governed under the SolarEdge Communication Plan Terms and Conditions available on the SolarEdge website; or
- The SolarEdge Energy Bank battery which is covered under the SolarEdge Energy Bank battery Warranty available on the SolarEdge website.

This Limited Warranty does not cover cosmetic or superficial defects, dents, marks or scratches which do not influence the proper functioning of the Product.

THE LIMITED WARRANTIES SET OUT HEREIN ARE IN LIEU OF ANY OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS PURCHASED BY BUYER FROM SOLAREDGE, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL (INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), ALL OF WHICH ARE EXPRESSLY EXCLUDED TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW.

Claims by buyer that go beyond the warranty terms set out herein, including claims for compensation or damages, are not covered by the Limited Warranty, insofar as SolarEdge is not subject to statutory liability.

In such cases, please contact the company that sold you the Product. Eventual claims in accordance with the law on product liability remain unaffected.

Coverage under the Limited Warranty is subject to buyer complying with the foregoing notification requirements and cooperating with SolarEdge's directions. SolarEdge's sole obligation and buyer's exclusive remedy for any defect warranted hereunder, is limited to those actions expressly stated above. Such actions are final and do not grant any further rights, in particular with respect to any claims for compensation.

Unless otherwise specified in an executed Agreement with SolarEdge, the Limited Warranty and related provisions set out herein are subject to SolarEdge's General Terms and Conditions, including, without limitation, the provisions thereof which relate to disclaimer of warranties, limitation of liability and governing law and jurisdiction.

Australian Customers: Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure. The benefits to the consumer given by the warranty are in addition to any other rights and remedies of the consumer under a law in relation to the goods or services to which the warranty relates. This warranty only applies to end consumers who have purchased the products for their own use.

SolarEdge offers extended warranties to customers. These warranties are broader than the standard SolarEdge Limited Warranty but in some respect may duplicate the rights given under the warranty provided to our Australian customers.

Revised: May 2021