Steca Tarom MPPT

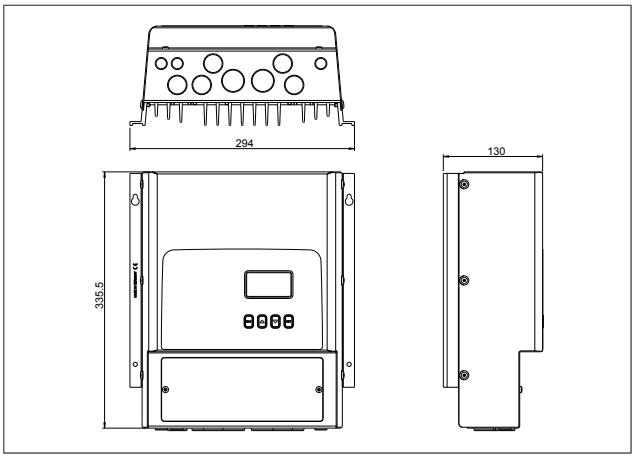
6000, 6000-M

The Steca Tarom MPPT solar charge controller sets new standards in the area of Maximum Power Point trackers. Outstanding efficiency along with unique safety features make it a universal top-grade charge controller.

There are two inputs that can be connected in parallel or used separately. Each input has its own MPP tracker. So there are two charge controllers available in one device. Different module arrays can be flexibly combined in one charge controller.

With an input voltage of up to 200 V, all kinds of solar modules can be used in various connection schemes. This charge controller combines high flexibility, maximum yields, professional battery care and an appealing design on the basis of advanced technology.

60 A



Product features

- Two independent maximum power point trackers (MPP trackers)
- Two inputs (connected in parallel or used separately for two different module arrays)
- Robust metal casing
- Comprehensive data logging of energy values for up to 20 years
- Data logger Micro-SD card for all minute values (6000-M only)
- Voltage and current regulation
- PWM control
- Temperature compensation
- Monthly maintenance charge
- Three configurable multifunctional contacts (6000-M only)
- Adjustable cut-off voltages
- Battery type: gel/liquid lead battery (for 6000-M also Li, NiCd and NiMh batteries)
- Integrated, automatic module switch
- 36 V and 60 V batteries can be charged with special settings in expert menu level

Electronic protection functions

- Overcharge protection
- Reverse polarity protection of module and battery
- Automatic electronic fuse
- Open circuit protection without battery
- Reverse current protection at night
- Overtemperature and overload protection
- PE connection

Displays

- Multifunction graphical LCD display with backlighting
- Configuration via display unit

Interfaces for the Steca Tarom MPPT 6000-M

- StecaLink Bus
- Open Steca RS232 interface
- Battery emergency off signal connection (optional, only for use with lithium-ion batteries)

Options

- External temperature sensor (included in the scope of delivery with the 6000-M)
- Connection for battery voltage sensor cable

Certificates

- Compliant with European Standards (CE)
- RoHS compliant
- Made in Germany
- Developed in Germany
- Manufactured according to ISO 9001 and ISO 14001

Steca PA TS-S
External temperature sensor

6000-M only:
Steca PA CAB2 Tarcom
Data cable

Areas of application:

	MPPT 6000 / MPPT 6000-M
Characterisation of the operating performance	
System voltage	12 V / 24 V / 48 V
Nominal power	900 W / 1,800 W / 3,600 W
Max. DC-DC efficiency	99.4 % (U_{Batt}=48 V; U_{in}=70 V; P=0,65*P_{nom})
European efficiency	96.6 % (U_{Batt}=24 V; U_{in}=30 V) 98.9 % (U_{Batt}=48 V; U_{in}=70 V)
European efficiency (weighted across all U_{Batt} and U_{in})	96.4 %
Static MPP efficiency	99.9 % (DIN EN 50530)
Dynamic MPP efficiency	99.8 % (DIN EN 50530)
Weighted REW (Realistic Equally Weighted efficiency)	94.8 %
Own consumptiom	< 1 W
DC input side	
Min. MPP voltage / input	17 V / 28 V / 56 V
Max. MPP voltage / input	180 V
Min. open circuit voltage solar module / input (at minimum operating temperature)	20 V / 40 V / 80 V
Max. open circuit voltage solar module / input (at minimum operating temperature)	200 V
Module current / input	30 A
Battery side	
Charge current	60 A
End of charge voltage	14.1 V / 28.2 V / 56.4 V
Boost charge voltage	14.4 V / 28.8 V / 57.6 V
Equalisation charge	15 V / 30 V / 60 V
Set battery type	liquid (adjustable via menu)
Operating conditions	
Ambient temperature	-25 °C … +50 °C
Fitting and construction	
Terminal (fine wire)	35 mm² - AWG 2
Degree of protection	IP 31
Dimensions (X x Y x Z)	295 x 335 x 125 mm
Weight	approx. 6,300 g

programmable

Technical data at 25 °C / 77 °F

WINNER OF INNOVATION PRIZE 2014

1st place at the Photovoltaic Solar Power Symposium in Bad Staffelstein

Steca Tarom MPPT 6000-M awarded the Otti Innovation Prize 2014

The innovative Steca Tarom MPPT 6000-M is a response to the current wave of technological change gripping the photovoltaic sector. Through the reduction of module prices and feed-in compensation, the appeal of off-grid and private consumption systems is growing markedly. The MPPT charge controller is particularly well suited to such applications. Emergent lithium-ion batteries also represent new challenges for charging technology, which the Steca Tarom MPPT 6000-M handles superbly.

This innovative product won over the judges due to its outstanding benefits: At 3.6 kW, the appliance is suitable for all lithium-ion batteries. In addition to complex charging algorithms, the charge controller features battery diagnosis, a long-term data logger, interfaces and a high level of efficiency.

Overview of functions:

	Tarom MPPT 6000	Tarom MPPT 6000-M
Comprehensive, integrated data logger for 20 years of data recording	✓	✓
Buzzer for alarms	✓	✓
Three configurable multifunctional contacts for... • ... programmable deep discharge protection (LVD) • ... generator/surplus manager • ... automatic switch functions (day, evening, night) • ... four timers		 ✓ ✓ ✓ ✓
Unique lithium-ion battery charge strategy		✓
Innovative charge strategy for NiCd batteries		✓
State of health (SOH) determination during ongoing operation		✓
Optimised SOC algorithm		✓
IUIa charging for increased battery capacity (optional)		✓

Lead acid

Revolutionary innovative algorithms for lead batteries

State of charge (SOC):
The Steca Tarom MPPT 6000-M is equipped with a new type of highly-flexible algorithm for precise state of charge (SOC) calculation enabling automatic adaptation to battery and user behaviour. This enables the current state of charge to be assessed at any time.

State of health (SOH):
The Steca Tarom MPPT 6000-M incorporates an entirely new professional method of state of health (SOH) determination of the actual battery capacity. Following measurement, a statement can be formulated about how the battery is ageing.

This revolutionary new development provides advanced inspection options for user, operator and manufacturer – e.g. for SOH-based awarding of battery warranties.

IUIa charging: Depending on the type of battery and its state, the battery capacity can be increased by up to 20 percent by means of a constant current charge phase following full charging (IUIa charging). This function is now available for the first time for stand-alone PV systems too in the Steca Tarom MPPT 6000-M.

Lithium

Professional charging strategy for all lithium-ion batteries

only with TAROM MPPT 6000-M

The Steca Tarom MPPT 6000-M is the first MPPT charge controller to also offer the option of charging lithium-ion batteries professionally using PV current. The latest research results in this area were used in its development, which took place in close cooperation with renowned, international research institutes. A self-developed charge strategy can be perfectly adapted to all available lithium chemistries using a wide range of parameters.

NiCd

Professional charging of NiCd batteries

Using the innovative Steca Tarom MPPT 6000-M all alkaline batteries like NiCd or NiMh batteries can also be charged. A professional, configurable charging characteristic curve is available for this, which can be adapted to special battery and system prerequisites. Particularly with professional use, this charge strategy opens up entirely new possibilities.

Greater efficiency. Greater flexibility. Greater comfort.
Less devices. Less modules. Less costs.

Save in the right places with Steca Tarom MPPT
With its innovative functions, the Steca Tarom MPPT not only offers greater efficiency, flexibility and comfort but also helps to avoid certain unnecessary costs that are incurred during the planning, implementation and ongoing operation of PV systems.

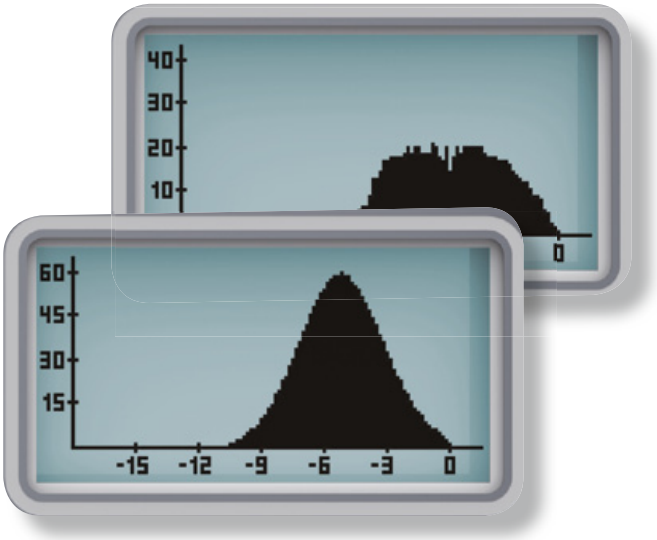
No need for additional devices!

... due to added flexibility as a result of the wide input voltage range
The Steca Tarom MPPT can be used with a wide input voltage range, which allows greater flexibility when selecting modules. The entire input voltage range of up to 200 V can be used for 12 V, 24 V and 48 V batteries.

... due to the two separate inputs
Two inputs each with independent MPP tracking in one charge controller provide greater options when it comes to system planning. With the Steca Tarom MPPT you can not only vary the module types for each input but the circuits too. Series and parallel circuits can be combined easily in one system using the universal and flexible Steca Tarom MPPT. There is no need for an external module circuit box as all module strings can be connected directly to the charge controller leading to significant savings on installation costs.

...due to two maximum power point trackers (MPPT)
The two separate maximum power point trackers enable various module types to be used with just one Steca Tarom MPPT charge controller. Leftover module stock can also be used in a system without any problems. Significantly greater options are also available when upgrading existing systems – without the extra cost of replacing an existing charge controller. The Steca Tarom MPPT is particularly suitable for systems where partial shading of the module array is unavoidable. Due to the two separate MPP trackers, the charge controller can power different strings with an individually adjusted MPP. This enables the maximum efficiency to be exploited for each string enhancing the total output of the system – in spite of partial shading. The same principle applies also for use on roofs or areas with various angles of inclination or orientations.

... due to the comprehensive, integrated data logger
The Steca Tarom MPPT is equipped with a unique, comprehensive data logger, which enables data of the two inputs to be monitored and saved independently over a period of twenty years. The previous 18 hours can be graphically displayed. Daily, monthly and annual totals are summarised automatically for an outstanding overview of system utilisation at a glance.

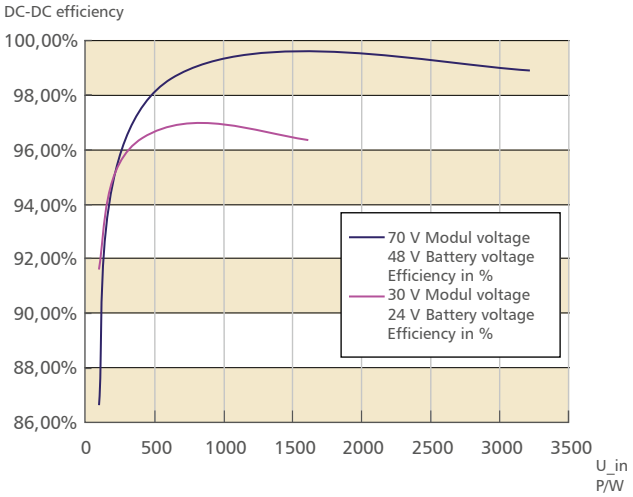


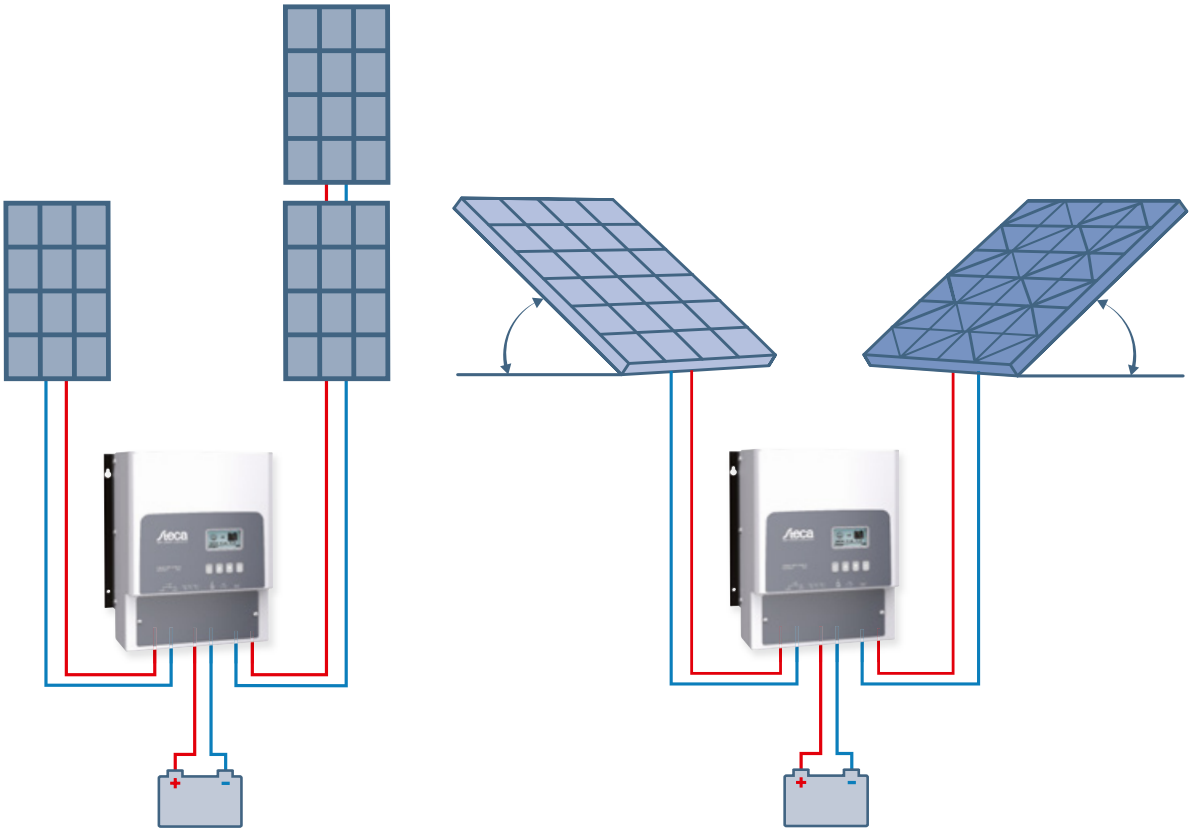
No need for additional modules!

...due to the extra high efficiency
The Steca Tarom MPPT is one of the few MPPT charge controllers that can reliably attain a high and – more importantly – constant efficiency across all input and output voltage ranges. The high level of reliability of the MPPT solar charge controller enables you to obtain even more power from your PV system. For example, significantly less energy is lost due to unnecessary heat losses. Conversely this means that, using the same power, as much as an entire module can be saved during planning if required. Particularly with limited mounting options or a limited budget this is an indisputable benefit.

Save time and effort during installation!

...due to the easily accessible, easy-to-connect terminals
The extra spacious connection terminal area can be accessed via two screws on the front of the device meaning installation of cables with a thickness of up to 35 mm² is simple, fast and secure. An integrated module switch means the Steca Tarom MPPT can be connected without any voltage connection, sparks or light arcs. Only when the charge controller is switched on via the menu are the module arrays connected up. This makes installation child's play.





Enjoy numerous added benefits!

User-friendly graphical LCD display
All system states are displayed intuitively via icons on the graphical multifunction display enabling simple understanding of the energy flow. All parameters can be configured using the multi-lingual, intuitive menu.

Communication options
The PA HS400 current sensor can be connected via the StecaLink enabling all current flows in the system to be detected. The charge controller also shows the battery's current state of charge (SOC). Professional control of loads and generators is possible via the multifunctional contacts.

The Steca Tarom MPPT 6000-M is equipped with three multifunctional contacts, which can be programmed independently of one another. These versatile individual functions can be combined virtually as required:

Function overview of multifunctional contacts:

Deep discharge protection
Deep discharge protection automatically protects the battery against harmfully low levels of discharge. All voltage thresholds can be freely configured via a menu based either on the battery's current state of charge (SOC) or on the battery voltage.

Evening, night light and daylight function
The charge controller allows configuration of three different automatic timer functions: evening light, night light and daylight. All the important time and delay values can be set with this. With the evening light function, the load is automatically switched on at sunset and the time after which the load is switched off again can be individually specified. The night light function specifies the time after which the load is switched on after sunset and switched off again before sunrise. With the morning light function, the load is switched on automatically at night and automatically switched off again at sunrise.

Four freely programmable timers with week day function
The four freely programmable timers can be set individually based on day of the week, start and finish time. With the week day function, each timer can be used for just one or several days of the week at a time if required.

Generator function
Using the generator function, the Steca Tarom MPPT 6000-M – based on the SOC or the battery voltage – can start a generator automatically when the battery is discharged, and switch this off again when the battery is full. Using the surplus manager, an additional load can be activated automatically when the battery is full. This is switched off again as soon as no more energy surplus is available in the solar system. This guarantees that all available energy is used.

USE AND CONFIGURATION OF MPP TRACKERS

When is the use of an MPPT charge controller recommended?
There are essentially three situations where we recommend selecting an MPPT charge controller (Maximum Power Point Tracker) like the Steca Solarix MPPT or Tarom MPPT rather than a conventional PWM charge controller (Pulse Width Modulation) like the Steca Solsum, PRS, PR, Tarom or Power Tarom.

- Situation 1: 36 or 72-cell crystalline PV modules are not used
  36-cell modules (for 12 V systems) have MPP voltages of around 17 V and open circuit voltages close to 21 V. 72-cell modules for 24 V systems have double this voltage – i.e. roughly 34 V_{mpp} and 42 V_{oc}. PV modules which are conventionally used in grid-connected PV systems with e.g. 60 cells (usually around 30 V_{mpp}) are not suitable for 12 / 24 / 48 V systems with regular PWM charge controllers. An MPPT charge controller must be used here to attain optimal efficiency values. This controller type can convert higher PV voltages into lower battery voltages – with minimal losses.

- Situation 2: Battery frequently low
  If configuration of the solar energy system is tight or the battery is frequently at low voltage over long periods of time, an MPPT charge controller can provide more energy. In such cases the MPP tracker, in contrast to the switching charge controller, can convert the voltage difference between the battery and the solar module into additional charge current. In this way the energy yield can be increased when battery voltage is low.

- Situation 3: Low average temperatures and severe winters
  The colder the crystalline PV modules become, the higher the optimal working voltage (MPP or Maximum Power Point) will be. Due to their variable PV module voltage, MPPT charge controllers can adapt to this situation and convert the high voltage into a higher charge current.
  If the ground is covered with snow, background radiation of the environment will be significantly higher due to the irradiation being reflected on the snow. The power of the solar modules therefore increases, resulting in a higher battery charge current due to the MPPT charge controller.

For installations which are in operation throughout the year, it is important to maximise the energy yield in the months with the least sunlight. It is precisely here that the Steca MPPT charge controller can provide added value.

	Max. PV power for a 12 V battery	Max. PV power for a 24 V battery	Max. PV power for a 48 V battery
Steca Solarix MPPT 1010	125 W	250 W	-
Steca Solarix MPPT 2010	250 W	500 W	-
Steca Tarom MPPT 6000	850 W	1.700 W	3.400 W
Steca Tarom MPPT 6000-M	850 W	1.700 W	3.400 W

Overview of Steca MPPT charge controller rated output

Which criteria need to be observed when configuring MPPT charge controllers?
In order to select the correct MPPT charge controller, the following data must be known: the input voltage of the PV modules (U_{oc}), the maximum power voltage (U_{mpp}), the total output of the PV modules (in Wp) and the battery voltage (12 V, 24 V or 48 V) and temperature coefficient (V_{OC}).

- PV input voltage (U_{oc})
  The open circuit voltage of the entire module array (U_{oc}) that occurs during the lowest possible ambient temperature must never exceed the MPPT charge controller's maximum input voltage. If it does, this will destroy the charge controller.

- Maximum power voltage (U_{mpp})
  The maximum power voltage of the module string (U_{mpp}) must never fall below the minimum input voltage of the MPPT charge controller when the maximum ambient temperature occurs. The MPP voltage must be above the maximum battery voltage at all times – regardless of the temperature conditions and consequently at maximum ambient temperature too. For systems with a 12 V battery, this corresponds to an MPP voltage of at least 17 V_{mpp}; with use of a 24 V battery this will accordingly be at least 28 V_{mpp} and in case of a 48 V battery at least 56 V_{mpp}.

- Total output of the PV modules (Wp)
  The total output of the PV modules (in Wp) when connected should be less than or equal to the MPPT charge controller's rated power. Although module arrays with higher powers can be connected up without the Steca MPPT charge controller being destroyed, the actual charge capacity will then be limited to the charge controller's rated capacity. In practice, a module array that is oversized by up to 20 percent may be a good idea as the peak power (Wp) is only attained at very low temperatures, in strong sunlight and with clear skies. The module data is specified under „Standard Test Conditions" (STC) at 25 °C. In real application situations, the cell temperature will be significantly higher however. This leads to a lower output power – regardless of which charge controller is used.

- Note on efficiency
  The lower the voltage difference between the current PV input voltage and the battery voltage, the higher the MPP tracker's rate of efficiency will be. This is true for all MPPT charge controllers, regardless of the manufacturer.

- Battery voltage
  The battery voltage is selected depending on the power of the consumers. It is generally a good idea to select a battery voltage that is as high as possible to keep the current low and hence save costs.

EXAMPLE CONFIGURATION OF AN MPP TRACKER

Input voltage, calculation of maximum string length

$$\text{Modules} \leq \frac{U_{max_{charge\ controller}}}{U_{oc_{modules}} \cdot \left(1 + \beta_{V_{oc}} \cdot (T_{ambient_{min}} - T_{STC})\right)}$$

Minimum MPP voltage

$$\text{Modules} \geq \frac{U_{min_{charge\ controller}}}{U_{mpp_{modules}} \cdot \left(1 + \beta_{V_{oc}} \cdot (T_{ambient_{max}} - T_{STC})\right)}$$

Total output

$$\text{Modules}^{*} \leq \frac{P_{nom_{charge\ controller}} \cdot (1 + \text{DimFactor})}{P_{max-mpp_{modules}}}$$

$U_{OC_{module}}$ [V]: Open circuit voltage
V_{OC} [%/K]: Temperature coefficient of open circuit voltage
$U_{mpp_{module}}$ [V]: MPP voltage of solar module
$U_{min/max_{charge\ controller}}$ [V]: Minimum/maximum input voltage of charge controller
$T_{ambient_{min/max}}$ [°C]: Minimum/maximum ambient temperature
$P_{nom_{charge\ controller}}$ [W]: Rated power of charge controller
$P_{max\text{-}mpp_{module}}$ [Wp]: Rated solar module power at STC
DimFactor [%]: Overdimensioning factor
T_{STC} [°C]: 25 °C

* The maximum number of modules per string from calculation no.1 (maximum string length) may not be exceeded, even if the charge controller's capacity allows more modules. In this case several strings will have to be connected in parallel.

To illustrate this better, a concrete example with certain conditions can be found below:

- **Solar module (typical module for PV grid feeding with 60 cells)**
  Open circuit voltage U_{oc}: 37.6 V
  Temperature coefficient of open circuit voltage: -0.3 % / K
  MPP voltage U_{mpp}: 31.2 V
  Peak performance: 250 Wp
  Module current I_{mpp} bzw. I_{sc}: 8.0 / 8.5 A
  Specifications with STC = 25 °C
- **Battery: 48 V**
  Minimum MPP voltage of solar modules: 56 V
- **Charge controller: Steca Tarom MPPT 6000**
  Maximum open circuit voltage U_{oc} < 200 V
  Rated power by 48 V: 3,600 W
- **Boundary conditions:**
  Temperature range: -30 °C bis +90 °C
  Overdimensioning of solar modules: 15 %

The specifications for the module and charge controller requirements result in the following criteria:

Input voltage, calculation of maximum string length
A maximum of 4 modules can be connected in series:

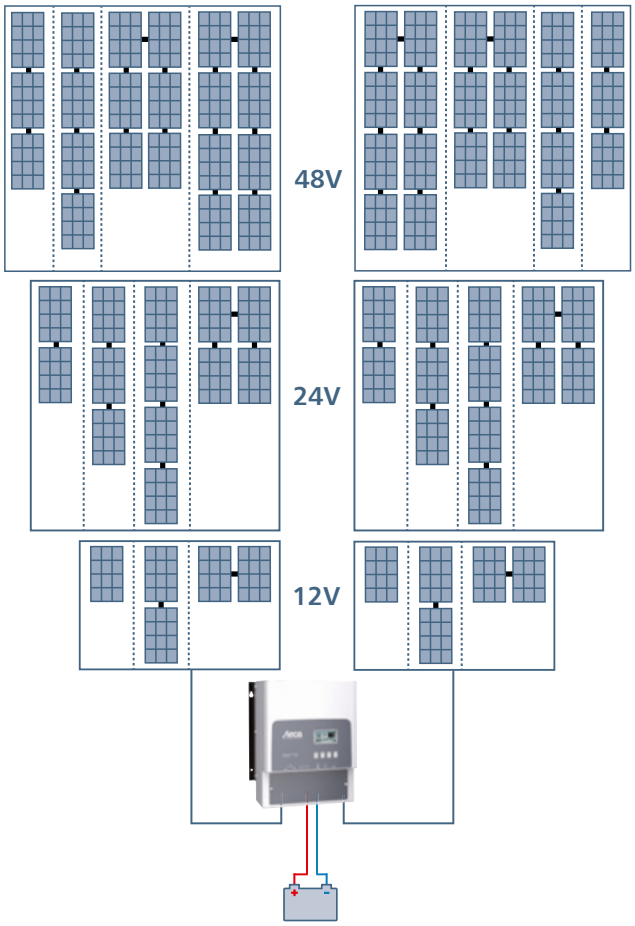
$$\text{Modules} \leq \frac{200\ \text{V}}{37.6\ \text{V} \cdot \left(1 + (-0.3/100) \cdot (-30\ °\text{C} - 25\ °\text{C})\right)} \leq 4.56$$

Minimum MPP voltage
At least 3 modules have to be connected in series:

$$\text{Modules} \geq \frac{56\ \text{V}}{31.2\ \text{V} \cdot \left(1 + (-0.3/100) \cdot (90\ °\text{C} - 25\ °\text{C})\right)} \geq 2.23$$

Total output
A maximum of 16 solar modules can therefore be used with the charge controller:

$$\text{Modules}^{*} \leq \frac{3{,}600\ \text{W} \cdot 1.15}{250\ \text{Wp}} \leq 16{,}56$$



Battery voltage	Number of modules in series per string	Number of module strings connected in parallel: 1	2	3	4	5
48 V	1	-	-	-	-	-
	2	-	-	-	-	-
	3	723 Wp (3 modules)	1,445 Wp (6 modules)	2,168 Wp (9 modules)	2,891 Wp (12 modules)	3,616 Wp (15 modules)
	4	964 Wp (4 modules)	1,927 Wp (8 modules)	2,891 Wp (12 modules)	3,854 Wp (16 modules)	-
24 V	1	-	-	-	-	-
	2	482 Wp (2 modules)	964 Wp (4 modules)	1,445 Wp (6 modules)	1,927 Wp (8 modules)	-
	3	723 Wp (3 modules)	1,445 Wp (6 modules)	-	-	-
	4	964 Wp (4 modules)	1,927 Wp (8 modules)	-	-	-
12 V	1	241 Wp (1 module)	482 Wp (2 modules)	723 Wp (3 modules)	964 Wp (4 modules)	1,204 Wp (5 modules)
	2	482 Wp (2 modules)	964 Wp (4 modules)	-	-	-
	3	723 Wp (3 modules)	-	-	-	-
	4	964 Wp (4 modules)	-	-	-	-

Permitted configurations for one input
Permitted configurations for both inputs connected in parallel
Configurations not permitted