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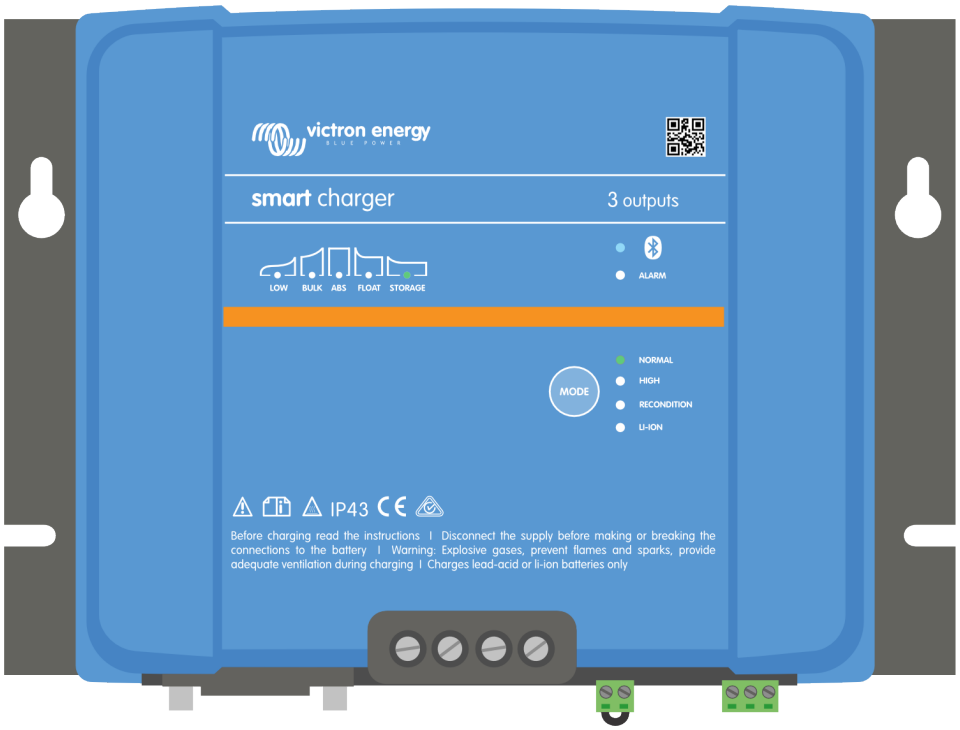

Smart IP43 Charger

12/30, 12/50, 24/16, 24/25 | (1+1) & (3) Output | 120-240V

Rev. 07 - 09/2022

This manual is also available in HTML5.

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1. Safety instructions

WARNING: CAREFULLY READ AND FOLLOW ALL SAFETY INSTRUCTIONS

- Carefully read the manual **before** the charger is installed and operated; retain the manual in a safe place for future reference.
- The charger must **not** be installed or operated by anyone who lacks the appropriate knowledge or competence required for safe installation and/or usage.
- **Charger installation and operation**
  a. Install the charger in a location with good natural airflow/ventilation and sufficient unobstructed space around it; refer to the the 'Installation' section for more information.
  b. Install the charger on a non-flammable substrate and ensure there are no heat-sensitive items in the immediate vicinity; it is normal for the charger to become hot during operation.
  c. Install the charger in a location where it is protected from environmental conditions such as water, moisture, dust and direct sunlight.
  d. Do not install or operate the charger directly above the battery, or in a sealed compartment with the battery; batteries can emit explosive gasses.
  e. Do not cover or place any other items on top of the charger.
- **Battery installation and charging**
  a. Install and charge the battery in a location with good natural airflow/ventilation.
  b. Ensure that there are no ignition sources near the battery; batteries can emit explosive gasses.
  c. Battery acid is corrosive; if battery acid comes into contact with skin immediately rinse with water.
  d. Do not charge non-rechargeable batteries or Li-ion batteries if the battery temperature is below 0°C.
- **Battery DC connection**
  a. Ensure that the DC system is fully shut down/isolated prior to disconnection of any existing cabling and/or new connections are made to the battery/DC system.
  b. Use flexible multi stranded copper DC power cable with sufficient cross sectional area, inline with an appropriate fuse or circuit breaker; refer to the 'Installation > Wiring' section for more information.
  c. Ensure that wiring polarity is correct; connect the positive DC cable (red insulation) to the positive (**+**) terminal and negative DC cable (black insulation) to the negative (**-**) terminal connection.
  d. There are specific wiring connection instructions for charging a battery installed within a vehicle; refer to the 'Installation > Wiring' section for more information.
- **Mains supply AC connection**
  a. AC connection to the mains supply must be in accordance with local electrical regulations. The charger must be plugged into an earthed AC mains power outlet.
  b. Do not operate the charger if the AC power cable is damaged, contact a service agent.
- **Charger setup**
  a. Refer to the battery manufacturers instructions and specifications to ensure the battery is suitable for use with this charger and confirm the recommended charge settings.
  b. The integrated charge modes (selected via the charger or Bluetooth) combined with adaptive charge logic are well suited for most common battery types; such as flooded lead-acid, AGM, Gel and LiFePO4.

  If necessary, advanced configuration with user defined settings is also possible using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

2. Quick start guide

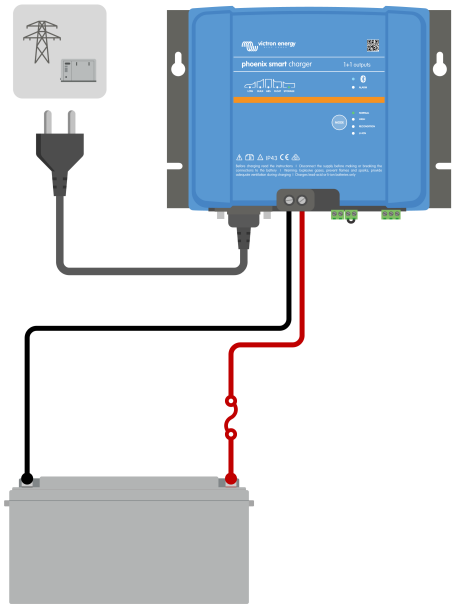
1. The **Smart IP43 Charger** range is designed to be permanently mounted using the mounting flanges integrated into the heat sink.

   Identify/provide a suitable and safe location for the charger on a non-flammable substrate, with at least 10cm of clearance surrounding the charger and good natural airflow/ventilation; do not install or place/operate the charger on top of the battery, directly above the battery, or in a sealed compartment with the battery.

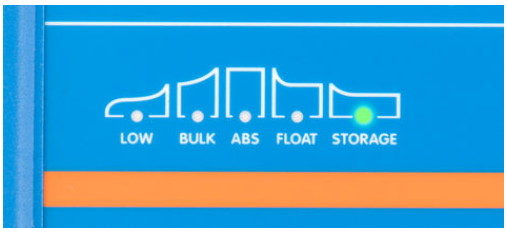
   Mount the **Smart IP43 Charger** vertically with the terminals facing down; secure using suitable pan/flange head screws though the mounting holes/slots.

2. Connect suitable DC power cabling between the **Smart IP43 Chargers** BATTERY terminals (torque the terminal screws to 2.4Nm) and the battery or DC system distribution bus; all LEDs will illuminate briefly when DC power is connected.

   There are specific wiring connection instructions for charging a battery installed within a vehicle; refer to the 'Installation > Wiring' section for more information.



3. Connect the AC power cable to a mains power outlet; all LEDs will illuminate briefly when the charger is powered up, then the LEDs indicating the current charge mode and charge state will illuminate.



4. Select the charge mode and charge current limit most appropriate for the battery type and capacity.
   a. **Setup using the charger:**
      i. Select the most appropriate mode from the integrated charge presets (Normal, Normal + Recondition, High, High + Recondition or Li-ion) by briefly pressing the MODE button on the charger to cycle through each option; the LED beside the currently selected charge mode (NORMAL / HIGH / LI-ION) will be illuminated, as well as the RECONDITION LED if enabled.

         Ensure that recondition stage is only enabled when required, as unnecessary or overuse will reduce battery life.

      ii. If required, enable low current mode (charge current limited to 50% of the maximum rated charge current); to enable (or disable) low current mode depress and hold the MODE button for 3 seconds, when enabled the LOW LED will blink.

b. **Setup using Bluetooth:**

i. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the LOCAL page, then connect to the device (default Bluetooth PIN Code is 000000).

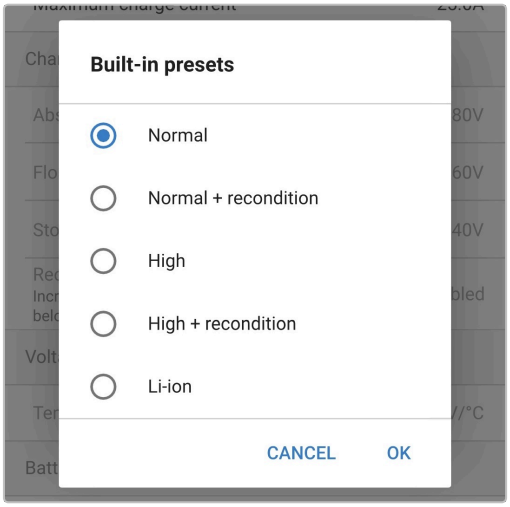
ii. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

iii. Select 'Battery settings' to access the 'Battery settings' menu.

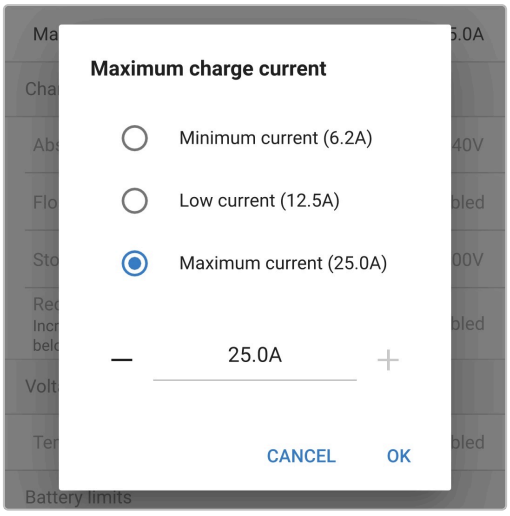
iv. Expand the 'Battery preset' drop-down menu, then select 'Built-in preset' or alternatively 'Select preset' for more specialised battery types.

v. Select the most appropriate mode from the integrated charge presets (Normal, Normal + Recondition, High, High + Recondition or Li-ion) in the 'Built-in presets' menu, then select 'OK'; the LED beside the currently selected charge mode (NORMAL / HIGH / LI-ION) will be illuminated, as well as the RECONDITION LED if recondition stage is enabled.

Ensure that recondition stage is only enabled when required, as unnecessary or overuse will reduce battery life.



vi. If required, enable low current mode (charge current limited to 50% of the maximum rated charge current) or minimum current mode (charge current limited to 25% of the maximum rated charge current); to enable (or disable) low or minimum current mode select the required option from the 'Maximum charge current' menu.



The charger will automatically store the selected charge mode and recall it for future charge cycles (even after being disconnected from power).

5. When the ABS LED is illuminated the charger has moved into absorption stage (bulk stage is complete); the battery will be approximately 80% charged (or >95% for Li-ion batteries) and may be returned into service if required.

6. When the FLOAT LED is illuminated the charger has moved into float stage (absorption stage is complete); the battery will be fully (100%) charged and is ready to be returned into service.

7. When the STORAGE LED is illuminated the charger has moved into storage mode (float stage is concluded); to maintain the battery at full charge, the battery can be left on continuous charge for an extended duration.

8. To stop charging isolate the power supply to the AC power cable.

3. Features

a. **Bluetooth setup and monitoring (Using VictronConnect)**

Equipped with integrated Bluetooth; enabling quick and simple setup, advanced configuration, comprehensive monitoring and firmware updates via the **VictronConnect** app and a Bluetooth enabled device (such as a mobile phone or tablet).

b. **VE.Smart Network compatible**

VE.Smart Networking capability allows multiple chargers to operate in unison with synchronised charging, and receive accurate battery voltage (Voltsense), charge current (Current-sense) and battery temperature (Temp-sense) data from a compatible battery monitor (such as a BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) to further enhance the charge cycle.

c. **VE.Direct interface**

Fully integrate with a **GX device** (such as a Cerbo GX) via VE.Direct interface, enabling system monitoring and control from a single device and connectivity to the **VRM** (Victron Remote Monitoring) portal for data logging and remote access to real time monitoring, as well as control of the charger.

d. **Integrated charge presets**

Integrated charge presets (selected via the MODE button or VictronConnect app) combined with adaptive charge logic are well suited for most common battery types; such as LiFePO4, AGM, Gel and flooded lead-acid. Advanced configuration with specific user defined settings is also possible using VictronConnect.

e. **Multi-stage charge algorithm**

The multi-stage charge algorithm is specifically engineered to optimise each recharge cycle and charge maintenance over extended periods.

f. **Adaptive absorption**

Adaptive absorption monitors the battery's response during initial charging and intelligently determines the appropriate absorption duration for each individual charge cycle. This ensures that the battery is fully recharged regardless of the discharge level or capacity and avoids excessive time at the elevated absorption voltage (that can accelerate battery aging).

g. **Temperature compensation**

Charge voltage is automatically compensated depending on the ambient temperature; this ensures that the battery is charged at the optimal charge voltage regardless of the climate and avoids the need for manual settings adjustments. Temperature compensation is not required and automatically disabled when in LI-ION charge mode.

h. **High efficiency**

The **Smart IP43 Charger** range is up to ~96% efficient; resulting in lower power usage, less heat generated and cooler operation

i. **Durable and safe**

Engineered to provide years of trouble-free and dependable operation in all usage conditions:

i. Protection against overheating: Output current will be derated if the ambient temperature increases above 40°C (linear derate from 100% at 40°C to 25% at 60°C)

ii. Protection against output short circuit: If a short circuit condition is detected the charger will shut down

iii. Protection against reverse polarity connection: If the charger is incorrectly connected to a battery with reverse polarity the internal (non-replaceable) fuse will blow

j. **Silent operation**

Totally silent operation since there is no cooling fan or moving parts, cooling is via natural convection; full rated output current is still provided up to an ambient temperature of 40°C.

k. **Lithium Ion compatible**

Compatible with Li-ion ($LiFePO_4$) batteries; when the integrated LI-ION charge mode is selected the charge cycle settings are altered to suit.

If the charger is connected to a battery where under voltage protection (UVP) has tripped, it will automatically reset UVP and start charging; many other chargers will not recognise a battery in this state.

Warning: Do not charge Li-ion batteries if the battery temperature is below 0°C.

l. **Storage stage**

An additional stage to extend battery life whilst the battery is unused and on continuous charge.

m. **Recondition stage**

An optional stage that can partially recover/reverse lead acid battery degradation due to sulfation; typically caused by inadequate charging or if the battery is left in a deeply discharged state.

n. **Configurable output current**

A fully configurable setting that limits the maximum charge current to a reduced level; beneficial when charging lower capacity batteries with a high current output charger.

o. **Recovery function**

The charger will attempt to recharge a severely discharged battery (even down to 0V) with low current and then resume normal charging once the battery voltage has risen sufficiently; many other chargers will not recognise a battery in this state.

p. **Power supply mode**

A specific mode to use the charger as a DC power supply; to power equipment at a constant voltage with or without a battery connected.

4. Operation

4.1. Charge algorithm

The **Smart IP43 Charger** range are intelligent multi-stage battery chargers, specifically engineered to optimise each recharge cycle and charge maintenance over extended periods.

The multi-stage charge algorithm includes the individual charge stages described below:

1. **Bulk**

   The battery is charged at maximum charge current until the voltage increases to the configured absorption voltage.

   The bulk stage duration is dependent on the battery's level of discharge, the battery capacity and the charge current.

   Once the bulk stage is complete, the battery will be approximately 80% charged (or >95% for Li-ion batteries) and may be returned into service if required.

2. **Absorption**

   The battery is charged at the configured absorption voltage, with the charge current slowly decreasing as the battery approaches full charge.

   The default absorption stage duration is adaptive and intelligently varied depending on the battery's level of discharge (determined from the duration of the bulk charge stage).

   Adaptive absorption stage duration can vary between a minimum of 30 minutes, up to a maximum limit of 8 hours (or as configured) for a deeply discharged battery.

   Alternatively, fixed absorption duration can be selected; fixed absorption duration is the automatic default when Li-ion mode is selected.

   Absorption stage can also be ended early based on the tail current condition (if enabled), which is when the charge current drops below the tail current threshold.

3. **Recondition**

   The battery voltage is attempted to be increased to the configured recondition voltage, while the charger output current is regulated to 8% of the nominal charge current (for example: 1.2A maximum for a 15A charger).

   Recondition is an optional charge stage for lead acid batteries and not recommended for regular/cyclic use; use only if required, as unnecessary or overuse will reduce battery life due to excessive gassing.

   The higher charge voltage during recondition stage can partially recover/reverse battery degradation due to sulfation, typically caused by inadequate charging or if the battery is left in a deeply discharged state for an extended period (if performed in time).

   The recondition stage may also be applied to flooded batteries occasionally to equalise individual cell voltages and prevent acid stratification.

   Recondition stage is terminated as soon as the battery voltage increases to the configured recondition voltage or after a maximum duration of 1 hour (or as configured).

   Note that in certain conditions it is possible for the recondition state to end before the configured recondition voltage is achieved, such as when the charger is simultaneously powering loads, if the battery was not fully charged before recondition stage commenced, if the recondition duration is too short (set to less than one hour) or if the charger output current is insufficient in proportion to the capacity of the battery/battery bank.

4. **Float**

   The battery voltage is maintained at the configured float voltage to prevent discharge.

   Once float stage is commenced the battery is fully charged and ready for use.

   The float stage duration is also adaptive and varied between 4 to 8 hours depending on the duration of the absorption charge stage, at which point the charger determines the battery to be in storage stage.

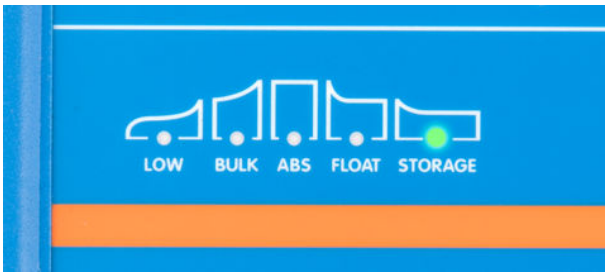
5. **Storage**

   The battery voltage is maintained at the configured storage voltage, which is slightly reduced compared to the float voltage to minimise gassing and extend battery life whilst the battery is unused and on continuous charge.

6. **Repeated absorption**

   To refresh the battery and prevent slow self-discharge while in storage stage over an extended period, a 1 hour absorption charge will automatically occur every 7 days (or as configured).

The indicator LEDs display the active charge state; refer to the image below:



Alternatively, a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app can be used to view the active charge state; refer to the 'Monitoring > VictronConnect > Status screen' and 'Monitoring > VictronConnect > Graph screen' sections for more information.

4.2. Charge modes

There are 3 integrated charge modes (Normal, High and Li-Ion), as well as an optional Recondition stage that can be included (except for Li-ion mode).

The integrated charge modes combined with adaptive charge logic are well suited for most common battery types; such as flooded lead-acid, AGM, Gel and LiFePO4.

The required charge mode can be selected via the MODE button on the charger or a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app; refer to the 'Setup > Setup using the charger' or 'Setup > Setup using Bluetooth' section for more information.

If necessary, advanced configuration with user defined settings is also possible using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app; refer to the 'Advanced configuration > Advanced settings' and 'Advanced configuration > Expert mode settings' sections for more information.

Any settings made are stored and will not be lost when the charger is disconnected from mains power or the battery.

4.2.1. Charge voltage

The charge voltage settings for each charge stage are altered depending on integrated charge mode selected; refer to the table below:

Mode	Absorption		Float		Storage		Recondition	
	12V	24V	12V	24V	12V	24V	12V	24V
Normal	14.4V	28.8V	13.8V	27.6V	13.2V	26.4V	Disabled	
Normal + Recondition	14.4V	28.8V	13.8V	27.6V	13.2V	26.4V	16.2V	32.4V
High	14.7V	29.4V	13.8V	27.6V	13.2V	26.4V	Disabled	
High + Recondition	14.7V	29.4V	13.8V	27.6V	13.2V	26.4V	16.5V	33.0V
Li-ion	14.2V	28.4V	Disabled		13.5V	27.0V	Disabled	

To ensure proper charging, battery longevity and safe operation it is important to select a charge mode appropriate for the battery type and capacity being charged; refer to the battery manufacturer's recommendations.

The **Smart IP43 Charger** range feature temperature compensation, which will automatically optimise the nominal/configured charge voltage based on ambient temperature (except for Li-ion mode or if manually disabled); refer to the 'Operation > Temperature compensation' section for more information.

4.2.2. Recondition mode

If enabled the recondition stage is included in the charge cycle; use only if required as a corrective/maintenance action - refer to the 'Operation > Charge algorithm' section for more information.

When the recondition mode is enabled the RECONDITION LED will be illuminated and blink during recondition stage.

Recondition mode can be enabled and disabled via the MODE button on the charger or a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app; refer to the 'Setup > Setup using the charger' or 'Setup > Setup using Bluetooth' section for more information.

4.2.3. Low current mode

If enabled the maximum charge current is limited to 50% of the maximum rated charge current; refer to the 'Technical Specifications' section for more information.

Low current mode is recommended when charging lower capacity batteries with a high current charger; charging at an excessive charge current can cause premature battery degradation and overheating.

Typically the maximum charge current for lead acid based batteries should not exceed ~0.3C (more than 30% of the battery capacity in Ah) and the maximum charge current for LiFePO4 batteries should not exceed ~0.5C (more than 50% of the battery capacity in Ah).

When low current mode is enabled the LOW LED will blink.

Low current mode can be enabled and disabled via the MODE button on the charger or a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app; refer to the 'Setup > Setup using the charger' or 'Setup > Setup using Bluetooth' section for more information.

It is also possible to set the charge current limit to a user defined value between the maximum rated charge current and the minimum charge current limit (25% of maximum) using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app; refer to the 'Advanced Configuration > Advanced settings' section for more information.

When the charge current limit is set to or below 50% of the maximum rated charge current the LOW LED will blink.

4.3. Temperature compensation

The **Smart IP43 Charger** range feature temperature compensation, which will automatically optimise the nominal/configured charge voltage based on ambient temperature (except for Li-ion mode or if manually disabled).

The optimal charge voltage of a lead-acid battery varies inversely with battery temperature; automatic temperature-based charge voltage compensation avoids the need for special charge voltage settings in hot or cold environments.

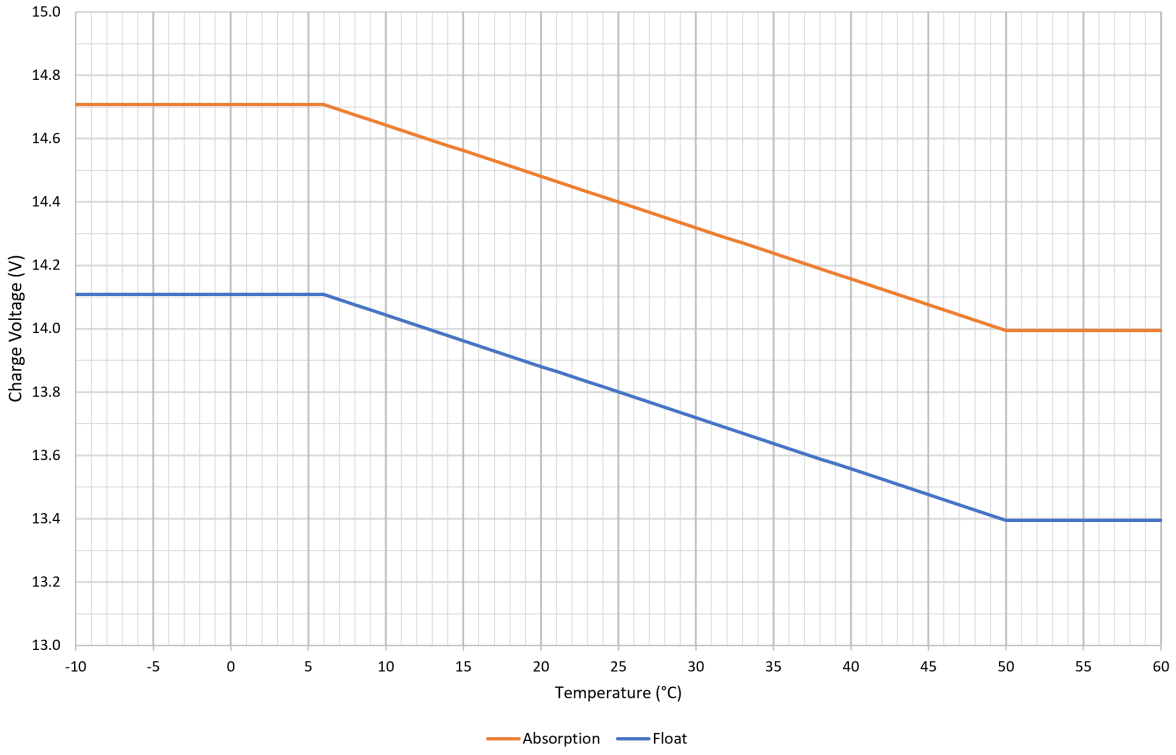
During power up the charger will measure its internal temperature and use that temperature as the reference for temperature compensation, however the initial temperature measurement is limited to 25°C as it's unknown if the charger is still warm from earlier operation.

Since the charger generates some heat during operation, the internal temperature measurement is only used dynamically if the internal temperature measurement is considered reliable; when the charge current has decreased to a low/negligible level and adequate time has elapsed for the charger's temperature to stabilise.

For more accurate temperature compensation, battery temperature data can be sourced from a compatible battery monitor (such as a BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) via VE.Smart Networking; refer to the 'Operation > VE.Smart Networking' section for more information.

The configured charge voltage is related to a nominal temperature of 25°C and linear temperature compensation occurs between the limits of 6°C and 50°C based on the default temperature compensation coefficient of -16.2mV/°C for 12V chargers (-32.4mV/°C for 24V chargers) or as configured.

Refer to the graph below for the default temperature vs charge voltage curve for 12V chargers:



The temperature compensation coefficient is specified in mV/°C and applies to the entire battery/battery bank (not per battery cell).

If the battery manufacturer specifies a temperature compensation coefficient per cell, it will need to be multiplied by the total number of cells in series (there are typically 6 cells in series within a 12V lead-acid based battery).

4.4. VE.Smart Networking

The **Smart IP43 Charger** range feature **VE.Smart Networking** capability, which enables Bluetooth connectivity and communication between multiple Victron products.

This powerful feature enables chargers to receive accurate battery voltage (Volt-sense), charge current (Current-sense) and battery temperature (Temp-sense) data from a compatible battery monitor (such as a BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) and/or multiple chargers to operate in unison with synchronised charging to further enhance the charge cycle.

A single compatible battery monitor (such as a BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) will provide voltage, temperature and/or current sense data to all (a single or multiple) chargers withing the common VE.Smart network.

Multiple compatible chargers in a common VE.Smart network (with or without a battery monitor) will also syncronise their charge algorithm (known as synchronised charging).

1. Only one battery monitor (BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) can be included in a VE.Smart network.
2. All battery monitor connections (voltage sensing cables, temperature sensor and current shunt) and chargers in a common VE.Smart network must be connected to the same battery / battery bank.
3. The maximum number of devices permitted in a VE.Smart network is 10.
4. Communication via VE.Smart networking requires all devices to be located within Bluetooth range of each other. Systems with poor or intermittent Bluetooth signal between devices will experience connection issues. Signal strength between devices can be checked in the VictronConnect VE.Smart networking page.
5. Multiple chargers in a common VE.Smart network must have the same charge settings, since the 'master' can change dynamically any charger could become the 'master'.
6. Multiple chargers in a common VE.Smart network do not need to be the same type or model, they just need to be VE.Smart Networking compatible (this includes VE.Smart Networking compatible Blue Smart chargers, Smart IP43 chargers and MPPT solar chargers).
7. Some older devices may not be VE.Smart networking compatible or have limitations; refer to the 'VE.Smart Networking Product Compatibility' table in the VE.Smart Networking manual to confirm.

4.4.1. Voltage sense

Voltage Sense uses battery voltage data that is accurately measured directly at the battery terminals (or very close) and provides it to the charger, the charger then uses this voltage data to dynamically increase the output voltage and precisely compensate for voltage drop in the cabling and connections between the charger and battery.

This enables the battery to be charged with the exact voltage as configured in the charger, instead of a lower voltage due to voltage drop in the cabling and connections.

Voltage drop is proportional to the charge current and cabling/connection resistance (V=IxR), so voltage drop will vary during a charge cycle and can be quite significant when charging at higher charge currents through cabling and connections with higher than optimal resistance; in this scenario voltage sense will be particularly beneficial.

Note that voltage sense does **not** allow inadequately rated cabling/connections to be used or compensate for excessively high voltage drop; for reliable and safe operation cabling and connections must all be suitably rated and appropriately sized for the application; refer to the 'Installation > Wiring' section for more information.

4.4.2. Synchronised charging

Synchronised charging capability enables multiple compatible chargers to be combined together in a common VE.Smart network, allowing the chargers to operate in unison as if they were one large charger.

The chargers will synchronise the charge algorithm between themselves with no further hardware or physical connections required, and simultaneously change charge states.

Synchronised charging works by systematically prioritising all chargers and assigning one as the 'master', this charger then controls the charge stage of all other 'slave' chargers. In case the initial 'master' is disconnected from the VE.Smart Network for any reason (out of Bluetooth range for example), another charger will be systematically reassigned as the 'master' and take over control; this can also be reversed if communication with the initial 'master' (that has a higher priority) is re-established. The 'master' charger can not be manually selected.

Synchronised charging does not regulate or equalise the current output of multiple chargers, each charger still has total control over it's own current output. Accordingly, current output variation between multiple chargers is normal (primarily dependent on cable resistance and charging conditions) and a total system current output limit cannot be configured; when a total system current output limit is important, consider using a GX device with DVCC (Distributed Voltage and Current Control) instead of VE.Smart Networking.

Synchronised charging can be setup with different charger types, providing they are VE.Smart Networking compatible (this includes compatible Blue Smart IP22 chargers, Smart IP43 chargers and SmartSolar MPPT solar chargers). Charging from solar chargers is not prioritised over mains supply chargers, so in some installations (primarily dependent on cable resistance and charging conditions) it is possible for solar power to be underutilised.

Synchronised charging can also be used in conjunction with a battery monitor (BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) to provide voltage, temperature and/or current sense data to the chargers in a common VE.Smart network; refer to the 'Operation > VE.Smart Networking > Voltage sense / Temperature sense / Current sense' sections for more information.

In the absence of a battery monitor providing current-sense data (requires a BMV or SmartShunt), the charge current from each individual charger is combined by the 'master' and referenced against the tail current setting.

4.5. Commencing a new charge cycle

A new charge cycle will commence when:

1. The configured Re-bulk condition is satisfied (typically due to a large load):
   a. 'Re-bulk method' set to 'Current' and 'Re-bulk current' is disabled (default configuration): The current output must be maintained at the maximum current output for four seconds.
   b. 'Re-bulk method' is set to 'Current' and 'Re-bulk current' is configured with a user defined value: The current output must exceed the configured 'Re-bulk current' for four seconds while the charger is in float or storage stage.
   c. 'Re-bulk method' is set to 'Voltage' and 'Re-bulk voltage offset' is configured with a user defined value: The battery voltage must drop below the configured 'Re-bulk voltage' for one minute.
2. The MODE button is pressed or used to select a new charge mode.
3. VictronConnect is used to select a new charge mode or change the function from ‘Power Supply’ to ‘Charger’ mode.
4. VictronConnect is used to disable and re-enable the charger (via the switch in the settings menu).
5. The remote terminals are used to disable and re-enable the charger (from an external switch or BMS signal).
6. The power supply to the AC power supply has been isolated and reconnected.

4.6. Estimating charge time

The time required to recharge a battery to 100% SOC (state of charge) is dependant on the battery capacity, the depth of discharge, the charge current and the battery type/chemistry, which has a significant effect on the charge characteristics.

4.6.1. Lead-acid based chemistry

A lead-acid battery is normally at approximately 80% state of charge (SOC) when the bulk charge stage is completed.

The bulk stage duration $\mathbf{T_{bulk}}$ can be calculated as $\mathbf{T_{bulk} = Ah / I}$, where **I** is the charge current (excluding any loads) and **Ah** is the depleted battery capacity below 80% SOC.

The absorption stage duration $\mathbf{T_{abs}}$ will vary depending on the depth of discharge; up to 8 hours of absorption may be required for a deeply discharged battery to reach 100% SOC.

For example, the time required to recharge a fully discharged Lead-acid based 100Ah battery with a 10A charger would be approximately:

- **Bulk stage** duration, $\mathbf{T_{bulk}}$ = 100Ah x 80% / 10A = 8 hours
- **Absorption stage** duration, $\mathbf{T_{abs}}$ = 8 hours
- **Total** charge duration, $\mathbf{T_{total} = T_{bulk} + T_{abs}}$ = 8 + 8 = 16 hours

4.6.2. Li-ion based chemistry

A Li-ion based battery is normally well above 95% state of charge (SOC) when the bulk charge stage is completed.

The bulk stage duration $\mathbf{T_{bulk}}$ can be calculated as $\mathbf{T_{bulk} = Ah / I}$, where **I** is the charge current (excluding any loads) and **Ah** is the depleted battery capacity below 95% SOC.

The absorption stage duration $\mathbf{T_{abs}}$ required to reach 100% SOC is typically less than 30 minutes.

For example, the charge time of a fully discharged 100Ah battery when charged with a 10A charger to approximately 95% SOC is $\mathbf{T_{bulk}}$ = 100 x 95% / 10 = 9.5 hours.

For example, the time required to recharge a fully discharged Li-ion based 100Ah battery with a 10A charger would be approximately:

- **Bulk stage** duration, $\mathbf{T_{bulk}}$ = 100Ah x 95% / 10A = 9.5 hours
- **Absorption stage** duration, $\mathbf{T_{abs}}$ = 0.5 hours
- **Total** charge duration, $\mathbf{T_{total} = T_{bulk} + T_{abs}}$ = 9.5 + 0.5 = 10 hours

4.7. Multiple isolated outputs

The **Smart IP43 Charger** 1+1 and 3 output models both include an integrated FET battery isolator and multiple isolated outputs.

Multiple isolated outputs make it possible for a single charger to charge multiple individual batteries that are at a different voltage/SOC level without current flow between the batteries, and with the charge current intrinsically distributed between all batteries depending on their voltage/SOC level and capacity.

The 1+1 output charger models can supply the full rated current from the main output, and the starter/auxiliary output is limited to a maximum of 4A; however the combined current of all outputs is limited to the full rated current.

The 3 output charger models can supply the full rated output current from all 3 outputs; however the combined current of all outputs is limited to the full rated output current.

The multiple isolated outputs are not regulated individually, one charge algorithm (charge cycle and charge voltage) is applied to all outputs; accordingly all batteries will need to be compatible with the common charge algorithm (typically the same chemistry type).

5. Installation

5.1. Mounting

The **Smart IP43 Charger** range is designed to be permanently mounted using the mounting flanges integrated into the heat sink.

Before mounting, the following aspects should be considered to identify/provide a suitable and safe location:

a. Install the charger in a location with good natural airflow/ventilation; in case airflow is a restricted, consider adding a cooling fan.

b. Ensure there is sufficient unobstructed space around the charger; a minimum clearance of 100mm above and below is recommended.

c. Install the charger on a non-flammable substrate and ensure there are no heat-sensitive items in the immediate vicinity; it is normal for the charger to become hot during operation.

d. Install the charger in a location where it is protected from environmental conditions such as water, high moisture and dust, and also located well away from any flammable liquids or gasses.

e. Do not install or place/operate the charger on top of the battery, directly above the battery, or in a sealed compartment with the battery; batteries can emit explosive gasses.

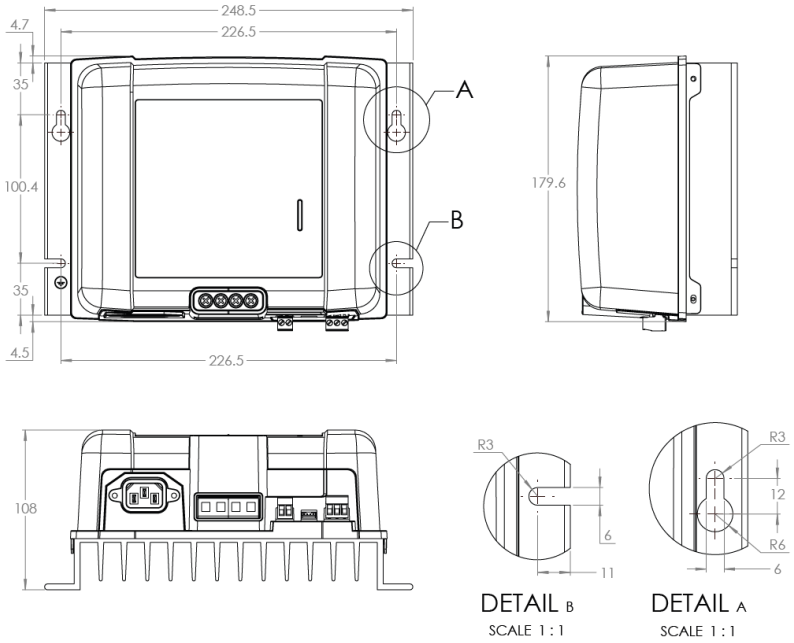
f. Do not cover or place any other items on top of the charger.

Mount the **Smart IP43 Charger** vertically with the terminals facing down; secure using suitable screws though the mounting holes/slots.

Select and use screws with a pan/flange head (do not use screws with a countersunk/tapered head), and a screw thread outer diameter well matched to the mounting hole/slot internal diameter (~5mm max OD to provide a clearance fit).

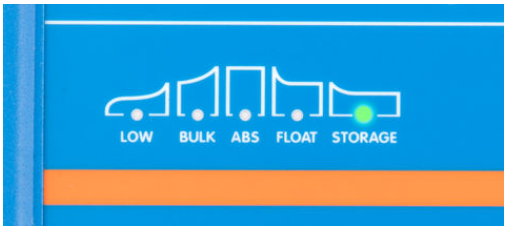
To aid installation, it is recommended to 'hang' the unit using the 2 upper screws (leave the screw heads ~3mm from the surface) and then install the 2 lower screws, before fully securing all 4 screws.

Refer to the drawing below for mounting dimensions:



5.2. Wiring

1. Connect suitable DC power cabling to the **Smart IP43 Chargers** BATTERY terminals.
   a. Use flexible multi stranded copper DC power cable with sufficient cross sectional area, inline with an appropriate fuse or circuit breaker; refer to the 'Installation > Wiring > DC power cable' and 'Installation > Wiring > Overcurrent protection' sections for more information.
   b. Ensure that wiring polarity is correct; connect the positive DC cable (red insulation) to the positive (**+**) terminal and negative DC cable (black insulation) to the negative (**-**) terminal connection.
   c. Torque the terminal screws to 2.4Nm using a small torque wrench with a suitable screw driver bit.
2. Connect the DC power cabling to the battery/batteries or DC system distribution bus - follow the instructions relevant to the installation type.
   a. **For fixed installations, or when charging a battery outside of a vehicle/installation:**
      i. Ensure that the DC system is shut down (all DC loads and charge sources off/isolated) prior to disconnection of any existing battery / DC system distribution bus cabling and connection of the charger to the battery terminals / DC system distribution bus.
      ii. Ensure that wiring polarity is correct; connect the positive DC cable (red insulation) to the positive (**+**) terminal and negative DC cable (black insulation) to the negative (**-**) terminal.
      iii. Torque all wiring termination hardware to manufacturers torque specifications using a suitable torque wrench and socket / screw driver bit.
   b. **For temporary installations when charging a battery installed within a vehicle, and the negative (-) battery terminal is grounded to the vehicle chassis (conventional):**
      i. Connect the positive DC cable / battery clamp (red insulation) directly to the battery positive (**+**) terminal first.
      ii. Then connect the negative DC cable / battery clamp (black insulation) to a suitable grounding point on the vehicle chassis (not directly to the negative battery terminal).
      iii. When disconnecting the charger, disconnect the DC cables / battery clamps in reverse of the connection order.
   c. **For temporary installations when charging a battery installed within a vehicle, and the positive (+) battery terminal is grounded to the vehicle chassis (unconventional):**
      i. Connect the negative DC cable / battery clamp (black insulation) directly to the battery negative (**-**) terminal first.
      ii. Then connect the positive DC cable / battery clamp (red insulation) to a suitable grounding point on the vehicle chassis (not directly to the positive battery terminal).
      iii. When disconnecting the charger, disconnect the DC cables / battery clamps in reverse of the connection order.
3. Connect VE.Direct communication cable (between VE.Direct port on charger and Venus device) and/or control wiring (remote on/off and/or programmable relay) as required for the installation.
4. Connect the AC power cable to a mains power outlet; all LEDs will illuminate briefly when the charger is powered up, then the LEDs indicating the current charge mode and charge state will illuminate.



Example wiring schematics depicting most typical installation configurations are also provided for reference; refer to the 'Installation > Schematics' section for more information.

5.2.1. DC Power cable

To ensure reliable and safe operation it is important to select and install suitably rated DC power cabling between the **Smart IP43 Charger** and the battery/batteries.

Cable type/specification selection should consider the following aspects:

a. **Conductor material and cross sectional area**

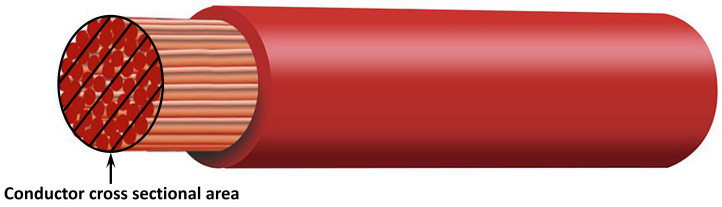
Conductor material and cross sectional area effects the resistance of a cable per unit length, and accordingly determines the maximum current capability/rating, as well as the power loss / voltage drop over the total cable length.

i. To prevent overheating of the cable and/or interfacing equipment, select high quality power cable with copper conductors and a conductor cross sectional area appropriately sized for the application.

The cable manufacturers maximum current rating for the cable (after applying any de-rating factors applicable to the installation) must exceed the maximum operating current possible within the system, and the cable must also be capable to safely withstand the fault current required to blow the fuse / trip the circuit breaker.

ii. To prevent high power loss and operational issues due to excessive voltage drop, design the system layout so that cable lengths are as short as possible and if needed increase conductor cross sectional area to reduce voltage drop to an acceptable level.

If needed, it is recommended to increase conductor cross sectional area so that the voltage drop over the total cable length is below ~0.5V and ~3% at maximum operating current.



b. **Strand diameter**

Strand diameter effects the contact area / resistance and accordingly determines the amount heat generated at terminations, as well as the flexibility capability/rating of the cable.

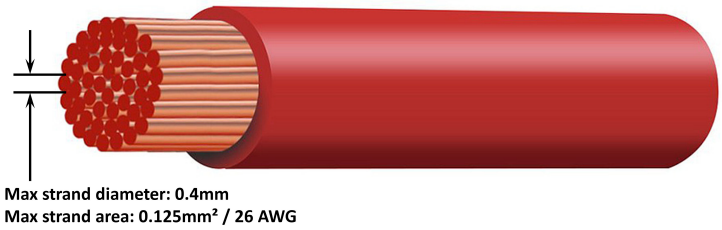
i. To prevent overheating of the cable and/or interfacing equipment at/near terminations, select high quality power cable with fine multi-stranded copper conductors.

In order to maximise contact area and minimise resistance at terminations, the diameter of each individual copper strand must not exceed 0.4mm (0.016 inch) or a surface area of 0.125mm² (AWG26).

If cable with a thicker strand diameter is used, the contact area at the interface between the conductor strands and termination will be insufficient and cause excessive resistance. A high resistance electrical connection will generate substantial heat when operating under load and result in severe overheating or potentially a fire.

ii. To enable easy cable routing with tight bends and prevent failure of the cable and/or interfacing equipment due to excessive force/stress at terminations and/or cyclic fatigue, select high quality power cable specifically designed for applications requiring high flexibility.

It is recommended to use high quality power cable with a flexibility class rating of 5 or higher (according to VDE 0295, IEC 60228 and BS6360).



c. **Insulation type**

Insulation type effects the maximum temperature capability/rating and accordingly the maximum current capability/rating, as well as the maximum voltage isolation capability/rating of a cable.

i. To prevent overheating of the cable insulation, select high quality power cable with an insulation temperature rating appropriate for the installation.

The cable manufacturers insulation temperature rating must exceed the maximum projected temperature for the installation, when considering the combination of maximum possible surrounding temperature and temperature rise due the heat generated by the cable itself under maximum load.

It is recommended to use high quality power cable with a maximum temperature rating of at least 90°C (194°F).

ii. To ensure robust electrical isolation, select high quality power cable with an insulation voltage rating appropriate for the maximum operating voltage of the system.

It is recommended to use high quality power cable with a maximum voltage rating of 0.6/1kV.

Refer to the table below for the recommended minimum cable cross sectional area / gauge in relation to cable length (one way length between charger and battery):

Charger model	Max output current	Minimum conductor cross sectional area			
		<2.5m	2.5 to 5.0m	5.0 to 7.5m	7.5 to 10m
12/30	30A	10mm^2 | 8 AWG	16mm^2 | 6 AWG	16mm^2 | 6 AWG	NR
12/50	50A	16mm^2 | 6 AWG	16mm^2 | 6 AWG	NR	NR
24/16	16A	4mm^2 | 12 AWG	10mm^2 | 8 AWG	16mm^2 | 6 AWG	16mm^2 | 6 AWG
24/25	25A	6mm^2 | 10 AWG	10mm^2 | 8 AWG	16mm^2 | 6 AWG	16mm^2 | 6 AWG

Certain combinations with high current and very long cable length are not recommended (NR) as voltage drop will be excessive even with the largest compatible cable size; in addition to high power loss this may cause charging issues.

5.2.2. Remote on/off

The Smart IP43 Charger is equipped with remote on/off terminals, these terminals enable charging to be turned on or off remotely dependent on their state.

There are 3 options to turn the Smart IP43 Charger on using the remote terminal(s):

1. Interconnect / short the L and H terminals (factory default is a shorting link between L and H). The L and H terminal can be interconnected /shorted via a switch, relay or other external device, like a battery management system (BMS).
2. Pull the H terminal to a high voltage level; when the voltage on the H terminal is above 2.9V (connected to battery positive for example) the charger will turn on. The H terminal can be connected to a high voltage level via a switch, relay or other external device, like a battery management system (BMS).
3. Pull the L terminal to a low voltage level; when the voltage on the L terminal is below 3.5V (connected to battery negative for example) the charger will turn off. The L terminal can be connected to a low voltage level via a switch, relay or other external device, like a battery management system (BMS).

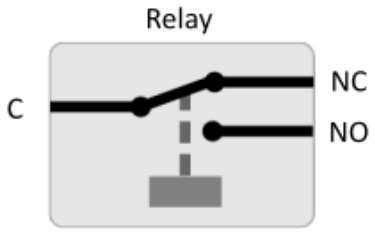
To turn the Smart IP43 Charger off using the remote terminal(s), both terminals need to have an open circuit relative to each other and be left floating (no connection to a high or low voltage level).

5.2.3. Programmable relay

The Smart IP43 Charger is equipped with a programmable relay, the relay can be used for external control based on the selected relay mode (Alarm, Remote control, or Charging) and operational conditions.

There are 3 programmable relay terminals:

1. NO (Normally open)
2. C (Common)
3. NC (Normally closed)



When the relay is switched off there is a closed circuit between C and NC, and an open circuit between C an NO.

When the relay is switched on there is a closed circuit between C and NO, and an open circuit between C an NC.

Wire the relay terminals to an external device as necessary in order to achieve the desired signal/control.

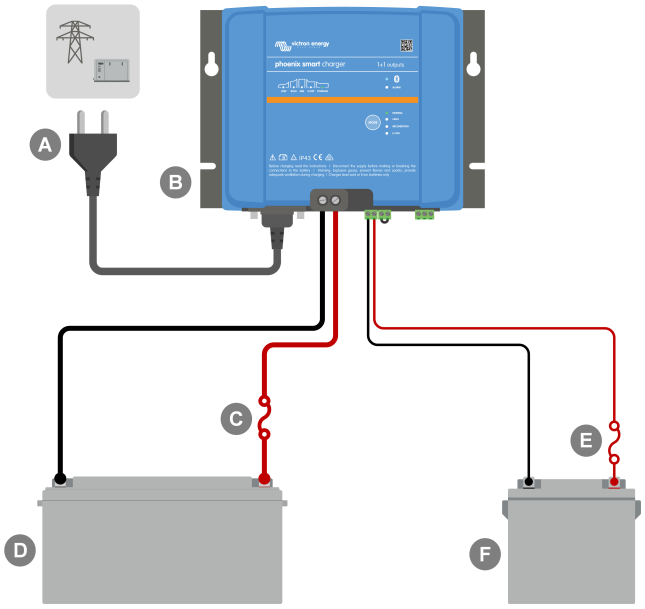
Note: The programmable relay function only works when AC input power is available and charging is enabled. If charging is disabled by any means (the remote on/off terminals, via VictronConnect or a GX device) the programmable relay functionally will also be disabled.

5.3. Schematics

5.3.1. Basic installation

Main and auxiliary (1+1) output models

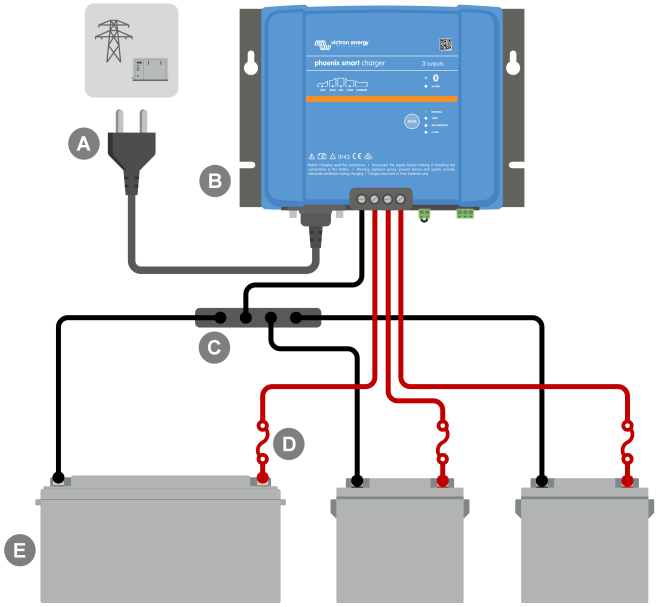
Refer to the wiring schematic below to connect a Smart IP43 Charger (1+1 output model) to a main battery / battery bank, and an optional auxiliary battery:



Key	Description
A	AC power supply (mains power grid, generator or inverter)
B	Smart IP43 Charger (1+1 output model)
C	Fuse / circuit breaker (locate as close as practical to main battery)
D	Main battery / battery bank
E	Fuse / circuit breaker (locate as close as practical to auxiliary battery)
F	Auxiliary battery (auxiliary battery is optional)

Multiple (3) output models

Refer to the wiring schematic below to connect a **Smart IP43 Charger** (3 output model) to multiple independent batteries / battery banks:

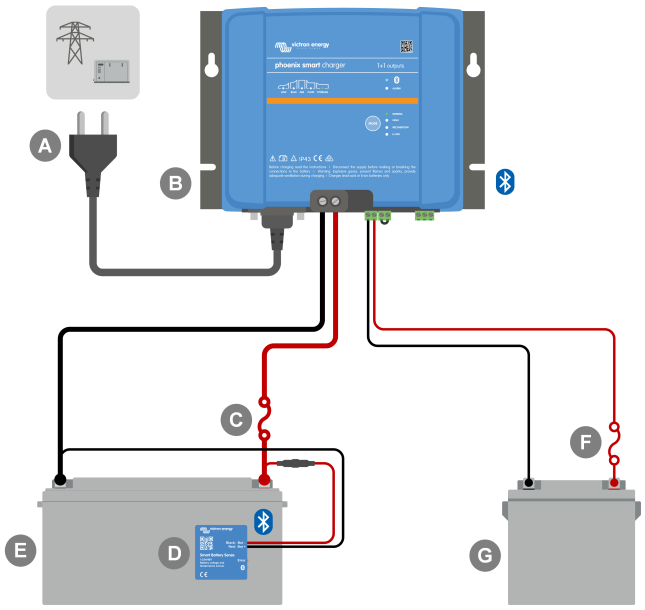


Key	Description
A	AC power supply (mains power grid, generator or inverter)
B	Smart IP43 Charger (3 output model)
C	DC negative busbar
D	Fuses / circuit breakers x3 (locate as close as practical to batteries)
E	Batteries / battery banks x3 (any combination of 1, 2 or 3 batteries)

5.3.2. VE.Smart Networking

Main and auxiliary (1+1) output models with Smart Battery Sense

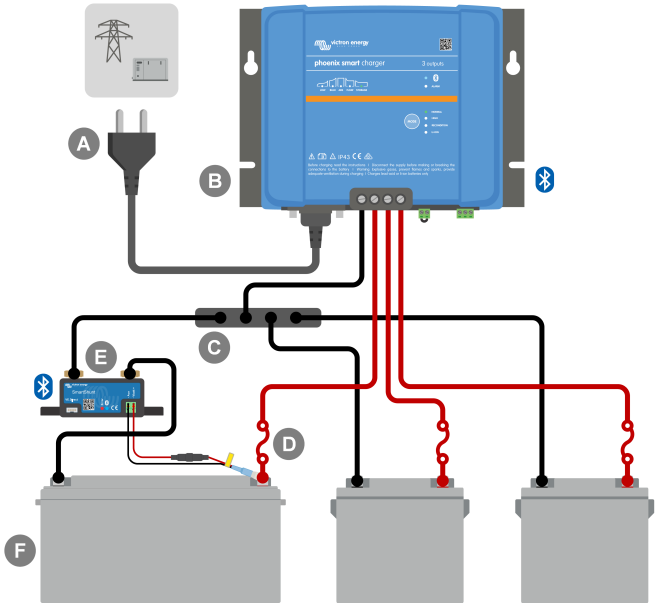
Refer to the wiring schematic below to connect a Smart IP43 Charger (1+1 output model) to a main battery / battery bank with a Smart Battery Sense, and a optional auxiliary battery:



Key	Description
A	AC power supply (mains power grid, generator or inverter)
B	Smart IP43 Charger (1+1 output model)
C	Fuse / circuit breaker (locate as close as practical to main battery)
D	Main battery / battery bank
E	Smart Battery Sense
F	Fuse / circuit breaker (locate as close as practical to auxiliary battery)
G	Auxiliary battery (auxiliary battery is optional)

Multiple (3) output models with SmartShunt

Refer to the wiring schematic below to connect a **Smart IP43 Charger** (3 output model) to multiple independent batteries / battery banks with a SmartShunt or BMV battery monitor:



Key	Description
A	AC power supply (mains power grid, generator or inverter)
B	Smart IP43 Charger (3 output model)
C	DC negative busbar
D	Fuses / circuit breakers x3 (locate as close as practical to batteries)
E	SmartShunt or BMV battery monitor shunt (locate as close as practical to battery, shown with optional temperature sensor PN: ASS000100000)
F	Batteries / battery banks x3 (any combination of 1, 2 or 3 batteries)

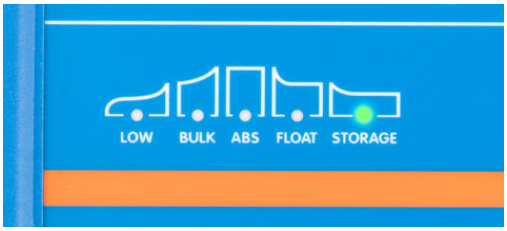
A **VE.Smart Network** must be setup between the **Smart IP43 Charger** and SmartShunt or BMV battery monitor to enable Bluetooth connectivity and communication between devices; refer to the 'Advanced Configuration > VE.Smart Networking' section for more information.

6. Setup

6.1. Setup using the charger

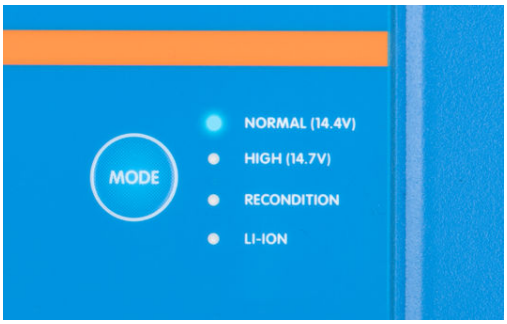
The charge mode and charge current limit most appropriate for the battery type and capacity can be selected directly on the charger, using the MODE button.

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.



2. Select the most appropriate mode from the integrated charge presets (Normal, Normal + Recondition, High, High + Recondition or Li-ion) by briefly pressing the MODE button on the charger to cycle through each option; the LED beside the currently selected charge mode (NORMAL / HIGH / LI-ION) will be illuminated, as well as the RECONDITION LED if recondition stage is enabled.

   Ensure that recondition stage is only enabled when required, as unnecessary or overuse will reduce battery life.



3. If required, enable low current mode (charge current limited to 50% of the maximum rated charge current); to enable (or disable) low current mode depress and hold the MODE button for 3 seconds, when enabled the LOW LED will blink.

The charger will automatically store the selected charge mode and recall it for future charge cycles (even after being disconnected from power).

To ensure proper charging, battery longevity and safe operation it is important to select a charge mode appropriate for the battery type and capacity being charged; refer to the 'Operation > Charge modes' section and the battery manufacturer's recommendations for more information.

6.2. Setup using Bluetooth

The charge mode and charge current limit most appropriate for the battery type and capacity can also be selected using Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

For further details about the VictonConnect app refer to the VictronConnect manual.

1. Download and install the VictronConnect app onto the mobile phone or tablet.

   The VictronConnect app can be downloaded from the following locations:

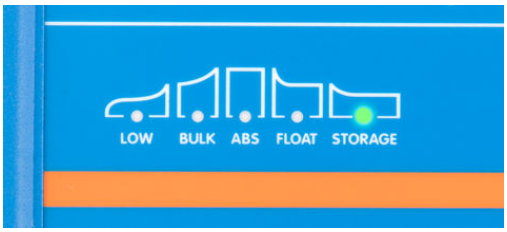
   a. Android - Google Play Store

   b. iOS/Mac - Apple App Store

   c. Windows and other - Victron Energy website > Downloads > Software

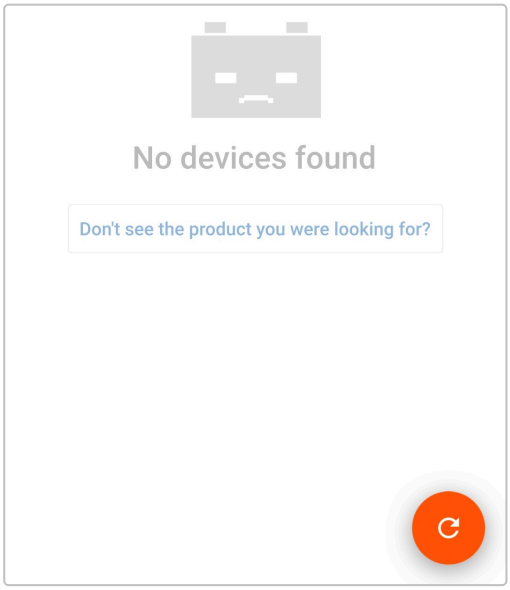
2. Enable Bluetooth on the Bluetooth enabled device (mobile phone or tablet) if not already enabled, but do not attempt to pair with the **Smart IP43 Charger**.

3. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.

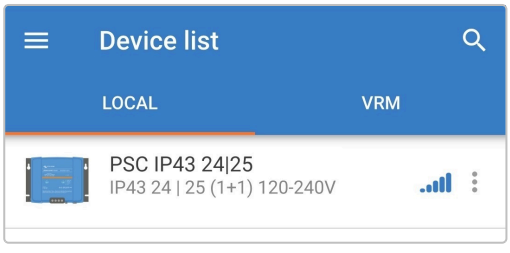


4. Open the VictronConnect app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, under 'Other devices'.

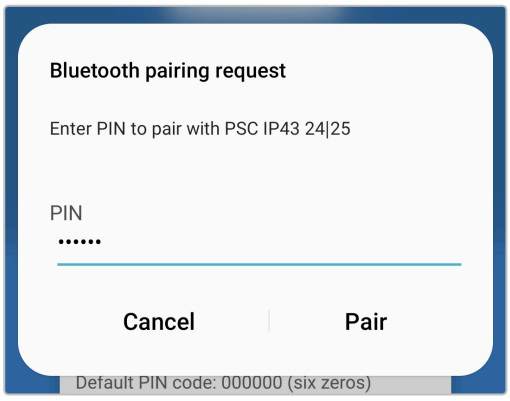
   In case the **Smart IP43 Charger** doesn't automatically appear, ensure that the mobile phone or tablet has Bluetooth enabled and is within close range, then perform a manual scan for devices by selecting the 'scan' button (round orange button with circular arrow) in the bottom right corner.



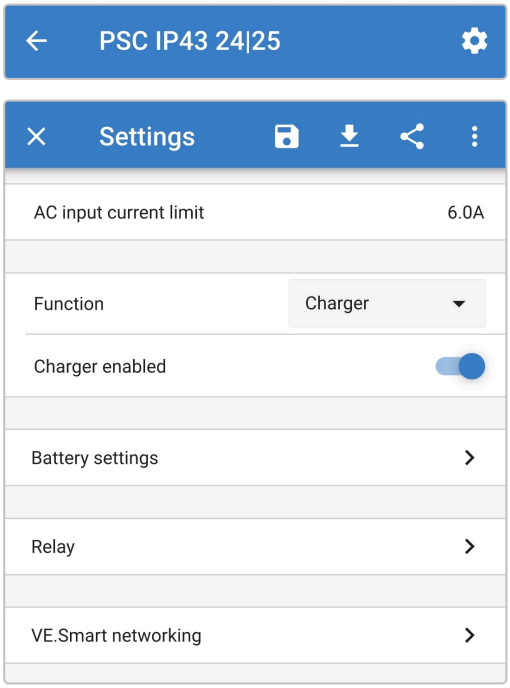
5. Select the **Smart IP43 Charger** from the 'LOCAL' page device list, under 'Other devices'.



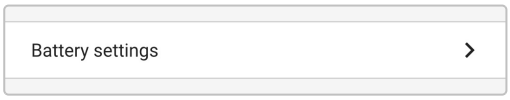
6. During initial connection a 'Bluetooth pairing request' prompt will appear requesting the Bluetooth PIN code; enter the default PIN code 000000, then select 'Pair'.



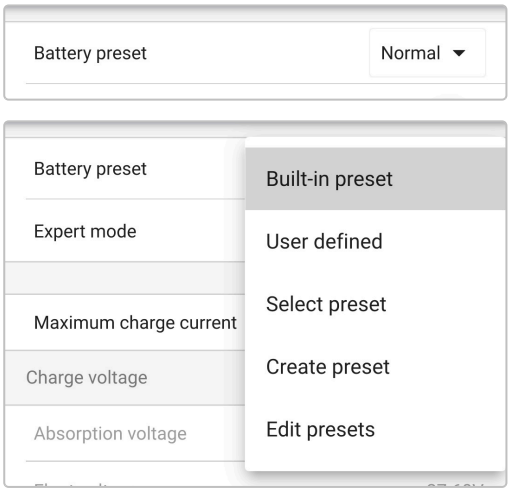
7. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.



8. Select 'Battery settings' to access the 'Battery settings' menu.

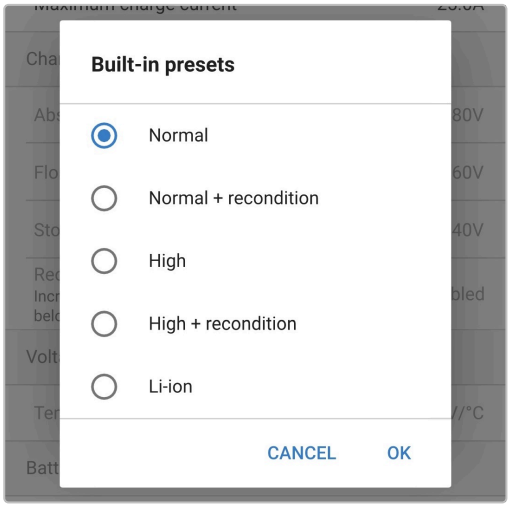


9. Expand the 'Battery preset' drop-down menu, then select 'Built-in preset' or alternatively 'Select preset' for more specialised battery types.



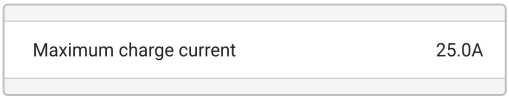
10. Select the most appropriate mode from the integrated charge presets (Normal, Normal + Recondition, High, High + Recondition or Li-ion) in the 'Built-in presets' menu, then select 'OK'; the LED beside the currently selected charge mode (NORMAL / HIGH / LI-ION) will be illuminated, as well as the RECONDITION LED if recondition stage is enabled.

    Ensure that recondition stage is only enabled when required, as unnecessary or overuse will reduce battery life.

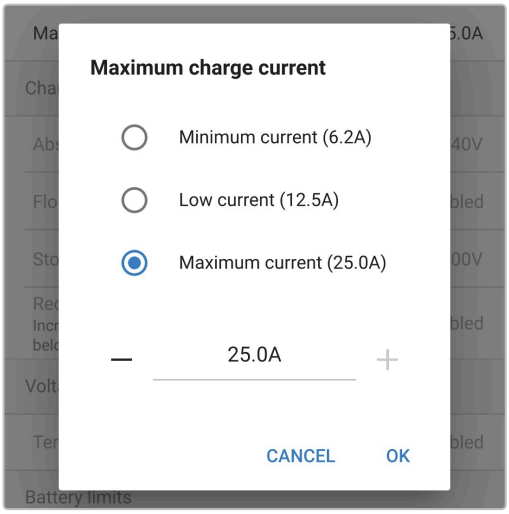


11. If required, enable low current mode (charge current limited to 50% of the maximum rated charge current) or minimum current mode (charge current limited to 25% of the maximum rated charge current); to enable (or disable) low current mode:

    a. Access the 'Maximum charge current' menu by selecting the ‘Maximum charge current' menu option.



    b. Select the most appropriate maximum charge current from the preset options (Minimum / Low / Maximum), or specify an alternative current (between the minimum and maximum limits) using the numeric input controls near the bottom.



The charger will automatically store the selected charge mode and recall it for future charge cycles (even after being disconnected from power).

To ensure proper charging, battery longevity and safe operation it is important to select a charge mode appropriate for the battery type and capacity being charged; refer to the 'Operation > Charge modes' section and the battery manufacturer’s recommendations for more information.

6.3. Bluetooth

6.3.1. Changing the PIN code

To prevent an unauthorised Bluetooth connection, it is highly recommended to change the default PIN code.

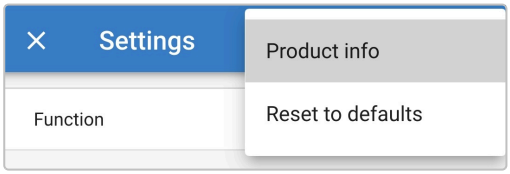
The Bluetooth PIN code can be changed using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

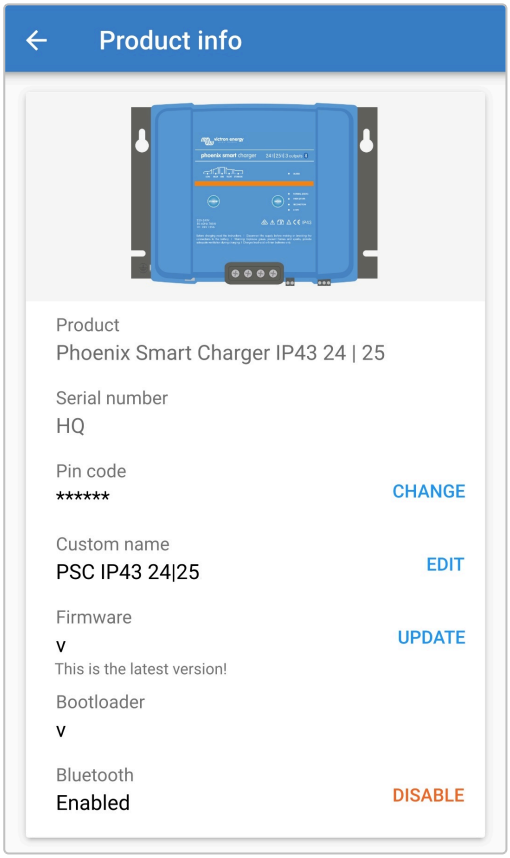
To change the Bluetooth PIN code:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).
3. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

4. Select the 'device options' icon (three vertical dots in the top right corner) to access the ‘device options’ menu.

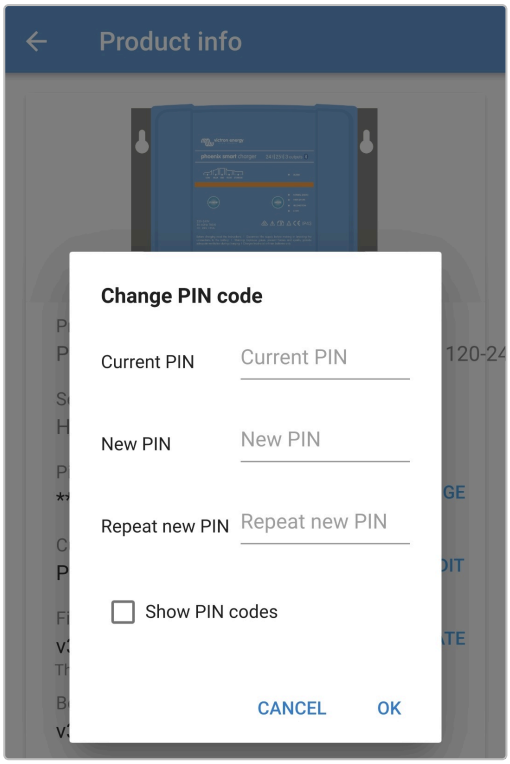
5. Select 'Product info’ to access the 'Product info' page.





6. Select ‘CHANGE’ (beside ‘Pin code’) to open the ‘Change PIN code’ window.

7. Enter the current PIN code and the desired new PIN code (twice), then select 'OK'; avoid using an obvious PIN code that is easy for someone else to guess, such as 123456.



6.3.2. Resetting the PIN code

If the PIN code is forgotten or lost, it can be reset to the default 000000 using the MODE button on the charger or a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

Reset PIN using the charger

To reset the Bluetooth PIN code:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Depress and hold the MODE button on the **Smart IP43 Charger** for 10 seconds.
3. All charge mode LEDs will blink twice to indicate that the PIN code has been successfully reset.

During this procedure:

a. The PIN code is reset to default (000000)

b. The active Bluetooth connection is disconnected

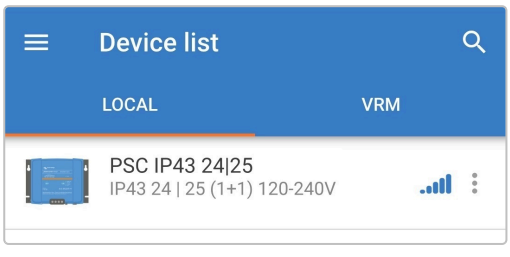
c. All Bluetooth pairing information is cleared

Accordingly, it's also necessary to remove/clear the Smart IP43 Charger Bluetooth pairing information from any Bluetooth enabled devices (mobile phones or tablets) that were previously paired before attempting to re-connect.

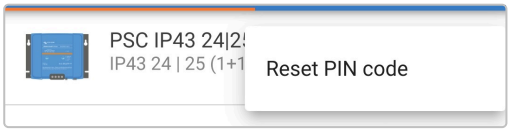
Reset PIN using Bluetooth

To reset the Bluetooth PIN code:

1. Locate and record the PUK code for reference later; the PUK code is located on a label stuck to the side of the **Smart IP43 Charger**.
2. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
3. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list.
4. Select the 'device options' icon (three vertical dots on the right side of the description) to access the Bluetooth pairing 'device options' menu.



5. Select 'Reset PIN code' to open the 'Reset PIN code' window.



6. Enter the PUK code (recorded earlier) and select 'OK'.

7. All charge mode LEDs will blink twice to indicate that the PIN code has been successfully reset.

During this procedure:

a. The PIN code is reset to default (000000)

b. Bluetooth pairing information is **not** cleared

Accordingly, it's **not** necessary to remove/clear the Smart IP43 Charger Bluetooth pairing information from any Bluetooth enabled devices (mobile phones or tablets) that were previously paired before attempting to re-connect.

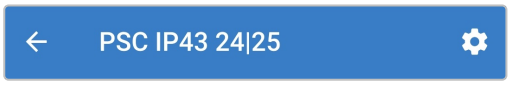
6.3.3. Disabling Bluetooth

It is possible to totally disable Bluetooth communication if desired, using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

Typically, there is no need to disable Bluetooth since unauthorised access is protected with a PIN code, but certain situations may warrant it for an even higher level of security.

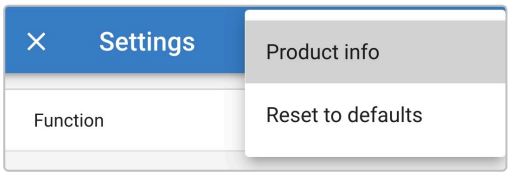
To disable Bluetooth:

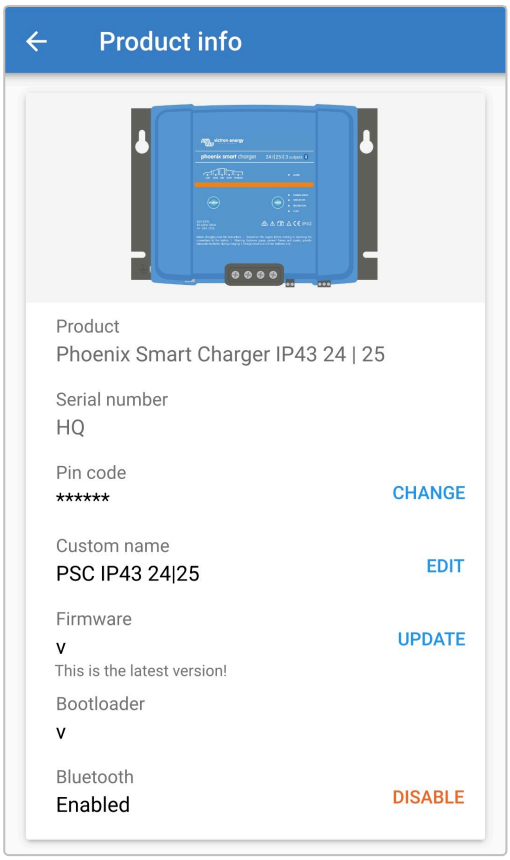
1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).
3. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.



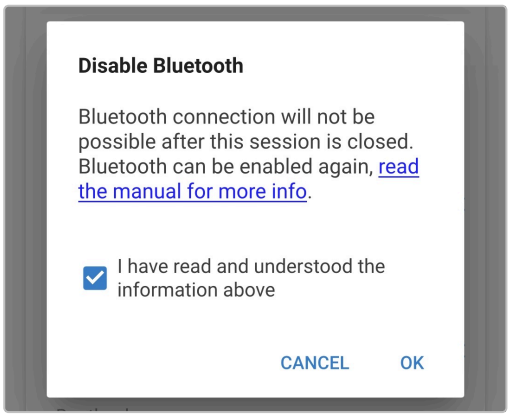
4. Select the 'device options' icon (three vertical dots in the top right corner) to access the ‘device options’ menu.

5. Select 'Product info’ to access the 'Product info' page.





6. Select 'DISABLE' (beside 'Bluetooth Enabled') to open the 'Disable Bluetooth' window.
7. Read the warning message, then tick the checkbox and select 'OK' to accept and progress.



8. Bluetooth will now be disabled, but can be re-enabled again.

6.3.4. Re-enabling Bluetooth

It is possible to re-enable Bluetooth communication using the MODE button on the charger.

To re-enable Bluetooth:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Depress and hold the MODE button on the **Smart IP43 Charger** for 10 seconds.
3. All charge mode LEDs will blink twice to indicate that Bluetooth has been successfully re-enabled, and all Bluetooth settings reset.

During this procedure:

a. Bluetooth is re-enabled
b. The PIN code is reset to default (000000)
c. All Bluetooth pairing information is cleared

Accordingly, it's also necessary to remove/clear the Smart IP43 Charger Bluetooth pairing information from any Bluetooth enabled devices (mobile phones or tablets) that were previously paired before attempting to re-connect.

6.4. VE.Smart Networking

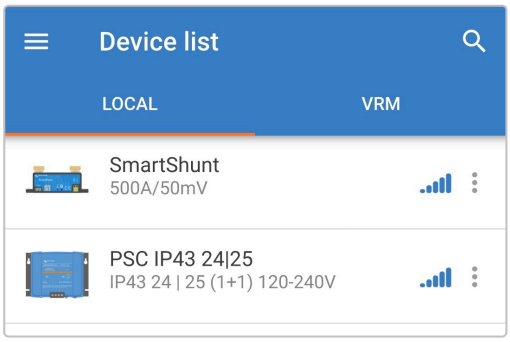
VE.Smart Networking enables Bluetooth connectivity and communication between multiple Victron products to further enhance the charge cycle; refer to the 'Operation > VE.Smart Networking' section for more information.

After VE.Smart networking compatible hardware is installed, VE.Smart networking needs to be setup/enabled.

6.4.1. Voltage, temperature and current sense

To setup a VE.Smart Network with Volt-Sense / Temp-Sense / Current-Sense:

1. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the battery monitor (BMV, SmartShunt, Smart Battery Sense or VE.Bus Smart Dongle) in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).

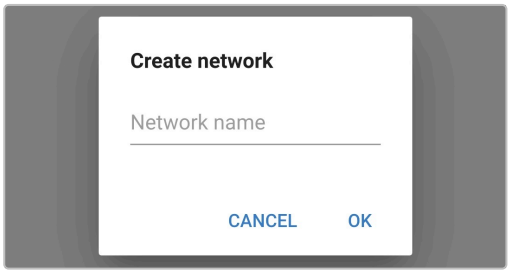


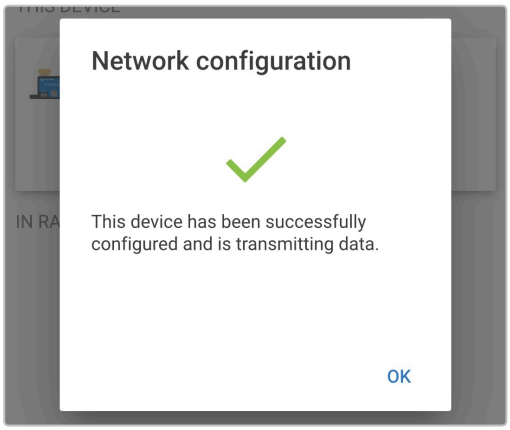
2. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

3. Select 'VE.Smart networking' to access the 'VE.Smart networking' page.

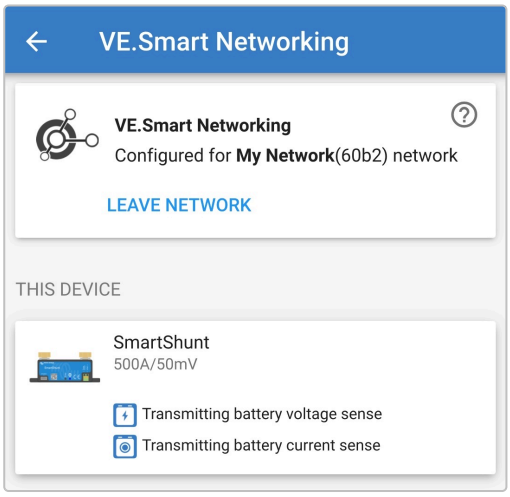
4. Select 'CREATE NETWORK' (or 'JOIN NETWORK' if the VE.Smart network has already been created).

5. Enter a name to identify the VE.Smart network and then select 'OK' to the prompts.





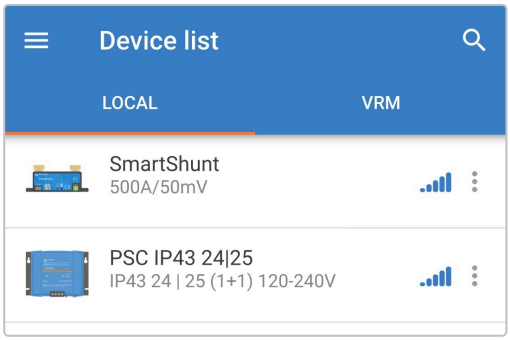
6. Once setup, details of the data being transmitted to the VE.Smart network are shown on the VE.Smart networking page.



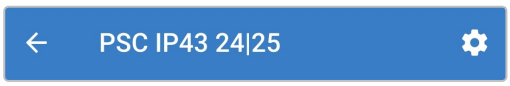
7. Exit the device by selecting the back 'arrow' icon and 'close' icon (cross) in the top left corner.

8. Connect the **Smart IP43 Charger** AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.

9. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).



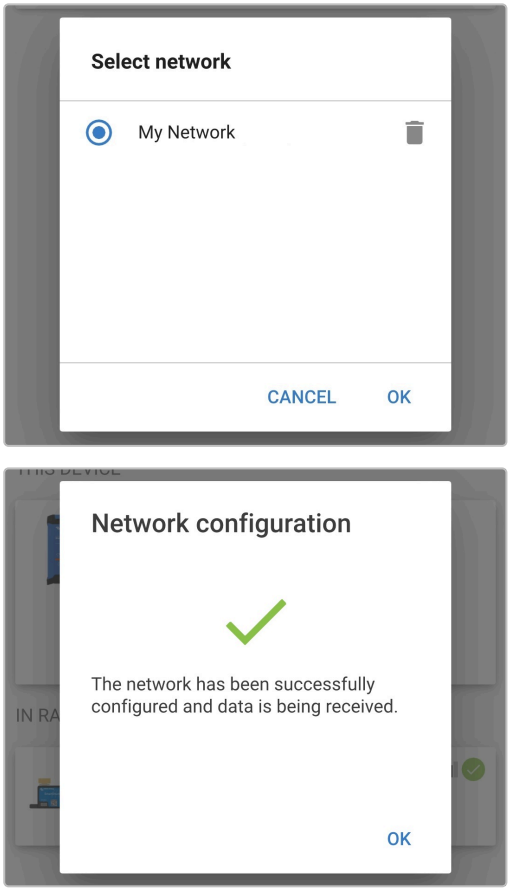
10. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.



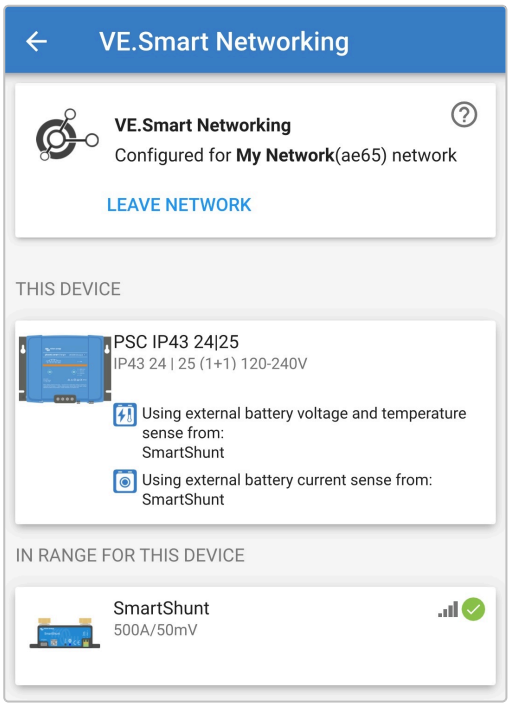
11. Select 'VE.Smart networking' to access the 'VE.Smart networking' page.

12. Select 'JOIN EXISTING'.

13. Select the VE.Smart network previously setup (or the network you want to join if there are multiple), then select 'OK' to the prompts.

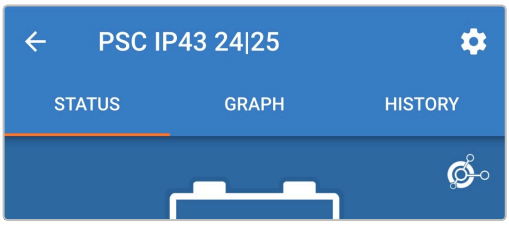


14. The VE.Smart network is now configured, details of the data being received from the VE.Smart network are shown on the VE.Smart network page.

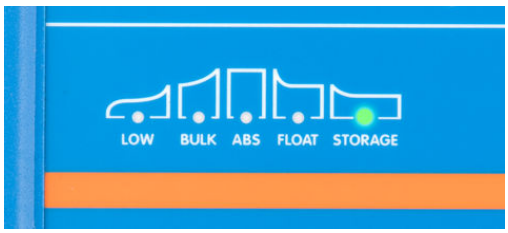


Once successfully configured:

a. The VE.Smart network symbol will appear in the top right corner of the STATUS screen (both the battery monitor and the charger).



b. The active charge state LED on the charger (BULK, ABS, FLOAT and STORAGE) will blink (turn off) momentarily every 4 seconds.



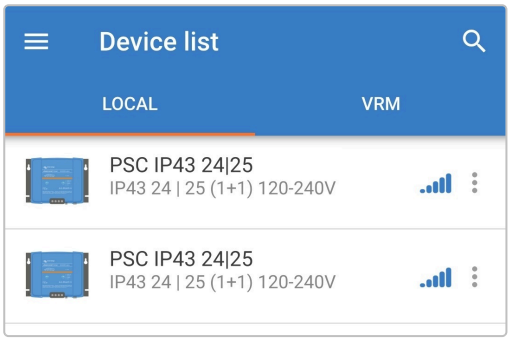
15. For systems with multiple compatible chargers, repeat the relevant steps above for each additional charger.

Multiple chargers in a common VE.Smart network must have the same charge settings, since the 'master' can change dynamically any charger could become the 'master'.

6.4.2. Synchronised charging

To setup a VE.Smart Network with Synchronised charging:

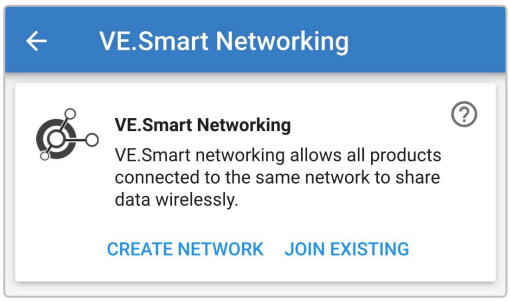
1. Connect the AC power cable for all compatible chargers to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the first **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).



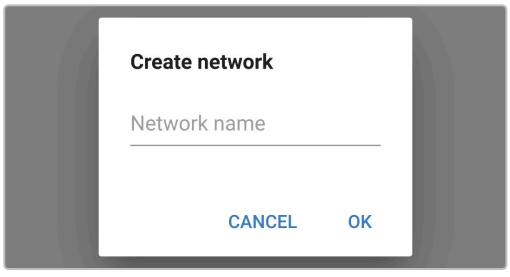
3. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

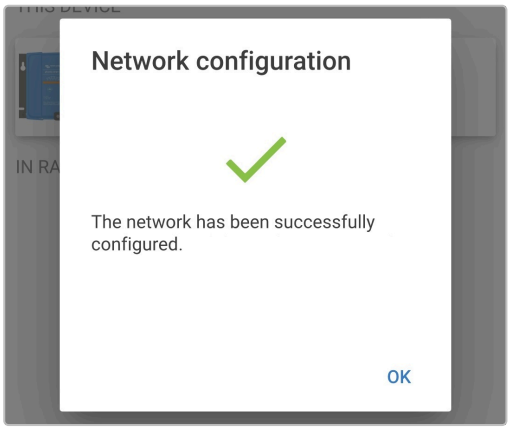
4. Select 'VE.Smart networking' to access the 'VE.Smart networking' page.

5. Select 'CREATE NETWORK' (or 'JOIN NETWORK' if the VE.Smart network has already been created).

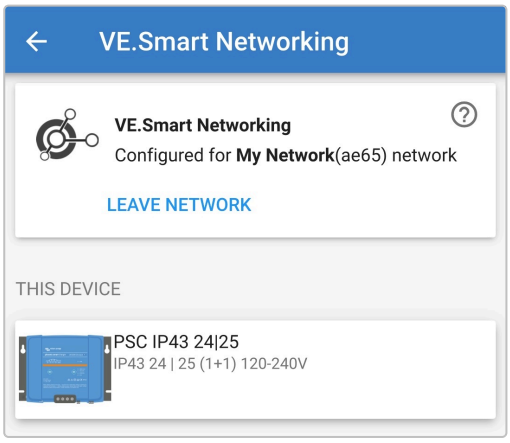


6. Enter a name to identify the VE.Smart network and select 'OK' to the prompts.



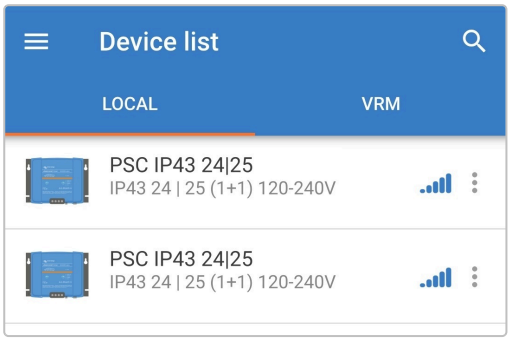


7. Once setup, details of the data being transmitted to the VE.Smart network are shown on the VE.Smart networking page.

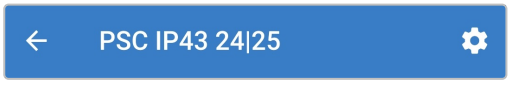


8. Exit the device by selecting the back 'arrow' icon and 'close' icon (cross) in the top left corner.

9. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate another compatible charger in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).

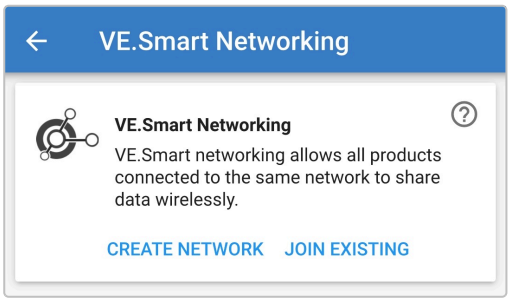


10. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

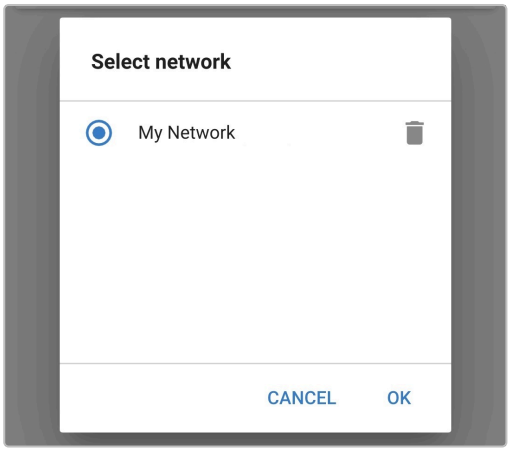


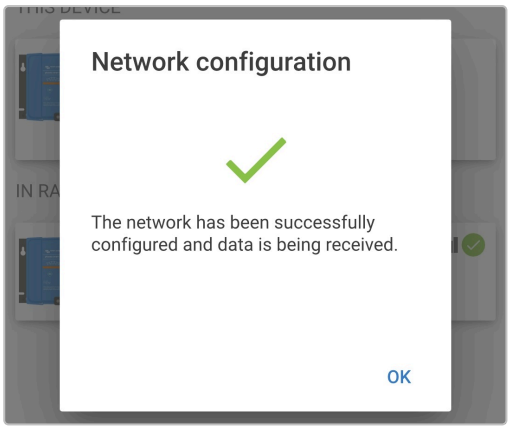
11. Select 'VE.Smart networking' to access the 'VE.Smart networking' page.

12. Select 'JOIN EXISTING'.

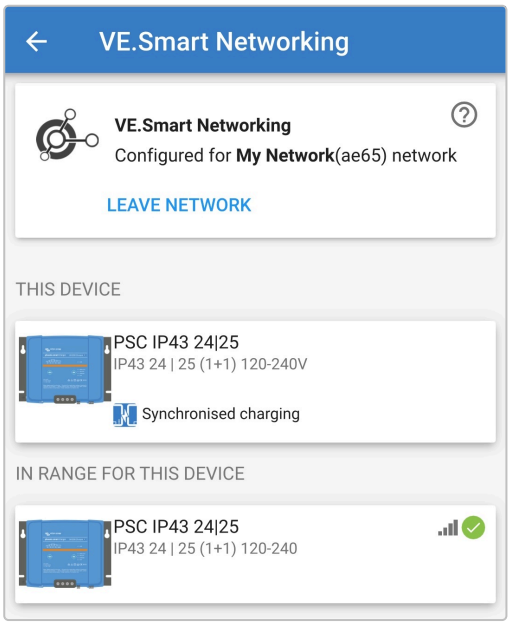


13. Select the VE.Smart network previously setup (or the network you want to join if there are multiple), then select 'OK' to the prompts.



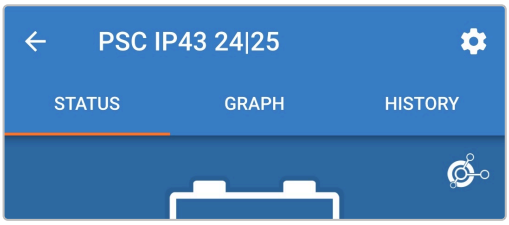


14. The VE.Smart network is now configured, details of the syncronised chargers in the VE.Smart network are shown on the VE.Smart network page.

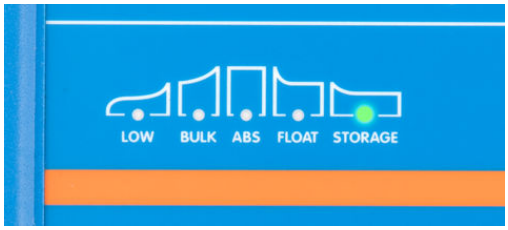


Once successfully configured:

a. The VE.Smart network symbol will appear in the top right corner of the STATUS screen (of each charger in the network).



b. The active charge state LED on the charger (BULK, ABS, FLOAT and STORAGE) will blink (turn off) momentarily every 4 seconds.



15. For systems with multiple compatible chargers, repeat the relevant steps above for each additional charger.

Multiple chargers in a common VE.Smart network must have the same charge settings, since the 'master' can change dynamically any charger could become the 'master'.

6.5. Reset to defaults

If needed, it is possible to reset/restore all **Smart IP43 Charger** settings to factory defaults.

Note that this does **not** reset any Bluetooth related settings, such as the PIN code or pairing information.

Settings can be reset/restored to factory defaults using a Bluetooth enabled device (such as a mobile phone or tablet) with the **VictronConnect** app.

To perform a system reset:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).
3. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

4. Select the 'device options' icon (three vertical dots in the top right corner) to access the ‘device options’ menu.

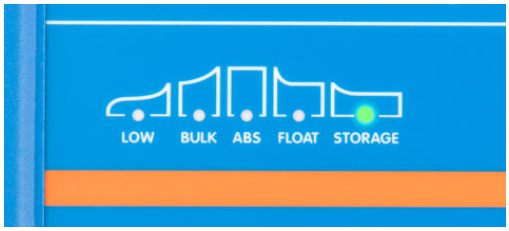
5. Select 'Reset to defaults' to open the 'Restore device?' window.
6. Select ‘YES’ to reset/restore all settings to factory defaults.

7. Monitoring

7.1. LED indications

7.1.1. Operation states

The **Smart IP43 Charger** has multiple LEDs that can be referenced to determine the current charge state and other operational information.



Refer to the LED indications in the table below:

Charge state	LOW	BULK	ABS	FLOAT	STORAGE	ALARM
Bulk	N/A	Illuminated	Off	Off	Off	Off
Absorption	N/A	Off	Illuminated	Off	Off	Off
Recondition *1	N/A	Blinking	Blinking	Off	Off	Off
Float	N/A	Off	Off	Illuminated	Off	Off
Storage	N/A	Off	Off	Off	Illuminated	Off
Low current mode	Illuminated	N/A	N/A	N/A	N/A	N/A
Charging disabled	Off	Blinking	Off	Off	Off	Off

*1 The RECONDITION LED will also blink during recondition stage.

7.1.2. Error states

If an error occurs, the red ALARM LED will illuminate, the charge state LEDs can then be referenced to determine the specific error state.

Refer to the LED indications in the table below:

Error state	LOW	BULK	ABS	FLOAT	STORAGE	ALARM
Bulk time protection	Off	Blinking	Off	Off	Off	Illuminated
Internal Error*	Off	Blinking	Blinking	Blinking	Off	Illuminated
Charger over-voltage	Off	Off	Blinking	Off	Blinking	Illuminated
Charger over-current	Off	Blinking	Off	Off	Blinking	Illuminated
Low mains voltage	Blinking	Off	Off	Off	Off	Illuminated
BMS connection lost	Off	Off	Off	Blink	Blink	Illuminated

** Note that warning #31 (Input voltage measurement out of range) uses the same LED blinking code. The difference is that on warning #31 the device continues to work.*

7.2. VictronConnect

The charger operation and recharge statistics can be closely monitored live or post charging using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

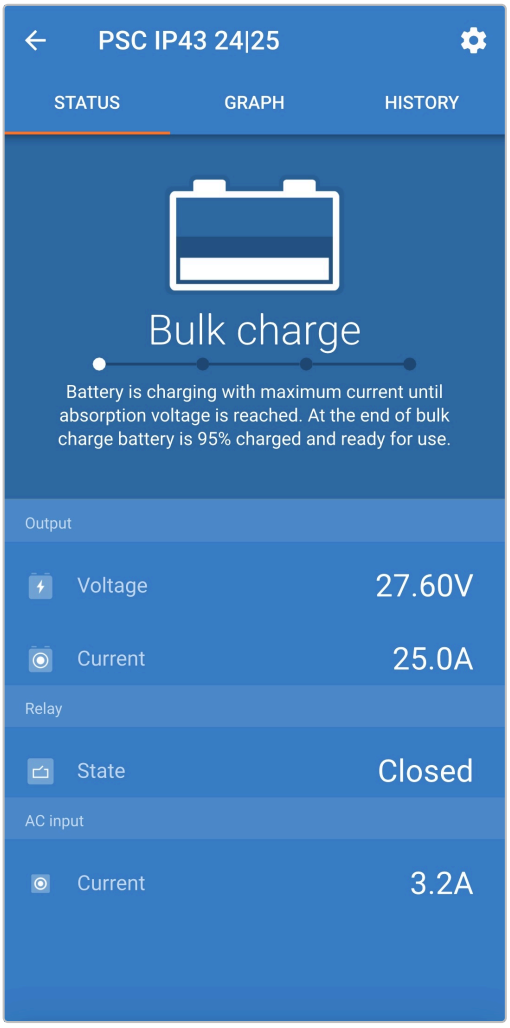
There are 3 different overview screens available (STATUS, GRAPH and HISTORY), each displaying different monitoring or historical data; spanning back over the last 40 charge cycles.

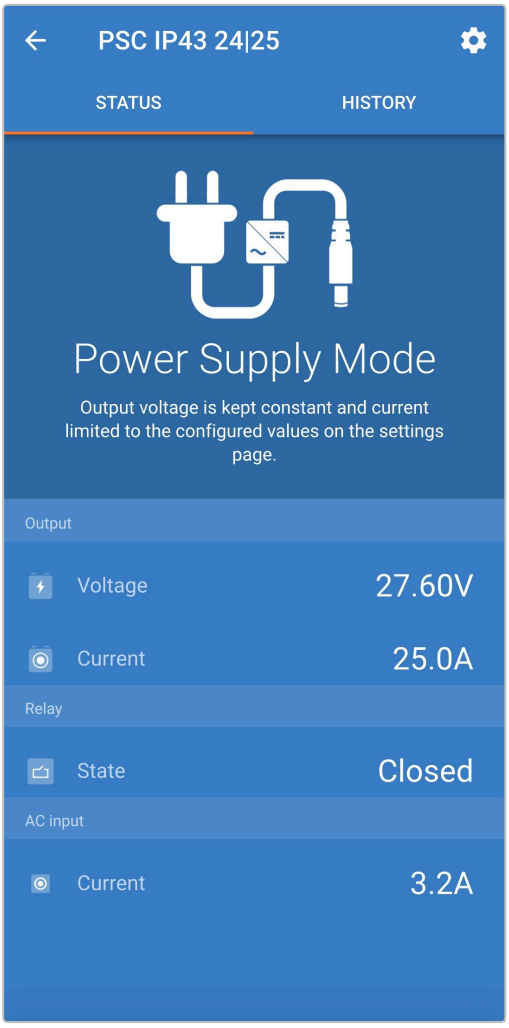
The desired screen can be selected by either selecting the window title or by swiping across between screens.

7.2.1. Status screen

The STATUS screen is the main overview screen; it displays the function mode (charger or power supply), the active charge state (in charger mode), the battery voltage and the charge/output current.

This data will update continuously in real time as the charge cycle progresses.

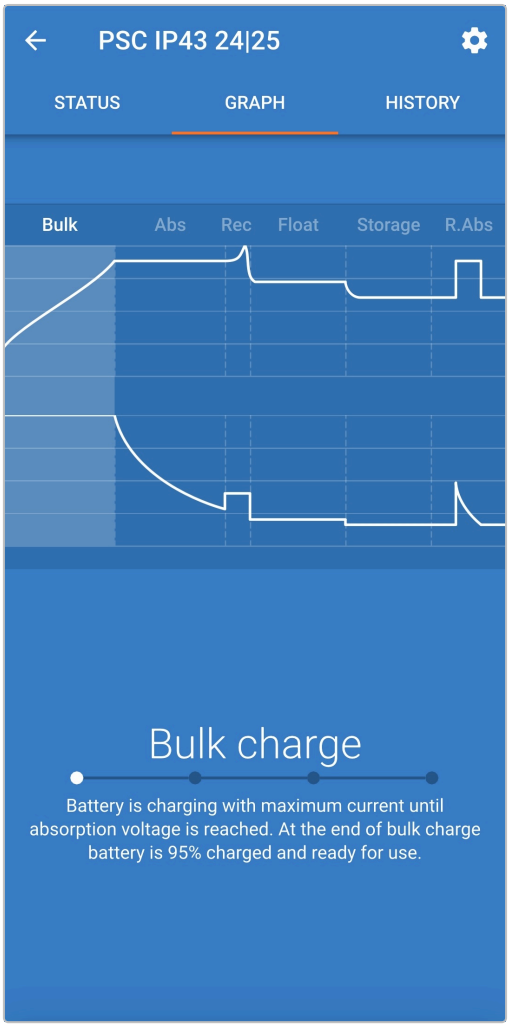




7.2.2. Graph screen

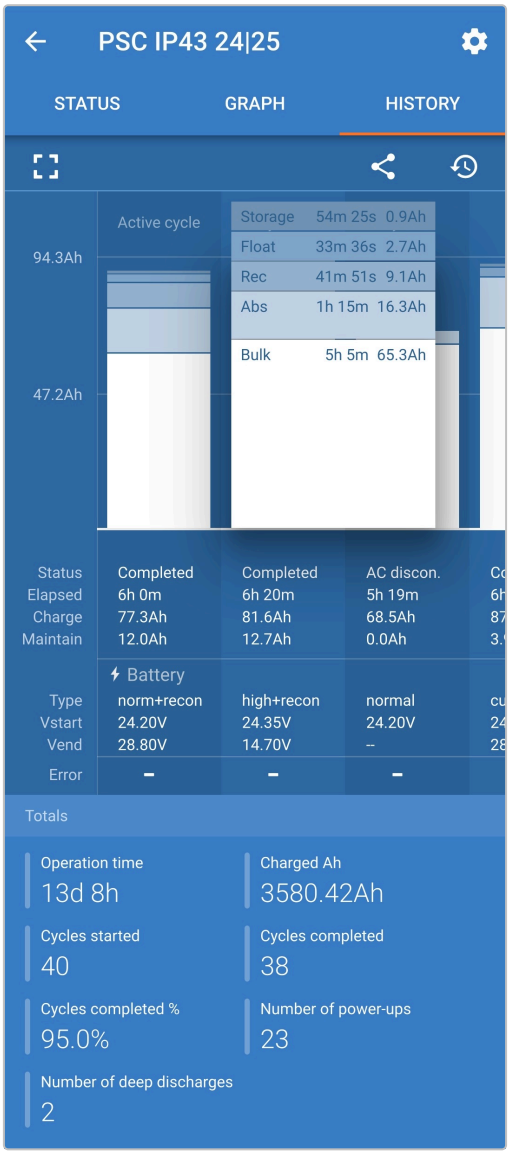
The GRAPH screen provides an easy to understand graphical representation of each charge state with respect to typical battery voltage and charge current.

The active charge stage is also highlighted and stated, along with a brief explanation.

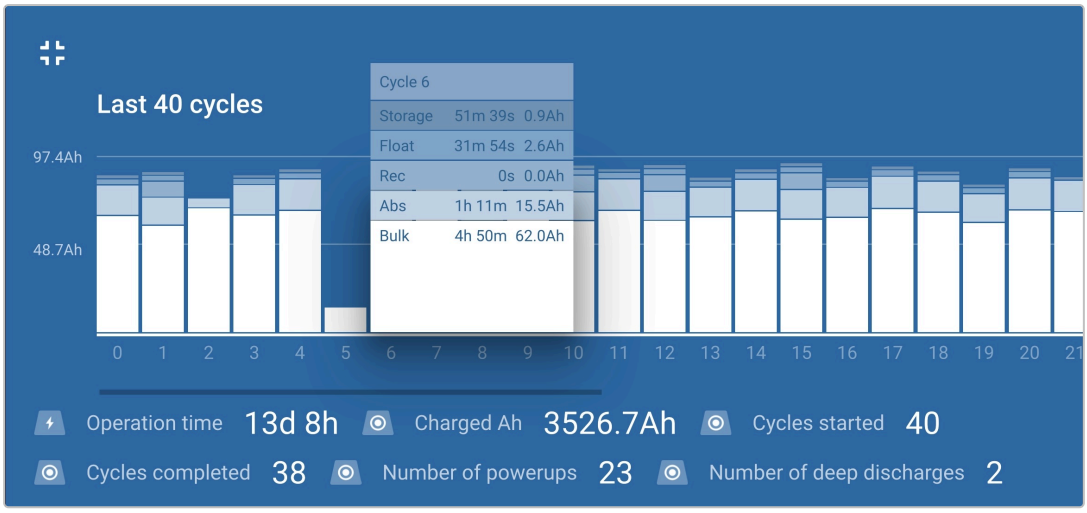


7.2.3. History screen

The HISTORY screen is a very powerful reference as it contains historical usage data over the charger's lifetime and detailed statistics for the last 40 charge cycles (even if the charge cycle is only partially completed).



By selecting the full screen view the data is displayed in landscape view with significantly more days visible at the same time.



Charge cycle statistics

a. **Cycle overview**

Expandable bar chart showing the time spent in each charge stage and the charge capacity provided (in Ah) during each charge stage

b. **Status**

Confirms if the charge cycle was successfully completed or if it was ended early/interrupted, including the reason/cause

c. **Elapsed**

The elapsed time of the recharge stages (Bulk and Absorption)

d. **Charge**

Total capacity provided during the recharge stages (Bulk and Absorption)

e. **Maintain**

Total capacity provided during the charge maintenance stages (Float, Storage and Recondition)

f. **Type**

The charge cycle mode used; either a ‘Built-in preset’ mode or a custom ‘User defined’ configuration

g. **Vstart**

Battery voltage when charging commences

h. **Vend**

Battery voltage when charging is complete (end of absorption stage)

i. **Error**

Displays if any errors occurred during the charge cycle, including the error number and description

Charger lifetime statistics

a. **Operation time**

The total operation time over the lifetime of the charger

b. **Charged Ah**

The total charge capacity (in Ah) provided over the lifetime of the charger

c. **Cycles started**

The total charge cycles started over the lifetime of the charger

d. **Cycles completed**

The total charge cycles completed over the lifetime of the charger

e. **Cycles completed %**

The percentage of charge cycles completed over the lifetime of the charger

f. **Number of power-ups**

The number of times the charger has been powered up over the lifetime of the charger

g. **Number of deep discharges**

The number of times the charger has recharged a deeply discharged battery over the lifetime of the charger

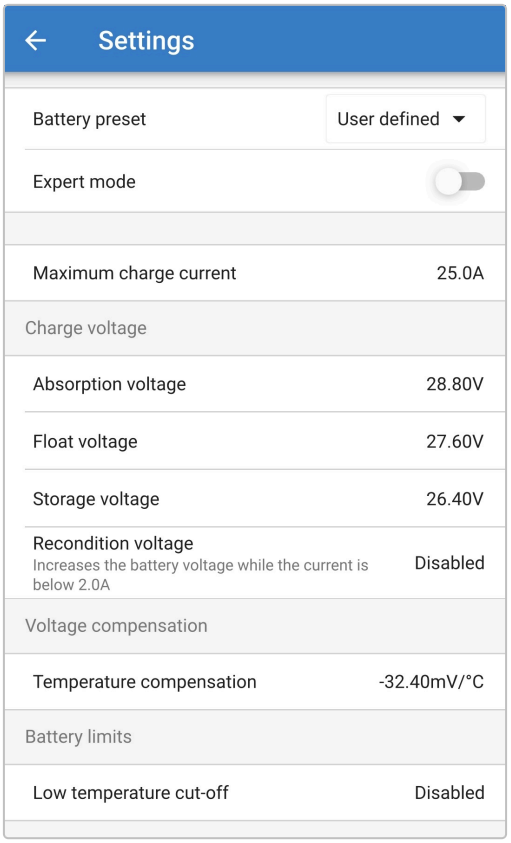
8. Advanced Configuration

8.1. Advanced settings

In specific use cases where the integrated charge modes are not suitable/ideal for the battery type being charged, or the battery manufacturer recommends specific charge parameters and fine tuning is desired, advanced configuration is possible using a Bluetooth enabled device (such as a mobile phone or tablet) with the VictronConnect app.

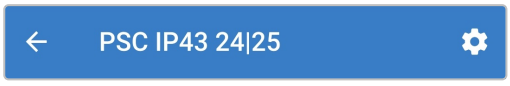
For most common battery types, advanced configuration is not required or recommended; the integrated charge modes and adaptive charge logic are typically suitable and perform very well.

The advanced settings page enables specific configuration of charge parameters and user defined settings to be saved and easily selected.



To access the advanced settings:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).
3. Select the ‘Setting’ icon (gear in the top right corner) to access the 'Settings' page.

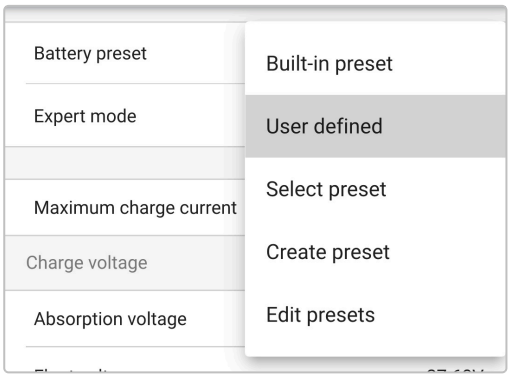


4. Select ‘Battery settings’ to access the 'Advanced settings' page.

To configure user defined advanced settings:

1. Select the 'Battery preset' dropdown arrow to expand the menu.

2. Select ‘User defined' from the dropdown menu.



3. ‘User defined' configuration will now be enabled.

4. Configure the advanced settings as required per battery manufacturers recommendations.

The advanced settings (with expert mode disabled) include:

a. **Battery preset**

The ‘Battery preset’ dropdown allows selection from the following options:

i. **Built-in preset**

Selection of a standard integrated pre-set (same as the general settings menu)

ii. **User defined**

Reselection of the last ‘user defined’ charge settings

iii. **Select preset**

Selection from an extended range of integrated battery charging pre-sets, including new user defined charging pre-sets

iv. **Create preset**

A new charging preset to be created and saved from user defined settings

v. **Edit presets**

An existing preset to be edited and saved

b. **Maximum charge current**

The maximum charge current setting allows selection between the default and a significantly reduced charge current limit preset; Maximum, Low (50% of maximum) or Minimum (25% of maximum) current. Alternatively a user defined maximum charge current (between the minimum and maximum limits) can be configured.

c. **Charge voltage**

The charge voltage settings enable the voltage setpoint for each charge stage to be independently configured and some charge stages (recondition and float) to be disabled or enabled.

The charge voltage setpoint for the following charge stages can be configured:

i. **Absorption**

ii. **Float**

iii. **Storage**

iv. **Recondition**

d. **Voltage compensation**

   i. **Temperature Compensation**

   The temperature compensation setting enables the charge voltage temperature compensation coefficient to be configured, or temperature compensation to be totally disabled (such as for Li-ion batteries). The temperature compensation coefficient is specified in mV/°C and applies to the entire battery/battery bank (not per battery cell).

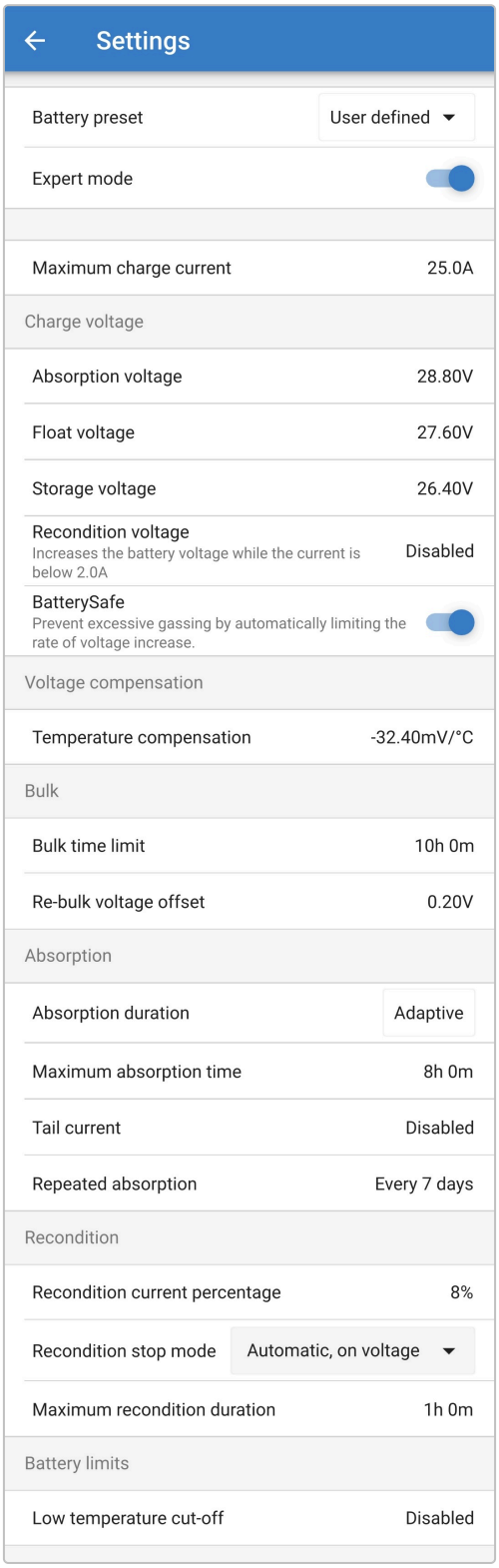
e. **Battery limits**

   i. **Low temperature cut-off**

   The low temperature cut-off setting disables charging in low temperature conditions to protect Lithium batteries from damage; this setting requires battery temperature to be provided by a compatible battery monitor via VE.Smart networking.

8.2. Expert mode settings

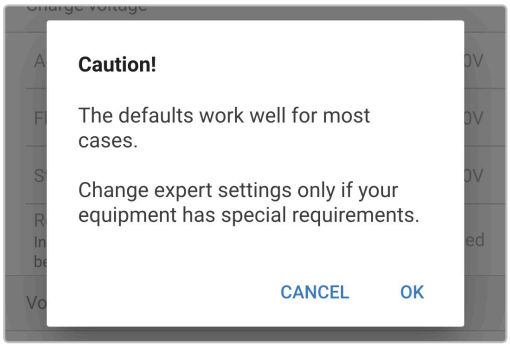
Expert mode expands the advanced settings menu even further, to include more specialised expert level configuration settings.



To access the expert mode settings:

1. Open the 'advanced setting' page and enable 'user defined' configuration - see the 'Advanced configuration > Advanced settings' section for instructions.
2. Toggle the 'Expert mode' switch on to enable additional 'Expert mode' settings (extension of the 'advanced settings' menu).

3. Read the warning message and then select 'OK' to accept and progress.



4. The ‘Expert mode' settings (extension of the 'advanced settings' menu) will now be enabled.

The ADDITIONAL expert mode settings include:

a. **Charge voltage**

   i. **BatterySafe**

   The BatterySafe setting allows the BatterySafe voltage control to be enabled or disabled. When BatterySafe is enabled, the rate of battery voltage increase during bulk stage is automatically restricted to a safe level. In cases where the battery voltage would otherwise increase at a faster rate, the charge current is reduced to prevent excessive gassing.

b. **Bulk**

   i. **Bulk time limit**

   The bulk time limit setting restricts the maximum time the charger can spend in bulk stage as a protection measure, since the absorption voltage should have been achieved by this time. If the bulk time limit is satisfied the charger will move directly to float stage.

   ii. **Re-bulk voltage offset**

   The re-bulk voltage offset setting is used to determine the re-bulk voltage threshold that will trigger a new charge cycle; the offset is relative to the configured 'Storage voltage' (re-bulk voltage = storage voltage - re-bulk voltage offset). If the battery voltage falls below re-bulk voltage threshold while the charger is in float or storage stage and remains below it for one minute, the charger will move back into bulk charge stage.

c. **Absorption**

i. **Absorption duration**

The absorption duration setting allows selection between adaptive absorption time (calculated based on the bulk time / level of discharge) or a fixed absorption time.

ii. **Maximum absorption time / Absorption time**

The maximum absorption time / absorption time setting enables the maximum adaptive absorption time or the fixed absorption time to be configured (depending if adaptive or fixed absorption time is selected). Note that regardless if adaptive or fixed absorption time is selected, the absorption phase can end early based on the tail current setting (if enabled).

iii. **Tail current**

The tail current setting enables the absorption stage to be ended early based on charge current. If the charge current drops below the tail current threshold for one minute, the absorption stage will immediately end and the charger will move to float or storage stage.

iv. **Repeated absorption**

The repeated absorption setting enables the elapsed time between each automatic refresh charge cycle (1h in absorption stage) to be configured. Repeated absorption is enabled by default and can be disabled which results in the battery staying in storage mode indefinitely.

d. **Recondition**

i. **Recondition current percentage**

The recondition current percentage is used to establish the charge current limit while the charger is in recondition stage; the percentage is relative to the configured 'Maximum charge current'. The charger will limit charge current to this lower level while in recondition stage.

ii. **Recondition stop mode**

The recondition stop mode setting allows selection between the recondition stage being ended upon the battery voltage reaching the recondition stage voltage setpoint or a fixed time period.

iii. **Maximum recondition duration**

The recondition time setting enables the maximum recondition time or the fixed recondition time to be configured (depending on the recondition stop mode selected).

8.3. Power supply mode

The **Smart IP43 Charger** range are also suitable for use as a DC power supply, to power equipment without a battery connected (or while also connected to a battery).

While it's still possible to use the charger as a power supply without changing any settings, a dedicated 'Power supply' mode exists for this purpose/usage and is recommended.

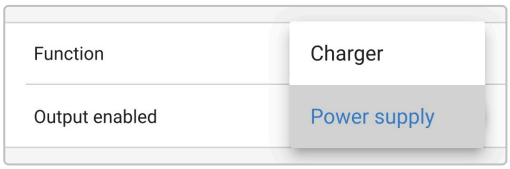
If the charger will be used as a power supply, it is recommended to activate 'Power supply' mode, as it will disable the internal charge logic and provide a constant DC supply voltage.

To enable power supply mode:

1. Connect the AC power cable to a mains power outlet; after a short delay, the LEDs indicating the current charge mode and charge state will illuminate.
2. Using a Bluetooth enabled device (such as a mobile phone or tablet), open the **VictronConnect** app and locate the **Smart IP43 Charger** in the 'LOCAL' page device list, then connect to the device (default Bluetooth PIN code is 000000).
3. Select the 'Setting' icon (gear in the top right corner) to access the 'Settings' page.

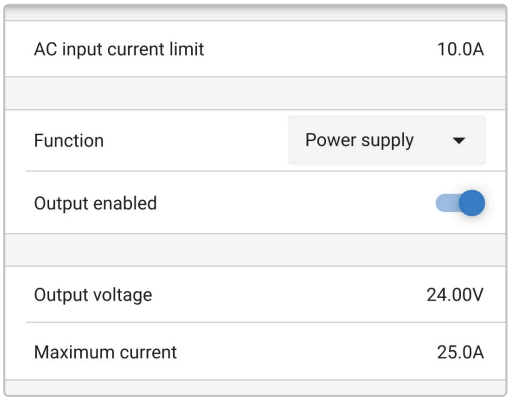
4. Select the 'Function' mode (Charger) to expand the dropdown menu.

5. Select 'Power supply' mode from the dropdown menu.



6. 'Power supply' mode will now be enabled; when enabled the BULK, ABS, FLOAT and STORAGE LEDs will be illuminated.

7. If required, adjust the desired output voltage and/or the 'Maximum current' limit.



To revert the charger function back to use as a normal battery charger, follow steps 1 to 3 above and then select 'Charger' mode from the 'Function' drop down menu.

9. Technical specifications

Specification	12/30 (1+1) & (3)	12/50 (1+1) & (3)	24/16 (1+1) & (3)	24/25 (1+1) & (3)
Nominal input voltage - AC supply	120 – 240VAC			
Input voltage range – AC supply	85 – 250VAC (full power from 100VAC, startup from 90VAC)			
Input frequency - AC supply	45 - 65Hz			
Input voltage - DC supply	90 - 375 VDC			
Power factor	>0.99			
Max Efficiency - 230VAC / 120VAC	95% / 93%	94% / 92%	96% / 94%	96% /94%
Charge voltage - Absorption / Float / Storage	Normal: 14.4V / 13.8V / 13.2V High: 14.7V / 13.8V / 13.2V Li-ion: 14.2V / N/A / 13.5V		Normal: 28.8V / 27.6V / 26.4V High: 29.4V / 27.6V / 26.4V Li-ion: 28.4V / N/A / 27.0V	
Temperature compensation (N/A for Li-ion)	-16mV/°C		-32mV/°C	
Charge algorithm	6-stage adaptive (3 stage for Li-ion)			
Max output current - Normal mode	30A	50A	16A	25A
Max output current - Low current mode	15A	25A	8A	12.5A
Max output current - Starter battery	4A (1+1 output models only)			
Back drain current	<1mA			
Max battery capacity (recommended)	300Ah	500Ah	160Ah	250Ah
Min battery capacity - Normal mode	Lead: 120Ah Li-ion: 60Ah	Lead: 200Ah Li-ion: 100Ah	Lead: 64Ah Li-ion: 32Ah	Lead: 100Ah Li-ion: 50Ah
Min battery capacity - Low current mode	Lead: 60Ah Li-ion: 30Ah	Lead: 100Ah Li-ion: 50Ah	Lead: 32Ah Li-ion: 16Ah	Lead: 50Ah Li-ion: 25Ah
Data communication	VE.Direct and Bluetooth (via VictronConnect app)			
Bluetooth power and frequency	-4dBm | 2402 - 2480MHz			
Remote on/off	Yes (2 pole terminal)			
Programmable relay	Yes (SPDT - 5A up to 250VAC / 5A up to 28VDC)			
Operating temperature	-20 to +60°C (0 - 140°F) Full rated output up to 40°C			
Max humidity	95%			
Enclosure				
Material and colour	Aluminium | Blue RAL 5012			
AC connection	IEC 320 C14 inlet with retainer clip (AC cord ordered separately)			
Battery connection	Screw terminals 16 mm² (AWG6)			
Number of battery connections	(1+1) models: 2 (2nd output via 2 pole terminal) | (3) models: 3			
Protection category	Electronic components: IP43 | Connection area: IP22			
Weight	2.7 kg (6.0 lbs)			
Dimensions (h x w x d)	180 x 249 x 116mm (7.1 x 9.8 x 4.6 inch)			
Compliance standards				
Safety	EN 60335-1, EN 60335-2-29			
Emission	EN 55014-1, EN 61000-6-3, EN 61000-3-2			
Immunity	EN 55014-2, EN 61000-6-1, EN 61000-6-2, EN 61000-3-3			
Vibration	IEC68-2-6:10-150Hz/1.0G			

10. Warranty

This limited warranty covers defects in materials and workmanship in this product, and lasts for five years from the date of original purchase of this product.

The customer must return the product together with the receipt of purchase to the point of purchase.

This limited warranty does not cover damage, deterioration or malfunction resulting from alteration, modification, improper or unreasonable use or misuse, neglect, exposure to excess moisture, fire, improper packing, lightning, power surges, or other acts of nature.

This limited warranty does not cover damage, deterioration or malfunction resulting from repairs attempted by anyone unauthorized by Victron Energy to make such repairs.

Victron Energy is not liable for any consequential damages arising from the use of this product.

The maximum liability of Victron Energy under this limited warranty shall not exceed the actual purchase price of the product.