ETREL

ETREL LOAD GUARD

USER MANUAL

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1 | PREFACE

Load guard is a sensor that is installed in the building's electric cabinet. It measures the electric current in the building's installation and sends real-time measurements to the charging station.

INCH charging station responds to received data by reducing the charging power in order to keep the total load of installation below the installation rated value or increasing it to utilise the remaining available power for faster charging.

As Load Guard measures electric current in both directions, it is capable of sensing the power surplus generated by local renewable energy sources, such as photovoltaics. Green energy is used for faster and cheaper charging, thanks to algorithms in INCH charging stations.

Figure 1: Etrel Load Guard

BENEFITS OF USING LOAD GUARD

- Optimised energy consumption of existing infrastructure.

- Reduced charging and operational costs.

- Local consumption of renewable energy sources.

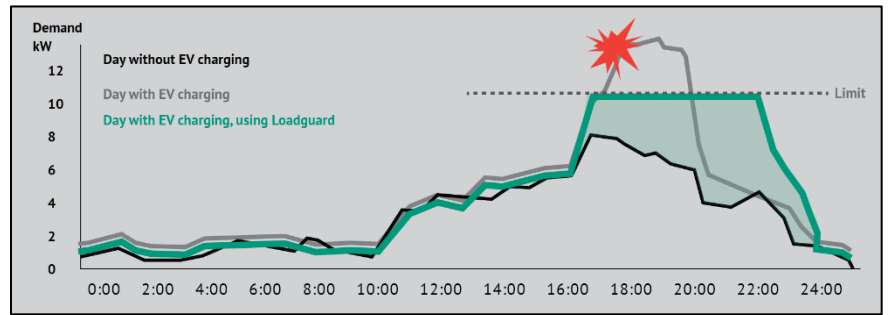- Future-proof and grid-friendly charging infrastructure.

Figure 2: Load Guard preventing the fuses overload

WHERE TO USE LOAD GUARD

Load Guard sensor is especially important in situations, where charging stations do not have a dedicated power supply but rather share available power with other consumers in the building.

Homes

Apartment buildings

Business fleets

Parking spaces

Commercial buildings

PREREQUISITES FOR USE

- Load Guard connected to the mains and LAN.

- A computer connected to the same LAN as the Load Guard.

- Load guard configuration program (Load Guard Configurator).

- INCH charging station (set up as a master) connected to the same LAN as Load Guard.

DISTANCE

Normally, a UTP Cat 6 cable is sufficient to use for distances up to at least 100 m between Load Guard and charging station. However, for longer distances it may be necessary to use active equipment, e.g., repeaters or network switches.

2 | LOAD GUARD

Load Guard is a device that measures the current and voltage across phases of a particular segment of the power grid, calculates power and sends all data to the master station.

Power management of master charging station decides, based on information provided by Load Guard, what target current to set on its connector and other stations of the cluster. If necessary, it will increase or decrease the charging power or even stop it completely to prevent the fuses from switching off due to overcharging.

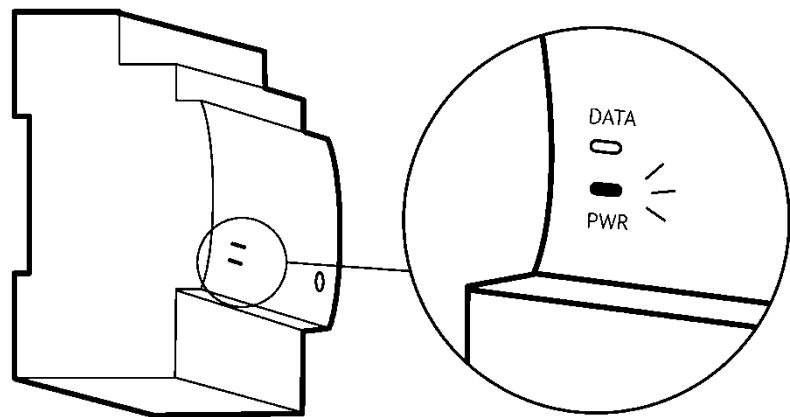**Load Guard allows charging with maximum current without overloading the fuses.**

Figure 3: LED lights of Load Guard

The Load Guard has LEDs on the front plate, labelled PWR and DATA. When the Load Guard is connected to the power supply, the PWR light should light up. If the connection between the Load Guard and the charging station is established, the DATA light flashes.
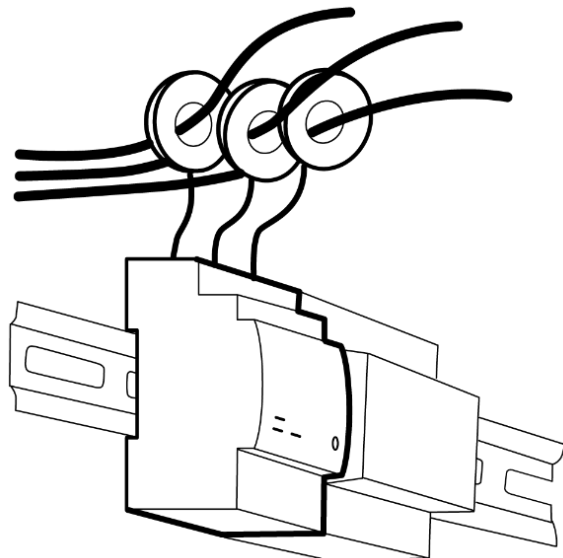

Figure 4: Measuring current transformers set on all three phases

To measure electric current, it uses 150 A current clamps (for conductors up to 16 mm in diameter) and 400 A current clamps (for conductors up to 24 mm in diameter). The length of the wires for connecting the current clamps to the Load Guard is 70 cm.

Figure 5: Load Guard with connected measuring current transformers

TECHNICAL SPECIFICATIONS

DIMENSIONS	90.5 x 53.5 x 61.8 [mm] Width 3 TE on DIN rail
WEIGHT	0.23 - 0.70 [kg], packaging adds 0.10 [kg]
CLAMP CABLE LENGTH	70 cm
CLAMP DIAMETER	Small 16 mm, large 24 mm
CONNECTION	Single-phase or three-phase
MAX. RATED CURRENT	150 A or 400 A per phase
OPERATING VOLTAGE	Up to 253 V AC phase voltage This limitation is set by the highest operational voltage of the charging station.
FREQUENCY	50 Hz or 60 Hz
TEMPERATURE RANGE	Operation temperature range: -25°C to +60°C Storage temperature range: -30°C to +90°C
COMMUNICATION	Ethernet
CONFIGURATION AND MONITORING	Web interface

3   CONNECTING THE LOAD GUARD

Load Guard is installed in electrical cabinet, after the main counter. It measures currents of all phases and is sending the measurements to the charging station in real time to ensure that the overload of the fuses cannot happen.

It can measure in both directions, so it can also measure the energy that is flowing back to the electrical grid. In case of production of energy at the location it can turn up the charging power suppling the electric vehicle.

Load Guard can be connected single-phase or three-phase. Current clamps should be put on certain phase conductors and the Load Guard should be properly connected to the power supply first and only then to the LAN.
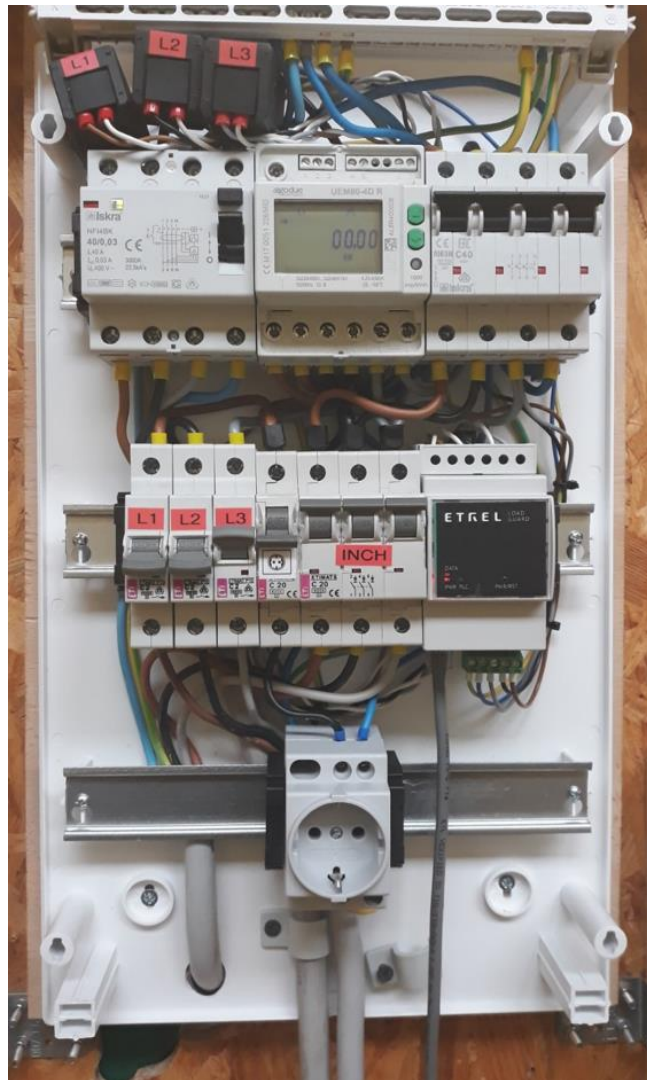

Figure 6: Load Guard installed in electrical cabinet
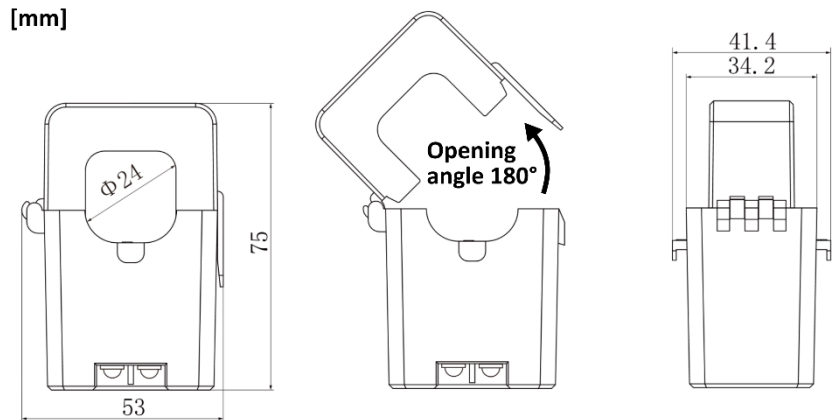
LOAD GUARD CURRENT TRANSFORMERS

[mm]

Opening angle 180°

Φ24

75

53

41.4
34.2

Figure 7: Dimensions of current transformers

CONNECTING THE CURRENT TRANSFORMERS

1. Open the buckle 2. Open upward 3. Insert the phase conductor 4. Fasten the buckle
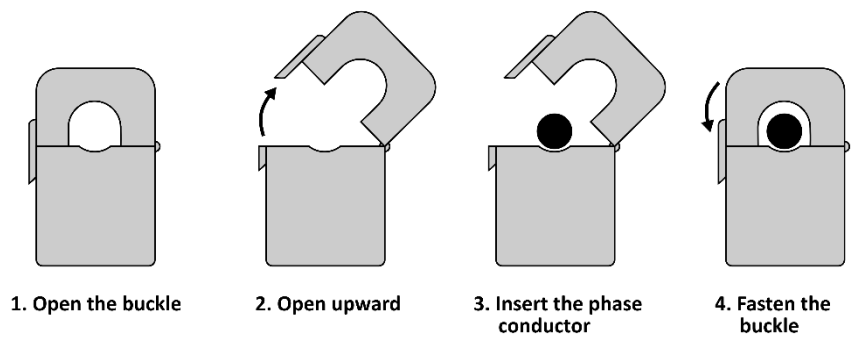
Figure 8: Connecting the current transformers

THREE-PHASE CONNECTION

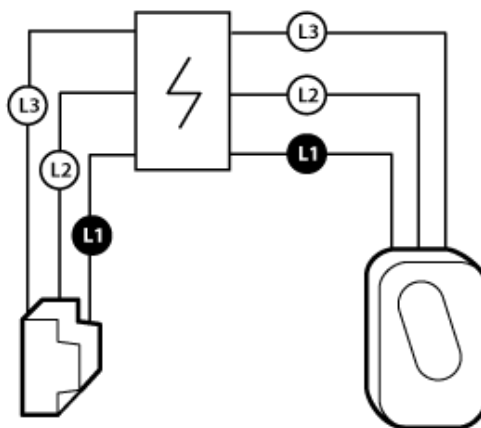For proper three-phase connection, current clamps must be placed on specific phase conductors.

Figure 9: Correct connection must consider the correct sequence of phases

The following figure shows the current clamp cables connection for all three phases (L1, L2 in L3) from left to right. The phase conductors for powering the Load Guard must be connected in the same way (from right to left). Positions for PE (earthing conductor) and N (neutral conductor) are also indicated. If phases are not connected in correct sequence, the Load Guard power calculation will be wrong.

Figure 10: Arrangement of input and output phases

Measuring current transformers are connected to the Load Guard as it is shown on the following figure.
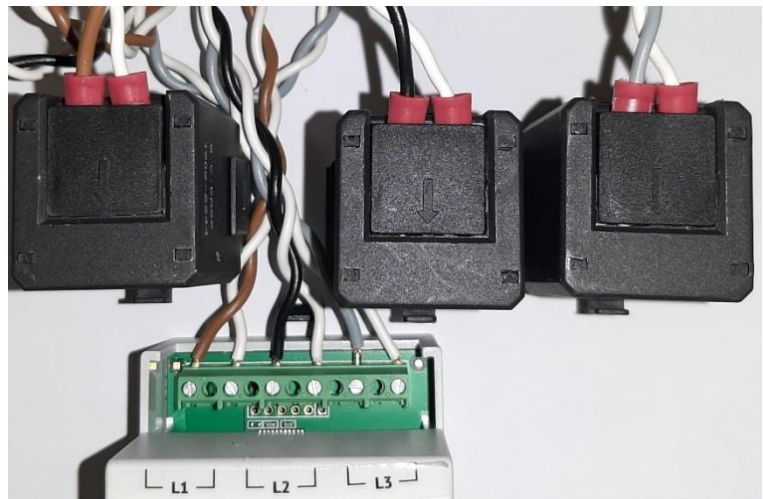

Figure 11: Load Guard and connected measuring current transformers

The procedure of setting up measuring current transformer on the conductor is to open it and close it with conductor wire inside of it. The conductor does not need to be interrupted for the connection.

The direction of energy flow must be considered. On the inside of the measuring current transformer there is an arrow, which must point in the direction of energy flow (from clamps to the consumers). If the direction of measuring current transformer is wrong, Load Guard will be measuring negative power. If this happens, turn the measuring current transformer correctly.

Figure 12: Arrow pointing in the direction of energy flow

SINGLE-PHASE CONNECTION

In case of single-phase connection, the measuring current transformer is set only on the phase conductor that is used, as shown on the following figure.
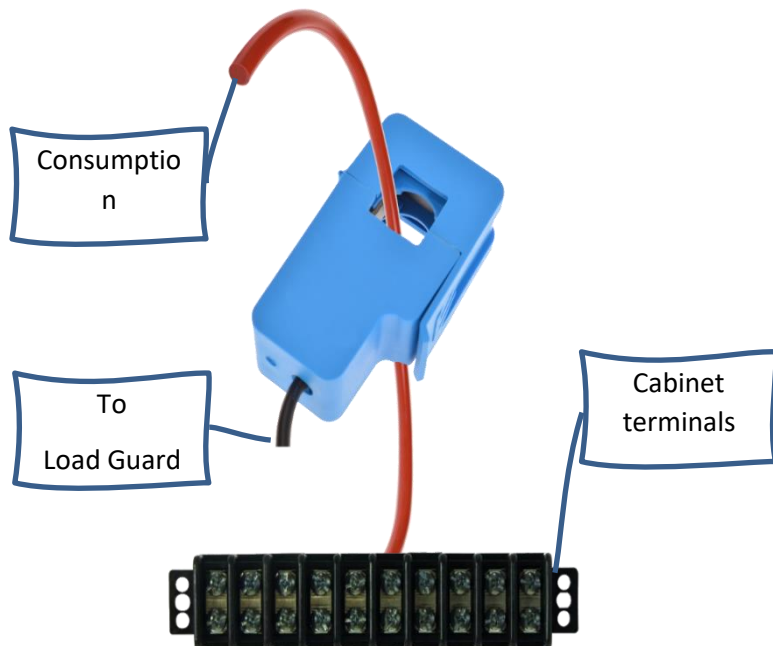

Figure 13: Single phase connection of measuring current transformer

Only one measuring current transformer is needed in single-phase connection. Load Guard must be connected as shown in the following figure.

If phase and neutral conductors are switched (L1 in N), the voltage in Load Guard Configuration Software will be very low, or even 0 V (instead of ~230 V).

Figure 14: Arrangement of input and output phases in case of single-phase connection

PRODUCTION OF ENERGY AT THE LOCATION

If on location there is also production of electrical energy present (photovoltaic cells, batteries, ...), the measuring current transformers can be set on two conductors (production conductor and consumption conductor). In this case the Load Guard would be measuring the difference of consumption and production currents and would enable higher charging current in time of production.
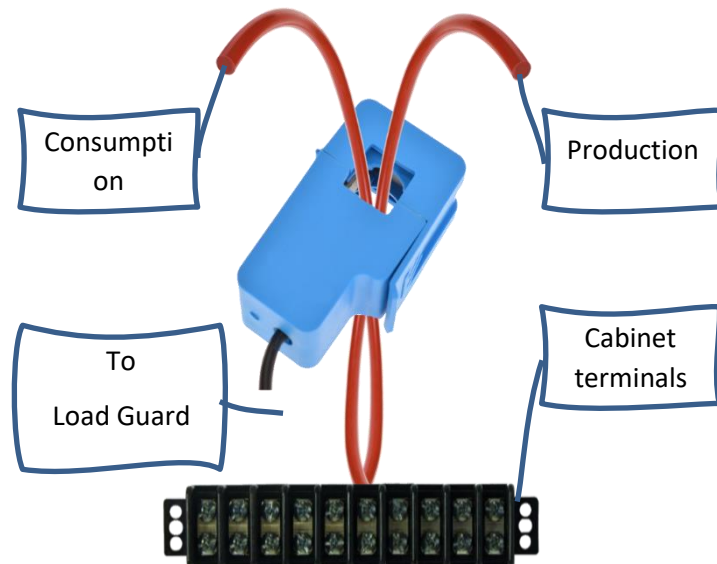

Figure 15: Measuring current transformer on two conductors

Possible example of connection in case of production and other consumption of energy at the location is presented below. The goal is to enable charging with maximal power with respect to the limitation of the main fuse.

In the presented example Load Guard is measuring currents of the common supply. Together with the specification of main fuse (or main static limitation) the charging station has all the data available to be able to adapt charging power dynamically, in regard with electrical circumstances at a certain moment.
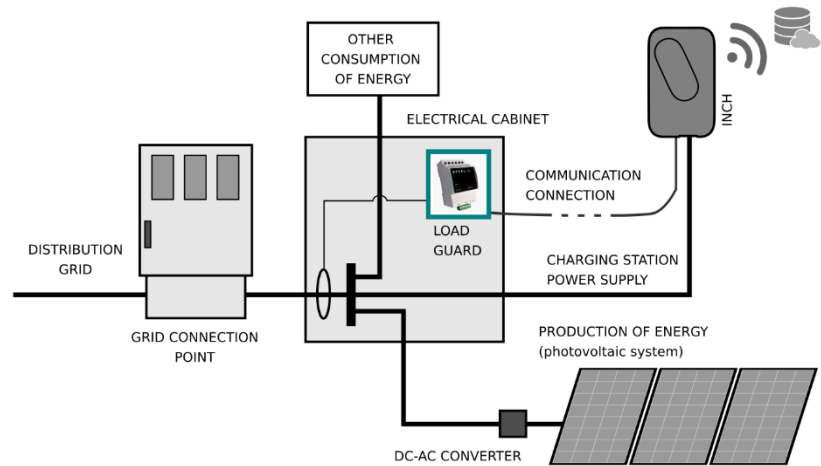

Figure 16: Example of production and consumption of energy at the location

4 OBTAINING IP ADRESS OF COMPUTER AND CHARGING STATION

To enable configuration of the Load Guard and of the charging station, the computer, Load Guard and charging station need to be in the same network segment: 192.168.1.xxx. First three numbers must be the same and the fourth must be different among the devices.

COMPUTER IP ADDRESS

To obtain IP address of the computer the Windows Command Prompt is used. Press **Win+R** on the keyboard and in the presented window type **cmd** and press **Enter** (or click **OK**).
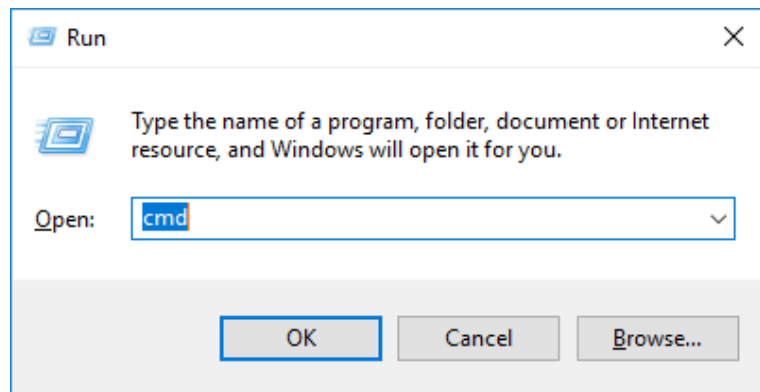

Figure 17: Starting the Command Prompt

Black Command Prompt windows will show and in it write command **ipconfig -all** and press **Enter** (Note: between "ipconfig" and "-all" there is a space).
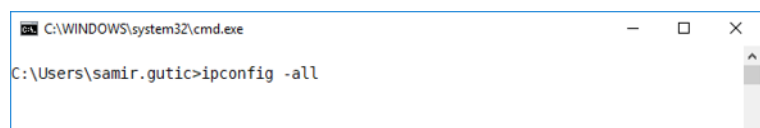

Figure 18: Ipconfig command

The configuration of all network interfaces will be displayed.

Figure 19: Display of configuration of all network interfaces of the computer

Options of wired interfaces are shown (ethernet). The part of the IP address that is inside of red rectangle must be the same as it is written in the Load Guard Configuration Software settings. If this is not true, the software could not find the Load Guard and even if Load Guard is found, the configuration is not possible.

CHARGING STATION IP ADDRESS

If the IP address of the charging station is not known, press the reset key for 5 seconds (figure below).

Figure 20: Charging station reset button

On the charging station display the message **Entering service menu** will be shown and after that also the IP address. To obtain the charging station IP address, press the sign of three dots for 5 s (in the upper right corner).

Figure 21: Display of IP address after pressing the reset button for 5 s
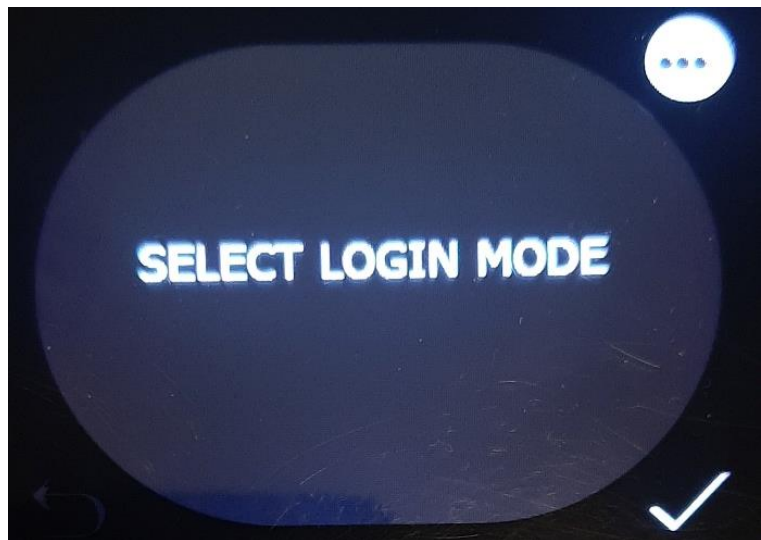

Figure 22: Selection of login mode

The IP address of the charging station and the state of the connection with central system will be displayed.

Figure 23: Display of network and state

5 | CONFIGURATION

SOFTWARE FOR CONFIGURATION

Configuration software **Load Guard Configurator 1.4.zip** can be downloaded from the following address:

https://etrelchargingsolutions.atlassian.net/wiki/download/attachments /258867203/Load Guard Configurator 1.4.zip?api=v2

Expand the compressed file in new folder **Load Guard Configurator 1.4**.

Click on **LoadGuardConfigurator.exe** inside the folder opens software for configuration of Load Guard. The message of Windows Firewall will be presented.
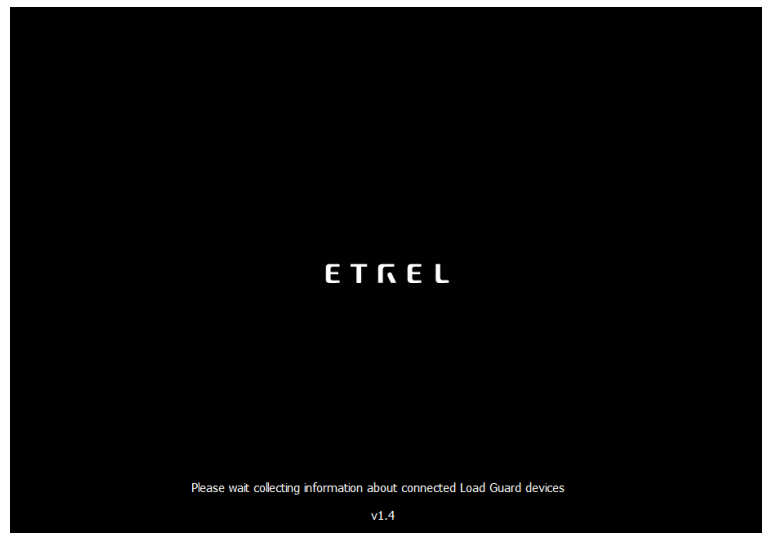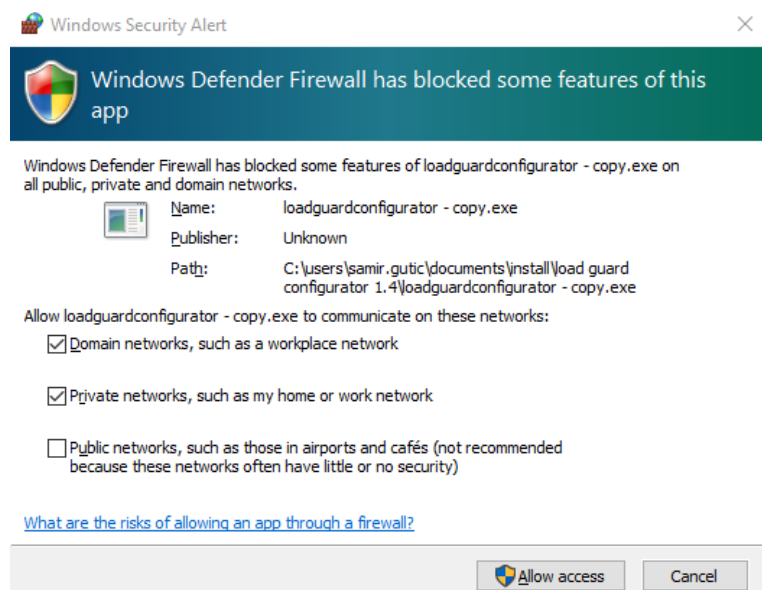

Figure 24: Starting configuration software

Figure 25: Message of Windows Firewall

Enable the access as shown on the previous figure. Then click on the Allow access and enable the configuration of the Load Guard. If the software finds the Load Guard in its network, the data of Load Guard will be presented on the screen.
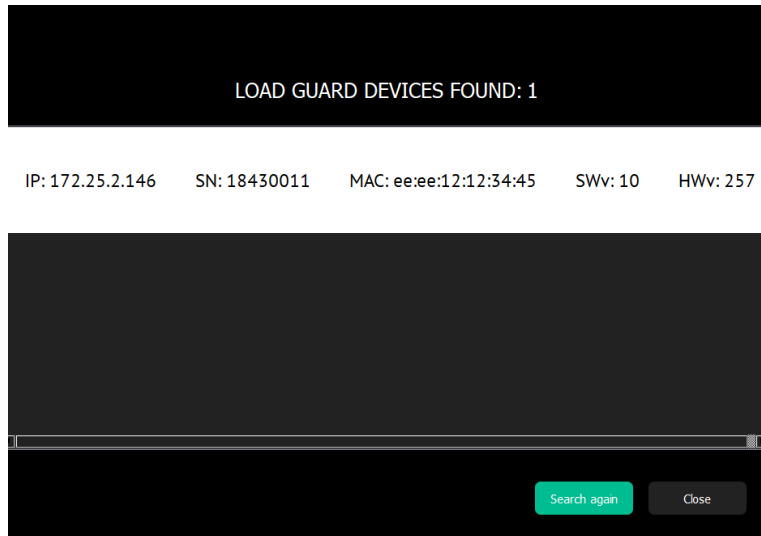
Figure 26: Display of Load Guard information

Load Guard serial number is important information. In the above case it is 18430011. For establishing connection this serial number must be listed in charging station web interface. Click on the white part of the screen (the line with Load Guard data) opens the configuration window. If the software finds Load Guard and the MAC address is not shown, this means that the computer is not in the same network as Load Guard.

Figure 27: MAC is not shown – the computer is not in the same network

CONFIGURATION OF THE LOAD GUARD

To configure Load Guard, the following is needed:

- IP address of the charging station that is used to connect Load Guard to.

- Serial number of the charging station that is used to connect Load Guard to.

LOAD GUARD NETWORK SETTINGS
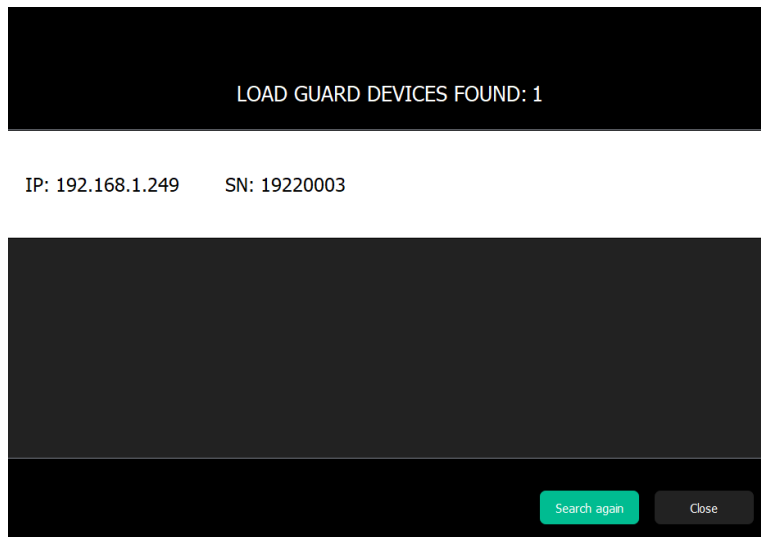
Click on the white part of the screen (the line with Load Guard data) opens the configuration window.
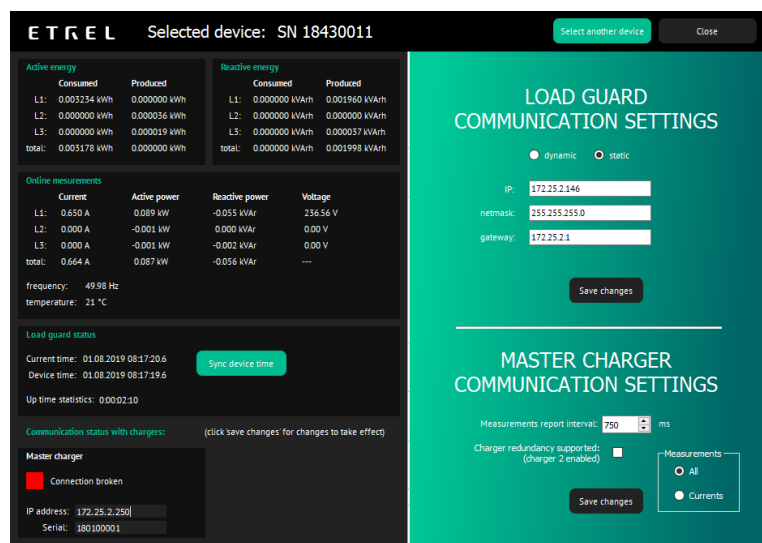

Figure 28: Windows for configuration settings

Default IP address of the Load Guard is **192.168.1.249**.

If the measured data are presented in a same way as on the above figure (currents, powers, voltages, times …) it means that the Load Guard Configurator software successfully connected to the Load Guard.

If the time on the Load Guard is wrong, the time synchronization must be performed with the click on **Sync device time**, otherwise the connection will not be functional. After that the settings are saved with a click on **Save changes** (bottom right).

Charging station can be connected in LAN network in two ways, statically or dynamically. If there is DHCP server present in the network, the dynamic option can be selected in **Load Guard communication settings**. Otherwise the **Static** option must be selected. Settings are displayed in the following figure.
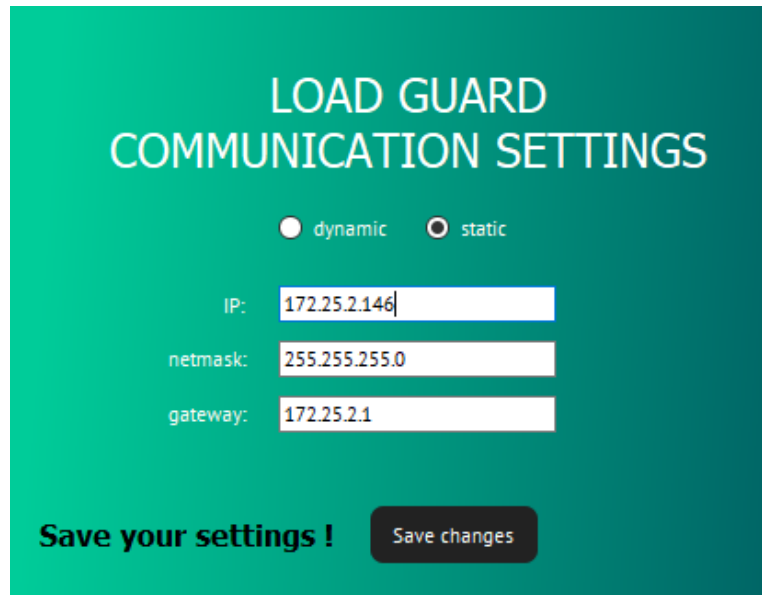
Figure 29: Static connection data entry

For saving of changes, click on **Save changes**. After that the Load Guard will reset automatically.
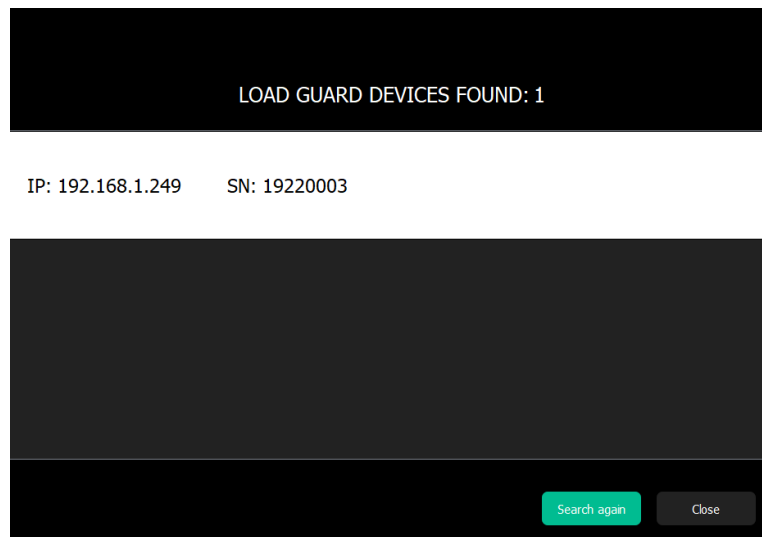
Figure 30: Load Guard is not in the same network group as computer

If the IP address of the Load Guard was changed in a way that the Load Guard is not part of the same network group as the computer anymore (e.g. switching of one of the first three numbers of the IP address), only the IP address and serial number of the Load Guard will be displayed.

In this case the IP address of the computer should be changed accordingly, so that the first three numbers of the IP address are the same as on Load Guard.

When purchasing Load Guard together with charging station, they are already set and tested at the factory and already configured for automatic pairing of both devices.

CHARGING STATION SERIAL NUMBER

Serial number of charging station can be found in charging station web interface. After the login to the web interface **Diagnostics** must be selected in Etrel menu. The serial number of the charging station will be displayed as shown on the below figure:

Charger model	PC-1Z3-BY-40
Serial number	18010000
Software version	1.12.5
CC hardware version	0.94
CC driver version	1.02
CC firmware version	1.11

Figure 31: Display of basic data in Diagnostics menu

We are interested in the number: 18010000, which is a serial number of charging station.

PAIRING

PAIRING OF LOAD GUARD TO CHARGING STATION

When all the needed information are available, the configuration of Load Guard can continue. In **IP address** field the IP address of the charging station must be written, also in the **Serial** field, the serial number of the charging station must be written. Serial number of the charging station can be obtained from the web interface of the charging station.

Correct IP address must be written, which is in the given case 172.25.2.250 and the serial number, which is in the given case 18310069. After that the changes are saved with click on **Save changes**.

If everything is set correctly, the message about the successful connection will be shown (Connection established).

Master charger

Connection establishı
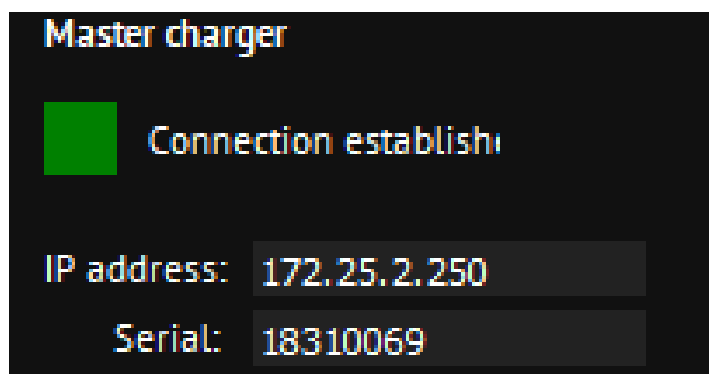
IP address: 172.25.2.250

Serial: 18310069

Figure 32: Connection with charging station established

If wrong serial number is set, the message would be: **Connection broken**.

The interval of measured data transmission can be set – **Mesurements report interval**. The time interval can be set between values 500 ms and 5000 ms (default setting is 750 ms).

In the **Measurements** window it is selected which data will be Load Guard sending to the charging station. To send all the data, the option **All** must be selected. If this is not set, the charging station will ignore some of the data that Load Guard is sending. Confirm the setting with click on **Save changes**.
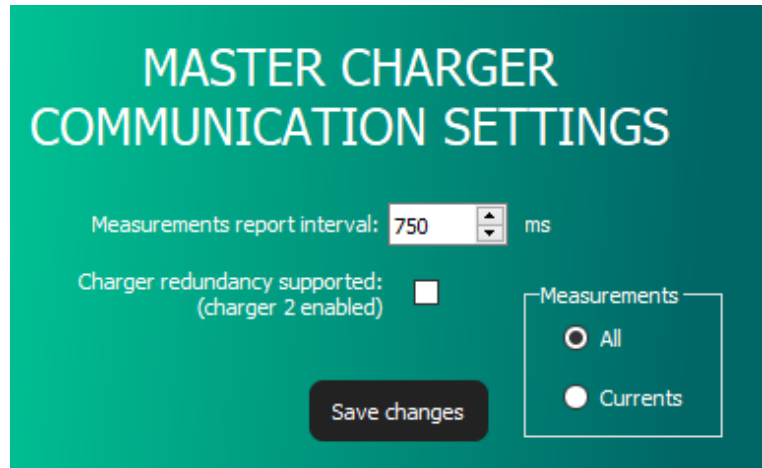

Figure 33: Setting the measurement report interval

PAIRING OF CHARGING STATION WITH LOAD GUARD

To connect to INCH charging station web interface use username: **root@etrel.com** and password: **toor**

In web configuration interface select **Power management** and then **General Configuration**. Make sure that the tick "Connect this charger to the power management master" is selected.
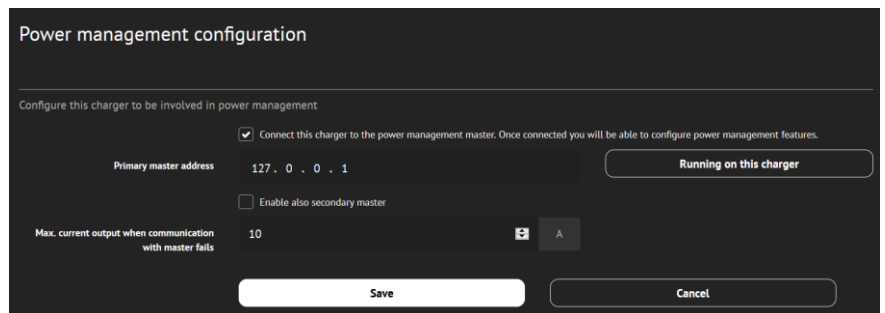

Figure 34: Power management configuration

In the web configuration interface select **Power management** and then **Power cluster configuration**. Select the tick at "Enable cluster service".
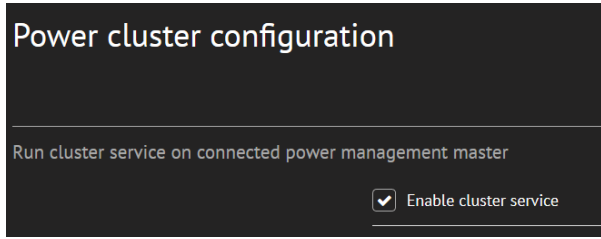
Figure 35: Enabling the cluster service

In web interface of the charging station click on **Power management** and then **Building power limits**. On the right the option **Load Guard installed** can be selected.
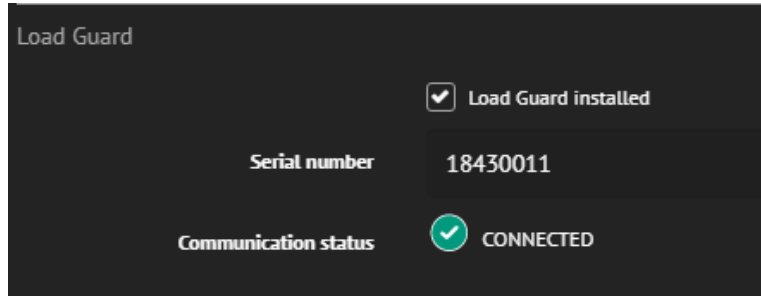

Figure 36: Connection with Load Guard is established

Serial number of the Load Guard must be written in the field **Serial number** (in the presented case this number is 18430011). After that click on **Save** and restart the charging station.

If the communication between Load Guard and charging station is established, the **Communication status** will be **Connected**. The following icon will be shown in the top right corner of the web interface:

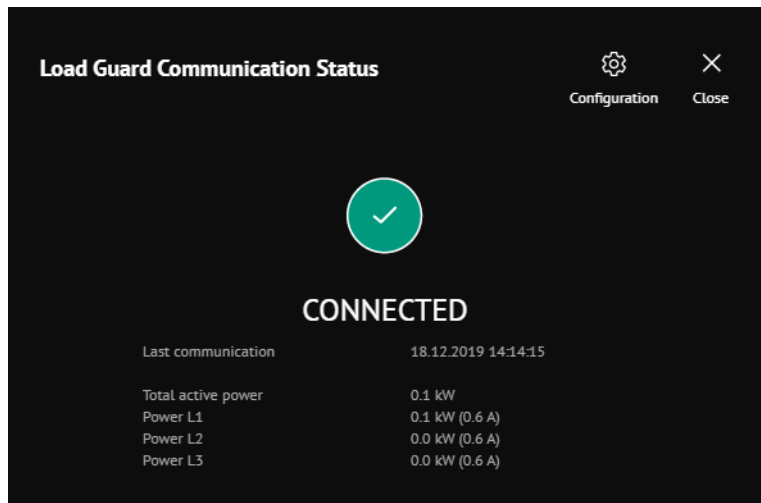The state **Connected** will also be shown in **Load Guard Communication Status**.

Figure 37: Display of network state

In the **Load Guard Communication Status** window, the following information that Load Guard is transmitting, can be viewed:

- Total active power [kW].

- Power [kW] and current [A] of phase L1.

- Power [kW] and current [A] of phase L2.

- Power [kW] and current [A] of phase L3.

If the connection with the Load Guard is not successful, or the connection is interrupted, red dot will show at the Load Guard icon.

The Load Guard Configuration software windows should look as it is presented on the following figure.
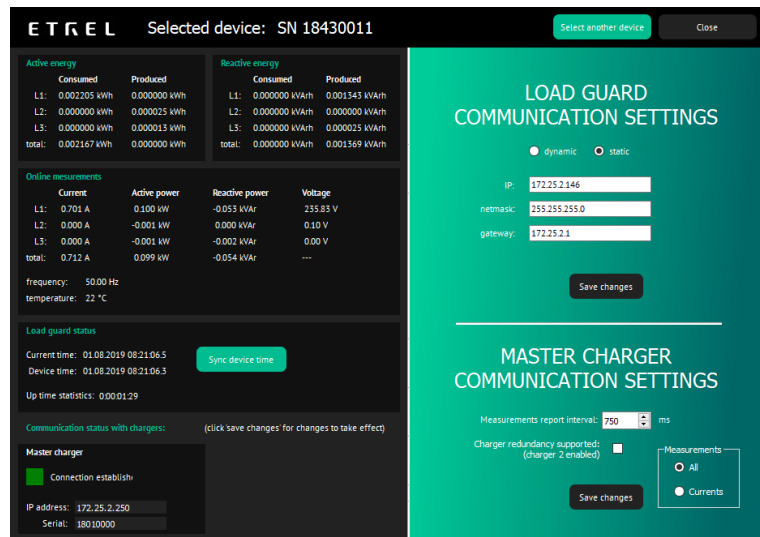

Figure 38: Configuration windows

During charging procedure on master charging station or any other charging station of this cluster, the Load Guard would measure total consumption current of the charging station and other loads and send the data to the master charging station.

If total current, that Load Guard measures, surpasses the set limitation of current (Max. building current), the master charging station will lower the target charging current of all charging stations in the cluster. This will be performed in a way that total current of all the charging station and other loads will not surpass the set limitation of current.

Most of the electric vehicles can not charge with charging current of less than 6 A. Because of this, in a case that the target current would be lowered to less than 6 A, the charging would be temporarily paused. Charging will continue when the Load Guard sends information that the total consumption is lower that the set limit for more than 6 A.

6 | TROUBLESHOOTING

If the message **Connection established** can be seen in Load Guard Configuration software, then the configuration of the Load Guard and the connection to the master charging station was successful. Same message will be displayed in web interface of the master charging station.

CONFIGURATION SOFTWARE CAN NOT FIND THE LOAD GUARD

If the configuration software (Load Guard Configurator 1.4) cannot find the Load Guard in the network, the following should be checked:

- Is Load Guard connected to the supply (Is PWR LED lit)?

- Is Load Guard connected to the ethernet network (Are LEDs on the ethernet socket lit or blinking)?

- Load Guard must be in the same LAN network as the computer that is used for the configuration and is the master charging station in the same network?

- Are other connections on the computer enabled (e.g. Wi-Fi, other ethernet interface)? If there is another connection enabled in the computer, it must be disabled. All of the possible connections should be disabled, except the one used for the connection to the Load Guard.

NO CONNECTION BETWEEN LOAD GUARD AND CHARGING STATION

If the connection is not successful, perform refresh of the web interface (Ctrl+F5). If this does not resolve the issue, perform reset of the charging station and reset the Load Guard as well. Sometimes click on the **Sync device time** helps. If the time on the Load Guard is not synchronized, the connection will not work correctly!

Try connecting to other charging station with the selection of option **Charger redundancy supported**. Into the new frame on the left side write the same data as for the first master charging station and save the settings. If the connection with the Load Guard is still not established, turn off the power supply of the Load Guard and charging station, wait for 30 seconds and then turn the power supply of the Load Guard and charging station back.

If this does not work, check all steps of the procedure and start with the configuration procedure again.

SERIAL NUMBER IS NOT VALID

If the Load Guard Configuration Software the message "Serial number is not valid" is shown, the correct serial number must be written in the web interface of charging station.
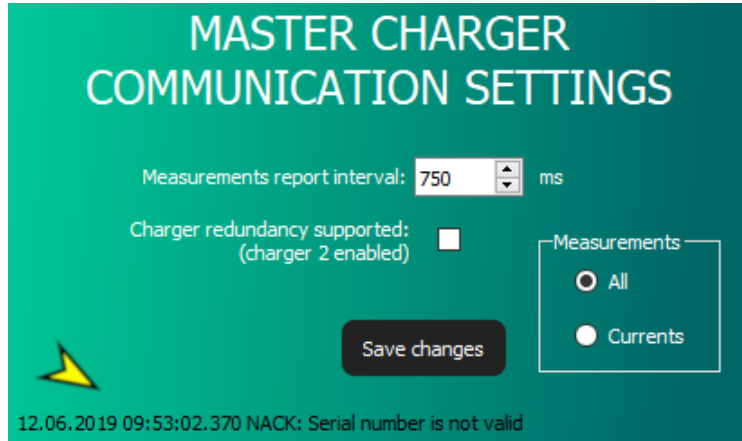

Figure 39: Message that the serial number is not valid

LOAD GUARD DOES NOT MEASURE VOLTAGE

When Load Guard is connected only in single-phase connection and in the "Load Guard Configurator" windows, the voltage is not shown, or it is very low (~5 V) it means that the supply of phase and neutral conductors of Load Guard are switched.

Note: The following two figures are showing single-phase connection.

Figure 40: Display of measurements when the neutral and phase conductors are not correctly connected

In this case the neutral and phase conductor should be switched to enable correct measurement of voltage.

Figure 41: Display of measurement when the neutral and phase conductors are correctly connected

NEGATIVE VALUE OF ACTIVE POWER

If the Load Guard Configuration windows is showing negative active power this could mean the following:

- Measuring current transformer is not turned correctly on the phase that is showing negative active power, or the conductors are switched directly on Load Guard (switched conductors on measuring current transformer or on the Load Guard)

- The measuring current transformer is set on two conductors (consumption conductor and production conductor), however the production is larger than production. This would mean that the displayed total power is not correct (because the power of the phase with negative power is subtracted).

Figure 42: The value of measured power is negative

DISPLAYED POWER IS NOT CORRECT

If the displayed power of any phase is not correct, that would mean that the conductors are not set on the right phase conductors.

Figure 43: Display of charging power

For correct calculation of phase L1 power the measuring current transformer L1 set on phase conductor of phase L1. In addition, the supply conductor of phase L1 must be correctly set on phase L1. Otherwise, Load Guard would be measuring current of one phase and voltage of another phase and like it is shown on the above figure, at current of 90.248 A the calculated power is lower than the power at current of 61.095 A which is not correct.