Smart EVSE v2

Charge controller for electric vehicles

Manual v1.02

Software version 2.02

Features

- Fits into a standard DIN rail enclosure.
- Measures the current consumption of other appliances, and automatically lowers or increases the charging current to the EV. (sensorbox required)
- The load balancing feature let's you connect up to 4 SmartEVSE's to one mains supply.
- Switched 230VAC output, for contactor/relay.
- Powered RS485 communication bus for sensorbox.
- Can be used with fixed cable, or socket and charging cable.
- Automatically selects current capacity of the connected cable (13/16/32/63A)
- Locking actuator support, locks the charging cable in the socket, automatically unlocks on a power failure.
- Buildt in temperature sensor.
- All module parameters can be configured using the display and buttons.
- Setup can also be done through serial CLI.
- Firmware upgradable through serial bootloader.
- The controller operates at a mains voltage from 110-240VAC
- Dimensions (W x D x H): 52 x 91 x 58 mm (width: 3 DIN modules)

Building the EVSE

In order to build a complete EVSE (charging station)
you will need:

- SmartEVSE.
- 4 pole NO Contactor rated for the max charging current. (for example Hager ESC440)
- Fixed charging cable or socket with locking solenoid.
- Enclosure with DIN rail. (for example Famatel type 3958)
- Terminal blocks (Wago TOPJOB S)

When using a fixed charging cable, make sure you'll add a resistor between PP and PE on the plug. Otherwise the EV will not start charging.
100 Ohm = 63A
220 Ohm = 32 A
680 Ohm = 16A

The EVSE needs to be protected with a circuit breaker and residual-current circuit breaker, usually located near or in the distribution board.

Diagram

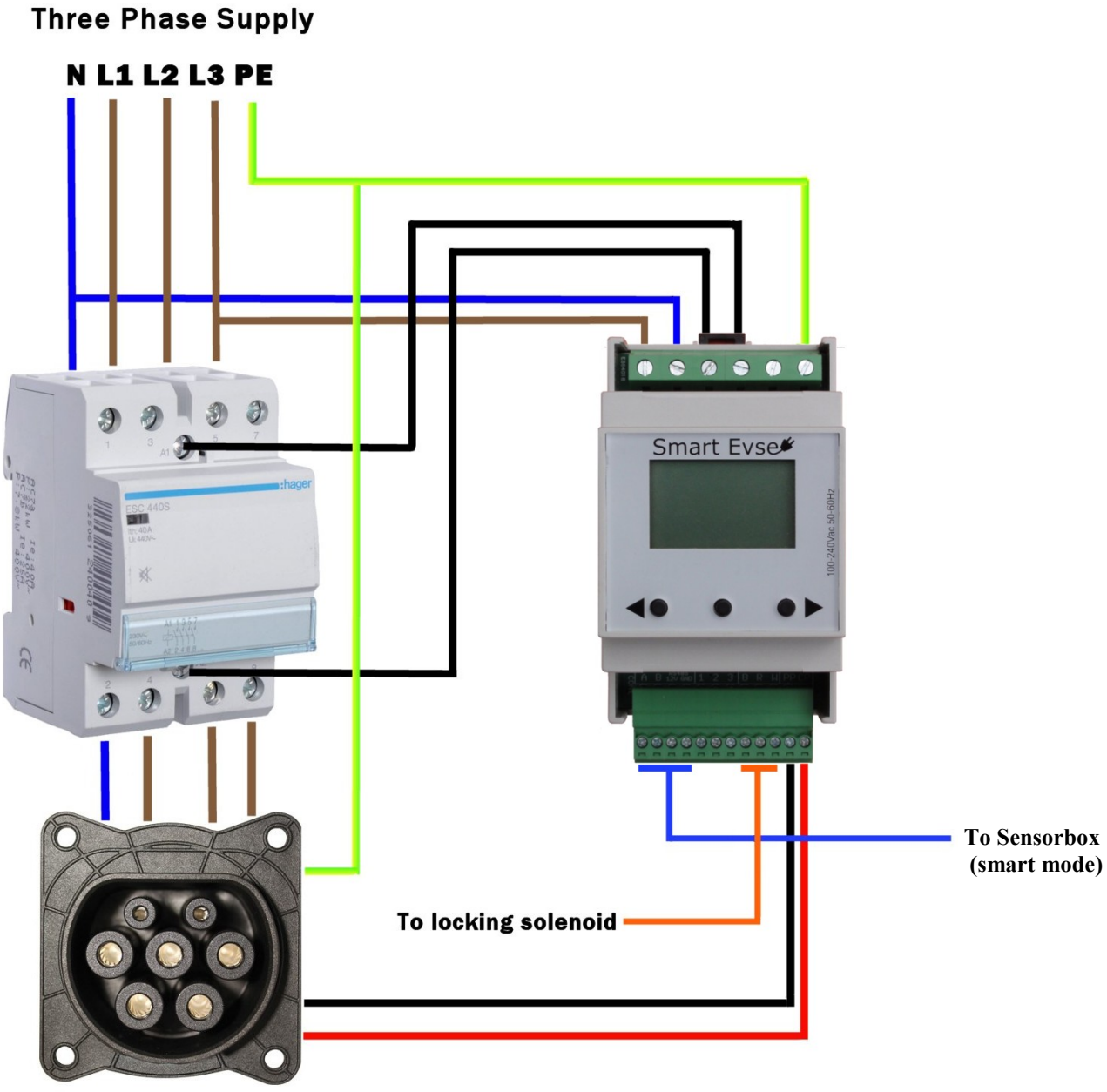
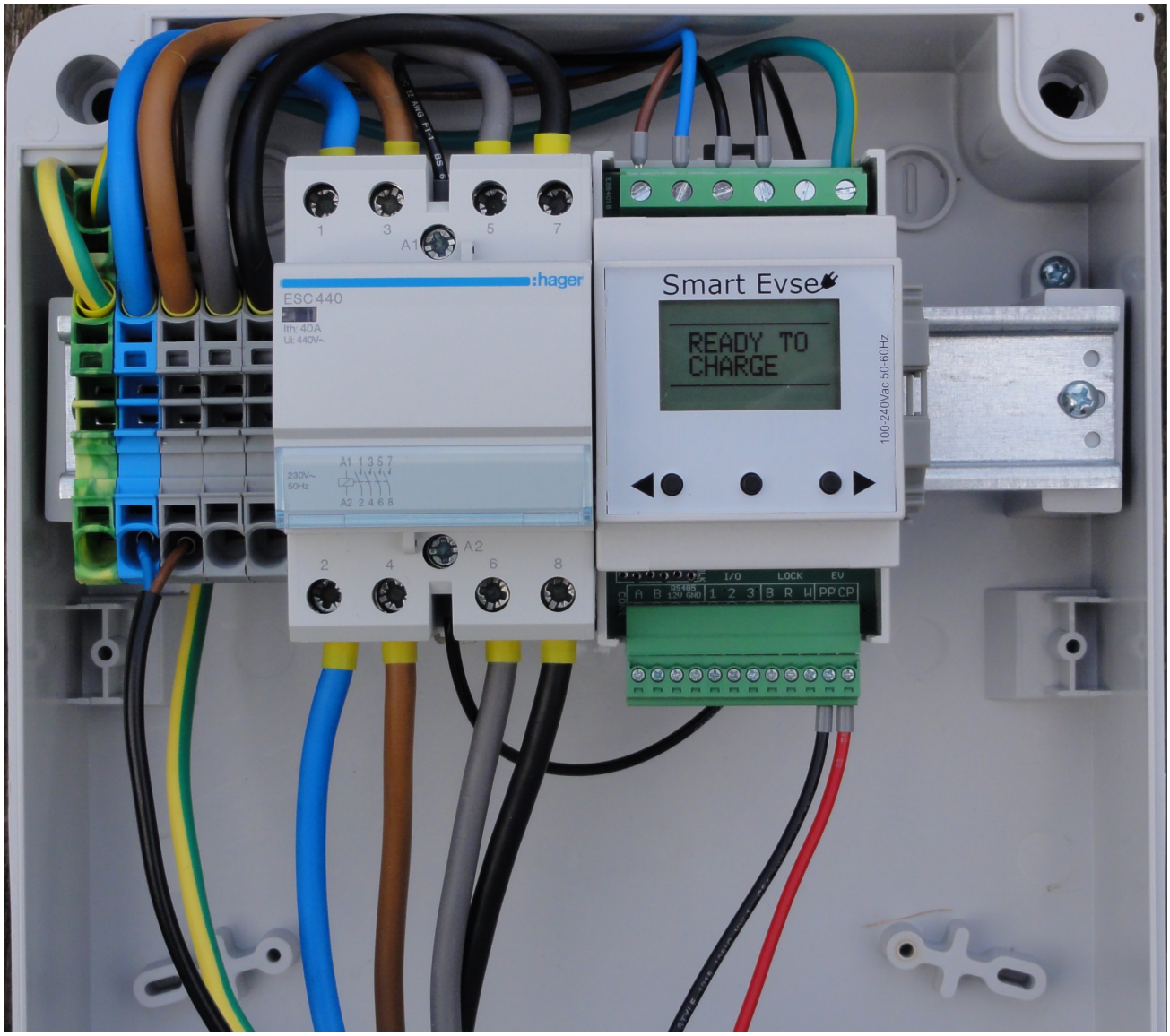
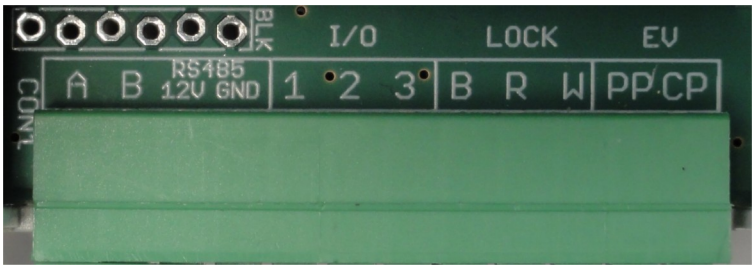


Figure 1, the connections required for a three phase EVSE.

Installed in Enclosure



Low voltage connections



All low voltage connections are made with a 12 pin plug-gable connector.
Just above the connector is the 6 pin FTDI connection for uploading new firmware and accessing the command line interface (CLI).

The A, B, 12V and GND connections are used to connect the sensorbox or other SmartEVSE modules.
The Sensorbox will require all 4 connections, if you want to use the load balancing option, connect only A, B and GND to the other modules.

The I/O connection 1,2 and 3 are for use with external buttons, Led's and other things you want to connect.
At the moment this requires making your own firmware version

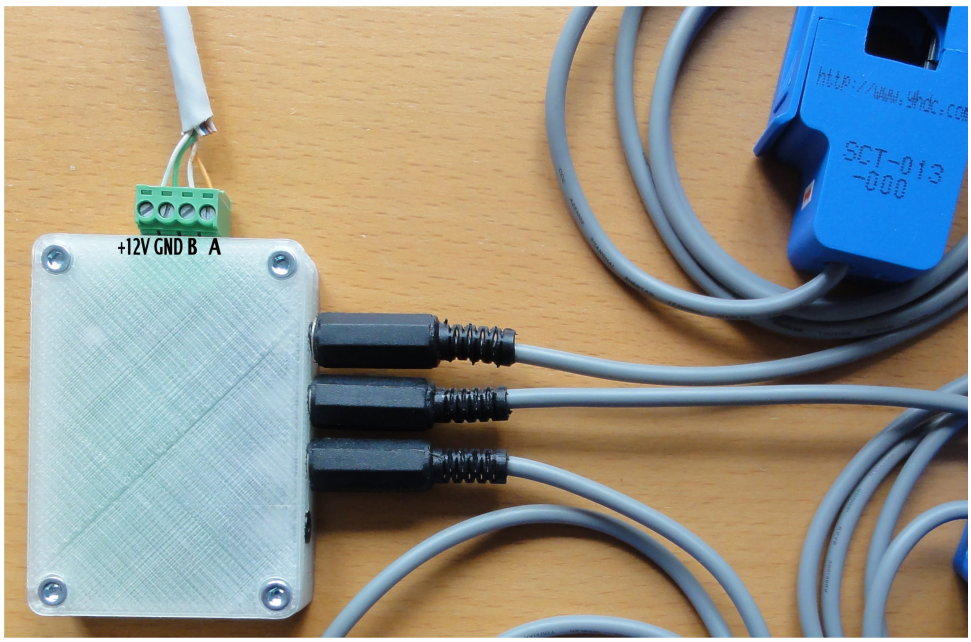
Lock: B, R, W need to be connected to the locking solenoid or 12V motor that will lock the charging cable in it's socket. (see next page)

The PP (proximity pilot) signal will determine what max current the charging cable can handle, and needs to be connected to the charging socket. In case of a fixed cable, this signal is not used.
The CP (control pilot) signal communicates with the EV, and will also inform the EV the maximum allowed charging current.
This signal needs to be connected to the CP pin of the charging socket, or connected to the CP wire if using a fixed cable.

The Sensorbox (optional)

The SmartEVSE is capable of dynamically adjusting the charging current, depending on other loads that use the same mains connection. We call this smart mode, and it will require the following extra items:

- Sensorbox
- Current Transformers (type SCT 013-000) one for each phase (usually three are required)
- 4+ wire cable for the connection between SmartEVSE and Sensorbox.



The Sensorbox should be placed where the Mains connection enters the building. Usually just after the kWh meter, this way it will be able to measure the total current per phase and send this information to the SmartEVSE.

In order to measure the current, Current transformers are used. Clip them around the L1,L2 and L3 wires, and plug the other end into the sensorbox.

The data cable coming from the sensorbox should be connected to terminals A, B, +12V and GND.

The Locking Actuator

A locking actuator can be used to lock the charging plug into the socket.
It will lock the cable when charging starts, and will unlock the cable after charging has stopped.

The SmartEVSE supports two types of locking actuators:

- Dostar locking solenoid (see picture)
- Phoenix Contact locking actuator (EV-T2M3SE12..) 12V DC

Dostar locking solenoids have three wires (usually blue, red and white) and can be connected directly to the B(lue) R(ed) W(hite) terminals on the module.
Sometimes the locking action is reversed (it locks, while it should unlock), you will then have to swap the red and white wires.

The Phoenix contact locking motor has 4 wires and needs to be connected as follows:
B: BL/YL
R: BL/GR + BL/BR
W: BL/RD

Incase of a power failure, the SmartEVSE will quickly unlock the charging cable from the socket automatically.

The locking actuator function needs to be enabled in the SmartEVSE module. See the Menu section.
When used with a fixed charging cable, this function is not used.

Configuring the SmartEVSE

The SmartEVSE has a display, which shows the charging status, and if smart mode is used, also the measured current per phase.
It is possible to configure all settings using the build in menu.
Three buttons below the display are used for navigating the menu.

Hold the center button for 2 seconds to enter the menu.
You can now use the left and right buttons to go to the different menu options.

Pressing the center button, selects the option, and allows you change the value (for example change the charging current)

What is displayed depends on the options you have set.
If you enabled smart mode (MODE-> SMART) then the MAINS and MIN options will be shown.
If you selected the CONFIG->FIXED option, a fixed cable is to be used, and therefore the cable LOCK option is removed.
Instead a CABLE current option is shown, to let you set the max current the charging cable can handle.

The EXIT menu option stores the settings, if you don't want to store the settings, wait 2 minutes (or disconnect the mains) and the setup menu will be exited without saving any settings.

All menu options:

CONFIG	Configure EVSE with Type 2 Socket or Fixed cable
Socket	EVSE has a type 2 socket
Fixed	EVSE has a fixed charging cable.
MODE	Use Normal EVSE mode, or Smart Mode (requires sensorbox)
Normal	The EV will charge with the current set at MAX
Smart	The EV will charge with a dynamic charge current, depending on sensorbox data, and MAINS, MAX, MIN settings.
LOADBL	Load Balancing mode for 2 - 4 EVSE's
Disable	No load balancing is used
Master	Set one of the EVSE's to Master,
Slave1-3	And the rest to Slave 1-3, when using load balancing.
MAINS	Set Max Mains current (*)
25-99A	
MAX	Set MAX charge current for the EV
10-80A	
MIN	Set MIN charge current for the EV (*)
6-16A	
LOCK	Enable or disable the locking actuator (config = socket)
Disable	No lock is used
Solenoid	Dostar type solenoid
Motor	Phoenix Contact motor driven lock
CABLE	Set the max current the charging cable can handle (config = fixed)
13-80A	
CAL	Calibrate CT1. CT2 and CT3 will use the same calibration value. (smart mode)
10.0-99.9A	A minimum of 10A is required in order to change the value.

* = Available in Smart Mode and when Load Balancing has been set to Master.

Load Balancing

It is possible to connect up to 4 SmartEVSE modules to each other, and let them share one mains supply.

Software configuration

Configure the SmartEVSE's load balancing option (LOADBL) and set one module to MASTER, the others to SLAVE 1,2,3.
Make sure there is only one Master, and the Slave numbers are unique.
Example: For a two unit Load Balancing setup, set the first module to Master, and the second to Slave 1.

On the Master configure the following:
MODE - Set this to Smart if a Sensorbox with CT's is used to measure the current draw on the mains supply.
It will then dynamically change the charge current for all connected EV's. If you are using a dedicated mains supply for the EV's you can leave this set to Normal.
MAINS - Set this to the capacity of the mains supply. This will be the maximum current all EV's combined will use.
MAX - Set the maximum charging current for the EV connected to -this- SmartEVSE.
MIN - Set to the lowest allowable charging current for all connected EV's.

On the Slave's configure the following:
MAX - Set the maximum charging current for the EV connected to -this- SmartEVSE.

After setting the Slave's load balancing option, there will be an error message on the display: "ERROR NO SERIAL COM"
This indicates, that the Slave unit was not able to communicate to the Master. This message will disappear after the modules are correctly wired up.

Hardware connections

Connect the A, B and GND connections from the Master to the Slave(s).
So A connects to A, B goes to B etc..

If you are using the Sensorbox, you should also connect the A, B and GND wires to the same screw terminals of the SmartEVSE.
Make sure that the +12V wire coming from the sensorbox is connected to only -one– SmartEVSE.
This wire will provide power to the Sensorbox.

Firmware Upgrade

The SmartEVSE module is firmware upgradable using the bootloader program, and a FTDI cable.

You can download the bootloader program from here:
https://github.com/SmartEVSE/smartevse
Click on "clone or download" on the right and download as zip file.

Unzip the file, and browse to the bootloader folder.
Start the AN1310ui.exe program , setup the COM port your FTDI cable uses (115200 8N1).
Make sure the "Write Options" checkboxes for Program Memory and EEProm are selected.
Connect the FTDI cable to the SmartEVSE module.
Make sure there is no car connected, and press the red STOP button (bootloader mode).

It should display "Bootloader firmware v1.05" on the bottom of the window.

If this worked, you should be able to reprogram the software in the module using a HEX file.
Ask us for this file, incase you did not generate it yourself.

Click on File, Open, and select the “SmartEVSE2.X.production.hex” file
Then click on the red arrow (Write device)

After programming, you can click on the green PLAY button to use the terminal mode, and the module should power up.