

European version of Open EVSE

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Background

I'm Wido den Hollander. I own a Tesla Model S since September 2013 in the Netherlands and I've build my own EVSE using the Open EVSE project.

This EVSE is capable of delivering 3-phase 32A 400V to my Model S resulting in a maximum charge power of 22kW. $(400V * 32A * \sqrt{3})$

The Open EVSE project is aimed at the US market which is Single Phase and with a fixed J1772/Type 1 connector and cable.

This document is to describe what I ran into using Open EVSE on the European 3-phase grid and what can be improved to support European EVSEs.

Service Level Detection

There is no such thing in Europe. We use what we call "Mode 3 charging" and we don't make a distinction between 230V and 400V. In fact, 230V is the voltage between neutral and a phase. 400V is between phases.

There is no requirement for service level detection in Europe.

230V Relays

When using a 3-phase connection you require a relay with 4 poles to switch all 3 phases and the neutral. These relays are usually powered with 230V.

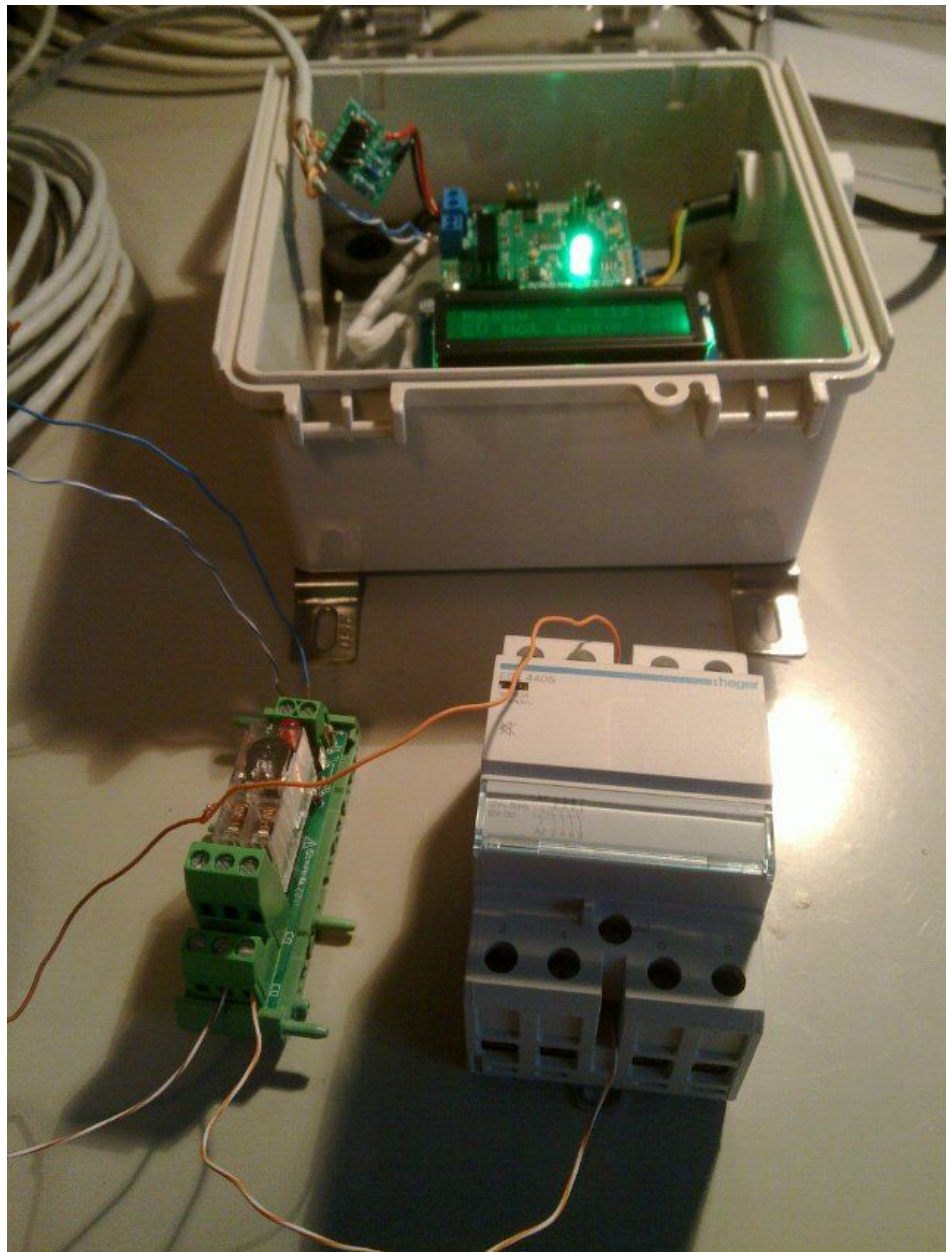
The current Open EVSE board can deliver about 100mA 12VDC on the relay output, which is not sufficient for a 4p relay. The ones that operate on 12VDC are rare and expensive. They also require at least 500mA.

A possible option would be to add a very small (Solid State) Relay on the Open EVSE board which contacts the Live/Hot so that output can be used to switch on the main relay for delivering power to the EV.

The picture here shows the 4p relays which I use.

I use a additional small relay to activate the big 40A 4p relay.

This could be integrated on the Open EVSE board itself.



Cable locking actuator

European charging stations use the Type 2 (aka "Mennekes") socket/plug. They don't have a fixed cable attached, but users have their own cable which they plug into the socket and car.



That is how the socket looks like on the charging station's side. The 5 pins are for:

- Control Pilot
- Proximity Pilot
- Ground
- Neutral
- L1, L2 and L3

These sockets are rated up to 32A 3-phase, that means 22kW. There are 43kW / 63A charging stations out there, but they have a fixed cable with a Type 2 connector attached to them.

43kW stations are however not build at home, all the EVSEs installed at home are 22kW / 32A at maximum.

To prevent the charging cable being unplugged during charging there is a locking pin in the socket which should lock the cable.

Open EVSE has no way of currently controlling that, so my EVSE does not lock the cable yet.



This is the actuator connected to the socket. It is controlled using 12VDC.

A 100ms pulse on the Red and Black pin locks the cable and reverse the polarity and send a 100ms pulse and the cable unlocks.

The locking should be done when the charging state goes from "EV Connected" to "EV Charging" and it should unlock when the state goes back from "Charging" to "Connected".

This could be achieved in two ways:

1. Have a output which reverse polarity so it can directly control the actuator
2. Have two additional outputs and have a separate circuit do the polarity reversing

Proximity Pilot / Cable max current

Since users use their own cable to charge their EV it could be that the cable is not rated for the maximum current the EV and EVSE support.

A resistor between the Proximity Pilot (PP) and Ground tells both the car and EVSE what the maximum current for that cable is.

Resistor	Max Current
1500 Ω	13A
680 Ω	20A
220 Ω	32A
100 Ω	63A

So if the "Max Current" in the EVSE is set to 32A, but a cable with a 680 Ω resistor is plugged in, the pilot signal should say "20A". The pilot signal should never exceed the max current of the cable.

The most common use-case is that users carry a 20A cable and plug their 32A capable EV like a Tesla Model S or Renault ZOE into a 22kW / 32A EVSE. In that case the charging should be limited to 20A.

This requires a additional input on the Open EVSE board to allow reading out the resistor value and adjusting the maximum current based on that.

Conclusion

To fully accommodate European Open EVSE setups the following changes are required:

1. Remove service level detection
2. 230V output for relay control
3. Support for cable locking actuator
4. Proximity Pilot / Cable max current detection