Installation and Construction Notes

You need to read and understand this if you want to build an EVSE that will be safe and need to pass a building inspectors review.

Before beginning this process please accept you are responsible for whatever you do, the ultimate safety, and your personal safety installing and using this equipment. Electricity is dangerous it could cause death or fires while installing or using this equipment if done improperly. You are accepting any and all responsibility for whatever you do or have done, personal, properly or consequential. We are providing these guide lines to help an educated a user implement a J1772 EVSE system. We are not the experts for your application. We provide a low voltage control board that provides the pilot signal and controls your relay. Your implementation and specific needs are out of our control.

The NEC requires that whatever you purchase and connect to the power lines needs to be UL listed. If you build something you need to use UL listed parts as they were intended to be used. If I build and sell a complete EVSE unit and sell it to you it needs to be UL listed. If you build your own, all that is required is all the parts are UL listed and you follow all the NEC rules. The control board we provide that provides the pilot signal, controls the power contactor (relay), and provides some human interface operates on safe low voltage, typically 24VDC, that is bonded to equipment ground so it is not directly connected to the power lines.

We believe this design is suitable for home use and possibly business use. We do not believe it is suitable for general public use. EVSE for general public use need the full safety approval of someone like UL. This determination of is this suitable is your responsibility.

If you are going to build and be inspected, we would recommend selecting all your parts and discussing the project with your local building department before beginning. For people who do not feel qualified to do this themselves or live in a place where a licensed electrician must do the work, discuss this with your electrician. Some of the wiring is in your main circuit breaker box and a qualified person is a good idea for this work since there will be power on in the breaker box. It is up to you to decide how to do this safely and properly for any special requirements you have.

If you are confused by the descriptions here or the terms used you need an electricians help. This is a big job and must be done correctly.

Let's get started:

A **GFI Circuit breaker** is needed in your circuit breaker panel. You need to have space to add the breaker in your panel and, you need to have electrical service capacity to you home for the new breaker. The breaker needs to be a 2 pole GFI (ground fault interrupting) breaker for 240 Volt use. The GFI brakes have a white wire coming out the side that must be connected the neutral buss in the breaker box. This will provide the charging current.

GFI is a protection circuit that ensures all the electricity makes the expected round trip from the breaker box and back with none leaking out of the circuit. If there is a short or an electrical leakage path the GFI detects it and turns the power off. It is just like the ones used for outdoor receptacles or ones in the bathroom. This is essential and could save a life if a fault ever occurs. The down side is if your vehicle is older or home built may have ground faults and they are difficult to track down. One common one is with flooded lead acid batteries, the acid on the outsides of the cases is a leakage path to the cars chassis.

What GFI breaker rating should you use? First the NEC only allows you to use 80% of the breakers rated amperage. So a 30 amp breaker allows you to use 24 Amps. At least one of those Amps will go the control circuit so you are left with 31. I recommend the smallest standard size your car allows. Standard values are 15, 20, 30, 40, 50Amps. Make sure you have enough current to meet the cars charging requirements.

Wire and Conduit is needed to connect the EVSE you are building to the breaker panel. The NEC Article 625 requires all 240 volt units be hard wired and no plug in connections. This is to ensure a good ground. Wire sizes vary with the current rating of the GFI breaker selected and can be found in the NEC. Conduit or cable is determined by the location, so refer to the NEC again.

An **Enclosure** is needed for the EVSE. We recommend a polycarbonate box with a clear cover that is UL listed and NEMA 4X rated for water resistance. The clear top allows the LCD or LED to be observed while giving good protection. The box will also be substantial enough to support the cable when it is not in use. There is a requirement for storing the cable when it is not in use and a simple tab and the top of the box will do it.

We like the **control board** to be located in the top of the box away from the power components mounted in the bottom. Parts need to be securely mounted to the metal panel that comes with the box. The panel and all metal parts must be connected to equipment ground. If you have some industrial component mounting rail (DIN 35) it will simplify the mounting but screws are fine. Don't select a box until you have all the parts and have checked they will all fit.

Selecting the **contactor** (relay) involves picking one with a 12 or 24 volt DC coil and contact rated at over 240 volts (typically 600 volts) and with a current rating greater or equal to your breaker rating. Most of these contactors will be 3 pole and you just don't use one. 24 volts DC is a very common industrial voltage for the coil and should provide many available contactors. There are basically 3 types, definite purpose which are exposed low cost units, NEMA heavy duty large exposed terminals, and IEC which are smaller, touch safe, but a little more expensive.

It is also possible to use two relays, one small signal relay with a 12 or 24 Volt DC coil connected to the board and its contacts controlling the contactor with an AC coil. Contactors with 240 volt AC coils are more common than DC coils and this may open up more possibilities. The small relay would switch the 240 VAC and drive the larger contactor coil. This would also be a way to use a definite purpose contactor with a 24VAC coil and a transformer. Remember to fuse the coil circuit or use the same fuse that protects the power supply.

While there is no specification about the relay type we believe this is a safety circuit and a contactor switching both power leads provides true separation from the power source. Solid State Relays rely on a triac or back to back SCR's and include snubbers that always conduct. The SSR do not provide true isolation. There is a requirement that both hot power leads be switched.

Our control board needs DC power 12 or 24 volts. The **power supply** must be able to power the contactor coil as well. The contactor catalog may specify the current or the resistance of the coil. If it is the resistance use ohms law to calculate the current. The power supply needs to be able to provide about ½ Amp for the control board and 20% for a safety factor over the coil requirements. Any type UL listed fully isolated supply can be used. We prefer the industrial switching units in a plastic case that again are touch safe. The supply must operate on the voltage you will be charging at, probably 240 Volts.

The power supply needs a **fuse**. The power supply instructions will recommend the proper fuse amperage. You may use a fuse or circuit breaker. They must be UL listed and rated for the power line voltage. We like the ultra-safe touch safe fuse holders and fuses with an interrupting ability of at least 10,000Amps (like class CC).

The **J1772 cable and connector set** need to be UL listed and rated at or above the breakers current rating. There are a few details about attaching the cable to the EVSE box. It needs to be done in such a way that it will break away from the box if the car drives away while plugged in. Additionally the wires need to be arranged and secured so they disconnect in an orderly fashion. First use an Anderson connector or ¼ inch QD on the pilot wire. Have as little slack as possible, possibly 3 inches so this will pull apart first removing the pilot signal and removing power. Next the two power leads to the J1772 cable need to have about twice that much slack. The power leads will connect directly to the bottom of the contactor. With this extra slack they will pull out next. Finally the ground wire needs still twice as much slack so it absolutely pulls out last. This orderly shout down maximizes safety and is required.

The cable needs to be secured to the box with a strain relief to resist normal pulls and use but not one of the extra high force ones used for overhead cables so the cable can break away before the box pulls away from its mounting. The strain relief needs to be plastic if it is used with a plastic box.

Remember to have a way to store the cable when not in use so the plug is 24 to 48 inches above the ground. This can be as simple as a tab on the box top and winding it around the box.

Wire it up per the drawings, double check it all and it is ready for use or inspection.

Good luck and happy charging.

If you have questions recommendations, improvements, please write.

6/23/2011 First Version
7/22/2011 Added 2 relays and Photos