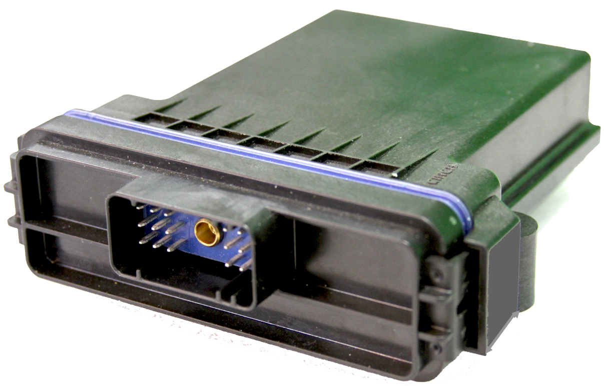
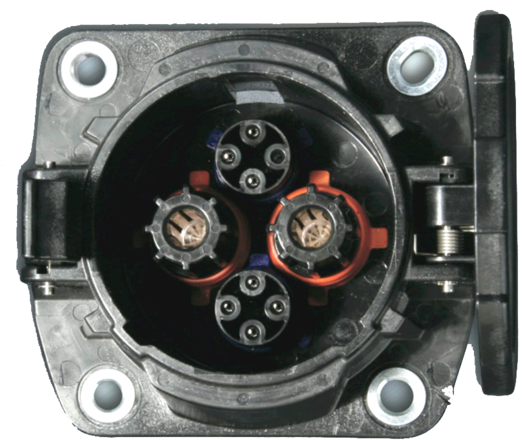
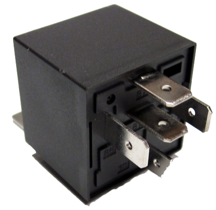
Installation and User Manual

EVTV
CHAdeMO Fast Charging Kit
For
Electric Vehicles







INTRODUCTION

This User Manual describes installation and use of the EVTV CHAdeMO Fast Charge Kit for Electric Vehicles. This kit was developed by Paulo Jorge Pires de Almeida, Damien Maguire, Collin Kidder, and Jack Rickard of the Electric Vehicle Television network.

The purpose of this kit is to enable any electric vehicle to use the Japanese/TEPCO fast charging standard known as CHAdeMO to quickly charge an electric vehicle to 80-90% charge in less than 30 minutes using available CHAdeMO fast charging stations.

Since it's introduction in 2009, CHAdeMO has become the largest network of fast charge stations in the world. As of this writing, CHAdeMO is used on some 50% of all electric vehicles sold, compared to 13% using the Tesla SuperCharger network and 7% using the SAE Combo standard.

As of April 2015, there were some 5735 CHAdeMO fast charge stations installed worldwide with 3087 in Japan, 1659 in Europe, and 934 in the United States.

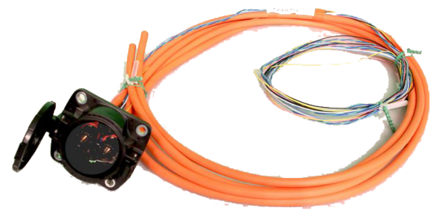
CHAdeMO is the world's first DC fast charging standard designed for modern Electric Vehicles, featuring high density lithium-ion batteries and compact yet powerful magnetic synchronized motors. The R&D of CHAdeMO dates back to 2005. After more than four years of thorough testing and on-site demonstration, the first commercial CHAdeMO charging infrastructure was commissioned in 2009.

The goal of the R&D was to develop a public infrastructure of fast chargers that enables EV driving without worrying about battery range. CHAdeMO allows electric vehicle charging at DC currents of up to 125 amperes and voltages up to 500volts. For most current vehicles, this allows 90% charge in less than 30 minutes.

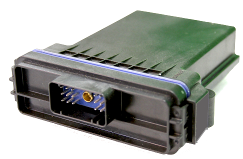
The EVTV CHAdeMO Fast Charge Kit can be installed on virtually any existing OEM electric vehicle or DIY electric car conversion. But installation is non-trivial and should only be attempted by knowledgeable qualified technical personnel.

EVTV CHADEMO FAST CHARGE KIT COMPONENTS

The CHAdeMO Fast Charge Kit includes the following components:



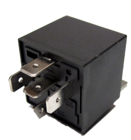
- **1 CHAdeMO Fast Charge Inlet and wiring harness.**



- **1 JLD505 Charge Controller**

- **1 Cinch Connector and Pin Set**

- **2 Gigavac High Voltage Contactor Relays**



- **1 12v Relay**

- **1 DS18B20 Temperature Sensor Probe**

- **1 400A 50mv 0.1% calibrated shunt**

- **1 USB Connection Cable**

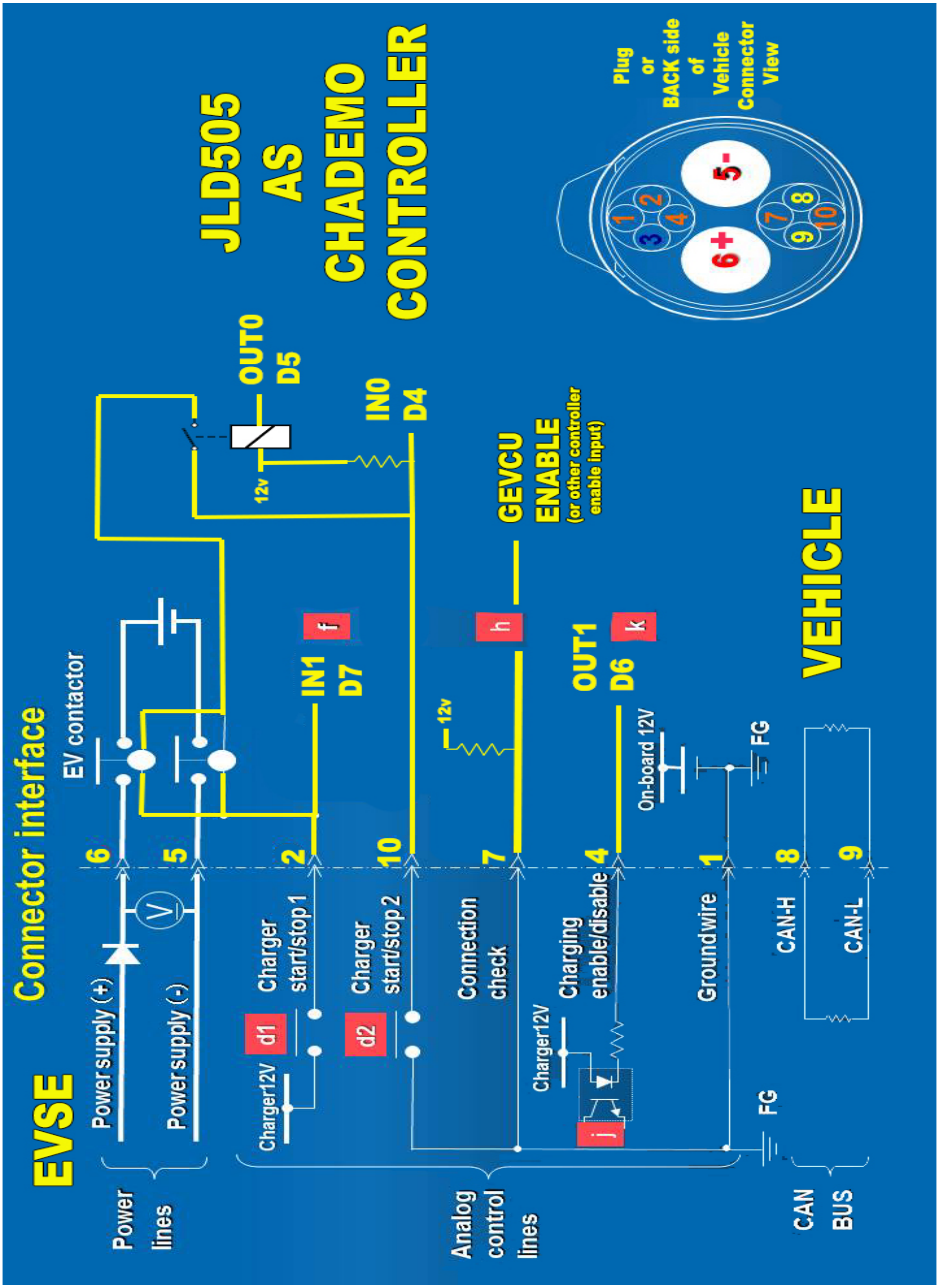
What You Will Need Not Included

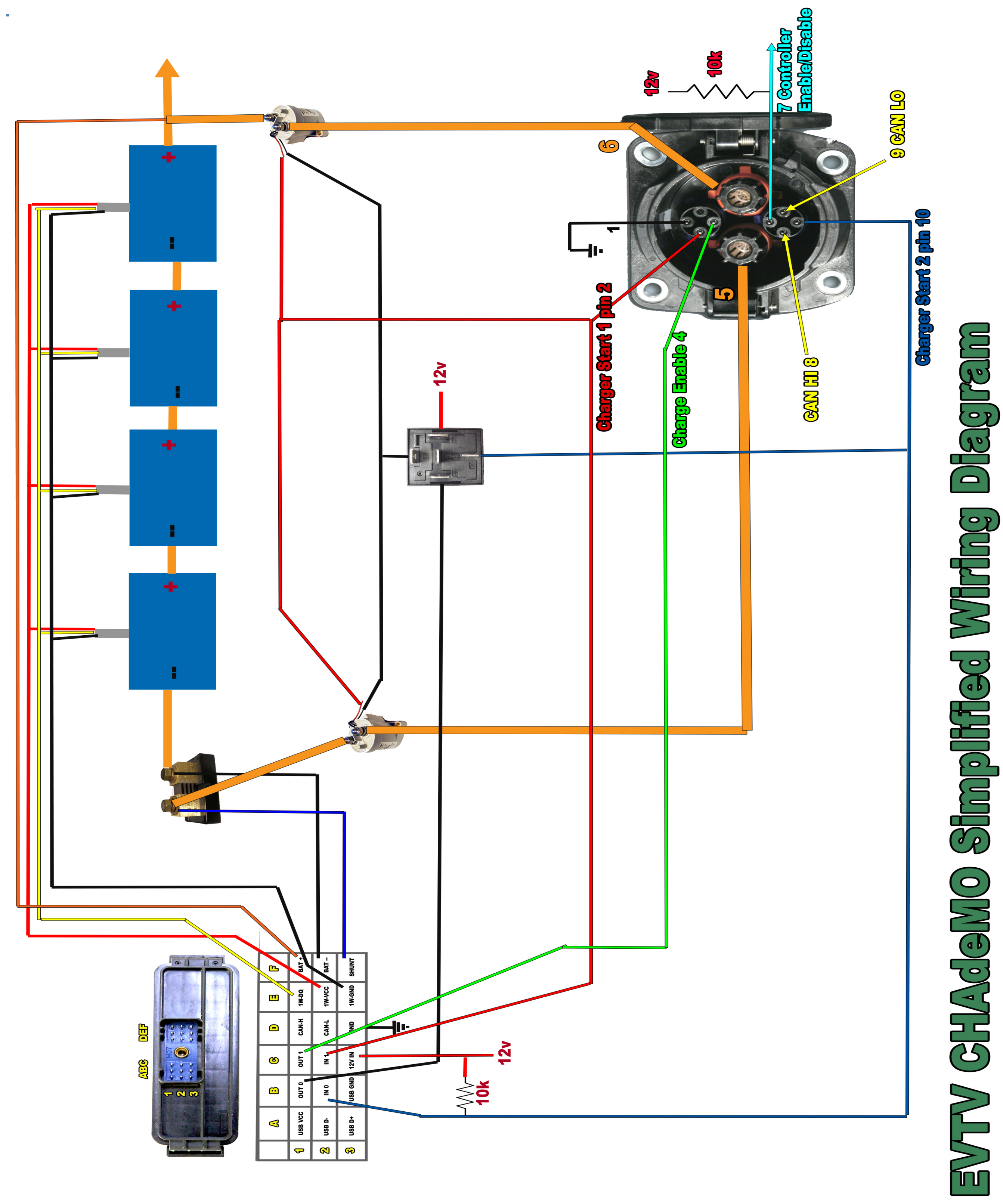
2 pullup resistors 10kOhm.

Assorted mounting hardware

Assorted cables/wiring and terminals

No specialized tools required.


JLD505
AS
CHADEMO
CONTROLLER
Plug or BACK side of Vehicle Connector View
6+
5-
1
2
3
4
7
8
9
10
OUT0
D5
12v
IN0
D4
GEVCU
ENABLE
(or other controller enable input)
VEHICLE
Connector interface
EV contactor
IN1
D7
f
h
12v
OUT1
D6
k
On-board 12V
FG
EVSE
Power supply (+)
Power supply (-)
Charger12V
d1
Charger start/stop 1
d2
Charger start/stop 2
Connection check
Charger12V
Charging enable/disable
j
Ground wire
FG
CAN-H
CAN-L
6
5
2
10
7
4
1
8
9
Power lines
Analog control lines
CAN BUS


EVTV CHAdeMO Simplified Wiring Diagram
12v
10k
7 Controller Enable/Disable
9 CAN LO
6
1
5
Charger Start 1 pin 2
Charge Enable 4
CAN HI 8
Charger Start 2 pin 10
12v
12v
10k
ABC
DEF
A
B
C
D
E
F
1
2
3
USB VCC
OUT 0
OUT 1
CAN-H
1W-DQ
BAT +
USB D-
IN 0
IN 1
CAN-L
1W-VCC
BAT -
USB D+
USB GND
12V IN
GND
1W-GND
SHUNT

The JLD505 module consists of a single two-layer printed circuit board mounted in a Modice Cinch LE weatherproof enclosure.

This module is compatible with the Arduino Uno multicrontroller board and uses the Arduino Integrated Development Environment for programming.

The heart of the module is an ATMEGA328P-AU 16 MHz multicontroller. The high-performance Atmel picoPower 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

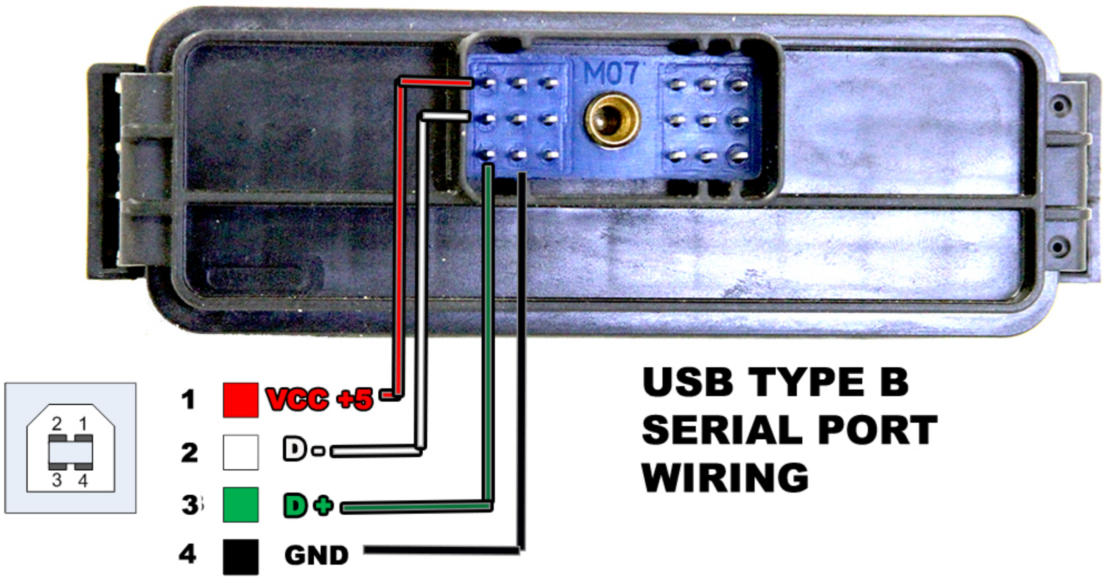
In addition to the multicontroller, the JLD505 provides three different communications channels:

USB SERIAL PORT

The JLD505 features an FT232R USART chip providing a Universal Serial Asynchronous Reciever/Transmitter capability linking USB to the TTL serial pins of the multicontroller through an ADUM1301 digital isolator. This provides a truly isolated USB port to the device.

You may find it curious that with all that going for it, the JLD505 doesn’t actually feature a USB port. The JLD505 is housed in a weatherproof IP67 enclosure. A USB port would be difficult to incorporate while maintaining weather integrity.

So we’ve brought the four USB connections out on the Cinch connector of the enclosure at pins A1, A2, A3, and B1. We also provide a sturdy bulkhead mount USB port with a short lead featuring four wires.



CAN PORT

An MCP2515 CAN controller provides the JLD505 with a Controller Area Network (CAN) version 2.0B interface. It works with the ADUM 3053 CAN Transceiver – a Signal and Power Isolated CAN Transceiver with Integrated Isolated DC-to-DC Converter. This allows us to communicate over CAN networks at up to 1 Mbps using either 11 or 29 bit message IDs with FULL isolation.

CAN is the communications bus used not only in electric vehicles, but all modern automobiles. The Chevy Volt, for example has 102 multicontrollers in the vehicle, all linked by CAN bus. The Tesla Model S is reported to have 52 multicontrollers, again linked by CAN bus.

The CAN interface allows us to do several things potentially with the JLD505.

CHADEMO.

The CHAdeMO fast charge protocol is a CAN bus protocol where the charge station and automobile communicate with each other over the battery pack state, how much current and voltage the charge station can deliver and how much current and voltage the car wants to command at any one moment in the charge process. We will use the JLD505 is the central controller for the EVTV CHADEMO Fast Charge Kit.

GEVCU

EVTV already offers a Generalized Electric Vehicle Control Unit (GEVCU) to drive a variety of controller/inverter motor combinations and control other features of the car. We recently added a module to provide vehicle information to a 7 inch color digital display titled the Electric Vehicle Interface Controller or EVIC. This software module can get some voltage and current information from the motor/inverters, but will accept the much more accurate information on battery state of charge, current and voltage from the JLD505 if it is available. It can detect the presence of the JLD505 automatically.

In this way, the JLD505 gives the GEVCU an enhanced battery monitoring capability.

CHARGING

A wide array of existing chargers such as the TCCH charger, the Elcon charger, and others are already sold with a CAN control option. JLD505 is uniquely equipped to monitor pack temperature, voltage and current, and can easily control the entire operation of these chargers from start to finish.

CAN is a differential bus protocol consisting of two wires CAN HI is available on Cinch connector pin D1 and CAN LO is available on pin D2. Normally, if the CAN bus is covering more than a foot or two through the vehicle, you should twist the wires into a twisted pair. This helps cancel out any noise picked up along the length of the wire.

BLUETOOTH

The JLD505 hosts a HM-13 Bluetooth Low Energy (LE) version 4.0 2.4GHz transceiver. This is the latest BLE 4.0 version and is compatible with Apple's IOS devices starting with Apple iPhone version 5S. It also supports all earlier Bluetooth modes. As a result, you can quite easily communicate with the JLD505 by laptop with no serial port cable at all. And it opens the door to colorful mobile device displays of battery information in the future.

JLD505 SENSORS

The JLD505 hosts a couple of unique sensors.

- Shunt based current measurement
- 1 Wire temperature measurement

SHUNT CURRENT MEASUREMENT

Hall effect devices are inexpensive and intrinsically provide isolation – an important consideration when measuring high voltage battery packs. But their accuracy poses some problems – particularly with varying temperatures and at lower current levels.

All serious attempts at coulomb counting are based on measuring the voltage across a high current low resistance sense resistor – termed a shunt. The amount of voltage measured is a function of the resistance of the shunt, and the current passing through it. They are inherently bi-directional, and all serious lab work in test/measurement is done with shunt devices.

We provide a somewhat expensive EMPRO 400A 50mv shunt that is calibrated to 0.1%. Shunts feature a "Class" rating. Class 5 shunts exhibit an accuracy of +/- 0.5 %. So at 400 amps we should indicate 50mv +/- 0.25 millivolts.

Most of the Chinese shunts we carry at EVTV are inexpensive Chinese 75mv shunts of 0.5%. Very good shunts are often available at 0.25% calibration. We pay double for these 0.1% laboratory grade shunts in a high current package. At 400A they should read 50mv +/- 0.05 mv.

With Class 1 0.1% shunts we can expect **+/- 0.05 mv** or **+/- 0.4** amps

Note that 400A is not the limit of current of the shunt. This shunt could easily do 1000 amperes for several minutes. The nature of electric vehicles is such that 1000 amps is rarely encountered for over a few seconds. Heating at those levels does affect accuracy. But then the need for very fine resolution kind of disappears at 1000 amps.

The 400A isn't a current limit. It's a ratio. This shunt will be carrying 400 A when exhibiting 50 mv. Therefore it is **0.000125** ohms fixed resistance.

The JLD505 uses a Texas Instruments **INA226** chip specifically designed for bi-directional current measurement form shunts, and converts the result into a serial I2C signal to the multicontroller. It has an internal 16-bit analog to digital converter capable of measuring shunt voltages down to 2.5uV or 0.0025 millivolts which would correspond to +/- 20 milliamperes with this shunt.

So while our INA226 gives us a RESOLUTION of 20ma, the accuracy of our shunt limits us to an ACCURACY of 400ma.

The maximum voltage it can measure across the shunt is about 82mv. With this shunt, that would correspond to **0.082/0.000125** or 656 amperes. If you need to measure currents above that, you would simply replace the shunt with one of a larger value.

The combination of this very new INA226 chip with the lab grade shunt gives us a level of accuracy in counting current that is just not done in electric vehicles.

To some degree we're throwing your checkbook at the problem in order to achieve lab grade accuracy. Why? Because we can. We already offer the very inexpensive JLD404 device which features Class 2.5 shunts and very reasonable accuracy. We want to position the JLD505 as a serious upgrade in the accuracy of coulomb counting.

In converting voltage measurements into I2C serial data, the INA226 inherently offers excellent isolation from the high voltage pack.

HIGH VOLTAGE PACK MEASUREMENT

The same INA226 chip allows us to measure pack voltage to a similar level of accuracy using a voltage divider.

TEMPERATURE MEASUREMENT

Again with temperature measurement we found Maxim had just released a new more accurate chip for their one-wire measurement system. The **DS2480B Serial to 1-Wire Line Driver** allows the multicontroller to receive temperature information from the DS18B20 Temperature Sensor Probe and present it as serial data over the SPI port on the multicontroller.

The DS18B20 communicates over a 1-Wire® bus that by definition requires only one data line (and ground) for communication with a central microprocessor. It has an operating temperature range of -55°C to +125°C and is accurate to ±0.5°C over the range of -10°C to +85°C. In addition, the DS18B20 can derive power directly from the data line ("parasite power"), eliminating the need for an external power supply.

Each DS18B20 has a unique 64-bit serial code, which allows multiple DS18B20s to function on the same 1-Wire bus. Thus, it is simple to use one microprocessor to control many DS18B20s distributed over a large area.

These are intelligent temperature sensors, but they have become ubiquitous in temperature measurement. As a result, they are available at very reasonable prices and in quantity everywhere.

The curious nature of Maxim's 1-Wire temperature system is you can tie as many of these DS18B20 temperature probes as you could conceivably want in an electric vehicle. We use this with the intent that you be able to add one temperature probe for each individual battery box in your vehicle.

We include one of the DS18B20 temperature sensor probes, but you can tie as many as you like to the bus available on the Cinch 18-pin connector and the software will rationally keep measurement data on all of them. The 1-Wire data line is available on the Cinch connector at pin E1. Pin E2 provides power for 1-Wire devices and pin E3 provides the return. But for a limited number of devices (say four or five) you should be able to tie the ground to the vehicle frame and use the parasitic aspect of the temperature probes to power off the data line itself.

DIGITAL OUTPUTS

The JLD 505 features two digital outputs OUT 0 on pin B1 and OUT 1 on pin C1 of the Cinch connector.

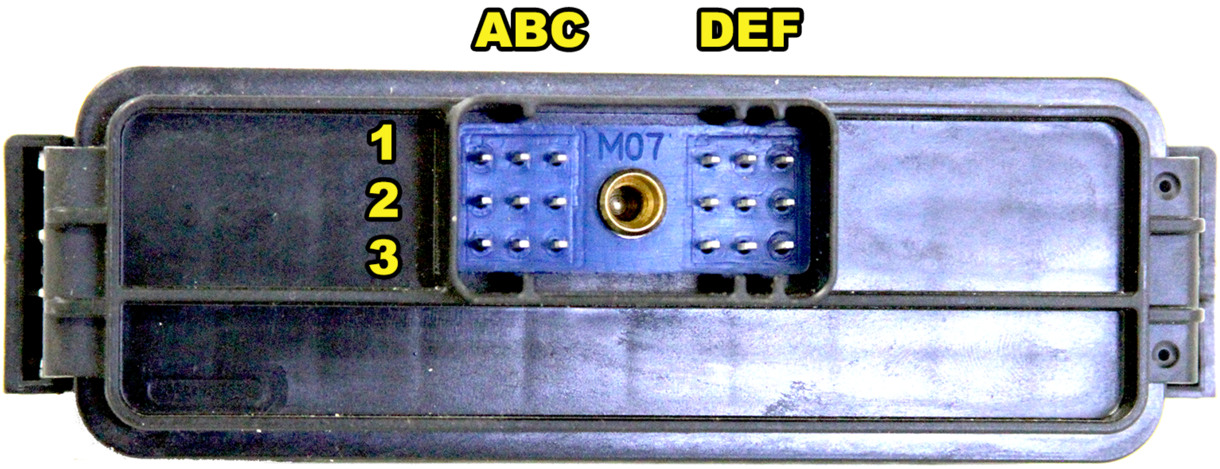
These outputs are isolated and protected MOSFET switch outputs capable of up to 6.8 amps of pulse current and a continuous 1.6 amp load. Basically, when either output is switched ON it connects the output pin to vehicle frame ground. We call this a LOW SIDE switch.

By using relays and 12v externally, you can use these switched grounds to turn most anything on or off. These MOSFETS are sufficiently powerful to drive any of the contactors commonly used on an electric vehicle.

DIGITAL INPUTS

The JLD 505 also features two digital inputs, IN 0 on pin B2 and IN 1 on pin C2 of the Cinch connector. These inputs are optically isolated and feature a 10k pullup resistor holding the input pin high normally. Receipt of a 12v input signal will turn on the optoisolator pulling the input pin to a low state.

JLD505 CONNECTIONS



	A	B	C	D	E	F
1	USB VCC	OUT 0	OUT 1	CAN-H	1W-DQ	BAT +
2	USB D-	IN 0	IN 1	CAN-L	1W-VCC	BAT --
3	USB D+	USB GND	12V IN	GND	1W-GND	SHUNT

12V POWER CONNECTIONS

The JLD505 requires 12v power as an input on pin C3 and vehicle frame ground on pin D3. As a battery monitoring system, we would envision this being permanent unswitched 12v power.

SHUNT CONNECTIONS

The provided 400A 50mv shunt should be connected to the negative terminal of the high voltage pack using either large M8 capscrew. Any loads powered by the system should be connected to the OTHER side of the shunt to make sure all current into and out of the pack is "counted".

Connect BATT- pin F2 to the small screw terminal closest to the pack negative lead. Connect SHUNT pin F3 to the small shunt screw terminal furthest from the pack negative terminal.

Finally, connect BATT+ to the most POSITIVE terminal of the high voltage battery pack. This allows us to measure the full pack voltage between BATT+ and BATT-.

JLD505 CONFIGURATION

To operate accurately on your EV, the JLD505 needs some accurate information about your battery pack. It holds this information in a series of persistent "variables" that are stored in Electrically Erasable Programmable Read Only Memory (EEPROM) on the device.

As a practical matter, what this means is you must "configure" your JLD505 with a laptop computer or other serial device. But once configured, it will remember this data even when power is removed from the unit. It will remain configured in this manner until you again connect to it and change the variables.

AMPHOUR CAPACITY – AH

Amphour capacity is of course the capacity of your high voltage pack in ampere-hours. If you use 100 72 Amp-hour cells in your pack, the amphour-capacity would be 72.

It is obvious that if you start with a fully charged pack, and fully discharge it, that you should, on a new battery pack, get at least 72 AH out of it.

Unfortunately, in cold weather you most likely won't. You might get 65 AH at temperatures freezing and below. If your pack is 7 years old, you might have 60Ah total capacity left. And 72 AH represents discharge to 100%. You can dramatically extend the life of your cells by limiting discharge to 80% of discharge.

When the JLD505 counts discharged current from your pack, less any current returned through regenerative braking, when it reaches the number entered here it considers your State of Charge or SOC to be zero.

So for example, with a 72Ah pack if you want SOC 0 to use 80% of the available capacity, you would enter 72 * 0.8 or 58 as your AH value.

The AH value is set using the **AH=XX** command where **XX** indicates the number of whole ampere hours you wish to set – maximum 255.

RESET VOLTAGE

Operation of the JLD505 should normally be continuous – that is powered by unswitched 12vdc all the time. Of course, if you are leaving your car unattended for several weeks, you will use a maintenance switch to disconnect the pack and prevent the JLD505 and other meters and devices from bleeding your pack to zero over time.

This is perfectly acceptable. The JLD505 will come up when power is applied and retrieve these persistent variables and immediately begin its work. Not a problem.

But during normal operation, JLD505 keeps continuous track of the number of coulombs or AH that are put INTO the pack by regenerative braking or charging and the amount of current OUT of the pack for driving the vehicle, running the heater, the DC-DC converter etc. In this manner, the ampere hour, kilowatt hour, and SOC values are continuously maintained.

Unfortunately, your battery pack is not 100% efficient. If you remove 72Ah from it, putting 72Ah back in won't quite get you back to 100% SOC. It's actually better than you probably think. The disparity is normally exaggerated by ampere-hour counters that struggle to have the same accuracy under 300 amps loads as they do with 20 amp regenerative braking or 9 amp charge rates. But there are losses. Typically round trip efficiency of LiFePo4 cells can be as high as 98.5%.

This roundtrip error accumulates over time. Each charge/discharge cycle causes the calculated SOC and AH to vary a bit more from the real state of the cells.

This can easily be reset by zeroing amp hours, kilowatt hours and SOC in our configuration screen. You can even connect a button to one of the inputs and use it to manually reset your AH.

Unfortunately, it is inconvenient to haul out the laptop to zero your AH and in actual practice driving real cars each day, we've found the "reset" button problematical.

Obviously, you have to remember to press the reset button to clear the amp hours after charging. Problem.

Worse, you can press it too often. Let's say your normal night time charge is interrupted by power outage, lightning strike, acts of God and nature, or whatever. You rush out in the morning, clear your AH and drive away. Your gages and your JLD505 think you have a fully charged pack. But it didn't charge at all. You have 10AH left but all your gages indicate you are fully charged. Don't ask us how we know this very unlikely event can happen. Yes, of course a quick check of SOC would have told you it wasn't full. But if it worked the last 212 mornings in a row, why would you do that?

Some other people's daughters, not mine mind you, will quickly learn they can relieve range anxiety and award themselves bonus miles just by pressing the silver button on the dashboard. Dad will never know….

The JLD505 automatically resets your AH, kilowatt hours, and SOC ANY time the measured pack voltage is equal to or greater than the RESET VOLTAGE.

This should be the fully charged voltage of your battery pack AFTER it has completed charge and the pack has settled to its normal open circuit voltage some hours after the charge.

For 100 LiFePo4 cells, our experience has been that in undercharging the pack slightly, we usually see 332 to 334 volts a few hours after the charge. So we might set the RESET voltage to 332v.

How does this work? While charging you will reach 332v and continue charging to perhaps 355 or even 360 volts. Each and every loop where it measures this voltage and it is above 332, it will reset your AH, kilowatt hours to zero and your SOC to 100%. After charge it will continue to do this ad infinitum.

The initial discharge of a fully charged pack is on the very steep part of the charge curve. So to get the pack voltage to be LESS than 332 volts, requires a drive of about ½ block. After the first initial decrease in voltage, at about 325 volts this decrease in voltage flattens out to a huge degree.

So by resetting every time it measures greater than 332 volts, JLD505 will keep showing 100% SOC. But it takes very little driving to bring your battery below that – even with regen. At that point, it ceases to reset and begins the normal count of current into and out of the pack.

In this way, partial chargers or interrupted charges will not reset these values. But a full charge will. It may take some experimentation to find just the right voltage for you.

If you do not want automatic reset, simply set this value to either zero or some value preposterously higher than you will ever see – 450v on a pack that charges to 360v for example.

RESET is set with the command **RESET=xxx** where **xxx** equals the number of whole volts.

CHARGER=ON/OFF

The charger variable determines whether your JLD505 controls a CAN controlled charger. JLD505 can only control a charger using the protocol of the TCCH Charger, also widely known in the US as the Elcon charger.

If **CHARGER=ON**, at any time the JLD505 receives one of the normal TCCH charger status CAN messages, it will begine sending the TCCH charge commands to control the charge process.

If **CHARGER=OFF** it will not do so. There are several values that MUST be set to properly charge your EV using the JLD505

CHARGEV

CHARGEV is the voltage to use for the constant current/constant voltage charge point. For LiFePo4 cells we recommend 3.55 volts per cell. For a hundred cell pack: **CHARGEV=355**

CHARGEA

C**HARGEA** is the maximum current to charge at. The JLD505 will send this as the current command to the TCCH charger. This would normally be set equal to or greater than the maximum charge current for the charger. If your charger can do 17A, you could set this to **CHARGEA=20**

CHARGEND

Once your TCCH charger reaches **CHARGEV,** it will decrease the amount of charge current as necessary to avoid going above **CHARGEV**. This will gradually taper the charge current. At some low current value, you would want the charge process to terminate. This is the END or termination current and is generally expected to be AH capacity /20 or 0.05 * AH. So for a 100Ah pack, this would be set to 5.

When the charge current diminishes to less than 5 amps, the JLD505 will instruct the charger to terminate.

CHADEMO=ON/OFF

The JLD505 is capable of managing the CHADEMO charge process. To take advantage of this, you must of course have a CHAdeMO charge port connected to your car and CHAdeMO connections made to your JLD505.

With **CHADEMO=ON**, the JLD505 will monitor for CHAdeMO CAN messages. On receipt of the FIRST CHAdeMO CAN message, the JLD505 will immediately commandeer both digital inputs and both digital outputs, redefining them for CHAdeMO signaling purposes.

Once the CHAdeMO charge sequence is complete and the CHAdeMO charge station disconnected, JLD505 will return use of the two digital inputs and two digital outputs to their previously configured purposes.

If **CHADEMO=OFF**, CHAdeMO CAN messages will be ignored.

During CHAdeMO fast charging, the JLD505 does need the following three configuration items:

- **CHADEMOV**
- **CHADEMOA**
- **CHADEMOEND**

CHADEMOV

Like the TCCH charge process, fast charging requires a cc/cv voltage. In doing fast charge, this is quite likely a different and/or lower voltage to avoid the last 5% or so of charging which tends to increase the temperature of the cells.

CHADEMOV=xxx where **xxx** is the desired termination voltage.

CHADEMOA

Again like the TCCH charge function, the fast charge process requires a maximum desired current for the pack.

CHADEMOA=xxx where **xxx** is the number of whole amps to charge at.

CHADEMOEND

Again, like the TCCH charge process, on reaching the CHADEMOV, the fast charge station will diminish current or "taper" the charge until termination.

CHADEMOEND=xxx where **xxx** is the termination current.

Note that tapered charging increases the charge time without significantly adding much in the way of charge energy. We would recommend a very HIGH **CHADEMOEND** somewhat below **CHADOMOA** as the termination current.

In this way, you will charge quickly to **CHADEMOV**, and hold it there until it just begins to taper. On LiFePo4 cells this will get you very nearly to a 95% SOC without spending the extra time to squeeze in that last 5%.

DIGITAL OUTPUTS

The JLD505 features two digital outputs which can be defined for several purposes:

- **CHADEMO**
- **TEMPERATURE**
- **VOLTAGE**
- **STATE OF CHARGE**

CHADEMO OUTPUTS

To define a digital output for CHAdeMO fast charging only:

DOUT0=CHADEMO or **DOUT1=CHADEMO**

The corresponding output will be used for CHAdeMO fast charging purposes only.

TEMPERATURE OUTPUTS

To define a digital output for temperature:

DOUT0=TEMP<XXX

In this case, digital output 0 will be set to ON if ANY of the reported temperatures from the temperature probes falls to less than **xxx** degrees Centigrade.

DOUT1=TEMP>XXX

In this case, digital output 1 will be set to ON if ANY of the reported temperatures from the temperature probes exceeds **xxx**

TEMPHYST=5

You can also define a temperature hysteresis value. This is the number added or subtracted from temperature to turn the digital outputs back off. For example, if digital output 1 is set for < 10 Centigrade, it would have to rise to 10+5 or 15 Centigrade before it will reset to off.

If you have a digital output set for >35 Centigrade, then it would not be reset before 35-5 or 30 Centigrade.

VOLTAGE OUTPUTS

To define a digital output for battery pack voltage:

DOUT0=VOLT<XXX

In this case, digital output 0 will be set to ON if the measured battery pack voltage falls below **xxx** at any time.

DOUT1=VOLT>XXX

In this case, digital output 1 will be set to ON if the measured battery pack voltage exceeds **xxx.**

You could, for example, use this setting as an emergency disconnect of AC voltage from the charger if the measured voltage exceeded **xxx.**

VOLTHYST=10

You can also define a voltage hysteresis value. This is the number added or subtracted from temperature to turn the digital outputs back off. For example, if digital output 1 is set for < 305 volts, it would have to rise to 305+10 or 315 volts before it will reset to off.

If you have a digital output set for >365 volts, then it would not be reset before 365-10 or 355 volts.

SOC OUTPUTS

To define a digital output for State of Charge:

DOUT0=SOC<XXX

In this case, digital output 0 will be set to ON if the calculated SOC falls below **xxx** at any time.

DOUT1=SOC>XXX

In this case, digital output 1 will be set to ON if the calculated SOC exceeds **xxx.**

By way of example, lets set **DOUT0=SOC<10** and **DOUT1=SOC<5.**

We could use the DOUT0 output to switch a relay putting a voltage divider across our 0-5v throttle input reducing it's output to 20% of normal. We would call this "daughter mode" and once our SOC fell to 10% it would cause operation of the vehicle to be very slow and sluggish. Sufficient to limp off the interstate highway and maybe make your way to a gas station. (What are you doing THERE in an electric car?).

If the SOC then falls below 5%, we use the DOUT1 output to disconnect the ENABLE signal from the motor controller/inverter – effectively disabling the vehicle.

BLUETOOTH CONFIGURATION

BLUETOOTH=ON/OFF

Turns Bluetooth operation on or off

BLUETOOTH=MENU

USB Serial port data, menus and input will be replicated over the Bluetooth channel.

BLUETOOTH=CAN

USB serial port data will be discontinued and CAN data sent out the CAN port will also be replicated as ASCII data strings out the Bluetooth port.

CAN data received via Bluetooth will be retransmitted on the CAN bus.

BLUERATE=19200

Data rate through the Bluetooth port will be set to 19200

BLUEPAIR=1234

Pairing code for Bluetooth will be changed to this value.