

User and Installation Manual

MD-Tech

PHEV Conversion Kit Version 7 with BMS Version 1.0



Table of Contents

1 For your safety4

 1.1 Guarantee from Plug-in Autos.....5

2 EU Declaration of Conformity.....6

3 Overview of the conversion kit.....8

4 Installation.....8

 4.1 The kit contains the following parts9

 4.2 PHEV Box Wiring.....12

 4.3 Connecting the PHEV Conversion Kit to your Prius.....13

 4.3.1 Required Tools for the installation13

 4.4 Remove Interior Trim from the rear compartment – Step 115

 4.5 Remove Rear Floor Panels - Step 216

 4.6 Remove Battery Covers - Step 317

 4.7 Hybrid Vehicle Battery Wire connection18

 4.8 Install Communication cables.....19

 4.9 Install on/off switch panel.20

 4.10 Switch connection to Vehicle HV ECU21

 4.11 Install the Bumper plug22

 4.12 Mount the Kit Box23

 4.13 Connect the Cables.....23

 4.14 Install Charger's LED light23

 4.15 Re-install Battery Service Plug24

 4.16 Test the Kit Installation.....26

5 The BMS29

 5.1 Basic Operation29

 5.1.1 Switch on the BMS.....29

 5.1.2 To switch off the BMS.....29

 5.2 The BMS Monitor29

 Bottom: reset the touch screen. To reset the display update pushing data, see the section. BMS Module Right side Buttons29

 5.3 The Battery System Monitor Module30

 5.3.1 BMS Module Left side Buttons - Balancing30

5.3.2 BMS Module Right side Buttons30

5.4 The BMS SD Card Data.....31

6 Operation32

6.1 Switch On32

6.2 EV driving.....32

6.3 PHEV Kit Battery empty33

6.4 Battery life34

7 Troubleshooting Installation34

8 Care and Maintenance36

9 Circuit Diagram.....36

1 For your safety

Read these simple guidelines. Not following them may be dangerous or illegal.
Read the complete user and installation guide for further information.



ROAD SAFETY COMES FIRST

Obey all local laws. Always keep your hands free to operate the vehicle while driving. Your first consideration while driving should be road safety.



QUALIFIED SERVICE

Only qualified personnel may install or repair this product.

Symbols Used in this Manual



Heavy object, should be handled by two persons or lifting gear.



Take care to follow advice in these steps .



High Voltage (HV) Direct Current (DC) Warning: Traction battery packs, motors, chargers and other HV sources could cause serious injury or death if proper precautions are not taken while working on or around such high voltage direct current sources. Electrical safety gloves should be worn. Personnel who are not trained in HV safety should be clear of the working area. To avoid electrical shock do not open the kit box when the system is running, (especially children).



Please refer to the video on the installation CD for general fitting, removal of panels and cable routing. Online videos are also available at www.plughybrid.de

This is a patent pending technology.

Read this guide carefully before having the car kit professionally installed and using it.
Check www.plughybrid.de/support for the latest version of the user and installation guide, additional information, and downloads related to your MD-Tech product.
This product may contain small parts. Keep them out of the reach of small children.
The car kit should only be installed by a qualified service technician using the original MD-Tech parts supplied in the sales package.

1.1 Guarantee from Plug-in Autos.

The battery has a 3 year guarantee or 1500 deep cycles, whichever comes first, other parts have a two-year limited parts guarantee.

A deep cycle is defined as discharge from a greater than 90% SOC to 0% SOC. Over the lifetime of the battery (1500 cycles) it is accepted that there will be a reduction in battery capacity. The battery guarantee is limited to a condition where there has been a failure of the battery where the battery fails to hold a useable charge.

If equipment defect occurs under normal use, the faulty part with and purchase document must be presented to **Plug-in Autos**, for replacement or repair.

Damaging the battery seals or deleting data from the SD card will void your battery guarantee.

Terms and Conditions apply:

Please download the terms and conditions at the time of purchase; they can be downloaded at www.plughybrid.de

Failure to follow the Operation and Battery Management System procedures and instructions will void your guarantee.



If you are going to leave the car for more than 10 days make sure the batteries are fully charged and the BMS is switched off. See section 3, BMS.

2 EU Declaration of Conformity

According to UN Transport regulation 010 for a type of electrical/electronic sub-assembly with regard to electromagnetic compatibility for vehicle use.

For the following equipment

Product: PHEV Kit
Type Description: PH04N2010C
Manufacturer's Name: Shanghai Fountainhead Electronics Co., Ltd.
Manufacturer's Address: No. 2028, Tingwei highway, Jinshan District, Shanghai City, 201508.
P.R.China

Is hereby confirmed to comply with the requirements set out in UN Transportation regulation 010 for electrical/electronic sub-assembly and 2006/95/EC LVD.

The product is marked with an E Mark performed with the involvement of a Notified Body: TÜV SÜD Czech s.r.o.

Directive UN Transportation 010:



10R - 03 6730

Person Responsible for making this declaration is the Authorised representative established within the EU,

Name, Surname: Sushil Parab
Position: General Manager

Place: 64347 Griesheim

Date: 15 April 2013

Signature:

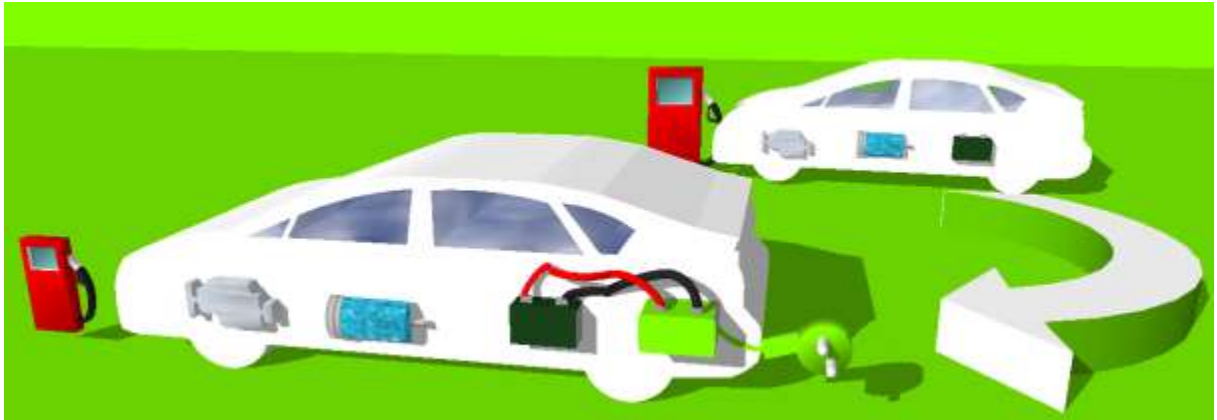
A handwritten signature in blue ink, appearing to read 'Sushil Parab', is written over the signature line.

Contact

Contacts	
<p>Shanghai Fountainhead Electronics Co., Ltd.</p> <p>Address: No.2028.Tingwei Road, Jinshan District, Shanghai, 201508, http://www.21ftd.com</p> <p>Tel:86-21-57248986</p> <p>Email: sales001@21ftd.com fangjh@mail.online.sh.cn</p>	<p>European Distributor UK: Plug-in Autos Ltd. Woodlands View Heol Eglwys, Pen-y-fai, Bridgend CF31 4LY UK Company Number 8735180</p> <p>Germany: Plug-in Autos UG (haftungsbeschränkt) Friedrich Ebert Str 9 64347 Griesheim Germany Registered: Amtsgericht Darmstadt HRB 90838</p> <p>Web: www.plughybrid.de</p> <p>Tel +49 (0)173 957 2675 email: contact@plughybrid.de</p>

3 Overview of the conversion kit

The PHEV kit adds a battery and a power management system to the vehicle



Hybrid to Plug-in Hybrid, PHEV Conversion

Overview of the Power Flow:

Charging: 220-240V AC (EU) household electricity → MD-Tech PHEV conversion kit

Driving: MD-Tech PHEV conversion kit → OEM stock traction battery → Prius electric motor

The PHEV conversion kit supplies power to the Prius traction battery. This extra power increases the distance that the car can travel using electric power.

4 Installation



Prepare a flat area of at least a 7x7 feet on the ground near the end of your Prius, and cover the floor with 5x5 feet of soft material or cardboard.



The equipment is heavy and should be moved and handled by at least two adults or lifting gear.

Remove the kit from the packaging box.

4. Take out the kit parts place them in a suitable location away from your immediate working area:

Take out the foam plastic cover from the cardboard box and pull out the steel box, this requires at least two people, carefully and steadily remove the entire steel box and place it gently on the floor. Do not tilt or turn over the equipment.



5. The equipment weights about 165 lbs (74kgs). MD-Tech strongly suggests you use professional lifting equipment. Slowly handle the equipment to avoid physical injury or equipment damage.

6. After propping up the cover firmly, with no risk of dropping down, gently remove all the insulating foam gently and check inside component and accessory bags against the following list:

4.1 The kit contains the following parts

- Cable with three wires for the ECU signal wires (green, brown and white) *see Kit figure 7 F*
- One dashboard panel on/off switch with red and green LED lights *see Kit figure 7 H*
- 6-pin phone wire (Converter to dash panel switch) *see Kit figure 7 G*
- Converter high voltage orange cable bundle (red & black wires with bullet connectors for the converter) *see Kit figure 7 A*
- Charger power cable *see Kit figure 7 E*
- 2 sets of equipment mounting screws (size M8) *see Kit figure 7 B*
- External power input bumper socket
- One double-sized spanner
- One Wire harness with four Anderson plugs for connecting the Batteries L and R, converter and BMS *see Kit figure 10.*
- Two black rubber blankets, longer one for left hand side *see Kit figure 7 D.*
- Template 1:1 for marking the kit box mounting hole positions *see Kit figure 9*
- Stainless steel box and cover (833 x 505.5 x 152mm), *see Kit figure 1*
- Batteries: 2 packs (4kWh). Please make sure batteries match your order, *see Kit figure 2*
- One 4000W converter, Connections: one red and one black power inlet cables attached to an Anderson plug. A two pin wire and connector (fits to the BMS) *see Kit figure 3*
- One charger mounted on right back connecting black power inlet cable, with left hand side one red and one black wire with an Anderson plug. *see Kit figure 6*
- Battery Management System is fixed on top of the charger (near right side).
- One circuit breaker mounted to the side of the box.
- One fire extinguisher is fixed at the middle of the box, on batteries. *see Kit figure 12*
- M8 size Blind Rivet Nuts for mounting the kit to the car. *see Kit figure 8*
- One Bluetooth OBDII scanner device. *see Kit figure 14*

Kit figure 4-1. PHEV Steel Container Box



Kit figure 2. Pair of Battery packs



Kit figure 3. DC:DC Converter



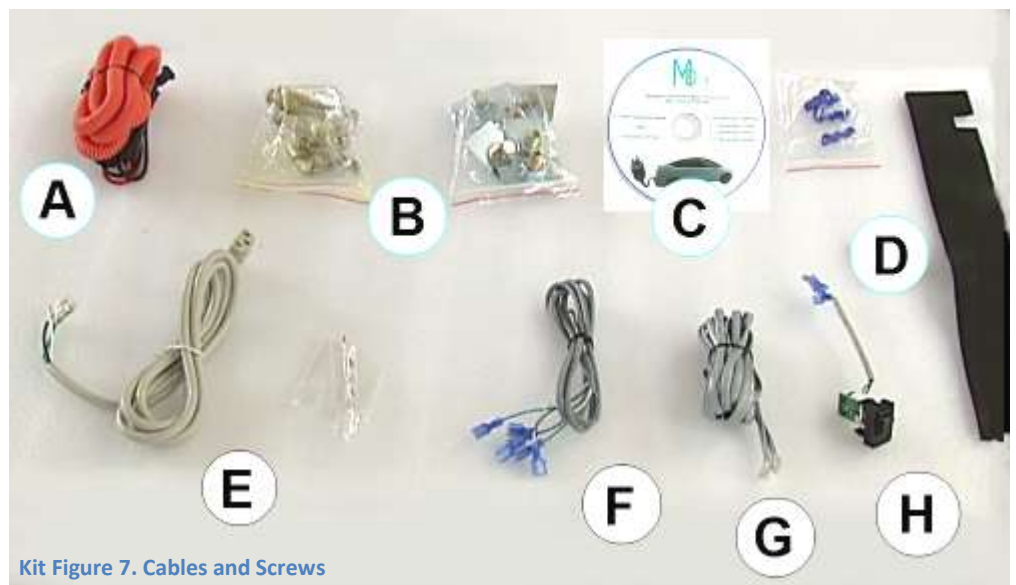
Kit figure 4. Battery System Monitor



Kit figure 5. Battery Management System, BMS Anderson plugs connect to Battery cable bundle and the Charger



Kit Figure 6. Charger

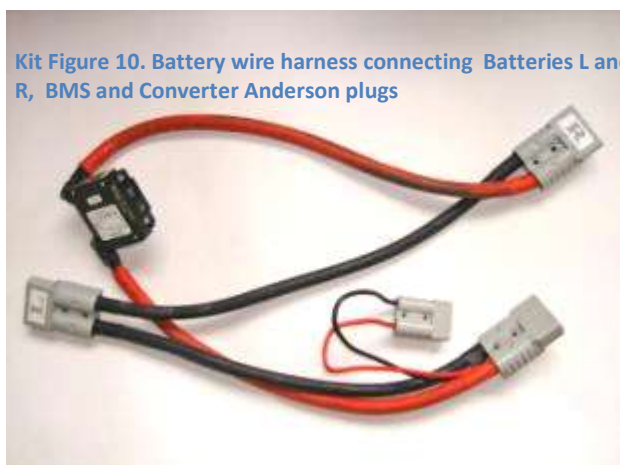


Kit Figure 7. Cables and Screws

Kit Figure 8. 6 x M8 Blind Rivet Nuts



Kit Figure 9. Template for marking holes



Kit Figure 10. Battery wire harness connecting Batteries L and R, BMS and Converter Anderson plugs



Kit Figure 11 Bumper Plug



Kit Figure 12. Fire Extinguisher

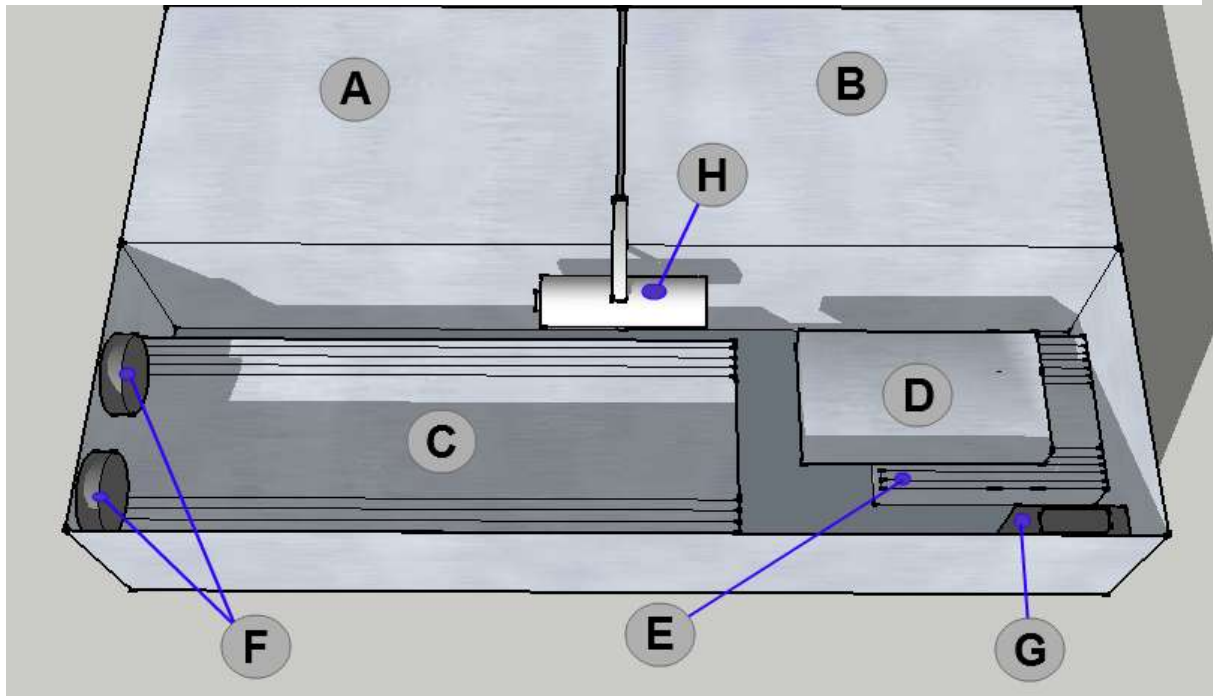


Kit figure 14. OBDII Scanner - Bluetooth comms



1. Please read through the instructions before installation.
2. Never connect wires improperly. Recheck wires at least 3 times before switching on the power.

Diagram. Component Layout



The Main Box contains has the following arrangement

- A. Left Battery
- B. Right Battery
- C. Converter
- D. BMS, Battery Management System

- E. Charger
- F. Ventilation holes
- G. Circuit Breaker
- H. Fire Extinguisher



4.2 PHEV Box Wiring

Wiring Check:

1. Make sure the circuit breaker is in the OFF position, BMS is switched off;
2. Make sure Charger, BMS and converter Anderson plugs are firmly connected.

Connect the cables and wires in the sequence described below. Incorrect cabling may cause short circuits and void the warranty.

1. Connect the Battery wire harness, see Kit figure 10, to the batteries; the Anderson plugs are labeled "R" and "L". Connect the battery plug labeled "R" to cable harness plug "R".
2. Connect the battery plug labeled "L" to wire harness plug "L".
3. Connect the left battery cable with the white plug to the BMS socket labeled "L".
4. Connect the right battery cable with white plug to the BMS socket labeled "R".
5. Connect the RJ45 phone cable to the BMS

6. Connect the RJ45 phone cable from the BMS to the converter

The Conversion Kit Box assembly is completed and ready to be installed into the vehicle.

4.3 Connecting the PHEV Conversion Kit to your Prius

4.3.1 Required Tools for the installation

Preparation tools required:

Screw shell M6-M14



Crosshead, Phillips screwdriver



Flathead screwdriver



Soldering iron



Automatic Wire stripper for removing insulation from the middle of a wire



Drill, 8mm, 13mm metal drill, and holesaw 4cm diameter



Torque wrench



High Voltage safety gloves 300V



Digital Voltmeter



Blind Rivet Nut Tool – M8



Installation Time: 1.5-2 hours by professionals.

Before installation, please be advised to login to Toyota Technical Website <http://techinfo.toyota.com> for Reference Instructions. (\$15 for two day usage as of June 2009)

Torque specifications are noted in the component illustrations; **N·m (kgf·cm, ft·lbf)**.

For example **12 (120,9)**

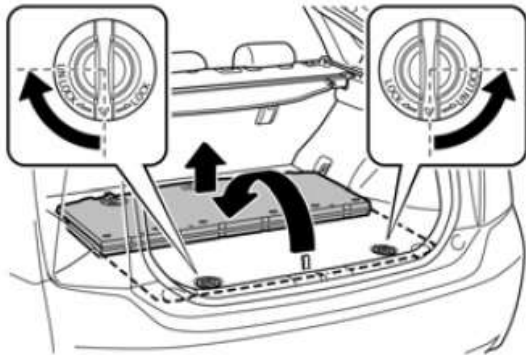


Place car key FOB at least 5 meters away from the vehicle when working on the vehicle.

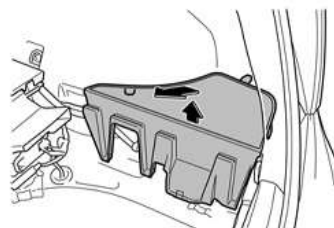
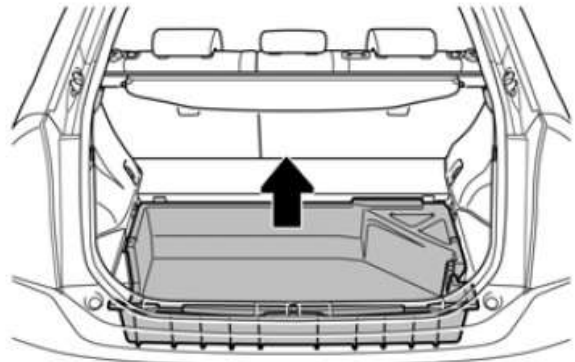


4.4 Remove Interior Trim from the rear compartment - Step 1

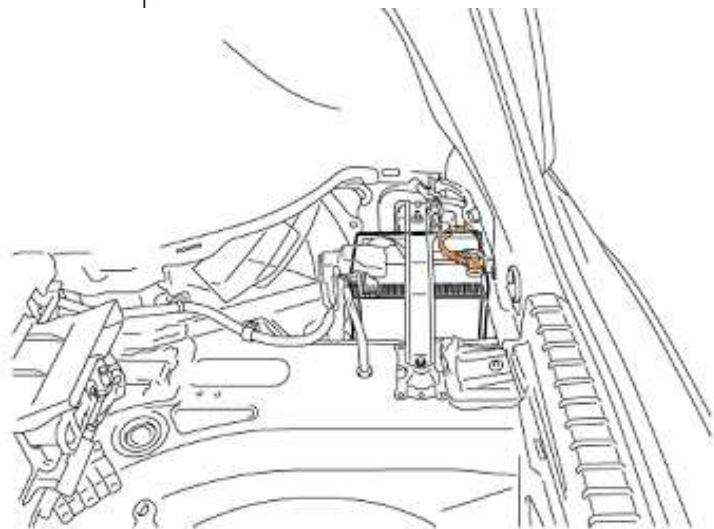
1. Rear Floor Board - main
2. Rear Floor Tool Box
3. Rear Floor Board - right
4. Disconnect the Rear 12V Battery negative terminal



Remove Main floor panel and toolbox

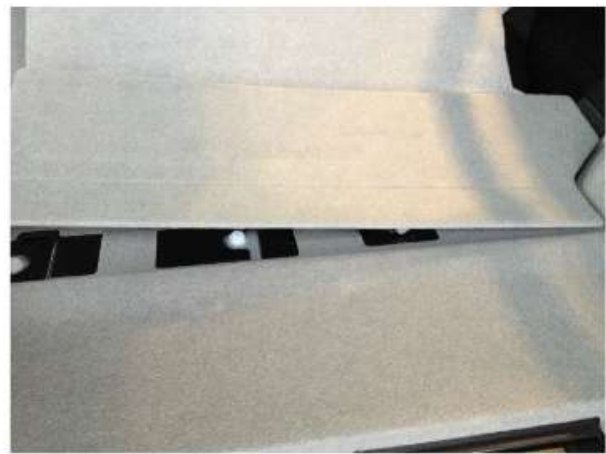
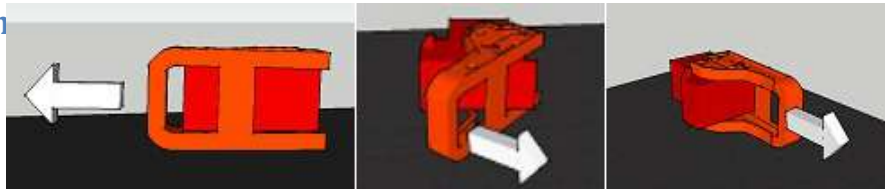


Remove right side floor panel



Disconnect 12V battery negative terminal

5. HV Battery Service Plug - See Next Steps



4.6 Remove Battery Covers - Step 3



Remove battery covers on the right side

Battery covers – Access Battery Terminals

In these steps you will attach the Orange power cable from the kit to the OEM battery.

Tighten the Battery Terminal bolts using a torque wrench to 5.6 (57,50); **N·m (kgf·cm, ft·lbf)**.



Check Battery Voltage is 0.0V

Connect High Voltage Kit cables



4.8 Install Communication cables

Remove the door scuff plates on the driver' side and route the **6 pin phone cable**, the **ECU signal wires** and the **Monitor Display cable** from the rear compartment of the vehicle to the front dashboard.

Notes: In the following example configuration the BMS Monitor will be mounted in the front of the car. It can be fitted anywhere inside the vehicle where there is a suitable mounting place.

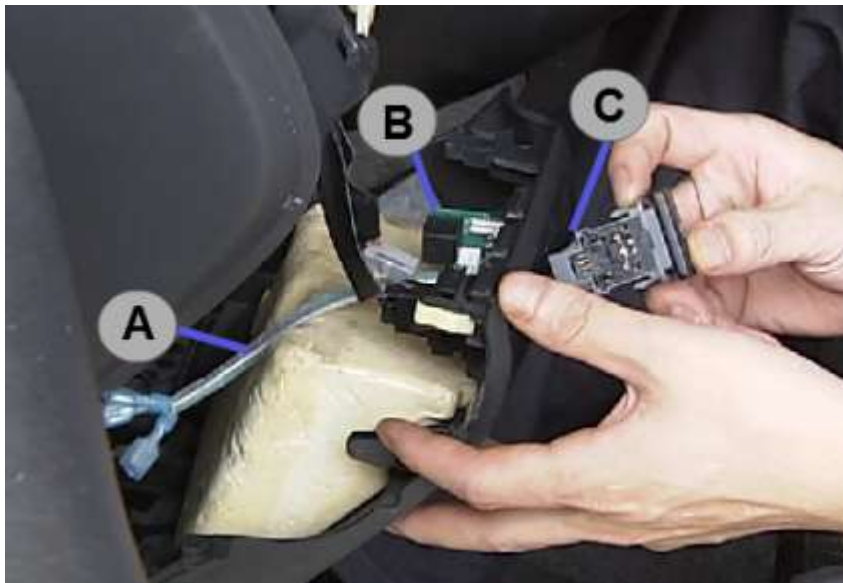




4.9 Install on/off switch panel.



Take off the blank panel on the left hand side driver console next to the EV switch. IN some models there is no spare switch panel. In this case drill a hole to fit the switch.



A. Connect the ECU Signal wires to Cable marked "A" , matching the colours for each wire. The Kit ECU Cable "A" has three wires for the HV ECU signal wires (green, brown and white) see *Kit figure 7 F*.

Route the BMS display cable to its desired position.

B. PHEV Kit On/Off switch

C. EV Button here is unplugged and removed to make space while fitting the PHEV Kit switch



4.10 Switch connection to Vehicle HV ECU

Method 1. Connect the Switch Control wires to battery compartment 12v Ready wire

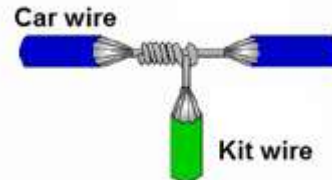


In the Generation 3 Prius a 12v Ready Signal wire is the Blue wire shown above, located on the right side of the battery. Remove the left plug for easier access

Run the dashboard switch wire back to the Hybrid Battery compartment.

Connect the Green wire from the dashboard switch to the 12v Ready signal, blue wire.

For a good connection solder these wires together and insulate.



The Kit Brown wire is to be connected to a vehicle ground point



4.11 Install the Bumper plug

Install the Bumper plug outlet and the charger cable. See Kit figure 11 and 7E

1. Remove the vehicle underside protection plate to gain access to the rear side of the bumper.
2. Drill a 4cm diameter hole in the bumper
3. Identify the charger cable. Take the end with the exposed wires and pass it through the rear cable grommet, with other wires going through to the bumper.

Remove the protective plate on the rear underside of the vehicle.	Pull out the bumper Clips and remove the securing screws, that hold the underside plate in place
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You need to get your hand behind the bumper from under the car, run the cable through the rear part of the bumper plug housing and silver ring then through the bumper hole.



Connect the wires to the plug: Black wire: Live line (L); White wire: Neutral Line (N); Green wire: Ground Line (E).

4.12 Mount the Kit Box

The cables and wires should be clear of the mounting space. Check the space using the cardboard template *see kit parts, kit figure 9*.



Disconnect the Anderson plugs and the BMS cables from of the batteries which will allow the batteries to be removed making the mounting box lighter. Remove the upper plate above the batteries. Remove the batteries.

1. Mark mounting holes according to size and dimension of the Kit's mounting brackets. Then remove the kit box.
2. Mark and drill holes using an M10 sized bit. Drill through the trunk floor plate.



See youtube video: http://youtu.be/ZCBaAd_L1Nc

3. Put the rubber blankets under the brackets (the long one for left bracket, the short one for the end of right bracket).
4. Mount the M8 Blind Rivet nuts in to the holes using a Blind Rivet Nut Tool.
5. Mount the Kit to the car and secure with bolts, spring washer and washer



Place the batteries back in to the box, bolt on the upper plate

6. Reconnect the Battery Anderson plugs left and right.



7. Be careful to attach the **left** BMS battery cable to the **left** BMS Module socket. Attach the right battery's BMS cable to the right BMS socket.

4.13 Connect the Cables

1. Connect the bumper plug charger cable to the charger socket through the hole on the side of the Kit box
2. Route the BMS Display cable through a hole in the Kit box and connect it to the BMS Module in the Kit Box.
3. Connect the 6 pin phone cable (from the dashboard switch), to the converter though the hole in the side of the Kit box.
4. Connect the bright orange colored cable, see kit figure 7A with Anderson pole connectors, red and black to the red and black Anderson pole connectors of the converter.



4.14 Install Charger's LED light

1. Install Charger's LED into the tail-light. Drill a small hole and through the interior side of the tail light, make sure to be clear of any other wires or fastenings. Secure the LED in the hole with a small grommet.



The Charger LED shows the status of the charger. When charging the LED will be RED.



4.15 Re-install Battery Service Plug



4-2 Re-install the HV Battery Service Plug



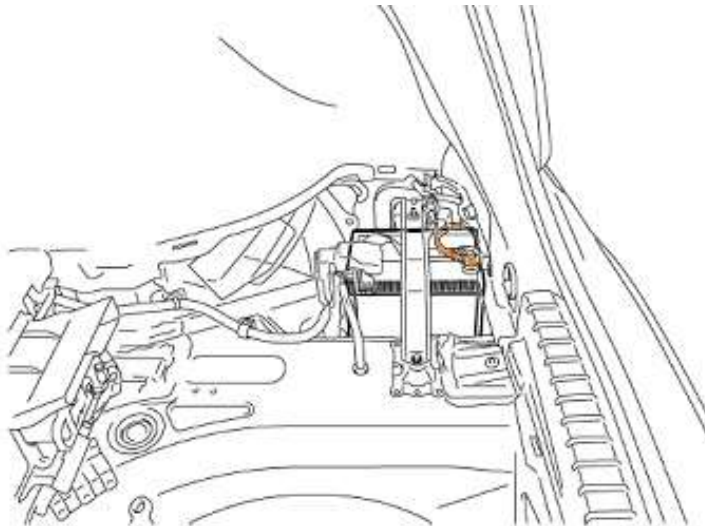
1. Push the plug in firmly



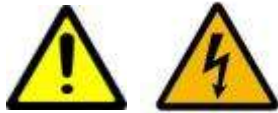
2. Push the plug in to the closing position

3. **Push the right** until it “clicks”

4. Re-connect the 12V Battery



Reconnect the 12V Battery



4.16 Test the Kit Installation

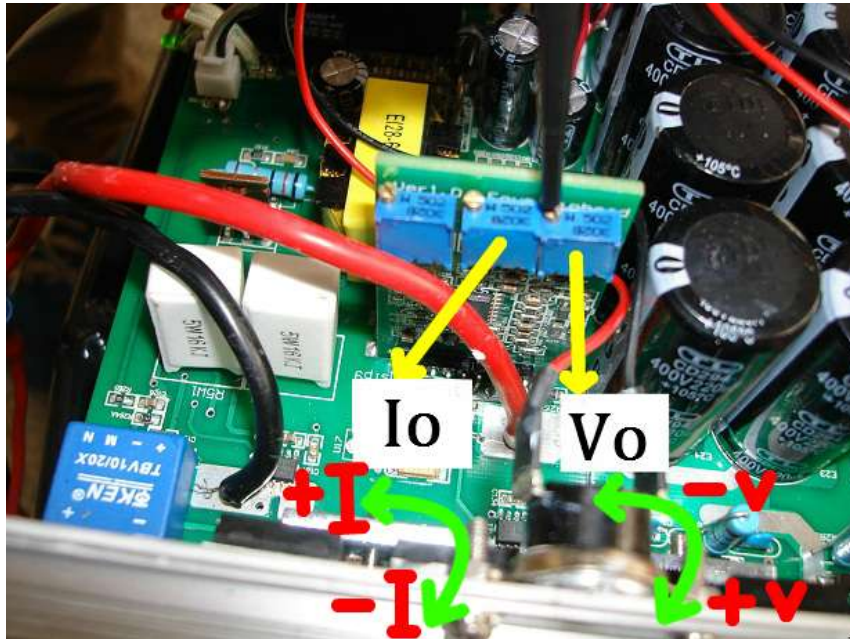
1. Turn off the PHEV Kit circuit breaker.
2. Turn on the car. If the car starts up and the “READY” status is visible, skip to step 8.
3. If the car does not start and the engine light is on, turn off the car and do steps 4-7.
4. Check Toyota high voltage Battery Service Plug, (the orange plug), to make sure it is plugged in correctly and secured.
5. Check the PHEV Kit to HV ECU wire connections are correct.
6. RESET TEMPORARY ERROR CODES.
 - Use scan tool to reset any error code,
 - or disconnect/reconnect the 12V battery,
 - or switch the vehicle off and wait for 15 minutes to reset the error code.
7. Turn on the car.
8. Turn on PHEV Kit circuit breaker.
9. Check if the green light on MD-Tech PHEV panel switch is on when the switch is ON. Also check the light on the side of the Converter output panel is green.
10. If the PHEV panel switch, green light is not on perform the following:
 - Use a meter to check if the 12V “Ready” signal is 12V on the PHEV switch panel.
 - Check the phone cable connector on the converter side to make sure pin 5,6 has 12V signal.
12. Use the BMS Monitor to Check PHEV converter output voltage. If the voltage is 2V to 5V higher than the HV battery voltage then Skip to step 14 - Do the standing charge test, else do:

If the Converter output is too low then do the following steps. (Example: HV battery voltage is 237v, Kit Converter output is 236v)

You can use an OBDII Scan device to check the HV battery voltage, see www.plughybrid.de installation pages for further instructions on setting up the OBDII device.

13. Converter output voltage is less than 1V higher than the HV Battery.

Converter output voltage is less than 1 volt higher than the traction battery	The Converter output is set too low. 1. Switch the car off. 2. Through the PHEV Kit converter cover and adjust the “Vo” screw. One full turn clockwise. See <i>diagram below - Converter Adjustment</i> Do the Standing Charge Test, see next step.
---	--



4-3 Converter Adjustment

14. Do the standing charge test:

1. **Switch the PHEV Kit off** using the dashboard switch.
2. Drive in EV mode until the OEM Hybrid battery indicator shows half full,
3. Park the car in EV mode with the car turned on.
4. **Switch on the PHEV kit.**
5. Wait five minutes with the car in EV mode and with the PHEV kit on.
During this time monitor the BMS Display "Voltage out" and "Output current".
When the BMS Display shows "Voltage out" around 245V the "Output current" should start to drop off from 20Amps to around 7 amps. It is this current drop off that you are looking for.

Within the five minutes Observe:

The HV Battery State of Charge, SOC indicator should rise but not to full, (less than 75% SOC if using an OBDII scanner). If the engine starts to turnover, then the Kit Converter output voltage is set too high. If the HV Hybrid battery indicator does not rise above half (more than 60% SOC if using an OBDII scanner), then the Kit Converter output is too low, redo step 13.

15. Re-charge the batteries and wait overnight for the cells to balance. New batteries should be fully re-charged and checked that they are balanced before driving.

A balanced pack has a voltage less than 0.006V difference from the high to the low cell.

Please check the battery voltages are balanced, for the first few times you drive the vehicle. – See "BMS Display Monitor"

	Re-assemble trim Re-assemble battery covers
--	--

YOU ARE NOW READY TO DRIVE.

If you need to drive immediately without fully charging the Kit then simply switch the kit off at the dashboard and drive as normal.

PLEASE READ THROUGH THE FOLLOWING SECTIONS ON OPERATION AND MAINTENANCE THAT WILL AFFECT YOUR GUARANTEE.

5 The BMS

5.1 Basic Operation

To switch on the BMS check that all cables are connected correctly.

5.1.1 Switch on the BMS

Step 1. Make sure that the main circuit breaker is in the on position

Step 2. Using the right switch press the switch to the on position, "1" down.

5.1.2 To switch off the BMS



Only switch the BMS off , "0", if you are leaving the vehicle for ten days, or if you are performing any maintenance, and need to unplug any cable on the BMS

Step 1. Make sure the circuit breaker is in the on position, "1" down.

Step 2. Using the right switch press the switch to the off position, "0" down.

5.2 The BMS Monitor

The Battery System Monitor shows detailed information on the PHEV Kit system.

Buttons:



5-1 Battery System Monitor

The BMS Display is a touch screen monitor.

Buttons located on the right side of the Display screen
Top: Turn on the touch screen

Bottom: reset the touch screen. To reset the display update pushing data, see the section. **BMS Module Right side Buttons**

Monitor Screen:

Page1. Shows current SOC (State of Charge)

Displays four system readings:

Input Voltage to the Converter (V_i),

Output Voltage from the Converter (V_o),

Input Current to the Converter (I_i)

Output Current (I_o) flowing into stock (OEM) batteries;

Page2. Displays battery voltages

Page3. Shows Battery temperatures and Voltages; Total Kit Battery (T), Average (A), Cell Highest (H) and Cell Lowest (L)

5.3 The Battery System Monitor Module

The BMS Module maintains the health of the batteries. It controls important battery protection functions.

5.3.1 BMS Module Left side Buttons - Balancing

On the left side of the BMS module there is switch that controls the battery balancing function.

The Default position is "0". In the picture below it is set to "1"



Leave this left side 0/1 switch in the "0" position.

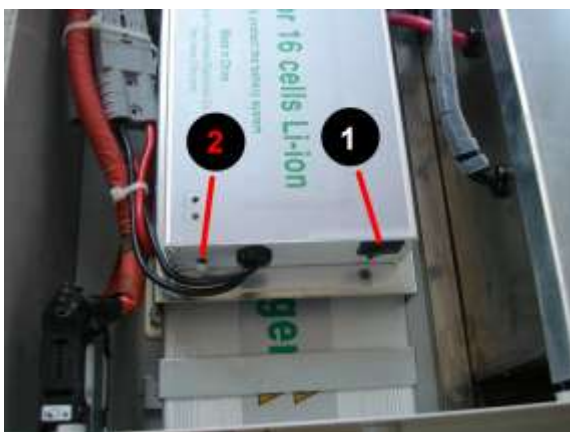
"1" is for manual balancing, and should not be set to "1" for more than 24 hours.

In the "0" position balancing is triggered every 15 charging cycles. Balancing is active for 24 hours. The BMS monitor screen will go back to its normal refresh rate only after it is switched off and switched on again using the on/off switch on the right side.

In the "1" position balancing starts after two minutes and BMS monitor screen will update every two minutes. Balancing charge is 1.5C

In both positions "0" and "1" the BMS runs a test to check if the highest cell voltage is more than 10mV higher than the lowest cell voltage. If this is the case balancing will start until the difference is only 5mV.

5.3.2 BMS Module Right side Buttons



On the Right side of the BMS has one flat switch and a button switch.

1. The 0/1 switch is the BMS on/off power switch.
2. This small round button is a **display data** reset button. If the BMS Monitor is not updating press and hold this button for 3 seconds. Switch the BMS off then on again. This should restart the data push to the BMS monitor screen.

5.4 The BMS SD Card Data

The slot on the left side of the BMS module holds the SD Card that came with the kit. To remove the card, disconnect the BMS cable and push the card in and it will pop out. Insert the SD card in to an SD card adapter and computer

The data is stored in DAY files from the day of factory production.



Deleting data from the card will void your battery guarantee. Copy all files to your computer before analysis. Re-insert the SD card to the BMS module with an hour. The SD card should not be removed for long periods to avoid data loss. Longer than 24 hours will require manual editing of the files to re-initiate readings and may void warranty.

View the system / battery data using a spreadsheet application like MS Excel that can import tab delimited data. Open your application and import the data.

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG
1	SoC	Vb	ic	to	ll	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	Max	Min	Ave	TM1	TM2	TM3	TM4	B1	B2	B3	B4
2	34	0	0	0	0	3282	3279	3281	3281	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
3	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
4	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
5	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
6	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
7	34	0	0	0	0	3282	3281	3281	3281	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
8	34	0	0	0	0	3282	3279	3281	3281	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
9	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3266	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
10	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
11	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
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14	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3266	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
15	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
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18	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
19	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
20	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
21	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3267	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
22	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3267	3266	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
23	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3269	3267	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
24	34	0	0	0	0	3282	3281	3281	3282	3278	3282	3281	3276	3278	3269	3266	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				
25	34	0	0	0	0	3282	3279	3281	3282	3278	3282	3281	3276	3278	3267	3266	3269	3265	3270	3270	3273	3282	3263	3274	20	19	20	20				

BMS data

6 Operation

The PHEV kit is designed to be simple to use. Use the kit when EV mode driving is possible.

6.1 Switch On



Start the car as normal, switch the PHEV Kit dashboard switch to the “ON” position. The Green LED light will come on. The kit is now providing power to your car.

6-1 Dashboard switch

6.2 EV driving

The Prius has driving modes that support electric only driving, EV Mode and Blended Mode. Electric driving can be engaged by using familiar Prius driving techniques. These techniques are described in the standard Prius Manual and driving instructions that came with the car.



Electric mode can be achieved by pressing the EV mode button, (European version) or by using the accelerator “pedal” method. The accelerator pedal method engages electric driving in blended mode up to speeds of 70km/h. The Prius will go in to Electric mode when certain vehicle conditions prevail. Using the “pedal” method the OEM traction battery should be over 60% State of Charge, (SOC). See figure 3-2 SOC of the traction battery. The PHEV kit should be configured to keep the traction battery charged between 60-70% SOC.

6-2 State of Charge of the Traction battery

Driving Techniques for Maximizing MD-Tech Prius PHEV Mileage:

1. Maintain a constant, steady speed as frequently as you can;
2. After attaining the speed you desire on the road, release the accelerator or lift your foot off the pedal entirely, then very lightly ease back on to the pedal to maintain a steady speed of under 44 mph or 70km/h.

Using this “Pedal” method the Prius EV mode can be engaged.



To preserve Kit power:

Switch the kit off when driving at higher speeds or where no EV driving is possible. For example on highways travelling faster than 70km/h.

Switch the kit off when travelling down long hills or where OEM battery SOC is showing full bars on the centre console.

PHEV Kit Battery Details and performance

Batteries	Type	Capacity	EV Range	Charge time
	LiFePO4	80 AH	40km	4.5 hours



The PHEV kit may be set up incorrectly if you consistently experience full Bars in the OEM traction battery display. Please contact your nearest service partner to adjust the converter settings.



Be aware when travelling down hills the spinning wheels and braking regeneration will charge the OEM battery. **Switch off the kit while travelling down hills or when the OEM battery is above 65% (Full Bars).** Pushing too much charge to the battery is wasteful; to prevent overcharging the engine will spin to use up electrical energy. Error codes may occur and shut down the electric drive, if this happens stop the car safely and switch off the engine for 15 minutes before restarting the car. This will clear any temporary error codes. A Scan tool can also be used to clear the codes.

Note : The circuit breaker on the right hand side of the enclosure box is set to be switched off automatically if the current exceeds a pre-set limit (125A). In the event this breaker switches off you will then need to manually switch it back on before use.

Please switch the equipment off immediately if damage or defect is found. Please do not disassemble the components if the equipment is working normally, and if you are not a qualified professional. Contact your nearest service partner for repairs.



6.3 PHEV Kit Battery empty

When the PHEV kit battery is empty the red LED light will come on above the Kit dashboard switch. See *Figure 4-1 Dashboard Switch*. The PHEV Kit will no longer be able to recharge the traction battery. Drive the car as normal, being aware that the traction battery has lost the extra boost of power from the PHEV Kit. Do not switch the kit on again until you have recharged the battery.

Switching on the kit when the batteries have gone through a Low Voltage Cut-off event can cause premature ageing of your batteries and may void warranty. Recharge the batteries for a minimum of 2 hours before using the kit again, full charge is 4.5 hours


Do not allow the kit battery to remain fully discharged, 0%SOC, for more than 7 days. If this cannot be avoided switch off the BMS.

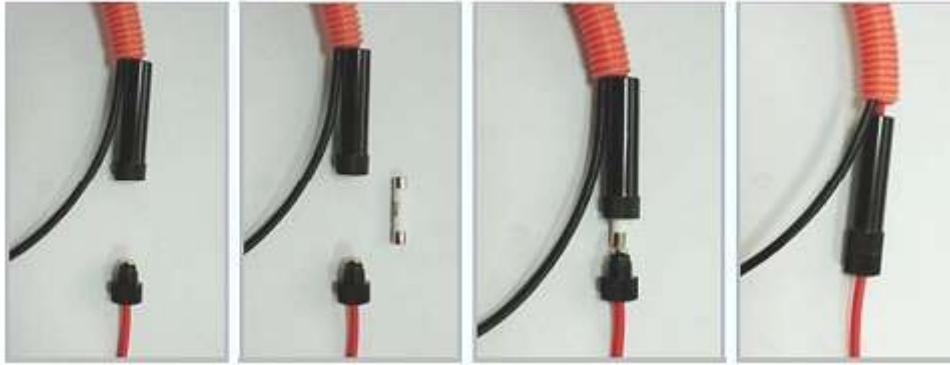
6.4 Battery life

To extend battery life, recharge the battery as often as possible, lithium-ion batteries last longer if they are charged up. Use household electricity (220V-240vAC 50Hz rated at 13 amps). Use the charger provided, plugging a power cord in to the bumper plug.

If the PHEV kit will not be used for 10 days make sure the battery has been fully charged. Only use the 230V AC charger for Europe or the rated voltage in other countries, please check the label on MD-Tech charger provided. If the kit will not be used for over 21 days, fully charge the batteries and switch off the BMS to avoid battery failure. Batteries should be stored in a cool dry place. A top up charge for one hour should be applied after 3 months of storage.

7 Troubleshooting Installation

RED LED flickers on the PHEV Console On/Off switch	Check the 12v Ready Signal wire is properly connected to the switch and the HV ECU
SOC is above 10% but Switch LED lights are RED and GREEN are on	Switch the circuit breaker on the right side of the kit box off then on again.
Charger will not come on	<p>Step 1 Switch the circuit breaker on the right side of the kit box off then on again.</p> <p>If this does not work perform Step 2: The charge block fuse may need to be replaced- see below. Use a Flat Head screwdriver to lever out the fuse. Locate the spare fuse behind the fuse holder.</p>
	
The BMS Display shows power Vi and Vo but no Io. No power appears to be coming from the kit	The Converter output fuse may need to be replaced. Replace with a 30A rated fuse – see below



While parked for 5 minutes, SOC at 50% with the PHEV kit on, the Prius battery display does not get higher than 60% SOC.



The Converter output is set too low. Using high voltage gloves:

Check the Converter output with a DVM, record the output voltage.

Switch off the vehicle.

Remove the Orange Service Plug, set the PHEV Kit circuit breaker to "off". **Wait 5 minutes.**

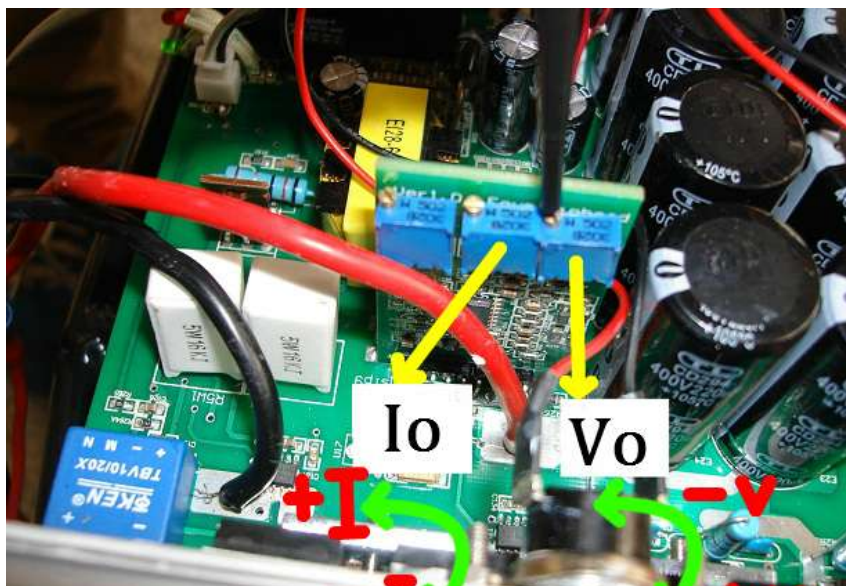
Remove the PHEV Kit converter cover and adjust the V_o screw. One full turn clockwise.

Insert the Orange Service Plug and switch the PHEV Kit Circuit Breaker to "on".

Check the Converter Output voltage: Re-test the Converter Output voltage with a DVM.



Switch off the Car

Reconnect the Converter Output to HV battery cable and re-test.

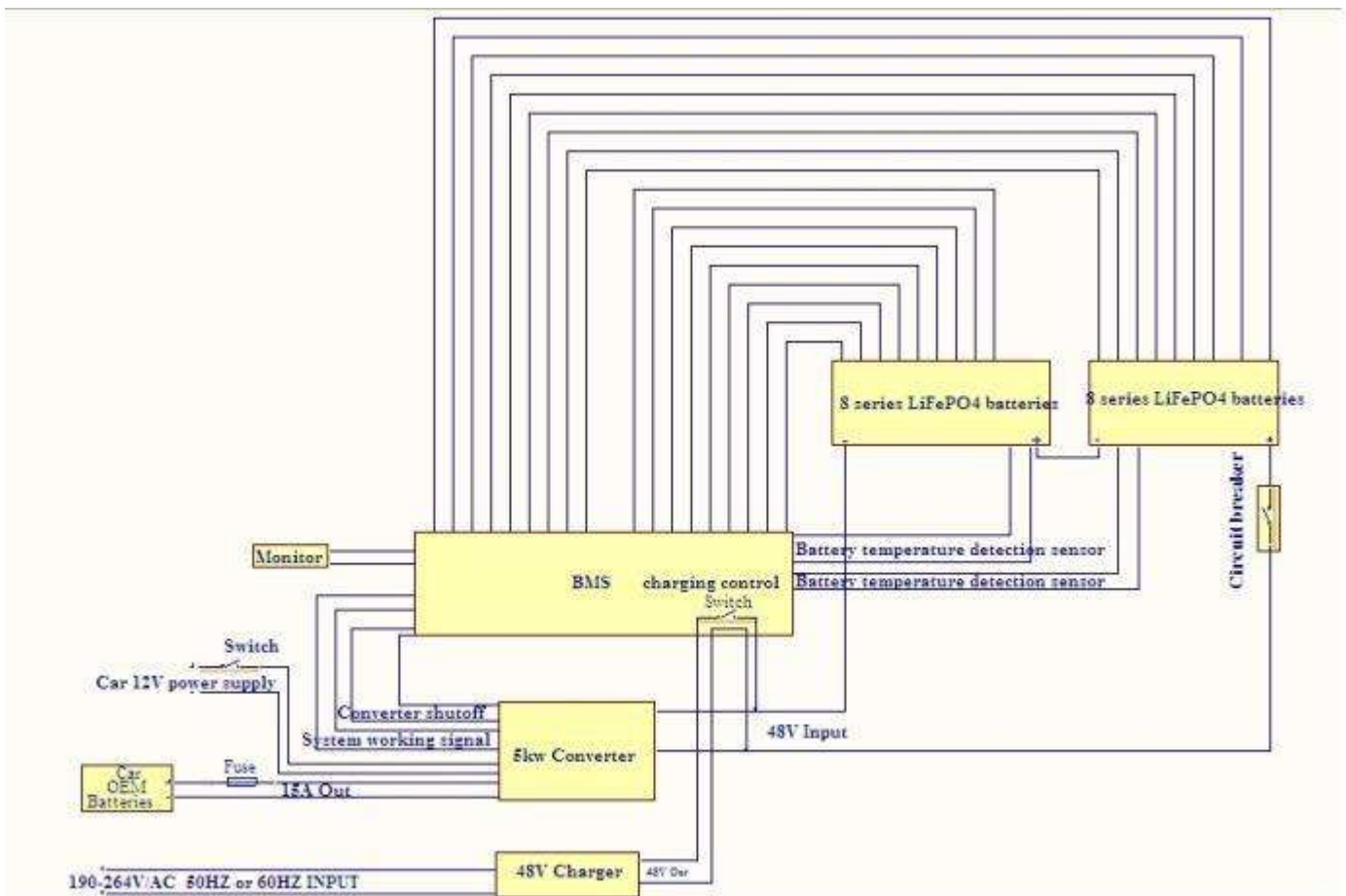


7-1 Converter Adjustment

8 Care and Maintenance

	<p>Keep the PHEV Kit dry, do not open the Kit box in wet weather, where moisture can get in to the box.</p>
	<p>The Kit should be serviced once a year for a battery and BMS check up</p>

9 Circuit Diagram



Notes