L5v2 Plug-In Conversion Module(PCM)

Diagnostic Trouble Codes

Questions: Please call A123 Systems Customer Service at 617-778-5575.

Contents

LED and Connectors

Diagnostic Test and Fault Codes

Chapter 1

LED and Connectors

This chapter includes the following sections:

Malfunction Indicator Light

The following table defines the Malfunction Indicator Light (MIL) error codes.

Error Code	Fault	Quick Check
1	Current Sensor Offset	Wiring to the Current Sensor.
2	Balance Board CAN Communications	Pins on 8-pin connector to module boards.
3	DC/DC Status Signal	Module interconnects/service plug fuse.
4	Cell Over-Voltage Limit	Check cell voltage. Cross check with module board's reported voltage.
5	Not implemented	Not implemented
6	Battery Sub-Module Temperature Sensor	Thermistor connections on module boards.
7	AC Pre-charge	N/A
8	Service Plug Interlock	Crash sensor/service plug.
9	Crash Sensor	Crash sensor
10	Balance Board Auto Addressing	Flashing LEDs on module boards – 8 pin connectors.
11	Cell Under-Voltage Limit	Individual cell voltages.
12	CAN Communications from OEM Battery	N/A
13	CAN Communications From Vehicle	N/A
14	12V Supply Low Voltage	Adjustment of 12V power supply.
15	Over Current Limit	N/A
16	Module Over-Voltage Fault	N/A

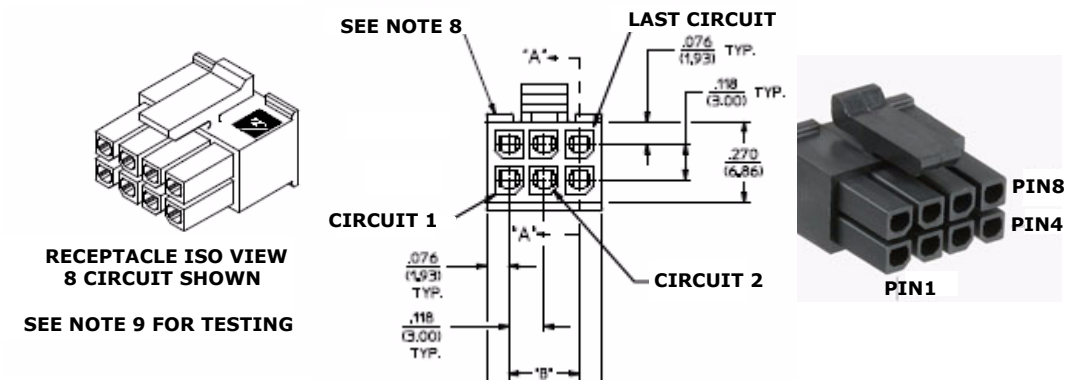
Module Balance Boards LEDs

Each module board had three LEDs. An un-programmed or unassigned board does not blink.

- LED (D30) blinks out its board ID number +1. Board numbers range from 1 to 7. Therefore the number of blinks range from 2 to 8.
- LED (D29) indicates power is present. If this LED is not solid red, check the power connections to the circuit board.
- LED (D28) indicates if any cell readings are greater than 4.1V. During fastening this LED can turn on. If so, once all fasteners are tightened the LED turns off.

Balance Board Connectors

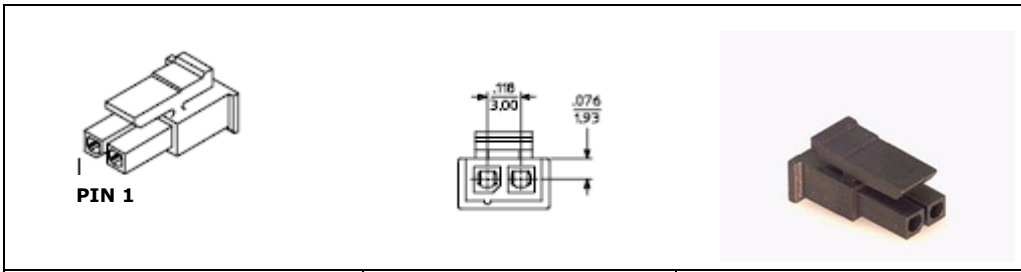
Connectors – J8 through J14 (Molex 43025-0800, Pins 43030-0007)



Pin	Function	Color
Pin 1, 5	GND	Red
Pin 2, 6	VCC	Brown
Pin 3, 7	CAN	Yellow
Pin 4, 8	CANL	Black

Balance Board Thermistor Connectors

Sub-module Thermistor Connectors (Molex 43645-0200, Pins 43030-0007)



Pin	Function	Color
Pin 1	Thermistor Leg 1	Black
Pin 2	Thermistor Leg 2	Black

Molex Micro-Fit Connector

Molex micro-fit connectors are used on connectors J8 through J14 and on all thermistor connections (Molex 43030-0007).

NOTE: Verify that the slit in the rectangular pin has not opened up excessively. Figure 1-1 illustrates the coined area of a rectangular pin.

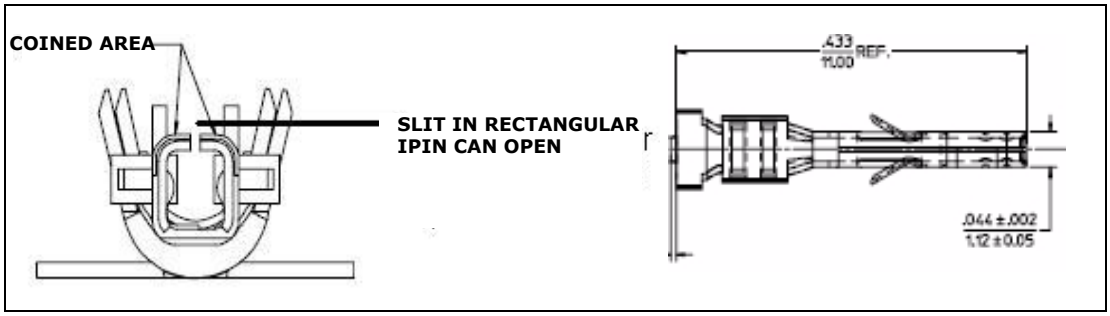
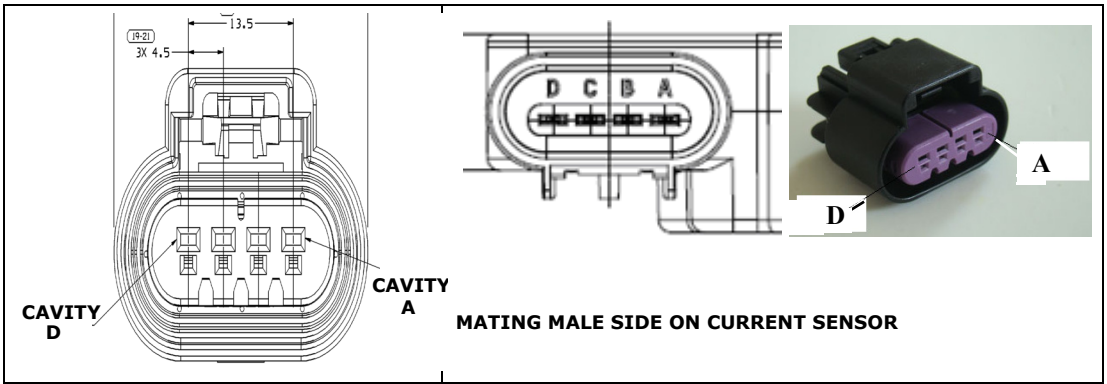


Figure 1-1 Rectangular pin

Current Sensor Connector

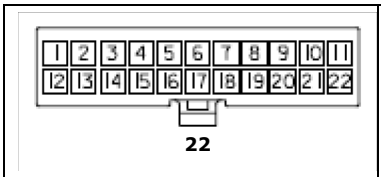
J17 (Delphi GT150 P/N 15326815)



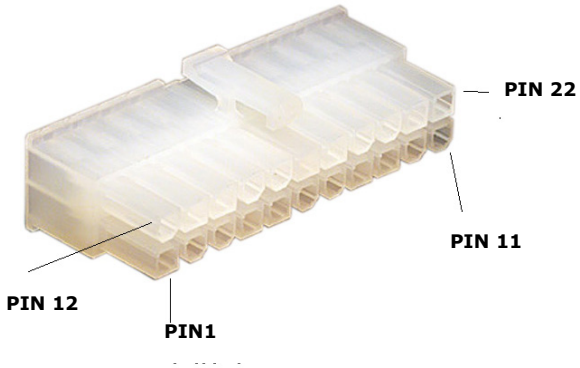
Pin	Function	Color
Pin A	No Connection	N/A
Pin B	VCC	Yellow
Pin C	GND	Black
Pin D	SENSE	Grey

Power Center Board Signal Connector

J1 (Molex 39-01-2225, Pins 39-00-0039)



MATING MALE CONNECTOR ON CIRCUIT BOARD

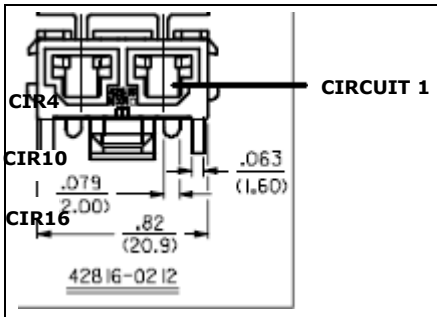


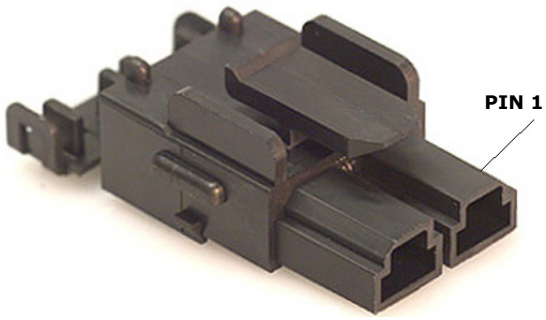
HARNESS SIDE FEMALE

Pin	Function	Color
Pin 1, 12, 13, 14, 15, 16	GND	Black
Pin 2	Interlock input from BMS.	Pink
Pin 3	HV sense	Orange
Pin 4	AC enable signal from BMS.	Grey
Pin 5	EV output to vehicle.	Violet
Pin 6	Interlock contact B.	Light Green
Pin 7	Interlock contact A.	Yellow
Pins 8, 19	Input power from 12V power supply.	Red
Pin 9	Input from 12V vehicle battery to no dry contact.	Dark Green
Pin 10	Pre-charge circuit bi-pass input signal from BMS.	Violet
Pins 11, 20, 21, 22	Output 12V power for BMS, crash sensor, and service plug interlock.	Red
Pin 17	EV mode input signal from BMS.	White
Pin 18	ABS signal from vehicle that enables 12V battery power.	Blue

Power Center – AC Input Connector

AC Input to Power Center (Molex 42816-0212, Pins 43375-1001-C)

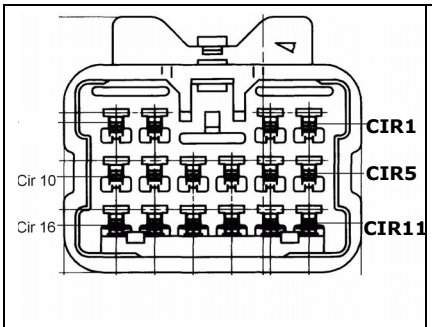




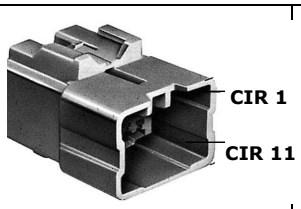
Pin	Function	Color
Pin 1	Neutral	Black
Pin 2	Line	Red

Vehicle Communications Harness

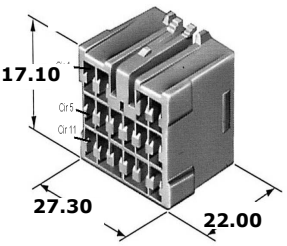
J2 (Yazaki Male Connector 7282-1160, Contacts 7114-4020)



MALE CONNECTOR



MALE CONNECTOR

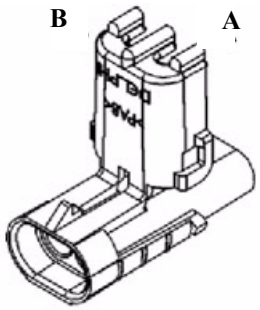


FEMALE CONNECTOR

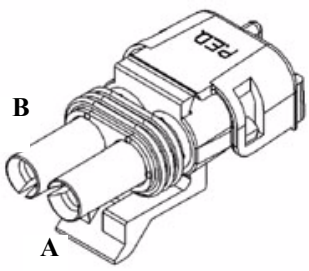
Pin	Function	Color
Pin 1	No connect	N/A
Pin 2	No connect	N/A
Pin 3	Dash light drive	Blue
Pin 4	Brake light drive	Brown
Pin 5	Prius 12V battery	Dark Green
Pin 6	Prius pre-charge signal to BMS	Light Green
Pin 7	Prius main relay	Yellow
Pin 8	Interlock A - power switch	Yellow
Pin 9	BMS – CAN H	Yellow
Pin 10	BMS – CAN L	Black
Pin 11	Vehicle – CAN L	Black
Pin 12	Vehicle – CAN H	Blue
Pin 13	Interlock B – power switch	Light Green
Pin 14	Box on signal from switch	Orange
Pin 15	EV output to vehicle	Violet
Pin 16	ABS input from vehicle	Blue

Blower Connector

J17 (Delphi Connector 12010973, Pins 12089040)



HARNESS SIDE

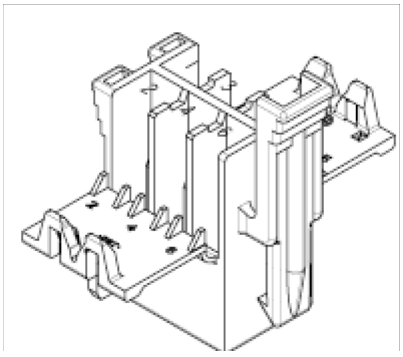


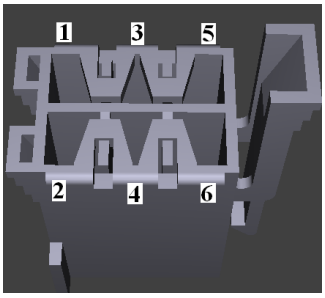
BLOWER SIDE

Pin	Function	Color
Pin A	Blower drive signal	Red
Pin B	GND	Black

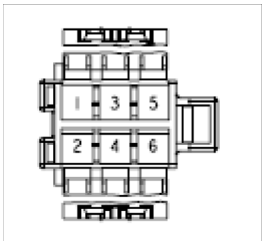
IFM P/N 1 → J25

J25 (Tyco 929504-2, Contacts 929939-1)





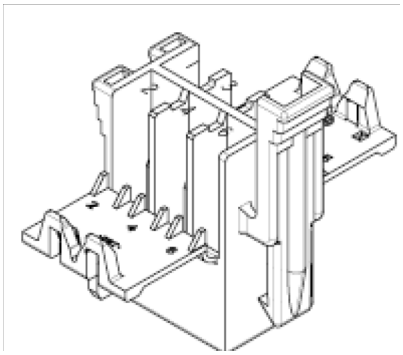
HARNESS SIDE

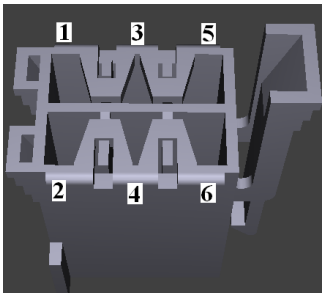


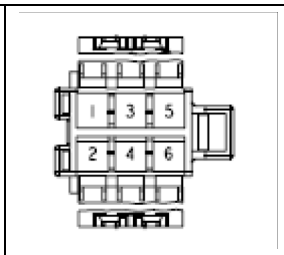
Pin	Function	Color
Pin 1	12V ECU power in	Red
Pin 2	Ground to power center	Black
Pin 3	CANL (Prius, BMS, Battery Board)	Black
Pin 4	CANH (Prius, BMS, Battery Board)	Yellow
Pin 5	CANL (Vehicle CAN Bus)	Black
Pin 6	CANH (Vehicle CAN Bus)	Blue

IFM N2 → J24

J24 (Tyco 929504-2, Contacts 929939-1)



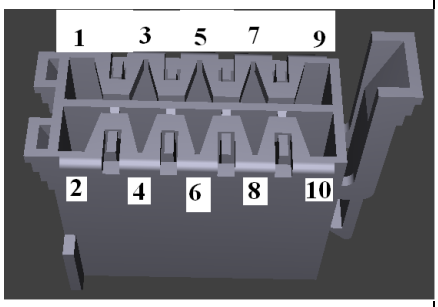




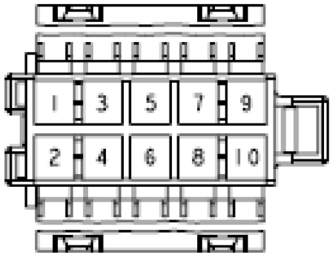
Pin	Function	Color
Pin 1	Programming jumper	Purple
Pin 2	DB9 RS232 GND (Pin 5)	Grey
Pin 3	DB9 RS232 RX (Pin 3)	Blue
Pin 4	DB9 RS232 TX (Pin 2)	Green
Pin 5	Programming jumper	Purple
Pin 6	No connection	N/A

IFM X21 → J23

J23 (Tyco 929504-4, Contacts 929939-1)



WIRE SIDE

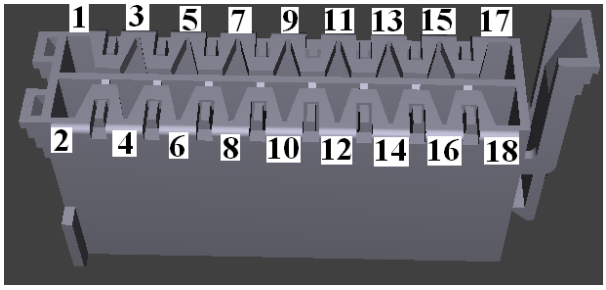


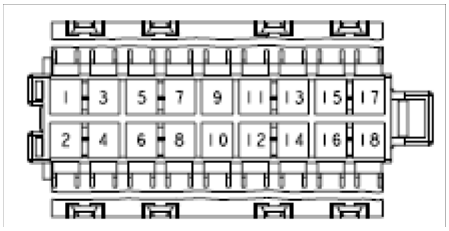
WIRE SIDE

Pin	Function	Color
Pin 1	Fan Power (0 to 12V)	Red
Pin 2	DC/DC Charge PWM (0 to 12V)	Blue
Pin 3	DC/DC Discharge PWM (0 to 12V)	Purple
Pin 4	DC/DC Enable (12V)	Blue
Pin 5	12V IN ECU Power	Red
Pin 6	No connection	N/A
Pin 7	No connection	N/A
Pin 8	Dash light indicator	Blue
Pin 9	Brake light drive	Brown
Pin 10	12V in ECU power	Red

IFM X20 → J22

J22 (Tyco 929504-6, Contacts 929939-1)

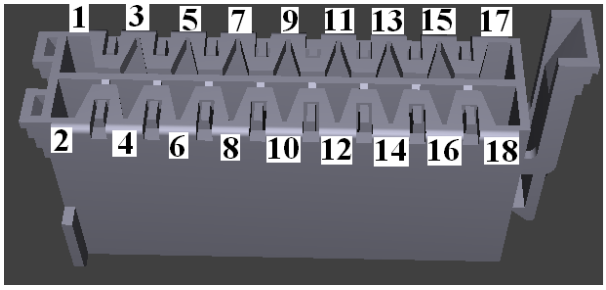


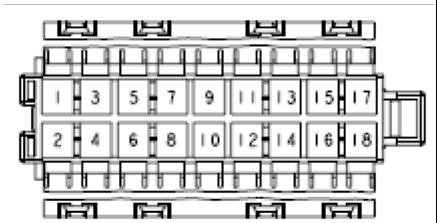


Pin	Function	Color
Pin 1	12V in ECU power	Red
Pin 2	Pre-charge relay drive	Purple
Pin 3	Interlock power IN	N/A
Pin 4	Battery contactor drive	N/A
Pin 5	Interlock power IN	N/A
Pin 6	HV POS contactor drive	Blue
Pin 7	Interlock Power IN	N/A
Pin 8	HV NEG contactor drive	N/A
Pin 9	Interlock PWR IN	N/A
Pin 10	Tap contactor drive	Green
Pin 11	No connection	N/A
Pin 12	No connection	N/A
Pin 13	12V ECU power drive	Red
Pin 14	Cur Sense 5V OUT	Yellow
Pin 15	Boot Up interlock enable	Pink
Pin 16	Battery board 12V drive	Blue
Pin 17	AC on relay	Grey
Pin 18	EV button drive	N/A

IFM X10 → J7

J7 (Tyco 929504-6, Contacts 929939-1)

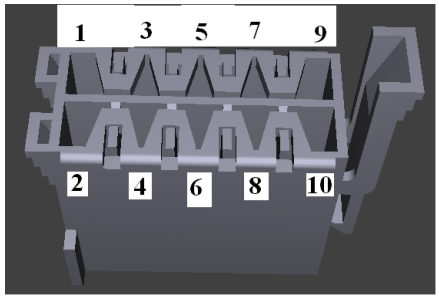


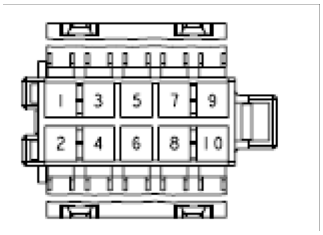


Pin	Function	Color
Pin 1	No connection	N/A
Pin 2	No connection	N/A
Pin 3	No connection	N/A
Pin 4	No connection	N/A
Pin 5	No connection	N/A
Pin 6	No connection	N/A
Pin 7	No connection	N/A
Pin 8	No connection	N/A
Pin 9	Fan ground	Black
Pin 10	No connection	N/A
Pin 11	No connection	N/A
Pin 12	No connection	N/A
Pin 13	12V ECU power drive	Red
Pin 14	No connection	N/A
Pin 15	12V ECU power	Red
Pin 16	12V sense interlock	N/A
Pin 17	No connection	N/A
Pin 18	12V sense crash sensor	Purple

IFM X11 → J6

J6 (Tyco 929504-4, Contacts 929939-1)

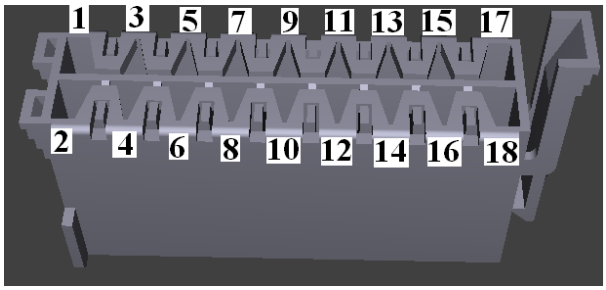


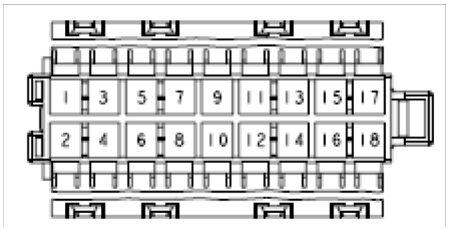


Pin	Function	Color
Pin 1	Current Sensor input	Grey
Pin 2	No connection	N/A
Pin 3	DC/DC status in 5V	N/A
Pin 4	No connection	N/A
Pin 5	Current Sensor ground	Black
Pin 6	No connection	N/A
Pin 7	No connection	N/A
Pin 8	No connection	N/A
Pin 9	No connection	N/A
Pin 10	HV bus voltage sensor	Orange

IFM X12 → J5

J5 (Tyco 929504-6, Contacts 929939-1)





Pin	Function	Color
Pin 1	12V DC/DC thermistor power	N/A
Pin 2	DC/DC temperature IN	Dark Green
Pin 3	12V air temp thermistor power	Light Green
Pin 4	Air temperature IN	Blue
Pin 5	No connection	N/A
Pin 6	No connection	N/A
Pin 7	DC/DC ground	Black
Pin 8	No connection	N/A
Pin 9	No connection	N/A
Pin 10	No connection	N/A
Pin 11	No connection	N/A
Pin 12	12V power supply IN	Red
Pin 13	No connection	N/A
Pin 14	Hymotion box ON	Brown
Pin 15	No connection	N/A
Pin 16	No connection	N/A
Pin 17	Prius pre-charge	Light Green
Pin 18	Prius main contactor	Yellow

Chapter 2

Diagnostic Test and Fault Codes

This chapter includes the following sections:

DTC and Fault Codes

This section includes the following DTC and Fault Codes:

DTC 1 – Current Sensor Offset Check

This test serves as an initial connectivity check. The Current Sensor 2.5V +/-(300mV) with zero current flows through the sensor at startup.

Step	Test	Action
1.	Verify the following connectors are connected to the Current Sensor. • J17 • J6-X11 • J22-X20	• If any of the connections are disconnected, restore the connection and charge the system. • Otherwise continue to the next step.
2.	Verify that the resistance of the following connections are no less than 1 ohm. • J17-2 (C on new sensor) to J6-6 • J17-1(B on new sensor) to J22-14 • J17-3(D on new sensor) to J6-1	• If any of the connections are less than 1 ohm, replace the Main Harness. • Otherwise continue to the next step.
3.	a. Take out the service plug. b. Plug the system into a 120V AC outlet. c. Back-probe the Current Sensor connector.	• If pin B to pin C does not measure +5V, replace the Main Harness. • Otherwise continue to the next step.
4.	a. Take out the service plug. b. Plug the system into a 120V AC outlet. c. Back-probe the Current Sensor connector.	• If pin D to pin C does not measure 2.5V +/- 300mV, replace the Current Sensor. • Otherwise continue to the next step.
5.	a. Take out the service plug. b. Plug the system into a 120V AC outlet. c. Back-probe the IFM Connector J6 pin 1.	• If you do not have 2.5V +/- 300mV relative to chassis replace the Main Harness. • If you do have 2.5V +/- 300mV relative to chassis, reflash the IFM.
6.	a. Take out the service plug. b. Plug the system into a 120V AC outlet.	• If the measurements between J22 pin 14 and J6 pin 6 are 5V, replace Main Harness. • If the measurements between J22 pin 14 and J6 pin 6 are not 5V, reflash the IFM.

DTC 2 – Balance Board CAN Communication

This fault occurs if there is an inconsistent connection with a module board. A completely missing connection manifests itself as a self-addressing fault (0 MIL). This fault is recorded after the BMS has lost communications for more than 20 seconds

Step	Test	Action
1.	a. Check the wiring to each module board. Each board has an 8-pin molex connector (J8 – J14). b. Check that the connector is seated correctly. c. Ensure J1, J22, and J25 are also seated correctly.	• If any of the connections are seated incorrectly, reseat the connection. and charge the system. • Otherwise continue to the next step
2.	a. Measure the resistance between J1 pin 13 (power center GND) and the last module board J14 pin 1 with all connectors (J8 – J14) plugged in. b. Verify each module board connector is tight.	• If the resistance is equal to or greater than 2 ohms, replace the Main Harness. • If the resistance is less than 2 ohms, continue to the next step.
3.	a. Measure the resistance between J22-X20 pin 16 and the last module board (J14) pin 2 with all connectors (J8 – J14) plugged in. b. Verify each module board connector is tight.	• If the resistance is equal to or greater than 2 ohms, replace the Main Harness. • If the resistance is less than 2 ohms, continue to the next step.
4.	a. Measure the resistance between J25-P/N1 pin 4 and the last module board (J14) pin 3 with all connectors (J8 – J14) plugged in. b. Verify each module board connector is tight.	• If the resistance is equal to or greater than 2 ohms, replace the Main Harness. • If the resistance is less than 2 ohms, continue to the next step.
5.	a. Measure the resistance between J25-P/N1 pin 3 and the last module board (J14) pin 4 with all connectors (J8 – J14) plugged in. b. Verify each module board connector is tight.	• If the resistance is equal to or greater than 2 ohms, replace the Main Harness. • If the resistance is less than 2 ohms, continue to the next step.
6.	a. Disconnect J8 through J14. b. Verify that the pins within the connector have not opened up.	• If the pins within the connector have opened up, replace the Main Harness. • Otherwise continue to the next step.

7.	a. Measure the resistance across J25 pin 3 and J25 pin 4 with connectors J8 to J14 connected to module. b. Without the vehicle connected on the interface harness you should measure between 100 and 130 ohms.	• If the resistance is not between 100 and 130 ohms, replace the Main Harness. • If the resistance is between 100 and 130 ohms, continue to the next step.
8.	a. Verify that the EMI suppression choke is in place on the module board harness. b. Verify that either 2 chokes are present or the wiring has been double looped.	If the 2 chokes are not present or the wiring has not been double looped, swap out the pack and place a new choke on the harness with the wire double looped. Charge the system.

Fault Code 3 – DC/DC Fault

This fault occurs when the DC/DC converter sees an operating condition outside its safe range. This could be an Over-Voltage, an Under-Voltage, or an Over-Temperature.

Step	Test	Action
1.	a. Remove the Prius Service Plug. b. Check that the HV connections from the L5 BREM to the vehicle battery pack contactors are tight.	• Tighten the HV connections if necessary and charge the system. • Otherwise continue to the next step.
2.	a. Check that the L5v2 PCM service plug fuse has not cleared by the DMM resistance check. b. Check that the fuse is still intact.	• Replace L5v2 BREM service plug if necessary and charge the system. • Otherwise continue to the next step.
3.	a. Remove the system from the vehicle. b. Open the power electronics basin of L5v2 system. c. Check that all screws on the DC/DC converter barrier strip are completely tightened and not cross-threaded.	• Remove any cross-threaded screws if necessary, tighten all screws, and charge the system. If screws cannot be tightened without stripping the screw terminal threads, replace the DC/DC. • Otherwise continue to the next step.
4.	Check for any loose nuts or bolts on DC/DC bus-bar carrier.	• If necessary, tighten are loose bolts or nuts on the HV and bus bar carrier to the proper torque. • Otherwise continue to the next step.
5.	Verify the white signal connector (J16) is properly secured into the DC/DC converter.	• Secure J16 if necessary and charge the system. • Otherwise continue to the next step.

6.	Check the crimp integrity of all wires in J16.	• Replace the Main Harness if the crimps do not appear good. • Otherwise continue to the next step.
7.	Verify the resistance between the following connections is below 1 ohm: • J16-7 to J6-3 • J16-4 to J5-7 • J16-16 to J5-2 • J16-15 to J5-1 • J16-3 to J23-3 • J16-2 to J23-2	• If the resistance is equal to or greater than 1 ohm, replace the Main Harness. • If the resistance is less than 1 ohm, continue to the next step.
8.	Check the polarity on blower wiring. • Red wire should be in position A. • Black wire should be in position B.	• If the polarity is incorrect, swap the wires. • Otherwise continue to next step.
9.	a. Remove the top cover from the pack and the L5v2 battery stack. b. Check the inter-module bus-bar connections.	• If nuts are not tight, tighten them, verify the module interconnect bus-bars are in place, and charge the system. • Otherwise replace the DC/DC converter.

Fault Code 4 – Cell Fault

This fault occurs when the BMS reports that voltage from a module board is higher than 3.68V.

Step	Test	Action
1.	a. Use the CAN probe tool in the OBD – II port. b. Turn the vehicle off and plug in the system. c. Verify that 1 or more cell voltage readings have exceeded 3.68V.	Note and modules with cells above 3.68V and charge the system. Continue to the next step.
2.	a. Remove the top cover. b. Remove the module board covers. c. Check for loose nuts on the battery stack.	• If necessary, remove the system from the vehicle and tighten all loose nuts on the battery pack and charge the system. • Otherwise continue to the next step.
3.	a. Use a DMM to verify that the cell voltage in the noted module is above 3.68V. Module numbers are determined by LED flashes. • Flashes = module number + 1. • Module 1 flashes 2 times.	Replace the battery module if any readings are reater than 3.68V.

Fault Code 6 – Battery Sub-Module Temperature Fault

This fault occurs if one of the battery thermistors are out of range (-30 C to 65 C). Two thermistors are plugged into the front of each module balance board.

Step	Test	Action
1.	a. Plug the Can Probe tool into the OBD II port. b. Note all 14 battery module temperature readings and their module locations.	• If a battery modules with a temp 2 at -64°C, max cell voltage reading is below 4.096V, replace the battery module. • If a battery modules with a temp 2 at -64°C, max cell voltage reading is equal to or above 4.096V, continue to next step.
2.	a. Remove the system from the vehicle. b. Remove the top cover and module board cover for the module board of interest. c. Verify that all nuts on the battery module are tight.	• If the nuts on the battery module are tight, replace the battery module. • If the nuts on the battery module are not tight, tighten them and charge the system.
3.	a. Remove the system from the vehicle and remove the top cover from the system. b. Verify that all 2 pin thermistor connectors are securely plugged into the module boards. c. Verify there are 2 thermistors per module board for a total of 14 thermistors.	• If any thermistors are unplugged or loose, secure the thermistors and charge the system. • Otherwise continue to next step.
4.	a. Disconnect all thermistor connectors. b. Verify that the pins within the connector have not opened up.	• If any pins within the connector have opened up, re-crimp a new 2-pin molex connector on the thermistor and charge the system. • Otherwise continue to next step.
5.	a. Measure the resistance of each thermistor using a DMM. • If the temperature is below 0°C you should have between 200k to 35k. • If the temperature is from 0 to 15°C you should have between 35k to 14k. • If the temperature is from 15°C to 40°C you should have between 14k and 5k.	If the resistance is not correct, replace the module.

Fault Code 7 – AC Pre-Charge Fault

This fault occurs if the DC/DC converter is not able to successfully pre-charge during charging.

Step	Test	Action
1.	a. Remove the service plug from system. b. Remove system from the vehicle. c. Open the power electronics basin of the L5v2 system. d. Verify that the AC input to the power center connector is properly seated.	• If necessary, properly seat the AC input connector to the power center and charge the system. • Otherwise continue to the next step.
2.	Verify that the orange HV wire leaving the power center is fastened tightly to the appropriate contactor post.	• If necessary, securely fasten the orange HV wire to the appropriate contactor post using the fastener. Charge the system. • Otherwise continue to the next step.
3.	Check that all screws on the DC/DC converter barrier strip are completely tightened and not cross threaded.	• If necessary, remove violating screws and attempt to tighten screws. If all screws tighten without stripping the barrier strip screw terminal threads, charge the system. • If all screws do not tighten without stripping the barrier strip screw terminal threads replace the DC/DC.
4.	Check for any loose nuts or bolts on the DC/DC bus-bar carrier.	• If necessary, tighten loose nuts and bolts and charge the system. • Otherwise continue to the next step.
5.	Check the screw terminals on the power center to ensure screws are properly secured.	• If necessary tighten screws on power center screw terminal and charge the system. • Otherwise continue to the next step.
6.	Verify that white connector J1 on power center is properly seated.	• If necessary, properly seat J1 and charge the system. • Otherwise continue to the next step.
7.	Measure the resistance of the connection J1-4 to J22-17.	• If resistance is not less than 1 ohm replace the Main Harness. • Otherwise continue to next step.
8.	Check that J16, J5, and J23 are properly seated.	• If necessary, properly seat any unseated connectors and charge the system. • Otherwise continue to the next step.

9.	Verify the resistance between the following connections are below 1 ohm: • J16-7 to J6-3 • J16-4 to J5-7 • J16-16 to J5-2 • J16-15 to J5-1 • J16-3 to J23-3 • J16-2 to J23-2	• If the resistance is less than 1 ohm, replace the Main Harness. • Otherwise continue to next step.
10.	a. Re-seat the system service plug. b. Plug the system into a 120V AC outlet. c. Measure the voltage from the contactor post. The orange HV wire from the power center is located at the HV GND screw terminal location on the DC/DC.	• If the measurement is not between 150V to 190V off 120V AC outlet, replace the power center and charge the system. • Otherwise continue to next step.
11.	With the system plugged in carefully (170V DC off 120V AC input) measure voltage across terminal B and HV GND screw terminal locations on the DC/DC converter.	• If the measurement is not between 150V to 190V off 120V AC line, replace the Inductor and charge the system. • Otherwise continue to next step.
12.	With the system unplugged and the service plug removed, measure the resistance from the HV orange wire leaving the power center to the term B screw terminal location on the DC/DC converter.	• If the measurement is not less than 1 ohm, replace the Inductor and charge the system. • Otherwise continue to next step.
13.	Measure the resistance of the inductor B connecting the bus-bar going to the motor B screw terminal location and the orange wire.	• If the resistance is not less that 1 ohm, replace the inductor and charge the system. • Otherwise continue to next step.
14.	Measure the resistance of the bus-bar going from the inductor to the motor B screw terminal location.	• If the resistance is not less that 1 ohm, replace the Bus-bar Carrier. • Otherwise continue to the next step.
15.	a. Connect the DMM to measure the voltage between J16-7 and chassis ground. b. Seat the service plug and plug in 120V. c. Take voltage measurement when the DC/DC light momentarily turns red.	• If 5V is present, reflash the IFM. • If 5V is not present, replace DC/DC Converter

Fault Code 8 – Service Plug Fault

This fault occurs if the service plug is disconnected from the system. Also a service plug fault is reported when the system is plugged in and the crash sensor is open.

Step	Test	Action
1.	Verify the crash sensor is depressed. This can be done without removing the cover by pushing a screw driver through the hole on the cover.	• If the crash sensor is not depressed, reset it by pushing down on it. Charge the system. • Otherwise continue to next step.
2.	Check that the L5v2 service plug is properly seated in place.	• If necessary, push down on service plug handle to ensure that it is properly seated and charge the system. • Otherwise continue to next step.
3.	Check that the white interlock connector for the service plug is properly clipped into place.	• If necessary, clip the service plug interlock holder into place to reset the service plug and charge the system. • Otherwise continue to next step.
4.	a. With the service plug inserted, plug the system into 120V AC. b. Measure the voltage on the service plug interlock referenced to chassis.	• If 12V is not present, replace the crash sensor and charge the system. • Otherwise continue to next step.
5.	a. Unfasten the crash sensor from the chassis. b. With the service plug unseated, plug the system into 120V AC. c. Back-probe the crash sensor connector to measure voltage on pin 3 referenced to chassis.	• If 12V is not present, replace the crash sensor and charge the system. • Otherwise continue to next step.
6.	a. With the service plug unseated, plug the system into 120V AC. b. Back-probe the crash sensor connector to measure voltage on pin 1 referenced to chassis.	• If 12V is not present, replace the crash sensor and charge the system. • Otherwise continue to next step.
7.	Verify that connector J1 on the power center and J7 on the IFM are properly seated.	• If necessary, seat any unsecured connectors and charge the system. • Otherwise continue to next step.

8.	Perform a resistance check on the following connections: • J1-20 to J3-3 (crash sensor 12V) • J7-10 to J3-2 (Crash Sensor NO) • J7-16 to J4-1 (service plug) • J3-1 (crash sensor NC) to J4-2 (service plug)	If the resistance is not less than 1 ohm, replace the Main Harness and charge the system.

Fault Code 9 – Crash Sensor Fault

This fault occurs if the system is running while the crash sensor changes state. In the event of a sudden impact the crash sensor has a mechanical switch that moves the wired circuit running through it from the closed to an open position. This circuit is wired to the HV contactors so that the power is pulled from the contactors in the event of an impact. The BMS is able to detect the state of this switch.

Step	Test	Action
1.	Check that the crash sensor is depressed. This can be done without removing the cover by pushing a screw driver through the hole on the cover.	• If necessary, reset the crash sensor by pushing down on it. • Otherwise continue to the next step.
2.	Perform a resistance check on the following connections: • J1-20 to J3-3 (crash sensor 12V) • J7-10 to J3-2 (Crash Sensor NO) • J3-1 (crash sensor NC) to J4-2 (service plug).	• If the resistance is not less than 1 ohm, re-crimp the connections to the crash sensor and re-insert. If the resistance is now less than 1 ohm charge the system. • Otherwise replace the Main Harness.
3.	a. Connect the system to 120V AC with the service plug connected. b. Measure the voltage on J3-2 crash sensor.	• If the voltage is 0V on J3-2 when the voltage is 12V on J3-3, reflash the IFM. • Otherwise replace the Crash Sensor.

Fault Code 10 – Auto Address Fault

This fault occurs upon boot-up anytime the BMS cannot establish communications with any of the 7 module boards.

Step	Test	Action
1.	a. Check the wiring to each module board. Each board has an 8-pin molex connector (J8 – J14). b. Check the connector is seated correctly. c. Also verify that J1, J22, and J25 are seated.	• If necessary, seat all unseated connectors and charge the system. • Otherwise continue to next step.
2.	a. With all connectors (J8 – J14) plugged in, measure the resistance between J1 pin 13 (power center GND) and the last module board J14 pin 1. b. Verify each module board connector is tight.	• If the resistance is less than 1 ohm, replace the Main Harness. • Otherwise continue to next step.
3.	a. With all connectors (J8 – J14) plugged in, measure the resistance between J22-X20 pin 16 and the last module board (J14) pin 2. b. Verify each module board connector is tight.	• If the resistance is less than 2 ohm, replace the Main Harness. • Otherwise continue to next step.
4.	a. With all connectors (J8 – J14) plugged in, measure the resistance between J25-P/N1 pin 4 and the last module board (J14) pin 3. b. Verify each module board connector is tight.	• If the resistance is less than 2 ohm, replace the Main Harness. • Otherwise continue to next step.
5.	a. With all connectors (J8 – J14) plugged in, measure the resistance between J25-P/N1 pin 3 and the last module board (J14) pin 4. b. Verify each module board connector is tight.	• If the resistance is less than 2 ohm, replace the Main Harness. • Otherwise continue to next step.
6.	a. With connectors J8 to J14 connected to module, measure the resistance across J25 pin 3 and J25 pin 4.	• Without the vehicle connected on the interface harness, measurement should be between 100 and 130 ohms. If not replace the Main Harness • Otherwise continue to next step.

7.	Remove the board covers and plug the system into 120V AC with the service plug in place.	If all boards do not have the 12V power LED on, replace the first module from the right that does not have power (with the battery stack facing you). Continue to the next step.
8.	With all boards powered, verify that all boards have a blinking communications light.	• If all boards to not have a blinking communications light, replace the first module from the right that does not have a blinking communications light (battery stack facing you) and charge the system. • Otherwise continue to the next step.
9.	Disconnect J8 through J14. Verify that the pins within the connector have not opened up.	• If pin profiles are not good, replace the Main Harness. • Otherwise continue to next step.
10.	a. Verify that the EMI suppression choke is in place on the module board harness b. Verify that either 2 chokes are present or the wiring has been double looped.	If necessary, swap the pack, place a new choke on the harness with the wire double looped and charge the system.

Fault Code 11 – Battery Cell Low Fault

This fault is reported if a cell voltage of lower than 1.5V is measured by a module board. In this event the BMS shuts off all module boards. The last recorded cell voltage can be seen in the CAN probe software.

Step	Test	Action
1.	a. Using the CAN probe tool in the OBD – II port, turn the vehicle off and plug in the system. b. Verify that 1 or more cell voltage readings are below 1.5V if any readings are present.	• Note the modules with cells below 1.5V and continue to next step. • Otherwise continue to the next step.
2.	a. Remove the system from vehicle. b. Remove top and module board covers. c. Check for loose nuts on the battery stack.	• If necessary, tighten all loose nuts on the battery stack and charge the system. • Otherwise continue to the next step.
3.	Verify, using a DMM, that a cell voltage in the battery stack is below 1.5V.	• Replace modules with cells below 1.5V. • Otherwise continue to the next step.

4.	a. With the system in the vehicle and turned off, back-probe the L5v2 side of the interface harness while connected to the vehicle. b. Measure the resistance across J2 pin 9 and J2 pin 10.	If the resistance does not measure approximately 60 ohms, note the resistance.

Fault Code 12 – Battery CAN Fault

This fault occurs in addition to a vehicle red triangle in the dashboard. Checks for this fault are termination, interface harness integrity, and install harness connectivity.

Step	Test	Action
1.	Disconnect the L5v2 interface harness. The resistance of the following connections should be less than 1 ohm. • Install the Harness Main Connector pin 9 to Prius BMS pin 19 (Battery CANL) • Install the Harness Main Connector pin 10 to Prius BMS pin 18 (Battery CANH) • Install the Harness Main Connector pin 11 to Prius. • OBD-II Port pin 6 (Vehicle CANH). • Install Harness Main Connector pin 12 to Prius. • OBD-II Port pin 14 (Vehicle CANL). • System Chassis GND to Vehicle Chassis.	• If the resistances are less than 1 ohm, remake all connections between the L5v2 vehicle interface connector and the vehicle exactly as detailed by the A123 Systems *Hymotion Service Manual* and restart vehicle. • Otherwise continue to the next step.
2.	a. Remove the system from the vehicle. b. Remove the electronics basin cover. c. Measure the resistance of the following connections. They should be less than 1 ohm: • J25 pin 3 to J2 pin 9 • J25 pin 4 to J2 pin 10	• If the pins resistances are not less than 1 ohm replace the Main Harness. • Otherwise continue to the next step.
3.	With the vehicle disconnected, measure the resistance between J2 pin 9 and J2 pin 10.	• If the resistance is not between 100 and 130 ohms, replace the Main Harness. • Otherwise continue to the next step.

4.	With the system disconnected, measure the resistance across the install harness main connector pin 9 and install harness main connector pin 10.	If the resistance is not between 100 and 130 ohms, replace the Main Harness.

Fault Code 13 – Vehicle CAN Fault

This fault occurs in addition to a vehicle red triangle in the dashboard. Checks for this fault are termination, interface harness integrity, and install harness connectivity. This fault can also occur if the system is shutdown quickly and the system does not see the vehicle go off before the vehicle CAN bus is checked.

Step	Test	Action
1.	Verify the fault is being reported while the vehicle is off and when there is no red triangle on the dashboard.	• If so allow 2 minutes for the system to shut off. Then turn the system / vehicle back on. The fault will have cleared. This is a software bug. If the vehicle is shut off quickly, the system could report seeing a failure with the vehicle CAN bus before registering the vehicle is off. Restart the vehicle with delay. • Otherwise continue to the next step.
2.	a. With the system in the vehicle and turned off, back-probe the L5v2 side of the interface harness while connected to the vehicle. b. Measure the resistance across J2 pin 11 and J2 pin 12.	Resistance should measure approximately 60 ohms. Note the resistance and continue to the next step.
3.	Disconnect the L5v2 interface harness. The resistance of the following connections should be less than 1 ohm: • Install Harness Main Connector pin 9 to Prius BMS pin 19 (Battery CANL) • Install Harness Main Connector pin 10 to Prius BMS pin 18 (Battery CANH) • Install Harness Main Connector pin 11 to Prius • OBD-II Port pin 6 (Vehicle CANH) • Install Harness Main Connector pin 12 to Prius • OBD-II Port pin 14 (Vehicle CANL)	• If resistance is not less than 1 ohm, remake all connections between the L5v2 vehicle interface connector and the vehicle as detailed by the A123 Systems *Hymotion Service Manual*. Restart the vehicle. • Otherwise continue to the next step.

4.	a. Remove the system from the vehicle. b. Remove the electronic basin cover. The resistance of the following connections should be less than 1 ohm. • J25 pin 6 to J2 pin 11 • J25 pin 5 to J2 pin 12	• If the resistance is not less than 1 ohm, replace the Main Harness. • Otherwise continue to the next step.
5.	a. With the vehicle disconnected, measure the resistance between J2 pin 11 and J2 pin 12.	• If the resistance is not between 100 and 130 ohms, replace the Main Harness. • Otherwise swap the battery pack.

Fault Code 14 – Supply Low Fault

This fault occurs in addition to a red triangle in the dashboard. This occurs if the supply voltage is below 9.6V upon boot-up.

Step	Test	Action
1.	With the system in the vehicle, have someone turn on the vehicle while you are measuring the 12V battery.	• If the voltage on the multimeter goes below 10V, boost the vehicle 12V battery pack with a booster pack. Notify customer that if problem persists that they may have a weak 12V battery and to get it replaced. Restart the vehicle. • Otherwise continue to the next step.
2.	a. If a fault occurred during charging, remove the system from the vehicle and remove the electronics basin cover. b. Plug the system into 120V AC and measure output from the 12V power supply.	• If the output is below 10V, adjust 12V PSUP output to 15V. • Otherwise continue to the next step.
3.	Check the resistance of the J2 pin connection.	• If the resistance is not less than 1 ohm replace the Main Harness. • Otherwise continue to the next step.

NOTE: If you can turn on the vehicle, leave in ready mode to charge up 12V battery**.**

Fault Code 15 – Over Current Fault

This fault occurs if a current greater than 130A is reported by the Current Sensor. Possible causes of this are a faulty DC/DC converter or bad Current Sensor. If the Current Sensor is has faulty wiring, a Current Sensor offset fault (DTC 1) is reported.

Step	Test	Action
1.	Measure the resistance of the following connections. • J17-2 (C on new sensor) to J6-6 • J17-1 (B on new sensor) to J22-14 • J17-3 (D on new sensor) to J6-1	• If the resistance is not less than 1 ohm, replace Main Harness. • Otherwise continue to the next step.
2.	Verify that all the pins and wires within the Current Sensor connector J17 are secure and appropriately crimped.	• If necessary re-crimp the connections on Current Sensor and charge the system. • Otherwise continue to the next step.
3.	Verify that J22 and J6 are properly secured and that the wires and crimps are securely connected. • J22-14 • J6-5 • J6-1	• If the wires and crimps are not good, replace the Main Harness. • Otherwise continue to the next step.
4.	With the service plug out, plug the system into 120V AC outlet and back-probe the Current Sensor connector.	• If pin B to pin C does not measure +5V, replace the Current Sensor. • Otherwise continue to the next step.
5.	With the service plug out and the system plugged in, back-probe the Current Sensor connector.	• If pin D to pin C does not measure 2.5V +/- 300mV, replace the Current Sensor. • Otherwise continue to the next step.
6.	With the service plug out and the system plugged in, back-probe the IFM connector J6 pin 1.	• If measurements are not 2.5V +/- 300mV relative to chassis, replace the Main Harness. • If measurements are 2.5V +/- 300mV relative to chassis, reflash the IFM.
7.	With the service plug out and the system plugged in, back-probe the IFM between J22 pin 14 and J6 pin 6.	• If measurements are not 5V, reflash the IFM. • If measurement are 5V, replace the Main Harness.

Non MIL faults

This section describes the following non MIL faults:

Vehicle Red Triangle without Pack Fault

Pack faults and descriptions are detailed in the following table.

Fault	A red triangle vehicle fault without the accompaniment of a pack status fault.
Description	This occurs as follows. 1. The service plug is not seated correctly on the Prius Pack. 2. The System is not Powered up when the vehicle is turned on. This causes a red triangle because the CAN bridge can not be made.

System not Running

Fault and description are detailed in the following table.

Fault	System charges without issue but does not operate with the vehicle and does not give an error code.
Description	This occurs as follows. 1. A welded battery contactor – system will charge without issue. During system operation system will not leave state 2 and go into state 5 or 6. DC/DC will always be powered on; 2. Pack switch bus. No vehicle operation but will charge. 3. User did not hit brakes before turning on vehicle.

System not Charging

Fault and description are detailed in the following table.

Fault	The system does not receive power off of the wall outlet and no fault code is given.
Description	This occurs as follows. 1. Pack circuit breaker is tripped, 2. In-line GFCI trip. 3. Problem with 12V supply to BMS. 4. Problem with charge port.

Vehicle not Turning On

Fault and description are detailed in the following table.

Fault	User selects the vehicle power switch but vehicle does not turn on.
Description	This occurs as follows. 1. Error with the interlock circuit. 2. Very low battery (not enough power for vehicle to turn on).

No EV Mode

Fault and description are detailed in the following table.:

Fault	Vehicle is unable to enter EV mode.
Description	This occurs as follows. 1. Check power center, 2. Check continuity 3. Check Output from IFM. Could be a Main Harness issue.

Vehicle not Turning Off

Fault and description are detailed in the following table.

Fault	Vehicle will not turn off.
Description	This occurs as follows. 1. Loose ground connection. Indicator: • Does not turn on while charging • If pack is charged and pack is on and running, light is on. • Once pack is depleted light is off.