SUBARU

Confidence in Motion

Technician Reference Booklet

2014 XV Crosstrek Hybrid

New Technology Training

Module 702

AUTOMOTIVE Youth Educational Systems PROUD PARTNER

WE SUPPORT PROFESSIONAL CERTIFICATION THROUGH THE National Institute for AUTOMOTIVE SERVICE EXCELLENCE

MSA5P1702C

November 2013

This Technical Reference Booklet (TRB) is designed to be used in a classroom environment or as a guide for self study.
The TRB is not intended to be used as a supplement or substitute for the Subaru Service Manual. Always consult the appropriate Service Manual when performing any diagnostics, maintenance or repair to any Subaru vehicle.

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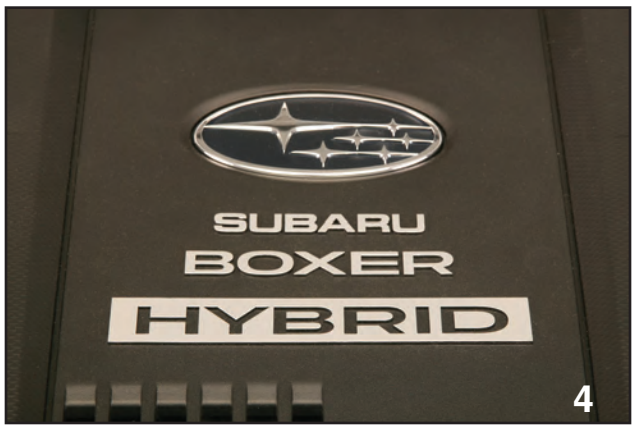
Table of Contents

Introduction

2014 XV Crosstrek Hybrid



Engine Cover

The 2014 model year Subaru XV Crosstrek model lineup introduces the first Subaru Hybrid model, the XV Crosstrek Hybrid and the XV Crosstrek Hybrid Touring.

Subaru XV Crosstrek model lineup:

- 2.0i Premium
- 2.0i Limited
- Hybrid
- Hybrid Touring

The 2014 XV Crosstrek Hybrid is classified as a mild hybrid vehicle that can provide:

- Engine Drive Mode
- Electric Vehicle Mode (EV)
- Electric Motor Assist
- Automatic Start Stop functions

The Lineartronic™ Continuously Variable Transmission (CVT Hybrid), which is equipped with a 13.68 horsepower 3 phase Alternating Current (AC) permanent magnet synchronous motor, provides the new Hybrid driving force.

Warning:

- Only technicians who have received Instructor led technical training for the Hybrid Electrical Vehicle Systems should perform service or maintenance of high voltage circuits.
- All the harnesses and connectors for power cables are orange in color. In addition, caution labels indicating [High Voltage] are attached on the High Voltage Battery and the battery cover. Do not touch the wires and parts related to high voltage without proper Personal Protective Equipment.

XV Crosstrek vehicle specifications

Model	2.0 L	2.0 L HEV
Engine type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine	
Valve arrangement	DOHC	
Bore × stroke mm (in)	84.0 × 90.0 (3.31 × 3.54)	
Displacement cm^3 (cu in)	1,995 (121.73)	
Compression ratio	10.5	10.8
Ignition order	1 — 3 — 2 — 4	
Idle speed at parking or neutral position rpm	MT: 650±50 CVT: 650±50	MT: 650±100 CVT: 650±100
Maximum output kW (HP)/rpm	110 (147)/6,200	110 (147)/6,000
Maximum torque N·m (kgf-m, ft-lb)/rpm	196 (20.0, 145)/4,200	

5

Engine Specifications

Model		2.0 L	2.0 L HEV
Ignition timing (at idling) BTDC		MT: 16°±10° CVT: 16°±10°	MT: 10°±10° CVT: 10°±10°
Spark plug	Type and manufacturer	NGK: SILZKAR7B11	NGK: DILZKAR7B11
Generator		12 V — 110 A	—
Integrated starter generator (ISG)		—	12 V — 180 A
Battery	Type and capacity (5HR)	12 V — 48 AH (55D23L)	12 V — 48 AH (55D23L) (12 volt auxiliary battery) 12 V — 41 AH (N55-R) (12 volt engine restart battery)
	CCA	390 A	390 A (12 volt auxiliary battery) 450 A (12 volt engine restart battery)
High voltage battery	Type and capacity (1HR)	—	100.8 V — 5.5 AH Ni-MH (nickel metal hydride) battery
Drive motor	kind	—	Three-phase AC synchronous motor
	Rated voltage	—	100 V
	Maximum output	—	10 kW [13.6 PS]
	Maximum torque	—	65 N·m [6.6 kgf-m]

6

Electrical Specifications

Model			2.0 L DOHC non-turbo	2.0 L DOHC motor hybrid
Transmission type			CVT	CVT (HEV)
Clutch type			TCC	
Gear ratio		Forward	3.581 — 0.570	3.420 — 0.544
		Rev.	3.667	3.502
Reduction gear (front)	Final reduction	Type of gear	Hypoid	
		Gear ratio	3.700	
Transfer reduction ratio			1.000	
Reduction gear (rear)		Type of gear	Hypoid	
		Gear ratio	3.700	

7

CVT Specifications

Model			2.0 L	2.0 L HEV
Type			Rack and pinion	
Turns, lock to lock			3.1	2.8
Minimum turning diameter	m (ft)	Curb to curb	10.6 (34.8)	
		Wall to wall	11.5 (37.7)	

8

Steering specifications

Model			2.0 L		2.0 L HEV
			5MT	CVT	CVT
Fuel tank		L (US gal, Imp gal)	60 (15.9, 13.2)		52 (13.7, 11.4)
Engine oil	Total capacity (at overhaul)	L (US qt, Imp qt)	5.7 (6.0, 5.0)		
	When replacing engine oil and oil filter	L (US qt, Imp qt)	4.8 (5.1, 4.2)		
	When replacing engine oil only	L (US qt, Imp qt)	4.6 (4.9, 4.0)		
Transmission gear oil		L (US qt, Imp qt)	3.5 (3.7, 3.1)	—	—
CVTF		L (US qt, Imp qt)	—	11.93 — 12.43 (12.6 — 13.1, 10.5 — 10.9)	13.46 — 13.96 (14.2 — 14.8, 11.8 — 12.3)
Front differential gear oil		L (US qt, Imp qt)	—	1.3 — 1.4 (1.4 — 1.5, 1.1 — 1.2)	1.3 — 1.4 (1.4 — 1.5, 1.1 — 1.2)
Rear differential gear oil		L (US qt, Imp qt)	0.8 (0.8, 0.7)		
Engine coolant		L (US qt, Imp qt)	7.6 (8.0, 6.7)	8.0 (8.5, 7.0)	8.2 (8.7, 7.2)

9

Capacity Specifications

Note: No towing with Hybrid Vehicle.

Note: Hybrid vehicle must be flat towed. (See Subaru XV Crosstrek Hybrid Owner's manual)

Model			5 door											
			2.0 i-Prm											
Transmission			CVT											
OP code			C0	C0	U5	U6	U5	U6	U5	U6	U5	U6	U5	U6
			IE	CM	3A	3A	3E	3E	3S	3S	VE	VE	VS	VS
Curb weight (C.W.)	Total	kg (lb)	1,440 (3,175)	1,455 (3,208)	1,440 (3,175)	1,440 (3,175)	1,440 (3,175)	1,440 (3,175)	1,455 (3,208)	1,455 (3,208)	1,440 (3,175)	1,440 (3,175)	1,455 (3,208)	1,455 (3,208)
	Front	kg (lb)	860 (1,896)	865 (1,907)	860 (1,896)	860 (1,896)	860 (1,896)	860 (1,896)	865 (1,907)	865 (1,907)	860 (1,896)	860 (1,896)	865 (1,907)	865 (1,907)
	Rear	kg (lb)	580 (1,279)	590 (1,301)	580 (1,279)	590 (1,301)	580 (1,279)	580 (1,279)	590 (1,301)	590 (1,301)	580 (1,279)	580 (1,279)	590 (1,301)	590 (1,301)
Gross vehicle weight (G.V.W.)		kg (lb)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)	1,970 (4,343)
Gross axle weight (G.A.W.)	Front	kg (lb)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)	1,010 (2,227)
	Rear	kg (lb)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)	1,000 (2,205)

10

5 Door 2.0 i-Premium CVT

Model			5 door HEV								
			2.0 i-Prm								
Transmission			CVT (HEV)								
OP code			U5	U5	U5	U5	U5	C5	C5	C5	C5
			IA	IE	IS	IE	KS	IE	IS	CM	1U
Curb weight (C.W.)	Total	kg (lb)	1,560 (3,440)	1,560 (3,440)	1,580 (3,484)	1,565 (3,451)	1,580 (3,484)	1,560 (3,440)	1,575 (3,473)	1,575 (3,473)	1,580 (3,484)
	Front	kg (lb)	930 (2,051)	930 (2,051)	940 (2,073)	935 (2,062)	940 (2,073)	930 (2,051)	935 (2,062)	935 (2,062)	940 (2,073)
	Rear	kg (lb)	630 (1,389)	630 (1,389)	640 (1,411)	630 (1,389)	640 (1,411)	630 (1,389)	640 (1,411)	640 (1,411)	640 (1,411)
Gross vehicle weight (G.V.W.)		kg (lb)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)	2,120 (4,674)
Gross axle weight (G.A.W.)	Front	kg (lb)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)	1,110 (2,447)
	Rear	kg (lb)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)	1,050 (2,315)

11

5 Door HEV 2.0 i-Premium CVT (HEV)

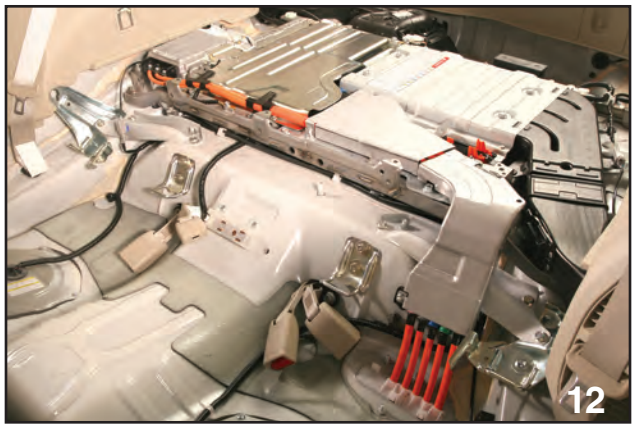
Hybrid Service Safety Precautions

CAUTION (HYBRID SYSTEM)

1. PRECAUTIONS FOR MAINTENANCE AND SERVICE

The hybrid system includes a high voltage circuit. Mishandling may cause electric shocks and leakage. Therefore, perform proper operations by following procedures in the Subaru Service Manual.

- Technicians who have not received Subaru Hybrid training should not perform maintenance or service of high voltage circuits.
- All the harnesses and connectors for power cables are orange in color. In addition, caution labels indicating [High Voltage] are attached on the High Voltage battery and its battery cover. Do not touch the wires and parts related to high voltage carelessly.
- Use great care, when handling the power supply circuits for high voltage system shown in the figure.



High Voltage Battery and Harness

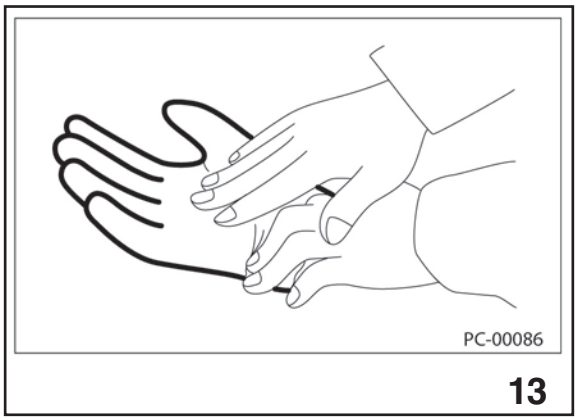
- When performing maintenance of the high voltage system, make sure to take measures for preventing electrocution, by wearing insulated gloves, removing the Service Plug, etc. In addition, carry the removed Service Plug in your pocket in order to prevent other servicemen from accidentally installing during work. <Ref. to PC-10, Service Plug, CAUTION (HYBRID SYSTEM), Precaution.

NOTE: Do not turn the ignition to ON with the Service Plug removed in order to prevent malfunctions.

NOTE: After removing the Service Plug, be sure to wait for ten minutes before touching the high voltage connectors and terminals. This time allows the High Voltage Condenser in the Inverter to discharge.

- When wearing insulated gloves for work, make sure there are no holes or damage to the gloves.
- During the work, do not carry any metallic products, such as mechanical pencils and scales, which may be dropped and may cause short.
- Parts with high voltage and strong magnetic force are used. Therefore, during the work, do not carry any metallic products that may cause short, or magnetic recording media (such as cash cards and prepaid cards) whose magnetic record may get destroyed.

- When touching the high voltage terminals without insulation covering, make sure, in advance, to wear insulated gloves and confirm that the voltage is 0 V using a CAT III multimeter (voltages can be near 200 volts).
- Insulate the high voltage connectors and terminals with insulation tape immediately after removing.
- Be sure to tighten the high voltage screw terminals firmly to the specified torque. Lack of and excess of torque cause failures.
- Be careful not to allow foreign matter to enter the battery.
- Make sure to insulate the power cable terminals by wrapping insulation tape around.
- To work on the high voltage wire connections, wrap tools with electrical tape for insulation before use, or use insulated tools.
- When using tools wrapped with electrical tape as alternatives to insulated tools, cover tools with the standardized product, pressure-sensitive polyvinyl chloride tape for electrical purposes, and confirm the insulated condition before working.
- When inspecting insulated gloves, make sure there are no cracks, breakage, other damages, or air leakage by rolling insulated gloves from the opening side up to the wrist area and pressing the inflated portion. **Do not use wet insulated gloves**.



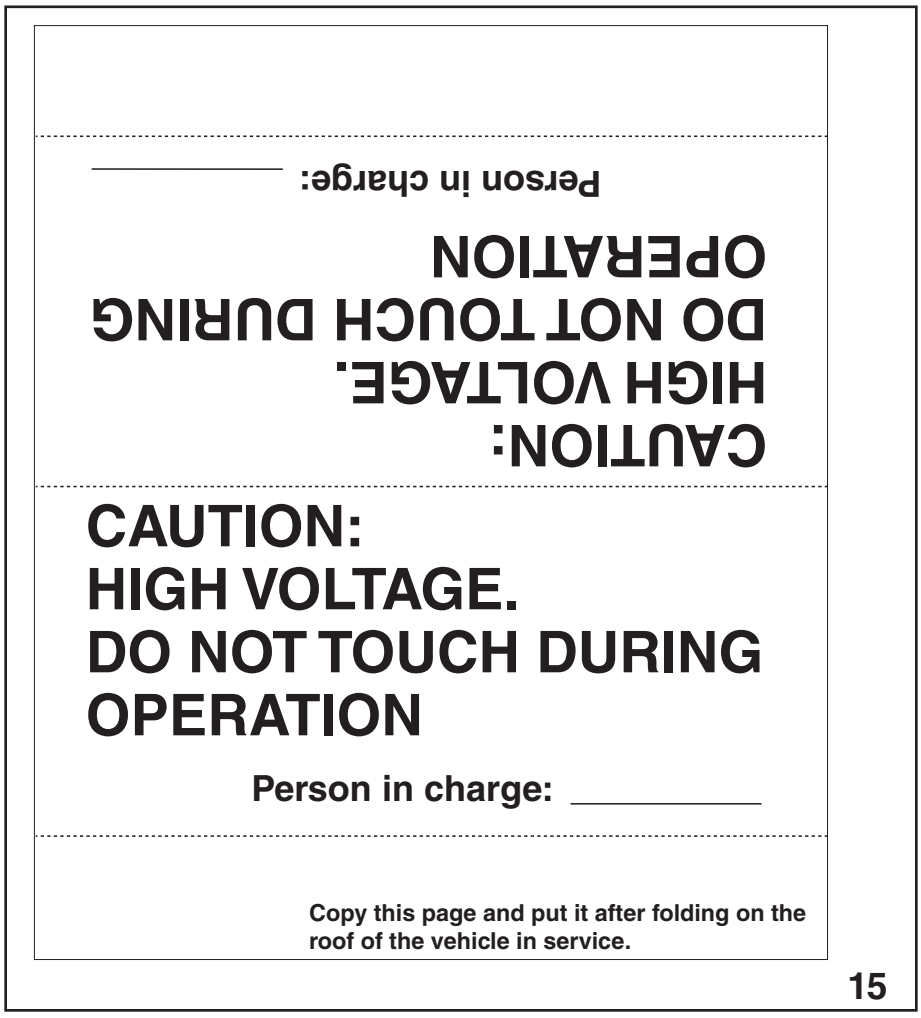
Checking Rubber Gloves for holes

Pressurizing Gloves

- When performing work, wear or use insulated gloves, protective goggles, and rubber boots for electrical purposes, insulated protective shoes or insulating rubber sheet.
- Even after the Service Plug is removed, make sure to wear insulated gloves during maintenance of all the parts inside the cover including the battery cover, and of underfloor power cable. (Maintenance of the high voltage battery cooling fan and cooling duct parts outside the battery cover, and the drive motor control module parts does not require to wear insulated gloves even in the compartment, because the voltage is 12 V only.)
- For maintenance of engine compartment and of CVT unit except for the power cable, insulated gloves are not required.

- During the work for the high voltage system, make sure to alert other servicemen to take precautions, for instance by displaying [HIGH VOLTAGE WORK. DO NOT TOUCH] on the vehicle. (An example is shown. Make a photocopy for use.)

HIGH VOLTAGE CAUTION LABEL



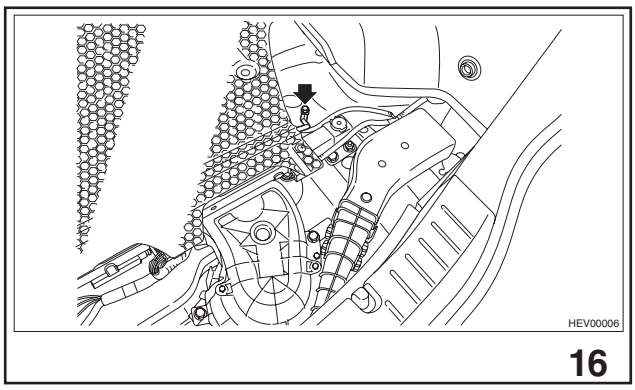
Sample of High Voltage Caution Label

- After performing work for the high voltage system, make sure to check again for misplaced parts and tools, tightening conditions of high voltage terminals, and connector connections, before connecting the Service Plug.

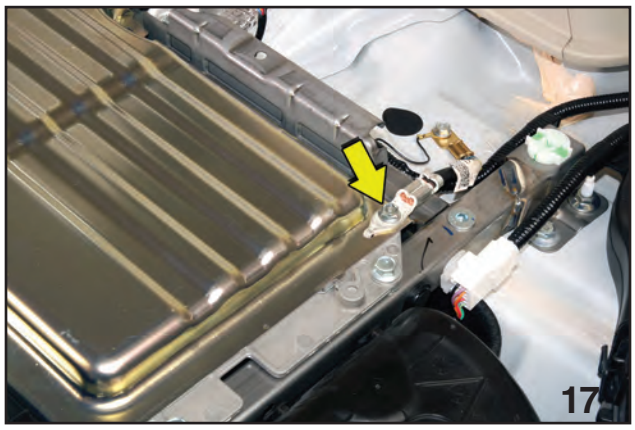
CAUTION: Make sure the connectors are properly connected.

- Make sure to check the positive and negative terminal connections during the battery removal and installation procedures.
- Never connect the battery in reverse polarity. Otherwise, the control module will be broken instantly, and other parts will also be damaged.
- Do not disconnect the battery terminals while the engine is running. A large counter electromotive force will be generated, and this voltage may damage electronic parts such as control modules.
- When disconnecting the connectors of the electrical components, always be sure to turn the ignition switch to OFF. Perform the Clear Memory Mode after connecting the connectors.

- When measuring the voltage or resistance of individual sensors or all control modules, use a tapered pin with a diameter of less than 0.6 mm (0.024 in). Do not insert the pin 4 mm (0.16 in) or more into the part.
- Take care not to allow water to get into the connectors when servicing or washing the vehicle in rainy weather. Avoid exposure to water even if the connectors are waterproof.
- Use the engine ground terminal or engine assembly for the grounding point when measuring the voltage and resistance in engine compartment.
- All parts related to the hybrid system are precision parts. Do not drop or otherwise apply impact. Do not reuse the parts that are dropped accidentally.
- Each warning light may illuminate during or after the diagnosis. However, this does not indicate a system malfunction. After the hybrid system diagnosis, perform Clear Memory Mode.
- Use the body ground bolt on the inverter frame as the grounding point, when measuring voltage and resistance in rear of the vehicle.

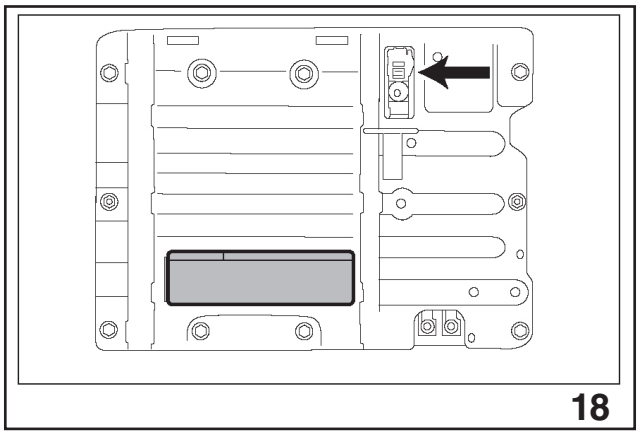


Body Ground Bolt Location



Body Ground Bolt

- Take the ignition key or access key out of the vehicle, except when the key is needed inside.



Service Plug Location

Service Plug

Warning Label

- When the part is replaced or the warning label is detached, make sure to attach a new warning label in the original position and direction.
- This vehicle starts and stops the engine automatically, when the ready-to-drive (READY) indicator light in the meter illuminates. Make sure to turn the ignition to OFF before performing maintenance.
- When the state of battery charge is in a good condition while the engine is warmed-up, the engine will be stopped automatically while the vehicle is stopped. Therefore, when continuous running of the engine is necessary during vehicle stoppage in the cases such as ignition timing inspection, set to «Auto Start Stop Cancel Drive Mode (Engine only or Engine + Motor)». <Ref. to HEV(diag)-75, HYBRID POWERTRAIN CONTROL SYSTEM, OPERATION, System Operation Check Mode.>

2. Service Plug

- When performing maintenance of wires and parts for the high voltage system, make sure to remove the Service Plug in order to cut off the high voltage circuits.
- **Make sure to wear insulated gloves during the work.**
- Carry the removed Service Plug in your pocket in order to prevent other servicemen from accidentally installing during work.
- All the wires and connectors for power cables are orange in color.

Removal of Service Plug

WARNING: Take the ignition key or access key out of the vehicle to avoid malfunctions of hybrid system.

1) Disconnect the ground cable from battery. <Ref. to NT-4, BATTERY, NOTE, Note.>

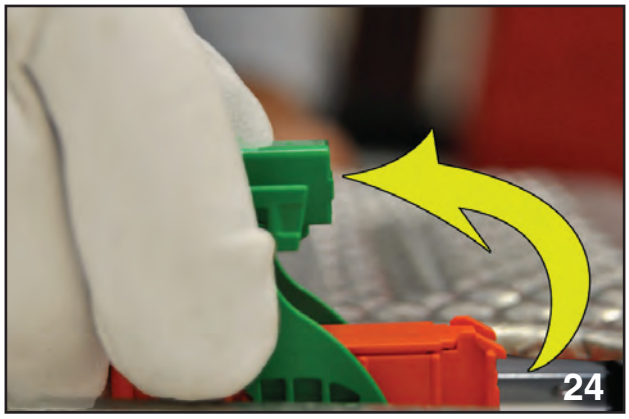
NOTE: For the 12 volt engine restart battery, disconnect the ground terminal from battery sensor.

2) Remove the mat - rear cargo area floor.
3) Remove the Service Plug.

WARNING:
After removing the Service Plug, be sure to wait for ten minutes before touching the high voltage parts, wires, terminals, and connectors, because of high voltage accumulated in the condenser within high voltage components. 21

Service Plug in place

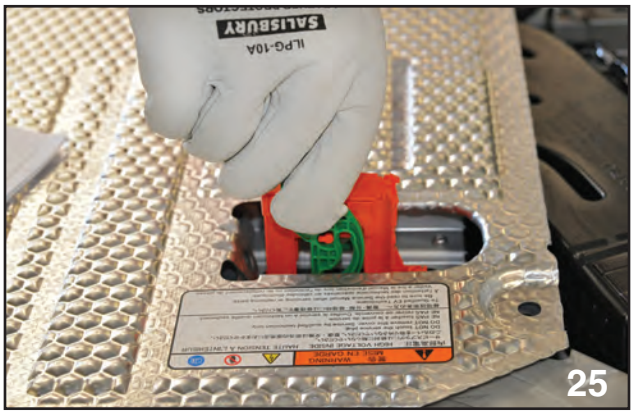
Step 1 and 2



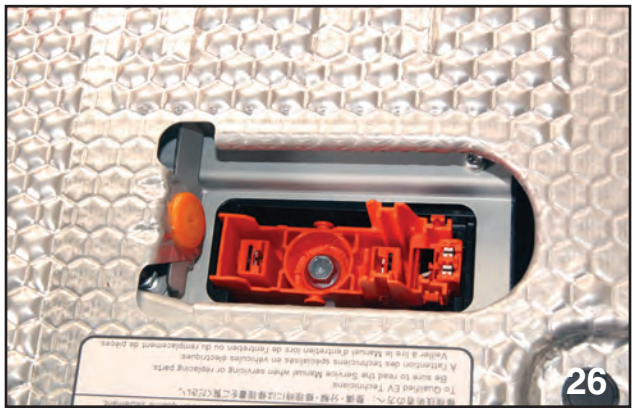
Step 3

(1) Pull up the lever until it touches the stopper.

(2) Gently Push the locking tab and pull the lever vertical.



Removing Service Plug



Exposed Terminals

(3) Gently pull the Service Plug straight up and remove from the vehicle.

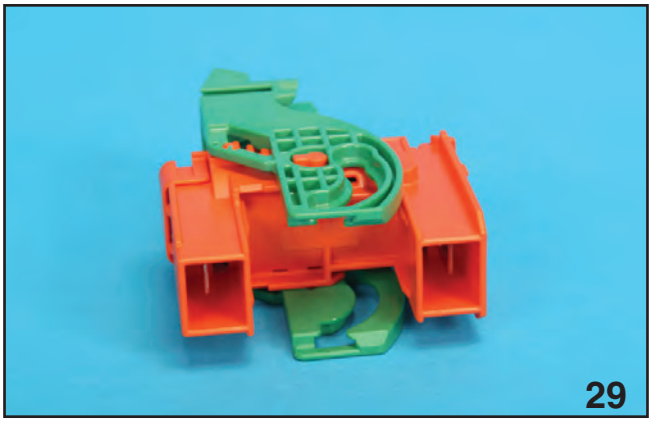
WARNING: Do not touch the exposed terminals of the battery circuit. High voltage may exist.

Place electrical tape over the exposed terminals immediately after removal.

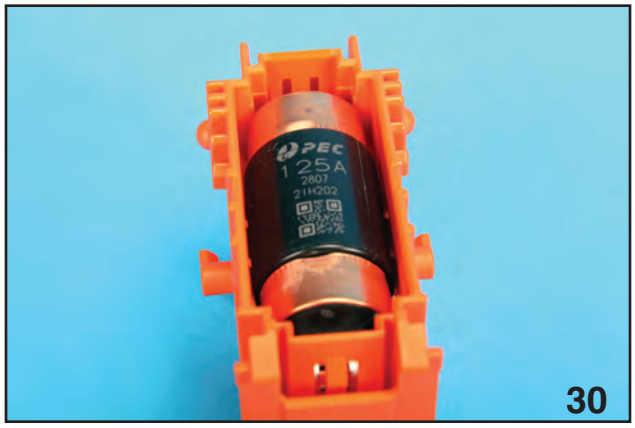
Electrical Tape over exposed terminal

Service Plug in pocket

Place the Service Plug into your pocket. Examine the Service Plug for any abnormality, replace if any defect is found.



Service Plug



125 AMP Fuse

A 125 AMP fuse is located inside the Service Plug. The fuse is not serviceable. Replace the Service Plug as an assembly.

NOTE: A blown fuse indicates a major electrical problem exists. Always follow the service manual when performing any diagnostics and repair.

Installation of Service Plug

CAUTION:

- Before installing the Service Plug, make sure to check again for misplaced parts and tools, tightening conditions of high voltage terminals, and connector connections.
- Always replace faulty Service Plug with a new part.
- Always use the original Service Plug to install. Never use a Service Plug removed from another vehicle.

Install in the reverse order of removal.

NOTE: Move the lever to the horizontal position and push it until a click is heard and securely locked.

3. PROCEDURES AT AN ACCIDENT SCENE

Preparation items:

- ◊ Protective equipment (insulated gloves, rubber gloves, protective goggles, and rubber boots for electrical purposes)
- ◊ Saturated boric-acid solution 20 L (In a container, dissolve 800 g of boric acid powder purchased at a drug store in 20 L of water.)
- ◊ Red litmus paper (purchase at a drug store)
- ◊ ABC extinguisher (used for oil fire and electric fire both)
- ◊ Cloth, old towels (for wiping electrolytic solution)
- ◊ Insulation tape
- ◊ CAT III Circuit tester

Procedures at an accident scene

Do not touch the exposed wires, any wires maybe high voltage. When it is necessary or possible to touch them, make sure to wear insulated gloves and insulate the wires using insulation tape.

When vehicle is on fire, extinguish a fire using an ABC extinguisher. Attempting to extinguish a fire with a small amount of water may be more of a danger. Therefore, spray a large amount of water from a fire hydrant, or wait for arrival of firefighters.

When the vehicle is submerged in water, do not touch the Service Plug and any other high voltage parts and wires due to a possibility of electrical shock. Perform work after completely pulling out the vehicle.

- Check for any leakage in the high voltage battery vicinity.

Do not touch any leaked fluid, because it may be a strong alkaline electrolytic solution. When it is necessary to touch it, wear insulated gloves and protective goggles, neutralize with saturated boric-acid solution, confirm that red litmus paper does not change to blue, when sampling the fluid and then wipe off with cloth.

- When the vehicle is damaged due to collision, stop the hybrid system in the following steps.

1. Turn the ignition to OFF.

NOTE: When the ignition cannot be turned to OFF, remove the fuse in engine compartment.

2. Wear insulated gloves and remove the Service Plug. <Ref. to PC-10, Service Plug, CAUTION (HYBRID SYSTEM), Precaution.>

4. MOVING DAMAGED VEHICLE

- When one of the following conditions applies, use a tow truck to move the vehicle.

CAUTION: Refer to [Towing] for towing procedures. <Ref. to NT-14, TOWING, NOTE, Note.>

- High voltage system parts and wires are damaged.
- The ready-to-drive (READY) indicator light does not illuminate with the ignition at ON.

CAUTION: Using a tow truck, tow the vehicle with the negative terminal of 12 volt auxiliary battery disconnected, and the Service Plug removed. <Ref. to PC-10, Service Plug, CAUTION (HYBRID SYSTEM), Precaution.>

- Move the vehicle by driving it, only when towing by a tow truck is unnecessary and there is no problem to drive the vehicle.

CAUTION: When the hybrid system warning light illuminates, or abnormal noise, odor, or strong vibration is detected during driving, perform the following procedures.

1. Bring the vehicle to a stop in a safe place.
2. Apply the parking brake.
3. Turn the ignition to OFF and disconnect the negative terminal from 12 volt auxiliary battery.
4. Wear insulated gloves and remove the Service Plug. <Ref. to PC-10, Service Plug, CAUTION (HYBRID SYSTEM), Precaution.>

Procedure after moving damaged vehicle

When there is fluid leakage on the road surface, it may be strong alkaline electrolytic solution. Wear insulated gloves and protective goggles, neutralize with saturated boric-acid solution, confirm that red litmus paper does not change to blue, and then wipe off with cloth.

5. PRECAUTION DURING REPAIR OF DAMAGED VEHICLE

Protective equipment

- ◊ Insulated gloves for electrical purposes
- ◊ Rubber gloves for electrical purposes
- ◊ Protective goggles for electrical purposes
- ◊ Rubber boots for electrical purposes
- ◊ Saturated boric-acid solution 20 L (In a container, dissolve 800 g of boric acid powder purchased at a drug store in 20 L of water.)
- ◊ Red litmus paper (purchase at a drug store)
- ◊ Cloth, old towels (for wiping electrolytic solution)
- ◊ Insulation tape
- ◊ CAT III Circuit tester

CAUTION: Follow the procedures to ensure safety.

Make sure to use insulated tools, and wear insulated gloves or rubber gloves, protective goggles, and rubber boots for electrical purposes.

Check for any leakage in the high voltage battery vicinity.

CAUTION:

- **Do not touch any leaked fluid, because it may be strong alkaline electrolytic solution. When it is necessary to touch it, wear insulated gloves and protective goggles, neutralize with saturated boric- acid solution, confirm that red litmus paper does not change to blue, and then wipe off with cloth.**
- **If the electrolytic solution should touch the skin directly, immediately wash it away with saturated boric-acid solution or plenty of water. Also, take off the contaminated clothes.**
- **If it enters your eyes, scream for help, do not rub your eyes, immediately wash it away with plenty of water, and consult a doctor.**

When the vehicle is damaged due to collision, stop the hybrid system in the following steps.

CAUTION: Do not touch the exposed wires, when whether they are high voltage wires or not is unknown. When it is necessary or possible to touch them, make sure to wear insulated gloves and insulate the wires using insulation tape.

1. Turn the ignition to OFF.

NOTE: When the ignition cannot be turned to OFF, remove the fuse in engine compartment.

2. Wear insulated gloves and remove the Service Plug. <Ref. to PC-10, Service Plug, CAUTION (HYBRID SYSTEM), Precaution.>

6. PRECAUTION FOR HIGH VOLTAGE BATTERY

Through the route specified by the manufacturer, make sure to collect the high voltage batteries that are no longer needed due to replacement or other reasons.

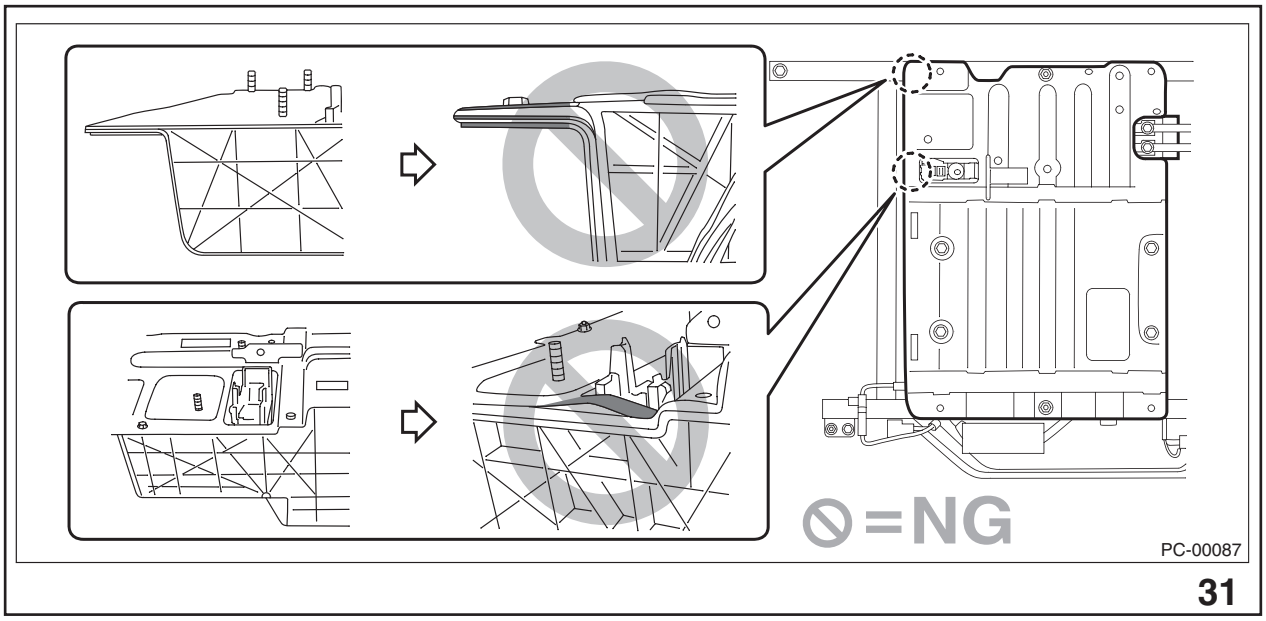
CAUTION:

- **When high voltage batteries are dumped or left without proper measures, electric shock accidents may occur. Be sure to collect the high voltage batteries through the route specified by the manufacturer.**
- **Do not leave the removed high voltage batteries in a place where water may splash, because generated heat may cause fire.**
- **When the collision is severe, high impact is applied to the high voltage battery, possibly causing damage inside the high voltage battery. Therefore, visually check the exterior of high voltage battery, and replace with a new one if deformation or such evidence is found at the following locations.**

Note: The Hybrid Electrical system will turn off immediately during a severe collision (from any angle with or without airbag deployment) and generate DTC P1C1E AUTODISCONNECT EXPERIENCE.

During the time this DTC is in memory of the Drive Motor Control Module (DMCM) vehicle speed will be limited to 12.4 M.P.H. (20 km/h) or slower.

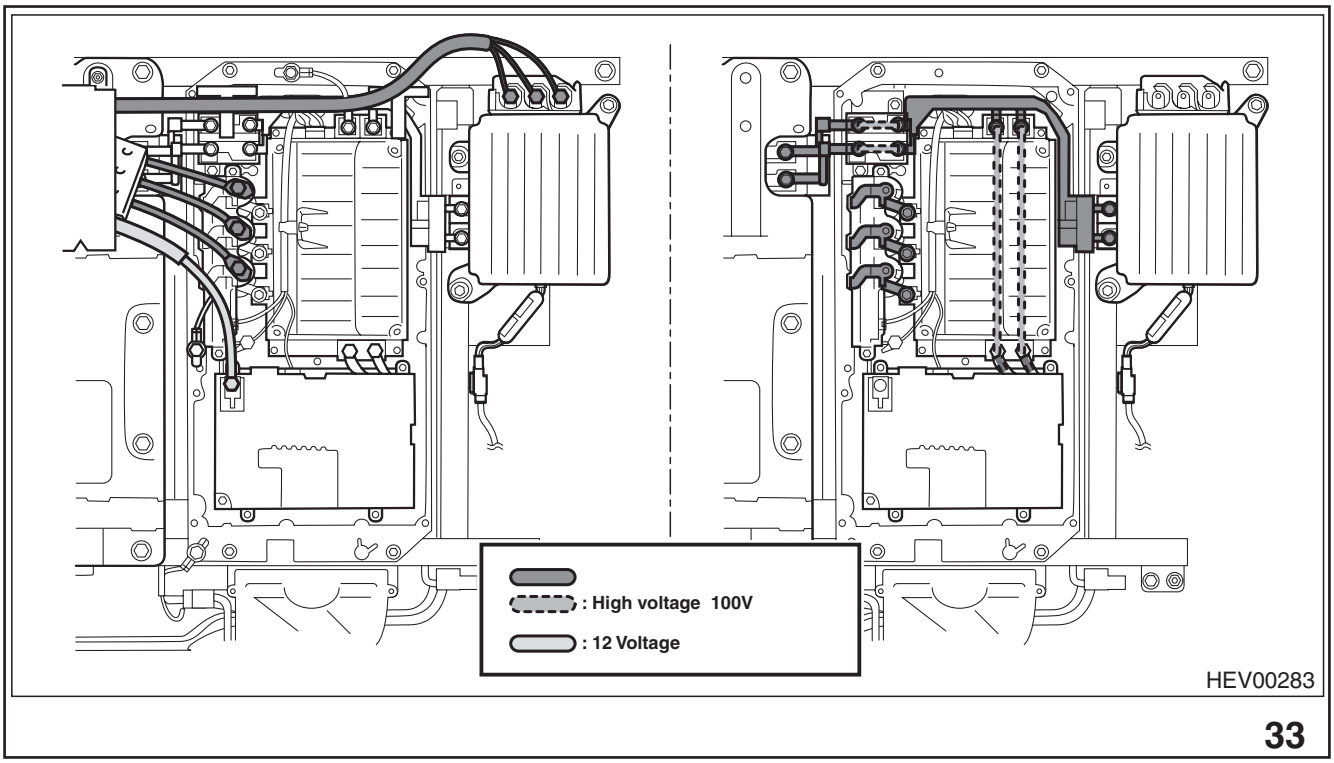
Clearing the DTC with the Select Monitor is the only way to return the vehicle to normal conditions. Always check for physical damage to the Hybrid components before attempting to clear the DTC.



Crumple Zones of High Voltage Battery

Left C Pillar Trim Vent

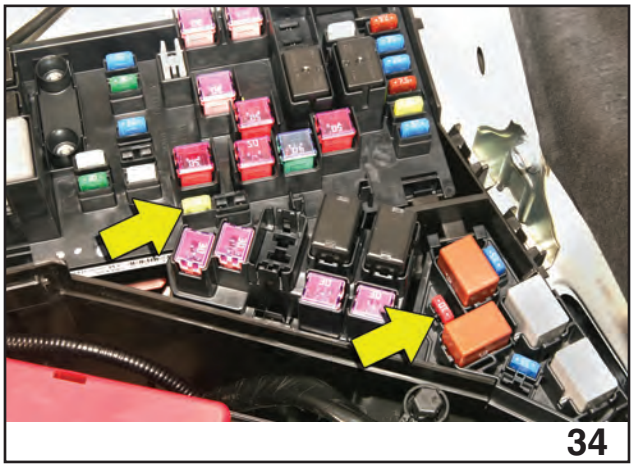
Note: The cooling system for Hybrid components use a cooling fan and duct work that carries air from the passenger compartment left C pillar trim vent to the Hybrid components package shelf. *Do not block the vent. A blocked vent will obstruct air flow through the cooling system and may cause overheating of the Hybrid components.*



High Voltage Circuits

Pre-delivery Inspection

During PDI of the 2014 XV Crosstrek, install the backup power supply fuse and remove the transit fuse. This is the same procedure that is performed on current model year XV Crosstrek vehicles. There are no special procedures for the PDI of a XV Crosstrek Hybrid. Follow the instructions provided in the service manual for complete PDI procedures.

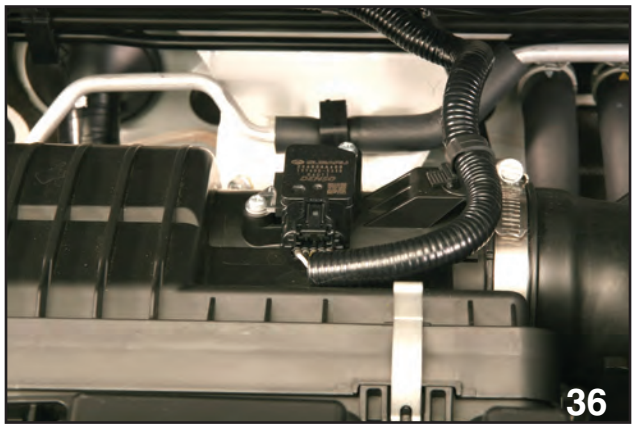


PDI Fuses

Engine Air Filter

The introduction of the Restart Battery makes it necessary to relocate the air filter housing and Mass Airflow Meter.

Air Filter Housing Location



Mass Airflow Meter

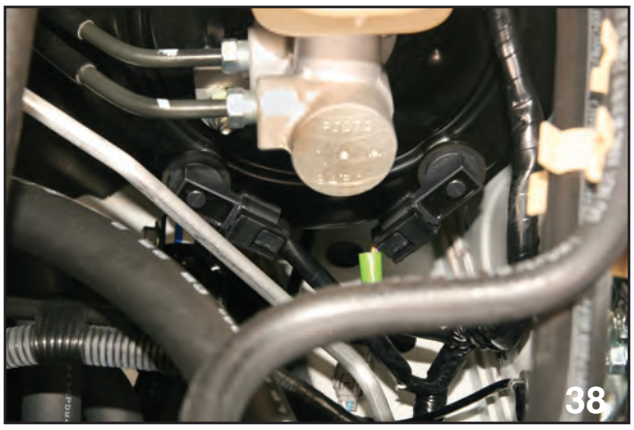
The housing is now located on the back side of the Intake Manifold. The Mass Airflow Meter is located on the back side of the housing.

Air Filter

The air filter can be removed after the back side of the housing has been removed.

Brake Vacuum Pump

The XV Crosstrek Hybrid provides vehicle operations that operate with the engine off. This makes it necessary to employ an Electric Vacuum Pump to create the negative pressure required for Power Brake operation.

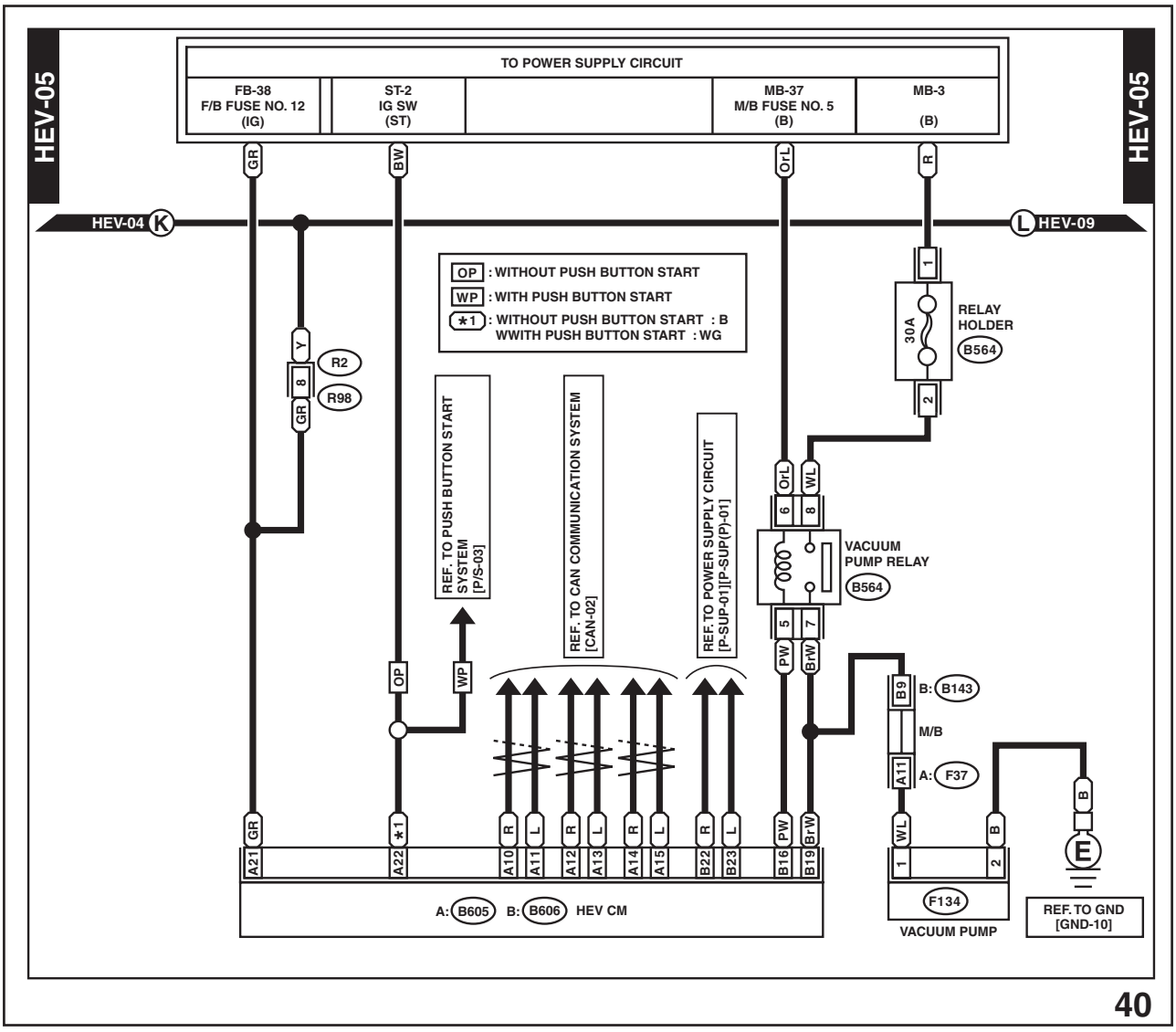


Brake Booster Pressure Sensors

Brake Vacuum Pump

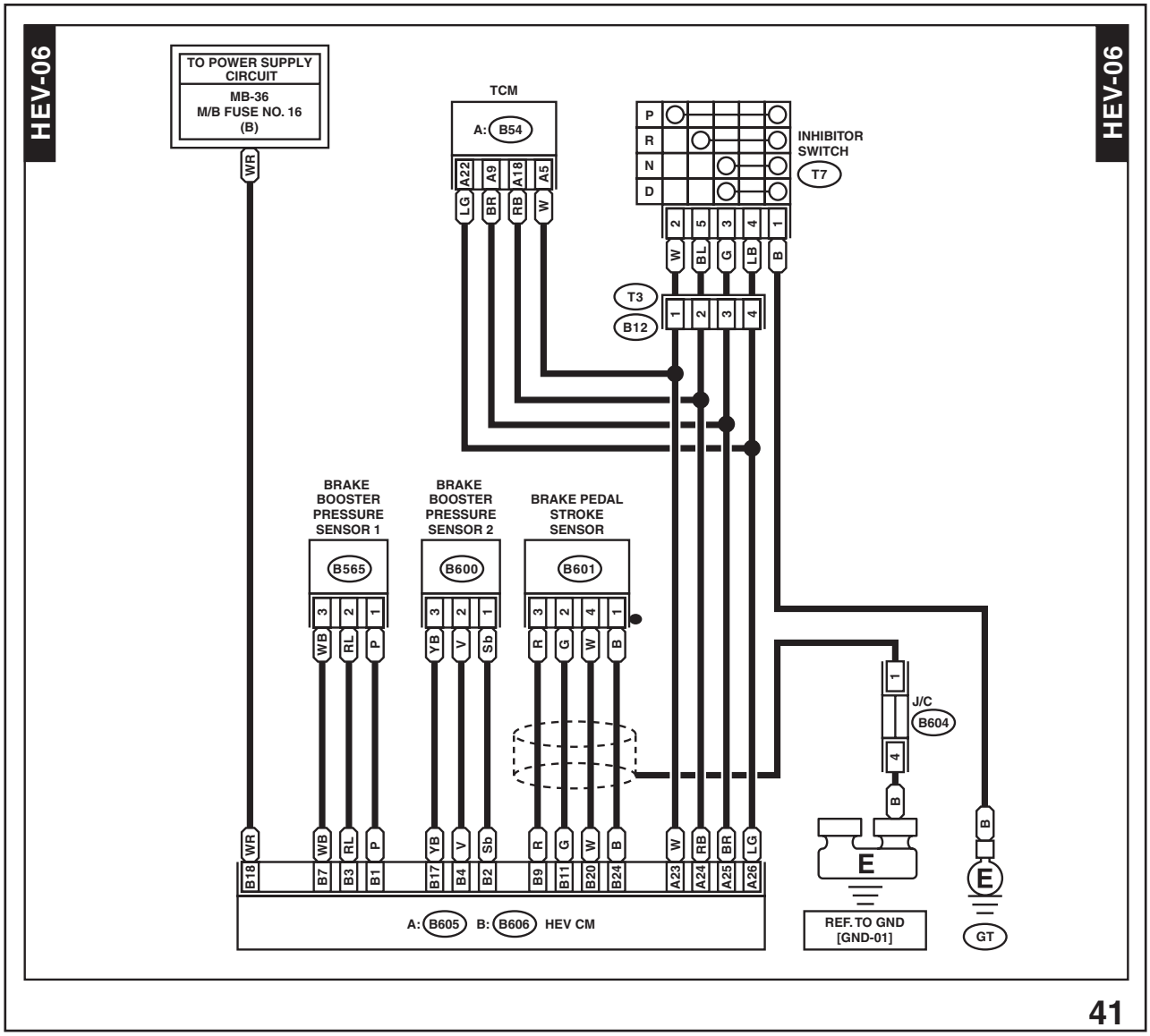
Two Brake Booster Pressure Sensors are utilized to provide more accurate data to the Hybrid Electric Vehicle (HEV) Control Module.

Note: Never twist or attempt to remove the Brake Booster Pressure Sensors. If a Sensor fails, replace the Brake Booster.



Brake Vacuum Pump Wiring Schematic

The Brake Vacuum Pump Relay is controlled by the HEV CM.



Brake Booster Pressure Sensors Wiring Schematic

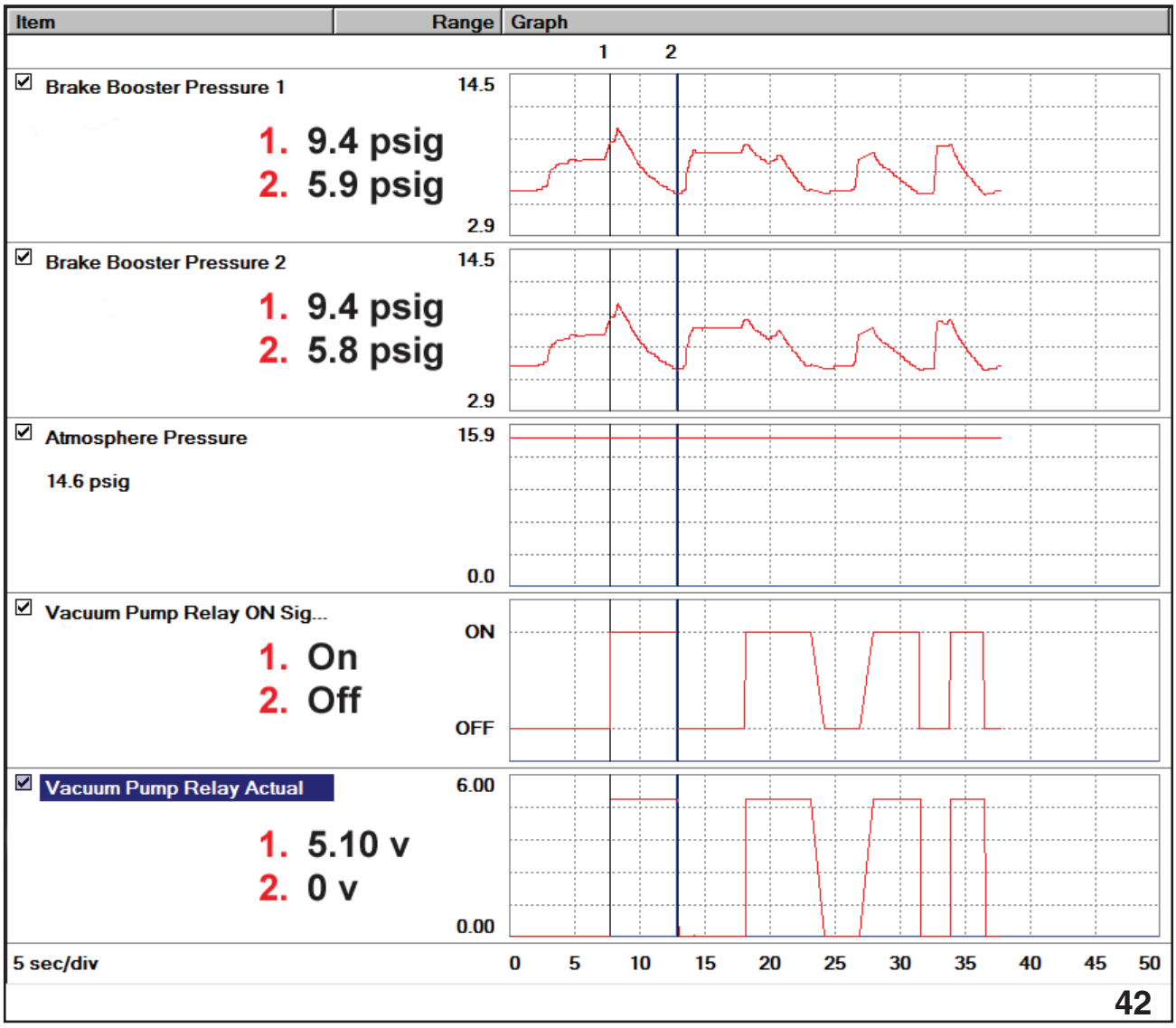
Input from both Brake Booster Pressure Sensors go to the HEV CM.

Work support is provided in the Subaru Select III Monitor to diagnosis the Brake Vacuum Pump System.

Note: Operating parameters for the Brake Vacuum Pump system are unique due to the functionality of the Hybrid and Automatic Start Stop operations (Engine Off).

An example of operating parameters would be:

- Vehicle Speed 0
- Transmission in D range
- Atmospheric Pressure 14.6 P.S.I.
- Vacuum Pump On at 9.4 P.S.I. (Brake Booster Pressure)
- Vacuum Pump Off at 5.8 P.S.I. (Brake Booster Pressure)



Brake Vacuum Pump Data

The operating parameters are adjusted by altitude and vehicle speed. The results in Work Support of the Select Monitor account for altitude and output failed or pass results from a compulsory test with altitude automatically considered.

Automatic Grill Shutter System

The 2014 XV Crosstrek Hybrid is equipped with an Automatic Grill Shutter (AGS) System. The AGS is designed to improve fuel efficiency by improving body aerodynamics and decreasing engine warm up time.

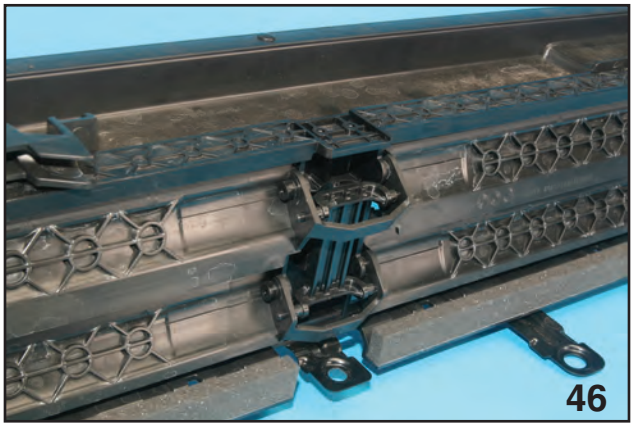
AGS Closed

AGS Open

The AGS defaults to the open position in case of electrical communication malfunction.

Note: The AGS is not spring loaded to the open position.

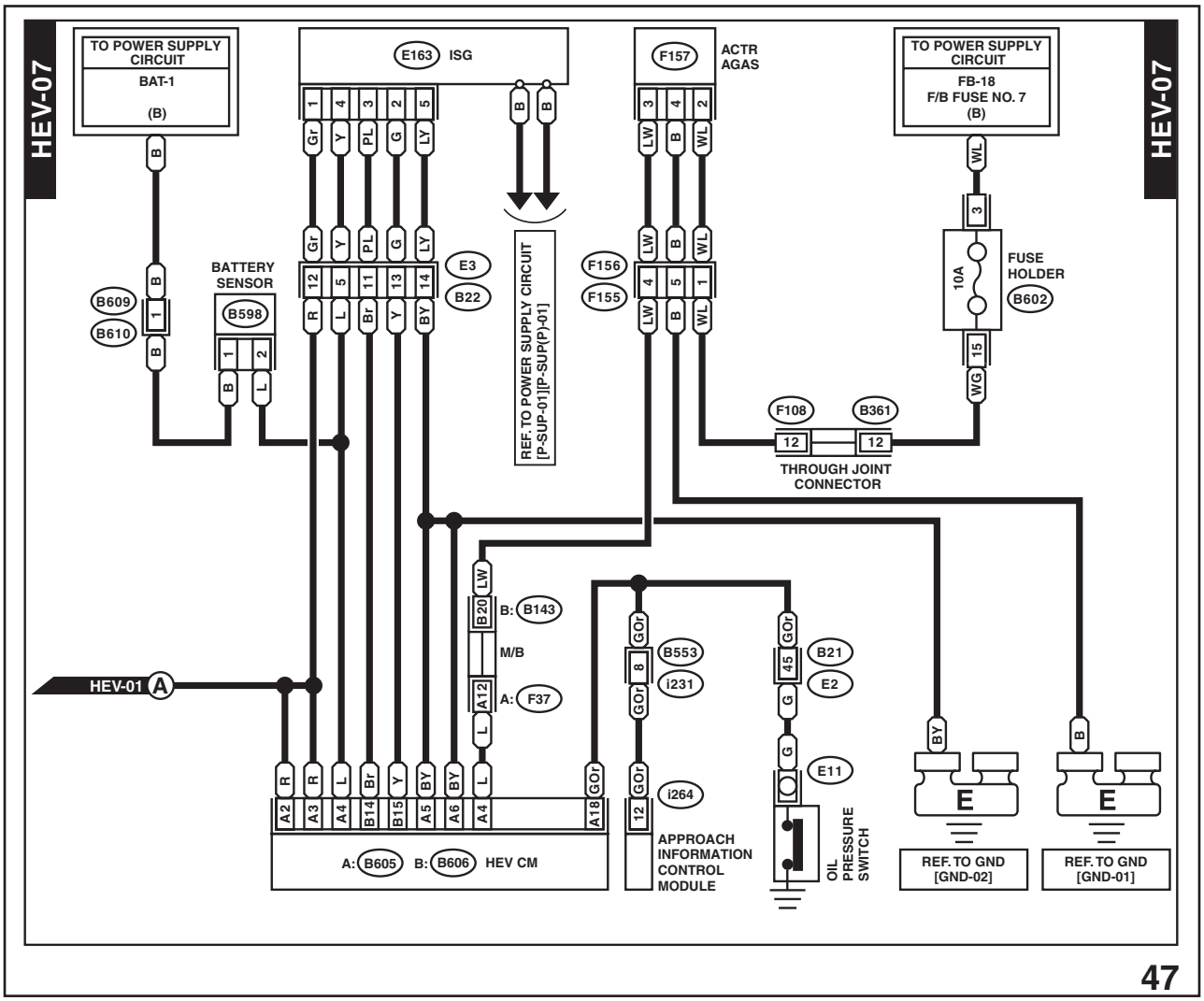
AGS Actuator



AGS Construction

The 3 wire actuator receives command signals and transmits position through a single LIN communications wire that is routed to the HEV CM. The actuator drives the top plate of the AGS shutter and a mechanical link drives the lower plate.

The Engine Control Module (ECM) determines the position for AGS operation but the ECM is not compatible for LIN operation so the information for control and verification is sent though the Power Unit (PU) CAN.



AGS Wiring Schematic

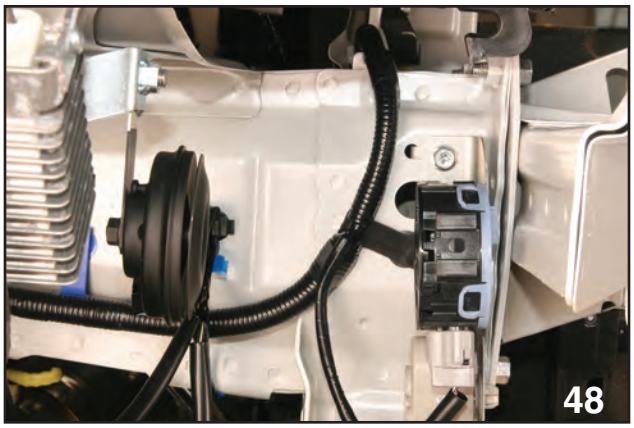
During service or replacement, the AGS automatically initializes so there is not a special procedure required to calibrate the AGS to the vehicle.

Note: The AGS will remain closed if the ambient temperature is lower than 37 degrees Fahrenheit (3 degrees C).

The opening and closing of the AGS is determined by ambient temperature, coolant temperature, and vehicle speed.

Pedestrian Approach System

The XV Crosstrek Hybrid is equipped with a Pedestrian Approach System that emits a sound that varies with vehicle speed. The sound is created to warn Pedestrians of the on-coming Hybrid Electric Vehicle (engine off). The speaker is located behind the front bumper beam on the passenger side of the vehicle.



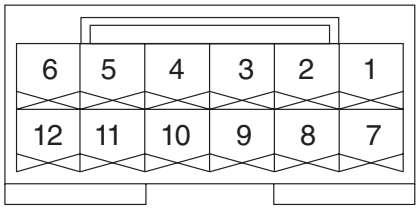
Speaker

Control Module

The Pedestrian Approach Control Module is located behind the HVAC control panel.

Control	Contents of Control while in EV Mode
Normal sound control	• Sound output is according to vehicle speed from 0 to 15 M.P.H. • When the ignition switch is ON and the Select lever is in P range and the Select lever button is pressed and held down, a sound is emitted for 3 seconds as soon as the brake pedal is released. • When the ignition switch is ON and the Select lever is in any range other than P range, a sound is emitted for 3 seconds as soon as the brake pedal is released.
Pitch control changes according to vehicle speed	The pitch of the notification sound is controlled according to the vehicle speed.
Volume UP control	When the vehicle is starting, the volume of the notification sound is boosted.
Fade-in/fade-out control	Sound volume is gradually changed when sound starts and ends.
Sound control according to vehicle speed while running	Sound ON <---> OFF is controlled according to vehicle speed.

1. APPROACH INFORMATION CONTROL MODULE

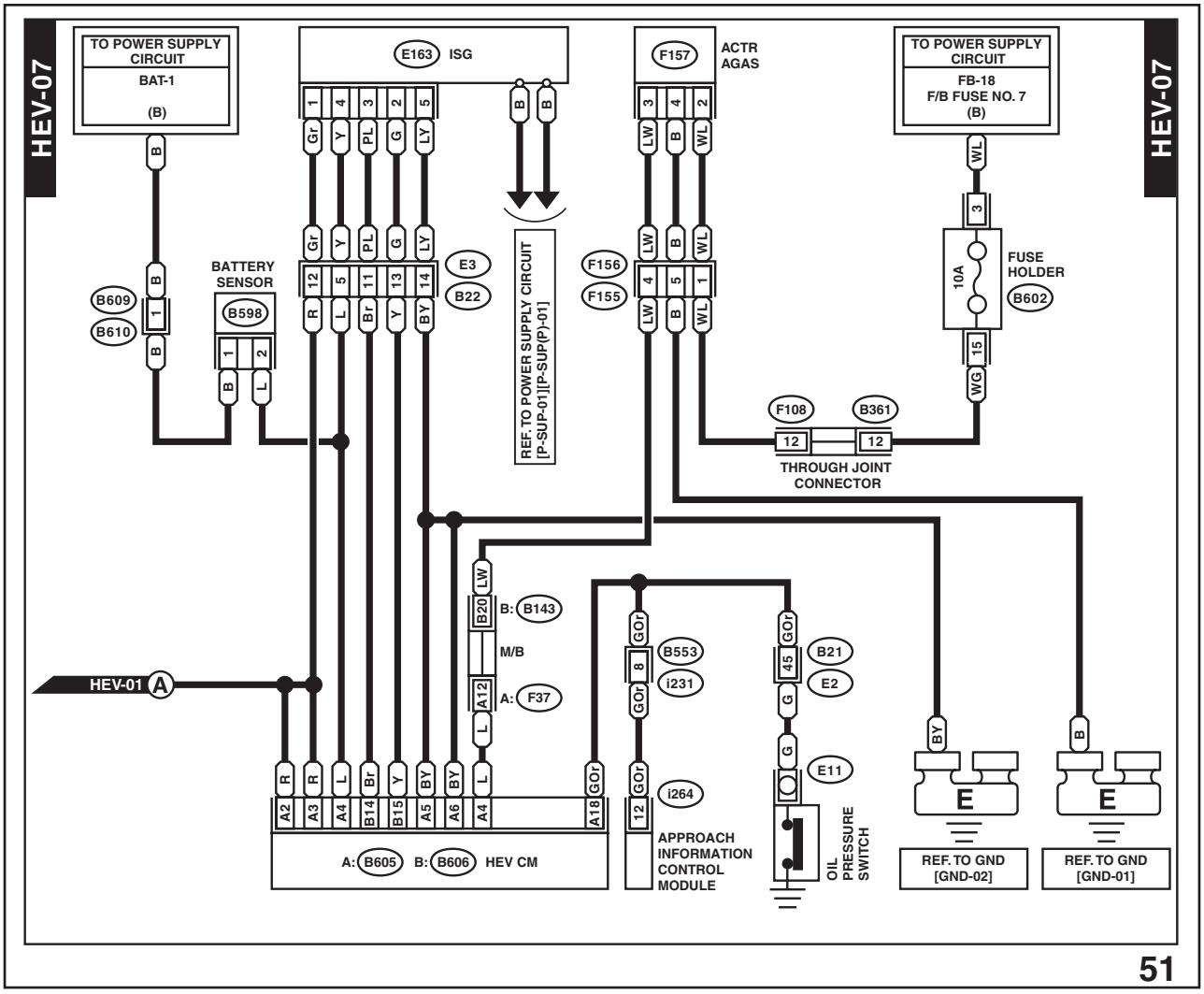


HEV00005

Item	Terminal No. (terminal symbol)	Measuring condition	Measurement value	Note
Operational power supply	1 (IG)	IG ON	10 V or more	—
STOP light signal	2 (STP)	Brake pedal ON → OFF	8 V or more → less than 1 V	—
Approach report speaker output (+)	3 (SP+)	—	—	Pulse output
Vehicle speed signal	6 (SPD)	—	—	Pulse output
GND	7 (GND)	Always	0 V	—
Approach report speaker output (–)	8 (SP–)	—	—	Pulse output
K-line	9 (PRST)	—	—	Communication line
IND output	10 (IND)	OFF	8 V or more	—
Shift position signal	11 (SFTP)	Except for P range	8 V or more	—
Oil pressure signal	12 (OPSW)	Engine running	8 V or more	—

50

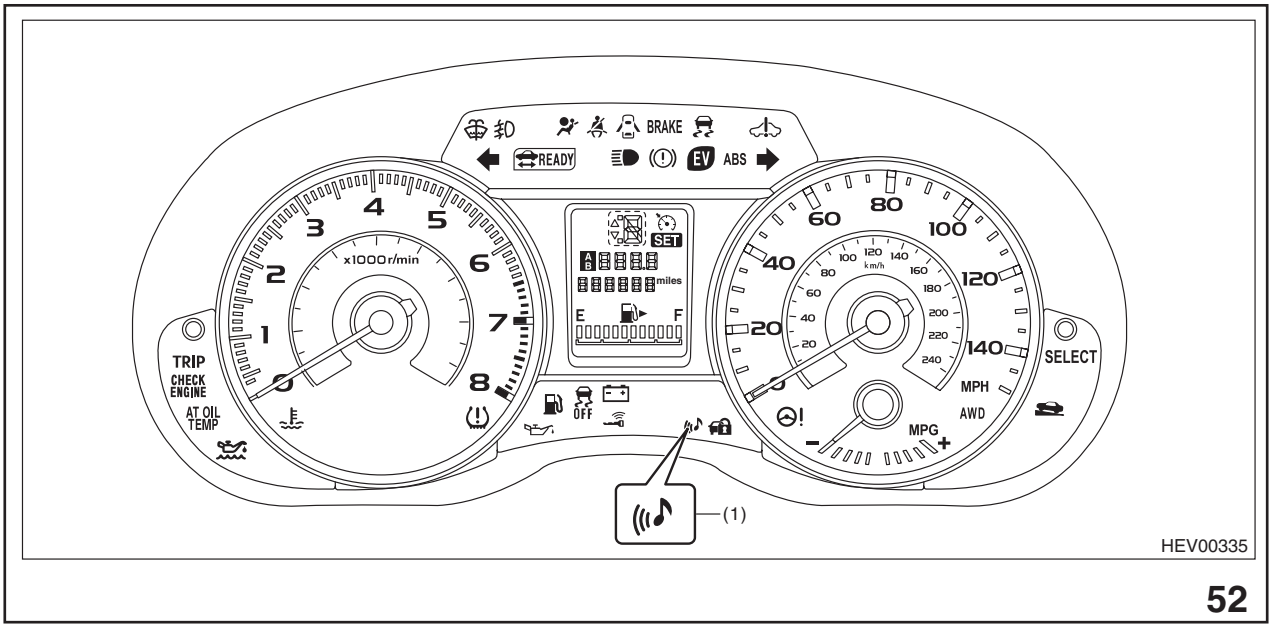
Approach Information Control Module I/O Chart



Approach System Wiring Schematic

The Pedestrian Approach System Control Module shares the input of the engine oil pressure switch with the Hybrid Electric Vehicle Control Module (HEV CM). The engine oil pressure switch is wired to only these two control units. The oil pressure switch signal communicates engine off (no oil pressure) to the control units. The Approach Control Module uses the information to trigger the on status of sound generation when vehicle speed is sensed or when the brake pedal is released in EV Mode. The HEV CM uses the signal to determine if the engine is off and if the EV Mode should be in standby. The oil pressure signal is placed into the HEV CAN to communicate with the Combination Meter to turn on and off the Oil Pressure Warning Light.

Note: The Oil Pressure Warning light will not illuminate while the vehicle is in EV Mode or making the transition to Engine Drive Mode.



52

(1) Approach Report Warning Light

The Approach Warning Light will illuminate if the system is not working correctly.

NOTES:

Hybrid Safety Kit

Technician and vehicle safety considerations should always be the first step with any service or repair to any automobile. To support this fundamental principal, a Technician Hybrid vehicle safety kit is being issued as a new essential tool.

NOTE: ***Always consult the Subaru Service Manual and all Service Bulletins for the most accurate information for Technician and Vehicle safety.***

CAUTION: Do not attempt to service or repair a Hybrid vehicle until you have received Instructor led training.

Hybrid Safety Kit

Hybrid Safety Kit Contents

The Hybrid Safety Kit J-51311 contains the following items:

Rubber Insulation Gloves, Leather Protector Gloves, Rubber floor mat, magnetic Danger sign, ABC fire extinguisher, caution tape, and orange masking tape.

The Rubber Insulation tools should always be worn when performing any work on the hybrid component parts or hybrid wiring of the XV Crosstrek. The Leather Gloves should be worn over the Rubber Insulation Gloves to add a layer of protection. This prevents snags or punctures that could take away the Rubber Insulation Gloves ability to isolate the technician from high voltage.

Rubber Insulated Gloves

Leather Glove over Rubber Glove

The Rubber Insulation Gloves must be inspected every 6 months by a certified high voltage equipment inspection organization. The date printed on the gloves is updated at inspection and serves as reminder to have your gloves inspected again, 6 months from that date. New Rubber Insulation Gloves also have the inspection date. New Rubber Insulation Gloves have a shelf life of 12 months plus 6 months of service time.

NOTE: Do not use any new glove with a date older than 18 months, or an in-service glove older than 6 months.

Pressure Checking Rubber Glove

The gloves must be pressure checked before each use.

Roll up the end of the glove and squeeze the captured air. Listen for any leak.

Do not use the gloves if a leak is detected. ***Discard any leaking gloves.***

Correct Glove Positioning

Always make sure that the Rubber insulation Glove is at least 2 inches higher up on your arm than the Leather Protector Glove. This ensures electricity that may be present at the Leather Protector does not arc to your unprotected arm.

Please monitor STIS, and what's New, for updates and additional information on the Technician Safety Kit and procedures for inspecting the Rubber Insulation Gloves.

Magnetic Danger Sign (Service Hat)

The magnetic service hat should always be placed on the roof of any hybrid vehicle that is being serviced. This protects you and others in your service area. For additional safety, advise others working around you that you are servicing a Hybrid vehicle.

Safety Glasses

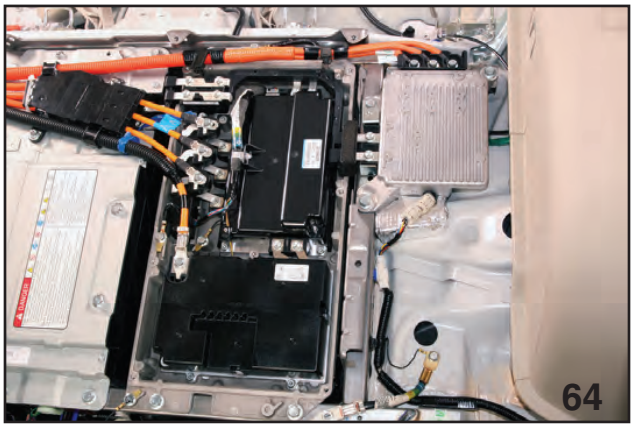
Yellow Caution Tape

Always wear safety glasses when working with suspect fluids in the High Voltage Battery area. The fluids may have a high alkalinity and will cause eye and skin irritation. Consult the Subaru Service Manual for additional information.

If a chemical leak has been discovered, flag the rear of the vehicle with caution tape. It is recommended that the Service Plug be removed from the High Voltage Battery if a chemical leak is discovered.

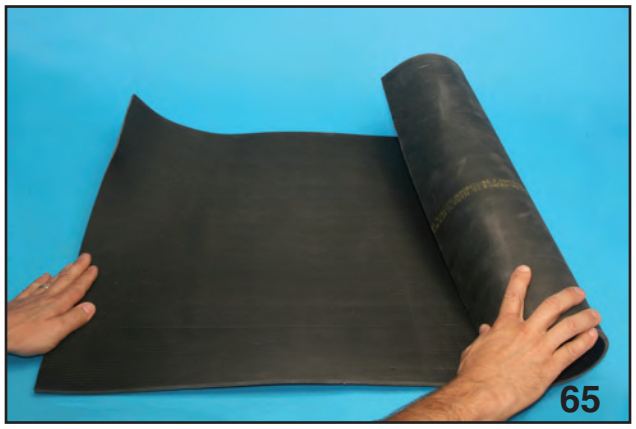
WARNING: Never attempt to remove the Service Plug if you have not attended Instructor led Hybrid vehicle training.

ABC Fire Extinguisher



Component Tray

The Technician Safety Kit is equipped with an ABC fire extinguisher; however, the Hybrid Component Tray is made from Magnesium and requires special fire fighting training to extinguish. It is recommended that you call local emergency services in case of fire.



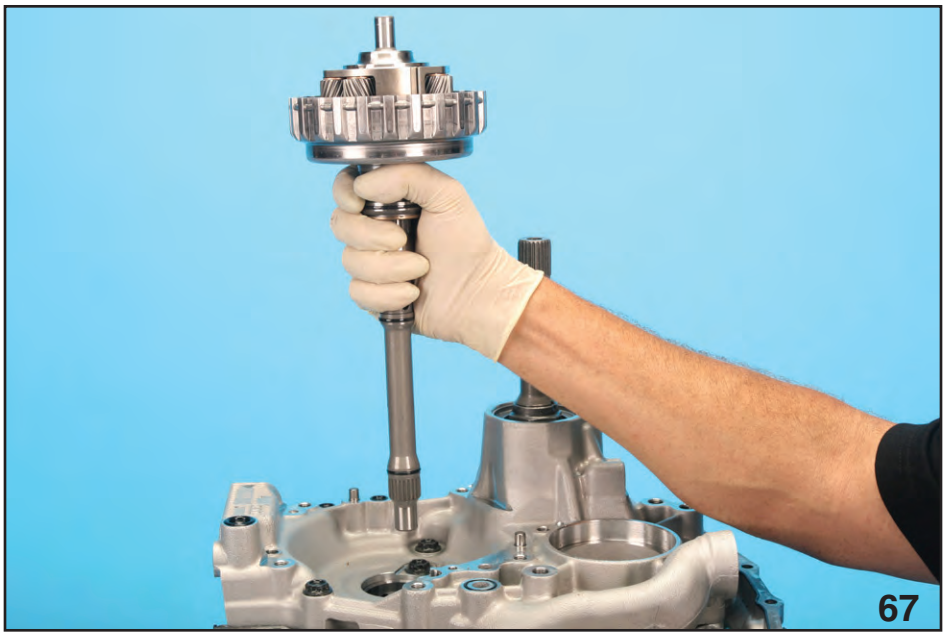
Rubber Floor Mat

The rubber floor mat should be used to insulate your body from the vehicle. The method of use is based on the service or repair being performed.

NOTES:

Hybrid Lineartronic™ Continuously Variable Transmission Power Flow (CVT Power Flow)

Conventional input of mechanical power flow through the CVT is from the engine to the Torque Converter and to the Input Shaft of the Forward Clutch Drum or to the Sun Gear of the Planetary Gear set.



Input Shaft and Forward Clutch

For the purpose of this explanation only the Forward Gear range will be utilized.

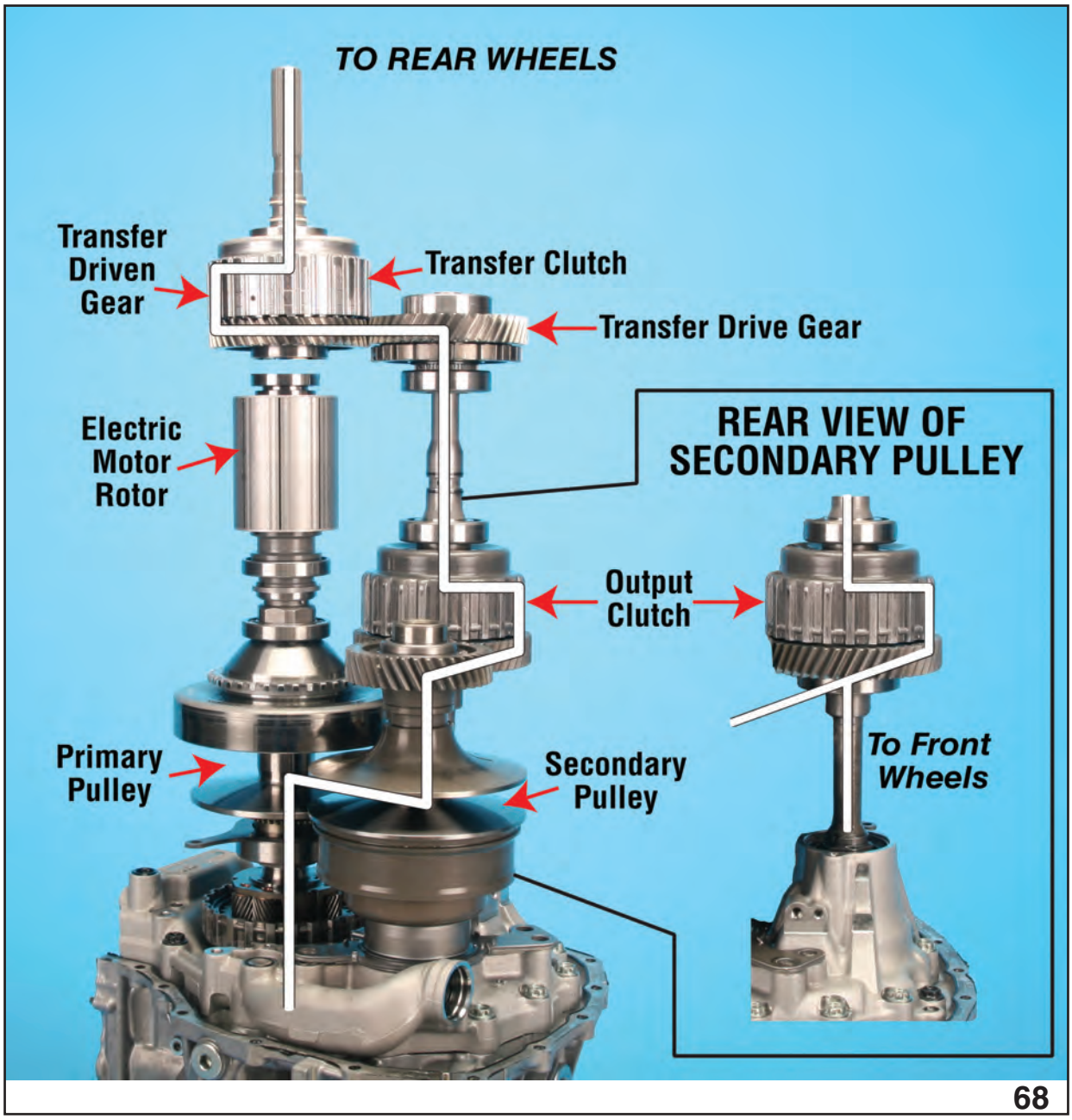
Equipped with the Hybrid Motor, the CVT Power Flow can change to the input of mechanical power coming from the Hybrid Electric Motor instead of from the engine. A combination of power sources, the engine and the motor, will occur during Electric Motor Assist Mode.

Note: The 2014 XV Crosstrek Hybrid provides the following Modes of driving or charging:

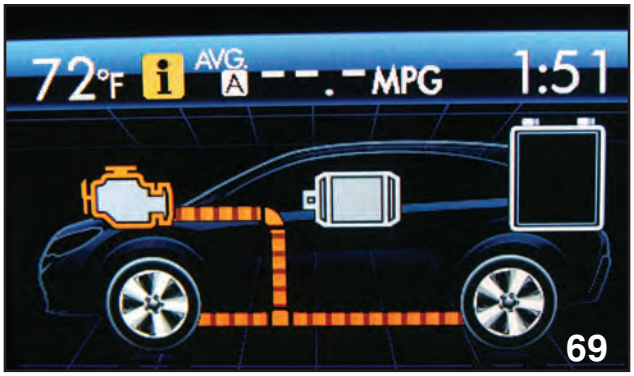
- Engine Drive Mode
- Electric Motor Assist Mode
- Electric Vehicle Mode (EV Mode)
- D Charge Mode
- Regenerative Braking

Each of these Driving or Charging Modes can be displayed on the Multi-Function Display.

The Power Flow of the CVT will be covered in the following text along with the corresponding Multi-Function Display of that Driving or Charging Mode.



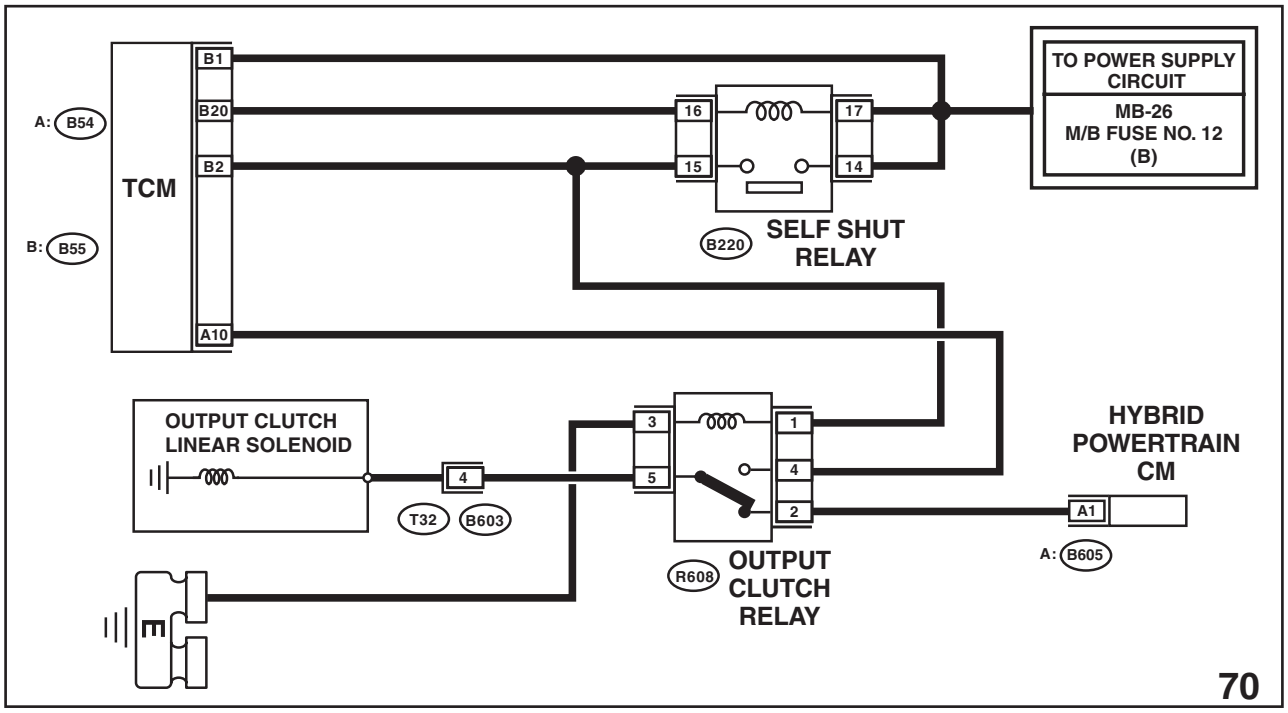
Engine Drive Mode



MFD During Engine Drive Mode

During Engine Drive Mode, the power from the Torque Converter comes into the transmission through the input shaft of the Forward Clutch Drum. The planetary gear set carrier which is splined to the Primary Pulley is the output of the planetary gear set. When the Forward Clutch is engaged, the carrier is locked to the Forward Clutch Drum and a mechanical link is established from the engine to wheels via the transmission.

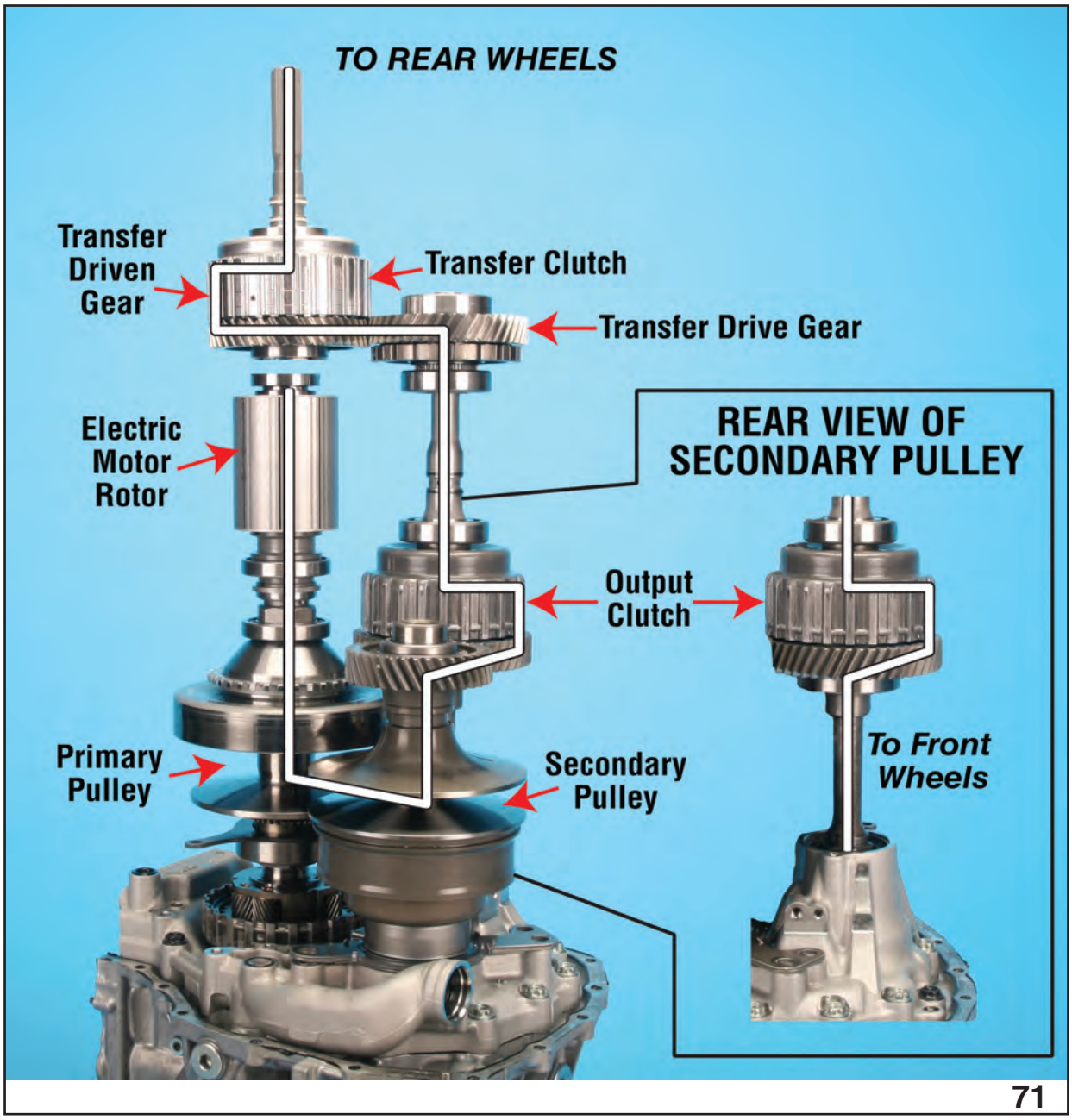
In the transmission, the Primary Pulley turns a chain that drives the Secondary Pulley. The Reduction Drive Gear is splined to the top of the Secondary Pulley, so any time the Secondary Pulley rotates, the Reduction Drive Gear rotates. The Reduction Driven Gear is now equipped with a clutch hub to interact with the Output Clutch. The Output Clutch must be engaged before any power from the engine can be delivered to the wheels. This action occurs before the power gets to the transfer section of the transmission. If the Output Clutch is engaged, the power flows from the Output Clutch driven shaft to the Transfer Drive Gear to the front Differential and Transfer Driven Gear. This provides power to the front and rear wheels. The Electric Motor Rotor is splined to the Primary Pulley, so anytime the Primary Pulley is turning, the Motor Rotor rotates. In the case of the Engine Drive Mode, the Motor is ineffective, providing neither High Voltage Battery charging or driving forces.



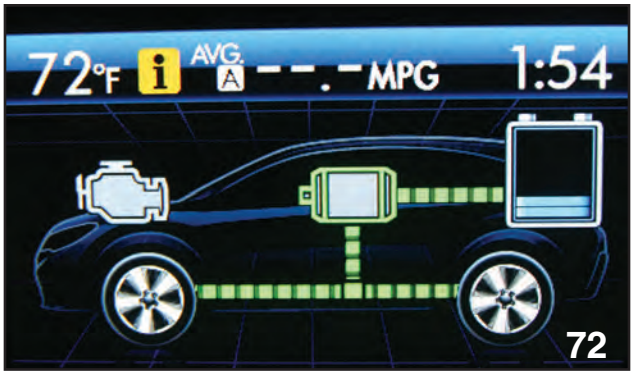
Output Clutch Relay Wiring Schematic

The Output Clutch is turned off by supplying high current (1 amp) to the Output Clutch Linear Solenoid. The Linear solenoid drains away hydraulic pressure that applies the clutch. Failsafe for the Output Clutch Linear Solenoid is full application.

Electrical control is provided by the TCM or the Hybrid Powertrain Control Module. Normal control is through the TCM for all Driving Modes, while the Hybrid Powertrain Control Module provides power and control during a TCM failure.



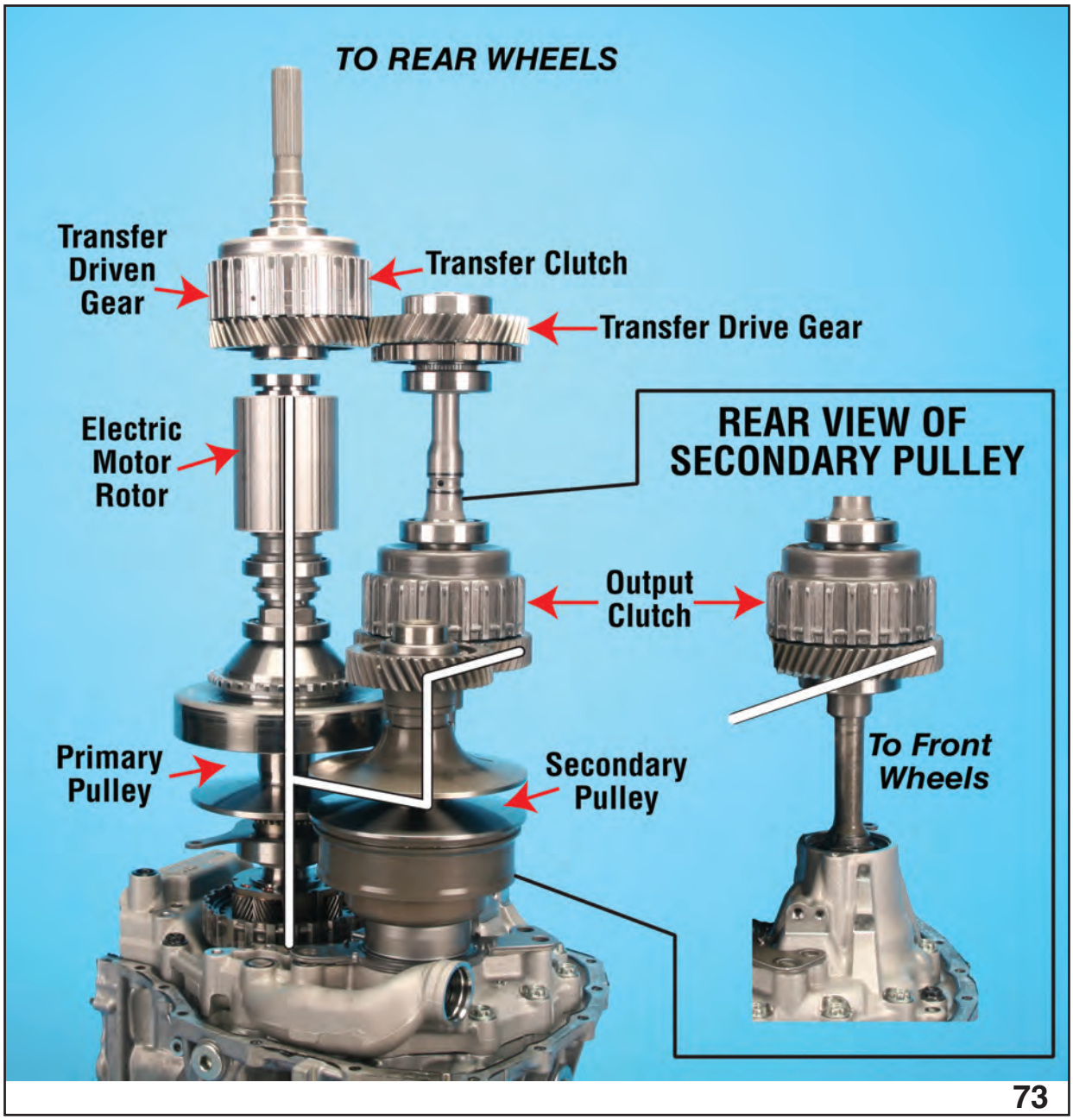
EV Mode



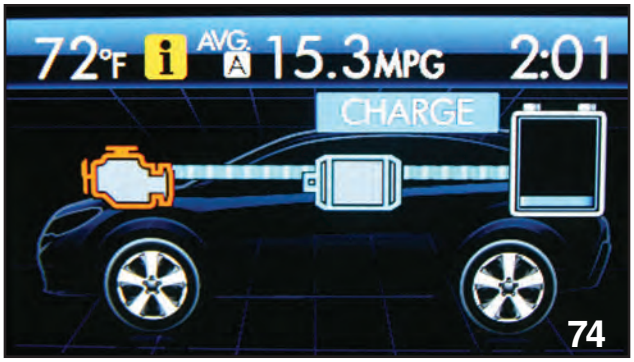
MFD during EV Mode

During EV Mode, the engine is off and the Forward Clutch is disengaged. The driving force for vehicle movement is now provided by the Hybrid Motor. The Motor Rotor turns the Primary Pulley which turns the chain, driving the Secondary Pulley. The Output Clutch is engaged, so the Reduction Gear set sends power to the front and rear wheels.

Note: The Forward and Reverse Linear Solenoid reduces the pressure in the Forward Clutch by draining away hydraulic pressure. Higher amperage equals lower available pressure.



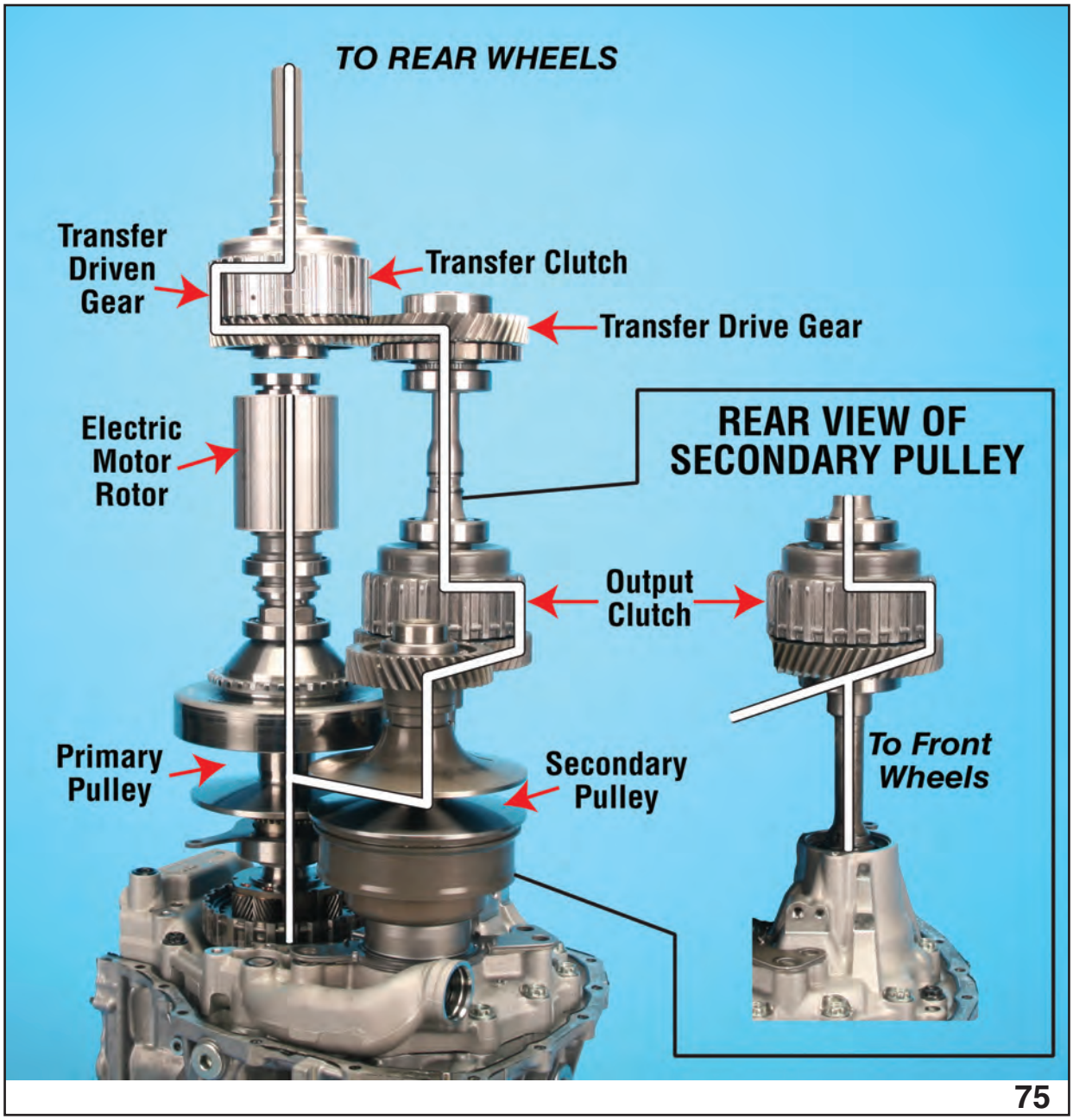
D Charge Mode, Output Clutch Off



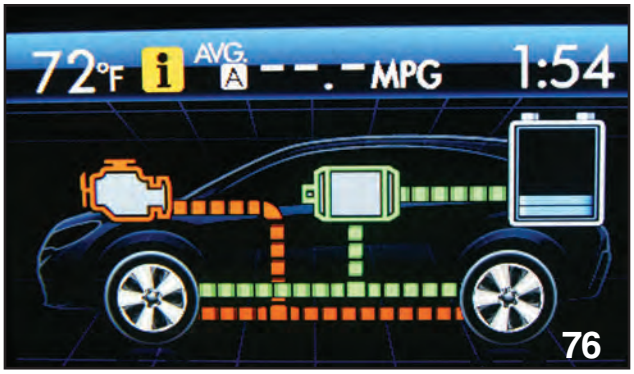
MFD during D Charge Mode

During D Charge Mode, the engine is running and the transmission is in Drive gear range. The Forward Clutch is on, driving the Primary Pulley. The Output Clutch is off so power cannot be sent to the front and rear wheels.

The Hybrid Motor Rotor is being driven Primary Pulley. This creates a rotating magnetic field inside the Hybrid Motor and generates AC voltage. The Hybrid Motor is wired to the Motor Inverter which rectifies the AC voltage and turns it into approximately 100 volts DC, charging the Hybrid Battery.



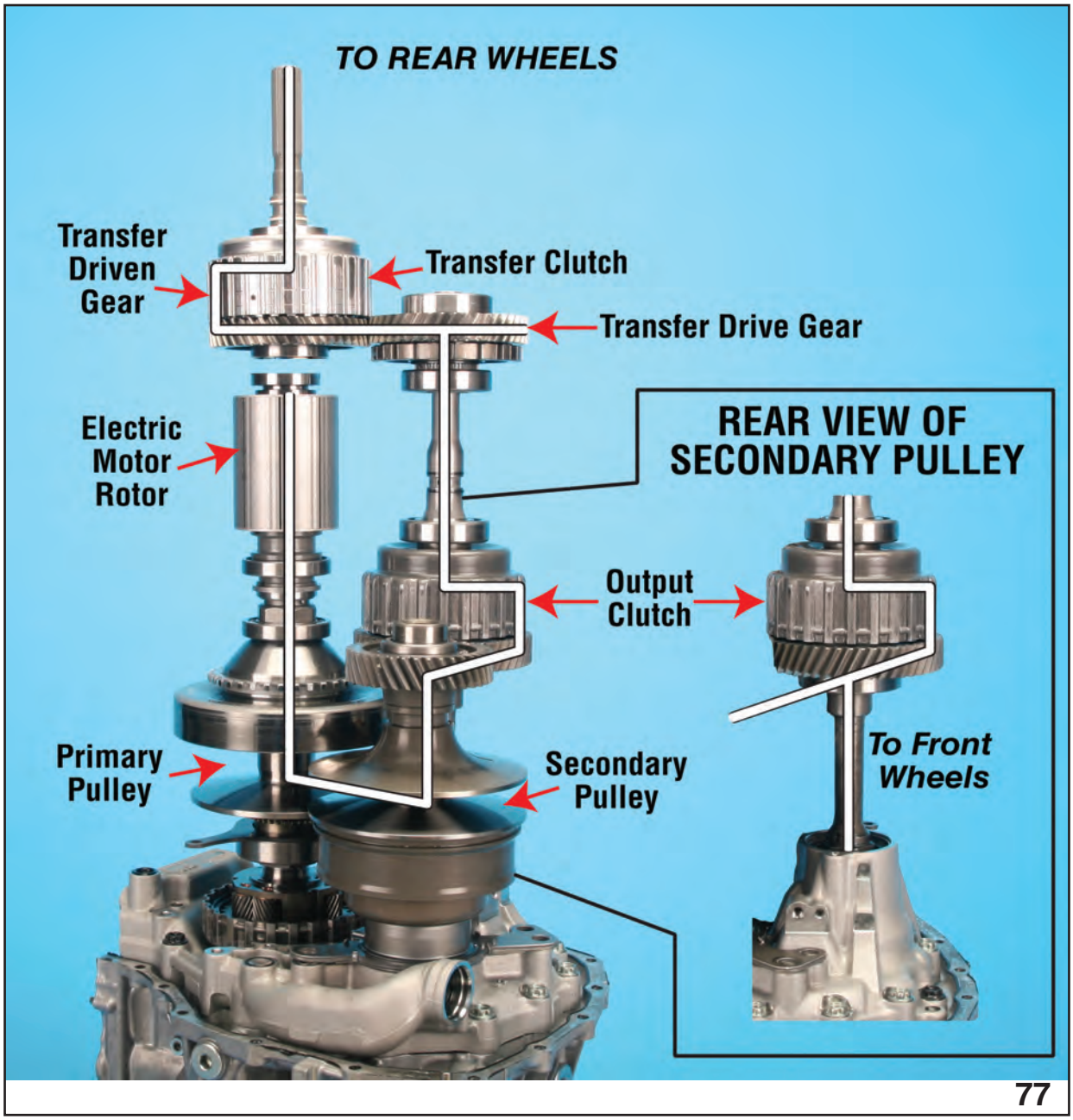
Engine Drive and Electric Motor Assist Mode



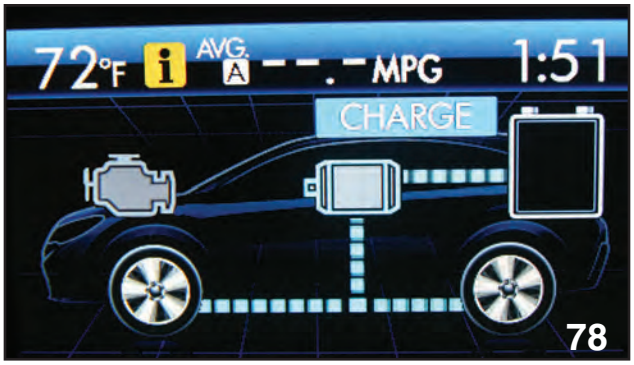
MFD during Engine Drive and Electric Motor Assist Mode

Electric Motor Assist Mode is created by using the driving force from the engine and the Hybrid Motor at the same time. The Engine Control Module and the Hybrid Electric Vehicle Control Module communicate to establish a target torque (power) output. This prevents one driving force from overpowering the other, slowing down the output of power. The output of torque or power must be exactly synchronized to allow both driving forces to contribute evenly.

The Power Flow through the transmission is identical to the Engine Drive Mode with the addition of the mechanical output from the Hybrid Motor.



Regenerative Braking



MFD During Regenerative Braking

There are two types of Regenerative Braking. Engine Drive Mode Regenerative Braking and EV Mode Regenerative Braking. During Engine Mode Regenerative Braking the Input (Forward) Clutch is still applied but with reduced hydraulic pressure. This functionality allows the kinetic energy of the vehicle to affect the Hybrid Motor (The engine assists with braking). The Output Clutch is applied allowing the energy of the moving front wheels to power the Reduction Driven Gear and the moving rear wheels to power the Output Clutch Driven Shaft, via the Transfer Gear set. The combined power of all moving wheels turns the Reduction Gear Set which turns the Secondary Pulley. The Secondary Pulley turns the chain that powers the Primary Pulley. The rotating Primary Pulley turns the Hybrid Motor, generating AC voltage.

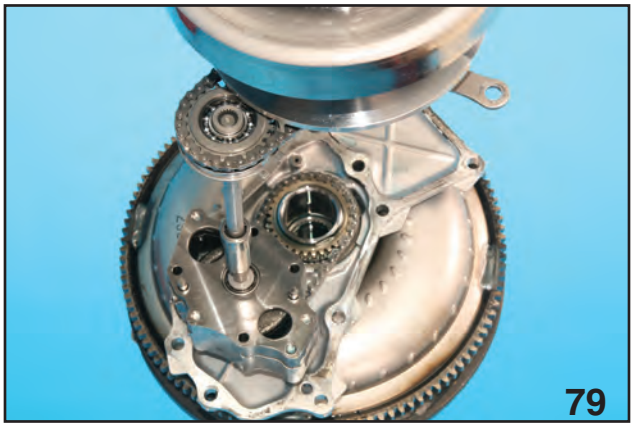
During EV Mode Regenerative Braking the Input (Forward) Clutch is turned completely off, allowing all of the kinetic energy to affect the Hybrid Motor. The Power Flow is then the same as during Engine Drive Mode Regenerative Braking.

CVT Oil Pump

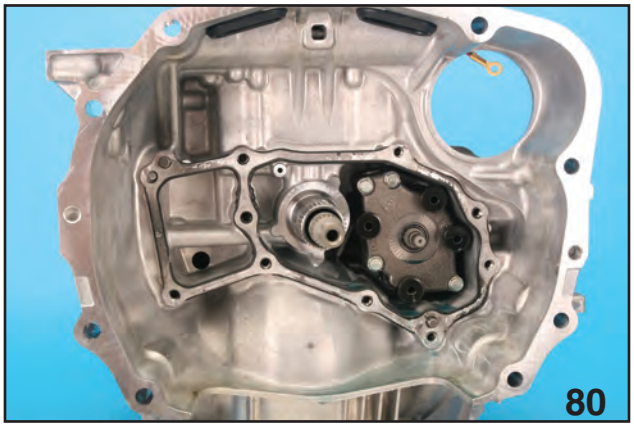
The Lineartronic™ Hybrid CVT requires two new methods of supplying the oil pressure required to operate the pulleys and clutches.

During EV Mode, the engine is off and the conventional method of driving the oil pump is not available. Oil pressure must be maintained to change pulley ratios and to maintain tension on the drive chain.

During normal engine drive, the torque converter impeller housing drives the oil pump drive gear. This is the conventional method of driving the CVT oil pump. The drive gear operates a chain that rotates the driven gear. The driven gear is splined to the oil pump drive shaft.



Oil Pump Drive



Oil Pump

A second mechanical oil pump drive system has been installed into the Hybrid CVT. A second oil pump drive shaft is installed into the back side of the oil pump that is driven from a gear set and chain powered by the rotation of the Primary Pulley.

New Oil Pump Drivens Sprocket

Each driven gear is equipped with a one-way clutch that allows the slower drive shaft to become ineffective.

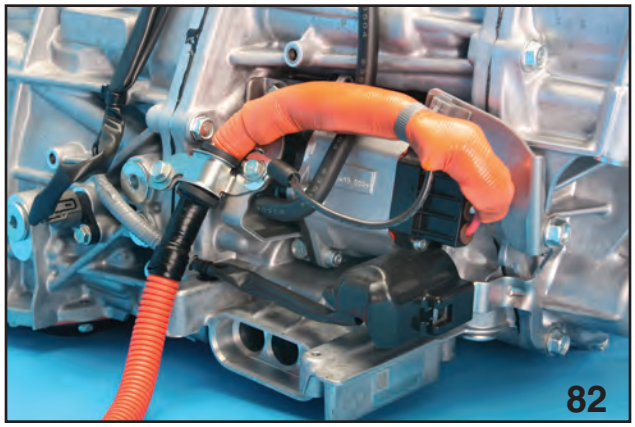
The new mechanical oil pump drive system functions during deceleration whenever the Primary Pulley speed is greater than engine speed and during Regenerative Braking.

During EV Mode, the engine is off and the Torque Converter cannot drive the oil pump. At this time high line pressure is still required to change ratios and maintain tension of the drive chain. A new Electric Oil Pump installed on the left rear of the transmission works with the new mechanical oil pump drive to keep the line pressure at the proper level.

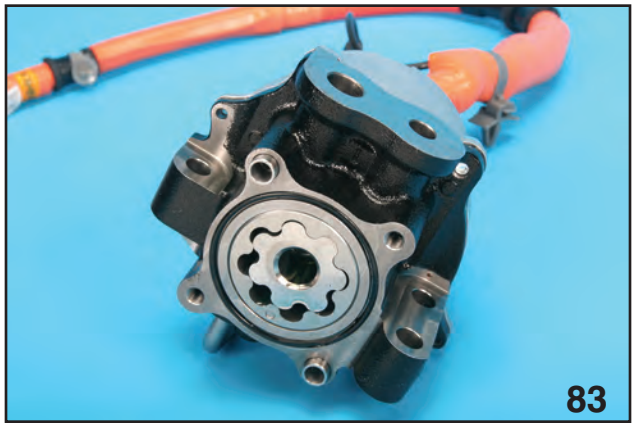
Note: The Electric Oil Pump (EOP) is on during Automatic Start Stop (during the engine off function). The EOP is also on during the transition from zero vehicle speed to a vehicle speed that enables the new mechanical oil pump drive system to create sufficient secondary pressure.

The Electric Oil Pump is 3 phase 100 volts AC operated by the Electric Oil Pump Inverter.

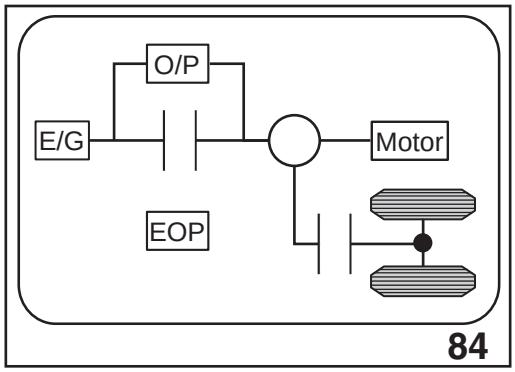
Work support is provided with the Subaru Select Monitor.



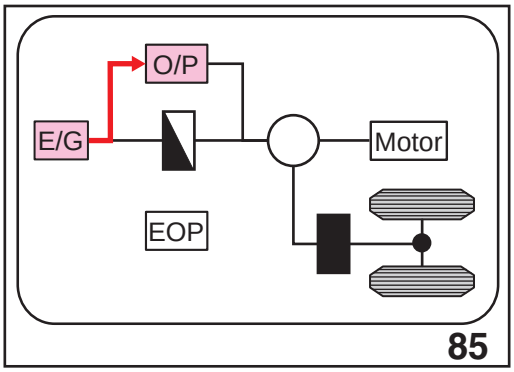
Electrical Oil Pump



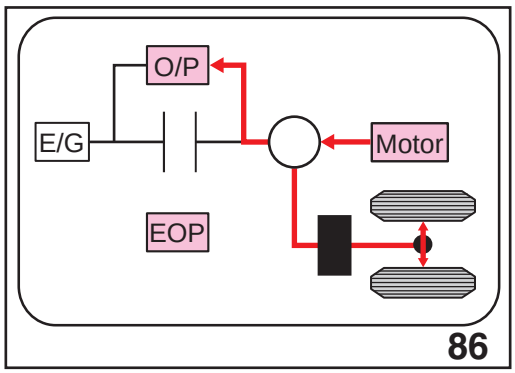
Internal View of Electric Oil Pump



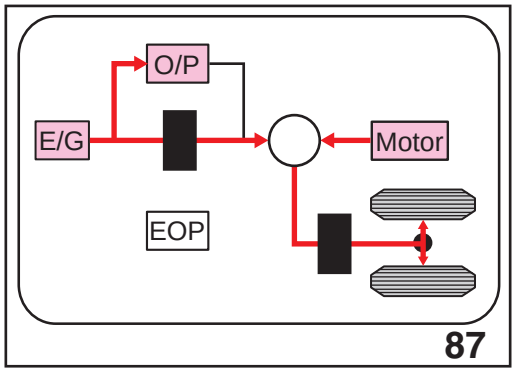
Engine OFF



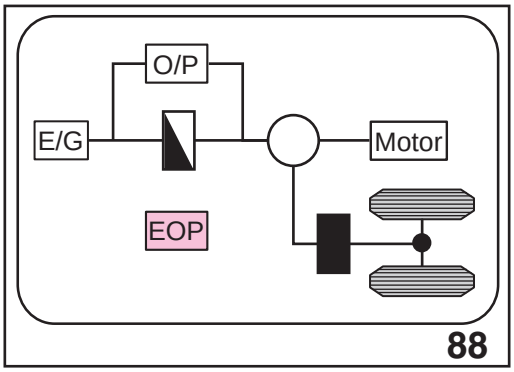
Engine ON



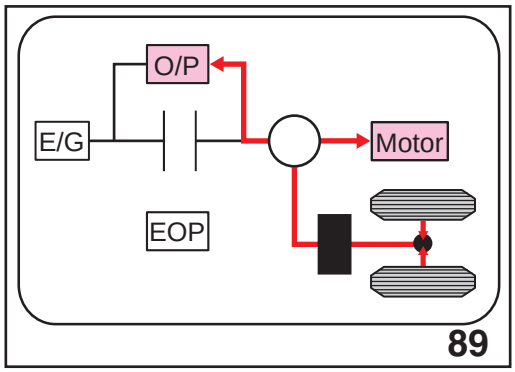
EV Mode



Electrical Motor Assist Mode



Automatic Start Stop Engine OFF

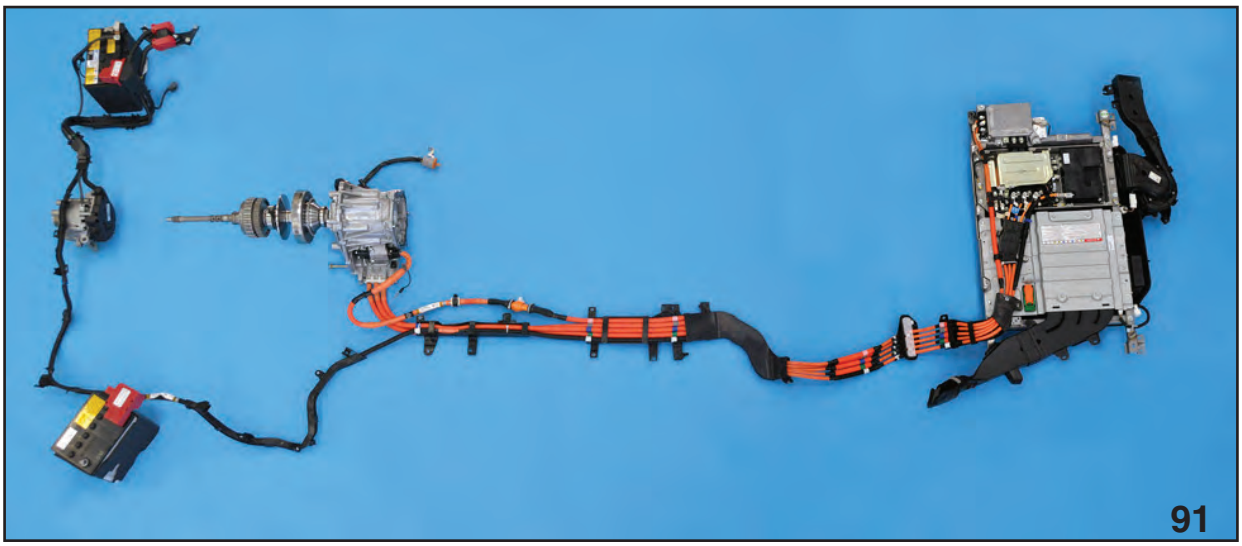


Regenerative Braking

Electrical Wiring Configuration

The Electrical System of the XV Crosstrek Hybrid operates from the storage capabilities of 3 batteries and the driving or charging functions of 3 devices. The wiring connecting these components are very precisely mounted to the vehicle and should always be returned to their original positions whenever service work is performed.

Warning: All wiring contained inside the orange colored wiring jacket should be considered High Voltage.



Hybrid High Voltage Wiring Complete

Hybrid Motor wiring and Electric Oil Pump wiring are color coded orange and can carry a very high voltage potential of 3 phase AC current.

Do not attempt to repair this wiring. Replace the wiring as a single part if any damage to the wiring is diagnosed.

High Voltage Harness Routing

The Hybrid Wiring Harness is routed from Hybrid component package shelf to the CVT.

A single high amperage orange wire, (protected by a black wiring jacket), is routed next to the Hybrid orange wires. This wire carries 12 volts from the DC/DC Converter to the Auxiliary Battery and is the primary charging source for the 12 volt Auxiliary Battery.

Batteries

The Auxiliary Battery is the battery that is usually equipped on gasoline vehicles, charged by the alternator. However, on the XV Crosstrek Hybrid, the Auxiliary Battery is charged by the alternator only after the Hybrid Battery drops below 38 % of full capacity. This can be seen on the MFD display as zero to one bar on the battery meter display.

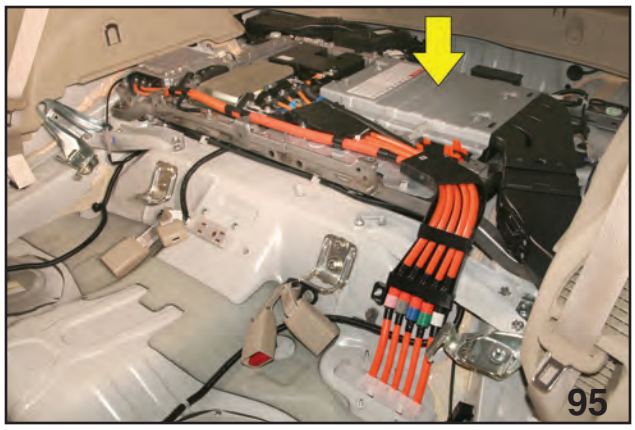
1. Auxiliary Battery – Provides electrical storage for the conventional starter and all vehicle operations except Automatic Start Stop. A high amperage wire is routed from the positive post of the Auxiliary Battery to the Interconnect Relay.

Auxiliary Battery

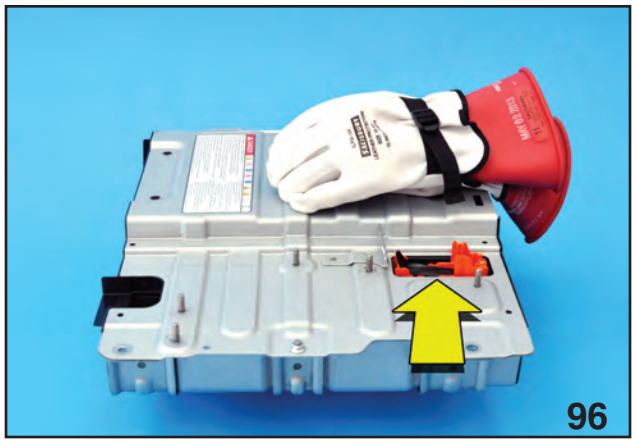
2. Restart Battery – Provides electrical storage for operation of the Integrated Starter Generator (ISG). The ISG provides the engine restart functions of the Automatic Start Stop system.

Restart Battery

3. High Voltage Battery – Provides electrical storage for all Electric Vehicle (EV) Mode operations. The High Voltage Battery also provides electrical power to charge the Auxiliary Battery.



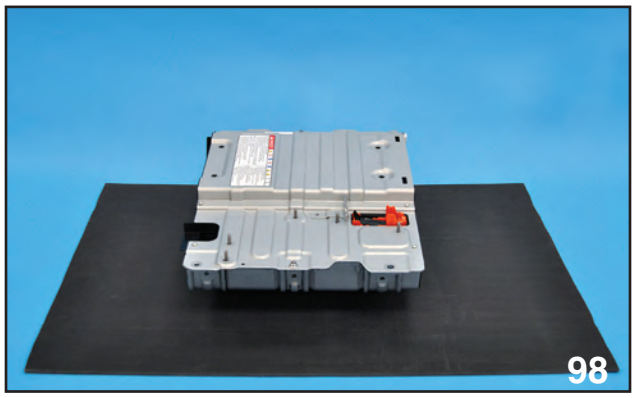
High Voltage Battery



High Voltage Battery Service Plug Removed

The 100 volt (Nickel Metal Hydride) High Voltage Hybrid Battery is not serviceable. Always wear rubber insulation gloves with the leather gloves placed over the rubber gloves when removing the battery from the vehicle. This will prevent any accidental tearing to the rubber insulation gloves. If the battery is suspected of having an internal short, place the battery on the rubber safety mat upon removal and contact the Tech line for instructions. **Place caution tape across and around the battery.**

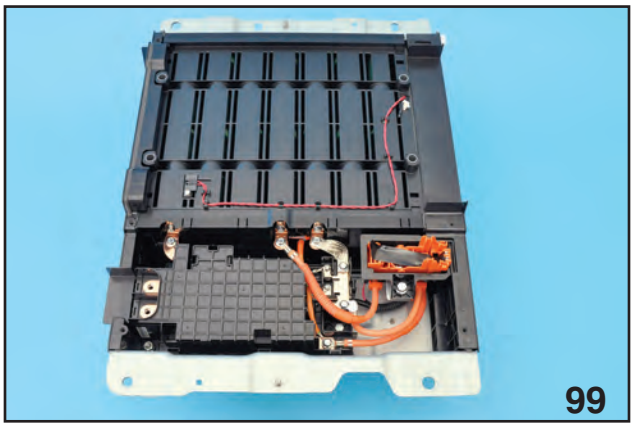
High Voltage Battery Removal



High Voltage Battery on Rubber Mat

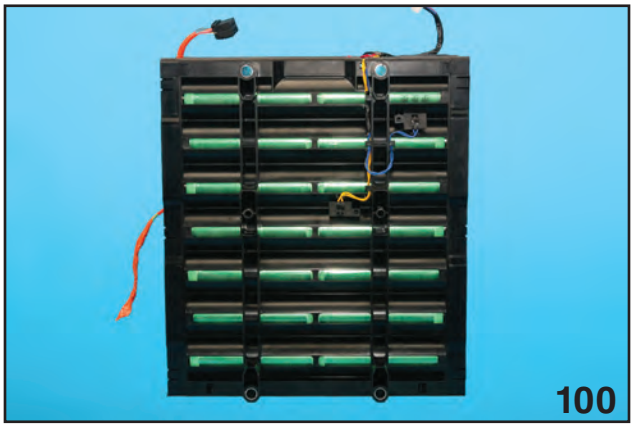
The High Voltage Hybrid Battery assembly contains many parts that control Hybrid Battery charging and discharging for Hybrid vehicle operation.

Warning **Never disassemble the High Voltage Battery or remove any of the outer covers. High voltage exists below the covers and at the output terminals.**

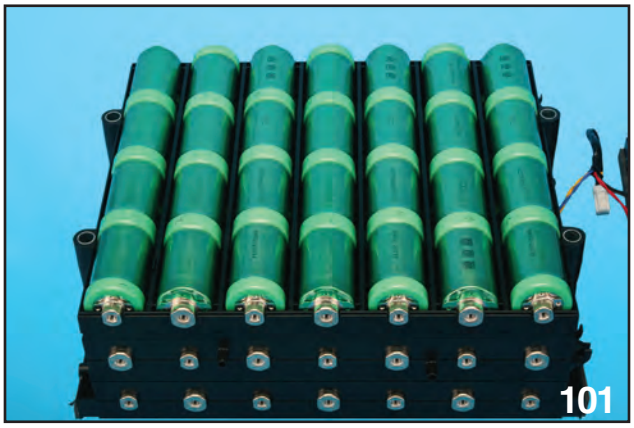


High Voltage Battery Construction

The following explanation of the High Voltage Battery construction supports your understanding of Hybrid operation and the information that can be displayed on the Subaru Select Monitor III. There are no serviceable parts in the battery assembly.

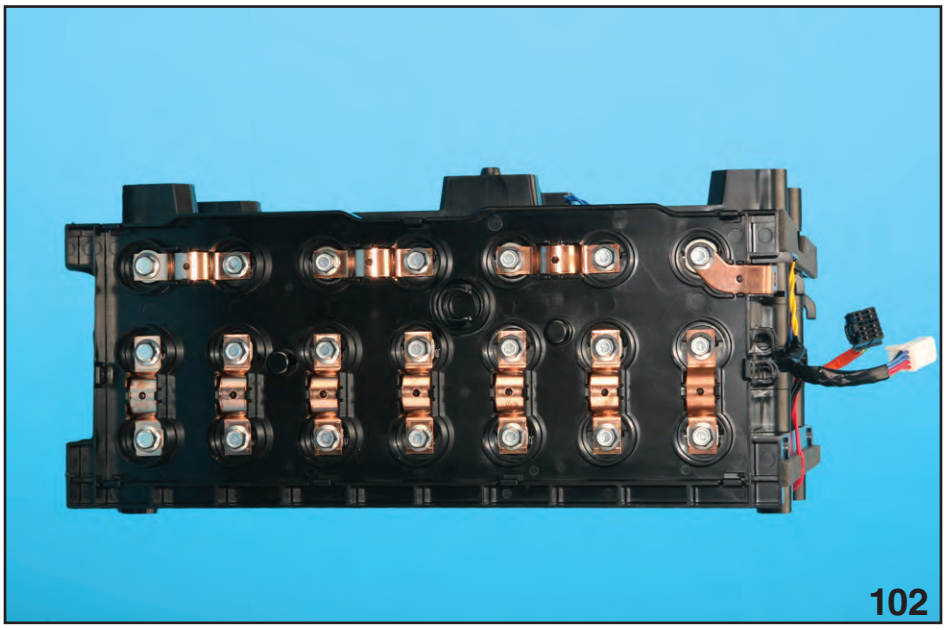


Top View Battery Cells

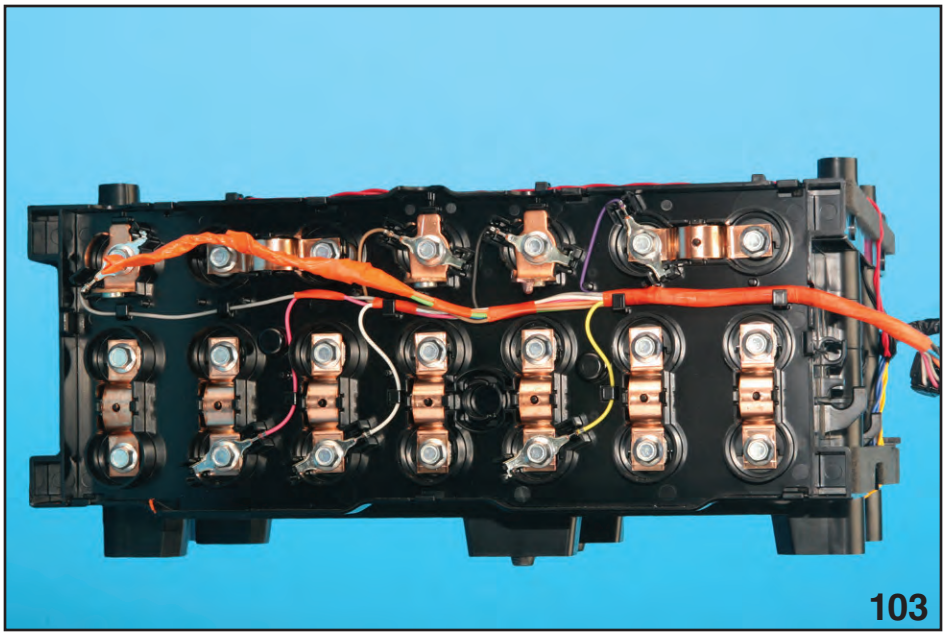


Individual Cell Rows

The High Voltage Battery is constructed of 21 rows of batteries. Each row contains 4 individual, 1.2 volt to 1.5 volt, (84 total individual cells), Nickel Metal Hydride batteries. The batteries are arranged positive to negative (series circuit) so the total voltage of the High Voltage Battery increases with each row.

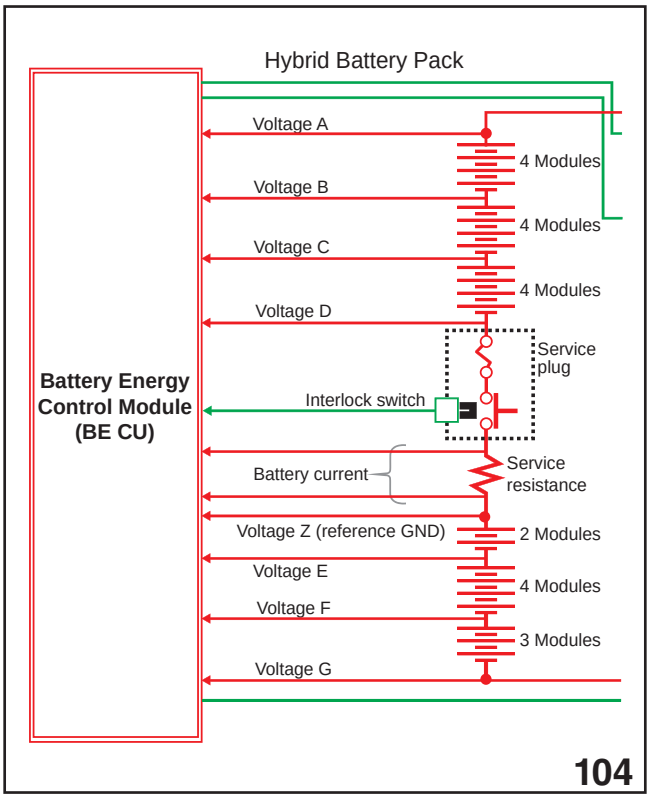


High Voltage Battery Passenger Side

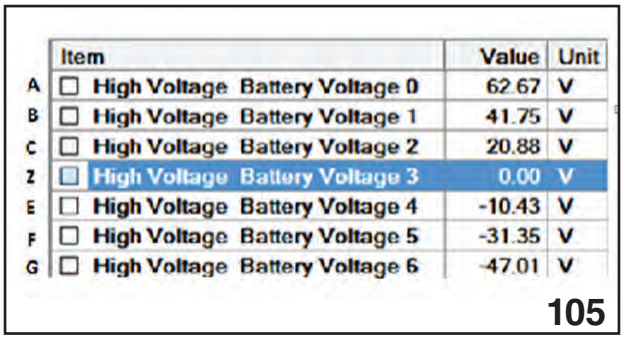


High Voltage Battery Driver Side

The individual rows are attached to each other at the outer sides of the battery case, positive to negative, negative to positive. Wires are attached to specific connections to monitor voltages of groups of rows.



High Voltage Battery Construction



High Voltage Battery Voltages

The Subaru Select Monitor III displays the voltages of 7 points in the battery pack circuit. Each point references the middle of the battery. The middle of the 100 volt battery is approximately 50 volts. High Voltage Battery Voltage 3, as displayed on the Subaru Select Monitor, is the middle of the battery. Since the BECM uses this as a ground reference, the value displayed is 0 volts. This reference point is “Voltage Z” in the picture above.

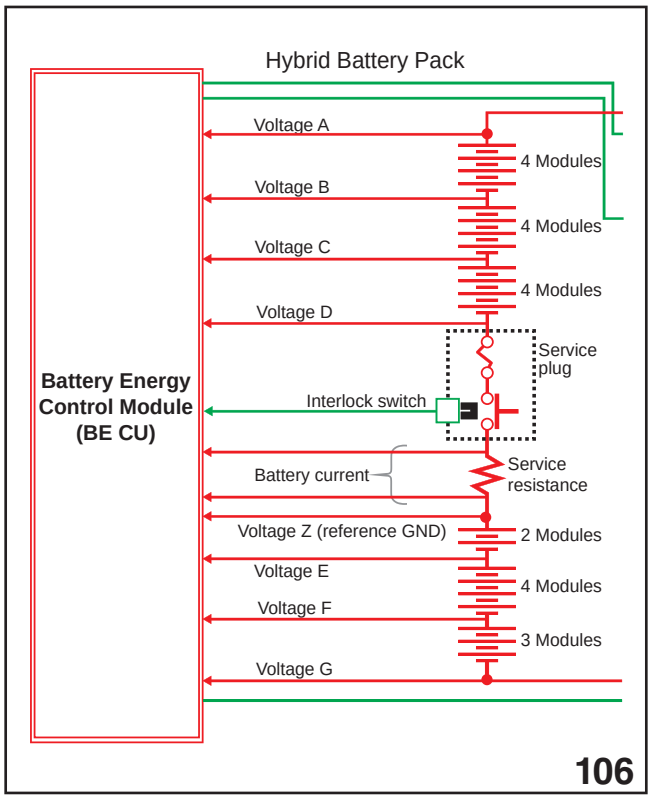
Note: DTCs for the High Voltage Battery and BECM reference voltage points A, B, C, D, E, F, G, and Z.

Moving towards the most positive potential voltage, the next point in the battery pack circuit with a different voltage is point C, or High Voltage Battery Voltage 2 (20.88 volts). This value is based on the number of rows in the first group of batteries.

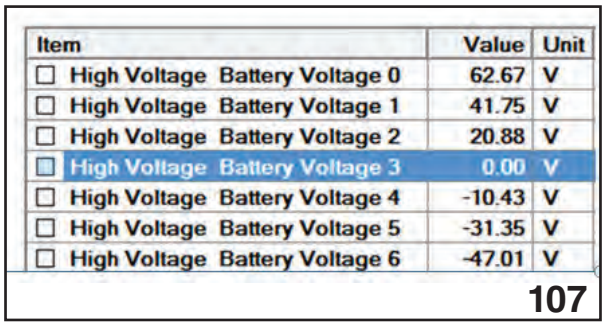
Note: See High Voltage Battery Construction artwork to determine the number of rows in each group of batteries.

Point B in the battery pack circuit is the value of 2 groups of batteries. The Subaru Select Monitor display, High Voltage Battery Voltage 1, should show the total voltage of the 2 groups (41.75 volts).

Point A in the battery pack circuit is the most positive potential at 62.67 volts. This is the total of 3 groups of batteries. The Subaru Select Monitor display, High Voltage Battery Voltage 0, indicates the point A value.



High Voltage Battery Construction



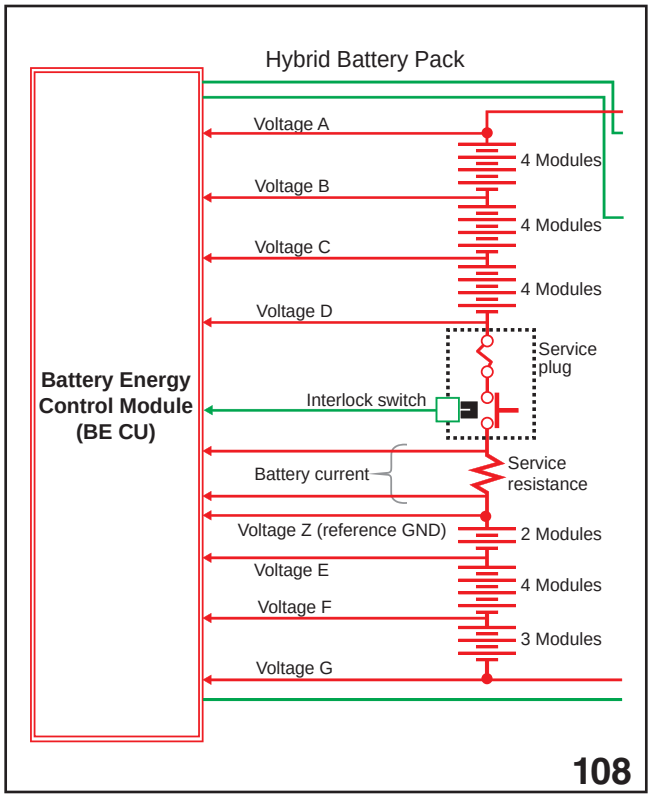
High Voltage Battery Voltages

High Voltage Battery Voltage 4, point E in the battery circuit, display is -10.43 volts. The display is negative because the ground reference (Point Z), is more positive.

High Voltage Battery Voltage 5, point F in the battery circuit, display is -31.35 volts , the total voltage of 2 groups of batteries.

High Voltage Battery Voltage 6, point G in the battery circuit, is the most negative potential in the battery (3 groups of batteries.)

Disregard the negative value of point G and add High Voltage Battery Voltage 6 to High Voltage Battery Voltage 1 to determine the total battery voltage.

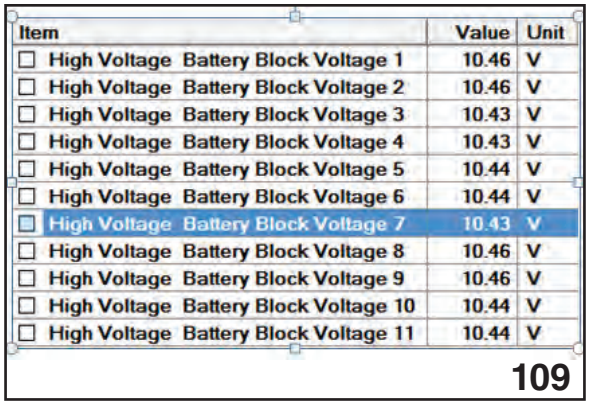


High Voltage Battery Construction

The BECM also checks the performance of the High Voltage Battery by monitoring the voltage of 11 Blocks of batteries. Each block is the calculated value of 2 rows of batteries. Since the battery is constructed from an odd number of rows, the value of one row, located between points F and G, is used twice. The BECM uses these calculated values to locate low performance or damaged batteries.

Note: High Voltage Battery Block Voltages cannot be added together to determine total battery voltage.

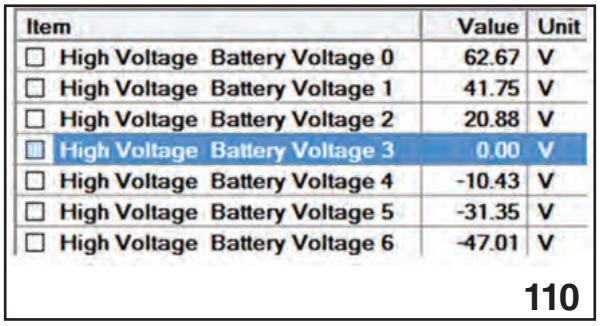
Note: During this performance check the BECM calculates the voltages except at High Voltage - Battery Block Voltage 7. Block 7 is the only physical check of 2 rows of batteries (Z to E).



Item	Value	Unit
High Voltage Battery Block Voltage 1	10.46	V
High Voltage Battery Block Voltage 2	10.46	V
High Voltage Battery Block Voltage 3	10.43	V
High Voltage Battery Block Voltage 4	10.43	V
High Voltage Battery Block Voltage 5	10.44	V
High Voltage Battery Block Voltage 6	10.44	V
High Voltage Battery Block Voltage 7	10.43	V
High Voltage Battery Block Voltage 8	10.46	V
High Voltage Battery Block Voltage 9	10.46	V
High Voltage Battery Block Voltage 10	10.44	V
High Voltage Battery Block Voltage 11	10.44	V

109

High Voltage Battery Block Voltage



Item	Value	Unit
High Voltage Battery Voltage 0	62.67	V
High Voltage Battery Voltage 1	41.75	V
High Voltage Battery Voltage 2	20.88	V
High Voltage Battery Voltage 3	0.00	V
High Voltage Battery Voltage 4	-10.43	V
High Voltage Battery Voltage 5	-31.35	V
High Voltage Battery Voltage 6	-47.01	V

110

High Voltage Battery Voltage

Block Voltages are calculated by using the values measured from points A to Z and Z to G.

For example: Block Voltages 1 and 2 are calculated by subtracting the voltage measured at point B from the voltage at point A, then dividing the result by the number of 2 row sets of batteries in that group. The calculation is for 2 blocks so the BECM uses the calculated value 2 times.

62.67 – 41.75 = 20.92 20.92/2 = 10.46

Block Voltages 3 and 4 are calculated by subtracting the voltage measured at point C from the voltage at point B, then dividing the result by the number of rows in that group (4) and dividing that result by 2.

Block 10 and 11 are calculated by the following:

High Voltage Battery Voltage 6 – High Voltage Battery Voltage 5

Drop the negative sign of both numbers, 47.01 – 31.35 = 15.66

Then divide the calculated value of High Voltage Battery Voltage 9 by 2.
(This is necessary to get the calculated voltage of just one row of batteries).

10.45/2= 5.22

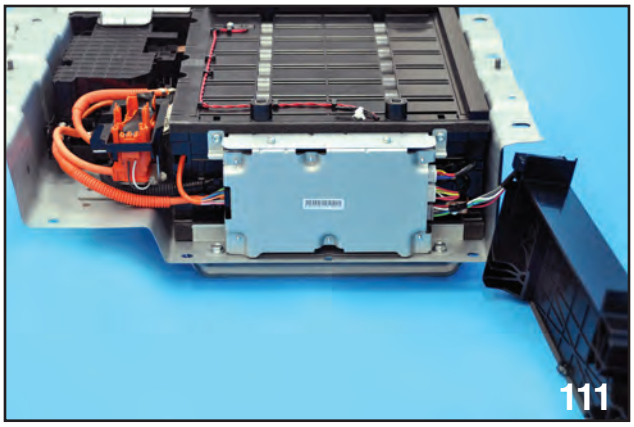
Then add the one row voltage value to the result of High Voltage Battery Voltage 6 – High Voltage Battery 5.

47.01 - 31.35 = 15.66

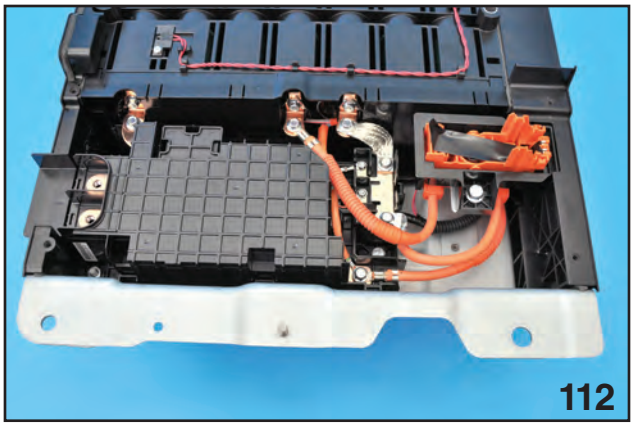
15.66 + 5.22 = 20.88

This result is now divided by 2 to represent the calculated value for High voltage Battery Voltage 10 and High voltage Battery Voltage 11.

20.88/2 = 10.44



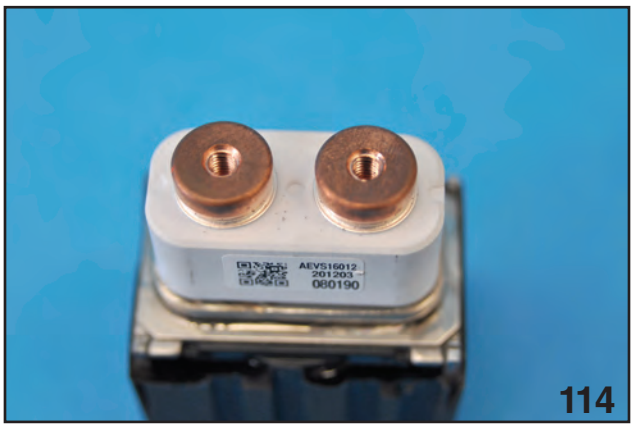
Battery Energy Control Module



High Voltage Battery Wiring

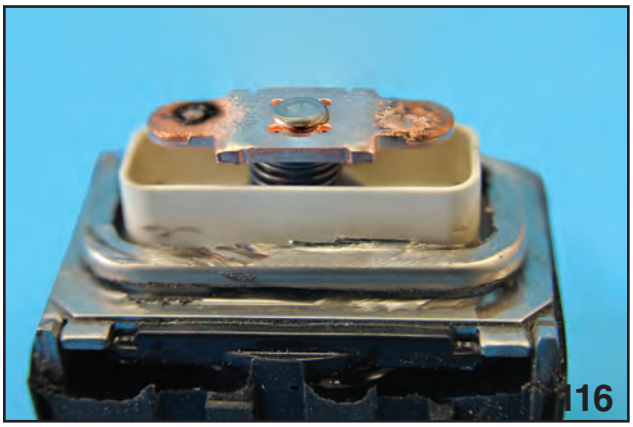
The BECM controls the input and output of electrical power from the High Voltage Battery with a Positive Contactor and a Negative Contactor. The Contactors are large relays designed to operate high voltage and amperage devices.

Contactor



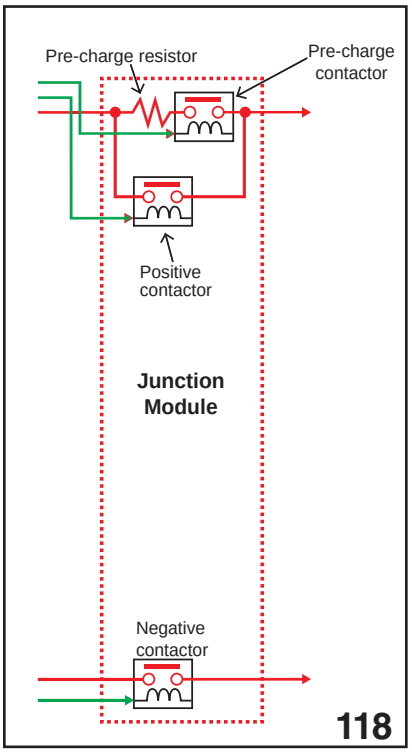
Contactor Connection Points

Internal View of Contact Points



Contactor Bridge

HEV Ready Light

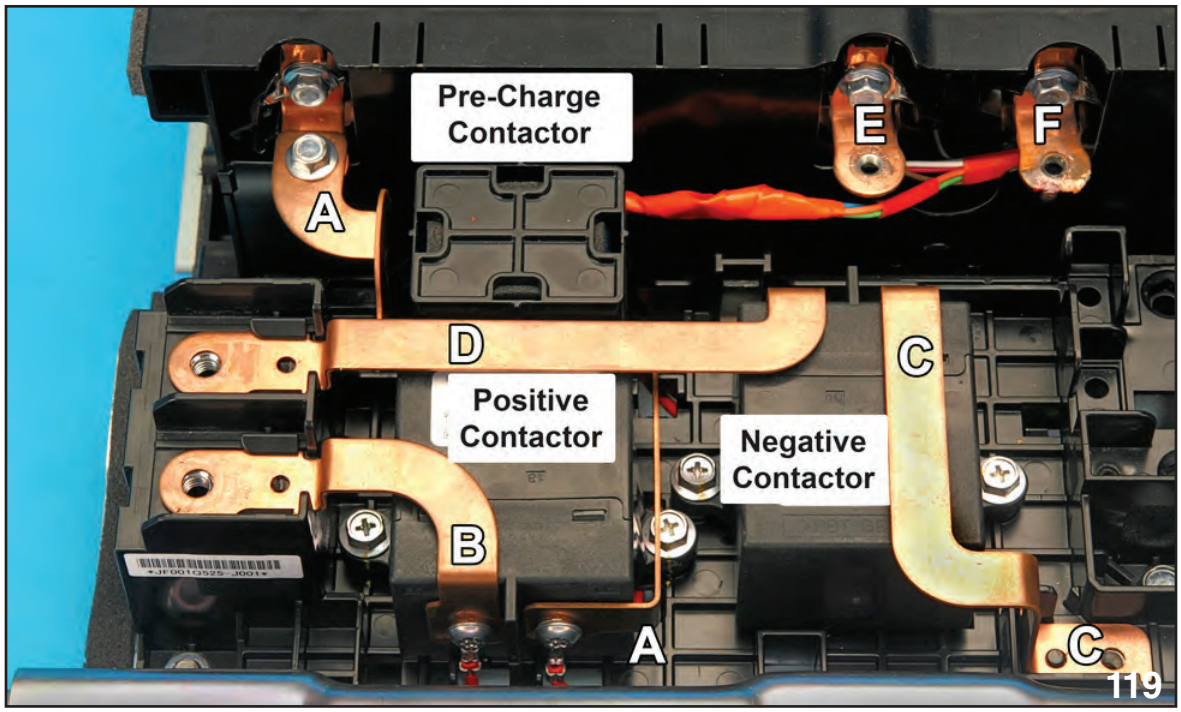


Contactor Configuration

The illumination of the Hybrid Ready Light indicates the Battery Energy Control Module (BECM) has closed (turned on) the Contactors.

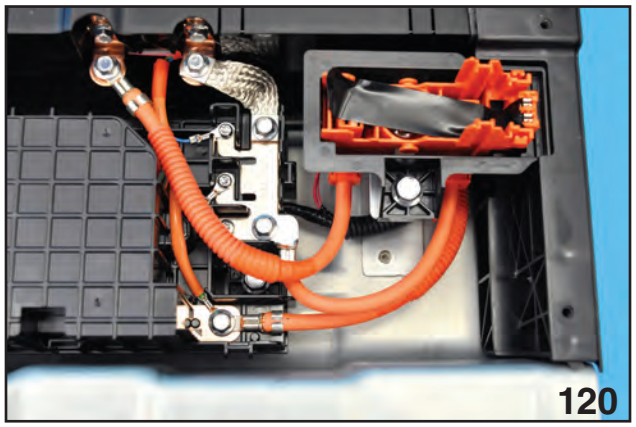
As the High Voltage Battery is turned on, a high amperage flow potential exists. This condition is known as High In Rush Current. High In Rush Current can damage control modules and create high heat loads. Control of High In Rush Current is accomplished with a Pre-Charge Contactor and resistor which allows the High Voltage Battery to turn on, but not at full power. The BECM will close the Negative Contactor and the Pre-Charge Contactor, routing the positive circuit from the High Voltage Battery through a resistor and into the Hybrid electrical circuit. The BECM will close the Positive Contactor after it receives information that all systems are working correctly. After the Positive Contactor closes, the full amperage potential of the High Voltage Battery becomes available to the Hybrid circuit.

Contactor and High Voltage Battery Voltage



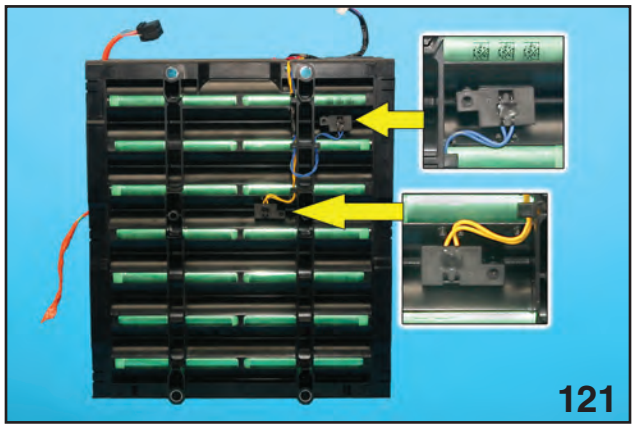
High Voltage Battery and Contactor Voltages

		Opposing Reference Point
A.	Positive terminal from the High Voltage Battery	
	1. Always on	
	2. 100 volts if Service Plug is installed	C or D
	3. 60 volts if Service Plug is removed	E
B.	Normal positive outlet of the High Voltage Battery	
	1. 100 volts if Positive Contactor is on	C or D
	2. 100 volts always if Positive Contactor is in a welded (locked on) condition	C or D
C.	Negative terminal (via wire) of High Voltage Battery	
	1. Always on	
	2. 100 volts if Service Plug is installed	A or B
	3. 40 volts if Service Plug is removed	F
D.	Normal Negative outlet of the High Voltage Battery	
	1. 100 volts if Negative Contactor is on	A or B
	2. 100 volts always if Negative Contactor is in a welded (locked on) condition	A or B
E.	Negative connection for Service Plug	
	1. Always 60 volts	A or B
F.	Positive connection for Service Plug	C or D
	1. Always 40 volts	



Shunt Resistor

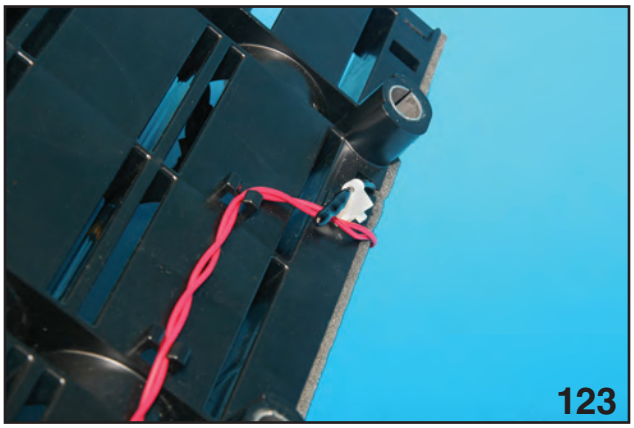
The BECM monitors amperage flow through the High Voltage Battery by measuring the voltage drop through a shunt resistor. As the current flow increases , the amount of voltage drop between the two indicated wires increases. The BECM calculates the amperage by changing the voltage drop into amperage. For example; .050 volts = 100 amps, .025 volts = 50 amps. High Voltage Battery amperage is displayed on the Subaru Select Monitor in the BECM menu selection.



High Voltage Battery Temperature Sensors

Temperature Sensor Close-up

High Voltage Battery temperature is monitored with three sensors. The sensors are seated in between the indicated rows of batteries.

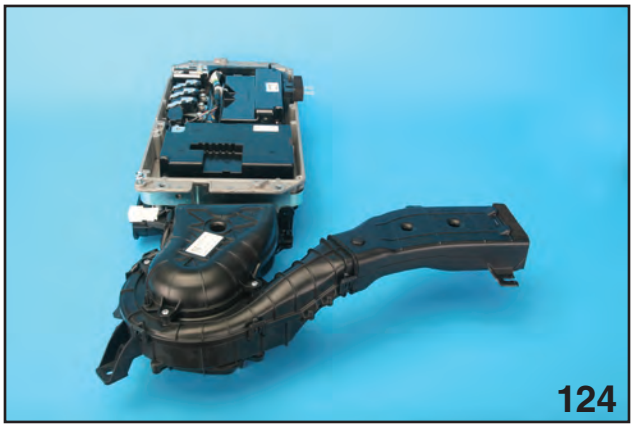


High Voltage Battery Air Temperature Sensor

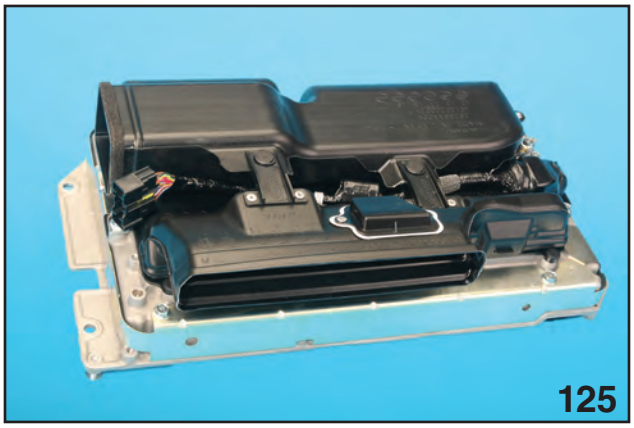
A temperature sensor for measuring the air surrounding the battery is also employed. The input signal to the BECM from this sensor controls the duty ratio to the Hybrid component cooling fan motor.

NOTE: Duty ratio of the fan motor is controlled by the HEV CM.

The relay for the cooling fan motor is controlled by the DMCM.

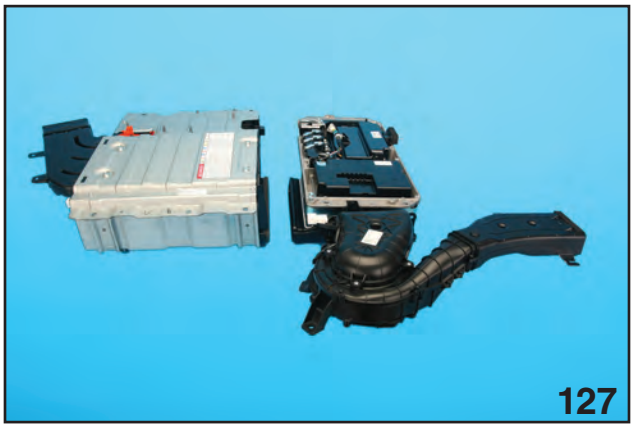


Cooling Fan Assembly and Hybrid Component Tray



Bottom View of Hybrid Component Tray

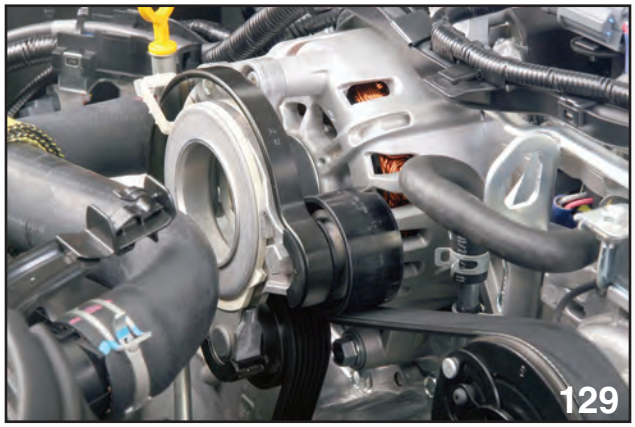
Left C pillar Trim Vent



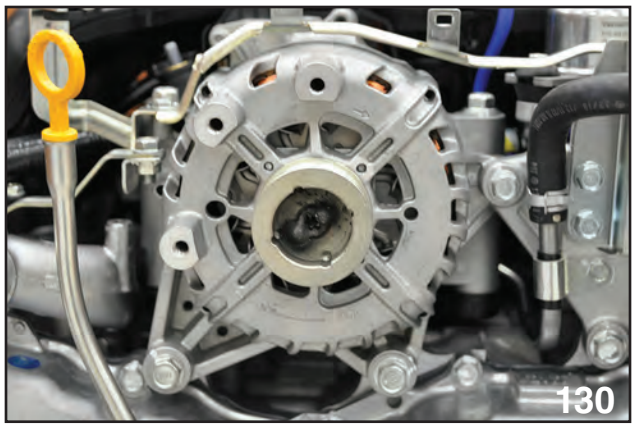
High Voltage Battery and Cooling System

Driving and Charging Devices

Integrated Starter Generator – A means of starting the gasoline engine while the vehicle is in gear, stationary or moving, must be employed. This task is accomplished using a new Integrated Starter Generator (ISG) and the new Automatic Start Stop System. The ISG is an alternator and a starter motor.

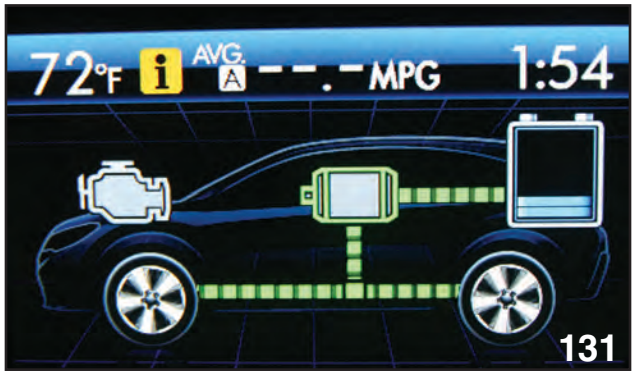


ISG and Belt

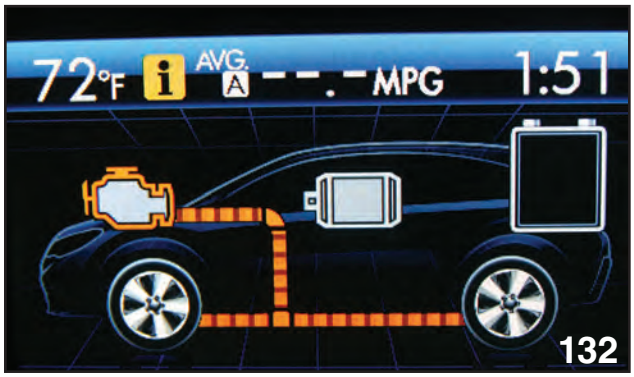


Welded Drive Pulley

The ISG provides alternator (charging) functions to the Restart Battery only, except during vehicle operation where the High Voltage Battery State of Charge falls below 38% of maximum. The ISG also restarts the engine during EV Mode engine start, and Automatic Start Stop operation.

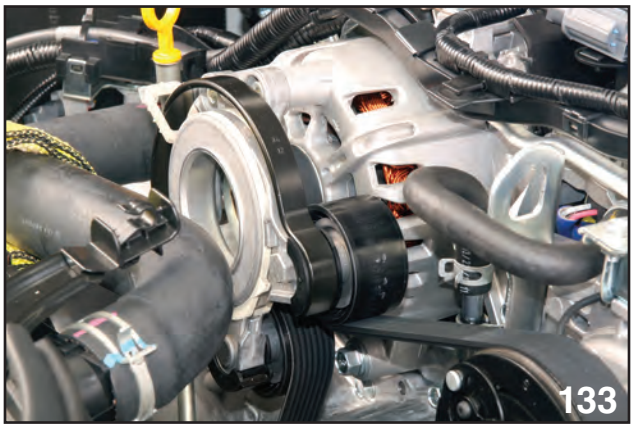


EV Mode



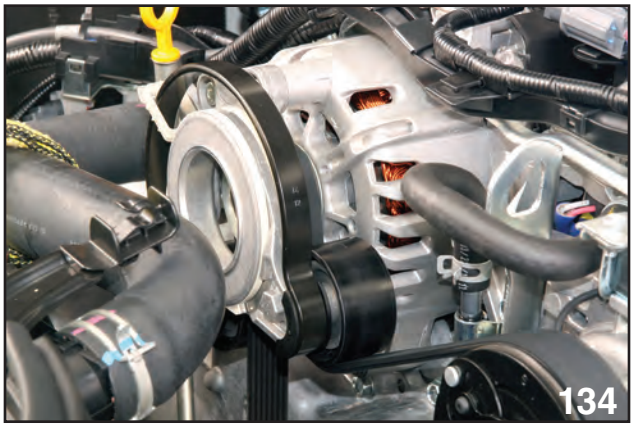
Engine Drive Mode

The transition from EV Mode to Engine Drive Mode must be smooth and seamless. This occurs at a vehicle speed from 0 to 25 mph or when established vehicle conditions are met from driving or the driving environment.



Engine OFF

The Accessory Drive Belt also serves to start the engine from the rotation of the ISG during engine restart.

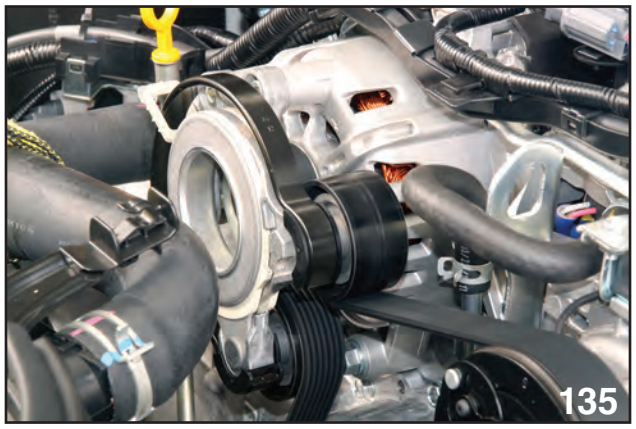


ISG Start

The tension of the belt during engine restart must be much higher than normal to prevent belt slippage. A two pulley pendulum tensioner controls the belt tension. During engine restart the belt becomes tighter and automatically reduces the tension after engine start.

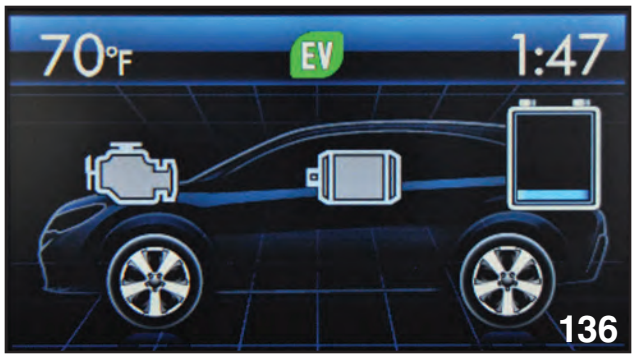
During engine restart the torque of the rotating ISG, against the stationary belt, pitches the tensioner downward and tightens the belt.

NOTE: The two pulleys can move independently.



Just After Engine Start

As the engine starts, the ISG no longer becomes the driving force placed on the belt so the tensioner pitches upward and the tension is reduced. This reduces belt wear and reduces the engine power required to turn the belt.

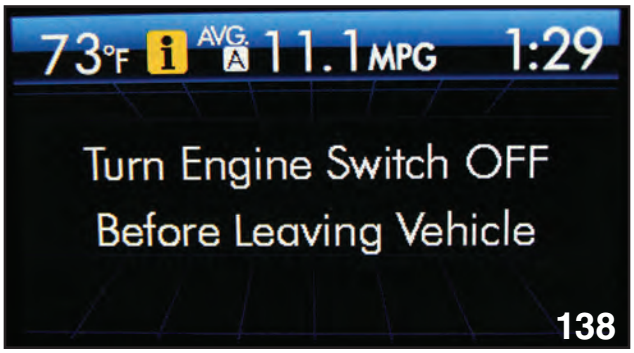


EV Mode Automatic Start Stop

During Automatic Start Stop Mode, the engine turns off and saves fuel while all electric, safety, environmental, and operational equipment stays active.

MFD during Automatic Start Stop

The Multi-function Display will indicate the total time the engine has been turned off during Automatic Start Stop Mode. The time is displayed as Fuel Saving Time. This value will reset to zero if the trip meter stalk is used to clear the trip meters.

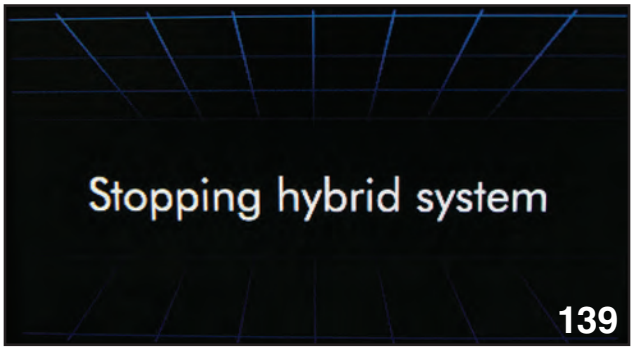


MFD during exit of vehicle

Caution: **While driving the XV Crosstrek Hybrid in EV Mode and coming to a stop to park the vehicle, always shift to Park, set the Parking Brake, and turn off the ignition. Failure to turn off the ignition will create a warning display on the Multi-function Display and the engine will restart automatically.**

NOTE: The engine will not automatically restart immediately. There will be a delay.

The following message will be displayed after turning off the ignition.

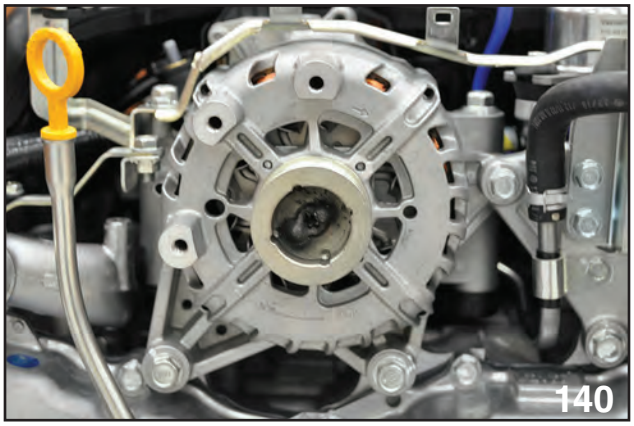


MFD during Ignition OFF

Note: The following conditions are required for activation of Automatic Start Stop and EV Mode.

1. Brake Booster pressure is present.
2. Engine Restart Battery is above 70% fully charged.
3. Engine Restart Battery is above 12.6 volts.
4. Engine Restart Battery temperature and high voltage battery are between 14 and 172 degrees Fahrenheit.
5. Engine Restart Battery is judged to be functioning correctly.
6. Engine Coolant temperature is above 125 degrees Fahrenheit.
7. Gear range is initially in Drive (D Range). Vehicle will not cancel Automatic Start Stop if active and shifted into park or any other gear range.
8. High Voltage Battery is greater than 40% fully charged.
9. ISG temperature is less than 212 degrees Fahrenheit.
10. Vehicle speed is less than 8 miles per hour.
11. The vehicle is not on a steep hill.
12. Accelerator pedal opening is less than 0.5% for Automatic Start Stop and not greater than 20% for EV Mode.
13. Brake pedal is pressed.
14. The front defroster is off.
15. In vehicle temperature is within 5 degrees Fahrenheit of the set temperature.

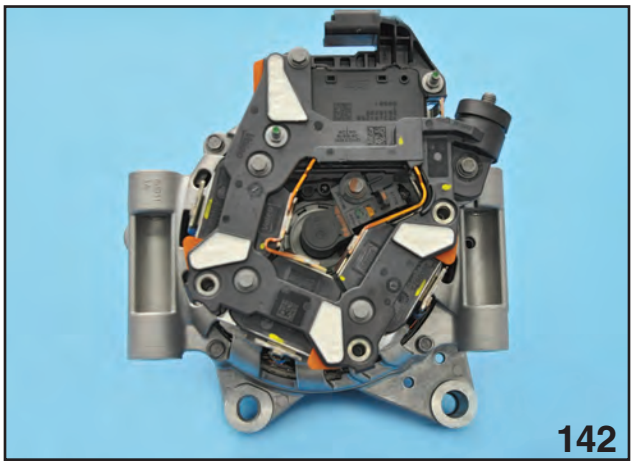
NOTE: The In Vehicle Temperature Sensor is equipped to measure humidity. Temperature and humidity must be within a specified level before EV Mode or Automatic Start Stop can operate.



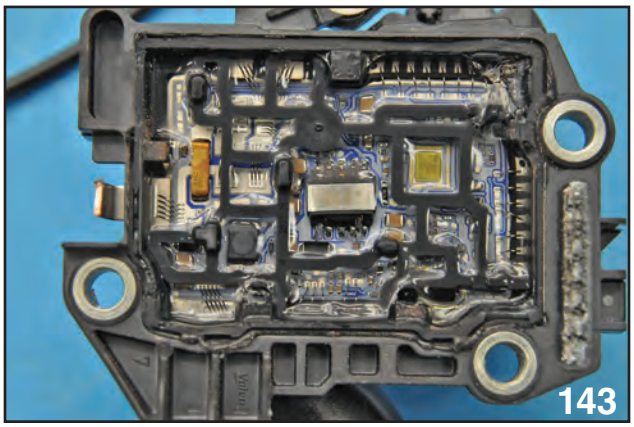
ISG Mounting Bolts

ISG rear view

The ISG Pulley is welded in place to prevent loosening from high torque operation. 5 bolts secure the ISG to the engine block.



ISG Control Unit location



ISG Control Unit internal view

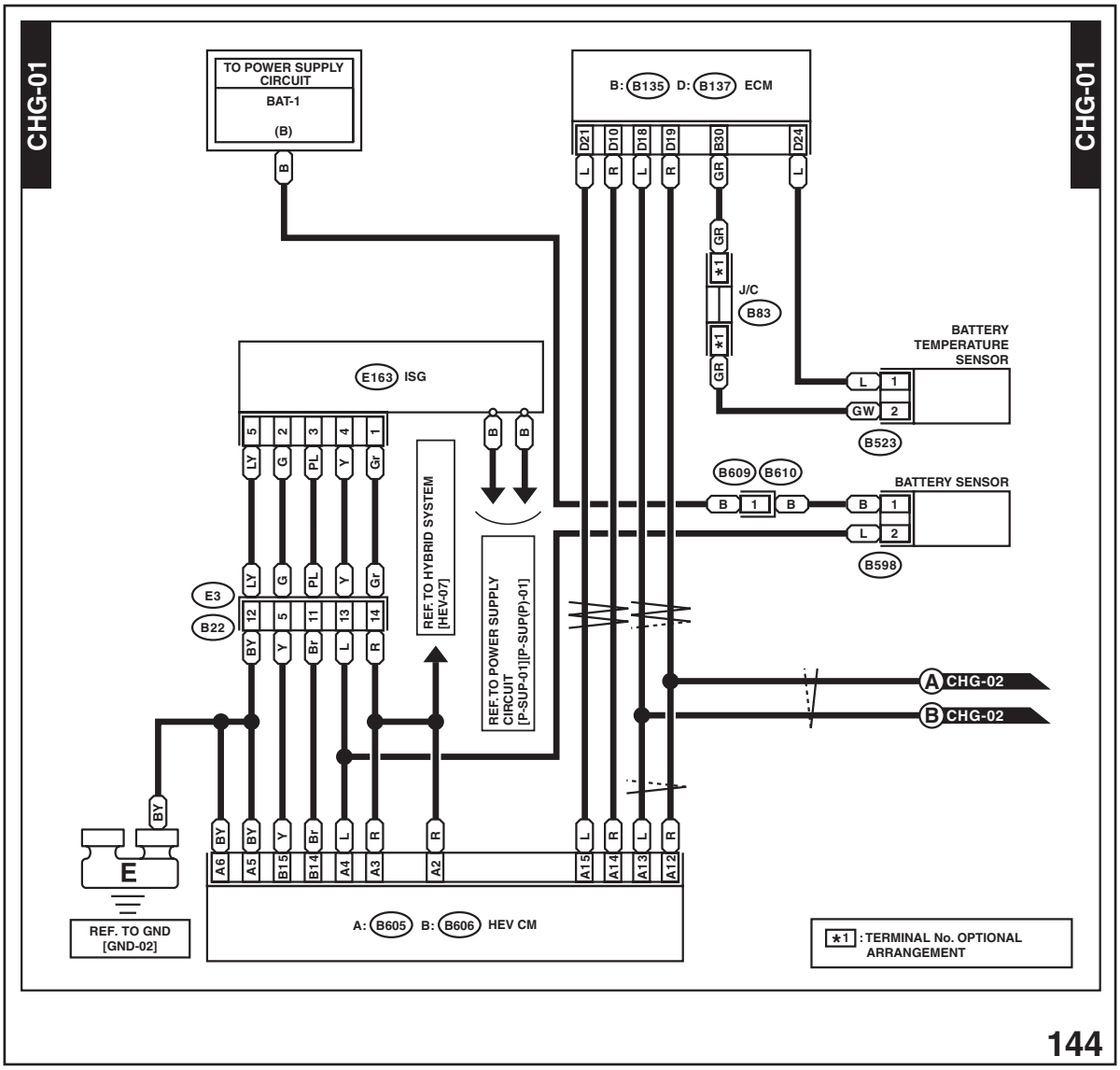
The ISG Control Unit is mounted on the back side of the ISG and is not serviceable separately. The ISG Control Unit controls the charging and starting functions of the ISG.

ISG Terminals and Inputs Signals

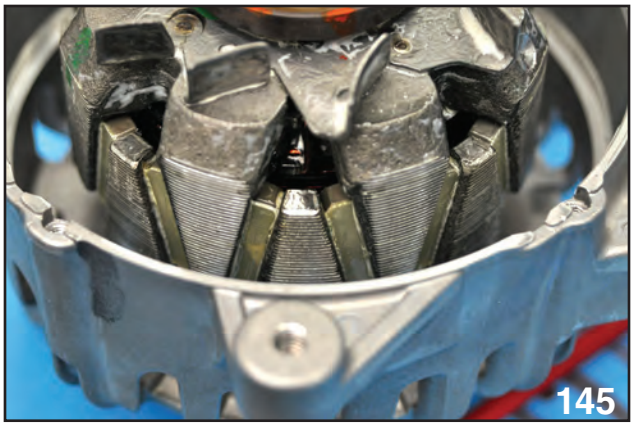
1. Positive power supply for ISG Control Unit, Auxiliary Battery
2. Crank inhibit signal (Must turn off before start function begins) This signal is sent from the HEV CM.
3. Crank signal (Energizes rotor slightly advanced of actual start signal) This signal is sent from the HEV CM.
4. LIN communications (HEV CM sends a crank and stop crank signal)
5. Negative power supply for ISG Control Unit, Auxiliary Battery

The working power for the ISG Control Unit comes from the Auxiliary Battery. During actual ISG start function, the Restart Battery voltage drops and could create computer errors with the ISG Control Unit.

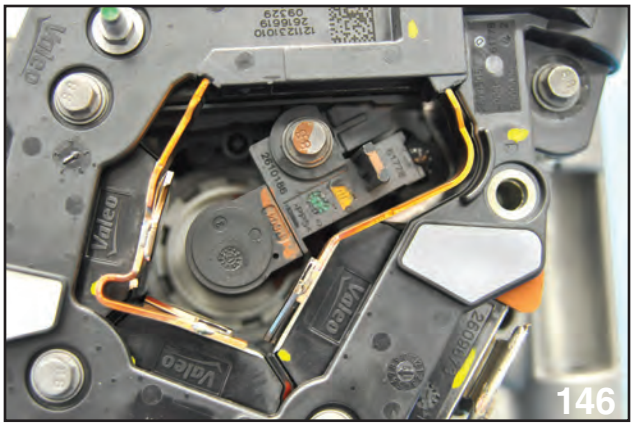
The Crank signal from the HEV CM turns on the rotor and it begins to build a magnetic field. This will take a certain time to reach maximum potential. LIN communications to the ISG Control Unit control the starter motor function of the ISG by activating the H bridge. Modulated three phase AC voltage flowing thorough the stator then interacts with the north and south poles of the rotor.



ISG Wiring Schematic

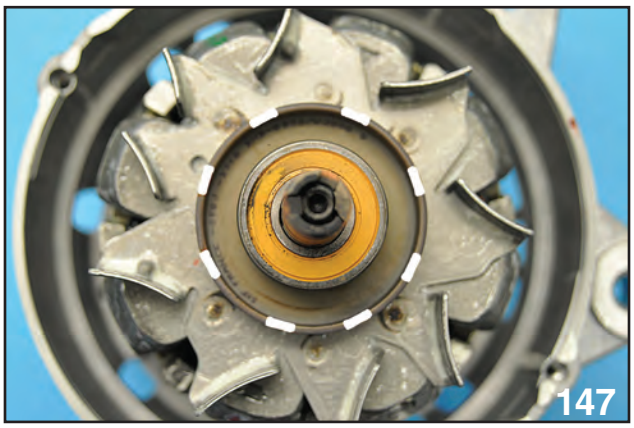


ISG Rotor

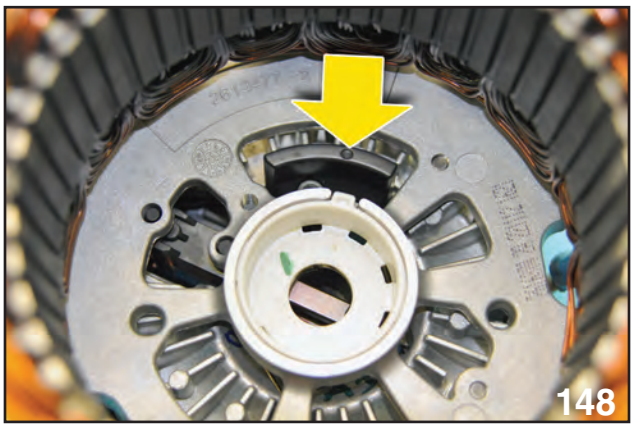


ISG Brushes

The permanent magnets placed between the claw poles of the rotor increase the total magnetic field of the rotor. This adds strength and speed of the ISG for starter and charging functions without adding additional rotor coil windings.

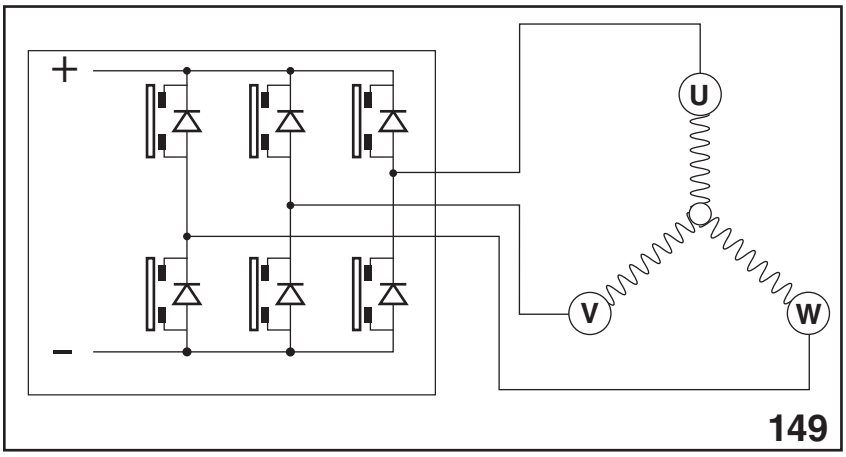


Resolver Rotor

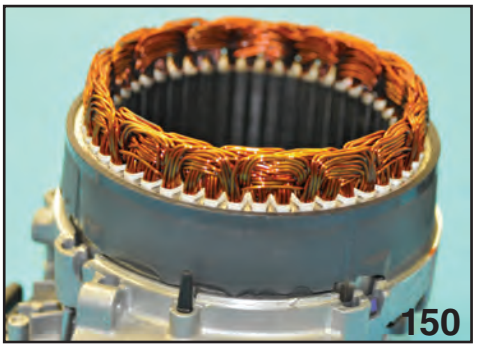


Resolver

The ISG is equipped with resolver to monitor ISG speed and position of the rotor. The ISG Control Unit uses the signals of the resolver to properly time the on and off control of the U,V, and W windings.

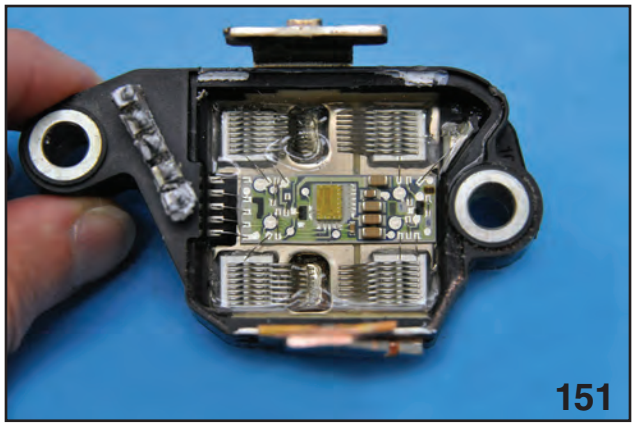


ISG Transistor and Diode Configuration



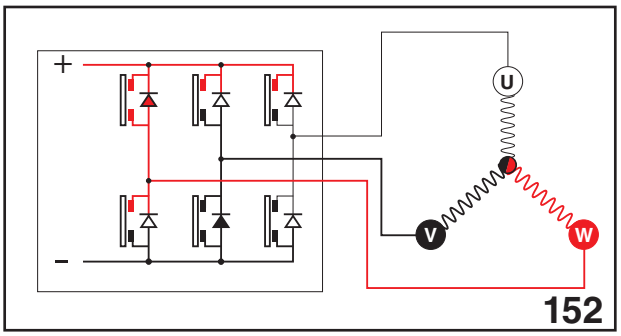
ISG Stator

The U,V, and W windings are the conventional stator windings of the alternator. The number of windings is slightly higher than a typical alternator. The synchronized movement of the alternating magnetic field around the stator attracts and repels the alternating magnetic poles of the rotor. This creates the motor function.

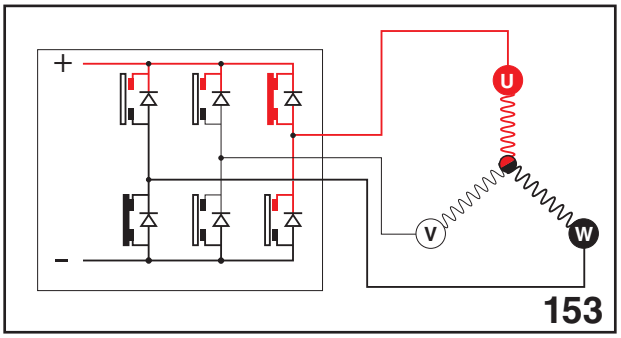


ISG Transistors and Diodes (1 set)

Diodes and high amperage transistors are connected to the stator windings. The diodes rectify AC voltage during the charging function and the transistors control the motor operation.



Charging



Motor Function

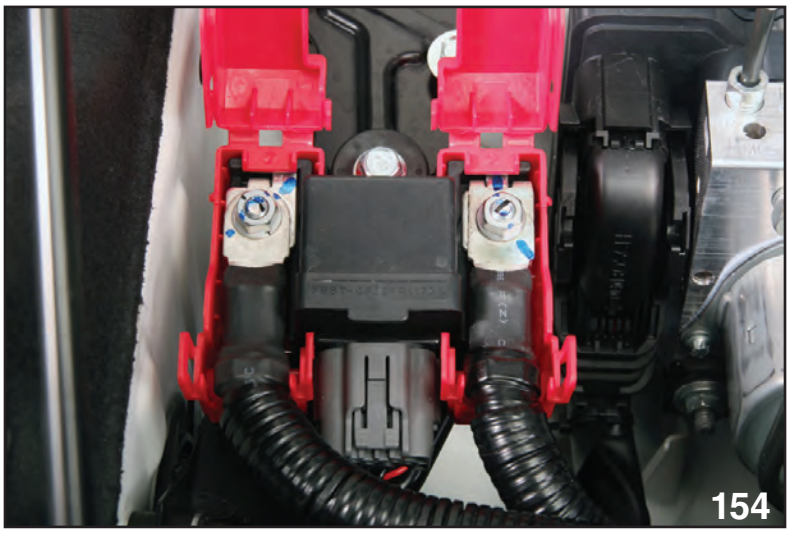
The ISG is also used to stop the engine faster by creating a heavy mechanical load during the engine off command of Automatic Start Stop operation (alternator goes to high charge).

Interconnect Relay

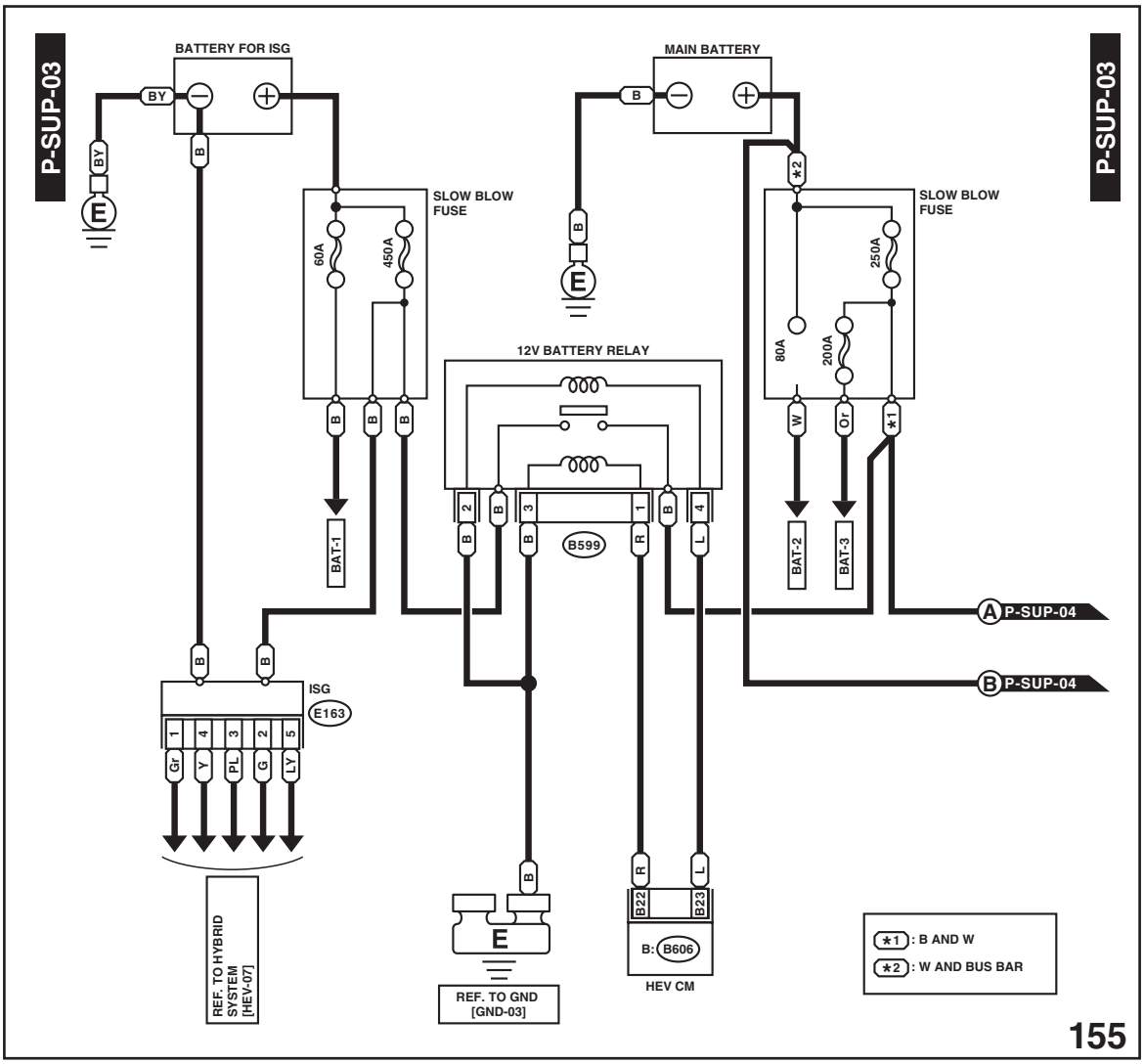
The Interconnect Relay provides an open or closed circuit from the ISG and Restart Battery to the Auxiliary Battery. This allows the ISG to charge the Auxiliary Battery when the High Voltage Battery state of charge is lower than 38%, or if the DC/DC Converter is not functioning.

Note: If the ISG fails, the Interconnect Relay (12 Volt Relay) will close and the battery warning light in the combination meter will illuminate. The DC/DC Converter will turn off the 12 volt output to the Auxiliary Battery, however, the High Voltage Battery will continue to charge. As the State of Charge of the High voltage Battery increases, the amount and timing of the Electric Motor Assist will advance.

When the voltage of the Auxiliary and Restart Batteries drop below a specific level, the engine will no longer operate.



Interconnect Relay



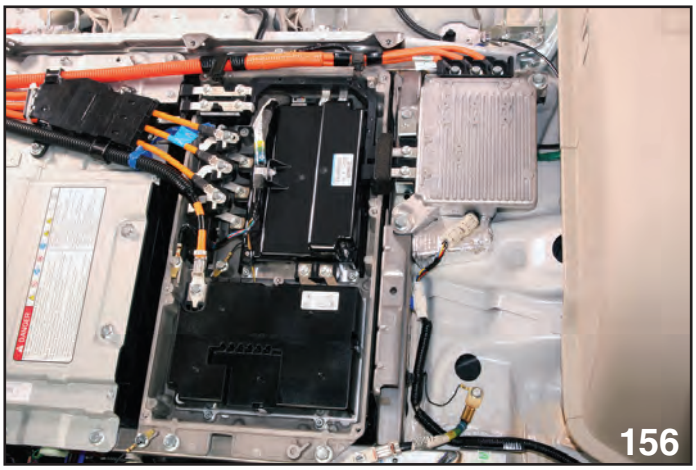
Interconnect Relay Wiring Schematic

The Interconnect (12 Volt Battery Relay) is a normally open relay. The HEV CM closes the relay by providing 12 volts positive to terminal 1 of B599. The spring that opens the relay is assisted with an opening coil (electro magnet). The HEV CM turns on the opening coil with 12 volts positive sent to terminal 4 of B599.

Electrical Operation

Before Automatic Start Stop activates

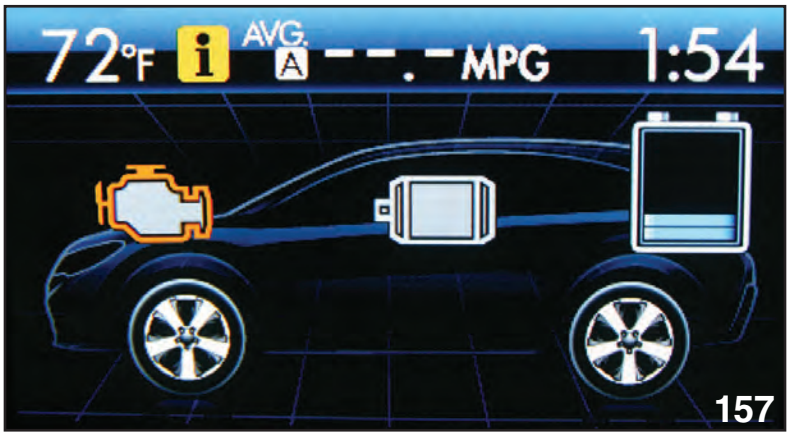
When the driver starts the engine (conventional starter), electric power from the Hybrid Battery begins to operate the DC/DC Converter.



DC/DC Converter

This changes 100 volts DC to approximately 13.8 volts DC and charges the Auxiliary Battery. The Auxiliary Battery provides the working power for the vehicle computers, safety equipment, heating and air conditioning, conventional starter, engine operation, and transmission operation.

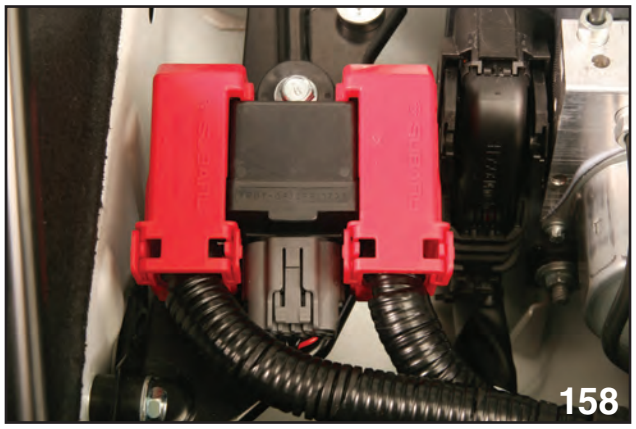
If the vehicle remains stationary, the Hybrid Battery state of charge will begin to drop.



High Voltage Battery Meter

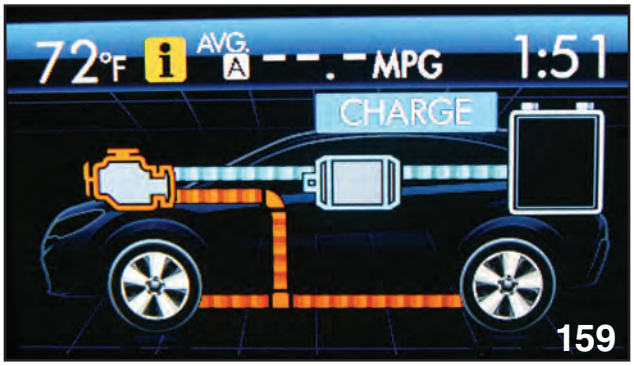
When the state of charge of the Hybrid Battery drops below 38%, the DC/DC Converter output will be turned off and the Interconnect Relay will close and the ISG will begin to charge the Auxiliary Battery.

Note: The ISG cannot charge the Hybrid Battery.

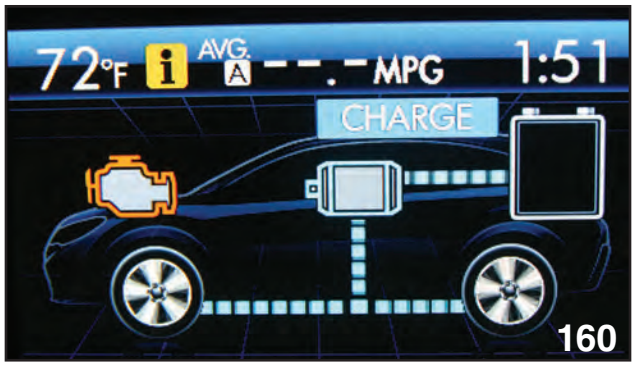


Interconnect Relay

As the vehicle begins to move the vehicle computers will determine when the best time to charge the Hybrid Battery exists.



Charging while Driving

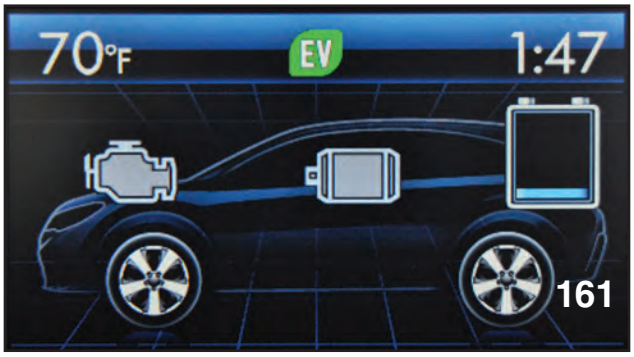


Charging while Decelerating (Regenerative Braking)

Charging should not inhibit acceleration or contribute to high fuel consumption so charging is performed during light engine load driving and during deceleration.

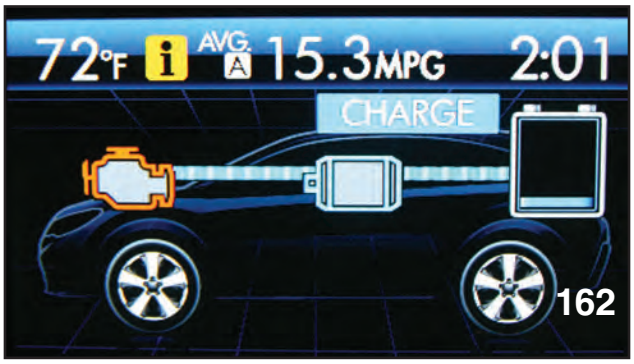
During Automatic Start Stop Operation

When the driver stops the vehicle and the vehicle computers determine the driver's intent is to stay stationary with the brake applied in Drive Gear Range, the engine will turn off.



MFD during Automatic Start Stop Engine Off

All other systems remain active. At this time the DC/DC Converter continues to operate. The Hybrid Battery state of charge will begin to drop. As soon as the state of charge drops below 38%, the engine will start. The state of charge of the Hybrid Battery is still low, the brake is still applied and the transmission is in Drive Gear Range.



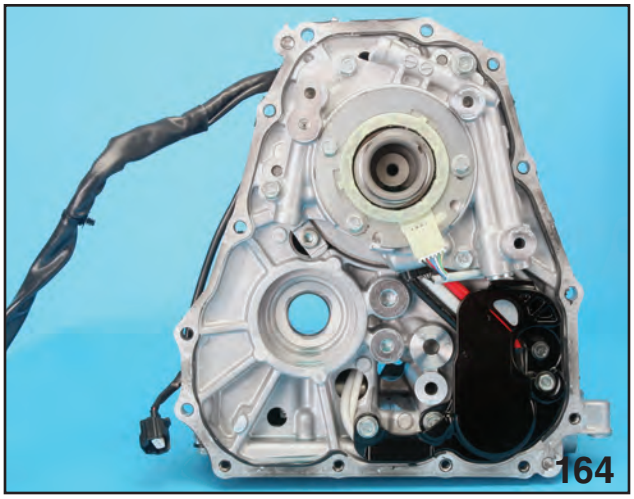
MFD during D Charge Mode

The TCM will now turn off the Output Clutch and the ECM will increase the engine speed to about 1200 RPMs. The engine is now driving the Hybrid Motor which is operating as an AC voltage generator. This begins to charge the Hybrid Battery. The D Charge Mode will remain active until the driver releases the brake pedal or the Hybrid Battery state of charge exceeds 40%.

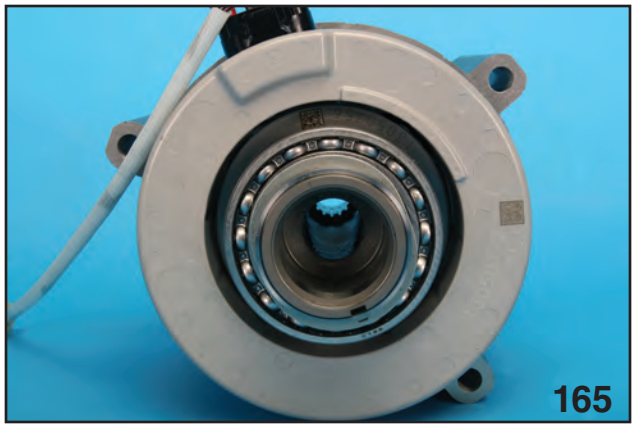
NOTE: D Charge Mode can activate anytime the vehicle is stationary, in Drive Gear Range, and the brake is applied.

Hybrid Motor

The Hybrid Motor provides mechanical power to the Primary Pulley of the Lineartronic™ Continuously Variable Transmission (CVT). Charging functions are provided when the Primary Pulley is the driving force rather than the driven member.



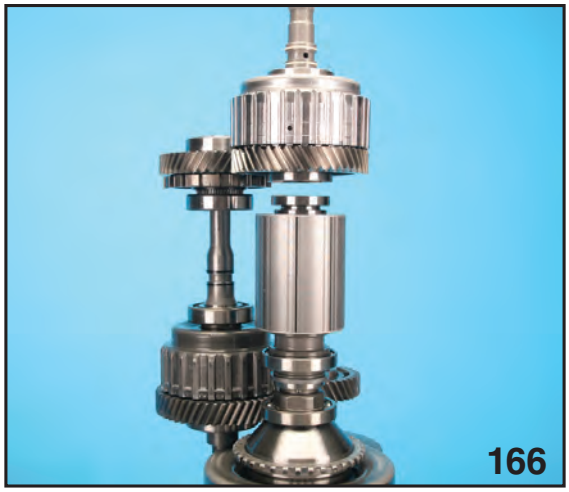
Hybrid Drive Motor Assembly



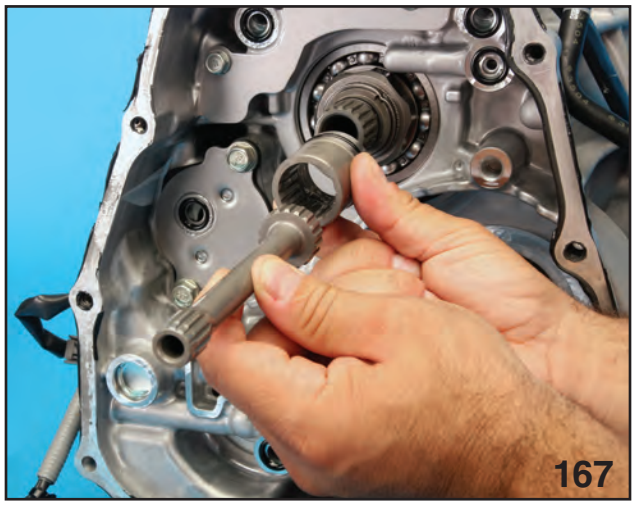
Hybrid Motor

The Hybrid Motor assembly is built into the new mid-section of the CVT (Gen 2) and cannot be serviced separately.

NOTE: Replacement of the Hybrid Electric Motor, with housing, will be allowed.

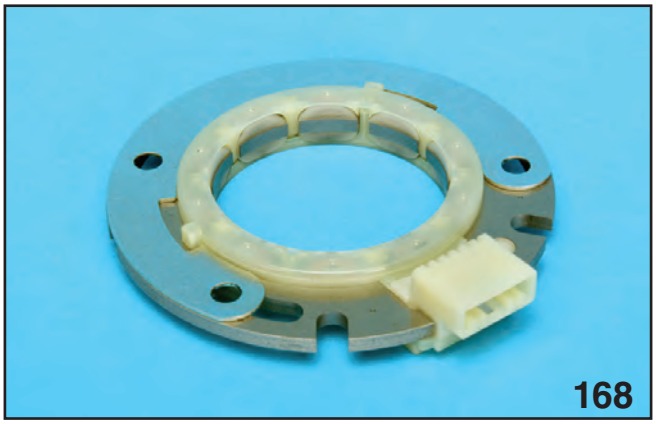


Hybrid CVT Configuration

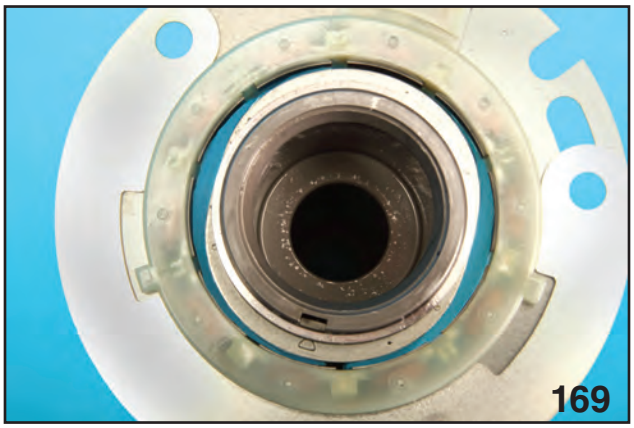


Coupling Sleeve and Connecting Shaft

The Hybrid Electric Motor Rotor is splined to the Primary Pulley with a Coupling Sleeve and a Connecting Shaft. The Connecting Shaft is designed to twist slightly to reduce mechanical shock between the Hybrid Electric Motor Rotor and the Primary Pulley.

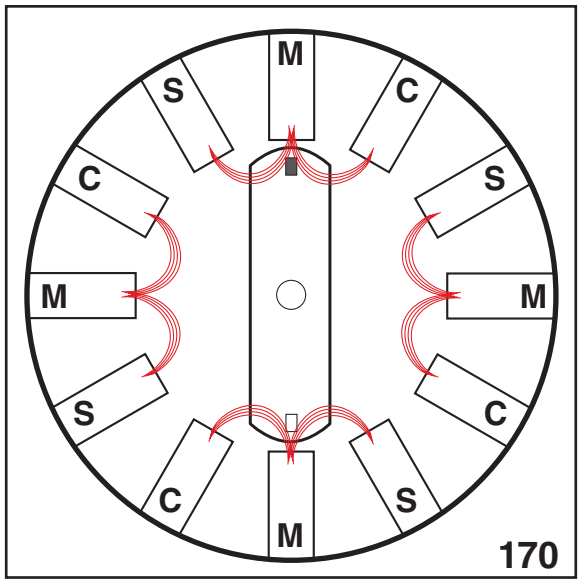


Resolver

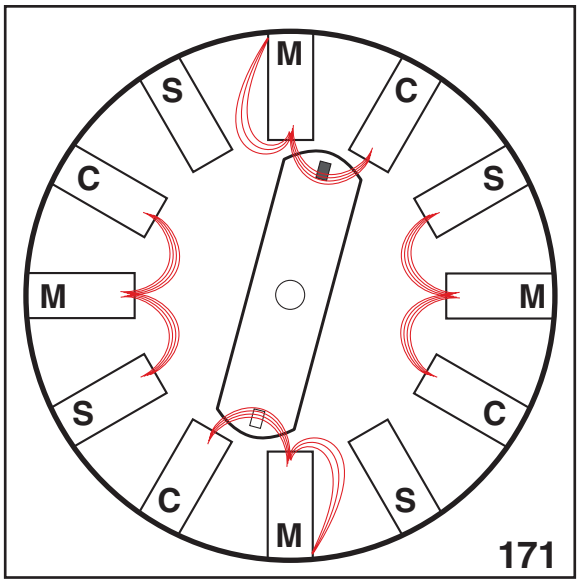


Resolver Rotor

A Resolver and a Resolver Rotor are positioned over the drive end of the Hybrid Motor to monitor the speed and direction of the Hybrid Motor Rotor. This Resolver functions similar to the Electronic Power Steering Resolver. The Hybrid Motor Control Module (DMCM) controls the working power, and receives the signals from the Hybrid Motor Resolver.

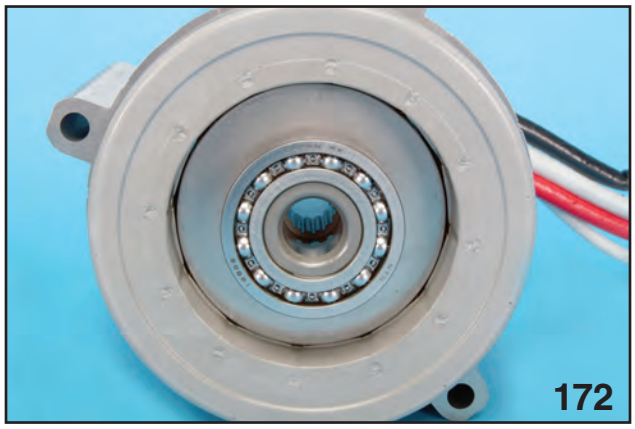


12:00 Position



12:30 Position

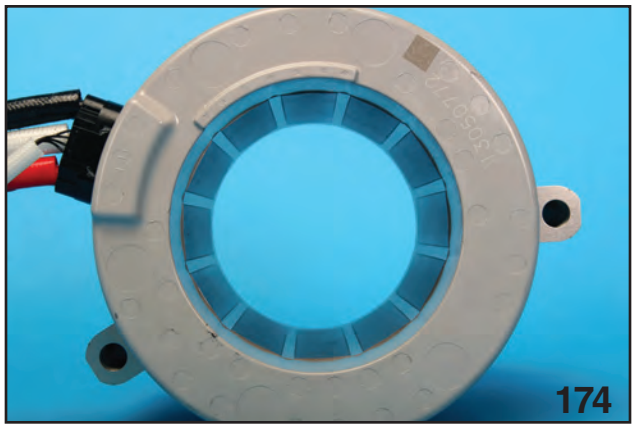
The Resolver Rotor changes the magnetic field of the Sine and Cosine Windings as it rotates. This action creates changes in voltage and provides the DMCM with signals that allow speed and direction to be determined.



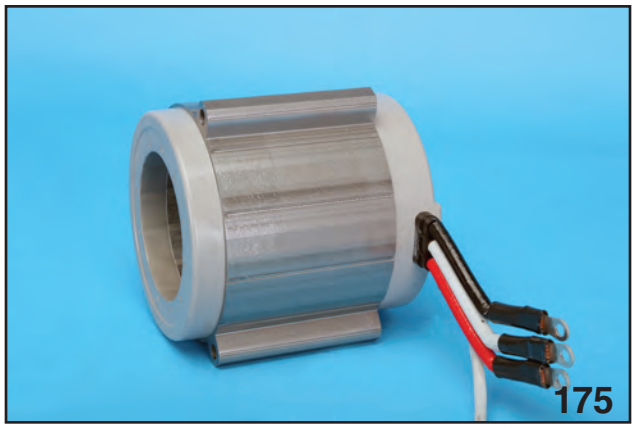
Lower Motor Bearing

Motor Rotor

Support for the Hybrid Motor Rotor is provided by an upper and lower caged ball bearing. The lower bearing is seated in the mid section of the transmission case. A shim selected at the factory controls the clearance between the case and the bearing. The upper bearing is seated in the Hybrid Motor Resolver Housing.

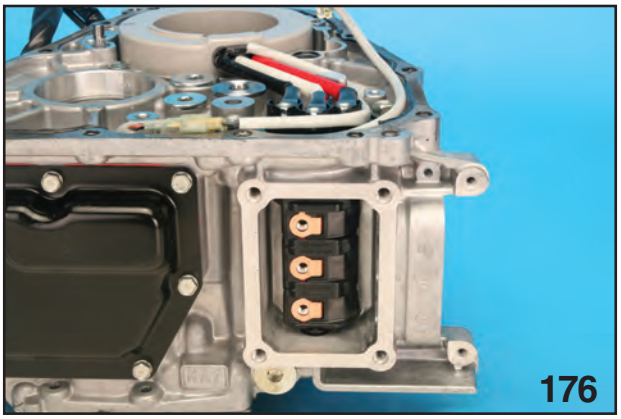


Stator



U, V, and W

The Hybrid Motor Rotor is equipped with very strong permanent magnets. The magnetic field they create is used to provide motor and charging functions. The magnets interact with the stator windings which are wired to the U, V, and W wires.



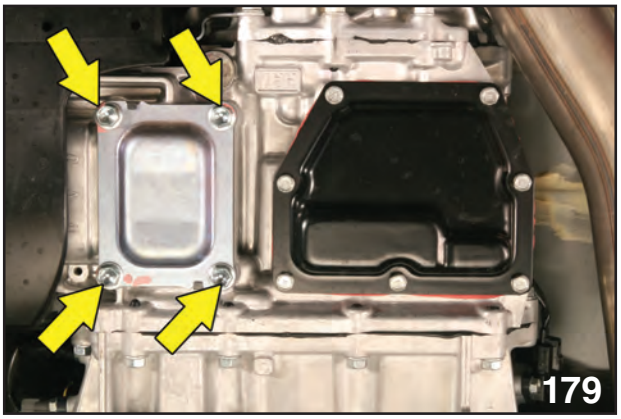
Junction Block Installed

Junction Block Bus Bars

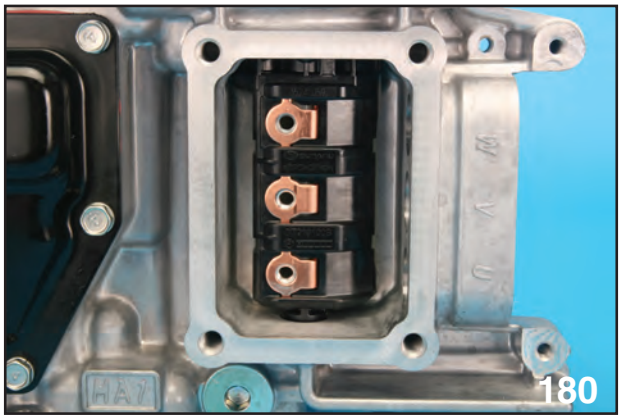
The three phase stator winding wires connect to an electrical junction block inside the transmission. The electrical junction block provides a connection point for the Hybrid High Voltage wires (orange). The bus bars are protected with a plastic cover.

Junction Block O-rings

An O-ring located around the junction block mount keeps transmission oil sealed from the Hybrid High Voltage wire connections.



High Voltage Access Cover



U, V, and W Connections

When removing the transmission from the vehicle, the Hybrid High Voltage wires must be disconnected from the transmission. The access cover must be removed to gain access to the bolts securing the wires to the junction block.

Note: Transmission oil has a very low dielectric constant and is a very poor conductor of electricity.

WARNING: The following procedures must be performed before removing the transmission.

1. **The Service Plug must be removed.**
2. **The exposed terminals of the High Voltage Battery Harness must be covered with electrical tape.**
3. **The negative battery cable ends of Auxiliary and Re-Start Batteries must be removed and covered with electrical tape.**

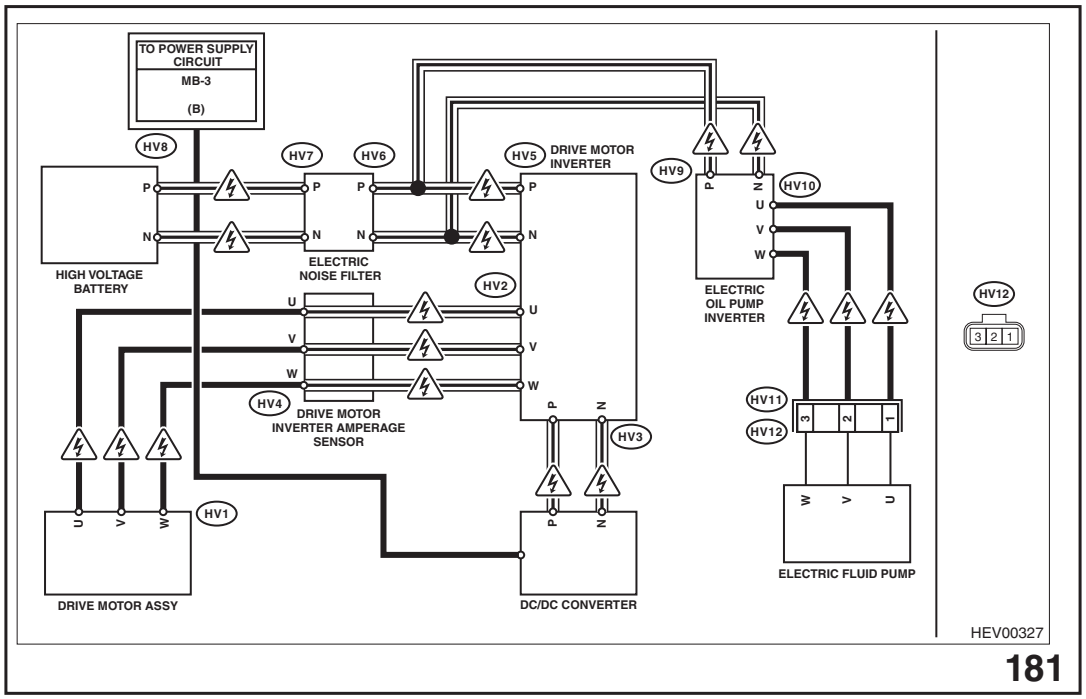
WARNING: The Hybrid Electrical Wires at the transmission have a very high voltage potential. Never remove the access cover until all 3 of the warnings above have been completed.

Note: Do not over tighten the bolts securing the Hybrid Electrical Wires to the junction block.

Note: Always torque the bolts securing the Hybrid Electrical Wires to the junction block to the proper specifications. Failure to do so will create a high resistance connection and create high heat that will damage the junction block. A damaged junction block cannot be replaced separately from the Hybrid Electric Motor Assembly.

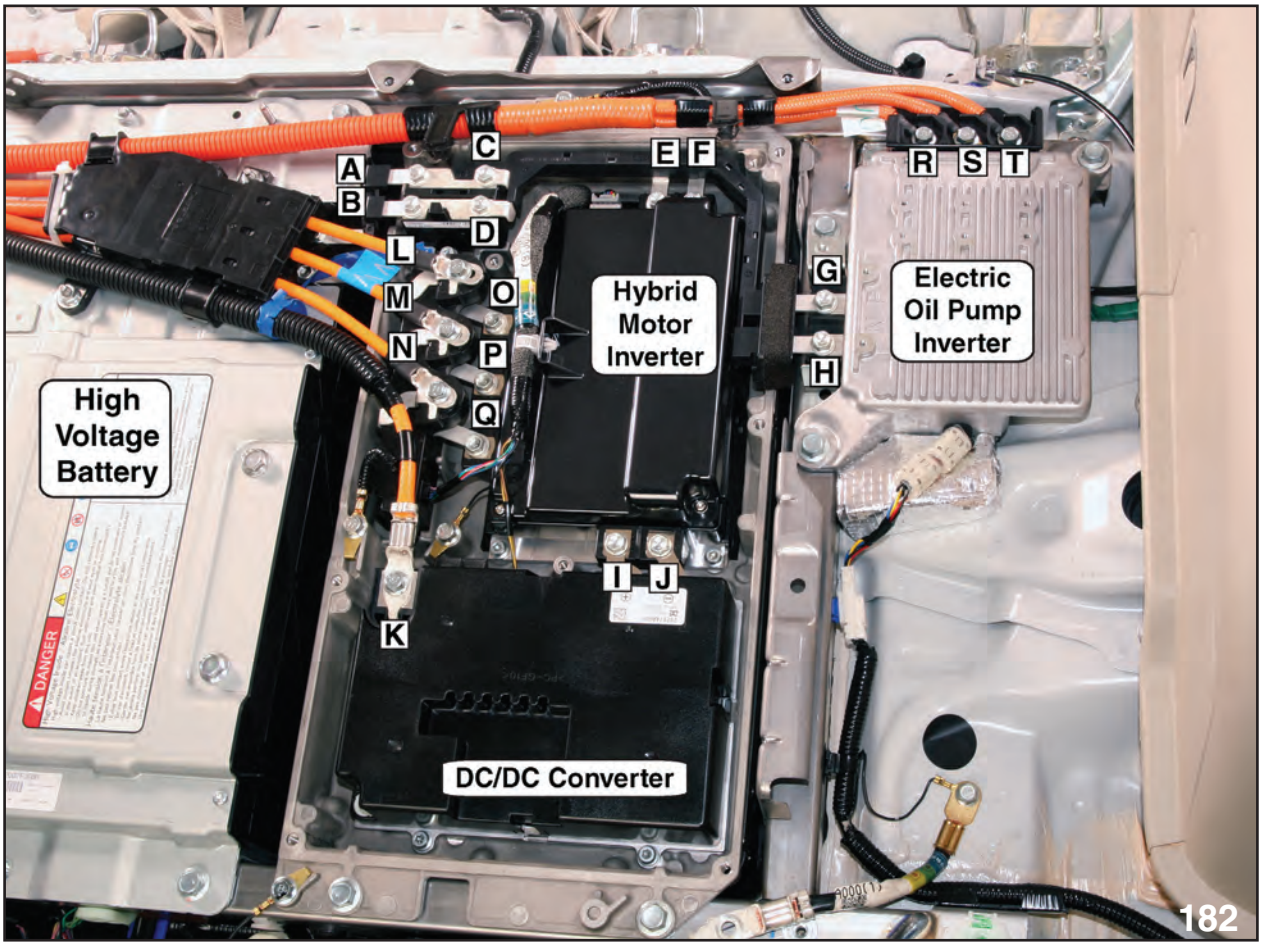
The Hybrid Electric Wires are wired to the Motor Inverter (IPU) for Hybrid Motor operation and rectification of the AC voltage during charging.

NOTE: Intelligent Power Unit (IPU)



High Voltage Wiring Configuration

Hybrid Component and High Voltage Battery



Hybrid System Voltages

A. Bus bar connection from High Energy Battery, Positive 100 volts DC with engine running or during engine off with Automatic Start Stop.

B. Bus bar connection from High Energy Battery, Negative 100 volts DC with engine running or during engine off with Automatic Start Stop.

C. Motor Inverter and Electric Oil Pump Inverter Bus bar connection at Noise Suppressor, Positive 100 volts DC with engine running or during engine off with Automatic Start Stop.

D. Motor Inverter and Electric Oil Pump Inverter Bus bar connection at Noise Suppressor, Negative 100 volts DC with engine running or during engine off with Automatic Start Stop.

E. Motor Inverter Power Positive Input, 100 volts DC with engine running or during engine off with Automatic Start Stop.

F. Motor Inverter Power Negative Input, 100 volts with engine running or during engine off with Automatic Start Stop.

G. Electric Oil Pump Inverter Power Positive Input, 100 volts DC with engine running or during engine off with Automatic Start Stop.

H. Electric Oil Pump Inverter Power Negative Input, 100 volts DC with engine running or during engine off with Automatic Start Stop.

I. DC/DC Converter Power Positive Input, 100 volts DC with engine running or during engine off with Automatic Start Stop.

J. DC/DC Converter Power Negative Input, 100 volts DC with engine running or during engine off with Automatic Start Stop.

K. DC/DC Converter Power Output, 13.8 volts DC (Ground is through Magnesium tray).

L. Motor Inverter Output U winding, approx. 200 volts AC with engine running, during Hybrid Motor operation and during charging.

M. Motor Inverter Output V winding, approx. 200 volts AC with engine running, during Hybrid Motor operation and during charging.

N. Motor Inverter Output W winding, approx. 200 volts AC during Hybrid Motor operation and during charging.

O. Motor Inverter Output U winding, approx. 200 volts AC with engine running, during Hybrid Motor operation and during charging.

P. Motor Inverter Output V winding, approx. 200 volts AC with engine running, during Hybrid Motor operation and during charging.

Q. Motor Inverter Output W winding, approx. 200 volts AC with engine running, during Hybrid Motor operation and during charging.

R. Electric Oil Pump Inverter Output U winding, approx. 200 volts AC during Hybrid operation and Automatic Start Stop.

S. Electric Oil Pump Inverter Output V winding, approx. 200 volts AC during Hybrid operation and Automatic Start Stop.

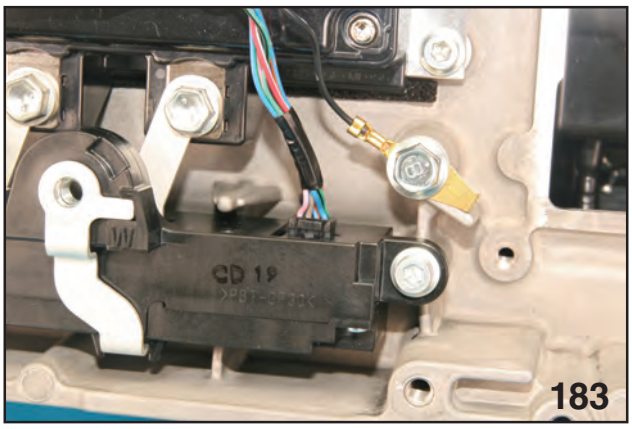
T. Electric Oil Pump Inverter Output W winding, approx. 200 volts AC during Hybrid operation and Automatic Start Stop.

NOTE: The circuits between the following points are constructed of individual Bus Bars that are inserted through an Inductive Amperage Sensor:

L ⟶ O

M ⟶ P

N ⟶ Q



Inductive Amperage Sensor

Amperage Sensor Bus Bar

NOTES:

High Voltage Battery Removal

Service Hat

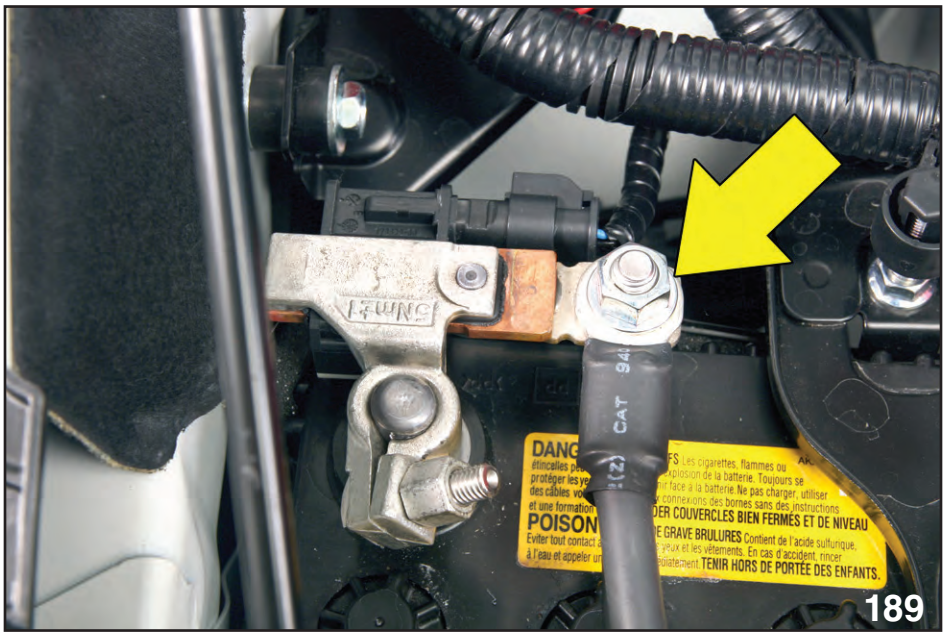
Place the “Danger High Voltage” top hat on the vehicle roof before performing any repair or diagnostics on a Hybrid Vehicle.

Auxiliary Battery

Auxiliary Battery Terminal

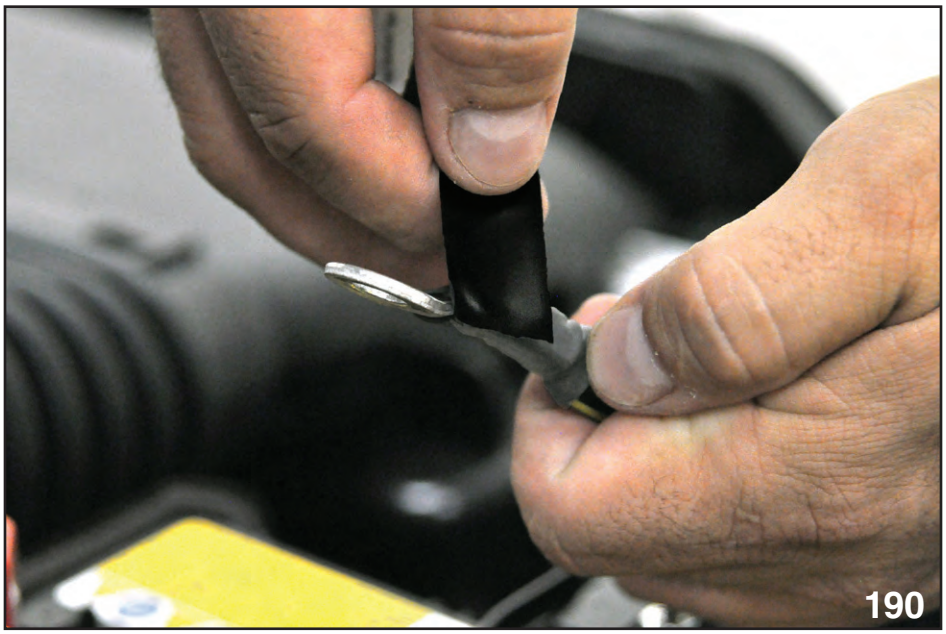
Remove the negative battery cable and terminal from the Auxiliary Battery and wrap the terminal with electrical tape.

Note: The positive battery cable extends to the DC/DC Converter and the Interconnect Relay.



Restart Battery Negative Cable

Remove the negative cable from the Re-start Battery terminal and wrap the cable end with electrical tape.



Insulating Ground Cable

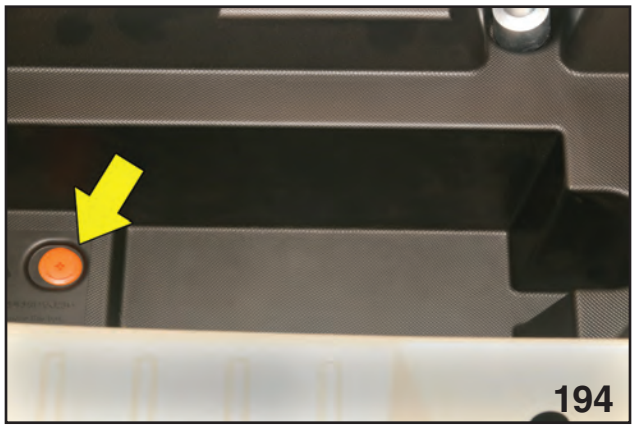
Cargo Area

Cargo Area Open

Warning Label

The High Voltage Hybrid Battery is located under the cargo storage platform. Remove the storage platform and confirm the warning label is in place. Replace any WARNING label that is damaged. Always install the warning label in the same position as the original.

WARNING: RUBBER INSULATION GLOVES with LEATHER PROTECTORS must be worn for the remainder of High Voltage Battery removal.



Orange Trim Tab

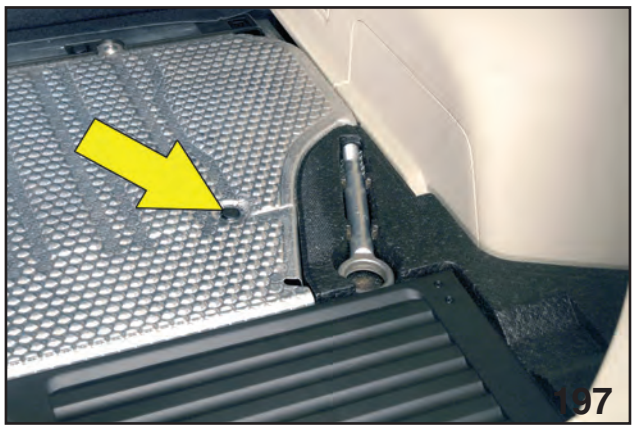
Remove the orange trim tab that secures the storage box to the vehicle body

Note: Always install an orange trim tab to this location.

Removing Service Plug

Tape Exposed Terminals

While wearing approved and tested insulation gloves, remove the Service Plug. Pull the lever until it contacts the locking tab. Push the locking tab in the direction of the arrow and continue to pull the lever to the vertical position and pull upward. Immediately place electrical tape over the exposed battery terminals.



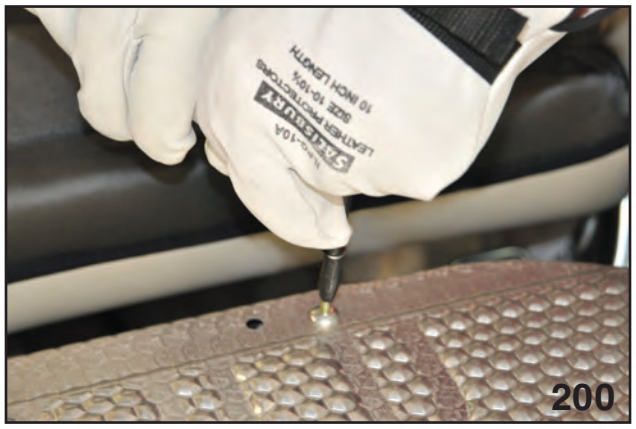
High Voltage Cover Trim

High Voltage Cover Trim Tab

Keep Service Plug Secure

Place the Service Plug in your pocket or in a locked tool box that you control.

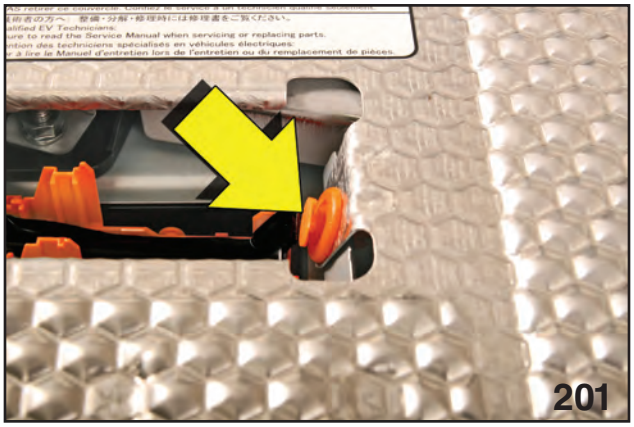
Remove the trim tabs that secure the left and right side cargo platform supports and remove the supports.



Torx® Bolts

Remove the Torx® bolts (T25) that secure the High Voltage Battery cover.

Note: Always position the Torx® socket into the bolt squarely and vertical. Push down on the socket will applying the force required to loosen the bolt.



Orange Trim Tab

Removing High Voltage Battery Cover

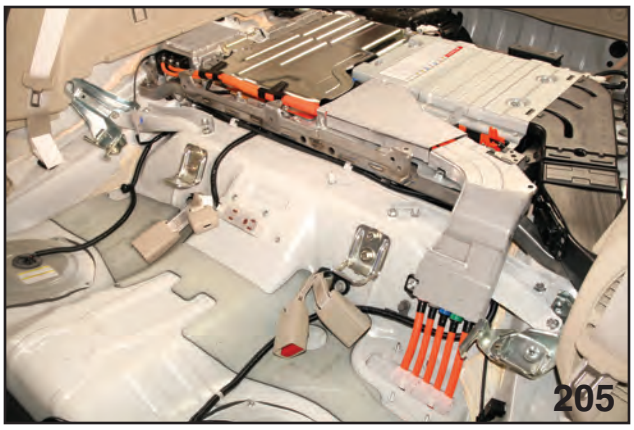
Remove the orange trim tab near the Service Plug.

Note: Always return an orange trim tab to this location. Lift the cover to clear all of the Hybrid components and remove the cover from the rear of the vehicle.

Air Duct Sliding Connection

C Pillar Intake Vent

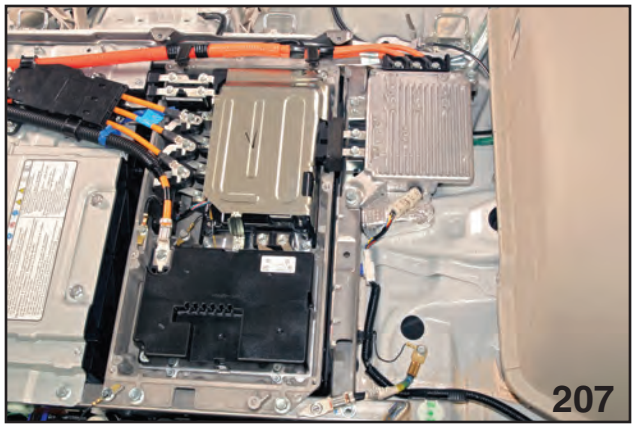
Slide the cooling duct connector in the direction of the arrow. Check the air duct and vent for any obstructions or deformation. Clear the duct or replace any damaged parts that would slow down airflow.



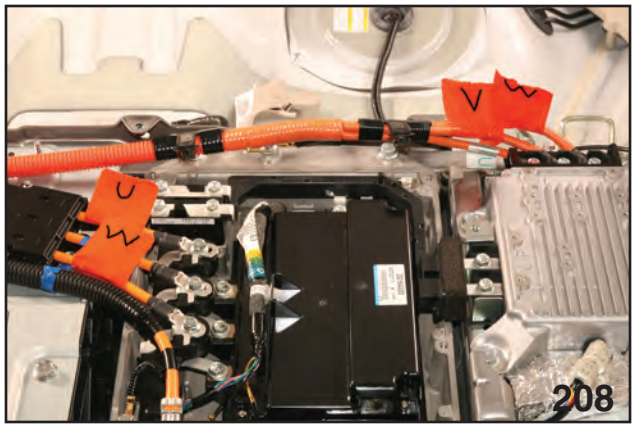
High Voltage Battery and Harness

High Voltage Battery

NOTE: The rear seat has been removed for photography. The rear seat does not need to be removed to remove the High Voltage Battery. Remove the metal wiring harness protectors. Remove bolts from the Inverter Cover. Lift the Inverter Cover, unclip the wiring harness locator tabs, and remove from the rear of the vehicle.



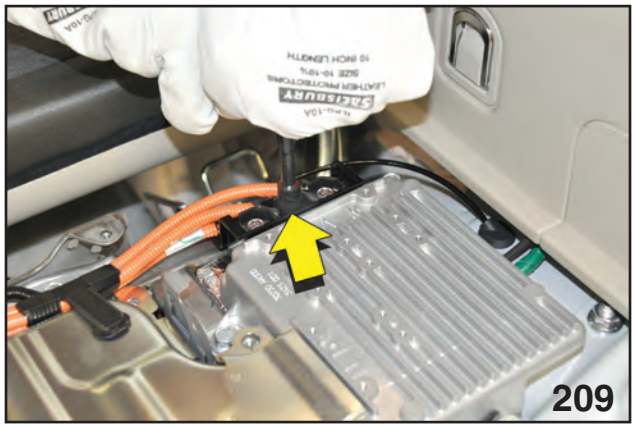
Motor and Electric Oil Pump Inverter



3 Phase Wires Labeled

Label the wires (U,V,W) of the Hybrid Motor Inverter and the Electric Oil pump Inverter.

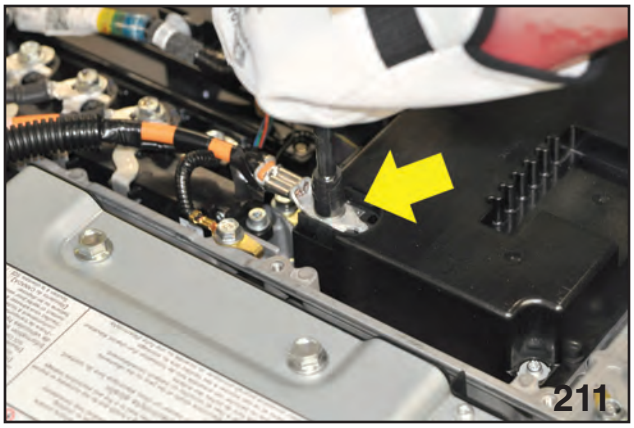
NOTE: The factory labels one wire on each harness.



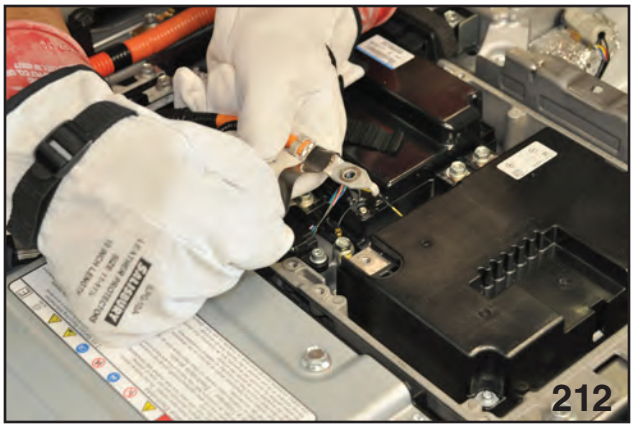
Removing Electric Oil Pump Wires

Tape Wire ends

Remove the wires from the Electric Oil Pump Inverter. Tape each wire as it is removed.



DC/DC Output Wire



Tape Output Wire Terminal

Remove the wire from the output of the DC/DC Converter. Tape the wire end.

Removing Motor Wires

Tape all wire terminals

Remove the wires and tape the wire ends of the Hybrid Motor Inverter.

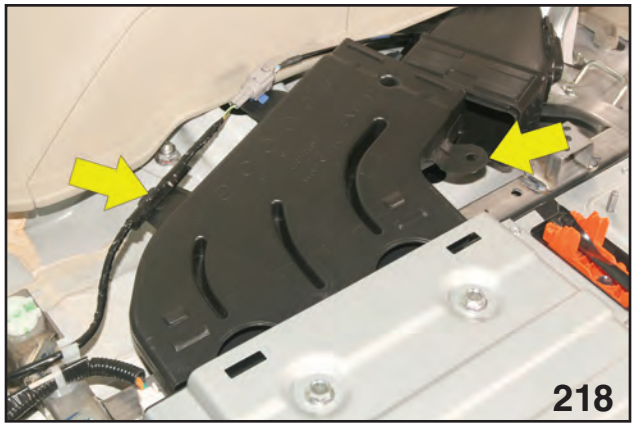
Harness Bracket

Harness Bracket

Remove the nuts securing the wiring harness to the vehicle.

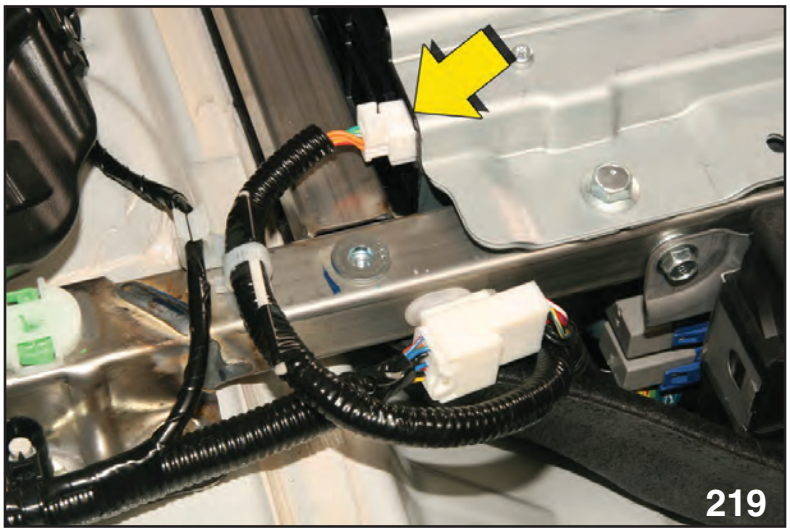
NOTE: The 2 nuts securing the metal bracket, ground the coaxial covering the Hybrid Motor Harness.

Move Harness Clear



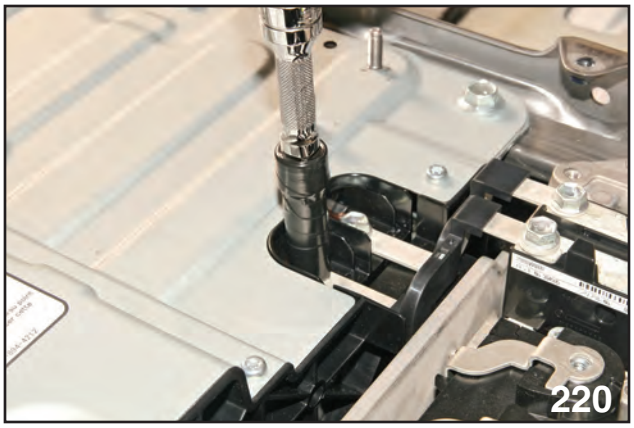
Air Vent Duct

Position the wiring harness away from the leading edge of the High Voltage Battery. Disengage the location tabs of the air vent inlet and remove the Air Inlet.



BECM Connector

Disconnect the Body Harness from the BECM.



Positive and Negative High Voltage Battery Terminals

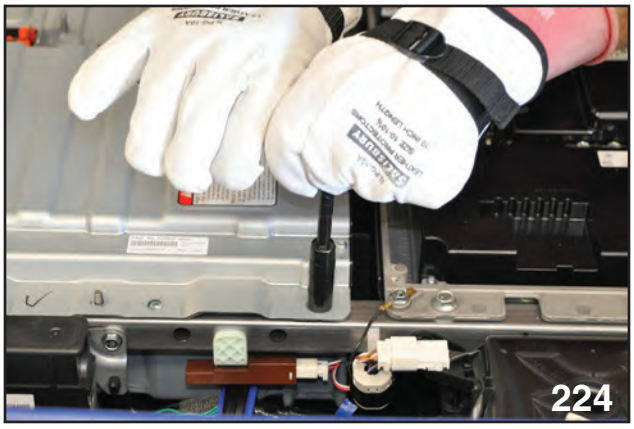
Noise Suppressor

Remove the bolts that connect the High Voltage Battery outlet to the Bus Bars. Remove the bolts securing the Bus Bars to the Noise Suppressor.

Bus Bar

Remove the Bus Bar.

High Voltage Battery Mounting Bolts



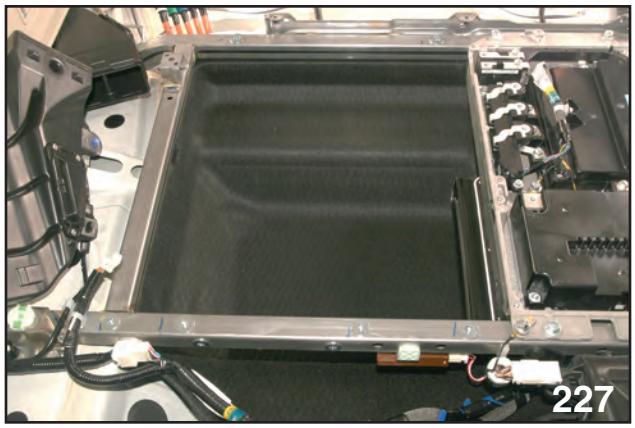
High Voltage Battery Mounting Bolt

Remove the 5 bolts that secure the Hybrid Battery to the vehicle.

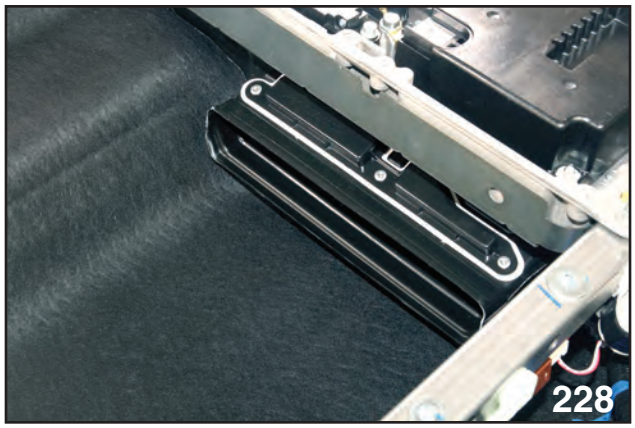
Protect Vehicle Trim

Removing High Voltage Battery

Place a fender cover over the rear bumper cover and rear gate entry threshold. The next step requires two technicians that are wearing rubber insulation gloves with leather protector gloves. Tilt the driver side of the High Voltage Battery upward and slide the High Voltage Battery slightly towards the driver side of the vehicle. **The air duct of the battery must disengage from the air duct of the Hybrid Component Tray.** Lift the High Voltage Battery towards the rear of the vehicle and rest it on the fender cover. The technician from the inside of the vehicle should now exit the vehicle and assist with moving the High Voltage Battery to a safe location.



Secondary Containment Tray

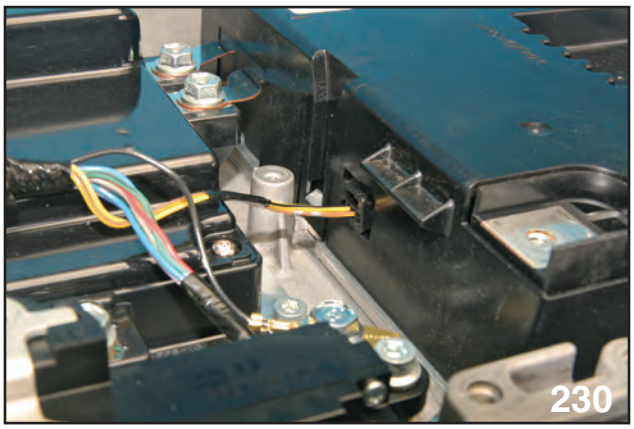


Air Duct

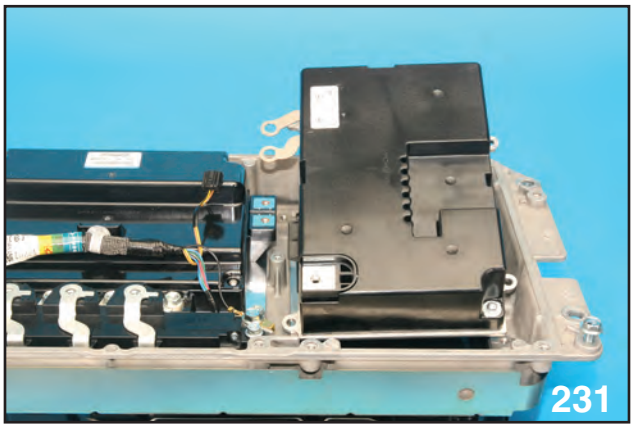
Check the Secondary Containment Liner.

CAUTION: Any liquid in this area may have a high alkalinity and will cause eye and skin irritations. Review the cautions in the introduction section of this TRB and the Subaru Service Manual for additional information.

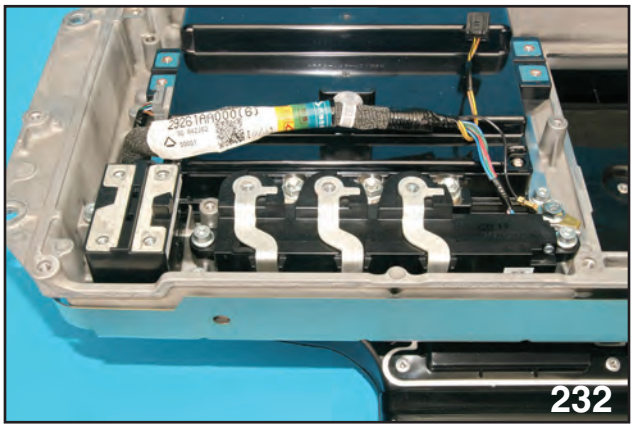
Bus Bar



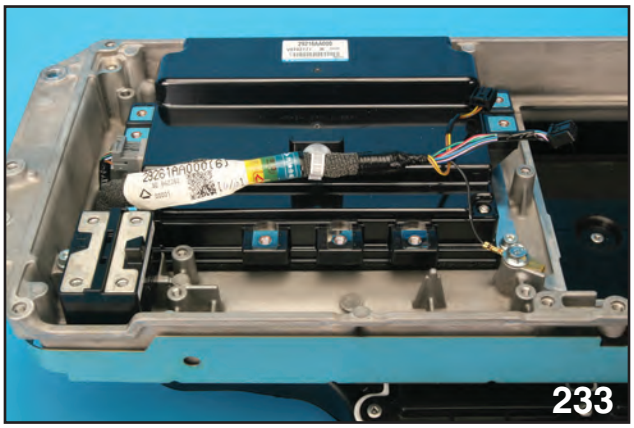
DC/DC Connector



DC/DC Converter



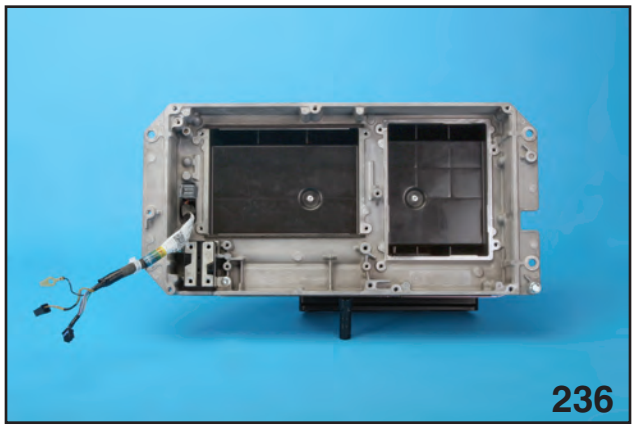
Induction Amperage Sensor, Noise Suppressor and Motor Inverter



Motor Inverter and Noise Suppressor

Bottom view of Motor Inverter (IPU)

Motor Inverter (IPU)

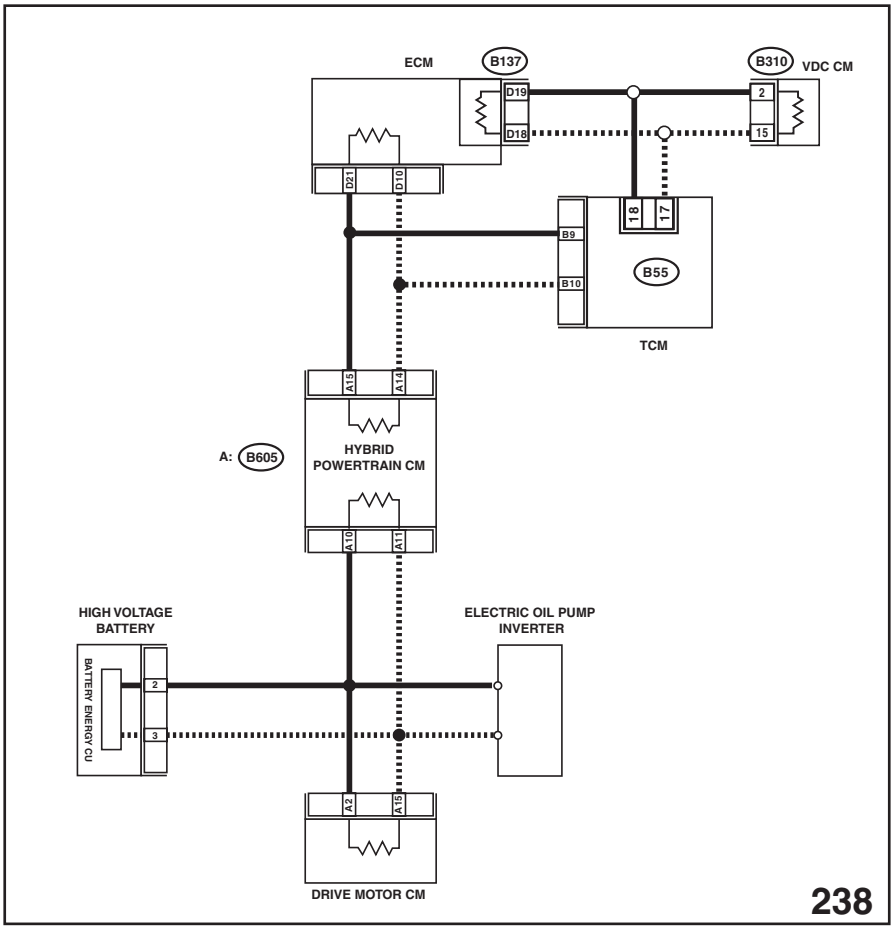


Hybrid Component Tray (Magnesium)

NOTES:

XV Crosstrek Hybrid CAN Communications

Note: The following information describes the physical CAN construction of the XV Crosstrek Hybrid. Complete operation of each component part is not included.



2014 XV Crosstrek Hybrid CAN

A conventional drive train, where the engine is the only driving force, uses the engine ECM as the manager of all engine operating commands. The XV Crosstrek Hybrid can be propelled by two forces, the engine or the Hybrid Electric Motor. The human machine interface remains the same sharing the same gas pedal, speedometer, brake system and all vehicle controls. However, with the potential of two driving forces, one Control Module must be in control. This provides seamless transition from engine to electric propulsion. The XV Crosstrek Hybrid Powertrain Control Module monitors all driving conditions, controlling the engine and the Hybrid Electric Motor.

This dual control can only be accomplished with the additional communications from two new High Speed Controller Networks (CAN). The XV Crosstrek Hybrid introduces the HEV CAN and the PU CAN.

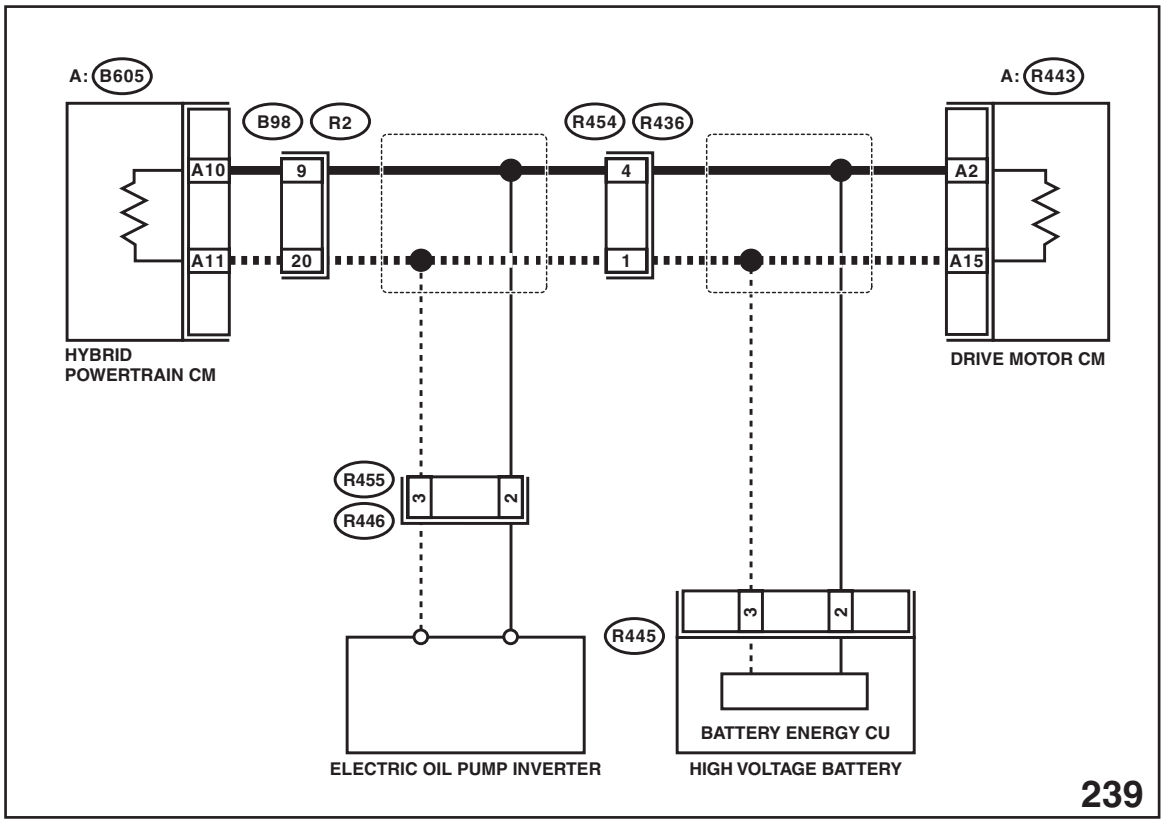
Details of the Hybrid Electric Vehicle CAN and the Power Unit CAN operation will be introduced on the next few pages.

Each of the new High Speed Controller Area Networks is constructed similar to the Main CAN. Equipped with 2 terminators, each of their total circuit resistance values is about 60 ohms.

Note: The HEV Control Module provides a gateway function that allows all Controller Area Networks to communicate with each other. This function also allows diagnostic communication and work support to be provided over the two CAN wires on the diagnostic connector.

HEV CAN

The HEV CAN terminators are located in the Hybrid Powertrain Control Module (HEV Control Module) and the Drive Motor Control Module (DMCM). The terminator in the HEV Control Module, connected to the HEV CAN, is dedicated to the HEV CAN. The Electric Oil Pump Inverter and the Battery Energy Control Unit are connected to the HEV CAN in CAN branch circuits. Driving and charging functions are controlled in this CAN circuit.



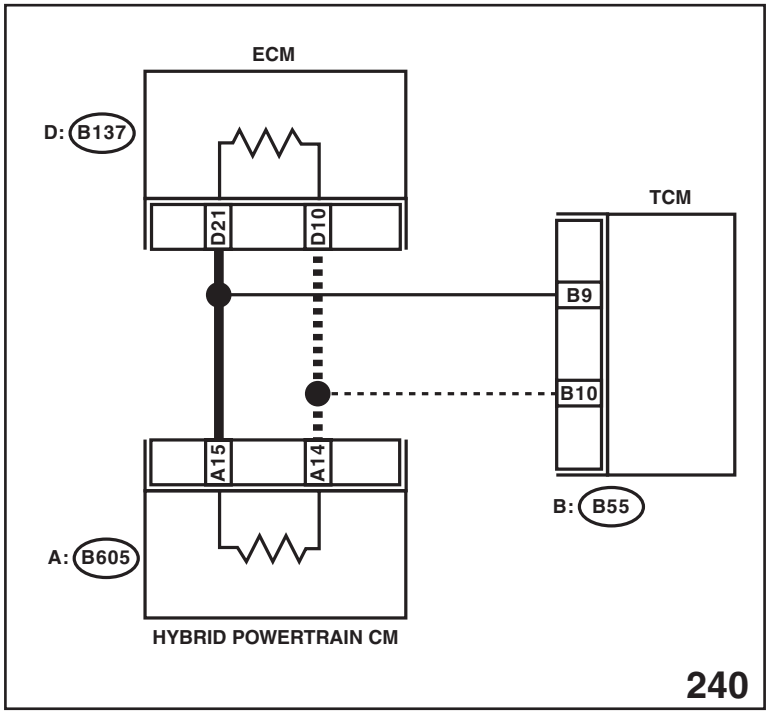
HEV CAN

Information from the HEV Control Module to the Drive Motor Control Module provides torque and rotational speed requirements needed from the Hybrid Electric Motor. The HEV Control Module also sends a signal to the Electric Oil Pump Inverter. Control of the Electric Oil Pump requires no electronic communications back to the Electric Oil Pump Inverter.

NOTE: The Secondary Oil Pressure Sensor detects Electric Oil Pump operation.

PU CAN

The PU (Power Unit) CAN terminators are located in the Engine ECM and the Hybrid Powertrain Control Module. The TCM is connected as a CAN branch circuit. The terminals of the TCM connecting to the HEV CAN are dedicated to the HEV CAN.



PU CAN

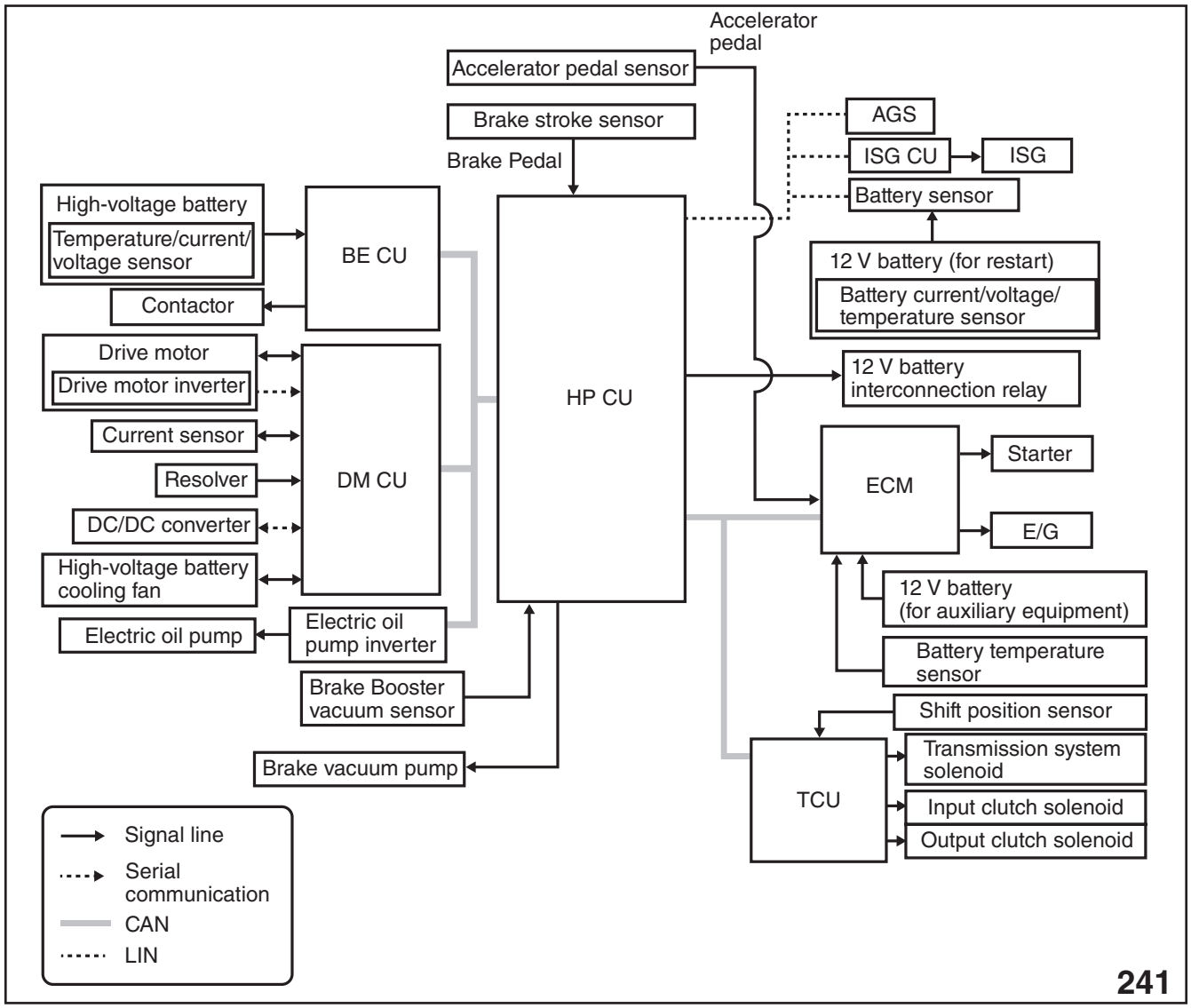
The Hybrid Powertrain Control Module issues the main engine operating commands and sends them to the Engine ECM through the PU CAN. These commands and instructions include: Torque requirements, Fuel Cut requirements (Automatic Start Stop), and Rotation speed requirements.

Normal idling and fuel cut (deceleration) is determined and controlled by the Engine ECM.

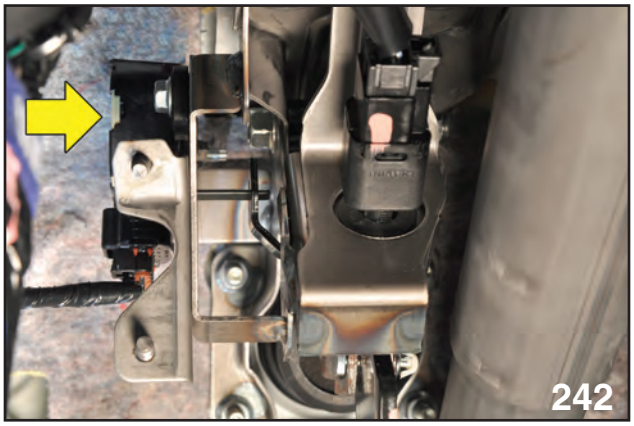
Inputs for engine speed and engine coolant temperature are sent to the HEV CM through the PU CAN.

The PU CAN also controls gear ratios and clutches in the CVT. Communications from the HEV CM to the TCM allow the HEV CM to control gear ratios and the Forward and Output Clutch in EV Mode and Automatic Start Stop Mode. (HEV CM also controls gear ratio in Engine Drive Mode).

NOTE: The ECM and TCM will return to conventional control if the PU CAN has failed.



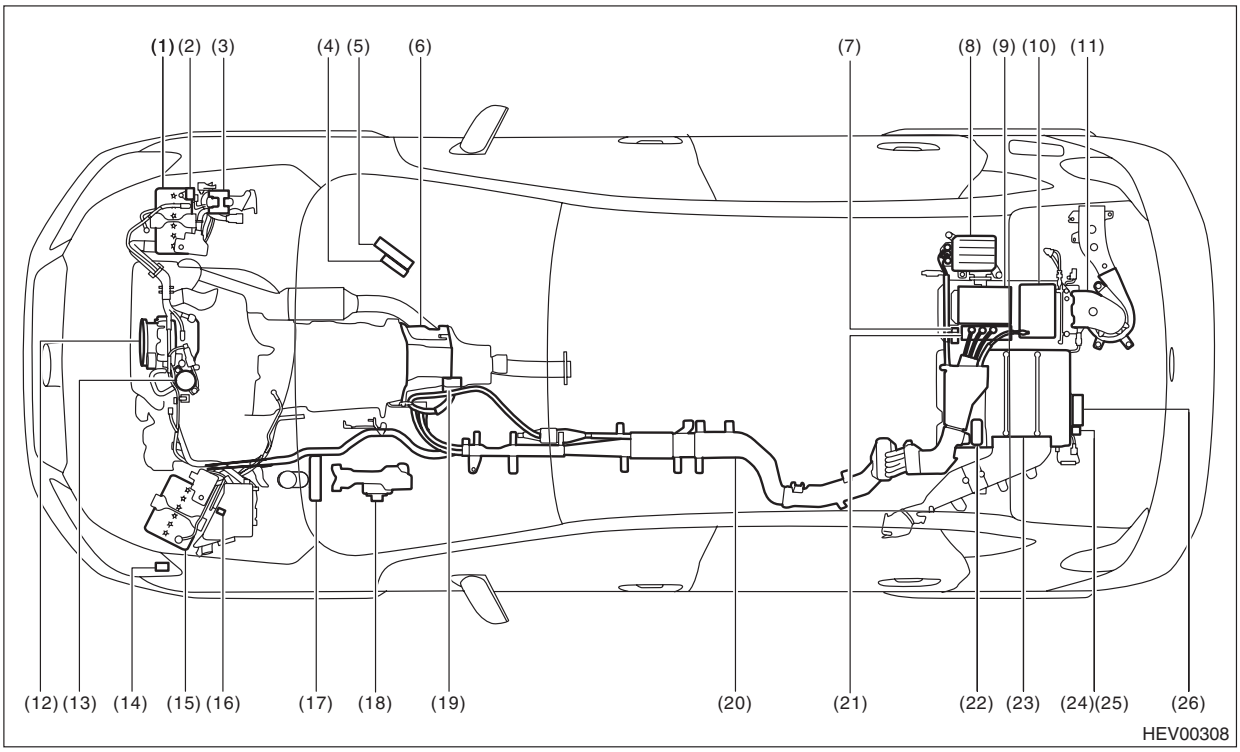
HEV CAN and PU CAN



Brake Stroke Sensor

NOTE: The Brake Pedal Stroke Sensor provides input that determines the EV Mode On/ Off Status.

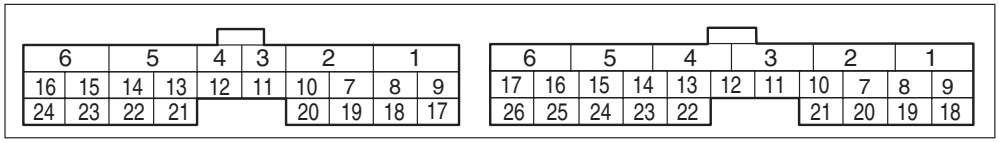
Hybrid Component Locations



(1)	12 volt engine restart battery	(10)	DC/DC converter	(19)	Electric oil pump
(2)	Battery sensor	(11)	High voltage battery cooling fan	(20)	Power cable
(3)	12 V battery-to-battery connecting relay	(12)	Integrated starter generator (ISG)	(21)	Drive motor inverter current sensor
(4)	Hybrid powertrain control module (HPCM)	(13)	Brake vacuum pump	(22)	Service plug
(5)	Engine control module (ECM)	(14)	Battery temperature sensor	(23)	High voltage battery (including battery energy control module (BECM))
(6)	Drive motor ASSY	(15)	12 volt auxiliary battery	(24)	DMCM power relay
(7)	Noise filter	(16)	Brake vacuum pump relay	(25)	High voltage battery cooling fan/ drive motor inverter power relay
(8)	Electric oil pump inverter	(17)	Brake booster (including brake booster pressure sensor)	(26)	Drive motor control module (DMCM)
(9)	Drive Motor Inverter	(18)	Brake pedal ASSY (including brake stroke sensor)		

243

Hybrid Component location



TO B: B606

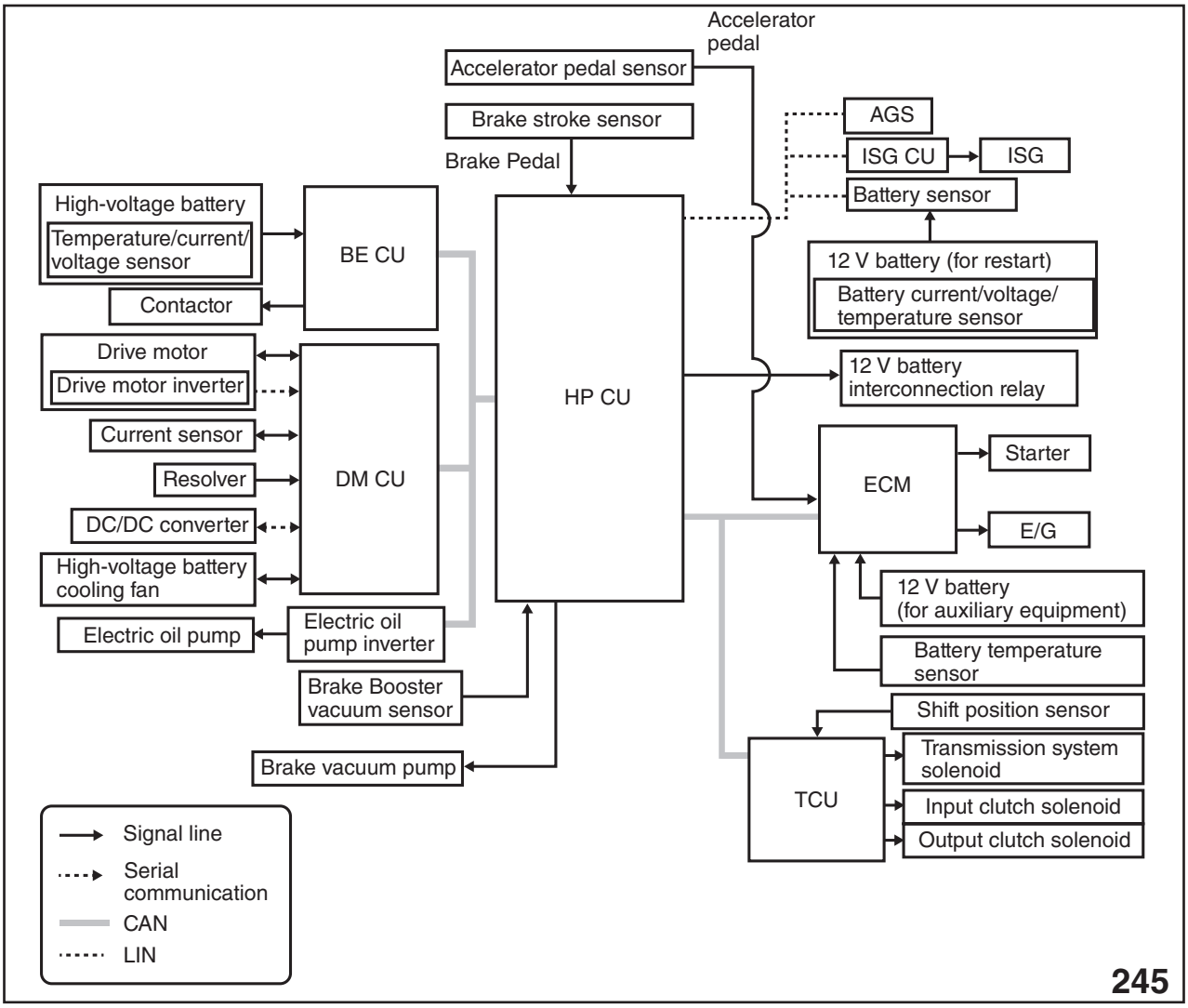
TO A: B605

HEV00080

Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(B605) No. 1	Linear solenoid output	—	Cannot be measured	—
(B605) No. 2	Main power supply 1	Always	11 — 15 V	—
(B605) No. 3	Main power supply 2	Always	11 — 15 V	—
(B605) No. 4	LIN communication	—	Cannot be measured	LIN communication line
(B605) No. 5	GND1	Always	0 V	—
(B605) No. 6	GND2	Always	0 V	—
(B605) No. 7	(Not used)	—	—	—
(B605) No. 8	(Not used)	—	—	—
(B605) No. 9	(Not used)	—	—	—
(B605) No. 10	HEV CAN H	—	Cannot be measured	CAN communication line
(B605) No. 11	HEV CAN L	—	Cannot be measured	CAN communication line
(B605) No. 12	MAIN CAN H	—	Cannot be measured	CAN communication line
(B605) No. 13	MAIN CAN L	—	Cannot be measured	CAN communication line
(B605) No. 14	PU CAN H	—	Cannot be measured	CAN communication line
(B605) No. 15	PU CAN L	—	Cannot be measured	CAN communication line
(B605) No. 16	(Not used)	—	—	—
(B605) No. 17	(Not used)	—	—	—
(B605) No. 18	Oil pressure SW input	Engine running	11 — 15 V	—
		When ignition switch is ON	0 V	—
(B605) No. 19	(Not used)	—	—	—
(B605) No. 20	(Not used)	—	—	—

244

Hybrid Powertrain Control Module (HPCM) I/O



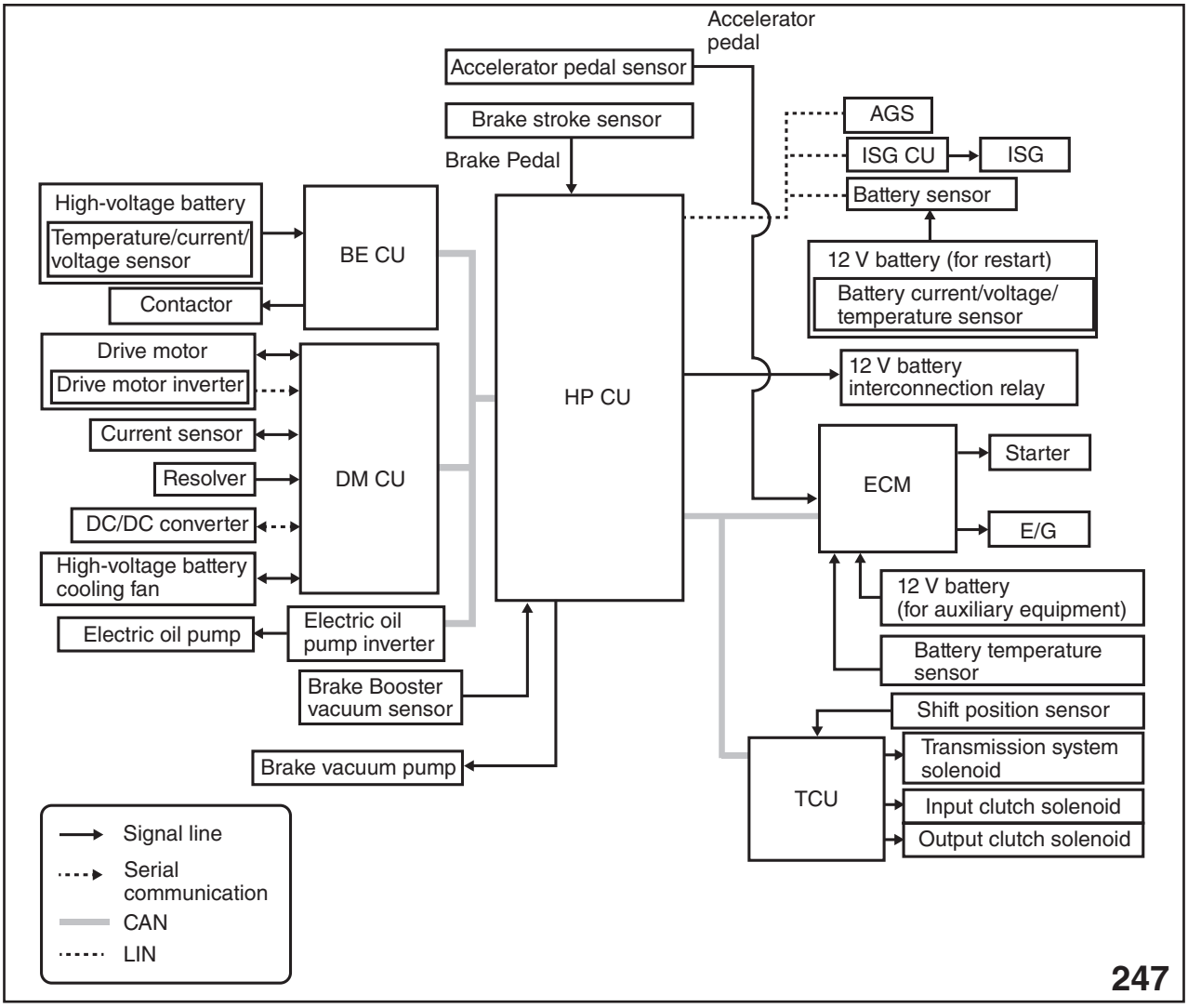
HEV CAN and PU CAN

NOTES:

Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(B605) No. 21	IG SW input	Ignition switch ON	11 — 15 V	—
(B605) No. 22	Starter drive request signal	Model without push button start at cranking	8 — 14 V	—
		Model with push button start at cranking	Waveform	—
(B605) No. 23	P range SW input	P range	Less than 1 V	—
		Except for P range	8 V or more	—
(B605) No. 24	R range SW input	R range	Less than 1 V	—
		Except for R range	8 V or more	—
(B605) No. 25	N range SW input	N range	Less than 1 V	—
		Except for N range	8 V or more	—
(B605) No. 26	D range SW input	D range	Less than 1 V	—
		Except for D range	8 V or more	—
(B606) No. 1	GND1 for sensors	Always	0 V	—
(B606) No. 2	GND2 for sensors	Always	0 V	—
(B606) No. 3	Brake booster pressure sensor input 1	Always	0.5 — 4.5 V	—
(B606) No. 4	Brake booster pressure sensor input 2	Always	0.5 — 4.5 V	—
(B606) No. 5	(Not used)	—	—	—
(B606) No. 6	(Not used)	—	—	
(B606) No. 7	Sensor power supply output 1	When ignition switch is ON	4.5 V or more	—
(B606) No. 8	(Not used)	—	—	—
(B606) No. 9	Sensor power supply output 3	When ignition switch is ON	4.5 V or more	—
(B606) No. 10	(Not used)	—	—	—
(B606) No. 11	Brake stroke sensor input 1	When brake pedal is depressed	Approx. 1 V	—
		When brake is not depressed	Approx. 2.5 V	—
(B606) No. 12	(Not used)	—	—	—
(B606) No. 13	(Not used)	—	—	—
(B606) No. 14	ISG CRK output	When ignition switch is ON	Less than 1 V	—
(B606) No. 15	ISG INH output	When ignition switch is ON	Less than 2 V	—
(B606) No. 16	Brake vacuum pump relay output	When brake vacuum pump operates	9 V or more	—
		When brake vacuum pump not activated	0 V	—
(B606) No. 17	Sensor power supply output 2	When ignition switch is ON	4.5 V or more	—
(B606) No. 18	Battery voltage 2 monitor input	Always	11 — 15 V	—
(B606) No. 19	Vacuum pump relay monitor input	When brake vacuum pump operates	9 V or more	—
		When brake vacuum pump not activated	0 V	—

246

Hybrid Powertrain HPCM I/O



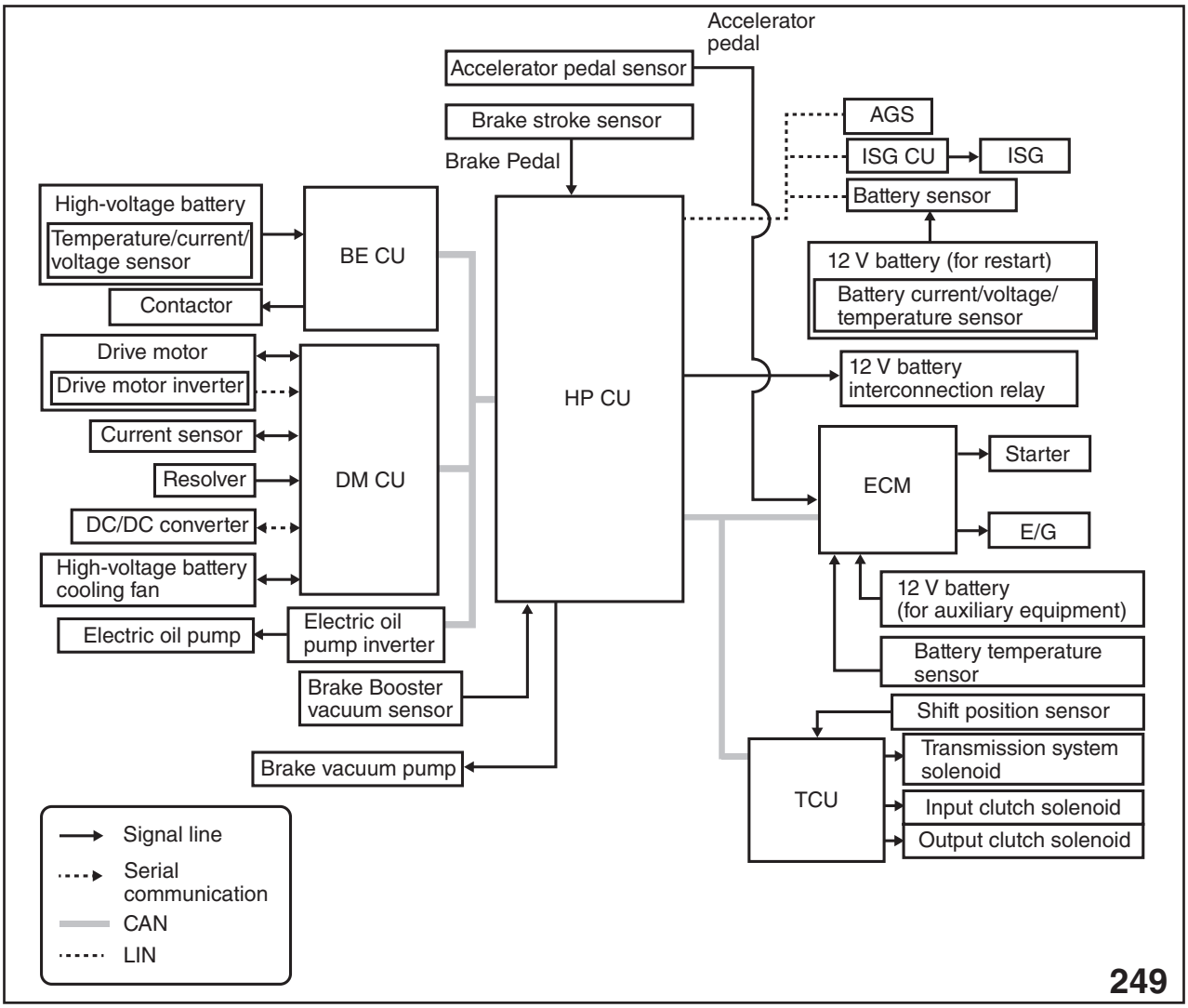
HEV CAN and PU CAN

NOTES:

Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(B606) No. 20	Brake stroke sensor input 2	When brake pedal is depressed	Approx. 4 V	—
		When brake is not depressed	Approx. 2.5 V	—
(B606) No. 21	(Not used)	—	—	—
(B606) No. 22	Battery relay CLOSE output	—	—	—
(B606) No. 23	Battery relay OPEN output	—	—	—
(B606) No. 24	GND3 for sensors	Always	0 V	—

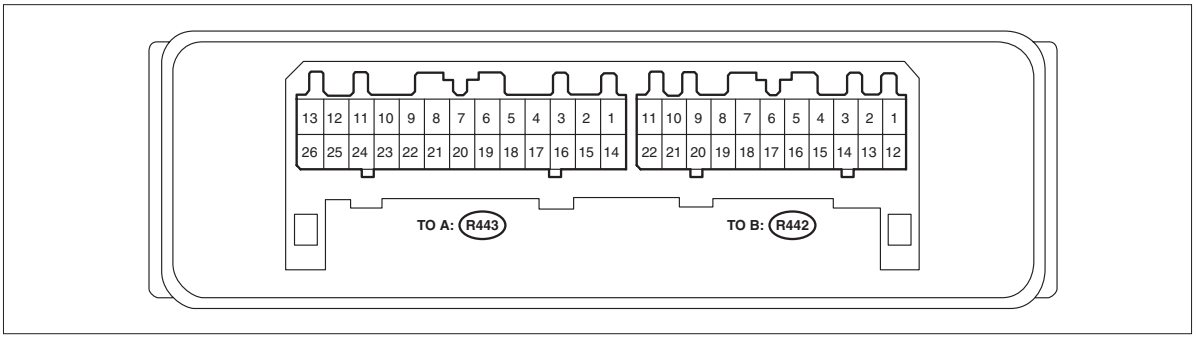
248

Hybrid Powertrain HPCM I/O



HEV CAN and PU CAN

NOTES:

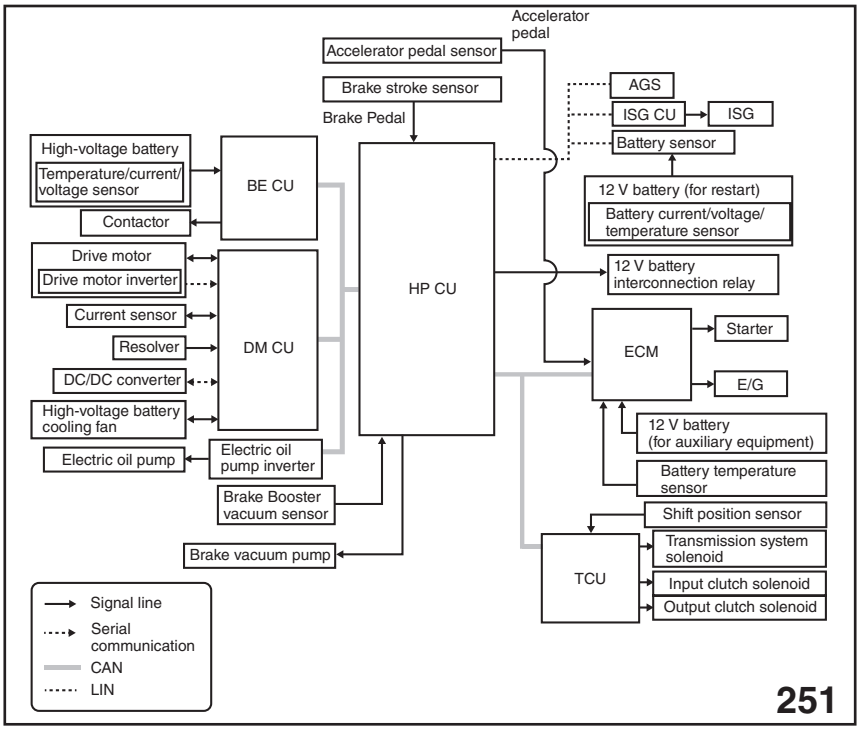


Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(R443) No. 1	(Not used)	—	—	—
(R443) No. 2	HEVCAN H	—	Cannot be measured	CAN communication line
(R443) No. 3	CT W	When ignition switch is ON	2.45 — 2.55 V	—
(R443) No. 4	(Not used)	—	—	—
(R443) No. 5	CT V	When ignition switch is ON	2.45 — 2.55 V	—
(R443) No. 6	SVCC2	When ignition switch is ON	4.9 — 5.1 V	—
(R443) No. 7	CT U	When ignition switch is ON	2.45 — 2.55 V	—
(R443) No. 8	SVCC1	When ignition switch is ON	4.9 — 5.1 V	—
(R443) No. 9	(Not used)	—	—	—
(R443) No. 10	IG	When ignition switch is ON	11 — 15 V	—
(R443) No. 11	SS RY	When ignition switch is ON	0 V	—
(R443) No. 12	GND1	Always	0 V	—
(R443) No. 13	IG SS1	When ignition switch is ON	11 — 15 V	—
(R443) No. 14	(Not used)	—	—	—
(R443) No. 15	HEVCAN L	—	Cannot be measured	CAN communication line
(R443) No. 16	(Not used)	—	—	—
(R443) No. 17	SGND2	When ignition switch is ON	0 V	—
(R443) No. 18	SGND1	When ignition switch is ON	0 V	—
(R443) No. 19	SCIMOCO	—	Cannot be measured	SCI communication line
(R443) No. 20	SCICOMO	—	Cannot be measured	SCI communication line
(R443) No. 21	FANPIN	When ignition switch is ON	11 — 15 V	—
(R443) No. 22	FANPOUT	When ignition switch is ON	11 — 15 V	—
(R443) No. 23	(Not used)	—	—	—
(R443) No. 24	IPUPWR RY	When ignition switch is ON	0 V	—
(R443) No. 25	GND2	Always	0 V	—
(R443) No. 26	IG SS2	When ignition switch is ON	11 — 15 V	—

250

Drive Motor Control Module (DMCM) I/O

Pin number	Item	Meaning or function
No. 1	—	—
No. 2	HEVCAN H	HEV CAN High signal
No. 3	CT W	Current signal W phase
No. 4	—	—
No. 5	CT V	Current signal V phase
No. 6	SVCC2	Sensor Voltage supply2
No. 7	CT U	Current signal U phase
No. 8	SVCC1	Sensor Voltage supply1
No. 9	—	—
No. 10	IG	IG switch input
No. 11	SS RY	Self Shut Relay (DMCM) driving signal
No. 12	GND1	Ground1
No. 13	IG SS1	Main power1 [IG power supply from self shut relay (No.1)]
No. 14	—	—
No. 15	HEVCAN L	HEV CAN Low signal
No. 16	—	—
No. 17	SGND2	Signal ground2 of current sensor
No. 18	SGND1	Signal ground1 of current sensor
No. 19	SCIMOCO	Serial communication signal from DMCM to DC/DC
No. 20	SCICOMO	Serial communication signal from DC/DC to DMCM
No. 21	FANPIN	FAN Power In
No. 22	FANPOUT	FAN Power Out
No. 23	—	—
No. 24	IPUPWR RY	Power relay for Inverter and battery pack (Driving signal)
No. 25	GND2	Ground2
No. 26	IG SS2	IG power supply from self shut relay (No.2)



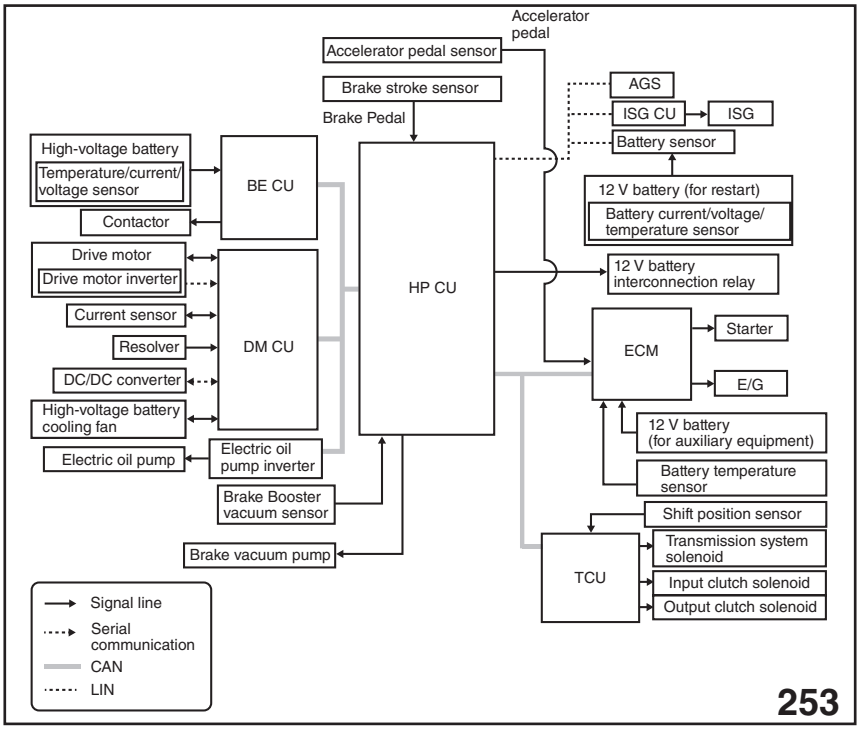
HEV CAN and PU CAN

Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(R442) No. 1	UN	—	Cannot be measured	—
(R442) No. 2	UP	—	Cannot be measured	—
(R442) No. 3	TMP B	When ignition switch is ON	0.23 V — 4.6 V	—
(R442) No. 4	TMP A	When ignition switch is ON	0.23 V — 4.6 V	—
(R442) No. 5	AGND1	Always	0 V	—
(R442) No. 6	R1	—	Cannot be measured	—
(R442) No. 7	S4	—	Cannot be measured	—
(R442) No. 8	S3	—	Cannot be measured	—
(R442) No. 9	S2	—	Cannot be measured	—
(R442) No. 10	S1	—	Cannot be measured	—
(R442) No. 11	(Not used)	—	—	—
(R442) No. 12	WN	—	Cannot be measured	—
(R442) No. 13	WP	—	Cannot be measured	—
(R442) No. 14	VN	—	Cannot be measured	—
(R442) No. 15	VP	—	Cannot be measured	—
(R442) No. 16	(Not used)	—	—	—
(R442) No. 17	R2	—	Cannot be measured	—
(R442) No. 18	(Not used)	—	—	—
(R442) No. 19	(Not used)	—	—	—
(R442) No. 20	(Not used)	—	—	—
(R442) No. 21	(Not used)	—	—	—
(R442) No. 22	SCIIPU	—	Cannot be measured	SCI communication line

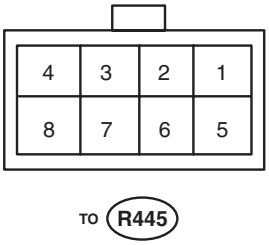
252

Drive Motor Control Module (DMCM) I/O

Pin number	Item	Meaning or function
No. 1	UN	UN phase driving signal
No. 2	UP	UP phase driving signal
No. 3	TMP B	Motor temperature sensor B input
No. 4	TMP A	Motor temperature sensor A input
No. 5	AGND1	Analog Ground 1
No. 6	R1	Resolver excitation signal 1
No. 7	S4	Detected signal from resolver 4
No. 8	S3	Detected signal from resolver 3
No. 9	S2	Detected signal from resolver 2
No. 10	S1	Detected signal from resolver 1
No. 11	—	—
No. 12	WN	WN phase driving signal
No. 13	WP	WP phase driving signal
No. 14	VN	VN phase driving signal
No. 15	VP	VP phase driving signal
No. 16	—	—
No. 17	R2	Resolver excitation signal 2
No. 18	—	—
No. 19	—	—
No. 20	—	—
No. 21	—	—
No. 22	SCIIPU	Serial communicaton signal with IPU



HEV CAN and PU CAN

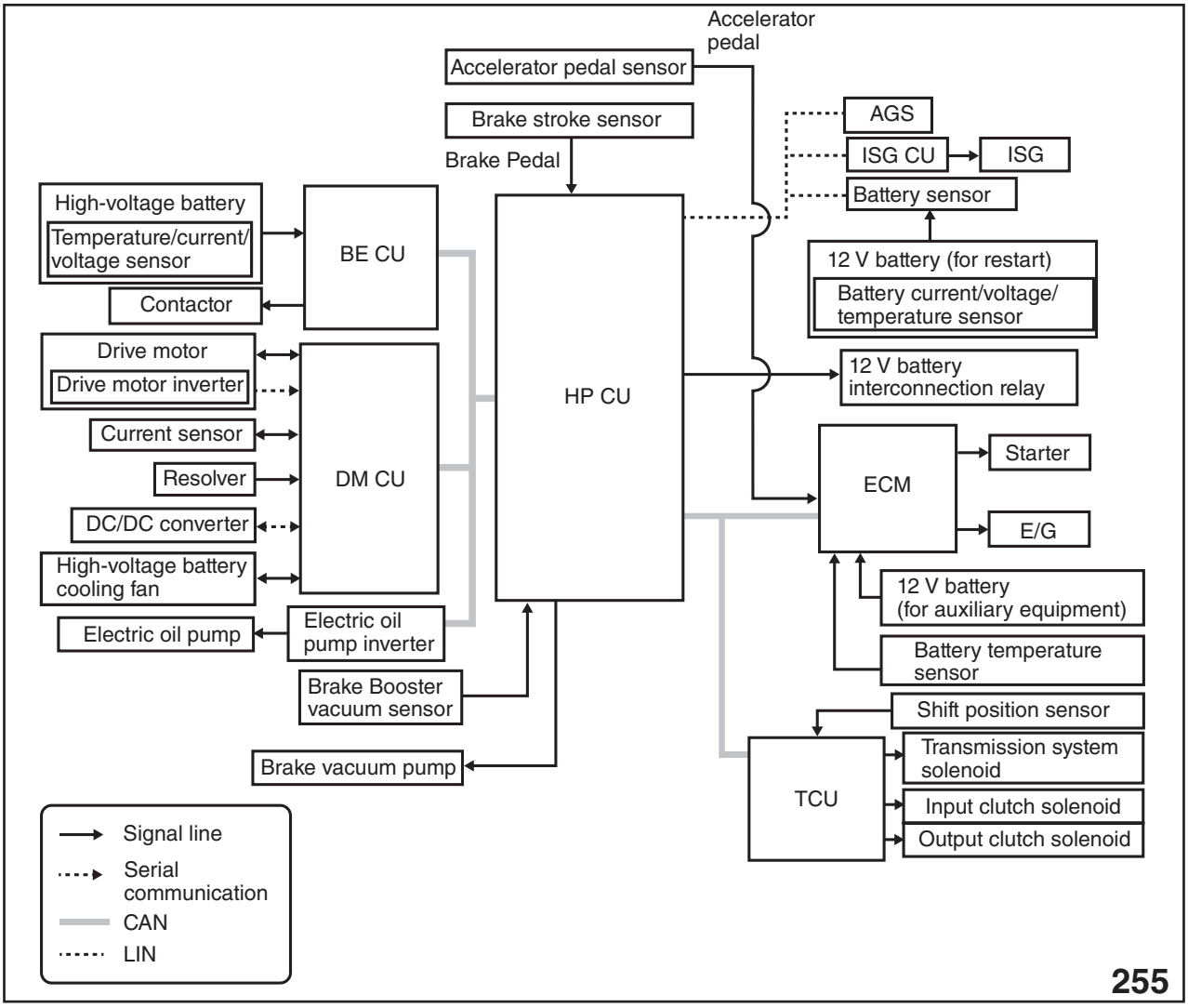


HEV00082

Terminal No. (terminal symbol)	Item	Measuring condition	Measurement value	Note
(R445) No. 1	Main power supply 1	Always	11 — 15 V	—
(R445) No. 2	HEVCAN H	—	Cannot be measured	CAN communication line
(R445) No. 3	HEVCAN L	—	Cannot be measured	CAN communication line
(R445) No. 4	GND	Always	0 V	—
(R445) No. 5	Main power supply 2	Always	11 — 15 V	—
(R445) No. 6	IG power supply	When ignition switch is ON	11 — 15 V	—
(R445) No. 7	(Not used)	—	—	—
(R445) No. 8	GND	Always	0 V	—

254

High Voltage Battery



HEV CAN and PU CAN

NOTES:

NOTES:

XV Crosstrek Hybrid Diagnostics and Servicing

WARNING: The electrical system of the XV Crosstrek Hybrid has a high voltage circuit. Read all cautions and warning in the appropriate Subaru Service Manual before beginning any diagnostics.

Caution: Always test the rubber insulation gloves for air tightness and check the last inspection date of the gloves. Never use a rubber insulation glove with an inspection date older than 6 months (New insulation gloves are inspected at the factory and have a shelf life of 12 months plus 6 months of service). Always wear the leather protectors over the rubber insulation gloves. Position the rubber insulation gloves at least 2 inches higher up on the arm than the leather protectors.

Before beginning any service work or diagnostics, place the High voltage service hat on the roof or best visible area of the vehicle and notify personnel working around you that you are servicing a Hybrid vehicle.

Normal Vehicle Characteristics and Service Cautions

1. Do not turn on the ignition for at least 10 seconds after connecting all battery cables. This will generate a DTC.
2. When clearing the memory of any control unit, keep the ignition off for at least 30 seconds. Failure to wait for 30 seconds will prevent the DTC from being cleared.
3. The Positive and Negative Contactors do not turn off immediately when the ignition switch is turned off.
4. Never start the vehicle with the Service Plug removed.
5. The vehicle generates and discharges high frequency AC voltage which can create high frequency sound. The High Voltage Battery cover and cargo area platform insulate the noise from the passenger compartment. Operating the vehicle with these devices removed will allow the noise to be heard in the passenger compartment.
6. Always turn the ignition off when parking the vehicle. Failure to do so may result in the vehicle starting automatically in Automatic Start Stop.
7. During engine or vehicle diagnostics that is not associated with the high voltage circuit, place the vehicle in Maintenance Mode manually or with the Subaru Select Monitor.
8. Do not attempt normal operation of the vehicle on an elevated lift. DTCs will generate and the Hybrid system will turn off. If operation on an elevated lift is necessary for diagnostics, do not make rapid changes in acceleration or deceleration rates. Clear all DTCs when the diagnostics are complete.
9. A vibration in the drive train or an intermittent shuttering feeling while driving is a symptom of a shorted Hybrid Electric Motor and/ or associated wiring. The vehicle should be removed from service until repaired.

NOTES:

When performing diagnostics of the XV Crosstrek Hybrid, follow the guidance provided in the Subaru Service Manual.

Note: The high voltage circuit is made from many components. The same DTC can be generated from a failure in any of the separate parts or connecting circuits.

Example: P0AA6 High Battery Voltage Isolation Fault

CW:DTC P0AA6 HYBRID BATTERY VOLTAGE SYSTEM ISOLATION FAULT

DIAGNOSIS:

- Detects leakage in high voltage system circuit.
- If HEV system leakage resistance, leakage resistance in high voltage battery are smaller than the standard, it is judged as faulty.
- Immediately at fault recognition

TROUBLE SYMPTOM:

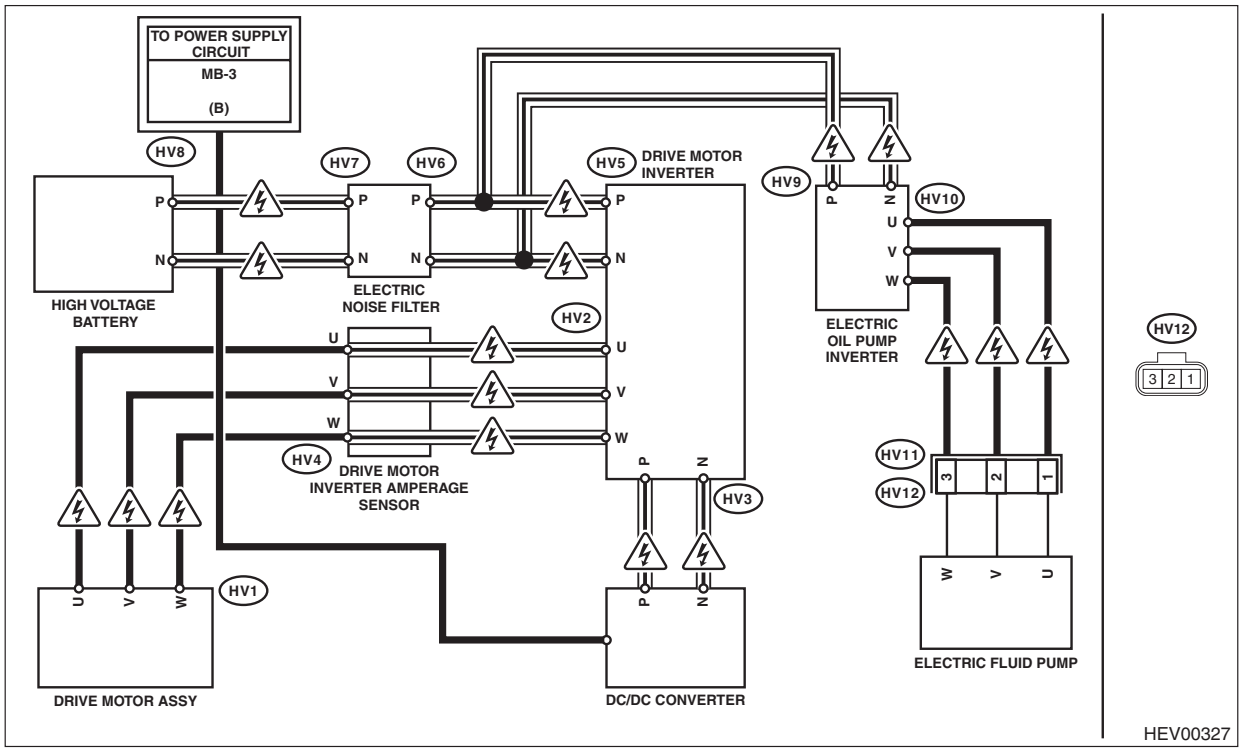
Normal control

CAUTION:

Before performing diagnosis, refer to "CAUTION" in "General Description". <Ref. to HEV(diag)-8, CAUTION, General Description.>

WIRING DIAGRAM

Hybrid System <Ref. to WI-133, WIRING DIAGRAM, Hybrid Electric Vehicle System.>



257

High Voltage Circuit Configuration

Before beginning diagnostics review the PID's of the Battery Energy Control System. Four of the PID's are very similar in name but are very different in meaning.

These two PID's display the calculated resistance to body ground of the entire Hybrid high voltage wiring except the High Voltage Battery (before the contactors).

DTCs generated from faults related to these PID's can be repaired.

HEV System Leakage Resistance (+)

HEV System Leakage Resistance (-)

Item	Value	Unit	Maximum	Minimum	Average
☐ High Voltage Battery Control Status	Normal		-	-	-
☐ High Voltage Battery SOC	44.5	%	44.5	43.5	43.5
☐ High Voltage Battery SOH	99.5	%	99.5	99.5	99.5
☐ High Voltage Battery Total Voltage	109.0	V	116.0	106.2	108.9
☐ High Voltage Battery Amperage	5.14	A	10.88	-36.42	-0.51
☐ High Voltage Battery Charge Power Limit 1	11.5	kw	11.6	0.0	10.9
☐ High Voltage Battery Discharge Power Limit 1	13.5	kw	13.5	0.0	12.9
☐ High Voltage Battery Temperature 1	23.0	Deg.c	23.0	22.5	22.5
☐ High Voltage Battery Temperature 2	23.0	Deg.c	23.0	22.5	22.5
☐ High Voltage Battery Temperature 3	23.0	Deg.c	23.0	22.5	22.5
☐ High Voltage Battery Intake Air Temperature	22.5	Deg.c	23.0	22.5	22.5
☐ High Voltage Battery Internal Resistance	0.16	ohm	0.16	0.16	0.16
☑ HEV System Leakage Resistance (+)	2	kohm	1000	0	700
☑ High Voltage Battery Pack Leakage Resistance (+)	1000	kohm	1000	1000	1000
☑ HEV System Leakage Resistance (-)	2	kohm	1000	0	700
☑ High Voltage Battery Pack Leakage Resistance (-)	1000	kohm	1000	1000	1000
☐ OBD Test Status	Not Complete		-	-	-
☐ HEV Fail Lamp Signal	ON		-	-	-
☐ Trip Count	680	Time	680	680	680
☐ Count	Common		-	-	-
☐ Time Count	105100	ms	105100	8700	56800
☐ Ignition Switch	ON		-	-	-
☐ Sarvice Plug Status	ON		-	-	-
☐ High Voltage Battery Fuse Condition	Normal		-	-	-

258

BECM Select Monitor Data

These two PID's display the calculated resistance to body ground of the High Voltage Battery. The only repair possible for a failure related to these PID's is replacement of the High Voltage Battery.

High Voltage Battery Pack Leakage Resistance (+)

High Voltage Battery Pack Leakage Resistance (-)

Caution: Always use the Select Monitor or CAT III approved digital multi-meters when performing diagnostics.

Diagnostics in step 1 are confirming if the High Voltage Battery is leaking (shorted) to body ground.

The BECM provides a temporary path to ground before the Contactors to check for Battery leakage. If a leak is detected, the BECM will not turn on the Contactors. This test will be performed within one minute of the ignition coming on.

Note: The one minute wait time allows the data to be displayed on the Select Monitor.

	Step	Check	Yes	No
1	**CHECK CURRENT DATA.** 1) Turn the ignition switch to OFF → ON. 2) Leave the vehicle 1 minute unattended. 3) Using the Subaru Select Monitor, confirm the current data of battery energy control system, the values of «High Voltage Battery Pack Leakage Resistance (+)»«High Voltage Battery Pack Leakage Resistance (–)». <Ref. to HEV(diag)-60, BATTERY ENERGY CONTROL SYSTEM, OPERATION, Read Current Data.>	Is the value of «High Voltage Battery Pack Leakage Resistance (+)» or «High Voltage Battery Pack Leakage Resistance (–)» 290 kΩ or less?	Replace the high voltage battery. <Ref. to HEV-17, High Voltage Battery.>	Go to step **2**.

259

P0AA6 Step 1

Step 2 is confirming the leakage is in the High Voltage wiring and if the problem still exists.

	Step	Check	Yes	No
2	**CHECK CURRENT DATA.** 1) Stop the engine. 2) Start the engine. 3) Leave the vehicle 1 minute unattended. 4) Using the Subaru Select Monitor, confirm the current data of battery energy control system, the values of «HEV System Leakage Resistance (+)» «HEV System Leakage Resistance (–)». <Ref. to HEV(diag)-60, BATTERY ENERGY CONTROL SYSTEM, OPERATION, Read Current Data.>	Is the value of «HEV System Leakage Resistance (+)» or «HEV System Leakage Resistance (–)» 290 kΩ or less?	Go to step **3**.	Even if DTC is detected, the circuit has returned to a normal condition at this time. Reproduce the failure, and then perform the diagnosis again. NOTE: In this case, temporary poor contact of connector, temporary open or short circuit of harness may be the cause.

260

P0AA6 Step 2

After reviewing step 2 and checking the current data, HEV System Leakage Resistance + and -, a short to ground or insulation problem does exist. The next step is to start isolating the problem. Follow the provided diagnostics step by step. Read the entire box before performing any work.

Step 3 begins the process of checking the High Voltage circuits for possible shorts to ground. It is possible the circuits only short to ground when they are under electrical load. The instructions included in this step are preparing the vehicle for a normal safe High Voltage off condition. Failure to follow these instructions may result in electrical shock. This step in the diagnostics introduces the use of the Mega-Ohm Meter which can output very High Voltage and cause electrical shock.

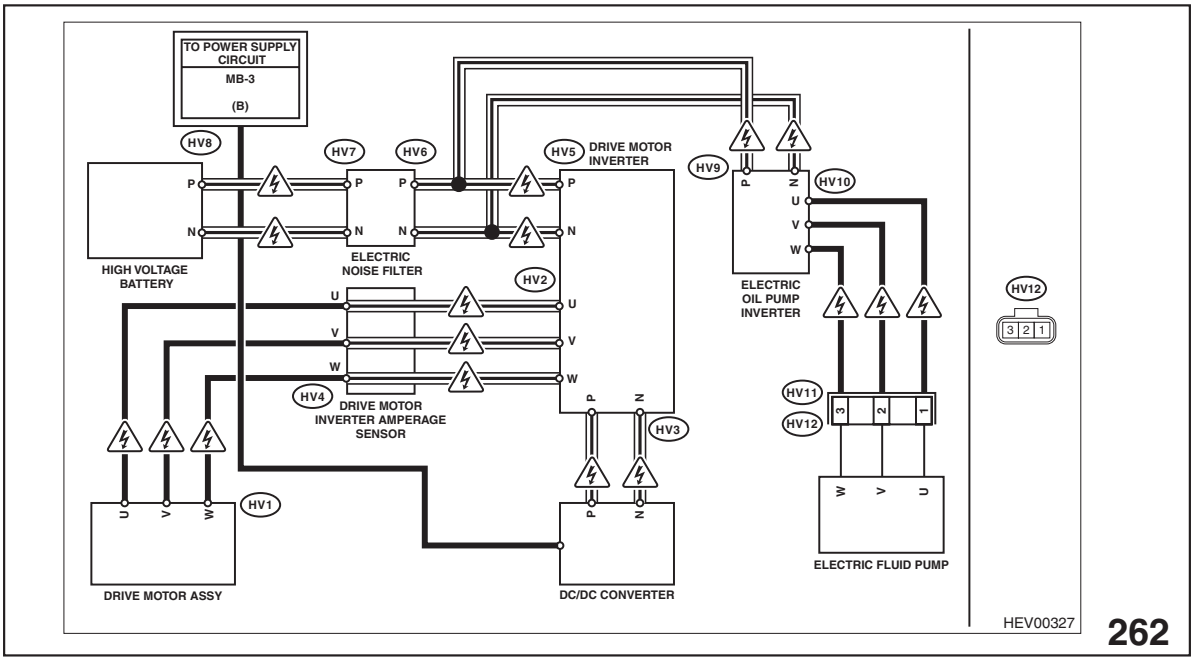
	Step	Check	Yes	No
3	**CHECK POWER CABLE AND BUS BAR.** 1) Turn the ignition switch to OFF. 2) Disconnect the ground cable of the 12 volt auxiliary battery, and as for the 12 volt engine restart battery, disconnect the ground cable from the battery sensor. <Ref. to NT-4, BATTERY, NOTE, Note.> 3) Remove the service plug. <Ref. to HEV-15, Service Plug.> 4) Wait for 10 minutes. 5) Disconnect the power cable (HV4) from drive motor inverter current sensor. 6) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Go to step **13**.	Go to step **4**.

261

P0AA6 Step 3

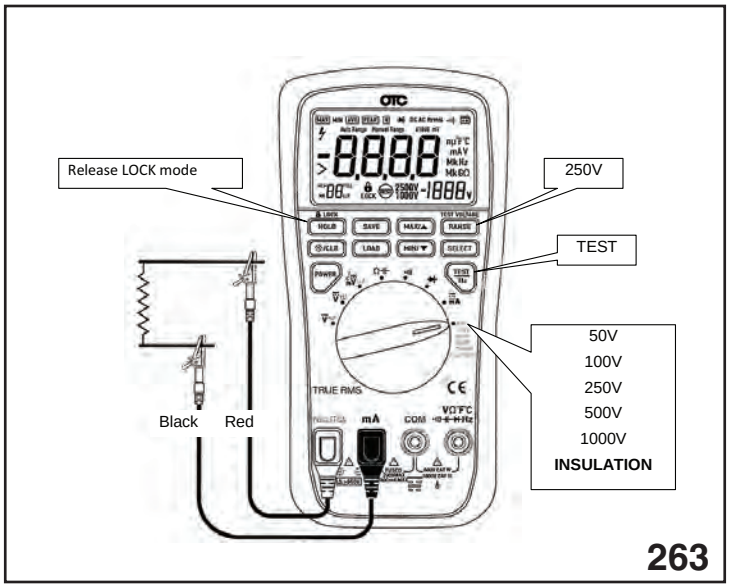
This tool must be use when performing the outlined steps. It is necessary to place the identified circuits in an electrically loaded condition to find the problem.

Warning: This device outputs very high voltage. Follow all safety precautions when using for diagnostics.



262

Hybrid High Voltage Circuit Configuration



Mega Ohm Meter

The Mega Ohm Meter introduces high voltage into a circuit to check resistance while under electrical load. The meter uses ohms law to determine resistance and therefore insulation condition. The current returned is measured and then the selected voltage is divided by the amperage to determine the resistance. If the current is high (not properly insulated or leaking), the resistance value will drop.

A Mega Ohm Meter has several voltage settings that can be selected. Always use the setting that is recommended by the Subaru Service Manual.There are many Mega Ohm meters available for purchase. Review the operating instructions and warnings provided for the meter you purchase.

A test button is provided on the meter to activate the flow of electricity into the circuit being tested. Warning: Never touch the circuit being tested or test leads of the Mega Ohm Meter. High voltage is present anytime the test button is activated. Never use the lock button or hold button to keep the test function active.

Note: The symbol "M" accompanied by the ohms sign symbol stands for Million. The symbol "m" accompanied by the ohms sign stands for milli-ohms (a thousands of 1 ohm).

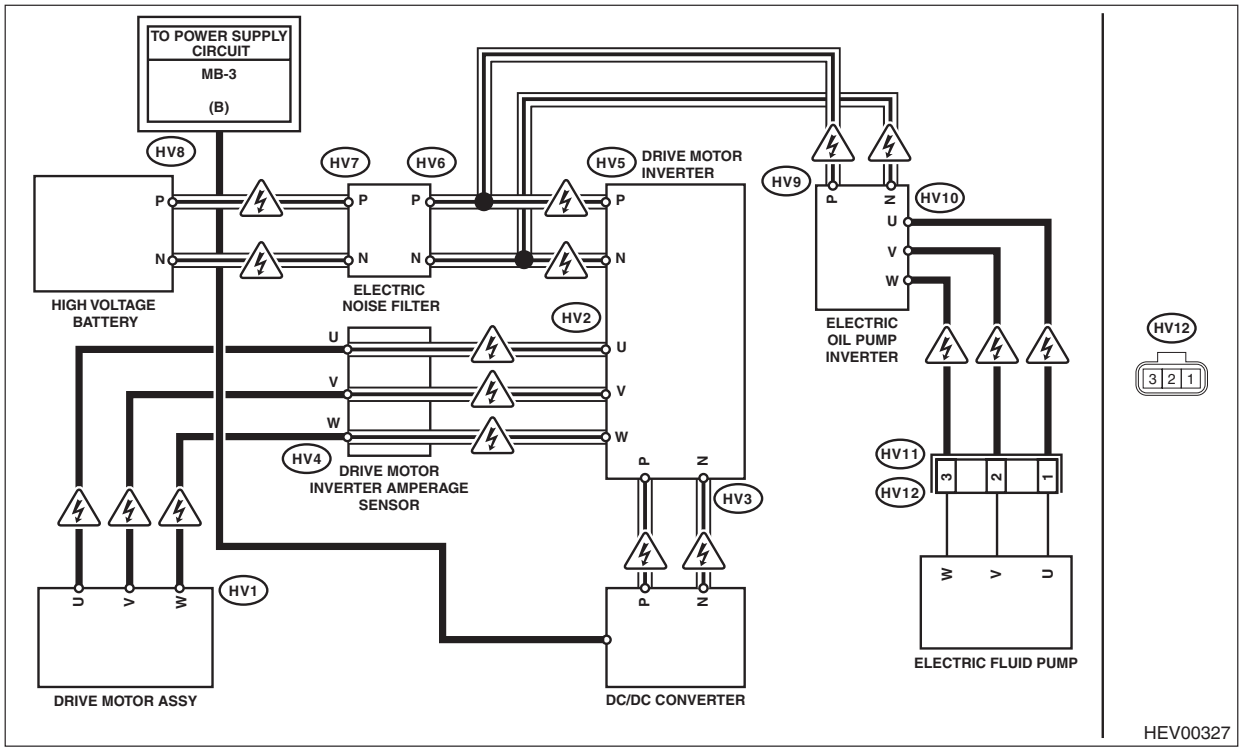
The remainder of the diagnostic steps continue testing the High Voltage circuit and the High Voltage system components for short to ground. If a part is failed, replace it with a new one and follow the Subaru Service Manual during installation. Do not over tighten or under tighten any bolts. If a foreign object has been found to be the fault, creating the short, remove it and determine where it came from and repair that area.

Note: The High Voltage area of the vehicle must be kept dry. Excess moisture can result in creating a High Voltage leak.

Step		Check	Yes	No
4	**CHECK POWER CABLE AND BUS BAR.** 1) Disconnect the power cable (HV10) from electric oil pump. 2) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Go to step **14**.	Go to step **5**.

264

P0AA6 Step 4



265

Hybrid High Voltage Circuit Configuration

Step		Check	Yes	No
5	**CHECK BUS BAR.** 1) Check the bus bar between the high voltage battery (HV8) and the noise filter (HV7) and the surrounding area for metallic foreign bodies, and if there are any, remove them. 2) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Even if DTC is detected, the circuit has returned to a normal condition at this time. Reproduce the failure, and then perform the diagnosis again.	Go to step **6**.

266

P0AA6 Step 5

Step		Check	Yes	No
6	**CHECK POWER CABLE AND BUS BAR.** 1) Remove the bus bar between high voltage battery (HV8) and the noise filter (HV7). 2) Using a megohmmeter (250 V range), measure the resistance between High Voltage battery terminals and chassis ground. ***Connector & terminal*** ***(HV8) P — Chassis ground:*** ***(HV8) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Go to step **7**.	Replace the high voltage battery. <Ref. to HEV-17, High Voltage Battery.>

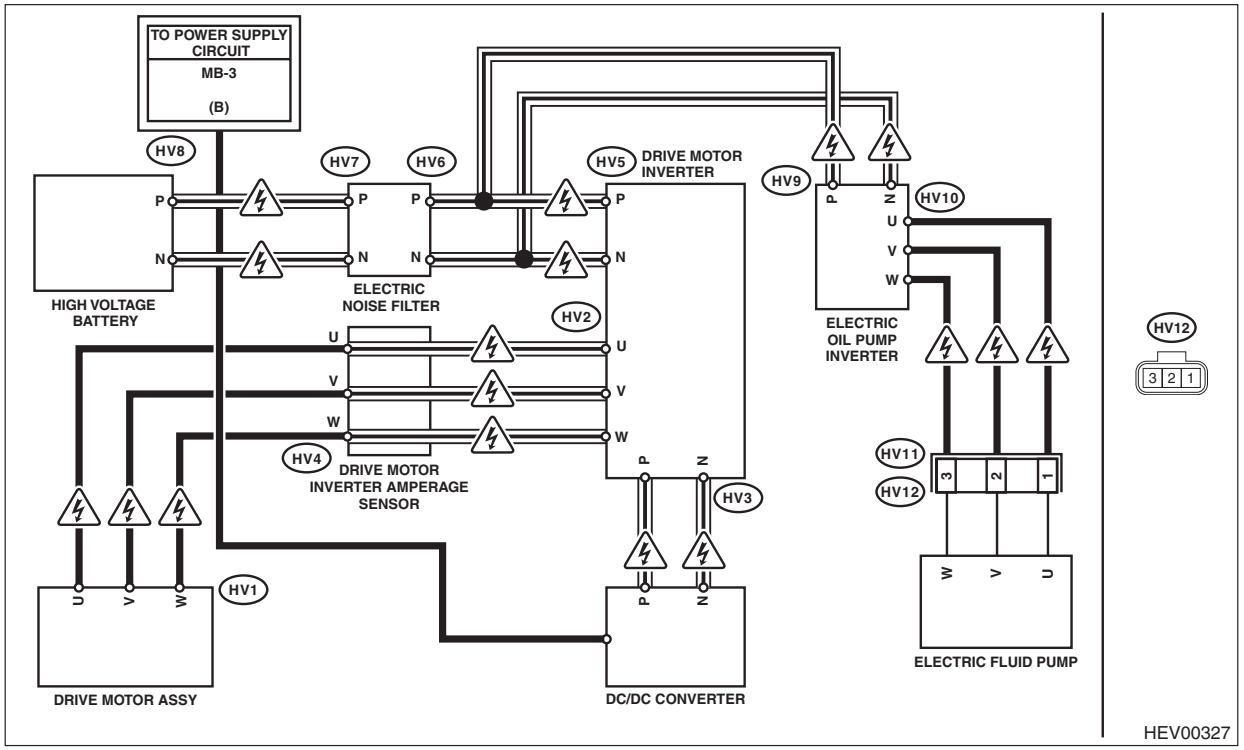
267

P0AA6 Step 6

Step		Check	Yes	No
7	**CHECK POWER CABLE AND BUS BAR.** 1) Check bus bars between the noise filter (HV6), the drive motor inverter (HV5), and electric oil pump inverter (HV9) and the surrounding area for metallic foreign bodies, and if there are any, remove them. 2) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Even if DTC is detected, the circuit has returned to a normal condition at this time. Reproduce the failure, and then perform the diagnosis again.	Go to step **8**.

268

P0AA6 Step 7



269

Hybrid High Voltage Circuit Configuration

	Step	Check	Yes	No
8	**CHECK POWER CABLE AND BUS BAR.** 1) Remove the DC/DC converter (HV3). 2) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Replace the DC/DC converter. <Ref. to HEV-38, DC/DC Converter.>	Go to step **9**.

270

P0AA6 Step 8

	Step	Check	Yes	No
9	**CHECK POWER CABLE AND BUS BAR.** 1) Remove the electric oil pump inverter (HV9). 2) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Replace the electric oil pump inverter. <Ref. to HEV-42, Inverter.>	Go to step **10**.

271

P0AA6 Step 9

Step		Check	Yes	No
10	**CHECK POWER CABLE AND BUS BAR.** 1) Remove the drive motor inverter current sensor (HV2) from the drive motor inverter. 2) Check the bus bar of the drive motor inverted current sensor (HV2) and the surrounding area for metallic foreign bodies, and remove them if there any, then reinstall the sensor. 3) Using a megohmmeter (250 V range), measure the resistance between high voltage battery side terminal and chassis ground. ***Connector & terminal*** ***(HV7) P — Chassis ground:*** ***(HV7) N — Chassis ground:***	Is the resistance 2 MΩ or more?	Even if DTC is detected, the circuit has returned to a normal condition at this time. Reproduce the failure, and then perform the diagnosis again.	Go to step **11**.

272

P0AA6 Step 10

Freeze Frame Data has been enhanced capture up to 10 samples of time and data. The time between samples and the data captured is depended on the DTC.

Trip Count displays the number of ignition cycles since the memory was last cleared.

Time Count is the clock time of the ignition cycle when the DTC was generated.

Count value can be Common or Not Common. Common means that the control unit clock for that particular control unit is synchronized to the BIU, which holds the master time of the vehicle. Not Common means independent timing. When multiple DTCs are set, check the Time Count to confirm which DTC was set first. The remainder of the DTCs may be the result of a problem and not the actual cause.

NOTE: When using this method make sure the Count value is common.

First detection

P0AA6 : Hybrid Battery Voltage System Isolation Fault

Item	History3	History2	History1	Detect	Unit
Trip Count	657	657	657	657	Time
Time Count	60000	64000	68000	68500	ms
HEV System Leakage Resistance (+)	545	545	4	3	kohm
High Voltage Battery Pack Leakage Resista...	1000	1000	1000	1000	kohm
HEV System Leakage Resistance (-)	1000	1000	4	3	kohm
High Voltage Battery Pack Leakage Resista...	1000	1000	1000	1000	kohm
Count	Common	Common	Common	Common	

273

P0AA6 Freeze Frame Data

Maintenance Mode

Read all steps before attempting to activate Maintenance Mode.

(Auto Start/Stop function OFF and Motor-Only Running function OFF)

Maintenance mode can be initiated without the Select Monitor by implementing the following procedure:

With the ignition switch ON and the engine OFF, perform the following actions while depressing the brake pedal (Do not press or release the accelerator pedal too quickly).

1. Depress the accelerator pedal 2 times with the transmission in N range.
   (Fully closed --> Fully open --> Fully closed --> Fully open)

   Do not press or release the accelerator pedal too fast, the input may not be received.
2. Depress the accelerator pedal 2 times with the transmission in P range.
   (Fully closed --> Fully open --> Fully closed -->Fully open)
3. Depress the accelerator pedal 2 times with the transmission in N range.
   (Fully closed --> Fully open --> Fully closed --> Fully open)
4. Shift into P range and start the engine.

(The Hybrid Warning Light in the combination meter flashes and Maintenance mode is displayed in the MFD.)

5. Maintenance mode will terminate when the ignition switch is turned OFF. (This also happens when Maintenance mode is initiated with the SSM III).

CAUTION

- **Perform all the above operations within 60 seconds after turning the ignition switch ON.**

Hybrid Failsafe Operation

There are 6 levels of failsafe controls for the XV Crosstrek Hybrid. The control of each level is preset, allowing only partial Hybrid operation or Automatic Start Stop functions.

Failsafe level	Warning lamp	EV / Idling stop mode	High voltage relay	Driving control
6	On	Inhibit	Emergency shut down	ECM, TCM
5	On	Inhibit	Emergency shut down	HEV control
4	On	Inhibit	Normal shut down	HEV control
3	On	Inhibit (No more cranking)		HEV control
2	On	Inhibit		HEV control
1	On			HEV control
				274

Hybrid Failsafe Levels

Failsafe	Detected failure	DTC	Hybrid Warning Light	Note
Level 6 Independent control by ECM & TCM HEV CU gives up control.	CAN Channel 1 Bus Error	U0073	ON	
	CAN Channel 1 ECU ID not received	U0100	ON	
	CAN Channel 1 TCU ID not received	U0101	ON	
	CAN Channel 1 ECU Erratic data	U0401	ON	
	CAN Channel 1 TCU Erratic data	U0402	ON	
	CAN Channel 2 Bus Error	U0075	ON	
	CAN Channel 2 No receive ECU ID	U1100	ON	
	CAN Channel 2 TCU ID not received	U1101	ON	
	CAN Channel 2 ECU Erratic data	U1401	ON	
	CAN Channel 2 TCU Erratic data	U1402	ON	
	CAN Channel 3 Bus Error	U0076	ON	
	CAN Channel 3 INV ID not received	U0110	ON	
	CAN Channel 3 INV Erratic data	U0411	ON	
	HPCU microcomputer failure	P0A1D	ON	
	HPCU RAM failure	P0604	ON	
	HPCU ROM failure	P0605	ON	
Level 5 Emergency shut down of high voltage system	CAN Channel 3 BAT ID not received	U0111	ON	
	CAN Channel 3 BAT Erratic data	U0412	ON	
Level 4 Emergency shut down of high voltage system. Battery should be replaced.	Collision detection	P1C1E	ON	1
Level 3 Normal shut down of high voltage system EV mode, Auto Start Stop is not available. Engine doesn't restart in EV or Auto Start Stop mode. Igniton key OFF to escape from EV or Auto Start Stop and restart engine manually.	LIN Bit Error	U1676	ON	
	LIN Check sum Error (ISG)	U1720	ON	
	ISG Self-diagnosis Functional Error	P1C14	ON	
	ISG Control Circuit failure	P0620	ON	
	Auto Start Stop Functional Error	P06EF	ON	
	Battery Relay Stuck Closed	P1C09	ON	
	Starter Battery Charging Error	P1C18	ON	
	Battery Relay Open side wiring failure	P1C07	ON	
	Battery Relay Close side wiring failure	P1C06	ON	

Note 1: ISG Active test is disabled.

Failsafe	Detected failure	DTC	Hybrid Warning Light	Note
Level 2 Inhibit EV mode, Auto Start Stop Engine restart at EV mode and Auto Start Stop	CAN Channel 1 VDC ID not received	U0122	ON	-
	CAN Channel 1 VDC Erratic data	U0416	ON	-
	LIN Check sum Error (Battery sensor)	U1711	ON	-
	Vacuum Pump Functional Error	P1C10	ON	-
	Vacuum Pump Relay Stuck Open	P1C11	ON	-
	Vacuum Pump Relay Stuck Closed	P1C12	ON	-
	Vacuum Sensor Erratic Characteristic	P0556	ON	-
	Brake Stroke Sensor Erratic Characteristic	P057B	ON	2
	Brake Stroke Sensor 1 Open circuit/Ground short	P057C	ON	2
	Brake Stroke Sensor 1 High voltage short	P057D	ON	2
	Charging system failure	P065A	ON	-
	Brake Stroke Sensor 2 Open circuit/Ground short	P1C0C	ON	2
	Brake Stroke Sensor 2 High voltage short	P1C0D	ON	2
	Brake Stroke Sensor Learning failure	P1C0E	ON	2
	Battery Sensor Internal Error	P1C00	ON	3
	Battery Relay Stuck Open	P1C08	ON	-
	Rear Wheel Speed Sensor Error	P2158	ON	2
	Speed Sensor Error	P215A	ON	2
Level 1 Hybrid warning lamp turns ON.	Brake Switch 2 Lo Failure	P0719	ON	-
	Brake Switch 2 Hi Failure	P0724	ON	-
	Brake Switch 1 Lo Failure	P0572	ON	-
	Brake Switch 1 Hi Failure	P0573	ON	-
	CAN Channel 1 BDY ID not received	U0140	ON	-
	CAN Channel 1 MET ID not received	U0155	ON	-
	CAN Channel 1 EPS ID not received	U0131	ON	-
	CAN Channel 1 ACN ID not received	U0164	ON	-
	CAN Channel 1 ABG ID not received	U0151	ON	-
	CAN Channel 1 EYE ID not received	U1235	ON	-
	CAN Channel 1 BDY Erratic data	U0422	ON	-
	CAN Channel 1 ACN Erratic data	U0424	ON	-
	CAN Channel 1 ABG Erratic data	U0452	ON	-
	CAN Channel 1 EYE Erratic data	U1433	ON	-
	CAN Channel 1 MET Erratic data	U0423	ON	-
	CAN Channel 1 EPS Erratic data	U0420	ON	-
	CAN Channel 3 EOP ID not received	U0287	ON	-
	CAN Channel 3 EOP Erratic data	U0588	ON	-
	Auxiliary Battery Temp. Sensor Ground short	P0516	ON	-
	Auxiliary Battery Temp. Sensor Open circuit/High voltage short	P0517	ON	-
	Voltage monitor line Open circuit	P058D	ON	3
	Linear Solenoid Open circuit/High voltage short	P1C05	ON	-
	Linear Solenoid Ground short	P1C04	ON	-
	ISC Charactaristic Lo	P0506	ON	-
	ISC Characteristic Hi	P0507	ON	-

Note 2: Regeneration at braking is disabled.

Note 3: Active test of 12V Battery relay is disabled.

Failure	DTC	Fail safe		
		Reduced output power	Shut down Contactors (HPCU fail safe Level 5, Level 6)	HPCU Warning Lamp
Service Plug				
High Voltage Fuse	P0A95		✓	✓
High Voltage Service Disconnect Open	P0B37		✓	✓
Junction Module				
Hybrid Battery Negative Contactor Circuit Stuck Closed	P0AA4			✓
Hybrid Battery Positive Contactor or Pre-charge Contactor Circuit Stuck Closed	P1C40		✓	✓
Hybrid Battery Voltage System Isolation Sensor Circuit	P0AA7			✓
Hybrid Battery Contactor Power Supply Circuit	P1C42		✓	✓
Hybrid Battery Positive Contactor Control Circuit/Open	P0AD9		✓	✓
Hybrid Battery Positive Contactor Control Circuit Low	P0ADB		✓	✓
Hybrid Battery Negative Contactor Control Circuit/Open	P0ADD		✓	✓
Hybrid Battery Negative Contactor Control Circuit Low	P0ADF			✓
Hybrid Battery Pre-charge Contactor Control Circuit	P0AE4			✓
Hybrid Battery Pre-charge Contactor Control Circuit Low	P0AE6		✓	✓
Hybrid Battery Contactor Power Supply Circuit	P1C43		✓	✓
Hybrid Battery System Precharge Time Too Long	P0C78		✓	✓
Battery Pack				
Hybrid Battery Voltage System Isolation Fault -- Minus side, External	P0AA6			✓
Hybrid Battery Voltage System Isolation Fault Minus side, Internal	P0AA6			✓
Hybrid Battery Voltage System Isolation Fault -- Plus side, External	P0AA6			✓
Hybrid Battery Voltage System Isolation Fault Plus side, Internal	P0AA6			✓
Hybrid Battery Pack State of Charge Low	P0A7D	✓	✓	✓
Hybrid Battery Pack State of Charge High	P0C30	✓	✓	✓
High Voltage Circuit short	P1C41		✓	✓
Hybrid Battery Pack Deterioration	P0A7F			✓
Hybrid Battery Block Voltage Too Low	P1C5E		✓	✓
Battery Current				
Hybrid Battery Charging Current High	P0CA6		✓	✓
Hybrid Battery Discharging Current High	P0CA7		✓	✓
Hybrid Battery Pack Current Sensor Circuit Range/Performance	P0AC0	✓		✓
Hybrid Battery Pack Current Sensor Circuit Low	P0AC1	✓		✓
Hybrid Battery Pack Current Sensor Circuit High	P0AC2	✓		✓
Hybrid Battery Pack Current Sensor Circuit Intermittent/Erratic	P0AC3	✓		✓
Hybrid Battery Pack Current Sensor "A" Circuit	P0ABF	✓		✓
Battery Temperature				
Hybrid Battery Pack Over Temperature	P0A7E		✓	✓
Hybrid Battery Pack Air Temperature Sensor "A" Circuit Range/Performance	P0AAD			✓
Hybrid Battery Pack Air Temperature Sensor "A" Circuit Low	P0AAE			✓
Hybrid Battery Pack Air Temperature Sensor "A" Circuit High	P0AAF			✓
Hybrid Battery Temperature Sensor "A" Circuit Range/Performance	P0A9C	✓		✓
Hybrid Battery Temperature Sensor "A" Circuit Low	P0A9D	✓		✓
Hybrid Battery Temperature Sensor "A" Circuit High	P0A9E	✓		✓
Hybrid Battery Temperature Sensor "B" Circuit Range/Performance	P0AC6	✓		✓
Hybrid Battery Temperature Sensor "B" Circuit Low	P0AC7	✓		✓
Hybrid Battery Temperature Sensor "B" Circuit High	P0AC8	✓		✓
Hybrid Battery Temperature Sensor "C" Circuit Range/Performance	P0ACB	✓		✓
Hybrid Battery Temperature Sensor "C" Circuit Low	P0ACC	✓		✓
Hybrid Battery Temperature Sensor "C" Circuit High	P0ACD	✓		✓

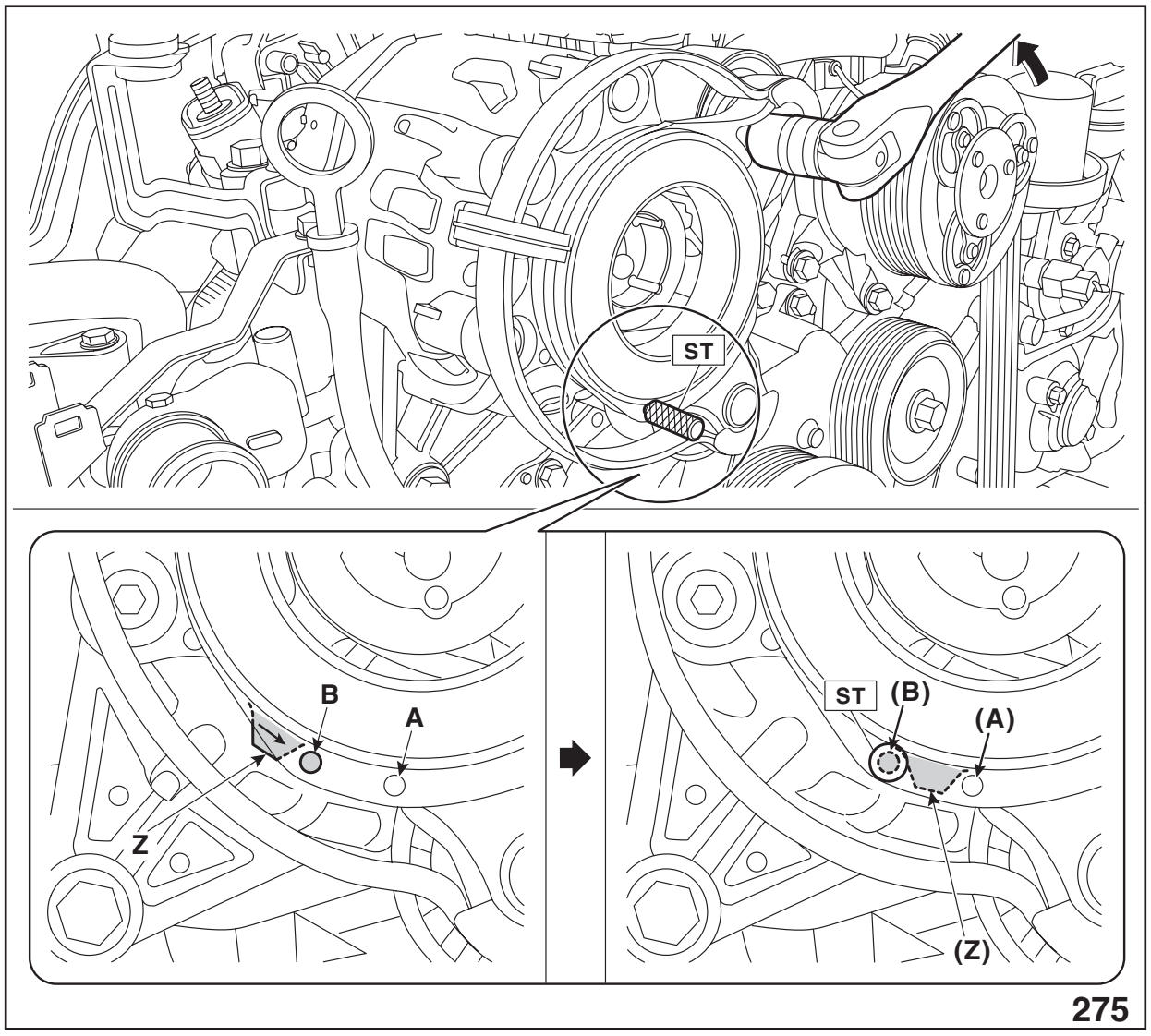
		Fail safe		
		Reduced output power	Shut down Contactors (HPCU fail safe Level 5, Level 6)	HPCU Warning Lamp
Battery Voltage				
Hybrid Battery Voltage Low	P0B25		✓	✓
Hybrid Battery Voltage High	P0B26		✓	✓
Hybrid Battery Voltage Sense “Z" Circuit	P0BB8		✓	✓
Hybrid Battery Voltage Sense "A" Circuit Range/Performance	P0B3C	✓		✓
Hybrid Battery Voltage Sense "A" Circuit Low	P0B3D	✓		✓
Hybrid Battery Voltage Sense "A" Circuit High	P0B3E	✓		✓
Hybrid Battery Voltage Sense “B" Circuit Range/Performance	P0B41	✓		✓
Hybrid Battery Voltage Sense “B" Circuit Low	P0B42	✓		✓
Hybrid Battery Voltage Sense “B" Circuit High	P0B43	✓		✓
Hybrid Battery Voltage Sense “C" Circuit Range/Performance	P0B46	✓		✓
Hybrid Battery Voltage Sense “C" Circuit Low	P0B47	✓		✓
Hybrid Battery Voltage Sense “C" Circuit High	P0B48	✓		✓
Hybrid Battery Voltage Sense "D" Circuit	P0B4A			✓
Hybrid Battery Voltage Sense “D" Circuit Range/Performance	P0B4B	✓		✓
Hybrid Battery Voltage Sense “D" Circuit Low	P0B4C	✓		✓
Hybrid Battery Voltage Sense “D" Circuit High	P0B4D	✓		✓
Hybrid Battery Voltage Sense “E" Circuit Range/Performance	P0B50	✓		✓
Hybrid Battery Voltage Sense “E" Circuit Low	P0B51	✓		✓
Hybrid Battery Voltage Sense “E" Circuit High	P0B52	✓		✓
Hybrid Battery Voltage Sense “F" Circuit Range/Performance	P0B55	✓		✓
Hybrid Battery Voltage Sense “F" Circuit Low	P0B56	✓		✓
Hybrid Battery Voltage Sense “F" Circuit High	P0B57	✓		✓
Hybrid Battery Voltage Sense “G" Circuit Range/Performance	P0B5A	✓		✓
Hybrid Battery Voltage Sense “G" Circuit Low	P0B5B	✓		✓
Hybrid Battery Voltage Sense “G" Circuit High	P0B5C	✓		✓
Hybrid Battery Block 1 Balancing Performance	P1C45		✓	✓
Hybrid Battery Block 2 Balancing Performance	P1C46		✓	✓
Hybrid Battery Block 3 Balancing Performance	P1C47		✓	✓
Hybrid Battery Block 4 Balancing Performance	P1C48		✓	✓
Hybrid Battery Block 5 Balancing Performance	P1C49		✓	✓
Hybrid Battery Block 6 Balancing Performance	P1C4A		✓	✓
Communication, Controller				
HPCU data not arrived	U1290		✓	✓
DMCU data not arrived	U0110			✓
HPCU counter error	U1591		✓	✓
MMCU counter error	U0411			✓
HPCU check sum error	U1591		✓	✓
DMCU check sum error	U0411			✓
CAN1 Bus Off	U0076		✓	✓
CAN1 Register failure	P0604		✓	✓
BECU Failure(DataFlashROM)	P062F		✓	✓
BECU Failure (FlashROM)	P0605		✓	✓
BECU Failure (ADC)	P0A1F		✓	✓
BECU Failure (RAM)	P0604		✓	✓
BEEU Failure (WDT circuit)	P0A1F		✓	✓
Communication error between MainCPU and SubCPU	P1C44		✓	✓
SubCPU received HV battery failure state	P1C44		✓	✓
Battery Energy Control Module	P0A1F		✓	✓
12V Battery failure (voltage too high / Low, current/voltage sensor failure)	P0000			✓

Removing/Installing the V-belt Tensioner Assy

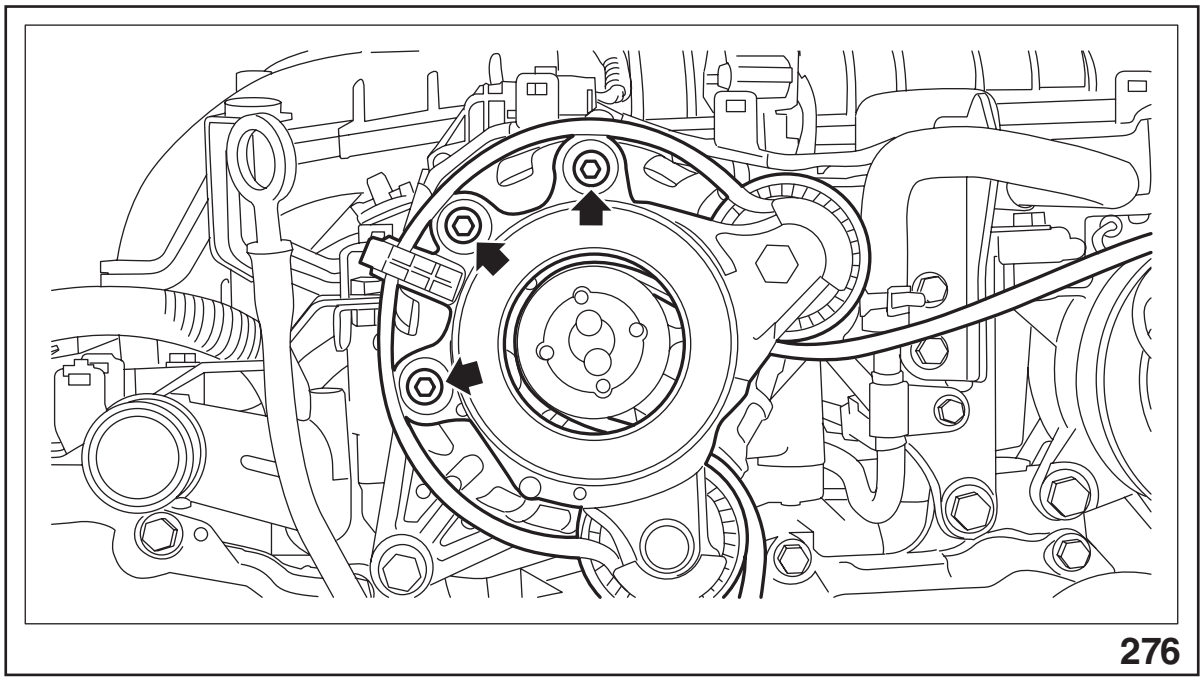
Removing an Undamaged V-belt

1. Lift the engine cover at two points on the front of the cover. Then, while pressing the engine cover at two points on the back of the cover and pushing it toward the rear of the vehicle, lift and remove the engine cover.
2. Remove the V-belt tensioner Assy.
   1) Set a tool on the V-belt tensioner Assy and turn it counterclockwise until protruding point Z on the V-belt tensioner Assy moves to a point between stopper pin holes A and B. Then insert the special tool into stopper pin hole B.

<Special Tool> 499267300: Stopper pin



ISG Stopper Pin Positioning Holes



ISG Mounting Plate Bolts

2) Take the V-belt off the idler pulley.

3) Remove the V-belt tensioner Assy and then take off the V-belt.

Note: The two pulley pendulum belt tensioner is comprised of 4 major parts. An outer mounted spring, 2 independent pulley assemblies, and a mounting plate.

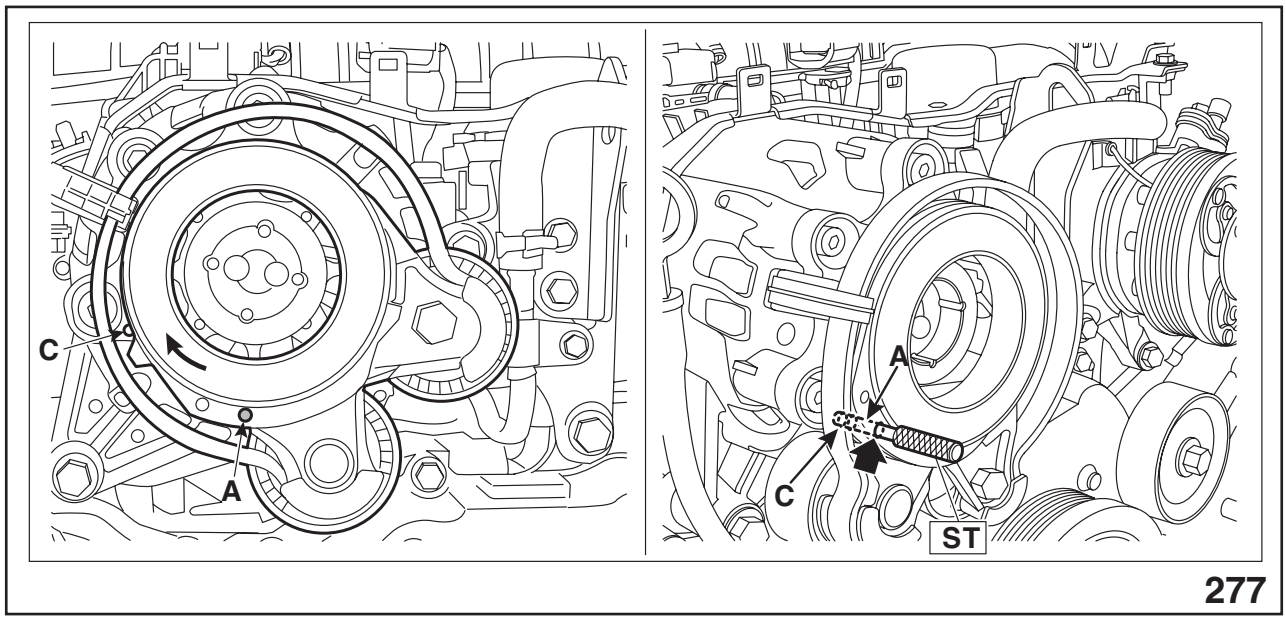
The mounting plate is bolted to the ISG and is stationary.

The 2 pulleys with their own mounting plates, are positioned on the main mounting plate. The mounting plates of the pulleys can scissor over each other which allows the pulleys to move towards or away from each other.

The spring is always trying to push the two pulleys together. If the accessory belt is in place, only one special tool is required to cage the tension of the spring. If the belt brakes, two special tools are required as both pulleys are pushed away from the indexing point of the main mounting plate.

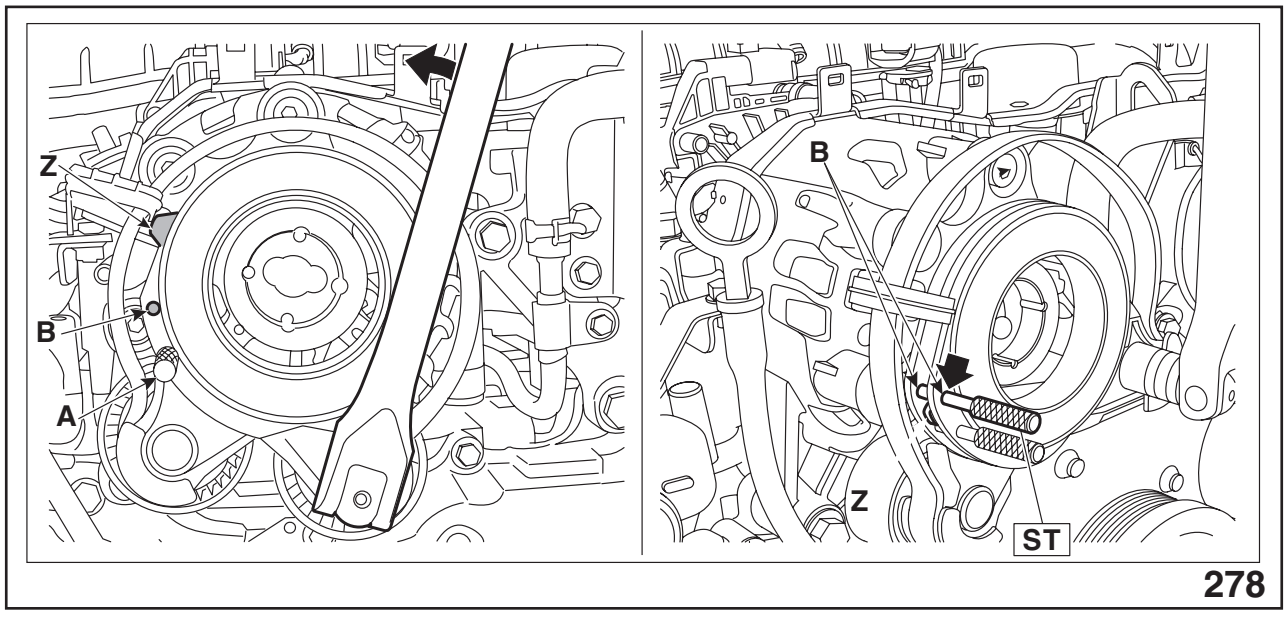
Removing a Damaged V-belt

1. Remove the V-belt tensioner Assy.
   1) Turn the V-belt tensioner Assy until stopper pin hole A in the V-belt tensioner Assy and stopper pin hole C in the ISG are in the same position. Then, insert the special tool through stopper pin hole A and stopper pin hole C as far as it will go.



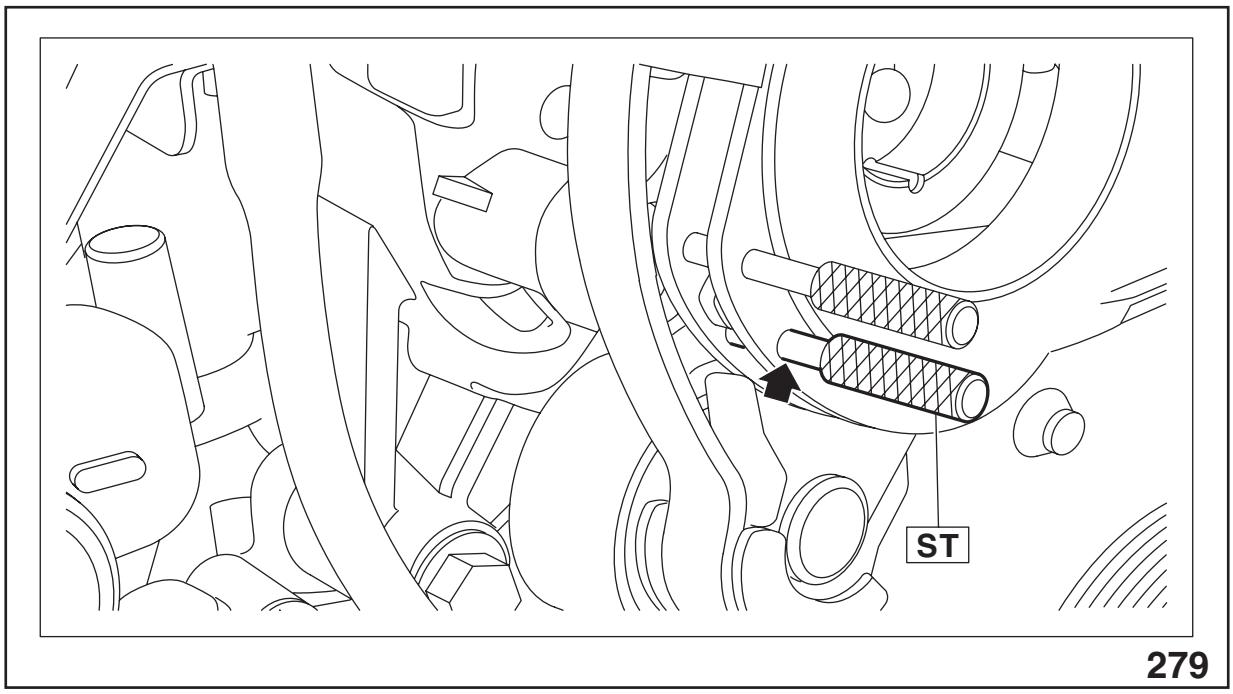
A over C *Install ST to A*

   2) Set a tool on the V-belt tensioner Assy. and turn it counterclockwise until protruding point Z on the V-belt tensioner Assy. moves to a point between stopper pin holes A and B. Then insert the special tool into stopper pin hole B.



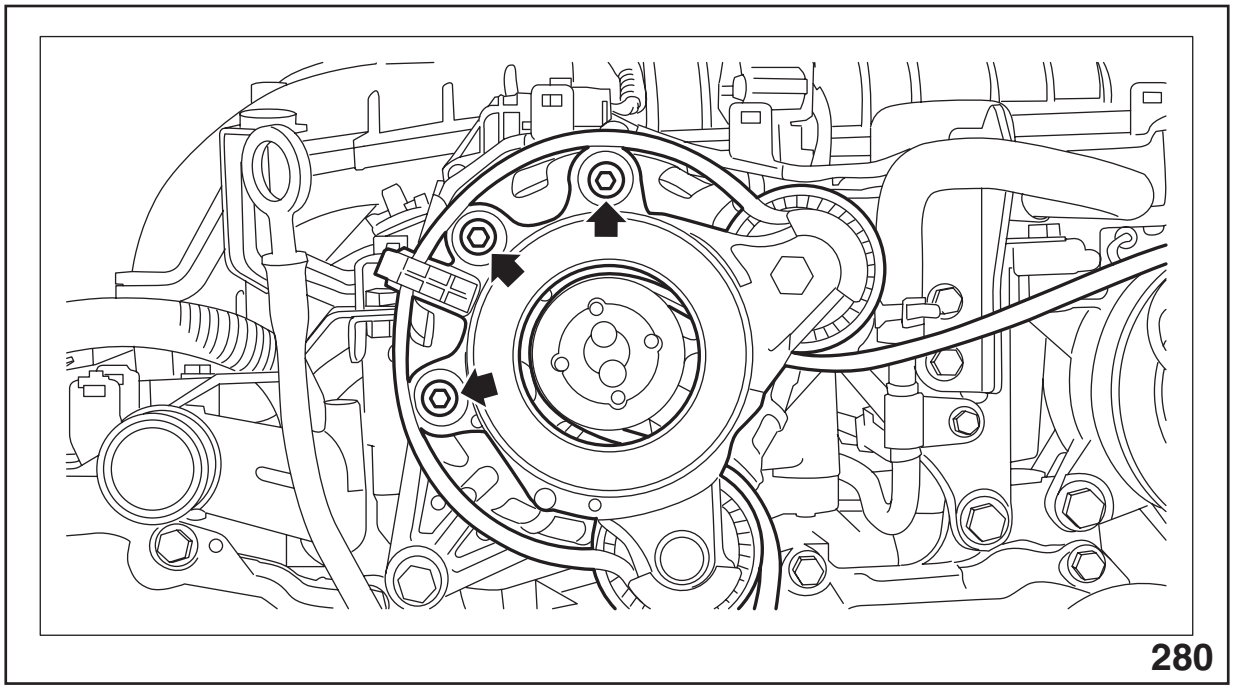
Z to Center of A and B *Install ST to B*

3) Pull out the special tool that was inserted into stopper pin hole A.



Remove ST from A

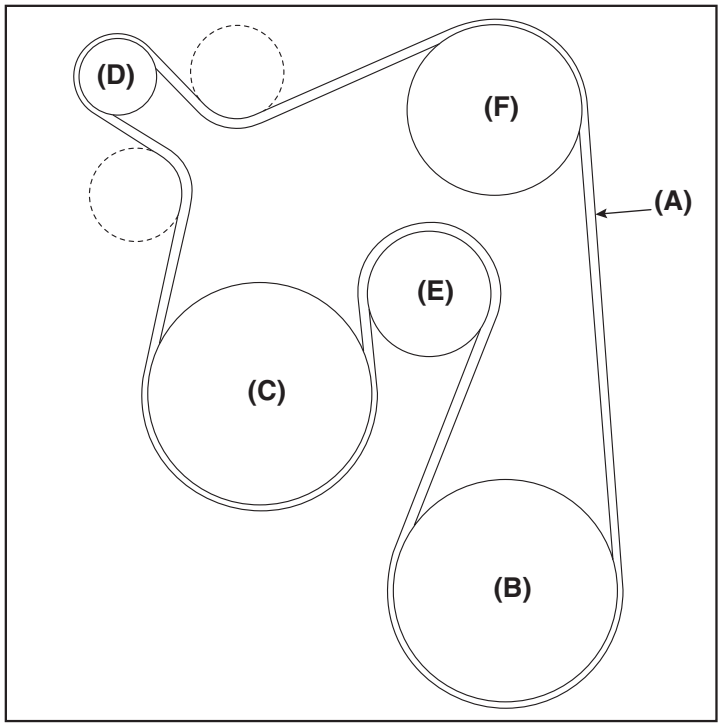
4) Remove the V-belt tensioner Assy.



ISG Mounting Plate Bolts

Installing the V-belt Tensioner Assy & V-belt

1. Set the V-belt as shown in the figure below.

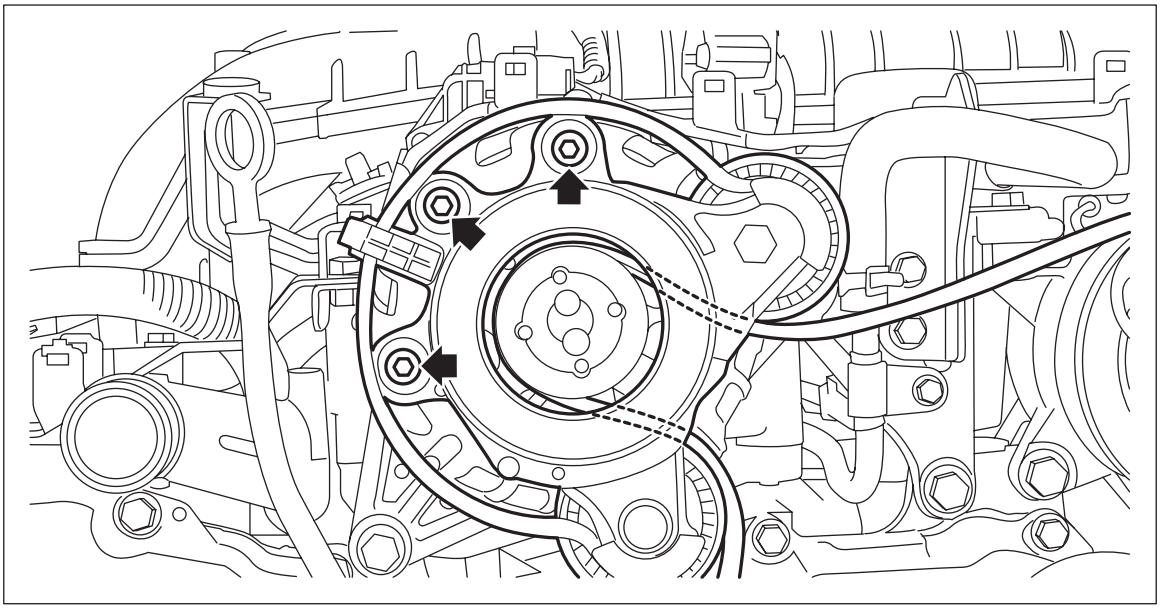


A) V-belt
B) Water pump pulley
C) Crank pulley
D) ISG pulley
E) Idler pulley
F) A/C compressor pulley

281

Belt Configuration

2. Install the V-belt tensioner Assy.



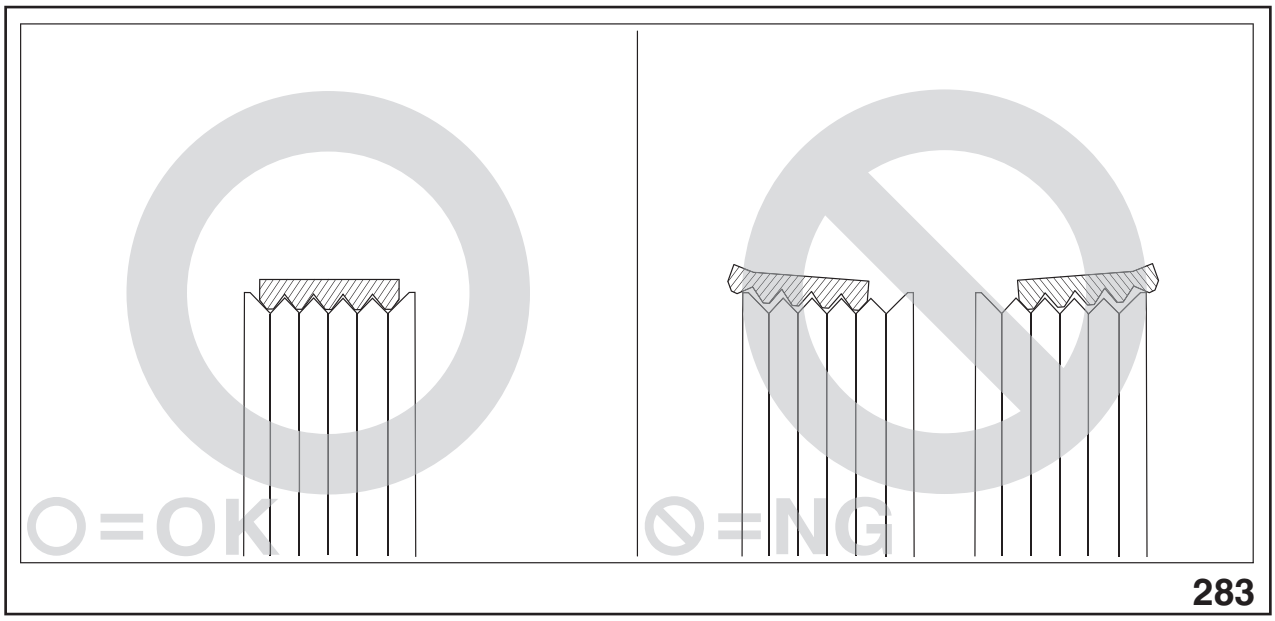
T: 25N·m (2.5 kgf-m, 18.4 ft-lb)

282

Torque Values

3. Set a tool on the V-belt tensioner Assy and slightly turn it counterclockwise, and then pull out the special tool that was inserted into stopper pin hole B.

CAUTION: Before pulling out the special tool, make sure the ribs in the V-belt are properly seated in the rib grooves in each pulley.



Belt Alignment

Jump starting the vehicle

If the Auxiliary Battery state of charge is too low to operate the conventional starter, connect jumper cables to the Auxiliary Battery and another 12 volt battery vehicle or a jump box.

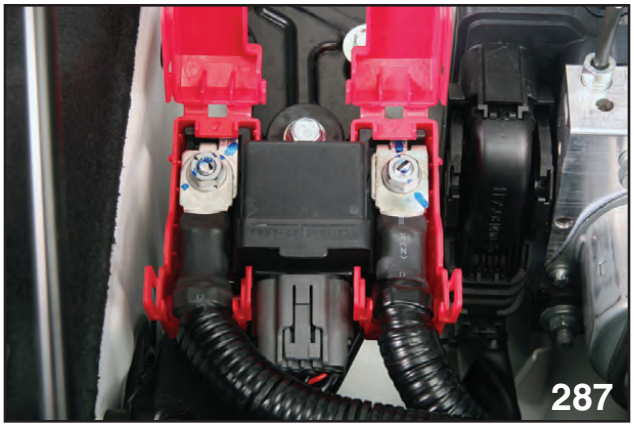
Connect to Auxiliary Battery Only

Never connect jumper cables to the Restart Battery. The smaller battery posts and clamps will not offer sufficient surface area to hold the jumper cables in place and the jumper cable may fall to body ground. DTC's may also be created.

Small Restart Battery Post

Restart Battery Post Cover

If this should occur, a short circuit to body ground will occur from Restart Battery to the rear of the vehicle to the DC/DC Converter. The entire Hybrid wiring harness and possibly the DC/DC Converter could be damaged.



Interconnect Relay

Do not attempt to place a bypass on the Interconnect Relay. The relay and wiring harness are not designed to conduct the amperage required to operate the starter.

NOTES: