



"Hybrid - EVs What They're All About"

Presented by Motor Age & TST

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What To Expect From This Webinar

- **A 60 to 90+ Minute Webinar**
- During this webinar we will explore the electrical systems that provide the power and energy needed to move today's Hybrid and Electric Vehicles.
- Your handout can be downloaded from <https://www.tstseminars.org>
- **Have Something To Write With**
- All Slides Are Numbered
- **For Best Results Hard Wire Your Tablet, Laptop, Computer or TV**
- The Recording Will Be Available at [Motor Age Training Account](#) & [TSTseminars.org](#)

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What Will Be Covered

- **We will follow the flow of energy from the high-voltage DC battery through the inverter, DC-DC converter, A/C compressor, and electric generator/motor systems.**
- We will discuss how these components work together, how energy is converted and controlled, and what technicians need to understand when diagnosing Hybrid and EV systems.
- **This webinar will provide a practical look at the technology behind Hybrid and EV propulsion and the electrical systems that make these vehicles operate.**

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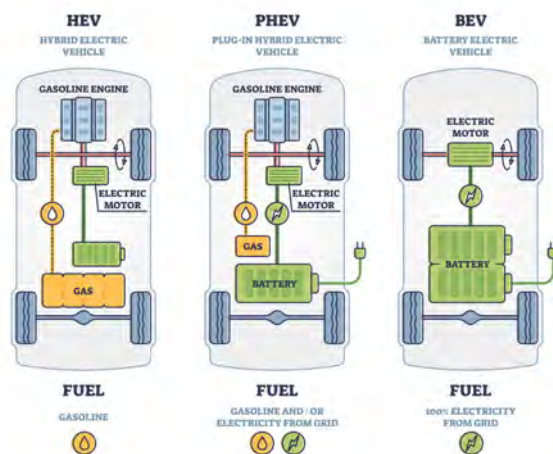
Type Of Vehicles

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Hybrid - Plug In - EVs

TYPES OF ELECTRIC VEHICLES



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Hybrid - Plug In - EVs



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Hybrid's - Plug In's - EV's

Nissan Leaf:



Tesla Model S:



BMW i3:



Courtesy of



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Hybrid - Plug In - Extended Range - EVs

- Hybrid vehicle's use at least two forms of propulsion - gas engine and electric motor(s)
This can be a Parallel or Series - Parallel design.
- Plug in Hybrids use a gas engine - electric motor (s). Unlike a regular hybrid, a PHEV can be plugged into an external charger to recharge its battery. This allows it to drive on electricity alone for a certain distance before the gasoline engine is needed.
- Extended-Range vehicle's (EREV) is a bit different from most plug-in hybrids. The Chevrolet Volt is the example. It first drives as an electric vehicle until the battery depletes to a lower level where the gas engine starts to charge the battery. This is a Series type vehicle.
- EV use electric motor(s) and a high voltage battery.

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Hybrid's - Plug In's - Extended Range - EVs

Vehicle Type	Main Propulsion	Gas Engine Role
Hybrid (HEV)	Gas + Electric	Helps drive wheels and charge battery
Plug-in Hybrid (PHEV)	Electric or Gas	Drives wheels and/or assists propulsion
Extended-Range EV (EREV)	Primarily Electric	Extends range when battery is low
Battery EV (BEV)	Electric Only	No gas engine

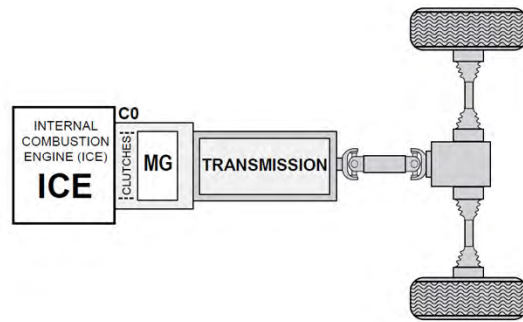
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A Type Of Parallel Design Hybrid

The **Type-4** hybrid-drive is a type of parallel system design.

- Uses single motor/generator (MG) integrated between the ICE and the transmission. A decoupling clutch (C0), positioned between the MG and the crankshaft, allows for electric-only MG propulsion when the ICE is OFF.
- The ICE and MG may be used together to provide maximum power to the drive wheels.
- During regenerative braking, the MG acts as a generator.
- A 12 V starter motor is used for initial ICE start.
- The MG serves as a starter motor for START/STOP operation.
- Power flow is completed using a conventional automatic transmission or a dual-clutch automatic transmission (DCT).



Courtesy of ASE

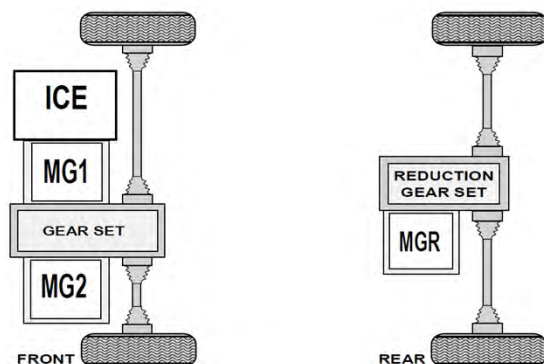
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A Power Split Like Series Parallel Design Hybrid

The Type-5 hybrid-drive system uses a power split system like the Type-1. A secondary electric propulsion system is added to provide all-wheel drive.

- Power from the internal combustion engine (ICE) and MG1 and/or MG2 can propel the vehicle.
- MG1 is used to control the effective gear ratio between the ICE and the drive wheels.
- MG1 is used as the starter motor for the ICE, and conversely, it can be driven by the ICE to act as a generator.
- MG2 serves as a generator during regenerative braking and also provides REVERSE.
- MGR can provide propulsion and regenerative braking.



Courtesy of ASE

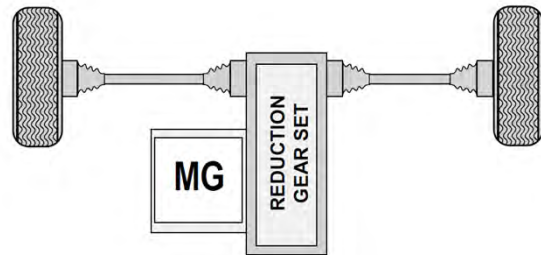
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An Electric Drive System

The Type-6 is a battery electric drive system.

- Uses one or more MG located within the axle drive assembly. There may be multiple axle drive assemblies for all-wheel drive operation.
- The MG functions as an electric motor to provide the torque required to propel the vehicle.
- During regenerative braking, the MG(s) acts as a generator.
- A reduction gear set is used to multiply torque to the drive wheels.



Courtesy of ASE

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Safety First

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High Voltage Safety



Courtesy ATTS Inc. / Dorman Training Center

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Check HV Class 0 - 1000 Volt Gloves



Note: This is NOT A SMOKE Machine!

Never use smoke to test gloves, as this will cause damage to the glove and protection level.

The pump is a lot easier than the "roll" method for checking for leaks.
One step better is the Flo Dynamics Glove Testing machine that can also be used to test HV Battery cases for leaks.

Courtesy ATTS Inc. / Dorman Training Center

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Eye & Face Protection



Salisbury AS1200 PrismShield Plus Arc Flash Face Shield Kit 12 Cal SKA12-PP (pictured right)

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HV Multimeter Lead Testing OSHA Requirements



OSHA now requires that test leads be verified before every use.

Fluke makes such a tester - PRV240



Courtesy ATTS Inc. / Dorman Training Center

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The One Hand Rule

The One-Hand Rule is a safety guideline used when working around high-voltage circuits. It recommends using only one hand when there is a possibility of contact with energized components. This helps reduce the chance of creating an electrical current path through the chest and heart.

- Use only one hand at a time.
- **Keep the other hand in your pocket or behind your back.**
- Avoid touching objects with different electrical potentials simultaneously.
- **Avoid creating a path for electrical current to travel through your heart.**
- Always follow additional high-voltage safety practices, including proper PPE, lockout/tagout procedures, insulated tools, and verification that the circuit is de-energized before work begins.
- **Important: The one-hand rule is an additional precaution, not a substitute for proper de-energization, PPE, and established electrical safety procedures.**

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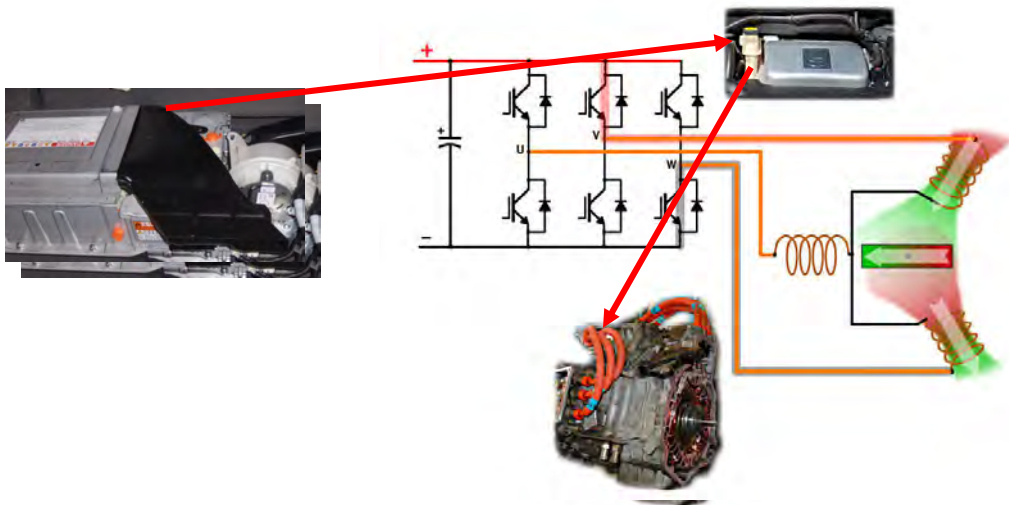
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Major Components

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Major Components



Courtesy ATTS Inc. / Dorman Training Center

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Hybrid / EV Common Electric Components

Electric / Hybrid drive engines have five main components you should be familiar with:

1. An Alternating Current (AC) motor
2. A Direct Current (DC) to (AC) & (AC) to (DC) Inverter
3. HV DC to 12 V DC Converter
4. A NiMH (nickel metal hydride battery) pack
5. A NiMH battery charge/discharge controller

EV Components



AC Motor



DC - DC Converter



DC-AC Inverter



HV BATTERY

Courtesy ATTS Inc. / Dorman Training Center

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Hybrid / EV Components

What does an Inverter do?

1. Converts the HV battery's high voltage DC current to three-phase AC current for the MGs (motor generators) and on Regen AC is converted to DC to charge the HV battery.
2. Boosts DC voltage from a lower to a higher voltage. For example, a Gen 2 Prius' HV battery's DC 201.6 V is boosted to about 600 V before being converted to AC for the MG.



Courtesy ATTS Inc. / Dorman Training Center

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Hybrid / EV Components

What does a Converter do?

1. It takes the HV DC voltage and converts it to a usable 12V to charge the 12V battery.
2. This powers the vehicle's sound system, computer, lights, and other non - HV components.
3. In Toyota, Nissan and other hybrids, the converter is located on the underside of the inverter. In Hondas, they are located at the HV battery/power control unit. In Fords, one is located on the right side next to the battery.



Courtesy ATTS Inc. / Dorman Training Center

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Water



DEIONIZED water must be used in all Hybrid and Electric Vehicles

USE OF ANY OTHER WATER CAN CAUSE

ISOLATION FAULTS

Courtesy ATTS Inc. / Dorman Training Center

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Equipment

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Batteries - Starters - Alternator & Loads



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Insulation Tests

- Whether or not wiring passes an insulation test tells us whether there is damage to a wire's insulation and/or conduit, and damage to motor winding insulation.
- Put the rotary switch on your MegOhm meter on the (50V - 1000V) *insulation* position.



Courtesy ATTS Inc. / Dorman Training Center

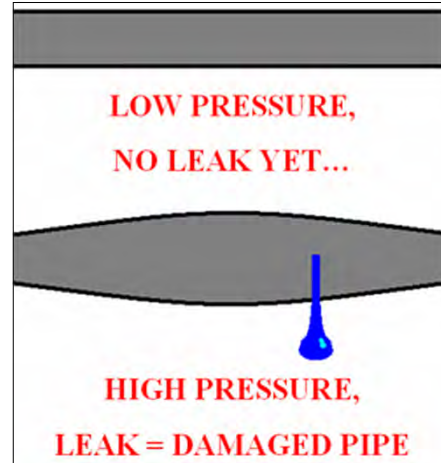
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Insulation Tests

- **Basics:**

- **Doing an insulation test is like pressure - testing a pipe.**
- **You confirm a leak in a pipe by increasing pressure until liquid shoots out.**
- **In wires, instead of liquid pressure, there's electrical pressure: VOLTAGE.**



Courtesy ATTS Inc. / Dorman Training Center

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Equipment

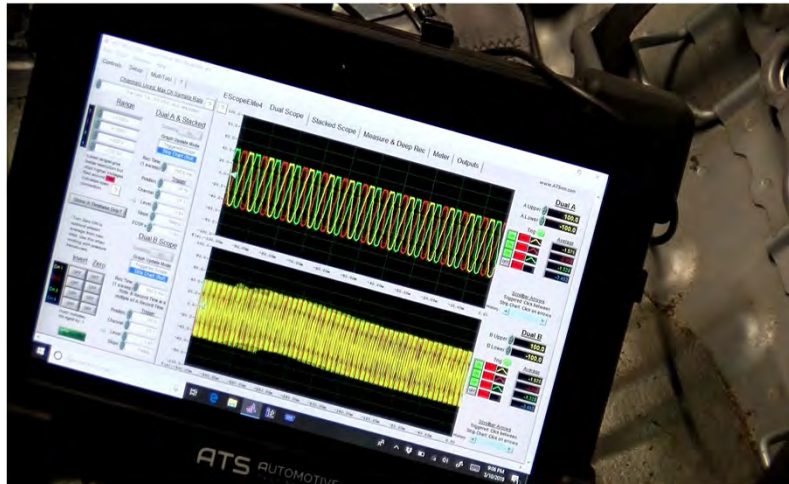


Courtesy ATTS Inc. / Dorman Training Center

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HV AC Voltage Of U V W After Rectification By The Inverter's IGBT's

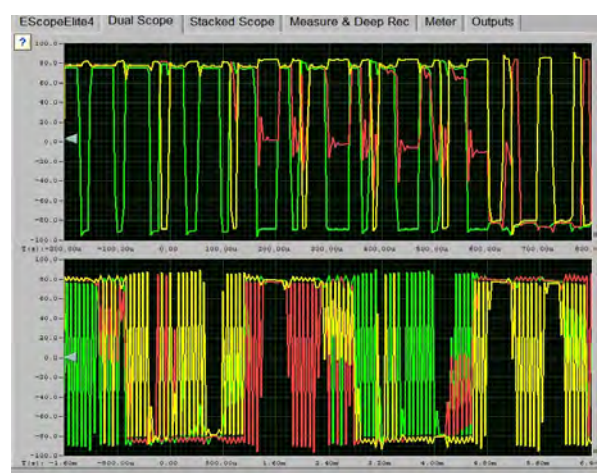
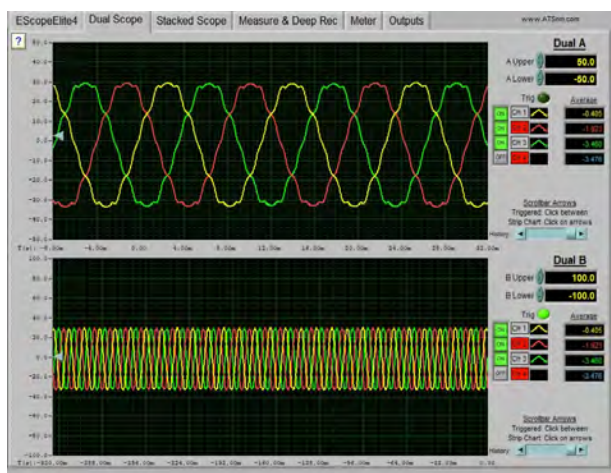


Courtesy ATTS Inc. / Dorman Training Center

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HV AC Voltage Of U V W & Rectification By The Inverter's IGBT's



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HV Batteries

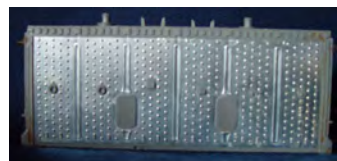
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Cylindrical And Prismatic NiMH Batteries

Two types of NiMH cells are used in all of today's hybrid vehicle battery packs:

- **D size Cylindrical cells**
- **Rectangular Prismatic flat cells**
- **Capacity of both is ~ 6.5 AH**
- **Both can output more than 100 Amps**



Courtesy ATTSS Inc. / Dorman Training Center

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Cylindrical Pack Construction

Cylindrical batteries form compact 6 cell sticks, but the round shape is difficult to cool and pack densely, so a pack made of these cells will have a larger volume than an equivalent prismatic pack.

But it has the advantage that it can be mounted in any position.



Courtesy ATTS Inc. / Dorman Training Center

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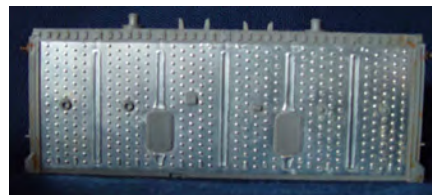
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Prismatic Cells

Gen 1 Pack = 2 Subpacks



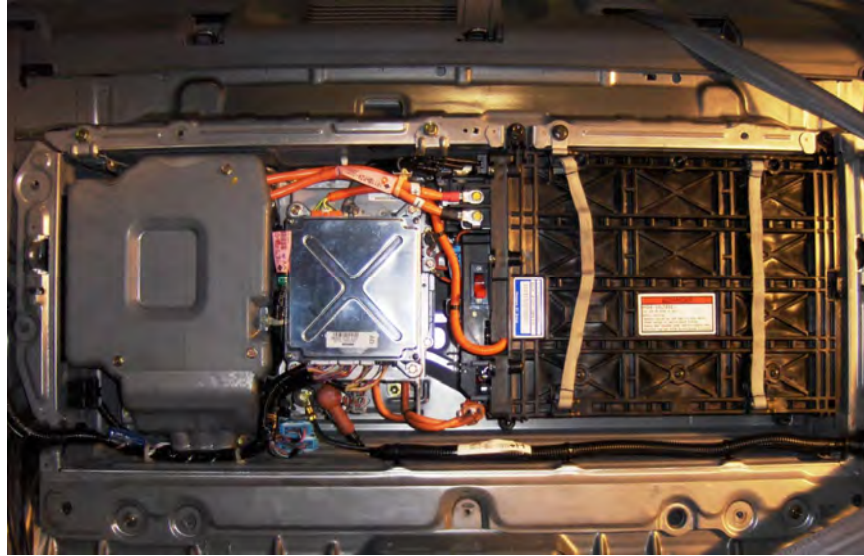
Gen 2 Subpack = 6 Cells



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Honda Civic: What's Behind The Cover & What HV Battery



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Toyota High Voltage Battery



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Ford High Voltage Battery



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Ford Explorer High Voltage Battery



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Chevy Volt HV Battery

The Chevy Volt pouch cells are sandwiched together with coolant cells to ensure the pouches don't overheat. Each cell is around 5 x 7 inches (12.7mm x 17.7mm) and weighs around 1 pound	
The Volt modules come in different sizes and so are bolted together with different amounts of pouch cells, depending on the module. Coolant manifolds are shown at the bottom of the module on both sides	
The traction battery contains 5 modules with around 200 cells with an overall voltage of 360 V to 400 V	



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Nissan Leaf HV Battery

Nissan Leaf The pouch cell is a self-contained battery. Maximum cell voltage is 4 V, but actual voltage is closer to 3.8 V.	
Each module contains 4 cells (2 in series and 2 in parallel). Series connection will increase voltage, parallel connection will increase capacity.	
The traction battery contains 48 modules with almost 200 pouch cells and an overall voltage 360 V to 400 V	



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Tesla HV Batteries

Tesla uses the 18650 cell which has a rated voltage of 3.7v.

The name comes from the battery's dimensions - 18mm x 65mm. (0.717 x 2.58 inches)

(Update: Since 2017 Tesla now produce the 2170 battery - 21mm x 70mm.)



Each module contains over 400 cells connected in both series and parallel.

Also shown in the picture is the coolant connections.



Depending on the size of the traction battery, it will contain 14 or more modules with an overall voltages between 300v and **350 V to 400 V**



Note: Tesla is moving to the 4680 battery - looks like a D cell



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Chevy Bolt HV Battery



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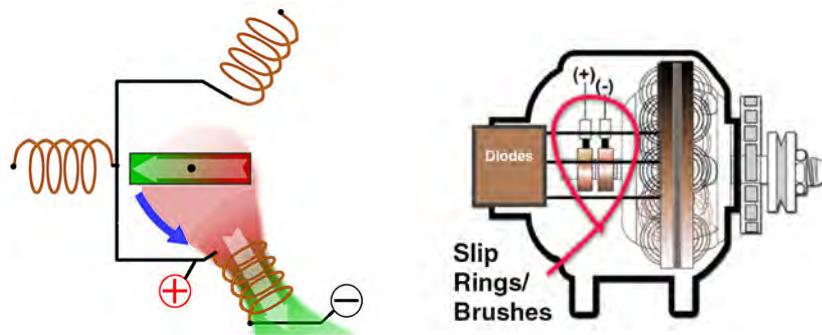
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Motors

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Motors 101



Hybrid / EV Motor layout is similar to an alternator

- Three wire coils
- Spinning bar magnet

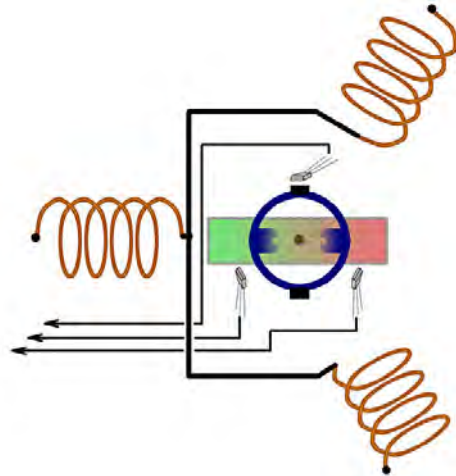
Courtesy ATTSS Inc. / Dorman Training Center

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How It's Done Without Brushers

- **Hall - Effect / Inductive Sensors**
- **Small Magnets Attached To Rotor Shaft**
- **Outputs Trigger Drive Electronics**



Courtesy ATTS Inc. / Dorman Training Center

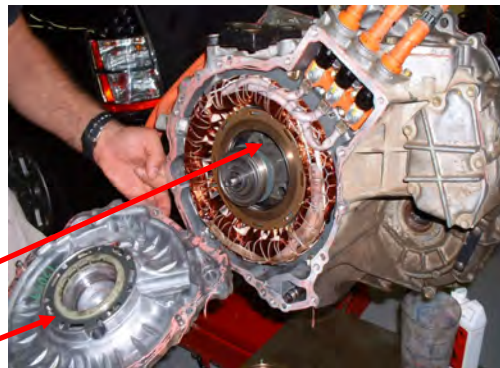
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Resolver

Coil A is excited with constant AC voltage and has a constant frequency output. Coils S and C output values (voltage) that correspond to the position of the rotor. The MG ECU detects the difference between S and C output values, and it calculates the rotational speed based on the amount of change in the position within a given length of time.

Rotor
Resolver



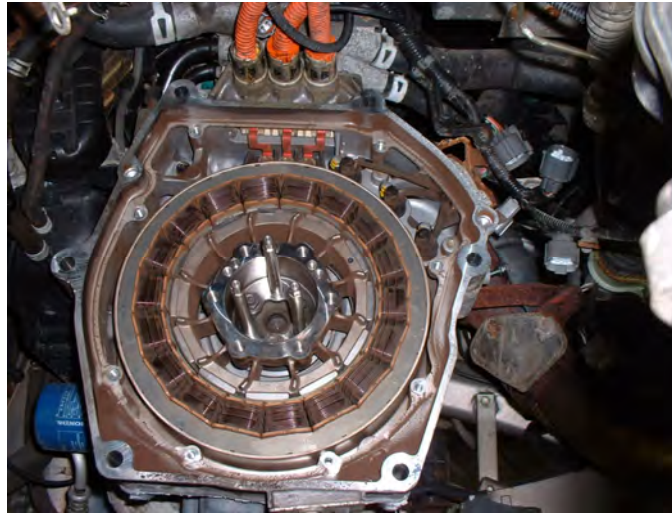
The Rotor rotates inside the Resolver pick up that creates a magnetic field that is sent to the HV computer. The Resolver measures rotational speed - direction of rotation - and the position of the rotor rotation. There are 2 Stators one for MG 1 and another for MG 2.

Text - Source Toyota Motor Company

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Honda Insight MG / IMA



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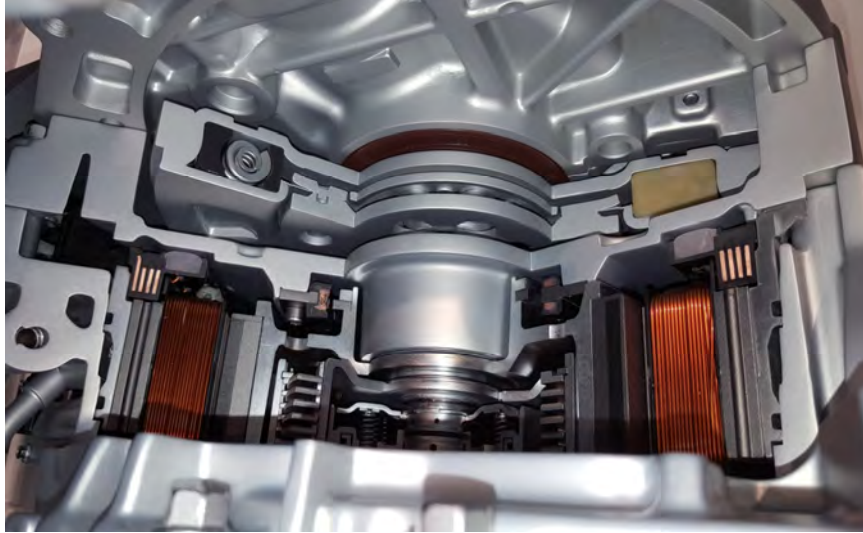
Hyundai MG



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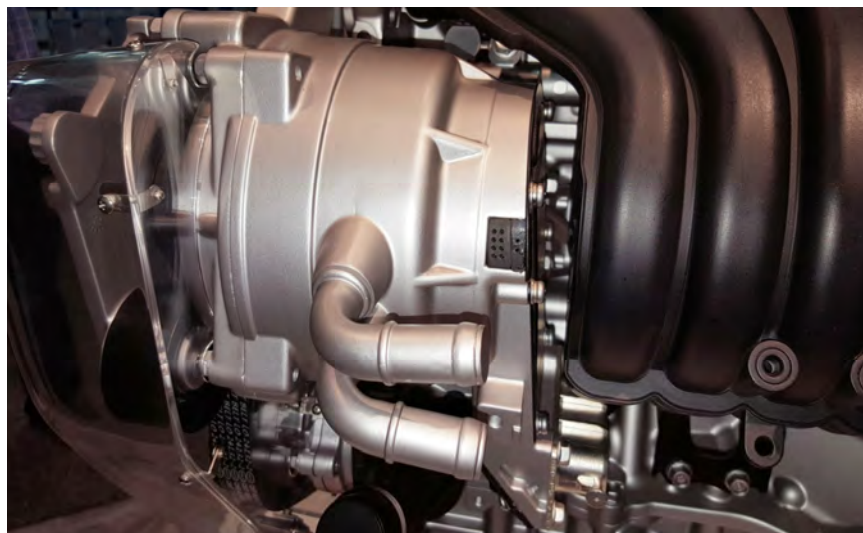
Hyundai MG Damper / Clutch Disk



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Hyundai BAS Hybrid System



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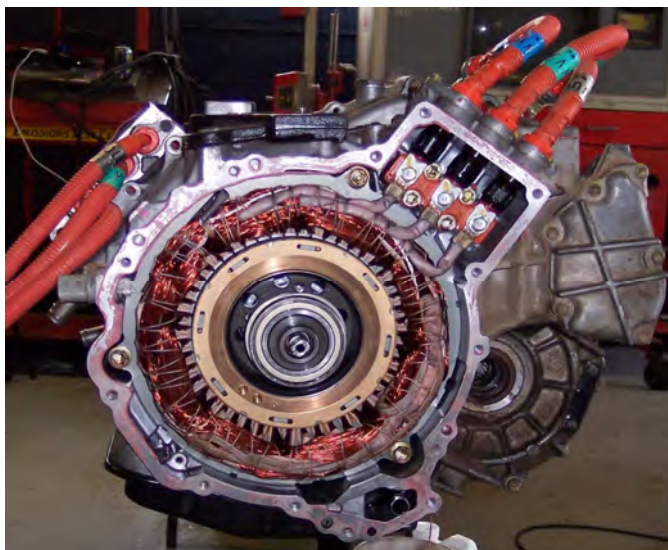
Prius MG 1



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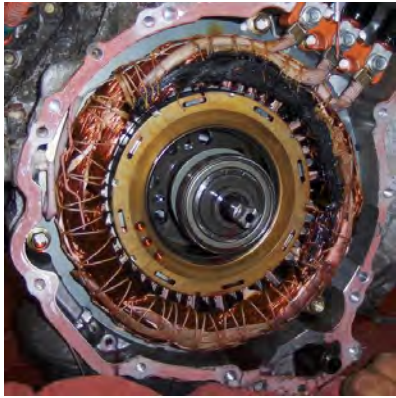
Prius MG 2



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MG Problems



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Hybrid Ford / Mercury Electric Drive Motor 1



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Hybrid Ford / Mercury Electric Drive Motor 2



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Chevy Bolt EV MG



1 MG - 266 ft lbs of torque

Only 3 rotating parts in the MG

Courtesy of John Kelly – Weber State

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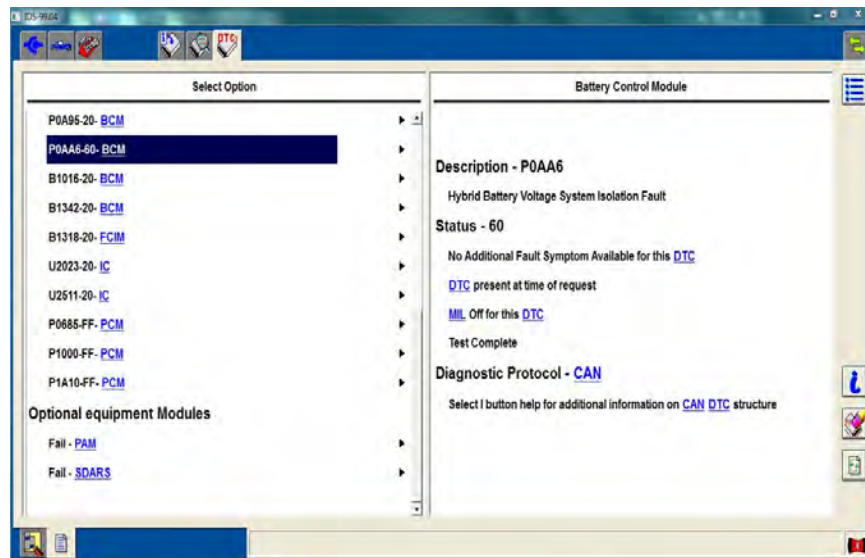
Testing An Isolation Fault



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Ford / Mercury Hybrid Shut Down

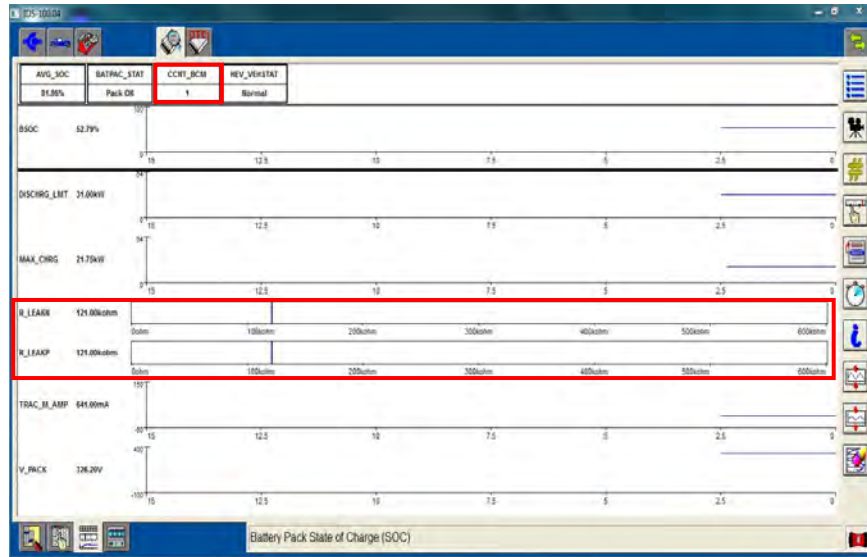


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Ford / Mercury Hybrid Shut Down

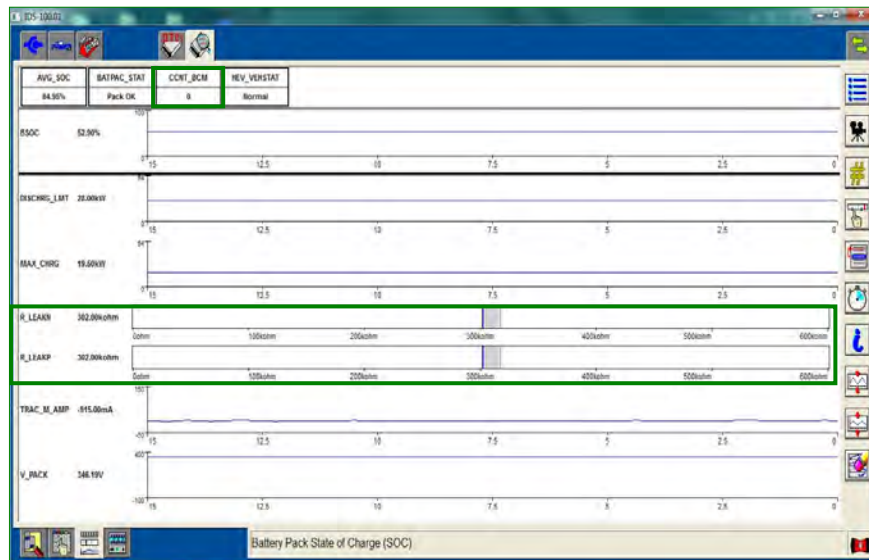


Courtesy ATTS Inc. / Dorman Training Center

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Ford / Mercury Hybrid Shut Down



Courtesy ATTS Inc. / Dorman Training Center

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Ford / Mercury Motor Generator Unit



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2014 Prius V Flywheel - Damper Plate - MG



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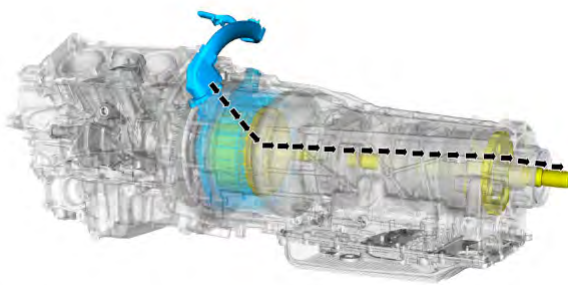
Prius Flywheel - Damper Plate



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Ford Explorer Hybrid MG



E303359



Electric Drive Mode - The engine is off and the electric motor drives the transmission providing torque to the wheels meeting driver demand. The engine disconnect clutch is disengaged during electric drive mode.

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Other Information

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Service Disconnects Disable The HV

Honda



GM



Audi / VW MB & ...



Toyota

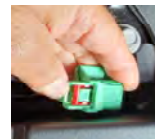


Wait 5 - 10 minutes for discharge!

Ford



Newer Ford's



BMW i3



Courtesy ATTS Inc. / Dorman Training Center

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Maintenance

Day - to - day moneymakers

3,000 to 5,000 miles

Oil Service

OIL TYPE - Weight



5,000-6000 Miles

Correct Tires & Rotation

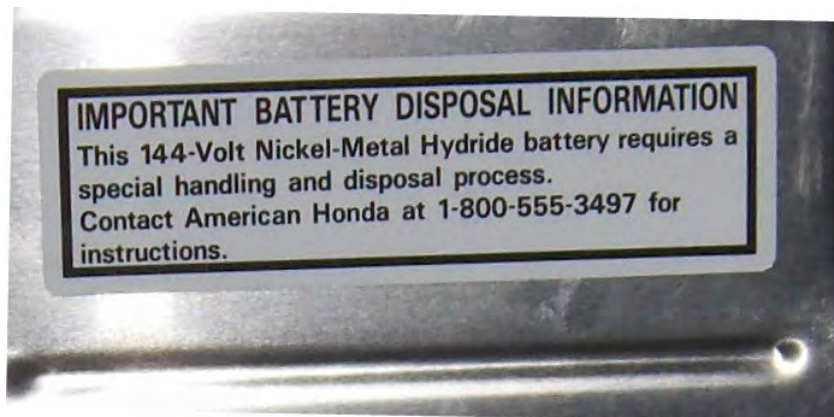
Inspect and clean rotors

Courtesy ATTS Inc. / Dorman Training Center

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Honda Hybrid Battery

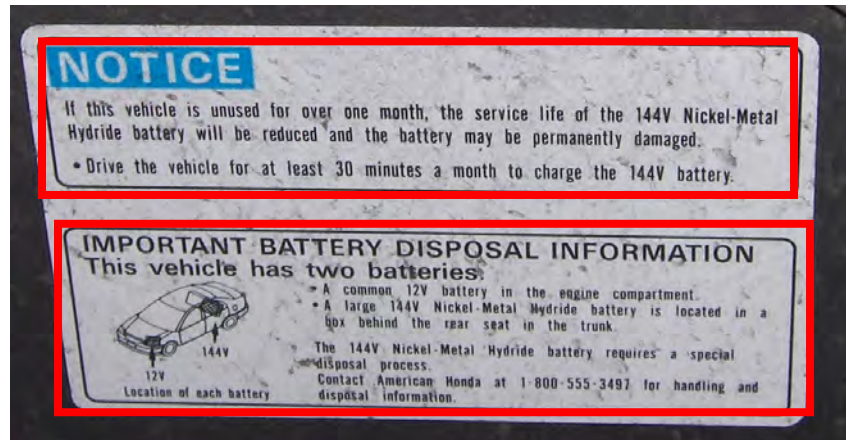


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Honda Battery Information



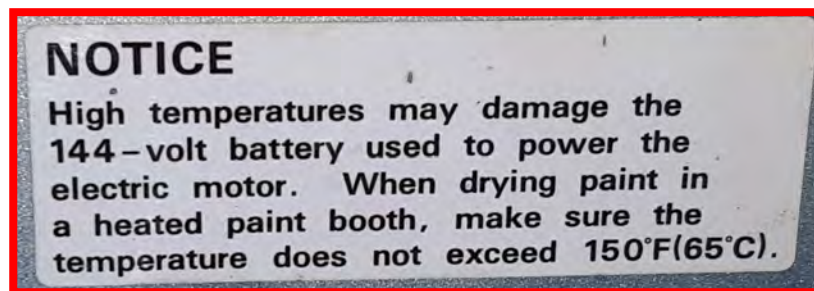
Courtesy ATTS Inc. / Dorman Training Center

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Honda High Voltage Batteries

Notice: Don't Overheat The HV Battery



Courtesy ATTS Inc. / Dorman Training Center

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Honda Civic: What's Behind The Cover & What HV Battery



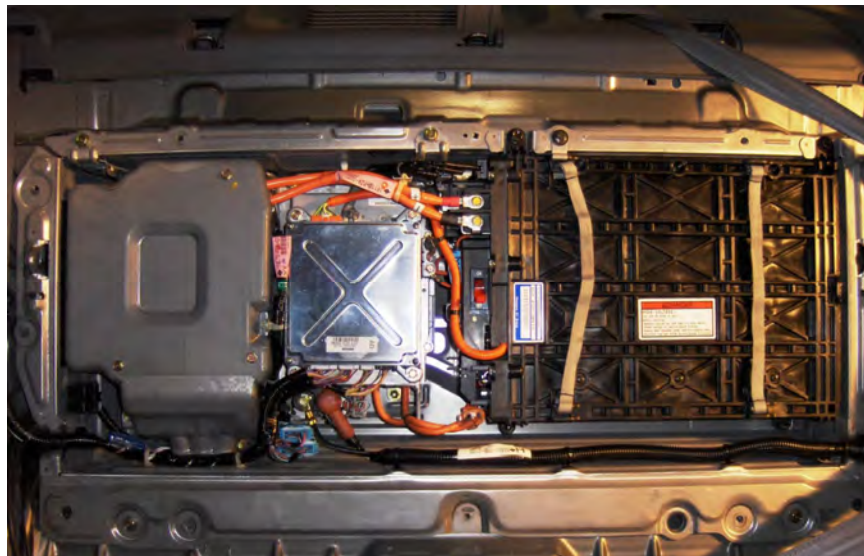
HV from electric motor

12 volt starter motor

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Honda Civic: What's Behind The Cover & What HV Battery



Courtesy ATTS Inc. / Dorman Training Center

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EV Battery Testing

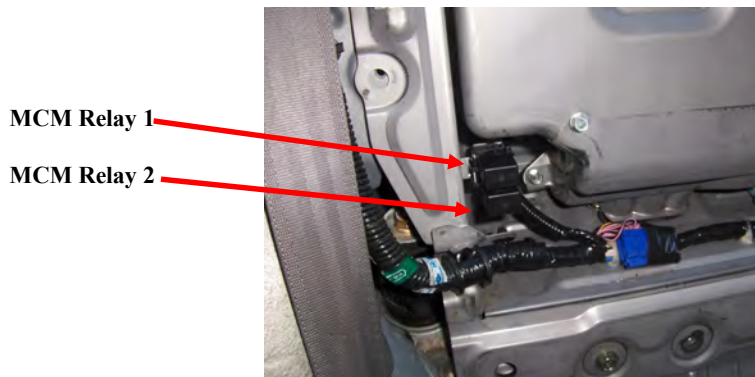
Test-Quick EV Battery Pack Leak Tester
 Rotunda Part Number: 499-LPT-100
 Supplier Part Number: 38C2100
 Price: USD \$630
 Color: [Select](#)
 Details | [ROI Calculator](#)
 The new Test-Quick LPT-100, by Flis-Dynamics, is the most affordable and simple to use low pressure leak tester on the market. The only low-pressure leak tester that guarantees 100% in being vapor or smoke leak detection dye free. Leak test EV battery packs contamination free with only filtered and moisture free air to ensure it is sealed correctly after performing service. The LPT-100 allows for a technician to connect, test, and provide an accurate leak flow rate on the flow meter. Switch control knob to Decay/Off to perform pressure decay testing.
WARNING: This product contains chemicals known to the state of California to cause cancer, and birth defects or other reproductive harm. www.P65Warnings.ca.gov
Product Features:
 • Uses shop air only (75 - 175 psi)
 • Supply pressure 14" H2O +/- 1" H2O
 • Tests with only 100% filtered and moisture free air
 • Engineered with Ford Engineering to comply with EV Battery Pack testing procedures.
 • Flow meter and gauge provides two testing modes - leak flow rate or pressure decay.
 • Test supply line 120" 3/4" ID
 • Hand-held and light weight.
 • Dimensions (H x W x D) 10 3/4" x 7" x 10"
 • Weight 9.5 lbs
 • Limited one year warranty

	Part Number: 414-010 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P1-FL	Qty: 1 USD \$581.17 Check Availability Cart Wish List
	Part Number: 414-011 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P2-FL	Qty: 1 USD \$269.27 Check Availability Cart Wish List
	Part Number: 414-012 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P2-FL	Qty: 1 USD \$238.70 Check Availability Cart Wish List
	Part Number: 414-013 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P2-FL	Qty: 1 USD \$210.83 Check Availability Cart Wish List
	Part Number: 414-014 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P3-FL	Qty: 1 USD \$219.27 Check Availability Cart Wish List
	Part Number: 414-015 Name: Adapter, Leak Test Shipped in TKIT(s): TKIT-2020P3-FL	Qty: 1 USD \$298.83 Check Availability Cart Wish List

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System Main Relays

All hybrid / electric vehicle use at least three system relays to disconnect the high voltage from the HV system. The example from a Honda Civic Hybrid shows their two system relays that they call the MCM (Motor Control Module).



Courtesy ATTS Inc. / Dorman Training Center

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System Main Relays

The following example of a 2010 or later Toyota Prius have three contact - type System Main Relays (SMRs). **The SMRB and SMRP controls the positive side of the HV battery**, while and SMRG control the negative side. When the driver turns the vehicle to READY On, the ECU closes the HV circuit.

- **The ECU first closes SMRB, then SMRP.**
- The resistor in series with SMRP reduces initial current flow.
- **Next, the ECU closes SMRG and opens SMRP.**

This allows full HV battery current to enter the Inverter.

When the driver turns the power switch Off, the ECU opens the HV circuit, or when a collision occurs, Air Bags deploy, or some other system fault that will result in the vehicle being disabled.



Courtesy ATTS Inc. / Dorman Training Center

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid

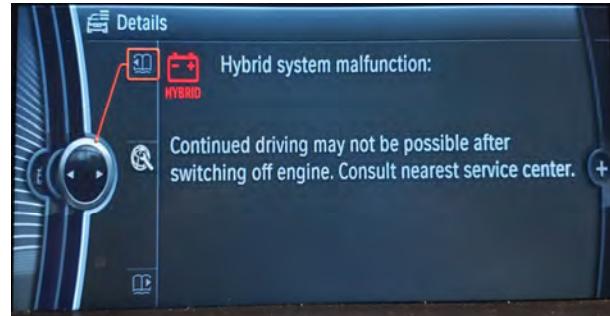
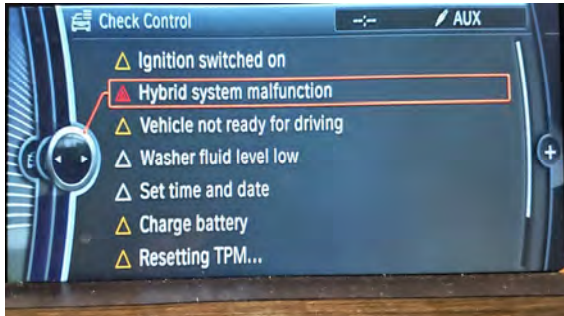


Courtesy ATTS Inc. / Dorman Training Center

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid



Courtesy ATTS Inc. / Dorman Training Center

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid

ISTA+ Vehicle: 7/F04/SEDAN/750Li Hybrid/N63/AUTO/US/LL/2010/09 KL 15: KL 30: AIL-DIT-AS6125_S0C/1RST - High-voltage battery: Evaluating the battery state of charge - V.B

Procedure	Functional Description
Current state of charge: .00 % State of charge of the high-voltage battery: Time (min) in the range. Nominal range: 30 to 60 %: 0 to 40 %: 0.0 40 to 50 %: 0.0 50 to 54 %: 0.0 54 to 58 %: 0.0 58 to 62 %: 0.0 62 to 68 %: 0.0 68 to 70 %: 0.0 70 to 100 %: 0.0 Refer also to following functional description: Active hybrid 7 voltage supply, "High-voltage battery".	Power supply F04 The hybrid car F04 has two vehicle electrical systems driven by two different voltages: - Conventional 12 V electrical system from the BMW 7-Series. - High-voltage electrical system for supplying the high-voltage components with voltage (nominal voltage 126 V). PRB1100045

Measuring devices Keyboard Full Screen Continue

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid

ISTA+ Vehicle: 7/F04/SEDAN/750Li Hybrid/N63/AUTO/US/LL/2010/09 KL 15: 11.8 V KL 30: 11.8 V

VIN: C198324

Operations Vehicle information Vehicle management Service plan Favourites Workshop/Operating fluids Measuring devices

Vehicle details Repair history Control unit tree Control unit list Operations report Info from Service Consultation

VIN: WBAKX8C58C198324
Mileage: 202625
Drive type: REAR WHEEL
Production date: 01/09/2010
Body: SEDAN
First registration: -
Basic version: US
Technical actions: -

Serial number: 7
Engine: N63
Engine: N63B
Control: 2010
Steering: LL
Engine: -
Upbuild: NASV

Note: This is a vehicle with an alternative drive. Work on vehicles with alternative drives may only be executed by specially qualified technicians. Otherwise there is danger of injury. The BMW Group Trainingsakademie, among others, offers the required qualifications.

Selection designation: 750Li Hybrid
Gearbox: AUTO
I-level actual: F001-18-09-520
Last saved program version: -
Programming data: -
Type approval no.: -
Road-Map/Abc: -

State: Special defect code: Title: [OK]

Breakdown: ☒ Yes ☐ No

Retrofit: -

Optional equipment: -

Display measures plan Write service history Start vehicle test Information search

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid

ISTA+ Vehicle: 7/F04/SEDAN/750Li Hybrid/N63/AUTO/US/LL/2010/09 KL 15: 11.6 V KL 30: 11.6 V

VIN: C198324

Operations Vehicle information Vehicle management Service plan Favourites Workshop/Operating fluids Measuring devices

Repair/maintenance Troubleshooting Service functions Software update Control Unit Replacement Vehicle modification

Fault memory Fault pattern Function Structure Component Structure NED Text Search SAE fault code input

Code	Description	Mileage	Existent	Class
21F071	High-voltage battery: Voltages of individual battery cells differ considerably	202625	yes	
21F072	High-voltage battery: At least one battery cell defective (warning threshold)	202625	yes	
21F07E	High-voltage battery: Battery aged	202625	yes	
21F085	SME, internal fault: Voltage of high-voltage battery cannot be determined	-1	No	
21F089	High-voltage battery, temperature sensors: Several sensors defective	202625	No	
21F0AF	SME, internal fault: Connection between battery cells defective	-1	unknown	
21F0B0	SME, internal fault: Measuring system of battery cells defective	-1	unknown	
21F11C	High-voltage battery: Charge too low	-1	yes	
21F11D	High-voltage battery: Charge too low	0	yes	
21F123	High-voltage battery: Voltage of individual battery cell, undervoltage (shutdown th	202625	yes	
21F139	High-voltage battery: Deactivation faulty	202625	yes	

Number of fault memories: 41 / 41 No fault patterns: 0 Filter: Default

Show fault code Delete fault memory Filter fault memory Show completely Calculate test plan

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid



Courtesy ATTS Inc. / Dorman Training Center

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid



Courtesy ATTS Inc. / Dorman Training Center

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2011 BMW 750Li N63 4.4L V8 F04 Active Hybrid



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GM - Saturn Hybrid Info



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GM - Saturn Hybrid Info

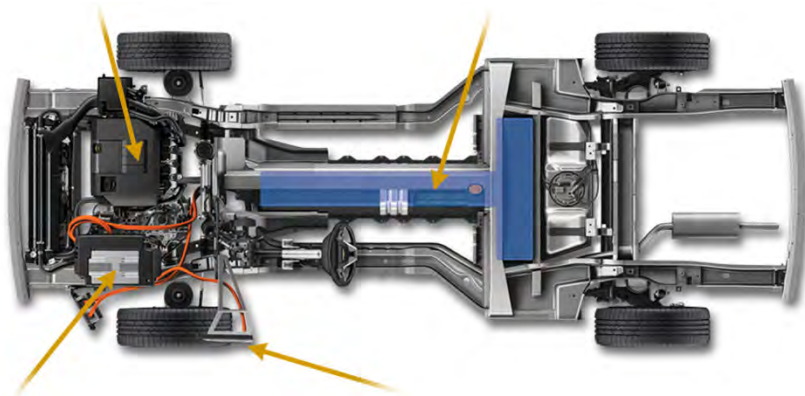


Conventional Engine
with a Generator with Starter

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GM Chevy VOLT



88

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GM Chevy VOLT



Courtesy ATTS Inc. / Dorman Training Center

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GM Chevy VOLT - 111 kW Electric Traction Motor



90

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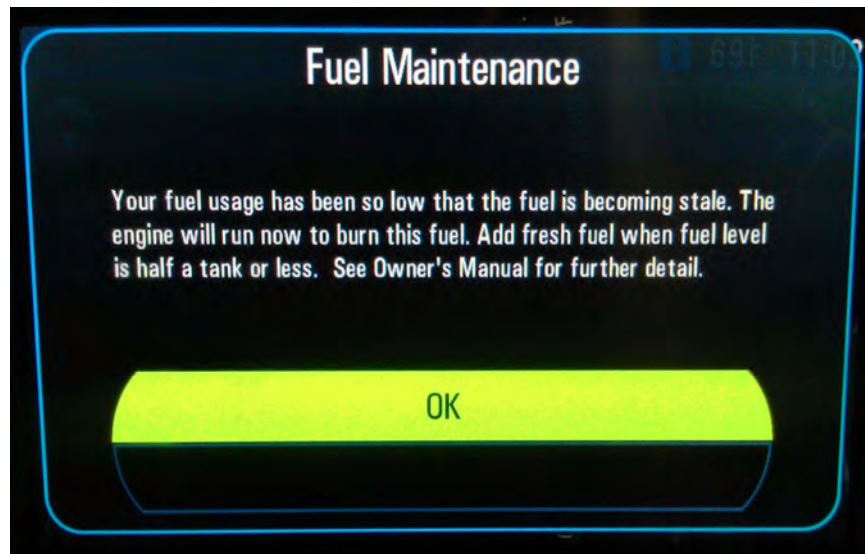
GM Chevy VOLT



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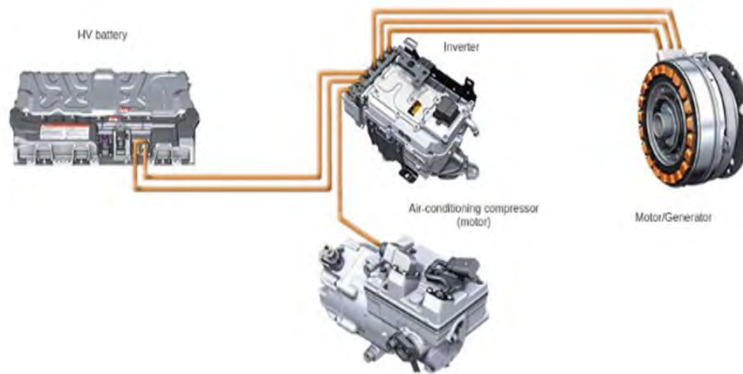
GM Chevy VOLT



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EV - Electric Vehicles

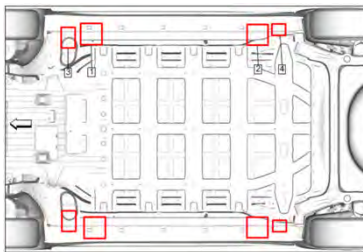


Courtesy ATTS Inc. / Dorman Training Center

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EV Vehicle Lift Points



Chevy Bolt EV



Ford Lighting EV

Tesla Lifting Pucks Two Different Sizes EV



Courtesy ATTS Inc. / Dorman Training Center

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Chevy Bolt EV



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Chevy Bolt EV



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Chevy Bolt EV 400 Volt Battery & 5 psi Warning



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Chevy Bolt EV - High Voltage Battery



Lithium-ion HV Battery has 288 cells and is rated at 66 kWh - Battery weights 960 lbs

Courtesy ATTSS Inc. / Dorman Training Center

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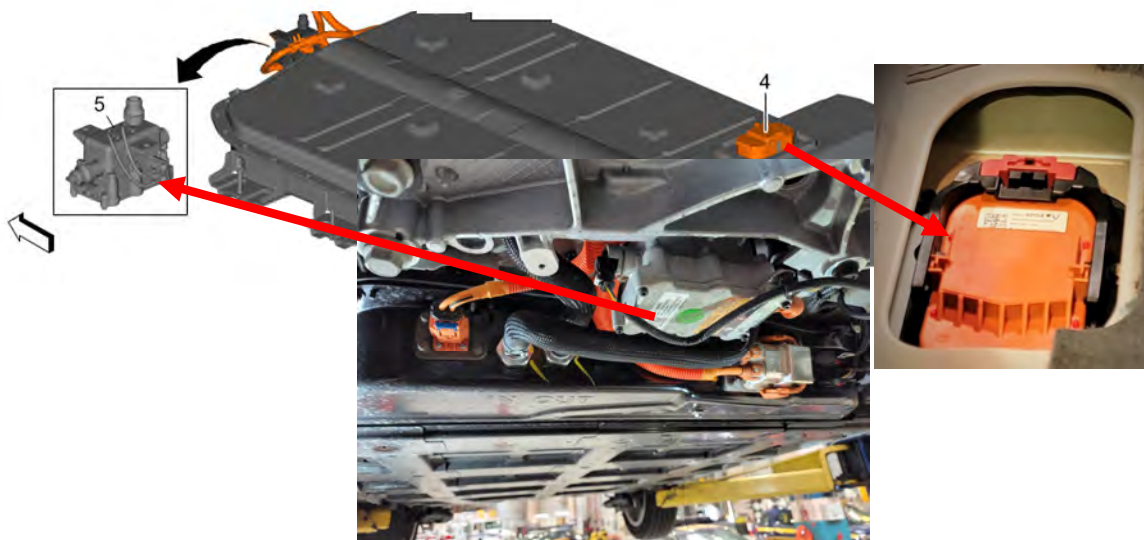
Chevy Bolt EV - HV Battery Charger - Inverter - MG



99

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Chevy Bolt EV - HV Battery



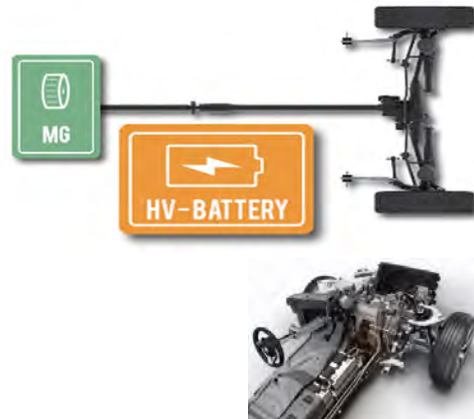
Courtesy of AllData & G Truglia - TST

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EV - Electric Vehicles

- **Voltage level: > 300 volts * 400 V & up**
- **Number of MGs: One electrical motor**
***(not All some has more than one)**
- **Fuel economy: 100%**
- **Main form of propulsion: MG**
- **Regenerative braking**
- **Pure electric drive at all speeds**

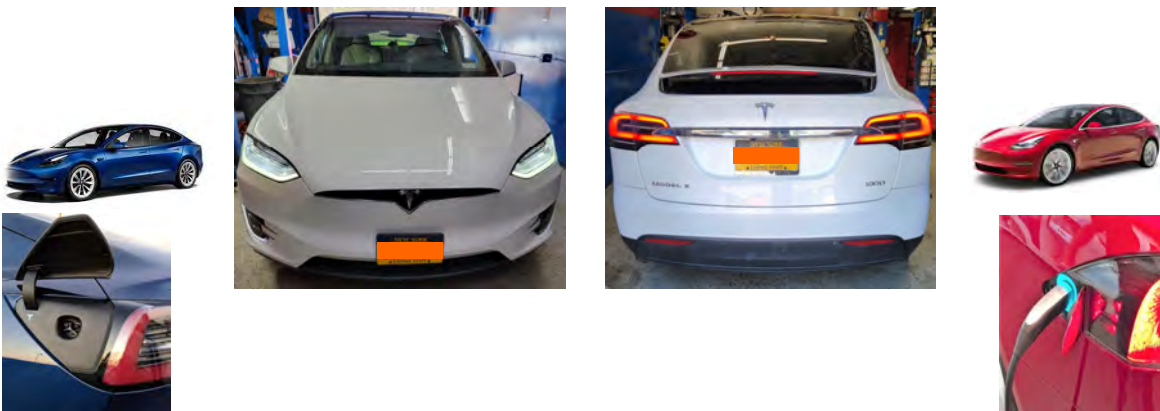


Courtesy ATTS Inc. / Dorman Training Center

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Tesla Has The Same Components Without The ICE Just Package A Bit Different



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J1772 & NACS Adaptors



NACS North American Charging Standard

Courtesy ATTS Inc. / Dorman Training Center

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EV Chargers SAE J1772



SAE J1772 Charge port for Level 1 - 2 - 3 charging. Level 1 is 120 volt (slow charge AC) (full charge about 12 hrs) - Level 2 (medium charge AC) 240 volts - (full charge about 8 hrs) -

Level 3 (high speed DC charge) - (full charge about just over 1 hr)

** Note: Only available commercially*

Courtesy ATTS Inc. / Dorman Training Center

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On To The Vehicle

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Sponsored by



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THANK YOU

"Hybrid - EVs What They're All About"

Presented by Motor Age & TST