TECH LINK

November 2018, Volume 20, No. 21

New PicoScope Oscilloscope Kits Now Available

The CH-51450 PicoScope is a GM-specific 4-channel, PC-based automotive oscilloscope that can be used in the service bay or on the road to diagnose electrical circuits as well as signals relating to vacuum, fuel and hydraulic pressures, noise, vibration and harshness. GM Tools and Equipment has recently released several PicoScope diagnostic kits that are available to all GM dealerships.

The CH-51450 PicoScope was first shipped to U.S. dealerships as an essential tool in 2015 as part of the CH-51450-A NVH kit. For more information and to review special pricing, log in to GM GlobalConnect, select Service from the Departments menu, and then select the Special Service Tools website link.

Here's a look at each of the new kits that incorporate different capabilities and components of the PicoScope oscilloscope.

CH-51450-SCOPE

The CH-51450 4-channel oscilloscope uses extremely high capture rates and digital storage to capture and view up to 32 waveforms containing millions of samples. When using the tool for electrical diagnosis, the oscilloscope shows circuits as they are functioning to provide an accurate depiction of what the circuit is doing, which allows for analysis of the waveform captures to help identify intermittent faults.

continued on page 2

CONTENTS

GM Customer Care and Aftersales

New PicoScope Oscilloscope Kits Now Available

– continued from page 1

The PicoScope can be used for diagnosing:

- Noise, vibration and harshness
- Propshaft balancing
- Camshafts
- Ignitions (primary and secondary)
- Injectors and fuel pumps
- Starter and charging circuits

CH-51450 PicoScope oscilloscope

- Batteries, alternators and starter motors
- Lambda, airflow, ABS and MAP sensors
- Electronic throttle control
- CAN bus, LIN bus and FlexRay

The PicoScope software includes more than 150 guided tests. The built-in tests cover a range of testing procedures for analyzing batteries, alternators, starter motors, cylinder balance and other components. Each guided tests includes a number of insights, such as how to connect various tool components, example waveforms, analysis tips, and suggestions on how to reach a diagnosis.

CH-51450-LEAD

CH-51450 LEAD kit

The CH-51450-LEAD kit is designed to be used with the PicoScope oscilloscope to diagnose electrical circuits. In addition, it aids in diagnosing variable valve timing issues, including camshaft correlation faults and stuck phasers. On the new sliding camshaft system on the new 2.0L turbocharged engine (RPO LSY), for example, it can verify if the camshaft actuators are functioning properly.

The kit contains:

- Premium test leads
- GM-approved back-pinning probe set
- Small crocodile clip
- Battery clips
- 20A/60A DC current clamp
- Telescoptic pac
- Guide to Oscilloscope Diagnostics manual

The back-pinning probes slip down the side of the insulation on the back of multi-plug terminals, enabling the electrical signals to be picked up without stripping wires or disconnecting plugs.

TIP: The CH-51450-LEAD kit is available through the Loan Tool Program. Refer to part number CH-51450-LEAD-LNR for the loaner tool on the GM special tools website.

CH-51450 DIAG

CH-51450-DIAG kit

The CH-51450 PicoScope and CH-51450 LEAD components are available together in the CH-51450-DIAG kit.

The kit includes:

- 4-channel oscilloscope
- USB 3.0 cable
- Premium test leads
- GM-approved back-pinning probe set
- Small crocodile clip
- Battery clips
- 20A/60A DC current clamp
- Accessory box
- PicoScope quick start guide
- Guide to Oscilloscope Diagnostics manual

continued on page 3

New PicoScope Oscilloscope Kits Now Available

– continued from page 2

CH-51450-A NVH and Propshaft Balancer

CH-51450-A NVH kit

The CH-51450-A NVH kit provides real-time diagnosis of vehicle vibration conditions using the PicoScope. With the optical balancing kit, the system provides analysis and procedures for balancing propshafts.

The kit includes:

- 4-channel oscilloscope
- GM-spec NVH and balancing software
- 3 axis NVH interface
- 3 axis accelerometer
- Accelerometer magnet
- Colored BNC cables
- Optical tachometer sensor
- Optical tachometer power adapter
- Magnetic mounting fixture
- BNC cable for optical sensor

Go to the GM special tools website for more information about each kit.

Software Updates

Periodic software updates have been released for the CH-51450-A NVH kit on the GM Tools and Equipment website. Download the software through the Service Workbench selection of "Essential Tools – Software Updates" in GM GlobalConnect (U.S. only). In Canada, the software is available for download through the Service Application selection of GM Special Tools & Equipment – Software Updates in GM GlobalConnect.

Software updates and support for the PicoScope oscilloscope are available on the Pico website at picotech.com/downloads.

Additional information about how to use the varying capabilities of the PicoScope oscilloscope can be found in the Guide to Oscilloscope Diagnostics manual, which can be downloaded from the GM Tools and Equipment website. Click the Support tab for each specific CH-51450 kit to access the link to the manual.

Thanks to Chuck Berecz

Rear Vision Camera Display Unavailable

The Rear Vision Camera display on the infotainment screen may show an image of a video camera icon with a slash through it when some 2018-2019 Silverado 2500/3500 and Sierra 2500/3500 models are shifted into Reverse.

If the vehicle is not equipped with the Rear Vision Camera (RPO UVC), such as vehicles with the box delete option, the display of the icon is a normal operating condition. The video camera icon with a slash through it is displayed to inform the driver that a rear camera is not available on the vehicle.

Per Federal Motor Vehicle Safety Standards (FMVSS), the infotainment system can no longer be reconfigured to eliminate an image when placed in Reverse, unlike previous model years.

Rear Vision Camera kits can be purchased at GM dealerships under RPO RWR.

Thanks to Scott Fibranz

Icon displays to indicate a rear camera is not available on the vehicle.

Measuring Voltage Drop and Resistance

In the simplest terms, electricity consists of the movement of electrons, which flow through batteries, wires, switches, and other conductors. A common comparison is that electrons in a wire flow like water in a hose. The flow of electrons is called electrical current and the pressure that causes current to flow is called voltage.

For example, pinching a garden hose while the water is flowing creates a resistance to water flow, and the pressure inside the hose would be lower after the water passed the resistance. Electricity is similar. Any time current in a circuit flows through a resistance, the voltage is lower after it's passed through the resistance. The proper name for this is voltage drop, and there's a relationship between the size of the resistance, the amount of current flow, and the amount of voltage drop. This is expressed by the mathematical formula called Ohms Law: Current = Voltage / Resistance.

To find voltage: Voltage = Current x Resistance

To find resistance: Resistance = Voltage / Current

If there are several resistances arranged one after the other in series, the voltage drops further each time it passes through each resistance. Ultimately, the voltage in a circuit will drop from source voltage to zero volts as the current moves from and returns to the source.

Measuring Voltage

Measuring voltage is actually measuring the difference between electrical pressures at two different places in an electrical circuit.

The battery negative terminal and anything in the vehicle that is connected directly to it are collectively referred to as "ground." If both leads from the EL-39200 Digital Multimeter (DMM) are touched to the same point in a circuit — even at the battery positive terminal — the DMM reads zero, because there's no difference between them.

Use a DMM to test a circuit.

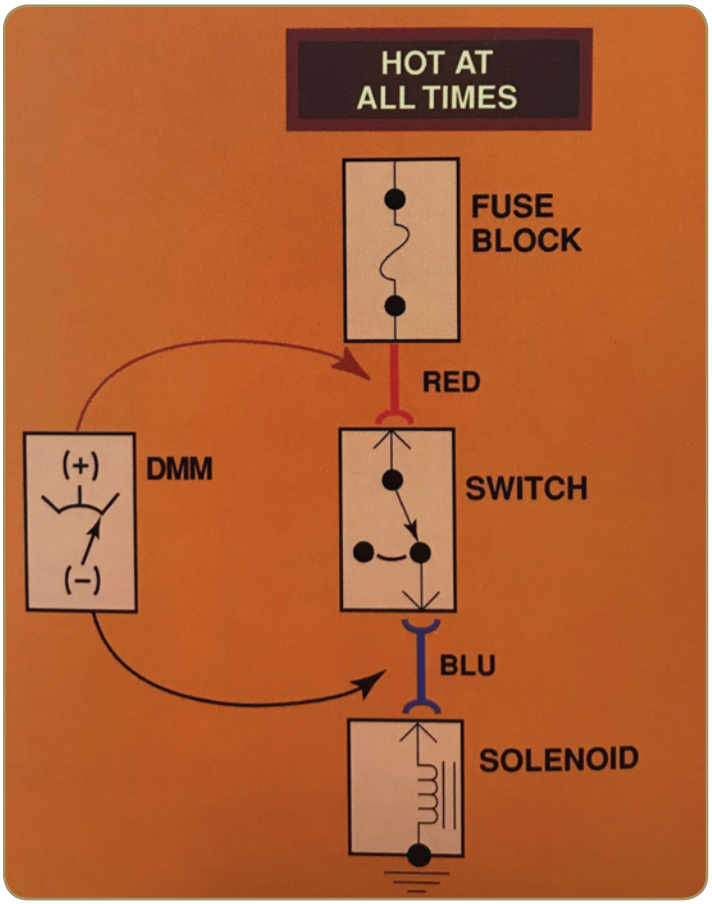
It's customary to measure voltage in a vehicle with reference to the battery negative terminal or ground. If the negative DMM lead is touched to the battery negative terminal and the positive lead is touched to another part of the electrical system, the DMM will indicate how many volts difference there is between the two points.

With reference to the battery negative terminal (ground), the place the voltage is highest is at the source — the battery positive terminal. This is called B+, battery voltage, or source voltage.

TIP: Since electronic components may be sensitive to test voltages, do not perform any tests on circuits unless directed to do so in the appropriate Service Information.

Voltage Drop

Voltage drops must be measured in a live, functioning circuit, with current flowing. If there is an open, the voltage drop reading is meaningless.



Voltage drop test

To measure voltage drop directly between two points in a circuit, set the DMM to the V (DC) position and select the MIN MAX function. Place the positive DMM lead ahead of the suspected resistance and the negative lead after the resistance. With the circuit operating, the meter readout showing the difference in voltage between the two points is the actual voltage drop.

TIP: A DMM has polarity. If the readout indicates a negative number, reverse the leads.

Whenever voltage is dropped by an unwanted resistance, there's less voltage left over to power the intended load in the circuit. For instance, a corroded terminal in a starter motor cable terminal (an unwanted resistance) uses up some of the voltage that should be available for the starter motor. The result (an unwanted voltage drop) causes poor or no cranking. If any voltage drop is higher than acceptable, be sure to disconnect the appropropriate terminals and look for corrosion and damaged wiring or any other conditions that may cause an open/high resistance in the circuit.

continued on page 5

Measuring Voltage Drop and Resistance

– continued from page 4

Every circuit contains built-in voltage drops. For instance, each load is a voltage drop. The voltage is dropped when a motor runs, a relay clicks, or a lamp is illuminated. And nearly every sensor in a computer-controlled engine management system works on the voltage drop principle. A sensor that drops too little voltage can cause as much of a problem as one that drops too much.

Another kind of voltage drop occurs in all circuits. These voltage drops are not intentionally designed in, but they're unavoidable and have to be accounted for. Every component in a circuit — every length of wire, every switch, every terminal — offers some resistance to current flow. Each of these resistances cause a tiny, but measurable, voltage drop. Engineers decide how much voltage drop is considered normal and acceptable. Many diagnostic procedures provide specifications for acceptable voltage drops.

Resistance

Resistance is the opposition offered by a substance to the passage of steady electric current or, more specifically, the current flow within a circuit.

There are no materials that offer absolutely no resistance, nor is there a material that has total resistance; but some materials come close to those extremes. Metals have relatively little resistance. Nonconductors — made from insulating materials such as glass, ceramic, rubber and plastic — have nearly infinite resistance.

Resistance is measured with the ohmmeter function of the DMM. The ohm is the standard measure of resistance.

Disconnect the power feed (i.e. fuse, control module) from the suspect circuit and disconnect the load. The presence of external voltage can upset the meter reading. The DMM measures resistance by sending a small current through the circuit.

The DMM leads can add 0.1 to 0.2 ohms of resistance to a measurement. Touch the leads together to read the resistance of the leads. To eliminate this built-in resistance, press the Relative (REL) mode (or Delta) button and the DMM will automatically subtract this value from the subsequent readings.

Place one lead to one end of the circuit to be tested and the other lead on the other end of the circuit to check the resistance. If a circuit shows low resistance, that means it has good continuity.

Resistance specifications are listed in many of the diagnostic procedures in the Service Information.

Be sure to follow all the diagnostic instructions in the appropriate Service Information, including the circuit/system testing procedures, before replacing any components.

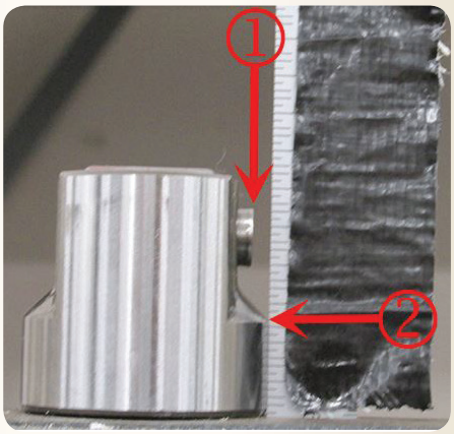
Thanks to Scott Barone

Excessive High Pressure Fuel Pump Roller Pin Movement

Some 2016-2019 Malibu models equipped with the 1.5L 4-cylinder engine (RPO LFV) may have severe low power under acceleration. The low power condition may be due to the ignition timing being extremely retarded on acceleration.

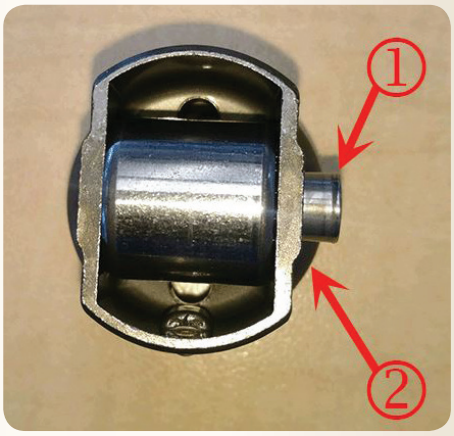
Use GDS 2 to review the ignition timing pattern. If the pattern is extremely retarded during the low power event, remove the high pressure fuel pump roller follower and inspect the roller pin for excessive lateral movement.

Some lateral movement of the roller pin is normal. However, in extreme cases, the pin could walk out enough to protrude past the body of the follower and allow contact with the cylinder head. The normal lateral movement of the pin when pushed all the way to one side should not protrude past the body of the follower.



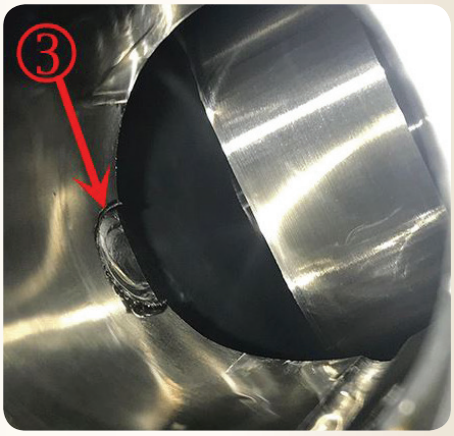
1. Normal lateral movement of the pin
2. Body of the follower

If the roller pin has excessive lateral movement, with the pin "walking" past the body of the follower, it will contact and damage the cylinder head follower bore.



1. Excessive lateral movement of the pin
2. Body of the follower

If there is damage to the cylinder head follower bore because the pin has protruded past the follower body, the roller body should be replaced. If there is any question about the extent of the excessive pin walk, replace the roller follower and evaluate the components. Replacement of the cylinder head will be required if there is damage to the roller follower bore.



3. Damage to the cylinder head follower bore

Once the necessary components are replaced, evaluate the low power under acceleration condition.

Thanks to Robert Halas

EL-50332 Hybrid/EV Battery Service Tool Update

After replacing a hybrid/EV battery section on the 2011-2019 Volt; 2014-2016 ELR, Spark EV; 2017-2018 CT6 PLUG-IN; and 2017-2019 Bolt EV models, the new battery section has to be balanced with the rest of the battery pack.

The battery balance procedure requires using the EL-50332 Hybrid/EV Battery Service Tool. When using the tool, it's critical to connect the cables properly. In addition, the EL-50332 tool occasionally requires software updates.

EL-50332 EV Battery Service and Depowering Tool

Battery Cell Balancing

The EL-50332 Hybrid/EV Battery Service Tool is used to match the voltage level of a replacement battery section to the existing battery sections following a service event. The tool charges or discharges the replacement section, as required, based on measured cell group voltage data.

The EL-50332 tool requires feedback from the Battery Energy Control Module during the balancing process. Communication is through the A4 Hybrid/EV Battery Pack and a low voltage interface harness provided with the EL-50332 tool. The charging and discharging is performed by direct connection to the replacement battery section positive and negative terminals.

Hybrid/EV Battery Cells

Using the Volt as an example, there are 96 cell groups in the hybrid battery assembly. These cell groups are electrically connected in series. The battery cell groups are joined to form three sections.

The Battery Energy Control Module monitors the voltage of the 96 battery cell groups through four Hybrid Battery Interface Control Modules and determines when a fault condition is present. The Hybrid Powertrain Control Module 2 is the host controller for DTC information.

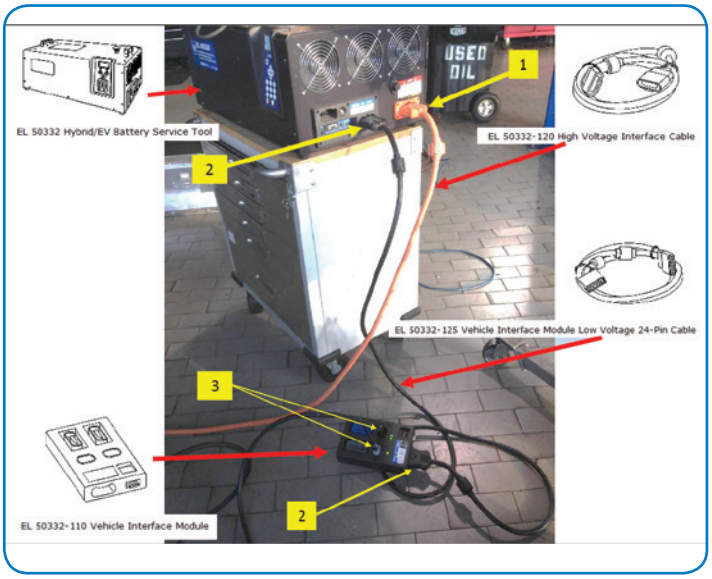
Battery Balance Procedure

TIP: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) must be used.

The EL-50332 tool includes a universal fuse box, a vehicle interface module and a number of cables. Before balancing a battery section, make sure all the external EL-50332 components and cables are in good condition and working order.

EL-50332-270 VIM 2

Refer to the Hybrid/EV Battery Cell Balancing procedure in the appropriate Service Information for complete instructions on connecting the EL-50332 tool. Here are a few tips to assist on hooking up the tool to a battery section.



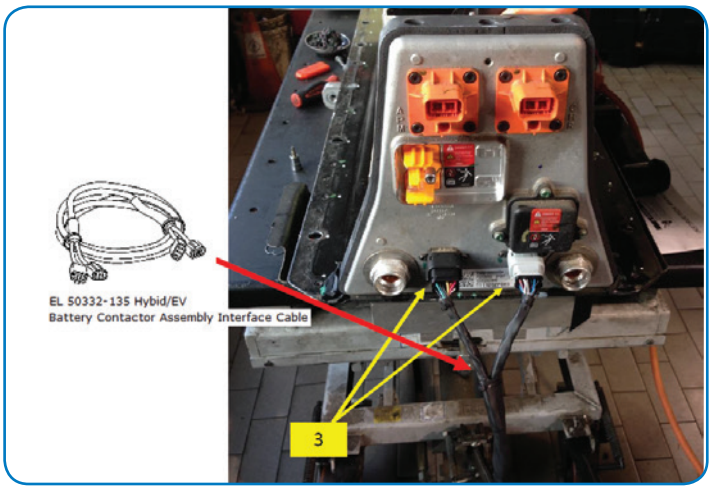
1. EL-50332-120 High Voltage Interface Cable
2. EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable
3. EL-50332-110 Vehicle Interface Module

- Connect the EL-50332-120 High Voltage Interface Cable to the EL–50332 Hybrid/EV Battery Service Tool (#1) and to the EL-50332-105 Universal Fuse Box (not shown).
- Connect the EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable to the EL-50332-110 Vehicle Interface Module (#3) and to the EL-50332 Hybrid/EV Battery Service Tool. (#2). There are two different Vehicle Interface Modules (VIM) to use, depending on the vehicle.

continued on page 7

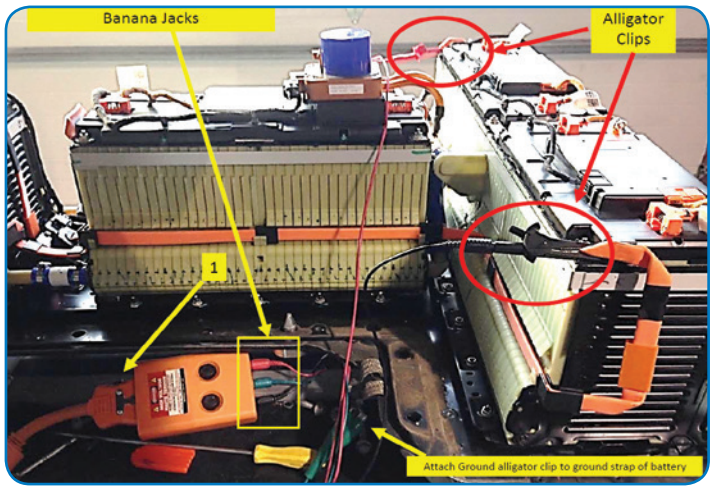
EL-50332 Hybrid/EV Battery Service Tool Update

– continued from page 6



3. EL-50332-135 Hybrid/EV Battery Contactor Assembly Interface Cable

- Connect the EL-50332-XX Hybrid/EV Battery Contactor Assembly Interface Cable (use the appropriate cable for the vehicle application and connector type) to the A4 Hybrid/EV Battery Pack (#3) and to the EL-50332-110 Vehicle Interface Module.



EL-50332-105 Universal Fuse Box

- Connect the EL-50332-145 Black/Red/Green Banana Jack Cable to the EL-50332-105 Universal Fuse Box (#1)

continued on page 8

EL-50332 Tool Components

The following cables and components are available with the EL-50332 tool.

	EL-50332 Hybrid/EV Battery Service Tool
	EL-50332-50 Spark EV Harness
	EL-50332-55 Spark EV OB-II Harness
	EL-50332-60 Spark EV HV Harness
	EL-50332-105 Universal Fuse Box
	EL-50332-110 Vehicle Interface Module
	EL-50332-115 Power Inverter Module High Voltage Interface Cable

	EL-50332-120 High Voltage Interface Cable
	EL-50332-125 Vehicle Interface Module Low Voltage 24-Pin Cable
	EL-50332-130 eAssist Cable
	EL-50332-135 Hybrid/EV Battery Contactor Assembly Interface Cable
	EL-50332-140 14V Accessory Power Module Interface Cable
	EL-50332-145 Black/Red/Green Banana Jack Cable
	EL-50332-160 12V Auxiliary Power Cable

	EL-50332-165 12V Auxiliary Clamps Adapter Cable
	EL-50332-170 High Voltage Alligator Clamps
	EL-50332-175 120V Power Cable
	EL-50332-210 HPCM2 Low Voltage Adapter Cable
	EL-50332-270 Vehicle Interface Module 2
	EL-50332-325 Low Voltage Adapter Harness
	EL-50332-335 High Voltage Adapter Harness

EL-50332 Hybrid/EV Battery Service Tool Update

– continued from page 7

- Connect the EL-50332-155 Green Banana Jack Cable to the A4 Hybrid/EV Battery Pack ground G340.
- Connect the EL-50332-145 Black Banana Jack Cable to the appropriate section negative stud to be balanced and the EL-50332-150 Red Banana Jack Cable to the appropriate section positive stud to be balanced.

If any codes appear when starting up the tool, check the following:

- Make sure the USB flash drive is fully inserted into the machine.
- Do not hook the machine to the battery section until instructed to do so by the machine.
- Update the balance machine software to the latest version available.

The time to complete the balancing process is related to the total capacity of the battery pack and depends on the charge condition of the battery pack and the section being balanced. Larger battery packs will take longer to balance. Also, the more adjustment that is needed, the more time that will be required to complete the balancing.

The EL-50332 tool balances the selected section by charging/discharging, as appropriate. Initial balancing will be in a constant current mode (max 5 amp charge, 7.5 amp discharge). The tool will transition to a constant voltage mode (decreasing current) near the end of the event.

A warranty code and pack voltage current data will be displayed at the conclusion of the balancing event. An audible tone will sound at the end of balancing or if there is a fault condition.

The Software Downloads pages includes the EL-50322 Instruction Manual.

Software Updates

Tool software updates for the EL-50332 are available on the GM Dealer Equipment Website (U.S.). GM dealerships can download the updates by going through GM GlobalConnect > Service Workbench > GM Essential Tools – Software Updates.

Follow the on-line instructions. It may take approximately one hour to update the tool software, depending on the download speed of the dealership's internet connection.

In Canada, go to the Service Department page in GM GlobalConnect. Select "GM Special Tools & Equipment – Software Updates" located under the Applications section.

To update the EL-50332 tool software, use the Update function found under the Utility menu on the tool. Use the USB flash drive that was included with the tool, if available, or locate a suitable USB flash drive.

Install the USB flash drive with the updated software into the USB-A port. When performing an update, the tool will first check the inserted USB drive. Next, the version information of the currently loaded software and the new version information found on the USB drive will be displayed on the screen.

The current software version on the tool also can be checked by going to the Tool Info menu and selecting the Version utility. Tool information available in the Version utility includes the software version, EEPROM, version date, tool serial number, and build number. Use the arrow keys to scroll between the screens of version information.

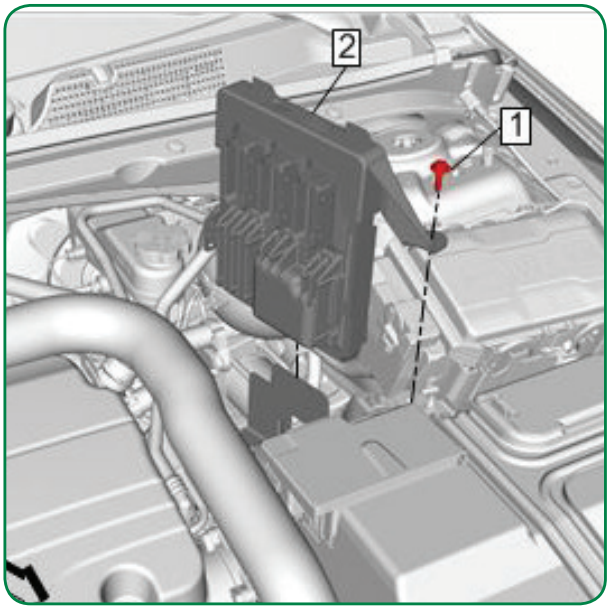
TIP: To view the EL-50322 Instruction Manual, go to the gmtoolsandequipment.com website and select the Software Downloads link. The manual is listed under Support Documents for the EL-50322 tool.

Thanks to Chuck Berecz

Check for Low Voltage or Loss of Power/Ground during ECM Diagnosis

When performing diagnosis on a vehicle for several Engine Control Module (ECM)-related DTCs, it's critical to check for conditions that may cause low battery voltage or a momentary loss of power or ground to the ECM. Verify that there are not any power or ground concerns before replacing the K20 ECM.

A high number of ECMs with no trouble found have been replaced on vehicles equipped with the 5.3L V8 engine (RPO L83) and 1.5 4-cylinder engine (RPO LFV).



ECM on the 1.5L engine (LFV)

The ECM DTCs (in the chart on the right) may be set

DTC P0601	Control Module Read Only Memory Performance
DTC P0602	Control Module Not Programmed
DTC P0603	Control Module Long Term Memory Reset
DTC P0604	Control Module Random Access Memory Performance
DTC P0606	Control Module Processor Performance
DTC P062B	Control Module Fuel Injector Control Performance
DTC P062F	Control Module Long Term Memory Performance
DTC P0630	VIN Not Programmed or Mismatched - ECM
DTC P16F3	Control Module Redundant Memory Performance
DTC P262B	Control Module Power Off Timer Performance

These DTCs are related to internal microprocessor integrity conditions in the ECM as well as incomplete ECM programming.

If any of these DTCs are set, verify that the battery cables are clean and tight and that the battery is fully charged. In addition, check that all ECM power and ground supply circuits do not have an open or high resistance and that there are not any connection or terminal tension issues. Low voltage or a temporary loss of power or ground to the ECM may cause a DTC to set.

TIP: The ECM can withstand normal current draws that are associated with vehicle operations. However, avoid overloading any of these circuits when testing for opens or shorts. Do not ground or apply voltage to any of the ECM circuits unless called out in the appropriate Service Information diagnostic procedures. These circuits should only be tested with a DMM unless the diagnostic procedure instructs otherwise.

Thanks to Tracy Lucas

TECH LINK

GM TechLink is published for all GM retail technicians and service consultants to provide timely information to help increase knowledge about GM products and improve the performance of the service department.

Publisher:
John Meade
GM Customer Care and Aftersales

Editor:
Lisa G. Scott
GM Customer Care and Aftersales

Technical Editor:
Mark Spencer
mspencer@gpstrategies.com

Production Manager:
Marie Meredith

Creative Design:
5by5 Design LLC
dkelly@5by5dzign.com

Fax number:
1-248-729-4704

Write to:
TechLink
PO Box 500
Troy, MI 48007-0500

GM TechLink on the Web:
GM GlobalConnect

Engine ID Needed during ECM Programming

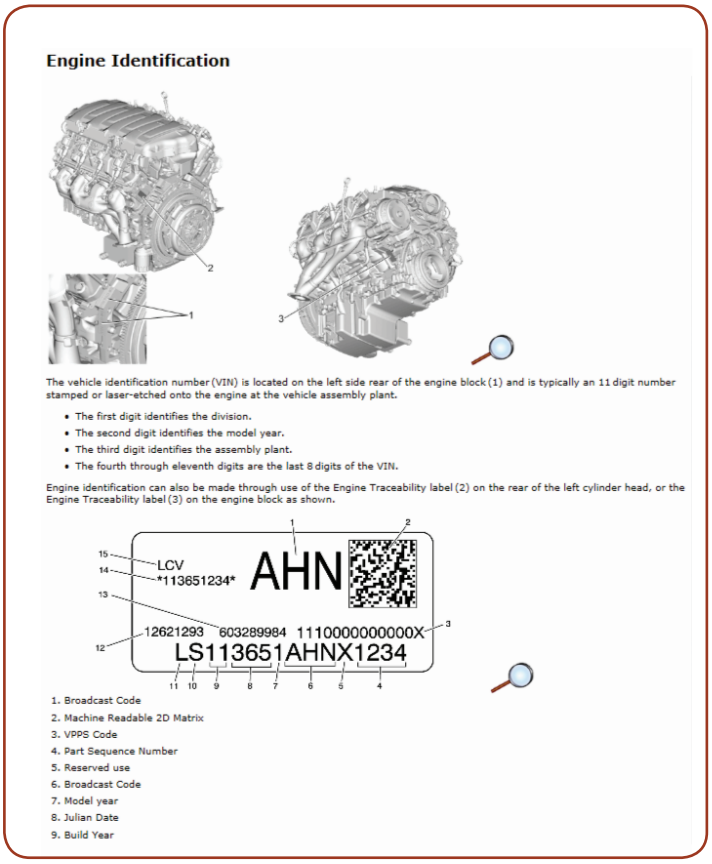
While programming an Engine Control Module (ECM) on some 4-cylinder engines, the Service Programming System (SPS) may prompt for an engine identification number. The engine ID number is used to track engine calibrations.

Engine IDs may be requested when programming ECMs on the following models and engine RPOs:

Model	Engine RPO
2013-2019 ATS	2.0L (LTG), 2.5L (LCV, LKW))
2013-2019 Malibu	2.0L (LTG), 2.5L (LCV, LKW)
2014-2019 CTS, XTS	2.0L (LTG)
2014-2019 Impala, Regal	2.0L (LTG), 2.5L (LCV, LKW)
2015-2019 Colorado, Canyon	2.5L (LCV)
2015-2019 Envision	2.0L (LTG), 2.5L (LCV)
2016-2018 CT6	2.0L (LTG)
2017-2019 XT5	2.0L (LTG)
2017-2019 LaCrosse	2.0L (LTG)
2017-2019 Acadia	2.5L (LCV)
2018-2019 Traverse	2.0L (LTG), 2.5L (LCV, LKW)
2018-2019 Equinox, Terrain	2.0L (LTG)
2019 Blazer	2.0L (LTG)

The engine ID number is found on the engine tag, which is typically located on the front timing cover or the side of the engine block near the oil pan. For engine tag location on a specific vehicle, check the appropriate Service Information under General Information > General Information > Introduction > Vehicle, Engine and Transmission ID and VIN Location, Derivative and Usage.

Engine tag with the engine ID



Engine ID location is shown in the Service Information.

For reference, the engine ID is circled in the photo. When entering the ID from the tag, do not enter any spaces if they exist in the identification number.

Thanks to Norman Grayson

Service Know-How

10218.11V – Emerging Issues (U.S.) – November 8, 2018

The monthly GM Service Know-How Emerging Issues seminars provide service/technical information on current issues and GM certified repairs. The latest service topics from GM Brand Quality and Engineering covered this month include a review of the proper GM-approved back probing method when testing connectors and how to install the tonneau cover on the new Silverado 1500 and Sierra 1500.

To view Emerging Issues seminars:

- Log into www.centeroflearning.com.
- Enter Emerging Issues in the Search box.
- Select the desired Emerging Issues seminar course title.
- Click the Launch button.