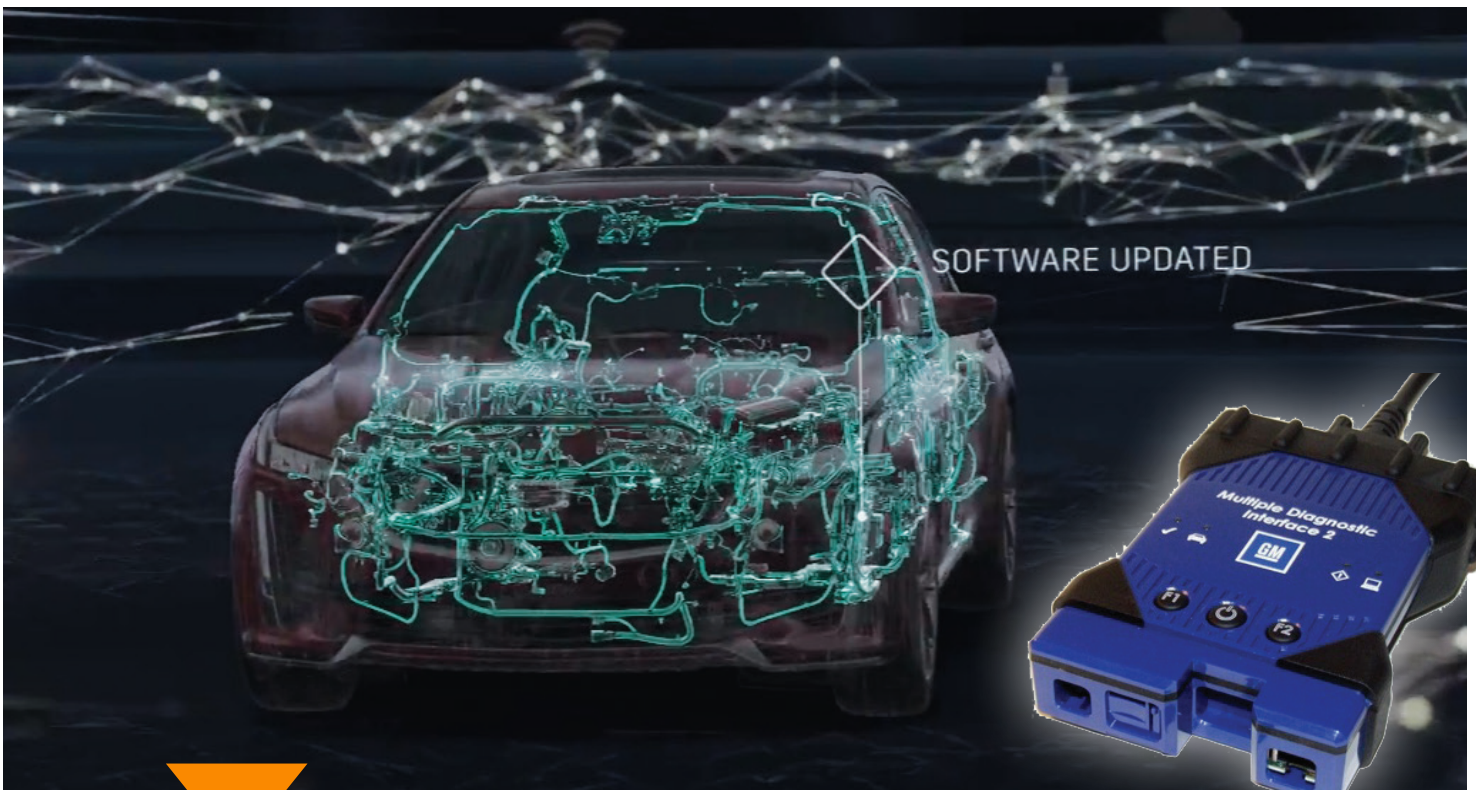


## PROGRAMMING WITH THE Vehicle Intelligence Platform



**GM's new Vehicle Intelligence Platform, or VIP, currently used on 2020-2022 Corvette, CT4, CT5 and 2021-2022 Tahoe, Suburban, Yukon, Escalade and Envision models, offers increased capacity and the ability to better manage technology complexity.**

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# Programming with the Vehicle Intelligence Platform



With a fivefold increase in system capacity and responsiveness over the current Global A system, the next-generation VIP electrical architecture offers the capability of managing over 100 computer modules. It's able to support active safety systems, Over-the-Air (OTA) vehicle software updates, 5G networks, enhanced cybersecurity protections and EV technologies.

The VIP electrical architecture includes two-wire CAN buses and two-wire Ethernet buses to ensure high speed data transfer and multiple single-wire LIN buses to exchange information between master control modules and other smart devices. Low speed General Motors Local Area Network (GMLAN) networks are no longer used in VIP vehicles.

## CAN PROTOCOL

The VIP architecture communication protocol is based on the widely used CAN (Controller Area Network) protocol. CAN buses are used where data needs to be exchanged at a high rate, primarily by a control device using the information to adjust a vehicle system, such as powertrain or body controls. Each CAN data network consists of two twisted wires, called CAN (+) and CAN (-), with a 120 ohm( $\Omega$ ) termination resistor at each end of the bus between the CAN (+) and CAN (-) circuits.

Ethernet data communication technology uses a single twisted copper pair of wires at speeds of 100 Mbit/s and 1000 Mbit/s. The Ethernet system uses point-to-point communication that is connected via an Ethernet switch [Module <--> Switch <--> Module]. The Ethernet bus does not use terminating resistors.

The K56 Serial Data Gateway Module and the A11 Radio have an Ethernet switch that connects to other Ethernet modules. These modules communicate with other devices and systems in the vehicle via CAN and LIN buses. DTCs will be read on CAN to diagnose Ethernet, LIN, and system faults.

Any Ethernet harness failures should be repaired only using the appropriate kit to perform de-pin/re-pin overlays. In cases where the wiring harness repair kits are not available, the entire harness should be replaced. No crimps or splicing should be performed on the Ethernet wiring harness.

## SERIAL DATA GATEWAY

To signal any loss of communication and set DTCs, the K56 Serial Data Gateway Module must know and learn the control modules on the vehicle and their associated buses. If the Serial Data Gateway Module is replaced or another module is added to the bus, such as a dealer-installed accessory, a learn process must be done using the Serial Data Gateway Module learn procedure in SPS.

The learn process will not cause any previously learned contents to be forgotten or overwritten. If the learn process is not completed on a new Serial Data Gateway Module, DTC U1977 (ECU Identification Self Learn Not Completed) will be set until the learn procedure is performed. If the learn process is invalid due to internal malfunction or a Serial Data Gateway Module swap, DTC U3000 42 (Control Module – General Memory Failure) or DTC U3002 56 (Vehicle Identification Number – Invalid/Incompatible Configuration) will be set. The Serial Data Gateway Module will then lose communication with all control modules and set DTCs against control modules not on the vehicle.

The Serial Data Gateway Module also functions as a gateway to isolate the secure networks on the vehicle from unsecured networks. Isolating primary networks helps ensure advanced driver assistance systems and active safety features, such as enhanced collision avoidance, can all operate in conjunction with each other. If harmful software enters the vehicle through the infotainment system, OnStar, or the DLC, other vehicle systems may be affected.

## POWER MODING

In the VIP architecture, the K9 Body Control Module (BCM) is the Power Mode Master (PMM) and the K56 Serial Data Gateway Module is the back-up PMM. There are five power modes: Off, Accessory, Run/Service Mode (Engine Off), Propulsion (Engine On), and Start. As the PMM, the BCM uses a number of vehicle states and inputs to determine which power mode is required. It reports this information to other modules via serial data.

CONTINUED ON PAGE 3

## MDI 2 REQUIRED

The EL-52100 MDI 2 is required for control module programming, configuration and setup on vehicles equipped with the VIP architecture. The MDI 1 does not have the capability to complete programming and setup procedures. Using an MDI 1 on these vehicles could result in erroneous data or failed programming events that could lead to unnecessary module replacement.

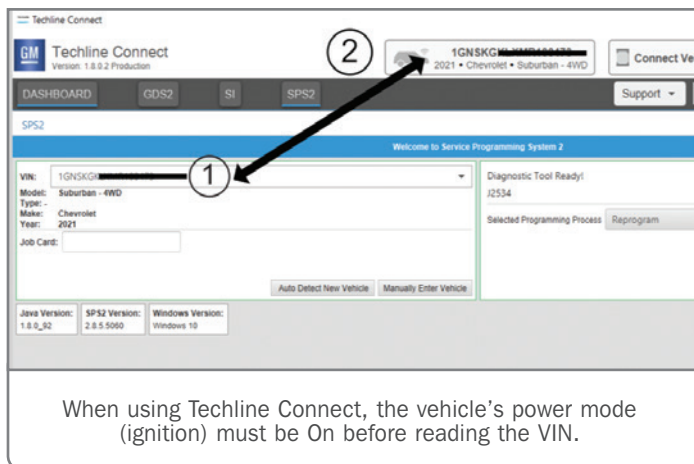
When a scan tool is installed, it will attempt to communicate with every control module that may be available on the vehicle, depending on optional equipment. If an option is not installed on the vehicle, the tool will display No Communication for that control module. In order to avoid misdiagnosis of a No Communication message, refer to the Data Link References that lists the control modules and the buses with which the modules communicate in the appropriate Service Information and the vehicle build RPO codes to determine optional control modules.

## PROGRAMMING A MODULE

When SPS (Service Programming System) programming a module, follow all SPS on-screen instructions.

These tips also should will help in successful programming:

**Confirm the VIN** – Techline Connect (TLC) does not automatically execute the Vehicle Identification Number (VIN) Read with the power mode Off. Technicians must confirm that the VIN is correctly identified prior to programming by verifying the VIN reflected in Techline Connect matches the VIN plate on the vehicle. Be sure not to select a VIN that is already in the Techline Connect application memory from a previous vehicle.



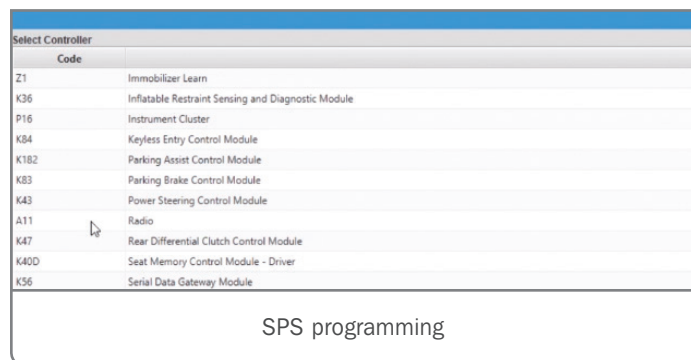
To use the VIN Read when using Techline Connect, the vehicle's power mode (ignition) must be On before reading the VIN from the vehicle's Engine Control Module (ECM), which is the vehicle's VIN master module. Programming or reprogramming modules with the incorrect VIN and using software and calibration files from incorrect VINs can cause future serviceability issues as well as potential vehicle performance issues that may require the vehicle to be reprogrammed again.

**Battery Voltage** – Stable battery voltage is critical during programming. Any fluctuation, spiking, over voltage or loss of voltage will interrupt programming. Install a GM Authorized Programming Support Tool to maintain system voltage. Do not use a battery charger.

**Power Mode Off** – The power mode (ignition) must be Off to begin module programming. Any load on the vehicle's battery, such as interior lights, exterior lights and Daytime Running Lamps, and HVAC operation, may affect the download process and may cause errors to occur.

**Do Not Change the Power Mode** – Do not change the power mode of the vehicle (position of the ignition switch) during the programming procedure unless instructed to do so. Programming will direct the appropriate control module(s) to change power mode as needed during the procedure, independent of the vehicle's power mode.

**Keep Vehicle Fully Asleep** – Ensure that the vehicle will not become awake during the programming event by keeping all doors closed (vehicle fully asleep). For access to the vehicle, trip the driver's door latch to the closed position so that the door can remain open. If a closed door is opened during programming, buses will wake up and cause error codes to set.



**Clear All DTCs** – After programming, clear all DTCs and allow the vehicle to go into sleep mode. DTCs U1962 (Unable to Authenticate Serial Data Message) and U1983 (Serial Data Gateway Module Security Hardware Internal Malfunction) may set and the Check Engine MIL may illuminate if the DTCs are not cleared and the vehicle does not go to sleep after programming or Serial Data Authentication Configuration (SDAC).

If SDAC fails, DTC U1962 will set as a current DTC. It will not clear until another programming event occurs that runs SDAC, or the standalone SDAC procedure is performed using SPS. If DTC U1962 is stored only as a history DTC and not retrieved as a current DTC, do not perform the SDAC procedure.

**Wait 5 Minutes** – After programming, let the vehicle sit for five minutes with the ignition Off, Retained Accessory Power Off and the key fob removed from the vehicle after completing programming. After five minutes, the system can be operated to verify repairs.

► Thanks to Bret Raupp and Peter Shear



# Service Front Suspension Lift System Message

Some 2020-2021 Corvettes may display a Service Front Suspension Lift System message on the Driver Information Center (DIC). DTCs C103C (Left Front Strut Position Sensor Signal) and/or C103E sym64 (Right Front Strut Position Sensor Signal – Signal Plausibility Failure) also may be set.

**TIP:** DTCs C103C and C103E are capable of setting in more than one module on the Corvette, so confirm that the codes are set in the K218 Front Suspension Leveling/Lifting Hydraulic Power Pack Module before performing any diagnosis or repairs.

If these conditions are present, check the mileage and service history on the vehicle. If the vehicle has low mileage or if previous service work on the front suspension lift system has been done, check for possible air entrapment in the system.



Attempt to operate the front lift system several times using the Lift/Lower Select Switch.

The front leveling system consists of the following electrical components:

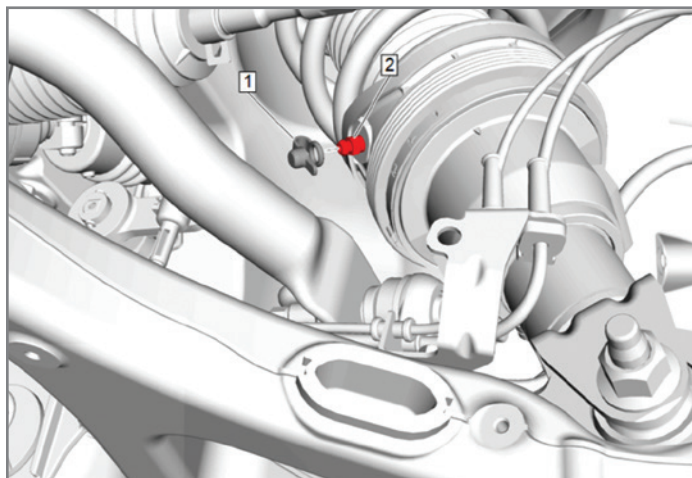
- S86 Vehicle Stability Control System Switch
- Front Ride Height Leveling Subsystem:
  - K218 Front Suspension Lifting/Leveling Hydraulic Power Pack Module
  - Fluid Reservoir

- Front Ride Height Hydraulic Control Unit (HCU)
- Front Ride Height Left/Right Front Actuator (includes displacement sensor)
- P16 Instrument Cluster
- K20 Engine Control Module
- K160 Brake System Control Module

Begin diagnosis by attempting to operate the front lift system several times using the Lift/Lower Select Switch on the center console. If the DTCs reset or if the system will raise briefly and then sink back down, there may be air trapped within the front suspension lift system. Refer to the appropriate Service Information for the DTCs. Be sure to follow "Test B" at the end of the flowchart.

## BLEED THE SYSTEM

Test B covers performing the Prime Front Suspension Pump procedure using the scan tool if the DTCs reset. Perform the pump procedure five times in an attempt to purge any trapped air bubbles from the system.



Front hydraulic suspension actuator bleeder valve

CONTINUED ON PAGE 5

# Twisted Transmission Cooler Line

A harsh shift, shudder, surge or stall condition may be present on some 2021 Silverado, Tahoe, Suburban, Sierra, Yukon, and Escalade models equipped with the 6L80 or 6L90 6-speed automatic transmission (RPOs MYC, MYD), 8L90 8-speed automatic transmission (RPO MQE), or 10L80 or 10L1000 10-speed automatic transmission (RPOs MQC, MQB, MGM, MGU) and with low mileage. These conditions may be caused by a twisted transmission cooler line.



Example of twisted cooler line

When checking for a twisted cooler line, it may be necessary to remove the underbody panels in order to clearly see all the lines.

If a twisted cooler line is found, disconnect the cooler line from the transmission auxiliary cooler and untwist it. Reconnect the cooler line if the rubber is not deformed or misshapen or there are not any other issues with the line. If the cooler line is damaged or deformed from being twisted, it should be replaced.

Check the transmission fluid level following the procedures in the appropriate Service Information and add fluid if needed.

► Thanks to Terry Neuendorf

Next, raise and lower the front suspension system through 10 complete cycles. If the DTCs reset, perform the Front Hydraulic Suspension Bleed procedure and reevaluate the concern. Any time the front hydraulic suspension system is opened, it's necessary to bleed the system at the front hydraulic suspension actuator bleeder valve using the CH-29532-A Pressure Brake Bleeder and CH-44894-A Brake Bleeder Adapter. Be sure to perform the bleed procedure before replacing any components.



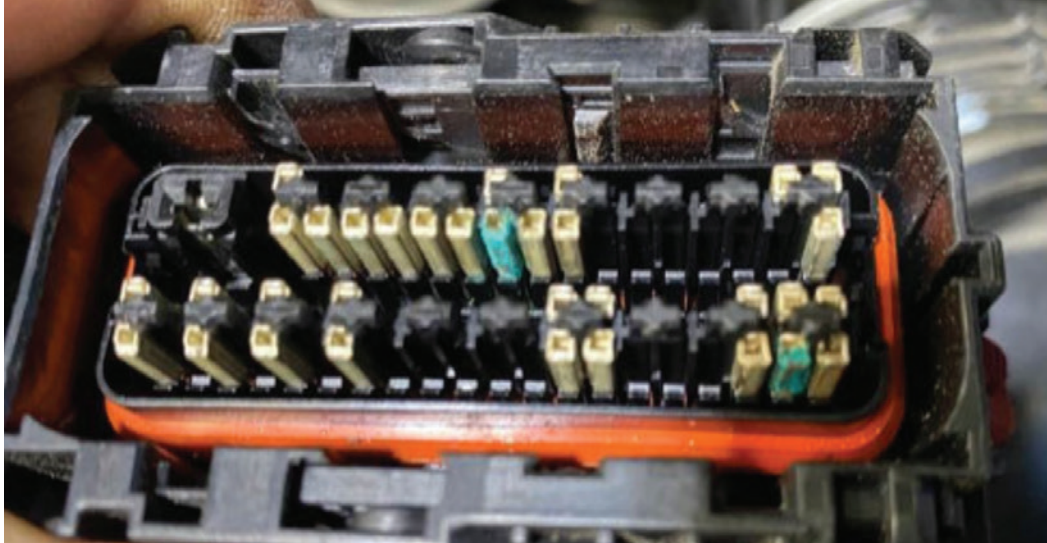
The vehicle should reach a front fascia height of at least 35 mm.

After bleeding the system, verify proper system operation by measuring the distance between the floor and the lower portion of the vehicle's front fascia. A correctly operating vehicle should reach a front fascia height of at least 35 mm within four seconds of pump operation.

For additional information, refer to #PIC6434.

► Thanks to Matt Bierlein

# Corroded Terminals in ECM CONNECTOR



2013-2019 ATS models equipped with the 2.0L 4-cylinder engine (RPO LTG) or 2.5L 4-cylinder engine (RPO LCV) may have a crank, no start condition with an intermittent Check Engine MIL illuminated. Some of the following DTCs may be set: P0014, P0013, P0017, P0192, P0236, P0237, P0335, P0336, P0340, P0341, P0365, P0366, P0420, P0452, P0641, P2123, P2138, P2227, P2228, and/or P2618.

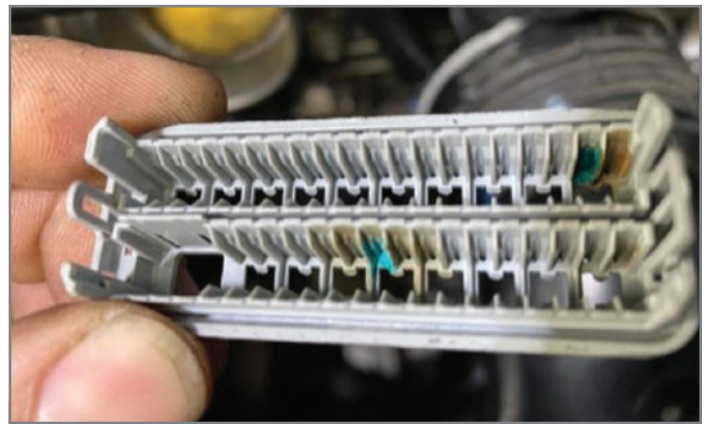
If these conditions are found, check the Engine Control Module (ECM) for any corrosion.

Disconnect all three ECM connectors – X1, X2 and X3 – from the ECM and remove the terminal guide from each connector so all the metal terminals can be seen.

Use a bright light to inspect all the terminals in all three connectors for green corrosion, coolant or oil. Inspect all terminals regardless which DTCs may have set. Every terminal must be inspected since circuits that are corroded or contaminated can back feed into other circuits that are not corroded and set DTCs for associated systems.

## CORRODED TERMINALS

Any terminal that has signs of green corrosion should be replaced with terminated leads. Do not clean the terminals. The contact area is difficult to clean and will lead to poor connections and intermittent DTCs. Solder all terminated leads and cover with



Terminal guide removed from connector

shrink tubing. Do not use crimp connectors to splice the circuits together.

If the ECM terminals inside the ECM socket are corroded, the ECM must be replaced.

## CONNECTORS CONTAMINATED WITH COOLANT

If coolant is seen in any ECM connector, check if the engine coolant temperature sensor circuits are in that connector. If the circuits are in the connector, unplug the engine coolant temperature sensor connector and inspect it for signs of coolant.

CONTINUED ON PAGE 7





"Y" hose from coolant reservoir

If there is evidence of coolant, replace the engine coolant temperature sensor, the engine coolant temperature sensor connector, all associated circuits and terminated leads all the way into the ECM connector. Solder all terminated leads and cover with shrink tubing. Do not use crimp connectors to splice the circuits together.

If the coolant source is not from the coolant wicking up the engine coolant temperature circuits and into the ECM, inspect the coolant reservoir and "Y" hose located above the ECM for leaks. Replace the reservoir or "Y" hose as needed.

If the coolant was leaking down onto the ECM from the reservoir or "Y" hose, the ECM may have to be replaced, depending if coolant saturated the ECM and ECM sockets. Shake the ECM and listen for any coolant sloshing inside the ECM. Replace the ECM if coolant is heard inside the ECM. If coolant is only in the ECM socket, clean the ECM sockets with electrical contact cleaner and blow out with compressed air.

## CONNECTORS CONTAMINATED WITH ENGINE OIL

If there is engine oil seen in any ECM connector, check if the engine oil pressure sensor circuits are in that connector. If the circuits are in the connector, unplug the engine oil pressure sensor connector and inspect it for signs of engine oil.

If there are signs of engine oil, replace the engine oil pressure sensor, the engine oil pressure sensor connector, all the associated circuits and terminated leads all the way into the ECM connector. Solder all terminated leads and cover with shrink tubing. Do not use crimp connectors to splice the circuits together.

Inspect the ECM connector socket for oil contamination. If there oil is found, use electrical contact cleaner and compressed air to clean the socket. If the ECM socket is saturated with engine oil and it is suspected that oil has entered the ECM, replace the ECM.

For additional information, refer to #PIP5790.

► Thanks to David Rutkowski

# Changes to the AFM and DFM Feature ON 2021 SILVERADO 1500 AND SIERRA 1500

Some 2021 Silverado 1500 and Sierra 1500 trucks equipped with the 5.3L V8 engine (RPO L82) and 6L80 6-speed automatic transmission (RPO MYC) or the 5.3L V8 engine (RPO L84) and 8L90 8-speed automatic transmission (RPO MQE) may not have the Active Fuel Management/AFM (L82 engine) or Dynamic Fuel Management/DFM (L84 engine) feature. Beginning in March 2021, trucks produced without AFM or DFM are identified with RPO YK9 – Not Equipped with Cylinder Deactivation.

**TIP:** Any truck with RPO YK9 cannot be reprogrammed and changed to turn on or activate the AFM/DFM functionality.

AFM can provide maximum fuel economy under light load driving conditions by deactivating engine cylinders 1, 7, 6, and 4, switching to a V4 mode.

DFM has the ability to deactivate any combination of cylinder valves, which allows for a large variety of firing sequences. The control of every cylinder event optimizes engine performance so

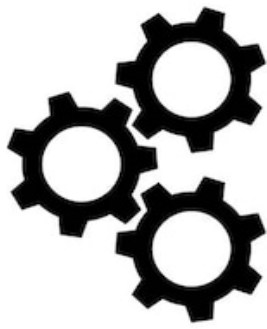
that peak efficiency is obtained throughout the range of engine operation.

While diagnosing engine or electrical wiring concerns on these models, keep in mind that internal components related to AFM or DFM functions will be present in the engines as well as related wiring, connectors and fuses. The Engine Control Module (ECM) will not be capable of activating the cylinder deactivation technology.

When diagnosing and repairing concerns regarding engine or electrical functions that may be related to AFM- or DFM-related hardware, follow the diagnostics in the appropriate Service Information. No changes have been made to AFM- or DFM-related components.

For additional information, refer to Bulletin #21-NA-078.

► Thanks to Richard Renshaw



# TORQUE CONVERTER CLUTCH SHUDDER

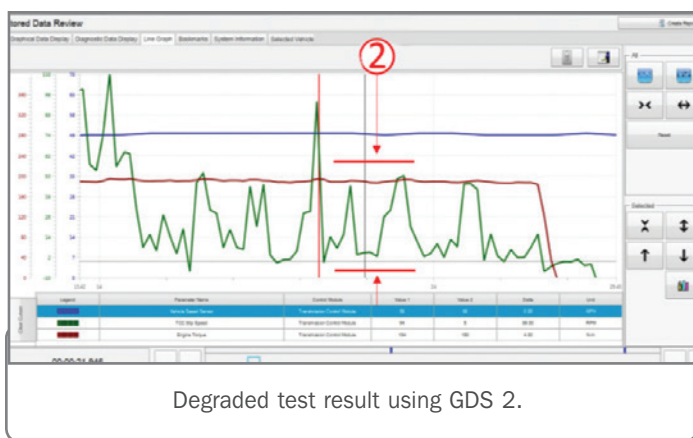
## UNDER LIGHT THROTTLE ACCELERATION

Some 2019-2020 Colorado and Canyon models equipped with the 8L90 8-speed automatic transmissions (RPO M5T) – VIN breakpoint from March 1, 2019 to End of Production – may have a shake or shudder condition during light throttle acceleration at 25–80 mph (40–128 km/h) when the transmission is not actively shifting gears. The condition may be described as driving over rumble strips or rough pavement.

Shudder can be evident in both Drive and M7 mode. It will not occur with the Torque Converter Clutch (TCC) locked (zero slip) or released (open).

**TIP:** After repairs for a shudder condition, any vehicle that returns with suspect shudder should be diagnosed using the diagnostics in the appropriate Service Information, GDS, PicoScope and other diagnostic tools. Sometimes shudder is not caused by the TCC and may be the result of a chuggle, surge or vibration. Repairs for a TCC shudder should only be completed once per vehicle. Additional information can be found in Service Information under Torque Converter Diagnosis.

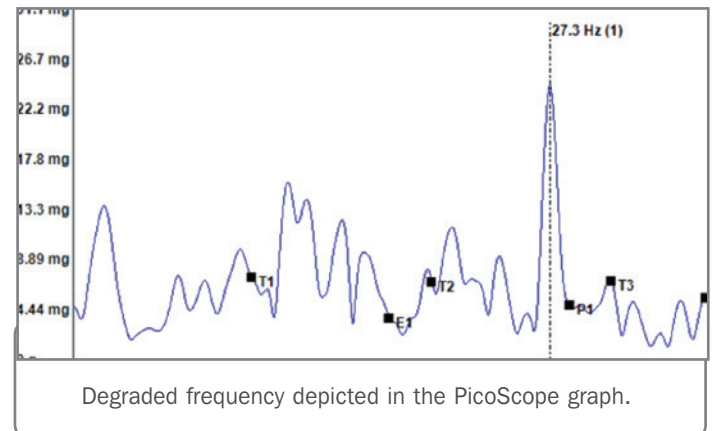
The TCC Slip Control Test using GDS 2 or the TCC Shudder/PicoScope Test should be followed to diagnose a TCC shudder condition. These diagnostic methods are covered in Bulletin #21-NA-047.



Evaluate the vehicle on a smooth road with transmission sump temperature at 122°F–158°F (50°C–70°C), engine speed between 1,100 rpm and 1,500 rpm, and engine torque between 150Nm and 250 Nm.

Be sure any other known vehicle vibration issues (tires, brakes, etc.) have been corrected before conducting testing. If TCC shudder

is present, a vibration peak (using the PicoScope) will appear. TCC shudder vibration frequency is stationary in 8th gear. If the vibration frequency follows vehicle speed or engine speed, then it is not TCC shudder.



If the test results show a vehicle has a degraded TCC RPM slip at steady throttle or TCC shudder frequency at slight tip-in, the appropriate fluid exchange procedure should be completed using the DT-52263 Transmission Fluid Exchange Kit and the DT-45096 TransFlow Cooler Flush Machine.

The fluid exchange procedure must be followed as published in Bulletin #21-NA-047. The exchange process is required to obtain the proper level of new blue label Mobil 1 Synthetic LV ATF HP fluid. Intermixing of other types of transmission fluid or after-market additive packages will result in a low concentration level of new fluid and will not provide satisfactory results.

Refer to Bulletin #21-NA-047 for complete testing and repair procedures as well as parts information.

► Thanks to Mark Gordon





# Poor HEATER Performance

There may be poor heater performance from the driver-side HVAC vents on some 2019-2021 Silverado and Sierra models and 2021 Tahoe, Suburban, Yukon and Escalade models. In some cases, the driver-side center instrument panel vent will have the lowest temperature.

There may be two possible causes for the poor performance:

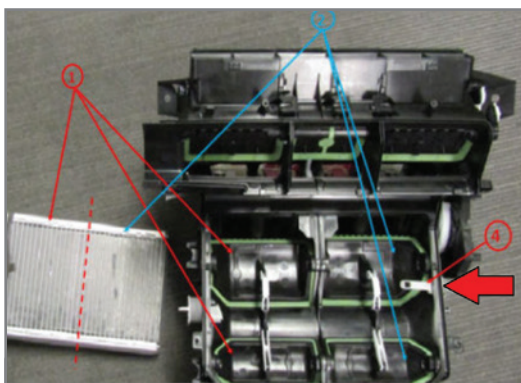
- The heater core may have become plugged, which will affect the driver-side center vent first.
- The links that connect the driver-side temperature doors inside the HVAC case may have become disconnected.

Both single- and dual-zone HVAC cases have four temperature doors. There are two passenger-side temperature doors and two driver-side temperature doors.

Inside the HVAC case, there are four white links that connect each of the four temperature doors. If one of these white links becomes disconnected, the doors will not operate properly.

If diagnostics indicate that the poor heater performance may be due to an issue within the HVAC case, remove the Evaporator Air Temperature (EAT) sensor from the HVAC case (arrow in the photo indicates the EAT sensor location in relation to the driver-side temperature door).

Use a bore scope through the opening for the EAT sensor to inspect both driver-side temperature doors while changing the HVAC temperature setting from full cold to full hot, or manually rotate the driver-side temperature door shaft with the temperature actuator removed.



1. Two passenger-side temperature doors and heater core
2. Two driver-side temperature doors and heater core
4. EAT sensor location in relation to the driver-side temperature door.

If a temperature door is not moving properly, there may be an issue with one of the white links that connect a temperature door, a temperature door issue, or an actuator issue. Follow the diagnostics in the appropriate Service Information to determine the root case. It may be necessary to disassemble the HVAC case to identify the source of a door issue and to replace any parts.

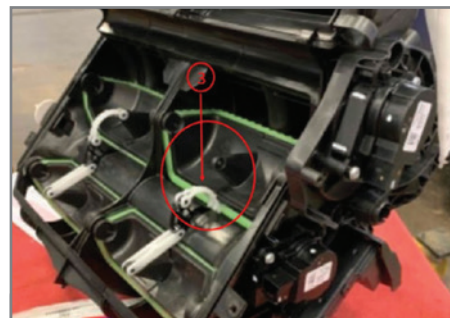
If the temperature doors are moving through their full travel, check the performance of the system, including:

- Checking for a low coolant level in the surge tank bottle.
- Checking that the surge tank cap is properly installed and holds pressure.
- Checking for leaks in the system. Also check connections and confirm the rear heater operates correctly on SUV models.

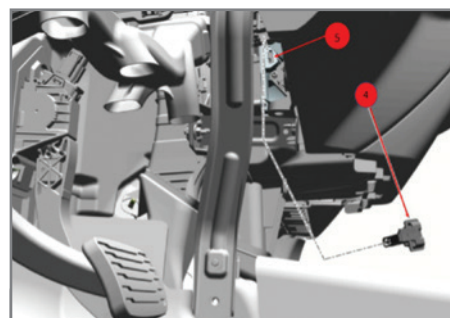
Next, drain the coolant system. Look for any sludge in the radiator lines or if the coolant is liquid or sludge during the draining process.

Flush the coolant system to remove any contaminants, replace the heater core, and install new coolant using a 50/50 mix of the recommended coolant and clean, potable water. Confirm the system is leak-free and performance is normal.

For additional information, refer to #PIT5818.



There are four white links (#3) that connect each of the four temperature doors.



Use a bore scope through the opening (#5) for the EAT sensor (#4) to inspect both driver-side temperature doors.

► Thanks to Jim Will

# Latest EL-50332 EV Battery Service and Depowering Tool Software Released

Software update version 10 for the EL-50332 EV/HEV Battery Service and Depowering Tool was recently released and is available through the Special Tools and Software Updates link in GM GlobalConnect.

The software update (EL-50332-SWV10) increases the allowable tool voltage from 4.15 volts per cell to 4.2 volts per cell in the Bolt EV battery pack to enable module balancing on a nearly fully charged battery. The current tool was not able to initiate module balancing on a battery pack that was almost fully charged.

The software update also contains all previously introduced updates for the EV Battery Depowering Tool.

## SOFTWARE DOWNLOAD

The EL-50332-SWV10 software update is available at no charge for GM dealerships through the Special Tools and Software Updates link in the App Center within GM GlobalConnect (U.S. only). Select the link for EL-50332-SWV10 Battery Depowering Tool Software Update March 2021 and follow the instructions.

In Canada, the software is available for download through the Service Application selection of GM Special Tools & Equipment – Software Updates in GM GlobalConnect.

To update the EL-50332 tool when software updates are available, use the Update function found under the Utility menu on the tool. Complete tool update instructions are available on the GM Tools and Equipment website under the Support Documents link for the software download.

For questions regarding the software update, contact Bosch Automotive Service Solutions Technical Support at 1-800-GM-TOOLS (1-800-468-6657).

▶ Thanks to Dan Clarkson



The screenshot shows the GM Special Service Tools website. The 'Software Downloads' section lists several tools with their respective software links and support documents. The EL-50332 EV Battery Depowering Tool is highlighted with an orange border. Below the list, a text box states: 'The software update is available through the GM Tools and Equipment website.'



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