DM

DIAGNOSIS MANUAL
ECM SYSTEM

WG2503-E3

Kubota

KiSC issued 08, 2016 A

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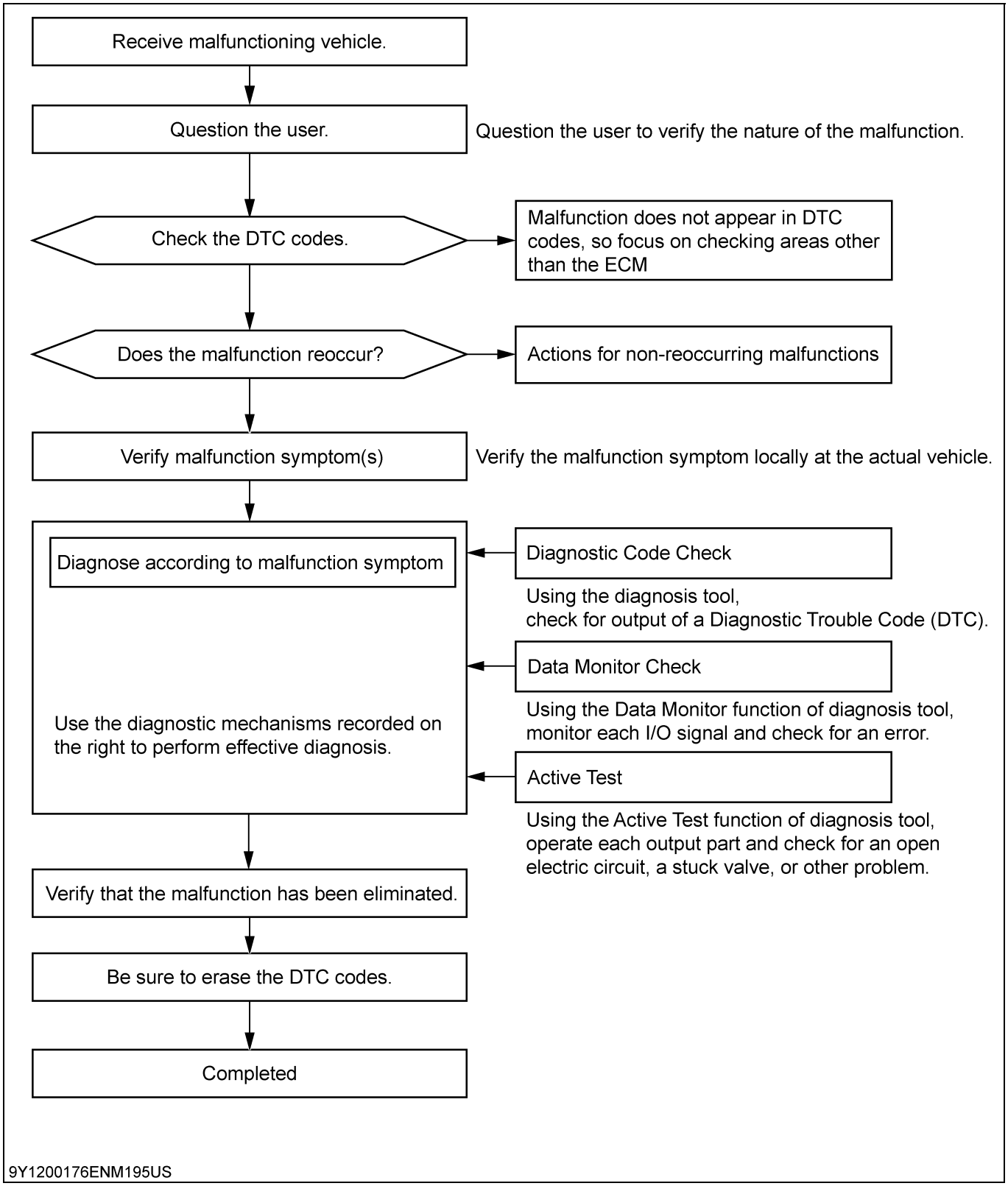


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1. OUTLINE

[1] OVERALL DIAGONOSTIC PROCEDURE



9Y1200176ENM195US

	No Start
Checks	**Action**
DEFINITION: The engine cranks OK but does not start.	
Preliminary Checks	• Refer to Important Preliminary Checks.
Control Module Checks	• Check the battery cranking voltage, voltage should not be less then 9.0 VDC. • Check the inline fuse in the ECM battery power circuit. Refer to Engine Controls Schematics. • Check battery power, ignition power and ground circuits to the ECM. Refer to Engine Control Schematics. Verify voltage and/or continuity for each circuit.
Sensor Checks	• Check the TMAP sensor. • Check the Camshaft position (CMP) and Crankshaft (CKP) position sensors. • Check the Gasoline pressure sensor.
Fuel System Checks	• Check for fuel pump electrical circuit. • Verify proper fuel pump pressure. • Verify proper Fuel rail pressure. • Refer to the Gasoline Fuel System Diagnosis. • Check Electrical connections at the injectors.
Ignition System Checks	• Check for the proper primary side ignition voltage output. • Verify that the spark plugs are correct. • Check the spark plugs for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for loose ignition coil connections at the coil.
Engine Mechanical Checks	• Check for the following: – Vacuum leaks – Improper valve timing – Low compression – Bent pushrods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes
Exhaust System Checks	• Check the exhaust system for a possible restriction: – Inspect the exhaust system for damaged or collapsed pipes. – Inspect the muffler for signs of heat distress, or for possible internal failure. • Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis.

	Hard Start
Checks	**Action**
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start, but immediately dies.	
Preliminary Checks	• Refer to Important Preliminary Checks. • Make sure the vehicle's operator is using the correct starting procedure. • Be sure that there is fuel in the fuel tank. • Check to make sure the manual tank valve is fully open.
Sensor Checks	• Check the Crankshaft Position (CKP) sensor. • Check the Camshaft sensor.
Fuel System Checks	■ **IMPORTANT** • **A closed LPG / Natural Gas manual fuel shut off valve will create an extended crank, OR no start condition.** • Verify the excess flow valve, in the LPG / Natural Gas manual shut-off valve, is not tripped. • Check mixer module assembly, for proper installation and leakage. • Verify proper operation, of the low pressure lock-off solenoids. • Check for air intake system leakage, between the mixer and the throttle body. • Check the fuel system pressures. Refer to the Fuel System Diagnosis.
Ignition System Checks	■ **NOTE** • **LPG / Natural Gas, being a gaseous fuel, requires higher, secondary ignition system voltages, for the equivalent gasoline operating conditions.** • Check for the proper ignition voltage output • Verify that the spark plugs are correct, for use with LPG / Natural Gas. • Check the spark plugs, for the following conditions: – Wet plugs – Cracks – Wear – Improper gap – Burned electrodes – Heavy deposits • Check for loose ignition coil connections. ■ **IMPORTANT** **1. If the engine starts, but then immediately stalls, check Crankshaft Position (CKP).** **2. Check for improper gap, debris, or faulty connections.**
Engine Mechanical Checks	■ **IMPORTANT** • **The LPG / Natural Gas Fuel system, works on a fumigation principle of fuel introduction, and is more sensitive to intake manifold leakage, than the gasoline fuel supply system.** • Check for the following: – Vacuum leaks – Improper valve timing – Low compression – Bent pushrods – Worn rocker arms – Broken or weak valve springs – Worn camshaft lobes. Refer to Workshop Manual • Check the intake and exhaust manifolds, for casting flash.
Exhaust System Checks	• Check the exhaust system for a possible restriction: • Inspect the exhaust system, for damaged or collapsed pipes. • Inspect the muffler, for signs of heat distress, or for possible internal failure. • Check for possible, plugged, catalytic converter. Refer to Restricted Exhaust System Diagnosis.
Additional Checks	

Diagnostic Calibration Configuration and Corrective Actions

Each fault within the GCP is capable of being uniquely configured in the engine's diagnostic calibration to cause one or more corrective actions while a given fault is active.

Table 2 identifies the configuration options and corrective actions available for configuration of each fault. The desired action is set by KUBOTA.

Table 2: Diagnostic Corrective Actions

Corrective Action	Description
Enable	Enables the fault for fault detection.
Shutdown	Cause an engine shutdown when fault becomes active.
Never Forget	Retain fault as historic/previously active until cleared by a technician and does not allow historic fault to be "auto-cleared".
Turn on MIL	Turn on MIL output when fault becomes active.
CL Disable	Disable closed-loop while the fault is active.
CL Disable Key-Cyc	Disable closed-loop while the fault is active and for the remainder of the key cycle.
AL Disable	Disable adaptive learn while the fault is active.
AL Disable Key-Cyc	Disable adaptive learn while the fault is active and for the remainder of the key cycle.
Power Derate 1	Limit TPS to the Power Derate 1 % set in the diagnostic calibration while the fault is active. The Power Derate 1 TPS % should be set higher than Power Derate 2 as Power Derate 2 adds a higher level of protection.
Power Derate 2	Limit TPS to the Power Derate 2 % set in the diagnostic calibration while the fault is active. If the calibration is set to "Latched for Key-Cycle" Power Derate 2 remains active until engine speed and FPP conditions are satisfied. The Power Derate 2 TPS % should be set lower than Power Derate 1 as Power Derate 2 adds a higher level of protection.
Low Rev Limit	Limit RPM to the Low Rev Limit speed set in the diagnostic calibration while the fault is active. If the calibration is set to "Latched for Key-Cycle" Low Rev Limit remains active until engine speed and FPP conditions are satisfied.
Forced Idle	Limit RPM to the Forced Idle speed set in the diagnostic calibration while the fault is active and for the remainder of the key cycle.
Soft Warning	Turn on the soft warning output when the fault becomes active.
Hard Warning	Turn on the hard warning output when the fault becomes active.
Stopped Check	Run fault detection/checking while the engine is in a key-on, engine-off condition. ■ **NOTE** • **It is recommended that this feature only be used for general sensor faults (high/low voltage) and some output drivers.**

(Continued)

States (CL Test State)

1) Inactive
2) Pre-cat init test
3) Pre-cat heater test
4) Pre-cat power test
5) Pre-cat voltage test
6) Pre-cat BM test
7) Post-cat heater test
8) Post-cat power test
9) Post-cat rich test
10) Post-cat lean test
11) Finished
12) Invalid

Pre-Catalyst Monitored Status (CL Pre-Cat Test Status)

1) Test Not Started
2) Test Running
3) Test Finished: Passed
4) Pre-cat EGO Lazy (generates appropriate EGO Lazy fault)
5) Pre-cat EGO Power Low
6) Pre-cat EGO non-responsive
7) Pre-cat EGO fueling error
8) Cannot start test (FPP or TCP % above limit is detected)

Post-Catalyst Monitored Status (CL Post-Cat Test Status)

1) Test Not Started
2) Test Running
3) Test Finished: Passed
4) Post-cat EGO Lazy (generates appropriate EGO Lazy fault)
5) Post-cat EGO Power Low
6) Post-cat EGO Rich Failure
7) Post-cat EGO Lean Failure
8) Cannot start test (FPP or TCP % above limit is detected)

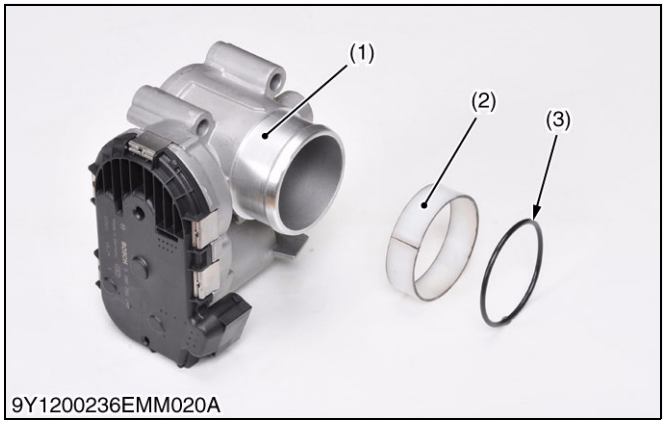
ELECTRONIC THROTTLE BODY (ETB) (ALL)

The Kubota fuel systems utilize Drive By Wire (DBW), to control engine speed, in this type of application. There is no direct connection between the operator pedal, and the throttle shaft. Speed and load control are determined by the ECM. Defaults programmed into the ECM software, and throttle position sensors, allow the ECM, to maintain safe operating control, over the engine.

In a drive by wire application, the Electronic Throttle Body (ETB) (1) device, or "throttle body assembly", is connected to the intake manifold of the engine. The electronic throttle control device, utilizes an electric motor, connected to the throttle shaft. In addition, a Foot Pedal Position sensor (FPP) is located in the operator's compartment. When the engine is running, electrical signals are sent from the foot pedal position sensor, to the engine ECM, when the operator depresses or release the foot pedal. The ECM then sends an electrical signal to the motor, on the electronic throttle control, to increase or decrease the angle of the throttle blade, thus increasing or decreasing the air flow to the engine.

The electronic throttle control device also incorporates two internal Throttle Position Sensors (TPS), which provide output signals to the ECM, as to the location of the throttle shaft and blade. The TPS information is used by the ECM, to correct for speed and load control, as well as emission control, and engine protection.

The ETB (1) utilized on USA emission certified engines do not require any periodic adjustment.



(1) Electronic Throttle Body (ETB)
(2) Spacer
(3) O-Ring

THREE WAY CATALYST (ALL)

The emission certified engine has been designed and calibrated, to meet the emission standards in effect for 2010. To help meet the emission requirements, the vehicle has been attached with a Three Way Catalyst (TWC). Kubota has designed and supplied the catalyst in a separate unit. The catalyst function is the final treatment, of the exhaust gases, which are created from the combustion process. The three-way catalyst consists of a honeycomb, coated with a mixture of platinum, palladium, and rhodium. As the hot gases flow through the catalyst section, an oxidation and reduction reactions takes place. This chemical reaction reduces the amount of CO, HC and NOx, in the engines exhaust. The Exhaust gas then flows through the outlet.

JOINT POINTS (A, B, C, D)

- **A: The points below are jointed.**
  IGNITION_FUSE (15A)
  ALTERNATOR_PIN_2
  VIC2_PIN_S
  COIL_CYL_#1,2,3,4_PIN_1
  INJ_CYL_#1,2,3,4_PIN_2
  O_2_SENSOR_PRE_CATALYST_PIN_C
  O_2_SENSOR_POST_CATALYST_PIN_C
- **B: The points below are jointed.**
  BATTERY +
  KEY_SWITCH_PIN_OFF
  ALTERNATOR_CHARGE_INDICATION_LAMP
  FUEL_SEL_PIN_NG
  MIL_LAMP
- **C: The points below are jointed.**
  ECM_PIN_19 (5 V_EXT1)
  THROTTLE_ACTUATOR_PIN_3
  TMAP (BOOST) PIN_B
  FPM_PIN_C
  VIC1_PIN_M
- **D: The points below are jointed.**
  ECM_PIN_20 (5 V_RTN1)
  COOLANT_TEMPERATURE_SENSOR_PIN_1
  O_2_SENSOR_PRE_CATALYST_PIN_A
  O_2_SENSOR_POST_CATALYST_PIN_A
  THROTTLE_ACTUATOR_PIN_2
  TMAP (BOOST)_PIN_C
  FPM_PIN_A
  VIC1_PIN_L

(1) FPM
(2) FPM Intermediate Harness
(3) VIC1 Connector
(4) ACCEL SENSOR1
(5) ACCEL SENSOR2
(6) MIL
(7) CAN for Vehicle
(8) FEED_PUMP
(9) KEY OFF
(10) KEY ST
(11) KEY IG
(12) Charge Indication
(13) ECM 10A FUSE
(14) Power Relay
(15) IGNITION 15A FUSE
(16) VSW 5A FUSE
(17) Fuel_pump Relay
(18) FUEL_PUMP 15A FUSE
(19) STARTER 15A FUSE
(20) Starter Relay
(21) STARTER
(22) 60A FUSE
(23) ALTERNATOR
(24) BATTERY
(25) BODY EARTH
(26) ENG. BODY
(27) VIC2 Connector
(28) SPEED_METER
(29) GOV_SEL2
(30) GOV_SEL1
(31) ECM (1/2)
(a) to ECM_PIN_14 (CAN1 +)
(b) to ECM_PIN_15 (CAN1 −)

JOINT POINTS (A, B, C, D)

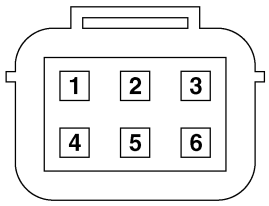
- **A: The points below are jointed.**
  IGNITION_FUSE (15A)
  ALTERNATOR_PIN_2
  VIC2_PIN_S
  COIL_CYL_#1,2,3,4_PIN_1
  INJ_CYL_#1,2,3,4_PIN_2
  O_2_SENSOR_PRE_CATALYST_PIN_C
  O_2_SENSOR_POST_CATALYST_PIN_C
- **B: The points below are jointed.**
  BATTERY +
  KEY_SWITCH_PIN_OFF
  ALTERNATOR_CHARGE_INDICATION_LAMP
  FUEL_SEL_PIN_NG
  MIL_LAMP
- **C: The points below are jointed.**
  ECM_PIN_19 (5 V_EXT1)
  THROTTLE_ACTUATOR_PIN_3
  TMAP (BOOST) PIN_B
  FPM_PIN_C
  VIC1_PIN_M
- **D: The points below are jointed.**
  ECM_PIN_20 (5 V_RTN1)
  COOLANT_TEMPERATURE_SENSOR_PIN_1
  O_2_SENSOR_PRE_CATALYST_PIN_A
  O_2_SENSOR_POST_CATALYST_PIN_A
  THROTTLE_ACTUATOR_PIN_2
  TMAP (BOOST)_PIN_C
  FPM_PIN_A
  VIC1_PIN_L

■ **NOTE**

- **The picture shows the pin arrangement of the connector housing viewed from the harness connector mating side.**

(1) ECM (2/2)
(2) COIL_CYL_#1
(3) COIL_CYL_#2
(4) COIL_CYL_#3
(5) COIL_CYL_#4
(6) INJ_SYL_#1
(7) INJ_SYL_#2
(8) INJ_SYL_#3
(9) INJ_SYL_#4
(10) Knock sensor
(11) Crank sensor
(12) Cam sensor
(13) TMAP (BOOST)
(14) Lockoff Valve
(15) Throttle Actuator
(16) O_2 sensor Pre Catalyst
(17) O_2 sensor Post Catalyst
(18) Can termination Connector
Open: termination OFF
Close: termination ON
(19) DEPR
(20) DIAG_TOOL Connector
(21) CAN Tool
(22) Oil SW
(23) Coolant temperature sensor
(a) to VSW_FUSE (5A)
(b) to DEPR_FUSE (5A)
(c) to ECM_FUSE (10A)
(d) to VIC1_PIN_N
(e) to VIC1_PIN_P

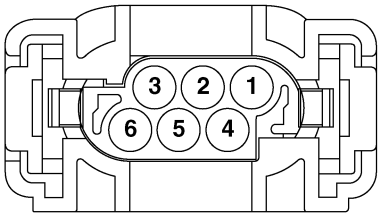
Connector Number: C016*1
Name: DEPR Connector



9Y1200176ENM059A

Pin Number	Description	Wire Color
1	CAN Termination	WHITE
2	CAN 1 +	DK_BLUE/PINK
3	VRELAY	PINK/DK_GREEN
4	Ground	BLACK
5	CAN –	DK_BLUE/WHITE
6	V_{BAT} (12 V)	RED/TAN

Connector Number: C017*1
Name: Bosch Throttle Connector



9Y1200176ENM060A

Pin Number	Description	Wire Color
1	DBW –	TAN/ORANGE
2	5 V_RTN 1	BLACK/LT_GREEN
3	5 V_EXT 1	LT_GREEN/RED
4	DBW +	PINK/WHITE
5	TPS 2	LT_BLUE/DK_BLUE
6	TPS 1	PURPLE/LT_BLUE

■ **NOTE**
- ***1: All connector views are the mating connector view.**

LPG / NATURAL GAS PRESSURE REGULATORS

LPG / NATURAL GAS DUAL STAGE REGULATOR (DSR)

The EControls LPG / Natural Gas DSR is a two stage mechanical regulator with an integral vaporizer which reduces the fuel inlet or tank pressure to a specific lower pressure and adds heat to the fuel for vaporization. You should check the following items at a minimum of once per year:

- Check for any fuel leaks at the inlet and outlet fittings.
- Check for any fuel leaks at the connecting seams of the regulator body.
- Check the inlet and outlet coolant fittings at the regulator body.
- Check the inlet and outlet coolant lines for hardening, cracking, chaffing or splits. If any of these conditions exist replace the coolant lines.
- Check the inlet and outlet coolant line hose clamps at each connection, tighten if necessary.
- Check the mounting bracket to insure the regulator is securely mounted, tighten if necessary.
- Check any of the rubber isolators used for mounting for cracking, hardening or separation.
- Check the regulator for a buildup of oil in the second stage chamber of the regulator. Drain the oil by opening the drain plug located at the bottom of the secondary chamber.

■ **NOTE**

- **Certain Kubota LPG / Natural Gas systems may be fitted with a Direct Electronic Pressure Regulator (DEPR) which is downstream of the DSR. Check these items when inspecting the DEPR:**
- Check the harness connection on the electronic control section, to insure it is seated and locked.
- Check to make sure the DEPR assembly is securely mounted.

■ **NOTE**

- **All EControls LPG / Natural Gas systems are fitted with an LPG / Natural Gas Fuel Lock Off device which is typically mounted to the inlet of the DSR. These are the additional items when inspecting the regulator:**
- Check for any fuel leaks at the inlet and outlet fittings.
- Check the Lock Off electrical connector, to insure it is seated and locked.
- Check to insure the solenoid retaining nut is tightened and fully seated.

GASOLINE FUEL PRESSURE MANIFOLD

On Bi-fuel and dedicated gasoline engines, fuel is delivered to the gasoline injector rails via an electric fuel pump. The ECM controls fuel delivery pressure via a PWM low side drive circuit connected to the ground terminal of the pump. The ECM increases or decreases the fuel pump's voltage to achieve the desired pressure using pressure feedback information from the gasoline fuel pressure manifold assembly. This manifold assembly also measures the gasoline fuel temperature and provides this information to the ECM. This manifold, along with the electric fuel pump, will be located on the chassis. By closely maintaining the target fuel pressure using minimum pump current flow, a minimal amount of fuel is returned to the tank. The fuel pressure manifold and fuel pump do not require adjustment. The following items must be inspected once per year.

- Check the mounting bracket for the fuel pressure manifold and fuel pump, for cracks or breakage.
- Check the securing method for the fuel pressure manifold and fuel pump to insure the devices are firmly attached.
- Check the electrical connection at both the fuel pressure manifold and fuel pump.

INJECTOR RAIL AND INJECTORS

The injector rail and injectors require no periodic adjustment. You should annually inspect the following items on the fuel rails and injectors.

- Check to make sure the rail bracket is securely attached to the engine.
- Check to make sure the rail brackets have no cracking or breaking.
- Check to make sure that each injector is securely attached to the rail bracket.
- Check each injector electrical connection to insure the connector is securely attached.
- Leak check all the connections on the manifold at each injector connector, and the inlet and outlet fitting at the rail, using an electronic leak detector or a soapy solution.
- Check the injector delivery hose (if used) for any cracking, kinky, cuts, or deformation, and replace if necessary.

ELECTRICAL SYSTEM CHECKS

The electrical system, sensors, wiring harness, and ECM do not require any periodic adjustments. You should annually inspect the following items.

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(1) Restricted Exhaust System Diagnosis

Exhaust System Description

The emission certified engine has been designed and calibrated to meet the emission standards in effect for 2010. To help meet the emission requirements the vehicle has been attached with a three way catalyst. The catalyst is a three way catalyst, sound damping and spark arresting unit. Besides controlling the noise created from the combustion process, and preventing sparks from escaping from the exhaust system the most important function is treating the exhaust gases which are created from the combustion process. The three-way catalyst consists of a honeycomb core coated with a mixture of precious metals. The hot gases flow through the catalyst honeycomb core where an oxidation and reduction reactions take place. These chemical reactions reduce the amount of CO, HC and NOX in the engines exhaust. The Exhaust gas then flows through the tailpipe outlet.

During normal operation the exhaust system could become damaged. Damage which reduces the flow of the exhaust gas will create increased back pressure in the engine. Reduction in exhaust flow can result from crushed muffler outlets or melted catalyst brick inside the converter.

It may be necessary to measure the back pressure in the exhaust system. To determine if the back pressure in the engine is correct use the following procedure.

Diagnostic Aids

Tools Required:

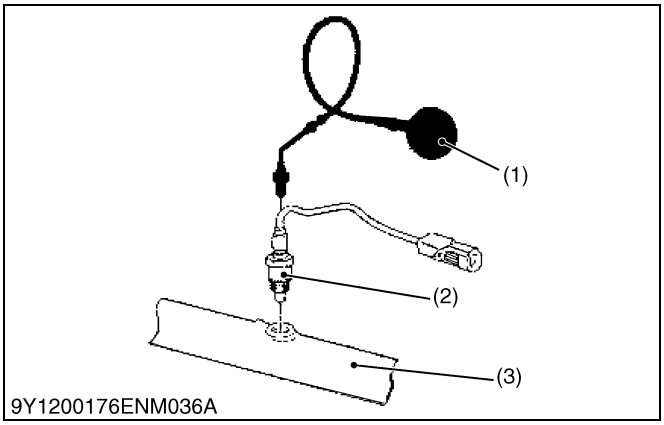
- Back pressure gage 0 to 69 kPa (0 to 0.70 kgf/cm^2, 0 to 10 psi)

Diagnostic Scan Tool:

- EControls GCP Display SW Tool

Check at Heated Exhaust Gas Oxygen Sensor (HEGO)

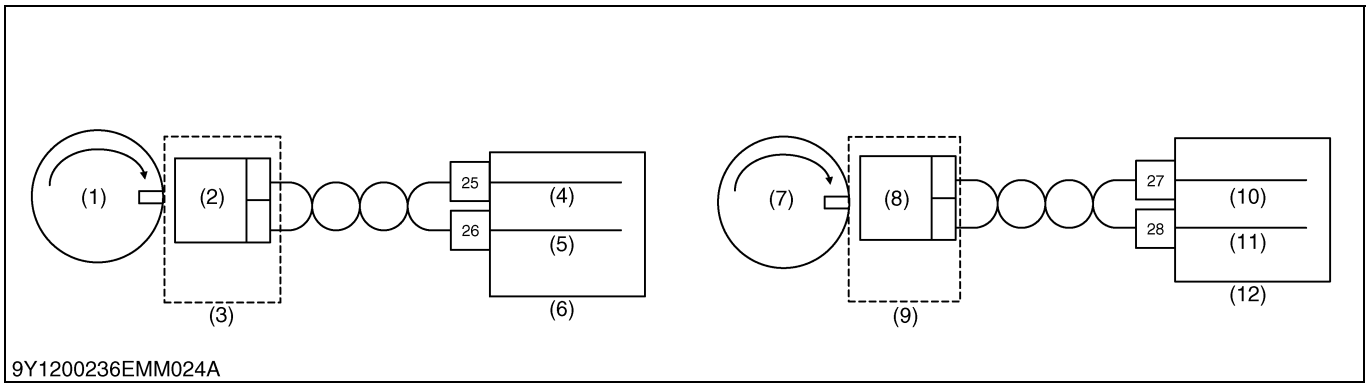
1. Carefully remove the HEGO.
2. Install exhaust back pressure gage in place of the HEGO. (Refer to below figure.)
3. With the engine idling at normal operating temperature, observe the exhaust system back pressure reading on the gage. Reading should not exceed 8.6 kPa (0.088 kgf/cm^2, 1.2 psi).
4. Increase engine speed to 2000 min^{-1}(rpm) and observe gage. Reading should not exceed 20.7 kPa (0.211 kgf/cm^2, 3.00 psi).
5. If the back pressure at either speed exceeds specification, a restricted exhaust system is indicated.
6. Inspect the entire exhaust system for a collapsed pipe, heat distress or possible internal muffler failure.
7. If there are no obvious reasons for the excessive back pressure, the catalytic converter is suspected to be restricted and should be replaced using the recommended procedures.



(1) Back Pressure Gage
(2) Oxygen Sensor (O_2S)
(3) Exhaust Manifold

DTC		606	627	628	
Name		Internal Processor Diagnostics	Fuel Pump Relay Control/Coil	Fuel Pump Relay Control/Coil	Fuel Pump Motor Feedback
DTC Name		Microprocessor Failure-COP	Fuel Pump Relay Coil Open	Fuel Pump Relay Ground Short	
J1939	**SPN**	629	1348	1348	1347
	FMI	31	5	4	5
MIL		ON	ON	ON	ON
Detected Item		• Faulty ECU	• Open coil in relay • Open in relay driver circuit in engine harness	• Relay pull in coil shorted internally • relay driver circuit shorted to ground in wire harness	
DTC Set Preconditions		• Key on	• Key On, Engine Off	• Engine Running	
DTC Set Conditions		• Internal microprocessor error	• Fuel Pump relay coil output open circuit	• Fuel Pump relay coil output shorted to ground	• Fuel pump motor high-side on-state < 4.0 volts • Battery voltage > 8.0 volts
Period for Judgment or Number of Occurrence for Judgment		• N/A	• 10 samples	• 10 samples	• 2 sec
System Action		• Never Forget • AL Disable KC • Power derate 2	• None	• None	• None
Engine Warning Light		OFF	ON	ON	ON

[4] Diagnosis Procedure by DTC
(1) Crank/Cam Sensors (DTC 16, 336, 337, 341, 342)



9Y1200236EMM024A

(1) Crankshaft
(2) Magnetic Crank Sensor
(3) Sensor
(4) Crank +
(5) Crank -
(6) ECM
(7) Camshaft
(8) Magnetic Cam Sensor
(9) Sensor
(10) Cam +
(11) Cam -
(12) ECM

DTC 16-Crank and/or Cam Could Not Synchronize During Start

- Hardware: Crankshaft Position Sensor/Camshaft Position Sensor Input Circuits
- Enabling Conditions: Engine Cranking or Running
- Set Conditions: Engine cranking longer than 4 revolutions above 90 min^{-1} (rpm) without crank and/or cam synchronization
- Corrective Action(s): Illuminate MIL and/or sound audible warning or illuminate secondary warning lamp
- Emissions related fault
- Possible causes: Mechanical misalignment between cam and crank, CMP or CKP signal (+)/ground (–) wires misplaced in connectors, bad ECM

The crankshaft position sensor is a magnetic pick-up sensor installed in the engine block adjacent to a "coded" trigger wheel located on the flywheel. The sensor-trigger wheel combination is used to determine crankshaft position (with respect to TDC cylinder #1 compression) and the rotational engine speed. Determination of the crankshaft position and speed is necessary to properly activate the ignition, fuel injection, and throttle governing systems for precise engine control.

The camshaft position sensor is a magnetic pick-up sensor installed in the engine block or valve train adjacent to a "coded" trigger wheel located on or off of the camshaft. The sensor-trigger wheel combination is used to determine cam position (with respect to TDC cylinder #1 compression). Determination of the camshaft position is necessary to identify the stroke (or cycle) of the engine to properly activate the fuel injection system and ignition (for coil-on-plug engines) for precise engine control.

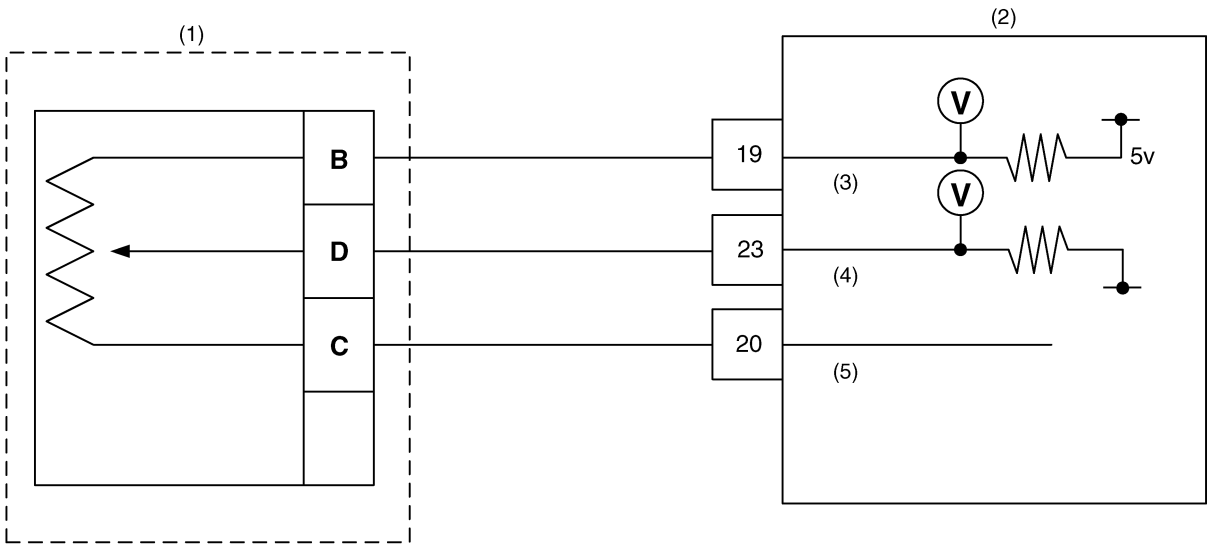
Typically, this fault will result in an engine that will not start or run.

DTC 16-Crank and/or Cam Could Not Synchronize During Start

Diagnostic Aids

- If there are any other CMP or CKP DTC’s, diagnose them first
- Ensure that all 3 terminals are in the correct slot in the connector for both the CMP and the CKP sensors
- Ensure that the cam and crank are properly installed and timed
- Check that crankshaft and/or camshaft position sensor(s) is/are securely connected to harness
- Check that crankshaft and/or camshaft position sensor(s) is/are securely installed into engine block
- Check crankshaft and/or camshaft position sensor(s) circuit(s) wiring for open circuit
- Connect a 2 channel oscilloscope, scope CMP and CKP inputs and compare to known good waveforms

(3) MAP (Manifold Absolute Pressure Sensor) (DTC 107, 108)



9Y1200236EMM028A

(1) TAMP Sensor
(2) ECM
(3) 5V ext 1
(4) MAP Signal
(5) 5V rtn 1

DTC 107-MAP Low Voltage

- Hardware: Manifold Absolute Pressure Sensor
- Enabling Conditions: Engine Cranking or Running
- Set Conditions: MAP sensor voltage feedback less than 0.050 V when throttle position is greater than 5 % and engine speed is less than 4000 min^{-1} (rpm).
- Corrective Action(s): Illuminate MIL and disable adaptive learn fueling correction for the rest of the key-cycle.
- Emissions related fault
- Possible Causes: Loss of 5.00 V reference feed to sensor, open or shorted to ground sensor signal wire, faulty sensor or faulty ECM.

DTC 108-MAP High Pressure

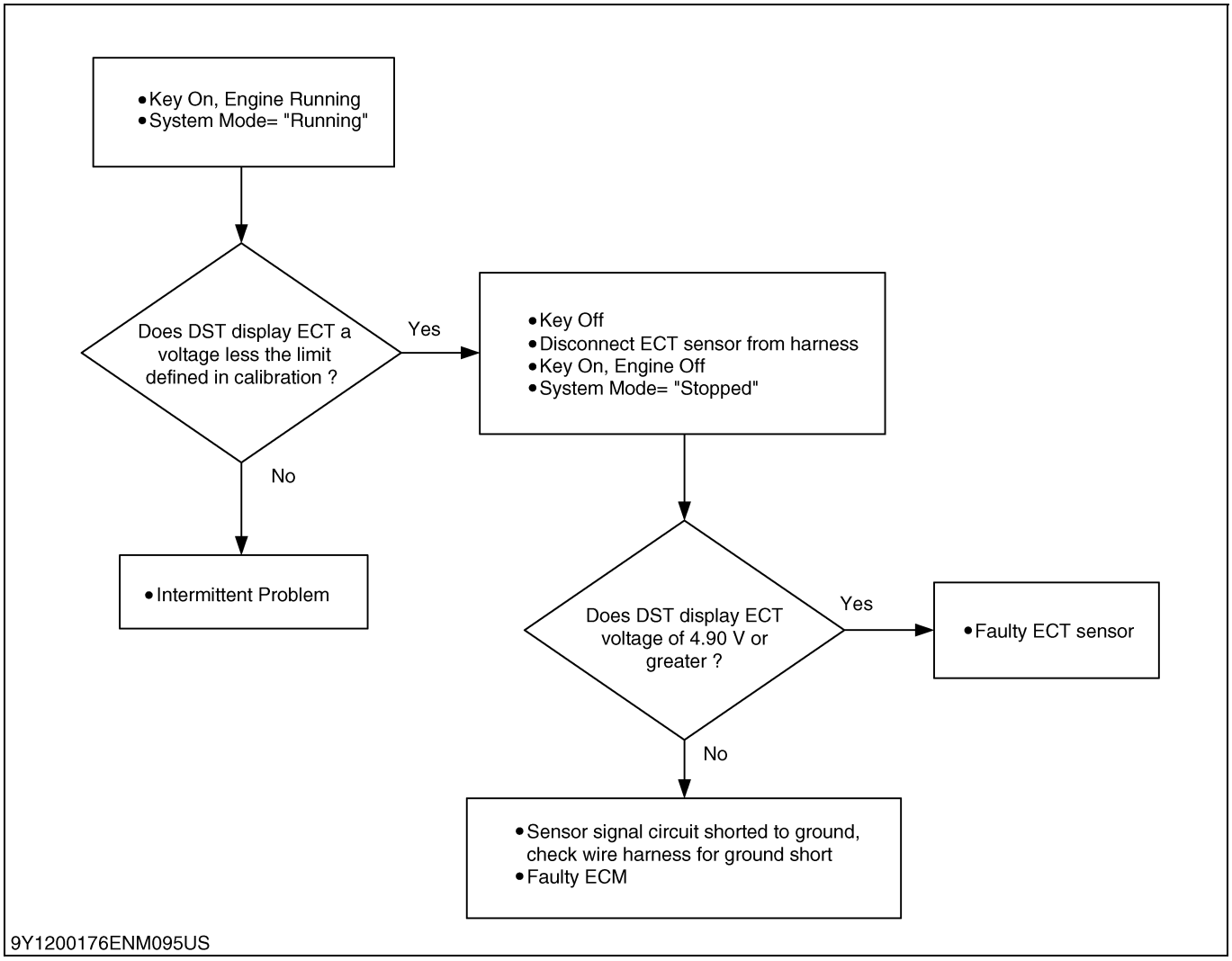
- Hardware: Manifold Absolute Pressure Sensor
- Enabling Conditions: Engine Cranking or Running
- Set Conditions: MAP is higher than 110 kPa (1.12 kgf/cm^2, 16.0 psi) when throttle position is less than 3 % and engine speed is greater than 1000 min^{-1} (rpm).
- Corrective Action(s): Illuminate MIL and disable adaptive learn fueling correction for the rest of the key-cycle.
- Emissions related fault
- Possible Causes: 5.00 V reference feed shorted to voltage, signal circuit shorted to voltage, open 5 Vrtn1 (sensor ground), faulty sensor or faulty ECM.

The Manifold Absolute Pressure sensor is a pressure transducer connected to the intake manifold. It is used to measure the pressure of air in the manifold prior to induction into the engine. The pressure reading is used in conjunction with other inputs to determine the rate of airflow to the engine. The rate of airflow into the engine is used to determine the required fuel flow rate.

When these fault are active, the ECM operates in a limp home mode in which an estimated MAP based on TPS feedback is used to fuel the engine.

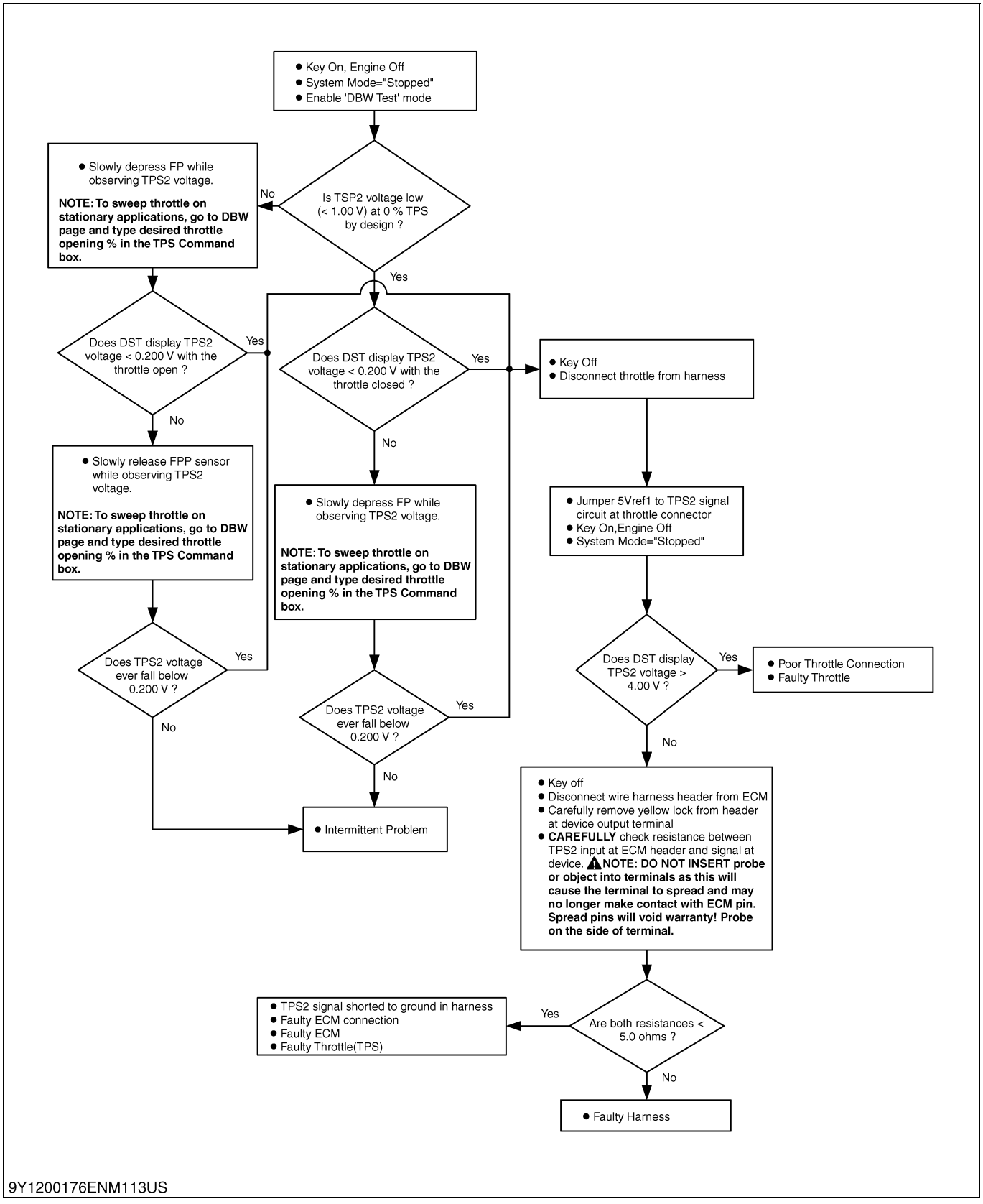
DTC 117-ECT Low Voltage

Diagnostic Aids Chart



DTC 222-TPS2 Signal Voltage Low

Diagnostic Aids Chart



9Y1200176ENM113US

DTC 172-Adaptive Learn Bank1 Low (Gasoline)

Diagnostic Aids

■ **NOTE**

- **If any other DTCs are present, diagnose those first.**
- Oxygen Sensor Wire - Sensor may be mispositioned contacting the exhaust. Check for short to ground between harness and sensor and on sensor harness
- Injectors - System will be rich if an injector driver or driver circuit fails shorted-to-ground. The system will also be rich if an injector fails in an open position or leaks.
- Fuel Pressure - System will be rich if fuel pressure is too high. Check fuel pressure in the fuel rail during key-on, engine off and during normal operating conditions.
- System Electrical Grounding - ECM and engine must be grounded to the battery with very little resistance allowing for proper current flow. Faulty grounds can cause current supply issues resulting in many undesired problems (causing sensors to provide bad information to the ECM).
- Internal mechanical engine damage causing lower than normal intake manifold vacuum
- MAP sensor that indicates pressure higher than true pressure
- Coolant Temperature Sensor - A sensor that indicates the engine is colder than actual engine temperature
- If all tests are OK, replace the HO_2S sensor with a known good part and retest.

DTC 1111-RPM Above Fuel Rev Limit Level

- Hardware: Fuel Rev Limit- Crankshaft Position Sensor
- Enabling Conditions: Engine Running
- Set Conditions: Engine speed greater than the Fuel Rev Limit speed (4000 min^{-1} (rpm)) for longer than 0.5 seconds
- Corrective Action(s): Illuminate MIL
- Non-emissions related fault
- Possible Causes: Engine over speed condition, faulty CKP sensor or input

DTC 1112-RPM Above Spark Rev Limit Level

- Hardware: Spark Rev Limit- Crankshaft Position Sensor
- Enabling Conditions: Engine Running
- Set Conditions: Engine speed greater than the Spark Rev Limit speed (4200 min^{-1} (rpm)) for longer than 0.5 seconds
- Corrective Action(s): Illuminate MIL
- Non-emissions related fault
- Possible Causes: Engine over speed condition, faulty CKP sensor or input

The fault of DTC 219 will set anytime the engine RPM exceeds 3900 min^{-1} (rpm) for longer than 1 second. This fault is designed to help prevent engine or equipment damage. The throttle will be lowered in order to govern the engine to the speed set in the diagnostic calibration.

The fault of DTC 1111 will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage and will disable fuel injectors or gaseous fuel actuator to reduce engine speed. The throttle will also be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override.

The fault of DTC 1112 will set anytime the engine RPM exceeds the limit set in the diagnostic calibration for the latch time or more. This speed overrides any higher max governor speeds programmed by the user. This fault is designed to help prevent engine or equipment damage and will disable the ignition coils to reduce engine speed. In addition, the throttle will be lowered in order to govern the engine to the speed set in the diagnostic calibration for Max Gov Override and the fuel injectors or gaseous fuel control actuator will be disabled to reduce the engine speed below the speed set in the diagnostic calibration for Fuel Rev Limit.

DTC 219-RPM Higher Than Max Allowed Governed Speed

Diagnostic Aids

■ **NOTE**

- **If any other DTCs are present, diagnose those first.**
- Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- Check mechanical operation of the throttle
- Check the engine intake for large air leaks downstream of the throttle body

DTC 1111-RPM Above Fuel Rev Limit Level

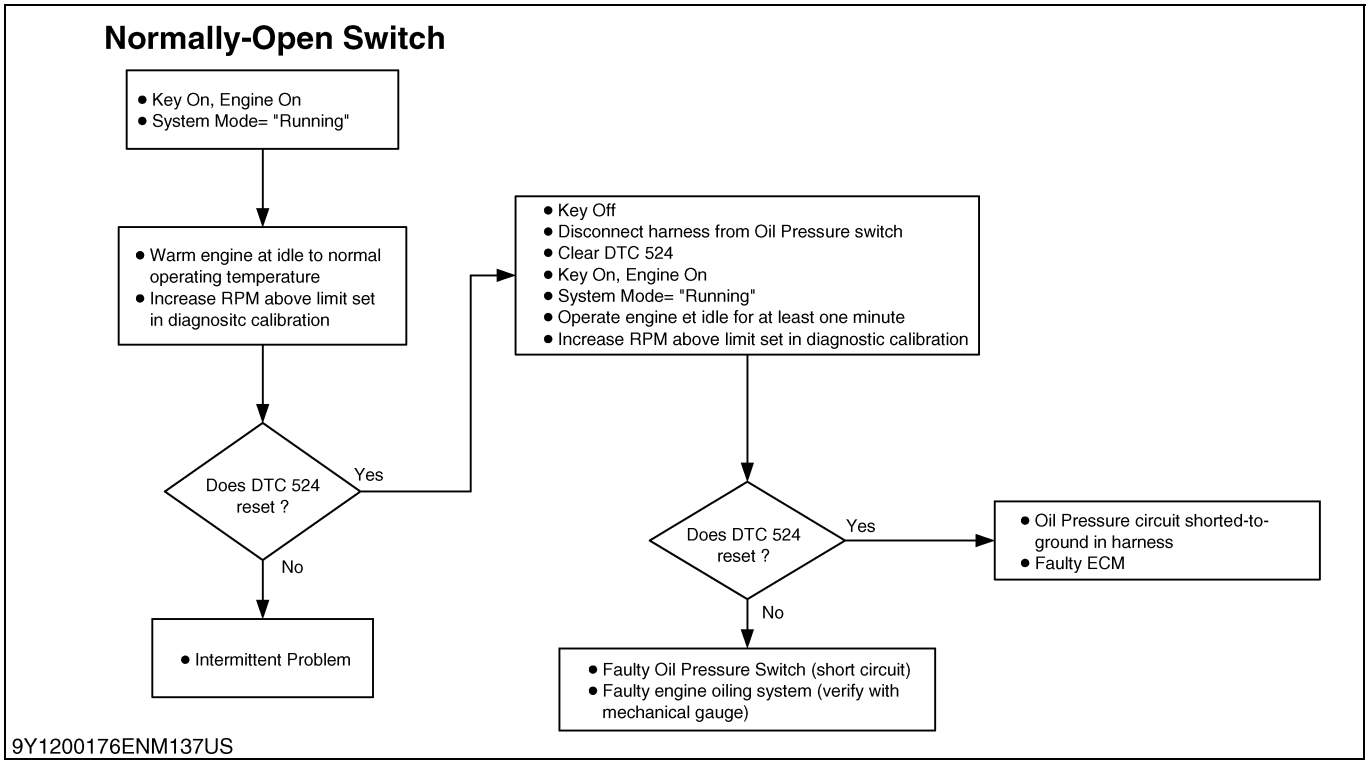
Diagnostic Aids

■ **NOTE**

- **If any other DTCs are present, diagnose those first.**
- Ensure that no programmed governor speeds exceed the limit set in the diagnostic calibration for Max Gov Override Speed
- Check mechanical operation of the throttle
- Check the engine intake for large air leaks downstream of the throttle body

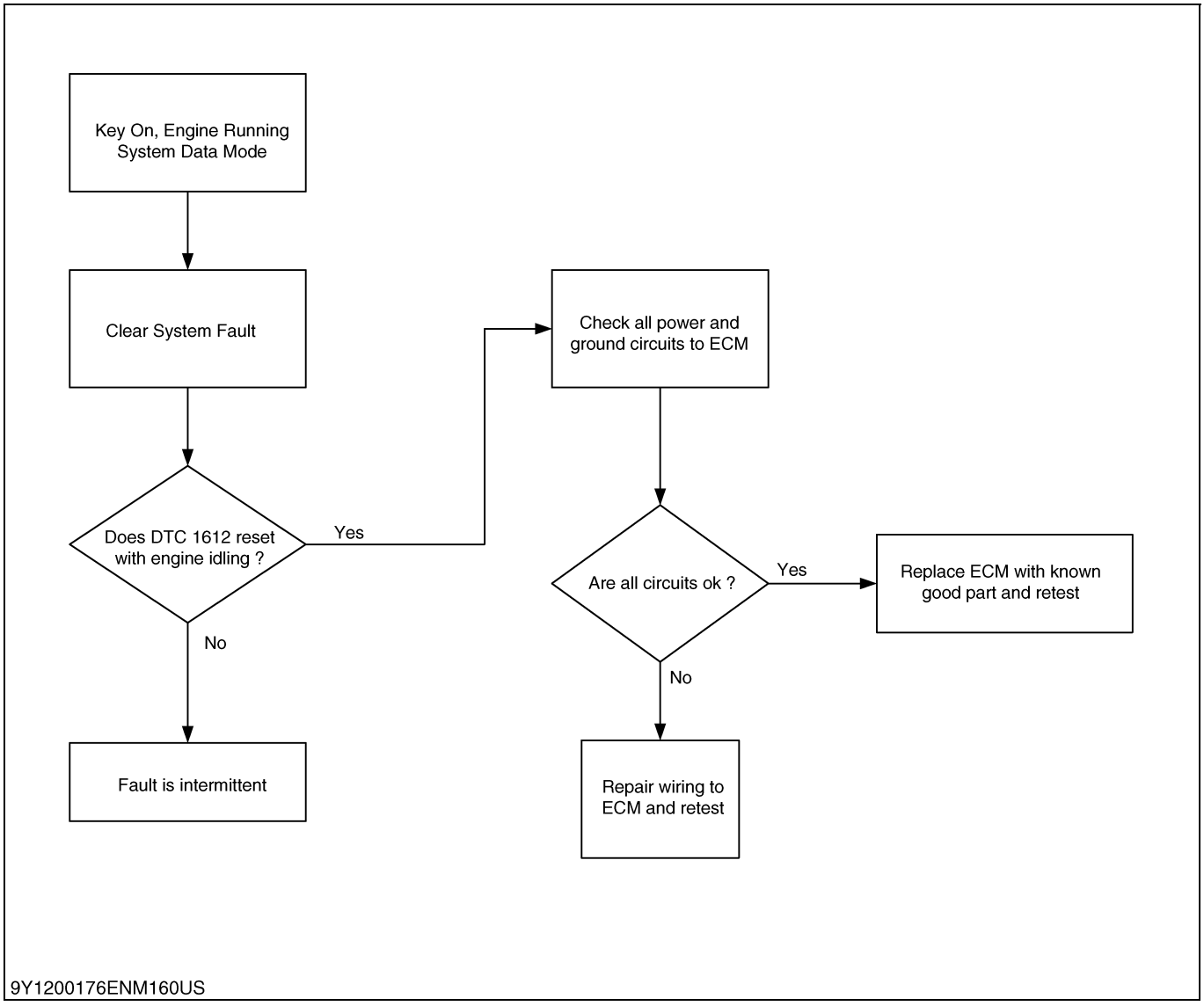
DTC 524-Oil Pressure Low

Diagnostic Aids Chart



DTC 1612-Microprocessor Failure-RTI 1

Diagnostic Aids Chart



DTC 1611-Sensor Supply Voltage (5 Vext1/2) Simultaneous out-of-range

- Hardware: External Sensor Supply Voltage Regulator 1/2
- Enabling Conditions: Engine On
- Fault Conditions: Voltage feedback on sensor supply circuit #1 above 5.40 V or below 4.60 V for longer than 1 second, and Voltage feedback on sensor supply circuit #2 above 5.40 V or below 4.60 V for longer than 1 second
- Corrective Action(s): Illuminate MIL, AL disable, AL disable in key cycle, Power derate 2, Low rev limit, Forced idle
- Non-emissions related fault
- Possible Causes: This fault indicates that both power supply feedback voltages are out-of-range as defined in the calibration. In configurations where the crank and/or camshaft position sensors are powered hall effect sensors, the engine may stall due to loss of synchronization.

The external 5-volt supply powers sensors and other components in the engine control system. The accuracy of this supply is critical to the accuracy of the sensors' feedback, therefore, it is supplied from a precision regulator whose output is internally monitored by the ECM. The ECM monitors the 5-volt supply to ratio metrically correct sensor feedback and determine if the circuit is overloaded, shorted, or otherwise out of specification.

The fault of DTC 642 and DTC 652 will set if the internally measured voltage feedback of the regulator output is lower than the low voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

The fault of DTC 643 and DTC 653 will set if the internally measured voltage feedback of the regulator output is higher than the high voltage limit as defined in the diagnostic calibration anytime the engine is running or stopped at key-on (if applicable).

(21) EPR (HD EPR) or CFV (DTC 1171 to 1177)

DTC 1171-EPR/CFV Regulation Pressure Higher than Expected

- Hardware: EPR (HD EPR) or CFV
- Enabling Conditions: Engine Running
- Set Conditions: EPR (actual-commanded) pressure is higher than 2.5 in H2O for longer than 5 seconds
- Corrective Action(s): Illuminate MIL, AL disable
- Emissions related fault
- Possible Causes: This fault sets if the actual pressure sensed in the EPR/CFV is greater than the commanded pressure by X. Typical values for X are listed below (may vary per specific engine calibration): X = + 2.0 in H2O for EPR (HD EPR or DEPR).
  This fault indicates that the device is at its minimum limit of authority and the pressure command cannot be achieved likely due to delivery/supply pressure being higher than expected. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table due to improper fuel supply pressure, and a Power Derate 1 condition is activated to reduce the possibility of engine damage.

The EPR is the second generation of EControls' Electronic Pressure Regulator found in many industrial and heavy-duty applications. The 2nd generation EPR is a "smart" actuator integrated with the primary stage regulator designed to control gaseous fuel pressure in these condary stage regulator. The EPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The EPR allows for fast and accurate gaseous fuel control to provide a combustible mixture to the engine.

The third generation of EControls' Electronic Pressure Regulator is the DEPR. The DEPR is a "smart" actuator that is fed supply pressure through a DSR (Dual Stage Regulator). The DSR is fully mechanical. The DEPR receives fuel pressure commands from the ECM and quickly and precisely modulates fuel pressure to the gaseous fuel mixer. The DEPR allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

The fourth generation of EControls' gaseous fuel control valve is the CFV. The CFV contains both a high pressure Electronic Pressure Regulator and a precision Continuous Flow Valve. The inlet pressure to the CFV is typically 85 psig (586 kPa). The CFV receives mass flow commands from the ECM and quickly and precisely modulates both the fuel pressure and metering valve to achieve the desired mass flow. The CFV allows for very fast and very accurate gaseous fuel control to provide a combustible mixture to the engine.

DTC 1172-EPR/CFV Regulation Pressure Lower than Expected

- Hardware: EPR (HD EPR) or CFV
- Enabling Conditions: Engine Running
- Set Conditions: EPR (actual-commanded) pressure is lower than -2.5 in H2O for longer than 5 seconds
- Corrective Action(s): Illuminate MIL, AL disable
- Emissions related fault
- Possible Causes: This fault sets if the actual pressure sensed in the EPR/CFV is greater than the commanded pressure by X. Typical values for X are listed below (may vary per specific engine calibration): X = + 2.0 in H2O for EPR (HD EPR or DEPR).
  This fault indicates that the device is at its minimum limit of authority and the pressure command cannot be achieved likely due to delivery/supply pressure being higher than expected. Adaptive fueling correction is disabled to avoid improper learning of the fuel correction table due to improper fuel supply pressure, and a Power Derate 1 condition is activated to reduce the possibility of engine damage.

DTC 1173-Megajector/EPR Comm Lost

- Hardware: EPR (HD EPR) or CFV
- Enabling Conditions: Engine Running
- Set Conditions: No EPR / CFV packets received within 500 ms
- Corrective Action(s): Illuminate MIL, AL disable, AL disable in key-cycle, power derate 2, Low rev limit
- Emissions related fault
- Possible Causes: This fault indicates that the ECM is no longer receiving CAN packets from the EPR/CFV which also results in the EPR/CFV not receiving communication from the ECM. This is often a result of a power loss at the EPR/CFV or improper CAN termination or wiring.

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