

THIS GUIDE IS FOR USE BY A TRAINED TECHNICIAN. FOR ADDITIONAL TECHNICAL SUPPORT, USE THE FOLLOWING:



+1 (804) 227-3023



gsetechs@powertraincontrol.com



GSEhelp.com

gsetechs@powertraincontrol.com



GSEhelp.com



v1.3

TRANSMISSION OVERVIEW

The PCS 4LHD/4LHDX is a four-speed, longitudinal rear-wheel drive electronically controlled automatic overdrive transmission with torque converter clutch and advanced valve body features.

GEAR	1st	2nd	3rd	4th	R
RATIO	3.059	1.625	1.000	0.696	2.29

*The GSE industry typically only uses 2 or 3 gears.

PREVENTATIVE MAINTENANCE

- Service interval is 1,000 hours / 12 months whichever comes first
- Filter and pan gasket should be replaced (**PCS Part# TRN7090**)
- Fluid must be **DEXRON VI**

DIAGNOSTIC TOOLS

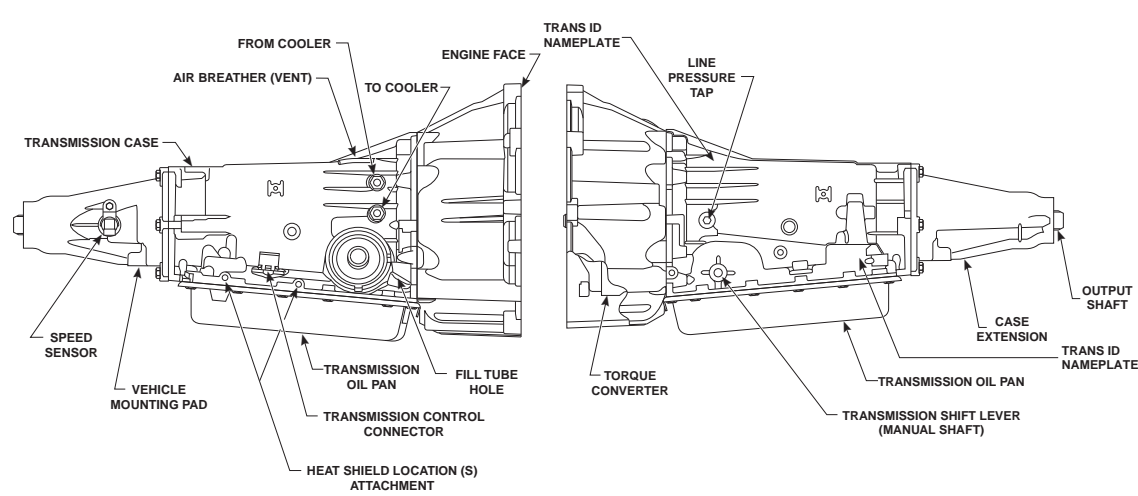


Transmission Diagnostic Device (TDD)
PCS Part #: A-TDD5000



Rugged COM Cable
PCS Part #: A-TCM4182

TRANSMISSION FEATURE LOCATIONS



COOLER FITTINGS

Two variants of case cooler interfaces exist within the fleet.

VARIANT 1

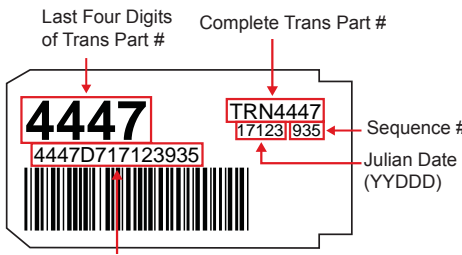
Tapped -6ORB (9/16-18" w/O-Ring)
Recommended Fitting
PCS Part #: TRN0212
-6ORB Male to -6JIC Male

VARIANT 2

Tapped 1/4" NPS (Straight Pipe, 0.54-18")
Recommended Fitting
PCS Part #: TRN0215
1/4" NPS Male to -6JIC Male

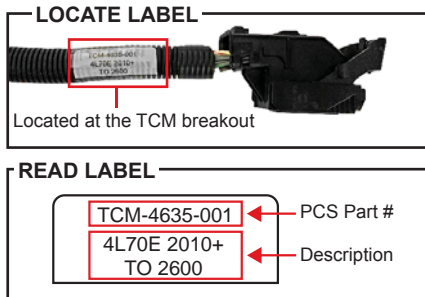
PART NUMBER LOCATOR

TRANSMISSION (See Trans ID Nameplate Above)

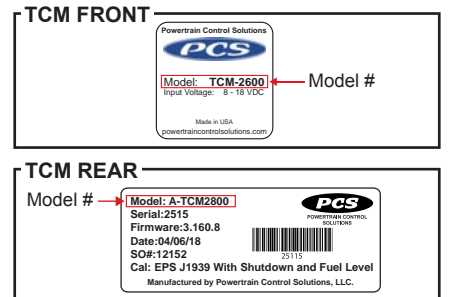


Trans serial # is a 14 digit number comprised of:
[Last 4 of Part #] + D7 + [Julian Date] + [Sequence #]

HARNESS

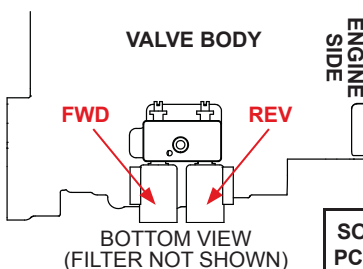


TCM



IDENTIFY GEN 2 OR GEN 3 VALVE BODY

GEN 2 (used for abuse protection)

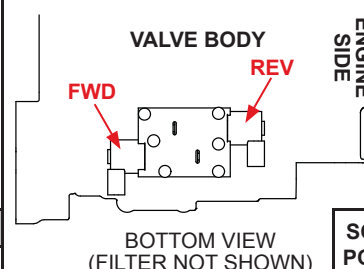


ID Methods Below (Choose 1):

- Remove pan, filter, and compare to image.
- Measure solenoid resistance:
Trans Pin E to Pin R: 3-6Ω
Trans Pin E to Pin S: 3-6Ω
- Use TDD to confirm reverse solenoid operation

SOLENOID PCS PART#	FWD	REV
	HDW7225	HDW7230

GEN 3 (used for abuse protection, inching, e-shift, and anti-collision)



ID Methods Below (Choose 1):

- Remove pan, filter, and compare to image.
- Measure solenoid resistance:
Trans Pin E to Pin R: 10-15Ω
Trans Pin E to Pin S: 10-15Ω
- Use TDD to confirm reverse solenoid operation

SOLENOID PCS PART#	FWD	REV
	VBM1050	VBM1050

PRE-RAMP CHECK LIST

KEY OFF PHYSICAL INSPECTION

Fastener Torque:	Inspect all mounting bolts, torque converter bolts, flywheel bolts, and all other driveline hardware for proper torque.
Position Lever Check:	Move the shift lever through all ranges and verify that the transmission shift arm is centered in the detent for each position.

KEY ON, ENGINE OFF SOFTWARE VERIFICATION

Connect:	Connect to the TCM with the PCS TCM Diagnostic software. To download the software, please visit: www.GSEhelp.com .
Position Lever Verification:	Move the shift lever through the ranges and verify the actual shift lever position matches the position shown in the software.
Throttle Position Sensor:	Verify the throttle position reading is zero when the pedal is not press and 100% when fully depressed.

STATIONARY ENGINE RUNNING CHECKS

Fluid Level Check:	Start the engine and check the fluid level is sufficient.
Engine RPM:	Verify the engine RPM on the software matches the actual engine RPM.
DTC Check:	Verify there are no diagnostic codes set.

TEST DRIVE (Operate the vehicle until trans is at operating temp)

Vehicle Speed:	Move the vehicle and verify that the vehicle speed operates properly.
Shifting:	Check proper transmission operation in all gears.

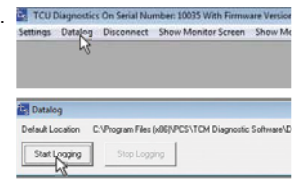
*Data log recommended. For help, view "How to Datalog."

POST DRIVE CHECK

DTC Verification:	Check for diagnostic codes.
Fluid Level Verification:	Verify the fluid level is correct and no fluids are leaking from the vehicle.

HOW TO DATALOG

1. Open PCS TCM Diagnostic Software .
2. Connect to the TCM.
3. Click "Datalog" on the top menu.
4. Note the stored file location and click "Start Logging."
5. Operate the vehicle. When complete click, "Stop Logging."



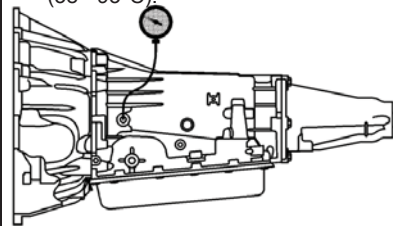
CONTROLLER AREA NETWORK (CAN)

- Most CAN GSE applications use J1939.
- High speed, two wire communication protocol used for communication between control modules. Typically ECM to TCM for sharing engine RPM, throttle position, and other signals.
- Twisted wire, two 120-ohm terminating resistors
- CAN H (pin 7 of bulkhead)
- CAN L (pin 1 of bulkhead)
- Measuring resistance between CAN H and CAN L must be 60Ω.

LINE PRESSURE TAP

Line pressure tap (1/8" NPT) available for diagnostics.

1. Remove pressure plug
2. Install appropriately rated pressure gauge for transmission line pressure measurement. Pressures could exceed 300 PSI.
3. Command current using PCS software
4. Start the Engine.
5. Perform test in Neutral at 1200 RPM between 100 - 200°F (38 - 93°C).



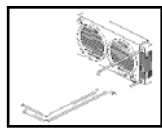
	AMP	PSI
4LHD	0	170-193
	0.5	135-166
	1	54-80
4LHDX	0	198-227
	0.5	154-193
	1	53-85

WARNING: Only perform this test in Neutral with the brakes applied and engine speeds below 1500 RPM. Failure to do so may result in extremely high pressures (in excess of 300 PSI) that could damage the transmission or the gauge and result in serious injury.

TRANSMISSION REPLACEMENT CONSIDERATIONS

COOLER AND COOLER LINES

- Cooler and cooler lines must be flushed free and clear of debris.
- Cooler fitting information on page 1.



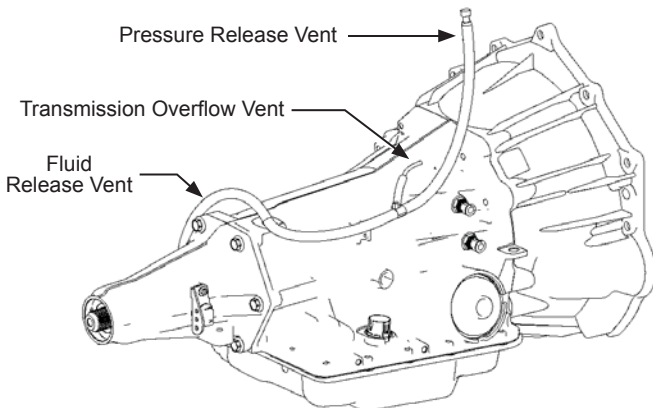
TRANSMISSION CONNECTOR

Transmission connector must have arrow out.



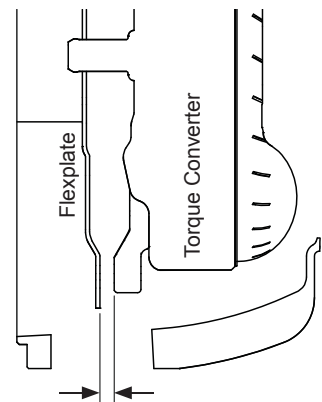
TRANSMISSION VENT

Vent must be clear of exhaust and heat sources. (PCS Part#: TRN7006-REV2)



TORQUE CONVERTER PULL-UP

1. Align and install the bellhousing/transmission to the engine. Before tightening the bellhousing fasteners, check to be sure converter **rotates freely**.
2. Torque bellhousing fasteners to spec. Push the torque converter back into the transmission as far as possible.
3. Measure the gap between the flexplate mounting surface and the torque converter mounting pads.



Gap distance must be between .060" (1.5mm) and .187" (4.7mm). Do not proceed and contact PCS if gap is out of range.

gsetechs@powertraincontrol.com



GSEhelp.com



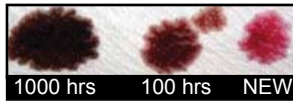
v1.3

1 CHECK FLUID LEVEL AND CONDITION

CHECK FLUID CONDITION

FLUID COLOR

- Fluid should be red in color.
- Burnt smelling fluid (dark color) most likely indicates internal abnormal transmission operation.



CONTAMINATED FLUID



Fluid that has a cloudy or milky appearance is possibly contaminated with water from engine coolant or an external source.

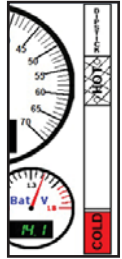
- Transmission Vent
- Radiator
- Fluid Storage Container

CHECK FLUID LEVEL

LEVEL CHECK PROCEDURE

- Engine at idle
- Move lever through the ranges to fill all transmission cavities
- "Proper" level is very transmission temperature dependent

DIPSTICK INDICATORS



NOTES

- Software will calculate proper level based on temp
- Too low - no pressure, intermittent pressure
- Too high - expands with heat, could overflow

2 CHECK FOR CODES

PCS SOFTWARE INTERFACE VIA LAPTOP



- Transmission controller is accessed via a serial data interface and a laptop.
- Clicking on the code number will open a code description window.
- If the software doesn't connect and there is power to the unit, try a different TCM.

Communication Connector



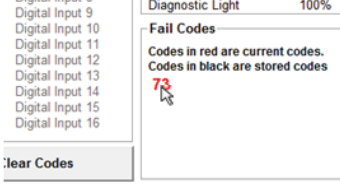
Labeled "OPTIONAL COM NOT REQUIRED FOR USE."

When not in use cap is required.

Rugged COM Cable (A-TCM4182)



Fail Codes



CHECK TRANS INDICATOR



If vehicle is equipped with a check trans indicator, full description of light operation can be found on page 5.

NOTE: DTC's may be visible on factory installed dash displays or with a J1939 code reader.

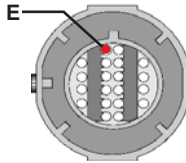
3 CHECK THE BASICS

Without power, the trans behavior depends on the valve body.
GEN 2: 1 forward gear, reverse, min pressure, trans slips when loaded
GEN 3: No forward, no reverse

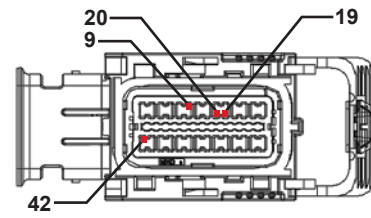
TRANSMISSION CONNECTOR



- Arrow facing out.
- Verify switched ignition on pin E (10A fuse).

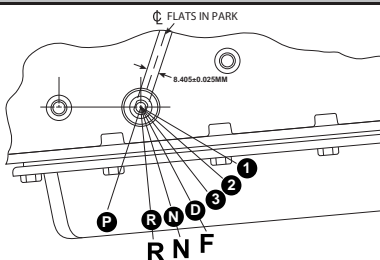


TCM CONNECTOR



PIN:	
Switched Ignition	19
Battery	20
Ground	42 or 9
FUSE:	
Switched Ignition	10A
Battery	10A

SHIFT LINKAGE: Ensure cable fits transmission detent.



This figure depicts all lever positions. Most applications only utilize F-N-R. Park is not used in GSE applications.

4 CHECK THE SIGNALS

Having the transmission harness schematic is strongly recommended for reference during this step. It can be obtained from:

www.GSEhelp.com

Connect to the TCM using the software and verify the following items:

- Shift lever matches reported lever position.
- Throttle position matches the reported TPS. Must be 0% at idle and 100% at full throttle. Abuse protection typically set at 15%
- Engine RPM matches reported engine RPM. Abuse protection typically set at 1500 RPM.
- Other abuse protection inputs such as seat switch, shift inhibit, etc. This is vehicle specific. Use the Abuse Protection monitor screen in the software.
- Vehicle speed in the software should be zero when the vehicle is stopped and increases as the vehicle speeds up. Vehicle speed is not going to be accurate - this is intentional for calibration purposes.

5 DIRECTLY CONTROL THE TRANSMISSION

To directly control the transmission, turn to page 4, "Transmission Diagnostic Device (TDD) Quick Reference."



WARNING: Use of the diagnostic device must only be performed by a trained technician. The device will control the transmission without safety devices or normal operating controls on the vehicle. Extreme caution must be observed. The vehicle could move suddenly and without notice. All testing must be performed with an operator on the seat. The brakes must be functional and pressed until it is desired for the vehicle to move. Severe injury or death could occur if safety precautions are not taken while operating the diagnostic device.

CONNECT TDD TO TRANSMISSION AND POWER

- Step 1. Connect handheld to harness.
- Step 2. Connect to transmission with arrow facing out. **Reference Figure 1.**
- Step 3. Connect to battery.
 - Step 3.1 - Turn all toggle switches to the off position (↑). For switch functions, **Reference Figure 2.**
 - Step 3.2 - Connect the red clamp to the battery's positive terminal.
 - Step 3.3 - Connect the black clamp to the battery's negative terminal.
 - Step 3.4 - Verify the power LED is on. If it is not on, check the battery connections and the 10A fuse.



Figure 1

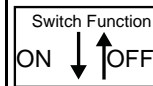


Figure 2

Step 4. With operator on seat, brakes fully pressed, start engine. The vehicle will move suddenly when commanded by the TDD.

NOTE: Gen 3 valve body vehicles will move independent of shift lever position in all tests.

GEN 2 REVERSE CLUTCH SOLENOID TEST

Turning the solenoid ON prevents reverse (abuse protection reverse lockout).

REV	FWD	LINE	TCC	SSA	SSB
OFF	OFF	OFF	OFF	ON	ON

- Step 1. Move shift lever into Reverse with REV OFF. The vehicle should move in Reverse.
- Step 2. Move shift lever into Neutral.
- Step 3. Turn REV ON.
- Step 4. Move shift lever into Reverse. Vehicle should not move.

GEN 3 REVERSE CLUTCH SOLENOID TEST

Turning the solenoid OFF prevents reverse (abuse protection reverse lockout).

REV	FWD	LINE	TCC	SSA	SSB
OFF	OFF	OFF	OFF	ON	ON

- Step 1. Move shift lever into Reverse with REV OFF. The vehicle should not move in Reverse.
- Step 2. Move shift lever into Neutral.
- Step 3. Turn REV ON.
- Step 4. Move shift lever into Reverse. Vehicle should move.

FORWARD CLUTCH SOLENOID TEST

Turning the solenoid ON enables forward (abuse protection forward lockout, when OFF).

REV	FWD	LINE	TCC	SSA	SSB
OFF	ON	OFF	OFF	ON	ON

- Step 1. Move shift lever into Drive with FWD ON. Vehicle should move forward in 1st gear.
- Step 2. Move shift lever into Neutral.
- Step 3. Turn FWD OFF.
- Step 4. Move shift lever into Drive. Vehicle should not move.

LINE PRESSURE SOLENOID TEST

Increasing current to this solenoid reduces transmission pressure (softer shifts). Turning the switch ON provides 1A to the solenoid (minimum pressure).

REV	FWD	LINE	TCC	SSA	SSB
OFF	ON	OFF	OFF	ON	ON

- Step 1. Move shift lever into Drive with LINE OFF. Move forward and turn OFF SSA to shift into 2nd gear. The vehicle should shift with maximum firmness.
- Step 2. Move the shift lever into Neutral.
- Step 3. Move the shift lever into Drive with LINE, SSA, and SSB ON. Move forward and turn OFF SSA to shift into 2nd gear. The vehicle should shift with minimum firmness.

SHIFT SOLENOID A&B TEST

The shift solenoids select the gear of the transmission.

REV	FWD	LINE	TCC	SSA	SSB
OFF	ON	OFF	OFF	ON	ON

- Step 1. Move shift lever into Drive. The vehicle should move in 1st gear.
- Step 2. At an appropriate speed, move the shift solenoids to switch gears. **Reference the table below.**

GEAR	SSA	SSB
1	ON	ON
2	OFF	ON
3	OFF	OFF
4	ON	OFF

TCC SOLENOID TEST

Turning the solenoid ON locks the converter clutch.

REV	FWD	LINE	TCC	SSA	SSB
OFF	ON	OFF	OFF	ON	ON

- Step 1. Move the shift lever into Drive while firmly applying the brakes.
- Step 2. Turn the TCC ON. The engine should stall.

MODE SWITCH*

	P	R	N	D	3	2	1
P/N	ON	OFF	ON	OFF	OFF	OFF	OFF
IMS P	ON	OFF	ON	OFF	ON	OFF	ON
G3	OFF	OFF	OFF	ON	ON	ON	ON
G2	OFF	ON	ON	ON	ON	OFF	OFF
G1	ON	ON	OFF	OFF	ON	ON	OFF

*Only for shift cable applications.

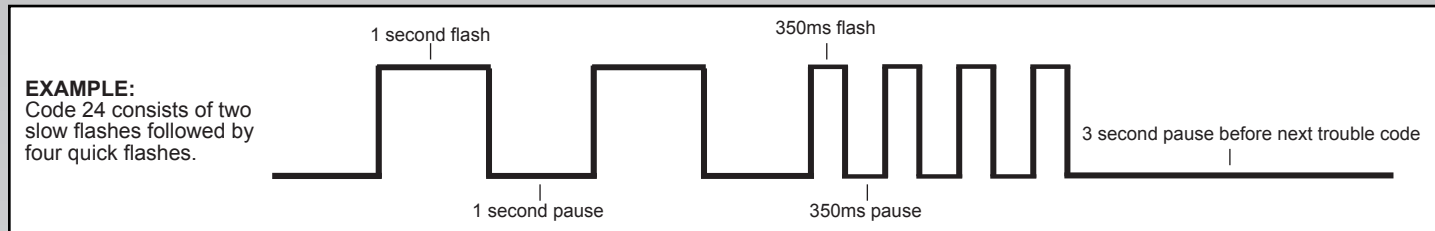
TRANSMISSION TEMPERATURE SENSOR

°F	°C	Min Ω	Typ Ω	Max Ω
-40	-40	90636	100707	110778
32	0	8481	9423	10365
86	30	2013	2237	2461
122	50	876	973	1070
158	70	420	467	514
212	100	159	177	195
302	150	42.5	47.2	51.9

Diagnostic trouble codes (DTC's) can be read using the PCS diagnostic software or the check transmission light installed on the dash.

If a DTC is active and the engine is running, the check transmission light will be on solid to indicate there is an active code. When the ignition is turned on, but the engine is not running, the light will flash a pattern so the DTC can be read. The flashing will indicate both active and stored codes.

The codes consist of two numbers. The first number is flashed at one second intervals, then a one second pause and the second number is flashed at 350ms. There is a three second pause in between trouble codes.



CODE	DESCRIPTION	FAIL CONDITIONS	ACTION TAKEN	ACTIVE TO STORED CONDITIONS
1	CAN Com. Lost	<i>Code 1 is the same as code 23. It is reported as code 1 or code U0001 on some software versions. See Code 23 below for a full description.</i>		
21 522499	Throttle Position High	Throttle Position High Throttle position voltage has been above 4.9 Volts for more than 1 second.	Max line pressure. Shift points fixed at 35% throttle.	Throttle position below 4.9 volts for more than 1 second.
22 522500	Throttle Position Low	TPS voltage is less than 0.20 volts for more than 1 second.	Max line pressure. Shift points fixed at 35% throttle.	Throttle position above 0.20 volts for more than 1 second.
23 522731	CAN Com. Lost	No CAN communications for greater than 5 seconds. Note: Reported as code 1 or U0001 in some software versions.	Max line pressure. Shift points fixed at 35% TPS. Inhibit 4th/TCC.	Valid CAN message received.
24 522741	Output Speed Sensor	No Code 21, 22, 23. Sets when not in Park or Neutral, Engine RPM greater than 3000, Input shaft speed greater than 10%, Output speed less than 200. All conditions met for 3 seconds.	Calculate output shaft speed from input shaft speed and commanded gear, Max line pressure.	Key Cycle
28 522751	Lever Position Error	Sets when TCM receives an illegal combination from lever position sensor for 2 seconds.	Max pressure. Assume Overdrive 4 is selected. Inhibit 4th/TCC.	Key Cycle
37 522740	Brake Switch Stuck Off	Sets when Brake is not pressed, Vehicle speed is below 5 MPH for greater than 6 seconds, then Vehicle speed is greater than 20 MPH for greater than 6 seconds, for a total of 7 times.	Inhibit TCC	Key Cycle or when Brake Pedal is pressed
38 522743	Brake Switch Stuck On	Sets when Brake is pressed, Vehicle speed is below 5 MPH for greater than 6 seconds, then Vehicle speed is greater than 20 MPH for greater than 6 seconds, for a total of 7 times.	Inhibit TCC	Key Cycle or When Brake Pedal is pressed
39 522744	TCC Stuck OFF	TCC slip is greater than 65 RPM for 3 seconds when TCC is commanded on in 2nd or 3rd.	Inhibit TCC/4th gear	Key Cycle
51 522736	TCM	Sets when Internal memory writes/reads fail, COP stops operating or processor executes an Illegal Opcode.	2nd Gear, Max line pressure, Inhibit TCC	Key Cycle
52 522733	System Voltage High Long	Sets when system voltage is greater than 16 volts for 30 minutes.	2nd Gear, Max line pressure, Inhibit TCC	Key Cycle or when system voltage drops below 15V.
53 522734	System Voltage High	Sets when system voltage is greater than 19.5 volts for 5 seconds.	2nd Gear, Max line pressure, Inhibit TCC	Key Cycle or when system voltage drops below 18V.
58 522737	Trans Temp High TFT Circuit Low	Sets when Transmission Temperature Is above 151°C (304°F).	Inhibit 4th/TCC	When trans temp drops below 148°C for 5 seconds.
59 522738	Trans Temp Low TFT Circuit High	Transmission Temperature Is Below - 37°C (-34°F) for 1 second.	Inhibit 4th/TCC	When trans temp goes above -35°C for 5 seconds.
68 522753	Component Slipping/TCC/4th Clutch Slipping	No DTC 23, 28, 71, 74. Throttle Position is greater than 25%, Engine speed is 200 rpm or more than input speed for 6 seconds when in 4th gear and TCC engaged.	Max line pressure, Inhibit 4th	Key Cycle
69 522745	TCC Stuck On	No DTC 21, 22, 23, 71, 74 Sets when TCC slip is between -25 and 25 rpm, TCC solenoid is commanded off, TPS is greater than 25% for 4 seconds.	TCC Commanded on, Max Line Pressure	Key Cycle
71 522501	Engine Speed Circuit Low	Sets when Engine speed is less than 50 RPM, transmission range is R, D4, D3, D1 for 2 seconds.	Inhibit 4th and TCC	When Engine RPM goes above 300 RPM

NOTE: J1939 codes, if available, can be found in the column "CODE" below the GM 2-digit code.



CODE	DESCRIPTION	FAIL CONDITIONS	ACTION TAKEN	ACTIVE TO STORED CONDITIONS
72 522742	Intermittent Output Shaft Speed	No DTC 21, 22, 23, 28, 71, 74. Sets when Engine RPM is greater than 300, range is D4, D3, D2, or D1, Throttle position is greater than 25% and Output shaft speed changes more than 500 rpm in one measurement period.	Max line pressure. Calculate TOSS from TISS and commanded Gear.	Key Cycle
73 522746	Pressure Control Circuit	Force motor current is more than 0.16 Amps different than commanded current for 2 seconds.	Max line pressure.	Key Cycle
74 522739	Input Speed Sensor Circuit	No DTC 28. Sets when Range is not park or neutral, engine speed greater than 300 RPM, Output speed greater than 200 RPM, Input speed less than 50 RPM, for 2 seconds.	Max line pressure. Inhibit 4th/TCC.	When Input Speed goes above 75 RPM for 2 seconds.
75 522735	System Voltage Low	Sets when the ignition is on, voltage is less than the following conditions: -40°F (-40°C) = 7.3V 194°F (90°C) = 10.3V 302°F (150°C) = 11.7V Engine Speed is greater than 300 rpm for 4 seconds.	2nd Gear with Max pressure. Inhibit TCC.	Clears when system voltage is greater than the following conditions for 4 seconds:- 40°F (-40°C) = 7.3V 194°F (90°C) = 10.3V 302°F (150°C) = 11.7V
79 522732	Transmission Fluid Overtemp	No DTC 58 sets when transmission fluid temperature is greater than 270°F (132°C), for 5 minutes.	None.	When trans temp falls below 266°F (130°C) for 5 seconds.
81 522750	Shift Solenoid B (SSB) Circuit Fault	Battery Voltage above 10V TCM detects an open circuit, short to battery, short to ground, or over-current condition on the shift solenoid B circuit for 2 seconds.	2nd or 3rd gears only. Max Line Pressure.	When Fault condition removed for 2 seconds.
82 522748	Shift Solenoid A (SSA) Circuit Fault	Battery Voltage above 10V TCM detects an open circuit, short to battery, short to ground, or over-current condition on the shift solenoid A circuit for 2 seconds.	2nd and 3rd gears only or 1st and 4th gear only. Max line pressure.	When Fault condition removed for 2 seconds.
83 522752	TCC Solenoid Circuit Fault	Battery Voltage above 10V. TCM detects an open circuit, short to battery, short to ground, or over-current condition on the TCC solenoid circuit.	Inhibit TCC. Inhibit 4th when in Hot mode.	When Fault condition removed for 2 seconds.
84	Accelerator Pedal Performance	Measured throttle voltage difference exceeds allowable tolerance.	Assume 0% throttle.	Key Cycle
85 522754	Undefined Ratio Error	No DTC 21, 22, 23, 24, 28, 71, 72 sets when RPM is greater than 300 RPM, TPS is greater than 25%, VSS is greater than 7 MPH, ratio falls out of range for 6 seconds.	2nd gear with Max line pressure. Inhibit TCC.	Key Cycle
86 522749	Low Ratio Error (Shift Solenoid B (SSB) Stuck On)	No DTC 21, 22, 23, 24, 28, 71, 72, 74, 85 sets when RPM is greater than 300 RPM, TPS is greater than 25%, VSS is greater than 7 MPH, transmission ratio matches 4th when 1st is commanded or 3rd gear when 2nd gear is commanded, for 6 seconds.	2nd gear with Max line pressure. Inhibit TCC.	Key Cycle
87 522747	High Ratio Error (Shift Solenoid B (SSB) Stuck Off)	No DTC 21, 22, 23, 24, 28, 71, 72, 74, 85 sets when RPM is greater than 300 RPM, TPS is greater than 25%, VSS is greater than 7 MPH, transmission ratio matches 1st when 4th is commanded or 2nd gear when 3rd gear is commanded, for 6 seconds.	2nd gear with Max line pressure. Inhibit TCC.	Key Cycle
91	Non-Idle Inch	TPS greater than 15% or RPM greater than 800 RPM during inching.	Transmission locked	Key Cycle
92	Movement Not Commanded	Output shaft movement detected when not commanded.	Transmission locked	Key Cycle
93	Inching Past Target	Output shaft movement detected past desired stopping point.	Transmission locked	Key Cycle
94	Forward Clutch Solenoid Circuit Fault	Forward clutch current is more than 0.16 Amps different than commanded current for 2 seconds.	Trans commanded to neutral; however an electrical failure of the clutch solenoid could result in unpredictable vehicle movement.	Key Cycle
95	Reverse Clutch Solenoid Circuit Fault	Reverse clutch current is more than 0.16 Amps different than commanded current for 2 seconds.	Trans commanded to neutral; however an electrical failure of the clutch solenoid could result in unpredictable vehicle movement.	Key Cycle
98	Anti-collision System Fault	No communication with anti-collision module or anti-collision DTC.	Disable anti-collision system	Valid communication received or anti-collision fault cleared.

NOTE: J1939 codes, if available, can be found in the column "CODE" below the GM 2-digit code.



+1(804) 227-3023



GSEhelp.com