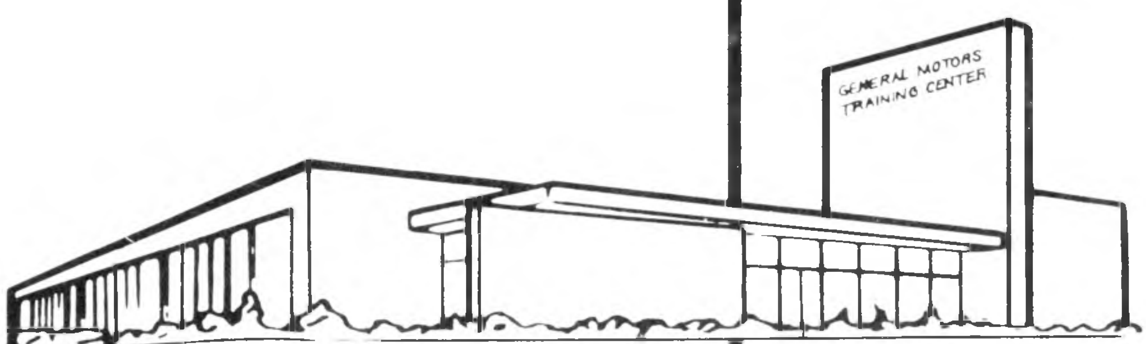
Hydramatic 4L80-E Transmission Electrical Supplement



GM

Product Service Training

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Name

Dealership

FOREWORD

This Technician's Guide is for your use while you are at the School and after the program has been completed. Enter your name and Dealership on the cover so that it may be forwarded to you in the event it is mislaid or lost.

Many of the items and points discussed in class will not necessarily be easy to remember when you return to your shop. Use the space provided in this guide to make notes during the program.

While this booklet will serve as an excellent review of the extensive program presented in the Training Centre sessions, it is not intended to substitute for the various Service Manuals normally used on the job. The range of specifications and variations in procedures between carlines and models requires that the appropriate service publications be referred to, as necessary, when performing these operation.

All information contained in this booklet is based on the latest data available at the time of publication approval. The right is reserved to make product or publication changes, at any time, without notice.

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Introduction

To help meet ever changing fuel economy and emission standards, transmissions with electronic controls are being introduced into the General Motors Fleet. Transmissions such as the 4L80E offer advantages which far outweigh those achieved by their non-electronic counterparts. Such advantages include:

- Calibration Flexibility

  A. Shift pattern--The ability to control shift point accuracy for all throttle and load conditions

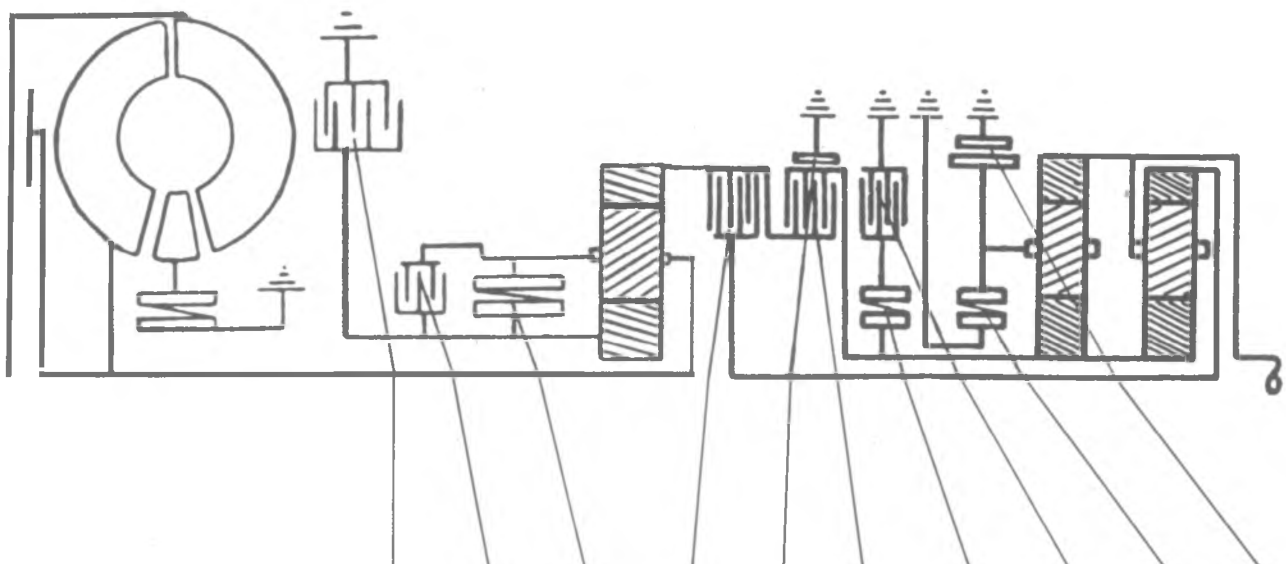
  B. Shift quality/feel--Adjusts pressures for:
     1. Altitude compensation
     2. A/C compensation
     3. Oil temperature compensation
     4. Power enrichment or turbo/supercharger compensation
     5. Improved garage shifts
     6. Adaptive learning
     7. All shifts including TCC

- Reduced Valve Body Complexity

  A. Reduced hardware content (valves, springs, etc.)

  B. Software calibrateable--Reduces the number of total tranmission models and valve body configurations.

HYDRA-MATIC 4L80-E



RANGE	GEAR	SHIFT SOLENOIDS A	SHIFT SOLENOIDS B	4th CLUTCH	OVER-RUN CLUTCH	OVER-DRIVE ROLLER CLUTCH	FOR-WARD CLUTCH	FRONT BAND	DIRECT CLUTCH	INTER-MEDIATE SPRAG	INTER-MEDIATE CLUTCH	LO ROLLER CLUTCH	REAR BAND
P-N		on	off			H							
D (boxed)	1ST	on	off			holding						H	
	2ND	off	off			H	on			H	on	O.R.	
	3RD	off	on			H	on		on	O.R.	on	O.R.	
	4TH	on	on	on		O.R.	on		on	O.R.	on	O.R.	
D	1ST	on	off		on	H	on					H	
	2ND	off	off		on	H	on			H	on	O.R.	
	3RD	off	on		on	H	on		on	O.R.	on	O.R.	
2	1St	on	off		on	H	on					H	
	2ND	off	off		on	H	on	on		H	on	O.R.	
1	1ST	on	off		on	H	on					H	on
R	REVERSE	on	off		H				on				on

Figure 1. 4L80E Range Reference Chart

Notes

Diagnostics

Hydra-matic 4L80-E and 4L80-E/HD diagnostics are summarized as follows:

A. Codes are available for most failures.
B. A scan tool interface is incorporated for ease of diagnosis.
C. The Service Engine Soon (SES) or (TRANS) lamps illuminate under specific conditions.

Fault Codes

Throughout this diagnosis guide, transmission fault codes are described by the condition which causes them and an "Action" that results. Each "Action", or default as it's also called, is the PCM/TCM's response to a given situation, such as an overheated transmission or a failed component. The action called for is designed to limit damage to the transmission or permit operation until the customer can return to the dealership for repairs. The action will continue until conditions are met that allow the system to return to normal. Those conditions are given under the heading "Recovery".

A "Recovery" condition must be met for an "Action" to stop. For example, the term "Valid Condition" says repairs must be performed and/or conditions no longer exist which caused the fault code to set. In some cases, not only may a valid condition be necessary, but an additional operation like switching the ignition key OFF and then ON again is needed. This is called a "Next Ignition Cycle."

Notes

4L80-E

The 4L80E is a prime example of an advanced, electronically controlled transmission. The 4L80E uses an electronic control module to monitor a number of vehicle and engine inputs as well as control engine and transmission outputs for improved vehicle performance.

Vehicles with gasoline engines will be equipped with a multi-function computer called a Powertrain Control Module (PCM). The PCM controls all engine functions such as: fuel delivery, EGR and spark timing. Additionally, the PCM controls transmission electronic functions such as: shift timing, torque converter clutch operation and shift feel.

Diesel-powered vehicles are equipped with a different controller than gasoline vehicles. This controller is called a Transmission Control Module (TCM). While a TCM monitors some diesel engine operating parameters like TPS and VSS, the TCM does not control any engine functions.

PCM/TCM

The PCM/TCM is located behind the glove box on all vehicles except the van (G-van under seat) and is the center of the transmission electronic control system.

In order to match a PCM/TCM to a particular vehicle application, a removable computer chip called a Programmable Read Only Memory (PROM) or MEMory CALibrator (MEM-CAL) is used. Vehicles with PCMs use a MEM-CAL, while vehicles with TCMs use a PROM.

A PROM programs the TCM for specific vehicle characteristics including weight, axle ratio, engine size, etc. The PROM allows great adaptability without requiring a different TCM part number for each application.

A MEM-CAL (used in a PCM, Figure 2) contains three circuits: a PROM, CAL-PAC and ESC module. The CAL-PAC runs the vehicle in fuel backup if a PROM or controller malfunction occurs. The ESC portion of the MEM-CAL controls ignition spark retard.

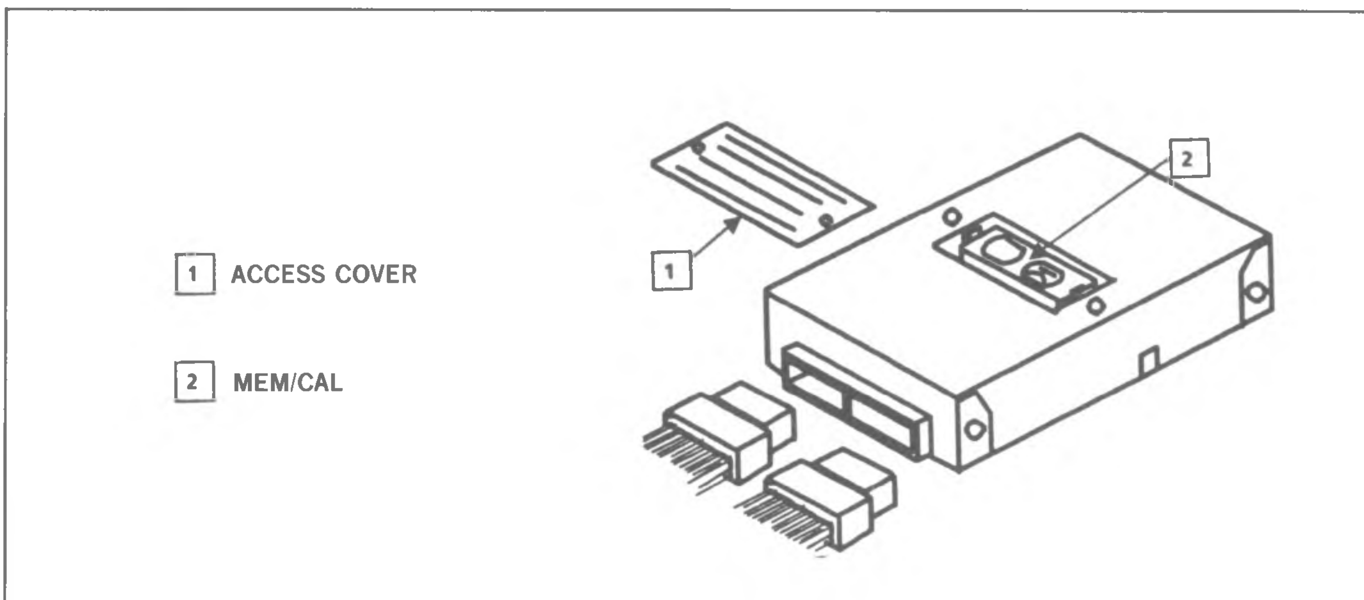


Figure 2. Powertrain Control Module (PCM), All Gas Engines

Both PCMs and TCMs are classified as "microporcessors." A microprocessor is a computer which monitors data (in this case, as fast as 40 times per second) from devices called Inputs (sensors and switches), makes a decision based on that data and then commands an appropriate output.

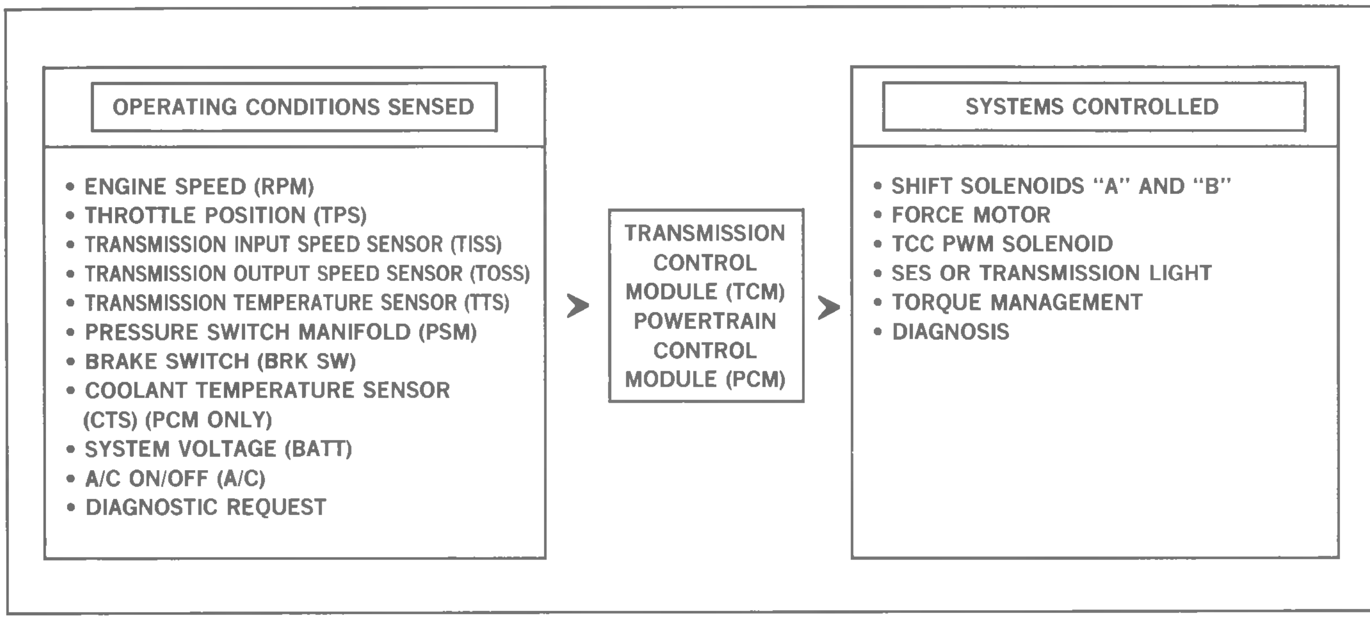


Figure 3. PCM/TCM Inputs and Outputs

PCM/TCM INPUTS AND CODES

The PCM/TCM receives direct input information from the following sources (Figure 3).

PCM/TCM Inputs

1. Throttle position sensor (TPS)
2. Transmission temperature sensor (Trans-temp)
3. Coolant sensor (CTS) (PCM only)
4. System voltage (BATT)
5. Engine speed (RPM)
6. Transmission Input Speed Sensor (TISS)
7. Transmission Output Speed Sensor (TOSS)
8. Pressure Switch Manifold (PSM)
9. Brake switch (BRK SW)
10. A/C on/off (A/C)
11. Diagnostic Request

Throttle Position Sensor (TPS) Input Information

The Throttle Position Sensor (TPS) is mechanically connected to the throttle shaft of the TBI unit or the injector pump on diesel applications. The sensor is a potentiometer with one end of the sensor resistor strip connected to a 5 volt supply from the PCM/TCM. The other end of the resistor strip is connected to ground. A third terminal is the signal circuit to the PCM/TCM: this terminal is connected to a movable contact inside the TPS. The movable contact moves up or down the resistor strip which varies the voltage value to the PCM/TCM. As the throttle is depressed the voltage will increase from approximately .5V to 4.5V (Figure 4). When the throttle is released the reverse will occur. Inside the PCM/TCM, the sensor voltage value is converted to a percentage for use by the controller in determining throttle opening. This percentage is used in determing:

1. Shift Pattern -- low volt = low % = earlier shift
   high volt = high % = later shift
2. Main Line Pressure--
   low volt = low % = minimum psi
   high volt = high % = maximum psi

In a sense, the TPS replaces the throttle cable or vacuum modulator used on previous transmissions.

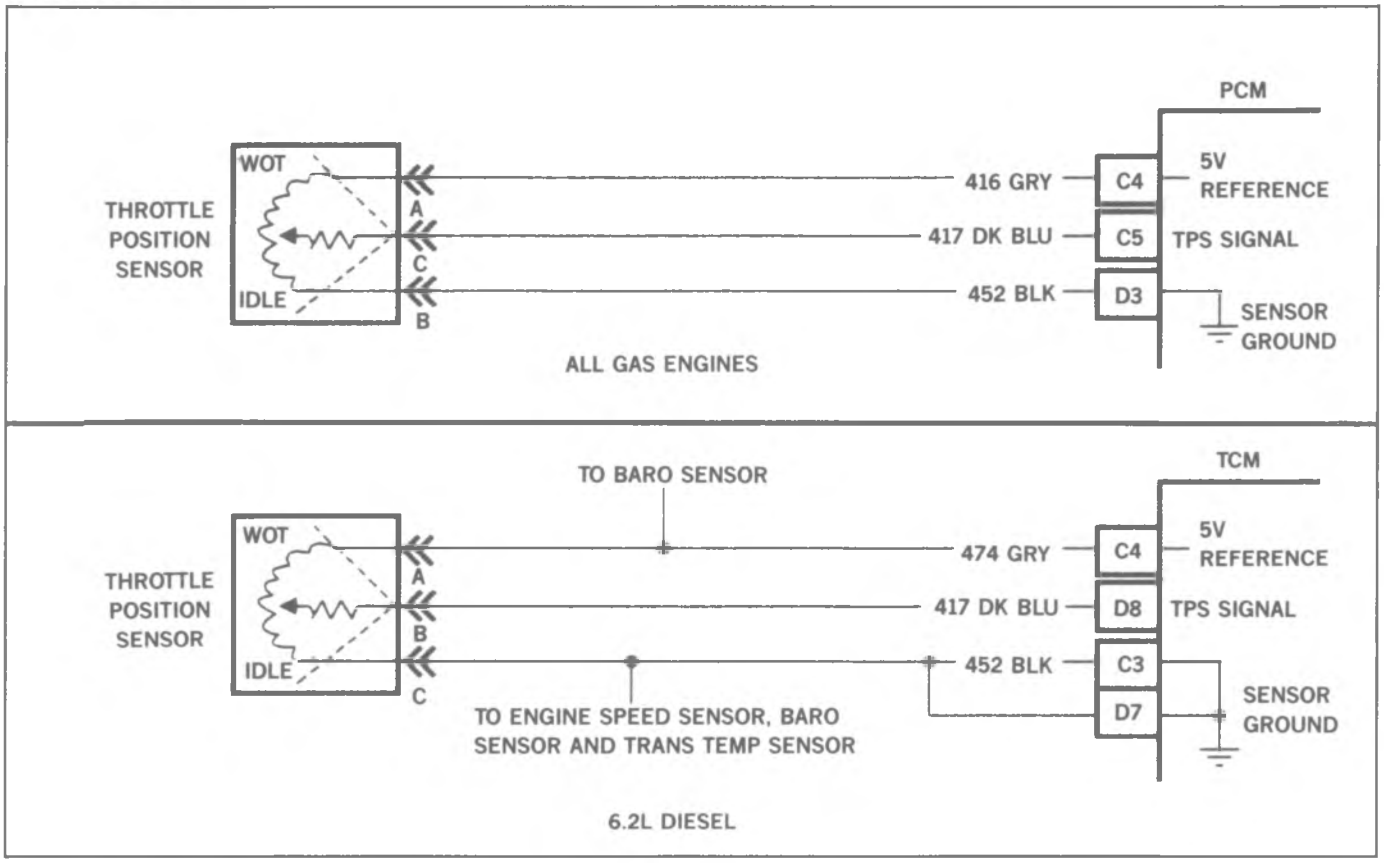


Figure 4 Throttle Position Sensor (TPS)

To monitor TPS operations the PCM/TCM constantly compares the TPS reference signals to the TPS signal line. This process is called "ratiometric comparison". The PCM/TCM establishes a ratio between the TPS 5 volt reference signal and the TPS signal line. If this ratiometric comparison is not correct, the PCM/TCM will set a code 21 (signal voltage high), or a code 22 (signal voltage low). If code 21 or 22 are set, the PCM/TCM will assign a default value of 35% TPS.

Notice: Ratiometric comparison is a process by which the control module compares the signal voltage from a sensor to a reference voltage and establishes a ratio. If this ratio falls outside a calibrated specification, a code will be set. Ratiometric comparison allows for fluctuations in source and signal voltage without setting false codes.

Code 21 (Signal Voltage High) Will Set If (Gas):
- Engine running
- TPS signal voltage over 4.5V at any time
- All conditions met for 5 seconds.

Code 21 (Signal Voltage High) Will Set If (Diesel):
- Engine is running
- TPS signal voltage greater than 1.1 volts at anytime
- Engine speed less than 750 RPM.
- all above conditions met for 5 seconds

Code 22 (Signal Voltage Low) Will Set If (Gas or Diesel):
- Engine running
- TPS signal voltage less than .2 volts for 1 second.

If a code 21 or 22 is set, the PCM/TCM will effect transmission operation by commanding:

Action	**Recovery**
Maximum Line Pressure	Next ignition cycle
Harsh/Firm Shifts	Next ignition cycle
Fixed Shift Points	Next ignition cycle
No 4th gear	Next ignition cycle
No TCC	Next Ignition cycle

Notice: If a TPS code is set, the scan tool may read the TPS default value (35%), depending on the version of T100 or TECH 1 software being used.

Transmission Temperature Sensor (Trans-Temp)

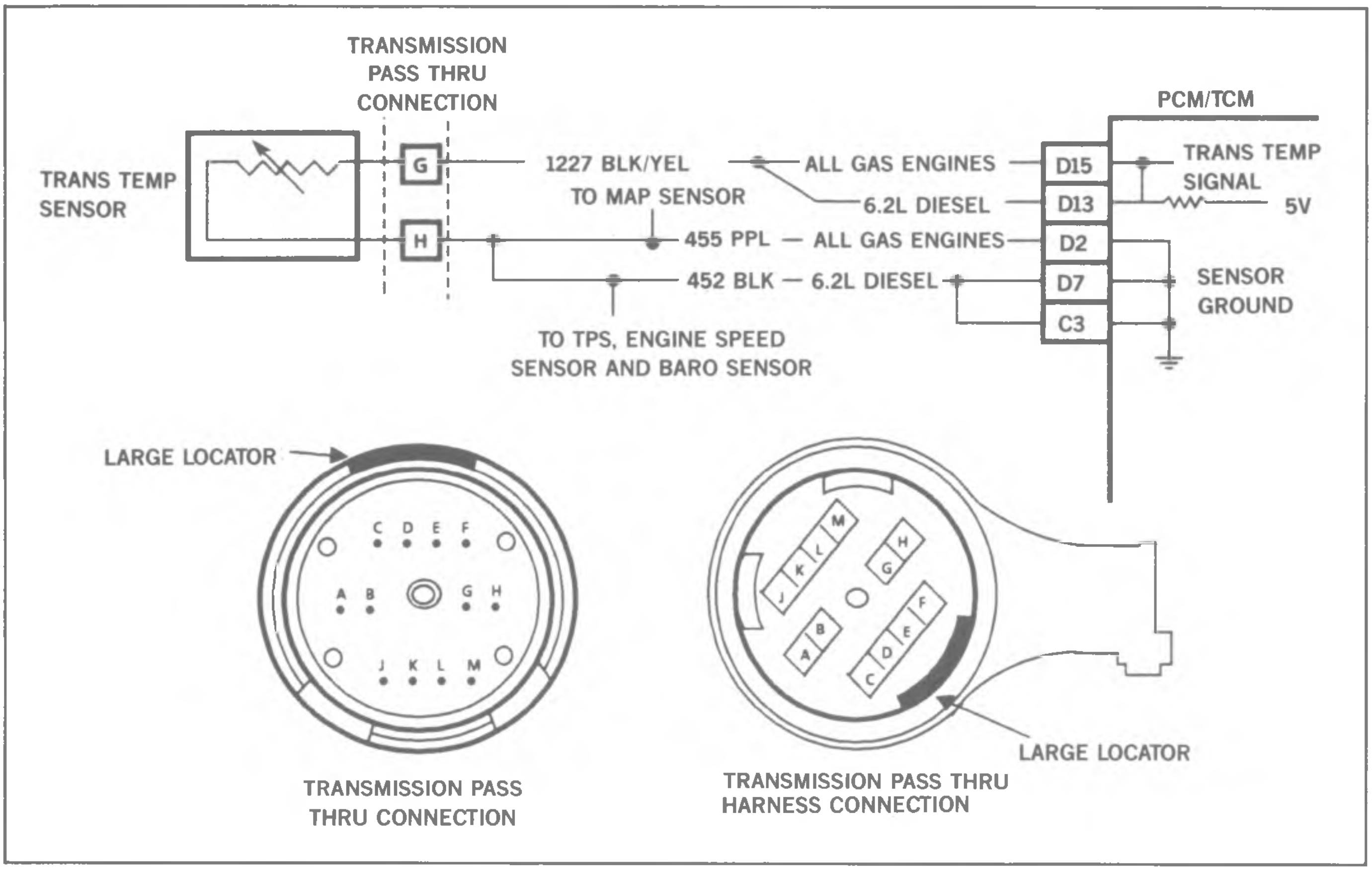


Figure 5. Trans Temp Input to the PCM/TCM

The transmission temperature sensor is used to control TCC and line pressure.

The transmission temperature sensor attaches to the valve body of the 4L80-E. It signals the PCM/TCM regarding transmission fluid temperature. The sensor is a negative temperature coefficient thermistor which receives a 5 volt signal from the PCM/TCM. When the temperature is cold, the sensor resistance is high; therefore, the PCM/TCM sees a high signal voltage (Figure 5). As the fluid warms, the sensor resistance lessens, the voltage drop across the sensor decreases, so the signal voltage will become lower. The transmission temperature sensor may be tested with an Ohmmeter across pin contacts G and H of the transmission pass through connector. Nominal resistance values at specified temperatures are given in Figure 6. Voltage levels at the PCM/TCM (Pin D15) at normal operating temp (100°C--212°F) is about 1.5 to 2.0 volts.

Temperature sensor modes:

1. Hot mode (Above 122°C (250°F)) - TCC On In 3rd and 4th - This reduces transmission temperature by decreasing heat generated in the torque converter. It also provides maximum cooling by routing transmission fluid directly to the transmission cooler in the engine radiator.

2. Super-hot mode (Above 150°C (300°F)) - TCC Off, Inhibit Operation of 4th - Super-hot is a condition where a hot engine adds heat to the transmission through the transmission cooler. By inhibiting TCC and 4th gear operation, the engine works under less load. This reduces the heat added to the transmission fluid by the transmission cooler. As both engine and transmission cool off, TCC and 4th are permitted again.

°C	°F	MINIMUM RESISTANCE	NOMINAL RESISTANCE	MAXIMUM RESISTANCE
-40°C	-40°F	80965	100544	120123
-30°C	-20°F	42701	52426	62151
-20°C	-4°F	23458	28491	33524
-10°C	14°F	13366	16068	18770
0°C	32°F	7871	9370	10869
10°C	50°F	4771	5640	6508
20°C	68°F	2981	3500	4018
30°C	86°F	1915	2232	2550
40°C	104°F	1260	1460	1660
50°C	122°F	848.8	977.1	1105
60°C	140°F	584.1	668.7	753.4
70°C	158°F	410.3	467.2	524.2
80°C	176°F	293.7	332.7	371.7
90°C	194°F	213.9	241.0	268.2
100°C	212°F	158.1	177.4	196.8
110°C	230°F	118.8	132.6	146.5
120°C	248°F	90.40	100.6	110.8
130°C	266°F	69.48	77.29	85.11
140°C	285°F	53.96	60.13	66.29
150°C	202°F	42.43	47.31	52.20
160°C	320°F	32.51	36.13	39.73
170°C	338°F	25.13	27.92	30.71
180°C	356°F	19.42	21.58	23.74
190°C	374°F	15.01	16.68	18.35
200°C	392°F	11.60	12.89	14.18

Figure 6. Transmission Sensor Temperature-to-Resistance

The PCM/TCM monitors the transmission temperature through the use of dual pull-up resistors which feed the temperature sensor circuit. If the PCM/TCM determines that the voltage drop (transmission temperature) is either too high or too low as compared to PCM/TCM calibrated values, a code will set. If sensor signal voltage is too low, code 58 will be set. If sensor signal voltage is too high, code 59 will be set.

Code 58 (High Temp) (Signal Low Voltage) Will Set If:
- Sensor signal voltage indicates transmission temperature is above 153°C (307°F) for more than one second

Code 59 (Low Temp) (Signal High Voltage) Will Set If:
- Sensor signal voltage indicates a transmission temperature below -48°C (-54°F) for more than one second

If code 58 or 59 is set the PCM/TCM substitutes a default temperature value of 130°C (265°F).

The PCM/TCM will respond by commanding:

Action	Recovery
Harsh shifts	Valid condition
TCC occurs in 2nd, 3rd, and 4th	Valid condition

Coolant Temperature Sensor (CTS)

The coolant temperature sensor is a Negative Temperature Coefficient (NTC) thermistor, mounted in the engine cooling system and used on gasoline engine equipped vehicles only. Low coolant temperature produces high sensor resistance while high coolant temperatures cause low sensor resistance. The PCM supplies a 5 volt signal to the sensor, then measures the voltage drop across the sensor (Figure 7). The PCM compares the sensor voltage reading to calibrated values to determine actual temperature of the engine. At a normal engine operating temperature of 85°C - 95°C (184°F - 203°F), the voltage measures about 2.05 volts at the PCM.

The PCM uses engine temperature to inhibit TCC as well as control line pressure and shift times.

DEGREES		SENSOR RESISTANCE (OHMS)	VOLTAGE DROP ACROSS SENSOR (VOLTS)
°C	°F		
-40	-40	INF. TO 100K	5
-8	+18	14570	3.93
0	32	9560	3.56
10	50	5910	2.98
20	68	3760	2.41
30	86	2300	1.86
40	104	1589	1.40
50	122	942	3.69
60	140	730	3.27
70	158	455	2.87
80	176	349	2.44
90	194	252	2.05
100	212	180	1.70
110	230	136	1.39
120	248	108	1.15

— NOTE —
An ECM internal shunt circuit will come into play as temperature increases beyond 50°C. As temperature is decreasing, internal shunt comes in at 40°C. There is a 10°C. overlap.

Figure 7. Coolant Sensor Temperature Vs. Resistance Values

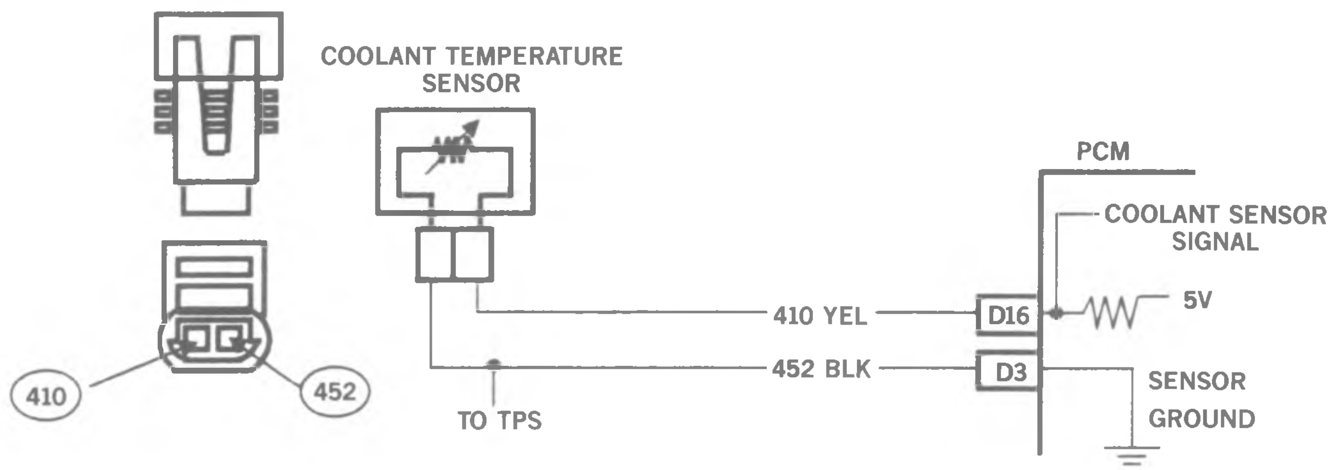


Figure 8. CTS Inputs to the PCM

Engine coolant temperature, like transmission temperature, is monitored through a pull-up resistor circuit (Figure 8). If the voltage drop (coolant temperature) is judged to be either too high or low as compared to PCM calibrated values, a code will result. Code 14 indicates a shorted sensor circuit condition while code 15 indicates an open sensor circuit.

Code 14 (High Temp) (Signal Low Voltage) Will Set If:
- Sensor signal voltage indicates coolant temperature above 135°C (270°F) for more than 6 seconds

Code 15 (Low Temp) (Signal High Voltage) Will Set If;
- Sensor signal voltage indicates coolant temperature less than -33°C (-27°F) for more than 30 seconds

If either code 14 or 15 is set, the PCM substitutes a default temperature value of 90°C.

The PCM then effects transmission operation by commanding:

Action	Recovery
TCC applies when engine is cold	Valid condition

System Voltage Level (BATT)

The PCM/TCM monitors battery voltage to assure the PCM/TCM will always be operating within safe standards (Figure 9). The PCM/TCM is calibrated to operate between 8.5 volts and 19.5 volts. If voltage drops below 8.5 volts the PCM/TCM responds by setting Code 75.

If battery voltage exceeds 19.5 volts the PCM/TCM responds by setting code 53.

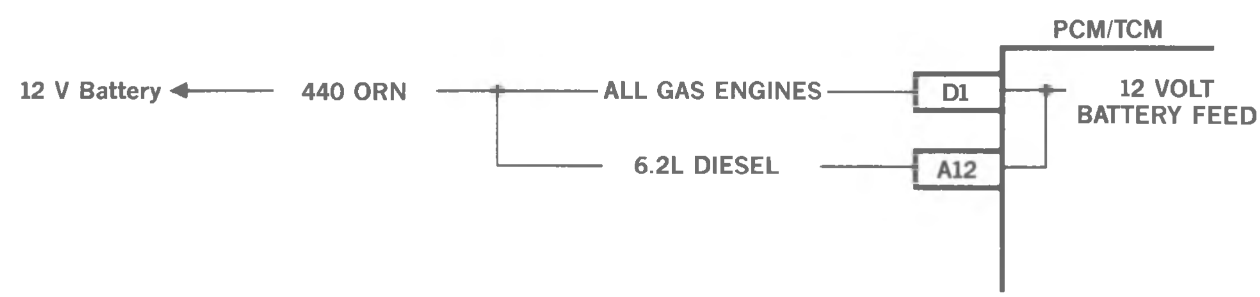


Figure 9. Battery Voltage Input

Code 75 (System Voltage Low) Will Set If:

- System voltage drops below 6.7 volts at -40°C (-40°F), 8.6 volts at 90°C (194°F), 10.5 volts at 150°C (304°F).
- Failure occurs for longer than 4 seconds.

If a code 75 is set, the PCM/TCM responds by commanding:

Action	Recovery
2nd gear only	Valid condition
Maximum line pressure	Valid condition
No TCC	Valid condition

Code 53 (System Voltage High) Will Set If:

- System voltage exceeds 19.5 volts
- Failure occurs for longer than 2 seconds

If Code 53 is set, the PCM/TCM responds by commanding:

Action	Recovery
2nd gear only	Next Ignition Cycle
Maximum line pressure	Next Ignition Cycle
No TCC	Next Ignition Cycle

Engine Speed (RPM)

Engine RPM is determined by a different method in gasoline-powered vehicles than in diesel-powered vehicles.

In gasoline-powered vehicles, engine RPM is derived from reference pulses from the ignition module located within the distributor (Figure 10). As the engine components rotate, the distributor shaft turns a toothed wheel called a timer core. As the timer core rotates, an AC voltage is induced within the distributor pickup coil assembly. This AC signal is sent to the ignition module. The ignition module then sends a digital square wave signal to the PCM. Within the PCM, this digital signal is compared to a fixed-frequency clock signal to determine engine RPM.

Notice: The number of timer core teeth will vary, depending on the number of cylinders.

In diesel-powered vehicles, engine RPM is derived from an engine speed sensor mounted to the rear of the intake manifold (Figure 11). The diesel engine speed sensor consists of a four tooth timer core and a pickup coil assembly to indicate crankshaft speed. As the sensor shaft is rotated by the oil pump drive, an AC signal is produced. Unlike gasoline-powered applications, the AC signal from the diesel engine speed sensor is sent (unbuffered) directly to the TCM. Within the TCM, the speed signal is converted to a digital signal and is then compared to a fixed-frequency clock signal to determine engine RPM.

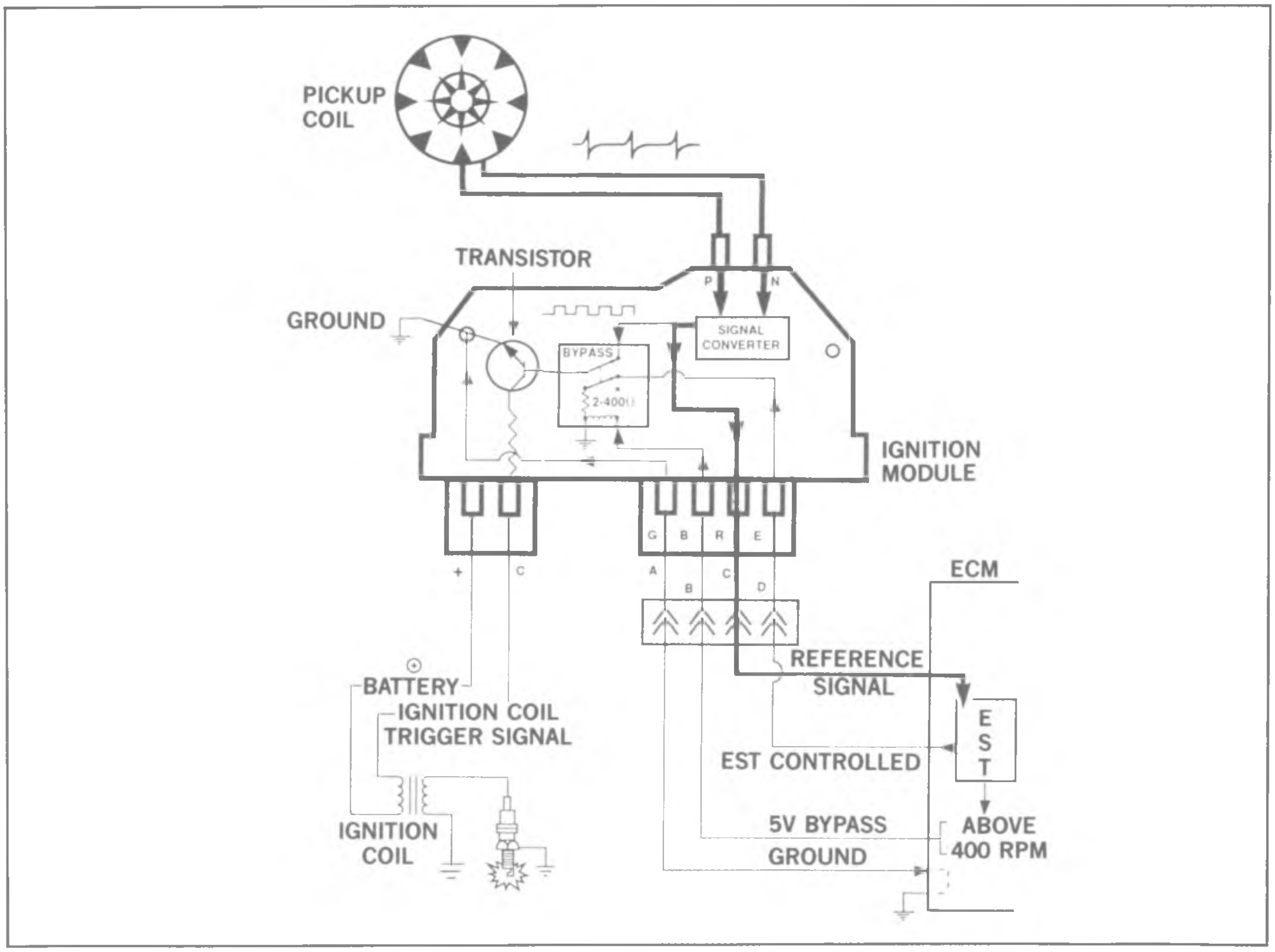


Figure 10. Gasoline Engine Speed Sensor Schematic (Ignition Distributer)

1 ENGINE HARNESS
2 RIGHT VALVE COVER
3 ENGINE SPEED SENSOR

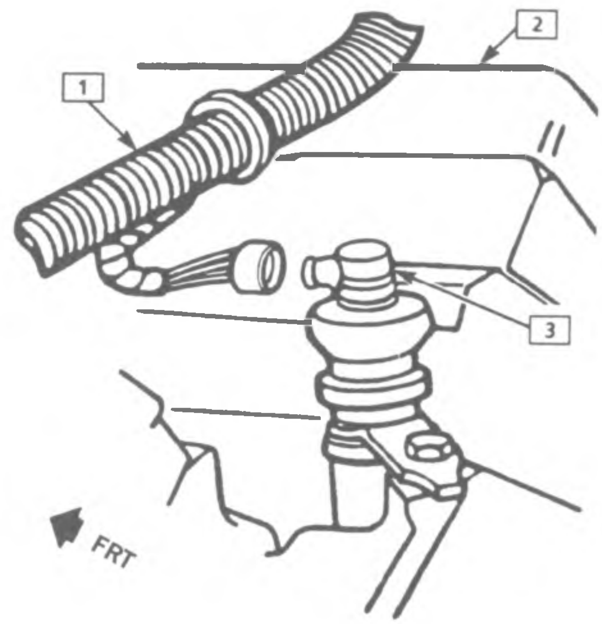


Figure 11. C-K-G Engine Speed Sensor (6.2L)

Reluctance Sensors

CONSTRUCTION OF A PM PICKUP

A permanent magnet pickup, as figure 12 shows, consists very simply of a magnet wrapped inside a coil. The coil has two lead wires from its ends.

The tip of the magnet is positioned next to a rotating reluctor wheel. A reluctor wheel is made of magnetic metal (iron or steel). It has evenly spaced teeth or lugs with air gaps between them. Air has a high magnetic reluctance. Iron or steel has a low magnetic reluctance.

SIGNAL GENERATION

When the reluctor wheel is not turning, the permanent magnet produces a steady magnetic field. This field cuts through the coil winding. But it produces no voltage, since both the field and the coil are stationary.

As the reluctor wheel turns, the teeth move in and out of the field. The field is strongest when a tooth exactly aligns, and weakest when an air gap aligns. The change in field strength causes a weak voltage to be induced in the coil.

It is a pulsating or alternating voltage, similar to an A.C. "sine wave".

This produces a signal that can be used to count engine RPM or revolutions of the transmission output shaft, for example.

VSS BUFFER

The weak, analog signal from the sensor must be strengthened (amplified), and converted to a digital signal that the onboard computer can use. This is done in the VSS buffer.

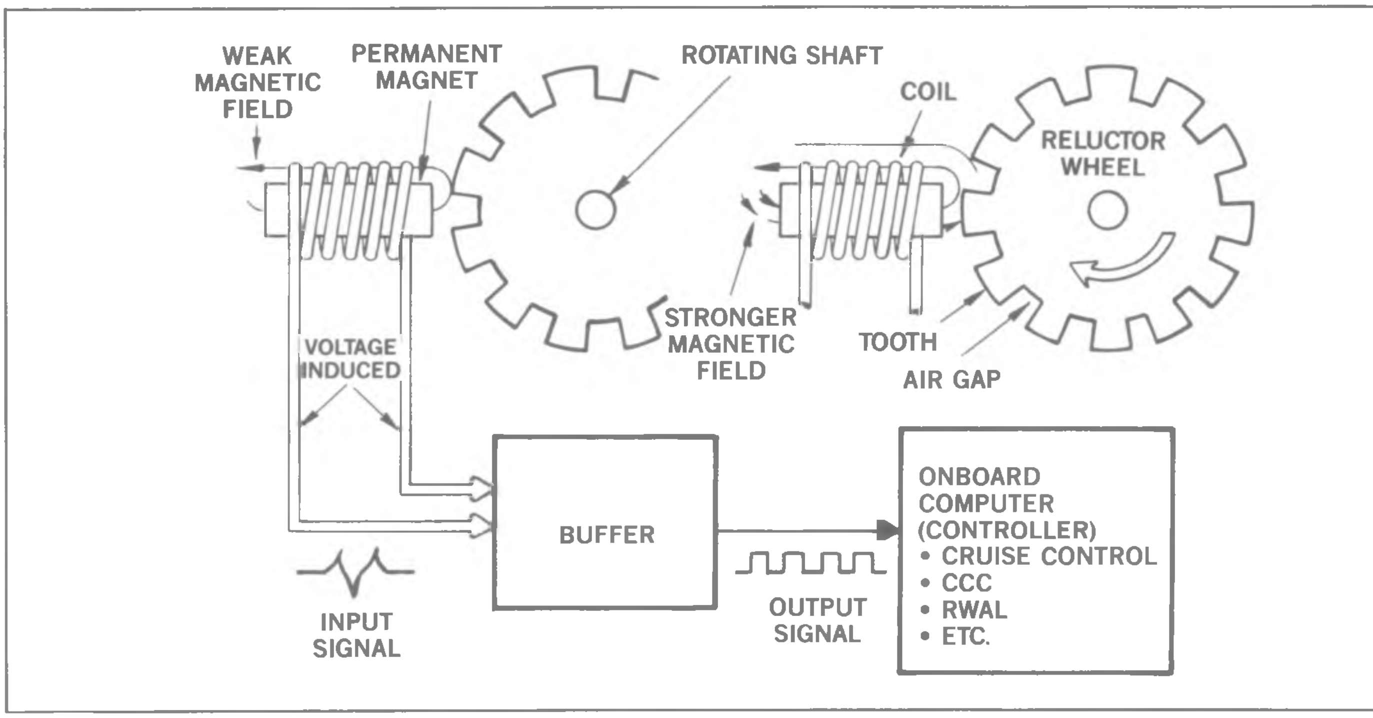


Figure 12.

TRANSMISSION INPUT SPEED SENSOR (TISS)

The input sensor is of the magnetic induction type and is located on the left side of the transmission just forward of center. Serrations cut in the forward clutch housing induce a small A/C current as they pass by the input sensor. Inside the PCM/TCM, this analog signal is changed to a digital signal. This digital signal is then compared by the processor to a fixed clock signal internally within the PCM/TCM to determine actual turbine speed. While there is no specific code for an input sensor problem, the PCM/TCM uses input sensor readings to calculate gear ratio, turbine speed, TCC slip, to determine if the engine is running and to control line pressure.

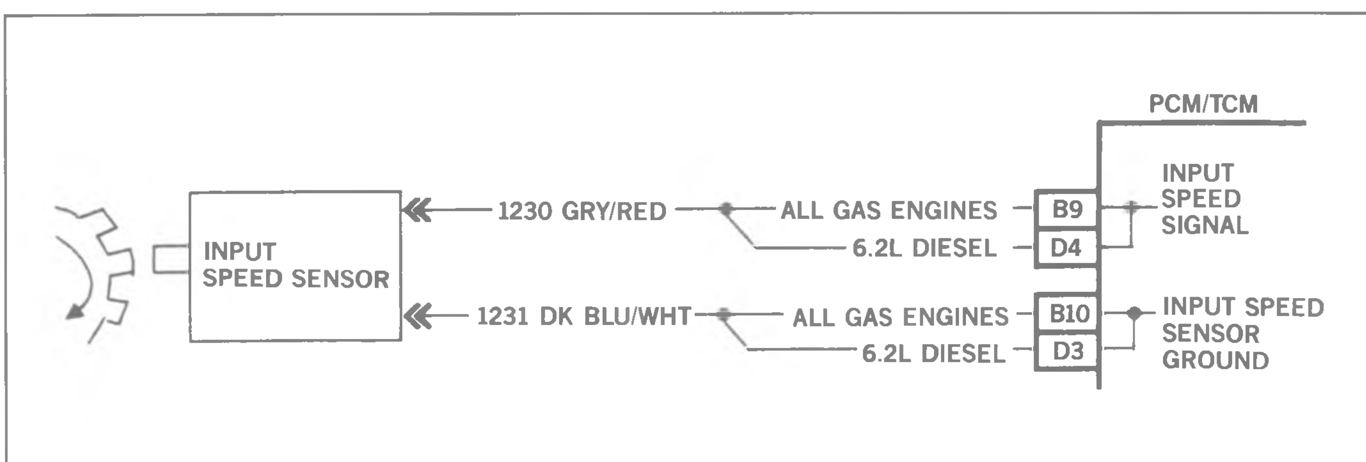


Figure 13.

TRANSMISSION OUTPUT SPEED SENSOR (TOSS)

The output sensor circuit consists of a magnetic induction type sensor, digital ratio adapter, located in the instrument cluster or wiring. Gear teeth cut in the outside diameter of the rear internal gear induce an alternating current in the sensor.

On 2wd vehicles, transmission output speed and vehicle speed are derived from a module called a Digital Ratio Adapter Controller (DRAC). The DRAC module's job is threefold; it:

- Acts as an interpreter for the PCM/TCM as well as other components (converts AC signal to a digital DC square wave).
- Changes frequency feed to each component) RWAL, cruise, cluster, PCM/TCM).
- Allows the systems to be easily updated for changes in tire size and axle ratio.

Notice: all vehicles except C-K use an externally-mounted DRAC assembly.

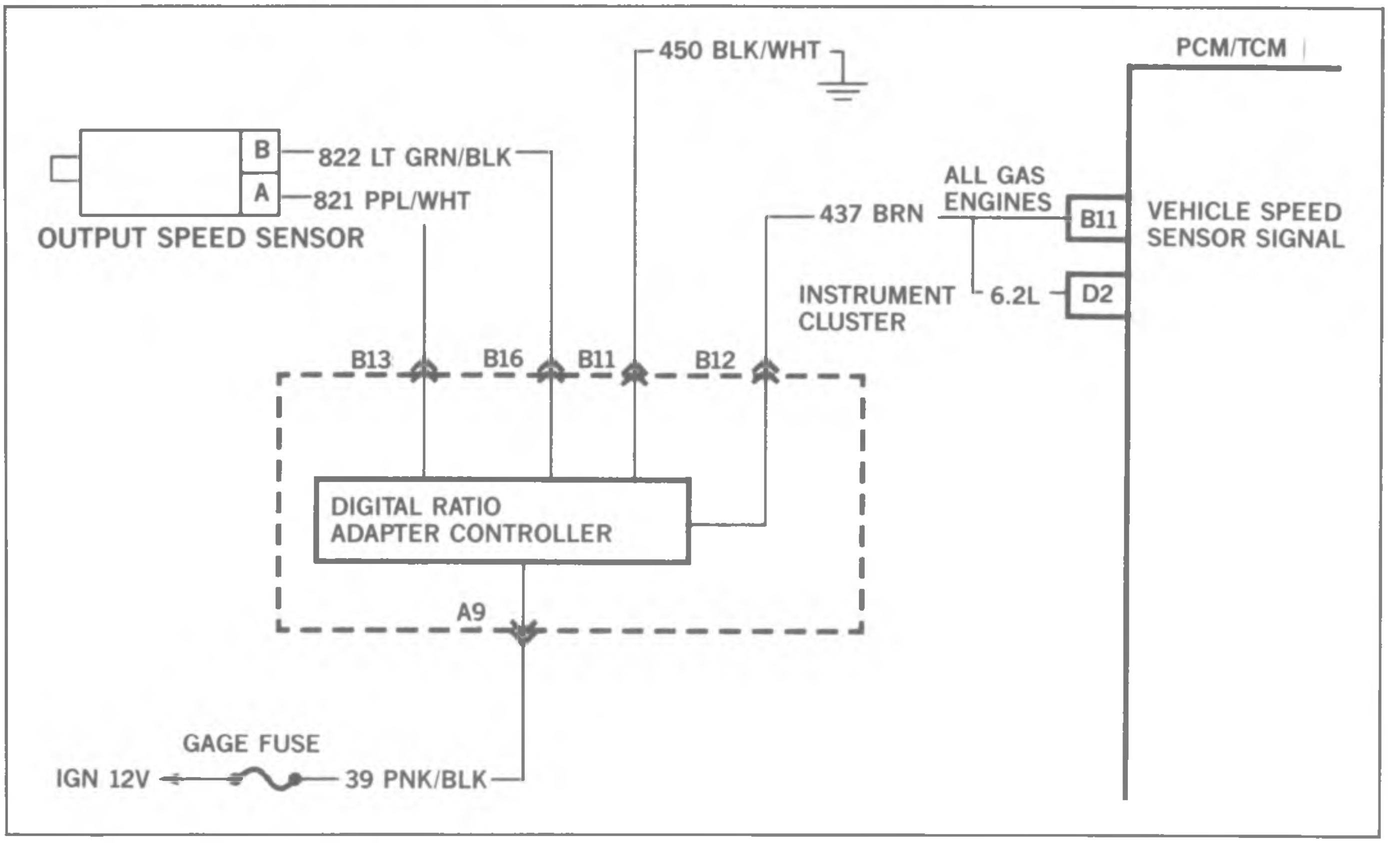


Figure 14. Output Speed Sensor Circuit (C-2WD)

Vehicle speed is derived differently on 4WD vehicles than on 2WD vehicles. 4WD vehicles also use a DRAC to determine vehicle speed, but with one important difference. 4WD vehicles have an additional sensor on the transfer case (Figure 15). The DRAC uses the transfer case output signal instead of the Transmission Output Speed Sensor (TOSS) to determine vehicle speed. The transfer case sensor now becomes the Vehicle Speed Sensor (VSS).

The VSS signal is changed to a digital signal by the DRAC and sent to the PCM/TCM. There it is compared to a fixed frequency clock signal to determine output MPH. The DRAC also provides signals to Cruise, RWAL and the instruments.

The Transmission Output Speed Sensor is sent unbuffered to the PCM/TCM. There it is compared to transmission input speed (TISS) and used to determine Calculated Inputs (see next topic).

If the input versus output speed ratiometric comparison is not correct, a code 85 will result. If input speed exceeds 3000 RPM while output speed registers less than 200 RPM a code 24 will be set.

Because of the multitude of axle ratios and tire sizes available, the 4L80-E utilizes transmission output speed (TOSS) alone to determine shift timing, not actual vehicle speed. That is why diagnostic tools such as TECH 1 are unable to give readouts in MPH/KPH.

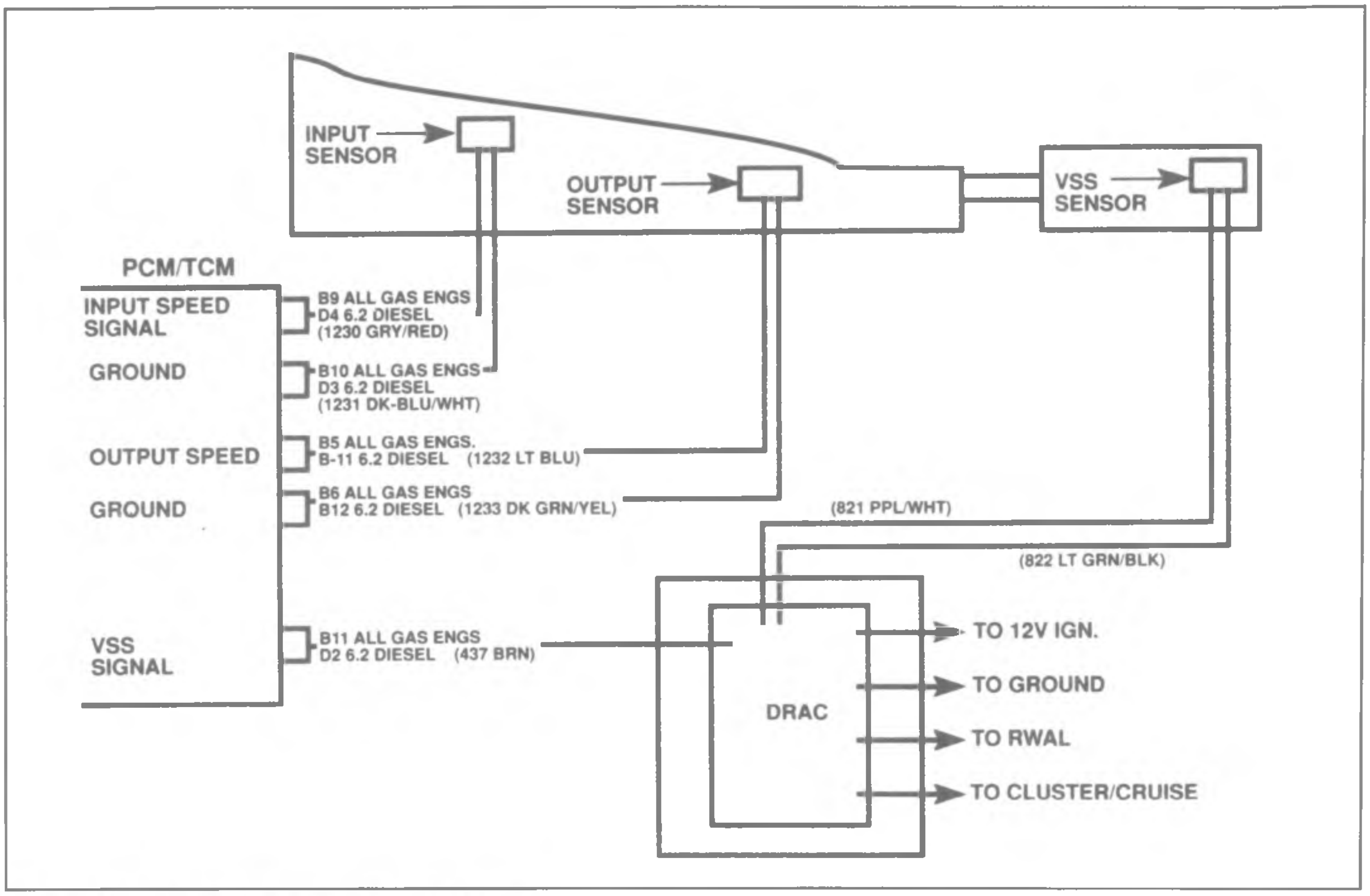


Figure 15. Speed Sensor Circuit (4WD)

Code 24 (Output Sensor) Will Set If:

- Input speed is at least 3000 rpm and output speed is less than 200 rpm for at least one second.
- PSM must show transmission is in gear.

Code 85 (Undefined Ratio) Will Set If:

- PCM/TCM ratiometric calculation produces an unknown gear ratio based on manual valve position (PSM) and speed sensor inputs for any gear but 4th for more than 5 seconds

If codes are set, the PCM will effect transmission operation by commanding:

Code 24	Recovery
Line pressure maximum	Next Ignition Cycle
2nd gear operation only	Next Ignition Cycle
Calculate output speed from input speed	Next Ignition Cycle

Code 85	Recovery
Line pressure maximum	Next Ignition Cycle

Notice: If an input speed sensor error is present, output speed and input speed may register 0 mph when using a scan tool.

Calcuated Inputs

Some inputs to the PCM/TCM processor are not directly accomplished by sensors, they are calcuated based on inputs from various sensors and fixed calibration values. These include:

1. Turbine Speed
2. Overdrive Ratio
3. Combined Ratio
4. Ratio
5. Slip

1. Turbine Speed

Turbine Speed is input sensor speed when the transmission is in 1st, 2nd, and 3rd gears. When the transmission shifts into 4th, Turbine Speed is calculated by multiplying input speed by a calibrated value. Turbine Speed is not accurate in 4th gear because the forward clutch drum is overrunning and its ratio is in overdrive.

2. Overdrive Ratio

Overdrive Ratio is calcuated by comparing input speed to engine speed. Input speed should be within 200 RPM of engine speed if 4th gear is functioning correctly. Overdrive ratio is calculated by dividing engine speed by input speed.

To monitor Overdrive Ratio error, the PCM/TCM performs a ratiometric comparisons of engine speed to input shaft speed. If overdrive ratio calcuation is incorrect, a Code 68 will be set.

Code 68 (Overdrive Ratio) Will Be Set If:

- Engine speed is 200 RPM higher than input speed
- 4th Gear Operation
- TCC is applied
- No Code 28 set (PSM)
- All conditions are met for at least 2 seconds

If Code 68 is set, the PCM/TCM will respond by commanding:

Action	Recover
Higher Than Normal Line Pressure	Next Ignition Cycle
No 4th Gear	Next Ignition Cycle
No TCC	Next Ignition Cycle

Notice: If TCC fails to apply in 3rd gear, a Code 39 will set (see code index). If TCC fails to apply in 4th, a Code 68 will be set.

3. Combined Ratio

Combined Ratio is the combination of both Overdrive Ratio and Ratio. The PCM/TCM will calculate this as the Total Ratio of the unit.

4. Ratio

Ratio is calcuated by the PCM/TCM based on input and output sensor readings. The PCM/TCM calculates the ratio for 1st, 2nd and 3rd and compares it to the commanded ratio for diagnosis purposes (Figure 16).

GEAR RATIO CHART

	more ~~less~~ than	LESS ~~more~~ than
1st	2.38	2.63
2nd	1.43	1.58
3rd	.95	1.05
rev	1.97	2.17

Figure 16. Gear Ratio Chart

5. Slip

Slip refers to the amount of torque convertor slippage calculated from engine speed and turbine speed. The PCM/TCM uses this calculation to determine TCC clutch slippage or convertor malfunctions. This input is used to determine the amount of total commanded TCC Duty Cycle. If the slip calculation is higher than PCM/TCM calibrations have determined for that specific engine load and road speed, the percentage of TCC solenoid Duty Cycle will be increased to compensate. If slip exceeds 65 RPM, Code 39 will set, indicating the TCC is stuck Off.

Pressure Switch Manifold (PSM)

The pressure switch manifold contains five normally open pressure switch assemblies which are used to indicate transmission manual valve range through the use of a Binary code (Figure 17). Each switch produces either an open or a ground for the three PCM/TCM signal lines, depending on which switches have pressure applied to them. The sequence of which switches are open and which switches are closed will be used by the PCM/TCM to determine actual manual valve position (except park/neutral). This input is used for line pressure, TCC and shift solenoid control. The pressure switch manifold is attached to the valve body.

Notes

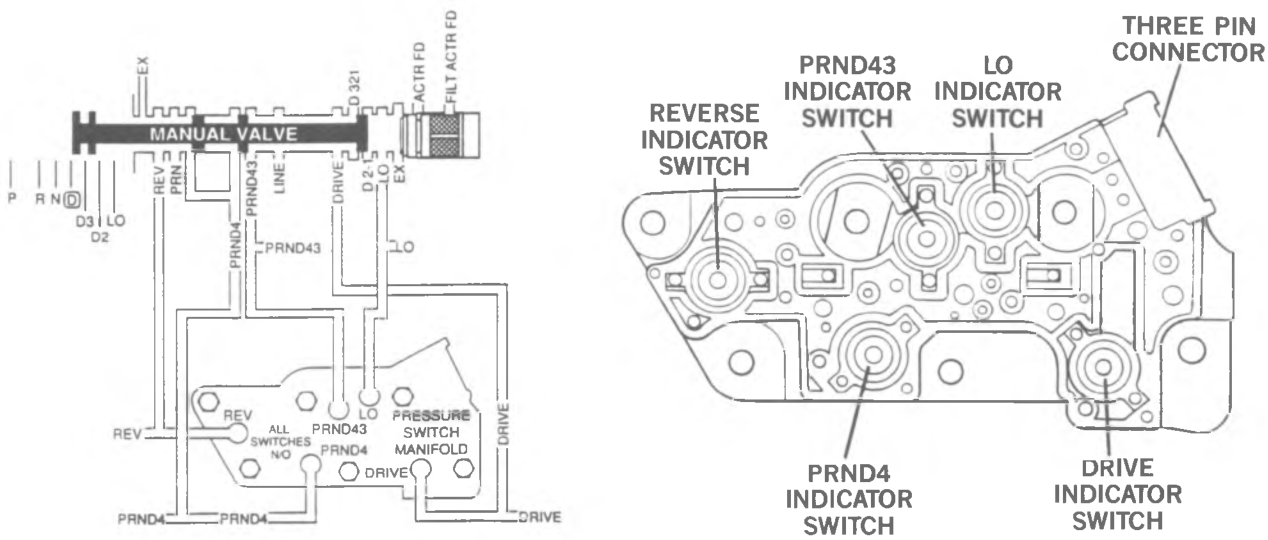


Figure 17. Pressure Switch Manifold

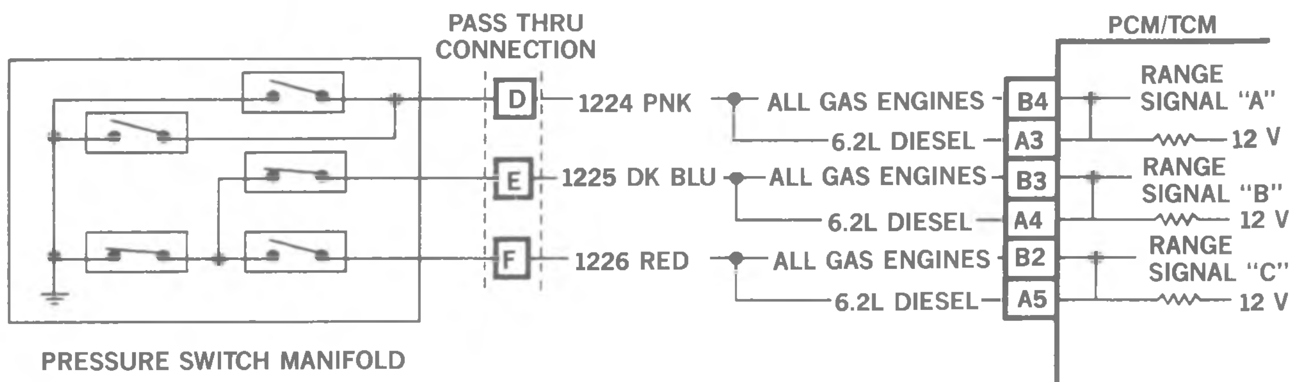
To monitor PSM operation, the PCM/TCM compares the voltage values it sees to a PSM combination chart stored in its memory (Figure 18). If the PCM/TCM does not recognize the PSM switch sequence (voltage sequence) for the range selected, a Code 28 will result.

Notice: Seven valid combinations and two invalid combinations are available from the PSM. Valid combinations for Circuits A, B and C are shown in Figure 18. Invalid combinations are A=0, B=0 and C=0; or A=0, B=1 and C=0.

Code 28 (PSM Fault) Will Set If:	**Recovery**
• An invalid pressure switch combination is recognized	Next ignition cycle

If Code 28 is set, the PCM/TCM will respond by commanding:

Action	**Recover**
Higher than normal line pressure	Valid Condition
No 4th	Valid Condition
No TCC	Valid Condition
(Assumes OD Range has been selected)	



Valid PSM Combination Chart

	A	B	C
Park	12	0	12
Rev	0	0	12
Neutral	12	0	12
4th	12	0	0
3rd	12	12	0
2nd	12	12	12
1st	0	12	12
Invalid	0	12	0
Invalid	0	0	0

Expected Voltage Readings

Figure 18. Pressure Switch Manifold Schematic

Brake Switch

The Brake Switch is operated by brake pedal travel. The switch is normally closed when the brake is released. This applies battery voltage to the PCM/TCM signal line (Figure 19). When brakes are applied the PCM/TCM receives a Zero (0) volt signal on the signal line which causes TCC to be released. Brake switch input is used for line pressure and TCC control.

Notice: The C-K Brake Switch Assembly contains up to three separate switch contacts. These are for cruise control, stop lamp and RWAL.

Notes

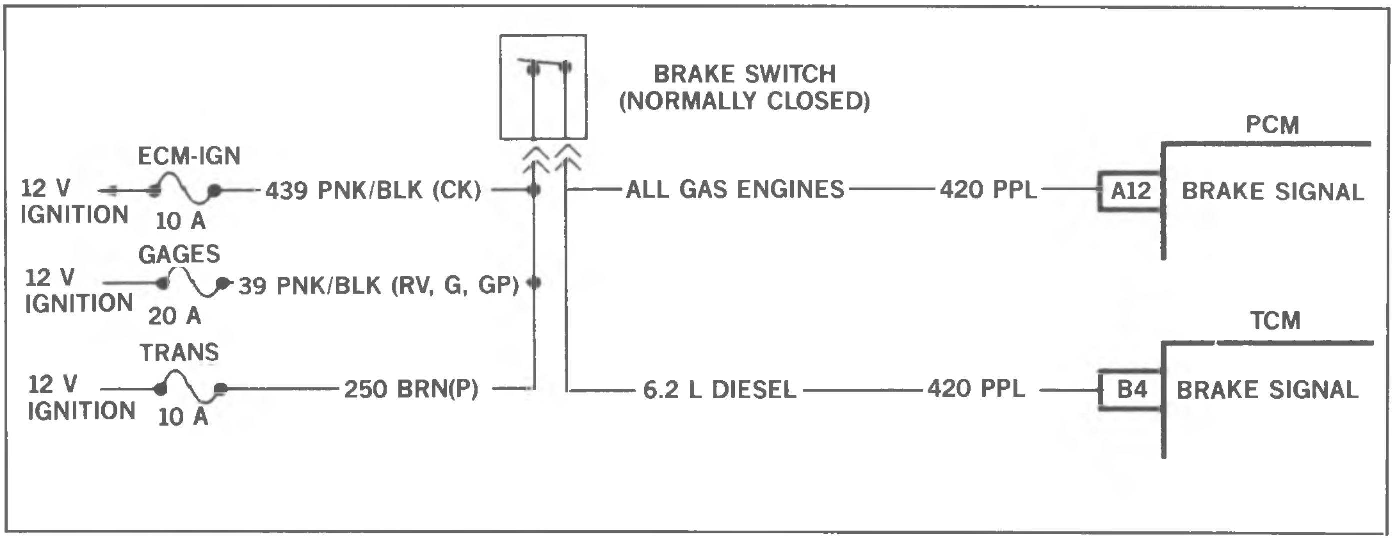


Figure 19. Brake Switch Schematic Diagram

A/C Request

A/C Request is used by the PCM/TCM as a discreet input regarding A/C pressure Cycling switch status (Figure 20). When the Pressure cycling Switch closes, a voltage signal is sent from the cycling switch to the A/C compressor clutch and the PCM/TCM. This signal is used by the PCM/TCM to adjust transmission line pressure, as well as shift timing for the added engine load provided by the compressor. As the cycling switch opens, the compressor will be cycled off and the PCM/TCM will see a Zero (0) volt signal on the A/C signal line. As the cycling switch closes, the compressor will run and the PCM/TCM will see a 12 volt signal on the A/C signal line.

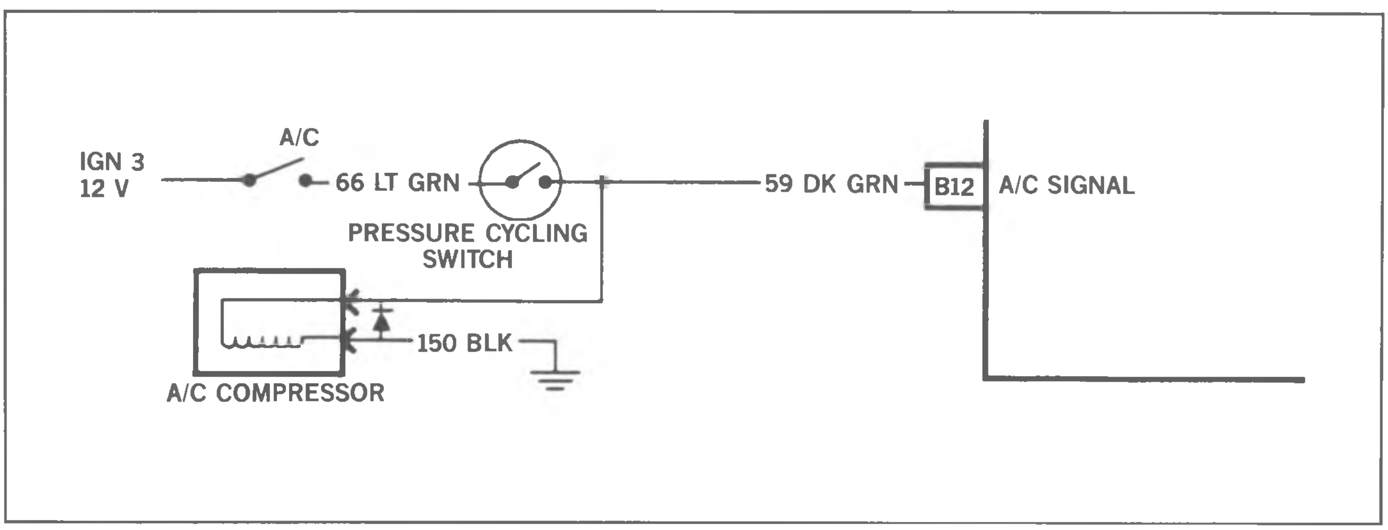


Figure 20. A/C Switch Schematic Diagram

Diagnostic Request

To enter Diagnostic Mode, the PCM/TCM must receive an input from the ALDL. By placing a specified resistance value across ALDL pins A and B, the PCM/TCM processor will receive a specific Diagnostic Mode Input based on the voltage drop across pin B to ground. The Diagnostic Modes are as follows:

MODE	A-B RESISTANCE
Normal/Open/Road Test	Greater than 20K
Fuel Backup/Factory Test	3.9K
Diagnostic Mode/Field Service Mode	0

A-B Resistance values other than the Diagnostic Mode cannot be performed manually. Road Test and Fuel Back-up Modes are accomplished automatically through the Tech 1 or T-100 Diagnostic Equipment. The Diagnostic Mode/Field Service Mode allows the PCM/TCM to display any trouble codes which relate to the systems being monitored.

Notes

Outputs

An Output Device is a component which can be used by the PCM/TCM to control specific powertrain functions. The following are the outputs on the 4L80-E:

1. Shift solenoids A and B
2. Force motor
3. Torque management
4. TCC-PWM solenoids
5. SES or Transmission Lights
6. Diagnosis

Shift Solenoids

A Shift Solenoid is a two-port, feed bleed device which consists of a coil/plunger-ball assembly (Figure 21). The solenoid assembly works in conjunction with an orifice to pressurize the shift valve end chamber when voltage is applied to its coil. The controlled pressure then moves the shift valve against a spring causing a shift to occur. When voltage is no longer applied the chamber is then opened to exhaust and the opposite shift valve action occurs. Shift solenoids eliminate the need for TV and governor pressures to control shift valve operation.

The 4L80E transmission uses two shift solenoids, Solenoid A and Solenoid B.

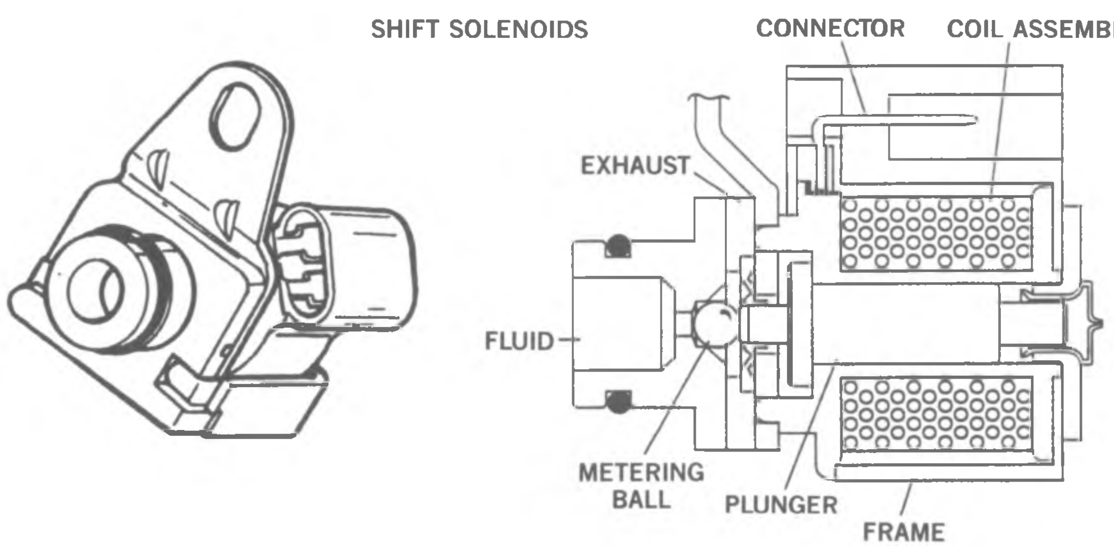


Figure 21. Shift Solenoid

Solenoid A

Solenoid A is attached to the valve body and is normally open to exhaust. The PCM/TCM activates the solenoid by providing a ground internally through one of its "Quad Driver Modules". Solenoid A is "ON" (exhaust closed) in 1st and 4th gears but "OFF" (exhaust open) in 2nd and 3rd. When the solenoid is on, pressure acts against the shift valves to force the valve to move. When the solenoid is off, spring pressure forces the shift valve to shuttle in the opposite direction in its bore. Solenoid A feeds the 1-2, and 3-4 shift valves (Figure 22).

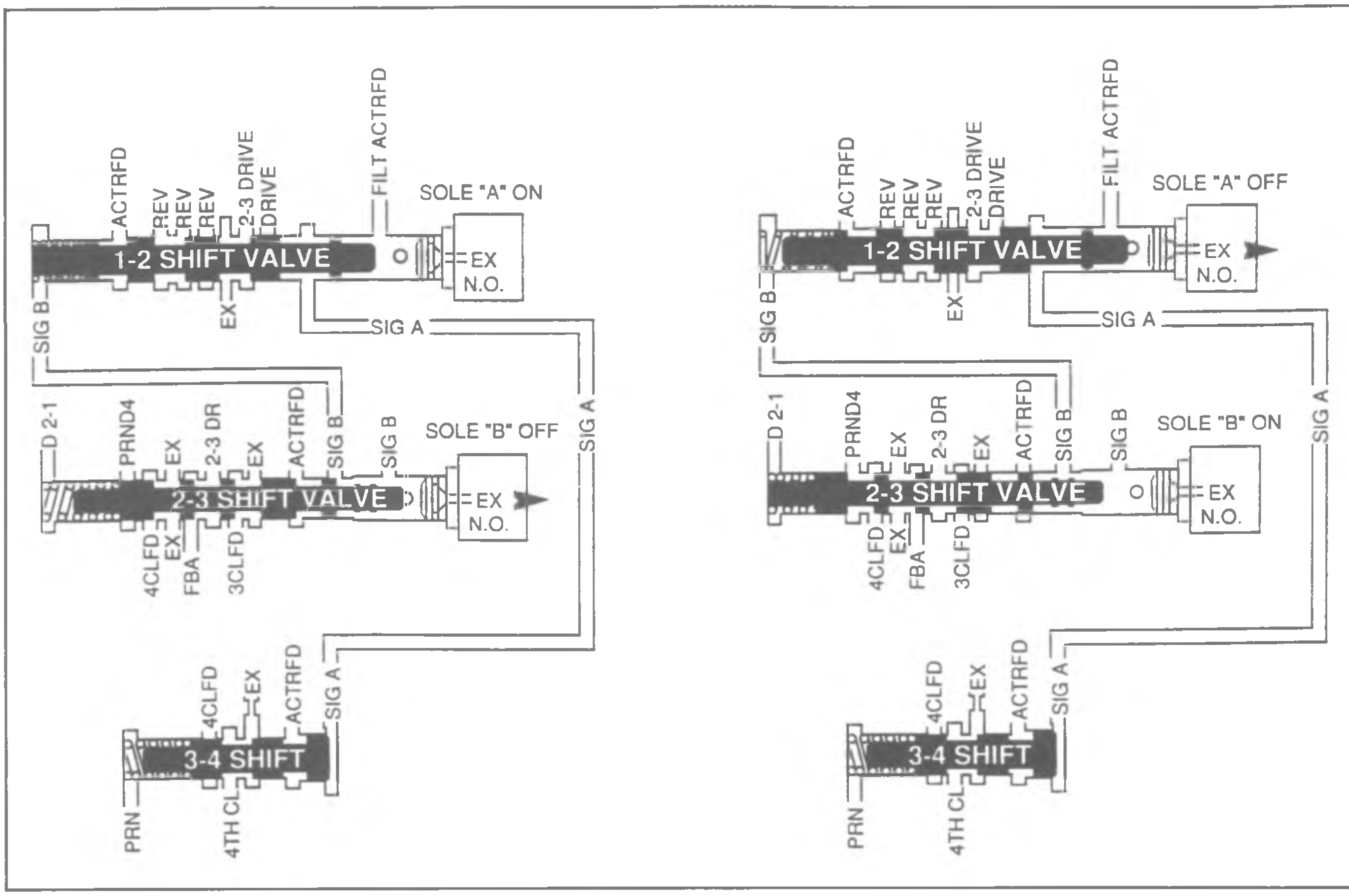


Figure 22. Solenoid Schematic Diagram

Solenoid B

Solenoid B is attached to the valve body and is also normally open to exhaust. The PCM/TCM activates the solenoid by providing a ground internally through one of its Quad Drive modules. Solenoid B is "ON" (exhaust closed) in 3rd and 4th gears and "OFF" (exhuast open) in 1st and 3nd gears. When the solenoid is on, pressure acts against the shift valve to force the valve to move. When the solenoid is off, spring pressure forces the shift valve to shuttle in the opposite direction in its bore. Solenoid B feeds the 2-3 shift valve and the spring side of the 1-2 shift valve (Figure 22).

Notice: If both solenoids lose power, second gear only will result.

Solenoid Control

The PCM/TCM uses numerous inputs to determine when a solenoid should be activated or deactivated. These input parameters are used by the processor to determine which position the solenoids should be placed (ON or OFF) to provide proper upshift and downshift points for all conditions. The inputs used by the processor for control of Solenoid A and B include:

1. TPS
2. VSS
3. PSM
4. BRK SW
5. TRANS TEMP
6. CTS (Gas Engine Only)
7. MALFUNCTION STATUS

Solenoid Diagnosis

The PCM/TCM can determine if Solenoid B is physically frozen in the apply or release position. To monitor for these malfunctions the PCM/TCM commands the transmission into 1st or 2nd gear. The PCM/TCM then monitors the combined ratio calcuation. If the combined ratio indicates the vehicle is operating in 3rd or 4th gear, a frozen closed (On Position) Solenoid B is indicated and Code 86 will be stored.

Code 86 (Solenoid B Closed) will set when:

- VSS above 11 KPH
- TPS more than 25%
- PCM/TCM commands 1st or 2nd gear
- Combined ratio indicates transmission is at a 1-1 ratio or less (3rd or 4th gear)
- Conditions met for at least 6 seconds

To determine a stuck open (Off) solenoid, the PCM/TCM monitors combined ratio while the transmission is commanded to be in 3rd or 4th gear. If combined ratio indicates the vehicle is in 1st or 2nd gear, a Code 87 will result.

Code 87 (Solenoid B Open) will set when:

- Vehicle speed is above 11 KPH
- TPS is more than 25%
- PCM/TCM commands 3rd or 4th gear
- Combined ratio indicates transmission is in 1st or 2nd gear
- Conditions are met for 6 seconds)

If Code 86 or 87 is set, the PCM/TCM will respond by commanding:

Action	Recovery
Actions have been Inhibited	None

The PCM/TCM continually monitors both Solenoid A and B Quad Driver Module (QDM) circuits. The commanded state of the QDMs will determine whether circuit voltage levels will be high or low. If the Quad Driver is commanded "ON" by the PCM/TCM with the circuit in good condition, the voltage level will drop as the circuit energizes.

However, if the voltage remains high while the circuit is being commanded "ON", or if the voltage drops, then floats back up when the circuit is commanded "ON" a code will be set. The opposite is also true. If a solenoid is being commanded "OFF", the circuit should be at a high voltage level. If the circuit is at a low state when the solenoid is commanded "OFF", a code will also be set.

Either a shorted circuit or an open circuit will set the same code, Code 82 Solenoid A, Code 81 Solenoid B.

Code 81 (Solenoid B QDM Fault) Will Set If:

- QDM is commanded "ON", circuit voltage remains high for 2 seconds or more
- QDM is commanded "OFF", circuit voltage remains low for 5 seconds or more.

If Code 81 is set, the PCM/TCM will respond by commanding: 13

Action	Recovery
2nd gear only	Next Ignition Cycle
Maximum Line pressure	Next Ignition Cycle
No TCC	Next Ignition Cycle

Code 82 (Solenoid A QDM Fault) Will Set If:

- QDM is commanded "ON", circuit voltage remains high for 2 seconds or more
- QDM is commanded "OFF" circuit voltage remains low for 5 seconds or more

If Code 82 is set, the PCM/TCM will respond by commanding:

Action	Recovery
2nd and 3rd gears only or 1st and 4th gear only	Next Ignition Cycle

Notice: Shift solenoid resistance should measure 20 ohms minimum when measured at 20°C. Shift solenoid current flow should not exceed 0.75 amps. The shift solenoid should energize at a voltage of 7.5 volts or more (measured across the terminals). The shift solenoid should de-energize when voltage is 1 volt or less.

Force Motor

A Force Motor (also known as a Variable Force Solenoid, VFS) is a three-port, spool valve, electronic pressure regulator that controls pressure based on current flow through its coil-winding (Figure 23). The Force Motor is attached to the valve body and controls main line pressure by moving a pressure regulator boost valve against spring pressure. The Force Motor eliminates the need for a TV cable or vacuum modulator to adjust line pressure according to engine load changes. The Force Motor position is controlled by a combination of two methods. High side and Low side control. One terminal of the Force Motor receives a fixed frequency (292.5 Hz) signal which varies in positive (+) Duty Cycle. This feed circuit to the Force Motor is called "Force Hi". The opposite terminal of the Force Motor is called "Force Low" (Figure 24). Force Low is used to provide a ground for the solenoid. It is through this combination of "Force Hi" and "Force Low" circuitry that actual Force Motor current is finely controlled. This advanced control method assures instantaneous control of line pressure when changes in TPS and adaptive learning occur.

Notice: Force Low will remain at ground potential unless excessive current flow occurs (1.5A). When a shorted circuit causes high current flow, the PCM/TCM will control a field effect transistor (QDM) in the Force Low circuit to limit current flow. This current limiting process protects the PCM/TCM from damage from shorted circuits.

Force High	Force Low	Line Pressure
+ 0% Duty Cycle	0 Amps	Maximum
+40% Duty Cycle	1.1 Amps @ 4-5 V	Minimum

Notes

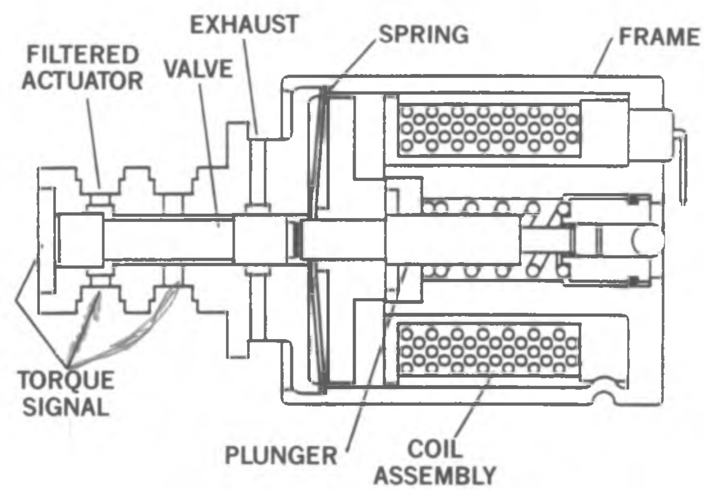


Figure 23. Force Motor

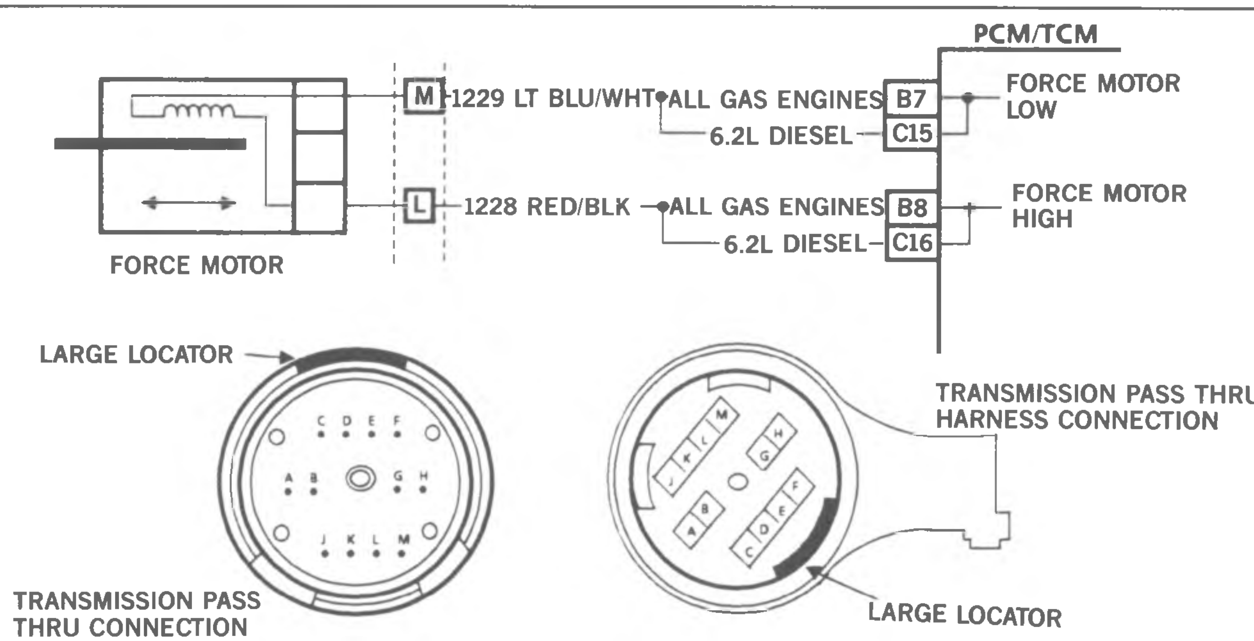


Figure 24. Force Motor Schematic Diagram

Line pressure will vary as (+) Duty Cycle and current flow vary. The Force Motor will be pulsed to 100% Full ON or 0% Full Off once every 10 seconds to prevent contamination from sticking the force motor spool valve. The processor portion of the PCM/TCM uses specific input information to precisely control the Force Motor. This action does not occur during a shift operation.

Notice: Cycling the valve ON or OFF in this manner prevents spool valve contamination. This results in pressure gauge fluctuations when monitoring line pressure.

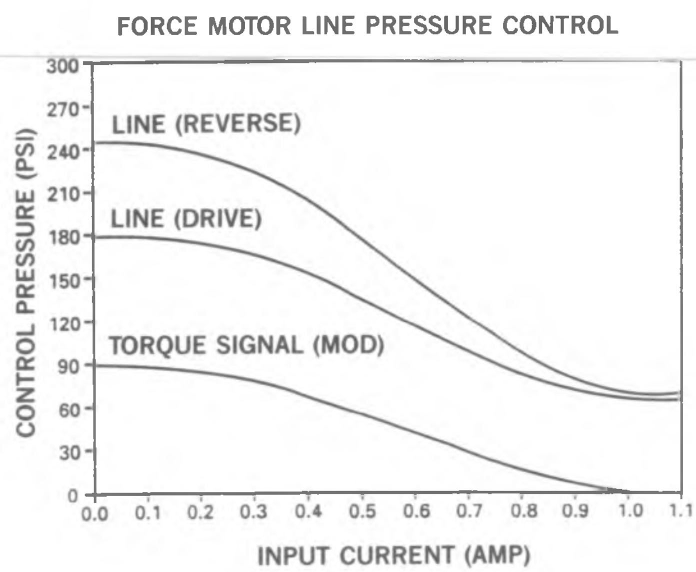


Figure 25. Torque Signal/Main Line Pressure Relationship (Hydra-matic 4L80-E)

Force Motor Control is divided into three separate control modes of operation by the control module program. They are: Garage Shift Control, Engine Braking Control and Main System Control. These control modes allow the PCM/TCM to "fine tune" pressure changes for all conditions.

The following are the inputs used by the processor for each type of control:

Garage Shifts
1. PSM
2. Transmission Input Speed Sensor (TISS)
3. Trans Temp
4. VSS

Engine Braking Control
1. PSM
2. Transmission Output Speed Sensor (TOSS)
3. Ratio

Main System
1. TPS
2. Transmission Output Speed Sensor (TOSS)
3. Ratio
4. Solenoid State
5. Trans Temp
6. Power Enrichment
7. PSM
8. TCC Enables
9. A/C Status
10. Engine Speed
11. Slip
12. PCM Backup Fuel Mode

Force Motor Diagnosis

To monitor Force Motor operation, the PCM/TCM uses the Force Low to provide a return circuit to ground for the Force Motor coil current. The coil current travels through a saturated field effect transistor which is used as a protective switch, and across a calibrated resistor. This signal is provided to the processor which measures the resistor voltage drop and then calculates the corresponding Force Motor current.

The Force Motor is designed to operate in a current range of 0.1 - 1.1 Amp average. If Force Motor current constantly exceeds 1.5 Amps at 85°C (amperage may surge as high as 2 Amp for a short period of time) the Drive Circuit will limit current flow. The PCM/TCM Program then performs a ratiometric comparison of commanded Force Motor current versus actual Force Motor current. If Actual Force Motor current is not within 0.16 Amp of commanded Force Motor current, Code 73 will result.

Code 73 (Force Motor Current) will result if:
- Actual Force Motor current is higher or lower than commanded Force Motor current by more than 0.16 Amp.
- More than 1 second

If Code 73 is set, the PCM/TCM will respond by commanding:

Action	**Recovery**
Maximum Line Pressure	Next Igntion Cycle

Notice: Force Motor resistance should measure 3.5-4.6 ohm when measured at 20°C.

Adaptive Learning

The 4L80E PCM/TCM programming allows for adjustments in line pressure based on needs of the transmission. This process is referred to as Adaptive Learning and is used to assure consistent shifting and increased transmission life. As transmission components wear and shift overlap time increases, it becomes advantageous to adjust line pressure to adapt for increases in shift overlap.

Notice: Shift overlap refers to the amount of time it takes for a shift to be completed. This time will usually measure between 0.4 - 1.35 seconds, but will vary with load and transmission wear.

Adaptive Learning is accomplished for the 4L80E by monitoring the following inputs and calculations:
1. TPS
2. VSS
3. Transmission Temperature
4. Shift Overlap Times

PCM/TCM adaptive calculations are accomplished by comparing shift overlap times to the other input values. Within the PCM/TCM program memory, Adaptive Learning specifications are contained within eight (8) cells or memory blocks. Each memory block contains specific input values (comparisons) as well as Adaptive Learning output commands.

Current transmission values will then be compared to thé appropriate cell or block to determine the Adaptive Learning output command. The PCM/TCM will then apply the calculated (+) Duty Cycle command to the Force Motor to adjust line pressure for the change in transmission operation. Adaptive Learning is constantly updated by the PCM/TCM. This updating and storage will continue unless battery power is lost to the PCM/TCM, at which time the process will begin again.

Notice: Adaptive Learning is limited for 1991 and 1992 model years. These model years will be limited to 2 psi change. If battery power is lost, 8 shifts will be required for the PCM/TCM to "relearn" proper block-cell position.

Torque Management

A transmission is most susceptible to damage when a shift is in process. Typically, transmission shifts take approximately 0.4 to 1.35 seconds to complete. The time when a component is not fully released or fully applied, is called "shift overlap". Shift overlap varies from transmission to transmission. It also varies with operating parameters and transmission condition (Figure 26). High torque engines can cause severe damage to clutches and bands during shift overlap. Therefore, during the shift it is beneficial to limit engine torque. The process of limiting engine torque during shifts is called Torque Management.

As the PCM receives input information from ratio, shift solenoid position, TPS and RPM, it can determine when a shift is about to occur. Currently, the technique calls for a momentary reduction (or retard) of spark advance. This can be for as much as 57 crankshaft degrees and as long as 20 ms. This allows the shift to occur with reduced engine torque during the points of shift overlap, thus reducing the strain on the clutches and bands.

Notice: Amounts of retard and time interval will vary with engine application. Torque management is inhibited on 1991-1992 4L80E equipped domestic vehicles.

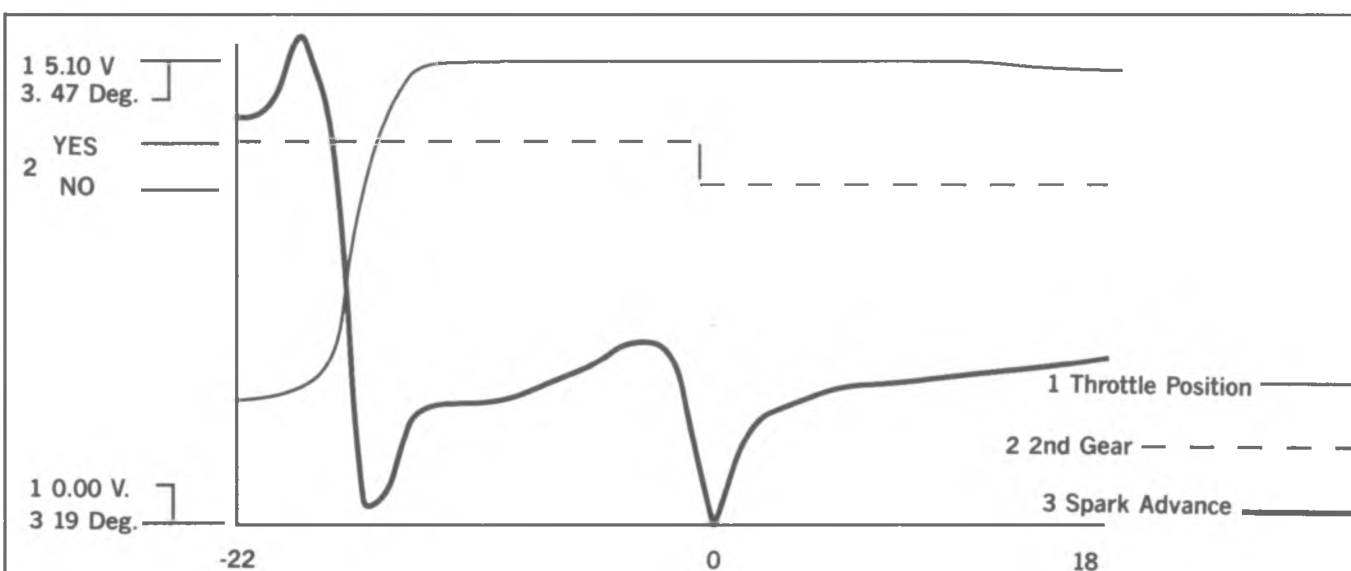


Figure 26. Torque Management Scope Pattern

TCC-PWM Solenoid

The TCC solenoid is a three-port assembly which uses (—) Duty Cycle, Pulse Width Modulation (Fixed 32 Hz) to control the rate of TCC apply release (Figure 27). The solenoid's ability to "ramp" apply and release pressures result in a smoother apply and release of TCC in all conditions (Figure 28).

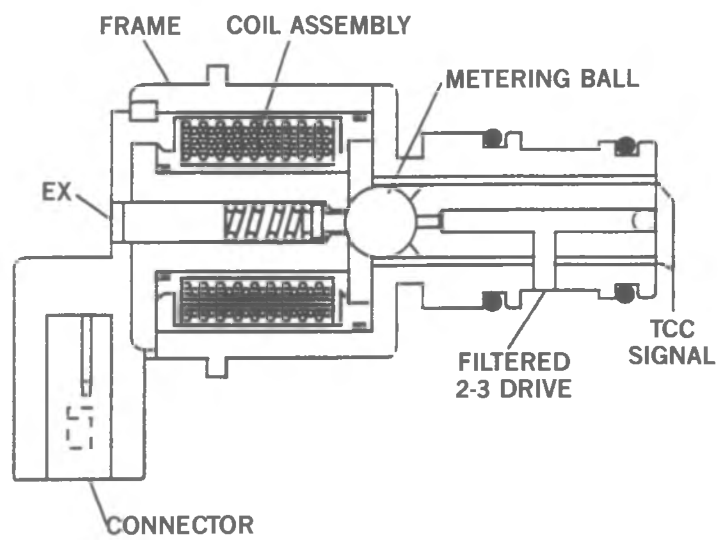


Figure 27. Pulse Width Modulated (PWM) Solenoid

The TCC solenoid is a normally closed valve, mounted to the valve body and used to control the position of the TCC apply valve.

Notice: TCC-PWM solenoid resistance should be 10 ohm minimum when measured at 20°C. Maximum solenoid current flow should not exceed 1.5 amps.

As TCC is commanded (—) Duty Cycle will increase from 0% to as high as 100% when TCC is fully applied. As TCC is released (—) Duty Cycle will decrease from 100% to 0%, at which time the TCC system is fully released. By varying the Duty Cycle, the solenoid can control how fast the TCC apply valve moves, thus eliminating the need for a TCC accumulator.

Duty Cycle can be overridden by the Brake Switch or TPS. If the PCM/TCM sees a brake input or if TPS indicates idle position or heavy acceleration, TCC Duty Cycle is commanded immediately 0% (full off) and TCC is released. Like the Force Motor and Shift Solenoids, the internal PCM/TCM program uses specific inputs to determine what the proper Duty Cycle should be.

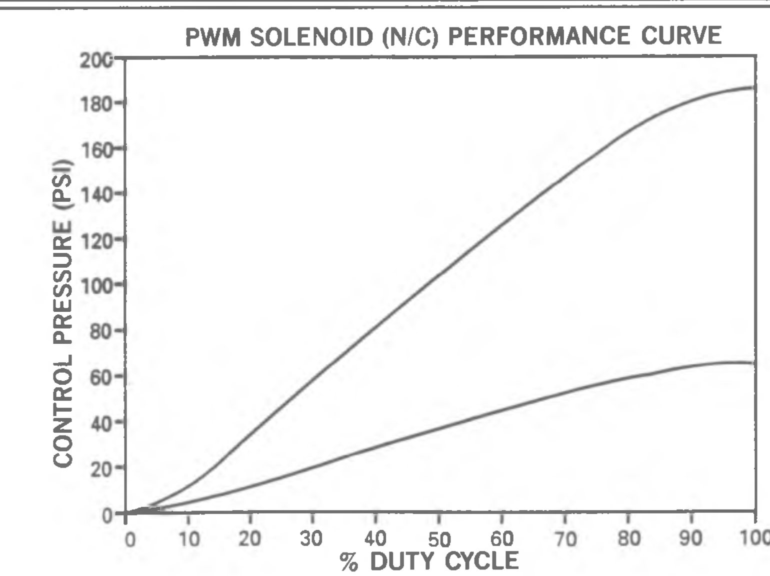


Figure 28. TCC (PWM) Solenoid, % Duty Cycle

Notice: 100% Duty Cycle will only be achieved if the PCM/TCM notes a large slip factor. If slip factor is normal, only 60 to 95% Duty Cycle will be required for full apply of the TCC.

TCC-PWM Solenoid Inputs

1. TPS
2. Output Speed
3. PSM
4. Ratio
5. Transmission Temperature
6. CTS
7. Slip
8. A/C Status
9. TCC Actual Duty Cycle
10. Brk SW
11. Malfunction Status

Notice: Voltage spike protection for all 4L80E solenoids is provided by Zenor diodes (23-44V) which are mounted internally within the PCM/TCM. Unlike previous models, the solenoid assemblies do not contain diodes.

To determine actual TCC operation the PCM/TCM monitors commanded TCC Duty Cycle, and TCC Slip. If TCC Duty Cycle is commanding full apply, but Slip calculations indicate more than 65 RPM, a Code 39 will be set.

The PCM/TCM also monitors circuit operation (Figure 29). When TCC Duty Cycle is commanded at 0%, the PCM/TCM expects to see circuit voltage at a high voltage level. When the PCM/TCM commands TCC Duty Cycle to 60%, the PCM/TCM expects to see circuit voltage at a lower level. If either measurement is incorrect, a Code 83 will result.

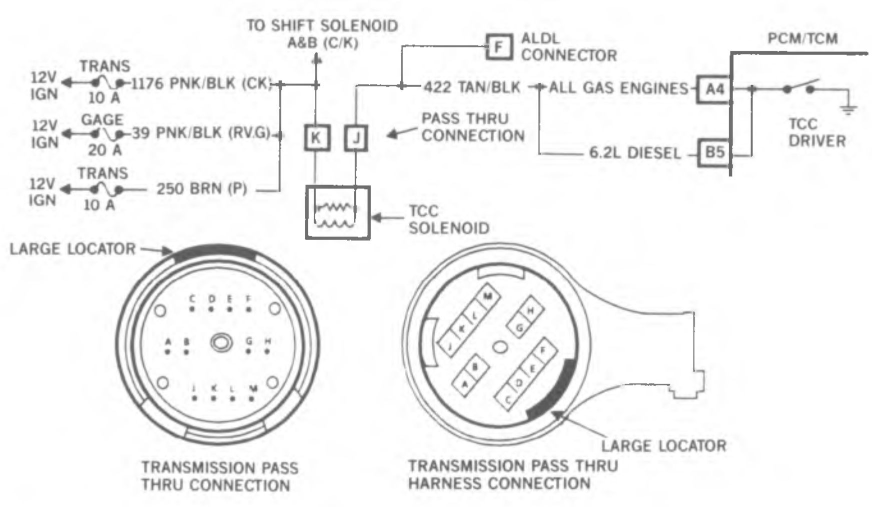


Figure 29. TCC Schematic Diagram

Code 39 (TCC Stuck Off) Will Be Set If:
- TCC Duty Cycle commands TCC to fully apply
- TCC Slip is calculated to be greater than 65 RPM for more than 2 seconds
- 2nd or 3rd gear is indicated.

If Code 39 is set the PCM/TCM will respond by commanding:

Action	Recovery
Actions have been disabled	None

Code 83 (TCC Circuit Fault) Will Set If:
- TCC Duty Cycle commanded to 0% (OFF), TCC circuit voltage at a low voltage level for more than 2 seconds
- TCC Duty Cycle commanded to 60% (ON), TCC circuit voltage at a high voltage level for more than 2 seconds

If Code 83 is set, the PCM/TCM will respond by commanding:

Action	Recovery
Actions have been disabled	None

SERVICE ENGINE SOON and TRANS Lights

Driver Alert Lights are used on both PCM and TCM equipped vehicles. PCM equipped vehicles will use a "SES" lamp while TCM-equipped vehicles will use a "TRANS" lamp.

In the case of the "SES" and "TRANS" lamps, the light may or may not go on to alert the driver that a malfunction has occurred. If the malfunction is related only to transmission operation (i.e., Code 73, Force Motor) the lamp will not go on to alert the driver. If the malfunction is a shared parameter for emissions and transmission operation (i.e., Code 21, TPS) the light will go on so the driver will be alerted and action can be taken..

The "SES" and "TRANS" lamps will go on when the following occurs:
1. Key on (Bulb Test)
2. Diagnostic Display
3. PCM Reset

To control the lamp the PCM/TCM controls the ground circuit. When the lamp is on, the PCM/TCM will have applied the ground through the use of a QDQ Driver circuit. To turn off the lamp, the QDQ driver opens the circuit ground.

Notice: The term QDQ is an abbreviation for a Quad Driver Quad Pack. This type of Driver is a surface-mounted device which replaces the Quad Driver modules (QDM) currently used for some circuits. QDQs are used for low current flow circuits only. (SES, TRANS lights, etc.) QDQs require a minimum of 34 ohms circuit resistance and are current limiting Driver circuits.

Diagnostics

The PCM/TCM constantly monitors most of the inputs and outputs used for transmission control. Within the software calibration of the PCM/TCM each input/output is assigned a specific tolerance or window for proper operation. The PCM/TCM constantly monitors the inputs/outputs and compares their values to the window. If an input/output goes outside of that specific window and other specific requirements are met, a malfunction code will be stored by the PCM/TCM.

Currently, a total of 19 codes relate to the transmission control system. Access to malfunction codes can be attained by two methods: manually and with a scan tool.

Code Index

Code Number	Description	Actions
14	Engine Temp High	PCM/TCM substitutes default temp of 90°C (195°F) and TCC applies when engine is cold
15	Engine Temp Low	Same as 14
21	TPS Voltage High	Maximum Line Pressure Harsh/Firm Shifts Fixed Shift Points 4th Gear Inhibited TCC Inhibited
22	TPS Voltage Low	Same as 21
24	Output Speed Low	Maximum Line Pressure 2nd Gear Operation only
28	PSM Invalid Combination	High Line Pressure 4th Gear Inhibited TCC Inhibited
39	TCC Stuck OFF	None
53	System Voltage High	2nd Gear Only Maximum Line Pressure TCC Inhibited
58	Transmission Temp High	4th Gear Inhibited Harsh Shifts TCC Off
59	Transmission Temp Low	Substitutes Default Temp of 130°C (265°F) Harsh Shifts TCC in 2nd, 3rd and 4th
68	Overdrive Ratio Incorrect	High Line Pressure 4th Gear Inhibited TCC Inhibited
73	Force Motor Current Incorrect	Maximum Line Pressure
75	System Voltage Low	Maximum Line Pressure 2nd Gear Only TCC Inhibited

12 no reference on Diesel
tach signal

Code Index (Cont'd)

Code Number	Decription	Actions
81	QDM Fault, B Solenoid	Maximum Line Pressure 2nd Gear Only TCC Inhibited
82	QDM Fault, A Solenoid	2nd and 3rd Gears Only or 1st and 4th Gears Only
83	QDM Fault, TCC	None
85	Undefined Ratio	Maximum Line Pressure
86	Solenoid B, Sutck ON	Actions Inhibited
87	Solenoid B, Stuck OFF	Actions Inhibited

Manual Method (Diagnostic Circuit Check)

To manually access information codes, locate the ALDL connector (Figure 30). This connector contains 12 cavities and is located on the driver's side of the vehicle at the base of the dash assembly. Code Display may be accessed as follows:

1. Install a jumper across ALDL terminals A and B.
2. Turn igntion to RUN position.
3. Note "Service Engine Soon" or "TRANS" lights.
4. The sequence begins with the light flashing three Code 12s, which indicates the PCM/TCM is capable of diagnostics.
5. Following Code 12 displays, each stored code will be displayed three times in numeric order from lowest to highest.
6. When all codes have been displayed, Code 12 will again begin to flash, this indicates the end of Code Display.
7. As long as jumper is installed Code Display will continue to repeat.

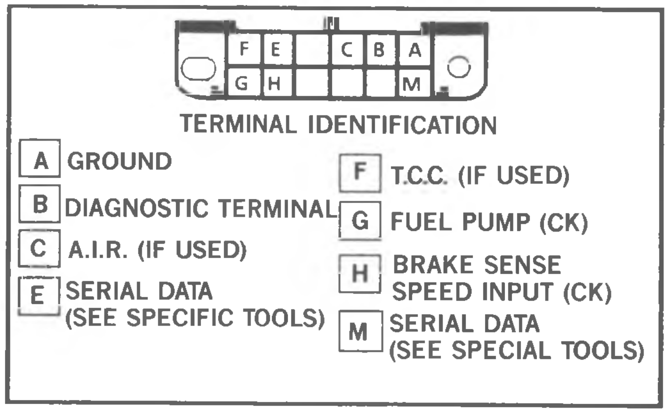


Figure 30. ALDL Connector

Scan Tools

The proper scan equipment for diagnosis of the 4L80E is either the Tech 1 or the T-100. Diagnosis with scan equipment allows for a more thorough and timely approach to diagnosis. The GMP6 controller being used with the 4L80E is a bidirectional, high-speed (8192 Baud) computer. When scan equipment is attached to the ALDL, the PCM/TCM will communicate with the scan equipment as well as allow the scan equipment to communicate with it. This bi-directional ability allows you to not only monitor input/output information and malfunction codes, but also affords you the opportunity to act as an override to the PCM/TCM to control specific output operations. Scan equipment will communicate with the PCM/TCM on the "serial data" line (Pin M) of the ALDL connector.

TECH 1

Note: TECH 1 information given here is brief and subject to change. More complete and accurate instructions are provided with the transmission diagnosis cartridge itself. Its part name is the Hydra-Matic 88-91 Transmission Cartridge. It covers all automatic transmissions through the years 88-91 that interface with an ECM, PCM or TCM.

ATTACHING THE TECH 1.

1. Make Sure The Vehicle Ignition Is Off!
2. Insert the Hydra-Matic 88-91 Transmission Cartridge into the Master Cartridge Slot on the bottom of the TECH 1. Verify that no other "Master" cartridge is installed in the auxiliary slot at the top of TECH 1.
3. Connect the ALDL Cable to the top of the TECH 1 and tighten the screw.

4. Insert the TECH 1 power plug into the cigarette lighter and the Power-Up display will be visible on the TECH 1 screen.

   If the Power-Up display is correct, continue to Step 5. If anything other than the Power-Up display appears, or the screen is blank, go to Step 6.
5. Turn the Ignition ON and you are ready to proceed with selecting the model year and transmission.
6. If the TECH 1 screen remains blank, DO NOT CONNECT THE TECH 1 CABLE TO THE VEHICLE'S ALDL CONNECTOR. Damage to the TECH 1 could result. Do the steps which follow:
   a. Make sure that both the TECH 1 power plug and cigarette lighter socket have good, clean contacts.
   b. Verify that the cigarette lighter has a good fuse.
   c. Check that +12V power is present at the center contact of the lighter socket, and that the outside contact of the lighter socket is grounded. If the lighter socket has reverse polarity, either rewire the lighter socket or use a battery adapter cable to power the TECH 1.

      If the display is still not correct, Appendix B of the handbook provided with the cartridge lists possible causes and remedies. If the problem continues, go to the TECH 1 operator's manual and perform the TECH 1 Self-Test Procedure.

USING THE TECH 1

Operate the TECH 1 by pressing buttons as shown in Figure 31 to choose the desired response or operation.

GENERAL TECH 1 KEY FUNCTIONS	
YES & NO	Answer questions asked by the **TECH 1** and scroll through data parameters.
EXIT	Return to previous step.
↑ & ↓	Used to control data display or to tun ou-puts ON or OFF.
0 - 9	Numeric keys (0 - 9): used for entering trouble code designations.
FO - F9	Function keys (F0 - F9): used to select from functions displayed on a "menu".
ENTER	Used at end of a numeric key sequence or to inform **TECH 1** that a requested action has been completed.

Figure 31. General TECH 1 Key Functions

The TECH 1, equipped with the Hydra-Matic 88-91 Transmission Cartridge, displays the following menu when connected to the ALDL of a vehicle equipped with a 4L80E or 4L80E-HD transmission (Figure 32).

ACTIVE TECH 1 KEYS	
↑	Stop the menu display from cycling.
↓	Go to next page of menu.
F0	DATA LIST
F1	SHIFT TESTS F0 Shift Points F1 TCC Test F2 Engagements
F2	TROUBLE CODES ENTER to Clear
F3	SNAPSHOT F0 Slow Data F1 Fast Data

F4	MISC TESTS
	FO Output Tests
	  F4 TCC PWM Solenoid
	  F5 Gear Control
	    F1 Shift Sol A
	    F2 Shift Sol B
	    F3 Gear Shifts
	  F6 Force Motor
	F1 Performance Test (N/A)

EXIT	Return to vehicle selection

Figure 32. Main Menu

FO - DATA LIST

This function enables the user to view PCM/TCM inputs and outputs coming to or from the transmission and its related sensors.

PCM

A representative data list (print-out) for a PCM (gas engine) is shown in Figure 33.

TECH 1 DATA LIST	
1. INPUT SPEED	0 RPM
2. OUTPUT SPEED	0 RPM
3. ENGINE SPEED	0 RPM
4. INPUT SPEED	0 RPM
5. 1 / 2 / 3 RNG	ON ON ON
6. PRNDL SWITCH	DRIVE 2
7. CURRENT GEAR	2
8. SOL A SOL B	OFF OFF
9. DES. FORCE MOTOR	0.00 AMPS
10. ACT. FORCE MOTOR	0.00 AMPS
11. BRAKE SWITCH	OFF
12. SYSTEM VOLTAGE	12.2 V
13. COOLANT TEMP	28°C 82°F
14. TRANS TEMP	25°C 77°F
15. THROTTLE ANGLE	0 %
16. THROT POSITION	0.66 V
17. TCC DUTY CYCLE	0 %
18. TCC SLIP	0 RPM
19. 1-2 SHIFT TIME	0.00 SEC
20. 2-3 SHIFT TIME	0.00 SEC
21. TRANS GEAR RATIO	0.00
22. TURBINE SPEED	0 RPM

Figure 33. PCM Data List

FO is a read data function only. It displays transmission related data in pre-selected pairs. Data is up-dated at 200ms intervals. Scrolling is done with the "Yes" and "No" keys. Items not in sequence can be custom paired by locking one item at the top with the FO key and scrolling the rest of the display up. If desired, items may be custom paired by locking one item at the bottom with the F1 key and scrolling the rest of the display down.

TCM

Some test features are not available on vehicles which use a TCM:

1. Mode F1 Engagement tests cannot be run.
2. Coolant Temp is N/A.
3. Some Data List items may read N/A.

A representative data list for a TCM (diesel) is shown in Figure 34.

TECH 1 DATA LIST	
1. INPUT SPEED	0 RPM
2. OUTPUT SPEED	0 RPM
3. ENGINE SPEED	0 RPM
4. INPUT SPEED	0 RPM
5. 1 / 2 / 3 RNG	ON ON ON
6. PRNDL SWITCH	DRIVE 2
7. CURRENT GEAR	2
8. SOL A SOL B	OFF OFF
9. DES. FORCE MOTOR	0.00 AMPS
10. ACT. FORCE MOTOR	0.00 AMPS
11. BRAKE SWITCH	OFF
12. SYSTEM VOLTAGE	12.2 V
13. COOLANT TEMP	N/A
14. TRANS TEMP	30°C 86°F
15. THROTTLE ANGLE	0 %
16. THROT POSITION	N/A
17. TCC DUTY CYCLE	0 %
18. TCC SLIP	0 RPM
19. 1-2 SHIFT TIME	0.00 SEC
20. 2-3 SHIFT TIME	0.00 SEC
21. TRANS GEAR RATIO	0.00
22. TURBINE SPEED	0 RPM

Figure 34. TCM Data List

Notes

F1 - SHIFT TESTS

F0 - Shift Points - This function monitors and stores engine and transmission data while a vehicle is driven through all shift points. Based on RPM drop and TCC command by the PCM/TCM, TECH 1 will recognize each shift, calculate shift time and end the test when commanded.

Engine Speed, Transmission Output Speed, TPS, TCC and Gear are displayed, as well as printed.

F1 - TCC Test - This function resembles the shift point test, however, TECH 1 only recognizes the TCC apply signal. The shift time determination begins at the apply command and is based on TCC Slip (RPM Drop). If TCC fails to mechanically apply, a "NO TCC APPLY" message will be displayed.

TCC Slip RPM, Output Speed (TOSS), TPS, TCC and Coolant Temp are displayed as well as printed.

F2 Engagements - This function monitors and stores data when the vehicle is shifted out of Park or Neutral into a drive gear. The engagement time calculation is started with the change in the P/N switch state and is based on RPM drop.

PRNDL, RPM, Output Speed, TPS and Coolant Temp are displayed as well as printed.

F2 - TROUBLE CODES

On command, TECH 1 is able to display codes stored by the PCM/TCM. Codes are identified as either Current (C) or History (H). Codes are displayed one at a time and scrolled automatically. Codes may be cleared while in this mode by pressing the ENTER key following the command "CLEAR CODES".

NOTICE: A Current Code is a code which is present all the time. To check if your code is current, erase the codes, operate the vehicle, if the same code returns the code is classified as a current code. If the code no longer returns after operating the vehicle within the parameters needed to set the code, the code which was stored is classified as a History Code.

Current (or "Hard") codes indicate a present fault; History codes indicate a fault which existed at one time, but is not now in effect.

When dealing with certain History Codes, default actions, as described in earlier chapters, may still be evident. These defaults can exist if the vehicle has not yet reached or encountered a "Valid Condition", or same set of conditions for which the PCM/TCM test for that fault.

F3 - SNAPSHOT

The SNAPSHOT function allows for capturing on command a block of data and then replaying it. The SNAPSHOT can be taken anytime as an aid to detailed examination of a given fault.

Two modes of operation are possible; F0 - Slow Data and F1 - Fast Data.

F0 - Slow Data - This mode captures data similar to the DATA LIST mode. A sample of all items is made at the normal rate of 200ms intervals. Selections are offered which enable the operator to either trigger the sample manually with the ENTER key, or automatically as conditions occur which cause a given malfunction code(s) to set.

F1 - Fast Data - This mode captures data 20 times per second. At this speed the sample is limited to certain items. These include Engine RPM, Transmission Output Speed, TPS and Gear. The trigger is manual only, using the ENTER key. It can be pressed up to seven (7) times to mark points in time over the course of the SNAPSHOT test.

Replay and print-out of the SNAPSHOT are available in either mode. A sample printout is shown in Figure 35.

```
|     SLOW DATA MODE        |
| F0:  ANY CODE             |
| F1:  SINGLE CODE          |
| F2   KEY PRESS            |

|     SLOW DATA MODE        |
| F6:  REPLAY DATA          |
|                           |

|     VIEW STORED DATA      |
| F4:  FIRST SAMPLE         |
| F5:  TRIGGER PT           |
| F6:  LAST SAMPLE          |

|    STORED DATA WILL       |
|       BE ERASED!          |
| F0:  NEW TEST             |
| EXIT: MENU                |

| CURRENT GEAR              |
|       1             SSB   |
| SOL A        SOL B        |
|  ON           OFF     ON  |
```

Figure 35. SNAPSHOT of 4L80E

```
|       MISC TESTS          |
| F0:  OUTPUT TESTS         |
| F1:  PERFORMANCE          |
|                           |

|                           |
|     OUTPUT CONTROL        |
|       =ON        =OFF     |
|                           |

|     OUTPUT OPTIONS        |
| F1:  SHIFT SOL A          |
| F2:  SHIFT SOL B          |
| F3:  GEAR SHIFTS          |

|     OUTPUT OPTIONS        |
| F4:  TCC PWM SOL          |
| F5:  GEAR CONTROL         |
| F6:  FORCE MOTOR          |
```

Figure 36. MISC TESTS Menu

F4 - MISC TESTS

F0 - Output Tests - This enables the user to override certain key PCM/TCM outputs. Currently, the following options are available (Figure 36):

F4 - TCC PWM SOL
This option gives the user ability to toggle the TCC ON or OFF, overriding commands from the PCM/TCM. This function will "Time Out" after a certain period allowing the PCM/TCM to resume control of TCC.

F5 - Gear Control
Selecting either solenoid for manual control automatically disables the other. Consequently, the transmission will operate only in gears called for by combinations having one or both solenoids OFF, not those requiring both solenoids be ON.

F1 - Shift Solenoid "A" - This option gives the user control of Solenoid "A", overriding commands from the PCM/TCM. Use the UP and DOWN arrows to switch the solenoid On and OFF.

F2 - Shift Solenoid "B" - This option gives the user control of Solenoid "B", overriding commands from the PCM/TCM. Use the UP and DOWN arrows to switch the solenoid ON and OFF.

F3 - Gear Shifts - This option enables the user to select any forward gear, overriding the PCM/TCM command. This function does not "Time Out", as does the TCC function, but gear override operation is limited. See the TECH 1 Cartridge Manual for specific limitations.

F6 - Force Motor
This option enables the user to control desired Force Motor amperage up or down. Amperage reads directly and operates within the range of 0.5 to 1.0 Amps.

All Output Tests, with the exception of the Force Motor Test, can be run while driving the vehicle or operating it on a hoist. The Force Motor Test can only be run with the vehicle idling in Park.

NOTE: Output Test commands can only be performed wihtin predetermined parameters.
EG: Solenoid "A" command for first gear will not occur when vehicle speed is above a point which may damage the transmission.

F1 - Performance Test - TECH 1 is currently unable to give Performance Tests with the 4L80E because 4L80E shift points are determined not from KPH but transmission output speed.

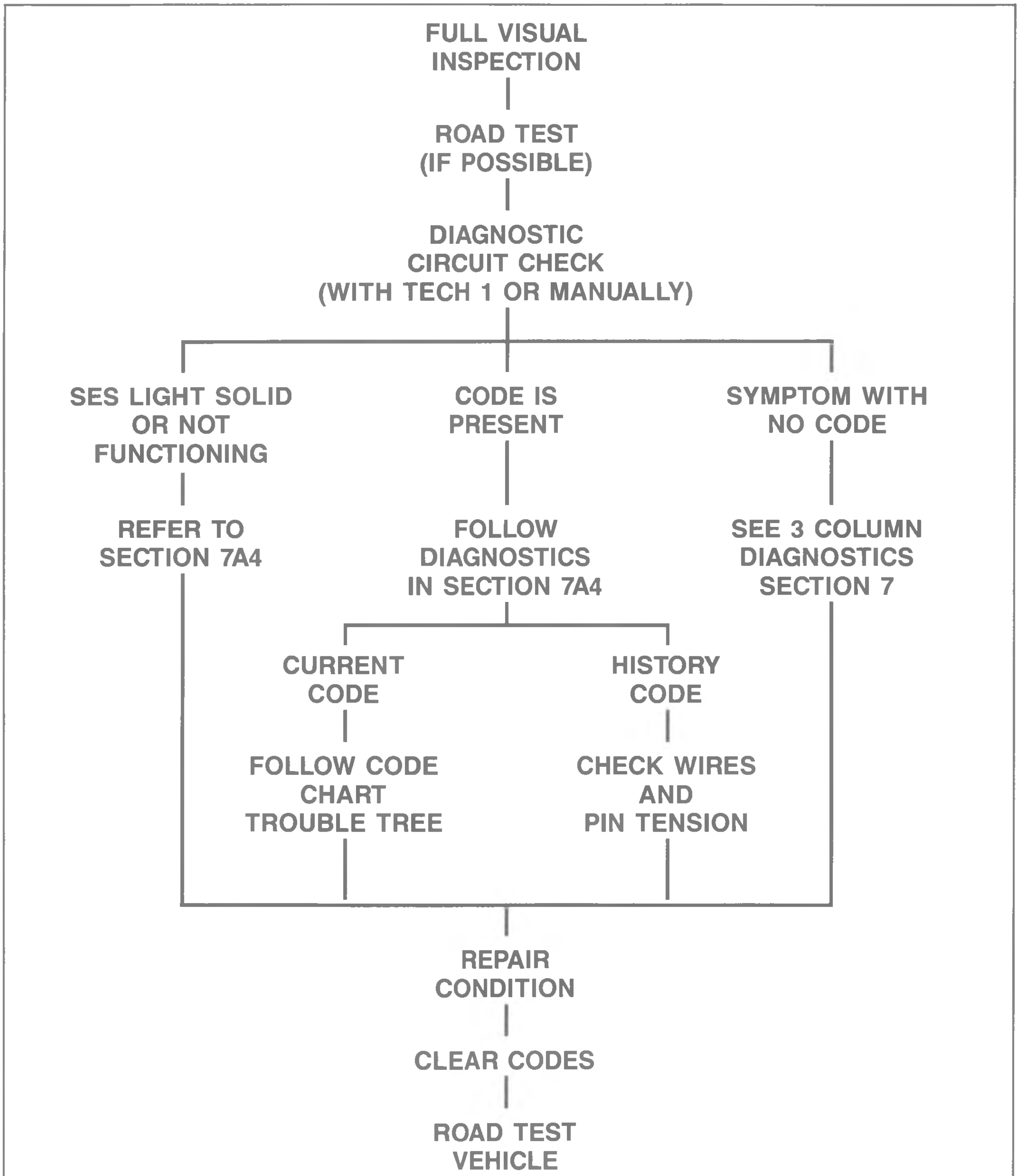


Figure 37. Diagnosis Tree Chart

ALDL--TCC Testing

Pin F of the ALDL connector is a designated test point for the TCC electrical circuit. Pin F is connected in parallel to the PCM/TCM driver circuit and TCC solenoid. To diagnose the TCC electrical circuit:

1. Connect a digital voltmeter or a Duty Cycle meter between ALDL pins A and F.
2. With the ignition "ON", vehicle stopped:
   - Meter reads 12 volts/—0% Duty Cycle, proceed to Step 3.
   - Meter reads 0 volts, proceed to Step A
3. Drive the vehicle at speeds of a least 90 KPH while maintaining constant throttle position. Note voltage or (—) Duty Cycle reading
   - Meter reading--voltage drops, or negative Duty Cycle increases--proceed to Step B
   - Meter reading stays the same as in Step 2--proceed to Step C

Step A--Check for an open between ALDL pin F and circuit power source (fuse, wire, connection, solenoid).

Step B--TCC electrical circuit OK--monitor RPM change while repeating Step 3.
(RPM drops)--TCC operating normally.
(No RPM change)--Monitor transmission cooler pressure during time when TCC is OFF, then ON.
(Pressure changes)--Check TCC, Apply Oil Circuit Bushings and seals. If needed, replace converter.
(No pressure change)--TCC valves stuck, solenoid hydraulic or feed circuit hydraulic leak.

Step C--Check PCM/TCM input readings with the TECH 1 or T-100 to locate which input is causing the PCM/TCM to inhibit the TCC apply command.

Notice: The TCC Solenoid is controlled by a negative duty cycle command from the PCM/TCM, therefore, as negative duty cycle increases, solenoid voltage at pin F will decrease —.50% DC = 6V.

Notice: Do not use the code Trouble Tree procedures to diagnose History Faults. History Codes are usually the result of poor connection rather than component failures.

Notice: PCM/TCM codes may be cleared by using one of the following methods:
1. Disconnect the battery.
2. Use Tech 1 or T-100 to clear the codes.
3. Cycle the ignition key at least 50 times.

Notes

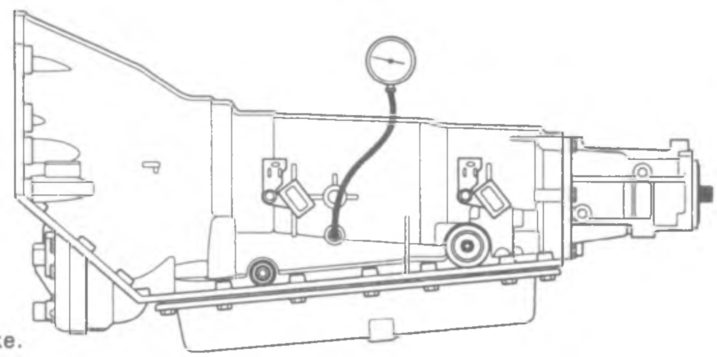
1991 HYDRA-MATIC 4L80-E LINE PRESSURE CHECK PROCEDURE

Line pressures are calibrated for two sets of gear ranges — Drive-Park-Neutral, and Reverse. This allows the transmission line pressure to be appropriate for different pressure needs in different gear ranges:

Gear Range	Line Pressure Range
Drive, Park or Neutral	35 - 171 PSI
Reverse	67 - 324 PSI

Before performing a line pressure check, verify that the force motor is receiving the correct electrical signal from the vehicle computer:

1. Install a scan tool.
2. Start the engine and set parking brake.
3. Check for a stored force motor malfunction code, and other malfunction codes.
4. Repair vehicle if necessary.



Inspect

- Fluid level (see Section 7A)
- Manual linkage

Install or Connect

- TECH 1 Scan tool
- Oil pressure gage at line pressure tap

5. Put gear selector in Park and set the parking brake.
6. Start engine and allow it to warm up at idle.
7. Access the "override force motor" test on the TECH 1 scan tool.
8. Increase FORCE MOTOR CURRENT in 0.1 Amp increments and read the corresponding line pressure on the pressure gage. (Allow pressure to stabilize for 5 seconds after each current change.)
9. Compare data to the Drive-Park-Neutral line pressure chart below.

   Line pressure will pulse either high or low every ten seconds to keep the force motor plunger free. This is normal and will not harm the transmission.

***NOTICE** Total test running time should not exceed 2 minutes, or transmission damage could occur.

CAUTION Brakes must be applied at all times to prevent unexpected vehicle motion.

If pressure readings differ greatly from the line pressure chart, refer to the Diagnosis Charts contained in this section.

The TECH 1 scan tool is only able to control the force motor in Park and Neutral with the vehicle stopped at idle. This protects the clutches from extremely high or low pressures in Drive or Reverse ranges.

Force Motor Current (Amp)	Line Pressure (PSI)
0.02	157 - 177
0.10	151 - 176
0.20	140 - 172
0.30	137 - 162
0.40	121 - 147
0.50	102 - 131
0.60	88 - 113
0.70	63 - 93
0.80	43 - 73
0.90	37 - 61
0.98	35 - 55

Figure 38.

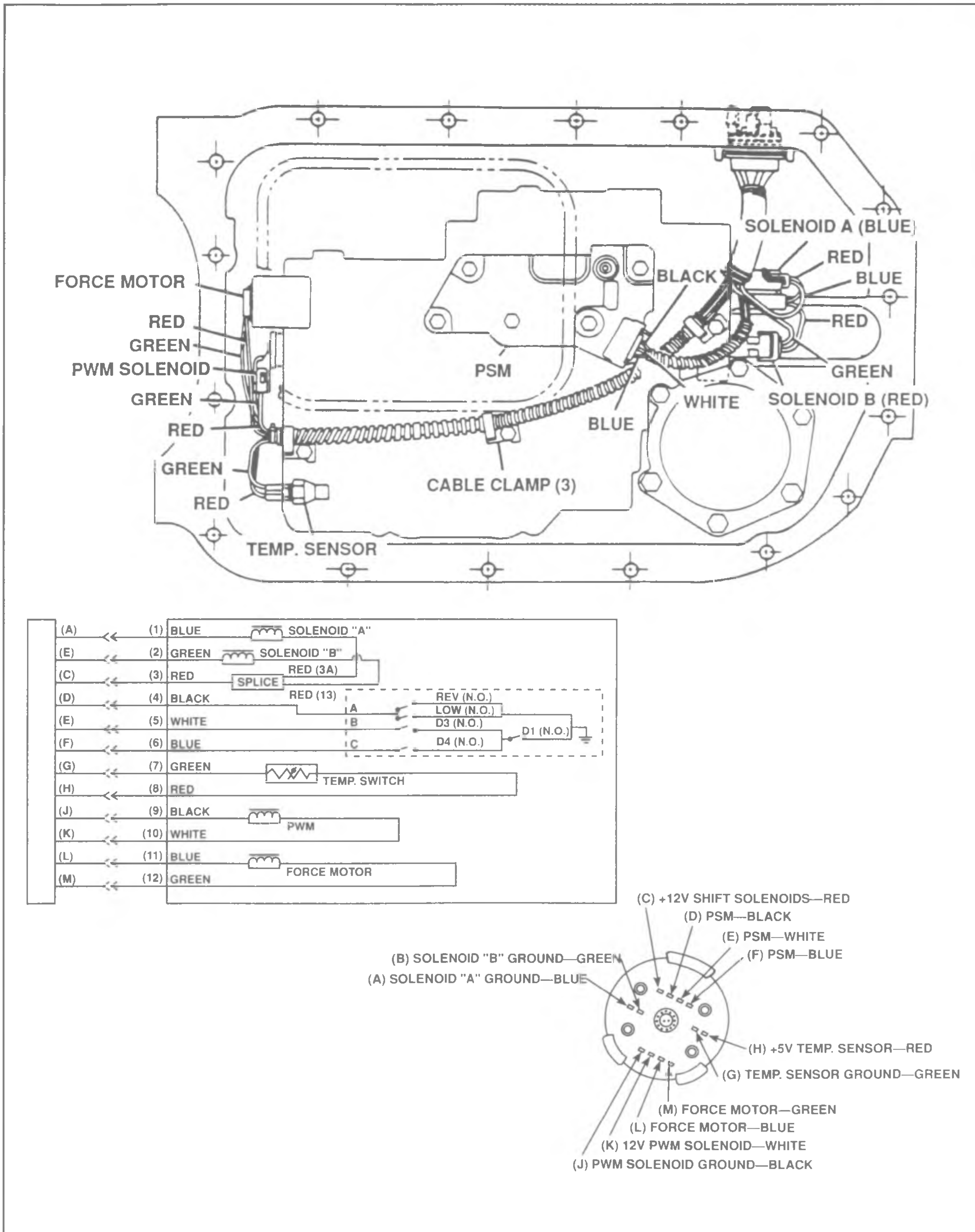


Figure 39. 4L80-E Electrical Components and Connections

PCM CONNECTOR IDENTIFICATION

This PCM voltage chart is for use with a digital voltmeter to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

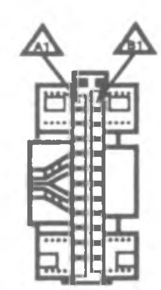
- **Engine at operating temperature** • **Closed loop** • **Engine idling (for "Engine Run" column)**
- **Test terminal not grounded** • **Tech 1 not installed** • **Tech 1 in open/road test mode**

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
A1	FUEL PUMP RELAY CONTROL	465	DK GRN/WHT	(1)	14
A2	SHIFT SOLENOID "B" CONTROL	1223	YEL/BLK	12	14
A3	SHIFT SOLENOID "A" CONTROL	1222	LT GRN	12	*
A4	TCC SOLENOID CONTROL	422	TAN/BLK	12	14
A5	NOT USED	—	—	—	—
A6	EAC CONTROL (7.4L UNDER 8500 GVW)	436	BRN	12	14
A7	"SERVICE ENGINE SOON" LAMP CONTROL	419	BRN/WHT	0	14
A8	NOT USED	—	—	—	—
A9	NOT USED	—	—	—	—
A10	NOT USED	—	—	—	—
A11	EVRV (EGR) CONTROL	435	GRY	11	12
A12	BRAKE SIGNAL	420	PPL	(2)	(2)

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
B1	NOT USED	—	—	—	—
B2	RANGE "C" SIGNAL	1226	RED	12	14
B3	RANGE "B" SIGNAL	1225	DK BLU	12	0
B4	RANGE "A" SIGNAL	1224	PNK	12	14
B5	TRANSMISSION OUTPUT SPEED SIGNAL (4WD)	1232	LT BLU	0	0
B6	TRANSMISSION OUTPUT SPEED SENSOR GROUND	1233	DK GRN/ YEL	0	0
B7	FORCE MOTOR LOW	1229	LT BLU/ WHT	0	.85
B8	FORCE MOTOR HIGH	1228	RED/BLK	0	4.50
B9	TRANSMISSION INPUT SPEED SIGNAL	1231	DK BLU/ WHT	0	*
B10	TRANSMISSION INPUT SPEED SENSOR GROUND	1230	GRY/RED	0	0
B11	VEHICLE SPEED AND TRANSMISSION OUTPUT SPEED SIGNAL (2WD)	437	BRN	0	0
B12	A/C SIGNAL	59	DK GRN	(3)	(3)

(1) Battery voltage first 20 seconds.
(2) Battery voltage brakes "OFF."
0 volts brakes "ON."
(3) 0 volts A/C "OFF" battery voltage A/C "ON."
* Less than .50 volt.

BACK VIEW OF CONNECTOR



24 PIN A-B CONNECTOR

ENGINE 4.3L, 5.7L, 7.4L AND 4L80-E TRANSMISSION

1991

Figure 40. C/K Truck PCM Connector ATerminal End View (All Gas Engines) 4L80-E Transmission (1 of 2)

PCM CONNECTOR IDENTIFICATION

This PCM voltage chart is for use with a digital voltmeter to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

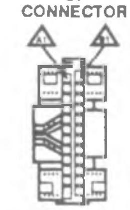
- Engine at operating temperature • Closed loop • Engine idling (for "Engine Run" column)
- Test terminal not grounded • Tech 1 not installed • Tech 1 in open/road test mode

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
C1	FUSED IGNITION FEED	439	PNK/BLK	12	14
C2	SYSTEM GROUND	450	BLK/WHT	*	*
C3	SYSTEM GROUND	551	TAN/WHT	*	*
C4	TPS REFERENCE VOLTAGE	416	GRY	5	5
C5	TPS SIGNAL	417	DK BLU	.60	(2)
C6	IAC COIL "A" HIGH	441	LT BLU/ WHT	NOT	USE-ABLE
C7	IAC COIL "A" LOW	442	LT BLU/ BLK	NOT	USE-ABLE
C8	IAC COIL "B" LOW	444	LT GRN/ BLK	NOT	USE-ABLE
C9	IAC COIL "B" HIGH	443	LT GRN/ WHT	NOT	USE-ABLE
C10	MAP SIGNAL	432	LT GRN	4.77	1.45
C11	SERIAL DATA	(1)	(1)	(1)	(1)
C12	NOT USED	—	—	—	—
C13	O_2 SENSOR GROUND	413	TAN	0	*
C14	O_2 SIGNAL	412	PPL	(3)	(4)
C15	INJECTOR #2 CONTROL	468	WHT	12	14
C16	INJECTOR #1 CONTROL	467	GRN	12	14

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
D1	BATTERY VOLTAGE FEED	440	ORN	12	14
D2	MAP/TTS SENSOR GROUND	455	PPL	0	0
D3	TPS/CTS SENSOR GROUND	452	BLK	0	0
D4	MAP REFERENCE VOLTAGE	474	GRY	5.0	5.0
D5	ESC (KNOCK) SIGNAL	496	DK BLU	2.5	2.5
D6	DIAGNOSTIC TEST TERMINAL	451	WHT/BLK	5	5
D7	FUEL PUMP SIGNAL	120	GRY	(5)	(5)
D8	NOT USED	—	—	—	—
D9	NOT USED	—	—	—	—
D10	NOT USED	—	—	—	—
D11	EST CONTROL	423	WHT	0	1.0
D12	EST BYPASS	424	TAN/BLK	0	4.64
D13	EST REFERENCE LOW	453	BLK/RED	0	0
D14	EST REFERENCE HIGH	430	PPL/WHT	0	1.5
D15	TRANSMISSION TEMPERATURE SIGNAL	1227	BLK/YEL	2.24	2.0
D16	COOLANT TEMPERATURE SIGNAL	410	YEL	1.5	1.69

(1) 1061 ORN/BLK or 461 ORN or 488 from 2 volts to 5 volts.
(2) .70 volts measured between terminals "C5" and "D2" 4.26v W.O.T.
(3) .26 volt to .46 volt.
(4) Varies (toggles) .1 volt to .9 volt.
(5) 12 volts first 20 seconds.
* Less than .50 volt.

BACK VIEW OF CONNECTOR



24 PIN A-B CONNECTOR

ENGINE 4.3L, 5.7L, 7.4L AND 4L80-E TRANSMISSION

1991

Figure 41. C/K Truck PCM Connector Terminal End View (All Gas Engines) 4L80-E Transmission (2 of 2)

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a digital voltmeter to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

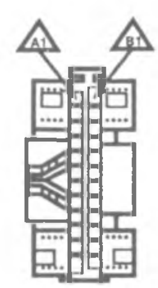
- Engine at operating temperature
- Engine idling (for "Engine Run" column)
- Test terminal not grounded
- Tech 1 not installed
- Tech 1 in open/road test mode

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
A1	NOT USED	—	—	—	—
A2	NOT USED	—	—	—	—
A3	RANGE "A" SIGNAL	1224	PNK	12	14
A4	RANGE "B" SIGNAL	1225	DK BLU	12	0
A5	RANGE "C" SIGNAL	1226	RED	12	14
A6	SHIFT SOLENOID "B" CONTROL	1223	YEL/BLK	12	14
A7	SHIFT SOLENOID "A" CONTROL	1222	LT GRN	12	*
A8	DIAGNOSTIC TEST TERMINAL "B"	451	WHT/BLK	5	5
A9	NOT USED	—	—	—	—
A10	NOT USED	—	—	—	—
A11	NOT USED	—	—	—	—
A12	BATTERY VOLTAGE FEED	440	ORN	12	14

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
B1	NOT USED	—	—	—	—
B2	NOT USED	—	—	—	—
B3	A/C SIGNAL	59	DK GRN	(1)	(1)
B4	BRAKE SIGNAL	420	PPL/BLK	(2)	(2)
B5	TCC CONTROL	422	TAN/BLK	12	14
B6	NOT USED	—	—	—	—
B7	NOT USED	—	—	—	—
B8	NOT USED	—	—	—	—
B9	"TRANS" LAMP CONTROL	(3)	(3)	0	14
B10	SERIAL DATA	(4)	(4)	(5)	(5)
B11	TRANSMISSION OUTPUT SPEED SIGNAL (4WD ONLY)	1232	LT BLU	0	0
B12	GROUND	1233	DK GRN/ YEL	0	0

(1) 0 volts A/C "OFF."
Battery voltage A/C "ON."
(2) Battery voltage brakes "OFF."
0 volts brakes "ON."
(3) 419 BRN/WHT or 1234 GRY/RED.
(4) 1061 ORN/BLK or 461 ORN or 488 LT GRN.
(5) Varies 2 to 5 volts.
* Less than .50 volt.

BACK VIEW OF CONNECTOR



24 PIN A-B CONNECTOR

ENGINE 6.2L DIESEL AND 4L80-E TRANSMISSION

1991

Figure 42. C/K Truck TCM Connector Terminal End View (6.2L Diesel) 4L80-E Transmission (1 of 2)

TCM CONNECTOR IDENTIFICATION

This TCM voltage chart is for use with a digital voltmeter to further aid in diagnosis. These voltages were derived from a known good vehicle. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

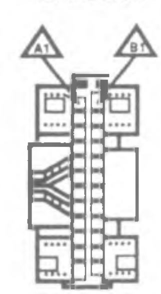
- Engine at operating temperature
- Engine idling (for "Engine Run" column)
- Test terminal not grounded
- Tech 1 not installed
- Tech 1 in open/road test mode

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
C1	SYSTEM GROUND	450	BLK/WHT	0	0
C2	SYSTEM GROUND	551	TAN/WHT	0	0
C3	SENSOR GROUND	452	BLK	0	0
C4	TPS REFERENCE	416	GRY	5	5
C5	NOT USED	—	—	—	—
C6	NOT USED	—	—	—	—
C7	NOT USED	—	—	—	—
C8	NOT USED	—	—	—	—
C9	NOT USED	—	—	—	—
C10	NOT USED	—	—	—	—
C11	NOT USED	—	—	—	—
C12	NOT USED	—	—	—	—
C13	NOT USED	—	—	—	—
C14	NOT USED	—	—	—	—
C15	FORCE MOTOR LOW	1229	LT BLU/ WHT	0	.85
C16	IGNITION FEED	439	PNK/BLK	12	14

PIN	PIN FUNCTION	CKT #	WIRE COLOR	NORMAL VOLTAGES	
				KEY "ON"	ENG RUN
D1	NOT USED	—	—	—	—
D2	VSS	437	BRN	(1)	(1)
D3	TRANSMISSION INPUT SPEED SENSOR GROUND	1231	DK BLU/ WHT	0	0
D4	TRANSMISSION INPUT SPEED SIGNAL	1230	GRY/RED	0	(2)
D5	NOT USED	—	—	—	—
D6	ENGINE SPEED SIGNAL	(3)	(3)	0	(4)
D7	SENSOR GROUND	452	BLK	0	0
D8	TPS SIGNAL	417	DK BLU	.67	(5)
D9	NOT USED	—	—	—	—
D10	NOT USED	—	—	—	—
D11	NOT USED	—	—	—	—
D12	NOT USED	—	—	—	—
D13	TRANSMISSION TEMPERATURE SIGNAL	1227	BLK/YEL	(6)	(6)
D14	NOT USED	—	—	—	—
D15	NOT USED	—	—	—	—
D16	FORCE MOTOR HIGH	1228	RED/BLK	.11	4.43

(1) Varies from .06 to battery voltage depending on position of drive wheels.
(2) 10.5 volts AC, varies with rpm.
(3) 643 WHT (CK).
121 WHT (R/V, P, G).
(4) .40 volt AC, varies with rpm.
(5) .67 volt to 4.8 volts W.O.T.
(6) About 2 volts, varies with temperature.

BACK VIEW OF CONNECTOR



24 PIN A-B CONNECTOR

ENGINE 6.2L DIESEL AND 4L80-E TRANSMISSION
1991

Figure 43. C/K Truck TCM Connector Terminal End View (6.2L Diesel) 4L80-E Transmission (2 of 2)

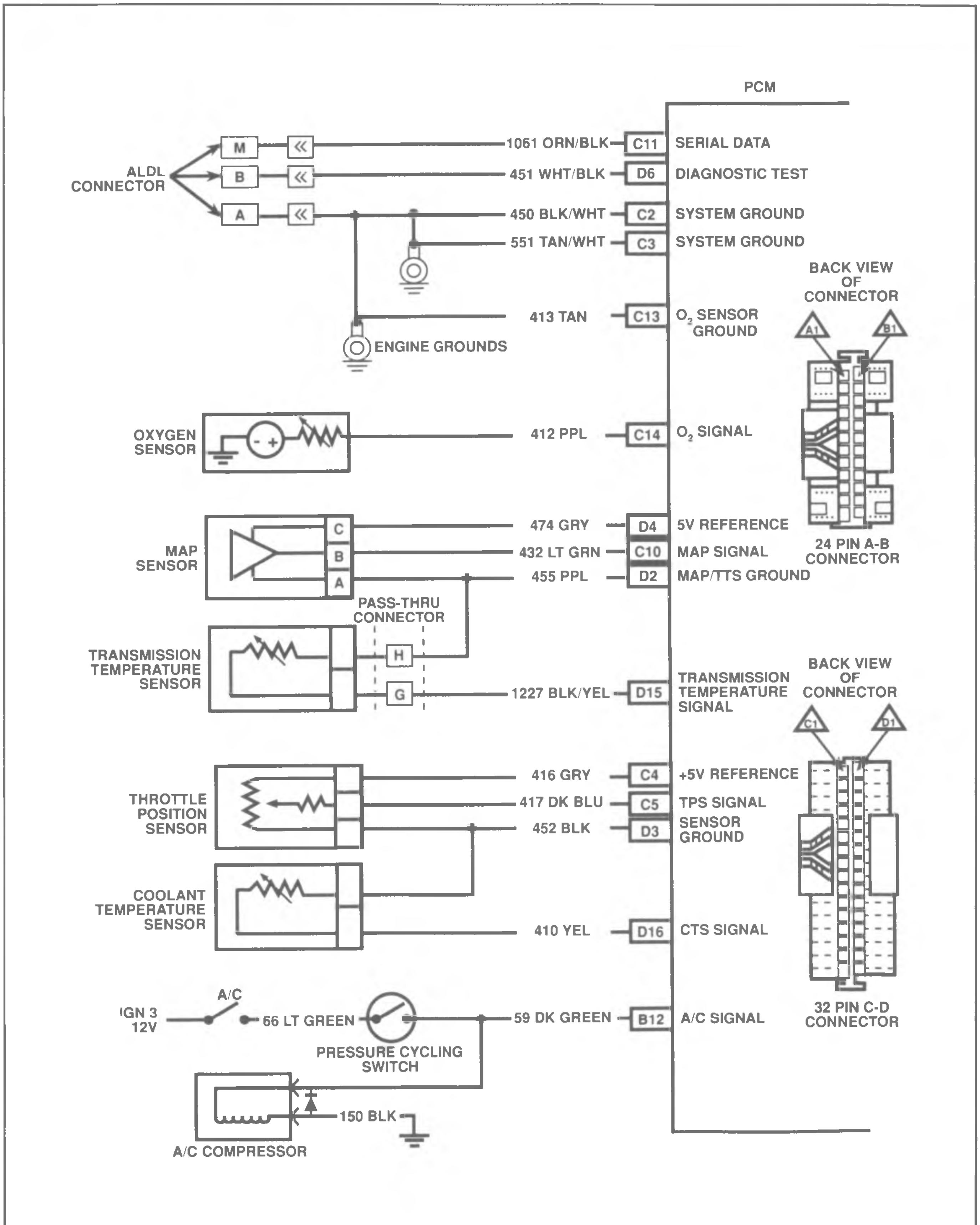


Figure 44. C/K Truck PCM Wiring Diagram (All Gas Engines) 4L80-E Transmission (1 of 5)

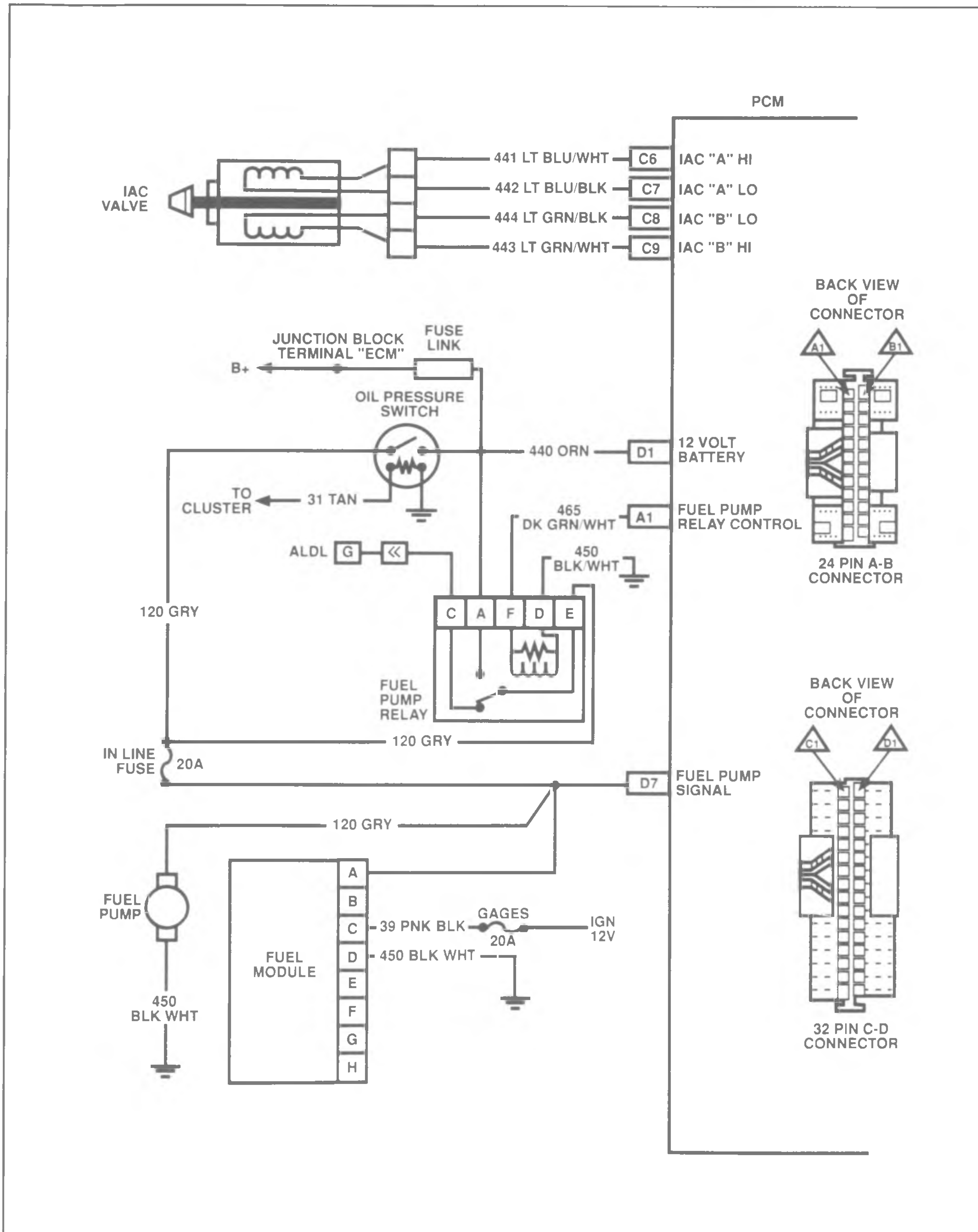


Figure 45. C/K Truck PCM Wiring Diagram (All Gas Engines) 4L80-E Transmission (2 of 5)

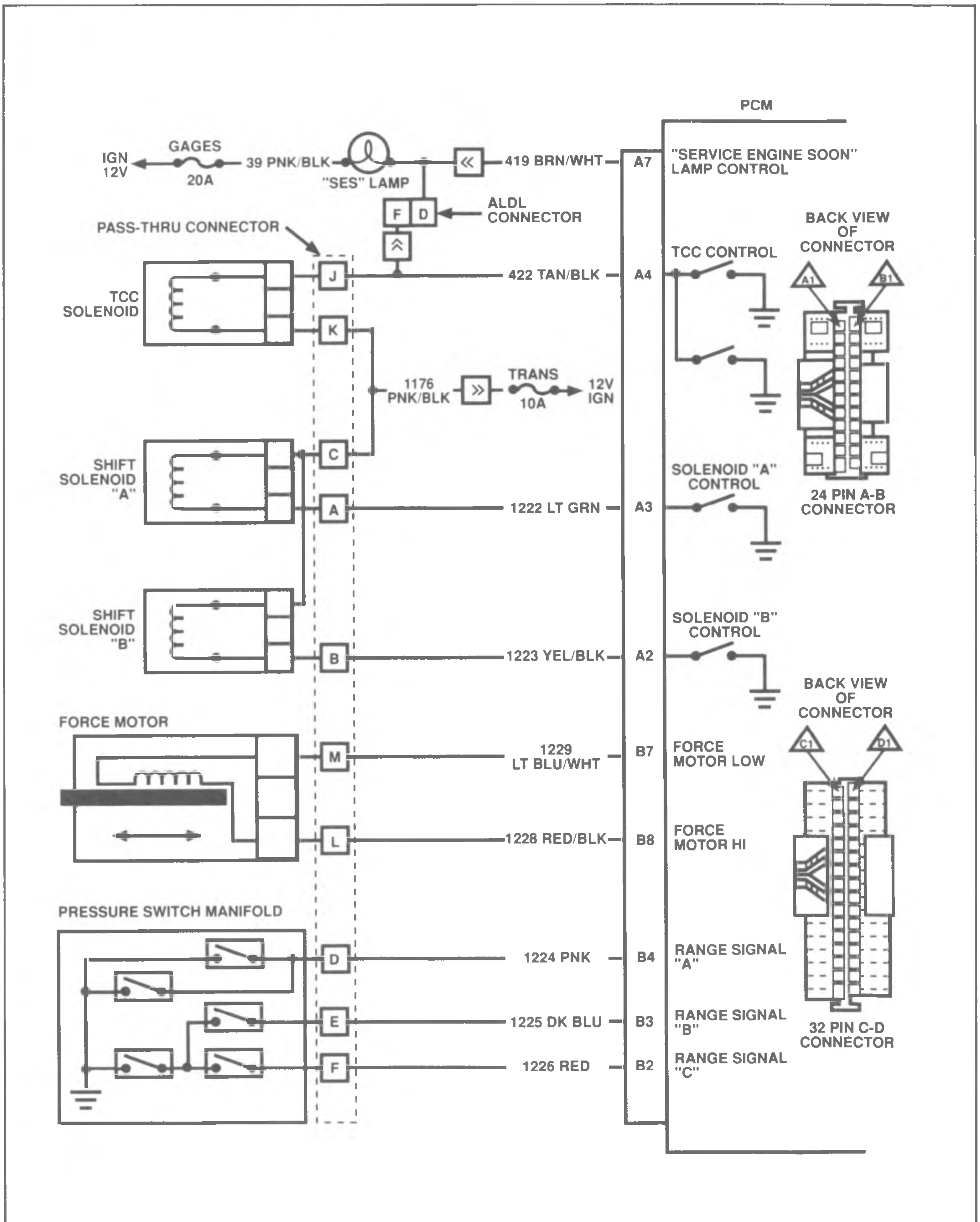


Figure 46. C/K Truck PCM Wiring Diagram (All Gas Engines) 4L80-E Transmission (3 of 5)

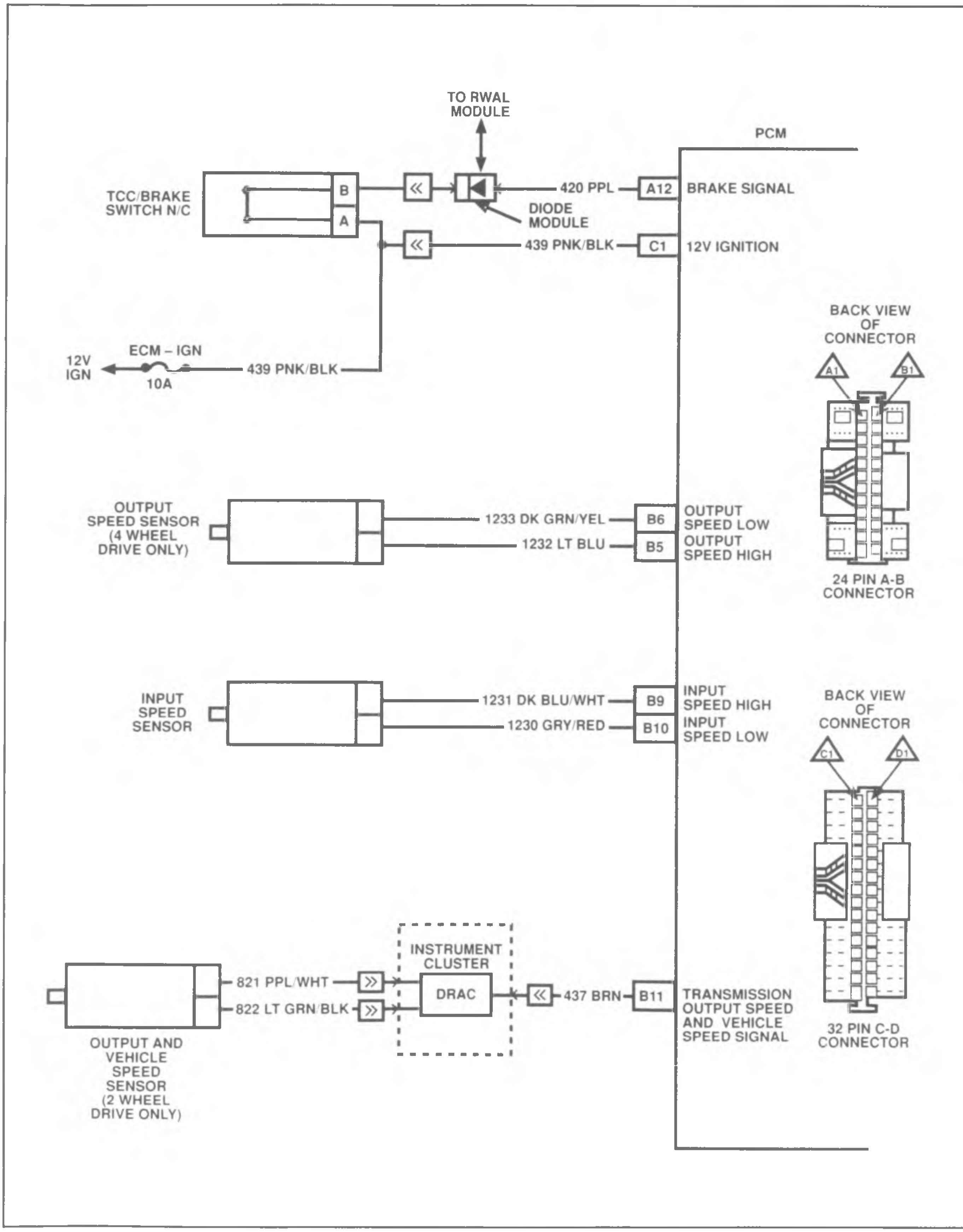


Figure 47. C/K Truck PCM Wiring Diagram (All Gas Engines) 4L80-E Transmission (4 of 5)

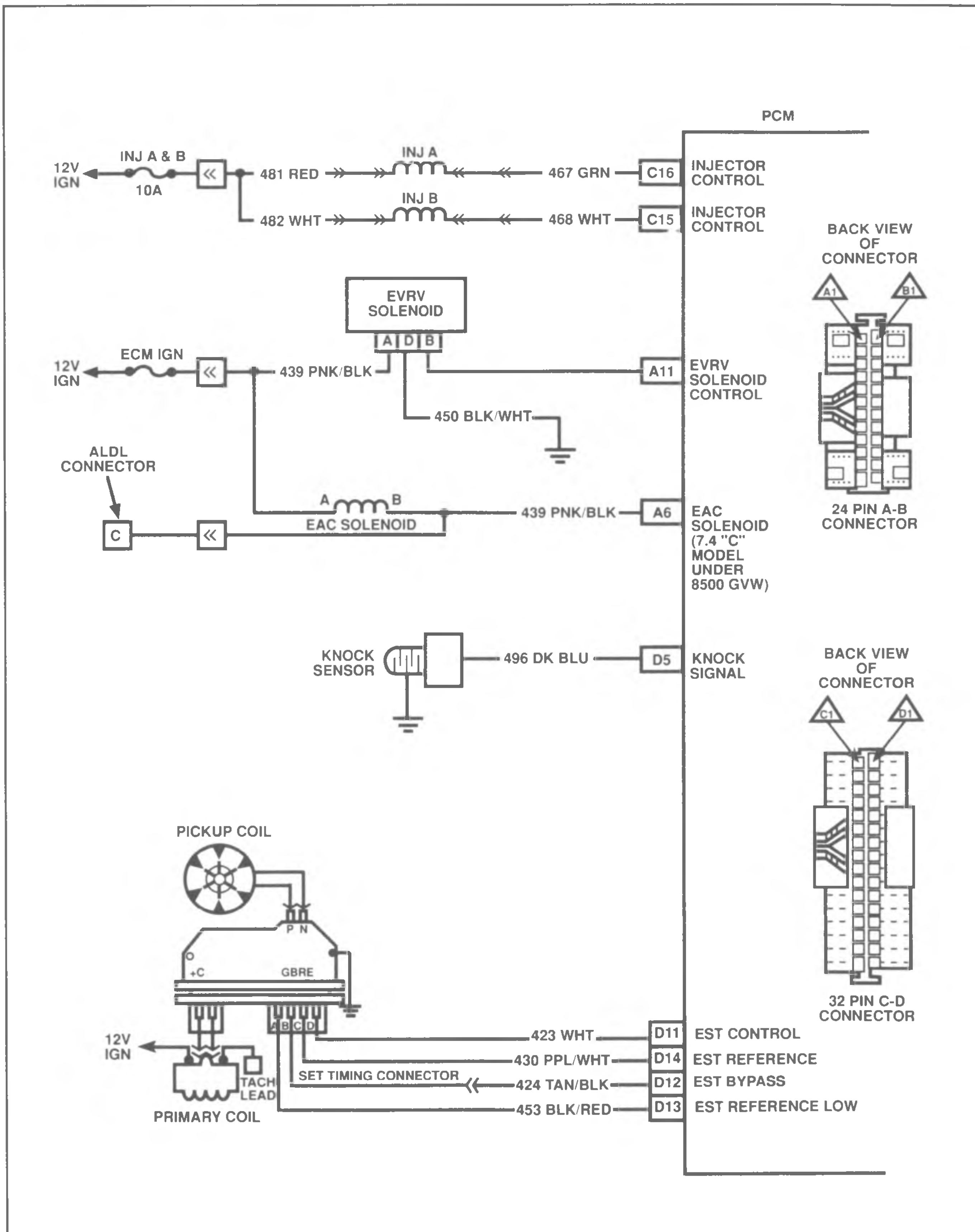


Figure 48. C/K Truck PCM Wiring Diagram (All Gas Engines) 4L80-E Transmission (5 of 5)

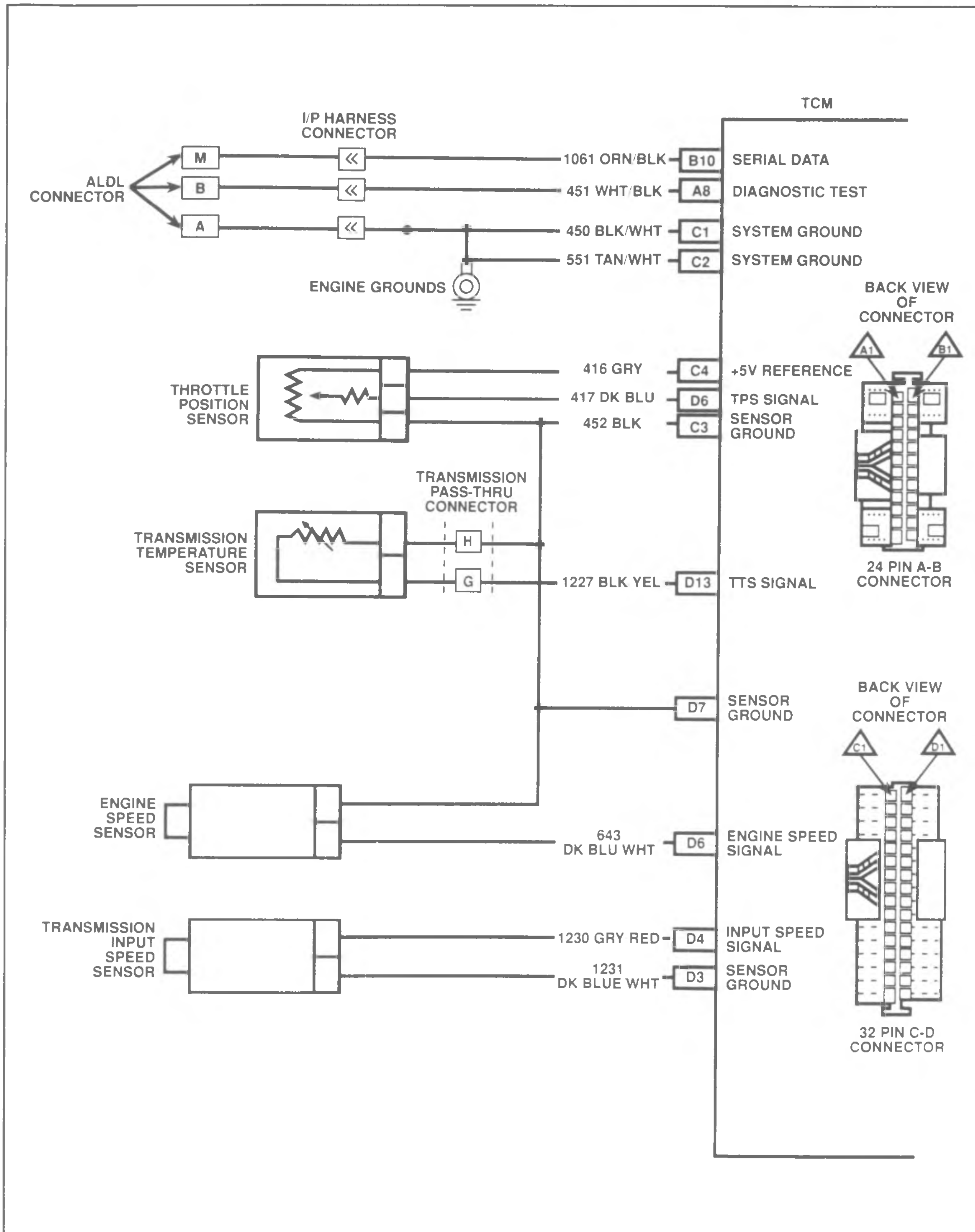


Figure 49. C/K Truck TCM Wiring Diagram (6.2L Diesel) 4L80-E Transmission (1 of 3)

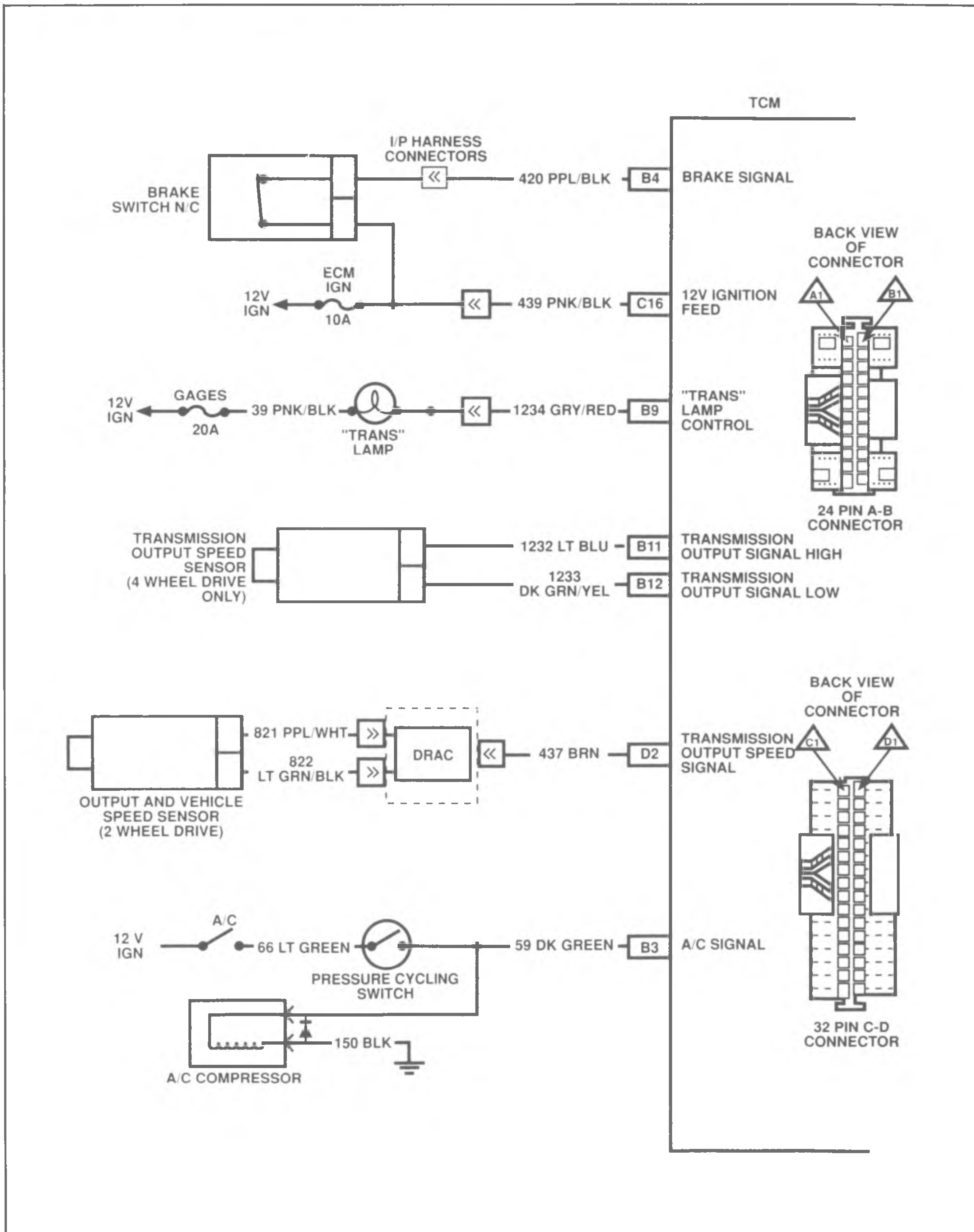


Figure 50. C/K Truck TCM Wiring Diagram (6.2L Diesel) 4L80-E Transmission (2 of 3)

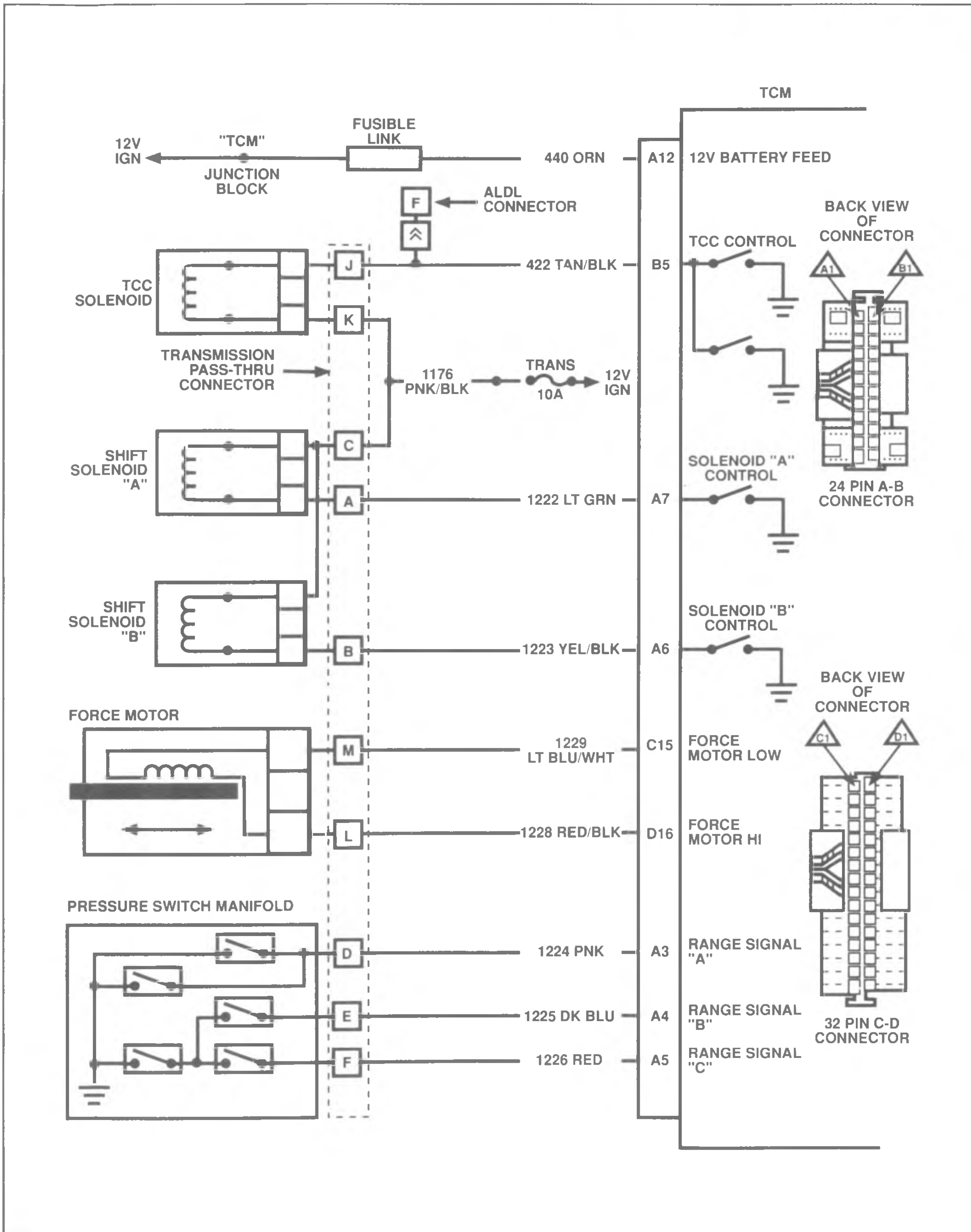


Figure 51. C/K Truck TCM Wiring Diagram (6.2L Diesel) 4L80-E Transmission (3 of 3)

Notes

Notes

Notes

GM

Product
Service
Training