08 GRP11 Two - Mode Hybrid Hybrid System Control Module (HCP)

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Idle Speed Diagnostics								
Idle Diagnostics P0506, P0507 have the following common enable criteria	***				Motor A speed faults: P0A3F, P1B03, P0A40, P0C52, P0C53, P0C5C, P0C5D Motor B speed faults: P0A45, P1B04, P0A46, P0C57, P0C58, P0C61, P0C62 Vehicle Speed/TOS sensor faults: P0722, P077B, P215C Accelerator pedal position Accel Pedal position Engine State Vehicle speed Commanded RPM Delta IdleConditons present	Not active Not active Not active Not Defaulted <= 1 % Running (not starting or stopping states) <= 1 kph < 50 RPM for >= 5 seconds		
Idle Air Control (IAC) System - RPM Too Low	P0506	This DTC sets when the idle speed is lower than the targeted idle speed DTC Pass	Idle speed Idle speed	Filtered input speed error (desired - actual) is greater than fail threshold 75 RPM. Filter coefficient for engine speed = 0.002	** Common Enables ** Common Enables		1 loop execution at 100 ms rate Pass condition met for 15 seconds	Two Trips

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		DTC RePass after failure	Idle Speed	Filtered input speed error (desired - actual), is less than fail threshold 50. Filter coefficient for engine speed = 0.002	Hi idle diagnostic ** Common Enables	Fault Active	Pass condition met for 15 seconds	
Idle Air Control (IAC) System - RPM Too High	P0507	This DTC sets when the idle speed is higher than the targeted idle speed	Idle speed	Filtered input speed error (desired - actual) is less than fail threshold -150 RPM. Filter coefficient for engine speed = 0.002	** Common Enables		1 loop execution at 100 ms rate	Two Trips
		DTC Pass	Idle speed		** Common Enables		Pass condition met for 15 seconds	
		DTC RePass after failure	Idle Speed	Filtered input speed error (desired - actual), is greater than fail threshold -140. Filter coefficient for engine speed = 0.002	Low idle diagnostic ** Common Enables	Fault Active	Pass condition met for 15 seconds	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Power Moding Diagnostics								
System Voltage Low	P0562	Sets when the low voltage system voltage is below a threshold DTC Pass	Ignition Voltage	Ignition Voltage <= 10 Volts Ignition Voltage > 10 Volts	Ignition Key Status Engine Speed	RUN/CRANK >= 0 RPM	(5 * 1) seconds in a (6 * 1) second window (6 -5) * 1 seconds	Special C
System Voltage Hi	P0563	Sets when the low voltage system voltage is above a threshold DTC Pass	Ignition Voltage	Ignition Voltage >= 18 Volts Ignition Voltage < 18 Volts	Ignition Key Status	RUN/CRANK	(5 * 1) seconds in a (6 * 1) second window (6 - 1) * 1 seconds	Special C
Ignition Switch Run/Start Position Circuit Low	P2534	Detects a run crank relay open circuit DTC Pass	Runk Crank Line voltage Run Crank Line Voltage	Ignition Run Crank line voltage <= 2 Volts Ignition Run Crank line voltage > 2 Volts	CAN Communication ECM run crank active data	enabled available and active	(200 * 0.025) seconds in a (215 * 0.025) second window (215 - 200) * 0.025 seconds	One Trip
Stuck Clutch Diagnostics								
Common Stuck Clutch diagnostic secondary enables for codes P07A3, P07A5, P07A7, P07A9	***				|Input speed - Input speed profile|	> 250 Rpm		

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Transmission Friction Element A Stuck On	P07A3	Detects a stuck C1 clutch	C1 Slip speed	C1 slip speed <= 80 RPM **FOR** > (60 **+** 120) * 0.025 seconds	Range State C1 slip acceleration Excess torque on C1 *** C1 Slip Speed	Mode 2 <= 30 RPM/s > 350 Nm FOR 10 * 0.025 seconds Neutral, Mode 2, Gear 3,	(120* 0.025) seconds (15 * 0.025)	Two Trips
		DTC Pass	C1 Slip Speed	> 45 RPM	Operating Mode	Gear 4	seconds	
Transmission Friction Element B Stuck On	P07A5	Detects a stuck C2 clutch	C2 Slip speed	C2 slip speed <= 50 RPM FOR > (8 + 120) * 0.025 seconds	Range State C2 slip acceleration Excess torque on C2 *** C2 Slip Speed	Mode 1 <= 10000 RPM/s > 350 Nm FOR 5 * 0.025 seconds Neutral, Mode 1, Gear 1	(120 * 0.025) seconds (10 * 0.025)	Two Trips
		DTC Pass	C2 Slip Speed	> 70 RPM	Operating Mode		seconds	
Transmission Friction Element C Stuck On	P07A7	Detects a stuck C3 clutch	C3 Slip speed	C3 slip speed <= 80 RPM FOR > (60 + 120) * 0.025 seconds	Range State C3 slip acceleration Excess torque on C3	Mode 2 <= 30 RPM/s > 200 Nm FOR 10 * 0.025 seconds	(120 * 0.025) seconds	Two Trips

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		DTC Pass	C3 Slip Speed	*** C3 Slip Speed > 45 RPM	*** Operating Mode	*** Neutral, Mode 1, Mode 2, Gear 1, Gear 2, Gear 3	*** (15 * 0.025) seconds	
Transmission Friction Element D Stuck On	P07A9	Detects a stuck C4 clutch	C4 Slip speed	**Fail Case 1:** C4 slip speed <= 100 PRM **FOR** > (4 + 120) * 0.025 seconds **Fail Case 2:** C4 slip speed <= 80 RPM **FOR** > (60 + 120) * 0.025 seconds	Range State C4 slip acceleration Excess torque on C4 *** Range State C4 slip acceleration Excess torque on C4 ***	Mode 1 <= 10000 RPM/s > 300 Nm FOR 5 * 0.025 seconds *** Mode 2 <= 50 RPM/s > 200 Nm FOR 10 * 0.025 seconds	(120* 0.025) seconds *** (120 * 0.025) seconds	Two Trips
		DTC Pass	C4 Slip Speed	C4 Slip Speed > 150 RPM	Operating Mode	Neutral, Mode 1, Mode 2, Gear 2, Gear 4	(10 * 0.025) seconds	
Transmission Auxilary Oil Pump Diagnostics								

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Transmission Auxiliary Oil Pump (TAOP) Feedback Signal out of Bound	P0C2B	This DTC sets when the TAOP controller is not communicating with the HCP	Incomplete or no fault message communication with TAOP controller.	A complete fault status message must be received every 1.5 seconds	RunCrankActive	= 1 for more than 0.2 seconds	1.5 seconds	Two Trips
Auxiliary Transmission Fluid Pump Performance	P2797	This diagnostic monitors the aux pump performance based on aux pump desired and actual speed values DTC Pass	Aux pump speed Aux pump speed	|Aux pump speed - Commanded Aux pump Speed| > 500 RPM |Aux pump speed - Commanded Aux pump Speed| <= 500 RPM	RunCrankActive Desired Speed	= 1 for more than KeTAPD_t_DiagDlyIgnOn seconds >= KeTAPD_n_PmpPerf_Min Spd	Fail Condition met for (100 * 0.025) seconds in a (120 * 0.025) second window Pass met for (120 -100) * 0.025 seconds	Two Trips
System Speed Rationality								
	P0C2F	The DTC Monitors the Calculated Input Speed and Compares this with the Sensed Engine Speed	SPI Sensed Engine Speed and Input Speed	Sensed SPI Engine Speed Above 500 RPM a difference ≥ 150 RPM else ≥ 1500 RPM	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	500 ms	One Trip

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
			CAN Sensed Engine Speed and Input Speed	Sensed CAN Engine Speed Above 500 RPM a difference ≥ 150 RPM else ≥ 1500 RPM			**Pass Conditions:** Sensed SPI Engine Speed Above 500 RPM a difference ≤ 150 RPM else ≤ 1500 RPM	
							Pass Conditions: Sensed CAN Engine Speed Above 500 RPM a difference ≤ 150 RPM else ≤ 1500 RPM for 500ms	
Transmission Output Speed Sensor								
Output Speed Sensor Circuit Direction Error	P077B	The DTC detects if the Transmission Output Speed Sensor Direction is Incorrect by Comparing with Calculated Direction from Motor Speed Sign	Transmission Output Speed Direction Raw	≠ Motor Direction	Transmission Output Speed	Not FAULT ACTIVE	1.15 seconds (46 counts at 25ms)	One Trip
					Hybrid Motor Speed based Estimated Output Speed is Valid	Calculated based on M1 or M2 Speed Equation		
					Transmission Output Speed and Motor Output Speed Difference	≤ 50 RPM	**Pass Conditions**: Same as FAIL for 5 seconds (200 counts at 25ms)	
					Motor Estimated Transmission Output Speed	≥ 50 RPM		
Internal Mode Switch 2								

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Internal Mode Switch 2 R1 Circuit Low Voltage	P181C	The DTC Monitors if the IMS R1 Circuit is Shorted to a Low Voltage	Converted Directional IMS	Transitional 17	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS R1	R1 Position Has Not Been Observed High	Converted Directional IMS	Transitional 2	**Pass Conditions:** Has Been Observed High for 3.125 seconds	
					AND Directional IMS R1	R1 Position NOT High for 5 seconds		
Internal Mode Switch 2 R1 Circuit High Voltage	P181D	The DTC Monitors if the IMS R1 Circuit is Shorted to a High Voltage	Converted Directional IMS	Transitional 30	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS R1	R1 Position Has Not Been Observed Low			**Pass Conditions:** Has Been Observed Low for 3.125 seconds	
Internal Mode Switch 2 R2 Circuit Low Voltage	P181E	The DTC Monitors if the IMS R2 Circuit is Shorted to a Low Voltage	Converted Directional IMS	DRIVE	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS R2	R2 Position Has Not Been Observed High	Converted Directional IMS	PARK	**Pass Conditions:** Has Been Observed High for 3.125 seconds	
					AND Directional IMS R2	R2 Position Low for 5 seconds		
Internal Mode Switch 2 R2 Circuit High Voltage	P181F	The DTC Monitors if the IMS R2 Circuit is Shorted to a High Voltage	Converted Directional IMS	Transitional 14 OR Transitional 29	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS R2	R2 Position Has Not Been Observed Low			**Pass Conditions:** Has Been Observed Low for 3.125 seconds	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Internal Mode Switch 2 D1 Circuit Low Voltage	P183A	The DTC Monitors if the IMS D1 Circuit is Shorted to a Low Voltage	Converted Directional IMS	Transitional 8 OR Transitional 20	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS D1	D1 Position Has Not Been Observed High			**Pass Conditions:** Has Been Observed High for 3.125 seconds	
Internal Mode Switch 2 D1 Circuit High Voltage	P183B	The DTC Monitors if the IMS D1 Circuit is Shorted to a High Voltage	Converted Directional IMS	Transitional 27	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS D1	D1 Position Has Not Been Observed Low			**Pass Conditions:** Has Been Observed Low for 3.125 seconds	
Internal Mode Switch 2 D2 Circuit Low Voltage	P183C	The DTC Monitors if the IMS D2 Circuit is Shorted to a Low Voltage	Converted Directional IMS	Transitional 24	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS D1	D2 Position Has Not Been Observed High			**Pass Conditions:** Has Been Observed High for 3.125 seconds	
Internal Mode Switch 2 D2 Circuit High Voltage	P183D	The DTC Monitors if the IMS D2 Circuit is Shorted to a High Voltage	Converted Directional IMS	Transitional 11 AND Transitional 23	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS D2	D2 Position Has Not Been Observed Low			**Pass Conditions:** Has Been Observed Low for 3.125 seconds	
Internal Mode Switch 2- Invalid Range	P183E	The DTC Monitors if the IMS is in an Invalid Range	Converted Directional IMS	Illegal (All Circuits Open)	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
							Pass Conditions: Same as Fail for 3.125 seconds	
Internal Mode Switch 1-2 Correlation	P183F	The DTC Monitors if the IMS Direction and Range Correlation is Invalid	Converted Directional IMS	Correlation Fault Neutral (With No IMS Faults the Direction IMS and Range IMS Indicate Different Detent Postions)	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	1.25 seconds	One Trip
							Pass Conditions: Same as Fail for 1.7 seconds	
Internal Mode Switch 2 S Circuit Low Voltage	P184A	The DTC Monitors if the IMS S Circuit is Shorted to a Low Voltage	Converted Directional IMS	Transitional 9	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS S	S Position Has Not Been Observed High			**Pass Conditions:** Has Been Observed High for 3.125 seconds	
Internal Mode Switch 2 S Circuit High Voltage	P184B	The DTC Monitors if the IMS S Circuit is Shorted to a High Voltage	Converted Directional IMS	Transitional 26 AND DRIVE	Ignition Voltage	≥ 6.0 V for 2 consecutive samples	2.7 seconds	Two Trips
			AND Directional IMS S	S Position Has Not Been Observed Low			**Pass Conditions:** Has Been Observed Low for 3.125 seconds	
			AND Directional IMS R1	R1 Has Been Observed Low				
Transmission Output Speed Sensor								

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Vehicle Speed Output Shaft Speed Correlation	P215B	The DTC Monitors if the Difference between the Transmission Output Speed and Output Speed Calculated from the Wheel Speed Sensors	Transmission Output Speed and Output Speed Calculated from the Wheel Speed Sensors Difference	10 kph	Number of Secured Vehicle Speed Sources	2	10 seconds (400 counts at 25ms)	Two Trips
					Secured Vehicle Speed Use Transmission Output Speed	TRUE		
					Secured Vehicle Speed Use Wheel Speed	TRUE	**Pass Conditions:** Same as Fail for 20 seconds (800 counts at 25ms)	
Controller Diagnostics								
Control Module Read Only Memory (Rom)	P0601	This DTC will be stored if any software or calibration check sum is incorrect	Calculated Checksum does not match stored checksum		Ignition Status	Run or Crank	1 failure if it occurs during the first ROM test of the ignition cycle, otherwise 5 failures Frequency: Runs continuously in the background	One Trip
Control Module Not Programmed	P0602	Indicates that the HCP needs to be programmed	Fails if No Start Calibration is set to true which is only available on a new un-programmed HCP		Ignition Status	Run or Crank	Runs once at power up	One Trip
Control Module Long Term Memory Reset	P0603	Non-volatile memory checksum error at controller power-up	Checksum at power-up does not match checksum at power-down		Ignition Status	Run or Crank	1 failure Frequency: Once at powerup	One Trip

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Control Module Random Access Memory (RAM) Failure	P0604	Indicates that HCP is unable to correctly write and read data to and from RAM	Data read does not match data written		Ignition Status	Run or Crank	Should finish within 30 seconds at all operating conditions	One Trip
PCM Processor Performance/Integrity Check 1. Main processor Arithmetic Logic Unit (ALU) fault 2. Main configuration register fault 3. Software timed loop execution 4. Communication (SPI bus) between main and secondary processors	P0606	Indicates that the HCP has detected an internal processor integrity fault	1. ALU not reporting as expected 2. Configuration register not reporting as expected 3. Software tasks loops > schedule tasks loop 4. Loss of SPI communication between main and secondary processors		Ignition Status Run/Crank Voltage OR Powertrain Relay Voltage	Accessory, Run, Crank > 7 Volts > 7 Volts	1. In main processor, 50 ms 2. In main processor, 50 ms 3. Error > 5 times of loop time; loop time are 12.5, 25, 50, 100 and 250 ms in the main processor 4. In the main processor, the detection time is set to 200 msec with sample limit=30 and fail limit= 10 at 6.25 msec loop rate.	One Trip
Control Module Long Term Memory Performance	P062F	Indicates that the NVM Error flag has not been cleared	Last EEPROM write did not complete		Ignition voltage	≥ 5 volts 	1 failure Frequency: Once at power-up	One Trip
Torque Security Diagnostics								

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Internal Control Module Torque Performance	P061A	The regenerative braking ring compares the primary path torque calculations to the value created by a redundant secondary calculation. The values should be equal.	The primary path calculation differs from the redundant calculation	>100 Nm	Regenerative Braking Torque	> 0 Nm	13 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	One Trip
Internal Control Module Torque Calculation Performance	P061B	The system torque monitor compares the primary path torque calculations to limits created by a redundant secondary calculation.						One Trip
		Fail Case 1: Exceeds upper torque limit	When the redundant calculation of the system torque exceeds the upper limit created by the primary torque calculation (0.2g = 678Nm offset) for greater than 200ms	678Nm (equivalent to .2g)		Runs continuously when a torque source is present	16 fail counts out of 20 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 2: Exceeds lower torque limit	When the redundant calculation of the system torque exceeds the lower limit created by the primary torque calculation (0.15g = 508Nm offset) for greater than 200ms	508Nm (equivalent to .15g)		Runs continuously when a torque source is present	16 fail counts out of 20 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 3: Transmission output torque rationality check violated	Axle torque request is converted to transmission output torque. When this converted output torque violates the rationality check comparison by 1 Nm for greater than			Runs continuously when a torque source is present	16 fail counts out of 20 sample counts Executes in a 12.5ms loop	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
			200ms a failure is flagged.	1Nm			Detects in 200ms	
		Fail Case 4: Brake torque request rationality check violated	Brake torque request is converted to transmission output torque. When this converted output torque violates the rationality check comparison by 1 Nm for greater than 200ms a failure is flagged.	1Nm		Runs continuously when a torque source is present	16 fail counts out of 20 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 5: Output torque negative when driver request is positive	When the driver requested torque is positive while the commanded output torque is negative and below a -0.05g (-170Nm) threshold for greater than 100ms.	-170Nm (equivalent to -0.05g)		Runs continuously when a torque source is present	12 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 6: Output torque positive when driver request is negative	When the driver requested torque is negative while the commanded output torque is positive and greater than a 0.05g (170Nm) threshold for greater than 100ms.	170Nm (equivalent to 0.05g)		Runs continuously when a torque source is present	12 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
Torque Management System – Forced Engine Shutdown	P06AF	The main processor monitor ring compares the ECM 2nd pattern (nibble pattern) to known good pattern to determine ECM state of health.	The nibble pattern is incorrect	The pattern does not match (F, 5, B, D, A, 6, 3, 0)		Runs continuously	4 fail counts out of 6 sample counts Executes in a 12.5 ms Loop Detects in 200ms	One Trip

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Alive Rolling Count / Protection Value fault for the Regenerative Braking Axle Torque	P1B15	Detect the ARC (Alive Rolling Count) or Protection Value fault by checking the ARC and Protection Value of the Regenerative Braking Axle Torque	The current alive rolling count value does not equal the previous alive rolling count value incremented by 1	Current ARC ≠ Previous ARC +1	Ignition Key Status	Run/Crank for > 0.5 s	10 fail counts out of 16 sample counts	One Trip
			The primary signal value does not equal the protection value	Primary Value ≠ Protection Value			Executes in a 12.5 ms Loop	
							Detects in 200ms	
Alive Rolling Count / Protection Value fault for the Engine Actual Torque Steady State	P15F0	Detect the ARC (Alive Rolling Count) or Protection Value fault by checking the ARC and Protection Value of the Engine Actual Torque Steady State	The current alive rolling count value does not equal the previous alive rolling count value incremented by 1	Current ARC ≠ Previous ARC +1	Ignition Key Status	Run/Crank for > 0.5 s	10 fail counts out of 16 sample counts	One Trip
							Executes in a 12.5 ms Loop	
			The primary signal value does not equal the protection value	Primary Value ≠ Protection Value				
							Detects in 200ms	
Alive Rolling Count / Protection Value fault for the commanded predicted axle torque	P15F1	Detect the ARC (Alive Rolling Count) or Protection Value fault by checking the ARC and Protection Value of the commanded predicted axle torque	The current alive rolling count value does not equal the previous alive rolling count value incremented by 1	Current ARC ≠ Previous ARC +1	Ignition Key Status	Run/Crank for > 0.5 s	10 fail counts out of 16 sample counts	One Trip
			The primary signal value does not equal the protection value	Primary Value ≠ Protection Value			Executes in a	
							12.5ms loop	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
							Detects in 200ms	
Internal Control Module Transmission Direction Range Switch	P16F2	Detect transmission direction errors by reading the states of the Direction IMS switches as well as determining a transmission direction and comparing it to the transmission direction from the primary controls path.						One Trip
		Fail Case 1: No direction match with no IMS failures	Read the Direction IMS switches and determine that they represent a valid transmission direction (P,R,N,D) but it does not match the transmission direction determined by the primary controls path.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 2: Multiple transmission directions with no IMS failures	Read the Direction IMS switches and determine that they represent more than one valid transmission direction (P,R,N,D).			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 3: No direction match with one IMS failure	Read the Direction IMS switches and determine that one switch has failed and calculate a transmission direction, but it does not match the transmission direction determined by the primary controls path.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 4: Multiple transmission directions with one IMS failure	Read the Direction IMS switches and determine that one switch has failed and calculate a transmission direction			Runs continuously	6 fail counts out of 8 sample counts	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
			transmission direction and determine that they represent more than one valid transmission direction (P,R,N,D).				Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 5: Unable to determine transmission direction	Reads the Direction IMS switches and determine that more than one switch has failed and cannot calculate a transmission direction.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
Dual Store Fault	P16F3	Detect the dual store memory fault by comparing the primary value and the dual store value of the individual variables						One Trip
		Fail Case 1: Detect the dual store memory fault by comparing the primary value and the dual store value of the brake torque request output	The primary value and the dual store value of the brake torque request output are not equal (ATRR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 2: Detect the dual store memory fault by comparing the primary value and the dual store value of the immediate output torque request	The primary value and the dual store value of the immediate output torque request are not equal (ATRR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 3: Detect the dual store memory fault by comparing the primary value and the dual store value of the commanded predicted axle torque	The primary value and the dual store value of the commanded predicted axle torque are not equal (AXLR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
							Detects in 200ms	
		Fail Case 4: Detect the dual store memory fault by comparing the primary value and the dual store value of the Engine Actual Torque Steady State	The primary value and the dual store value of the Engine Actual Torque Steady State are not equal (ETQR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 5: Detect the dual store memory fault by comparing the primary value and the dual store value of the transfer case range (4wd) variables	The primary value and the dual store value of the transfer case range (4wd) are not equal (FWDR)			Runs continuously	5 fail counts out of 16 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 6: Detect the dual store memory fault by comparing the primary value and the dual store value of the selected range equation	The primary value and the dual store value of the selected range equation are not equal (HSER)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 7: Detect the dual store memory fault by comparing the primary value and the dual store value of the range state	The primary value and the dual store value of the range state are not equal. (HSER)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 8: Detect the dual store memory fault by comparing the primary value and the dual store	The primary value and the dual store value of the Motor A torque			Runs continuously	20 fail counts out of 30 sample counts	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		value of the Motor A torque command	command are not equal. (HTDR)				Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 9: Detect the dual store memory fault by comparing the primary value and the dual store value of the Motor B torque command	The primary value and the dual store value of the Motor B torque command are not equal (HTDR)			Runs continuously	20 fail counts out of 30 sample counts Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 10: Detect the dual store memory fault by comparing the primary value and the dual store value of the Motor A torque achieved	The primary value and the dual store value of the Motor A torque achieved are not equal (MTQR)			Runs continuously	20 fail counts out of 30 sample counts Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 11: Detect the dual store memory fault by comparing the primary value and the dual store value of the Motor B torque achieved	The primary value and the dual store value of the Motor B torque achieved are equal (MTQR)			Runs continuously	20 fail counts out of 30 sample counts Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 12: Detect the dual store memory fault by comparing the primary value and the dual store value of the Estimated Regenerative Braking Axle torque	The primary value and the dual store value of the Estimated Regenerative Braking Axle torque are not equal. (RGNR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		Fail Case 13: Detect the dual store memory fault by comparing the primary value and the dual store value of the Estimated Regenerative Braking Output Torque	The primary value and the dual store value of the Estimated Regenerative Braking Output Torque are not equal (RGNR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 14: Detect the dual store memory fault by comparing the primary value and the dual store value of the Regenerative Braking Axle Torque Request	The primary value and the dual store value of the Regenerative Braking Axle Torque Request are not equal (RGNR)			Runs continuously	20 fail counts out of 30 sample counts Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 15: Detect the dual store memory fault by comparing the primary value and the dual store value of the Trans input speed	The primary value and the dual store value of the Trans input speed are not equal (TISR)			Runs continuously	20 fail counts out of 30 sample counts Executes in a 6.25ms loop Detects in 200ms	
		Fail Case 16: Detect the dual store memory fault by comparing the primary value and the dual store value of the Hybrid Commanded Engine Torque	The primary value and the dual store value of the Hybrid Commanded Engine Torque are not equal (TRAR)			Runs continuously	10 fail counts out of 16 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 17: Detect the dual store memory fault by comparing the primary value and the dual store value of the Direction IMS Failure Active status	The primary value and the dual store value of the Direction IMS Failure Active status are not equal (TRGR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
							Detects in 200ms	
		Fail Case 18: Detect the dual store memory fault by comparing the primary value and the dual store value of the Trans Direction State Fault Active	The primary value and the dual store value of the Trans Direction State Fault Active are not equal (TRGR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 19: Detect the dual store memory fault by comparing the primary value and the dual store value of the Transmission Direction State.	The primary value and the dual store value of the Transmission Direction State are not equal (TRGR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 20: Detect the dual store memory fault by comparing the primary value and the dual store value of the Validated Trans Range State	The primary value and the dual store value of the Validated Trans Range State are not equal (TRGR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 21: Detect the dual store memory fault by comparing the primary value and the dual store value of the conversion factor for TOS	The primary value and the dual store value of the conversion factor for TOS are not equal (VSPR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 22: Detect the dual store memory fault by comparing the primary value and the dual store	The primary value and the dual store value of the rate limited secure			Runs continuously	5 fail counts out of 8 sample counts	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		value of the rate limited secure vehicle speed	vehicle speed are not equal (VSPR)				Executes in a 25ms loop Detects in 200ms	
		Fail Case 23: Detect the dual store memory fault by comparing the primary value and the dual store value of the Signed, Filtered, Default Output speed	The primary value and the dual store value of the Signed, Filtered, Default Output speed are not equal (TOSR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
		Fail Case 24: Detect the dual store memory fault by comparing the primary value and the dual store value of the Trans Output Acceleration	The primary value and the dual store value of the Trans Output Acceleration are not equal (TOSR)			Runs continuously	5 fail counts out of 8 sample counts Executes in a 25ms loop Detects in 200ms	
Internal Control Module Transmission Range Control Performance	P16F4	Detect transmission range errors by comparing the Direction IMS switch with the Range IMS						One Trip
		Fail Case 1: Positive transmission ranges that do not match	The Range IMS and Direction IMS from the primary controls path and both have valid transmission positions (P, R, N, D) but the two do not match.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 2: Error corrected Direction IMS does not match	The Range IMS has a valid transmission position and the Direction IMS from the primary controls path has an error corrected transmission position,			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
			but the two do not match.				Detects in 200ms	
		Fail Case 3: Range IMS is between valid transmission positions and Direction IMS is error corrected	The Range IMS indicates a transitional PRNDL position and the Direction IMS has an error corrected transmission position.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 4: Range IMS is invalid and Direction IMS is error corrected	The Range IMS is invalid due to a fault or a problem with the TCM, and the Direction IMS has an error corrected transmission position.			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 5: Range IMS is between valid transmission positions and Direction IMS is invalid	The Range IMS indicates a transitional PRNDL position and the Direction IMS is invalid due to a fault or a problem with the HCP			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
		Fail Case 6: Range IMS and Direction IMS are both invalid	The Range IMS is invalid due to a fault or a problem with the TCM, and the Direction IMS is invalid due to a fault or a problem with the HCP			Runs continuously	6 fail counts out of 8 sample counts Executes in a 12.5ms loop Detects in 200ms	
Internal Control Module Programmable Logic Device	P16F5	The main processor monitor rings tests the capability of the PLD to detect any incorrect keys.				Does not run during shutdown test (see P16F9)	4 fail counts out of 6 sample counts	One Trip

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
			The hardwired signal that is from the PLD indicates receipt of a correct key when the main processor monitor deliberately sends bad keys		Ignition Key Status	Not OFF	Executes in a 12.5 ms Loop Detects in 200ms	
Internal Control Module Commanded Range State	P16F6	The Transmission Range State monitor verifies that there are no mismatches in system equations, the transmission range state being executed is valid, and the transmission range state has not performed an invalid transition						One Trip
		Fail Case 1: Invalid Transmission Range State	The current Transmission Range State being used by the system is detected to be an invalid value within the current Transmission			Runs continuously	1 failure Detected within 25ms of failure	
		Fail Case 2: Invalid Transmission Range State Group	The current Transmission Range State Group being used by the system is an invalid value.			Runs continuously	1 failure Detected within 25ms of failure	
		Fail Case 3: Invalid Transmission Range State transition	The current Transmission Range State has changed, and the change in value is not one of the supported transitions from the			Runs continuously	1 failure Detected within 25ms of failure	
		Fail Case 4: Range Equation mismatches current Transmission Range State	The Range Equation can not be rationalized against the current Transmission Range State.			Runs continuously	1 failure Detected within 25ms of failure	
		Fail Case 5: Torque Determination State mismatches current Transmission Range State	The Torque Determination State can not be rationalized against the current Transmission Range State.			Runs continuously	1 failure Detected within 25ms of failure	
		Fail Case 6: Input Torque Optimization State mismatches current Transmission Range State	The Input Torque Optimization State can not be rationalized			Runs continuously	1 failure	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
		current Transmission Range State	against the current Transmission Range State				Detected within 25ms of failure	
Internal Control Module Shutdown Performance	P16F9	The main processor monitor ring is testing the ability of the PLD to detect a seed/key error and take necessary action						One Trip
		Fail Case 1: Monitor MCPA for shutdown path test passed	The CAN signal that is from MCPA indicates test status equals failed	A value of 1 at test startup or a value of 0 at the end of test would fail	1. Ignition Key Status	OFF	Executes in a 12.5 ms Loop	
					High Voltage Contactor Status	OPEN		
					2. Ignition Key Status	Run/Crank		
					AND			
					P16F9 Status	Test Failed on Previous Key Cycle	Detects in 350ms	
		Fail Case 2: Monitor MCPB for shutdown path test passed	The SPI signal that is from MCPB indicates test status equals failed	A value of 1 at test startup or a value of 0 at the end of test would fail	1. Ignition Key Status	OFF	Executes in a 12.5 ms Loop	
					High Voltage Contactor Status	OPEN		
					2. Ignition Key Status	Run/Crank		
					AND			
					P16F9 Status	Test Failed on Previous Key Cycle	Detects in 350ms	
Alive Rolling Count / Protection Value fault for the Transfer case range (4WD Hi-Lo-Neutral)	P279D	Detect the ARC (Alive Rolling Count) or Protection Value fault by checking the ARC and Protection Value of the Transfer case range (4WD Hi-Lo-Neutral)	The current alive rolling count value does not equal the previous alive rolling count value incremented by 1	Current ARC ≠ Previous ARC +1	Ignition Key Status	Run/Crank for > 0.5 s	5 fail counts out of 8 sample counts	One Trip
			The primary value does not equal the protection value	Primary Value ≠ Protection Value			Executes in a 12.5 ms Loop	
							Detects in 200ms	

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Battery Pack Diagnostics								
Hybrid Battery System Discharge Time Too Long	P0C76	High voltage bus disccharge time too long	Failed discharge: High voltage bus & Discharge time Failed discharge count	 > 60V > 500 ms ≥ 2			2 consecutive failed discharge events	Special Type C
Hybrid Battery Pack Overtemperature	P0A7E	High voltage battery overtemperature	Battery temperature	> 65°C			5 seconds (50 fail / 60 sample; 100ms frequency)	Special Type C
Hybrid Battery Contactor Control Sequence Incorrect	P1A21	Contactor control functionality	Contactors closed this key on & Shutdown in process & Battery contactor state	= TRUE = FALSE ≠ CLOSED			50 ms	One trip
Autostart Diagnostics								
Hybrid System Performance	P0AB9	This diagnostic indicates an autostart or autostop attempt failed.	A problem during the autostart/stop process causes the engine to stall.				12.5 ms	Special Type C
Communication Diagnostics								

Component / System	Fault Code	Monitor Strategy Description	Malfunction Criteria	Threshold Value	Secondary Parameters	Enable Conditions	Time Req'd	MIL Illum
Control Module Communication Bus A Off	U0073	Detects that a CAN serial data bus shorted condition has occurred to force the CAN device driver to enter a bus-off state.	CAN device driver	= bus-off state.	Ignition switch	Run	3 failures out of 5 samples Detects in 0.17 seconds at loop rate of 12.5 msec	Type B
Control Module Communication Bus B Off	U0074	Detects that a CAN serial data bus shorted condition has occurred to force the CAN device driver to enter a bus-off state.	CAN device driver	= bus-off state.	Ignition switch	Run	3 failures out of 5 samples Detects in 0.17 seconds at loop rate of 12.5 msec	Type B
Lost Communication With ECM/PCM on Bus A	U0100	Detects that CAN serial data communication has been lost with the ECM on Bus A	Missed ECM Messages		Ignition switch	Run	Detects within 0.18 seconds at 6.25 msec loop rate	Type B
Lost Communication With ECM/PCM on Bus B	U1818	Detects that CAN serial data communication has been lost with the ECM on Bus B	Missed ECM Messages		Ignition switch	Run	Detects within 0.18 seconds at 6.25 msec loop rate	Type B
Lost Communication With TCM	U0101	Detects that CAN serial data communication has been lost with the ECM on Bus A	Missed TCM Messages		Ignition switch	Run	Detects within 0.18 seconds at 6.25 msec loop rate	Type B
Lost Communication With Transfer Case Control Module (supported when applicable)	U0102	Detects that CAN serial data communication has been lost with the TCCM on Bus A	Missed TCCM Messages		Ignition switch	Run	Detects within 10 seconds at 6.25 msec loop rate	Type B
Lost Communication With Brake System Control Module	U0129	Detects that CAN serial data communication has been lost with the EBCM on Bus A	Missed EBCM Messages		Ignition switch	Run	Detects within 0.18 seconds at 6.25 msec loop rate	Type B
Lost Communication With Motor Control Processor on Bus B	U1815	Detects that CAN serial data communication has been lost with the MCPA on Bus B	Missed MCPA Messages		Ignition switch	Run	Detects within 10 seconds at 6.25 msec loop rate	Type B
Lost Communication With Battery Pack Control Module	U1888	Detects that CAN serial data communication has been lost with the BPCM	Missed BPCM Messages		Ignition switch	Run	Detects within 0.18 seconds at 6.25 msec loop rate	Type B