3 HARDWARE AND WIRING

Section **Page**

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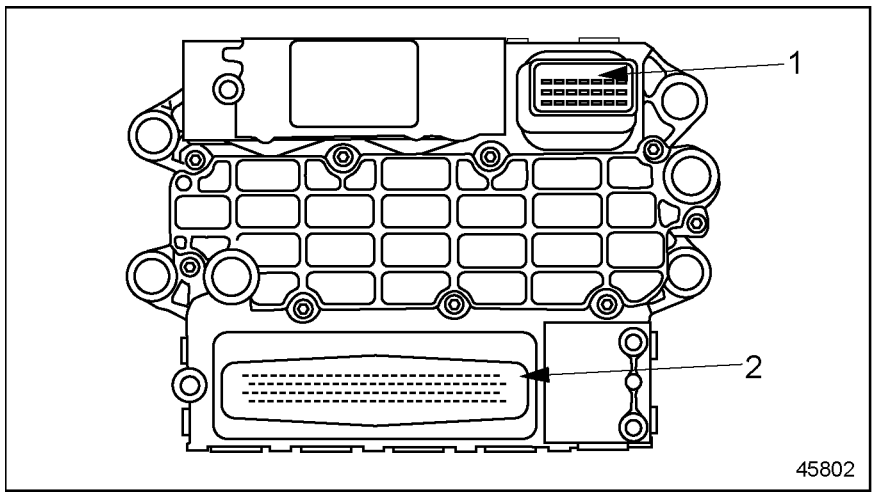
3.1 MOTOR CONTROL MODULE2

The engine mounted Motor Control Module2 (MCM2) includes control logic to provide overall engine management. See Figure 3-1.



1. 21–pin Connector (OEM Responsibility)
2. 120–pin Connector (Detroit Diesel Responsibility)

Figure 3-1 Motor Control Module2

NOTE:
Do NOT ground the MCM2 housing. This can result in false codes being logged.

Operating Range	
Full Functionality	11 V ≤ KL 30 ≤ 30 V
Restricted Functionality	6.5 V ≤ KL30 ≤ 11 V 30 V ≤ KL30 ≤ 32 V
Operating Range for Injection	8 V ≤ KL30 ≤ 32 V
Restricted Operating Range for Injection	6.5 V ≤ KL30 ≤ 8 V
Over Voltage Shutdown	35 V
Under Voltage Shutdown of Micro Controller	4 V
Maximum DC Voltage	55 V
Reverse Battery Protection	Unlimited
Current Consumption	
Quiescent Current 2	<1 mA
Maximum Average Current (normal operation)	40 A
Typical Current Consumption (engine stalled, not actuators driven)	TBD
Maximum Power Dissipation (normal operation)	50 W

Table 3-1 Electrical Limits

3.1.1 ENVIRONMENTAL CONDITIONS

Vibration of 3g should not be exceeded.

The MCM2 is not water proof.

The MCM2 has to be protected from impacts.

3.1.2 ENGINE HARNESS

The MCM2 has a 120–pin connector Engine Harness which is factory installed. It also has a 21–pin connector which is the responsibility of the OEM.

MCM2 120–pin Connector for Heavy–Duty Engines

The pinouts for the 120–pin connector for the DD16, DD15, and DD13 engines are listed in Table 3-2, Table 3-3, Table 3-4, and Table 3-5.

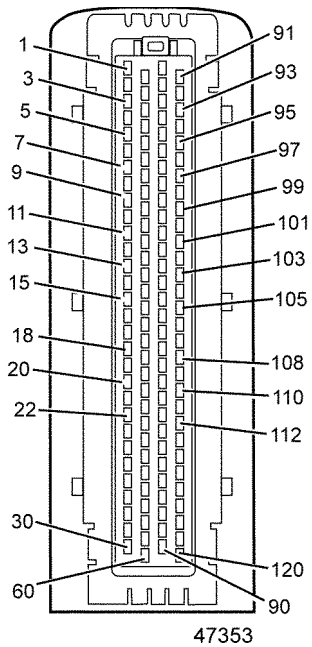
Pin	Function	Connector
1	Quality Control Valve	
2	Quality Control Valve	
3	NC	
4	Electronic Unit Pump (cyl 4) - pin 1	
5	Electronic Unit Pump Common (cyl 4) - pin 2	
6	Electronic Unit Pump (cyl 6) - pin 1	
7	Electronic Unit Pump Common (cyl 6) - pin 2	
8	Electronic Unit Pump (cyl 5) - pin 1	
9	Electronic Unit Pump Common (cyl 5) - pin 2	
10	Electronic Unit Pump (cyl 2) - pin 1	
11	Electronic Unit Pump Common (cyl 2) - pin 2	
12	Electronic Unit Pump (cyl 3) - pin 1	
13	Electronic Unit Pump Common (3) pin 2	
14	Electronic Unit Pump (cyl 1) - pin 1	
15	Electronic Unit Pump Common (cyl 1) - pin 2	
16	Injector (cyl 4) - pin 1	
17	Injector Common (cyl 4) - pin 2	
18	Injector (cyl 6) - pin 1	
19	Injector Common (cyl 6) - pin 2	
20	Injector (cyl 5) - pin 1	
21	Injector Common (cyl 5) - pin 2	
22	Injector (cyl 2) - pin 1	
23	Injector Common (cyl 2) - pin 2	
24	Injector (cyl 3) - pin 1	
25	Injector Common (cyl 3) - pin 2	
26	Injector (cyl 1) - pin1	
27	Injector Common (cyl 1) - pin2	
28	Optimized output for starter actuation with emergency branch (ground connection not via ECU)	
29	NC	
30	Sensor Exhaust Pressure Before Turbo Charger	

Table 3-2 MCM2 Connector – DD16, DD15, and DD13 (1 of 4)

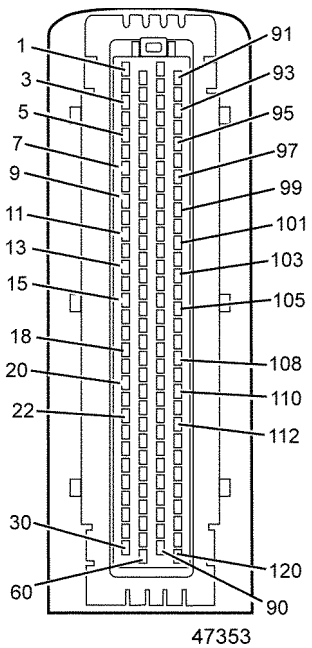
Pin	Function	Connector
31	Outlet Camshaft Phase Shifter	
32	Jake Brake Low	
33	Actuator Fan 2	
34	Fuel Cutoff Valve HC Dosing Unit	
35	NC	
36	Turbo Compound Valve	
37	Water Pump	
38	Output to electric actuators with a ground connection via ECU	
39	Heatable Cartridge	
40	NC	
41	Grid Heater Enable	
42	NC	
43	Input for inductive crankshaft sensor (analysis of the falling edge from the sensor signal)	
44	NC	
45	Input for inductive crankshaft sensor (2 pins) or hall sensor (3 pins) – (analysis of the falling edge from the sensor signal)	
46	Motor Service Switch Supply	
47	Fan Speed Sensor (hall sensor)	
48	Signal Ground	
49	Water Pump Speed Sensor (hall sensor)	
	NC	
50	Sensor Ground	
51	Inductive Turbo Speed Sensor	
52	Sensor Ground	
53	NC	
54	Oil Pressure Switch	
55	Sensor Ground	
56	Knock Sensor 2 (pin 2)	
57	Water Level Fuel filter	
58	Sensor Power Supply 1	
59	NC	
60	NC	

Table 3-3 MCM2 Connector – DD16, DD15, and DD13 (2 of 4)

Pin	Function	Connector
61	Volute Connection	
62	SW and PWM Power Supply Output (high side)	
63	NC	
64	NC	
65	HC Dosing Valve	
66	Jake Brake High	
67	W and PWM Power Supply Output (high side)	
68	PCV Pressure Control Valve	
69	Compressor Bypass	
70	Volute Shutoff Valve	
71	Sensor Supply for LIN Sensors	
72	Similar to K-line (ISO9149) with 12 V Supply	
73	Signal Ground	
74	Engine CAN: CAN Low	
75	Engine CAN: CAN High	
76	Motor Service Switch — Start/Stop Switch	
77	Supply Fuel Temperature Sensor	
78	Fuel Rail Pressure Sensor	
79	Grid Heater Diagnose	
80	Coolant Inlet Temperature Sensor	
81	NC	
82	Sensor Supply 2	
83	EGR Temperature (after EGR Cooler)	
84	HC Doser Fuel Pressure In	
85	Sensor Supply 2	
86	Turbo Compressor In Temp	
87	Charge Air Pressure (directly after Intake Air Sensor ground)	
88	Sensor Ground	
89	NC	
90	Intake Air Throttle Valve Position	

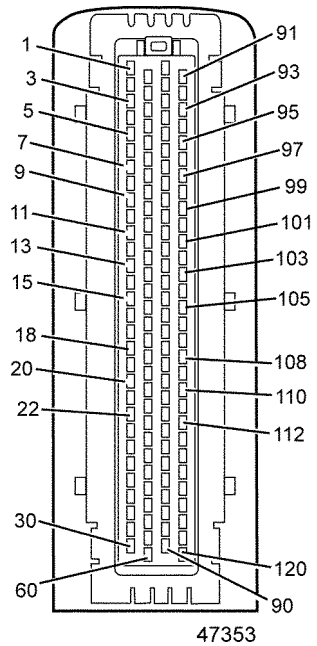


Table 3-4 MCM2 Connector – DD16, DD15, and DD13 (3 of 4)

Pin	Function	Connector
91	SW and PWM Power Supply Output (high side)	
92	NC	
93	NC	
94	Fuel Filter Water Separator	
95	Output to electric actuators with a ground connection via ECU	
96	Exhaust Brake	
97	Urea Tank Heating Valve	
98	Fan 1	
99	Switchable Air Compressor	
100	Intake Air Throttle (+)	
101	Intake Air Throttle (-)	
102	Sensor Ground	
103	Sensor Ground	
104	Sensor Ground	
105	Sensor Ground	
106	Intake Manifold Temperature (EGR and fresh air mixed)	
107	Electrostatic Oil Separator Diagnosis	
108	Engine Oil Temperature Sensor	
109	EGR Delta Pressure Sensor	
110	Coolant Outlet Temp Sensor	
111	HC Doser Fuel Pressure Out	
112	Turbo Compressor Out Temp	
113	Turbo Compound Pressure Sensor	
114	Sensor Ground	
115	Exhaust Temperature after Turbine Outlet Temp Sensor	
116	Oil Level Sensor	
117	Sensor Power Supply 1	
118	NC	
119	Charge Air Temperature (directly after intercooler)	
120	NC	

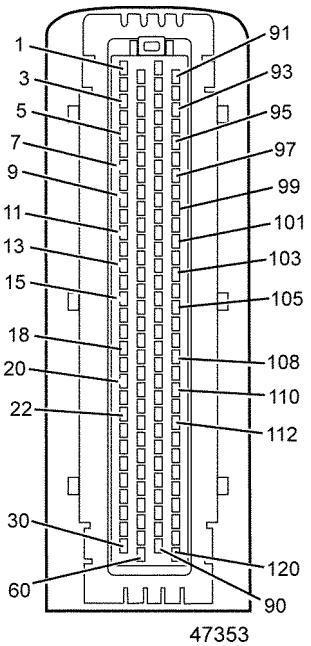


Table 3-5 MCM2 Connector – DD16, DD15, and DD13 (4 of 4)

MCM2 120–pin Connector for MDEG Engines

The pinouts for the 120–pin connector for the MDEG engine are listed in Table 3-6, Table 3-7, Table 3-8, and Table 3-9.

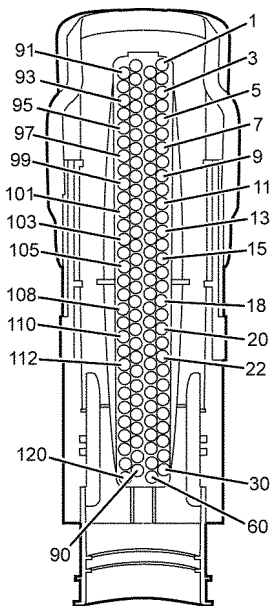
Pin	Signal Type	Function	Connector
1	RPU_H	IMV/FMU High Side Supply Metering Unit (PWM)	
2	RPU_L	IMV/FMU Low Side Supply Metering Unit (S/W)	
3	PV_IM1	Output for EGR position	
4	MV_B5F	NC	
5	MV_B5	Spill Control Valve / Amplifier / PLD (EUP)	
6	MV_B5D	NC	
7	MV_B5	Spill Control Valve / Amplifier / PLD (EUP)	
8	MV_B5B	NC	
9	MV_B5	Spill Control Valve / Amplifier / PLD (EUP)	
10	MV_B4E	NC	
11	MV_B4	Spill Control Valve / Amplifier / PLD (EUP)	
12	MV_B4C	NC	
13	MV_B4	Spill Control Valve / Amplifier / PLD (EUP)	
14	MV_B4A	NC	
15	MV_B4	Spill Control Valve / Amplifier / PLD (EUP)	
16	MV_B2F	Injector (cyl 4) – pin 1	
17	MV_B2	Injector Common (cyl 4) – pin 2	
18	MV_B2D	Injector (cyl 6) – pin 1	
19	MV_B2	Injector Common (cyl 6) – pin 2	
20	MV_B2B	Injector (cyl 5) – pin 1	
21	MV_B2	Injector Common (cyl 5) – pin 2	
22	MV_B1E	Injector (cyl 2) – pin 1	
23	MV_B1	Injector Common (cyl 2) – pin 2	
24	MV_B1C	Injector (cyl 3) – pin 1	
25	MV_B1	Injector Common (cyl 3) – pin 2	
26	MV_B1A	Injector (cyl 1) – pin 1	
27	MV_B1	Injector Common (cyl 1) – pin 2	
28	START_B	Optimized output for starter actuation with emergency branch (ground connection not via ECU)	
29	A16	Knock Sensor 1 (pin 1)	
30	A01	P3 Exhaust Pressure Sensor (before turbocharger)	

Table 3-6 MCM2 Connector – MDEG (1 of 4)

Pin	Signal Type	Function	Connector
31	PWM_5	NC	
32	PWM_7	Two-stage Hydraulic Brake System	
33	PWM_6	Actuator Fan 2	
34	PWM_8	Fuel Cutoff Valve HC Dosing Unit	
35	PWM_10	VTG MDEG only for 4 cylinder	
36	PWM_9	NC	
37	PWM_11	NC	
38	PV_M	Output to electric actuators with a ground connection via MCM2	
39	HSW2	NC	
40	SW_1	PVC Pressure Control Valve	
41	HSW1	Grid Heater Enable	
42	DYN3_N	NC	
43	DYN3	Input for inductive crankshaft sensor (analysis of the falling edge from the sensor signal)	
44	DYN2_N	NC	
45	DYN2	Input for inductive crankshaft sensor (2 pins) or hall sensor (3 pins) – (analysis of the falling edge from the sensor signal)	
46	D3_V	Motor Service Switch Supply	
47	DYN4	Fan Speed Sensor (hall sensor)	
48	DYM2_M	Signal Ground	
49	DYN5	NC	
50	SGND_TL	Sensor Ground	
51	DYN1	Inductive Turbo Speed Sensor	
52	SGND_P	Sensor Ground	
53	A23	NC	
54	A09	Oil Pressure Switch	
55	SGND_P	Sensor Ground	
56	A20	Knock Sensor 2 (pin 2)	
57	A05	Water Level Fuel Filter	
58	SENS1_V	Sensor Power Supply 1	
59	A17	Knock Sensor 1 (pin 2)	
60	A02	EGR Throttle Position	

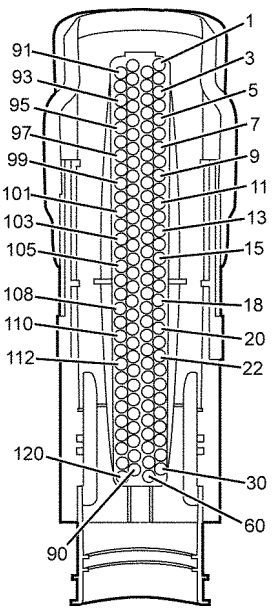


Table 3-7 MCM2 Connector – MDEG (2 of 4)

Pin	Signal Type	Function	Connector
61	PWM_1	Volute Connection	
62	PV_B2	SW and PWM Power Supply Output (high side)	
63	PWM_2	Output for ERG Position	
64	PV_B2	NC	
65	PWM_12	HC Dosing Valve	
66	PWM_13	Jake Brake High	
67	PV_M	Output to electric actuators with a ground connection via ECU	
68	SW_2	PCV Pressure Control Valve	
69	SW_8	NC	
70	SW_6	NC	
71	LIN_V	Sensor Supply for LIN Sensors	
72	LIN	Similar to K-line (ISO9149) with 12 V Supply	
73	DYN3_M	Signal Ground	
74	CAN3L	Engine CAN: CAN Low	
75	CAN3H	Engine CAN: CAN High	
76	D3_S	Motor Service Switch — Start/Stop Switch	
77	A29	Fuel Pressure Low Side	
78	A15	Fuel Rail Pressure Sensor	
79	D1	Grid Heater Diagnose	
80	A27	Coolant Inlet Temperature Sensor	
81	A13	NC	
82	SENS2_V	Sensor Power Supply 2	
83	A24	EGR Temperature (after EGR Cooler)	
84	A10	HC Doser Fuel Pressure In	
85	SENS2_V	Sensor Power Supply 2	
86	A21	Turbo Compressor Temperature Sensor	
87	A06	Charge Air Pressure (directly after Intake Air Sensor ground)	
88	SGND_P	Sensor Ground	
89	A18	Knock Sensor 2 (pin 1)	
90	A03	Intake Air Throttle Position	

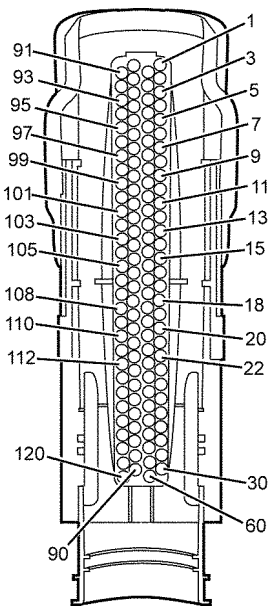


Table 3-8 MCM2 Connector – MDEG (3 of 4)

Pin	Signal Type	Function	Connector
91	PV_B1	SW and PWM Power Supply Output (high side)	
92	PWM_3	Grid Heater	
93	PV_B1	NC	
94	PWM_4	Fuel Filter Water Separator	
95	PV_M	Output to electric actuators with a ground connection via ECU	
96	SW_4	Exhaust Brake	
97	SW_5	NC	
98	SW_3	Fan 1	
99	SW_7	NC	
100	H_OUT1	Intake Air Throttle Valve (+)	
101	H_OUT2	Intake Air Throttle Valve (-)	
102	SGND	Sensor Ground	
103	SGND	Sensor Ground	
104	SGND	Sensor Ground	
105	SGND	Sensor Ground	
106	A30	Intake Manifold Temperature (EGR and fresh air mixed)	
107	D2	Electrostatic Oil Separator Diagnosis	
108	A28	Engine Oil Temperature Sensor	
109	A14	Intake Air Delta P Sensor (before turbocharger)	
110	A26	Engine Coolant Outlet Temp Sensor	
111	A12	HC Doser Fuel Pressure Out	
112	A25	Turbo Compressor Out Temp (T2)	
113	A11	Turbo Compound Pressure Sensor (OBD)	
114	SGND_S2	Sensor Ground	
115	A22	NC	
116	A08	Oil Level Sensor	
117	SENS1_V	Sensor Power Supply 1	
118	A07	NC	
119	A19	Charge Air Temperature (directly after intercooler) (T2N)	
120	A04	Air Mass Absolute Pressure Sensor	

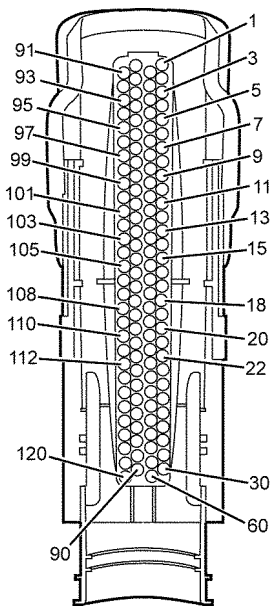


Table 3-9 MCM2 Connector – MDEG (4 of 4)

Connector Brackets

The harnesses on MCM2 must be bracketed and held secure. The bracket design will change for different engines as the routing is different. The 120–pin connector and the 21-pin connector must be tie-wrapped to the brackets as shown in the following drawing (see Figure 3-2).

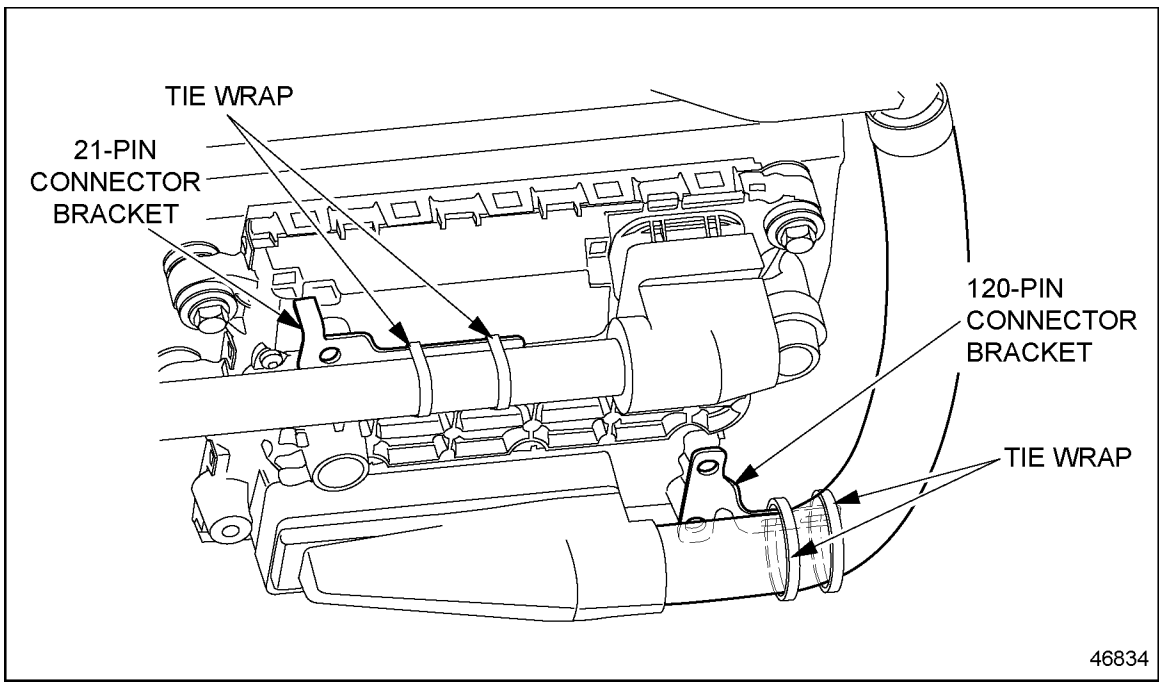
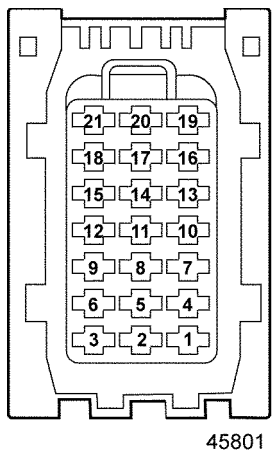


Figure 3-2 120–pin Connector and 21–pin Connector Tie-wrapped to Brackets

MCM2 21–pin Connector

The wiring for the VIH 21–pin to the MCM2 is listed in Table 3-10. The side of the connector shown is looking into the pins.

Pin	Signal Type	Function	Connector
21/1	CAN2L	OBD-CAN: CAN Low	
21/2	CAN2GND	OBD-CAN: HF Ground	
21/3	CAN2H	OBD-CAN: CAN High	
21/4	CAN2GND	OBD-CAN: HF Ground	
21/5	KL31	Battery (-) (current demand 40A)	
21/6	KL31	Battery (-) (current demand 40A)	
21/7	KL15	IGN	
21/8	KL31	Battery (-) (current demand 40A)	
21/9	KL31	Battery (-) (current demand 40A)	
21/10	CAN1GND	IES Motor CAN HF Ground	
21/11	KL30	Battery (+) (current demand 40A)	
21/12	KL30	Battery (+) (current demand 40A)	
21/13	CAN1H	IES Motor CAN Signal Level (Ub level CAN high)	
21/14	KL30	Battery (+) (current demand 40A)	
21/15	KL30	Battery (+) (current demand 40A)	
21/16	CAN1GND	IES Motor CAN HF Ground	
21/17		Not Used	
21/18	KDiag_S	K-line (ISO9141)	
21/19	CAN1L	IES Motor CAN Signal Level (Ub level CAN low)	
21/20	KL50	Crank Start Input	
21/21	START_B	Optimized output for starter actuation with emergency branch (ground connection not via ECU)	



Front
Looking into the Pins on the Harness

Table 3-10 21–Pin Connector to the MCM2

Part	DDC Part Number
Connector	024 545 76 26
1.0 – 2.5 mm Contact (single)	014 545 82 26
0.5 – 1.0 mm Contact (single)	014 545 83 26
Seal (2.2 – 3.0 mm^2 insulation diameter)	000 545 29 39
Seal (1.2 – 2.1 mm^2 insulation diameter)	000 545 28 39
Backshell	001 545 79 83
Cavity Plug	000 545 62 80

Table 3-11 21–Pin Connector to the MCM2 Part Numbers

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3.2 COMMON POWERTRAIN CONTROLLER2

The Common Powertrain Controller2 (CPC2) has three 18–pin connectors and one 21–pin connector. The following sections contain the connector pin-outs for truck, vocational, transit bus, fire truck, and crane applications.

The CPC2 is the interface between the MCM2 and the vehicle/equipment for engine control and manages other vehicle/equipment functions. See Figure 3-3.

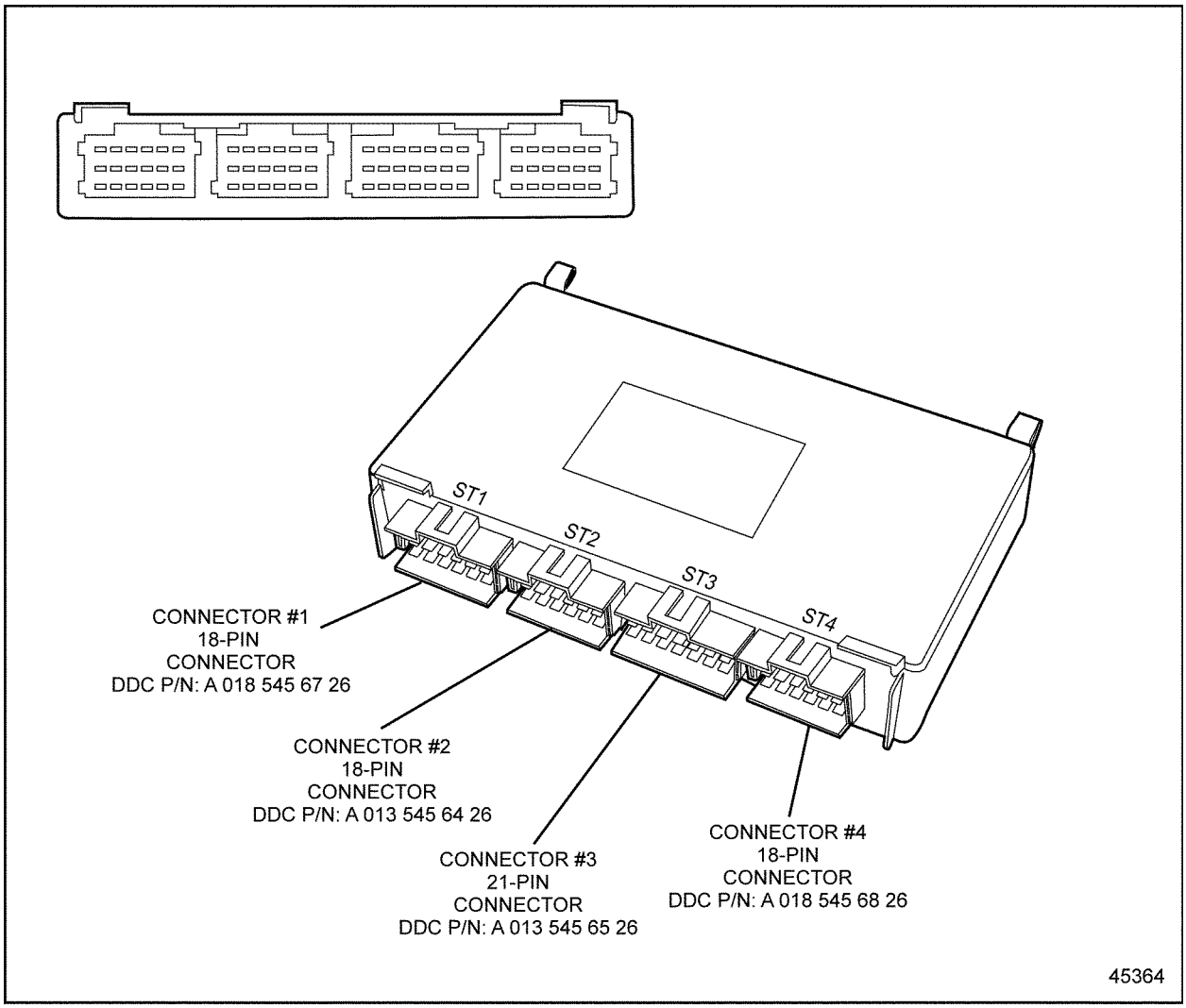


Figure 3-3 The Common Powertrain Controller

The OEM is responsible for mounting this part in an enclosed, protected environment. The mounting bracket is the responsibility of the OEM. There must be maximum physical separation of the VIH from other vehicle/equipment electrical systems. Other electrical system wires should ideally be at least three feet away from the VIH and should not be parallel to the VIH. This will eliminate coupling electromagnetic energy from other systems into the VIH. See Figure 3-4 for the CPC2 dimensions.

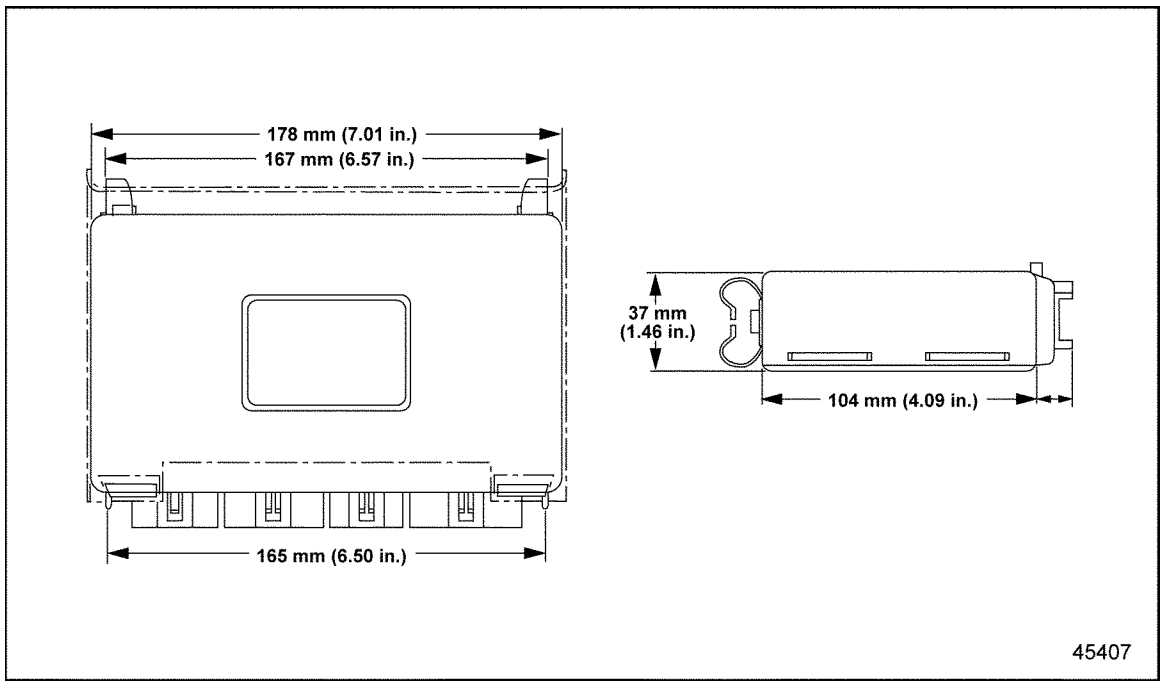


Figure 3-4 CPC2 Dimensions

NOTE:
The CPC2 should be mounted with the connectors pointing down.

3.2.1 ENVIRONMENTAL CONDITIONS

Temperature, vibration, and water intrusion must be considered.

Temperature

The ambient operating temperature range is –40°F to 185°F (-40°C to 85°C).

Water Intrusion

The CPC2 is not water tight and cannot be subject to water spray. It must be mounted in an enclosed, protected environment.

3.2.2 CPC2 VEHICLE INTERFACE HARNESS

The following criteria are to be used when designing the VIH.

Criteria: VIH Design

The four vehicle connectors are designed to accept 18 AWG wires for all circuits.

The conductor must be annealed copper, not aluminum, and must comply with the industry standard SAE J1128 document.

Color code the wires as shown in the schematics. If the wires used are the same color, hot stamp the cavity number on the wires.

NOTE:
The Vehicle Speed Sensor (VSS) must be a twisted pair. The twists are a minimum of 12 turns per foot (305 mm) and are required to minimize electromagnetic field coupling.

NOTE:
J1939 cable is required for the J1939 datalink wires. Refer to SAE J1939–11 spec for specific requirements.

The low speed propriety Engine-CAN link between the MCM2 and the CPC2 must be a twisted shielded cable with 0.75 mm diameter wire (approximately 20 AWG), bundle shielded with drain wire and 30 twists per meter. The insulation is rated to 105°C. Termination resistors for the Engine-CAN link are located in the CPC2 and MCM2.

Frequency Input

The CPC2 has one frequency input on the VIH that can accept a variable reluctance sensor. A typical frequency input functions is the Vehicle Speed Sensor (VSS). Requirements for a variable reluctance signal interface are listed in Table 3-12.

Parameter	Range
Input Amplitude Range	V Peak to Peak
Input Frequency Range	0 to 10,000 Hz

Table 3-12 Variable Reluctance Signal Interface

Digital Inputs

These inputs are in low state by providing a connection to battery ground and placed in high state by providing an open circuit.

Digital Input Requirements:

High State:	$V_{in} \geq 2/3$ Battery (+)
Low State:	$V_{in} \leq 1/3$ Battery (+)
Isink:	Capable of sinking 5–20 mA

NOTE:
Use switches that will not oxidize with the passage of time and environmental factors due to the low source current.

Digital Outputs

There are 15 digital outputs located on the CPC2. The high power outputs are listed in Table 3-13 and the low power outputs are listed in Table 3-14.

Connector	Pin	High Power Outputs	Application
4	9	DO_HP_FLEX_01	OI Active Lamp/Water-in-Fuel Indicator
3	17	DO_HP_FLEX_02	OI Alarm
3	7	DO_HP_HS_01	AGS2 PTO Valve/Top2 Lockout Solenoid/Allison Modulation Valve
3	8	DO_HP_HS_02	AGS2 PTO Lap/Top2 Shift Solenoid
4	10	DO_HP_HS_04	Vehicle Power Shutdown/Ignition Relay
3	9	DO_HP_LS_01	AGS2 Backup lamp/Water-in-Fuel Indicator
4	7	DO_HP_LS_02	High Exhaust System Temperature Lamp

Table 3-13 High Power Outputs

Low-side High Power Output Characteristics:

Resistance:	12 V - vehicle power: R > 8 ohms
Inductivity:	≤ 800 mH (if valve or relay load)
Capacity:	≤ 10 nF
Isink:	Capable of sinking less than or equal to 2.0 A

Connector	Pin	Low Power Outputs	Application
1	13	DO_LP_FLEX_01	Malfunction Indicator Lamp
2	10	DO_LP_FLEX_02	DEF (Urea) Low lamp
3	10	DO_LP_FLEX_03	Amber Warning Lamp
3	12	DO_LP_FLEX_04	AGS2 Check Transmission Lamp
3	16	DO_LP_FLEX_05	Red Stop Lamp
4	6	DO_LP_FLEX_06	Wait-to-Start Lamp (Grid Heater)
1	4	DO_LP_LS_01	Throttle Position Sensor Ground
1	5	DO_LP_LS_02	DPF Regeneration Lamp

Table 3-14 Low Power Outputs

Low-side Low Power Output Characteristics:

Resistance: 12 V - vehicle power: R > 64 ohms
Inductivity: < 1.3 H (if relay load)
Capacity: < 10 nF
Inrush Lamp Current: < 2.5 A
Isink: Capable of sinking less than or equal to 0.25 A

3.2.3 VIH WIRING

The OEM is responsible for wiring four connectors to the CPC2, one 21–connector to the MCM2, one 31–pin connector to the Engine Harness and a 10–pin Diesel Particulate Filter (DPF) connector. The connector and terminal part numbers are listed in the following pages.

Truck Applications

The pin assignments for the Common Powertrain Controller (CPC2) #1 connector (18–pins) for truck applications islisted in Table 3-15. The side of the connector shown is looking into the pins.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-16.

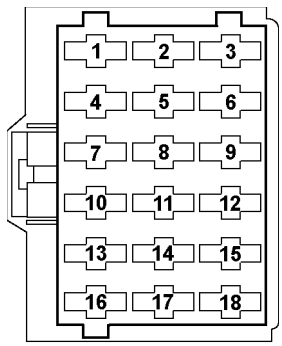
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Dual-speed Axle	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	PWM_FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Stop Engine / Aux Shutdown #1	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Set / Coast Enable	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Cruise Control Enable	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Resume / Accel Enable	
1/17	Digital Input_FLEX_07	Not Used	
1/18	SFP_01	Run Start	

Table 3-15 Connector #1 Pin Assignments – Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-16 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC2) #2 connector (18–pins) for truck applications is listed in Table 3-17. The side of the connector shown is looking into the pins.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-18.

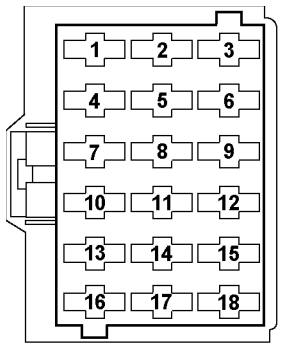
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587(+)	
2/6	J1708_B_C	J1587(–)	
2/7	Digital Input_FLEX_15	Service Brake Released Switch	
2/8	Digital Input_FLEX_16	Remote Throttle Select Switch	
2/9	Digital Input_FLEX_09	Remote PTO Switch	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Fan Override	
2/14	Digital Input_FLEX_13	Engine Brake Low	
2/15	Digital Input_FLEX_14	Engine Brake Medium	
2/16	VCAN_L_C	J1939 (-)	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939 (+)	

Table 3-17 Connector #2 Pin Assignments – Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-18 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC2) #3 connector (21–pins) for truck applications islisted in Table 3-19 . The side of the connector shown is looking into the pins.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-20.

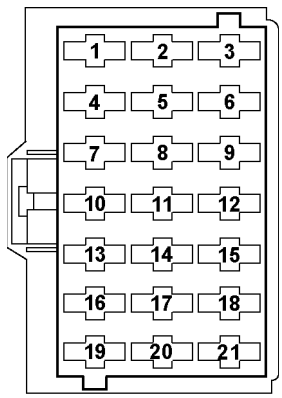
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	OI Thermostat	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	AGS2 Transmission Temp Lamp	
3/7	Digital Output_HP_HS_01	Top2 Lockout Solenoid/AGS2 PTO Valve	
3/8	Digital Output_HP_HS_02	Top2 Shift Solenoid/AGS2 PTO Lamp	
3/9	Digital Output_HP_LS_01	AGS 2 Backup Lamp/WIF Lamp	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	AGS2 Check Trans Lamp	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	OI Alarm	
3/18	Digital Input_SFP_02	ABS Active (AGS2 Transmission)	
3/19	Digital Output_LP_FLEX_02	Engine CAN (-)	
3/20	PTCAN_L 5V	Engine CAN Shield	
3/21	PTCAN_GND 5V	Engine CAN (+)	

Table 3-19 Connector #3 Pin Assignments – Truck Application

Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	A 013 545 78 26

Table 3-20 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC2) #4 connector (18–pins) for truck applications islisted in Table 3-21. The side of the connector shown is looking into the pins.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-22.

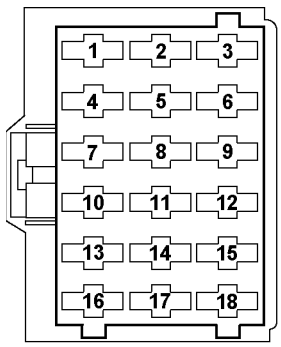
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released/PTO Request for AGS2	
4/9	Digital Output_HP_FLEX_01	OI Active Lamp/WIF Lamp	
4/10	Digital Output_HP_HS_04	Vehicle Power Shutdown	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Vehicle Speed Output	
4/13	Digital Input__FLEX_19	DPF Inhibit Switch	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Trans Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	Hood Tilt Switch/AGS2 PTO Feedback	

Table 3-21 Connector #4 Pin Assignments – Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-22 Connector #4, 18–pin Connector, Key C

Vocational Applications

The pin assignments for the Common Powertrain Controller (CPC2) #1 connector (18–pin) for vocational applications are listed in Table 3-23. The side of the connector shown is looking into the pins.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-24.

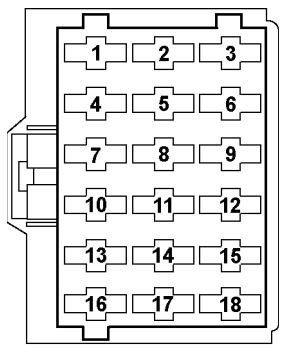
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Dual-speed Axle	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	PWM_FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Stop Engine / Aux Shutdown #1	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Set / Coast Enable	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Cruise Enable	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Resume / Accel Enable	
1/17	Digital Input_FLEX_07	Throttle Inhibit	
1/18	SFP_01	Run Start	

Table 3-23 Connector #1 Pin Assignments – Vocational Applications

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-24 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC2) #2 connector (18–pin) for vocational applications are listed in Table 3-25. The side of the connector shown is looking into the pins.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-26.

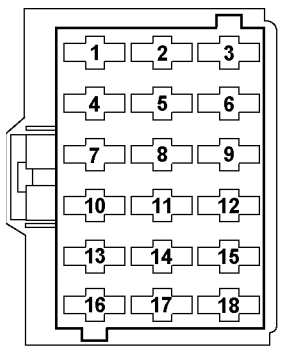
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Service Brake Switch	
2/8	Digital Input_FLEX_16	Remote Throttle Select Switch	
2/9	Digital Input_FLEX_09	Remote PTO Select	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Fan Override	
2/14	Digital Input_FLEX_13	Engine Brake Low	
2/15	Digital Input_FLEX_14	Engine Brake Medium	
2/16	VCAN_L_C	J1939-	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939+	

Table 3-25 Connector #2 Pin Assignments – Vocational Applications

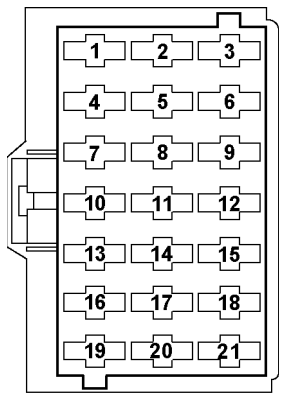
Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-26 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC2) #3 connector (21–pin) for vocational applications are listed in Table 3-27. The side of the connector shown is looking into the pins.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-28.

Pin	Signal Type	Function	Connector
3/1	Analog_In_01	Not Used	
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	AGS2 Trans Temp Lamp	
3/7	Digital Output_HP_HS_01	AGS2 PTO Valve	
3/8	Digital Output_HP_HS_02	AGS2 PTO Lamp	
3/9	Digital Output_HP_LS_01	AGS 2 Backup Lamp/AGS2 PTO Valve	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	AGS2 Check Trans Lamp	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	Starter Lockout/Run Signal	
3/18	Digital Input_SFP_02	ABS Active (AGS2 Transmission)	
3/19	Not Used	Engine CAN (-)	
3/20	Not Used	Engine CAN Shield	
3/21	Not Used	Engine CAN (+)	



42707

Front
Looking into the Pins on the Harness

Table 3-27 Connector #3 Pin Assignments – Vocational Applications

Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-28 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC2) #4 connector (18–pin) for vocational applications are listed in Table 3-29. The side of the connector shown is looking into the pins.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-30.

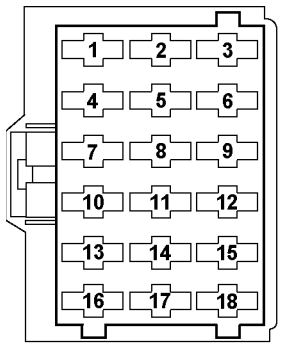
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust System Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released/PTO Request for AGS2	
4/9	Digital Output_HP_FLEX_01	Deceleration Lamp/WIF Lamp	
4/10	Digital Output_HP_HS_04	Not Used	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Vehicle Speed Output	
4/13	Digital Input__FLEX_19	DPF Inhibit Switch	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Trans Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	AGS2 PTO Feedback	

Table 3-29 Connector #4 Pin Assignments – Vocational Applications

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

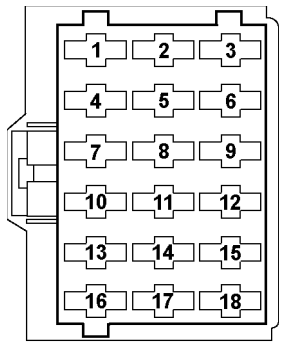
Table 3-30 Connector #4, 18–pin Connector, Key C

Coach Applications

The pin assignments for the Common Powertrain Controller (CPC2) #1 connector (18–pin) for coach applications are listed in Table 3-31.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-32.

Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	PWM_FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Stop Engine / Aux Shutdown #1	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Set / Coast Enable	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Cruise Control Enable	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Resume / Accel Enable	
1/17	Digital Input_FLEX_07	Throttle Inhibit	
1/18	SFP_01	Run Start	



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Front
Looking into the Pins on the Harness

Table 3-31 Connector #1 Pin Assignments – Coach Application

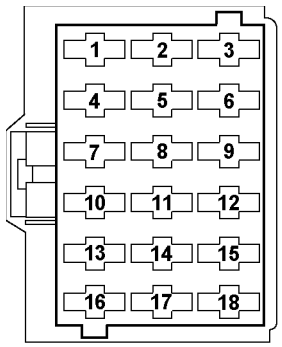
Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-32 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC2) #2 connector (18–pin) for coach applications are listed in Table 3-33.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-34.

Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Service Brake Released Switch	
2/8	Digital Input_FLEX_16	Not Used	
2/9	Digital Input_FLEX_09	Not Used	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Fan Override	
2/14	Digital Input_FLEX_13	Engine Brake Low	
2/15	Digital Input_FLEX_14	Engine Brake Medium	
2/16	VCAN_L_C	J1939 (-)	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939 (+)	



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Front
Looking into the Pins on the Harness

Table 3-33 Connector #2 Pin Assignments – Coach Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-34 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC2) #3 connector (21–pin) for coach applications are listed in Table 3-35.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-36.

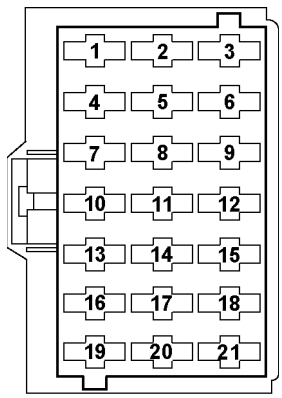
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	Not Used	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	AGS2 Transmission Temp Lamp	
3/7	Digital Output_HP_HS_01	Not Used	
3/8	Digital Output_HP_HS_02	Not Used	
3/9	Digital Output_HP_LS_01	Not Populated	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	Not Used	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	Starter Lockout/Run Signal	
3/18	Digital Input_SFP_02	Not Used	
3/19	Not Used	Engine CAN (-)	
3/20	Not Used	Engine CAN Shield	
3/21	Not Used	Engine CAN (+)	

Table 3-35 Connector #3 Pin Assignments – Coach Application

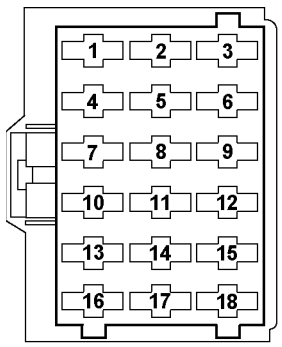
Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26
CPC2 - socket 1.0-2.5mm wire (strip)	—

Table 3-36 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC2) #4 connector (18–pin) for coach applications are listed in Table 3-37.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-38.

Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released	
4/9	Digital Output_HP_FLEX_01	Deceleration Lamp	
4/10	Digital Output_HP_HS_04	Vehicle Power Shutdown	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Not Used	
4/13	Digital Input__FLEX_19	DPF Inhibit Switch	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	Engine Brake Disable	



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Front
Looking into the Pins on the Harness

Table 3-37 Connector #4 Pin Assignments – Coach Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

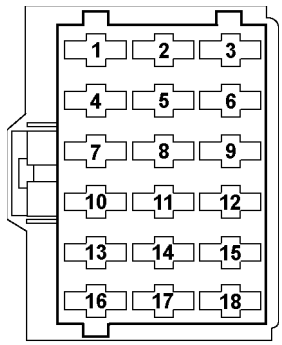
Table 3-38 Connector #4, 18–pin Connector, Key C

Fire Truck Applications

The pin assignments for the Common Powertrain Controller #1 connector (18–pin) for fire truck applications are listed in Table 3-39.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-40.

Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	
1/2	Digital Input_FLEX_02	Parking Brake	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	PWM_FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Not Used	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Set / Coast Enable	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Cruise Enable	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Resume / Accel Enable	
1/17	Digital Input_FLEX_07	Throttle Inhibit	
1/18	SFP_01	Run Start	



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Front
Looking into the Pins on the Harness

Table 3-39 Connector #1 Pin Assignments – Fire Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-40 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller #2 connector (18–pin) for fire truck applications are listed in Table 3-41.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-42.

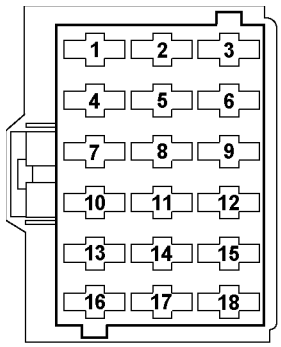
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Not Populated	
2/8	Digital Input_FLEX_16	Remote Throttle Select Switch	
2/9	Digital Input_FLEX_09	Remote PTO Select Switch	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Fan Override	
2/14	Digital Input_FLEX_13	Engine Brake Low	
2/15	Digital Input_FLEX_14	Engine Brake Medium	
2/16	VCAN_L_C	J1939 (-)	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939 (+)	

Table 3-41 Connector #2 Pin Assignments – Fire Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-42 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller #3 connector (21–pin) for fire truck applications are listed in Table 3-43.

The part numbers for the #3 connector, Key C and terminals are listed in Table 3-44.

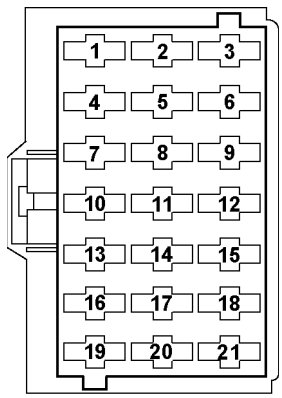
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	Not Used	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	Coolant Level Low Lamp	
3/7	Digital Output_HP_HS_01	Not Used	
3/8	Digital Output_HP_HS_02	Not Used	
3/9	Digital Output_HP_LS_01	Engine Brake Active/WIF Lamp	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	Cruise Active Lamp	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	Not Populated	
3/18	Digital Input_SFP_02	Not Used	
3/19	Not Used	Engine CAN (-)	
3/20	Not Used	Engine CAN Shield	
3/21	Not Used	Engine CAN (+)	

Table 3-43 Connector #3 Pin Assignments – Fire Truck Application

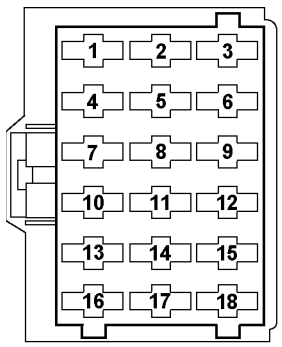
Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	A 013 545 78 26

Table 3-44 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller #4 connector (18–pin) for fire truck applications are listed in Table 3-45.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-46.

Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust Temperature Lamp	
4/8	Digital Input_FLEX_E1	Not Used	
4/9	Digital Output_HP_FLEX_01	Not Populated	
4/10	Digital Output_HP_HS_04	Not Used	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Not Used	
4/13	Digital Input__FLEX_19	DPF Inhibit Switch	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	Engine Brake Disable	



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Looking into the Pins on the Harness

Table 3-45 Connector #4 Pin Assignments – Fire Truck Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

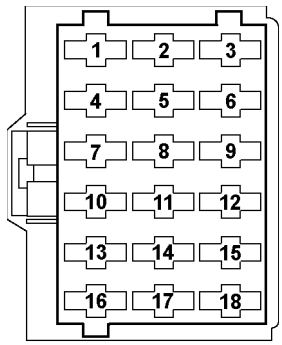
Table 3-46 Connector #4, 18–pin Connector, Key C

Crane Applications

The pin assignments for the Common Powertrain Controller #1 connector (18–pin) for crane applications are listed in Table 3-47.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-48.

Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Stop Engine / Aux Shutdown #1	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Set / Coast Enable	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Cruise Control Enable	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Resume / Accel Enable	
1/17	Digital Input_FLEX_07	Throttle Inhibit	
1/18	SFP_01	Run Start	



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Front
Looking into the Pins on the Harness

Table 3-47 Connector #1 Pin Assignments – Crane Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-48 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller #2 connector (18–pin) for crane applications are listed in Table 3-49.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-50.

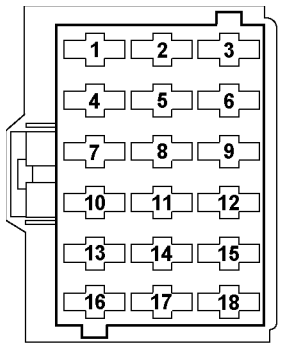
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Service Brake Released Switch	
2/8	Digital Input_FLEX_16	Remote Throttle Select	
2/9	Digital Input_FLEX_09	Remote PTO Enable Switch	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Fan Override	
2/14	Digital Input_FLEX_13	Engine Brake Low	
2/15	Digital Input_FLEX_14	Engine Brake Medium	
2/16	VCAN_L_C	J1939 (-)	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939 (+)	

Table 3-49 Connector #2 Pin Assignments – Crane Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-50 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller #3 connector (21–pin) for crane applications are listed in Table 3-51.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-52.

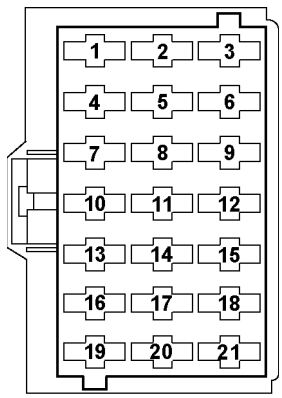
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	—	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	Low Battery voltage Lamp	
3/7	Digital Output_HP_HS_01	Not Used	
3/8	Digital Output_HP_HS_02	Not Used	
3/9	Digital Output_HP_LS_01	Engine Brake Active/WIF Lamp	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	Cruise Active Lamp	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	Not Used	
3/18	Digital Input_SFP_02	Not Used	
3/19	Not Used	Engine CAN (-)	
3/20	Not Used	Engine CAN Shield	
3/21	Not Used	Engine CAN (+)	

Table 3-51 Connector #3 Pin Assignments – Crane Application

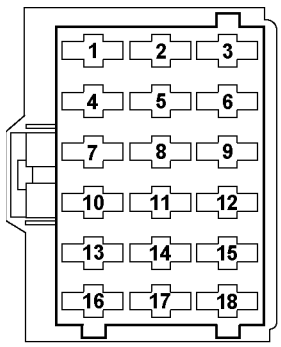
Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-52 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller #4 connector (18–pin) for crane applications are listed in Table 3-53

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-54.

Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released	
4/9	Digital Output_HP_FLEX_01	Deceleration Lamp/WIF Lamp	
4/10	Digital Output_HP_HS_04	Vehicle Power Shutdown	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Not Used	
4/13	Digital Input__FLEX_19	DPF Inhibit Switch	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Trans Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	RPM Freeze	



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Front
Looking into the Pins on the Harness

Table 3-53 Connector #4 Pin Assignments – Crane Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

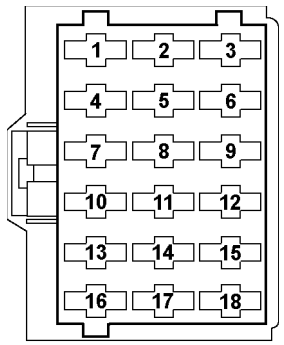
Table 3-54 Connector #4, 18–pin Connector, Key C

Transit Bus Applications

The pin assignments for the Common Powertrain Controller (CPC2) #1 connector (18–pin) for transit bus applications are listed in Table 3-55.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-56.

Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
1/5	Digital Output_LP_LS_01	DPF Regeneration Lamp	
1/6	Digital Input_SFP_06	Idle Validation Switch 1 (idle active)	
1/7	SFP_08	Throttle Position Sensor	
1/8	SFP_07	Throttle Position Sensor Supply	
1/9	PWM_FPO_02	Tachometer	
1/10	Digital Input_FLEX_20	Stop Engine / Aux Shutdown #1	
1/11	Digital Input_FLEX_08	Limiter 0	
1/12	Digital Input_FLEX_03	Not Used	
1/13	Digital Output_LP_FLEX_01	MIL Lamp	
1/14	Digital Input_FLEX_04	Not Used	
1/15	Digital Input_FLEX_05	Stop Engine Override	
1/16	Digital Input_FLEX_06	Not Used	
1/17	Digital Input_FLEX_07	Throttle Inhibit	
1/18	SFP_01	Run Start	



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Front
Looking into the Pins on the Harness

Table 3-55 Connector #1 Pin Assignments – Transit Bus Application

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-56 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC2) #2 connector (18–pin) for transit bus applications are listed in Table 3-57.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-58.

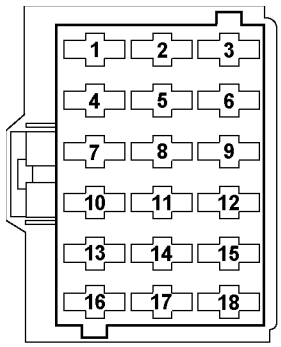
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Not Used	
2/8	Digital Input_FLEX_16	Not Used	
2/9	Digital Input_FLEX_09	Not Used	
2/10	Digital Output_LP_FLEX_03	Amber Warning Lamp	
2/11	Digital Input_FLEX_10	Limiter 1	
2/12	Digital Input_FLEX_11	A/C Status	
2/13	Digital Input_FLEX_12	Not Used	
2/14	Digital Input_FLEX_13	Not Used	
2/15	Digital Input_FLEX_14	Not Used	
2/16	VCAN_L_C	J1939 (-)	
2/17	VCAN_GND_C	J1939 Shield	
2/18	VCAN_H_C	J1939 (+)	

Table 3-57 Connector #2 Pin Assignments – Transit Bus Application

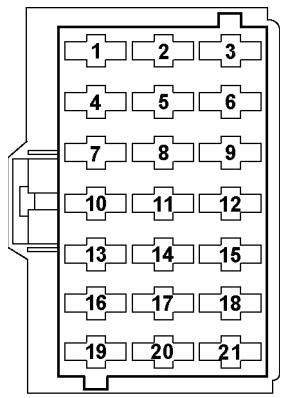
Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-58 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC2) #3 connector (21–pin) for transit bus applications are listed in Table 3-59.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-60.

Pin	Signal Type	Function	Connector
3/1	Analog_In_01	Not Used	
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	Coolant Level Low Lamp	
3/7	Digital Output_HP_HS_01	Not Used	
3/8	Digital Output_HP_HS_02	Not Used	
3/9	Digital Output_HP_LS_01	High Oil Temperature Lamp	
3/10	Digital Output_LP_FLEX_02	Urea Low Lamp	
3/11	SFP_14	Low Coolant Level Sensor	
3/12	Digital Output_LP_FLEX_04	Low Oil Pressure Lamp	
3/13	SFP_09	Vehicle Speed (+)	
3/14	SF_VGND	Vehicle Speed (-)	
3/15	Analog_In_SFP_13	Ambient Air Temperature Sensor	
3/16	Digital Output_LP_FLEX_05	Red Stop Lamp	
3/17	Digital Output_HP_FLEX_02	Starter Lockout/Run Signal	
3/18	Digital Input_SFP_02	Not Used	
3/19	Not Used	Engine CAN (-)	
3/20	Not Used	Engine CAN Shield	
3/21	Not Used	Engine CAN (+)	



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Front
Looking into the Pins on the Harness

Table 3-59 Connector #3 Pin Assignments – Transit Bus Application

Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-60 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC2) #4 connector (18–pin) for transit bus applications are Table 3-59, and listed in Table 3-61.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-62.

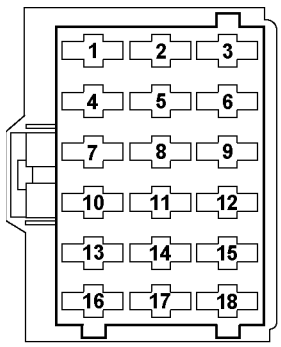
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Not Populated	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Not Populated	
4/3	C_ECAN_H	Not Populated	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust Temperature Lamp	
4/8	Digital Input_FLEX_E1	Not Used	
4/9	Digital Output_HP_FLEX_01	Deceleration Lamp	
4/10	Digital Output_HP_HS_04	Vehicle Power Shutdown	
4/11	Frequency_SFP_10	Not Used	
4/12	PWM_FPO_01	Not Used	
4/13	Digital Input__FLEX_19	—	
4/14	Digital Input_SFP_03	Not Populated	
4/15	Digital Input_SFP_04	Not Populated	
4/16	Digital Input_FLEX_17	Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	Not Used	

Table 3-61 Connector #4 Pin Assignments – Transit Bus Application

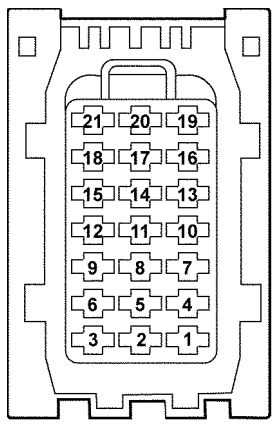
Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-62 Connector #4, 18–pin Connector, Key C

VIH to MCM2 Connector Wiring

The wiring for the 21–pin MCM2 connector is listed in Table 3-63. The side of the connector shown is looking into the pins.

Pin	Signal Type	Function	Connector
21/1	CAN2L	OBD-CAN: CAN Low	
21/2	CAN2GND	OBD-CAN: HF Ground	
21/3	CAN2H	OBD-CAN: CAN High	
21/4	CAN2GND	OBD-CAN: HF Ground	
21/5	KL31	Battery (-) (current demand 40A)	
21/6	KL31	Battery (-) (current demand 40A)	
21/7	KL15	IGN	
21/8	KL31	Battery (-) (current demand 40A)	
21/9	KL31	Battery (-) (current demand 40A)	
21/10	CAN1GND	IES Motor CAN HF Ground	
21/11	KL30	Battery (+) (current demand 40A)	
21/12	KL30	Battery (+) (current demand 40A)	
21/13	CAN1H	IES Motor CAN Signal Level (Ub level CAN high)	
21/14	KL30	Battery (+) (current demand 40A)	
21/15	KL30	Battery (+) (current demand 40A)	
21/16	CAN1GND	IES Motor CAN HF Ground	
21/17		Not Used	
21/18	KDiag_S	K-line (ISO9141)	
21/19	CAN1L	IES Motor CAN Signal Level (Ub level CAN low)	
21/20	KL50	Crank Start Input	
21/21	START_B	Optimized output for starter actuation with emergency branch (ground connection not via ECU)	



Front
Looking into the Pins on the Harness

Table 3-63 21–Pin Connector to the MCM2

Part	DDC Part Number
Connector	024 545 76 26
1.0 – 2.5 mm Contact (single)	014 545 82 26
0.5 – 1.0 mm Contact (single)	014 545 83 26
Seal (2.2 – 3.0 mm^2 insulation diameter)	000 545 29 39
Seal (1.2 – 2.1 mm^2 insulation diameter)	000 545 28 39
Backshell	001 545 79 83
Cavity Plug	000 545 62 80

Table 3-64 21–Pin Connector to the MCM2 Part Numbers

VIH Power Wiring

The OEM-supplied VIH power wiring (see Figure 3-5) supplies 12 volts to the CPC2 and MCM2. The system must be sourced directly from the battery. The terminals are designed to accept 14 AWG wire with an insulation diameter of 3.2 mm minimum and 5.6 mm maximum.

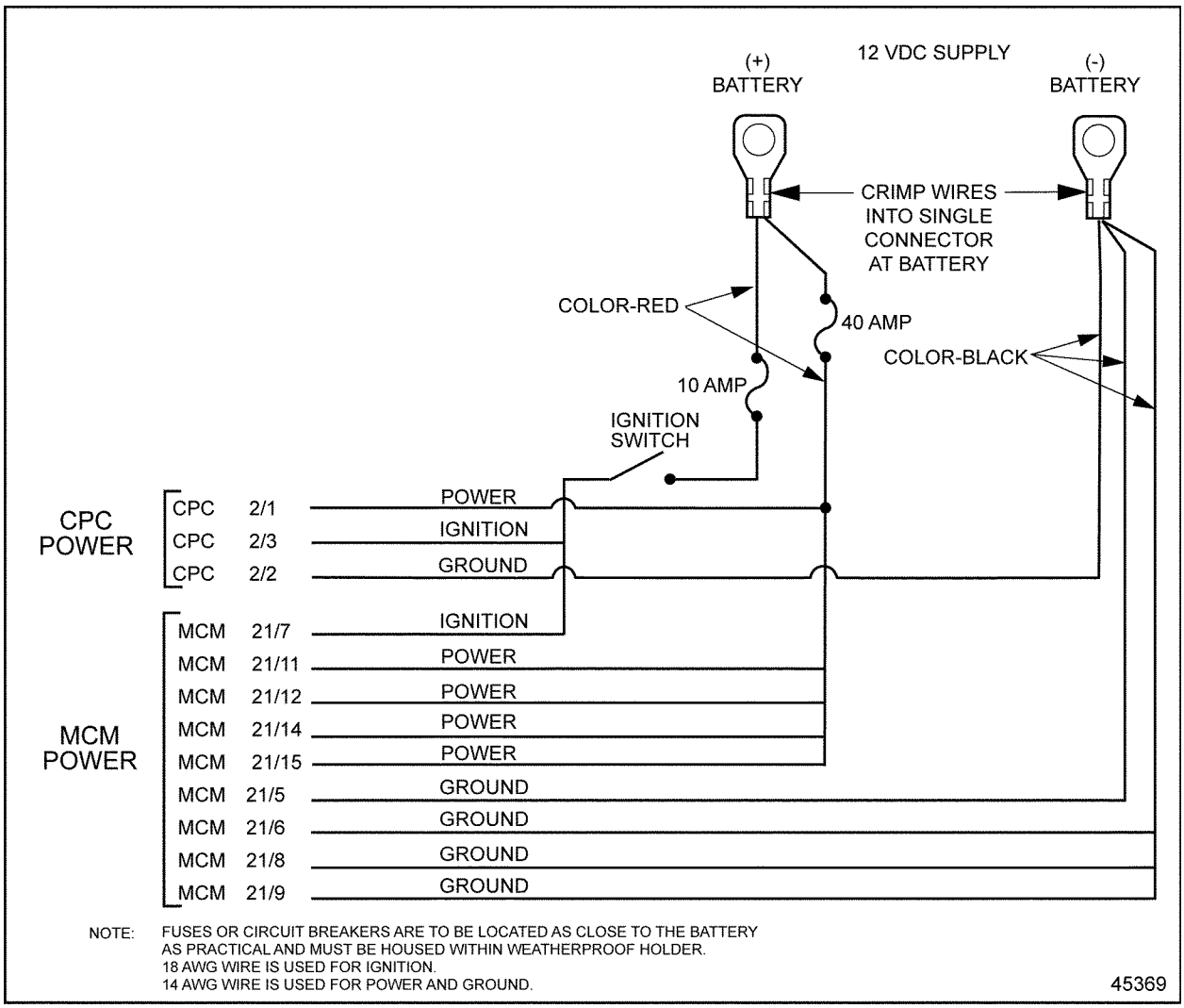


Figure 3-5 Power Wiring

Power and ground must be sourced directly from the battery. An electrically solid connection to the battery or bus bar is required so the battery can filter electrical noise from the power lines. Power for other vehicle systems must not be sourced from the VIH power wires. ***Do not*** use chassis ground.

NOTE:
The ground wire must be electrically separate from chassis ground.

Power and ground bus bars may be used. The bus bar must be connected to the battery posts with 0 AWG or larger wire depending upon the total vehicle current requirement. The connecting wires must be as short as possible to minimize circuit resistance. ***Do not*** connect the ground wire to the chassis ground. The bus bar and all related MCM2 and CPC2 ground circuity must **not** be any part of the chassis ground circuit.

Provide maximum physical separation of the VIH power wiring from other vehicle electrical systems. Other electrical system wires should ideally be at least three feet away from the VIH power wiring and should not be parallel to the VIH power wiring. This will eliminate coupling electromagnetic energy from other systems into the VIH power wiring.

NOTICE:
Connection to reverse polarity will damage the system if not properly fused.

A 40 amp fuse must be used and installed as close to the battery as possible.

The conductor must be annealed copper not aluminum and must comply with the industry standard, *SAE J1128 JAN 95 Low Tension Primary Cable*. Contact the Society of Automotive Engineers to obtain documents, refer to Appendix for their address.

Splices must be soldered and sealed with a waterproof insulator. Alpha FIT-300, Raychem TAT-125 or any equivalent heat shrink - dual wall epoxy encapsulating adhesive polyolefin is required.

Detroit Diesel Corporation recommends color coding. Alternatively, wires may be hot stamped with the cavity number.

Wire Resistances

VIH power terminals require 14 AWG wire. The total resistance of the power harness cannot exceed 60 mΩ. The characteristics for Teflon coated and GXL type wire gauges are listed in listed in Table 3-65.

SAE Wire Gauge	Metric Gauge #	Area mm²	Resistance mΩ/m	Resistance mΩ/ft @ 20°C	Resistance mΩ/ft @ 120°C	Diameter mm
16	1	1.129	15.300	4.66	6.50	0.72
14	2	1.859	9.290	2.83	3.94	1.18
12	3	2.929	5.900	1.80	2.50	1.86
10	5	4.663	3.720	1.13	1.58	2.97
8	8	7.277	2.400	0.73	1.02	4.63

Table 3-65 Wire Characteristics

Total power harness resistance is determined by shorting together the eight terminals in the ECU connector, and then measuring the resistance from the battery (+) to battery (-) terminal at the maximum operating temperature (105°C). Disconnect the harness from the batteries before measuring the resistance.

Communications – SAE J1939 Data Link

SAE J1939 Data Link+, SAE J1939 Data Link-, and SAE J1939 Data Link Shield are used as the J1939 communication link. J1939 cable is required for the J1939 data link. Termination resistors are required per the SAE specification. Refer to SAE J1939–11 for specific requirements.

NOTICE:
The communication system operation will degenerate if the wrong cable is used.

The CPC2 connector pin assignments for SAE J1939 are listed in Table 3-66.

Pin	Signal Type	Function
2/18	Data Link	SAE J1939 (+)
2/17	Data Link	J1939 Shield
2/16	Data Link	SAE J1939 (-)

Table 3-66 J1939 CPC2 to VIH Connector Pin Assignments

The following SAE documents cover the SAE J1939 Data Link. Contact the Society of Automotive Engineers to obtain documents, refer to Appendix C for their address.

SAE J1939	Top Layer (Overview)
SAE J1939/11	Physical Layer
SAE J1939/21	Data Link Layer
SAE J1939/71	Vehicle Application Layer
SAE J1939/01	Truck and Bus Applications
SAE J1939/73	Application Layer — Diagnostics

J1939 cable is available from the following sources:

Belden Electronics Division
2200 U.S. 27 South
Richmond, IN 47374
Phone: 1–800–235–3361
www.belden.com

Tyco Electronics Corporation
Raychem Wire & Harnessing
300 Constitution Drive
Menlo Park, CA 94025
www.raychem.com

Communications – Proprietary Engine-CAN Data Link

The low speed proprietary Engine-CAN link between the MCM2 and the CPC2 must be a twisted shielded cable with 0.75 mm diameter wire (approximately 20 AWG), bundle shielded with drain wire and 30 twists per meter. The insulation is rated to 105°C. Termination resistors for the Engine-CAN link are located in the CPC2 and MCM2. The wiring for the MCM2 21–pin connector and the CPC2 18–pin #4 connector are listed in Table 3-67.

CPC2 18–Pin #4 Connector	Function	MCM2 21–Pin Connector
4/3	Engine-CAN Data Link (+)	21/13
4/1	Engine-CAN Data Link (-)	21/19
4/2	Engine-CAN Data Link (Shield)	21/10

Table 3-67 Propriety Engine-CAN Data Link

3.2.4 POWER SUPPLY – 12 VOLT SYSTEM

Normal operating voltage on a 12 V system for the CPC2 and MCM2 is 11-16 VDC.

NOTICE:
Operating the CPC2 or MCM2 over the voltage limits of 16 volts will cause damage to the CPC2 or MCM2.

Operating the CPC2 and/or MCM2 between 8 and 11 volts may result in degraded engine operation. (Transient operation in this range during engine starting is considered normal for 12 volt systems.)

NOTICE:
Reversing polarity will cause damage to the CPC2 and/or MCM2 if the Power Harness is not properly fused.

NOTE:
All output loads, ignition and CPC2 power must be powered from the same battery voltage source.

Average Current Draw

The maximum average current draw is listed in Table 3-68. This information should be used to size the alternator.

System	Maximum Average Current Draw (12 V Nominal Supply)		
	Crank	Idle	Full Load/Rated Speed
MCM2 – Engine Loads	1.0 A avg	21.0 A avg	25.0 A avg
CPC2 – Vehicle Loads*	18.0 A peak	55.0 A peak	55.0 A peak

* Vehicle loads are controlled by the OEMs who can best determine the total maximum current draw for their installation.

Table 3-68 Maximum Average Current Draw

The current draw for a CPC2 configuration is listed in Table 3-69.

Configuration	Condition	Current
CPC2	Ignition Off	<1 mA
	Ignition On and Engine Stopped	120 mA

Table 3-69 Current Draw for CPC2 Configuration

The current draw for a MCM2 is listed in Table 3-70.

Configuration	Condition	Current
MCM2	Ignition Off	<1 mA
	Ignition On and Engine Stopped	400 mA

Table 3-70 Current Draw for MCM2 Configuration

Overall maximum ACM current capability is 50.0 amps.

Loads	Current — amps			
	Actual Load		ACM Capability	
	Imax (avg)	Imax (pk)	Imax (avg)	Imax (pk)
ACM Quiescent Draw	0.5	0.5	0.5	0.5
Sensors	0.2	0.2	0.3	0.3
NOx1 — engine out	1.0	12.0	8.0	16.0
NOx2 — tailpipe out	1.0	12.0	8.0	16.0
Pump	0.5	1.0	2.0	2.0
Injector	2.0	2.0	2.0	2.0
Diffuser Heater	2.0	2.0	2.0	2.0
Compressed Air Solenoid	1.5	1.5	1.5	1.5
Engine Coolant Solenoid	1.5	1.5	1.5	1.5
Electric Line Heaters	9.0	9.0	9.0	9.0
Total	19.2	41.7	34.8	50.8

Table 3-71 ACM Current

Battery Isolator

A battery isolator is not required. However, some applications require a battery that is dedicated to the engine and completely isolated from the rest of the vehicle. Commercially available battery isolators can be used.

Main Power Shutdown

The main power supply shutdown schematic shows the DDC approved method for main power switch implementation. See Figure 3-6.

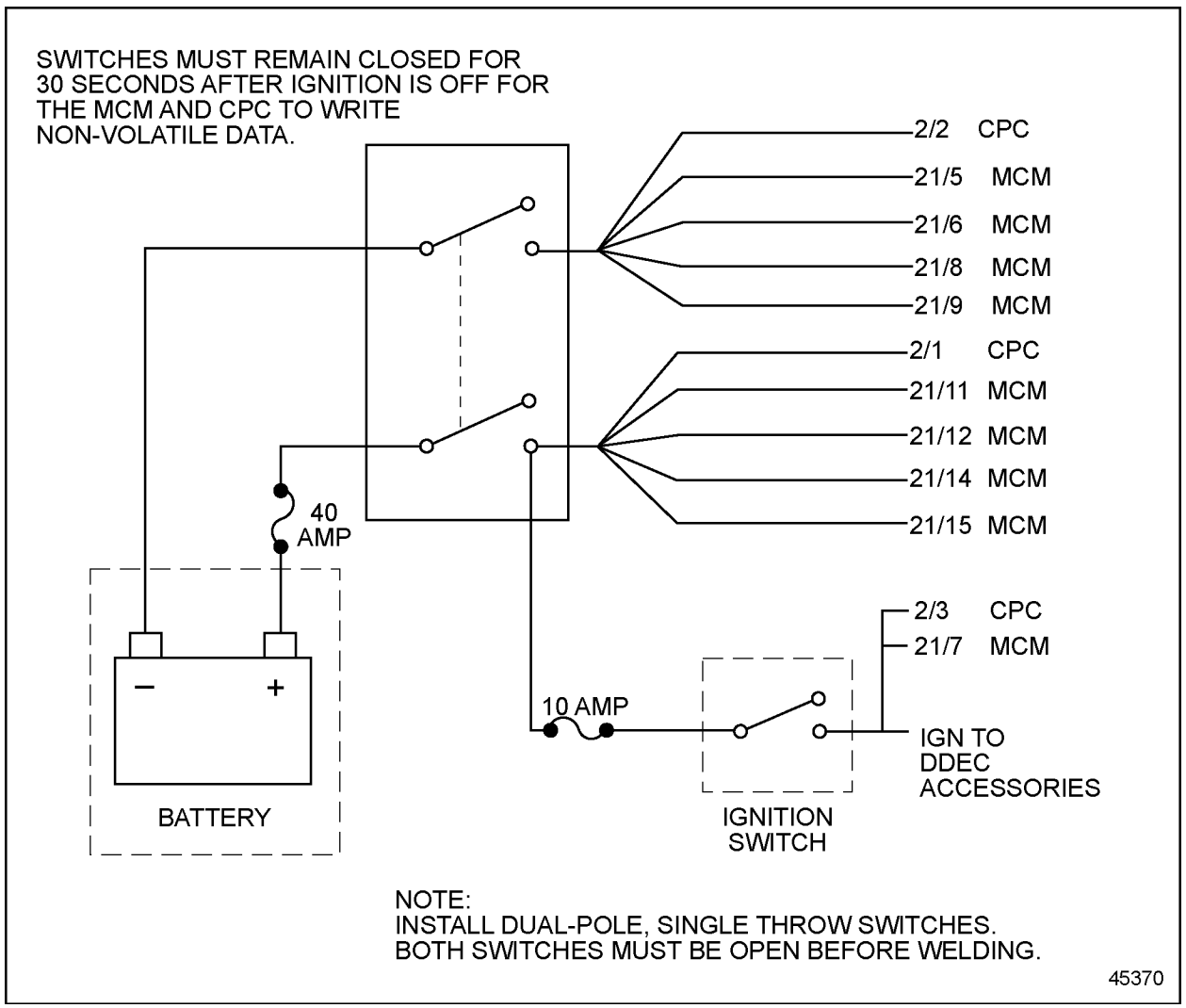


Figure 3-6 Main Power Supply Shutdown

NOTE:
Switches must remain closed for 30 seconds after ignition is off for the MCM2 and CPC2 to write non-volatile data.

NOTE:
It is recommended that both the positive (+) and negative (-) battery leads be disconnected.

NOTE:
Disconnecting positive power is not sufficient to isolate the CPC2 for welding purposes.

NOTICE:
When welding, the following must be done to avoid damage to the electronic controls or the engine: □ Both the positive (+) and negative (-) battery leads must be disconnected before welding. □ The welding ground wire must be in close proximity to welding location - the engine must never be used as a grounding point. □ Welding on the engine or engine mounted components is NEVER recommended.

NOTE:
The alternator should be connected directly to the battery for isolation purposes.

3.2.5 FUSES

A Battery (+) fuse and an ignition circuit fuse must be provided by the vehicle wiring harness. Blade-type automotive fuses are normally utilized; however, manual or automatic reset circuit breakers which meet the following requirements are also acceptable. The fuse voltage rating must be compatible with the CPC2 – MCM2's maximum operating voltage of 16 volts.

CAUTION: **FIRE**
To avoid injury from fire, additional loads should not be placed on existing circuits. Additional loads may blow the fuse (or trip the circuit breaker) and cause the circuit to overheat and burn.

CAUTION:

FIRE

To avoid injury from fire, do not replace an existing fuse with a larger amperage fuse. The increased current may overheat the wiring, causing the insulation and surrounding materials to burn.

The ignition fuse current rating must be sized for the loads utilized in each application; however, a rating of between 5 and 10 amps is usually sufficient.

The Battery (+) fuse current rating must satisfy two criteria:

- Must not open during normal operation
- Must open before the MCM2 or CPC2 is damaged during a reverse battery condition

Bussmann ATC-30 and Delphi Packard Electric Systems MaxiFuse 30 amp rated fuses or equivalent will satisfy these requirements. Acceptable blow times versus current and temperature derating characteristics are listed in Table 3-72 and Table 3-73.

% of Rated Fuse Current	Minimum Blow Time	Maximum Blow Time
100%	100 hours	-
135%	1 minutes	30 minute
200%	6 seconds	40 seconds

Table 3-72 Fuse Current and Blow Time

Temperature	% of Rated Fuse Current
-40°C	110% max
+25°C	100%
+120°C	80% min

Table 3-73 Fuse Temperature and Current

3.2.6 CONNECTORS

The OEM is responsible for the four connectors at the CPC2, the 21–pin connector at the MCM2.

The part numbers for the CPC2 connectors, the 21–pin connector at the MCM2, the 31–pin MCM2 pigtail connector and the 10–pin DPF connector are listed in the following tables.

Part	DDC Part Number
CPC2 - 18 Pin Connector - B Key	018 545 67 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-74 Connector #1, 18–pin Connector, B Key

Part	DDC Part Number
CPC2 - 18 Pin Connector - A Key	013 545 64 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-75 Connector #2, 18–pin Connector, A Key

Part	DDC Part Number
CPC2 - 21 Pin Connector - A Key	013 545 65 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-76 CPC2 Connector #3, 21–pin Connector, Key A

Part	DDC Part Number
CPC2 - 18 Pin Connector - C Key	018 545 68 26
CPC2 - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC2 - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-77 CPC2 Connector #4, 18–pin Connector, Key C

Part	DDC Part Number
Connector	024 545 76 26
1.0 – 2.5 mm Contact (single)	014 545 82 26
0.5 – 1.0 mm Contact (single)	014 545 83 26
Seal (2.2 – 3.0 mm^2 insulation diameter)	000 545 29 39
Seal (1.2 – 2.1 mm^2 insulation diameter)	000 545 28 39
Backshell	001 545 79 83
Cavity Plug	000 545 62 80

Table 3-78 21–Pin Connector to the MCM2 Part Numbers

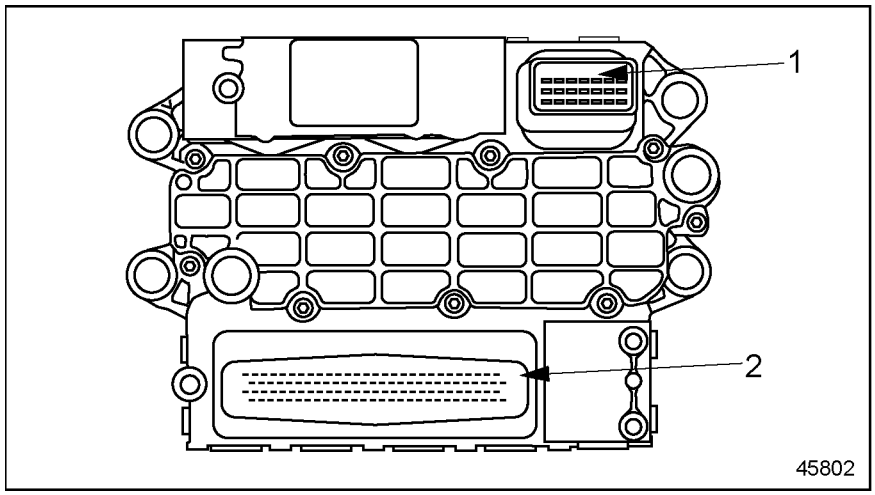
The components listed in Table 3-79 are required to incorporate a SAE J1708/J1939 Data Link in a VIH for diagnostic and reprogramming devices.

Component	DDC Part Number	Deutsch Part Number
Nine-pin Deutsch Connector	23529496	HD10-9-1939P
Connector Cover	23529497	HDC 16–9
Two (2) Cavity Plugs	23507136	114017
Seven (7) Terminals	23507132	0460-202-16141

Table 3-79 VIH Components to Incorporate an SAE J1708/J1939 Data Link

3.3 AFTERTREATMENT CONTROL MODULE

The Aftertreatment Control Module (ACM) is a further development of the current frame module with increased capacity for inputs, outputs, and up to four CAN interfaces. The ACM controls the urea dosing for exhaust gas aftertreatment as an independent ECU of Selective Catalytic Reduction (SCR) and Diesel Particulate Filter (DPF) functionality. The ACM will work with operating voltages of 12V or 24V. Additionally, the ACM is able to drive up to 19 switches for proportional valves and read input of up to 26 sensors.



1. 21–pin Connector
2. 120–pin Connector

Figure 3-7 Aftertreatment Control Module

All power supply lines from the vehicle and powertrain CAN are connected with the 21–pin connector. The sensors and actuators use the 120–pin connector.

3.3.1 COOLING

The ACM does not use a liquid cooler so the cover of the cooler has been removed. The power dissipation depends on the mounting location and the maximum ambient temperature. Mounting locations and ambient conditions are important. The OEM is responsible for a safe operating mode depending on cooling conditions and maximum approved functionality through parameterization.

3.3.2 TEMPERATURE CONDITIONS

The ACM is designed for working between -40°C (-40°F)and +150°C (302°F).

In maximum mode the ACM can drive 19 outputs and five high side supplies with peak current up to 40 Amps. This means a maximum power dissipation of approximately 100 W. In this case there is a high risk of thermal overstress.

NOTICE:
The maximum temperature of the ACM housing must not exceed 105°C (302°F). Exceeding the ACM maximum temperature under full load will cause irreversible damage inside the ECU.

3.3.3 ACM MOUNTING

The ACM is mounted with four screws and requires ISO mount damping elements.

When mounting the ACM keep the following in mind:

- □ Headers or harness bundles should not point up to prevent potential water pooling.
- □ Protect the plastic cover against mechanical damage to the maximum extent possible.
- □ Isolator mounts are required for electrical, thermal, and vibration isolation from the chassis.
- □ Harness bundle strain relief must be provided via the housing bosses.

NOTE:
Do NOT ground the ACM housing. This can result in false codes being logged.

3.3.4 ACM WIRING

The pinouts for the 120–pin connector for the ACM are listed in Table 3-80, Table 3-81, Table 3-82, and Table 3-9.

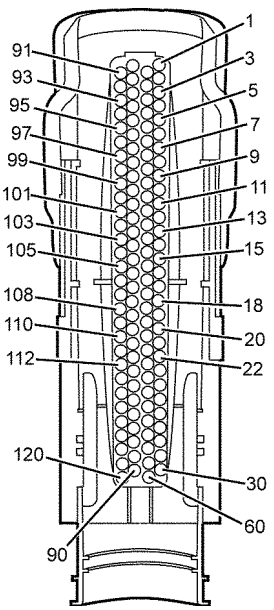
Pin	Signal Type	Function	Connector
1	HS1_SCR	HS1 SCR Supply (1)	
2	RO_Pin02_DPF	NC	
3	HS1_SCR	HS1 SCR Supply (2)	
4	RO_Pin04_DPF	NC	
5	HS1_SCR	HS1 SCR Supply (3)	
6	Elect_1_heating	Elect 1 Heating	
7	RO_Pin07_DPF	NC	
8	RO_Pin08_scr	Res Out Pin 8 SCR	
9	HS3_SCR	HS3 SCR Supply Urea heating (3)	
10	VLS_soot	NC	
11	SGND_RSa_02_DPF	NC	
12	SV_APS	Air Shutoff Valve (GGVS)	
13	SGND_RSa_02_DPF	NC	
14	RO_Pin14_SCR	NC	
15	HS3_SCR	HS3 SCR Supply Urea heating (1)	
16	Elect_5_heating	Elect 5 Heating	
17	HS2_SCR	NC	
18	Elect_3_heating	Elect 3 Heating	
19	HS4_SCR	HS4 SCR Supply (1)	
20	Pump_AdB	Urea Pump	
21	HS_DPF	NC	
22	MH_MDU	Diffuser Heating	
23	HS_DPF	NC	
24	Elect_2_heating	Elect 2 Heating	
25	HS_DPF	NC	
26	CV_APS	APS Air Control Valve	
27	T1V_DPF	Temperature DPF	
28	DV_MDU	Urea Dosing Valve	
29	T1b_DOC2	NC	
30	SGND_T1b_DOC2	NC	

Table 3-80 ACM Connector (1 of 4)

Pin	Signal Type	Function	Connector
31	KI. 15_out	NC	
32	Elect_4_heating	Elect 4 Heating	
33	KI. 15_out	NC	
34	CV_Heat_AdB	Solenoid Valve for Heating DEF Tank	
35	RO_Pin35_DPF	NC	
36	1939_CAN_H	NC	
37	RO_Pin37_SCR	NC	
38	1939_CAN_GND	NC	
39	HS3_SCR	HS3 SCR Supply Urea Heating (2)	
40	Sensor_CAN_H	Sensor CAN H	
41	Sensor_CAN_L	Sensor CAN L	
42	Sensor_CAN_GND_VS	Sensor CAN RF-GND = Supply	
43	Sensor_CAN_GND	Sensor CAN GND	
44	Sensor_CAN_H	NC	
45	Sensor_CAN_L	NC	
46	Sensor_CAN_GND_VS	NC	
47	Sensor_CAN_GND	NC	
48	Sensor_CAN_H	NC	
49	Sensor_CAN_L	NC	
50	Sensor_CAN_GND_VS	Sensor CAN RF-GND = Supply	
51	Sensor_CAN_GND	Sensor CAN GND	
52	Sensor_CAN_H	Sensor CAN H	
53	Sensor_CAN_L	Sensor CAN L	
54	Sensor_CAN_GND_VS	NC	
55	Sensor_CAN_GND	NC	
56	Sensor_CAN_H	NC	
57	Sensor_CAN_L	NC	
58	Sensor_CAN_GND_VS	NC	
59	Sensor_CAN_GND	NC	
60	Sensor_CAN_H	NC	

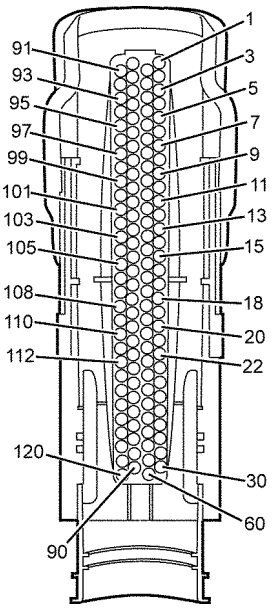


Table 3-81 ACM Connector (2 of 4)

Pin	Signal Type	Function	Connector
61	Sensor_CAN_L	NC	
62	Sensor_CAN_GND_VS	NC	
63	RH_T_T	Ambient Air Temperature Sensor	
64	1939_CAN_H	NC	
65	1939_CAN_L	NC	
66	1939_CAN_GND_VS	NC	
67	RH_T_H	NC	
68	1939_CAN_H	NC	
69	1939_CAN_L	NC	
70	1939_CAN_GND	NC	
71	1939_CAN_GND	NC	
72	P2_DPF	DPF Outlet Pressure	
73	SGND_T1_DPF	Sensor Ground DPF Temperature	
74	P_Air_MDU	Air Pressure Sensor	
75	SGND_T1_SCR	SCR Inlet Temperature GND	
76	T1_SCR	SCR Inlet Temperature	
77	SGND_T21_SCR	SCR Outlet Temperature GND	
78	T2_SCR	SCR Outlet Temperature	
79	SGND_RSp_01_SCR	NC	
80	RSp_01_SCR	NC	
81	SGND_RSp_01_DPF	NC	
82	SGND_RSp_02_SCR	NC	
83	RSp_02_SCR	NC	
84	V_SENS2	Sensor Power Supply (SCR)	
85	T_AdB_MDU	Temperature Dosing Unit	
86	SGND_T_AdB_MDU	Temperature Dosing Unit GND	
87	P1_DPF	DPF Inlet Pressure	
88	SGND_P	Sensor Ground	
89	RSp_02_DPF	NC	
90	RH_T_H_GND	Ambient Air Sensor GND	

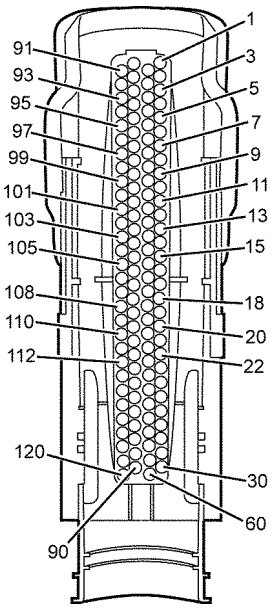


Table 3-82 ACM Connector (3 of 4)

Pin	Signal Type	Function	Connector
91	RSa_01_DPF	NC	
92	Sensor_CAN_GND	NC	
93	1939_CAN_GND	NC	
94	SGND_RSa_02_DPF	NC	
95	RSa_02_DPF	NC	
96	1939_CAN_GND	NC	
97	T1_DOC_2	DOC 2 Inlet Temperature	
98	SGND_T1_DOC_2	DOC 2 Inlet Temperature Ground	
99	SGND_P_AdB_MDU	MDU Pressure In Ground	
100	P_AdB_MDU	DEF Pressure Sensor MDU	
101	1939_CAN_L	NC	
102	SGND_T_AdB_Tank	DEF Tank Temperature Ground	
103	T_AdB_Tank	DEF Tank Temperature	
104	SGND_Soot	NC	
105	Soot	NC	
106	HS4_SCR	NC	
107	T1_DOC_1	DOC 1 Inlet Temperature	
108	SGND_T1_DOC_1	DOC 1 Inlet Temperature Ground	
109	L_AdB_Tank	DEF Tank Level Sensor	
110	HS4_SCR	NC	
111	T1b_DPF	DPF Temperature (dual line)	
112	SGND_T1b_DPF	DPF Temperature Ground	
113	RSa_01_SCR	NC	
114	SGND_RSa_01_SCR	NC	
115	RSa_02_SCR	NC	
116	SGND_RSa_02_SCR	NC	
117	SENS1_V	Sensor Power Supply 1(DPF)	
118	RSp_01_DPF	NC	
119	RSa_03_SCR	NC	
120	SGND_RSa_03_SCR	NC	

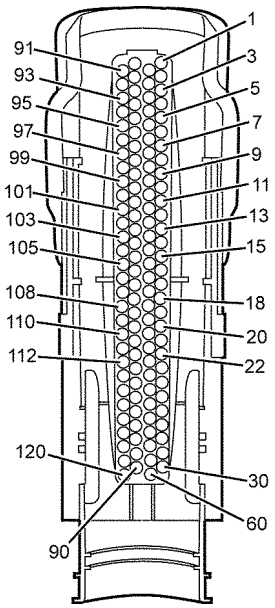
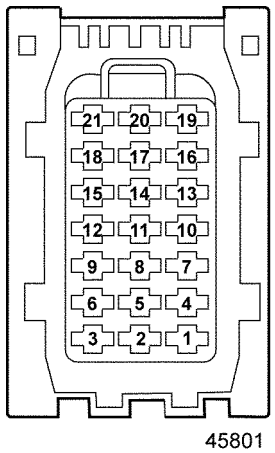


Table 3-83 ACM Connector (4 of 4)

ACM 21–pin Connector

The wiring for the ACM 21–pin connector is listed in Table 3-84. The side of the connector shown is looking into the pins.

Pin	Signal Type	Function	Connector
21/1	OBD_CAN_L	NC	
21/2	OBD_CAN_GND	NC	
21/3	Ubatt_MINUS	Battery (-) Ground	
21/4	OBD_CAN_GND	NC	
21/5	Ubatt_MINUS	Battery (-) Ground	
21/6	Ubatt_MINUS	Battery (-) Ground	
21/7	OBD_CAN_H	NC	
21/8	Ubatt_MINUS	Battery (-) Ground	
21/9	Ubatt_MINUS	Battery (-) Ground	
21/10	Powertrain CAN_H	Powertrain CAN High	
21/11	Ubatt_PLUS	Battery (+) Unfused	
21/12	Ubatt_PLUS	Battery (+) Unfused	
21/13	Powertrain CAN_GND	Powertrain CAN: CAN High	
21/14	Ubatt_PLUS	Battery (+) Unfused	
21/15	Ubatt_PLUS	Battery (+) Unfused	
21/16	K15	Ignition	
21/17	Development	NC	
21/18	Ubatt_PLUS	Battery (+) Unfused	
21/19	Powertrain CAN_GND	Powertrain CAN Ground	
21/20	Powertrain CAN_L	Powertrain CAN Low	
21/21	Development	NC	



Front
Looking into the Pins on the Harness

Table 3-84 21–Pin Connector to the ACM

Part	DDC Part Number
Connector	024 545 76 26
1.0 – 2.5 mm Contact (single)	014 545 82 26
0.5 – 1.0 mm Contact (single)	014 545 83 26
Seal (2.2 – 3.0 mm^2 insulation diameter)	000 545 29 39
Seal (1.2 – 2.1 mm^2 insulation diameter)	000 545 28 39
Backshell	001 545 79 83
Cavity Plug	000 545 62 80

Table 3-85 21–Pin Connector to the MCM2 Part Numbers

3.3.5 AFTERTREATMENT AND SCR SYSTEM

The exhaust Aftertreatment System (ATS) is designed for use in heavy–duty commercial vehicles, which are in compliance with the EPA 2010 exhaust emission standards. ATS electronic functions are regulated by the ACM.

The ATS includes a Diesel Oxidation Catalyst (DOC) for pretreatment of the gas and active regeneration oxidation of injected HC, a Diesel Particulate Filter (DPF) for particulate matter filtration and regeneration, a vanadium-free Selective Catalytic Reduction (SCR) subsystem for nitric oxides (NOx) conversion and an ammonia slip catalyst (ASC).

The ATS design will include either a modular system which consists of one separate DOC + DPF and SCR + Slip unit or an integrated system where both DPF and SCR subsystems are contained in a single housing. The two subsystems will be connected by a pipe when modular. In an effort to reduce system back pressure, the SCR unit is to have a minimum of two parallel paths for the exhaust gas to flow through. The DPF subsystem will require HC injection into the exhaust gases for active regeneration of the filter.

NOTE:
Personnel who will come in contact with urea/DEF must read the Material Safety Data Sheet that should accompany its delivery.

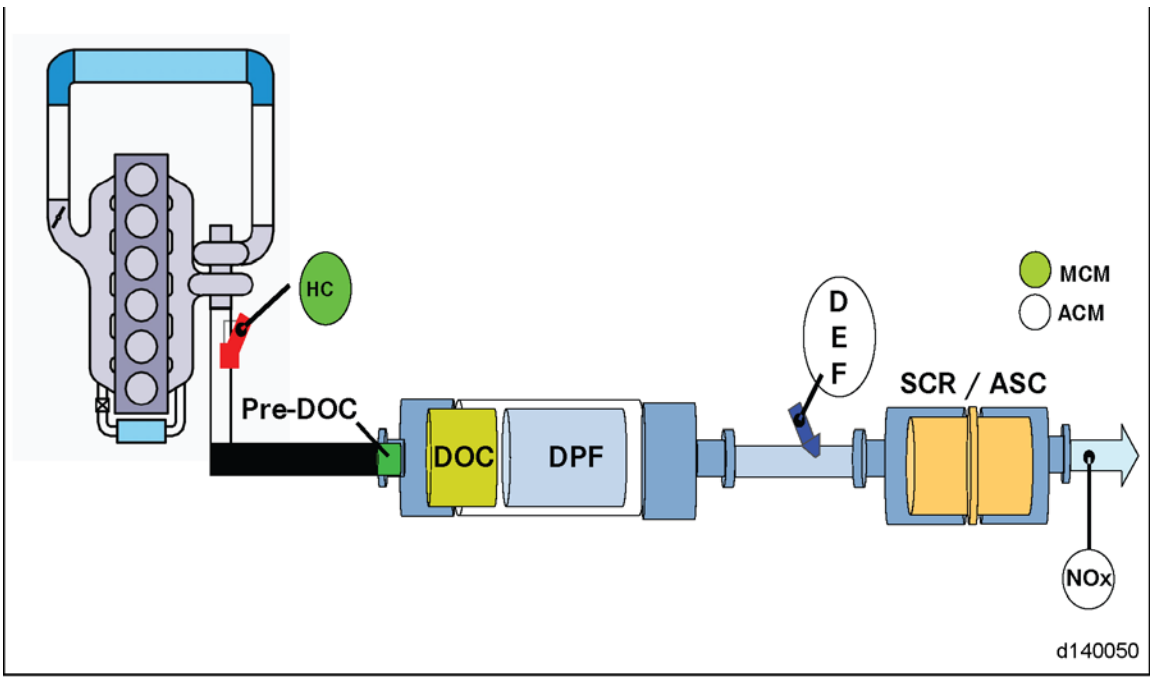


Figure 3-8 ATS and SCR

The functions of the DPF unit are:

- Filtration of the particulate emission
- regeneration of the DPF via conversion of the HCs on the pre-DOC
- Possibility of DPF ash-cleaning within the scope of the service interval

- Oxidation of the possible HC-slip after the DPF on the DPF coating (or post-DOC) and generation of a sufficient quantity of NO2 for the demanded SCR performance

The functions of the SCR unit are:

- Conversion of the NOx emission to harmless nitrogen (N_2) and water vapor (H_2O)
- Oxidation of the possible ammonia-slip after the SCR catalysts on the DOC-S3
- Noise reduction

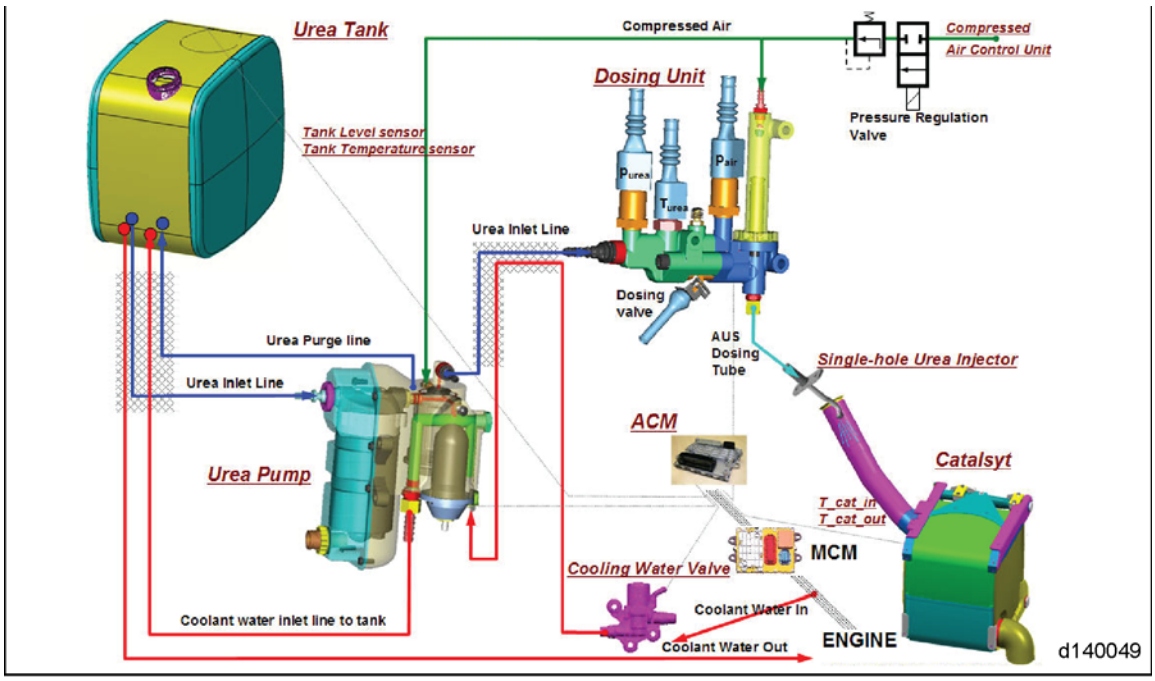


Figure 3-9 SCR System

Procurement Responsibility

The procurement responsibility for system components is listed in Table 3-86.

DDC Responsibility	OEM Responsibility
Compressed Air Control Unit	Urea Tank
Urea Pump	Urea/Air/Coolant Lines
Urea Dosing Unit	Urea Tank Level Sensor
Coolant Water Valve	Urea Tank Temperature Sensor
Urea Injector	Urea Pressure Sensor
ACM	Air Pressure Sensor
Mechanical Interface Connectors	Catalyst In, Out Temperature Sensors
—	Humidity and Temperature Sensor
—	Frame Mount

Table 3-86 Procurement Responsibility for Aftertreatment and SCR System

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3.4 ON-BOARD DIAGNOSTICS

On-board Diagnostics (OBD) requires a standard data link connector conforming to SAE J1939–13 specifications and Wait to Start Lamp and the Malfunction Indicator Lamp.

Transmissions supporting transmission output shaft speed via J1939 must also support both error and unavailable status to be considered compliant with Detroit Diesel engines.

3.4.1 DATA LINK CONNECTOR LOCATION

The connector is to be located in the driver's side footwell region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's edge of the center console (or the vehicle centerline if the vehicle does not have a center console). The location of the connector should be no higher than the bottom of the steering wheel when in the lowest adjustable position.

NOTE:
The connector may not be located on or in the center console. The connector may not be located on the horizontal faces near the floor-mounted gear selector, parking brake lever, or cup holders nor on the vertical faces near the car stereo, climate system or navigation system controls.

The location of the connector must by one that is easily identified and accessed (e.g. to connect an off-board tool). For vehicles equipped with a driver's side door, the connector must be easily identified and accessed by a technician standing or crouched on the ground outside the driver's side of the vehicle with the driver's side door open.

If the connector is covered, the cover must be removable by hand without the use of any tools and be labeled “OBD” to aid technicians in identifying the location of the connector. Access to the diagnostic connector may not require opening or the removal of any storage accessory (e.g., ashtray, coin box). The label shall be submitted to ARB for review and approval, at or before the time the manufacturer submits its certification application.

Data Link Connector Wiring

The SAE J1708/J1939 OEM-supplied nine-pin data link connector is required.

REQUIRED: The J1939 data link must be wired to this connector.

The components listed in Table 3-87 are required to incorporate a SAE J1708/J1939 Data Link in a VIH for diagnostic and reprogramming devices.

Component	DDC Part Number	Deutsch Part Number
Nine-pin Deutsch Connector	23529496	HD10-9-1939P
Connector Cover	23529497	HDC 16–9
Two (2) Cavity Plugs	23507136	114017
Seven (7) Terminals	23507132	0460-202-16141

Table 3-87 VIH Components to Incorporate an SAE J1708/J1939 Data Link

The following illustration shows the wiring for the nine-pin connector (see see Figure 3-10).

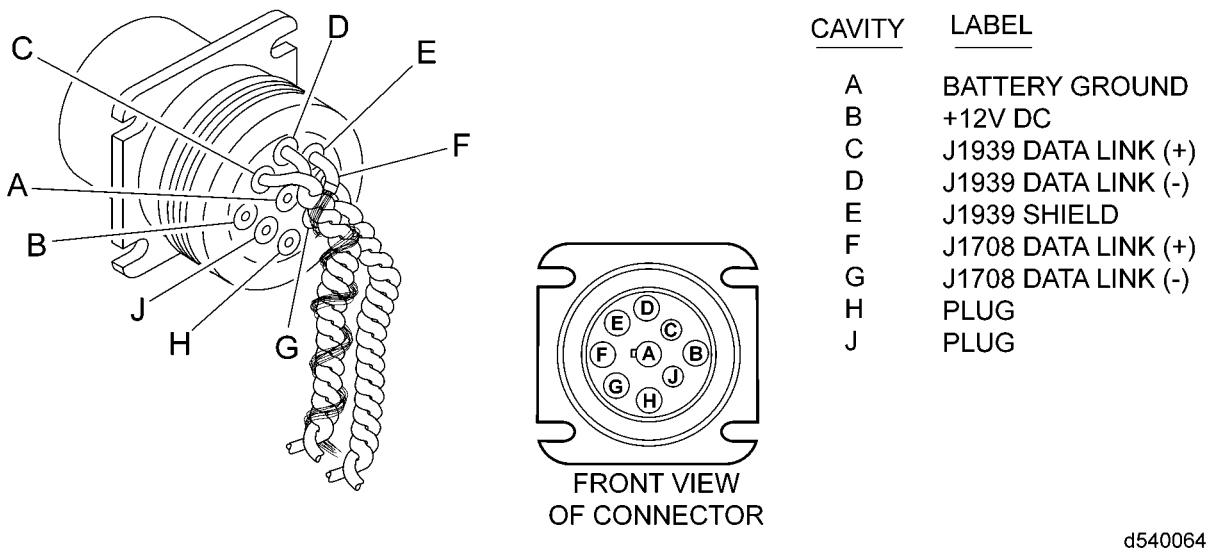

Figure 3-10 Wiring for 9-pin Data Link Connector

The SAE J1708 Data Link must be twisted pairs. The twists are a minimum of 12 turns per foot (305 mm). The maximum length for the SAE J1708 Data Link is 130 ft (40 m).

3.4.2 LAMP REQUIREMENTS

OBD regulations require circuit continuity detection of the Wait to Start Lamp and the Malfunction Indicator Lamp.

Lamp Output	Lamp	Source	Source Address	Lamp Circuit
Malfunction Indicator Lamp (MIL)		ACM CPC2 MCM2	0x3D 0x00 0x01	The lamp circuit must be monitored for malfunctions that cause the lamp to fail to illuminate when commanded on (e.g., burned out bulb).
Wait to Start Lamp (WTS Lamp)		CPC2	0x00	The lamp circuit must be monitored for malfunctions that cause the lamp to fail to illuminate when commanded on (e.g., burned out bulb).

Table 3-88 2010 Lamp Status Support

The MIL is to be located on the driver's side instrument panel and must be of sufficient illumination and location to be readily visible under all lighting conditions. The MIL is to be amber in color when illuminated. There is to be only one MIL used to indicate all faults detected by the OBD system on a single vehicle.

NOTE:
The MIL may not be used for any purpose other than that specified in this manual.

Multiplexed Lamps

If an OEM device is controlling lamps, the device must be capable of detecting any circuit continuity malfunctions. The OEM must broadcast circuit malfunction information (continuity checks) on the powertrain J1939 data link per J1939–73 requirements.

A multiplexed MIL must default to ON if communication is lost between modules for any reason or if the sending device indicates the data is unavailable for data is in error. For applications in which the CPC controls the lamp, the bulb must be of sufficient resistance to allow for detection of a circuit continuity error.

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3.5 WIRES AND WIRING

Detroit Diesel Corporation recommends color coding and hot stamping wire numbers in contrasting colors at intervals of four inches or less.

3.5.1 GENERAL REQUIREMENTS

NOTE:
Avoid renumbering DDC circuits since all troubleshooting guides reference the circuit numbers shown in the schematic. DDC suggests including a prefix or suffix with the DDC circuit numbers when conflicts exist.

3.5.2 GENERAL WIRE

All wires used in conjunction with DDEC VI must meet the following criteria:

NOTICE:
DDC does not recommend using any type of terminal lubricant or grease compounds. These products may cause dirt or other harmful substances to be retained in the connector. DDC has not tested these products and cannot stand behind their use.

NOTICE:
Insulation must be free of nicks.

Criteria: Wires

Tape, conduit, loom or a combination thereof must be used to protect the wires. Refer to sections 3.6 and 3.7.

All wires must be annealed copper wire (not aluminum).

All wires must comply with SAE J1128.

All wires must be insulated with cross-link polyethylene (XLPE) such as GXL, or any self-extinguishing insulation having a minimum rating of -40°C (-40°F) to 125°C (257°F).

3.5.3 CRIMP TOOLS

The part numbers for the crimp tools for working with the MCM2 and CPC2 connectors are listed in Table 3-89.

Description	Part Number
Extraction Tool	726503–1
Hand Crimp Tool	169400–0
Crimp Dies for 0.5 mm – 1.0 mm Terminals	734262–0
Crimp Dies for 1.0 mm – 2.5 mm Terminals	169917–0

Table 3-89 Crimp Tools

3.5.4 DEUTSCH TERMINAL INSTALLATION AND REMOVAL

The method of terminal installation and removal varies. The following sections cover Deutsch terminal installation and removal.

Deutsch Terminal Installation Guidelines

Deutsch connectors have cable seals molded into the connector. These connectors are push-to-seat connectors with cylindrical terminals. The diagnostic connector terminals are gold plated for clarity.

NOTICE:
Improper selection and use of crimp tools have varying adverse effects on crimp geometry and effectiveness. Proper installation of terminals require specialized tools. Do not attempt to use alternative tools.

The crimp tool to use in Deutsch terminal installation is J–34182 (Kent-Moore part number).

NOTICE:
Terminal crimps must be made with the Deutsch crimp tool P/N: HDT-48-00 to assure gas tight connections.

NOTICE:
If a separate seal is required, be sure to install the seal onto the wire before stripping the insulation.

Use the following instructions for installing Deutsch terminals:

1. Strip approximately .25 inch (6 mm) of insulation from the cable.
2. Remove the lock clip, raise the wire gage selector, and rotate the knob to the number matching the gage wire that is being used.
3. Lower the selector and insert the lock clip.
4. Position the contact so that the crimp barrel is 1/32 of an inch above the four indenters. See Figure 3-11. Crimp the cable.

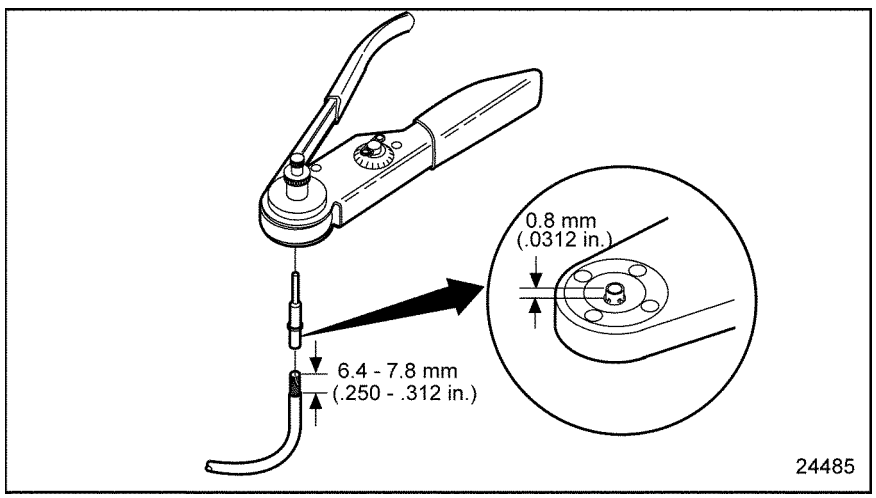

Figure 3-11 Setting Wire Gage Selector and Positioning the Contact

5. Grasp the contact approximately one inch behind the contact crimp barrel. Hold the connector with the rear grommet facing you. See Figure 3-12.

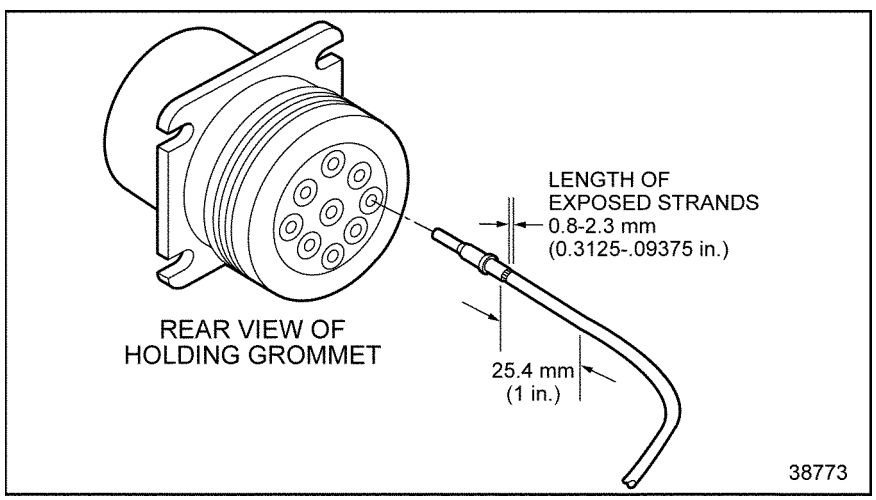

Figure 3-12 Pushing Contact Into Grommet

6. Push the contact into the grommet until a positive stop is felt. See Figure 3-12. A slight tug will confirm that it is properly locked into place. See Figure 3-13.

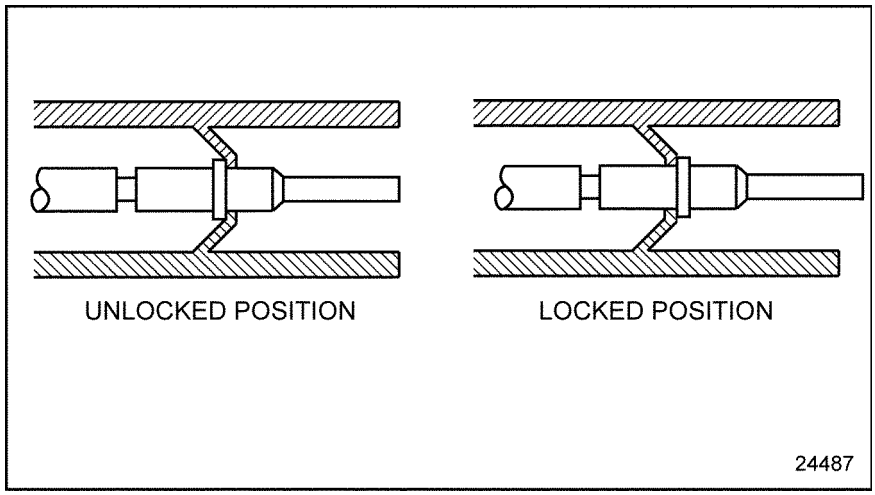

Figure 3-13 Locking Terminal Into Connector

Deutsch Terminal Removal

The appropriate size removal tool should be used when removing cables from connectors. The proper removal tools are listed in Table 3-90.

Tool	Kent-Moore Part Number
Removing (12 AWG)	J–37451
Removing (16-18 AWG)	J–34513-1

Table 3-90 Removal Tools for Deutsch Terminals

Remove Deutsch terminals as follows:

1. With the rear insert toward you, snap the appropriate size remover tool over the cable of contact to be removed. See Figure 3-14.

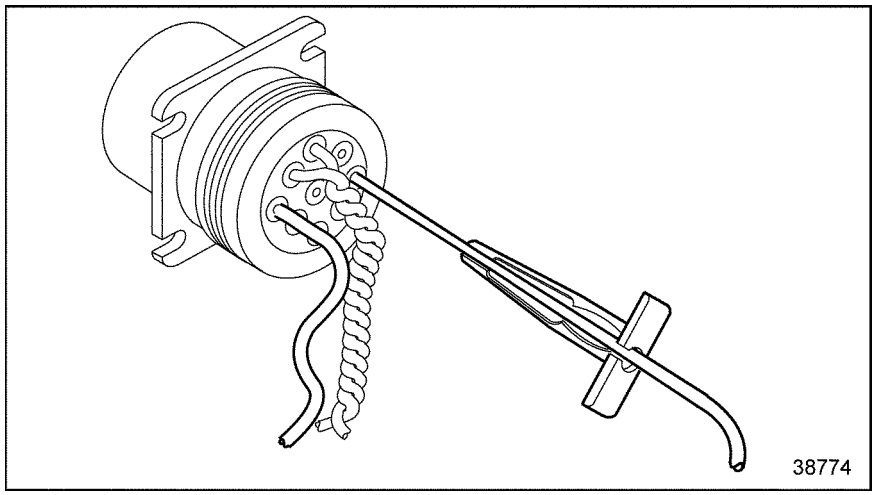

Figure 3-14 Removal Tool Position

2. Slide the tool along the cable into the insert cavity until it engages and resistance is felt. Do not twist or insert tool at an angle. See Figure 3-15.

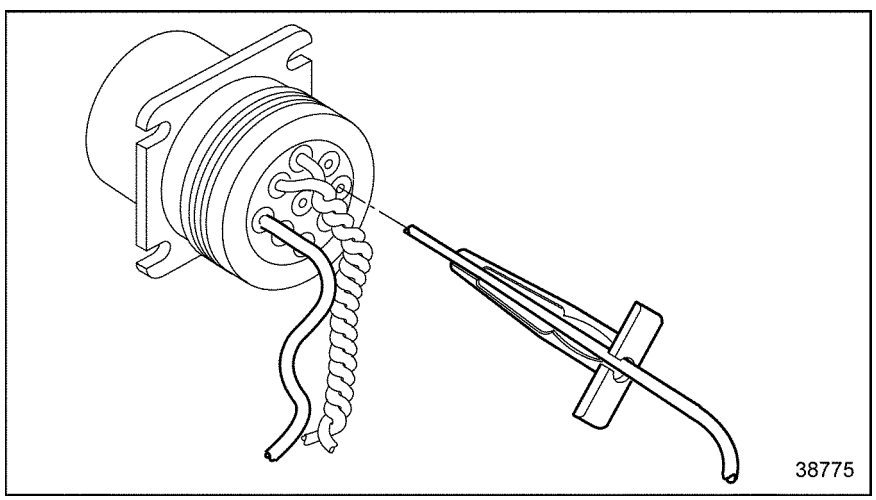

Figure 3-15 Removal Tool Insertion

3. Pull contact cable assembly out of the connector. Keep reverse tension on the cable and forward tension on the tool.

3.5.5 SPLICING GUIDELINES

The following are guidelines which may be used for splices. The selection of crimpers and splice connectors is optional. Select a high quality crimper equivalent to the Kent-Moore tool, J–38706, and commercially available splice clips.

The recommended technique for splicing and repairing circuits (other than power and ignition circuits) is a clipped and soldered splice. Alternatively, any method that produces a high quality, tight (mechanically and electronically sound) splice with durable insulation is considered to be acceptable.

Clipped and Soldered Splicing Method

The tools required are listed in Table 3-91.

Tool	Part Number
Heat Gun	--
Sn 60 solder with rosin core flux	--
Wire Stripper	Kent-Moore J–35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent

Table 3-91 Recommended Splicing Tools

Criteria: Splicing Straight Leads

No more than one strand in a 16 strand wire may be cut or missing.

Use Sn 60 solder with rosin core flux.

The exposed wire must be clean before the splice is soldered.

Soldering splice connectors is optional. To solder splice connectors:

1. Position the leads, so one overlaps the other. See Figure 3-16.

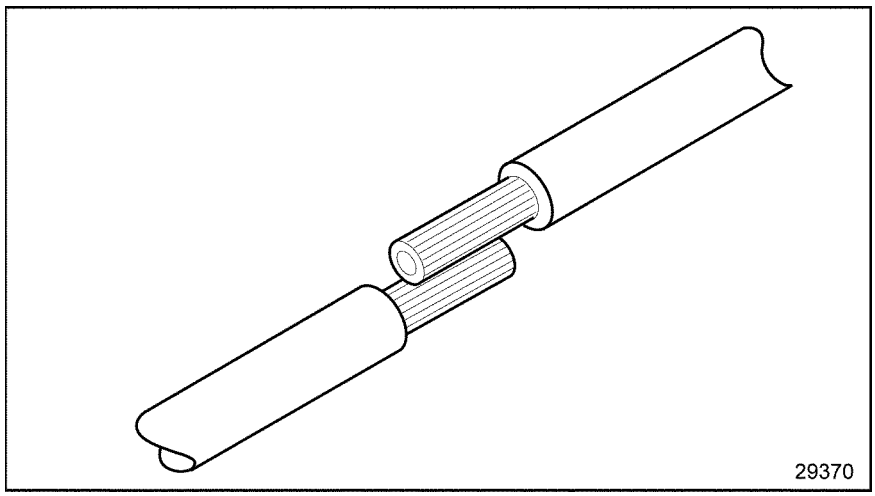

Figure 3-16 Positioning the Leads

2. Secure the leads with a commercially available clip and hand tool. See Figure 3-17.

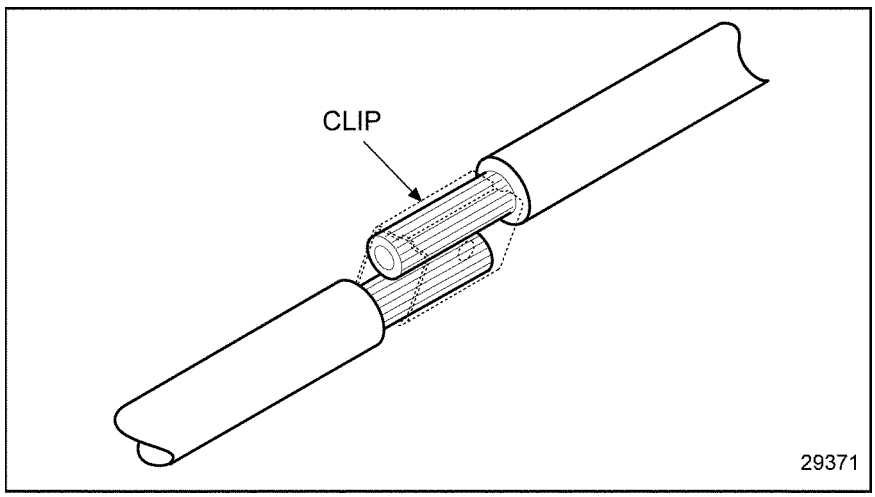

Figure 3-17 Securing the Leads With a Clip

3. Use a suitable electronic soldering iron to heat the wires. Apply the solder to the heated wire and clip (not to the soldering iron) allowing sufficient solder flow into the splice joint.

4. Pull on wire to assure crimping and soldering integrity. The criteria listed in Table 3-92 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 3-92 Applied Load Criteria for Terminals

5. Loop the lead back over the spliced joint and tape. See Figure 3-18.

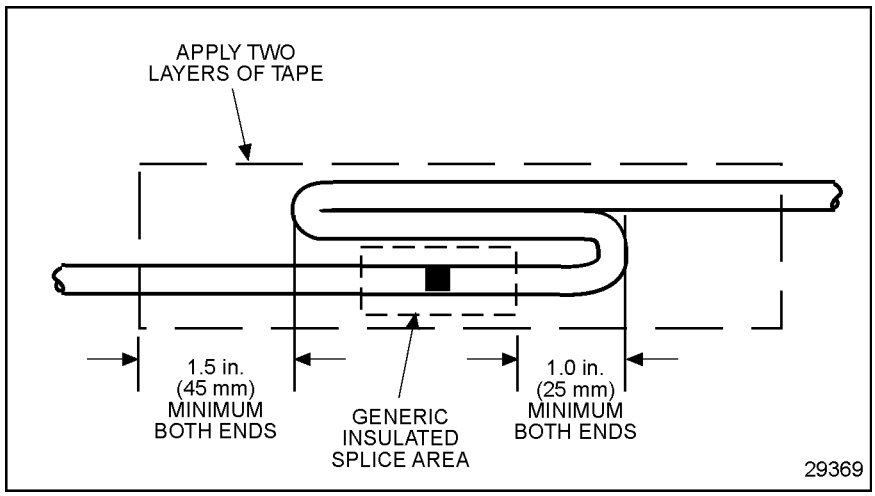

Figure 3-18 Recommended Strain Relief of Spliced Joint

Splicing and Repairing Straight Leads-Alternate Method 1

The tools required are listed in Table 3-93.

Tool	Part Number
Heat Gun	--
Wire Stripper	Kent-Moore J–35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent
Terminal Crimper for Metri-Pack 280 (12 AWG)	Kent-Moore J–38125-6
Terminal Crimper for Metri-Pack 280 (18 AWG)	Kent-Moore J–39848
Terminal Crimper for Weather Pack	Kent-Moore J–35606
Terminal Crimper for Deutsch	Kent-Moore J–34182
Terminal Crimper for Metri-Pack 150	Kent-Moore J–35123

Table 3-93 Recommended Splicing Tools

Criteria: Splicing Straight Leads

No more than one strand in a 16 strand wire may be cut or missing.

The recommended method to splice straight leads follows:

1. Locate broken wire.
2. Remove insulation as required; be sure exposed wire is clean and not corroded.
3. Insert one wire into the splice clip until it butts against the clip. Stop and crimp (see Figure 3-19, A).
4. Insert the other wire into the splice clip until it butts against the clip stop (see Figure 3-19, B).

NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

5. Visually inspect the splice clip for cracks, rupture, or other crimping damage. Remove and replace damaged clips before proceeding.
6. Pull on wire to ensure the splice integrity. The criteria listed in Table 3-94 must be met.

Wire Gage	Must Withstand Applied Load
14 AWG	45 lb (200 N)
16 AWG	27 lb (120 N)
18 AWG	20 lb (90 N)

Table 3-94 Applied Load Criteria for Terminals

7. Shrink the splice clip insulative casing with a heat gun to seal the splice (see Figure 3-19, C).

NOTICE:
Splices may not be closer than 12 in. (.3 m) apart to avoid degradation in circuit performance. Replace wire to avoid having splices closer than 12 in. (.3 m) apart.

8. Loop the lead back over the spliced joint and tape. See Figure 3-18.

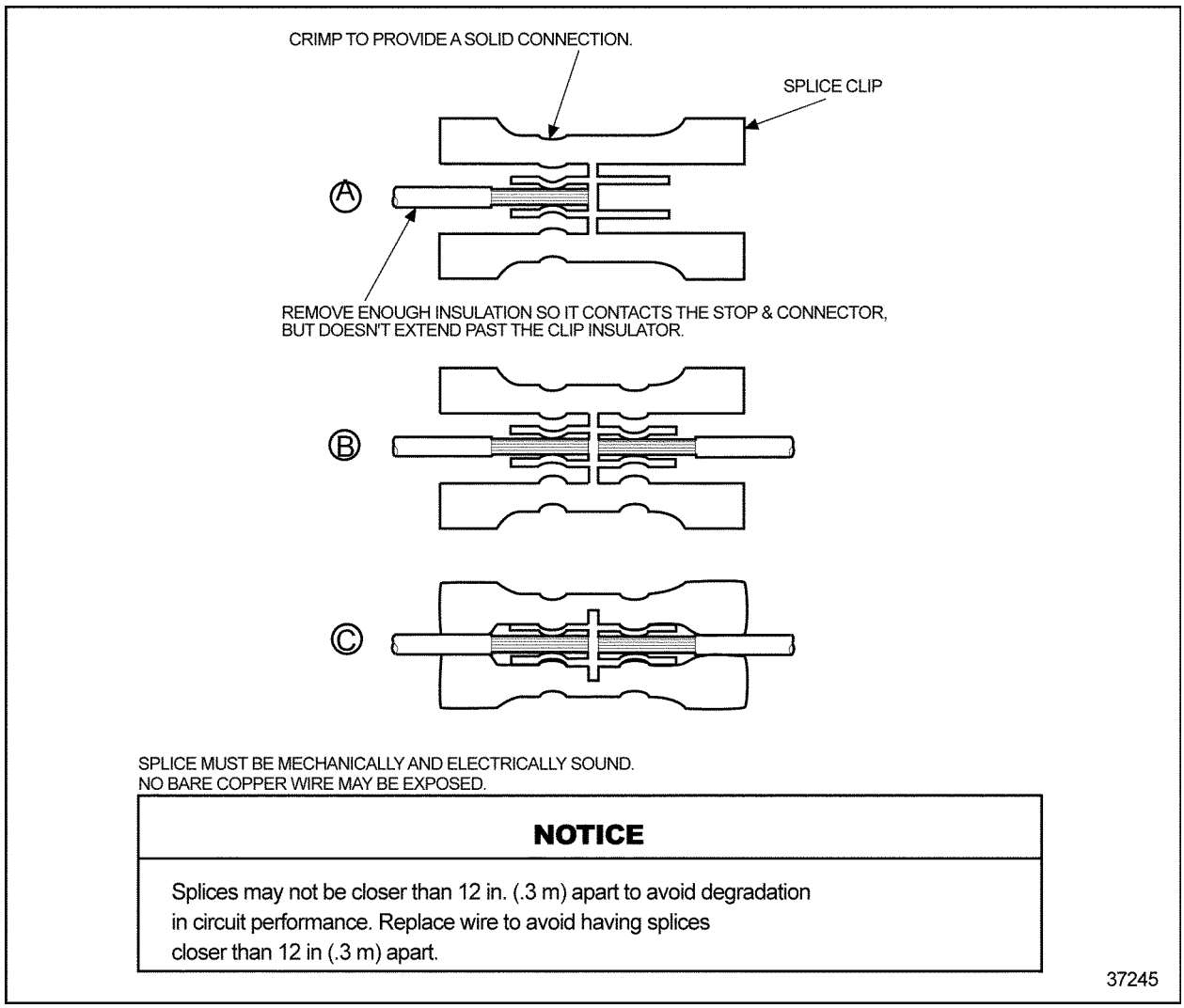

Figure 3-19 Splicing Straight Leads - Alternate Method 1

Splicing and Repairing Straight Leads - Alternate Method 2

This method is not allowed or recommended for power or ignition circuits. The tools required are listed in Table 3-95.

Tool	Part Number
Heat Gun	--
Wire Stripper	Kent-Moore J–35615 or equivalent
Splice Clips (commercially available)	Wire size dependent
Heat Shrink Tubing	Raychem HTAT or equivalent
Terminal Crimper for Metri-Pack 280 (12 AWG)	Kent-Moore J–38125-6
Terminal Crimper for Metri-Pack 280 (18 AWG)	Kent-Moore J–39848
Terminal Crimper for Weather Pack	Kent-Moore J–35606
Terminal Crimper for Deutsch	Kent-Moore J–34182
Terminal Crimper for Metri-Pack 150	Kent-Moore J–35123

Table 3-95 Recommended Splicing Tools

Criteria: Splicing Straight Leads

No more than one strand in a 16 strand wire may be cut or missing.

An acceptable option for splicing straight leads is:

1. Locate broken wire.
2. Remove insulation as required; be sure exposed wire is clean and not corroded.
3. Slide a sleeve of glue lined, shrink tubing (Raychem HTAT or equivalent) long enough to cover the splice clip on the wire and overlap the wire insulation, about .25 in. (6 mm) on both sides (see Figure 3-20, A).
4. Insert one wire into splice clip until it butts against the splice clip. Stop and crimp (see Figure 3-20, B).
5. Insert the remaining wires into the splice clip one at a time until each butts against the splice clip; stop and crimp (see Figure 3-20, B).

NOTICE:
Any terminal that is cracked or ruptured is unacceptable as malfunctions may occur.

6. Visually inspect the terminal for cracks, rupture, or other crimping damage. Remove and replace damaged terminal before proceeding.
7. Slide the shrink tubing over the crimped splice clip (see Figure 3-20, C).
8. Shrink tubing with a heat gun to seal the splice (see Figure 3-20, D).

NOTICE:
A minimum of two layers of heat shrink tubing must be applied to splices that have more than one lead in or out.

9. Loop the lead back over the spliced joint and tape. See Figure 3-18.

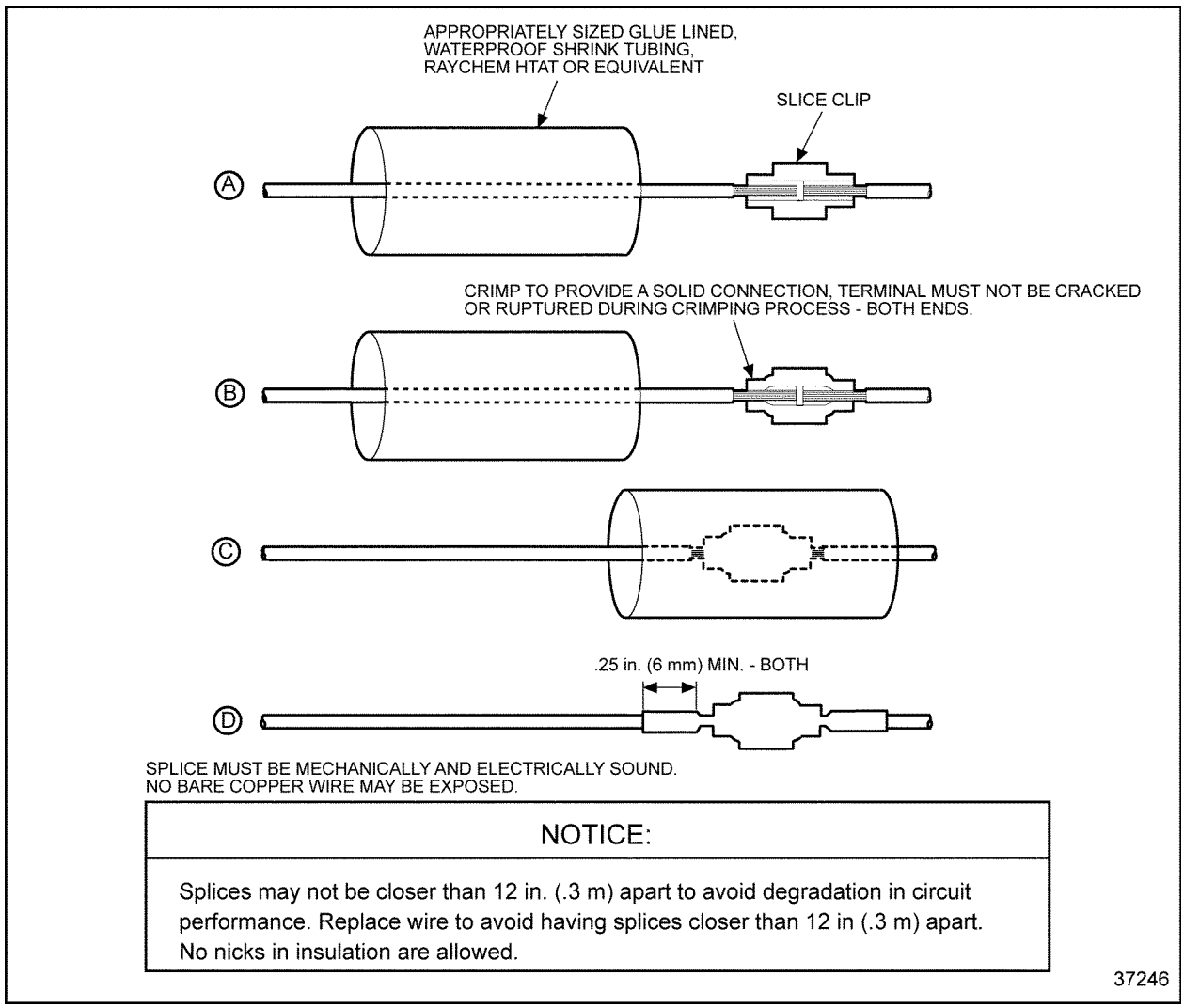

Figure 3-20 Splicing Straight Leads - Alternate Method 2

Shrink Wrap

Shrink wrap is required when splicing non insulated connections. Raychem HTAT or any equivalent heat shrink dual wall epoxy encapsulating adhesive polyolefin is required. Shrink wrap must extend at least .25 in. (6 mm) over wire insulation past splice in both directions.

Alpha Wire Corporation
711 Lidgerwood Ave
P.O. Box 711
Elizabeth, New Jersey 07207-0711
1-800-52ALPHA
www.alphawire.com

Tyco Electronics Corporation
Raychem Cable Identification and Protection
300 Constitution Drive
Menlo Park, CA 94025
Phone: 1–800–926–2425
www.raychem.com

To heat shrink wrap a splice:

NOTICE:
The heat shrink wrap must overlap the wire insulation about .25 in. (6 mm) on both sides of the splice.

1. Select the correct diameter to allow a tight wrap when heated.
2. Heat the shrink wrap with a heat gun; do not concentrate the heat in one location, but apply the heat over the entire length of shrink wrap until the joint is complete.
3. Repeat step 2 to apply a second layer of protection (if required by splicing guidelines).

Staggering Wire Splices

Position spliced wires properly as follows:

NOTICE:
You must stagger positions to prevent a large bulge in the harness and to prevent the wires from chafing against each other.

1. Stagger the position of each splice (see Figure 3-21) so there is at least a 2.5 in. (65 mm) separation between splices.

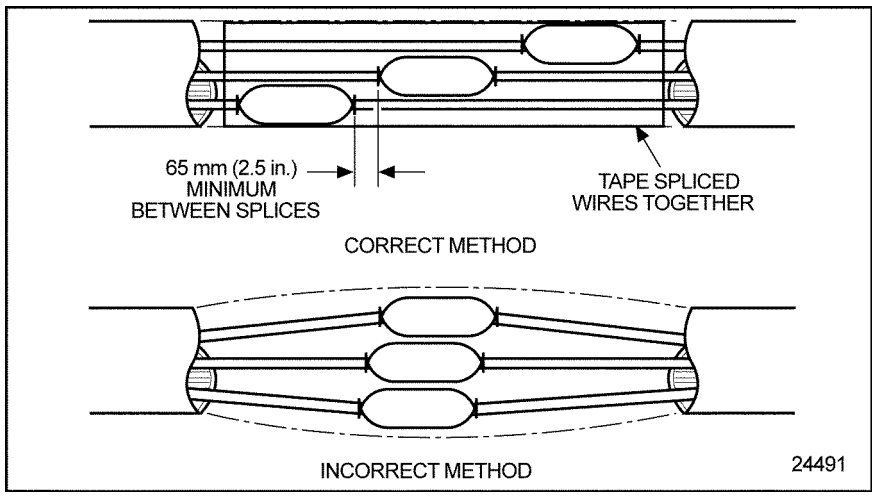

Figure 3-21 The Correct and Incorrect Method of Staggering Multiple Splices

NOTICE:
A minimum of two layers of heat shrink tubing extending .25 in. (6 mm) past the splice must be used to complete the splice.

2. Heat shrink a minimum of two layers of heat shrink tubing.
3. Tape the spliced wires to each other. Refer to section 3.6.

3.6 CONDUIT AND LOOM

Conduit must be used to protect the harness cable and cable splices.

NOTICE:
The conduit must not cover any connectors, switches, relays, fuses, or sensors.

The following guidelines should be used when designing a harness:

NOTICE:
Wires should be sized and cut to near equal length prior to installing conduit.

- The distance between the back of the connector or other listed devices to the end of the conduit should not exceed:
  - 1.0 in. (25 mm) for a single connector/device
  - 3 in. (75 mm) for multiple connectors/devices
- All cable breakouts and conduit ends must be secured in place with conduit outlet rings or tape.

Criteria: Conduit and Loom

Due to the wide variety of operating conditions and environments, it is the responsibility of the OEM to select a conduit that will survive the conditions of the specific applications. Flame retardant convoluted polypropylene conduit or equivalent may be used for most installations. Heat retardant nylon conduit or oil, water, acid, fire, and abrasion resistant non-metallic loom conforming to SAE J562A* is also acceptable. The diameter of conduit should be selected based on the number of wires being protected.

* If non-metallic loom is used, secure the ends with tightly wrapped nylon straps to prevent unraveling.

Conduit should cover the wires without binding and without being excessively large.

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3.7 TAPE AND TAPING

Tape must be used when conduit is utilized. Be sure to follow the tape manufacturers' guidelines. The harness manufacturer may use tape under the harness covering (conduit or loom) to facilitate harness building. Tape must be tightly wrapped at all conduit interconnections with a minimum of two layers (refer to section 3.6). Be sure to firmly secure the start and finish ends of tape.

Criteria: Tape

NOTICE:
Black vinyl electrical tape should not be used in applications where the temperature exceeds 176°F (80°C).

In applications where the temperature doesn't exceed 176°F (80°C), black vinyl electrical tape that is flame retardant and weather resistant may be used.
In applications where temperature exceeds 176°F (80°C), vinyl electrical tape should not be used. For these applications, adhesive cloth backed, flame retardant polyethylene or fiber glass tape (Delphi #PM-2203, Polikan #165 or equivalent) is recommended.

Criteria: Taping

The tape must extend a minimum of 1 in. (25 mm) past the conduit.
The tape must be crossed over butted conduit ends.
The tape must be extended a minimum of 1 in. (25 mm) in each direction at all branches.

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3.8 SENSORS AND ACTUATORS

DDEC is designed to operate with several types of sensors as listed in Table 3-96.

Sensor Type	Description
Variable Reluctance/Magnetic Pick-up	Used to monitor the crankshaft position, engine speed, turbo speed, and vehicle speed.
Thermistor	Used to monitor temperatures.
Variable Capacitance	Used to monitor manifold, and oil gallery pressures.
Variable Resistance (Potentiometer)	Used to sense throttle position.
Switch	Used to signal coolant level.

Table 3-96 Sensor Types

The sensors integrated into the Engine Harness are factory-installed (refer to section 3.8.1). The sensors integrated into the Vehicle Interface Harness are installed by the OEM (refer to section 3.8.4).

3.8.1 FACTORY-INSTALLED SENSORS

The sensors integrated into the factory-installed Engine Harness are listed in Table 3-97.

Sensor	Function
Camshaft Position Sensor (CMP Sensor)	Indicates a specific cylinder in the firing order.
Crankshaft Position Sensor (CKP Sensor)	Senses crankshaft position and engine speed for functions such as fuel control strategy.
Engine Coolant Temperature Sensor (ECT Sensor)	Senses coolant temperature for functions such as engine protection, fan control and engine fueling.
EGR Temperature Sensor	Senses EGR exhaust temperature after EGR cooler. Used for EGR system diagnosis.
Engine Oil Pressure Sensor (EOP Sensor)	Senses gallery oil pressure for functions such as engine protection.
Engine Oil Temperature Sensor (EOT Sensor)	Senses oil temperature for functions such as reducing variation in fuel injection and fan control.
Exhaust Pressure Sensor (before turbo)	Monitors exhaust pressure for EGR and boost control.
Fan Speed Sensor	Monitors fan speed.
Intake Manifold Pressure Sensor (IMP Sensor)	Senses turbo boost for functions such as smoke control and engine protection.
Intake Manifold Temperature Sensor (IMT Sensor)	Senses boost temperature
Knock Sensor	Monitors engine knock pulses for injector control, timing, and boost.
Supply Fuel Temperature Sensor (SFT Sensor)	Senses fuel temperature for functions such as engine fueling.
Turbo Compressor Temperature Out Sensor	Senses turbo out air temperature.
Turbo Speed Sensor (TSS)	Monitors turbo speed.
Water-in-Fuel Sensor (MBE 900 and DD15)	Detects water in the fuel filter that alerts the owner/driver that the fuel filter needs to be dried out.
Water Pump Speed Sensor	Monitors water pump speed.

Table 3-97 Function of Factory-installed Sensors

3.8.2 AFTERTREATMENT AND SCR SENSORS

These systems come with the sensors listed in Table 3-98 installed.

Sensor	Part Number	Function
Air Pressure Sensor	DD-138900	Senses system air pressure to maintain 3 Bar > Urea pressure for proper dosing. Sensor is also used for air pressure system leak testing.
DEF Level Sensor	DD-138801	DEF (urea) level tank sensor used for on-board diagnostics (OBD) and driver warning indicators.
DPF Inlet Pressure Sensor	HMN 472 153 10 28	Used for regen calculation. The catalyzed DPF function is to convert HC and CO emissions during active regeneration as well as to convert NO to NO2 to support the NOx conversion in the SCR.
DPF Outlet Pressure Sensor	HMN 472 153 11 28	Used for regen calculation. The catalyzed DPF function is to convert HC and CO emissions during active regeneration as well as to convert NO to NO2 to support the NOx conversion in the SCR.
DPF Outlet Temperature Sensor	HMN 680 540 0317	Temperature measured at the outlet of the after-treatment system that is installed within the exhaust system of the vehicle. It's located after the DPF that is within the after-treatment unit.
DOC Inlet Temperature	HMN 680 540 03 17	Monitors exhaust temperature coming into the DOC. Used for regen calculation and to support soot oxidation and convert HC injected during active regeneration.
DOC Outlet Temperature	HMN 680 540 03 17	Temperature measured between the DOC and the DPF in the after-treatment assembly located in the exhaust system of the vehicle.
DOC Outlet Temperature Inboard	HMN 680 540 01 17	Monitors exhaust temperature exiting out of the DOC. Used for regen calculation and to support soot oxidation and convert HC injected during active regeneration.
DOC Outlet Temperature Outboard	HMN 680 540 04 17	Monitors secondary exhaust flow temperature exiting out of the DOC. Used for regen calculation and to support soot oxidation and convert HC injected during active regeneration.
SCR Inlet Temperature	A 680 542 00 18	Used for NOx calculation
SCR Outlet Temperature	A 680 491 03 37	Used for NOx calculation
Smart NOx Sensor (DPF Outlet)	HMN 472 153 08 28	Measures the NOx concentration, air/fuel ration and equilibrium oxygen partial pressure in the exhaust gas.
Smart NOx Sensor (SCR Outlet)	HMN 472 153 09 28	Measures the NOx concentration, air/fuel ration and equilibrium oxygen partial pressure in the exhaust gas.
Temp and Humidity Sensor	DD-138775	Ambient reference input
Turbo Compressor In Temperature Sensor	23527831	Senses the temperature of the turbo compressor inlet. Refer to section 3.8.7.
Urea Pressure Sensor	DD-138894	Provides a dosing unit pressure signal so the DEF is kept in a required pressure range.
Urea Temperature Sensor	DD-138899	Proper DEF flow is a function of the temperature sensor input and balanced operation of the electronic controls.

Table 3-98 Function of Aftertreatment Sensors

3.8.3 ACTUATORS FOR THE SCR SYSTEM

Actuator	Part Number	Description
Air Pressure Limiting Solenoid Valve	DD138788	Master control solenoid allows vehicle compressed air supply to activate urea control. The ACM controlled solenoid facilitates DEF urea dosing or system purging to prevent freezing.
Pressure Limiting Valve	DD138787	Operates as a pressure regulator. Air pressure is regulated to approximately 5.5 Bar through the valve for proper system operation.
Overflow Valve	DD138786	Operates as a system check valve. When a calibrated minimum air pressure is reached the valve opens allowing pressure to the downstream devices.
Air Control Unit Set (12V)	DD138805	Supplies air to dosing valve to atomize DEF for dosing. Air pressure purges system to prevent freezing.
Dosing Unit (12V)	DD138783	Provides control flow for DEF dosing for SCR function. Atomizes DEF for SCR injection.
Supply Unit (12V)	DD138782	Provides a filtered DEF flow and stores a small DEF volume to maintain pressure. A permanent magnet brush motor is used to pump DEF.
Cooling Water Valve	DD138769	Provides engine coolant upon command to flow through the supply unit and DEF tank to prevent freezing.
Dosing Unit Diffuser Heater	807500	Prevents freezing by providing heat for air pressure upon command, for DEF atomizing and SCR function.
Dosing Unit Heater	TBD	Prevents freezing of DEF between the dosing valve and nozzle
Urea Injector	TBD	Injects DEF mixture into SCR

Table 3-99 Actuators

3.8.4 OEM-INSTALLED SENSORS

All sensors must be of the proper type and continuously monitor vehicular and environmental conditions, so the MCM2 can react to changing situations.

The OEM is responsible for installing the sensors listed in Table 3-100.

Sensor	Part Number	Function
Ambient Air Temperature Sensor (AAT Sensor)	23518328	Senses ambient air temperature specifically for the Ambient Air Temperature Override Disable feature or for OI. This sensor is required.Refer to section 3.8.5.
Engine Coolant Level Sensor (ECL Sensor)	23526906 23526905 23526907	Senses coolant level for engine protection. Refer to section 3.8.6.
Turbo Compressor In Temperature Sensor	23527831	Senses the temperature of the turbo compressor inlet. Refer to section 3.8.7.
Vehicle Speed Sensor (VSS)	--	Senses vehicle speed for Cruise Control and Vehicle Speed Limiting. Refer to section 3.8.8.

* Available in some applications

Table 3-100 Function and Guidelines for OEM-installed Sensors

NOTE:
The OEM harness must be securely fastened every six (6) in. It is required that the harness be fastened within six (6) in. of the sensor.

3.8.5 AMBIENT AIR TEMPERATURE SENSOR

The AAT Sensor is a thermistor type sensor with a variable resistance that produces an analog signal between 0 and 5 V, representing the temperature of the ambient air. The AAT Sensor (see Figure 3-22) is used with the Idle Shutdown Timer, specifically for the Ambient Air Temperature Override Disable feature, Optimized Idle or for the Aftertreatment System. For additional information on these features, refer to Chapter 5.

NOTE:
This sensor is required for on-board diagnostic calculations.

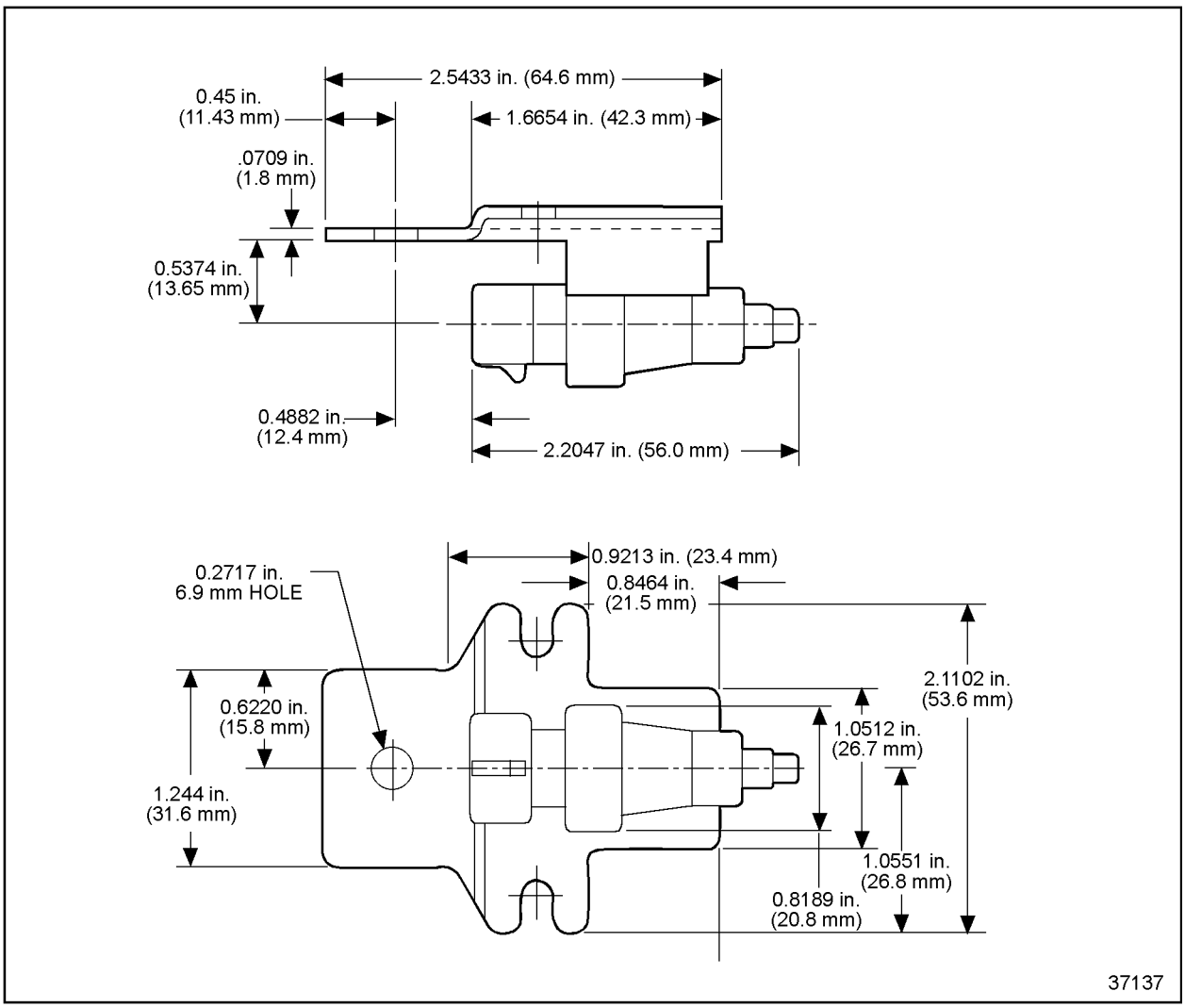


Figure 3-22 Ambient Air Temperatures Sensor Dimensions

Ambient Air Temperature Sensor Installation

Install the AAT Sensor where ambient air temperature can be read. A protected location on the frame rails where it will not be splattered with dirt and grime and is removed from any heat source such as exhaust is preferred.

The parameter for the AAT Sensor are listed in Table 3-101.

Parameter Group	Parameter	Options	Default	Access
31	Ambient Air Temp Sensor Enable	0 – Not Available 1 – Hardwired 2 – Temp from J1939 3 – Temp from J1587 4 – Temperature from ECAN	0 – Not Available	VEPS, DRS
31	MID for Ambient Air Temp	0 — 255	0	VEPS, DRS

Table 3-101 Ambient Air Temperature Sensor Parameters

3.8.6 ENGINE COOLANT LEVEL SENSOR

The ECL Sensor provides an input to the engine protection system and warn the operator if a low coolant level has been reached.

The main component of the ECL Sensor consists of a conductivity probe, which connects to the CPC2 (see Figure 3-23).

NOTICE:
The probe has an operational temperature range of -40 to 257°F (-40 to 125°C). Exposure to temperatures beyond this range may result in unacceptable component life, or degraded sensor accuracy.

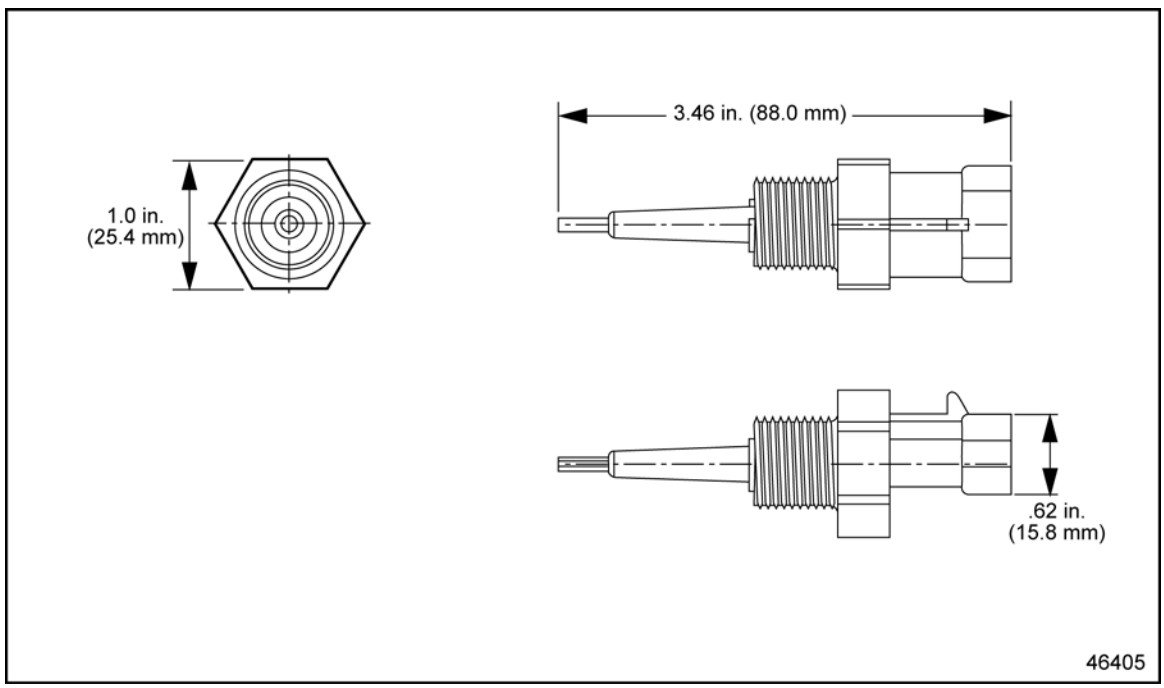


Figure 3-23 Engine Coolant Level Sensor Specifications

The connector listed in Table 3-102 is a Metri-Pack 280 series push-to-seat connector.

Coolant Level Sensor Connector	
Connector	P/N: 15300027
Terminal	P/N: 12077411
Seal	P/N: 12015323
Secondary Lock	P/N: 15300014

Table 3-102 Metri-Pack 280 Connectors and Part Numbers

The OEM must connect the ECL Sensor probe as shown in the next illustration (see Figure 3-24). Polarity of the ground and signal must be correct for proper operation.

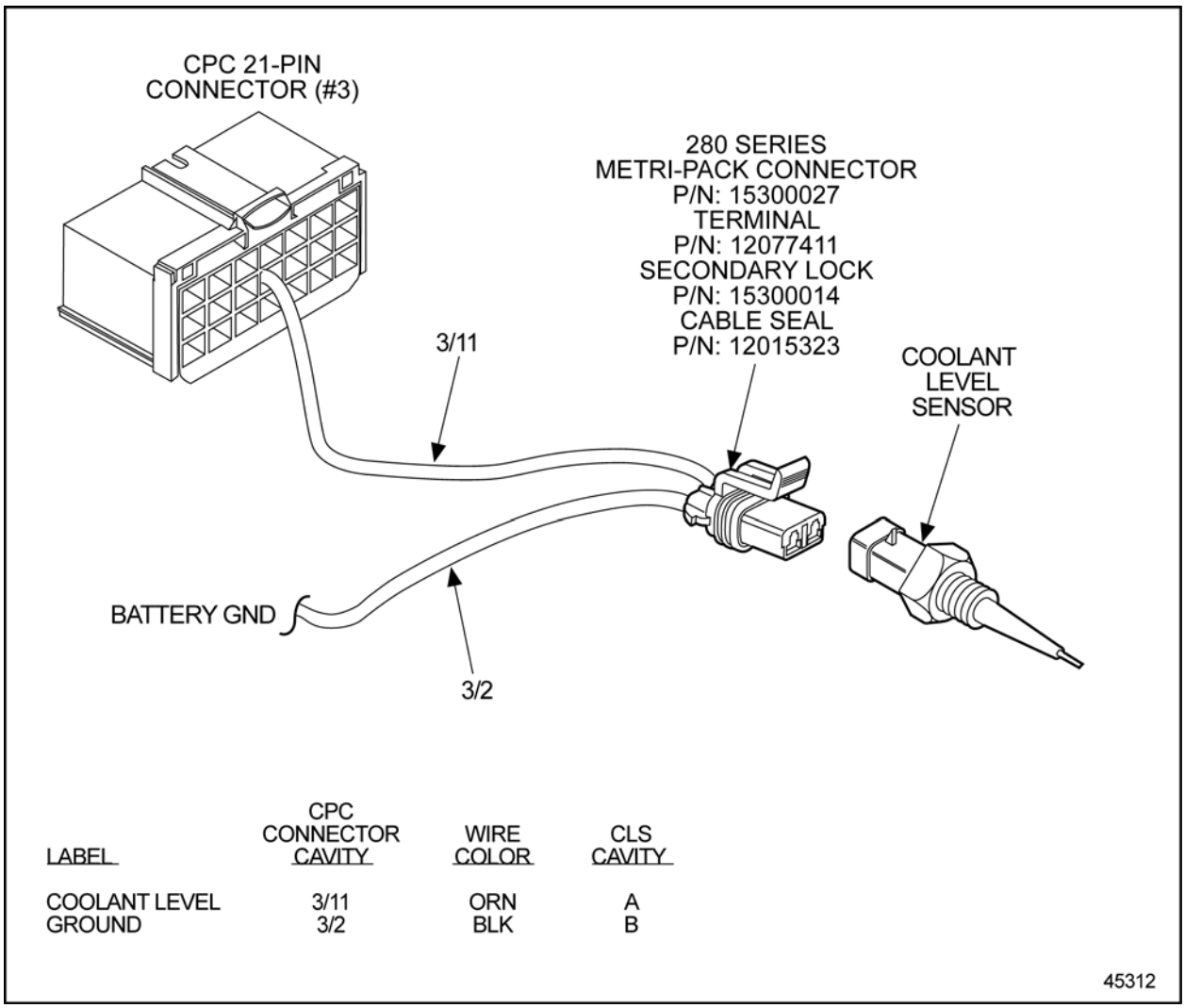


Figure 3-24 Engine Coolant Level Sensor Installation for CPC2

The probe should be located in either the radiator top tank or a remote mounted surge tank. It should be mounted horizontally in the center of the tank and must be in a position to signal low coolant before aeration occurs. Typically, this is a height representing 98% of the drawdown quantity. The probe should be located so that it is not splashed by deaeration line, stand pipe or coolant return line flows. The insulated portion of the probe should be inserted into the coolant 1/2 in. or more past the inside wall of the tank. See Figure 3-25.

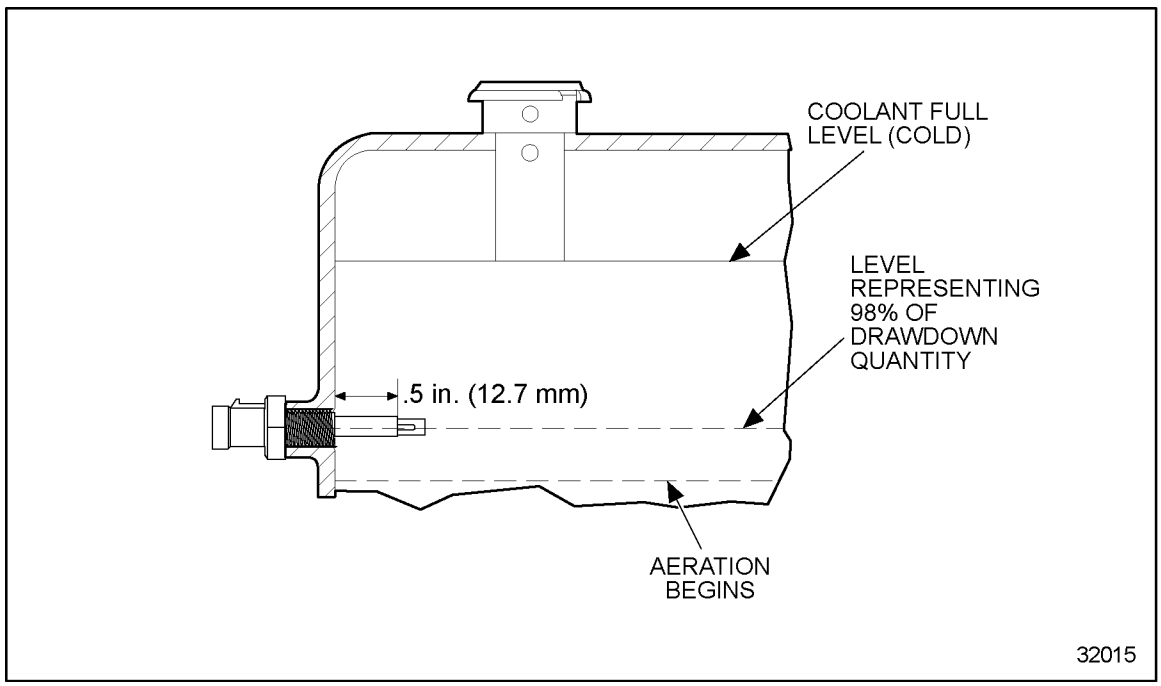


Figure 3-25 Engine Coolant Level Sensor Location - Top of Radiator Tank

Determine proper location for low coolant level sensor while running the drawdown test. It *must* actuate a warning before the satisfactory drawdown level is reached.

The ECL Sensor components are OEM supplied hardware and can be purchased as kits or individual components, depending on OEM requirements.

The following kits listed in Table 3-103 and Table 3-104 provide all the necessary hardware for proper installation of the ECL Sensor. Kits are available through the DDC parts distribution network.

Component	Part Number
ECL Sensor	23526905
Metri-Pack Connector Kit	15300027
Metri-Pack Terminals	12077411
Secondary Lock	15300014
wire Seal	12015323
Terminal	12103881

Table 3-103 ECL Sensor Installation Kit 1/4 in. NPTF P/N: 23515397

Component	Part Number
ECL Sensor	23526906
Metri-Pack Connector Kit	15300027
Metri-Pack Terminals	12077411
Secondary Lock	15300014
Wire Seal	12015323
Terminal	12103881

Table 3-104 ECL Sensor Installation Kit 3/8 in. NPTF P/N: 23515398

The sensor must be enabled with VEPS or the DRS as listed in Table 3-105.

Parameter Group	Parameter	Options	Default
13	Cool Level Sensor Input Enable	0 = Disabled 1 = Dual Level Probe Sensor (IMO), fixed threshold* 2 = Single Level Probe Sensor, temp dependent 3 = Dual Level Float Sensor (FTL), fixed threshold/FTL Gentec 4 = Single Level Probe Sensor, fixed threshold	2

* Not supported in NAFTA

Table 3-105 Enabling the Engine Coolant Level Sensor

3.8.7 TURBO COMPRESSOR IN TEMPERATURE SENSOR

The TCI Sensor produces a signal representing the temperature of the turbo compressor inlet. This sensor is required for the Series 60. See Figure 3-26 and Figure 3-27 for installation.

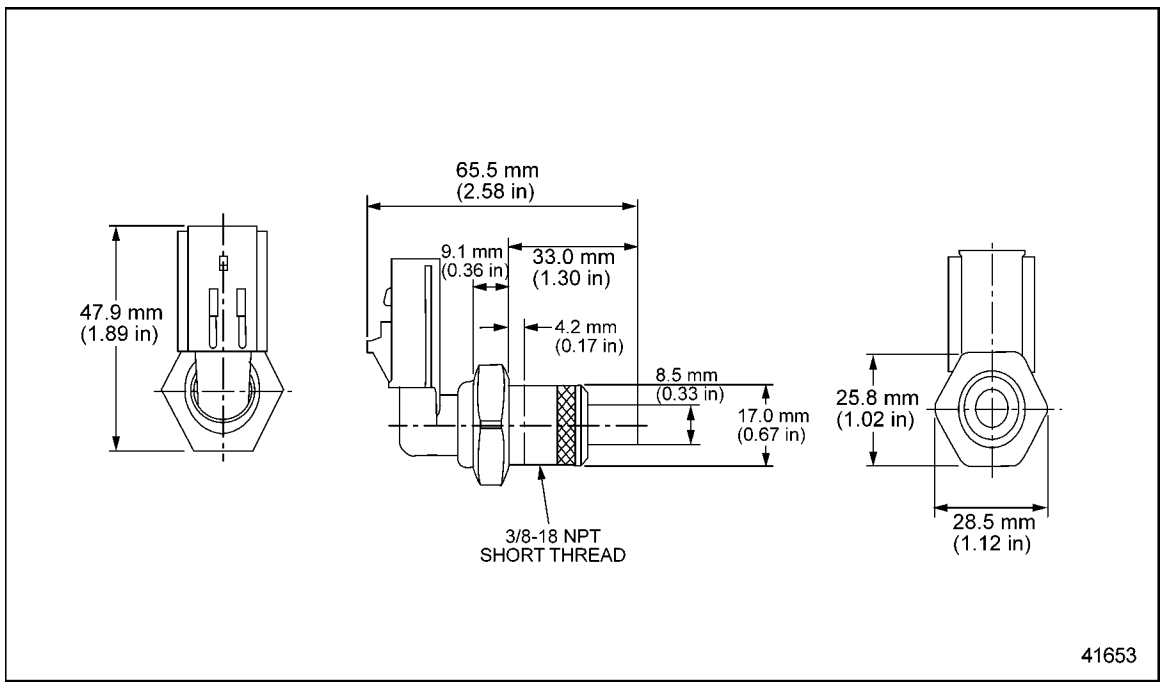


Figure 3-26 Turbo Compressor In Temperature Sensor

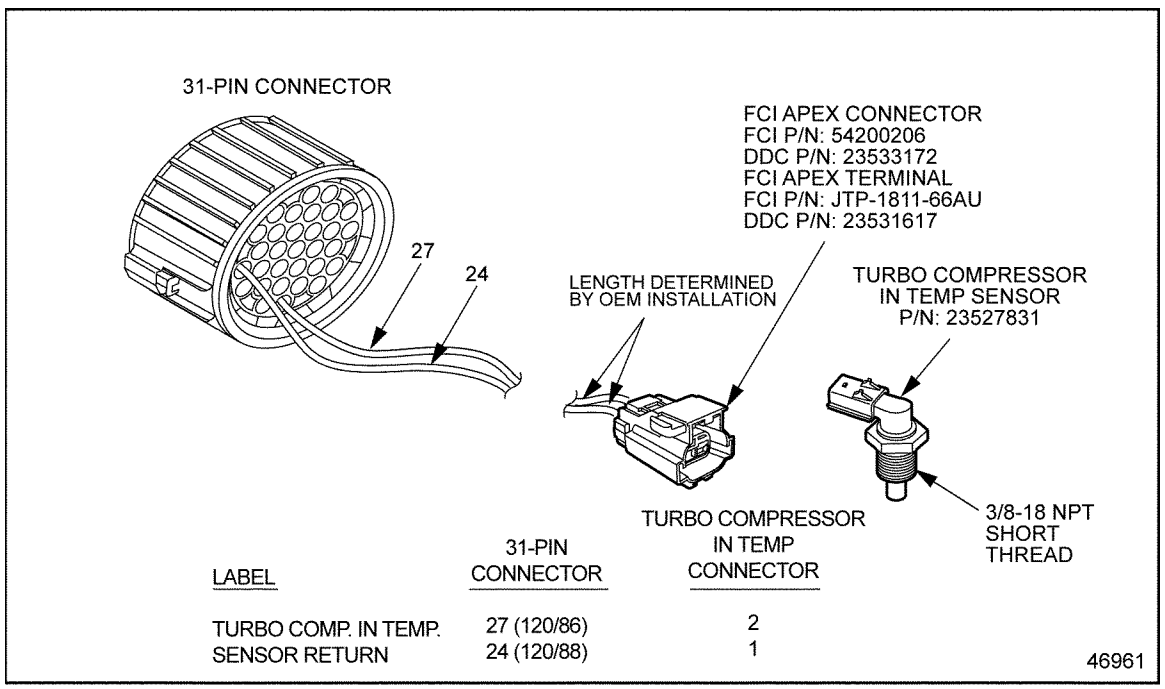


Figure 3-27 Turbo Compressor In Temperature Sensor Installation

3.8.8 VEHICLE SPEED SENSOR

The CPC2 can calculate vehicle speed providing that it is properly programmed and interfaced with a Vehicle Speed Sensor (VSS) that meets requirements. The VSS (see Figure 3-28) provides a vehicle speed signal for use in Cruise Control and Vehicle Speed Limiting. The VSS signal type can be changed.

NOTE:
DDC does not approve of the use of signal generator sensors.

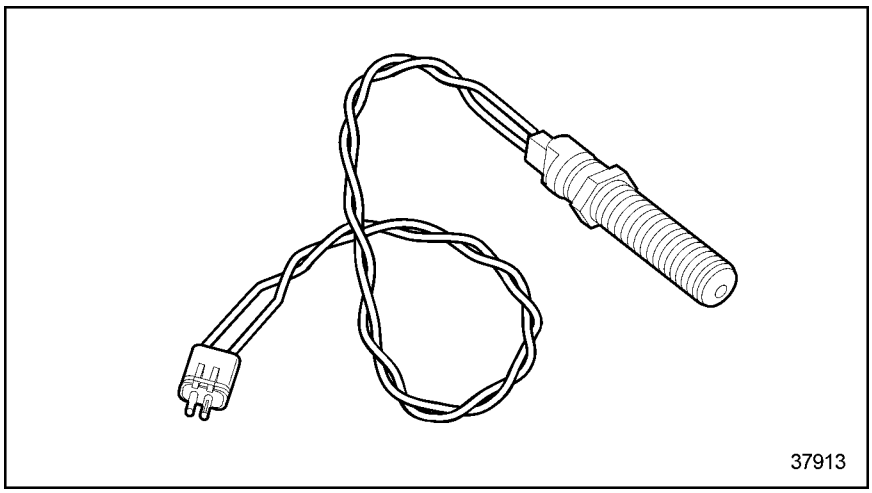


Figure 3-28 Vehicle Speed Sensor

To obtain accurate vehicle mileage, the parameters listed in Table 3-106 must be programmed with VEPS, DRS, or DDDL 7.0.

Parameter Group	Parameter	Range	Default
8	Vehicle Speed Sensor	0 = No Sensor 1 = C3 Sensor 2 = Square Wave (Hall Sensor) 3 = J1939 (ETC1) 4 = Magnetic Pickup 5 = J1939 (TCO1) 6 = J1939 (CCVS Source 1) 7 = J1939 (CCVS Source 2) 8 = J1939 (CCVS Source 3)	4 = Magnetic
8	Axle Ratio	1 – 20.0	5.29
8	Number of Output Shaft Teeth	0 – 250	16
8	Tire Revs per Unit Distance	160 – 1599	312
8	Top Gear Ratio	0.1 – 2.55	1
8	Second Highest Gear Ratio	0.1 – 5.75	2.54
8	Two Spd Axle Second Axle Ratio	1 – 20.0	5.29
8	Anti Tamper	0 = Disable 1 = Enable VSS Anti Tamper Function via ABS 2 = Enable Anti Tamper Function via Gear Ratio	0 = Disable
8	Gear Ratio Tolerance	0 — 60	2

Table 3-106 Vehicle Speed Sensor Parameters

Magnetic Pickup

The magnetic pickup requirements are listed in Table 3-107. Magnetic Pickup size is determined by installation requirements.

Parameters	Range
Frequency Range	0 - 10 kHz
Low Threshold Voltage	>1.8 Volts Peak to Peak

Table 3-107 Magnetic Pickup Vehicle Speed Sensor Requirements

The Vehicle Speed Sensor is wired to the 21–pin #3 connector of the CPC2 as listed in Table 3-108.

CPC2 Connector/Pin	Function
3/13	VSS (+)
3/14	VSS (-)

Table 3-108 Vehicle Speed Sensor Wiring

Magnetic Vehicle Speed Sensors can be obtained from the following sources:

Wabash Technologies	**Airpax Instruments**	**Invensys Electro Corporation**
1375 Swan Street Huntington, Indiana 46750-0829 Tel: 260-356-8300 www.wabashtech.com	Phillips Technologies 150 Knotter Drive Chesire, Connecticut 06410 Tel: 800-643-0643	1845 57th Street Sarasota, Florida 34231 Tel: 1–800–446–5762 Fax: 941-355-3120 www.electrocorp.com

See Figure 3-29 for the installation of the Magnetic VSS.

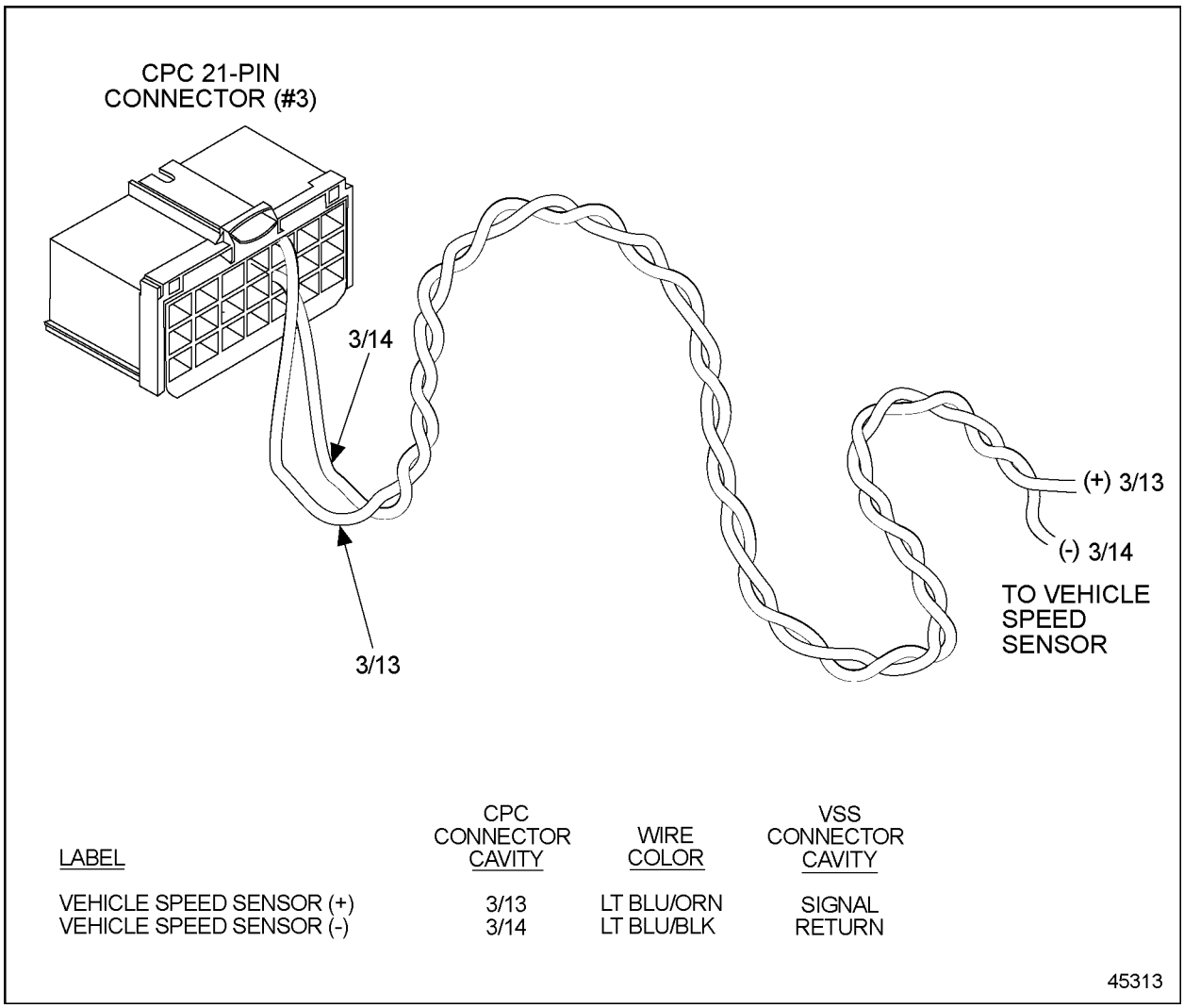


Figure 3-29 Magnetic Vehicle Speed Sensor Installation – CPC2

SAE J1939 Data Link

A VSS wired to the CPC2 is not required if the transmission output shaft speed message is being transmitted over the SAE J1939 Data Link. To obtain accurate vehicle mileage, the parameters listed in Table 3-109 must be programmed with VEPS.

NOTE:
Transmissions supporting transmission output shaft speed via J1939 must also support both error and unavailable status to be considered compliant with Detroit Diesel engines.

Parameter Group	Parameter	Range	Default
8	Vehicle Speed Sensor	0 = No Sensor 1 = C3 Sensor 2 = Square Wave (Hall Sensor) 3 = J1939 (ECT1) 4 = Magnetic Pickup 5 = J1939 (TCO1) 6 = J1939 (CCVS Source 1) 7 = J1939 (CCVS Source 2) 8 = J1939 (CCVS Source 3)	4 = Magnetic
8	Axle Ratio	1 – 20.0	5.29
8	Tire Revs per Unit Distance	160 – 1599	312
8	Top Gear Ratio	0.1 – 2.55	1
8	Second Highest Gear Ratio	0 — 5.75	2.54
8	Two Spd Axle Second Axle Ratio	1 – 20.0	5.29
8	Anti Tamper	0 = Disable 1 = Enable VSS ABS Anti Tampering Function 2 = Enable VSS without ABS Anti Tampering Function	0 = Disable
8	Gear Ratio Tolerence	0 — 60	2

Table 3-109 Vehicle Speed Sensor Parameters for J1939 Option

VSS Anti-tamper

If the sensor appears to be working improperly, but the vehicle speed is not zero, VSS Anti-Tamper will log a VSS fault.

3.9 LAMPS

The instrument panel warning lamps, the Amber Warning Lamp (AWL) and the Red Stop Lamp (RSL), are supplied by the OEM. The functionality of each lamp along with the wiring requirements are covered separately in the following sections. Seven of the lamps can be multiplexed:

- Amber Warning Lamp (AWL)
- DPF Regeneration Lamp (DPF Lamp)
- High Exhaust System Temperature Lamp (HEST Lamp)
- Malfunction Indicator Lamp (MIL)
- Red Stop Lamp (RSL)
- Wait to Start Lamp (WTS Lamp)
- Water-in Fuel Lamp (WIF Lamp)

The multiplexed lamp status is listed in Table 3-110 on the next page.

Multiplexed Lamp Output	Lamp	SPN	Source	Source Address
Amber Warning Lamp (AWL)		SPN 624	ACM CPC2 MCM2	0x3D 0x00 0x01
Red Stop Lamp (RSL)		SPN 623	ACM CPC2 MCM2	0x3D 0x00 0x01
DPF Regeneration Lamp		SPN 3697	ACM	0x3D
High Exhaust System Temperature Lamp (HEST)		SPN 3698	ACM	0x3D
Malfunction Indicator Lamp (MIL)		SPN 1213	ACM CPC2 MCM2	0x3D 0x00 0x01
Wait to Start Lamp (WTS Lamp)		SPN 1081	CPC2	0x00
Water-in-Fuel Lamp (WIF Lamp)		SPN 97	MCM2	0x01
Diesel Exhaust Fluid Low Lamp (DEF Lamp)		Not Supported	Hardwired to CPC2 at this time	—
Optimized Idle Lamp		Not Supported	Hardwired to CPC2 at this time	—

Table 3-110 2010 Multiplexed Lamp Status Support

3.9.1 AGS2 BACKUP LAMP

The AGS2 Backup Lamp is controlled by the CPC2.

The AGS2 Backup Lamp remains ON when the AGS2 transmission is in reverse.

AGS2 Backup Lamp Requirements and Guidelines

The following requirements and guidelines apply to the AGS2 Backup Lamp:

- The AGS2 Backup Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The AGS2 Backup Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/09 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-111.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 09 DO Selection	2 = AGS2 Backup Lamp	0 = Disabled 1 = Grid Heater Wired* 2 = AGS2 Backup Lamp 3 = Engine Brake Active 4 = Not Used 5 = FUSO Engine Brake Active Lamp* 6 = WIF Lamp	0 = Disabled	VEPS or DRS
35	3 09 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-111 AGS2 Backup Lamp Programming Options

3.9.2 AGS2 CHECK TRANS LAMP

The AGS2 Check Trans Lamp is controlled by the CPC2.
The AGS2 Check Trans Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When the AGS2 transmission ECU sends a diagnostic trouble code with an SPN 2003

AGS2 Check Trans Lamp Requirements and Guidelines

The following requirements and guidelines apply to the AGS2 Check Trans Lamp:

- The AGS2 Check Trans Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The AGS2 Check Trans Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/12 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-112.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 12 DO Selection	2 = AGS2 Check Transmis-sion Indica-tion Lamp	0 = Disabled 1 = Oil Level Lamp 2 = AGS2 Check Transmission Indication Lamp 3 = Oil Pressure Low Lamp 4 = Cruise Active Lamp 5 = FUSO Retarder Control 2*	0 = Disabled	VEPS or DRS
35	3 12 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-112 AGS2 Check Trans Lamp Programming Options

3.9.3 AGS2 TRANS TEMP LAMP

The AGS2 Trans Temp Lamp is controlled by the CPC2.
The AGS2 Trans Temp Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When transmission temp is high

AGS2 Trans Temp Lamp Requirements and Guidelines

The following requirements and guidelines apply to the AGS2 Trans Temp Lamp:

- The AGS2 Trans Temp Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The AGS2 Trans Temp Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/6 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-113.

Parameter Group	Parameter	Setting	Options	Default	Access
09	3 6 AO Selection	3 = AGS2 Check Transmis-sion Indica-tion Lamp	0 = Disabled 1 = Coolant Temperature Lamp 2 = Coolant Temperature Gauge 3 = AGS2 Transmission Temp Indication Lamp 4 = Battery Voltage Low Lamp 5 = Coolant Level Low Lamp	0 = Disabled	VEPS or DRS

Table 3-113 AGS2 Trans Temp Lamp Programming Options

3.9.4 AMBER WARNING LAMP

The AWL is controlled by the ACM, CPC2, and the MCM2.
The AWL remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When an electronic system fault occurs (This indicates the problem should be diagnosed as soon as possible.)

The AWL flashes:

- When the Diagnostic Request Switch is used to activate the AWL to flash inactive codes
- During last 90 seconds before Idle Shutdown if programmed for override
- When Idle Shutdown occurs or the Optimized Idle system shutdown occurs

AWL and PasSmart

AWL is active with PasSmart. When the Passing Speed Duration time expires, the Amber Warning Lamp on the dashboard will begin to flash one minute prior to ramping the Vehicle Limit Speed (VLS) back down to the normal VLS limit. The rampdown event always takes 5 seconds regardless of the Passing Speed Increment programmed into the ECU. The rampdown alert can be distinguished from an engine fault warning in that the AWL flashes for the former and remains on constantly for the latter.

PasSmart still operates when there is an active engine fault. In this situation the Amber Warning Lamp goes from constant illumination to flashing one minute before the VLS limit ramps down. At the end of the passing event when PasSmart is deactivated, the Amber Warning Lamp will return to constant illumination if the engine fault is still active.

Amber Warning Lamp Requirements and Guidelines

The following requirements and guidelines apply to the AWL:

- The AWL is required.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source.
- The AWL must be integrated into the instrument panel or placed in clear view of the equipment operator.
- The lens color must be amber.
- The words CHECK ENGINE must appear on or near the AWL lamp.
- The AWL is connected to pin 2/10 in the CPC2.
- This lamp can be multiplexed on J1939

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-114.

Parameter Group	Parameter	Setting	Options	default	Access
35	2 10 DO Selection	—	0 = Disabled 1 = Check engine lamp (yellow) enabled	1 = Check engine lamp (yellow) enabled	VEPS or DRS

Table 3-114 AWL Programming Options

3.9.5 CRUISE ACTIVE LAMP

The Cruise Active Lamp is controlled by the CPC2.
The Cruise Active Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When Cruise Control is active

Cruise Active Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Cruise Active Lamp:

- The Cruise Active Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The Cruise Active Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/12 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-115.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 12 DO Selection	4 = Cruise/PTO Active Lamp	0 = Disabled 1 = Oil Level Lamp* 2 = AGS2 Check Transmission Indication Lamp 3 = Oil Pressure Low Lamp 4 = Cruise/PTO Active Lamp 5 = FUSO Retarder Control 2*	0 = Disabled	VEPS or DRS
35	3 12 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-115 Cruise Active Lamp Programming Options

3.9.6 DECELERATION LAMP

The Deceleration Lamp is controlled by the CPC2.

The Deceleration Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When percent throttle is zero and Cruise Control is inactive

Deceleration Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Deceleration Lamp:

- The Deceleration Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The Deceleration Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 4/09 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-116.

Parameter Group	Parameter	Setting	Options	Default	Access
35	4 09 DO Selection	11 = Deceleration Lamp	0 = Disabled 1 = Accelerator Pedal Idle Position* 2 = Actual Torque* 3 = Road Speed* 4 = Engine Speed* 5 = Coolant Temp* 6 = Pedal Torque* 7 = Boost Temp* 8 = Oil Pressure (MCM Threshold)* 9 = Coolant Temp (MCM Threshold)* 10 = OI Active Lamp 11 = Deceleration Lamp 12 = FUSO Ground Starter Lockout Relay* 13 = WIF Lamp	0 = Disabled	VEPS or DRS
35	4 09 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-116 Deceleration Lamp Programming Options

3.9.7 DIESEL EXHAUST FLUID (UREA) LOW LAMP

The Diesel Exhaust Fluid (DEF) Low Lamp is controlled by the CPC2 and ACM.

The DEF Low Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When the conditions listed in the following Table occur.

DEF (Urea) Tank	Lamps	
DEF (Urea) Tank > 1/4 full (range > 1, 500 miles)	—	No Lamps lit
DEF (Urea) Tank < 1/4 full (range < 1, 500 miles)		DEF Low Lamp lit solid for 30 seconds every engine-on cycle.
DEF (Urea) Tank < 1 gallon (range < 600 miles or –2 fuel fill opportunities)		DEF Low Lamp lit solid
DEF (Urea) Tank < 1/2 gallon (range < 300 miles or –1 fuel fill opportunities)		DEF Low Lamp flashing
DEF (Urea) Tank < 1/4 gallon (range < 150 miles or –1/2 fuel fill opportunities)		DEF Low Lamp flashing AWL lit solid
DEF (Urea) Tank Empty		DEF Low Lamp flashing AWL lit solid Light engine derate

Diesel Exhaust Fluid Low Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Diesel Exhaust Fluid Low Lamp:

- The Diesel Exhaust Fluid Low Lamp is required.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The Diesel Exhaust Fluid Low Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/10 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-117.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 10 DO Selection	6 = DEF Low Lamp	0 = Disabled 1 = Air Filter Lamp 2 = Not Used 3 = Not Used 4 = Not Used 5 = FUSO Retarder Control 1 6 = DEF Low Lamp	6 = DEF Low Lamp	VEPS or DRS

Table 3-117 Diesel Exhaust Fluid Low Lamp Programming Options

3.9.8 DPF REGENERATION LAMP

This lamp is controlled by the ACM and the CPC2.
The DPF Regeneration Lamp remains ON when

- Stationary regeneration is required.
- At the start of every ignition cycle, the lamp turns ON for approximately five (5) seconds (a bulb check).

The DPF Regeneration Lamp flashes when a stationary regeneration is required immediately. If the lamp flashing is ignored, derate and/or shutdown could occur.

DPF Regeneration Lamp Requirements and Guidelines

The following requirements and guidelines apply to the DPF Regeneration Lamp:

- The DPF Regeneration Lamp is required.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The DPF Regeneration Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- The lens color must be amber.
- This output is wired to pin 1/5 of the CPC2.
- This lamp can be multiplexed on J1939.
- The DPF Regeneration symbol shown above is required.

Programming Requirements and Flexibility

The parameters for the DPF Regeneration Lamp are listed in Table 3-118.

Parameter Group	Parameter	Options	Default	Access
35	1 05 DO Selection	0 = Disabled 1 = Ground, Analog Accelerator Pedal 2 = DPF Lamp	2 = DPF Lamp	VEPS, DRS

Table 3-118 DPF Regeneration Lamp Options

3.9.9 HIGH EXHAUST SYSTEM TEMPERATURE LAMP

The HEST Lamp is controlled by the ACM, CPC2, and the MCM2.
The HEST Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check).
- When the vehicle speed is less than 5 mph and the DPF outlet temperature is greater than 525°C.

When the engine elevates rpm for a parked regen but the exhaust temperatures are relatively cool, the HEST lamp will flash once every ten seconds.

High Exhaust System Temperature Lamp Requirements and Guidelines

The following requirements and guidelines apply to the HEST Lamp:

- The HEST Lamp is optional and must be supplied by the OEM.
- A 12 volt light of less than 2.0 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 2.0 A (DC) current.
- The HEST Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- The lens color must be amber.
- This output is wired to pin 4/7 of the CPC2.
- This lamp can be multiplexed on J1939.

Programming Requirements and Flexibility

The parameters for the High Exhaust System Temperature Lamp are listed in Table 3-119.

Parameter Group	Parameter	Options	Default	Access
35	4 07 DO Selection	0 = Disabled 1 = Accelerator Pedal Kick Down* 2 = Actual Torque* 3 = Road Speed* 4 = Engine Speed* 5 = Coolant Temperature* 6 = Pedal Torque* 7 = Boost Temperature* 8 = Oil Pressure (MCM threshold)* 9 = Coolant Temperature (MCM threshold)* 10 = Vehicle Power Shutdown/ignition relay 11 = Optimized idle ACC Bus (ignition relay) 12 = Split Valve 1* 13 = High Exhaust System Temperature Lamp	13 = High Exhaust System Temperature Lamp	VEPS, DRS

* Not supported in NAFTA

Table 3-119 High Exhaust System Temperature Lamp Options

3.9.10 LOW BATTERY VOLTAGE LAMP

The Low Battery Voltage Lamp is controlled by the CPC2.

The Low Battery Voltage Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When a low battery voltage is detected

Low Battery Voltage Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Low Battery Voltage Lamp:

- The Low Battery Voltage Lamp is optional.
- A 12 volt light of less than 2.0 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 2.0 A (DC) current.
- The Low Battery Voltage Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/6 of the CPC2.

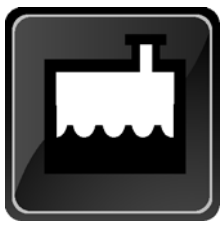
Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-120.

Parameter Group	Parameter	Setting	Options	Default	Access
09	3 6 AO Selection	4 = Battery Voltage Low Lamp	0 = Disabled 1 = Coolant Temperature Lamp 2 = Coolant Temperature Gauge 3 = AGS2 Transmission Temp Indication Lamp 4 = Battery Voltage Low Lamp 5 = Coolant Level Low Lamp	0 = Disabled	VEPS or DRS

Table 3-120 Low Battery Voltage Lamp Programming Options

3.9.11 LOW COOLANT LEVEL LAMP



The Low Coolant Level Lamp is controlled by the CPC2.
The Low Coolant Level Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When a low coolant level is detected

Low Coolant Level Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Low Coolant Level Lamp:

- The Low Coolant Level Lamp is optional.
- A 12 volt light of less than 2.0 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 2.0 A (DC) current.
- The Low Coolant Level Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/6 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-121.

Parameter Group	Parameter	Setting	Options	Default	Access
09	3 6 AO Selection	5 = Coolant Level Low Lamp	0 = Disabled 1 = Coolant Temperature Lamp 2 = Coolant Temperature Gauge 3 = AGS2 Transmission Temp Indication Lamp 4 = Battery Voltage Low Lamp 5 = Coolant Level Low Lamp	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-121 Low Coolant Level Lamp Programming Options

3.9.12 LOW OIL PRESSURE LAMP

The Low Oil Pressure Lamp is controlled by the CPC2 and MCM2.
The Low Oil Pressure Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When a low oil pressure fault is detected

Requirements and Guidelines

The following requirements and guidelines apply to the Low Oil Pressure Lamp:

- The Low Oil Pressure Lamp is optional.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The Low Oil Pressure Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 3/12 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-122.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 12 DO Selection	3 = Oil Pressure Low Lamp	0 = Disabled 1 = Oil Level Lamp* 2 = AGS2 Check Transmission Indication Lamp 3 = Oil Pressure Low Lamp 4 = Cruise/PTO Active Lamp 5 = FUSO Retarder Control 2*	0 = Disabled	VEPS or DRS
35	3 12 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-122 Low Oil Pressure Lamp Programming Options

3.9.13 MALFUNCTION INDICATOR LAMP

The Malfunction Indicator Lamp (MIL) is controlled by the ACM, CPC2, and the MCM2.
The MIL remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- For any emission related fault, the light will go out when the fault has been inactive for three consecutive drive cycles in which the diagnostic was able to make a pass/fail determination

Malfunction Indicator Lamp Requirements and Guidelines

The following requirements and guidelines apply to the MIL:

- The MIL is required.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The MIL must be integrated into the driver's side of the instrument panel.
- The lens color must be amber.
- The MIL must be of sufficient illumination and location to be readily visible under all lighting conditions.
- This output is wired to pin 1/13 of the CPC2.
- This lamp can be multiplexed on J1939.
- There shall be only one MIL used to indicate all faults detected on a single vehicle.
- OBD regulations require circuit continuity detection of the MIL. The lamp circuit must be monitored for malfunctions that cause the lamp to fail to illuminate when commanded on (e.g., burned out bulb).

Multiplexed MIL

If an OEM device is controlling lamps, the device must be capable of detecting any circuit continuity malfunctions. The OEM must broadcast circuit malfunction information (continuity checks) on the powertrain J1939 data link per J1939–73 requirements.

A multiplexed MIL must default to ON if communication is lost between modules for any reason or if the sending device indicates the data is unavailable for data is in error. If the CPC controls the lamp, the bulb must be of sufficient resistance to allow for detection of a circuit continuity error.

Programming Requirements and Flexibility

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 13 DO Selection	—	0 = Disabled 1 = MIL	1 = MIL	VEPS or DRS

Table 3-123 MIL Programming Options

3.9.14 OPTIMIZED IDLE ACTIVE LAMP

The Optimized Idle Active Lamp is controlled by the CPC2 and MCM2.
The Optimized Idle Active Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When Optimized Idle is active

Optimized Idle Active Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Optimized Idle Active Lamp:

- The Optimized Idle Active Lamp is optional.
- A 12 volt light of less than 2.0 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 2.0 A (DC) current.
- The Optimized Idle Active Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 4/09 of the CPC2.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-124.

Parameter Group	Parameter	Setting	Options	Default	Access
35	4 09 DO Selection	10 = OI Active Lamp	0 = Disabled 1 = Accelerator Pedal Idle Position* 2 = Actual Torque* 3 = Road Speed* 4 = Engine Speed* 5 = Coolant Temp* 6 = Pedal Torque* 7 = Boost Temp* 8 = Oil Pressure (MCM2 Threshold)* 9 = Coolant Temp (MCM2 Threshold)* 10 = OI Active Lamp 11 = Deceleration Lamp 12 = Not Used 13 = WIF Lamp	0 = Disabled	VEPS or DRS
35	4 09 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-124 Optimized Idle Active Lamp Programming Options

3.9.15 RED STOP LAMP

The RSL is controlled by the CPC2 and MCM2.
The RSL remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When a potential engine damaging fault is detected

The RSL flashes:

- When Engine Protection Shutdown occurs
- When the Diagnostic Request Switch is used to activate the RSL to flash active codes

Red Stop Lamp Requirements and Guidelines

The following requirements and guidelines apply to the RSL:

- The RSL is required.
- A 12 volt light of less than 0.25 (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 (DC) current.
- The RSL must be integrated into the instrument panel or placed in clear view of the equipment operator.
- The lens color must be red.
- The words STOP ENGINE must appear on or near the RSL lamp.
- The RSL is connected to pin 3/16 in the CPC2.

Programming Requirements and Flexibility

The options for this output are listed in Table 3-125.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 16 DO Selection	—	0 = Disabled 1 = Stop Engine Lamp (red)	1 = Stop Engine Lamp (red)	VEPS or DRS

Table 3-125 RSL Programming Options

3.9.16 WAIT TO START LAMP

The Wait to Start Lamp is controlled by the CPC2 and MCM2.
The Wait to Start Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When the grid heater system is active; the driver should **not** start the engine when the light is on

Wait to Start Lamp Requirements and Guidelines

The following requirements and guidelines apply to the Wait to Start Lamp:

- OBD regulations require circuit continuity detection of the Wait to Start Lamp. The lamp circuit must be monitored for malfunctions that cause the lamp to fail to illuminate when commanded on (e.g., burned out bulb).
- The Wait to Start Lamp is required for grid heater applications.
- A 12 volt light of less than 0.25 A (DC) is required depending on the ignition source. Digital output circuits are designed to sink no more than 0.25 A (DC) current.
- The Wait to Start Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.
- This output is wired to pin 4/06 of the CPC2.

Multiplexed Wait to Start Lamp

If an OEM device is controlling lamps, the device must be capable of detecting any circuit continuity malfunctions. The OEM must broadcast circuit malfunction information (continuity checks) on the powertrain J1939 data link per J1939–73 requirements.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-121.

Parameter Group	Parameter	Setting	Options	Default	Access
35	4 06 DO Selection	1 = Grid Heater Lamp	0 = Disabled 1 = Grid Heater Lamp 2 = Accelerator Pedal Idle Position* 3 = Run Signal Starter Lockout	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-126 Wait to Start Lamp Programming Options

3.9.17 WATER-IN-FUEL LAMP (R2.0 OR LATER)

The Water-in-Fuel (WIF) Lamp is controlled by the CPC2 and the MCM2.
The Water-in-Fuel (WIF) Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- When an ECAN signal is received indicating the water separator tank is full and requires draining

Lamp status will also be broadcast over J1939 (SPN 97).

Water-in-Fuel Lamp Requirements and Guidelines

The following requirements and guidelines apply to the WIF Lamp:

- This lamp is required for the DD15, DD13, DD16 and MDEG engines.
- The CPC2 pin used is 3/9 for the DD15, DD13, DD16 engines and 4/9 for the MDEG engine.
- A 12 volt light of less than 0.25 A(DC) is required. This digital output is designed to sink no more than 0.25 A(DC) current.
- The WIF Lamp must be integrated into the instrument panel or placed in clear view of the vehicle operator.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-127 and Table 3-128.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 09 DO Selection	6 = WIF Lamp	0 = Disabled 1 = Grid Heater Hardware* 2 = AGS2 Backup Lamp 3 = Engine Brake Active 4 = Not Used 5 = FUSO Engine Brake Active Lamp* 6 = WIF Lamp	0 = Disabled	VEPS, DRS

* Not supported in NAFTA

Table 3-127 WIF Lamp Programming Options for DD15, DD13, and DD16 Engines

Parameter Group	Parameter	Setting	Options	Default	Access
35	4 09 DO Selection	13 = WIF Lamp	0 = Disabled 1 = Accelerator Pedal idle Position* 2 = Actual Torque* 3 = Road Speed* 4 = Engine Speed* 5 = Coolant Temperature* 6 = Pedal Torque* 7 = Boost Temperature* 8 = Oil Pressure (threshold)* 9 = Coolant Temperature (engine controller threshold) 10 = Optimized Idle Active Lamp 11 = Deceleration Lamp 12 = Not Used 13 = WIF Lamp	0 = Disabled	VEPS, DRS

* Not supported in NAFTA

Table 3-128 WIF Lamp Programming Options for the MDEG Engine

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