3 HARDWARE AND WIRING

Section **Page**

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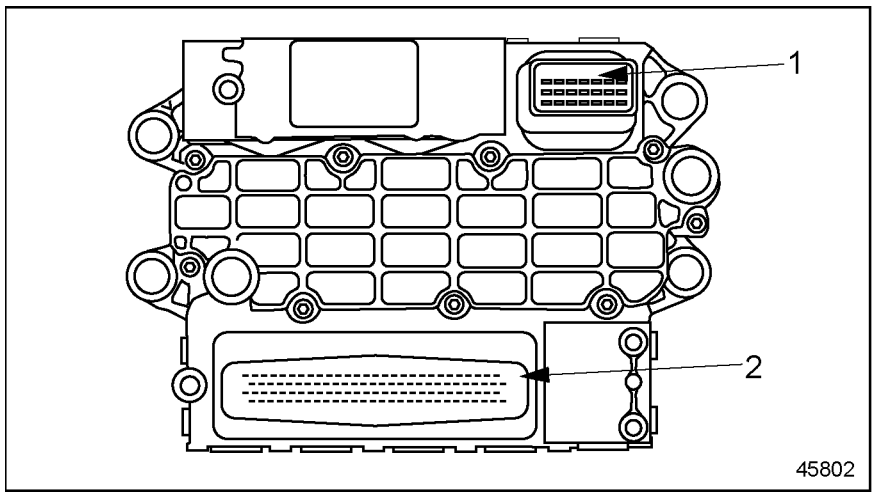
3.1 MOTOR CONTROL MODULE

The engine mounted Motor Control Module (MCM) 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 Module

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

3.1.1 ENGINE HARNESS

The MCM has a 120–pin connector Engine Harness which is factory installed. It also has a 21–pin connector and 31–pin connector which are the responsibility of the OEM.

MCM 120–pin Connector for Series 60 Engines

The pinouts for the 120–pin connector for the Series 60 engine are listed in Table 3-1, Table 3-2, Table 3-3, and Table 3-4.

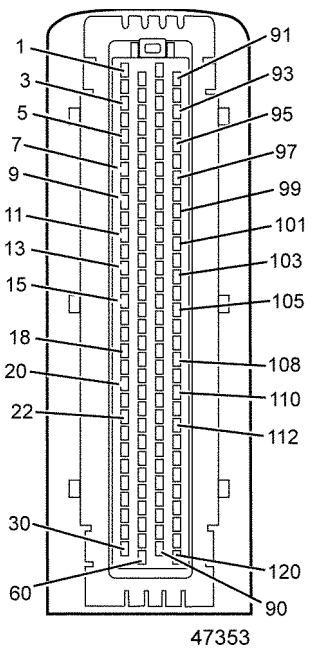
Pin	Signal Type	Function	Connector
1	RPU_H	NC	
2	RPU_L	NC	
3	PV_IM1	NC	
4	MV_B5F	Spill Control Valve (cyl 4) - pin 4	
5	MV_B5	Spill Control Valve Common - pin 3	
6	MV_B5D	Spill Control Valve (cyl 6) - pin 4	
7	MV_B5	Spill Control Valve Common - pin 3	
8	MV_B5B	Spill Control Valve (cyl 5) - pin 4	
9	MV_B5	Spill Control Valve Common - pin 3	
10	MV_B4E	Spill Control Valve (cyl 2) - pin 4	
11	MV_B4	Spill Control Valve Common - pin 3	
12	MV_B4C	Spill Control Valve (cyl 3) - pin 4	
13	MV_B4	NC	
14	MV_B4A	Spill Control Valve (cyl 1) - pin 4	
15	MV_B4	NC	
16	MV_B2F	Needle Control Valve (cyl 4) - pin 2	
17	MV_B2	Needle Control Valve Common - pin 1	
18	MV_B2D	Needle Control Valve (cyl 6) - pin 2	
19	MV_B2	Needle Control Valve Common - pin 1	
20	MV_B2B	Needle Control Valve (cyl 5) - pin 2	
21	MV_B2	Needle Control Valve Common - pin 1	
22	MV_B1E	Needle Control Valve (cyl 2) - pin 2	
23	MV_B1	Needle Control Valve Common (cyl 1,2,3) - pin 1	
24	MV_B1C	Needle Control Valve (cyl 3) - pin 2	
25	MV_B1	NC	
26	MV_B1A	Needle Control Valve (cyl 1) - pin 2	
27	MV_B1	NC	
28	START_B	NC	
29	A16	DOC Outlet Temp Sensor	
30	A01	DPF Outlet Pressure Sensor	

Table 3-1 MCM Connector – Series 60 (1 of 4)

Pin	Signal Type	Function	Connector
31	PWM_5	NC	
32	PWM_7	Jake 1	
33	PWM_6	Two-speed Fan or Variable Speed Fan	
34	PWM_8	NC	
35	PWM_10	NC	
36	PWM_9	NC	
37	PWM_11	NC	
38	PV_M	Ground	
39	HSW2	NC	
40	SW_1	NC	
41	HSW1	NC	
42	DYN3_N	CKP/TRS (-)	
43	DYN3	CKP/TRS (+)	
44	DYN2_N	CMP/SRS (-)	
45	DYN2	CMP/SRS (+)	
46	D3_V	NC	
47	DYN4	Fan Speed	
48	DYM_2M	NC	
49	DYN5_S	NC	
50	SGND_TL	Sensor Ground	
51	DYN1	Turbo Speed Sensor	
52	SGND_P	Sensor Ground	
53	A23	NC	
54	A09	Engine Oil Pressure Sensor	
55	SGND_P	Sensor Ground	
56	A20	NC	
57	A05	NC	
58	SENS1_V	Sensor Power Supply	
59	A17	NC	
60	A02	EGR Valve Position	

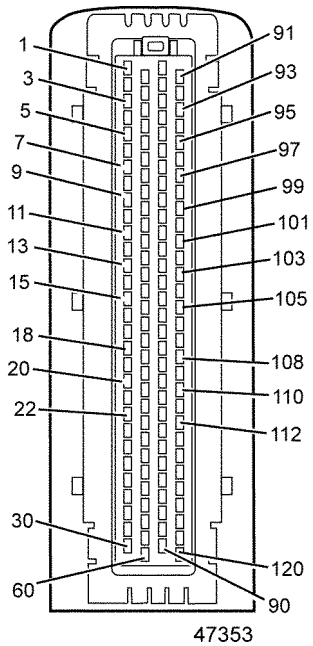


Table 3-2 MCM Connector – Series 60 (2 of 4)

Pin	Signal Type	Function	Connector
61	PWM_1	EGR Valve	
62	PV_B2	Power Supply	
63	PWM_2	NC	
64	PV_B2	Power Supply	
65	PWM_12	Doser	
66	PWM_13	Jake 2	
67	PV_M	Ground	
68	SW_2	NC	
69	SW_8	Fuel Cutoff Valve	
70	SW_6	Ether Start	
71	LIN_V	NC	
72	LIN	NC	
73	DYN_3M	NC	
74	CAN3L	VNT CAN (-)	
75	CAN3H	VNT CAN (+)	
76	D3_S	NC	
77	A29	Supply Fuel Temperature Sensor	
78	A15	NC	
79	D1	NC	
80	A27	NC	
81	A13	NC	
82	SENS2_V	Sensor Supply	
83	A24	EGR Temperature Sensor	
84	A10	Fuel Compensation Pressure Sensor	
85	SENS2_V	Sensor Supply	
86	A21	Turbo Compressor In Temp	
87	A06	Intake Manifold Pressure Sensor	
88	SGND_P	Sensor Ground	
89	A18	DOC Inlet Temp Sensor	
90	A03	Intake Air Throttle Valve	

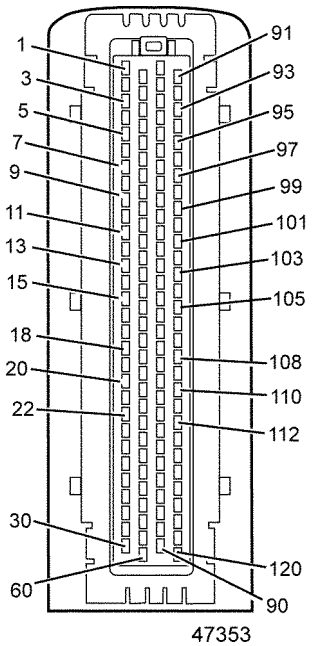


Table 3-3 MCM Connector – Series 60 (3 of 4)

Pin	Signal Type	Function	Connector
91	PV_B1	Power Supply	
92	PWM_3	NC	
93	PV_B1	Power Supply	
94	PWM_4	NC	
95	PV_M	NC	
96	SW_4	NC	
97	SW_5	NC	
98	SW_3	Single-speed Fan or Two-speed Fan	
99	SW_7	NC	
100	H_Out1	Intake Air Throttle (+)	
101	H_Out2	Intake Air Throttle (-)	
102	SGND	Sensor Ground	
103	SGND	Sensor Ground	
104	SGND	Sensor Ground	
105	SGND	Sensor Ground	
106	A30	Intake Air Temperature Sensor	
107	D2	NC	
108	A28	Engine Oil Temperature Sensor	
109	A14	EGR Delta Pressure Sensor	
110	A26	Engine Coolant Temp Sensor	
111	A12	Fuel Line Pressure Sensor	
112	A25	Turbo Compressor Out Temp	
113	A11	NC	
114	SGND_S2	Sensor Ground	
115	A22	DPF Outlet Temp Sensor	
116	A08	NC	
117	SENS1_V	Sensor Power Supply	
118	A07	DPF Inlet Pressure Sensor	
119	A19	NC	
120	A04	NC	

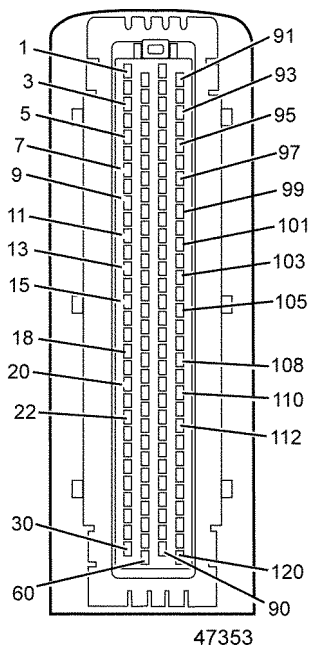


Table 3-4 MCM Connector – Series 60 (4 of 4)

MCM 120–pin Connector for MBE 900 Engines

The pinouts for the 120–pin connector for the MBE 900 engine are listed in Table 3-5, Table 3-6, Table 3-7, and listed in Table 3-8.

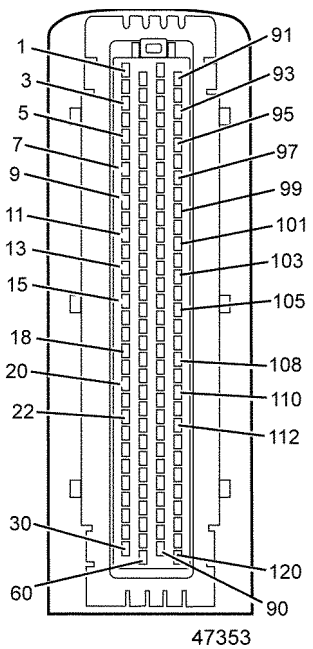
Pin	Signal Type	Function	Connector
1	RPU_H	NC	
2	RPU_L	NC	
3	PV_IM1	NC	
4	MV_B5F	Electronic Unit Pump (cyl 4) – pin 1	
5	MV_B5	Electronic Unit Pump Common (cyl 4) – pin 2	
6	MV_B5D	Electronic Unit Pump(cyl 6) – pin 1	
7	MV_B5	Electronic Unit Pump Common (cyl 6) – pin 2	
8	MV_B5B	Electronic Unit Pump (cyl 5) – pin 1	
9	MV_B5	Electronic Unit Pump Common (cyl 5) – pin 2	
10	MV_B4E	Electronic Unit Pump (cyl 2) – pin 1	
11	MV_B4	Electronic Unit Pump Common (cyl 2) – pin 2	
12	MV_B4C	Electronic Unit Pump (cyl 3) – pin 1	
13	MV_B4	Electronic Unit Pump Common (cyl 3) – pin 2	
14	MV_B4A	Electronic Unit Pump (cyl 1) – pin 1	
15	MV_B4	Electronic Unit Pump Common (cyl 1) – pin 2	
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	NC	
29	A16	DOC Outlet Temp Sensor	
30	A01	DPF Outlet Pressure Sensor	

Table 3-5 MCM Connector – MBE 900 (1 of 4) – C Sample

Pin	Signal Type	Function	Connector
31	PWM_5	NC	
32	PWM_7	Constant Throttle Valve	
33	PWM_6	Two-speed Fan or Variable Speed Fan	
34	PWM_8	NC	
35	PWM_10	NC	
36	PWM_9	NC	
37	PWM_11	NC	
38	PV_M	Ground	
39	HSW2	Electrostatic Oil Separator	
40	SW_1	NC	
41	HSW1	Grid Heater	
42	DYN3_N	NC	
43	DYN3	CKP (+)	
44	DYN2_N	NC	
45	DYN2	CMP (+)	
46	D3_V	NC	
47	DYN4	Fan Speed	
48	DYM2_M	CMP (-)	
49	DYN5_S	NC	
50	SGND_TL	Sensor Ground	
51	DYN1	Turbo Speed Sensor	
52	SGND_P	Sensor Ground	
53	A23	NC	
54	A09	Engine Oil Pressure Sensor	
55	SGND_P	Sensor Ground	
56	A20	NC	
57	A05	Water-in- Fuel Sensor	
58	SENS1_V	Sensor Power Supply	
59	A17	NC	
60	A02	EGR Throttle Position	

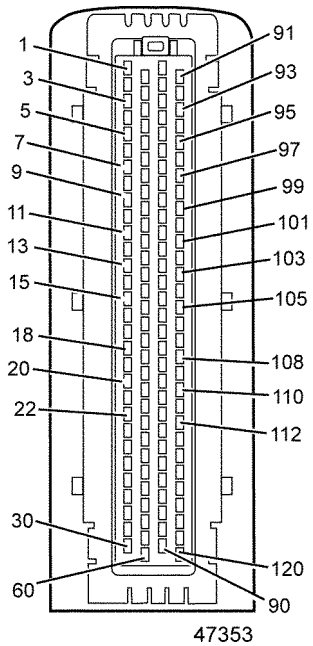


Table 3-6 MCM Connector – MBE 900 (2 of 4) – C Sample

Pin	Signal Type	Function	Connector
61	PWM_1	EGR Valve	
62	PV_B2	Power Supply	
63	PWM_2	NC	
64	PV_B2	Power Supply	
65	PWM_12	Doser	
66	PWM_13	NC	
67	PV_M	Ground	
68	SW_2	NC	
69	SW_8	Fuel Cutoff Valve	
70	SW_6	NC	
71	LIN_V	NC	
72	LIN	NC	
73	DYN3_M	CKP (-)	
74	CAN3L	Wastegate CAN (-)	
75	CAN3H	Wastegate CAN (+)	
76	D3_S	NC	
77	A29	Supply Fuel Temperature Sensor	
78	A15	NC	
79	D1	Grid Heater	
80	A27	NC	
81	A13	NC	
82	SENS2_V	Sensor Power Supply	
83	A24	NC	
84	A10	Fuel Compensation Pressure Sensor	
85	SENS2_V	Sensor Power Supply	
86	A21	Turbo Pressure/Temp Sensor	
87	A06	Intake Manifold Pressure Sensor	
88	SGND_P	Sensor Ground	
89	A18	DOC Inlet Temp Sensor	
90	A03	Intake Air Throttle Position	

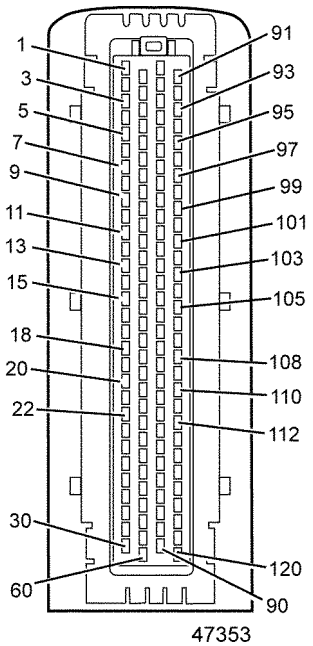


Table 3-7 MCM Connector – MBE 900 (3 of 4) – C Sample

Pin	Signal Type	Function	Connector
91	PV_B1	Power Supply	
92	PWM_3	High Tech Grid Heater	
93	PV_B1	Power Supply	
94	PWM_4	NC	
95	PV_M	Ground	
96	SW_4	Exhaust Brake	
97	SW_5	NC	
98	SW_3	Single-speed or Two-speed Fan	
99	SW_7	NC	
100	H_OUT1	Intake Air Throttle 5kHz (+)	
101	H_OUT2	Intake Air Throttle 5kHz (-)	
102	SGND	NC	
103	SGND	Sensor Ground	
104	SGND	Sensor Ground	
105	SGND	Sensor Ground	
106	A30	Intake Manifold Pressure Sensor	
107	D2	Diagnostic Electrostatic Oil Separator	
108	A28	Engine Oil Temperature Sensor	
109	A14	EGR Delta Pressure Sensor	
110	A26	Engine Coolant Temp Sensor	
111	A12	Fuel Line Pressure Sensor	
112	A25	Intake Air Temperature Sensor	
113	A11	NC	
114	SGND_S2	Sensor Ground	
115	A22	DPF Outlet Temp Sensor	
116	A08	NC	
117	SENS1_V	Sensor Power Supply	
118	A07	DPF Inlet Pressure Sensor	
119	A19	NC	
120	A04	Turbo Compressor Temperature Sensor	

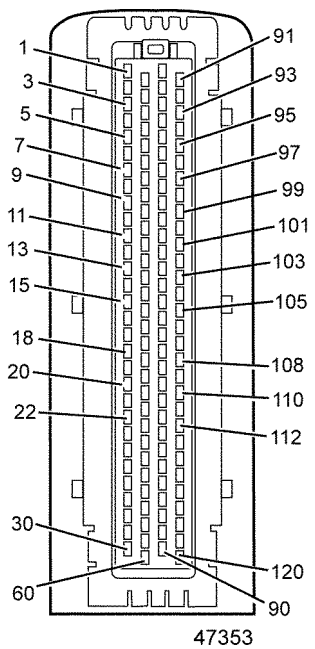


Table 3-8 MCM Connector – MBE 900 (4 of 4) – C Sample

MCM 120–pin Connector for MBE 4000 Engines

The pinouts for the 120–pin connector for the MBE 4000 engine are listed in Table 3-9, Table 3-10, Table 3-11, and Table 3-12.

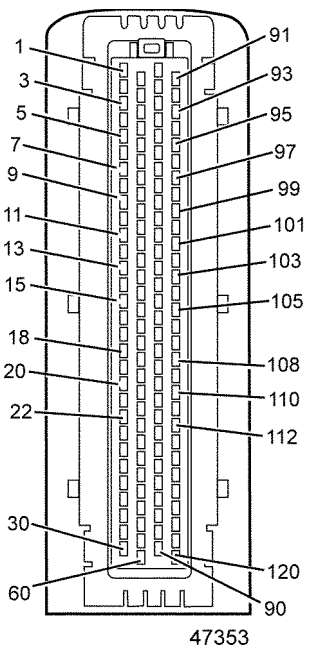
Pin	Signal Type	Function	Connector
1	RPU_H	NC	
2	RPU_L	NC	
3	PV_IM1	NC	
4	MV_B5F	Electronic Unit Pump (cyl 4) – pin 2	
5	MV_B5	Electronic Unit Pump Common (cyl 4) – pin 1	
6	MV_B5D	Electronic Unit Pump (cyl 6) – pin 2	
7	MV_B5	Electronic Unit Pump Common (cyl 6) – pin 1	
8	MV_B5B	Electronic Unit Pump (cyl 5) – pin 2	
9	MV_B5	Electronic Unit Pump Common (cyl 5) – pin 1	
10	MV_B4E	Electronic Unit Pump (cyl 2) – pin 2	
11	MV_B4	Electronic Unit Pump Common (cyl 2) – pin 1	
12	MV_B4C	Electronic Unit Pump (cyl 3) – pin 2	
13	MV_B4	Electronic Unit Pump Common (cyl 3) – pin 1	
14	MV_B4A	Electronic Unit Pump (cyl 1) – pin 2	
15	MV_B4	Electronic Unit Pump Common (cyl 1) – pin 1	
16	MV_B2F	Injector (cyl 4) – pin 2	
17	MV_B2	Injector Common (cyl 4) – pin 1	
18	MV_B2D	Injector (cyl 6) – pin 2	
19	MV_B2	Injector Common (cyl 6) – pin 1	
20	MV_B2B	Injector (cyl 5) – pin 2	
21	MV_B2	Injector Common (cyl 5) – pin 1	
22	MV_B1E	Injector (cyl 2) – pin 2	
23	MV_B1	Injector Common (cyl 2) – pin 1	
24	MV_B1C	Injector (cyl 3) – pin 2	
25	MV_B1	Injector Common (cyl 3) – pin 1	
26	MV_B1A	Injector (cyl 1) – pin 2	
27	MV_B1	Injector Common (cyl 1) – pin 1	
28	START_B	NC	
29	A16	DOC Outlet Temp Sensor	
30	A01	DPF Outlet Pressure Sensor	

Table 3-9 MCM Connector – MBE 4000 (1 of 4) – C Sample

Pin	Signal Type	Function	Connector
31	PWM_5	NC	
32	PWM_7	Constant Throttle Valve	
33	PWM_6	Two-speed Fan or Variable Speed Fan	
34	PWM_8	NC	
35	PWM_10	Wastegate	
36	PWM_9	NC	
37	PWM_11	NC	
38	PV_M	Ground	
39	HSW2	Electrostatic Oil Separator	
40	SW_1	NC	
41	HSW1	Grid Heater	
42	DYN3_N	NC	
43	DYN3	CKP (+)	
44	DYN2_N	NC	
45	DYN2	CMP (+)	
46	D3_V	NC	
47	DYN4	Fan Speed	
48	DYM2_M	CMP (-)	
49	DYN5	NC	
50	SGND_TL	Sensor Ground	
51	DYN1	Turbo Speed Sensor	
52	SGND_P	Sensor Ground	
53	A23	NC	
54	A09	Engine Oil Pressure Sensor	
55	SGND_P	Sensor Ground	
56	A20	NC	
57	A05	NC	
58	SENS1_V	Sensor Power Supply	
59	A17	NC	
60	A02	EGR Throttle Position	

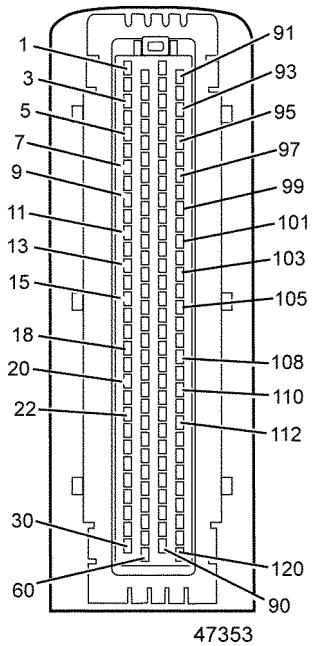


Table 3-10 MCM Connector – MBE 4000 (2 of 4) – C Sample

Pin	Signal Type	Function	Connector
61	PWM_1	EGR Valve	
62	PV_B2	Power Supply	
63	PWM_2	NC	
64	PV_B2	Power Supply	
65	PWM_12	Doser	
66	PWM_13	EPV2 (Entry Connecting Flap)	
67	PV_M	Ground	
68	SW_2	NC	
69	SW_8	Fuel Cutoff Valve	
70	SW_6	NC	
71	LIN_V	NC	
72	LIN	NC	
73	DYN3_M	CKP (-)	
74	CAN3L	NC	
75	CAN3H	NC	
76	D3_S	NC	
77	A29	Supply Fuel Temperature Sensor	
78	A15	NC	
79	D1	Grid Heater	
80	A27	NC	
81	A13	NC	
82	SENS2_V	Sensor Power Supply	
83	A24	NC	
84	A10	Fuel Compensation Pressure Sensor	
85	SENS2_V	Sensor Power Supply	
86	A21	Turbo Compressor Temperature Sensor	
87	A06	Intake Manifold Pressure Sensor	
88	SGND_P	Sensor Ground	
89	A18	DOC Inlet Temp Sensor	
90	A03	Intake Air Throttle Position	

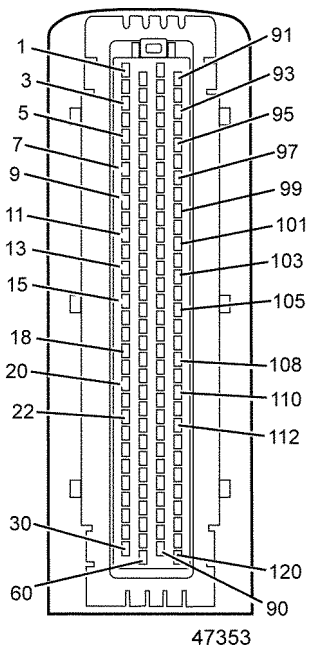


Table 3-11 MCM Connector – MBE 4000 (3 of 4) – C Sample

Pin	Signal Type	Function	Connector
91	PV_B1	Power Supply	
92	PWM_3	High Tech Grid Heater	
93	PV_B1	Power Supply	
94	PWM_4	NC	
95	PV_M	Ground	
96	SW_4	EPV1 (Entry Shutoff Flap)	
97	SW_5	NC	
98	SW_3	Single-speed Fan or Two-speed Fan	
99	SW_7	NC	
100	H_OUT1	Intake Throttle Valve 5 kHz (+)	
101	H_OUT2	Intake Air Throttle Valve 5 kHz (-)	
102	SGND	Sensor Ground	
103	SGND	Sensor Ground	
104	SGND	Sensor Ground	
105	SGND	Sensor Ground	
106	A30	Intake Air Temperature Sensor	
107	D2	Electrostatic Oil Separator	
108	A28	Engine Oil Temperature Sensor	
109	A14	Intake Air Delta P Sensor	
110	A26	Engine Coolant Temp Sensor	
111	A12	Fuel Line Pressure Sensor	
112	A25	NC	
113	A11	NC	
114	SGND_S2	Sensor Ground	
115	A22	DPF Outlet Temp Sensor	
116	A08	NC	
117	SENS1_V	Sensor Power Supply	
118	A07	DPF Inlet Pressure Sensor	
119	A19	Intake Manifold Pressure Sensor	
120	A04	Turbo Compressor Pressure Sensor	

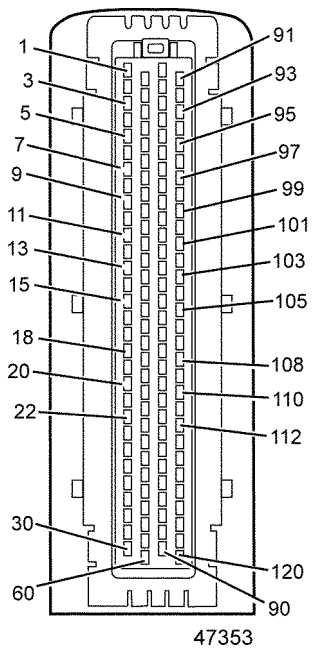


Table 3-12 MCM Connector – MBE 4000 (4 of 4) – C Sample

Connector Brackets

The harnesses on MCM 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 for the Series 60 engine (see Figure 3-2).

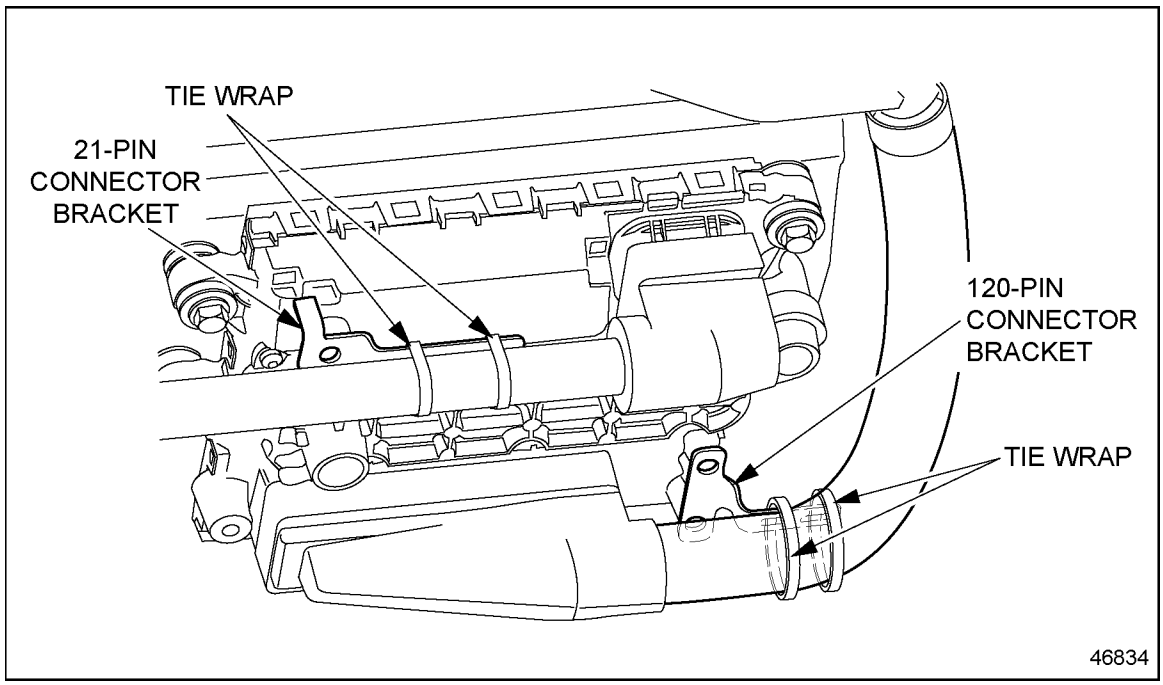
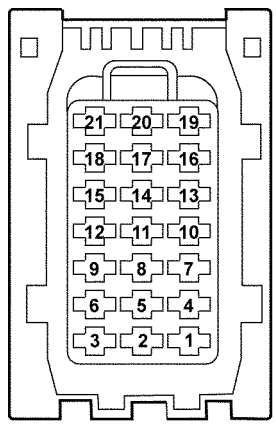


Figure 3-2 Series 60 Engine 120–pin Connector and 21–pin Connector Tie-wrapped to Brackets

MCM 21–pin and 31–pin Connectors

The wiring for the VIH 21–pin to the MCM is listed in Table 3-13. The side of the connector shown is looking into the pins.

Pin	Signal Type	Function	Connector
21/1	CAN2L	Not Used	
21/2	CAN2GND	Not Used	
21/3	CAN2H	Not Used	
21/4	CAN2GND	Not Used	
21/5	KL31	Battery (-)	
21/6	KL31	Battery (-)	
21/7	KL15	IGN	
21/8	KL31	Battery (-)	
21/9	KL31	Battery (-)	
21/10	CAN1GND	Engine CAN Shield	
21/11	KL30	Battery (+)	
21/12	KL30	Battery (+)	
21/13	CAN1H	Engine CAN +	
21/14	KL30	Battery (+)	
21/15	KL30	Battery (+)	
21/16	CAN1GND	Not Used	
21/17	BOOT	Not Used	
21/18	KDiag_S	Not Used	
21/19	CAN1L	Engine CAN –	
21/20	KL50	Crank Start Input	
21/21	START_B	Crank Activation Output	



Front
Looking into the Pins on the Harness

Table 3-13 21–Pin Connector to the MCM

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 3-14 21–Pin Connector to the MCM Part Numbers

The part numbers for the 31–pin MCM pigtail connector are listed in Table 3-15.

Part	DDC Part Number
Connector	008 545 31 26
Terminal	006 545 52 26
Seals	000 545 72 80
Cavity Plugs	000 545 62 80
Backshell	000 546 99 35

Table 3-15 31–pin MCM Pigtail Connector Part Numbers

The pinout for the 31–pin pigtail on the Engine Harness is listed in Table 3-16. The OEM is responsible for wiring to this connector.

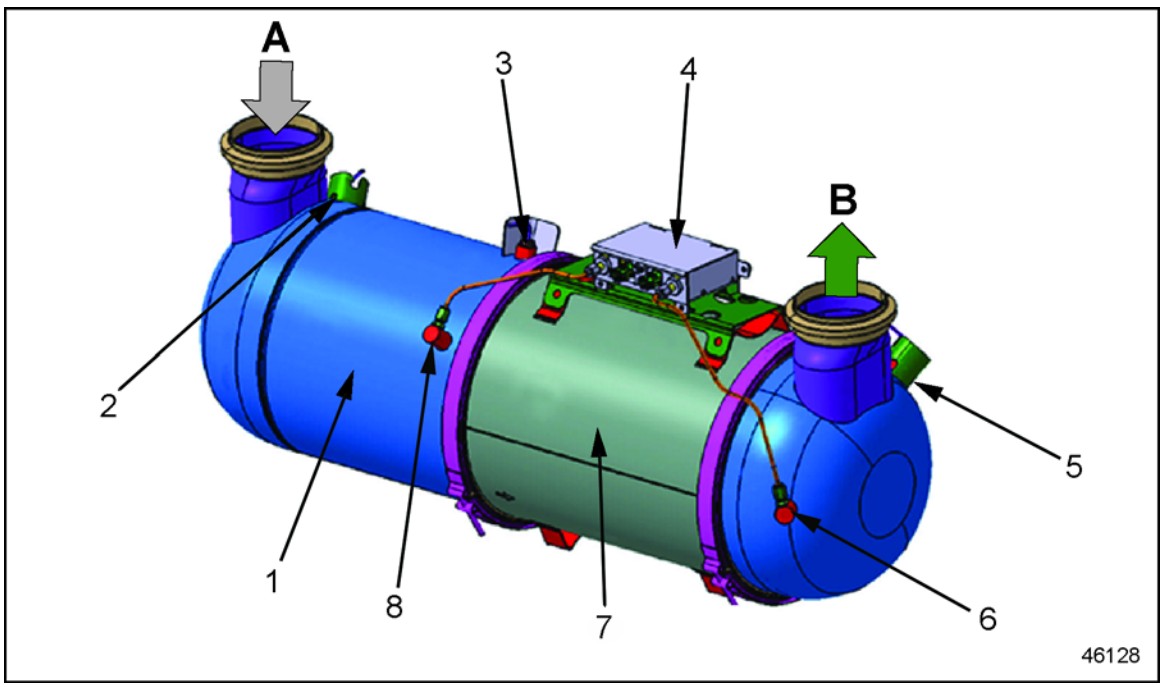
31–pin	120–pin	Function	Series 60	MBE 900	MBE 4000	HDE
31/1	—	Spare	—	—	—	—
31/2	—	Power Supply (IGN)*	—	—	—	X
31/3	—	Fuel Heater Supply #1†	—	X	-	X
31/4	—	Spare	—	—	—	—
31/5	—	Full Heater Supply #2†	—	X	—	X
31/6	—	Spare	—	—	—	—
31/7	—	Power Supply Ground*	—	—	—	X
31/8	120/70	Ether Start	X	—	—	—
31/9	120/33	Fan Control #2 – High of Two-speed Fan or Variable Speed Fan	X	X	X	X
31/10	120/98	Single Speed Fan or Low for Two-speed Fan	X	X	X	X
31/11	—	Fuel Heater Ground #1†	—	X	—	X
31/12	—	Spare	—	—	—	—
31/13	—	Spare	—	—	—	—
31/14	120/71	Water-in-Fuel Sensor Supply	—	X	—	—
31/15	120/67	Water-in-Fuel Sensor Ground	—	X	—	—
31/16	120/96	Engine Brake Solenoid Control	—	X	—	—
31/17	120/29	DOC Outlet Temp Sensor (Exhaust Gas Temperature in Front of Particulate Trap)	X	X	X	X
31/18	120/89	DOC Inlet Temp Sensor	X	X	X	X
31/19	120/115	DPF Outlet Temp Sensor(Exhaust Gas Temperature After Particulate Trap)	X	X	X	X
31/20	—	Full Heater Ground #2†	—	X	—	X
31/21	—	Spare	—	—	—	—
31/22	120/91	Power Supply (Eng Brk, Fan, Ether)	X	X	X	X
31/23	120/47	Fan Speed	X	X	X	X
31/24	120/88	Sensor Ground	X	X	X	X
31/25	120/59	HDMS Fan Thermal Switch	X	—	X	X
31/26	120/57	Water-in-Fuel Sensor	—	X	—	—
31/27	120/86	TCI Temp	X	—	—	—
31/28	120/114	Sensor Ground	X	X	X	X
31/29	120/85	Sensor Supply	X	X	X	X
31/30	120/30	DPF Outlet Pressure Sensor (Exhaust Gas Pressure After Particulate Filter)	X	X	X	X
31/31	120/118	DPF Inlet Pressure Sensor (Exhaust Gas Pressure Before Particulate Filter)	X	X	X	X

*Fused at 15 amps
† Optional for MBE 900 and HDE. Must use 14 AWG wire and fuse at 20A.

Table 3-16 31–pin MCM Pigtail Connector

3.1.2 DPF HARNESS

The Aftertreatment Device (ATD) configuration includes a Diesel Oxidation Catalyst (DOC) and a Diesel Particulate Filter (DPF). See Figure 3-3.



1. Diesel Oxidation Catalyst
2. DOC Inlet Temperature Sensor
3. DOC Outlet Temperature Sensor
4. Sensor Junction Box
5. DPF Outlet Temperature Sensor
6. Diesel Particulate Filter
7. A= Engine Exhaust Inlet
8. B= Exhaust Outlet

Figure 3-3 Aftertreatment Device

The ATD may be horizontally or vertically mounted depending on the vehicle chassis configuration. See Figure 3-4 for a typical mounting view of the ATD.

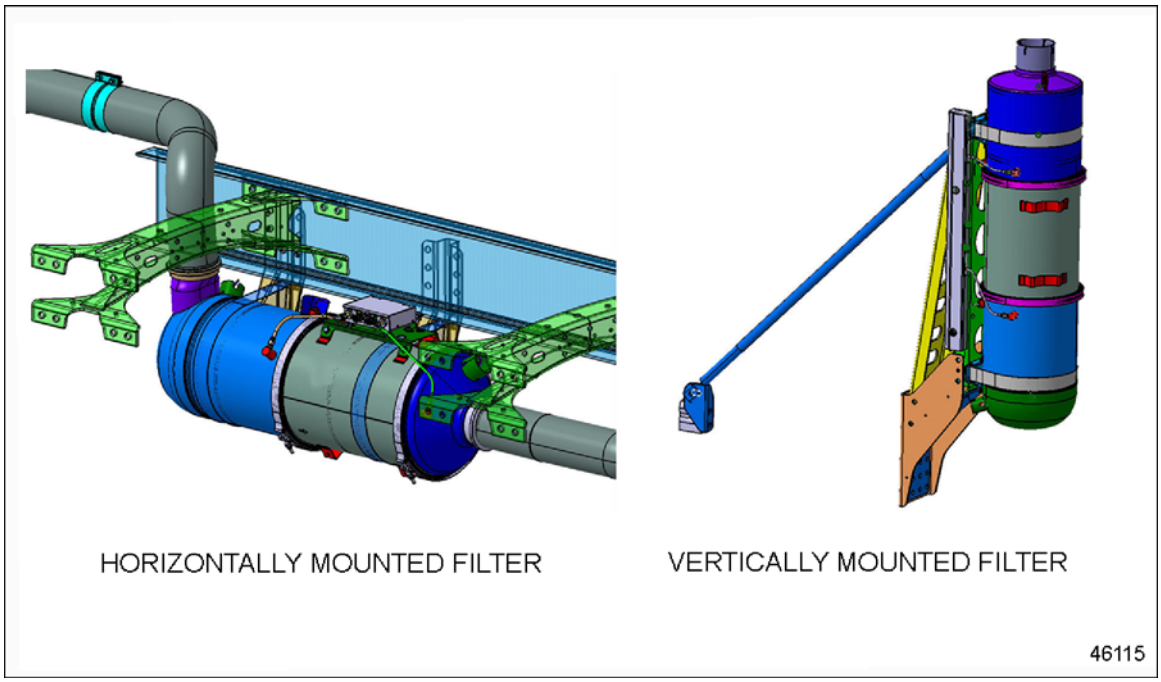


Figure 3-4 Typical Mounting Views of an Aftertreatment Device

The wiring for the DPF Harness is determined by the ATD mount position.

DPF Harness – Vertical Mount ATD (31-pin to 10 pin connector)

See Figure 3-5 for the DPF Harness wiring for vertical mount ATDs.

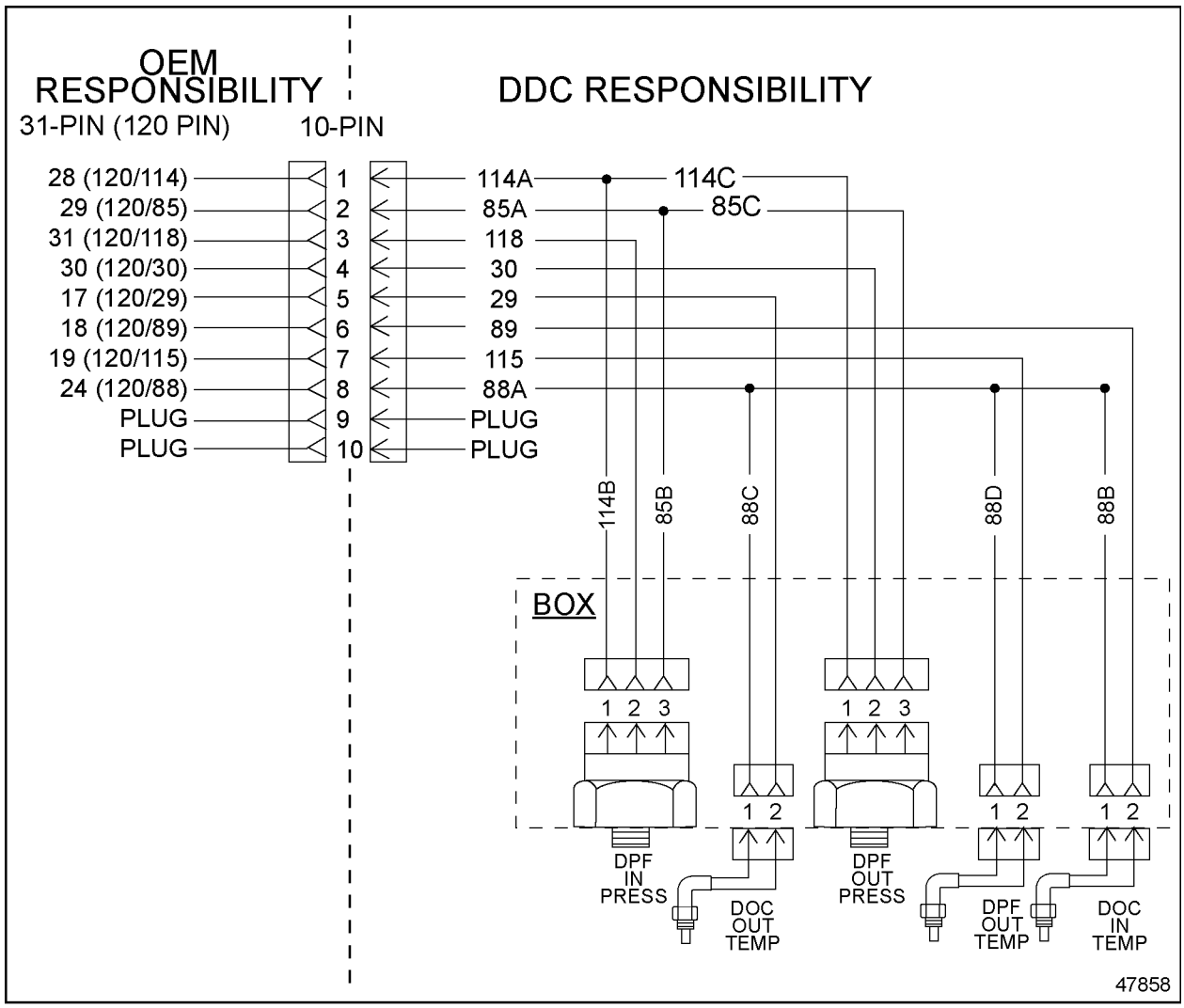


Figure 3-5 Vertical and Under Step Mount ATD Wiring — OEM Responsibility

The wiring for the 10–pin DPF connector is listed in Table 3-17.

The DDC part numbers for the DPF connector arelisted in Table 3-18.

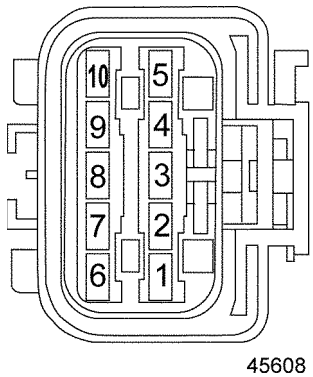
Pin	Function	Connector
1	Sensor Ground	 45608
2	Sensor Supply	
3	DPF Inlet Pressure Sensor (Exhaust Gas Pressure Before Particulate Filter)	
4	DPF Outlet Pressure Sensor (Exhaust Gas Pressure After Particulate Filter)	
5	DOC Outlet Temperature Sensor (Exhaust Gas Temp in Front of Particulate Trap)	
6	DOC Inlet Temperature Sensor	
7	DPF Outlet Temperature Sensor(Exhaust Gas Temp After Particulate Trap)	
8	Sensor Ground	
9	Plug	
10	Plug	

Table 3-17 DPF 10–pin Connector

Part	DDC Part Numbers
10–pin Connector	23531613
Terminal (Male)	23531614
Plug	23531615

Table 3-18 DDC Part Numbers for the DPF 10-pin Connector

DPF Harness – Horizontal Mount ATD (31-pin to 10-pin Connector/2-pin Connector)

See Figure 3-6 for the DPF Harness wiring for horizontal mount ATDs.

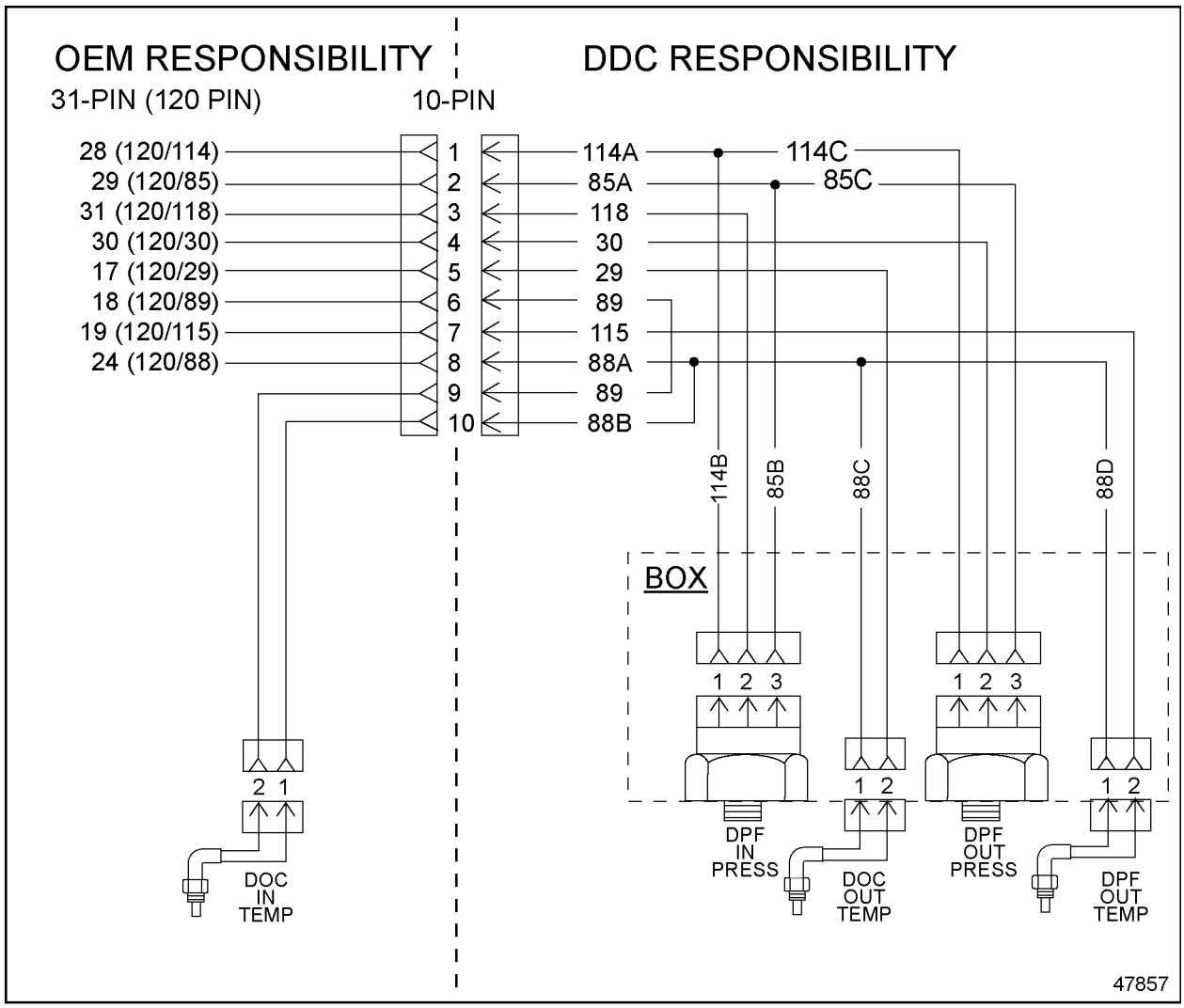


Figure 3-6 Horizontal Mount ATD Wiring — OEM Responsibility

The wiring for the DPF 10–pin connector and 2–pin connector is listed in Table 3-19.

The DDC part numbers for the DPF connector arelisted in Table 3-20.

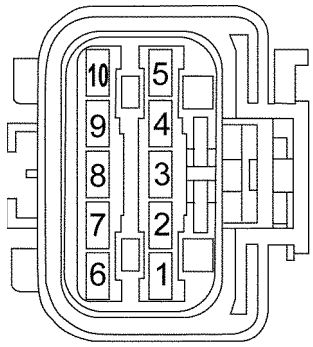
Pin	Function	Connector
1	Sensor Ground	 45608
2	Sensor Supply	
3	DPF Inlet Pressure Sensor (Exhaust Gas Pressure Before Particulate Filter)	
4	DPF Outlet Pressure Sensor (Exhaust Gas Pressure After Particulate Filter)	
5	DOC Outlet Temperature Sensor (Exhaust Gas Temp in Front of Particulate Trap)	
6	DOC Inlet Temperature Sensor	
7	DPF Outlet Temperature Sensor(Exhaust Gas Temp After Particulate Trap)	
8	Sensor Ground	**DPF 2–pin Connector**
9	DOC Inlet Temperature Sensor	2
10	Sensor Ground	1

Table 3-19 DPF 10–pin Connector and 2–pin Connector — Horizontal Mount ATD

Part	DDC Part Numbers
10-Pin Connector	23531613
Terminal (Male)	23531614
Plug	23531615
2-Pin Connector	23537171
Terminal (Female)	23531617

Table 3-20 DDC Part Numbers for the DPF 10-pin and 2–pin Connector — Horizontal Mount ATD

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3.2 COMMON POWERTRAIN CONTROLLER

The Common Powertrain Controller (CPC) 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 CPC is the interface between the MCM and the vehicle/equipment for engine control and manages other vehicle/equipment functions. See Figure 3-7.

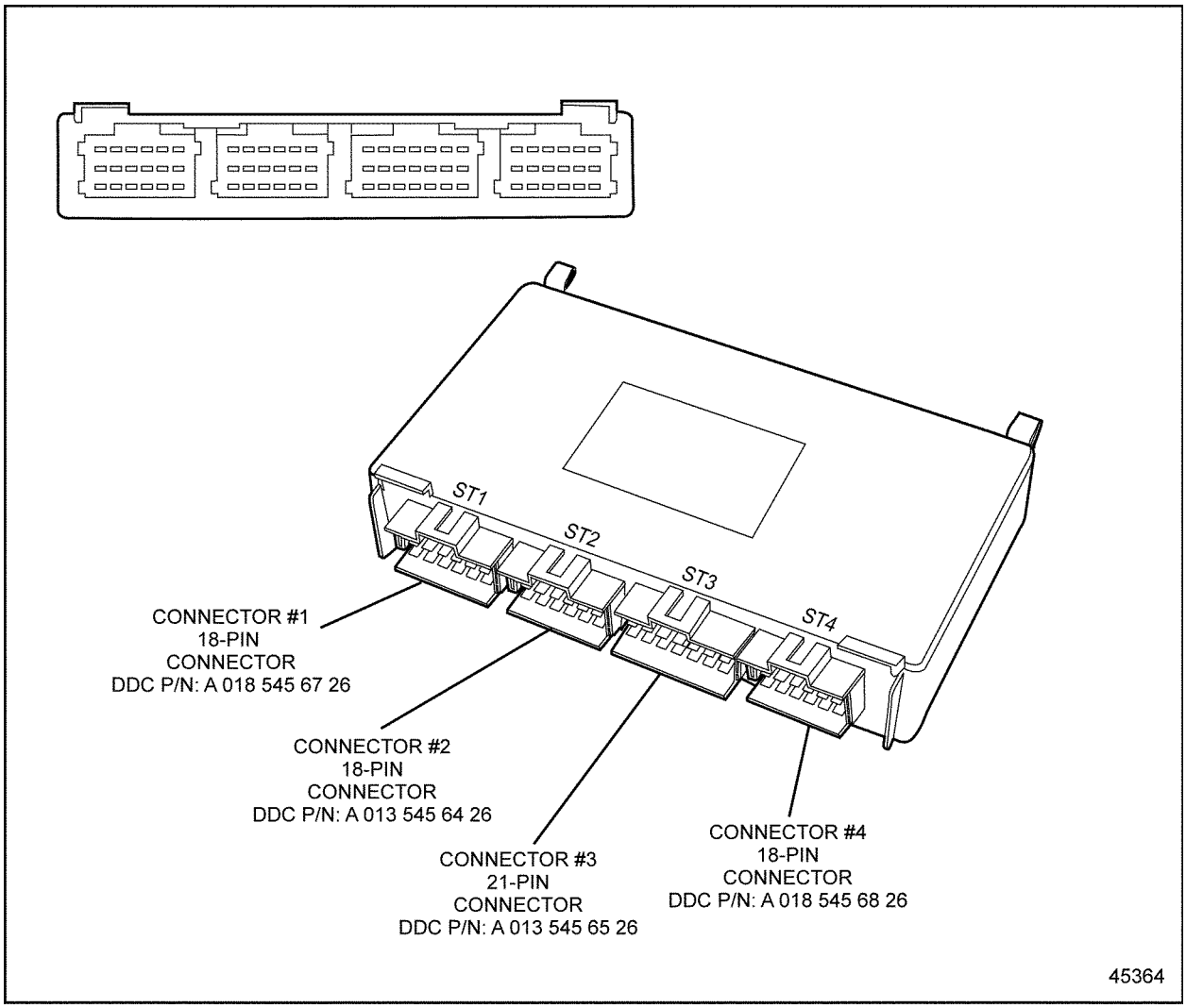


Figure 3-7 The Common Powertrain Controller

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 3-8 for the CPC dimensions.

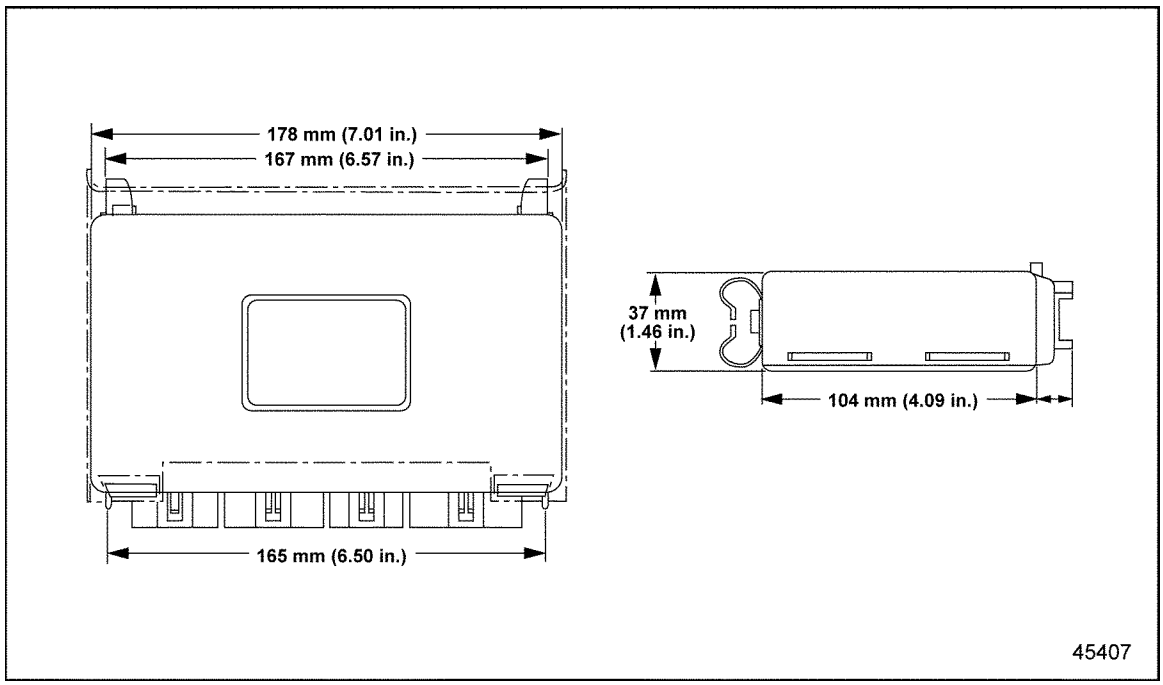


Figure 3-8 CPC Dimensions

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

The CPC communicates over the J1587 and J1939 Data Links to the vehicle (see Figure 3-9).

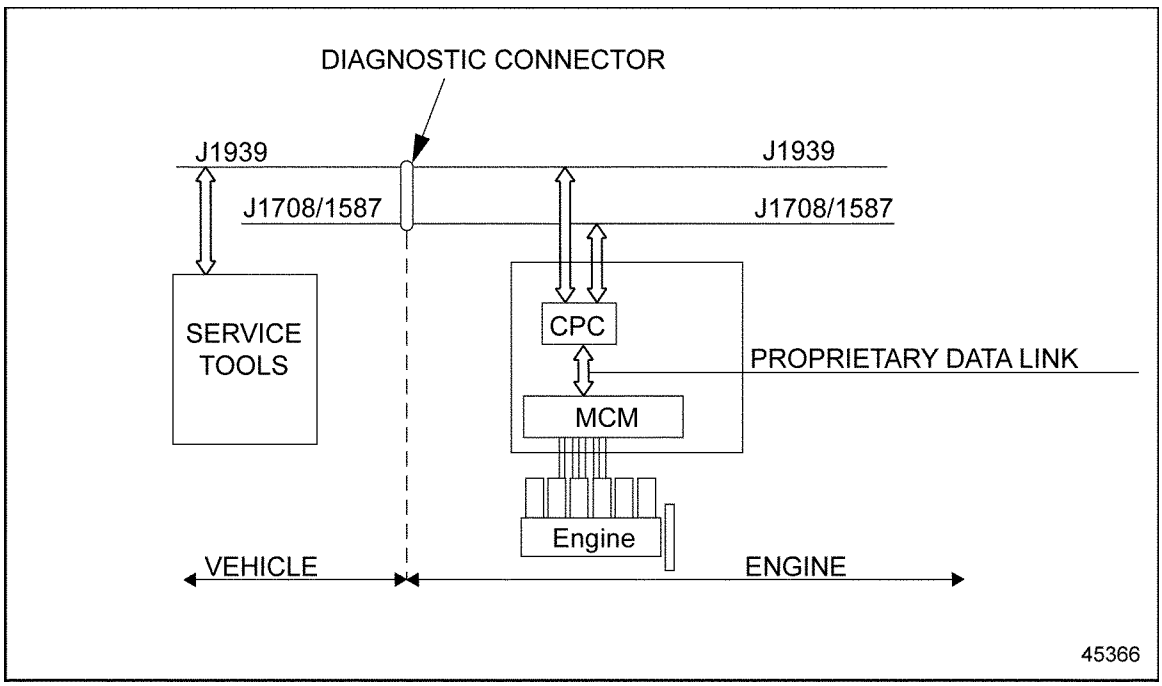


Figure 3-9 NAFTA Architecture On-highway

Within the CPC, sets of data for specific applications are stored. These include idle speed, maximum running speed, and speed limitation. Customer programmable parameters are also stored here.

The CPC receives data from the operator (accelerator pedal position, switches, various sensors) and other electronic control units (for example, synchronization controllers for more than one genset, air compressor controls).

From this data, instructions are computed for controlling the engine and transmitted to the MCM via the proprietary data link.

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

3.2.2 CPC VEHICLE INTERFACE HARNESS

The OEM supplied Vehicle Interface Harness (VIH) connects the CPC to the MCM and other vehicle systems (see Figure 3-10).

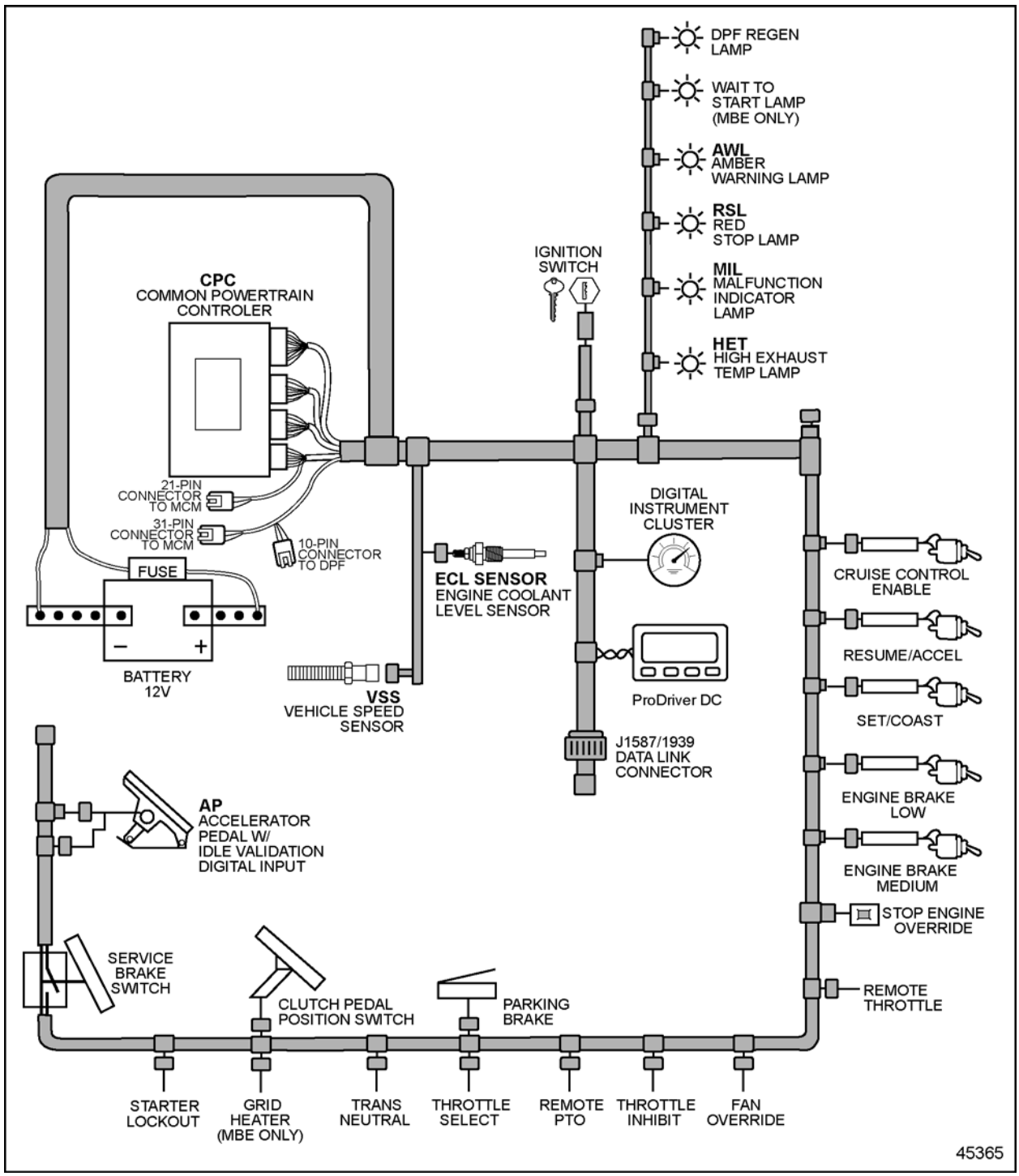


Figure 3-10 Vehicle Interface Harness

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 MCM and the CPC 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 CPC and MCM.

Frequency Input

The CPC 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 3-21.

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

Table 3-21 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 CPC.

High Power Outputs

DO_HP_FLEX-01 – 4/9

DO_HP_FLEX_02 – 3/17

DO_HP_HS_01 — 3/7

DO_HP_HS_02 — 3/8

DO_HP_HS_04 — 4/10

DO_HP_LS_01 — 3/9

DO_HP_LS_02 — 4/7

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

Low Power Outputs

DO_HP_FLEX-1 – 1/13

DO_HP_FLEX_2 – 2/10

DO_HP_FLEX_3 — 3/10

DO_HP_FLEX_4 — 3/12

DO_HP_FLEX_5 — 3/16

DO_HP_FLEX_6 — 4/6

DO_HP_LS_01 — 1/4

DO_HP_LS_02 — 1/5

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 CPC, one 21–connector to the MCM, 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 (CPC) #1 connector (18–pins) for truck applications islisted in Table 3-22. 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 3-23.

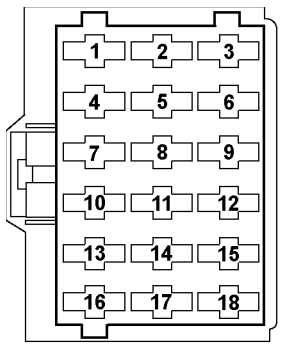
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Dual-speed Axle	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
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 3-22 Connector #1 Pin Assignments – Truck Application

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

Table 3-23 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC) #2 connector (18–pins) for truck applications is listed in Table 3-24. 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 3-25.

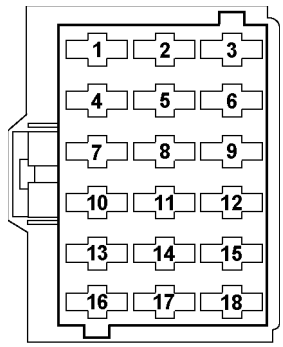
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587(+)	
2/6	J1708_B_C	J1587(–)	
2/7	Digital 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 3-24 Connector #2 Pin Assignments – Truck Application

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

Table 3-25 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC) #3 connector (21–pins) for truck applications islisted in Table 3-26 . 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 3-27.

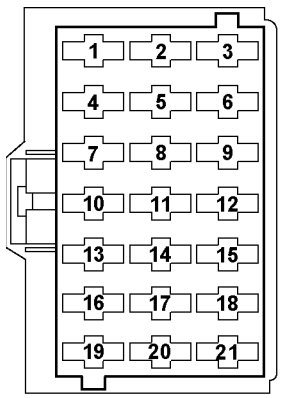
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	OI Thermostat	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	Not Used	
3/7	Digital Output_HP_HS_01	Top2 Lockout Solenoid/AGS2 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	
3/10	Digital Output_LP_FLEX_02	AGS2 Trans Temp 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	Not Used	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	

Table 3-26 Connector #3 Pin Assignments – Truck Application

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

Table 3-27 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC) #4 connector (18–pins) for truck applications islisted in Table 3-28. 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 3-29.

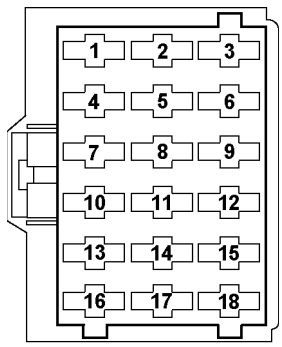
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (-)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (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	OI Active 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	—	
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 3-28 Connector #4 Pin Assignments – Truck Application

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

Table 3-29 Connector #4, 18–pin Connector, Key C

Vocational Applications

The pin assignments for the Common Powertrain Controller (CPC) #1 connector (18–pin) for vocational applications are listed in Table 3-30. 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 3-31.

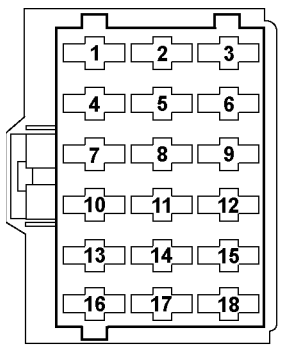
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Dual-speed Axle	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor Ground	
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 3-30 Connector #1 Pin Assignments – Vocational Applications

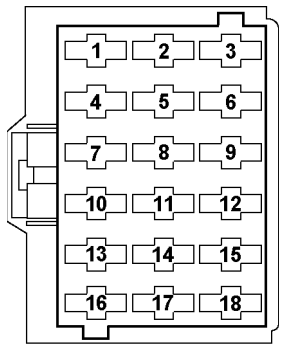
Part	DDC Part Number
CPC - 18 Pin Connector - B Key	018 545 67 26
CPC - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-31 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC) #2 connector (18–pin) for vocational applications are listed in Table 3-32. 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 3-33.

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 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+	



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Front
Looking into the Pins on the Harness

Table 3-32 Connector #2 Pin Assignments – Vocational Applications

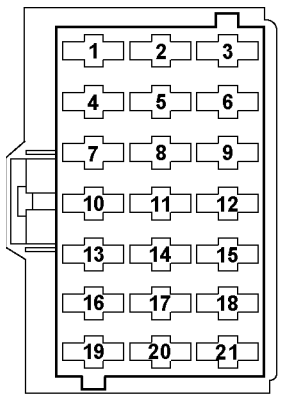
Part	DDC Part Number
CPC - 18 Pin Connector - A Key	013 545 64 26
CPC - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-33 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC) #3 connector (21–pin) for vocational applications are listed in Table 3-34. 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 3-35.

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	Not Used	
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	AGS 2 Backup Lamp/AGS2 PTO Valve	
3/10	Digital Output_LP_FLEX_02	AGS2 Trans Temp Lamp/AGS2 PTO 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	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	



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Front
Looking into the Pins on the Harness

Table 3-34 Connector #3 Pin Assignments – Vocational Applications

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

Table 3-35 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC) #4 connector (18–pin) for vocational applications are listed in Table 3-36. 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 3-37.

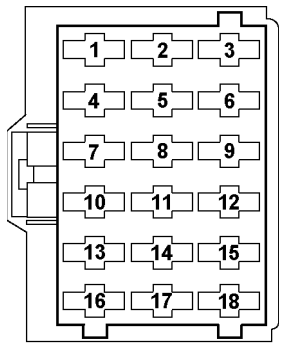
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (-)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (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	
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	—	
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 3-36 Connector #4 Pin Assignments – Vocational Applications

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

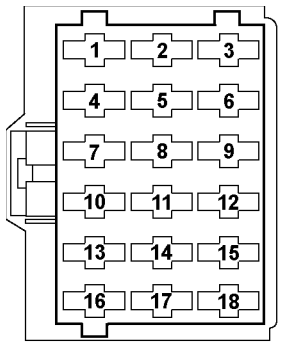
Table 3-37 Connector #4, 18–pin Connector, Key C

Coach Applications

The pin assignments for the Common Powertrain Controller (CPC) #1 connector (18–pin) for coach applications are listed in Table 3-38.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-39.

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	Not Used	
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 3-38 Connector #1 Pin Assignments – Coach Application

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

Table 3-39 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC) #2 connector (18–pin) for coach applications are listed in Table 3-40.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-41.

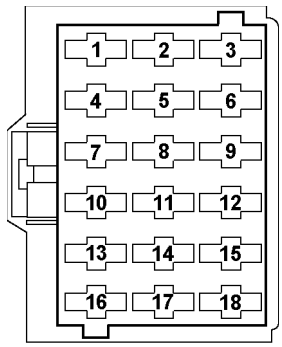
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Service Brake Released Switch	
2/8	Digital Input_FLEX_16	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 (+)	

Table 3-40 Connector #2 Pin Assignments – Coach Application

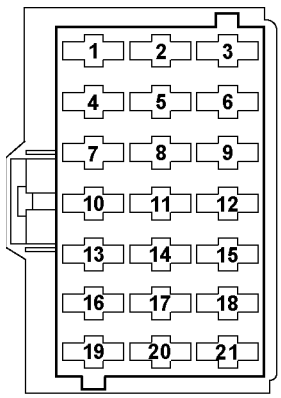
Part	DDC Part Number
CPC - 18 Pin Connector - A Key	013 545 64 26
CPC - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-41 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC) #3 connector (21–pin) for coach applications are listed in Table 3-42.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-43.

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	Not Used	
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 Used	
3/10	Digital Output_LP_FLEX_02	Low Battery Voltage 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	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	



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Front
Looking into the Pins on the Harness

Table 3-42 Connector #3 Pin Assignments – Coach Application

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

Table 3-43 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC) #4 connector (18–pin) for coach applications are listed in Table 3-44.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-45.

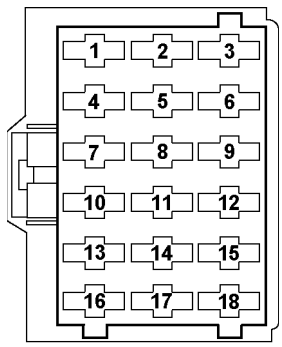
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (-)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust System Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released	
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	Engine Brake Disable	

Table 3-44 Connector #4 Pin Assignments – Coach Application

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

Table 3-45 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 3-46.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-47.

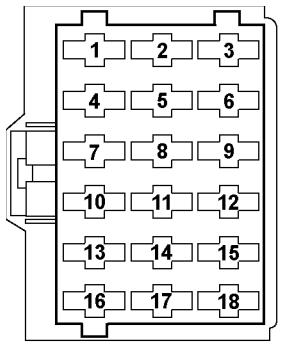
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Parking Brake	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position Sensor 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	Not Used	
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	

Table 3-46 Connector #1 Pin Assignments – Fire Truck Application

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

Table 3-47 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 3-48.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-49.

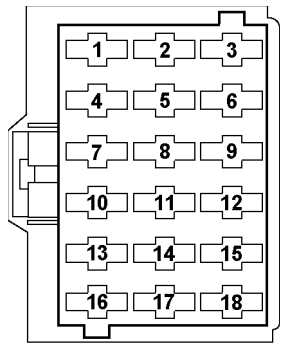
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital Input_FLEX_15	Not Used	
2/8	Digital Input_FLEX_16	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 3-48 Connector #2 Pin Assignments – Fire Truck Application

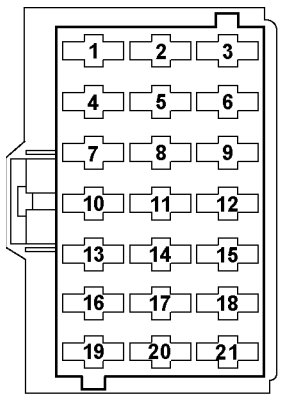
Part	DDC Part Number
CPC - 18 Pin Connector - A Key	013 545 64 26
CPC - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-49 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 3-50.

The part numbers for the #3 connector, Key C and terminals are listed in Table 3-51.

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	Not Used	
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	
3/10	Digital Output_LP_FLEX_02	Coolant Level 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	
3/18	Digital Input_SFP_02	Not Used	
3/19	Not Used	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	



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Front
Looking into the Pins on the Harness

Table 3-50 Connector #3 Pin Assignments – Fire Truck Application

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

Table 3-51 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 3-52.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-53.

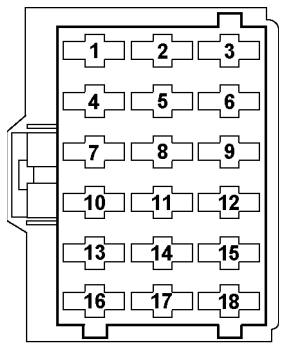
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (+)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust System Temperature Lamp	
4/8	Digital Input_FLEX_E1	Not Used	
4/9	Digital Output_HP_FLEX_01	Not Used	
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	—	
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	

Table 3-52 Connector #4 Pin Assignments – Fire Truck Application

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

Table 3-53 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 3-54.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-55.

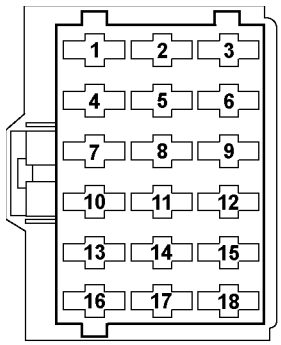
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position 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	Not Used	
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	

Table 3-54 Connector #1 Pin Assignments – Crane Application

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

Table 3-55 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 3-56.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-57.

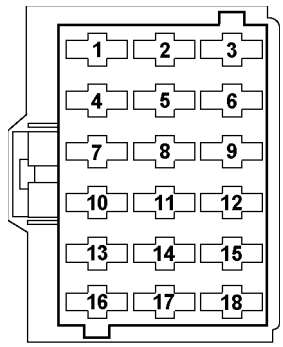
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital 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 3-56 Connector #2 Pin Assignments – Crane Application

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

Table 3-57 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 3-58.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-59.

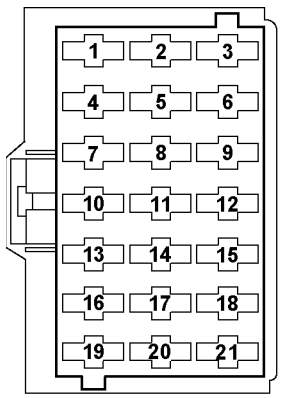
Pin	Signal Type	Function	Connector
3/1	Analog_In_01	—	 42707 Front Looking into the Pins on the Harness
3/2	Analog_GND	Sensor Return	
3/3	Analog__SUP_5V	Sensor Supply	
3/4	Analog_In_02	PTO	
3/5	Analog_Out_01	Not Used	
3/6	Analog_Out_02	Not Used	
3/7	Digital Output_HP_HS_01	Not Used	
3/8	Digital Output_HP_HS_02	Not Used	
3/9	Digital Output_HP_LS_01	Engine Brake Active	
3/10	Digital Output_LP_FLEX_02	Low Battery Voltage 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	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	

Table 3-58 Connector #3 Pin Assignments – Crane Application

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

Table 3-59 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 3-60

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-61.

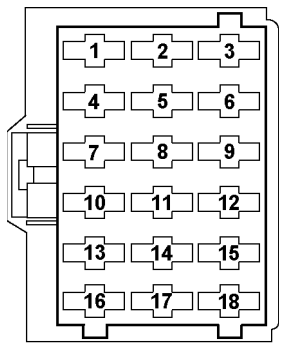
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (-)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust System Temperature Lamp	
4/8	Digital Input_FLEX_E1	Clutch Released	
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	Trans Neutral Switch	
4/17	Digital Input_FLEX_21	DPF Regeneration Switch	
4/18	Digital Input_FLEX_18	RPM Freeze	

Table 3-60 Connector #4 Pin Assignments – Crane Application

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

Table 3-61 Connector #4, 18–pin Connector, Key C

Transit Bus Applications

The pin assignments for the Common Powertrain Controller (CPC) #1 connector (18–pin) for transit bus applications are listed in Table 3-62.

The part numbers for the #1 connector, Key B and terminals are listed in Table 3-63.

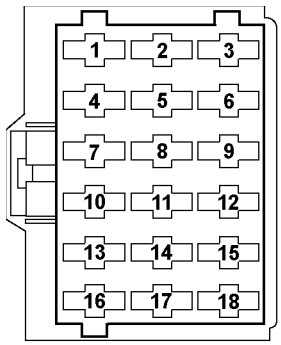
Pin	Signal Type	Function	Connector
1/1	Digital Input_FLEX_01	Transmission Retarder Active	 46727 Front Looking into the Pins on the Harness
1/2	Digital Input_FLEX_02	Park Brake Interlock	
1/3	Digital Input_SFP_05	Idle Validation Switch 2 (throttle active)	
1/4	Digital Output_LP_LS_02	Throttle Position 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	Not Used	
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	

Table 3-62 Connector #1 Pin Assignments – Transit Bus Application

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

Table 3-63 Connector #1, 18–pin Connector, B Key

The pin assignments for the Common Powertrain Controller (CPC) #2 connector (18–pin) for transit bus applications are listed in Table 3-64.

The part numbers for the #2 connector, Key A and terminals are listed in Table 3-65.

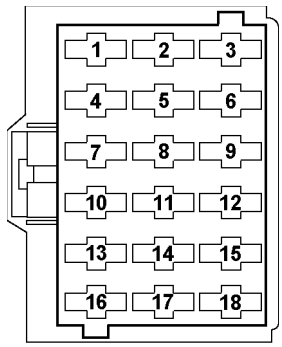
Pin	Signal Type	Function	Connector
2/1	Battery (+) PSU (KL_30)	Main Battery +12 V	 46724 Front Looking into the Pins on the Harness
2/2	Battery (-) PSU (KL_31)	Main Battery Ground	
2/3	Battery (+) Switched PSU	Ignition	
2/4	K_DIAG_C	K-line	
2/5	J1708_A_C	J1587 (+)	
2/6	J1708_B_C	J1587 (–)	
2/7	Digital 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 3-64 Connector #2 Pin Assignments – Transit Bus Application

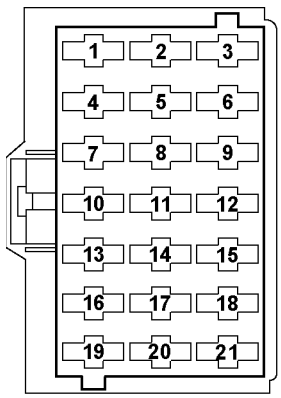
Part	DDC Part Number
CPC - 18 Pin Connector - A Key	013 545 64 26
CPC - socket 0.5-1.0mm wire (single)	013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	013 545 78 26

Table 3-65 Connector #2, 18–pin Connector, A Key

The pin assignments for the Common Powertrain Controller (CPC) #3 connector (21–pin) for transit bus applications are listed in Table 3-66.

The part numbers for the #3 connector, Key A and terminals are listed in Table 3-67.

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	Not Used	
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 Used	
3/10	Digital Output_LP_FLEX_02	Coolant Level 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	Not Populated	
3/20	Not Used	Not Populated	
3/21	Not Used	Not Populated	



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Front
Looking into the Pins on the Harness

Table 3-66 Connector #3 Pin Assignments – Transit Bus Application

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

Table 3-67 Connector #3, 21–pin Connector, Key A

The pin assignments for the Common Powertrain Controller (CPC) #4 connector (18–pin) for transit bus applications are Table 3-66, and listed in Table 3-68.

The part numbers for the #4 connector, Key C and terminals are listed in Table 3-69.

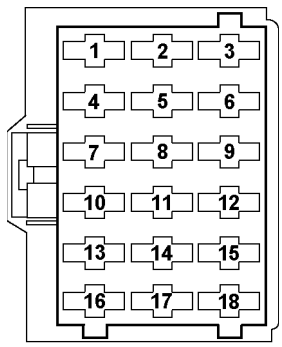
Pin	Signal Type	Function	Connector
4/1	C_ECAN_L	Engine CAN (-)	 46725 Front Looking into the Pins on the Harness
4/2	C_ECAN_GND	Engine CAN Shield	
4/3	C_ECAN_H	Engine CAN (+)	
4/4	Digital Input_SFP_11	Not Populated	
4/5	Digital Input_SFP_12	Not Populated	
4/6	Digital Output_LP_FLEX_06	Wait to Start Lamp (Grid Heater)	
4/7	Digital Output_HP_LS_02	High Exhaust System Temperature Lamp	
4/8	Digital Input_FLEX_E1	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 3-68 Connector #4 Pin Assignments – Transit Bus Application

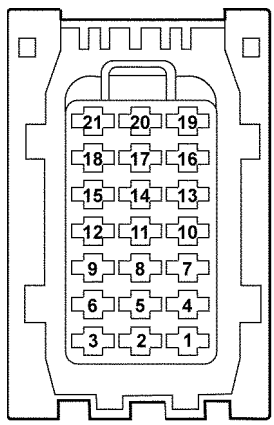
Part	DDC Part Number
CPC - 18 Pin Connector - C Key	A 018 545 68 26
CPC - socket 0.5-1.0mm wire (single)	A 013 545 76 26
CPC - socket 1.0-2.5mm wire (single)	A 013 545 78 26

Table 3-69 Connector #4, 18–pin Connector, Key C

VIH to MCM Connector Wiring

The wiring for the 21–pin MCM connector is listed in Table 3-70. The side of the connector shown is looking into the pins.

Pin	Signal Type	Function	Connector
21/1	CAN2L	Not Used	
21/2	CAN2GND	Not Used	
21/3	CAN2H	Not Used	
21/4	CAN2GND	Not Used	
21/5	KL31	Battery (-)	
21/6	KL31	Battery (-)	
21/7	KL15	IGN	
21/8	KL31	Battery (-)	
21/9	KL31	Battery (-)	
21/10	CAN1GND	Engine CAN Shield	
21/11	KL30	Battery (+)	
21/12	KL30	Battery (+)	
21/13	CAN1H	Engine CAN +	
21/14	KL30	Battery (+)	
21/15	KL30	Battery (+)	
21/16	CAN1GND	Not Used	
21/17	Not Used	Not Used	
21/18	KDiag_S	Not Used	
21/19	CAN1L	Engine CAN –	
21/20	KL50	Crank Start Input	
21/21	START_B	Crank Activation Output	



Front
Looking into the Pins on the Harness

Table 3-70 21–Pin Connector to the MCM

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 3-71 21–Pin Connector to the MCM Part Numbers

The part numbers for the 31–pin MCM pigtail connector are listed in Table 3-72.

Part	DDC Part Number
Connector	008 545 31 26
Terminal	006 545 52 26
Seals	000 545 72 80
Cavity Plugs	000 545 62 80
Backshell	000 546 99 35

Table 3-72 31–pin MCM Pigtail Connector Part Numbers

The pinout for the 31–pin pigtail on the Engine Harness is listed in Table 3-73. The OEM is responsible for wiring to this connector.

31–pin	120–pin	Function	Series 60	MBE 900	MBE 4000	HDE
31/1	—	Spare	—	—	—	—
31/2	—	Power Supply (IGN)*	—	—	—	X
31/3	—	Fuel Heater Supply #1†	—	X	—	X
31/4	—	Spare	—	—	—	—
31/5	—	Fuel Heater Supply #2†	—	X	—	X
31/6	—	Spare	—	-	—	—
31/7	—	Power Supply Ground*	—	—	—	X
31/8	120/70	Ether Start	X	—	—	—
31/9	120/33	Fan Control #2 – High of Two-speed Fan or Variable Speed Fan	X	X	X	X
31/10	120/98	Single Speed Fan or Low for Two-speed Fan	X	X	X	X
31/11	—	Fuel Heater Ground #1†	—	X	—	X
31/12	—	Spare	—	—	—	—
31/13	—	Spare	—	—	—	—
31/14	120/71	Water-in-Fuel Sensor Supply	—	X	—	—
31/15	120/67	Water-in-Fuel Sensor Ground	—	X	—	—
31/16	120/96	Engine Brake Solenoid Control	—	X	—	—
31/17	120/29	DOC Outlet Temp Sensor (Exhaust Gas Temperature in Front of Particulate Trap)	X	X	X	X
31/18	120/89	DOC Inlet Temp Sensor	X	X	X	X
31/19	120/115	DPF Outlet Temp Sensor(Exhaust Gas Temperature After Particulate Trap)	X	X	X	X
31/20	—	Fuel Heater Ground #2†	—	X	—	X
31/21	—	Spare	—	—	—	—
31/22	120/91	Power Supply (Eng Brk, Fan, Ether)	X	X	X	X
31/23	120/47	Fan Speed	X	X	X	X
31/24	120/88	Sensor Ground	X	X	X	X
31/25	120/59	HDMS Fan Thermal Switch	X	—	X	X
31/26	120/57	Water-in-Fuel Sensor	—	X	—	—
31/27	120/86	TCI Temp	X	—	—	—
31/28	120/114	Sensor Ground	X	X	X	X
31/29	120/85	Sensor Supply	X	X	X	X
31/30	120/30	DPF Outlet Pressure Sensor (Exhaust Gas Pressure After Particulate Filter)	X	X	X	X
31/31	120/118	DPF Inlet Pressure Sensor (Exhaust Gas Pressure Before Particulate Filter)	X	X	X	X

*Fused at 15 amps
† Optional for MBE 900 and HDE. Must use 14 AWG wire and fuse at 20A.

Table 3-73 31–pin MCM Pigtail Connector

VIH Power Wiring

The OEM-supplied VIH power wiring (see Figure 3-11) supplies 12 volts to the CPC and MCM. 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.

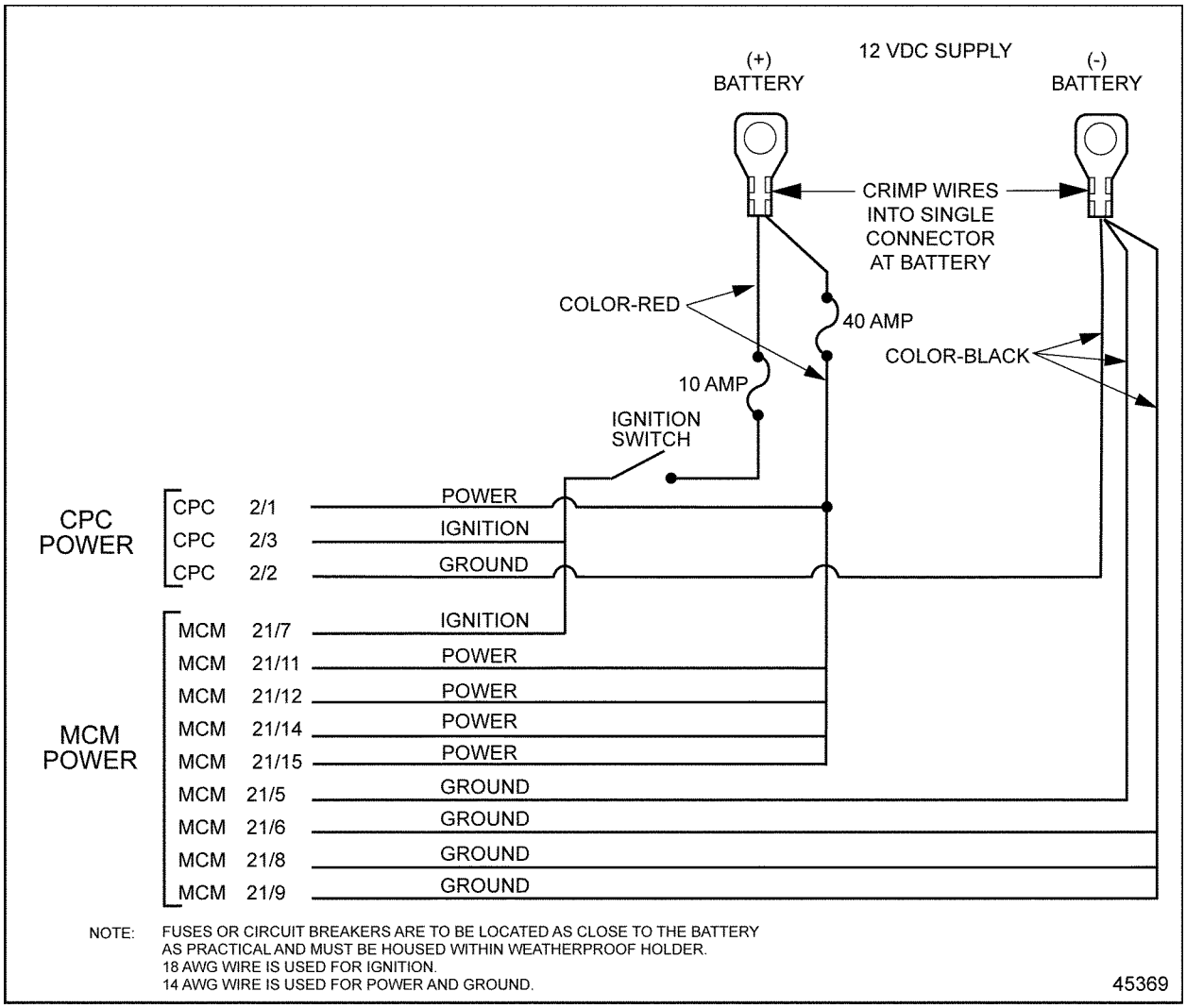


Figure 3-11 Power Wiring

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 MCM and CPC 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 3-74.

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 3-74 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 CPC connector pin assignments for SAE J1939 are listed in Table 3-75.

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

Table 3-75 J1939 CPC 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 MCM and the CPC 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 CPC and MCM. The wiring for the MCM 21–pin connector and the CPC 18–pin #4 connector are listed in Table 3-76.

CPC 18–Pin #4 Connector	Function	MCM 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 3-76 Propriety Engine-CAN Data Link

3.2.4 POWER SUPPLY – 12 VOLT SYSTEM

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

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

Operating the CPC and/or MCM 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 CPC and/or MCM if the Power Harness is not properly fused.

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

Average Current Draw

The maximum average current draw is listed in Table 3-77. This information should be used to size the alternator.

System	Maximum Average Current Draw (12 V Nominal Supply)		
	Crank	Idle	Full Load/Rated Speed
MCM – Engine Loads	1.0 A avg	21.0 A avg	25.0 A avg
CPC – 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 3-77 Maximum Average Current Draw

The current draw for a CPC configuration is listed in Table 3-78.

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

Table 3-78 Current Draw for CPC Configuration

The current draw for a MCM is listed in Table 3-79.

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

Table 3-79 Current Draw for MCM Configuration

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 3-12.

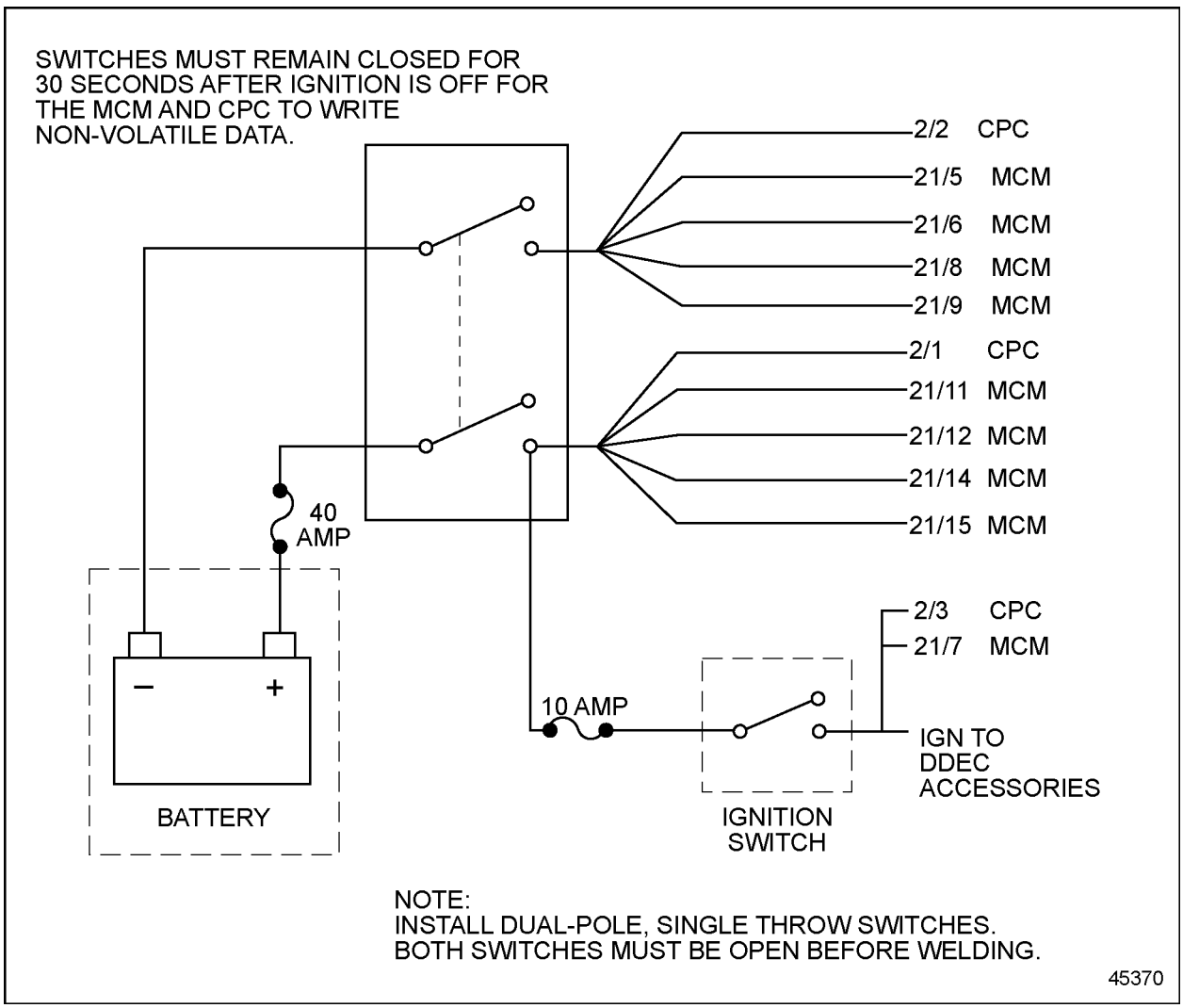


Figure 3-12 Main Power Supply Shutdown

NOTE:
Switches must remain closed for 30 seconds after ignition is off for the MCM and CPC 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 CPC 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 CPC – MCM'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 MCM or CPC 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 3-80 and Table 3-81.

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

Table 3-80 Fuse Current and Blow Time

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

Table 3-81 Fuse Temperature and Current

3.2.6 CONNECTORS

There are three 18–pin connectors and one 21–pin connector to the CPC. The OEM is responsible for the four connectors at the CPC, the 21–pin connector at the MCM, the 31–pin MCM pigtail connector and the 10–pin DPF connector.

NOTE:
The CPC connectors are not water tight and cannot be subject to water spray.

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

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

Table 3-82 Connector #1, 18–pin Connector, B Key

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

Table 3-83 Connector #2, 18–pin Connector, A Key

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

Table 3-84 CPC Connector #3, 21–pin Connector, Key A

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

Table 3-85 CPC 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 3-86 21–Pin Connector to the MCM Part Numbers

Part	DDC Part Number
Connector	008 545 31 26
Terminal	006 545 52 26
Seals	000 545 72 80
Cavity Plugs	000 545 62 80
Backshell	000 546 99 35

Table 3-87 31–pin MCM Pigtail Connector Part Numbers

Part	DDC Part Numbers
10-Pin Connector	23531613
Terminal (Male)	23531614
Plug	23531615
2-Pin Connector	23537171
Terminal (Female)	23531617

Table 3-88 DDC Part Numbers for the DPF 10-pin and 2–pin Connector — Horizontal Mount ATD

Part	DDC Part Numbers
Connector	23531613
Terminal	23531614
Plug	23531615

Table 3-89 DDC Part Numbers for the DPF 10-pin Connector — Vertical Mount ATD

Data Link Connector

The SAE J1708/J1587 nine-pin data link connector is required. DDC recommends that the OEM-supplied Data Link Connector be conveniently positioned in a well protected location facilitating subsequent DDDL 7.0 usage (i.e., reprogramming, diagnostics, etc.).

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

The components listed in Table 3-90 are required to incorporate a SAE J1939/J1587 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 3-90 VIH Components to Incorporate an SAE J1939/J1587 Data Link

The following illustration shows the wiring for the nine-pin connector (see see Figure 3-13).

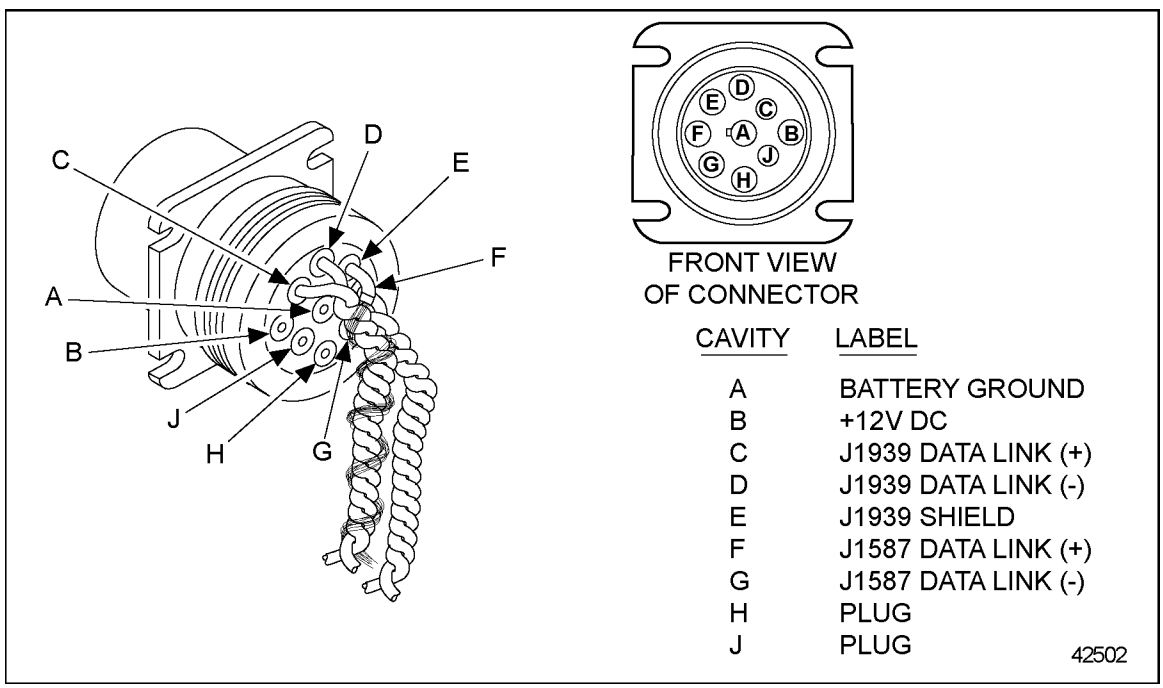


Figure 3-13 Wiring for 9-pin Data Link Connector

The SAE J1587/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 J1587/J1708 Data Link is 130 ft (40 m).

3.3 WIRES AND WIRING

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

3.3.1 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.

3.3.2 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 3.4 and 3.5.

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).

3.3.3 CRIMP TOOLS

The part numbers for the crimp tools for working with the MCM and CPC connectors are listed in Table 3-91.

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 3-91 Crimp Tools

3.3.4 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 3-14. Crimp the cable.

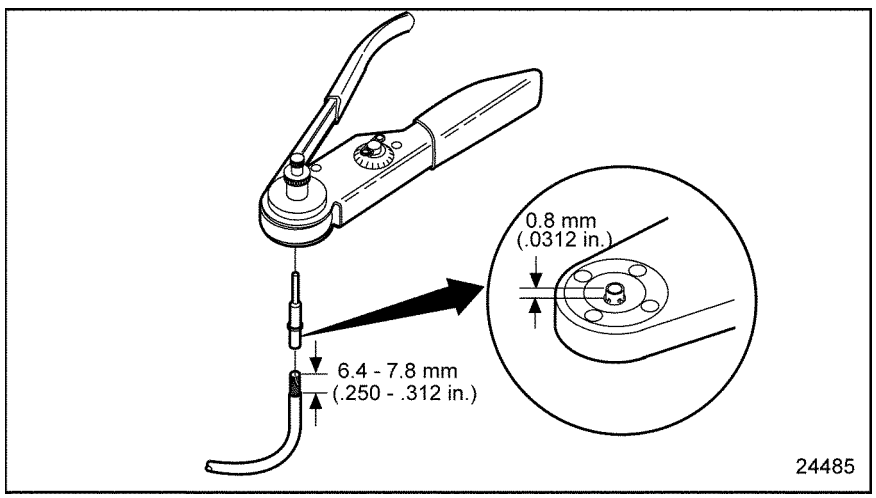


Figure 3-14 Setting Wire Gage Selector and Positioning the Contact

5. Grasp the contact approximately one inch behind the contact crimp barrel. Hold the connector with the rear grommet facing you. See Figure 3-15.

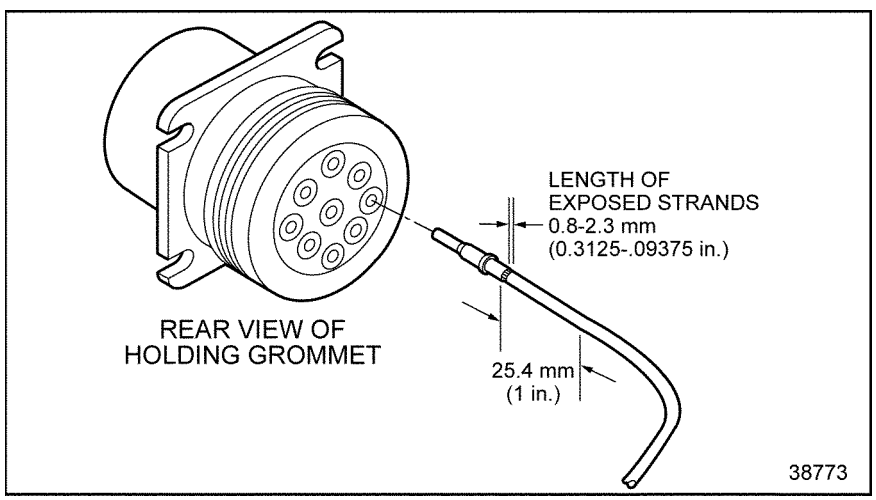


Figure 3-15 Pushing Contact Into Grommet

6. Push the contact into the grommet until a positive stop is felt. See Figure 3-15. A slight tug will confirm that it is properly locked into place. See Figure 3-16.

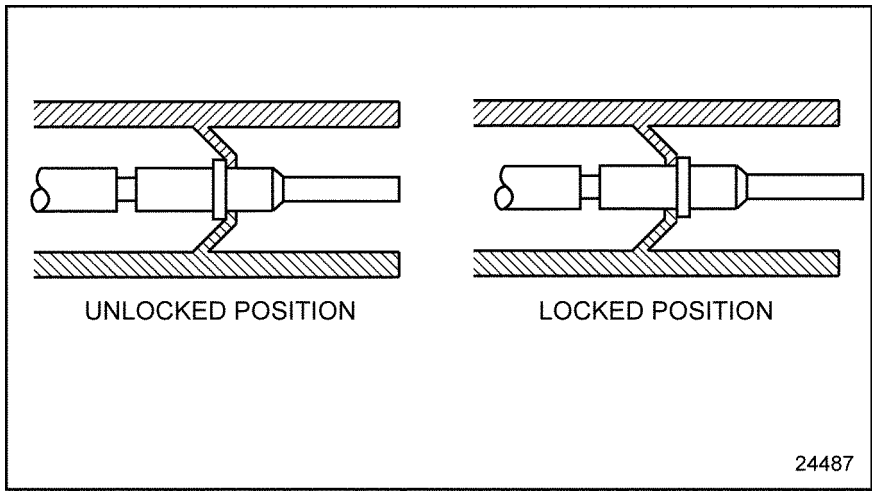


Figure 3-16 Locking Terminal Into Connector

Deutsch Terminal Removal

The appropriate size removal tool should be used when removing cables from connectors. The proper removal tools are listed in Table 3-92.

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

Table 3-92 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 3-17.

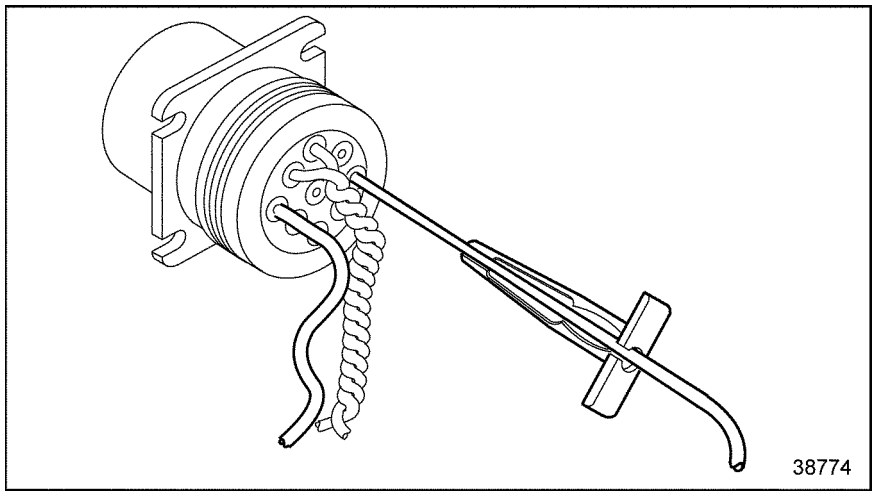


Figure 3-17 Removal Tool Position

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 3-18.

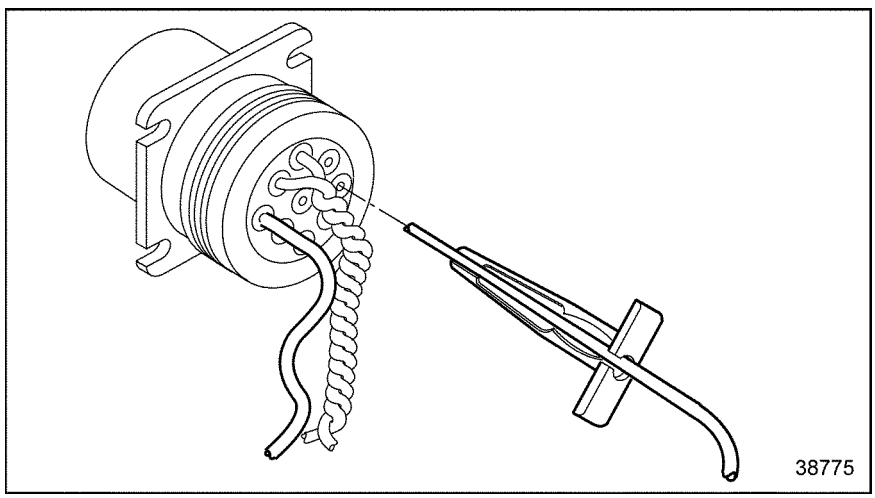


Figure 3-18 Removal Tool Insertion

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

3.3.5 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 3-93.

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 3-93 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 3-19.

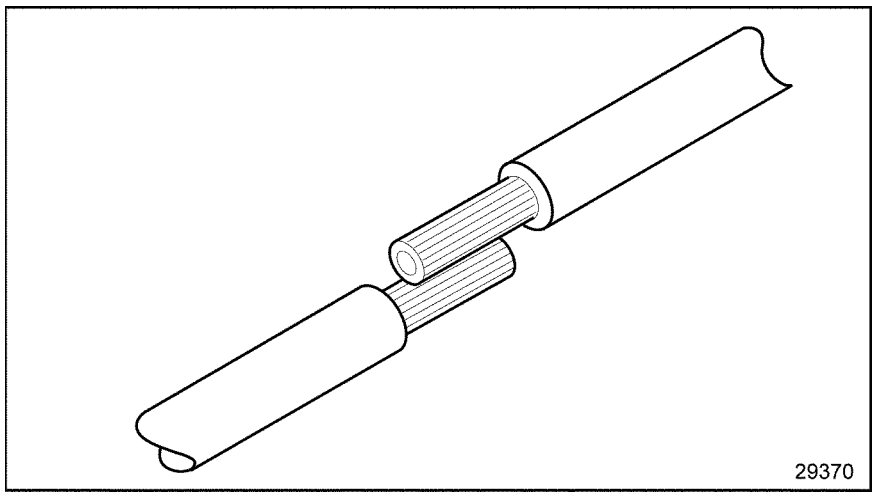


Figure 3-19 Positioning the Leads

2. Secure the leads with a commercially available clip and hand tool. See Figure 3-20.

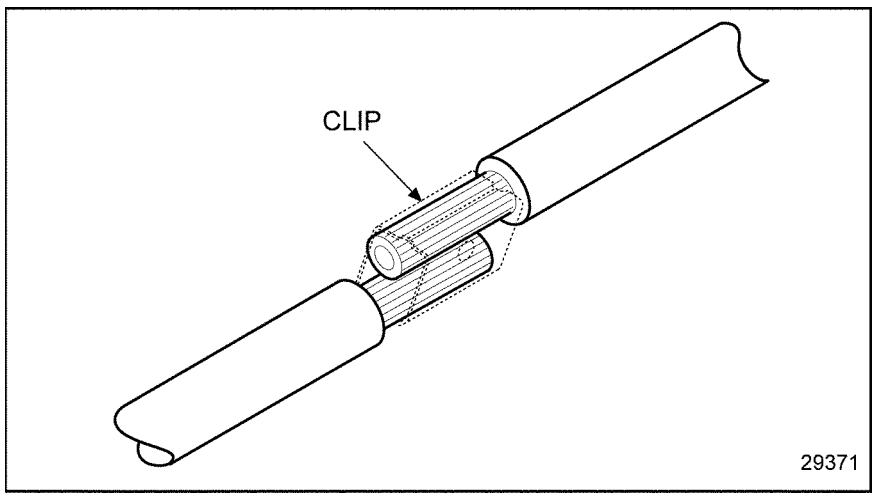


Figure 3-20 Securing the Leads With a Clip

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 3-94 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

5. Loop the lead back over the spliced joint and tape. See Figure 3-21.

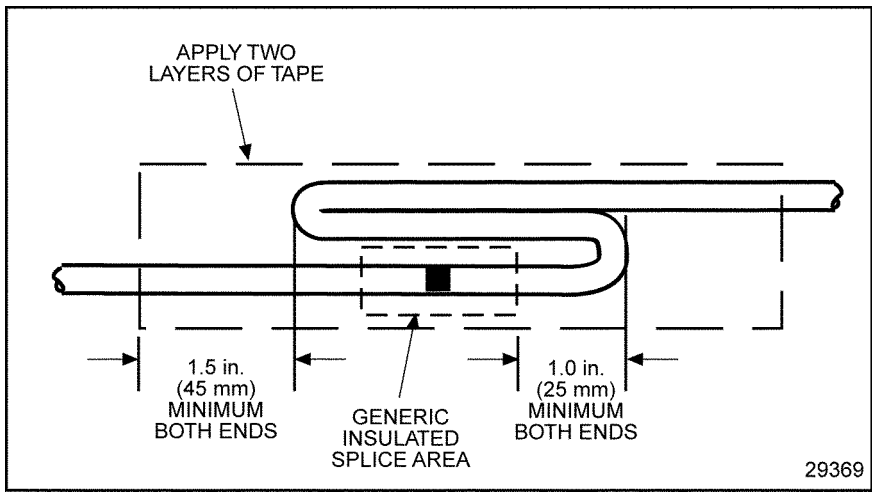


Figure 3-21 Recommended Strain Relief of Spliced Joint

Splicing and Repairing Straight Leads-Alternate Method 1

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.

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 3-22, A).
4. Insert the other wire into the splice clip until it butts against the clip stop (see Figure 3-22, 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 3-96 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 3-96 Applied Load Criteria for Terminals

7. Shrink the splice clip insulative casing with a heat gun to seal the splice (see Figure 3-22, 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 3-21.

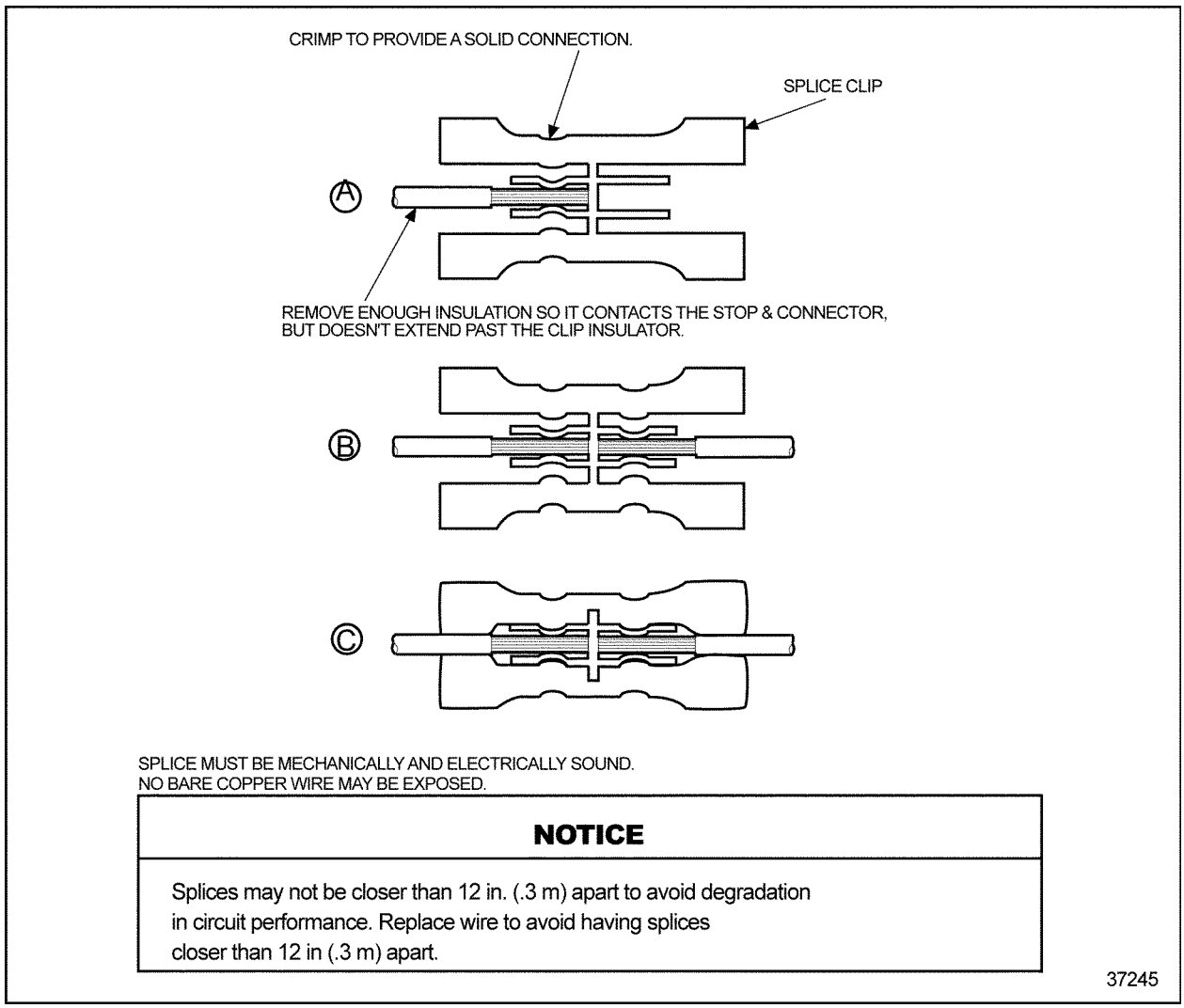


Figure 3-22 Splicing Straight Leads - Alternate Method 1

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 3-97.

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 3-97 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 3-23, A).
4. Insert one wire into splice clip until it butts against the splice clip. Stop and crimp (see Figure 3-23, 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 3-23, 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 3-23, C).
8. Shrink tubing with a heat gun to seal the splice (see Figure 3-23, 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 3-21.

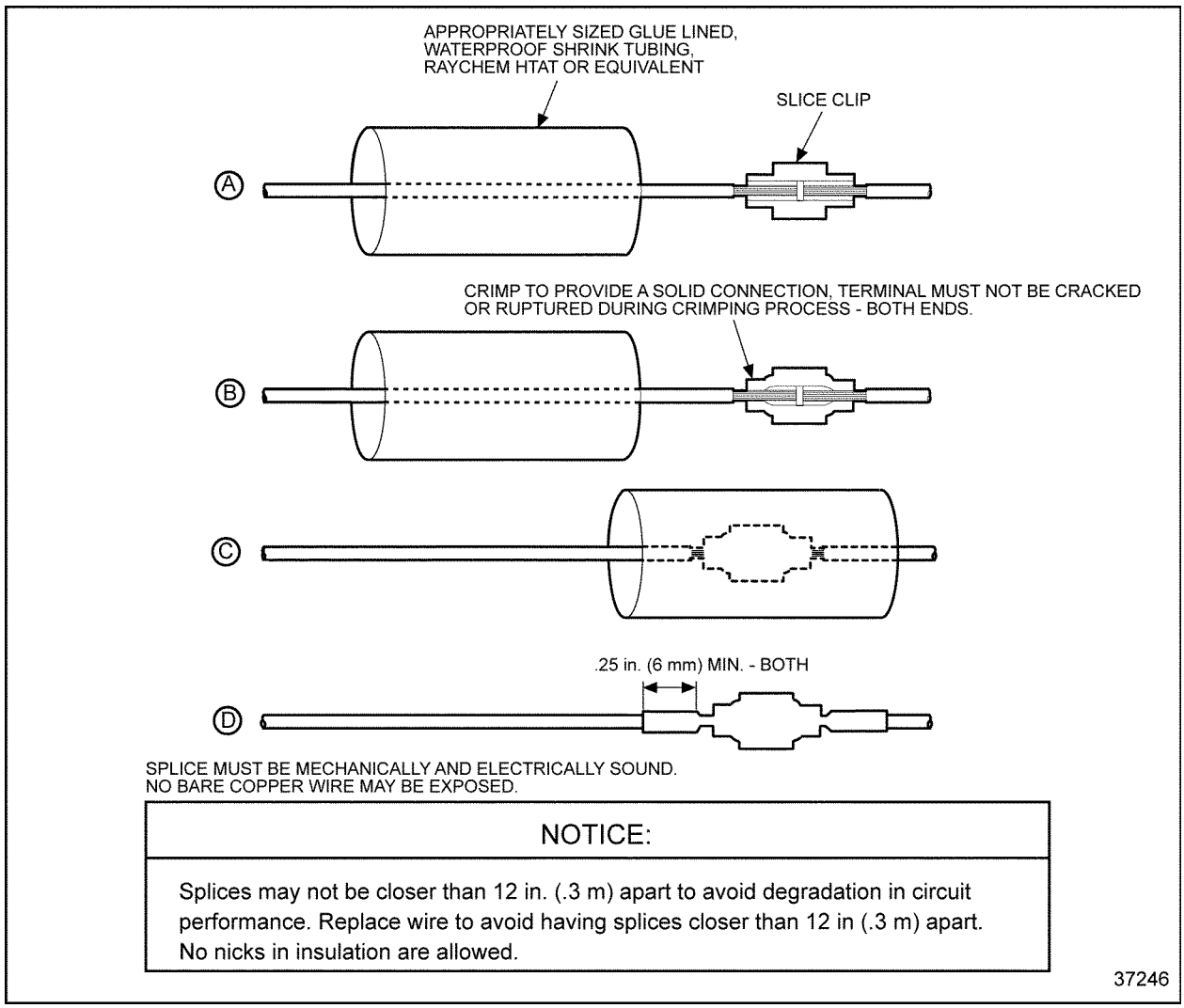


Figure 3-23 Splicing Straight Leads - Alternate Method 2

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	**Tyco Electronics Corporation**
711 Lidgerwood Ave	Raychem Cable Identification and Protection
P.O. Box 711	300 Constitution Drive
Elizabeth, New Jersey 07207-0711	Menlo Park, CA 94025
1-800-52ALPHA	Phone: 1–800–926–2425
www.alphawire.com	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 3-24) so there is at least a 2.5 in. (65 mm) separation between splices.

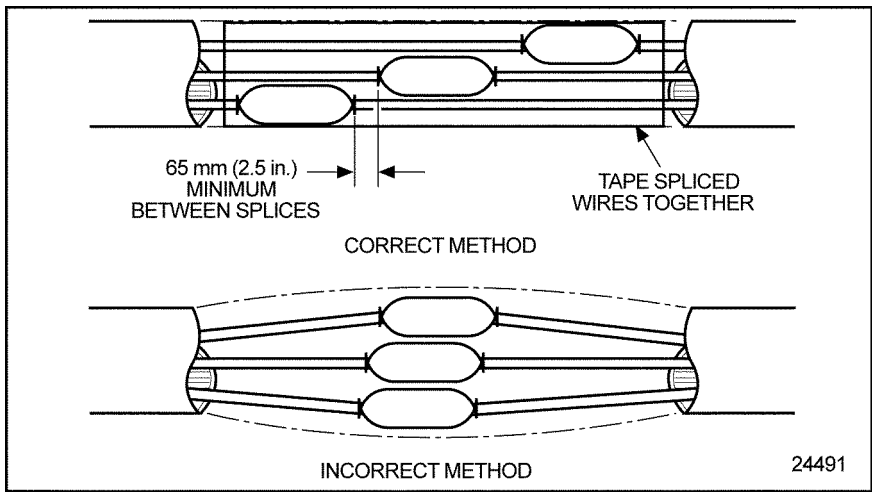


Figure 3-24 The Correct and Incorrect Method of Staggering Multiple Splices

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 3.4.

3.4 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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3.5 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 3.4). 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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3.6 SENSORS

DDEC is designed to operate with several types of sensors as listed in Table 3-98.

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 3-98 Sensor Types

The sensors integrated into the Engine Harness are factory-installed (refer to section 3.6.1). The sensors integrated into the Vehicle Interface Harness are installed by the OEM (refer to section 3.6.2).

3.6.1 FACTORY-INSTALLED SENSORS

The sensors integrated into the factory-installed Engine Harness are listed in Table 3-99.

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.
DPF Inlet Pressure Sensor	Sensor measures pressure between the Diesel Oxidation Catalyst (DOC) and the Diesel Particulate Filter (DPF) in the aftertreatment assembly located in the exhaust system of the vehicle.
DPF Outlet Pressure Sensor	Sensor measures pressure on the outlet of the after-treatment device in the exhaust system of the vehicle. Located after the DPF that is within the aftertreatment device.
DPF Outlet Temperature Sensor	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 aftertreatment unit.
DOC Inlet Temperature	DOC Temperature In - Temperature measured at the inlet of the after-treatment device in the exhaust system of the vehicle. Located before the DOC that is within the after-treatment device.
DOC Outlet Temperature	Temperature measured between the DOC and the DPF in the aftertreatment assembly located in the exhaust system of the vehicle.
EGR Delta Pressure Sensor EGR Delta P Sensor	Senses EGR pressure for EGR control.
EGR Temperature Sensor	Senses EGR exhaust temperature after EGR cooler. Used for EGR system diagnosis.
Engine Coolant Temperature Sensor (ECT Sensor)	Senses coolant temperature for functions such as engine protection, fan control and engine fueling.
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.
Fuel Line Pressure Sensor	Senses fuel line pressure
Fuel Compensation Pressure Sensor	Compensates fuel line pressure
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
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 only)	Detects water in the fuel filter that alerts the owner/driver that the fuel filter needs to be dried out.

Table 3-99 Function of Factory-installed Sensors

See Figure 3-25 for the location of the sensors for the DOC and DPF.

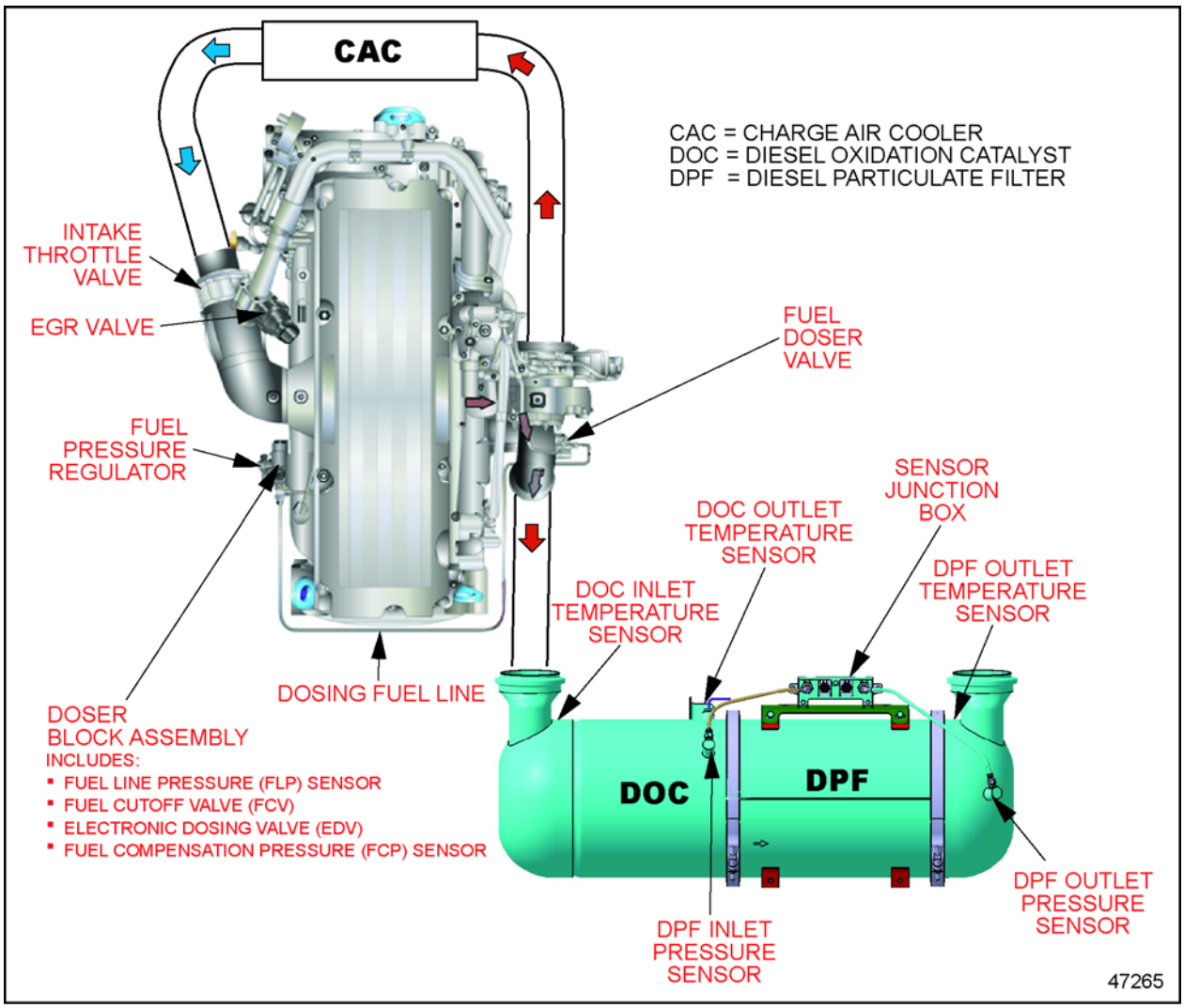


Figure 3-25 Sensor Location for the DOC and DPF

3.6.2 OEM-INSTALLED SENSORS

All sensors must be of the proper type and continuously monitor vehicular and environmental conditions, so the MCM 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. Refer to section 3.6.3.
Engine Coolant Level Sensor (ECL Sensor)	23526906 23526905 23526907	Senses coolant level for engine protection. Refer to section 3.6.4.
Turbo Compressor In Temperature Sensor	23527831	Senses the temperature of the turbo compressor inlet. Refer to section 3.6.5.
Vehicle Speed Sensor (VSS)	--	Senses vehicle speed for Cruise Control and Vehicle Speed Limiting. Refer to section 3.6.6.

* 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.

3.6.3 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 3-26) is used with the Idle Shutdown Timer, specifically for the Ambient Air Temperature Override Disable feature or for Optimized Idle. For additional information on these features refer to Chapter 5.

NOTE:
This sensor is optional.

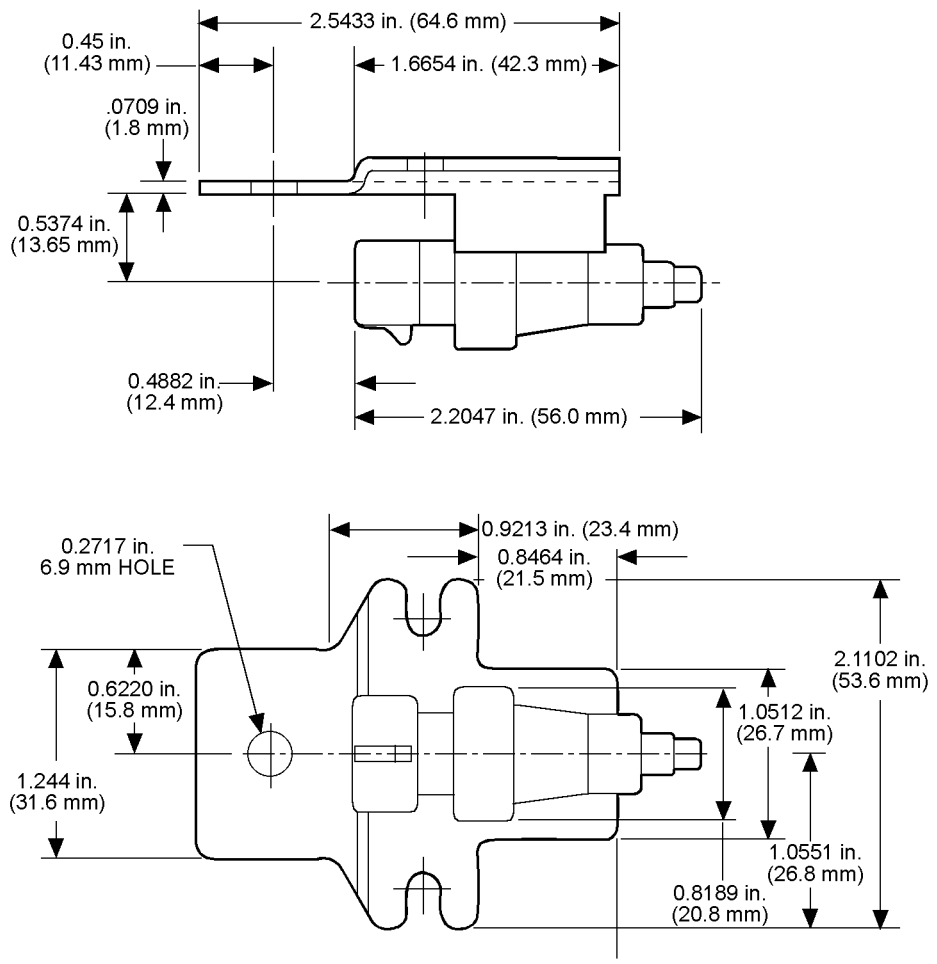


Figure 3-26 Ambient Air Temperatures Sensor Dimensions

Ambient Air Temperature Sensor Installation

Install the AAT Senaor 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. See Figure 3-27 for AAT Sensor installation.

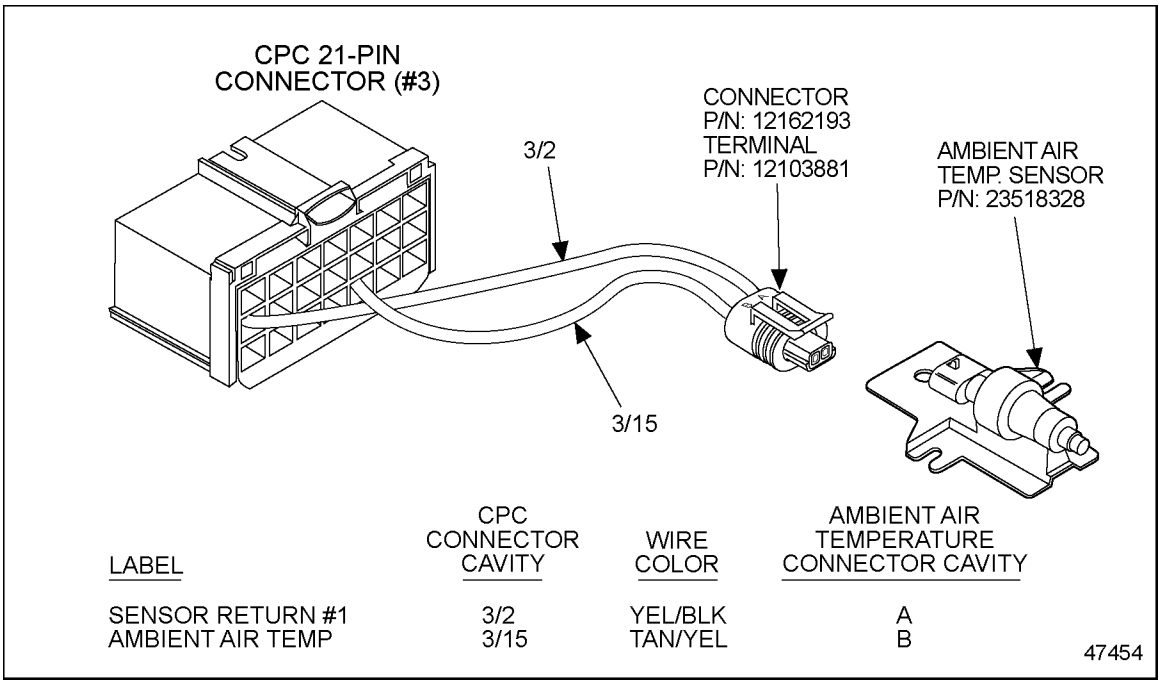


Figure 3-27 Ambient Air Temperature Sensor Installation

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 – Reserved for J1939 3 – J1587 4 – 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

3.6.4 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.

NOTE:
This sensor is required.

The main component of the ECL Sensor consists of a conductivity probe, which connects to the CPC (see Figure 3-28).

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.

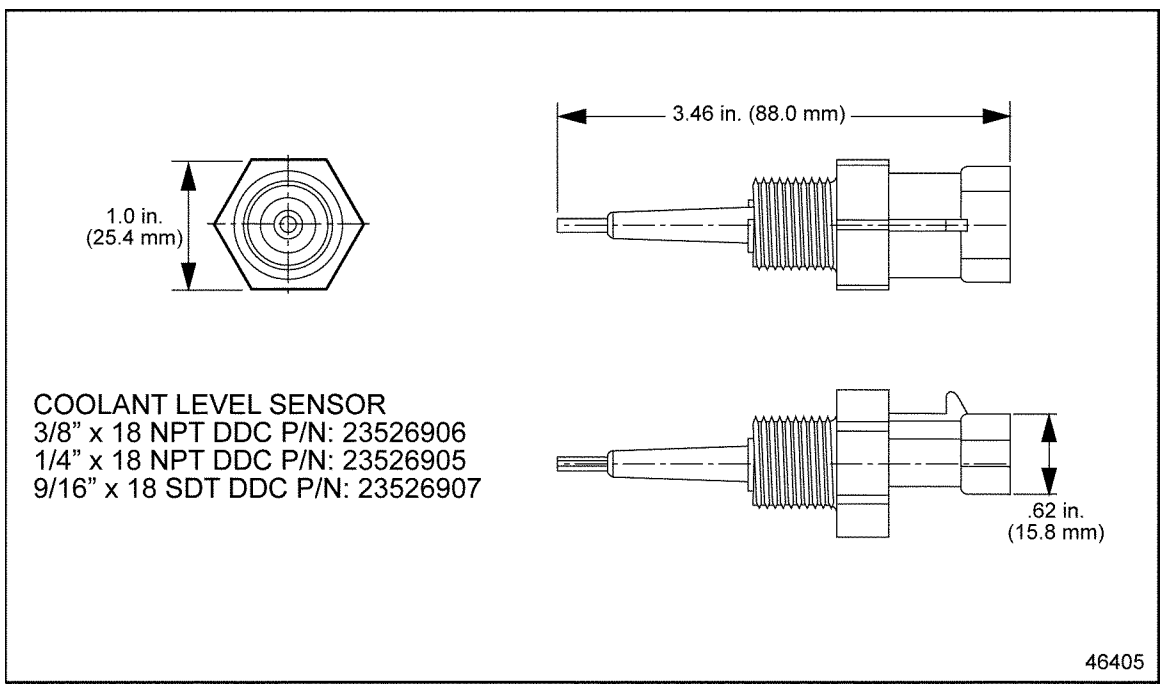


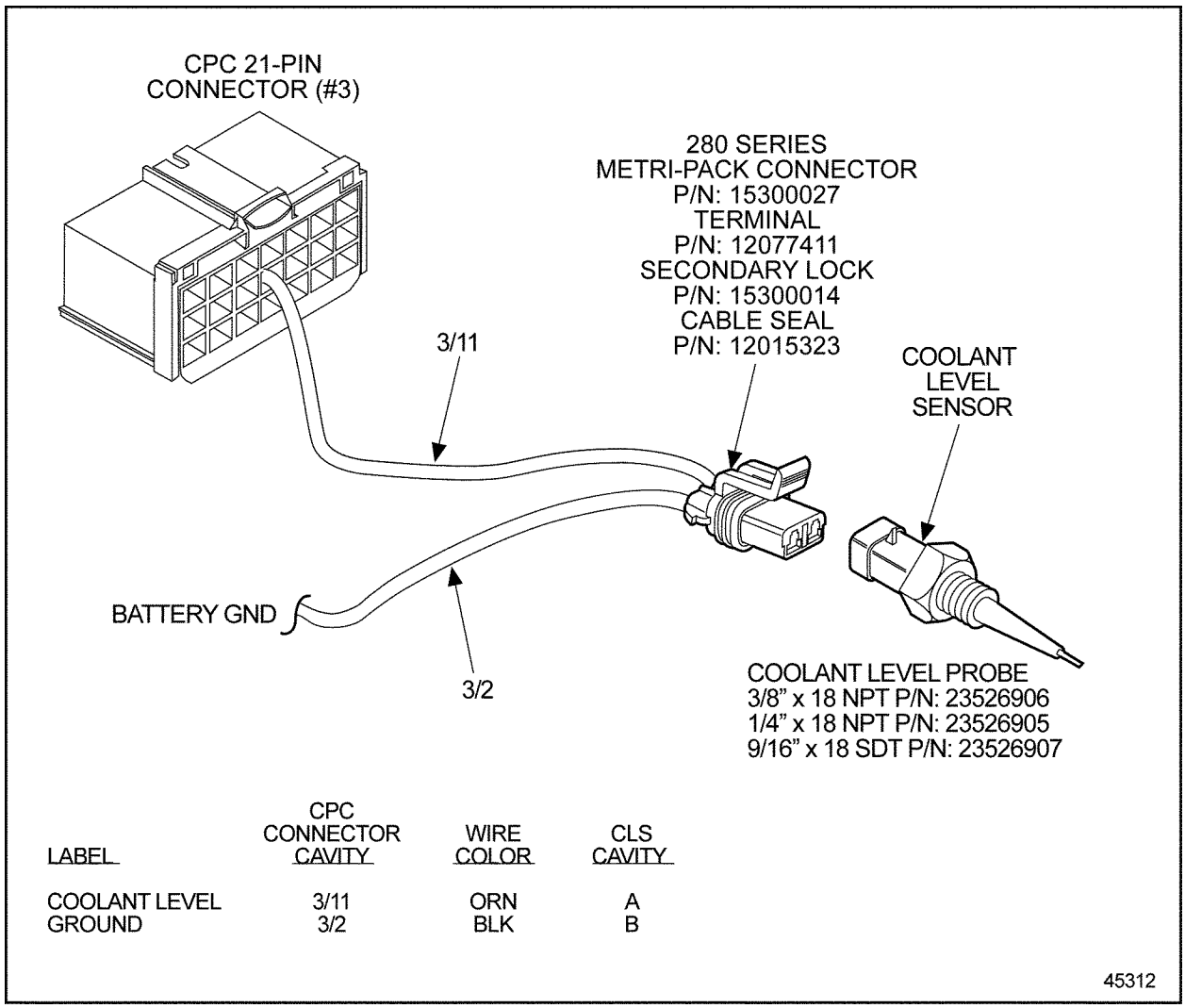
Figure 3-28 Engine Coolant Level Sensor Specifications

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 3-29). Polarity of the ground and signal must be correct for proper operation.



LABEL	CPC CONNECTOR CAVITY	WIRE COLOR	CLS CAVITY
COOLANT LEVEL	3/11	ORN	A
GROUND	3/2	BLK	B

Figure 3-29 Engine Coolant Level Sensor Installation for CPC

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 3-30.

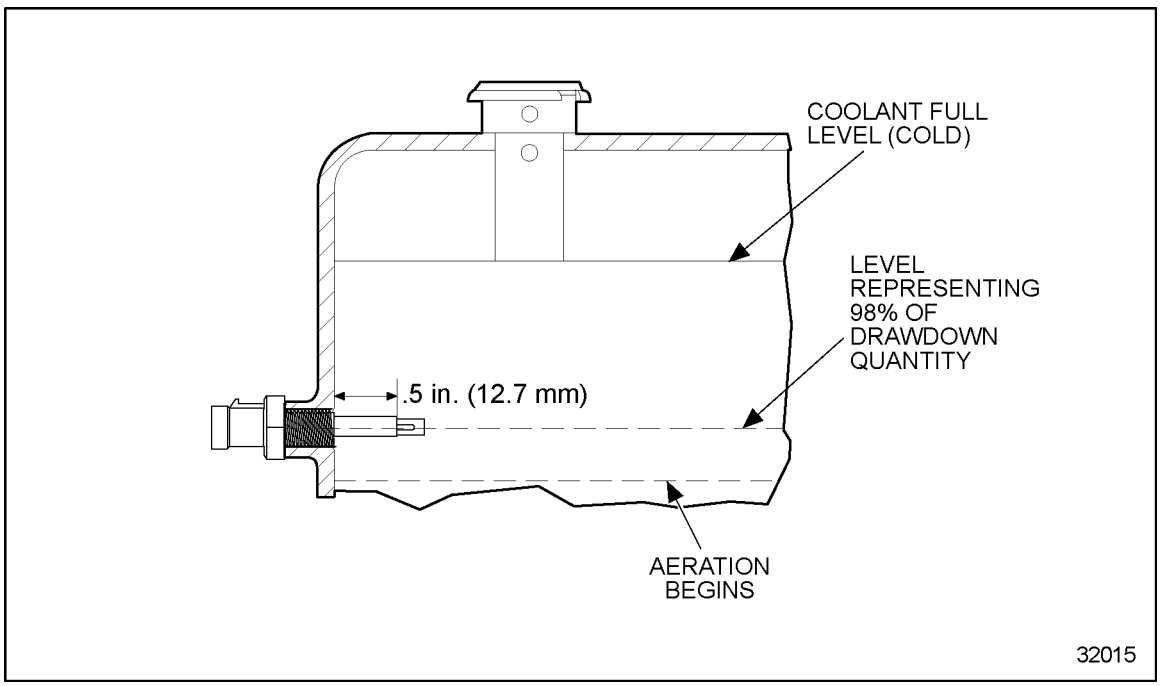


Figure 3-30 Engine Coolant Level Sensor Location - Top of Radiator Tank

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
32	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

3.6.5 TURBO COMPRESSOR IN TEMPERATURE SENSOR

The TCI Sensor produces a signal representing the temperature of the turbo compressor inlet. See Figure 3-31 and Figure 3-32 for installation.

NOTE:
This sensor is required for the Series 60.

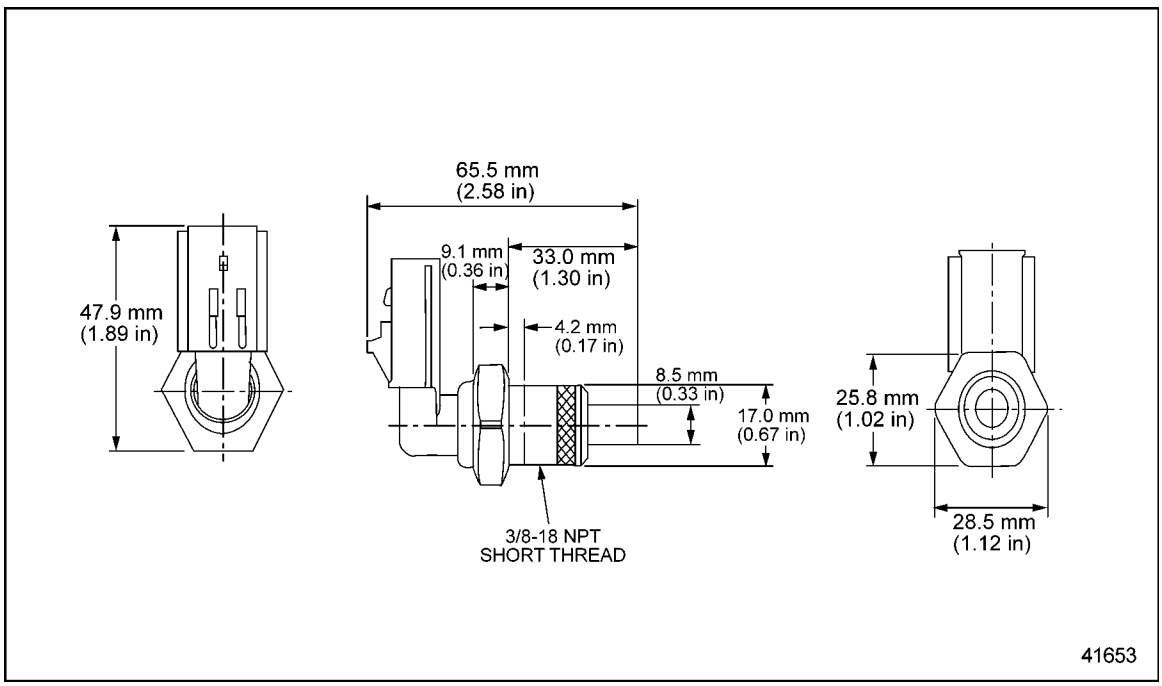


Figure 3-31 Turbo Compressor In Temperature Sensor

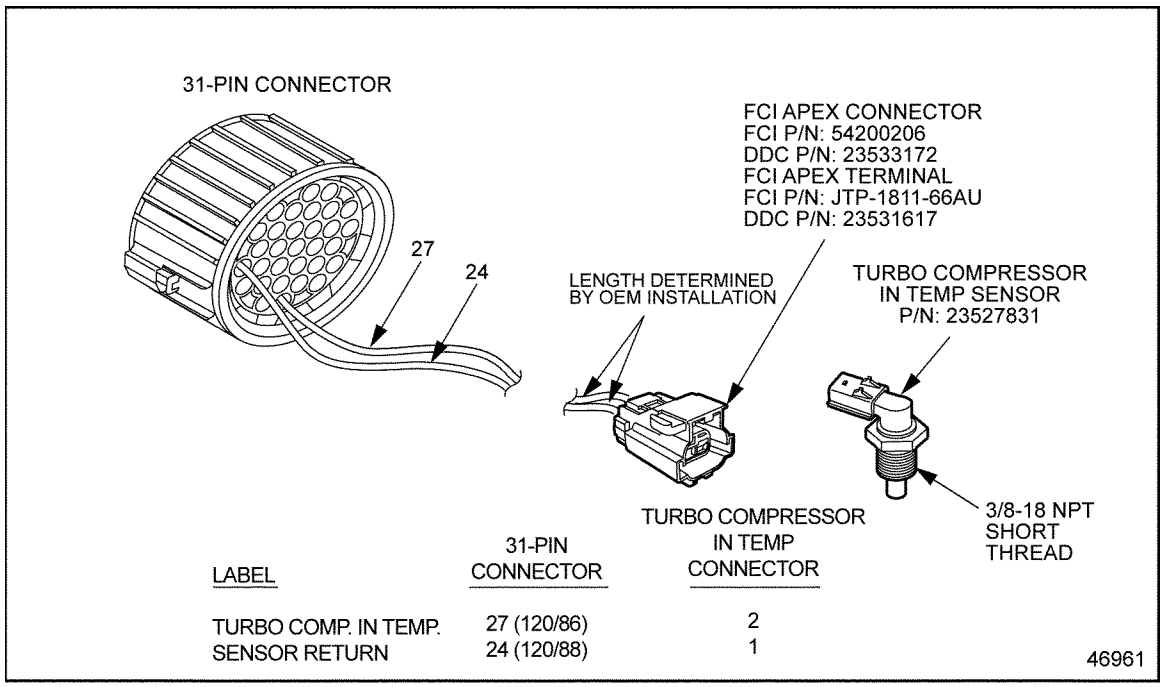


Figure 3-32 Turbo Compressor In Temperature Sensor Installation

3.6.6 VEHICLE SPEED SENSOR

The CPC 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 3-33) 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.

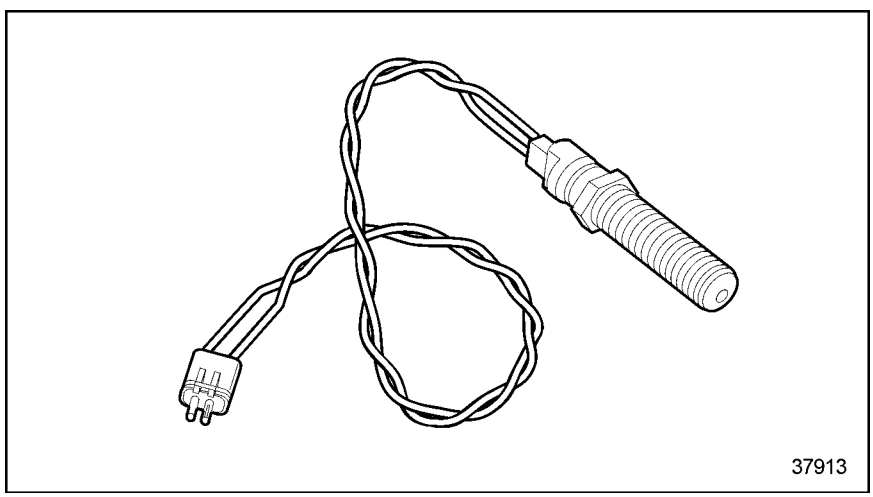


Figure 3-33 Vehicle Speed Sensor

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 l/km	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

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

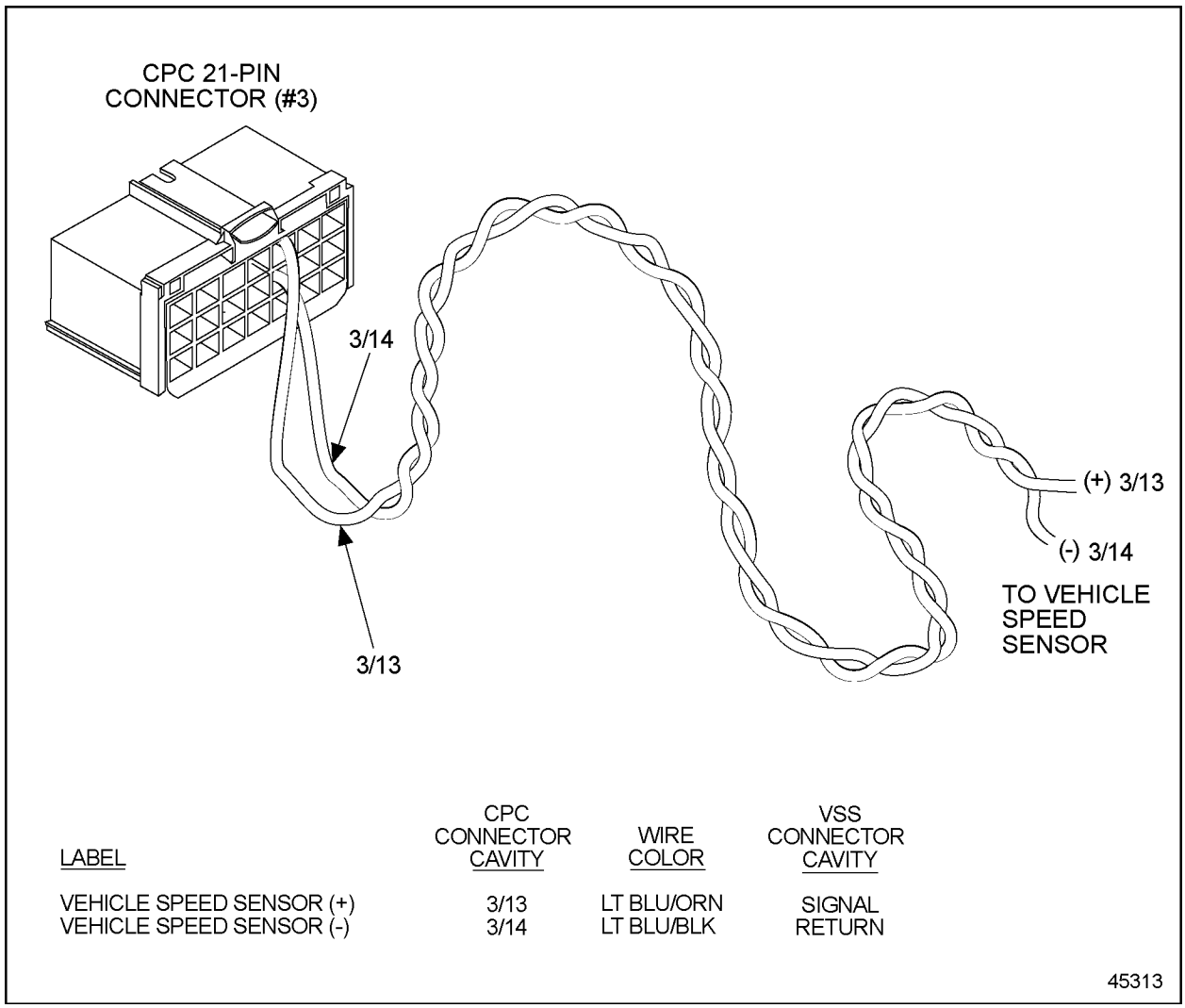
Table 3-107 Magnetic Pickup Vehicle Speed Sensor Requirements

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

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

Table 3-108 Vehicle Speed Sensor Wiring

See Figure 3-34 for the installation of the Magnetic VSS.



LABEL	CPC CONNECTOR CAVITY	WIRE COLOR	VSS CONNECTOR CAVITY
VEHICLE SPEED SENSOR (+)	3/13	LT BLU/ORN	SIGNAL
VEHICLE SPEED SENSOR (-)	3/14	LT BLU/BLK	RETURN

Figure 3-34 Magnetic Vehicle Speed Sensor Installation – CPC

SAE J1939 Data Link

A VSS wired to the CPC 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.

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 l/km	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

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.

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3.7 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.

3.7.1 AMBER WARNING LAMP

The AWL is controlled by DDEC VI.
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 CPC.

3.7.2 RED STOP LAMP

The RSL is controlled by DDEC VI.
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 CPC.

3.7.3 DPF REGENERATION LAMP

This lamp is controlled by DDEC VI.
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 CPC.
- 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 3-110.

Parameter Group	Parameter	Options	Default	Access
35	1 05 Fault Detection	0 = Disabled 1 = Enabled	0 = Disabled	VEPS, DRS
46	DPF Lamp Config	0 = Hardwired 1 = J1939 PTC1	0 = Hardwired	VEPS, DRS

Table 3-110 DPF Regeneration Lamp Options

3.7.4 HIGH EXHAUST SYSTEM TEMPERATURE LAMP

The HEST Lamp is controlled by DDEC VI.
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.

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 CPC.
- This lamp can be multiplexed on J1939.

Programming Requirements and Flexibility

The parameters for the High Exhaust System Temperature Lamp are listed in Table 3-111.

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
35	4 07 Fault Detection	0 = Disabled 1 = Enabled	0 = Disabled	VEPS, DRS
46	Hi Exhaust Temp Lamp Config	0 = Hardwired 1 = J1939 PTC1	0 = Hardwired	VEPS, DRS

* Not supported in NAFTA

Table 3-111 High Exhaust System Temperature Lamp Options

3.7.5 MALFUNCTION INDICATOR LAMP

The Malfunction Indicator Lamp (MIL) is controlled by DDEC VI.
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 is inactive

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 instrument panel or placed in clear view of the vehicle operator.
- The lens color must be amber.
- This output is wired to pin 1/13 of the CPC.
- This lamp can be multiplexed on J1939.

3.7.6 LOW OIL PRESSURE LAMP

The Low Oil Pressure Lamp is controlled by DDEC VI..
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 CPC.

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	3 = Oil Pressure Low 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 Low Oil Pressure Lamp Programming Options

3.7.7 CRUISE ACTIVE LAMP

The Cruise Active Lamp is controlled by DDEC VI..
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 CPC.

Programming Requirements and Flexibility

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

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 12 DO Selection	4 = Cruise Active 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 3-113 Cruise Active Lamp Programming Options

3.7.8 DECELERATION LAMP

The Deceleration Lamp is controlled by DDEC VI.

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 CPC.

Programming Requirements and Flexibility

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

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*	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 3-114 Deceleration Lamp Programming Options

3.7.9 LOW BATTERY VOLTAGE LAMP

The Low Battery Voltage Lamp is controlled by DDEC VI.

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 3/10 of the CPC.

Programming Requirements and Flexibility

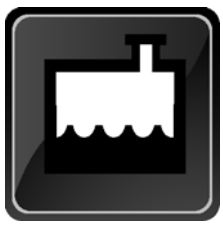
The options for this digital output are listed in Table 3-115.

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 10 DO Selection	3 = Battery Voltage Low Lamp	0 = Disabled 1 = Air Filter Lamp* 2 = AGS2 Transmission Temp Indication Lamp 3 = Battery Voltage Low Lamp 4 = Coolant Level Low Lamp 5 = FUSO Retarder Control 1*	0 = Disabled	VEPS or DRS
35	3 10 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-115 Low Battery Voltage Lamp Programming Options

3.7.10 LOW COOLANT LEVEL LAMP



The Low Coolant Level Lamp is controlled by DDEC VI..
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 3/10 of the CPC.

Programming Requirements and Flexibility

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

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 10 DO Selection	4 = Coolant Level Low Lamp	0 = Disabled 1 = Oil Level Lamp* 2 = AGS2 Check Transmission Indication Lamp 3 = Oil Pressure Low Lamp 4 = Coolant Level Low Lamp 5 = FUSO Retarder Control 1*	0 = Disabled	VEPS or DRS
35	3 10 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-116 Low Coolant Level Lamp Programming Options

3.7.11 OPTIMIZED IDLE ACTIVE LAMP

The Optimized Idle Active Lamp is controlled by DDEC VI..
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 CPC.

Programming Requirements and Flexibility

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

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 (MCM Threshold)* 9 = Coolant Temp (MCM Threshold)* 10 = OI Active Lamp 11 = Deceleration Lamp 12 = FUSO Ground Starter Lockout Relay*	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 3-117 Optimized Idle Active Lamp Programming Options

3.7.12 WAIT TO START LAMP

The Wait to Start Lamp is controlled by DDEC VI..
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:

- 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 CPC.

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 06 DO Selection	1 = Grid Heater Lamp	0 = Disabled 1 = Grid Heater Lamp 2 = Accelerator Pedal Idle Position* 3 = Run Signal Starter Lockout	1 = Grid Heater Lamp	VEPS or DRS
35	4 06 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-118 Wait to Start Lamp Programming Options

3.7.13 AGS2 BACKUP LAMP

The AGS2 Backup Lamp is controlled by DDEC VI.

The AGS2 Backup Lamp remains ON:

- For approximately five (5) seconds at the start of every ignition cycle (a bulb check)
- 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 CPC.

Programming Requirements and Flexibility

The options for this digital output are listed in Table 3-119.

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*	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 3-119 AGS2 Backup Lamp Programming Options

3.7.14 AGS2 CHECK TRANS LAMP

The AGS2 Check Trans Lamp is controlled by DDEC VI..
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 CPC.

Programming Requirements and Flexibility

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

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 3-120 AGS2 Check Trans Lamp Programming Options

3.7.15 AGS2 TRANS TEMP LAMP

The AGS2 Trans Temp Lamp is controlled by DDEC VI..
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 3/10 of the CPC.

Programming Requirements and Flexibility

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

Parameter Group	Parameter	Setting	Options	Default	Access
35	3 10 DO Selection	2 = AGS2 Check Transmis-sion Indica-tion Lamp	0 = Disabled 1 = Air Filter Lamp* 2 = AGS2 Transmission Temp Indication Lamp 3 = Battery Voltage Low Lamp 4 = Coolant Level Low Lamp 5 = FUSO Retarder Control 1*	0 = Disabled	VEPS or DRS
35	3 10 DO Fault Detection	–	0 = Disabled 1 = Enabled	0 = Disabled	VEPS or DRS

* Not supported in NAFTA

Table 3-121 AGS2 Trans Temp Lamp Programming Options

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