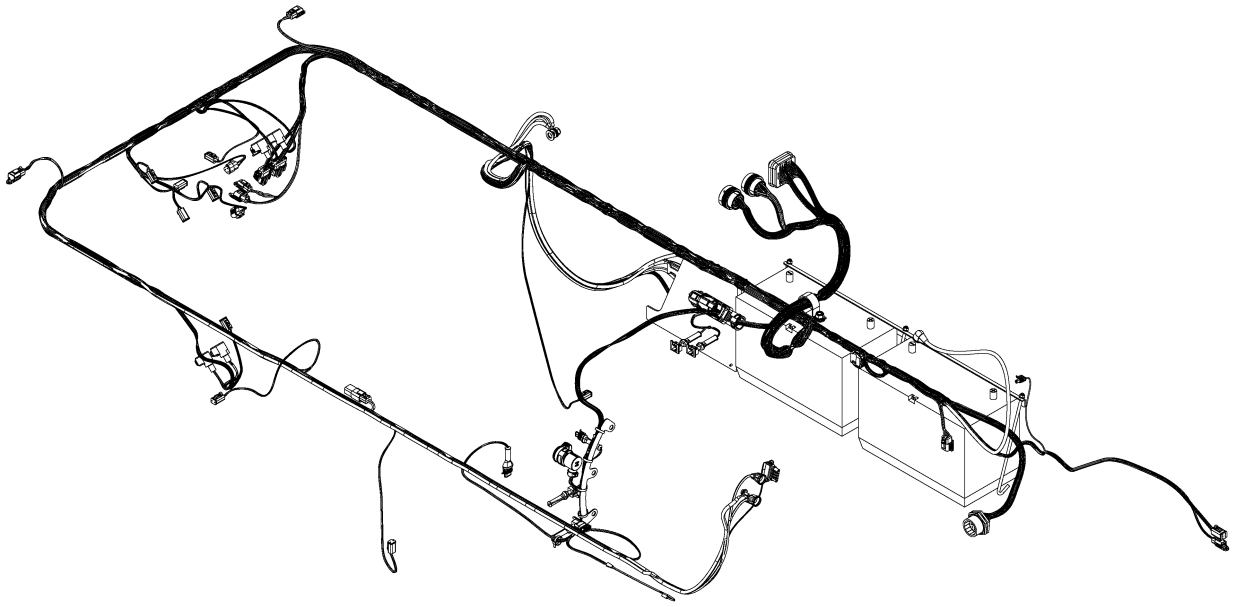
SERVICE REPAIR

MANUAL

Hyster K019 (H300HD2, H330HD2, H360HD2, H360HD2-EC, H210-48HD2, H230-48HD2, H250-48HD2) Forklift Service Repair Manual

HYSTER

ELECTRICAL SYSTEM



HYSTER

PART NO. 4133478

2200 SRM 1936

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the Operating Manual or the Periodic Maintenance section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use HYSTER APPROVED parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the WARNING and CAUTION notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the WARNING symbol and word are on orange background. The CAUTION symbol and word are on yellow background.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

This section is for the following models:

Series Code / Model Designation Reference Table

This table consist of the following Series Codes
used in this manual.

Series Code	European Model	Americas Model
K019	H13.00-16.00XM-6	H210-250-48HD2, H300-360HD2
K019EC	H6.00-7.00XM-12EC	H360HD2-EC
L007	H8.00-12.00XM-6	H190-280HD2, H250HD2
B238	H16.00XM-9, H18XM-7.5, H16XM-12, H18XM-9	H360-36HD, H360-48HD

General

This manual provides general information on the electrical system of B238, K019, and L007 lift trucks. This manual provides a link between the electrical schematic and the actual location of the electrical components on the lift truck.

The description and replacement procedures for the electrical system components are located in the relevant manual for the component. An example would be a transmission solenoid, which is shown in Transmission Repair (ZF-WG161) 1300SRM1456.

The actual electrical schematic drawings are shown in Diagrams 8000SRM1938 for L007 and K019, and in Diagrams 8000SRM1982 for B238.

Electrical Schematic and System Description

ELECTRICAL SCHEMATIC

The electrical schematic is laid out over several pages in Diagrams 8000SRM1938 for L007 and K019 and in Diagrams 8000SRM1982 for B238. Each page shows the electrical connection between the components, connectors, and wires.

The layout of the schematic is function driven, which means that each sheet represents one particular function or area as indicated by the title of the sheet. The index of the electrical schematic is shown in Table 1. Each page shows the electrical connection between the components, connectors, and wires.

Table 1. Electrical Schematic Index

Number	Title	Contents
1	Index	Sheet Title Index
2	Main Power	Battery, Key Switch
3	Engine Common / T3	Engine controller and components
4	T4F/EAS	Fan Clutch, Tier 4F/Stage IV sensors
5	DEF	DEF Sensors, DEF Supply Module
6	XMSN	Transmission controller and components
7	Cab Lights	Cab roof and interior lights
8	Frame Lights	Front and tail lights, reverse alarm
9	Lights	Mast lights, flasher, jumper
10	Twist Module	Powered Cab Tilt
11	Monitoring	Instrument cluster, senders, alarms, diagnostics
12	OPS/Park Brake	Park brake switch and solenoid, suspension seat
13	Hydraulic Controls Cab	Hydraulic controller, levers, Operator Presence
14	Auxiliary Functions	Hydraulic Stop Lock-, Twist Lock-, Joystick switches
15	Wipers	Wipers and washers, switches, timer
16	Radio/Horn	Radio, Horn, DC converter, 12V plug
17	HVAC	Heating, Air Conditioning and Ventilation
18	Automatic Greasing	Lubrication, Pump and Switch
19	Front End FLT	Carriage, Slide Shift
20	ECH Attachment	Connection between Mast and ECH Attachment
21	Connector Overview	Connector codes, names and applied harness
22-26	Wire List	List of used wires and their functions
27	Fuses	List of used fuses and their functions

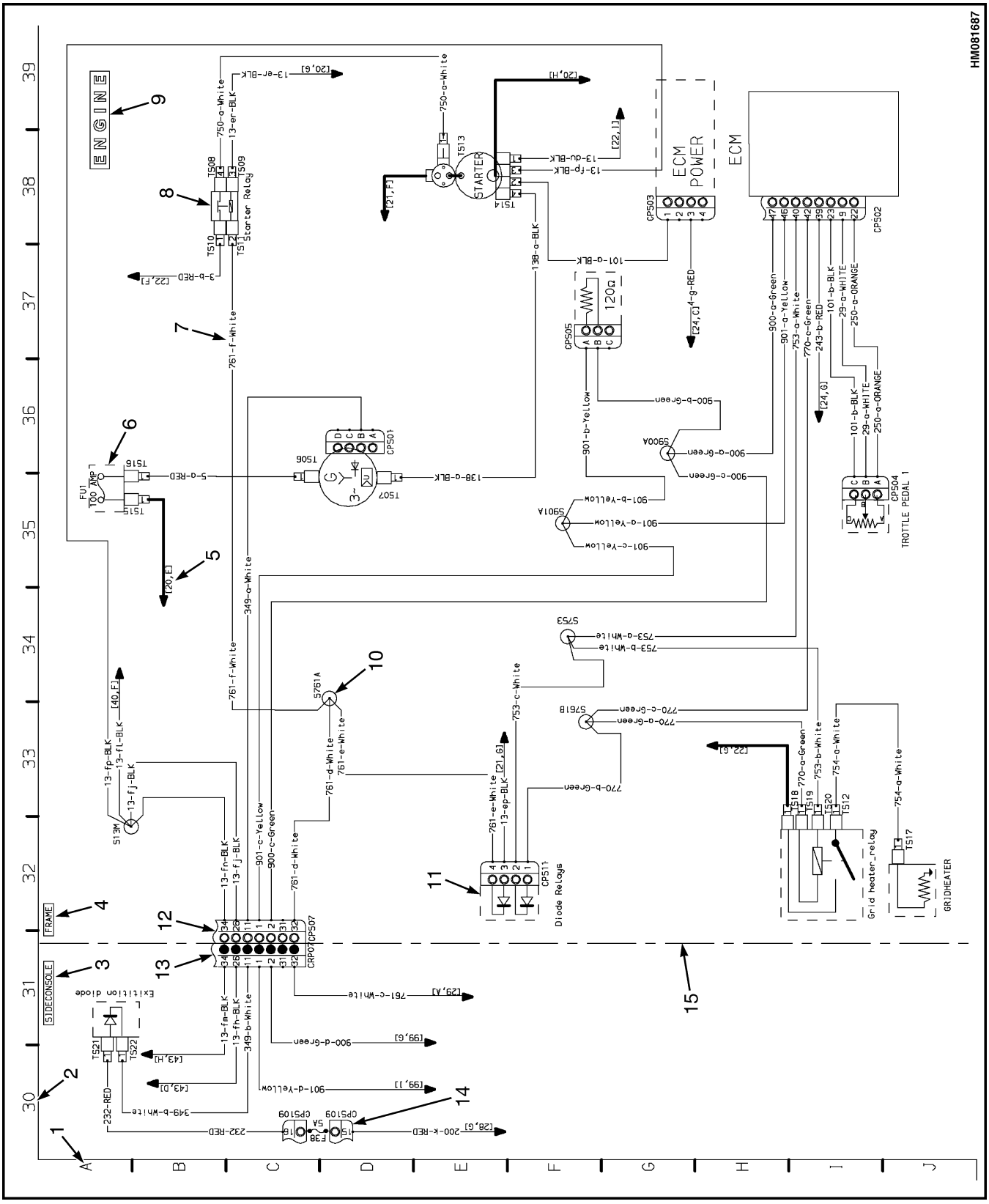


Figure 1. Schematic Example

Legend for Figure 1

1. ROW LETTER - A
2. COLUMN NUMBER - 30
3. WIRE HARNESS NAME - SIDE CONSOLE
4. WIRE HARNESS NAME - FRAME
5. WIRE CONTINUATION LOCATION- [20, E]
6. MEGA FUSE - 100 AMP
7. WIRE NUMBER AND COLOR - 761-F-WHITE
8. RELAY - STARTER
9. SHEET NAME - ENGINE
10. SPLICE - S761A
11. DIODE BLOCK
12. CONNECTOR - CPS07
13. CONNECTOR - CRP07
14. FUSE - 5 AMP
15. HARNESS DIVIDING LINE

SCHEMATIC LOCATION NUMBER

The schematic is divided into rows with a letter from A to J and into columns numbered 0 to 9 for each sheet. See Figure 1.

The column numbering consists of the sheet number plus the column number. For example, column 57 is the 7th column on sheet 5.

The schematic location number is the combination of a row letter and column number, which allows quick identification of a point on the schematic. For example, [57,A] is the 7th column on sheet 5, row A.

ELECTRICAL COMPONENTS

Electrical components are indicated by a symbol and a description that are placed close to each other on the schematic. An example is the starter relay on [38,C]. See Figure 1.

ELECTRICAL WIRES

Each electrical wire is indicated by a solid line and has been identified with an identification number and a color indication of the wire insulation. If a wire continues on a different sheet, then the solid line ends with an arrow and receives in addition the schematic location number where this wire continues.

Wire Identification Number

Each electrical wire in the electrical schematic has an identification number that is also printed on the insulation of the wires.

The wire identification numbers consist of a function ID number and when needed a suffix letter.

The function ID numbers are numbered from 1 through 999. Specific ranges of numbers are assigned for different function ID groups. See Table 2.

Table 2. Function ID Numbers

Function Group	Number Range
Dedicated Circuits	001 - 100
Grounds	101 - 149
Current sense ground	150 - 199
Switched B+	200 - 239
Fused B+	240 - 249
Regulated power 5V	250 - 279
Regulated power 12V	280 - 299
Analog inputs - hydraulics/mast	300 - 319
Analog inputs - chassis	320 - 339
Analog inputs - powertrain	340 - 399
Analog inputs - CAB/OHG	400 - 419
Additional analog inputs	420 - 499
Digital inputs - hydraulics/mast	500 - 509
Digital inputs - chassis	510 - 539
Digital inputs - powertrain	540 - 559
Digital inputs - CAB/OHG	560 - 569
Encoder inputs	570 - 599
Additional digital inputs	600 - 699
Digital outputs - hydraulics/mast	700 - 719
Digital outputs - chassis	720 - 749
Digital outputs - powertrain	750 - 779
Digital outputs - CAB/OHG	780 - 799
PWM outputs - hydraulics/mast	800 - 829
PWM outputs - chassis	830 - 839
PWM outputs - powertrain	840 - 889
PWM outputs - CAB/OHG	890 - 899
Communication (e.g., CAN)	900 - 909
Non-standard functions	910 - 999

Wires with the same number are interconnected through splices and connectors, and therefore have the same electrical function.

When a circuit is spliced into several wires, or when a wire passes a connector, each wire number receives the next unique suffix letter. An example is 42-a, 42-b.

To simplify the schematic, sometimes the identification has been omitted for a spliced function. It may concern an intersection between a switch and a splice, or a right-hand component operating simultaneously with a left hand component.

There is a wire number overview in Diagrams 8000SRM1938 for L007 and K019, and in Diagrams 8000SRM1982 for B238. In this overview each wire is listed with the wire harness it is part of, and with the connector identification number and pin numbers it connects to. The actual location of a connector code can be looked up in Connector Overview.

Electrical Wire Colors

In addition to the function ID numbers on the electrical wires, different wire isolation colors are used to identify the circuit levels. See Table 3.

Table 3. Electrical Wire Colors

Wire Color	Circuit Level
Red	Battery Level Power Circuits
Black	Heavy Current Grounds
Green	Signal Grounds
White	Other Circuits
Yellow (Twisted Pair)	CAN Hi
Green (Twisted Pair)	CAN Lo
Orange	5 Volt
Pink	12 Volt

Wire Harnesses

Wires are bound together in wire harnesses to secure against the adverse effects of vibration, abrasion and moisture. The description of wire harnesses follows from its location in the truck or from the functions it connects with.

Figure 2 provides an overview of the different harnesses that belong to the different truck options and their connector numbers.

Figure 14 through Figure 23 shows a 3D-view of most of the wire harnesses with their terminals and connectors. The legends for these figures mention the connector codes and connector description for verification. See also Wire Harness Identification and Connector Location.

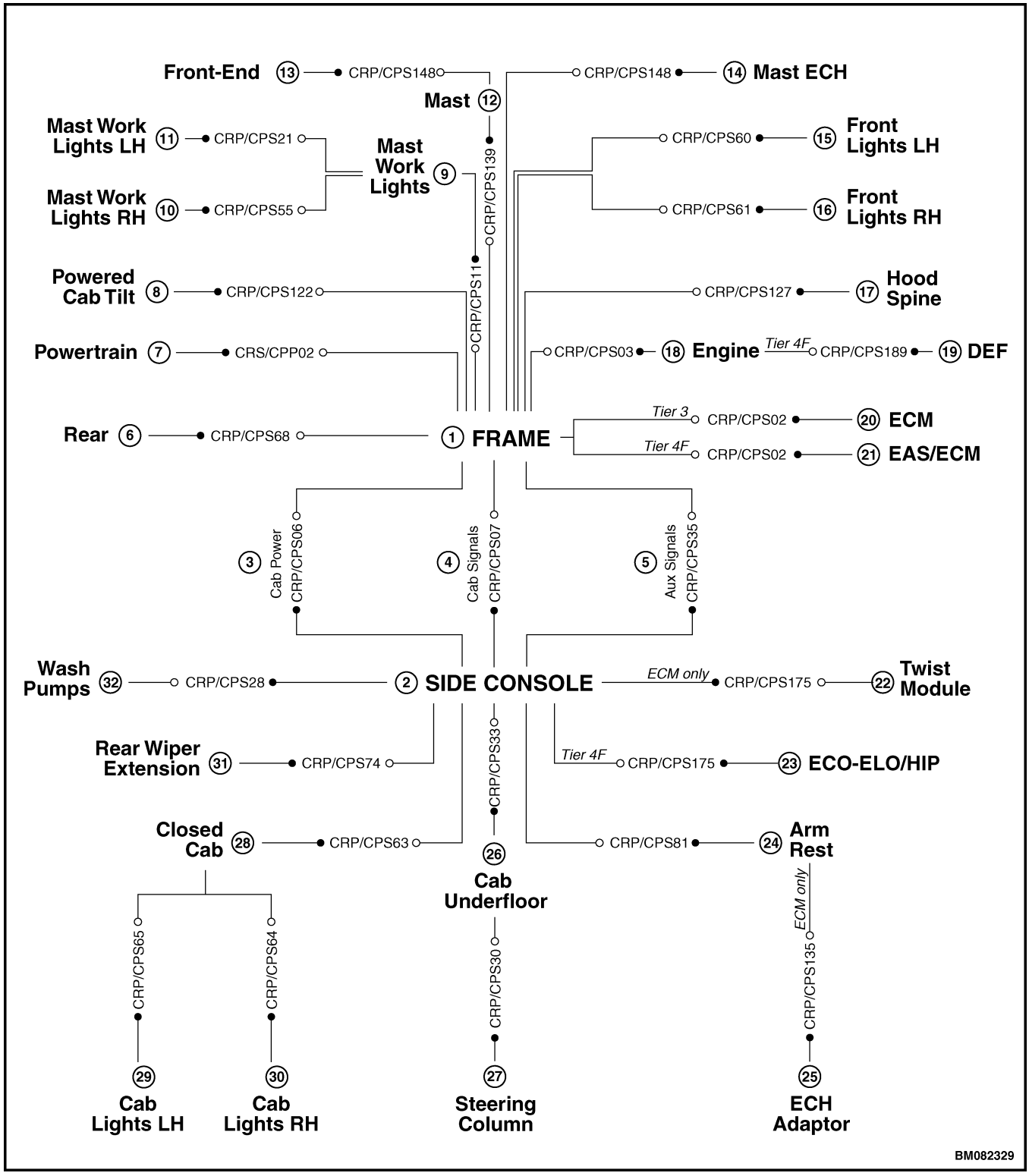


Figure 2. Harnesses Overview

Legend for Figure 2

1. FRAME
2. SIDE CONSOLE
3. CAB POWER
4. CAB SIGNALS
5. AUX SIGNALS
6. REAR
7. POWERTRAIN
8. POWERED CAB TILT
9. MAST WORK LIGHTS
10. MAST WORK LIGHTS RH
11. MAST WORK LIGHTS LH
12. MAST
13. FRONT-END
14. MAST ECH
15. FRONT LIGHTS LH
16. FRONT LIGHTS RH
17. HOOD SPINE
18. ENGINE
19. DEF
20. ECM
21. EAS/ECM
22. TWIST MODULE
23. ECO-ELO/HIP
24. ARM REST
25. ECH ADAPTOR
26. CAB UNDERFLOOR
27. STEERING COLUMN
28. CLOSED CAB
29. CAB LIGHTS LH
30. CAB LIGHTS RH
31. REAR WIPER EXTENSION
32. WASH PUMPS

Not shown in the harness overview and in the 3D-views are harnesses that are merely an extension cord for some of the connectors, or jumpers that connect between wires. The lay-out of these harnesses can be read from the electrical schematic. For the actual location of these harnesses, read the code of the mating connector from the electrical schematic and look up the figure and item number from Connector Overview. For example: the Closed Cab harness connects with the Cab Lights RH, which connects to CPS 64. See Top Cab Harness Connectors.

Not shown on the figures for the frame harnesses are the connectors for engine components such as sensors, fan clutch and grid heater relays.

There are four jumper options:

- Jumper Power Supply by Ignition provides power supply for side, tail and hazard lights when the ignition switch is turned to the ON position. See schematic location [99, H]. This harness is to be plugged into connector CPS651, which connects pin A with pin B.
- Jumper Power Supply by Battery directly provides power supply from the batteries to the circuit for side, tail and hazard lights, allowing activating these lights irrespective of the ignition switch position. See schematic location [98, H]. This harness is to be plugged into connector CPS650, which connects pin B with pin C.
- The strobe light jumper allows activation by ignition by connecting a jumper between pin number 2 and pin 3 of the strobe switch. See schematic location [72, L].
- Operator Presence Switch Jumper, which is removed when connecting the optional seat-belt sequencer.

Harness Interconnection

On the electrical schematic the interconnection between two harnesses is indicated by a harness dividing line, which will run across the two mating harness connectors. See Figure 1, item 15.

ELECTRICAL CONNECTORS

Connector Types

Connector types are identified by letter codes. Multiple pin or socket connectors have a three letter code. Terminators, that are not isolated when detached, have a two letter code. The explanation of the letter codes is shown in Table 4.

Table 4. Connector Types

Letter Code	Explanation
CRP	Connector Receptacle Pin
CRS	Connector Receptacle Socket
CPP	Connector Plug Pin
CPS	Connector Plug Socket
TS	Terminal Socket
TP	Terminal Pin

Connector Identification

Each connector is identified by the letter code of the connector type and a unique identification number, e.g. CRP07.

Connectors have the same identification number if they interconnect between two wire harnesses, e.g. CRP07 interconnects with CPS07.

On the schematic a connector may be represented complete with all wires it normally contains, or partial, showing the few wires that are relevant for the particular page of the schematic.

A completely represented connector shows two rounded corners, as shown on Figure 1, item 11.

A partially represented connector has one curled corner, as shown on Figure 1, item 12.

As the wires in a connector will relate to different functions, portions of a connector can be divided over several schematic pages according the different electrical function of the wires. In general there is no relation between a connector and a schematic location. The only possibility to look up a schematic location is through the connector listing.

A connector is not shown on the schematic if the connector is an integral part of a component or if it does not have a minimum length of wire harness between the component and the connector. In these cases the schematic just shows the wire harness connector.

Connector Pin Numbers

On the schematic the pin numbers are indicated by a number or letter inside the connector symbol, with the relevant wire ending at the relevant pin number.

On the connector itself pin numbers are shown in relief, but can be as small as 1 mm high. To read the numbers, clean the housing and provide sufficient lighting.

Pin numbers can be located on the inside of the connector next to the pin, on the backside of the connector next to the wires, or on the connector housing.

Connector Description

For orientation purposes each connector has been provided with a description, which is shown in the connector overview in Table 11, and in the legend for the wire harnesses. The description matches the component it is attached with.

For connectors between harnesses the description is a combination of the two harness names. For instance CPS139: Frame-Mast. The first part of the description indicates the wire harness that the connector is part of, the second part indicates the wire harness that the connector connects with. An exception is the interconnection between frame and side console harness, which is through three connectors.

To avoid having three identical descriptions, the descriptions Cab Signals, Cab Power and Aux Signals have been assigned.

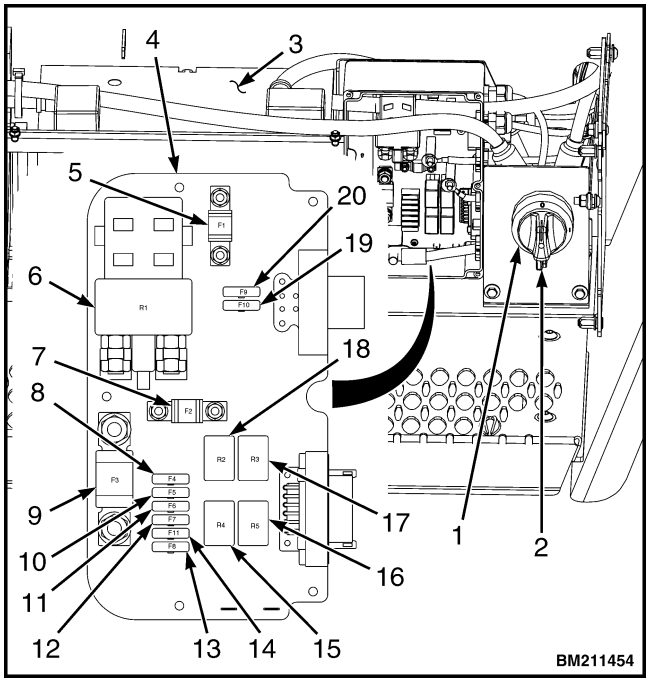
FUSES

The grid heater, cab and alternator have separate fuses and relays that are located on the powerboard in the battery box attached to the fuel tank on the left-hand side of the truck. See Figure 3 and Table 5.

Four fuse panels are located behind the cover under the instrument panel. The four fuse panels contain the fuses that protect all other electrical circuits. See Figure 4 and Table 6.

On the inside of the instrument cover is a label that shows the location of the fuses in the four fuse panels.

In some cases a fuse is not adopted on the electrical schematic. It concerns fuses that are an integral part of a component, like retrofitted radio's or the Twist Module.



Legend Item	Code	Description	Value	Connector	Location
1.		BATTERY DISCONNECT SWITCH	--	--	--
2.		BATTERY DISCONNECT SWITCH LOCK	--	--	--
3.		BATTERY	--	--	--
4.		POWERBOARD	--	--	--
5.	F1	ALTERNATOR	125A	TS15/TS16	[38,A]
6.	R1	RELAY GRID HEATER	--	TS18/ CPS166	[35,H]
7.	F2	CAB SUPPLY	125A	TS10/TS01	[22,D]
8.	F4	DEF HOSE HEATING	15A	CPS166	[52D]
9.	F3	GRID HEATER	150A	F3	[35,H]
10.	F5	SPARE	10A	CPS166	[53,C]
11.	F6	DEF MODULE HEATER	10A	CPS166	[53,D]
12.	F7	SPARE	7.5A	CPS166	[53,C]
13.	F8	SPARE	10A	CPS166	[53,C]
14.	F11	SPARE	15A	CPS166	[54,C]
15.	R4	RELAY DEF HOSE CPS146	--	CPS166	[51,C]
16.	R5	RELAY DEF PUMP HEATER	--	CPS166	[52,D]
17.	R3	RELAY DEF HOSE CPS141	--	CPS166	[51,D]
18.	R2	RELAY DEF HOSE CPS140	--	CPS166	[52,C]

Legend Item	Code	Description	Value	Connector	Location
19.	F10	ENGINE ECM SUPPLY	30A	CPS178	[33,H]
20.	F9	CAB TILT	30A	CPS178	[105,F]

Figure 3. Main Fuses and Main Relays

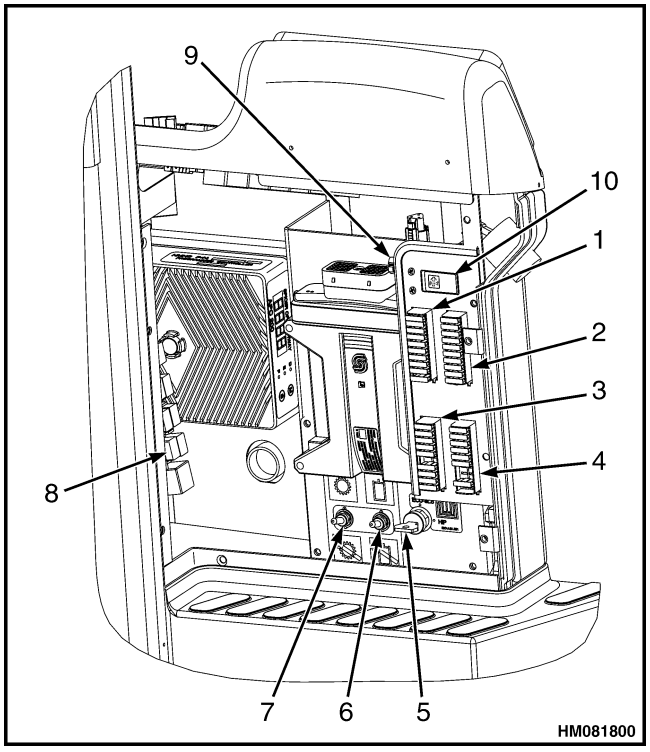


Figure 4. Fuse Panel, Hydraulic Controller and Hydraulic Relays

Legend for Figure 4

1. FUSE PANEL 1
2. FUSE PANEL 2
3. FUSE PANEL 3
4. FUSE PANEL 4
5. ECO-ELO SWITCH
6. HYDRAULIC SERVICE SWITCH
7. TRANSMISSION CALIBRATION SWITCH
8. RELAY PANEL (SEE FIGURE 5)
9. DIAGNOSTIC PLUG
10. REGENERATION SWITCH (TIER 4 ONLY)

Table 6. Fuse Panel Overview

Fuse	Description	Value	Location
Fuse Panel 1			
F1	Engine Start	30A	[25,B]
F2	ECM Ignition	5A	[31,E]
F3	Low Brake Pressure Warning	5A	[29,F]
F4	Ignition	7.5A	[29,F]
F5	Transmission B+	7.5A	[64,C]
F6	Hydraulic Controller	30A	[138,E]
F7	Attachment Controls	15A	[145,A]

Table 6. Fuse Panel Overview (Continued)

Fuse	Description	Value	Location
F8	Park Brake Solenoid	5A	[123,A]
F9	Instrumentation	10A	[120,B]
F10	Alternator On	5A	[34,A]
Fuse Panel 2			
F11	Flood Lights	30A	[78,J]
F12	Strobe Light B+	5A	[71,I]
F13	Brake Lights	10A	[82,H]
F14	Front Drive Lights	15A	[71,G]
F15	Interior Lights	5A	[71,H]
F16	Mast/Attachment Lights	15A	[81,E]
F17	Direction Indicators	10A	[97,D]
F18	Side/Tail Lights	10A	[82,E]
F19	Rear Drive Lights	10A	[79,I]
F20	Reverse Lights/Alarm/Strobe	10A	[79,I]
Fuse Panel 3			
F21	Front Screen Wash/Wipe	10A	[152,B]
F22	Roof Screen Wash/Wipe	10A	[152,B]
F23	Rear Screen Wash/Wipe	10A	[152,C]
F24	Horn	10A	[166,C]
F25	Sped Power Ignition	5A	[168,G]
F26	Automatic Greasing (opt)	10A	[182,F]
F27	Seat Suspension Compressor	15A	[122,F]
F28	Heater/AC/Ventilation Fan	25A	[171,F]
F29	AC Condenser, Fans	30A	[179,H]
F30	Parkbrake Warning Buzzer	5A	[179,G]
Fuse Panel 4			
F31	Power Socket 12V DC	10A	[168,H]
F32	Radio/CB/Intercom	10A	[168,H]
F33	12V Converter for Accessories	10A	[166,H]
F34	Hazard Lights	10A	[97,D]
F35	Sped Power B+	25A	[168,G]
F36	12V Relay	3A	[168,H]
F37	OPS System	5A	[126,C]
F38	EAS Sensor	10A	[43,A]
F39	Power Socket Switched 24V B+	15A	[168,G]
F40	Power Socket 24V ign	5A	[168,G]

RELAYS

Except for the main relays shown on Figure 3, all relays are installed on the relay panel that is located left of the fuse panel. See Figure 5 and Table 7.

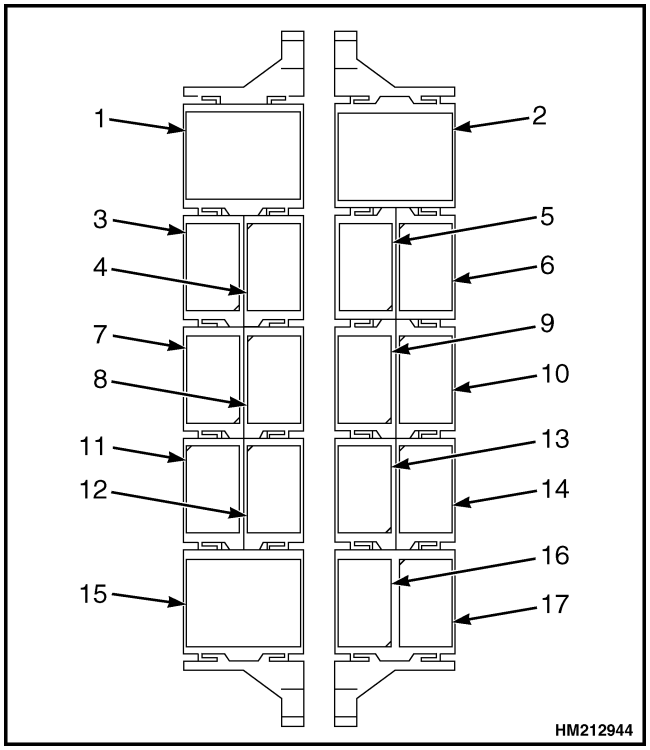


Figure 5. Relay Panel

Table 7. Relays Overview

Item	Description	Connector	Location
1	Main Power	CPS16	[27,E]
2	Lights	CPS174	[97,B]
3	Horn	CPS84	[166,C]
4	OPS	CPS84	[136,I]
5	Start Enable	CPS15	[31,D]
6	Ignition	CPS15	[27,G]
7	Hydraulic Controller	CPS120	[139,F]
8	Twistlock	CPS120	[145,E]
9	Start Inhibit	CPS13	[30,B]
10	Neutral	CPS13	[30,B]
11	12 Volt Relay	CPS108	[165,F]
12	Override	CPS108	[107,C]
13	AC3	CPS36	[179,G]
14	Reverse Lights & Alarm	CPS36	[82,I]
15	Flasher Unit	CPS76	[92,B]
16	AC1	CPS115	[179,F]
17	AC2	CPS115	[179,F]

FLYBACK DIODES

Some components induce current surges when they are switched off. These surges can cause sparking of mechanical contacts in switches and relays, which results in premature erosion of these contacts. Flyback diodes prevent these symptoms by connecting the induced current surge to ground.

Always check functionality of a flyback diode when a switch or relay has failed. In most cases a failed diode will not conduct at all. Sometimes a failed diode causes a short circuit.

Replacement diodes are integrated in connectors that attach the correct diode polarity to the wire harnesses. Table 8 provides a complete listing of all flyback diodes fitted.

Table 8. Flyback Diodes

Connector	Diode Description	Location	Harness Name	Figure Number
CPS17	Diode_Main_Power	[25,A] ,[28,D]	Sideconsole	17
CPS172	Diode_Neutral_Signal	[28,C] ,[30,D]	Sideconsole	17
CPS18	Diode_Hydraulic_controller	[139,D]	Sideconsole	17
CPS236	Diode_Cab_Tilt_Pump	[109,G]	Powered Cab Tilt	N/A
CPS34	Diode_Calibration	[63,C]	Sideconsole	17
CPS39	Lights_Diode	[123,C] ,[76,I]	Sideconsole	17
CPS54	Backup_Diode	[88,G]	Rear	N/A
CPS82	Diode_Horn	[164,D]	Cab Underfloor	18

CAN (CONTROLLER AREA NETWORK)

CAN bus is a standard for an electronic system that allows communication between different controllers without the need for a host computer.

The different controllers have their own controlled network of sensors, actuators and control devices. Functioning of these components cannot be influenced by other controllers unless the programming of a network controller specifically allows.

Each controller requires its own voltage supply to feed the controller and to provide signals to the components that belong to the controller network. Without voltage supply a controller does not function.

Communication occurs through sending and receiving signals. Each signal contains amongst others a code for the type of message (e.g. coolant temperature), the message itself (83°) and the ID of the controller (ECM) that has sent the signal. Each controller has been programmed to react only to certain messages from certain controllers. All other messages are ignored.

Only two wires (wire 900 and 901) are required for communication: The data wire and the data inverse wire. Integrity of signal transfer is verified by comparing the return signal of the data inverse wire with the original signal of the data wire.

The can bus system includes the following controllers:

- Engine Control Module
- Transmission controller
- Hydraulic controller
- Instrument cluster
- Diagnostic connector*

(*) The diagnostic connector itself is not a controller. Instead, the IFAK cable that leads to the laptop computer contains the controller that will make contact with the CANbus system when plugged into the diagnostic connector.

All sensors that belong to one system controller are shown on one sheet of the electrical diagram.

The diagnostic connector itself is not a controller. Instead, the IFAK cable that leads to the laptop computer contains the controller that will make contact with the CANbus system when plugged into the diagnostic connector.

The optional Electronic Climate Control has an independent control system that does not communicate through can bus wires 900 to 903.

The CANbus inverse wire and data wire are twisted together to reduce sensitivity to electromagnetic interference. For the same purpose there are termination resistors at the extreme ends of the string of controllers. The CANbus system will not function if both 120 Ohm resistors are faulty or disconnected.

One of these two termination resistors is not visible on the schematic, because it is included in the ZF transmission controller.

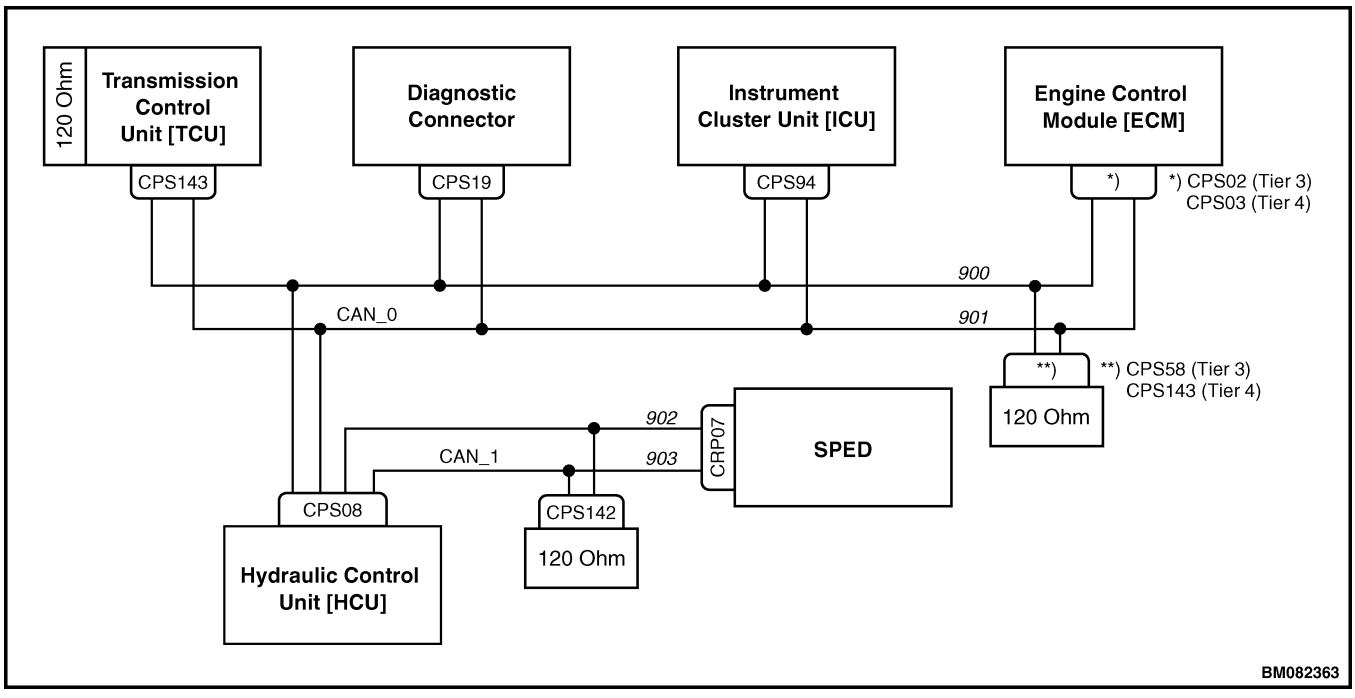


Figure 6. CANbus Circuit

Troubleshooting

Most controllers have a memory that retains codes for situations that occurred within their own controlled circuit. Also faults in the controller itself are stored as a fault code. Both the IFAK cable and the instrument cluster contain a controller that makes these codes visible on a lap top computer, respectively on the hour meter display. The explanation of these codes is shown on the different fault code tables for engine, transmission, hydraulic system and Electronic Climate Control.

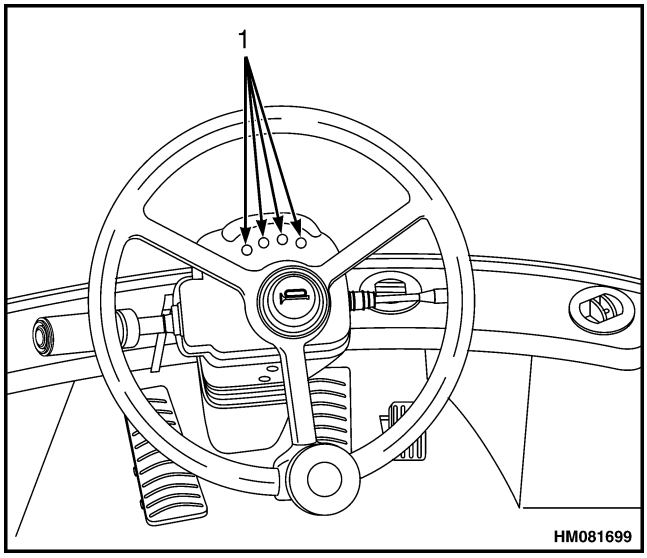
The can bus connection itself can be verified by checking continuity of the data inverse wires 900 (green) and the data wires 901 (yellow), and by checking the 120 Ohm resistance value of the end resistor. For schematic location and actual location see Table 11.

Diagnostics of a faulty CAN bus system requires thorough knowledge and specific software. As controllers cannot be repaired, there is no other option than to replace a controller if it is found to be defective.

INSTRUMENT PANEL

The lights and instruments that are shaded in Figure 7, Figure 8, and Table 9 are controlled by CAN-bus signals. The legend also shows the related pin numbers for connector CPS94.

To test functionality of the individual warning lights, switch the ignition from OFF to ON. All lights should light up for one second. As there are no serviceable components, the entire instrument panel must be replaced if found defective.



1. WARNING LIGHTS

Figure 7. Central Warning Lights

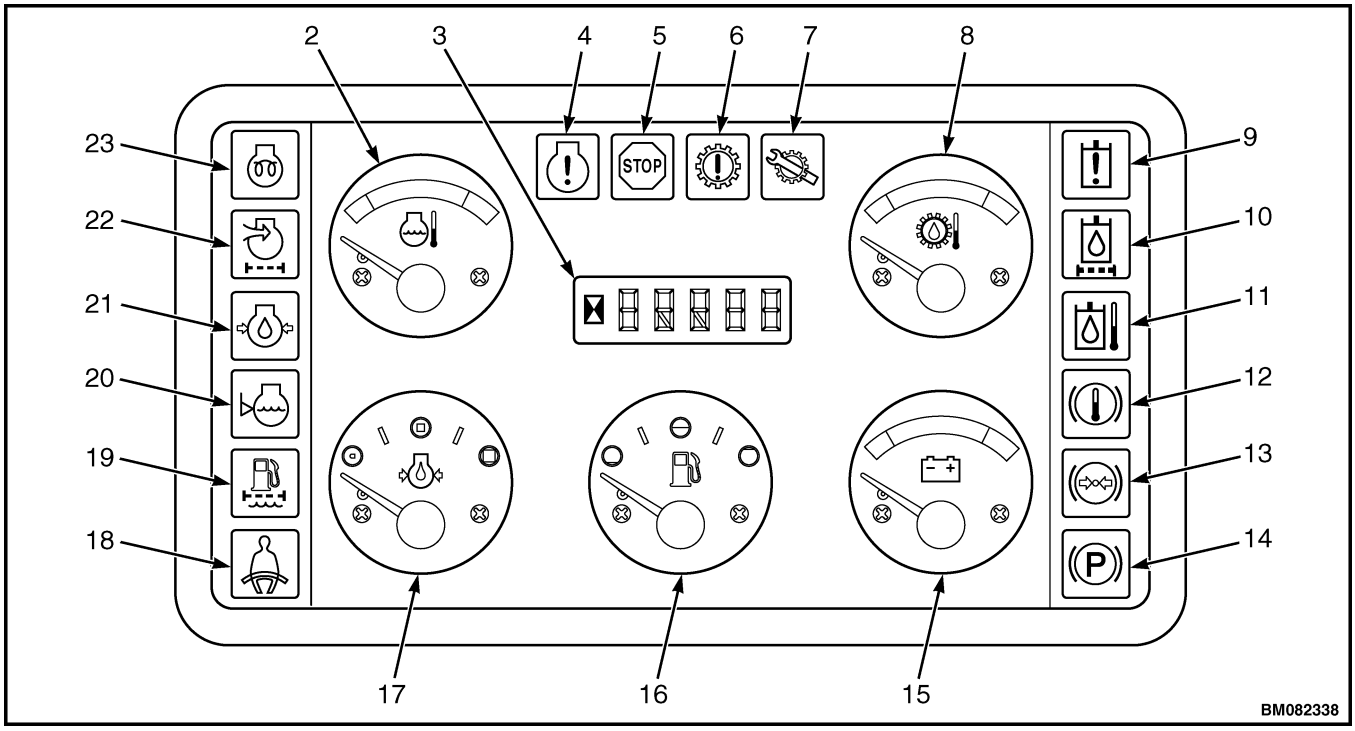


Table 9. Legend for Central Warning Lights and Instrument Panel

Item	Description	Pin Number	Central Warning Light	Buzzer
1	Central Warning Lights	CAN	----	----
2	Engine Coolant Temperature Gauge & High Coolant Temperature Warning Light	CAN	●	●
3	Hour Meter / Active Fault code Display/ Fault Log Display	CAN	----	----
4	Engine System Fault/Malfunction Warning Light	CAN	●	----
5	Engine System Urgent Stop Warning Light	CAN	●	●
6	Transmission System Fault/Malfunction Warning Light	CAN	●	●
7	Transmission Calibration Warning Light	12	----	----
8	Transmission (Sump) Oil Temperature Gauge & High Oil Temperature Warning Light	CAN	●	●
9	Hydraulic System Fault/Malfunction Warning Light	CAN	●	●
10	Hydraulic Oil Filter Restriction warning light	CAN	●	
11	Hydraulic (Tank) Oil High Temperature Warning Light	CAN	●	●
12	Wet Brake High Oil Temperature Warning Light	CAN	●	●
13	Brake System Low Oil Pressure Warning Light	11	●	●
14	Parking Brake Warning Light	7	----	----

Table 9. Legend for Central Warning Lights and Instrument Panel (Continued)

Item	Description	Pin Number	Central Warning Light	Buzzer
15	Battery Voltage Gauge & Low Battery Voltage Warning Light	1	●	----
16	Fuel Level Gauge & Low Fuel Level Warning light	24	●	----
17	**Tier 3/Stage IIIA**: Engine Oil Pressure Gauge & Low Oil Pressure Warning light	CAN	●	●
	Tier 4F/Stage IV: Engine Diesel Emission Fluid (DEF) Level Gauge & Low DEF Level Warning Light	CAN	●	----
18	Seat Belt Warning Light	2	----	----
19	Engine Fuel Filter Water Separator Warning Light	CAN	●	
20	Engine Coolant Low Level Warning Light	CAN	●	●
21	Engine Oil Low Pressure Warning Light	CAN	●	●
22	Engine Air Filter Restriction Warning Light	20	●	----
23	Engine Wait To Start Warning Light	CAN	----	----

Figure 8. Central Warning Lights and Instrument Panel

Instrument Panel Connectors

The instrument panel connects with the system through connector CPS94, which is located at the rear of the instrument panel. See Figure 9 and Table 10.

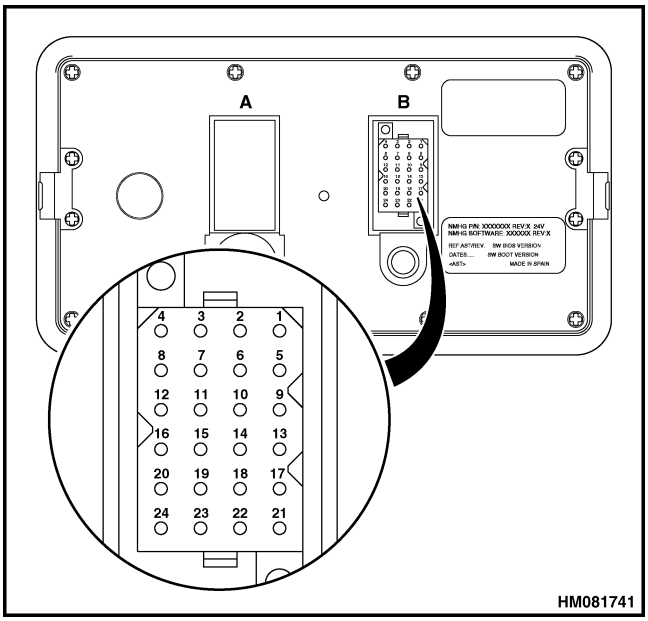


Figure 9. Instrument Panel Connectors

Table 10. Pin Descriptions

Pin	Description
1	Battery positive input (Diagnostic Switch)
2	Seat switch input
3	NOT USED
4	Ground
5	NOT USED
6	NOT USED
7	Park Brake Warning Light Input
8	NOT USED
9	NOT USED
10	NOT USED
11	Brake System Low Pressure Light
12	Transmission Calibration Warning Light
13	NOT USED
14	Can - H
15	Can - L
16	NOT USED
17	Buzzer output 10 mA
18	NOT USED
19	Central Warning Light output 25 mA
20	Engine Air Filter Restriction Warning Light input
21	NOT USED
22	NOT USED
23	NOT USED
24	Fuel Level Gauge input

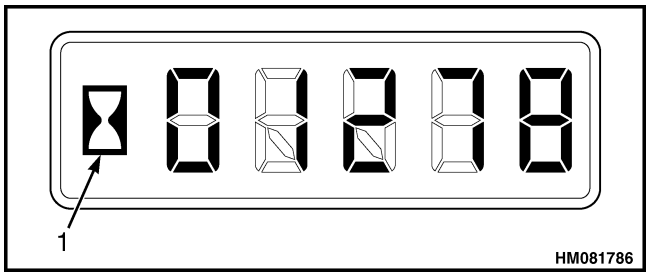
LCD DISPLAY

The LCD display can show values for different modes:

- Hourmeter Mode
- Fault Code Mode
- Transmission Calibration
- Fault Code Log Mode

Hourmeter Mode

Under normal conditions an hourglass is shown, indicating that the LCD display shows engine running hours. The running hours are stored every 6 minutes when the engine is above 300 rpm. The maximum number of hours that can be displayed is 99,999 hours. See Figure 10.



1. HOUR GLASS

Figure 10. Hourmeter Display

Fault Code Mode

If a control system detects an error, the LCD display switches between Hour Meter and Error Mode every 2 seconds. Fault codes start with a letter that relate to the controller that signal the fault. Fault codes starting with 'E' refer to the engine, 'T' to the transmission, 'H' to hydraulics. See Figure 11.

An explanation and suggested corrective action for the fault codes is provided in below manuals:

- Cummins Engine Fault Code Guide 0600SRM1101 for engine fault codes.
- Transmission Operations and Diagnostics 1300SRM1455 for Transmission fault codes.
- Hydraulic Control System (L007) 1900SRM1935, Hydraulic Control System (K019) 1900SRM1964 and for B238 Hydraulic Control System 2200SRM1980 for hydraulic system fault codes.

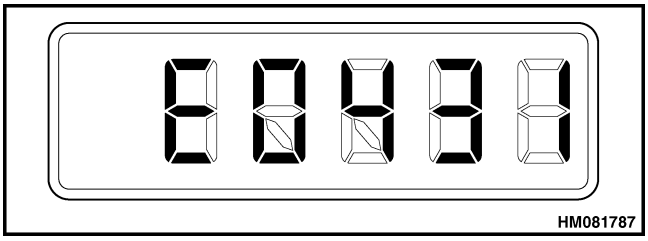


Figure 11. LCD Display Engine Fault Code

Transmission Calibration

The display is a convenient replacement for a PC, when performing some of the transmission calibration and test procedures. See Figure 12. See Transmission Operations and Diagnostics 1300SRM1455 for a description of these procedures.

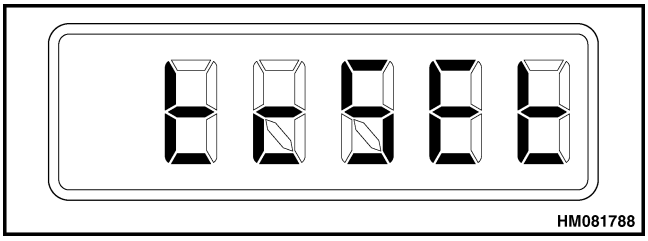


Figure 12. LCD Display Transmission Calibration

Fault Code Log Mode

The instrument panel stores all fault codes received from the engine, transmission and hydraulic controller. The instrument panel does not store calibration and exceed codes from the transmission. Faults that have occurred can be reviewed at a later point in time by entering into the Fault Code Log Mode. The display will show Err_H. See Figure 13.

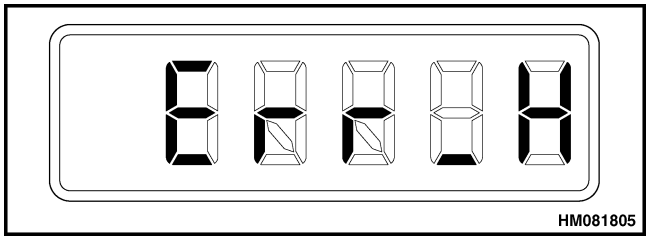


Figure 13. LCD Display Fault Log Mode

Access

1. Apply the parking brake.
2. Turn the key switch into the ON position, but do not start the engine.
3. Press and release the service switch 3 times.

Press approximately for one second and release for one second. After each press-and-release cycle the display will show a number that increases with each cycle. After the third cycle the display will show a 3. The display is now in fault log mode.

When no faults have been recorded, the LCD display shows "clear."

Recorded faults are shown in batches of four numbers, each being displayed during three seconds.

The numbers represent the following:

- Error code
- Hourmeter reading at most recent occurrence of this fault
- Hourmeter reading at first occurrence of this fault
- Number of occurrences of this fault

The batches with fault code information are shown in sequence of occurrence. The most recently occurred fault code is shown first.

When all recorded fault codes have been shown, the display will continue to repeat these recorded fault codes until the user exists the fault log mode.

Clear

To clear the fault codes logged in the display, proceed as follows:

1. Access into the fault log mode. See Access.
2. Press-and-release the service switch three more cycles. This is a repetition of the access procedure.

   The data erasing process will start and confirm successful completion by showing 'clear' on the display.

   If data-erasing is not successful, the display will continue to show fault code data.

Exit

To exit the fault log mode, turn the ignition OFF and ON and leave ignition ON for more than 2 seconds.

An alternative procedure to return to normal mode is by releasing the park brake or by starting the engine.

GENERAL FAULT FINDING

Below procedure is a guideline to facilitate fault finding in electrical circuits. Following the entire procedure is not always practical. Use common sense. For instance, if only one light out of a set of two has failed, you will first check the bulb of the failed light.

The procedure is not suited for electronic circuits like CANbus, which requires specific knowledge and software. Fortunately, defective electric components and connections that are part of a CANbus circuit will generate a fault code in the controller. The fault code guide provides further detail about the defect. Always verify presence of fault codes.

Preparation

1. Have the Electrical Schematic available. See Diagrams 8000SRM1938 for L007 and K019, and in Diagrams 8000SRM1982 for B238.
2. Identify the symptoms of the defect.
3. Establish how the relevant switches and levers should operate. See the Operating Manual.
4. Observe the condition of the truck. Look for signs of mechanical damage, overheating, unusual sounds, burn smells.

Define the Problem Area

1. Determine the schematic location of the failed function. See Connector Overview.
2. Establish which sections of the failed function operate correctly. Identify these sections on the schematic.

Identify Possible Causes of Malfunction

Make a list of every possible fault. Use your initial observations to help you writing down these faults.

Determine the Most Probable Cause

1. Prioritize each of the listed possible faults.
2. Perform a Fuse Check, a Wiring Check and a Component Check for each of the listed faults.

Fuse Check

Determine which fuse protects the component in the failed circuit. See Connector Overview to look up the related page of the schematic and find the fuse reference number.

Investigate if an overload condition or a short circuit caused the fuse to fail. First make repairs to solve the short circuit or overload condition. See Wiring Check.

Replace the fuse after the repair has been made. The actual location of the fuse is indicated on Figure 4.

Wiring Check

Check signal presence at the component.

If no signal is present, check the signal at the next component closer to the battery (relay, fuse, switch, ignition switch). See Diagrams 8000SRM1938 for L007 and K019, and in Diagrams 8000SRM1982 for B238.

Check for damaged wire insulation in particular when there are erratic failures.

Check connection to battery ground. Establish virtually zero resistance for battery ground connections.

Component Check

Isolate the component and check electrical functionality according the electric schematic.

Switches and connectors must have virtually zero resistance when closed.

Check for open circuits, short circuits and insulation breakdown.

Check if coils and relays do not overheat, which indicates a defect.

Repair and Test

Remove the ground cable from the battery when doing repairs. Replace or repair the defective components after the cause of failure has been established. Replace the fuse found defective.

After the repair, do a test to make sure that the proper repair has been made and that there are no other faults in the circuit.

Wire Harness Identification and Connector Location

Below Figure 14 through Figure 23 show a 3D-view of most of the wire harnesses with their terminals and connectors. The legends for these figures mention the connector codes and connector description for verification. Related is Table 11, which indicates the item and figure number to find a connector or terminal.

Table 11. Connector Overview

Connector	Description	Location	Harness
CPP02	POWERTRAIN-FRAME	[36,D], [62,H]	Powertrain
CPP03	Engine_ECM_Signals	[43,A]	EAS
CPP03	Tier3_Adaptor	[37,J]	Tier3 Adaptor
CPP04	EAS-DEF	[44,J], [54,J]	Powertrain
CPS02	ECM_TIER3	[39,H]	Tier3 Adaptor
CPS03	DEF_SUPPLY_MODULE	[59,H]	DEF
CPS04	Throttle_Pedal	[31,J]	Cab Underfloor
CPS05	Ecm_Power_Tier3	[39,J]	Tier3 Adaptor
CPS06	Cab_Power	[24,F], [33,E], [81,A]	Frame
CPS07	Cab_Signals	[125,A], [132,C], [108,A], [176,C], [185,F], [31,G], [32,C], [42,E], [63,E], [81,B]	Frame
CPS08	Hydraulic_Controller	[132,B]	Sideconsole
CPS09	Aux1_Lever	[139,J]	Armrest
CPS10	Hydraullic_Temperature	[111,E]	Frame
CPS100	Brake_light	[82,I]	Cab Underfloor
CPS101	Lift_Solenoid1	[133,J]	Hydraulics
CPS103	Coolant_Level	[34,F]	Frame
CPS105	Sideconsole-TWIST_Mod	[102,E]	Sideconsole
CPS106	TWIST_Module	[102,I]	Twistmodule
CPS107	DC/DC_Convertor	[167,I]	Sideconsole
CPS108	Override/12VRelay	[107,C], [165,F]	Sideconsole
CPS109	Fuses_31-40	[124,C], [124,D], [165,H], [165,I], [167,H], [43,G], [96,D]	Sideconsole
CPS11	Frame-Mast_Lts	[94,G]	Frame
CPS110	Radio_Power	[161,H]	Closed Cab/Open Cab
CPS111	Radio_Sound	[162,I]	Closed Cab/Open Cab

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS112	Tilt_Lever	[137,J]	Armrest
CPS113	Lift_Lever	[136,J]	Armrest
CPS114	Aux0_Lever	[138,J]	Armrest
CPS115	Relays_AC	[178,F]	Sideconsole
CPS116	HVAC_unit	[173,F]	Sideconsole
CPS117	Sideconsole-AC_cond	[173,C]	Sideconsole
CPS118	Twist_Locks	[142,I]	Armrest
CPS119	Hydr. Stop	[142,J]	Armrest
CPS12	Convertor_Temp	[61,J]	Powertrain
CPS120	HYDR_CONTR/ TwistLocks	[138,F], [144,F]	Sideconsole
CPS122	Frame-Cab_Tilt	[105,F]	Frame
CPS125	Frame-Hydraulics	[130,F]	Frame-Hydraulics
CPS129	Tilt_Solenoid	[132,J]	Hydraulics
CPS13	Neutral/Start_inhibit	[29,B]	Sideconsole
CPS130	Aux_Solenoid	[131,J]	Hydraulics
CPS131	Accum_Charge_disable_Sol	[132,I]	Hydraulics
CPS132	Lowering_Solenoid	[130,J]	Hydraulics
CPS133	FAN_CLUTCH	[43,E]	EAS
CPS134	CAN_termination_resistor	[49,A]	EAS
CPS135	Switches_Joystick	[141,B]	Armrest
CPS136	ECH_Mast-ECH_Attachment	[204,F]	ECH Mast
CPS137	Aux2	[140,F], [141,F]	Armrest
CPS138	Aux3	[140,G], [141,G]	Armrest
CPS139	Frame-Mast	[149,G]	Frame
CPS14	Key_Switch	[26,B]	Sideconsole
CPS140	HOSE HEATING 1	[56,H]	DEF
CPS141	HOSE HEATING 2	[56,H]	DEF
CPS142	Sped_Signals	[137,F]	Sideconsole
CPS143	XMSN_connector	[63,A], [65,I]	Sideconsole
CPS144	Suspension_Seat	[120,G]	Armrest
CPS145	Accessory_Socket_24V	[168,E]	Sideconsole
CPS146	HOSE HEATING 3	[56,G]	DEF

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS147	CAC_Temp	[35,F]	Hoodspine
CPS148	Mast-Front_End	[193,E]	Mast
CPS149	Aux 0	[197,A], [197,F]	DFSSFP
CPS15	Start_Enable/IGN	[28,G], [31,E]	Sideconsole
CPS150	Aux 1	[197,C], [197,G]	DFSSFP
CPS151	Aux 2	[197,B], [197,G]	DFSSFP
CPS152	Aux 3	[197,D], [197,H]	DFSSFP
CPS153	SCR THERMISTOR CONTROLLER	[53,C]	EAS
CPS154	DEF Sensors	[57,E]	DEF
CPS155	OPS	[127,E]	Sideconsole
CPS156	DOC_TEMP	[51,J]	EAS
CPS157	NOx_Sensor_DOC	[52,J]	EAS
CPS158	CAN_termination_resistor	[54,A]	DEF
CPS159	NOx_Sensor_SCR	[53,J]	EAS
CPS16	Main_Power_Relay	[26,E]	Sideconsole
CPS160	XMSN_connector	[60,G]	Powertrain
CPS161	Turbine_speed	[60,B]	Powertrain
CPS162	XMSN_Filter_Switch	[60,J]	Powertrain
CPS163	DEF_TANK_HEATING_VALVE	[56,F]	DEF
CPS164	DEF DOSING MODULE	[49,J]	EAS
CPS166	PDM	[35,H], [41,C]	Frame
CPS168	TBAP Sensor to Engine	[59,J]	Frame
CPS169	TBAP Sensor	[56,J]	Frame
CPS17	Diode_Main_Power	[25,A], [27,D]	Sideconsole
CPS170	PS_Feedback option	[144,F]	Sideconsole
CPS171	Brake_Temperature_Sensor	[110,B]	Frame
CP172	Diode_Neutral_Signal	[27,C], [29,D]	Sideconsole
CPS173	Low_Brake_Pressure	[110,F]	Hydraulics
CPS174	Light_Relay	[96,B]	Sideconsole
CPS175	ECO-eLo/HiP	[102,I]	Sideconsole

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS178	Frame-PDM_box	[32,I], [104,F]	Frame
CPS179	Inhibit_Aux1	[139,J]	Armrest
CPS18	Diode_Hydraulic_controller	[138,D]	Sideconsole
CPS180	Alternator Connector	[40,D]	Frame
CPS181	Lub_Display_Frame	[183,D]	Sideconsole
CPS182	Lub_Display_Att	[184,D]	Sideconsole
CPS183	LUBRICATION PUMP	[186,D]	Frame
CPS184	LUBRICATION SWITCH	[187,D]	Frame
CPS185	LUBRICATION SWITCH	[187,A]	Lubrication Switch
CPS186	LUBRICATION PUMP	[186,A]	Lubrication Pump
CPS19	Diag_Connector	[119,G]	Sideconsole
CPS20	Washer_Front	[159,J]	Wash_Pumps
CPS200	ZF_DIAG	[67,H]	Sideconsole
CPS21	Mast_Lts-Mast_Lts_RH	[95,H]	Mast Work Lights
CPS22	Engine_Speed	[60,C]	Powertrain
CPS23	Output_Speed	[60,A]	Powertrain
CPS233	Cab_Tilt_Switch	[105,H]	Powered Cab Tilt
CPS234	Cab_Tilt	[108,I]	Powered Cab Tilt
CPS235	Cab_Tilt_Pump	[106,I]	Powered Cab Tilt
CPS236	Diode_Cab_Tilt_Pump	[108,F]	Powered Cab Tilt
CPS24	Internal_Speed	[60,B]	Powertrain
CPS25	Diagnostic_Switch	[119,B]	Sideconsole
CPS26	SERVICE_SWITCH	[134,G]	Sideconsole
CPS27	CALIBRATION_SWITCH	[62,B]	Sideconsole
CPS28	SideConsole/ Wsh_Pumps	[155,G]	Sideconsole
CPS29	Shift_Lever	[69,B]	Steer Column
CPS30	Underfloor-SteerColumn	[116,I], [162,B], [69,D], [92,J]	Cab Underfloor
CPS31	Monotrol_Pedal	[69,H]	Cab Underfloor

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS32	Inching_Pedal	[68,I]	Cab Underfloor
CPS33	Sideconsole-Underfloor	[115,H], [154,G], [164,B], [26,I], [30,I], [67,G], [82,G], [91,G]	Sideconsole
CPS34	Diode_Calibration	[62,C]	Sideconsole
CPS35	Aux_Signals	[108,D], [113,D], [147,F], [42,E]	Frame
CPS36	AC3/Rev_lts	[178,G], [81,I]	Sideconsole
CPS37	Fuses_1-10	[122,B], [137,E], [145,A], [144,A], [24,B], [24,C], [28,E], [28,F], [30,F], [31,A], [63,C], [119,B]	Sideconsole
CPS38	Washer_Roof	[158,I]	Wash_Pumps
CPS39	Lights_Diode	[123,C], [75,I]	Sideconsole
CPS40	RH Rear Drive LIghts	[78,C]	Cablights
CPS41	Outer Front FLood Lights	[78,C]	Cablights
CPS42	Inner Front Flood Lights	[78,D]	Cablights
CPS43	Rear_Drive_Lts	[78,F]	Cab Lights
CPS44	Outer_Flood_Light	[78,F]	Cab Lights
CPS45	Inner_Flood_Light	[78,G]	Cab Lights
CPS450	Seat_Belt_Sequencer	[128,G]	Australian_OPS
CPS46	12V_Plug	[166,E]	Sideconsole
CPS47	Beacon/Strobe_Switch	[72,J], [73,J]	Sideconsole
CPS48	Flood/ RR_Drive_LTS_Switch	[76,G], [75,G]	Sideconsole
CPS49	Front_Lts-Marker_Lts	[87,A]	Front Drive Light
CPS50	FUSES_11-20	[77,H], [77,I], [70,H], [70,I], [80,E], [81,E], [82,G], [82,H], [96,D]	Sideconsole
CPS51	Fuses_21-30	[121,F], [151,C], [165,C], [165,D], [168,F], [169,F], [170,F], [171,F], [178,H], [181,F]	Sideconsole
CPS52	Side/ Front_Lights_Switch	[81,D], [81,E]	Sideconsole
CPS53	Att_Lights_Switch	[81,F], [81,G]	Sideconsole
CPS54	Backup_Diode	[84,E]	Rear
CPS55	Mast_Lts-Mast_Lts_LH	[96,H]	Mast Work Lights
CPS56	Drive_Light	[88,B]	Front Drive Light

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS58	CAN_termination_resistor	[39,F]	Tier3 Adaptor
CPS60	Frame-LH_Front_Lights	[86,C]	Frame
CPS61	Frame-RH_Front_Lights	[86,E]	Frame
CPS62	Frame-Hydraulics	[42,F], [127,A], [131,F]	Frame
CPS63	Closed_Cab-SideConsole	[153,H], [163,G], [172,D], [73,G]	Closed Cab/Open Cab
CPS64	RH_Cab_Lights	[76,E]	Cab Lights
CPS65	LH_Cab_Lights	[76,G]	Cab Lights
CPS650	by_battery	[97,G]	8800053
CPS651	by_ign	[99,G]	8800054
CPS66	LH-Mas_Lts	[98,J]	Mast Light Extension
CPS660	Container_Pos_Speed_Red	[103,B]	Sideconsole
CPS666	OPS_Breakout	[124,G]	Sideconsole
CPS67	Front_Lts-RH_Marker_Lts	[87,E]	Frame Lights
CPS68	Frame-Rear	[84,I]	Frame
CPS69	RH_Tail_lights	[87,I]	Rear
CPS70	Eng_Shut-down_Jumper	[25,C], [27,C]	Sideconsole
CPS71	Wiper_Timer	[152,F]	Sideconsole
CPS72	LH_Tail_lights	[87,J]	Rear
CPS73	SPED	[168,F]	Sideconsole
CPS74	Sideconsole-Wiper_Rear	[150,G]	Sideconsole
CPS75	Roof_Wiper	[154,J]	Closed Cab/Open Cab
CPS76	Flasher_Unit	[90,B]	Sideconsole
CPS77	Hazard_Switch	[91,D], [92,D]	Sideconsole
CPS78	Front_Wiper	[156,I]	Cab Underfloor
CPS79	RH-Mast_Lts	[98,J]	Mast Light Extension
CPS80	Horn_Switch_Armrest	[168,C], [169,C]	Armrest
CPS81	Armrest-Sideconsole	[122,G], [124,I], [136,G], [143,D], [155,D], [167,B]	Armrest
CPS82	Diode_Horn	[163,D]	Cab Underfloor

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CPS83	Horn_Button	[160,B]	Steer Column
CPS84	Seat_Switch/ Horn_Relay	[135,I], [166,C]	Sideconsole
CPS86	Front_Wiper_Switch	[157,B], [158,B]	Armrest
CPS87	REGEN_EN/ DISABLE_SW	[41,H], [41,I]	Sideconsole
CPS88	WIF_Sensor	[36,E]	Frame
CPS89	Front_Washer_Switch	[157,C], [158,C]	Armrest
CPS90	Roof Wiper/ Washer_Switch	[157,E], [158,E]	Armrest
CPS91	Rear Wiper/ Washer_Switch	[157,F], [158,F]	Armrest
CPS92	Wiper_Rear	[151,H]	Rear Wiper Extension
CPS93	Hoist_Pressure	[135,J]	Hydraulics
CPS94	Instrument_Cluster	[118,A]	Sideconsole
CPS95	Washer_Rear	[158,H]	Wash_Pumps
CPS96	Map_Light	[71,I]	Sideconsole
CPS97	Air_filter	[110,B]	Hoodspine
CPS98	Parkbrake_Solenoid	[128,B]	Hydraulics
CPS99	Lift_Solenoid2	[133,J]	Hydraulics
CRP01	AC-Clutch	[179,B]	Frame
CRP03	ECM_T4	[49,A]	EAS
CRP148	DFSSFP	[194,G]	DFSSFP
CRP06	Cab_Power	[24,F], [32,E], [81,A]	Sideconsole
CRP07	Cab_Signals	[124,B], [132,C], [176,C], [185,F], [31,G], [31,C], [42,F], [63,E], [81,B], [108,A]	Sideconsole
CRP10	Condensor_Unit	[170,B]	Closed Cab/Open Cab
CRP105	TWIST_Mod-Sideconsole	[102,E]	Twistmodule
CRP11	Mast_Lts-Frame	[94,G]	Mast Work Lights
CRP117	AC_cond-Sideconsole	[172,C]	Closed Cab/Open Cab
CRP12	ECM_Cross-over	[50,D]	EAS
CRP122	Cab_Tilt-Frame	[106,F]	Powered Cab Tilt
CRP125	Hydraulic-Frame	[130,F]	Hydraulic-Frame
CRP139	Mast-Frame	[190,F]	Front End FLT
CPS139A	Mast-Frame	[200,F]	Front End CH

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CRP142	End_Resistor	[137,G]	Sideconsole
CRP148	Front-End	[194,G]	Front End
CRP14	Reverse_Light	[88,I], [89,G]	Tail Light
CRP15	Rear Light	[88,I], [89,G]	Tail Light
CRP155	OPS_JUMPER	[127,E]	OPS Jumper
CRP16	Rear Light	[88,I], [89,G]	Tail Light
CRP17	Rear LIght	[88,I], [89,G]	Tail Light
CRP175	ECO-eLo/HIP	[102,H]	ECO-Elo/HIP
CRP18	Rear Light	[88,I], [89,G]	Tail Light
CRP183	LUBRICATION PUMP	[187,D]	Lubrication Pump
CRP184	LUBRICATION SWITCH	[188,D]	Lubrication Switch
CRP21	Mast_L-RH-Mast_Lts	[95,I]	Mast Light Extension
CRP28	Wsh_Pumps-SideConsole	[155,G]	Wash_Pumps
CRP30	SteerColumn-Underfloor	[116,I], [161,B], [69,D], [92,J]	Steer Column
CRP300	BACKUP_ALARM	[84,F]	Rear
CRP33	Underfloor-Sideconsole	[115,H], [154,G], [164,B], [26,I], [30,I], [67,G], [82,H], [91,G]	Cab Underfloor
CRP35	Aux_Signals	[108,D], [114,D], [147,F], [42,B]	Sideconsole
CRP420	Seat_Belt_Switch	[122,I]	Armrest
CRP440	Seat_Switch	[122,J]	Armrest
CRP49	LH_Marker_Lights-LH_Lts	[87,A]	Frame Lights
CRP55	Mast_Lts_LH-Mas_Lts	[96,H]	Mast Light Extension
CRP60/61	Front_Lights-Frame	[86,C], [86,E]	Front Drive Light
CRP62	Hydraulics-Frame	[131,F], [127,A], [112,F]	Hydraulics
CRP63	SideConsole-Closed_Cab	[153,G], [164,G], [173,D], [73,G]	Sideconsole
CRP64	RH_Cab_Lights	[76,E]	Closed Cab/Open Cab
CRP65	LH_Cab_Lights	[76,G]	Closed Cab/Open Cab
CRP650	Lights_Jumper	[97,G]	Sideconsole
CRP660	Speed_Lim_Jumper	[103,B]	Sideconsole
CRP67	RH_Marker_Lights-RH_Lts	[87,E]	Side Indicator
CRP68	Rear-Frame	[84,I]	Rear

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
CRP69/72	Tail_Lights	[87,I]	Tail light
CRP70	Eng_Shut-down_Jumper	[25,C], [27,C]	Sideconsole
CRP72	LH_Tail_Lights	[87,J], [151,F]	Tail light
CRP74	Wiper_Rear-Sideconsole	[150,G]	Rear Wiper Extension
CRP81	Sideconsole-Armrest	[122,F], [124,I], [136,G], [143,D], [155,D], [166,B]	Sideconsole
CRP88	WIF_Sensor	[39,F]	Tier3 Adapter
CRS01	Parkbrake_Switch_Element	[120,B]	Sideconsole
CRS02	FRAME-POWERTRAIN	[36,D], [62,H]	Powertrain
CRS03	Frame-Engine	[36,J], [43,A]	Frame
CRS04	DEF-EAS	[56,A]	DEF
TS01	FUSE_CAB_125A	[22,B]	Frame
TS02	Battery+	[22,J]	Battery Cable +
TS03	Battery-	[20,J]	Battery Cable -
TS04	Battery+	[21,J]	Battery Cable +
TS05	Battery-	[21,J]	Battery Cable +
TS06	Alternator_B+	[39,D]	Frame
TS07	Alternator_Ground	[39,D]	Battery Cable -
TS10	Supply_PDM	[21,B]	Supply_PDM
TS100	Ground_Startermotor	[37,E]	Battery Cable -
TS102	Armrest_Ground	[167,D]	Armrest
TS103	Armrest_Ground	[169,D]	Armrest
TS13	Startermotor_Solenoid	[37,D]	Powertrain
TS14	Ground_Startermotor	[36,A]	Battery Cable -
TS15	Fuse_Alternator_125A	[39,A]	Battery Cable +
TS16	Fuse_Alternator_125A	[38,A]	Frame
TS18	Gridheater_Relay	[35,H]	Frame
TS19	Grid_Heater	[36,H]	Frame
TS20	Alternator_B+	[39,D]	Frame

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
TS21	Ground_Startermotor	[36,A]	Battery Cable -
TS22	Buzzer	[125,B]	Side Console
TS23	Groundpoint_Frame	[36,A]	Battery Cable -
TS24	Groundpoint_Frame	[36,A]	Battery Cable -
TS25	Buzzer	[125,B]	Side Console
TS38	ECO-eLo/HIP 2	[103,G]	ECO-Elo/HIP
TS34	Inching_Switch	[25,J]	Cab Underfloor
TS35	Inching_Switch	[25,J]	Cab Underfloor
TS31	ECO-eLo/HIP 1	[102,G]	ECO-Elo/HIP
TS40	Groundpoint_Frame	[36,A]	Frame
TS41	Fuel Sender	[110,C]	Frame
TS43	RH_Interior_Light	[73,A]	Closed Cab/Open Cab
TS44	RH_Interior_Light	[73,A]	Closed Cab/Open Cab
TS45	LH_Interior_Light	[73,B]	Closed Cab/Open Cab
TS46	LH_Interior_Light	[73,B]	Closed Cab/Open Cab
TS48	Strobe_Light	[78,B]	Cab Lights
TS57	RH_Indicator	[88,D]	Side Indicator
TS58	RH_Side_Light	[88,D]	Side Indicator
TS59	RH_Side/ Indicator_Ground	[88,D]	Side Indicator
TS60	LH_Side/ Indicator_Ground	[88,B]	Side Indicator
TS61	LH_Side_Light	[88,B]	Side Indicator
TS62	LH_Side_Indicator_Light	[88,A]	Side Indicator
TS64	Indicator_Switch_54	[93,G]	Steer Column
TS65	Strobe_Light	[78,E]	Cab Lights
TS66	Indicator_Switch_L	[92,H]	Steer Column
TS67	Indicator_Switch_R	[93,H]	Steer Column
TS68	Horn	[163,E]	Cab Underfloor
TS69	Horn	[163,E]	Cab Underfloor
TS76	Fuel Sender +	[110,C]	Frame

Table 11. Connector Overview (Continued)

Connector	Description	Location	Harness
TS77	Starter_Motor+	[37,D]	Battery Cable +
TS80	Master_Warning	[117,J]	Steer Column
TS81	Master_Warning	[117,J]	Steer Column
TS82	Buzzer	[114,G]	Sideconsole
TS83	Buzzer	[114,G]	Sideconsole
TS84	Groundpoint_Frame	[36,A]	Frame
TS89	Radio_Coms	[161,F]	Closed Cab/Open Cab
TS90	Radio_Coms	[161,F]	Closed Cab/Open Cab
TS91	Right_Speaker+	[162,I]	Closed Cab/Open Cab
TS92	Right_Speaker-	[162,I]	Closed Cab/Open Cab
TS93	Left_Speaker+	[163,I]	Closed Cab/Open Cab
TS94	Left_Speaker-	[163,I]	Closed Cab/Open Cab
TS96	Strobe_Light	[78,B]	Cab Lights
TS97	Strobe_Light	[78,F]	Cab Lights
TS98	Ventilation_Fan	[171,D]	Closed Cab/Open Cab

FRAME HARNESS CONNECTORS

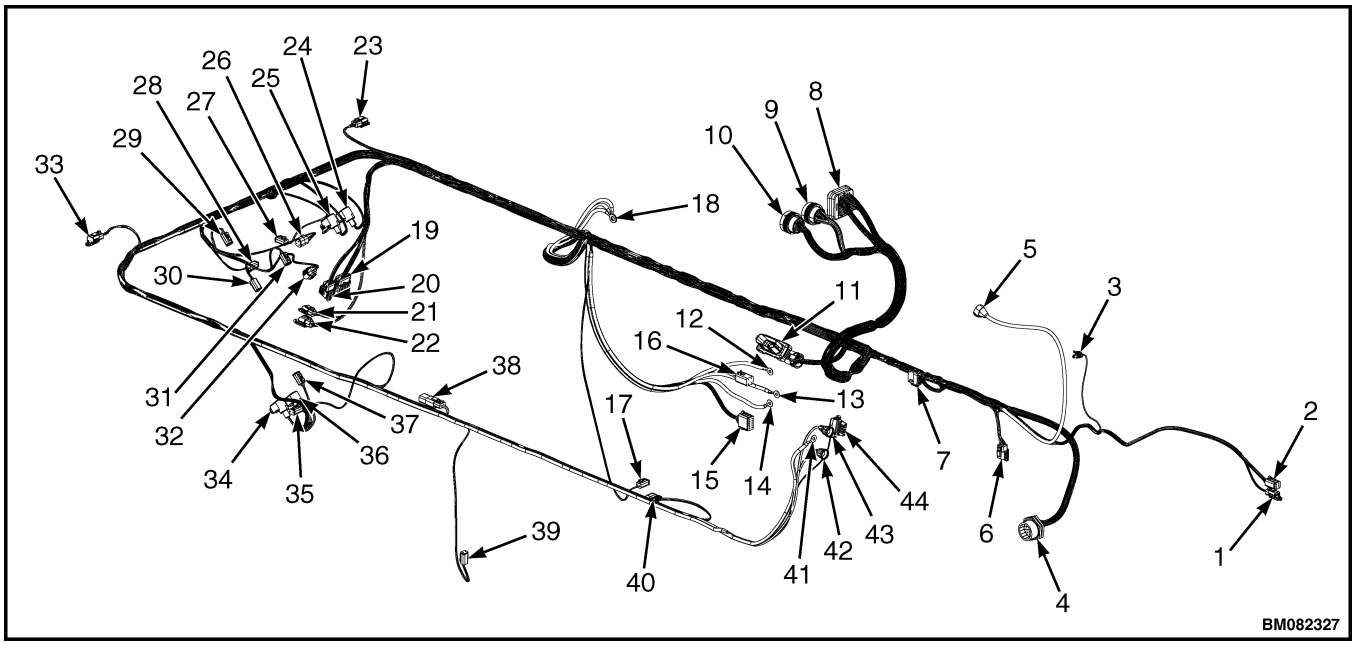


Figure 14. Frame Harness Connectors

Table 12. Legend for Frame Harness Connectors

Legend	Connector	Description
1	CPS184	Lubrication Switch
2	CPS68	Frame-Rear
3	CRP01	AC Clutch
4	CRS03	Frame-Engine
5	TS19	Gridheater
6	CPS183	Lubrication Pump
7	CPS127	Frame-Hoodspine
8	CPS07	Cab Signals
9	CPS06	Cab Power
10	CPS35	Aux Signals
11	CPP02	Frame-Powertrain
12	TS01	Fuse Cab 125A
13	TS18	Gridheater Relay
14	TS15	Fuse Alternator 125A
15	CPS166	PDM
16	CPS178	Frame-PDM Box
17	CPS10	Hydraulic Temperature
18	TS84	Groundpoint-Frame
	TS40	Groundpoint-Frame
	TS14	Ground-Startermotor
19	CPS148	Frame-Mast
20	CPS141A	Frame-Mast EC
21	CPS11	Frame-Mast_LTS
22	CPS102	Lift & Tilt Sensor
23	CPS61	Frame - RH Front Lights
24	CPS130	Aux Solenoid
25	CPS99	Lift Solenoid2
26	CPS173	Low Brake Pressure
27	CPS168	Brake Light Switch
28	CPS171	Brake Temperature Sensor
29	CPS98	Park Brake Solenoid
30	CPS131	Accumulator Charge Disable Solenoid
31	CPS132	Lowering Solenoid
32	CPS93	Hoist Pressure
33	CPS60	Frame - LH Front Lights
34	CPS129	Tilt Solenoid

Table 12. Legend for Frame Harness Connectors (Continued)

Legend	Connector	Description
35	CPS167	Fuel Sensor
36	CPS101	Lift Solenoid1
37	CPS169	Pump Disable
38	CPS122	Frame-Cab Tilt
39	CPS88	WIF Sensor
40	CPS62	TBAP Sensor to Engine
41	TS07	Alternator-Ground
42	TS20	Alternator B+
43	TS06	Alternator B+
44	CPS180	Alternator Connector

MAST ECH HARNESS CONNECTORS

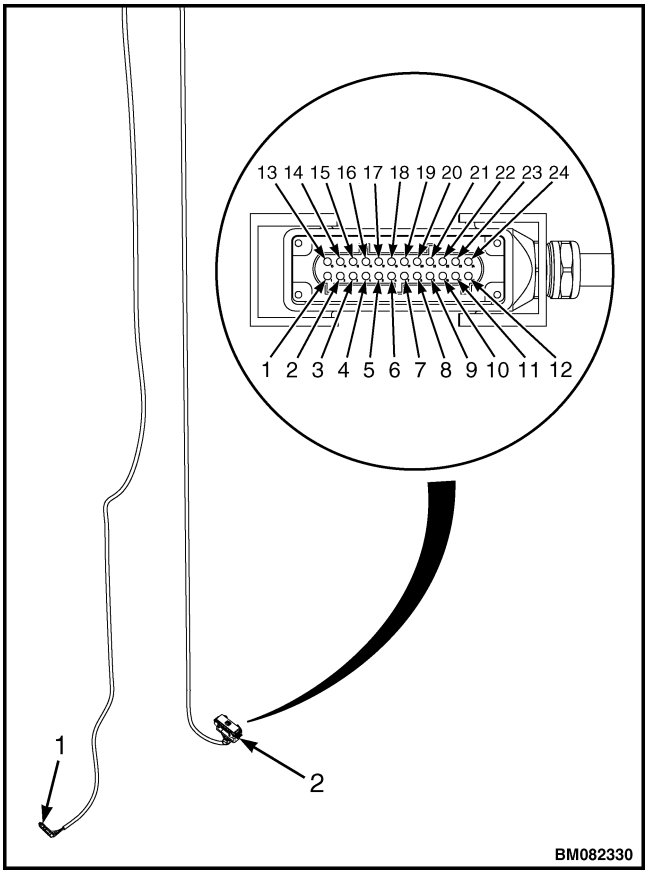


Figure 15. Mast ECH Harness Connectors

Table 13. Legend for Mast ECH Harness Connectors

Legend	Connector	Description
1	CPS141A	Mast ECH-Frame
2	CPS136	ECH Mast-ECH Attachment, See Table 14

Table 14. Mast ECH Harness Connector Pins

Pin	Description	Pin	Description
1	24V DC	13	Seated LH
2	Ground	14	Seated LH
3	Extend	15	Twistlocks Lock
4	Retract	16	Twistlocks Unlock
5	Side Shift left	17	Spare
6	Side Shift right	18	Green/Yellow Spare
7	Work Lights	19	----
8	Lower Interrupt	20	----
9	Service Override	21	----
10	Pressure Signal	22	----
11	Twistlocks Locked	23	----
12	Not Locked Twistlocks	24	----

TOP CAB HARNESS CONNECTORS

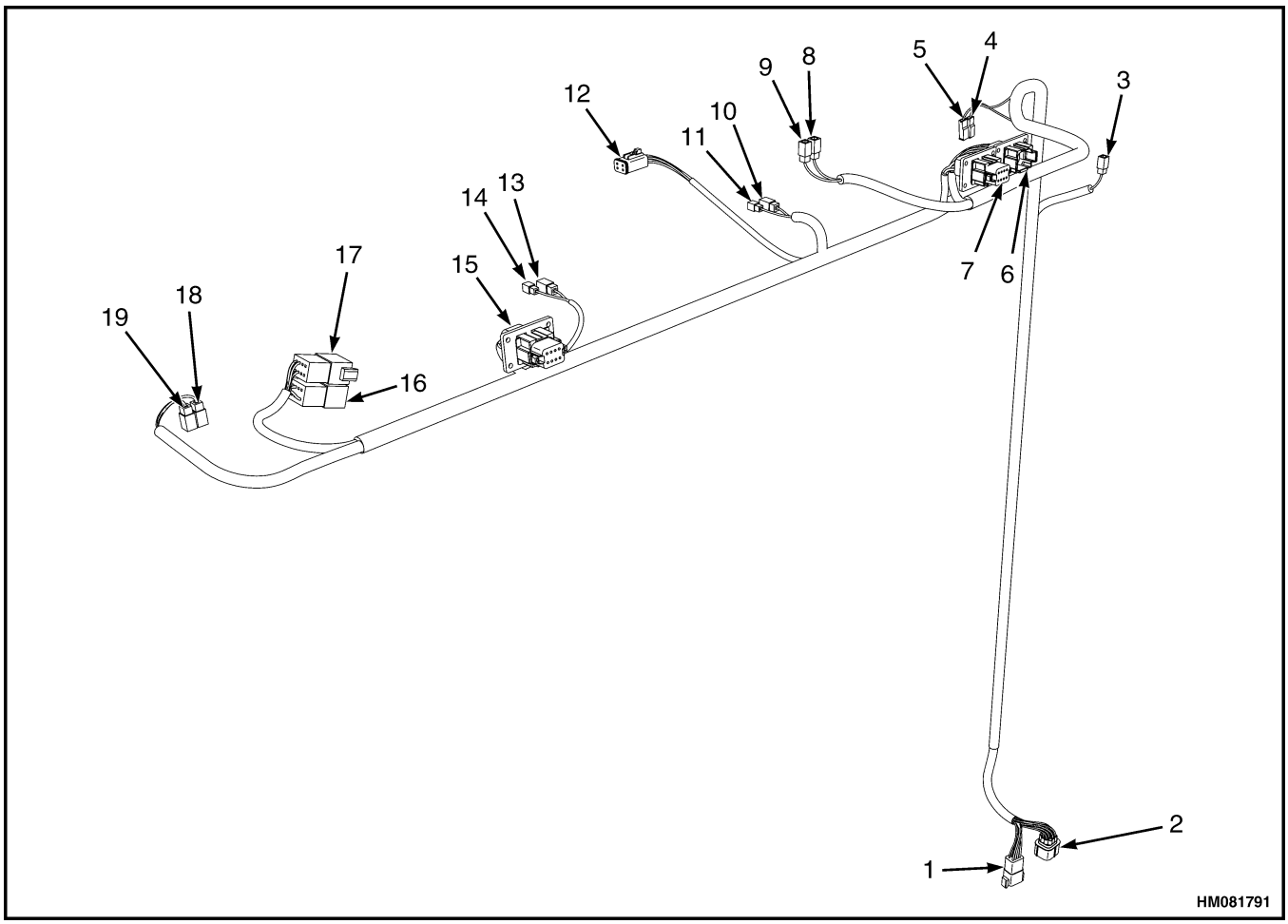
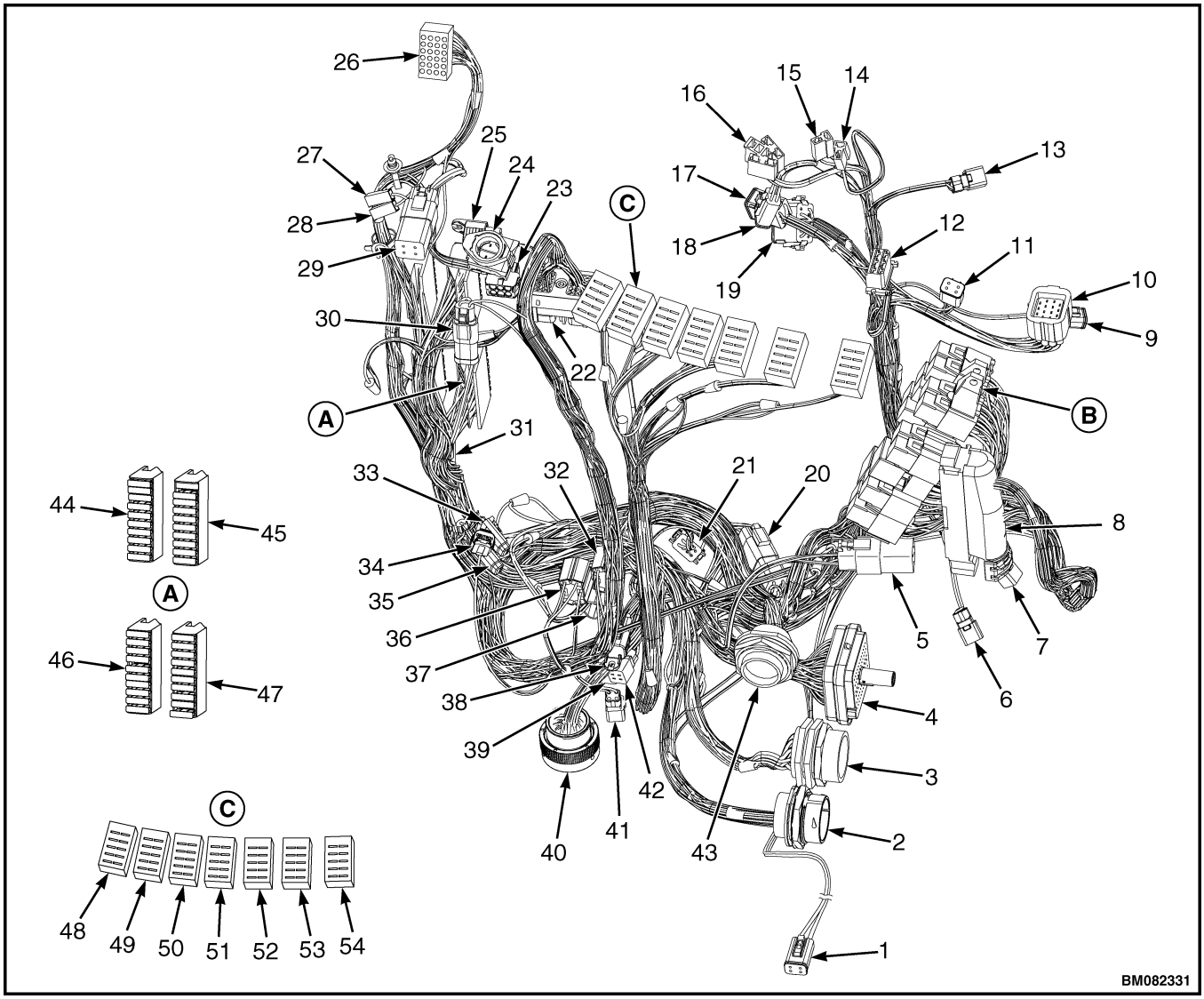


Figure 16. Top Cab Harness Connectors

Table 15. Top Cab Harness Connectors

Item	Connector	Description
1	CRP117	AC Condenser – Side Console
2	CPS63	Closed Cab – Side Console
3	TS98	Ventilation Fan
4	TS44	RH Interior Light
5	TS43	RH Interior Light
6	CRP10	Condenser Unit
7	CRP64	RH Cab Lights
8	TS89	Radio Coms
9	TS90	Radio Coms
10	TS91	Right Speaker
11	TS92	Right Speaker
12	CPS75	Roof Wiper
13	TS93	Left Speaker
14	TS94	Left Speaker
15	CRP65	LH Cab Lights
16	CPS110	Radio Power
17	CPS111	Radio Sound
18	TS45	LH Interior Lights
19	TS46	LH Interior Lights

SIDE CONSOLE HARNESS CONNECTORS



A. FUSES
B. RELAYS (SEE RELAYS)
C. SWITCHES

Figure 17. Side Console Harness Connectors

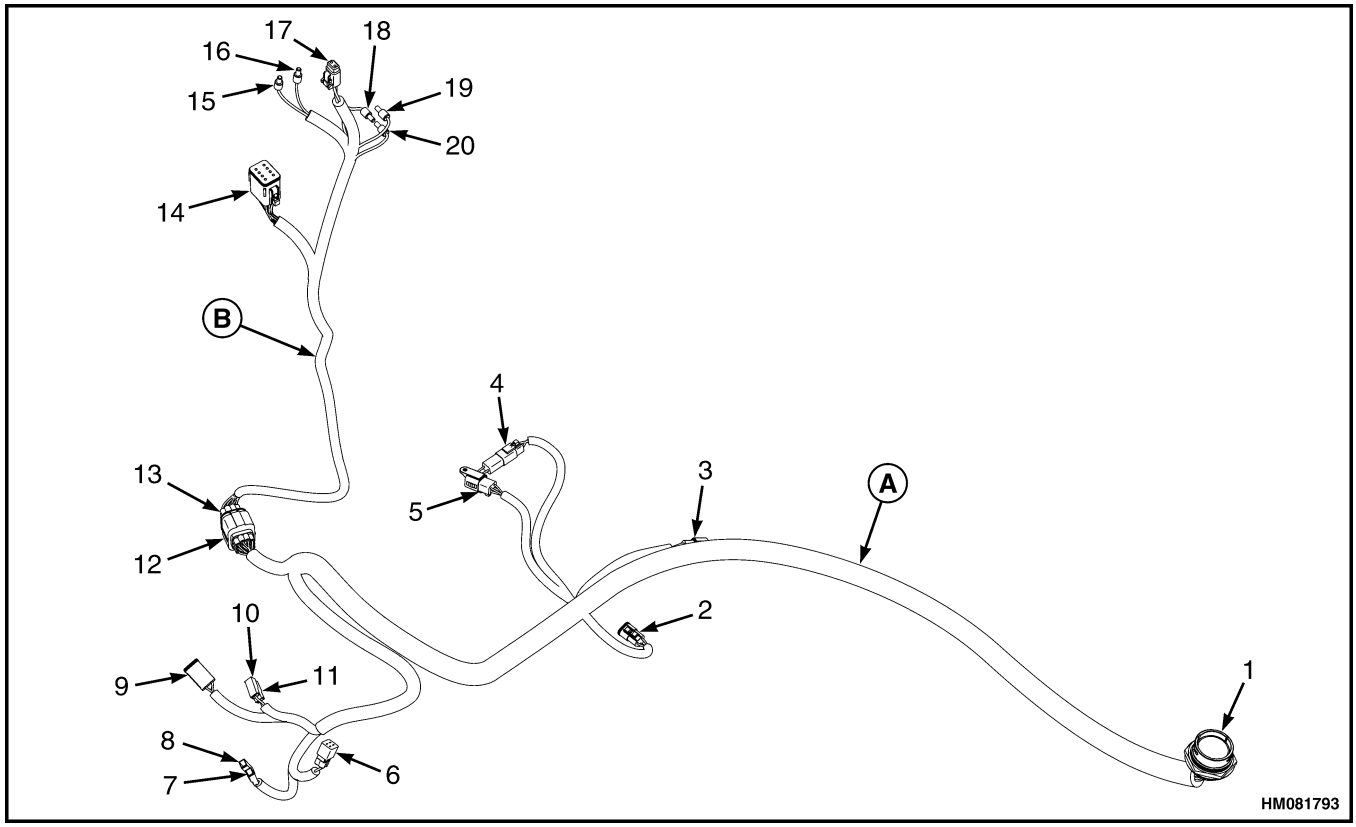
Table 16. Legend for Side Console Harness Connectors

Item	Connector	Description
1	CPS28	Side Console Wash Pumps
2	CRP35	Aux Signals
3	CRP06	Cab Power
4	CRP07	Cab Signals
5	CPS107	DC/DC Convertor
6	CPS18	Diode Hydraulic Controller
7	CPS17	Diode Main Power
8	CPS143	XMSN Connector
9	CPS666	OPS Breakout
10	CRP63	Side Console - Closed Cab
11	CPS74	Side Console – Wiper Rear
12	CPS71	Wiper Timer
13	CPS172	Diode Neutral Timer
14	CPS46	12V Plug
15	CPS96	Map Light
16	CPS14	Key Switch
17	CSP117	Side Console – AC Cond
18	CPS116	HVAC Unit
19	CPS105	Side Console – Twist Module
20	CRP70	Eng Shutdown Jumper
21	CPS155	OPS
22	CPS08	Hydraulic Controller
23	CPS200	ZF Diagnostics
24	CRS01	Park Brake Switch Element
25	CRP19	Diagnostics Connector
26	CPS94	Instrument Cluster
27	TS82	Buzzer

Table 16. Legend for Side Console Harness Connectors (Continued)

Item	Connector	Description
28	TS83	Buzzer
29	CPS73	SPED
30	CRP142	CAN End Resistor
31	CRP145	Accessory Socket 24V
32	CPS27	Calibration Switch
33	CPS182	Lubrication Display Attachment
34	CRP175	ECO-eLO/HiP
35	CPS181	Lubrication Display Frame
36	CPS26	Service Switch
37	CRP650	Lights Jumper
38	CPS170	PS Feedback Option
39	CRP660	Speed Limiter Jumper
40	CPS33	Side Console - Underfloor
41	CRP34	Diode Calibration
42	CPS39	Lights Diode
43	CRP81	Side Console - Arm Rest
44	CPS37	Fuses 1-10
45	CPS50	Fuses 11-20
46	CPS51	Fuses 21-30
47	CPS109	Fuses 31-40
48	CPS53	Attachment Lights Switch
49	CPS52	Side/Front Lights Switch
50	CPS48	Flood/Rear Drive Lights Switch
51	CPS47	Beacon/Strobe Switch
52	CPS77	Hazard Switch
53	CPS87	Regeneration Enable/Disable Switch
54	CPS25	Diagnostic Switch

CAB UNDERFLOOR HARNESS CONNECTORS



A. CAB UNDERFLOOR **B.** STEERING COLUMN

Figure 18. Cab Underfloor Harness Connectors

Table 17. Legend for Cab Underfloor Harness Connectors

Item	Connector	Description
1	CRP33	Underfloor – Side Console
2	CPS04	Throttle Pedal
3	CPS78	Front Wiper
4	CPS100	Brake Light
5	CPS31	Monotrol Pedal
6	CPS82	Diode Horn
7	TS68	Horn
8	TS69	Horn
9	CPS32	Inching Pedal
10	TS34	Inching Switch
11	TS35	Inching Switch
12	CPS30	Underfloor – Steer Column
13	CRP30	Steer Column – Underfloor
14	CPS29	Shift Lever
15	TS80	Master Warning
16	TS81	Master Warning
17	TS67	Indicator Switch R
18	TS64	Indicator Switch 54
19	TS66	Indicator Switch L
20	CPS83	Horn Button

ARMREST HARNESS CONNECTORS

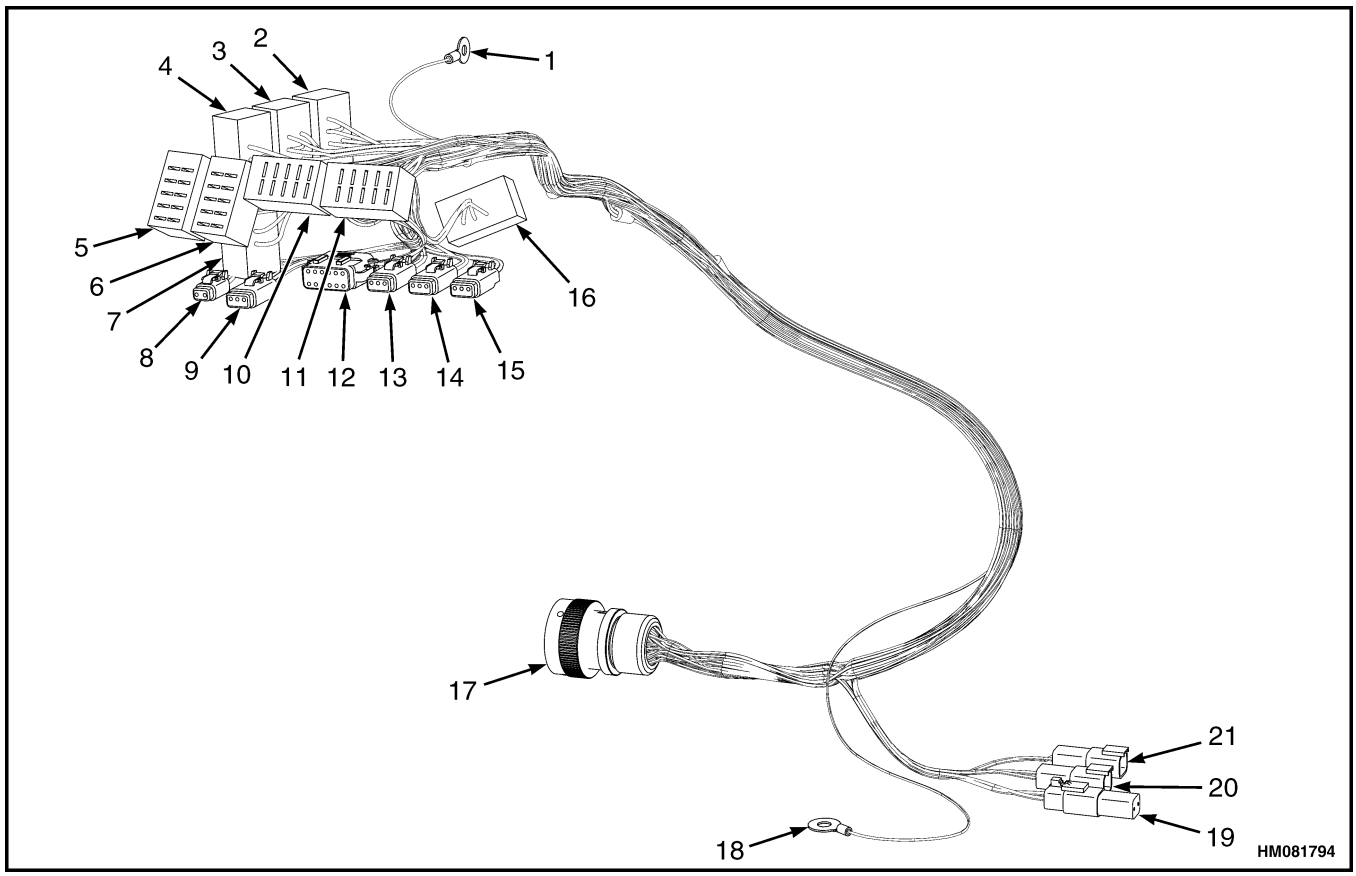


Figure 19. Armrest Harness Connectors

Table 18. Legend for Armrest Harness Connectors

Item	Connector	Description
1	TS102	Armrest Ground
2	CPS91	Rear Wiper/Washer Switch
3	CPS90	Roof Wiper/Washer Switch
4	CPS86	Front Wiper Switch
5	CPS80	Horn Switch Armrest
6	CPS118	Twist Locks
7	CPS89	Front Washer Switch
8	CPS179	Inhibit Auxiliary 1
9	CPS09	Auxiliary 1 Lever
10	CPS137	Auxiliary 2
11	CPS138	Auxiliary 3
12	CPS135	Switches Joystick
13	CPS114	Auxiliary 0 Lever
14	CPS112	Tilt Lever
15	CPS113	Lift Lever
16	CPS119	Hydraulic Stop
17	CPS81	Armrest – Side Console
18	TS103	Armrest Ground
19	CPS144	Suspension Seat
20	CRP440	Seat Switch
21	CRP420	Seat Belt Switch

ECM HARNESS CONNECTORS (TIER 3/ STAGE IIIA)

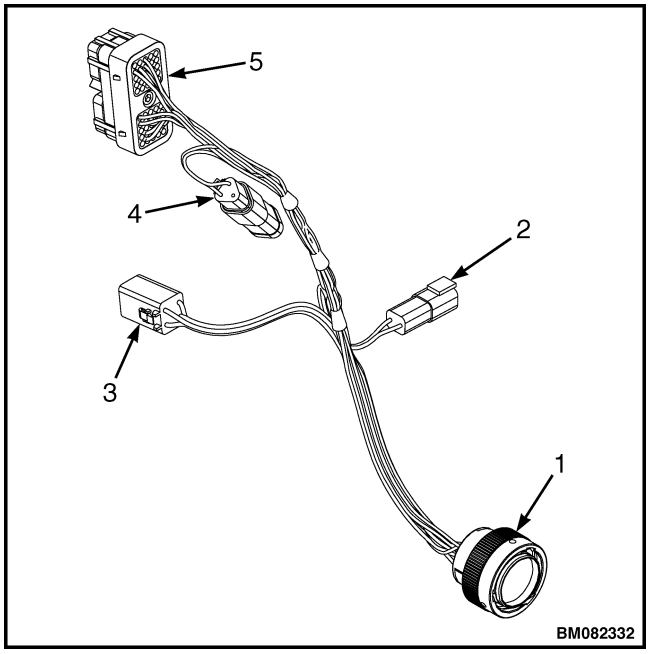


Figure 20. ECM Harness Connectors (Tier 3/Stage IIIA)

Table 19. Legend for ECM Harness Connectors (Tier 3/Stage IIIA)

Item	Connector	Description
1	CPP03	Tier 3 Adaptor
2	CRP88	WIF Sensor
3	CPS05	ECM Power Tier 3
4	CRP58	CAN Termination Resistor
5	CPS02	ECM - Tier 3

EAS/ECM HARNESS CONNECTORS (TIER 4F/STAGE IV)

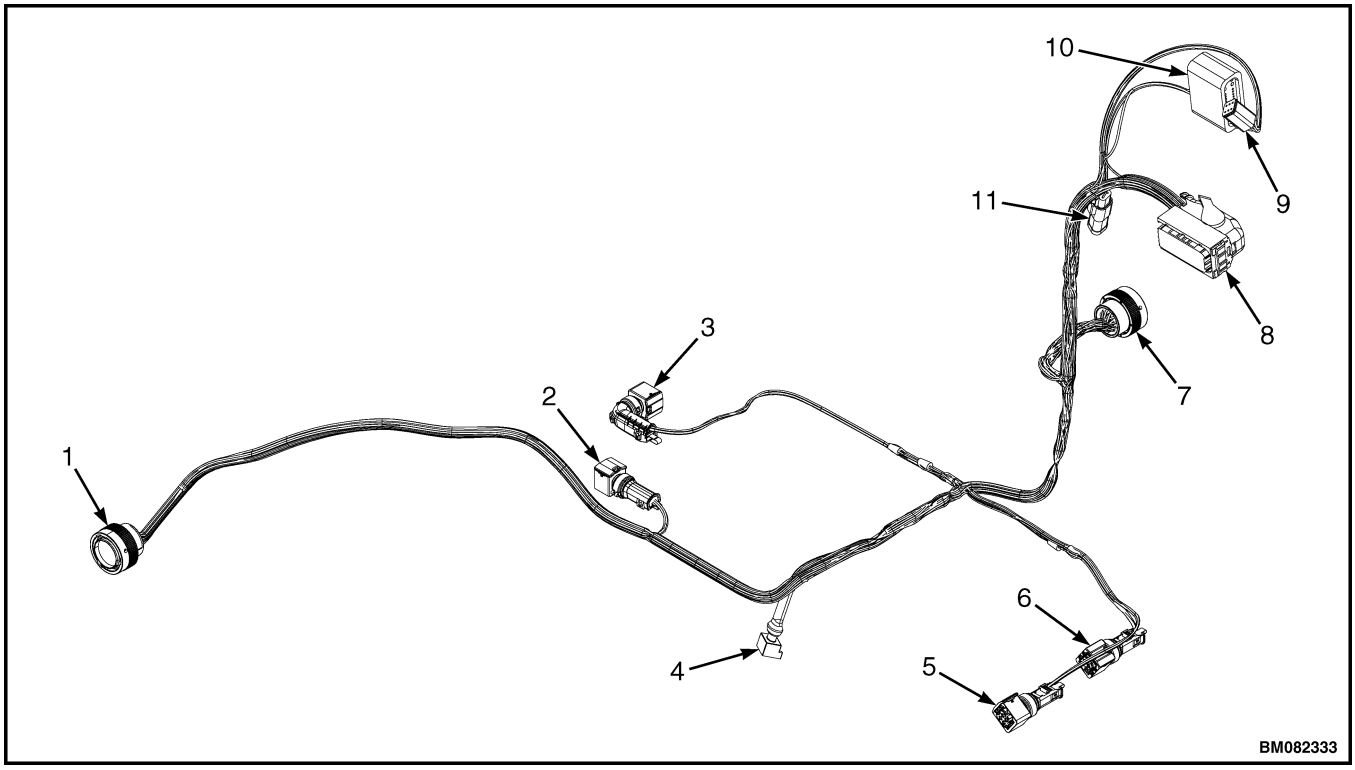


Figure 21. EAS/ECM Harness Connectors (Tier 4F/Stage IV)

Table 20. Legend for EAS/ECM Harness Connectors (Tier 4F/Stage IV)

Item	Connector	Description
1	CPS189	EAS – DEF
2	CPS153	SCR Thermistor Controller
3	CPS159	NOx Sensor SCR
4	CPS164	DEF Dosing Module
5	CPS157	NOx Sensor DOC
6	CPS156	DOC Temp
7	CPP03	Engine ECM Signals
8	CRP03	ECM Tier 4
9	CPS133	Fan Clutch
10	CRP12	ECM Cross Over
11	CPS134	CAN Termination Resistor

DEF TANK HARNESS CONNECTORS

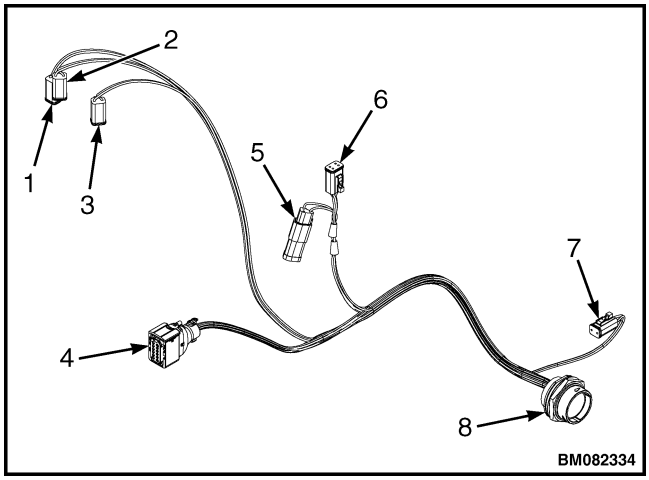


Figure 22. DEF Tank Harness Connectors

Table 21. Legend for DEF Tank Harness Connectors

Item	Connector	Description
1	CPS146	Line Heater 1 (DEF Hose)
2	CPS140	Line Heater 3 (DEF Hose)
3	CPS141	Line Heater 2 (DEF Hose)
4	CPS03	DEF Supply Module
5	CPS158	CAN Termination Resistor
6	CPS154	DEF Sensors
7	CPS163	DEF Tank Heating Valve
8	CRP189	DEF - EAS

POWERTRAIN HARNESS CONNECTORS

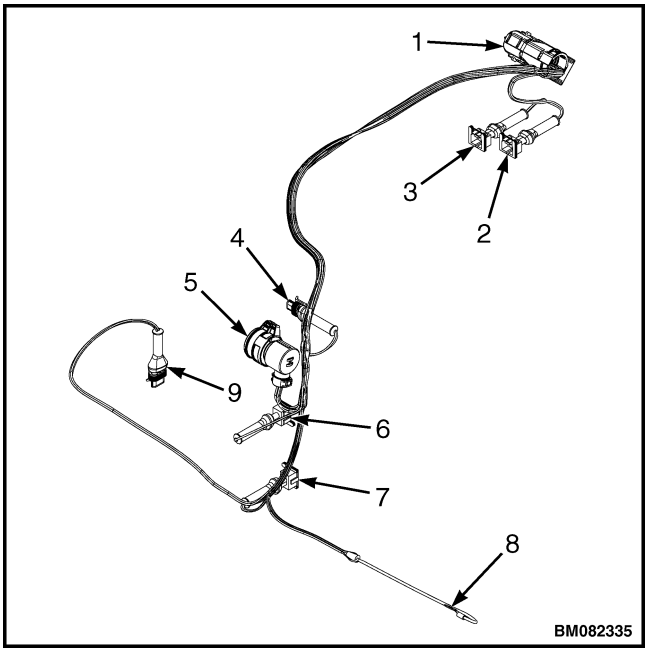


Figure 23. Powertrain Harness Connectors

Table 22. Legend for Powertrain Harness Connectors

Item	Connector	Description
1	CRS02	Powertrain – Frame
2	CPS24	Internal Speed
3	CPS161	Turbine Speed
4	CPS162	XMSN Filter Switch
5	CPS150	XMSN Connector
6	CPS22	Engine Speed
7	CPS12	Convertor Temp
8	TS13	Startermotor Solenoid
9	CPS23	Output Speed

HOODSPINE HARNESS TIER 3/STAGE IIIA CONNECTORS

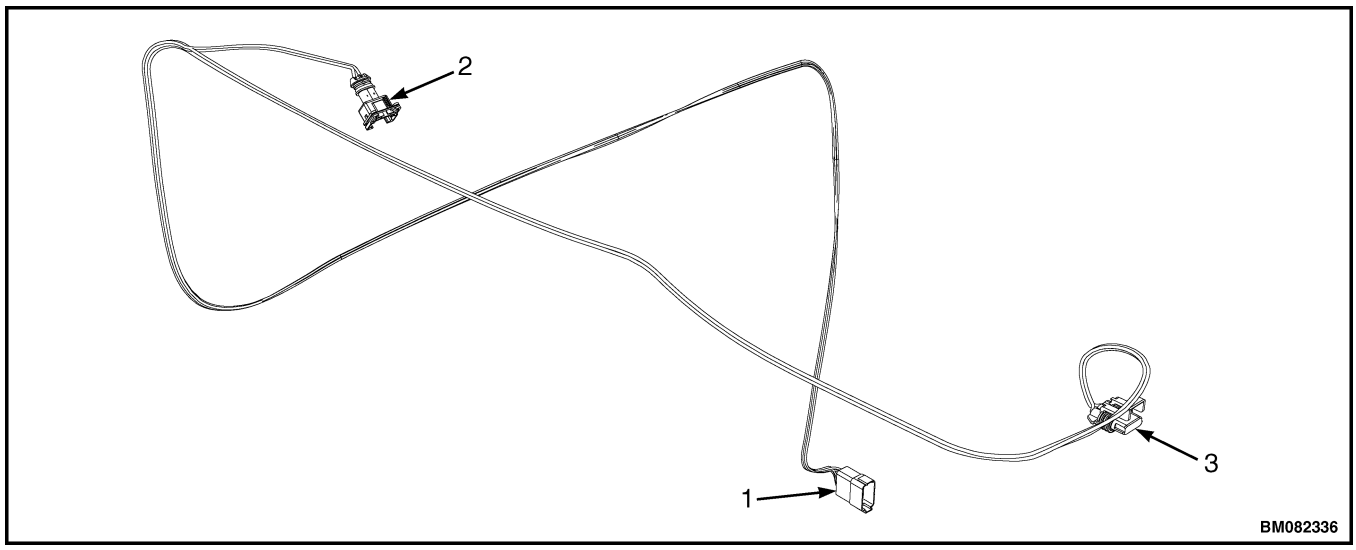


Figure 24. Hoodspine Harness Tier 3/Stage IIIA Connectors

Table 23. Legend for Hoodspine Harness Tier 3/Stage IIIA

Item	Connector	Description
1	CRP127	Hoodspine – Frame
2	CPS97	Air Filter
3	CPS103	Coolant Level

HOODSPINE HARNESS TIER 4F/STAGE IV CONNECTORS

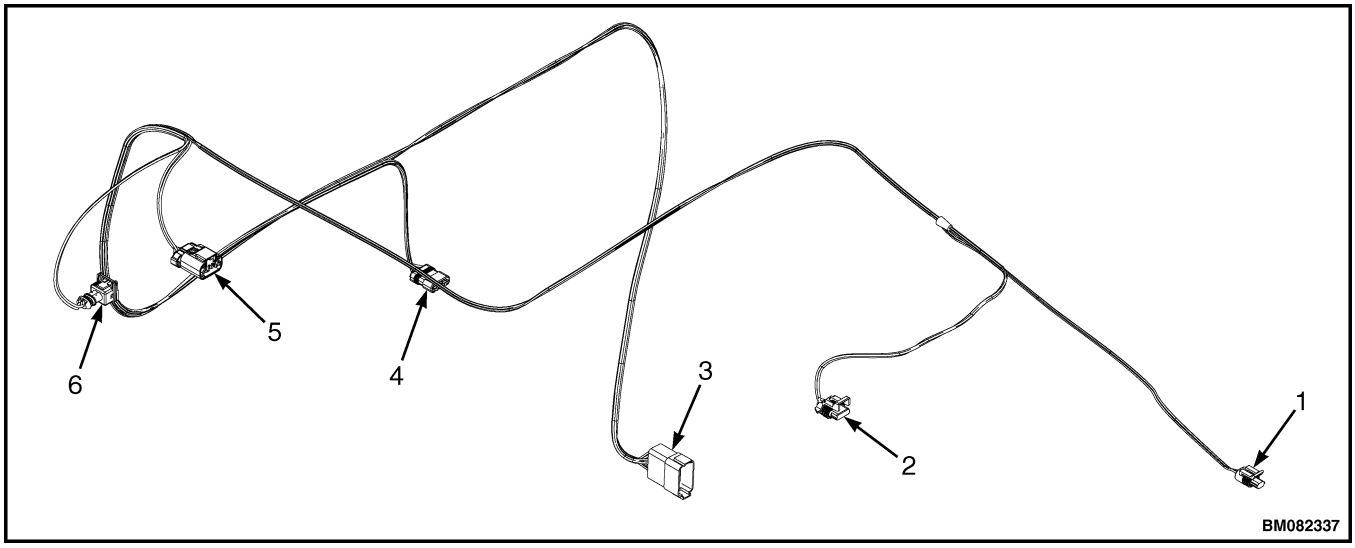


Figure 25. Hoodspine Harness Tier 4F/Stage IV Connectors

Table 24. Legend for Hoodspine Harness Tier 4F/Stage IV

Item	Connector	Connector	Description
	L007	B238/K019	
1	CPS147	CPS147	CAC Temperature
2	CPS103	CPS103	Coolant Level
3	CRP127A	CRP127	Hoodspine – Frame
4	CPS152	--	TBAP Sensor to Engine
5	CPS151	CPS57	TBAP Sensor
6	CPS188	CPS97	Air Filter

NOTES