SERVICE REPAIR

MANUAL

Hyster J019 (H300HD2, H330HD2, H360HD2, H360HD2-EC) Forklift Service Repair Manual

HYSTER

ELECTRICAL SYSTEM

H8.0-12.0XM-6 (H190-280HD$_2$) [K007];

H13.0-14.0XM-6 (H300-330HD$_2$) [J019];

H16.0XM-6 (H360HD$_2$) [J019];

H10.0-12.0XM-12EC (H360HD$_2$-EC) [J019];

H16XM-9, H16XM-12, H18XM-7.5, H18XM-9 (H360-36HD, H360-48HD) [A238]

HYSTER

PART NO. 4059559

2200 SRM 1592

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

This section is for the following models:

H8.0-12.0XM-6 (H190-280HD2) [K007];
H13.0-14.0XM-6 (H300-330HD2) [J019];
H16.0XM-6 (H360HD2) [J019];
H10.0-12.0XM-12EC (H360HD2-EC) [J019];
H16XM-9, H16XM-12, H18XM-7.5, H18XM-9 (H360-36HD, H360-48HD) [A238]

"THE QUALITY KEEPERS"

HYSTER APPROVED PARTS

General

This manual provides general information on the electrical system K007, J019, and A238 lift trucks and 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 would be located in **Transmission** 1300SRM1456.

The actual electrical schematic drawings are located in Diagrams SRM.

Electrical Schematic and System Description

ELECTRICAL SCHEMATIC

The electrical schematic is laid out over several pages/sheets in Diagrams SRM. 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. Table 1 and Table 2 shows the index of the different sheets.

Table 1. Electrical Schematic Index, Tier III

Number	Title	Contents
1	Index	
2	Main Power	Battery, Key Switch
3	Engine	Engine controller and components
4	Transmission	Transmission controller, senders and controls.
5	Cab Lights	Cab roof and interior lights
6	Frame Lights	Front and tail lights, reverse alarm
7	Lights 2	Mast lights, flasher, jumper
8	Twist Module	Twist Module, Override relay, Powered Cab Tilt
9	Monitoring	Instrument cluster, senders, alarms, diagnostics
10	Park Brake	Park brake switch and solenoid, suspension seat
11	Hydraulic Controls	Hydraulic controller, levers, Operator Presence
12	Auxiliary Functions	Auxiliary switches
13	Wipers	Wipers and washers, switches, timer
14	Radio/ Horn	Radio, Horn, DC converter, 12V plug
15	HVAC	Heating, Air Conditioning and Ventilation
16	Front End FLT	Front End Fork Lift Truck
17	Front End CH	Front End Container Handler

Table 2. Electrical Schematic Index, Tier IV

Number	Title	Contents
1	Index	
2	Main Power	Battery, Key Switch
3	Engine	Engine controller and components
4	Engine 2	Fan clutch, Tier IV sensors
5	Transmission	Transmission controller, senders and controls.
6	Cab Lights	Cab roof and interior lights
7	Frame Lights	Front and tail lights, reverse alarm
8	Lights 2	Mast lights, flasher, jumper
9	Twist Module	Twist Module, Override relay, Powered Cab Tilt
10	Monitoring	Instrument cluster, senders, alarms, diagnostics
11	Park Brake	Park brake switch and solenoid, suspension seat
12	Hydraulic Controls	Hydraulic controller, levers, Operator Presence
13	Auxiliary Functions	Auxiliary switches
14	Wipers	Wipers and washers, switches, timer
15	Radio/ Horn	Radio, Horn, DC converter, 12V plug
16	HVAC	Heating, Air Conditioning and Ventilation
17	Front End FLT	Front End Fork Lift Truck
18	Front End CH	Front End Container Handler

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 3.

Table 3. Function ID Numbers

Function Group	Number Range
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 (eg., CAN)	900 - 909
Non-standard functions	910 - 999

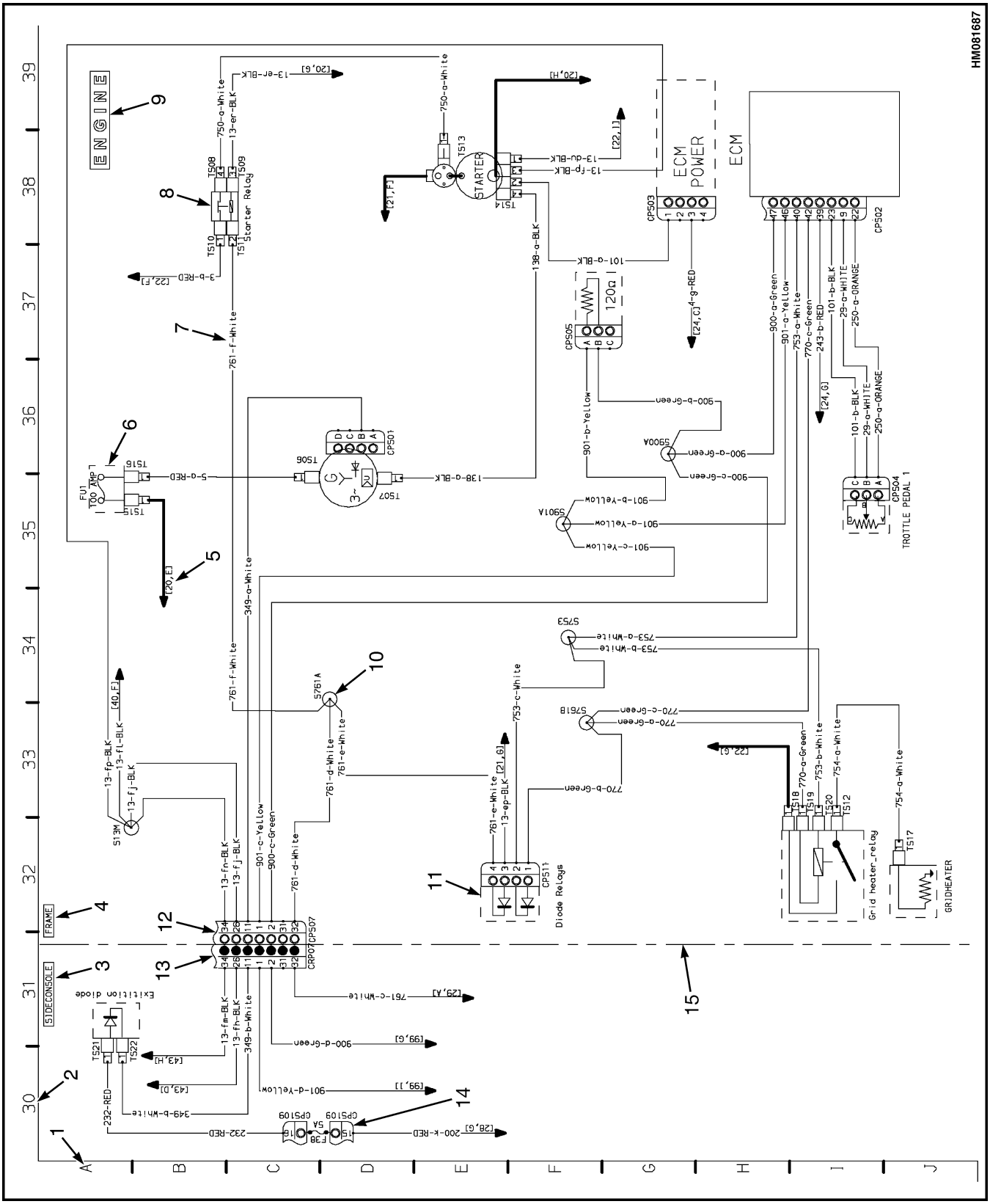


Figure 1. Schematic Example

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

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, then 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 the Diagrams SRM. 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 4.

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.

Table 5 provides an overview of the different harnesses that belong to the different truck options.

Figure 10 through Figure 16 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. See also Wire Harness Identification and Connector Location.

Table 4. Electrical Wire Colors

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

Table 5. Harnesses by Option

<table>
<tr><td colspan="2">Common to Truck</td><td>Side Console, Figure 14A</td><td>Arm Rest, Figure 16</td><td>Cab Underfloor, Figure 15A</td><td>Steering Column, Figure 15B</td></tr>
<tr><td colspan="2">Tier IV</td><td colspan="4">Frame, Figure 10</td></tr>
<tr><td colspan="2">Tier III</td><td colspan="4">Frame, Figure 11</td></tr>
<tr><td rowspan="2">Cab</td><td>Open Cab</td><td colspan="4">Open Cab - Not Shown</td></tr>
<tr><td>Closed Cab</td><td>Closed Cab Figure 13</td><td>Cab Lights Figure 13</td><td>Rear Wiper Extension Figure 14B</td><td>Wash Pumps Figure 14C</td></tr>
<tr><td colspan="2">Mast Work Lights</td><td colspan="2">Mast Lights Figure 12A</td><td colspan="2">Mast Work Lights LH/RH Not Shown</td></tr>
<tr><td colspan="2">Mast Harness Fork Lift Truck</td><td colspan="2">Mast Fork Lift Figure 12B</td><td colspan="2">Front End Figure 12C</td></tr>
<tr><td colspan="2">Mast Harness Container Handler</td><td colspan="4">Mast Container Handler Not Shown</td></tr>
</table>

Not shown in a 3D-view 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.

Connected with the frame harness are:

- Brake temperature harness: Connects to CPS127 and CPS128.
- Powered cab tilt harness: Connects to CPS12.
- Front drive light harness: Connects to CPS60 and CPS61.
- Side & indicator lights harness: Connects to CPS49 and CPS67.
- Rear lights harness: Connects to CPS68 and CPS69.

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

Connected with the mast light harness is the RH mast work light extention, which connects to CPS 147. See Figure 12.

There are three different 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 [88,g]. This harness is to be plugged into connector CPS142, 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 to activate these lights irrespective of the ignition switch position. See schematic location [87,g]. This harness is to be plugged into connector CPS141, 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 [62,j].

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 6.

Table 6. 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. Eg CRP07.

Connectors have the same identification number if they interconnect between two wire harnesses. Eg 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 and alternator have separate fuses that are located in the engine compartment at the left hand frame channel. Close to these fuses the starter relays and the grid heater relays are located. See Figure 2 and Figure 3.

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.

On the inside of this cover a label is fitted that shows the location of the fuses in the four fuse panels. See Figure 4.

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.

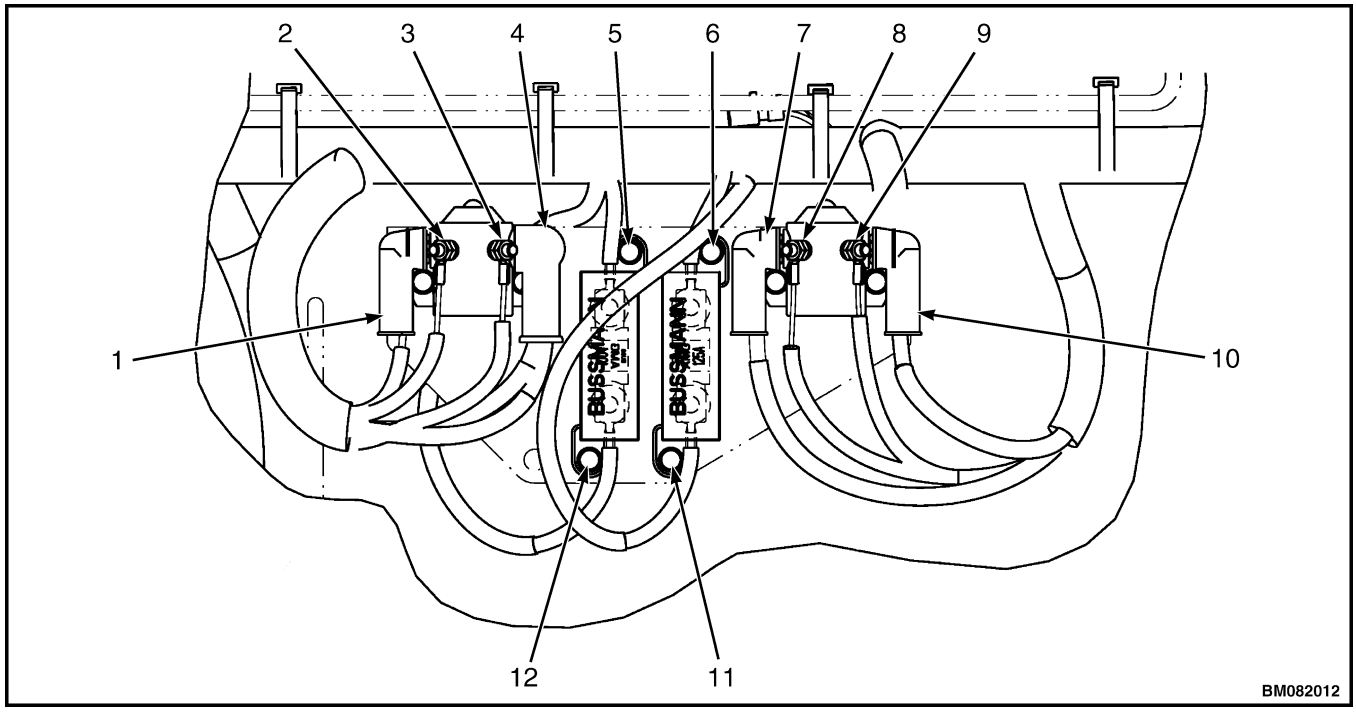


Figure 2. Starter and Grid Heater Relays Tier III

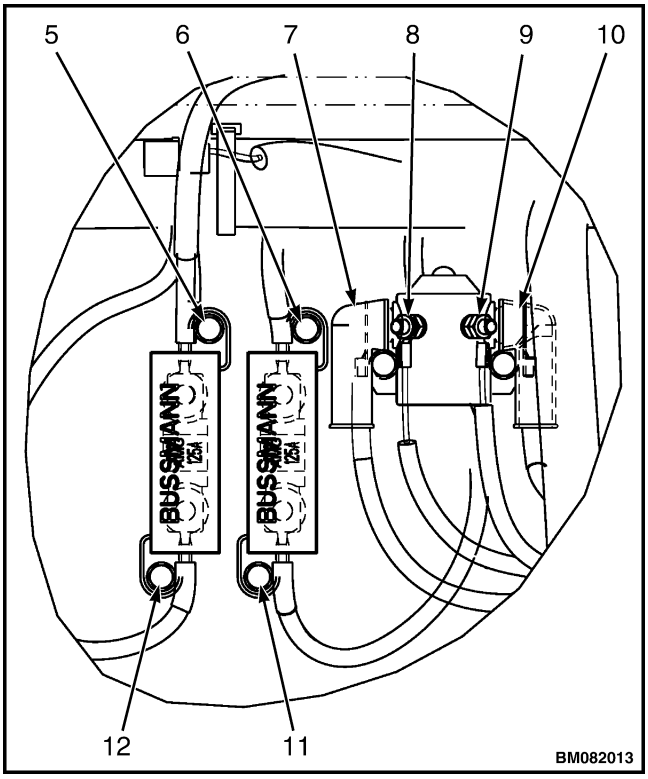


Figure 3. Starter and Grid Heater Relays Tier IV

Table 7. Legend for Starter and Grid Heater Relays

Item	Description	Value	Connector	Tier III Location	Tier IV Location
1	Starter Relay	----	TS08	[39,B]	-
2	Starter Relay	----	TS09	[39,B]	-
3	Starter Relay	----	TS11	[38,B]	-
4	Starter Relay	----	TS10, TS26	[38,B]	-
5	Fuse Alternator	100 A	TS16	[37,A]	-
6	Fuse Grid Heater	125 A	TS32	[33,E]	[32,E]
7	Grid Heater Relay	----	TS12	[33,G]	[32,G]
8	Grid Heater Relay	----	TS20	[33,G]	[32,G]
9	Grid Heater Relay	----	TS19	[33,G]	[32,G]
10	Grid Heater Relay	----	TS18	[33,G]	[32,G]
11	Fuse Grid Heater	125 A	TS95	[33,E]	[32,E]
12	Fuse Alternator	100 A	TS15	[37,A]	[37,B]

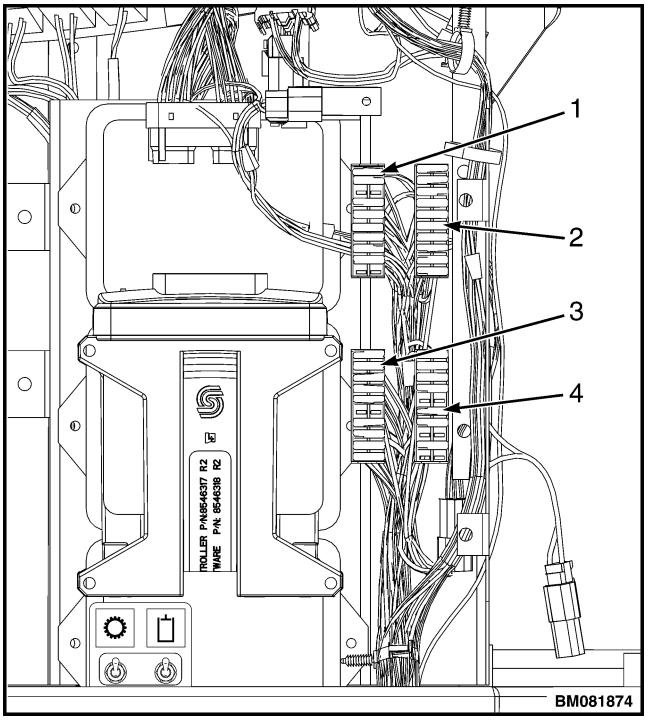


Figure 4. Fuse Panel

FUSE PANEL #1				
Value	**Description**	**Fuse**	**Tier III**	**Tier IV**
10A	ENGINE START TIER III	F1	[26,B]	-
30A	ENGINE START TIER IV	F1	-	[25,B]
5A	ECM IGNITION	F2	[31,H]	[31,H]
30A	ECM SUPPLY	F3	[30,H]	[30,H]
7.5A	ENGINE START	F4	[29,F]	[28,F]
7.5A	XMSN SUPPLY	F5	[43,D]	[52,D]
30A	HYDRAULIC CONTROLLER	F6	[120,E]	[129,E]
15A	ATTACHMENT CONTROLS	F7	[125,A]	[134,A]

FUSE PANEL #1				
Value	**Description**	**Fuse**	**Tier III**	**Tier IV**
5A	PARKING BRAKE SOLENOID	F8	[103,A]	[112,A]
10A	INSTRUMENTATION	F9	[100,B]	[109,B]

FUSE PANEL #2				
Value	**Description**	**Fuse**	**Tier III**	**Tier IV**
5A	OPS SWITCH	F10	[118,E]	[127,E]
30A	FLOOD LIGHTS	F11	[58,J]	[67,J]
5A	STROBE LIGHT B+	F12	[51,I]	[60,I]
10A	BRAKE LIGHTS	F13	[63,H]	[72,H]
10A	FRONT DRIVE LIGHTS	F14	[63,E]	[72,E]
5A	INTERIOR LIGHTING	F15	[51,H]	[60,H]
15A	MAST/ ATTACHMENT LIGHTS	F16	[61,E]	[70,E]
10A	DIRECTION INDICATORS	F17	[77,D]	[86,D]
10A	SIDE/TAIL LIGHTS	F18	[62,E]	[68,I]
10A	REAR DRIVE LIGHTS	F19	[59,I]	[68,H]

FUSE PANEL #3				
Value	**Description**	**Fuse**	**Tier III**	**Tier IV**
10A	REVERSE LIGHT/ALARM AND STROBE	F20	[59,I]	[68,I]
10A	FRONT WIND-SHIELD WASHER/ WIPER	F21	[132,B]	[141,B]
10A	ROOF WIND-SHIELD WASHER/ WIPER	F22	[132,B]	[141,B]
10A	REAR WIND-SHIELD WASHER/ WIPER	F23	[132,C]	[141,C]
10A	HORN	F24	[146,C]	[155,C]
20A	CAB TILT POWER AS-SIST	F25	[85,H]	[94,H]
---	OPEN	F26	--	--
15A	SEAT SUS-PENSION COMPRESSOR	F27	[102,F]	[111,F]
20A	HEATER/AC/ VENTILATION FAN	F28	[152,F]	[161,F]
15A	AC FAN 1	F29	[159,H]	[168,H]

FUSE PANEL #4				
Value	**Description**	**Fuse**	**Tier III**	**Tier IV**
15A	AC FAN 2	F30	[159,G]	[168,G]
10A	POWER SOCKET 12VDC	F31	[148,H]	[157,H]
10A	RADIO/CB/ INTERCOM	F32	[148,G]	[157,G]
10A	CONVERTER FOR ACCES-SORIES	F33	[146,H]	[155,H]
10A	HAZARD LIGHTS	F34	[77,D]	[86,D]
---	OPEN	F35	---	---
3A	12V RELAY,	F36	[148,G]	[157,G]
---	OPEN	F37	---	---
---	OPEN	F38	---	---
15A	POWER SOCKET 24VDC	F39	[148,G]	[157,G]

RELAYS

Except for the grid heater and starter relay, all relays are fitted on the relay panel that is located left of the fuse panel. The relay panel contains 15 smaller relays, plus the main power relay. The 15 smaller relays are identical and can be swapped to check functionality. The relay panel can also contain a flasher unit. See Figure 5.

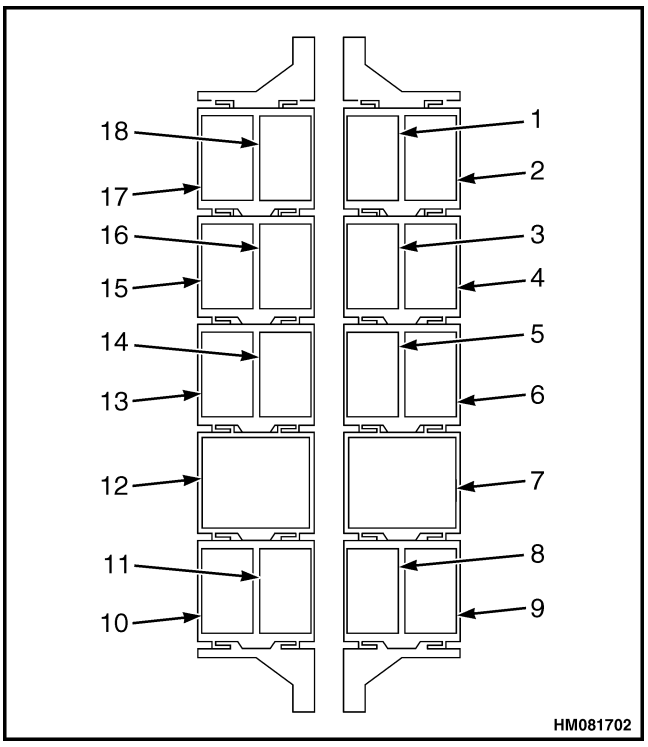


Figure 5. Relay Panel

Table 8. Legend for Figure 5

Item	Description	Connector	Tier III	Tier IV
1	Flood Lights	CPS62	[55,I]	[64,I]
2	Main Lights	CPS62	[56,I]	[64,I]
3	Start Inhibit	CPS13	[29,C]	[29,C]
4	Neutral	CPS13	[29,B]	[29,B]
5	Hydraulic Controller	CPS36	[27,H]	[26,H]
6	Reverse Lights/ Alarm	CPS36	[62,I]	[71,J]
7	Main Power	CPS16	[27,E]	[26,E]
8	AC Fan 3	CPS115	[159,F]	[168,F]
9	Ignition	CPS15	[27,G]	[26,G]
10	AC Fan 2	CPS115	[159,E]	[168,E]
11	AC Fan 1	CPS115	[159,E]	[168,E]
12	Flasher Unit	CPS76	[72,B]	[81,B]
13	Start Enable	CPS120	---	[30,E]
14	Twist Lock/ Unlock	CPS120	[125,E]	[134,E]
15	12 Volt Relay	CPS108	[145,F]	[154,F]
16	CH Override	CPS108	[87,B]	[96,B]
17	Horn	CPS84	[147,C]	[155,C]
18	Seat Switch	CPS84	[116,I]	[125,I]

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 9 provides a complete listing of all flyback diodes fitted.

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 it's own connection to voltage supply, to feed the controller and also 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 (eg 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 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:

Transmission controller

Hydraulic controller

Instrument cluster

Diagnostic connector*

Engine Control Module

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

Table 9. Flyback Diodes

Connector	Diode Description	Tier III Location	Tier IV Location	Figure	Item
CPS11	Relays	[33,F]	[32,F]	Figure 10 and Figure 11	59
CPS17	Main Power	[25,A], [28,D]	[24,A], [27,D]	Figure 14 **A**	63
CPS34	Calibration	[43,C]	[52,C]	Figure 14	78
CPS39	Lights	[104,C], [56,I]	[113,C], [65,I]	Figure 14	79
CPS54	Backup	[66,F]	[75,F]	Figure 10 and Figure 11	67
CPS82	Horn	[144,D]	[153,D]	Figure 15	97
CPS123	Cab Tilt Pump	[89,F]	[98,F]	----	----

Diagnostic

Interconnection between the controllers is schematically shown in Figure 6. The controllers are connected through data inverse wire number 900 (green) and data wire number 901 (yellow) that are twisted together. The purpose of twisting is to reduce sensitivity to electromagnetic interference. For the same purpose there are termination resistors at the extreme ends of the string of controllers. The system will not function if both 120 Ohm resistors are faulty or disconnected.

The ZF transmission controller has an end resistor included in the controller unit.

The sensors that relate to the different controllers are primarily shown on sheet 9 of the electrical schematic. Sensors for the transmission are shown on sheet 4.

The optional electronic climate control has an independent control system that does not communicate through can bus wires 900 and 901.

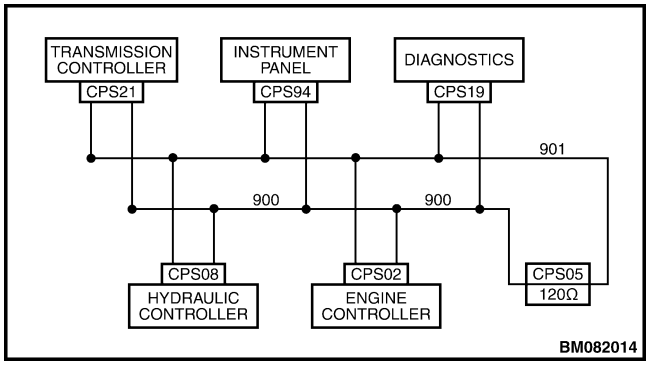


Figure 6. CAN Bus Circuit

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 fault codes. 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.

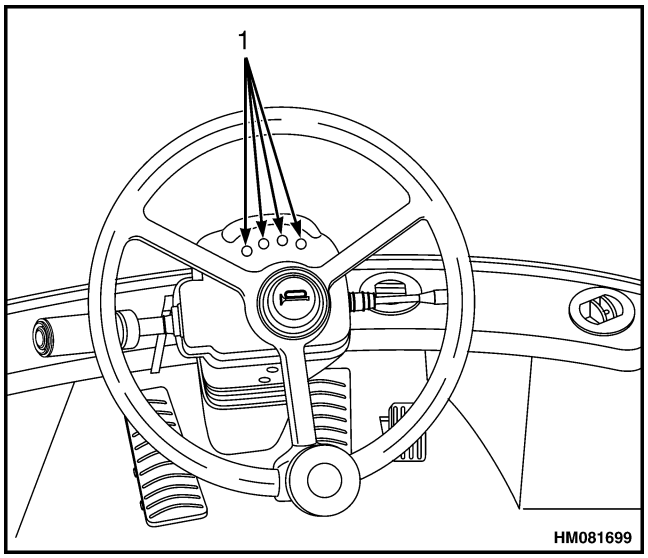
The can bus connection itself can be verified by checking continuity of the data inverse wires 900 (green) and the data wires 901 (yellow), and by checking the 120 Ohm resistance value of the termination resistor. For schematic and actual location see Table 11.

Diagnostics of a faulty CAN bus systems 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 and Figure 8 are controlled by CAN bus signals. The legend also shows the related pin numbers of 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. CENTRAL WARNING LIGHT

Figure 7. Instrument Panel

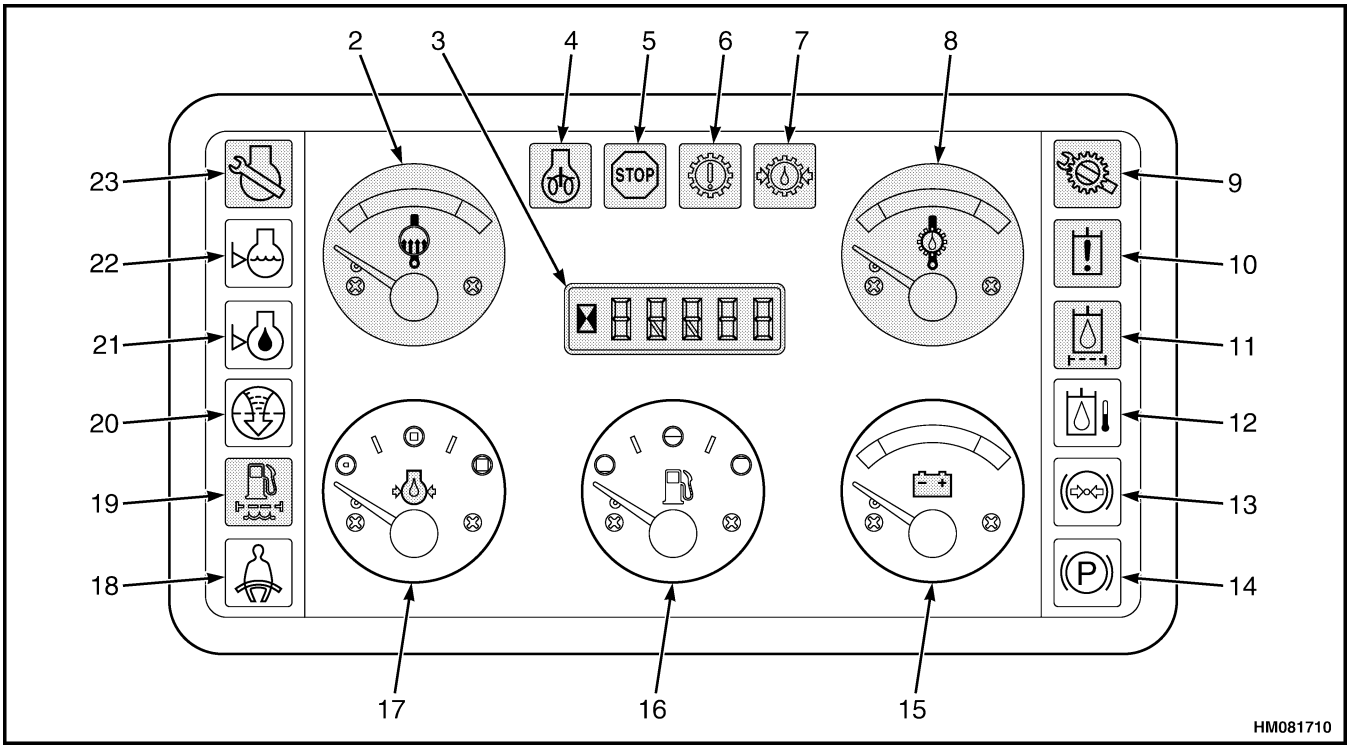


Figure 8. Tier III Instrument Panel

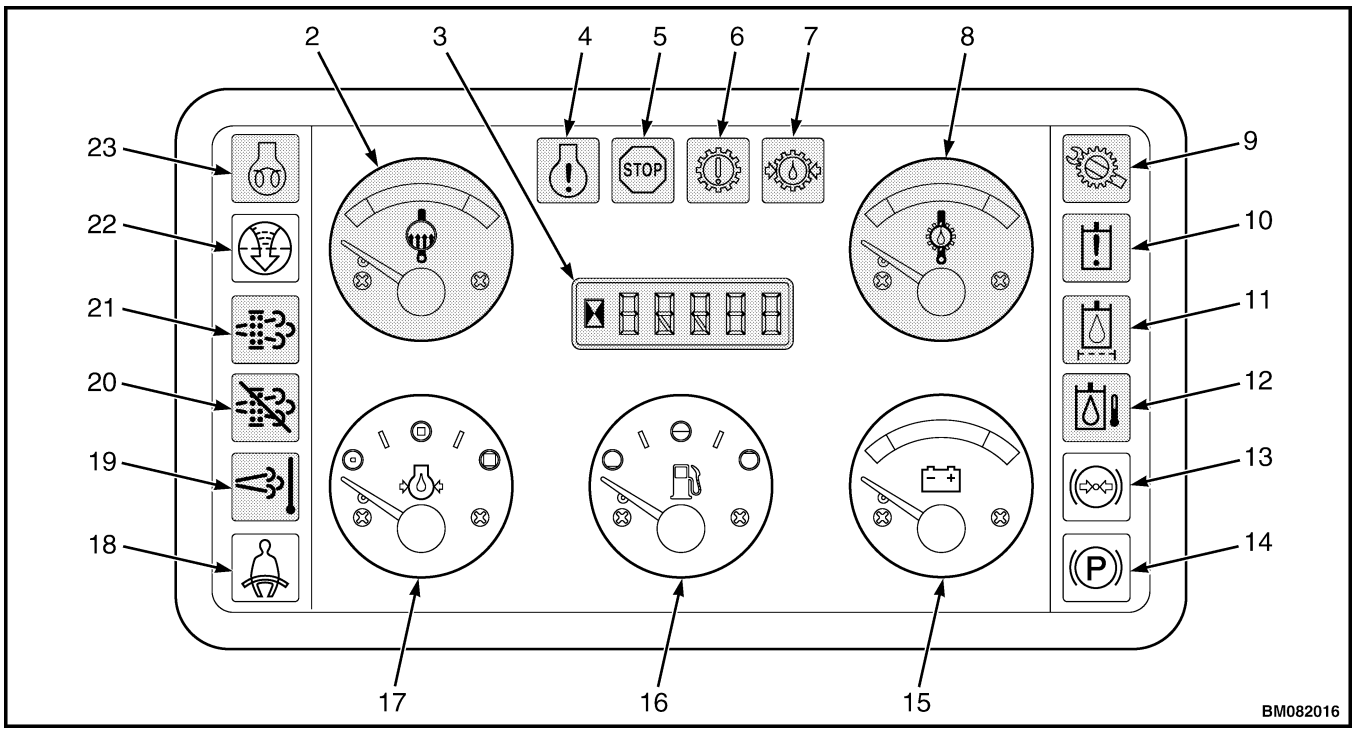


Figure 9. Tier IV Instrument Panel

Table 10. Legend for Figure 7, Figure 8 and Figure 9

Item	Description	Tier III Pin Number	Tier IV Pin Number
1	Central Warning Lights	CAN	CAN
2	Coolant Temperature Gauge. See **NOTE 2**.	CAN	CAN
3	Hour Meter/Fault Code Display	CAN	CAN
4	Engine Warning Light/Wait To Start	CAN	N/A
4	Engine Warning Light	----	CAN
5	Engine Stop Warning Light	CAN	CAN
6	Transmission Warning Light	CAN	CAN
7	Transmission Pressure Warning Light	CAN	CAN
8	Transmission Oil Temperature Gauge. See **NOTE 2**.	CAN	CAN
9	Transmission Calibration Warning Light.	CAN	CAN
10	Hydraulic System Malfunction Warning Light	CAN	CAN
11	Hydraulic Oil Filter Restriction Warning Light	CAN	CAN
12	Hydraulic Oil High Temperature Warning Light	6	6
13	Brake System Low Pressure Warning Light	13	13
14	Parking Brake Warning Light	7	7
15	Voltmeter Gauge. See **NOTE 2**.	1	1
16	Fuel Level Gauge	24	24
17	Engine Oil Pressure Gauge. See **NOTE 2**.	23	23
18	Seat Belt Warning Light	2	2
19	Fuel Filter/Water Separator Warning Light	CAN	N/A
19	Exhaust High Temperature Warning Light	N/A	CAN
20	Engine Air Filter Warning Light	9	N/A
20	Regeneration Inhibited Warning Light	N/A	CAN
21	Engine Oil Level Warning Light. See **NOTE 1**.	8	N/A
21	Regeneration Required Warning Light.	N/A	CAN
22	Coolant Level Warning Light	5	N/A
22	Engine Air Filter Warning Light	N/A	20
23	Engine Maintenance Warning Light	CAN	N/A
23	Wait to Start Warning Light	N/A	CAN

NOTE 1: To obtain functionality provide both the sensor and wiring.

NOTE 2: The icon in the gauge will flash after receiving a CAN signal.

CAN: Connection with CAN signals is through pin 14 and 15.

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 SRM.
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, burnt smells.

Define the Problem Area

1. Determine the schematic location of the failed function. See Table 11.
2. Establish which sections of the failed function operate correctly. Identify these sections on the schematic.

Identify Possible Causes of Malfunction

1. 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 Table 11 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 electric diagram.

Check for damaged wire insulation especially 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 10 through Figure 16 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.

NOTE: Figure 10 and Figure 11 share the same legend itemized from 1 to 69.

NOTE: Figure 13 through Figure 16 share the same legend itemized 1 to 119

Table 11. Connector Overview

Code	Description	Tier IV Location	Tier III Location	Figure	Harness Name
CPS01	ZF DIAG (ZF WG161)	[55,H]	[46,H]	Figure 14	Side Console
CPS02	Engine ECM Signals	[38J], [40,F]	[39,I]	Figure 10 and Figure 11	Frame
CPS03	Engine ECM Power	---	[39,J]	Figure 10 and Figure 11	Frame
CPS04	Throttle Pedal	[36,I]	[37,I]	Figure 10 and Figure 11	Frame
CPS05	CAN Termination Resistor	[36,F]	[37,F]	Figure 10 and Figure 11	Frame
CPS06	Cab Power	[24,F], [32,D]	[25,F], [33,J]	Figure 10 and Figure 11	Frame
CPS07	Cab Signals	[115,D], [122,F]	[106,D], [113,F]	Figure 10 and Figure 11	Frame
CPS08	Hydraulic Controller	[115,B]	[124,B]	Figure 14	Side Console
CPS09	Aux 1 lever	[129,J]	[120,J]	Figure 16	Armrest
CPS10	Hydraulic Temperature	[100,G]	[91,G]	Figure 10 and Figure 11	Frame
CPS100	Brake light	[73,I]	[64,I]	Figure 10 and Figure 11	Frame
CPS101	Aux Solenoid	[121,J]	[112,J]	Figure 10 and Figure 11	Frame
CPS102	Tilt Solenoid	[122,J]	[113,J]	Figure 10 and Figure 11	Frame
CPS103	Lift Solenoid 1	[122,J]	[113,J]	Figure 10 and Figure 11	Frame
CPS104	Lift Solenoid 2	[123,J]	[114,J]	Figure 10 and Figure 11	Frame
CPS105	Sideconsole - Twist Module	[92,D]	[83,D]	Figure 14	Side Console

Table 11. Connector Overview (Continued)

Code	Description	Tier IV Location	Tier III Location	Figure	Harness Name
CPS106	TWIST Module	[91,E]	[82,E]	Not shown	Twist Module
CPS107	DC/DC Convertor	[157,I]	[148,I]	Figure 14	Side Console
CPS108	Override	[154,F]	[145,F]	Figure 5	Side Console
CPS108	12V Relay	[96,B]	[87,B]	Figure 5	Side Console
CPS109	Fuses 31-40	[155,H], [155, I]	[146,H], [146,I]	Figure 14	Side Console
CPS11	Diode Relays	[32,F]	[33,F]	Figure 10 and Figure 11	Frame
CPS110	Radio Power	[151,H]	[142,H]	Figure 13	Closed Cab
CPS111	Radio Sound	[151,I]	[142,I]	Figure 13	Closed Cab
CPS112	Tilt Lever	[127,J]	[118,J]	Figure 16	Armrest
CPS113	Lift Lever	[127,J]	[118,J]	Figure 16	Armrest
CPS114	Aux 0 lever	[128,J]	[119,J]	Figure 16	Armrest
CPS115	Relay AC Fan 1 and 2	[168,F]	[159,F]	Figure 5	Side Console
CPS116	HVAC Unit	[162,F]	[153,F]	Figure 14	Side Console
CPS117	Side console - AC	[162,C]	[153,C]	Figure 14	Side Console
CPS118	Twist locks	[130,G], [132,G]	[122,G], [123,G]	Figure 16	Armrest
CPS119	Hydraulic Stop	[131,I]	[122,I], [123,I]	Figure 16	Armrest
CPS12	Frame - Cab Tilt	[95,F]	[86,F]	Figure 10 and Figure 11	Frame
CPS120	Relay TwistLocks	[134,E], [31,F]	[125,E]	Figure 5	Side Console
CPS121	Cab Tilt Pump	[97,H]	[88,H]	Not shown	Powered Cab Tilt
CPS122	Cab Tilt Switch	[96,G]	[87,G]	Not shown	Powered Cab Tilt
CPS123	Diode Cab Tilt Pump	[98,F]	[89,F]	Not shown	Powered Cab Tilt
CPS124	Frame - Mast Lights	[84,H]	[75,H]	Figure 10 and Figure 11	Frame
CPS125	Engine-Fuel Filter	---	[38,G]	Figure 10 and Figure 11	Frame
CPS126	Hoist Pressure	[124,J]	[115,J]	Figure 10 and Figure 11	Hydraulics
CPS127	Frame-Brake Temperature (ZF WG161)	[102,A]	[93,A]	Figure 11	Frame
CPS128	Frame-Brake Temperature (ZF WG161)	[102,B]	[93,B]	Figure 11	
CPS129	TBAB SENSOR	[41,H]		Not Shown	Frame
CPS13	Neutral & Startinhibit Relay	[28,C]	[29,C]	Figure 5	Side Console