CATERPILLAR®

SENR6716-02
August 1997

Schematic

938F Wheel Loader
IT38F Integrated Toolcarrier
Electrical System

938F: IT38F:
1KM1-UP 5DR1-UP
2RM1-UP 8FN1-UP
8SM1-UP
7SN1-UP

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Connector Location

Connector Number	Schematic Location	Machine Location
CONN 1	A-15	4
CONN 2 Diagnostic Conn	B-15	8
CONN 3	D-15	52
CONN 4	D-15	50
CONN 4A	E-15	50
CONN 5	D-15	49
CONN 5A	H-13	49
CONN 6	E-15	51
CONN 6A	F-15	51
CONN 7	A-13	52
CONN 8	E-15	23
CONN 9	A-12	21
CONN 9A	B-13	21
CONN 10	A-11	53
CONN 11	A-11	53
CONN 12	B-11	54
CONN 13	B-11	54
CONN 14	B-10	54
CONN 15 Options Code Plug	F-12	52
CONN 16 Std Harness Code Plug	G-11	53
CONN 16A Service Code Plug For Bleeding Brake Oil	G-11	53
CONN 17 Diagnostic Conn	H-11	53
CONN 18	I-12	56
CONN 19	I-12	56
CONN 20	C-10	C
CONN 21	D-10	C
CONN 22	D-10	C
CONN 23	F-10	C
CONN 23A	F-11	C
CONN 24	F-11	C
CONN 25	B-8	C
CONN 26	B-7	54
CONN 27	D-8	C
CONN 28	B-7	33
CONN 29	B-7	48
CONN 30	D-7	C
CONN 31	D-7	C
CONN 32	D-7	C
CONN 33	D-7	C
CONN 34	D-6	56
CONN 35	D-6	A
CONN 36 Harness Code Plug	F-6	A
CONN 37 Service Mode Plug	F-5	A
CONN 38	B-5	54
CONN 39	A-2	55
CONN 39A	I-6	55
CONN 39B	I-3	55
CONN 40	A-3	57
CONN 40A	H-6	57
CONN 40B	H-3	57
CONN 41	A-3	57
CONN 41A	D-6	57
CONN 41B	D-3	57
CONN 42	A-3	57
CONN 42A	H-6	57
CONN 42B	H-3	57
CONN 43	C-3	15
CONN 44 Customer Data Conn	D-3	52
CONN 45 ECAP Service Conn	D-3	52
CONN 46	E-3	A
CONN 47	E-3	A
CONN 48	B-2	55
CONN 49	C-2	59
CONN 49A	H-5	59
CONN 49B	H-2	59
CONN 49C	E-2	59
CONN 50	C-2	58
CONN 50A	I-5	58
CONN 50B	I-2	58
CONN 50C	E-2	58
CONN 51	C-2	45
CONN 52	D-2	C
CONN 52A	D-2	C
CONN 53	F-1	A
CONN 54	F-1	A
CONN 55	G-14	60
CONN 56	H-14	61
CONN 57	H-14	61
CONN 58	H-14	63
CONN 58A	H-15	63
CONN 59	H-14	62
CONN 60	H-14	62
CONN 61	I-4	58
CONN 62	H-2	31
CONN 63	C-4	C

The connectors shown in this chart are for harness to harness connectors. Connectors that join a harness to a component are generally located at or near the component. See the Component Location Chart.

Related Electrical Service Manuals

Title	Form Number
Alternator 9W-3043	SENR3685
Caterpillar Monitoring System	SENR6717
Payload Monitor	SENR4733
Starting And Charging Systems	SENR2947
Starting Motor: 9X-9995	
Consist: 3E-2298	SENR3581
8C-4773	SENR3859
10E-8558	SENR3559
Traction Control System	SENR5956
Transmission Control	SENR5989

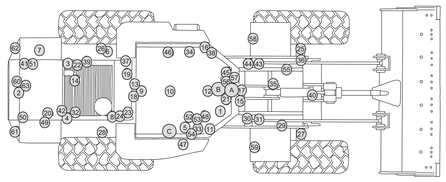
Monitoring System Modes

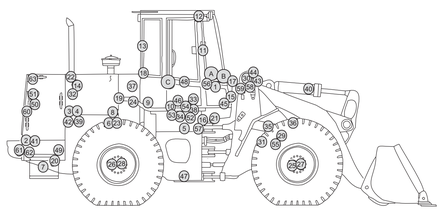
Mode Of Operation	Mode Number
Normal	0
Harness Code	1
Numeric Readout	2
Service	3
Tattletale (Log)	4
Units	5
Setup	6
Calibration	7

Component Location

Component	Schematic Location	Machine Location
Alarm - Action	E-5	1
Alarm - Backup	D-15	2
Alternator	E-13	3
Arc Suppressor (A/C)	A-15	4
Arc Suppressor -(Secondary Steering)	A-14	5
Aux Start Recptacle	F-14	6
Battery	F-15	7
Breaker - Alternator (80A)	C-15	8
Breaker - Blower Motors (15A)	C-11	C
Breaker - Main (80A)	C-15	8
Breaker - Running Lamp (15A)	C-15	8
Breaker - Seat (Air Compressor/Heater) (15A)	C-11	C
Caterpillar Monitoring System	E-5	A
Control - CST Autoshift	E-12	9
Control - Secondary Steering	A-14	5
Control - Traction Control System	H-12	10
Control - WLPCSII	E-3	11
Converter	F-7	12
Defroster - (Rear) (COSA Only)	F-11	13
Dimmer	E-4	C
Flasher	E-6	A
Fuses	C-11	C
Fuses	C-15	C
Gauge (Quad)	F-4	A
Horn - Forward	B-1	43
Intake Air Heater	F-13	14
Keypad - (WLPCS)	C-3	11
Lamp - Action	D-4	B
Lamp - Auto Ride Control	F-4	B
Lamp - Automatic Transmission Mode	D-4	B
Lamp - Defroster (Rear Window)(COSA Only)	E-11	B
Lamp - Flood Indicator	D-4	B
Lamp-Hazard Flasher	F-4	B
Lamp - Hi/Low/Position/Turn (Left Hand) (COSA Only)	E-1	B
Lamp - Hi/Low/Position/Turn (Right Hand) (COSA Only)	E-1	B
Lamp - Neutra11zer Override	D-4	B
Lamp - Ride Control	F-4	B
Lamp - Turn Indicator (Left)	F-4	B
Lamp - Turn Indicator (Left)	F-4	B
Lamp - Turn Indicator (Right)	D-4	B
Motor - (Secondary Steering)	A-14	5
Motor - Blower (2)	C-3	15
Motor - Washer (Front)	B-13	16
Motor - Washer (Rear)	B-13	16
Motor - Wiper (Front)	B-3	17
Motor - Wiper (Rear)	F-10	18
Relay - Bosch Motor (Secondary Steering)	A-14	5
Relay - Start	C-15	8
Resistor - (Blower Motor)	C-3	15
Resistor - (Intake Air Heater)	F-13	14
Resistor - (Main Relay)	C-14	8
Resistor - (Starter)	F-14	19
Sender - Fuel Level	D-14	20
Sensor - Articulation Mgle Position	I-10	21
Sensor - Coolant Temp	E-14	22
Sensor - Engine Speed	C-13	23
Sensor - Hydraulic Temp	B-14	24
Sensor - Torque Converter Oil Temp	C-13	34
Sensor - Transmission Speed	C-13	34
Sensor - Wheel Speed (Left Front)	A-2	25
Sensor - Wheel Speed (Left Rear)	I-11	26
Sensor - Wheel Speed (Right Front)	A-2	27
Sensor - Wheel Speed (Right Rear)	I-11	28
Sensor - WLPMS Lift Cylinder Pressure	A-2	29
Sensor - WLPMS Lift Position	A-2	30
Solenoid - 4th Function Diverter Valves (1T38F Only)	H-1	31
Solenoid - (Pilot Valve Up) Bucket/ForkDetent	B-6	C
Solenoid - (Pilot Valve Up) Float Detent	B-5	C
Solenoid - (Pilot Valve Up) 11ft Detent	B-6	C
Solenoid - A/C Clutch	A-15	4
Solenoid - Engine Shutdown	B-15	32
Solenoid - ON/OFF Pilot	I-11	33
Solenoid - Proportional (Left Front)	I-11	38
Solenoid - Proportional (Left Rear)	H-11	38
Solenoid - Proportional (Right Front)	I-11	38
Solenoid - Proportional (Right Rear)	H-11	38
Solenoid - Ride Control (2)	B-1	35,36
Solenoid - Start Aid	E-14	37
Solenoid - Transmission (6)	C-12	34
Starter	F-14	39
Switch - 4th Function Diverter (1T38F Only)	F-10	C
Switch - A/C Hi/Low Pressure	A-15	4
Switch - Auto Ride Control	E-7	C
Switch - Beacon	D-10	C
Switch - Blower	D-5	A
Switch - Brake Oil Pressure	C-13	38
Switch - Bucket Positioner	B-1	40
Switch - Bucket/Fork Positioner (1T38F Only)	F-10	C
Switch - Defroster (Rear Window)(COSA Only)	E-11	C
Switch - Detent Lockout	B-7	C
Switch - Dimmer (COSA Only)	D-2	C
Switch - Disconnect	F-14	41
Switch - Engine Oil	A-15	42
Switch - Flood Lamp	E-11	C
Switch - Forward Horn	C-6	B
Switch - Intake Air Heater	E-8	C
Switch - Key Start	E-9	C
Switch - Kickout Neutra11zer (1T38F Only)	F-10	C
Switch - Lift Positioner	A-1	44
Switch - Neutra11zer	C-1	45
Switch - Parking Brake	E-12	46
Switch - Primary Steer Pressure	A-14	47
Switch - Primary Steering (Alt)	B-13	47
Switch - Running Lamp	E-10	C
Switch - Secondary Steer Manual	D-8	C
Switch - Secondary Steer Pressure	A-14	5
Switch - Secondary Steering (AU)	B-13	5
Switch - Start Aid	D-8	C
Switch - Start Aid Coolant	E-14	22
Switch-Stop Lamp	C-1	45
Switch - Tach/Speedo/Serv Meter Select	F-8	C
Switch - Test/Enable	F-8	C
Switch - Thermostat (Blower Motor)	C-3	15
Switch - Transmission Auto/Manual	D-11	C
Switch - Transmission Downshift	B-6	48
Switch - Transmission Neutralizer Override	E-7	C
Switch - Turn Signal	D-6	B
Switch - Wiper (Front Intermittant)	E-8	C
Switch - Wiper (Rear)	E-8	C
Tachometer/Speedometer	E-4	A
TCS Display Module	B-3	C
Transmission Shifter	F-3	B

Machine locations are repeated for components located close together.
A = Operator Compartment - Dash Console
B = Operator Compartment - Steering Column
C = Operator Compartment - Right Console





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Machine Harness Connector and Component Locations

Component Identifiers (CID[1]) Module Identifier (MID[2])

CID	Component
Caterpillar Monitoring System MID 30	
096	Fuel Level Sensor
110	Engine Coolant Temp Sensor
177	Torque Converter Oil Temp Sensor
248	CAT Data Link
263	8 Volt Sensor Power Supply
271	Action Alarm
324	Action Lamp
600	Hydraulic Oil Temp Sensor
819	Display Data Link
821	9 Volt Display Power Supply
Autoshift Transmission Control MID 81	
168	Electrical System Voltage
190	Engine RPM Sensor
191	Transmission Speed Sensor
248	CAT Data Link
362	Ride Control Solenoid
368	Auto/Manual Switch
617	Air Inlet Heater Relay
621	Downshift Switch
641	Solenoid 1 (Forward High)
642	Solenoid 2 (Reverse)
643	Solenoid 3 (Forward Low)
644	Solenoid 4 (Speed 1)
645	Solenoid 4 (Speed 2)
646	Solenoid 6 (Speed 3)
650	Harness Code
660 thru 668	Shift Handle
680	Ride Control Switch
687	Options Identification Code
Traction Control System MID 28	
168	Electrical System Voltage
248	CAT Data Link
263	10 Volt Power Supply
270	Harness Code
605	Left Front Speed Sensor
606	Right Front Speed Sensor
607	Left Rear Speed Sensor
608	Right Rear Speed Sensor
609	Left Front Brake Solenoid
610	Right Front Brake Solenoid
611	Left Rear Brake Solenoid
612	Right Rear Brake Solenoid
613	ON/OFF Solenoid
615	Articulation Angle Sensor
616	Test/Enable Switch
653	TCS (ECM) Control
687	TCS Options Code Plug

[1] The CID is a diagnostic code that indicates which component is faulty.
[2] The MID is a diagnostic code that indicates which electronic control module diagnosed the fault.

Failure Mode Identifiers (FMI)[1]

FMI No.	Failure Description
0	Data valid but above normal operational range.
1	Data valid but below normal operational range.
2	Data erratic, intermittent, or incorrect.
3	Voltage above normal or shorted high.
4	Voltage below normal or shorted low.
5	Current below normal or open circuit.
6	Current above normal or grounded circuit.
7	Mechanical system not responding properly.
8	Abnormal frequency, pulse width, or period.
9	Abnormal update.
10	Abnormal rate of change.
11	Failure mode not identifiable.
12	Bad device or component.
13	Out of calibration.

[1]The FMI is a diagnostic code that indicates what type of failure has occurred.

Off Machine Switch Specification

Part No.	Function	Actuate	Deactuate	Contact Position
3E-6429	Supplemental Steering Oil Flow	1.5 ± 0.3 L/min (.4 ± .1 gpm)	1.0 ± 0.3 L/min (.25 ± .1 gpm)	Normally Open
3E-6449	Start Aid Coolant	38 ± 5°C (100 ± 5°F)	49 ± 5°C MIN (120 ± 9°F)	Normally Closed
3E-6450	Primary Steering Pressure	2200 kPa MAX (319 psi MAX)	700 ± 100 kPa (100 ± 15 psi)	A-Ct Normally Closed A-B, Normally Open
3E-6455	Engine Oil Pressure (EMS)	83 ± 21 kPa (12 ± 3 psi)	70 ± 21 kPa (10 ± 3.0 psi)	A-B, Normally Open A-C, Normally Closed
3E-7693	Brake Oil Pressure (ABS)	10700 kPa MAX (1550 psi MAX)	8960 ± 345 kPa (1300 ± 50 psi)	A-B, Normally Open A-C, Normally Closed
114-5333	Refrigerant Pressure (A/C)	1275 to 1750 kPa [1] (185 to 255 psi)	-	Normally Open [2]

[1] Hysteresis band exists: with increasing pressure the closed condition can be maintained up to 2800 kPa (405 psi), with decreasing pressure the closed condition can be maintained down to 1275 kPa (185 psi).
[2] Contact position is shown as part of the harness connector.

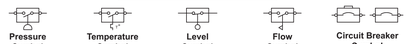
Resistor, Sender and Solenoid Specifications

Part No.	Component Description	Resistance (Ohms)[1]
1G-1950	Resistor - Blower Motor Speed	Overall 2.0 ± .1; Tap 1.0 ± 05
6T-7864	Resistor - Main Realy	39 ± 1.95
3E-7842	Resistor - Starter/Diagnostic Conn	150 ± 7.5
134-7262	Sender - Fuel Level	240 - 260 Empty 27.5 - 39.5 Full
3E-8848	Sensor - Engine Speed	1000-1200
4W-9972	Sender - Hydraulic Oil Temp, Torque Converter	54°C (130°F)-560 to 716 110°C (230°F) - 72 to 82
6V-2455	Sensor - Transmission Speed	110 - 200
8T-8808	Solenoid - Fourth Function Diverter	34.3 ± 1.7
134-3999	Solenoid - A/C Clutch	17.6 ± 0.6
8C-3663	Solenoid - Engine Shutdown	1.55 ± 0.15 10.3± 1.03
116-4152	Solenoid - Pilot ON/Off	34.3 ± 1.7
6T-8046	Solenoid - Aide Control	20.1 ± 1.0
3E-6332	Solenoid - Start Aid	6.00
3E-8591	Solenoids - Transmission	29.8 ± 1.5

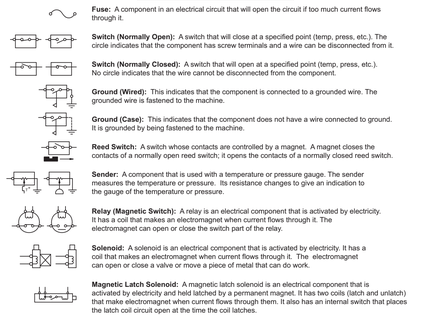
[1] At room temperature unless otherwise noted.

Harness And Wire Electrical Schematic Symbols

Symbols



Symbols and Definitions



Fuse: A component in an electrical circuit that will open the circuit if too much current flows through it.

Switch (Normally Open): A switch that will close at a specified point (temp, press, etc.). The circle indicates that the component has screw terminals and a wire can be disconnected from it.

Switch (Normally Closed): A switch that will open at a specified point (temp, press, etc.). No circle indicates that the wire cannot be disconnected from the component.

Ground (Wired): This indicates that the component is connected to a grounded wire. The grounded wire is fastened to the machine.

Ground (Case): This indicates that the component does not have a wire connected to ground. It is grounded by being fastened to the machine.

Reed Switch: A switch whose contacts are controlled by a magnet. A magnet closes the contacts of a normally open reed switch; it opens the contacts of a normally closed reed switch.

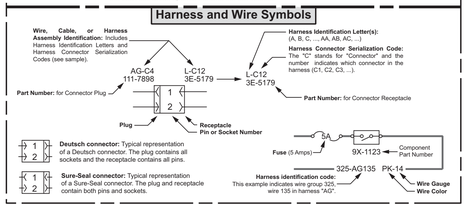
Sender: A component that is used with a temperature or pressure gauge. The sender measures the temperature or pressure. Its resistance changes to give an indication to the gauge of the temperature or pressure.

Relay (Magnetic Switch): A relay is an electrical component that is activated by electricity. It has a coil that makes an electromagnet when current flows through it. The electromagnet can open or close the switch part of the relay.

Solenoid: A solenoid is an electrical component that is activated by electricity. It has a coil that makes an electromagnet when current flows through it. The electromagnet can open or close a valve or move a piece of metal that can do work.

Magnetic Latch Solenoid: A magnetic latch solenoid is an electrical component that is activated by electricity and held latched by a permanent magnet. It has two coils (latch and unlatch) that make electromagnet when current flows through them. It also has an internal switch that places the latch coil circuit open at the time the coil latches.

Harness and Wire Symbols



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Wire Description

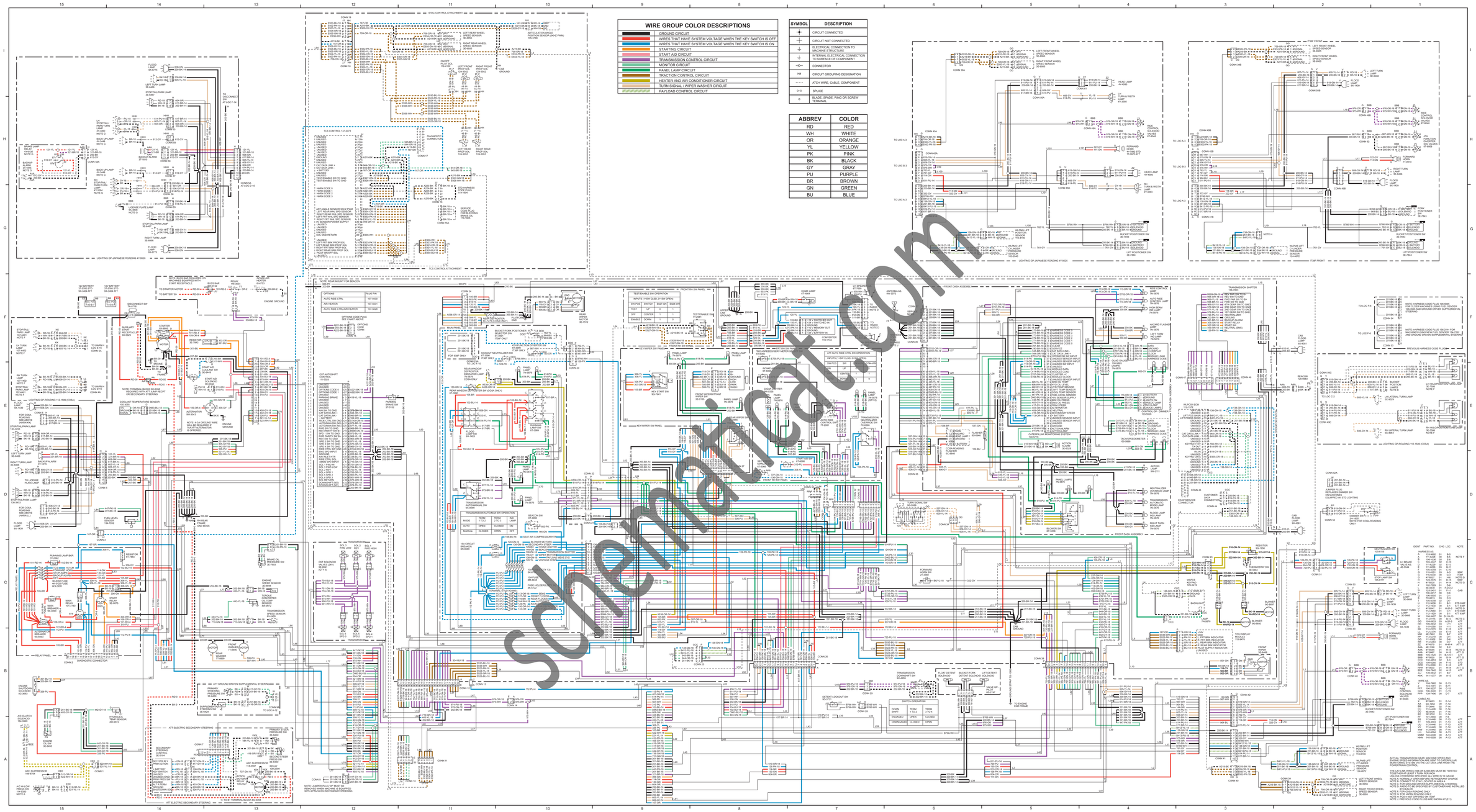
Wire Number	Wire Color	Description
Power Circuits		
101	RD	Bat (+)
102	BU	Hd Lmp
105	BR	KeySw
108	BU	Aux Ckt
109	OR	Alt Output (+) Term
112	PU	Main Power Rly Output
113	OR	Opr Mon Panel
114	GN	Warning Horn (Forward)
116	BR	Aux Ckt
118	GY	Aux Ckt
120	YL	Aux Ckt
121	YL	Back Alarm To Lamp
124	GN	A/C
126	PK	Xmsn Ctrl
127	OR	Aux Ckt
128	PK	Aux Ckt
129	BU	Aux Ckt
130	GN	Aux Ckt
133	OR	Aux Ckt
135	BU	Aux Ckt
136	GN	Suppl Ster
138	GN	Auto Lube Pump To Payload Mon
144	GN	Aux Ckt
150	OR	Bat (+)
164	WH	Hydra Ctrl WTL Powertrain Ctrl
167	OR	Aux Ckt
188	WH	Aux Ckt
Ground Circuits		
200	BK	Main Chassis
201	BK	Operator Monitor Return
202	BK	XMSN Ctrl
203	BK	Chassis Diagnostic
207	BK	Starter Diagnostic
250	BK	Payload Mon - Customer Ond
251	BK	Payload Mon - System Ond
270	BK	Ident Code 0
271	BK	Ident Code 1
272	BK	Ident Code 2
273	BK	Ident Code 3
274	BK	Ident Code 4
275	BK	Ident Code 5
290	BK	Service
291	BK	Clear
A219	BK	Ctrl Gnd
A221	BK	XMSN Ctrl Options Code 0
A222	BK	XMSN Ctrl Options Code 1
A223	BK	Ctrl Harness Code 0
A224	BK	Ctrl Harness Code 1
A225	BK	Ctrl Harness Code 2
A226	BK	Ctrl Harness Code 3
Basic Machine Circuits		
301	BU	Starter No.1 Sol
302	OR	Starter No. 1 Resistor To Diagnostic
304	WH	Starter Relay No. 1 Output
306	GN	Starter Relay Coil To Neut Start SW Or Key SW
307	OR	Key SW To Neut Start SW Or Vmis Sensor Module

Wire Number	Wire Color	Description
Accessory Circuits (Continued)		
503	BR	Wiper - Rear (Park)
504	YL	Wiper - Rear (Low)
505	BU	Wiper- Rear (Hi)
506	PU	Washer - Front
507	WH	Washer - Rear
508	PU	Radio Speaker - Left
509	WH	Radio Speaker - Left (Commom)
511	BR	Radio Speaker - Right
512	GN	Radio Speaker - Right (Common)
513	OR	A/C Compressor/Refrigerant Pressure SW
515	GY	Blower Motor (Hi)
516	GN	Blower Motor (Medium)
517	BU	Blower Motor (Low)
521	YL	A/C SW To Refrigerant SW
522	WH	A/C Clutch To Thermostat SW
537	GN	Turn Signal SW To Flasher
538	BR	Hazard Indicator
A513	PK	DC/DC Converter Memory Output
A538	OR	Rear Window Defroster (Resistive Element In Glass)
Lighting Circuits		
603	PK	Rotary Beacon
604	OR	Stop Lamp
605	YL	Turn Lamp - Left
606	GY	Turn Lamp - Right
608	GN	Flood Lamp - Rear
610	OR	Head Lamp Basic
611	PU	Head Lamp Hi
612	GY	Backup Lamp
614	PU	Park/Tail/Dash/Lamp
615	YL	Cab Flood Lamp/Rops
617	BR	Tail/Position Lamp - Left (Road Pkg)/Width
619	GN	Head Lamp Lo
661	GN	Tachometer Lamp
662	YL	Speedometer Lamp
663	GY	Gauge Lamps
Control Circuits		
709	OR	Sensor Power Supply
710	GN	XMSN Speed Pickup Signal
720	PU	XMSN Brake SW
727	GN	Suppl Ster Motor Relay
751	GN	XMSN Shift Sot No. 1 Or 3
752	YL	XMSN Shift Sot No. 2
754	BU	XMSN Shift Sot NO. 3 Or 1
755	OR	XMSN Shift Sot No. 4 Or 5
761	GY	Uft Kickout Sot SW
762	YL	Bucket Positioner Sot SW
B766	WH	Kickouts / Detent Disable SW To Kickouts
D743	GN	Ride Cont - Wft tmpt Cont SW To Ond N/D
D744	WH	Ride Cont - Wft tmpt Cont SW To Ond N/C
E701	PK	Auto Ride Cntl SW
E702	OR	Auto Ride Cntl SW
E707	GN	Display +V
E708	PK	Display Clock
E735	PU	Tack/Serv Mtr/Odometer Select
818	BR	Serial Data (Transmit)
819	OY	Serial Data (Receive)

SENR6716-02
20 Page, (Dimensions: 39 inches x 24 inches)

SENR6716-02

20 Page, (Dimensions: 39 inches x 24 inches)



WIRE GROUP COLOR DESCRIPTIONS

- GROUND CIRCUIT
- WIRES THAT HAVE SYSTEM VOLTAGE WHEN THE KEY SWITCH IS OFF
- WIRES THAT HAVE SYSTEM VOLTAGE WHEN THE KEY SWITCH IS ON
- STARTING CIRCUIT
- START AID CIRCUIT
- TRANSMISSION CONTROL CIRCUIT
- MONITOR CIRCUIT
- PANEL LAMP CIRCUIT
- TRACTION CONTROL CIRCUIT
- HEATER AND AIR CONDITIONER CIRCUIT
- TURN SIGNAL / WIPER WASHER CIRCUIT
- PAYLOAD CONTROL CIRCUIT

SYMBOL	DESCRIPTION
+	CIRCUIT CONNECTED
+	CIRCUIT NOT CONNECTED
+	ELECTRICAL CONNECTION TO MACHINE STRUCTURE
+	INTERNAL ELECTRICAL CONNECTION TO SURFACE OF COMPONENT
-J1-	CONNECTOR
HR	CIRCUIT GROUPING DESIGNATION
- - -	ATCH WIRE, CABLE, COMPONENT
o-o	SPLICE
o	BLADE, SPADE, RING OR SCREW TERMINAL

ABBREV	COLOR
RD	RED
WH	WHITE
OR	ORANGE
YL	YELLOW
PK	PINK
BK	BLACK
GY	GRAY
PU	PURPLE
BR	BROWN
GN	GREEN
BU	BLUE

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THIS SCHEMATIC IS FOR THE 938F WHEEL LOADER AND IT38F INTEGRATED TOOLCARRIER ELECTRICAL SYSTEM

MEDIA NUMBER: SENR6716-02

SCHEMATIC PART NUMBER: 103-5670, CHANGE: 03, VERSION: -

Components are shown installed on a fully operable machine with the key and engine off, transmission shifter in neutral and with parking brake set.

Refer to the appropriate Service Manual for Troubleshooting, Specifications and Systems Operations.