

Important Safety Information

Most accidents involving product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “WARNING” as shown below.



The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning, explaining the hazard, can be either written or pictorially presented.

Operations that may cause product damage are identified by NOTICE labels on the product and in this publication.

Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are therefore not all inclusive. If a tool, procedure, work method or operating technique not specifically recommended by Caterpillar is used, you must satisfy yourself that it is safe for you and others. You should also ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance or repair procedures you choose.

The information, specifications, and illustrations in this publication are on the basis of information available at the time it was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service given to the product. Obtain the complete and most current information before starting any job. Caterpillar dealers have the most current information available. For a list of the most current publication form numbers available, see the Service Manual Contents Microfiche, REG1139F.

Specifications

Component Measurements

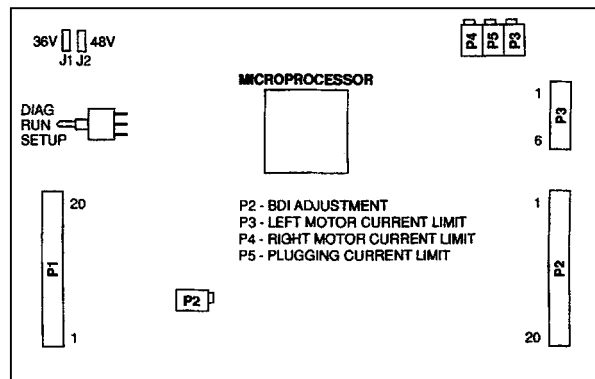
Component	Meter Scale	Meter Positive (+) Test Lead	Meter Negative (-) Test Lead	Desired Indication
DIODES (voltage indication)				
All	Diode	Anode	Cathode	0.3 to 0.9 volts
All	Diode	Cathode	Anode	OL
RESISTORS (resistance indication) 36/48V Panels With 927566 Transistors				
R302	200 Ω			39 ohms ± 5%
R312	200 Ω			39 ohms ± 5%
HEAD CAPACITOR (resistance indication)				
Head capacitor	20 KΩ	Positive side of capacitor (+)	Negative side of capacitor, (-)	0 then change to above 10 K ohms
CONTACTOR COILS (resistance indication) 36/48V Panels				
Directional (right)	200 Ω	X	Y	36.0 ohms ± 10% ¹
Directional (left)	200 Ω	X	Y	36.0 ohms ± 10% ¹
Bypass and pump	200 Ω	X	Y	76.0 ohms ± 10% ¹
Line	200 Ω	X	Y	88.0 ohms ± 10% ¹

¹ Measured resistance with terminals disconnected (coil isolated).

Current Measurements

CURRENT VALUES (AMPS)	
Transistor	927566
Current Limit	255 ± 5%
Plugging Current	300 ± 5%

Logic Board Layout

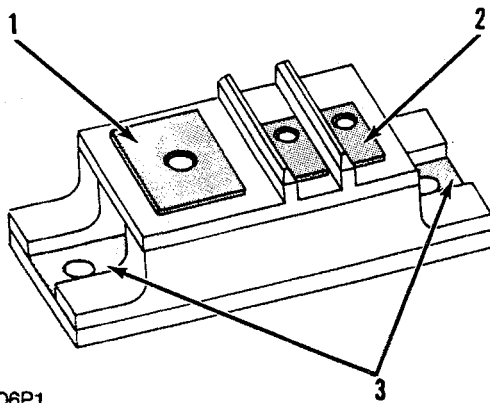


Transistor Measurements

Specifications			
Multimeter Setting	(+) Test Lead	(-) Test Lead	927566 Results
Resistance	Emitter	Base	45 to 135 Ω
Diode	Base	Collector	.3 to .9V
Diode	Collector	Base	OL
Diode	Emitter	Collector	.3 to .9V
Diode	Collector	Emitter	OL

Transistor Connections

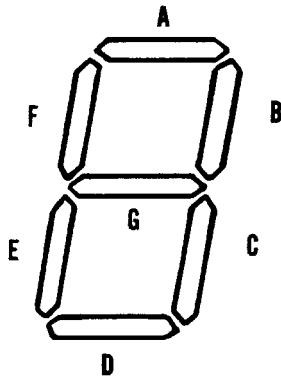
927566



C30706P1

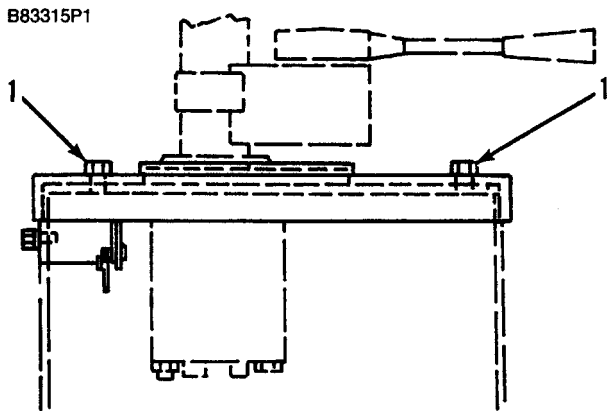
(1) Emitter. (2) Base. (3) Collector.

LED Display Layout



C25548P1

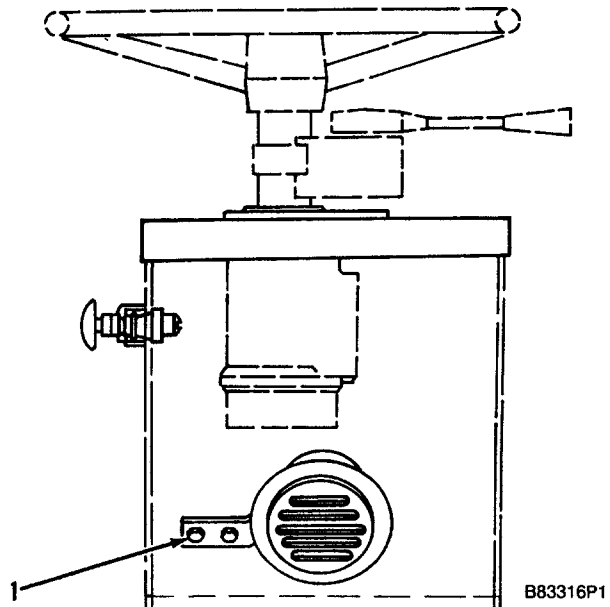
Instrument Panel



B83315P1

- (1) Tighten screws that fasten the instrument panel to a torque of 3 to N•m (27 to 35 lb in)

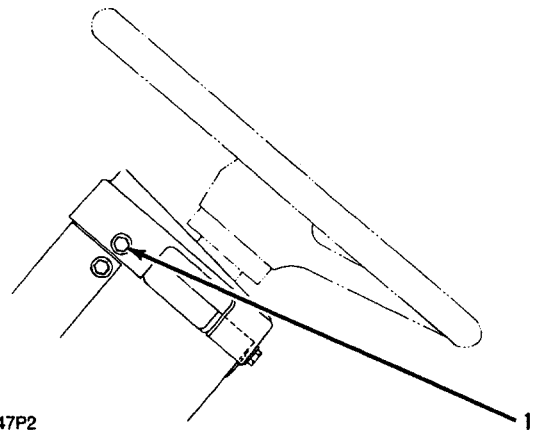
Horn



B83316P1

- (1) Tighten screws to a torque of 3 to N•m (27 to 35 lb in)

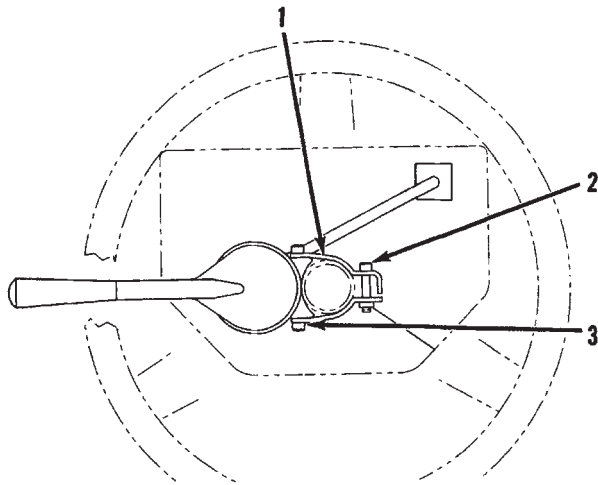
Console



C07647P2

- (1) Tighten bolts that fasten the cover to a torque of 1.5 to 2.5 N•m (13 to 22 lb in)

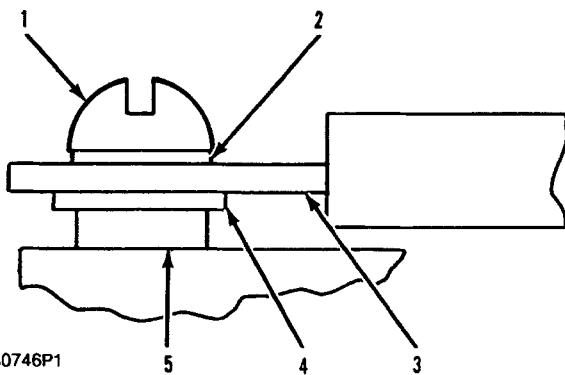
Direction Switch



C23473P1

- (1) Put a bead of 9S3263 Thread Lock on the inner radius of clamp before installation.
- (2) Torque bolts that hold clamp to steering column to 2.8 to 3.4 N•m (25 to 31 lb in)
- (3) Torque bolts that hold clamp to switch to3.4 to 3.9 N•m (31 to 35 lb in)

Head Capacitor



C30746P1

NOTE: Proper torque and assembly of capacitor hardware is critical. Avoid disassembly unless capacitor has to be replaced.

- (1) Tighten capacitor terminal screw to a torque of 2.2 to 2.8 N•m (19 to 25 lb in)
- (2) Spring washer 925805
- (3) Ring terminal of wire assembly
- (4) Lockwasher 8C7507
- (5) Head Capacitor terminal

Thermal Switch

Contacts open at 76 to 84°C (169 to 183°F)
 Contacts close at 64 to 72°C (147 to 162°F)

Contactors

Torque for nuts that hold contactor bridge assembly 1.4 N•m (12 lb in)

Tip Clearance (Gap)

Line 3.15 ± .10 mm (.124 ± .004 in)
 Directional (left and right)..... 2.62 ± .08 mm (.103 ± .003 in)
 Bypass 3.15 ± .10 mm (.124 ± .004 in)
 Pump 3.15 ± .10 mm (.124 ± .004 in)

Fuses

24 Volt Trucks

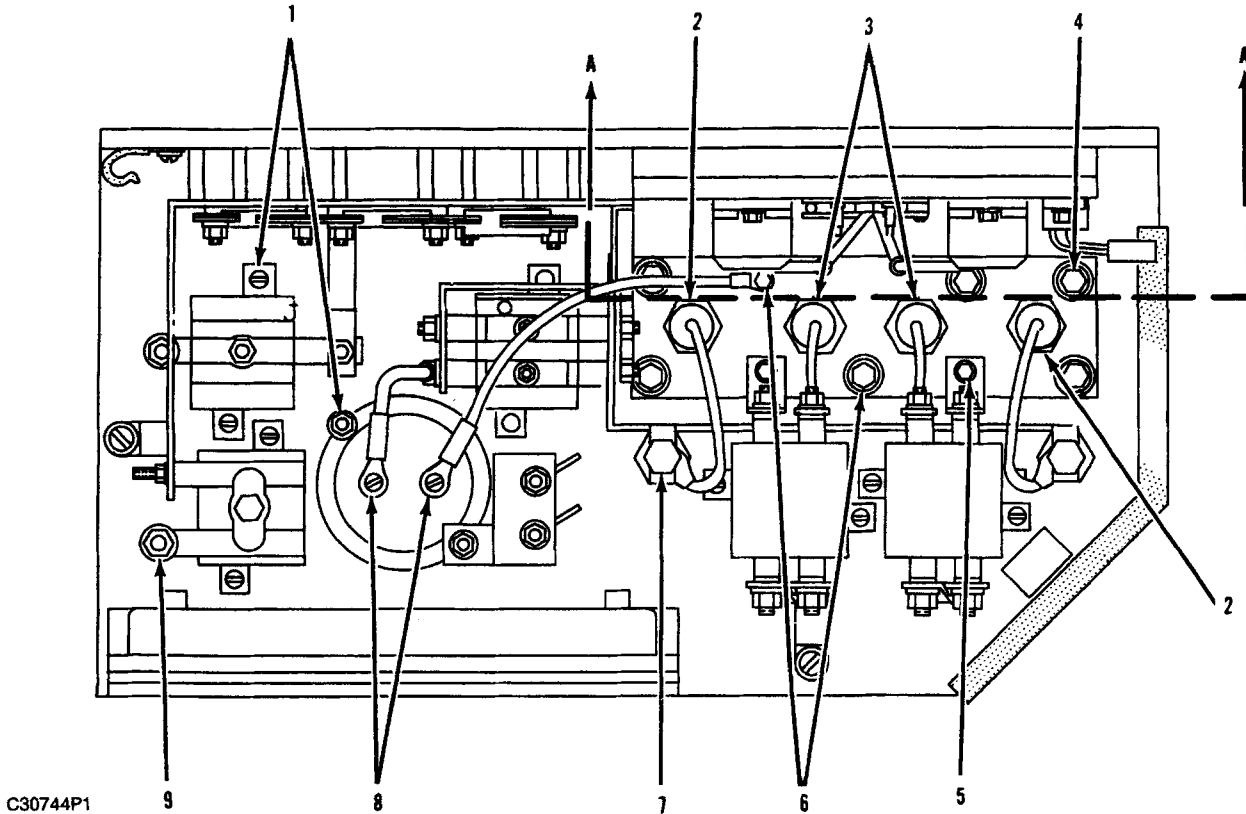
Pump 500 A
 Power Steering 80 A
 Logic 10 A
 Drive 600 A
 Horn 3 A

36/48 Volt Trucks

Pump 300 A
 Power Steering 60 A
 Logic 10 A
 Drive 600 A
 Horn 3 A

Control Panel

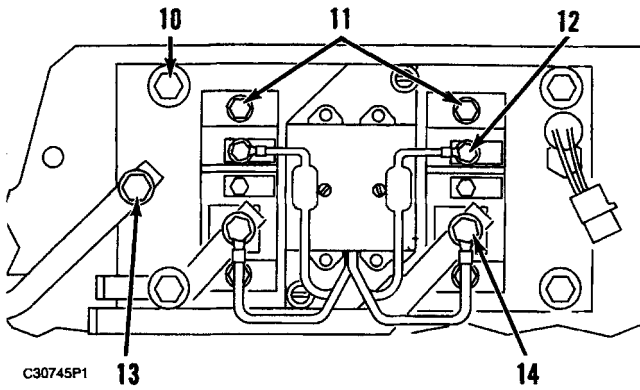
Panels With 927566 Transistors



NOTE: Put a small amount of 5P8937 or 5P9210 Thermal Joint Compound on the surface of the transistor, diode or thermal switch that contacts the heatsink.

- (1) Put 9S3263 Thread Lock on the threads of all screws that are used to fasten components on the control panel.
- (2) Tighten 4 diode (left and right) to a torque of 11.4 to 15.4 N•m (101 to 136 lb in)
- (3) Tighten 5 diode (left and right) to a torque of 11.4 to 15.4 N•m (101 to 136 lb in)
- (4) Apply 9S3263 Thread Lock to the threads of the four bolts that hold the negative heatsink to the control panel. Tighten to a torque of 5.5 to 9.5 N•m (49 to 84 lb in)

- (5) Apply 9S3263 Thread Lock to the threads.
- (6) Tighten bolts to a torque of 4 to 6 N•m (35 to 55 lb in)
- (7) Apply 9S3263 Thread Lock to the threads and tighten bolts to torque of 3 to 4 N•m (27 to 35 lb in)
- (8) Tighten Head Capacitor terminal screws to a torque of 2.2 to 2.8 N•m (19 to 25 lb in)
- (9) Use a wrench (backup wrench) to hold bolts and tighten the nuts that fasten the cables of buss bars to the contactors to a torque of 4 to 6 N•m (35 to 55 lb in)



View A-A

- (10) Tighten bolts that hold the positive heatsink to the control panel to a torque of 10 to 14 N•m (90 to 125 lb in)
- (11) Tighten screws that fasten power transistors (1 TRN L, 1 TRN R) to positive heatsink to a torque of..... 4 to 6 N•m (35 to 55 lb in)
- (12) Tighten screws at power transistors (1 TRN L, 1 TRN R) base connections to a torque of1.3 to 1.7 N•m (11.5 to 15 lb in)
- (13) Tighten the bolts that fasten the buss bars to the heatsink to a torque of 3 to 4 N•m (27 to 35 lb in)
- (14) Tighten the bolts that fasten the buss bars to the power transistors to a torque of 4 to 6 N•m (35 to 55 lb in)

Systems Operation

Glossary

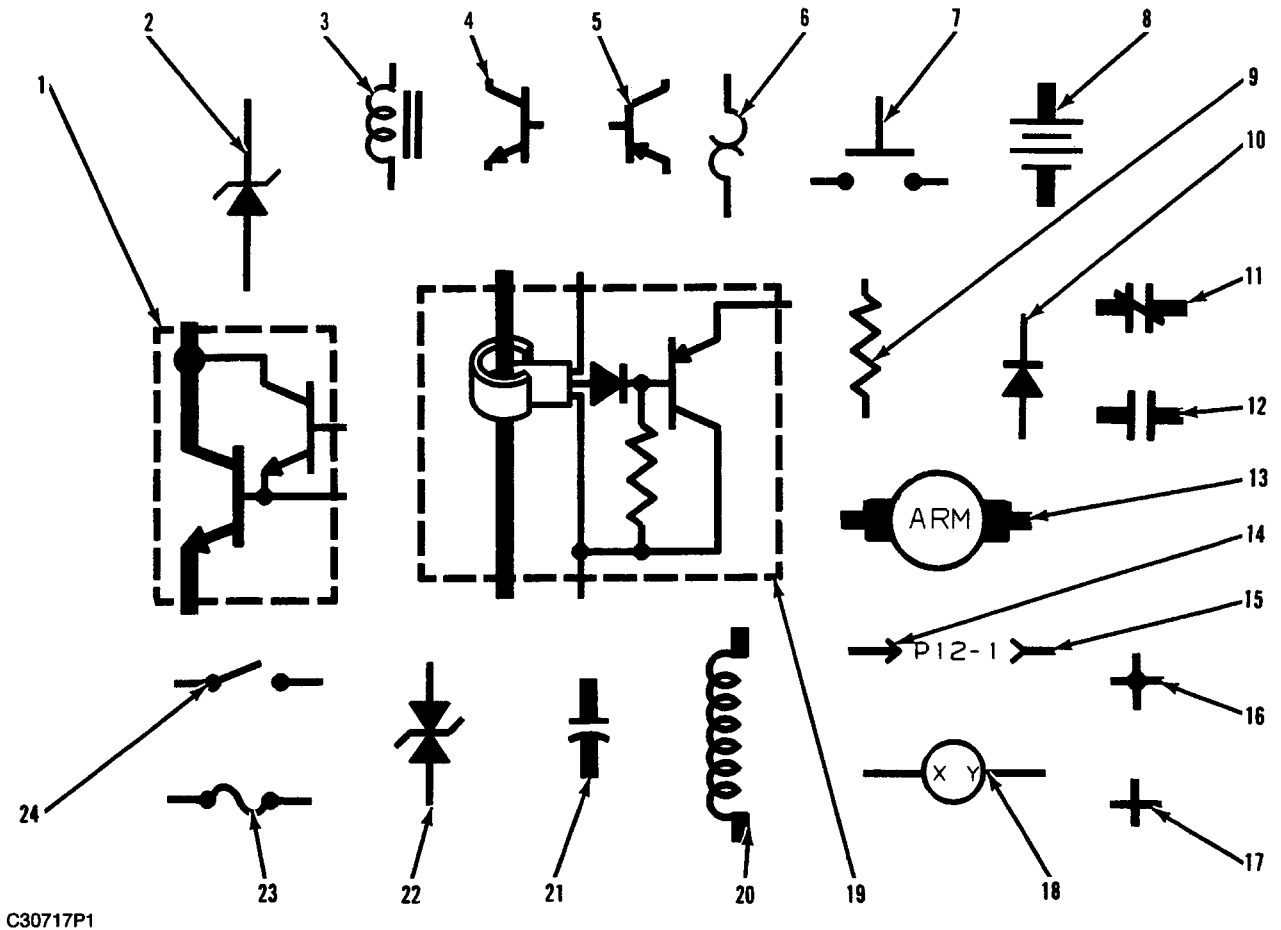
NAME	DESCRIPTION
Accelerator	A device that converts mechanical movement into a digital voltage pattern to the logics for variable drive motor speed.
Activate	Word used with a component or circuit. To change from the normal condition to the “activated” condition because of an application of force or electricity.
Ammeter	An electric meter used to measure current flow in amperes.
Ampere (or Amp)	The unit of measurement of current flow. The amount of current that one volt can push through a resistance of one ohm.
Analog to Digital Converter	A device that converts an analog voltage into a pattern of digital HIGH and LOW voltage signals.
Anode	The positive (+) side of a diode.
Armature	The rotating portion of an electric motor or generator.
Base	The terminal of a transistor through which control current flows (see Transistor).
Battery	Two or more cells connected together for a supply of electric current.
BDI	Battery Discharge Indicator—An electrically controlled display showing the operator the state of battery charge.
Brush	A conductor, normally a block of carbon, that makes sliding contact between the stationary and moving part of the motor or generator.
Bus Bar	A heavy electrical conductor to which other smaller wires are connected.
Capacitor	Device used to store electrical energy for short periods of time.
Cathode	The negative (–) side of a diode.
CVMS	Central Vehicle Monitoring System.
Circuit	A way for current to go from the positive (+) side of an electrical power source to the negative (–) side of an electrical power source. This can be through wires and electrical components.
Coil	A component made from many circles or turns of wire used to concentrate a magnetic field.
Collector	A terminal of a transistor through which main current flows (see Transistor).
Commutator	An armature component used to transfer current from the brushes to the armature windings.
Compound Motor	A motor which has a field winding in series with the armature and a shunt field winding in parallel with the series winding and armature.
Compound/Series Motor	Similar to a compound motor except the parallel shunt field windings are controlled on and off to vary speed and torque.
Conduct	To allow the flow of current.
Conductor	A material that provides a path for current flow.
Connector	Part of a wire assembly or harness that connects with another wire assembly or harness. Used for ease of assembly and disassembly.

NAME	DESCRIPTION
Contactor Assembly	An electrical component consisting of an electromagnetic coil and a set of heavy contact tips. Control current passes through the coil, building a magnetic field which closes or opens the contact tips.
Contactor Coil	An electromagnet used to close or open contact tips in a contactor assembly.
Contact Tips or Contacts	The portion of a switch, relay or contactor where the circuit can be opened or closed.
Continuity	Having the ability to allow current flow.
Control Circuits	The wires and components carrying low current used to signal the logics unit, turn on main components, or support auxiliary circuits (indicated by narrow lines on a schematic).
Counter Electromotive Force (CEMF)	An opposing voltage set up by a collapsing or increasing magnetic field within a coil.
Current	The movement or flow of electricity through a conductor. A circuit must be complete for current to flow.
Current Limit	The maximum allowable armature current of a stalled drive motor during pulsing.
Current Sensor	A hall-effect sensor in the drive motor circuit that produces an increasing voltage output as the drive motor current increases.
Current Shunt	A precision low-value resistor connected in series with the armature of a motor. The logics uses the measured voltage drop across the shunt to control maximum current allowed in selected power circuits.
Deactivate	To change from the activated condition back to the normal (deactivated) condition. It can be caused by the application of force, the removal of force, or the removal of electricity.
Digital Signal	A signal in which the elements may be either of two distinct values. For example high voltage, low voltage.
Diode	A semiconductor device that allows current to flow in one direction, from the anode to the cathode.
Display	An electrical device that converts voltage inputs to a visual output.
Electrical Braking	Electrically trying to rotate the drive motor opposite to the direction of truck movement.
Electromagnet	A coil of wire, most often wound on an iron core, which produces a strong magnetic field when current is sent through the coil.
Electromotive Force (EMF)	The force that causes an electric current to flow in a circuit. This force is measured in volts.
Emitter	A terminal of a transistor through which low control current and main current flow (see Transistor).
Ferrite Bead	A small bead located on the base connection of the power transistors to reduce high frequency oscillation at the power transistor.

NAME	DESCRIPTION
Field Windings	The stationary coils that produce a magnetic field in motors and generators.
Filter	An electrical device or component for restriction or suppression of undesired voltage spikes.
Fuse	A component in an electrical circuit that will open the circuit if too much current goes through it.
Grounded	A wire or wires that are in contact with the metal chassis of the vehicle (ground). Can be caused by a loss of insulation from the wire, or by connecting the wire to the vehicle.
Hall-Effect Switch	A solid state switch consisting of a movable magnet and a small printed circuit board with three terminals. Two of the terminals are connected to a supply voltage, and the third terminal produces a voltage output change as the magnet passes by the small printed circuit board.
Harness	An assembly made of two or more wires that are held together.
Heat Sink	A mounting frame used for semiconductor cooling.
Hour Meter	An electrically activated device used to record the amount of usage a truck receives.
Indicator	A lamp or LED that gives an indication of some vehicle condition when it turns on or flashes.
Input	A voltage change at the incoming connection of a component.
Insulator	A material that has a very large resistance so that it will not let current flow through it.
LED	Light Emitting Diode – a diode that emits light (lights) when current flows in the forward direction.
Linear Output Hall-Effect Transducer (LOHET)	A device that converts an increasing magnetic field to an increasing linear output voltage.
Logics or Logic Unit	The main printed circuit board containing a microprocessor and circuits to condition the voltage signals that go into or come out of the logics. It electronically monitors and controls the truck's functions.
Magnetic Field	The area around a magnet where magnetic forces can be detected.
Microprocessor	A small computer chip preprogrammed to control the various electrical functions on a lift truck.
Normal Condition	Words used with a switch or relay. Their normal condition is their condition when they are not controlled by the application of force, temperature, pressure, or electricity.
Normally Closed (N.C.)	A switch or relay whose contacts are closed in the normal condition.
Normally Open (N.O.)	A switch or relay whose contacts are open in the normal condition.
OFF-Time	The amount of time current does not flow through a transistor.
Ohm	The unit of measurement of resistance. The amount of resistance that will let one volt push only one ampere of current through it.

NAME	DESCRIPTION
ON-Time	The amount of time current flows through a transistor.
Open Circuit	Wiring or components of a circuit that have no continuity.
Optical Switch	An electronic device made up of an infrared light signal generator and photosensitive signal receiver that changes a digital voltage when the light pattern is conducting or blocked.
Output	The current flow from a component which initiated from a voltage change at the component's input.
Overload	The presence of voltage or current which is greater than an electrical circuit or component is designed to handle.
Permanent Magnet Motor	A motor which has permanent magnets in place of field windings.
Pin	The male contact of a connector that fits into a female contact (socket) of another connector.
Plugging	A portion of electrical braking where the generated current is directed back through the armature.
Plugging Current Limit	The maximum allowable current at the drive motor armature during the plugging portion of electrical braking.
Potentiometer	An adjustable resistor to preset electronic controls for proper specifications.
Power Circuits	The main current carrying components and conductors (indicated by the heavy lines on a schematic).
Power Transistor	A component in the power circuit which allows main motor current to pass through when turned on.
Pulsing	Current flow in a circuit being turned on and off.
Regen Current Limit	The maximum allowable current at the drive motor armature during the regen portion of electrical braking.
Regenerative Braking (Regen)	A portion of electrical braking where the generated current is used to charge the battery a small amount and reduce arcing and heat at the drive motor brushes.
Relay	An electrical component consisting of an electromagnetic coil and a set of small contact tips. Control current passes through the coil, building a magnetic field which closes or opens the contact tips. When the contact tips are closed, low current can flow in a separate isolated circuit.
Resistor	A component made of a material that has a specific resistance to the flow of current.
Schematic	A line drawing of an electrical or electronic assembly which uses symbols to show individual components. It shows how the components, wires and connectors function electrically.
Semiconductor	Components such as, transistors, diodes, thyristors, etc. Having electrical characteristics between a conductor and an insulator.
Series Wound Motor	A motor in which the armature is connected in series with the field windings.
Short Circuit	An electrical connection between two or more components that is not desired.

Symbol Library



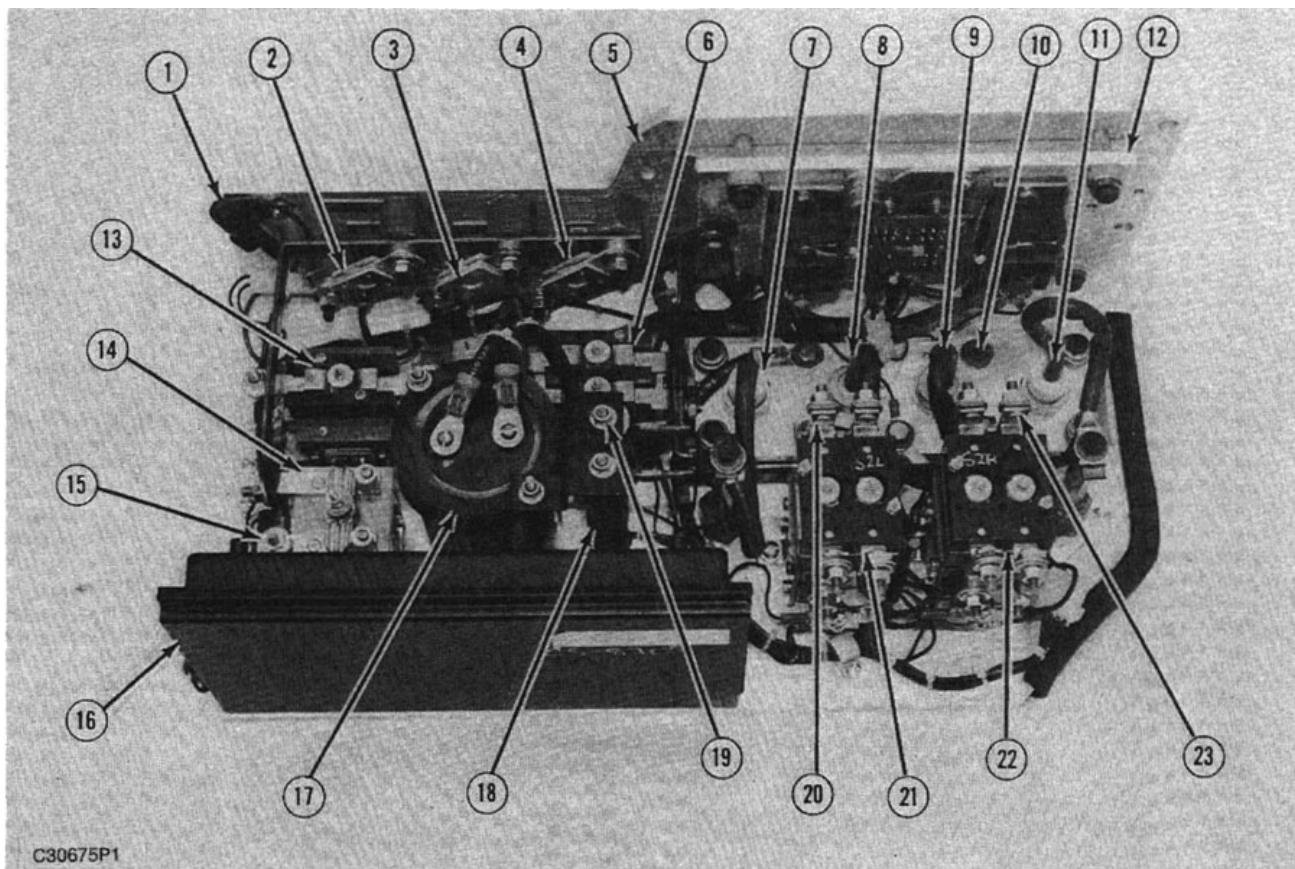
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Schematic Symbols

(1) Power transistor. (2) Zener diode. (3) Ferrite bead. (4) NPN transistor. (5) PNP transistor. (6) Thermal switch. (7) Switch. (8) Battery. (9) Resistor. (10) Diode. (11) Normally closed contacts. (12) Normally open contacts. (13) Armature. (14) Male contact of a connector (pin). (15) Female contact of a connector (socket). (16) Wire connection. (17) No wire connection. (18) Contactor coil. (19) Hall-Effect current sensor. (20) Field windings. (21) Capacitor. (22) Varistor. (23) Fuse. (24) Switch.

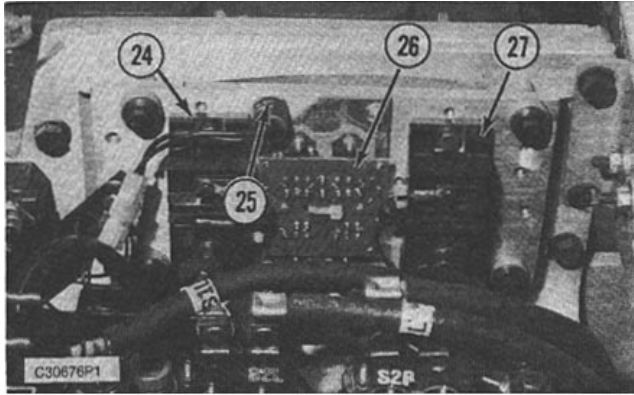
Location Of Control Panel Components

Panels With 927566 Transistors



MicroCommand Control Panel

(1) Logic fuse. (2) Power steering fuse. (3) Pump fuse. (4) Drive fuse. (5) Control panel. (6) Bypass contactor. (7) 4 Diode L. (8) 5 Diode L. (9) 5 Diode R. (10) Battery negative connection. (11) 4 Diode R. (12) 1 TRN heatsink. (13) Pump contactor. (14) Line contactor. (15) Battery positive connection. (16) Logic unit (logics). (17) Head capacitor. (18) R302. (19) R312. (20) Left shunt. (21) Left directional contactor. (22) Right directional contactor. (23) Right shunt.



Heatsink Components
(24) 1 TRN L. (25) Thermal switch. (26) Driver board. (27) 1 TRN R.

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