From 7.2

7.4 **NOTE** Check if contactor 1A will close when the lift truck with a load is started on a ramp. If the contactor 1A will not close on a ramp, the accelerator potentiometer or the accelerator card is bad.

The accelerator potentiometer is correct. Check the output of the accelerator card. Measure the voltage between R6 and battery negative. The correct voltage is approximately 8 volts at "CREEP" and decreases to 0.0-0.2 volts at maximum speed. This signal voltage must decrease to less than 0.5 volts before the control card will permit the contactor 1A to close on "TIME".

7.5 The signal voltage from the accelerator card does not decrease to less than 0.5 volts. Disconnect the battery and replace the accelerator card.

7.6 The voltage at R6 decreases correctly. Check the voltage at R8 when the voltage at R6 has decreased to 0.0-0.2 volts.

7.7 The voltage at R8 is less than 0.5 volts. The control card has a defect, replace the control card.

7.8 1.0-2.0 volts at R8. Check for battery voltage between terminal 3 of the 1A electronic driver and battery negative.

7.9 There is battery voltage across the electronic driver. Disconnect the battery and replace the electronic driver.

7.10 No battery voltage across the electronic driver. Check for battery voltage at the positive side of the coil for the 1A contactor.

7.11 Battery voltage at the positive side of the coil for the contactor 1A. Replace the coil.

RAISE DRIVE WHEELS

FAULT NUMBER 8. THE FIELD WEAKENING CONTACTOR WILL NOT ENERGIZE. THE OTHER OPERATIONS OF THE LIFT TRUCK ARE NORMAL

Possible Causes:

- Control card is bad or needs adjustment
- Accelerator potentiometer is bad or needs adjustment
- Accelerator card is bad or needs adjustment
- Field weakening contactor has a defect
- Electronic driver for field weakening is bad

8.0 Disconnect the battery and separate the connector. Check adjustments "C/L", "F.W.P.U." and "F.W.D.O." on the control card. Check the wires between the current sensor and the control card.

8.1 Set the adjustments according to the specifications for the lift truck for which you are making repairs. The operation of the lift truck will not be correct if any of the sensor wires are disconnected or open.

8.2 Connect the battery and turn the key switch to the "ON" position. Set the controls so that the lift truck will normally operate. Check the adjustment of the accelerator potentiometer. Measure the voltage between R5 and battery negative. The correct voltage is 4.0-4.5 volts and decreases smoothly to 0.0-0.2 volts when the accelerator is moved for maximum speed.

8.3 The voltage at R5 is wrong. Check the linkage and the adjustment of the accelerator potentiometer. If the voltage does not decrease smoothly between "CREEP" and maximum speeds, replace the accelerator potentiometer.

8.4 The accelerator potentiometer is correct. Check the output of the accelerator card. Measure the voltage between R6 and battery negative. The correct voltage is approximately 8 volts at "CREEP" and decreases to 0.0-0.2 volts at maximum speed. This signal voltage must decrease to 0.5 volts before the control card will permit the field weakening contactor to close.

8.5 The signal voltage from the accelerator card does not decrease to 0.5 volts. Disconnect the battery and replace the accelerator card.

To 8.6

From 8.4

8.6 The signal voltage decreases correctly at R6. Measure the voltage between R9 and battery negative when the voltage at R6 is less than 1.0 volts.

8.7 The voltage at R9 is less than 0.5 volts. Replace the control card.

8.8 The voltage is correct (typical voltage is 1.0-2.0 volts when R6 is 0.5 volts).

Check for battery voltage between terminal 3 of the electronic driver for field weakening and battery negative.

8.9 There is battery voltage across the electronic driver, disconnect the battery and replace the electronic driver.

8.10 No battery voltage across the electronic driver. Check for battery voltage at the positive side of the coil for the field weakening contactor.

8.11 Battery voltage at the positive side of the coil for the field weakening contactor. Replace the coil.

FAULT NUMBER 9. PLUGGING PROBLEMS

9.0 Plugging is too quick.

- Check the "PLUG" adjustment on the control card.
- Check D 4 for an open circuit.
- Check if the current sensor wires are broken or disconnected.
- Replace the control card if there is no adjustment.

9.1 Plugging is too slow.

- Check the "PLUG" adjustment on the control card.
- Replace the control card if there is no adjustment.

FAULT NUMBER 9A PLUGGING PROBLEMS (E60-120B and N30-50C LIFT TRUCKS ONLY)

NOTE

The weight of the E60-120 and N30-50C lift trucks can cause the brushes of the traction motor to wear quickly and also cause too much heat to be generated in the traction motor during plugging. These series of lift trucks have an auxiliary resistor for the current flow generated during plugging. When plugging, a plugging contactor opens so that the current flows through the plugging resistor. During lift truck operation, the auxiliary plugging contactor is closed except during plugging. This fault procedure checks the parts of the auxiliary plugging system.

9A.0 Do the checks in 9.0 or 9.1 except do not replace the control card. Replace the control card if there is no plugging signal as described in the checks in this procedure.

9A.1 Plugging is too slow. Disconnect the battery. Check that the auxiliary plugging resistor is connected correctly. Lift truck will not operate if the plugging resistor is open.

9A.2 Plugging is too quick. Measure the voltage between the terminal 2 of the auxiliary plugging card and battery negative during plugging. The correct voltage is approximately 8 volts. If there is no voltage from R10 to terminal 2 during plugging, replace the control card.

9A.3 Replace the control card if there is no adjustment.

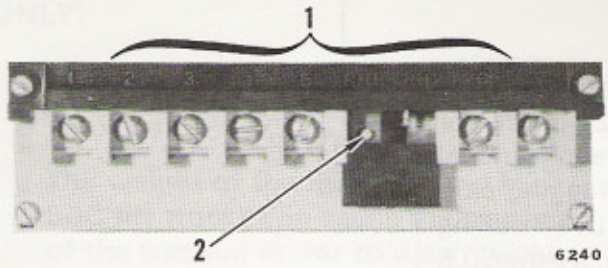
9A.5 The coil for the auxiliary plugging contactor has a short-circuit. Repair the contactor coil.

To 9A.4

From 9A.2

9A.4 If the voltage is correct between R10 and terminal 2, check for battery voltage between terminal 5 of the auxiliary plugging card and battery negative during plugging. If there is more than 0.5 volts at terminal 5, the auxiliary plugging card will not permit the auxiliary plugging contactor to open. Replace the auxiliary plugging contactor to open. Replace the auxiliary plugging card. Check the auxiliary plugging contactor 9A.5 for a coil with a short-circuit.

9A.6 Adjust the potentiometer adjustment on the auxiliary plugging card so that the auxiliary plugging contactor closes just after the lift truck comes to a stop.



AUXILIARY PLUGGING CARD

1. ELECTRIC TERMINALS 1-7
2. ADJUSTMENT POTENTIOMETER

TERMINAL NUMBER	FUNCTION
1	Battery negative
2	Senses the plugging signal from R10 of the Control card. (0.0 volts when not plugging increases to approximately 8.0 volts when plugging.)
3	Battery negative. Connected to R4 of Control Card.
4	Sends signal to R7 of the Control Card that plugging is completed.
5	Output voltage to energize Auxiliary Plugging Contactor. (Approximately battery voltage when contactor is closed. Less than 0.5 volts when the contactor is open during plugging.
6	Battery positive supply.
7	Senses voltage at armature A1 terminal to indicate when plugging is complete.

FIGURE 3. TERMINAL FUNCTIONS FOR THE AUXILIARY PLUGGING CARD

CHECKS AND REPAIRS

GENERAL

This section gives you additional information for making checks and repairs for faults found in the Troubleshooting section. Each series of lift trucks has its own arrangement of control switches and accelerator. To repair and adjust the control switches. See the section ELECTRICAL REPAIRS AND ADJUSTMENTS for each series of electric lift trucks.

WARNING

Some adjustments in this section must be done with the battery connected and power applied to the controller. When making these adjustments, make sure the drive wheels are raised from the floor. Do not disable the SRO circuit.

WARNING

Make sure you disconnect the battery and separate the connector before you disassemble any part of the controller. Make sure you also discharge the capacitors C1.

CHECKING FOR THE CORRECT OPERATION

A service person must understand the operation of the lift truck with an EV-1 controller. If you understand and have operated a lift truck with normal operation, you will better understand a bad operation. Listen and feel for a normal or bad operation as you operate the lift truck on a level surface.

A. Check the specific gravity of the battery. If the specific gravity is less than 1.260, the battery is not fully charged or has a defect.

B. Connect the battery connector. The horn can now be operated.

C. You must be on the operator's seat to close the seat switch (or the operator's platform to close the foot switch). Move the MONOTROL or accelerator to the operating range before you turn the key switch to the "ON" position. Turn the key switch to the "ON" position. The SRO circuit will keep the logic from energizing the traction circuit. (SitDrives with a "FORWARD" and "REVERSE" lever on a column mount can be checked the same as lift truck with MONOTROL control. Move the lever to a "FORWARD" or "REVERSE" position before moving on the accelerator to the operating range). Release the accelerator to reset the SRO circuit. Changing the controls from "REVERSE" to "FORWARD" or "FORWARD" to "REVERSE" will also reset the SRO circuit. The lift system can be operated when the key switch is "ON". The lift truck is ready to move.

D. Slowly move the accelerator a small amount for the "REVERSE" direction. Listen for the reverse contactor to close. Listen for a very low volume hum from the controller. The lowest power that can be applied to the traction circuit when the direction contactor is closed is the "CREEP" speed. The "CREEP" speed can be adjusted so that the lift truck will or will not begin to move at the low power setting where the controller just begins to operate.

E. Move the accelerator a small amount so that the lift truck will begin to move very slowly.

F. Increased movement of the accelerator for causes the lift truck to move faster. The SCR hum becomes louder with a higher frequency sound.

G. Check the plugging. During full speed in the reverse direction, move the control to the "FORWARD" full speed position. A correctly adjusted lift truck will stop smoothly and will then move in a forward direction. It will accelerate smoothly to full speed.

CONTROL AND POWER FUSES

The power fuse panel is found under the floor plate or behind an access panel on the left side of SitDrive trucks. The power fuse panel is found in the motor compartment of other electric lift trucks. The control fuse is separate from the power fuse panel on all the lift trucks. The control fuse is under the floor plates of the SitDrive trucks. The fuses can be checked electrically with an ohmmeter.

CONTROL CARD

The control card has an "Static Return to OFF" (SRO) circuit. The key switch and seat (or "brake switch" on the "N" and "R" trucks) switch must be closed before the accelerator is moved to operate the lift truck. A service person must understand the SRO sequence when troubleshooting. The SRO is a safety circuit. The switches for the SRO circuit are described in the section ELECTRICAL REPAIRS AND ADJUSTMENTS. A section is printed for each series of electric lift trucks.

The control card has a pulse monitor trip (PMT) circuit that checks for a short-circuit of SCR 1. If short-circuit occurs in a circuit connected to SCR 1, the logic in the control card will stop the lift truck.

CAUTION

Some voltage measurements must be made with the SRO circuit complete. If you are working alone, put a weight in the seat to close the seat (or foot) switch. You can operate the controls with your hand and also make the voltage measurement. Make sure the drive wheels are raised from the surface before doing troubleshooting.

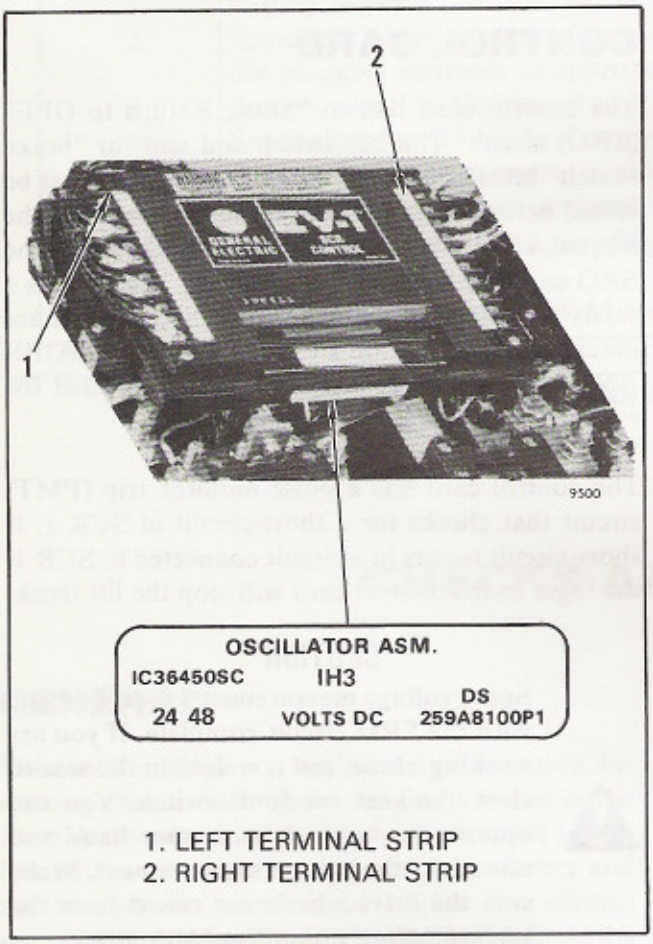
CAUTION

Do not try to put jumpers on the terminals in the controller. The terminals are close together and it is easy to make a very high cost error.

Removal

The control card is a plastic case holding a printed circuit board with electronic parts. A 14 pin connector connects the logic control card to the traction circuit. The control card has a left (L) and right (R) terminal strip. A reference number such as R5 in this section indicates terminal number 5 on the right (R) terminal strip.

There are two different control cards used in the electric lift trucks made by Hyster Company. Both control cards look the same. A label on the edge of the cases shows if the control card is a 1H3 or a 1E3. The 1E3 card has the "field weakening" function. In an emergency, a 1E3 card will work as a replacement for the 1H3 card. The "field weakening" function will not be energized. DO NOT use a 1H3 card as a replacement for a 1E3 card.

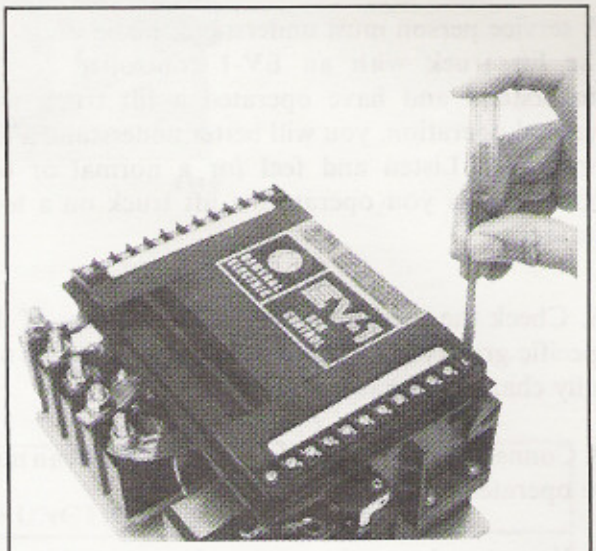


1. LEFT TERMINAL STRIP
2. RIGHT TERMINAL STRIP

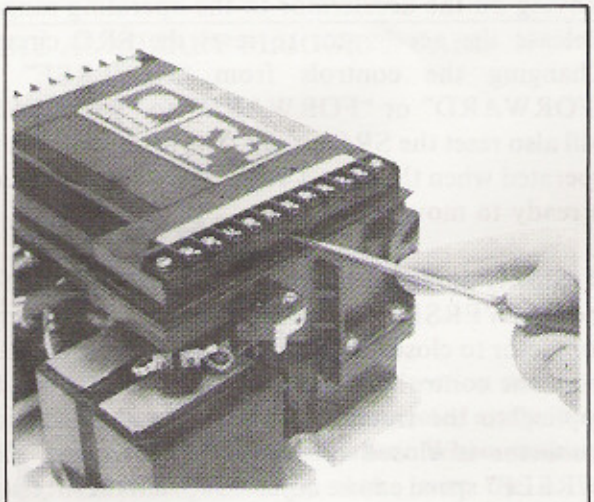
FIGURE 4. THE CONTROL CARD

A bad control card cannot be repaired by service personnel and must be replaced. To remove a control card:

STEP 1. Disconnect the Battery.

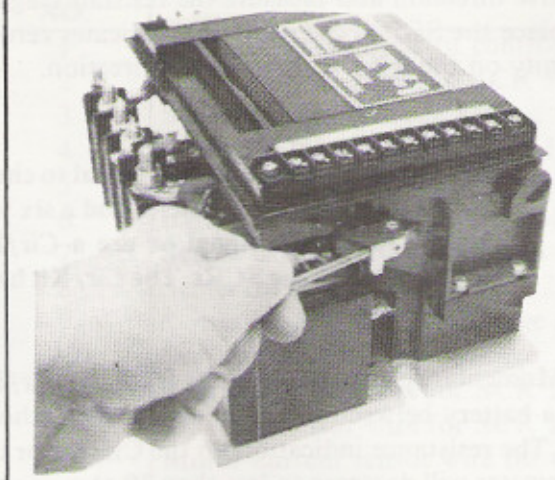


STEP 2. Remove the (L) and (R) terminal strips. Loosen the two mounting screws for each terminal strip only enough to release the terminal strip. If the screws are removed, the O-ring retainers can be lost.

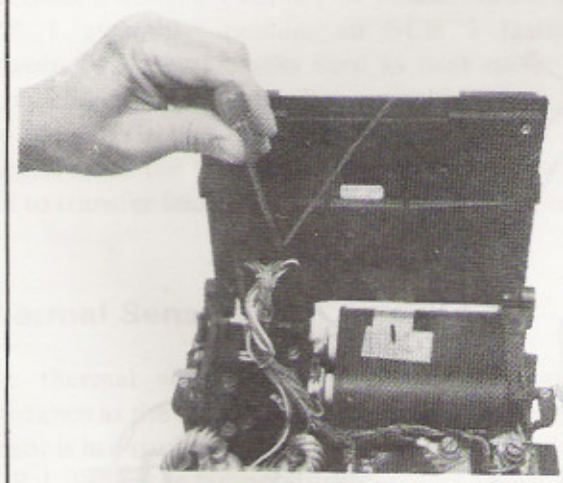


STEP 3. Use a screwdriver to remove each terminal strip from the control card. Leave the wires connected to the terminal strip.

FIGURE 5. REMOVING THE CONTROL CARD
(Sheet 1 of 2)



STEP 4. Open the two latches. Push on the edge of the control card with your fingers. Rotate the control card towards you while lifting the control card from its pivots.



STEP 5. Disconnect the control card plug from the control card.

FIGURE 5. REMOVING THE CONTROL CARD
(Sheet 2 of 2)

Installation

To install a control card as follows:

A. Carefully install the control card plug.

B. Install the control card in the mounts and close the latches.

C. Install the terminal strips.

SCRs

In this section on Checks And Repairs, there are instructions to check the SCRs. This part of the section describes the methods to check the SCRs.

An SCR "QUICK CHECK"

Turn the key switch to the "OFF" position and disconnect the battery. Discharge the capacitor C1. Set the selector switch on your ohmmeter to the R X 100 scale. Do not disconnect any wires. Make a resistance check between the anode and the cathode of the SCR. Replace any SCR that indicates a short-circuit.

The normal failure of an SCR is a short-circuit. This "quick check" will indicate a short-circuit in an SCR. This "quick check" can help you quickly find if the fault is in the traction circuit or one of the control circuits of an electric lift truck. This same check can be used to find a short-circuit in D 3 or D 4. This check will not always indicate a fault in D 3 or D 4. A diode failure in the traction circuit will first have a short-circuit. The increased current flow can cause the diode to open. To check an SCR or diode for an open circuit, complete the following procedures.

Checking An SCR

NOTE

The following checks will indicate most SCRs with defects. The checks will not always indicate a fault that does not occur regularly during operation. Normally, an SCR with this type of fault will indicate a resistance between the anode and cathode of less than 50 000 ohms.

WARNING

Make sure you disconnect the battery and separate the connector before you disassemble any part of the controller. Make sure you also discharge capacitor C1.

You will need a Cir/Kit or an ohmmeter to check the SCRs. Disconnect the control card plug for access to the ends of the wires. See Figure 6. The SCRs can stay attached to the heat sink to make checks.

A. Touch the probes of the Cir/Kit or ohmmeter to the heat sink and the cathode wire. Measure the resistance. Change the probe connections to the reverse direction and measure the resistance. Replace the SCR if the resistance indicates less than 50 000 ohms in either direction.

B. Measure the resistance between the gate wire and the cathode. Change the probe connections to the reverse direction and measure the resistance again. Replace the SCR if the resistance indicates zero or infinity on the RX1 scale in either direction.

NOTE

Six volts is needed as a gate signal to check the SCRs. Use an ohmmeter and a six volt supply for a gate signal or use a Cir/Kit meter to check the SCRs. The Cir/Kit has a six volt supply.

C. Momentarily connect six volts from the Cir/Kit [or a battery between the gate (+) and the cathode (–)]. The resistance indication on the Cir/Kit or the ohmmeter will decrease to less than 10 ohms on the RX1 Scale. Replace the SCR if the resistance does not decrease when a six volt gate signal is applied momentarily. Make sure you touch the gate wire momentarily with the six volt connection or you will damage the SCR. Make sure the polarity of your test circuit is correct.

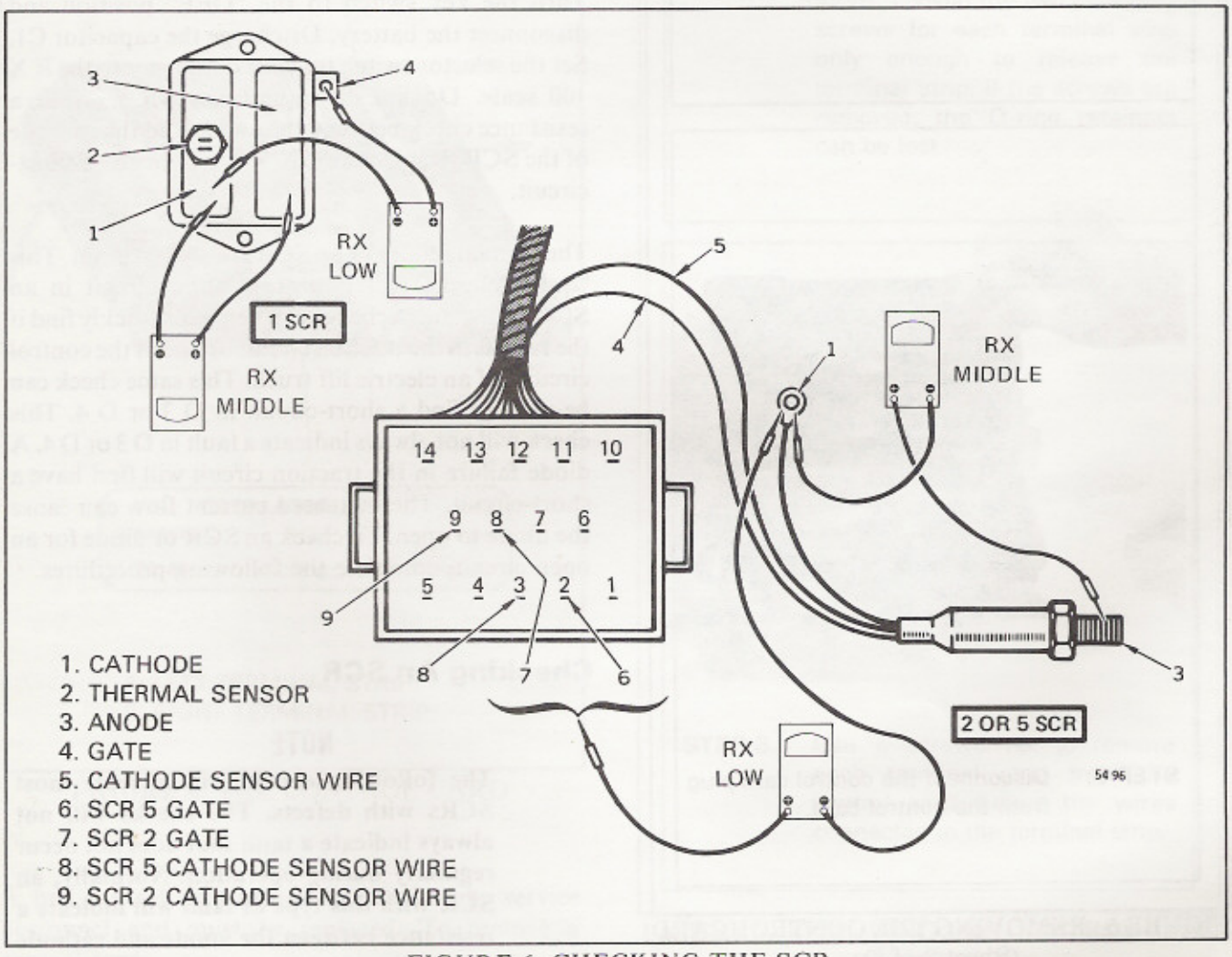


FIGURE 6. CHECKING THE SCR

PIN NO.	FUNCTION
1	Not connected inside of control card. Used for EV-1 Analyzer only
2	Sends the gate signal to SCR 5
3	Senses SCR 5 cathode voltage
4	Sends the gate signal to SCR 1
5	Senses SCR 1 cathode voltage as input to oscillator
6	Battery negative for the control card
7	Senses capacitor C1 voltage as input to oscillator control circuit
8	Sends the gate signal to SCR 2
9	Senses SCR 2 cathode voltage and is the gate signal return
10	Senses traction motor voltage.
11	Thermal sensor wire for SCR 1
12	Thermal sensor wire for SCR 1
13	Motor current sensor wire for the current limit circuit
14	Motor current sensor wire for the current limit circuit

FIGURE 7. PIN ARRANGEMENT AND FUNCTION FOR THE CONTROL CARD PLUG

D. When the checks are complete, connect the wires unless the SCR must be replaced.

The SCR 1 Assembly

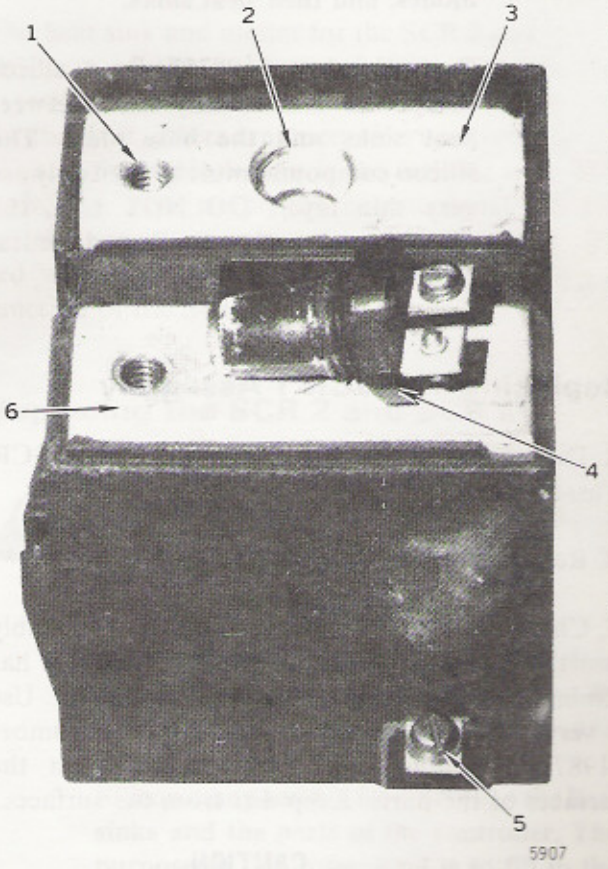
The SCR 1 assembly cannot be disassembled. The SCR 1 assembly includes an SCR 1 fastened between two metal blocks used as heat sinks. An epoxy case holds the complete assembly. There is a thin sheet of electrical insulation between the SCR 1 assembly and the base plate. The insulator permits heat to transfer from the heat sinks to the base plate.

Thermal Sensor

The thermal sensor is a resistor that changes resistance as the temperature increases. The thermal sensor is in a stud mount on the cathode heat sink for SCR 1. When the temperature increases above 185° F (85°C), the thermal sensor changes the input to the logic card. The card decreases the percent of SCR 1 "ON" time to decrease the SCR 1 temperature.

Checking The SCR 1

See the section SCRs on page for doing the checks on SCR 1.



1. CATHODE SENSOR CONNECTION
2. THERMAL SENSOR MOUNTING HOLE
3. CATHODE HEAT SINK
4. THERMAL SENSOR
5. GATE TERMINAL
6. ANODE HEAT SINK

FIGURE 8. THE SCR 1 ASSEMBLY

To remove the SCR 1 from the circuit for making the checks, do the following: Disconnect the control card plug from the control card. Disconnect the power strap from the anode. Disconnect the wire for the gate signal. Be careful that you do not let the wire connection screw fall into the controller.

NOTE

Silicon compound is used between the heat sinks and the parts of the controller. The purpose of this compound is to fill in the micrometer size spaces between the parts to give better heat flow. Always use a very thin layer of compound between the parts. Too much compound will be an insulator and cause both electrical and heat faults. It is better to use no compound instead of too much. There are two types of compounds:

- **Part number 304408 is a silicon bearing grease and is used between the SCRs, diodes, and their heat sinks.**
- **Part Number 1198757 is a silicon compound and is only used between heat sinks and the base plate. This silicon compound must be used only as a very thin layer. DO NOT USE this silicon compound on SCRs and diodes.**

Replacing The SCR 1 Assembly

A. Disconnect the electrical connections to the SCR 1 assembly.

B. Remove the two mounting screws.

C. Check the insulator between the SCR 1 assembly and the base plate. Replace the insulator if it has damage. The insulator is also a heat conductor. Use a very thin coat of silicon grease (Part Number 1198757 or approved equivalent) between the surfaces of the parts. Keep dirt from the surfaces.

CAUTION

The insulator is very thin. Dirt between the surfaces of the SCR 1 and the base plate will damage the insulator and cause a short-circuit.

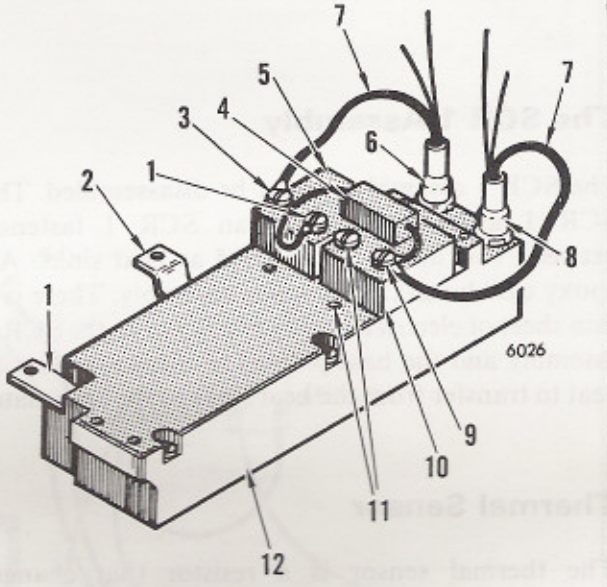
D. Install the new SCR 1 assembly. Make sure the heat sinks make full contact with the insulator and base plate. Check the resistance between both heat sinks and the base plate with an ohmmeter. A correct installation will indicate infinity.

E. Install the electrical connections.

THE INDUCTOR AND CAPACITOR ASSEMBLY (THE "OFF" CIRCUIT FOR SCR 1)

WARNING

Make sure you disconnect the battery and separate the connector before you disassemble any part of the controller. Make sure you also discharge capacitor C1.



1. T1 (TO SCR 1 CATHODE)
2. T2
3. T4
4. INDUCTOR RESISTOR
5. SCR 5 FILTER
6. SCR 5
7. CATHODE WIRES
8. SCR 2
9. 1X
10. SCR 2 FILTER
11. T3
12. TRANSFORMER AND INDUCTOR ASSEMBLY

FIGURE 9. THE PULSE TRANSFORMER AND INDUCTOR ASSEMBLY

There is an inductor and a capacitor assembly for the traction circuit. This assembly generates the reverse polarity voltage to change the SCR 1 to "OFF" for each pulse. This assembly has the following parts:

- Transformer and inductor assembly
- SCR 2 and heat sink
- SCR 5 and heat sink
- Suppressors for SCR 2 and SCR 5
- Capacitor C1

The transformer and inductor assembly is a plastic case that fastens to the base plate. This assembly is also the mount for the other parts.

The normal repair of the transformer and inductor assembly is to replace it. There are four screws that hold the inductor assembly to the base plate.

Checking The Transformer and Inductor Assembly

A fault in the transformer assembly does not often occur. Most faults that do occur at the transformer assembly are caused by loose internal connections. A transformer assembly will not normally indicate a fault except during the stress in an operating circuit. A check with an ohmmeter between T1 and T2 or between T3 and T4 will indicate an open circuit. A good transformer winding will indicate approximately zero ohms.

NOTE

The 72-80 volt lift trucks do not use a transformer winding between T1 and T2 because the inductance from the power cables is great enough to charge capacitor C1. There is a cable connection at T1, but T2 is removed on the 72-80 volt lift trucks.

Checking the Suppressors for the SCR 2 and SCR 5

The suppressors are a resistor and capacitor in series inside a plastic case. The suppressors prevent damage to the SCRs from electrical noise. To check the SCR suppressors, remove the suppressors from the transformer and inductor assembly. Touch the probes of an ohmmeter to the terminals. The indicator will begin to move toward the low resistance direction and then return to infinity. A bad suppressor can cause a fault that does not occur regularly during lift truck operation. A bad suppressor can also cause a fault similar to a bad SCR 2 or bad SCR 5.

NOTE

Checking these suppressors for a short-circuit can be difficult. Sometimes these suppressors will not indicate a defect except during the stress in an operating circuit.

The inductor resistor has a resistance of 4.75 to 5.25 ohms when checked with an ohmmeter.

Checking the SCR 2 and SCR 5

See also the "Quick Check": procedure for an SCR on page 27.

The heat sink and mount for the SCR 2 and SCR 5 are part of the pulse transformer and inductor assembly. The heat sink is also the anode connection for the SCR. There are three wires connected to the SCR. A large black wire is the cathode wire. The white wire is the supply for the gate signal. The red wire is a sensor connection for the control card. The red wire is connected to the cathode wire at the junction of the SCR.

Replacing the SCR 2 and SCR 5

CAUTION

Do not use a hammer and punch to loosen or tighten the SCRs.

NOTE

Make an identification of the wires before you disconnect them. The wires must be connected again in the correct positions.

NOTE

Silicon compound is used between the heat sinks and the parts of the controller. The purpose of this compound is to fill in the micrometer size spaces between the parts to give better heat flow. Always use a very thin layer of compound between the parts. Too much compound will be an insulator and cause both electrical and heat faults. It is better to use no compound instead of too much. There are two types of compounds:

- **Part number 304408 is a silicon bearing grease and is used between the SCRs, diodes, and their heat sinks.**
- **Part Number 1198757 is a silicon compound and is only used between heat sinks and the base plate. This silicon compound must be used only as a very thin layer. DO NOT USE this silicon compound on SCRs and diodes.**

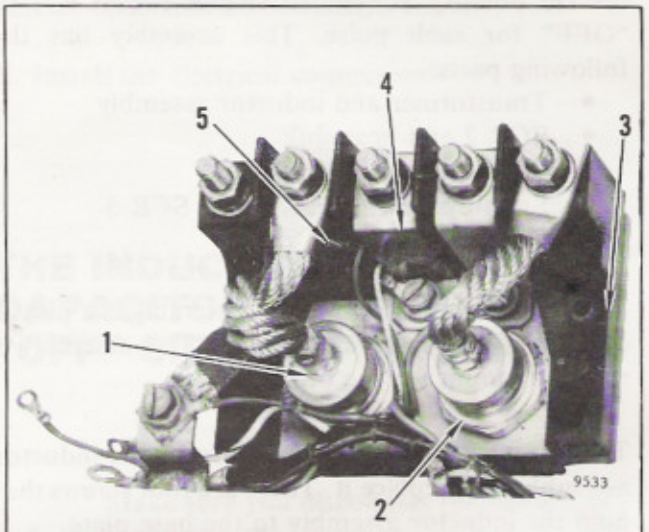
Disconnect the wires to the SCR. Use a deep socket to remove the SCRs. Put the wires through the top of the socket and use a handle or wrench to turn the socket. Use a thin layer of silicon grease (Part Number 304408 or approved equivalent) between the surfaces of the heat sink and the replacement SCR. Tighten the SCR to a torque of 3.4 N.m (30 lbf ft).

Checking The Capacitor C1

FIGURE 10. THE CAPACITOR C1

The capacitor C1 is connected to the transformer and inductor assembly. To check C1 for a short-circuit, discharge C1 and disconnect the terminals. Measure the resistance between the terminals. The ohmmeter will indicate a low resistance and increase to more than 100 000 ohms. A capacitor with a short-circuit must be replaced.

D 3 And D 4 Heat Sink Assembly



1. D 3
2. D 4
3. HEAT SINK
4. MOTOR CURRENT SENSOR
5. D 3 SUPPRESSOR

FIGURE 11. THE D 3 AND D 4 HEAT SINK ASSEMBLY

The heat sink assembly for the diodes D 3 and D 4 is also the connection for the power cables. A suppressor for D 3 and the motor current sensor is connected to this assembly. The heat sink assembly is connected to the base plate. A thin insulator with a silicone surface separates the heat sink assembly from the base plate.

Checking The Diodes D 3 and D 4

You will need a Cir / Kit or an ohmmeter to check the rectifiers. Disconnect the cathode wires from the connectors. The diodes can stay attached to the heat sinks to make checks.

Touch the probes of the Cir / Kit or ohmmeter to the heat sink and the cathode wire. Measure the resistance. Change the probe connections to the reverse direction and measure the resistance. A good diode will indicate 7-14 ohms on the RX1 Scale in one direction and greater than 50 000 ohms in the other direction.

Replacing The Diodes D 3 and D 4

CAUTION

Do not use a hammer and punch to loosen or tighten the diodes.

Disconnect the wire to the rectifier. Use a deep socket to remove the diodes. Put the wire through the top of the socket and use a handle or wrench to turn the socket. Use a thin layer of silicone grease (Part Number 304408) between the surfaces of the heat sink and replacement diode. Tighten the diode to a torque of 30 inch pounds (3.4 N.m).

NOTE

The D 3 has a suppressor connected in parallel to the diode. The suppressor is a capacitor and resistor in series. This suppressor can be checked like the suppressors described on page .

MOTOR CURRENT SENSOR

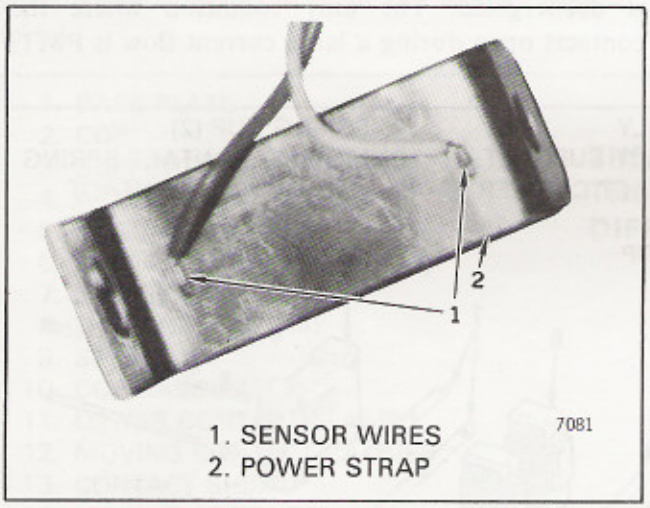


FIGURE 12. MOTOR CURRENT SENSOR

The motor current sensor is a shunt with two sensor wires connected. All of the traction motor current flows through this power strap. The metal between the connection points of the sensor wires has a small resistance. This small resistance between the two sensor wires sends a voltage signal to the control card. The voltage signal increases as the motor current increases. The control card compares the voltage with the "C/L" current limit adjustment. The control card controls the current flow so that the traction circuit is not damaged.

THE ELECTRONIC DRIVER MODULE

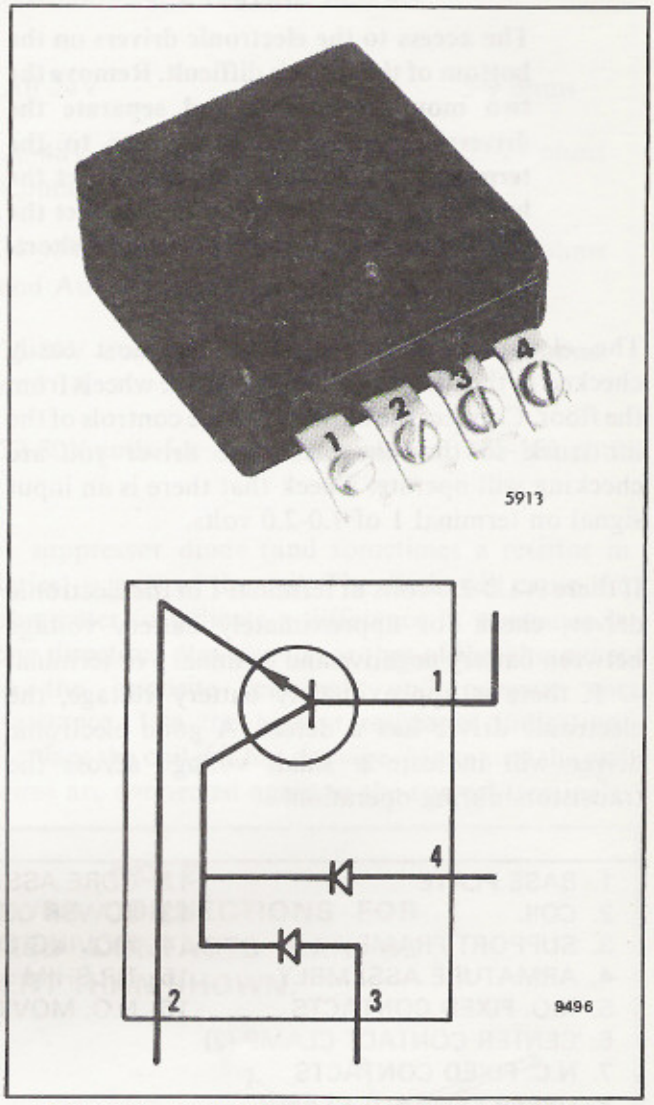


FIGURE 12. THE ELECTRONIC DRIVER MODULE

The electronic drivers are solid-state switches. The small voltage from the control card controls the operation of the electronic drivers. The electronic driver controls the operation of the contactors. The electronic drivers are in a stack and connected to the base plate of the controller. The following list is the normal arrangement for the stack:

- the PMT electronic driver is on the bottom next to the base plate.
- the electronic driver for field weakening (if used) will be in the middle.

- the electronic driver for 1A (if used) will be on top of the stack.

NOTE

The access to the electronic drivers on the bottom of the stack is difficult. Remove the two mounting screws and separate the drivers as necessary for access to the terminals. Make sure you disconnect the battery when you separate or connect the electronic drivers. Do not cause a short-circuit.

The electronic driver modules are most easily checked in the lift truck. Raise the drive wheels from the floor. Connect the battery. Set the controls of the lift truck so that the electronic driver you are checking will operate. Check that there is an input signal on terminal 1 of 1.0-2.0 volts.

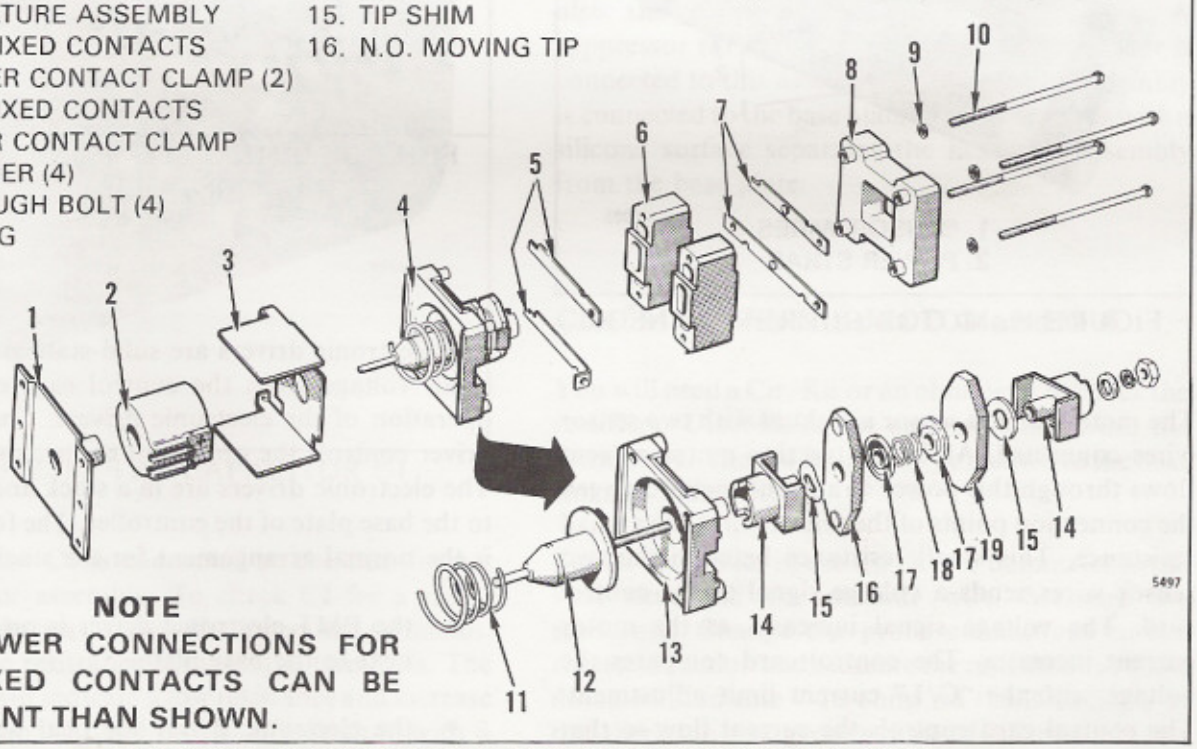
If there is 1.0-2.0 volts at terminal 1 of the electronic driver, check for approximately battery voltage between battery negative and terminal 3 or terminal 4. If there is approximately battery voltage, the electronic driver has a defect. A good electronic driver will indicate a small voltage across the transistors during operation.

"FORWARD" AND "REVERSE" CONTACTORS

The "FORWARD" and "REVERSE" contactor assemblies control the direction of current flow through each traction motor. The contactor is a heavy-duty switch that opens and closes the power circuit. The traction circuit has a "FORWARD" and "REVERSE" contactor assembly. Each contactor assembly has the following parts: two sets of normally open (NO) contacts, two sets of normally closed (NC) contacts, and a coil. The coil is an electromagnet that moves the NO contacts to the closed position against spring pressure. The coil is in the control circuit. The contactor tips are in the traction circuit. A suppressor is part of each coil.

When a contactor coil is energized, the normally open (NO) contacts close and the normally closed (NC) contacts open. This action gives a direction control to the traction motor. The contacts normally have a long service life because the current flow through the contacts is stopped before the contacts open. The SCR 1 is "OFF" before the contactor coil is deenergized. The only condition where the contacts open during a large current flow is PMT.

1. BASE PLATE
2. COIL
3. SUPPORT FRAME
4. ARMATURE ASSEMBLY
5. N.O. FIXED CONTACTS
6. CENTER CONTACT CLAMP (2)
7. N.C. FIXED CONTACTS
8. UPPER CONTACT CLAMP
9. WASHER (4)
10. THROUGH BOLT (4)
11. SPRING
12. CORE ASSEMBLY
13. LOWER CONTACT SUPPORT
14. MOVING CONTACT CARRIER (2)
15. TIP SHIM
16. N.O. MOVING TIP
17. SPRING CUP (2)
18. MOVING CONTACT SPRING
19. N.C. MOVING CONTACT



NOTE
THE POWER CONNECTIONS FOR THE FIXED CONTACTS CAN BE DIFFERENT THAN SHOWN.

FIGURE 14. "FORWARD" AND "REVERSE" CONTACTOR

CONTACTOR REPAIR

The normal repair to the contactor assembly is the replacement of the contacts, coil and the complete assembly.

Removing A Contactor Assembly

Make an identification and disconnect the wires and cables from the contactor assembly. Remove the mounting screws and remove the contactor assembly.

Contactor Contacts

The contactor contacts are made of special silver alloy. The contacts will look black and rough from normal operation. This condition does not cause problems with the operation of the lift truck. Cleaning is not necessary. DO NOT USE A FILE ON THE CONTACTS. DO NOT LUBRICATE THE CONTACTS. Replace the contacts when the silver alloy is worn away to the copper support metal.

Coil (See Figure 14)

Check the coil with an ohmmeter. The typical resistance for a coil is as follows:

All 24V	5-9 ohms
36-48V Coil for Direction Contactor	23-29 ohms
36-48V Coils for 1A, FW and Aux. Plugging	30-40 ohms
72-80V Coils for Direction and 1A	72-88 ohms
72-80V coils for Aux. Plugging	125-150 ohms

A suppressor diode (and sometimes a resistor in series) is part of the coil. The diode will cause the ohmmeter to indicate a difference in resistance in one direction. Reverse the probes of the ohmmeter to the opposite terminals and measure the resistance. Use the highest resistance indication. Replace the coil if it has damage. Make sure the coil wires are connected again to the correct terminals.

1. BASE PLATE
2. COIL
3. SUPPORT FRAME
4. ARMATURE ASSEMBLY
5. FIXED CONTACTS
6. UPPER CONTACT CLAMP (2)
7. WASHER (4)
8. THROUGH BOLT (4)
9. SPRING
10. CORE ASSEMBLY
11. LOWER CONTACT CLAMP
12. MOVING CONTACT CARRIER
13. CONTACT SHIM
14. MOVING CONTACT
15. MOVING CONTACT SPRING
16. SPRING CUP

NOTE
THE POWER CONNECTIONS FOR THE FIXED CONTACTS CAN BE DIFFERENT THAN SHOWN.

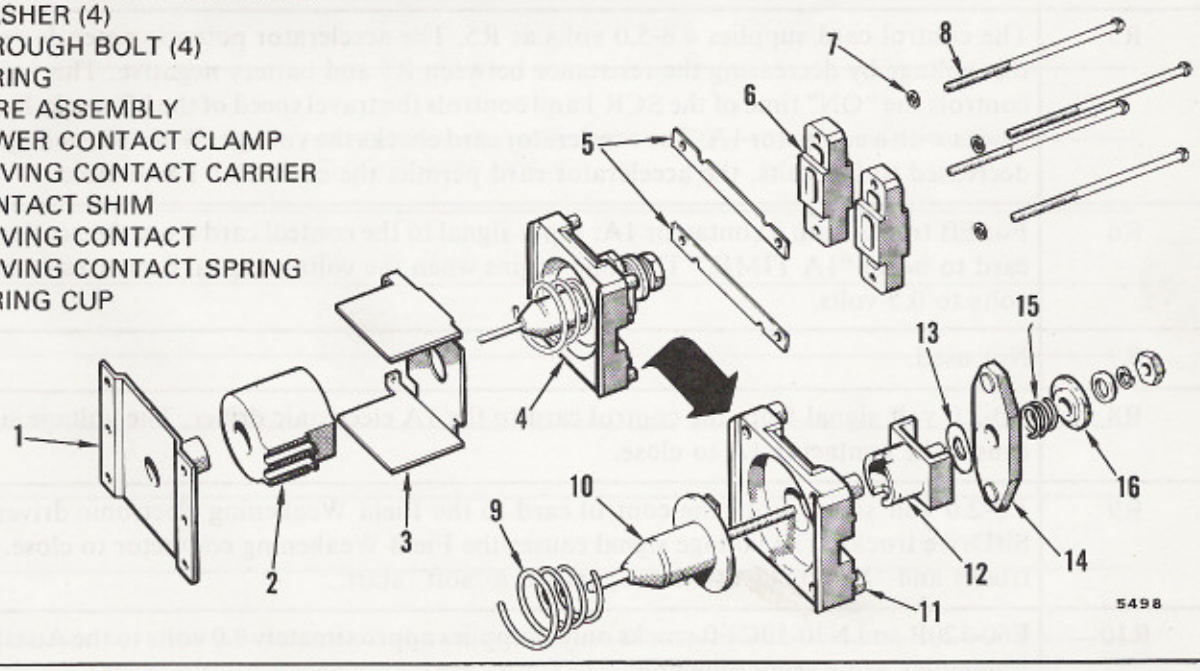
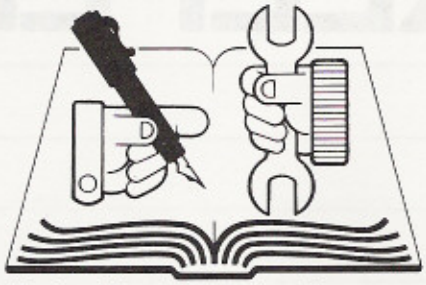


FIGURE 15. PUMP, 1A OR FW, CONTACTOR, EXPLODED VIEW

TABLE 1. DESCRIPTION OF CONTROL CARD TERMINALS

TERMINAL NUMBER	FUNCTION
L1	Not used.
L2	Not used.
L3	Battery positive to the control card. This voltage also resets the SRO check and the PMT circuit.
L4	Not used when lift truck has MONOTROL pedal. On lift trucks with a direction control lever, this terminal is connected to L7. This connection is so that the SRO check does not deenergize the controller when the direction switch is in the neutral position.
L5	Input for the SRO check. A four volts or greater signal must be received at this terminal before a voltage signal is applied at L9 or L10.
L6	Not used.
L7	Input for the SRO check. The controller is deenergized if battery voltage is removed from this terminal for more than 0.75 seconds after voltage is applied at L9 or L10.
L8	Not used.
L9	Battery voltage from the direction switch for the "FORWARD" direction.
L10	Battery voltage from the direction switch for the "REVERSE" direction.
R1	Test point for 8.2 volt power supply.
R2	Not used.
R3	Supplies 1.0-2.0 volt control signal to PMT electronic driver. Less than 0.5 volts is a PMT signal.
R4	Not used. Electrically the same point as battery negative.
R5	The control card supplies 4.8-5.0 volts at R5. The accelerator potentiometer decreases this voltage by decreasing the resistance between R5 and battery negative. This voltage controls the "ON" time of the SCR 1 and controls the travel speed of the lift truck. For lift trucks with a contactor 1A: The accelerator card checks the voltage. When the voltage has decreased to 0.5 volts, the accelerator card permits the contactor 1A to close.
R6	For lift trucks with a contactor 1A: Input signal to the control card from the accelerator card to begin "1A TIME." The time begins when the voltage signal decreases from 8.0 volts to 0.5 volts.
R7	Not used.
R8	1.0-2.0 volt signal from the control card to the 1A electronic driver. The voltage signal causes the contactor 1A to close.
R9	1.0-2.0 volt signal from the control card to the Field Weakening electronic driver for SitDrive trucks. The voltage signal causes the Field Weakening contactor to close. "R" trucks and "N" trucks use this signal for a "soft" start.
R10	E60-120B and N30-50C lift trucks only: Supplies approximately 8.0 volts to the Auxiliary Plugging Card during plugging.



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