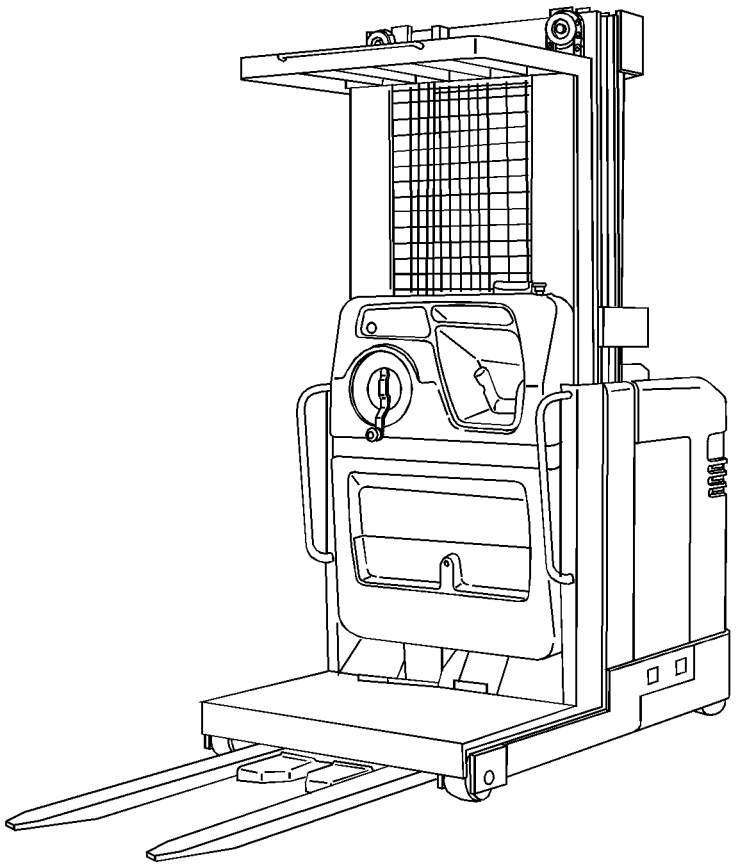
MITSUBISHI
FORKLIFT TRUCKS

SERVICE MANUAL

EOP15	**1EOP240500-up**
EOP24	**1EOP240500-up**
EOP15P	**1EOP240500-up**
EOP24P	**1EOP240500-up**



Quality Makes the Difference

WENB8560-01

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Overhead guard

The Overhead Guard is constructed of steel tubing and bar stock. The overhead guard covers the floor area to protect the operator and complies with ANSI specification B56.1. A bar at the rear of the guard provides an attachment point for the tether.

Tether

The Tether is a device which is worn around the waist of the operator whenever the truck is operated. The tether prevents the operator from falling from the carriage.

Operator's Controls

The operator's compartment provides the operator with complete control of the vehicle. The controls have been designed for operator safety, efficiency, and comfort.

Steering control and the key switch are located on the left side of the operator's console. The travel/lift/lower control, horn button, wire guidance on/off switch (optional), and emergency stop are located on the right side of the operator's console.

The upper portion of the operator's console has an accessory bin for storing pencils, pens, clipboards, picklist, etc.

For trucks equipped with electronic power steering, five drive unit position lights are located above the steering wheel. Additionally, vehicles equipped with wire guidance will have the "Locked-on-Wire" light located next to the wheel position indicator.

A kill switch (deadman) pedal is located on the compartment floor. The pedal is spring loaded to the power off/brake engaged position. The pedal disables the travel and lift/lower circuits and applies the brake whenever the pedal is released.

Operator Compartment Options

The following components are available per customer request (partial list):

- Fan
- Dome Light
- Work Lights

Maintenance Displays

Additional maintenance displays are provided for Service Technician use:

- All trucks have a display mounted on the Interface Card Assembly (visible when the cover is removed).
- Trucks equipped with the electronic power steer option will have a seven-segment display mounted on the Steer Controller Card Assembly.
- Trucks equipped with the wire guidance option will use the display mounted on the Operator's Console for testing purposes.

Trucks equipped with Electronic Power Steering, but not the wire guidance option, may require the technician to use a Display Board and Keypad tool to diagnose the system.

Electronic Control System

Interface Card Assembly

The Interface Card Assembly forms the core element for the truck electronic control system, and functions as an interface between the Operator Control Handle Assembly and the EV100LX Control System for travel system control. It is also used to control lift/lower, and checks data transfer from the Electronic Power Steering System (if equipped). The card can shut down the system via the Brake Dump Solenoid or the Power Disconnect Contactor if it detects critical malfunctions. It is equipped with DIP switches that allow different options to be turned on or off and for system configuration.

K1 Relay Coil: Supplies negative battery voltage to the horn, completing a circuit from B+ to B- across the horn assembly.

K2 Relay Coil: Supplies positive battery voltage to the forward and reverse contactor coils when S2 switch is closed, via the EV100 control.

Carriage Wiring Board

The Carriage Wiring Board is located on the operator's platform, below the directional/speed control. The Carriage Wiring Board is an interface between all carriage controls and the over-the-mast cables. Shunts (P/N 0907249) located on the Carriage Wiring Board (electronic steer vehicles only), allow the service technician to select the vehicle voltage. Replacement Carriage Wiring Boards do not contain any shunts. The shunts must be removed from the old board and installed on the new one. It also is used to calculate the status of three switches (S11, S3, S45), via the "combo" line.

Options

Wire Guidance

Wire guidance allows the truck to maintain a straight path automatically, without steering assistance from the operator.

Functional Inspection

Before putting a vehicle into operation, the installation checks shown on the next page should be performed by a Certified Mitsubishi Dealer Technician.

At the same time, the Mitsubishi installation report should be completed and forwarded to Mitsubishi's Warranty Division.

Vehicle Operation

Refer to the Operation and Maintenance Manual to help perform the functional inspections.

Warranty

The installation report starts the Mitsubishi warranty on the vehicle. Failure to complete the installation report may nullify the warranty on the vehicle.

What To Look For

Using the list of functional inspections on the following page as a guide, ensure the vehicle meets the following (report any discrepancies or deficiencies in the vehicle immediately):

- The general operation of the vehicle.
- Does it meet Mitsubishi specifications?
- Is the unit built to satisfy the sales order?

Operator's Daily Checklist

For safe and efficient operation, complete the following checks at the beginning of each day or shift of operation. Report any malfunction to the Service Department. **Do not operate the truck until it is repaired.**

If you are not qualified to inspect the truck, or if you do not understand the proper inspection procedure (see Scheduled Maintenance - Chapter 5), contact the authorized Mitsubishi Forklift dealer.

Visual Checks

1. Battery:
   - Proper voltage
   - Fully charged
   - No leakage
   - Installed properly with secure fastening
   - Connector in good condition and properly attached to mating connector
2. Guards and covers properly installed.
3. The wearable surface of the drive and load wheels must not be damaged. They must have adequate material remaining.
4. Lift chains should be in place and properly lubricated.
5. Hydraulic hoses should be in good condition.
6. Warning and accessory lights should operate.
7. Safety decals should be in place and should be legible.
8. All controls should return to neutral when released.
9. General inspection (such as leaks, bent forks, abnormal sounds, cracked welds, loose hardware, etc.).

Operational Checks

1. Lift/lower - smooth and responsive to commands.
2. Auxiliary functions - operate when control is activated.
3. Brakes - travel slowly and check that brakes work. With a rated load and at full speed, the truck should stop within 6 to 11 feet (1.83 to 3.35 meters).
4. Directional/speed control - truck motion should be smooth and should respond to commands throughout all speed ranges.
5. Steering - smooth without binding or excess play.
6. Horn - sound it.
7. Kill (deadman) switch pedal - should disable travel and apply brake when released.
8. Emergency Off button - should disable travel and lift circuits when depressed.

Configure Mode Standard Features

The following items are available when the correct Password is entered.

Configure Menu and Submenus		
Menu	**Sub-menu**	**Description**
DEFAULT	Reset? N Reset? Y	Restore all defaults to factory settings.
UNITS		Select between English and Metric
	ENGLISH*	
	METRIC	
GUIDANCE[3]		Selects between wire and rail guidance. This will only appear if both options are installed on the truck.
	NONE	
	WIRE	
	RAIL	
WIREFREQ[3]		Select wire guidance frequency
	5.25 kHz	
	6.2 kHz	
	OTHER	
GUIDESET[3]		Set heading angle and distance from wire.
	HA SLOW	0.6° to 2.0° in 0.2° increments. Factory default = 1.6°
	HA STOP	2.0° to 4.0° in 0.2° increments. Factory default = 3.0°.
	DFW SLOW	0.6" to 1.6" (1.5 - 4.0 cm) 0.2" (5 cm) increments. Factory default = 1.6" (4.0 cm)
	DFW STOP	1.2" to 3.0" (1.5 - 4.0 cm) in 0.2" (5 cm) increments. Factory default = 3.0" (7.6 cm).
ConfigWr		Enter New Configure Password (default is 2).
	XXXXXXXX[1]	Current displayed.
VERSION	Quit Ver	Display software version
	DC	xx.y (Software version for Display Controller)
	ESA	xx.y (Software version for Steer Controller)
QUIT	SAVE? N SAVE? Y	Exit configure mode. Allows user to save or abandon any changes.

[1]XXXXXXXX are variables entered by the individual using Configure Mode.

[2]Denotes Factory Default setting.

[3]Visible only if option is purchased.

EV100LX Control Panel

The Orderpicker has speed ranges from 0-5.9 mph (9.4 km/hr) in both forward and reverse directions. Infinite selection of speeds is obtained through the use of a main SCR. The SCR is turned on and off to control the flow of electricity to the drive motor; the on and off time varies from 1.8 to 20 milliseconds. At creep speed, the main SCR is on for 1.8 milliseconds and off for 20 milliseconds; at top control speed, the time sequence is reversed. Because of a small voltage drop across the Silicon Controlled Rectifier, maximum speed is obtained by bypassing the SCR and connecting the drive motor directly across the battery using the "1A" contactor. Refer to the component identification drawing (Figure 4-1) and the simplified schematic (Figure 4-2).

This section describes:

- System Components
- Control Features
- Basics of Circuit Operation

System Components

Silicon Controlled Rectifiers

The SCR is basically an electrically controlled on/off switch. The SCR has a positive side (anode), a negative side (cathode), and a gate. When the SCR is gated, current can pass through; when the SCR is turned off, no current can pass.

NOTE: In the schematic diagrams, current flows in the direction the arrow is pointing.

The SCR is turned on by applying the correct voltage to the rectifier control leads. It is turned off in two ways:

1. By placing a positive charge on the negative side of the SCR that is greater than the battery positive.
2. By placing equal charges (both positive and negative) on both sides of the SCR.

There are three SCRs in the EV100 LX Control; although each works in the same manner, each serves a different function.

#1 Rectifier (REC1)

The REC1 rectifier is the main rectifier in the power circuit and provides switching effect for current flowing through the drive motor. When the rectifier is turned on, power flows through the drive motor; when it is turned off, power to the motor is turned off.

#2 Rectifier (REC2)

The REC2 rectifier is a switching device used with the capacitor to turn off the #1 Rectifier (REC1).

#5 Rectifier (REC5)

The REC5 rectifier is used as the 1-C capacitor charging switch.

Wiring Conventions

The wiring cables and harnesses are identified to give an indication of what subsystem they are connected to. Below is a table of contents of the code sleeve identifications which are used on the cables and their related systems:

Code Sleeve Identification	Attached to...
JPS	Interface Card
PA, PB, PC, PT, PY, PZ	Connections on EV100LX Controller
JPC	Operator's Carriage
JPW	Electric Steering/Wire Guidance
JP	Standard Wiring

Lift/Lower

1. Moving the Lift/Lower control out of the neutral position will cause the voltage from potentiometer VR2 to change. This voltage goes into the Carriage Wiring Board at JPC9-5 to JPC11-8, through the mast cable and into the Interface Card at JPS25-7. The Interface Card determines whether a lift or lower operation is desired based on this voltage.
2. If a lift has been requested, the Interface Card will turn on the “P” coil driver which provides a ground for the "P" contactor at JPS4-2. As the "P" contactor is energized, voltage is applied to the lift motor MP and the carriage will lift. The lift motor/lift pump assembly supplies hydraulic pressure and flow to the lift system. The operator’s platform will elevate at a single rate, regardless of the position of VR2 as long as VR2 is in the lift range.
3. If VR2 is in the lower range, the voltage is applied to the Interface Card as described above. The Interface Card will now, however, activate SOL1 which is the load holding solenoid. When this solenoid is activated, hydraulic fluid will flow from the lift cylinders back to the reservoir. The Operator’s Platform will lower at a constant rate of speed.

Emergency Lower

Provisions are made to lower the carriage to the ground when emergencies occur. Refer to Figure 4-5.

1. When the Emergency Lower Valve is opened, hydraulic fluid is allowed to pass through the emergency lower valve at a constant rate.

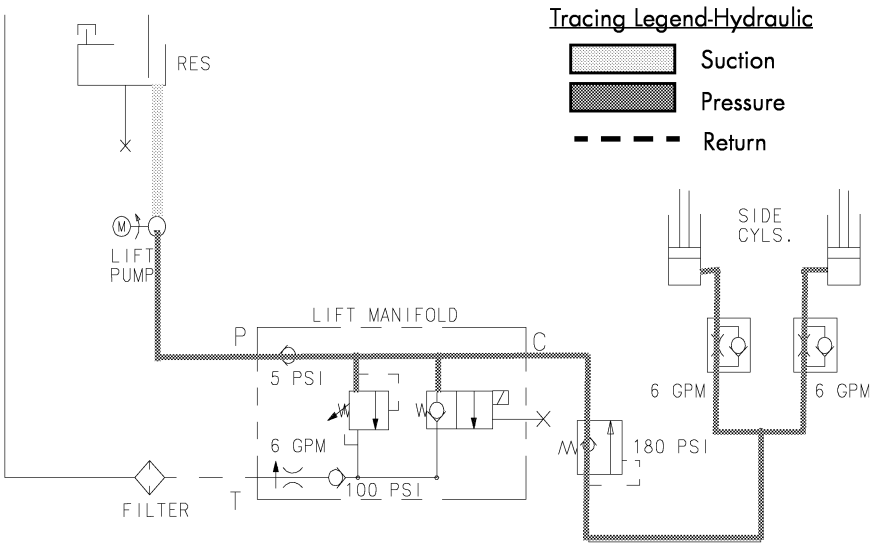


Figure 4-3: Schematic - Hydraulic, Single Speed Lift (Two-Stage, Manual Steer Shown)

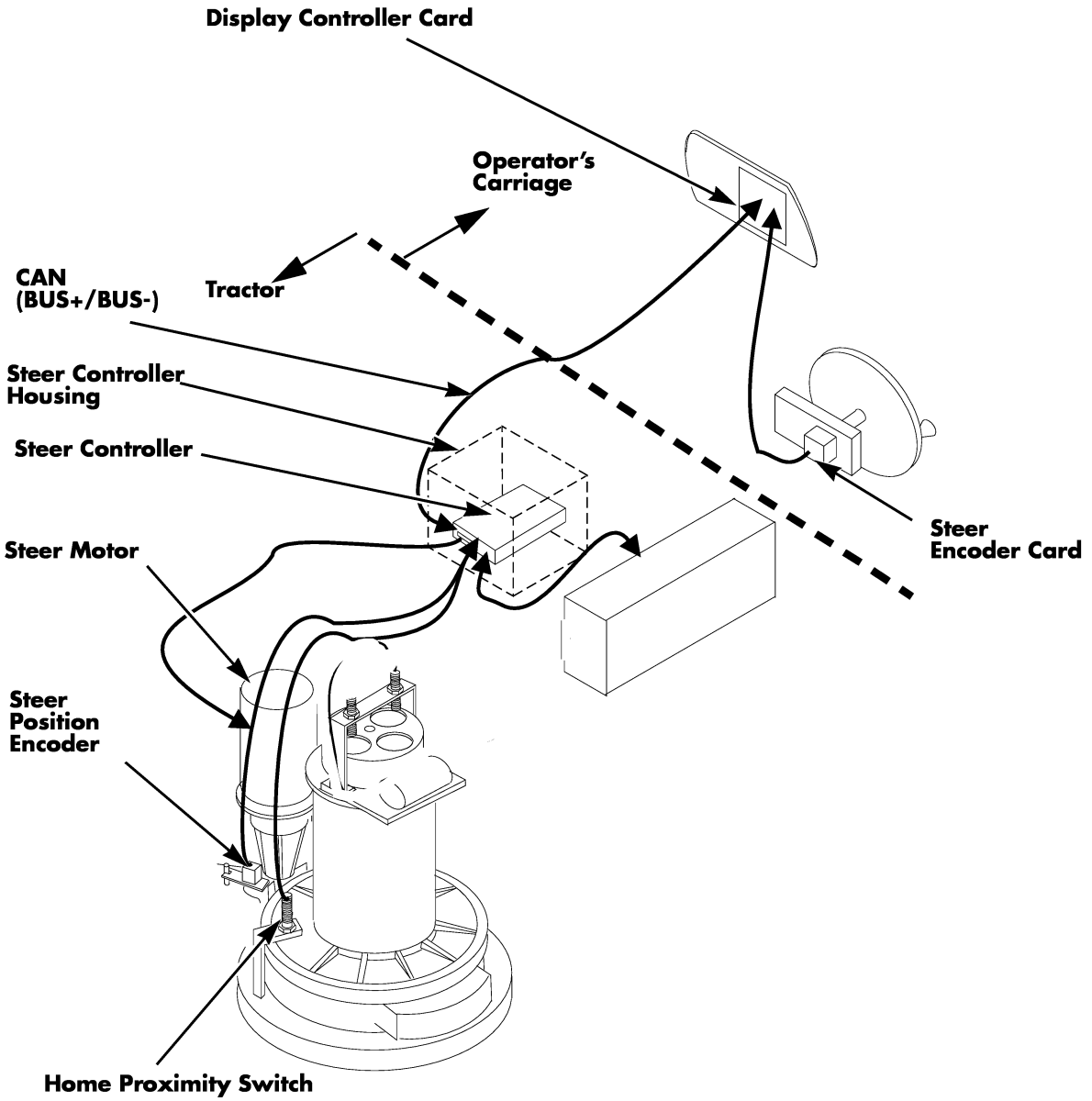


Figure 4-9: Steering Signal Paths (without wire guidance)

Carriage Wiring Board

The Carriage Wiring Board is located on the operator's platform, below the directional/speed control. The Carriage Wiring Board is an interface between all carriage controls and the over-the-mast cables.

Shunts located on the Carriage Wiring Board (electronic steer vehicles only), allow the service technician to select the vehicle voltage. Replacement Carriage Wiring Boards do not contain any shunts. The shunts must be removed from the old board and installed on the new one.

BUS +/BUS-

These lines are used for communication between the Steer Controller Card and Display Controller Card.

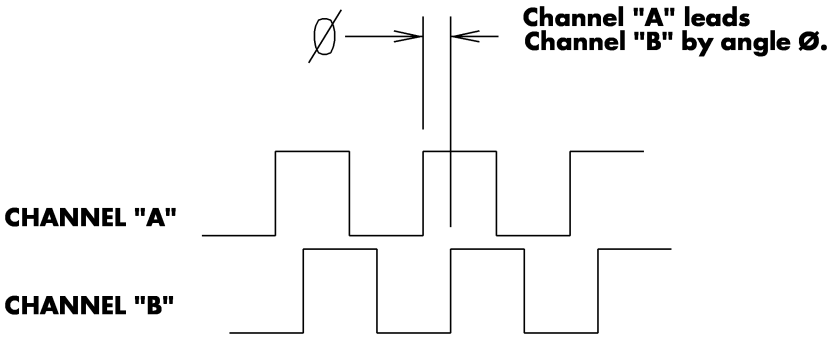


Figure 4-15: Steering Encoder Output - Left Turn

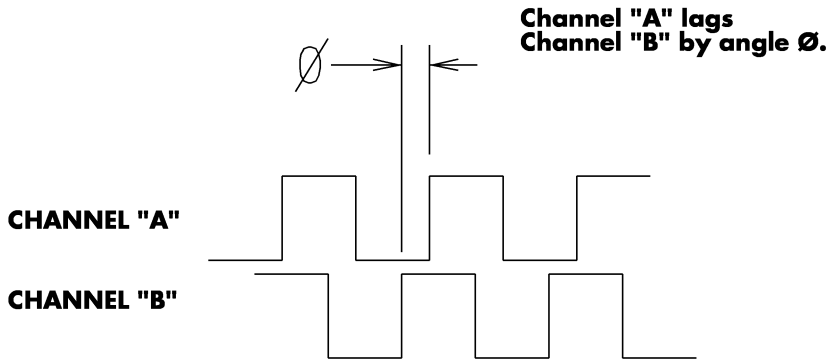


Figure 4-16: Steering Encoder Output - Right Turn

Learn Steer

1. Before beginning this portion of Learn, jack the tractor up so the drive tire is off the floor.

⚠WARNING

Use extreme care whenever the truck is jacked up for any reason. Never block the truck between the telescopic and the floor. Use a suitable hoist to stabilize the mast. Keep hands and feet clear from beneath vehicle while jacking. Use jack stands or solid blocks to support truck, do not rely on jacks.

When "Steer" is selected from the Learn menu the following message appears:

"Jack up drive unit and block vehicle" "Ready?"

This message will continue to scroll across the display until the "Enter" button is pressed.

2. Press the "Enter" button; the following message appears:

"Step on deadman to start test"

After depressing the deadman, this message is displayed:

"Learning steer unit, to ABORT press enter"

Power is now applied to the steer motor. The drive unit turns in both directions. This process determines the minimum power to steer the drive unit.

After determining the minimum power, the drive unit is steered 80^{o} to the left and 45^{o} to the right. This determines the steering rate.

If the system does not sense either the position feedback sensor or the "Home" sensor, the Learn sequence fails. A failure causes the following message to appear:

"Unable to learn ... press ENTER to continue"

NOTE: If repeated failures are encountered, run tests I51 on page 6-147 and I54 on page 6-150.

When the Learn process is complete, "Done Learning" will be displayed.

5. To install a new IC into the socket:
   a. Note that one corner of this type of IC is beveled. Also note that the corresponding corner of the socket is also beveled.
   b. Align these two beveled corners and gently press the IC into the socket.

⚠ CAUTION

If forced, the EPROM can be installed incorrectly (so the beveled corners do not match). This will damage the EPROM and/or socket board.

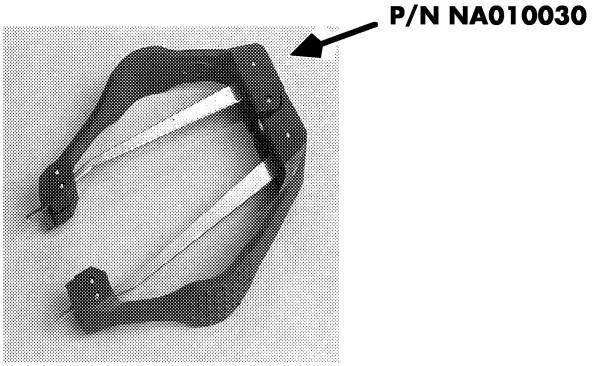


Figure 5-3: Integrated Circuit Tool

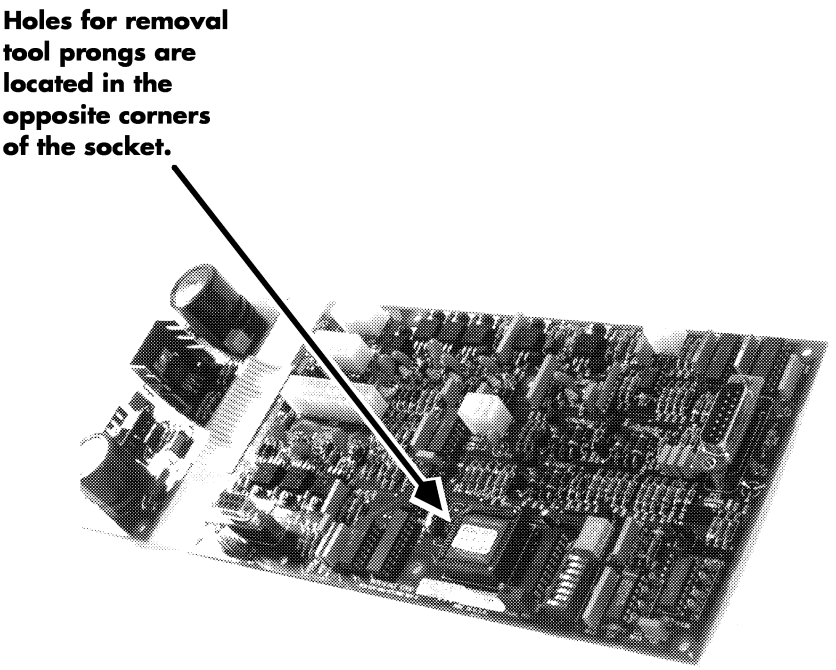


Figure 5-4: Installation of Integrated Circuit

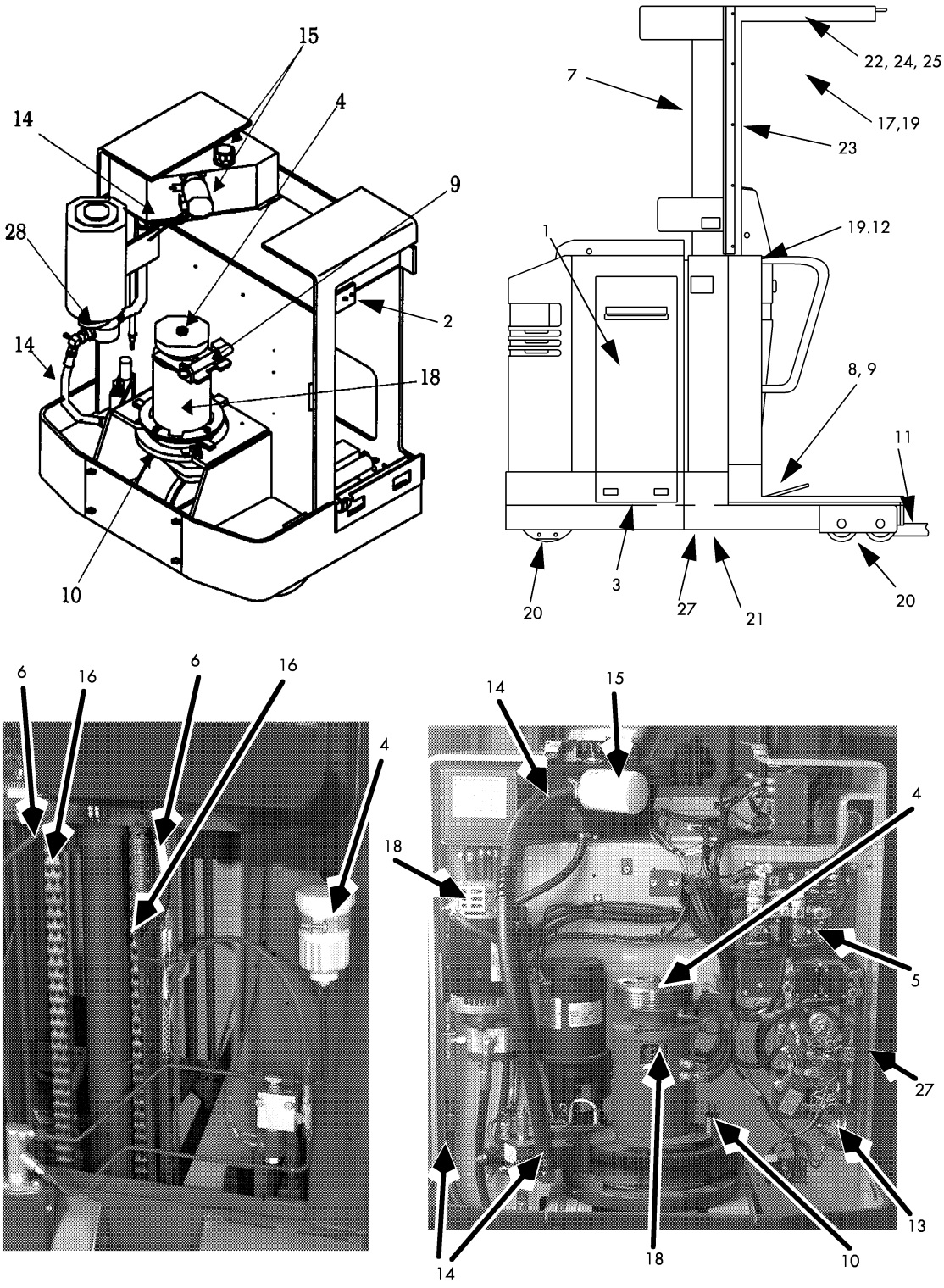


Figure 5-8: Lubrication/Inspection Points

Motors

All motors are designed to operate with a minimum of maintenance. Sealed bearings are used in all motors thereby eliminating lubrication. Included in the motor section are the following maintenance procedures:

- Motor Cleaning
- Brush Care
- Commutator Care
- Prevention of Motor Overheating
- Open Circuit Test
- Short Circuit Test

The procedures, along with periodic inspection help to provide trouble-free motor performance.

Motor Cleaning

Periodic motor cleaning is essential to prevent overheating and electrical grounds. To clean the motor properly, use the following procedure:

1. Wear safety glasses. Use clean, dry, low pressure air [30 psi, (207 kPa)], to blow carbon dust and other foreign materials from:

- Motor Housing
- Brush Holders
- Commutator
- Field and Armature Windings (if accessible).

Adjustment and Repair

Power Section

The following procedures are recommended for repair/replacement of the mechanical drive systems.

Drive Transmission Service

Maintenance or replacement of components used in the drive transmission are limited to the following:

- Steering Gear
- Pivot Bearing and Related Components
- Drive Axle
- Axle Oil Seal
- Cover
- Miscellaneous Hardware

NOTE: The parts manual will list specific part numbers for serviceable items. Any major rework/service which the drive unit may need will require the drive unit to be sent back to the factory.

Drive Unit Removal

The tools required will vary slightly depending on the type of steering system used. In general, the following hand tools should be available:

- 14 mm Apex (allen)
- 10 mm Apex
- 10 mm Socket
- 10 mm Combination wrench
- 19 mm Socket (bumper removal)
- 21 mm Socket (wheel lug nuts)

1. Disconnect battery.
2. Remove screws [1] holding bumper to truck (19 mm socket), then bumper [2].
3. If the truck is wire guided, remove the sensor near the front bumper.
4. If the drive tire is to be removed, loosen the lug nuts, using a 19 mm socket.
5. Remove proximity sensor(s) and associated hardware on the drive unit casting.
6. Remove drive motor. See Figure 5-15.

NOTE: If the drive unit is the only item requiring service, separating the brake assembly from the drive motor is not necessary.

7. Jack and block the tractor end so that the weight of the truck is removed from the drive tire. See WARNING.

Brake

Brake Adjustment

Brake adjustment should be checked regularly. When the truck is carrying its rated load and traveling at full speed on a level floor, the brake should stop the truck within 6 to 10 feet. Do not adjust the brake to stop the vehicle in less than 6 feet.

Brake Adjustment Procedure

Loosen the set screw [28], Refer to Figure 5-30 on page 5-51 for numbers in [brackets].

Turn the plug [29] clockwise for quicker stopping and counterclockwise to increase the stopping distance.

Brake Inspection

If the brakes cannot be adjusted by the adjustment procedure, inspect the brake shoes [8]. Use the following procedure:

Brake Inspection Procedure

1. Disconnect the battery.
2. Remove nut [1].
3. Hold the deadman pedal in the down position to release pressure on the brake drum [2].
4. Lift the brake drum [2] off.
   - Inspect the brake shoes [8].

IF...	THEN...
The brake material is worn through, extremely thin or loose on the shoe.	Replace the brake shoes.
The brake shoes are usable.	Go to Step 5.

5. Loosen the nut [12]. Lift brake control lever [11] off and reposition one or two serrations to the left. Retighten nut [12].
6. Reassemble the brake drum.
7. Readjust plug [29] to give a stopping distance of 6 to 10 feet.
8. After adjusting the stopping distance (Step 7), ensure the brake does not drag when the deadman pedal is fully depressed.

Center Lift Cylinder (3-Stage) Reassembly

1. All packings and O-rings (except O-ring, item 15) to be dipped in new, clean system hydraulic fluid before assembly. (See Figure 5-34 & Figure 5-35 on page 5-57).
2. Lubricate inside of cylinder housing using clean, system hydraulic fluid.
3. Reassemble cylinder by reversing disassembly procedure, noting the following:
   - To prevent damage to packings at the top of the cylinder, use the following tools:
     - Service Driver - P/N 1056017
     - Service Guide - P/N 1056018
   - If removed, clean threads on piston plug [16] using Loctite® primer (6V1541). Apply Loctite® (1056016) to threads on piston plug. Tighten using a strap wrench only. Do not mar chrome plating on piston.
   - Pressure test cylinder in less than fully extended position at 4500 psi.
   - Plug fitting opening to prevent foreign matter from entering cylinder.

High Pressure Relief Valve Adjustment

1. Install a calibrated pressure gauge (3000 psi/20,682 kPa) in the test port [1].
2. Back-out high pressure relief [2].
3. Verify that the manual lower valve [3] is closed.
4. Place a rated load on the forks.
5. Start the lift system and turn the pressure relief screw clockwise until the platform starts to lift. Note the pressure required when the platform starts to elevate. On 3-stage trucks, continue lifting until the third stage of the mast starts lifting.
6. Adjust the pressure relief valve to a pressure 100 - 300 psi (689.4-2068 kPa) greater than the values recorded in step 5. This can be done by chaining the mast sections together or adding more weight to the forks.
7. After the adjustment is complete, tighten the relief valve lock nut.
8. Check the lift system for proper operation.

2-Stage Elevating System Service Notes

Refer to Figure 5-43 through Figure 5-46.

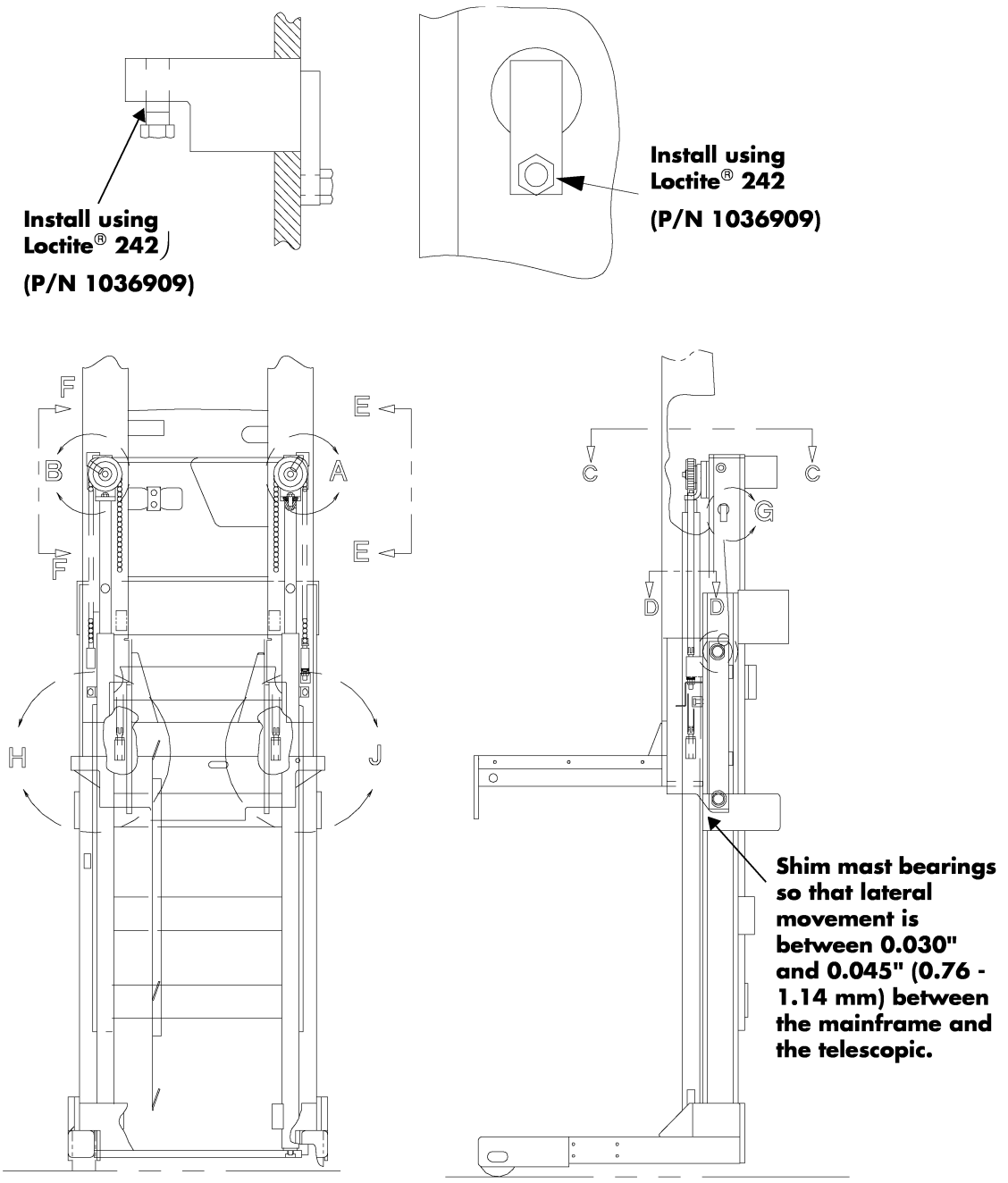


Figure 5-43: Two-Stage Elevating Section

Manual Steering Wire Rope Replacement

It is recommended that two people be used for this procedure. Refer to Figure 5-52 and Figure 5-53.

1. Insure that the P/Ns are correct for the application. Refer to the Parts Manual.
2. Insure that the drive tire is pointed as close to straight ahead as possible before you begin. This can be accompanied by driving the truck a short distance to verify that the steering is positioned correctly.
3. Elevate the operator's platform approximately 72" (2 meters). See WARNING.

⚠WARNING

Before doing any work under the elevated platform, place a safety stand capable of supporting the weight of the carriage under the operator's platform.

4. Lower the carriage onto the support. Open the Emergency Lower Valve and lower the telescopic another inch (2.54 cm). This permits easier installation of the wire rope assemblies on the lower drum. Make sure you tighten the Emergency Lowering Valve.
5. Remove the jam nuts and adjusting nuts from the ends of the cables. These nuts are located on the lower drum. Refer to Figure 5-52 or Figure 5-53.
6. Remove the cable assembly from the jack shaft take-up drum.
7. Remove the cable assembly from the mast pulleys. On 3-stage trucks, the right mounting bracket for the pulley assembly [2,3] must be unbolted from the operator's platform to allow the cable assembly to be removed.
8. At the steering control in the operator's compartment, insure that the steering knob is pointed straight down (6 o'clock) and that the slot for the cable ball is at 12 o'clock.
9. Remove the cable assembly from the package. Be careful not to kink the cable.
10. At the drum located near the steering control, place the swaged ball in the hole located at the top of the drum. The end of the cable which is NOT COLOR CODED is to be wound first.
11. The end of the cable that is not color coded is installed to the right on the cable drum as viewed from "B". See Figure 5-52 and Figure 5-53. Wind the cable clockwise around the drum 3-1/4 turns. The cable will travel towards the steering wheel as it is wound around the drum.
12. Wind the color-coded end of the cable counterclockwise around the drum 3-1/4 times.
13. Temporarily secure the cable to the drum using tape or a cardboard tube.

Voltage To Frame

Voltage grounds are the most common causes for system intermittent "overloads."

Voltage to frame leakage is a result of dirt accumulation and can occur at:

- Motors
- Heatsinks
- Battery
- Switches
- Contactor panel
- Cables/Wiring

Check for voltage to frame using the following procedure:

1. Use a voltmeter set to a voltage above this truck system.
2. Connect voltmeter leads as follows:
   - Positive lead to PC-1; Negative lead to truck frame.
   - Positive lead to truck frame; Negative lead to TP4.

Voltage readings of 2-3 volts in either test should be eliminated.

3. Eliminating voltage to frame can be accomplished by isolating a particular area of the truck's electrical system. Use the following procedure:
   - Connect voltmeter leads as in Step 2 above.
   - Remove battery from truck. Reconnect battery to receptacle. If voltage drops, battery needs cleaning or resealing.
4. If battery checks good, reinstall in truck and:
   - Remove fuses (one at a time). If voltage drops when fuse is removed the defective circuit is isolated.
   - Disconnect motor leads (one at a time). If voltage drops, motor needs cleaning or repair.

Maintenance Tips

Cleaning Hydraulic Components	Dip in clean kerosene or equivalent light solvent. Wash them off. Blow them dry using dry, compressed air.
Replacing or Reinstalling Hydraulic Cartridge Valves	Dip cartridge in hydraulic oil. Ensure O-ring is well lubricated. Screw them in by hand until the outer O-ring touches the manifold. Use a wrench to tighten them. Tighten cartridge 1/2 turn then back off 1/4 turn. Continue this process until cartridge is tight. Tightening O-ring components in this manner will prevent damage to the O-ring seal.
Replacing or Reinstalling Hydraulic Seals	Immerse in hydraulic oil those compounds with spring chambers and activate the spring to remove any air.

NOTE: After locating and repairing any leak or other problem, fill the reservoir and bleed the system.

⚠ CAUTION

When clamping lift/lower manifold in vise, ensure valve body is not damaged which might void warranty.

Follow these procedures to avoid future hydraulic problems.

Hydraulic Oil	Check regularly for the correct level and for the presence of contaminants or bubbles.
Reservoir Oil	Change semiannually.
Reservoir Strainer	Clean semiannually.
New Oil	Use only clean containers. Pass all oil added to the reservoir thru a 25 micron rated filter.
Filling cap Air Vent	Check for possible clogging.
Return Filter	Replace semiannually.

⚠ CAUTION

Do not use brake fluid in the hydraulic system.

Function 5	Plugging Distance (Current)	Allows for the adjustment of the plugging distance of the truck (the distance a truck will travel before coming to a stop and accelerating in the other direction). The larger the current setting, the shorter the stopping distance. It can be set between 200 and 1000 amperes. Each unit on the Handset is equal to 3.14 amps. For example, a setting of 20 would be 200+ (20 x 3.14) = 263 amperes. **Factory Set: 100** **WARNING: Plug settings must be in accordance with Factory Setting. An excessively high setting could damage the controller or the drive motor.**
Function 6	1A Drop Out Current	Allows for the adjustment of the 1A contactor drop out current. The 1A contactor will be dropped out and the truck motor torque will be limited to SCR current limit when the set dropout current is reached. The setting is adjustable from 450 amperes (unit 0) to 1260 amps (unit 250). Settings above 250 will disable this function and 1A dropout will not occur. Each unit is equal to 3.24 amperes. For example, a setting of 20 would be 450 + (20 x 3.24) = 515 amperes. **Factory Set: 255**
Function 7	Not Used	
Function 8	Not Used	
Function 9	Not Used	
Function 10	Not Used	
Function 11	Speed Limit 1	Allows for the adjustment of the speed limit (maximum battery volts to the motor) when the SL1 limit switch input signal is received by the control card. SL1 limit switch is a normally closed switch connected to battery negative; the switch opening enables speed limit. The setting is adjustable from 0 to 180 (96% to 0% battery volts). Setting of 0 units will disable speed limit functions and allow top speed with no limit switch connected. **Factory Set: 125**
Function 12	Not Used	
Function 13	Speed Limit 3	Same as Function 11, except using SL3 limit switch for input **Factory Set: 150**

Status Code - 03

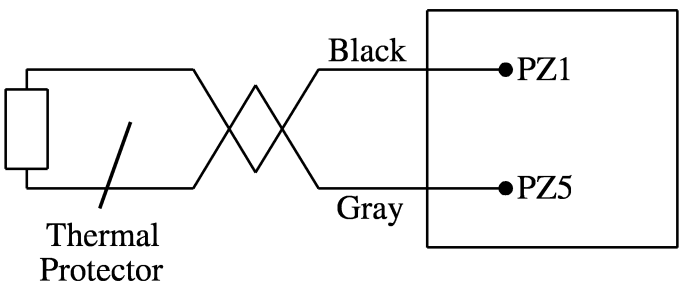
Status Code - 03	Reverse directional request on initial power-up.
Memory Recall	No
Circuit	Traction - see attached diagram.
Symptom	Reverse contactor will not pick up static return to off (SRO) lock out.
Possible Causes	Reverse directional request on initial Powerup (closure of battery plug, key switch or kill switch). • Return directional switch lever to neutral and select a direction. Mast cable Directional potentiometer (variable resistor) Over the mast cable Short circuit between TB2 and TB6. • Disconnect wire from TB6 and check for short circuit between TB2 and wire. Defective Card. • Disconnect wire at TB6 and measure voltage at TB5; should be less than 60% of battery volts.
Status Indication Criteria	Status Code -03 indicates that TB6 is greater than 60% battery volts at initial power-up.

Status Code - 08

Status Code - 08	Speed control input voltage too low on Powerup after initial key switch closure.
Memory Recall	No
Circuit	Traction - see attached diagram.
Symptom	Forward or reverse contactor will not pick up.
Possible Causes	Speed control input misadjusted or defective. • Input voltage at TB1 should be more than 3.0 volts. Adjust or replace accelerator unit to insure that the voltage at TB1 is more than 3.0 volts before advancing throttle. Short circuit between battery negative and TB1 in accelerator input circuit. • Disconnect wire from TB1. Check for short circuit from wire to battery negative. Resistance should be greater than 4.7K ohms. Defective card. • Disconnect wire from TB1. Measure voltage from TB1 to negative. Voltage should be greater than 4.5 volts. If not, replace card. Defective EV100 Control Card. • Check for code on Interface Card.
Status Indication Criteria	Status code - 08 indicates that speed control input voltage at TB1 is less than 3.0 volts, and any of the following connections are opened and closed: battery plug, deadman switch or key switch.

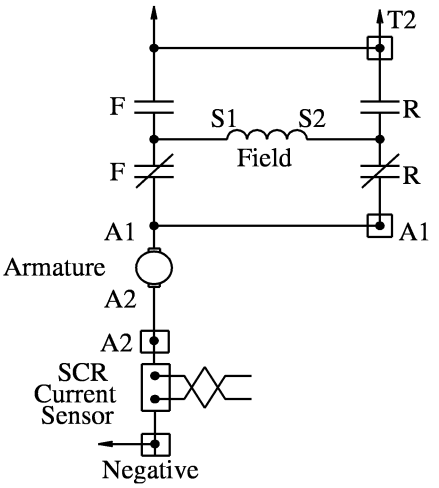
Status Code -41

Status Code - 41	Open thermal protector or control over temperature.
Memory Recall	No
Circuit	Traction
Symptom	Reduced power or no power to traction motor in SCR range.
Possible Causes	Open thermal protector circuit. • Check for loose connection or broken wire between: Black wire - thermal protector and PZ1. Gray wire - thermal protector and PZ5. Defective thermal protector. • Disconnect wires from PZ1 and PZ5. At room temperature (25°C/75°F), measure resistance between black and gray wire. • Replace TP if ohmic value is greater than 300 ohms. SCR is in thermal cutback • Allow control to cool; status code should disappear.
Status Indication Criteria	Status code - 41 indicates that voltage between PZ1 and PZ5 is greater than 1.8 volts.



Status Code - 51

Status Code - 51	Excessive capacitor voltage when motor current is high.
Memory Recall	Yes
Circuit	Traction
Symptom	Forward or reverse contactor opens, closes, and then opens again and can only be closed by opening and closing the key switch.
Possible Causes	Excessive source inductance. • Tag lines without filters are being used. • Battery cables are too long. High peak current in motor. Shorted REC2 circuit. • Check for shorted field winding. • Check for shorted armature winding.
Status Indication Criteria	Status code - 51 is displayed when capacitor volts exceed 225 volts and motor current is greater than 300 amps.



Codes

Code 0

Code Title	No Error
Reason	The system is operating properly
System Response	Interface Card Display: 0 System Response: The heartbeat LED in the lower right corner of the display will blink at a rate of approximately 60 times per minute.
How to Clear	None

Corrective Actions and Checks:

None.

Code 1

Code Title	Internal System Error
Reason	This is an internal problem with the Firmware on the Interface Card.
System Response	Interface Card Display:1 System Response:Complete Shutdown
How to Clear	Cycle the key switch Off/On.

Corrective Actions and Checks:

If turning the key switch Off/On does not correct the problem, then replace the firmware first. If that doesn't correct the problem, replace the Interface Card.

Remember, if the firmware is replaced Learn must be run.

Code L

Code Title	Throttle Learn Mode
Reason	Learn has been started.
System Response	Interface Card Display: L System Response: Truck Shutdown
How to Clear	Complete Learn.

Corrective Actions and Checks:

1. A code L indicates that the system is being prepared to run Learn. When the truck is actually in Learn Mode, a Code J is displayed. Refer to Learn Mode instructions for more information.

Code U

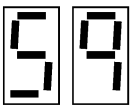
Code Title	Unable to Program EEPROM
Reason	Values obtained during Learn can not be saved.
System Response	Interface Card Display: U System Response: Traction Shutdown
How to Clear	Turn the key switch Off/On.

Corrective Actions and Checks:

1. If turning the key switch Off/On does not correct the problem, then replace the firmware first. If that doesn't correct the problem, replace the Interface Card.

Remember to run Learn if the firmware or Interface Card is replaced.

Code 59

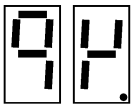
Code Title	CAN transmission buffer (detected by Display Controller Card).
Reason	During power-up or run time, the Display Controller Card failed to transmit within 100ms. This is reported by the Display Controller Card.
System Response	1. Alarm sounds: Yes 2. Electric Steering Display: CODE 59 Inform Service 3. Speed Limit: 0.0 mph (dump brake) 4. How code appears on Steer Controller: 
How to Clear	If cycling the key switch Off/On does not clear this code then follow the procedure below.

Corrective Actions and Checks:

1. This code could be the result of static electricity or shorts to frame. Check and clean all static straps. Check for shorts to frame.
2. The Display Controller Card may be bad.

Remember to run Learn if any boards are replaced.

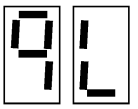
Code 9K

Code Title	Tractor antenna signal too high.
Reason	Near wire voltage is greater than 4.75 volts.
System Response	1. Alarm sounds: Yes 2. Electric Steering Display: CODE 9K Inform Service 3. Speed Limit: 0.0 mph (dump brake) 4. How code appears on Steer Controller: 
How to Clear	Turn key switch Off/On.

Corrective Actions and Checks:

Refer to the "Corrective Actions and Checks:" for Code 9J.

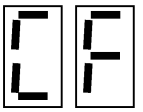
Code 9L

Code Title	Guide wire signal too high at both coil pair.
Reason	The line driver may be out of adjustment.
System Response	1. Alarm sounds: Yes 2. Electric Steering Display: CODE 9L Inform Service 3. Speed Limit: 0.0 mph (dump brake) 4. How code appears on Steer Controller: 
How to Clear	Turn key switch Off/On.

Corrective Actions and Checks:

Refer to the "Corrective Actions and Checks:" for Code 9J.

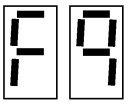
Code CF

Code Title	Steer input command failure.
Reason	The drive unit did not steer when a steer input was requested.
System Response	1. Alarm sounds: Yes 2. Electric Steering Display: CODE CF Inform Service 3. Speed Limit: 0.0 mph (dump brake) 4. How code appears on Steer Controller: 
How to Clear	Turn key switch Off/On.

Corrective Actions and Checks:

1. Check the power lead connections to the steer motor.
2. Check for an open in the steer motor power circuit.
3. Visually make sure that the pinion gear on the steering gear reducer output shaft turns as the steer motor armature rotates. If not, inspect the pinion gear on the end of the steering gear reducer. If the pinion gear can be pulled off by hand, replace the entire steer motor/gear reducer assembly.
4. The steer motor or gear reducer may be defective.

Code F9

Code Title	Steer Controller - COP time-out.
Reason	Steer Controller internal failure.
System Response	1. Alarm sounds: Yes 2. Electric Steering Display: Code F9. Inform Service 3. Speed Limit: 0.0 mph (dump brake) 4. How code appears on Steer Controller: 
How to Clear	The key must be cycled Off/On to clear this fault.

Corrective Actions and Checks:

1. Cycle the key switch Off/On several times to see if the code clears.
   - This problem could be a result of static electricity or shorts to frame. Clean and check static straps. Check for shorts to frame.
2. Replace the Steer Controller.

After replacing boards, be sure to run Learn.

Test A56 - Display Right Guidance Coil Voltage

This test displays the voltage of the load right guidance coil as sensed by the Steer Controller. Refer to Figure 6-20 on page 6-133 to determine which coil this test checks.

Related Codes and Tests:

Code 91 - Drive Unit Turned >10° While Guiding On Wire.

Code 92 - Tracking Limits Exceeded.

Code 93 - Not Near Wire - Tractor Coil Pair.

Code 9J - Load Antenna Signal Too High.

Code 9L - Signal Too High at Both Coil Pairs.

Procedure:

Ensure that the truck is set to the proper frequency. If the frequency used is not standard, it must first be learned.

For information on using maintenance mode, refer to Chapter 3. This test can also be run from active maintenance.

Expected Results:

1. The Electric Steering Display will show the voltage which the Steer Controller senses from the load right guidance coil.
2. The test is a success if the voltage displayed is within these limits:

Test Setup	Voltage Displayed
Truck centered on wire	0.83 - 2.17
Truck not near wire	<0.5

If the values are not as above:

1. Run Tests A53, A54, and A55.
2. If either Test A55 and/or Test A56 fail and Test A53 and Test A54 pass, swap the cables from the antennas at JPW1 and JPW2 and rerun the tests.
   - If the values displayed remain the same then replace the Filter Card. If that does not correct the problem, replace the Steer Controller.
   - If the values change, check the wiring to the antenna that is giving the bad indication.
3. If the cables check OK, first, try cleaning the sensor assembly of all dirt. If that doesn't help then replace the antenna which is giving the bad indication.

Possible Causes of Test Failure:

If all tests fail:

1. Check line driver for proper operation.
2. The Filter Card may be bad.
3. The Steer Controller may be bad.

Test I50 - Display Auto/Manual Switch Position

Using this test, the Auto/manual input is displayed. A successful test proves that the Steer Controller is correctly reading the Auto/manual input.

Related Codes and Tests:

This test directly shows the position of the Auto/manual switch input.

Procedure:

For information on using maintenance mode, see Chapter 3. This test can also be run from active maintenance.

The following should be observed:

Switch Position	Electric Steering Display
O	Auto
I	Manual

If this is not observed, then the test is a failure.

NOTE: If the wire between the Interface Card (JPS9-16) and the Steer Controller (JP104) becomes disconnected, the system defaults to Auto.

Possible Causes of Test Failure:

1. Check for a broken wire between the Steer Controller and the Interface Card.
2. The Auto/Manual switch could be defective.
3. Check for an open between the Auto/Manual switch (JPC9) and the carriage wiring board.

Test I62 - Speed Proximity Connection

This test applies only to trucks with wire guidance.

This test verifies the connection between the Steer Controller and the speed proximity switch SP2.

Related Codes and Tests:

None

Procedure:

1. For information on using maintenance mode, see Chapter 3. This test can also be run from active maintenance.
2. The electric steering display will show the state of the speed proximity input to the Steer Controller.

Connector JP2	Electric Steering Display
Connected	In
Disconnected	Out

If this is not observed then the test is a failure.

Possible Causes of Test Failure:

1. Check for +12 volt at JP2-22 with respect to TP4. If not present, replace the Steer Controller.
2. Check for continuity between JP2-20 and TP4. If an open is found, replace the Steer Controller.
3. Check the wiring between the Steer controller and the proximity switch. Move the wire around as you make the continuity check.
4. The speed feedback proximity sensor may be defective.

Lubrication Equivalency Chart

LUBRICATION EQUIVALENCY CHART									
Lube P/N	TEXACO	CITGO	EXXON	PHILLIPS	GULF	SHELL	CHEVRON	SOHIO	MOBIL
*LUBE 'A' Hyd. Reservoir Oil for Cold Storage (+40° - 20° F) applications.	Aircraft Hyd Oil 15 Mil-H-5606B		Univis J13 similar to Mil-H-5606A.			Aeroshell Fluid 4 Mil-H-5606A	Aviation Hydraulic Fluid A Mil-H-5606A		
**LUBE 'A'(1056009) Hyd. Reservoir Oil for Cold Storage In & Out (20° to 70°) application.	HD AZ 32 1627 Rando					Tellus T Oil 32			
LUBE 'B' Hyd. Reservoir Oil for extreme heating conditions See Note 3.							AW-MV		423 or 424
LUBE 'B' (8T9578) Hyd. Reservoir Oil for Standard (+50° -120°F) applications. See note 1.	Rando Oil HD 46 Hydraulic Oil Mil-H-17672B	Pacemaker XD-20 Hydraulic Oil Mil-H-460001B.	Nuto H46	Magnus A, 315	Harmony 46-AW	Tellus T Oil-46			DTE-15
LUBE 'C' Drive Unit gear Case for below 30° F. Pump Motors w/oil cup, foot pedal, lift chains, etc. for above and below 30°F.	URSATEX 10W-30 2166	C-6 10W-30 Motor Oil Mil-H-46152.	Exxon Extra Motor Oil 10W-30 API Service SE	Trop-Artic All Season Motor Oil 10W-40 Mil-L-46152	Gulflube Motor Oil X.H.D. 10W-30	Shell Rotella T Oil 15W-40 API Service SE CC and CD	Delco 400 Motor Oil 15W-40 API Service SE	Multron 10W-30 Mil-L-46152 API Service SE	Delvac Special 10W-30 API Service SE
LUBE 'D' Drive Unit Gear case for above 30°F	Multigear Lubricant EP 85W-90 Mil-L-2105B	Premium Gear Oil MP90 Mil-L-2105B	Gear Oil GX 80W-90 Mil-L-2105B	Philube SMP Gear Oil SAE 80W-90 Mil-L-2105C	Multi-purpose Gear Lubricant 80W-90	Spirax HD-85W-90 Mil-L-2105B	Universal Gear Lubricant 80W-90 Mil-L-2105B	Gear EP 90	Mobilube HD 80W-90.
LUBE 'E' Drive Unit and Caster swivel, caster spring rod pivots, steer gear box, load wheels, uprights, reach arms, caster wheel bearings, etc., (above and below 30° F).	Regal AFB 2 Grease Mil-G-18709A	HEP2 (above 30°F only)	RONEX MP or UNIREX N2	Philube 1B and RB Grease	Gulfcrown Grease No. 2	Alvania Grease EP2	Avi-Motive Grease	Bearing Guard "LT"	Mobil Grease 77

Schematic - Electrical

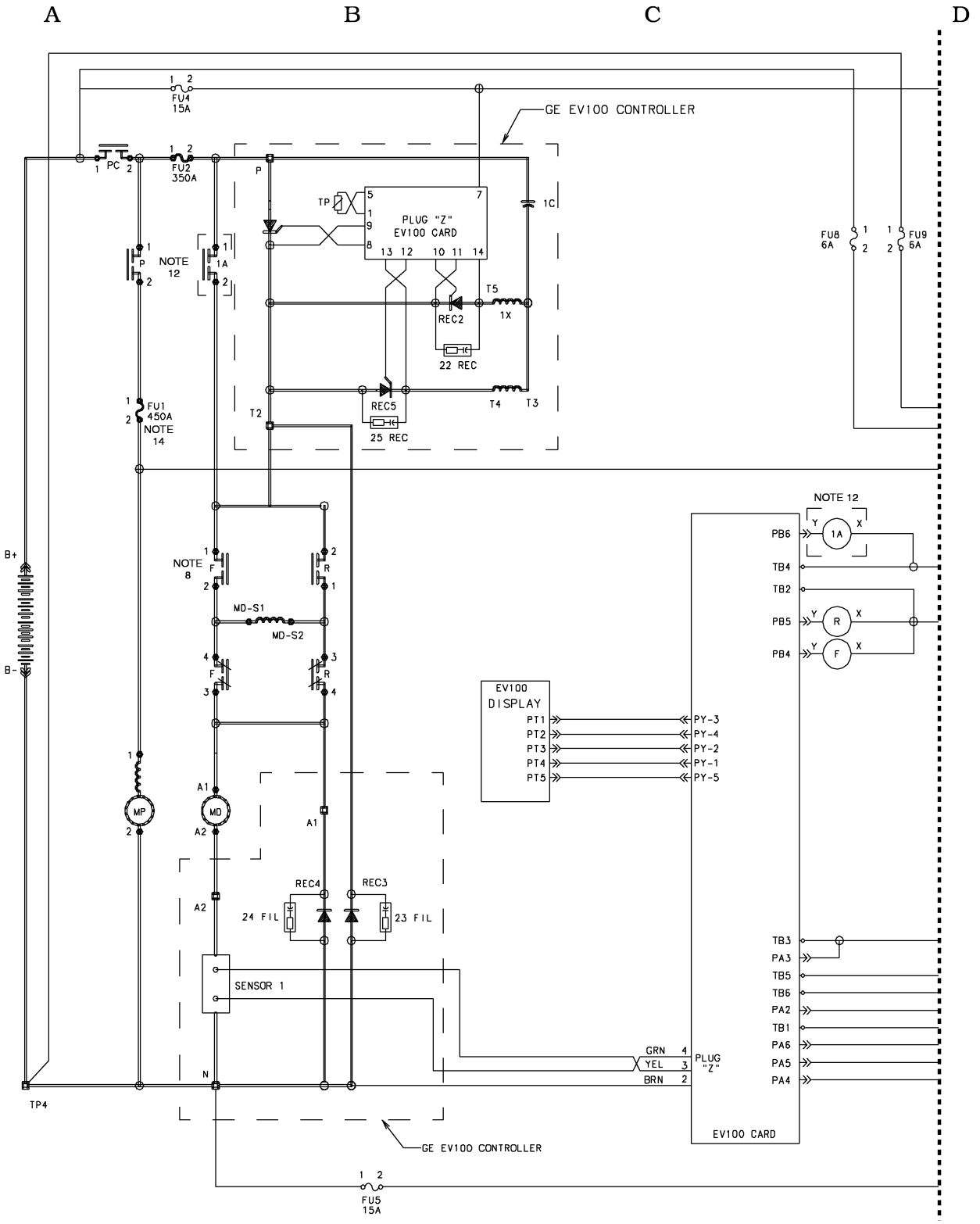


Figure 7-5: Schematic - Electrical (Sheet 1 of 3)

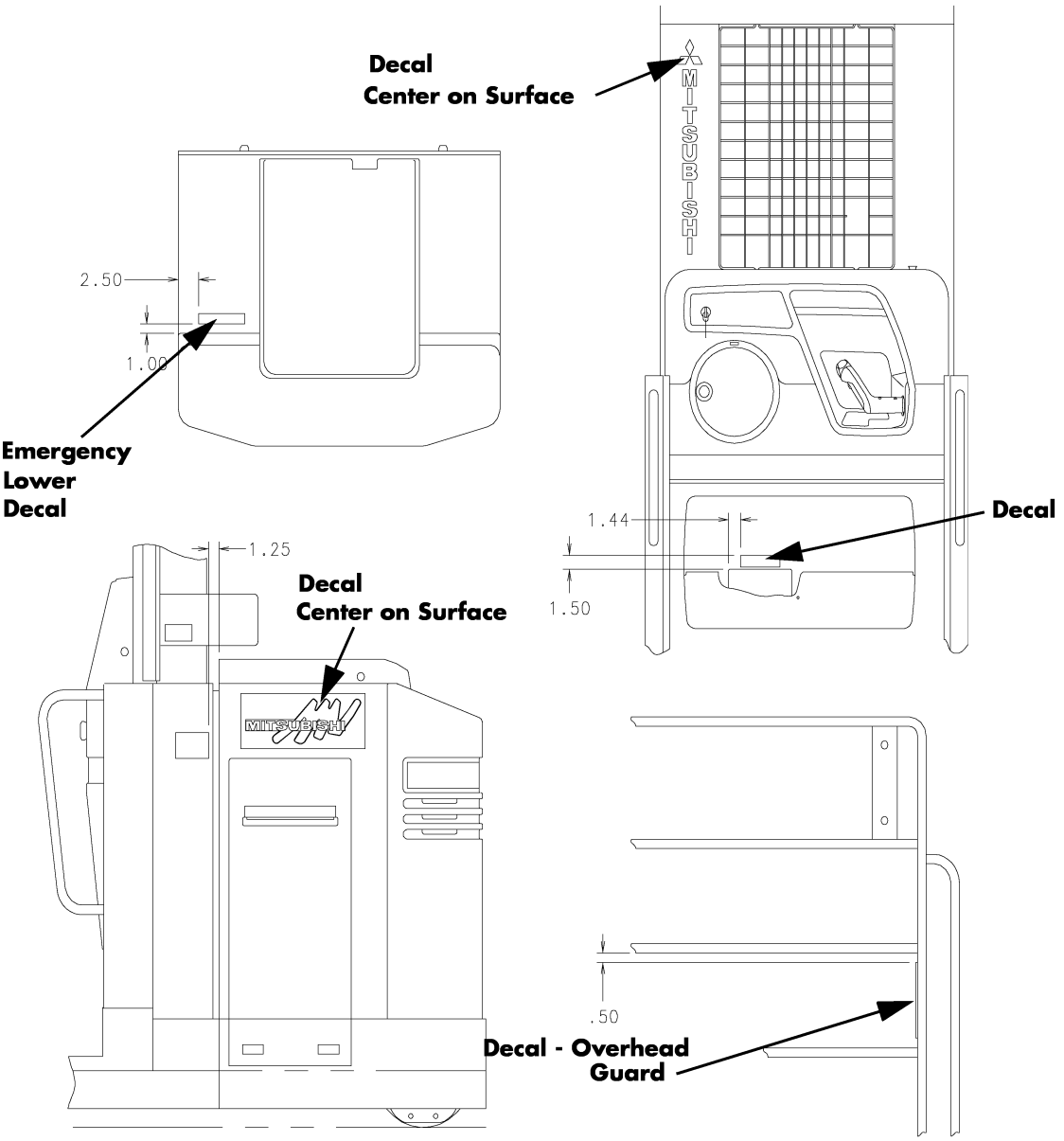


Figure 7-6: Decal Locations (Sheet 2 of 3)