

# LeeBoy

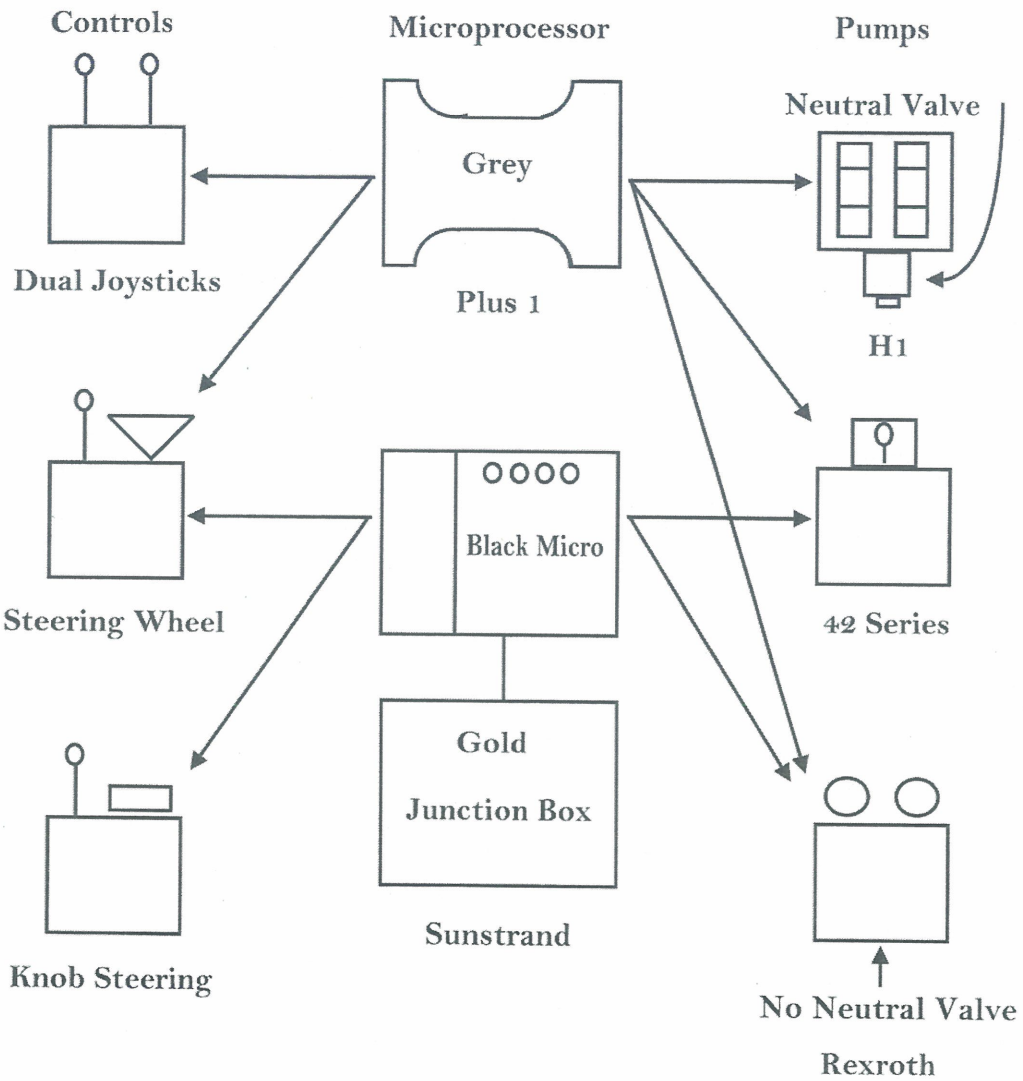
## Electric Steering Service Guide



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# Steering Systems



### STEERING SYSTEM WIRING

#### Wiring Guidelines

1. Protect all wires from mechanical abuse. Wire can be run in flexible metal or plastic conduits.
2. Use 85°C wire with abrasion resistant insulation. 105°C wire should be considered near hot surfaces.
3. Use #18 gauge wire or greater. #14 or #16 wire is preferred.
4. Separate high current wires such as solenoids, lights, alternators, or fuel pumps from control wires.
5. Run wires along the inside of, or close to, metal machine frame surfaces where possible. This simulates a shield, which will minimize the effects of EMI/RFI radiation.
6. Do not run the wires near sharp metal corners. Consider running the wire through a grommet when rounding a corner.
7. Do not run wires near hot machine members.

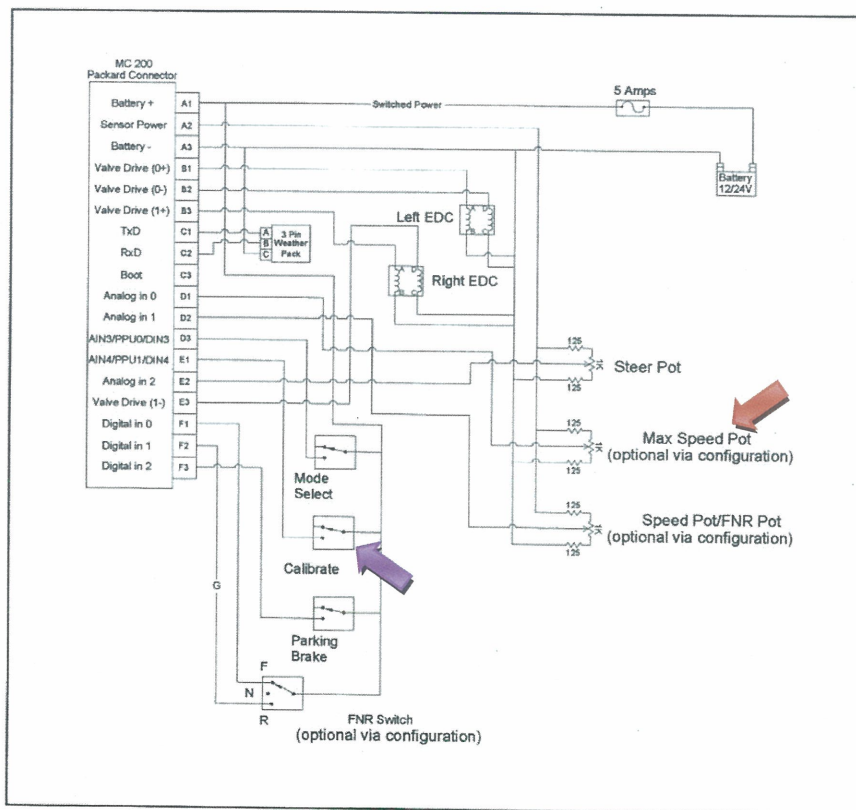


FIGURE 4-19. STEERING WIRING DIAGRAM

8515 Conveyor Paver

4.51

Note the purple arrows indicate 'purple wire' for calibration, red arrow indicates 'Max Speed Pot' that is not used.

## Optimizing Sunstrand Electronic Steering

### **Black Micro**

1. Position steering wheel and joystick in center or neutral position.
2. Turn the ignition key into the 'ON' position.
3. Turn steering wheel completely **left** for ten seconds, then turn steering wheel completely **right** for ten seconds, then back to **center**.
4. Move the joystick completely **forward** for ten seconds, then move joystick completely **reverse** for ten seconds, then back to **neutral**.
5. Turn ignition switch to the 'START' position and crank engine.
6. Attempt to move machine, if machine does not move repeat steps 1-5.

**Note: Machine will not drive straight at this point, operate with caution.**

Optimizing is informing the processor what the limits or range of the input potentiometers.

## Calibration for Sunstrand Electronic Steering

### **Black Micro**

1. Turn ignition key to the 'OFF' position
2. Open dash panel. Locate the two **purple** wires located on the left below the fuse panel.
3. Connect the two purple wires to a standard single pole 'ON'-'OFF' switch. Turn this calibration switch into the 'ON' position, this will connect the two purple wire thus sending a ground signal to the processor.
4. Turn the ignition switch to the 'START' position to start machine. Run the engine throttle to full RPM. Turn the calibration switch to the 'OFF' position.
5. Turn the steering wheel completely **left**, then move joystick **forward** until machine barely starts to move. Turn the calibrate switch to the 'ON' position and then back to the 'OFF' position. Then return joystick to **neutral**. **Note: The slower the machine movement when you toggle the switch, the smoother the calibration will turn out.**

## Calibration Continued

6. Leave the steering wheel completely **left**, then move the joystick **reverse** until machine barely starts to move. Turn the calibration switch to the 'ON' position and then back to the 'OFF' position. Then return joystick to **neutral**. Note: The slower the machine movement when you toggle the switch, the smoother the calibration will turn out.
7. Turn the steering wheel completely **right**, then move joystick **forward** until machine barely starts to move. Turn the calibrate switch to the 'ON' position and then back to the 'OFF' position. Then return joystick to **neutral**. Note: The slower the machine movement when you toggle the switch, the smoother the calibration will turn out.
8. Turn the steering wheel completely **right**, then move joystick **reverse** until machine barely starts to move. Turn the calibrate switch to the 'ON' position and then back to the 'OFF' position. Then return joystick to **neutral**. Note: The slower the machine movement when you toggle the switch, the smoother the calibration will turn out.
9. Position the joystick in the neutral position and the steering wheel in the center position.
10. Push the joystick **forward** completely, noting the machine will not drive straight. Move joystick just slightly toward neutral (approx. 1/16-1/8inch). Turn steering wheel left or right until machine tracks straight. Toggle the calibration switch to the 'ON' position and the back to the 'OFF' position to store that calibration to the processor. **NOTE: For best results calibrate machine on smooth, straight ground with plenty of room. Lowering screed close to the ground will make it easier to achieve better results.**
11. Push the joystick **reverse** completely, noting the machine will not drive straight. Move joystick just slightly toward neutral (approx. 1/16-1/8 inch). Turn steering wheel left or right until machine tracks straight. Toggle the calibration switch to the 'ON' position and the back to the 'OFF' position to store that calibration to the processor. **NOTE: For best results calibrate machine on smooth, straight ground with plenty of room. Lowering screed close to the ground will make it easier to achieve better results.**
12. Machine should track straight both in forward direction and reverse direction, if not repeat steps 1-11.
13. When tracking straight remove calibration switch from purple wires and store wires in original position.

**Calibration is informing the processor the relationship between the right pump and the left pump. Calibration is used to allow the machine to straight line track.**



## Plus 1 Optimizing and Calibration

### Startup

When the key is turned on the status light will come on for approximately 3 second while the Plus One powers up. The status light will turn off when the machine is ready to start.

If the **light stays on**, this means that the **joystick(s)** in the control box are **not in neutral** and the Plus One will **not allow the engine to start**. Placing the joystick(s) in neutral will turn off this light and allow the engine to start.

If the **light** starts to **blink** see the **Fault Code** table in this manual.

### Optimization

The processor will automatically recognize which type of steering control (Dual Joystick or Steering Wheel) is installed and if there is one or two boxes connected. On machines with two boxes; the Plus One will only operate if both boxes are of the same type.

Plus One will not allow the Engine Enable to come on until the Optimization procedure has been done.

**Note:** If the pumps are the high current (Sauer H1 or Rexroth) perform the pump selection.

### Pump Control Outputs

The Plus One controller is setup to operate dual hydrostatic pumps, three options are built in;

**Low current** outputs for the **Sauer 42 series** pumps(default setting)

**High current** outputs for the **Sauer H1** series pumps

**High current** output for **Rexroth** pumps

If the High current pumps are used you must switch the Plus One to high current outputs

**To set for high current output:** Turn the machine off. Open the dash board panel and locate the Hi Output connector and plug it into the Hi Output receptacle.

#### **Pump Selection (High Current Pumps only):**

The adjustment of the pump parameters in the PLUS1 controller is to handle the different resistance levels in the two High Current pumps; a Sauer H1 and a Rexroth. This is only done for the High Current pumps; the low current (M4200) pump requires no changes.

## Pump Selection

1. Turn OFF power to the control system (Key in Stop/Off position)
2. Connect at least one Steering Wheel or Dual Joystick control box
3. Turn all RUN / STOP switches on the control box(or boxes) to STOP
4. Open the control panel and install the Y-adapter that allows connecting the Optimize and Calibrate plugs at the same time
5. Connect the High Current plug to the High Current connection
6. Connect the Optimize plug to the Y-adapter (ensure that the wires In and Out match)
7. Connect the Calibrate plug to the Y-adapter (ensure that the wires In and Out match)
8. Turn ON the power to the control system (Key in ON position)
9. Wait for the Status Light on the control panel to go out (indicates waiting for commands / running OK)
10. Move the Left Joystick on either Dual Joystick box (if more than one is installed) or the Speed/Direction Joystick on either Steering Box (if more than one is installed) to one of the following positions to choose which parameters to load:
  - a. All the way Forward – loads the Sauer H1 parameters
  - b. All the way Reverse – loads the Rexroth parameters
11. *C<sub>1</sub> Neutral = 42 Series Pump*  
If both Left Joysticks (Dual Joystick boxes) or both Speed/Direction Joysticks (Steering boxes) are moved then NO parameters will be changed; user can only move one Left Joystick or Speed/Direction Joystick
12. Toggle the RUN / STOP switch on the box with the positioned Left Joystick (or Speed/Direction Joystick) to RUN
13. If Parameter Change is successful, the Status Light will flash very rapidly
14. Toggle the RUN / STOP switch used in step 12 to STOP (the Status Light will stop flashing)
15. Turn OFF the power to the control system (Key in OFF position)
16. Disconnect the Optimize and Calibrate plugs from the Y-adapter

After a Parameter Change routine is completed, all Optimize and Calibrate values are reset to default values. Optimize and Calibrate routines will have to be processed again if they were already done before the Parameter Change.

**To OPTIMIZE the Dual JOYSTICK Steering Control Box:**

1. Turn the machine off. Open the dash board panel and locate the Optimize/Calibrate connector and plug it into the Optimize receptacle.
2. Place all joysticks in the center position and move the Run/Stop switch(s) into the Stop position.
3. Turn the power key to the on position (power to the Plus One controller). Outputs are disabled. The status light will blink a slow continuous blink to indicate Optimize Mode.
4. Wait 5 seconds for the Plus One to capture the joysticks in center position.
5. Push joysticks full forward for 5 seconds.
6. Push joysticks full reverse for 5 seconds.

If a second control box is present optimize it in the same manner. The status light will stop blinking. Unplug the Optimize/Calibrate connector from the Optimize receptacle and turn off the power key.

**To OPTIMIZE the STEERING WHEEL Control Box:**

1. Turn the machine off. Open the dash board panel and locate the Optimize/Calibrate connector and plug it into the Optimize receptacle.
2. Place all steering wheels and joysticks in the center position and move the Run/Stop switch(s) into the Stop position. **Be sure that the steering wheels are centered!**
3. Turn the power key to the on position (power to the Plus One controller). Outputs are disabled. The status light will blink slowly with no pauses to indicate Optimize Mode.
4. Wait 5 seconds for the Plus One to capture the steering wheel center position.
5. Turn the steering wheel full right and push the FNR joystick full forward for 5 seconds.
6. Turn the steering wheel full left and the FNR joystick full reverse for 5 seconds.

If a second control box is present optimize it in the same manner. The status light will stop blinking. Unplug the Optimize/Calibrate connector from the Optimize receptacle and turn off the power key.

## **Calibration**

Calibration (also called straight line tracking) involves 4 steps: Threshold, low, mid and high speed setting.

There are separate procedure for calibrating machines with Dual Joystick steering control and Steering wheel control. On machines with two control boxes the calibration will only need to be done with one box. THIS PROCEDURE WILL SET THE MAXIMUM SPEED OF THE MACHINE.

### **To CALIBRATE the Dual JOYSTICK Steering Control Box:**

Turn the machine off. Open the dash board panel and locate the Optimize/Calibrate connector and plug it into the Calibrate receptacle.

Place all joysticks in the center position and move the Run/Stop switch into the Run position. If two control boxes are present place the other Run/Stop switch to the stop position.

Turn machine on and the status light will blink rapidly with no pauses to indicate Calibration Mode.

#### **Setting the threshold:**

1. Start the engine and run at ½ throttle
2. Move left joystick forward until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.
3. Move left joystick reverse until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral
4. Move right joystick forward until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.
5. Move right joystick reverse until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.

#### **Setting the straight line tracking:**

1. Move joysticks forward until machine begins to move forward slowly, adjust Right Joystick forward or reverse as necessary to make sure machine is traveling straight. Toggle Run/Stop switch from Run to stop and back to run
2. Move Left Joystick forward to approximately 1/2 joystick position, adjust Right Joystick forward or reverse as necessary to make sure machine is traveling straight. Toggle Run/Stop switch from Run to stop and back to run.

### Setting the straight line tracking (CONTINUED)

3. Move Left Joystick to full forward, adjust the Right Joystick forward or reverse as necessary to make sure machine is traveling straight. When the machine has achieved full speed, reduce joystick position until the machine slows to the desired maximum speed and then toggle Run/Stop switch from Run to stop and back to run.  
**NOTE: This setting determines the machines maximum speed. Any joystick movement beyond this point will have no effect on the machines forward speed.**
4. Repeat for reverse.
5. Bring both joysticks to neutral.
6. Keeping power to the Plus One, unplug the Optimize/Calibrate connector from the Calibrate receptacle (this will write the calibration values to memory).

Turn off and restart machine. Run machine to verify acceptable operation. Machine will now operate in typical dual joystick mode with speed and direction of each track controlled by the respective joystick.

#### **To CALIBRATE the STEERING WHEEL Control Box:**

Turn the machine off. Open the dash board panel and locate the Optimize/Calibrate connector and plug it into the Calibrate receptacle.

Place all steering wheels and joysticks in the center position and move the Run/Stop switch into the Run position. If two control boxes are present place the other Run/Stop switch to the stop position. Turn machine on and the status light will blink rapidly with no pauses to indicate Calibration Mode.

#### **Setting the threshold:**

1. Start the engine and run at ½ throttle
2. Turn the steering wheel full left; Move FNR joystick forward until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.
3. With steering wheel still at full left; Move FNR joystick reverse until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral
4. Turn the steering wheel full right. Move FNR joystick forward until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.
5. With steering wheel still at full right; Move FNR joystick reverse until machine begins to move slightly, then toggle run/stop switch from run to stop and back to run. Return joystick to neutral.

### Setting the straight line tracking:

1. Move FNR joysticks forward until machine begins to move forward slowly, adjust the steering wheel as necessary to make sure machine is traveling straight. Toggle Run/Stop switch from Run to stop and back to run
2. Move FNR Joystick to approximately 1/2 joystick position, adjust the steering wheel as necessary to make sure machine is traveling straight. Toggle Run/Stop switch from Run to stop and back to run.
3. Move FNR Joystick to full forward. When the machine has achieved full speed, reduce joystick position until the machine slows to the desired maximum speed. Adjust the steering wheel as necessary to make sure machine is traveling straight. Toggle Run/Stop switch from Run to stop and back to run. **NOTE: This setting determines the machines maximum speed. Any joystick movement beyond this point will have no effect on the machines forward speed.**
4. Repeat for reverse.
5. Bring the FNR joystick to neutral and center the steering wheel.
6. Keeping power to the Plus One, unplug the Optimize/Calibrate connector from the Calibrate receptacle (this will write the calibration values to memory).
7. Turn off and restart machine. Run machine to verify acceptable operation.

### Steering/Acceleration and Deceleration

Steering the machine is done by slowing the left or right track. When a steering wheel with FNR joystick control box is used the steering wheel angle at which counter-rotation starts and the speed limit for counter-rotation are preprogrammed into the PLUS One's memory. This limits the ability to counter-rotate the tracks at high speeds. If the FNR joystick is at 100% forward, as the steering wheel was turned from centered to full right the right track would only slow to 0% forward (at the inflection point) and never counter-rotate. If the FNR joystick is at 50% forward the right track would counter-rotate at 50% reverse (if the speed limit allows it to). You can achieve full counter-rotation at either full left or full right (hard-over) up to the speed limit, at which point the counter-rotating track would decelerate to zero speed (if over the speed limit). The counter-rotating track can never exceed the speed of the forward track.

Each joystick and steering wheel has been setup with individual profile and ramping to give smooth control.

Ramping for acceleration and deceleration is proportional to the amount of movement of the joystick.

### **Steering Box Control Selection**

The Plus One will only assign control of the machine to a steering control box if all joysticks are in neutral, the steering wheels are centered and the Run/Stop switches are in the Stop position.

The Plus One will assign control to the first box that is switched to the Run position.

If at anytime the Run/Stop switch is set to the Stop position the machine will decelerate to stop and set the brake after 3 seconds. At anytime during operation if the Run/Stop switch on the second control box is set to the Run position the machine will decelerate to stop and set the brake after 3 seconds. Control will be restored to the operator when this switch is set back to Stop (the machine will ramp back to the setting of the operator's controls). This purpose of this is to allow personnel on the opposite side of the machine to pause the machine and then return control to the operator by flipping the Run/Stop switch back to Stop.

Machine control can be switched to the second steering control box by setting all joysticks in neutral, centering the steering wheels, switching both Run/Stop switches to the Stop position and then switching the second box to Run.

### **Neutral Safety Lockout**

This is an option built into the Plus One program.

If at anytime the machine is in Neutral with the Run/Stop switch in the Run position, the Plus One will disable the control box after a set period of time. The operator will be required to switch from Run to Stop and back to Run to regain control. This is provided as a safety in the event that the operator leaves his station with the control box still active. When activated the machine will not if the joysticks were accidentally moved without someone at the controls. The length of time until lockout activates can be adjusted with the Service Tool. The default is set at 30 Minutes.

### **Vibrator/Electric Actuator Relay and Backup Alarm Outputs**

Anytime one or more joysticks are in the forward position (none can be in reverse) the Vibrator/Electric Actuator Relay +12VDC output is turned on. The output is disabled in a counter-rotate condition.

Anytime a joystick is in the reverse position or a counter-rotate condition exists, the Backup Alarm +12VDC output is turned on.

### **Brake Release/Pump Neutral Bypass Valve**

This +12VDC output is turned on when any joystick is not in neutral and the Run/Stop switch is in the Run position. The output is turned off when the joysticks are brought to neutral, the operators Run/Stop switched is switched to Stop or the opposite control box is set to Run. There is a proportional time delay, based on output to the pump coils. The maximum delay is 10 seconds if full outputs to the pumps were present and the minimum delay is 3 seconds. The time delay will start when the joysticks are brought to neutral, the operators Run/Stop switched is switched to Stop or the opposite control box is set to Run.

When the run signal is returned the output is immediately turned on and there is a .2 second delay on outputs to the pump coil. This delay allows time for the brake to release before the propel coils are energized.

### **Critical Faults**

The following faults will prevent machine movement:

1. Steering control box not detected.
2. Joysticks not optimized.
3. Pump control coil fault.
4. Brake valve/ Pump neutral bypass coil fault (High current output mode only).
5. Joystick(s) not in Neutral at startup.
6. Joysticks in neutral with Run/Stop switch in Run position safety timeout.

A joystick fault can prevent machine movement if:

- There is only one box present
- The fault happens in the box that has control (Run/Stop switch in Run position)
- The fault occurs when neither box has control

The machine will operate if fault occurs in the box that is not currently in control (*i.e.* the left box is operating the machine and the right box has a fault). The fault will disable the machine once the controlling box is put in the Stop position. Disconnecting the faulted box will allow control to be restored to the opposite box.

**IV. Fault Codes for Status LED**  
**(The Status light will also blink the fault codes)**

<b>Blink Code</b>	<b>Reason for Fault</b>	<b>Corrective Action</b>
Continuous On (at startup)	Joysticks not in neutral at startup	Place all joysticks in neutral
Continuous On (while running)	Joysticks in neutral too long with Run/Stop Switch in Run position (safety timeout)	Toggle Run/Stop switch from Run to Stop and back to Run
Continuous rapid blink	Calibration Mode	Open dashboard panel and unplug the Optimize/Calibrate plug from the Calibrate receptacle
Continuous slow blink	Optimize Mode	Open dashboard panel and unplug the Optimize/Calibrate plug from the Optimize receptacle
21	Left Steering Control Box not optimized	Perform Optimize procedure in Section III
22 or 27	Left Steering Control Box: Left joystick or FNR joystick fault	Voltage <100mv or >4900 mv Check wires to Left joystick or FNR joystick
23 or 28	Left Steering Control Box: Right joystick or steering wheel fault	Voltage <100mv or >4900 mv Check wires to right joystick or steering wheel
24	Right Steering Control Box not optimized	Perform Optimize procedure in Section III
25 or 37	Right Steering Control Box: Left joystick or FNR joystick fault	Voltage <100mv or >4900 mv Check wires to Left joystick or FNR joystick
26 or 38	Right Steering Control Box: Right joystick or steering wheel fault	Voltage <100mv or >4900 mv Check wires to right joystick or steering wheel
31	Break Release / Pump neutral bypass valve coil	*Only used in high current output mode* The output is open or short circuited Check the coil and wires.
32	Right pump FWD or REV output fault	The output is open or short circuited Check the coil and wires.
33	Left pump FWD or REV output fault	The output is open or short circuited Check the coil and wires.
36	Vibrator/ Electric Actuator relay fault	The output is open or short circuited Check the relay and wires.