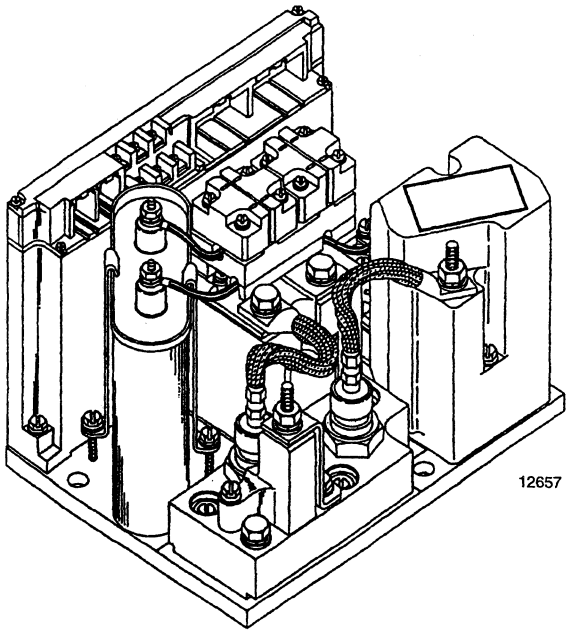
EV-100LXT/LX/LXP/LXD
EV-200LXT/LX
MOTOR CONTROLLER & DIAGNOSTIC HAND SET

DESCRIPTION, CHECKS, REPAIRS, ADJUSTMENTS AND TROUBLESHOOTING



HYSTER

PART NO. 897409

2200 SRM 460

TABLE 3 - TERMINAL AND PLUG WIRE CONNECTIONS FOR SINGLE MOTOR TRACTION CIRCUIT WITH SCR PUMP MOTOR CONTROLLER

PLUG OR TERM. NO.	WIRE	FUNCTION
PA1	-	Not used
PA2	50	Status code 93 input
PA3	7	Status code 90 input
PA4	22	Status code 94 input
PA5	21	Status code 94 input
PA6	17	Status code 91 input
PB1	37	Status code 95 input
PB2	31	Status code 95 input
PB3	60	Battery Discharge Indicator enable signal input
PB4	27	Pump (PMT) coil driver
PB5	23	1A coil driver
PB6	41	Status code 92 input
TB1	29	Accelerator potentiometer input
TB2	15A	SL1 input
TB3	7	SL2 input
TB4	10	Key switch input - Battery voltage supply from key switch
TB5	6	SL3 input
TB6	8	SL4 input
PY1	WHT	Instrument panel display number 4 input
PY2	BLK	Instrument panel display number 3 input
PY3	GRN	Instrument panel display number 1 input
PY4	BARE	Instrument panel display number 2 input
PY5	RED	Instrument panel display number 5 input
PY6	-	Not used
PY7	-	Not used
PY8	90	Signal wire between Traction and Pump cards - From Pump card PY12
PY9	91	Signal wire between Traction and Pump cards - From Pump card PY11
PY10	92	Signal wire between Traction and Pump cards - From Pump card PY10
PY11	-	Not used
PY12	-	Not used
PY13	-	Not used
PY14	-	Not used
PZ1	BLK	Signal wire from SCR 1 thermal protector
PZ2	BRN	Battery negative
PZ3	YEL	Signal wire from current sensor
PZ4	GRN	Signal wire from current sensor
PZ5	GRY	Signal wire from SCR 1 thermal protector
PZ6	-	Not used at Traction Card - No color or number shown for Pump Card
PZ7	WHT	Battery positive
PZ8	BLU/WHT	Signal wire to SCR 1 gate
PZ9	BLU	Signal wire from SCR 1 cathode
PZ10	WHT/RED	Signal wire to SCR 2 gate
PZ11	RED	Connection between filter for SCR 2 and control card
PZ12	WHT/PUR	Signal wire to SCR 5 gate
PZ13	PUR	Connection between filter for SCR 5 and control card
PZ14	ORN	Sensor wire for voltage check across capacitor C1

⚠ WARNING

Before disconnecting the hand set from the control card, make sure to raise the drive wheel(s). Turn the key to the OFF position, disconnect the battery and discharge capacitors C1.

Disconnect the plug at the Y connector on the control card to disconnect the hand set. Connect the plug for the instrument panel display plug at the Y connector.

Function Descriptions

The following pages have descriptions for the different functions. The setting for each function is specific for each control card. To identify the control card, check the label at the top edge of each card case. There are some painted letters and numbers followed by letters on the lower part of the label. The last two letters identify the type of card installed. The following types of control cards are used:
EV-100 or 200 LXT - Traction (with Regen)
EV-100 or 200 LX - Traction (with & without Regen. & without BDI)
EV-100 LXM - Dual Motor Traction (without BDI)
EV-100 or 200 LXPX - Pump Control
EV-100 LXDX - Dual Motor Traction (without BDI)
EV-100 LXDT - Dual Motor Traction (with BDI)

NOTE: EV-100 LXDX and EV-100 LXDT are used on TRUCK MODELS J1.60XMT, J1.80XMT and J2.00XMT (J30XMT, J35XMT and J40XMT) ONLY.

The same nomenclature is also shown on TABLE 10 through TABLE 28 and in the following section headings for the traction and pump control cards.

Traction Control Cards (EV-100/200 LXT/LX)

NOTE: These control cards are used with the motor controllers that control the speed of the traction motor(s).

⚠ WARNING

If any of the function settings are changed, the operators must be told that the lift truck will operate differently.

Do not adjust the function settings outside of the range of setting numbers shown in the TABLE 10 through TABLE 27. Settings out side the ranges can cause damage to the components of the traction system and can cause the truck to operate differently than normal. This different operation of the truck can result in personal injury.

FUNCTION 1 STORED STATUS CODE (Push 1)

This function memory contains the last status code of the possible PMT fault that caused the lift truck to stop operation. These codes can be removed from the display by turning the key to the **OFF** position. The code will be stored in memory in the control card. This status code will be written over if a new possible PMT fault occurs. The status code can be cleared from memory by adjusting the setting number to zero. The setting number must be stored by pushing the **STORE** key for one second. Adjustment of this function does not change the operation of the lift truck.

FUNCTION 2 CREEP SPEED (Push 2)

This function permits the adjustment of the creep speed of the lift truck. The range of adjustment is from 0 (5%) to 255 (15%). The percent values are the SCR 1 **ON** TIME. A constant creep speed frequency will be maintained when the accelerator input voltage is between 3.7 and 3.5 volts (an ohm value between 6K and 4.7K ohms).

FUNCTION 3 CONTROLLED ACCELERATION AND 1A TIME (Push 3)

This function permits the adjustment of the maximum rate of acceleration. The setting determines the time allowed to reach maximum SCR speed after the accelerator is set for maximum speed from stop. The control will stay in SCR acceleration for between 0.77 second (8) and 21.5 seconds (255) before the 1A contactor will close. The numbers in () are the setting numbers for the times shown. The 1A contactor will automatically close 0.2 second after the controlled acceleration stops. The speed control input is less than 0.5 volt (accelerator potentiometer set at less than 50 ohms). Do not adjust the function for a setting less than the minimum setting of 8.

FUNCTION 4 CURRENT LIMIT (Push 4)

This function permits the adjustment of the current limit of the control. The rating of the control will determine the range of adjustment for this function. See

TABLE 10 - EV-100 **LXT** FUNCTION VALUE SETTINGS - **E/J1.25-1.75XL (E25-35XL) 36/48V**
(Traction Card with Regen.)

FUNCTION		RECOMMENDATION		ALLOWED RANGE	
No.	Description	Factory Setting	Factory Value	Setting Min/Max	Value Min/Max
1	Stored Status Code	000[1]	-	000[1]/255	-
2	Creep Speed	000	5%	000/255	5%/15%
3	Controlled Acceleration & 1A Time	010	0.94 Sec	008/255	0.77 Sec/21.5 Sec
4	Current Limit C/L	200	180 Amp	000/210	-
5	Plugging Distance (Current)	150	670 Amp	000/160	200 Amp/700 Amp
6	1A Drop Out Current	077	700 Amp	000/250[2]	450 Amp/1260 Amp
7	Field Weakening Pick Up (Current)	000	-	000/255	-
8	Field Weakening Drop Out (Current)	000	-	000/255	-
9	Regen. Braking C/L	125	350 Amp	000/148	75 Amp/400 Amp
10	Regen. Start (% ON Time)	080	30%	000/255	0%/95% SCR 1 ON Tiime
11	Speed Limit 1 (Max mtr, V w/NC sw open)	000	-	000/255	-
12	Speed Limit 2 (Max mtr, V w/NC sw open)	000	-	000/255	-
13	Speed Limit 3 (Max mtr, V w/NC sw open)	120	30%Batt V	000/180	96%(Min Limit-Max Spd)/ 0%(Max Limit-Min Spd)
14	Internal Resistance Compensation	010[3]	-	005/025	-
15	Battery Volts	200	36/48V	184/250	36 or 48 Volt Operation
16	Pedal Position Plug	040	228 Amp	000/187	100 Amp/700 Amp
17	Card Type Selection	042	-	040/044	-
18	Steer Pump Time Delay (Seat Sw)	025	14 Sec	[4]	[4]

[1] Any number other than "zero" can be read as a possible fault.
[2] Settings greater than 250 will disable the 1A Drop Out function.
[3] Average value for most batteries. See procedure for a more accurate value.
[4] Setting of 000-128 (1.5-65.0 Sec) with seat brake. Setting of 021-128 (12-65 Sec) without seat brake.

TABLE 20 - EV-100 **LXM** FUNCTION VALUE SETTINGS - **J25-35B**
(Dual Traction Card)

FUNCTION			RECOMMENDATION		ALLOWED RANGE	
No.	Description		Factory Setting	Factory Value	Setting Min/Max	Value Min/Max
1	Stored Status Code		000[1]	-	000[1]/255	-
2	Creep Speed	24V	150	9.5%	000/255	5%/15%
	Creep Speed	36V	100	8%	000/255	5%/15%
3	Controlled Acceleration & 1A Time		010	0.9 Sec	008/255	0.77 Sec/21.5 Sec
4	Current Limit C/L		255	330 Amp	255	330 Amp
5	Plugging Distance (Current)	24V	120	577 Amp	000/150	200 Amp/671 Amp
	Plugging Distance (Current)	36V	100	514 Amp	000/150	200 Amp/671 Amp
6	1A Drop Out Current	24V	110[2]	806 Amp	000/250[2]	450 Amp/1260 Amp
	1A Drop Out Current	36V	100[2]	774 Amp	000/250[2]	450 Amp/1260 Amp
7	PA4 Input Sw Function		**000**	-	**000/127**	(See **WARNING** below)
11	Speed Limit 1		000[9]	-	000[9]	-
12	Speed Limit 2		000[9]	-	000[9]	-
13	Speed Limit 3		000[9]	-	000[9]	-
14	Internal Resistance Compensation		000[9]	-	000[9]	-
15	Battery Volts	24V	024	24 V	000/031	24 Volt Operation
	Battery Volts	36V	036	36 V	032/044	36 Volt Operation
16	Pedal Position Plug		040	228 Amp	000/255	100 Amp/916 Amp
17	Card Type Selection		002	-	000/004	-
18	Steer Pump Time Delay (w/o Seat Brake)		025	14 Sec	[4]	[4]

[1] Any number other than "zero" can be read as a possible fault.
[2] Settings greater than 250 will disable the 1A Drop Out function.
[9] Not used, set to 000 (zero).
[4] Setting of 000-128 (1.5-65.0 Sec) with seat brake. Setting of 021-128 (12-65 Sec) without seat brake.

NOTE: There are no Functions 8 through 10, for the Dual Traction Card. Settings for these functions have no effect on operation.

⚠ WARNING

Settings greater than 127, for Function 7, will prevent the inside motor from operating in reverse during a turn. This different operation of the truck can result in personal injury. NEVER set Function 7 to a number greater than 127.

TROUBLESHOOTING

GENERAL

Many electrical malfunctions of the lift truck will be shown in the status code number on the digital display. There is a digital display on the hand set or instrument panel display (optional on some units). There is a table, in this troubleshooting section, for each status code with a description of the malfunction, the circuit that has the incorrect input, the symptom and the possible causes. THESE TABLES ARE FROM THE GE MANUAL SO SOME OF THE NOMENCLATURE IS DIFFERENT THAN IS NORMALLY USED BY HYSTER COMPANY.

NOTE: Make sure to check that the Function Codes are correct for your lift truck to **make sure the trouble is not just a wrong setting**. See TABLE 10 through TABLE 28 for the correct values. If there is no status code display and the lift truck does not operate correctly, there can be a fault in the control card.

Connect the hand set as follows:
Disconnect Plug Y at the SCR control card (Traction or Pump) if the display is connected. Connect the hand set plug at the location "Y" on the control card. Connect the battery, push and hold the **CONT** button and turn the key to the **ON** position. The display will show "8888" to check that all segments of the display are working. The status codes have a (-) in front of the display number. If there is no (-), the hourmeter function, battery indicator function or a function setting is displayed.

NOTE: If the battery is disconnected when there is a stored status code, the status code "-" will be missing on the hand set display when a battery is connected.

The following Status Codes indicate possible faults in these areas:

AREA OF FAULT
STATUS CODE #

Card Inputs
Blank through -17

Contactor Panel
-23 through -26

SCR Panel
-41 through -57

Regenerative Braking
-70 through -76

Truck Management
-90 through -95

Pump Control
-117 through -157

NOTE: **1.** A blank display, during operation, can mean that the regenerative braking diode is shorted. The symptom for this malfunction is; no operation and traction power fuse open. If the diode is shorted, there is a short-circuit across the battery as soon as the regen. contactor closes and the fuse will open. If the regenerative braking diode is open, there will be no symptoms except that there will be stiff plugging and no regenerative braking.

2. Another malfunction that can cause the lift truck to go dead when operating at the higher speeds, is an shorted 1A coil. The lift truck operates normally until the 1A contactor is normally energized. At this time the traction motor has no power and the traction contactor contacts will open.

3. If the coil of the FW contactor has a short-circuit, the lift truck will operate normally until the FW contactor is energized. The lift truck will then lose power and the traction contactor contacts will open.

4. Status codes -90 through -95 are defined by **HYSTER** and may not be used on all lift truck models. The reason for the display of these status codes can vary between **HYSTER** lift truck models. Status codes -90 through -95 can be used to define high motor temperature or worn brushes on the lift pump or traction motors. Sensors on the motors or in the brushes are used to measure motor temperature and brush wear. On some lift truck models, lights on the instrument panel assembly will illuminate to indicate which sensor is causing the status code. See TABLE 1, TABLE 3, TABLE 4, TABLE 7 and the **DIAGRAMS** SRM section for your lift truck model for additional information.

STATUS CODE	DESCRIPTION	MEMORY RECALL	Yes
-25	1A contactor does not open or opens slowly.	CIRCUIT	Traction

INDICATION OF FAULT

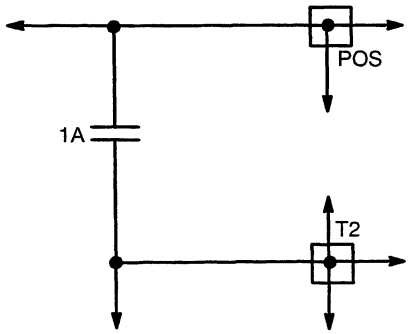
Tips of 1A or forward and reverse contactor wear rapidly. Status Code 46 can be on the display, but no fault can be found.

POSSIBLE CAUSE

NOTE: This status code can only be found when the hand set is connected. This status code is shown as an additional information for Status Code 46.

Malfunction of 1A contactor

- Check 1A contactor for slow operation as it opens.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when the 1A contactor takes more than 0.060 second to open.

STATUS CODE	DESCRIPTION	MEMORY RECALL	Yes
-26	Electronic driver (in control card) for the 1A, PS, RB or FW contactor has a short-circuit.	CIRCUIT	Traction

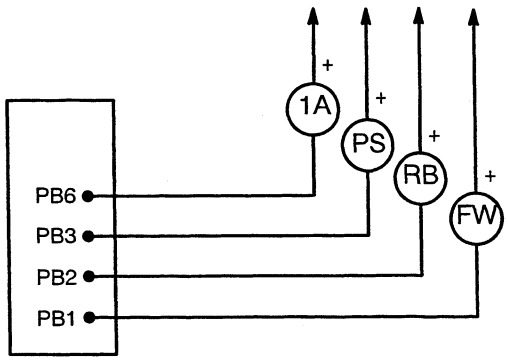
INDICATION OF FAULT

1A, PS, RB or FW contactor energizes as soon as the key is moved to the **ON** position.

POSSIBLE CAUSE

Malfunction of coil driver in control card

- Replace control card.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when there is a short-circuit in the electronic driver for the 1A, PS, RB or FW contactor.

STATUS CODE -73	DESCRIPTION	MEMORY RECALL	Yes
	Regenerative braking contactor does not open or opens slowly.	CIRCUIT	Traction

INDICATION OF FAULT

Forward or reverse contactors deenergize and energize, then will only energize when the key is moved to the **OFF** then **ON** position.

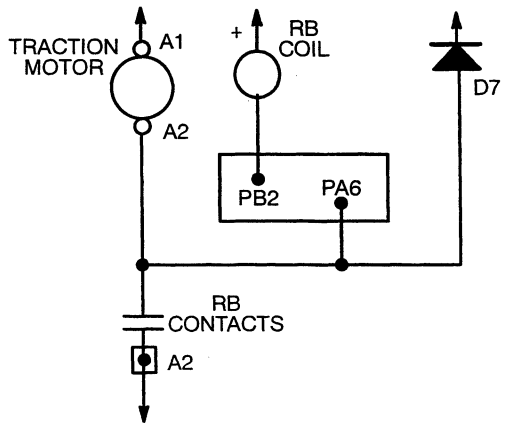
POSSIBLE CAUSE

RB contactor malfunction.

- Check the RB contactor for smooth operation and wear on the moving parts.

Input signal to PA6 is not regular.

- Check for an open-circuit or loose connections in the PA6 circuit from PA6 to the A2 connection (positive connection) of the RB contactor.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when the RB contactor does not open within 100 milliseconds after power is removed from the coil.

STATUS CODE -74	DESCRIPTION	MEMORY RECALL	Yes
	Regenerative braking contactor closes too slowly.	CIRCUIT	Traction

INDICATION OF FAULT

Forward or reverse contactors deenergize and energize, then will only energize when the key is moved to the **OFF** then **ON** position.

POSSIBLE CAUSE

RB contactor malfunction.

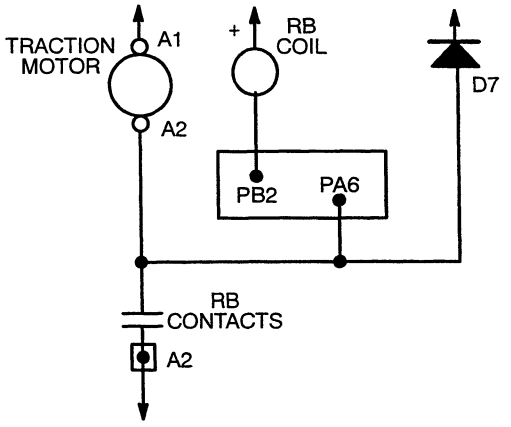
- Check the RB contactor for smooth operation and wear on the moving parts.

Input signal to PA6 is not regular.

- Check for an open-circuit or loose connections in the PA6 circuit from PA6 to the A2 connection (positive connection) of the RB contactor.

RB contactor coil circuit malfunction.

- Check the resistance of the coil for the RB contactor. The correct resistance is 10-14 ohms.
- Check for loose connections from PB2 to the negative side of the RB contactor coil.
- Check for loose connections from battery positive to the positive side of the RB contactor coil.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when the RB contactor does not close within 100 milliseconds after power is applied to the coil.

STATUS CODE -148	DESCRIPTION	MEMORY RECALL	No
	Voltage at T2 is less than 12% of battery voltage.	CIRCUIT	Pump

INDICATION OF FAULT

Lift pump contactor will not energize.

Lift pump control will not operate.

POSSIBLE CAUSE

Malfunction of the lift pump contactor.

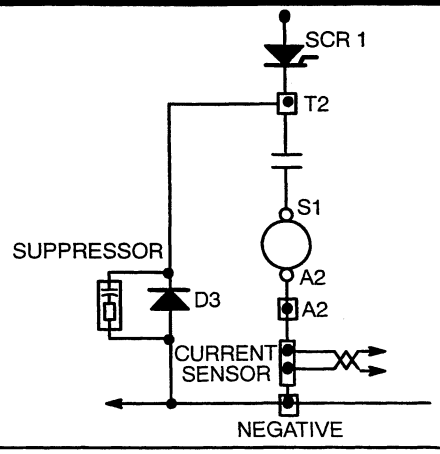
- Welded lift pump contactor tips.
- Lift pump contactor tip assembly does not move freely.

Malfunction of diode D3 (Pump) circuit.

- Check for a short-circuit of diode D3.
- Check for a short-circuit of suppressor for diode D3.

Control card is the wrong type.

If the lift pump control is used without a pump contactor, the control card must be set correctly. See Function 17 for the correct setting.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when the voltage at T2 is less than 12% of battery voltage.

STATUS CODE -149	DESCRIPTION	MEMORY RECALL	Yes
	SCR 5 (Pump) does not go **ON** correctly.	CIRCUIT	Pump

INDICATION OF FAULT

Lift pump contactor will deenergize, energize and deenergize, then will only energize when the key is moved to the **OFF** then **ON** position.

Lift pump motor will not operate or continues to operate until the battery is disconnected.

POSSIBLE CAUSE

Malfunction of SCR 5 (Pump) circuit.

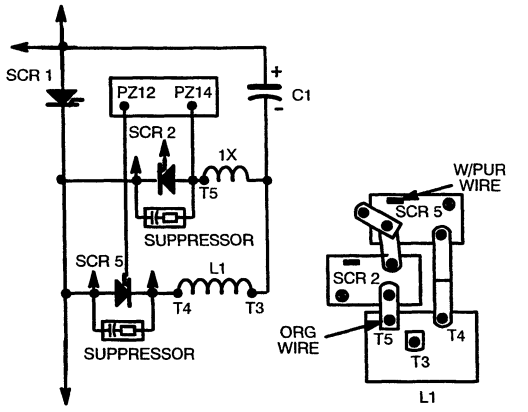
- Check for a short-circuit of SCR 5.
- Check for a short-circuit of suppressor for SCR 5.
- Check for an open-circuit across SCR 2 or an open gate lead to SCR 5. Check that the SCR 5 will gate on.
- Check for an open-circuit or loose connection between SCR5 and PZ12 (white/purple wire).

Malfunction of SCR 2 (Pump) circuit.

- Check for a short-circuit of SCR 2.
- Check for a short-circuit of suppressor for SCR 2.
- Check for an open-circuit across SCR 5 or an open gate lead to SCR 2.

Malfunction of capacitor C1 (Pump).

- Check for open capacitor.
- Check for loose connections at capacitor terminals.



REASON FOR STATUS CODE DISPLAY

This status code is displayed when SCR 5 (Pump) does not go **ON** with a gate signal during operation.

TABLE OF CONTENTS

This section is for the following models:

E2.00-3.20XM (E45-65XM) [F108];
J2.00-3.20XM (J40-65XM) [A216];
N30XMH [C210]

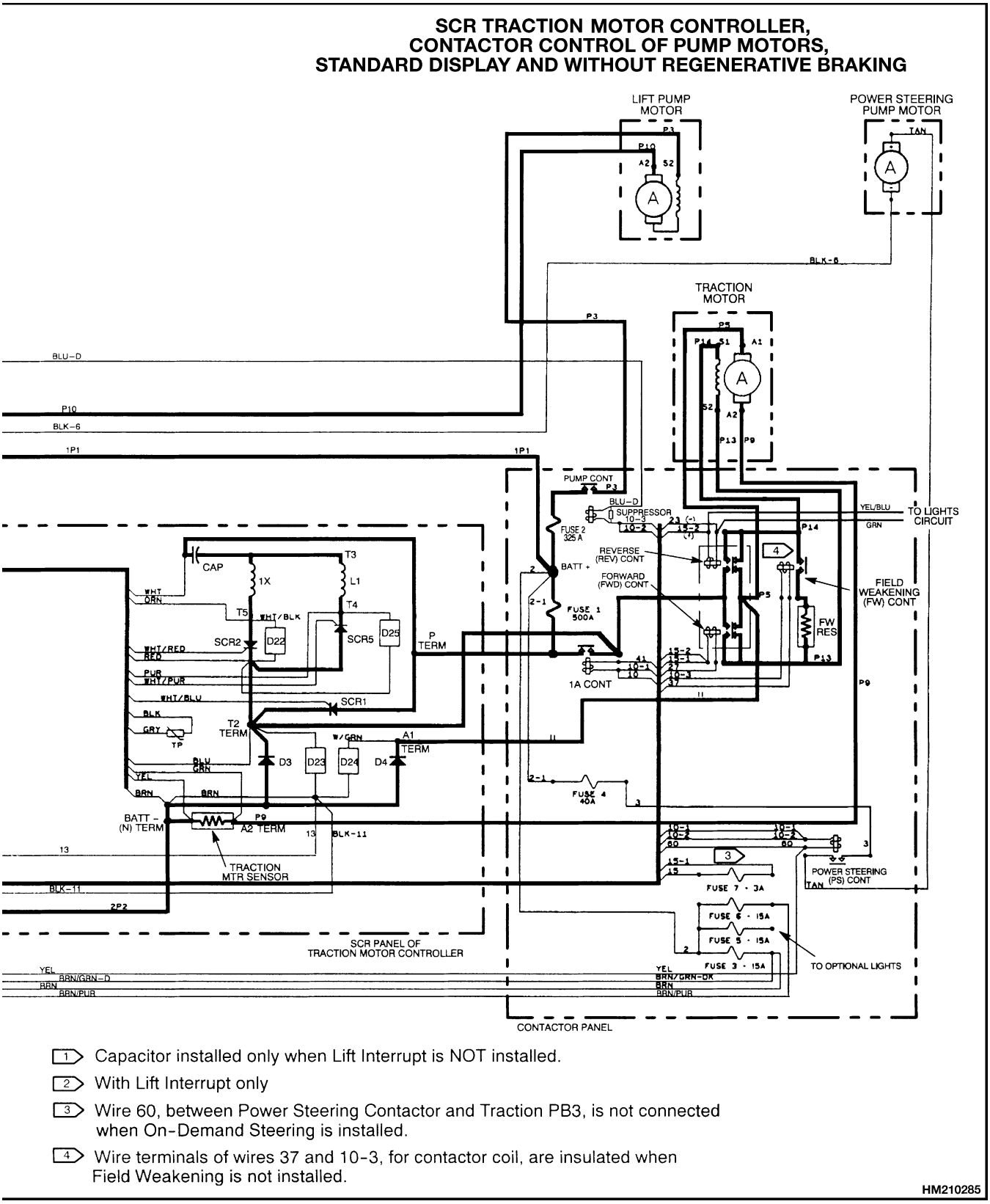


Figure 6. Wiring Diagram E2.00-3.20XM (E45-65XM) and N30XMH

Legend for Figure 12

1. TRACTION MOTOR
2. LIFT PUMP MOTOR
3. STEERING PUMP MOTOR
4. HORN
5. MONOTROL PEDAL
6. CONTROL LEVER SWITCHES
7. MOTOR CONTROLLERS COMPARTMENT
8. BATTERY COMPARTMENT

NOTES

Legend for Figure 23

1. YEL/PINK WIRE
2. RED/BLUE-LT AND RED/WHT WIRES
3. CONTACTOR FOR WIRE 50 (TO DRIVER TERM. 1)
4. CONTACTOR FOR WIRE 50 (TO PUMP PB3)
5. GRN WIRE
6. WHT-5 WIRE
7. PINK WIRE
8. BLUE-LT WIRE
9. CONNECTOR FOR YEL/GRN WIRE (PY11)
10. CARD PLUG Y (CARD-TO-CARD AND DISPLAY WIRES)
11. CARD PLUG A (INPUT SIGNAL)
12. TERMINAL BOARD CONNECTIONS
13. 2P1
14. BRN AND BRN (POWER DISCONNECT)
15. RED/WHT AND PINK (SEAT SW)
16. P14
17. P9
18. P5
19. P13
20. 1P2
21. CARD PLUG Z (STATIC PANEL SIGNALS)
22. 1P3
23. TAN WIRE
24. P3
25. P10
26. MAIN CHASSIS HARNESS
27. STANDARD DISPLAY HARNESS
28. ENHANCED DISPLAY HARNESS
29. BATTERY NEG STUD
30. PUMP CONTACTOR DRIVER
31. WIRE 10-3
32. WIRE 10-4
33. WIRE 60

Legend for Figure 29

1. BATTERY CHANGE INDICATOR WITH LIFT INTERRUPT
2. DIGITAL DISPLAY
3. WARNING LIGHT, FASTEN SEAT BELT
4. WARNING LIGHT, BRAKE FLUID RESERVOIR IS LOW
5. WARNING LIGHT, PARKING BRAKE INDICATOR
6. INDICATOR LIGHT, STEERING PUMP MOTOR
7. WARNING LIGHT, MOTOR BRUSHES ARE WORN (TRACTION, HYDRAULIC, OR STEERING)
8. INDICATOR LIGHT, TRACTION MOTOR
9. INDICATOR LIGHT, HYDRAULIC MOTOR
10. WARNING LIGHT, MOTOR TEMPERATURE OVER LIMIT (TRACTION OR HYDRAULIC)
11. WARNING LIGHT, SERVICE INTERVAL
12. INDICATOR LIGHT, HOURMETER
13. PUSH BUTTON, DISPLAY STATUS CODES
14. PUSH BUTTON, SET PERFORMANCE LEVEL
15. PERFORMANCE LEVEL INDICATORS (FOUR LEDS)
16. HOURMETER
17. VOLTMETER

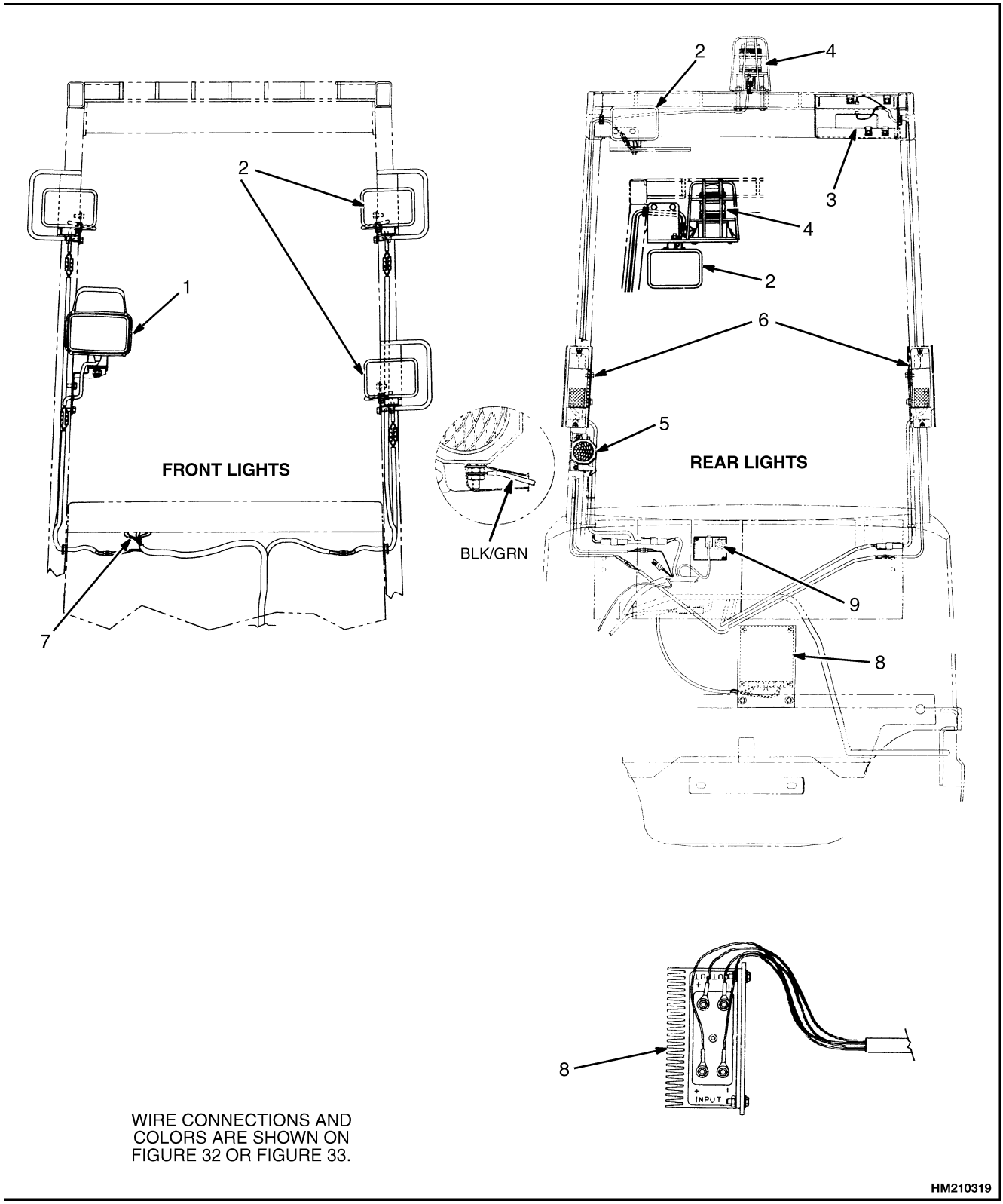
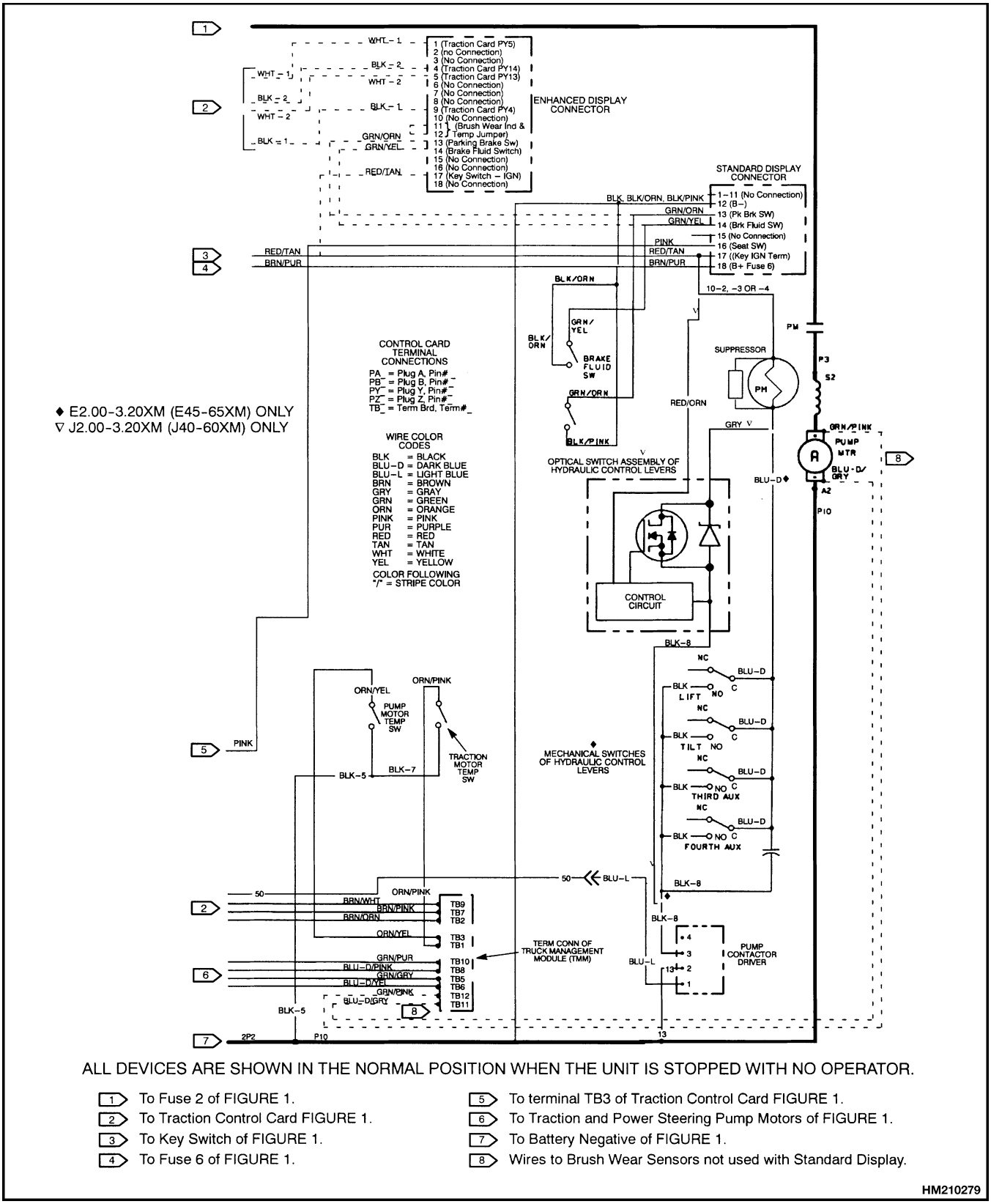


Figure 35. Lighting Wiring Diagram J2.00-3.20XM (J40-60XM)



ALL DEVICES ARE SHOWN IN THE NORMAL POSITION WHEN THE UNIT IS STOPPED WITH NO OPERATOR.

1. To Fuse 2 of FIGURE 1.
2. To Traction Control Card FIGURE 1.
3. To Key Switch of FIGURE 1.
4. To Fuse 6 of FIGURE 1.
5. To terminal TB3 of Traction Control Card FIGURE 1.
6. To Traction and Power Steering Pump Motors of FIGURE 1.
7. To Battery Negative of FIGURE 1.
8. Wires to Brush Wear Sensors not used with Standard Display.

HM210279

Figure 3. Contactor Control for Lift Pump Motor Schematic

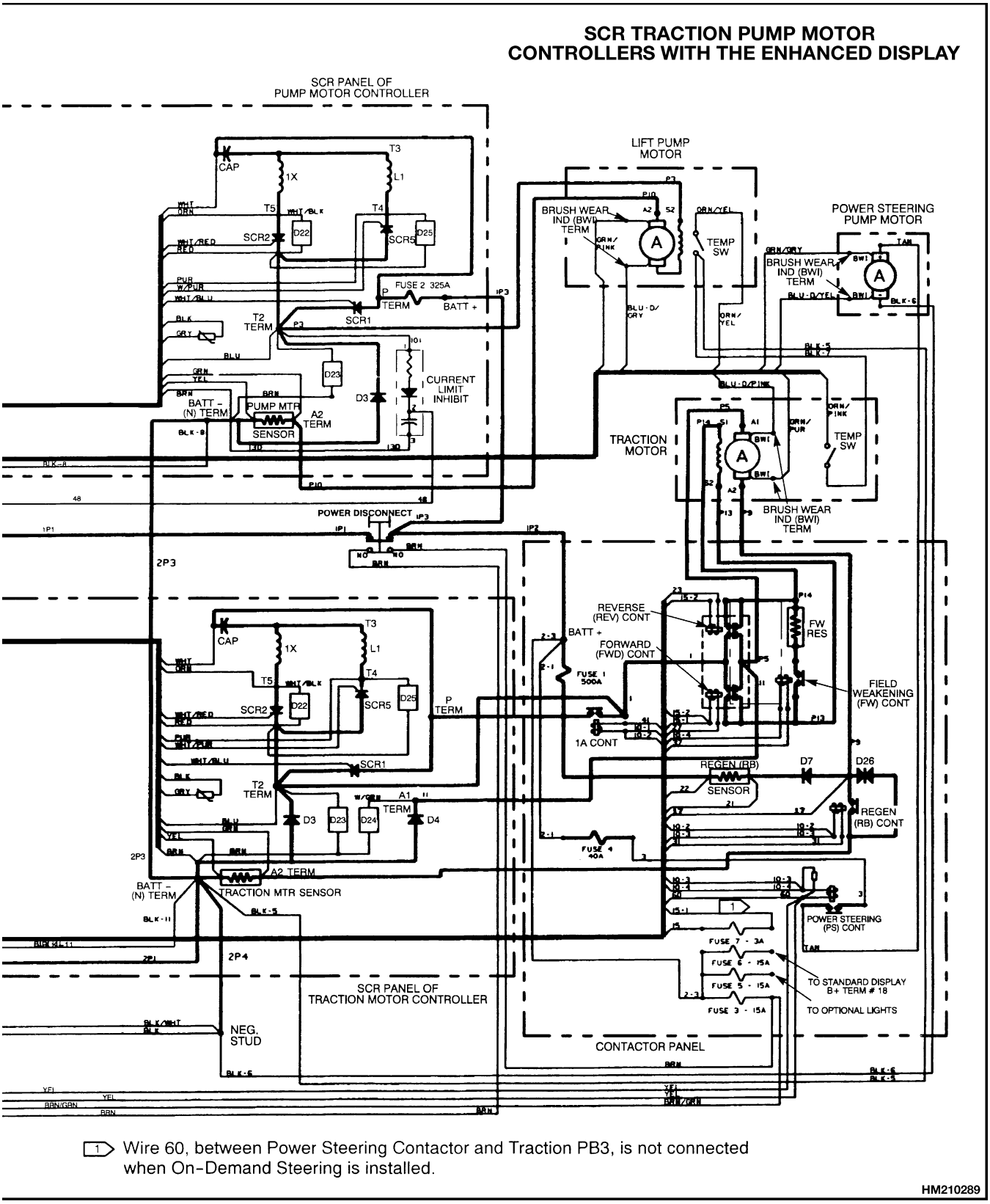


Figure 9. Wiring Diagram J2.00-3.20XM (J40-60XM)

Legend for Figure 14

1. CARD PLUG Y (CARD-TO-CARD AND DISPLAY WIRES)
2. BLUE-LT AND WHT/BLUE
3. PINK AND PINK
4. WHT AND WHT/PINK
5. RED/BLUE-LT
6. RED/BLUE-LT
7. GRN/WHT
8. CARD PLUG A (INPUT SIGNALS)
9. CONNECTOR FOR 50
10. CONNECTOR FOR 70
11. CONNECTOR FOR 48
12. WIRE 32
13. CARD PLUG Z (STATIC PANEL SIGNALS)
14. BRN AND BRN/GRN-DK
15. BRN/WHT
16. BRN/PURPLE
17. BLK/TAN
18. P9
19. 2P2
20. P13
21. P14
22. P5
23. 1P1
24. P3
25. P10
26. 2P3
27. CARD PLUG B (CONTACTOR CONTROL SIGNAL)
28. BLK 8 AND BLK 5
29. BLUE-DK
30. BLUE-DK/GRN
31. GRAY

Legend for Figure 20

1. TRACTION MOTOR
2. LIFT PUMP MOTOR
3. STEERING PUMP MOTOR
4. HARNESS FOR TEMP. AND BWI SENSORS
5. MAIN CHASSIS HARNESS
6. DISPLAY PANEL HARNESS
7. TO INSTRUMENT PANEL
8. TO ON-DEMAND STEERING
9. BATTERY+ CONTROL WIRES

NOTES

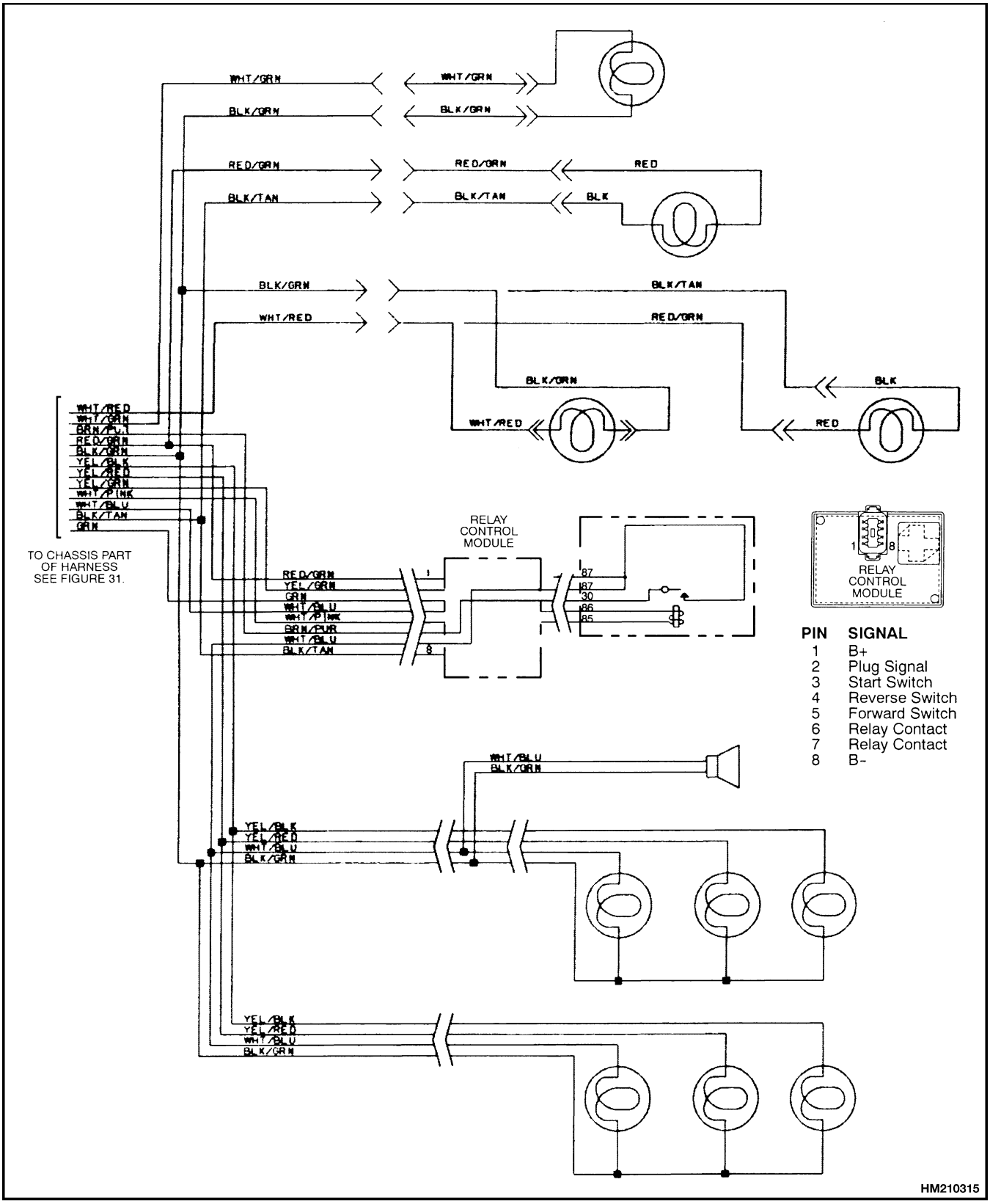
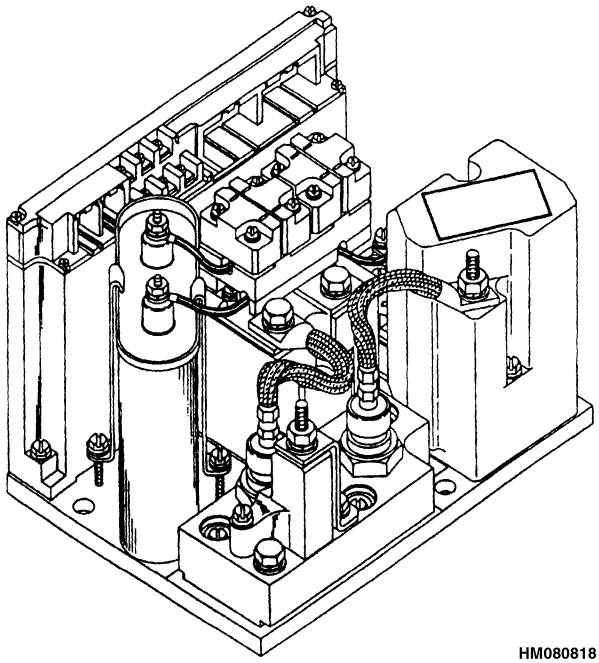


Figure 33. Lighting Schematic (Rear) J2.00-3.20XM (J40-60XM)

EV-100ZX™ SCR MOTOR CONTROLLER

DESCRIPTION, ADJUSTMENTS, TROUBLESHOOTING, REPAIRS, AND THEORY

E1.50-1.75XM, E2.00XMS (E25-35XM, E40XMS) [D114];
E.200-3.20XM, E2.50-3.00XMS (E45-65XM, E45-50XMS) [F108];
E3.50-5.50XL (E70-120XL) [C098];
J2.00-3.20XM, J2.50XMS (J40/50/60/65XM, J50XM Short) [A216];
N30XMH [C210]

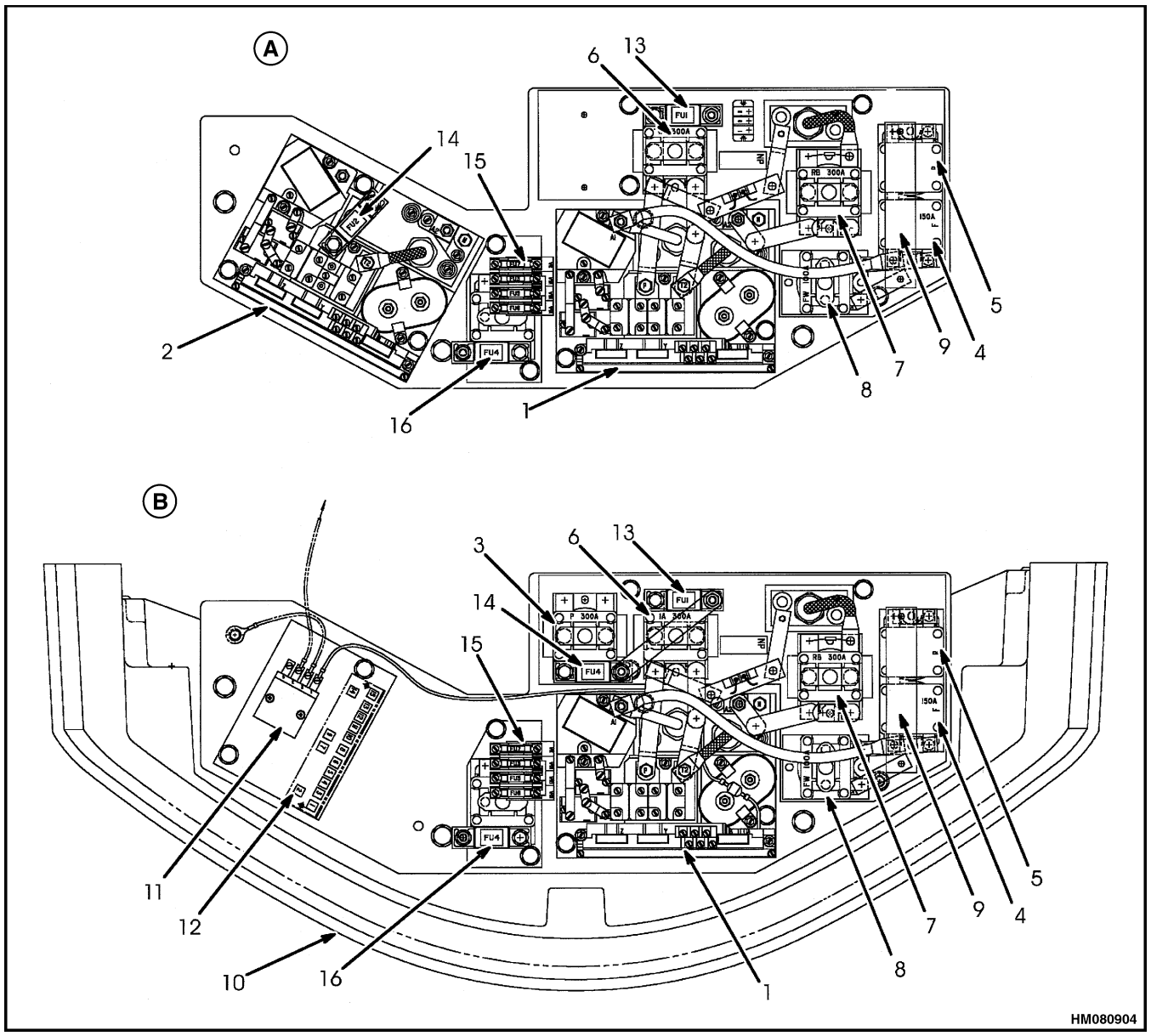


HM080818

HYSTER

PART NO. 897636

2200 SRM 557



A. MOTOR CONTROLLER WITH REGENERATIVE BRAKING, 1A BYPASS, AND SCR CONTROLLER FOR HYDRAULIC PUMP

B. MOTOR CONTROLLER WITH REGENERATIVE BRAKING, 1A BYPASS, AND CONTACTOR CONTROL FOR HYDRAULIC PUMP

1. TRACTION CONTROLLER
2. SCR CONTROL FOR HYDRAULIC PUMP MOTOR CONTROLLER
3. HYDRAULIC PUMP MOTOR CONTACTOR
4. FORWARD CONTACTOR
5. REVERSE CONTACTOR
6. 1A BYPASS CONTACTOR
7. REGENERATIVE BRAKING CONTACTOR
8. FIELD WEAKENING CONTACTOR
9. FIELD WEAKENING RESISTOR
10. COUNTERWEIGHT
11. ELECTRONIC DRIVER
12. TRUCK MANAGEMENT MODULE (TMM1)
13. FUSE 1 (TRACTION CIRCUIT)
14. FUSE 2 (HYDRAULIC PUMP CIRCUIT)
15. FUSE PANEL (FU 7, FU 3, FU 5, FU 6)
16. FUSE 4 (STEERING CIRCUIT)

Figure 2. Typical Configurations of EV-100ZX Motor Controller in J-XM Model Lift Trucks

Table 4. Terminal and Plug Wire Connections for Controller with SCR Control of Traction Circuit and SCR Control of Hydraulic Pump Motor — Control Card - Type ZP (Continued)

Plug or Terminal No.	Wire Color or Wire Number	Function
PY4	BLK-3	Instrument panel display/number 10 input (ground).
PY5	WHT-3	Instrument panel display number 2 input.
PY6	—	Not used.
PY7	—	Not used.
PY8	—	Not used.
PY9	—	Not used.
PY10	BRN/ORN	Signal wire between hydraulic pump control card and traction control card (brush wear indicators, all motors).
PY11	BRN/PNK	Signal wire between hydraulic pump control card and traction control card (brush wear indicators, all motors).
PY12	BRN/WHT	Signal wire between hydraulic pump control card and traction control card (temperature switches, hydraulic pump motor, and traction motor).
PY13	WHT-4	Instrument panel display number 7 input.
PY14	BLK-4	Instrument panel display number 6 input.
PZ1	BLK	Signal wire from SCR 1 thermal protector.
PZ2	BRN	Battery negative.
PZ3	YEL	Signal wire from current sensor.
PZ4	GRN	Signal wire from current sensor.
PZ5	GRY	Signal wire from SCR 1 thermal protector.
PZ6	—	Not used.
PZ7	WHT	Battery positive.
PZ8	BLU/WHT	Signal wire to SCR 1 gate.
PZ9	BLU	Signal wire from SCR 1 cathode.
PZ10	WHT/RED	Signal wire to SCR 2 gate.
PZ11	RED	Connection between filter for SCR 2 and control card.
PZ12	WHT/PUR	Signal wire to SCR 5 gate.
PZ13	PUR	Connection between filter for SCR 5 and control card.
PZ14	ORN	Sensor wire for voltage check across capacitor C1.

500 amps. The pedal position has no effect on the plugging distance with this setting.

Use the following information to adjust the current value:

Range	100 to 930 amps
Parameter Range	0 to 255
Resolution	3.2A per set unit
Example:	Parameter of 20 = 164 amps
	20 × 3.2A = 64A
	64A + 100 (range min) = **164A**

Function Number 17 CARD TYPE SELECTION

(Push CONT and 2)

WARNING

Wrong parameters entered into the register in Function Number 17 CARD TYPE SELECTION can cause the truck to operate differently than normal. This different operation of the truck can cause an injury. NEVER set Function Number to a parameter that is not shown for your lift truck.

This register permits the selection of the card type used for your lift truck application.

Function Number 18 STEERING PUMP TIME DELAY

(Push CONT and 3)

WARNING

A parameter set lower than the number shown in the Tables for the Parameter Registers can permit the steering pump to stop if the seat switch opens momentarily during normal operation. There is no power steering if the steering pump stops. The sudden and difficult steering effort that is not expected can cause injury or property damage.

This register selects input for the steering pump contactor. Closing the seat switch or the FWD/REV switch can be the input. The parameter also sets the time delay for the contactor to open after the switch opens.

NOTE: There is no delay time for the contactor to close after receiving the input signal from the seat switch or the FWD/REV switch. Parameters in the 0-128 range adjust the delay after the seat switch opens. Parameters in the 129-255 range adjust the delay after the FWD/REV switch opens. **Adjust the setting to the number shown in Tables for the Register Parameters**.

Function Number 19 MAINTENANCE ALERT (Tens/Units)

(Push CONT and 4)

This register can be set by the service person to give a Status Code -99 when scheduled maintenance is required. The range for this register is 0 to 99 hours.

Function Number 20 MAINTENANCE ALERT (Thousands/Hundreds)

(Push CONT and 5)

This register can be set by the service person to give a Status Code -99 when scheduled maintenance is required. The range for this register is 100 to 9900 hours.

Function Number 21 MAINTENANCE SPEED LIMIT

(Push CONT and 6)

This register can be set by the service person to control the speed limit (maximum battery volts to the motor) when the Maintenance Alert (Status Code -99) is activated by the control card. The range for this register is 0 to 180.

Function Numbers 22 Through 28 TEMPORARY DATA REGISTERS

CAUTION

Function Number 25 (temporary storage register for fault data) and Function Number 26 (temporary storage register for battery charge data) must not be changed by the user to any number above zero. Any number above zero can cause the instrument panel display to not operate correctly and the lift truck can become disabled.

These registers can be read with the Handset, but the data in them changes during lift truck operation. Do not change the parameters in registers for Function

Table 5. Status Codes List (Continued)

Status Code	Description
-149	SCR 5 does not go **ON** correctly
-150	C1 volts low
-151	C1 volts high with high motor current
-152	C1 volts high with low motor current
-154	Short circuit in electronic driver for the hydraulic pump contactor or 1A contactor
-157	Polarity check, current sensor output voltage

* Not used on all models of lift trucks. Status Codes in this group will flash on the display.
NOTE: Motor speed is decreased when a status code -41 is indicated.

REGISTER MAPS

The information in the Register Maps shown in Table 6 and Table 7 is not needed by most service people. This additional technical information is for service engineers who have special troubleshooting requirements. These registers and their descriptions are designed by the General Electric Company. Many of these registers are programmed by Hyster Company to do certain functions. These register maps as programmed by Hyster Company are shown in the **Parameter Tables**.

NOTE: The number of the EEPROM register is offset by one from the PC Register Number and the Function Number in the Register Map Tables. The EEPROM begins its count from zero (0) while the PC and Handset count from one (1).

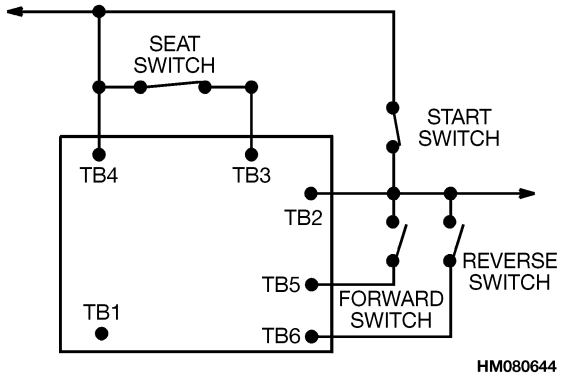
NOTE: EEPROM = Electrically Erasable Programmable Read Only Memory

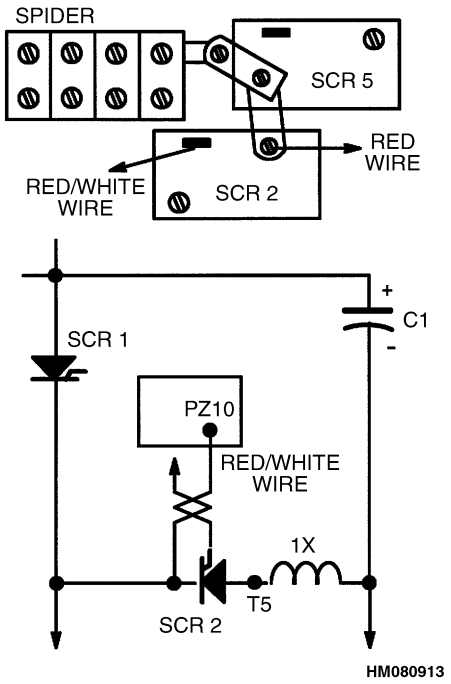
Table 6. Register Map for Control Cards ZH and ZY (Traction)

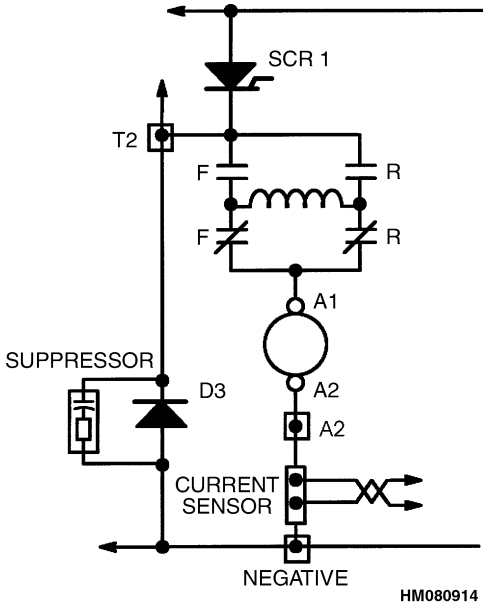
EEPROM Register Number	PC Register Number	Handset (HS) Number	Description	Access By:	Restrictions
0	1	1	Fault Code	HS or PC	Erases when battery is disconnected
1	2	2	Creep	HS or PC	None
2	3	3	Controlled Acceleration	HS or PC	None
3	4	4	Current Limit	HS or PC	None
4	5	5	Current Limit (Plugging)	HS or PC	None
5	6	6	1A Dropout	HS or PC	None
6	7	7	FW Pickup	HS or PC	None
7	8	8	FW Dropout	HS or PC	None
8	9	9	Regenerative Braking Current Limit	HS or PC	None
9	10	10	Regenerative Start	HS or PC	None
10	11	11	Speed Limit 1	HS or PC	None
11	12	12	Speed Limit 2	HS or PC	None
12	13	13	Speed Limit 3	HS or PC	None
13	14	14	Battery Voltage Compensation	HS or PC	None
14	15	15	Battery Voltage Selection	HS or PC	None

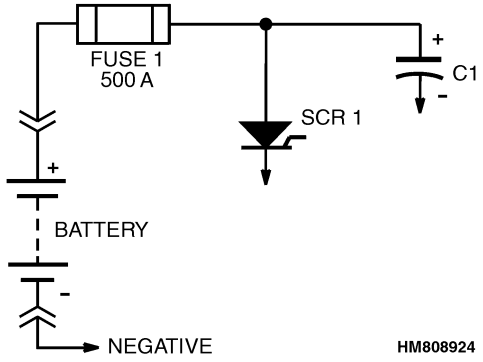
Table 7. Register Map for Control Card ZP (Hydraulic Pump) (Continued)

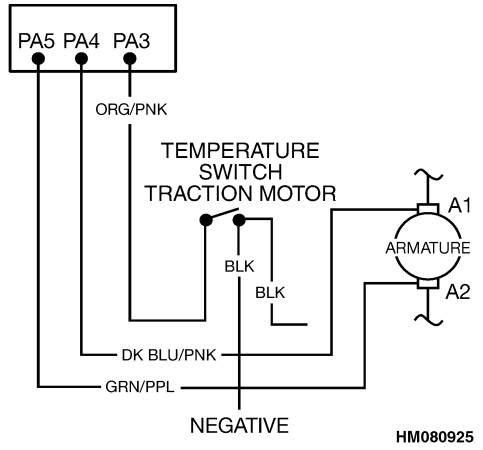
EEPROM Register Number	PC Function Number	Handset (HS) Function Number	Function	Access By:	Restrictions
110	111	62	Instrument Panel Display SL4-4	HS or PC	None
111	112		NOT USED	PC Only	
112	113		Secure Hourmeter (Tens/Units)	PC Only	Read Only
113	114		Secure Hourmeter (Thousands/Hundreds)	PC Only	Read Only
114	115		Secure Auxiliary Hourmeter (Thousands/ Hundreds)	PC Only	Read Only
115	116		Secure Auxiliary Hourmeter (Thousands/ Hundreds)	PC Only	Read Only
116	117			PC Only	GE Use Only
117	118			PC Only	GE Use Only
118	119			PC Only	GE Use Only
119	120			PC Only	GE Use Only
120	121			PC Only	None
121	122			PC Only	None
122	123			PC Only	None
123	124			PC Only	None
124	125			PC Only	None
125	126			PC Only	None
126	127			PC Only	None
127	128			PC Only	None

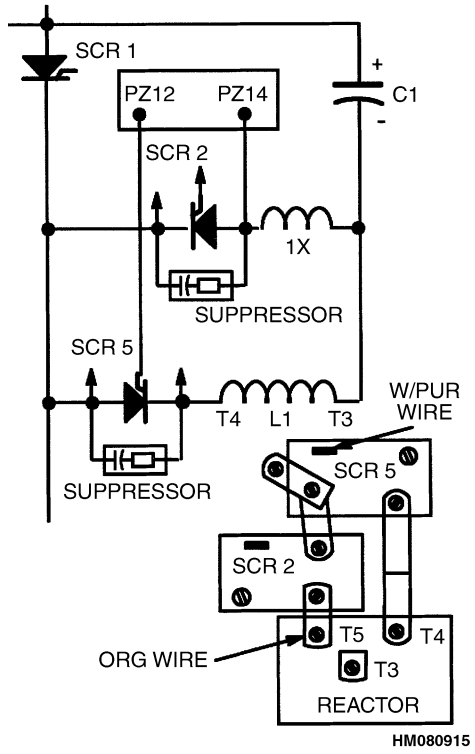
Status Code **-11**	**Description** The START switch is closed when the key switch is closed and voltage is applied to the control card.	**Cause of Status Indication** This Status Code is indicated when TB2 is greater than 60% of battery voltage when the key switch is closed.
Memory Recall No **Circuit** Traction (ZX Control Card Only)	**Indication of Fault** Forward or Reverse contactor does not close. **Possible Cause** <u>START switch needs adjustment or is damaged.</u> Input voltage must be less than 60% of battery voltage when the key switch is closed. Replace or adjust the START switch. <u>Short circuit between battery positive and TB2 in START switch circuit.</u> Disconnect the wire from TB2. Check for a short circuit between the end of the wire and the battery positive. Resistance must be greater than 4.7 kohms. <u>Control card malfunction.</u> Disconnect the wire from TB3 and measure the voltage from TB3 to battery negative. If the voltage is not zero, replace the control card.	

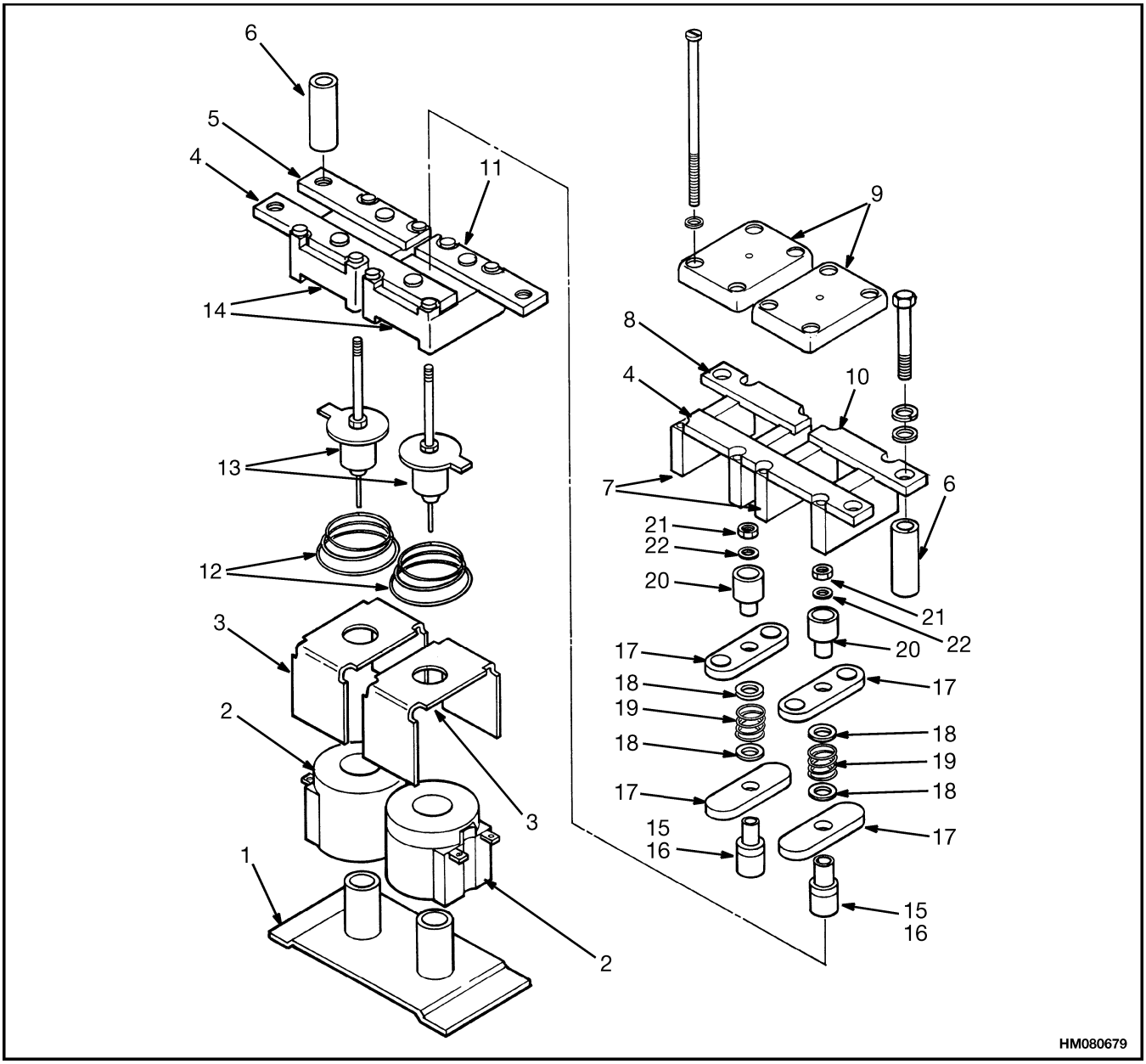
Status Code **-47**	**Description** SCR 2 does not go to **ON** correctly. (Also see Status Code -25).	**Cause of Status Indication** This Status Code is indicated when SCR 2 has a failure and does not go **ON**.
Memory Recall Yes **Circuit** Traction	**Indication of Fault** Forward or Reverse contactors open and close, then close only when the key switch is opened and closed. **Possible Cause** <u>Malfunction of SCR 2 circuit.</u> Check that SCR 2 goes **ON** with a gate signal. Check for an open circuit or loose connection between SCR 2 gate and PZ10 (white/red wire). Check for an open circuit or loose connection between SCR 1 and C1 and through the SCR 2 circuit. <u>Malfunction of Forward or Reverse contactors.</u> Check for Forward or Reverse contactors momentarily opening and closing during operation when traveling over bumps and dock plates.	

Status Code **-48**	**Description** Voltage check at T2 is less than 12% of battery voltage.	**Cause of Status Indication** This Status Code is indicated when a voltage check at T2 is less than 12% of battery voltage.
Memory Recall Yes **Circuit** Traction	**Indication of Fault** Forward or Reverse contactors do not close. **Possible Cause** <u>Malfunction of Forward or Reverse contactors.</u> Check for welded contacts that hold a Forward or Reverse contactor closed. Check for slow operation of a Forward or Reverse contactor. <u>Malfunction of diode D3 circuit.</u> Check for a short circuit across D3. Check for a short circuit across the suppressor for D3.	

Status Code **-76**	Description Voltage on C1 too high during regenerative braking.	Cause of Status Indication This Status Code is indicated when the voltage on C1 is greater than 225 volts during regenerative braking.
Memory Recall Yes **Circuit** Traction	**Indication of Fault** Forward or Reverse contactors open and close, then close only when the key switch is opened and closed. **Possible Cause** Bad connection or irregular connection in battery power circuit. Check battery power circuit for loose connections. Check the power fuse and battery connections that can open during regenerative braking. Too much inductance from cables. Check that battery cables are too long.	

Status Code **-90**	Description Traction motor temperature too high.	Cause of Status Indication This Status Code is indicated when the voltage at terminal PA3 of the hydraulic pump control card is at zero volts.
Memory Recall No **Circuit** Traction and Hydraulic Pump	**Indication of Fault** Status Code is indicated as a flashing number on the instrument panel display. The lift truck speed is reduced when either the hydraulic pump motor or the traction motor are too hot. **Possible Cause** Traction motor is too hot. Temperature sensor has closed battery negative. Permit traction motor to cool. Other causes. PA3 has a short circuit to battery negative. There is a short circuit in the sensor wires. There is a short circuit or other malfunction in the sensor.	

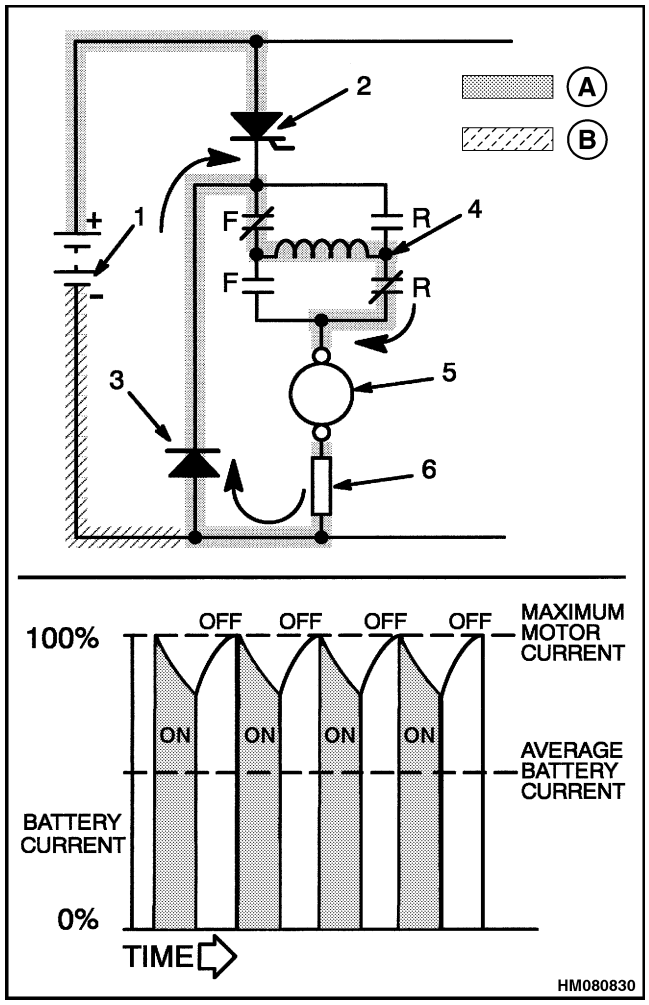
Status Code **-149**	Description SCR 5 in the hydraulic pump controller does not go **ON** correctly.	Cause of Status Indication This Status Code is indicated when SCR 5 does not go **ON** correctly.
Memory Recall Yes **Circuit** Hydraulic Pump	**Indication of Fault** Hydraulic pump motor does not operate or continues to operate until the battery is disconnected. **Possible Cause** Malfunction of SCR 5 circuit. Check for a short circuit across SCR 5. Check for a short circuit across the suppressor for SCR 5. Check for an open circuit across SCR 2 or an open gate lead to SCR 5. Check for an open circuit or a loose connection between SCR 5 and PZ12 (white/purple wire). Malfunction of SCR 2 circuit. Check for a short circuit across SCR 2. Check for a short circuit across the suppressor for SCR 2. Check for an open circuit across SCR 5 or an open gate lead to SCR 2. Malfunction of C1. Check for open capacitor C1. Check for loose connections of capacitor terminals.	



1. MAGNET BASE
2. COIL
3. MAGNET FRAME
4. BUS
5. BUS
6. SPACER
7. BUS CLAMP
8. BUS
9. COVER
10. BUS
11. BUS
12. RETURN SPRING
13. ARMATURE
14. BUS BASE
15. MOVABLE TIP CARRIER
16. PLUNGER BUSHING
17. MOVABLE TIP
18. SPRING SEAT
19. TIP SPRING
20. UPPER BUS INSULATION
21. NUT
22. WASHER

Figure 15. Direction Contactor

The graph in Figure 23 shows the typical induction current during equal **ON** and **OFF** times of SCR 1.



1. BATTERY
2. SCR 1 (**OFF**)
3. DIODE D3
4. MOTOR FIELD
5. MOTOR ARMATURE
6. MOTOR CURRENT SENSOR

Figure 23. Induction Current

CONTROL CARDS

The control cards for the traction circuit and the hydraulic circuit are described separately in the following paragraphs.

NOTE: The configuration of the controller divides the base plate into three groups:

1. Traction controller group
2. Contactor group
3. Controller group for the hydraulic pump motor

The three groups of components are fastened to the rear plate of the battery compartment. Typical controller configurations are shown in Figure 1. (If the SCR controller for the hydraulic pump motor is not used, a single contactor for the hydraulic pump motor is installed in that position.)

The control card makes checks as part of the logic sequence. The control card only permits lift truck operation during the correct conditions. The control card checks and controls the functions described in the following paragraphs.

Pulse Monitor Trip (PMT) (Traction Circuit Only)

The PMT circuit is part of the control card function. When the SRO checks are complete, the control card senses the voltage across SCR 1. If the voltage across SCR 1 stays at a low voltage, there is a fault in the traction circuit. If the control card senses a short circuit (low voltage) across SCR 1, it does not permit a direction contactor to close. The PMT circuit also checks the traction circuit for faults during lift truck operation. If SCR 1 stays **ON** for greater than 32 milliseconds, the PMT circuit opens the direction contactor. The control card immediately closes the contactor again. If the fault occurs again, the control card opens the contactor until the fault is corrected or the PMT circuit is reset. The circuit is reset when the key switch is turned to **OFF** and then to **ON** again.

When the control card senses a fault across SCR 1, it removes the signal that closes a direction contactor. A loss of signal from the control card de-energizes and opens the direction contactors. A PMT occurs when the control card senses a malfunction in the operation of SCR 1 and stops sending a signal to the direction contactors.

SRO Circuit (Traction Circuit Only)

The lift truck is equipped with a safety circuit, called the **Static Return to OFF** (SRO) circuit, that prevents the operation of the lift truck if the starting sequence is not correct. The function of the SRO circuit is to make sure the operator is in the seat and ready to operate the controls. The starting sequence:

1. The operator must be on the operator's seat and the seat switch closed. (The seat switch closes when the weight of the operator is on the seat.)

(3) **Warning light, parking brake indicator.** The red light is **ON** when the parking brake is applied and the seat switch is closed, and goes **OFF** when the parking brake is released.

(4) **Warning light, brake fluid reservoir is low (Early Only).** The red light is **ON** for 1 second when the key switch is turned to the **START** position and must go **OFF** after 1 second. If the warning light is **ON** during operation, the brake fluid level in the reservoir is too low.

(5) **Warning light, fasten seat belt.** The red light is **ON** for 8-10 seconds after the key switch is turned to the **ON** position.

Later Display Panel

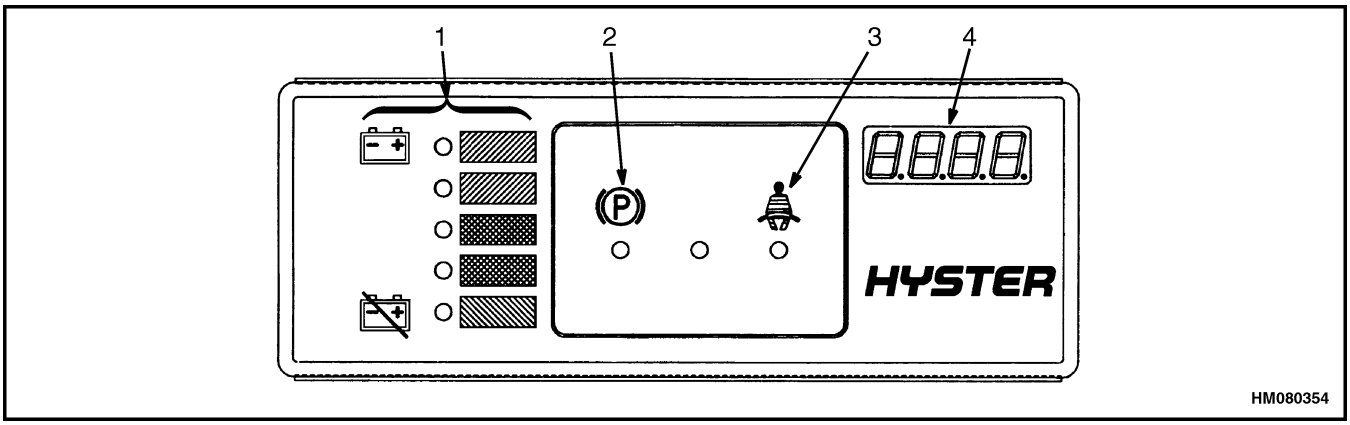
When the key switch is turned to **ON**, a start program causes each warning light to illuminate to show that the function is operating. This later display panel has the following functions:

(1) **Battery Charge Indicator With Lift Interrupt.** Later Basic display panels have a battery indicator that is a scale with a series of 5 round LEDs in three colors (green, orange, red). See Figure 35. There are two green LEDs and bars at the top, two orange LEDs and bars in the center and a red LED and bar at the bottom. As the battery voltage decreases during operation, different LEDs illuminate to indicate a discharged battery. No more than two LEDs are illuminated at one time. When the battery is fully charged, the two green LEDs of the scale are illuminated. When the battery discharges during operation, the LEDs illuminate from top to bottom (green to red). The red LED indicates that the battery is discharged. The battery must be charged or a charged battery must be installed before lift truck operation can continue.

The battery charge indicator uses the traction control shunt to measure the current during operation. This current and battery voltage are checked at the same time for an accurate reading of battery voltage with a load (during use). This method can make operation of the lift truck different when the battery is low or a different battery is connected. This method permits better use of the battery charge.

The controller also checks the battery voltage each time a battery is connected. The traction control prevents lift truck operation if the battery voltage is not correct as set by traction function 15. A status code of -16 (voltage too high) or -15 (voltage too low) indicates on the display panel. The battery can have a voltage that is too high or too low. A battery with the correct voltage can also be deeply discharged from use or other reasons and have a voltage that is less than the minimum of the voltage range.

Batteries that have different ampere hour ratings or are of different ages can sometimes be used in the same lift truck. It can be necessary to adjust traction Function Number 14 so that the weakest battery is not damaged. Follow the procedure for adjusting traction in Traction Control Cards (Label Letters - ZH and ZY).



1. BATTERY DISCHARGE INDICATOR
2. PARKING BRAKE SYMBOL AND LED
3. FASTEN SEAT BELT SYMBOL AND LED
4. DIGITAL DISPLAY

Figure 35. Basic Display Panel and Plug Connector (Later Display Panel)

TABLE OF CONTENTS

go on and the indicator light for the hydraulic motor will show which motor has the problem.

(10) **Warning light, Motor Temperature Over Limit.** The traction motor and the hydraulic pump motor have thermal switches inside the motors. When the temperature increases to the limit set by the manufacturer of the motor, the thermal switch closes and the warning light on the display panel illuminates. The indicator light for traction motor (8) or for the hydraulic motor (9) will show which motor has the problem.

(14, 15) **Set Lift Truck Performance.** The lift truck can be set to four performance levels by the operator. (If the customer does not want this function available to the operator, a service person can set all four levels to the same setting.) Each time the operator pushes the button (14), performance level will increase by one step. At the maximum (rabbit) level, the performance levels will begin at the lowest (turtle) level again. The four performance levels set by the manufacturer are:

- Low performance for handling fragile loads.
- Medium speed for less consumption of battery charge during a work shift.
- Higher performance with higher consumption of battery charge during a work shift.
- Maximum lift truck performance with maximum consumption of battery charge.

The performance settings can be made with either the PC or the Handset (Functions 11, 12, and 13).

The four performance levels can be set to any level up to the maximum limits. Two or more adjacent performance levels can be set to the same limits. The performance levels must be set at the same or in ascending order (from turtle to rabbit). The register interlocks will not permit a higher performance level setting toward the turtle than the adjacent registers toward the rabbit.

Fault Code Memory. The control cards for the traction motor controller and hydraulic pump motor each have memory registers in which the last 16 status codes can be stored. Each status code is stored with the hourmeter time and the battery charge at the time of the fault. The status code for the last fault will be indicated on the Status Code Indicator (2). If the key switch is turned to **OFF**, the status code will be removed from the four-digit display.

The push button (13) will cause the status codes for the faults to be shown on the Status Code Indicator (2). When the button is pushed and held down, the indicator light for the traction motor (8) will illuminate. The status codes in memory for the detected faults will be displayed, starting with the most recent fault. If the push button is released, the display will stop. If the button is pushed again, the display will start from the beginning again. The hourmeter time and the battery charge at the time of the fault will not be shown. A Handset or a PC must be used to show this additional information. A Handset or a PC must be used to clear the status code from the register.

If the button is pushed twice and then held down, the indicator light for the hydraulic pump motor (9) will illuminate. The status codes in memory for the detected faults will be displayed, starting with the most recent fault. If the push button is released, the display will stop. If the button is pushed twice to start the sequence again, the display will start from the beginning. The hourmeter time and the battery charge at the time of the fault will not be shown. A Handset or a PC must be used to show this additional information. A Handset or a PC must be used to clear the status code from the register.

There can be 16 status codes in the memory for each system (traction or lift). Push and hold the push button to display all the status codes in the memory for detected faults of the traction system. The Traction Motor Indicator will be on to show that the status codes are for the traction system. If the push button is released, then pushed and held again, the digital display will start over, showing all the status codes for the traction system. Push the button twice and hold the push button to display all the status codes in the memory for detected faults of the lift system. The Lift Pump Motor Indicator will be on to show that the status codes are for the lift system. If the push button is released, then pushed twice and held again, the digital display will start over, showing all the status codes for the lift system.

Legend for Figure 9

1. TOP COVER
2. FILTER FOR LED INDICATORS
3. HOUSING FOR LED INDICATORS
4. KEY SWITCH
5. ASSEMBLY HOUSING
6. O-RING GASKET
7. BUZZER
8. FIBER INSULATING WASHERS
9. CIRCUIT BOARD (LH) FOR BATTERY INDICATOR
10. BATTERY INDICATOR
11. JUMPER HARNESS
12. HOURMETER
13. GASKET FOR HOURMETER
14. CIRCUIT BOARD FOR LED INDICATORS
15. GASKET FOR LED INDICATORS

3. If the housing or filter for the indicators will be replaced, remove the screws that fasten the LED housing to the cover. If the hourmeter or hourmeter gasket will be replaced, remove the screws that fasten it to the top cover. Install the replacement parts to the top cover. Make sure that the hourmeter is installed so that it can be read after the cover is installed.

4. Remove the nut that fastens the key switch. See Figure 8. Remove the key switch from the housing. Make a note of which wires are on which terminals and disconnect the wires. Install the wires on the same terminals of the replacement switch.

5. Align the notch in the shaft housing of the key switch with the tab in the housing of the display panel. Install the replacement switch. Tighten the nut and connect the wires.

NOTE: It is not necessary to do Step 7 if only the meter movement of the battery indicator will be replaced on the existing circuit board.

6. Carefully lift the meter movement up off the pins of the circuit board without bending the pins. See Figure 9. Carefully install the replacement meter movement on the pins. Make sure the pins are correctly aligned on the back of the meter before pushing the meter on the pins.

7. If the battery indicator, circuit board for the hourmeter, or the buzzer will be replaced, remove the screws that fasten the circuit board to the housing. Disconnect the connector from the circuit board. Remove the buzzer from the bottom of the circuit board. Make sure to install the fiber washer when installing the replacement buzzer on the replacement circuit board. If necessary, carefully lift the meter movement up off the pins of the circuit board without bending the pins. See Figure 9. Carefully install the replacement meter movement on the pins of the replacement circuit board. Make sure the pins are correctly aligned on the back of the meter before pushing the meter on the pins. Connect the electrical connector to the circuit board and install the circuit board assembly in the housing.

8. If the LED indicator assembly will be replaced, first remove the 18-pin connector. It is necessary to remove the front steering column cover with the display panel assembly attached for access to the connector. After removing the screws that fasten the front cover, carefully disconnect the connector. It can be necessary to disconnect the key switch wires (Step 4) and the two-wire connector for enough clearance to disconnect the 18 pin connector. Remove the two screws that fasten the LED assembly to the housing. Install the replacement LED assembly, carefully connecting all connectors and wires. Install the front steering column cover with the display panel assembly attached. Install the LED gasket over the LED indicators.

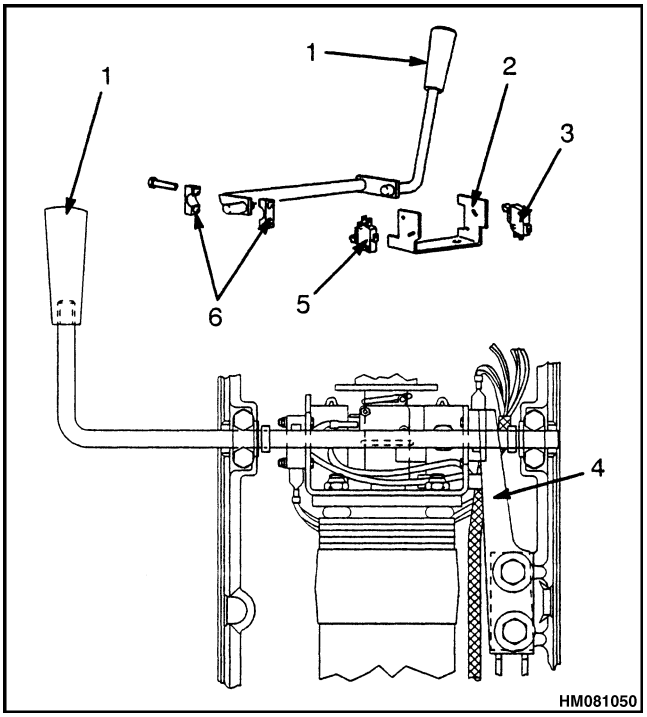
9. If necessary, install a new O-ring gasket. Carefully install the O-ring gasket in the groove of the top cover. Carefully install the top cover assembly over the LED indicators and assembly housing without damaging either the LED gasket or O-ring gasket. Make sure the O-ring gasket is still correctly aligned with the cover and housing before installing the screws. Install the eight screws that fasten the top cover to the panel housing and tighten them in a cross pattern.

PERFORMANCE DISPLAY PANEL, REPLACE PARTS

NOTE: The only replaceable parts of the display panel are the O-ring seal, key switch, wires to the key switch, and the housing that fastens to the steering column. All other parts of the panel must be replaced as a single unit. See Display Panel Assembly of this section.

DIRECTION CONTROL SWITCHES, E70-120XL$_3$ (STEERING COLUMN)

The direction control switches send battery voltage to close the Forward or Reverse contactors. This control has a pair of microswitches in the steering column. See Figure 20. Each microswitch controls one direction. Remove the cover of the steering column so that you can disconnect the three wires from the switch. Replace the switch and reconnect the wires. Adjust the switch in its mount bracket so that the switch opens and closes correctly when that direction is selected. Install the cover for the steering column.



1. DIRECTION CONTROL LEVER
2. SWITCH BRACKET
3. REVERSE SWITCH
4. SPRING
5. FORWARD SWITCH
6. MOUNT BRACKET

Figure 20. Direction Control Lever and Switches (E70-120XL$_3$)

BRAKE FLUID SWITCH, REPLACE

This switch is a magnetic switch on the reservoir of the master cylinder for the service brakes. It sends a signal to the control card of the display panel to illuminate the indicator for low fluid level. The switch is part of the reservoir. To replace the reservoir, see the **Brake System** for your unit.

BRUSH WEAR AND OVERTEMPERATURE SENSORS

The Brush Wear Indicators illuminate when the motor brushes must be replaced. The sensor wires for the brush wear indicators are an insert in the brush material when it is made. The sensor wires are insulated from the brush material. When the brush wears within approximately 1.5 mm (0.06 in.) of the brush lead, the insulation between the sensor wire and the brush material is destroyed. The connection between the brush and the sensor wire causes the warning indicator to illuminate if the circuit is operating correctly. Motor indicators on the display panel will also illuminate to show which motor has worn brushes.

The Overtemperature Sensors are thermal switches. These switches are in the traction and lift pump motors. They send a signal to the control card of the Performance Display Panel to illuminate the correct indicators to tell the operator that the motor is too hot. The Overtemperature warning indicator will illuminate if the circuit is operating correctly. Motor indicators on the display panel will also illuminate to show which motor is too hot. The control card of the Performance Display Panel sends a signal to the traction control card for a slower travel speed if either motor is too hot.

ROCKER SWITCHES FOR LIGHTS

These switches are ON/OFF switches that control the optional front, rear, and operator compartment lights. See Figure 21. Rocker switches for the optional lights are mounted to the instrument panel to the right of the steering column. Remove the cover under the instrument panel for access to the under side of the instrument panel or switch mounting surface. Replace a switch as described in the following paragraphs:

1. Disconnect the battery and remove the key.

2. Put tags on the switch wires or wire harness for correct identification during installation. Remove the wires from the switch terminals.

7. Install the wires on the correct terminals as removed.

8. Install the converter assembly on the lift truck frame using the same M8 capscrews, washers, and nuts. Tighten the nuts and capscrews.

9. Install the access plate. Install the battery as described in the section **Periodic Maintenance** or **Operator Manual** for your lift truck.

Relay, Replace

The Relay is an electrical switch that is energized with the Reverse contactor coil to operate the Reverse lights. The relay is in the top cavity of the counterweight. Replace the relay as follows:

1. Disconnect the battery and remove the key.

2. Open the hood for access to the relay.

3. Pull the relay away from the relay socket.

4. Install the replacement relay on the socket and close the hood.

Reverse Alarm, Replace

The Reverse Alarm is fastened to the left rear leg of the overhead guard. The alarm operates from signals from the traction control card to let people know the lift truck is traveling in the reverse direction. Replace the reverse alarm as follows:

1. Disconnect the battery and remove the key.

2. Open the hood for access to the electrical plug of the alarm. See Figure 24. Disconnect the square six pin plug for the alarm.

3. Turn the special round nut on the rear of the bracket that fastens the reverse alarm counterclockwise to remove it. Remove the reverse alarm.

4. Align and install the replacement alarm on the bracket and tighten the special round nut.

5. Put the wire and connector in the same position as the old wire and connector. Connect the alarm and wire harness connectors. Close the hood.

HORN AND HORN BUTTON

The Horn is under the brake pedal and floor plate. Replace the horn as follows:

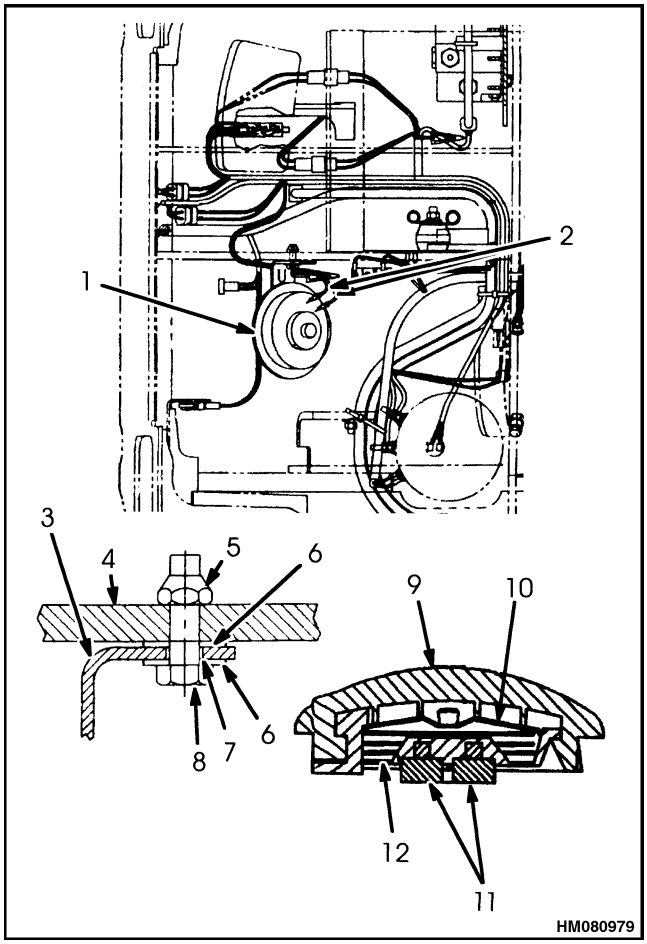
1. Disconnect the battery and remove the key.

2. Remove the floor plates.

3. Disconnect the wires fastened to the horn terminals. Do not lose the screws.

4. Hold the horn and remove the capscrew, nut, washers, and insert that fasten the horn to the lift truck frame. Do not lose the parts. Remove the horn.

5. Install the capscrews and washers on the horn bracket as shown in Figure 26. Keep the insert in the hole of the bracket during installation.



1. HORN
2. TERMINALS
3. HORN BRACKET
4. LIFT TRUCK FRAME
5. NUT
6. INSULATING WASHER
7. INSULATING INSERT
8. CAPSCREW
9. COVER
10. CONTACT PLATE
11. CONTACT SET AND SETSCREW
12. SPRING

Figure 26. Horn and Horn Button

Legend for Figure 32

A. E45-65XM$_2$

1. FUSE 7 (15A)
2. FUSE 6 (15A)
3. FUSE 5 (15A)
4. FUSE 3 (15A)
5. POWER STEERING CONTACTOR
6. FUSE 4 (POWER STEERING) (40A)
7. LINE CONTACTOR
8. TRACTION MOTOR CONTROLLER
9. FUSE 1 (TRACTION MOTOR)

B. E70-120XL$_3$

10. CONTACTOR FOR LIFT PUMP MOTOR
11. CONTACTOR DRIVER MODULE
12. FUSE 2 (LIFT PUMP MOTOR) (325A)
13. FUSE
14. 1A CONTACTOR
15. PUMP #1 CONTACTOR
16. PUMP #2 CONTACTOR (DUAL PUMPS ONLY)
17. PUMP #2 FUSE (DUAL PUMPS ONLY)
18. PUMP #1 FUSE

Brush Wear and Overtemperature Sensors Check - ZX Motor Controllers

WARNING

Some checks and adjustments in this section must be done with the battery connected and power applied to the controller. Lift truck movement during checks or adjustments can cause personal injury. Raise the drive wheels to prevent lift truck movement. See the Operating Manual or the section Periodic Maintenance of the Service Manual for your lift truck to raise the drive wheels.

Never have any metal on your fingers, arms, or neck. These metal items can accidentally make an electrical connection and cause an injury.

ALWAYS disconnect the battery before making checks or adjustments that do not need power applied.

CAUTION

The SEM Display Panel must be adjusted using a computer to allow lift truck operation. Refer to the section SEM Display Panel (Windows Version) Display Panel for SEM Controls, (Windows Version) 2200 SRM 942 for the adjustment procedure.

CAUTION

Correct meter polarity is necessary for some checks. Meter correct positive is indicated as (+). Meter correct negative is indicated as (−).

Use a meter with a minimum rating of 20,000 ohms per volt to make measurements. Most digital voltmeters are good.

The operation of the brush wear and overtemperature indicators can be checked during periodic maintenance. The battery must be removed from the lift truck for access to the motors.

The Brush Wear Indicators illuminate when the motor brushes must be replaced. The sensor wires for the brush wear indicators are an insert in the brush material when it is made. The sensor wires are insulated from the brush material. When the brush wears within approximately 1.5 mm (0.060 in.) of the brush lead, the insulation between the sensor wire and the brush material is destroyed. The connection between the brush and the sensor wire causes the warning indicator to illuminate if the circuit is operating correctly. Motor indicators on the Performance Display Panel will also illuminate to show which motor has worn brushes. Check that the correct indicator comes on for each motor as well as the warning indicator.

The Overtemperature Sensors are thermal switches that complete a circuit to send a signal to the display panel if the motor gets too hot. The Overtemperature warning indicator will illuminate if the circuit is operating correctly. Motor indicators on the display panel will also illuminate to show which motor is too hot. Check that the correct indicator comes on for each motor as well as the warning indicator. The motor for the power steering pump does not have a thermal switch.

Use a jumper cable so that the battery can be connected for operation of the motors. See Figure 33. Remove the battery as described in the section **Periodic Maintenance** or **Operator Manual** for your lift truck. Raise the drive wheels. See How To Raise

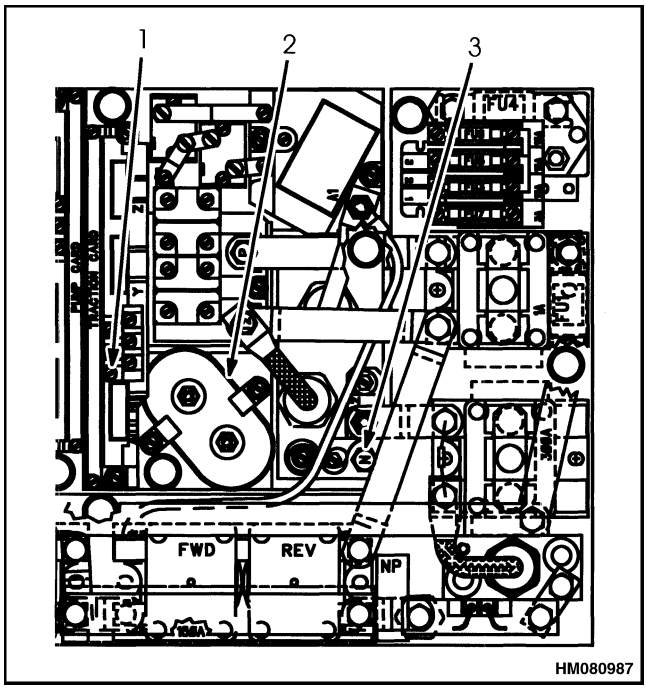
3. Connect a voltmeter between the TB1 terminal (+) of the traction control card and a battery negative (−). See Figure 37. Connect the battery after the voltmeter is connected.

4. Sit in the seat or put a weight in the seat to close the seat switch or the switch of the seat brake. Turn the key to the **START** and **ON** position. DO NOT depress the MONOTROL pedal or accelerator pedal.

5. The correct voltmeter reading is 3.7 volts or more. If the voltage reading is too low, remove the top floor plate and adjust the mount plate for the position sensor. Move the plate to a position for the correct voltage. Repeat Step 4 and Step 5 until the voltage is correct after the screws have been tightened with the mount plate in the correct position.

6. Install the floor plate and sit in the seat or put a weight in the seat to close the seat switch or the switch of the seat brake. Turn the key to the **START** and **ON** position. Depress the MONOTROL pedal or accelerator pedal to the floor plate. The correct voltmeter reading is 0.4 volt or more. If the voltage reading is too low, remove the top floor plate and adjust the position sensor on the mount plate for 0.4 volt. Check that the voltage of Step 5 is correct. Repeat Step 4 through Step 6 until both voltages (Step 5 and Step 6) are correct.

7. Install the floor plate, remove the voltmeter and lower the lift truck off the blocks.



1. TERMINAL TB1 OF TRACTION CONTROL CARD (METER +)
2. TRACTION CAPACITOR C1 (LIFT CAPACITOR NOT SHOWN)
3. BATTERY NEGATIVE (METER −)

Figure 37. Voltmeter Connection Points on SCR Motor Controllers

Battery Specifications

E2.00-3.20XM (E45-65XM, E45-65XM$_2$, N30XMH, N30XMH$_2$)

Model	Minimum Compartment Size Length × Width	Battery Size Minimum/ Maximum		Weight	
		Length	Width	Minimum	Maximum
E2.00XM, E2.50XM*	695 × 987 mm (27.4 × 38.8 in.)	978/983 mm (38.5/38.7 in.)	681/691 mm (26.8/27.2 in.)	985 kg (2172 lb)	1453 kg (3203 lb)
E45-50XM (E45-50XM$_2$)*				1044 kg (2302 lb)	1498 kg (3302 lb)
E2.50XM, E3.00XM*	842 × 987 mm (33.2 × 38.8 in.)		800/838 mm (31.5/33.0 in.)	1317 kg (2903 lb)	1771 kg (3904 lb)
(E45-60XM, E45-60XM$_2$)*					
E3.00-3.20XM (E65XM, E65XM$_2$)	1010 × 987 mm (39.8 × 38.8 in.)		1001/1006 mm (39.4/39.6 in.)	1553 kg (3424 lb)	1998 kg (4405 lb)
(N30XMH, N30XMH$_2$)					

*Short Wheelbase
612 mm (24.1 in.) = maximum height for batteries with a cover.
579 mm (22.8 in.) = maximum height for batteries without a cover.

The tolerances of the battery compartment are +3 and −0 mm (+0.118 and −0 in.). The battery size column shows the size range that will permit the battery to still fit into a battery compartment.

The battery compartment length is front to back. Width is side to side. The length dimension of the battery must fit within the battery compartment side-to-side dimension with a clearance of 0 to 13 mm (0 to 0.5 in.) maximum. Battery width must fit within the battery compartment front-to-back dimension.

WARNING

The battery must fit the battery compartment so that the battery restraint system will operate correctly. Use only batteries with the correct length shown in this table. Adjust the spacer plate and side spacers to prevent the battery from moving more than 13 mm (0.5 in.) forward or backward.

190 mm (7.5 in.) Motor and Large Lift Pump*										
Model	Mast	V	Lifting				Lowering			
			Rated Load		No Load		Rated Load		No Load	
			m/sec	ft/min	m/sec	ft/min	m/sec	ft/min	m/sec	ft/min
E50XM E50XM$_2$	Two-Stage LFL	36 48	0.284 0.376	56 74	0.513 0.625	101 123	0.574	113	0.508	100
	Two-Stage FFL	36 48	0.295 0.391	58 77	0.472 0.625	93 123	0.538	106	0.457	90
	Three-Stage FFL	36 48	0.290 0.381	57 75	0.462 0.610	91 120	0.549	108	0.467	92
	Four-Stage FFL	36 48	0.279 0.391	55 77	0.452 0.610	89 112	0.447	88	0.411	81
E55XM E55XM$_2$	Two-Stage LFL	36 48	0.279 0.371	55 73	0.513 0.625	101 123	0.584	115	0.508	100
	Two-Stage FFL	36 48	0.290 0.381	57 75	0.472 0.625	93 123	0.554	109	0.457	90
	Three-Stage FFL	36 48	0.279 0.371	55 73	0.462 0.610	91 120	0.559	110	0.467	92
E60XM E60XM$_2$	Two-Stage LFL	36 48	0.249 0.310	49 61	0.513 0.625	101 123	0.569	112	0.457	90
	Two-Stage FFL	36 48	0.249 0.330	49 65	0.472 0.625	93 123	0.538	106	0.366	72
	Three-Stage FFL	36 48	0.249 0.330	49 65	0.462 0.610	91 120	0.544	107	0.396	78

LFL = Limited Free Lift FFL = Full Free Lift
*Standard 19 cc (1.16 in.^{3}) displacement pump, 190 mm (7.5 in.) standard pump motor and 610 mm (24 in.) load center.
Oil temperature 54 to 66°C (130 to 150°F). Lifting speeds (valve fully open) ±10% acceptable. No Load lowering speeds are minimum values. Rated Load lowering speeds are maximum values. N/A = Not Available

E2.00-3.20XM, E2.00-3.20XM$_2$ MAST SPEEDS (72 OR 80 VOLT) EUROPE

190 mm (7.5 in.) Motor and Large Lift Pump*						
Model	Mast	V	Lifting		Lowering	
			Rated Load	No Load	Rated Load	No Load
			m/sec	m/sec	m/sec	m/sec
E2.00XM **E2.00XM$_2$**	Two-Stage LFL	72 80	0.376 0.422	0.544 0.605	0.559	0.508
	Two-Stage FFL	72 80	0.396 0.442	0.569 0.635	0.508	0.457
	Three-Stage FFL	72 80	0.386 0.432	0.559 0.625	0.528	0.467
	Four-Stage FFL	72 80	0.330 0.366	0.483 0.538	0.447	0.411
E2.50XM **E2.50XM$_2$**	Two-Stage LFL	72 80	0.345 0.391	0.544 0.605	0.574	0.508
	Two-Stage FFL	72 80	0.366 0.411	0.569 0.635	0.538	0.457
	Three-Stage FFL	72 80	0.356 0.401	0.559 0.625	0.549	0.467
	Four-Stage FFL	72 80	0.315 0.351	0.483 0.538	0.447	0.411
E3.00XM **E3.00XM$_2$**	Two-Stage LFL	72 80	0.300 0.335	0.488 0.544	0.569	0.457
	Two-Stage FFL	72 80	0.310 0.345	0.503 0.564	0.538	0.366
	Three-Stage FFL	72 80	0.310 0.345	0.503 0.559	0.544	0.396
E3.20XM **E3.20XM$_2$**	Two-Stage LFL	72 80	0.295 0.330	0.488 0.544	0.559	0.457
	Two-Stage FFL	72 80	0.300 0.335	0.503 0.564	0.523	0.366
	Three-Stage FFL	72 80	0.300 0.335	0.503 0.559	0.533	0.396

LFL = Limited Free Lift FFL = Full Free Lift
*Standard 19 cc (1.16 in.^{3}) displacement pump, 190 mm (7.5 in.) standard pump motor and 500 mm (20 in.) load center.
Oil temperature 54 to 66°C (130 to 150°F). Lifting speeds (valve fully open) ±10% acceptable. No Load lowering speeds are minimum values. Rated Load lowering speeds are maximum values. N/A = Not Available.

J2.00-3.20XM MAST SPEEDS (72 OR 80 VOLT) EUROPE

Cont. or Transistor Controlled Standard Motor and Large Lift Pump*						
Model	Mast	V	Lifting		Lowering	
			Rated Load	No Load	Rated Load	No Load
			m/sec	m/sec	m/sec	m/sec
J2.00XM	Two-Stage LFL	72 80	0.376 0.422	0.544 0.605	0.569	0.508
	Two-Stage FFL	72 80	0.396 0.442	0.569 0.635	0.523	0.457
	Three-Stage FFL	72 80	0.386 0.432	0.559 0.625	0.538	0.467
J2.50XM	Two-Stage LFL	72 80	0.345 0.391	0.544 0.605	0.584	0.508
	Two-Stage FFL	72 80	0.366 0.411	0.569 0.635	0.554	0.457
	Three-Stage FFL	72 80	0.356 0.401	0.559 0.625	0.559	0.467
J3.00XM	Two-Stage LFL	72 80	0.300 0.335	0.488 0.544	0.559	0.457
	Two-Stage FFL	72 80	0.310 0.345	0.503 0.564	0.523	0.366
	Three-Stage FFL	72 80	0.310 0.345	0.503 0.559	0.533	0.396
J3.20XM	Two-Stage LFL	72 80	0.295 0.330	0.488 0.544	0.569	0.457
	Two-Stage FFL	72 80	0.300 0.335	0.503 0.564	0.533	0.366
	Three-Stage FFL	72 80	0.300 0.335	0.503 0.559	0.544	0.396

LFL = Limited Free Lift FFL = Full Free Lift
*Standard 19 cc (1.16 $in.^3$) displacement pump, 190 mm (7.5 in.) standard pump motor and 500 mm (20 in.) load center.
Oil temperature 54 to 66°C (130 to 150°F). Lifting speeds (valve fully open) ±10% acceptable. No Load lowering speeds are minimum values. Rated Load lowering speeds are maximum values.

Adhesives and Sealants

Hyster Part No.	Loctite® Part No.	Description	Size
360387	222	Small Screw Threadlock (Purple)	50 ml (1.7 oz)
318702*	242	Removable Threadlock (Blue)	10 ml (0.34 oz)
226414*	271	High Strength Threadlock (Red)	10 ml (0.34 oz)
318996	277	High Viscosity Threadlock (Red)	50 ml (1.7 oz)
318650	290	Low Viscosity Threadlock (Green)	0.6 ml (0.02 oz)
251099	290	Low Viscosity Threadlock (Green)	50 ml (1.7 oz)
355844*	422	SuperBonder® Adhesive	3 ml (0.1 oz)
350830	515	Gasket Eliminator (Purple)	6 ml (0.2 oz)
313022*	515	Gasket Eliminator (Purple)	50 ml (1.7 oz)
273338*	567	Pipe Sealant with Teflon® (White)	50 ml (1.7 oz)
318705	595	Super Flex® Silicone	100 ml (3.4 oz)
318701	609	Retaining Compound	10 ml (0.34 oz)
341959	680	Retaining Compound	50 ml (1.7 oz)
226415		Primer T - Aerosol	177 ml (6 oz)
316865		Antiseize Compound	476 ml (16 oz)
360053		Chisel Gasket Remover (10 Aerosol cans per case)	536 ml (18 oz)
318700*		Adhesive & Sealant Kit (Contains one each of * items)	

Loctite®, Super Flex®, and SuperBonder® are registered trademarks of the Loctite Corporation.
Teflon® is a registered trademark of Du Pont de Nemours Co. Inc.

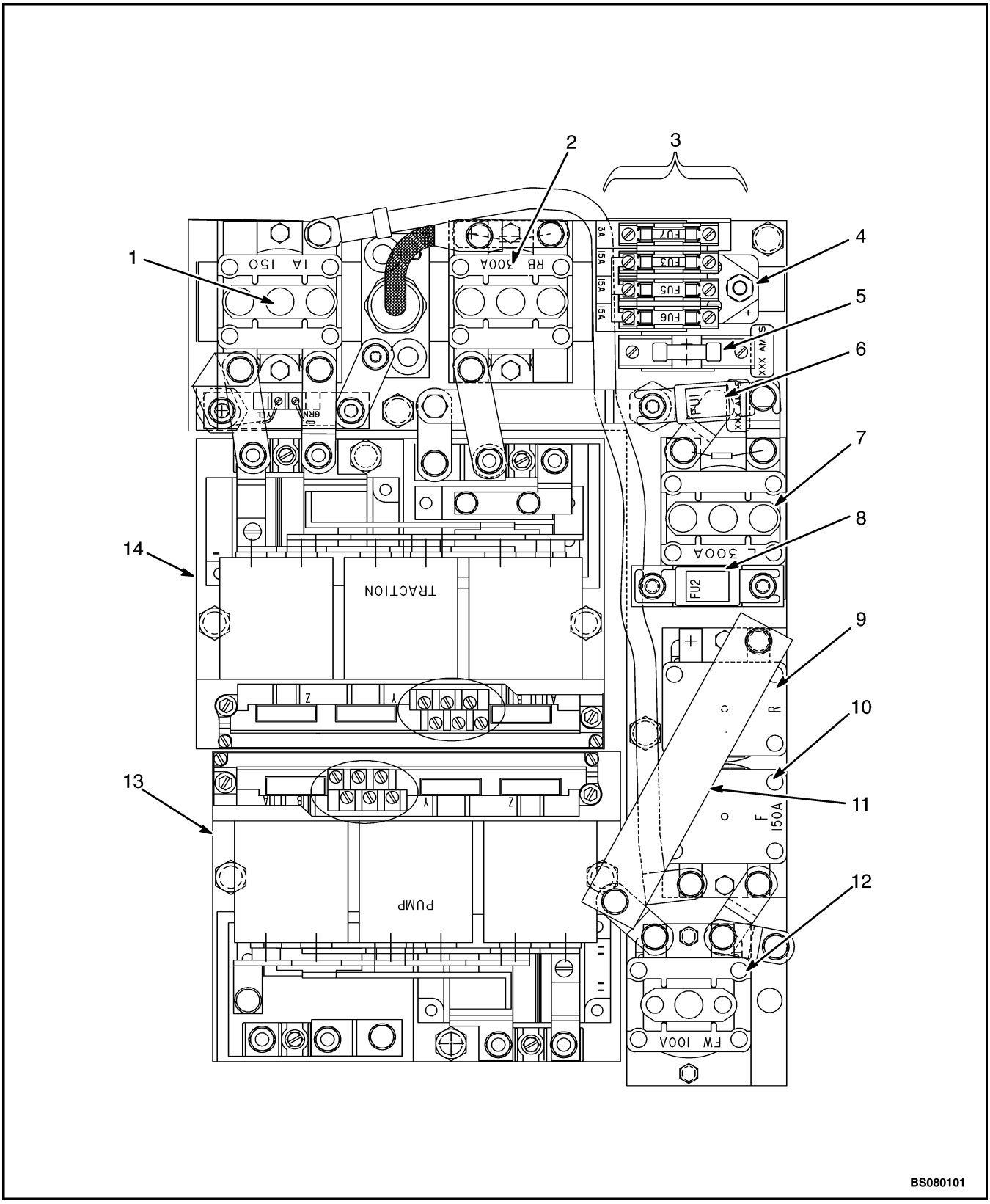


Figure 2. Transistor Controllers for Traction Motor and Hydraulic Pump Motors E1.25-3.20XM

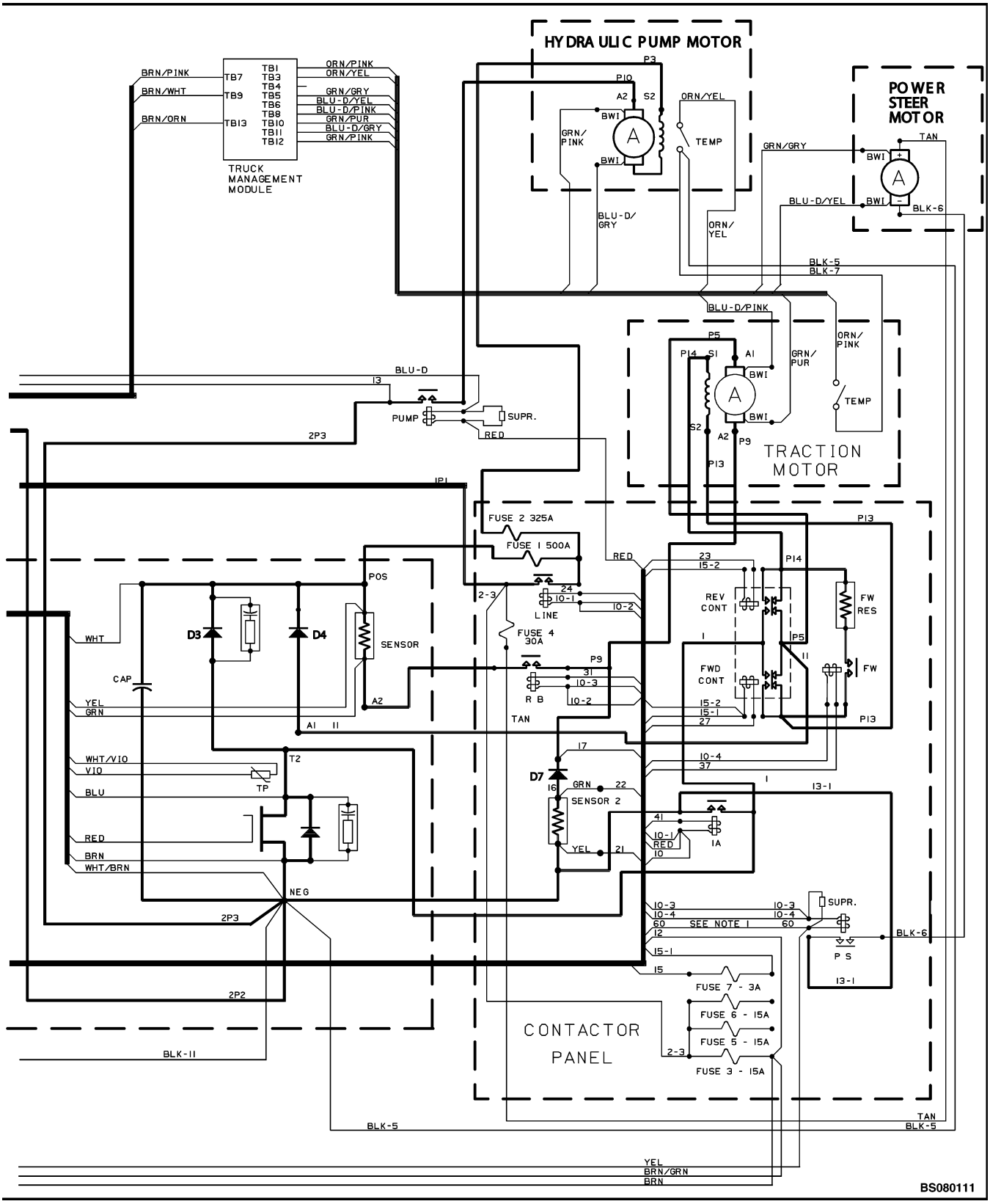


Figure 7. Transistor Controller for Traction Motor, Contactor Control for Hydraulic Pump Motor Wiring Diagram E1.50-3.20XM

Legend for Figure 12

1. BATTERY CONNECTOR
2. POWER CABLE 2P1
3. NEGATIVE TERMINAL POST
4. POWER CABLE P3
5. POWER CABLE 1P1
6. POWER CABLE P10
7. LIFT PUMP MOTOR
8. POWER CABLE P5
9. POWER CABLE P13
10. TRACTION MOTOR
11. STEERING PUMP MOTOR
12. POWER CABLE 2P2
13. POWER CABLE P9
14. POWER CABLE P14
15. POWER CABLE 2P3

Table 3. Terminal and Plug Wire Connections for Control Card JH

With: Transistor Control of Hydraulic Pump, Regenerative Braking, Power Steering On Demand, Premium Display, GE Battery Discharge Indicator (BDI) with Lift Interrupt, Brush Wear and Temperature Indicators, and TMM1 module (see Table 4).		
Plug or Terminal No.	**Wire Color or Wire Number**	**Function**
PA1	37	To coil for Field Weakening contactor.
PA2	50	To BLU-L and then to PB3 on hydraulic pump control card.
PA3	—	Not used.
PA4	—	Not used.
PA5	—	Not used.
PA6	—	Not used.
PB1	12	Battery positive from Fuse 5.
PB2	24	To coil for Line contactor.
PB3	60	To contactor coil for Steering pump motor.
PB4	27	Forward contactor coil negative.
PB5	23	Reverse contactor coil negative.
PB6	41	1A contactor coil negative.
TB1	YEL/PNK	Accelerator potentiometer input.
TB2	GRN	Start switch input.
TB3	15	Voltage supply from Fuse 7.
TB4	PNK	Seat switch input.
TB5	10-1	Battery supply voltage.
TB6	RED/BLU-L	Key switch input. Battery voltage supply from key switch.
	RED/WHT	Battery voltage supply to seat switch.
	WHT-5	FORWARD direction switch input.
	BLU-L	REVERSE direction switch input.

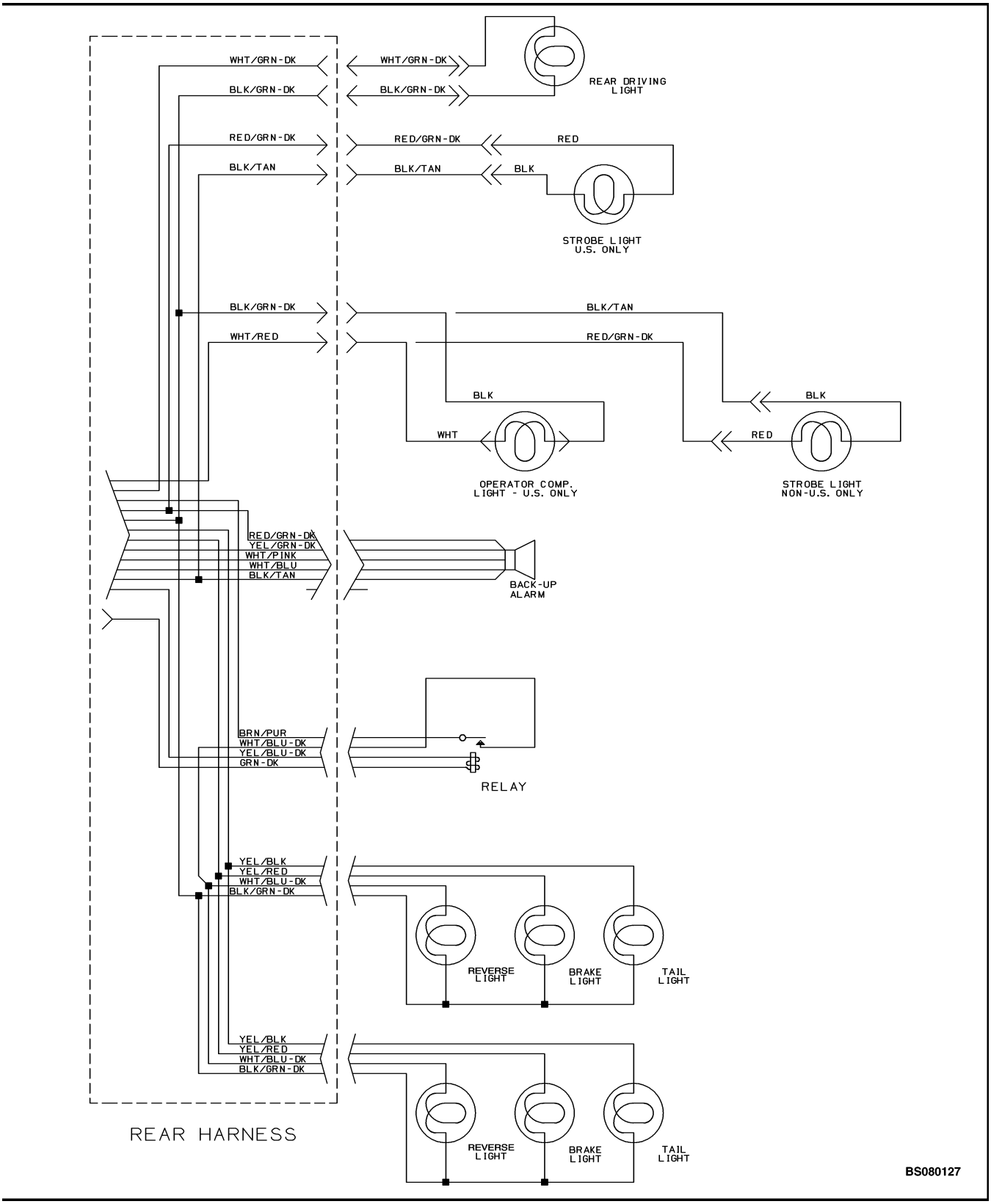
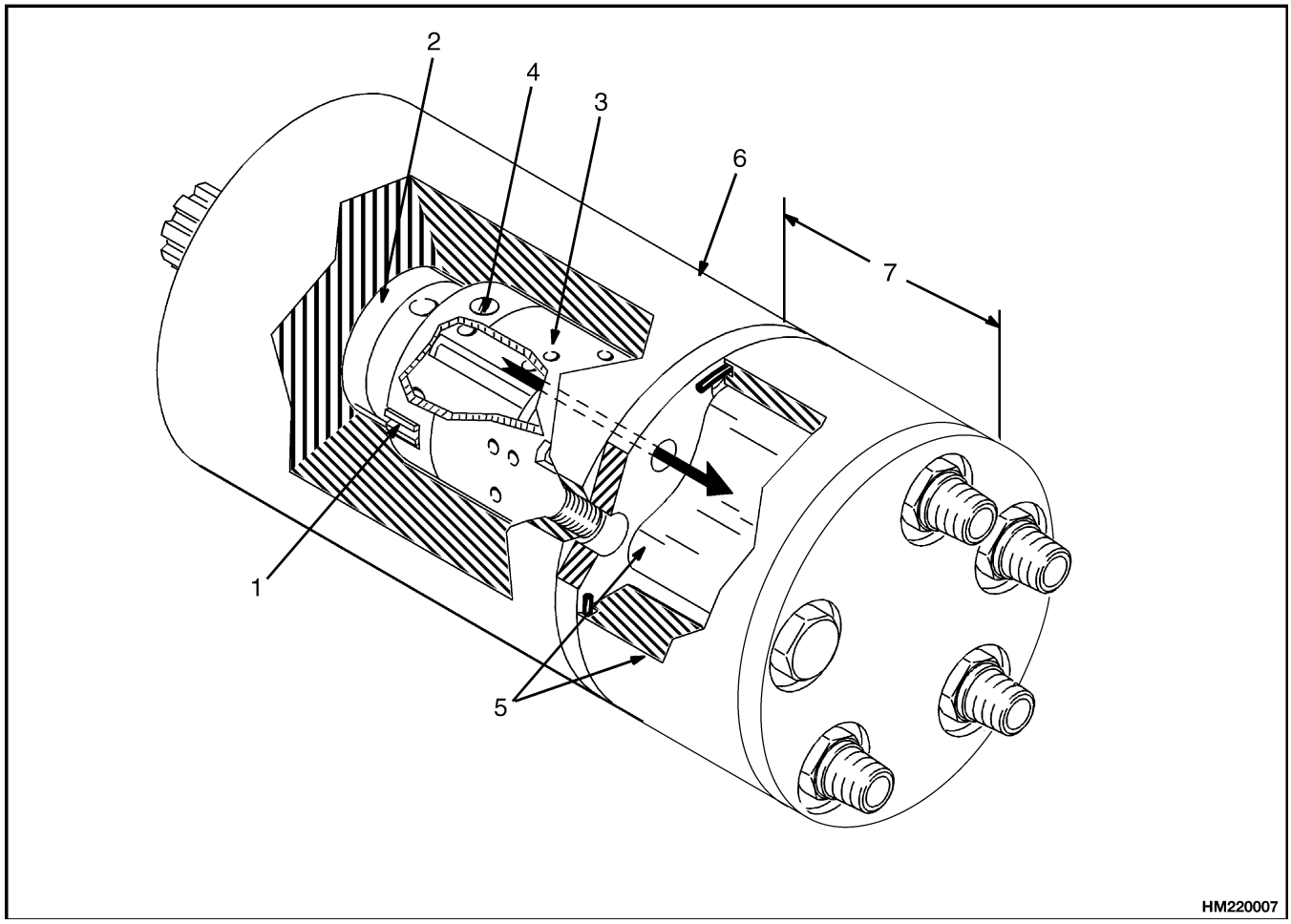


Figure 22. Wiring Diagram for Lights



1. SPRING SET
2. SPOOL
3. SLEEVE
4. CENTER PIN
5. GEAR SET
6. CONTROL SECTION
7. METERING SECTION

Figure 2. Steering Control Unit

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Steering wheels do not move when steering wheel is turned.	Oil level is low or there is no oil in the tank.	Fill tank to the correct level. Check for leaks.
	Steering control unit is damaged.	Repair or install new control unit.
	There is no oil flow from the steering control unit to the steering cylinder.	Repair or install new components. Check for leaks.
	Sleeve and spool in the control unit will not move.	Install new components.
	Hydraulic hoses are not connected or are damaged.	Check for leaks. Tighten connections. Install new components as necessary.
Steering is slow or difficult.	Relief valve for the steering system is not adjusted correctly.	Adjust or install new relief valve.
	Oil pressure from the hydraulic pump is low.	Check for restrictions. See Troubleshooting Table, Hydraulic System.
	A seal in the steering cylinder has a leak.	Repair cylinder. Install new seal or new cylinder.
	Hydraulic lines are too small or have restrictions.	Remove any restrictions. Install larger or new hydraulic lines.
	Steering control unit is worn, not assembled correctly, or is damaged.	Repair or install new control unit.
Steering wheel turns the tires in the wrong direction.	Hydraulic lines are not connected correctly at the steering cylinder or at the steering control unit.	Connect lines correctly. Remove air from system.
Steering operation is not smooth.	Oil level in the tank is low.	Fill tank. Check for leaks.
	Air was not removed after repair to the hydraulic system.	Remove air from system.
	Steering control unit is assembled incorrectly or is damaged.	Repair or install new control unit.
	Hydraulic pump has a leak at the inlet.	Fix any leaks. Remove air from system.

Description

GENERAL

Five **Service Manual** sections are required for the complete Description, Checks, Adjustments, Troubleshooting, Repairs, and Theory of these motor controllers:

- **SR/SP Transistor Motor Controllers Description, Checks, Adjustments, Troubleshooting, Repairs, and Theory of Operation** 2200 SRM 724 (this section)
- **EV-100ZX, EVT100 SR (SEM) and SP Motor Controllers Troubleshooting and Adjustments with a Computer (Windows Version** 2200 SRM 947
- **Transistor Motor Controllers (SR and SP) Parameter Tables for Four-Wheel SitDrive® Electric Lift Trucks** 2200 SRM 739
- **Electrical System for Trucks with EV-100/ 200ZX or SR (SEM) and SP Motor Controllers** 2200 SRM 560
- **SEM Display Panel (Windows Version)** 2200 SRM 942

This section describes the operation and the functions of the Transistor Motor Controllers (SR and SP). The SR letters are used to identify the transistor motor controller that uses the SEM (Separately Excited Motor) technology. This motor controller is used to control the operation of the shunt traction motor. The SP motor controller is a transistor motor controller that controls the series lift pump motor and does not use the SEM technology. These motor controllers are made by General Electric Company.

The motor controllers are similar, but control different types of motors and have some different components. Both motor controllers are connected to the display panel on the instrument panel (dash) of the lift truck. This display panel provides access to both motor controllers for adjustments and data display on the Liquid Crystal Display (LCD) screen.

The display panel has a connector for a serial cable that will connect to a serial port of a personal computer (PC) for checks, adjustments, and troubleshooting.

- A Cable Kit, Display Panel to Computer, is required (Hyster Part No. 1361412). See your dealer for Hyster lift trucks.
- The HYTECH™ software for a personal computer is available on a 3.5 inch diskette. See your dealer for Hyster lift trucks.

These motor controllers have logic circuits and functions that control and keep a record of the operations of the motor controller. The registers also store a record of potential malfunctions or operations that are not correct. for the motor controller. These malfunctions or incorrect operations can indicate possible causes of a problem during troubleshooting.

This SRM section has the following components:

- A Description of the Transistor Motor Controller (this section).
- A series of SR (SEM) and SP Status Code Charts that describe an indication of a malfunction or operation that is not correct and its possible causes. These status codes can be shown on the LCD screen of the display panel.
- Checks and replacement of the motor controller are described in SR/SP Transistor Motor Controller Repair.
- A basic Theory of Operation on how a transistor motor controller operates using the SEM technology.

An electronic diagnostic and adjustment device can also be used to check and adjust the motor controllers. This electronic diagnostic and adjustment device is called a Handset and is described later in this section. A PC with the control software installed has access to function registers of the motor controllers through the SEM display panel. The Handset has access to fewer function registers of each motor controller and can only make changes to a limited number of the registers of these SR and SP motor controllers. The Handset can only be connected to a motor controller at the motor controller 12-pin connector.

A short description and the replacement of the display panel is in the section **SEM Display Panel** 2200 SRM 942.

These transistor motor controllers are covered units with no serviceable components. This section describes the procedures for using the electronic diagnostic and adjustment devices for checking and adjusting the operation of the motor controller.

Authorized technicians can adjust the controllers for different units or types of operations. Self diagnostics are provided to monitor internal components as well as detect problems with certain inputs and outputs. Adjustable register values and status codes are accessed using a Handset or a personal

NOTE: The bench checks and adjustments are done using the same procedures described for the Handset earlier.

HOW TO CHECK AND ADJUST REGISTERS

The Handset can be used to access many registers that control the operation of the lift truck. The values for the limits on these motor controller functions can also be set with the Handset.

CAUTION

Prevent damage to the motor controllers. The motor controllers can be damaged if power is not correctly connected or disconnected. Always disconnect the battery connector before connecting or disconnecting connectors at the motor controllers.

NOTE: To check the value of a function, push key(s) for the function number and wait 1 second. The value for that function appears.

Connect the Handset as previously described. Use the Handset to check or adjust the functions by following the procedure as shown in Figure 7.

WARNING

NEVER attempt to adjust any of the function values without using the procedures and values given in this section. Failure to follow these instructions can cause personal injury or property damage.

CAUTION

The plug cover on the small connector of the motor controller must be installed for correct operation. Make sure to disconnect the power and replace the plug cover each time the Handset is disconnected.

Disconnect the Handset and return the lift truck to normal operation as described in Returning Lift Truck to Normal Operation of this section.

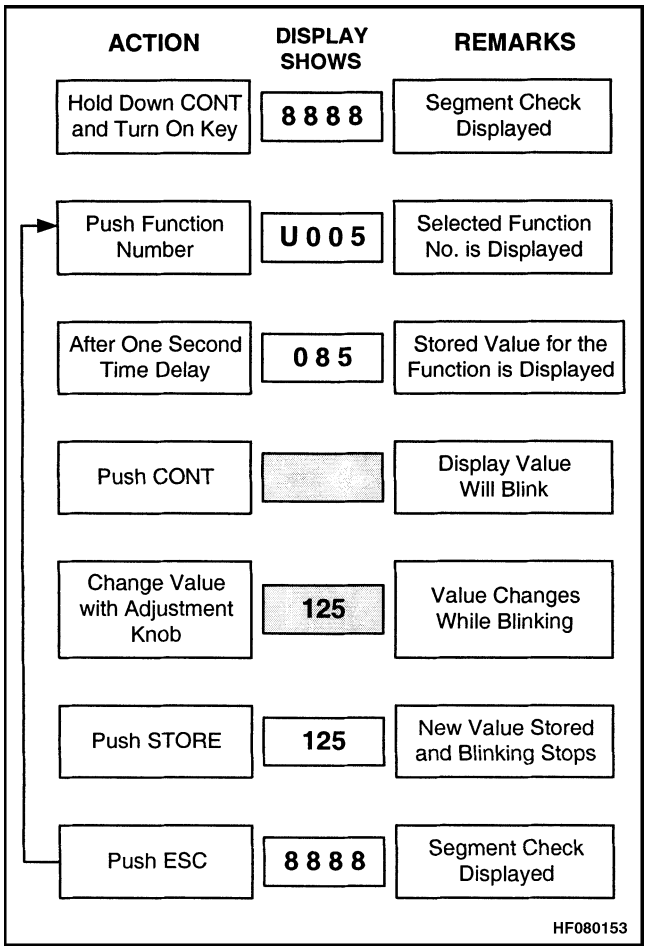


Figure 7. Set Sequence for Handset

Function Number 55 MODE 2 - MAXIMUM ARMATURE % ON TIME (MODE 2 - TRAVEL SPEED LIMIT)

(Push CONT and 8)

NOTE: This travel speed limit is in effect when mode 2 is selected on the Premium Display Panel.

Same as Function Number 51.

Function Number 56 MODE 3 - CONTROLLED ACCELERATION

(Push CONT and 9)

NOTE: This controlled acceleration is in effect when mode 3 is selected on the Premium Display Panel.

Same as Function Number 48.

Function Number 57 MODE 3 - FIELD WEAKENING (FW) START

(Push CONT and 10)

WARNING

Function Number 57 is not normally adjusted in the field. Adjusting Function Number 57 between the minimum and maximum values does not change lift truck performance.

NOTE: This FW start is in effect when mode 3 is selected on the Premium Display Panel.

Same as Function Number 49.

Function Number 58 MODE 3 - FIELD WEAKENING (FW) RATIO

(Push CONT and 11)

WARNING

Function Number 58 is not normally adjusted in the field. Adjusting Function Number 58 between the minimum and maximum values does not change lift truck performance.

NOTE: This FW ratio is in effect when mode 3 is selected on the Premium Display Panel.

Same as Function Number 50.

Function Number 59 MODE 3 - MAXIMUM ARMATURE % ON TIME (MODE 3 - TRAVEL SPEED LIMIT)

(Push CONT and 12)

NOTE: This travel speed limit is in effect when mode 3 is selected on the Premium Display Panel.

Same as Function Number 51.

Function Number 60 MODE 4 - CONTROLLED ACCELERATION

(Push CONT and 13)

NOTE: This controlled acceleration is in effect when mode 4 is selected on the Premium Display Panel.

Same as Function Number 48.

Function Number 61 MODE 4 - FIELD WEAKENING (FW) START

(Push CONT and 14)

WARNING

Function Number 61 is not normally adjusted in the field. Adjusting Function Number 61 between the minimum and maximum values does not change lift truck performance.

NOTE: This FW start is in effect when mode 4 is selected on the Premium Display Panel.

Same as Function Number 49.

Function Number 62 MODE 4 - FIELD WEAKENING (FW) RATIO

(Push CONT and 15)

WARNING

Function Number 62 is not normally adjusted in the field. Adjusting Function Number 62 between the minimum and maximum values does not change lift truck performance.

NOTE: This FW ratio is in effect when mode 4 is selected on the Premium Display Panel.

Same as Function Number 50.

If a status code number is indicated on the LCD screen of the display panel, checks and adjustments cannot be done. See Table 5 and the following SR (SEM) and SP Status Code Charts to find and correct the malfunction. There are no checks or adjustments for the status codes. These code numbers are only codes to help identify a possible malfunction. A short description of each status code is shown in Table 5.

The Status Code Charts in this section have a more complete description of the status code, the circuit that has generated the input for the status code, the symptom, and the possible causes.

Table 5. List of Status Codes

Status Code	Description	Status Code	Description
	Traction Motor Controller (Input Signal)		**Regenerative Braking**
BLANK	No input voltage to controller or display panel.	**76**	C1 voltage too high during REGEN.
01	No input from seat switch.	**77**	Motor current during REGEN.
02	FWD switch closed on initial start.		
03	REV switch closed on initial start.		
05	Start switch did not close.		**Motor Stall**
06	Accelerator depressed, no direction selected.	**82**	Traction motor stalled for more than 3.5 seconds.
07	Accelerator input voltage too high.		
08	Accelerator input voltage too low.		
09	Both FWD and REV switches closed at same time.		**Motor Conditions and User Defined***
11	The START switch is closed before the key switch is closed.	**90**	Temperature too high, traction motor*
15	Battery voltage too low.	**91**	Temperature too high, hydraulic pump motor*
16	Battery volts too high.	**93**	Brush wear, steering pump motor*
17	Wrong control type selected.	**93**	Brush wear, power steering motor*
23	Motor field current too high on initial start - REV.	**94**	Brush wear, traction motor*
24	Motor field current too high on initial start - FWD.		
27	Voltage to logic circuit less than 10 volts.	**95**	Brush wear, lift pump motor*
28	Motor field current too high for too long during operation.	**99**	Maintenance Required
41	Open thermal protector or motor controller temperature too high.		**Pump Motor Controller**
*Not used on all models of lift trucks. Status Codes in this group flash on the LCD screen of the display panel.			
NOTE: Motor speed is decreased when a status code 99 is indicated.			

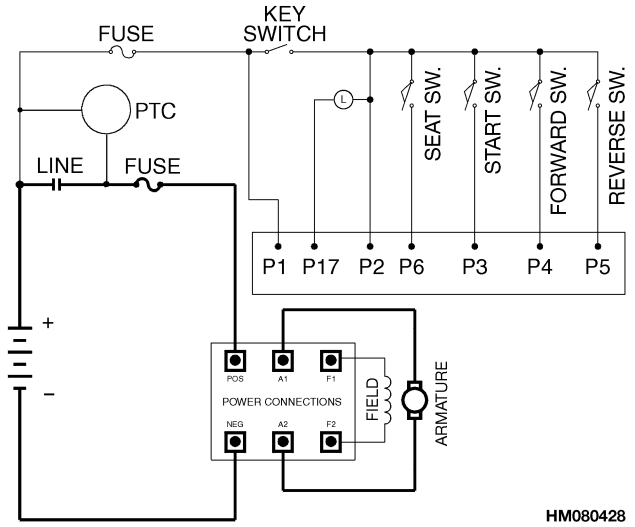
Status Code	Description	Memory Recall	Circuit
23	Motor field current is high at start of reverse travel.	No	Traction

Symptom

Maximum travel speed is reduced or lift truck does not move.

Possible Causes and Test Procedures

- Confirm that the motor field stud is not shorted to the hydraulic pump.
- Malfunction of motor controller.
  Replace the traction motor controller.



Cause of Status Indication

This status code is displayed when the current in the motor field is too high at start of reverse travel.

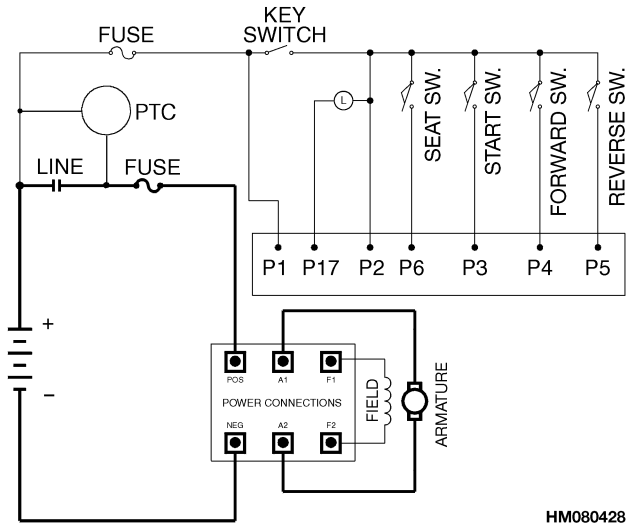
Status Code	Description	Memory Recall	Circuit
24	Motor field current is high at start of forward travel.	No	Traction

Symptom

Maximum travel speed is reduced or lift truck does not move.

Possible Causes and Test Procedures

- Confirm that the motor field stud is not shorted to the hydraulic pump.
- Malfunction of motor controller.
  Replace the traction motor controller.



Cause of Status Indication

This status code is displayed when the current draw in the motor field is too high at start of forward travel.

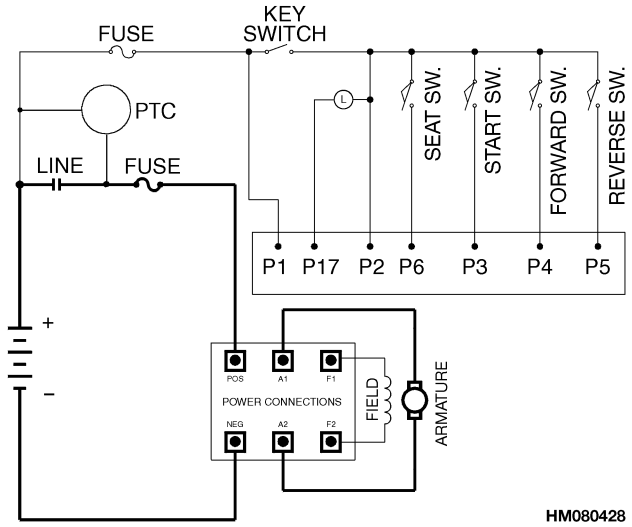
Status Code	Description	Memory Recall	Circuit
67	The armature current is too high (greater than current limit value).	Yes	Traction

Symptom

Control does not operate (line contactor drops out).

Possible Causes and Test Procedures

- Short circuit in armature (terminal A1 to A2).
  Disconnect power cables from traction motor terminals A1 and A2. Check for a short circuit between the terminals.
- Short circuit of armature terminal A1 or A2 to battery positive or battery negative.
  Disconnect power cables from traction motor terminals A1 and A2. Check for a short circuit between each terminal to battery positive and then each terminal to battery negative.
- Short circuit between power cables to the armature terminals (A1 and A2).
  Disconnect power cables from traction motor terminals A1 and A2. Check for a short circuit between the power cables.
- Noise
  Missing or damaged horn suppressor.
  Confirm that all inductive loads/accessories are suppressed.



Cause of Status Indication

This status code is displayed when the armature transistor current is greater than its current limit setting.

The line contactor drops out and the key must be moved to the **OFF** position to reset the motor controller.

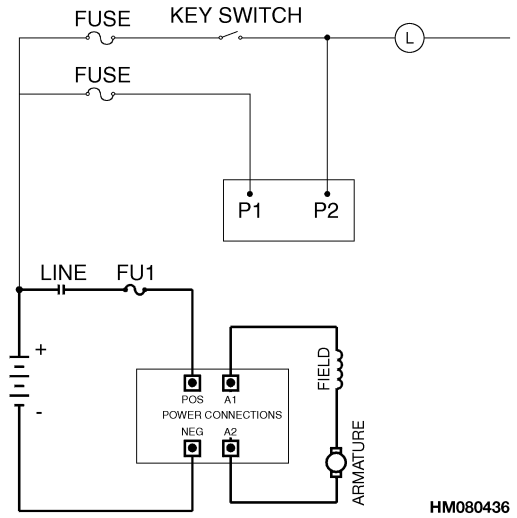
Status Code	Description	Memory Recall	Circuit
127	Motor controller internal power supply is less than 10 volts.	Yes	Pump

Symptom

Lift pump will not operate.

Possible Causes and Test Procedures

- Discharged Battery.
  Check battery to make sure it is charged.
- Loose connection at P1 of pump motor controller.
  Make sure that the wire connection at P1 is tight.



Cause of Status Indication

This status code is displayed when the internal power supply of the pump motor controller is less than 10 volts.

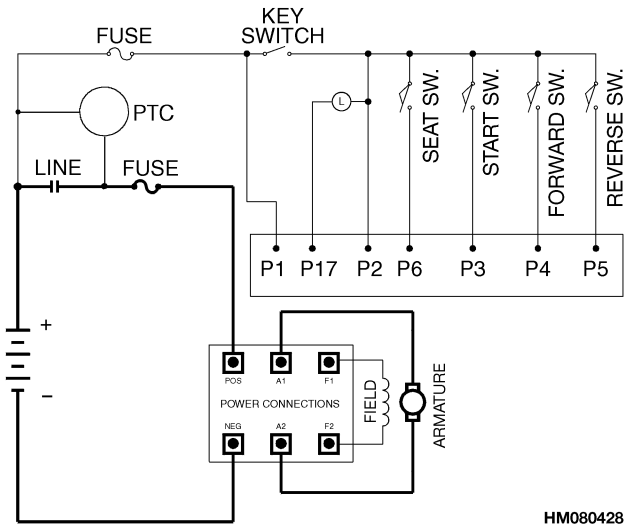
Status Code	Description	Memory Recall	Circuit
128	Motor current is too high during lift.	Yes	Pump

Symptom

The pump motor controller sees that motor current is too high for 70 seconds and stops operation. Lift pump motor does not operate.

Possible Causes and Test Procedures

- Discharged Battery (high motor current due to low voltage).
  Check battery to make sure it is charged.
- Operation of lift pump in high motor current condition for too long.
  Verify that lift truck is being operated correctly. Instruct operator to avoid lifting loads that are too heavy.



Cause of Status Indication

This status code is displayed during the run mode when the motor controller sees that pump motor current is too high for too long.

WARNING

Some checks in this section must be done with the battery connected and power applied to the controller. When making these checks, make sure the drive wheels are raised from the floor.

Make sure you disconnect the battery and separate the connector before you remove any power cables from the power terminals of the motor controller. The capacitor stores electrical energy and can cause injury if a person discharges a capacitor through parts of the body. AFTER the battery is disconnected and the key in the OFF position, make sure you also discharge the capacitor C1. Discharge the capacitor C1 by pushing and holding the horn button until the horn stops making a sound. The capacitor C1 discharges through the horn.

NOTE: The bolts and screws connected to the electronic components are normally metric sizes.

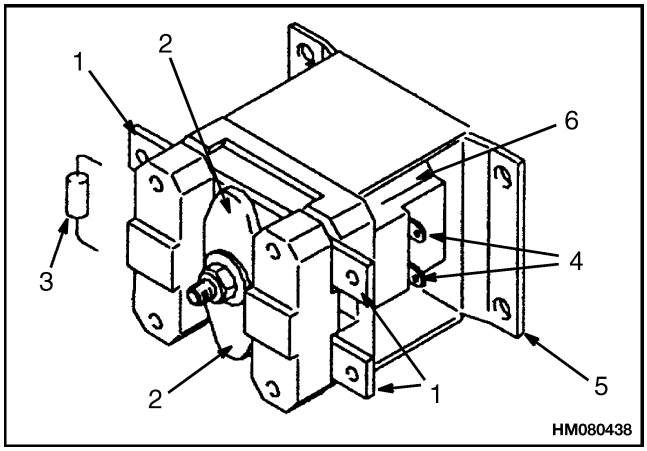
Make sure that you use the correct fastener for the part that is disassembled or removed.

FUSES

The fuses are found on the motor controller assembly or contactor panels. See Figure 8 or Figure 9. The condition of the fuses can normally be checked by looking at them or can be checked with an ohmmeter.

CONTACTORS

There can be three contactors on these lift trucks. All lift trucks have a power steering contactor and a line contactor. See Figure 10. Also see Figure 12. Lift trucks that do NOT have a pump motor controller (SP) also have a contactor to energize the lift pump motor. See Figure 10.



1. POWER TERMINALS
2. CONTACTS
3. CURRENT LIMITER (LINE CONTACTOR ONLY)
4. COIL TERMINALS
5. MOUNT BRACKET
6. COIL

Figure 10. Line or Pump Motor Contactor

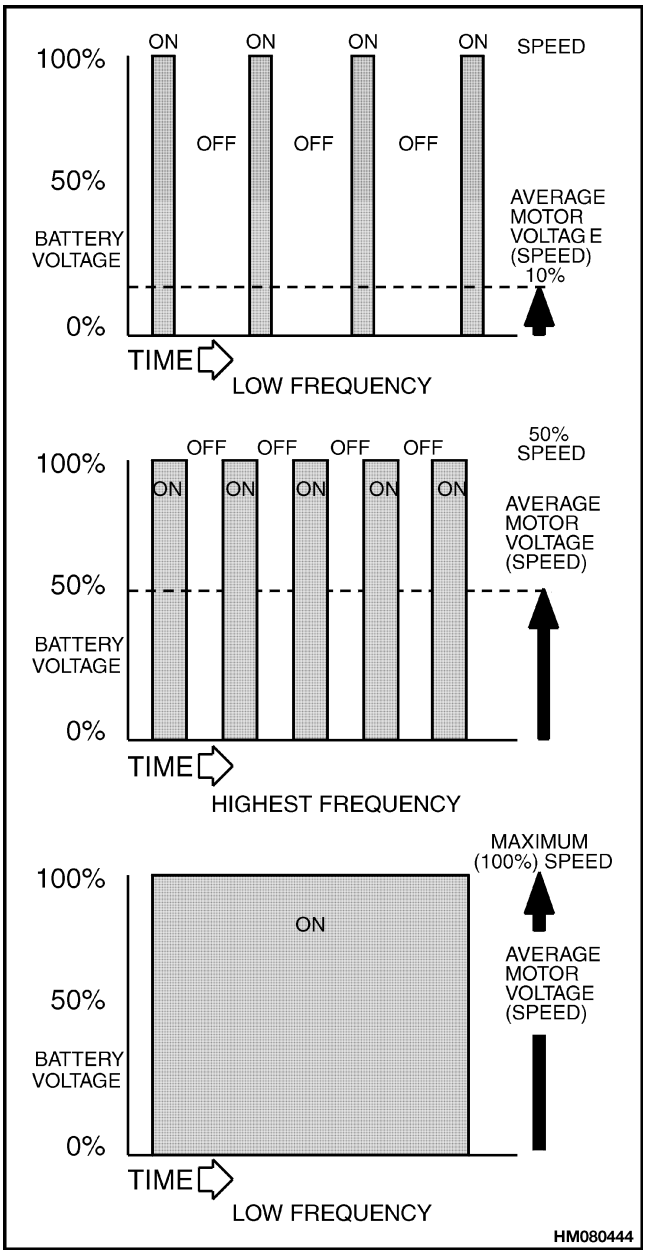


Figure 16. Average Voltage

SEM SYSTEM OPERATION (SR MOTOR CONTROLLER)

Reverse Circuit

The direction of armature rotation on a shunt motor is determined by the direction in which current flows through the field windings. A shunt motor field usually requires about 10% of the armature current at full torque. The lower current makes it possible to replace the reversing contactors of a series motor system with a transistor circuit. See Figure 17.

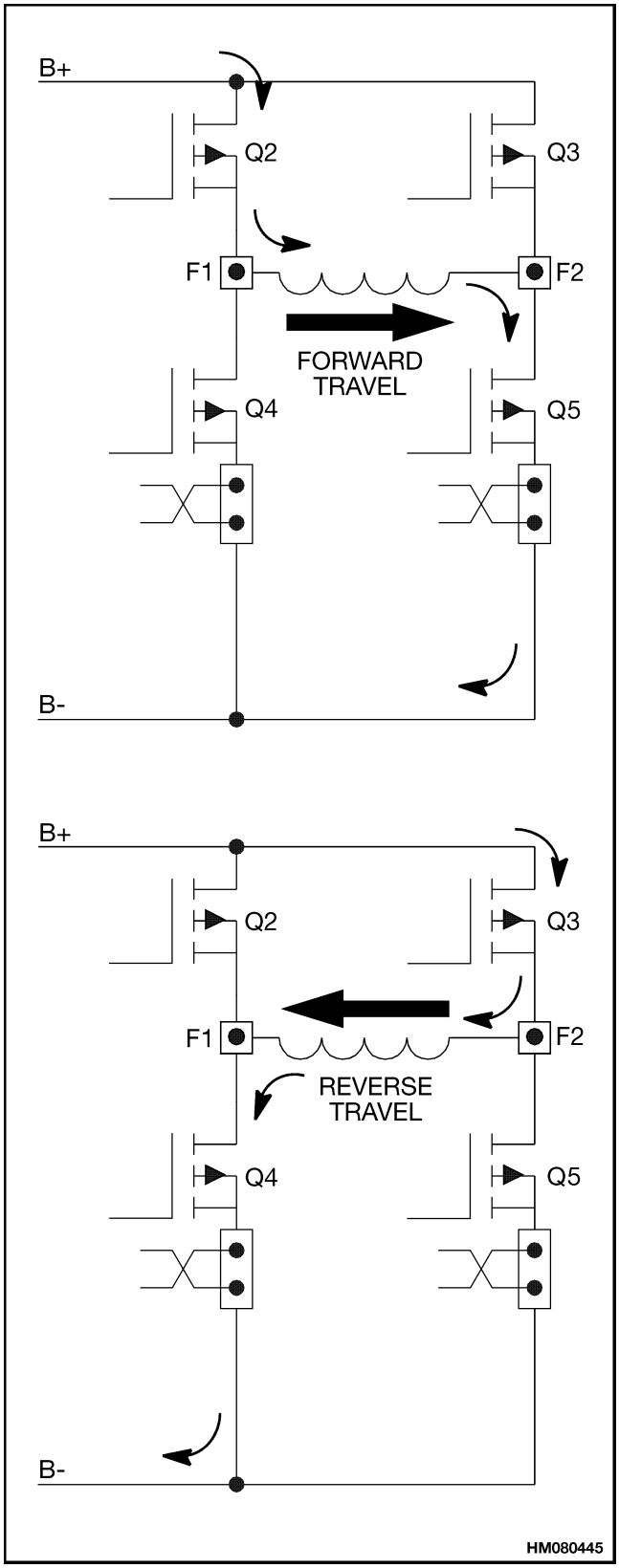


Figure 17. Current Flow through Power Circuit for Direction Control

SEM DISPLAY PANEL

GENERAL

These SEM Display Panels are on the instrument panel (dash) to the right of the steering column. Both SEM Display Panels (Standard and Premium) have a LCD (Liquid Crystal Display) screen. The screen is a display for the operator as described in the following Features descriptions, The SEM Display Panel is connected to both the traction and lift pump circuits through the motor controllers. If the lift pump motor has contactor control, the pump circuit is not connected to the SEM Display Panel. Some inputs to the traction motor controller go through the contactor driver module. Two connectors are on the back of each SEM Display Panel. The 18 pin connector connect the motor circuits and the nine pin connector is for connection to a Personal Computer (PC). All motor controller checks and adjustments for each motor controller can be made by the PC using this connector. Refer to the section **TROUBLESHOOTING AND ADJUSTMENT WITH A COMPUTER, 2200 SRM 597** for the correct procedures.

NOTE: Many motor controller checks and adjustments can also be made using the Hand Set. However, the Hand Set must be connected at each of the motor controller connector in turn. Refer to the section **TRANSISTOR MOTOR CONTROLLERS (SR AND SP), 2200 SRM 724** or **2200 SRM 808** for the correct procedures.

⚠ WARNING

Some adjustments can cause the lift truck to operate differently than normal. This different operation of the truck can result in personal injury or damage. Do NOT try to set the function reference values to any value outside the values in the section MOTOR CONTROLLERS, Parameter Tables, 2200 SRM 739 or 2200 SRM 808.

SEM DISPLAY PANEL FEATURES

The following features are part of both the Standard and Premium Display Panels:

- LED (Light Emitting Diode) symbol indicators
- LCD (Liquid Crystal Display) screen
- Battery Discharge Indicator (BDI) (with lift interrupt when enabled)
- Service Reminder (if enabled)
- Status Codes
- Hourmeter of traction and lift pump times

These features are shown in the Standard Display Panel. See FIGURE 1. The symbol indicators are shown and described in SEM DISPLAY PANEL INDICATORS of this manual. The symbol indicators are also shown at the descriptions for these indicators following FIGURE 1. Since the indicators are for common features, these indicators are also shown in the Premium Display Panel. See FIGURE 2.

Descriptions Of Common Features

LED SYMBOL INDICATORS

The LED symbol indicators are bright red and indicate the function that is shown on the LCD screen. Some of them are also used as a visual warning for the operator of a potential problem that needs an action from the operator.

LCD SCREEN

The LCD screen shows operator messages for the different functions. The Standard Display Panel can show a maximum of 16 numbers (including spaces).

BATTERY DISCHARGE INDICATOR (BDI)

The Battery Discharge Indicator (BDI) uses a bar graph as a “fuel” gauge for the battery state-of-charge. As the battery discharges, the bar gets shorter to show less “fuel”. The green band near the bar shows the normal operating range for the battery. The yellow band is the area that the battery can still be operated in without damage. This band is yellow to indicate that the battery is nearing the point of discharge where it can be damaged with continued hard use. The red band indicates the discharge condition where battery damage can occur. The battery indicator symbol will come ON at this time. Charge the battery very soon to prevent battery damage. Continued operation will cause Lift-Interrupt (if enabled) to occur to help prevent battery damage. At lift-interrupt, the last two segments of the bar graph are the only ones shown and are alternately ON and OFF. The

in the menu to convert the file. A binary image file with the same base filename and an extension of ".BIN" will be created (for example, "NACCO1.BIN" will be created from "NACCO1.CFG").

The resulting file can be used to program the SEM Display Panel's flash memory directly using any standard flash memory programming device.

File - Password history
Select this menu item to download password history events from the SEM Display Panel's flash memory. The password events can be displayed on screen, saved to a file on disk or sent to any standard printer attached to the PC's parallel port (PRN or LPT1).

For each password event, the following information is displayed:

Event number

Password at login

Name associated with password

Hourmeter reading at login

File - Backup (Ctrl+B)
Select this menu item to create a backup archive of SEM Display Panel setup files, binary image files, password history event reports and program configuration information on diskette.

File - Restore (Ctrl+R)
Select this menu item to restore a backup archive of setup files, binary image files, password history event reports and program information from diskette.

File - DOS Shell (Ctrl+F10)
Select this menu item to leave the program temporarily to perform a DOS command or run another program. To return the ITW program, type **EXIT** at the DOS prompt.

File - Exit (Alt+X)
Select this menu item to exit the program and return to the DOS command prompt. If you have made any changes to the current setup file, you will be prompted to save the changes before exiting the program.

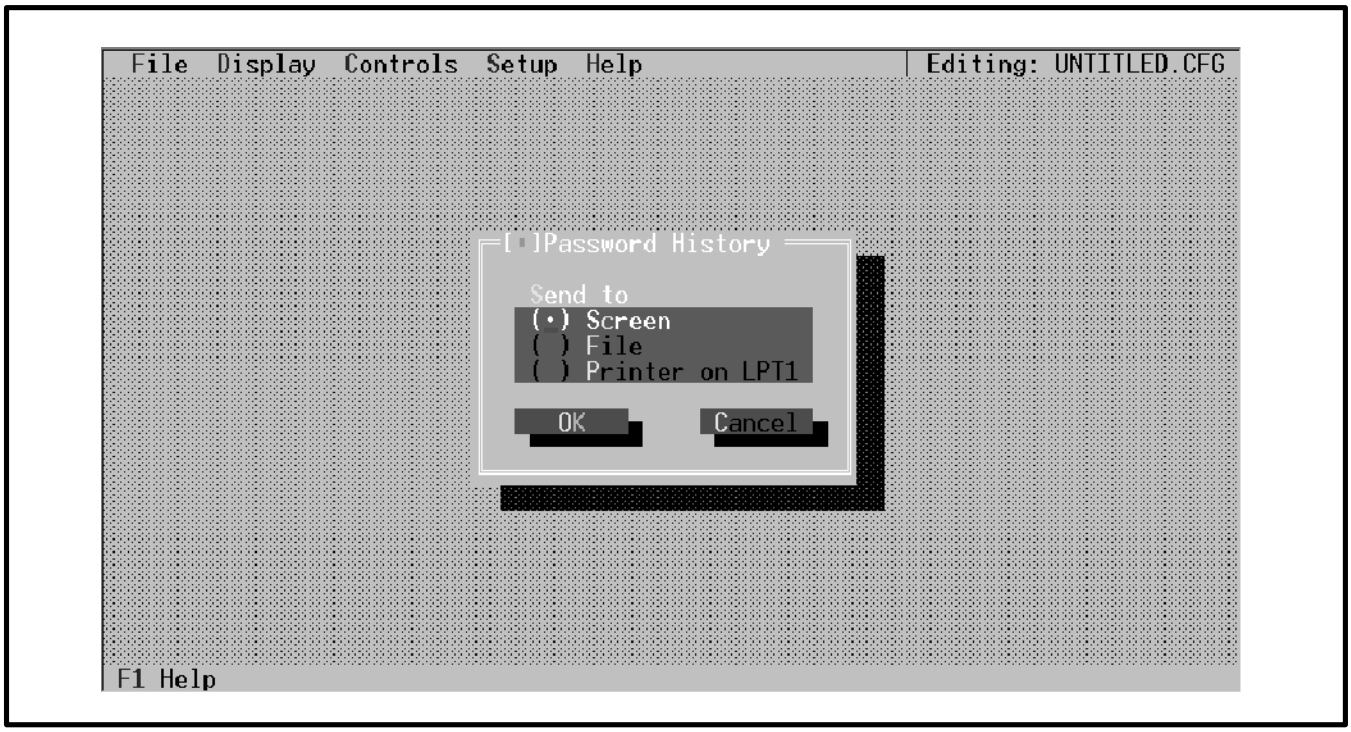


FIGURE 13. PASSWORD HISTORY

The “Password history” dialog allows you to choose a destination for the password history event report downloaded from a SEM Display Panel using the “File – Password history” menu item.

The report can be sent to one of three locations:

Screen

The report is displayed in a scrolling window on the desktop.

File

The report is saved to an ASCII text file on disk. You will be prompted for a file name. The name must be a valid DOS file name; a file extension of “.TXT” is recommended. The report file can then be viewed using any standard ASCII file viewer (for example, the DOS “EDIT.COM” program).

By default, password event report files are stored in the “REPORT” subdirectory of the directory where the “ITW.EXE” program is installed. For example, if the program is installed in “C:\ITW”, report files are stored in “C:\ITW\REPORT”. The default directory for report files can be changed by selecting the “Setup – File locations” menu item.

Printer on LPT1

The report is sent to a text printer attached to the PC’s parallel port (PRN or LPT1). If the printer is not ready to print (i.e., out of paper or off-line), you will be prompted to correct this condition before continuing.

After selecting a destination, click “OK”in the menu or press the **Enter** key to generate the report.

Select “Cancel” in the menu or press the **Esc** key to close the dialog without generating a report.

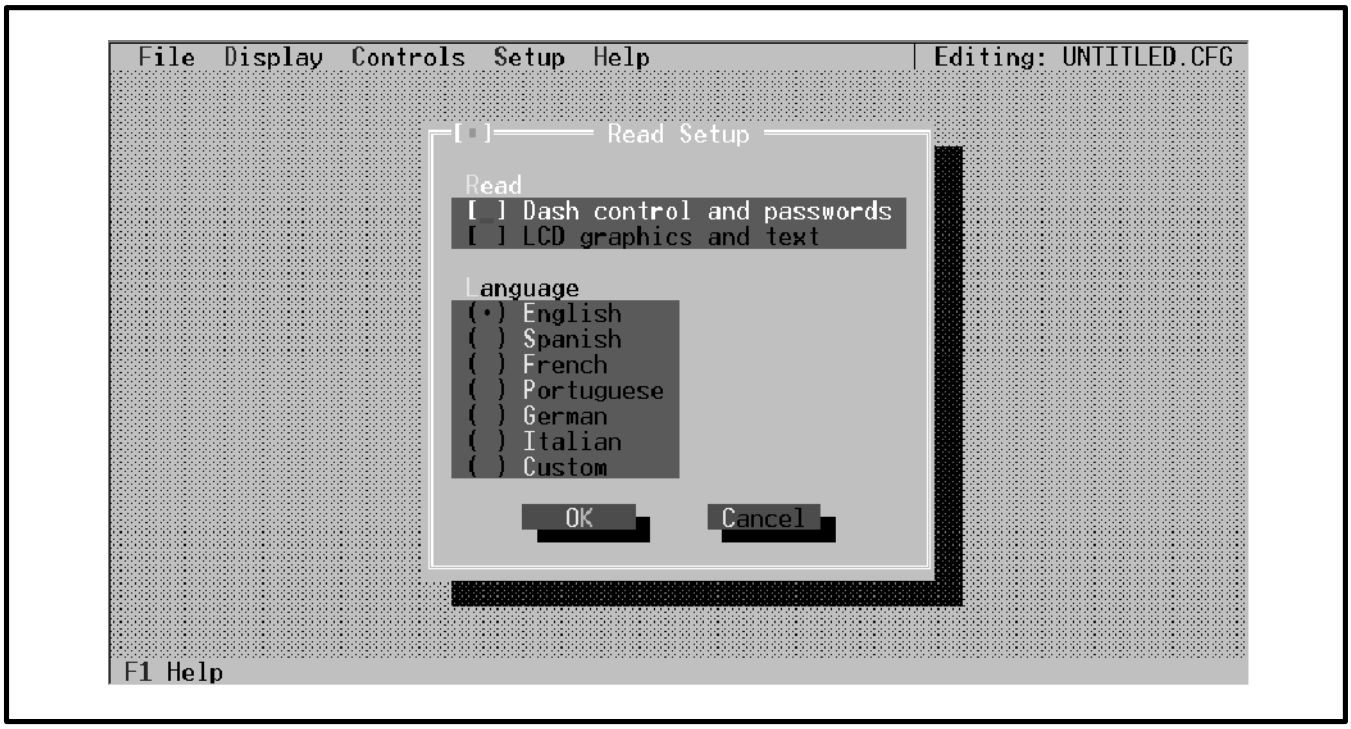


FIGURE 23. READ SETUP

The “Read setup” dialog allows you to read the setup and text messages for a selected language from a SEM Display Panel connected to the PC’s serial communications port. This feature can be used to construct a setup file and language file from a previously programmed SEM Display Panel.

If you have made changes to the currently open setup file, you will be prompted to save these changes before the dialog is displayed. To save the changes, select “Yes” in the menu. You will be prompted for a file name if you have not previously named the setup file; otherwise, changes will be saved to the current file name. If you select “No” in the menu, all changes will be discarded.

Data read from the SEM Display Panel. overwrites the current setup data in the PC’s memory and replaces the selected language’s text messages, if defined, on disk.

The following controls are provided:

Read

To read data from the SEM Display Panel , use the mouse or keyboard to check the check boxes next to the data items you wish to receive.

Dash control and passwords

Reads configuration options, additional maintenance questions interval, passwords, and password configuration data from the SEM Display Panel.

LCD graphics and text

Reads fault code, startup question, and special function text messages for the selected language from the display.

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:

WARNING

Indicates a condition that can cause immediate death or injury!

CAUTION

Indicates a condition that can cause property damage!

Table 2. SR (SEM) Register Parameters for Traction Motor Controller - E1.50-2.00XMS (E25-40XM$_2$S) (36 to 48V) (High Speed Motor With E or ES Rating) (Continued)

U.S. and European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	**Description**	**Factory Register Value**	**Factory Amount**	**Parameter Values (Min/Max)**	**Amount (Min/Max)**
53	Mode 2 Field Weakening (FW) Start	100[1]	—	88/115[1]	—
54	Mode 2 Field Weakening (FW) Ratio	35[1]	—	32/58[1]	—
55	Mode 2 Maximum Armature % On Time	70	—	50/115	—
56	Mode 3 Controlled Acceleration	82	2.05 sec	30/255	1.0 to 6.3 Seconds
57	Mode 3 Field Weakening (FW) Start	100[1]	—	88/115[1]	—
58	Mode 3 Field Weakening (FW) Ratio	35[1]	—	32/58[1]	—
59	Mode 3 Maximum Armature % On Time	51	—	50/115	—
60	Mode 4 Controlled Acceleration	52	1.30 sec	30/255	1.0 to 6.3 Seconds
61	Mode 4 Field Weakening (FW) Start	100[1]	—	88/115[1]	—
62	Mode 4 Field Weakening (FW) Ratio	35[1]	—	32/58[1]	—
63	Mode 4 Maximum Armature % On Time	51	—	50/115	—
64-128	NOT USED	—	—	—	—

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 5. SR (SEM) Register Parameters for Traction Motor Controller - E2.00-3.20XM (72 to 80V) (9-Inch Traction Motor) (Continued)

European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
18	Steering Pump Time Delay	25	—	0/128	—
19	Maintenance Code (Tens and Units)	255	—	0/255	—
20	Maintenance Code (Thousands and Hundreds)	255	—	0/255	—
21	Auto Regen Braking Current Limit (With Auto Regen)	51	—	51/143	—
21	Auto Regen Braking Current Limit (Without Auto Regen)	255	—	144/255	—
22	Mode	184	184	184	184
23	For Special Programs	0	—	0/255	—
24	Field Weakening Start	100[1]	—	88/115[1]	—
25	Monitor	0[1]	—	0	—
26	Base Ratio	75[1]	—	72/78[1]	—
27	NOT USED	—	—	—	—
Set the register value for Function Numbers 28 to 0 (zero) whenever the status codes are cleared (erased from memory). Status codes will then be stored in the correct order of occurrence. The PC software program will automatically "ask" the technician if a 0 (zero) setting is wanted.					
29-47	NOT USED	—	—	—	—
Function Numbers 48 through 63 are **ONLY** used with lift trucks that have the **PREMIUM** display panel.					
48	Mode 1 Controlled Acceleration	52	1.30 sec	30/255	1.0 to 6.3 Seconds
49	Mode 1 Field Weakening (FW) Start	100[1]	—	88/115[1]	—
50	Mode 1 Field Weakening (FW) Ratio	55[1]	—	52/78[1]	—
51	Mode 1 Maximum Armature % On Time	98	—	50/115	—

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 8. SP Register Parameters for Pump Motor Controller - E45-65XM$_2$ (36 to 48V) (Continued)

U.S. Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	**Description**	**Factory Register Value**	**Factory Amount**	**Parameter Values (Min/Max)**	**Amount (Min/Max)**
16	Internal Resistance Compensation	10	—	10	—
17	Card Type Selection	65[1]	—	63/71[1]	—
18-47	NOT USED	—	—	—	—
48	Mode 1 Controlled Acceleration	120	10.1 sec	25/150	2.1 to 12.6 Seconds
49	Mode 1 Speed Limit 2	35	—	30/70	Must be **LESS** than register value of Function 53
50	Mode 1 Speed Limit 3	84	—	30/255	Must be same or **MORE** than register value of Function 54
51	NOT USED	—	—	—	—
52	Mode 2 Controlled Acceleration	80	—	25/150	Must be **LESS** than register value of Function 48 and **MORE** than register value of Function 56
53	Mode 2 Speed Limit 2	48	—	30/70	Must be **LESS** than register value of Function 57 and **MORE** than register value of Function 49

[1]A register value setting outside the parameter values can cause the hydraulic system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 11. SR (SEM) Register Parameters for Traction Motor Controller - J40-60XM$_2$ (36 to 48V) (EE Rated)

U.S. Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
1	Auto Regen Enable Speed	12	—	0/50	—
2	Creep Speed	15	2.75%	0/255	2% to 15% On Time
3	Controlled Acceleration	82	2.05 sec	30/255	1.5 to 6.3 Seconds
4	Armature Current Limit	255	—	0/255	—
5	Regen Ramp Rate	40	—	39/41	—
6	Field Weakening (FW) Ratio	35[1]	—	32/58[1]	—
7	Minimum Field Current	51	—	0/85	—
8	Maximum Field Current	255[1]	—	253/255[1]	—
9	Regenerative Braking Current Limit	75	—	0/80	—
10	Field Current For Regen Braking	225[1]	—	222/228[1]	—
11	Speed Limit 1	0	—	0	—
12	Maximum Armature % On Time	0	—	0	—
13	Speed Limit 3	130	—	51/180	Enabled by Status Codes 90, 91, and 99
14	Internal Resistance Compensation	16[2]	—	5/23[2]	—
15	Battery Voltage Selection	186[3]	—	184/250[3]	—
16	Stall Trip Point % On Time	100[4]	—	98/102[4]	—
17	Control Type Selection (With Lift Interrupt)	57[5]	—	55/59[5]	—
17	Control Type Selection (Without Lift Interrupt)	52[5]	—	50/54[5]	—
18	Steering Pump Time Delay	25	—	0/128	—

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 14. SP Register Parameters for Pump Motor Controller - J2.00-3.20XM (72 to 80V) (Continued)

European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
52	Mode 2 Controlled Acceleration	80	—	25/150	Must be **LESS** than register value of Function 48 and **MORE** than register value of Function 56
53	Mode 2 Speed Limit 2	48	—	30/70	Must be **LESS** than register value of Function 57 and **MORE** than register value of Function 49
54	Mode 2 Speed Limit 3	96	—	30/255	Must be **LESS** than register value of Function 50 and **MORE** than register value of Function 58
55	NOT USED	—	—	—	—
56	Mode 3 Controlled Acceleration	50	—	25/150	Must be **LESS** than register value of Function 52 and **MORE** than register value of Function 60

[1]A register value setting outside the parameter values can cause the hydraulic system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 16. SR (SEM) Register Parameters for Traction Motor Controller - N30XMH$_2$ (36 to 48V) (11-Inch Motor) (Continued)

U.S. Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
61	Mode 4 Field Weakening (FW) Start - 48V	130[1]	—	118/145[1]	—
62	Mode 4 Field Weakening (FW) Ratio - 36V	25[1]	—	22/48[1]	—
62	Mode 4 Field Weakening (FW) Ratio - 48V	35[1]	—	32/88[1]	—
63	Mode 4 Maximum Armature % On Time	51	—	50/115	—
64-128	NOT USED	—	—	—	—

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

"THE
QUALITY
KEEPERS"

HYSTER
APPROVED
PARTS

Table 3. SP Register Parameters for Pump Motor Controller - E1.50-2.00XMS (E25-40XM$_2$S) (36 to 48V) (Continued)

U.S. and European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	**Description**	**Factory Register Value**	**Factory Amount**	**Parameter Values (Min/Max)**	**Amount (Min/Max)**
52	Mode 2 Controlled Acceleration	80	—	25/150	Must be **LESS** than register value of Function 48 and MORE than register value of Function 56
53	Mode 2 Speed Limit 2	48	—	30/70	Must be **LESS** than register value of Function 57 and **MORE** than register value of Function 49
54	Mode 2 Speed Limit 3	96	—	30/255	Must be **LESS** than register value of Function 50 and **MORE** than register value of Function 58
55	NOT USED	—	—	—	—
56	Mode 3 Controlled Acceleration	50	—	25/150	Must be **LESS** than register value of Function 52 and **MORE** than register value of Function 60

[1]A register value setting outside the parameter values can cause the hydraulic system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 6. SR (SEM) Register Parameters for Traction Motor Controller - E45-65XM$_2$ (36 to 48V) (11 Inch-Traction Motor) (Continued)

U.S. Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	**Description**	**Factory Register Value**	**Factory Amount**	**Parameter Values (Min/Max)**	**Amount (Min/Max)**
17	Control Type Selection (With Lift Interrupt)	57[5]	—	55/59[5]	—
17	Control Type Selection (Without Lift Interrupt)	52[5]	—	50/54[5]	—
18	Steering Pump Time Delay	25	—	0/128	—
19	Maintenance Code (Tens and Units)	255	—	0/255	—
20	Maintenance Code (Thousands and Hundreds)	255	—	0/255	—
21	Auto Regen Braking Current Limit (With Auto Regen)	51	—	51/143	—
21	Auto Regen Braking Current Limit (Without Auto Regen)	255	—	144/255	—
22	NOT USED	—	—	—	—
23	For Special Programs	0	—	0/255	—
24	Field Weakening Start - 36V	140[1]	—	128/155[1]	—
24	Field Weakening Start - 48V	130[1]	—	118/145[1]	—
25	Monitor	0[1]	—	0	—
26	Base Ratio	65[1]	—	62/68[1]	—
27	NOT USED	—	—	—	—
Set the register value for Function Numbers 28 to 0 (zero) whenever the status codes are cleared (erased from memory). Status codes will then be stored in the correct order of occurrence. The PC software program will automatically "ask" the technician if a 0 (zero) setting is wanted.					
29-47	NOT USED	—	—	—	—
Function Numbers 48 through 63 are **ONLY** used with lift trucks that have the **PREMIUM** display panel.					
48	Mode 1 Controlled Acceleration - 36V	40	1.05 sec	30/255	1.0 to 6.3 Seconds

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 9. SP Register Parameters for Pump Motor Controller - E2.00-3.20XM (72 to 80V)

European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
1	Stored Status Code	0	—	0/255	—
2	Internal Resistance Comp. Start	10	—	10	—
3	Controlled Acceleration	50		25/150	—
4	Current Limit (C/L)	255	—	255	—
5-6	NOT USED	—	—	—	—
7	Controlled Acceleration Compensation	15	—	15	—
8-10	NOT USED	—	—	—	—
11	Speed Limit 1 (Tilt & Aux-1)	35	—	30/70	—
12	Speed Limit 2 (Slow Lift)	55	—	30/70	—
13	Speed Limit 3 (Fast lift)	255	—	30/255	—
14	Speed Limit 4 (NOT USED)	255	—	30/255	—
15	NOT USED	—	—	—	—
16	Internal Resistance Compensation	10	—	10	—
17	Card Type Selection	65[1]	—	63/71[1]	—
18-47	NOT USED	—	—	—	—
48	Mode 1 Controlled Acceleration	120	10.1 sec	25/150	2.1 to 12.6 Seconds
49	Mode 1 Speed Limit 2	35	—	30/70	Must be **LESS** than register value of Function 53
50	Mode 1 Speed Limit 3	84	—	30/255	Must be same or **MORE** than register value of Function 54
51	NOT USED	—	—	—	—

[1]A register value setting outside the parameter values can cause the hydraulic system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 12. SR (SEM) Register Parameters for Traction Motor Controller - J2.00-3.20XM (72 to 80V) (Continued)

European Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
19	Maintenance Code (Tens and Units)	255	—	0/255	—
20	Maintenance Code (Thousands and Hundreds)	255	—	0/255	—
21	Auto Regen Braking Current Limit (With Auto Regen)	51	—	51/143	—
21	Auto Regen Braking Current Limit (Without Auto Regen)	255	—	144/255	—
22	NOT USED	—	—	—	—
23	For Special Programs	0	—	0/255	—
24	Field Weakening Start	100[1]	—	88/115[1]	—
25	Monitor	0[1]	—	0	—
26	Base Ratio	65[1]	—	62/68[1]	—
27	NOT USED	—	—	—	—
Set the register value for Function Numbers 28 to 0 (zero) whenever the status codes are cleared (erased from memory). Status codes will then be stored in the correct order of occurrence. The PC software program will automatically "ask" the technician if a 0 (zero) setting is wanted.					
29-47	NOT USED	—	—	—	—
Function Numbers 48 through 63 are **ONLY** used with lift trucks that have the **PREMIUM** display panel.					
48	Mode 1 Controlled Acceleration	52	1.30 sec	30/255	1.0 to 6.3 Seconds
49	Mode 1 Field Weakening (FW) Start	100[1]	—	88/115[1]	—
50	Mode 1 Field Weakening (FW) Ratio	45[1]	—	42/68[1]	—
51	Mode 1 Maximum Armature % On Time	98	—	50/115	—
52	Mode 2 Controlled Acceleration	52	1.30 sec	30/255	1.0 to 6.3 Seconds

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

Table 15. SR (SEM) Register Parameters for Traction Motor Controller - N30XMH$_2$ (36 to 48V) (9-Inch Motor) (Continued)

U.S. Lift Truck Models					
		Default		Permitted Range	
Fcn. No.	Description	Factory Register Value	Factory Amount	Parameter Values (Min/Max)	Amount (Min/Max)
48	Mode 1 Controlled Acceleration - 48V	42	1.05 sec	30/255	1.0 to 6.3 Seconds
49	Mode 1 Field Weakening (FW) Start	120[1]	—	88/125[1]	—
50	Mode 1 Field Weakening (FW) Ratio - 36V	55[1]	—	45/78[1]	—
50	Mode 1 Field Weakening (FW) Ratio - 48V	55[1]	—	52/78[1]	—
51	Mode 1 Maximum Armature % On Time	98	—	50/115	—
52	Mode 2 Controlled Acceleration - 36V	40	1.05 sec	30/255	1.0 to 6.3 Seconds
52	Mode 2 Controlled Acceleration - 48V	42	1.05 sec	30/255	1.0 to 6.3 Seconds
53	Mode 2 Field Weakening (FW) Start	120[1]	—	88/125[1]	—
54	Mode 2 Field Weakening (FW) Ratio - 36V	55[1]	—	45/78[1]	—
54	Mode 2 Field Weakening (FW) Ratio - 48V	55[1]	—	52/78[1]	—
55	Mode 2 Maximum Armature % On Time	78	—	50/115	—
56	Mode 3 Controlled Acceleration	82	2.05 sec	30/255	1.0 to 6.3 Seconds
57	Mode 3 Field Weakening (FW) Start	120[1]	—	88/125[1]	—
58	Mode 3 Field Weakening (FW) Ratio - 36V	55[1]	—	45/78[1]	—
58	Mode 3 Field Weakening (FW) Ratio - 48V	55[1]	—	52/78[1]	—

[1]This function is not normally adjusted. Register values that are within the minimum/maximum parameter values will not change lift truck performance.
[2]Adjusting this register value to the wrong number can cause battery damage.
[3]Adjusting this register value to the wrong number can cause a status code of 15 or 16 and the lift truck will not operate.
[4]This register value sets electrical limits to protect the motor if a stall occurs. **NEVER** set a register value to a number above the maximum value or there can be motor damage if a stall does occur.
[5]A register value setting outside the parameter values can cause the traction system to operate differently than normal or cause damage to the motor controller or motor. **Personal injury** can also occur.

HYSTER TECHNICAL PUBLICATIONS

2200 SRM 739 8/03 (9/99)(3/99) Printed in U.S.A.

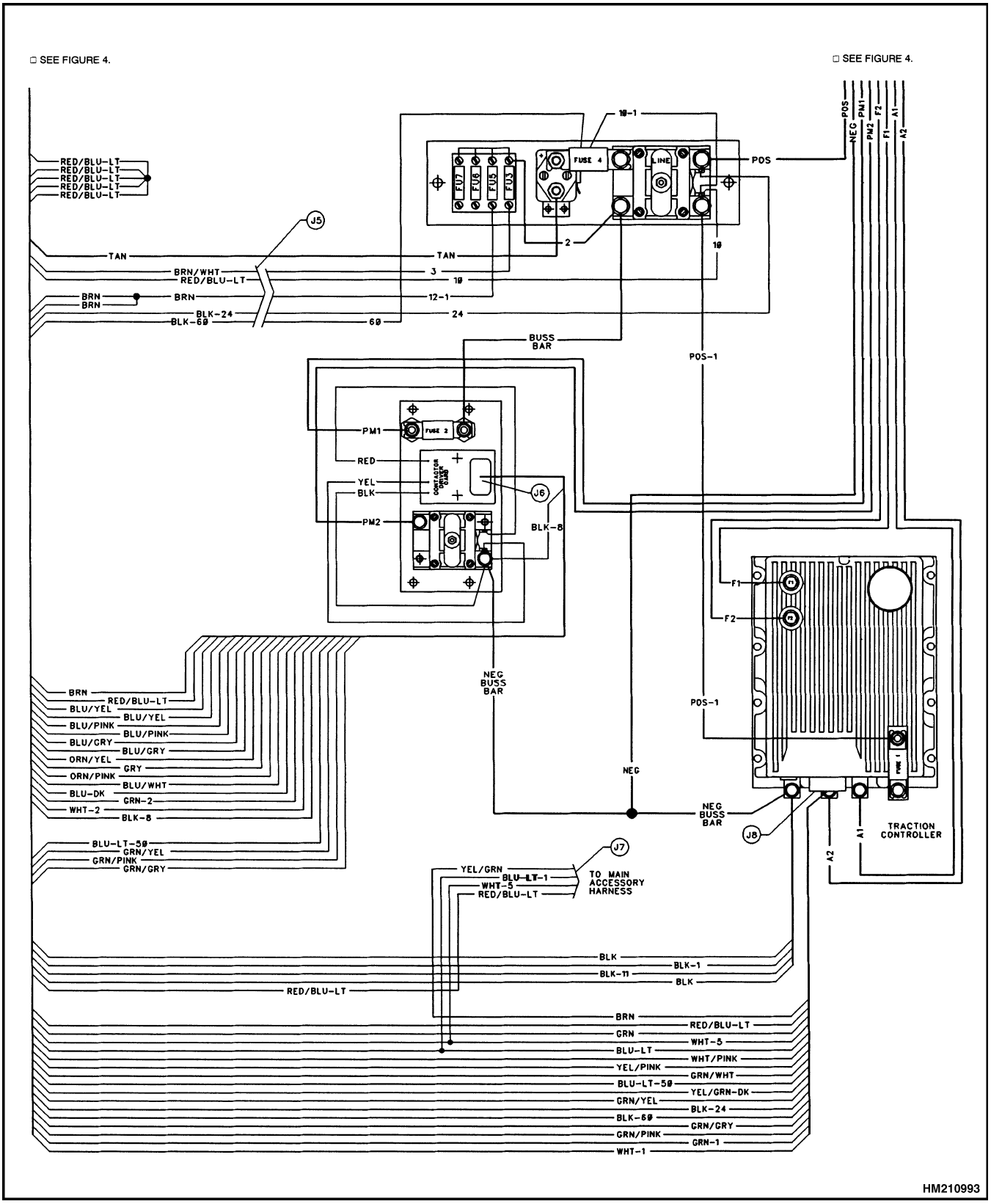


Figure 6. SR (SRM) Motor Controller and Contactor Control for Pump Motor E1.50-1.75XM, E2.00XMS (E25-35XM$_2$S, E40XM$_2$S), E2.00-3.20XM (E45-65XM$_2$) Wiring Diagram (Early Models)

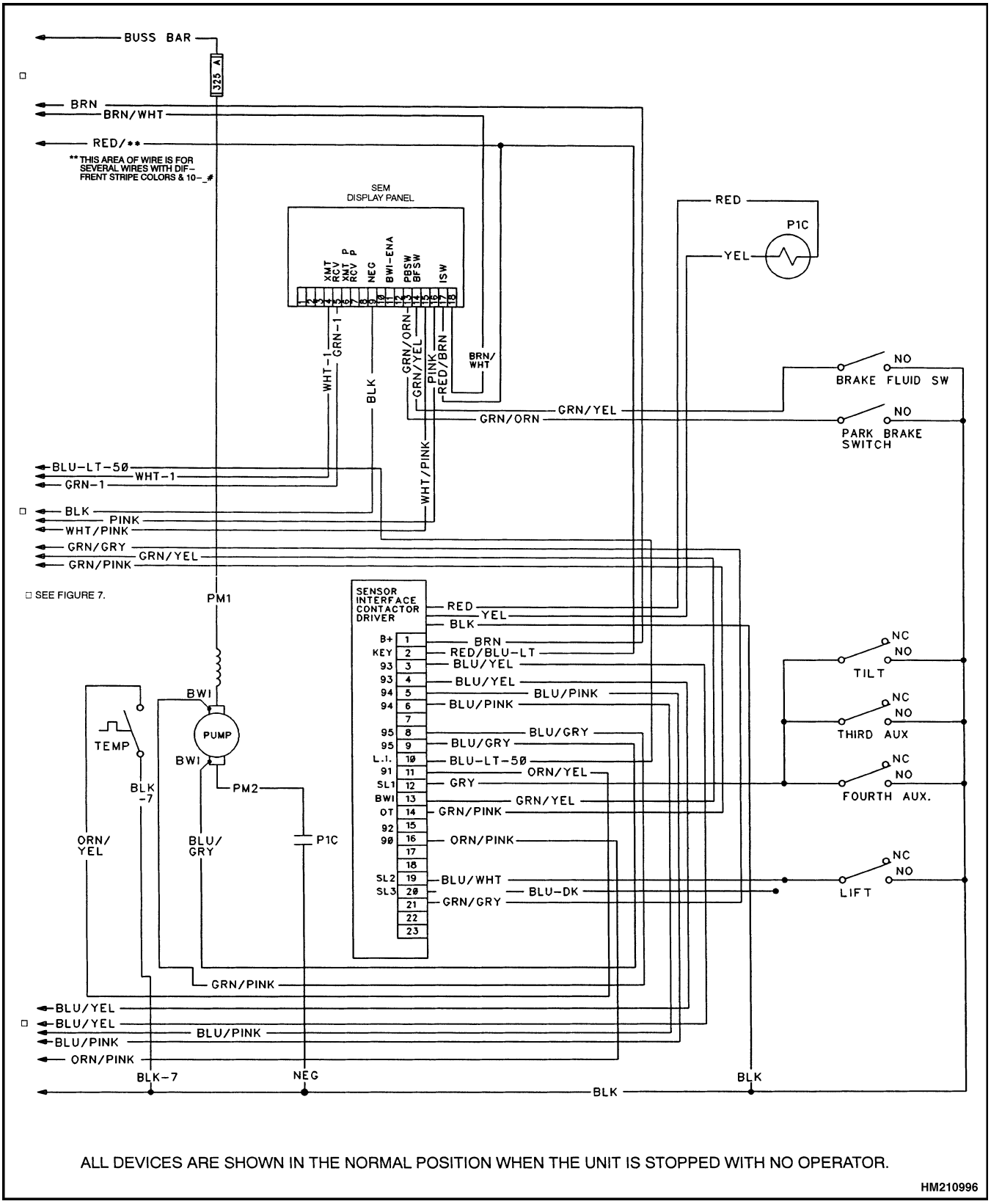


Figure 16. Contactor Control for Pump Motor (N30XMH$_2$) Schematic Diagram

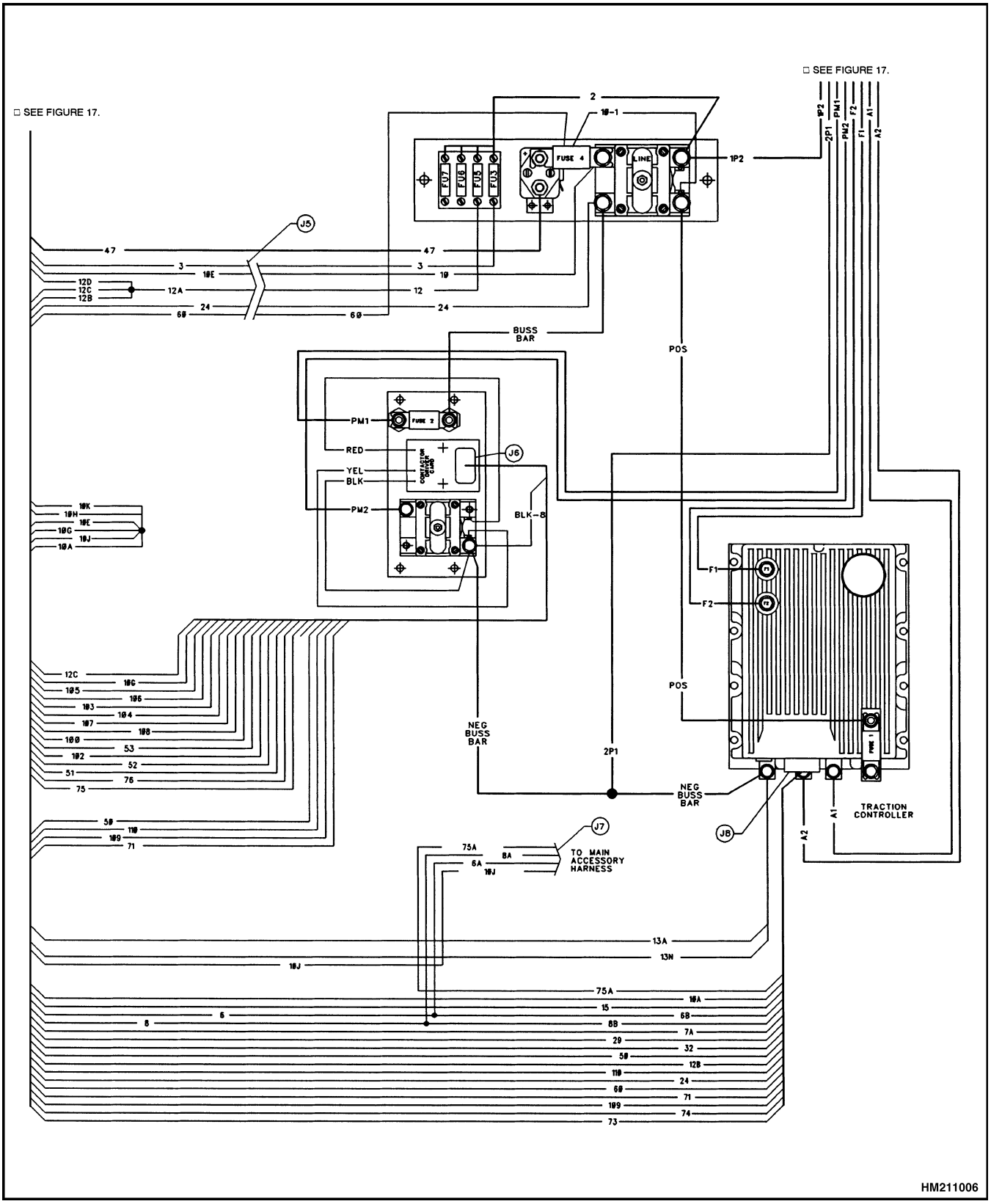


Figure 26. SR (SEM) Motor Controller and Contactor Control for Pump Motor J2.00-3.20XM (J40-60XM$_2$) Wiring Diagram

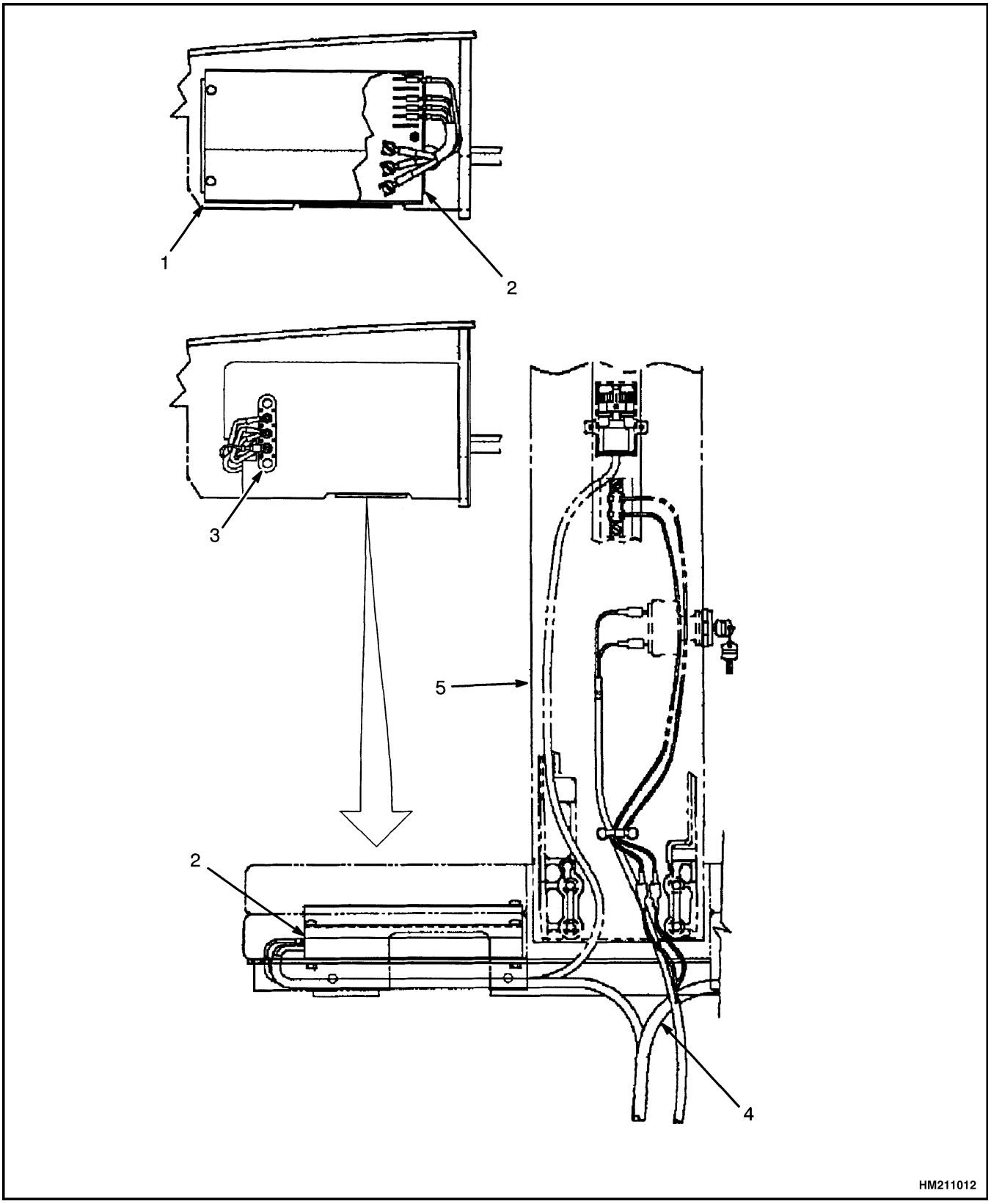


Figure 32. Steering Column Wiring Detail J2.00-3.20XM (J40-60XM$_2$), E2.00-3.20XM (E40-65XM$_2$), and N30XMH$_2$

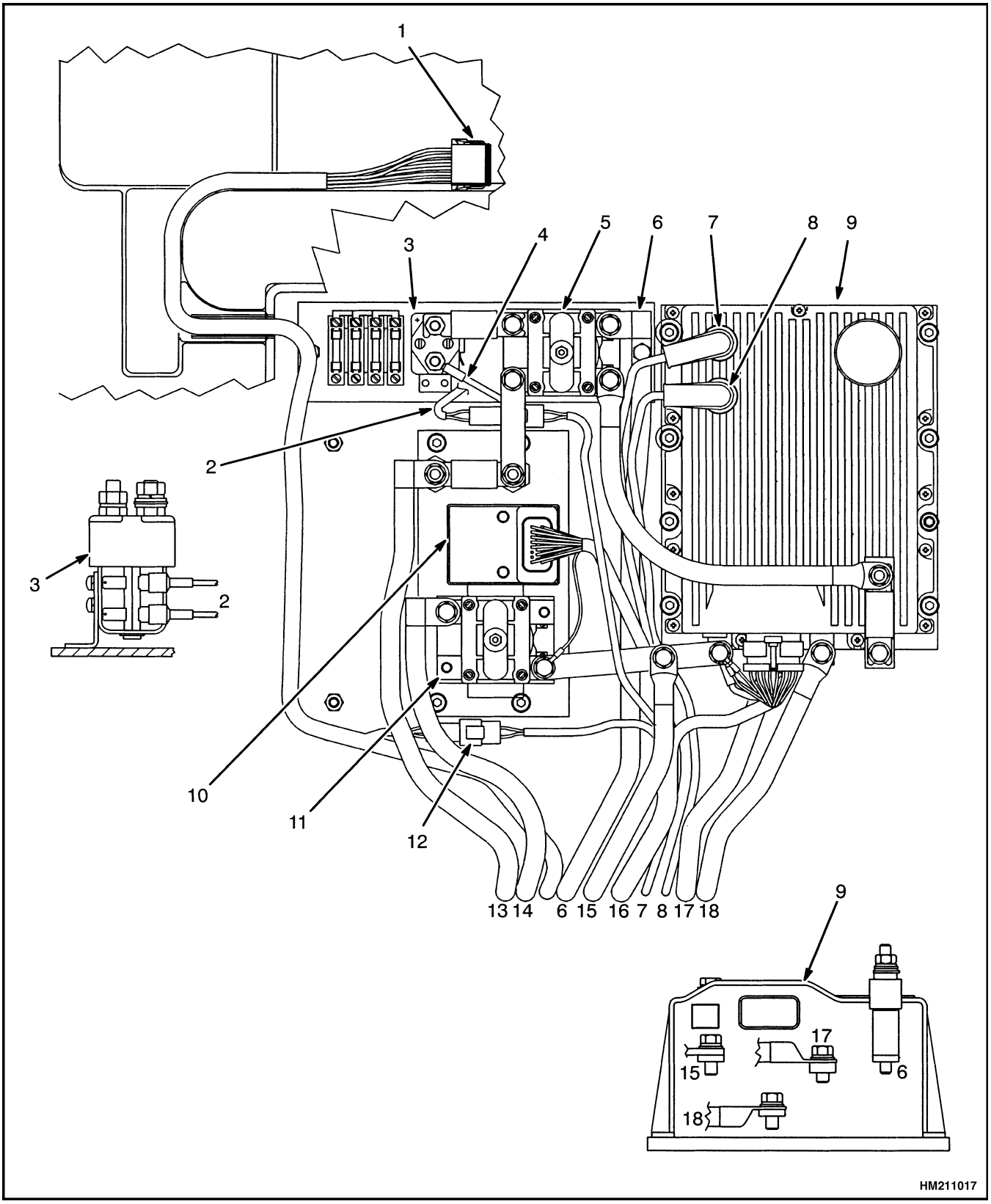
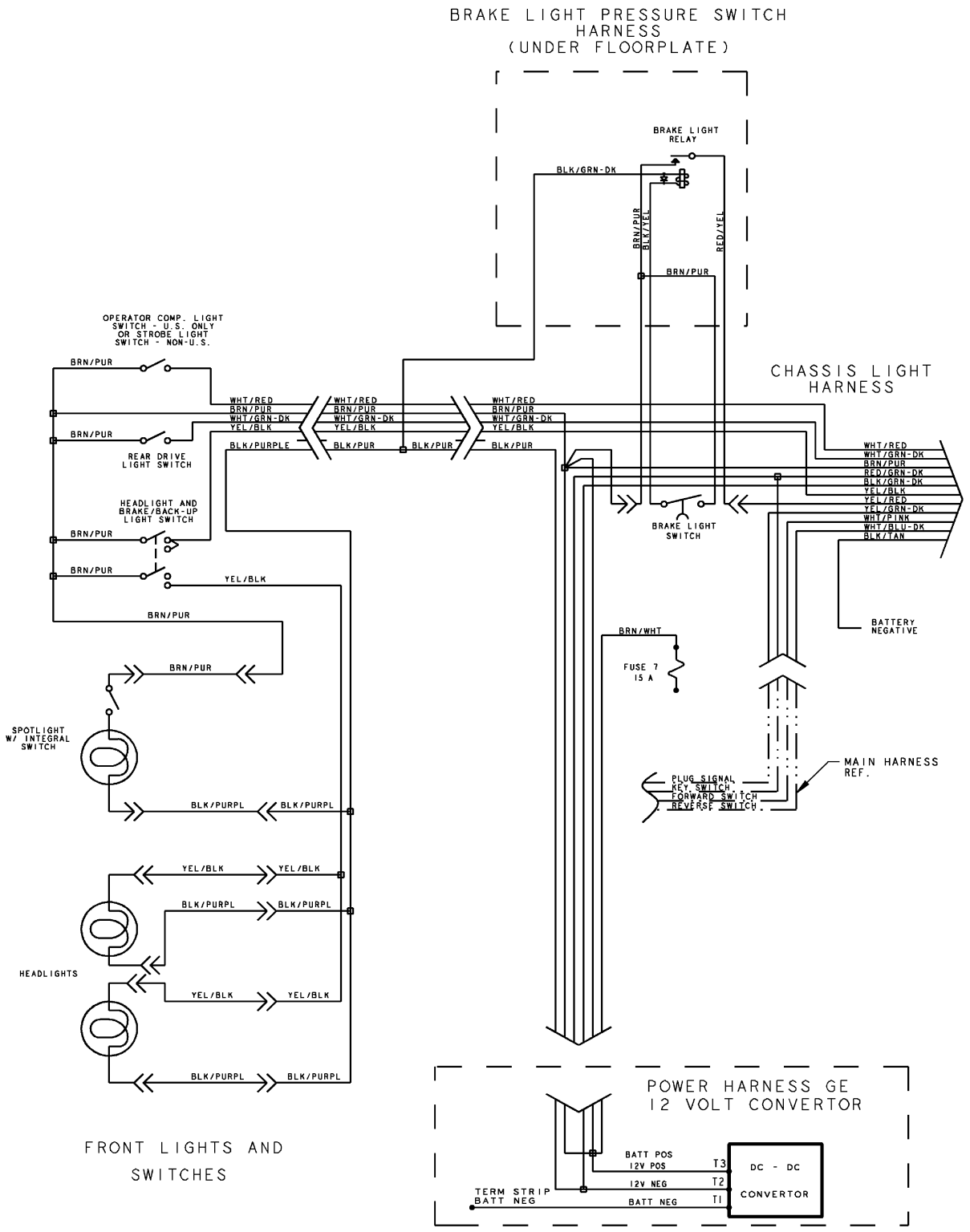


Figure 37. Panel Wiring With SR (SEM) Motor Controller and Contactor Pump Control


BRAKE LIGHT PRESSURE SWITCH HARNESS (UNDER FLOORPLATE)
BRAKE LIGHT RELAY
BLK/GRN-DK
BRN/PUR
BLK/YEL
RED/YEL
BRN/PUR
OPERATOR COMP. LIGHT SWITCH - U.S. ONLY OR STROBE LIGHT SWITCH - NON-U.S.
BRN/PUR
REAR DRIVE LIGHT SWITCH
BRN/PUR
HEADLIGHT AND BRAKE/BACK-UP LIGHT SWITCH
BRN/PUR
BRN/PUR
YEL/BLK
BRN/PUR
BRN/PUR
SPOTLIGHT W/ INTEGRAL SWITCH
BLK/PURPL
BLK/PURPL
YEL/BLK
YEL/BLK
BLK/PURPL
BLK/PURPL
HEADLIGHTS
YEL/BLK
YEL/BLK
BLK/PURPL
BLK/PURPL
FRONT LIGHTS AND SWITCHES
WHT/RED
BRN/PUR
WHT/GRN-DK
YEL/BLK
BLK/PURPLE
BLK/PUR
WHT/RED
BRN/PUR
WHT/GRN-DK
YEL/BLK
BLK/PUR
BLK/PUR
WHT/RED
BRN/PUR
WHT/GRN-DK
YEL/BLK
BLK/PUR
CHASSIS LIGHT HARNESS
WHT/RED
WHT/GRN-DK
BRN/PUR
RED/GRN-DK
BLK/GRN-DK
YEL/BLK
YEL/RED
YEL/GRN-DK
WHT/PINK
WHT/BLU-DK
BLK/TAN
BRAKE LIGHT SWITCH
BATTERY NEGATIVE
BRN/WHT
FUSE 7 15 A
PLUG SIGNAL
KEY SWITCH
FORWARD SWITCH
REVERSE SWITCH
MAIN HARNESS REF.
POWER HARNESS GE 12 VOLT CONVERTOR
BATT POS 12V POS
12V NEG
BATT NEG
T3
T2
T1
DC - DC CONVERTOR
TERM STRIP BATT NEG

BM210133

HYSTER TECHNICAL PUBLICATIONS

8000 SRM 742 6/04 (1/04)(10/03)(8/03)(3/99) Printed in U.S.A.

Additional Components of Premium Display Panel

The premium display panel has a different LCD screen and additional push buttons as described below.

ALPHANUMERIC SCREEN

This LCD screen shows the information for the common features and information for the additional features of the premium SEM display panel. Information with a maximum of 20 characters per line in two lines can be shown. This additional information includes the following (display letters shown in all capital letters): 1) ENTER PASSWORD (if enabled), 2) check list items (if enabled), 3) status code list (history) with number and short description, and 4) battery compensation information. The hourmeter times are also identified as TRACTION HOURS or PUMP HOURS. MAINTENANCE REQUIRED is also included with the maintenance reminder code 99 if the function is enabled.

All of the screen segments are shown as solid blocks during the indicator check to show that each segment is operating.

STAR PUSH BUTTON

This push button is used for MENU access. This push button will ONLY make a change when the key is in the **OFF** position. The star button is used to open the menu from the memory of the SEM display panel. After the menu is open, only one menu item is shown on the LCD screen at one time.

PUSH BUTTONS 1 THROUGH 5

These push buttons are used as described in Descriptions of Additional Features (Available with Premium Display) of this manual.

Adjustments With a Computer

COMPUTER SYSTEM

The Personal Computer (PC) for programming the SEM display panel must have the following minimum configuration:

- Requires Windows 95, 98, or better, a Pentium 133 MHz or better processor with 32 MB of RAM, 3.5 MB free space on the hard drive, and a CD-ROM drive. For information on how to use the DOS version of the ITW Switches program, see the section **Display Panel for SEM Controls, DOS Version** 2200 SRM 725.
- Shielded cable assembly with nine-pin DB-9 serial cable, male to female. This cable assembly is a standard computer extension cable with straight-through wiring. Other cable lengths can be used that are within the serial cable limits of PCs - recommendation is less than 10 m (30 ft). This cable assembly is normally available from vendors of computer equipment.
- Some computers can require a DB25F (female) to DB9 (male) adapter. Connector-to-connector pin assignments are shown in Table 1.

Table 1. Adapter Pins (DB25F to DB9)

25-Pin Connector	9-Pin Connector
Pin 2	Pin 3
Pin 3	Pin 2
Pin 4	Pin 7
Pin 5	Pin 8
Pin 6	Pin 6
Pin 7	Pin 5
Pin 8	Pin 1
Pin 20	Pin 4
Pin 22	Pin 9

The **Controls** menu contains the following menu items shown in Figure 9.

Controls - Single traction

Select this menu item to enable the SEM display panel's **Single traction** control port and execute an external program such as the HYTECH or GE SENTRY SOFTWARE. These programs are used for checks and adjustments of the motor controllers connected to your PC through the SEM display panel.

After closing the external program, you will be returned to the Dash Program. However, you must move the key to the **ON** and **OFF** positions before attempting to communicate with the SEM display panel again.

If you have made changes to a previously opened setup file and have not saved them to disk, you will be prompted to save these changes before continuing.

Controls - Dual traction LH

Select this menu item to enable the SEM display panel's **Dual traction LH** control port and execute an external program such as the HYTECH or GE SENTRY SOFTWARE. These programs are used for checks and adjustments of the motor controllers connected to your PC through the SEM display panel.

After closing the external program, you will be returned to the Dash Program. However, you must move the key to the **ON** and **OFF** positions before attempting to communicate with the SEM display panel again.

If you have made changes to a previously opened setup file and have not saved them to disk, you will be prompted to save these changes before continuing.

Controls - Dual traction RH

Select this menu item to enable the SEM display panel's **Dual traction RH** control port and execute an external program such as the HYTECH or GE SENTRY SOFTWARE. These programs are used for checks and adjustments of the motor controllers connected to your PC through the SEM display panel.

After closing the external program, you will be returned to the Dash Program. However, you must move the key to the **ON** and **OFF** positions before attempting to communicate with the SEM display panel again.

If you have made changes to a previously opened setup file and have not saved them to disk, you will be prompted to save these changes before continuing.

Controls - Pump

Select this menu item to enable the SEM display panel's **Pump** control port and execute an external program such as the HYTECH or GE SENTRY SOFTWARE. These programs are used for checks and adjustments of the motor controllers connected to your PC through the SEM display panel.

After closing the external program, you will be returned to the Dash Program. However, you must move the key to the **ON** and **OFF** positions before attempting to communicate with the SEM display panel again.

If you have made changes to a previously opened setup file and have not saved them to disk, you will be prompted to save these changes before continuing.

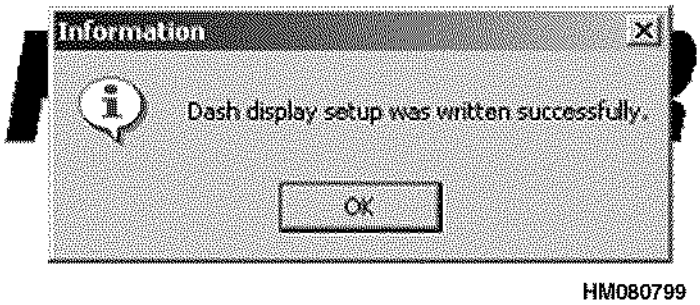


Figure 19. Dash Display Setup Was Written Successfully

Step 5

If changes were made to the **Dash Control Register** in **Step 2**, you will want to save these changes to a new .cfg file. We will use the name **Spanish1.cfg.** Select **File - Save as** and enter **Spanish1.cfg** in the box labeled File name as shown in Figure 20.

Finish - If desired, click **File - Exit** to quit the Dash Display Program or **File - Open** and select the desired .cfg file to reprogram the dash to the desired language. Follow the instructions beginning with Step 1 and substitute the desired language file for **Spanish.cfg**.

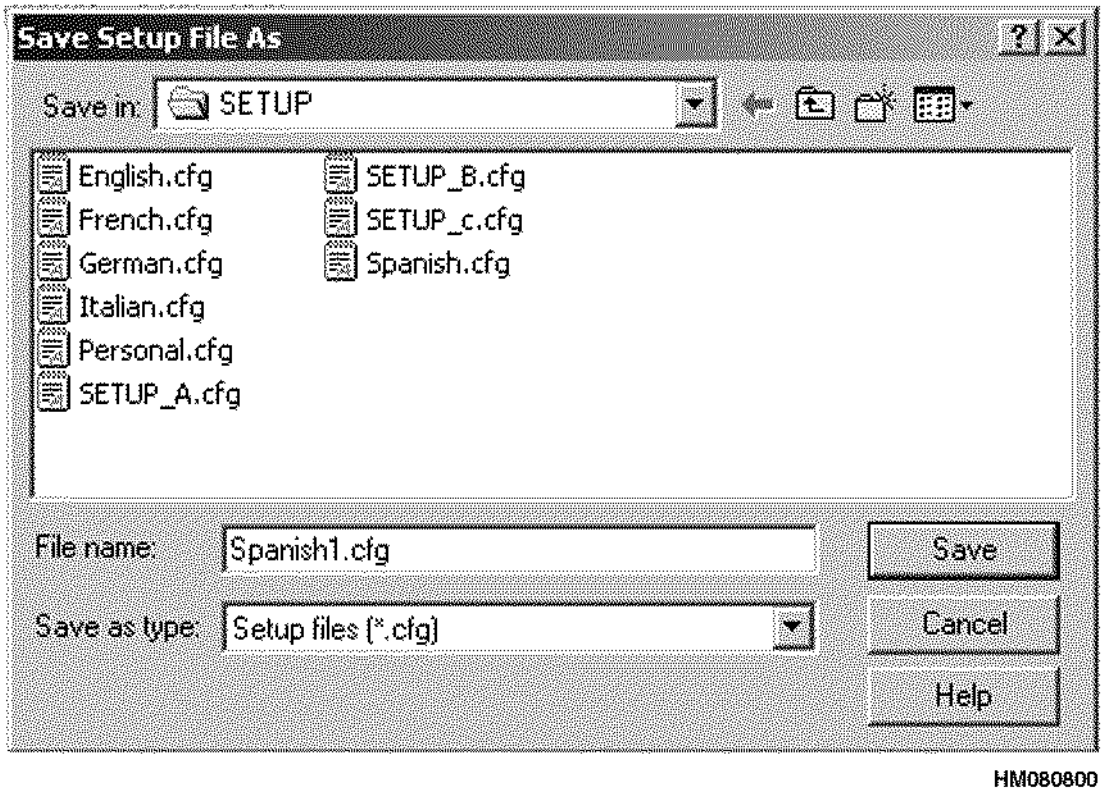


Figure 20. Saving Setup File

Step 2

Select **File - Save as**, and the screen shown in Figure 30 will appear. Enter the file name you wish to use in the **File name** text box and select the **Save** button. The file name **Setup_a.cfg** was used for this example. Store the new file in the **SETUP** directory as shown to allow the use of the **File - Backup** and **File - Restore** options explained in **Sample Session 7**.

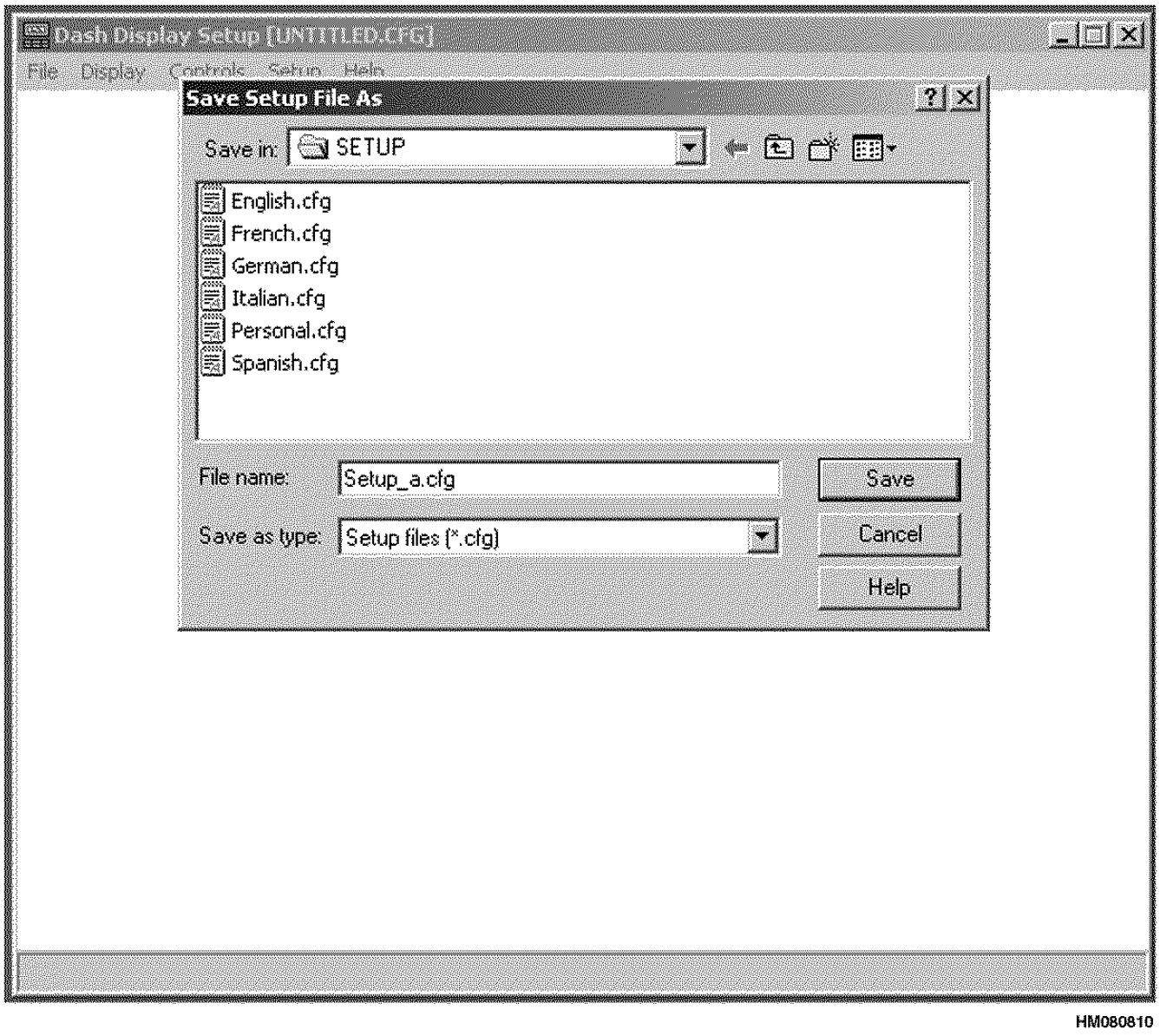
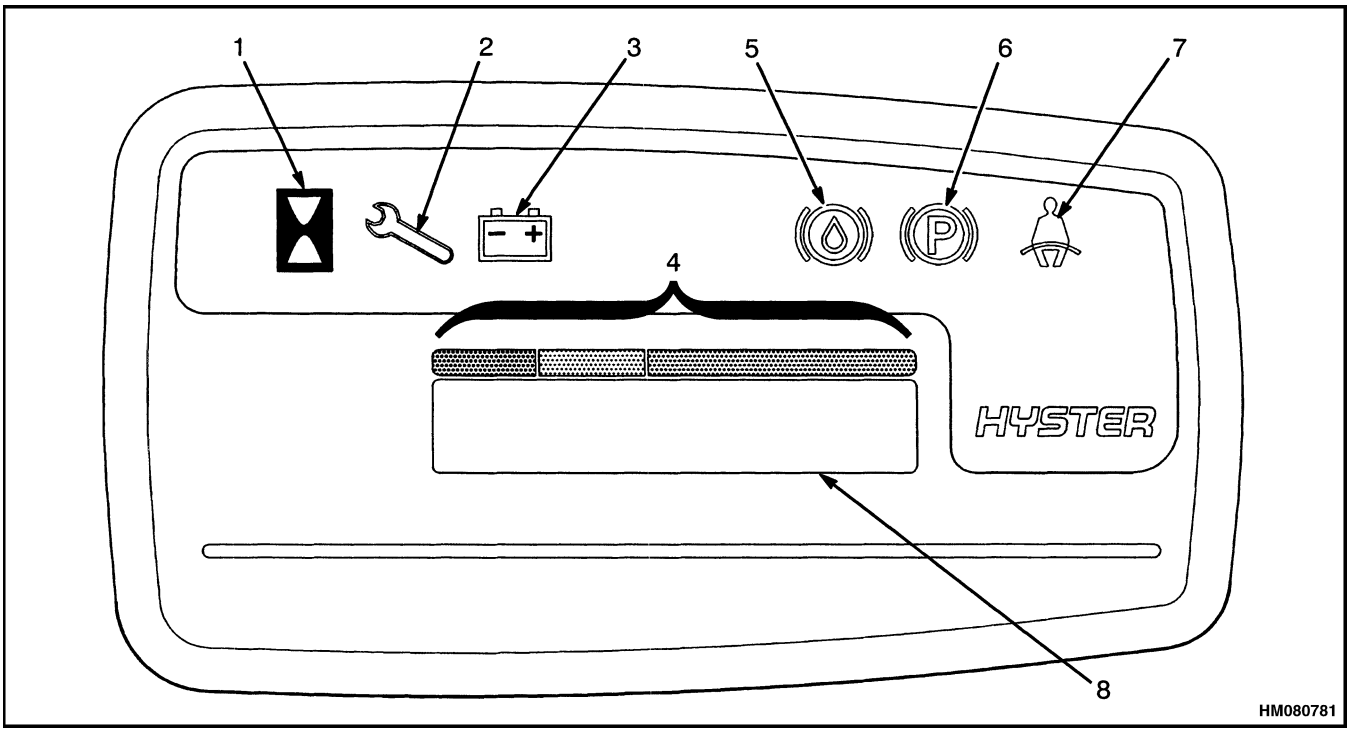


Figure 30. Save As Dialog Box

NOTES



1. HOURMETER SYMBOL
2. WRENCH INDICATOR SYMBOL
3. BATTERY SYMBOL
4. BATTERY STATE-OF-CHARGE (BDI)
5. BRAKE FLUID TOO LOW SYMBOL
6. PARKING BRAKE SYMBOL
7. SEAT BELT SYMBOL
8. LCD SCREEN

Figure 1. Standard Display Panel

HOURMETER INDICATOR SYMBOL

The hourmeter symbol is on when the traction or lift pump hours are shown on the LCD screen.

WRENCH INDICATOR SYMBOL

This red indicator is on when status code numbers are shown or when maintenance is due (99).

BATTERY INDICATOR SYMBOL

This red indicator is on when the battery needs charging or the wrong voltage battery is connected to the battery connector of the lift truck.

BATTERY STATE-OF-CHARGE (BDI)

The battery indicator symbol is on and the bar graph is shown on the LCD screen. See Common Features for more information.

The bar graph is on the LCD screen after the indicator function check for the standard display panel.

The bar graph and the message MODE #X are on the LCD screen after the LED Indicator check is complete for the premium display panel.

BRAKE FLUID TOO LOW SYMBOL

If this indicator symbol is illuminated during operation, the fluid level in the brake fluid reservoir is low and the reservoir must be filled.

PARKING BRAKE SYMBOL

This indicator symbol is illuminated when the parking brake is applied and the seat switch is closed. The indicator will go off when the parking brake is released.

If the parking brake is *not* applied and the operator leaves the seat or turns the key to the **OFF** position, the symbol and a warning tone will be on for approximately 10 seconds.

The **Display** menu contains the following menu items shown in Figure 8.

Display - Dash control register

Select this menu item to set the SEM display panel configuration options and the hours at which additional maintenance questions will be displayed.

This information is stored in the current setup file for later upload to the SEM display panel's flash memory.

Display - Password configuration

Select this menu item to set the SEM display panel password names and password configurations. Up to 625 passwords and their corresponding names and configurations can be entered. Passwords can also be deleted from the list if necessary. The password list can also be viewed in alphabetical format by password name if needed.

This information is stored in the current setup file for later upload to the SEM display panel's flash memory.

Display - LCD graphics and text

Select this menu item to enter status code text, startup question text, and special function text to be displayed on the SEM display panel's LCD screen. The text displayed is determined by the file selected using the **File - Open** menu item.

The selections available are:
- English.cfg
- French.cfg
- German.cfg
- Italian.cfg
- Spanish.cfg
- Personal.cfg

The file **Personal.cfg** is meant to be edited and saved for custom text and language requirements. The file is currently in English to provide a template for changes. If the user requires a different language for the template, delete the current **Personal.cfg** file and copy one of the other languages to a file named **Personal.cfg**.

Display - Write setup to display

Select this menu item to upload the current setup file to an SEM display panel connected to the PC's serial communication port.

Display - Read setup from display

Select this menu item to download the configuration data from an SEM display panel connected to the PC's serial communication port. The downloaded data replaces the current setup file data and language file data and can be saved to a disk.

If you have made changes to a previously opened setup file and have not saved them to a disk, you will be prompted to save these changes before starting the download process.

To view the downloaded data, open any of the configuration dialog boxes using the menu items on the Display menu.

Display - Erase password history

Select this menu item to erase any password event history information stored in an SEM display panel connected to the PC's serial communication port.

Step 3

Select **Display - LCD graphics** and review the screen as shown in Figure 16 to ensure the proper language has been loaded. Select **OK** to exit this box.

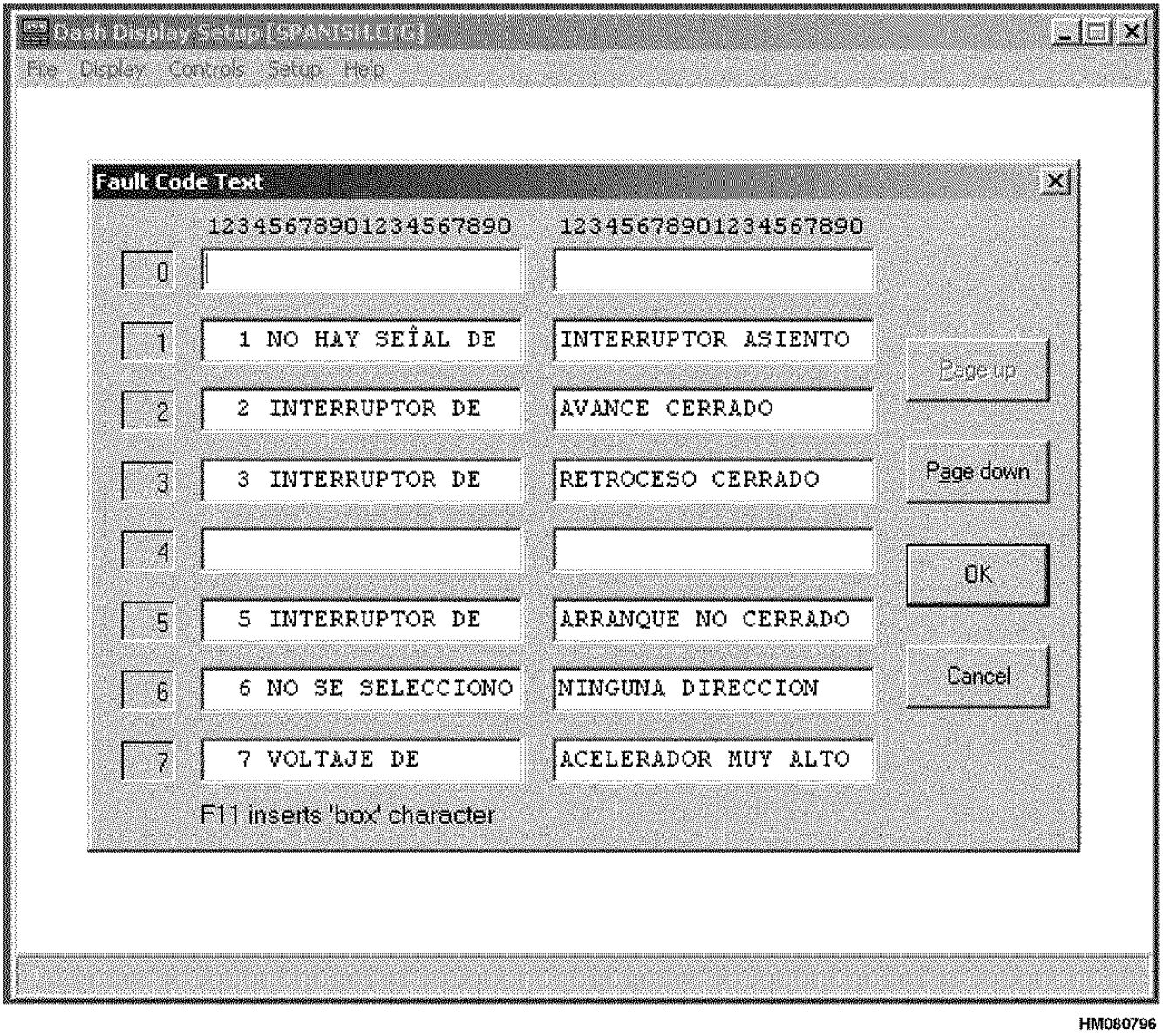


Figure 16. Fault Code Text

Step 4

To write to the display, select **Display - Write setup to display** with the truck battery connected, the serial cable connected, and the key in the **OFF** position. Be sure to follow the procedures found in the section **Adjustments with a Computer** in this manual. A screen identical to Figure 17 should appear. The box labeled **Dash Control and Passwords** does not need to be checked unless changes were made to the **Dash control register settings** shown in Figure 15.

Sample Session 4

Read and save a Setup from an SEM dash display.

Step 1

Read the setup from the SEM dash display by selecting **Display - Read setup from display**. The screen shown in Figure 28 should appear.

Select **OK**, and the screen shown in Figure 29 will appear.

When the information box reads **display was read successfully**, select **OK**.

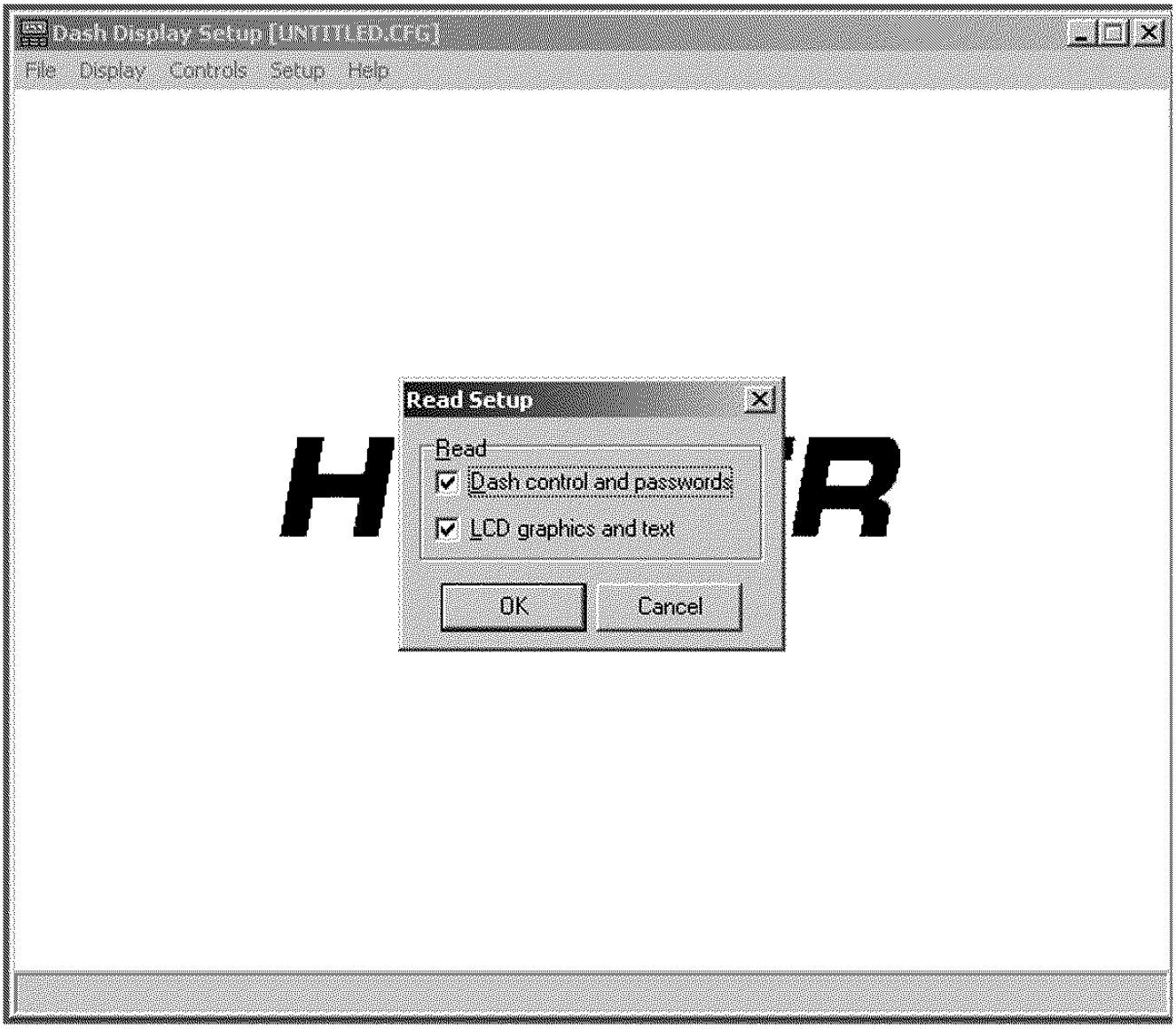


Figure 28. Read Setup Dialog Box

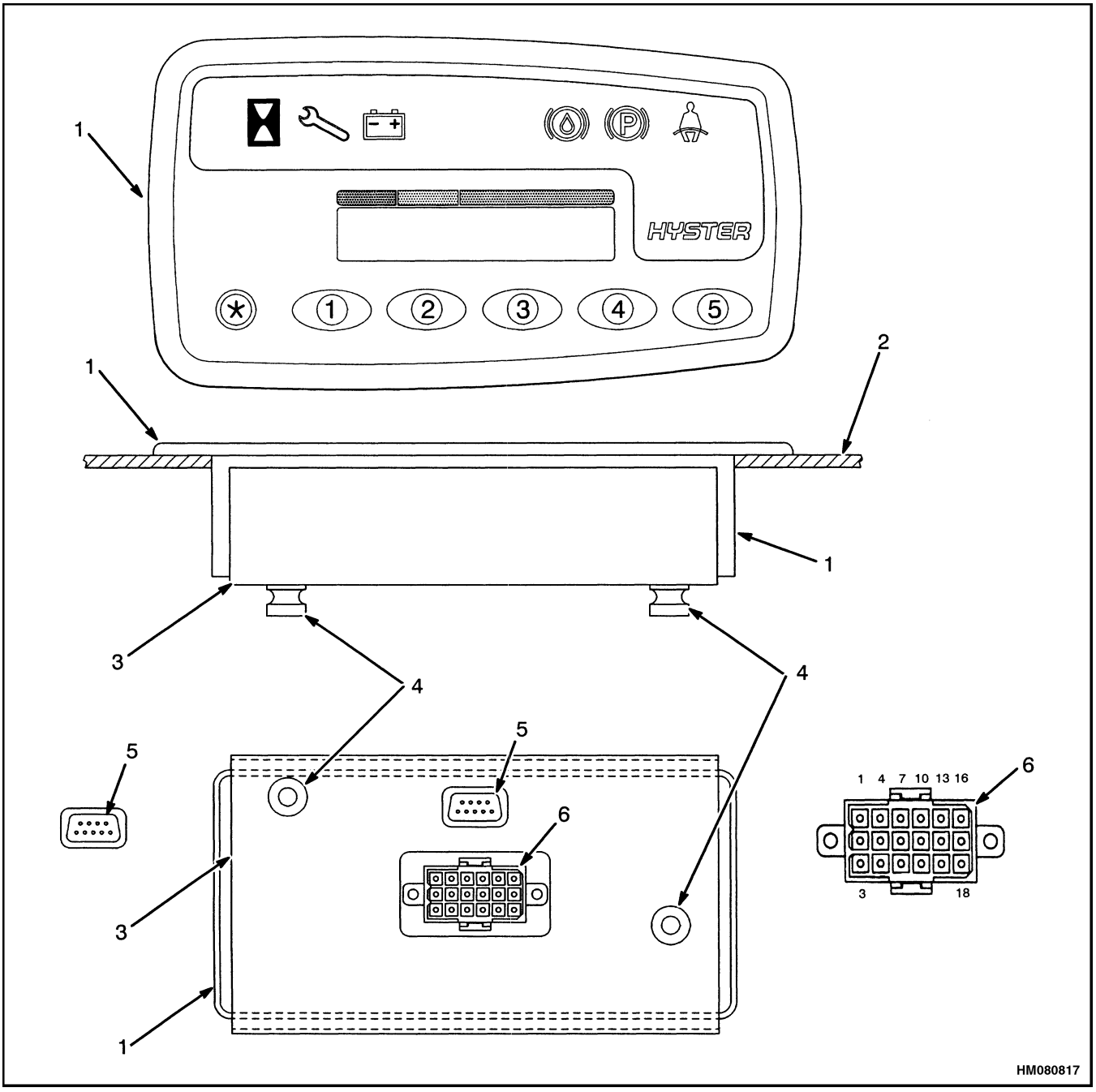


Figure 37. Mounting of SEM Display Panel

b. A communications program that permits a remote computer to connect to a local computer through a telephone and modem connection. This communications program permits a service engineer at a remote location to run the local programs and make checks and adjustments to the lift truck.

CONNECT A PC TO A CONTROL CARD

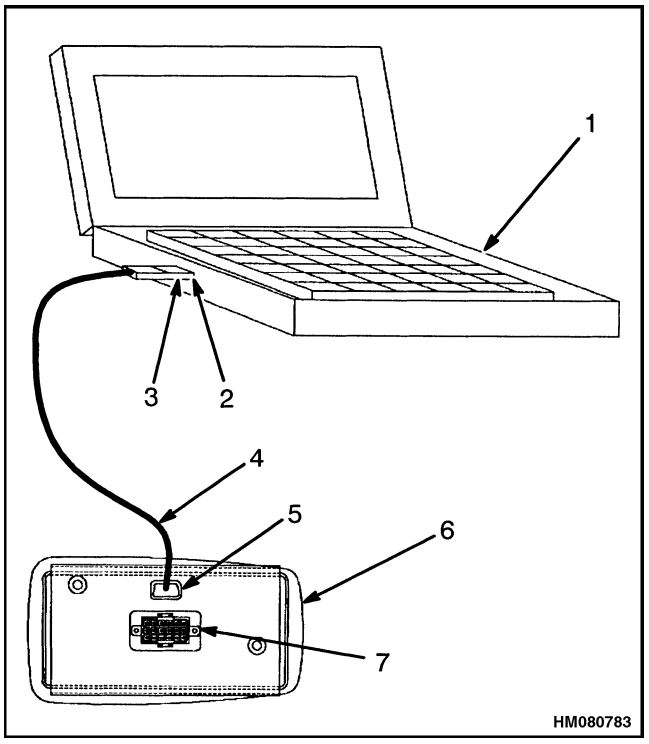
WARNING

Prevent movement of the lift truck and possible injury when making checks and adjustments. Before the PC is connected or disconnected to the control card or SEM Display Panel of the lift truck, do the following steps:

1. **Raise the drive wheels as described in the Operating Manual or the section Periodic Maintenance of the Service Manual for your lift truck.**
2. **Turn the key to the OFF position, disconnect the battery, and discharge the capacitor(s) as described in the Motor Controller section of the Service Manual for your lift truck.**
   The capacitors can be discharged on lift trucks with the SEM Display Panel using the horn. Disconnect the battery connector, move the key to the OFF position, and the operate horn until it stops making a sound. Do NOT make a short circuit at any of these motor controller terminals.

NOTE: The Dash Program allows a technician to use the HYTECH or GE SENTRY SOFTWARE™ program through the SEM Display Panel. These programs allow the technician to create different lift truck operating parameters for different users. The Dash Program is available on a CD-ROM. Refer to **Display Panel For SEM Controls (Windows Version)** 2200 SRM 942, for information on how to start the ITW Switches program.

Connect the personal computer (PC) to the small (9-pin) connector on the back of the SEM Display Panel (under instrument panel). Connect the PC as shown in Figure 1. All other units, without the SEM Display Panel, require connecting the computer at the motor controller. Connect the battery.



1. PERSONAL COMPUTER (PC)
2. COMPUTER SERIAL PORT
3. ADAPTER (PART OF KIT HYSTER P/N 1361412)
4. CABLE ASSEMBLY (PART OF KIT HYSTER P/N 1361412)
5. SMALL (9-PIN) CONNECTOR
6. BACK OF DISPLAY PANEL
7. LARGE (18-PIN) CONNECTOR FOR MOTOR CONTROLLERS

Figure 1. Connecting PC to Display Panel

Use this procedure to connect the computer to the control card or to the SR or SP motor controller in units without the SEM Display Panel. Turn the key switch to **OFF**. Connect the PC adapter cable at the connector Y-Plug on the control card (EV-100ZX, EV-T100) or to the 12-pin connector of the SR or SP motor controllers. See Table 3.

Table 3. Plug-Z Connection

Plug-Z	**24 vdc Power Source**
Pin 2	Negative terminal
Pin 7	Positive terminal
SR or SP Motor Ctrl.	**24 vdc Power Source**
Pin 1 (23-Pin)	Positive terminal
NEG Power Terminal	Negative terminal

HOW TO SAVE A CHANGED PARAMETER FILE

Select **Card - Save Register Data to File** to access the screen shown in Figure 11.

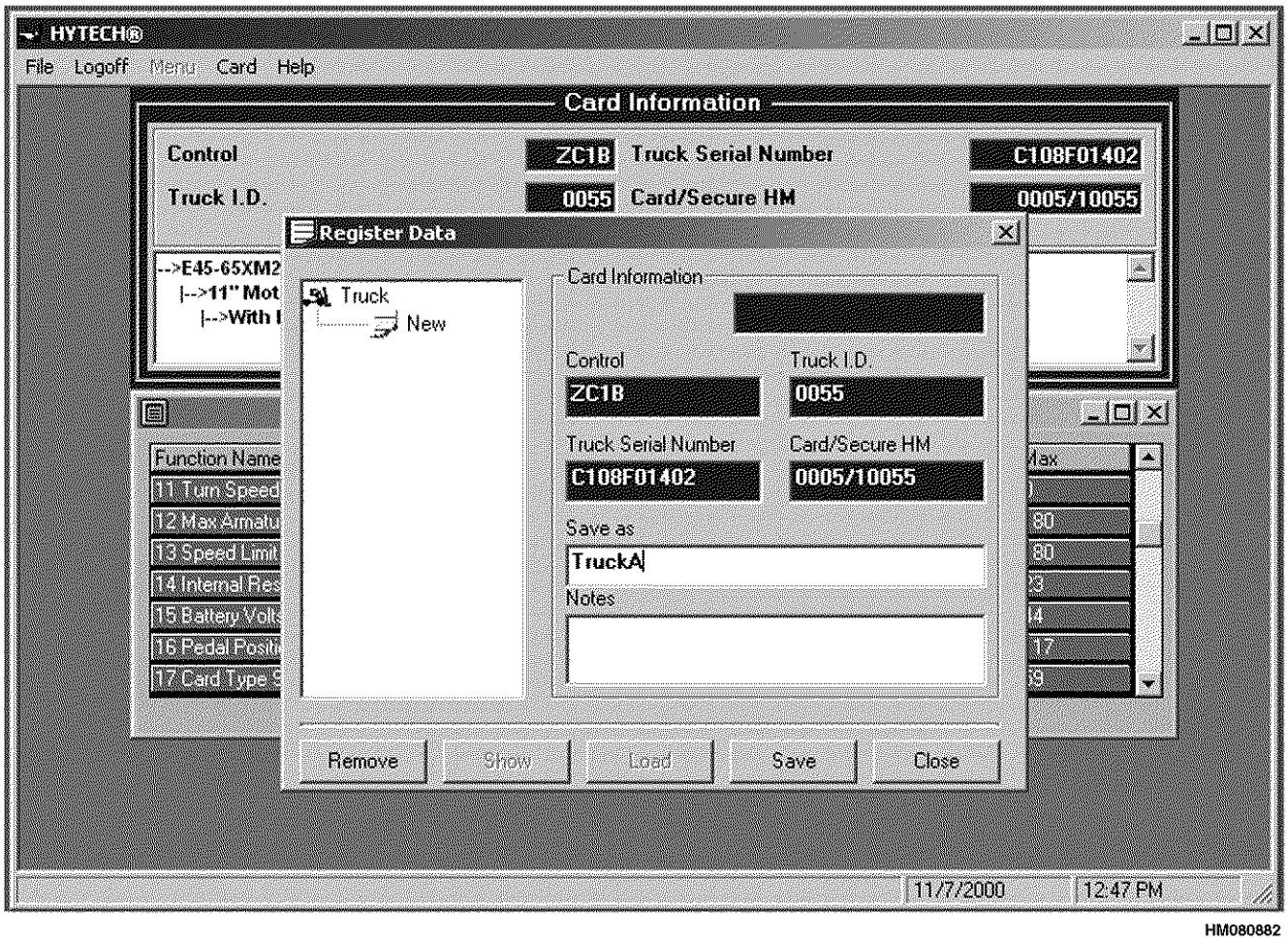


Figure 11. Saving Register Data to a File