

SERVICE REPAIR

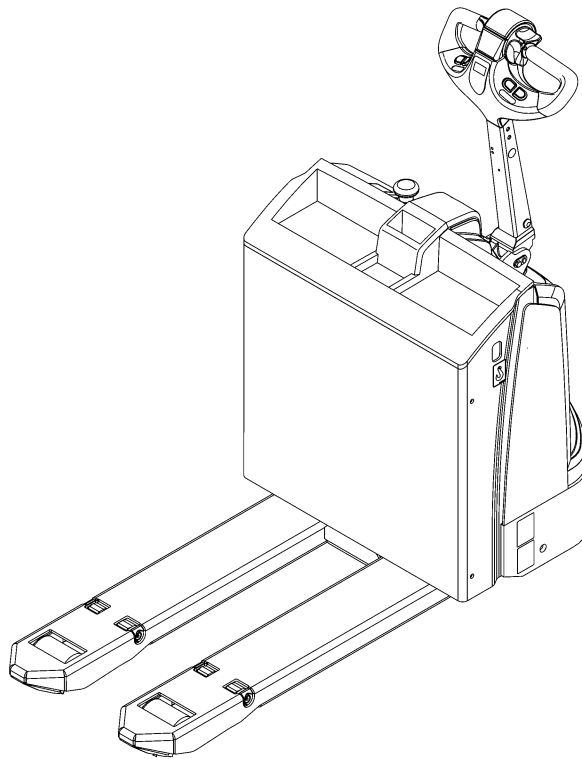
MANUAL

Hyster A290 (P2.0) Forklift

HYSTER

AC MOTOR CONTROLLER

P2.0 [A290]



HYSTER

SAFETY PRECAUTIONS

MAINTENANCE AND REPAIR

- The Service Manuals are updated on a regular basis, but may not reflect recent design changes to the product. Updated technical service information may be available from your local authorized Hyster® dealer. Service Manuals provide general guidelines for maintenance and service and are intended for use by trained and experienced technicians. Failure to properly maintain equipment or to follow instructions contained in the Service Manual could result in damage to the products, personal injury, property damage or death.
- 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 hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury and property damage.

On the lift truck, the **WARNING** symbol and word are on orange background. The **CAUTION** symbol and word are on yellow background.

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This section is for the following models:

P2.0 [A290]

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General

This section describes the AC Motor Controller. Procedures are outlined for controller programming and troubleshooting.

SAFETY PRECAUTIONS



WARNING

Disconnect the battery and separate the connectors before opening the compartment cover or inspecting or repairing the electrical system. If a tool causes a short circuit, the high current flow from the battery can cause personal injury or property damage.

All checks, adjustments, and repairs in the drive unit compartment are done with the compartment cover removed. Remove the drive unit compartment cover for access to the electrical components.



WARNING

The capacitor in the transistor controller can hold an electrical charge after the battery has been disconnected. To prevent electrical shock and personal injury, discharge the capacitor before inspection or repairing any component in the drive unit compartment. Wear safety glasses. Make certain the battery has been disconnected. DO NOT use a screwdriver to discharge the traction motor controller.



CAUTION

To avoid controller damage, always disconnect the battery before disconnecting any cables from the controller. Discharge the capacitor, and never put power to the controller with any power wire disconnected. Never short any controller terminal or motor terminal to the battery. Make sure to use proper procedure when servicing the controller.

The following steps must be followed to discharge the capacitors before any checks or repairs are performed on the controller or any part of the electrical system.

1. Block the wheels so that the truck will not roll or block the truck so that the wheels are off the floor. See
 - **Periodic Maintenance** 8000SRM1510 for lift truck model A290
2. Turn the key switch to the **OFF** position and disconnect the battery.
3. Discharge the capacitors in the controller by connecting a 100-ohm, 25-watt resistor across the controller's B+ and B- terminals using two insulated jumper wires. See Figure 1.

NOTE: DO NOT use any other method of discharging the capacitors. Remove the 100-ohm, 25-watt resistor before reconnecting the battery.

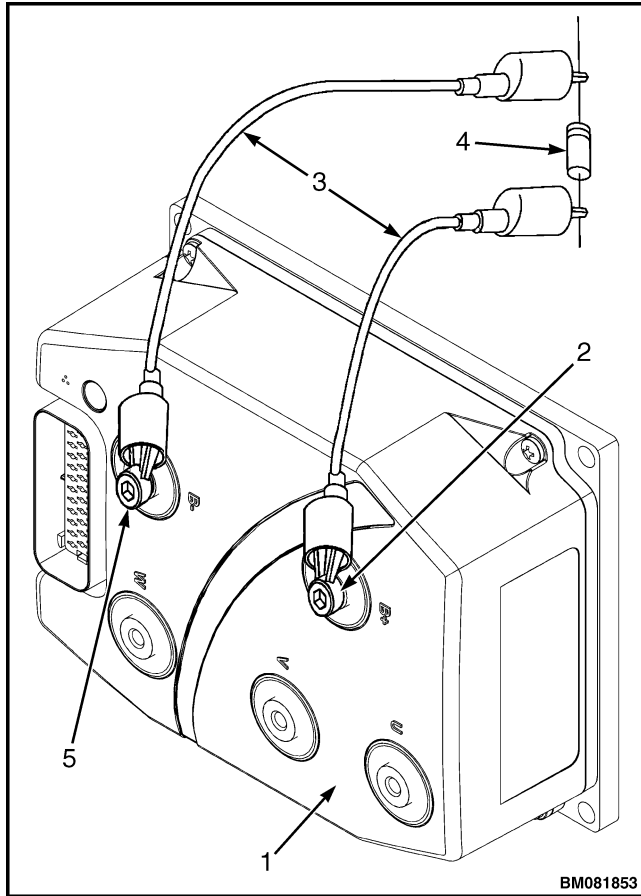


Figure 1. Discharging the Capacitors

Legend for Figure 1

1. CONTROLLER
2. POSITIVE CONNECTION
3. INSULATED JUMPER WIRES
4. 100-OHM, 25-WATT RESISTOR
5. NEGATIVE CONNECTION

Description

AC MOTOR CONTROLLER

The controller is a solid-state, AC motor controller. It can control the traction motor, brake, and hydraulic system. The controller receives inputs from the control handle by serial communication, and direct inputs from other switches depending on model. These may include the following:

- Key switch
- Control handle arm position switch

The controller directly controls the traction motor, lift pump motor, main contactor, and the brake. The motor controller controls the speed of the traction motor and the hydraulic lift pump motor operation. The controller software provides self diagnostics which are accessed by means of a Curtis handset.

PRINCIPLES OF OPERATION

The Traction Motor Controller uses a sophisticated microprocessor to control the logic and operation of the controller, eliminating the need for forward and reverse contactors. The controller has many programmable features, including maximum speed, acceleration rate, neutral braking, and braking current limit. The controller includes a full range of features as well as diagnostic and setup capability for reliable operation.

NOTE: There are no user-serviceable parts in the Curtis controller. No attempt should be made to open, repair, or otherwise modify the controller. Doing so may damage the controller and will void the warranty.

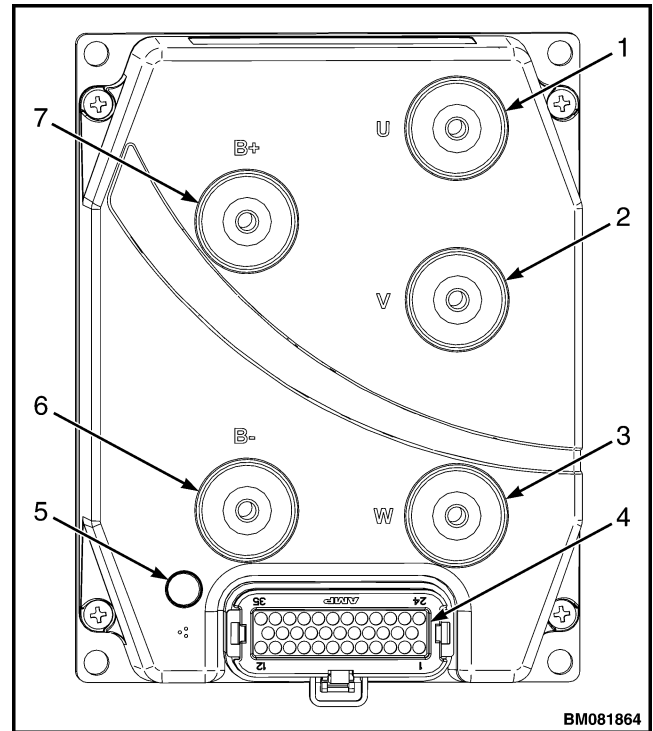
INSTALL

1. Make certain the mounting surface for the traction motor controller is clean. There should be no dirt between the contactor panel mounting plate and the traction motor controller.
2. Connect wires and cables to controller terminals. See Figure 2.
3. Refer to Programming Controller for setup of the controller.

The motor controller controls the speed of the traction motor and the hydraulic pump motor operation. The complete unit must be replaced if correct troubleshooting methods show that the unit is damaged.

PROGRAMMING CONTROLLER

The controller can be programmed using a 1311 handset. The areas that can be programmed are listed in Table 1 along with the adjustable ranges.



1. TRACTION MOTOR CONNECTION "U"
2. TRACTION MOTOR CONNECTION "V"
3. TRACTION MOTOR CONNECTION "W"
4. CONNECTOR
5. LED INDICATOR
6. B- CONNECTION
7. B+ CONNECTION

Figure 2. Controller

Table 1. Program Menu

Parameter Listing				
Parameter	Units	Range	Default Setting	Description
Main Menu				
Interlock Timeout	Sec	0 - 120		Max time for tiller in opening position with no input to controller
Buzzer Option		0 - 2		0 - None, 1 - Reverse Only, 2 - Forward & Reverse
Buzzer Deadband	Rpm	0 - 1000		Min motor rpm to activate buzzer
Throttle Setup Menu				
Forward Max	Rpm	3500 - 6000		Rotation of butterfly to max speed in forward direction
Forward Map	%	0 - 100		Adjust relationship to butterfly rotation for forward truck speed
Forward Dead Band		0 - 500		Minimum rotation of butterfly to enable forward travel
Reverse Dead Band		0 - 500		Minimum rotation of butterfly to enable reverse travel
Reverse Map	%	0 - 100		Adjust relationship of butterfly rotation to reverse truck speed
Reverse Max	Rpm			Rotation of butterfly to max speed in reverse direction
Hydraulic Functions Menu				
Lockout Enable		On/Off		ON -Lift Lockout Enabled OFF -Lift Lockout Disabled
Lift Run Time	Sec	0 - 10		Max time continuous lifting is enabled
Lift Delay Time	Sec	0 - 5		Max time hydraulic valve is open after pump stops
Lowering Delay time	Sec	0 - 5		Max time hydraulic valve is open after lowering valve is deactivated
Traction Settings Menu				
Snail Speed	Rpm	0 - 1000		Maximum motor speed in Snail Mode
Max Speed	Rpm	0 - 4330		Maximum motor speed
Max Acceleration	Sec	0.1 - 5		Time required to accelerate to max speed at full butterfly rotation

Table 1. Program Menu (Continued)

Parameter Listing				
Parameter	Units	Range	Default Setting	Description
Max Deceleration	Sec	0.1 - 5		Braking time required when butterfly is fully reversed from full speed
Neutral Braking	Sec	0.1 - 5		Braking time required when butterfly is released to neutral from full speed
Max Braking	Sec	0.1 - 5		Braking time required when releasing the tiller handle
Display Functions Menu				
BDI Warning Enable		On/Off		ON -Lift Lockout Enabled OFF -Lift Lockout Disabled
BDI Warning	%	0 - 100		% of battery charge to activated warning
Maintenance Timers Menu				
Total Maintenance Enable		On/Off		Enables/Disables signal when key on hours reaches preset level if BDI is present
Traction Maintenance Enable		On/Off		Enables/Disables signal when key on hours reaches preset level if BDI is present
Pump Maintenance Enable		On/Off		Enables/Disables signal when key on hours reaches preset level if BDI is present
Maintenance Interval	Hrs	10 - 20000		Sets the maintenance interval after which maintenance is required
Reset Total Maintenance		On/Off		When ON , resets key hours signal to next maintenance interval
Reset Traction Maintenance		On/Off		When ON , resets key hours signal to next maintenance interval
Reset Pump Maintenance		On/Off		When ON , resets key hours signal to next maintenance interval
Hour Meter Preset Menu				
10s of Hours	Hrs	0 - 20000		When replacing controller, input previous hours from the display - divide total hours by 10
Remaining Hours in Minutes	Min	0 - 600		When replacing controller, input previous minutes from display - multiply minutes by 6
Preset Total Hourmeters		On/Off		When replacing controller, resets total hourmeters
Preset Traction Hourmeters		On/Off		When replacing controller, resets traction hourmeters

Table 1. Program Menu (Continued)

Parameter Listing				
Parameter	Units	Range	Default Setting	Description
Preset Pump Hourmeters		On/Off		When replacing controller, resets pump hourmeters
Motor Temperature Control				
Temperature Hot	°C			Temperature limit when current to motor is reduced
Temperature Max	°C			Temperature limit when current to motor is reduced to zero

1311 Programmer Handset

DESCRIPTION/FEATURES

The programmer handset is a handheld tool that allows the user to program, test, and diagnose the traction motor controller. See Figure 3. It has been designed for ease of use with a *menu navigation* key, a *data increase/decrease* key, and 3 *bookmark* keys to control all programmer functions.

The display window contains a 7-line, 128 × 64 pixel LCD screen that is capable of displaying both text and graphics simultaneously. The window is visible in most lighting conditions and can be adjusted using the programmer setup menu.

The programmer is menu driven and accesses sub-menus by pressing the *menu navigation* key.

When the programmer is connected to the motor controller, all current motor controller information is uploaded into the 1311 programmer handset and ready for viewing. This upload is used by the programmer to generate menu items that will be displayed by the programmer.

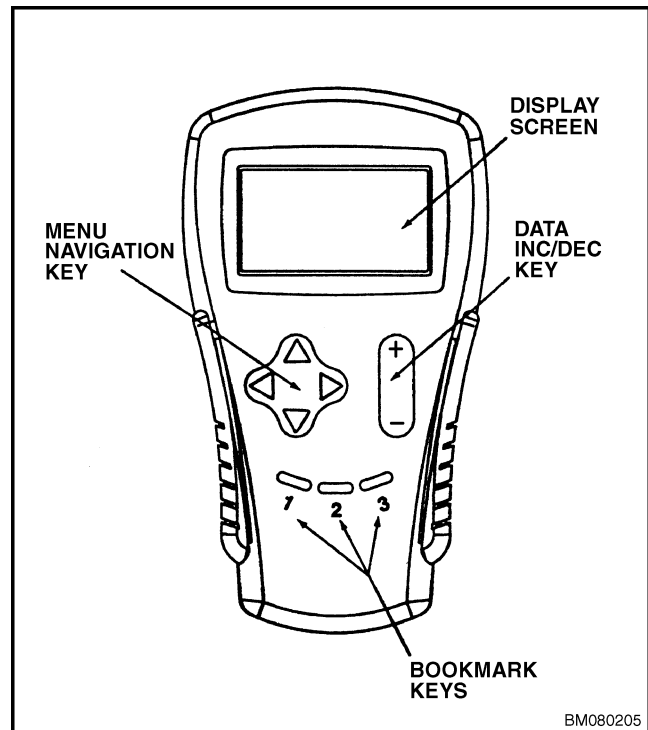


Figure 3. Curtis Model 1311 Programmer Handset

Menu Navigation Key

The *menu navigation* key is a 4-position switch that allows you to move up and down a menu list using the up or down arrows, or you can open and close submenus using the right and left arrows. Use the *menu navigation* key to move up or down through the main menu items. There is a blinking square on the left side of the programmer that indicates the current menu selection. See Figure 4.

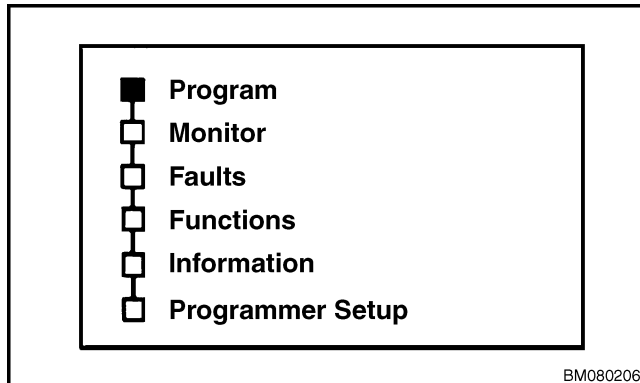


Figure 4. Menu Selection

After selection of a main menu item, submenus for the main selection can be opened using the right arrow. See Figure 5. As submenus are opened, a new series of indicator boxes will appear with a blinking square to indicate the current submenu selection. You can move up and down within the submenus using the up and down arrows. Pressing the left arrow will return the programmer to the main menu. Pressing the right arrow while in a submenu will bring up an additional information screen about the submenu item previously selected. See Figure 6.

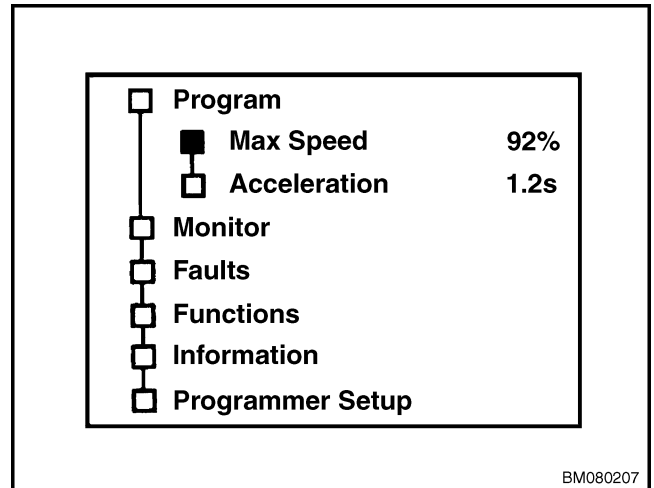


Figure 5. Menu Selection

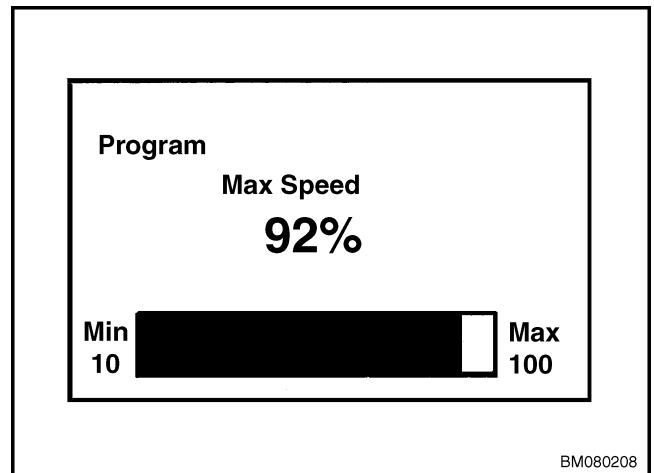


Figure 6. Menu Selection

Data Increase/Decrease Key

The *data increase/decrease* key allows the adjustment of various parameter settings. Press the (+) side of the *data increase/decrease* key to increase a value or press the (-) side of the *data increase/decrease* key to decrease a value. See Figure 3.

Bookmark Keys

There are 3 *bookmark* keys that can be set by the user. These keys allow you to bookmark your position within the menu structure, allowing you to quickly return to a selection without having to re-navigate the entire menu structure. While you are positioned at a menu item you want to bookmark, press one of the *bookmark* keys and hold it down for 4 seconds until the *BOOKMARK SET* screen appears. You can return to this preset menu item at any time by pressing the *bookmark* key you assigned to this item. Bookmarks are permanently retained in the programmer memory. Once the programmer has been unplugged or power to the controller has been interrupted, the bookmarks are cleared from the programmer memory. See Figure 3.

OPERATION

Connecting Handset to Traction Motor Controller

NOTE: Each time the programmer handset is connected to the controller, it acquires all of the controller function value settings and stores them in its temporary memory. This allows the user to revert back to the original settings at any time. The *SPECIAL PROGRAM MENU* selection *RESET ALL SETTINGS* is used to revert to the original settings. Any unwanted change made to any of the function values can be undone in this manner, as long as the programmer has not been unplugged or the key switch has not been turned to the **OFF** position (power disconnected).

1. Turn the key switch to the **OFF** position.
2. Disconnect the battery.
3. Remove drive unit compartment cover.



WARNING

The capacitor in the traction motor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing any component. Wear safety glasses. Make certain the battery has been disconnected. Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controller's B+ and B- terminals. **DO NOT use a screwdriver to discharge the traction motor controller.**

4. Discharge the capacitors in the controller.
5. Connect programmer handset to the 4-pin Molex™ connector on the traction motor controller.
6. Reconnect the battery.
7. Turn the key switch to the **ON** position.

Disconnecting the Handset From the Traction Motor Controller

1. Turn the key switch to the **OFF** position.
2. Disconnect the battery.



WARNING

The capacitor in the traction motor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing any component. Wear safety glasses. Make certain the battery has been disconnected. Discharge the capacitors in the controller by connecting a load (such as a contactor coil or a horn) across the controller's B+ and B- terminals. **DO NOT use a screwdriver to discharge the traction motor controller.**

3. Discharge the capacitors in the controller.
4. Disconnect programmer handset from the 4-pin Molex™ connector on the traction motor controller.

NOTE: The programmer handset should only be connected and disconnected with the key switch in the **OFF** position.

5. Install drive unit compartment cover.
6. Reconnect the battery.

MAIN MENU SELECTIONS

Program Menu

The program menu will contain submenus of adjustable parameters downloaded to the programmer from the motor controller. The motor controller can be setup for specific operating conditions by changing the parameters that can be accessed through the program menu selections. Those parameters that can be adjusted by the handset will be shown as submenu items under the program menu.

Use the up or down arrow on the *menu navigation* key to select a parameter. See Figure 7. Press the right arrow key to access the detail screen for the selected parameter. See Figure 8. The detail screen will show the measurement units, min/max range for the parameter, and a bar graph indicating the current parameter setting. The setting may be changed using the *data increase/decrease* key. Press the (+) side of the key to increase the value or press the (-) side of the key to decrease the value.

To return to the program menu or the main menu, press the left arrow on the *menu navigation* key.

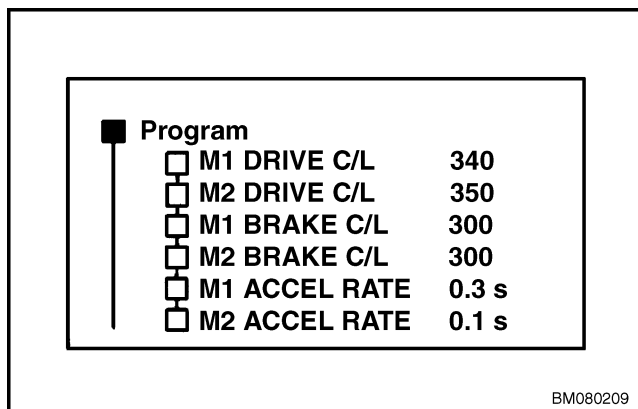


Figure 7. Menu Selection

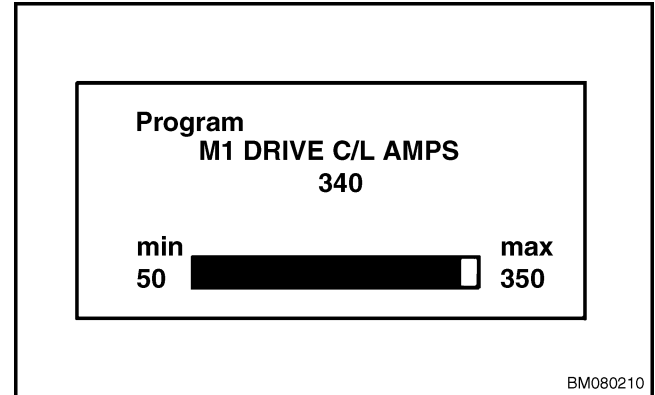


Figure 8. Menu Selection

Monitor Menu

The monitor menu will contain a list of all truck functions that can be read and displayed by the programmer. Using the *menu navigation* key, scroll up or down to select a parameter from the list. See Figure 9. Each menu item is constantly monitored and displayed to show real-time information about the selected function.

To view a single function in real time, press the right arrow on the *menu navigation* key and a detail screen about the selected parameter will appear. See Figure 10.

To return to the monitor menu or the main menu, press the left arrow on the *menu navigation* key.

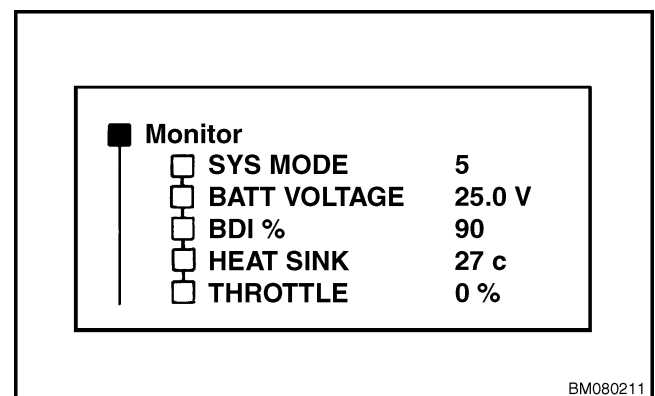


Figure 9. Menu Selection

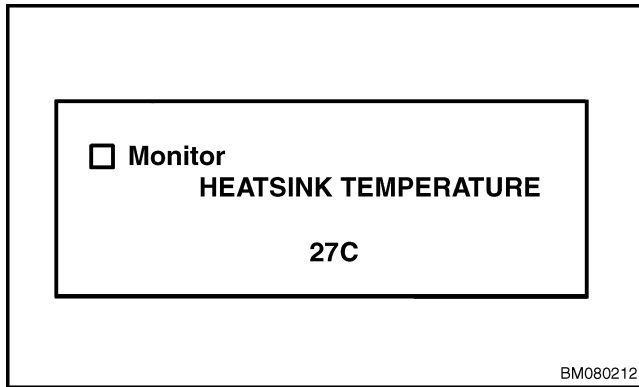


Figure 10. Menu Selection

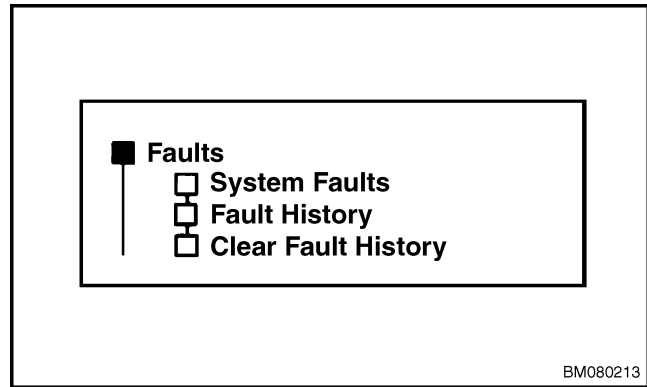


Figure 11. Menu Selection

Faults Menu

The *FAULTS* menu will provide the present status of the motor controller and access to past fault history. The fault history is uploaded to the programmer when the programmer is connected to the motor controller. Use the *menu navigation* key to access system faults, fault history, or to clear the fault history. See Figure 11.

System faults will show the current state of the motor controller. See Figure 12.

Fault history will list the faults that have been stored in the motor controller memory. These faults will be shown as descriptive text of the fault. Scroll through the faults using the up and down arrows on the *menu navigation* key. See Figure 13.

CLEAR FAULT HISTORY is used to remove faults from the controller memory after review. Use the (+) side of the *data increase/decrease* key to delete the faults from memory.

NOTE: You will be asked to confirm that you do want to clear the fault history. Use the (-) side of the *data increase/decrease* key to cancel any action and not clear the fault history.

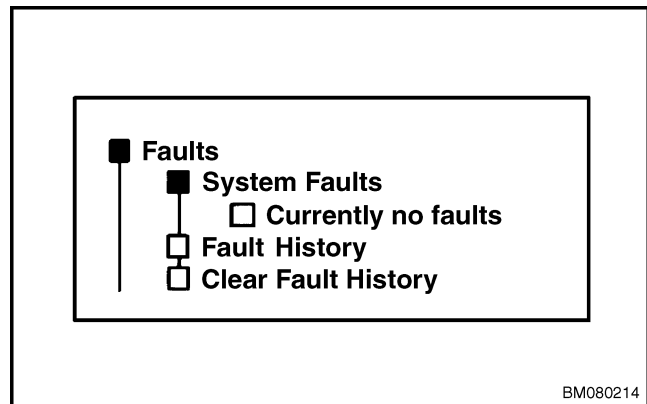


Figure 12. Menu Selection

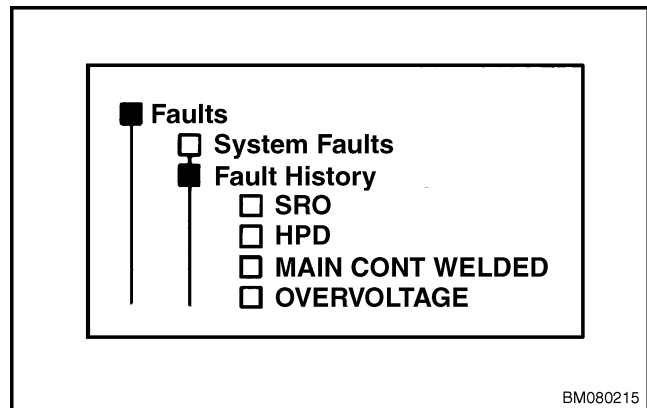


Figure 13. Menu Selection

Functions menu

The *FUNCTIONS* menu is used to copy data between motor controllers or reset the data in a controller to the original settings. Use the *menu navigation* key to select the *FUNCTIONS* menu to access the *SETTINGS* menu. See Figure 14. From this menu you can upload the parameter block from an existing controller and download that parameter block into another motor controller. See Figure 15.

Each time the programmer is connected to a motor controller, it uploads the present data from the controller into the programmer. Using the *SETTINGS* menu, this original information can be downloaded into the controller at any time to restore the controller with the original data. Any inadvertent change in controller parameters can be undone using this feature as long as the programmer has not been disconnected from the controller or the power has not been removed from the controller.

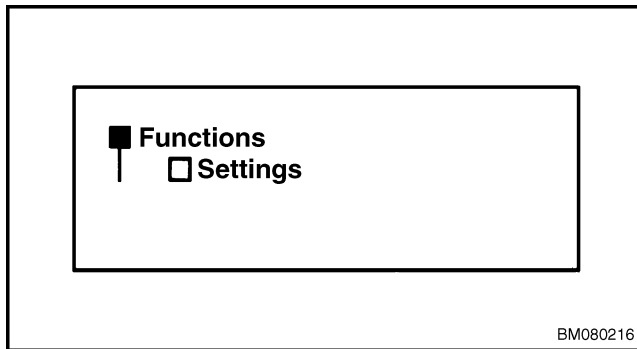


Figure 14. Menu Selection

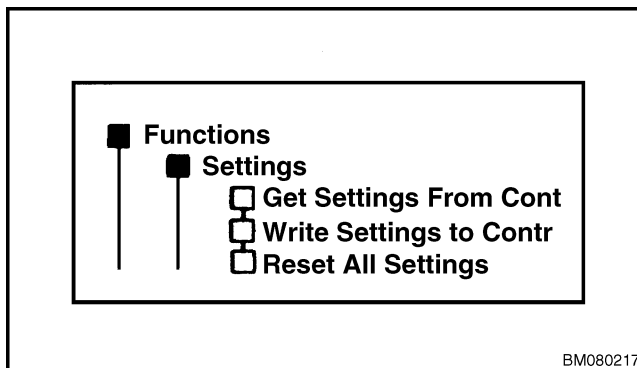


Figure 15. Menu Selection

Information Menu

The *INFORMATION* menu will display information about the controller. Use the *menu navigation* key to select the information menu and all specific controller information will be displayed on the screen. See Figure 16.

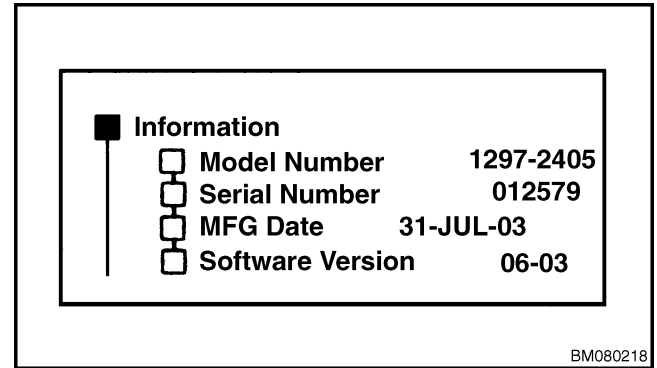


Figure 16. Menu Selection

Programmer Setup Menu

The *PROGRAMMER SETUP* menu contains several items that can be viewed, setup, or customized to the user's preference. See Figure 17.

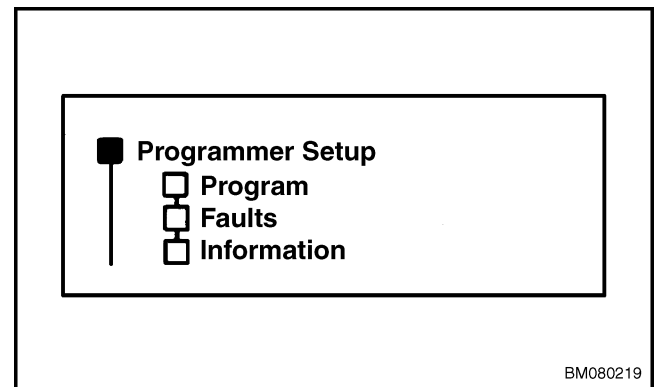


Figure 17. Menu Selection

Programming the Traction Motor Controller - 1311 Handset

WARNING

NEVER adjust function settings outside the range recommended for the specific truck model. See Table 1.

Program changes affect lift truck performance and operation. If function settings are changed, make sure all operators of the lift truck know that the truck has been changed and may operate differently.

1. Turn the key switch to the **OFF** position.
2. Disconnect and separate the battery connector.
3. Remove drive unit compartment cover.

WARNING

The capacitor in the traction motor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing any component. Wear safety glasses. Make certain the battery has been disconnected. Discharge the capacitors using the recommended procedures and never by any other method.

4. Discharge the capacitors in the traction motor controller by connecting a 100-ohm, 25-watt resistor across the controller's B+ and B- terminals using two insulated jumper wires.
5. Connect programmer handset to traction motor controller. The cord of the handset plugs into the J3 connector on the front of the controller.

NOTE: Each time the programmer handset is connected to the controller, it acquires all of the controller function value settings and stores them in temporary memory. This allows the user to return to the original settings at any time. Any unwanted change made to any of the function values can be undone in this manner, as long as the programmer has not been unplugged or the key switch has not been turned to the **OFF** position (power disconnected).

6. Reconnect the battery.
7. Turn the key switch to the **ON** position.

8. Select the *PROGRAM* menu on the programmer handset.
9. Use the up or down arrows on the *menu navigation* key to scroll until the desired function is reached.
10. Press the right arrow on the *menu navigation* key to enter the function being changed.

WARNING

NEVER adjust function settings outside the range recommended for the specific truck model. See Table 1.

11. Using the *data increase/decrease* key, change the function setting to the new setting. Pressing the (+) side of the key will increase the parameter value. Pressing the (-) side of the key will decrease the parameter setting.

WARNING

Program changes affect lift truck performance and operation. If function settings are changed, make sure all operators of the lift truck know that the truck has been changed and may operate differently.

12. Press the left arrow on the *menu navigation* key to return to the *PARAMETERS* menu.
13. Repeat Step 8 through Step 12, as required, until all of the functions are set to the desired value.

NOTE: Any unwanted change made to any of the function values can be undone using the *RESET ALL SETTINGS* from the *FUNCTIONS* menu as long as the programmer has not been unplugged or the key switch has not been turned to the **OFF** position (power disconnected).

14. Turn the key switch to the **OFF** position.
15. Disconnect the battery connector.

**WARNING**

The capacitor in the traction motor controller can hold an electrical charge after the battery is disconnected. To prevent electrical shock and injury, discharge the capacitor before inspecting or repairing any component. Wear safety glasses. Make certain the battery has been disconnected. Discharge the capacitors using the recommended procedures and never by any other method.

16. Discharge the capacitors in the traction motor controller by connecting a 100-ohm, 25-watt resistor across the controller's B+ and B- terminals using two insulated jumper wires.
17. Disconnect the programmer handset from the controller.
18. Install the drive unit compartment covers.
19. Reconnect the battery.

Display (BDI)/Hourmeter

The 8-character LCD on the Display provides a continuous sequence of hourmeter, battery state of charge, and fault messages. See Figure 18. Fault messages are displayed using fault codes.

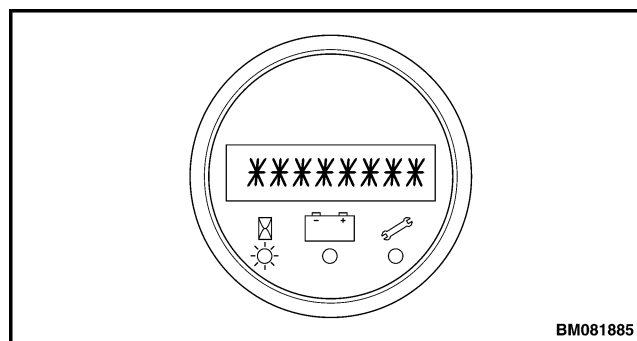


Figure 18. BDI/Hourmeter

Fault Codes

The Curtis controller has a Status LED built into it and can be seen through a window in the label on top of the controller. This Status LED displays fault codes. During normal operation, with no faults present, the Status LED flashes steadily on and off like a heartbeat.

Fault codes may intermittently appear during truck use. These signals may be sent as a result of power loss to the controller from the battery. Turning the key switch **OFF** and then **ON** again will usually clear these fault codes. If the codes remain after cycling the key switch, the lift truck must be serviced.

If these intermittent faults continually appear, perform the following checks:

- Check for loose cable connections at the battery cable connectors.

- Check for loose wiring and wire connectors at the controller.
- Check for loose cable connections at the battery.
- Check battery cells for proper voltage and state of charge.

If a loose wire or connection is found, make the necessary repairs before returning the truck to service.

Fault codes may also intermittently appear after the battery has been changed. If the BDI indicator will not reset, this may indicate that the battery is not properly charged. Always install fully charged, properly functioning batteries to the lift truck.

NOTE: Minimum reset voltage for the BDI is 25.2 volts (open cell), specific gravity should be approximately 1.250 per cell.

Status Code	Display Message	Fault
12	Fault 12	Controller Overcurrent
Description		Causes
Main contactor open All truck functions disabled Brake activated		Short circuit in traction motor Motor parameters are incorrect Controller fault
Troubleshooting		
<ol style="list-style-type: none"> 1. Turn off and restart the truck. 2. Check the wiring for a short-circuit or low impedance on the motor phases. 3. Insure motor parameters are correct. 4. If no fault is found in the wiring or the parameters but the alarm persists, then the problem lies in the controller. 		

Status Code	Display Message	Fault
13	Fault 13	Current Sensor Fault
Description		Causes
Main contactor open All truck functions disabled Brake activated		Short circuit in traction motor Controller fault
Troubleshooting		
<ol style="list-style-type: none"> 1. Turn off and restart the truck. 2. Check motor insulation. 3. If no fault is found and the alarm persists, then the problem lies in the controller. 		

Status Code	Display Message	Fault
14	Fault 14	Precharge Failed
Description		Causes
Main contactor open All truck functions disabled Brake activated		Short circuit in traction motor Controller fault
Troubleshooting		
<ol style="list-style-type: none"> 1. Release all the tiller controls. 2. Check the value of the parameter Main Menu Monitor / Battery / Capacitor Charge. 3. If no fault is found in the wiring or the parameters but the alarm persists, then the problem lies in the controller. 		

Status Code	Display Message	Fault
15	Fault 15	Controller Severe Under Temp
Description		Causes
Main contactor open All truck functions disabled Brake activated		Controller is being operated below -40°C
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Controller / Temperature. 2. Bring the temperature to above the lower limit of -40°C. Release all tiller controls, turn off and re-start the truck. 3. If no fault is found and the alarm persists, then the problem lies in the controller. 		

Status Code	Display Message	Fault
16	Fault 16	Controller Severe Overtemp
Description		Causes
Main contactor open All truck functions disabled Brake activated		Short circuit of motor to frame Controller fault
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Controller / Temperature. 2. Bring the temperature to below the upper limit of $+95^{\circ}\text{C}$. Release all tiller controls, remove all loads from the truck, turn off and restart the truck. 3. Check that the controller is installed correctly. 4. If no fault is found and the alarm persists, then the problem lies in the controller. 		

Status Code	Display Message	Fault
17	Fault 17	Severe Undervoltage
Description		Causes
Traction reduced		Incorrect battery parameters Battery resistance too high Battery disconnected during truck operation Loss of capacitor charge to below critical limit Fuse to key switch open Main contactor not closing
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Battery / Capacitor Voltage. 2. Return the capacitor voltage to above the minimum critical value. 3. Check battery parameters. 4. Check battery wiring. 5. Check fuses. 6. Check the status of the main contactor. 7. If no fault is found and the alarm persists, then replace the controller. 		

Status Code	Display Message	Fault
18	Fault 18	Severe Overvoltage
Description		Causes
Main contactor open All truck functions disabled Brake activated		Incorrect battery parameters Battery resistance too high to supply regen current Battery disconnected during regen braking Voltage at capacitors above critical limit
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Battery / Capacitor Voltage. 2. Return the capacitor voltage to below the maximum permitted value. Turn off and restart truck.. 3. Check battery parameters. 4. Check battery wiring. 5. If no fault is found and the alarm persists, then replace the controller. 		

Status Code	Display Message	Fault
21	Fault 21	Controller Undertemp Cutback
Description		Causes
Reduced performance		Controller is being operated below -30°C
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Battery /Controller / Temperature. 2. Bring the temperature above -30°C, release all tiller controls, and restart the truck. 3. If no fault is found and the alarm persists, then replace the controller. 		

Status Code	Display Message	Fault
22	Fault 22	Controller Overtemp Cutback
Description		Causes
Traction reduced Braking reduced		Controller is being operated above $+85^{\circ}\text{C}$ Truck is overloaded Controller incorrectly installed
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Controller / Temperature. 2. Bring the temperature below $+85^{\circ}\text{C}$. Release all tiller controls, remove all loads from truck, switch off truck and wait a few minutes for truck to cool. Restart truck. 3. Check that the controller is installed correctly. 4. If no fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
23	Fault 23	Undervoltage Cutback
Description		Causes
Traction reduced		Battery is discharged Incorrect battery parameters Battery resistance is too high Key switch fuse is open Main contactor is open Excessive loss of capacitor charge
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Battery / Capacitor Voltage. 2. Return the capacitor voltage to above the minimum permitted value. 3. Check the battery parameters. 4. Check the battery wiring. 5. Check the fuses. 6. Check the status of the main contactor. 7. If no fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
24	Fault 24	Overvoltage Cutback
Description		Causes
Braking reduced		Battery voltage too high during regen braking Incorrect battery parameters Battery resistance too high to supply regen current Voltage at capacitors above maximum limit
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of parameter Main Menu Monitor / Battery / Capacitor Voltage. 2. Return the capacitor voltage to below the maximum permitted limit. Turn off and restart the truck. 3. Check the battery parameters. 4. Check the battery wiring. 5. If no fault is found and fault still persists, replace the controller. 		

Status Code	Display Message	Fault
25	Fault 25	5V Supply Failure
Description		Causes
None		External charge impedance on pin 26 is too low
Troubleshooting		
<ol style="list-style-type: none"> 1. Return the voltage on pin 26 to within the permitted range. Turn off and restart the truck. 2. In no fault is found and fault still persists, replace the controller. 		

Status Code	Display Message	Fault
26	Fault 26	Digital Out 6 Overcurrent
Description		Causes
The Digital Out 6 driver is not active		External charge impedance on pin 19 is too low
Troubleshooting		
<ol style="list-style-type: none"> 1. Identify the cause of the overcurrent. 2. If no fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
27	Fault 27	Digital Out 7 Overcurrent
Description		Causes
The Digital Out 7 driver is not active		External charge impedance on pin 20 is too low
Troubleshooting		
<ol style="list-style-type: none"> 1. Identify the cause of the overcurrent. 2. If no fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
28	Fault 28	Motor Temp Hot Cutback
Description		Causes
Reduced traction		Motor temperature has exceeded parameter limit Motor temperature parameters incorrect
Troubleshooting		
<ol style="list-style-type: none"> 1. Check values of parameters Main Menu Monitor / Motor / Temperature and Inputs / Analog 2. 2. Check the motor parameters. 3. Return the motor temperature to within the permitted limits. 4. If no fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
29	Fault 29	Motor Temp Sensor Fault
Description		Causes
Reduced traction Motor temperature cutback disabled		Motor temperature sensor is not connected or is faulty Input on pin 8 is 0V or 10V
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the values of parameters Main Menu Monitor / Motor / Temperature Inputs / Analog 2. 2. Check the status of the temperature sensor thermistor on the traction motor. 3. Bring thermistor voltage back within limits. 4. If not fault is found and the fault still persists, replace the controller. 		

Status Code	Display Message	Fault
31	Fault 31	Coil 1 Driver Open/Short
Description		Causes
Main contactor does not operate		Main contactor coil driver open or shorted
Troubleshooting		
<ol style="list-style-type: none"> 1. Check wiring between controller and main contactor. Check for clean and tight connections. 2. check main contactor coil for open or shorted condition. 3. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
32	Fault 32	EM Brake Driver Open/Short
Description		Causes
Truck stops Brake activated		Brake coil driver open or shorted
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the wiring between the controller and the brake. Check for clean and tight connections. 2. Turn OFF and restart the truck. 3. Check the brake coil for open or shorted condition. 4. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
33	Fault 33	Coil 3 Drive Open/Short
Description		Causes
Hydraulic pump contactor inoperable		Hydraulic pump coil driver open or shorted
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the wiring between the controller and the pump contactor. Check for clean and tight connections. 2. Turn OFF and restart the truck. 3. Check the contactor coil for open or shorted condition. 4. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
34	Fault 34	Coil 4 Driver Open/Short
Description		Causes
Solenoid valve inoperable		Solenoid driver open or shorted
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the wiring between the controller and the solenoid. Check for clean and tight connections. 2. Turn OFF and restart the truck. 3. Check the solenoid coil for open or shorted condition. 4. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
35	Fault 35	PD Open/Short
Description		Causes
Auxiliary function inoperable		Auxiliary function driver open or shorted Connector not making good contact Wiring damaged
Troubleshooting		
<ol style="list-style-type: none"> 1. Check wiring and insure connectors are clean and making good contact. 2. Turn OFF and restart the truck. 3. If no fault is found and fault persists, replace the controller 		

Status Code	Display Message	Fault
36	Fault 36	Encoder Fault
Description		Causes
Brake activated		Motor encoder phase error Wiring damaged
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the value of the parameter Main Menu Monitor / Motor / Motor RPM. 2. Check the motor wiring and insure all connections are clean and tight. 3. Turn OFF and restart the truck. 4. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
37	Fault 37	Motor Open
Description		Causes
Main contactor open All truck functions disabled Brake activated		One of the motor phases is open Wiring is damaged
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the wiring for all motor phases. 2. Check the continuity of all motor phases. 3. Turn OFF and restart the truck. 4. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
38	Fault 38	Main Contactor Welded
Description		Causes
Main contactor open All truck function disabled Brake activated		Main contactor tips are welded Phases U and V of traction motor are open
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the main contactor tips for a welded condition. 2. Check the wiring for phases U and V at the traction motor. 3. Check the power wiring of the main contactor. Insure the connections are clean and tight. 4. Turn OFF and restart the truck. 5. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
39	Fault 39	Main Contactor Did Not Close
Description		Causes
Main contactor open All truck functions disabled Brake activated		Contactors contacts have oxidized External load on the capacitor bank Fuse to the key switch open
Troubleshooting		
<ol style="list-style-type: none"> 1. Check the contactor tips and insure they are clean and smooth. Remove any oxidation. 2. Check the power wiring to the main contactor. Insure all connections are clean and tight. 3. Check the value of the parameter Main Menu Monitor / Battery / Capacitor Voltage 4. Check the fuses. 5. Turn OFF and restart the truck. 6. If no fault is found and fault persists, replace the controller. 		

Status Code	Display Message	Fault
41	Fault 41	Throttle Wiper High
Description		Causes
Butterfly traction control deactivated		Voltage on pin 16 at the controller is too high
Troubleshooting		
<ol style="list-style-type: none"> 1. This fault is not caused by external components. 2. If the fault appears repeatedly, replace the controller. 		