

RICO Quick Troubleshooting Guide

Flight Systems SE1000 Controller

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*Notes:

- 1) Not all parameters listed in the “Handheld Programmer” section have the ability to be changed.
- 2) Any parameter change should be approved by Rico

Section 1. INTRODUCTION

The SE1000 DC Transistor Motor Controller is a third generation product derived from the industry proven and very reliable EV100 SCR Control introduced in 1985. Since 1989, today's industry standard EV100LX SCR Controller with full featured programmable diagnostics brought electric vehicle features and functions to a new level. Now, Flight Systems SE1000 brings a new level of power transistor (IGBT) control with new and expanded vehicle system diagnostic features and performance... like *GE SENTRY Software™* RS-232-C communications protocol software for "real-time systems communication" with personal computers.

Section 2. FEATURES OF SE1000 TRANSISTOR MOTOR CONTROLLERS

Section 2.1 Performance

Section 2.1.1 Oscillator Card Features

The oscillator section of the card has two adjustable features and one fixed feature. The % ON time has a range of approximately 0 to 100 percent. Although the percent ON time and the percent OFF time varies, the frequency of the oscillator remains constant to reduce the amount of audible noise.

Section 2.1.1.a Creep Speed

With the accelerator at maximum ohms or volts, the creep speed can be adjusted by Function 2 of the Handset. At creep speed, the ON time can decrease to approximately 5%, with the OFF time approximately 95%. At full transistor operation, this condition will be reversed (short OFF time, long ON time). This variation of ON and OFF time of the oscillator varies the voltage applied to the motor thereby varying the speed of the motor for a given load.

Section 2.1.1.b Top Speed (Motor Volts) Limit

Top speed is fixed and is obtained with the accelerator at minimum ohms or volts. Speed limit (SL1) is active in all card types and must be disabled with the Handset (See Function 11 to disable) if speed limits are not used.

Section 2.1.1.c Control Acceleration and 1A Time

This feature allows for adjustment of the time it takes for the control to accelerate to 100% applied battery voltage to the motor on hard acceleration. The 1A contactor will automatically close 0.2 seconds after the controlled acceleration stops and the accelerator input is less than 0.5 volts or less than 200 ohms. C/A is adjusted by function 3 from 0.1 to 22 seconds.

Section 2.1.2 Current Limit

This circuit monitors motor current by utilizing a sensor in series with the armature. The information detected across the sensor is fed back to the card so current may be limited to a pre-set value. If heavy load currents are detected, this circuit overrides the oscillator and limits the average current to a value set by Function 4 of the Handset. The C/L setting is based on the maximum thermal rating of the control. Because of the flyback current through 3REC, the motor current is usually greater than battery current, except at 100% ON time, or when the 1A contactor is closed. See current limit curves for available current and adjustment range.

Section 2.1.3 Braking

Section 2.1.3.a Plug Braking

Slow down is accomplished when reversing direction by providing a small amount of retarding torque for deceleration. If the vehicle is moving and the directional lever is moved from one direction to the other, the motor field is reversed. The plug signal is initiated when the directional switch has moved from one direction to the other. The motor armature, driven by the inertia of the vehicle, acts as a generator. This generated current passes through 4REC and the sensor. The oscillator circuit regulates this plug current to the level set by the Handset by controlling the ON and OFF time of the transistors to bring the vehicle to a smooth stop and reversal. Function 5 adjusts the plugging current when the accelerator potentiometer is at minimum resistance.

Section 2.1.3.b Regenerative Braking

If the vehicle is moving and the directional lever is moved from one direction to the other, this initiates a plugging signal by reversing the motor field. During the standard running mode and plugging mode, the RB contactor remains closed. In the plugging mode, the motor armature acts as a generator. Once the generated current reaches a sufficient current level, the plugging mode transitions to regenerative braking mode.

Transitioning to regenerative braking mode opens the RB contactor, disconnecting the motor armature from battery positive and inserting 7REC and Regen SENSOR-2 in the regen circuit. During the Q1 on time, the field and armature current is increased. During the power transistor Q1 off time, the energy stored in the field and armature generates the regenerative current, which passes through 7REC, #2 Sensor, battery,

3REC/4REC and back to the motor field and armature.

The control will remain in regenerative mode as long as the regen current can be maintained. When the regenerative current cannot be maintained and drops below the regenerative current limit, the regenerative braking mode transitions back to plugging mode. During the transition back to plugging mode, the RB contactor closes, enabling the control to function in plugging mode and regulating plugging currents to bring the vehicle to a smooth stop and reversal. The accelerator potentiometer input will modulate plugging as well as regenerative braking current. The major advantage of regen is longer motor life due to reduced motor heating.

This feature has two adjustable functions, regen current limit (Function 9) and regen start (Function 10). When using a logic card that contains the Auto-Regen feature, regenerative braking current may also be controlled by placing a potentiometer on the brake pedal. Using a potentiometer to regulate voltage at PA6, minimum regen current will be applied to the motor when PA6 is reduced to 3 volts, and maximum current is applied when the voltage is reduced to 1 volt. The brake potentiometer circuit is only available on logic cards that contain Auto-Regen.

Section 2.1.3.c Pedal Position Plug Braking

This selectable feature allows control of the plugging distance based on pedal position when there has been a directional switch change. Pedal position will reduce the plugging current to the value set by Function 16 as the accelerator is returned to the creep speed position. Maximum plug current is obtained with the accelerator in the top speed position.

Section 2.1.3.d Auto Braking

This feature requires an “Auto Plug/Regen” logic card (see Section 4., Ordering Information) and can be setup with the Handset using Function 17. This feature is selected by initiating a “neutral position” with either the directional switch or the accelerator switch. Once activated, Auto Braking operates similar to Pedal Position Plug Braking and is adjusted by using Function 16 on the Handset.

Section 2.1.4 Auxiliary Speed Control

Section 2.1.4.a Field Weakening

If the vehicle is supplied with a field weakening circuit, the “FW PU” (Function 7) and “FW DO” (Function 8) can be adjusted with the Handset. Field weakening is a method of attaining higher running speed for the vehicle in level running operation. Typical settings for this feature are: pickup FW contactor from 125 to 150 percent of normal full-load running current (1A), and dropout FW contactor from 275 to 300 percent current. FW contactor dropout puts the motor back in the 1A range to climb ramps and inclines.

Section 2.1.4.b Speed Limits

This feature provides a means to control speed by limiting motor volts utilizing three “adjustable speed limits” selected by limit switches. The NC switches are connected between input points on the control card and battery negative. ***The lower motor volt limit always takes priority when more than one switch input is open.*** This motor volt limit regulates top speed of the transistor controller, but actual truck speed will vary at any set point depending on the loading of the vehicle. Each speed limit can be adjustable with the Handset using Functions 11, 12, and 13, for speed limits SL1, SL2, and SL3 respectively. SL1 is

active in all card types and must be disabled with the Handset if speed limits are not used.

Section 2.1.5 Ramp Start

This feature provides maximum control torque to restart a vehicle on an incline. The memory for this function is the directional switch. When stopping on an incline, the directional switch must be left in its original or neutral position to allow the control to initiate full power when restarted. The accelerator potentiometer input will modulate ramp start current.

Section 2.1.6 Steer Pump Contactor Time Delay

This feature provides two options for SP time delay. Option 1 provides a 0.5 to 63 second time delayed drop out of the steer pump contactor when the Forward or Reverse directional switch is opened. This Option 1 is overridden by a 1.5 second time-delayed dropout whenever the seat switch is opened. Option 2 provides a 0.5 to 63 second time delayed drop out of the SP contactor when the seat switch is opened.

Section 2.1.7 Coil Drivers & Internal Coil Suppression

This feature allows the use of battery volt Line, F, R, 1A, SP, RB, and FW contactor coils without external suppression.

Section 2.2 System Protective Override

Section 2.2.1 Static Return to Off (SRO)

This feature is designed to require the driver to return the directional lever to the neutral position anytime he leaves the vehicle and returns. Additionally, if the seat switch or key switch is opened, the control shuts off and cannot be restarted

until the directional lever is returned to neutral. A time delay of approximately 2 seconds is built into the seat switch input to allow momentary opening of the seat switch if a bump is encountered.

Section 2.2.2 Accelerator Volts Hold Off

This feature checks the voltage level at the accelerator input whenever the key switch or seat switch is activated. If the voltage is less than 2.5 volts, the control will not start. This feature assures that the control is calling for low speed operation at start-up.

Section 2.2.3 Pulse Monitor Trip (PMT)

The PMT design contains three features which shut down or lock out control operation if a fault conditions occurs that would cause a disruption of normal vehicle operation:

- Look ahead
- Look again
- Automatic look again and reset

The PMT circuit will not allow the control to start under the following conditions:

1. If power transistor Q1 is shorted, or if 1A contactor is welded, the control will not allow the Fwd or Rev contactor to close.
2. If the Fwd and/or Rev internal coil drivers are shorted, or if the 3REC diode is shorted.

The PMT circuit will shut down operation of the control (opening of the F or R contactor) under the following conditions:

- If transistor Q1 fails to shut off, or if 1A power tips remain closed when they should be open. After opening the F or R contactor, the PMT circuit will check for a fault, and if none is found will reclose the directional contactor. If the fault still

exists, the directional contactor will open and remain open.

- If 1A closes before a second failure, the look again counter will automatically reset. This eliminates the inconvenience of resetting the PMT with the key switch if the trip is due to random noise.

When the PMT circuit prevents the F or R contactors from closing, the PMT circuit must be reset by opening the key switch.

Section 2.2.4 1A Current Drop Out

This adjustable feature can be set to open the 1A contactor if the traction motor is subject to excessive currents. The dropout is adjustable with handset Function 6. Once the control has dropped out the 1A contactor due to excessive current, the directional or accelerator switch must be returned to neutral to reset the dropout circuit to allow the control to pick up the 1A contactor again. Using this feature may reduce the 1A contactor tip life; therefore, it should be used only where needed to protect the motor.

Section 2.2.5 1A Thermal Hold Off

This feature prevents the 1A contactor from closing when the vehicle is in severe thermal cutback. When the control goes into severe cutback, the Must Pulse To Time feature will inhibit the 1A timer.

Section 2.2.6 Thermal Protector (TP)

This temperature sensitive device is internal to the power transistor (Q1) module. If the transistor's temperature begins to exceed the design limits, the thermal protector will lower the maximum current limit, and maintain the transistors within their temperature limits. Even at a reduced current limit, the vehicle will normally be able to reach sufficient speed to initiate 1A operation, allowing the

control to cool. As the control cools, the thermal protector will automatically reset, returning the control to full power.

Section 2.2.7 Must Pulse To Time

This feature prevents the IA timer from timing if the oscillation pulse rate has not reached a pre-designed level of operation.

Section 2.2.8 Low Voltage

Batteries under load, particularly if undersized or more than 80 percent discharged, will produce low voltages at the control terminals. The EVT100 control is designed for use down to 50 percent of nominal battery voltage of 48-144 volts (depending on card type). Lower battery voltage may cause the control to operate improperly.

Section 2.3 Diagnostics

Section 2.3.1 Systems Diagnostics and Status Codes

The logic card detects the system's present operating status and can be displayed to either the Dash Display or the Handset. There are currently over 75 status codes that are available with SE1000 systems using Traction and Pump controls and Truck Management Module (TMM). Along with the status code display from the TMM, the logic card is capable of reducing the current to the control, alerting the operator of a critical fault condition.

Section 2.3.1.a Standard Status Codes

The SE1000 has over 65 Status Codes that assist the service technician and operator in trouble shooting the forklift. If mis-operation of the vehicle occurs, a status code will be displayed on the Dash Display for vehicles so equipped, or by plugging the Handset into the logic card's "Y plug" location and then reading the status code.

With the status code number, follow the procedures outlined in Section 14. DIAGNOSTIC STATUS CODES to determine the problem and a solution.

Note: The Status Code Instruction Sheets do not purport to cover all possible causes of a display of a "status code". They do provide instructions for checking the most direct inputs that can cause status codes to appear

Section 2.3.1.b Stored Status Codes

This feature records the last 16 "Stored Status Codes" that have caused a PMT controller shut down and/or disrupted normal vehicle operation. (PMT type faults are reset by cycling the key switch). These status codes, along with the corresponding BDI and hourmeter readings, can be accessed with the Handset, or by using the RS-232 communications port and sending the information to a Personal Computer terminal.

Section 2.3.3 Hourmeter Readings

This feature will display the recorded hours of use of the traction and pump control to the Dash Display each time the key switch is turned off.

Section 2.3.3.a Maintenance Alert & Speed Limit

This feature is used to display Status Code - 99 and/or activate a speed limit when the vehicle operating hours match the hours set into the Maintenance alert register. This feature is set with the Handset using Functions 19, 20 and 21. The operator is alerted that maintenance on the vehicle is required.

Section 2.3.4 Battery Discharge Indication (BDI)

The latest in microprocessor technology is used to provide accurate battery state-of-charge information and to supply passive and active warning signals to the vehicle operator.

Features and functions:

- Displays 100 to 0 percent charge.
- Display blinks with 20% charge.
- Disables pump circuit with 10% charge.
- Adjustable for use on 48 to 144 volts.

Section 2.3.4.a Internal Resistance Compensation

This feature is used when the Battery Discharge Indicator is present. Adjustment of this function will improve the accuracy of the BDI.

Section 2.3.5 Handset

This is a multi-functional tool used with the LX, ZX, SE, and SX Series solid-state controls. The Handset consists of a Light Emitting Diode (LED) display and a keyboard for data entry.

Features and functions:

- Monitor existing system status codes for both traction and pump controls.
- Monitor intermittent random status codes.
- Monitor battery state-of-charge, if available.
- Monitor hourmeter reading on traction and pump controls.
- Monitor or adjust the control functions.

Section 2.3.6 RS-232 Communication Port

This serial communication port can be used with Interactive Custom Dash Displays to allow changes to vehicle operating parameters by the operator. It can also be used by service personnel to send control operating information and settings into a personal computer program.

Section 2.3.6.a Interactive Dash Display Modes

The Interactive Custom Dash Display allows the operator to select the best vehicle performance for changing factory (task) conditions. There are four (4) “operator interaction modes” that can be selected by depressing a push-button on the dash display.

From the Dash Display, the operator may select any of four pre-set interactive modes consisting of (4) Controlled Acceleration levels, (4) Field Weakening Pick Up levels and (4) Speed Limit levels.

These interactive modes are “pre-set” using the Handset (Functions 48 - 62) or a personal computer (Functions 97 - 112). This feature allows the operator to select the best vehicle performance for changing factory (task) conditions.

The following table outlines the normal logic flow for pre-setting the four interactive modes:

Setting Logic Table

	Mode 1	Mode 2	Mode 3	Mode 4
C/A Time	=> Mode 2	=< Mode 1 => Mode 3	=< Mode 2 => Mode 4	=< Mode 3
FW Pickup	=< Mode 2	=> Mode 1 =< Mode 3	=> Mode 2 =< Mode 4	=> Mode 3
SL1	=> Mode 2	=< Mode 1 => Mode 3	=< Mode 2 => Mode 4	=< Mode 3

Section 2.3.7 Circuit Board Coil Driver Modules

Coil drivers are internal to the control card, and are the power devices that operate the Line, F, R, IA, D, FW, RB, and SP contactor coils. On command from the control card, these drivers initiate opening and closing the contactor coils. All driver modules are equipped with reverse battery protection, such that if the battery is connected incorrectly, the contactors cannot be closed electrically.

Section 2.3.8 Truck Management Module (TMM)

The Truck Management Module is a multi-function accessory card (IC3645TMM7A), or an integral function of the SE1000 Pump control when used with the SE1000 Traction control. The Module provides the OEM the ability to initiate status codes or operator warning codes to be displayed on the Dash Display whenever a normally open switch or sensor wire provides a signal to the Module.

Section 3. ORDERING INFORMATION FOR CONTROLLERS

EXAMPLE.....	<u>IC3645SE</u>	<u>8</u>	<u>J</u>	<u>100</u>	<u>D1</u>
ARGUMENT NO.	01	02	03	04	05

ARGUMENT NO. 01 BASIC CATALOG NUMBER

ARGUMENT NO. 02 VOLTAGE

8	36/80 VDC
9	90/144 VDC

ARGUMENT NO. 03 BASE SIZE

J	11.00 X 16.00 INCHES
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ARGUMENT NO. 04 POWER RATING

100	1000 AMPS
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ARGUMENT NO. 05 APPLICATION

D1	STANDARD TRACTION WITH BDI AND REGEN
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Section 17. SE1000 HANDSET INSTRUCTIONS

Section 17.1 General Features

The GE Handset is a multi-functional tool to be used with the LX, ZX, and SX Series solid-state controls. The Handset consists of a Light Emitting Diode (LED) display and a keyboard for data entry.

Section 17.2 Purpose / Setup Functions

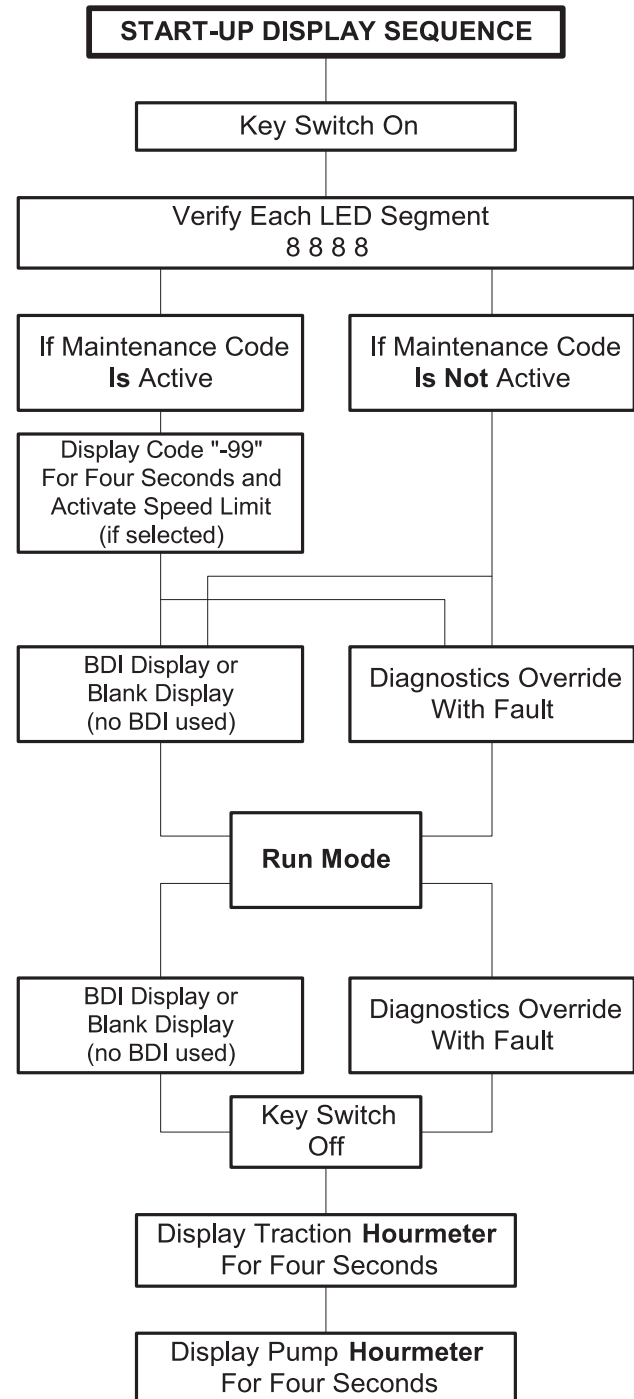
The purpose of the Handset is to allow authorized personnel to perform the following functions of the SE1000 Control:

- Monitor existing system fault codes
- Monitor intermittent random fault codes
- Monitor battery state of charge on systems with BDI
- Monitor hourmeter reading
- Monitor or adjust the following control functions:
 - Creep speed
 - Controlled Acceleration and 1A time
 - Regenerative Braking Current Limit and Disable
 - Current Limit
 - Plugging Distance (Current)
 - Pedal Position Plug Range or Disable
 - 1A Drop Out Current or Disable
 - Speed Limit Points
 - Truck Management Fault Speed Limit
 - Internal Resistance Compensation for Battery State of Charge Indication
 - Battery Voltage (36/48 volts is auto ranging)
 - Selection of Card Operation Type.
 -

Warning : Before connecting or disconnecting the Handset tool, turn off the key switch, unplug the battery and jack up the drive wheels of the vehicle.

At the transistor control traction card, unplug the "Y plug" if the dash display is in use, and plug in the Handset to the plug location "Y" on the control card. After

installing the Handset tool, plug the battery in and turn the key switch on. The following is the start-up display sequence that will occur:



NOTE: The vehicle can be operated with the Handset connected, however, the adjustment knob must be set fully clockwise to insure the control operates at top speed.

Section 17.3 Setup Function Procedures

Warning: Before making any adjustments to the control, you must consult the operating and maintenance instructions supplied by the vehicle manufacturer. Failure to follow proper set up instructions could result in mis-operation or damage to the control system.

With the Handset connected, hold down the **CONT** key and turn on the key switch. This will place you in the set up mode, ready to monitor or adjust control function settings.

NOTE: The term “Push” means to depress key for approximately one second.

Section 17.3.1 Setup Mode

SET-UP MODE		
ACTION	DISPLAY SHOWS	REMARKS
Hold Down CONT And Turn On Key	8 8 8 8	Segment Check Displayed
Push Function Number	U 0 0 5	Selected Function No. Is Displayed
After One Second Time Delay	0 8 5	Stored Value For The Function Is Displayed
Push CONT	0 8 5	Display Value Will Blink
Change Value With Adjustment Knob	125	Value Changes While Blinking
Push STORE	125	New Value Stored And Blinking Stops
Push ESC	8 8 8 8	Segment Check Displayed

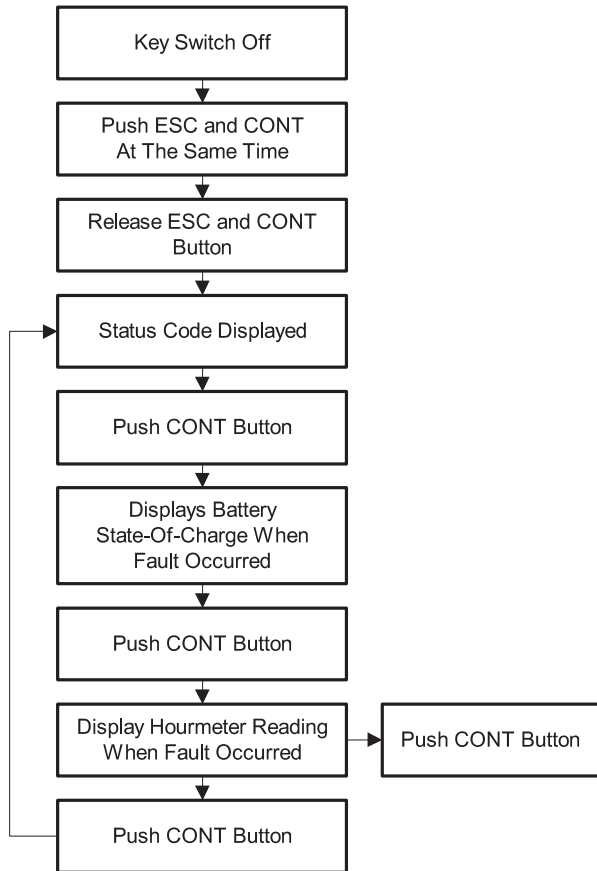
At this point, another function can be monitored/changed by pushing another function number, or the vehicle can be placed in the run mode by holding the **ESC** key down for one second or longer. The display will return to either the diagnostics mode, the BDI display, or a blank display (if BDI is not used and there are no fault codes). The vehicle can now be operated with the Handset connected or the Handset can be disconnected before operation.

NOTE: You can return to the segment check mode at any time, by holding down the **ESC** key until 8888 appears in the display.

Section 17.3.2 Status Code Scrolling

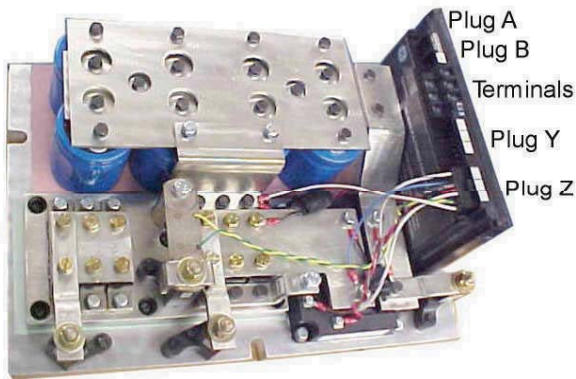
The SE1000 controller furnishes a function register that contains the last 16 “stored status codes” that shut down vehicle operation (a PMT type fault that is reset by cycling the key switch) and the battery state of charge reading at the time the fault occurred. The first of the 16 status codes will be overwritten each time a new status code occurs. This stored status code register can be cleared from memory by using the Handset.

ACCESSING STORED STATUS CODES WITH GE HANDSET



Section 17.3.3 SE1000 Handset and Plug Connections

Plug locations



Handset



Section 17.4 Description of Setup Function Numbers

Section 17.4.1 Setup Functions for Single Motor Traction Logic Cards

FUNCTION 1: [Push 1] STORED FAULT CODE

This function register contains the last fault that shut down vehicle operation (PMT type fault that is reset by cycling the key switch). This fault code will be overwritten each time a new fault occurs and can be cleared from memory by adjusting the value to zero. This register will be cleared when the battery is unplugged.

FUNCTION 2: [Push 2] CREEP SPEED

This function allows for the adjustment of the creep speed of the vehicle. A constant creep speed frequency will be maintained when an accelerator input voltage between 3.7 and 3.5 volts or an accelerator ohmic input between 6K and 4.7K ohms is provided.

Range 2% to 15% on time
 Setting 0 to 255
 Resolution 0.03% per set unit
Example: Setting of 20 = 2.6% on time

FUNCTION 3: [Push 3] CONTROLLED ACCELERATION AND 1A TIME

This function allows for the adjustment of the rate of time it takes for the control to accelerate to 96% applied battery voltage to the motor on hard acceleration. The 1A contactor will automatically close 0.2 seconds after the controlled acceleration stops and the accelerator input is less than 0.5 volts or less than 200 ohms.

Range 0.1 to 22.0 seconds
Setting 0 to 255
Resolution 0.084 seconds per set unit
Example: Setting of 20 = 1.8 seconds C/A
and 2.0 1A time.

FUNCTION 4: [Push 4] CURRENT LIMIT

This function allows for the adjustment of the current limit of the control. The rating of the control will determine the range of adjustment for this function. Please refer to the operating instructions for the control used in your vehicle.

Range See control C/L curves
Setting 0 to 255

Example: 0 = min. current, 255 = max.
current

FUNCTION 5: [Push 5] PLUGGING DISTANCE (CURRENT)

This function allows for the adjustment of the plugging distance of the vehicle. The larger the current setting, the shorter the stopping distance.

Range 200 to 800 amps
Setting 0 to 255
Resolution 2.35 amps per set unit

Example: Setting of 20 = 247 amps

Warning: *Plug settings must be in accordance with control operating instructions. An excessively high setting could cause damage to control system or traction motor.*

FUNCTION 6: [Push 6] 1A DROP OUT CURRENT

This function allows for the adjustment of the 1A contactor drop out current. The 1A contactor will be dropped out and the vehicle motor torque will be limited to TRANSISTOR current limit when the set drop out current is reached.

Range 450 to 1260 amps
Setting 0 to 250
Resolution 3.24 amps per set unit

Settings above 250 set units will disable 1A drop out function (1A will not drop out).

Example: Setting of 20 = 515 amps

FUNCTION 7: [Push 7] FIELD WEAKENING PICK UP

This function allows the adjustment of field weakening contactor pick up current. This setting allows the FW contactor to pick up when the vehicle has returned to about 150% of its full load level running current after acceleration.

Range 52 to 466 amps
Setting 0 to 255
Resolution 1.6 amps per set unit

Example: Setting of 20 = 84 amps

Note: The FW contactor will not pick up with a setting of less than 5.

**FUNCTION 8: [Push 8]
FIELD WEAKENING DROP OUT**

This function allows for the adjustment of the field weakening contactor drop out current. This setting allows the FW contactor to drop out when the vehicle requires greater than 300% of the full load level running current for greater torque.

Range 65 to 895 amps
Setting 0 to 255
Resolution 3.25 amps per set unit

Example: Setting of 20 = 130 amps

**FUNCTION 9: [Push 9]
REGEN BRAKING C/L**

This function allows for the adjustment of the Regen braking current limit. The higher the current, the shorter the stopping distance.

Range 75 to 1000 amps
Setting 0 to 255
Resolution 4.0 amps per set unit

Example: Setting of 20 = 119 amps

**FUNCTION 10: [Push 10]
REGEN START**

This function allows for the adjustment of the percent on time at which the control will start to regen. Adjustment of this function allows the OEM to set the regen start speed of the vehicle to eliminate regen attempts when motor regen current is low.

Range 0 to 95% on time
Setting 0 to 255
Resolution .37% per set unit

Example: Setting of 20 = 7.4% on time

**FUNCTION 11: [Push 11]
SPEED LIMIT 1 (SL1)**

This function allows for the adjustment of the speed limit (maximum battery volts to the motor) when the SL1 limit switch input signal is received by the control card. SL1 limit switch is a normally closed switch connected to battery negative, the switch opening enables speed limit.

Range 96% to 0% battery volts
Setting 0 to 170

Note: Setting of 0 set units will disable speed limit function and allow top speed with no limit switch connected.

**FUNCTION 12: [Push 12]
SPEED LIMIT 2 (SL2)**

Same as Function 11 except using SL2 limit switch for input.

**FUNCTION 13: [Push 13]
SPEED LIMIT 3 (SL3)**

Same as Function 11 except using SL3 limit switch for input.

Note: The SL3 set speed limit is also activated by the Truck Management Module fault codes 90 and 93. See instructions for IC3645TMM7A Truck Management Module for details.

**FUNCTION 14: [Push 14]
INTERNAL RESISTANCE COMPENSATION**

This function is used when the Battery Discharge Indicator is present. Adjustment of this function will improve the accuracy of the BDI. In order to make this setting the voltage drop *of a fully charged battery* under load must first be determined by following the steps listed below:

1. Load the traction motor to 100 amps in 1A and record the voltage (V_O) at the control panel positive and negative power terminal.
2. Load the traction motor to 200 amps in 1A and record the voltage (V_L) at the control panel positive and negative power terminal.
3. Calculate voltage drop (V_D) as follows:
 $V_D = V_O - V_L$
4. Use the table below to determine the setting using the calculated V_D as a reference.

SETTING	EVT100 V_D	SETTING	EVT100 V_D
2	11.44	17	1.34
3	7.60	17	1.27
4	5.72	19	1.20
5	4.57	20	1.14
6	3.81	21	1.09
7	3.27	22	1.04
8	2.86	23	0.99
9	2.54	24	0.95
10	2.28	25	0.91
11	2.08	26	0.88
12	1.90	27	0.85
13	1.76	28	0.82
14	1.63	29	0.79
15	1.52	30	0.76
16	1.43	31	0.74

FUNCTION 15: [Push 15] BATTERY VOLTS

This function allows for the adjustment of voltage range for controls equipped with the Battery Discharge Indication function. In order for the BDI to operate properly, the setting as shown in the table must be entered .

Battery volts

24 volts
36 volts
48 volts
72 volts
80 volts
36/48 volts
120 volts

Set units

Between 0 and 31
Between 32 and 44
Between 45 and 69
Between 70 and 80
Between 81 and 173
Between 174 and 250
Between 110 and 130

144 volts
No BDI

Between 140 and 150
Between 251 and 255

Note: The following functions have function numbers larger than the numbers on the Handset keyboard. To access these functions, push the CONT key and the number shown in the following instructions at the same time.
The Seat Switch must be open.

FUNCTION 16: [Push CONT and 1] PEDAL POSITION PLUG

This function will allow the adjustment of the pedal position plug range. Pedal position will reduce the plugging current to the current value set by this function as the accelerator is returned to the creep speed position. Maximum plug current is obtained with the accelerator in the top speed position.

Range 100 to 800 amps
Setting 0 to 249
Resolution 2.75 amps per set unit

Example: Setting of 20 = 155 amps

Any setting greater than 249 disables pedal position plugging.

FUNCTION 17: [Push CONT and 2] CARD TYPE SELECTION

This function allows for the selection of the card type used for your vehicle's application. The table below shows the setting to select card application type, depending on which control card is used.

Note: Non-Auto Plug/Regen Logic cards must be used for settings below.

FUNCTIONS	STANDARD WITH FW	SPEED LIMIT	REGEN & FW
Std C/L	0 to 4	20 to 24	40 to 44

Settings for these functions should be made in between the values shown.

Warning: These settings must be changed by authorized personnel only, following instructions supplied by the manufacturer. Card type selection must be made within the capabilities of the TRANSISTOR control panel used and the supporting electro-mechanical devices. Failure to comply with proper application standards could result in mis-operation or damage to the control and/or motors.

FUNCTION 18: [Push CONT and 3] STEER PUMP TIME DELAY

This function allows for the selection of steer pump contactor pick up input, either seat switch or directional switch closing, and adjustment of the time delay for the contactor drop out.

- Pick up on seat switch closure and time delay drop out on seat switch opening:

Range 1.5 to 65 seconds
 Setting Between 0 and 128
 Resolution 0.5 seconds per set unit

Example: Setting of 20 = 10.5 seconds

- Pick up on directional switch closure and drop out time delay on directional switch opening:

Range 0.5 to 63 seconds
 Setting 129 to 255
 Resolution 0.5 seconds per set unit

Example: Setting of 149 = 10.5 seconds

Note: Drop out will be 1.5 seconds after the seat switch opens.

Note: To set the Maintenance hours (user selectable) to 1,234 hours, follow the instructions in Function 19 & 20.

FUNCTION 19: [Push CONT and 4]

MAINTENANCE CODE TENS AND ONES HOURS SET

This function allows for the adjustment of the tens and ones hours of the maintenance code activation time.

Range 0 to 99
 Setting 0 to 99

Example: 34 Hours

FUNCTION 20: [Push CONT and 5] MAINTENANCE CODE THOUSANDS AND HUNDREDS HOURS SET

This function allows for the adjustment of the thousands and hundreds hours of the maintenance code activation time.

Range 0 to 99
 Setting 0 to 99

Example: 12 Hours

Note: The maintenance hours have now been set to 1,234.

FUNCTION 21: [Push CONT and 6] MAINTENANCE CODE SPEED LIMIT

This function allows for the adjustment of the speed limit (maximum battery volts to the motor) when the maintenance code is activated by the control card.

Range 100% to 0% battery volts
 Setting 0 to 170
 Resolution -0.56 % per set unit

Example: Setting of 20 = 88.8 % battery volts

FUNCTION 28: [Push CONT and 13] STORED STATUS CODE COUNT POINTER

This register contains the location of the last stored status code recorded of the 16 stored status codes. These stored status

codes have caused a PMT controller shutdown and/or disruption of normal vehicle operation.

To determine which stored status code was the last one recorded, read the number stored in Function 28. Using the **Memory Map** (See Section 16.1) for your logic card, match the “**stored status code pointer number**” [the number shown in (*bold italics*) in the HS (Handset) number column] on the memory map, with the number obtained from Function 28. This will be the last stored status code recorded.

Note: When scrolling the stored status code register, the register always starts at status code 1 and scrolls to status code 16. Instructions for scrolling the register are in Section 17.3.2 of this instruction booklet.

DASH DISPLAY INTERACTIVE MODES

Note: The following functions (Functions 48 - 62) are mode settings that are activated from the Interactive Dash Display. Each function must be set using the logic table shown below. If you try to set the function outside these guidelines, an error code will be displayed to prompt you to enter the correct setting.
If: 80 is displayed, the setting is too low
If: 81 is displayed, the setting is too high

Setting Logic Table

	Mode 1	Mode 2	Mode 3	Mode 4
C/A Time	=> Mode 2	=< Mode 1 => Mode 3	=< Mode 2 => Mode 4	=< Mode 3
FW Pickup	=< Mode 2	=> Mode 1 =< Mode 3	=> Mode 2 =< Mode 4	=> Mode 3
SL1	=> Mode 2	=< Mode 1	=< Mode 2	=< Mode 3

		=> Mode 3	=> Mode 4	
--	--	-----------	-----------	--

Note: The following functions have function numbers larger than the numbers on the Handset keyboard. To access these functions, push the CONT key and the number shown in the following instructions at the same time.
The Seat Switch must be closed.

FUNCTION 48: [Push CONT and 1] MODE 1 - CONTROLLED ACCELERATION AND 1A TIME

This function allows for the adjustment of the rate of time it takes for the control to accelerate to 96% applied battery voltage to the motor on hard acceleration. The 1A contactor will automatically close 0.2 seconds after the controlled acceleration stops and the accelerator input is less than 0.5 volts or less than 50 ohms. This CA and 1A time takes effect when the Mode 1 settings are called for by the interactive Dash Display.

Range	0.1 to 22.0 seconds
Setting	0 to 255
Resolution	0.084 seconds per set unit

Example: Setting of 20 = 1.8 seconds C/A and 2.0 1A time.

FUNCTION 49: [Push CONT and 2] MODE 1 - FIELD WEAKENING PICK UP

This function allows the adjustment of field weakening contactor pick up current. This setting allows the FW contactor to pick up when the vehicle has returned to about 150% of its full load level running current after acceleration.

This FW pick-up value takes effect when the Mode 1 settings are called for by the interactive Dash Display.

Range	52 to 466 amps
Setting	0 to 255
Resolution	1.6 amps per set unit

Example: Setting of 20 = 84 amps

**FUNCTION 50: [Push CONT and 3]
MODE 1 - SPEED LIMIT 1 (SL1)**

This function allows for the adjustment of the speed limit (maximum battery volts to the motor) that is activated whenever mode 1 is selected by the operator. **No speed limit switch is required for this function. Therefore, to disable the function, this register must be set to zero.**

Range	96% to 0% battery volts
Setting	0 to 170

Note: Setting of 0 set units will disable speed limit function and allow top speed with no limit switch connected. This Speed Limit (SL1) value takes effect when the Mode 1 settings are called for by the Interactive Dash Display.

**FUNCTION 52: [Push CONT and 5]
MODE 2 - CONTROLLED ACCELERATION
AND 1A TIME**

Same as function 48.

This CA and 1A time takes effect when the Mode 2 settings are called for by the interactive Dash Display.

**FUNCTION 53: [Push CONT and 6]
MODE 2 - FIELD WEAKENING PICK UP**

Same as Function 49.

This FW pick-up value takes effect when the Mode 2 settings are called for by the Interactive Dash Display.

**FUNCTION 54: [Push CONT and 7]
MODE 2 - SPEED LIMIT 1 (SL1)**

Same as Function 50.

This Speed Limit (SL1) value takes effect when the Mode 2 settings are called for by the Interactive Dash Display.

**FUNCTION 56: [Push CONT and 9]
MODE 3 - CONTROLLED ACCELERATION
AND 1A TIME**

Same as function 48.

This CA and 1A time takes effect when the Mode 3 settings are called for by the Interactive Dash Display.

**FUNCTION 57: [Push CONT and 10]
MODE 3 - FIELD WEAKENING PICK UP**

Same as Function 49.

This FW pick-up value takes effect when the Mode 3 settings are called for by the Interactive Dash Display.

**FUNCTION 58: [Push CONT and 11]
MODE 3 - SPEED LIMIT 1 (SL1)**

Same as Function 50.

This Speed Limit (SL1) value takes effect when the Mode 3 settings are called for by the Interactive Dash Display.

**FUNCTION 60: [Push CONT and 13]
MODE 4 - CONTROLLED ACCELERATION
AND 1A TIME**

Same as function 48.

This CA and 1A time takes effect when the Mode 4 settings are called for by the Interactive Dash Display.

**FUNCTION 61: [Push CONT and 14]
MODE 4 - FIELD WEAKENING PICK UP**

Same as Function 49.

This FW pick-up value takes effect when the Mode 4 settings are called for by the Interactive Dash Display.

**FUNCTION 62: [Push CONT and 15]
MODE 4 - SPEED LIMIT 1 (SL1)**

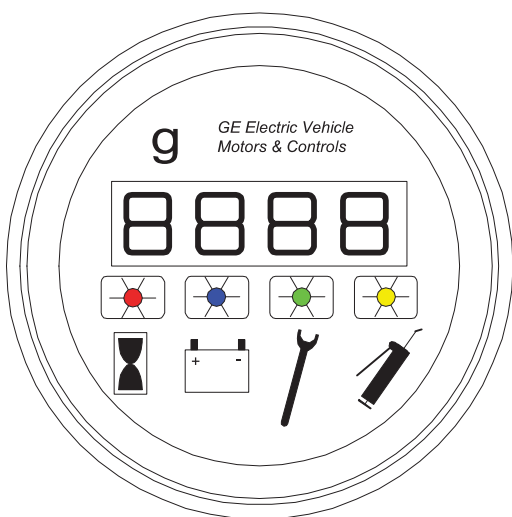
Same as Function 50.

Section 18. DASH DISPLAYS

Section 18.1 Application

The SE1000 Standard and Interactive Dash Displays allow the operator and maintenance personnel easy access to truck operation information and real-time systems diagnostics of the controller, motor and various accessories. Hourmeter readings, battery discharge information, maintenance information and system status codes are clearly displayed during startup and running modes. Shielded cable connections are made to the Dash Display by means of five (5) 22-gage wires to the “Y” Plug of the traction and hydraulic pump controls.

Section 18.2 Standard Dash Displays

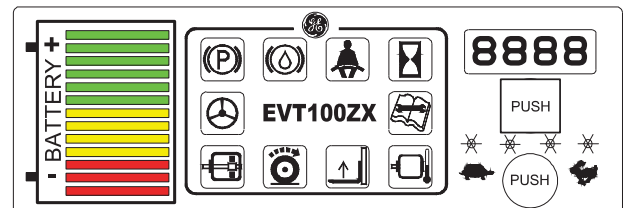


The Standard Dash Display is a four segment Light Emitting Diode (LED) instrument that displays the LX, ZX, and SX

Status Codes, Hourmeter Readings, Battery Discharge Indication, and Maintenance Required Code. The four LED's above the symbols indicate the active readout mode.

Section 18.3 Interactive Custom Dash Displays

The Interactive Custom Dash Display allows the operator to select the best vehicle performance for changing factory (task) conditions. There are four (4) “operator



interaction modes” that can be selected by depressing a pushbutton on the dash display.

From the Dash Display, the operator may select any of four pre-set interactive modes consisting of (4) Controlled Acceleration levels, (4) Field Weakening Pick Up levels and (4) Speed Limit levels.

These interactive modes are “pre-set” using the Handset (Functions 48 - 62) or a personal computer (Functions 97 - 112). This feature allows the operator to select the best vehicle performance for changing factory (task) conditions.

The table below outlines the normal logic flow for pre-setting the four interactive modes:

Setting Logic Table

	Mode 1	Mode 2	Mode 3	Mode 4
C/A Time	=> Mode 2	=< Mode 1 => Mode 3	=< Mode 2 => Mode 4	=< Mode 3
FW Pickup	=< Mode 2	=> Mode 1 =< Mode 3	=> Mode 2 =< Mode 4	=> Mode 3
SL1	=> Mode 2	=< Mode 1 => Mode 3	=< Mode 2 => Mode 4	=< Mode 3

Section 12. TROUBLE SHOOTING INSTRUCTIONS

Trouble-shooting the SE1000 control should be quick and easy by following the instructions outlined in the following status code instruction sheets.

If mis-operation of the vehicle occurs, a status code will be displayed on the Dash Display for vehicles equipped with a Dash Display or by plugging a Handset into the logic card's plug "Y" location and then reading the status code.

With the status code number, follow the procedures outlined in the status code instruction sheets to determine the problem.

Checking and replacement of components are also outlined in sections of this instruction book. Please refer to those sections as needed.

Important Note: Due to the interaction of the logic card with all vehicle functions, almost any status code or control fault could be caused by the logic card. After all other status code procedures have been followed and no problem is found, the logic card should then be replaced as the last option to correct the problem.

The same device designations have been maintained on different controls but the wire numbers may vary. Refer to the elementary and wiring diagrams for your specific control. The wire numbers shown on the elementary diagram will have

identical numbers on the corresponding wiring diagrams for a specific truck, but these numbers may be different from the numbers referenced in this publication.

WARNING: Before trouble-shooting, jack up the drive wheels, disconnect the battery, and discharge capacitor 1C. Reconnect the battery as needed for the specific check. Capacitors should be discharged by connecting a 200 ohm 2 watt resistor between the positive and negative terminal on the control panel.

Check resistance on R x 1000 scale from frame to power and control terminals. A resistance of less than 20,000 ohms can cause misleading symptoms. Resistance less than 1000 ohms should be corrected first.

Before proceeding, visually check for loose wiring, mis-aligned linkage to the accelerator switch, signs of overheating of components, etc.

Tools and test equipment required are: clip leads, volt-ohm meter (20,000 ohms per volt) and basic hand tools.

Caution! Discharge The Capacitors Before Removing!

Electrolytic capacitors can store a significant amount of charge (energy) and must be shorted (discharged) by touching a 200 ohm 2-watt resistor between positive (+) and negative (-) for three seconds or greater.

Section 13. DIAGNOSTIC STATUS CODES

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
NONE	Segments do not illuminate on the Dash Display and/or the Handset.	No input voltage to the control card or the display unit.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller & Pump Controller	<p>SYMPTOM Display screen on Dash Display and/or Handset is blank.</p> <p>POSSIBLE CAUSE</p> <p>Positive or negative control voltage is not present.</p> <ul style="list-style-type: none"> Insure that the key switch is closed and voltage is present between PB1 & battery negative (Power Terminal "N"). Also check for voltage between TB4 and control negative. <p>Open circuit between control card Plug Y & the Dash Display or Handset.</p> <ul style="list-style-type: none"> Check for an open circuit or loose connection going from the "Y" plug and the Dash Display or Handset. <p>Defective Dash Display or Handset.</p> <ul style="list-style-type: none"> Replace Dash Display or Handset. 	<p style="text-align: right;">SC00</p>
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-01	No seat switch or deadman switch input. (No voltage to TB3)	This status code will be displayed when TB3 is less than 50% battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or Reverse contactor will not close.</p> <p>POSSIBLE CAUSE</p> <p>Mis-adjusted or defective seat or deadman switch.</p> <ul style="list-style-type: none"> Check to see that the seat switch closes properly. <p>Open circuit between battery positive and TB3.</p> <ul style="list-style-type: none"> Check for loose connections or broken wires: <ul style="list-style-type: none"> Between the seat switch and TB3. Between the key switch and the battery positive side of the seat switch. Between the seat switch and TB4. <p><u>On vehicles without a seat/deadman switch, check for a loose connection or broken wire from TB4 and/or TB3</u></p>	<p style="text-align: right;">SC01</p>

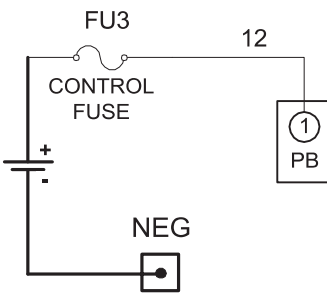
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-02	Forward directional switch is closed on initial power up.	This status code will be displayed when TB5 is greater than 60% of battery voltage at initial key switch on.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM Forward contactor will not close because of Static Return to Off (SRO) lock out.</p> <p>POSSIBLE CAUSE Forward directional switch is closed on initial start up (i.e. closure of battery, key switch or seat/deadman switch).</p> <ul style="list-style-type: none"> Return directional switch lever to neutral and then return lever to forward position. <p>Forward directional switch is welded closed or mis-adjusted to be held closed.</p> <ul style="list-style-type: none"> Replace or adjust directional switch to insure that it opens when the directional switch is returned to neutral. <p>Short circuit between TB2 and TB5.</p> <ul style="list-style-type: none"> Disconnect the wire from TB5 and check for a short circuit between TB2 and the wire that was connected to TB5. <p>Defective logic card.</p> <ul style="list-style-type: none"> Replace the logic card. 	<p style="text-align: right;">SC02</p>
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-03	Reverse directional switch is closed on initial power up.	This status code will be displayed when TB6 is greater than 60% of battery voltage at initial key switch on.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM Reverse contactor will not close because of Static Return to Off (SRO) lock out.</p> <p>POSSIBLE CAUSE Reverse directional switch is closed on initial start up (i.e. closure of battery, key switch or seat/deadman switch).</p> <ul style="list-style-type: none"> Return directional switch lever to neutral and then return lever to reverse position. <p>Reverse directional switch is welded closed or mis-adjusted to be held closed.</p> <ul style="list-style-type: none"> Replace or adjust directional switch to insure that it opens when the directional switch is returned to neutral. <p>Short circuit between TB2 and TB6.</p> <ul style="list-style-type: none"> Disconnect the wire from TB6 and check for a short circuit between TB2 and the wire that was connected to TB6. <p>Defective logic card.</p> <ul style="list-style-type: none"> Replace the logic card. 	<p style="text-align: right;">SC03</p>

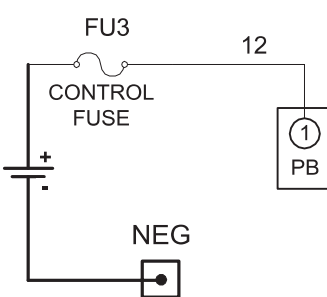
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-05	Start switch or brake switch fails to close.	This status code will be displayed when TB1 is less than 2.5 volts and TB2 is less than 60% of battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor will not pick up.</p> <p>POSSIBLE CAUSE</p> <p>Defective brake switch circuit.</p> <ul style="list-style-type: none"> • Check brake switch to insure closure with brake pedal released. • Check for open circuit or loose connections in wiring from brake switch to seat switch and TB3, and from brake switch to start switch. <p>Defective start switch circuit.</p> <ul style="list-style-type: none"> • Check start switch to insure closure when accelerator is depressed. • Check for open circuit or loose connections in wiring from brake switch to start switch and from TB2 to start switch. <p>Defective accelerator switch.</p> <ul style="list-style-type: none"> • Check accelerator switch potentiometer for proper operation and ohmic value. 	

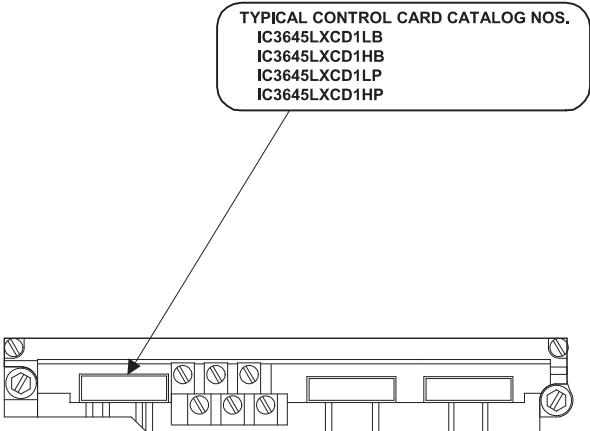
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-06	Accelerator depressed with no direction selected.	This status code will be displayed when TB5 & TB6 are less than 60% of battery volts, and TB1 is less than 2.5 volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor will not pick up.</p> <p>POSSIBLE CAUSE</p> <p>Accelerator pedal is depressed before closing forward or reverse directional switch.</p> <ul style="list-style-type: none"> • Status code will disappear when directional switch is closed or when accelerator pedal is released. <p>Defective directional switch</p> <ul style="list-style-type: none"> • Check forward or reverse switch to insure closure when direction is selected. <p>Open circuit between directional switch(es) and battery positive or between directional switch(es) and TB5 or TB6.</p> <ul style="list-style-type: none"> • Check all control wires and connections shown in Trouble Shooting Diagram. 	

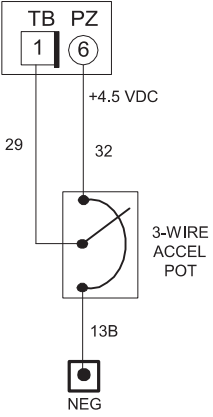
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-07	Accelerator input voltage too high during run mode.	This status code will be displayed when the accelerator input voltage at TB1 is higher than 3.7 volts, and a directional contactor is picked up.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor picks up but control will not operate when accelerator pedal is depressed or status code -07 is displayed then disappears when the vehicle starts to accelerate.</p> <p>POSSIBLE CAUSE Accelerator input mis-adjusted or defective.</p> <ul style="list-style-type: none"> Input voltage at TB1 should be less than 3.7 volts. Adjust or replace accelerator unit to insure that the voltage at TB1 will vary from 3.5 volts to less than .5 volts when the pedal is depressed. <p>Open circuit between battery negative and TB1 in accelerator input circuit.</p> <ul style="list-style-type: none"> Check for broken wires or loose connections or open potentiometer / voltage supply in the circuit shown in Figure 1. <p>Short circuit from battery positive to wiring in accelerator input circuit.</p> <ul style="list-style-type: none"> Disconnect wire from TB1 and measure voltage at wire to negative. Should be zero volts for potentiometer type and less than 3.7 volts for solid state type accelerator input. 	<p style="text-align: right;">SC07</p>
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-08	Accelerator input voltage too low on power up after initial key switch closure.	This status code will be displayed when the accelerator input voltage at TB1 is less than 3.0 volts, and any of the following connections are opened & closed: battery plug, seat switch or key switch.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor does not pick up.</p> <p>POSSIBLE CAUSE Accelerator input mis-adjusted or defective.</p> <ul style="list-style-type: none"> Input voltage at TB1 should be more than 3.0 volts. Adjust or replace accelerator unit to insure that the voltage at TB1 is more than 3.0 volts before depressing pedal. <p>Short circuit between battery negative and TB1 in accelerator input circuit.</p> <ul style="list-style-type: none"> Disconnect wire from TB1. Check for short circuit from wire to battery negative. Resistance should be greater than 4.7K ohms. <p>Defective Card</p> <ul style="list-style-type: none"> Disconnect wire from TB1. Measure voltage from TB1 to negative. Voltage should be greater than 4.5 volts, if not, replace card. 	<p style="text-align: right;">SC08</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-09	Both the forward and reverse directional switches are closed at the same time.	This status code will be displayed when TB5 & TB6 are greater than 60% of battery volts at the same time.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor will not pick up.</p> <p><u>POSSIBLE CAUSE</u> Forward or reverse directional switch welded closed or mis-adjusted to be held closed.</p> <ul style="list-style-type: none"> Replace or adjust directional switches to insure that they open when directional switch is returned to neutral. <p>Short circuit between battery positive and TB5 and/or TB6.</p> <ul style="list-style-type: none"> Disconnect wires from TB5 and TB6 and check wire for short circuit to positive side of directional switch. <p>Defective card</p> <ul style="list-style-type: none"> Disconnect wires and measure voltage at TB5 and TB6. Voltage should be less than 60% of battery volts. 	<p style="text-align: right;">SC09</p>
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-11	Start switch closed on power up after initial key switch closure.	This status code will be displayed when TB2 is greater than 60% of battery voltage when the key switch is closed.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor does not pick up.</p> <p><u>POSSIBLE CAUSE</u> Start switch input mis-adjusted or defective.</p> <ul style="list-style-type: none"> Input voltage at TB2 should be less than 60% battery volts at key switch closing. Adjust or replace accelerator unit to insure that the voltage at TB2 is less than 60% battery volts before closing the start switch pedal. <p>Short circuit between battery positive and TB2 in start switch input circuit.</p> <ul style="list-style-type: none"> Disconnect wire from TB2. Check for short circuit from wire to battery positive. Resistance should be greater than 4.7K ohms. <p>Defective Card</p> <ul style="list-style-type: none"> Disconnect wire from TB2. Measure voltage from TB2 to negative. Voltage should be zero, if not, replace card. 	<p style="text-align: right;">SC11</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION												
-15	Battery voltage is too low or control card is mis-adjusted.	This status code will be displayed when the battery volts are less than 1.95 volts per cell at initial key switch on. See table below.												
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM												
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor will not pick up.</p> <p><u>POSSIBLE CAUSE</u> Discharged battery</p> <ul style="list-style-type: none"> Check battery for proper open circuit voltage as shown in SC 15 figure and charge battery, if required. <p>Defective battery</p> <ul style="list-style-type: none"> Check each battery cell for proper voltage (greater than 1.95 volts at cell). Replace or repair battery. <p>Incorrect control card adjustment.</p> <ul style="list-style-type: none"> Check Function 15 for proper adjustment for battery being used. See Handset instruction sheet for details. Adjust to proper settings. <p><u>Check "minimum" battery volts at PB1 & NEG.</u></p>	 <table border="1" data-bbox="1201 472 1469 798"> <thead> <tr> <th>NOMINAL BATTERY VOLTS</th> <th>MINIMUM LIMIT VOLTS AT 1.95 VDC PER CELL</th> </tr> </thead> <tbody> <tr> <td>24</td> <td>23.4</td> </tr> <tr> <td>36</td> <td>35.1</td> </tr> <tr> <td>48</td> <td>46.8</td> </tr> <tr> <td>72</td> <td>70.2</td> </tr> <tr> <td>80</td> <td>78</td> </tr> </tbody> </table> <p style="text-align: right;">SC15</p>	NOMINAL BATTERY VOLTS	MINIMUM LIMIT VOLTS AT 1.95 VDC PER CELL	24	23.4	36	35.1	48	46.8	72	70.2	80	78
	NOMINAL BATTERY VOLTS	MINIMUM LIMIT VOLTS AT 1.95 VDC PER CELL												
24	23.4													
36	35.1													
48	46.8													
72	70.2													
80	78													

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION												
-16	Battery voltage is too high or control card is mis-adjusted.	This status code will be displayed when the battery volts are greater than 2.4 volts per cell at initial key switch on. See table below.												
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM												
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward and reverse contactor will not pick up.</p> <p><u>POSSIBLE CAUSE</u> Incorrect control card adjustment</p> <ul style="list-style-type: none"> Check Function 15 for proper adjustment for battery being used. See Handset instructions for details. Adjust to proper setting. <p>Battery over charged or incorrect battery used.</p> <ul style="list-style-type: none"> Check battery for proper open circuit voltage as shown in SC 16 figure. If voltage is excessive, check battery charger for proper output voltage. <p><u>Check "maximum" battery volts at PB1 & NEG.</u></p>	 <table border="1" data-bbox="1201 1354 1469 1680"> <thead> <tr> <th>NOMINAL BATTERY VOLTS</th> <th>MAXIMUM LIMIT VOLTS AT 2.40 VDC PER CELL</th> </tr> </thead> <tbody> <tr> <td>24</td> <td>28.8</td> </tr> <tr> <td>36</td> <td>43.2</td> </tr> <tr> <td>48</td> <td>57.6</td> </tr> <tr> <td>72</td> <td>86.4</td> </tr> <tr> <td>80</td> <td>96.0</td> </tr> </tbody> </table> <p style="text-align: right;">SC16</p>	NOMINAL BATTERY VOLTS	MAXIMUM LIMIT VOLTS AT 2.40 VDC PER CELL	24	28.8	36	43.2	48	57.6	72	86.4	80	96.0
	NOMINAL BATTERY VOLTS	MAXIMUM LIMIT VOLTS AT 2.40 VDC PER CELL												
24	28.8													
36	43.2													
48	57.6													
72	86.4													
80	96.0													

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-17	"Card Type" selection is invalid.	This status code will be displayed when the card type selection value is set to an invalid number.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactors will not close.</p> <p>POSSIBLE CAUSE Invalid card type selection.</p> <ul style="list-style-type: none"> Review function 17 in the Handset Instruction sheets. Adjust and set card type value as instructed by OEM service manual. <p>Verify that the correct logic card catalog number is installed in the controller.</p>	<div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 0 auto;"> <p>TYPICAL CONTROL CARD CATALOG NOS. IC3645LXCD1LB IC3645LXCD1HB IC3645LXCD1LP IC3645LXCD1HP</p> </div>  <p style="text-align: right;">SC17</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-21	3-wire Accelerator input is less than 0.25 volts.	This status code will be displayed when TB1 voltage is less than 0.25 volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM Controller will not operate.</p> <p>POSSIBLE CAUSE Accelerator potentiometer needs adjustment or is damaged.</p> <ul style="list-style-type: none"> Input voltage at TB1 must be greater than 0.25 volts when the accelerator pedal is fully released. <p>Short-circuit between battery negative and TB1 in accelerator input circuit.</p> <ul style="list-style-type: none"> Disconnect wire from TB1 and check for short-circuit from end of wire to battery NEG. Resistance must be greater than 4.7 K ohms. <p>Open-circuit between accelerator potentiometer and PZ6.</p> <ul style="list-style-type: none"> Make sure +4.5 volts is present from PZ6 to accelerator. 	 <p style="text-align: right;">SC21</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-23	Forward and reverse contactor coil current is low.	This status code will be displayed when the current draw in the forward or reverse contactor coil circuit is less than 100 milliamps & T2 volts is <88% of Bat volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor will not pick up. Status code may alternate between code 23 and code 24. Complete check for code 23, if the problem is not found, perform check for code 24.</p> <p><u>POSSIBLE CAUSE</u> Defective F and R contactor coil circuit.</p> <ul style="list-style-type: none"> Check for open circuit or loose connection between PB4 and positive side of F contactor coil and between PB5 and positive side of R contactor coil. Remove plug B. Check ohmic value from PB4 to positive side of F coil. Value should be 10 to 14 ohms. Make same check for R coil. <p>Defective 1A, FW, RB, L1, or SP contactor coil.</p> <ul style="list-style-type: none"> Remove plug B. Check ohmic value from positive side of each coil to its respective plug connection. Value should be 10 to 14 ohms. 	<p style="text-align: right;">SC23</p>
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-24	T2 voltage is low. (Less than 88% battery voltage.)	This status code will be displayed when T2 volts is less than 88% of battery volts and the “F” & “R” driver is energized.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Control does not operate. Status code may alternate between code 23 and code 24. Complete checks for 24, if the problem is not found, perform code 23 check.</p> <p><u>POSSIBLE CAUSE</u> Defective F or R contactor.</p> <ul style="list-style-type: none"> F or R power tips fail to close because: <ol style="list-style-type: none"> Welded normally closed power tips. Binding contactor tip assembly. Defective F or R contactor coil. (See status code 23) <p>“RB” contactor (if applicable) failed to close. Ensure Function 17 has correct setting.</p> <p>Open motor circuit</p> <ul style="list-style-type: none"> Check for open circuit or loose connection in motor circuit from the A1 connection to the A2 connection on the control panel. 	<p style="text-align: right;">SC24</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-26	Shorted coil driver for SP, RB, L, or FW contactors.	This status code will be displayed when there is a shorted SP, RB, L, or FW coil driver.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM SP, RB, L, or FW contactor picks up immediately when key switch is closed.</p> <p>POSSIBLE CAUSE Defective coil driver internal to logic card.</p> <ul style="list-style-type: none"> Replace logic card. 	<p style="text-align: right;">SC26</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-27	Logic card power supply is less than 10 Volts DC.	This status code will be displayed when the logic card power supply is less than 10 volts.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactors close and open, then can only be closed by opening and closing the key switch.</p> <p>POSSIBLE CAUSE Discharged Battery</p> <ul style="list-style-type: none"> Check battery to insure proper state of charge. Voltage may be dropping below 10 Volts DC under load. <p>Loose connection at PB1.</p> <ul style="list-style-type: none"> Insure that the wire connection at PB1 is tight. <p>Shorted Q1 Power Transistor Snubber.</p> <ul style="list-style-type: none"> Remove one side of snubber across Blue and Brown wires, if symptom clears replace snubber. <p>Defective logic card</p> <ul style="list-style-type: none"> Replace logic card. <p>Defective Q1 Power Transistor.</p> <ul style="list-style-type: none"> Measure for low resistance (<200 ohms) at PZ4 to NEG. 	<p style="text-align: right;">SC27</p>

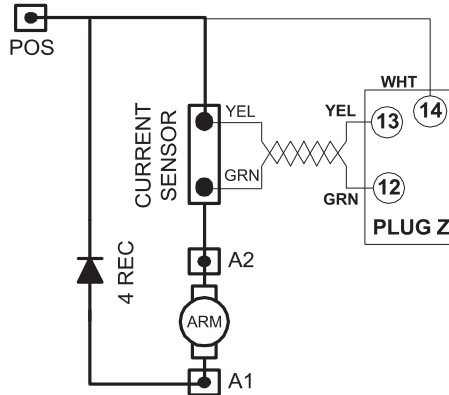
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-41	Open thermal protector (TP) or transistor over temperature.	This status code will be displayed when the voltage between PZ1 and PZ5 is greater than 0.8 volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM Reduced or no power to traction motor in control range.</p> <p>POSSIBLE CAUSE Control is in thermal cut-back.</p> <ul style="list-style-type: none"> Allow control to cool, status code should disappear. <p>Open thermal protector circuit.</p> <ul style="list-style-type: none"> Check for loose connection or broken wire at connection PZ5 and PZ1. <p>Defective thermal protector.</p> <ul style="list-style-type: none"> Disconnect wires from PZ1 and PZ5. At room temperature (25° C or 75° F) measure resistance between WHT/VIO and VIO wire. Replace Q1 if ohmic value is greater than 1200 ohms. <p>Defective Logic Card</p> <ul style="list-style-type: none"> Replace Logic Card 	

SC41

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-42	Controller “motor current sensor” input is missing (PZ12 - Green).	This status code will be displayed when the voltage between PZ12 & PZ13 is greater than 0.1 volts with no current flowing in the motor circuit.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p>SYMPTOM No power to traction motor in control range.</p> <p>POSSIBLE CAUSE Open sensor wire circuit to PZ12 .</p> <ul style="list-style-type: none"> Check for loose connection or broken wire (green wire) from current sensor to PZ12 on the logic card. 	

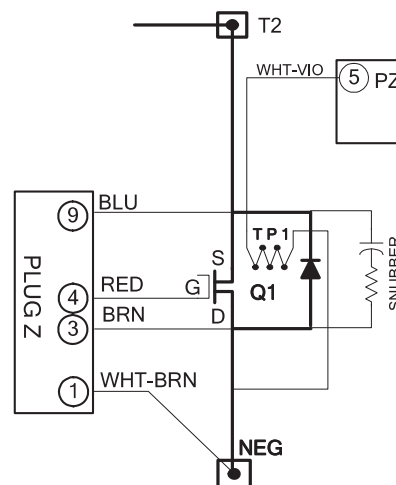
SC42

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-43	Controller “motor current sensor” input is missing (PZ13 - Yellow).	This status code will be displayed when the voltage between PZ12 & PZ13 is greater than 0.1 volts with no current flowing in the motor circuit.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> No power to traction motor in control range.</p> <p><u>POSSIBLE CAUSE</u> Open sensor wire circuit to PZ13 .</p> <ul style="list-style-type: none"> Check for loose connection or broken wire (yellow wire) from current sensor to PZ13 on the logic card. 	



SC43

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-44	Power Transistor (Q1) did not turn off properly.	This status code will be displayed when, during control operation, the transistor fails to turn off. This will result in a PMT condition.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactors close and open, then can only be closed by opening and closing the key switch.</p> <p><u>POSSIBLE CAUSE</u></p> <ul style="list-style-type: none"> Check for open circuit or loose connections between the transistor and PZ4 (red wire). Check for shorted snubber. <p>Defective Q1 power transistor.</p> <ul style="list-style-type: none"> Turn off time for transistor is out of specification. No field test is possible. Replace transistor. 	



TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-45	Power Transistor (Q1) did not turn on properly.	This status code will be displayed when the Power Transistor fails to gate "on".
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor will close and open, and then can only be closed by opening and closing the key switch.</p> <p>POSSIBLE CAUSE</p> <p>Defective transistor circuit.</p> <ul style="list-style-type: none"> • Check for open circuit or loose connections between the transistor and PZ4 (red wire). • Check for open circuit or loose connection between T2 and PZ9 (blue wire). <p>Defective Q1 power transistor.</p> <ul style="list-style-type: none"> • Intermittent or open transistor gate. Field test may or may not show defect. Replace transistor after above checks show no problem found. 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-46	"Look Ahead" test for T2 volts less than 12% of battery volts.	This status code will be displayed when the voltage at T2 is less than 12% of battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor will not pick up.</p> <p>POSSIBLE CAUSE</p> <p>Defective Q1 power transistor.</p> <ul style="list-style-type: none"> • Check for shorted transistor. <p>Defective 1A contactor.</p> <ul style="list-style-type: none"> • Check for welded 1A contactor power tips. <p>Defective snubber.</p> <ul style="list-style-type: none"> • Check for shorted snubber. 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-48	“Look Ahead” test for T2 volts greater than 88% of battery volts.	This status code will be displayed when the voltage at T2 is greater than 88% of battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor will not pick up.</p> <p>POSSIBLE CAUSE Defective forward or reverse contactor.</p> <ul style="list-style-type: none"> • Check for welded forward or reverse contactor power tips. • Check for sluggish operation of forward or reverse contactor. <p>Defective 3 REC circuit.</p> <ul style="list-style-type: none"> • Check for shorted 3 REC. 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-50	Capacitor volts low after line contactor closes.	This status code will be displayed when the capacitor volts is less than 85% of battery volts during the run mode.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor picks up. Control does not operate.</p> <p>POSSIBLE CAUSE Defective Line contactor.</p> <ul style="list-style-type: none"> • Check for open line contactor power tips. • Check for loose or open connections in cables from battery positive to control positive circuit. <p>Defective Power fuse.</p> <ul style="list-style-type: none"> • Check power fuse for open circuit. <p>No battery voltage at PZ14.</p> <ul style="list-style-type: none"> • Check for battery voltage at POS and PZ14. • Check for loose connection at PZ14 (white wire). 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-51	Capacitor volts are low before the line contactor closes (internal card function during precharge).	This status code will be displayed during “key on” when the capacitor volts is less than 85% of battery volts at initial key switch on.
MEMORY RECALL NO	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Line contactor does not close when Capacitor does not precharge.</p> <p>POSSIBLE CAUSE Defective capacitor.</p> <ul style="list-style-type: none"> • Check capacitor bank per component checking section. • Check for loose or open connections in capacitor circuit. <p>Defective control fuse for PB1 input.</p> <ul style="list-style-type: none"> • Check control fuse for open circuit. <p>Defective logic card</p> <ul style="list-style-type: none"> • Replace logic card. <p>Defective Q1 power transistor.</p> <ul style="list-style-type: none"> • Check transistor Q1 for shorted condition and replace if necessary. <p>Note: Repeated “charging/discharging” the capacitors during trouble shooting will cause status code -51. Also, “do not” connect <u>any</u> loads to the load side of the Line Contactor.</p>	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-53	Power Transistor fails to turn off during plugging operation.	This status code will be displayed when the transistor fails to turn off while plugging. This will result in a PMT condition.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactors close and open, then can only be closed by opening and closing the key switch.</p> <p>POSSIBLE CAUSE Defective Q1 power transistor.</p> <ul style="list-style-type: none"> • Turn off time for transistor is out of specification. No field test is possible. Replace transistor. <ul style="list-style-type: none"> • Check for open circuit or loose connections between the transistor and PZ4 (red wire) 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-54	Shorted F, R, or 1A contactor coil driver on the logic card.	This status code will be displayed when any of the Forward, Reverse or 1A contactor coil driver(s) is shorted internal to the logic card.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Control will not operate.</p> <p><u>POSSIBLE CAUSE</u> Defective logic card.</p> <ul style="list-style-type: none"> Replace logic card. 	<p style="text-align: right;">SC54</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-57	Controller “motor current sensor” input voltage polarity check.	This status code will be displayed when the voltage input to PZ13 and PZ12 is the wrong polarity.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactors close and open, then can only be closed by opening and closing the key switch.</p> <p><u>POSSIBLE CAUSE</u> Reversed yellow and green current sensor wires.</p> <ul style="list-style-type: none"> Insure that the green wire connects to PZ12 with no open circuits and that the yellow wire connects to PZ13 with no open circuits or loose connections. <p><u>Reversed power cable connection.</u></p> <ul style="list-style-type: none"> Insure that the battery positive cable connects to control POS and the motor A2 cable connects to control A2. <p><u>Line contactor tips open during run mode.</u></p> <ul style="list-style-type: none"> Check contactor operation and contactor tips. 	<p style="text-align: right;">SC57</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-70	Regen current sensor input missing (green wire).	This status code will be displayed when the input signal at PZ10 is missing.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Control does not operate.</p> <p><u>POSSIBLE CAUSE</u> Defective regen sensor input circuit.</p> <ul style="list-style-type: none"> • Check green sensor wire for open circuit or loose connection between sensor (welded connection) and PZ10. • Check for proper setting of Function 17. 	<p style="text-align: right;">SC70</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-71	Regen current sensor input missing (yellow wire).	This status code will be displayed when the input signal at PZ11 is missing.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Control does not operate.</p> <p><u>POSSIBLE CAUSE</u> Defective regen sensor input circuit.</p> <ul style="list-style-type: none"> • Check yellow sensor wire for open circuit or loose connection between sensor (welded connection) and PZ11. • Check for proper setting of Function 17. 	<p style="text-align: right;">SC71</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-72	Regen contactor (RB) does not pick up.	This status code will be displayed when the logic card is in the run mode and less than 50% battery volts at PZ7.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Regen contactor does not operate.</p> <p>POSSIBLE CAUSE Open connection in the PZ7 circuit.</p> <ul style="list-style-type: none"> • Check for open circuit or loose connection between PZ7 and the A2 connection of the controller. • Check for open circuit or loose connection between 7 REC and the A2 connection of the controller. • Check for proper setting of Function 17. 	<p style="text-align: right;">SC72</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-73	Regen contactor (RB) does not drop out or drops out slowly.	This status code will be displayed when the RB contactor power tips fail to open after 100 milliseconds after power is removed from the RB contactor coil.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor close and open, then opens and can only close by opening and closing the key switch.</p> <p>POSSIBLE CAUSE Defective RB contactor.</p> <ul style="list-style-type: none"> • Check RB contactor for smoothness of operation and excessive wear on moving parts. <p>Short circuit to positive at PZ7 input.</p> <ul style="list-style-type: none"> • Check for short circuit between PZ7 and battery positive. 	<p style="text-align: right;">SC73</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-74	Regen contactor (RB) picks up too slowly.	This status code will be displayed when the RB contactor power tips do not close within 100 milliseconds after power is applied to the RB contactor coil.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor close and open, then opens and can only close by opening and closing the key switch.</p> <p>POSSIBLE CAUSE Defective RB contactor.</p> <ul style="list-style-type: none"> • Check RB contactor for smoothness of operation and excessive wear on moving parts. <p>Intermittent PZ7 input.</p> <ul style="list-style-type: none"> • Check for loose connections in PZ7 circuit from PZ7 to RB contactor A2 connection. <p>Defective RB contactor coil circuit.</p> <ul style="list-style-type: none"> • Check RB contactor coil for proper ohmic value. It should be 10-14 ohms. • Check coil connection from PZ8 to RB coil (-) for loose connection. • Check coil connection from battery positive to RB coil (+) for loose connection. 	
TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-76	Capacitor (1C) voltage too high.	This status code will be displayed when the voltage on the capacitor goes above 96 volts during the regenerative braking cycle.
MEMORY RECALL YES	CORRECTIVE ACTIONS	TROUBLE-SHOOTING DIAGRAM
Circuits valid for Traction Controller	<p>SYMPTOM Forward or reverse contactor close and open, then opens and can only close by opening and closing the key switch.</p> <p>POSSIBLE CAUSE</p> <ul style="list-style-type: none"> • Unplugging the battery connector during regenerative braking. • Line contactor bouncing open during regen. • Main power fuse opening during regen. • Intermittent battery plug connection. 	

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-80	Voltage at capacitor (1C) is less than 14 volts.	This status code will be displayed when the voltage at PZ14 is less than 14 volts. This occurs typically in the run mode of operation.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor will not pick up.</p> <p><u>POSSIBLE CAUSE</u></p> <p>Line Contactor opened up during run.</p> <ul style="list-style-type: none"> • Check connection from PB2 to L coil (-) for loose connection. • Check connection from battery (+) to L coil (+) for loose connection. • Check power connection from battery (+) to contactor L. • Check FU1 and FU3 for blown element. 	<p style="text-align: right;">SC80</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-81	Battery voltage is less than 14 volts.	This status code will be displayed when the battery voltage measured at PB1 is less than 14 volts.
MEMORY RECALL YES	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Forward or reverse contactor will not pick up.</p> <p><u>POSSIBLE CAUSE</u></p> <p>Line Contactor opened up during run.</p> <ul style="list-style-type: none"> • Check connection from PB2 to L coil (-) for loose connection. • Check connection from battery (+) to L coil (+) for loose connection. • Check power connection from battery (+) to contactor L. • Check FU1 and FU3 for blown element. 	<p style="text-align: right;">SC81</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-90	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at zero volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes "on and off".</p> <p><u>POSSIBLE CAUSE</u> User defined status code is displayed by switch closure or motor brush sensor closure to Negative.</p> <ul style="list-style-type: none"> See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> Terminal 1 (TMM7A) is shorted to Negative. Plug PA3 (Pump) is shorted to Negative. Defective input switch (shorted). Defective TMM card. Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC90</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-91	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at zero volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes "on and off".</p> <p><u>POSSIBLE CAUSE</u> User defined status code is displayed by switch closure or motor brush sensor closure to Negative.</p> <ul style="list-style-type: none"> See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> Terminal 3 (TMM7A) is shorted to Negative. Plug PA6 (Pump) is shorted to Negative. Defective input switch (shorted). Defective TMM card. Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC91</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-92	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at zero volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes "on and off".</p> <p><u>POSSIBLE CAUSE</u></p> <p>User defined status code is displayed by switch closure or motor brush sensor closure to Negative.</p> <ul style="list-style-type: none"> • See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> • Terminal 4 (TMM7A) is shorted to Negative. • Plug PB6 (Pump) is shorted to Negative. • Defective input switch (shorted). • Defective TMM card. • Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p style="text-align: right;">SC92</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-93	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes "on and off".</p> <p><u>POSSIBLE CAUSE</u></p> <p>User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> • See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> • Terminal 5 (TMM7A) is shorted to Positive. • Plug PA1 (Pump) is shorted to Positive. • Defective input switch (shorted). • Defective TMM card. • Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p style="text-align: right;">SC93</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-93	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p>SYMPTOM Status Code flashes "on and off".</p> <p>POSSIBLE CAUSE User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> Terminal 6 (TMM7A) is shorted to Positive. Plug PA2 (Pump) is shorted to Positive. Defective input switch (shorted). Defective TMM card. Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC93A</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-94	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p>SYMPTOM Status Code flashes "on and off".</p> <p>POSSIBLE CAUSE User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> Terminal 8 (TMM7A) is shorted to Positive. Plug PA4 (Pump) is shorted to Positive. Defective input switch (shorted). Defective TMM card. Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC94</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-94	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes “on and off”.</p> <p><u>POSSIBLE CAUSE</u> User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> • See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> • Terminal 10 (TMM7A) is shorted to Positive. • Plug PA5 (Pump) is shorted to Positive. • Defective input switch (shorted). • Defective TMM card. • Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC94A</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-95	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes “on and off”.</p> <p><u>POSSIBLE CAUSE</u> User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> • See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> • Terminal 11 (TMM7A) is shorted to Positive. • Plug PZ11 (Pump) is shorted to Positive. • Defective input switch (shorted). • Defective TMM card. • Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC95</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-95	USER DEFINED STATUS CODE See Instructions for Truck Management Module for details.	This status code will be displayed when the voltage at the respective terminal of the TMM or Pump Logic Card is at battery volts.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller & Pump Controller	<p><u>SYMPTOM</u> Status Code flashes “on and off”.</p> <p><u>POSSIBLE CAUSE</u> User defined status code is displayed by switch closure or motor brush sensor closure to Positive.</p> <ul style="list-style-type: none"> • See GEH-TMM7A Truck Management Module Instructions for OEM Defined Status Codes for complete corrective action required. <p>Other causes for status code:</p> <ul style="list-style-type: none"> • Terminal 12 (TMM7A) is shorted to Positive. • Plug PZ10 (Pump) is shorted to Positive. • Defective input switch (shorted). • Defective TMM card. • Defective Pump card. 	<p>WHEN TMM7A CARD IS USED</p> <p>SC95A</p>

TRACTION STATUS CODE	DESCRIPTION OF STATUS	CAUSE OF STATUS INDICATION
-99	USER DEFINED STATUS CODE Maintenance Alert & Speed Limit.	This status code will be displayed when the “normal” hourmeter reading exceeds the “maintenance alert hours” setting for the truck.
MEMORY RECALL NO	CORRECTIVE ACTIONS	<u>TROUBLE-SHOOTING DIAGRAM</u>
Circuits valid for Traction Controller	<p><u>SYMPTOM</u> Status Code is displayed for 4-seconds when the key switch is first turned on, and/or the truck may run at a reduced speed.</p> <p><u>CUSTOMER SELECTED SETTING WITH THE HANDSET:</u> User defined status code is displayed when the normal hourmeter reading exceeds the programmed “maintenance alert hours” setting selected by the user.</p> <ul style="list-style-type: none"> • Maintenance Code Hourmeter, Function 19 & 20 are programmed with the Handset and command the display of status code -99. • If desired, Maintenance Code Speed Limit, Function 21 can be programmed with the Handset. <p>User should perform desired maintenance function.</p>	<p><u>NO DIAGRAM</u></p> <p>USER SHOULD PERFORM THE DESIRED MAINTENANCE FUNCTION</p>

Section 14. COMPONENT TESTING

Note: For disassembly of the capacitor bank and/or component replacement, follow instructions in Section 13.2 Removal of the Capacitor Bank (1C) Assembly and Section 13.3 Disassembly for Component Replacement.

Note: The following component tests can be performed with a meter similar to a Simpson #260, a SEC #CT-500, or a digital meter similar to a Wavetek #110DVM or a TEK #DMM254. The settings for these instruments are shown in the tables below.

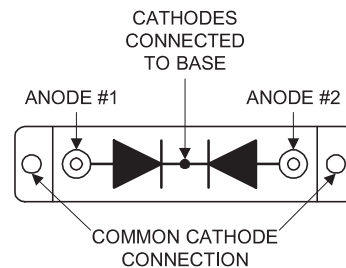
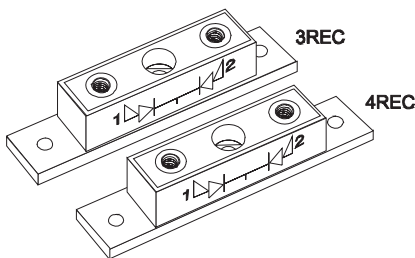
Section 14.1 Diode Modules (3REC AND 4REC)

3REC and 4REC diodes measure about 5 to 15 ohms in the conducting direction (anode to cathode) on the R X 100 scale and 10,000 ohms or higher, in the non-conducting direction (cathode to anode) on the R X 10000 scale.

TEST	DIODE MODULE (3 & 4 REC) COMP TERM ID NUMBER			Analog Scale	Simpson 260	SEC CT-500	DMM Scale	Wavetek 110 DVM	TEK DMM 254
	1	2	BASE						
1	+		-	R x 1	5 ohms	5-6 ohms	Diode	0.181v	0.155v
2		+	-	R x 1	5 ohms	5-6 ohms	Diode	0.182v	0.153v
3	-		+	R x 1	Inf.	Inf.	Diode	O/L	F/S
4		-	+	R x 1	Inf.	Inf.	Diode	O/L	F/S

Note: (+) and (-) refer to Positive & Negative lead of meter.

Note: O/L, F/S, & Inf. indicates beyond meter scale.



Section 14.2 Power Transistor Test (Q1)

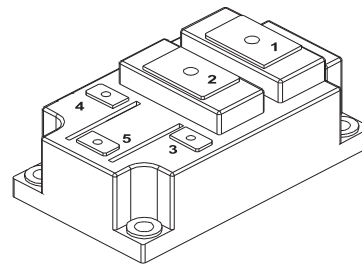
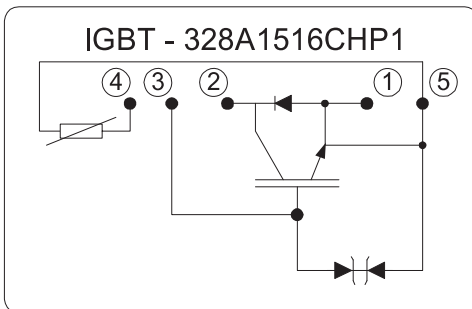
Note: The only Thermal Protector on the SE1000 is internal to the Power Transistor (Q1). To test the thermal protector, read the resistance between PZ5 (WHT/VIO) and PZ1 (WHT/BRN) wires at the card plug the reading should be approximately 750 ohms nominal at 25° C.

Section 14.2 Power Transistor Test (Q1) (Continued)

IGBT MODULE – 328A1516CHP1						Analog Scale	Simpson 260	DMM Scale	Wavetek 110 DVM
COMPONENT TERMINAL IDENTIFICATION NUMBER									
TEST	1	2	3	4	5				
1	+	-	**	**		R x 100	3.6K ohms	200K	41.5K ohms
2	-	+	**	**		R x 10K	55K ohms	200K	41.5K ohms
3				-	+	R x 100	720 ohms	2K	778 ohms
4			+	-		R x 100	Inf.	200K	O/L
5			-	+		R x 100	Inf.	200K	O/L

Note: (+) and (-) refer to Positive & Negative lead of meter.
** Jumper 3 & 4

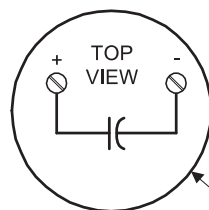
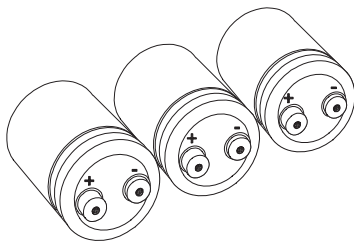
Note: O/L, F/S, & Inf. indicates beyond meter scale.



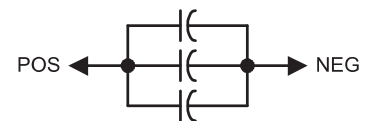
IGBT - 328A1516CHP1

Section 14.3 Capacitor (C1) Test

Note: Electrolytic capacitors can store a significant amount of charge (energy) and must be shorted (discharged) by placing a 200 ohm 2 watt resistor between positive (+) and negative (-) for three seconds or greater.



CAPACITOR BODY



Single Capacitor Test

Measure ohms through the capacitor using the Rx100 scale. Meter should swing toward zero, and then reverse and swing slowly to above 200 ohms. Meter polarity is not critical.

Capacitor Bank Test

Measure ohms through the capacitor using the R x 100 scale. Meter should swing toward zero then reverse and swing slowly to above 2000 ohms. Meter polarity is not critical.

Caution:

- One shorted capacitor in bank, bank fails test.
- One open capacitor in bank, bank passes test. Each Capacitor must be checked individually for open circuit test.