

## 11 — DIAGNOSTICS AND TROUBLESHOOTING

These controllers detect a wide variety of faults or error conditions. Faults can be detected by the operating system or by the VCL code. This chapter describes the faults detected by the operating system

Faults detected by VCL code (faults 51–67 in Table 6) cannot be defined here as they will vary from application to application. Refer to the appropriate OEM documentation for information on these faults.

### DIAGNOSTICS

Diagnostics information can be obtained in either of two ways: (1) by reading the display on a 1313 handheld or 1314 PC programmer or (2) by observing the fault codes issued by the Status LEDs. See Table 5 for a summary of LED display formats.

The 1313 /1314 programmer will display all faults that are currently set as well as a history of the faults that have been set since the history log was last cleared. The 1313/1314 displays the faults by name.

The pair of LEDs built into the controller (one red, one yellow) produce flash codes displaying all the currently set faults in a repeating cycle. Each code consists of two digits. The red LED flashes once to indicate that the first digit of the code will follow; the yellow LED then flashes the appropriate number of times for the first digit. The red LED flashes twice to indicate that the second digit of the code will follow; the yellow LED flashes the appropriate number of times for the second digit.

#### Example:

B+ Undervoltage Cutback (code 23).

In the Fault menu of the 1313/1314 programmer, the words B+ Undervoltage Cutback will be displayed; the real-time battery voltage is displayed in the Monitor menu (“Capacitor Voltage”).

The controller’s two LEDs will display this repeating pattern:

Red	Yellow	Red	Yellow
*	* *	* *	* * *
(first digit)	(2)	(second digit)	(3)

The numerical codes used by the yellow LED are listed in the troubleshooting chart (Table 6), which also lists possible fault causes and describes the conditions that set and clear each fault.

## Summary of LED Display Formats

The two LEDs have four different display modes, indicating the type of information they are providing.

**Table 5 Types of LED Display**

<b>Display</b>	<b>Status</b>
Neither LED illuminated	Controller is not powered on; or vehicle has dead battery; or severe damage.
Yellow LED flashing	Controller is operating normally.
Yellow and red LEDs both on solid	Controller is in Flash program mode.
Red LED on solid	Internal hardware fault detected by the Supervisor or Primary microprocessor. Missing or corrupt software. Interrupting a software download may cause corruption of the software. Cycle KSI to clear. Reload software or replace controller if necessary.
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.

## TROUBLESHOOTING

The troubleshooting chart, Table 6, provides the following information on all the controller faults:

- fault code
- fault name as displayed on the programmer's LCD
- the effect of the fault
- possible causes of the fault
- fault set conditions
- fault clear conditions.

Whenever a fault is encountered and no wiring or vehicle fault can be found, shut off KSI and turn it back on to see if the fault clears. If it does not, shut off KSI and remove the 35-pin connector. Check the connector for corrosion or damage, clean it if necessary, and re-insert it.

The fault actions (effect of fault) in Table 6 use the same bit-structure as the User\_Fault\_Action\_xx listed in the OEM-defined User Faults on page 113. The variable System\_Action (available in WinVCL Monitor or TACT) returns the decimal number corresponding to the active fault action bit(s). The Dual Drive fault actions, Bits 12–15, are listed in the supplemental Dual Drive Operation manual.

System_Action Bit	Action
No defined System_Action	Effect of fault as noted in Table 6
Bit0 = ShutdownMotor	Disable the motor.
Bit1 = ShutdownMainContactor	Shut down the main contactor (only if Main Enable = On)
Bit2 = ShutdownEMBrake	Shut down the EM brake (only if EM Brake Disable Upon Fault = On).
Bit3 = ShutdownThrottle	Set the Throttle_Command = 0%.
Bit4 = ShutdownInterlock	Set the Interlock_State = Off.
Bit5 = ShutdownDriver1	Shut down Driver1.
Bit6 = ShutdownDriver2	Shut down Driver2.
Bit7 = ShutdownDriver3	Shut down Driver3.
Bit8 = ShutdownDriver4	Shut down Driver4.
Bit9 = ShutdownPD	Shut down Proportional Driver
Bit10 = FullBrake	Set the Brake_Command = 100%.
Bit11 = [reserved]	N/A (for 1232–1238E/SE, and 1239E controllers)
Bit12 = TrimDisable	Disable Dual Drive trim calculation.
Bit13 = SevereDual	For Dual Drive system, one controller has a severe fault but the main contactor must stay closed so the other controller can continue to operate.
Bit14 = ShutdownSteer	Steer angle = 0° (DD applicable).
Bit15 = LOSDual	For Dual Drive system, set the max speed to Dual_LOS_Max_Speed parameter for operation in Limited Operating Strategy.

**Example:**

HPD/Sequencing Fault, Flash Code 47.

Effect of fault = Shutdown Throttle.

System\_Action = 8 (equates to Bit3 set: 0000 0000 0000 1000)

Table 6 TROUBLESHOOTING CHART

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
12	<b>Controller Overcurrent</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>External short of phase U,V, or W motor connections.</li> <li>Motor parameters are mis-tuned.</li> <li>Controller defective.</li> <li>Speed encoder noise problems.</li> </ol>	<p><i>Set:</i> Phase current exceeded the current measurement limit.</p> <p><i>Clear:</i> Cycle KSI.</p>
13	<b>Current Sensor Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>Leakage to vehicle frame from phase U, V, or W (short in motor stator).</li> <li>Controller defective.</li> </ol>	<p><i>Set:</i> Controller current sensors have invalid offset reading.</p> <p><i>Clear:</i> Cycle KSI.</p>
14	<b>Precharge Failed</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>See Monitor menu » Battery: Capacitor Voltage.</li> <li>External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging.</li> </ol>	<p><i>Set:</i> The precharge failed to charge the capacitor bank.</p> <p><i>Clear:</i> Cycle Interlock input or use VCL function <i>Enable_Precharge()</i>.</p>
15	<b>Controller Severe Undertemp</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>See Monitor menu » Controller: Temperature.</li> <li>Controller is operating in an extreme environment.</li> </ol>	<p><i>Set:</i> Heatsink temperature below -40°C.</p> <p><i>Clear:</i> Bring heatsink temperature above -40°C, and cycle interlock or KSI.</p>
16	<b>Controller Severe Overtemp</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>See Monitor menu » Controller: Temperature.</li> <li>Controller is operating in an extreme environment.</li> <li>Excessive load on vehicle.</li> <li>Improper mounting of controller.</li> </ol>	<p><i>Set:</i> Heatsink temperature above +95°C.</p> <p><i>Clear:</i> Bring heatsink temperature below +95°C, and cycle interlock or KSI.</p>
17	<b>Severe B+ Undervoltage</b> <i>No drive torque.</i>	<ol style="list-style-type: none"> <li>Battery parameters are misadjusted.</li> <li>Non-controller system drain on battery.</li> <li>Battery resistance too high.</li> <li>Battery disconnected while driving.</li> <li>See Monitor menu » Battery: Capacitor Voltage.</li> <li>Blown B+ fuse or main contactor did not close.</li> </ol>	<p><i>Set:</i> Capacitor bank voltage dropped below the Severe Undervoltage limit (see page 25) with FET bridge enabled.</p> <p><i>Clear:</i> Bring capacitor voltage above Severe Undervoltage limit.</p>
17	<b>Severe KSI Undervoltage</b> <i>No action.</i>	<ol style="list-style-type: none"> <li>See Monitor menu » Battery: Keyswitch Voltage.</li> <li>Non-controller system drain on battery/ KSI circuit wiring.</li> <li>KSI disconnected while driving.</li> <li>Blown KSI fuse.</li> </ol>	<p><i>Set:</i> When below Brownout Voltage for 2 seconds (see Table D-1).</p> <p><i>Clear:</i> Bring KSI voltage above Brownout Voltage.</p>
18	<b>Severe B+ Overvoltage</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>See Monitor menu » Battery: Capacitor Voltage.</li> <li>Battery parameters are misadjusted.</li> <li>Battery resistance too high for given regen current.</li> <li>Battery disconnected while regen braking.</li> </ol>	<p><i>Set:</i> Capacitor bank voltage exceeded the Severe Overvoltage limit (see page 25) with FET bridge enabled.</p> <p><i>Clear:</i> Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.</p>

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
18	<b>Severe KSI Overvoltage</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Incorrect (to high) battery-voltage applied to KSI (pin 1) 2. See Monitor menu » Battery: Keyswitch Voltage.  Note: Prevents the Main Contactor closure if KSI is greater than the Severe Overvoltage limit.	<i>Set:</i> KSI voltage exceeded Severe Overvoltage limit <i>Clear:</i> Bring KSI voltage below the Severe Overvoltage limit (see page 25, Severe Overvoltage)
22	<b>Controller Overtemp Cutback</b> <i>Reduced drive and brake torque.</i>	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	<i>Set:</i> Heatsink temperature exceeded 85°C. <i>Clear:</i> Bring heatsink temperature below 85°C.
23	<b>B+ Undervoltage Cutback</b> <i>Reduced drive torque.</i>	1. Normal operation. Fault indicates the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu » Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	<i>Set:</i> Capacitor bank voltage dropped below the Undervoltage limit (see page 25) with the FET bridge enabled. <i>Clear:</i> Bring capacitor voltage above the Undervoltage limit.
24	<b>B+ Overvoltage Cutback</b> <i>Reduced brake torque. Note: This fault is declared only when the controller is running in regen.</i>	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See Monitor menu » Battery: Capacitor Voltage.	<i>Set:</i> Capacitor bank voltage exceeded the Overvoltage limit (see page 25) with the FET bridge enabled. <i>Clear:</i> Bring capacitor voltage below the Overvoltage limit.
25	<b>+5V Supply Failure</b> <i>None, unless a fault action is programmed in VCL.</i>	1. External load impedance on the +5V supply (pin 26) is too low. 2. See Monitor menu » outputs: 5 Volts and Ext Supply Current.	<i>Set:</i> +5V supply (pin 26) outside the 5V±10% range. <i>Clear:</i> Bring voltage within range.
26	<b>Digital Out 6 Open/Short</b> <i>Digital Output 6 driver will not turn on.</i>	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	<i>Set:</i> Digital Output 6 (pin 19) current exceeded 1 Amp. <i>Clear:</i> Remedy the overcurrent cause and use the VCL function <i>Set_DigOut()</i> to turn the driver on again.
27	<b>Digital Out 7 Open/Short</b> <i>Digital Output 7 driver will not turn on.</i>	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	<i>Set:</i> Digital Output 7 (pin 20) current exceeded 1 Amp. <i>Clear:</i> Remedy the overcurrent cause and use the VCL function <i>Set_DigOut()</i> to turn the driver on again.

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
28	<b>Motor Temp Hot Cutback</b> <i>Reduced drive torque.</i>	<ol style="list-style-type: none"> <li>1. Motor temperature is at or above the programmed Temperature Hot setting, and the current is being cut back.</li> <li>2. Motor Temperature Control Menu parameters are mis-tuned.</li> <li>3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.</li> <li>4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.</li> </ol>	<p><i>Set:</i> Motor temperature is at or above the Temperature Hot parameter setting.</p> <p><i>Clear:</i> Bring the motor temperature within range.</p>
29	<b>Motor Temp Sensor Fault</b> <i>MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.</i>	<ol style="list-style-type: none"> <li>1. Motor thermistor is not connected properly.</li> <li>2. If the application doesn't use a motor thermistor, Motor Temp Sensor Enable should be programmed Off.</li> <li>3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.</li> </ol>	<p><i>Set:</i> Motor thermistor input (pin 8) is at the voltage rail (0 V or 10 V).</p> <p><i>Clear:</i> Bring the motor thermistor input voltage within range.</p>
31	<b>Coil1 Driver Open/Short</b> <i>ShutdownDriver1.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
31	<b>Main Open/Short</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = On.</p> <p><i>Clear:</i> Correct open or short, and cycle driver</p>
32	<b>Coil2 Driver Open/Short</b> <i>ShutdownDriver2.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
32	<b>EMBrake Open/Short</b> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type &gt;0.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
33	<b>Coil3 Driver Open/Short</b> <i>ShutdownDriver3.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Driver 3 (pin 4) is either open or shorted.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
34	<b>Coil4 Driver Open/Short</b> <i>ShutdownDriver4.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Driver 4 (pin 3) is either open or shorted.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
35	<b>PD Open/Short</b> <i>ShutdownPD.</i>	<ol style="list-style-type: none"> <li>1. Open or short on driver load.</li> <li>2. Dirty connector pins.</li> <li>3. Bad crimps or faulty wiring.</li> </ol>	<p><i>Set:</i> Proportional driver (pin 2) is either open or shorted.</p> <p><i>Clear:</i> Correct open or short, and cycle driver.</p>
36	<b>Encoder Fault</b> <i>ShutdownEMBrake;</i> Motor disabled.	<ol style="list-style-type: none"> <li>1. Motor encoder failure.</li> <li>2. Bad crimps or faulty wiring.</li> <li>3. See Monitor menu » Motor: Motor RPM.</li> </ol>	<p><i>Set:</i> Motor encoder phase failure detected.</p> <p><i>Clear:</i> Either cycle KSI, or if parameter LOS Upon Encoder Fault= On and Interlock has been cycled, then the Encoder Fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.</p>
36	<b>Sin/Cos Sensor Fault</b> <i>ShutdownEMBrake;</i> Motor disabled.	<ol style="list-style-type: none"> <li>1. Sin/Cos sensor failure.</li> <li>2. Bad crimps or faulty wiring.</li> <li>3. See Monitor menu » Motor: Motor RPM.</li> </ol>	<p><i>Set:</i> Greater than Sin_Cos_Fault_Threshold % difference from expected value between two phases seen 5 times within one second.</p> <p><i>Clear:</i> Cycle KSI, or VCL reset, or Entry into LOS mode if enabled, (or entry into an ACIM auto-characterization).</p>

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
37	<b>Motor Open</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Motor phase is open. 2. Bad crimps or faulty wiring.	<i>Set:</i> Motor phase U, V, or W detected open. <i>Clear:</i> Cycle KSI.
38	<b>Main Contactor Welded</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	<i>Set:</i> Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. <i>Clear:</i> Cycle KSI
39	<b>Main Contactor Did Not Close</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact.* 3. External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.	<i>Set:</i> With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. <i>Clear:</i> Cycle KSI.  *New contactors may need to be cycled electrically & mechanically to remove any non-conductive material on the tips. Use reduced voltage (e.g., 12V) to prevent tip damage through excessive arcing.
41	<b>Throttle Wiper High</b> <i>ShutdownThrottle.</i>	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	<i>Set:</i> Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function <i>Setup_Pot_Faults()</i> ). <i>Clear:</i> Bring throttle pot wiper voltage below the fault threshold.
42	<b>Throttle Wiper Low</b> <i>ShutdownThrottle.</i>	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too low.	<i>Set:</i> Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function <i>Setup_Pot_Faults()</i> ). <i>Clear:</i> Bring throttle pot wiper voltage above the fault threshold.
43	<b>Pot2 Wiper High</b> <i>FullBrake.</i>	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too high.	<i>Set:</i> Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function <i>Setup_Pot_Faults()</i> ). <i>Clear:</i> Bring Pot2 wiper voltage below the fault threshold.
44	<b>Pot2 Wiper Low</b> <i>FullBrake.</i>	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too low.	<i>Set:</i> Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function <i>Setup_Pot_Faults()</i> ). <i>Clear:</i> Bring Pot2 wiper voltage above the fault threshold.
45	<b>Pot Low OverCurrent</b> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. See Monitor menu » Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	<i>Set:</i> Pot low (pin 18) current exceeds 10 mA. <i>Clear:</i> Clear pot low overcurrent condition and cycle KSI.
46	<b>EEPROM Failure</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	<i>Set:</i> Controller operating system tried to write to EEPROM memory and failed. <i>Clear:</i> Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
47	<b>HPD/Sequencing Fault</b> <i>ShutdownThrottle.</i>	<ol style="list-style-type: none"> <li>1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence.</li> <li>2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs.</li> <li>3. See Monitor menu » Inputs.</li> </ol>	<p><i>Set:</i> HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs.</p> <p><i>Clear:</i> Reapply inputs in correct sequence.</p>
47	<b>Emer Rev HPD</b> <i>ShutdownThrottle;</i> <i>ShutdownEMBrake.</i>	<ol style="list-style-type: none"> <li>4. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.</li> </ol>	<p><i>Set:</i> At the conclusion of Emergency Reverse, the fault was set because various inputs were not returned to neutral.</p> <p><i>Clear:</i> If EMR_Interlock = On, clear the interlock, throttle, and direction inputs. If EMR_Interlock = Off, clear the throttle and direction inputs.</p>
49	<b>Parameter Change Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.</li> </ol>	<p><i>Set:</i> Adjustment of a parameter setting that requires cycling of KSI.</p> <p><i>Clear:</i> Cycle KSI.</p>
51-67	<b>OEM Faults</b> <i>(See OEM documentation.)</i>	<ol style="list-style-type: none"> <li>1. These faults can be defined by the OEM and are implemented in the application-specific VCL code. See OEM documentation.</li> </ol>	<p><i>Set:</i> See OEM documentation.</p> <p><i>Clear:</i> See OEM documentation.</p>
68	<b>VCL Run Time Error</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. VCL code encountered a runtime VCL error.</li> <li>2. See Monitor menu » Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.</li> </ol>	<p><i>Set:</i> Runtime VCL code error condition.</p> <p><i>Clear:</i> Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.</p>
69	<b>External Supply Out of Range</b> <i>None, unless a fault action is programmed in VCL.</i>	<ol style="list-style-type: none"> <li>1. External load on the 5V and 12V supplies draws either too much or too little current.</li> <li>2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mis-tuned.</li> <li>3. See Monitor menu » Outputs: Ext Supply Current.</li> </ol>	<p><i>Set:</i> The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings (page 54).</p> <p><i>Clear:</i> Bring the external supply current within range.</p>
71	<b>OS General</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. Internal controller fault.</li> </ol>	<p><i>Set:</i> Internal controller fault detected.</p> <p><i>Clear:</i> Cycle KSI.</p>
72	<b>PDO Timeout</b> <i>ShutdownThrottle;</i> CAN NMT State set to Pre-operational.	<ol style="list-style-type: none"> <li>1. Time between CAN PDO messages received exceeded the PDO Timeout Period.</li> </ol>	<p><i>Set:</i> Time between CAN PDO messages received exceeded the PDO Timeout Period.</p> <p><i>Clear:</i> Cycle KSI or receive CAN NMT message.</p>



Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
73	<b>Stall Detected</b> <i>ShutdownEMBrake;</i> Motor disabled; Control Mode changed to LOS (Limited Operating Strategy).	<ol style="list-style-type: none"> <li>1. Stalled motor.</li> <li>2. Motor encoder failure.</li> <li>3. Bad crimps or faulty wiring.</li> <li>4. Problems with power supply for the motor encoder.</li> <li>5. See Monitor menu » Motor: Motor RPM.</li> </ol>	<p><i>Set:</i> No motor encoder movement detected.</p> <p><i>Clear:</i> Either cycle KSI, or if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Stall Detected fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.</p>
74	<b>Fault On Other Traction Controller</b>	<ol style="list-style-type: none"> <li>1. Dual Drive fault: see Dual Drive manual.</li> </ol>	
75	<b>Dual Severe Fault</b>	<ol style="list-style-type: none"> <li>1. Dual Drive fault: see Dual Drive manual.</li> </ol>	
77	<b>Supervisor Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. The Supervisor has detected a mismatch in redundant readings.</li> <li>2. Internal damage to Supervisor microprocessor.</li> <li>3. Switch inputs allowed to be within upper and lower thresholds for over 100 milliseconds. (for recurring errors, check the switches for moisture).</li> </ol>	<p><i>Set:</i> Mismatched redundant readings; damaged Supervisor; illegal switch inputs.</p> <p><i>Clear:</i> Check for noise or voltage drift in all switch inputs; check connections; cycle KSI.</p>
78	<b>Supervisor Incompatible</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. The main OS is not compatible with the Supervisor OS.</li> </ol>	<p><i>Set:</i> Incompatible software.</p> <p><i>Clear:</i> Load properly matched OS code or update the Supervisor code; cycle KSI.</p>
82	<b>Bad Calibrations</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. Internal controller fault.</li> </ol>	<p><i>Set:</i> Internal controller fault detection.</p> <p><i>Clear:</i> Cycle KSI.</p>
83	<b>Driver Supply</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	<ol style="list-style-type: none"> <li>1. Internal controller fault in the voltage supply for the driver circuits.</li> </ol>	<p><i>Set:</i> Internal controller fault detection.</p> <p><i>Clear:</i> Cycle KSI.</p>

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
87	<b>Motor Characterization Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0 = sequencing error. Normally caused by turning off Motor Characterization Test Enable before running the test. 1 = encoder signal seen but step size not auto-detected; set up Encoder Steps manually 2 = motor temp sensor fault 3 = motor temp hot cutback fault 4 = controller overtemp cutback fault 5 = controller undertemp cutback fault 6 = undervoltage cutback fault 7 = severe overvoltage fault 8 = encoder signal not seen, or one or both channels missing 9 = motor parameters out of characterization range 20 = Sin/Cos sensor not found 21 = phasing not detected 22 = Sin/Cos sensor characterization failure 23 = started characterization procedure while motor rotating.	<i>Set:</i> Motor characterization failed during the motor characterization process. Normally caused by turning off Motor_Characterization_Test_Enable before running test. Needs controller reset. <i>Clear:</i> Correct fault; cycle KSI, or VCL reset.
88	<b>Encoder Pulse Count Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	1. Encoder Steps parameter does not match the actual motor encoder.	<i>Set:</i> Detected wrong setting of the Encoder Steps parameter. <i>Clear:</i> Ensure the Encoder Steps parameter matches the actual encoder; cycle KSI.
89	<b>Motor Type Fault</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	2. The Motor_Type parameter value is out of range.	<i>Set:</i> Motor_Type parameter is set to an illegal value. <i>Clear:</i> Set Motor_Type to correct value and cycle KSI.

Table 6 TROUBLESHOOTING CHART cont'd

CODE	PROGRAMMER LCD DISPLAY EFFECT OF FAULT	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
91	<b>VCL/OS Mismatch</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>ShutdownInterlock;</i> <i>ShutdownDriver1;</i> <i>ShutdownDriver2;</i> <i>ShutdownDriver3;</i> <i>ShutdownDriver4;</i> <i>ShutdownPD;</i> <i>FullBrake.</i>	1. The VCL software in the controller does not match the OS software in the controller.	<i>Set:</i> VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not.  <i>Clear:</i> Download the correct VCL and OS software into the controller.
92	<b>EM Brake Failed to Set</b> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle.</i> Position Hold is engaged when Interlock = On.	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	<i>Set:</i> After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. <i>Clear:</i> 1. Activate the Throttle (EM Brake type 2). 2. Activate the Interlock (EM Brake type 1).
93	<b>Encoder LOS (Limited Operating Strategy)</b> Enter LOS control mode.	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detected fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle is stalled.	<i>Set:</i> Encoder Fault (code 36) or Stall Detected (code 73) was activated, if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Encoder LOS (code 93) control mode is activated, allowing limited motor control. <i>Clear:</i> Cycle KSI or, if LOS mode was activated by the Stall Detected fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.
94	<b>Emer Rev Timeout</b> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle.</i>	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	<i>Set:</i> Emergency Reverse was activated and ran until the EMR Timeout timer expired. <i>Clear:</i> Turn the emergency reverse input Off.
98	<b>Illegal Model Number</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Model_Number variable contains illegal value. 2. Software and hardware do not match. 3. Controller defective.	<i>Set:</i> Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_Number, and a fault is issued if one is not found. <i>Clear:</i> Download appropriate software for your controller model.
99	<b>Parameter Mismatch</b> <i>ShutdownMotor;</i> <i>ShutdownMainContactor;</i> <i>ShutdownEMBrake;</i> <i>ShutdownThrottle;</i> <i>FullBrake.</i>	1. Dual drive enabled on only one controller. 2. Incorrect position feedback type chosen for motor technology in use. 3. Dual drive is enabled in torque mode.	<i>Set:</i> When the Dual Drive software is enabled, the controller must be set to either Speed Mode Express or Speed Mode; otherwise this fault is set. Motor Techology=0 must be paired with Feedback Type=1, and Motor Technology=1 must be paired with Feedback Type=2; otherwise this fault is set. <i>Clear:</i> Adjust parameters to appropriate values and cycle KSI.