KÄRCHER

MEMORANDUM

DATE: March 28, 2023

TO: Justin Lamar
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FROM: Jeffrey Bernath

RE: T-Rex Troubleshooting Guide Rev 4

The purpose of this memo is to document the first steps that should be taken in the event that the machine does not function. Further assistance from the team at KNA may be needed if the issues persist.

Machine Info

The Deluxe machine includes a "Machine info" section in the settings menu. This can be used to help trouble shoot the machine. Navigate "Machine info" using the following path:

Setting button>Configuration>Machine info

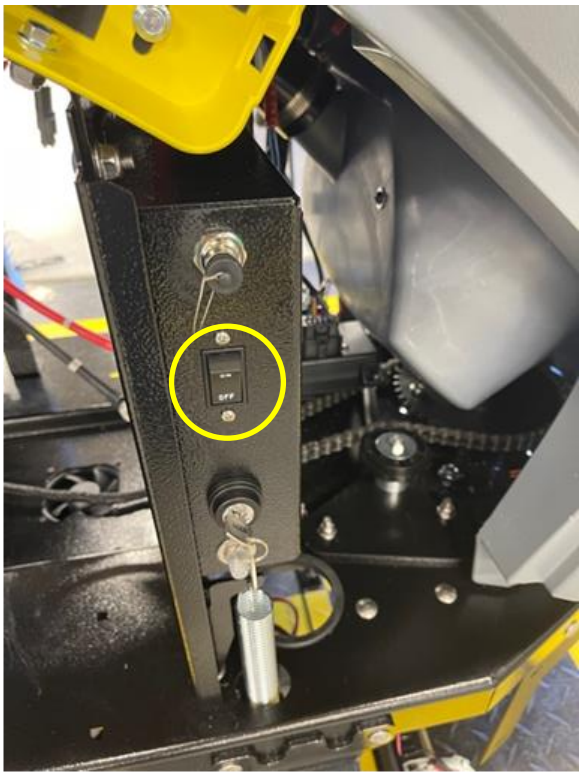
The following is a list of items that can be found in the "Machine info" section.

- Machine Hours
- Serial Number
- Software

See TREX Deluxe - Flowchart Quick View_20210907.pdf.

Reset the Machine

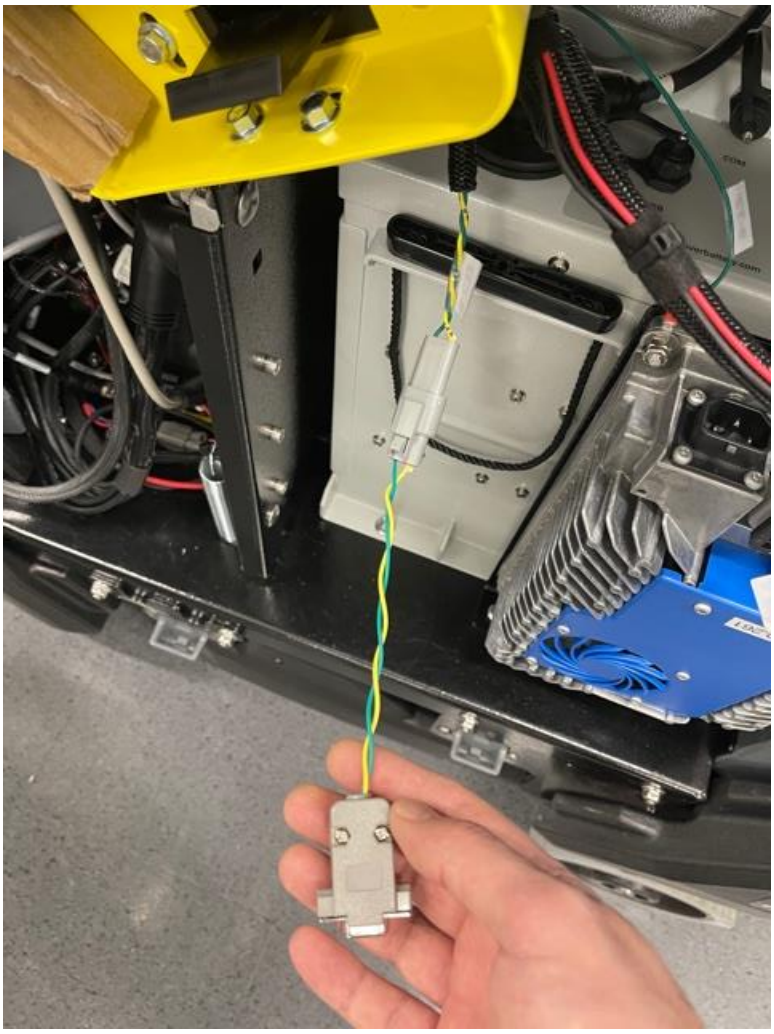
Reset machine by turning on the main breaker for 5 seconds then turning back on. The horn will beep if the machine was successfully reset. This should take care of most issues.



[Figure 1: Main Breaker]

Check Diagnostic Message Over CAN

CAN1 can be accessed from the left side of the machine with the included CAN1 cable (see Figure 3). The CAN Interpreter can be used to check if any lockout conditions are present and can be used to check warning and error codes.



[Figure 2: CAN1 access]

Diagnostic messages are sent on CAN ID 10FF8001h (see Table 1).

Byte	Description	Values
Byte 0	Error/Waring codes	See (Table 2: Warnings and Error Codes). The warning/error code will be display in the lower right corner of a warning of error screen (see Figure 3) .
Byte 2	Lockouts 1 = asserted	Bit 0 – E-stop Bit 1 – Key switch Bit 2 – Door interlock Bit 3 – Bag presences Bit 4 – Brake release Bit 5 – Reserved Bit 6 – Operator presences invalid state Bit 7 – Fault state
Byte 3	Lockouts 1 = asserted	Bit 0 – AC power to charger/ Operator presences invalid state Bit 1 – Low battery Bit 2 – Dead battery Bit 3 – Stalled actuator Bit 4 – Bag full Bit 5 – Brake disconnected Bit 6 – Error state Bit 7 – Missing Battery CAN messages
Byte 4	Lockouts 1 = asserted	Bit 0 – Missing Serial number Bit 1 – Contactor Welded Bit 2 – Contactor Coil Bit 3 – Contactor Pre-Charge Bit 4 – Contactor Open Bit 5 – Maintenance required Bit 6 – Missing Brain CAN timeout Bit 7 – Missing CAN message at start up
Byte 5	Lockouts 1 = asserted	Bit 0 – Safety Micro Asserted Bit 1 – Throttle Not in the Neutral Position Bit 2 - Error state, but transport is enabled

[Table 1: Diagnostic CAN Message, CAN ID 10FF8001h]

[Figure 3: Example Error/Warning Page]

Hex Code	Description of failure	Corrective actions
01	Brush Motor Overheat (Transportable Error)	• Inspect brush motor for damage. • Inspect brush motor thermistor for damage. • Measure the resistance across the brush motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect the following conductors for damage: - E1 - E2 - B35 - B34 - A57 - A56 • Inspect the following connectors for damage: - B-C24 - E-C1 - B-C2 - A-C9 - A-C12 • Replace controller (8644-283.0) if all other checks are good.
02	Brush Motor Overcurrent (Transportable Error)	• Inspect brush motor for damage. • Inspect the following conductors for damage: - B65 - B64 - B63 • Inspect the following connectors for damage: - B-C22 - B-C23 - B-C14 - B-T21 - B-T27
03	Brush Motor Short (Transportable Error)	• Check for: - Faulty motor. - Loose/broken connection to motor on large motor leads. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect brush motor for damage. • Inspect the following conductors for damage (short circuit): - B65 - B64 - B63 • Inspect the following connectors for damage (short circuit): - B-C22 - B-C23 - B-C14 - B-T21 - B-T27 • Check motor resistance. What is a short according to the DMC? • Replace controller (8.644-283.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
04	Brush Motor Low FET Error (Transportable Error)	• Power up test on low side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect brush motor for damage. • Inspect the following conductors for damage: - B65 - B64 - B63 • Inspect the following connectors for damage: - B-C22 - B-C23 - B-C14 - B-T21 - B-T27 • Replace controller (8.644-283.0) if all other checks are good.
05	Brush Montoro High FET Error (Transportable Error)	• Power up test on high side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect brush motor for damage. • Inspect the following conductors for damage: - B65 - B64 - B63 • Inspect the following connectors for damage: - B-C22 - B-C23 - B-C14 - B-T21 - B-T27 • Replace controller (8.644-283.0) if all other checks are good.
06	Brush Motor Internal Motor Controller Error (Transportable Error)	• Motor Controller problem detected. • Replace controller (8.644-283.0).
07	Brush Motor Unknown Motor Controller Error	• Motor Controller problem detected. • Replace controller (8.644-283.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
08	Brush Motor External Temperature Sensor Error (Transportable Error)	• A problem was detected with the external temperature sensor. • Inspect brush motor thermistor for damage. • Measure the resistance across the brush motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect the following conductors for damage: - E1 - E2 - B35 - B34 - A57 - A56 • Inspect the following connectors for damage: - B-C24 - E-C1 - B-C2 - A-C9 - A-C12 • Replace controller (8.644-283.0) if all other checks are good.
09	Side Broom Motor Overheat (Transportable Error)	• Inspect side broom motor for damage. • Inspect side broom motor thermistor for damage. • Measure the resistance across the side broom motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect the following conductors for damage: - F1 - F2 - B39 - B38 - A61 - A60 • Inspect the following connectors for damage: - B-C26 - F-C1 - B-C2 - A-C9 - A-C15
0A	Side Broom Motor Overcurrent (Transportable Error)	• Inspect side broom motor for damage. • Inspect the following conductors for damage: - B55 - B56 - B57 • Inspect the following connectors for damage: - B-C7 - B-C8 - B-C15 - B-T22 - B-T28

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
0B	Side Broom Motor Open Circuit (Transportable Error)	• Inspect side broom motor for damage (open circuit). • Inspect side broom motor breaker for damage (open circuit). • Inspect the following conductors for damage (open circuit): - B55 - B56 - B57 • Inspect the following connectors for damage (open circuit): - B-C7 - B-C8 - B-C15 - B-T22 - B-T28
0C	Side Broom Motor Short (Transportable Error)	• Check for: - Faulty motor. - Loose/broken connection to motor on large motor leads. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect side broom motor for damage. • Inspect the following conductors for damage (short circuit): - B55 - B56 - B57 • Inspect the following connectors for damage (short circuit): - B-C7 - B-C8 - B-C15 - B-T22 - B-T28 Check motor resistance. What is a short according to the DMC? • Replace controller (8.644-771.0) if all other checks are good.
0D	Side Broom Motor Low FET Error (Transportable Error)	• Power up test on low side FET detected a problem. - Check battery voltage - Check motor wiring • After the condition is corrected, cycle the key switch to clear the fault. • Inspect side broom motor for damage. • Inspect the following conductors for damage: - B55 - B56 - B57 • Inspect the following connectors for damage: - B-C7 - B-C8 - B-C15 - B-T22 - B-T28 • Replace controller (8.644-771.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
0E	Side Broom Motor High FET Error (Transportable Error)	• Power up test on high side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect side broom motor for damage. • Inspect the following conductors for damage: - B55 - B56 - B57 • Inspect the following connectors for damage: - B-C7 - B-C8 - B-C15 - B-T22 - B-T28 • Replace controller (8.644-771.0) if all other checks are good.
0F	Side Broom Motor Internal Motor Controller Error (Transportable Error)	• Motor Controller problem detected. • Replace controller (8.644-771.0).
10	Side Broom Motor Unknown Motor Controller Error	• Motor Controller problem detected. • Replace controller (8.644-771.0).
11	Side Broom Motor External Temperature Sensor Error (Transportable Error)	• A problem was detected with the external temperature sensor. • Inspect side broom motor thermistor for damage. • Measure the resistance across the side broom motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect the following conductors for damage. - F1 - F2 - B39 - B38 - A61 - A60 • Inspect the following connectors for damage. - B-C26 - F-C1 - B-C2 - A-C9 - A-C15

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
12	Brake Manually Released	• Inspect brake switch. • Inspect the following conductors for damage: - D3 - D4 - B19 - B76 - B75 splice to splice - B9 splice to splice - B5 - A65 - A96 splice to splice - A12 - A29 • Inspect the following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage: - D43 - Q18
13	Drive Motor Short	• Check for: - Faulty motor. - Loose/broken connection to motor on large motor leads. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect traction motor for damage. • Inspect the following conductors for damage (short circuit): - B52 - B53 - B54 - D1 - D2 • Inspect the following connectors for damage (short circuit): - B-C5 - B-C6 - B-C12 - B-T19 - B-T25 - D-C1 - D-T1 - D-T2 • Check motor resistance. What is a short according to the DMC? • Replace controller (8.644-283.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
14	Drive Motor Low FET Error	• Power up test on low side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect traction motor for damage. • Inspect the following conductors for damage: - B52 - B53 - B54 - D1 - D2 • Inspect the following connectors for damage: - B-C5 - B-C6 - B-C12 - B-T19 - B-T25 - D-C1 - D-T1 - D-T2 • Replace controller (8.644-283.0) if all other checks are good.
15	Drive Motor High FET Error	• Power up test on high side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect traction motor for damage. • Inspect the following conductors for damage: - B52 - B53 - B54 - D1 - D2 • Inspect the following connectors for damage: - B-C5 - B-C6 - B-C12 - B-T19 - B-T25 - D-C1 - D-T1 - D-T2 • Replace controller (8.644-283.0) if all other checks are good.
16	Drive Motor Internal Motor Controller Error	• Motor Controller problem detected. • Replace controller (8.644-283.0).
17	Drive Motor Unknown Motor Controller Error	• Motor Controller problem detected. • Replace controller (8.644-283.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
18	Brake Detect Error	• Inspect brake. • Inspect the following conductors for damage. - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect the following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage: - U13 - Q7 - U54
19	Drive Motor External Temperature Sensor Error	• A problem was detected with the external temperature sensor. • Inspect traction motor thermistor for damage. • Measure the resistance across the side broom motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect the following conductors for damage: - R1 - R2 - D8 - D7 - B33 - B32 - A55 - A54 • Inspect the following connectors for damage: - D-C3 - R-C1 - D-C1 - B-C11 - B-C2 - A-C11 • Replace controller (8.644-283.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
1A	Drive Motor Open Circuit	• Inspect traction motor for damage. • Inspect breaker. • Inspect brake. • Inspect the following conductors for damage (open circuit): - B52 - B53 - B54 - D1 - D2 - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect the following connectors for damage (open circuit): - B-C5 - B-C6 - B-C12 - B-T19 - B-T25 - D-C1 - D-T1 - D-T2 - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage. - U13 - Q7 - U13

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
1B	Drive Motor Overheat	• Inspect motor for damage and replace if necessary. • Inspect thermistor and thermistor harness. • Check if brake disengages when propelling. • Inspect traction motor thermistor for damage. • Measure the resistance across the side broom motor thermistor (acceptable range 2KΩ-50KΩ). • Inspect traction motor for damage. • Inspect brake. • Inspect the following conductors for damage (open circuit).=: - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 - R1 - R2 - D8 - D7 - B33 - B32 - A55 - A54 • Inspect the following connectors for damage (open circuit): - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 - D-C3 - R-C1 - D-C1 - B-C11 - B-C2 - A-C11 • Inspect the following components, and nearby components, on the main controller for damage: - U13 - Q7 - U13 • Replace controller (8.644-283.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
1C	Vacuum Motor Short (Transportable Error)	• Check for” - Faulty motor. - Loose/broken connection to motor on large motor leads. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect vacuum motor for damage. • Inspect the following conductors for damage (short circuit): - B62 - B63 - B64 • Inspect the following connectors for damage (short circuit): - B-C13 - B-C20 - B-C21 - B-T20 - B-T26 • Check motor resistance. What is a short according to the DMC? • Can this be caused by damage to the DMC?
1D	Vacuum Motor Low FET Error (Transportable Error)	• Power up test on low side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect vacuum motor for damage. • Inspect the following conductors for damage (short circuit): - B62 - B63 - B64 • Inspect the following connectors for damage (short circuit): - B-C13 - B-C20 - B-C21 - B-T20 - B-T26 • Replace controller (8.644-771.0) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
1E	Vacuum Motor High FET Error (Transportable Error)	• Power up test on high side FET detected a problem. - Check battery voltage. - Check motor wiring. • After the condition is corrected, cycle the key switch to clear the fault. • Inspect vacuum motor for damage. • Inspect the following conductors for damage (short circuit): - B62 - B63 - B64 • Inspect the following connectors for damage (short circuit): - B-C13 - B-C20 - B-C21 - B-T20 - B-T26 • Replace controller (8.644-771.0) if all other checks are good.
1F	Vacuum Motor Internal Motor Controller Error (Transportable Error)	• Motor Controller problem detected. • Replace controller (8.644-771.0).
20	Vacuum Motor Unknown Motor Controller Error	• Motor Controller problem detected. • Replace controller (8.644-771.0).
21	Vacuum Motor Overcurrent Error (Transportable Error)	• Inspect vacuum motor for damage or debris. • Inspect the following conductors for damage (short circuit): - B62 - B63 - B64 • Inspect the following connectors for damage (short circuit): - B-C13 - B-C20 - B-C21 - B-T20 - B-T26

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
22	Vacuum Motor Open Circuit (Transportable Error)	• Inspect vacuum motor for damage or debris. • Inspect vacuum motor breaker. • Inspect the following conductors for damage (open circuit): - B62 - B63 - B64 • Inspect the following connectors for damage (open circuit): - B-C13 - B-C20 - B-C21 - B-T20 - B-T26
23	Clogged Hose, Hopper, or Bag (Transportable Error)	• Inspect the vacuum sensor. • Inspect the following conductors for damage (open circuit): - B40 - B41 - A82 - A81 - A12 • Inspect the following connectors for damage (open circuit): - B-C2 - A-C9 - A-C6 - B-T33 - B-T34 • Inspect the following components, and nearby components, on the main controller for damage: - D43 - Q20

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
24	Actuator Overcurrent	• Inspect the actuator for damage. • Inspect the deck linkage for damage. • Inspect the following conductors for damage: - A13 - A14 - A15 - A16 - A17 - B20 - B21 - B22 - B23 - B24 - B25 - B26 - B27 • Inspect the following connectors for damage: - A-C6 - A-C8 - B-C1 - B-C16 • Inspect the following components, and nearby components, on the main controller for damage: - D6 - D7 - Q3 - Q4 - Q5 - Q6 - U11

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
25	Traction Motor DMC Over Temperature	• The on-board temperature sensor is indicating an out-of-range condition. Check for: - Operating in extreme environment, - Excessive load, - Faulty or disconnected brake engaged while driving. Allowing controller to cool may restore full power and/or allow motion. If the problem persists, the controller PCB may be damaged. • Inspect console area. • Check operating conditions. • Inspect brake. • Inspect the following conductors for damage: - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect the following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage: - U13 - Q7 - U54 • Replace controller (8.644-283.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
26	Brush Motor DMC Over Temperature (Transportable Error)	• The on-board temperature sensor is indicating an out-of-range condition. Check for: - Operating in extreme environment, - Excessive load, - Faulty or disconnected brake engaged while driving. Allowing controller to cool may restore full power and/or allow motion. If the problem persists, the controller PCB may be damaged. • Inspect console area. • Check operating conditions. • Inspect brake. • Inspect the following conductors for damage: - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect the following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following component and nearby components. On the main controller for damage: - U13 - Q7 - U54 • Replace controller (8.644-283.0).
27	Side Broom Motor DMC Over Temperature (Transportable Error)	• The on-board temperature sensor is indicating an out-of-range condition. Check for: - Operating in extreme environment. - Excessive load. - Faulty or disconnected brake engaged while driving. Allowing controller to cool may restore full power and/or allow motion. If the problem persists, the controller PCB may be damaged. • Inspect console area. • Check operating conditions. • Replace controller (8.644-771.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
28	Vacuum Motor DMC Over Temperature (Transportable Error)	• The on-board temperature sensor is indicating an out-of-range condition. Check for: - Operating in extreme environment, - Excessive load, - Faulty or disconnected brake engaged while driving. Allowing controller to cool may restore full power and/or allow motion. If the problem persists, the controller PCB may be damaged. • Inspect console area. • Check operating conditions. • Replace controller (8.644-771.0).
29	Traction Motor DMC Temperature Error (FET)	• The FET (Field Effect Transistor) temperature sensor on-board has indicated a temperature above the allowable limit. Check for: - Operating in extreme environment. - Excessive load. - Faulty or disconnected brake engaged while driving. Allowing controller to cool will restore full power and/or allow motion. • Inspect console area. • Check operating conditions. • Inspect brake. • Inspect The following conductors for damage: - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect The following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage: - U13 - Q7 - U54 • Replace controller (8.644-283.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
2A	Brush Motor DMC Temperature Error (FET) (Transportable Error)	• The FET (Field Effect Transistor) temperature sensor on-board has indicated a temperature above the allowable limit. Check for: - Operating in extreme environment. - Excessive load. - Faulty or disconnected brake engaged while driving. Allowing controller to cool will restore full power and/or allow motion. • Inspect console area. • Check operating conditions. • Inspect brake. • Inspect The following conductors for damage: - D5 - D6 - B28 - B77 - B75 (splice to splice) - B9 (splice to splice) - B5 - A65 - A96 (splice to splice) - A12 - A19 • Inspect The following connectors for damage: - D-C4 - D-C1 - B-C11 - B-C1 - A-C8 - A-C6 • Inspect the following components, and nearby components, on the main controller for damage: - U13 - Q7 - U54 • Replace controller (8.644-283.0).
2B	Side Broom Motor DMC Temperature Error (FET) (Transportable Error)	• The FET (Field Effect Transistor) temperature sensor on-board has indicated a temperature above the allowable limit. Check for: - Operating in extreme environment. - Excessive load. - Faulty or disconnected brake engaged while driving. Allowing controller to cool will restore full power and/or allow motion. • Inspect console area. • Check operating conditions. • Replace controller (8.644-771.0).

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
2C	Vacuum Motor DMC Temperature Error (FET) (Transportable Error)	• The FET (Field Effect Transistor) temperature sensor on-board has indicated a temperature above the allowable limit. Check for: - Operating in extreme environment. - Excessive load. - Faulty or disconnected brake engaged while driving. Allowing controller to cool will restore full power and/or allow motion. • Inspect console area. • Check operating conditions. • Replace controller (8.644-771.0).
2D	Serial Number Error - Missing Serial Number (Transportable Error)	• If any of the PCB have been changed refer to the installation instructions for proper procedure. • Contact manufacture.
2E	Lithium Battery CAN Communication Error - Battery CAN Module Unplugged, Installed Backwards, or damaged.	• Check lynk for damage or improper installation (backwards). • Inspect The following conductors for damage: - B85 - B86 • Inspect The following connectors for damage: - B-C32
2F	Received too many Errors in a Short Amount of Time.	• Review error log on LCD and see other errors for resolution.
30	Contactor Error (Welded) - Damaged Contactor	• Inspect contactor • Inspect contactor diodes • Inspect The following conductors for damage: - A38 - A87 - A88 - B43 - B31 - L1 • Inspect The following connectors for damage: - A-C9 - A-C3 - A-T6 - A-T3 - B-T36 - B-T35 - B-C2 - L-T1 - L-T2 • Inspect the following components, and nearby components, on the main controller for damage: - D25 - Q11 - Q13 - D34

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
31	Contactor Error (Open) - Damaged Contactor	• Inspect contactor • Inspect contactor diodes • Inspect The following conductors for damage: - A38 - A87 - A88 - B43 - B31 - L1 • Inspect The following connectors for damage: - A-C9 - A-C3 - A-T6 - A-T3 - B-T36 - B-T35 - B-C2 - L-T1 - L-T2 • Inspect the following components, and nearby components, on the main controller for damage: - D25 - Q11 - Q13 - D34
32	Brush Motor Open Circuit (Transportable Error)	• Inspect brush motor for damage (open circuit). • Inspect brush motor breaker for damage (open circuit). • Inspect The following conductors for damage (open circuit): - B65 - B64 - B63 • Inspect The following connectors for damage (open circuit): - B-C22 - B-C23 - B-C14 - B-T21 - B-T27

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
33	Brush Motor High Voltage Protect Error (Transportable Error)	• High voltage was detected on the motor outputs. Check for disconnected power cables. - Reconnect cables. • After the condition is corrected, returning the throttle to neutral will clear the fault. • Inspect The following conductors for damage: - H5 - H6 - H7 - H8 - L1 - P1 - J1 - B65 - B64 - B63 - Main breaker/Contactor Bus Bar • Inspect The following connectors for damage: - H-C3 - H-C4 - H-T5 - H-T7 - H-T6 - H-T8 - L-T1 - L-T2 - P-T1 - P-T2 - J-T1 - J-T2 - B-C22 - B-C23 - B-C14 - B-T21 - B-T27

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
34	Side Broom Motor High Voltage Protect Error (Transportable Error)	• High voltage was detected on the motor outputs. Check for disconnected power cables. - Reconnect cables. • After the condition is corrected, returning the throttle to neutral will clear the fault. • Inspect The following conductors for damage: - H1 - H2 - H3 - H4 - L1 - P1 - J1 - B55 - B56 - B57 - Main breaker/Contactor Bus Bar • Inspect The following connectors for damage: - H-C1 - H-C2 - H-T1 - H-T2 - H-T3 - H-T4 - L-T1 - L-T2 - P-T1 - P-T2 - J-T1 - J-T2 - B-C7 - B-C8 - B-C15 - B-T22 - B-T28

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
35	Drive Motor High Voltage Protect Error	• High voltage was detected on the motor outputs. Check for disconnected power cables. - Reconnect cables. • After the condition is corrected, returning the throttle to neutral will clear the fault. • Inspect The following conductors for damage: - H5 - H6 - H7 - H8 - L1 - P1 - J1 - B52 - B53 - B54 - D1 - D2 - Main breaker/Contactor Bus Bar • Inspect The following connectors for damage: - H-C3 - H-C4 - H-T5 - H-T7 - H-T6 - H-T8 - L-T1 - L-T2 - P-T1 - P-T2 - J-T1 - J-T2 - B-C5 - B-C6 - B-C12 - B-T19 - B-T25 - D-C1 - D-T1 - D-T2

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
36	Vacuum Motor High Voltage Protect Error (Transportable Error)	• High voltage was detected on the motor outputs. Check for disconnected power cables. - Reconnect cables. • After the condition is corrected, returning the throttle to neutral will clear the fault. • Inspect The following conductors for damage: - H1 - H2 - H3 - H4 - L1 - P1 - J1 - B62 - B63 - B64 - Main breaker/Contactor Bus Bar • Inspect The following connectors for damage: - H-C1 - H-C2 - H-T1 - H-T2 - H-T3 - H-T4 - L-T1 - L-T2 - P-T1 - P-T2 - J-T1 - J-T2 - B-C13 - B-C20 - B-C21 - B-T20 - B-T26

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
37	CAN1 Failure	• Inspect The following conductors for damage: - A51 - A52 - A1 - A2 - A62 - A63 - A43 - A44 - A47 - A48 - A45 - A46 - A49 - A50 - A11 - A10 - B1 - B2 - B85 - B86 - B87 - B88 • Inspect The following connectors for damage: - A-C16 - A-C1 - A-C3 - A-C4 - A-C13 - A-C10 - A-C8 - B-C1 - B-C32 - B-C28

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
38	Operator presence invalid state	• Inspect The following connectors for damage: - A-C6 - B-C10 - C-C2 - C-T3 - C-T2 - C-T1 - B-C1 - A-C8 • Inspect The following conductors for damage: - A27 - A28 - A12 - A65 - B5 - B3 - B4 - B7 - C7 - C8 - C9
39	Pre-charge Error	• Inspect the following components, and nearby components, on the main controller for damage. - U24
3A	DMC1 CAN connection failure	• Inspect The following connectors for damage: - A-C10 • Inspect The following conductors for damage: - A50 - A49 • Replace controller (8.644-283.0) if all other checks are good.
3B	DMC2 CAN connection failure (Transportable Error)	• Inspect The following connectors for damage: - A-C13 • Inspect The following conductors for damage: - A48 - A47 • Replace controller (8.644-771.0) if all other checks are good.
3C	HMI CAN connection failure	• Inspect The following connectors for damage: - A-C1 - A-C3 • Inspect The following conductors for damage: - A1 - A2 - A63 - A62 • Replace controller (8.644-910.0 for autonomous), (8.644-414.0 for deluxe) if all other checks are good.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
3D	Both DMC CAN connection failure	• Inspect The following connectors for damage: - A-C4 - A-C10 - A-C13 • Inspect The following conductors for damage: - A44 - A43 - A48 - A47 - A50 - A49 • Replace controller (8.644-284.0) if all other checks are good.
3E	Lithium battery - Battery General BMS Alarm	
3F	Lithium battery - Battery High Voltage Alarm	
40	Lithium battery - Battery Low Voltage Alarm	
41	Lithium battery - Battery High Temperature Discharge Alarm	
42	Lithium battery - Battery Low Temperature Discharge Alarm	
43	Lithium battery - Battery High Temperature Charge Alarm	
44	Lithium battery - Battery Low Temperature Charge Alarm	
45	Lithium battery - Battery High Discharge Current Alarm	
46	Lithium battery - Battery High Charge Current Alarm	
47	Lithium battery - Battery Missing Battery Alarm (Active battery count does not equal configured number)	

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
48	Lithium battery - Battery Internal BMS Alarm	
49	Lithium battery - Battery Load Qualification Alarm	
4A	Charger - H002	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
4B	Charger - H003	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
4C	Charger - H004	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
4D	Charger - F001	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
4E	Charger - F002	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
4F	Charger - F003	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
50	Charger - F004	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
51	Charger - F005	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
52	Charger - F006	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
53	Charger - F007	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
54	Charger - F009	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
55	Charger - F013	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
56	Charger – E001	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
57	Charger – E002	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
58	Charger – E003	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
59	Charger – E004	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5A	Charger – E005	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5B	Charger – E006	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5C	Charger – E007	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5D	Charger – E008	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5E	Charger – E009	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
5F	Charger – E010	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
60	Charger – E011	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
61	Charger – E012	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
62	Charger – E013	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
63	Charger – E014	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
64	Charger – E015	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
65	Charger – E016	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A0	Charger – E017	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A1	Charger – E018	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A2	Charger – E019	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A3	Charger – E020	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A4	Charger – E021	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A5	Charger – E022	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A6	Charger – E023	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A7	Charger – E024	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A8	Charger – E025	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
A9	Charger – E026	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AA	Charger – E027	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AB	Charger – E028	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AC	Charger – E029	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AD	Charger – E030	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AE	Charger – E031	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
AF	Charger – E032	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B0	Charger – E033	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B1	Charger – E034	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
B2	Charger – E035	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B3	Charger – E036	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B4	Charger – E037	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B5	Charger – E038	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B6	Charger – E039	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B7	Charger – E040	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B8	Charger – E041	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
B9	Charger – E042	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BA	Charger – E043	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BB	Charger – E044	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BC	Charger – E045	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BD	Charger – E046	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BE	Charger – E048	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
BF	Charger – E049	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C0	Charger – E050	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C1	Charger – E051	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C2	Charger – E052	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C3	Charger – E053	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C4	Charger – E054	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C5	Charger – E055	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C6	Charger – E056	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C7	Charger – E059	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C8	Charger – E060	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
C9	Charger – E061	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CA	Charger – E062	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CB	Charger – E063	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CC	Charger – E064	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CD	Charger – E065	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CE	Charger – E066	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
CF	Charger – E067	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
D0	Charger – E068	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
D1	Charger – E080	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
D2	Charger – E084	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
D3	Charger – E085	See 535-0008-02.01.00_AlarmsAndFaults.pdf for resolution
D4	Unknown charger error	Unplug the charger and wait 60 second. If the problem persist, replace the charger.
80	The battery is dead and will need to be charged. The machine will no longer transport.	Charge the battery.
81	The vacuum bag is missing install a bag to allow cleaning. Transport mode is still allowed.	Install a vacuum bag.
82	The battery is dead and will need to be charged. Transport mode is still allowed.	Charge the battery.

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
83	Side Broom Motor PWM is being limited by unspecified source. All modes are still allowed.	
84	Side Broom Motor Limited. The controller is driving but a power-limiting condition is active. All modes are still allowed.	
85	Side Broom Motor Temperature High. PWM limiting within range of High Motor Temperature. All modes are still allowed.	
86	Side Broom Motor ANIN Limit. Motor temperature is above software limit. Throttle input range is being affected. All modes are still allowed.	
87	Brush Motor PWM is being limited by unspecified source. All modes are still allowed.	
88	Brush Motor Limited. The controller is driving but a power-limiting condition is active. All modes are still allowed.	
89	Brush Motor Temperature High. PWM limiting within range of High Motor Temperature. All modes are still allowed.	

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
8A	Brush Motor ANIN Limit. Motor temperature is above software limit. Throttle input range is being affected. All modes are still allowed.	
8B	Traction Motor PWM is being limited by unspecified source. All modes are still allowed.	
8C	Traction Motor Reverse Limited. The controller is driving in reverse, but a power-limiting condition is active. All modes are still allowed.	
8D	Traction Motor Forward Limited. The controller is driving forward, but a power-limiting condition is active. All modes are still allowed.	
8E	Traction Motor Temperature High. PWM limiting within range of High Motor Temperature. All modes are still allowed.	
8F	Traction Motor ANIN Limit. Motor temperature is above software limit. Throttle input range is being affected. All modes are still allowed.	
90	Vacuum Motor PWM is being limited by unspecified source. All modes are still allowed.	

[Table 2: Warnings and Error Codes – Cont.]

Hex Code	Description of failure	Corrective actions
91	Vacuum Motor Limited. The controller is driving but a power-limiting condition is active. All modes are still allowed.	
92	The battery is dead and will need to be charged. All modes are still allowed.	
93	The batteries are charging, and the machine is locked out.	
94	Traction motor PWM is being limited by the active current limit	
95	The throttle was not in the neutral position during startup.	• Step off of he operator platform • Inspect The following connectors for damage:A-C6 - B-C10 - C-C2 - C-T4 - C-T5 - C-T6 - B-C1 - A-C8 • Inspect The following conductors for damage: - A24 - A30 - A3 - A66 - A24 - A67 - B16 - B17 - B18 - C10 - C11 - C12

[Table 2: Warnings and Error Codes – Cont.]

DMC CODE INTERPRETATION

DMC Code	Description of Error	Corresponding VCM error code
0x21	Motor Shorted	Controller 82 (Traction Motor): 13 Controller 83 (Brush Motor): 03 Controller 84 (Vacuum Motor): 1C Controller 85 (Side Boom Motor): 0C
0x22	Motor Open	Controller 82 (Traction Motor): 1A Controller 83 (Brush Motor): 32 Controller 84 (Vacuum Motor): 22 Controller 85 (Side Boom Motor): 0B

0x29		Controller 82 (Traction Motor): 19 Controller 83 (Brush Motor): 08 Controller 84 (Vacuum Motor): Controller 85 (Side Boom Motor): 11
0x2A		Controller 82 (Traction Motor): 35 Controller 83 (Brush Motor): 33 Controller 84 (Vacuum Motor): 36 Controller 85 (Side Boom Motor): 34
0x31		Controller 82 (Traction Motor): 29 Controller 83 (Brush Motor): 2A Controller 84 (Vacuum Motor): 2C Controller 85 (Side Boom Motor): 2B
0x32		Controller 82 (Traction Motor): 1B Controller 83 (Brush Motor): 01 Controller 84 (Vacuum Motor): Controller 85 (Side Boom Motor): 09
0x51		Controller 82 (Traction Motor): 14 Controller 83 (Brush Motor): 04 Controller 84 (Vacuum Motor): 1D Controller 85 (Side Boom Motor): 0D
0x52		Controller 82 (Traction Motor): 15 Controller 83 (Brush Motor): 05 Controller 84 (Vacuum Motor): 1E Controller 85 (Side Boom Motor): 0E
0x71		Controller 82 (Traction Motor): 25 Controller 83 (Brush Motor): 26 Controller 84 (Vacuum Motor): 28 Controller 85 (Side Boom Motor): 27
Any other number		Controller 82 (Traction Motor): 16 Controller 83 (Brush Motor): 06 Controller 84 (Vacuum Motor): 1F Controller 85 (Side Boom Motor): 0F