



LINCS II 24 Volt DC System Component Description

Section 06-04-03

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Scope of This Publication

This document contains descriptions, for components located inside the Low Voltage Control Cabinet (LVCC), for the Human Machine Interface (HMI), and for position sensing by rotary transducers.

Safety

This publication contains special instructions that pertain to safety, operation, maintenance, and repair of the machine. Listed below are the signal words and symbols that precede these instructions and their meanings:


DANGER

- The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

- The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

- The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol .

CAUTION

- The caution label (without safety alert symbol) is used to address practices not related to personal injury – only equipment damage.

NOTICE

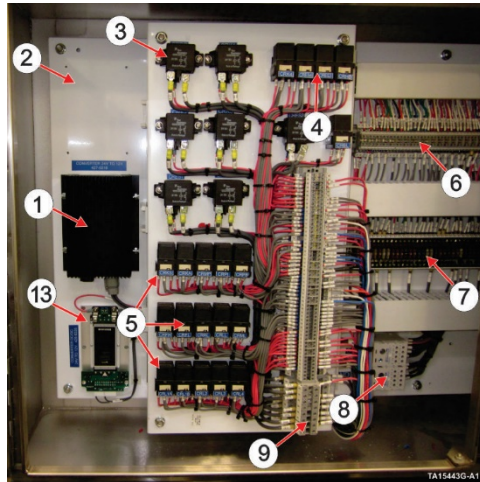
The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

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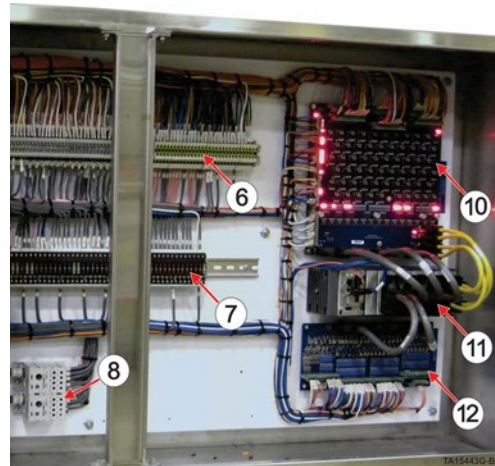
Low Voltage Control Cabinet (LVCC) Components



Mounted left side of machine rear frame, beside cab



Left side

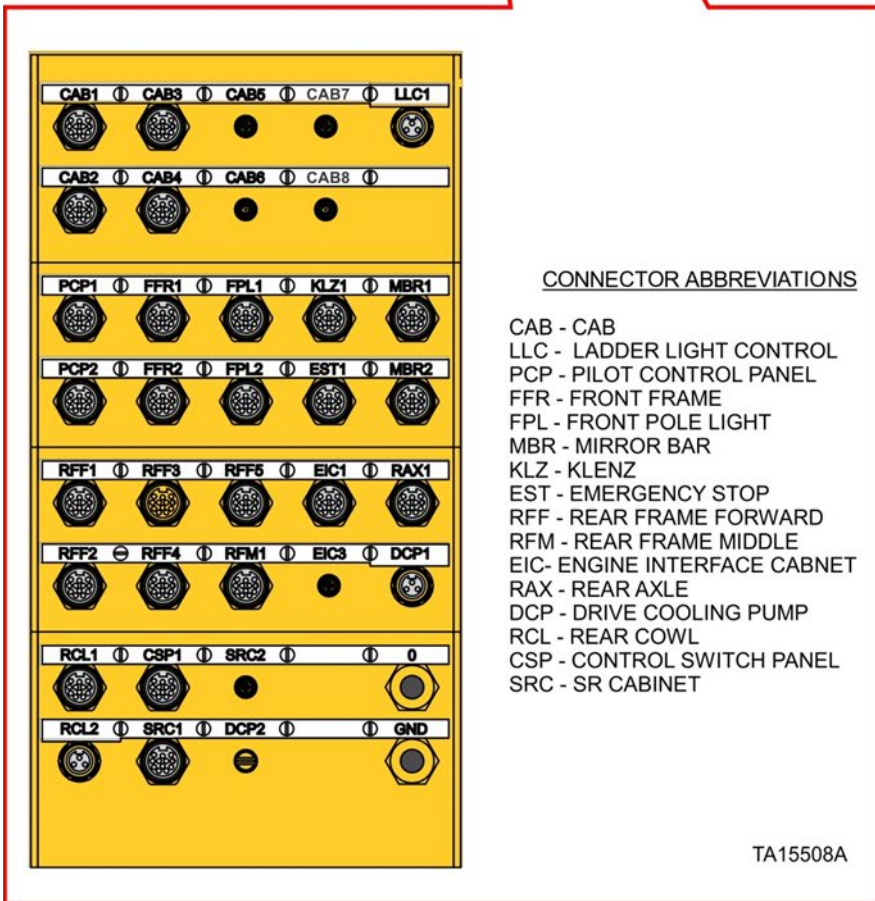
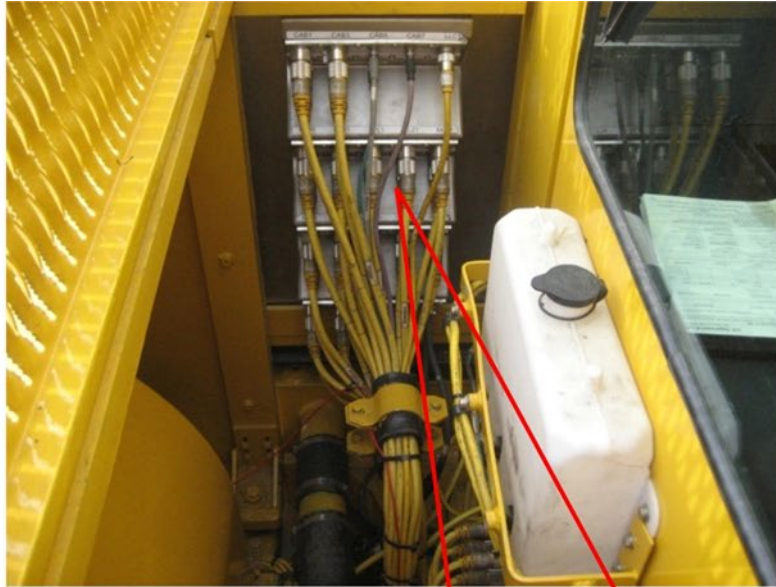


Right side

- 1. DC Converter (24V to 12V)
- 2. Not used
- 3. 50A Relay
- 4. 20A Relay
- 5. 20A Relay
- 6. Terminal Strip TS1

- 7. Terminal Strip TS2 (fuse)
- 8. Power Distribution Block
- 9. Terminal Strip TS3
- 10. Digital Interface Card
- 11. Vehicle Control Unit
- 12. Analog Interface Card
- 13. DC to DC Converter (24V to 12V)

Figure 1. Low voltage cabinet

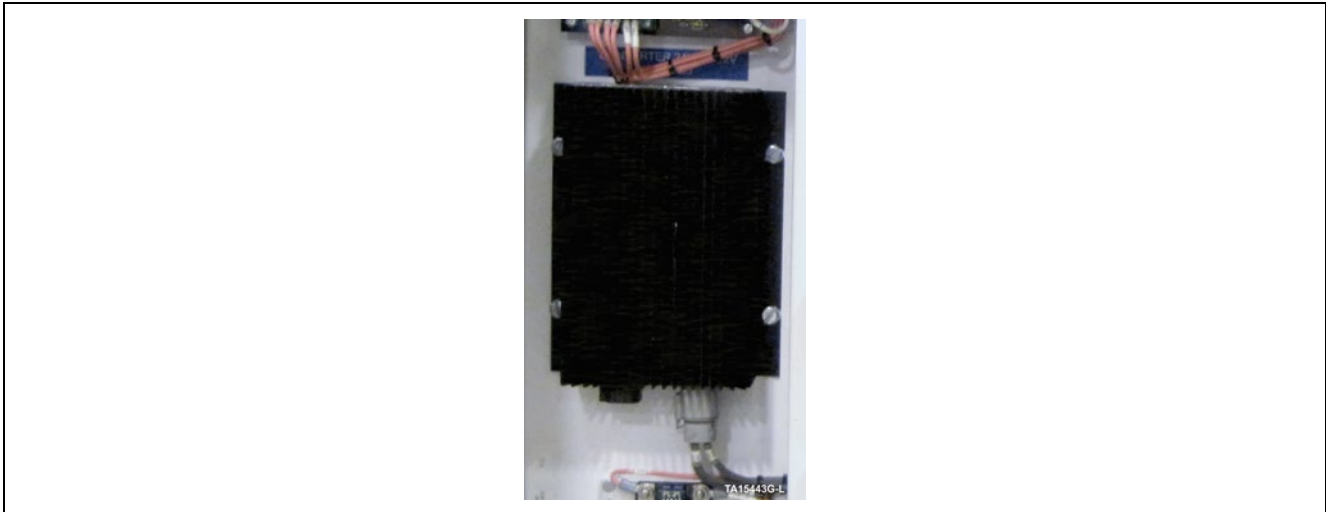


(Mounted Inside LVCC)

Figure 2. Low voltage cabinet connections

DC to DC Converter (24V to 12V)

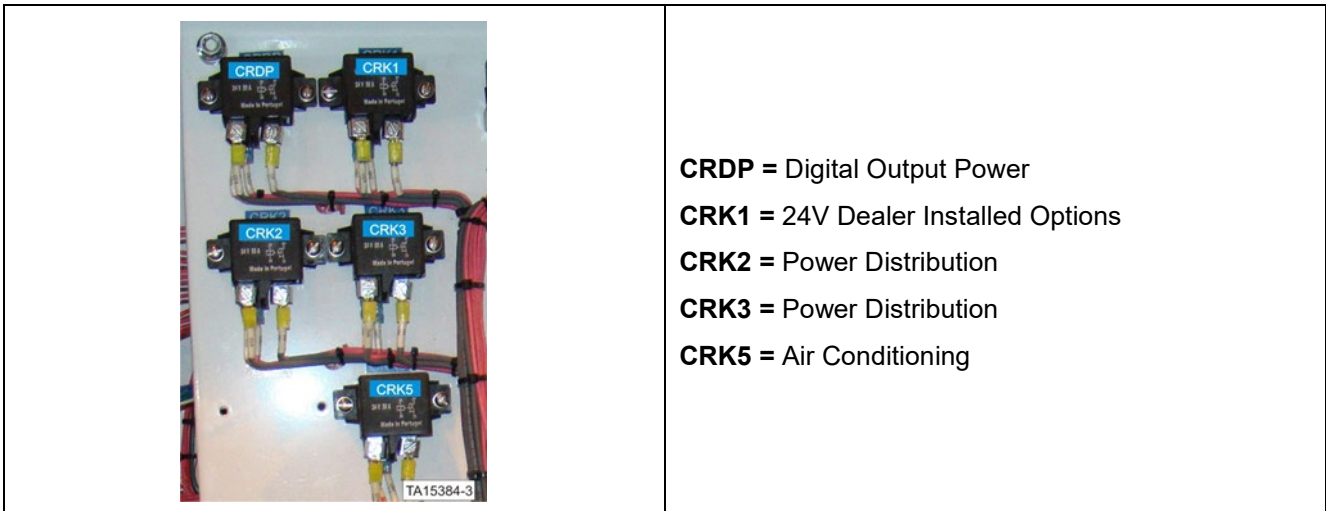
Power converter for cab 12V power outlets and dealer installed options.



(Mounted Inside LVCC)

Figure 3. DC to DC Voltage converter/24-Volt to 12-Volt (typical)

50A Relays



- CRDP** = Digital Output Power
- CRK1** = 24V Dealer Installed Options
- CRK2** = Power Distribution
- CRK3** = Power Distribution
- CRK5** = Air Conditioning

(Mounted Inside LVCC)

Figure 4. 50A Relays

20A Relays

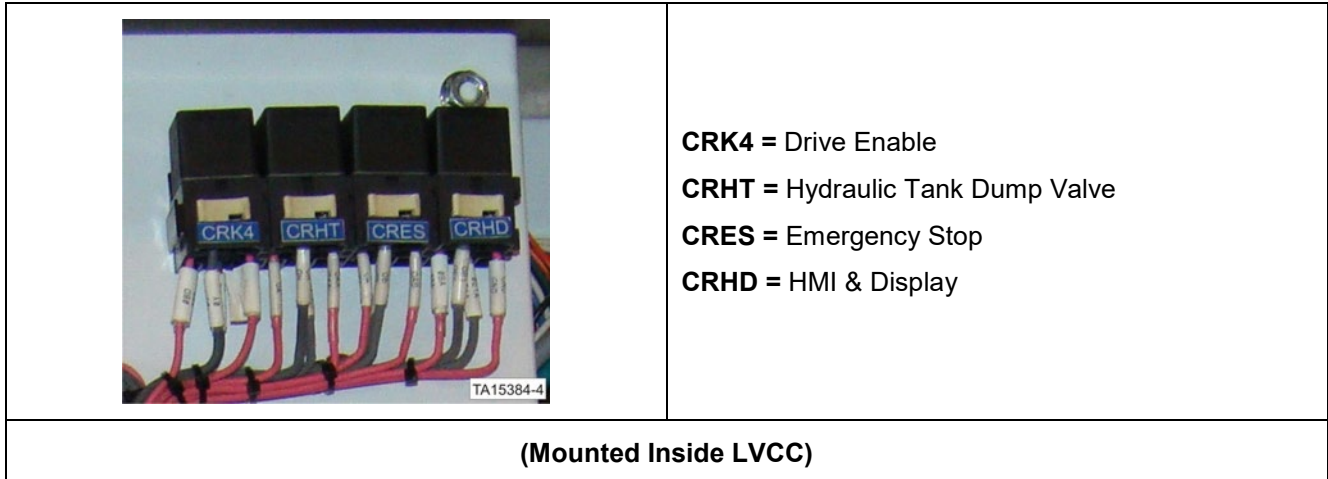


Figure 5. 20A Relays

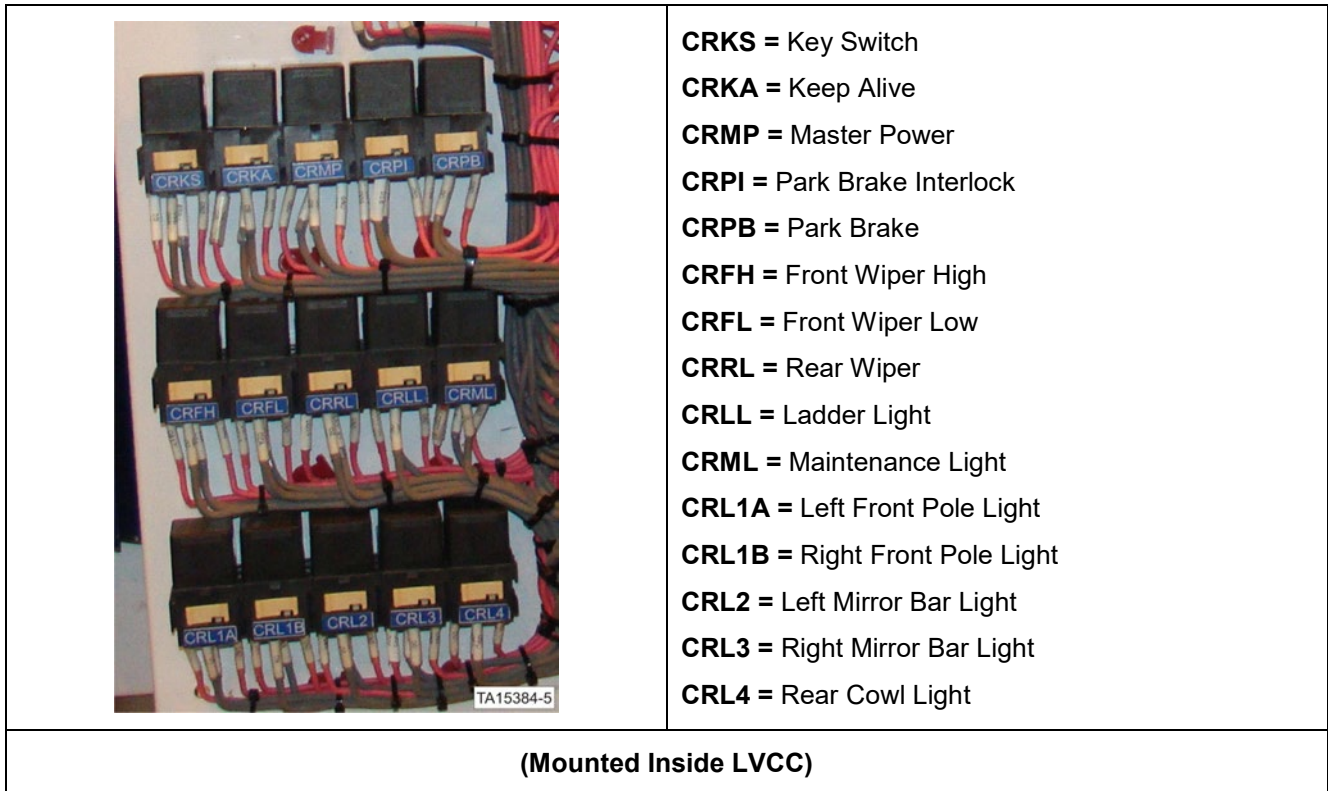


Figure 6. 20A Relays

Terminal Strip TS1

Signal distribution terminal strip.



(Mounted Inside LVCC)

Figure 7. Terminal strip TS1

Terminal Strip TS2

Fuse terminal strip

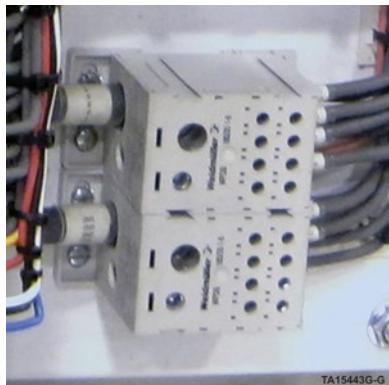


(Mounted Inside LVCC)

Figure 8. Terminal strip TS2

Power Distribution Block

Provides the 24V DC and GND distribution point for low voltage cabinet.



(Mounted Inside LVCC)

Figure 9. Power distribution block

Terminal Strip TS3

Provides 24V and GND distribution point for low voltage cabinet.

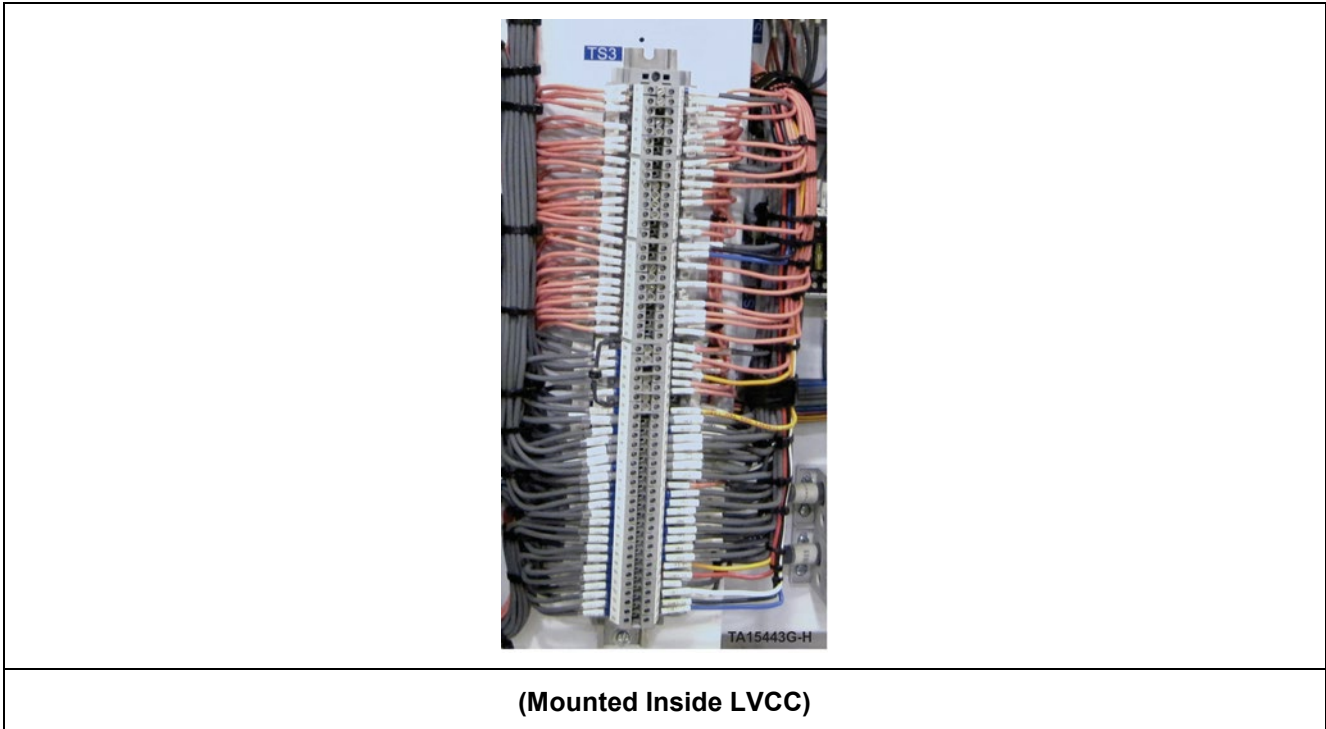
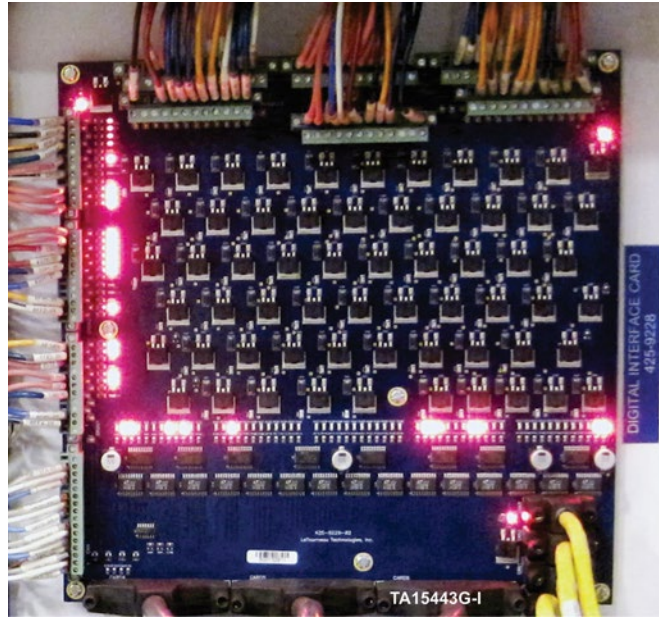


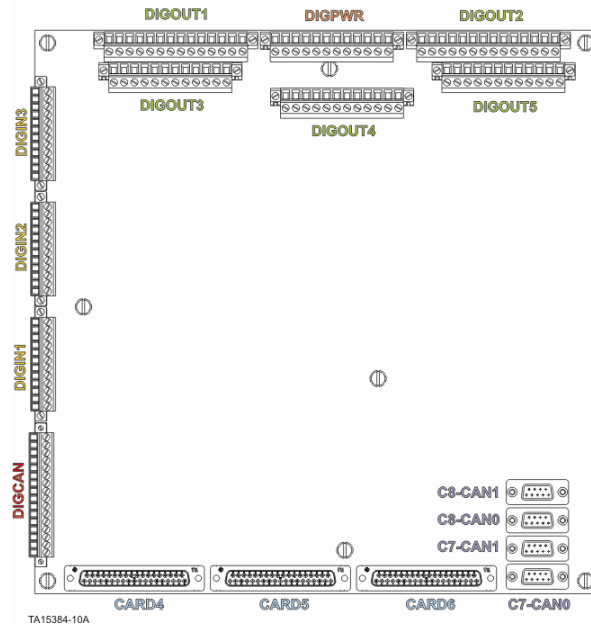
Figure 10. Terminal strip TS3

Digital Interface Card

Digital I/O's, CAN, CAN power & foot pot power.



DIGITAL INTERFACE CARD CONNECTOR LAYOUT



(Mounted Inside LVCC)

Figure 11. Digital interface card

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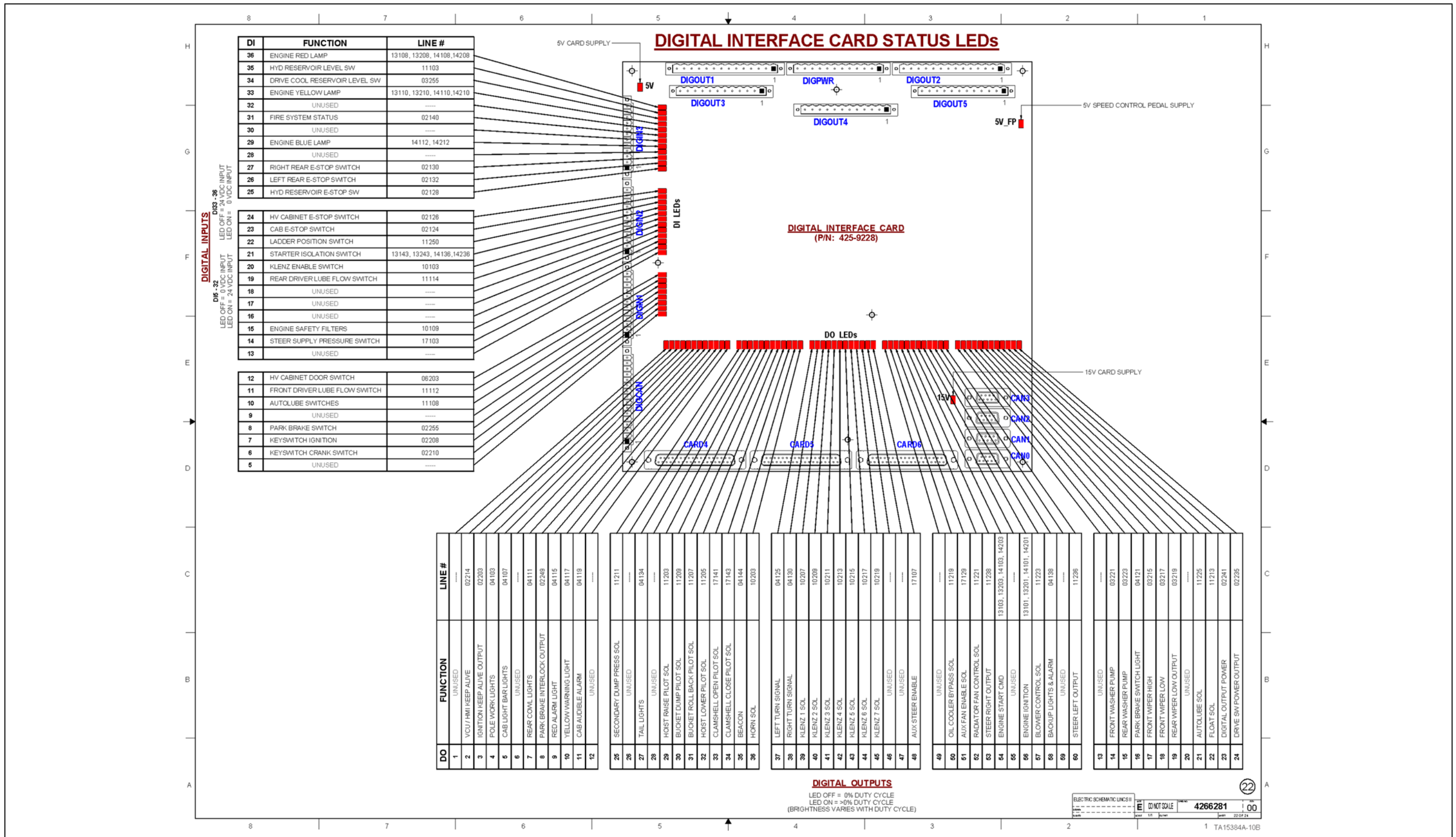
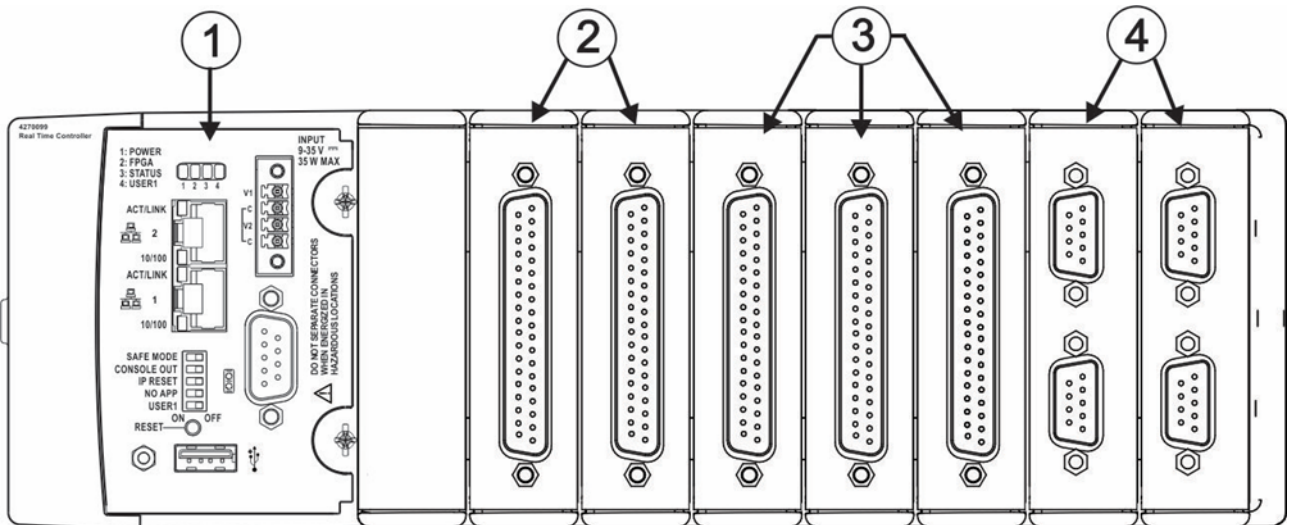


Figure 12. Digital interface card status LED's

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Vehicle Control Unit (VCU)

The VCU is essentially the brains of the machine. All control, protection and safety features are provided through the VCU. The VCU consists of a Controller, two Analog Input modules, three Digital I/O modules and two CAN modules. Once the Park Brake switch LED is on, the VCU is fully booted.

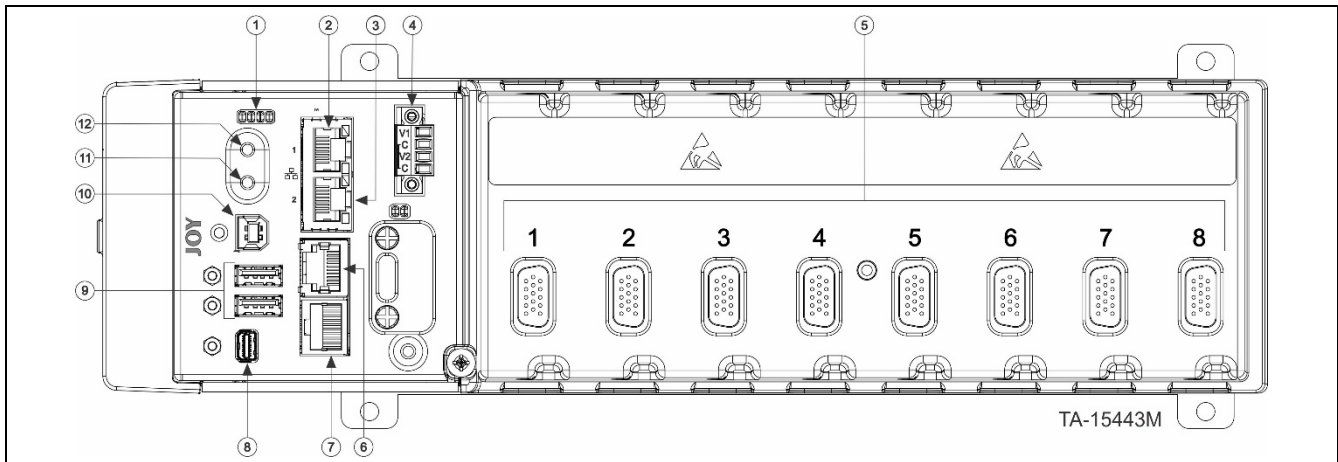


1) Controller, 2) Analog modules, 3) Digital modules, 4) CAN modules
(mounted inside LVCC)

Figure 13. Vehicle control unit

Controller

The Controller is a small, rugged, reliable embedded real-time controller featuring an industrial real-time processor for real-time applications. The controller is designed for extreme ruggedness, reliability, and low power consumption.



<p>1) LED's</p>	<p>1) Power: Lit solid yellow when controller is powered on. 2) STATUS: Not used. 3) USER1 (RT): OFF indicates the software is not running SLOW BLINK indicates there is no communication with the HMI. FAST BLINK indicates the controller status is good and communication with the HMI is present. 4) FPGA: SLOW BLINK (0.5Hz): Normal operation. FASTER BLINK (2Hz): Programming drives. VERY FAST BLINK (10Hz): Loss of communication between controller and FPGA (Failsafe Mode).</p>
<p>2) RJ-45 Ethernet Port 1</p>	<p>Interfaces VCU with the HMI in operator cab.</p>
<p>3) RJ-45 Ethernet Port 2</p>	<p>Not used.</p>
<p>4) Power Connection</p>	<p>24V power connection (V2 and C).</p>
<p>5) I/O Connections</p>	<p>Module slots.</p>
<p>6) RS-232 Serial Port</p>	<p>Machine ID Key</p>
<p>7) RS-485/422 Serial Port</p>	<p>Not used.</p>
<p>8) USB Device Port</p>	<p>Not used.</p>
<p>9) USB Host Ports</p>	<p>Not used.</p>
<p>10) USB Device Port</p>	<p>Not used.</p>
<p>11) Reset Button</p>	<p>Resets the VCU controller.</p>
<p>12) Power Button</p>	<p>Not used.</p>

Figure 14. VCU Controller

Analog Input Module:

The Analog Input Module is a 32-channel 16-bit Analog Input Module with a 37-pin DSUB connector. The Analog Modules receive inputs from components such as machine transducers and the Speed Control Pedal.

Digital I/O Module:

The Digital I/O Module is a 32 digital input/output channel module with a 37-pin DSUB connector. Each channel is programmed via software to be either an input or an output channel. All channels have overvoltage, overcurrent, and short-circuit protection.

CAN Module:

The CAN bus module has two 9-pin male DSUB connectors that provide connections to a high-speed CAN bus. The CAN bus allows microcontrollers and devices to communicate with each other.

Analog Interface Card

Conditions 4-20ma and voltage signals for vehicle controller.

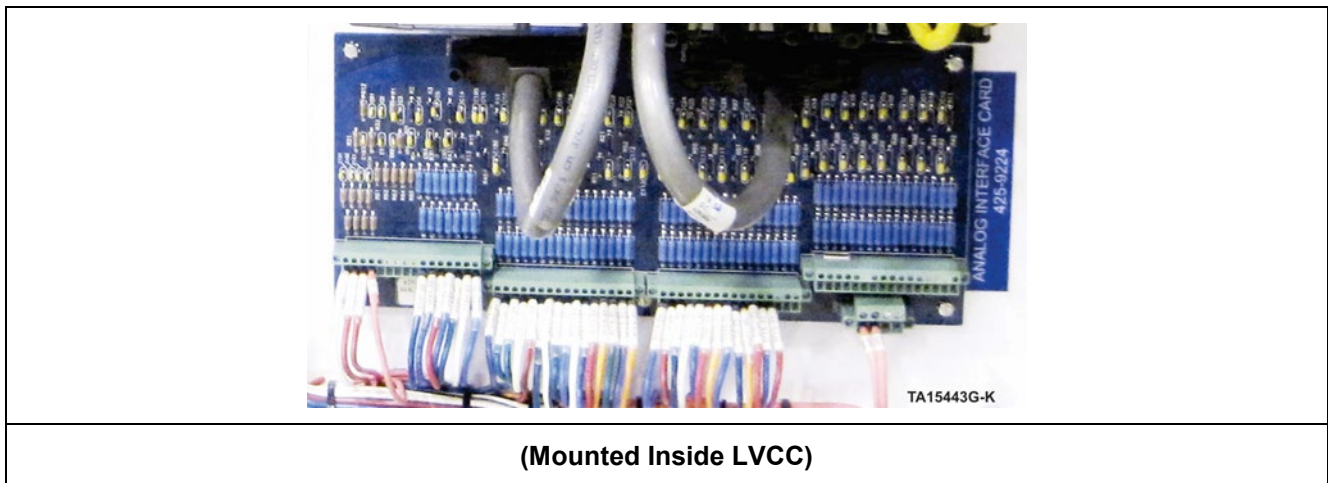
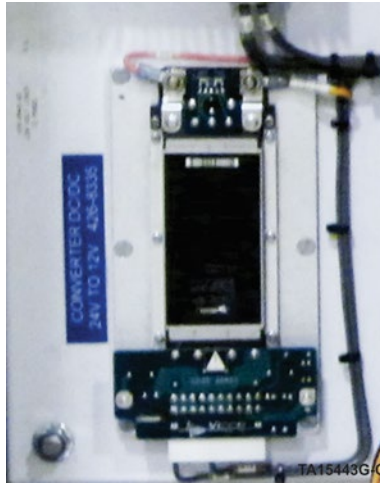


Figure 15. Analog interface card

DC to DC Converter (24V to 12V)

Provides 12V to cab display.



(Mounted Inside LVCC)

Figure 16. DC to DC voltage converter/24-volt to 12-volt

Operators Cab



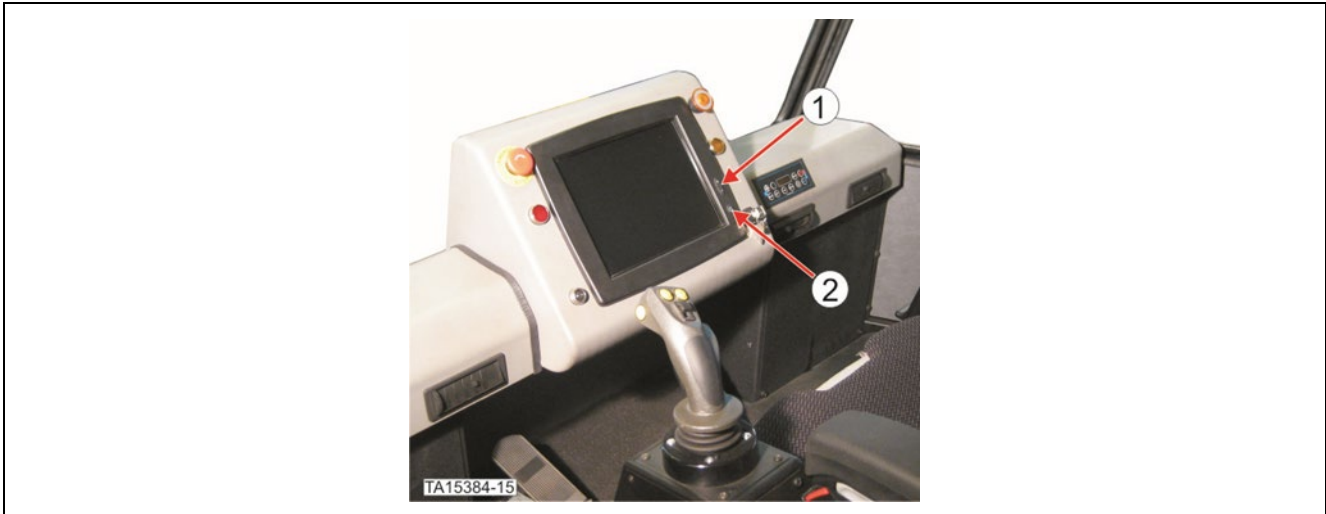
1) Display, 2) HMI (Human Machine Interface)

Figure 17. Operators cab

Display

The cab display offers a sealed enclosure with an ultra-wide vertical viewing angle, anti-glare screen, sunlight readable and integrated touch screen. The power to the display is supplied through a 24V to 12V converter that supplies voltage to both the video board and the backlight. Video and data communications are performed through the USB port and the DVI video connector.

The display power switch has been disabled as it is controlled by the LINCS software while the dimmer switch allows the operator to increase or decrease the intensity of the backlight.



1) Dimmer switch, 2) Power switch (disabled)

Figure 18. Cab display

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HMI (Human Machine Interface)

The HMI, which is located under the operators' seat, is a reliable, industrial controller. The purpose of the HMI is to interface between the VCU (Vehicle Control Unit) and the cab display. Machine information is transmitted between the HMI and the VCU using the LAN1 connection. The HMI then displays this information on the cab display by way of the DVI-I connector. Touch screen commands are then relayed back to the HMI via the USB1 port.

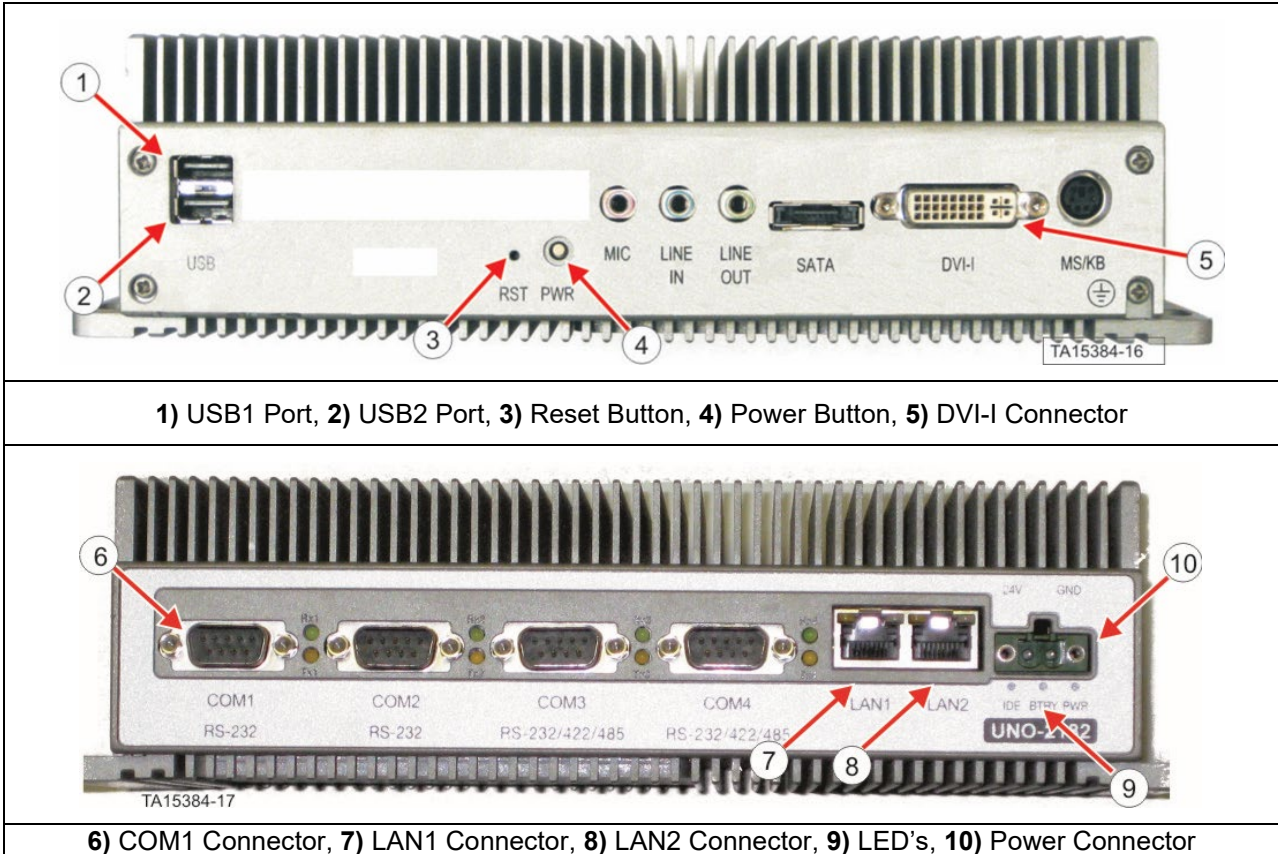


Figure 19. HMI connectors

1. USB1: This port is used to send the touch screen commands from the cab display to the HMI.
2. USB2: Connects to the USB service port on the dash. The service port is used for downloading log files.
3. RST: Reset Button is used to reset the internal program, causing a re-boot.
4. PWR: The power button is for cycling power to the HMI ON or OFF. The internal BIOS of the HMI has an auto-power ON/OFF sequence, eliminating the need for the button except under troubleshooting circumstances.
5. DVI-I: Digital video connector provides video to the cab display.
6. COM1: Serial connection to the I-Button reader.
7. LAN1: Ethernet connector for the VCU.
8. LAN2: Ethernet connector for LAN service port on the dash. Use to be determined.

9. LED's:

- PWR LED Green when powered, Orange in Stand-by mode and OFF when power not supplied.
- BTRY LED On indicates that internal Lithium battery needs to be replaced (currently not used).
- IDE LED Flashes when reading/writing to internal hard drive.

10. Power Connector: 24V power connection for HMI.

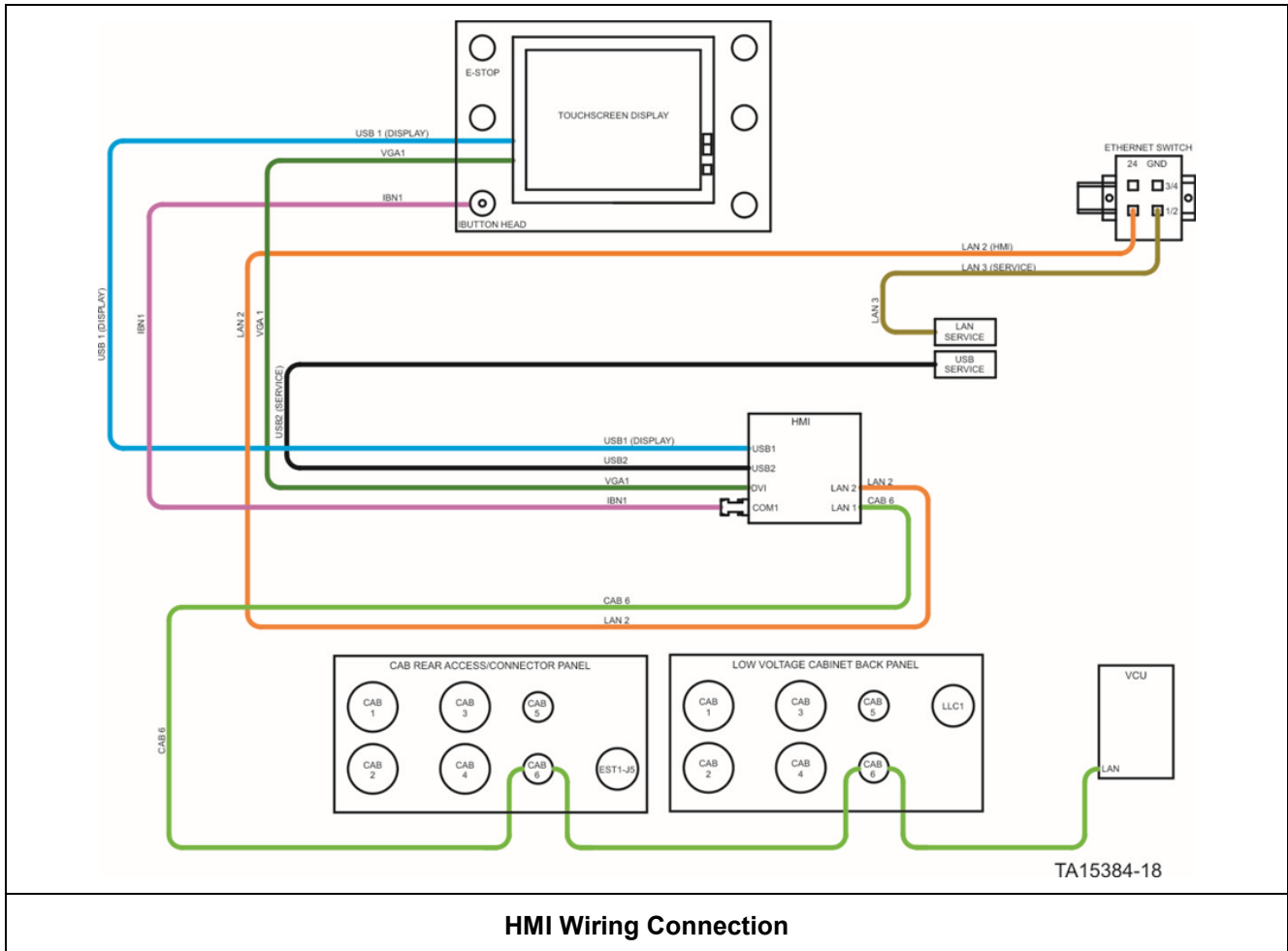


Figure 20. HMI wiring connections

The HMI provides the following functions:

- Gauge cluster
- Channel charting
- Event viewing
- Channel forcing
- Calibrations
- Additional channel and event log storage capacity
- Software upload
- Download logs
- Configure VCU (Factory Rep access only)
- Create user access keys

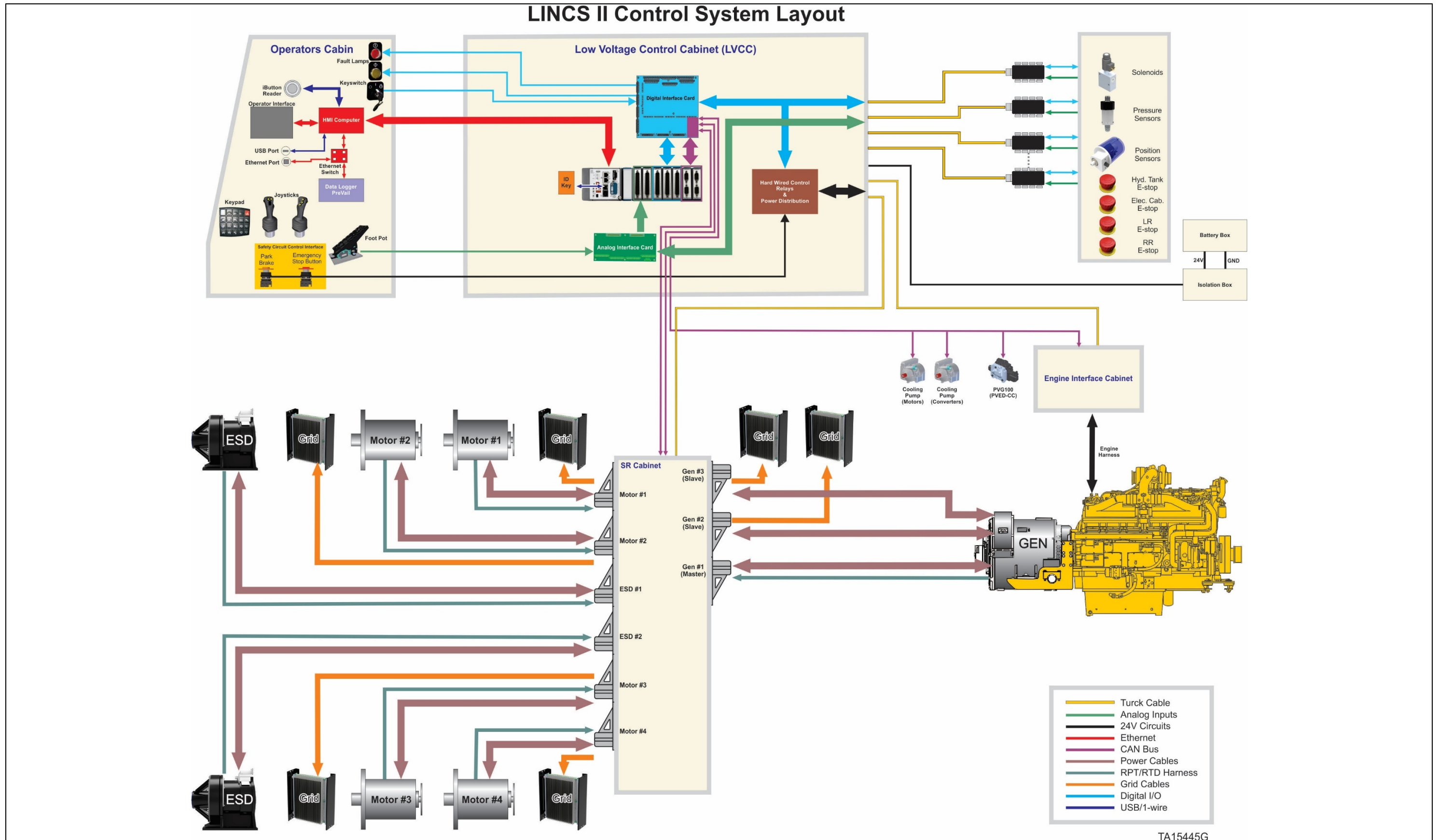


Figure 21. LINCS II basic control system layout

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Position Sensors

The machine control software system (LINCS®) uses encoders to determine component angles.

- Bucket - from complete rollback through full dump
- Lift arms - from completely lowered through fully raised
- Steering - frame articulation) from steered fully left through steered fully right

Encoders may be attached to the component by either direct shaft attachment (through a coupling) or by rod linkage.

Automatic Bucket Leveling Circuit

Bucket angle and lift arm heights are continuously monitored by using encoders. The LINCS® computer system uses the bucket angle signal and the bucket height signal to automatically level the bucket from any position when the lift arms are lowered by pressing the “return to dig” control switch.

The bucket level encoder is mounted on a support on the torque tube structure and is connected to the bell crank pivot retaining capture plate. The bucket height encoder is mounted on a support stand outside the right lift arm. Each encoder is driven by a driveshaft, which is connected to either the right lift arm or bell crank. The bucket angle and bucket heights are displayed on the main LINCS Main Operator Screen. The bucket height signal is also used by the LINCS computer to stop hoisting when a limit has been set by using the Alternate Height switch. The Alternate Height switch is used for loading vehicles of uniform height. When the bucket height switch is turned ON, the bucket will automatically stop at the same height each time the hoist joystick is used to raise the lift arms. If the Alternate Height switch is turned OFF, the lift arms will rise to full height.

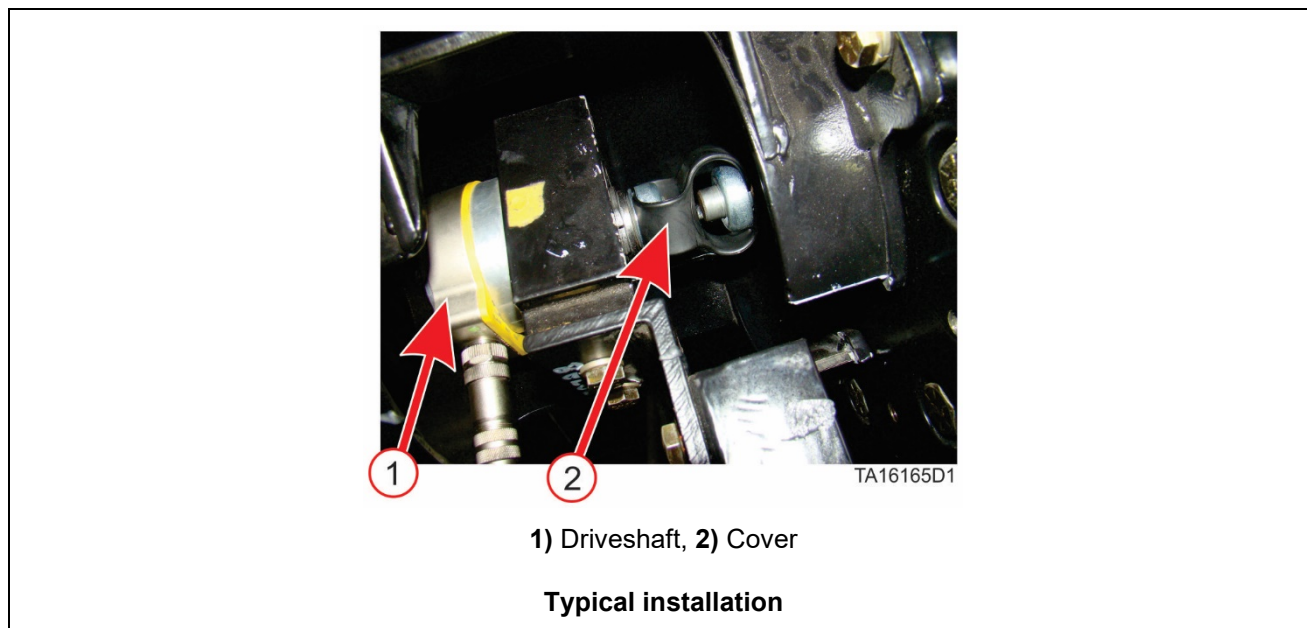


Figure 22. Automatic bucket leveling circuit encoder (Gen3 machines)

Setting up the Contactless Position Sensors (Gen 3 machines only)

Align the arrows on the encoder with the arrows on the shaft when assembling the encoder and the mount housing. Run the machine calibration routine after installing the encoder. Running the machine calibration routine ensures the machine will operate within the specific motion limit range for each component: lift arms, bucket, and articulation steering (frames).

The mount housing has a Zerk fitting used to grease the shaft. Typically, a single shot of grease is applied to ensure proper lubrication. The typical hourly schedule is every 500 hours.

NOTICE

Maintenance requirements can change. Always refer to the machine hourly PM schedules to determine maintenance requirements. The PM schedules are always considered to be required maintenance.

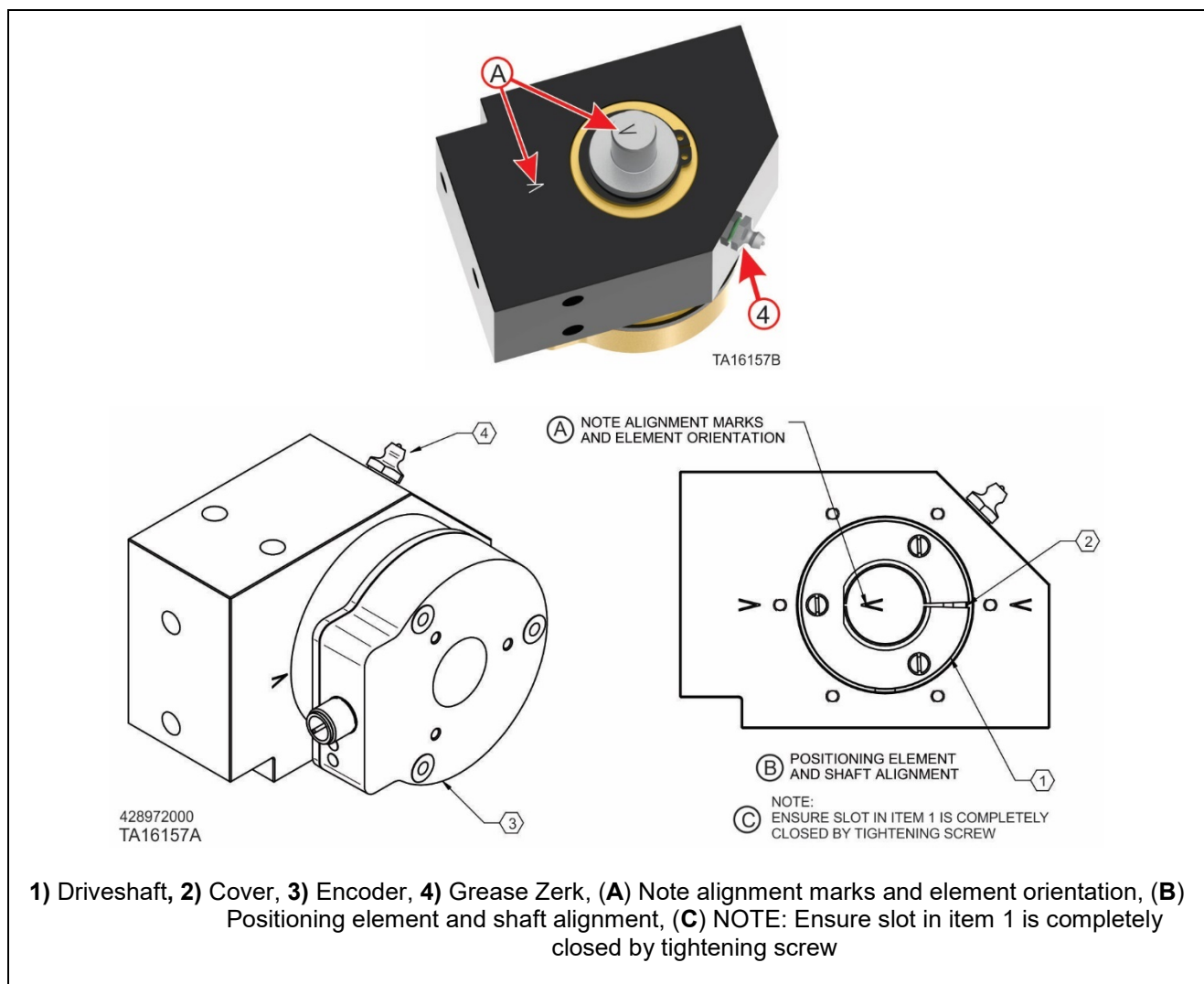


Figure 23. Bucket encoder (L-1350 Gen3 machines)