LINCS II 24 Volt DC System Component Description

Section 06-04-03

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines, which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

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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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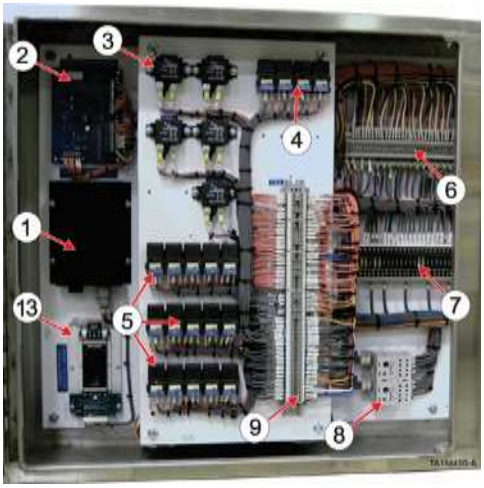
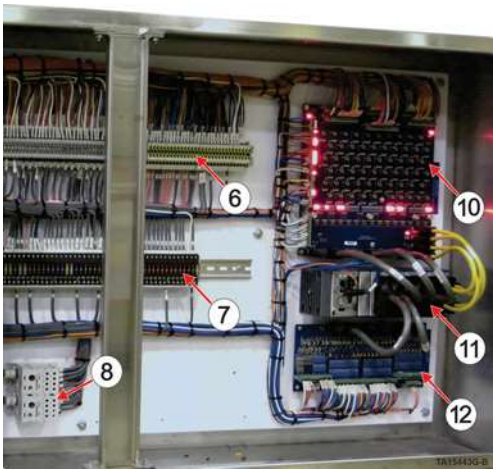
Low Voltage Control Cabinet (LVCC) Components

Mounted left side of machine rear frame, beside cab



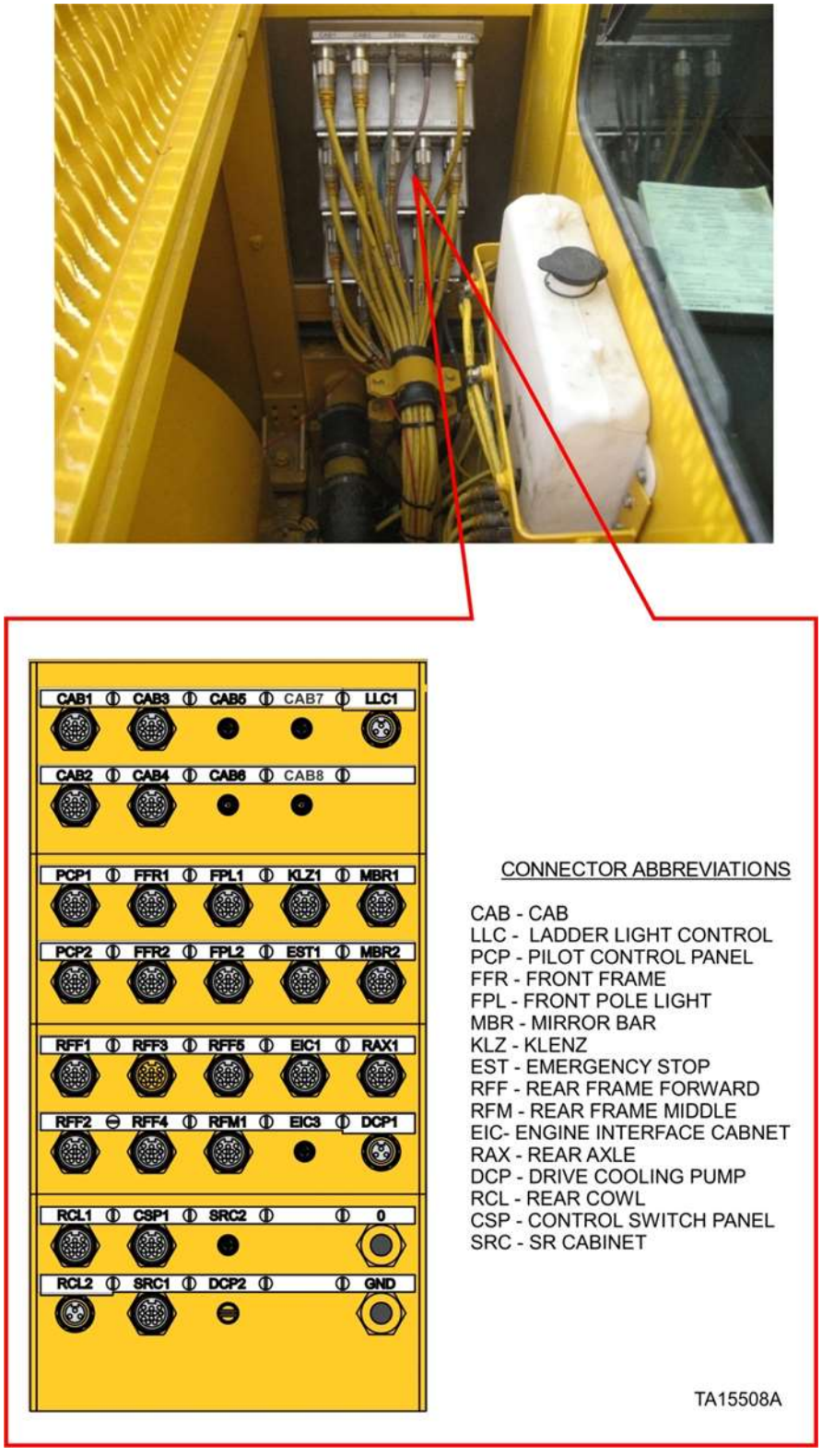
Left side



Right side

1. DC Converter (24V to 12V)
2. Estop Interface Card DC
   (Card not present on current production machines or machines with an upgraded E-stop system).
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)

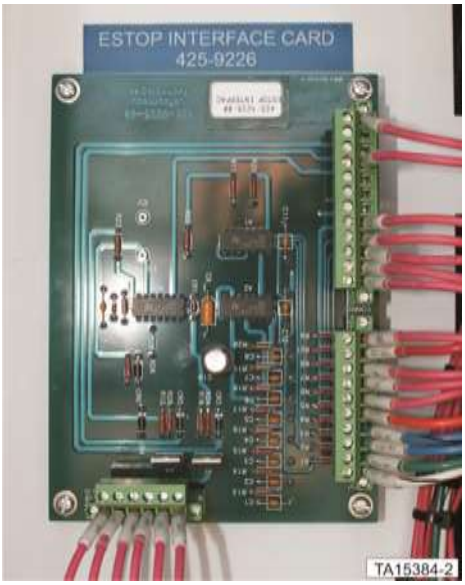
Power converter for cab 12V power outlets and dealer installed options.

(Mounted Inside LVCC)

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

ESTOP Interface Card

Interface for Emergency Shutdown switches, fire suppression system, and hydraulic relays. Provides input to the vehicle controller.



Not present on current production machines or machines with an upgraded E-stop system.

(Mounted Inside LVCC)

Figure 4. E-stop interface card

50A Relays

CRDP = Digital Output Power

CRK1 = 24V Dealer Installed Options

CRK2 = Power Distribution

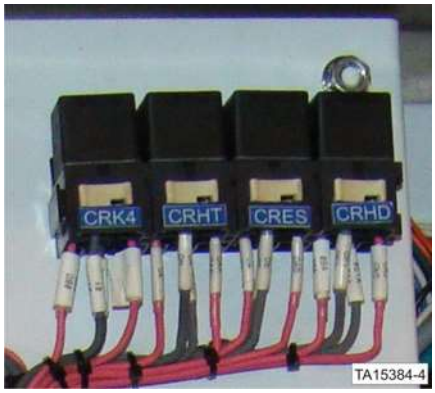
CRK3 = Power Distribution

CRK5 = Air Conditioning

(Mounted Inside LVCC)

Figure 5. 50A Relays

20A Relays



CRK4 = Drive Enable
CRHT = Hydraulic Tank Dump Valve
CRES = Emergency Stop
CRHD = HMI & Display

(Mounted Inside LVCC)

Figure 6. 20A Relays

CRKS = Key Switch
CRKA = Keep Alive
CRMP = Master Power
CRPI = Park Brake Interlock
CRPB = Park Brake
CRFH = Front Wiper High
CRFL = Front Wiper Low
CRRL = Rear Wiper
CRLL = Ladder Light
CRML = Maintenance Light
CRL1A = Left Front Pole Light
CRL1B = Right Front Pole Light
CRL2 = Left Mirror Bar Light
CRL3 = Right Mirror Bar Light
CRL4 = Rear Cowl Light

(Mounted Inside LVCC)

Figure 7. 20A Relays

Terminal Strip TS1

Signal distribution terminal strip.

(Mounted Inside LVCC)

Figure 8. Terminal strip TS1

Terminal Strip TS2

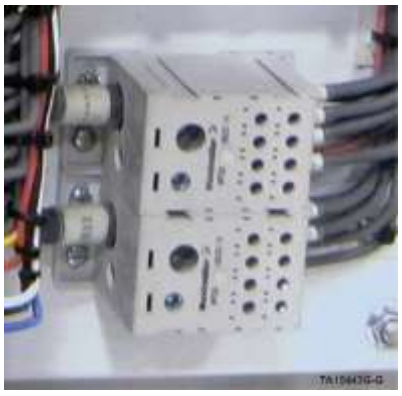
Fuse terminal strip

(Mounted Inside LVCC)

Figure 9. Terminal strip TS2

Power Distribution Block

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

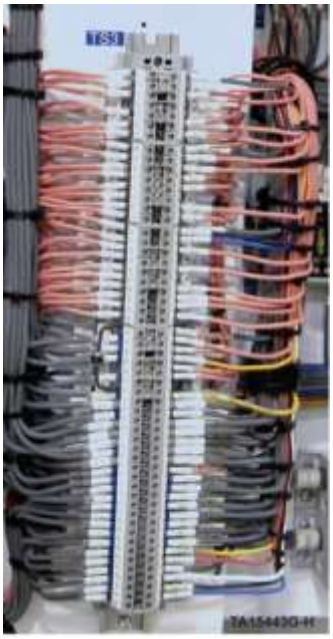


(Mounted Inside LVCC)

Figure 10. Power distribution block

Terminal Strip TS3

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

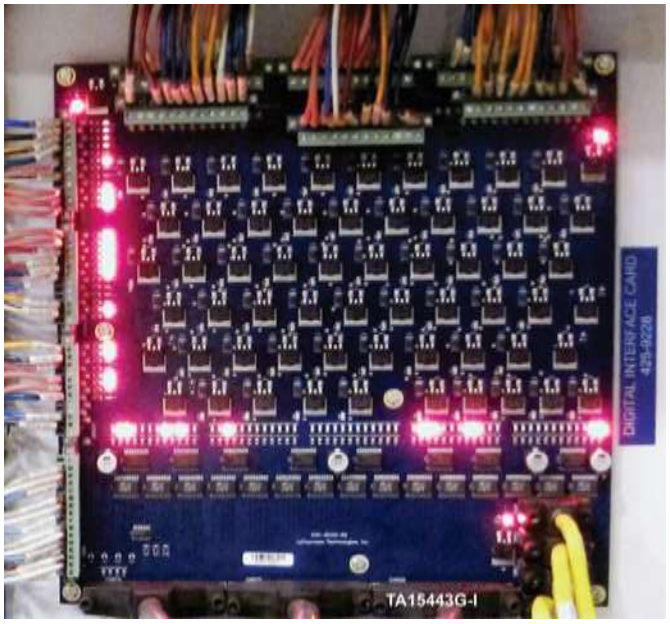


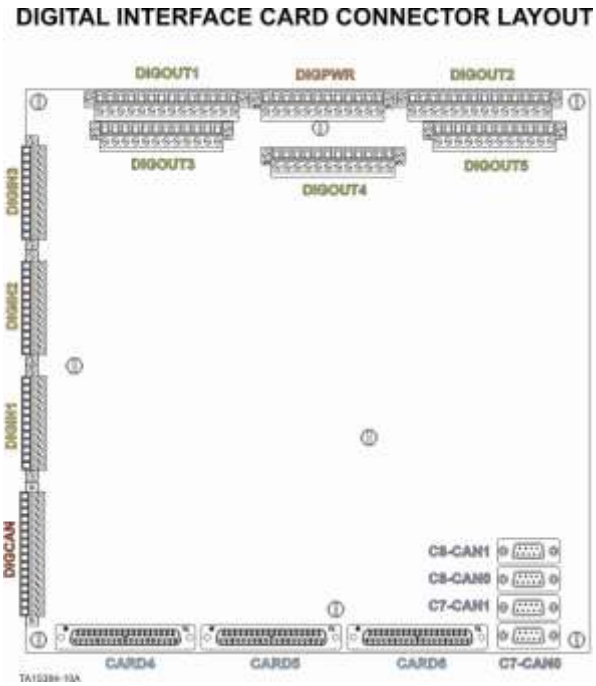
(Mounted Inside LVCC)

Figure 11. Terminal strip TS3

Digital Interface Card

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





(Mounted Inside LVCC)

Figure 12. Digital interface card

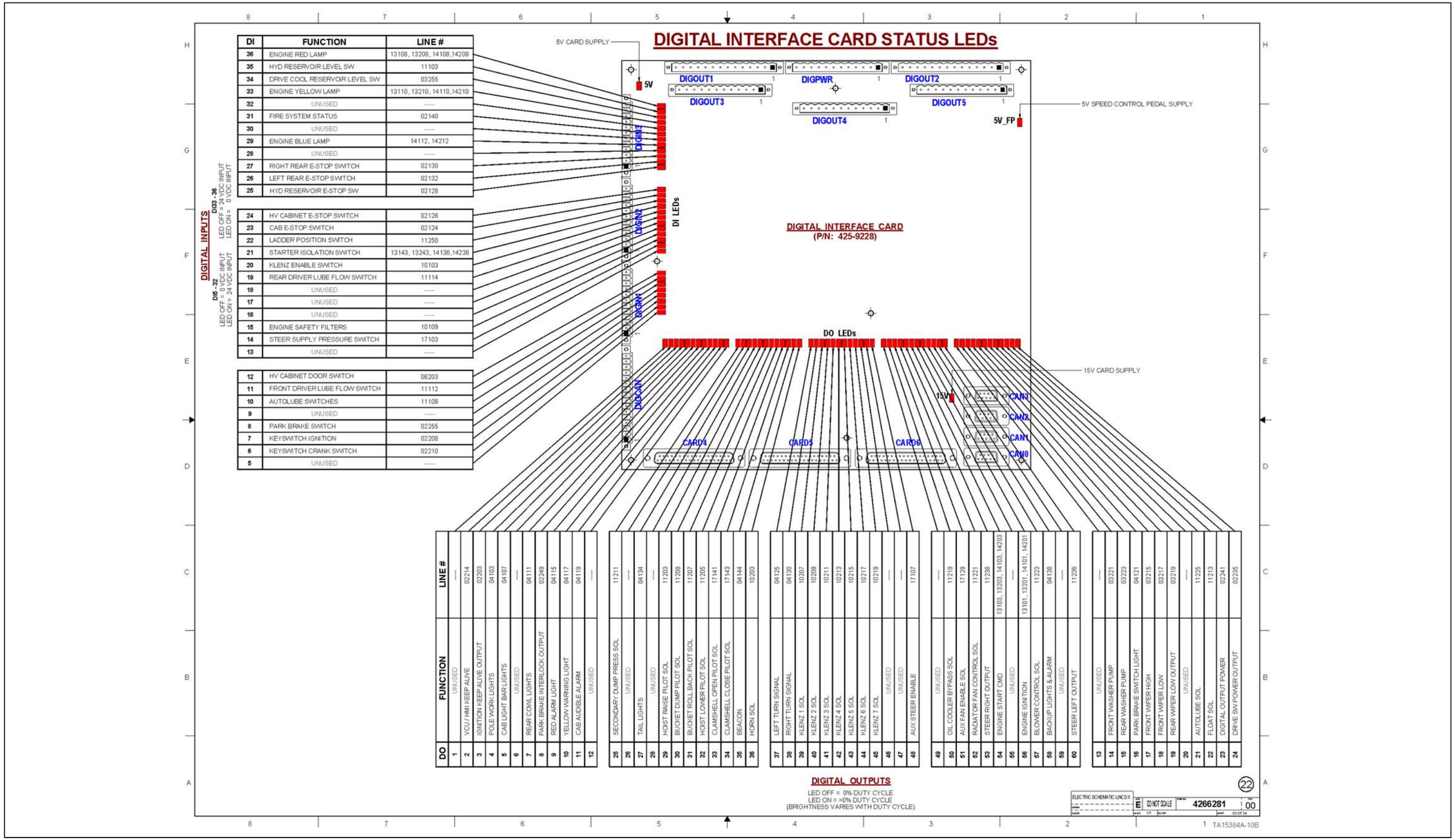


Figure 13. Digital interface card status LED's

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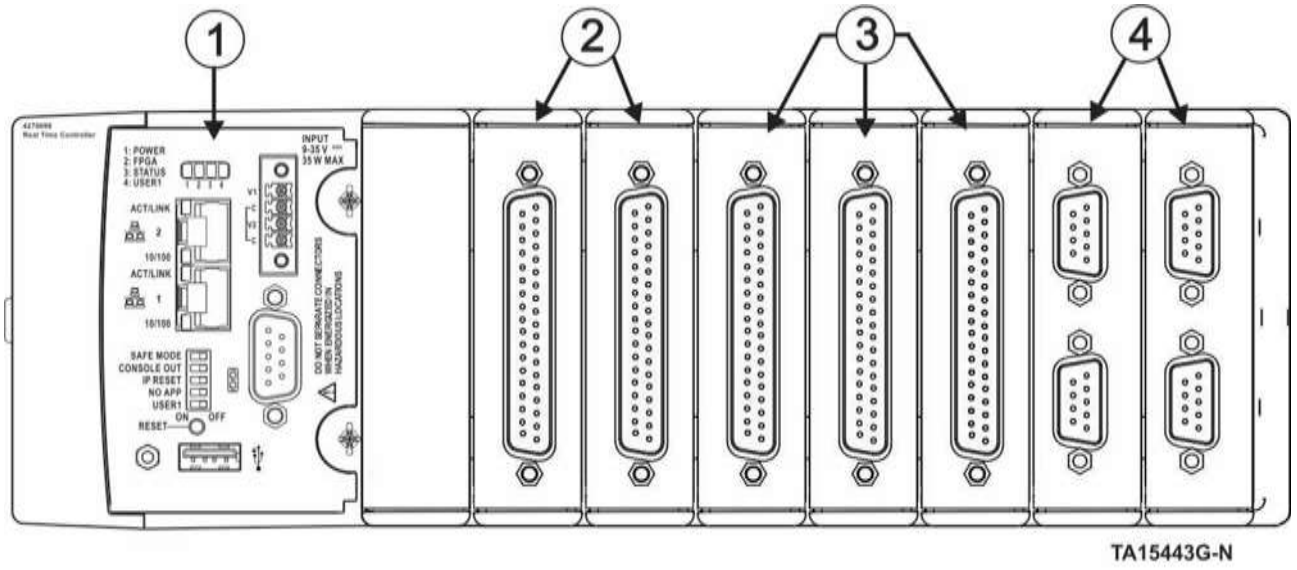
Vehicle Control Unit (VCU)

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.



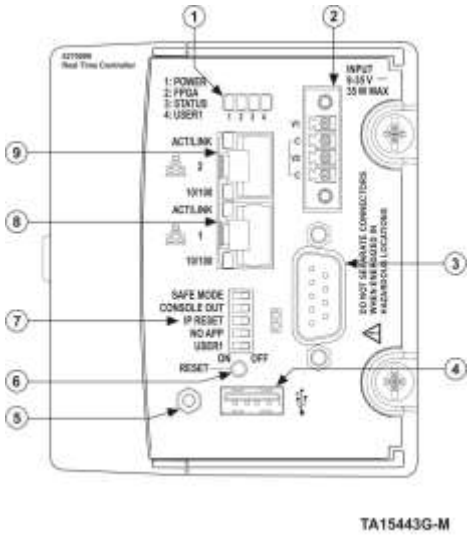
1) Controller, **2)** Analog modules, **3)** Digital modules, **4)** CAN modules

(mounted inside LVCC)

Figure 14. 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.



VCU Controller

1) LED's	**1)** Power: Lit when controller is powered on. **2)** FPGA: Blinking indicates FPGA is communicating with the RT (real time) program. **3)** STATUS: Not used. **4)** RT: OFF indicates the software is not running SLOW BLINK indicates there is no communication with the HMI. ONE BLINK WITH A 2 SEC DELAY (repeated) indicates there is a VCU Module error (modules swapped, missing or not working). Cab display will show following message 'The following module(s) are either not present or have failed: 2,4' (example only) TWO BLINKS WITH A 2 SEC DELAY (repeated) indicates there is a file read error. Cab display will show the following message 'Error reading VCU configuration file' FAST BLINK indicates the controller status is good and communication with the HMI is present.
2) Power Connector	24V power connection (V1 and C).
3) RS-232 Serial Port	Not Used
4) USB Port	Not used.
5) USB Retention Standoff	Not used.
6) Reset Button	Resets the VCU controller.
7) DIP Switches	All switches OFF.
8) RJ-45 Ethernet Port 1	Interfaces VCU with the HMI in operator cab.
9) RJ-45 Ethernet Port 2	___

Figure 15. 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.

(Mounted Inside LVCC)

Figure 16. Analog interface card

DC to DC Converter (24V to 12V)

Provides 12V to cab display.

(Mounted Inside LVCC)

Figure 17. DC to DC voltage converter/24-volt to 12-volt

Operators Cab

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

Figure 18. 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.

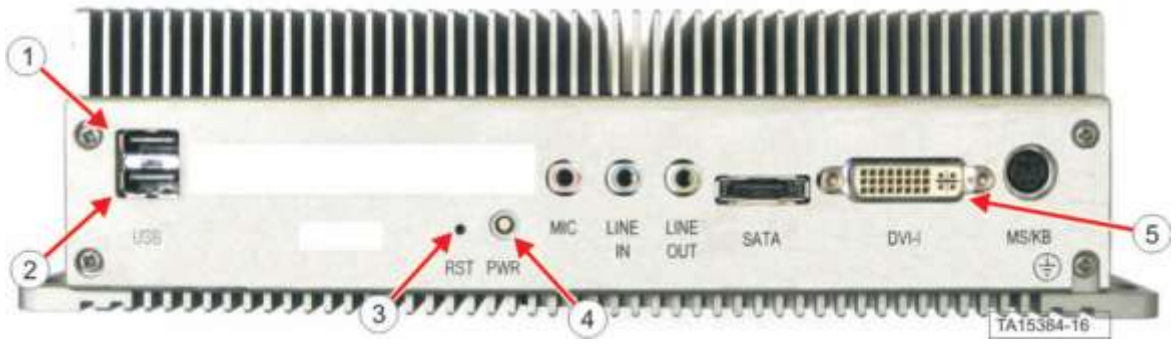
The display power switch has been disabled as it is controlled by the LINCS software while the dimmer switch allows the operator to increase or decrease the intensity of the backlight.

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

Figure 19. Cab display

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.



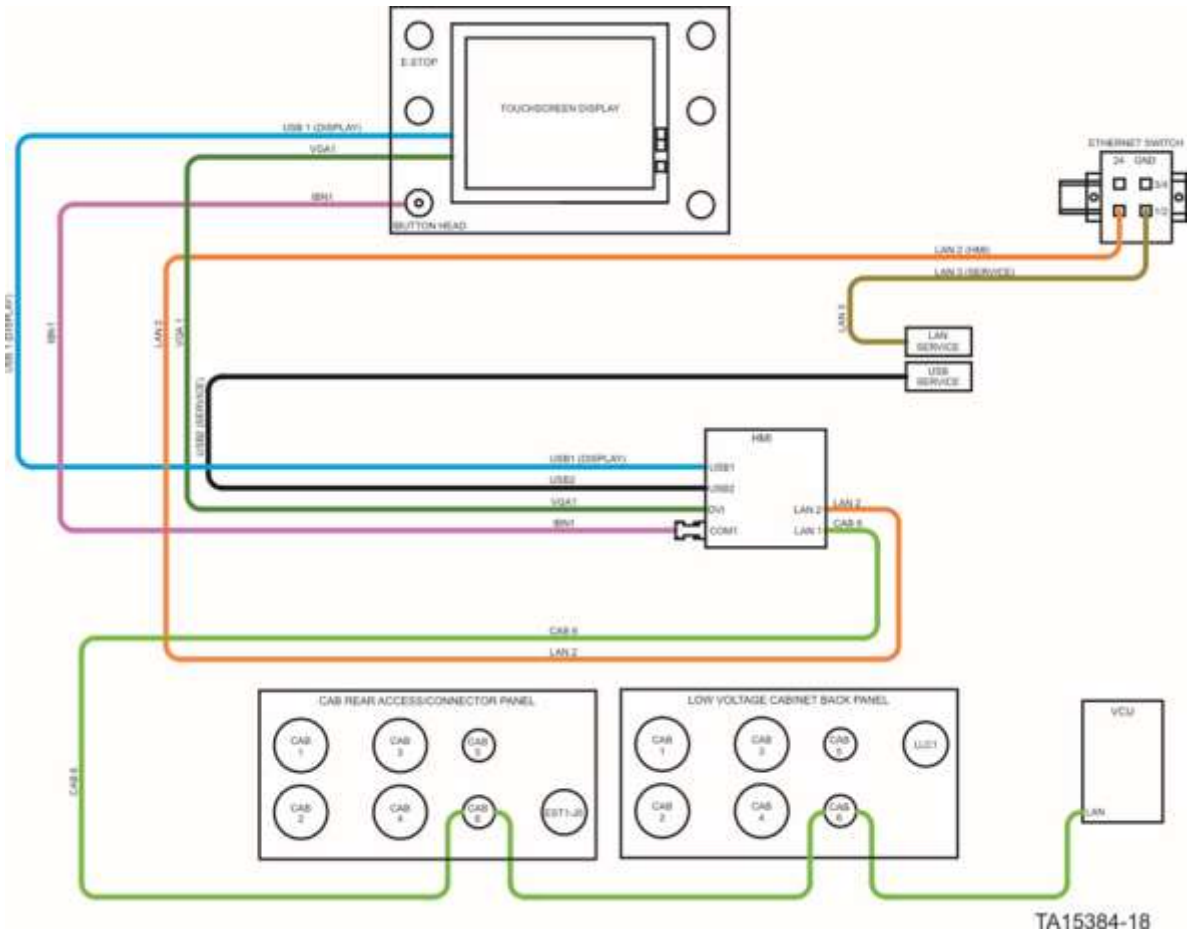
1) USB1 Port, **2)** USB2 Port, **3)** Reset Button, **4)** Power Button, **5)** DVI-I Connector

6) COM1 Connector, **7)** LAN1 Connector, **8)** LAN2 Connector, **9)** LED's, **10)** Power Connector

Figure 20. 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.



HMI Wiring Connection

Figure 21. 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

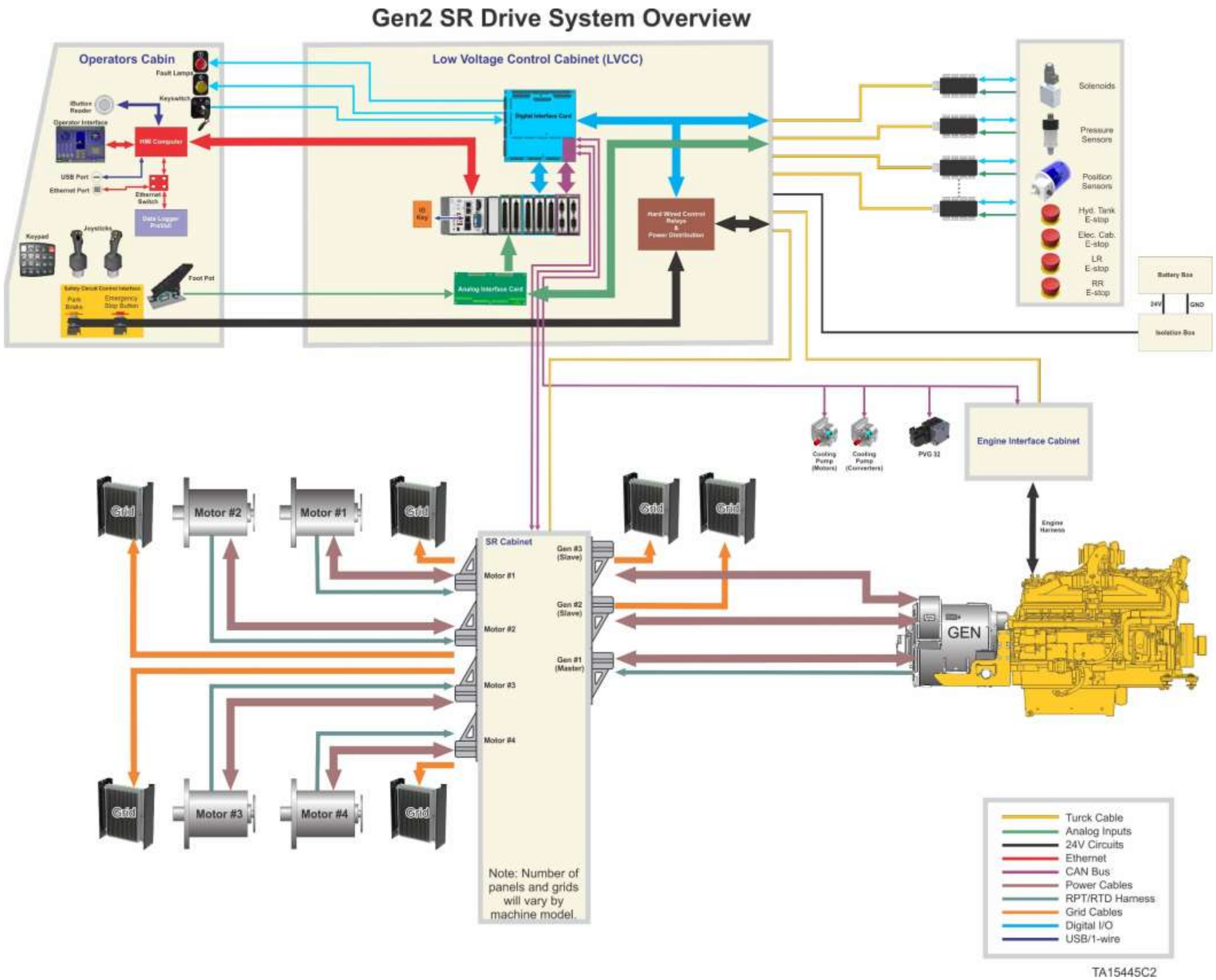


Figure 22. LINCS II basic control system layout

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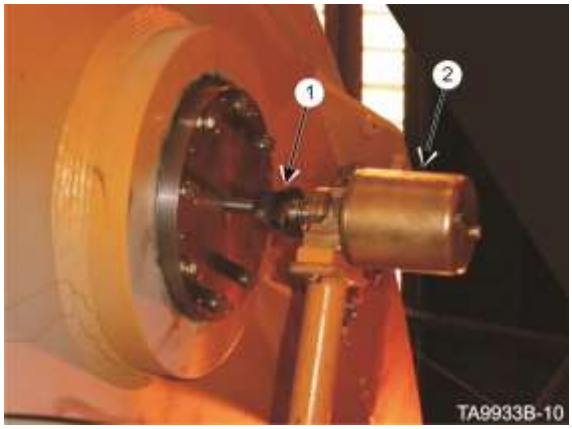
Position Sensing

Rotary Transducers Automatic Bucket Leveling Circuit

Bucket angle and lift arm heights are continuously monitored by encoders. The LINCS II computer system uses the bucket angle signal in conjunction with 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 height and bucket level position sensors are rotary encoders. 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 transducer is mounted on a support stand outside the right lift arm. By powering the lift arms down, using the hoist joystick control, the encoders are driven by a driveshaft, which is connected to the right lift arm or bell crank (refer to illustration “AUTOMATIC BUCKET LEVELING CIRCUIT – ROTARY ENCODER”). Both encoders send signals to the LINCS computer system. 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.



1) Driveshaft, **2)** Cover

Driveshaft Coupling

Bucket height rotary transducer – mounted right side, in front of operator’s cab-typical installation

Figure 23. Automatic bucket leveling circuit - rotary encoder

Position Sensor Setup

The Generation 2 machines lift arm, bell crank, and steer position sensors give an output of 4 to 20mA.

- From 0˚ to 1˚ the integral LED is on.
- The output increases linearly from 4mA at 0˚ to 20mA at 120˚.
- From >120˚ to 360˚ the output is 20mA. The output steps down to 4mA at >360˚. The shaft can rotate continuously: it has no stops.

Setup is the same for all Generation 2 machines.

Lift Arm Sensor

- Position the bucket at full rollback. Lower the lift arms until the hoist cylinders are fully retracted.
- Loosen the coupling set screw on the lift arm side.
- Rotate the sensor shaft for 3VDC between the signal and ground terminals.
- Tighten the set screw.

This should give the following results.

	Cylinders Fully Retracted	Cylinders Fully Extended	CW Rotation of Sensor Shaft
L950	3V	8.53V	15˚ to 98˚
L1150	3V	8.93V	15˚ to 104˚
L1350	3V	9.07V	15˚ to 106˚
L1850	3V	~9.00V*	15˚ to ~105˚*
L2350	3V	8.8V	15˚ to 102˚

* The precise cylinder stroke is not known at this time

Bell Crank Sensor

- Set the bucket on the ground in the level position.
- Loosen the coupling set screw on the bell crank side.
- Rotate the sensor shaft for 6VDC between the signal and ground terminals.
- Tighten the set screw.

The signal voltage extremes for the Generation 2 high lift should be:

- 8.77V for bucket rollback (41.55˚ sensor shaft rotation from the bucket level on ground position)
- 4.82V for bucket dump (17.70˚ sensor shaft rotation from the bucket level on ground position)

The signal voltage extremes will vary for the various size loaders and for high lift versus standard.

Steer Position Sensor

- Set the steering angle at zero and install the safety link.
- Loosen the sets screws at the sensor housing shaft.
- Rotate the sensor housing shaft for 6VDC between the signal and ground terminals.
- Tighten the set screws.

This should give the following results.

Steer Position	Signal Voltage
Right	>2V <6V
0˚	6V
Left	>6V <10V

The signal voltage will depend on the amount of rotation of the sensor shaft. That is controlled by the linkage and steering angle.

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