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Miller Industries 3000 – Individual Light Control (MITT-ILC) Lighting System

Installation, Setup, Operation, and Troubleshooting for the MITT-ILC System

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1 Purpose

The purpose of this manual is to provide a comprehensive overview of the updated Miller Industries 3000 – Individual Light Control WeCANX2.0 (hereafter referred to as MITT-ILC) system and an installation, operation, and troubleshooting guide.

The MITT-ILC system has been updated with new hardware configurations and software features, so installation, setup, and use procedures have changed. The material in this manual will assist field technicians, dealers, and customers to install, set up, operate, and troubleshoot the MITT-ILC system.

2 System Overview

The MITT-ILC system has been updated to provide several advantages to Miller distributors and customers. In this new system, the central junction box has been eliminated, replaced by a modular, distributed system that increases control by dividing it among several zones. Every harness is pre-assembled, and each lighting drop comes with a mating connector. Lighting drop connectors are pre-programmed, color-coded, and location-specific.



Figure 1: Example of Color-Coded Lighting Drop



Figure 2: Example of Color-Coded Lighting Drop



Figure 3: Example of Color-Coded Lighting Drop



Figure 4: Example of Color-Coded Lighting Drop



Figure 5: Example of Pre-Assembled Toolbox Wiring Harness

Customization is also easier, with 273 points individually adjustable in the Whelen Command software. Taillights are now independent of the lighting control system.

The MITT-ILC system controls the following functions and electrical loads on the wrecker:

- Warning Lights
- Ground Illumination
- Scene Lighting
- Millennium Lights
- Body-Mounted Marker Lights



- Lightbars
- Pylon Lights
- Toolbox Compartment Lighting
- Glo Lights/Accent Lighting
- Operator Station Power
- Power Take Off (PTO) Engagement
- All System Power

The MITT-ILC system hardware comprises five main panels: one panel under the hood and two pre-installed panels in each toolbox. One optional, pre-installed panel is available in the tunnel box. Each panel controls one of five or six (depending on whether the optional tunnel box lighting is enabled) pre-designated sectors of the vehicle. Each sector can be individually configured with specific light patterns and behavior. The Whelen-developed controller-area network, called WeCANX, allows components to communicate with each other, governed by the Core-R module. Panels are connected to each other by twisted pair CAN cables, power, and ground.

The MITT-ILC system is pre-programmed and configured. Some custom configuration can be adjusted by enabling specific inputs on the modules. Most custom configuration is adjusted using the Whelen Command software. This manual will assist customers and installers with custom configuration through enabling inputs as well as through the software, including extracting the pre-loaded configuration file, adjusting module addressing and STEADY-LOCK, and running output diagnostics. Further capabilities of the software are beyond the scope of this manual; for information on more advanced usage, contact Whelen support ([Section 4.3.5: Advanced .wln Configuration File and Lightbar File Manipulation](#)).

The software is available for download at <https://www.whelen.com/whelen-command>, and the MITT-ILC system files are available at <https://www.millerind.com/display-controller>. Refer to [Section 4.3: Software](#) for more information about Whelen Command.

2.1 MITT-ILC System Architecture

The MITT-ILC electrical architecture divides the wrecker into five or six discrete sectors or zones. Each zone is controlled by its local distribution panel, which controls warning lights, ground illumination, Millennium lights, pylon lights, and accent lights. Illumination on display panels, work lights, lightbars, and traffic advisory lights are controlled by the distribution panel in the truck cab.

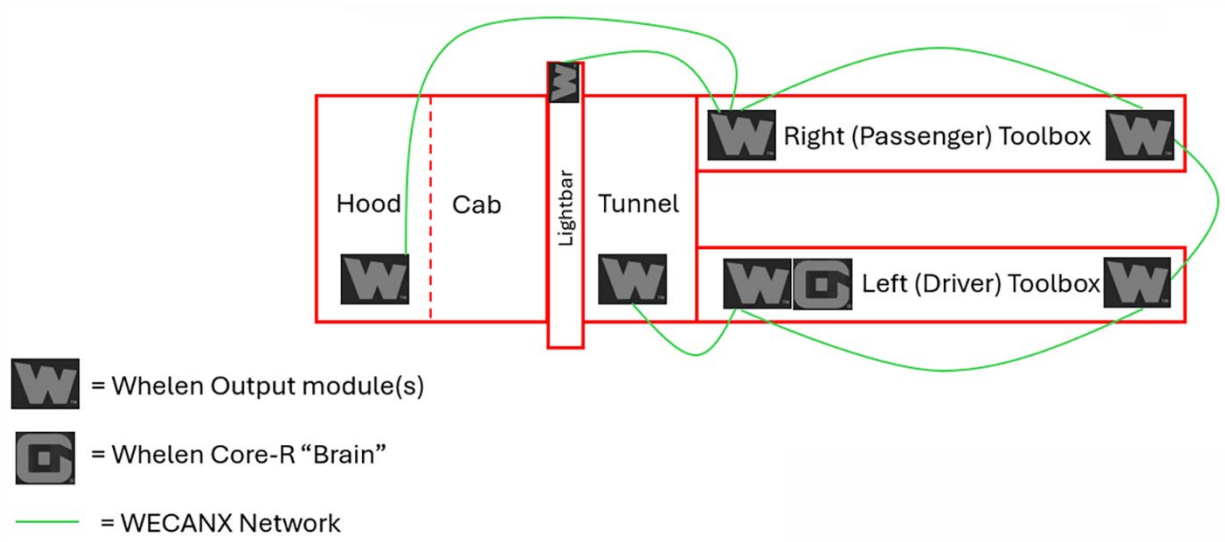


Figure 6: WeCANX Network

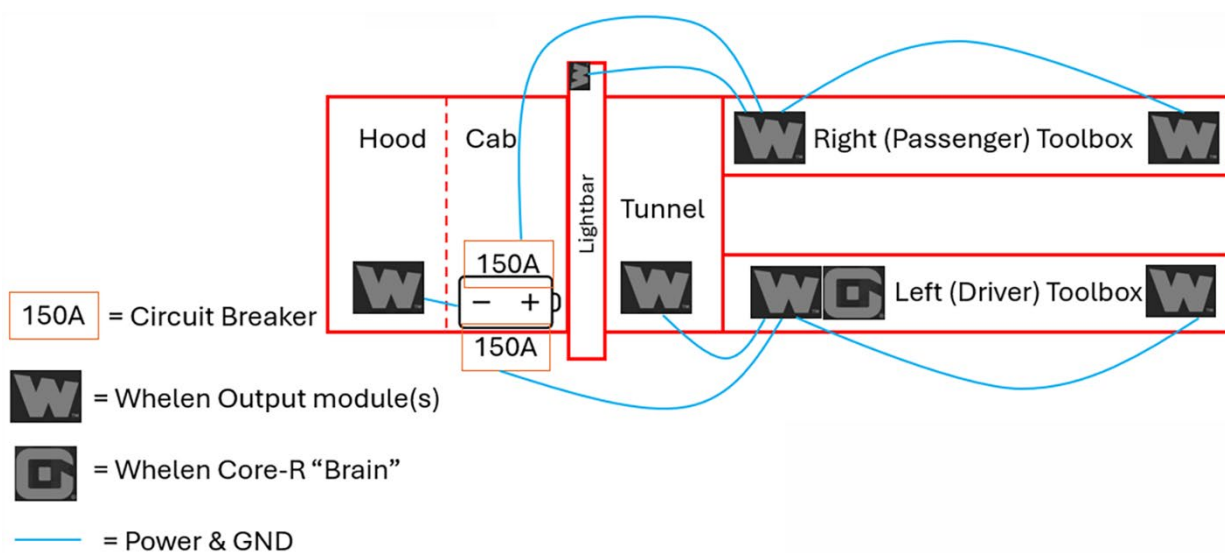


Figure 7: Power Distribution

Below are two examples of individual light placements on Miller Industries recovery vehicles.

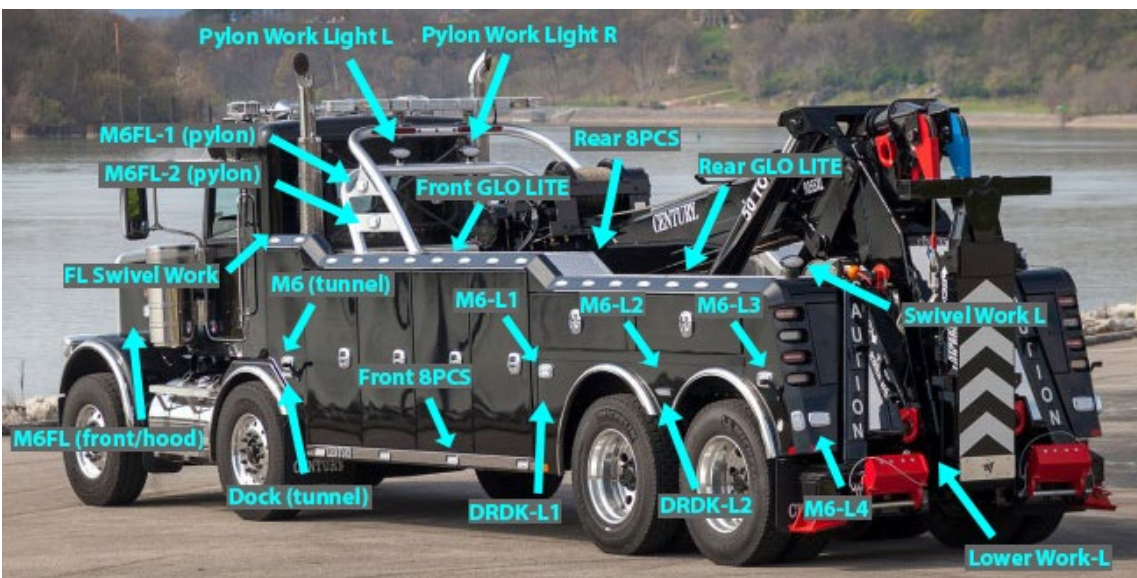


Figure 8: M6, Swivel, and Pylon Light Locations on 9055xl

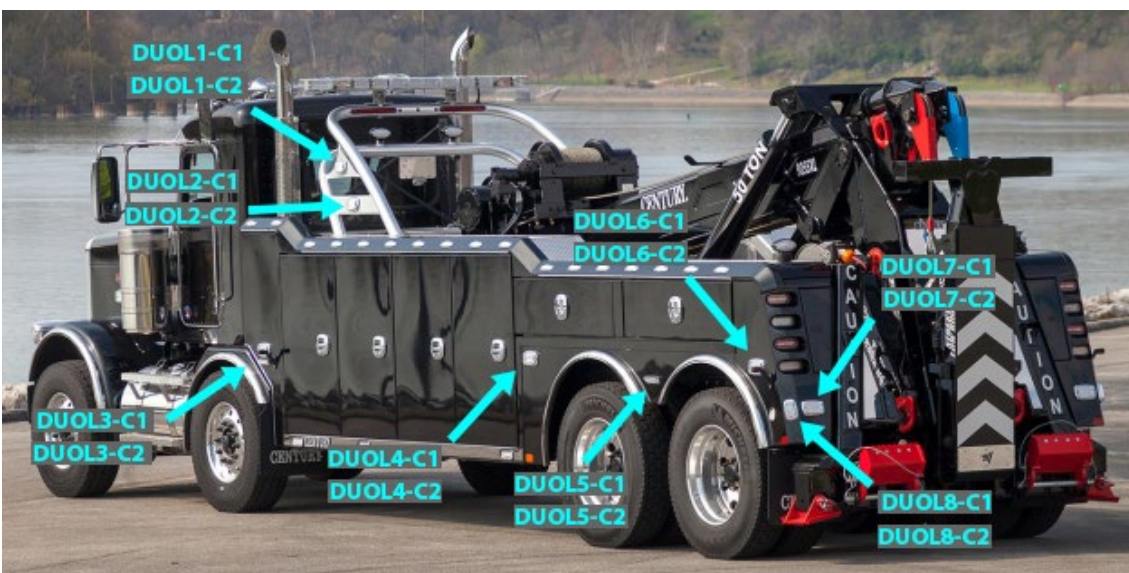


Figure 9: Duo Light Locations on 9055xl

2.1.1 Electrical Load Management

The MITT-ILC system is equipped with active load management designed to balance electrical loads and keep the battery from reaching critically low voltage. Note that the PTO and power to the controls are not affected unless the battery or charging system reaches a critically low level.



Load shed is triggered at 11.9VDC. If the battery or charging system reaches this level, the load management system strategically turns off work lighting and any connected electrical loads. Additionally, the control head keypads indicate load shed by alternately blinking the top and bottom rows of buttons.

When the battery reaches more than 11.9VDC, the blinking stops.

NOTE:

If the load management system turns off a function automatically, the operator can override the automatic shutoff and manually turn the function back on, even if load management is still active.

2.2 System Hardware Layout

The default installation of the MITT-ILC hardware includes at least five distribution panels, at least two control head keypads, pre-installed and pre-routed wiring harnesses, and some loose harnesses.

2.2.1 Panel Components

The panels are made up of the hardware components of the MITT-ILC system mounted to flat aluminum plates. The following describes the various components that the MITT-ILC system uses.

Refer to [Section 7.2: Panel Connections and Component Pin-Out](#) for detailed pin-out and input information for each component.

2.2.1.1 Core-R Controller Module

This component is placed on the left-hand forward panel only. The Core-R controller handles inputs from the chassis, remote emergency stop, and toolbox lock/unlock signal, relaying them as necessary to the appropriate zone. This component is the brain of the system, controlling all other modules via the WeCANX network. The Core-R comes preprogrammed with the custom Miller Industries .wln configuration file, which configures the entire system.

Confirm that the configuration is the most current version by checking the Miller Industries website, detailed in [Section 4.3.1: Downloads](#).



Figure 10: Core-R Module

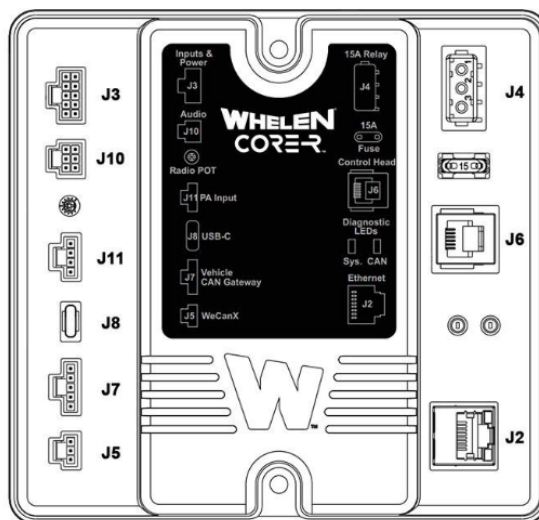


Figure 11: Core-R Module Drawing

2.2.1.2 CEM16 2.5A

The CEM16 is a 16-output module with high-side switching (12VDC) and four inputs, either high-side or low-side. Outputs are rated at 2.5 amps each and have built-in current limiting, so fusing the output end is not necessary. Each CEM16 module has a unique associated address that appends to 16; for example, one CEM16 in the left-hand forward panel is addressed 1602 and the other is addressed 1607.



Figure 12: CEM16 Module

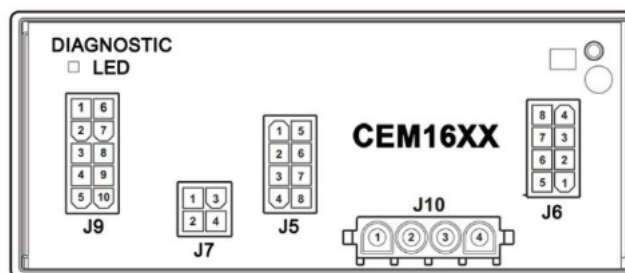


Figure 13: CEM16 Module Drawing

2.2.1.3 CEM4HC

This expansion module is a four-output module with high-side switching only (10-30VDC). Outputs are rated at 15 amps each and have built-in current limiting, so fusing the output end is not necessary. Each CEM4HC module has a unique associated address that appends to CEM4HC; for example, one CEM4HC in the left-hand forward panel is addressed CEM4HC01 and another in the right-hand forward panel is addressed CEM4HC02.



Figure 14: CEM4HC Module

2.2.1.4 Chassis Input

The 8-pin chassis input connector, located on the left-hand forward panel only, is part of the input harness connected to the Core-R Controller. This connector controls power to the left and right turn signals, brake lights, marker lights, vehicle ignition, reverse lights, lock and unlock, and emergency stop. Mating connector DT06-8SA connects the chassis inputs to this Deutsch connector.

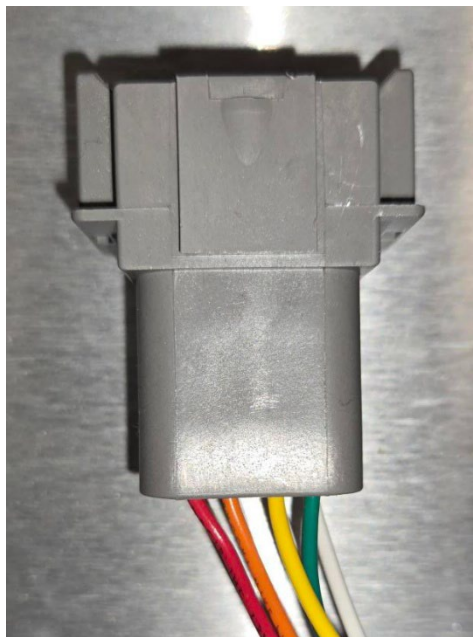


Figure 15: Chassis Input Connector



Figure 16: Mating Connector DT06-8SA

2.2.1.5 Fuse Boxes

The fuse boxes are installed on each panel in the left-hand and right-hand toolboxes. Each is covered with a snap-on lid and accepts both power and ground. The left-hand forward fuse box accepts power and ground from the battery and provides power and ground to the left-hand rear panel. The right-hand forward fuse box accepts power and ground from the battery and provides power and ground to the right-hand rear panel.

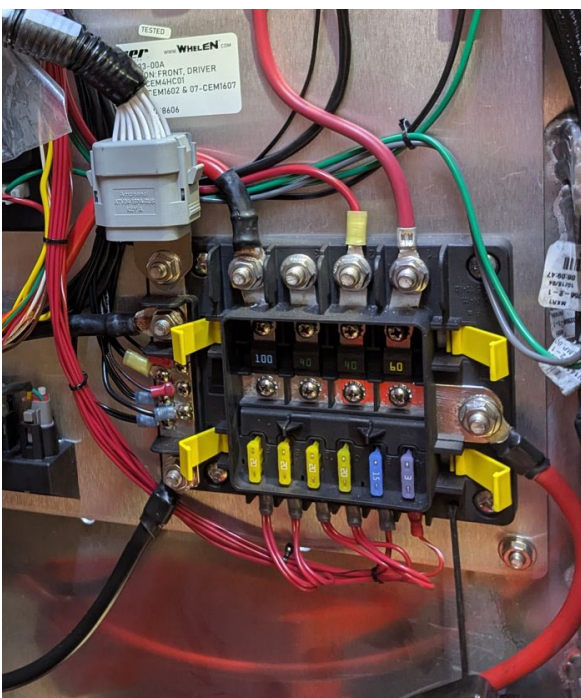


Figure 17: Fuse Box (LH Forward Panel)

Table 1: Example Fusing Table (LH Forward Panel)

Fuse ID	Fuse Rating	Description
1	60	HCM
2	40	Lock Box
3	40	Tunnel Box
4	100	Rear Left Panel
A	3	Core
B	15	Core J4
C	20	CEM1602
D	20	CEM1602
E	20	CEM1607
F	20	CEM1607

2.2.1.6 Traffic Advisory Module

The traffic advisory module controls the Millennium lights and allows for both Warning and Traffic Advisory options in addition to the standard ON setting that enables running lights. The CTA is limited to 15 amps, and all eight outputs are low-side-switched (0VDC or Ground). Each traffic advisory module has a unique associated address that appends to CTA; for example, the right-hand rear traffic advisory module is addressed CTA01, and the left-hand rear traffic advisory module is addressed CTA02.



Figure 18: Traffic Advisory Module

2.2.1.7 CAN Splitter

The CAN splitter connects the WeCANX system, including the hood and cab components, the right-hand rear panel, and additional connections available in the right-hand forward panel. Also, the CAN splitter connects to WeCANX lightbars. The CAN splitter is a passive device that splices up to six CAN connections together using the two 3-pin Deutsch and one 12-pin Deutsch connector interfaces. The 12-pin Deutsch connector holds four CAN connections on the localized panel, and the two 3-pin connections are used as trunk or long-distance connections. For example, connections from panel to panel use the CAN splitter. Power and ground for the lightbars is supplied by the panel-mounted fuse box. All CAN connections must use only gold-plated terminals.



Figure 19: CAN Splitter

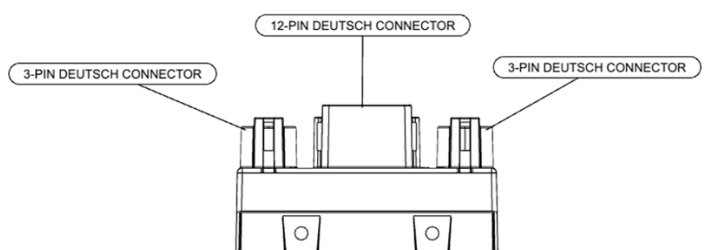


Figure 20: CAN Splitter Connections

2.2.1.8 Control Head Keypads

One control head keypad is available in the vehicle cab and the other is placed in the left-hand rear toolbox. Additionally, customers have the option to include a right-hand rear control head keypad. These control head keypads provide operators with the main interface to the MITT-ILC system, with labeled buttons that activate or change functions. Each control head keypad has a unique associated address that appends to CCT7MI; for example, the control head keypad in the left-hand rear panel is addressed CCT7MI2. For details on the buttons and slider functions, refer to [Section 5.4: Control Head Keypad Functions](#).



Figure 21: Control Head Keypad

2.3 Panels

Panels contain all the configurable hardware components of the MITT-ILC system. The placement of the panels under the hood and inside the toolboxes allows easy access for wiring and service purposes. All panels come pre-wired, pre-installed, and terminated, with harnesses pre-routed, except the under-hood module. Each forward toolbox panel has an independent connection to the positive and negative posts on the battery through a 150-amp circuit breaker.

The distribution panels are installed under the hood, in the left-hand forward toolbox, the left-hand rear toolbox, the right-hand forward toolbox, and the right-hand rear toolbox. If the optional tunnel box lighting is enabled, a sixth panel is located in the tunnel box.

2.3.1 Under-Hood Panel

This panel controls lighting local to the vehicle cab, including grille and hood warning lights. The under-hood panel is included on all Miller builds, even if it's not required on the initial setup. If not used in the initial build, the module is still reserved for future upgrades.

It is critical to find a good ground for the ground bus connector on the hood harness. There is typically a ground bus located on the left-hand side firewall, near the most common mounting location of the CEM16 module. The ground bus is easy to find, with multiple cables connected to a single point or a multi-stud bus, usually with a red corrosion-inhibiting paint. The red corrosion-inhibiting paint must be removed, following the chassis manufacturer's procedures, then reapplied after the ground connection is completed.

Components and part numbers of the under-hood panel:

Table 2: Components & PN of Under-Hood Panel

Part Number	QTY	Description
03028292	1	CONTROLLER, WHELEN CEM1601 (HOOD MODULE)
07042558	1	MITT-ILC M6 MOUNTING PLATE (HOOD)
03033834	1	MITT-ILC CAB/HOOD CAN
03034727	1	MITT-ILC HOOD M6 Harness 2
03033841	1	MITT-ILC HOOD M6 HARNESS



Figure 22: Under-Hood Panel



Figure 23: Under-Hood CEM1601 Module

2.3.2 Left-Hand Forward Toolbox Panel

This distribution panel is the master panel and controls lighting local to the forward driver's side body. Additionally, this panel and its components control the lightbar, razor lights (if equipped), warning lights, swivel lights, left-hand and right-hand pylon lights, marker lights, and toolbox beacon lights.

Some chassis, including Freightliner and International, enable load sensing on the chassis 7-way tow plug used to transmit chassis signals to the Core-R module. If the load sense feature is enabled, it can randomly send a low voltage signal to the marker/turn signal/brake/reverse light circuits that trigger the Core-R input to full-on. If the load sensing feature cannot be turned off at the chassis, the solution is to install 330-ohm resistors from the chassis input connector to ground.

Components of the left-hand forward toolbox panel:

Table 3: Components & PN of LH Forward Toolbox Panel

Part Number	QTY	Description
09028606	1	MITT-ILC FRONT LEFT PANEL
03037634	1	350A PDM 4 MIDI 6ATO [FUSE BOX]
03033840	1	MITT-ILC TLBX DOOR HARNESS
03037412	1	MITT-ILC LEFT PYLON HARNESS
03033838	1	MITT-ILC LH FRONT LGHTS HC4 [HARNESS]
03028291	1	CONTROLLER, WHELEN CORE-R
03028301	1	CONTROLLER, WHELEN CEM1602
03028301	1	CONTROLLER, WHELEN CEM1607
03028354	1	CAN SPLITTER
03028294	1	CONTROLLER, WHELEN HC CEM4HC01
03033842 †	1	MITT-ILC Second CEM16 M6 DUO&V [HARNESS]
03032386 *†	3	RESISTOR, 330 OHM

*: For Freightliner or International chassis that have load sense voltage on the chassis inputs

†: Optional; not included in standard package and purchased separately

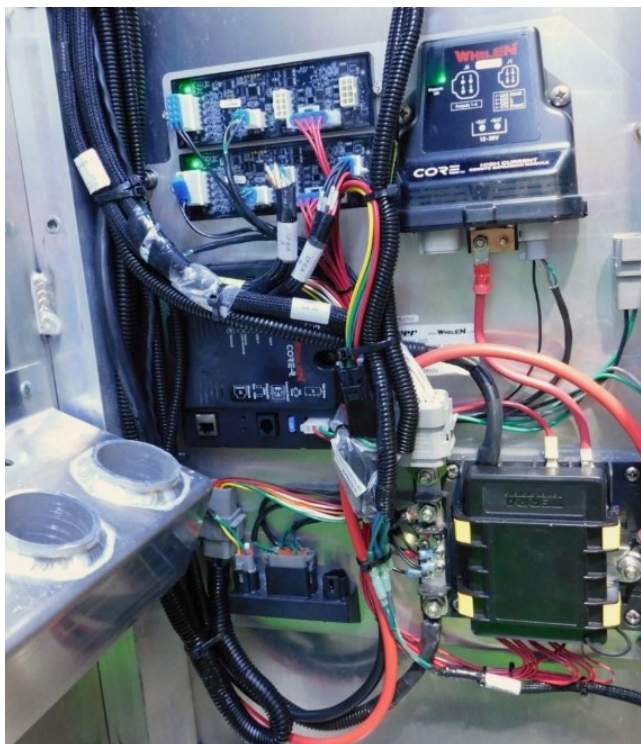


Figure 24: LH Forward Panel

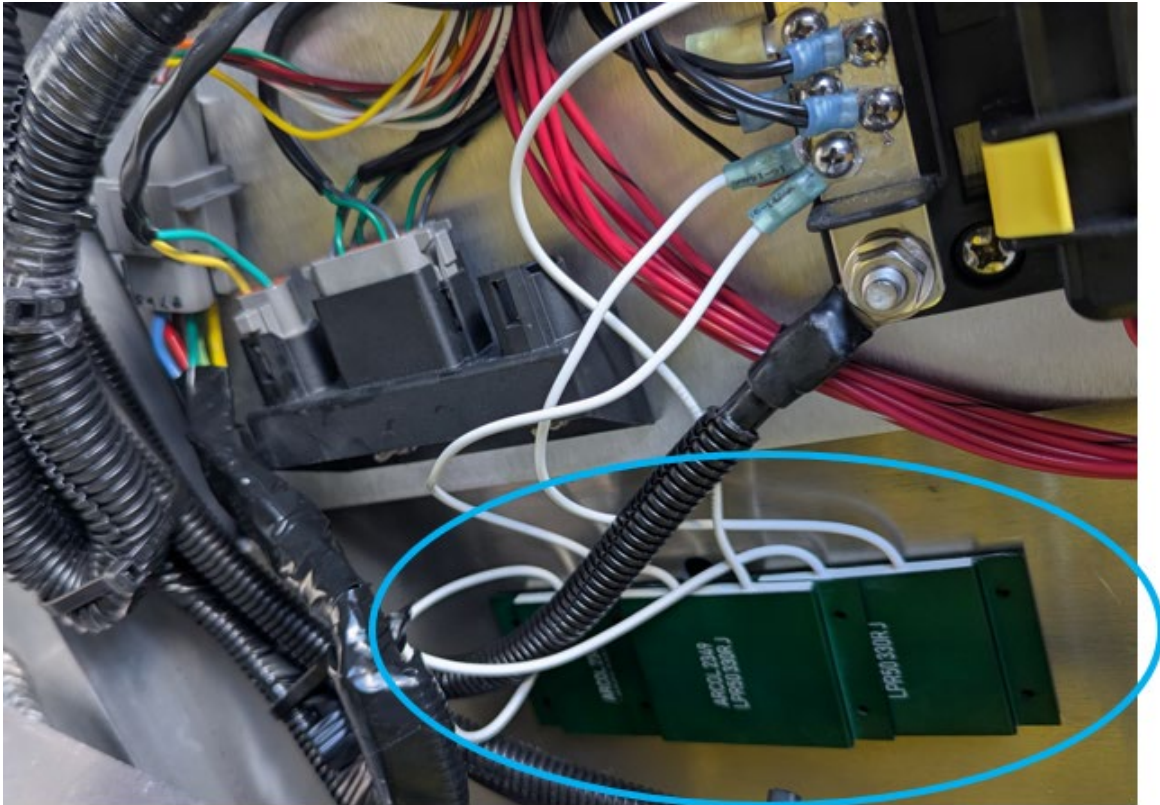


Figure 25: 330-Ohm Resistors

2.3.3 Left-Hand Rear Toolbox Panel

Each rear panel provides power distribution to local body areas, encompassing side beacon lights, marker lights, swivel lights, left turn lights, left toolbox lights, lower work lights, dock lighting, Millennium lights (when equipped), M6 Duo lights, and power to the controls. The default left-hand rear toolbox compartment contains a control head keypad near the control panel.

Components of the left-hand rear toolbox panel:



Table 4: Components & PN of LH Rear Toolbox Panel

Part Number	QTY	Description
09028623	1	MITT-ILC REAR LEFT PANEL
03028330	1	KEYPAD, WHELEN 21SLIDE DRVR 2
03034029	1	CONTROLLER, WHELEN CEM1603
03034029	1	CONTROLLER, WHELEN CEM1608
03028354	1	CAN SPLITTER
03033835	1	MITT-ILC LEFT REAR CEM16 [HARNESS]
03038134	1	HARNESS, BOTTOM MARKER EXT
03033908	1	CONTROLLER, WHELEN CTA1 MODULE
03028452	1	REAR FUSE BLOCK, ATCX10, 30A/100A
03033845	1	MITT-ILC TAIL TLBX CROSSOVER
03033842 †	1	MITT-ILC Second CEM16 M6 DUO&V [HARNESS]
03033844 †	1	MITT-ILC CTA MILLENNIUM LIGHT

†: Optional; not included in standard package and purchased separately

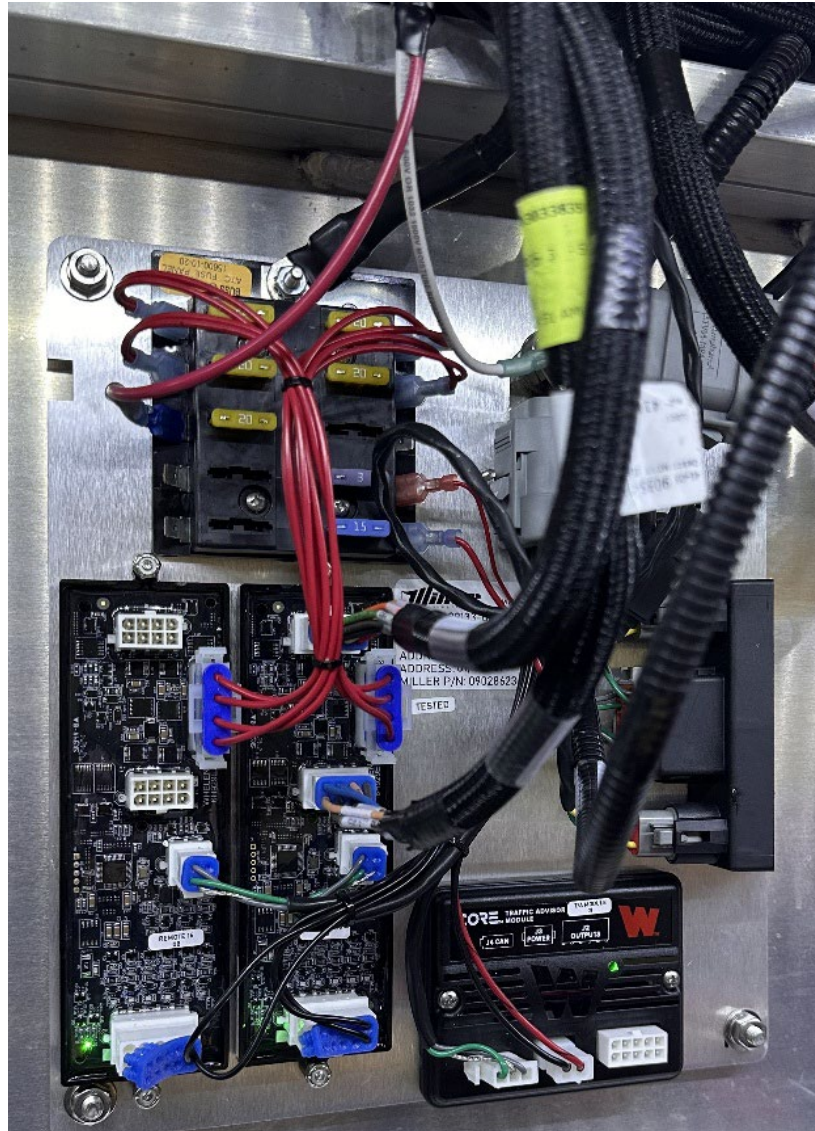


Figure 26: LH Rear Toolbox Panel

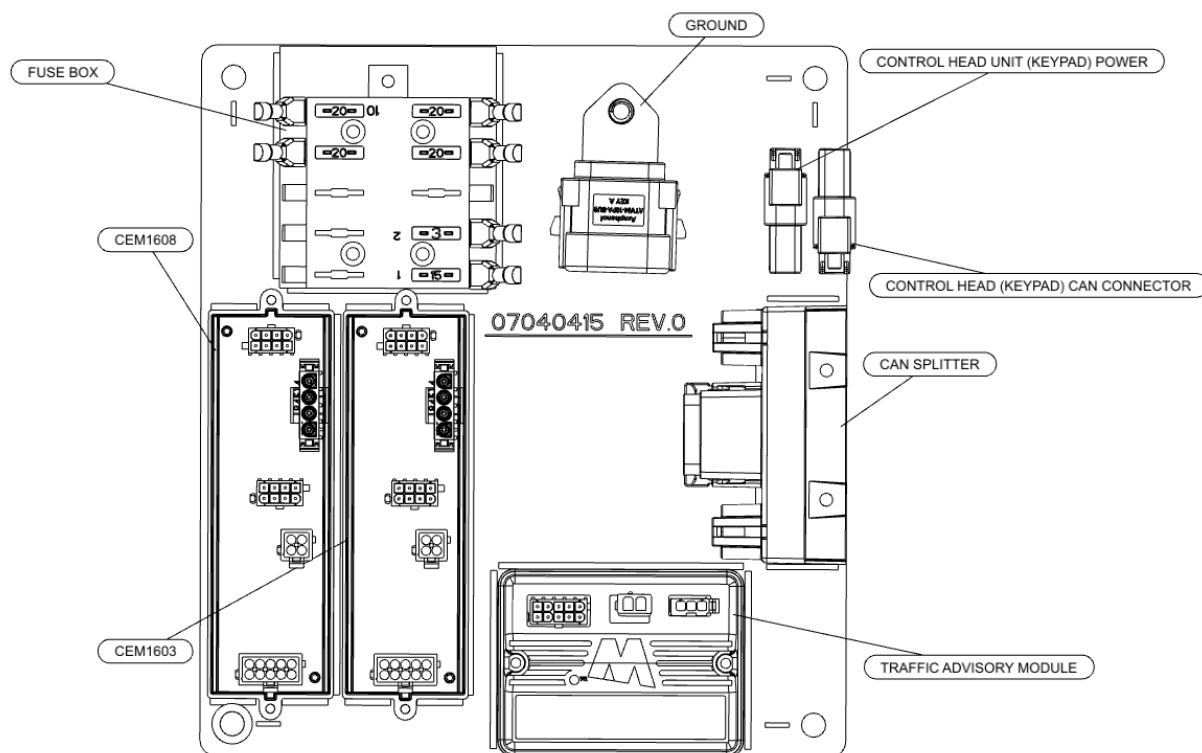


Figure 27: LH Rear Toolbox Panel Drawing

2.3.4 Right-Hand Rear Toolbox Panel

Each rear panel provides power distribution to local body areas, encompassing side beacon lights, marker lights, swivel lights, right turn lights, right toolbox lights, lower work lights, dock lighting, Millennium lights (when equipped), M6 Duo lights, and power to the controls. Optionally, one control head keypad can be installed in the right-hand rear toolbox compartment near the control panel.

Components of the right-hand rear toolbox panel:



Table 5: Components & PN of RH Rear Toolbox Panel

Part Number	QTY	Description
09028785	1	MITT-ILC REAR RIGHT PANEL
03028331	1	KEYPAD, WHELEN 21SLIDE PASS 3
03034030	1	CONTROLLER, WHELEN CEM1604
03034030	1	CONTROLLER, WHELEN CEM1609
03028354	1	CAN SPLITTER
03033909	1	CONTROLLER, WHELEN CTA2 MODULE
03028452	1	REAR FUSE BLOCK, ATCX10, 30A/100A
03033836	1	MITT-ILC RIGHT REAR CEM16 [HARNESS]
03038134	1	HARNESS, BOTTOM MARKER EXT
03033845	1	MITT-ILC TAIL TLBX CROSSOVER
03033844 †	1	MITT-ILC CTA MILLENNIUM LIGHT [HARNESS]
03033842 †	1	MITT-ILC Second CEM16 M6 DUO&V [HARNESS]

†: Optional; not included in standard package and purchased separately

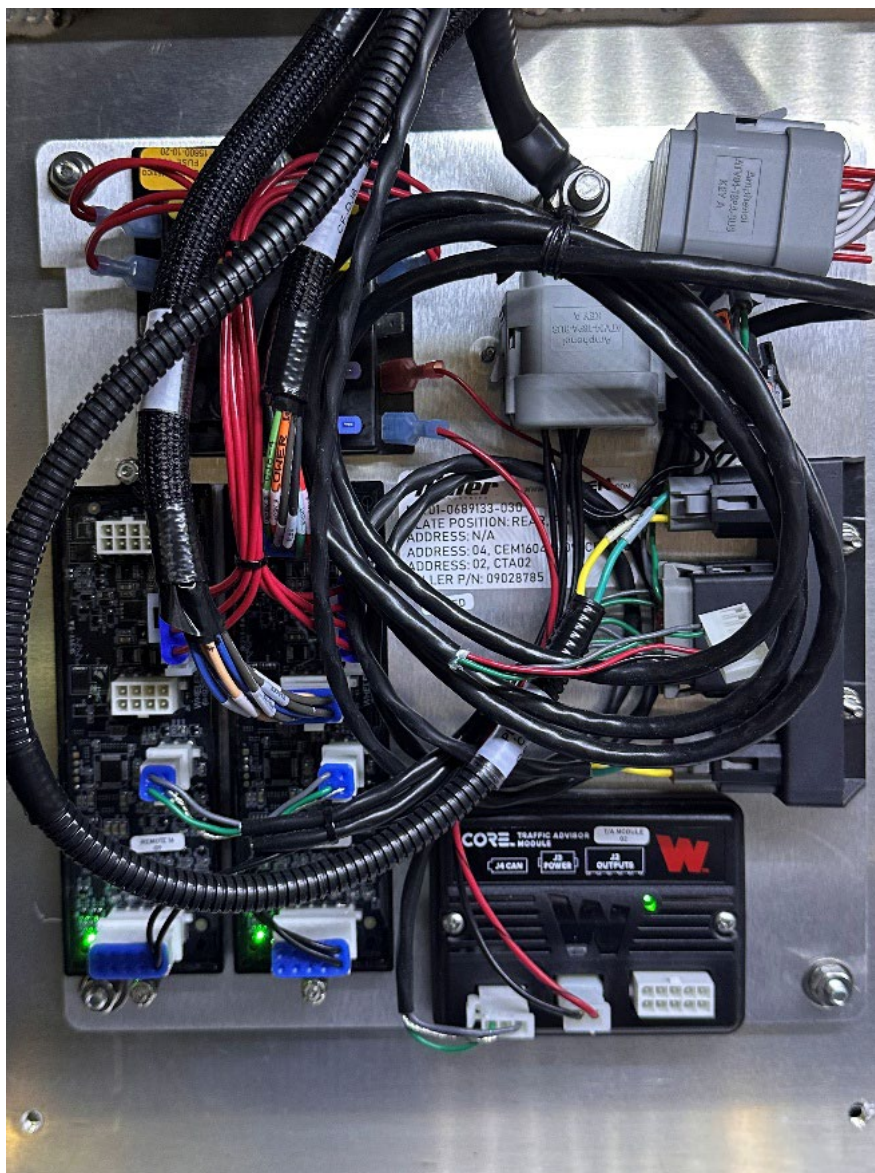


Figure 28: RH Rear Toolbox Panel

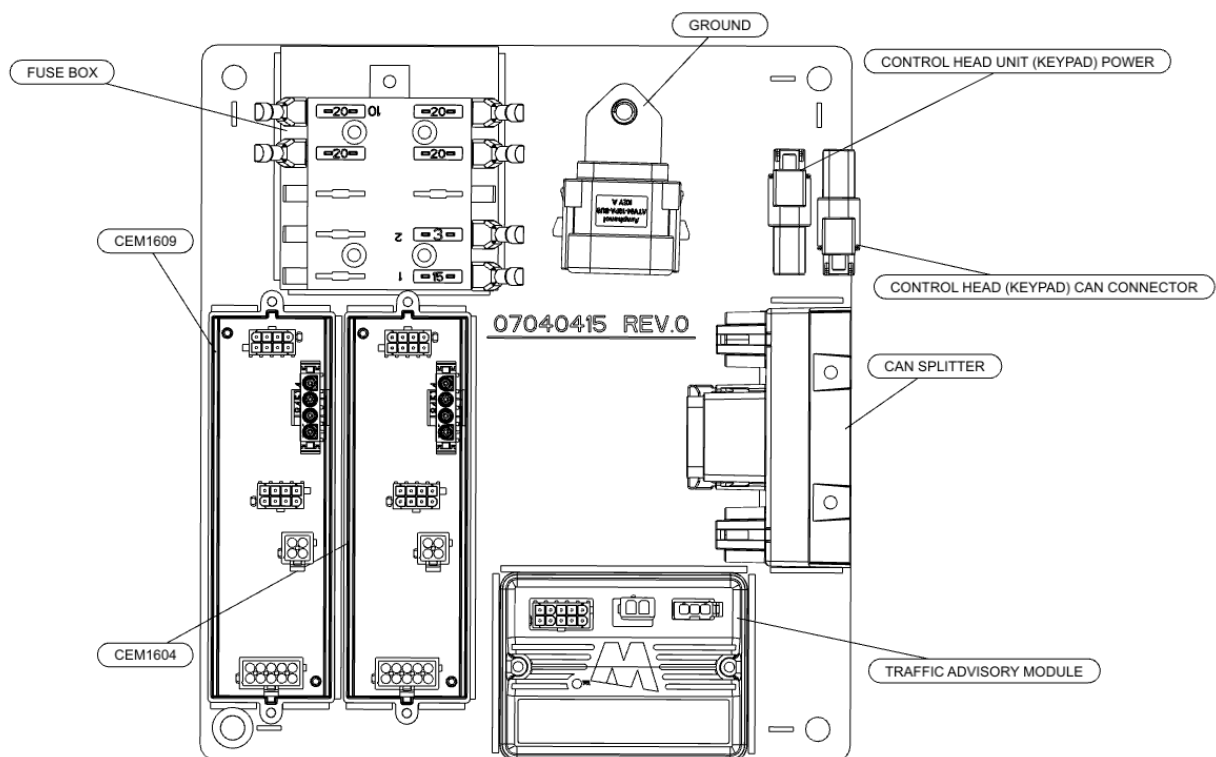


Figure 29: RH Rear Toolbox Panel Drawing

2.3.5 Right-Hand Forward Toolbox Panel

This panel supplies power and ground distribution to all electrical components on the right-hand forward side of the wrecker as well as the pylon and lightbar.

Components of the right-hand forward toolbox panel:



Table 6: Components & PN of RH Forward Toolbox Panel

Part Number	QTY	Description
09028784	1	MITT-ILC FRONT RIGHT PANEL
03034031	1	CONTROLLER, WHELEN CEM1605
03034031	1	CONTROLLER, WHELEN CEM1610
03028300	1	CONTROLLER, WHELEN HC CEM4HC02
03033840	1	MITT-ILC TLBX DOOR HARNESS
03034674	1	MITT-ILC RIGHT PYLON HARNESS
03033839	1	MITT-ILC RH FRONT LGHTS CEM16 [HARNESS]
03033838	1	MITT-ILC LH FRONT LGHTS HC4 [HARNESS]
03031609	1	WECANX LIGHT BAR
03028354	1	CAN SPLITTER
03037634	1	350A PDM 4 MIDI 6ATO [FUSE BOX]
03033842 †	1	MITT-ILC Second CEM16 M6 DUO&V [HARNESS]
03033844 †	1	MITT-ILC CTA MILLENNIUM LIGHT [HARNESS]

†: Optional; not included in standard package and purchased separately

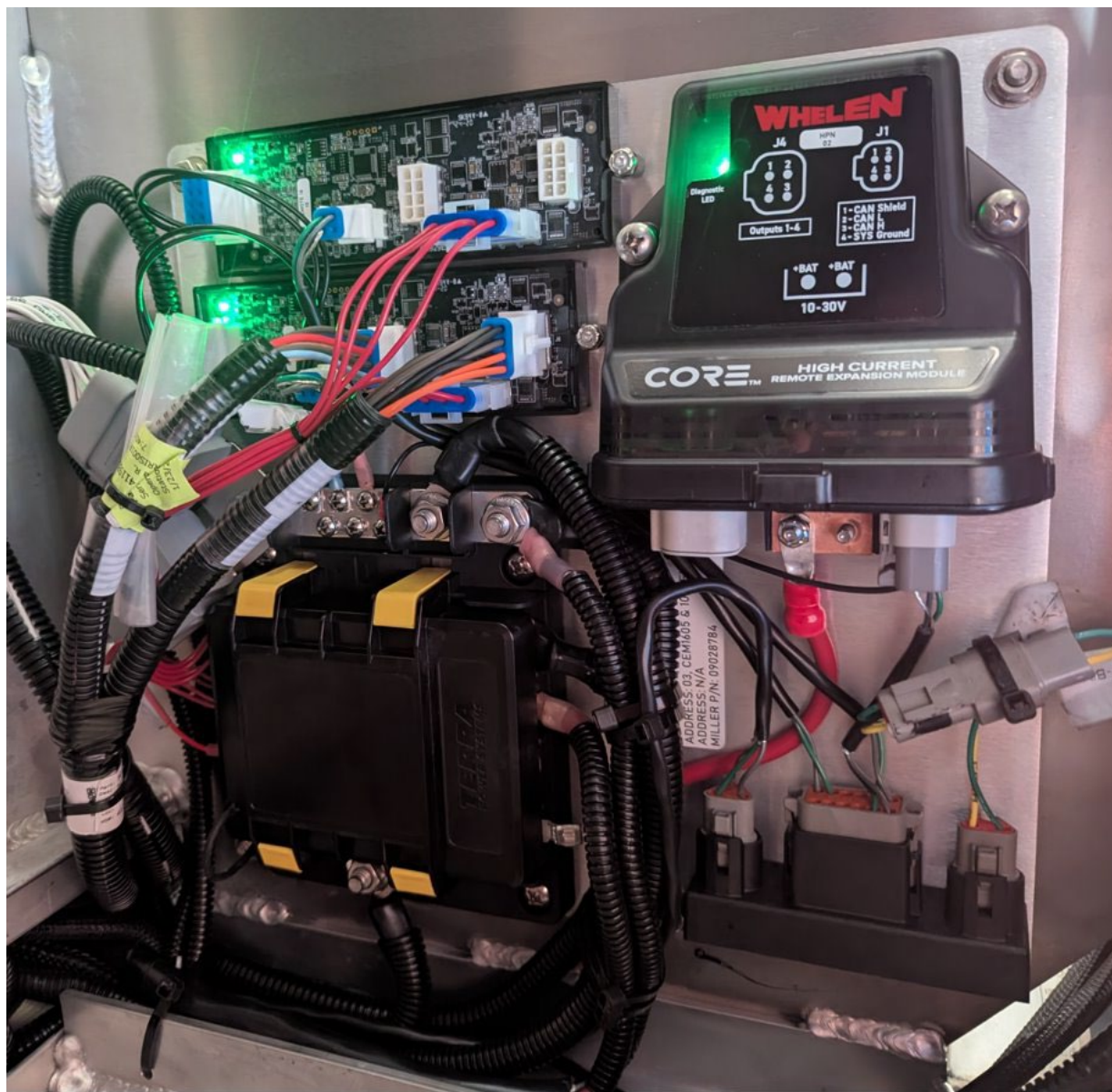


Figure 30: RH Forward Toolbox Panel

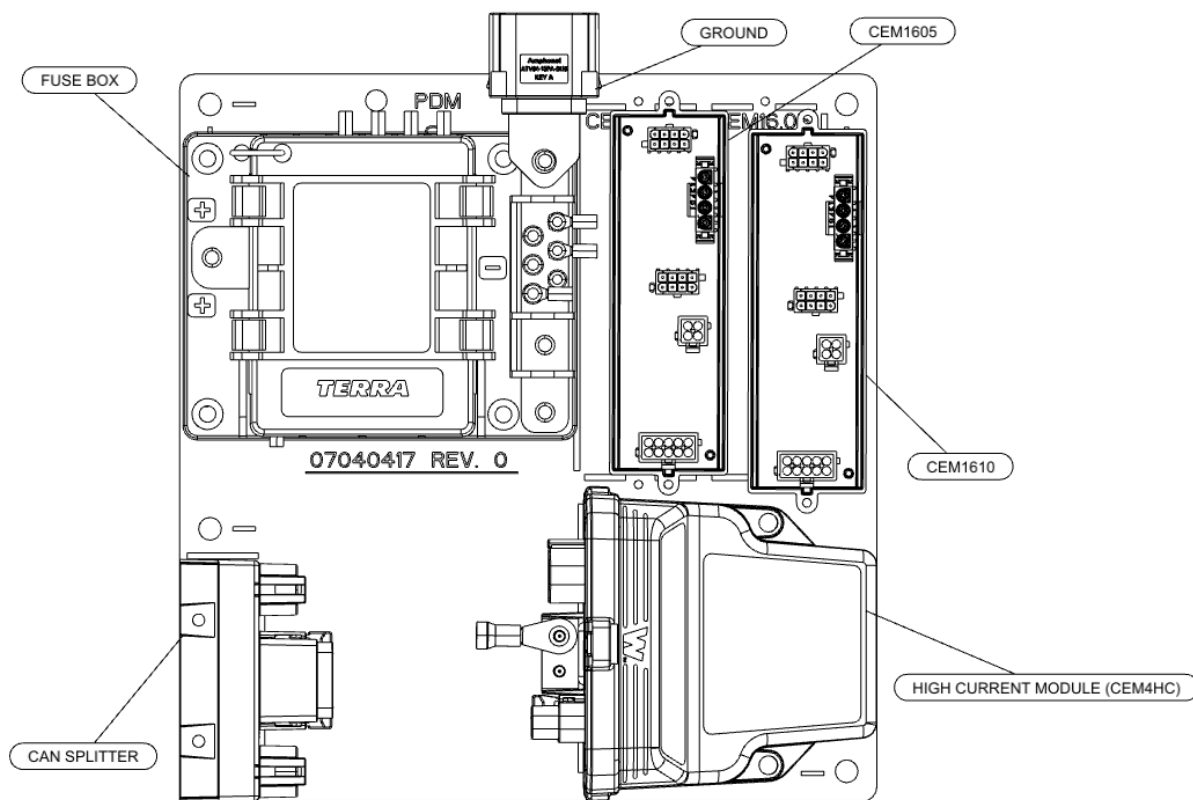


Figure 31: RH Forward Toolbox Panel Drawing

2.3.6 Optional Tunnel Box Panel

This panel controls lighting local to the tunnel box, including door handle lights, toolbox compartment lighting, marker lights, warning lights, ground lighting, and upper work lighting circuits on the right and left sides. This module is only included on wreckers that have the tunnel box installed.

Components of the tunnel box panel:

Table 7: Components & PN of Tunnel Box Panel

Part Number	QTY	Description
03034874	1	CONTROLLER, WHELEN CEM1606
03034764	1	MITT-ILC TUNNEL BOX HARNESS 1
03035131	1	MITT-ILC TUNNEL BOX HARNESS 2



Figure 32: Tunnel Box Panel

3 Installation

Although the MITT-ILC system is largely pre-wired on the wrecker, some preparation and installation are required.

Before beginning installation, become familiar with electrical wiring and circuit best practices. For information on some Miller and Whelen best practices, see [Section 7.3: Best Practices](#).

Any unused wires must be correctly capped off at installation. Sync, pattern selection, and low power wires often need to be capped. Additionally, Whelen lightheads used with the MITT-ILC system do not need to use the grey sync wire or the white/violet Scan-Lock wire. Use a waterproof cap or connector such as an adhesive-lined heat-shrink tube to protect the wires from water wicking.

WARNING!

Body-mounted warning or scene lights that do not have unused wires capped correctly void the product warranty!

3.1 Chassis Frame Preparation

The chassis frame must be set up with the following before any other connections are made:

- Two 150-amp circuit breakers, one to each forward toolbox, installed at the truck batteries
- Four 4-gauge power and ground wires, two to each forward toolbox
- Chassis input cable routing from the chassis junction box to the 8-pin chassis input connector on the left-hand forward panel



Figure 33: 4-Gauge Loomed Power/Ground Cables, Chassis Inputs Ready for Install

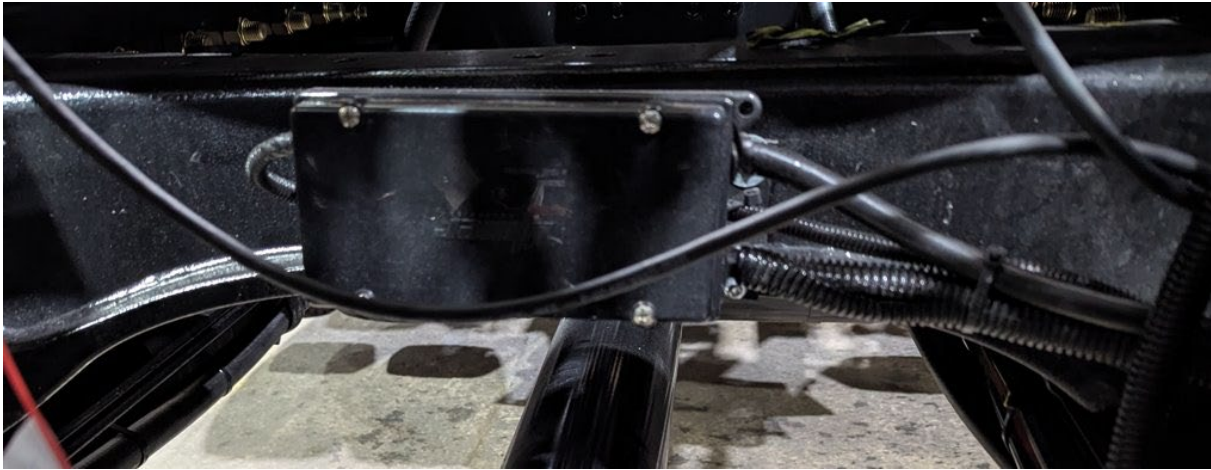


Figure 34: Junction Box



Figure 35: 150-Amp Circuit Breakers on Battery

3.2 Under-Hood Panel Installation

1. Install the CEM16 in the engine compartment of the chassis. Note that the placement of the CEM16 differs between chassis with manual transmissions and those with automatic transmissions.
 - Manual Transmission: For a chassis with manual transmission, mount the CEM16 on the same panel that contains the PTO Override.
 - Automatic Transmission: Mount the CEM16 in a convenient location near the firewall of the engine compartment, out of any extreme temperature or debris impact zones. In many cases, the best location is near the firewall on the left-hand side of the compartment.



Figure 36: CEM1601 Connection

2. Ground the CEM16 using the ground bus connector in a convenient location.

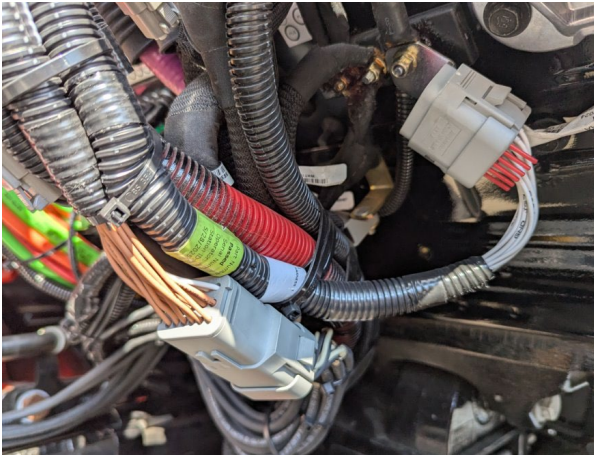


Figure 37: Example Under-Hood Ground Bus



Figure 38: Example Under-Hood Ground Location

1. Route and connect three harnesses:

- 03028295: This harness brings CAN and power to the control head keypad in the cab of the truck from the right-hand forward panel, fused by a 3-amp ATO/ATC style fuse. This harness also connects to the CAN on CEM1601, under the hood.
- 03034727: This harness provides power to the CEM1601, under the hood.
- 03033841: This harness facilitates the output lighting control to M6 and Marker/GLO lights.

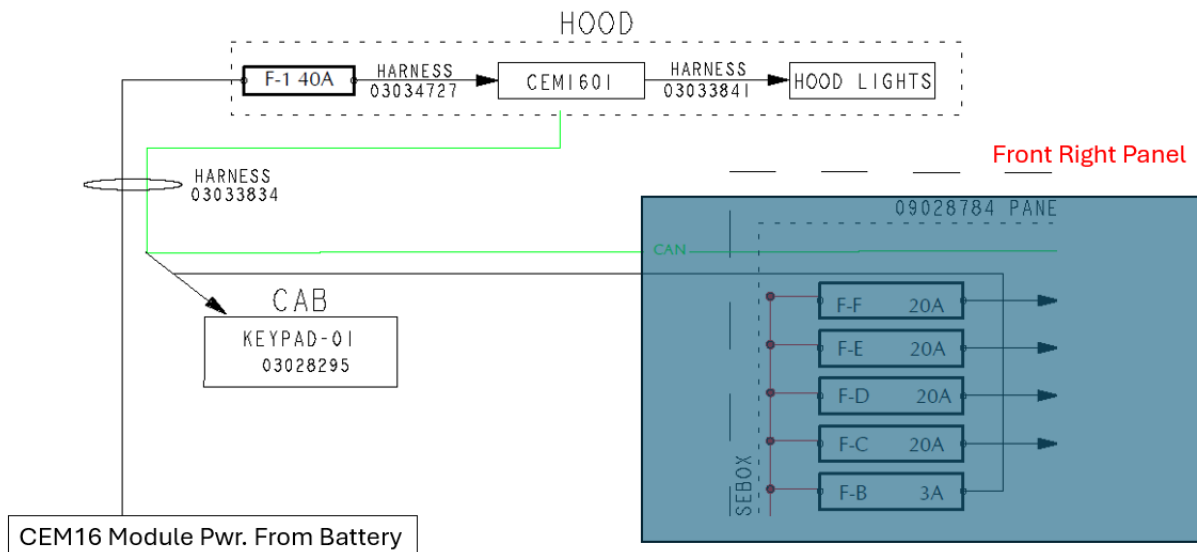


Figure 39: Harness Routing Diagram

3.3 Toolbox Panel Installation

The four toolbox-mounted panels arrive pre-installed, with the harnessing pre-routed and ready to plug in, except for the CEM4HC harnessing. Harnessing for the CEM4HC ships loose with every truck. Some elements on each panel require installation or connection by the distributor or customer.

3.3.1 Left-Hand Forward Panel (09028606) Customer Connections

1. On the panel, which is preinstalled:
 - a. Connect power and ground wires to the fuse box, protected by the 150-amp breaker mounted at the battery. Recommended wire gauge is 4ga or larger.
 - b. Protect the power and ground wires with a wire loom.
 - c. Connect the chassis inputs (marker lights, turn signals, brake lights, reverse lights, and ignition).
 - d. If the optional tunnel box panel is included, use harness 03035131 to connect power, ground, CAN splitter, and LOCK/UNLOCK signals.

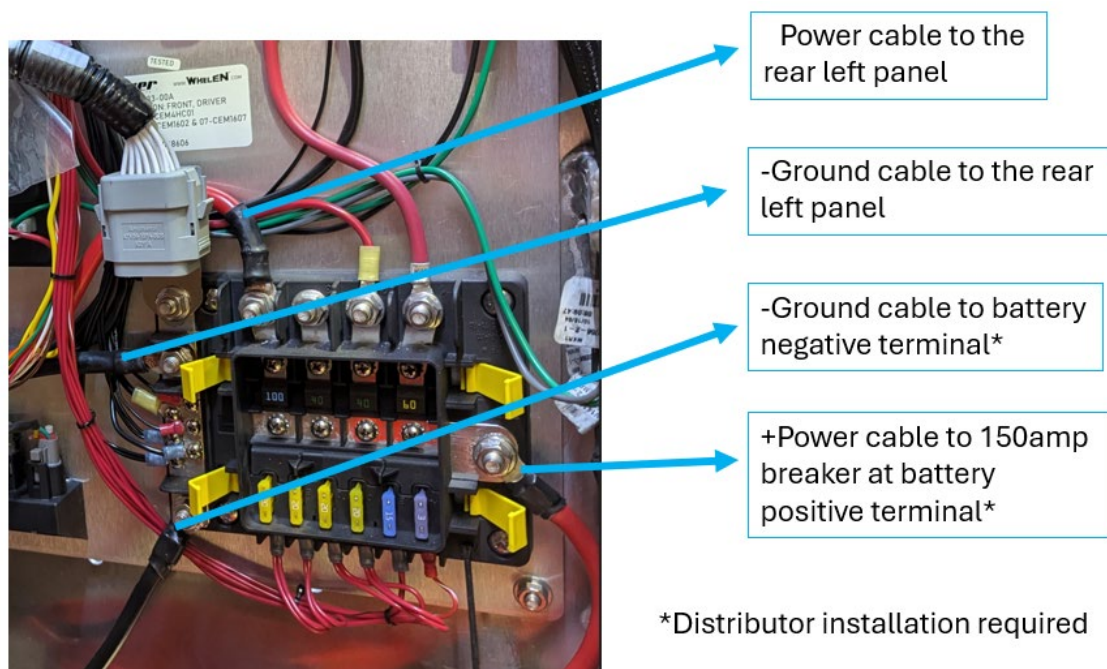


Figure 40: Diagram of LH Forward Panel Power and Ground

Table 8: LH Forward Fusing Table

Fuse ID	Fuse Rating	Description
1	60	HCM
2	40	Lock Box
3	40	Tunnel Box
4	100	Rear Left Panel
A	3	Core
B	15	Core J4
C	20	CEM1602
D	20	CEM1602
E	20	CEM1607
F	20	CEM1607

2. Connect harness 03033837, which comes preinstalled:
 - a. Connect the PTO, CF-E09, using the 2-pin Deutsch connector.
 - b. Connect lighting as needed, keeping in mind that each drop, including spliced drops or daisy-chained drops, is limited to approximately 2.5 amps output. The below lighting drops are spliced together; therefore, the total output for all combined for each line is as follows (drops not listed below are rated to the full 2.5 amps per drop).
 - i. Marker lights, CF-E05 and CF-E06, together total approximately 2.5 amps max.
 - ii. Toolbox lights, CF-E07 and CF-E12, together total approximately 2.5 amps max.
 - iii. Toolbox lights, CF-E14 and CF-E(14), together total approximately 2.5 amps max.
3. Connect the left pylon harness, 03034712, to CF-E11, using the 8-pin Deutsch connector (Work and M6).



Figure 41: Pylon Connector - Toolbox End



Figure 42: Pylon Connector - Pylon End

4. Connect the optional high-current harness, 03033838, to the CEM4HC. Note that outputs from this module are limited to 15 amps per wire.
5. Connect the optional M6 Duo or M6V harness, 03033842, to CEM1607.
6. Connect the PTO connector, CF-E09, to the PTO air solenoid, if equipped, in the engine compartment.

3.3.2 Left-Hand Rear Panel (09028623) Customer Connections

All panel connections are pre-wired.

1. Connect harness 03033835, which comes preinstalled:
 - a. Connect lighting as needed, keeping in mind that each drop, including spliced drops or daisy-chained drops, is limited to approximately 2.5 amps output. The below lighting drops are spliced together; therefore, the total output for all combined for each line is as follows (drops not listed below are rated to the full 2.5 amps per drop).
 - i. Marker lights, CF-C04, CF-C05, CF-C(06), together total approximately 2.5 amps max.
 - ii. Toolbox lights, CF-C01, CF-C10, and CF-C10A, together total approximately 2.5 amps max.
2. Connect the optional M6 Duo or M6V harness, 03033842, to CEM1608.
3. Connect the optional Millennium Light harness 03033844, to CTA01.



Table 9: LH Rear Fusing Table

FUSE#	Fuse Rating	Description
1	20	CEM16
2	20	CEM16
3	20	CEM16
4	20	CEM16
5	-	Spare-01
6	-	Spare-02
7	-	Spare-03
8	3	Keypad
9	15	Towmate*
10	15	CTA

3.3.3 Right-Hand Rear Panel (09028785) Customer Connections

All panel connections are pre-wired.

1. Connect harness 03033836, which comes preinstalled:
 - a. Connect lighting as needed, keeping in mind that each drop, including spliced drops or daisy-chained drops, is limited to approximately 2.5 amps output. The below lighting drops are spliced together; therefore, the total output for all combined for each line is as follows (drops not listed below are rated to the full 2.5 amps per drop).
 - i. Marker lights, CF-D04, CF-C05, CF-D(06), together total approximately 2.5 amps max.
 - ii. Toolbox lights, CF-D01, CF-D10, and CF-D10A, together total approximately 2.5 amps max.



Table 10: RH Rear Fusing Table

FUSE#	Fuse Rating	Description
1	20	CEM16
2	20	CEM16
3	20	CEM16
4	20	CEM16
5	-	Spare-01
6	-	Spare-02
7	-	Spare-03
8	3	Keypad
9	15	Towmate*
10	15	CTA

3.3.4 Right-Hand Forward Panel (09028784) Customer Connections

1. On the panel, which is preinstalled:
 - a. Connect power and ground wires from battery, protected by the 150-amp breaker mounted at the battery. Recommended wire gauge is 4ga or larger.
 - b. Protect the power and ground wires with a wire loom.
 - c. Connect the lightbar, 03031609:

- i. Connect the power wire to the 40-amp MIDI fuse on the fuse box.

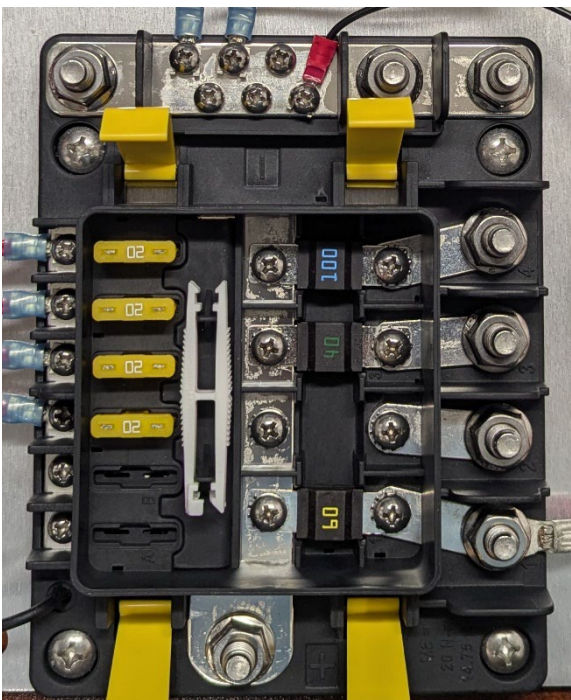


Figure 43: RH Forward Fuse Box

Table 11: RH Forward Fusing Table

FUSE #	Fuse Rating	Description
1	60	HC4-2
2	-	Spare-1
3	40	Lightbar
4	100	Rear Right Panel
A	-	Spare-2
B	-	Spare-3
C	20	CEM1605
D	20	CEM1605
E	20	CEM1610
F	20	CEM1610

- ii. Connect the ground wire to the ground bus.
- iii. Connect the CAN connector DT06-3S-C015 to the CAN splitter, then connect the cable to CM-B01 on harness 03033834.

2. Install harness 03033834:

- a. Route the harness to the hood, then through the firewall to the control head keypad in the truck cab.
- b. Connect the power wire to the 3-amp ATO fuse in the fuse box.
- c. Connect the ground to the ground bus of the fuse box.
- d. Plug the CAN connector CF-B01 to the CAN splitter mounted on the panel.
- e. The other CAN connector CM-B01 is used for the lightbar.



Figure 44: Pylon Connector - Toolbox End



Figure 45: Pylon Connector - Pylon End

3. Connect harness 03033839, which comes preinstalled:
 - a. Connect the right pylon connection, CF-G11, to the 8-pin Deutsch connector.
 - b. Connect lighting as needed, keeping in mind that each drop, including spliced drops or daisy-chained drops, is limited to approximately 2.5 amps output. The below lighting drops are spliced together; therefore, the total output for all combined for each line is as follows (drops not listed below are rated to the full 2.5 amps per drop).
 - i. Marker lights, CF-G05 and CF-G06, together total approximately 2.5 amps.
 - ii. Toolbox lights, CF-G07 and CF-G12, together total approximately 2.5 amps max for both combined.
 - iii. Toolbox lights, CF-G14 and CF-G(14), together total approximately 2.5 amps max for both combined.
 - c. Connect U/L Lights connector. CF-G09, to the underlift work lights on the boom/underlift. Each underlift work light has its own power and ground connection, so no splicing is necessary.
4. Connect the optional high-current harness, 03033838, to the CEM4HC. Note that outputs from this module are limited to 15 amps per wire.
5. Connect the optional M6 Duo or M6V harness, 03033842, to CEM1610.

3.4 Tunnel Box Installation

The tunnel box lighting components are optional. The harness inside the tunnel box, 03034764, is pre-installed, but the harness providing power and CAN connection must be installed by the customer. The harness from the forward left 03035131 needs to be connected on panel side then plugged to 03034764

1. Install harness 03035131 on the left-hand forward panel:
 - a. Connect harness 03035131 to the pre-installed tunnel box harness, 03034764.
 - b. Route harness 03035131 to the front left panel, trim the blunt cuts to length, and install the supplied connectors/terminals.
 - c. Connect the power wire to the 40-amp MIDI fuse in the fuse box on the left-hand forward panel.
 - d. Connect the ground to the ground bus of the fuse box on the left-hand forward panel.
 - e. Connect the LOCK/UNLOCK wires to the connector on the forward-left panel.
 - f. Connect a 3-pin Deutsch connector to the CAN cables, then to the CAN splitter.

Harness 03034764



Harness 03035131

Figure 46: Harnesses in Tunnel Box

2. Connect harness 03034764 to CEM1606:

- a. Connect lighting as needed, keeping in mind that each drop, including spliced drops or daisy-chained drops, is limited to approximately 2.5 amps output. The below lighting drops are spliced together; therefore, the total output for all combined for each line is as follows (drops not listed below are rated to the full 2.5 amps per drop).
 - i. Left-hand marker lights CF-X04, CF-X07, CF-X09, CF-X10, CF-X12, and CF-X13 together total approximately 2.5 amps max.
 - ii. Left-hand toolbox lights CF-X14 and CF-X15 together total approximately 2.5 amps max.
 - iii. Right-hand marker lights CF-X18, CF-X21, CF-X23, CF-X24, CF-X26, and CF-X27, together total approximately 2.5 amps max.
 - iv. Right-hand toolbox lights CF-X05, CF-X11, CF-X17, CF-X19, CF-X25, and CF-X32 together total approximately 2.5 amps max.



Figure 47: Harness 03034764 Connection at CEM1606

3.5 Taillights

In the new MITT-ILC system, the taillights are independent from the wrecker lighting control system to provide redundancy. The rear crossover harness connects the WeCANX network between the left-hand rear and right-hand rear toolboxes, bridges the 2SPD and free spool winch control stations, and bridges the taillight signals from each toolbox to the chassis connection.

The connector on the taillight harness is a 5-way metripack connector with combined stop and turn. Most chassis use a 5-way connector. However, some chassis use a 6-way connector, so a specific adapter must be ordered separately and installed between the chassis input and harness 03033845. If the chassis has a 5-way connector, no adapter is needed.

6-way to 5-way adapters:

- Paccar: 03033843, MITT-ILC TAILLIGHT ADAPTER2, Paccar 6-way multipack
- International/Freightliner: 03038116, MITT-ILC ADPT INTERNATIONAL, APEX adapter

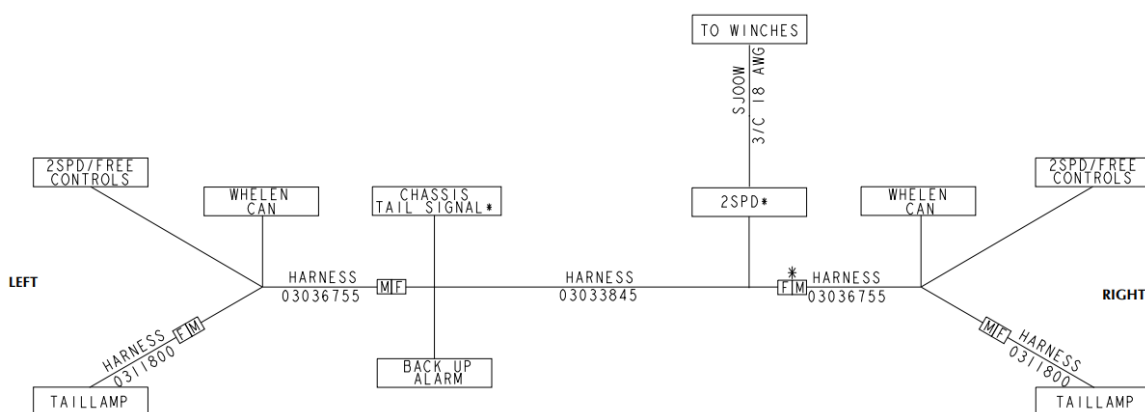


Figure 48: Circuit Drawing of Taillight Harness

1. Connect the 12-pin Deutsch connector on harness 03033845 (CM-V01) to harness 03036755 on the left (connector CF-N01) and right (connector CF-N02) rear toolbox panels.

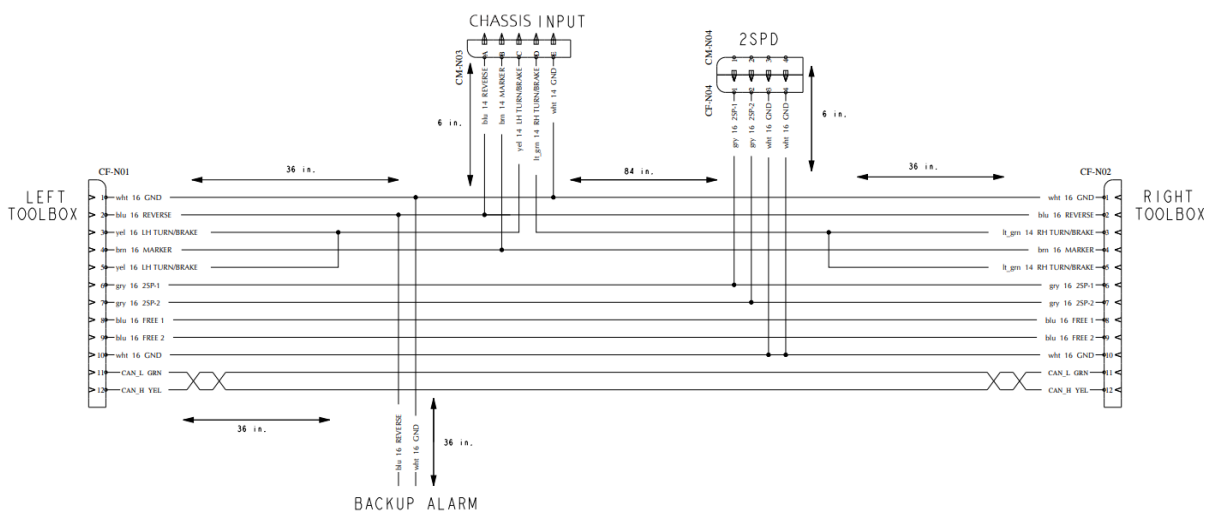


Figure 49: Harness 03033845

2. Connect the 2SPD drop to the front and rear winch solenoids, respectively.

3. Confirm that the backup alarm is connected.
4. Connect the chassis end of the frame temporary taillights connection to the adapter, if necessary, then connect the adapter to chassis input CF-N03.

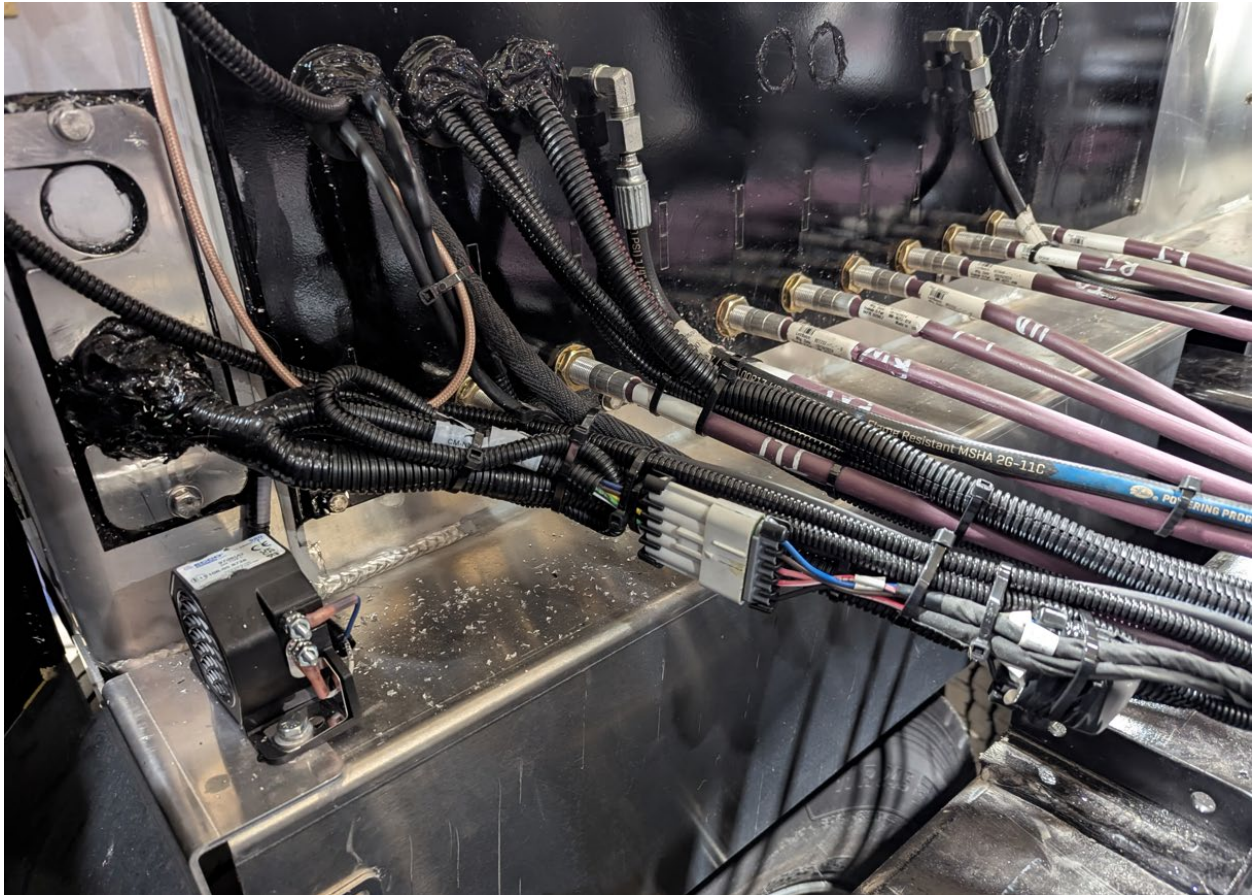


Figure 50: Taillight Harness Connection

5. Connect harness 0311800 as follows.

NOTE:

Some chassis beyond the makes listed here may require similar taillight modification. During installation, if the marker lights turn on momentarily, then turn off, use the steps outlined for Freightliner, International, or Westernstar chassis.

- Kenworth, Paccar, and Peterbilt chassis: This configuration allows three lights to behave as stop/turn and marker lights and one as reverse. The modification to the PL-3 light connector at B is enabled by connecting the unconnected black wire to MARKER in the taillight harness.



Figure 51: Harness 0311800 Connection for Kenworth, Paccar, and Peterbilt Chassis



Figure 52: Paccar, Peterbilt, Kenworth Chassis: Three Marker/Brake/Turn Lights, One Reverse Light

- Freightliner, International, or Westernstar chassis: Because these chassis have less amperage on the taillight connection, MARKER input must be broken up. This configuration allows two lights to function as marker/stop/turn and two to function as reverse lights. On a Freightliner or International chassis, modify the PL-3 light connector at B by disconnecting the turn wire from Turn and connecting it to Reverse.

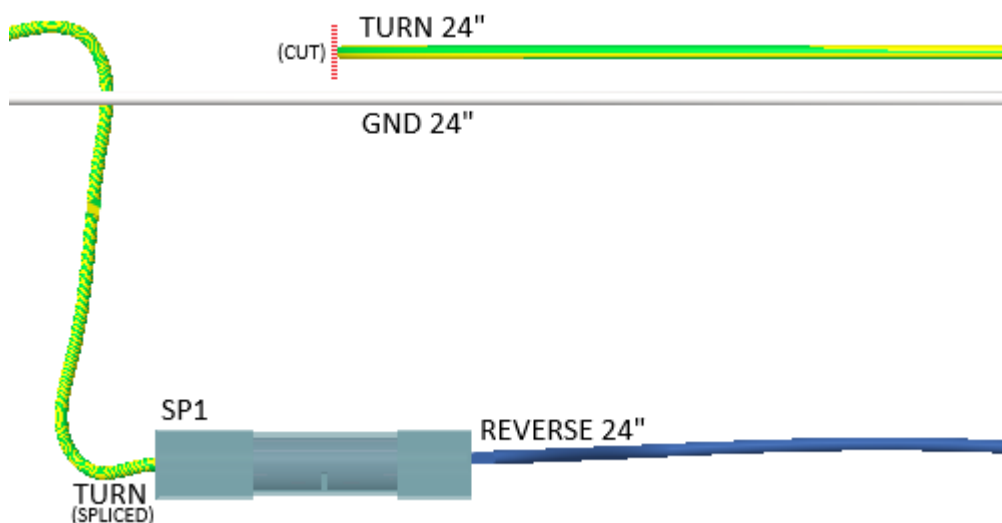


Figure 53: Harness 0311800 Connection for Freightliner, International, and Westernstar Chassis



Figure 54: International, Freightliner Chassis: Two Marker/Brake/Turn Lights, Two Reverse Lights



Figure 55: Individual Taillights

4 Setup/Customization

Customization of the light system is available through either permanently grounding specific wires or through the Whelen Command software.

4.1 Program Modifications Through Grounding Inputs

Some modifications to the base program can be made by grounding wires to specific pins on the J9 connectors of the CEM1602 and CEM1607 modules and do not need to involve any software in the process.

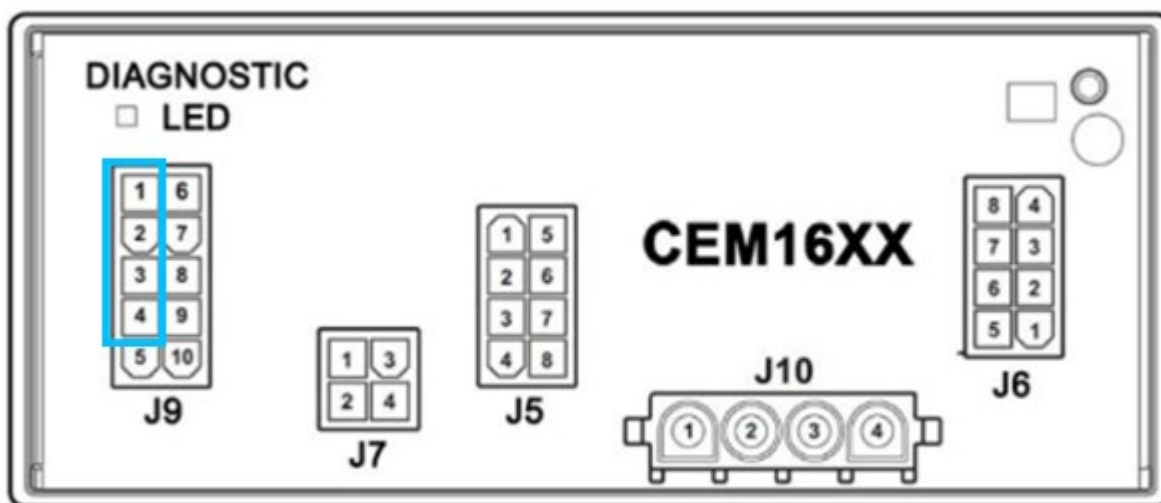


Figure 56: CEM16 Connector J9-1 Through J9-4 Pin Locations

4.1.1 Manual Transmission Mode

If the vehicle has a manual transmission, the manual transmission mode must be enabled. This mode prevents PTO engagement from any location other than the cab-mounted control head keypad. Note that the PTO can still be disengaged from any location. To enable this mode, ground pin 2 on the J9 connector of the CEM1602 module.

4.1.2 Lightbar Cruise Mode

This mode allows the corner modules of the lightbars to be illuminated in low intensity when the truck's Marker Light input is ON. Because this is not legal in all 50 states, this mode is an option, not a standard feature. To enable Lightbar Cruise Mode, ground pin J9-1 on CEM1602.

4.1.3 Cab Control Head Keypad Backlight Dim

Some operators find that the default intensity of the cab-mounted control head keypad is too bright. This setting can be adjusted permanently to the lowest intensity (2.5%) by grounding pin 3 on the J9 connector on the CEM1602 module. Note that all other control head keypads will remain at default intensity even if this setting is changed for the cab-mounted control head keypad.

Alternatively, the intensity can be adjusted temporarily by pressing and holding the **DVI** button on the control head keypad until the backlight dims to the desired intensity. This adjustment lasts only until the next ignition cycle.

4.1.4 Courtesy Lights

When this mode is active, any time the ignition switch moves from RUN to OFF, the ground lighting circuit (if equipped) turns on for 30 seconds. This provides area lighting around the vehicle cab to keep operators safe when exiting. After 30 seconds, the lights turn off, and the system sleeps after an hour. To enable Courtesy Lights, ground pin 4 on the J9 connector on the CEM1602 module.

4.1.5 Supplemental Reverse Lighting

In this mode, any time the vehicle is put into reverse, the Lower Work and Swivel Work lights turn on to provide additional area lighting off the rear of the vehicle. To enable this mode, ground pin 2 on the J9 connector on the CEM1607 module.



Figure 57: Reverse Light Locations

4.1.6 Millennium Lights Flash Disable

Millennium lights have a variety of flash modes enabled as a standard feature of the MITT-ILC system, some acting as traffic advisory features. However, this is not legal in all states, so the system can lock this feature out if necessary. To disable flash modes on Millennium lights, ground pin 3 on the J9 connector on the CEM1607 module.

4.1.7 Automatic Dynamic Variable Intensity (DVI™) Lights Enable

DVI™ gradually increases and decreases warning light intensity, which better conveys visual information to approaching motorists at night. In this mode, if the photocell in the lightbar detects night or low light for 4 seconds, any flashing light automatically uses DVI™ flash patterns. When the photocells in the lightbars detect daylight for 4 seconds, all flashing lights return to daytime flash patterns, without DVI™. Note that operators can temporarily override this mode by pressing the **DVI** button on the cab-mounted control head keypad. This mode can be simulated by shining a light on the photocell or by covering it completely.

To enable automatic DVI™ patterns, ground pin 4 on the J9 connector on the CEM1607 module.



Figure 58: Photocell on Lightbar



4.2 Adding Additional Lights

The MITT-ILC system is flexible and can enable new lights installed on the chassis or wrecker body or additional lightbars.

4.2.1 Adding M6/M6 Duo/M6V Lights

To enable additional M6, M6 Duo, or M6V lights, find a spare drop associated with the type of light to be enabled. For ease of identification, drop wires are both color-coded and labeled with the function or light they control. (See [Section 7.1: Global Information](#) for more information about color coding in the MITT-ILC system.)

The light type being added determines the location to connect to on the CEM16 module harness. M6 and M6 Duo lights connect to J5, and M6V lights connect to J6. Connect the new light to the appropriate drop, then connect the drop to the appropriate pin on the CEM16 module, as shown in [Section 7.2: Panel Connections and Component Pin-Out](#).

If the new light has STEADY-LOCK functionality available, the sticker on the lighthead displays STEADY-LOCK and the lock symbol. To enable STEADY-LOCK, cap the Scan-Lock, Low power, and Sync wires at installation. Use the Whelen Command software to set the desired behavior (see [Section 4.3.3: Configuring the System Using the Whelen Command Software](#)).



Figure 59: Lighthead Sticker with STEADY-LOCK

Note that CEM16 modules are limited to 2.5-amp outputs, possibly less if circuits are daisy-chained.

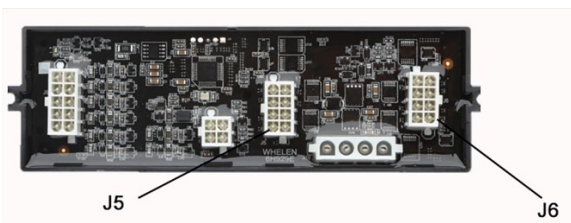


Figure 60: CEM16 Module J5 & J6 Connectors

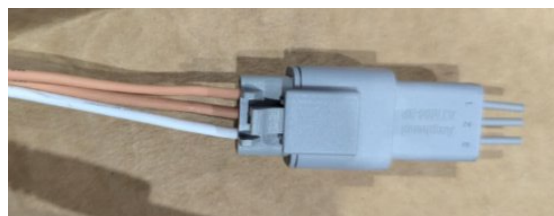


Figure 61: Mated Connector

Table 12: Harness 03033842 - M6 & M6 Duo Lights

CEM16 Location	CEM1607, 1608, 0609,1610	Control Keypad Button	Connector	Pin Number
J5-1	DUO1F-C1	SIDE BEACN	CF-K01	1
J5-2	DUO1F-C2	SIDE BEACN	CF-K01	2
J5-3	DUO2-C1	SIDE BEACN	CF-K03	1
J5-4	DUO2-C2	SIDE BEACN	CF-K03	2
J5-5	DUO3-C1	SIDE BEACN	CF-K05	1
J5-6	DUO3-C2	SIDE BEACN	CF-K05	2
J5-7	DUO4R-C1	SIDE BEACN	CF-K07	1
J5-8	DUO4R-C2	SIDE BEACN	CF-K07	2

Table 13: Harness 03033842 - M6V Lights

CEM16 Location	CEM1607, 1608, 1609, 1610	Control Keypad Button	Connector	Pin Number
J6-1	M6V1F-M6	SIDE BEACN	CF-K01	1
J6-2	M6V1F-DK	DRVR DOCK	CF-K01	2
J6-3	M6V2-M6	SIDE BEACN	CF-K03	1
J6-4	M6V2-DK	DRVR DOCK	CF-K03	2
J6-5	M6V3-M6	SIDE BEACN	CF-K05	1
J6-6	M6V3-DK	DRVR DOCK	CF-K05	2
J6-7	M6V4R-M6	SIDE BEACN	CF-K07	1
J6-8	M6V4R-DK	DRVR DOCK	CF-K07	2

4.2.2 Adding Lightbars

Although lightbars do not come preinstalled, the MITT-ILC system is designed to work with WeCANX lightbars, specifically Miller PN 03031609 (Whelen PN MLR742X), for simplicity. Hard-wired lightbars are also supported. Note that systems that use hard-wired lightbars must use the generic configuration file (See [Section 4.3.1: Downloads](#)).

4.2.2.1 Adding WeCANX Lightbars

The WeCANX lightbar receives power and ground from the 40-amp MIDI fuse on the right-hand forward panel's fuse box. The right-hand forward CAN splitter or the cab harness CAN splitter provides WeCANX connection.

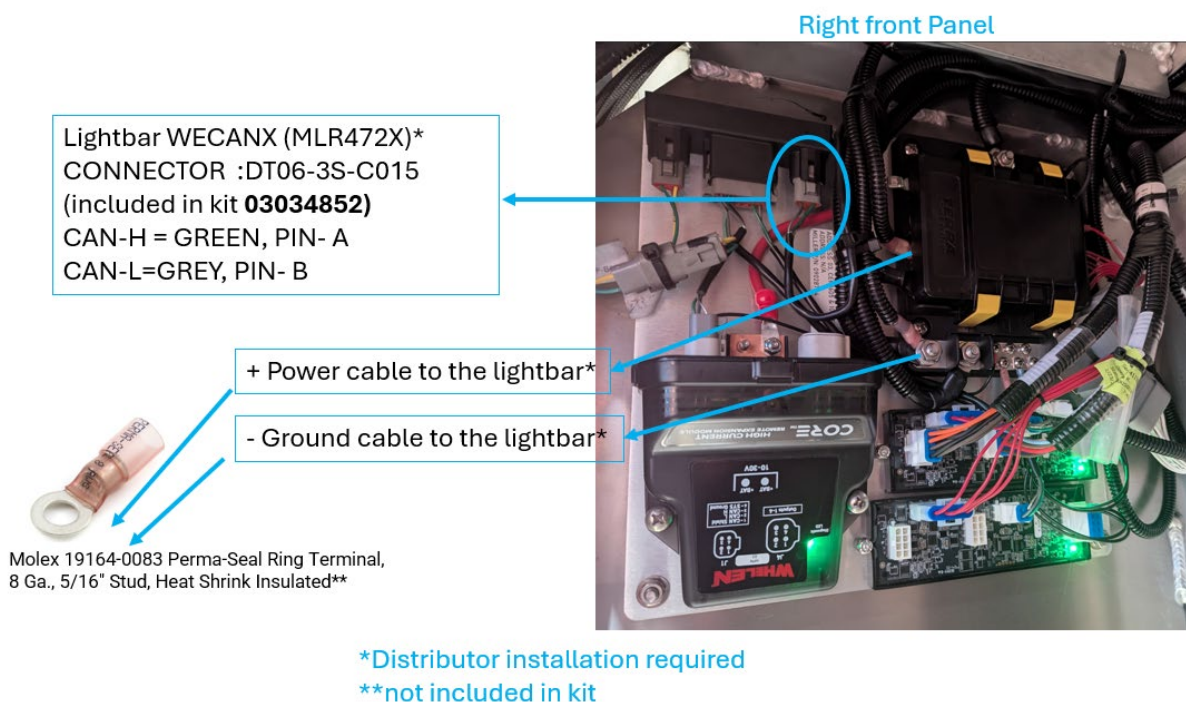


Figure 62: WeCANX Lightbar Power, Ground, and CAN Connections

The MITT-ILC system also supports multiple lightbars. Like with single lightbars, the panel-mounted fuse box supplies power and ground, and the panel-mounted CAN splitter supplies WeCANX connection.

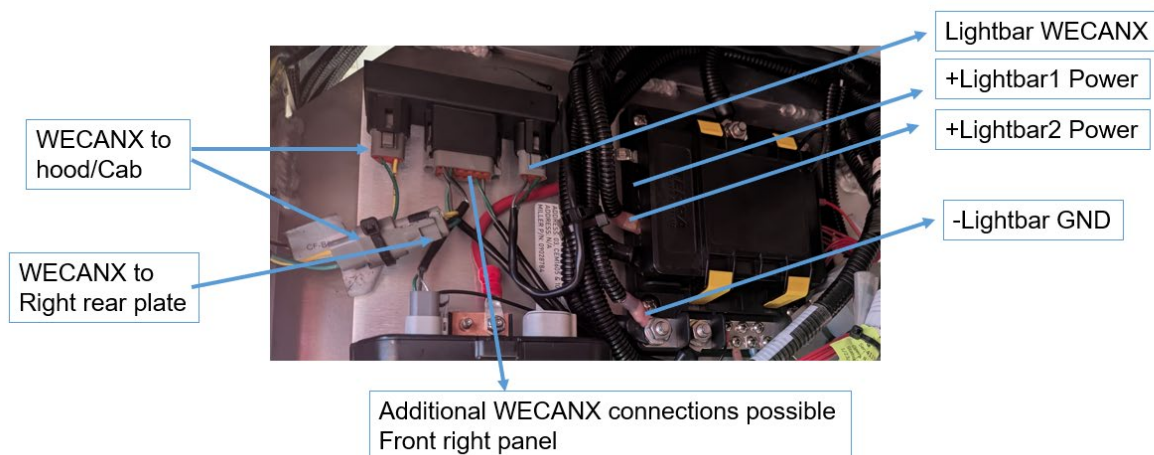


Figure 63: Connecting Multiple WeCANX Lightbars

4.2.2.2 Adding Generic Hard-Wired Lightbars

1. After installing the lightbar on the wrecker, connect the lightbar wires to the 18-pin connector, CF-A04, on harness 03033833 on the right-hand forward panel as shown:

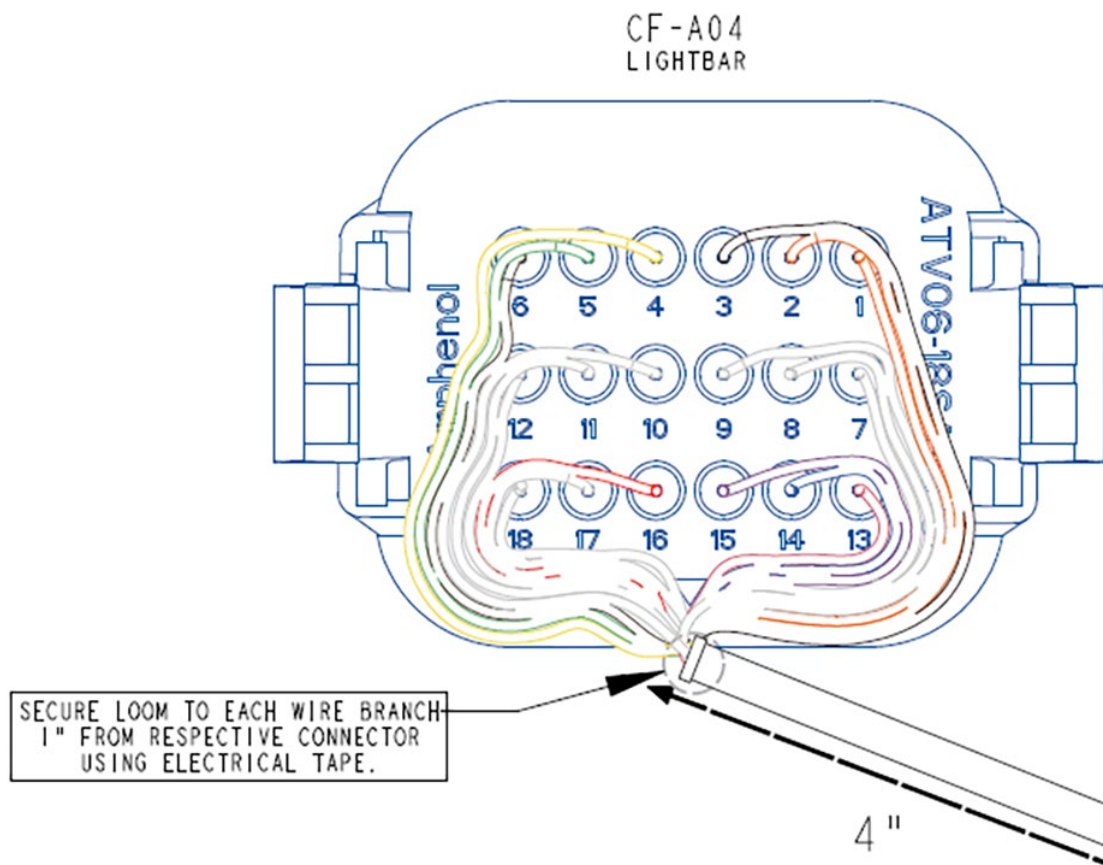


Figure 64: Hard-Wired Lightbar Connection to Harness 03033833

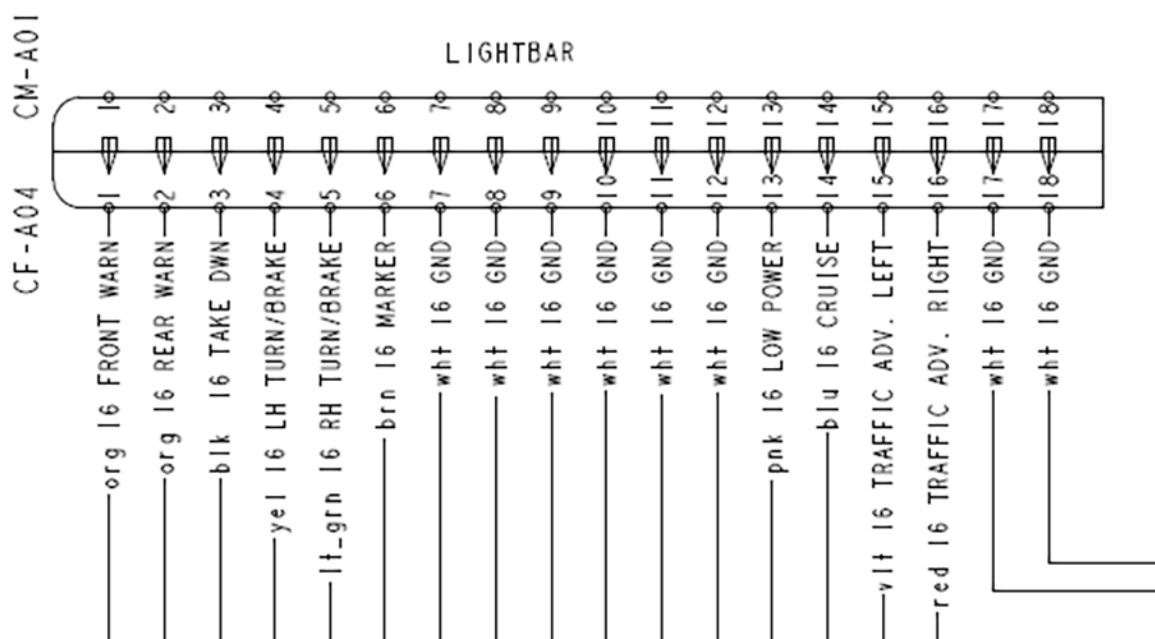


Figure 65: Pin-Out Diagram for 18-Pin Connector CF-A04

2. Connect the CEM1610-J5, CEM1610-J6, and ground bus connectors at CF-A01, CF-A02, and CF-A03.

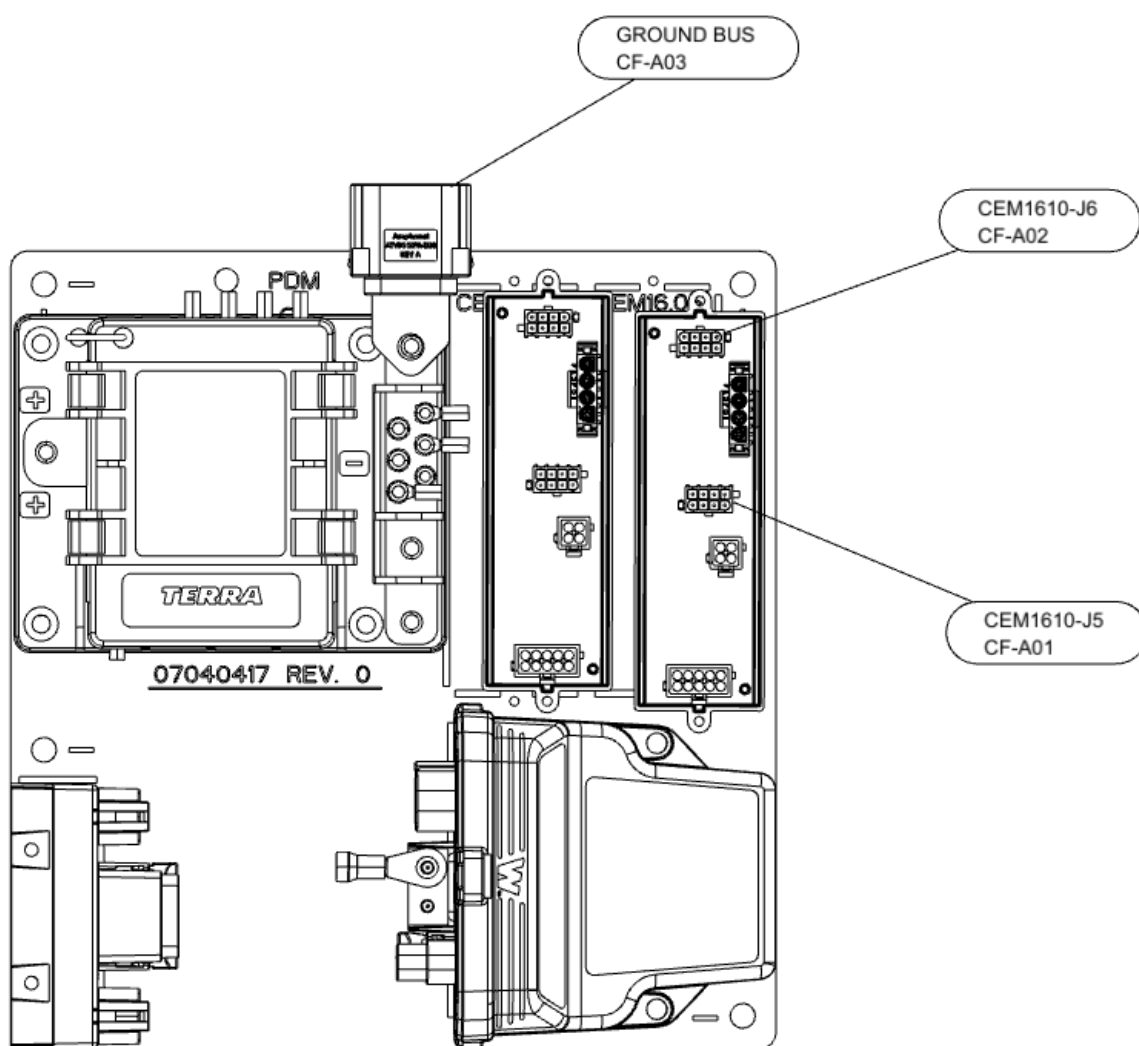
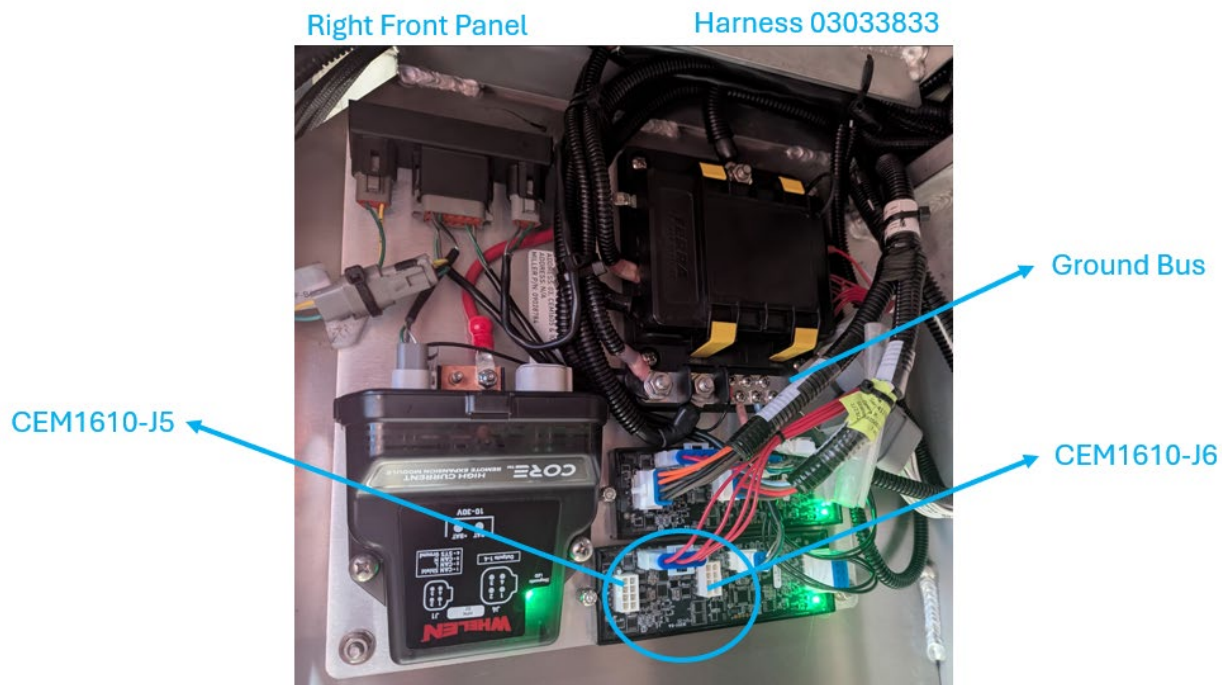


Figure 66: Hard-Wired Lightbar Connections at Ground, CEM1610-J5, and CEM1610-J6



**Distributor installation required*

Figure 67: Hard-Wired Lightbar Connector Locations

3. Make sure that the system uses the generic configuration file (see [Section 4.3.1: Downloads](#)). Note that this generic configuration file also assigns on/off control only to any lightheads programmed as side beacons.

4.3 Software

The digital programming for the MITT-ILC system is performed by the Whelen Command application, which sends configuration updates in .wln format to the Core-R module.

The major change between previous versions of the MITT-ILC system and this newest version is the ability to connect a generic, hardwired lightbar via the optional harness 03033833. The Miller .wln configuration files are specific to the lightbar type, either WeCANX or generic, hardwired.

4.3.1 Downloads

The Whelen Command application is available as a free download at:

<http://www.whelen.com/whelen-command>

Select the Core-R hardware type when prompted.



The MITT-ILC WECANX 2_0 configuration files and some explanatory materials are available as free downloads at:

<https://www.millerind.com/display-controller>

Scroll down to the section titled MITT-ILC WECANX 2_0. Two .wln files are available, standard and generic.

- a. If the lightbars on the wrecker are WeCANX, identifiable by having only power and CAN wires, select the Standard Configuration File, MITT-ILC WECANX Vxx.wln, where xx is the most current version number.
- b. If the lightbars on the wrecker are generic, identifiable by having an individual wire connected for each lighting function, select the Generic Configuration File, MITT-ILC GENERIC Vx.wln, where x is the most current version number.

4.3.2 Connecting a PC to the Core-R Module

A USB-C to USB-A (standard computer USB input) data transfer cable is required to connect to the Core-R module.

Make sure the cable is a high-quality USB-C to USB-A cable that is designed for data transfer. Some cables are designed for charging only and do not transfer data. Also, keep in mind that USB-C to USB-C connections do not work on all computers.

An example of a USB-C to USB-A cable is the Eaton/Tripp Lite U038-006-GY-MAX.

1. Connect the USB-C end of the cable to the J8 connector on the Core-R module. Note that the USB cable powers the Core-R module independently, so the system does not have to be on to extract or transfer the .wln file. However, to assign address IDs, assign STEADY-LOCK, and use output diagnostic functions, set the ignition switch to ON or start the vehicle and let it idle.
2. Open the Whelen Command application.
3. Update the firmware:
 - a. Make sure that the PC or laptop connected to the Core-R module has reliable power or sufficient battery capacity to operate for 10-15 minutes, because the update affects every connected module on the system. If the power or battery fails, the firmware can get corrupted, causing unpredictable results.
 - b. Automatic update: If the Whelen Command application is up to date, it will automatically check the system's latest firmware when the Core-R module is connected to a PC. It is recommended to always update the firmware if prompted to do so. At the firmware update prompt, click **Update All** to confirm the update.
 - c. Manual update: To check for firmware updates manually:
 - i. Click the W icon () in the upper-left corner of the Command window.
 - ii. Select **Update Firmware** from the menu.



- iii. In the Update Firmware window, click **Update All** to begin the update.
- iv. When the update is complete, click to close the Update Firmware window.

4.3.3 Configuring the System Using the Whelen Command Software

1. Choose the .wln configuration file to open:
 - a. To use the newest version of the .wln configuration file downloaded in [Section 4.3.1: Downloads](#):
 - i. Click the Open icon () at the top of the Command window.
 - ii. Navigate to the location of the downloaded file.
 - b. To make updates to the existing .wln configuration file:
 - i. Extract the file by clicking the Extract icon () at the top of the Command window.
 - ii. Save the file to a convenient location.
 - iii. Click the Open icon () and navigate to the location of the extracted file.
2. Assign module address IDs: Each module has a specific numerical ID based on the module type. For example, if there are three control head keypads (called *21 and Slide WCX* in following figure) installed, the cab-mounted control head keypad is identified as Installation ID 1, the left-hand or driver-side control head keypad as Installation ID 2, and the right-hand or passenger-side control head keypad as Installation ID 3.

If there are six CEM16 expansion modules installed, the under-hood module is identified as Installation ID 1, the left-hand forward module as Installation ID 2, and so on until each installed CEM16 module has a unique Installation ID.

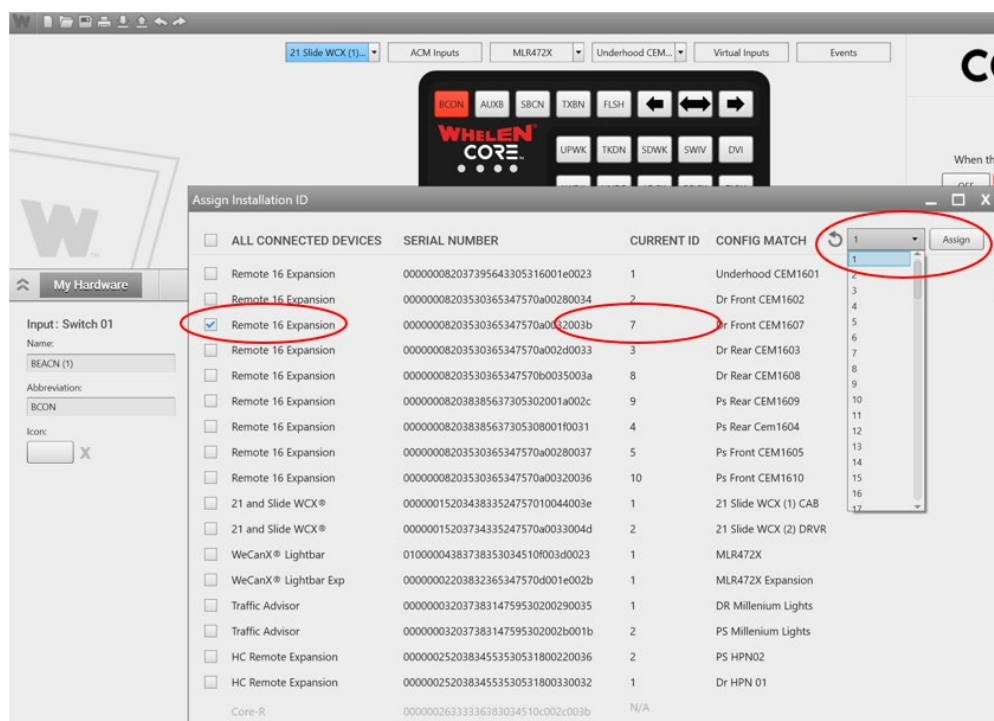


Figure 68: Assign Installation ID Screen

3. To change a module's Installation ID:

- Click the W icon ().
- Select **ID Assign Installation ID**.
- Click to select the appropriate module.
- Use the drop-down to adjust the Installation ID.
- Click **Assign** to assign the Installation ID.
- Make sure that the Installation ID is unique within the list of that module type; a duplicate ID causes unpredictable behavior for both modules.

4. Assign STEADY-LOCK: The MITT-ILC system now allows the distributor or customer to use Whelen Command to select specific lightheads with STEADY-LOCK enabled (see [Section 4.2.1: Adding M6/M6 Duo/M6V Lights](#)) and set those lightheads to steady burn instead of individual lights and their wiring determining flashing behavior.

To set STEADY-LOCK:

- Click the W icon ().
- Select **Assign STEADY-LOCK**. A new window opens, showing all STEADY-LOCK-enabled outputs. The outputs are arranged first by module, such as the Core-R or a CEM16, then



by output number (see [Section 7.2: Panel Connections and Component Pin-Out](#) for output identification).

- c. Select the lightheads to assign STEADY-LOCK to:
 - To select all available lightheads, click the **ALL CONNECTED DEVICES** checkbox.
 - To select individual lightheads, click the checkbox next to the output.

WARNING!

*Make sure PTO and Controls Power are **not** selected.
If PTO and Controls Power are selected during STEADY-LOCK
assignment when the truck is fully on,
damage to the PTO can occur!*

- d. When the desired outputs are selected, click **Assign** in the top-right corner of the window.

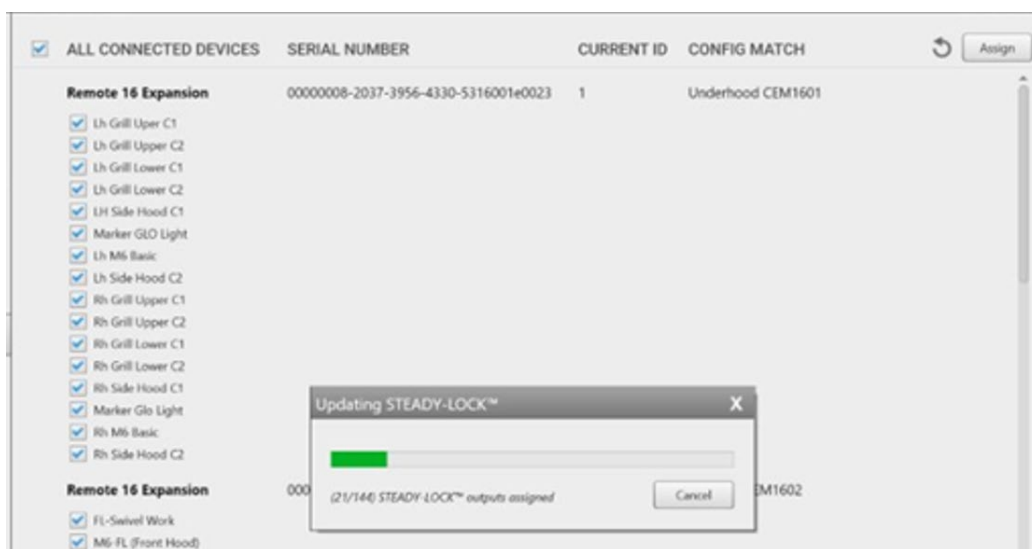


Figure 69: Assign STEADY-LOCK Screen

- e. When all are assigned, close the window. All selected outputs are now set to steady burn.
5. Save and transfer the updated .wln file:
 - a. Once all Installation IDs and STEADY-LOCK states are updated, click the Save icon () at the top of the Command window to save the .wln file.
 - b. Click the Transfer icon ()
 - c. Select **Core-R** from the list of devices.
 - d. Click **Transfer**.



4.3.4 Output Diagnostics

Whelen Command offers troubleshooting assistance using the Output Diagnostics feature. For details on this feature, see [Section 6: Troubleshooting](#).

4.3.5 Advanced .wln Configuration File and Lightbar File Manipulation

Some distributors or customers may need further modifications to outputs, flash patterns, etc. These modifications are outside the scope of this manual and Miller Industries support. For assistance with advanced modifications, contact Whelen support at (860) 526-9504 or techsupport@whelen.com.

5 Operation

5.1 Emergency Stop

The Core-R system monitors the emergency stop button on the wireless remote.

If the system detects that the button or switch has been activated, it automatically disengages the PTO. To alert the operator, the control head keypad flashes the **PTO (2 SEC)** button and the four red lights above the slide switch. This flashing continues until the emergency stop button or switch is reset.

The PTO will not re-engage until the emergency stop button has been reset. Once the emergency stop button has been reset, press and hold the **PTO (2 SEC)** button to resume engagement.



Figure 70: Control Head Keypad - PTO Button

5.2 Shut Down Delay

After the vehicle ignition is turned off, chassis lights, such as hazard lights, can remain active for up to an hour.

5.3 PTO Operation

The vehicle operator can use either the cab-mounted control head keypad or any control head keypad to engage the PTO, depending on the vehicle's transmission type.

5.3.1 Automatic Transmission

The default setting for the MITT-ILC system is for automatic transmissions. On an automatic transmission vehicle, the PTO can be engaged from any control head keypad anywhere on the vehicle.

5.3.2 Manual Transmission

Vehicles with manual transmissions must have the manual transmission mode enabled as described in [Section 4.1.1: Manual Transmission Mode](#). Once this mode is enabled, the PTO can be engaged only from the cab-mounted control head keypad. No other control head keypad button engages the PTO in this mode. However, the PTO can be disengaged from any location, and emergency stop works for any transmission setup.

5.4 Control Head Keypad Functions

The control head keypad is the main interface between the wrecker operator and the MITT-ILC system. The control head keypad features several rows of buttons and one slider. The buttons control the lighting behavior, wireless controls enable or disable, and PTO engagement or disengagement. The slider allows specific sets of lights to toggle to ON all at once.

The button function assignments differ between systems with the MITT-ILC GENERIC Vx.wln configuration file loaded and the MITT-ILC WECANX Vxx.wln file.

5.4.1 WeCANX Configuration Keypad Functions



Figure 71: Control Head Keypad - Top Row WeCANX

BEACN: Three-stage button, turns on lightbars:

First press: Turns on rear of lightbar
Second press: Turns on front of lightbar
Third press: Turns on whole lightbar

AUX BEACN: Turns on Auxiliary Beacon (Cab roof warning light)

SIDE BEACN: Turns on Side Beacon (all hood and body side-firing warning lights)

TL/BX BEACN: Turns on Toolbox Flashing lights

MARK FLASH: Turns on Flashing Marker Lights

Left Arrow: Two-stage button, turns on Left Traffic Director

First press: Turns on lightbar only
Second press: Turns on lightbar and Millennium lights

Center Out Arrow: Two-stage button, turns on Center Out Traffic Director:

First press: Turns on lightbar only
Second press: Turns on lightbar and Millennium lights



Right Arrow: Two-stage button, turns on Left Traffic Director:

First press: Turns on lightbar only
Second press: Turns on lightbar and Millennium lights



Figure 72: Control Head Keypad - Second Row WeCANX

UPPER WORK: Turns on Pylon Work lights

TAKE DOWN: Two-stage button, turns on Lightbar-Mounted Forward-Facing Scene lights

First press: Steady burn
Press and hold for 2 seconds: Flashing Traffic Director lights

SIDE WORK: Turns on Side Beacon (side-firing Razor lights)

SWIVEL WORK: Turns on Swivel lights

DVI: Two-stage button, turns on Dynamic Variable Intensity (DVI) nighttime-specific flash pattern:

First press: Turns on DVI
Press and hold for 2 seconds: Dims the cab-mounted control head keypad temporarily for one ignition cycle



Figure 73: Control Head Keypad - Third Row WeCANX

LOWER WORK: Turns on Lower Work lights.

U/L WORK: Turns on Underlift Work lights.

DRVR DOCK: Turns on Left-Hand Dock lights.

PASS DOCK: Turns on Right-Hand Dock lights.

TOOL BOX: Turns on Toolbox Compartment lights.

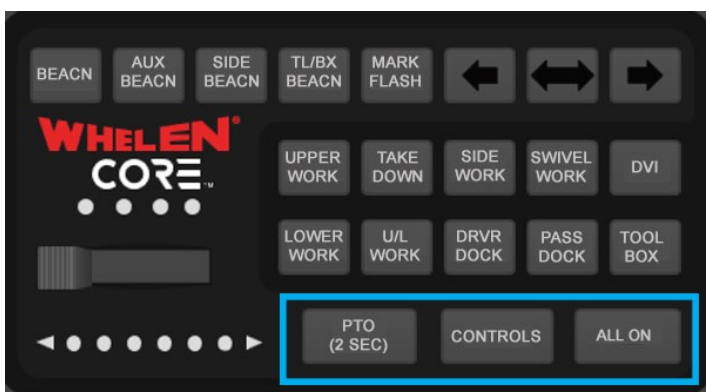


Figure 74: Control Head Keypad - Bottom Row WeCANX

PTO (2 SEC): Press and hold to engage the PTO.

CONTROLS: Press to enable Wireless Control Operation.

ALL ON: Turns on the following:

- BEACN
- MARKER FLASH
- UPPER WORK
- TAKE DOWN
- SIDE WORK
- SWIVEL WORK
- LOWER WORK
- U/L WORK
- DRVR DOCK
- PASS DOCK
- TOOL BOX



Figure 75: Control Head Keypad - Slide Switch WeCANX

Slide Switch: Three-position slider, turns on specific sets of lights:

Position 1 (full left):

BEACN
AUX BEACN
SIDE BEACN
TL/BX BEACN

Position 2 (center):

UPPER WORK
TAKE DOWN
SIDE WORK
SWIVEL WORK

Position 3 (full right):

LOWER WORK
U/L WORK
DRVR DOCK
PASS DOCK
TOOL BOX

5.4.2 Generic Configuration Keypad Functions



Figure 76: Control Head Keypad - Top Row Generic

BEACN: Three-stage button, turns on lightbars. CAN lightbar functionality is enabled, and two hardwired lightbars, front and rear, are also enabled.

First press: Turns on whole lightbar
Second press: Turns on front of lightbar
Third press: Turns on rear of lightbar

AUX BEACN: Turns on right-hand and left-hand Whelen 10x10 lights, no flashing

SIDE BEACN: Turns on all Side Beacon lights, no flashing (all hood and body side-firing warning lights)

TL/BX BEACN: Turns on Toolbox Flashing lights

MARK FLASH: Turns on Flashing Marker lights

Left/Right/Center Out Arrow: Any of these buttons turns on or off left-hand and right-hand Traffic Advisory lights



Figure 77: Control Head Keypad - Second Row Generic

UPPER WORK: Turns on Upper Work lights.

TAKE DOWN: Turns on or off additional output at CEM1610 (right-hand forward panel)

SIDE WORK: Turns on Side Beacon (side-firing Razor lights)

SWIVEL WORK: Turns on Swivel lights

DVI: Turns on or off Low Power output at CEM1610 (right-hand forward panel)



Figure 78: Control Head Keypad - Third Row Generic

LOWER WORK: Turns on Lower Work lights.

U/L WORK: Turns on Underlift Work lights.

DRVR DOCK: Turns on Left-Hand Dock lights.

PASS DOCK: Turns on Right-Hand Dock lights.

TOOL BOX: Turns on Toolbox Compartment lights.



Figure 79: Control Head Keypad - Bottom Row Generic

PTO (2 SEC): Press and hold to engage the PTO

CONTROLS: Press to enable Wireless Control Operation

ALL ON: Turns on the following:

BEACN
MARK FLASH
UPPER WORK
TAKE DOWN
SIDE WORK
SWIVEL WORK
LOWER WORK
U/L WORK
DRVR DOCK
PASS DOCK
TOOL BOX



Figure 80: Control Head Keypad - Slide Switch Generic

Slide Switch: Three-position slider, turns on specific sets of lights:

Position 1 (full left):

BEACN
AUX BEACN
SIDE BEACN
TL/BX BEACN

Position 2 (center):

UPPER WORK
TAKE DOWN
SIDE WORK
SWIVEL WORK

Position 3 (full right):

LOWER WORK
U/L WORK
DRVR DOCK
PASS DOCK
TOOL BOX



6 Troubleshooting

The MITT-ILC system offers software diagnostics as well as built-in troubleshooting in the form of diagnostic LEDs on the Core-R module, all expansion modules, and traffic advisory modules.

Additionally, customers can inspect the system for loose or disconnected wires, incorrect wiring, crimping, or capping, or water damage.

When troubleshooting, note that the Core-R module remains active for 60 minutes after the ignition signal is lost. The Core-R may need to be power-cycled before that period is complete; to quickly power-cycle the Core-R, unplug the J3 connector, wait 10 seconds, then plug the connector back in.

6.1 Diagnostic LEDs

The Core-R module, all CEM16s, all CEM4HCs, and all traffic advisory modules (CTAs) have LED lights that indicate the component's status. This allows operators to do a quick visual inspection of system status and identify immediate issues.

If all LEDs are steady green, the system detects no network errors. Any other behavior indicates activity or issues.

6.1.1 Core-R Diagnostic LEDs

The Core-R module features two diagnostic LEDs, one for system status and one for CAN status.

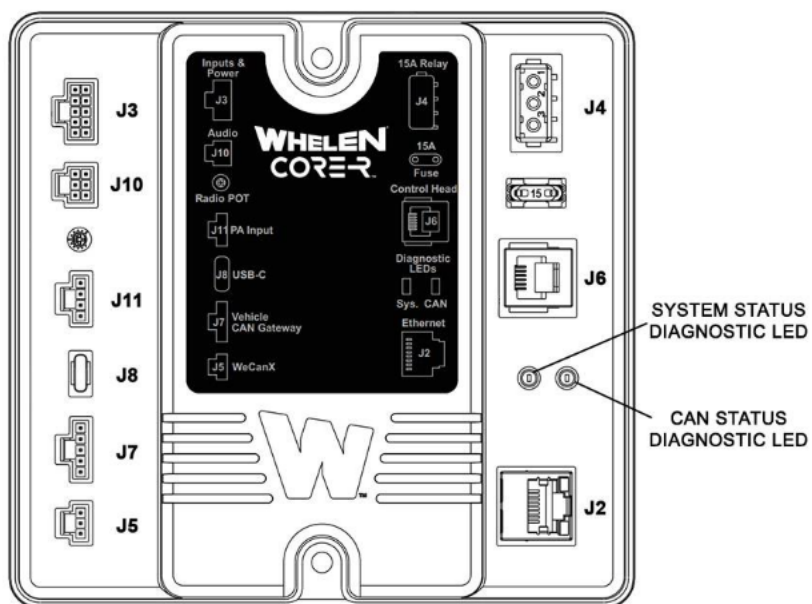


Figure 81: Core-R Module Diagnostic LEDs

The CAN status LED blinks when the CAN is communicating with connected devices. If no information is being communicated, the light is off.



The system status LED changes color to indicate the following:

Table 14: Core-R Status Light Details

Indicator Color	System Status	Details	Suggested Solution
Red	Memory Error	Unable to access flash memory	Contact Whelen Support. See Section 4.3.5: Advanced .wln Configuration File and Lightbar File Manipulation .
Orange	File Error	No .wln configuration file	Re-transfer the latest .wln configuration file to the Core-R.
White	Working	Processing and distributing .wln configuration file to connected WeCanX devices	No action required.
Cyan	Missing Node	Configuration file indicates more hardware than is physically connected to the bus	Connect the Core-R to a PC with Command installed, extract the configuration file, remove all reference to hardware not installed on the vehicle, transfer the corrected file. See Section 4.3.3: Configuring the System Using the Whelen Command Software .
Green	System Active	Normal behavior: communication available with connected devices	System normal.
Blue	Processing System Inputs	System actively communicating	No action required.

6.1.2 CEM16, CEM4HC, and Traffic Advisory Module Diagnostic LEDs

Both types of expansion module and the traffic advisory module have only one diagnostic LED each.

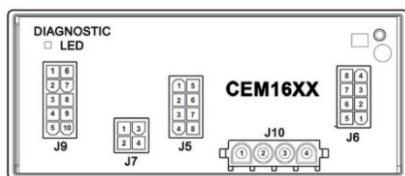


Figure 82: CEM16 Diagnostic LED

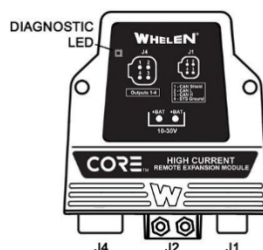


Figure 83: CEM4HC Diagnostic LED

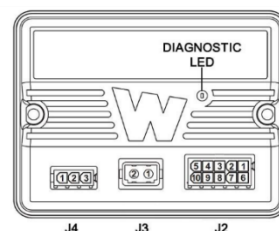


Figure 84: Traffic Advisory Module Diagnostic LED

These LEDs change color and/or flash to indicate status.

Table 15: CEM16, CEM4HC, & CTA Module Status Light Details

Indicator Color	System Status	Details	Suggested Solution
Green - Steady	System Active	Normal behavior: communication available with Core-R module	System normal.
Blue – Slow Flash	Bootload in progress	The device is waiting for firmware update	Do not turn power off. No other action required.
Blue – Quick Flash	Bootload cannot detect application	Device is actively receiving firmware update	Do not turn power off. No other action required.
Red – Flash	Power interruption during firmware update	Power was turned off or interrupted during firmware update. Component is unresponsive.	Power cycle the MITT-ILC system, then repeat firmware update.
Red – Flash	Fault diagnostics active	Flashes red when Whelen Command software output diagnosis is run from a connected PC	Expected behavior – no action required. Returns to steady green when software diagnostics session is closed.

NOTE:

Power should never be turned off or interrupted when an LED is flashing blue, either slow flash or quick flash. This can corrupt the firmware update.



6.2 Wiring

Loose, disconnected, overly tight, or incorrectly crimped or terminated wires can cause system failure or instability.

6.2.1 Power, Ground, and CAN Wiring

The first wires to check are power, ground, and CAN splitter connections. Make sure that each power and ground wire is both tight and present, with no resistive material like paint or washers between the stud and terminal.

When testing the power load, check total power draw and voltage drop. At max load, with all modules connected and all possible lights connected on every output, the load on each side is approximately 90 amps. This is highly dependent on the type and number of lights used, and in most cases, the power draw is well under 90 amps on either side.

Acceptable voltage drop at 90 amps is 0.5 to 0.75 volts, measured at the forward and/or rear panel. Loads under 90 amps have less voltage drop. If the voltage drop is greater than 0.75 volts, the issue is likely to be loose connections, poorly crimped terminals, partially tripped circuit breaker or fuse, incorrect wire sizing, or a missing ground connection. For fuse amperage information, see [Section 3.3: Toolbox Panel Installation](#).

Confirm that CAN splitter connections are properly seated between each component. Pay special attention to CAN connections between any components with flashing or otherwise abnormal LED indicators and their upstream connections. All CAN connections must use gold-plated terminals. CAN wiring consists of CAN-High and CAN-Low wires, using twisted pair CAN cable. Refer to [Section 7.2: Panel Connections and Component Pin-Out](#) for CAN splitter wiring diagrams.

The most common issues with CAN wiring are:

- a. CAN-H and CAN-L wires are swapped
- b. Incorrect termination or crimping on either wire
- c. Terminals not fully seated in connector
- d. Twisted pair CAN wire not used
- e. The CAN network has a loop in the circuit: CAN is a linear network and must not be looped

Refer to [Section 7.2: Panel Connections and Component Pin-Out](#) for specific wiring connections for each harness and module.

6.2.2 Wires, Connectors, and Routing

If power, ground, and CAN connections are correct, check all associated wires and connectors. Confirm that all terminals are fully seated, then confirm that wires are correctly seated within multi-wire connectors.



Check the tension on all looped or bundled wires: leave a manageable amount of slack along wires, because tight wires can cause strain on wire, terminals, and connectors.

For further information on crimping and wire routing, see [Section 7.3: Best Practices](#).

6.3 Software Updates

Confirm that the Whelen Command software is the latest version. Updates to Command are available on the Whelen site as described in [Section 4.3.1: Downloads](#). If there is a newer version, download and install it on the PC to connect to the Core-R.

Confirm that the Core-R software is the latest version by navigating to the Miller website and checking the version as described in [Section 4.3.1: Downloads](#). If there is a newer version available, first extract the .wln file from the Core-R and save it in a convenient location, then download the newest version and transfer it to the Core-R. Confirm that it works correctly. If the newer version does not work correctly, transfer the saved version of the configuration file back to the Core-R.

6.4 Output Diagnostics with Whelen Command Software

Whelen Command allows the operator to test power to any single specified output or list of outputs by sending a steady on signal to that connection. To engage Output Diagnostics:

1. Use a data transfer USB-C to USB-A cable to connect the Core-R module to a PC.
2. Open the Whelen Command application.
3. Extract the .wln configuration file by clicking the Extract icon () at the top of the Command window, then save the file to a convenient location.
4. Click the Open icon and navigate to the location of the extracted file.
5. Click the W icon () in the upper-left corner of the Command window, then select **Output Diagnostics**.
6. Confirm that all circuits are correctly named and given unique Installation ID numbers as outlined in [Section 4.3.3: Configuring the System Using the Whelen Command Software](#). All circuits must have unique names. Any unnamed outputs can cause issues.
7. On the Output Diagnostics window, select either **ALL CONNECTED DEVICES** or the specific inputs to test. Selecting inputs sends a steady ON signal to the circuit. Note that the diagnostic LED lights on the hardware modules will blink when in diagnostic mode.
8. If the circuit turns on from the software but the associated lighthouse does not, the probable cause of the fault may be faulty input wiring (short or open circuit or loose connection) or a defective lighthouse.
9. Close the **Output Diagnostics** window to return the MITT-ILC system to the configuration specified in the .wln file.



6.5 Further Steps

If the issue persists, contact Whelen support or Miller Industries support.

Whelen Support: (860) 526-9504 or techsupport@whelen.com

Miller Industries: (423) 238-4171

7 Appendix

Globally useful information appears in this section. Additionally, harness termination tables and pinout details are covered here.

7.1 Global Information

7.1.1 Schematic

The full electrical schematic for the MITT-ILC system is available on the Miller Industries Towing Equipment Inc. website at <https://www.millerind.com/display-controller/>.



7.1.2 Wire Color and CAN Connections

Table 16: Wire Color Coding

Item	Color	Light Head
1	Grey	Aux Beacon
2	Tan	Side Beacon
3	Light Blue	Toolbox Beacon
4	Light Green	Upper Work
5	Light Green	Side Work
6	Light Green	Swivel Work
7	Orange	Lower Work
8	Orange	U/L Work
9	Blue	Driver Dock
10	Blue	Passenger Dock
11	Black	Toolbox Light
12	Pink	PTO
13	Red	Controls Power
14	Brown	Marker
15	Green	RH Turn
16	Yellow	LH Turn
17	Red	Brake
18	Blue	Reverse
19	Grey	Lock
20	Light Green	Unlock
21	Red	Battery
22	White	Ground
23	Violet	Ignition
24	Grey	2spd-1
25	Grey	2spd-2
26	Blue	Freespool-1
27	Blue	Freespool-2

Table 17: CAN Splitter Connections

Pin	Connector	WeCANX Color	CAN Color	Function
J1-A	DT06-3S	Green	Yellow	CAN-H
J1-B	DT06-3S	Gray	Green	CAN-L
J1-C	DT06-3S	Black/White or Bare	Bare	SHIELD
J3-1	DT06-12SA-B016	Gray	Green	CAN-L
J3-2	DT06-12SA-B016	Green	Yellow	CAN-H
J3-3	DT06-12SA-B016	Black/White or Bare	Bare	SHIELD
J3-4	DT06-12SA-B016	Black/White or Bare	Bare	SHIELD
J3-5	DT06-12SA-B016	Green	Yellow	CAN-H
J3-6	DT06-12SA-B016	Gray	Green	CAN-L
J3-7	DT06-12SA-B016	Gray	Green	CAN-L
J3-8	DT06-12SA-B016	Green	Yellow	CAN-H
J3-9	DT06-12SA-B016	Black/White or Bare	Bare	SHIELD
J3-10	DT06-12SA-B016	Black/White or Bare	Bare	SHIELD
J3-11	DT06-12SA-B016	Green	Yellow	CAN-H
J3-12	DT06-12SA-B016	Gray	Green	CAN-L
J2-A	DT06-3S	Green	Yellow	CAN-H
J2-B	DT06-3S	Gray	Green	CAN-L
J2-C	DT06-3S	Black/White or Bare	Bare	SHIELD



Figure 85: CAN Splitter

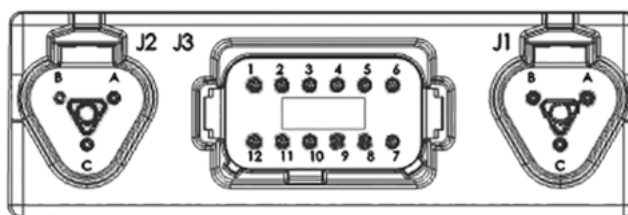


Figure 86: CAN Splitter Pin Diagram

7.2 Panel Connections and Component Pin-Out

The panel connections differ between systems configured with the MITT-ILC GENERIC Vx.wln configuration file and those configured with the MITT-ILC WECANX Vxx.wln file.

7.2.1 MITT-ILC WeCANX Connections

7.2.1.1 Under-Hood Panel Connections

Table 18: Harness 03033841 - CEM1601

CEM1601 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	LH GRILL UP C1	CF-J04	1
J5-2	SIDE BEACN	LH GRILL UP C2	CF-J04	7
J5-3	SIDE BEACN	LH GRILL LOW C1	CF-J04	2
J5-4	SIDE BEACN	LH GRILL LOW C2	CF-J04	8
J5-5	SIDE BEACN	LH SIDE HOOD C1	CF-J04	3
J5-6	MARKER	GLO LIGHT	CF-J05	1
J5-7	SIDE BEACN	LH M6 BASIC	CF-J06	1
J5-8	SIDE BEACN	LH SIDE HOOD C2	CF-J04	9
J6-1	SIDE BEACN	RH GRILL UP C1	CF-J04	4
J6-2	SIDE BEACN	RH GRILL UP C2	CF-J04	10
J6-3	SIDE BEACN	RH GRILL LOW C1	CF-J04	5
J6-4	SIDE BEACN	RH GRILL LOW C2	CF-J04	11
J6-5	SIDE BEACN	RH SIDE HOOD C1	CF-J04	6
J6-6	MARKER	GLO LIGHT	CF-J05	4
J6-7	SIDE BEACN	RH M6 BASIC	CF-J06	4
J6-8	SIDE BEACN	RH SIDE HOOD C2	CF-J04	12



Figure 87: CEM16

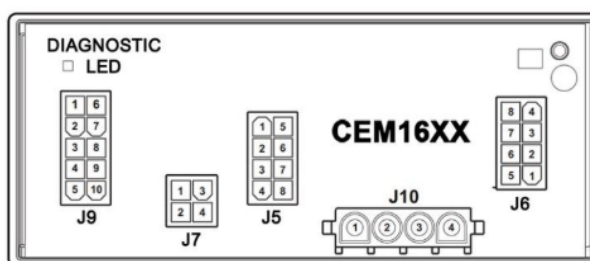


Figure 88: CEM16 Pin Diagram



7.2.1.2 Left-Hand Forward Panel Connections

Table 19: Harness 03033837 - CEM1602

CEM1602 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	DRVR DOCK	SWIVEL WORK - FL	CF-E01	1
J5-2	SIDE BEACN	M6 FL (FRONT/HOOD)	CF-E04	1
J5-3	SIDE BEACN	M6-FL-1 PYLON	CF-E11	1
J5-4	SIDE BEACN	M6-FL-2 PYLON	CF-E11	2
J5-5	UPPER WORK	PYLON WORK LIGHT - LEFT	CF-E11	3
J5-6	UPPER WORK	PYLON WORK LIGHT - RIGHT	CF-E11	4
J5-7	MARKER	MARKER (GENERAL PURPOSE)	CF-E05/06	1
J5-8	TL/BX BEACN	FLASH/WARN	CF-E08	4
J6-1	PTO (2 SEC)	PTO	CF-E09	1
J6-2	CONTROLS	CONTROLS POWER	CF-E10	1
J6-3	MARKER (NO FLASH) TOOL BOX	BOOM SIDE TOOLBOX ACCENT REAR (REAR-8PCS)	CF-E13	1
J6-4	TOOL BOX	TLBX LITE	CF-E07/12	1
J6-5	TOOL BOX	TLBX LITE	CF-E14/E(14)	1
J6-6	TOOL BOX	DOOR HANDLE LITE (NON FLASH)	CF-E08	2
J6-7	TOOL BOX	FRONT UNDER TLBX ACCENT LITE (FRONT-8PCS)	CF-E02	1
J6-8	MARKER	FRONT GLO LITE	CF-E03	1

Table 20: Harness 03033842 - M6 & M6 Duo CEM1607

CEM1607 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	DUO1F-C1	CF-K01	1
J5-2	SIDE BEACN	DUO1F-C2	CF-K01	2
J5-3	SIDE BEACN	DUO2-C1	CF-K03	1
J5-4	SIDE BEACN	DUO2-C2	CF-K03	2
J5-5	SIDE BEACN	DUO3-C1	CF-K05	1
J5-6	SIDE BEACN	DUO3-C2	CF-K05	2
J5-7	SIDE BEACN	DUO4R-C1	CF-K07	1
J5-8	SIDE BEACN	DUO4R-C2	CF-K07	2

Table 21: Harness 03033842 - M6V CEM1607

CEM1607 Location	Control Keypad Button	Output	Connector	Pin Number
J6-1	SIDE BEACN	M6V1F-M6	CF-K02	1
J6-2	DRVR DOCK	M6V1F-DK	CF-K02	2
J6-3	SIDE BEACN	M6V2-M6	CF-K04	1
J6-4	DRVR DOCK	M6V2-DK	CF-K04	2
J6-5	SIDE BEACN	M6V3-M6	CF-K06	1
J6-6	DRVR DOCK	M6V3-DK	CF-K06	2
J6-7	SIDE BEACN	M6V4R-M6	CF-K08	1
J6-8	DRVR DOCK	M6V4R-DK	CF-K08	2



Figure 89: CEM16

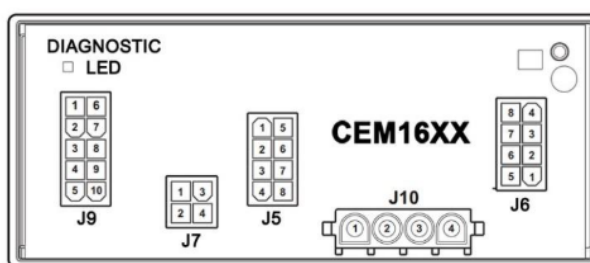


Figure 90: CEM16 Pin Diagram

Table 22: Harness 03033838 - CEM4HC1

CEM4HC_1 Location	Control Keypad Button	Output	Connector	Pin Number
J4-1	AUX BEACN	WHELEN MINI (10X10)	CF-F01	1
J4-2	DRVR DOCK SIDE WORK	RAZOR/H120	CF-F01	2
J4-3	DRVR DOCK SIDE WORK	RAZOR/H120	CF-F01	3
J4-4	SWIVEL WORK	SPARE	CF-F01	4



Figure 91: CEM4HC



Figure 92: CEM4HC Pin Diagram

Table 23: Core-R Connections

Core-R Location	Function
J3	INPUTS/CORE-R POWER
J4	RELAY/CONTROLS POWER
J5	WeCANX DATA LINK

Table 24: Chassis Input Connector to Core-R J3

Position	Label	Wire Color	Deutsch Connector	Pin Number
J3-1	Battery	Red (+)	N/A	N/A
J3-2	Left Turn	White/Brown (+)	DT06-08SA	1
J3-3	Right Turn	White/Red (+)	DT06-08SA	2
J3-4	Brake	White/Orange (+)	DT06-08SA	3
J3-5	Marker	Brown (+)	DT06-08SA	4
J3-6	Ground	Black	N/A	N/A
J3-7	Ignition	Red/White (+)	DT06-08SA	5
J3-8	Reverse	Orange (+)	DT06-08SA	6
J3-9	LOCK/UNLOCK	Yellow (+)	DT06-08SA	7
J3-10	E-Stop	Green (+)	DT06-08SA	8



Figure 93: Core-R Module

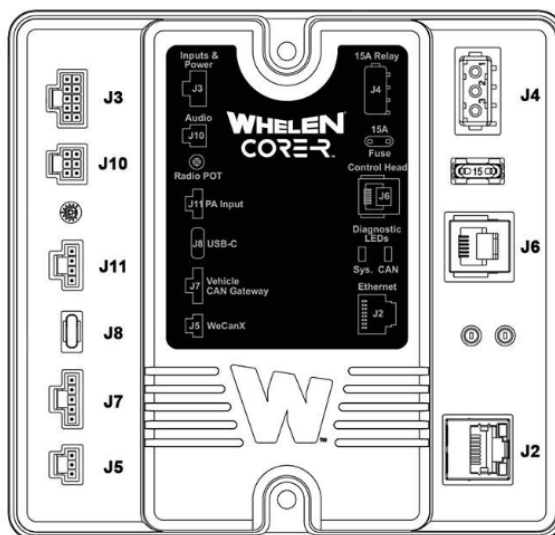


Figure 94: Core-R Module Input Diagram

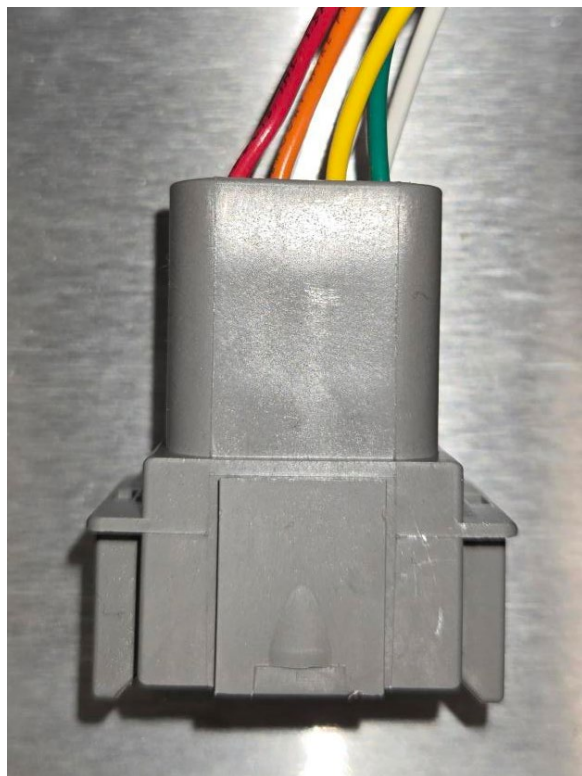


Figure 95: Chassis Input Connector

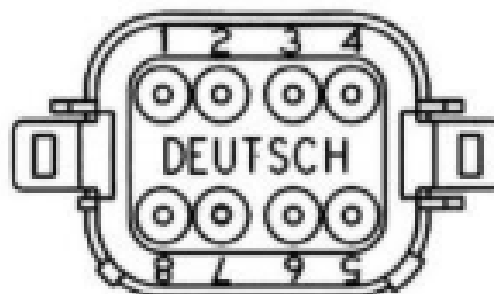


Figure 96: Chassis Input Connector Pin Diagram



7.2.1.3 Left-Hand Rear Panel Connections

Table 25: Harness 03033835 - CEM1603

CEM1603 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	M6-L1	CF-C04	1
J5-2	MARKER (NO FLASH)	CENTER TURN LEFT	CM-C01	2
J5-3	DRVR DOCK	DRIVER DOCK – L1	CF-C04	2
J5-4	MARKER	DOCK MARKER – L1/2/3	CF-C04/05/06	3
J5-5	DRVR DOCK	DRVR DOCK – L2	CF-C05	2
J5-6	DRVR DOCK	DRVR DOCK – L3	CF-C06	2
J5-7	SIDE BEACN	M6-L2	CF-C05	1
J5-8	MARKER	MARKER (GENERAL PURPOSE)	CF-C09/11	1
J6-1	SIDE BEACN	M6-L3	CF-C06	1
J6-2	SIDE BEACN	M6-L4	CF-C13	1
J6-3	LOWER WORK	LOWER WORK - L	CF-C14	1
J6-4	SWIVEL WORK	SWIVEL WORK - L	CF-C15	1
J6-5	CONTROLS	CONTROLS POWER - L	CF-C08	1
J6-6	LEFT TURN	LEFT TURN	CM-C01	3
J6-7	TOOL BOX	TOOLBOX LITE	CF-C01/10/10A	1
J6-8	MARKER	REAR GLO LITE	CF-C03	1

Table 26: Harness 03033842 - M6 & M6 Duo CEM1608

CEM1608 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	DUOL5-C1	CF-K01	1
J5-2	SIDE BEACN	DUOL5-C2	CF-K01	2
J5-3	SIDE BEACN	DUOL6-C1	CF-K03	1
J5-4	SIDE BEACN	DUOL6-C2	CF-K03	2
J5-5	SIDE BEACN	DUOL7-C1	CF-K05	1
J5-6	SIDE BEACN	DUOL7-C2	CF-K05	2
J5-7	SIDE BEACN	DUOL8-C1	CF-K07	1
J5-8	SIDE BEACN	DUOL8-C2	CF-K07	2

Table 27: Harness 03033842 - M6V CEM1608

CEM1608 Location	Control Keypad Button	Output	Connector	Pin Number
J6-1	SIDE BEACN	M6VL5-M6	CF-K01	1
J6-2	DRVR DOCK	M6VL5-DK	CF-K01	2
J6-3	SIDE BEACN	M6VL6-M6	CF-K03	1
J6-4	DRVR DOCK	M6VL6-DK	CF-K03	2
J6-5	SIDE BEACN	M6VL7-M6	CF-K05	1
J6-6	DRVR DOCK	M6VL7-DK	CF-K05	2
J6-7	SIDE BEACN	M6VL8-M6	CF-K07	1
J6-8	DRVR DOCK	M6VL8-DK	CF-K07	2



Figure 97: CEM16

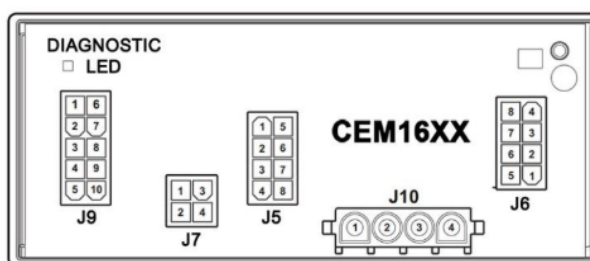


Figure 98: CEM16 Pin Diagram

Table 28: Harness 03033844 - CTA01

CTA01 Location	Label	Function
J2-1	gnd	Rear M1
J2-2	gnd	M2
J2-3	gnd	M3
J2-4	gnd	M4
J2-5	gnd	M5
J2-6	gnd	M6
J2-7	gnd	M7
J2-8	gnd	Front M8
J2-9	+batt	Common
J2-10	+batt	Common



Figure 99: Traffic Advisory Module

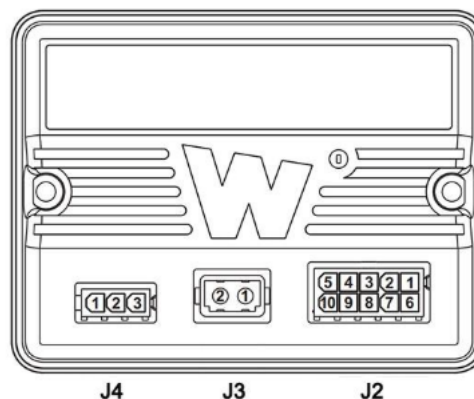


Figure 100: Traffic Advisory Module Pin Diagram

7.2.1.4 Right-Hand Rear Panel Connections

Table 29: Harness 03033836 - CEM1604

CEM1604 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	M6-R1	CF-D04	1
J5-2	MARKER (NO FLASH)	CENTER TURN RIGHT	CF-D01	2
J5-3	PASS DOCK	PASS DOCK – R1	CF-D04	2
J5-4	MARKER	DOCK MARKER – R1/2/3	CF-D04/05/06	3
J5-5	PASS DOCK	PASS DOCK – R2	CF-D05	2
J5-6	PASS DOCK	PASS DOCK – R3	CF-D06	2
J5-7	SIDE BEACN	M6-R2	CF-D05	1
J5-8	MARKER	MARKER (GENERAL PURPOSE)	CF-D09/11	1
J6-1	SIDE BEACN	M6-R3	CF-D06	1
J6-2	SIDE BEACN	M6-R4	CF-D13	1
J6-3	LOWER WORK	LOWER WORK - R	CF-D14	1
J6-4	SWIVEL WORK	SWIVEL WORK - R	CF-D15	1
J6-5	CONTROLS	CONTROLS POWER - R	CF-D08	1
J6-6	RIGHT TURN	RIGHT TURN	CF-D01	3
J6-7	TOOL BOX	TOOLBOX LITE	CF-D01/10/10A	1
J6-8	MARKER	REAR GLO LITE	CF-D03	1

Table 30: Harness 03033842 - M6 & M6 Duo CEM1609

CEM1609 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	DUOR5-C1	CF-K01	1
J5-2	SIDE BEACN	DUOR5-C2	CF-K01	2
J5-3	SIDE BEACN	DUOR6-C1	CF-K03	1
J5-4	SIDE BEACN	DUOR6-C2	CF-K03	2
J5-5	SIDE BEACN	DUOR7-C1	CF-K05	1
J5-6	SIDE BEACN	DUOR7-C2	CF-K05	2
J5-7	SIDE BEACN	DUOR8-C1	CF-K07	1
J5-8	SIDE BEACN	DUOR8-C2	CF-K07	2

Table 31: Harness 03033842 - M6V CEM1609

CEM1609 Location	Control Keypad Button	Output	Connector	Pin Number
J6-1	SIDE BEACN	M6VR5-M6	CF-K01	1
J6-2	PASS DOCK	M6VR5-DK	CF-K01	2
J6-3	SIDE BEACN	M6VR6-M6	CF-K03	1
J6-4	PASS DOCK	M6VR6-DK	CF-K03	2
J6-5	SIDE BEACN	M6VR7-M6	CF-K05	1
J6-6	PASS DOCK	M6VR7-DK	CF-K05	2
J6-7	SIDE BEACN	M6VR8-M6	CF-K07	1
J6-8	PASS DOCK	M6VR8-DK	CF-K07	2



Figure 101: CEM16

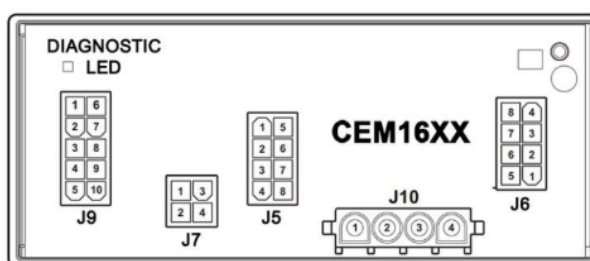


Figure 102: CEM16 Pin Diagram

Table 32: Harness 03033844 - CTA02

CTA02 Location	Label	Function
J2-1	gnd	Rear M1
J2-2	gnd	M2
J2-3	gnd	M3
J2-4	gnd	M4
J2-5	gnd	M5
J2-6	gnd	M6
J2-7	gnd	M7
J2-8	gnd	Front M8
J2-9	+batt	Common
J2-10	+batt	Common



Figure 103: Traffic Advisory Module

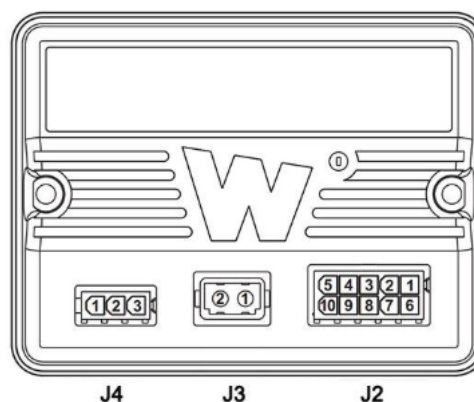


Figure 104: Traffic Advisory Module Pin Diagram



7.2.1.5 Right-Hand Forward Panel Connections

Table 33: Harness 03033839 - CEM1605

CEM1605 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	PASS DOCK	SWIVEL WORK - FR	CF-G01	1
J5-2	SIDE BEACN	M6 FR (FRONT/HOOD)	CF-G04	1
J5-3	SIDE BEACN	M6-FR-1 PYLON	CF-G11	1
J5-4	SIDE BEACN	M6-FR-2 PYLON	CF-G11	2
J5-5	MARKER	PYLON MARKER LIGHT – NON-FLASHING	CF-G11	3
J5-6	BRAKE	PYLON BRAKE LIGHT	CF-G11	4
J5-7	MARKER	MARKER (GENERAL PURPOSE)	CF-G05/06	1
J5-8	TL/BX BEACN	FLASH/WARN	CF-G08	4
J6-1	U/L WORK	L – U/L WORK	CF-G09	1
J6-2	U/L WORK	R – U/L WORK	CF-G09	3
J6-3	MARKER (NO FLASH) TOOL BOX	BOOM SIDE TOOLBOX ACCENT REAR (REAR-8PCS)	CF-G13	1
J6-4	TOOL BOX	TLBX LITE	CF-G07/12	1
J6-5	TOOL BOX	TLBX LITE	CF-G14/G(14)	1
J6-6	TOOL BOX	DOOR HANDLE LITE (NON FLASH)	CF-G08	2
J6-7	TOOL BOX	FRONT UNDER TLBX ACCENT LITE (FRONT-8PCS)	CF-G02	1
J6-8	MARKER	FRONT GLO LITE	CF-G03	1

Table 34: Harness 03033842 - M6 & M6 Duo CEM1610

CEM1610 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	SIDE BEACN	DUOR1-C1	CF-K01	1
J5-2	SIDE BEACN	DUOR1-C2	CF-K01	2
J5-3	SIDE BEACN	DUOR2-C1	CF-K03	1
J5-4	SIDE BEACN	DUOR2-C2	CF-K03	2
J5-5	SIDE BEACN	DUOR3-C1	CF-K05	1
J5-6	SIDE BEACN	DUOR3-C2	CF-K05	2
J5-7	SIDE BEACN	DUOR4-C1	CF-K07	1
J5-8	SIDE BEACN	DUOR4-C2	CF-K07	2

Table 35: Harness 03033842 - M6V CEM1610

CEM1610 Location	Control Keypad Button	Output	Connector	Pin Number
J6-1	SIDE BEACN	M6VR1-M6	CF-K02	1
J6-2	PASS DOCK	M6VR1-DK	CF-K02	2
J6-3	SIDE BEACN	M6VR2-M6	CF-K04	1
J6-4	PASS DOCK	M6VR2-DK	CF-K04	2
J6-5	SIDE BEACN	M6VR3-M6	CF-K06	1
J6-6	PASS DOCK	M6VR3-DK	CF-K06	2
J6-7	SIDE BEACN	M6VR4-M6	CF-K08	1
J6-8	PASS DOCK	M6VR4-DK	CF-K08	2



Figure 105: CEM16

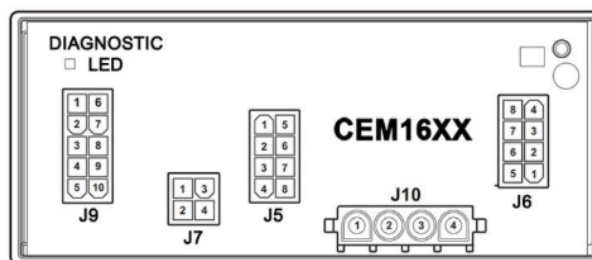


Figure 106: CEM16 Pin Diagram

Table 36: Harness 03033838 - CEM4HC2

CEM4HC_2 Location	Control Keypad Button	Output	Connector	Pin Number
J4-1	AUX BEACN	WHELEN MINI (10X10)	CF-F01	1
J4-2	DRVR DOCK SIDE WORK	RAZOR/H120	CF-F01	2
J4-3	DRVR DOCK SIDE WORK	RAZOR/H120	CF-F01	3
J4-4	SWIVEL WORK	SPARE	CF-F01	4



Figure 107: CEM4HC



Figure 108: CEM4HC Pin Diagram



7.2.1.6 Tunnel Box Connections

Table 37: Harness 03034764 - CEM1606

CEM1606 Location	Control Keypad Button	Output	Connector	Pin Number
J5-1	TOOL BOX	LH	CF-X14, CF-X15	1
J5-1	TOOL BOX	LH	CF-X32	3
J5-2	TL/BX BEACN	FLASHING/WARNING	CF-X05, CF-X19	2
J5-2	TL/BX BEACN	FLASHING/WARNING	CF-X32	4
J5-3	MARKER	GLO/MILLENNIUM	CF-X04	1
J5-4	UPPER WORK	LH	CF-X06	1
J5-5	SIDE BEACN	LH M6	CF-X08	1
J5-6	SIDE BEACN	LH M6 C2	CF-X08	2
J5-7	DRVR DOCK	LH	CF-X07	1
J5-8	MARKER	LH (BOTTOM)	CF-X09, CF-X010, CF-X12, CF-X13	2
J5-8	MARKER	LH (BOTTOM)	CF-X07	1
J6-1	TOOL BOX	RH	CF-X16, CF-X17	1
J6-1	TOOL BOX	RH	CF-X32	2
J6-2	TOOL BOX	DOOR HANDLE/ACCENT	CF-X05, CF-X19	3
J6-2	TOOL BOX	DOOR HANDLE/ACCENT	CF-X25, CF-X11	1
J6-2	TOOL BOX	DOOR HANDLE/ACCENT	CF-X32	6
J6-3	MARKER	GLO/MILLENNIUM	CF-X18	1
J6-4	UPPER WORK	RH	CF-X20	1
J6-5	SIDE BEACN	RH M6	CF-X22	1
J6-6	SIDE BEACN	RH M6 C2	CF-X22	2
J6-7	PASS DOCK	RH	CF-X21	1
J6-8	MARKER	RH (BOTTOM)	CF-X21, CF-X23, CF-X24, CF-X26, CF-X27	1
J6-8	MARKER	RH (BOTTOM)	CF-X21	2



Figure 109: CEM16

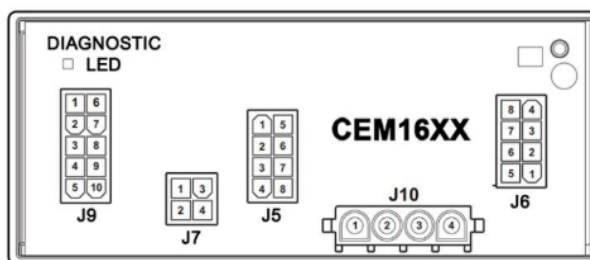


Figure 110: CEM16 Pin Diagram

7.2.2 Generic (Non-Whelen) Panel Connections

7.2.2.1 Right-Hand Forward Connections

Table 38: Harness 03033833 - CEM1610

CEM16 Location	Control Keypad Button	CEM1610	Connector	Pin Number
J5-1	BEACN	FRONT WARN	CF-A04	1
J5-2	BEACN	REAR WARN	CF-A04	2
J5-3	TAKE DOWN	TAKE DOWN	CF-A04	3
J5-4	CHASSIS	LEFT TURN	CF-A04	4
J5-5	CHASSIS	RIGHT TURN	CF-A04	5
J5-6	CHASSIS	MARKER	CF-A04	6
J5-7	DVI	LOW POWER ENABLE	CF-A04	13
J5-8	GND ENABLE	CRUISE	CF-A04	14
J6-1	<=	TRAFFIC ADV. LEFT	CF-A04	15
J6-2	=>	TRAFFIC ADV. RIGHT	CF-A04	16
J6-3	MARKER FLASH	MARKER – 0	CF-A02	1
J6-4	MARKER FLASH	MARKER – 180	CF-A02	2
J6-5	MARKER FLASH	MARKER – 0	CF-A02	3
J6-6	MARKER FLASH	MARKER – 180	CF-A02	4
J6-7	MARKER FLASH	MARKER – 0	CF-A02	5
J6-8	MARKER FLASH	MARKER – 180	CF-A02	6



Figure 111: CEM16

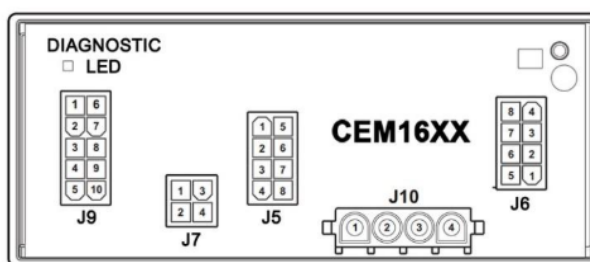


Figure 112: CEM16 Pin Diagram

7.3 Best Practices

These best practices are intended to augment technician knowledge. Following the best practices in this section will help maintain the life and quality of Miller Industries Towing Equipment Inc. products and Whelen electrical systems.

7.3.1 Crimping and Termination

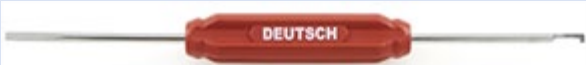
Correct termination and crimping is crucial to system performance. Incorrect crimping can lead to high resistance and heat buildup, which can damage components.

7.3.2 Connector De-Pinning Tools

To check pin connectors, wires, and crimping, use these specific tools to de-pin wires from terminals.

Table 39: Necessary Tools

Connector	Tool	Part Number
AMP Pin		PINPUSH Tyco 1-305183-1

AMP Socket		SOCKPUSH Tyco 1-305183-2
Mini- Universal Mate-N-Lok		Tyco 189727-1
Universal Mate-N-Lok		1804030-1
Deutsch flathead screwdriver with wedge lock removal		Deutsch DT-RT1

Deutsch contact remover tool: Size 16 HDP 16-20ga Size 16 HDP 14-16 ga Size 12 HDP		Deutsch 0411-336-1605 0411-291-1405 0411-337-1205
Deutsch hand crimper for stamped and formed contacts: Size 12, 12/14 ga Size 12 10/12 ga Size 16 14/16 ga Size 20 16/20 ga		Deutsch ATT-12-00 ATT-12-01 ATT-16-00 ATT-20-00
Deutsch hand crimper for solid contacts: Size 12/16/20, 12-20 ga		Deutsch HDT-48-00

7.3.2.1 Stamped and Formed Connector Crimping

Wire insulation should cover the exposed parts of the wire. Some skewing of the insulation is acceptable, and slight deformation is also acceptable. Any deviation from the examples should be corrected.



Figure 113: Examples of Acceptable Wire Crimp - Stamped & Formed Connectors

Wire barrel crimps should have uniform wall thickness, symmetrical crimp areas on both sides of the barrel, no flash at the bottom, and all wire strands should be captured by the crimp. No voids should be in the crimp compression area, though small voids at the inside tips are acceptable.

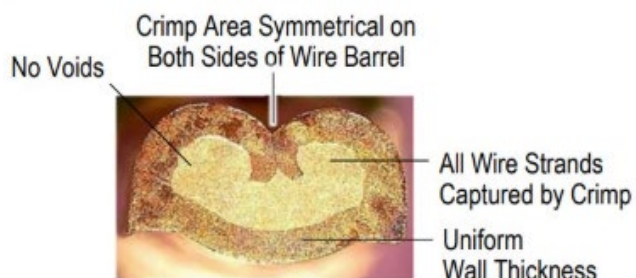


Figure 114: Example of Good Wire Crimp - Stamped & Formed Connectors

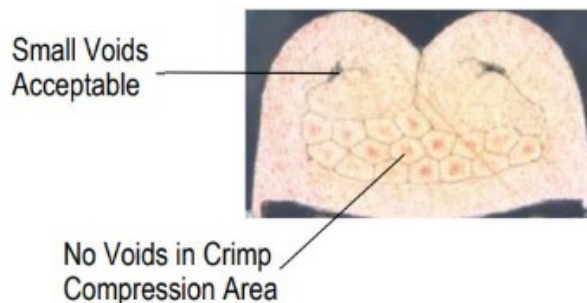


Figure 115: Example of Acceptable Wire Crimp - Stamped & Formed Connectors

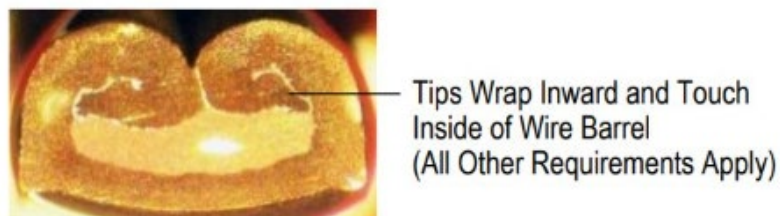
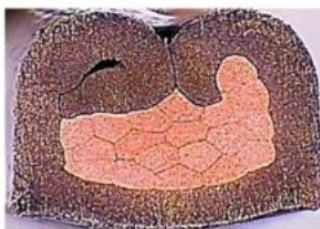


Figure 116: Example of Acceptable Wire Crimp - Stamped & Formed Connectors



Uneven Crimp and
Wall Thickness and
Flash on Both Sides



Uneven Crimp and
Wall Thickness



Crimp Too Loose and
Void on Both Sides

Figure 117: Examples of Bad Wire Crimps - Stamped & Formed Connectors

7.3.2.2 Solid Terminal Crimping

Solid terminals must be attached correctly to wires, and like in formed connectors, wires in solid terminals must be crimped correctly.

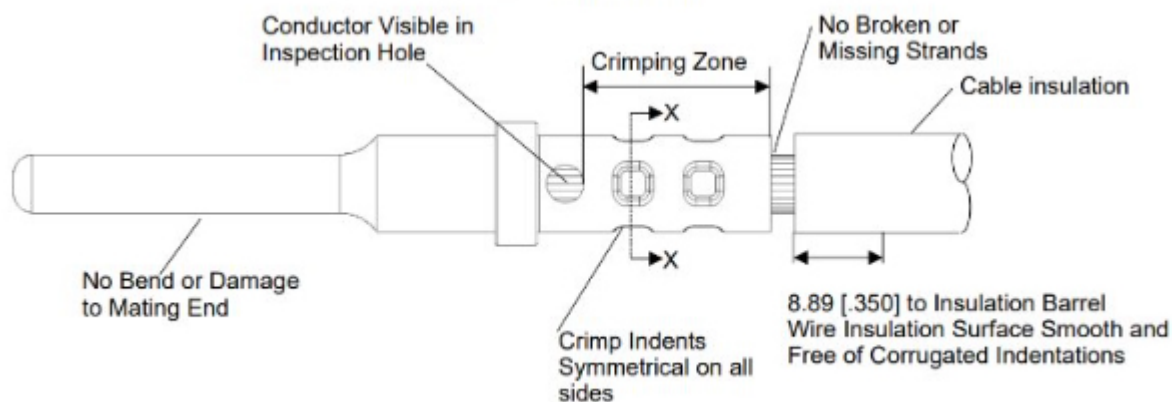


Figure 118: Example of Good Wire Crimp - Solid Terminal Connectors

Wire barrel crimps for solid terminals must also have uniform wall thickness around the whole barrel and have no voids in the crimp compression area, though small voids at the ends are acceptable.

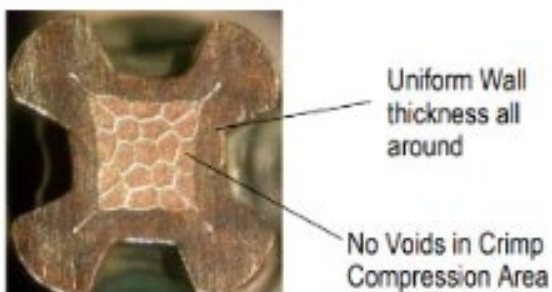


Figure 119: Example of Good Wire Crimp - Solid Terminal Connectors

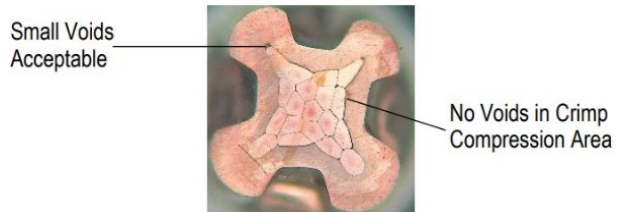
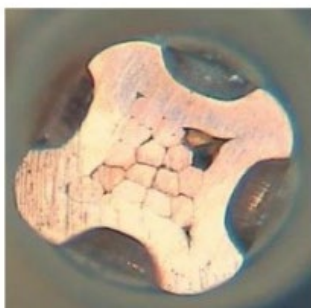


Figure 120: Example of Acceptable Wire Crimp - Solid Terminal Connectors



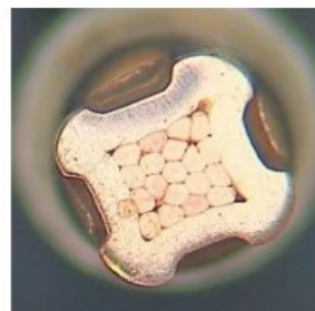
Crimp Too Loose and Voids in the Crimp

Figure 121: Bad Wire Crimp: Too Loose, Voids - Solid Terminal Connectors



Uneven Crimp and Wall Thickness

Figure 122: Bad Wire Crimp: Uneven - Solid Terminal Connectors



Crimp Too Loose and Void Within Crimp

Figure 123: Bad Wire Crimp: Too Loose, Voids - Solid Terminal Connectors

7.3.2.3 Lug/Ring Terminal Crimping

A good lug/ring terminal crimp has no fins from over crimping, uniform depression of the lug, and an intact, unpunctured eyelet neck. If an adhesive-lined heat-shrink tube is used on the terminal wire, it must be intact.

Because lug/ring eyelets have a variety of wall thicknesses, start crimp repairs with a larger crimp die. If a smaller crimp die is needed, adjust from there. Some crimp die labels are inaccurate and may not provide the crimp needed.



Figure 124: Example of Good Wire Crimp - Lug/Ring Connectors



Figure 125: Example of Bad Crimp: Over-Crimping - Lug/Ring Connectors



Figure 126: Example of Bad Crimp: Fins - Lug/Ring Connectors

7.3.3 Wire Routing

Cable management is often difficult on large harnesses, so care must be taken to avoid excessive tension on pigtail harness connections. The Mini Universal Mate-N-Lok connectors used on many Whelen products are susceptible to terminal disengagement when the harness is under tension. Correct wire routing is essential to the MITT-ILC system's long-term reliability.

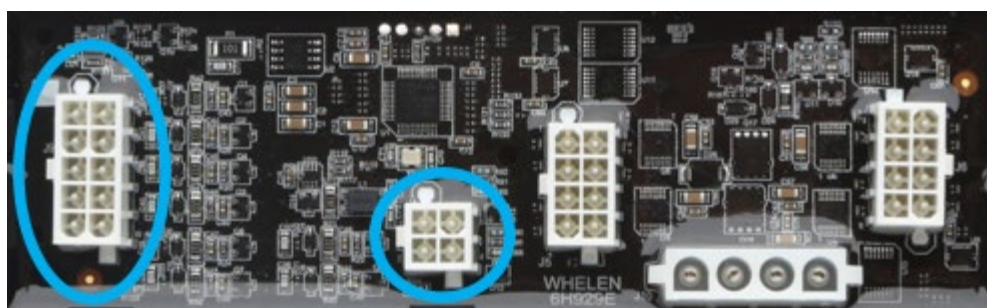


Figure 127: Mini Universal Mate-N-Lok Connectors



Figure 128: Example of Correct Tension on Mini Universal Mate-N-Lok Connectors

When routing wires and harnesses, leave a manageable amount of wire slack for serviceability.



Figure 129: Example of Correct Service Loop

7.3.4 Hardware Tolerances

When installing panels, fuse boxes, or any other components, become familiar with the maximum and minimum torque values for each screw and bolt. Torque values are often printed on the hardware box, and some values are stamped into the fuse box itself. For simplicity, this section provides torque values for the most common screws used in Whelen system installation on Miller products.

Hardware	Maximum Torque (ft/lb)	Maximum Torque (N/m)
M8 bolts	14.75	20
M5 screws	2.21	3
#8-32x5/16 screws (18-8 stainless steel)	1.65	2.24

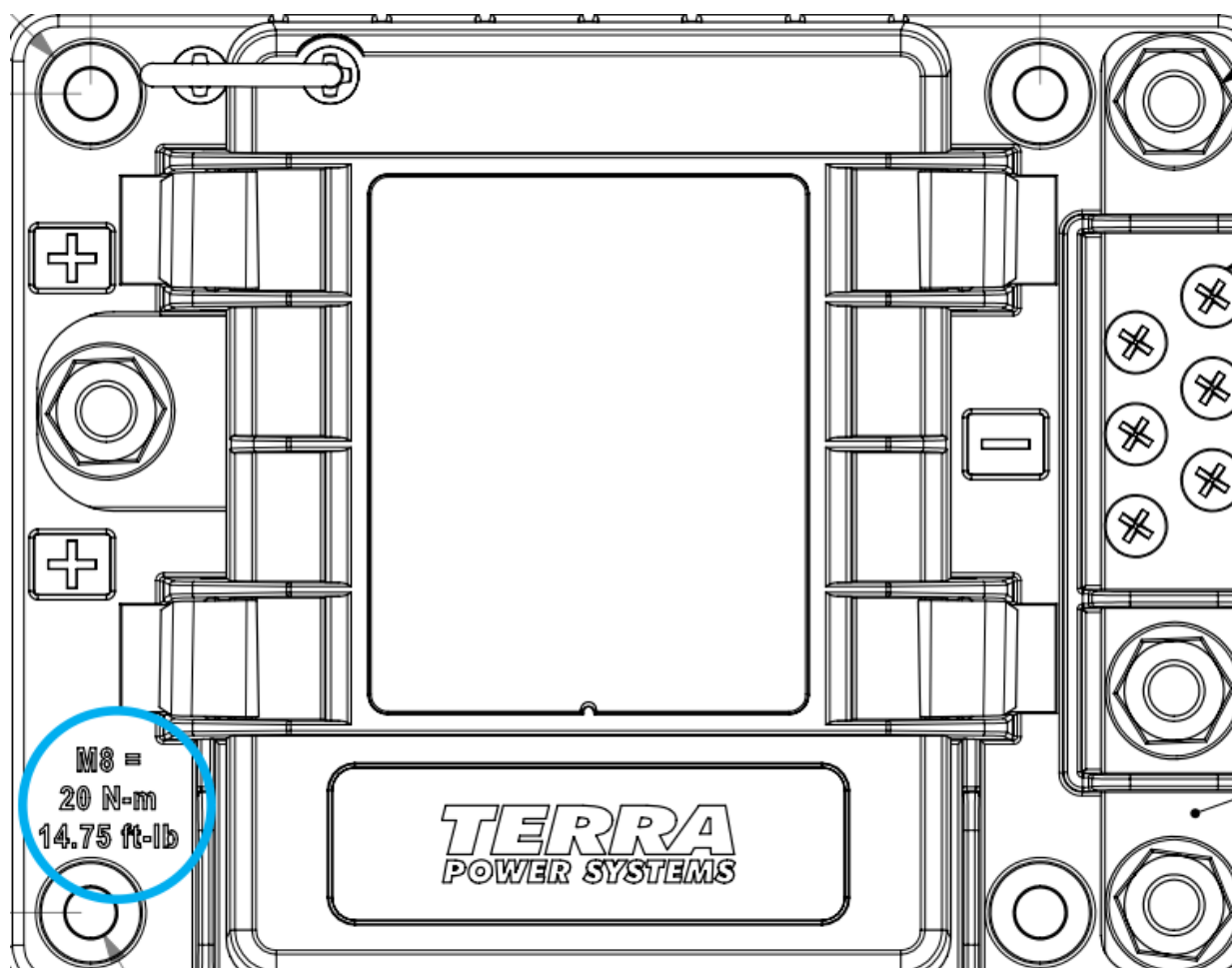


Figure 130: Maximum Torque Value Stamped Into Fuse Box



7.4 Abbreviations

Below is a list of all the abbreviations used in this manual.

- BEACN: Beacon
- CAN: Controller Area Network
- CEM: Controller Expansion Module
- CTA: Traffic Advisory Module
- DRVR: Driver (Left-Hand)
- DVI: Dynamic Variable Intensity
- Ft/lb: Foot/pounds
- GND: Ground
- LED: Light Emitting Diode
- LH: Left-Hand
- MARK: Marker
- MITT-ILC: Miller Industries 3000 – Individual Light Control
- N/m: Newtons/meter
- PASS: Passenger (Right-Hand)
- PN: Part Number
- PTO: Power Take Off
- RH: Right-Hand
- TL/BX: Toolbox
- U/L: Underlift
- VDC: Volts Direct Current