SIEMENS

INSTALLATION & OPERATION

TRAINGUARD EOT, A90385 &
HIGH-POWER TRAINGUARD EOT, A90388

MARCH 2025

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VERSION B

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The equipment covered in this manual has been tested and found to comply with the limits for Class A digital devices, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his / her own expense.

DOCUMENT HISTORY

Version	Release Date	Sections Changed	Details of Change
A	Apr 2020	N/A	Initial Release
B	Mar 2025	Title Page	Updated to include High-Power Trainguard EOT
		1.0	Updated to include High-Power Trainguard EOT & added a note to explain that both EOTs are discussed concurrently unless specified.
		1.1	Updated how often status update messages are sent to HOT (55-65 seconds). Removed reference to dual pipe configuration (future option).
		1.4	Table 1-1, updated heading for both assemblies and removed dual hose option (future option).
		1.5	Table 1-2 – updated with HP Manifold PNs. Table 1-2 & Table 1-4, removed all dual pipe PNs (future option).
		1.5.2	Added new table for EOT with HP Manifold PNs.
		3	Added information to each operating mode.
		3.1	Charging Modes descriptions added.
		3.2	Changed state reported to server from Active to Deployed.
		3.2.1	Updated Software P/N, display text and display screens.
		3.5.1	Auto charging mode section updated.
		3.5.2	Manual charging mode section updated.
		3.7.2.1	Table 3-3 – removed secondary pressure message as this is reported only for dual pipe models (future option).
		3.7.2.2	Table 3-4 – added for rotating messages when device not armed.
		3.8.1	Updated Section: Button Press Operation, added table.
		3.8.2.1	Updated single button press behavior description.
		3.9	Updated information for LED behavior section.
		3.10	Added High-Visibility Marker Section.
		3.11.1	Updated status update message range to 55-65 seconds.
		3.11.4	Air Generator section: added details for new manifold.
		3.11.5	Added “for standard manifold only” to heading.
		3.11.8	Added reference and description for GNSS receiver.
		3.11.9	Motion Detection Section: Rewritten for clarity.
		3.11.10	Cellular Modem section: added missing states & reference.

		3.11.11	Locator System section: added & updated 3 user options & added figure for GNSS user options.
		3.11.12	SD Card Section: Reworded for clarity, removed redundant sentence & added an example file name.
		3.12	Arming System Section: Reformatted Steps 1& 2 for clarity. Added new figures.
		4.2	Table 4-1 – Added “(not currently available)” to menu item for dual pipe configuration, added new config menu items.
		4.3.3	Replaced screens with latest.
		4.3.5.1	Updated with latest screen.
		5.2	Test procedure, updated steps 8 and 14.
		6.3.1	Air Transducer Calibration section: added details for new manifold and updated figure/note.
		6.7.4	Table 6-2 updated with latest Event Codes.
		7.2	Update to Table 7-1, changed combo wrenches from 1 ½" to 1 ¼" & added T25 Torx or star wrench for HP manifold air generator
		7.2.1	Updated drawing references to include both NYK:9000-90385-0XXX or NYK:9000-90388-0XXX. Updated number of connectors for both EOT types.
		7.2.2	Added a reference for NYK:9000-90388-0XXX housing cover. Removed page 2 reference to 90387 drawing.
		7.2.3	Updated drawing references to include both EOTs.
		7.2.5	Air Manifold section: added details for new manifold & dwg P/N for high-powered manifold assbly.
		7.2.6	Updated drawing references to include both EOTs.
		7.2.7	Manifold Assembly Removal section: added details for new manifold & dwg P/N for high-powered manifold assbly.
		7.2.9	Added for standard manifold only to heading.
		7.2.11	Added new content to include service of HP manifold air generator.
		7.2.11.4	Step 4: Increased the air pressure to 75 PSI instead of 70.
		7.2.12	Manifold Reinstallation section: added details for new manifold.
		9	Updated introduction to include High-Power Trainguard EOT and added updated drawings for Main Assembly, A90385, Main Assembly with HP Manifold A90388, Subassembly for Electronics Tray, A90386, Subassembly for EOT Dome, A90387, High-Powered Manifold Assembly, A40300, and Housing Cover Assembly, A90395. Updated Table 9-1.

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NOTES, CAUTIONS, AND WARNINGS

Throughout this manual, notes, cautions, and warnings are frequently used to direct the reader's attention to specific information. Use of the three terms is defined as follows:

⚠ WARNING

WARNING

INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY. WARNINGS ALWAYS TAKE PRECEDENCE OVER NOTES, CAUTIONS, AND ALL OTHER INFORMATION.

⚠ CAUTION

CAUTION

REFERS TO PROPER PROCEDURES OR PRACTICES WHICH IF NOT STRICTLY OBSERVED, COULD RESULT IN A POTENTIALLY HAZARDOUS SITUATION AND / OR POSSIBLE DAMAGE TO EQUIPMENT. CAUTIONS TAKE PRECEDENCE OVER NOTES AND ALL OTHER INFORMATION, EXCEPT WARNINGS.

NOTE

NOTE

Generally used to highlight certain information relating to the topic under discussion.

If there are any questions, contact Siemens Mobility, Inc.

ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

Static electricity can damage electronic circuitry, particularly low voltage components such as the integrated circuits commonly used throughout the electronics industry. Therefore, procedures have been adopted industry-wide which make it possible to avoid the sometimes invisible damage caused by electrostatic discharge (ESD) during the handling, shipping, and storage of electronic modules and components. Siemens Mobility, Inc. has instituted these practices at its manufacturing facility and encourages its customers to adopt them as well to lessen the likelihood of equipment damage in the field due to ESD. Some of the basic protective practices include the following:

- Ground yourself before touching card cages, assemblies, modules, or components.
- Remove power from card cages and assemblies before removing or installing modules.
- Remove circuit boards (modules) from card cages by the ejector lever only. If an ejector lever is not provided, grasp the edge of the circuit board but avoid touching circuit traces or components.
- Handle circuit boards by the edges only.
- Never physically touch circuit board or connector contact fingers or allow these fingers to come in contact with an insulator (e.g., plastic, rubber, etc.).
- When not in use, place circuit boards in approved static-shielding bags, contact fingers first. Remove circuit boards from static-shielding bags by grasping the ejector lever or the edge of the board only. Each bag should include a caution label on the outside indicating static-sensitive contents.
- Cover workbench surfaces used for repair of electronic equipment with static dissipative workbench matting.
- Use integrated circuit extractor / inserter tools designed to remove and install electrostatic-sensitive integrated circuit devices such as PROMs (OK Industries, Inc., Model EX-2 Extractor and Model MOS-40 Inserter (or equivalent) are highly recommended).
- Utilize only anti-static cushioning material in equipment shipping and storage containers.

GLOSSARY

TERM	DESCRIPTION
AAR	Association of American Railroads – An organization that establishes uniformity and standardization among different railroad systems.
AEI	Automatic Equipment Identification
AREMA	American Railroad Equipment Manufacturing Association – An organization that supersedes AAR.
ATCS	Advanced Train Control System – A set of standards compiled by the AAR for controlling all aspects of train operation.
CPU	Central Processing Unit
EOT	End-of-train device that enables information to be passed the entire length of the train via radio signals.
EOTPH	EOT Phone Home – remote tracking service
FRA	Federal Railroad Administration – an agency within the U.S. Department of Transportation concerned with intermodal transportation.
GNSS	Global Navigation Satellite System
HOT	Head-of-train devices that enables information to be passed the entire length of the train via radio signals.
HP	High-Powered / High-Power
HVM	High-Visibility Marker
IoT	Internet of Things
LED	Light-emitting Diode – a semiconductor diode which glows when a voltage is applied.
LPuP	Low Power Microprocessor
PBT	Polybutylene Terephthalate
PC	Polycarbonate
PCB	Printed Circuit Board
RS232	EIA interface standard between DTE and DCE, employing serial binary data interchange.
RX	Receive

TERM	DESCRIPTION
RXD	Receive Data
TX	Transmit
TXD	Transmit Data
UI	User Interface
USB	Universal Serial Bus

SECTION 1 **INTRODUCTION**

1.0 GENERAL INFORMATION

This manual provides installation information and detailed operating instructions for the Trainguard end-of-train (EOT) device (A90385) and the High-Power (HP) Trainguard end-of-train (EOT) device (A90388). This information is essential to proper system operation and problem diagnosis. It is strongly recommended that each system operator / maintainer become familiar with the information provided herein before attempting to program, calibrate, or troubleshoot the EOT.

⚠ WARNING

WARNING

THE A90385 AND A90388 END-OF-TRAIN (EOT) DEVICES ARE NON-VITAL PRODUCTS.

CAUTION MUST BE TAKEN WHEN INTERFACING THE EOT TO ANY VITAL EQUIPMENT AS THE EOT CAN NOT BE USED TO PERFORM, EITHER DIRECTLY OR INDIRECTLY, ANY VITAL FUNCTIONS.

ENSURE THAT THE EOT IS INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS, AND / OR ALL EQUIPMENT INTERCONNECTIONS ARE IN COMPLIANCE WITH RAILROAD PROCEDURES AND SPECIFICATIONS.

NOTE

NOTE

This manual covers the installation, operation, and servicing of the Siemens Trainguard EOT (end-of-train) units. Familiarity with the use and operation of HOT (head-of-train) units is assumed. This manual refers to some HOT functions as required for system operation and functions. Please refer to the corresponding service or instruction manuals for HOT devices, if needed, for complete instructions.

NOTE

NOTE

This manual covers both the Trainguard end-of-train (EOT) device (A90385) and the High-Power (HP) Trainguard end-of-train (EOT) device (A90388), concurrently, unless it is stated that a function or component is specific to one type of EOT only.

1.1 OVERVIEW

The end-of-train devices (EOTs) and head-of-train devices (HOTs) provide the Locomotive Engineer with information regarding conditions that are important to the operation of the train. These conditions include brake pipe pressure, measured at the rear of the train, and various status conditions. The status indications include:

- Arming status (emergency feature enabled / disabled)
- Communication status (good / comm-loss, rear-to-front or front-to-rear)
- EOT motion detection (moving / stopped)
- High-Visibility Marker (HVM) status (on / off / defective)
- Brake valve status (normal / emergency / defective)
- Battery status (good / low / dead)
- Battery charge (percent depleted)

The EOT sends messages to the HOT that convey the monitored brake pipe pressure, as well as the health and status information listed above. Any time the brake pipe pressure changes by 2 PSI or more, a status update message is sent to the HOT. In the absence of pressure change, a status update message is sent to the HOT every 55-65 seconds after the last status sent.

The EOT also processes and responds to HOT commands, such as communications tests and emergency brake commands, as well as (proprietary) position (latitude / longitude) and time (UTC) requests. The unit supports the AAR standard protocol (S-9152) on the frequency pair of 457.9375 MHz (TX) and 452.9375 MHz (RX).

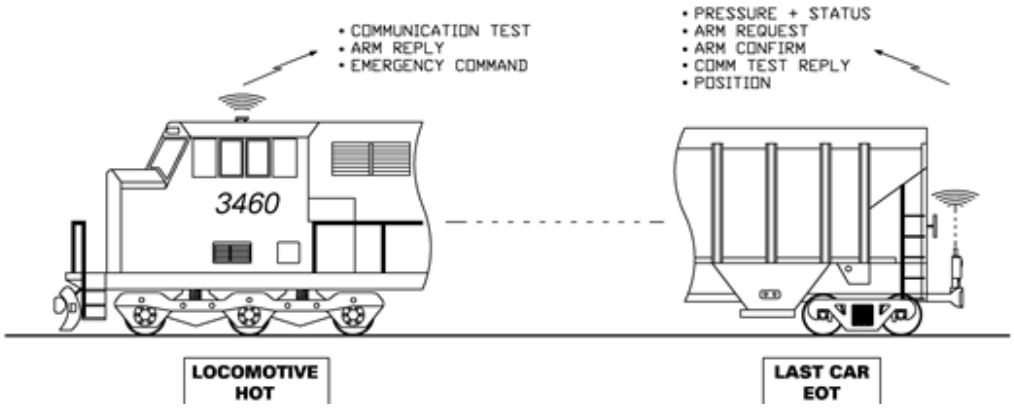


Figure 1-1 HOT / EOT Communications

Every EOT has a unique ID number, which is clearly marked on a metal nameplate on the front of the unit. This ID number is used to link the HOT in the locomotive to one EOT. Additionally, an AEI (Automatic Equipment Identification) tag with the same number reports the EOT's progress around the rail network via wayside AEI readers. The AEI tag is located behind the handle inside the EOT.

Before emergency commands can be enabled, the HOT must be armed/paired to the EOT. The arming process is initiated by pressing the ARM button on the EOT. Refer to section 3.12 (and the HOT manual) for information on the steps required to complete the arming sequence.

The EOT features an internal air-powered generator to keep the battery charged, a GNSS receiver, a 4G-LTE cellular modem for remote connectivity to the RailFusion EOT Phone Home tracking service, and an event recorder. Events are logged into non-volatile memory (SD card) and can be downloaded to a computer (see Section 4.0, *User Interfaces* for details). The SD card maintains approximately 10 years of EOT event recorder history.

A single multi-function pushbutton is used to perform various tasks, including:

- waking the EOT from sleep.
- sending an arm request message to the HOT.
- disabling and re-enabling the air generator (for EOTs that include an air generator stop valve).
- turning on the display.
- enabling and disabling Wi-Fi functionality.
- putting the EOT to sleep.

The LFP (Lithium Iron Phosphate) battery is housed in a sealed compartment molded into the enclosure and surrounded with protective foam on all sides. The battery will not be damaged if fully drained. It is more environmentally friendly than lead-acid batteries and can handle over 1000 full charge / discharge cycles.

A clear, high-strength, UV-stable polycarbonate dome allows visual access to the High-Visibility Marker (HVM) as well as to front displays (message and pressure), LEDs, and rear display (pressure). The dome is easy to remove for access to USB connector and maintenance items including RF connectors, antennas, memory card, and cellular modem SIM-card.

The FRA-approved HVM is implemented with a single ultra-high-intensity LED and focusing lens.

The manifold features short air paths to reduce the risk of clogging and / or icing, with the pressure transducer located very close to the air inlet for accurate measurement of brake pipe pressure. It provides a high exhaust flow rate for fast braking. It can be easily reconfigured for continuous generator operation (no generator stop-valve), or zero-leak operation (no generator). The air filter is easily accessible from the bottom of the EOT.

The EOT can handle the high levels of shock and vibration typical of the application due to the enclosure geometry with strengthening features, placement of the coupler mounting point close to the center of gravity, and shock-mounting of the electronics module.

The single electronic-tray design, extensive event logging, Web-based user interface and continuous self-testing make the EOT easy to use, service, and maintain.

The EOT features multiple user interfaces – Serial, Wi-Fi, USB, and Local UI – that facilitate access, configuration, management, control, and upgrading of the device. The standard 6-pin circular connector allows direct programming of the radio inside the EOT, and basic radio alignment tasks can be done without any disassembly. The EOT can be ordered in different configurations, with internal or external (long-range) UHF radio antennas, and an orange or red case color (other colors may be available upon request depending on quantity ordered). Refer to section 1.5 for ordering information.

⚠ CAUTION

CAUTION

RAILROADS SHOULD ENSURE THERE IS NO DUPLICATION OF ID NUMBERS ASSIGNED TO THEIR EOTS.

Figure 1-2 EOT Identification

1.2 ENCLOSURE

The Trainguard EOT is housed in a rugged, UV-stabilized PC / PBT blended resin enclosure equipped with an adjustable mounting mechanism. The mounting mechanism enables the EOT to be securely fastened to Type E or F couplers via the coring holes in the coupler head. An attached air hose connects the EOT to the train brake line.

1.3 DISPLAY

The 8-character EOT message display provides four different types of messages, some dependent on what mode the EOT is in. The message types are Blocking, Charging Mode, Fault, and Rotating messages. For a comprehensive listing of the EOT display messages and their meaning, reference Section 3.6, *Message Types*.

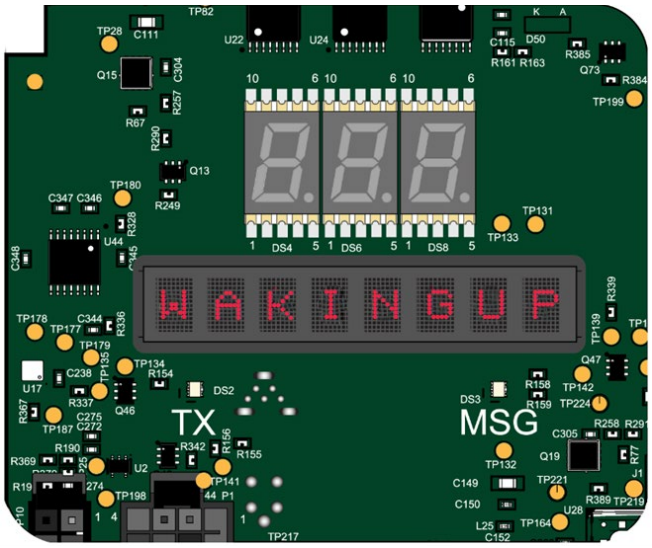


Figure 1-3 EOT Boot String

1.3.1 Alphanumeric and Pressure Displays

The front display has 8 characters and a pressure display with 3 numeric digits. The rear pressure display is also a 3-digit numeric display. The second pressure display on the rear of the EOT allows personnel on the opposite side of the train to view the brake pipe pressure without having to cross the track.

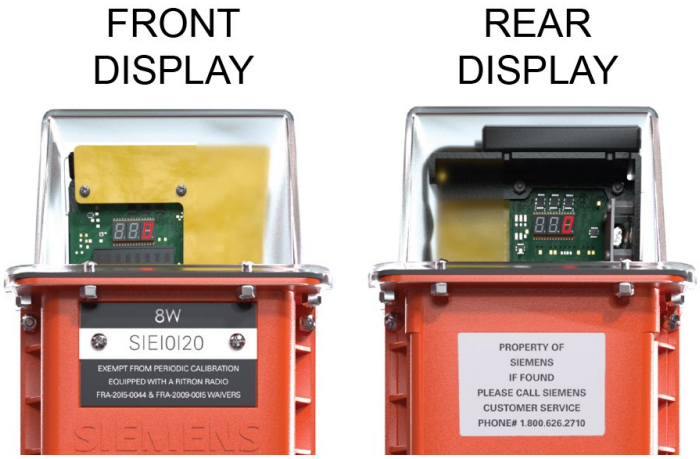


Figure 1-4 Front and Rear Display

1.4 SPECIFICATIONS

The following table provides the specifications for the EOT, for both the Standard Assembly and the High-Powered (HP) Manifold Assembly.

Table 1-1 EOT Specifications (Standard Assembly and High-Powered Manifold Assembly)

EOT Attribute	Details
Internal Power	$LiFePO_4$ (LFP) battery 12.8 V nominal 4500 mAh capacity >36-hour operation on generator failure Advanced charge-management with gas-gauge function
External Charger	Standard power supply 10-25 volt @ 2A max Industry standard 6-pin charge port
Enclosure	UV-stabilized PC / PBT blended resin Red and orange color options UV-stabilized PC clear dome for visual access Clam-shell sealed construction Easy access port for routine maintenance
Manifold	0-125 PSI operating pressure Measurement accuracy + / - 3 PSI Standard single hose option
Mounting Clamp	Industry-standard clamp fitting type E / F couplers Mount point near EOT center of gravity
Displays	Front and rear 3-digit pressure displays Front 8-character alphanumeric display
Radio	8 W narrowband UHF transceiver – 457.9375 MHz (TX) – 452.9375 MHz (RX) Internal and external (long-range) antenna options
Interfaces	Serial RS232 USB Wi-Fi 4G LTE IoT cellular modem GNSS (separate from modem) High reliability sealed electro-pneumatic connectors
Log Memory	Micro-SD card (8 GB standard)
Remote Connectivity	Remote GNSS position tracking Programmable call frequency Remote (and local) disable/ re-enable Continuous reporting (enabled and disabled) Remote over-the-air software update

EOT Attribute	Details
Ambient Conditions	Operating Temperature: -40°C to +70°C Operating humidity: 0-95% non-condensing Storage temperature: -55°C to +85°C
Dimensions (Approximate)	Height: 18.5 inches (47 centimeters) Width: 6.3 inches (16 centimeters) Depth: 5.5 inches (14 centimeters) 8.1 inches from handle to clamp hook (20.6 centimeters)
Weight	14.3 lbs. without hose (6.5 kilogram) 18.3 lbs. with steel glad-hand hose (8.3 kilogram)

1.4.1 Dimensions

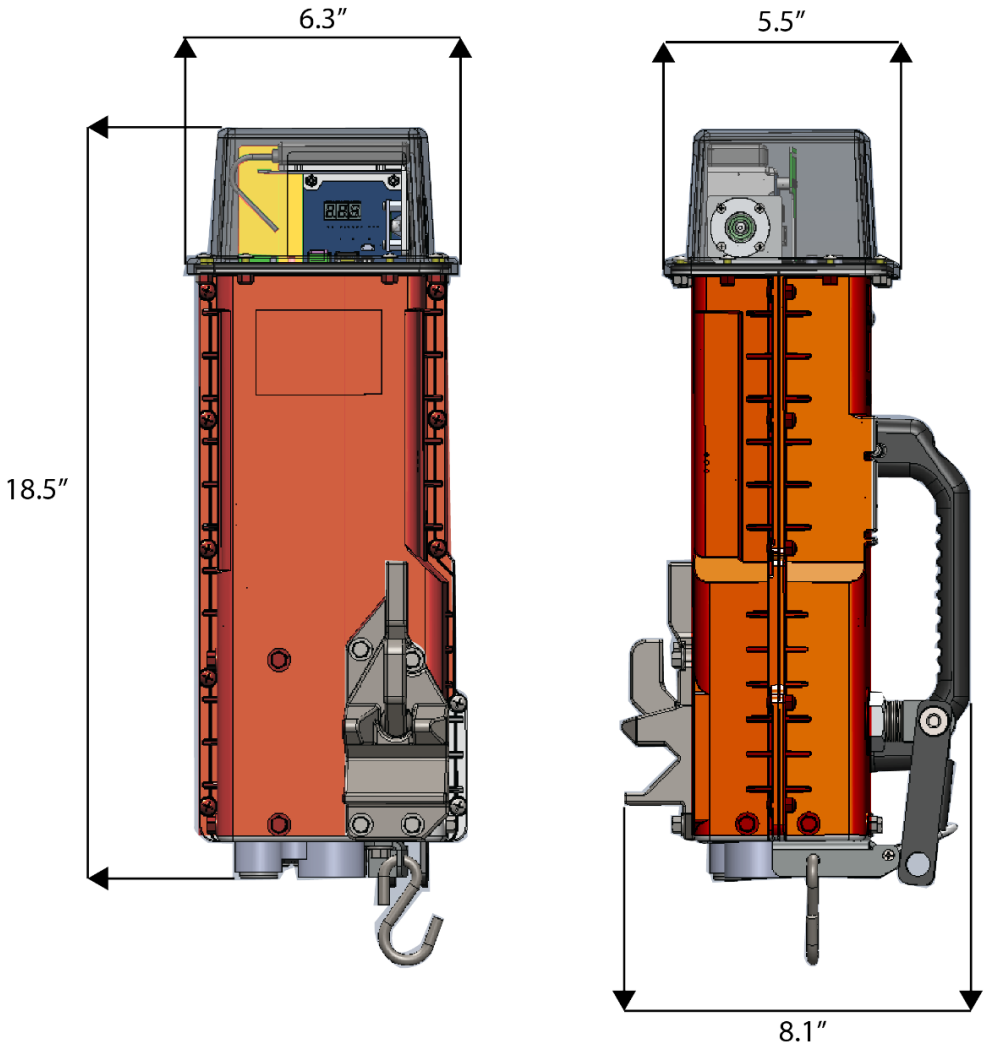


Figure 1-5 Trainguard EOT Dimensions

1.5 ORDERING INFORMATION

The following tables provide the different EOT configurations available at the time this manual was published. Additional configurations may be added from time to time. Please contact Siemens Customer Service for further information.

The following table provides part numbers from the EOT Kit.

Table 1-2 EOT Kit Part Number Information

EOT Kit P/N	NYK: 90**XX**90431000**X**
Config No.	NYK: 90**X**X90431000X
0	Without Pre-Paid Phone Home Service
1	With Pre-Paid Phone Home Service
Config No.	NYK: 90X**X**90431000X
1	Standard Manifold, Orange Housing, Internal Antenna
2	Standard Manifold, Red Housing, Internal Antenna
5	Standard Manifold, Orange Housing, External Antenna
6	Standard Manifold, Red Housing, External Antenna
9	Standard Manifold, Orange Housing, Int Ant, 406 MHz
A	Standard Manifold, Red Housing, Int Ant, 452 MHz WB
B	Standard HP Manifold, Orange Housing, Int Ant
C	Standard HP Manifold, Red Housing, Int Ant
F	Standard HP Manifold w/o Generator, Orange Housing, Int Ant
G	Standard HP Manifold w/o Generator, Red Housing, Int Ant
J	Standard HP Manifold, Orange Housing, Ext Ant
K	Standard HP Manifold, Red Housing, Ext Ant
N	Standard HP Manifold w/o Generator, Orange Housing, Ext Ant
O	Standard HP Manifold w/o Generator, Red Housing, Ext Ant
R	Standard HP Manifold, Orange Housing, Int Ant, 452 MHz SMA WB 8W
S	Standard HP Manifold, Red Housing, Int Ant, 452 MHz SMA WB 8W
V	Standard HP Manifold w/o Generator, Orange Housing, Int Ant, 452 MHz SMA WB 8W
W	Standard HP Manifold w/o Generator, Red Housing, Int Ant, 452 MHz SMA WB 8W
Config No.	NYK: 90XX90431000**X**
1	Standard Air Hose
2	Air Hose without Filter

1.5.1 EOT with Standard Manifold

The following table lists the part numbers for the EOT with standard manifold, A90385.

Table 1-3 EOT Part Numbering Information – EOT with Standard Manifold

EOT P/N	NYK:9000903850**XXX**
Config No.	NYK:9000903850X**XX**
11	Standard Manifold, Orange Housing, Internal Antenna
12	Standard Manifold, Red Housing, Internal Antenna
Config No.	NYK:9000903850**XXX**
111	Standard Manifold, Orange Housing, External Antenna
112	Standard Manifold, Red Housing, External Antenna

1.5.2 EOT with High-Powered (HP) Manifold

The following table lists the part numbers for the EOT with HP manifold, A90388.

Table 1-4 EOT Part Numbering Information – EOT with HP Manifold

EOT P/N	NYK:9000903880**XXX**
Config No.	NYK:9000903880**X**XX
0	E-Tray Assembly (EOT) (452 MHz), EOT Dome Assy (Standard)
1	E-Tray Assembly (EOT) (External Antenna), EOT Dome Assy (External Antenna)
2	E-Tray Assembly (EOT) (452 MHz) SMA WB 8W, EOT Dome Assy (Standard)
Config No.	NYK:9000903880X**X**X
1	Assembly, HP Manifold (Standard)
3	Assembly, HP Manifold (Single Pipe without Generator)
Config No.	NYK:9000903880XX**X**
1	Housing, Detail (orange), Housing Cover Assy (orange)
2	Housing, Detail (red), Housing Cover Assy (red)

1.5.3 EOT Peripheral Parts

The following table lists the part numbers of accessories available for installation, inter-connection, and servicing for the EOT with standard manifold, A90385, and the EOT with HP manifold, A90388.

Table 1-5 EOT Peripheral Parts

Siemens P/N	Description
Test Equipment	
NYK: Q3431/NB	HOT/EOT Tester (Narrow Band)
NYK: Q3433/NB	HOT/EOT Tester with Antenna Attenuator (Narrow Band)
Cables & Adapters	
NYK: 09654/10	Serial Download Cable, 10 feet
NYK:Z680399510001	Laptop charging / testing adapter
NYK: Q9361	AC Charger for EOT
NYK: Q9362	Cigarette lighter charger for EOT
Documentation	
OBE-00-17-06	Installation & Operation Manual (this manual)

SECTION 2 **INSTALLATION**

2.1 EOT INSTALLATION ON THE CAR COUPLER

The industry standard EOT mounting clamp can be used on E-type couplers and F-type couplers as follows:

1. Unlatch the crank handle from under the spring-loaded U-Latch.

Figure 2-1 Unlatching the Crank Handle

2. Make sure the locking arm is in the horizontal position. If it is not, rotate the crank handle counterclockwise until the locking arm reaches the horizontal position.

Figure 2-2 Locking Arm in Horizontal Position

3. Place the groove in the mounting mechanism on the web between the upper and lower forward coring holes in the coupler.

Figure 2-3 Clamp Groove on Coring Hole Web

4. Push the EOT against the coupler until the top of the clamp makes contact with the coupler body.

5. Hold the EOT in this position and turn the crank handle clockwise to raise the locking arm into the vertical position.

6. Continue to turn the crank handle clockwise until the EOT is snug against the coupler body. Verify the attachment to make sure the EOT is well seated against the coupler and no movement or slippage can occur. Hand tightening the EOT mount is sufficient to secure the EOT in place. **No tools should be used to tighten the EOT mount.**

Figure 2-4 Installed EOT

7. Once the locking arm is tightly in place, lift the U-Latch and slide it over the crank handle. A padlock may be applied, if desired.

8. Connect the EOT air hose to the brake line air hose and slowly open the angle cock.

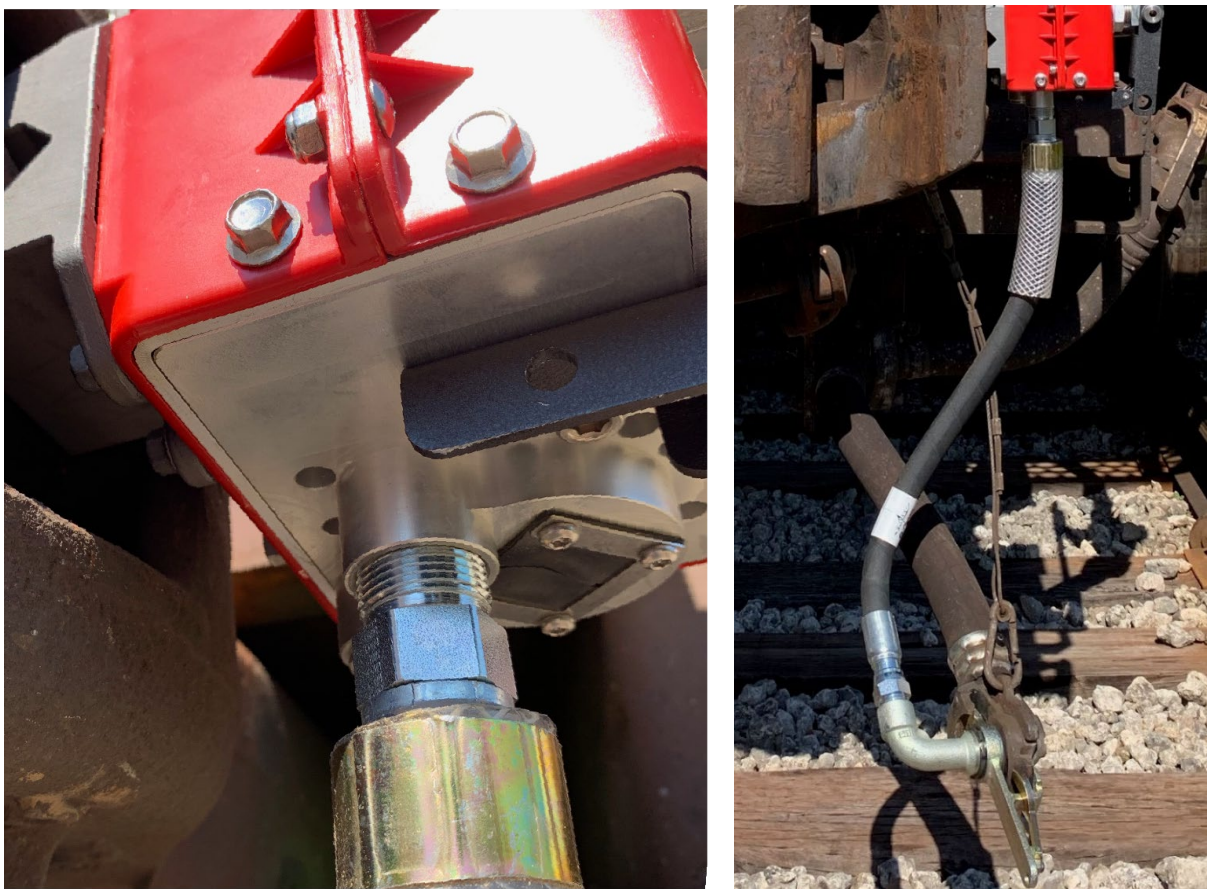


Figure 2-5 Coupling the EOT Air Hose

2.2 BRAKE TEST PROCEDURE

Upon installing the EOT, a brake test should be performed in accordance with the carrier's established brake test procedure.

The EOT must be installed and operating with the air generator operational during the performance of all required air brake inspections.

When the EOT is used to replace an existing end-of-train device on a train, an air brake leakage test must be satisfactorily performed on the train with the EOT operating and powered by the air generator.

If there is any indication that the battery is dead or has a low charge condition at the time of installation, the EOT should not be used until the battery is charged.

To test the Emergency Valve, the following procedure is recommended:

1. Arm the EOT to the HOT.
2. Verify that pressure is above 50 PSI on the display.
3. Verify battery voltage is 11.5 volts or more.
4. Push the START/ARM pushbutton twice in quick succession to temporarily stop the air generator.
5. Close the angle cock on the last car.

6. Initiate an emergency by activating the emergency switch on the HOT.
7. When the emergency command is received, the EOT display will read "BRAKING" and the air should be exhausted from the EOT and hose. Listen for the valve to open and confirm that the brake pressure reads zero on the pressure display.
8. Press the START/ARM pushbutton again to cancel the emergency command. This will close the emergency valve and re-enable the air generator. If the button is not pressed, the valve will be closed automatically after 30 seconds.
9. Slowly, re-open the angle cock.
10. Verify the full brake pipe pressure is again shown on the message display.

2.3 EOT REMOVAL

To remove the EOT device, use the following procedure:

1. Close the angle cock on the last car and bleed the air pressure from the EOT hose by pushing the bleeder valve button on the glad hand.

⚠ WARNING

WARNING

HIGH PRESSURE COMPRESSED AIR IS INSIDE THE HOSE. DO NOT REMOVE THE GLAD HAND UNTIL THE ANGLE COCK IS CLOSED, AND PRESSURE IS RELEASED.

2. Disconnect the air hose once pressure is fully released.
3. Release the crank handle from the U-Latch.
4. Hold the EOT by the carry handle and rotate the crank handle counterclockwise to loosen the unit until the locking arm is horizontal.
5. Remove the EOT from the coring holes.

SECTION 3 **OPERATION**

3.1 OPERATION OVERVIEW

This section provides an operation overview of the Trainguard EOT device. The EOT has five basic modes of operations, as follows:

- **Active** – the EOT is fully powered and ready to communicate with a head-of-train device. The EOT will not transition away from the active state while connected to compressed air. Also, the EOT will remain in the active state while it's maintained in an upright position.
- **Napping** – this mode is designed to preserve battery charge when the EOT loses air pressure during train switching moves.
- **Sleeping** – the EOT is inactive and most internal subsystems are unpowered, consuming very low power from the battery. The EOT can transition from active mode to sleep mode in two ways: when placed on its side (tilted position), or when forced to go to sleep via a long press of the START / ARM button (see section 3.5 for button operation). In both cases, the EOT must not be connected to compressed air, otherwise it will remain active.
- **Charging** – The following charging modes are available:
    - Manual: When the EOT is sleeping and connected via the charge port to an external power supply to recharge the internal battery, it is operating in charging mode. The conditions are the same for the EOT to be in sleep mode, but when an external charging voltage is detected, the EOT transitions to charging mode.
    - Auto: In any mode, if the external charging voltage is detected, EOT transitions to charging mode.

  For more information on Manual and Auto charging modes, refer to Section 3.5 Charging Mode.
- **Disabled** – the EOT receives a disabled command (issued locally or via remote tracking service) and it is prevented from active operation until it receives a re-enable command (issued locally or via remote tracking service). When an attempt is made to use a disabled EOT (placing it in active mode), it will briefly show a message on the display indicating no service is available before returning to sleep.

3.2 ACTIVE MODE

In active mode, the alphanumeric display can show a blocking message, a rotational message, or a blank screen. If a blocking message is shown, no other messages will be shown until the conditions for the blocking message are cleared. Rotating messages are displayed in a rotating order.

The display is normally turned on by pressing the START / ARM button. The display will remain illuminated for a configurable period (5 minutes is default). When the motion sensor indicates a change from the “stopped” state to the “moving” state, the display will light up (if dark) for 20 seconds. The EOT reports the state as **Deployed** to the EOTPH server.

3.2.1 Activating the EOT

To activate a sleeping EOT, press the START / ARM pushbutton for 1-2 seconds. The boot string “WAKINGUP” will appear on the display for 5 seconds. The display will then show the start-up sequence messages (see Table 3-1). The High-Visibility Marker (HVM) will then begin to flash as a self-test. If daylight is detected, this test will terminate after 30 seconds. Otherwise, the HVM will continue to operate.

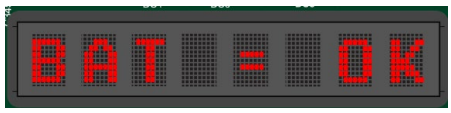
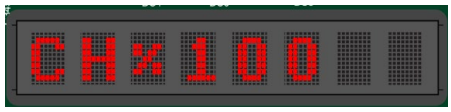
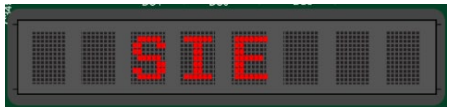
Following the start-up sequence, the display will begin continuously cycling standard messages, which include battery voltage (in volts) and battery charge level (in %). After approximately 5 minutes, the display will time out and become blank. However, even though the display is dark, the unit is still active.

NOTE

NOTE

When enabled, the optional Battery Readiness message that appears on the display during start-up has two possible notifications that indicate the battery’s state of readiness for deployment. Enabling and disabling the battery readiness feature, as well as the specific text to be displayed for each condition, can be configured at the factory per customer request (i.e. BAT = OK / BAT = NOK, BAT = SI / BAT = NO, etc.).

Table 3-1 EOT Startup Messages

Display	Display Example	Meaning / Comments
WAKING UP		Boot String - start of boot up
RDY 2 ARM		Ready to pair with the HOT
Software P/N		Application program part number
Battery Readiness[1]		BAT = OK (EOT ready for deployment) BAT = NOK (EOT should be charged prior to deployment)
Charge Percentage		Percent of battery charge remaining
Railroad ID		Railroad reporting mark
Unit ID		EOT ID number
Metric		Measurement unit

[1] The Battery readiness string is configurable and optional.

If the display on an active EOT unit is blank, pressing the START / ARM pushbutton will cause the display to be visible again (showing the cycling messages).

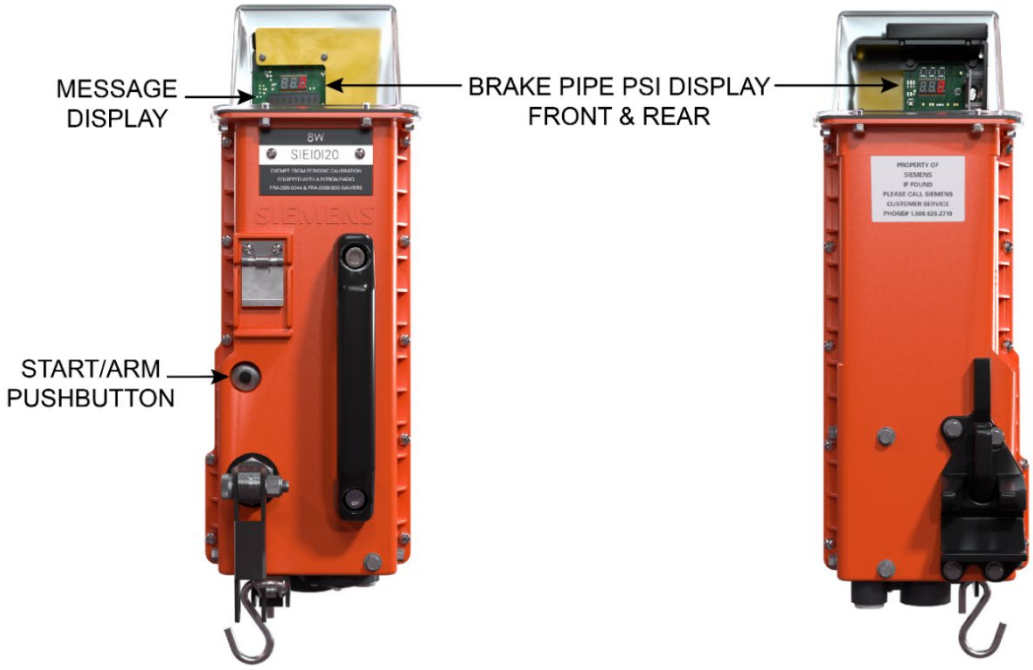


Figure 3-1 Displays and Pushbutton Locations

Figure 3-2 High-Visibility Marker Location

3.3 NAPPING MODE

Napping mode is an operational state that preserves the charge of the battery when the EOT loses air pressure during train switching moves. For the EOT to enter into napping mode, all of the following conditions must be met for 15 minutes:

- Air pressure must be zero.
- EOT must be vertical.
- No external charger is connected.
- EOT is not disabled.

When the EOT loses air pressure for 15 minutes, it will transition from active to napping mode by putting itself to sleep. The EOT will then wake up every 1 minute to check if the air pressure has returned or if the EOT position has changed from vertical to horizontal. The EOT will wake up immediately if requested by the user, i.e. user has pressed the ARM button, or if a charger is connected.

If air pressure has not returned and the EOT is still vertical then the EOT will return to napping. When air pressure returns, and/or the EOT has changed to a tilted position, or when the ARM button is pressed or a charger is connected, the EOT will switch from napping mode to active mode and normal operation.

The EOT will not transition into napping mode when any of the following conditions apply:

- Air pressure is present.
- The EOT is in a tilted/horizontal position.
- An external charger is connected.
- The EOT is in sleep mode from pressing the button.
- The EOT is disabled.

3.4 SLEEPING MODE

The Trainguard EOT has a 3-axis accelerometer to monitor vibrations and the orientation of the unit. The EOT will remain operational after activation as long as the unit is upright, and enough battery power is available (see the section 3.9.14, for more details).

If the EOT is placed in a horizontal position for at least 60 seconds with no air pressure detected, the unit will enter sleep mode. Once asleep, the EOT will not make or receive radio transmissions and can only be reactivated by pressing the START / ARM pushbutton. However, while in sleep mode, the EOT will report its location to the remote tracking service periodically, based on the programmed call spacing interval (once per day is default) if enough battery power is available. Under optimal conditions, the EOT will report its location for several months, up to one year. All displays and LEDs remain off when the unit is making the call in sleep mode.

The EOT can also be placed in sleep state (if no air pressure is detected) by pressing and holding the START / ARM for 7-10 seconds until PWR OFF? appears on the display. Releasing the pushbutton while this message is displayed will force the EOT to enter sleep state. If the pushbutton is held in the pressed position until the PWR OFF? message disappears from the display (3 seconds), the WIFION? / WIFIOFF? Message will appear. If the pushbutton is pressed until the Wi-Fi message goes away, it cancels the pushbutton operation, and the unit will remain active. The EOT reports the state as **Asleep** to the EOTPH server.

3.5 CHARGING MODE

The EOT supports two types of charging modes, auto or manual. Select a charging mode from the serial terminal interface menu as described in the following procedure:

1. In the serial terminal interface menu, enter option 3 **Configuration menu**.
2. In the Configuration menu, enter option 11 **Set Auto Charging Enable / Disable**.
3. In the Auto Charging Detection Menu, enter 1 for Automatic Charging or 2 for Manual Charging.

Figure 3-3 Main, Configuration, and Auto Charging Detection Menu Options

3.5.1 Auto Charging Mode

The auto charging mode function is described as follows:

- When the EOT is in active mode and connected via the charge port to an external power supply to recharge the internal battery, and auto-charging is enabled, the device will automatically go into charging mode. The EOT reports the state as **Charging** to the EOTPH server. The alphanumeric LED panel also shows the message **CHARGING** at this time.
- When the EOT is in sleep mode and the external power supply is connected, the external charging voltage is detected, and the EOT transitions to charging mode. The EOT will report the state as 'Charging' to the EOTPH server. When the power supply is removed, the EOT transitions back to sleep mode.
- When the EOT is in charging mode and auto-charging is enabled, pressing the START/ARM pushbutton will cause the EOT to wake up and display the rotating messages on the display. Provided the external power remains connected, the EOT will return to charging mode and show a **CHARGING** message after approximately 7-8 seconds.

3.5.2 Manual Charging Mode

The manual charging mode function is described as follows:

- When the EOT is in active mode and connected via the charge port to an external power supply to recharge the internal battery, the EOT will continue to work and charge the battery.
- When the EOT is in sleep mode and connected via the charge port to an external power supply to recharge the internal battery, the EOT will detect the external charging voltage and transition to charging mode. In this state, the EOT is operating with reduced power consumption and the display will show the battery charging progress. The EOT will revert to sleep mode any time the external supply voltage is removed.
- When the EOT is in manual charging mode, the user must press the START/ARM pushbutton to transition to active mode. If the pushbutton is pressed, the battery will continue to charge, even though the EOT will no longer be in charging mode. The EOT reports the state as **Charging** to the EOTPH server.

3.6 DISABLED MODE

The EOT can be disabled so all its functionality is blocked, preventing further use on trains until it is re-enabled. Disabling and re-enabling can be done either through the local user interface, with a computer connected to the EOT, or remotely via a request initiated on the EOT **Phone Home remote tracking service** website.

Whichever method is used, when the EOT receives a disable command, it continues to operate with full functionality until the next time it enters sleep mode. After that, when any attempt is made to "wake-up" the EOT to active mode, the message display will show NO SVC, to indicate the EOT cannot be used, and the EOT will return to sleep mode after approximately 60 seconds. The EOT reports the state as **Disabled** to the EOTPH server.

3.7 MESSAGE TYPES

3.7.1 Blocking Messages

Blocking messages may be initiated manually via a button press or internally by software, depending on specific conditions. Blocking messages will prevent the rotating messages from appearing until the blocking condition is cleared.

Table 3-2 Blocking Messages

Message	Meaning
BRAKING[1]	The emergency valve is open.
BAT DEAD	Remaining battery charge is 5% or less.
PWR OFF?[2]	Power-off request. Release pushbutton to place EOT in sleep mode.
GEN OFF	Air generator has been temporarily disabled. Press the pushbutton to re-enable the generator.
NO SVC	The EOT has been disabled.
WIFION? / WIFIOFF?[3]	Wi-Fi enable / disable request. Release pushbutton to turn Wi-Fi on or off.
INV ID	EOT ID reverted to 00000 indicating memory corruption / loss of configuration.
CAL NOW[4]	Annual calibration is now overdue.

[1] BRAKING will continue to be displayed as long as the emergency valve is open.

[2] Keeping the pushbutton pressed through this message will transition the user to the WIFION? / WIFIOFF? message.

[3] Keeping the pushbutton pressed through this message will cancel the pushbutton requests.

[4] CAL NOW only appears if annual calibration reminders are enabled in configuration.

3.7.2 Rotating Messages

Rotating Messages are displayed on a rotating basis for as long as the display is enabled. The display is not blank between messages.

3.7.2.1 Rotating Messages when Device is Armed

The following messages may be displayed after the EOT is successfully armed with an HOT, as shown in the following table.

Table 3-3 Rotating Messages for Armed Device

Message	Meaning
ARMED[1]	The EOT has been paired with the HOT.
Battery Voltage	Voltage of battery.
Battery Charge[2]	Percent of battery charge available.
Fault Messages[3]	See Table 3-5.
BAT LOW	Remaining battery charge is 30% or less.
CAL SOON[4]	30 days or less until annual calibration is due.

[1] ARMED is displayed to indicate successful completion of an arming sequence with the HOT. Once the EOT goes to sleep, the ARMED message is removed from the display rotation.

[2] Battery Charge percentage may be preceded by an asterisk (*). This indicates the percentage shown is an estimated value. The asterisk is removed the next time the battery reaches a full charge, indicating the reading is accurate.

[3] Multiple faults may be displayed.

[4] CAL SOON only appears if annual calibration reminders are enabled in configuration.

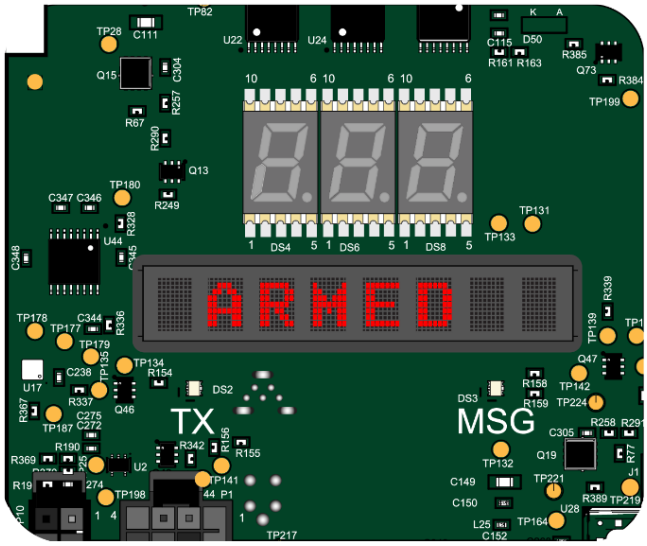


Figure 3-4 Rotating Message Example

3.7.2.2 Rotating Messages when Device is Not Armed

Ready to arm (RDY2ARM) is displayed to indicate that the device is ready to pair.

The following messages may be displayed when the device is not armed, as shown in the following table.

Table 3-4 Rotating Messages for Ready to Arm Device

Message	Meaning
RDY2ARM	The EOT is ready to pair with the HOT.
Battery Voltage	Voltage of battery.
Battery Charge[1]	Percent of battery charge available.
Fault Messages[2]	See Table 3-5.

[1] Battery Charge percentage may be preceded by an asterisk (*). This indicates the percentage shown is an estimated value. The asterisk is removed the next time the battery reaches a full charge, indicating the reading is accurate.

[2] Multiple faults may be displayed.

3.7.3 Fault Messages

EOT subsystems are continuously monitored for proper operation. When a fault is detected, the corresponding indication will be shown on the display. The indication will cycle on the display along with other messages already present in the rotation. Fault indications are persistent and will remain active through power and sleep cycles. A fault indication will be removed from the display message rotation only when the EOT determines the corresponding subsystem is operating correctly.

Table 3-5 Fault Messages

Message	Meaning	Sent to Remote Tracking
DVLV NG	Emergency (dump) valve failure	YES
GVLV NG	Generator stop valve failure	NO
GEN NG	Generator failure	YES
PS-X NG	Power supply circuit failure (external charging path)	YES
PS-G NG	Power supply circuit failure (generator charging path)	YES
XDCR NG	Pressure transducer failure	NO
ACCL NG	Accelerometer failure	NO
HVM NG	High-Visibility Marker failure	YES
TSNS NG	Temperature sensor failure	NO
SD NG	SD card failure	NO
CHGR NG	Charging management circuit failure	NO
GPS NG	GNSS receiver failure	NO
PB NG	Pushbutton failure	NO
OVSP NG	Generator overspin protection failure	NO
RPM NG	Generator RPM sensor failure	NO
EOT NG	EOT failure – not fit for operation	NO
CELL NG	Cell modem failure	NO
RTC NG	Real-time clock failure	NO
DLS NG	Daylight sensor failure	NO

3.7.4 Charging Mode Messages

Charging mode is a rotational message mode that only occurs when the EOT is not active. If the EOT is not active while an external charge is applied, the display will alternate between charging status messages and a blank screen. The messages for auto charging and manual are the same.

The charging messages shown in the following table may be displayed.

Table 3-6 Charging Mode Messages

Message	Meaning
CHARGING	Indication of charging mode
Battery Charge[1]	Current battery charge percentage
CHG DONE	Battery is fully charged
NO BAT	No battery detected (or battery completely depleted)

[1] Battery Charge percentage may be preceded by an asterisk (*). This indicates the percentage shown is an estimated value. The asterisk is removed the next time the battery reaches a full charge, indicating the reading is accurate.

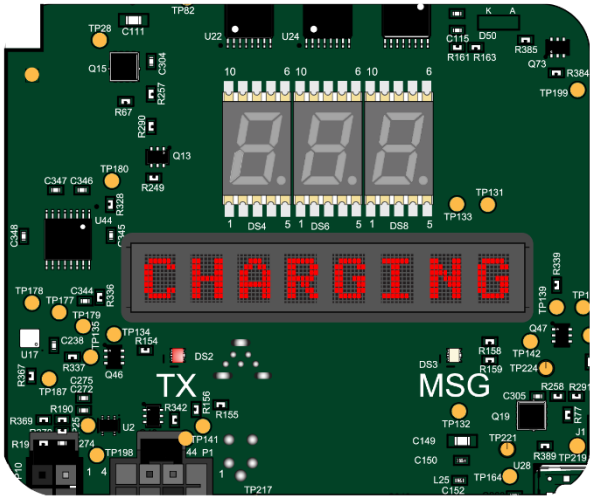


Figure 3-5 Charging Mode Message

3.7.5 Icons

All messages are seven characters or less so that in the 8th character position an informational icon can be displayed. These icons can be displayed with any message in active mode. The following icons may be displayed and are listed in priority order.

Table 3-7 Display Icon Definitions

Icon	Meaning
◊	Transmitting to HOT
⧖	Receiving from HOT
#	Cellular call in progress
+	GNSS has a valid fix
-	EOT is moving
↑	WIFI on

3.8 PUSHBUTTON OPERATION

The START/ARM pushbutton is used to perform different actions and functions depending on when it is pressed and how it is pressed.

3.8.1 Pushbutton Messages

These messages are displayed after the pushbutton is held for a certain amount of time during active mode. Releasing the pushbutton while one of these messages is displayed will carry out the displayed action.

- **PWROFF** – Displayed when the button is pressed and held for 7 – 10 seconds.
- **WIFION** and **WIFIOFF** – Displayed when the button is pressed and held for 11-14 seconds. This functionality can be enabled or disabled in the configuration. If disabled, the WIFION? and WIFIOFF messages do not appear.

If the button is released during a Wi-Fi message, then the action will take place, the message will clear, and the display will go back to its normal rotation.

If the button is released during the power off message (and the EOT is not connected to compressed air), then the EOT will be placed in sleep mode (or charging mode if external power is connected). If the button remains pressed after 10 seconds, the PWROFF message is removed, and the WIFION / WIFIOFF message is displayed. If the button is held longer than 14 seconds, the action is cancelled, the EOT will remain in the active state, and the display will go back to its normal rotation.

3.8.2 Button Press Operation

When using the pushbutton, button press operation is as described in the following table. The TX LED illuminates blue when the pushbutton is pressed to indicate button press operation.

Table 3-8 Button Press Operation

Operation	LED Behavior	Blink Count
Single Press	LED ON for press and OFF on release.	1
Double Press	LED ON for press and OFF on release.	2
Triple Press	LED ON for press and OFF on release.	3
Long Press	LED ON for press and OFF on release.	LED ON for the duration that the user presses the button.

3.8.2.1 Single Button Press

The single button press is recognized as 2 transitions (press-release) detected in a 0 to 4 second window. A single button press can be used to:

- Wake up the EOT if it is in sleep mode.
- Send ARM request to the HOT.
- Turn the display on (if off).
- Restart the generator (if stopped, in EOTs equipped with a generator stop valve).

3.8.2.2 Double Button Press

The double button press is recognized as 4 transitions (press-release-press-release) detected in a 1.5 second window, meaning, the user must press the button twice in rapid succession (similar to a mouse double-click on a computer). The double button press is used to stop the generator (if running, in an EOT equipped with a generator stop valve).

3.8.2.3 Triple Button Press

The triple button press is recognized as 6 transitions (press-release-press-release-press-release) detected in a 2.5 second window. This is reserved for future applications.

3.9 LED BEHAVIOR

Below the 8-character display, there are two LEDs that will illuminate to indicate when the EOT is transmitting a message to the HOT (TX) or receiving a message from the HOT (MSG).

3.9.1 TX LED

The TX LED, shown in the following figure.

- It illuminates red when the EOT is sending messages.
- It illuminates blue when the pushbutton is pressed to indicate button press operation. One blink indicates a single button press, two blinks indicates a double button press, and three blinks indicates a triple button press. The LED will remain lit during a long button press until the button is released.

When a message transmission is in progress and the user presses the pushbutton, both colors can be seen through the transmitting LED.

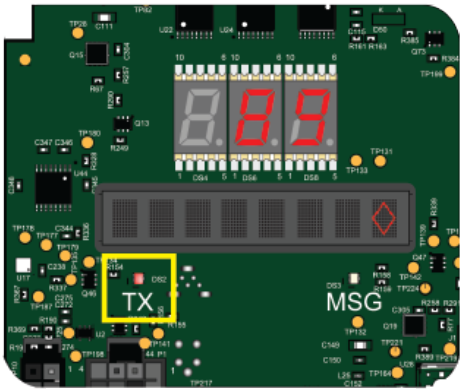


Figure 3-6 Transmitting LED

3.9.2 MSG LED

The MSG LED, shown in the following figure, will illuminate green when the EOT is receiving properly decoded HOT messages.

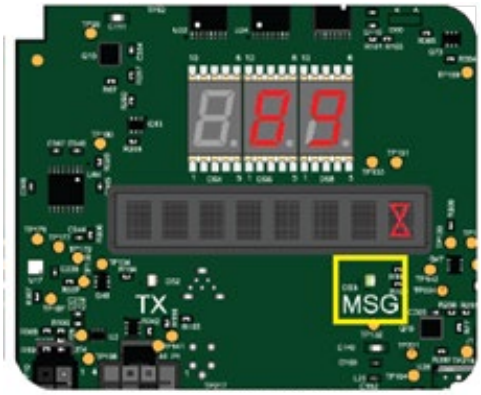


Figure 3-7 Receiving LED

3.10 HIGH-VISIBILITY MARKER

High-Visibility Marker Light (HVML) is a flashing light which is provided on the End of Train Device. In low visibility conditions, the HVML flashes red at a predefined interval and duty cycle. It is visible from long distances (a few miles/kilometers), which indicates the presence of a train.

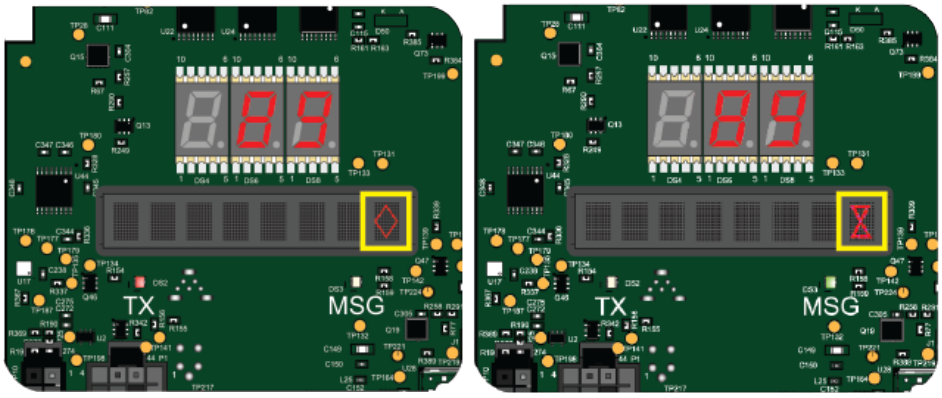
HVML ON: When HVML LEDs flash with predefined frequency and duty cycle.

HVML OFF: When HVML LEDs turn OFF completely.

3.11 EOT SUBSYSTEMS

3.11.1 Radio

While the EOT is active, it will send messages to and receive messages from the HOT. When a message is transmitted, a diamond symbol will appear in the last character position of the Message Display and the red LED labeled "TX" will illuminate. When a message is received and properly decoded, the green MSG LED will illuminate, and an hourglass will be displayed. Any time the START/ARM pushbutton is pressed, an arming request message will be sent to the HOT. The message is sent when the button is released.



Transmitting Symbol Receiving Symbol

Figure 3-8 Messages TX / RX indicators - Transmitting (Left) Receiving (Right)

When no pressure changes are detected, the EOT automatically sends a status update to the HOT approximately once a minute (randomized in the 55-65 seconds range). It also transmits a message when brake pressure changes by 2 PSI or more, or when motion status (moving / stopped), marker light status (on / off), or braking status (normal / emergency) changes.

The EOT recognizes four types of messages from the HOT: status update requests, emergency braking commands, time requests (proprietary) and position requests (proprietary). The EOT responds to status update requests, and braking commands with a confirmation message. It responds to position requests with latitude / longitude messages, and time requests with UTC messages.

3.11.2 Pressure Sensor

The EOT is equipped with a pressure sensor that measures the pressure of the compressed air in the train's brake pipe. It is located close to the air inlet port of the manifold to accurately measure the pressure of the air entering the EOT at the hose connection point.

3.11.3 Emergency (Dump) Valve

When commanded by the HOT, the EOT will open the emergency valve to allow quick venting of the compressed air in the brake pipe to the atmosphere. The emergency valve opens / closes a large port that allows a high flow rate during exhaust. The emergency valve is controlled by a pilot solenoid valve, which is energized to start the emergency activation.

3.11.4 Air Generator

The internal air-powered generator is used to recharge the battery when compressed air is available. Air flowing to the generator passes through a filter, which can be accessed at the bottom of the manifold for cleaning or replacement if required.

3.11.4.1.1 Standard Manifold (A90385 EOT)

The air generator on the standard manifold can be temporarily disabled, if needed. To temporarily disable the air generator:

- Double press the START/ARM pushbutton (two short button presses, in rapid succession within 1.5 seconds) when the air generator is operating.
- Pressing the START/ARM pushbutton once while the generator is disabled will re-enable it.
- If the START/ARM pushbutton is not pushed to re-enable the air generator, the air generator will start automatically after 5 minutes. The generator is automatically re-enabled when the EOT detects motion.

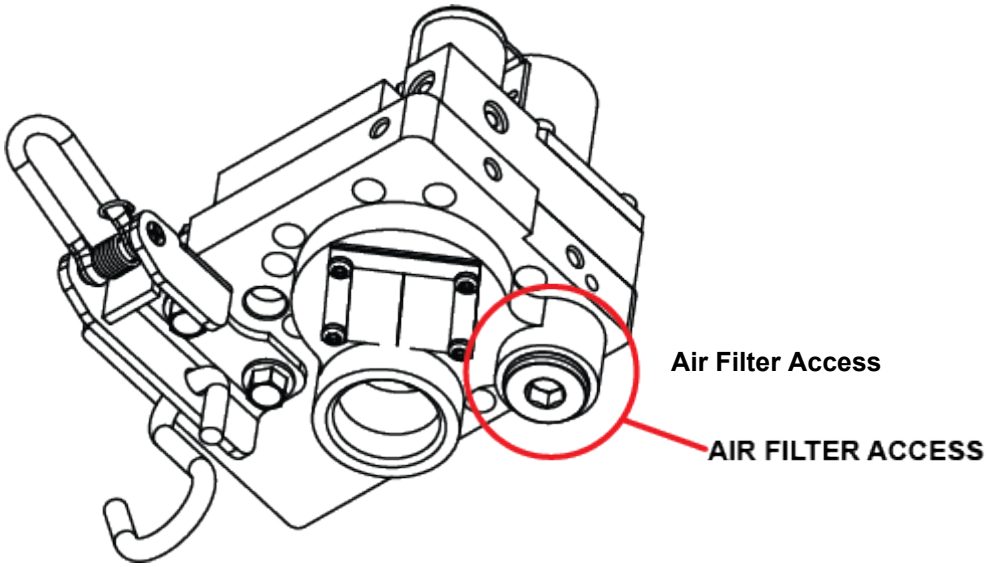


Figure 3-9 Air Filter Access Location (Standard Manifold)

3.11.4.1.2 HP Manifold (A90388 EOT)

The high-powered manifold air generator provides higher current output than the standard manifold air generator. It is not possible to temporarily disable the air generator on the HP Manifold.

Figure 3-10 Air Filter Access Location (HP Manifold)

3.11.5 Generator Stop-Valve (A90385 EOT Only)

A solenoid valve is used to control the flow of air to the generator. When the START/ARM pushbutton is double-pressed to stop the generator, the stop-valve is energized and air flow to the generator is interrupted. When the generator is re-enabled by the user (or conditions dictate that the generator must be re-enabled), the stop-valve is de-energized and air flow to the generator is restored.

3.11.6 High-Visibility Marker and Daylight Sensor

The EOT is equipped with a daylight sensor that determines whether it is day or night. During the day, the HVM is not needed, so it will not flash. The HVM will flash at night. To prevent cycling of the lamp (e.g., interpreting a passing shadow as a nighttime condition), the daylight sensor must sense darkness for approximately 1 minute for the "dark" state to be activated, and daylight for approximately 3 minutes for the "daylight" state to be activated.

When the motion sensor indicates a change from “stopped” state to “moving” state, the marker light will flash for 20 seconds (in daylight, when the marker is normally off). This allows the yard personnel to check the HVM on a departing train.

If the battery status is low (30% or less remaining charge), the HVM will not flash.

3.11.7 Accelerometer

The EOT is equipped with a 3-axis accelerometer that monitors the unit’s attitude (upright or tilted), shock / vibration levels, and assists with motion sensing. When the EOT is tilted, it will enter the sleep state after 60 seconds, as long as it does not sense air pressure. When the EOT is upright, it will not go to sleep on its own, although it may transition to the Napping State (see Section 3.3), or it can be forced to sleep by the user via a long press of the pushbutton, as long as a compressed air is not hooked up to the EOT.

3.11.8 GNSS Receiver

The Trainguard EOT contains a Global Navigation Satellite System (GNSS) receiver to determine its location. When the GNSS has a valid fix on the location, a plus sign (+) is shown in the 8th character position of the display. The GNSS receiver contains a real-time clock that is backed up by the battery as well as a supercapacitor. The EOT monitors the GNSS antenna status for shorts, as well as for proper connection between the GNSS receiver and the antenna, which is located under the clear dome, at the top of the electronic tray assembly.

The EOT uses the GNSS receiver to determine its position and then transmits this data to the EOT Phone Home tracking server, via a cellular modem. For more information, refer to Section 3.11.11, *Locator System*.

3.11.9 Motion Detection

One of the status indications provided by the EOT is motion detection (moving / stopped). The motion detection sensor functions by using GPS, accelerometer, and pressure readings to detect motion.

The EOT will detect the presence of movement (from a no motion to motion state) when the following conditions are met:

- EOT is in Awake Mode.
- Pressure is greater than 45 PSI.
- GPS speed is greater than 3.5 KPH for a consecutive 10 seconds with a valid GNSS fix.
- Accelerometer indicates motion for a consecutive 10 seconds.

The EOT will indicate a stopped status (from a motion to no motion state) when the following conditions are met:

- EOT is in awake mode.
- GPS speed is less than 3.5 KPH for a consecutive 20 seconds with a valid GNSS fix.
- Accelerometer also indicates no motion for a consecutive 25 seconds.

When the EOT determines it is moving, the plus sign (+) changes to a minus sign (-) in the 8th character position of the display. Additionally, when motion is detected:

- the display lights up (if dark) for 20 seconds.
- the EOT reports the state as **Deployed** to the EOTPH server.
- the HVM marker light will flash for 20 seconds (in daylight, when the marker is normally off).

The accelerometer in the EOT provides backup motion detection in the event that the GNSS signal is lost after motion is initially detected.

3.11.10 Cellular Modem

The EOT is equipped with a multi-band 4G-LTE cellular modem, which connects periodically to the RailFusion EOT Phone Home (EOTPH) server to report the EOT's geographic location, as well as status and diagnostic information. When the modem is performing a call to the server, a pound sign (#) is shown in the 8th character position of the display. Refer to Section 3.11.11, *Locator System*, for further information on the EOTPH server.

The EOT will call home at every state change. The following states are reported to the server:

- Awake
- Charging
- Deployed
- Disabled
- Emergency
- Sleeping

The EOT sends a position message with reason code ACKNOWLEDGE after receiving and successfully interpreting any command sent by the EOTPH. For example:

- For over the air software update commands, the EOT calls EOTPH and sends a position message with reason code ACKNOWLEDGE, once the new software is successfully programmed into the CPU FLASH. The software is only applied to the device once it is rebooted.
- For **Enable** commands, the EOT calls EOTPH and sends a position message with reason code ACKNOWLEDGE.
- For **Disable** commands, the EOT calls EOTPH and sends a position message with reason code ACKNOWLEDGE.

During calls to EOTPH, the EOT captures all responses provided by EOTPH in the event log.

3.11.11 Locator System

The EOT reports position, status, and diagnostic information to the RailFusion EOT Phone Home remote tracking service (www.eotph.com). Access to this website and data feed is controlled by Siemens Mobility, Inc. and is limited to owners and operators of Siemens Mobility EOT devices or other licensed EOT devices.

When EOT tracking is enabled (via subscription service), the EOT will call the server at pre-configured intervals. The default schedule is every two hours when the EOT is in active or charging modes, and every 24 hours when the EOT is in sleep mode. The schedule may vary depending on the user's needs and level of service.

There are three possible user options, available in the configuration menu, to determine how the EOT will report its position to the EOT Phone Home tracking server. These are as follows:

1. **Send last known good fix**: If the GNSS has a valid fix, it sends the current location, otherwise it sends the last known good location.
2. **Send the current fix**: The EOT will send the current location irrespective of a GNSS fix.
3. **Do not send invalid fix**: The EOT will only report the location if it has a valid GNSS fix.

The following figure shows the location of the user options in the configuration menu.

Figure 3-11 GNSS Receiver User Options

3.11.12 SD Card

The EOT stores all generated logs on an SD card. The logs can be accessed and downloaded via the serial terminal interface, via the Wi-Fi Web User Interface, or via the USB interface. The USB connection is available on the backside of the board once the clear dome is removed (see Section 4.4 for further information).

The EOT creates a new log file any time the date changes or a total power loss occurs. The file name displays as shown in the following example: 00099-2022-05-11-V54-000.csv

The file name contains the following information:

- reset counter (00099)
- file date (2022-05-11)
- firmware version (V54)
- firmware update count (000)

3.11.13 Low Power Microprocessor (LPuP)

The EOT contains a second microprocessor that consumes very low power. Whenever the EOT goes to sleep, control is transferred to the low power microprocessor (LPuP) and the main CPU, and its various subsystems are powered off. The LPuP will power up the main CPU when it is time to make a call to the EOT Phone Home tracking service, or when a user input is detected.

3.11.14 Battery

The EOT contains a Lithium Iron Phosphate ($LiFePO_4$) battery pack made up of 12 individual cells with total capacity of 4500 mA-h. The nominal voltage is 12.8 V, with initial voltage of 13.2 V on a fully charged battery. When fully discharged, the battery will measure 10 V.

If the battery charge is above 30%, the battery status is “Good.” When battery charge is 30% or less, the battery status is “Low.” The battery status is “Dead” when remaining charge is 5% or less. The EOT reports battery status to the HOT.

The napping state (see Section 3.3) assists in preserving battery charge to improve the life of the battery.

NOTE

NOTE

Battery status is sent to the HOT as a percentage of Charge Used (CU). Charge Used values indicate the percentage of the total battery capacity that has been used (CU = 0 indicates a fully charged battery, CU = 100 indicates a fully discharged battery).

Conversely, the battery charge information that appears on the EOT display indicates the percent of battery charge remaining (e.g., 100% indicates a fully charged battery).

3.11.15 Recharging the Battery

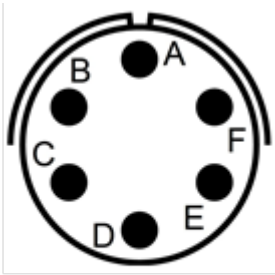
The EOT may be charged using any power supply in the range of 10 – 25 volts connected to the charging port. An appropriate charge-port connector is required to allow an interface between the EOT and the charging device. The EOT should be charged prior to deployment. As a rule of thumb, recharge the battery at an initial terminal whenever remaining charge is below 70%.

If the EOT is active and Auto Charging is enabled, when the external charging voltage is detected, the EOT will transition to Charging mode. When the power supply is removed, the EOT transitions to Sleep mode.

Figure 3-12 Battery Charging Cord

The pin assignments for the charging port connector are shown in the following table, along with the connector diagram.

Table 3-9 Charge Port Details



MS3112E-10-6S

Pin	Signal / Function
A	Radio Programming Port
B	EOT TXD data (RS232) to computer
C	BATT-
D	Radio RX Audio output
E	CHARGER+
F	EOT RXD data (RS232) from computer

3.12 PROCEDURE TO ARM THE EOT/HOT SYSTEM (STANDARD AAR-COMPATIBLE HOT ONLY)

Before arming the EOT/HOT system, verify that the EOT and HOT are operational.

If the display on the EOT is blank, press the START/ARM pushbutton to power-up the EOT (if sleeping), or to re-illuminate the display (if already active with the display dark).

The arming sequence for the HOT is provided in the following procedure:

1. The RDY2ARM message, shown in the following figure, will display on the EOT to indicate that the EOT is ready to pair with the HOT.

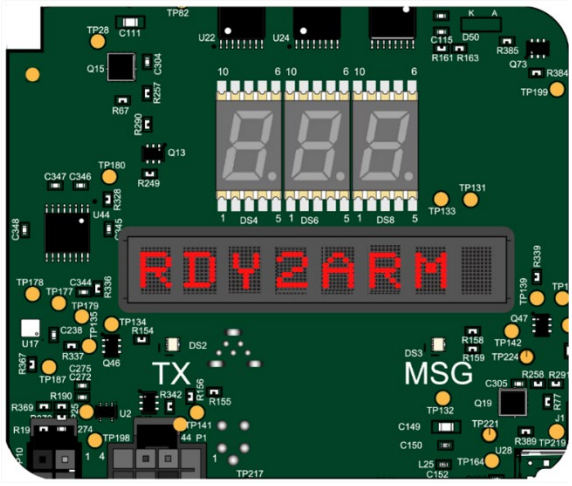


Figure 3-13 RDY2ARM Message on EOT

2. On the head-of-train device, set the ID number to match that of the EOT.
3. After confirming that the ID number entered in the HOT matches the ID number of the EOT, press the START/ARM pushbutton on the EOT to initiate the arming process.

4. Verify that the EOT transmitted the arming request message by observing that the red TX LED blinks (and a diamond symbol appears on the display). The HOT or locomotive computer screen will display the **Arm Now** message.
5. Press the COMM TEST/ARM pushbutton on the HOT within 5 seconds to complete the arming process. The green MSG LED on the EOT blinks (and an hourglass symbol appears on the display) to indicate that the EOT received a reply from the HOT. The “ARM RPLY” message, shown in the following figure, will display on the EOT.

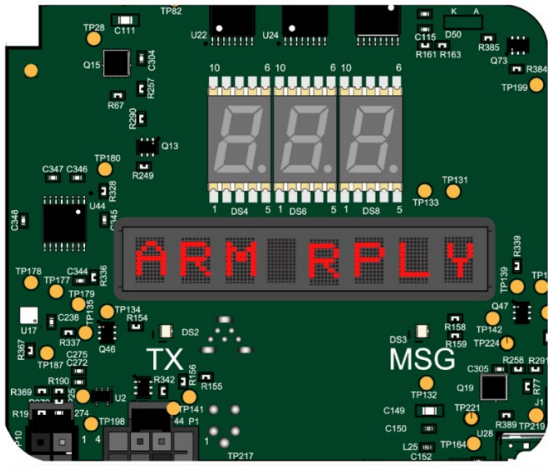


Figure 3-14 ARM RPLY Message on EOT

6. If arming is successful, the EOT displays “ARMED”, as shown in the following figure. The HOT should display a similar message and show "Emergency Enabled".

NOTE

NOTE

If arming fails after several attempts, refer to the Troubleshooting section of this manual (Section 6.0).

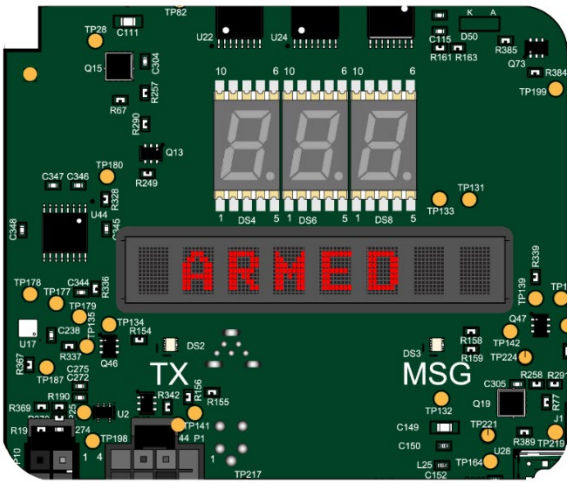


Figure 3-15 EOT Armed

3.13 PROCEDURE TO ARM THE EOT/HOT SYSTEM (NORFOLK SOUTHERN RED HOT ONLY)

The arming sequence for the HOT for Norfolk Southern Red Hot is provided in the following procedure:

1. Enter the EOT ID into the HOT and press the COMM TEST/ARM pushbutton.
2. The HOT should display an "ARM NOW" message.
3. Within 5 minutes, press the START/ARM pushbutton on the EOT to complete the arming process. The EOT will display the "ARMED" message shown in the previous figure, and the NS Red HOT will display "Emergency Enabled".

SECTION 4 USER INTERFACES

The EOT has four methods of user interaction:

- Local User Interface (displays and pushbutton)
- Serial Terminal Interface
- Wi-Fi Interface
- USB Interface.

Each of these methods have varying levels of EOT access, which will be discussed in this chapter.

4.1 LOCAL USER INTERFACE (DISPLAYS, BUTTON)

See Section 3.0 for details on the display: startup, messages, icons, and operation modes.

4.2 SERIAL INTERFACE

To access the serial user interface available on the EOT, the user must connect a computer to the EOT with a serial cable and a suitable charge port adapter (refer to Section 4.5).

Follow these steps to access the serial interface:

1. When using the serial terminal interface, insert one end of a straight serial RS232 cable into the host computer (or USB-to-serial adapter) and the other end into the adapter (P/N NYK: Z680399510001) plugged into the EOT.
2. Turn on the host computer and power up the EOT in the vertical position. Running a serial terminal emulation utility on the computer allows the user to communicate with the EOT and access the built-in menu system. There are several terminal emulation programs available for use. Siemens recommends Tera Term, which is a free, unlicensed, open-source and fully supported Windows-based program.
3. Once the Tera Term program has been downloaded and installed on the computer, launch the Tera Term program.
4. Ensure that the serial port connected to the EOT is selected in the New Connection window. In this example: COM1.

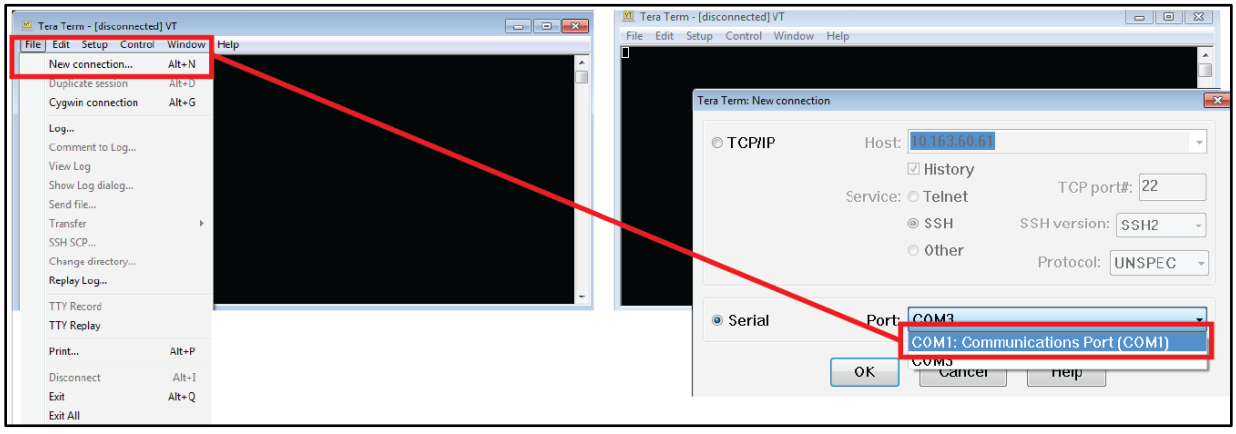


Figure 4-1 Select the Correct COM Port

5. Use the Setup menu to access the serial port submenu and make sure the serial communication parameters are properly configured as follows:
    - Speed: 115,200
    - Data: 8 bit
    - Parity: none
    - Stop bits: 1
    - Flow control: none
6. Once the terminal interface is configured, press **Enter** to access the EOT main menu. The main menu is shown in Figure 4-2. It includes an informational header indicating the versions of software currently installed in the EOT.
7. Select a menu item by typing the number (or character) shown to the left of the item description and pressing **Enter**. While navigating the menu structure, pressing **Enter** will refresh the current level menu on the screen. Table 4-1 lists all the menu options available via the serial terminal interface. In some cases, items listed in the table are examples or what may be displayed on the computer screen. Actual content may vary.

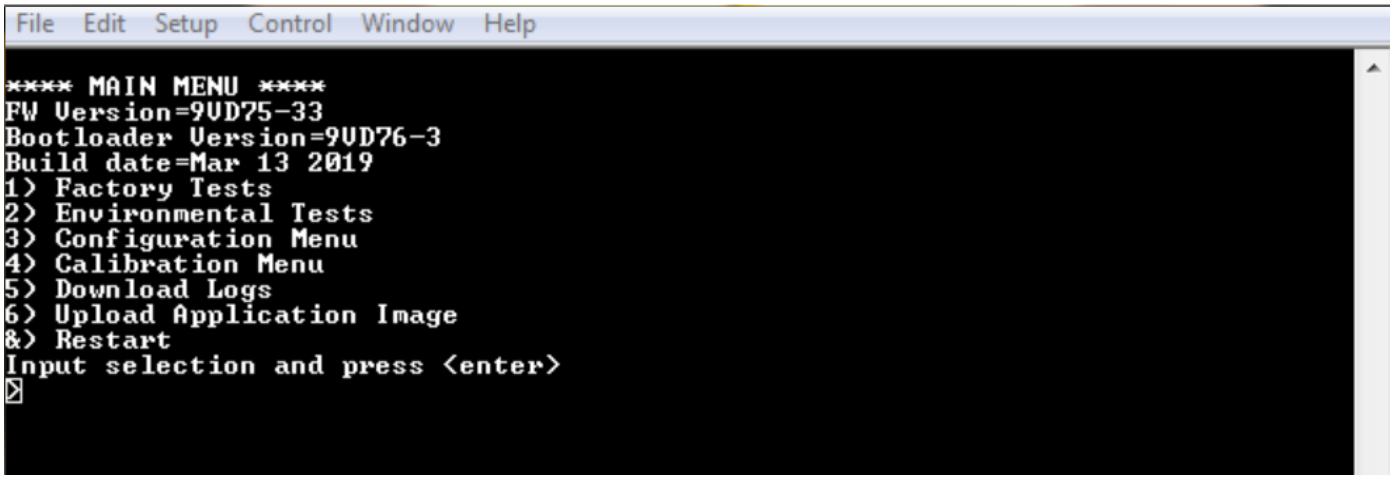


Figure 4-2 Serial Terminal Interface Main Menu

Table 4-1 Serial Terminal Interface Menus

Base Menu Items	Submenu Items
Main Menu	
**** MAIN MENU **** FW Version =9VD75-XX Bootloader Version =9VD76-X Build date =MM-DD-YYYY 1) Factory Tests 2) Environmental Tests 3) Configuration Menu 4) Calibration Menu 5) Download Logs 6) Upload Application Image 7) Restart Input selection and press <enter>	
1) FACTORY TEST MENU	
*** FACTORY TESTS MENU *** 1) All Tests – Future 2) GNSS Monitor 3) Accelerometer Monitor 4) SD Card Check 5) Display Check 6) Daylight Sensor Monitor 7) Cellular Modem Test 8) Button Monitor 9) Valve Check 10) UHF Message Monitor 11) UHF Radio Test 12) Display Last Voltage Readings 13) Display Last Charger Readings 14) Beacon Check 15) Generator Check 16) Deploy Simulation	**All Tests** *** Run All Factory Tests *** 1) Begin Testing X) Exit

Base Menu Items	Submenu Items
17) Temperature Check 18) Wi-Fi Test 19) LPuP Test 20) UHF Print data X) Exit Menu Input selection and press <enter>	
	GNSS Test *** GNSS Test *** 1) Turn on GNSS Monitoring 2) Turn off GNSS Monitoring X) Exit
	Accelerometer Test *** Accelerometer Test *** 1) Enable Accelerometer Monitoring 2) Disable Accelerometer Monitoring X) Exit
	SD Card Test *** SD Card Test *** 1) Run SD Card Test X) Exit
	Display Check *** Display Test *** 1) Turn on all displays 2) Turn off all displays X) Exit
	Daylight Sensor Test *** Daylight Sensor Test *** 1) Start Daylight Sensor Monitoring 2) Stop Daylight Sensor Monitoring X) Exit
	Cellular Modem Test *** Cellular Modem Test *** *** WARNING: The cellular antenna must be connected to run this test *** 1) Start Cellular Modem Test (wait for GNSS fix) 2) Start Cellular Modem Test (send message without GNSS fix) 3) Stop Cellular Modem Test 4) Power on modem without placing a call 5) Shut off power to cell modem during call X) Exit

Base Menu Items	Submenu Items
	Button Monitor Test *** Button Test *** 1) Enable Button Monitoring 2) Disable Button Monitoring X) Exit
	Valve Test *** Valve Test *** 1) Energize generator valve solenoid (ON) 2) De-energize generator valve solenoid (OFF) 3) Energize dump valve solenoid (ON) 4) De-energize dump value solenoid (OFF) X) Exit
	UHF Message Monitor *** UHF Message Monitor *** 1) Turn message monitoring on 2) Turn message monitoring off x) Exit
	UHF Radio Test *** UHF Radio Test *** 1) Send a 5-second MARK (1200 Hz) with PTT 2) Send a 5-second SPACE (1800 Hz) with PTT 3) Send a continuous MARK (1200 Hz) without PTT 4) Send a continuous SPACE (1800 Hz) without PTT 5) Stop sending tone X) Exit
	Display Last Voltage Readings *** Voltage Readings *** Supply 3.3V = 3.31V Supply 3.8V = 3.81V Supply 5.0V = 5.02V Supply 12.0V = 13.62V Supply Ext Input = 23.73V Supply Ext Reg = 16.03V Supply Gen Input = 0.00V Supply Gen Reg = 0.00V Supply Cell (3.8V) = 3.82V Supply GNSS (3.3V) = 3.27V Supply UHF1 = 15.79V HVM voltage (voltage) = 0.00V HVM current (voltage) = 0.00V Type x to return to the previous menu.

Base Menu Items	Submenu Items
	Display Last Charger Readings *** Charger Information *** Batt% = 100 Vbat = 14.37V Vin = 15.73V Vsys = 15.67V Ibat = 0.01A Iin = 0.12A Die Temp = 110.1F Charger State = 0x0040 System Status = 0x22C7 Charge Status = 0x0001 Type x to return to the previous menu.
	Beacon Check *** Beacon Test *** 1) Flash beacon on X) Exit
	Generator Check *** Generator Information *** Vgen = 0.00V Vgen_reg = 0.00V BPP = 0 RPM = 0 Type x to return to the previous menu.
	Deploy Simulation Check *** Motion Simulation Test *** 1) Turn on Deploy Simulation 2) Turn off Deploy Simulation X) Exit
	Temperature Check *** Temperature Information *** Temp (F)= 90 Type x to return to the previous menu.
	Wi-Fi Test *** Wi-Fi Test *** 1) Turn Wi-Fi on 2) Turn Wi-Fi off X) Exit
	LPuP Test *** LPuP Test *** 1) Start LPuP Test X) Exit

Base Menu Items	Submenu Items
	Print UHF data ***Print UHF Data Test *** 1) Enter UHF TX Raw Data 2) Enter UHF RX Raw Data X) Exit
2) ENVIRONMENTAL TEST MENU	
*** Environmental Tests Menu *** 1) Full Test X) Exit Menu Input selection and press <enter>	
3) CONFIGURATION MENU	***NOTE:** Parameters with an asterisk are only available with customer password entered. Default customer password is: Customer
*** Configuration Menu *** 1) Display Parameters 2) Enter Password 3) Set Calibration Date 4) Set Calibration Reminder Enabled 5) Set Calibration Technician 6) Set Calibration Location 7) Set Battery Replacement Date 8) Set Battery Replacement Technician 9) Set Battery Replacement Location 10) Set EOT Enable/Disable 11) Set Auto Charging Detection Enable/Disable* 12) Set Board Serial Number 13) Set Board Model Number 14) Set Pipe Configuration 15) Set Railroad ID 16) Set EOT ID* 17) Set Calibration for Light Sensor Light-to-Dark	

Base Menu Items	Submenu Items
18) Set Calibration for Light sensor Dark-to-Light 19) Set call spacing Wake period 20) Set call spacing Sleep period 21) Set Battery Readiness Enable/Disable 22) Set Battery Readiness Text for Ready 23) Set Battery Readiness Text for Not Ready 24) Set Wi-Fi Password 25) Set Wi-Fi Enable/Disable 26) Set HVM Enable/Disable* 27) Set Generator Enable/Disable* 28) Set Generator Valve Enable/Disable* 29) Set Alphanumeric Display Timeout 30) Set UHF Radio Disable* 31) Download/Upload Configuration 32) Select Measurement System Type 33) Select GNSS Fix option to send EOTPH 34) Select UHF Frame Type 35) Select EOT board series Type X) Exit Menu Input selection and press <enter>	
	Display Parameters CONFIGURATION PARAMETERS Board Serial Number: 90396D0073 Model Number: 90385-0111 Pipe Configuration: SINGLE Railroad ID: SIE EOT ID: 10118 Daylight Sensor Light-to-Dark Value: 40 Daylight Sensor Dark-to-Light Value: 45 Call Spacing Wake Time: 120 Call Spacing Sleep Time: 120

Base Menu Items	Submenu Items
	Battery Readiness Flag: 1 Battery Readiness Text for Ready: BAT = OK Battery Readiness Text for Not Ready: BAT=NOK Calibration Date: 01-01-2018 Calibration Set: Disabled Calibration Technician: NA Calibration Location: NA Battery Replacement Date: 01-01-2018 Battery Replacement Technician: NA Battery Replacement Location: NA Wi-Fi Password: SiemensEOTwifi Wi-Fi___33 Enabled: TRUE EOT Enabled: TRUE Generator Exists: TRUE Generator Valve Exists: TRUE HVM Exists: TRUE Alpha Display Timeout: 5 UHF Radio: Enabled Measurement System Type: Imperial Miss Event Count: 0 GNSS Invalid Fix Configured: Send Last Non-Good Fix Auto Charging Detection: True Type x to return to the previous menu.
	Enter Password Enter Password or X to return to the previous menu.
	Set Calibration Date Enter a date in MM-DD-YYYY format or X to exit.
	Set Calibration Reminder Enabled CALIBRATION ENABLED MENU 1) Enable Calibration Date Check for 1 Year 2) Disable Calibration Date Check for 1 year plus shelf period 3) Disabled Calibration Date Check X) Exit Menu
	Set Calibration Technician Enter text for Calibration Technician (up to 20 characters) or X to exit.
	Set Calibration Location Enter text for Calibration Location (up to 20 characters) or X to exit.
	Set Battery Replacement Date Enter a date in MM-DD-YYYY format or X to exit.

Base Menu Items	Submenu Items
	Set Battery Replacement Technician Enter text for Battery Replacement Technician (up to 20 characters) or X to exit.
	Set Battery Replacement Location Enter text for Battery Replacement Location (up to 20 characters) or X to exit.
	Set EOT Enable/Disable EOT ENABLE MENU 1) Enable EOT 2) Disable EOT X) Exit Menu
	Set Auto Charging Detection Enable / Disable* 1) Automatic Charging 2) Manual Charging 3) EOT Boot String X) Exit
	Set Board Serial Number Enter Board Serial Number or x to return to the previous menu:
	Set Board Model Number Enter Model Number or x to return to the previous menu:
	Set Pipe Configuration Select Pipe Configuration 1) Single Pipe 2) Dual Pipe (not currently available) X) Exit
	Set Railroad ID Enter Railroad (up to 7 characters) ID or x to return to the previous menu:
	Set EOT ID Enter EOT ID or x to exit
	Set Calibration for Light Sensor Light-to-Dark Enter count value for light-to-dark transition or x to exit
	Set Calibration for Light sensor Dark-to-Light Enter count value for dark-to-light transition or x to exit
	Call Spacing Wake Period Enter Wake Call Spacing (in minutes) or x to exit
	Set Call Spacing Sleep Period Enter Sleep Call Spacing (in minutes) or x to exit

Base Menu Items	Submenu Items
	Set Battery Readiness Enable / Disable READINESS FLAG 1) Enable Readiness Screen 2) Disable Readiness Screen X) Exit
	Set Battery Readiness Text for Ready Enter text for battery ready (up to 8 characters) or x to exit
	Set Battery Readiness Text for Not Ready Enter text for battery NOT ready (up to 8 characters) or x to exit
	Set Wi-Fi Password Enter a password (limit up to 30 characters)) or x to exit
	Set Wi-Fi Enable / Disable WIFI ENABLE MENU 1) Enable Wi-Fi capability 2) Disable Wi-Fi capability X) Exit
	Set HVM Enable / Disable* HVM ENABLE MENU 1) Enable HVM 2) Disable HVM X) Exit Menu
	Set Generator Enable / Disable* GENERATOR ENABLE MENU 1) Enable Generator 2) Disable Generator X) Exit Menu
	Set Generator Valve Enable / Disable* GENERATOR VALVE ENABLE MENU 1) Enable Generator Valve 2) Disable Generator Valve X) Exit Menu
	Set Alpha-Numeric Display Timeout Set Alpha-Numeric Display Timeout (in minutes) or x to exit

Base Menu Items	Submenu Items
	Set UHF Radio Disable* DISABLE UHF RADIO MENU 1) Enable UHF Radio 2) Disable UHF Radio temporarily (until reset) 3) Disable UHF Radio (persists after reset) X) Exit Menu
	Download / Upload Configuration ***** Download / Upload Configuration***** 1) Download Configuration 2) Upload Configuration X) Exit Menu
	Select Measurement System Type *** Select Measurement System Type*** 1) Imperial 2) Metric X) Exit Menu
	Select GNSS Fix option to send EOTPH ***Set GNSS option in case of invalid fix*** 1) Send last known good fix 2) Send the current fix 3) Do not send invalid fix X) Exit
	Select UHF Frame Type ***Select UHF Frame Type*** 1) 1 block 2) 3 block X) Exit Menu
	Select EOT board series Type ***Select EOT series Type*** 1) D series EOT 2) E series EOT X) Exit Menu
4) CALIBRATION MENU	
*** CALIBRATION MENU *** 1) Calibrate Primary Pressure Transducer X) Exit Menu Input selection and press <enter>	
5) DOWNLOAD LOGS MENU	

Base Menu Items	Submenu Items
*** LOG MENU *** Select an option: 1) 00099-2022-05-11-V54-000.csv 2) 00099-2018-01-02-V54-000.csv 3) 00098-2022-05-11-V54-000.csv 4) 00098-2018-01-02-V54-000.csv 5) 00097-2022-05-11-V54-000.csv 6) 00096-2022-01-02-V54-000.csv 7) 00096-2022-05-11-V54-000.csv 8) 00096-2018-01-02-V54-000.csv 9) 00095-2022-05-11-V54-000.csv 10) 00095-2018-01-02-V54-000.csv 11) 00093-2018-01-02-V54-000.csv 12) 00092-2018-01-02-V54-000.csv U) Scroll Up D) Scroll Down X) Exit	
6) UPLOAD APPLICATION IMAGE MENU	
*** UPLOAD IMAGE MENU *** 1) Upload an image X) Exit Menu Input selection and press <enter>	
&) RESTART MENU	
&) Restart	

4.3 WI-FI INTERFACE

The Trainguard EOT Wi-Fi function is enabled by default at the factory. This means the EOT is capable of creating an ad-hoc Wi-Fi network that a computer or other Wi-Fi enabled device can join. To reduce power consumption and limit potential interface with existing Wi-Fi networks at a location, the EOT Wi-Fi network remains powered off until it is turned on by the user. Once it's been turned on, the Wi-Fi network will be available for use until it's turned off, either by the user, or automatically any time the EOT is placed in sleep mode or reset.

To successfully connect a user's device to the EOT Wi-Fi network, it is strongly recommended that the automatic detect proxy settings be disabled, especially in Google Chrome™. It is possible, when using Google Chrome™, the cache data may be displayed instead of new responses from the EOT. Therefore, if issues are being experienced, clear the cache and restart/reload the webpage. Be aware that once the EOT Wi-Fi is disabled, it may take up to two minutes for it to drop off the list of available network connections.

Only one connection to the EOT is allowed at a time. If the EOT is connected to a Windows® computer and the user attempts to connect to it with a Macintosh®, the connection will continue to spin and never timeout. If the user is connected to the EOT on a Macintosh® and then tries to connect to the EOT on a Windows® computer, it times out and states "unable to connect."

When the time to call home occurs while connected to Wi-Fi, the Wi-Fi cannot respond, so a timeout happens and the interface may recover or may not depending on how long the call takes, which depends on GNSS reception.

4.3.1 Turn on Wi-Fi

There are two ways to turn on Wi-Fi: by using the serial terminal interface or by using the pushbutton, as described in the following sub-sections.

4.3.1.1 Serial Terminal Interface

1. Go to the Factory Tests menu.
2. Enter “18” for the Wi-Fi Test menu.
3. Enter “1” to turn Wi-Fi on.

4.3.1.2 Pushbutton

1. While the EOT is in active mode, hold the Pushbutton for 11-14 seconds.
2. The message WIFION? will appear on the display as shown in the following figure. Releasing the button during this message will turn on the Wi-Fi.

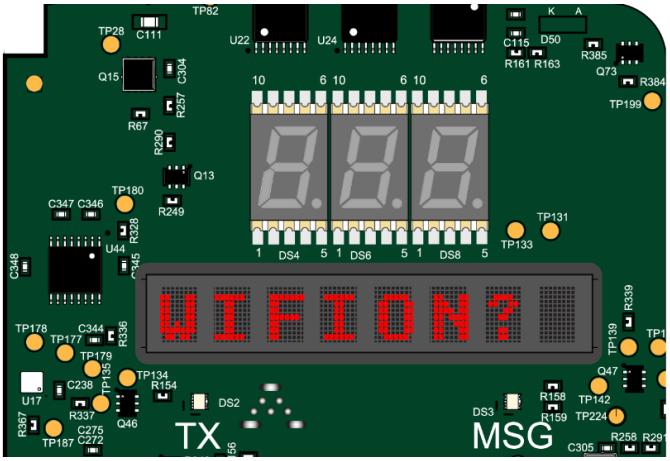


Figure 4-3 Pushbutton Wi-Fi On Message

4.3.2 Connect to EOT Web Server

1. Once Wi-Fi is turned on, use a Wi-Fi enabled device to scan for available Wi-Fi networks.
2. The name of the EOT Wi-Fi network will be EOT_XXXXX where XXXXX is the ID number of the EOT.

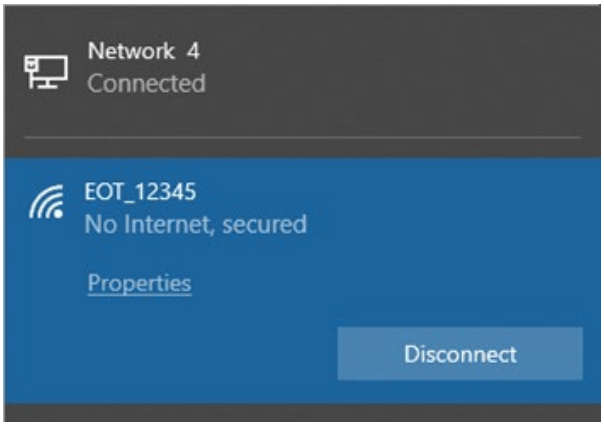


Figure 4-4 EOT Wi-Fi Identification

3. Connect to the EOT network and enter the required password. The default Wi-Fi password, which is programmed at the factory is **SiemensEOTwifi**.
4. Open an internet browser (Google Chrome™ is the recommended browser).
5. In the browser, navigate to http://192.168.10.1:8022. This is the IP address and port of the EOT web server.
6. When the home page loads, the browser has successfully connected to the web server.

4.3.3 Web Page Overview

4.3.3.1 Home

The Home page is the default web page when first connecting to the EOT web server. The user can navigate to this page and any other using the navigation menu to the left of the web page content.

Figure 4-5 EOT Wi-Fi Home Page

4.3.3.1.1 Navigation Menu

The navigation menu appears on every web page to the left of the content. It is used to navigate between the different pages of the EOT web server. The user interacts with the navigation menu by clicking on the name of the page they would like to request.

Figure 4-6 Web Page Navigation Menu

4.3.3.2 Monitor

The Monitor page shows system voltages, currents, and temperatures, as well as accelerometer readings. The information is updated automatically approximately every second. Before a user can navigate away from this page, the user must click the **Stop Updates** button at the bottom of the web page. Until then, the directory will be greyed out and unavailable.

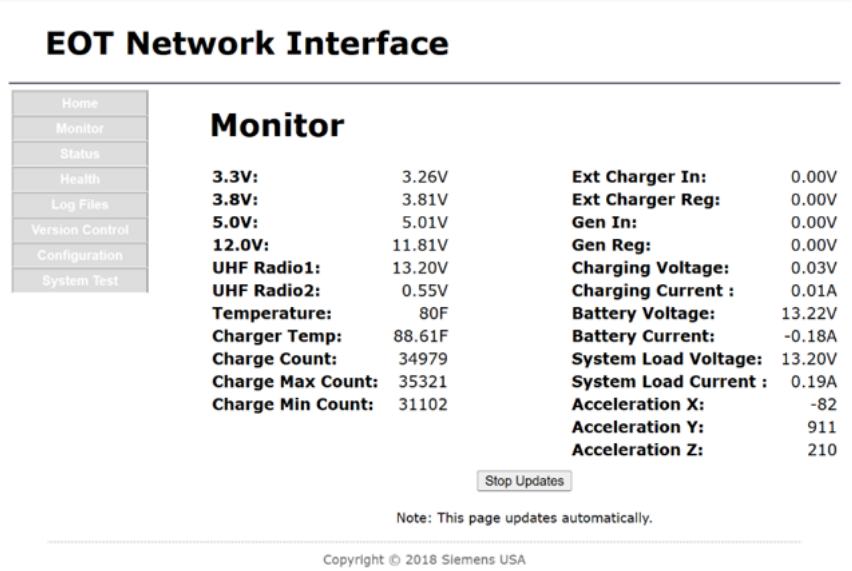


Figure 4-7 EOT Wi-Fi Monitor Page

4.3.3.3 Status

The Status page shows the state of various conditions that are monitored by the EOT's internal sensors. The information is updated automatically approximately every second. Before the user can navigate away from this page, the user must click the **Stop Updates** button as the bottom of the web page. Until then, the directory will be greyed out and unavailable.

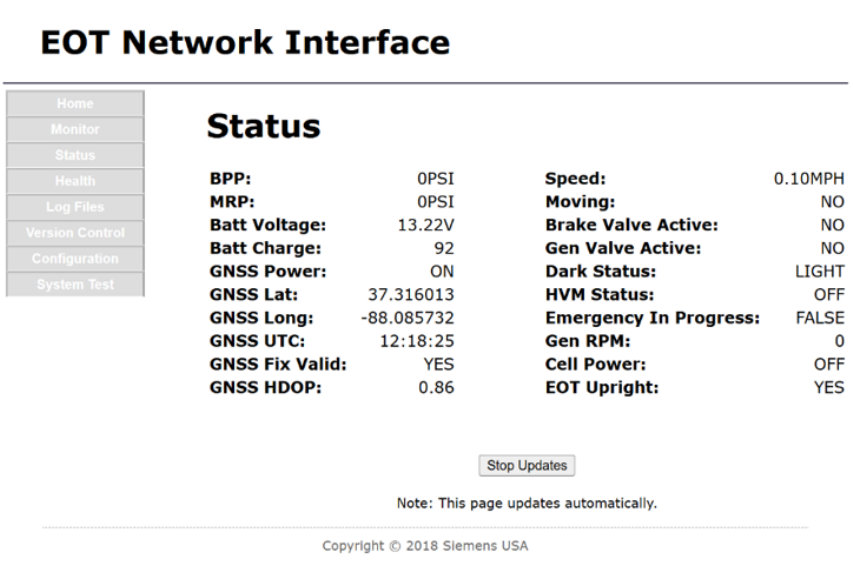


Figure 4-8 EOT Wi-Fi Status Page

4.3.3.4 Health

The Health page shows the health status of the EOT's hardware subsystems. The information is updated automatically approximately every second. Before the user can navigate away from this page, the user must click the **Stop Updates** button at the bottom of the web page. Until then, the directory will be grayed out and unavailable.

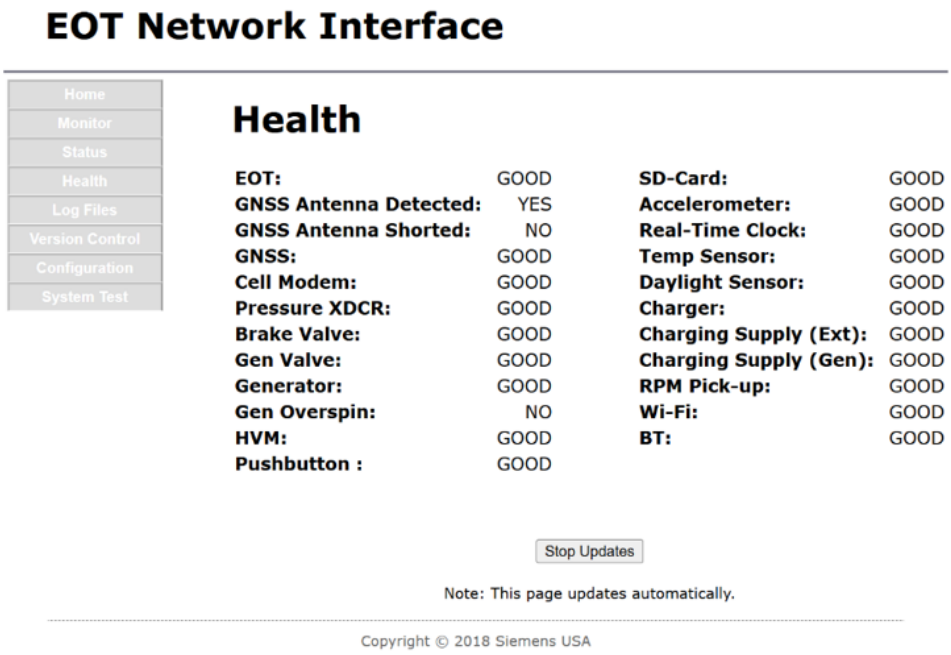


Figure 4-9 EOT Wi-Fi Health Page

4.3.3.5 Log Files

The Log Files page shows a list of log files that are stored on the EOT in reverse chronological order (from most recent to oldest). The user can download a log by clicking on the file name.

Only one file should be downloaded at a time. Allow the download of a file to complete before requesting the download of the next file.

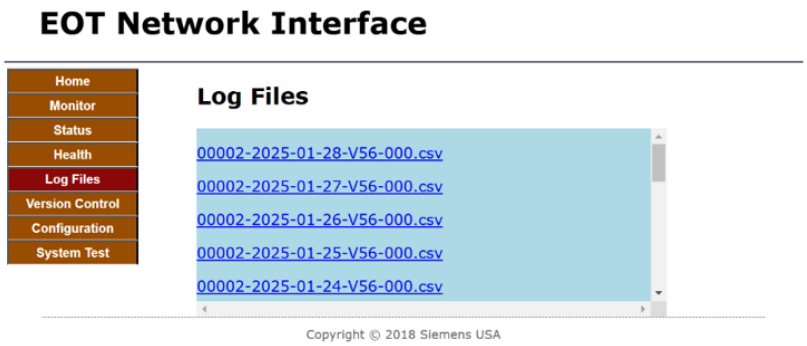


Figure 4-10 EOT Wi-Fi Log Files Page

4.3.3.6 Version Control

The Version Control page shows information related to the application running in the EOT. Click the **Update** button at the bottom of the page to get to the Firmware Update page where the EOT application can be updated via the web browser.

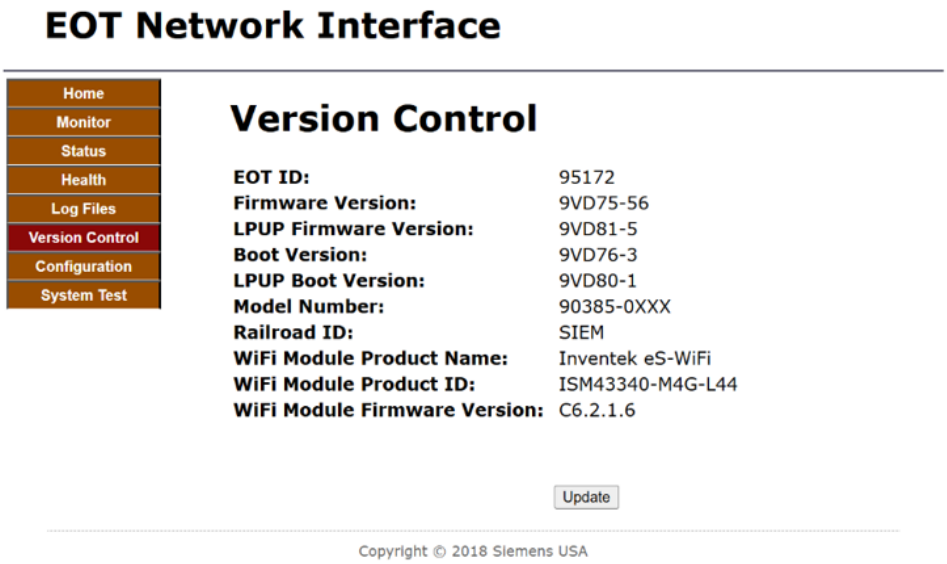


Figure 4-11 EOT Wi-Fi Version Control

4.3.3.7 Firmware Update

The Firmware Update page allows the user to select an application image file (.hex) and upload it to the EOT. After the upload is finished the EOT will restart and the bootloader will program the image.

Figure 4-12 EOT Wi-Fi Firmware Update Page

4.3.3.8 Configuration

The Configuration page shows the current configuration of the EOT.

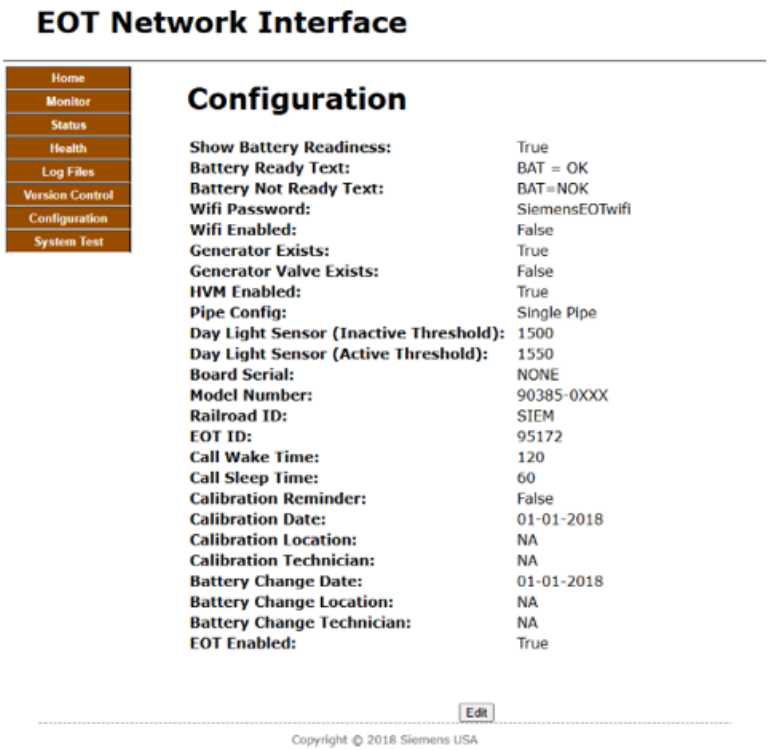


Figure 4-13 EOT Wi-Fi Configuration Page

4.3.3.9 Edit Configuration

Not yet implemented.

4.3.3.10 System Test

Not yet implemented.

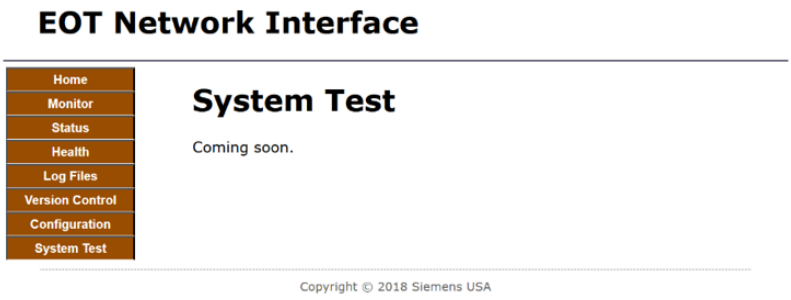


Figure 4-14 EOT Wi-Fi System Test Page

4.4 USB INTERFACE

The EOT provides a standard USB mass-storage slave interface accessible by removing the clear dome. The connector is found on the back side of the board, near the rear pressure display. By connecting a USB cable from the mini-B connector on the EOT to a computer, the EOT SD card will appear as a remote disk mapped to the user's computer. This allows copying log files from the SD card to the computer, as well as copying a new application to the SD card when a software update is required.

Figure 4-15 USB Connector Location

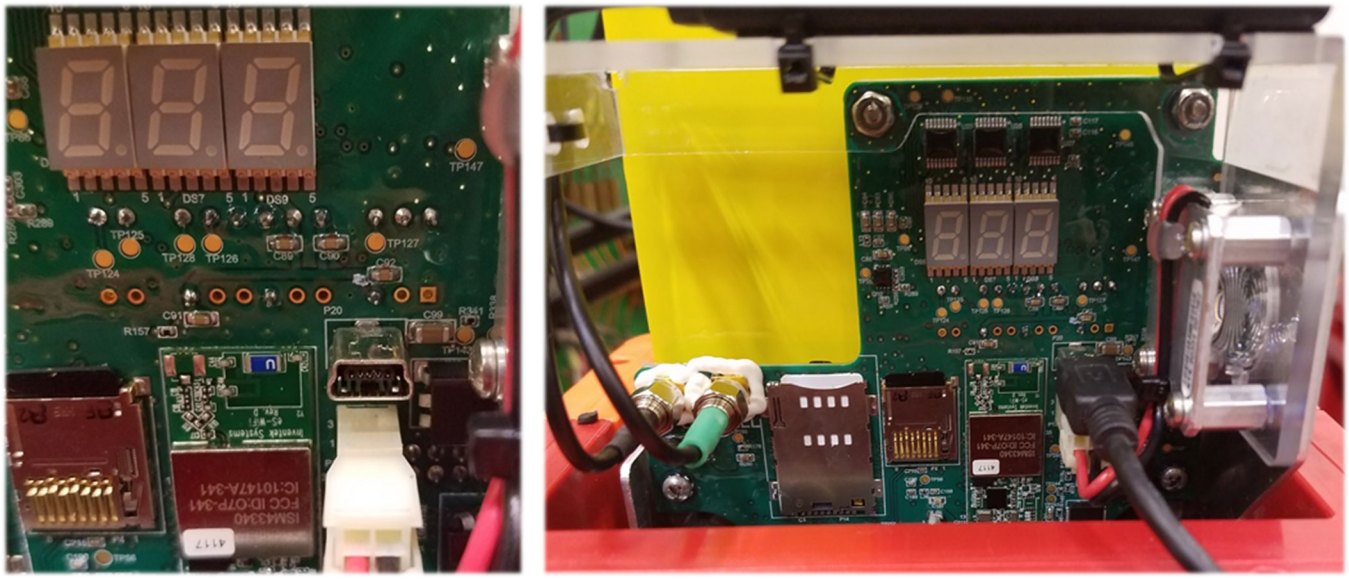


Figure 4-16 Mini USB Connection Point

Viewing and copying files from the EOT SD card follows the same process as using any other USB device.

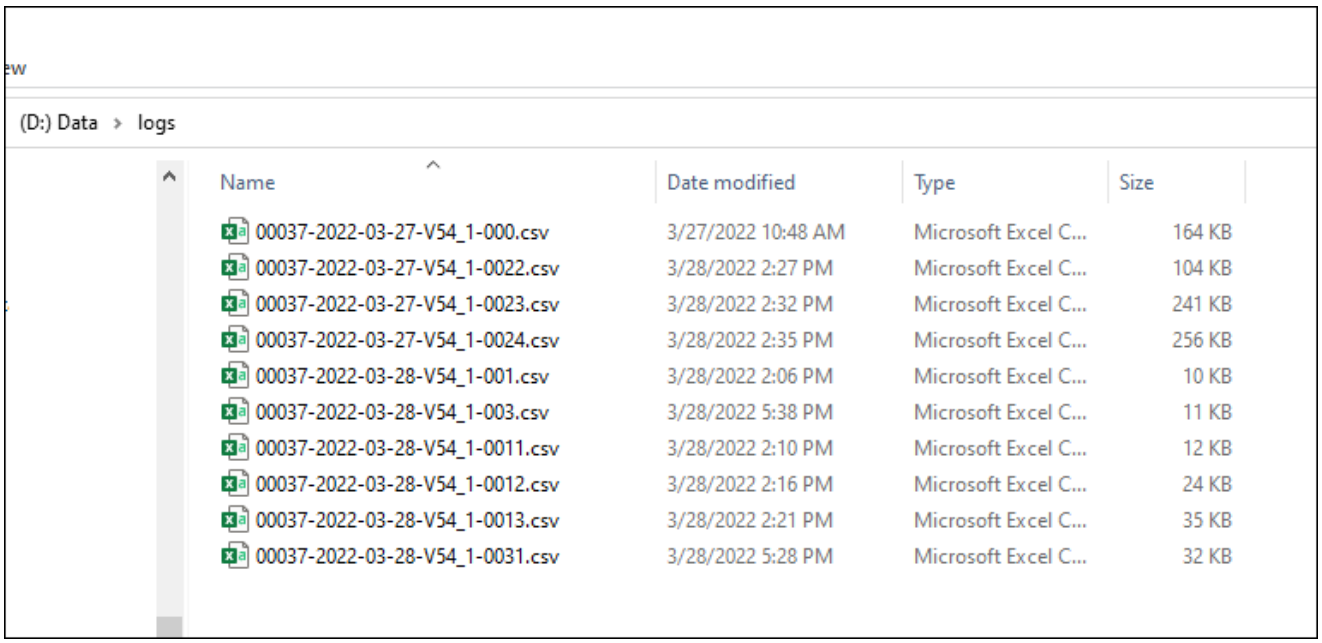


Figure 4-17 EOT As Removable Disk

NOTE

NOTE

While a computer is connected to the EOT via USB, no over-the-air software updates from EOT Phone Home (through the cellular connection) are allowed to happen since the SD card becomes exclusively dedicated to the USB interface.

NOTE

NOTE

When updating the EOT firmware via USB transfer, the name of the new file must be changed to **image.hex** prior to transferring to the SD card.

4.5 CHARGE PORT ADAPTER

A charge port adapter cable is required to connect a computer to the EOT (refer to Section 3.11.15 for charge port pin functions). Full functionality for downloading logs, radio alignment, configuration and testing is available through the charge port adapter P/N NYK:Z680399510001.

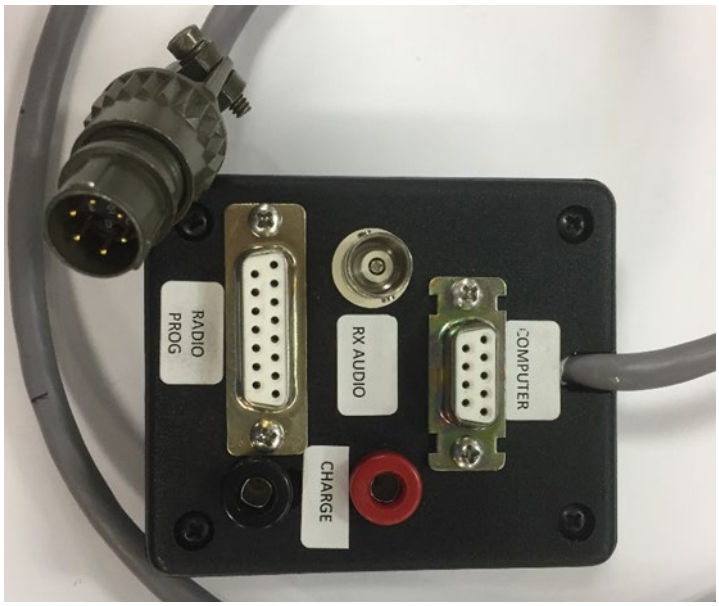


Figure 4-18 Charge Port Adapter

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SECTION 5 **FUNCTIONAL TESTING**

5.1 REQUIRED EQUIPMENT

- Functional HOT unit or HOT / EOT tester.
- Compressed air source (90 PSI min).
- Calibrated air gauge.
- Charging supply 10-25 volts (optional).
- Computer running Windows® with an available serial port or USB-to-serial adapter.

5.2 TEST PROCEDURE

1. Physically inspect the EOT for damage or broken parts. Operate the coupler mount and ensure that there are no defects on the clamp gearing and that the mechanism turns freely.
2. Inspect the air hose assembly for cuts or abrasions. Inspect the filter screen inside the glad hand. If it has been removed or cut, install a new one per railroad policy.
3. Power up the EOT by pressing the START/ARM pushbutton (press and hold button for one second). Upon power-up the unit will display “WAKINGUP”, followed by the Software Version number, Owner Railroad, ID number, and other status messages (see Table 3-1). Additionally, brake pressure will be displayed.
4. Verify that all displays are complete and legible.
5. Read the battery voltage and charge status on the display. If necessary, recharge the internal battery before proceeding.
6. Verify that the HVM is functional and flashing. It will flash for 30 seconds upon power-up and then will revert to photocell control. The photocell is located to the left of the alphanumeric display. To test the photocell, either cover the clear dome or shine a light on the sensor. Note that there is a 1-minute time delay for turning the HVM on and a 3-minute time delay for turning the HVM off.
7. With no air pressure on the EOT, lay the EOT down into a horizontal position. Ensure that the unit powers down within one minute. The HVM and display will go out. The EOT also may be shut down by holding the START/ARM pushbutton in for 7 - 10 seconds (in any position as long as there is no air pressure). The display will show PWR OFF?. Releasing the button while this message is displayed will shut down the unit.
8. Power the EOT again as in step 3, or if the EOT is equipped with the high-powered manifold, the EOT will automatically power on when air pressure is applied.
   Apply air pressure to the EOT using a calibrated air gauge in-line with the EOT. Verify that the pressure display on the EOT is within ± 3 PSI of the calibration gauge. If the EOT requires calibration, refer to Section 6.3, *Air Transducer Calibration*.
9. Apply power to the HOT unit.

10. On Siemens HOTs, press the Menu button once. The status display will show “Enter EOT# nnnnn” (where nnnnn is the current EOT number entered), press the five digits on the keypad that correspond to the EOT number and then press the ENTER / YES button to accept. Press the COMM TEST/ARM pushbutton. The HOT will communicate with the EOT and should display “Comm Test Passed” message.
11. On non-Siemens HOTs, dial in the five digits on the thumbwheel that correspond to the EOT number. Press the COMM TEST/ARM pushbutton.
12. When the COMM TEST/ARM pushbutton is pressed on the HOT, the EOT should blink the green MSG LED and should also display an hourglass on the eighth-character position of the alphanumeric display (when illuminated). If it does not show these indications, either the HOT is not set with an ID code that matches the EOT, or the EOT’s receiver does not properly receive and decode the message from the HOT.
13. When a message is transmitted from the Siemens EOT, the red TX LED will blink, and a diamond symbol will appear on the eighth-character position of the alphanumeric display (when illuminated).
14. On the EOT, press the START/ARM pushbutton, the message “ARMING” will appear on the display. The HOT should now display “Arm Now.” Press the COMM TEST/ARM pushbutton on the HOT within 5 seconds. If the EOT and HOT are successfully armed to each other, the Emergency Enabled lamp should be illuminated on the HOT. If the arming process does not result in the HOT displaying “Emergency Enabled,” repeat this process.
15. When the COMM TEST/ARM pushbutton is pressed on the HOT, the EOT’s MSG and TX LEDs should blink one after the other if the RF transmissions are fully functional.
16. Information transmitted by the EOT will be displayed on the HOT. Indications on the HOT user interface should correspond with the EOT status (HVM, motion sensor, pressure, etc.).
17. Apply air pressure to the EOT. With the EOT now armed to the HOT, activate the EMERGENCY feature on the HOT. The Dump Valve should open on the EOT and exhaust the air pressure to zero. The EOT will display BRAKING. The EOT brake valve will automatically close once the brake pressure reaches 0 PSI and the valve has been open a minimum of 15 seconds (or up to 2 minutes if pressure has not decreased to zero).
18. With the dump valve closed, apply 80 PSI to the EOT. The air generator should be running.
19. **This step applies to the standard manifold only and is not applicable to the HP manifold:** Double press the START/ARM pushbutton and the air generator solenoid valve should pick up and stop the flow of air through the generator. The display should show “GEN OFF” at this time. Press the START/ARM pushbutton again and the generator should operate normally.
20. To test the GNSS module and motion sensor, activate the EOT and place it outdoors with a clear view of the sky. Ensure that the battery voltage is at least 12 volts as shown on the EOT display. Press the START/ARM button to illuminate the display, if dark. Within 2 minutes, the display on the EOT should show a plus (+) symbol on the eighth character position (see Section 1.3, *Display*, for an example). If this symbol is observed, the GNSS is functional and has received a usable signal. To confirm operation of the motion sensor, the EOT may be picked up and moved in a straight line at a pace of 3 feet / second or faster. Note that there is a 10 second time delay in displaying motion from a stopped state. The display will show a minus (-) symbol in the eighth character position when motion is detected.

21. To test the cellular modem, use the serial terminal interface to initiate an immediate connection with the cellular service provider. Progress and results of cellular connectivity are shown on the terminal screen and logged in the internal event recorder of the EOT.

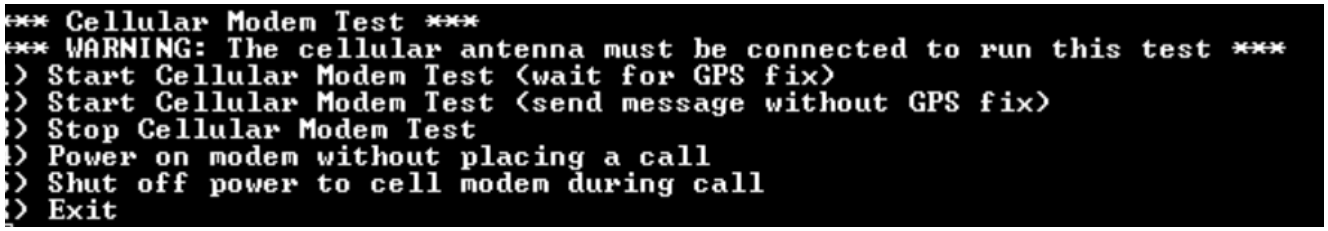

Figure 5-1 Cellular Modem Test

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SECTION 6 MAINTENANCE AND TROUBLESHOOTING

6.1 DATA DOWNLOADING

To download and view the data from the internal event log, any of the user interfaces described in Section 4.0 may be used. Details on accessing logs are available in Section 6.7.

For information on the available charge port adapter see Section 4.5.

See Section 4.2 for details on setting up the serial terminal interface with the EOT, and Section 4.3 for details on using the Wi-Fi interface.

The serial terminal interface option has functionality that allows full testing and configuration of the EOT. Since some of these functions have the potential to adversely impact EOT operation, they are password-protected. If the user needs to perform these maintenance and configuration tasks, contact Siemens Customer Service to request password support.

6.2 SETTING EOT ID NUMBER

The EOT ID number is factory set in accordance with authorized ID numbers issued by the Association of American Railroads. Generally, the ID number will never require changing. However, if a unit is repaired or parts are exchanged between units, the ID number can be set.

⚠ CAUTION

CAUTION

WHEN CHANGING OR SETTING AN ID NUMBER, ENSURE THAT THE NEW ID NUMBER IS NOT ALREADY IN USE. IT IS PROHIBITED FOR ANY TWO EOT'S TO HAVE THE SAME ID NUMBER. ADDITIONALLY, THE AEI TAG NUMBER AND ENGRAVED ID PLAQUE MAY NEED TO BE CHANGED TO MATCH A NEW EOT NUMBER.

To set the ID number, follow the steps in Section 4.2, *Serial Interface* (Tera Term) to open the serial terminal interface. From the Main Menu, type **3** and press **Enter** to access **3) Configuration Menu**

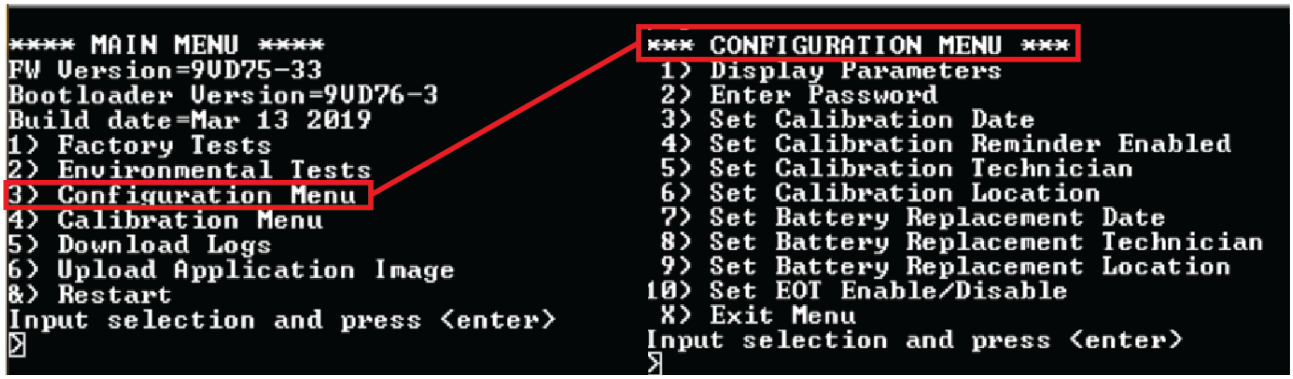


Figure 6-1 Configuration Menu

From the Configuration Menu, type **2** and press **Enter** to access **2) Enter Password**. Enter the customer password (default is: **Customer**) to enable the **Set EOT ID** menu option on the Configuration Menu.

Once the password has been entered, select **15) Set EOT ID** and enter the five-digit ID code that matches the AEI tag and engraved plaque on the EOT.

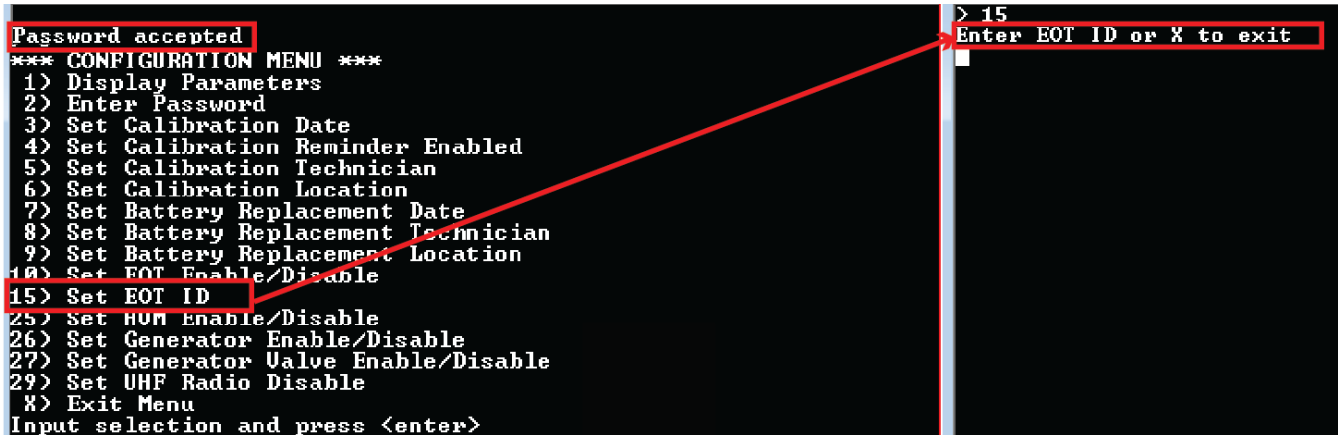


Figure 6-2 Enter New EOT ID

NOTE

NOTE

The password required to unlock the menu option mentioned above is *Customer*. The EOT menus will reset back to the most restrictive state once the EOT goes to sleep.

Shut down the EOT and restart it to verify that the new EOT number is displayed on the boot-up cycle and matches the AEI tag and engraved plaque.

6.3 AIR TRANSDUCER CALIBRATION

The air pressure transducer should be checked, and adjusted if required, whenever repairs are made. The calibration is electrically adjustable and is stored in non-volatile memory. The calibration of the EOT microprocessor module is matched with the pressure transducer located in the manifold. Replacement of the electronic board or the manifold will cause the pressure calibration data to become invalid and a new calibration should be done.

6.3.1 Procedure for Standard Manifold and HP Manifold

NOTE

NOTE

Pressure calibration should always be performed with a standard hose and high-flow air supply. The air-generator should be running to ensure pressure sensor calibration is performed under conditions that closely match how the EOT will be used on a train.

To adjust the air pressure calibration, complete the following steps:

1. Follow the steps in Section 4.2, *Serial Interface,* to access the serial user interface. Select the menu item **4) Calibration Menu > 1) Calibrate Primary Pressure Transducer**.

NOTE

NOTE

The instructions displayed on the terminal screen under *** Primary Transducer Calibration *** should not be followed. Perform the calibration as described in the next steps of this procedure.

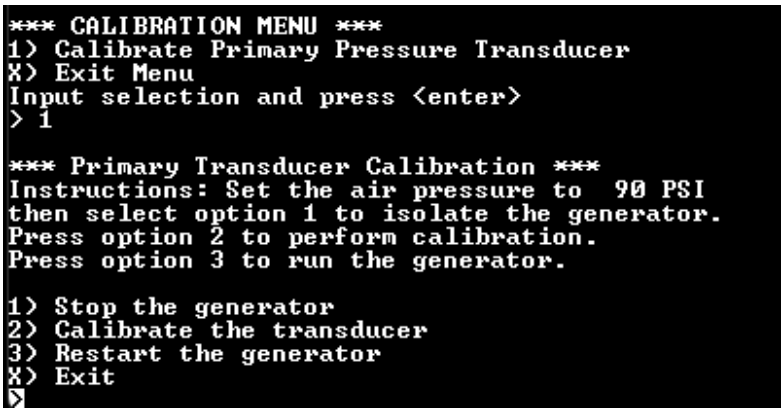


Figure 6-3 Calibration Menu

2. Apply air pressure to the EOT using a calibrated air gauge in line with the EOT and located as close to the EOT as possible. The air pressure must be set to 90 PSI per the calibrated gauge.
3. Select option 2 in the primary Transducer Calibration menu with the generator running.

NOTE

NOTE

The HP manifold is not equipped with a generator disable valve and will not respond to menu option 1 “Stop the generator”.

4. After calibration, the EOT may take a few seconds to adjust its pressure reading to the value that the user entered.

6.4 RADIO ADJUSTMENTS

The Trainguard EOT is equipped with a Ritron DTX-445 synthesized radio transceiver that is exempt from the requirements for annual testing calibration per FRA-2009-0015 waiver (consult Ritron for details). Furthermore, the Trainguard EOT itself is exempt from the requirements for annual calibration per FRA-2015-0044 waiver, and there are no radio-related adjustable components in the EOT circuitry. When required, all radio-related adjustments are performed directly to the Ritron radio using Ritron's DTXL-PCPS configuration utility for Windows (contact Ritron for further information or to obtain the utility).

The Trainguard EOT provides an easy method for adjusting the radio without the need to open the main EOT enclosure. To make radio adjustments, connect the NYK:Z680399510001 charge-port adapter to the EOT. Using a serial port (or USB-to-serial converter) on the computer, connect the Ritron programming cable between the computer and the DB15 connector on the charge-port adapter (contact Ritron for further information or to obtain the programming cable. The user can then run the DTXL-PCPS configuration utility, interfacing directly to the radio inside the EOT. Refer to Ritron's documentation on the DTXL-PCPS utility for details on how to perform necessary adjustments. Once all desired radio adjustments have been performed, the EOT must be shut down using the START/ARM pushbutton, as described in section 3.2.

The radio transmitter deviation (modulation) should be checked whenever repairs are made to the EOT unit. A calibrated radio service monitor is required to perform this adjustment.

6.4.1 Deviation Check

The easiest way to check deviation is to use the specialized charge port adapter (P/N NYK:Z680399510001).

The method for checking deviation and center frequency accuracy using the serial interface is described here. Connect the computer to the EOT using the charge port adapter and follow each step in Section 4.2, *Serial Interface* (Tera Term). Select the menu item **1) Factory Tests > 11) UHF Radio Test**. Under the UHF Radio Test menu, select either **1) Send a 5-second MARK (1200Hz) with PTT** or **2) Send a 5-second SPACE (1800 Hz) with PTT**. Once selected, the EOT will start transmitting. On the service monitor, read the deviation. It should be 2.45 KHz - 2.2 KHz. To stop the transmission, select **5) Stop sending tone**. During deviation measurements, do not transmit more than necessary to avoid overheating the transmitter. This test should not be repeated too many times in quick succession.

Radio transmitter verification may be done on-train with the use of a Siemens Q3431/NB, or Q3433/NB tester. These testers have 3 LED indicators—center frequency, deviation, and RF power level. If the tester shows 3 green (good) indicators upon completion of the test, the EOT has passed and satisfies FRA requirements. This test does not need to be performed by an electronics technician. Failure of any test, as indicated on the tester, requires that the EOT be serviced by a qualified technician. If the measured deviation is not within the allowable tolerance, it should be adjusted as described in Section 6.4.2, *Deviation Adjustment.*

6.4.2 Deviation Adjustment

Deviation calibration is done by making deviation adjustments directly in the Ritron radio transceiver using the DTXL-PCPS radio configuration utility as described in Section 6.4. The radio configuration utility allows the user to adjust all programmable radio parameters via a user-friendly graphical interface. Refer to the DTXL-PCPS manual for information on how to adjust the radio. The manual can be obtained by contacting Ritron directly.

6.5 ANNUAL TESTS

FRA Code of Federal Regulations, 49CFR232.409 (d), as of January 2020, requires that:

> *The telemetry equipment shall be tested for accuracy and calibrated if necessary according to the manufacturer's specifications and procedures at least every 368 days. The 368 days shall not include a shelf-life of up to 92 days prior to placing the unit in service. This test shall include testing radio frequencies and modulation of the device. The date and location of the last calibration or test as well as the name of the person performing the calibration or test shall be legibly displayed on a weather-resistant sticker or other marking device affixed to the outside of both the front unit and rear unit; […]*

There are no components in the Trainguard EOT that require annual calibration. Other than the Ritron transceiver, the EOT does not contain any adjustable circuitry that can influence the performance of the radio. Radio modules themselves are subject to FCC requirements, but do not explicitly require annual inspection. The Ritron radio transceiver inside this product was granted an FRA waiver (FRA- 2009-0015) and is therefore exempt from the requirements of 49CFR232.409 (d) listed above. The Trainguard EOT as a whole was granted an FRA waiver (FRA-2015-0044) and is also exempt from annual calibration requirements. There is no periodic maintenance or calibration required for the Trainguard EOT.

6.6 TROUBLESHOOTING

6.6.1 Failure to Arm

If the HOT / EOT system is not armed after several attempts, tests should be run on both the EOT and HOT to determine proper operational status. For this purpose, the Q3431/NB, or Q3433/NB HOT / EOT Tester (or similar device) should be used. If the tester reports that both units are functioning within their acceptable ranges, contact Siemens Technical Support for additional assistance at (800) 626-2710, prompt #1. If leaving a message for Technical Support, press the # key after leaving the message to save the message to the system.

6.6.2 EOT Will Not Turn On

If the EOT fails to turn on when the START/ARM pushbutton is pressed for at least 1 second, recharge the battery (see Section 3.11.15, *Recharging the Battery*). If the unit still fails to activate, contact Siemens Technical Support for assistance.

6.6.3 Operational Failure Reports

Analysis of reported EOT operational failures can be accomplished by downloading the contents of the built-in EOT event recorder. The download can be done using the serial terminal interface, the Wi-Fi interface, or the USB interface. Refer to section 4.2 and section 4.5 in this manual for cable / adapter part numbers and instructions on connecting to the serial terminal interface.

6.7 TRAINGUARD EOT LOGGING

The firmware in the Trainguard EOT creates log files based on the startup count and current date. A new file will be created for each day. Each file contains a header and an unlimited number of records. The parameters and column headers of the log will be discussed in section 6.7.4.

6.7.1 Accessing EOT Logs via Serial Terminal Interface

NOTE

NOTE

Ensure that the Zmodem directory is properly set up prior to selecting log for download.

After accessing the serial terminal interface Main Menu, type **5** to access the **Log Menu** and press **Enter**. Use **U** and **D** to scroll up / down the available log listings. When the desired log is visible, select the number corresponding to the log for download.

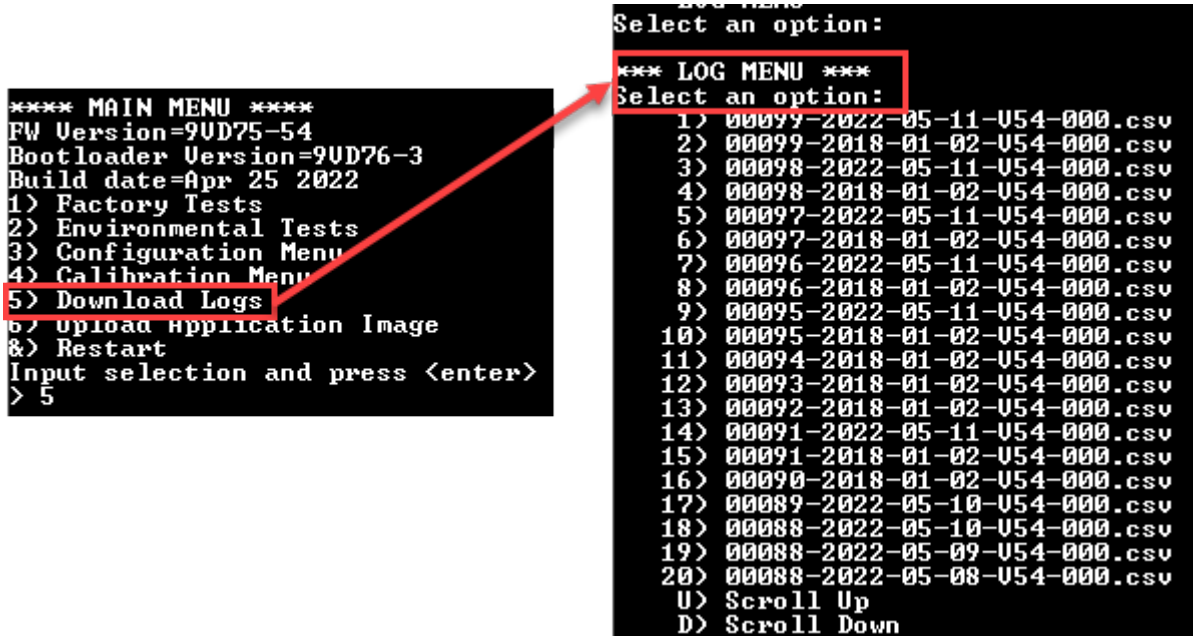


Figure 6-4 Access Logs Via Serial Terminal Interface

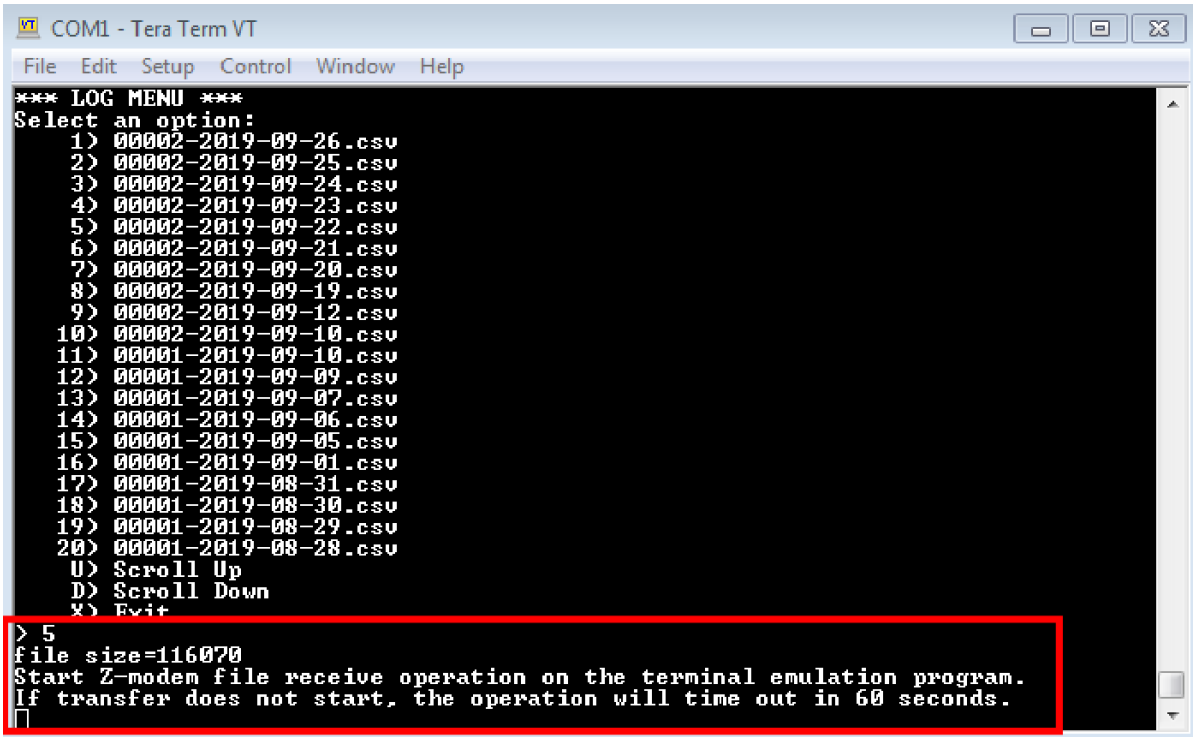


Figure 6-5 Select Log File

Once the log is selected, the user will have 60 seconds to start the “receive file” function on the terminal program.

Use the Tera Term **File** menu to select **Transfer > ZMODEM > Receive**, this will start the file retrieval process.

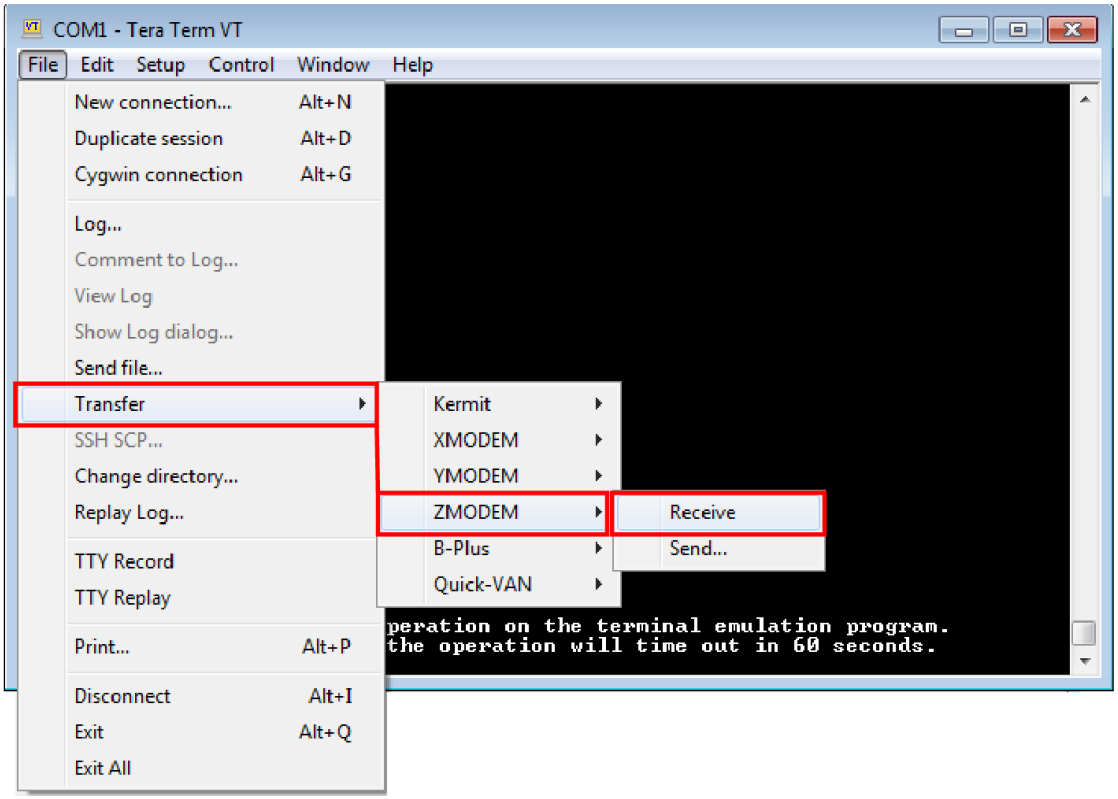


Figure 6-6 Receive Log File

The log will download to the pre-set location as a .csv file. This can be opened and viewed with any spreadsheet programs.

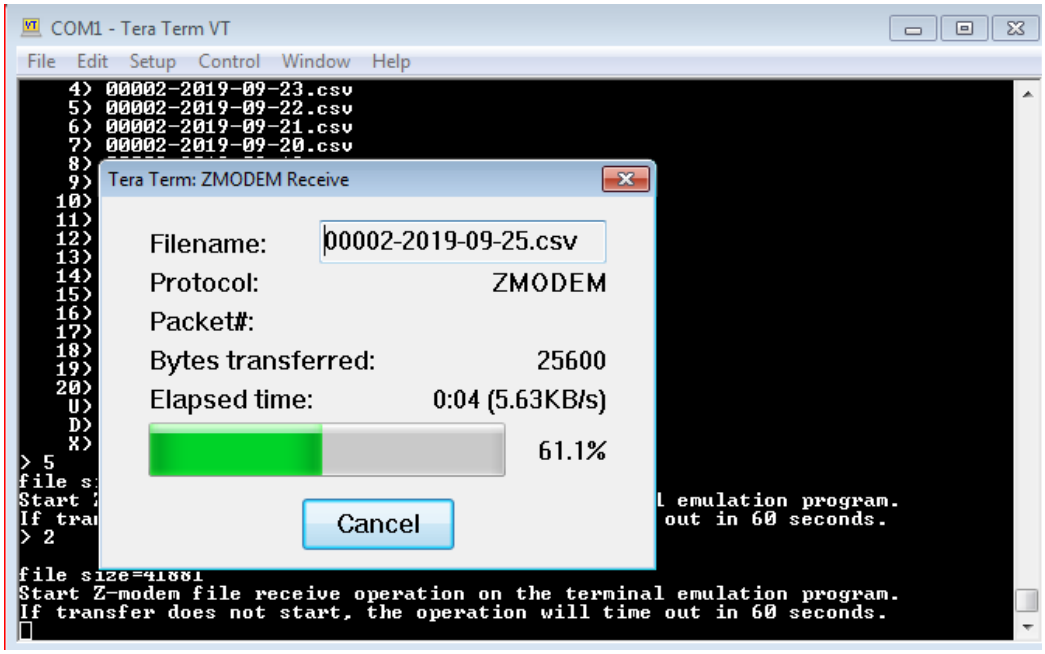


Figure 6-7 Downloading Log

6.7.2 Accessing EOT Logs via the Wi-Fi Interface

To access the log files from the Wi-Fi user interface, follow these steps:

1. Navigate to the **Log Files** menu.
2. Select the desired log file by clicking on the log file name. The web browser will download the log file to the web browser default download location on the PC or laptop.
3. The file can be opened from this location or saved to a different directory on the PC or laptop.

Figure 6-8 Downloading the Logs via Wi Fi Interface

6.7.3 Accessing EOT logs via the USB Interface

To access the log files via the USB interface, connect a laptop to the EOT using the procedure described in Section 4.4. Navigate to the EOT on Windows explorer (it will appear as a flash drive). Select the desired log file and save to the computer.

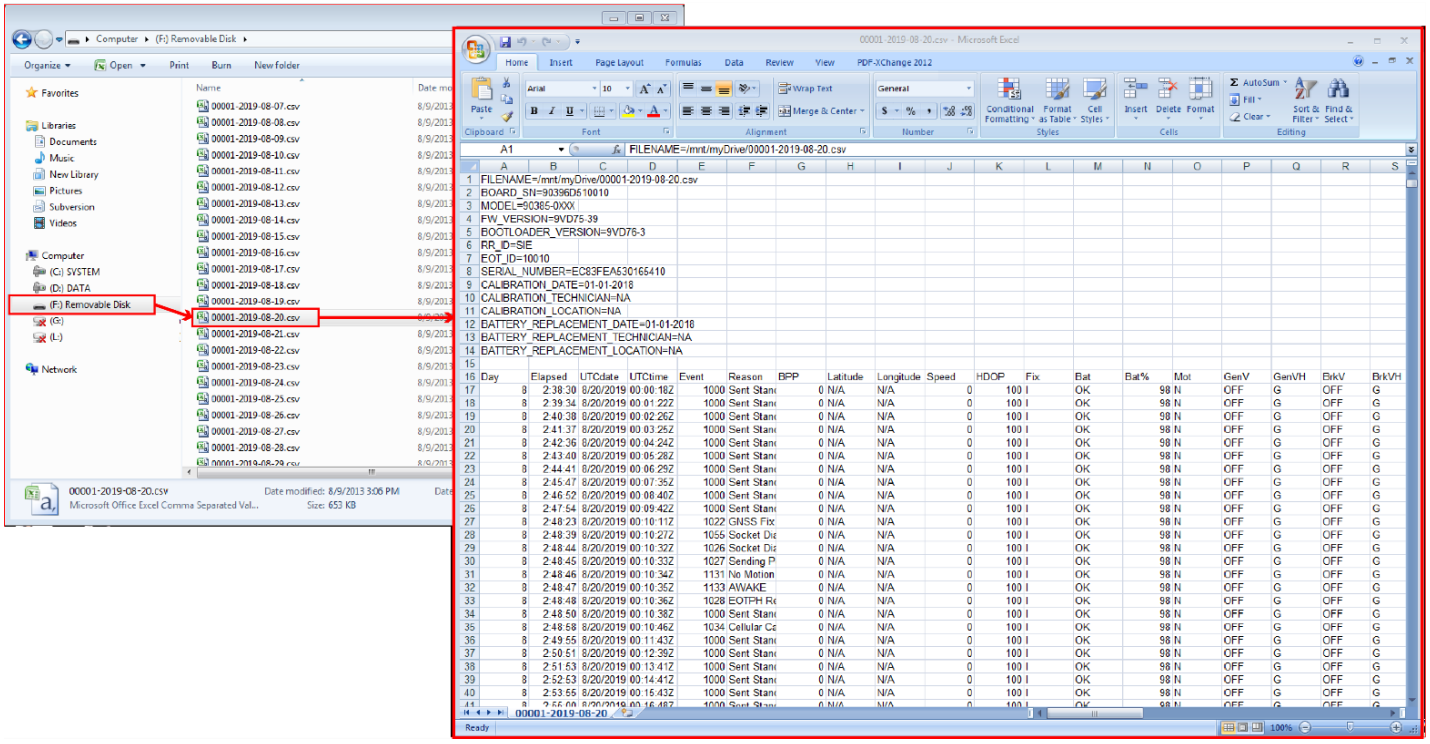


Figure 6-9 USB Access to Log File

6.7.4 Log Content

The log begins with the identification information listed as follows:

- Filename
- Board Serial Number
- EOT Model Number
- Firmware Version
- Bootloader Version
- Railroad ID
- EOT ID
- Serial Number
- Calibration Date
- Calibration Technician
- Calibration Location
- Battery Replacement Date
- Battery Replacement Technician
- Battery Replacement Location

The log data will then be listed in columns underneath each of the parameters listed in the following table.

NOTE

NOTE

Some parameters are numeric codes that will need the reference tables included in this section to decode. These parameters are marked with footnotes.

Table 6-1 Log Parameters

Abbreviated Parameter	Full Parameter Title	Definition
Day	Day Number	The number of the day since startup. This number starts with 01 which represents the first day.
Elapsed	Elapsed time	This is a representation of the elapsed time since start of the day in HH:MM:SS format.
UTCdate	UTC Date	This is the UTC date stamp of the event in the format MM-DD-YYYY.
UTCtime	UTC Time	This is the UTC time stamp of the event in the ISO8601 format HH:MM:SSZ.
Event[1]	Event code	A code to represent the reason text.

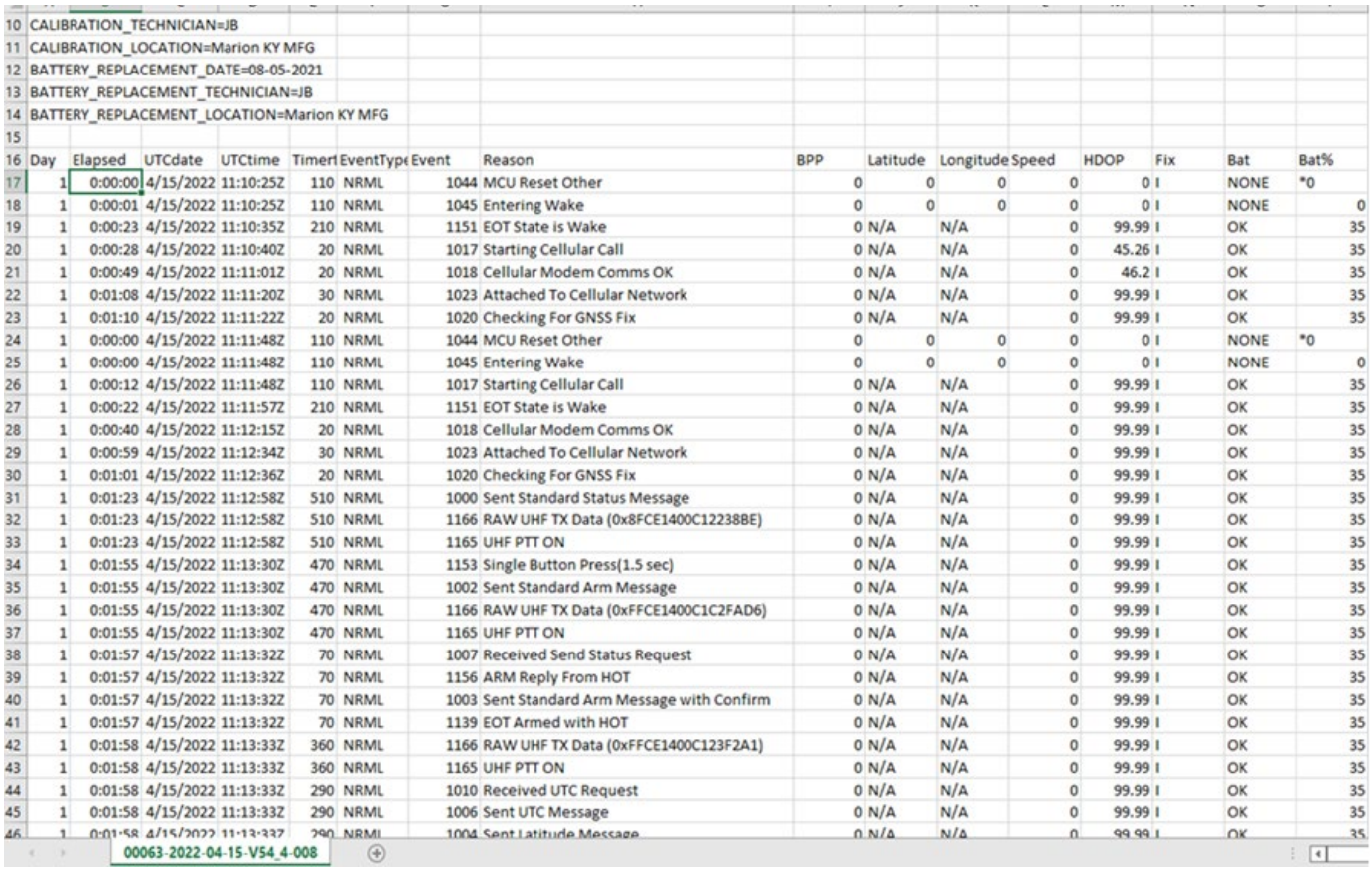
Abbreviated Parameter	Full Parameter Title	Definition
Reason	Reason	The text that provides a verbose explanation of the event code.
BPP	Brake Pipe Pressure	Represents the value of the brake pressure in PSI. Three digits will be added to the log.
Latitude	Latitude	The latitude is in decimal degrees.
Longitude	Longitude	The longitude is in decimal degrees.
Speed	Speed	Logged in MPH.
HDOP	Horizontal Dilution or Precision	GPS Horizontal Dilution of Precision. The closer the value is to 0, the more accurate the GPS readings will be.
Fix	GPS Fix	Shows the status of the GPS fix. I = Invalid, A = Active (valid).
Bat	Battery Status	Battery status can be NONE, OK, LOW or DEAD.
Bat%	Battery Charge Percentage	Remaining battery charge percentage.
Mot	Motion Status	This field can be Y or N where Y = YES (moving) and N = NO (not moving).
GenV	Generator Valve Status	Current status of generator valve, can be ON (energized / generator off) or OFF (de-energized / generator running).
GenVH	Generator Valve Health	Current health of generator valve, G = GOOD, B = BAD.
BrkV	Brake Valve Status	Current status of brake valve, can be ON (energized / dump valve open) or OFF (de-energized / dump valve closed).
BrkVH	Brake Valve Health	Current health of brake valve, G = GOOD, B = BAD.
HVM	HVM Status	Indicates the status of the HVM, can be ON or OFF.
HVMH	HVM Health	Indicates the health of the HVM, G = GOOD, B = BAD.
Dark	Dark Status	Daylight sensor status: indicates if darkness is detected. Y = YES, N = NO.
Emcy	Emergency Status	Indicates if emergency braking is in progress, Y = YES, N = NO.
Temp	Internal Temperature	The temperature of the EOT, in Fahrenheit.
3.3V	Voltage rail	These fields report the voltage values for power rails.
3.8V	Voltage rail	These fields report the voltage values for power rails.
5.0V	Voltage rail	These fields report the voltage values for power rails.
12.0V	Voltage rail	These fields report the voltage values for power rails.
GenRPM	Generator RPM	The rotational speed of the generator.
GenVin	Voltage rail	Generator voltage in - These fields report the voltage values for power rails.
GenVreg	Voltage rail	Generator regulator output - These fields report the voltage values for power rails.

Abbreviated Parameter	Full Parameter Title	Definition
GenOV	Generator overvoltage	Indicates generator overvoltage condition, Y = YES, N = NO.
ExtChgVin	External Charger voltage in	Input voltage of the external charging supply.
ExtChgVreg	External Charger voltage regulator	External charging regulator output voltage.
UHF1V	Voltage rail	UHF radio supply voltage.
CellV	Voltage rail	Cellular modem supply voltage.
GNSSV	Voltage rail	GNSS receiver supply voltage.
Vin	Input Voltage	This is the input voltage to the charging circuitry as reported by the charging IC.
Vbat	Battery Voltage	This is the battery voltage as measured from the charger IC telemetry.
Vsys	System Voltage	This is the system voltage that exits the charging circuitry. Vsys can come from Vbat or Vin.
Ibat	Battery Current I/O	This is the current entering (+) or exiting (-) the battery as reported by the charging IC.
Iin	Current Input	This is the current entering the charging circuit as reported by the charging IC. The current may be sourced from the external charger or the generator.
Qcount	Charge Amount	A charge counter value that relates to the quantity of charge (coulombs) stored in the battery, used to calculate charge percentage.
ChgStatus[2]	Charger status	These 3 status bits can be reported by the charge management IC.
ChgState[3]	Charger state	There are 11 operational states reported by the charge management IC.
ChgSysStatus[4]	Charger system status	These 14 bits are reported by the charge management IC based on individual real-time statuses of various system conditions.
ChgT	Charger Temperature	Core temperature in Fahrenheit reported by the charging IC.
GnssAntDet	GPS antenna detected	Indicates whether the GNSS antenna is connected, Y = YES, N = NO.
GnssAntShrt	GPS antenna shorted	Indicates whether the GNSS antenna is shorted, Y = YES, N = NO.
Orient	Orientation	Indicates if the EOT is upright (UP) or tilted (TILT).
CellH	Cellular Modem Health Status	Indicates the health of the cellular modem, G = GOOD, B = BAD.
MaxQcount	Maximum Qcount	The charge counter value corresponding to the battery being fully charged.
MinQcount	Minimum Qcount	The charge counter value corresponding to the battery being fully discharged.

Abbreviated Parameter	Full Parameter Title	Definition
Xaxis	X Axis	The acceleration value of the respective axis.
Yaxis	Y Axis	The acceleration value of the respective axis.
Zaxis	Z Axis	The acceleration value of the respective axis.
XaxisRelMax	X Axis Relative Max	The maximum acceleration measured along the X axis since the last log entry.
YaxisRelMax	Y Axis Relative Max	The maximum acceleration measured along the Y axis since the last log entry.
ZaxisRelMax	Z Axis Relative Max	The maximum acceleration measured along the Z axis since the last log entry.
XaxisMax	X Axis Max	The maximum acceleration measured along the X axis since startup.
YaxisMax	Y Axis Max	The maximum acceleration measured along the Y axis since startup.
ZaxisMax	Z Axis Max	The maximum acceleration measured along the Z axis since startup.

[1]Event codes are defined in Table 6-2.
[2]ChgStatus codes defined in Table 6-3.
[3]ChgState codes defined in Table 6-4.
[4]ChgSysStatus codes defined in Table 6-5.

The following figure shows an example of the comma-deliminated (.csv) format log opened up in Excel®.



CALIBRATION_TECHNICIAN=JB
CALIBRATION_LOCATION=Marion KY MFG
BATTERY_REPLACEMENT_DATE=08-05-2021
BATTERY_REPLACEMENT_TECHNICIAN=JB
BATTERY_REPLACEMENT_LOCATION=Marion KY MFG

Day	Elapsed	UTCdate	UTCtime	Timer	EventType	Event	Reason	BPP	Latitude	Longitude	Speed	HDOP	Fix	Bat	Bat%
1	0:00:00	4/15/2022	11:10:25Z	110	NRML	1044	MCU Reset Other	0	0	0	0	0	I	NONE	*0
1	0:00:01	4/15/2022	11:10:25Z	110	NRML	1045	Entering Wake	0	0	0	0	0	I	NONE	0
1	0:00:23	4/15/2022	11:10:35Z	210	NRML	1151	EOT State is Wake	0	N/A	N/A	0	99.99	I	OK	35
1	0:00:28	4/15/2022	11:10:40Z	20	NRML	1017	Starting Cellular Call	0	N/A	N/A	0	45.26	I	OK	35
1	0:00:49	4/15/2022	11:11:01Z	20	NRML	1018	Cellular Modem Comms OK	0	N/A	N/A	0	46.2	I	OK	35
1	0:01:08	4/15/2022	11:11:20Z	30	NRML	1023	Attached To Cellular Network	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:10	4/15/2022	11:11:22Z	20	NRML	1020	Checking For GNSS Fix	0	N/A	N/A	0	99.99	I	OK	35
1	0:00:00	4/15/2022	11:11:48Z	110	NRML	1044	MCU Reset Other	0	0	0	0	0	I	NONE	*0
1	0:00:00	4/15/2022	11:11:48Z	110	NRML	1045	Entering Wake	0	0	0	0	0	I	NONE	0
1	0:00:12	4/15/2022	11:11:48Z	110	NRML	1017	Starting Cellular Call	0	N/A	N/A	0	99.99	I	OK	35
1	0:00:22	4/15/2022	11:11:57Z	210	NRML	1151	EOT State is Wake	0	N/A	N/A	0	99.99	I	OK	35
1	0:00:40	4/15/2022	11:12:15Z	20	NRML	1018	Cellular Modem Comms OK	0	N/A	N/A	0	99.99	I	OK	35
1	0:00:59	4/15/2022	11:12:34Z	30	NRML	1023	Attached To Cellular Network	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:01	4/15/2022	11:12:36Z	20	NRML	1020	Checking For GNSS Fix	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:23	4/15/2022	11:12:58Z	510	NRML	1000	Sent Standard Status Message	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:23	4/15/2022	11:12:58Z	510	NRML	1166	RAW UHF TX Data (0x8FCE1400C12238BE)	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:23	4/15/2022	11:12:58Z	510	NRML	1165	UHF PTT ON	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:55	4/15/2022	11:13:30Z	470	NRML	1153	Single Button Press(1.5 sec)	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:55	4/15/2022	11:13:30Z	470	NRML	1002	Sent Standard Arm Message	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:55	4/15/2022	11:13:30Z	470	NRML	1166	RAW UHF TX Data (0xFFCE1400C1C2FAD6)	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:55	4/15/2022	11:13:30Z	470	NRML	1165	UHF PTT ON	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:57	4/15/2022	11:13:32Z	70	NRML	1007	Received Send Status Request	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:57	4/15/2022	11:13:32Z	70	NRML	1156	ARM Reply From HOT	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:57	4/15/2022	11:13:32Z	70	NRML	1003	Sent Standard Arm Message with Confirm	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:57	4/15/2022	11:13:32Z	70	NRML	1139	EOT Armed with HOT	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:58	4/15/2022	11:13:33Z	360	NRML	1166	RAW UHF TX Data (0xFFCE1400C123F2A1)	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:58	4/15/2022	11:13:33Z	360	NRML	1165	UHF PTT ON	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:58	4/15/2022	11:13:33Z	290	NRML	1010	Received UTC Request	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:58	4/15/2022	11:13:33Z	290	NRML	1006	Sent UTC Message	0	N/A	N/A	0	99.99	I	OK	35
1	0:01:58	4/15/2022	11:13:33Z	290	NRML	1004	Sent Latitude Message	0	N/A	N/A	0	99.99	I	OK	35

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Figure 6-10 EOT Log Example

Table 6-2 EOT Log Event Codes

Event Code	Meaning	Event Code	Meaning
1000	"Sent Standard Status Message"	1092	"OVSP NG"
1001	"Sent Standard Status Message with Confirm"	1093	"RPM NG"
1002	"Sent Standard Arm Message"	1094	"DISP NG"
1003	"Sent Standard Arm Message with Confirm"	1095	"EOT NG"
1004	"Sent Latitude Message"	1096	"GEN NG Cleared"
1005	"Sent Longitude Message"	1097	"GVLV NG Cleared"
1006	"Sent UTC Message"	1098	"DVLV NG Cleared"
1007	"Received Send Status Request"	1099	"XDCR NG Cleared"
1008	"Received Emergency Command"	1100	"ACCL NG Cleared"
1009	"Received Position Request"	1101	"BAT NG Cleared"
1010	"Received UTC Request"	1102	"RTC NG Cleared"
1011	"Emergency Start"	1103	"HVM NG Cleared"
1012	"Emergency End"	1104	"CELL NG Cleared"
1013	"EOT ID Archived"	1105	"TSNS NG Cleared"
1014	"Removed"	1106	"SD NG Cleared"
1015	"Battery Dead Shutdown"	1107	"CHRG NG Cleared"
1016	"Entering Sleep"	1108	"PS-X NG Cleared"
1017	"Starting Cellular Call"	1109	"PS-G NG Cleared"
1018	"Cellular Modem Comms OK"	1110	"RAD NG Cleared"
1019	"Cellular Modem Comms Failure"	1111	"GPS NG Cleared"
1020	"Checking For GNSS Fix"	1112	"DLS NG Cleared"
1021	"GNSS Fix Good"	1113	"PB NG Cleared"
1022	"GNSS Fix Not Good"	1114	"WIFI NG Cleared"
1023	"Attached To Cellular Network"	1115	"BT NG Cleared"
1024	"Cellular Network Attach Failed"	1116	"OVSP NG Cleared"
1025	"IP Address Obtained"	1117	"RPM NG Cleared 1"
1026	"Socket Dial Complete"	1118	"DISP NG Cleared"
1027	"Sending Position Message"	1119	"EOT NG Cleared"
1028	"EOTPH Response OK"	1120	"HVM Enabled (Local)"
1029	"EOTPH Response CM Refresh"	1121	"HVM Disabled (Local)"
1030	"EOTPH Response Re-enable EOT"	1122	"Generator Enabled (Local)"
1031	"EOTPH Response Disable EOT"	1123	"Generator Disabled (Local)"
1032	"EOTPH Response Call Spacing"	1124	"Generator Valve Enabled (Local)"
1033	"EOTPH Response OTA"	1125	"Generator Valve Disabled (Local)"
1034	"Cellular Call Complete"	1126	“XDCR NG 2”

1035	"Failed To Activate Context"	1127	“XDCR NG Cleared 2”
1036	"EOTPH Response Unknown"	1128	“RPM NG 2”
1037	"SIM Not Inserted"	1129	“RPM NG Cleared 2
1038	"Power On Reset"	1130	"Motion"
1039	"Watchdog Reset"	1131	"No Motion"
1040	"Software Reset"	1132	"DEPLOYED"
1041	"MCLR Reset"	1133	"AWAKE"
1042	"Config Mismatch Reset"	1134	“Configuration Reset to Default”
1043	"Brownout Reset"	1135	“Sent Standard Status Message Pressure Change”
1044	"MCU Reset Other"	1136	” Sent Standard Status Message On Motion”
1045	"Entering Wake"	1137	“Sent Standard Status Message On No Motion”
1046	"Generator Re-enabled (Timeout)"	1138	“Sent Standard Status Message With Emergency Confirm”
1047	"Generator Re-enabled (Overvoltage Clear)"	1139	“EOT Armed with HOT”
1048	"Generator Disabled (Overvoltage)"	1140	“Miss Event Duration”
1049	"Generator Re-enabled (Low Pressure)"	1141	“Double Button Press (1.5 Sec)”
1050	"Generator Re-enabled (Moving)"	1142	“RTC Update From GNSS”
1051	"Generator Re-enabled (Button)"	1143	“EOT State is Deployed”
1052	"Generator Disabled (Button)"	1144	“EOT State is Disabled”
1053	"Generator Re-enabled (Test)"	1145	“EOT State is Emergency”
1054	"Generator Disabled (Test)"	1146	“EOT State is Sleeping”
1055	"Socket Dial Start"	1147	“EOT State is Charging”
1056	"Socket Dial Retry"	1148	“Failed to Authorize”
1057	"Not Attached To Cellular Network"	1149	“EOTPH Message:”
1058	"Entering Sleep (Button)"	1150	“EOTPH AUTH Message”
1059	"Entering Sleep (Tilt)"	1151	“EOT State is Wake”
1060	"Entering Sleep (Disabled)"	1152	“Socket Dial Retry Limit Exceeded”
1061	"Entering Sleep (Call Complete)"	1153	“Single Button Press (1.5 Sec)”
1062	"Battery Replacement Date Changed"	1154	“Single Button Press (4 Sec)”
1063	"Battery Replacement Technician Set"	1155	“Triple Button Press (2.5 Sec)”
1064	"Battery Replacement Location Set"	1156	“ARM reply from HOT”
1065	"Calibration Date Changed"	1157	“No Reply ARM HOT”
1066	"Calibration Technician Set"	1158	“Hash Calculation Time”
1067	"Calibration Location Set"	1159	“Display ON Single Button Press”
1068	"Calibration Due Soon"	1160	“Long Press (10 Sec) WIFI ON”
1069	"Calibration Due Now"	1161	“Long Press (10 Sec) WIFI OFF”
1070	"EOT Re-enabled (Local)"	1162	“Data Block”

1071	"EOT Disabled (Local)"	1163	“Data Block One”
1072	"GEN NG"	1164	“Data Block Two”
1073	"GVLV NG"	1165	“UHF PTT ON”
1074	"DVLV NG"	1166	“RAW UHF TX Data”
1075	"XDCR NG"	1167	“UHF RX Frame Sync Valid”
1076	"ACCL NG"	1168	“RX Valid Message Count”
1077	"BAT NG"	1169	“UHF RX Frame Sync Invalid”
1078	"RTC NG"	1170	“UHF RX Packet with EOTID:”
1079	"HVM NG"	1171	"NAPPING START"
1080	"CELL NG"	1172	"NAPPING STOP"
1081	"TSNS NG"	1173	"RAW UHF first additional TX Data"
1082	"SD NG"	1174	"RAW UHF second additional TX Data"
1083	"CHRG NG"	1175	"UHF RX MSG EMGD FGYD DTWLD Not supported"
1084	"PS-X NG"	1176	"UHF RX MSG EMGD FGYD DTWLEN Not supported"
1085	"PS-G NG"	1177	"UHF RX MSG EMGD FGYEN DTWLD Not supported"
1086	"RAD NG"	1178	"UHF RX MSG EMGD FGYEN DTWLEN Not supported"
1087	"GPS NG"	1179	"UHF RX MSG EMGEN FGYD DTWLD Not supported"
1088	"DLS NG"	1180	"UHF RX MSG EMGEN FGYD DTWLEN Not supported"
1089	"PB NG"	1181	"UHF RX MSG EMGEN FGYEN DTWLD Not supported"
1090	"WIFI NG"	1182	"UHF RX MSG EMGEN FGYEN DTWLEN Not supported"
1091	"BT NG"	1183	"UHF RX MSG UNEXPECTED"

Table 6-3 Charge Status Bit Definitions

ChgStatus This register consists of individual status bits for the battery charge current control circuitry. Individual bits are mutually exclusive (a maximum of one bit is asserted at any given time).		
Bit	**Name**	**Description**
3	vin_uvcl_active	Indicates the input undervoltage control loop is actively controlling power delivery based on VIN_UVCL_SETTING (0x16)
2	iin_limit_active	Indicates the input current limit control loop is actively controlling power delivery based on IIN_LIMIT_DAC (0x46)
1	constant_current	Indicates the charge current control loop is actively controlling power delivery based on ICHARGE_DAC (0x44)
0	constant_voltage	Indicates the battery voltage control loop is actively controlling power delivery based on VCHARGE_DAC (0x45) 67
0xFF	I2C bus error.	The I2C Bus needs to be reset.

Table 6-4 Charge State Bit Definitions

ChgState This register consists of individual battery charger state indicator bits. Individual bits are mutually exclusive (a maximum of one bit is asserted at any given time).		
Bit	**Name**	**Description**
10	equalize_charge	Indicates battery charger is in lead-acid equalization charge state
9	absorb_charge	Indicates battery charger is in absorb charge state
8	charger_suspended	Indicates battery charger is in charger suspended state
7	precharge	Indicates battery charger is in precondition charge state
6	cc_cv_charge	Indicates battery charger is in constant-current constant-voltage state
5	ntc_pause	Indicates battery charger is in thermistor pause state
4	timer_term	Indicates battery charger is in timer termination state
3	c_over_x_term	Indicates battery charger is in C/x termination state
2	max_charge_time_fault	Indicates battery charger is in max_charge_time_fault state
1	bat_missing_fault	Indicates battery charger is in missing battery fault state
0	bat_short_fault	Indicates battery charger is in shorted battery fault state

Table 6-5 Charge System Status Bit Definitions

ChgSysStatus This register consists of individual real-time status bits which indicate various system conditions.		
Bit	**Name**	**Description**
13	charger_enabled	This bit indicates that the charging IC is actively charging a battery.
11	mppt_en_pin	This bit indicates that the external MPPT pin is detected as being high and maximum power point tracking is enabled.
10	equalize_req	This bit indicates that a rising edge has been detected at the EQ pin and a lead-acid equalization charge is running or is queued to run. See Lead-Acid Equalization Charge.
9	drvcc_good	This bit indicates that the DRVCC pin voltage is above the DRVCC undervoltage lockout level (4.3V typical).
8	cell_count_error	This bit indicates that an invalid combination of CELLS pin settings have been detected.
6	ok_to_charge	This bit indicates that all system conditions are met to allow battery charging operation.
5	no_rt	This bit indicates that no frequency setting resistor is detected on the RT pin. The RT pin impedance detection circuit will typically indicate a missing RT resistor for values above 1.4MΩ.
4	thermal_shutdown	This bit indicates that the charging IC is in thermal shutdown protection due to an excessively high die temperature (typically 160°C and above).
3	vin_ovlo	This bit indicates that the charging IC is in input voltage shutdown protection due to an input voltage above its protection shutdown threshold of approximately 38.6V (typical).
2	vin_gt_vbat	This bit indicates that the VIN pin input voltage is sufficiently above the BATSENS battery voltage to allow charging operation (typically +200mV).
1	intvcc_gt_4p3v	This bit indicates that the INTVCC voltage is above the switching charger undervoltage lockout threshold value of 4.3V (typical).
0	intvcc_gt2p8v	This bit indicates that the INTVCC pin voltage is above the measurement system undervoltage lockout threshold value of 2.8V (typical).

SECTION 7 **SERVICE AND REPAIRS**

7.1 TRAINGUARD EOT MODULAR SUBASSEMBLIES

The Trainguard EOT device is composed of six main modular subassemblies. These are as follows:

NYK:9000-90385-0XXX	Main Assembly (Xs designate case color, RF antenna and pipe configuration)
NYK:9000-90388-0XXX	Main Assembly with HP Manifold (Xs designate case color, RF antenna and pipe configuration)
NYK:9000-90386-000X	Sub Assembly Electronics Tray
NYK:9000-90387-0001	Dome Assembly
NYK:9000-90392-0001	Standard Manifold Assembly
NYK:9000-40300-0001	HP Manifold Assembly
NYK:9000-90395-000X	Front Cover Assembly
NYK:9000-90398-0001	Eyebolt Assembly

The electronics tray assembly contains the printed circuit board (PCB) assembly (the PCB assembly includes the displays, cell modem, GNSS receiver and manifold assembly interface), the radio transceiver, the High-Visibility Marker (HVM), and all antennas.

7.2 TOOLS REQUIRED

Proper servicing of the EOT can be accomplished with commonly used hand tools in the categories listed in the following table. Additional tools will be required if PCB or radio repairs are needed.

Table 7-1 Required Tools

Phillips head screwdrivers	5 - 50 in/lb. torque wrench
Nut driver set	Loctite® #248 solid stick
3/8” socket and ratchet set	Loctite® #425 purple thread coat
Allen wrench set	Feeler gauge set
Combination wrenches up to 1¼"	T25 Torx or star wrench (needed for the HP manifold air generator)

7.2.1 Housing Cover Assembly Removal

Refer to drawing NYK:9000-90385-0XXX or NYK:9000-90388-0XXX in the drawing section of this manual for details of the case assembly. The EOT has a two-piece, Polymer enclosure with a Polycarbonate dome. This enclosure is a high strength material that is unlikely to dent or deform.

To service the EOT as described in the following sections, follow this procedure to remove the front housing cover assembly:

1. Remove the dome by removing the eight screws and nuts holding it in place. If the EOT has an external antenna, it must be disconnected from the radio before the dome can be fully removed.
2. Separate the front housing cover and back case halves of the enclosure by removing the coupler mount eyebolt assembly, the ten screws and nuts on the two sides of the EOT and the four bolts on the bottom of the front housing cover (see drawing NYK:9000-90385-0XXX or NYK:9000-90388-0XXX).
3. Disconnect the two locking connectors (press the latch prior to pulling on the connector) for the START/ARM harness and charge port harness mounted in the front cover and connected to the PCB assembly, then lift the front cover off the EOT.

With the front cover removed, access to the main subassemblies is straightforward:

The electronics tray is held by four lock-tooth nuts that attach to the back-case assembly via standoffs and rubber shock mounts.

The internal UHF antenna, if equipped, is located on the front of the electronics tray.

The GNSS and cell antenna are located on the top bracket of the electronics tray and connect to the PCB via two male SMA connectors.

The electronics tray has either three (A90388 EOT) or four (A90385 EOT) connectors at the bottom that connect to the manifold assembly, and a 6-pin connector from the battery. These connectors must be unmated before removal of the electronics tray. Each connector has a latch that must be depressed to remove the connector. The battery connector and cable are attached to the front of the electronics tray with a small nut and cable tie to hold the cable in place. This nut must be removed before the electronics tray can be fully removed from the back-case assembly.

7.2.2 Antenna Service

The antennas on the Trainguard EOT should seldom, if ever, need to be serviced. The following instruction describes the procedures for removing the antennas. The UHF antenna (internal or external) is attached to the radio via a male SMA connector.

7.2.2.1 Procedure to Remove External UHF Antenna

If the EOT is equipped with an external UHF antenna, follow this procedure for removal:

1. Remove the eight screws and nuts that secure the dome assembly to the top of the EOT.
2. Unscrew the male SMA connector from the female SMA connector on the top of the UHF radio. Installation is in the reverse order.

To replace any broken or damaged parts of the external antenna assembly, refer to the NYK:9000-90387-000X Dome Assembly drawing included in this manual.

7.2.2.2 Procedure to Remove Internal UHF Antenna

To remove the internal UHF antenna, the NYK:9000-90395-000X Housing Cover assembly must be removed from the EOT to expose the internal Electronics Tray. Section 7.2.1 of this manual provides instructions for removing the housing cover assembly. Once the housing cover is removed, the UHF antenna male SMA connector can be disconnected from the UHF radio, using the following procedure:

1. Remove the five screws securing the UHF radio to the electronics tray to gain access to the bottom screws securing the UHF antenna to the electronics tray.
2. Remove the two screws and nuts at the top of the UHF antenna, which secure the antenna to the CELL/GPS antenna bracket and then remove the two screws on the bottom of the antenna to remove the UHF antenna. Installation is in the reverse order.

7.2.2.3 Procedure to Remove GNSS and Cell Modem Combo Antenna

The GNSS antenna and the cell modem antenna are a combination (combo) antenna that is part of the electronics tray assembly (see drawing NYK:9000-90386-000X). To replace the combo antenna, follow this procedure:

1. Remove the electronics tray as described in Section 7.2.1.
2. Using an open-end wrench, carefully disconnect the SMA male connectors from the combo antenna to the PCB assembly (A90396) of the electronics tray. The GNSS and modem antenna cables are permanently attached to the combo antenna.
3. Cut the three small cable ties securing the combo antenna to the bracket. The combo antenna is also secured to the bracket with double sided tape.
4. Carefully remove the antenna from the bracket. Low level heat would be useful to loosen up the adhesive on the tape but be cautious not to apply to much heat because it could damage the surrounding parts.
5. Once the combo antenna is removed, all adhesive residue will have to be removed from the bracket before installing a new combo antenna.
6. The new combo antenna will come with a new piece of double-sided tape pre-cut to the proper size and an alcohol pad to prep the antenna and bracket for installation. Be sure to install the antenna with the side marked “Face to Satellite” facing up.
7. Once the new combo antenna is secured with the double-sided tape, install the three cable ties in the pre-drilled holes on the bracket to secure the antenna and cables.
8. Connect the two combo antenna cables to the PCB (A90396) SMA connectors. The antenna cables are labeled as “LTE” and “GPS/GLO”. The mating SMA connectors on the PCB assembly (A90396) are marked as “CELL” and “GPS”. The cable labeled “LTE” connects to the SMA connector on the board labeled “CELL” and the cable labeled as GPS/GLO connects to the SMA connector labeled “GPS.”

7.2.3 Battery Removal or Replacement

The battery is part of the EOT assembly (NYK:9000-90385-0XXX or NYK:9000-90388-0XXX). The battery is located behind the metal plate exposed once the electronics tray is removed. The metal plate is held in place by the 4 standoff/shock mount assemblies that the electronics tray mounts on. To replace the battery remove the four standoffs using a 3/8” open end wrench and lift off the metal cover to expose the battery. Place the new battery in the padded compartment in the same orientation as the old battery replace the metal cover and secure it with the four standoff/shock mount assemblies. Install the electronics tray and secure the new battery harness to the stud below the radio on the electronics tray with a new screw down zip tie.

⚠ WARNING

WARNING

BATTERIES ARE CAPABLE OF DELIVERING HUNDREDS OF AMPS IF SHORTED. DO NOT ALLOW BATTERY OR LEAD WIRES TO TOUCH THE CASE. DO NOT ALLOW TOOLS TO CAUSE A SHORT ACROSS THE BATTERY TERMINALS.

7.2.4 HVM Module

The high-visibility module (HVM) is mounted on the side of the electronics tray assembly. There are no user-serviceable parts on the HVM. If defective, replace the HVM module. To remove the HVM, first remove the electronics tray from the EOT case. Section 7.2.1 of this manual provides instructions for removing the electronics tray assembly. Remove the four screws securing the HVM to the electronics tray assembly (item 12 on sheet 1 of drawing NYK:9000-90386-000X) . The HVM has a single cable which plugs into the printed circuit board assembly. The HVM lens assembly (item 9 on drawing NYK:9000-90386-000X) and the HVM O-ring (item 17 on drawing NYK:9000-90386-000X) may also be replaced at this time. Install the HVM in the reverse order. Detail section B-B on the NYK:9000-90386-000X drawing shows the stack up of the three parts for installation.

7.2.5 Air Manifold

For details of the manifold assembly, refer to drawing NYK:9000-90392-0001 for the standard manifold assembly, or drawing NYK:9000-40300-0001 for the high-powered manifold assembly, in Section 9.0 of this manual.

The air manifold consists of the following components:

- emergency dump valve assembly
- dump valve solenoid
- air motor-generator assembly
- air generator stop solenoid (Standard Manifold assembly NYK:9000-90392-0001 only)
- pressure transducer.

All air channels are machined into the base of the module and the manifold block resulting in a compact, precision assembly with minimal external parts.

The air motor-generator consists of a compact 3-phase AC generator which is spun at a high RPM by the exhaust of brake pipe air past a saw-tooth shaped turbine wheel. The air spins the wheel, which in turn rotates the generator. The output of the AC generator is rectified and regulated on the electronics tray printed circuit board assembly. The AC generator provides current to run the EOT and recharge the battery. The air generator alone cannot provide all the power the EOT needs to operate during radio transmissions. However, on average, the generator outputs more than enough power to maintain the battery fully charged under most operating conditions. The air generator on the HP manifold (NYK:9000-40300-0001) provides a higher output current. Depending on conditions, the air generator can provide up to 2 amps of current.

The air supply to the turbine first passes through a filter screen and a solenoid valve. The filter can be accessed by removing the 3/8” hex-drive plug at the bottom of the manifold. The solenoid, when energized, blocks the flow of air into the motor-generator eliminating all air leakage. This allows the EOT emergency feature to be tested with bottled-up air pressure remaining in the EOT brake hose when the angle cock of the last car is closed.

The Emergency dump valve is a conventional pressure-differential valve. Brake Pipe pressure is applied to an inlet port which has an adjacent exhaust port. Both ports are covered by one side of a rubber diaphragm. Normally, the pressure of the inlet air would cause the diaphragm to move, exposing the outlet port, and allowing the flow of air. However, the inlet air is also ported to the opposite side of the diaphragm through a restricting orifice. This air, coupled with the force of a return spring, slightly exceeds the force of the inlet air. This keeps the diaphragm seated across both the inlet and outlet ports and the valve is thus “closed”. In the emergency dump position, a solenoid valve is energized which exhausts the restricted air on the opposite side of the diaphragm. The diaphragm then has pressure only on one side and the Brake Pipe air pressure is sufficient to push the diaphragm outward to expose the exhaust port. Air then flows through the valve out to atmosphere. The bottom of the exhaust port is protected with a slit cover to keep debris out of the valve.

7.2.6 Coupler Mount Assembly

Reference drawing NYK:9000-90385-0XXX or NYK:9000-90388-0XXX in the drawing section of this manual for details of the coupler mount assembly. Item numbers 6 (Clamp Base), 7 (Clamp base O-ring), 8 (Clamp Hook), 9 (Machine Key) and 26 (NYK:9000-90398-0001 Eye Bolt Assembly) make up the coupler mount assembly. The coupler mount consists of a stationary mounting mechanism with a “V” groove and an adjustable locking arm. This mounting arrangement is designed to provide a solid, secure attachment of the EOT to any E or F type coupler with coring holes. This mounting arrangement allows the EOT to be installed securely on the coupler without the use of tools. Tightening by hand and securing the handle with the latch is sufficient to keep this EOT in place. If the shaft is hard to turn, check for any bending in the screw shaft or moveable portion of the assembly.

7.2.7 Manifold Assembly Removal

7.2.7.1 Procedure for Standard Manifold

To remove the standard manifold assembly:

1. First remove the front housing cover assembly as described in Section 7.2.1 of this manual.
2. Disconnect the four manifold assembly connectors from the bottom of the printed circuit board assembly on the electronics tray.
3. Remove the five bolts at the bottom of the back case assembly that secure the manifold assembly to the U-channel bracket in the case.
4. The manifold can now be removed from the back half of the EOT case assembly.
5. Reference drawing NYK:9000-90392-0001, in Section 9.0 of this manual, for details of the standard manifold equipment. The manifold assembly consists of a valve cap and a manifold. The valves, transducer, and air generator are mounted to the valve cap. The emergency dump valve diaphragm is between the valve cap and the manifold. The air filter, inlet port, and exhaust port are on the manifold.

7.2.7.2 Procedure for HP Manifold

To remove the HP manifold assembly:

1. First remove the front housing cover assembly as described in Section 7.2.1 of this manual.
2. Disconnect the three-position triangular, and six-position rectangular manifold assembly connectors from the bottom of the printed circuit board assembly on the electronics tray. The four-position rectangular connector can remain connected to the E-Tray.
3. Disconnect the connector from the air generator motor to the NYK:9000-40320-0001 rev limiter PCBA mounted to the U-channel bracket.
4. Remove the five bolts at the bottom of the back case assembly that secure the manifold assembly to the U-channel bracket in the case.
5. The manifold can now be removed from the back half of the EOT case assembly.
6. Reference drawing NYK:9000-40300-0001, in Section 9.0 of this manual, for details of the HP manifold equipment. The manifold assembly consists of a valve cap and a manifold. The valve, transducer and air generator are mounted to the valve cap. The emergency dump valve diaphragm is between the valve cap and the manifold. The air filter, inlet port, and exhaust port are on the manifold.

7.2.8 Pressure Transducer

The pressure transducer has a removable connector harness. To disconnect, pry the plastic locking fingers of the connector away from the body of the transducer. Pull the connector up and away from the transducer. The pressure transducer may be removed from the air manifold using a 1 1/16” wrench but should only require replacement if the air pressure cannot be adjusted properly.

7.2.9 Air Motor Cut-off Solenoid (Standard Manifold Only)

This is the solenoid that has the U-shaped metal bracket around the valve body. Using a 9/16” wrench turn the nut on top of the solenoid counterclockwise to remove. The solenoid has an O-ring seal on the base which must be installed in the groove upon reassembly.

7.2.10 Emergency Valve and Solenoid

To service the emergency valve diaphragm, the valve cap must be removed from the manifold. The diaphragm is between the cap and the manifold. Note the orientation of the diaphragm before removing and be sure to install the replacement diaphragm in the same manner. Be careful to replace the spring and the O-ring seals when reassembling this part. When the diaphragm is removed, inspect the seating portion for wear and the flexible portion for cuts or tears. Be sure the diaphragm lies flat in the groove when reinstalling.

The dump valve solenoid has the harness terminated with the triangular connector. If the dump valve is not operating properly, check the screen filter for debris and make sure the passage is clear. If the valve must be replaced, use a 9/16” wrench to remove the top nut and then slide the coil off the valve stem. Remove the valve stem with a large flat blade screwdriver. The solenoid has an O-ring seal on the base which must be installed in the groove upon reassembly.

7.2.11 Air Generator Service

The air generator is a 3-phase AC generator assembly consisting of the air generator and rotor. The rotor is attached to the shaft by two set screws, 180 degrees apart, in the side of the rotor. The air generator is electrically connected to the printed circuit board assembly, which rectifies the air generator output to DC and regulates the voltage.

7.2.11.1 Air Generator Removal for Standard Manifold Assembly, A90392

To remove the air generator on the standard manifold assembly (NYK:9000-90392-00XX), remove the four 8-32 x ½" Allen head cap screws on the air motor cover plate (item 7 on the NYK:9000-90392-00XX drawing).

7.2.11.2 Air Generator Removal for HP Manifold Assembly, A40300

To remove the air generator on the HP manifold assembly (NYK:9000-40300-00XX), remove the four T25 button head screws on the air motor cover plate (items 18 and 17 on the NYK:9000-40300-00XX drawing).

NOTE

NOTE

The block orifice (item 13 on the NYK:9000-40300-00XX drawing) and the o-ring (item 12) will be removed from the manifold when the air generator is removed.

When reinstalling the air generator, ensure the o-ring is reinstalled with the block orifice and air generator. Reference drawing NYK:9000-40300-00XX for proper installation.

7.2.11.3 Possible Conditions Requiring Air Generator Removal

- **GEN NG Message** – The electronics on the EOT sense battery charging voltage. They will show the message GEN NG if the system is not providing enough power to charge the battery with a minimum of 50 psi air supply. This message may appear on the display temporarily and clear itself after a short time. This is not indicative of a problem. In general, if the display still shows GEN NG after 1 minute of continuous operation under pressure greater than 50 PSI, then the air generator should be removed and serviced or replaced.
- **Stuck Rotor** – If the air generator rotor is stuck, the air sounds like it is blowing through the device with nothing happening. Ensure the air pressure applied is 50 psi or more. If this is the case, remove the air generator and check the gap. To procedure to check the gap between the rotor and the cover plate for each manifold assembly is described as follows:
- For the air generator used on the standard manifold assembly (NYK:9000-90392-00XX), the gap between the rotor and the cover plate should be 0.010". If the gap is too small, the rotor will contact the cover plate, and if it is too large, the rotor will contact the housing. To set the gap, remove the two set screws and apply blue Loctite® stick to the threads. Replace the set screws and use a 0.010" feeler gauge to set the gap. Tighten both set screws evenly when the gap is correct.
- For the air generator used on the HP manifold assembly (NYK:9000-40300-00XX), the gap between the rotor and the cover plate should be 0.039 +/- .020". If the gap is too small or too large, the rotor could contact the cover plate or will not receive optimal air flow. To set the gap, remove the two set screws and apply blue Loctite® stick to the threads. Replace the set screws and use a 0.039 +/- .020" feeler gauge to set the gap. Tighten both set screws evenly when the gap is correct.
- **Noisy or bad bearings** – When the air generator is operating properly, the air generator will make a smooth high-pitched whine. If the bearings are bad or going bad, the air generator will have an uneven sound and / or a high frequency rattle. With a little experience, bad bearings are easy to detect. Although, an air generator should not be condemned simply because it sounds "strange". The air generator will produce diverse sounds with varying pitches depending on environmental conditions, actual battery charge, and load (system current demand). The air generator assembly cannot be repaired. If the bearings are bad, the output too low, or the gap cannot be set, the air generator assembly must be replaced.

7.2.11.4 Air Motor-generator Test

Any time the air generator is replaced, the air generator should be tested in the assembled manifold before fully reassembling the EOT. Monitor the generator voltage using the terminal interface. The manifold will have to be placed in the EOT back case assembly and the front cover assembly will have to be reconnected to the EOT. All the screws and bolts do not have to be installed to complete the check. Complete the following procedure to test the air generator:

1. Connect the computer to the EOT using the charge port adapter and follow the steps in Section 4.2 Serial Terminal Interface (Tera Term) to connect to the EOT.
2. Select the menu item 1) Factory Tests > 15) Generator Information. The values initially reported will be “0”, this is normal.
3. Apply compressed air and listen to air motor-generator. It should turn freely and spin without binding.
4. Increase the air pressure to 75 PSI and let it run for few seconds.

5. Press enter on the computer to display current Generator Information. The Vgen value reported on the terminal should be a minimum of 12.0 volts. This voltage could be significantly higher depending on the state of charge of the EOT battery. If the voltage is low, double check the electrical connections on the output of the motor or re-gap the turbine wheel.

7.2.12 Manifold Reinstallation

7.2.12.1.1 Procedure for Standard Manifold Reinstallation

To install the manifold assembly into the case, ensure that all electrical connections are mated and all mechanical items are tight. The manifold assembly harness connectors are different shapes and will only mate to the proper receptable on the printed circuit board assembly.

1. Reposition the manifold assembly in the U-channel of the EOT back case and line up the five large mounting holes with the corresponding holes in the base of the manifold assembly.
2. Coat the threads of the five bolts with purple Loctite® (89999) and hand tighten each bolt in one of the manifold mounting holes. The longer bolts go through the two lower holes of the coupler base assembly. Do not tighten the five bolts completely until the front cover is applied to the EOT and eyebolt assembly is threaded into the clamp hook/base.
3. Hand tighten the four bolts on the front cover assembly that thread in to the manifold.
4. After the cover is in place and the eye bolt is started and hand tightened into the clamp/hook base assembly, use a 3/8” socket and tighten the nine manifold assembly bolts to 50 in/lbs.

7.2.12.1.2 Procedure for HP Manifold Reinstallation

To install the manifold assembly into the case, ensure that all electrical connections are mated and all mechanical items are tight.

1. Reposition the manifold assembly in the U-channel of the EOT back case and line up the five large mounting holes with the corresponding holes in the base of the manifold assembly.
2. Coat the threads of the five bolts with purple Loctite® (89999) and hand tighten each bolt in one of the manifold mounting holes. The longer bolts go through the two lower holes of the coupler base assembly. Do not tighten the five bolts completely until the front cover is applied to the EOT and eyebolt assembly is threaded into the clamp hook/base.
3. Hand tighten the four bolts on the front cover assembly that thread into the manifold.
4. After the cover is in place and the eye bolt is started and hand tightened into the clamp/hook base assembly, use a 3/8" socket and tighten the nine manifold assembly bolts to 50 in/lbs.
5. Connect the two connectors from the manifold assembly to the E-Tray PCBA. The manifold assembly harness connectors are different shapes and will only mate to the proper receptable on the printed circuit board assembly.
6. Connect the air generator motor connector to the NYK:9000-40320-0001 rev limiter PCBA.

7.3 ELECTRONIC TRAY

7.3.1 Removal

The electronics tray (NYK:9000-90386-0001) consists of the printed circuit board assembly (NYK:9000-90396-0001), a radio module (NYK:Z927-04886-0000), the combo GPS/CELL antenna array the HVM assembly (NYK:9000-90354-0002) and the UHF antenna (NYK:9000-90399-0001) if the EOT is the internal antenna model or E-Tray stiffener (NYK:Z660-39999-0001) if the EOT is the external antenna model. The radio module is mounted on the outside of the electronics tray metal chassis and is connected to the PCB assembly via a harness (NYK:9000-26790-0001). The HVM is mounted to one side of the electronics tray and is connected to the PCB assembly via a cable . The GPS/CELL combo antenna is mounted to the electronics tray top bracket (NYK:Z610-39960-0001). The electronics tray is held in the EOT housing by four lock tooth nuts and four standoff shock mount assemblies secured to the EOT back case half.

To remove the electronics package, follow this procedure:

1. The front cover assembly of the EOT must be removed first, as described in Section 7.2.1 of this manual.
2. Next, remove the four lock tooth nuts that secure the E-Tray to the EOT back case standoff/shock mounts.
3. Disconnect the four manifold assembly harnesses and the battery harness. The battery harness is also secured to a threaded stud on E-Tray assembly.
4. The lock nut securing the battery harness cable tie must also be removed before the E-tray can be fully removed from the EOT assembly.

7.3.2 A90396 Printed Circuit Board (PCB) Assembly

This module provides all EOT functions including local user interface (pressure displays, alphanumeric message display, LEDs, pushbutton, USB and Wi-Fi), cell modem and GNSS, communications functions, event logging, HVM control, battery charging, and manifold assembly control. The printed circuit board (PCB) assembly interfaces with the radio directly and with an external computer via the charging port, Wi-Fi, or USB. The main application program, device memory and event recorder are on this module. This module contains no easily serviceable parts other than the SD card and SIM card.

To remove the PCB from the E-Tray assembly, follow this procedure:

1. First remove the foam gasket material near the bottom of the assembly right above the four manifold connectors.
2. Disconnect the radio harness, HVM harness and GPS/CELL combo antenna SMA connectors from the PCB.
3. Remove the eleven lock tooth screws and two screws with spacers and nylocs securing the PCB assembly to the E-Tray metal chassis and combo antenna bracket.
4. Lift the PCB out of the chassis. Installation is in the reverse order.

7.3.3 Radio Module

The Ritron UHF transceiver is attached to the front of the E-Tray metal chassis. To remove the UHF transceiver, disconnect the UHF antenna SMA connector and UHF radio harness. Remove the five lock tooth screws that secure the radio to the front of the E-Tray assembly. Installation of the radio is in the reverse order.

There is no expected or periodic maintenance that requires access to the UHF radio hardware. All radio programming, alignment and configuration tasks are performed externally to the Electronics Tray without need to access the radio transceiver circuitry.

In case low level maintenance is required, please refer to specific documentation on the DTX-445 UHF transceiver available from Ritron. After working on the radio module, be sure the DB-15 connector on the module is tight.

7.4 RADIO ALIGNMENT

7.4.1 Required Equipment

- A radio service monitor with SINAD meter
- DTX 145 / 445 Ritron DTX-445 Maintenance Manual
- DTXL-PCPS Ritron DTX-445 Programming Kit
- Computer running Windows® with an available serial port or USB port and serial adapter.

7.4.2 Ritron Telemetry Radio

The radio used in the EOT is a variation of the DTX-445 transceiver manufactured by Ritron and is proprietary to Siemens. Replacement radios may be ordered from Siemens. Service manuals and general documentation may be obtained from Ritron at:

Ritron Inc.
Attn: Sales Department
505 West Carmel Drive
Carmel, IN 46032
Phone: 800-872-1872
Fax: 800-251-7329
Website: www.ritron.com

The DTX-445 radio is a synthesized telemetry radio. All settings and calibration parameter adjustments, including frequency, power, deviation, and sensitivity are made using a software program which is available from Ritron (part number DTXP-PCPS).

7.4.3 Ritron Radio Adjustments

Radios obtained from Siemens are factory set for the required operating parameters, including frequency, transmit deviation limit and audio output level. These settings are preset and only need to be verified when the radio is serviced.

NOTE

NOTE

These radio adjustment procedures are a summary only. For complete instructions, troubleshooting, and alignment, refer to the Ritron Maintenance Manual.

NOTE

NOTE

There is no expected or periodic maintenance that requires access to the UHF radio hardware. All radio programming, alignment and configuration tasks are performed with just the EOT clear dome removed. There is no need to access the radio transceiver circuitry. In case low level maintenance is required, please refer to specific documentation on the DTX-445 UHF transceiver, available from Ritron.

7.4.4 Setup

1. To make radio adjustments, connect the appropriate Z680-39951-0001 port adapter to the EOT charge port, and connect a serial interface of the computer to the “RADIO PROG” DB-15 connector on the adapter using the Ritron radio programming cable.
2. Connect a second serial interface of the computer to the EOT using the charge port adapter “COMPUTER” DB-9 connector and follow the steps in Section 4.2, *Serial Interface* (Tera Term) to connect to the EOT with a terminal emulator such as Tera Term.
3. On the terminal Select the menu item 1) Factory Tests > 11) UHF Radio Test.
4. On the computer, start the Ritron radio programmer software (DTXL-PCPS) to perform radio adjustment tasks.
5. Select Radio \ Read Radio. The programmer will update with current radio data. Verify under “Description” all channels read “Rx: 452.9375, 00 None, Tx: 457.9375, 00 None, WB”. (Note that the transmitter is set to wide-band but operates within the confines of FCC narrow-band regulations.)

7.4.5 Transmitter

1. Remove the EOT UHF antenna SMA connector and connect a coaxial cable between the SMA connector on the radio and the Service Monitor RF input (ensure the Service Monitor RF input is capable of handling at least 10 Watts of power). Set the Service Monitor to receive at 457.9375 MHz. During transmitter testing, observe the 20 seconds-ON and 2 minutes-OFF guidelines.
2. On the computer terminal select 1) Send a 5 second mark (1200 Hz) with PTT to force the EOT to transmit a 1200 Hz tone for 5 seconds. Verify that the output power measured by the Service Monitor is between 7.5 and 8.5 Watts (this will vary with battery voltage, so ensure the battery is fully charged prior to performing this test). If the power is too low or too high, adjust the output power setting on the radio using the DTXL-PCPS utility.
3. Verify on the Service Monitor that the frequency error is within + / - 100 Hz. If the center frequency error is outside this range, adjust the center frequency setting on the radio using the DTXL-PCPS utility.
4. Verify the deviation reading on the Service Monitor is within 2.20-2.45 KHz. Adjust the transmit deviation setting on the radio using the DTXL-PCPS utility if needed. Options 3 and 4 under 11) UHF Radio Tests on the EOT terminal interface can be useful if deviation must be adjusted. These options send a continuous 1200Hz or 1800HZ tone without transmitting the radio. If used in conjunction with the Ritron DTXL-PCPS>User Setup option with the “User selected Channel pins 1,2,3”, when the “TX Auxiliary Gain In” is adjusted the user can verify the transmit deviation real time on the CSM. Be sure to select option 5 on the EOT terminal after the adjustment is made to stop sending the continuous tone.

7.4.6 Receiver

RX Audio Level

1. Disconnect the EOT UHF antenna and connect a coaxial cable between the SMA connector on the radio and the Service Monitor RF output. Set the Service Monitor to transmit at 452.9375 MHz. Adjust the tone generator on the Service Monitor to 1 kHz with 2.5 kHz deviation. Adjust the output level to -93 dBm (5.01 µV).
2. Connect a coaxial cable between the RX AUDIO BNC jack on the port adapter and the audio frequency input jack on the Service Monitor if the Service Monitor has an audio meter or an Oscilloscope can be used.
3. Verify the RX Audio signal level is .96 to 1.05 Vp-p or 340-370 mVrms. If the receive audio level is out of range, adjust the RX Auxiliary Gain Out setting using the DTXL-PCPS utility.

SINAD Measurement

1. Disconnect the EOT UHF antenna and connect a coaxial cable between the SMA connector on the radio and the Service Monitor RF output. Set the Service Monitor to transmit at 452.9375 MHz. Adjust the tone generator on the Service Monitor to 1 kHz with 2.5 kHz deviation. Adjust the output level to -117.3 dBm (0.305 µV).
2. Connect a coaxial cable between the RX AUDIO BNC jack on the port adapter and the audio frequency input jack on the Service Monitor.
3. On the Service Monitor, verify that SINAD reads >12dB.

Table 7-2 UHF DTX-445 General Specifications

Parameter	Value	
FCC ID:	AIERIT17-445	
IC ID:	1084A-RIT17445	
FCC Rule Parts:	90	
IC Rule Parts:	RSS-119	
Frequency Range:		
	400.6 – 416.5* MHz	
	411 – 429* MHz	
	450 – 470 MHz	
Synthesizer Step:	6.25 kHz	
Channel Spacing	12.5 kHz	
RF Channels:	8 Independent TX / RX frequencies	
Frequencies unusable in 406.6 – 416.5 MHz band:	None. All 6.25 kHz steps available	
Frequencies unusable in 411 – 429 MHz band		
Unusable 6.25 kHz steps	**RX**	**TX**
	417.60000	417.58750
	418.03750	417.58750
	418.04375	417.58750
	418.05625	417.58750
	418.06250	
Frequencies unusable in 450 – 470 MHz band		
Unusable 6.25 kHz steps	**RX**	**TX**
	460.80000	460.78750
	461.23750	460.79375
	461.24375	460.80625
	461.25625	460.81250
	461.26250	
Frequency Stability:	+ / - 1.5 PPM (-30° to +60°)	
Tone / Code Signaling:	CTCSS (Quiet Call) and DCS	
Power Supply:	9 to 17 VDC	
Current Drain		
RX Standby:	25 mA at 12.5 VDC	
Transmit:	1.8 Amp @ 8 Watts at 12.5 VDC	
Transmit:	1.8 Amp @ 10 Watts at 14 VDC	

Parameter	Value	
Dimensions & Weight	**Dimensions**	**Weight**
Board only version:	4.75” x 2.8” x .625”	2.1 oz.
Shielded version:	4.75” x 2.8” x .625”	3.4 oz.
Encased version:	5.7” x 3” x 1.375”	7.3 oz.
Antenna Fitting:	BNC female with encased version. Other options available on board only version.	
Transmitter Duty Cycle:		
8 W board only model	100% with added heat sink** maintained at 25°	
8 W encased model	33% with case end cap*** maintained at 25° C	
5 W encased model	50% with case end cap*** maintained at 25° C	
(with heat sink or case end cap above 25° C, degrades linearly to 0% at 60° C)		
*pending model **a heatsink can be added to the board only versions using the two holes next to the RF PA shield ** case end cap refers to aluminum end cap on opposite side from connectors.		

Table 7-3 DTX-445 Receiver Specifications

Parameter	Value	
	25 kHz Wide band	12.5 kHz Narrow band
Sensitivity (12 dB SINAD):	0.25 µV	0.25 µV
Adjacent channel:	-67 dB	-60 dB
Spurious rejection:	-70 dB	-70 dB
Image rejection:	-75 dB	-75 dB
Intermodulation:	-67 dB	-67 dB
FM hum and noise:	-43 dB	-37 dB
Conducted spurious:	-57 dB	-57 dB
Receiver attack time (TX to RX):	< 10 ms	< 10 ms
Noise squelch attack time: (for 20 dB quieting)	< 15 ms	< 15 ms
RSSI squelch attack time:	< 5 ms	< 5 ms
RSSI squelch sensitivity:	PC adjustable; factory set for -106 dBm	
Noise squelch sensitivity:	PC adjustable; factory set for -121 dBm	
AUX OUT frequency response:	12 – 2500 Hz @ +1 / -3 dB	
AUX OUT level range:	0 to 3 Volts peak-to-peak	
Audio Speaker Output:	>700 mW into 8Ω, with less than 5% THD (0 to 2.5 Vrms)	
Audio Speaker freq response:	De-emphasized 6 dB / octave from 400 to 2500 Hz	

Table 7-4 DTX-445 Transmitter Specifications

Parameter	Value	
RF Power Output:	2 watts @ 12.5 VDC < .9 A	
	8 watts @ 12.5 VDC < 1.8 A	
	10 watts @ 14 VDC < 1.8 A	
Voice Emission Designator:	15K0F3E	10K0F3E
Data Emissions Designator for external modem:		9K8F1D
Deviation:	+ / - 5 kHz	+ / - 2.5 kHz
Transmitter attack time:	< 10 ms	< 10 ms
FM Hum and Noise:	-45 dB	-40dB
Audio Distortion:	< 5%	< 5%
Spurious Harmonics:	-25 dBm max	
AUX In frequency response:	8 Hz to 2500 Hz @ +1 / -3 dB	
AUX In level range:	0.1 to 5 V peak-to-peak	
Microphone freq response:	Pre-emphasized 6 dB / octave from 300 to 2500 Hz	
Microphone level:	25 mV rms for nominal + / - 3 kHz deviation on wideband channel	

SECTION 8 **WARRANTY**

To obtain expedited warranty claim service, expedited repair service, or if special shipping arrangements are required for the return of any Siemens product, please contact Siemens to obtain a Return Material Authorization (RMA#).

8.1 WARRANTY POLICY

All Siemens equipment, excluding credit card memory or other similar devices that already carry a manufacturer's warranty, is warranted against failure, due to materials or workmanship, for a period of two (2) years commencing on the month of manufacture. Replacement parts are warranted for a period of one (1) year, excluding customer-supplied material. Siemens will repair or replace, at our discretion, all defective material returned to our factory in Marion, Kentucky prepaid. The equipment will be fully repaired and tested to the original equipment specifications. Equipment will be returned at the equipment owners' expense with the existing warranty in effect.

Refer to the date on the "accepted by" sticker located on the unit to be repaired to determine the initiation of the warranty period for Siemens equipment. However, if the unit has been repaired, the "accepted by" sticker is replaced by a "repaired by" sticker. In that case the warranty would be one year from the date of repair.

The serial number code is as follows:

M1XXXXXXXXX…

Where M1 indicates manufactured in Marion, KY and the number is a sequential serial number assignment.

8.2 REPAIR POLICY

Equipment must be shipped to the following address. Equipment which has exceeded the warranty period must be shipped freight pre-paid to our factory, unless other arrangements have been previously negotiated. Repair charges will be estimated and charged upon determination of the extent of damage, current costs of parts, and labor. Return shipping is the responsibility of the equipment owner and will be charged accordingly.

Return all equipment to:

Siemens Mobility, Inc.,
Field Repair Department,
939 S. Main St.,
Marion, KY 42064, USA

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SECTION 9 **DRAWINGS**

The following lists all applicable Siemens drawings and their corresponding revision levels (at time of publication) for the Trainguard EOT device (A90385) and the High-Power (HP) Trainguard (EOT) device (A90388). These drawings are included in this manual.

Table 9-1 List of Applicable Drawings

Mech Drawing	Description	Revision
NYK:9000-90385-0XXX	End-of-Train (EOT) Main Assembly	B
NYK:9000-90388-0XXX	End-of-Train (EOT) Main Assembly with HP Manifold	A
NYK:9000-90386-000X	Subassembly, Electronics Tray	B
NYK:9000-90387-000X	Subassembly, EOT Dome	A
NYK:9000-90392-0001	Manifold Assembly	3
NYK:9000-40300-0001	HP Manifold Assembly	A
NYK:9000-90395-000X	Housing Cover Assembly	4
NYK:9000-90398-0001	Eyebolt Assembly	3

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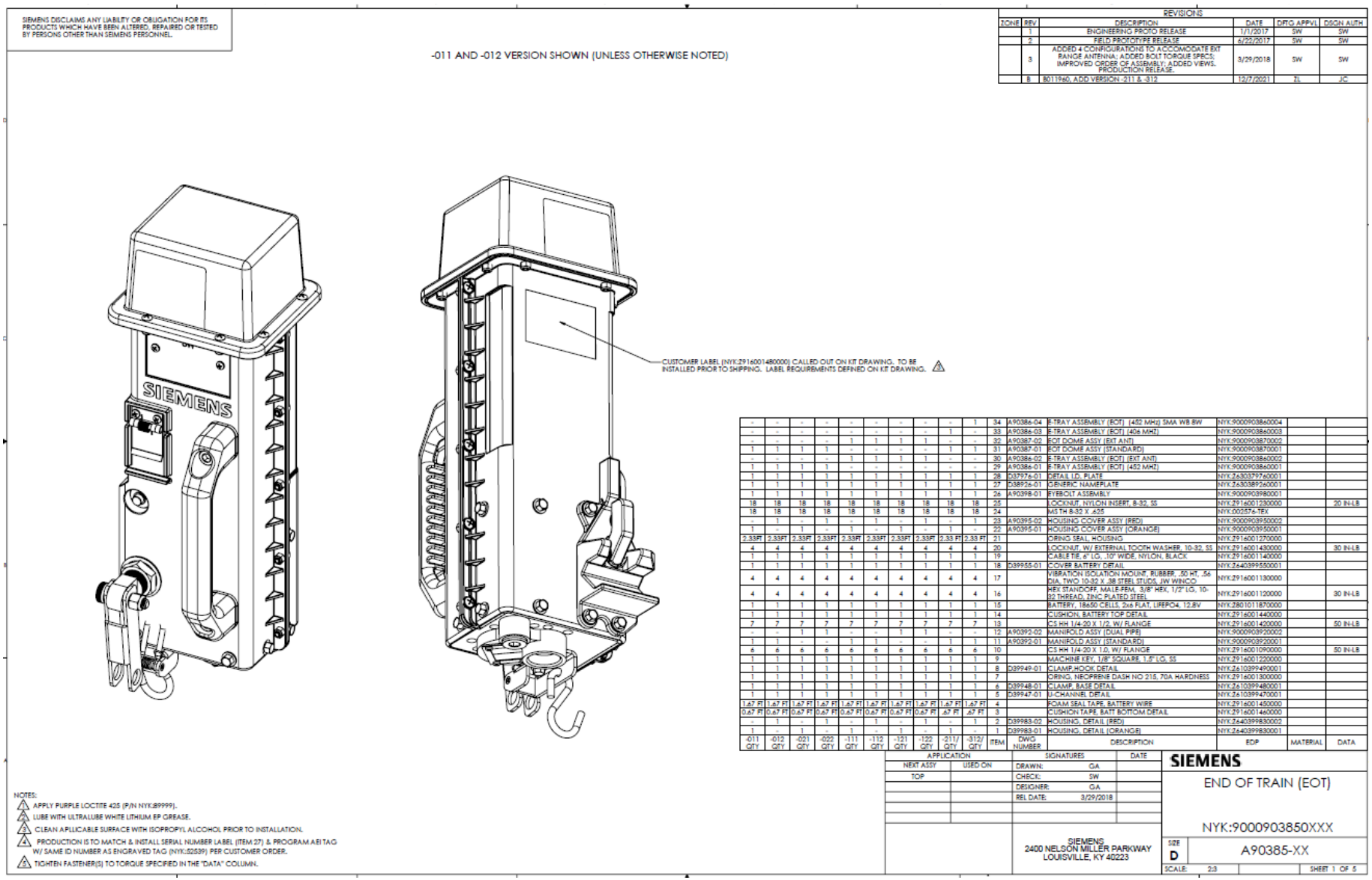


-011 QTY	-012 QTY	-021 QTY	-022 QTY	-111 QTY	-112 QTY	-121 QTY	-122 QTY	-211/ QTY	-312/ QTY	ITEM	DWG NUMBER	DESCRIPTION	EDP	MATERIAL	DATA
-	-	-	-	-	-	-	-	-	1	34	A90386-04	E-TRAY ASSEMBLY (EOT) (452 MHz) SMA WB BW	NYK:9000903860004		
-	-	-	-	-	-	-	-	1	-	33	A90386-03	E-TRAY ASSEMBLY (EOT) (406 MHZ)	NYK:9000903860003		
-	-	-	-	1	1	1	1	-	-	32	A90387-02	EOT DOME ASSY (EXT ANT)	NYK:9000903870002		
1	1	1	1	-	-	-	-	1	1	31	A90387-01	EOT DOME ASSY (STANDARD)	NYK:9000903870001		
-	-	-	-	1	1	1	1	-	-	30	A90386-02	E-TRAY ASSEMBLY (EOT) (EXT ANT)	NYK:9000903860002		
1	1	1	1	-	-	-	-	1	1	29	A90386-01	E-TRAY ASSEMBLY (EOT) (452 MHZ)	NYK:9000903860001		
1	1	1	1	1	1	1	1	1	1	28	D37976-01	DETAIL I.D. PLATE	NYK:Za3037976x0001		
1	1	1	1	1	1	1	1	1	1	27	D38926-01	GENERIC NAMEPLATE	NYK:Za3038926x0001		
1	1	1	1	1	1	1	1	1	1	26	A90398-01	EYEBOLT ASSEMBLY	NYK:9000903980001		
18	18	18	18	18	18	18	18	18	18	25		LOCKNUT, NYLON INSERT, 8-32, SS	NYK:Z916001230000		20 IN-LB
18	18	18	18	18	18	18	18	18	18	24		MS TH 8-32 X .625	NYK:002576-TEX		
-	1	-	1	-	1	-	1	-	1	23	A90395-02	HOUSING COVER ASSY (RED)	NYK:9000903950002		
1	-	1	-	1	-	1	-	1	-	22	A90395-01	HOUSING COVER ASSY (ORANGE)	NYK:9000903950001		
2.33FT	2.33FT	2.33FT	2.33FT	2.33FT	2.33FT	2.33FT	2.33FT	2.33 FT	2.33 FT	21		ORING SEAL, HOUSING	NYK:Z916001270000		
4	4	4	4	4	4	4	4	4	4	20		LOCKNUT, W/ EXTERNAL TOOTH WASHER, 10-32, SS	NYK:Z916001430000		30 IN-LB
1	1	1	1	1	1	1	1	1	1	19		CABLE TIE, 6" LG, .10" WIDE, NYLON, BLACK	NYK:Z916001140000		
1	1	1	1	1	1	1	1	1	1	18	D39955-01	COVER BATTERY DETAIL	NYK:Z640399550001		
4	4	4	4	4	4	4	4	4	4	17		VIBRATION ISOLATION MOUNT, RUBBER, .50 HT, .56 DIA, TWO 10-32 X .38 STEEL STUDS, JW WINCO	NYK:Z916001130000		
4	4	4	4	4	4	4	4	4	4	16		HEX STANDOFF, MALE-FEM, 3/8" HEX, 1/2" LG, 10-32 THREAD, ZINC PLATED STEEL	NYK:Z916001120000		30 IN-LB
1	1	1	1	1	1	1	1	1	1	15		BATTERY, 18650 CELLS, 2x6 FLAT, LIFEPO4, 12.8V	NYK:Z801011870000		
1	1	1	1	1	1	1	1	1	1	14		CUSHION, BATTERY TOP DETAIL	NYK:Z916001440000		
7	7	7	7	7	7	7	7	7	7	13		CS HH 1/4-20 X 1/2, W/ FLANGE	NYK:Z916001420000		50 IN-LB
-	-	1	1	-	-	1	1	-	-	12	A90392-02	MANIFOLD ASSY (DUAL PIPE)	NYK:9000903920002		
1	1	-	-	1	1	-	-	1	1	11	A90392-01	MANIFOLD ASSY (STANDARD)	NYK:9000903920001		
6	6	6	6	6	6	6	6	6	6	10		CS HH 1/4-20 X 1.0, W/ FLANGE	NYK:Z916001090000		50 IN-LB
1	1	1	1	1	1	1	1	1	1	9		MACHINE KEY, 1/8" SQUARE, 1.5" LG, SS	NYK:Z916001220000		
1	1	1	1	1	1	1	1	1	1	8	D39949-01	CLAMP HOOK DETAIL	NYK:Za1039949001		
1	1	1	1	1	1	1	1	1	1	7		ORING, NEOPRENE DASH NO 215, 70A HARDNESS	NYK:Z916001300000		
1	1	1	1	1	1	1	1	1	1	6	D39948-01	CLAMP, BASE DETAIL	NYK:Za1039948001		
1	1	1	1	1	1	1	1	1	1	5	D39947-01	U-CHANNEL DETAIL	NYK:Za1039947001		
1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	1.67 FT	4		FOAM SEAL TAPE, BATTERY WIRE	NYK:Z916001450000		
0.67 FT	0.67 FT	0.67 FT	0.67 FT	0.67 FT	0.67 FT	0.67 FT	0.67 FT	.67 FT	.67 FT	3		CUSHION TAPE, BATT BOTTOM DETAIL	NYK:Z916001460000		
-	1	-	1	-	1	-	1	-	1	2	D39983-02	HOUSING, DETAIL (RED)	NYK:Z640399830002		
1	-	1	-	1	-	1	-	1	-	1	D39983-01	HOUSING, DETAIL (ORANGE)	NYK:Z640399830001		

Figure 9-1 Main Assembly, A90385 Sheet 1

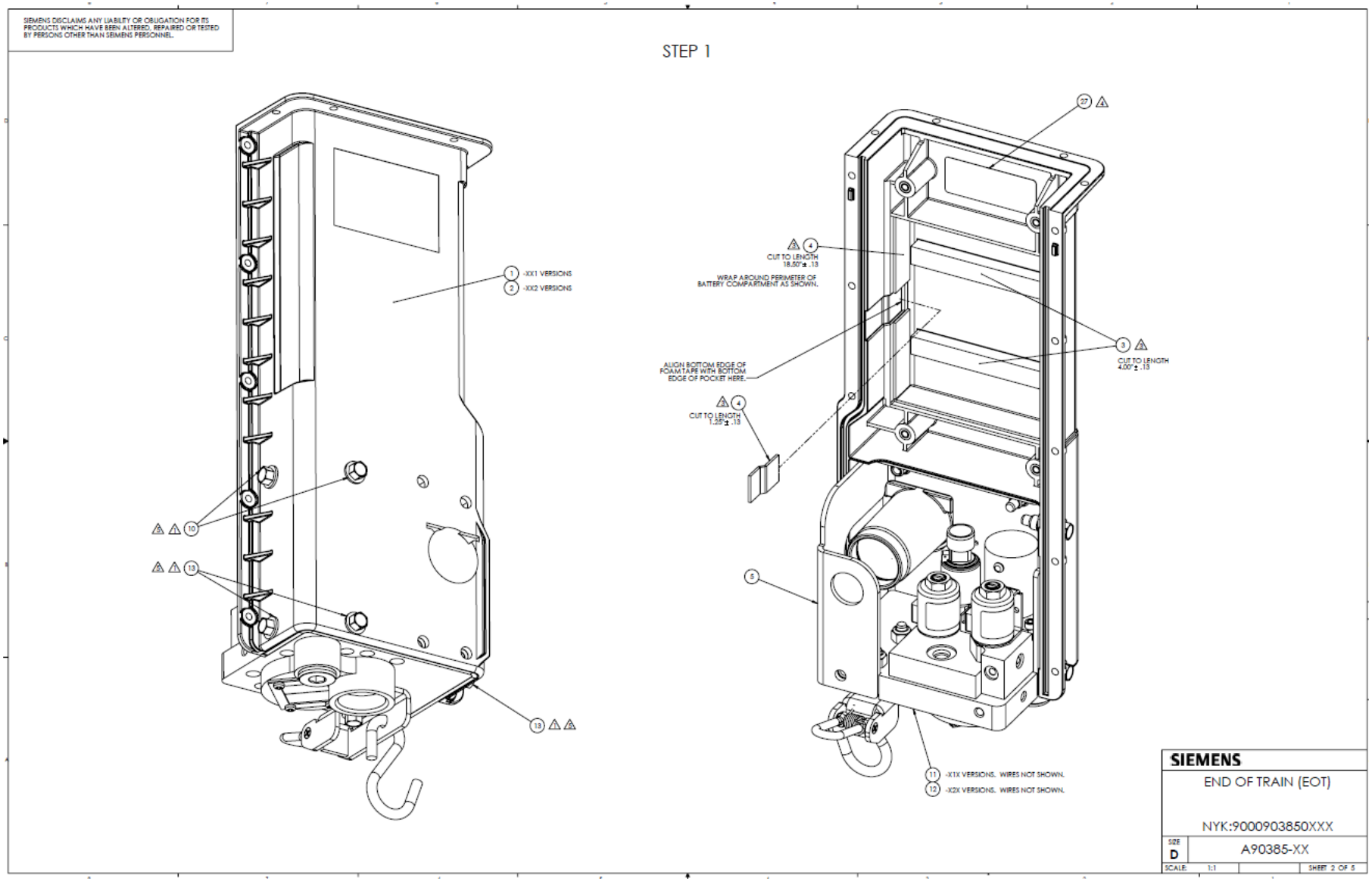


Figure 9-2 Main Assembly, A90385 Sheet 2

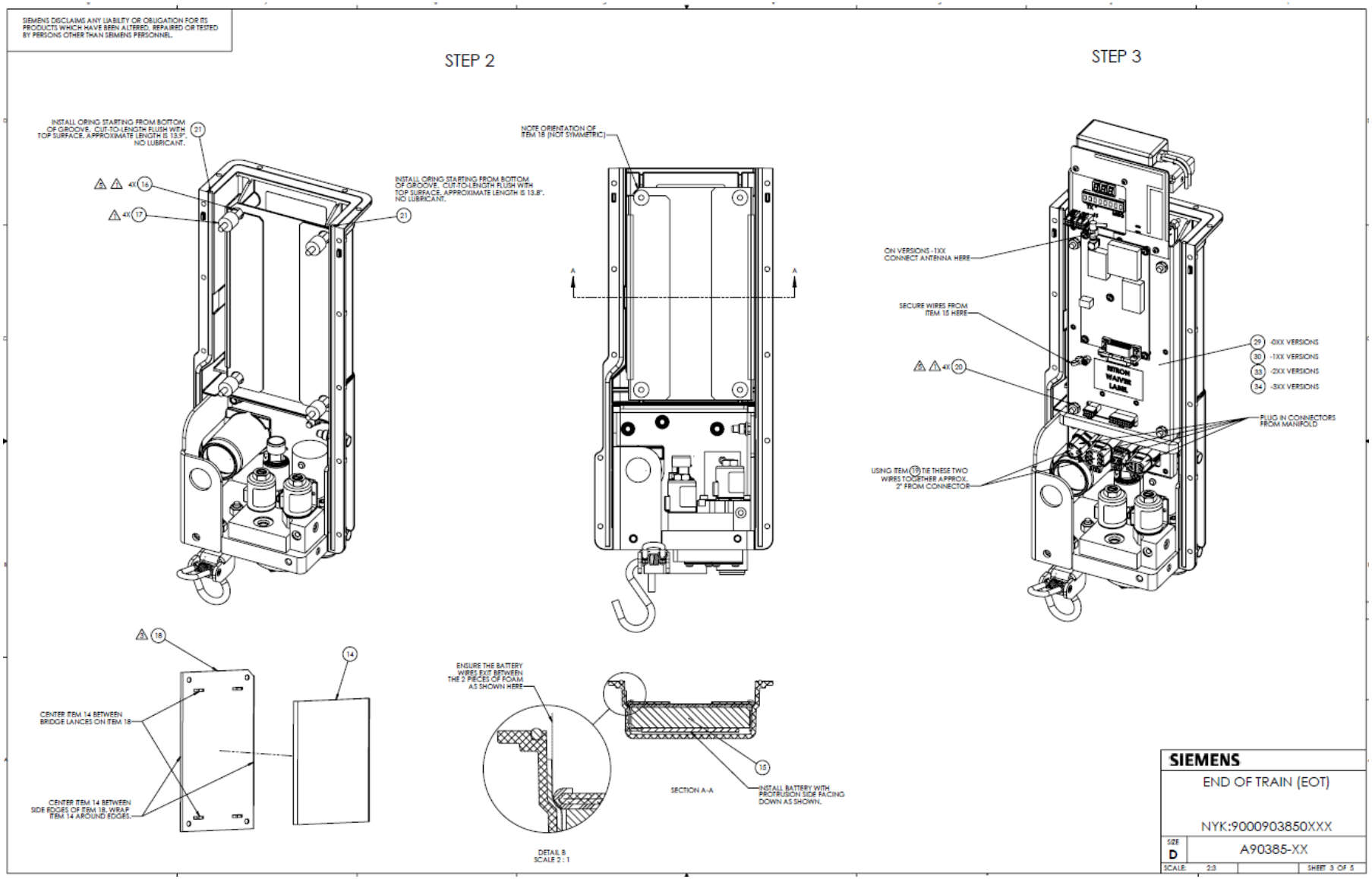


Figure 9-3 Main Assembly, A90385 Sheet 3

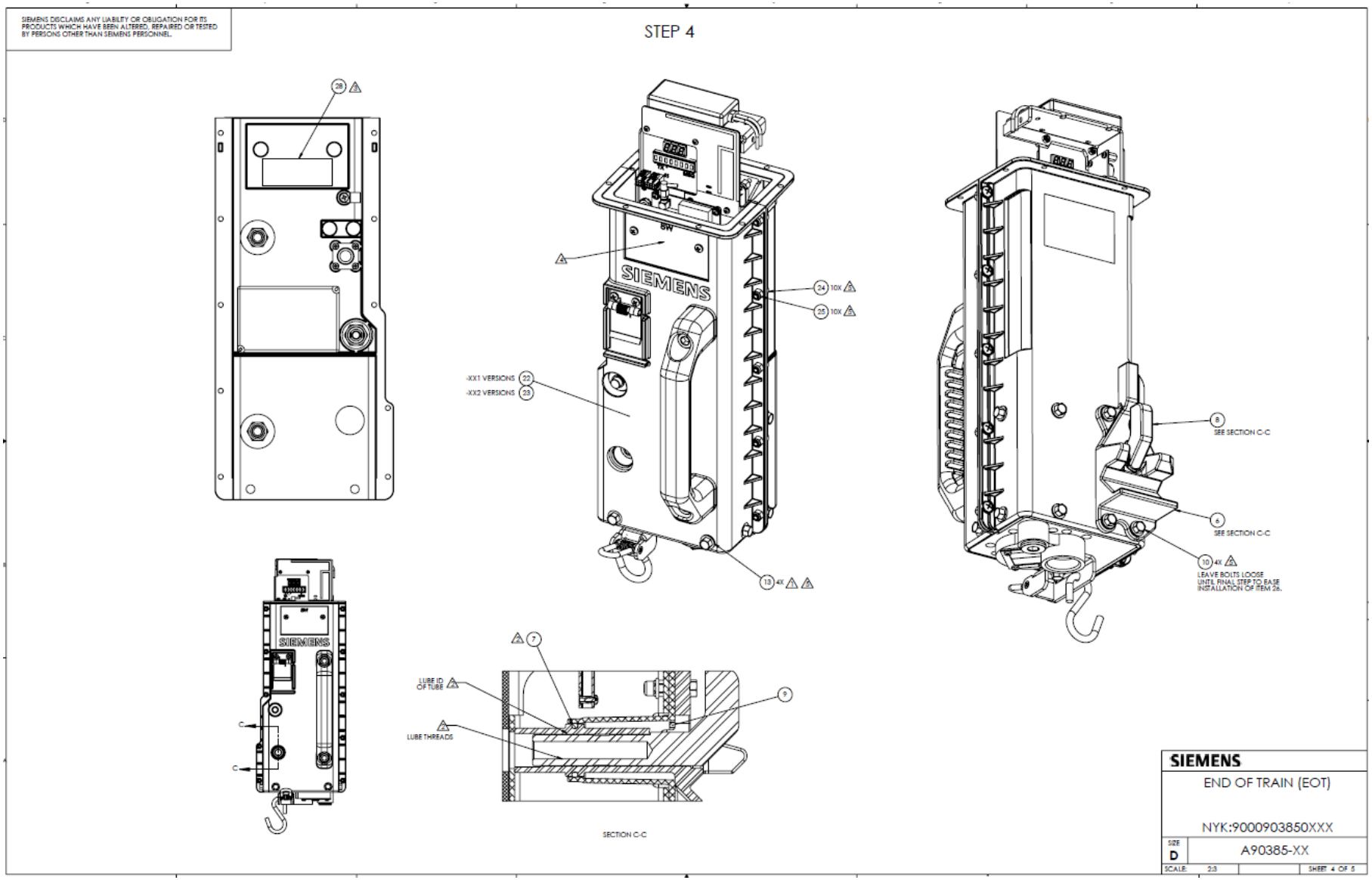


Figure 9-4 Main Assembly, A90385 Sheet 4

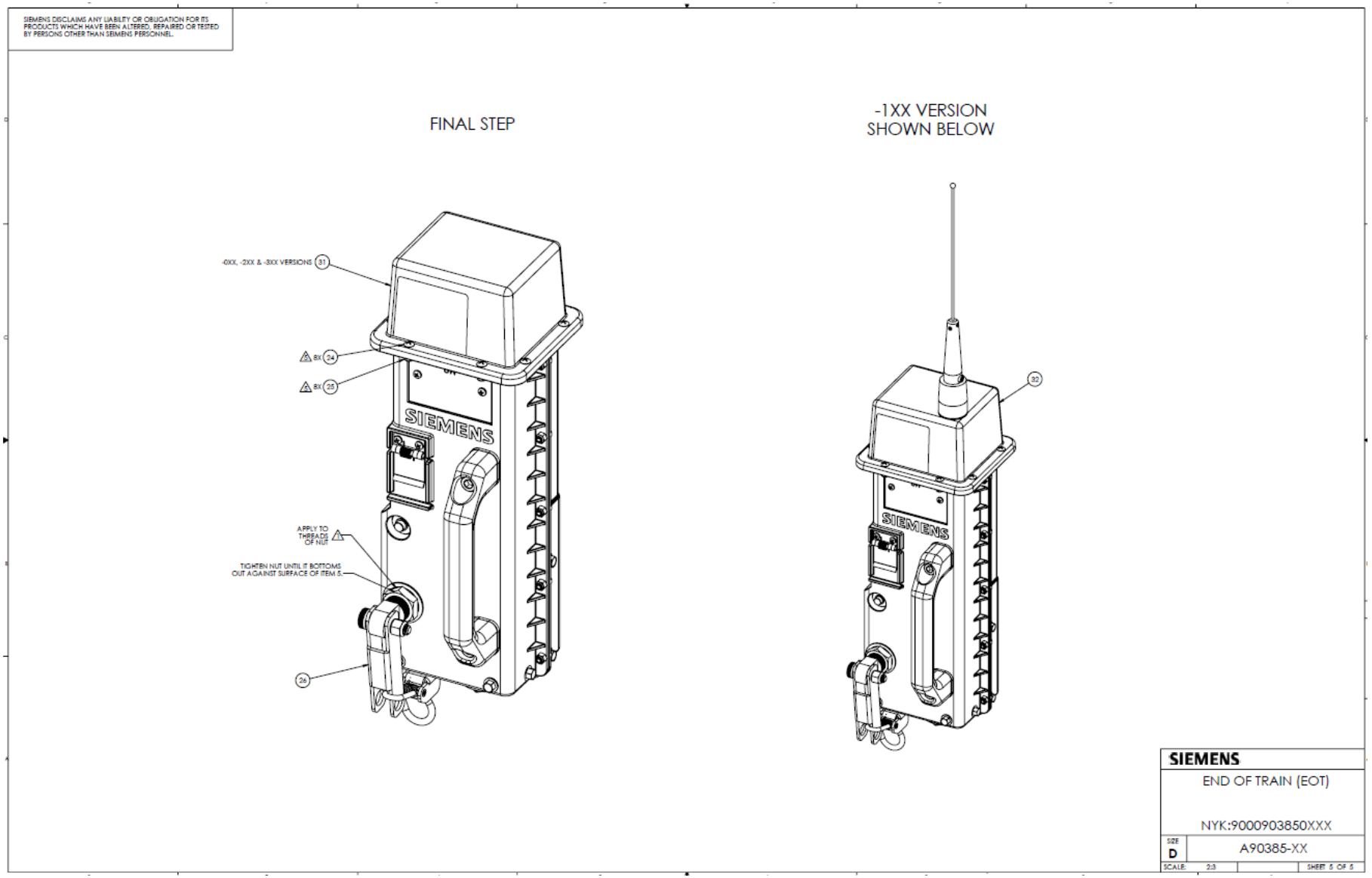


Figure 9-5 Main Assembly, A90385 Sheet 5

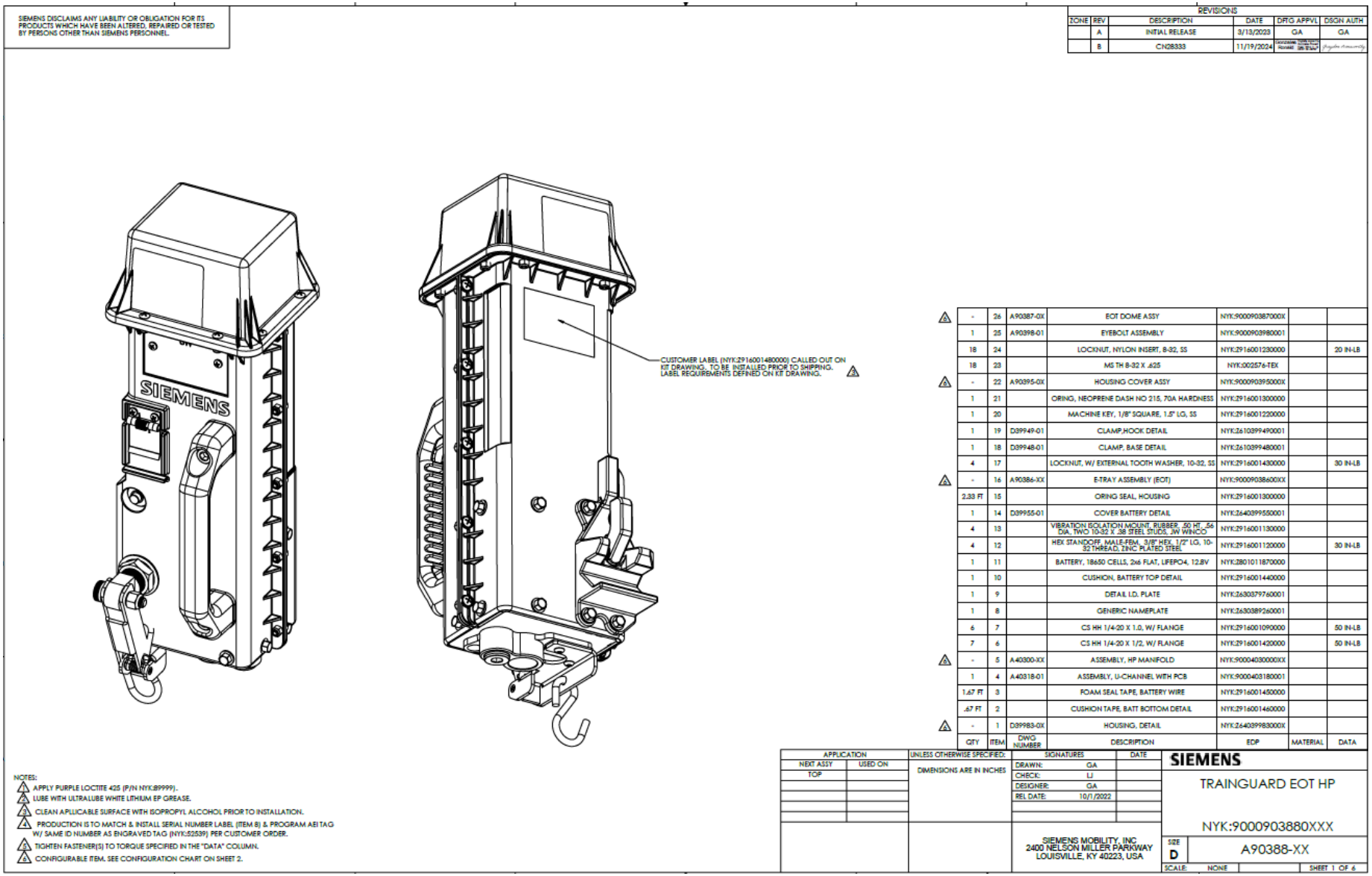
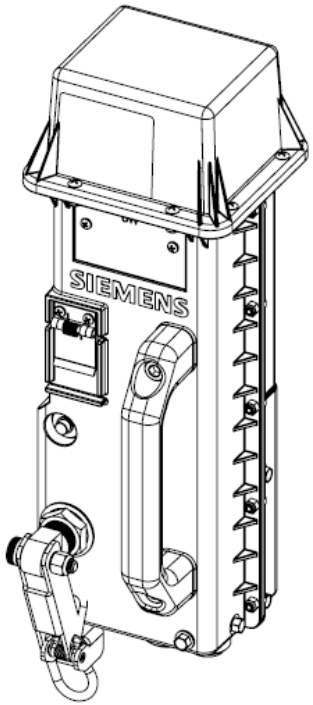


Figure 9-6 Main Assembly with HP Manifold, A90388 Sheet 1

CONFIGURATION CHART

NYK:9000903880XXX



CONFIGURE HOUSING COLOR

DASH NO.	QTY	DWG NUMBER	DESCRIPTION	EDP
1	1	D39983-01	HOUSING, DETAIL (ORANGE)	NYK:Z640399830001
	1	A90395-01	HOUSING COVER ASSY (ORANGE)	NYK:9000903950001
2	1	D39983-02	HOUSING, DETAIL (RED)	NYK:Z640399830002
	1	A90395-02	HOUSING COVER ASSY (RED)	NYK:9000903950002

CONFIGURE AIR MANIFOLD

DASH NO.	QTY	DWG NUMBER	DESCRIPTION	EDP
1	1	A40300-01	ASSEMBLY, HP MANIFOLD (STANDARD)	NYK:9000403000001
2	1	A40300-02	ASSEMBLY, HP MANIFOLD (DUAL PIPE)	NYK:9000403000002
3	1	A40300-03	ASSEMBLY, HP MANIFOLD (SINGLE W/O GEN)	NYK:9000403000003
4	1	A40300-04	ASSEMBLY, HP MANIFOLD (DUAL W/O GEN)	NYK:9000403000004

CONFIGURE E-TRAY, DOME

DASH NO.	QTY	DWG NUMBER	DESCRIPTION	EDP
0	1	A90386-11	E-TRAY ASSEMBLY (EOT) (452 MHZ)	NYK:9000903860011
	1	A90387-01	EOT DOME ASSY (STANDARD)	NYK:9000903870001
1	1	A90386-12	E-TRAY ASSEMBLY (EOT) (EXT ANT)	NYK:9000903860012
	1	A90387-02	EOT DOME ASSY (EXT ANT)	NYK:9000903870002
2	1	A90386-14	E-TRAY ASSEMBLY (EOT) (452 MHz) SMA WB SW	NYK:9000903860014
	1	A90387-01	EOT DOME ASSY (STANDARD)	NYK:9000903870001

SIEMENS	
TRAINGUARD EOT HP	
NYK:9000903880XXX	
SIZE D	A90388-XX
SCALE: NONE	SHEET 2 OF 6

Figure 9-7 Main Assembly with HP Manifold, A90388 Sheet 2

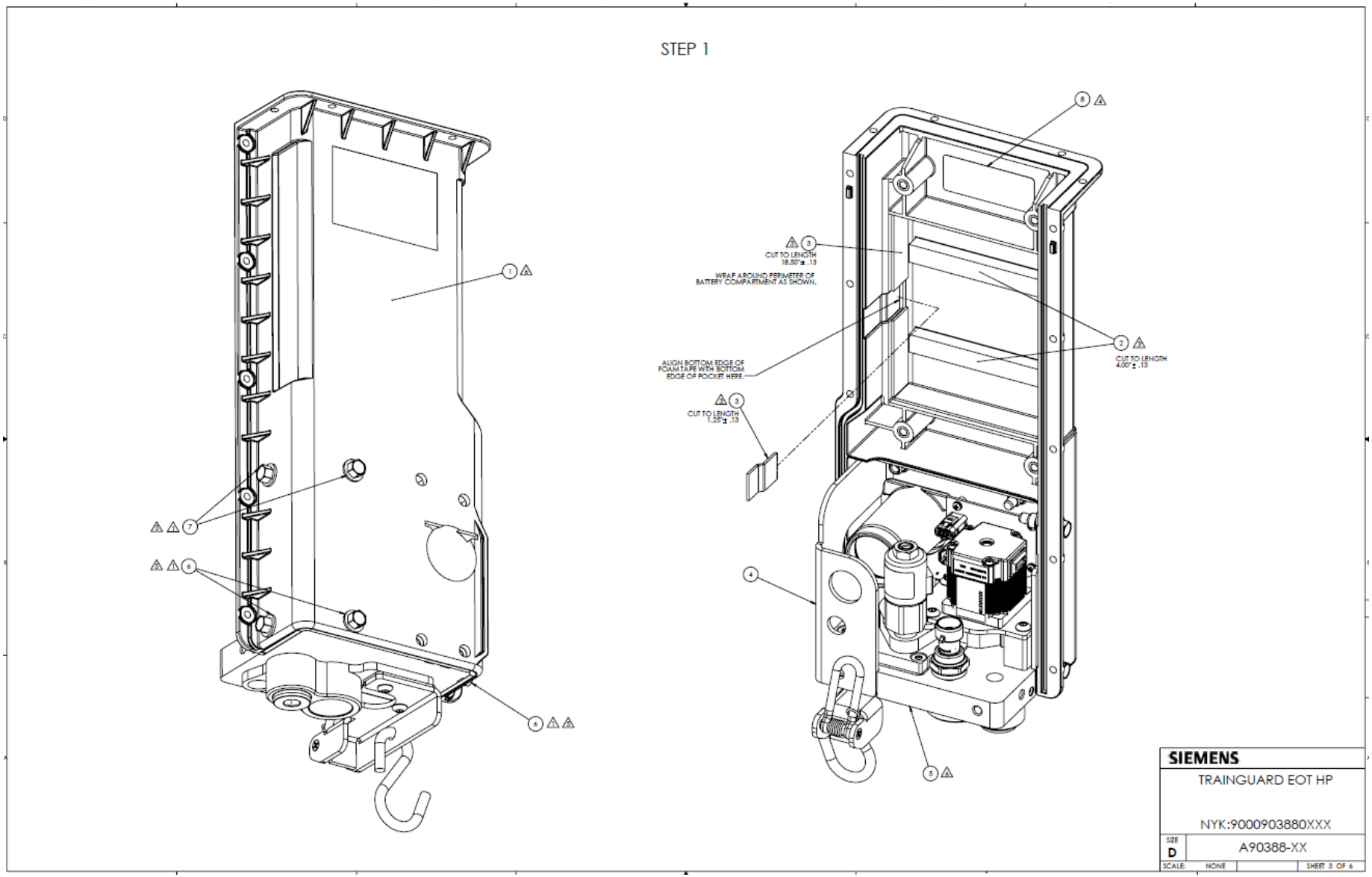


Figure 9-8 Main Assembly with HP Manifold, A90388 Sheet 3

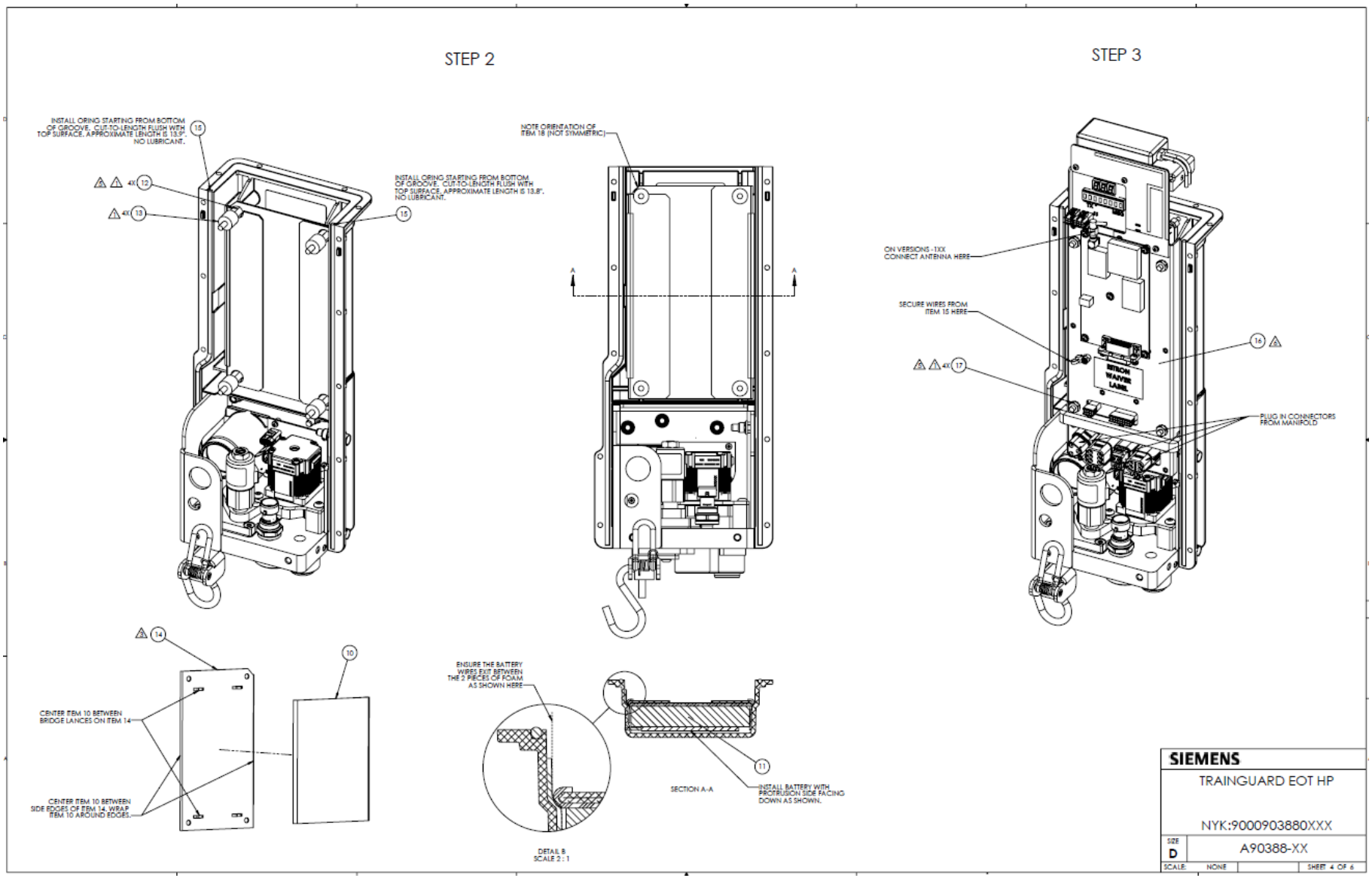


Figure 9-9 Main Assembly with HP Manifold, A90388 Sheet 4

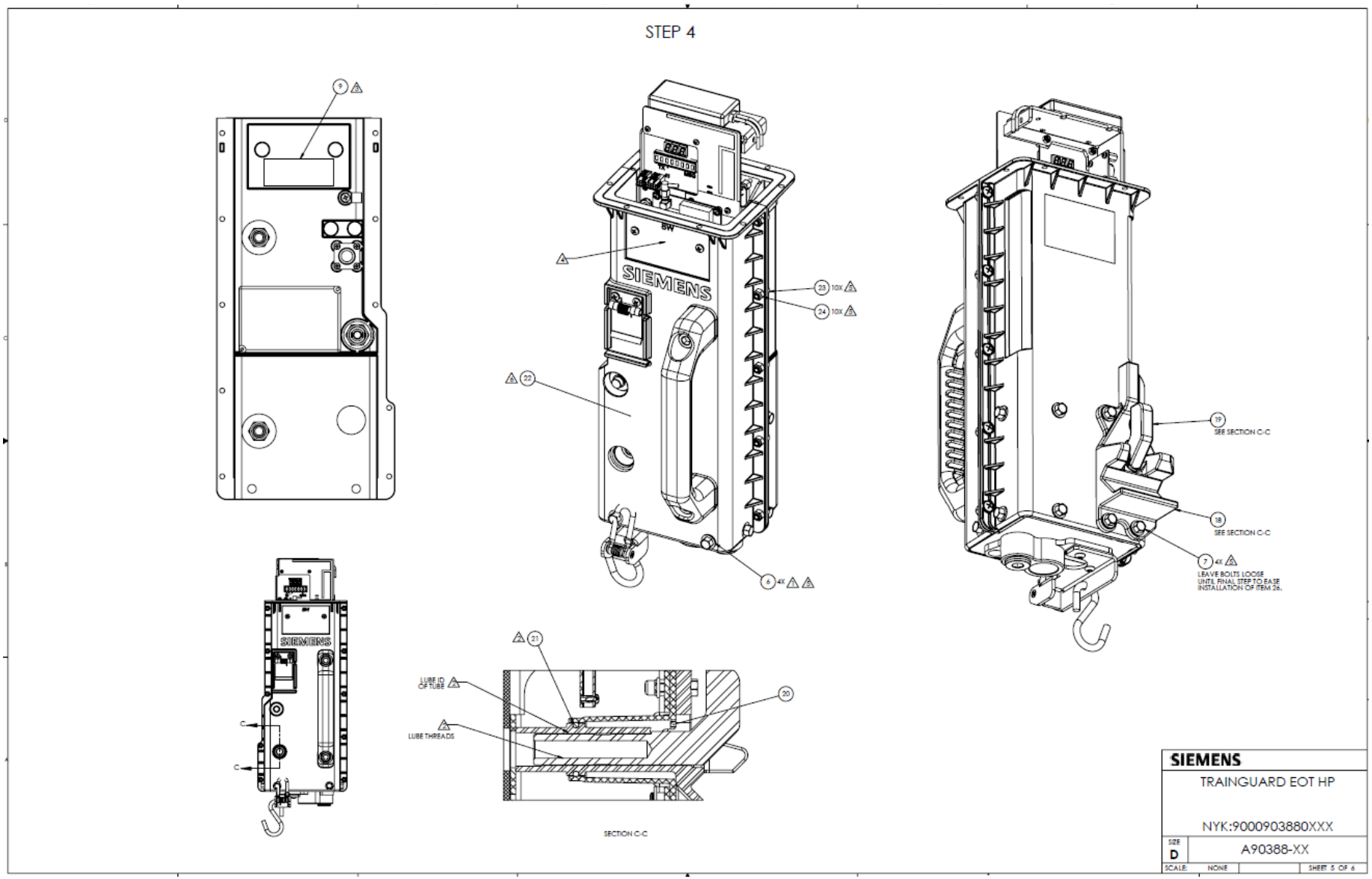


Figure 9-10 Main Assembly with HP Manifold, A90388 Sheet 5

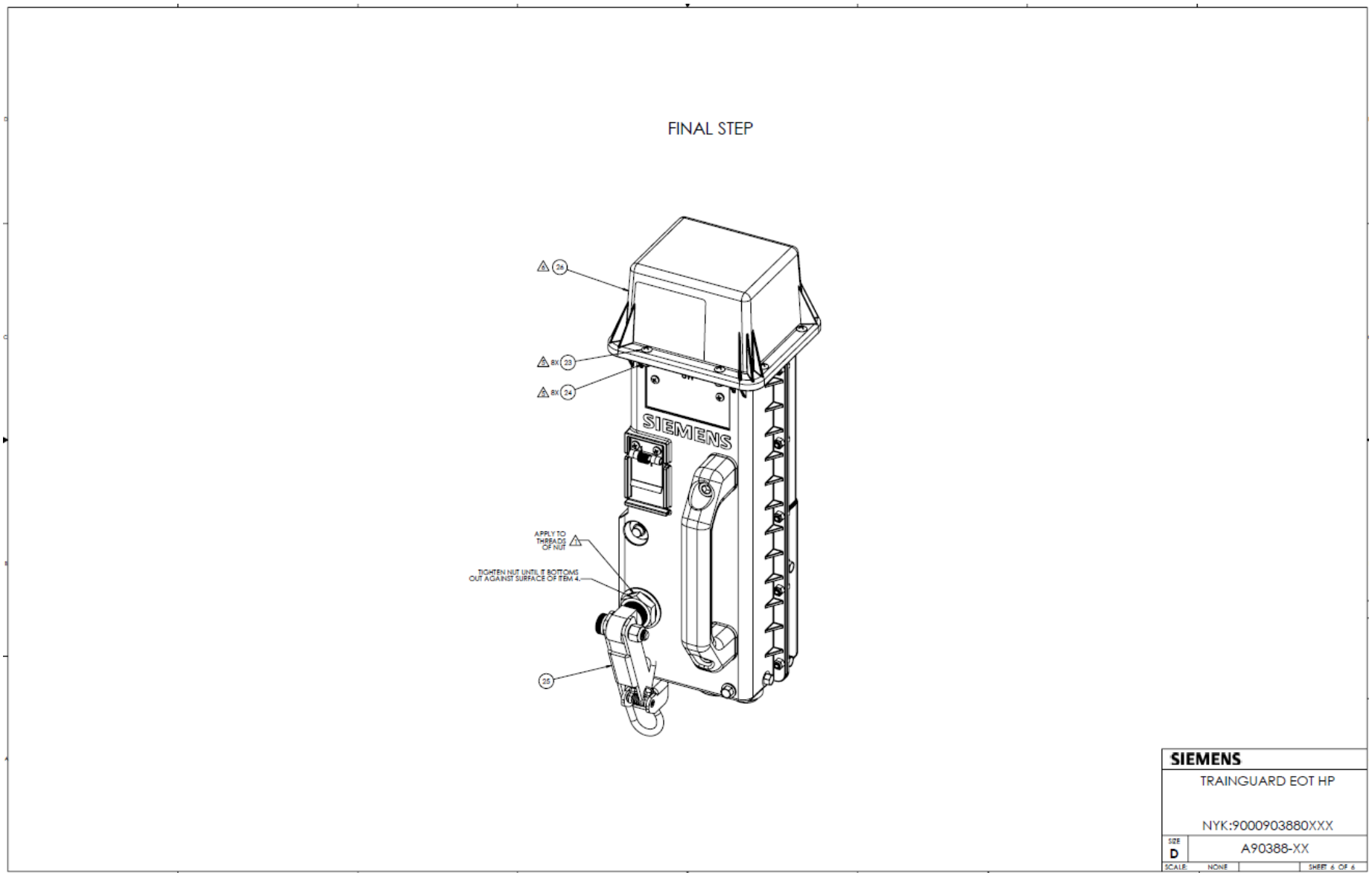


Figure 9-11 Main Assembly with HP Manifold, A90388 Sheet 6

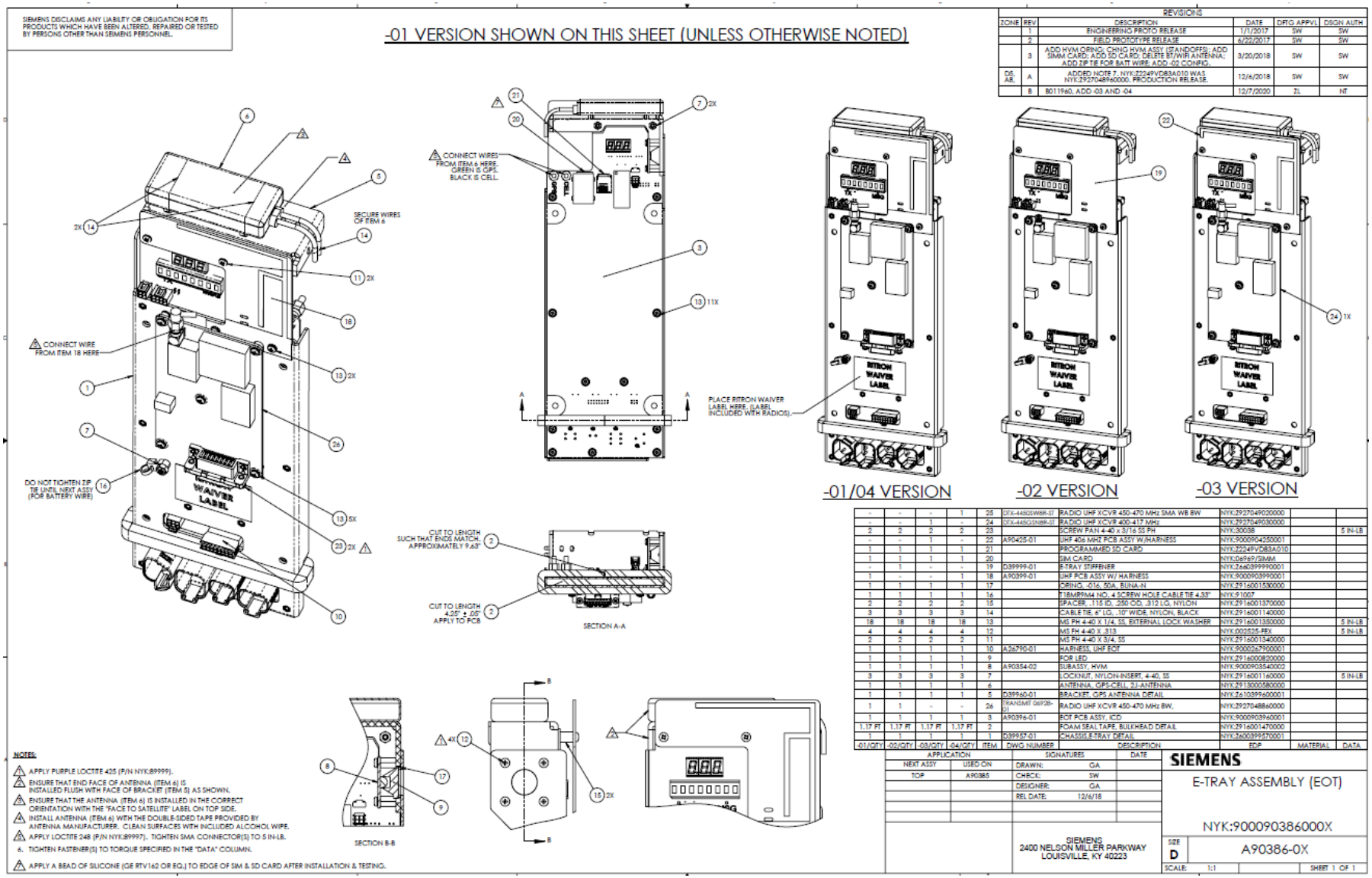


Figure 9-12 Subassembly for Electronics Tray, A90386

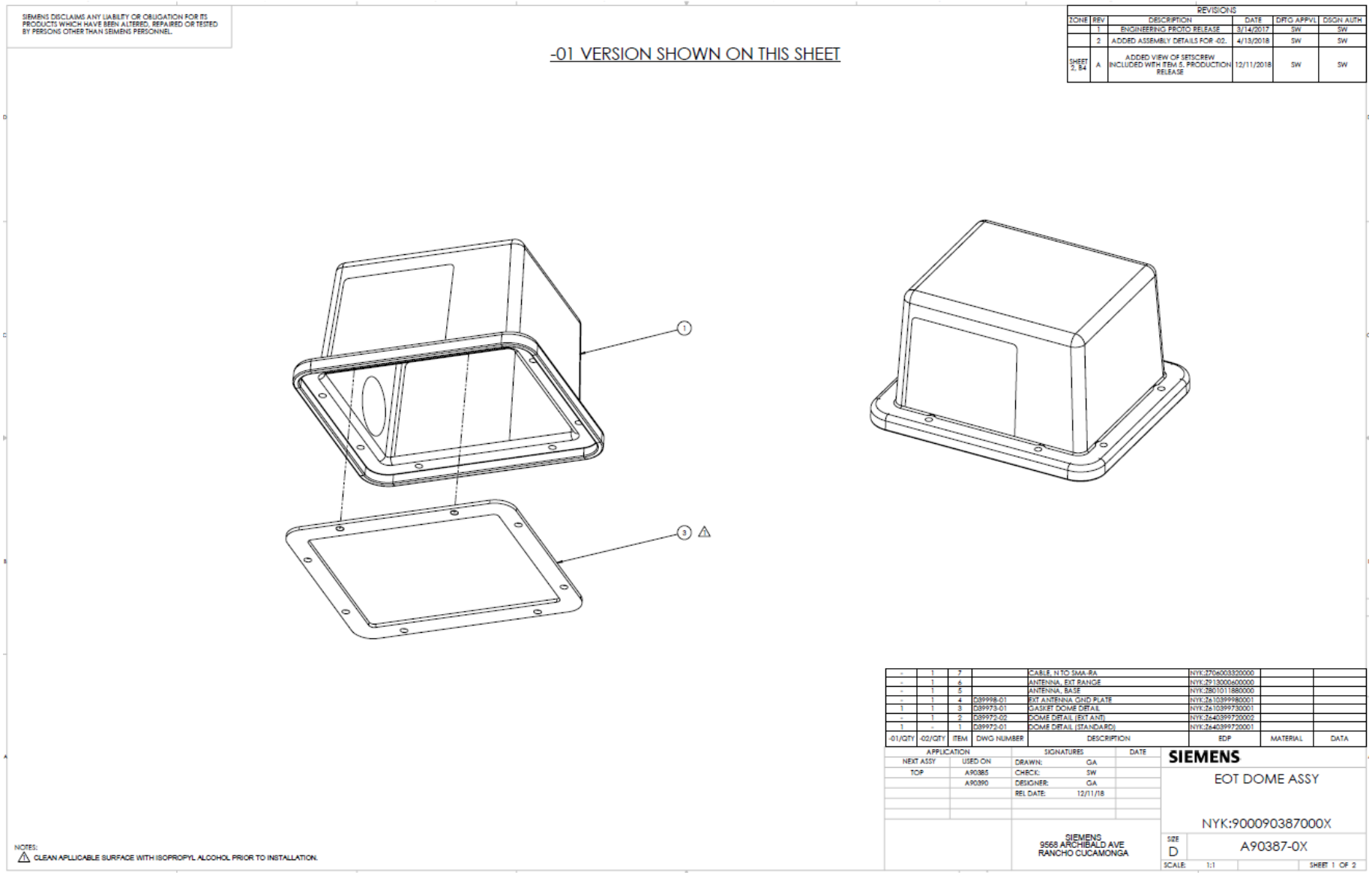


Figure 9-13 Subassembly for EOT Dome, A90387

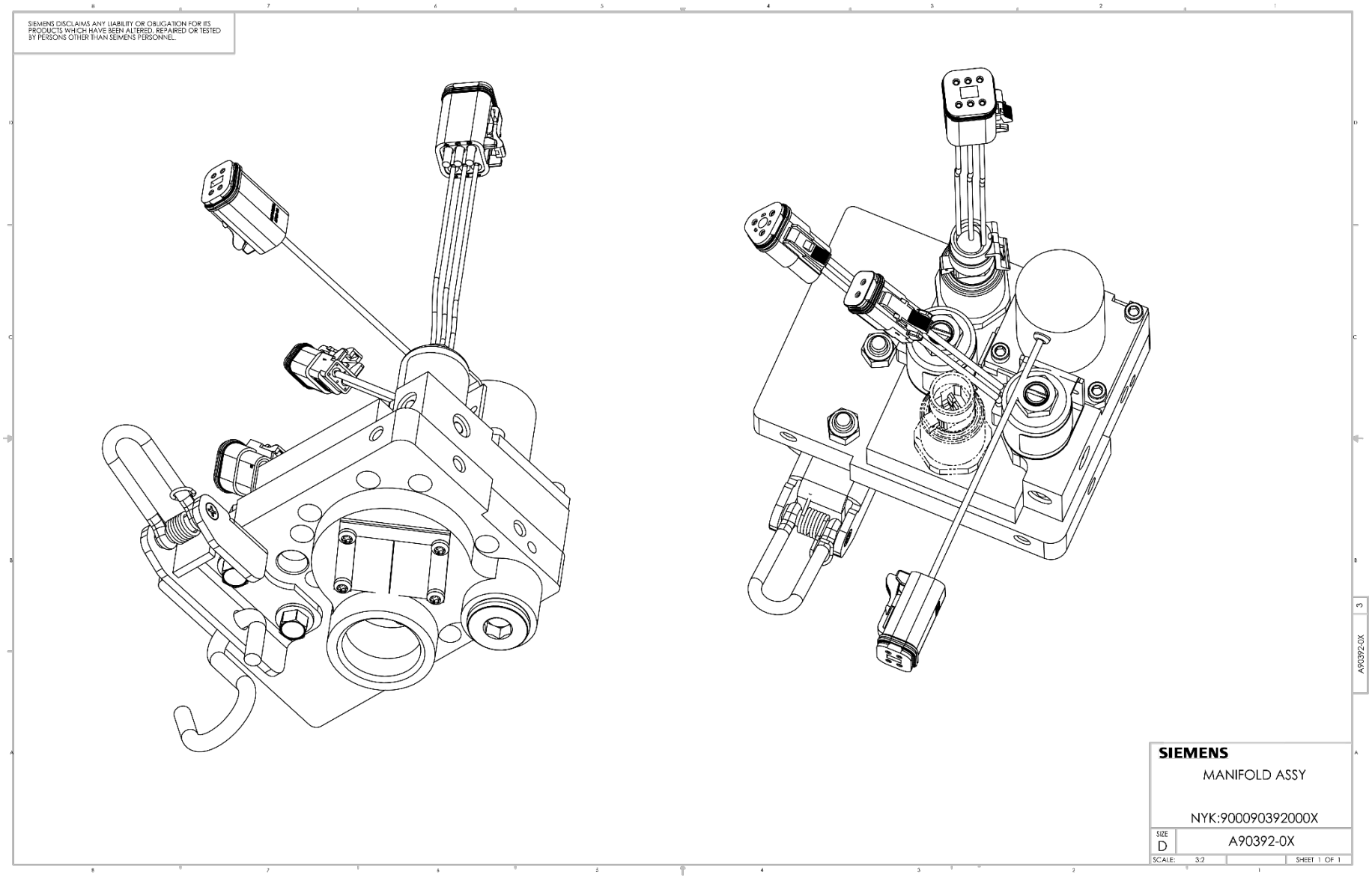


Figure 9-14 Manifold Assembly, A90392

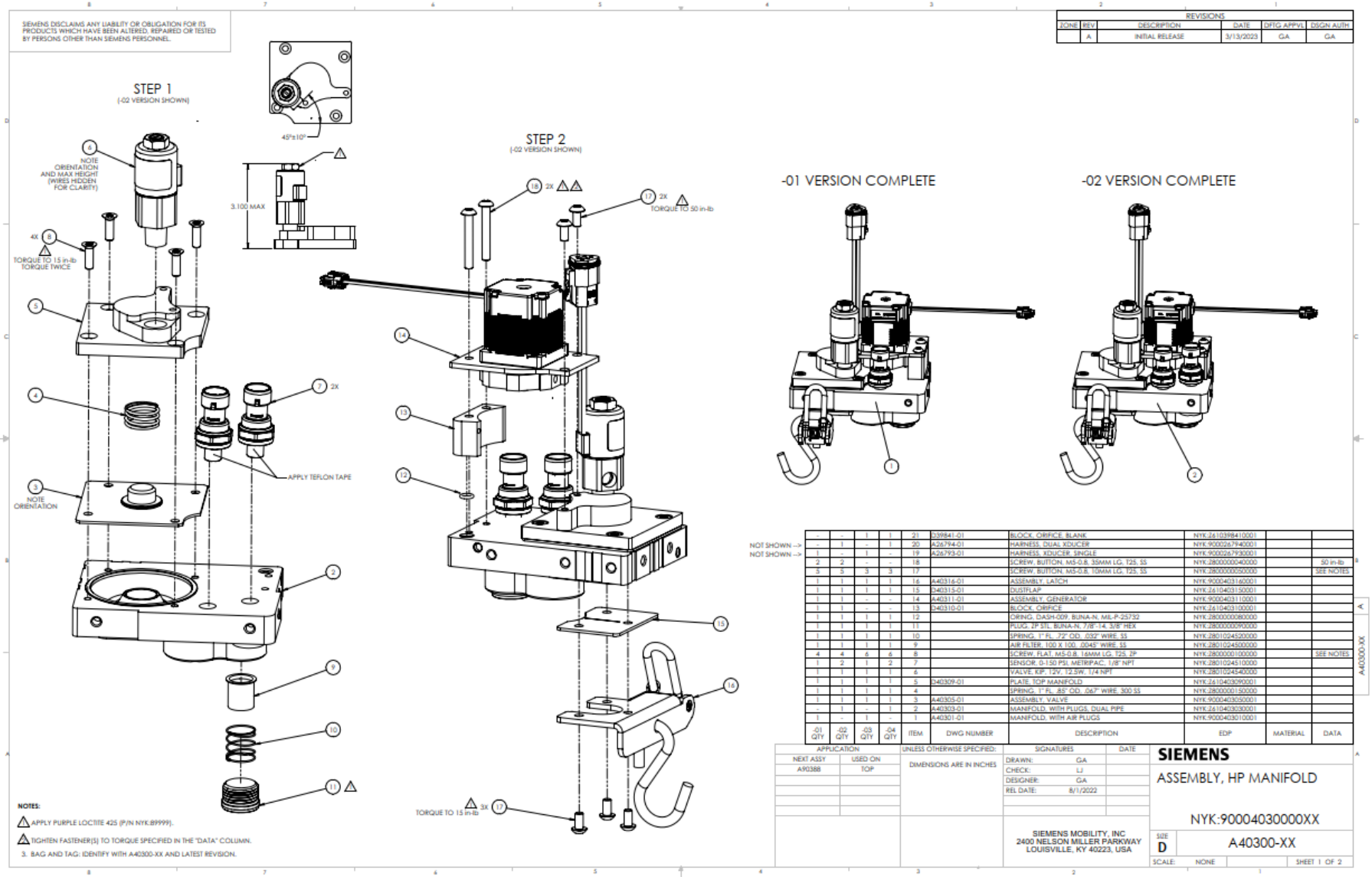


Figure 9-15 High-Powered Manifold Assembly, A40300

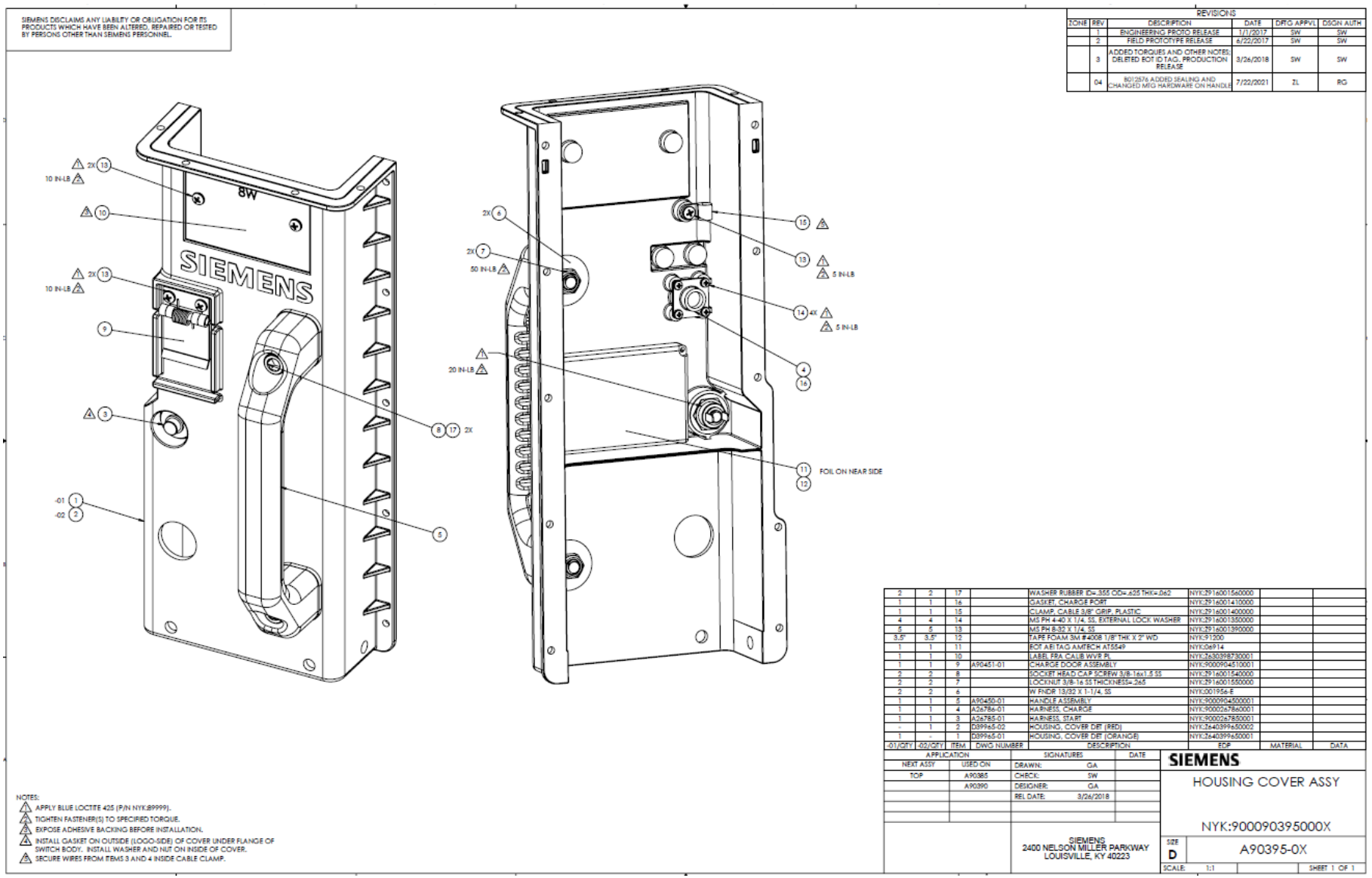


Figure 9-16 Housing Cover Assembly, A90395

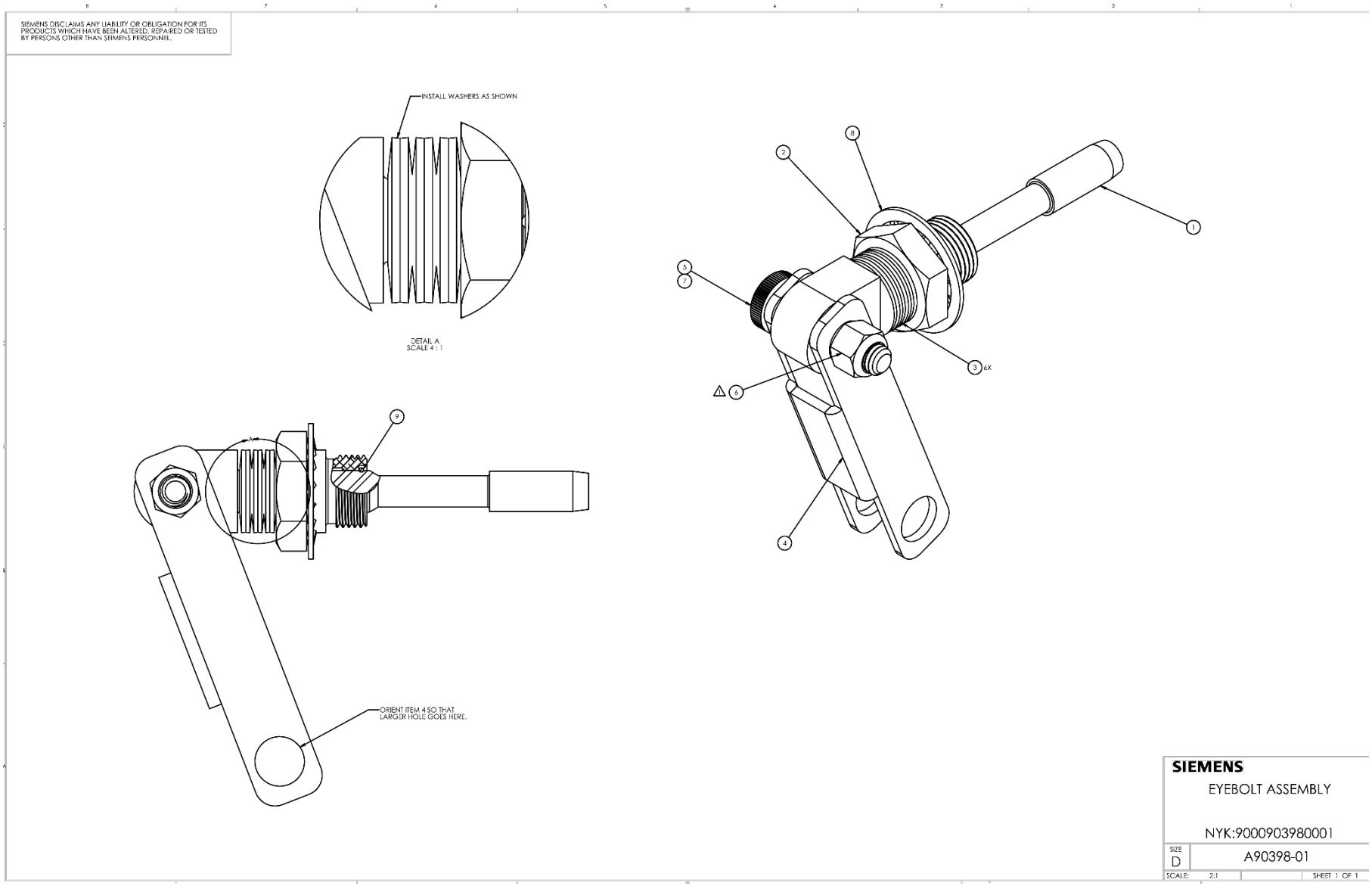


Figure 9-17 Eyebolt Assembly, A90398

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APPENDIX A – WI-FI RECOMMENDATIONS

A.1 INTERNET OPTIONS

IT departments may use proxies to filter data, control content, improve performance, or to connect to a corporate network. These proxies may cause problems when connecting to the EOT Wi-Fi webserver.

Connection problems caused by proxy scripts can be resolved by disabling **Automatically Detect Settings** in **Internet Options**, accessed via the control panel.

A.2 CLEARING BROWSER CACHES

The cached data utilized by internet browsers can interfere with the EOT Wi-Fi webpage. If the webpage is not loading up-to-date information, it is recommended to clear the cached data from the internet browser. Processes for clearing cached data differ between browsers, refer to the help pages for individual browsers. Once the cached data has been cleared, restart the browser.

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