

Eaton® PDI WaveStar TFA Static Transfer Switch

250 – 1200A

Installation and Operation Manual



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NOTICE

For safety reasons as well as to ensure optimal performance of your Eaton PDI WaveStar TFA Static Transfer Switch, please carefully read the instructions before trying to install, operate, service or maintain the system.

For any questions regarding the installation, operation, service or maintenance, contact the Eaton Help Desk. See paragraph [19.2 Getting Help](#) for details.

Please use the following e-mail for manual comments, suggestions, or to report a technical error in this manual.

E-ESSDocumentation@eaton.com

You can download the most recent version of this product manual from the Eaton web site's Product page, Resources section:

<https://www.eaton.com/us/en-us/catalog/low-voltage-power-distribution-controls-systems/eaton-pdi-busway.resources.html>

Eaton PDI WaveStar TFA Static Transfer Switch

250-1200A

Installation and Operation

Cover Photo: Eaton PDI WaveStar TFA Static Transfer Switches 800-1200A and 250-600A

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Our suite of backup power, power distribution and power management products are designed to protect you from a host of threats including power outages, surges, and lightning strikes, and enable you to monitor and control your power infrastructure.

We trust that our products will deliver high quality, reliable power for your business, and we are committed to your success.

Please read this manual, which details the installation and operation processes for your new Eaton product.

Thank you for choosing Eaton!

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Chapter 1 Safety

Please pay special attention to the use of “Danger” symbols throughout this manual indicating electrical or other safety hazards. Following these safety instructions is extremely important to avoid possible injury or death.



This symbol is used throughout this manual to indicate the presence of high voltages, representing a hazard for electric shock, burn or explosion. Follow the instructions carefully to avoid serious or fatal injury.

Follow safe electrical work practices:

- Read, understand, and follow the instructions before installing this product.
- Disconnect and lock-out all power supplying equipment before working on or installing a WaveStar Static Transfer Switch. Use a properly rated voltage sensing device to confirm power is OFF.
- Install equipment in an appropriate electrical environment per local regulations.
- PCBs are ESD sensitive equipment: Ground yourself, discharge any static charge and ensure that the device is effectively grounded before handling the unit.

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel and in accordance with all local safety codes. Power Distribution, Inc. assumes no responsibility for any consequences arising out of the use of this manual. **This document should not be viewed as sufficient by otherwise non-qualified personnel to operate, service, or maintain the equipment discussed.**

Chapter 2 System Description

This manual describes installation and operation of the Eaton® PDI WaveStar® TFA Static Transfer Switch 250-1200A 3-Pole. “TFA” stands for “True Front Access”. The TFA Static Transfer Switch (TFA STS) requires front access only for installation, operation, service, and infrared scanning. The TFA STS is a three-pole, two-position transfer device that transparently transfers, automatically or manually, an output load between two 3-phase input power sources.

2.1 Basic Characteristics

Purpose The purpose of a Static Transfer Switch (STS) is to keep power supplied to a downstream mission-critical load by switching between redundant power sources.

While a site UPS removes power anomalies originating between the power station and the site, an STS mitigates the effects of anomalies between the Uninterruptible Power Supply (UPS), utility power source, or another source and the STS load. These anomalies include the following:

- Loss of an upstream utility or UPS source
- Out of specification power from a power source
- Faulty transformers in PDUs
- Circuit breaker nuisance tripping

Transfer Switch The TFA STS is a standalone transfer switch with two AC input sources and one AC output load. The TFA STS transparently transfers the output load automatically from one power source to the other, if the active source fails or goes out of specification, or manually by operator directive, for testing or maintenance.

Static Transfer Switch Unlike electromechanical transfer switches, an STS has no moving parts. It uses semiconductor technology, specifically silicon controlled rectifiers (SCRs), as power switching elements, achieving faster transfers.

Sources The two input AC power sources should be independent power sources that are nominally of the same voltage, phase rotation, and frequency. Inputs are usually from uninterruptible power supplies (UPSs), but can be utility power sources, transformer outputs, or PDU outputs.

Output load The TFA STS has a single AC output that supplies redundant power to downstream loads.

3-pole The TFA STS switches a 3-phase AC load between the two AC sources. The neutral wire is not switched.

Primary and Secondary Systems A TFA STS can be integrated with a PDU on output in a primary system or integrated with two PDUs on input in a secondary system. The TFA STS cabinet is line-and-match with Eaton PowerHub 2 and PowerPak 2 PDUs.



NOTE

The term PDI in this manual refers to products previous manufactured by Power Distribution, Inc. All service and support for these features are now supplied by Eaton.

2.2 Specifications

2.2.1 Environmental Operating Specifications

- Operating temperature range: 0° to 40°C
- Operating altitude:
 - Up to 5000 feet above sea level without de-rating.
 - Above 5000 feet, output current is de-rated by 6% per 1000 feet.

System Description

- Relative humidity: 0 to 95% without condensation
- Audible Noise: ≤ 60 dBA at 5 ft. without alarm activation

2.2.2 Storage Conditions

If the TFA STS is not to be immediately installed and energized, it should be carefully stored in a warm, dry environment, preferably a heated building with air circulation and a uniform temperature to prevent condensation. The TFA STS should be stored in its factory protective coverings and should be kept free of contamination.

Storage temperature range must be within these limits: -40° to +80°C.

2.3 System Layout

[Figure 1](#) shows the layout of the TFA STS 250-600A and [Figure 2](#) shows the layout of the TFA STS 800-1200A. [Figure 3](#) and [Figure 5](#) show views of the TFA STS with covers on and off. [Figure 4](#) shows operator interfaces. [Figure 6](#) has an electrical submittal drawing.

Figure 1. TFA STS 250-600A 3-pole, Layout

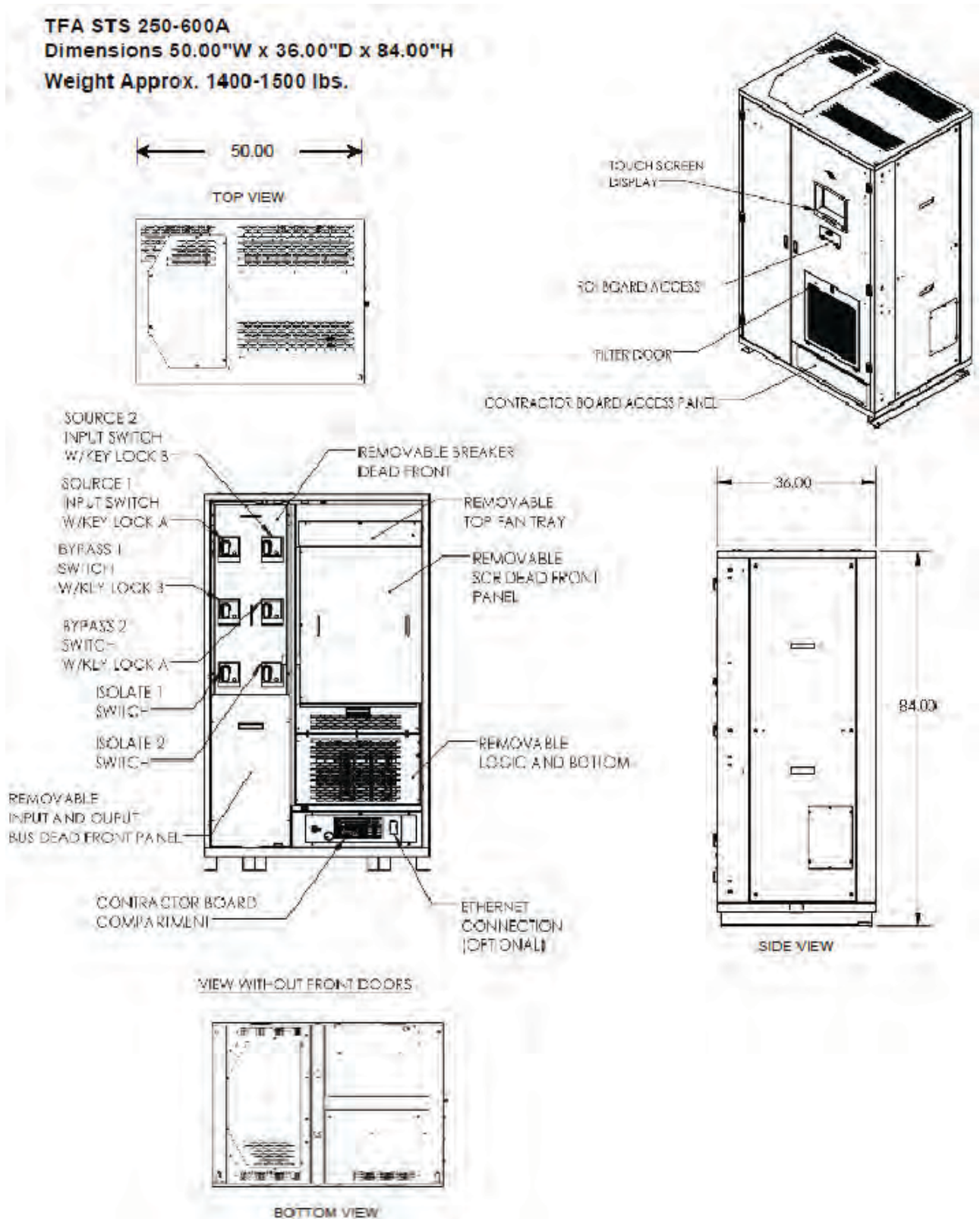


Figure 2. TFA STS 800-1200A, 3-Pole, Layout

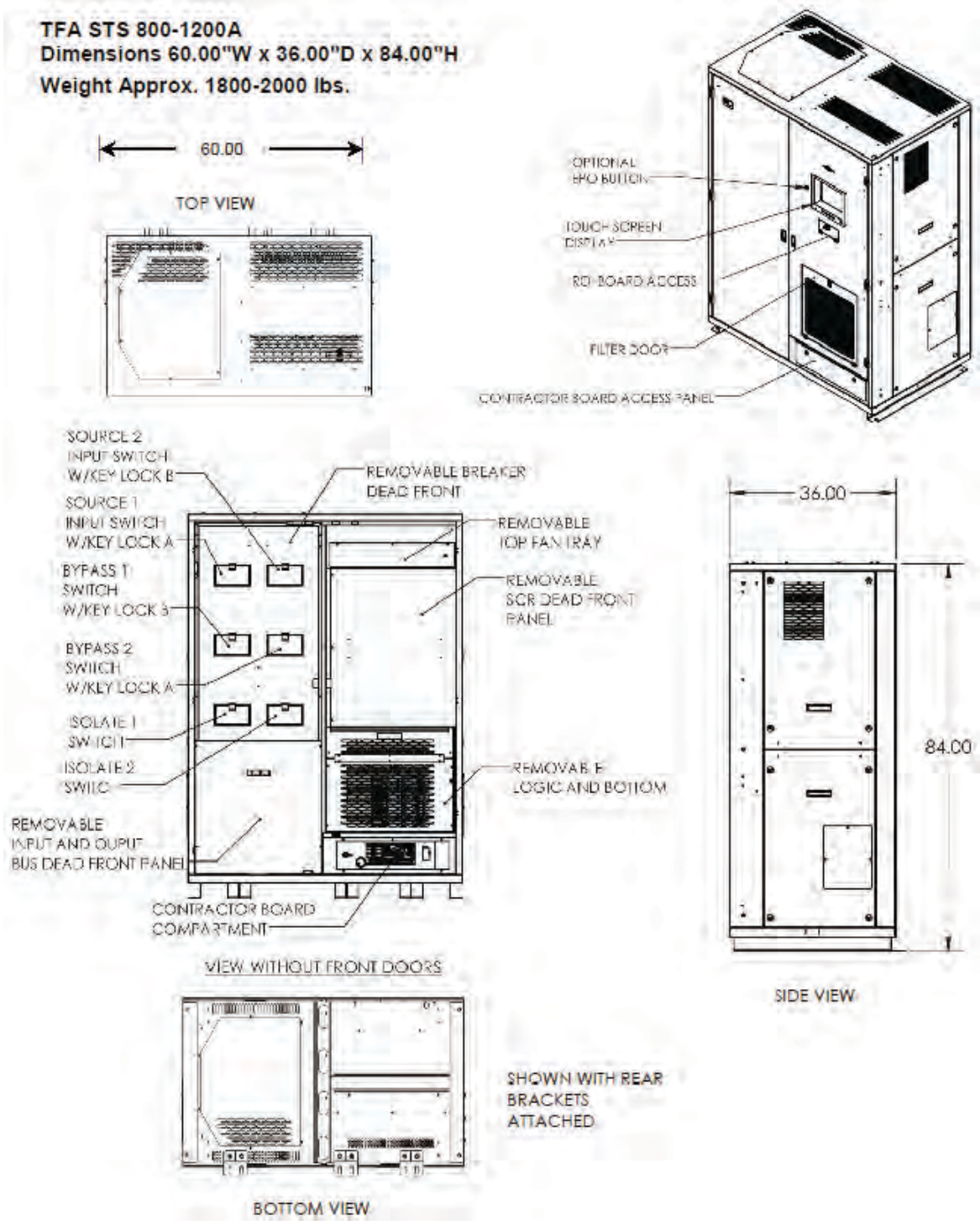


Figure 3. TFA STS 250-600A Front and Oblique Views, Doors and Panels Closed

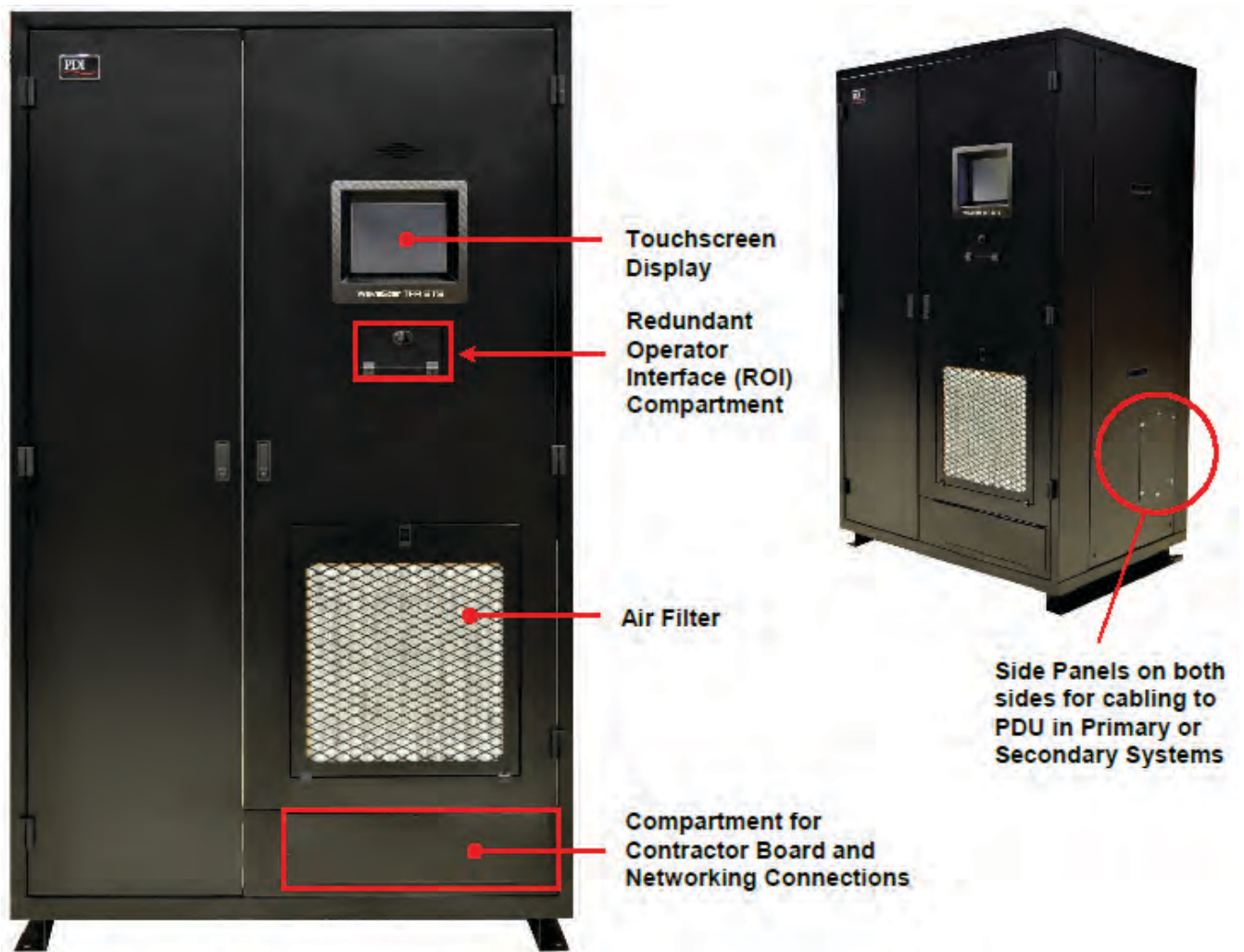
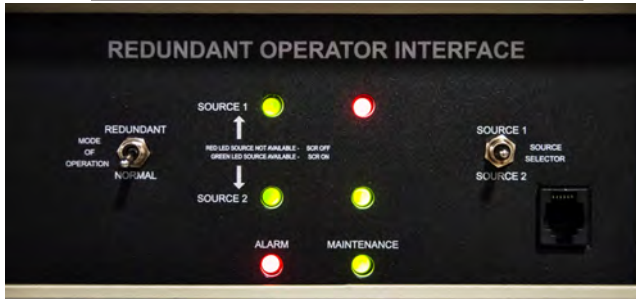


Figure 4. Operator Interfaces: Display and Redundant Operator Interface

Home screen from STS touchscreen display has a dynamic one-line view of MCSWs. The one-line diagram shows active and inactive power paths and other status.



Redundant operator interface (ROI) (shown with panel open) backs up display and monitor logic.

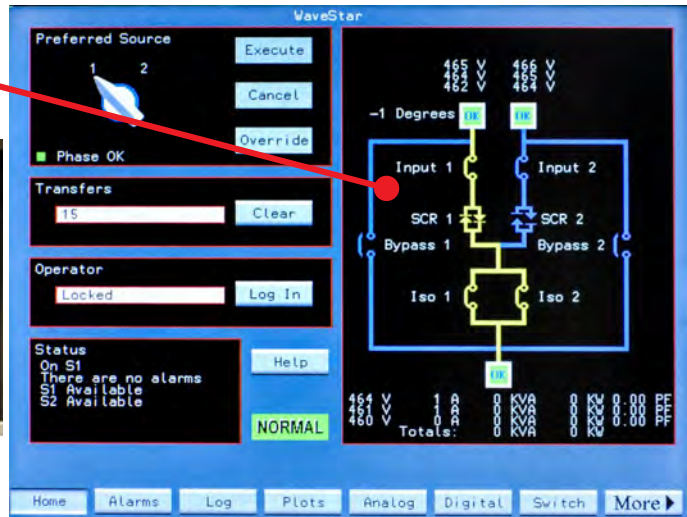
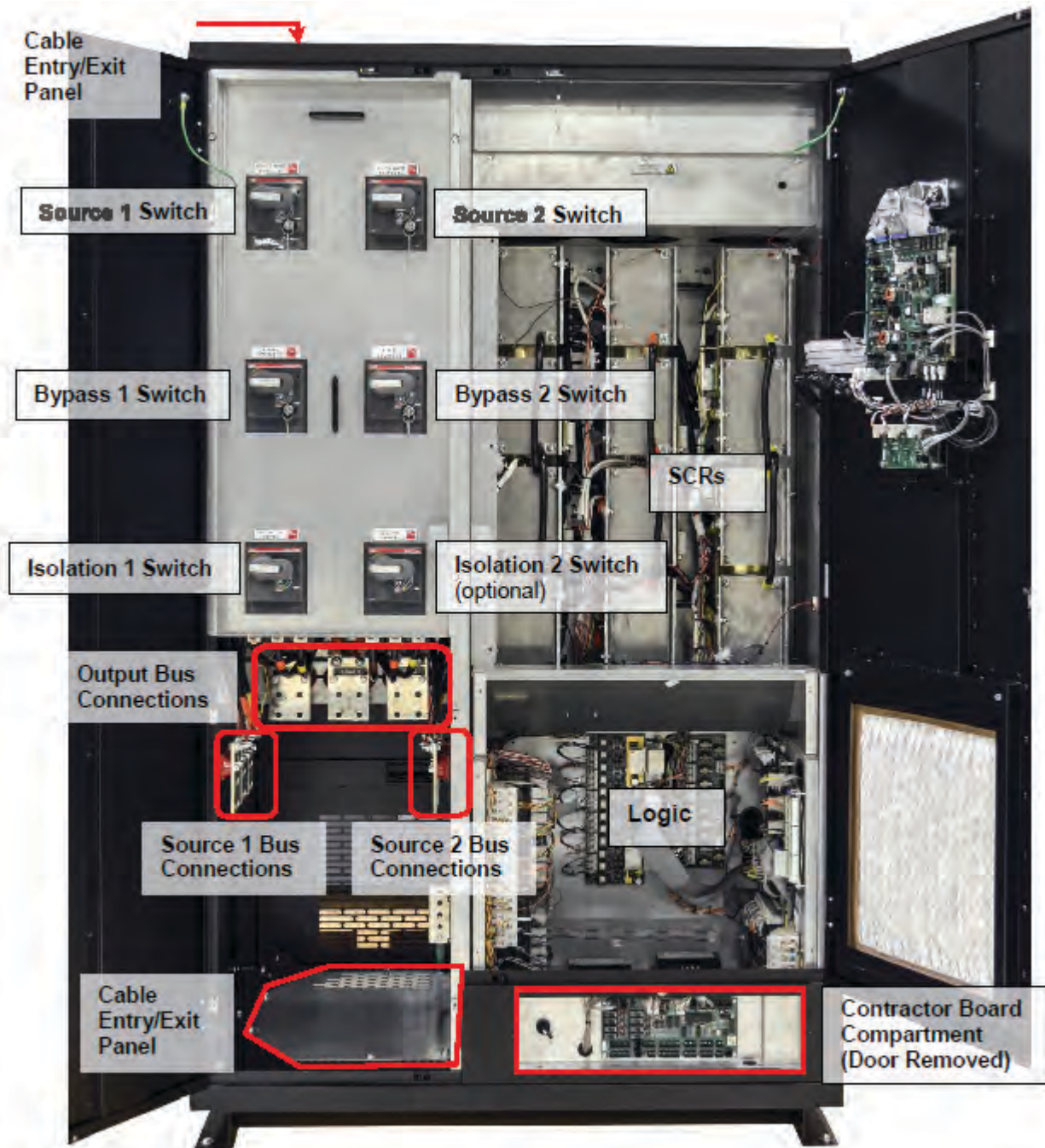
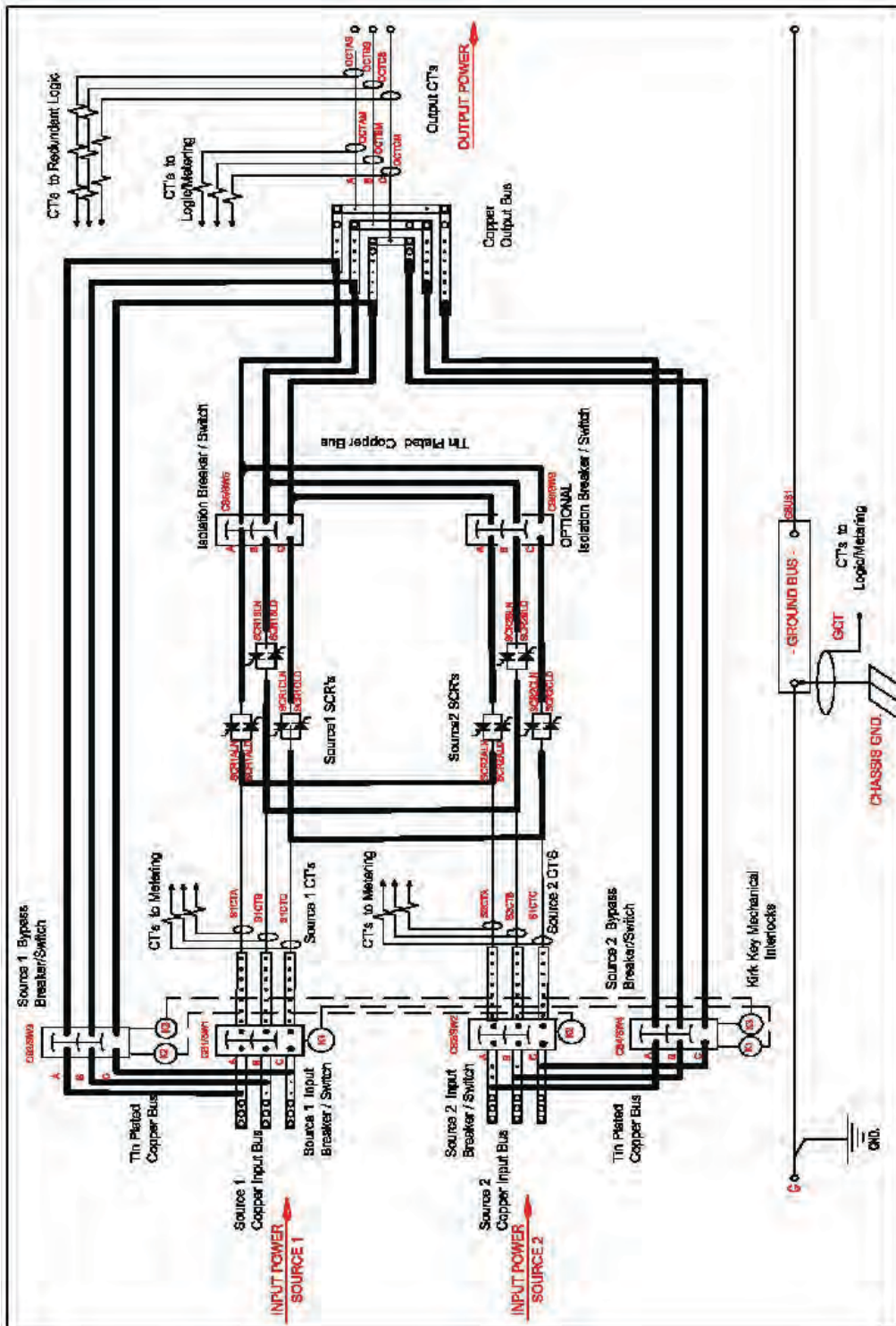


Figure 5. TFA STS 250-600A Front View, Doors Open



NOTE: TFA STS 800-1200A units have the same layout plan as 250-600A units except that the left-hand side (with switches and power cable entry) is larger because of higher amperages.

Figure 6. TFA STS 250-1200A 3-Pole Electrical Submittal Diagram



- Notes:
1. o=Customer Connection
 2. f=Factory Connection
 3. The unit is design to operate at 40°C Ambient temperature
 4. Wire Size is based on NEC
 5. TFA STS is equipped with redundant fans.

2.4 Transfer Process: Algorithms

2.4.1 The Problem of Transformer Current Inrush

One of the limiting factors in using an STS in mission critical facilities has been the inability of the electrical infrastructures to withstand the transformer inrush when switching occurs on the primary side of the transformer, typically at 480VAC. When downstream transformers saturate, currents can rise to 10-12 times the transformer rating, creating an outage by tripping circuit breakers and molded case switches in the STS or in a UPS upstream of the STS.

Eaton's patented **Volt Second Synchronizing (VSS)** algorithm solves this problem, dramatically reducing the current rise or inrush when transferring between sources. Transformer inrush is limited to (2) x the transformer's full load current rating, but is typically less than (1) x transformer rating.

2.4.2 Sense and Transfer Algorithms

Sense algorithms detect that the active power source is going out of specification and that a transfer is required. Eaton has optimized STS sense algorithms experimentally, but algorithm parameters can be adjusted by administrators if necessary.

Transfer algorithms move the load to the other source. Transfers are not performed by connecting the two sources ("Make before Break"), which would cause cross-currents between sources.

Administrators can choose between two transfer algorithms using the front panel touchscreen:

- **POG (Power or Gate)** (fast) algorithm transfers the load as quickly as possible from one source to another without connecting the sources together.
 - Automatic transfers including sense time are $\leq 1/4$ cycle for all phase conditions.
 - Manual transfers are $\leq 1/8$ cycle for in-phase conditions (phase-synchronized sources).
- **VSS (low inrush)** algorithm transfers the load in $\leq 3/4$ cycle, including sense time, and will balance the volt seconds of any magnetic load to not draw in-rush current.
 - Automatic transfers are $\leq 3/4$ cycle for all phase conditions, including sense time.
 - Manual transfers are $\leq 1/8$ cycle for in-phase conditions.

The TFA STS can successfully switch the load between sources that are 180° out-of-phase within the above-specified cycle times.

VSS is the recommended and default algorithm and should be used whenever there are transformers downstream of the STS, including small transformers embedded in devices. The POG algorithm can be used when there are no downstream transformers.

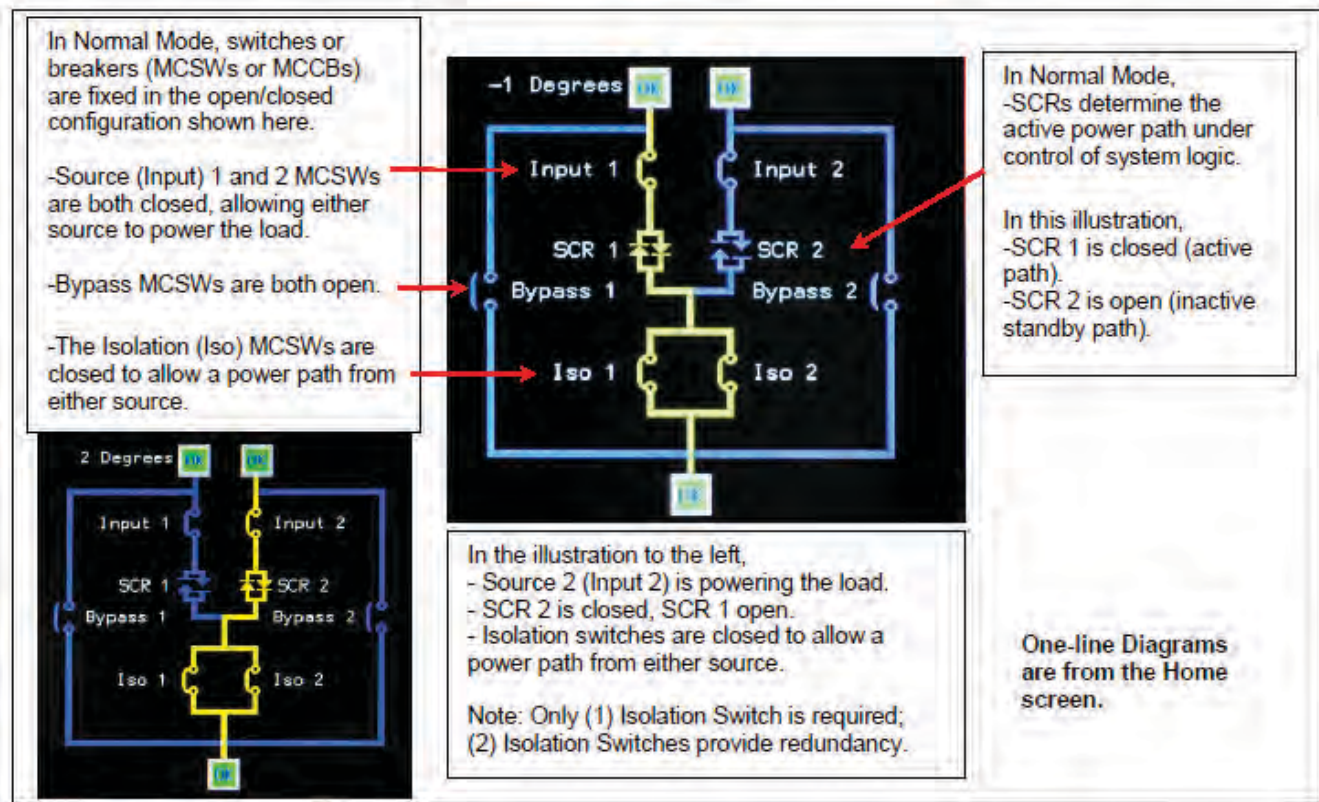
2.5 Transfer Process

2.5.1 Power Switching Components

There are three sets of Molded Case Switches (MCSWs) controlling whether the system is in Normal or Bypass Mode and two sets of SCRs, which provide power switching for transfers:

- Source 1 MCSW and Source 2 MCSW are switches from the two power sources controlling power flow to the SCRs.
- SCR 1 and SCR 2 open or close to control which source powers the load.
- Bypass 1 MCSW and Bypass 2 MCSW are used to shunt power around STS logic and power switching elements for maintenance.
- Isolation 1 MCSW and (optional) Isolation 2 MCSW isolate components for maintenance during Bypass Mode. The second isolation MCSW provides redundancy and is optional on units $\leq 800A$.

Figure 7. Normal Mode MCSW and SCR Configuration



2.5.2 Operational Modes: Normal and Bypass

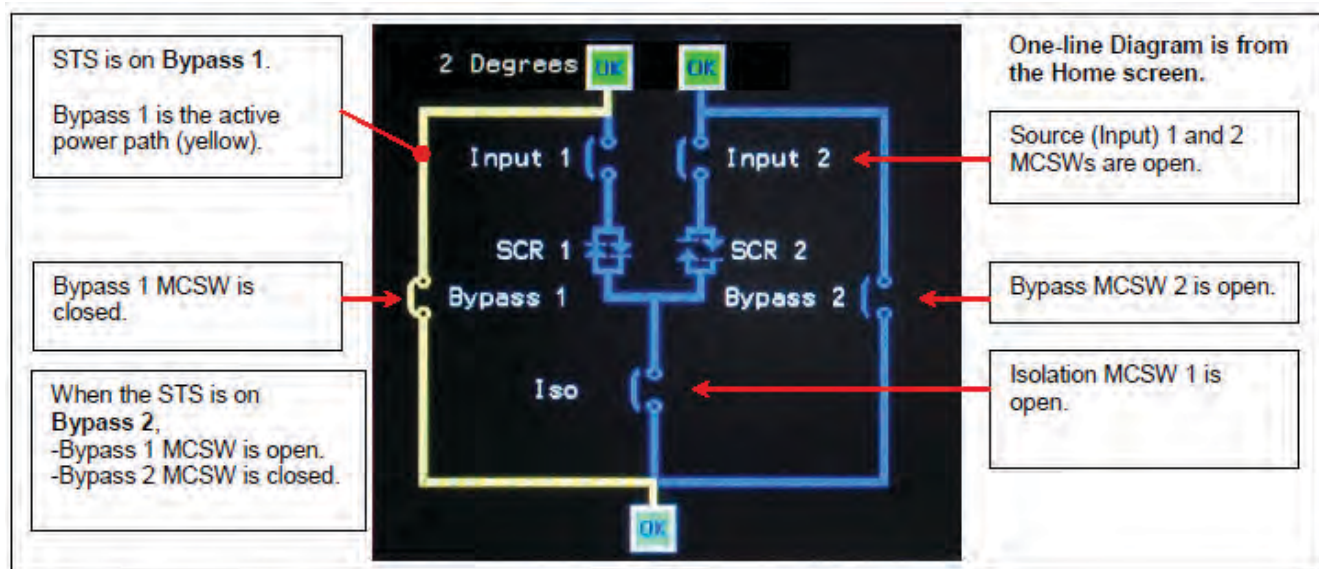
In **Normal Mode** operation (see [Figure 7](#)), the Monitor controls the transfer process:

- The MCSWs for Source 1 and 2 are both closed, allowing a power path from either source, hence allowing the load to be automatically transferred from one source to the other.
- The Isolation MCSWs are closed to provide a power path for either source.
- System logic opens or closes SCR 1 or SCR 2 to transfer the load rapidly from one source to the other.
- Bypass 1 and 2 MCSWs are both open while the bypass is unused.

The Monitor logic continuously monitors the two power sources using its sensing algorithms and controls transfers, using the POG or VSS algorithm, as specified by the user. The Monitor is itself continuously monitored by the Simple Algorithm Switch (SAS), which provides a backup transfer process using a simpler algorithm, if the Monitor fails.

In **Bypass Mode** operation (see [Figure 8](#)), operators isolate logic and power components for maintenance by changing the open/closed MCSW states. Keyed interlocks enforce correct coordination between MCSWs, preventing cross-currents between sides. Bypass MCSWs are mechanically interlocked to both being closed at the same time.

Figure 8. STS on Bypass (Bypass 1)



2.6 High Availability through Redundancy

- The STS is designed for an **MTBF** exceeding 2,000,000 hours.
- The STS has dynamic **tri-redundant logic** with voting circuits. Each level monitors the power being supplied to the load; if one level does not transfer the load in specified times, the second level will transfer the load within the CBEMA curve.
- The STS has **quad-redundant gate drivers**, redundant drivers for each set of SCRs. The drivers cannot inhibit or out vote the other. Therefore, both source 1 and source 2 SCRs have two levels of isolated, independent gate drivers.
- The STS has **tri-redundant logic power supplies**. The configuration of each DC logic power supply is such that a short circuit on one PCB cannot prevent the other PCBs from receiving tri-redundant power. Each PCB receives logic power via three isolated connectors.
- The STS has **N+3 fan redundancy** for forced air-cooling of the SCRs.
- The STS uses **tri-redundant fiber optic lite** pipes and circular redundant CAN Bus to route logic signals between logic PCBs.
- **Noise immune signal buses:** the STS uses optical buses and/or CAN buses to route signals between logic PCBs.
 - All signal buses are tri-redundant.
 - Each signal bus continuously transmits “bus integrity” signals, when not transmitting true data. If the “bus integrity” signals are not received by all receivers, then that bus is considered discontinuous and is alarmed.
 - The CAN Bus has circular redundancy so that there are two paths. One path can be severed and signals will continue to flow via the other path.
- The STS has two levels of operator controls and status displays. The Monitor and display is backed up by the Redundant Operator Interface (ROI).

2.7 Cooling

TFA STS 250A-1200A units use forced air cooling with redundant fans and reject heat through ventilation openings.

2.8 Operational Information and Controls

The TFA STS has a color graphics touchscreen, a backup operator interface (the ROI), help screens, and audible voice assistance that supplements the display in certain situations.

2.8.1 Graphics Touch-Screen Monitor/Display

The STS has a front touchscreen display that can display the following information:

- A dynamic one-line mimic display, showing the active source-to-output path, bypass, and measurements (See [Figure 4](#)).
- Setup and configuration settings
- Administrative and operational controls
- Alarm Log and Event Log
- AC wave form capture for transfer events or displaying the current wave structure
- Digital and Analog Points (Modbus registers)
- Voltage and current measurements for input sources and output load
- Harmonics for both voltage and current
- Load trending

2.8.2 Operational Assistance

- The Voice Unit annunciates alarms ("Static switch, new alarm") and cleared alarms at the unit and provides operator cautions ("You are not authorized for this function").
- The Help function provides both text and voice-over instructions to guide operators through transfer tasks for going to Bypass Mode and returning from Bypass to Normal Mode. The instructions are context-specific, providing information for transfers appropriate to the current STS source-to-output connections.

2.9 System Security

The TFA STS is designed for mission-critical environments and has security features appropriate to that environment:

- The administrator assigns each user a unique Personal Identification Number (PIN) associated with an access level, such as administrator or operator, determining what actions the user can perform.
- A PIN and password are required to login.
- No changes to system parameters or STS operation can be made through the touchscreen Monitor without a valid user login, and no changes at all can be made remotely via web access.
- Only one user can be logged in at a time. The Event Log records and time-stamps the user's login, changes to parameters or actions while the user is logged in, and the user's logout.
- A key is required to open doors, controlling access to the MCSWs and components. Key access is also required for the ROI.
- When an STS front door is opened, the unit alarms and the alarm is logged into the Event Log.

2.10 Communications

The TFA STS can transmit alarms, status, and waveform data to remote locations and receive control signals using several communications methodologies:

- Modbus RTU using RS422/485 (4-wire or 2-wire)
- Ethernet 10/100 Mb supporting these protocols:
 - Modbus TCP/IP
 - HTTP for the STS web server, providing web browser access to display pages
 - SNMP (Simple Network Management Protocol)
 - SNTP (Simple Network Time Protocol) for time synchronization
 - SMTP (Simple Mail Transfer Protocol) for E-mail summary alarm alerts
- Dry contact input and output signals, used for status conditions, summary alarm notification, remote EPO, and remote switching of input sources
- USB download of the Event Log using the display's USB port

All the above communications methods can be used simultaneously.

For detailed information on TFA STS communications, see [Chapter 8 Customer Communications Connections](#).

2.11 Optional Features

TFA STS 250-1200A 3-pole units have these optional features:

- A second MCSW Isolation Switch, providing redundancy for the Isolation Switch.
- Enhanced Contractor Board, providing additional dry contact and communications options, see paragraph [8.3.2 Enhanced Contractor Board](#) and other [Chapter 8 Customer Communications Connections](#) sections).
- Multi-Switch Link Option, allowing an N+1 UPS configuration, see paragraph [8.5.4 Multi-Switch Link Option \(N+1 UPS\)](#).
- Top Cable Landing Compartment Option, reducing cable length requirements for top cable entry (250 - 600A), see paragraph [4.2.4 Top Cable Landing Compartment](#).

2.12 Class A Computing Device

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a class A computing device pursuant to subpart B of part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his/her own expense will be required to take whatever measures may be required to correct the interference.

Chapter 3 Pre-Installation Preparation

3.1 Receiving

1. While the TFA STS is still on the truck, inspect the equipment and shipping skids for any signs of damage or mishandling. If the system shows any damage, note it on the freight bill and file a damage claim with the carrier within 24 hours.

Contact Eaton Help Desk if damage has occurred, see paragraph [19.2 Getting Help](#) for contact information. Do not attempt to install the system if damage is apparent.

2. Compare the shipment contents with the bill of lading. Verify that all units and any ordered spare parts have been received. Report any missing items to the carrier and Eaton immediately.
3. If the unit is stored before installation, store it in a dry environment within storage temperature specification (See paragraph [2.2 Specifications](#)).

Use the original packing materials or other suitable means to keep the unit clean.

3.2 Unloading, Unpacking, and Handling

The TFA STS is covered with an overhead plastic bag, shrink-wrapped, protected with corner cardboard, and strapped to a shipping skid or pallet with metal straps. You should unpack your Eaton product with the same care used in packing the product for safe and efficient delivery to your facility.

1. Before moving the unit, check the unit size and weight (see [Figure 1](#)).
2. Plan your route for moving the equipment. Ensure that all passages are large enough to accommodate the unit and support the weight. Check for any non-negotiable corners or offsets in hallways.
3. Before removing packaging, use a forklift or pallet jack to move the unit on its shipping skid as close as possible to its final installation position. Do not exceed a 10-degree tilt. Tipping the unit may cause it to fall which may cause damage to the unit or injury to personnel.
4. Exercise care when handling STS system cabinet(s) to avoid equipment damage or injury to personnel.
5. To remove the unit from its shipping skid, carefully cut the bands holding the unit or unit modules to the skid or palette. Use caution as bands are under tension and can cause personal injury. Remove all plastic wrapping and packing material from the unit. Use care not to scratch or damage the cabinet with sharp tools.



Do not remove the retaining bands securing the TFA STS to its pallet until the STS is near its final position and you are ready to remove the STS from its pallet.

Retaining bands are under tension; cut them carefully. Wear protective clothing and use eye, face, and hand protection when cutting bands.

6. Ensure that the unit is located on a level floor with room to maneuver around it. Lift the STS unit off its skid or palette with a forklift capable of handling the weight of the unit. Lift the STS unit from the front.
7. Keys are located on the unit:
 - a. Keys for integrated keyed interlocks (or alternatively Kirk Keys) are in the locks in their associated MSCW or MCCB.
 - b. Front door keys are tied to a front ventilation grill.

3.3 Internal Inspections

Execute the following inspections as soon as possible upon arrival of your Eaton equipment:

1. Open the front door and check the nameplate on the cabinets to verify that the model numbers correspond with the ones specified on the bill. Record the model and serial numbers for service reference.
2. The installer should open doors, remove the internal panels, and check for any damage that may have occurred during shipment. Check for loose connections or unsecured components as listed in the following section.

A yellow rectangular box with a black triangle containing an exclamation mark, followed by the word "CAUTION" in bold black capital letters.

The Installer should inspect the TFA STS for connections and safety prior to final positioning and installation.

3.3.1 Internal Wiring Inspection

The installer should perform a visual inspection to verify that lug connections have not come loose, as follows:

1. Check these connections to make sure vibration has not loosened the terminal screws.
 - a. Input source and MCSWs
 - b. Bypass MCSWs
 - c. Isolation MCSW(s)
2. Check all lugs on the following:
 - a. Neutral Bus
 - b. Ground Bus
 - c. Bus bars
 - d. Switches and circuit breakers
 - e. SCR switch modules

If loose connections are found during the installation, contact Eaton Help Desk, see paragraph [19.2 Getting Help](#) for contact information.

Chapter 4 Installation TFA STS 250-600A Models



- Severe or fatal injury can result from electrical shock during contact with high voltage conductors, monitoring PCBs, or similar equipment.
- Disconnect power before drilling holes, attaching cables or conduit, or connecting STS units to other power distribution equipment.
- Use Lock Out/Tag Out procedures.
- Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
- Leave ample space for attaching and routing wires.

 **IMPORTANT**

A licensed electrician must install each unit.

This chapter describes installation of TFA STS 250-600A models. Installation is the responsibility of the Installer, who must be an electrician certified for the locality where the installation is being performed.

4.1 Placing the TFA STS 250-600A Unit

4.1.1 Placement Information

- TFA STS Dimensions: 50"W x 36"D x 84"H
- Clearances:
 - Service clearance 36" front only
 - Ventilation clearances:
 - 6" both sides and rear
 - 18" top
- Weight: Approx. 1400-1500 lbs. (Insure TFA STS floor loading does not exceed the raised floor loading specifications. Obtain floor bracing if necessary.
- If a floor stand is used, add floor stand weight (165-300 lbs. depending on height) to floor loading computation: See table of floor stand weights in [Figure 19](#).

4.1.2 Mounting TFA STS on Floor

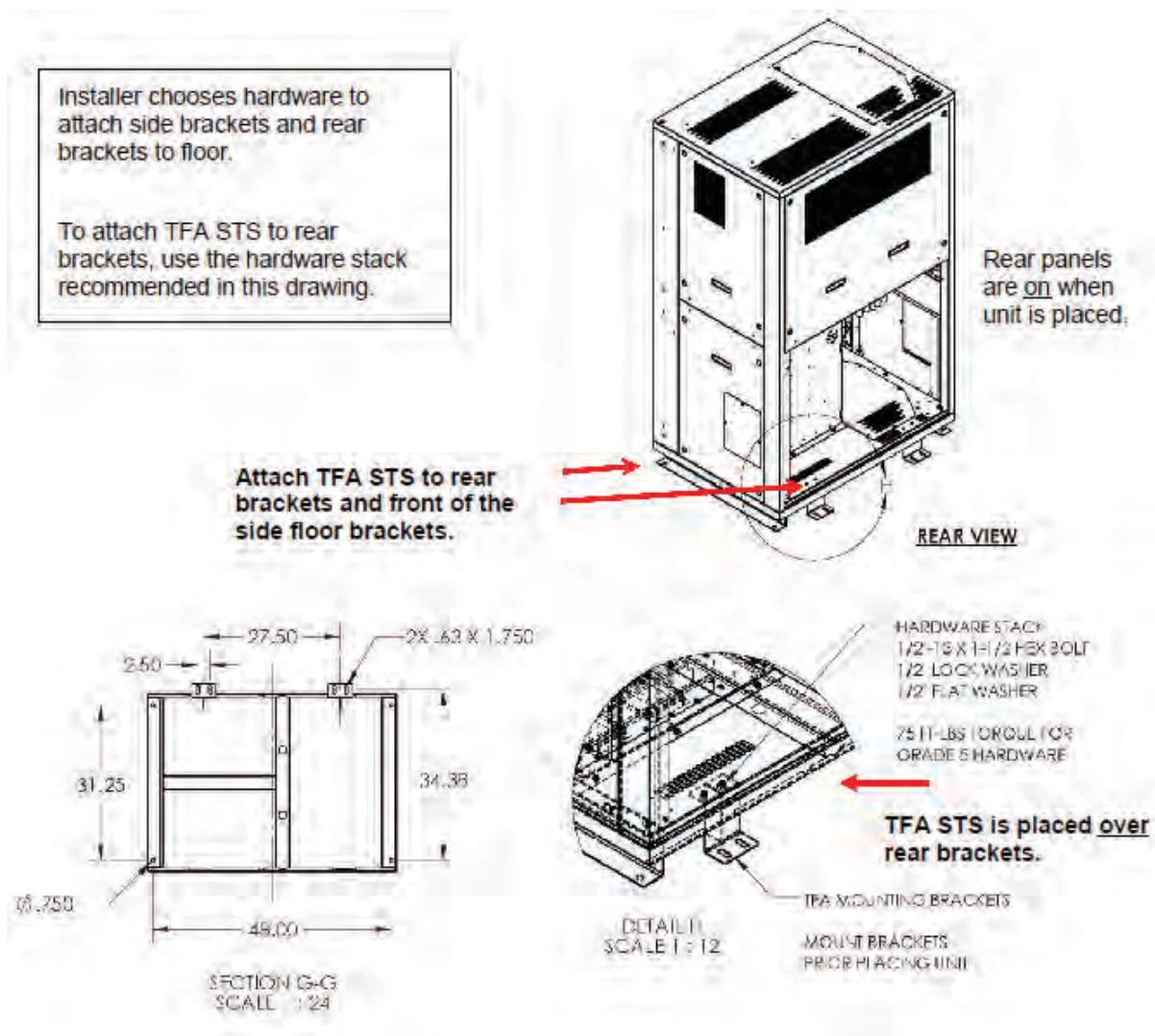
The TFA STS is front-access-only for installation as well as maintenance, service, and operation. In constrained spaces, the Installer may not be able to reach the rear mounting holes of the side floor brackets. Consequently, the TFA STS comes with (2) rear-mounted floor brackets that should be installed *before* moving the TFA STS into place. The following placement procedure assumes that rear access is not available.

Placement procedure:

1. Determine the position of the TFA STS precisely, including clearances.
2. Attach the (2) rear floor brackets to the floor based on your measurements and dimensions in the illustration below. Installer chooses and provides floor attachment hardware.

3. Move the TFA STS into its predetermined position using a forklift or pallet jack rated for the unit's weight. Insert forks from the front of the unit. Do not tilt the unit more than 10°.
4. The unit has pre-drilled holes for attaching the rear brackets. Place the TFA STS so that the holes are over the rear brackets.
5. Attach the frame of the TFA STS to the rear floor brackets using recommended hardware stack. You will have to reach through the cable entry/exit section to secure the brackets to the STS.
6. Attach the side floor brackets to the floor at their front holes (0.75" dia. holes). Installer chooses and provides floor attachment hardware.
7. If possible, also attach side floor brackets to the floor at their rear holes (0.75" dia. holes).

Figure 9. Side Floor Brackets and Rear Brackets



4.1.3 Mounting TFA STS on Floor Stand

For raised floor environments, floor stands are available in heights from 12" to 52". Each floor stand has an 8" adjustable height range.

Mounting with side brackets only

If space allows access to rear floor bracket holes, you can use the side brackets only for attaching the TFA STS to the floor stand.

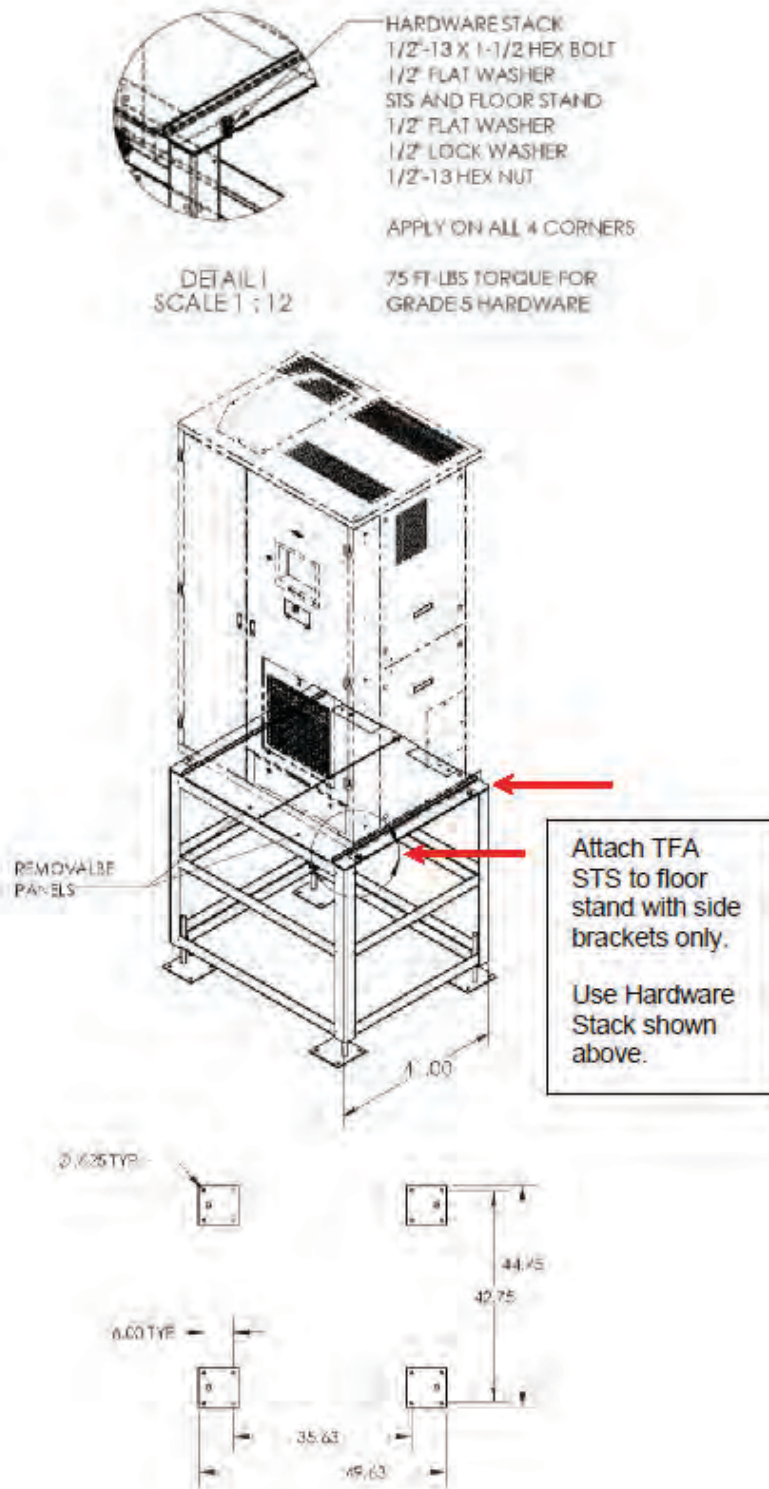
Placement procedure:

1. Determine the position of the TFA floor stand and TFA STS precisely, including clearances.
2. Create floor cutouts for the floor stand.
3. Using corner all-thread screws, adjust height of floor stand to match raised floor.
4. Place floor stand in floor cutout location. Attach the floor stand corner mounting plates to the floor using (4) screws or bolts for each corner plate. Installer chooses floor attachment hardware.
5. Place the TFA STS so that STS side bracket holes are over the floor stand holes. Use a forklift or palette jack rated for the unit's weight, insert forks from the front of the unit. Do not tilt the unit more than 10°.
6. Attach the left and right floor brackets to the floor stand using the hardware recommended in [Figure 10](#) as "HARDWARE STACK".

**NOTE**

See also [Figure 24](#), "Floor Stand Attachment Hardware."

Figure 10. Installing on Floor Stand with Side Brackets



Mounting with side and rear brackets

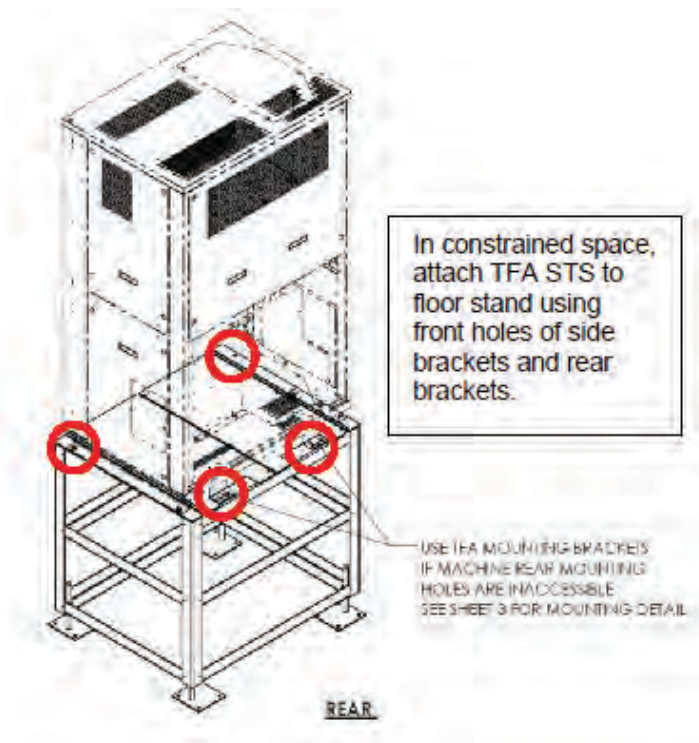
In constrained spaces, the Installer may not be able to reach the rear mounting holes of the side floor brackets.

1. Determine the position of the TFA floor stand and TFA STS precisely, including clearances.
2. Create floor cutouts for the floor stand.
3. Using corner all-thread screws, adjust height of floor stand to match raised floor.
4. Attach rear brackets to floor stand (see [Figure 9](#) and [Figure 11](#)) using recommended hardware stack in [Figure 9](#).
5. Place floor stand in floor cutout location. Attach the floor stand corner mounting plates to the floor using (4) screws or bolts for each corner plate. Installer chooses attachment hardware.
6. Place the TFA STS so that the TFA STS side bracket holes are over the floor stand holes. Use a forklift or pallette jack rated for the unit's weight. Insert forks from the front of the unit. Do not tilt the unit more than 10°.
7. Using the front bracket holes, attach the left and right floor brackets to the floor stand using recommended hardware stack in [Figure 10](#).
8. The unit has pre-drilled holes for attaching the rear brackets. Place the TFA STS so that the holes are over the rear brackets.
9. Attach the frame of the TFA STS to the rear floor brackets using the recommended hardware stack in [Figure 9](#). You will have to reach through the cable entry/exit section to secure the brackets to the STS.

**NOTE**

See also [Figure 24](#), "Floor Stand Attachment Hardware."

Figure 11. Installing on Floor Stand with Side and Rear Brackets



4.2 Power Connections

⚠ CAUTION

All wiring must comply with NEC and local codes.
Installers are responsible for selecting appropriate wiring.

4.2.1 Upstream Circuit Breaker Protection

Customers must provide upstream circuit breaker protection for the input wires to the TFA STS as required by the National Electric Code (NEC). For additional information, refer to your local codes and the NEC.

4.2.2 Power Sources

The two input feeds for the TFA STS should be from separate and independent sources to avoid a common source failure. The input feeds should nominally be of the same voltage and phase rotation. The input power wire size should be based on the upstream over current protection device, conforming to NEC and local codes.

Customer ground and phase power connections are made in the bottom left half of the unit. All connections are made from the front.

⚠ WARNING

Verify that all input power and control circuits are de-energized and locked out before making connections to the input bus or other connections inside the unit.

Only a qualified electrician should install power or control wiring or torque the connections.

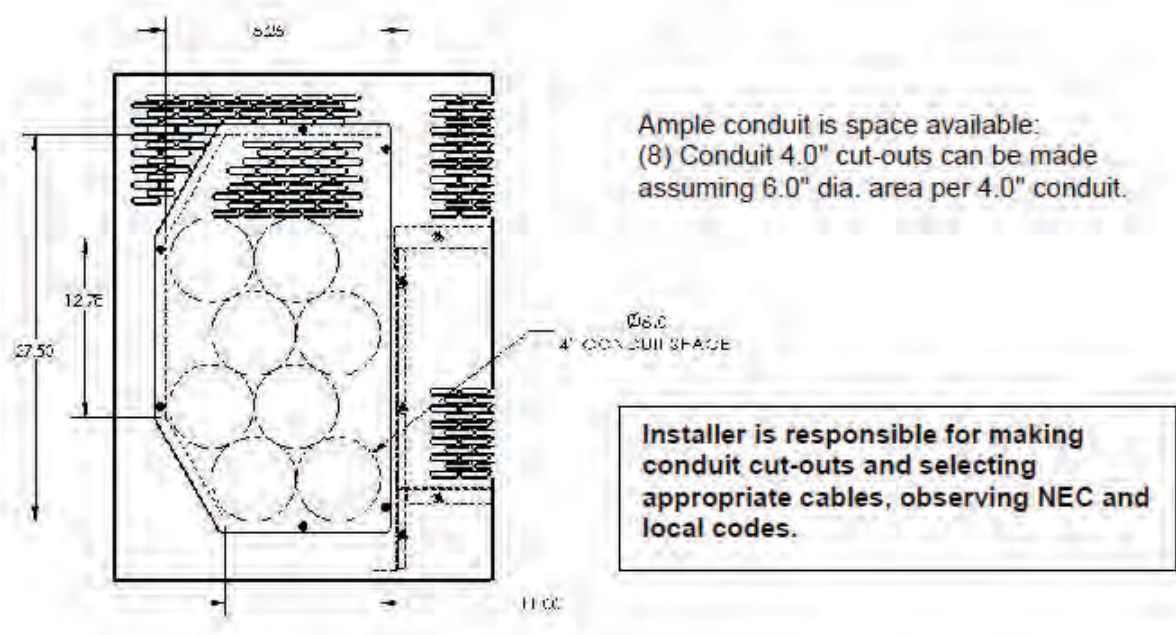
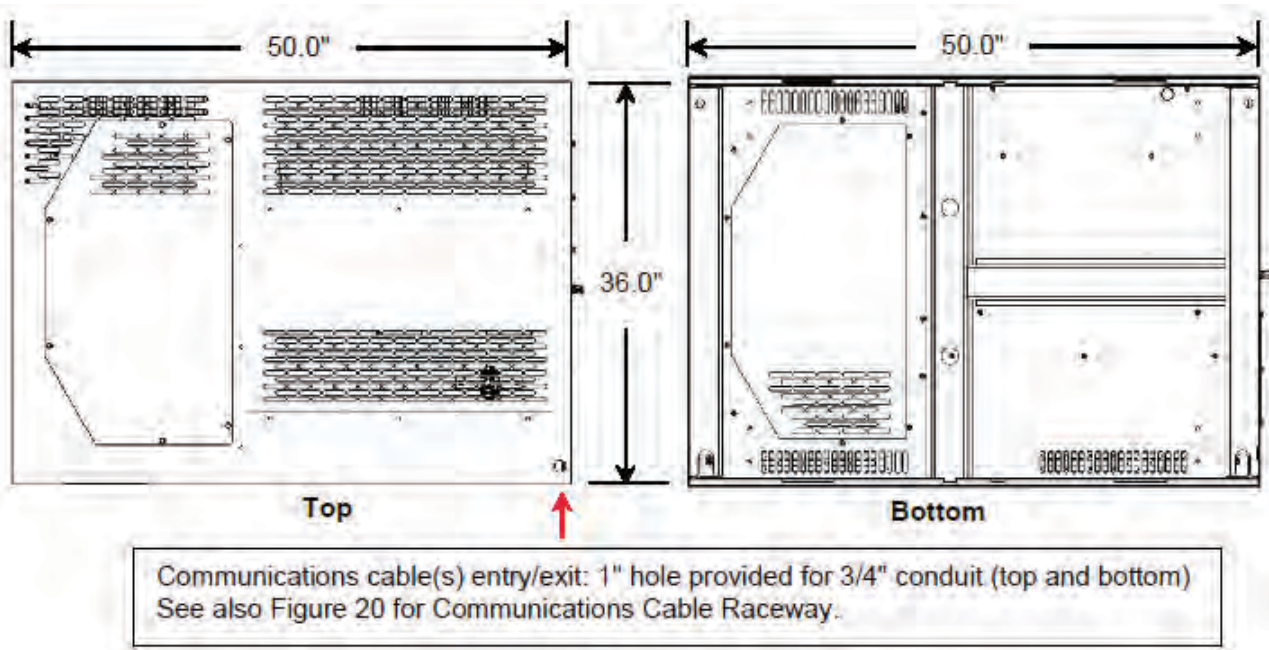
4.2.3 Cable Entry/Exit

Cable entry/exit can be from the top or bottom of the unit.

The preferred cable entry/exit is from the bottom, which locates cables closer to the source and output power busses and ground bus. For top cable entry/exit, cables can be run down along the inside rear of the unit.

Identical removable conduit panels are on the left side of the unit, top and bottom. There are no knock-outs in the panels; installers must make their own conduit cut-outs. TFA STS units 250-600A can accommodate up to (8) 4" conduits per conduit panel assuming 6" dia. area per conduit.

Figure 12. Cable Entry/Exit Panels

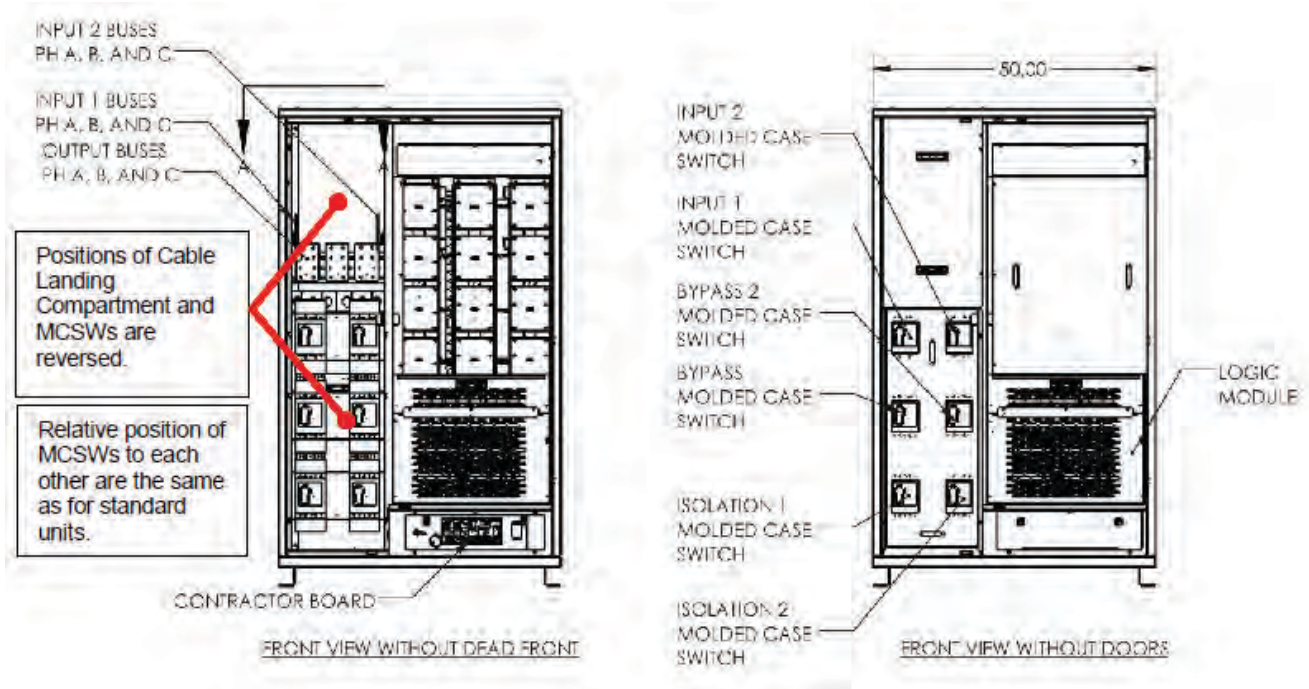


4.2.4 Top Cable Landing Compartment

Customers can specify a preference for bottom or top cable landing. If top cable landing is preferred, the unit can be manufactured with a Top Cable Landing Compartment. This configuration choice reverses the positions of the MCSWs and the cable landing compartment from the normal TFA STS layout. Unit dimensions, power connections, and operation are otherwise the same as for standard units.

When the TFA STS is configured for top cable landing, power cables do not have to be run down the rear of the unit for attachment from the bottom. Cable length requirements are thus reduced, reducing customer conductor costs.

Figure 13. Top Cable Landing Compartment Option (250-600A)



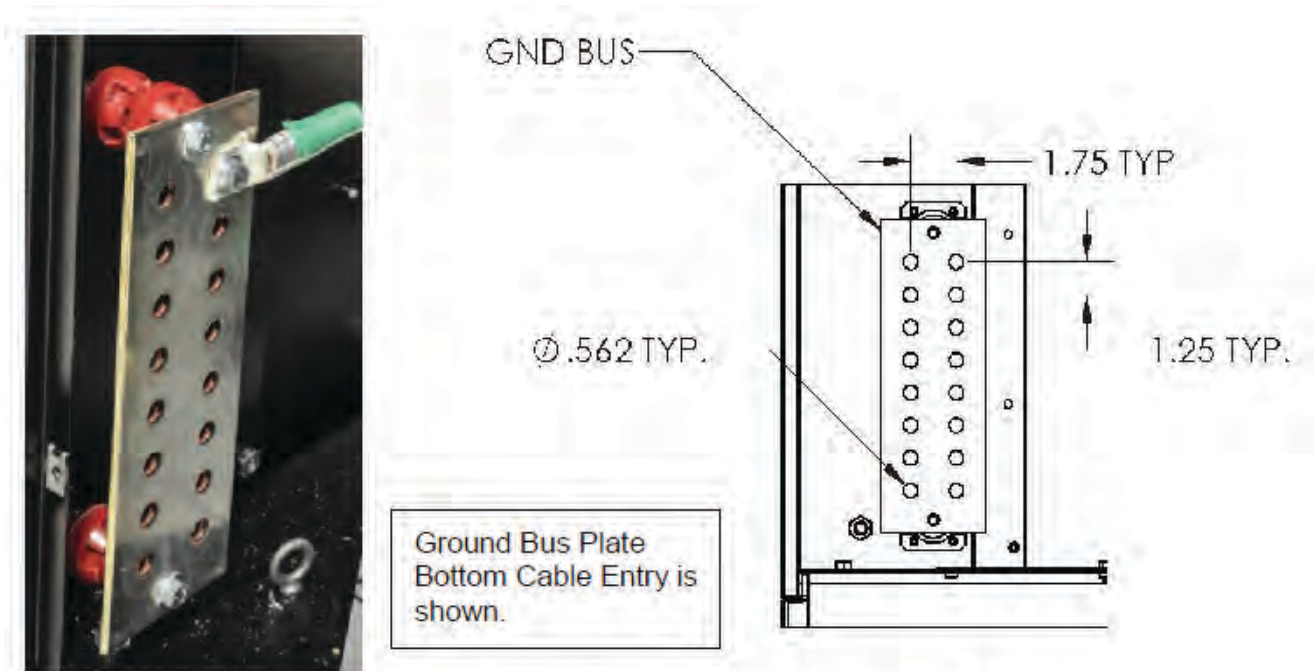
4.2.5 Ground

CAUTION

Grounding for the WaveStar TFA Static Transfer Switch must comply with local building codes and National Electric Codes.

The TFA STS has a single-point ground bus plate on the lower front left side with (16) x 0.562" dia. holes. STS internal ground connection takes (1) position. Lugs are provided by others (specifically, by the Installer). All input and output power feeds must include an equipment grounding means as required by the NEC and local codes.

Figure 14. Ground Bus Plate



Ground Bus Plate is located on the left side of the Cable Landing Compartment. When top cable landing is selected, ground bus plate is located at top left of the Cable Landing Compartment.



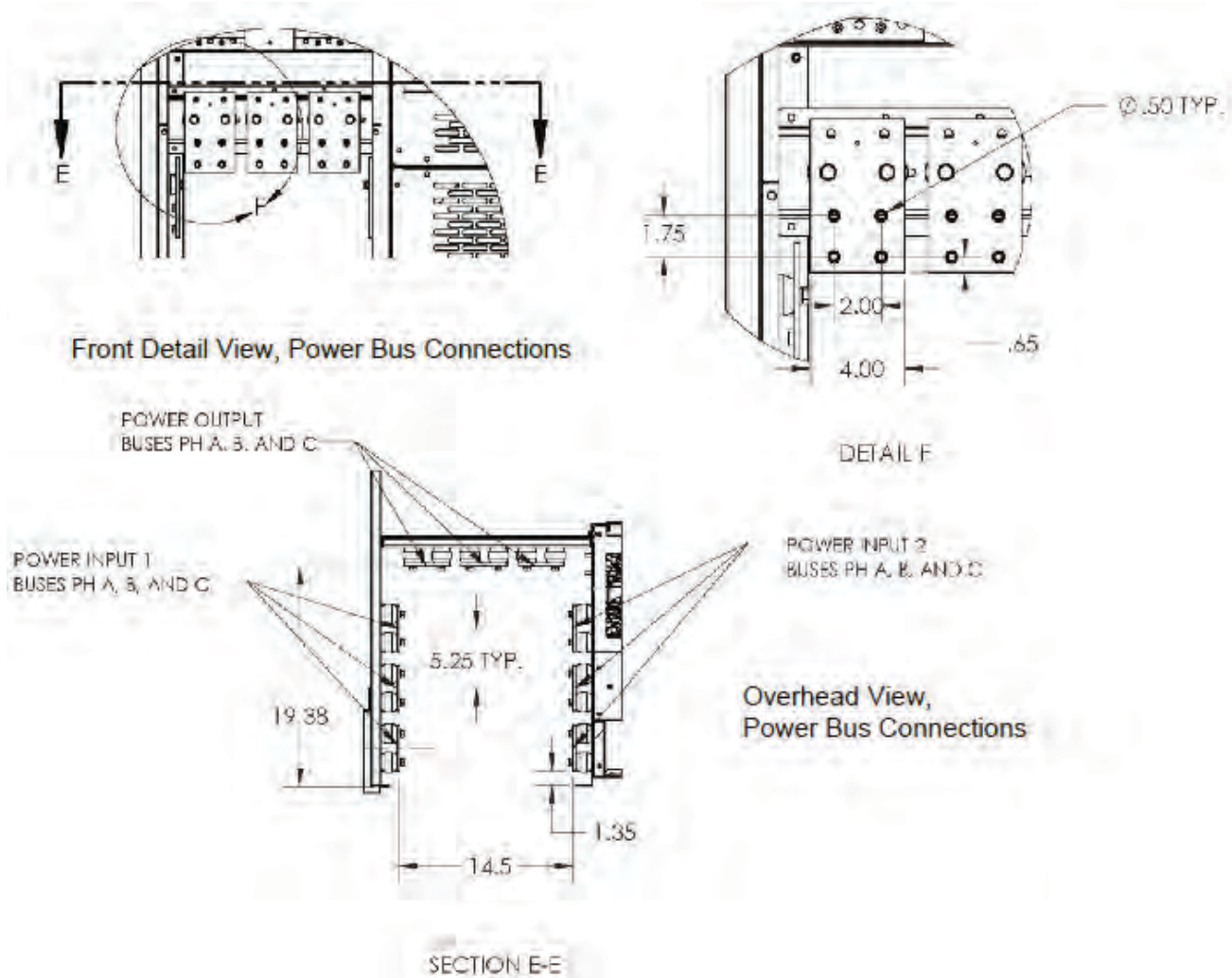
NOTE

Complete outline drawings are shown in [Figure 16](#) through [Figure 20](#).

4.2.6 Source and Output Power Connections

Connect phase cables to Source 1, Source 2, and Output bus plates. Source 1, Source 2, and Output each have (3) bus plates for the 3-phase connections. Each bus plate has (4) x 0.50" holes. Lugs are provided by others (specifically, by the Installer).

Figure 15. Power Bus Connections



4.2.7 Control Wiring

All control wiring to and from the TFA STS should be rated at minimum 10A and cable insulation should be rated for 600VAC, unless otherwise specified on the drawings. Control wire connections are only required for some options.

4.2.8 Primary and Secondary System Cabling

Left- and right-side panels allow cabling to PDU(s) in primary and secondary systems. See [Figure 1](#), [Figure 3](#), and [Figure 20](#) for panel locations.

4.3 Outline Drawings

The following five (5) pages have outline drawings for TFA STS 250-600A units with Bottom Cable Landing Compartments. Submittal drawings are also available from your Eaton sales representative for units with Top Cable Landing Compartments.

Figure 16. TFA STS 250-600A Outline Drawing 1

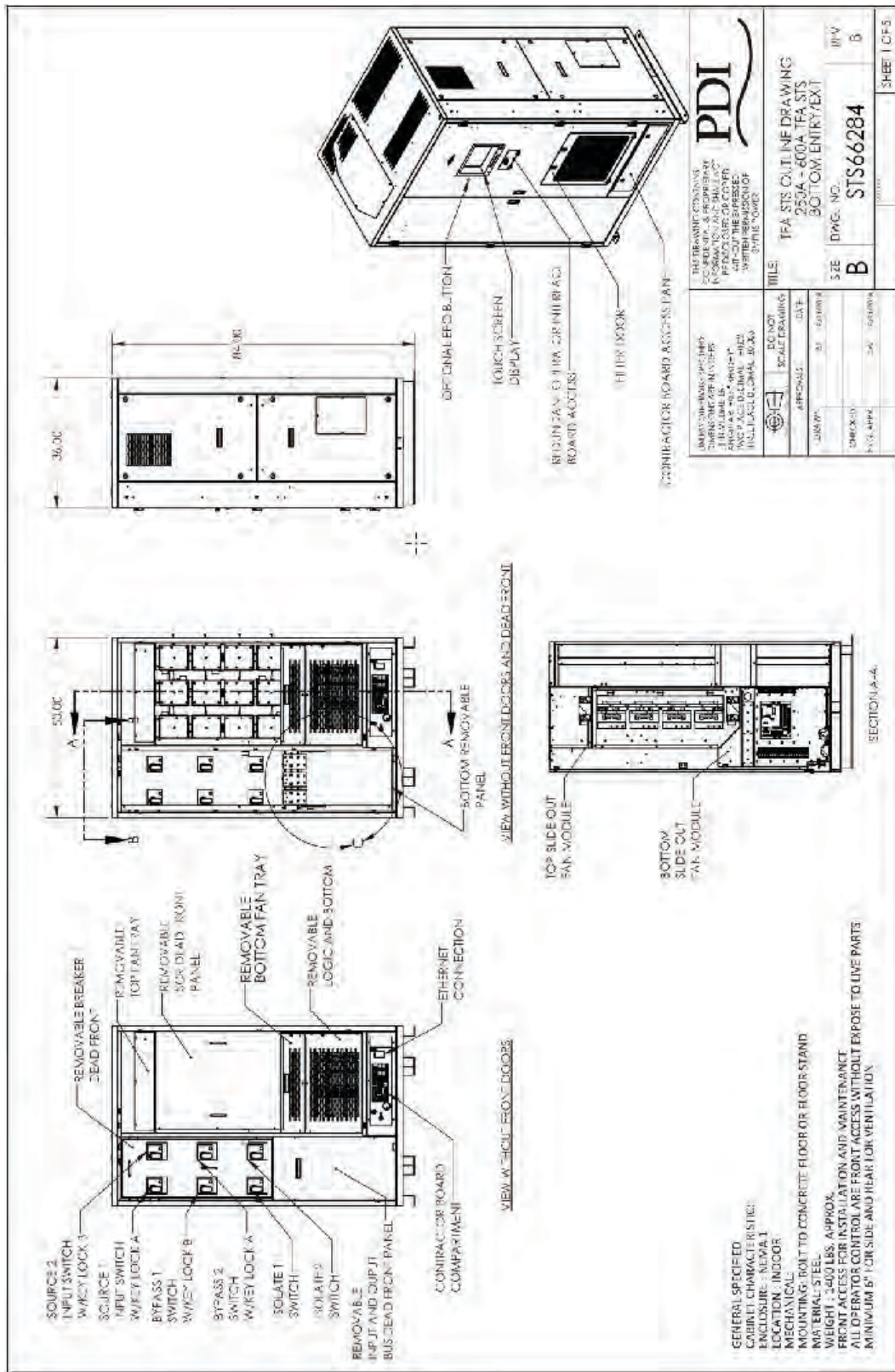


Figure 17. TFA STS 250-600A Outline Drawing 2

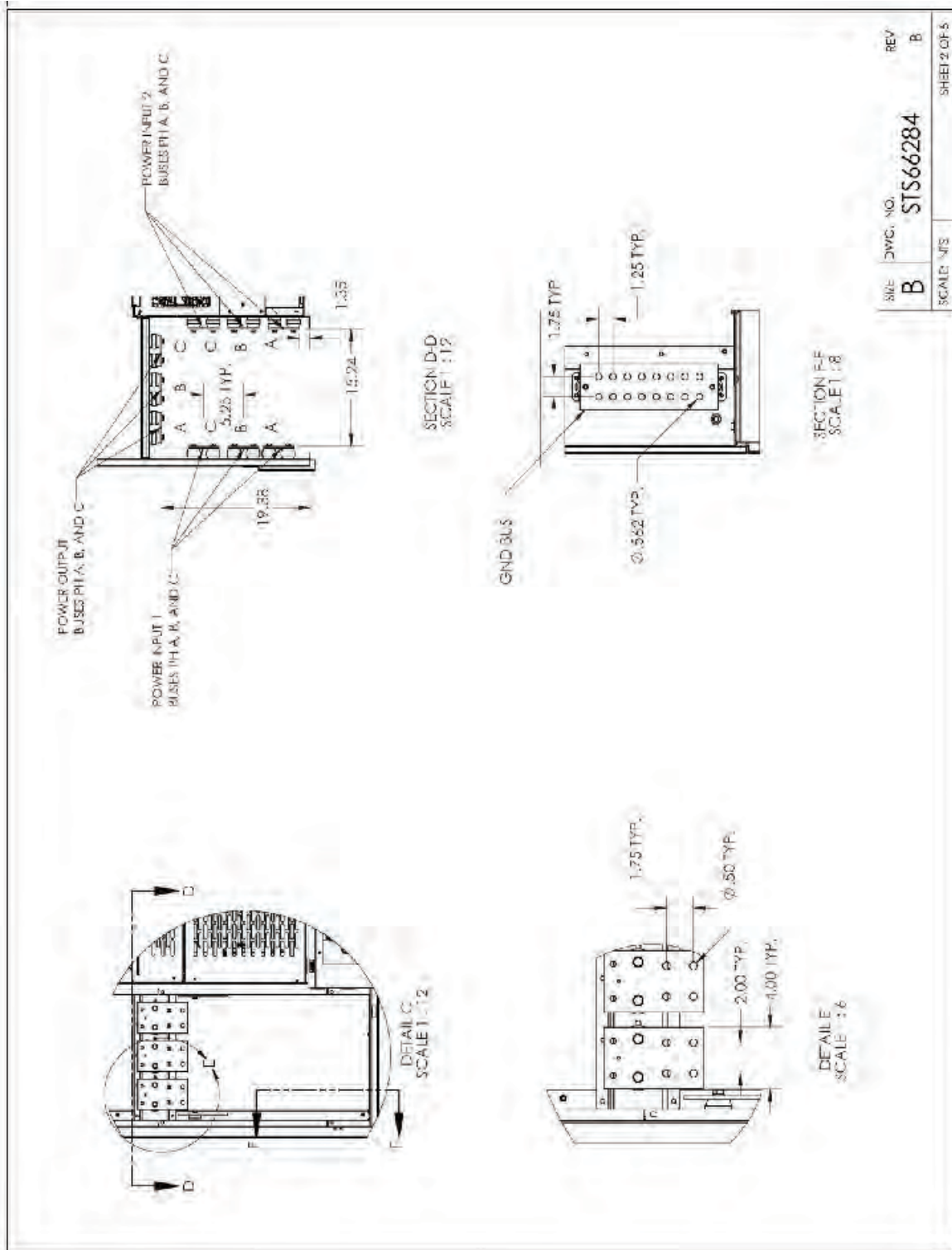


Figure 18. TFA STS 250-600A Outline Drawing 3

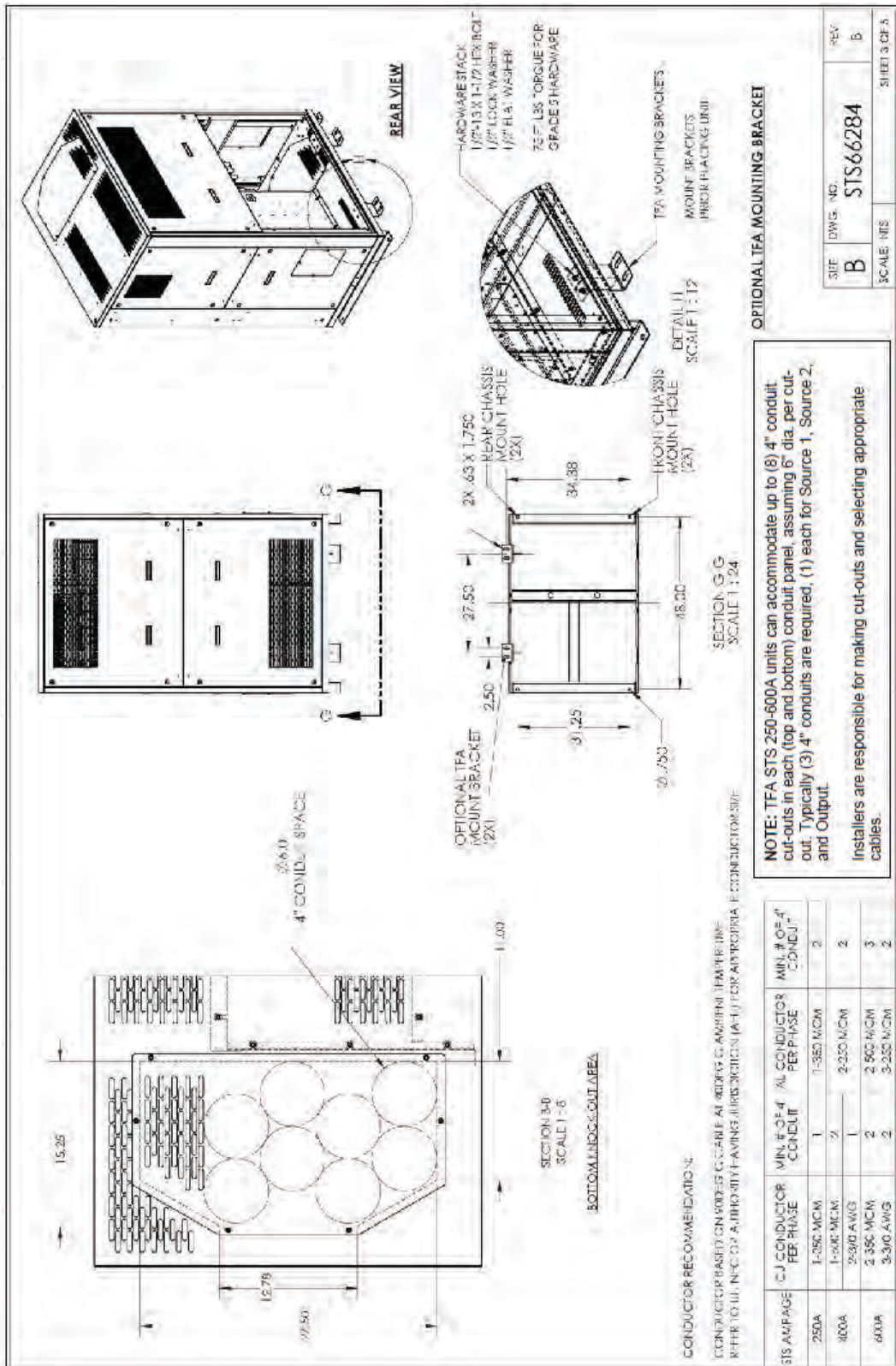


Figure 19. TFA STS 250-600A Outline Drawing 4

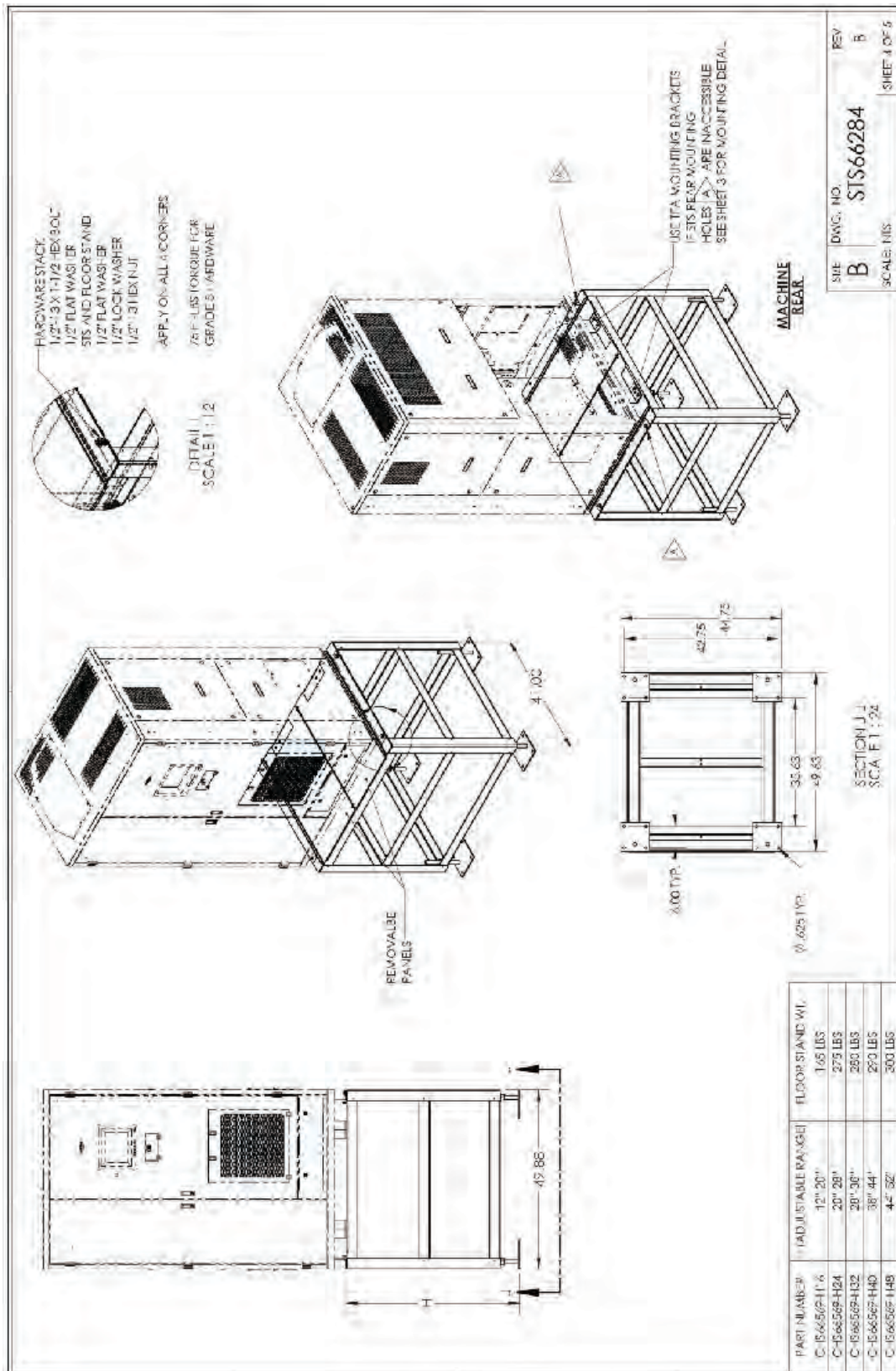
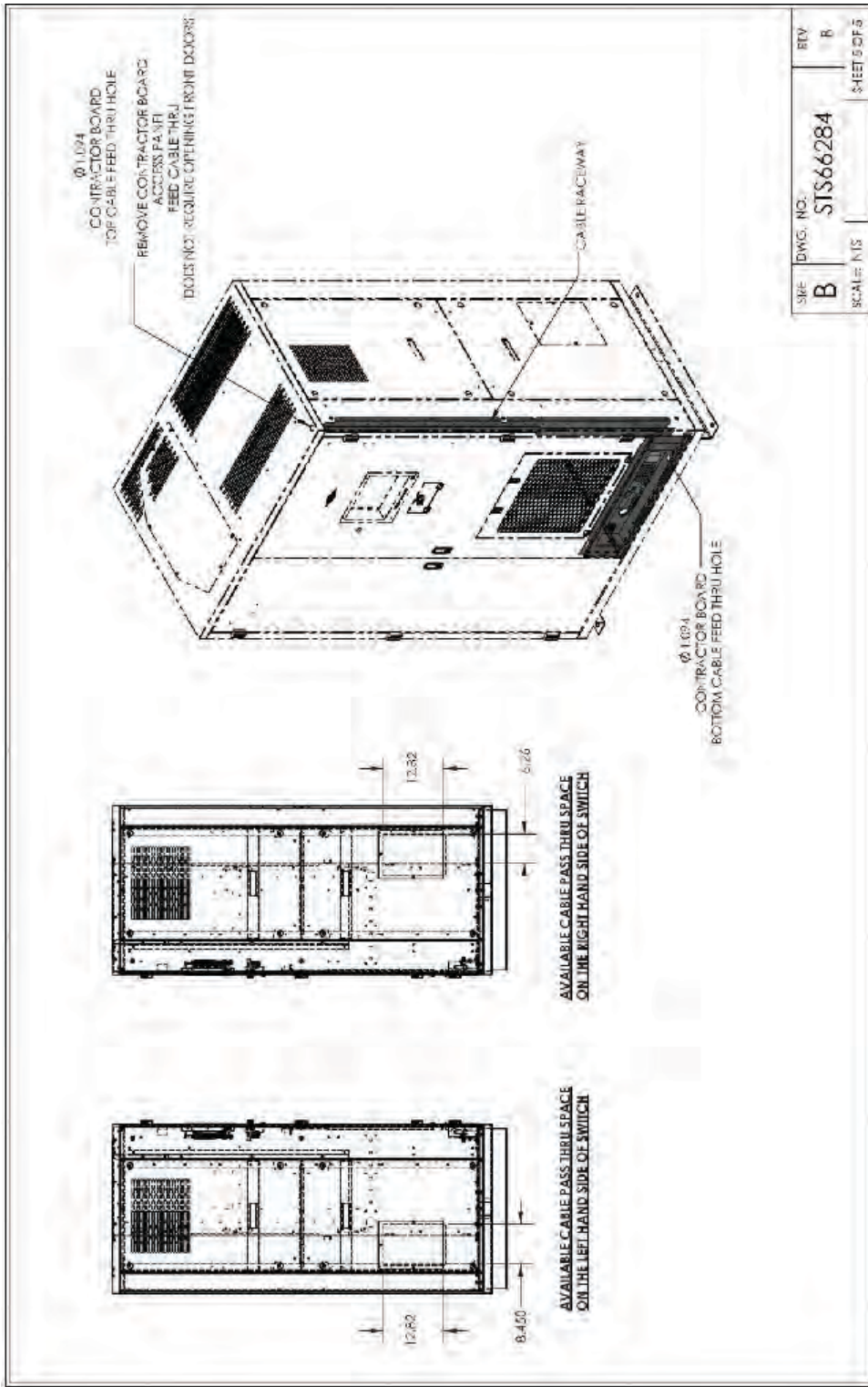


Figure 20. TFA STS 250-600A Outline Drawing 5



Chapter 5 Installation TFA STS 800-1200A Models

⚠ DANGER

- Severe or fatal injury can result from electrical shock during contact with high voltage conductors, monitoring PCBs, or similar equipment.
- Disconnect power before drilling holes, attaching cables or conduit, or connecting STS units to other power distribution equipment.
- Use Lock Out/Tag Out procedures.
- Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
- Leave ample space for attaching and routing wires.

⚠ WARNING

A licensed electrician must install each unit.

This chapter describes installation of TFA STS 800-1200A models. Installation is the responsibility of the Installer, who must be an electrician certified for the locality where the installation is being performed.

5.1 Placing a TFA STS 800-1200A Unit

5.1.1 Placement Information

- TFA STS Dimensions: 60"W x 36"D x 84"H
- Clearances:
 - Service clearance 36" front only
 - Ventilation clearances:
 - 6" both sides and rear
 - 18" top
- Weight: Approx. 1800-2000 lbs. (Insure TFA STS floor loading does not exceed the raised floor loading specifications. Obtain floor bracing if necessary.)
- If a floor stand is used, add floor stand weight (175-310 lbs. depending on height) to floor loading computation: See table of floor stand weights in [Figure 32](#), "TFA STS 800-1200A, Outline Drawing 4."

5.1.2 Mounting TFA STS on Floor

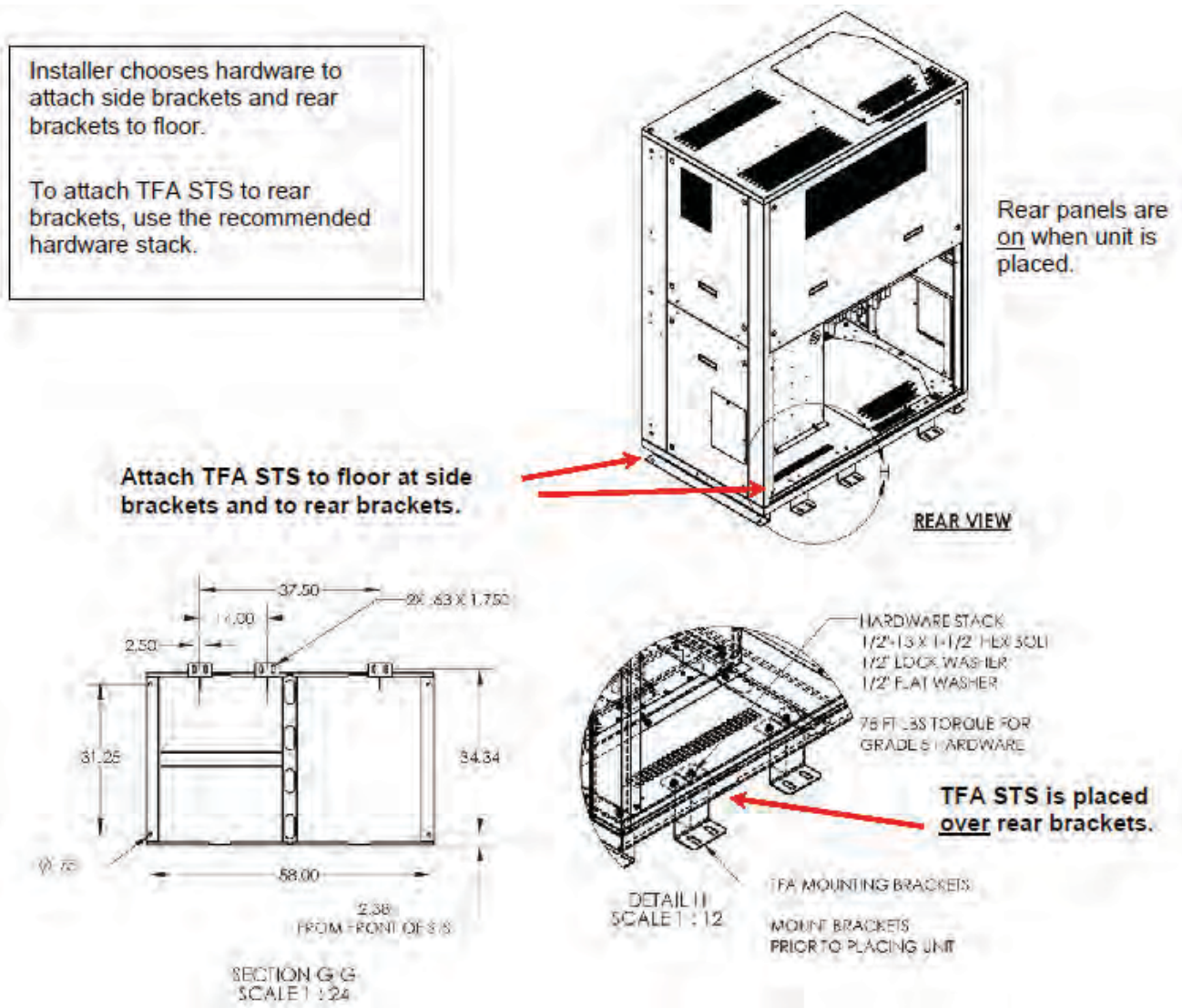
The TFA STS is front-access-only for installation as well as maintenance, service, and operation. In constrained spaces, the Installer may not be able to reach the rear mounting holes of the side floor brackets. Consequently, the TFA STS comes with (3) rear-mounted floor brackets that should be installed *before* moving the TFA STS into place. The following placement procedure assumes that rear access is not available.

Placement procedure:

1. Determine the position of the TFA STS precisely, including clearances.
2. Install the (3) rear floor brackets based on your measurements and dimensions in the illustration below.

3. Move the TFA STS into its predetermined position using a forklift or pallet jack rated for the unit's weight. Insert forks from the front of the unit. Do not tilt the unit more than 10°.
4. The unit has pre-drilled holes for attaching the rear brackets. Place the TFA STS so that the holes are over the rear brackets.
5. Attach the frame of the TFA STS to the rear floor brackets using the recommended hardware stack. You will have to reach through the cable entry/exit section to secure the brackets to the TFA STS.
6. Attach the side floor brackets to the floor at their front holes (0.75" dia. holes).
7. If possible, also attach side floor brackets to the floor at their rear holes (0.75" dia. holes).

Figure 21. Floor Brackets Side and Rear



5.1.3 Mounting TFA STS on Floor Stand

For raised floor environments, floor stands are available in heights from 12" to 52". Each floor stand has an 8" adjustable height range.

Mounting with side brackets only

You can use the side brackets alone for attaching the TFA STS to the floor stand if space allows access to rear floor bracket holes.

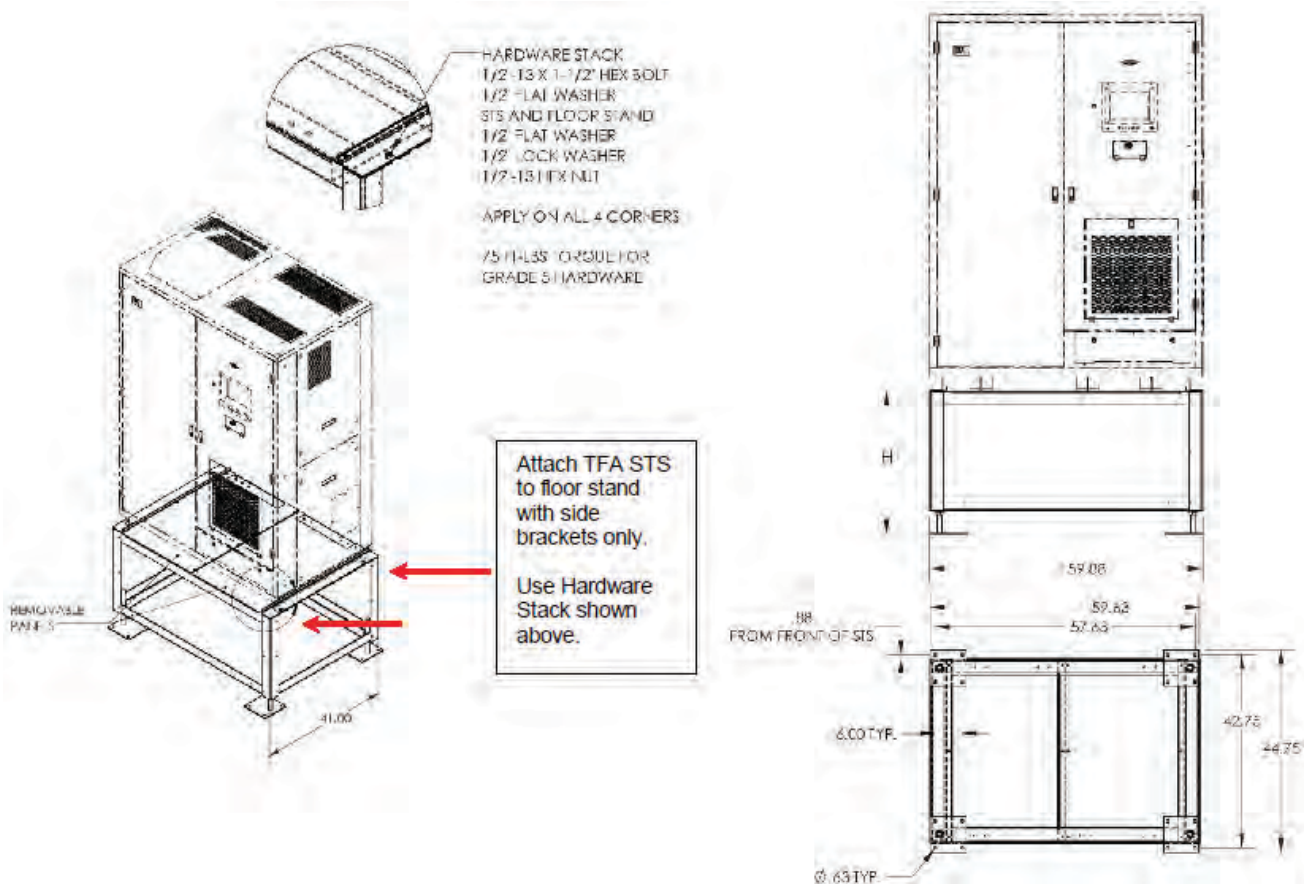
Placement procedure:

1. Determine the position of the TFA STS floor stand and TFA STS precisely, including clearances.
2. Create floor cutouts for the floor stand.
3. Using corner all-thread screws, adjust height of floor stand to match raised floor.
4. Place floor stand in floor cutout location. Attach the floor stand corner mounting plates to the floor using (4) screws or bolts for each corner plate. Installer chooses attachment hardware.
5. Place the TFA STS so that STS side bracket holes are over the floor stand holes. Use a forklift or pallette jack rated for the unit's weight, insert forks from the front of the unit. Do not tilt the unit more than 10°.
6. Attach the left and right floor brackets to the floor stand using the hardware recommended in [Figure 22](#) as "HARDWARE STACK".

**NOTE**

See also [Figure 24](#), "Floor Stand Attachment Hardware."

Figure 22. Installing on Floor Stand with Side Brackets



Mounting with side and rear brackets

In constrained spaces, the Installer may not be able to reach the rear mounting holes of the side floor stand brackets. In that case, follow these steps:

1. Determine the position of the TFA floor stand and TFA STS precisely, including clearances.
2. Create floor cutouts for the floor stand.
3. Using corner all-thread screws, adjust height of floor stand to match raised floor.
4. Attach rear brackets to floor stand. See recommended hardware stack in [Figure 24](#).
5. Place floor stand in floor cutout location. Attach the floor stand corner mounting plates to the floor using (4) screws or bolts for each corner plate. Installer chooses attachment hardware.
6. Place the TFA STS so that STS side bracket holes are over the floor stand holes. Use a forklift or pallet jack rated for the unit's weight. Insert forks from the front of the unit. Do not tilt the unit more than 10°.
7. Using the front bracket holes, attach the left and right floor brackets to the floor stand. See recommended hardware stack in [Figure 24](#).
8. The unit has pre-drilled holes for attaching the rear brackets. Place the TFA STS so that the holes are over the rear brackets.

- 9. Attach the frame of the TFA STS to the rear floor brackets using the recommended hardware stack in [Figure 21](#). You will have to reach through the cable entry/exit section to secure the brackets to the STS.

Figure 23. Install on Floor Stand with Side and Rear Brackets

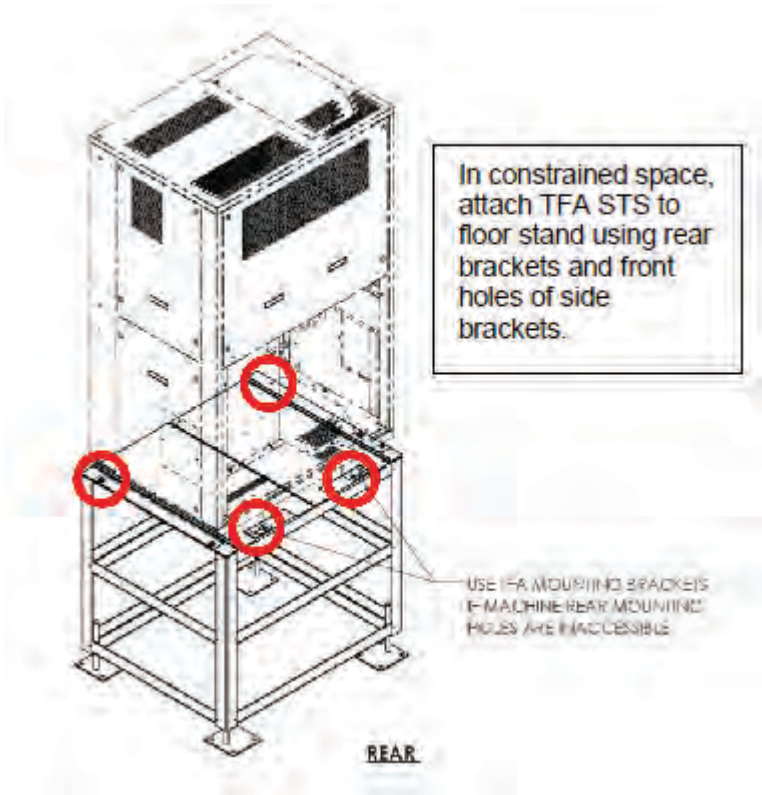
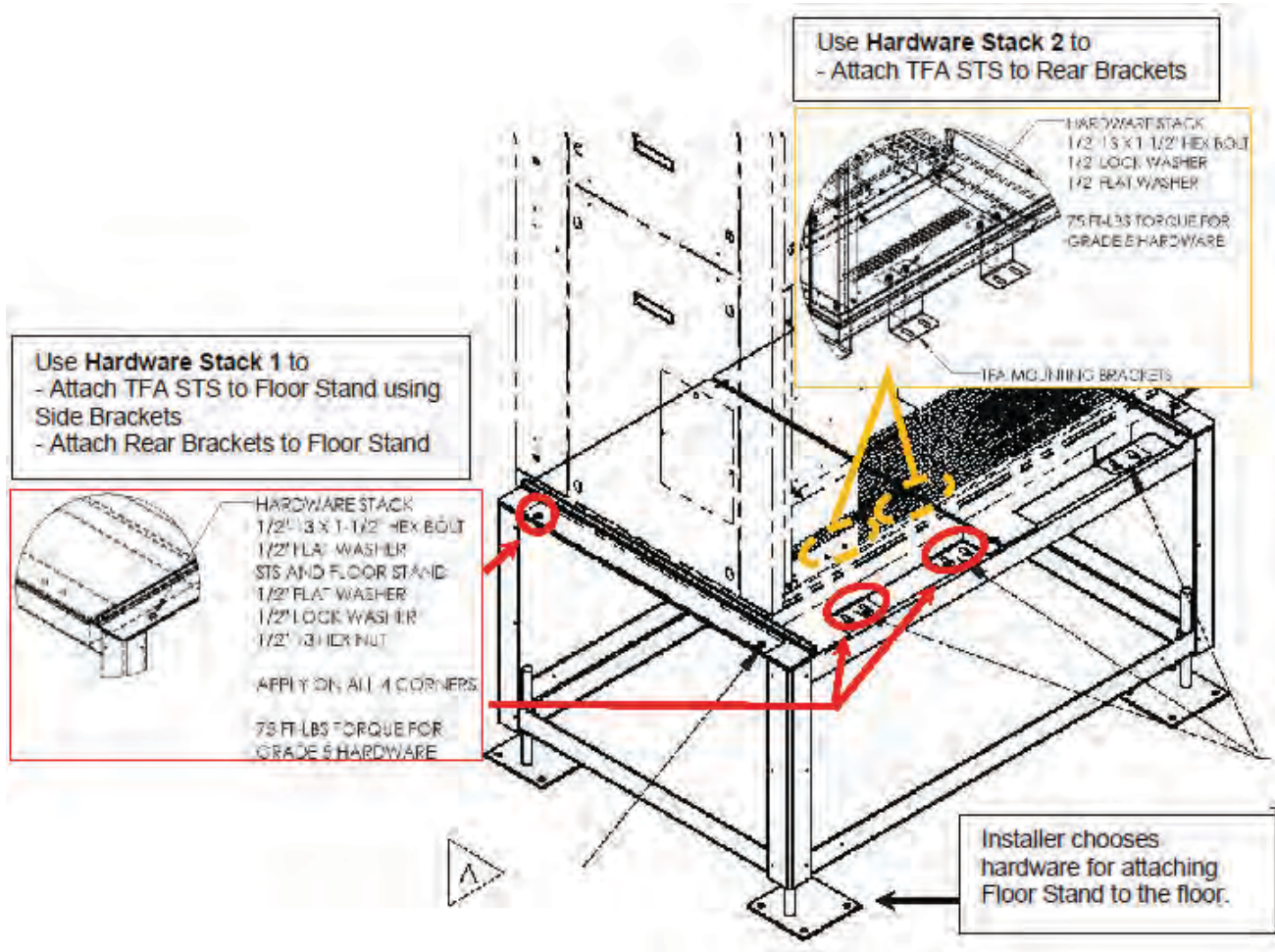


Figure 24. Floor Stand Attachment Hardware



5.2 Power Connections

CAUTION

All wiring must comply with NEC and local codes.
 Installers are responsible for selecting appropriate wiring.

5.2.1 Upstream Circuit Breaker Protection

Customers must provide upstream circuit breaker protection for the input wires to the TFA STS as required by the National Electric Code (NEC). For additional information, refer to your local codes and the NEC.

5.2.2 Power Sources

The two input feeds for the TFA STS should be from separate and independent sources to avoid a common source failure. The input feeds should nominally be of the same voltage and phase rotation. The input power wire size should be based on the upstream over current protection device, conforming to NEC and local codes.

Customer ground and phase power connections are made in the bottom left half of the unit. All connections are made from the front.

WARNING

Verify that all input power and control circuits are de energized and locked out before making connections to the input bus or other connections inside the unit.

Only a qualified electrician should install power or control wiring or torque the connections.

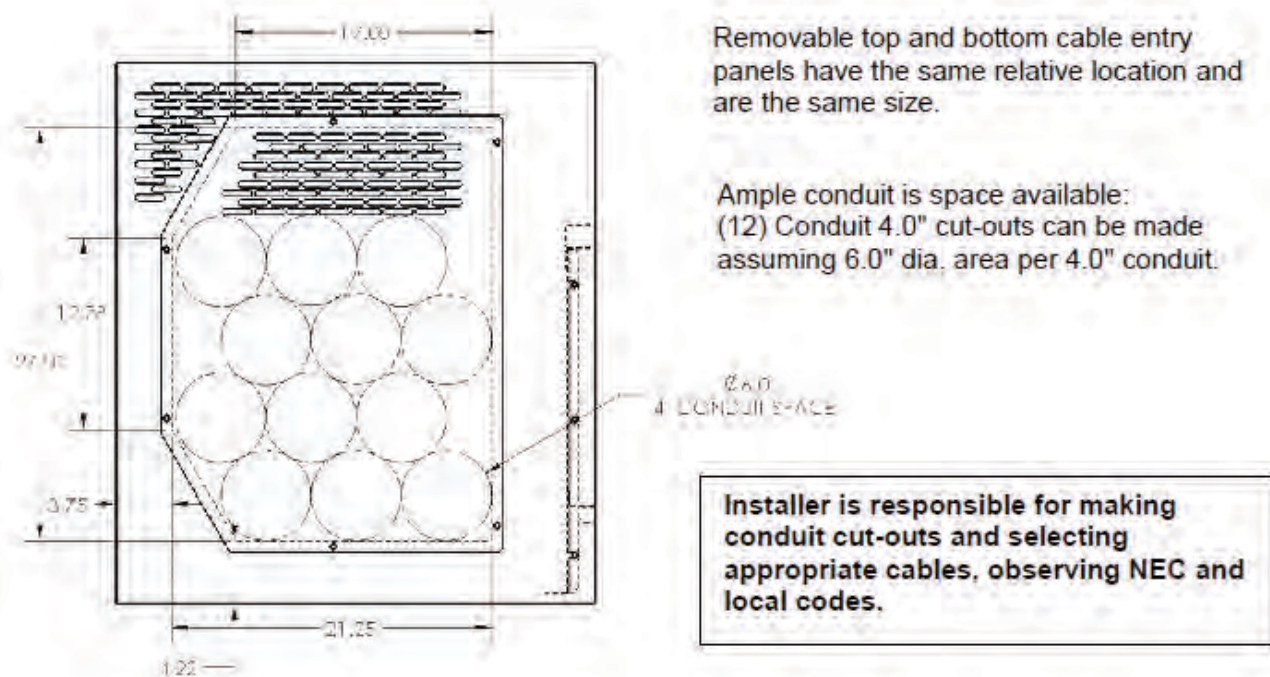
5.2.3 Cable Entry/Exit

Cable entry/exit can be from the top or bottom of the unit.

The preferred cable entry/exit is from the bottom, which locates cables closer to the source and output power busses and ground bus. For top cable entry/exit, cables can be run down along the inside rear of the unit.

Identical removable conduit panels are on the left side of the unit, top and bottom. There are no knock-outs in the panels; installers must make their own conduit cut-outs. TFA STS 800-1200A units have (12) possible 4" conduits per conduit panel assuming 6" dia. area per conduit as shown in [Figure 25](#).

Figure 25. Cable Entry/Exit Panels

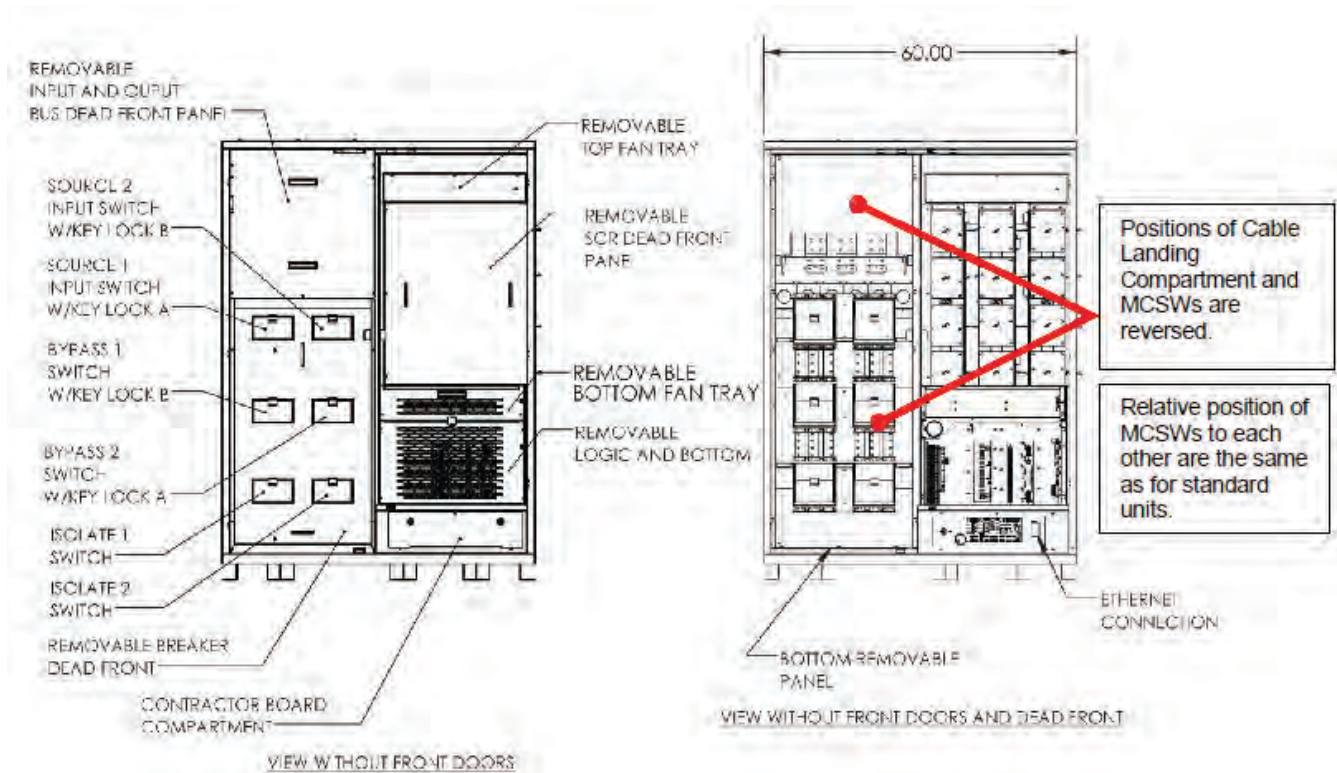


5.2.4 Top Cable Landing Compartment

Customers can specify a preference for bottom or top cable landing. If top cable landing is preferred, the TFA STS unit can be manufactured with a Top Cable Landing Compartment. This configuration choice reverses the positions of the MCSWs and the cable landing compartment from the normal TFA STS layout. Unit dimensions, power connections, and operation are otherwise the same as for standard units.

When the TFA STS is configured for top cable landing, power cables do not have to be run down the rear of the unit for attachment from the bottom. Cable length requirements are thus reduced, reducing customer conductor costs.

Figure 26. Top Cable Landing Compartment Configuration (800-1200A)



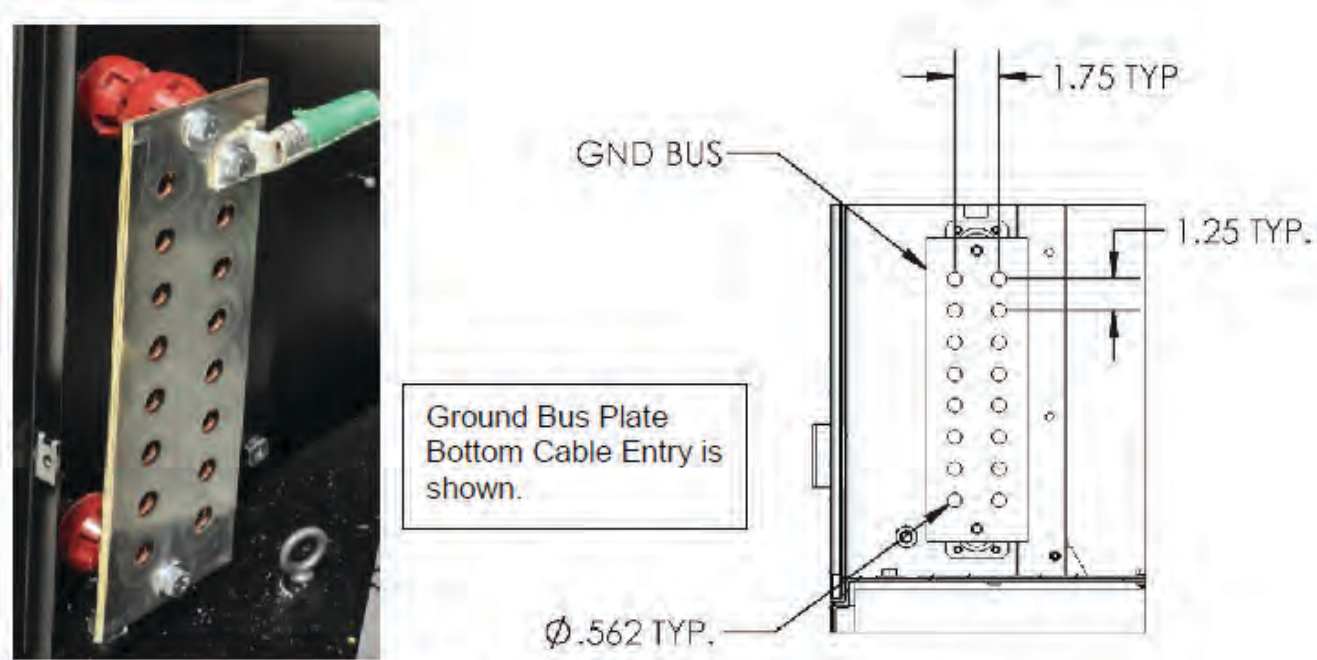
5.2.5 Ground

⚠ CAUTION

Grounding for the WaveStar TFA Static Transfer Switch must comply with local building codes and National Electric Codes.

The TFA STS has a single-point ground bus plate on the lower front left side with (16) x 0.562" dia. holes. STS internal ground connection takes (1) position. Lugs are provided by others (specifically, by the Installer). All input and output power feeds must include an equipment grounding means as required by the NEC and local codes.

Figure 27. Ground Bus Plate



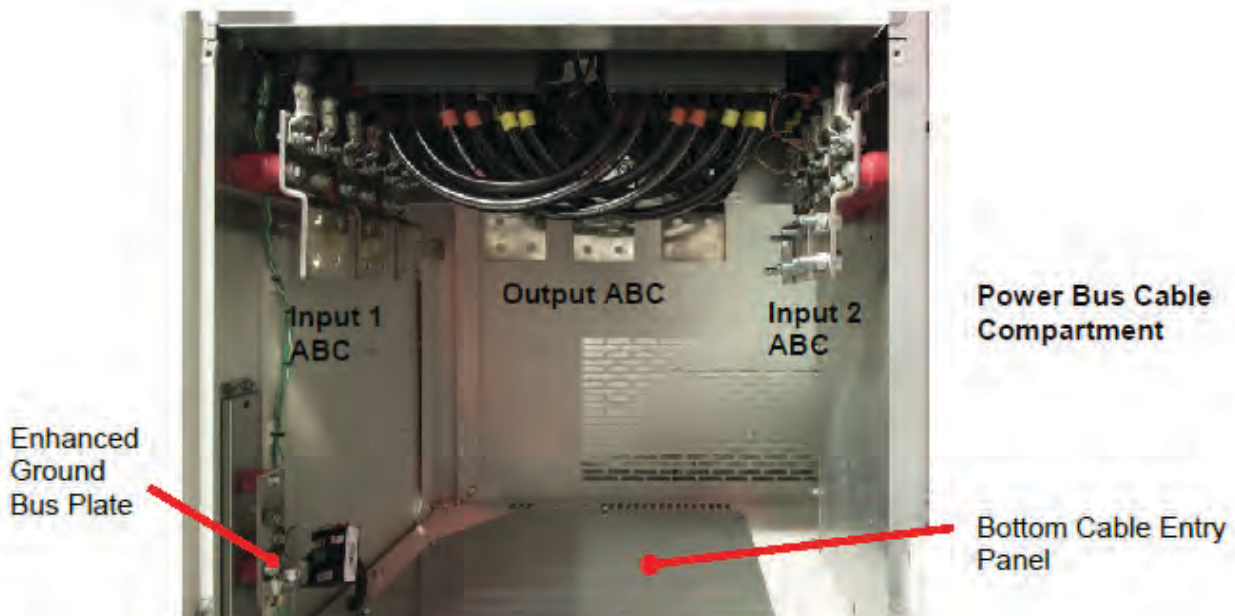
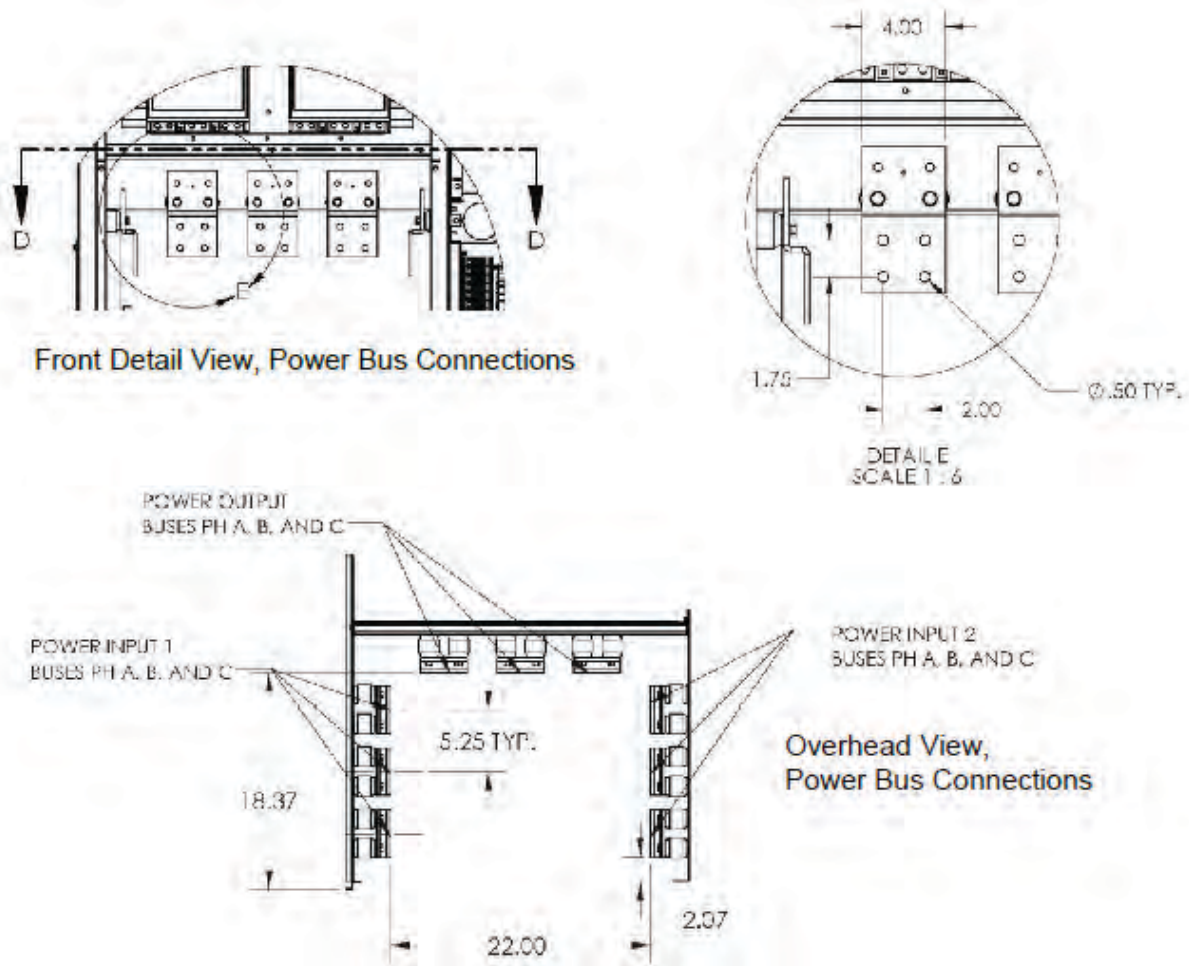
Ground Bus Plate is located on the left side of the Cable Landing Compartment. When top cable landing is selected, the ground bus plate is located at top left of the Cable Landing Compartment.

i **NOTE** Complete outline drawings are shown in [Figure 29](#) through [Figure 33](#).

5.2.6 Source and Output Power Connections

Connect phase cables to Source 1, Source 2, and Output bus plates. Source 1, Source 2, and Output each have (3) bus plates for the 3-phase connections. Each bus plate has (4) x 0.50" holes. Lugs are provided by others (specifically, by the Installer).

Figure 28. Power Bus Connections (800-1200A)



5.2.7 Control Wiring

All control wiring to and from the TFA STS should be rated at minimum 10A and cable insulation should be rated for 600VAC, unless otherwise specified on the drawings. Control wire connections are only required for some options.

5.2.8 Primary and Secondary System Cabling

Left- and right-side panels allow cabling to PDU(s) in primary and secondary systems. See [Figure 2](#), [Figure 6](#), and [Figure 33](#) for panel locations.

5.3 Outline Drawings

The following five (5) pages have outline drawings for TFA STS 800-1200A units with Bottom Cable Landing Compartments. Submittal drawings are also available from your Eaton sales representative for units with Top Cable Landing Compartments.

Figure 29. TFA STS 800-1200A Outline Drawing 1

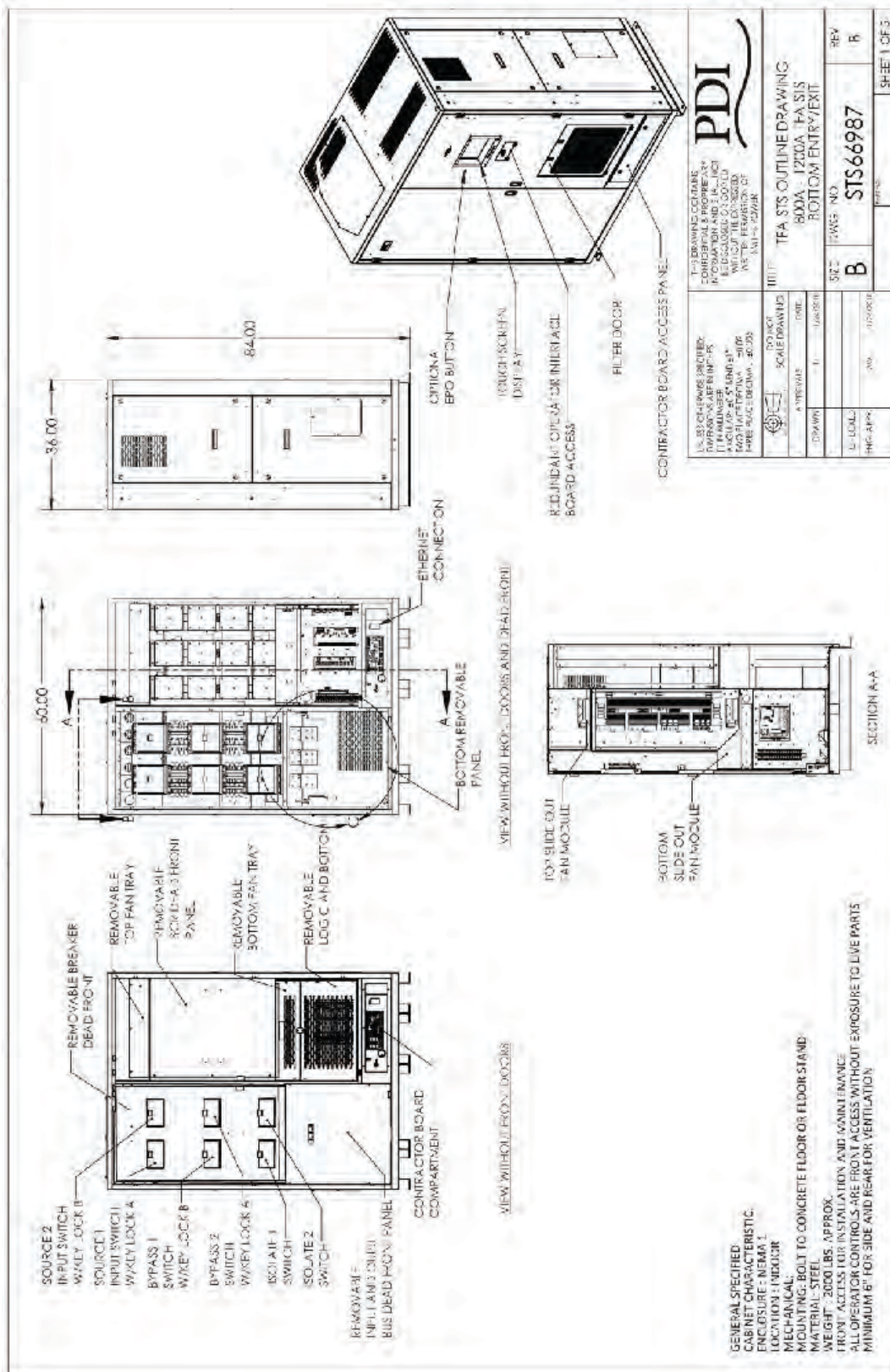
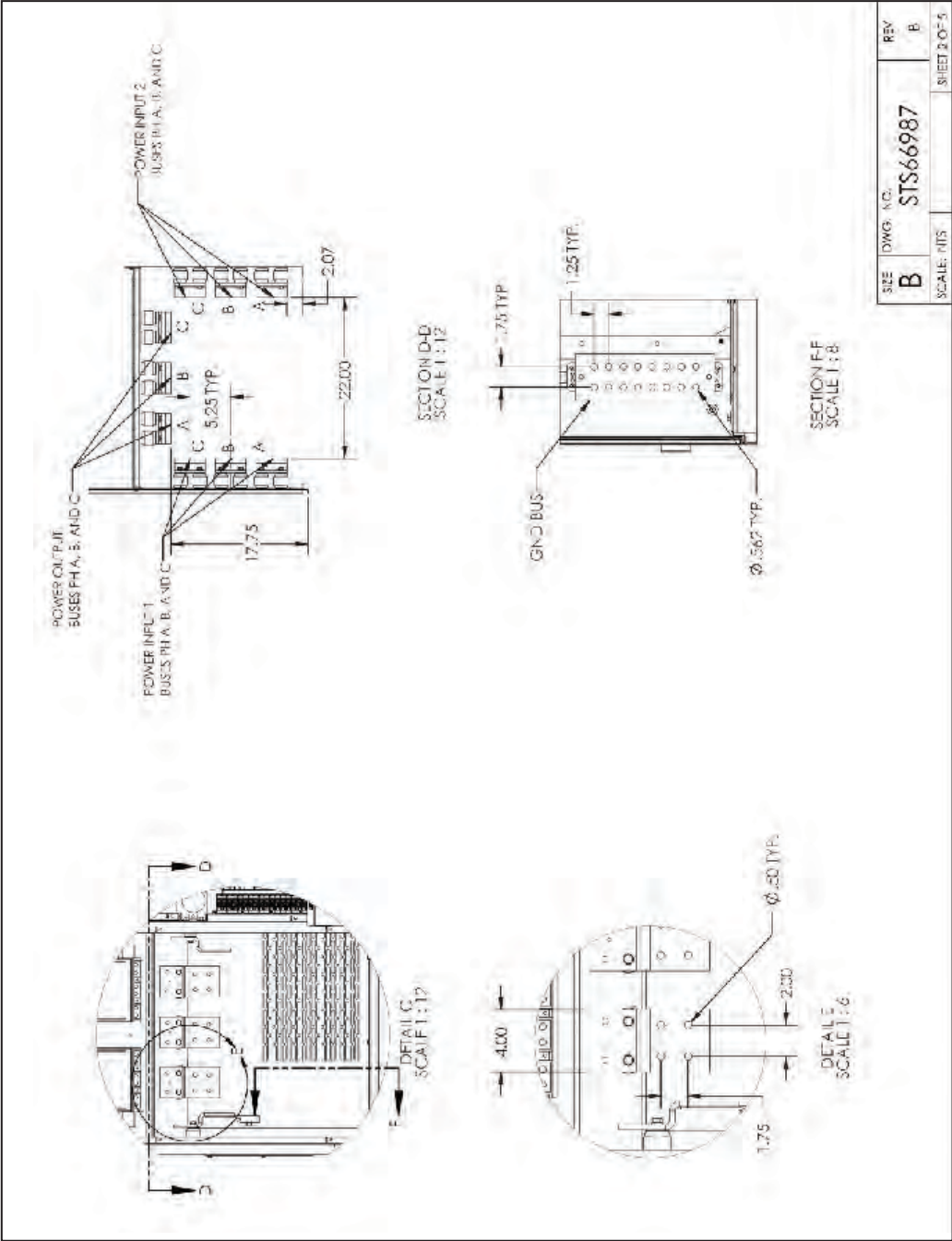


Figure 30. TFA STS 800-1200A Outline Drawing 2



SIZE	DWG. NO.	REV.
B	STS66987	B
SCALE: NTS		SHEET 2 OF 5

Figure 31. TFA STS 800-1200A Outline Drawing 3

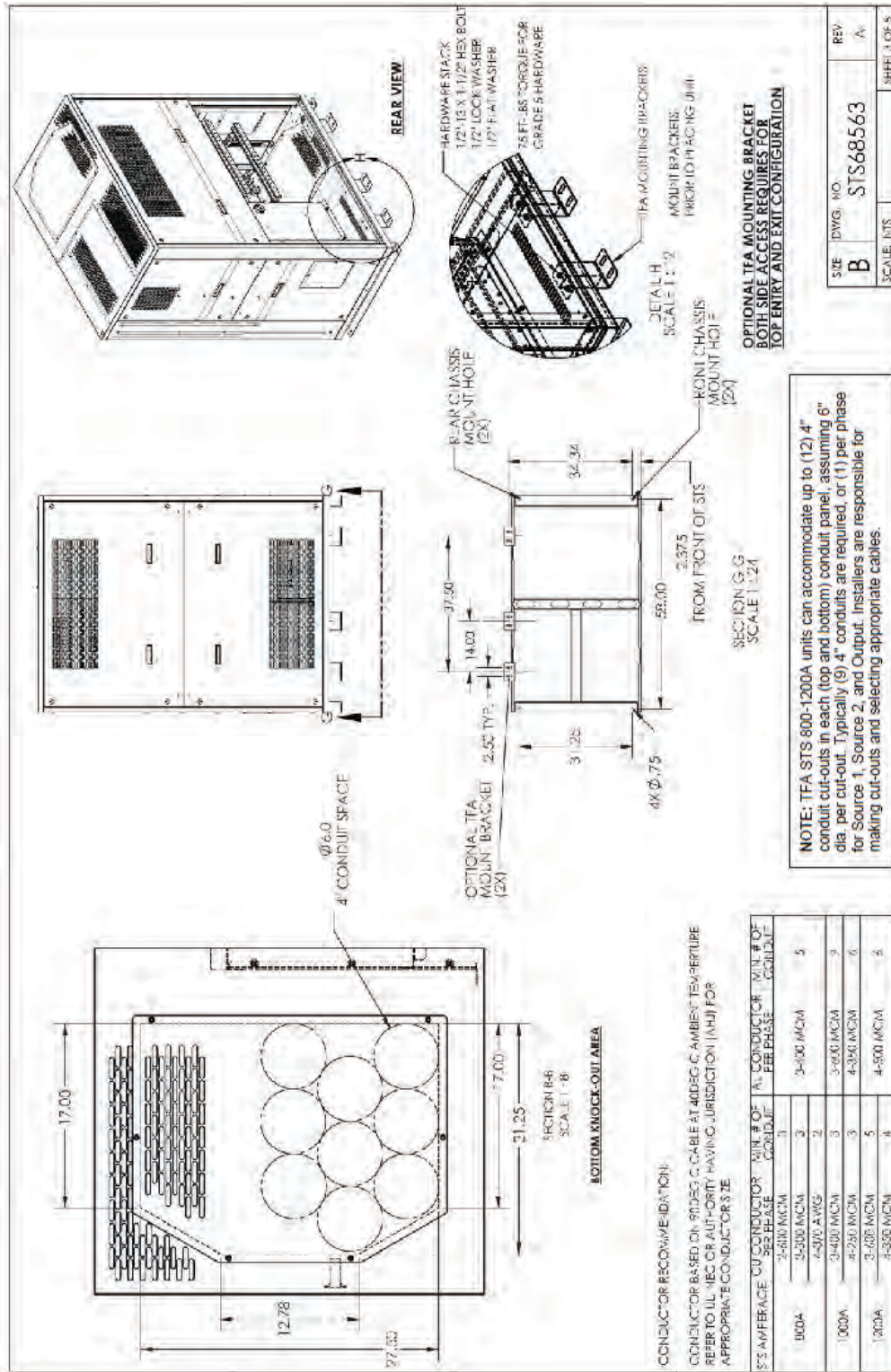


Figure 32. TFA STS 800-1200A Outline Drawing 4

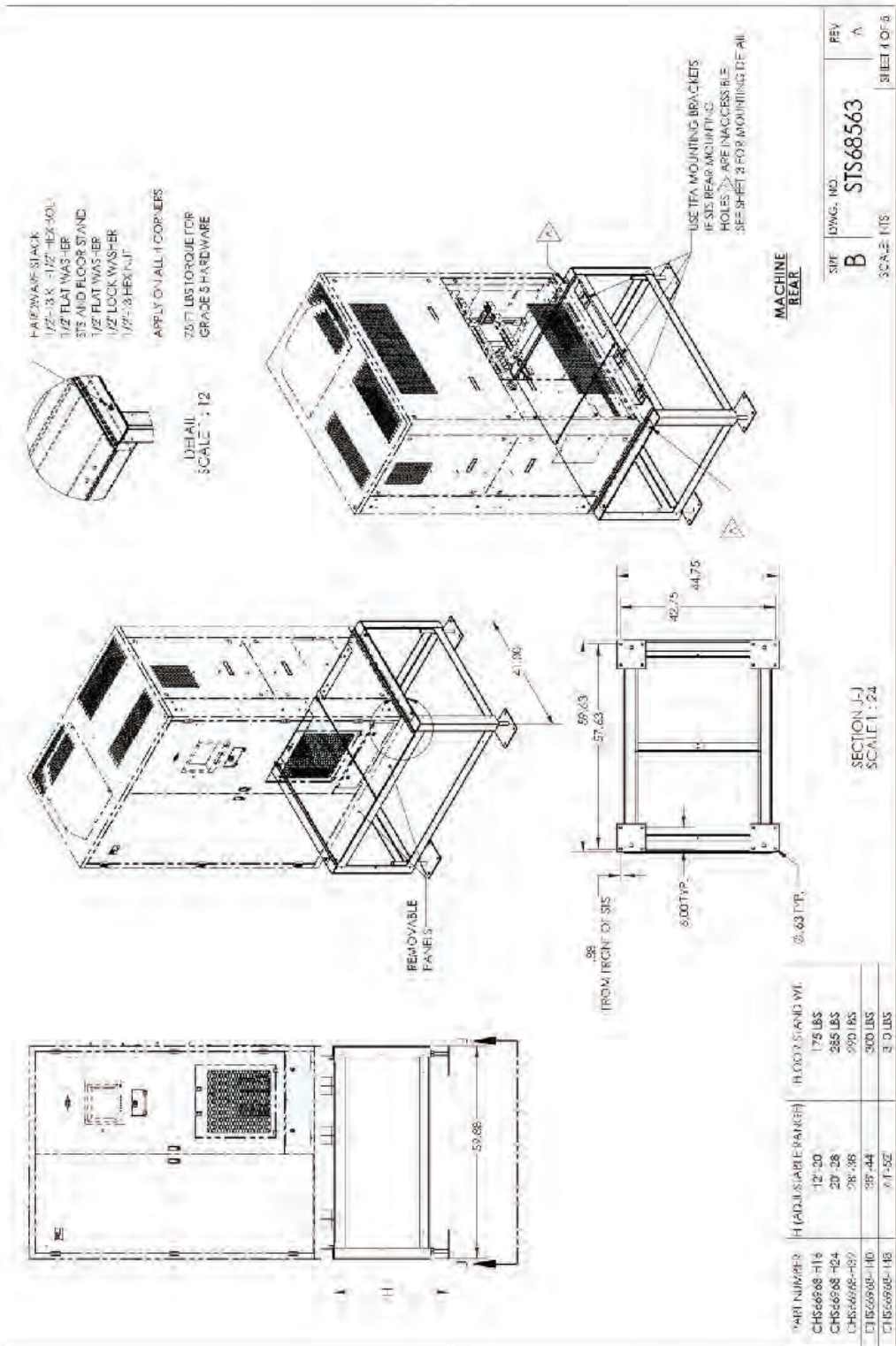
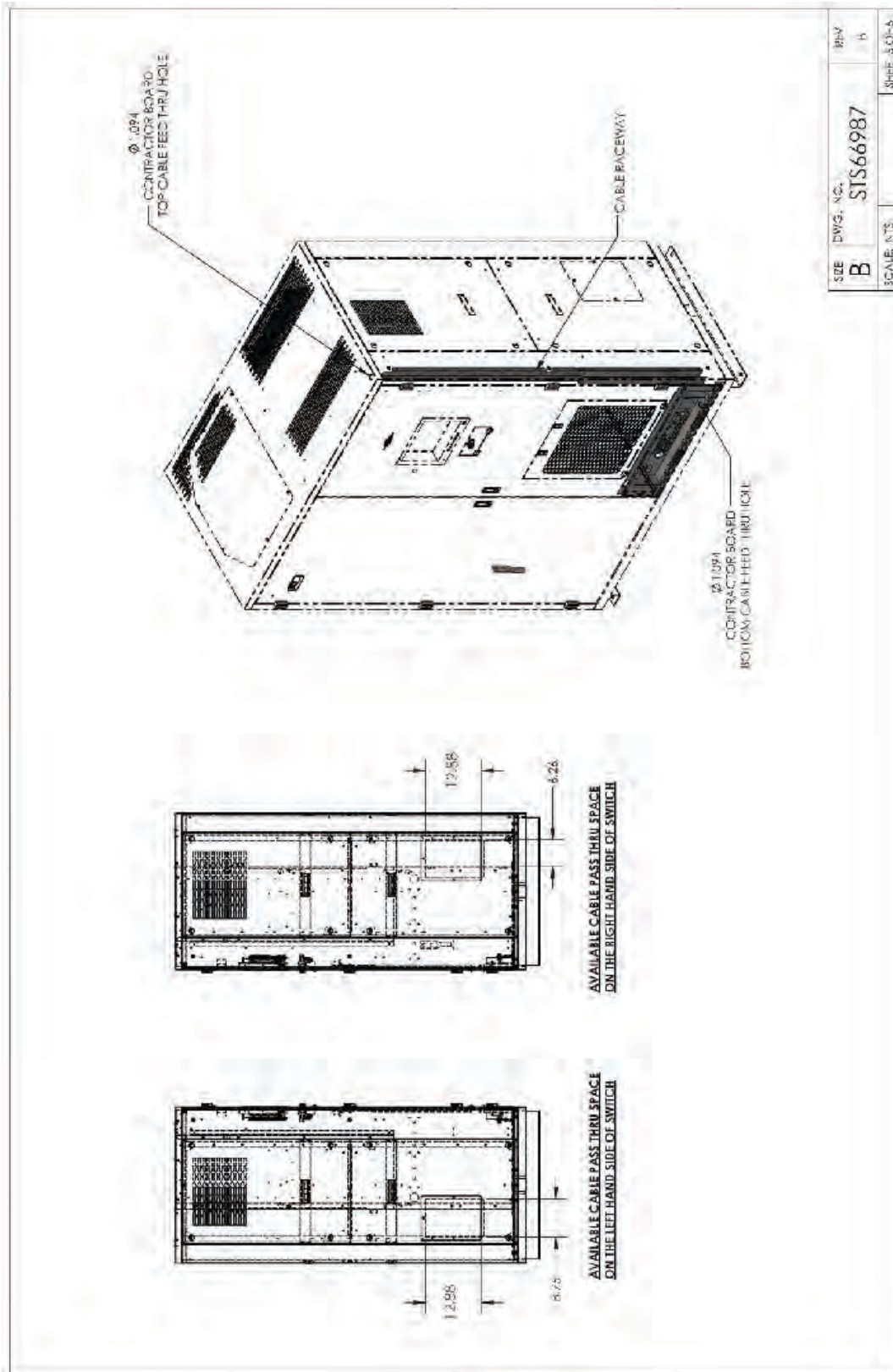


Figure 33. TFA STS 800-1200A Outline Drawing 5



Chapter 6 System Startup

⚠ DANGER

- Severe or fatal injury can result from electrical shock during contact with high voltage conductors, monitoring PCBs, or similar equipment.
- Disconnect power before drilling holes, attaching cables or conduit, or connecting PDUs to other power distribution equipment.
- Use Lock Out/Tag Out procedures.
- Wear suitable personal protective clothing and use protective equipment for performing mechanical and electrical installations.
- Leave ample space for attaching and routing wires.

⚠ WARNING

- A licensed electrician must install each unit.
 - Startup by an Eaton certified technician is required to validate the warranty.
-

6.1 TFA STS Startup Procedure

⚠ CAUTION

An Eaton-certified technician must perform the system startup on the TFA STS unit to initiate warranty coverage.

All the work performed in this section **must be** performed or witnessed by an Eaton Service Representative.

The startup sequence is as follows:

1. **Before applying input power to the STS**, the Installer and the Eaton Service Representative should perform the following checks:
 - a. Verify that the incoming power matches the unit rating (building electrical service and voltage) match the unit rating and the TFA STS Bill of Materials.
 - b. Check the customer connections to input and output buses.
 - c. Verify that the STS is connected to the grounding electrode conductor.
2. Open **all** MCSWs in the STS.
3. Apply power to the unit by energizing the building power circuit breaker or UPS output circuit breaker supplying the TFA STS unit.
4. Perform the following measurements:
 - a. Incoming voltage at input to the STS unit should match the unit rating (-10% to +5% of nominal rating).
 - b. Check for correct phase rotation (clockwise) and voltage at the Source 1 Power Input bus.
5. With all MCSWs open, verify input phasing is correct by verifying these measurements:

System Startup

- a. Zero volts between the phase A poles on the line side of all input MCSWs.
 - b. Zero volts between the phase B poles on the line side of all input MCSWs.
 - c. Zero volts between the phase C poles on the line side of all input MCSWs.
 - d. Zero volts between the phase A poles on the line side of all bypass MCSWs.
 - e. Zero volts between the phase B poles on the line side of all bypass MCSWs.
 - f. Zero volts between the phase C poles on the line side of all bypass MCSWs.
6. Perform initial bring-up, which **must** be performed in Bypass Mode:
- a. Close Bypass 1 MCSW and verify output voltage is present.
 - b. Open Bypass 1 MCSW; close Bypass 2 MCSW; and verify output voltage is present.

Chapter 7 Commissioning: Acceptance Testing

As part of acceptance testing, the STS should pass a Performance Test at 80% load minimum. An Eaton service technician will perform or witness acceptance testing.

7.1 Note on STS Testing and Commissioning Methodology

The Eaton PDI WaveStar TFA Static Transfer Switch has built in redundant logic and transfer abilities. The primary logic is connected to the line side of input Molded Case Switches (MCSW) and output bus in the static switch to detect upstream events – this then allows the switch to sense and transfer sources. The primary logic has embedded software that controls both the low inrush algorithm and the concurrent recording of any switch transfer events with its real-time wave form capture feature. The secondary logic is connected to the load side of the input MCSWs in the static switch and is used to trigger the switch to transfer upon opening of the input MCSWs along with the primary logic.

When performing transfer testing / operation of the static switch, the recommended method is to perform transfers automatically by using the front touch screen / graphics on the static switch or alternatively to manually use the redundant operation interface panel. When performing outage testing, the preferred method is to perform any outage operation by opening the upstream breaker supplying power to the either source on the static switch. This simulates a true site event and allows the primary logic to detect a real event upstream of the switch. If an outage is performed by opening the MCSWs at the static switch, the switch will still fail safe and transfer, however some of the primary logic has been bypassed and thus, this is not the recommended method for initiating an outage.

When connecting load banks to the static switch to test the switch operation under load conditions, it is important that the fan logic on the load banks is connected to a separate power source. The reason for this method is that in some cases, the load bank's fan logic may not sustain power during the 4 ms to 8 ms transfer of the switch – this may cause the load banks to drop power during an event that is seen by the switch to be normal and recorded on the switch as a "good" transfer event as per the design of the switch.

7.2 Additional Installation Requirements

After Startup and Acceptance Testing, the following tasks should be completed:

1. Connect and configure communications, including dry contacts, if not already done. See [Chapter 8 Customer Communications Connections](#).
2. The TFA STS should be set up in three categories:
 - a. Administrative setup: assign user PINs, passwords, and access levels. See [Chapter 11 System Setup: Administration](#).
 - b. Operational setup: configure transfer parameters. See [Chapter 12 System Setup: Operation](#).
 - c. Network setup: configure networking options and addresses. See [Chapter 13 System Setup: Networking](#).

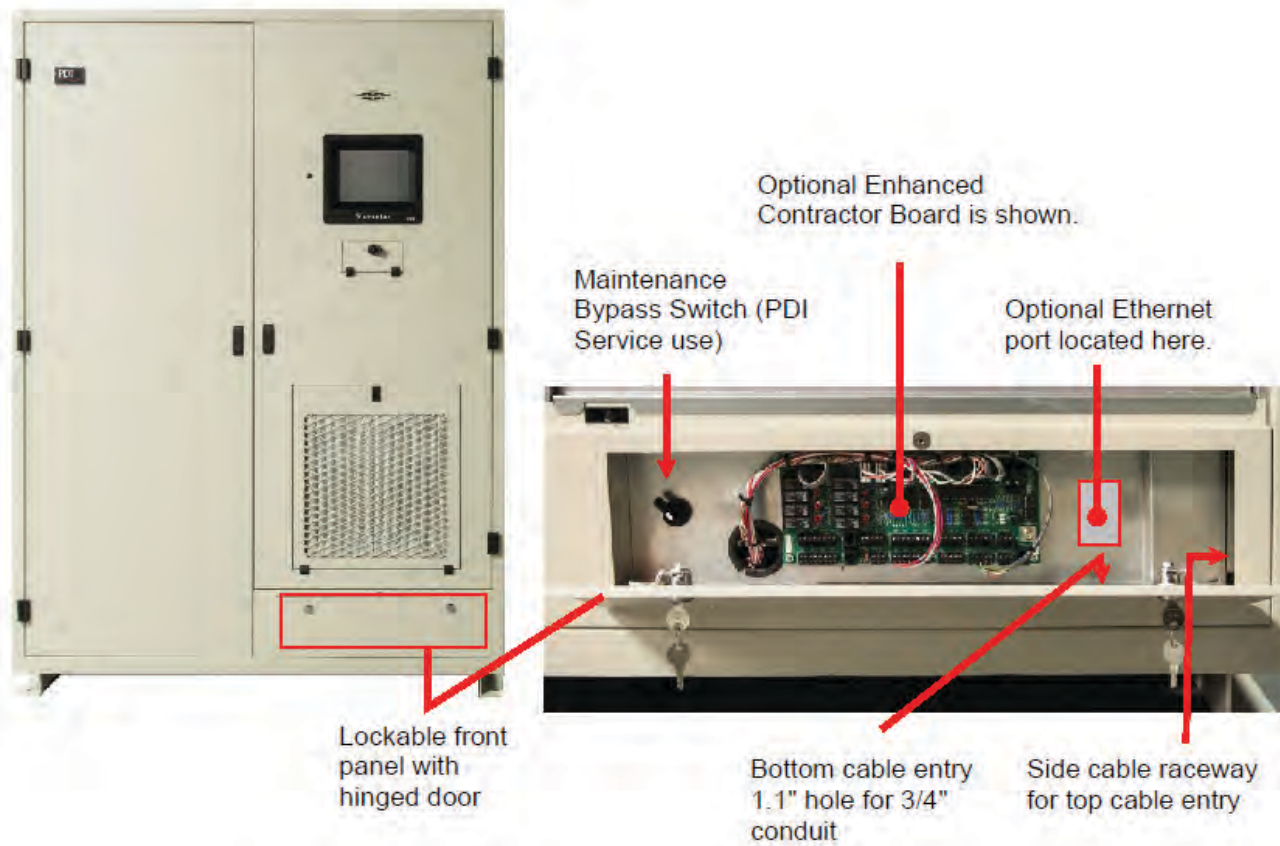
Chapter 8 Customer Communications Connections

Customers establish communications with the TFA STS through connection to a Contractor Board and an optional Ethernet port. These connections support several protocols and options, which can all be used simultaneously.

8.1 Contractor Board Compartment

The Contractor Board and the Ethernet port are both located in the Contractor Board Compartment near the bottom right front of the TFA STS, covered by a lockable panel.

Figure 34. Contractor Board Compartment



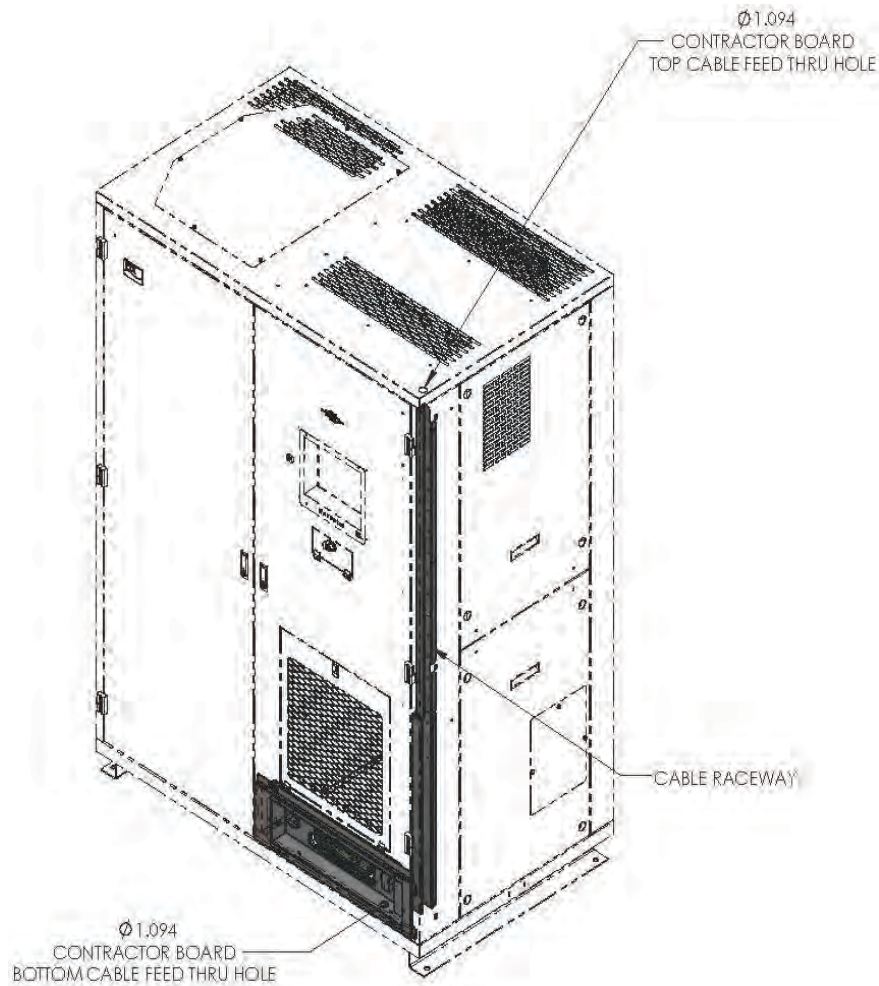
8.2 Communications Cable Entry

Ethernet and/or Modbus RTU communications cables can be run from the top or bottom of the unit to the Contractor Board Compartment.

Bottom cable entry: The Contractor Board Compartment has a 1.1" dia. cable feed hole for 3/4" conduit.

Top cable entry: The top front right corner of the unit has a 1.1" dia. cable feed through hole for 3/4" conduit leading to an internal cable raceway down to the Contractor Board Compartment.

Figure 35. Communications Cable Entry (Top and Bottom)



8.3 Contractor Boards

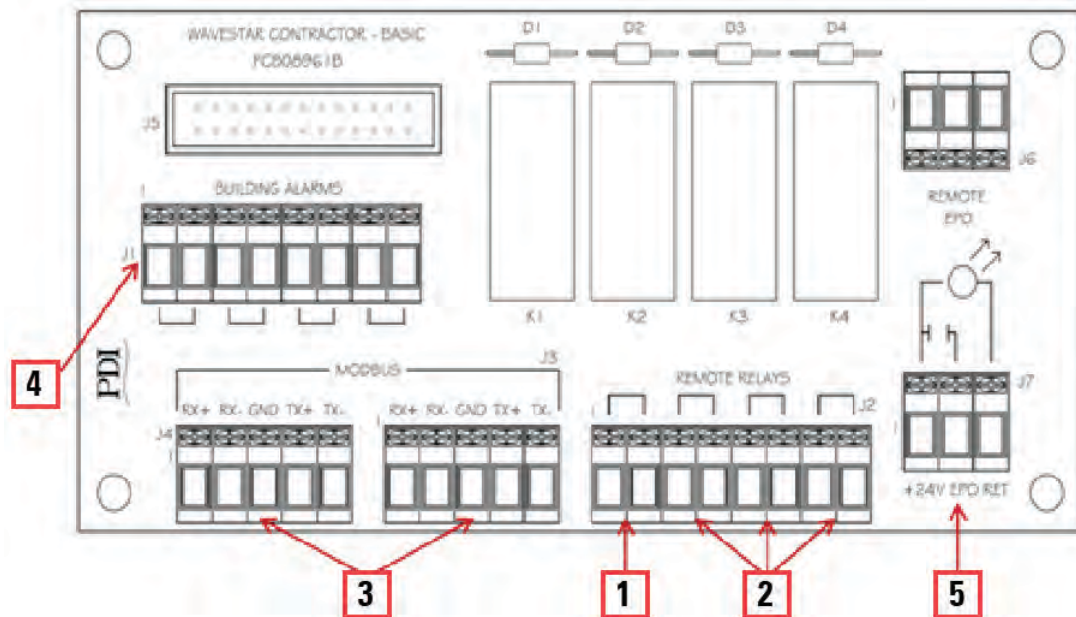
Except for Ethernet, all customer communications connections are made to a Contractor Board, either a Basic Contractor Board (standard) or an Enhanced Contractor Board (optional). Contractor Board connections include the following:

- Dry contact terminals
- Modbus RTU terminals
- Remote EPO
- Multi-Switch Link Option, supporting an N+1 UPS configuration

The following sections describe the formats of the Basic and Enhanced Contractor Boards.

8.3.1 Basic Contractor Board

Figure 36. Basic Contractor Board



The Basic Contractor Board connections (see [Figure 36](#)) are as follows:

Dry Contact Remote Relays: Programmable NO or NC dry contacts for external output of specific internal alarms or status:

1. **Relay 1:** Summary Alarm – signals when there is any active alarm on the STS.
2. **Other Relays:**
 - **Relay 2:** Load on S1
 - **Relay 3:** Load on S2
 - **Relay 4:** Output OK

Note: Remote relays can accept dry contacts rated up to 2A/250V.

3. **Modbus RTU Connection** – 4-wire Modbus upstream connection. (Note: for upstream 2-wire Modbus RTU, see paragraph [8.3.3 Modbus RTU Upstream Connection](#)).

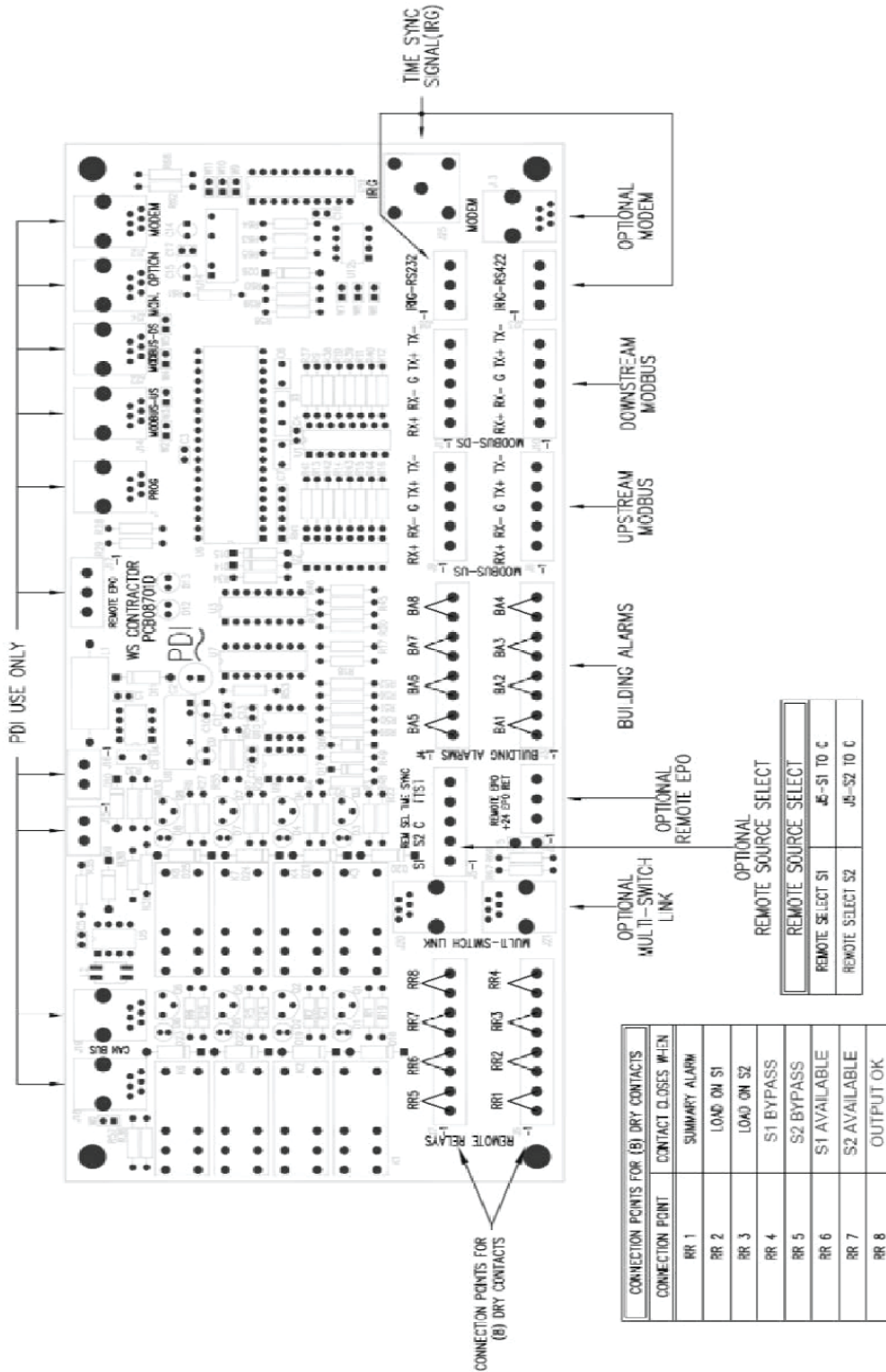
Input signals:

4. **Building Alarms** – Input terminal block to provide unit with input on four (4) external building alarms
5. **Remote EPO** – This is a dry contact connection point for input of remote EPO signal to system. Connect external dry contacts to terminals marked +24v and EPO for EPO circuit.

Warning: Connection of voltage to this point can cause damage to the unit. The return position enables a light for the remote EPO button.

8.3.2 Enhanced Contractor Board

Figure 37. Enhanced Contractor Board (Enhanced Remote Customer Interface Board)



The optional Enhanced Contractor Board has additional connectors of the same type found on the Basic Contractor Board as well as additional high-end interface options (See [Figure 37](#)).

**NOTE**

Remote relays can accept dry contacts rated up to 2A/250V.

The Contractor Boards have multiple applications in Eaton products and not all connections are supported on the TFA STS. The following connections are not currently supported on this product:

- Inter-Range Instrumentation Group (IRIG) time codes
- Cell-phone modem connection (discontinued)
- 9600 baud modem connection (discontinued)

8.3.3 Modbus RTU Upstream Connection

Both Contractor Boards have connections for RS422/RS485. The Modbus RTU RS422/RS485 interface is an isolated interface with soft bias.

The Modbus RTU interface should be configured for baud rate, parity, and address on the **Settings** screen (See paragraph [13.1 Settings Screen](#)). The address range is 1 to 247 and the address of each device must be unique.

Connect Modbus RTU wires to Modbus terminal(s) on a Contractor Board. The Basic Contractor Board has only an upstream connection. Connectors are paralleled for daisy-chaining. The Enhanced Contractor Board also has two paralleled upstream connectors. (The downstream connection is for a Branch Circuit Monitoring System (BCMS) connection to the STS.)

4-wire Modbus RTU is the default. For upstream 2-wire Modbus RTU, do one of these:

- Basic Contractor Board: Jumper together plus connections (RX+ to TX+) and minus connections (RX- to TX-).
- Enhanced Contractor Board: Jumper together plus connections (RX+ to TX+) and minus connections (RX- to TX-) on the upstream connectors.
- Enhanced Contractor Board: Place jumper on W2-W3.
- Monitor PCB: place jumper on the Monitor back panel at E2-E3. (Placing this jumper will set 2-wire Modbus for either Contractor Board.)

8.4 Ethernet Connection

A customer network Ethernet cable can be connected to a terminal to the right of the Contractor Board. (See [Figure 34](#)). The Ethernet connection allows you to run TCP/IP, Modbus TCP/IP, HTTP for the web server, SNMP, SNTP for time synchronization, and SMTP for email summary alarm alerts.

[Chapter 13 System Setup: Networking](#) describes configuration for these options. Use the **Settings** screen to set Ethernet parameters (see paragraph [13.2 Ethernet](#)).

8.5 Dry Contact Signals

8.5.1 Dry Contact Output Signals

Contractor Board remote relays signal status and alarms through closed dry contacts, shown in [Table 1](#). There are three predefined relay lists. Remote relays can be customized during setup to turn on for other points in the STS points list.

Table 1. Output Dry Contact Signals, Remote Relays

Remote Relays	Basic Contractor Board (Default List)	Enhanced Contractor Board	
		List 1	List 2
Relay 1	Summary Alarm	Summary Alarm	Summary Alarm
Relay 2	Load is on Source 1	Load is on Source 1	Load is on Source 1
Relay 3	Load is on Source 2	Load is on Source 2	Load is on Source 2
Relay 4	Output is OK	Source 1 is on Bypass	Source 1 is on Bypass
Relay 5	Not Available	Source 2 is on Bypass	Source 2 is on Bypass
Relay 6	Not Available	Source 1 is Available	STS cannot switch
Relay 7	Not Available	Source 2 is Available	Auto Retransfer is inhibited
Relay 8	Not Available	Output is OK	STS is on the Alternate Source (not the Preferred Source)
NOTE: Closed dry contacts signal the conditions shown in this table.			

8.5.2 Dry Contact Input Signals

[Table 2](#) lists dry contact signals to the STS from an external source, such as a BMS or DCIM system.

- **Remote EPO** shuts down the STS.
- **Remote Select S1** or **Remote Select S2** causes the STS to switch to that designated source.
- **Building Alarm 1-8** are input signals for various building sensors, such as fire, temperature, cooling failure, or underfloor water. The name of the Building Alarm is specified in the points list. A building alarm causes a point to be activated in the points list, but causes no other action.

Table 2. Input Dry Contact Signals

External Dry Contact Signal	Basic Contractor Board	Enhanced Contractor Board
Remote EPO	Available	Available
Remote Select S1	Not Available	Switch to Source 1
Remote Select S2	Not Available	Switch to Source 2
Building Alarm 1	Name Definable	Name Definable
Building Alarm 2	Name Definable	Name Definable
Building Alarm 3	Name Definable	Name Definable
Building Alarm 4	Name Definable	Name Definable
Building Alarm 5	Not Available	Name Definable
Building Alarm 6	Not Available	Name Definable
Building Alarm 7	Not Available	Name Definable
Building Alarm 8	Not Available	Name Definable

8.5.3 Remote Source Select Option

Two external two dry contacts can be used to control the remote selection of the preferred source. Dry contact closures are generally used when two UPSs supply power to the system. If the preferred UPS goes to bypass mode, the "good" UPS becomes preferred:

- Signal 1 (Remote Select S1) dry contact closure will make Source 1 preferred.
- Signal 2 (Remote Select S2) dry contact closure will make Source 2 preferred.
- If both dry contacts closures are open, the preferred source control is returned to the system operator control panel.

Any remote-control signal or closure puts the unit into a "Retransfer=Yes" mode to ensure system redundancy. Normally the closures are controlled by auxiliary contacts in the UPS bypass circuit breakers. If both dry contacts close, the first input to the TFA STS is recognized.

8.5.4 Multi-Switch Link Option (N+1 UPS)

In an N+1 UPS Configuration, there are multiple STS units, each with a preferred source fed by a separate UPS. The alternate source on all STSs is provided by a single backup UPS.

All STS units in an N+1 UPS configuration must have Enhanced Contractor Boards and the Multi-Switch Link Option installed, providing coordination among the STSs.

Because the backup UPS can only provide power through the STS to a single downstream load, when an STS transfers its load to the backup UPS, the STS must signal the other STS units that it is using the UPS. The other STS units are locked out and cannot transfer to the backup source.

An "Inhibit Transfer" alarm is signaled on each STS. The STSs are prevented from transferring until the Preferred Source on the STS using the backup UPS returns to normal and the STS retransfers the load back to the Preferred Source.

Chapter 9 Operational Interfaces

There are two STS operator interfaces:

- The touchscreen display, which is the normal operator interface
- The Redundant Operator Interface (ROI), which sets the operational mode and backs up the touchscreen display

9.1 Touchscreen Display

The STS has a 10.4-inch diagonal touchscreen display. The STS has a comprehensive set of screens covering setup, transfer controls, alarms, events, status, and measurements.

Changes to controls or parameters must be made from the touchscreen display; they cannot be changed remotely from a Building Management System (BMS) or from a web browser. (The BMS can issue dry contact control signals, such as Remote EPO or Remote Source Select.)

9.1.1 Voice Unit

A Voice Unit provides short audible statements that supplement text or graphics in certain situations, such as "Static Switch, new alarm," or "Static Switch, alarm cleared." The Voice Unit also steps operator through text procedures from the Help screens.

9.1.2 Home Screen

The **Home** screen (see [Figure 38](#)) is the first screen displayed when the STS is turned on.

Home screen has a dynamic graphic 1-line mimic showing active and inactive paths from sources to output with power measurements:

- The active path between one source and the output is shown in **yellow**.
- Inactive paths or bypass paths are shown in **blue**.

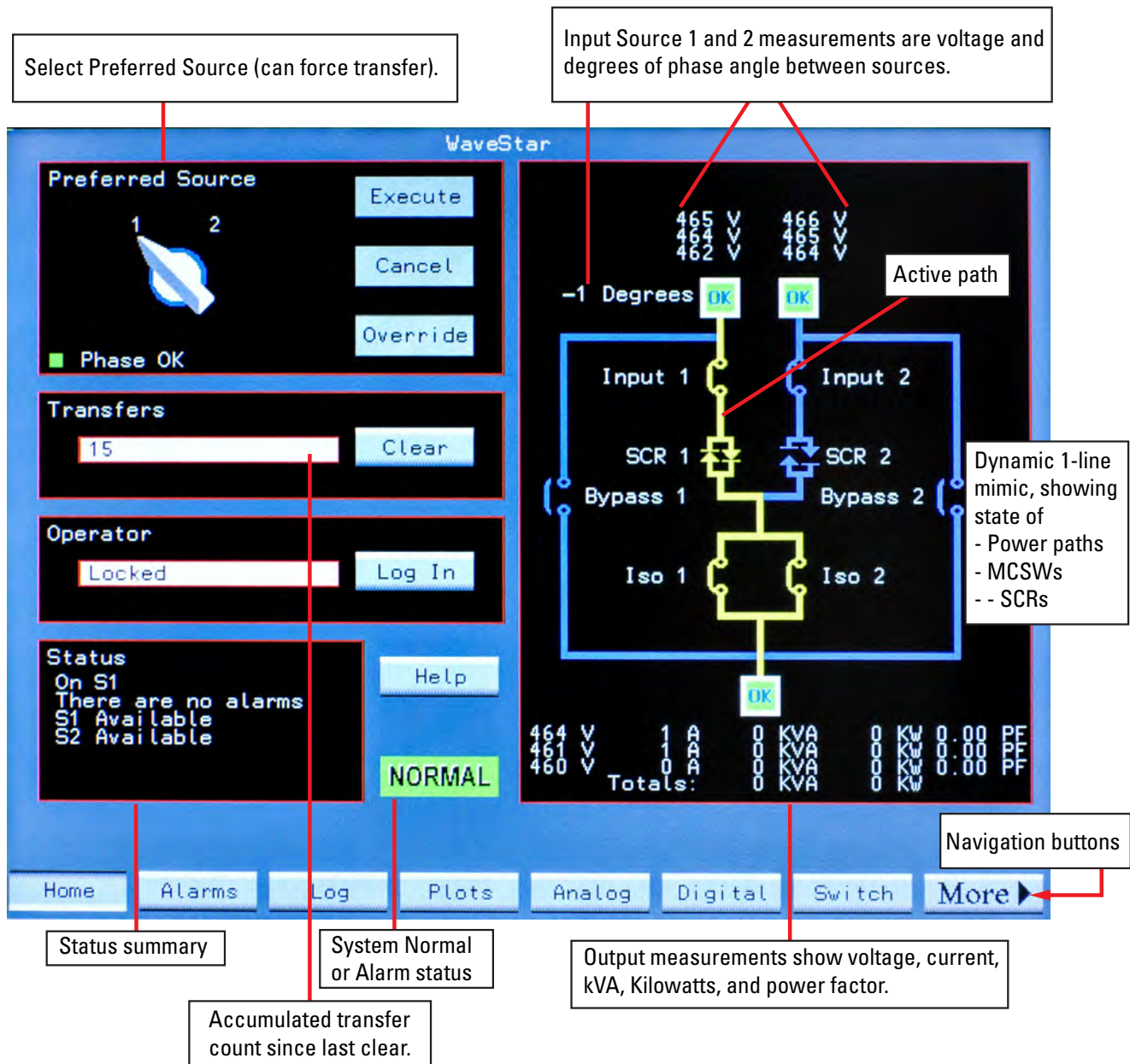
The **Status** Panel summarizes the general status of the unit. It shows which source is open or available, which bypass is being used, and how many alarms are present.

The **Normal/Alarm** status indicator shows if alarms are present:

Transfers panel has a counter of the number of transfers that have occurred since the last **Clear** of this counter.

The **Home** screen also has **Preferred Source** control (see paragraph [10.1.1 Preferred Source](#)).

Figure 38. Touchscreen Display: Home Screen



9.1.3 Navigation Buttons

The row of buttons at the bottom of the screen lets you select other screens. Touching the MORE button displays additional navigation buttons.

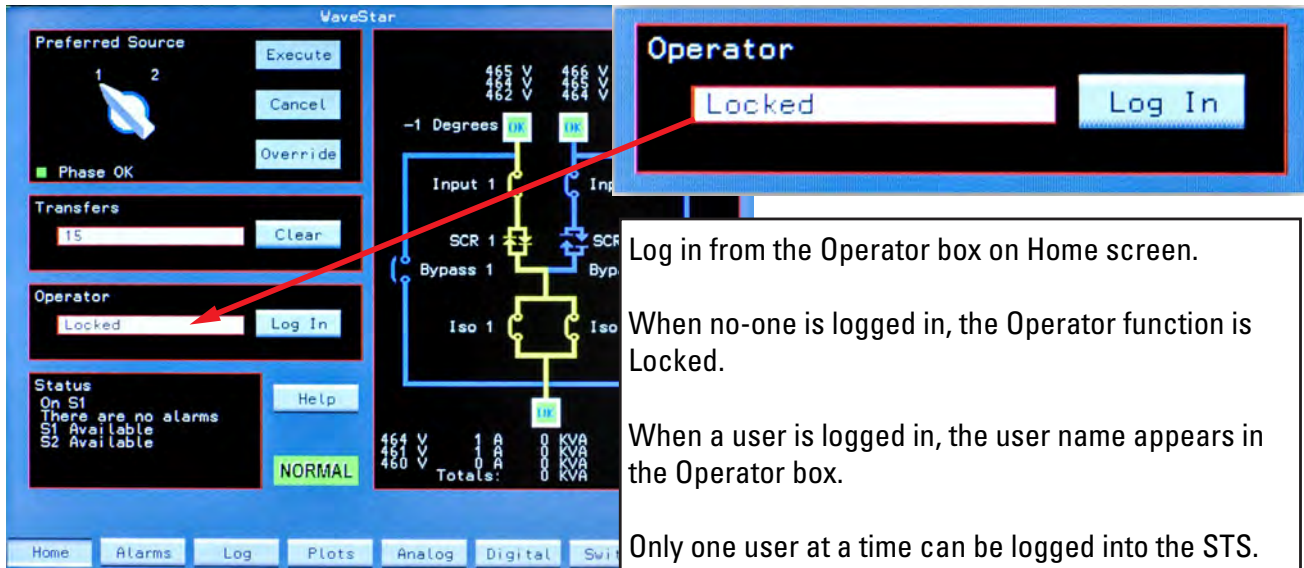
9.1.4 User/Operator Login

Viewing screens does not require login, nor does viewing screens remotely using a web browser. However, to use controls or change parameters, a user must log in from the **Operator** panel on the **Home** screen and have an access level that permits the action.

Only one user can be logged into the STS at a time. While logged in, a user's access level applies to all actions taken at the display.

To log in or log out, follow instructions in [Figure 39](#) and [Figure 40](#). Every time a user logs in or out, the event is recorded in the Event Log. After five (5) minutes of operator inactivity, the display reverts to the **Home** screen and the active user is logged out to prevent inadvertent or non-authorized operator access.

Figure 39. Logging in from the Home Screen



The screenshot shows the WaveStar Home Screen. On the left, there are sections for 'Preferred Source', 'Transfers', 'Operator', and 'Status'. The 'Operator' section shows 'Locked' and a 'Log In' button. A red arrow points from the 'Log In' button to a text box on the right. The text box contains the following text:

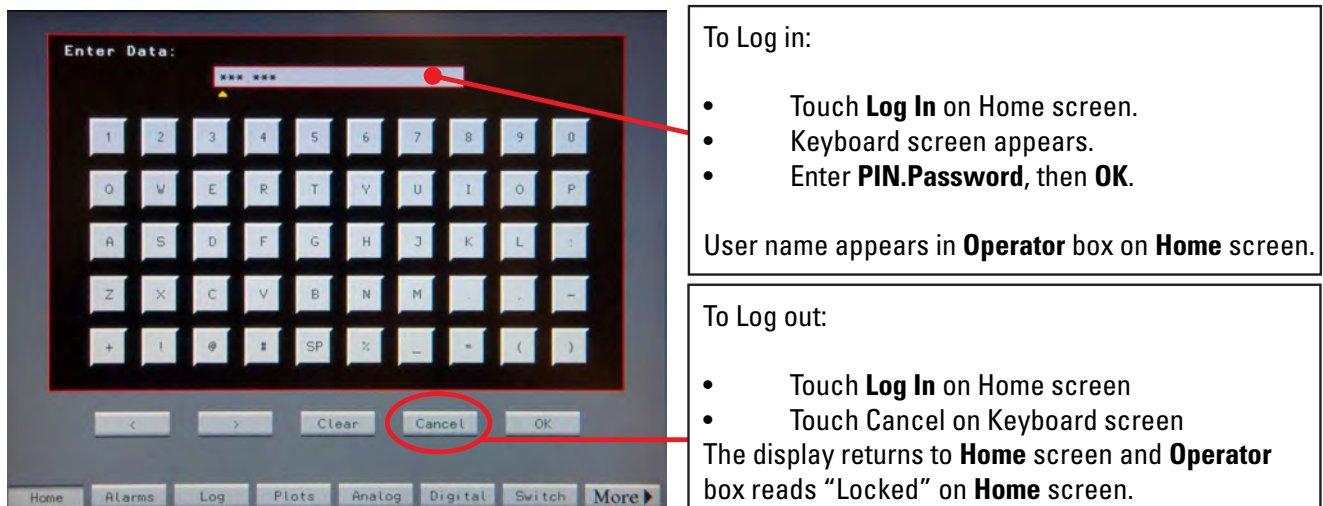
Log in from the Operator box on Home screen.

When no-one is logged in, the Operator function is Locked.

When a user is logged in, the user name appears in the Operator box.

Only one user at a time can be logged into the STS.

Figure 40. Keyboard Screen



The screenshot shows the Keyboard Screen. At the top, there is an 'Enter Data:' field with a red dot. Below it is a numeric keypad. At the bottom, there are buttons for '<', '>', 'Clear', 'Cancel', and 'OK'. The 'Cancel' button is circled in red. A red arrow points from the 'Cancel' button to a text box on the right. The text box contains the following text:

To Log in:

- Touch **Log In** on Home screen.
- Keyboard screen appears.
- Enter **PIN.Password**, then **OK**.

User name appears in **Operator** box on **Home** screen.

To Log out:

- Touch **Log In** on Home screen
- Touch **Cancel** on Keyboard screen

The display returns to **Home** screen and **Operator** box reads "Locked" on **Home** screen.

9.2 Redundant Operator Interface

The ROI panel is in a covered compartment just below the touchscreen display. Login is not required to use the ROI; key access provides security.

The ROI panel is **always active**: the toggle switches are enabled and the LEDs are valid in both Normal and Redundant modes (see [Figure 41](#) for an explanation of LEDs and toggle switches).

The ROI panel has these functions:

1. The ROI panel sets the operational mode of the STS, either Normal or Redundant Mode (see [Chapter 10 Operational Modes](#)):
 - a. The **MODE OF OPERATION** toggle switch should be left in **NORMAL** except for rare circumstances.
 - b. When the **MODE OF OPERATION** toggle switch is set to **REDUNDANT**, both the ROI panel and the touchscreen display are active, if the Monitor and display are operating properly, but the SAS board controls transfers, not the Monitor. Redundant Mode is required, for example, when the Monitor must be restarted, because it provides a backup transfer capability while the Monitor is restarting. Circumstances requiring Redundant Mode are rare and time spent in Redundant Mode should be brief.
2. In Normal Mode, the ROI panel automatically backs up
 - a. the display, providing a means to manually transfer the load if the touchscreen is not functional, and
 - b. the Monitor logic, if Monitor logic fails. The SAS board is always in standby mode, providing continuous backup to Monitor logic and the display.
3. In **REDUNDANT** mode, the ROI can also be used to directly initiate a transfer using the **SOURCE SELECTOR** momentary toggle switch.

NOTE 1 The **SOURCE SELECTOR** switch operates slightly differently in Normal and Redundant modes:



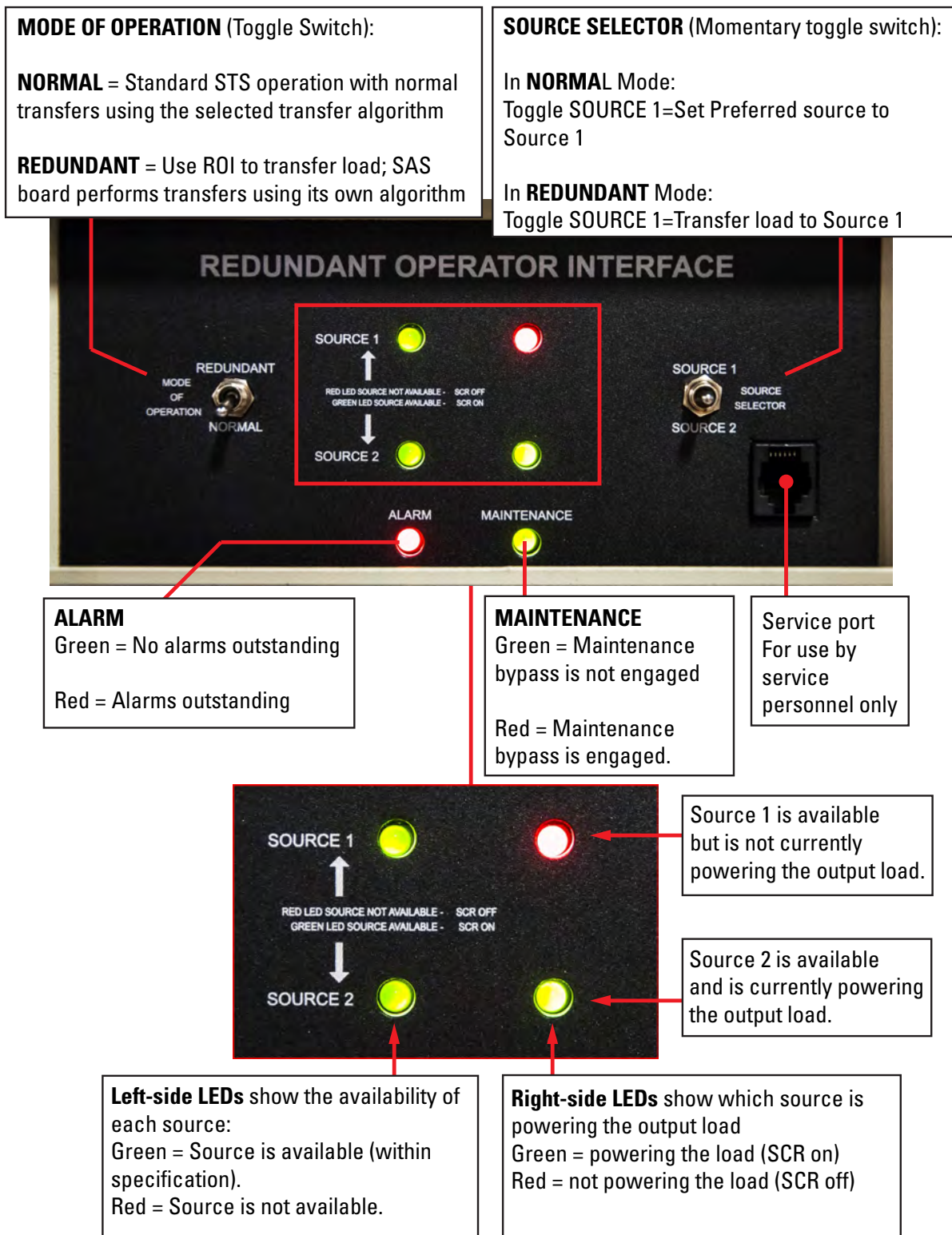
NOTE 2 In Normal mode, it sets the Preferred Source control to Source 1 or 2, as selected. This can cause a transfer, if other circumstances allow it.

NOTE 3 In Redundant mode, it causes an immediate transfer to the specified source, if the target power source is within specification and the load is not already on that source.



NOTE The **MAINTENANCE** light on the ROI panel refers to the **Maintenance Bypass Switch**, located next to the Contractor Board (see [Figure 34](#)). The Maintenance Bypass Switch is used by service personnel to disable MCSW trip units during maintenance.

Figure 41. Redundant Operator Interface (ROI)



Chapter 10 Operational Modes

The STS has three modes of operation:

- Normal
- Redundant
- Bypass

10.1 Normal Mode Operation

For normal operation, the **MODE OF OPERATION** toggle switch on the ROI panel should be set to **NORMAL**. The STS should be left in Normal mode for all but unusual circumstances. (See [Figure 41](#)).

In Normal mode, when the active source falls out of specification, transfer to the other power source is automatic. There are three (3) operational choices that govern automatic transfers:

1. Transfer algorithm: choose between **VSS** or **POG**; default=**VSS**. (See paragraph [12.2 Switch Settings Screen](#), and paragraph [2.4 Transfer Process: Algorithms](#)).
2. **Preferred Source**: choose whether Source 1 or Source 2 is the preferred power source; default=**Source 1** (see [Figure 39](#), **Home** screen).
3. **Retransfer = Yes or No**: after a transfer to the alternate source (i.e., the non-preferred source), should the STS automatically retransfer back to preferred source when that source is good or remain on the alternate source? Default=**Yes** (See paragraph [12.2 Switch Settings Screen](#)).

10.1.1 Preferred Source

In Normal mode operation, the load is connected to the designated **Preferred Source** by default, if the voltage and frequency of all phases of that source are within acceptable limits.

- At initial startup, **Source 1** is the default **Preferred Source**.
- The **Preferred Source** can then be set by a logged-in user with at least operator access privileges on the **Home** screen.
- Either input power source can be designated as the **Preferred Source** by the setting the **Preferred Source – 1 / 2** virtual control on the **Home** screen.
- When the **Preferred Source** fails—that is, when the Preferred Source goes outside acceptable predefined limits—the STS transfers the load to the alternate source using the chosen algorithm, VSS or POG.

10.1.2 Retransfer Control

The Retransfer control determines whether the STS maintains an affinity for the Preferred Source whenever it is within acceptable parameters.

Retransfer = Yes:

- If **Retransfer = Yes**, the load has an affinity for the Preferred Source. After transferring the load to the alternate source, when the Preferred Source returns to a condition that is within tolerance for at least the preset adjustable retransfer time delay, the load will be automatically be retransferred back to the Preferred Source.
- The load will always be transferred to the Preferred Source whenever the source is in-tolerance—no matter how long the Preferred Source takes to come back within specification—and will remain connected to the Preferred Source until it fails or a transfer is manually initiated.
- **Retransfer = Yes** is the default setting for this control.

Retransfer = No:

- The automatic retransfer to the Preferred Source can be disabled by an authorized user with administrator, service, or Eaton level privileges, by setting **Retransfer = No**.
- If **Retransfer = No**, there is no affinity to the Preferred Source, except at startup. The logic will transfer the load from the failing source to the "good" source and will remain on that source even after the Preferred Source returns to acceptable limits. The only effect of specifying a Preferred Source is to specify the source used at STS startup.
- **Retransfer = No** also allows the operator to verify the power source prior to reapplying the critical load. After verifying power reliability on the Preferred Source, the operator can force a manual transfer back.

10.1.3 Manual Transfers

Manual transfers can be made in three ways:

1. In Normal Mode, from Home screen, switching the Preferred Source to the other source will manually transfer the load to the other source if:
 - a. Preferred Source = Current Source, and
 - b. the new Preferred Source is within acceptable voltage limits and phase tolerances. The selected transfer algorithm, VSS or POG, is used.
2. In Normal Mode, toggling the SOURCE SELECTOR momentary toggle switch on the ROI panel is an alternative way to set the Preferred Source. Transfer behavior is the same as in (1.) above.
3. In Redundant Mode, from the ROI panel, toggling the SOURCE SELECTOR momentary toggle switch directly transfers the load to the other source, if not already on that source and the other source is within specification. The SAS logic board controls the transfer, not the Monitor logic.

10.1.4 Special Transfer Situations

To keep power flowing to the output load, STS logic responds to several special circumstances:

- **Excessive transfers.** If transfers between sources become excessive, the logic dynamically adjusts certain transfer parameters to minimize thrashing between sources until one or the other power source stabilizes.
- **Excessive load current.** If the load current exceeds an adjustable preset level, automatic transfers are disabled until load current falls below that level, even if the voltage on the selected source exceeds the transfer limits.
- **Shorted power switching element.** Shorted SCRs cannot be opened and the load must remain on or be transferred to the side with the shorted SCR to avoid cross-currents. Hence,
 - If there is a shorted SCR on the non-conducting side, the load is transferred to the non-conducting side and retransfer is inhibited. The input switch or circuit breaker on the previously conducting side is opened. An alarm is sounded and recorded with a date-and-time stamp in the Event Log.
 - If there is a shorted SCR on the conducting side, transfer is inhibited and the input switch or circuit breaker on the non-conducting side is opened. An alarm is sounded and recorded with a time/date stamp in the event log.

Example A:

1. Source 1 is the Preferred Source and is supporting the load.
2. Source 1 experiences an outage.
3. The load is transferred to Source 2.
4. The current inrush reduces voltage to Source 2 for (2) cycles.
5. This causes the internal voltage monitors to detect an outage on both sources.

6. The logic locks the load on Source 2 for 100 ms, allowing the source voltage to stabilize, and the load is not dropped.

Example B:

1. Source 1 is the Preferred Source and is supporting the load.
2. Source 2 experiences an outage (load remains on Source 1).
3. While Source 2 is unavailable, Source 1 experiences an 8 ms transient outage.
4. The load remains connected to Source 1 even though both sources experience outages for 8 ms.

10.2 Redundant Mode Operation

Redundant Mode is entered when the **MODE OF OPERATION** toggle switch is set to **REDUNDANT**.

In Redundant Mode:

- The SAS board controls transfers and Monitor logic is bypassed.
- "Retransfer Yes/No" is not a setting on the ROI panel and retransfer does not apply: The SAS board has no memory of previous transfers; it simply transfers when the current source is out of specification and the other source is within specification.
- Preferred Source does not apply:
 - Automatic transfers: When the currently active source goes out of specification, the SAS board will transfer to the alternate source if it is within specification.
 - Manual transfers: Using the momentary **SOURCE SELECTOR** toggle switch causes a transfer to the selected source, if it is not already on that source.

Redundant Mode is also entered if the SAS board detects the Monitor has failed. The SAS board then performs the load transfer.

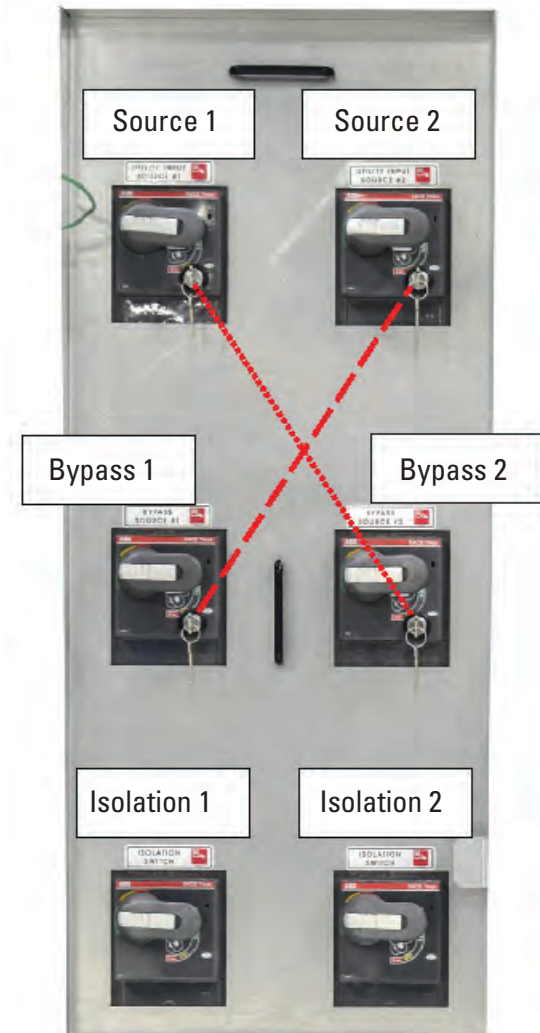
10.3 Bypass Mode

The STS has a Bypass Mode for maintenance. In Bypass Mode all electronic components are isolated from the power sources to allow safe unit servicing.

10.3.1 Integrated Key Interlocks

Bypass Mode is entered by physically setting up MCSWs to go to bypass. The STS has keyed-interlocked bypass MCSWs allowing logic to be disconnected from power sources without interrupting output load power (See [Figure 42](#)). Engaging the bypass and returning from bypass to STS normal mode both require the operator to manipulate the integrated keyed interlocks (or alternatively Kirk Keys) and MCSWs.

Figure 42. Keyed Interlocks for Bypass Mode



Source 1 MCSW and Bypass 2 MCSW are interlocked with **Key 1**:
If Source 1 MCSW is closed,
Bypass 2 MCSW must be open.
If Source 1 is open, Bypass 2 must be closed.

Source 2 MCSW and Bypass 1 MCSW are interlocked with **Key 2**:
If Source 2 MCSW is closed,
Bypass 1 MCSW must be open.
If Source 2 is open, Bypass 1 must be closed.

Bypass MCSWs are mechanically interlocked to prevent closing both MCSWs at the same time.

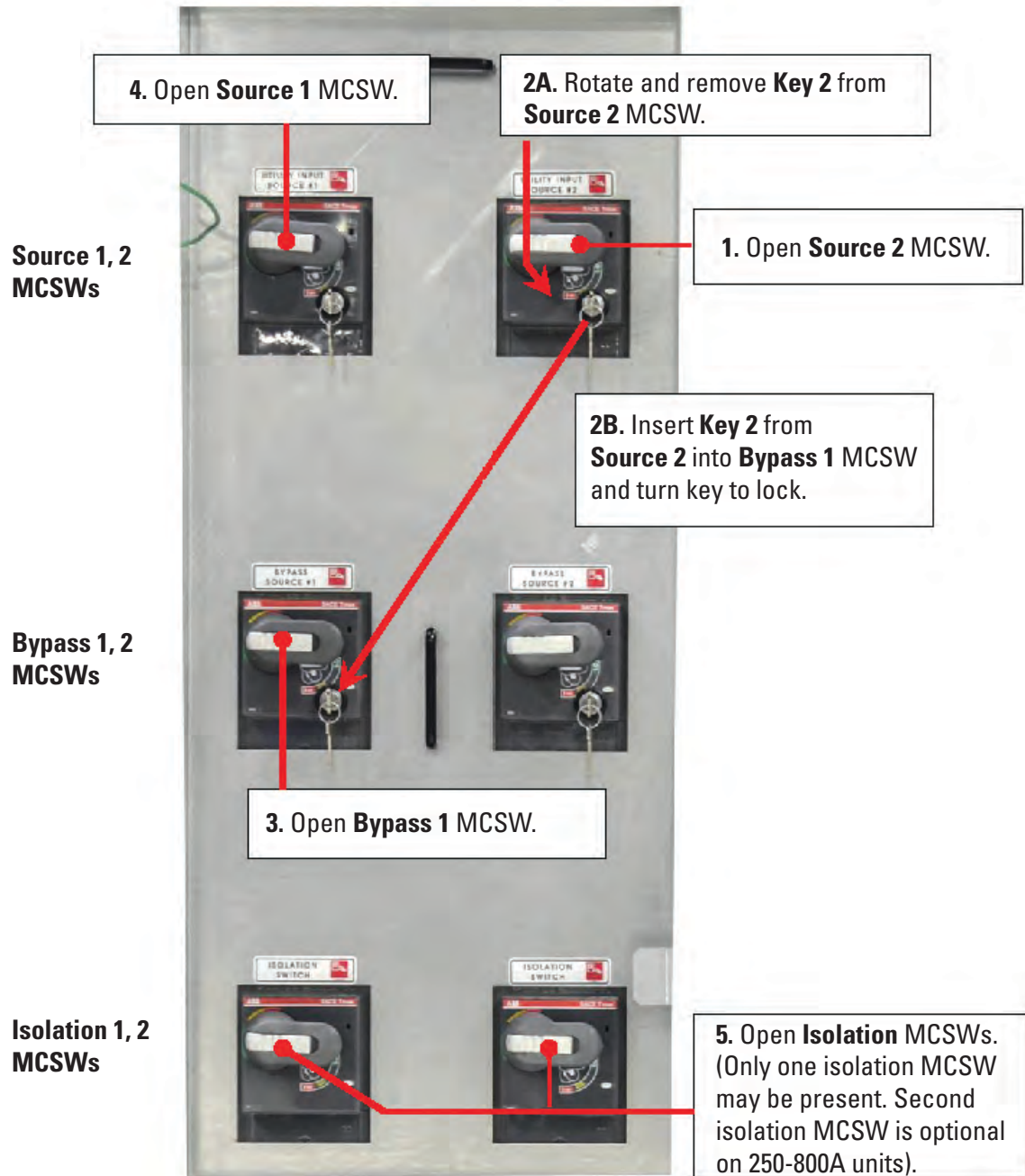
(Only one bypass MCSW should be closed at a time to prevent cross-connecting both sides.)

Isolation MCSWs are not interlocked.

10.3.2 Procedure for Going to Bypass 1

Figure 43. Procedure for Going to Bypass 1

Note: Source 1 is assumed the active power source at the start of this procedure.



Bypass procedure is illustrated in [Figure 43](#). The load is assumed to be powered by Source 1.

1. Open Source 2 input MCSW.

2. Rotate and remove the key from the Source 2 input MCSW; insert it in the Source 1 Bypass MCSW and turn the key.
3. Close Source 1 Bypass MCSW; because the MCSW closes "around" the power switch element, bypass is transparent to the load.
4. Open Source 1 input MCSW.
5. Open the isolation MCSW(s); STS switching logic is bypassed.

10.3.3 Help Assistance for Bypass

The **Help** screen also has instructions to guide an operator through steps for going to Bypass 1 or 2 or returning from either Bypass to Normal operation (See [Figure 44](#)). When the system senses a step has been completed, the **Help** screen proceeds to the next step. The Voice Unit also calls out each step as the operator executes the procedure.

Figure 44. Help for Bypass Operations

Help checklists guide an operator through the steps of going to bypass. There are checklists for going to Bypass 1 and 2 and returning to Normal STS operation.

Next Going to Bypass 1

- ✓ Select Source 1
- ✓ Open Input 2
- ▶ Close Bypass 1
- Open Isolation(s)
- Open Input 1

Next Going to Bypass 1

- ✓ Select Source 1
- ✓ Open Input 2
- ✓ Close Bypass 1
- ▶ Open Isolation(s)
- Open Input 1

Next Going to Bypass 1

- ✓ Select Source 1
- ✓ Open Input 2
- ✓ Close Bypass 1
- ✓ Open Isolation(s)
- ✓ Open Input 1
- In Bypass 1

The Help panel indicates completion of the procedure ("In Bypass 1").

The Status panel shows "Load on Bypass!!!"

The screenshots show the VaveStar interface with the following elements:

- Preferred Source:** 1, 2, Execute, Cancel, Override, Phase OK.
- Checklist:** Select Source 1, Open Input 2, Close Bypass 1, Open Isolation(s), Open Input 1.
- Status:** On St, 4 Alarms, 1001 Available, Input Open.
- Alarm:** Alarm (appears in the second screenshot).
- Final Status:** Bypass 1, Hold On St, 20 Alarms, 1001 Input Open, 1002 Input Open, Load on Bypass!!!.
- Circuit Diagram:** Shows Input 1, Input 2, SCR 1, SCR 2, Bypass 1, Bypass 2, and Iso.

Touch Help. Help overlays the Operator and Transfers panels on the Home screen.

Chapter 11 System Setup: Administration

This chapter describes administrative setup.

11.1 Administrative Access Level

Anyone can view the different display screens, but a login is required to use controls or make changes to parameters.

The STS has four access levels:

1. **PDI:** This level has authorization for all actions except clearing the **Event Log**. Eaton access is required to use the **Configuration** screen.
2. **Service:** This access level is for Eaton authorized service representatives. This level has authorization for all actions except clearing the **Event Log**.
3. **Administrator:** This access level has authorization for all actions and screens except Configuration Screen, which is not available to users. **NOTE:** The Administrator is the only user who can clear the **Event Log!**
4. **Operator:** An operator can only change the **Preferred Source**.

11.2 Initial Administrator Access

STS security is based on the identification of each user by a PIN with an associated password. The PIN identifies the user and the password allows access. This scheme also provides login history and accurate forensics if there is problem with the STS.

To initially set up STS users, Eaton provides a temporary Administrator PIN and password. The administrator should:

1. Log in on the **Home** screen in the **Operator** panel.
2. Navigate to the **Users** screen
3. Change the administrator PIN and password and then keep them secure.
4. Set up each user's security information as described in the following sections.

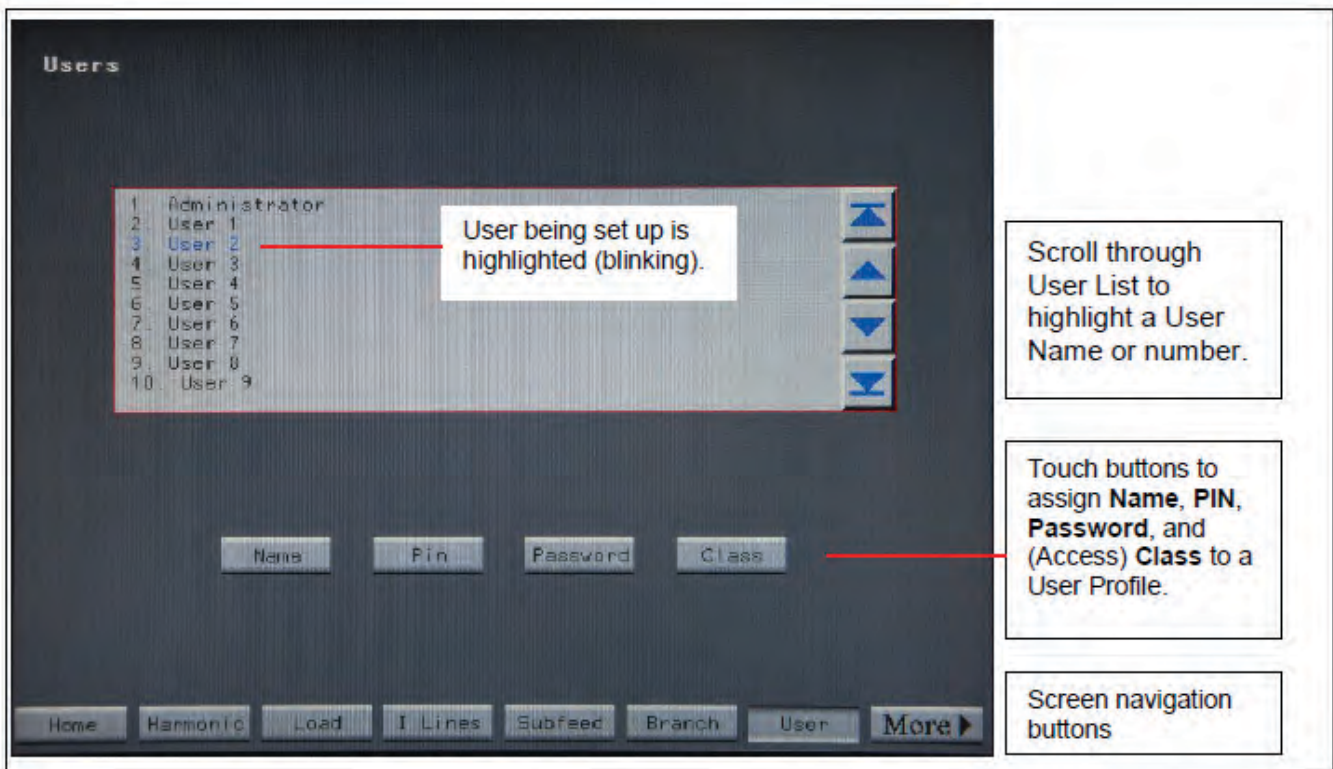
After initial startup, commissioning, testing, or restart, the administrator should clear any alarms that occurred.

11.3 Users Screen

- Touch the **User** button at the bottom of a display screen to display the **Users** Screen (see [Figure 45](#)).
- The **Users** screen:
 - Allows the Administrator set up new users and their level of access to the switch.
 - Displays the names of registered users and unassigned slots.
- Scroll through the User list using the scroll bar on the right side of the screen to highlight a user name or number.
- Set up or modify a user's profile using the **Name**, **PIN**, **Password**, and **Class** buttons. Each user must be assigned a Password and PIN.

- The Administrator sets a user's access Class by touching the **Class** button and entering the first letter of the Class:
 - **A**: Administrator
 - **S**: Service
 - **O**: Operator
- The PDI class is hardcoded and cannot be assigned by the administrator.

Figure 45. Users Screen



11.4 Setting Up a New User

To set up a new STS user, follow the steps below in [Table 3](#).

Table 3. Process - How to Setup a New User


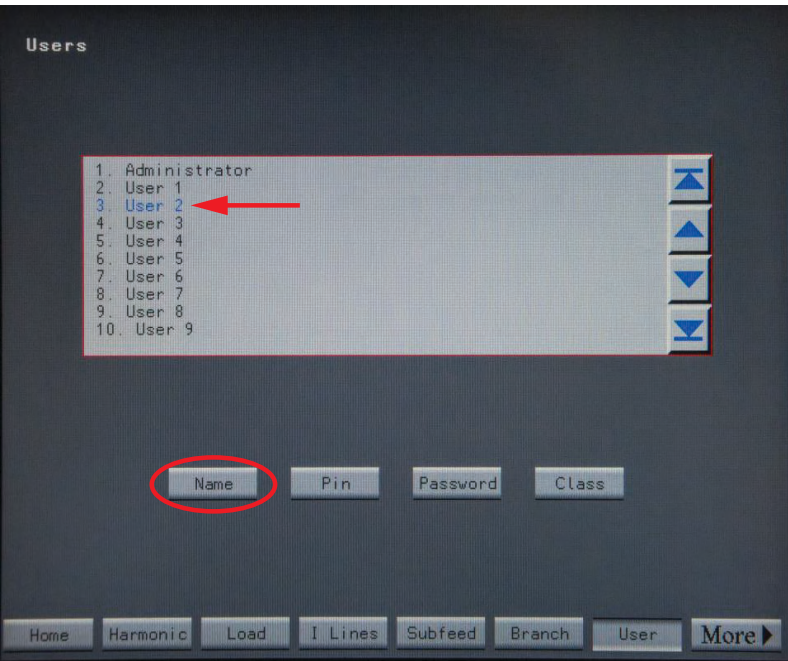
<ol style="list-style-type: none"> 1. Log in on the Home Screen Operator panel with Administrator or equivalent level privileges. 	
<ol style="list-style-type: none"> 2. Touch User button (or More to see User button) to navigate to the Users screen. 3. Using scroll bar, scroll down to an available user entry (in this example, User 2). The user entry becomes highlighted, blinking with alternating red/blue coloring. The entry can be an existing user, whose access properties (such as PIN or password) you wish to modify. 4. Touch Name to bring up the touchscreen keyboard. 	

Table 3. Process - How to Setup a New User (Continued)

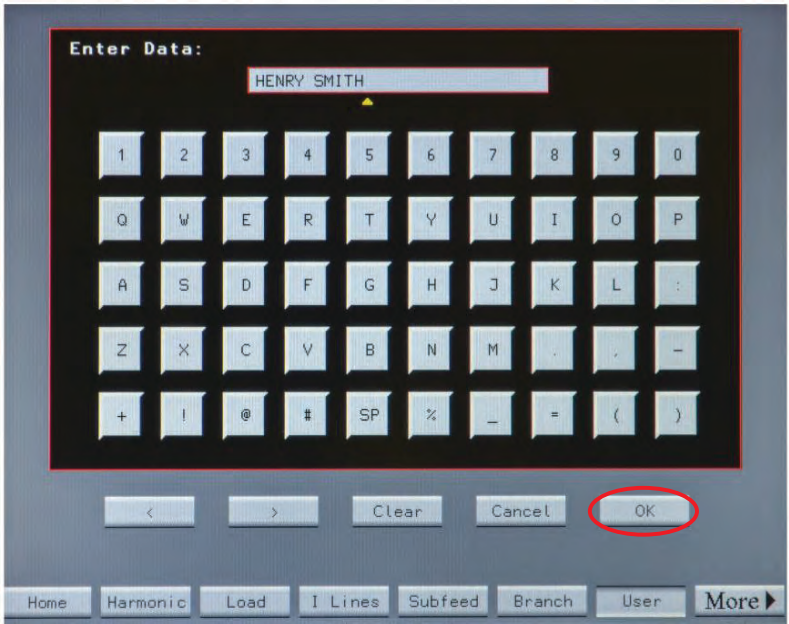
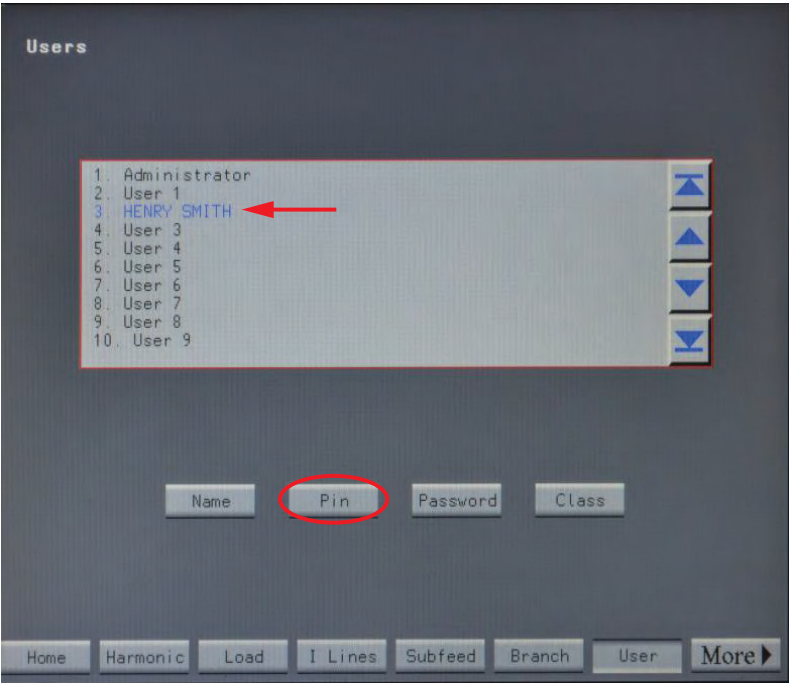
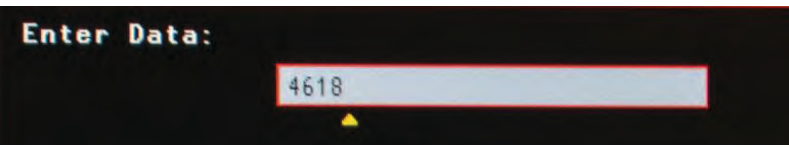
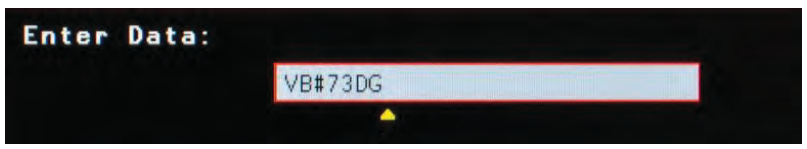

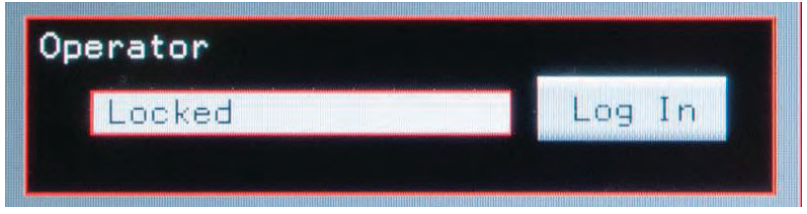


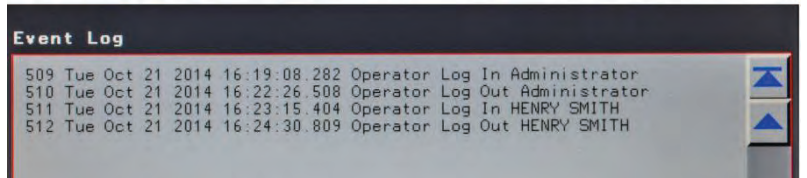
<p>5. Enter user name, such as "HENRY SMITH". Touch OK to enter name. Buttons: OK button enters data. Use arrow keys (< >) to position cursor; entering data overwrites text at cursor position; it does not insert text. Clear button clears entire entry. Cancel button returns to Users page without changing data.</p>	
<p>6. Name now shows on Users screen.</p> <p>7. Touch Pin to bring up touchscreen keyboard to enter user's PIN.</p>	
<p>8. Enter Pin using touchscreen keyboard. Touch OK.</p>	

Table 3. Process - How to Setup a New User (Continued)

<p>9. Touch Password on Users screen. Enter Password using touchscreen keyboard. Touch OK.</p>	
<p>10. Touch Class. Enter authorization Class using first letter of class:</p> <ul style="list-style-type: none"> • A: Administrator • S: Service • O: Operator <p>Touch OK.</p>	
<p>11. Log out as Administrator to test the user log in. (See paragraph 9.1.4 User/Operator Login to log out.) Only one user at a time can be logged in. Operator panel shows Locked.</p>	
<p>12. Log in as User ("Henry Smith" in this example): Touch Log In on Operator Panel on Home screen. Enter pin.password with touchscreen keyboard.</p> <p>13. User now shows as logged in on Operator panel on the Home screen.</p> <p>14. Log the User out. (See paragraph 9.1.4 User/Operator Login)</p>	 <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Enter pin.password. (Do not forget the dot between pin and password.) The PIN identifies the user, not the user name.</p> </div> 
<p>15. All user log-ins and log-outs are logged. The Event Log screen shows these events for both the Administrator and the User.</p>	

Chapter 12 System Setup: Operation

12.1 Configuration Screen

The **Configuration** screen (See [Figure 46](#)) is set up by Eaton at the factory and requires Eaton authorization to make changes, but any user can view the screen. Touch the **Config** button to view.

Eaton uses the **Configuration** screen to describe the system to the Monitor software, which is common for all Eaton STS products. Parameters include physical characteristics (standalone or redundant system, contractor board installation, fans, number of isolation MCSWs), power (voltages, frequency, KVA, etc.), and distribution options.

Figure 46. Configuration Screen



12.2 Switch Settings Screen

Touch the **Switch** button in the navigation buttons to display the **Switch Settings** screen (see [Figure 47](#)). The **Switch Settings** screen is used to select or adjust parameters for sense and transfer algorithms.

Two of the three main transfer parameters—transfer algorithm and retransfer setting—are set on the Switch Settings screen and require administrator or other higher-level authorization. The remaining choice—Preferred **Source**—is set on the **Home** screen and requires operator-level authorization.

Use the **Controls** panel to select the transfer algorithm and retransfer behavior by setting these virtual switches:

- **Mode (VSS/POG):** When the **VSS/POG** switch is touched to be moved, the **Execute** button is highlighted as a precaution. The operator must touch **Execute** to move the virtual switch to the opposite position, or **Cancel** to revert to the previous selection. (See paragraph).
- **Retransfer (Yes/No):** When **Retransfer=Yes**, the STS will switch back to the original preferred source after an outage on that source has ended and the power on this source is within prescribed parameters. When the **Retransfer** switch is touched to be moved, **Execute** is highlighted as a precaution. Touch **Execute** to move the virtual switch to the opposite position, or **Cancel** to revert to the previous selection.

The remaining parameters are **Optimization parameters** for the sense, transfer, and retransfer algorithms. These parameters have been experimentally set and optimized by Eaton. **NOTE:** Eaton strongly recommends that the **Fast**, **Delayed**, and **Retransfer Delay** settings not be changed.

Figure 47. Switch Settings Screen

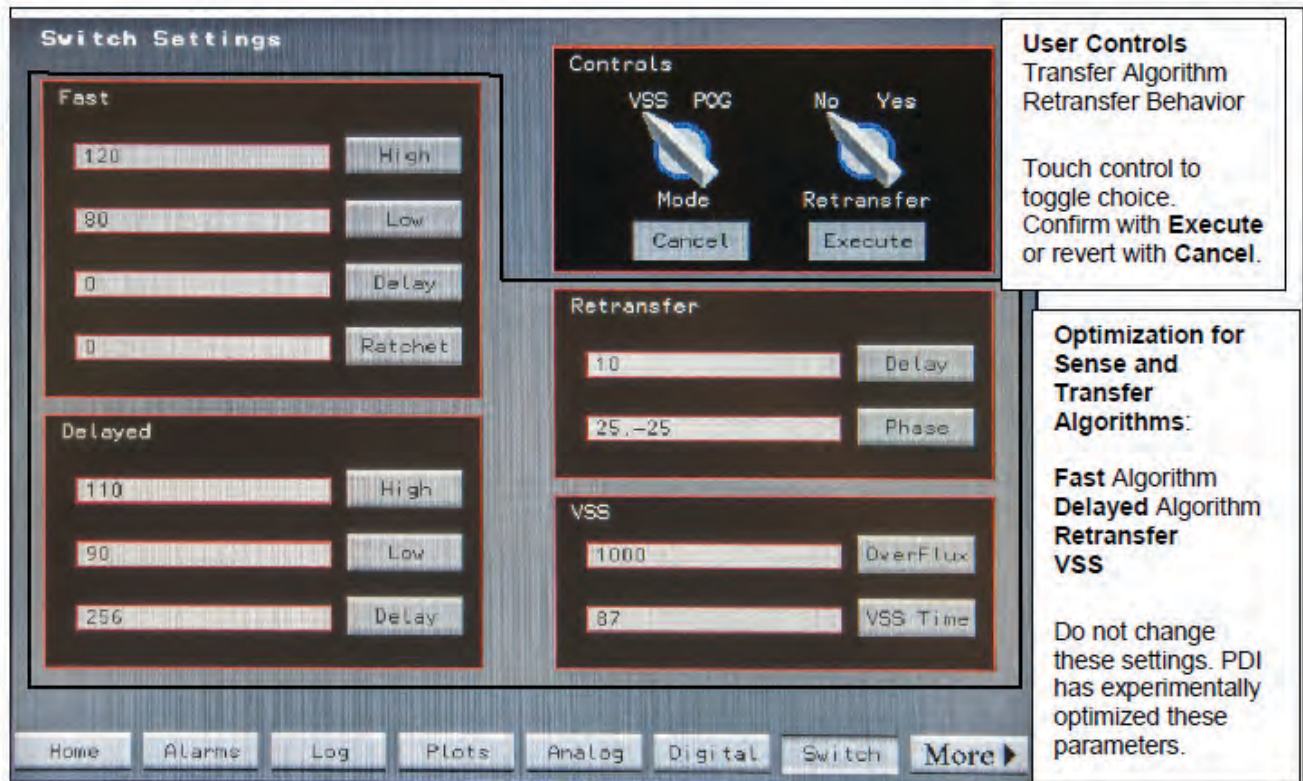


Table 4. Switch Default Settings

Switching – Fast Settings	
Parameter	Value
High Limit	120%
Low Limit	80%
Delay	0 Samples
Ratchet	2%

Switching – Slow Settings	
Parameter	Value
High Limit	110%
Low Limit	90%
Delay	256 Samples
Ratchet	0

Switching – Selectors	
Switch	Value
Mode	VSS
Retransfer	Yes

Switching – Retransfer	
Parameter	Value
Delay	10 seconds

Chapter 13 System Setup: Networking

The parameters for networking options are mainly found on the **Settings** screen. The STS has several networking options, which can all be used simultaneously.

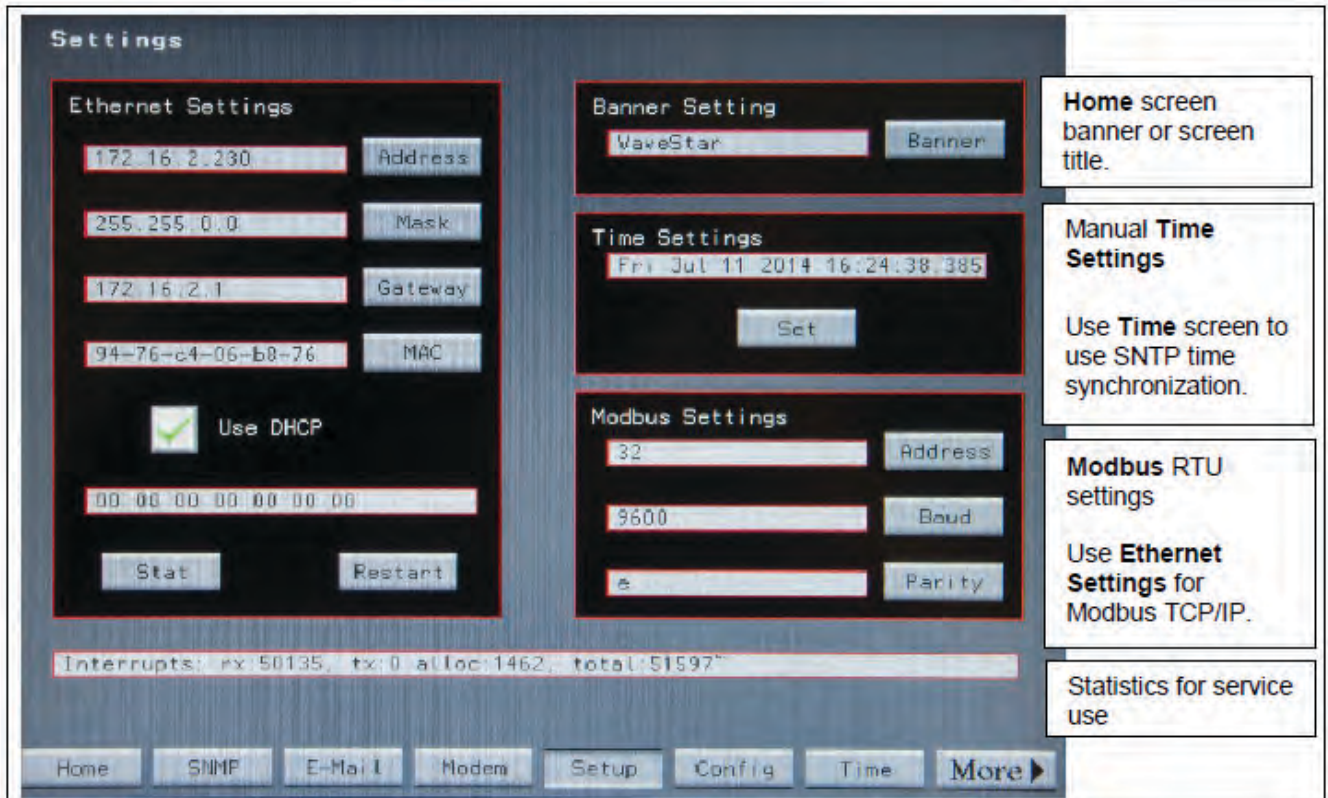
In addition, the STS has multiple methods to provide summary alarm notifications, including by email. Dry contacts provide a separate means of communication, using the Contractor Boards (See [Chapter 8 Customer Communications Connections](#)).

13.1 Settings Screen

Touch the **Settings** button on the **Home** screen to display the **Settings** Screen (See [Figure 48](#)).

The **Settings** screen has panels for Modbus RTU, Ethernet, manual Time setting, and the **Home** screen banner heading.

Figure 48. Networking Settings Screen



Modbus Settings This Panel is used to set parameters for Modbus RTU: Modbus address, baud rate, and parity. The Modbus address can be changed by touching the Address button. This will display the Keyboard Screen for entering the address for the unit. Pressing the other buttons in this panel will allow for the adjustment of those fields. The parity can be selected from the following: Even (E), Odd (O) or None (N).

13.2 Ethernet

The STS has an Ethernet port and cable. (For physical attachment see paragraph [8.4 Ethernet Connection](#)). The Ethernet cable must be physically attached to the customer network and STS Ethernet addresses set before Modbus TCP/IP, SNMP, or SNTP Time Synchronization are configured.

The **Ethernet Settings** panel in the **Settings** screen (Figure 49) allows the operator to set an IP address if a different address than the DHCP address is required.

- **Address** is the Ethernet IP address of the Switch, which can be set directly or by DHCP.
 - If the **Use DHCP** has a green check mark (✓), the DHCP address will be used for the IP address in **Address**.
 - **Use DHCP** icon has a red X, DHCP is not used to set the IP address. Enter an IP address in **Address** for the Switch.
- **Mask** to enter Ethernet IP mask address.
- **Gateway** to enter Ethernet Gateway.
- MAC ID is set in the factory and cannot be changed.
- **Use DHCP** button:
 - (✓): Use DHCP to assign IP address.
 - X: Do not use DHCP; use **Address** IP value.
- Stat button: shows communications statistics (a service function)
- Restart button: restarts the Monitor. On the ROI, the Mode of Operation must be set to **Redundant** so that there is a backup transfer process during the restart. **NOTE:** The Monitor must be restarted when **Ethernet Settings** change.

13.3 Time Settings

Time stamps are important data for log entries and alarms. The STS clock should be synchronized with clocks in other equipment to accurately diagnose problems affecting multiple systems. You can set the STS clock manually or with the Time Synchronization feature.

13.3.1 Manual Time Setting

To manually set the clock, enter a date and time in **Time Settings** on the **Settings** screen.

Press the **Set** button, which will bring up the **Keyboard** Screen. Enter time and date.

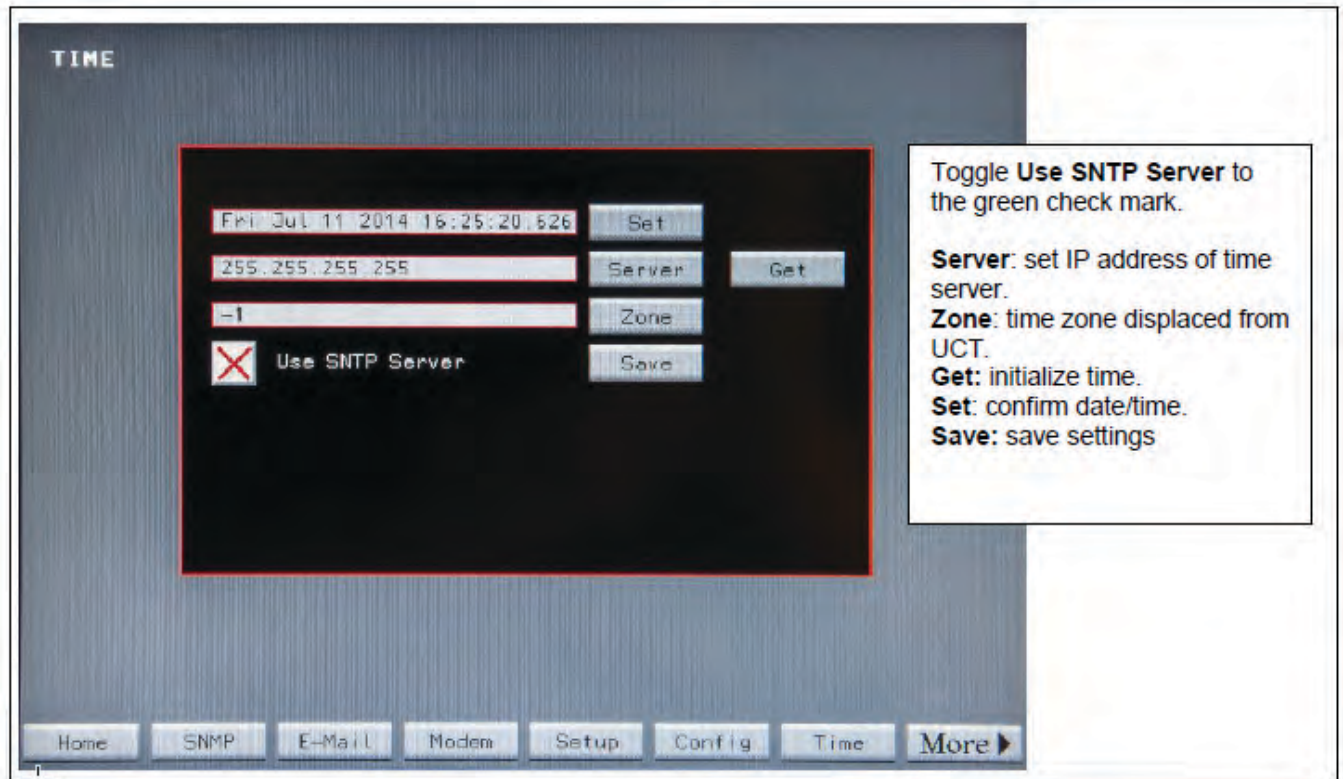
13.3.2 Time Synchronization Settings Screen (SNTP)

The Time Synchronization feature with SNTP requires the STS Ethernet connection.

Prerequisites:

1. The **Ethernet Settings** on the **Settings** screen must be configured.
2. The Ethernet port must be connected to a network with a reachable time server supporting SNTP.
3. You must have the IP address of the time server. The time server could be a dedicated time server possibly with a GPS receiver, a local computer running time server software, or a time server on the Internet. You should preferably use a local time server. All equipment related to the STS should use the same time server if they have access.

Figure 49. TIME Screen



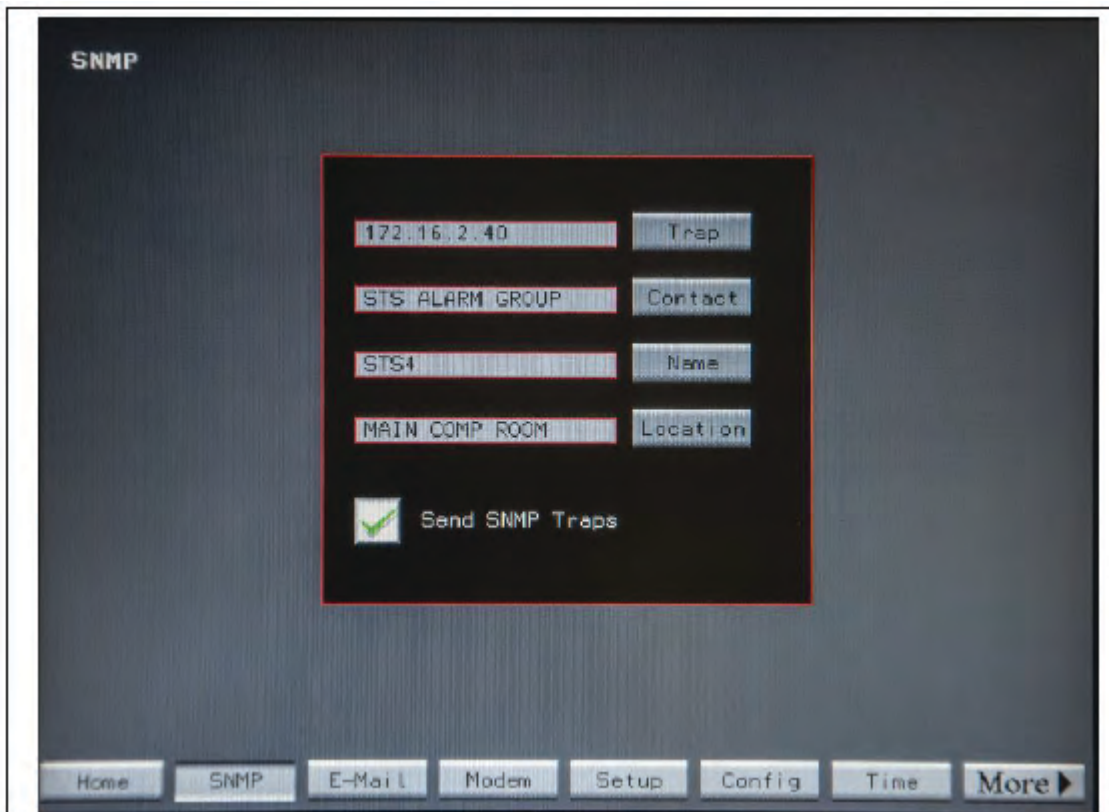
To have the STS use Simple Network Time Protocol (SNTP), follow these steps:

1. Press **Time** button at the bottom of the screen. The **TIME** screen displays (See [Figure 49](#)).
2. Press the **Server** button. Enter the time server's IP address.
3. Press the **Zone** button. Enter the time zone offset from Coordinated Universal Time (UCT) (-4 is Eastern Daylight time).
4. Make sure the **Use SNTP Server** checkbox has a green check. Touch **Use SNTP Server** to toggle between the green check (✓) (use SNTP Server) and red X (do not use SNTP Server).
5. Press **Get** to initialize time and verify that Time Synchronization is working.
6. Touch **Set** to confirm date/time.
7. Touch **Save** to save settings.

13.4 SNMP

The STS supports SNMP over its Ethernet connection. The STS sends a single trap, a summary alarm, if any alarm condition is raised on the STS. Touch the **SNMP** button on the **Home** Screen to display the **SNMP** Screen (Figure 51). Touch **MORE** to display additional buttons if **SNMP** button doesn't show.

Figure 50. SNMP Screen



The **SNMP** screen is used to setup sending a summary alarm SNMP trap to Management Stations or Contacts. A summary alarm trap is the only trap presented.

- Touch the **Trap** button to display the **Keyboard** Screen to set the IP address of the Management Station.
- Touch the **Contact** button to display the **Keyboard** Screen to set the name of the contact person who will be receiving the traps. The contact can be a group name recognized by your email system.
- Touch **Name** button to display the **Keyboard** Screen to enter the name or designation of the STS.
- Touch **Location** to display the **Keyboard** Screen to set the physical location of the STS.
- Touch **Send SNMP Traps** to toggle the between a green check mark ✓ (OK to send traps) and red X (do not send traps).

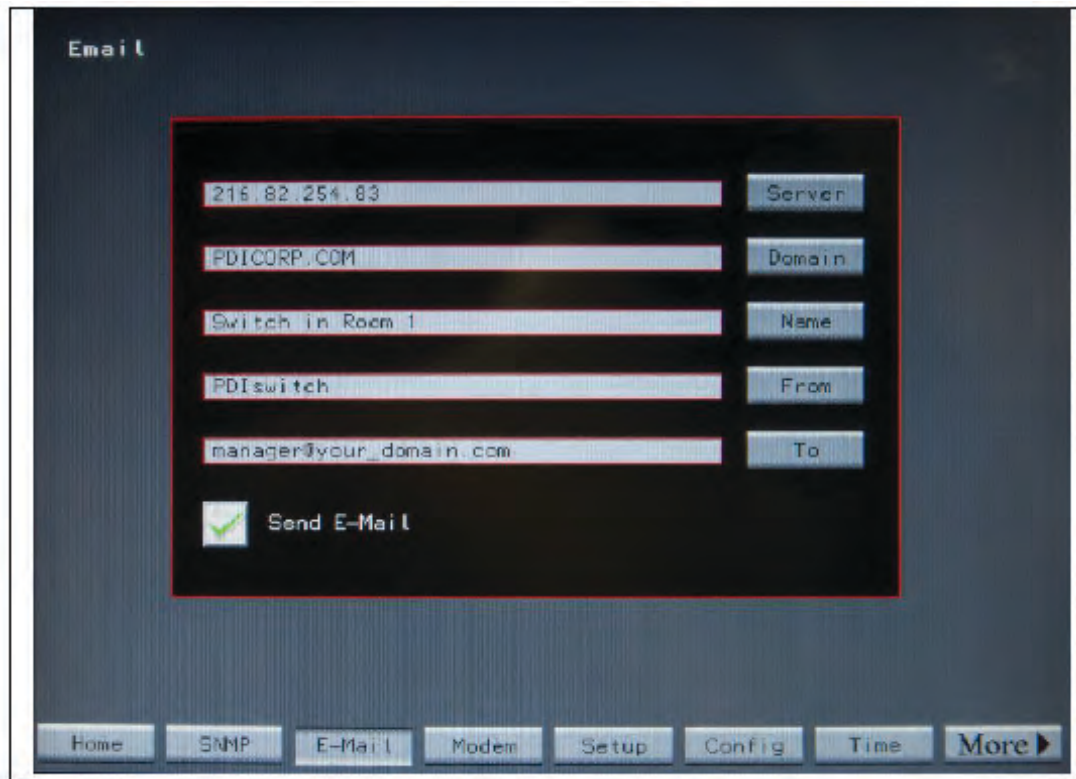
The TFA STS supports SNMP Version 1. Supported SNMP message types are **Get** and **GenNext**.

The SNMP MIB is available on the Eaton website or contacting the Eaton Help Desk, see paragraph [19.2 Getting Help](#).

13.5 Email Alarm Notification

The STS can email a summary alarm notification by SMTP. The IP address of the SMTP server, domain, name, from email address, and the recipient's email address can be set from the **EMAIL** screen. The email will include a link to the **Alarms** web page.

Figure 51. Email Screen



Touch the **Email** button on the navigation buttons to display the **Email** screen (See [Figure 51](#)). Enter email Server, Domain, Name, and email to/from names using screen buttons.

To have emails sent to a list of contacts within an organization, the IT Administrator can set up a group mail address through your mail portal and this address can be used as the **To** address on the **Email** screen.

The **Send Email** box has a red X when email notification is not enabled. Toggle the box to a green check mark (✓) to send email alarm notifications.



NOTE The **Modem** land line option has been **Discontinued**.

Chapter 14 Status, Alarms, and Other Diagnostic Information

14.1 Points Lists

The STS has two points lists (Modbus Register Maps):

- Digital Points, listed in [Table 6](#).
- Analog Points, listed in [Table 7](#).

These are displayed on the **Digital Values** and **Analog Values** screens.

14.1.1 Digital Values Screen

Touch the **Digital** button in the navigation buttons to display the **Digital Values** screen ([Figure 52](#)):

Figure 52. Digital Values Screen

The screenshot shows the 'Digital Values' screen with a list of points and their status. Annotations explain the status indicators and navigation options.

Digital Point Name	Digital Point Status
Aux Fans On	OK
Fan Logic	OK
Door	Closed
Crosscurrent 1	OK
Crosscurrent 2	OK
Switch State	OK
Maintenance	No
Contractor Timeout	Alarm
Contractor DC1	OK
Contractor DC2	OK
Summary	Alarm
NSW Timeout	Alarm
NSW Out 24V	OK
NSW Out 5V	OK
NSW S2 5V	OK
NSW S1 5V	OK
NSW S2 Fuse	OK
NSW S1 Fuse	OK
NSW Voting	OK
NSW Logic	OK
Downstream	OK
Switch Inhibit	OK

Annotations and their meanings:

- Green dot:** means point is OK.
- Red dot:** means point is in alarm condition.
- Blue dot:** is for status points, not defined as alarm points.
- Black dot (not shown):** means point is not used or is invalid for this STS implementation.
- Scroll bar:** used to scroll through Digital Points.
- Highlighted point:** The point you have scrolled to is highlighted.
- Buttons:** Setup, Name, Normal, Abnormal (used to change parameters for the highlighted point).
- Navigation:** Home, Alarms, Log, Plots, Analog, Digital, Switch, More.

You can change digital point parameters for the highlighted point using these buttons under Administrator or other higher access authority.

You can change the name of a point and change what is the normal or abnormal state, thus changing the trigger for an alarm.

The **Digital Values** screen has three columns:

- The first column gives the digital point's name. The dot at the beginning of each row indicates the general state of the point (for explanation of the dot indicator, see [Figure 52](#)).
- The second column describes the point's status, which may indicate an alarm or abnormal state.
- The third column has the date/time stamp when the alarm or abnormal state occurred.

14.1.2 Analog Values screen

Touch the **Analog** button in the navigation buttons to display the **Analog Values** screen ([Figure 53](#)).

Figure 53. Analog Values Screen

The screenshot shows the 'Analog' screen with a table of analog points. The table has two main columns: 'Analog Point Name' and 'Measured Value'. The 'Analog Point Name' column includes a status indicator (a dot) and a text description. The 'Measured Value' column shows the current reading and units. A scroll bar on the right side of the table allows navigation through the list.

Callouts explain the dot colors:

- Green dot means point is OK.
- Red dot means point is in alarm condition.
- Blue dot is for status points, not defined as alarm points.
- Black dot (not shown) means point is not used or is invalid for this STS implementation.

Callouts also explain the control buttons:

- Set High, Set Low, Calib.:** You can change analog point parameters using these buttons under Administrator or other higher access authority. You can change the allowable measurement bracket for the point, thus changing the trigger for an alarm. You can also calibrate the analog point's measurement.
- Clr TX:** Clr TX touched once clears the Transfer counter on the Home page. Touched twice, it also clears the total cumulative transfer counter.
- Clr PK:** Clr PK clears the peak (high) values of all analog points.

Other callouts include: 'Scroll through Analog Points using scroll bar.' and 'The point you have scrolled to is highlighted.'

Analog Point Name	Measured Value
● OK S 1 Volts AB	479 Volts
● OK S 1 Volts BC	475 Volts
● OK S 1 Volts CA	480 Volts
● Low S 2 Volts AB	0 Volts
● Low S 2 Volts BC	2 Volts
● Low S 2 Volts CA	2 Volts
● OK Output Volts AB	470 Volts
● OK Output Volts BC	467 Volts
● OK Output Volts CA	469 Volts
● OK Output Amps A	2 Amps
● OK Output Amps B	2 Amps
● OK Output Amps C	2 Amps
● Not Alarm Output Amps N	2 Amps
● OK Output KVA A	0 KVA
● OK Output KVA B	0 KVA
● OK Output KVA C	0 KVA
● OK S 1 A Amps	2 Amps
● OK S 1 B Amps	2 Amps
● OK S 1 C Amps	1 Amps
● OK S 2 A Amps	2 Amps
● OK S 2 B Amps	2 Amps
● OK S 2 C Amps	1 Amps

Each row displays an analog point with its status and last measurement. The dot indicators at the beginning of each row indicate the status of the point:

- Green = Normal
- Red = Abnormal (alarm)
- Blue = Status point only, will not generate an alarm
- Black = Point is not used or is invalid in this STS implementation

The first column also displays a text interpretation of the point's status, such as **OK**, **Low**, or **Not Alarm**.

To set parameters for a point, use the scroll bar to highlight a point. Then touch one of these buttons below the panel:

- **Set High** sets the upper bound on acceptable measurements
- **Set Low** sets the lower bound on acceptable measurements
- **Calibration** to calibrate the measurement

Clr TX button clears the transfer counter on the **Home** page, resetting it to zero.

- Touch **Clear TX** once to clear transfer counter since last **Clear TX**. This is the same as the **Clear** button on **Home** screen **Transfers** panel. The counter is stored in **Xfrs Since Clr**, a point in the Analog Points list.
- Touch **Clear TX** a second time to clear the cumulative total transfers counter, stored in **Xfrs Total** in the Analog Points list.

Clr PK clears the peak value measurement for each analog point. Each peak value will be immediately replaced on the point's next measurement.

14.2 Events, Alarms, and Waveform Plots

All events are recorded in the **Event Log**, such changes of state in a point, a transfer, user login, or an alarm. The Event Log has 512 entries.

Alarms are specific events listed on the **Alarms** screen and recorded in the **Event Log**.

The STS also records input and output waveforms for selected events, such as transfers or outages, which can be viewed in the **Plots** screen.

In case of power loss, the STS can continue recording events for approximately 15 seconds, providing diagnostic information.

14.2.1 Alarms

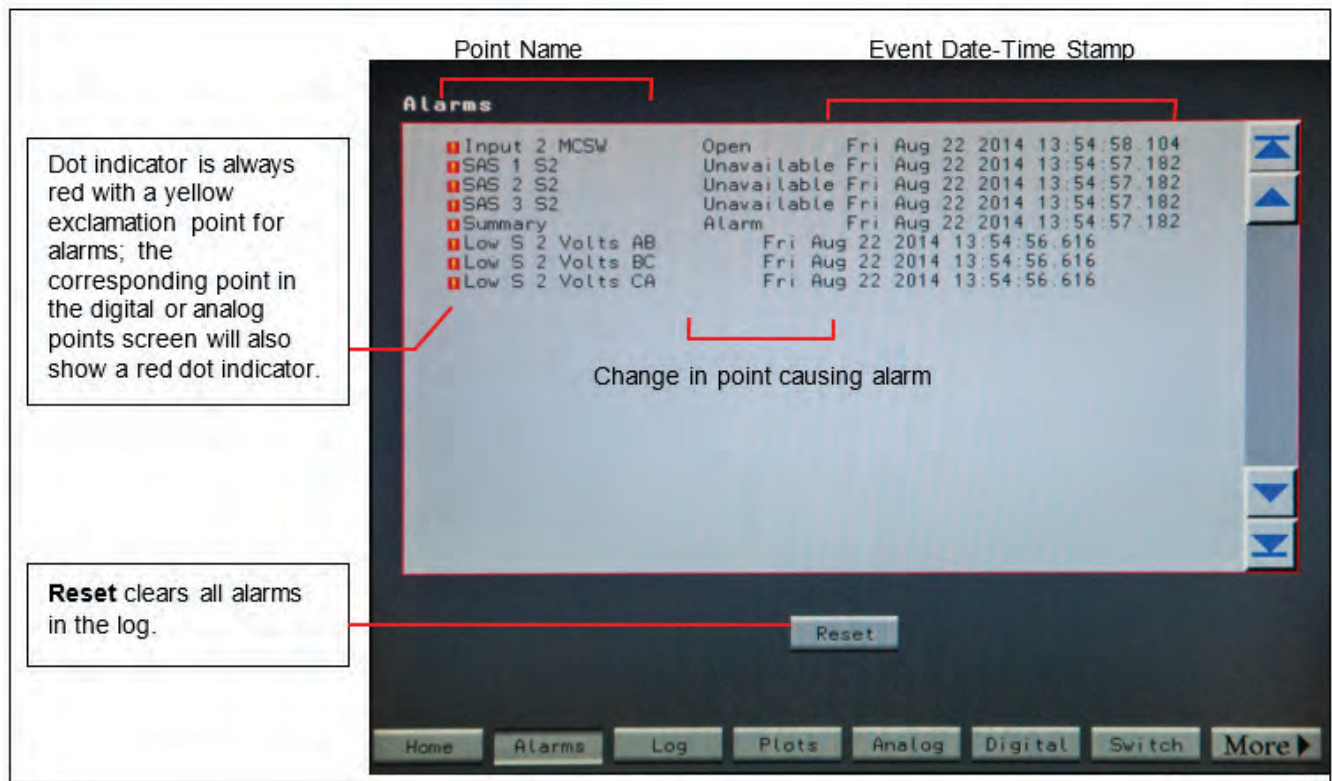
An alarm is signaled when any monitored condition is out of normal specification. Active alarms are signaled in several ways:

- The **Home** screen shows Alarm status and gives an alarm count.
- The Voice Unit of the STS states, "Static Switch, new alarm."
- A summary alarm can be signaled when any alarm occurs by one or more of these means:
 - Dry contact
 - SNMP trap
 - Email notification
- The **Alarms** screen lists a new alarm.
- The **Event Log** screen adds an alarm.
- The **Alarms** or **Log** web page shows a new alarm.

14.2.2 Alarms Screen

Touch the **Alarms** button on the **Home** or other screens to display the **Alarms** screen. When there are alarms indicated, view the **Alarms** screen at the unit ([Figure 54](#)) or in a web browser.

Figure 54. Alarms Screen



The **Alarms** screen displays all alarms with date-time stamps and the points' names. The point names are the same as in the points lists.

Touching the **Reset** button will clear all points from the **Alarms** Screen. If the alarm conditions remain active in the unit after clearing the screen, the alarms will show again.

14.2.3 Event Log Screen

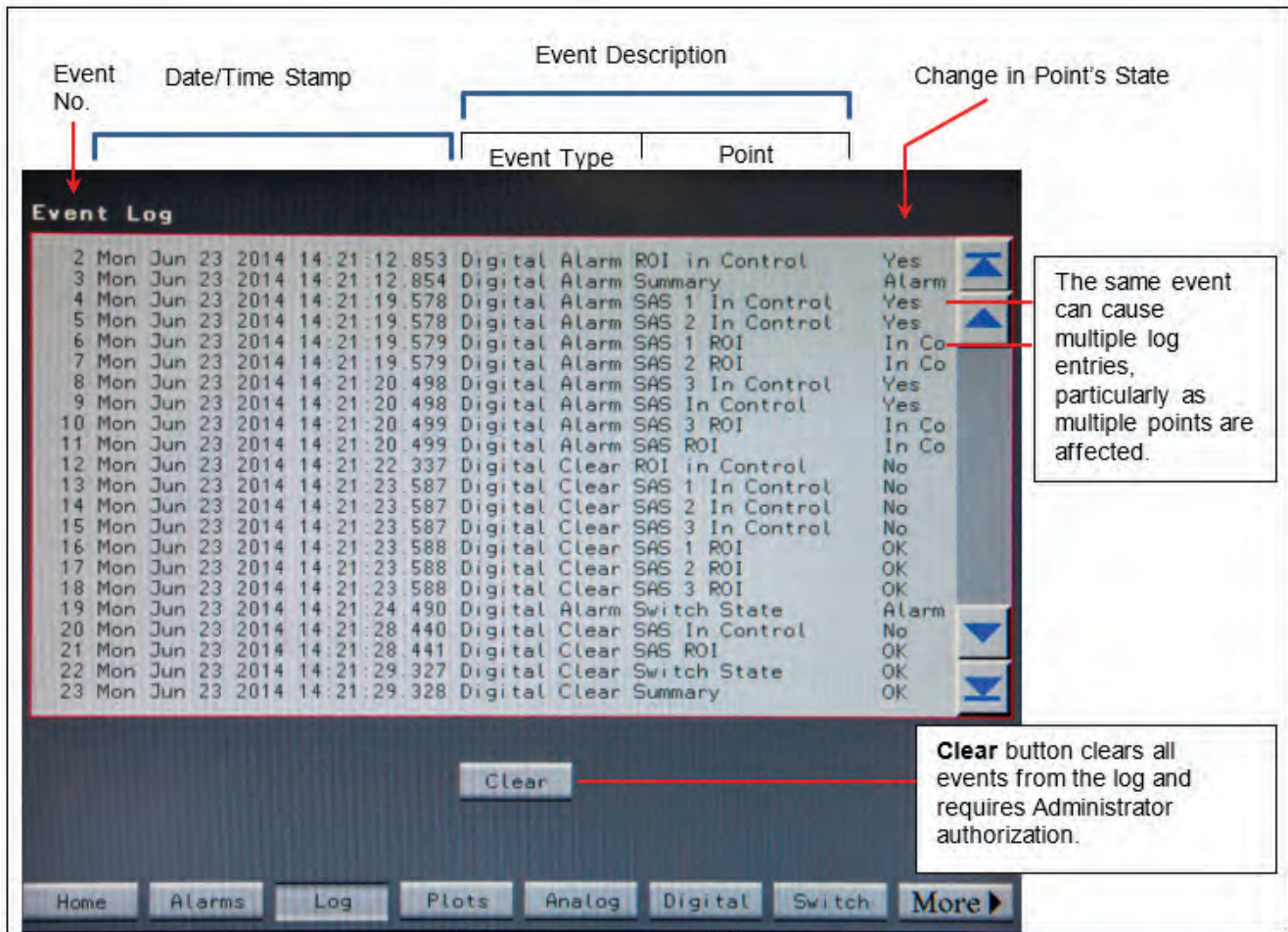
Touch the **Log** button in the navigation buttons to display the **Event Log Screen** (Figure 55).

Events include the following:

- Alarms
- Outages
- User login and logout
- Changes in state for digital points (binary states) in the Digital Points list (see Table 6).
- Crossed thresholds for analog points (measurements) in the Analog Points list (see Table 7).

The **Event Log** is a record of all such events that have taken place while the STS has been operational and since the **Log** was last cleared up to a maximum of 512 entries. The **Event Log** is stored in nonvolatile memory.

Figure 55. Event Log Screen



Each event is date-and-time-stamped in the order of occurrence. Events are described in the center panel. The same event often causes multiple log entries because multiple points are affected.

Scroll through event entries using the right-side scroll bar.

Touch the **Clear** button to clear all events in the log. This action requires Administrator-level authorization. **Only** the Administrator can clear the **Event Log** and it must be done from the touchscreen display. (The **Event Log** can be viewed remotely in a web browser, but cannot be cleared from a browser.)

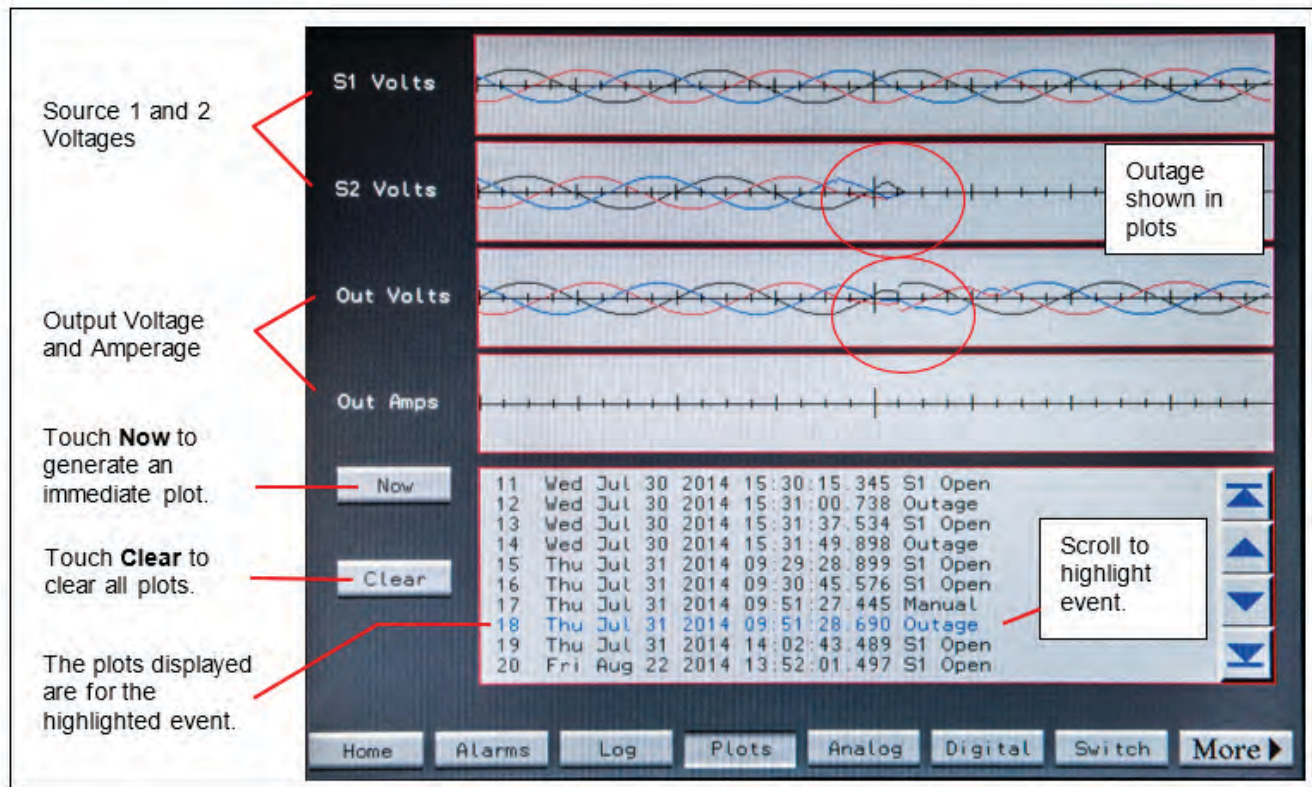
14.2.4 Downloading the Event Log File

A USB port on the front of the touchscreen display compartment lets you download the log file to a PC. When a PC is connected to this port with a USB cable, a shortcut is created on the PC's desktop. Clicking this shortcut will automatically download the **Event Log** as a CSV file to the PC. For security reasons, no other action is taken. The PC cannot send input to the STS and cannot request any other information.

14.2.5 Plots Screen

Touch the **Plots** button in the navigation buttons to display the **Plots** screen (Figure 56).

Figure 56. Plots Screen



The bottom panel displays a list of events with the date-time stamp of the event. The STS records waveforms for up to 25 events.

These events generate waveform plots:

- Outages (automatic transfers due to a source going out of specification)
- Dual outages, where both sources fail
- Manual transfers
- Immediate user-requested plot (**Now** button)

Touching the **Now** button will result in an instantaneous plot with the event name **Operator**.

The scroll bar on the right of the event list panel allows the user to scroll through the event list to display the waveform captures for a specific event.

The top four panels are the plots associated with the currently highlighted event. These four panels display the three phases of each source and output as waveform captures. The waveforms are color-coded for each phase: Phase A is blue, Phase B is red, and Phase C is black. These displays show breaks in the waves if there has been an outage or a transfer.

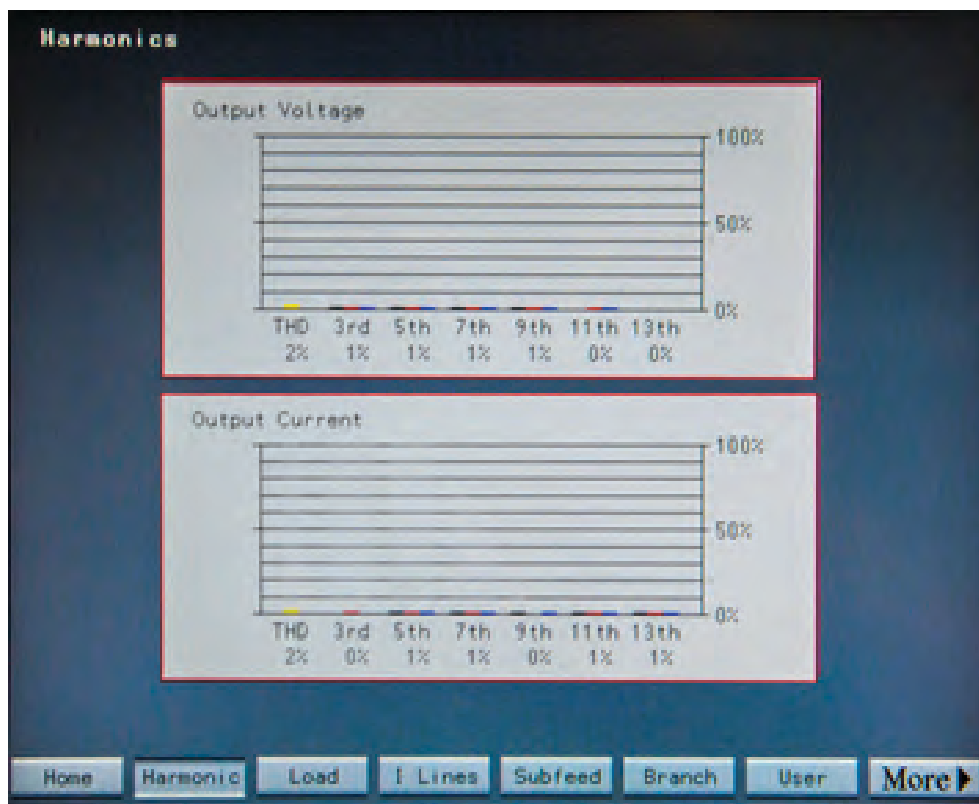
Touch the **Clear** button to clear all plots.

14.3 Additional Status Screens

14.3.1 Harmonics Screen

Touching the **Harmonic** button in the navigation buttons displays the **Harmonics** screen ([Figure 57](#)).

Figure 57. Harmonics Screen



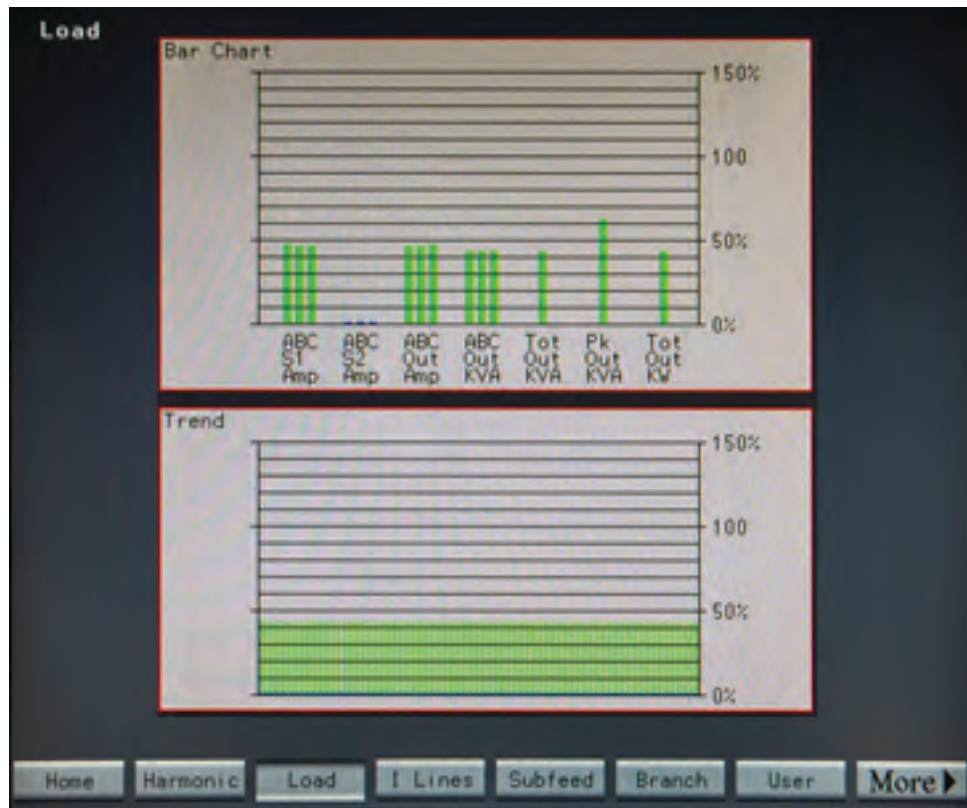
The **Harmonics** screen displays harmonics for

- STS output voltage harmonics as percent of total waveform.
- STS output current harmonics at percent of total waveform.

Harmonics are represented in a bar chart and each phase has a color-coded bar: Phase A is black, Phase B is red, and Phase C is blue. The yellow bar on the left side of the panel represents the Total Harmonic Distortion (THD). AC harmonics are always odd-numbered (3rd, 5th, 7th harmonic, etc.).

14.3.2 Load Screen

Touching the **Load** button displays the **Load** Screen ([Figure 58](#)).

Figure 58. Load Screen

The **Load** Screen Bar Chart displays the current for both sources and the output, total KVA, peak KVA, and total KW as bar charts. All bars start green, but turn yellow when they reach 80% or higher and turn red when they reach 100% or higher.

Load values are defined by Eaton on the **Configuration** Screen (See [Figure 46](#)). 100% load values are stored in the Analog Points list as Rated Total KVA (point 93) and Rated Phase Amp (point 94).

The **Trend** panel on the lower half of the screen shows the trend for total KVA.

14.3.3 Branch Screen

The standalone TFA STS does not have distribution branch circuits and the Branch screen does not apply.

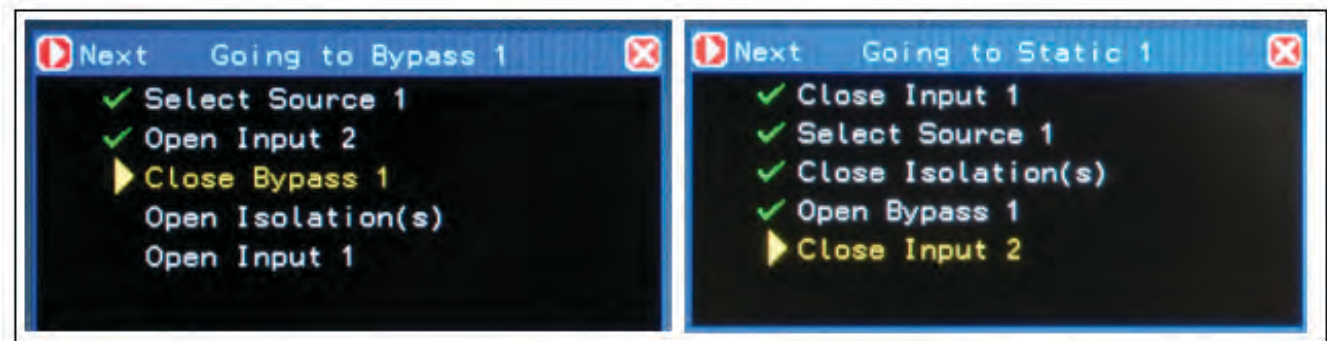
14.4 Help Screen

Touching the **Help** button on the **Home** screen displays **Help** screen, overlaid on the **Home** screen (see paragraph [10.3.3 Help Assistance for Bypass](#), and [Figure 44](#)).

The **Help** screen provides the operator a step-by-step procedure for going to and returning from Bypass. The procedure steps are listed and tracked as operations are performed.

Touch the **Next** arrowhead to display another help procedure.

Figure 59. Help Procedure Examples



Chapter 15 Operator Procedures

Once configured, the STS requires few operator interventions. The following procedures cover the main interventions.

15.1 Normal Startup

Powering up the STS for normal operation can be done as follows:

1. The STS should be left in Normal mode configuration for MCSWs as shown in [Figure 7](#), Normal Mode MCSW Configuration.
2. Apply power to the STS externally by closing circuit breakers feeding the unit.

15.2 Startup after Power Rework

Initial startup is covered in paragraph [6.1 TFA STS Startup Procedure](#). If power rework has been performed upstream of the STS, follow steps 2-4 of this procedure to verify correct input power to the STS.

15.3 Restarting the Monitor

When the Ethernet settings are changed on the **Settings** screen (see paragraph [13.2 Ethernet](#)), the Monitor must be restarted. Because the Monitor logic controls transfers, the STS must briefly be put in Redundant Mode to provide a backup transfer capability to the Monitor:

1. On the **Home** screen, make note of the existing parameters, particularly **Preferred Source** and the actively conducting source as indicating by the **yellow line** on the One-line display.
2. Use the ROI panel key to open the ROI panel.
3. On the ROI, set the **MODE OF OPERATION** toggle switch to **REDUNDANT** mode.
4. Login on the **Home** page as Administrator or other higher-level authorization.
5. In the navigation buttons, touch the **Setup** button to display the **Settings** screen.
6. In the **Ethernet Settings** panel, touch the **Restart** button to restart the Monitor. Touch the button just once: the restart will take around 30-45 seconds and it is not immediately apparent that the restart is proceeding.
7. When the **Home** screen reappears, do a visual check of Monitor parameters and settings for correctness:
 - a. On the dynamic One-line display, verify that the currently conducting source matches the source indicated by yellow line.
 - b. Verify that the **Preferred Source** selector is selecting the currently conducting source. (If the **Preferred Source** selector is not the current source, it will force a transfer when you return to **NORMAL** mode.)
 - c. If the **Preferred Source** is **not** the currently conducting source, login on the **Home** screen with at least operator-level authorization and set the **Preferred Source** selector to the source recorded in step 1.
8. After validating the Monitor, at the ROI set the **MODE OF OPERATION** toggle switch to **NORMAL** mode.
9. Close and lock the ROI panel.

15.4 SAS Board Transfers

If the Monitor fails to transfer the load, the SAS board will take over the transfer. If Alarms appear showing the SAS board in control, follow these steps:

1. Check the **Alarms** page for alarms showing the SAS board is in control.

2. Login on the **Home** page as Administrator or other higher-level authorization.
3. Touch the **Reset** button on the **Alarms** page to clear alarms. (Alarms will remain listed in the Event Log.)
4. Check that SAS board alarms clear and do not reappear.
5. If SAS board alarms reappear, contact your customer service representative.

15.5 Component Failure

The TFA STS has substantial component redundancy and a single component failure will normally not impact operation. Nevertheless, if alarms indicate component failure, contact your customer service representative. See paragraph [19.2 Getting Help](#) for contact details.

15.6 Common Feeder for both Sources

If both power sources are temporarily fed from a common upstream feeder, the unit should be put in bypass until two independent source feeders are available.

Chapter 16 Troubleshooting



Safety Precautions:

- The TFA STS has high voltages inside the cabinet!
- Do not operate the unit without all covers securely in place.
- Do not allow servicing by unauthorized personnel. You may void your warranty.
- Do not touch the printed circuit boards containing the processor and logic circuits. Untrained personnel can seriously damage the equipment and may cause themselves serious or fatal injuries.

If after reviewing and checking all the recommended correction procedures for any problem, please do not hesitate to contact Eaton for service-related calls or scheduling.

Table 5. Troubleshooting

Symptom	Probable Cause/Response
No power to unit.	No building power to Power Input bus. Restore building power.
	Unit not connected to Power Input bus. Connect unit to Power Input bus.
	Input breaker not closed. Turn on or reset breaker.
Specific output circuit is dead.	Output circuit breaker is off. Turn on or reset breaker.
	Output circuit breaker and/or cable are not connected to Equipment. Connect (if authorized) output circuit to equipment and turn on.
No output voltage from unit but the unit indicators are on.	Input circuit breaker off or tripped. Check display panel for alarms; acknowledge or reset alarms then turn on or reset breaker.
Monitor and display will not operate.	Blown Fuse (1, 2, 3, or 4).

Chapter 17 Digital and Analog Points

17.1 Digital Screen Points

[Table 6](#) shows the digital points as they show on the screen for the Digital Points List (Rev 2.86 and higher).

The Normal and Abnormal columns show what is Normal for the digital point (and hence not an alarm) and what is Abnormal (hence an alarm). These columns are meaningful only for points that are Alarms (as noted in the Alarm column).

Example: "Retransfer" (point 8) is not an alarm ("No" in Alarm column).

The same point name is used when the point appears on the Digital Values Screen, the Event Log Screen, or the Alarms Screen. The status for digital points is in an adjacent table following the list of points.

Custom STSs will have different points and the current points list may not apply.

Table 6. Digital Screen Points

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
Isolation 1 MCSW	Closed	Open	Yes	1	Yes	1001	1
Isolation 2 MCSW	Closed	Open	If Installed	2	Yes	1002	1
Bypass 1 MCSW	Open	Closed	Yes	3	Yes	1003	0
Bypass 2 MCSW	Open	Closed	Yes	4	Yes	1004	0
Input 1 MCSW	Closed	Open	Yes	5	Yes	1005	1
Input 2 MCSW	Closed	Open	Yes	6	Yes	1006	1
Override	No	Yes	No	7		1007	0
Retransfer	Yes	No	No	8	Yes	1008	1
ROI in Control	No	Yes	Yes	9	Yes	1009	0
Preferred Source	1	2	No	10	Yes	1010	0
PDU 1 CB	Closed	Open	If Installed	11	If Installed	1011	1
PDU 2 CB	Closed	Open	If Installed	12	If Installed	1012	1
Building 1	OK	Alarm	If Installed	13	If Installed	1013	0
Building 2	OK	Alarm	If Installed	14	If Installed	1014	0
Building 3	OK	Alarm	If Installed	15	If Installed	1015	0
Building 4	OK	Alarm	If Installed	16	If Installed	1016	0
Building 5	OK	Alarm	If Installed	17	If Installed	1017	0
Building 6	OK	Alarm	If Installed	18	If Installed	1018	0
Building 7	OK	Alarm	If Installed	19	If Installed	1019	0
Building 8	OK	Alarm	If Installed	20	If Installed	1020	0
Output Short	OK	Alarm	Yes	21	No	1021	0

Table 6. Digital Screen Points (Continued)

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
Open S1	OK	Alarm	Yes	22	No	1022	0
Open S2	OK	Alarm	Yes	23	No	1023	0
EPO	OK	Alarm	Yes	24	No	1024	0
Remote EPO	OK	Alarm	If Installed	25	No	1025	0
XFMR 1 HT	OK	Alarm	If Installed	26	If Installed	1026	0
XFMR 1 OT	OK	Alarm	If Installed	27	If Installed	1027	0
XFMR 2 HT	OK	Alarm	If Installed	28	If Installed	1028	0
XFMR 2 OT	OK	Alarm	If Installed	29	If Installed	1029	0
SCR High Temp	OK	Alarm	Yes	30	No	1030	0
SCR Over Temp	OK	Alarm	Yes	31	No	1031	0
Shunt Trip 1	OK	Trip	No	32	No	1032	0
Shunt Trip 2	OK	Trip	No	33	No	1033	0
DCPS S1V	OK	Alarm	Yes	34	No	1034	0
DCPS S2V	OK	Alarm	Yes	35	No	1035	0
DCPS OV	OK	Alarm	Yes	36	No	1036	0
S1 Rotation	OK	Alarm	Yes	37	No	1037	0
S2 Rotation	OK	Alarm	Yes	38	No	1038	0
On Source	Preferred	Alt	Yes	39	No	1039	0
Transfer	None	Done	No	40	No	1040	0
Shunt Trip	OK	Fail	No	41	No	1041	0
EPO Latched	OK	Alarm	No	42	No	1042	0
SAS D Open	OK	Alarm	Yes	43	No	1043	0
SAS D DC	OK	Alarm	Yes	44	No	1044	0
SAS D DC 1	OK	Alarm	Yes	45	No	1045	0
SAS D DC 2	OK	Alarm	Yes	46	No	1046	0
SAS D DC Main	OK	Alarm	Yes	47	No	1047	0
SAS D Pulse 1	OK	Alarm	Yes	48	No	1048	0
SAS D Pulse 2	OK	Alarm	Yes	49	No	1049	0
SAS D Pulse M	OK	Alarm	Yes	50	No	1050	0
SAS D Voting	OK	Alarm	Yes	51	No	1051	0
SAS D SCR 1 DC	Off	On	No	52	No	1052	0

Table 6. Digital Screen Points (Continued)

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
SAS D SCR 2 DC	Off	On	No	53	No	1053	0
SAS D Aux 3	OK	Alarm	Yes	54	No	1054	0
SAS D Aux 4	OK	Alarm	Yes	55	No	1055	0
SAS D Aux 5	OK	Alarm	Yes	56	No	1056	0
SAS D Aux 6	OK	Alarm	Yes	57	No	1057	0
SAS D Aux 7	OK	Alarm	Yes	58	No	1058	0
SAS 1 Fiber Rx	OK	Failed	Yes	59	No	1059	0
SAS 2 Fiber Rx	OK	Failed	Yes	60	No	1060	0
SAS 3 Fiber Rx	OK	Failed	Yes	61	No	1061	0
SAS 1 In Control	No	Yes	Yes	62	No	1062	0
SAS 2 In Control	No	Yes	Yes	63	No	1063	0
SAS 3 In Control	No	Yes	Yes	64	No	1064	0
SAS In Control	No	Yes	Yes	65	No	1065	0
SAS 1 SCR 1	OK	Short	Yes	66	No	1066	0
SAS 2 SCR 1	OK	Short	Yes	67	No	1067	0
SAS 3 SCR 1	OK	Short	Yes	68	No	1068	0
SAS 1 SCR 2	OK	Short	Yes	69	No	1069	0
SAS 2 SCR 2	OK	Short	Yes	70	No	1070	0
SAS 3 SCR 2	OK	Short	Yes	71	No	1071	0
SAS SCR 1	OK	Short	Yes	72	No	1072	0
SAS SCR 2	OK	Short	Yes	73	No	1073	0
SAS 1 S1 Gated	Off	On	No	74	No	1074	0
SAS 2 S1 Gated	Off	On	No	75	No	1075	0
SAS 3 S1 Gated	Off	On	No	76	No	1076	0
SAS 1 S2 Gated	Off	On	No	77	No	1077	0
SAS 2 S2 Gated	Off	On	No	78	No	1078	0
SAS 3 S2 Gated	Off	On	No	79	No	1079	0
SAS S1 Gated	Off	On	No	80	Yes	1080	0
SAS S2 Gated	Off	On	No	81	Yes	1081	0
SAS D Timeout	OK	Alarm	Yes	82	No	1082	0
SAS 1 Timeout	OK	Alarm	Yes	83	No	1083	0
SAS 2 Timeout	OK	Alarm	Yes	84	No	1084	0

Table 6. Digital Screen Points (Continued)

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
SAS 3 Timeout	OK	Alarm	Yes	85	No	1085	0
ROI Timeout	OK	Alarm	Yes	86	No	1086	0
DCPS Timeout	OK	Alarm	Yes	87	No	1087	0
SAS Tx 1 Down	OK	Alarm	Yes	88	No	1088	0
SAS Tx 2 Down	OK	Alarm	Yes	89	No	1089	0
SAS Tx 3 Down	OK	Alarm	Yes	90	No	1090	0
SAS Down	OK	Alarm	Yes	91	No	1091	0
SAS 1 Fuse A	OK	Alarm	Yes	92	No	1092	0
SAS 1 Fuse B	OK	Alarm	Yes	93	No	1093	0
SAS 1 Fuse C	OK	Alarm	Yes	94	No	1094	0
SAS 1 Output	OK	Failed	Yes	95	No	1095	0
SAS 1 ROI	OK	In Control	Yes	96	No	1096	0
SAS 1 Aux 5	OK	Alarm	No	97	No	1097	0
SAS 1 Aux 6	OK	Alarm	No	98	No	1098	0
SAS 1 Aux 7	OK	Alarm	No	99	No	1099	0
SAS 2 Fuse A	OK	Alarm	Yes	100	No	1100	0
SAS 2 Fuse B	OK	Alarm	Yes	101	No	1101	0
SAS 2 Fuse C	OK	Alarm	Yes	102	No	1102	0
SAS 2 Output	OK	Failed	Yes	103	No	1103	0
SAS 2 ROI	OK	In Control	Yes	104	No	1104	0
SAS 2 Aux 5	OK	Alarm	No	105	No	1105	0
SAS 2 Aux 6	OK	Alarm	No	106	No	1106	0
SAS 2 Aux 7	OK	Alarm	No	107	No	1107	0
SAS 3 Fuse A	OK	Alarm	Yes	108	No	1108	0
SAS 3 Fuse B	OK	Alarm	Yes	109	No	1109	0
SAS 3 Fuse C	OK	Alarm	Yes	110	No	1110	0
SAS 3 Output	OK	Failed	Yes	111	No	1111	0
SAS 3 ROI	OK	In Control	Yes	112	No	1112	0
SAS 3 Aux 5	OK	Alarm	No	113	No	1113	0
SAS 3 Aux 6	OK	Alarm	No	114	No	1114	0
SAS 3 Aux 7	OK	Alarm	No	115	No	1115	0
SAS 1 S1	Available	Unavailable	Yes	116	No	1116	1

Table 6. Digital Screen Points (Continued)

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
SAS 2 S1	Available	Unavailable	Yes	117	No	1117	1
SAS 3 S1	Available	Unavailable	Yes	118	No	1118	1
SAS 1 S2	Available	Unavailable	Yes	119	No	1119	1
SAS 2 S2	Available	Unavailable	Yes	120	No	1120	1
SAS 3 S2	Available	Unavailable	Yes	121	No	1121	1
SAS ROI	OK	In Control	Yes	122	No	1122	0
I Line 1 Aux	OK	Alarm	If Installed	123	If Installed	1123	0
I Line 1 Bell	OK	Alarm	If Installed	124	If Installed	1124	0
I Line 2 Aux	OK	Alarm	If Installed	125	If Installed	1125	0
I Line 2 Bell	OK	Alarm	If Installed	126	If Installed	1126	0
I Line 3 Aux	OK	Alarm	If Installed	127	If Installed	1127	0
I Line 3 Bell	OK	Alarm	If Installed	128	If Installed	1128	0
I Line 4 Aux	OK	Alarm	If Installed	129	If Installed	1129	0
I Line 4 Bell	OK	Alarm	If Installed	130	If Installed	1130	0
I Line 5 Aux	OK	Alarm	If Installed	131	If Installed	1131	0
I Line 5 Bell	OK	Alarm	If Installed	132	If Installed	1132	0
I Line 6 Aux	OK	Alarm	If Installed	133	If Installed	1133	0
I Line 6 Bell	OK	Alarm	If Installed	134	If Installed	1134	0
I Line 7 Aux	OK	Alarm	If Installed	135	If Installed	1135	0
I Line 7 Bell	OK	Alarm	If Installed	136	If Installed	1136	0
I Line 8 Aux	OK	Alarm	If Installed	137	If Installed	1137	0
I Line 8 Bell	OK	Alarm	If Installed	138	If Installed	1138	0
Aux Fans On	OK	Alarm	If Has Fans	139	No	1139	0
Fan Logic	OK	Alarm	If Has Fans	140	No	1140	0
Door	Closed	Open	Yes	141	No	1141	0
Crosscurrent 1	OK	Alarm	Yes	142	No	1142	0
Crosscurrent 2	OK	Alarm	Yes	143	No	1143	0
Switch State	OK	Alarm	Yes	144	No	1144	0
Maintenance	No	Yes	Yes	145	Yes	1145	0
Contractor Timeout	OK	Alarm	If Installed	146	No	1146	0
Contractor DC1	OK	Alarm	If Installed	147	No	1147	0
Contractor DC2	OK	Alarm	If Installed	148	No	1148	0

Table 6. Digital Screen Points (Continued)

Name	Normal	Abnormal	Alarm	Alarm Index	Status	Status Index	Normal Value
Summary	OK	Alarm	Yes	149	No	1149	0
NSW Timeout	OK	Alarm	If Neutral Sw	150	No	1150	0
NSW Out 24V	OK	Alarm	If Neutral Sw	151	No	1151	0
NSW Out 5V	OK	Alarm	If Neutral Sw	152	No	1152	0
NSW S2 5V	OK	Alarm	If Neutral Sw	153	No	1153	0
NSW S1 5V	OK	Alarm	If Neutral Sw	154	No	1154	0
NSW S2 Fuse	OK	Alarm	If Neutral Sw	155	No	1155	0
NSW S1 Fuse	OK	Alarm	If Neutral Sw	156	No	1156	0
NSW Voting	OK	Alarm	If Neutral Sw	157	No	1157	0
NSW Logic	OK	Alarm	If Neutral Sw	158	No	1158	0
Branch	OK	Alarm	If Has Branches	159	No	1159	0
Switch Inhibit	OK	Alarm	If Installed	160	No	1160	0

17.2 Analog Screen Points

[Table 7](#) lists the Analog Points as they show on the screen.

The same point name is used when the point appears on the Analog Values Screen, the Event Log Screen, or the Alarms Screen.

The normal range measurement bracket for each point is given in the Low Alarm Index and High Alarm Index, which are not indexed contiguously with the point, but in adjacent tables following the list of points.

Point values may be scaled as shown in the Value Scale column. For example, for “Output %KVA A” (point 34) a 68% measurement is listed as 68, not 0.68.

Custom STSs can have different points and the standard points list may not apply.

Table 7. Analog Screen Points

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
S 1 Volts AB	Volts	1	None	161	532
S 1 Volts BC	Volts	2	None	162	533
S 1 Volts CA	Volts	3	None	163	534
S 2 Volts AB	Volts	4	None	164	535
S 2 Volts BC	Volts	5	None	165	536
S 2 Volts CA	Volts	6	None	166	537
Output Volts AB	Volts	7	None	167	538
Output Volts BC	Volts	8	None	168	539

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
Output Volts CA	Volts	9	None	169	540
Output Amps A	Amps	10	None	170	541
Output Amps B	Amps	11	None	171	542
Output Amps C	Amps	12	None	172	543
Output Amps N	Amps	13	None	173	544
Output KVA A	KVA	14	None	174	545
Output KVA B	KVA	15	None	175	546
Output KVA C	KVA	16	None	176	547
S 1 A Amps	Amps	17	None	177	548
S 1 B Amps	Amps	18	None	178	549
S 1 C Amps	Amps	19	None	179	550
S 2 A Amps	Amps	20	None	180	551
S 2 B Amps	Amps	21	None	181	552
S 2 C Amps	Amps	22	None	182	553
Output Volts AN	Volts	23	None	183	554
Output Volts BN	Volts	24	None	184	555
Output Volts CN	Volts	25	None	185	556
Ground Amps	Amps	26	None	186	557
KW Out A	KW	27	None	187	558
KW Out B	KW	28	None	188	559
KW Out C	KW	29	None	189	560
Out Frequency	Hz	30	*100 (6000=60.00)	190	561
S 1 Frequency	Hz	31	*100 (6000=60.00)	191	562
S 2 Frequency	Hz	32	*100 (6000=60.00)	192	563
Phase	Degrees	33	None	193	564
Output %KVA A	%	34	68=68%	194	565
Output %KVA B	%	35	68=68%	195	566
Output %KVA C	%	36	68=68%	196	567
Total KVA	KVA	37	None	197	568
Output PF A	%	38	*100 (92=0.92)	198	569

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
Output PF B	%	39	*100 (92=0.92)	199	570
Output PF C	%	40	*100 (92=0.92)	200	571
Total KW	KW	41	None	201	572
Xfers Total	Count	42	None	202	573
Xfers Since Car	Count	43	None	203	574
Out Volts THD A	%	44	68=68%	204	575
Out Volts A 3rd	%	45	68=68%	205	576
Out Volts A 5th	%	46	68=68%	206	577
Out Volts A 7th	%	47	68=68%	207	578
Out Volts A 9th	%	48	68=68%	208	579
Out Volts A 11th	%	49	68=68%	209	580
Out Volts A 13th	%	50	68=68%	210	581
Out Volts THD B	%	51	68=68%	211	582
Out Volts B 3rd	%	52	68=68%	212	583
Out Volts B 5th	%	53	68=68%	213	584
Out Volts B 7th	%	54	68=68%	214	585
Out Volts B 9th	%	55	68=68%	215	586
Out Volts B 11th	%	56	68=68%	216	587
Out Volts B 13th	%	57	68=68%	217	588
Out Volts THD C	%	58	68=68%	218	589
Out Volts C 3rd	%	59	68=68%	219	590
Out Volts C 5th	%	60	68=68%	220	591
Out Volts C 7th	%	61	68=68%	221	592
Out Volts C 9th	%	62	68=68%	222	593
Out Volts C 11th	%	63	68=68%	223	594
Out Volts C 13th	%	64	68=68%	224	595
Out Amps THD A	%	65	68=68%	225	596
Out Amps A 3rd	%	66	68=68%	226	597
Out Amps A 5th	%	67	68=68%	227	598
Out Amps A 7th	%	68	68=68%	228	599
Out Amps A 9th	%	69	68=68%	229	600

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
Out Amps A 11th	%	70	68=68%	230	601
Out Amps A 13th	%	71	68=68%	231	602
Out Amps THD B	%	72	68=68%	232	603
Out Amps B 3rd	%	73	68=68%	233	604
Out Amps B 5th	%	74	68=68%	234	605
Out Amps B 7th	%	75	68=68%	235	606
Out Amps B 9th	%	76	68=68%	236	607
Out Amps B 11th	%	77	68=68%	237	608
Out Amps B 13th	%	78	68=68%	238	609
Out Amps THD C	%	79	68=68%	239	610
Out Amps C 3rd	%	80	68=68%	240	611
Out Amps C 5th	%	81	68=68%	241	612
Out Amps C 7th	%	82	68=68%	242	613
Out Amps C 9th	%	83	68=68%	243	614
Out Amps C 11th	%	84	68=68%	244	615
Out Amps C 13th	%	85	68=68%	245	616
Peak Total KVA	KVA	86	None	246	617
S1 Peak A Amp	Amps	87	None	247	618
S1 Peak B Amp	Amps	88	None	248	619
S1 Peak C Amp	Amps	89	None	249	620
S2 Peak A Amp	Amps	90	None	250	621
S2 Peak B Amp	Amps	91	None	251	622
S2 Peak C Amp	Amps	92	None	252	623
Rated Total KVA	KVA	93	None	253	624
Rated Phase Amp	Amps	94	None	254	625
Alarm Count		95	None	255	626
PDU 1 Volts AB	Volts	96	None	256	627
PDU 1 Volts BC	Volts	97	None	257	628
PDU 1 Volts CA	Volts	98	None	258	629
PDU 1 Volts AN	Volts	99	None	259	630

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
PDU 1 Volts BN	Volts	100	None	260	631
PDU 1 Volts CN	Volts	101	None	261	632
PDU 1 Amps A	Amps	102	None	262	633
PDU 1 Amps B	Amps	103	None	263	634
PDU 1 Amps C	Amps	104	None	264	635
PDU 1 KVA A	KVA	105	None	265	636
PDU 1 KVA B	KVA	106	None	266	637
PDU 1 KVA C	KVA	107	None	267	638
PDU 1 Total KVA	KVA	108	None	268	639
PDU 1 Peak Total KVA	KVA	109	None	269	640
PDU 1 %KVA A	%	110	68=68%	270	641
PDU 1 %KVA B	%	111	68=68%	271	642
PDU 1 %KVA C	%	112	68=68%	272	643
PDU 1 Total %KVA	%	113	68=68%	273	644
PDU 1 KW A	KW	114	None	274	645
PDU 1 KW B	KW	115	None	275	646
PDU 1 KW C	KW	116	None	276	647
PDU 1 Total KW	KW	117	None	277	648
PDU 1 PF A	%	118	*100 (92=0.92)	278	649
PDU 1 PF B	%	119	*100 (92=0.92)	279	650
PDU 1 PF C	%	120	*100 (92=0.92)	280	651
PDU 2 Volts AB	Volts	121	None	281	652
PDU 2 Volts BC	Volts	122	None	282	653
PDU 2 Volts CA	Volts	123	None	283	654
PDU 2 Volts AN	Volts	124	None	284	655
PDU 2 Volts BN	Volts	125	None	285	656
PDU 2 Volts CN	Volts	126	None	286	657
PDU 2 Amps A	Amps	127	None	287	658
PDU 2 Amps B	Amps	128	None	288	659
PDU 2 Amps C	Amps	129	None	289	660
PDU 2 KVA A	KVA	130	None	290	661
PDU 2 KVA B	KVA	131	None	291	662

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
PDU 2 KVA C	KVA	132	None	292	663
PDU 2 Total KVA	KVA	133	None	293	664
PDU 2 Peak Total KVA	KVA	134	None	294	665
PDU 2 %KVA A	%	135	68=68%	295	666
PDU 2 %KVA B	%	136	68=68%	296	667
PDU 2 %KVA C	%	137	68=68%	297	668
PDU 2 Total %KVA	%	138	68=68%	298	669
PDU 2 KW A	KW	139	None	299	670
PDU 2 KW B	KW	140	None	300	671
PDU 2 KW C	KW	141	None	301	672
PDU 2 Total KW	KW	142	None	302	673
PDU 2 PF A	%	143	*100 (92=0.92)	303	674
PDU 2 PF B	%	144	*100 (92=0.92)	304	675
PDU 2 PF C	%	145	*100 (92=0.92)	305	676
I Line 1 Amps A	Amps	146	None	306	677
I Line 1 Amps B	Amps	147	None	307	678
I Line 1 Amps C	Amps	148	None	308	679
I Line 1 KVA A	KVA	149	None	309	680
I Line 1 KVA B	KVA	150	None	310	681
I Line 1 KVA C	KVA	151	None	311	682
I Line 1 KW A	KW	152	None	312	683
I Line 1 KW B	KW	153	None	313	684
I Line 1 KW C	KW	154	None	314	685
I Line 1 PF A		155	*100 (92=0.92)	315	686
I Line 1 PF B		156	*100 (92=0.92)	316	687
I Line 1 PF C		157	*100 (92=0.92)	317	688
I Line 1 Total KVA	KVA	158	None	318	689
I Line 1 Total KW	KW	159	None	319	690
I Line 2 Amps A	Amps	160	None	320	691
I Line 2 Amps B	Amps	161	None	321	692
I Line 2 Amps C	Amps	162	None	322	693

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
I Line 2 KVA A	KVA	163	None	323	694
I Line 2 KVA B	KVA	164	None	324	695
I Line 2 KVA C	KVA	165	None	325	696
I Line 2 KW A	KW	166	None	326	697
I Line 2 KW B	KW	167	None	327	698
I Line 2 KW C	KW	168	None	328	699
I Line 2 PF A		169	*100 (92=0.92)	329	700
I Line 2 PF B		170	*100 (92=0.92)	330	701
I Line 2 PF C		171	*100 (92=0.92)	331	702
I Line 2 Total KVA	KVA	172	None	332	703
I Line 2 Total KW	KW	173	None	333	704
I Line 3 Amps A	Amps	174	None	334	705
I Line 3 Amps B	Amps	175	None	335	706
I Line 3 Amps C	Amps	176	None	336	707
I Line 3 KVA A	KVA	177	None	337	708
I Line 3 KVA B	KVA	178	None	338	709
I Line 3 KVA C	KVA	179	None	339	710
I Line 3 KW A	KW	180	None	340	711
I Line 3 KW B	KW	181	None	341	712
I Line 3 KW C	KW	182	None	342	713
I Line 3 PF A		183	*100 (92=0.92)	343	714
I Line 3 PF B		184	*100 (92=0.92)	344	715
I Line 3 PF C		185	*100 (92=0.92)	345	716
I Line 3 Total KVA	KVA	186	None	346	717
I Line 3 Total KW	KW	187	None	347	718
I Line 4 Amps A	Amps	188	None	348	719
I Line 4 Amps B	Amps	189	None	349	720
I Line 4 Amps C	Amps	190	None	350	721
I Line 4 KVA A	KVA	191	None	351	722
I Line 4 KVA B	KVA	192	None	352	723
I Line 4 KVA C	KVA	193	None	353	724

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
I Line 4 KW A	KW	194	None	354	725
I Line 4 KW B	KW	195	None	355	726
I Line 4 KW C	KW	196	None	356	727
I Line 4 PF A		197	*100 (92=0.92)	357	728
I Line 4 PF B		198	*100 (92=0.92)	358	729
I Line 4 PF C		199	*100 (92=0.92)	359	730
I Line 4 Total KVA	KVA	200	None	360	731
I Line 4 Total KW	KW	201	None	361	732
I Line 5 Amps A	Amps	202	None	362	733
I Line 5 Amps B	Amps	203	None	363	734
I Line 5 Amps C	Amps	204	None	364	735
I Line 5 KVA A	KVA	205	None	365	736
I Line 5 KVA B	KVA	206	None	366	737
I Line 5 KVA C	KVA	207	None	367	738
I Line 5 KW A	KW	208	None	368	739
I Line 5 KW B	KW	209	None	369	740
I Line 5 KW C	KW	210	None	370	741
I Line 5 PF A		211	*100 (92=0.92)	371	742
I Line 5 PF B		212	*100 (92=0.92)	372	743
I Line 5 PF C		213	*100 (92=0.92)	373	744
I Line 5 Total KVA	KVA	214	None	374	745
I Line 5 Total KW	KW	215	None	375	746
I Line 6 Amps A	Amps	216	None	376	747
I Line 6 Amps B	Amps	217	None	377	748
I Line 6 Amps C	Amps	218	None	378	749
I Line 6 KVA A	KVA	219	None	379	750
I Line 6 KVA B	KVA	220	None	380	751
I Line 6 KVA C	KVA	221	None	381	752
I Line 6 KW A	KW	222	None	382	753
I Line 6 KW B	KW	223	None	383	754
I Line 6 KW C	KW	224	None	384	755

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
I Line 6 PF A		225	*100 (92=0.92)	385	756
I Line 6 PF B		226	*100 (92=0.92)	386	757
I Line 6 PF C		227	*100 (92=0.92)	387	758
I Line 6 Total KVA	KVA	228	None	388	759
I Line 6 Total KW	KW	229	None	389	760
I Line 7 Amps A	Amps	230	None	390	761
I Line 7 Amps B	Amps	231	None	391	762
I Line 7 Amps C	Amps	232	None	392	763
I Line 7 KVA A	KVA	233	None	393	764
I Line 7 KVA B	KVA	234	None	394	765
I Line 7 KVA C	KVA	235	None	395	766
I Line 7 KW A	KW	236	None	396	767
I Line 7 KW B	KW	237	None	397	768
I Line 7 KW C	KW	238	None	398	769
I Line 7 PF A		239	*100 (92=0.92)	399	770
I Line 7 PF B		240	*100 (92=0.92)	400	771
I Line 7 PF C		241	*100 (92=0.92)	401	772
I Line 7 Total KVA	KVA	242	None	402	773
I Line 7 Total KW	KW	243	None	403	774
I Line 8 Amps A	Amps	244	None	404	775
I Line 8 Amps B	Amps	245	None	405	776
I Line 8 Amps C	Amps	246	None	406	777
I Line 8 KVA A	KVA	247	None	407	778
I Line 8 KVA B	KVA	248	None	408	779
I Line 8 KVA C	KVA	249	None	409	780
I Line 8 KW A	KW	250	None	410	781
I Line 8 KW B	KW	251	None	411	782
I Line 8 KW C	KW	252	None	412	783
I Line 8 PF A		253	*100 (92=0.92)	413	784
I Line 8 PF B		254	*100 (92=0.92)	414	785
I Line 8 PF C		255	*100 (92=0.92)	415	786

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
I Line 8 Total KVA	KVA	256	None	416	787
I Line 8 Total KW	KW	257	None	417	788
I Line 9 Amps A	Amps	258	None	418	789
I Line 9 Amps B	Amps	259	None	419	790
I Line 9 Amps C	Amps	260	None	420	791
I Line 9 KVA A	KVA	261	None	421	792
I Line 9 KVA B	KVA	262	None	422	793
I Line 9 KVA C	KVA	263	None	423	794
I Line 9 KW A	KW	264	None	424	795
I Line 9 KW B	KW	265	None	425	796
I Line 9 KW C	KW	266	None	426	797
I Line 9 PF A		267	*100 (92=0.92)	427	798
I Line 9 PF B		268	*100 (92=0.92)	428	799
I Line 9 PF C		269	*100 (92=0.92)	429	800
I Line 9 Total KVA	KVA	270	None	430	801
I Line 9 Total KW	KW	271	None	431	802
I Line 10 Amps A	Amps	272	None	432	803
I Line 10 Amps B	Amps	273	None	433	804
I Line 10 Amps C	Amps	274	None	434	805
I Line 10 KVA A	KVA	275	None	435	806
I Line 10 KVA B	KVA	276	None	436	807
I Line 10 KVA C	KVA	277	None	437	808
I Line 10 KW A	KW	278	None	438	809
I Line 10 KW B	KW	279	None	439	810
I Line 10 KW C	KW	280	None	440	811
I Line 10 PF A		281	*100 (92=0.92)	441	812
I Line 10 PF B		282	*100 (92=0.92)	442	813
I Line 10 PF C		283	*100 (92=0.92)	443	814
I Line 10 Total KVA	KVA	284	None	444	815
I Line 10 Total KW	KW	285	None	445	816
I Line 11 Amps A	Amps	286	None	446	817

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
I Line 11 Amps B	Amps	287	None	447	818
I Line 11 Amps C	Amps	288	None	448	819
I Line 11 KVA A	KVA	289	None	449	820
I Line 11 KVA B	KVA	290	None	450	821
I Line 11 KVA C	KVA	291	None	451	822
I Line 11 KW A	KW	292	None	452	823
I Line 11 KW B	KW	293	None	453	824
I Line 11 KW C	KW	294	None	454	825
I Line 11 PF A		295	*100 (92=0.92)	455	826
I Line 11 PF B		296	*100 (92=0.92)	456	827
I Line 11 PF C		297	*100 (92=0.92)	457	828
I Line 11 Total KVA	KVA	298	None	458	829
I Line 11 Total KW	KW	299	None	459	830
I Line 12 Amps A	Amps	300	None	460	831
I Line 12 Amps B	Amps	301	None	461	832
I Line 12 Amps C	Amps	302	None	462	833
I Line 12 KVA A	KVA	303	None	463	834
I Line 12 KVA B	KVA	304	None	464	835
I Line 12 KVA C	KVA	305	None	465	836
I Line 12 KW A	KW	306	None	466	837
I Line 12 KW B	KW	307	None	467	838
I Line 12 KW C	KW	308	None	468	839
I Line 12 PF A		309	*100 (92=0.92)	469	840
I Line 12 PF B		310	*100 (92=0.92)	470	841
I Line 12 PF C		311	*100 (92=0.92)	471	842
I Line 12 Total KVA	KVA	312	None	472	843
I Line 12 Total KW	KW	313	None	473	844
Fan 1 Amps	Amps	314	None	474	845
Fan 2 Amps	Amps	315	None	475	846
Spare 1 Amps	Amps	316	None	476	847
Monitor Power S1	Volts	317	None	477	848

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
Monitor Power S2	Volts	318	None	478	849
Monitor Power Out 1	Volts	319	None	479	850
Monitor Power Out 2	Volts	320	None	480	851
Monitor Power Backup	Volts	321	None	481	852
PDU 1 For Temp	Degrees C	322	None	482	853
PDU 2 FM Temp	Degrees C	323	None	483	854
Dist 1 Amps A	Amps	324	None	484	855
Dist 1 Amps B	Amps	325	None	485	856
Dist 1 Amps C	Amps	326	None	486	857
Dist 2 Amps A	Amps	327	None	487	858
Dist 2 Amps B	Amps	328	None	488	859
Dist 2 Amps C	Amps	329	None	489	860
Dist 3 Amps A	Amps	330	None	490	861
Dist 3 Amps B	Amps	331	None	491	862
Dist 3 Amps C	Amps	332	None	492	863
Dist 4 Amps A	Amps	333	None	493	864
Dist 4 Amps B	Amps	334	None	494	865
Dist 4 Amps C	Amps	335	None	495	866
Dist 5 Amps A	Amps	336	None	496	867
Dist 5 Amps B	Amps	337	None	497	868
Dist 5 Amps C	Amps	338	None	498	869
Dist 6 Amps A	Amps	339	None	499	870
Dist 6 Amps B	Amps	340	None	500	871
Dist 6 Amps C	Amps	341	None	501	872
Dist 7 Amps A	Amps	342	None	502	873
Dist 7 Amps B	Amps	343	None	503	874
Dist 7 Amps C	Amps	344	None	504	875
Dist 8 Amps A	Amps	345	None	505	876
Dist 8 Amps B	Amps	346	None	506	877
Dist 8 Amps C	Amps	347	None	507	878

Table 7. Analog Screen Points (Continued)

Name	Units	Value Index	Value Scale	Low Alarm Index	High Alarm Index
Dist 9 Amps A	Amps	348	None	508	879
Dist 9 Amps B	Amps	349	None	509	880
Dist 9 Amps C	Amps	350	None	510	881
Dist 10 Amps A	Amps	351	None	511	882
Dist 10 Amps B	Amps	352	None	512	883
Dist 10 Amps C	Amps	353	None	513	884
Dist 11 Amps A	Amps	354	None	514	885
Dist 11 Amps B	Amps	355	None	515	886
Dist 11 Amps C	Amps	356	None	516	887
Dist 12 Amps A	Amps	357	None	517	888
Dist 12 Amps B	Amps	358	None	518	889
Dist 12 Amps C	Amps	359	None	519	890
Dist 13 Amps A	Amps	360	None	520	891
Dist 13 Amps B	Amps	361	None	521	892
Dist 13 Amps C	Amps	362	None	522	893
Dist 14 Amps A	Amps	363	None	523	894
Dist 14 Amps B	Amps	364	None	524	895
Dist 14 Amps C	Amps	365	None	525	896
Dist 15 Amps A	Amps	366	None	526	897
Dist 15 Amps B	Amps	367	None	527	898
Dist 15 Amps C	Amps	368	None	528	899
Dist 16 Amps A	Amps	369	None	529	900
Dist 16 Amps B	Amps	370	None	530	901
Dist 16 Amps C	Amps	371	None	531	902

17.3 Analog Alarms Default Settings

Analog alarms are set by default to a percentage of standard unit ratings:

Source 1 Input Alarms

- Voltage phase-phase (A-B, B-C, C-A):
 - High limit = 110% of rated voltage

- Low limit = 90% of rated voltage

Source 2 Input Alarms

- Voltage phase-phase (A-B, B-C, C-A):
 - High limit = 110% of rated voltage
 - Low limit = 90% of rated voltage

STS Output Alarms

- Voltage phase-phase (A-B, B-C, C-A):
 - High limit = 110% of rated voltage
 - Low limit = 90% of rated voltage
- Current by phase (A, B, C):
 - High limit = 80% rated amperage
- kVA by phase (A, B, C)
 - High limit = 80% of rated phase kVA
- kVA Total
 - High limit = 80% of rated total kVA

Chapter 18 Maintenance and Service

18.1 Recommended Maintenance

18.1.1 Replace Filter

Replace the filter monthly with a 20" x 20" x 1" filter rated MERV 3 – 5.

18.1.2 Infrared Scanning

The TFA STS input and output connections at the bus plates are accessible for infrared scanning by opening the front doors. These connections should be scanned at least every (6) months. Maintain records of scanning results to see trends.



Because infrared scanning involves exposure to live voltages, wear suitable protective clothing and eye protection.

18.2 Eaton Large Systems Service and Support Department

With more than 40 years of experience servicing industry-leading power quality equipment, Eaton can help you maintain the reliable performance of your power quality equipment, giving you a higher return on your investment. Our commitment to our products commences with our startup service, continues with our factory Warranty and is continuously maintained through our Preventive Maintenance and Service Contracts.

18.3 Start Up

An Eaton Customer Support Engineer (CSE) will get your power quality equipment up and running as you demand. By following our standard startup procedures, you can be assured that your power quality equipment will perform to meet your requirements. Some of the features and benefits are as follows:

- Startup services provide a factory trained CSE to oversee visual inspection of the installation and system calibration.
- Startup service also provides factory trained CSEs to assist with operational training.

18.4 Eaton Service Contracts

Eaton Service contracts help to provide the added insurance that the reliability of your critical power systems is intact. By following our stringent maintenance procedures, Eaton's factory trained Customer Support Engineers provide the added assurance for the availability of critical systems, thereby maximizing the company's profitability. See below for further details.

18.4.1 The Service Promise

With factory-trained technicians in every major city in North America, Eaton can respond rapidly and provide on-site assistance in emergency down time situations. Eaton provides telephone support 24 hours a day, 7 days a week with a direct line to Service (1-800-843-9433).

18.4.2 Preventive Maintenance

During a preventive maintenance visit, Eaton technicians inspect, test, calibrate, update and clean components, as well as update software as applicable. You'll receive a report at the end of the visit detailing the results of the inspection and specific recommendations for remedial actions, proactive replacements, and upgrades.

18.4.3 Eaton Provides Flexibility and Commitment

- We understand that service plans are not “one size fits all.” That’s why we offer a broad range of service options, designed to meet the varied requirements and applications of businesses of all shapes and sizes. Eaton can modify your contract on variables such as number of PM visits per year, scope of coverage, response time and length of contract.
- Eaton employs 250+ field technicians with an average tenure of more than ten years. Eaton CSEs are experts on Eaton products and receive ongoing product training and certification. Our technicians have expertise in power, electrical engineering, software and connectivity, batteries, UPSs and related products, and can deliver advanced troubleshooting and a reduced mean time to repair.

When you rely on an Eaton service plan, rest assured that every factory-trained field technician stocks a solid inventory of parts to remedy emergencies.

18.4.4 Time and Materials

In most cases the customer will be covered by startup service or Maintenance Contracts, however, there may be times when the customer needs Eaton service and lacks the benefits that these two packages provide. Therefore, Eaton provides Time and Material coverage for those in need of our customer support engineers.

Chapter 19 Resources

19.1 Glossary

BCMS	Branch Circuit Monitoring System.
BMS	Building Management System.
dBa	Decibel A-weighting.
IRIG time codes	Inter-Range Instrumentation Group time codes.
KAIC	Kilo Ampere Interrupting Capacity, or Thousand Ampere Interrupting Capacity, a rating of the maximum short-circuit or overload current that a circuit breaker can safely interrupt.
LL RMS	Line-to-line, root mean squared.
MCCB	Molded case circuit breaker.
MCSW	Molded case switch.
Modbus RTU	Modbus Remote Terminal Unit, the basic Modbus protocol.
Modbus TCP/IP	Modbus RTU messages wrapped in TCP/IP protocol, providing faster communications than Modbus RTU.
NC	Normally closed; refers to the normal state of a dry contact when not signaling an event. The dry contact opens to signal an event.
NO	Normally open; refers to normal state of a dry contact when not signaling an event. The dry contact closes to signal an event.
PIN	Personal Identification Number, used to identify users and track their activities. Each user PIN is associated with a user name, access authorization, and a password.
POG	Power or Gate.
Power or Gate	Power or Gate (POG) is the faster of the two STS transfer algorithms, but does not reduce transformer inrush as does the VSS algorithm. See also <i>Volt Second Synchronizing</i> .
ROI	Redundant Operator Interface.
SAS	Simple Algorithm Switch.
SAS Board	A logic board that backs up the Monitor logic. The SAS board monitors transfers and takes over a transfer operation if it senses that the Monitor is not functional. The SAS board has a simpler transfer algorithm than the Monitor's VSS or POG algorithms.
SCR	silicon-controlled rectifier.
Silicon-controlled rectifier	Semiconductor power-switching element used in the WaveStar TFA Static Transfer Switch.
SMTP	Simple Mail Transfer Protocol.
SNMP	Simple Network Management Protocol.
SNTP	Simple Network Time Protocol.
STS	Static Transfer Switch.

Static transfer switch	A transfer switch using semiconductor power switching elements, such as silicon controlled rectifiers.
TCP/IP	Transmission Control Protocol/Internet Protocol, the standard Internet protocol.
TFA STS	WaveStar TFA Static Transfer Switch (with "True Front Access") .
THD	Total harmonic distortion.
UTC	Coordinated Universal Time.
VSS	Volt Second Synchronizing.
Volt Second Synchronizing	The Volt Second Synchronizing (VSS) algorithm reduces transformer inrush, limiting it to 150% of the transformer rating, but in practice usually much less, typically less than 100% of the full load transformer rating. The VSS algorithm is patented by Eaton.
WaveStar	WaveStar devices can interact with downstream Branch Circuit Monitoring Systems.

19.2 Getting Help

If help is needed with any of the following:

- Scheduling initial startup
- Regional locations and telephone numbers
- A question about any of the information in this manual
- A question this manual does not answer

Please call the Help Desk at:

United States:	1-800-843-9433
Canada:	1-800-461-9166 ext 260
All other countries:	Call your local service representative

Please use the following e-mail address for manual comments, suggestions, or to report an error in this manual:

E-ESSDocumentation@eaton.com

19.3 Warranty and End User License Agreement

To view the warranty please click on the link or copy the address to download from the Eaton website:

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