94-1100-00002850 F0

INSTALLATION MANUAL

Cyberex® SuperSwitch®4
200A–2000A Digital Static Transfer Switch

The Cyberex® SuperSwitch®4 is designed with a “true” fault-tolerant architecture, ensuring there is no single point of failure using patented transfer algorithms and robust electrical components.

For a comprehensive overview of publications available for the SuperSwitch®4 product line, refer to the inside cover of this publication. Web link and QR code references are also included.

The Cyberex® SuperSwitch®4 Digital Static Transfer Switch is part of the SuperSwitch® family of power distribution and switching products.

The Company

We are an established world force in the design and manufacture of power electronics and power protection equipment.

As a part of ABB, a world leader in electrical technology, we offer customers application expertise, service and support worldwide. We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance ABB's products result from over 100 years of experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

Quality control

To ensure that we meet our responsibilities and obligations to our customers, our people, our partners, our suppliers and to our shareholders, we are committed to deliver on-time and on-quality products, systems and services that meet or exceed our customers' expectations.

For more information

Further publications for the Cyberex® SuperSwitch®4 Digital Static Transfer Switch and accessories are available for free download from http://new.abb.com/ups/static-switches or by scanning the QR code below.

Contacting ABB for support

To contact ABB for information or repair service in the United States, call 1 800 292 3739. ABB offers a complete range of start-up services, repair services, preventive maintenance plans and service contracts.

For repair or maintenance service outside the 48 contiguous United States, contact ABB, if available in your area.

Please provide the following information for customer service when you contact the ABB service center:

Equipment
Part number
Serial number
Voltage rating
Current rating
Purchase date
Installation date
Location

To get important information on all equipment warranties, please contact the ABB service center or request service follow-up or by scanning the QR code below.

Safety notices

Cyberex® SuperSwitch®4 Digital Static Transfer Switch, henceforth referred to as SS4, is a high-energy device.

The following safety instructions must be observed when working with the device. Refer to the unit's nameplate for the specific model designation, operating voltage, and input power configuration. External input over-current protection is to be supplied by the user in accordance with nameplate ratings.

These symbols may appear on your SS4 or on labels inside the SS4. Most international safety agents accept them. Everyone in your organization who works with your system should understand the meaning of these symbols:

Safety notice	
	CAUTION – Refer to manual Stop and refer to the operator manual for more information.
	WARNING – Risk of electric shock There is a risk of electric shock present, and you should observe associated warnings. The SS4 contains high voltages.

Safety precautions

The SS4 is designed to receive power from more than one power source. The SS4 contains hazardous voltages, and hazardous voltages are present regardless of the mode of operation. Before making any connection(s) to the SS4, ensure that any/all power sources are de-energized and locked out.

As lethal voltages are present within the SS4 during all modes of operation, maintenance shall only be performed by authorized service personnel.

ABB neither recommends nor knowingly sells this product for use with life support applications or other FDA designated critical applications.

All wiring should be performed by qualified electricians and in the accordance with local and national electrical safety codes. Before placing the unit into service, a thorough inspection and supervised start-up should be performed by a qualified service technician.

Safety considerations

The SS4 Static Transfer Switch is designed for commercial applications. Furthermore, these systems are a sophisticated power system and should be handled with appropriate care, following these guidelines:

- Keep surroundings clean and free from excess moisture.
- Do not operate the SS4 system close to gas or electric heat sources.
- The system is not intended for outdoor use.
- The operating environment should be maintained within the parameters stated in the manual.
- Keep the cabinet doors closed and locked to ensure proper cooling airflow and to protect personnel from dangerous voltages inside the unit.
- Follow all relevant local/national codes, regulations, etc. for the safe use of this equipment.

Safety consideration	
	CAUTION Only authorized service personnel should perform maintenance on or service the SS4 system.

If service or routine maintenance is required:

- Ensure all power is disconnected and LOTO operation have been performed before performing maintenance.
- Ensure the area around the SS4 is clean and uncluttered.
- Observe all DANGER, CAUTION and WARNING notices affixed to the inside and outside of the equipment.

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1 General

1.1 Using this manual

This manual is provided to aid the user in the installation, operation, and maintenance of the SS4, manufactured by ABB. Read and understand the procedures described to ensure trouble-free installation and operation.

Read through each procedure before beginning the procedure. Perform only those procedures that apply to the SS4 cabinet being installed or operated. Section 10 details operations specific to three (3) pole 50Hz applications. Section 11 details operations specific to four (4) pole 60Hz applications.

1.1.1 List of symbols

Symbols	
	DANGER – Risk of electric shock This symbol in conjunction with the signal word "DANGER" indicates an imminent electrical hazard. Observe the warning associated with the risk of electric shock symbol.
	WARNING – Bodily injury This symbol in conjunction with the signal word "WARNING" indicates a potentially dangerous situation. Failure to observe the related safety note may cause personnel injury or death or equipment damages.
	CAUTION – Refer to manual This symbol in conjunction with the signal word "CAUTION" indicates that before proceeding, the user should refer to the appropriate section of this manual.
	IMPORTANT – NOTE This symbol indicates operator tips, particularly useful or important information for the use of the product. This symbol and wording does not indicate a dangerous situation.
	The universal symbol for Recycle.
	This symbol indicates that you should not discard waste electrical or electronic equipment (WEEE) in the trash. For proper disposal, contact your local recycling/reuse or hazardous waste center.

1.2 Electrical safety precautions

SS4 is designed for operation from a three (3) phase power source. Three (3) pole systems can operate from either a three (3) or four(4) wire sources, while four (4) pole systems operate only from a four (4) wire source. Refer to the unit's nameplate for the specific model designation, operating voltage, and input power configuration. Input over-current protection is to be supplied by the user in accordance with nameplate ratings.

Warning

WARNING

The SS4 is designed to receive power from more than one (1) power source. When any of the power sources is energized, this unit contains hazardous voltages. Hazardous voltages exist within the SS4 switch regardless of the mode of operation (e.g. active, idle, or bypass). Before making any connections to the unit or performing any maintenance, ensure that all power sources are turned off and locked out.

As lethal voltages exist within all operating modes of the SS4, maintenance can only be performed by qualified and authorized trained service personnel.

ABB neither recommends nor knowingly sells this product for use with life support applications or other FDA designated critical applications.

All wiring should be performed by qualified electricians and in accordance with local and national electrical safety codes. Before placing the unit into service, a thorough inspection and supervised start-up should be performed by a qualified technician.

The SS4 is not suitable for control of motor loads.

Warning

WARNING

To provide sufficient isolation protection when working upstream of the SS4, open the respective source feeder breakers (S1, S2) contained within the SS4. Prescribing to this maintenance method reduces the risk of electric shock due to backfeed.

1.3 Equipment description overview

The SS4 is a solid state, three (3) phase dual-position switch, which connects a set of three (3) phase load terminals to one (1) of two (2) sets of input terminals. Source 1 is usually designated as the preferred source and, as such, is the set of input terminals normally connected to the load. The other set of input terminals is designated as Source 2. Pairs of silicon-controlled rectifiers (SCRs) connected in an AC switch configuration and rated to carry the full load, perform the switching function between sources - six (6) pairs are used in three (3) pole models, and eight (8) pairs in four (4) pole models.

A manually operated maintenance bypass switching and isolating arrangement consisting of molded case switches is provided to permit load transfers to either Source 1 or Source 2 and to isolate the SCRs and logic elements for servicing without disrupting power to the critical load.

1.3.1 Application Overview

The SS4 is available in either three (3) pole or (4) pole models. The three (3) pole model performs non-overlapping simultaneous transfer to provide the best power available from its sources to the critical load bus. The four (4) pole model provides break before make, neutral overlapped transfer between sources to provide the best power available to the critical load bus. To maximize reliability, SS4 employs fault tolerant electronics with redundant control functions.

2 Cybersecurity

2.1 Disclaimer

This product is designed to be connected to and communicate information and data via a network interface. It is the Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). The customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc.) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB Ltd and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

We recommend connecting the system in private network, if not the case additional hardware that provide increased security controls/measures such as firewalls should be implemented

2.2 Ports used by this product

Table 2-1 TCP/UDP service ports used by this product

Port	Service	Purpose
22/tcp	SSH	Valid for SSH
502/tcp	Modbus/TCP	Valid for Modbus TCP
25/tcp	Email	Valid of Email
110/tcp	Email	Valid of Email
143/tcp	Email	Valid of Email
465/tcp	Email	Valid of Email
587/tcp	Email	Valid of Email
993/tcp	Email	Valid of Email
995/tcp	Email	Valid of Email
69/udp	TFTP	Valid for Software Upgrade

3 Installation

3.1 Environment overview

The SS4 is designed for indoor applications only and must be protected from excessive moisture or corrosive environments. The SS4 is not intended for use in the presence of explosive gases.

This unit complies with the limits for a Class A digital device in accordance with Part 15, Subpart J of the FCC rules; therefore, it is suitable for use in a commercial environment. If not used in accordance with its design intent, and in accordance with the instructions contained within this manual, SS4 may cause interference with radio frequency communications.

3.1.1 Operating environment

The SS4 is designed for indoor use in a clean (dust-free), temperature and humidity-controlled environment. Refer to Section 8.3 for detailed environmental requirements.

3.1.2 Access

The SS4 requires either front and side or front and rear access for installation and maintenance. The optional 'front access' configuration does not require side or rear access for installation and maintenance. Adequate space is required above the unit for conduit. Top entry/exit and ventilation is required. See content below for clearances.

Either top or bottom cable entry/exit within the same unit is provided as a standard feature. Bottom cable entry/exit requires sufficient cable bending space below the unit and must be provided by means of a raised floor or floor stands.

Service clearance – A minimum service clearance of 42 inches (91.4cm) is required at the front and either the side or rear of the unit, depending on installation (except for the 'front access' configuration which does not require side or rear service clearance). Clearance of 42 inches (107 cm) is required at the top for service and ventilation for units ≤1200A. For units >1200A, the required top clearance is 60" (152cm).

Refer to Outline Drawings for specific model dimensional and clearance information.

3.2 Handling

Caution

- Risk of unit damage.
- Exercise extreme care to avoid equipment damage or injury to personnel.
- Do not exceed a ten (10) degree tilt by forklift or incline ramp.
- Note the unit's weight before handling the cabinet.

Warning

WARNING – Risk of unit damage

- Electrical/electronic components can be damaged by debris during installation. Be sure to protect components from debris during transit and installation. Remove any loose hardware that falls inside the unit during transit or installation.

- The units are bolted to shipping pallets to allow handling by forklift or pallet jack. Units with structural feet may be shipped without a pallet and will be handled with lift equipment placed between the feet. Refer to outline drawing enclosed with unit for dimensional and center of gravity information.
- Set the packaged units in a level area with sufficient room for removal from the shipping pallet. Remove external shipping material; locate and remove the bolts at the base of the unit (used to secure unit to the pallet). Using a forklift, raise the units off the pallet and onto the floor.
- Internally inspect the unit per inspection items listed in section 3.3.1.

Note

- The SS4 is not designed to rest on its ends or sides, regardless of the packaging.

3.3 Pre-installation, inspection and unpacking

Inspect the SS4 shipping container for any signs of damage or mishandling before removing any packing material or attempting to unload the unit from the truck.

- Ensure that the items on the bill of lading correspond to the material indicated in the delivery note.
- Some units are shipped with bottom kick panels and hardware either attached to the outside of the cabinets or inside the cabinets.
- Inspect the outside of the packing material for obvious damage or rough handling.
- DO NOT remove the packaging material until the SS4 is off its pallet and ready for installation.
- DO NOT remove the SS4 enclosure from the pallet until all movement is completed.
- A thorough internal inspection should be conducted only after the enclosure has been positioned for installation, and prior to making electrical connections.
- Before moving the load (the unit and transport device, i.e. pallet jack or forklift), make sure that the pathway is wide enough for the load and can support the load all the way to the installation site.

If damage is observed, file a damage claim with the shipper immediately and contact your ABB representative to inform them of the equipment condition and claim.

- If there is no visible sign of damage or indication of excessive shock, verify the equipment received to the bill of lading. Report any missing or incorrect items to your ABB representative immediately.
- If the unit will be in storage before installation, use the original packing materials or other suitable means to keep the unit clean and to prevent damage. Note: Storage environment to be dry and within the temperature range of -20°C to 70°C (-4°F to 158°F).

3.3.1 Checking the Supplied Parts

- Verify all items have been received, including spare parts if purchased.
- Verify model numbers match the numbers shown on your order. Model and serial numbers are located on the inside of the front door. Record these numbers in the front of this installation manual.
- Open the doors and interior access panels to check for shipping damage.
- Check for unsecured components or any loose connections in the cabinet.
- Check for any unsafe condition that may be a potential safety hazard.
- Remove the spare Kirk Key from the unit, and store in a secure location.
- Once the inspection has been completed and no problems found, the unit may then be moved to the installation location.

3.4 Stabilizing and Anchoring

SS4 incorporates integral casters and stabilizing feet for 1200A units or smaller. Locate the unit in its final position on a level surface or stand. Lower the stabilizing feet, located at each corner of the unit, to maintain position. The SS4 can be anchored to a concrete floor or floor stands via an optional floor anchor kit. Consult factory if anchor kit may be required. Units larger than 1200A utilize structural feet and do not have casters.

Refer to outline drawings enclosed with the unit for specific dimensions and configurations.

3.5 Power & control connections

All labels shown herein will be placed throughout the enclosure to identify potentially dangerous areas that require extra safety precautions during equipment installation.

Caution

CAUTION – Risk of unit damage

- Verify input and control circuits are de-energized before making any connections inside the unit.

Warning

WARNING – Risk of electric shock

- Verify input and control circuits are de-energized before making any connections inside the SS4.
- Exercise extreme care to avoid equipment damage or injury to personnel.

Power and control wiring must comply with the NEC and applicable local codes. A qualified electrician must install all wiring. SS4 three (3) pole models are designed for operation with three (3) or four (4) wire solidly grounded sources only. SS4 four (4) pole models are designed for operation with four (4) wire solidly grounded sources only.

Caution

CAUTION

SS4 is equipped with non-automatic switches unless otherwise specified. As such, they provide no long-term over-current protection. Overload and fault protection must be user supplied in the form of upstream breakers or fused disconnect switches. Reference Section 6 for manufacturer's recommendations.

3.5.1 Bus bars

Bus bars, to accommodate standard NEMA two (2) hole lugs are provided internal to the unit for input and output power connections and, depending on installation, are accessible from the side or rear. Cable entrance/exit is from either the top or bottom of the unit via removable conduit plates.

Bus bars are provided internal to the unit for ground and neutral connection. Input and output power connections must include an equipment grounding means as required by NEC and local codes.

Each input and output power feed should include an insulated ground conductor sized per NEC based on the upstream over-current protection device.

The unit is designed to operate from a power source with a phase rotation of A-B-C. Both sources of power to SS4 must be within the phase tolerance window, normally +/-30 degrees for best operation.

Refer to outline drawings for specific model connection details.

Caution

CAUTION – Improper phase rotation

- May cause loss of the critical load.

After completion of installation and connections, clean the equipment carefully to remove any debris, wire strands, etc., which may have accumulated.

3.5.2 Connections for external wiring connected to the SS4

Use lugs consistent with applicable codes. Check bolted joints for tightness. Always use two (2) wrenches when tightening connections to prevent distortion or damage. Refer to Section 9.1 for standard hardware torque specifications. Refer to individual electrical components' labels (e.g. molded case switches) for component specific torque specifications.

Reference Section 5 for control wire connection instructions and figures.

Warning
 WARNING – DO NOT tighten the bolts on heatsink SCR clamps

4 Startup

4.1 Power up – three (3) pole models

Warning

- Failure to understand and follow these safety instructions may result in equipment malfunction, property damage, upstream safety circuit operation, personal injury, or death.
- Follow all national, local, and site-specific safety procedures.

Caution

- Information in Section 4.1 is for three (3) pole models. See Section 11 for four (4) pole model power up procedures.

For initial power up of 3-pole models, the steps below must be followed:

1. Before closing the upstream breakers:
    a. Ensure that the available voltage from Source 1 (S1) and Source 2 (S2) are within the safe operating limits of the SS4.
    b. Confirm that the phase rotations of both sources are the same.
    c. Verify the potential between equivalent phases of both sources is less than 10 Volts (typical).

Note

- If multiple upstream sources are present on either source (e.g. Generator, ATS, UPS, etc.), perform the above steps for them as well.

    d. Verify all circuit breakers within the SS4 are open.
    e. Verify all fuses are installed.
    f. On 1600-2000A STS's only:
        i. Verify SW1 is closed.
2. Close the Source 1 upstream breaker, which applies power to S1 of the SS4.
3. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
4. Unlock and close the S1 Bypass breaker (CB102), which applies power to the SS4 load.

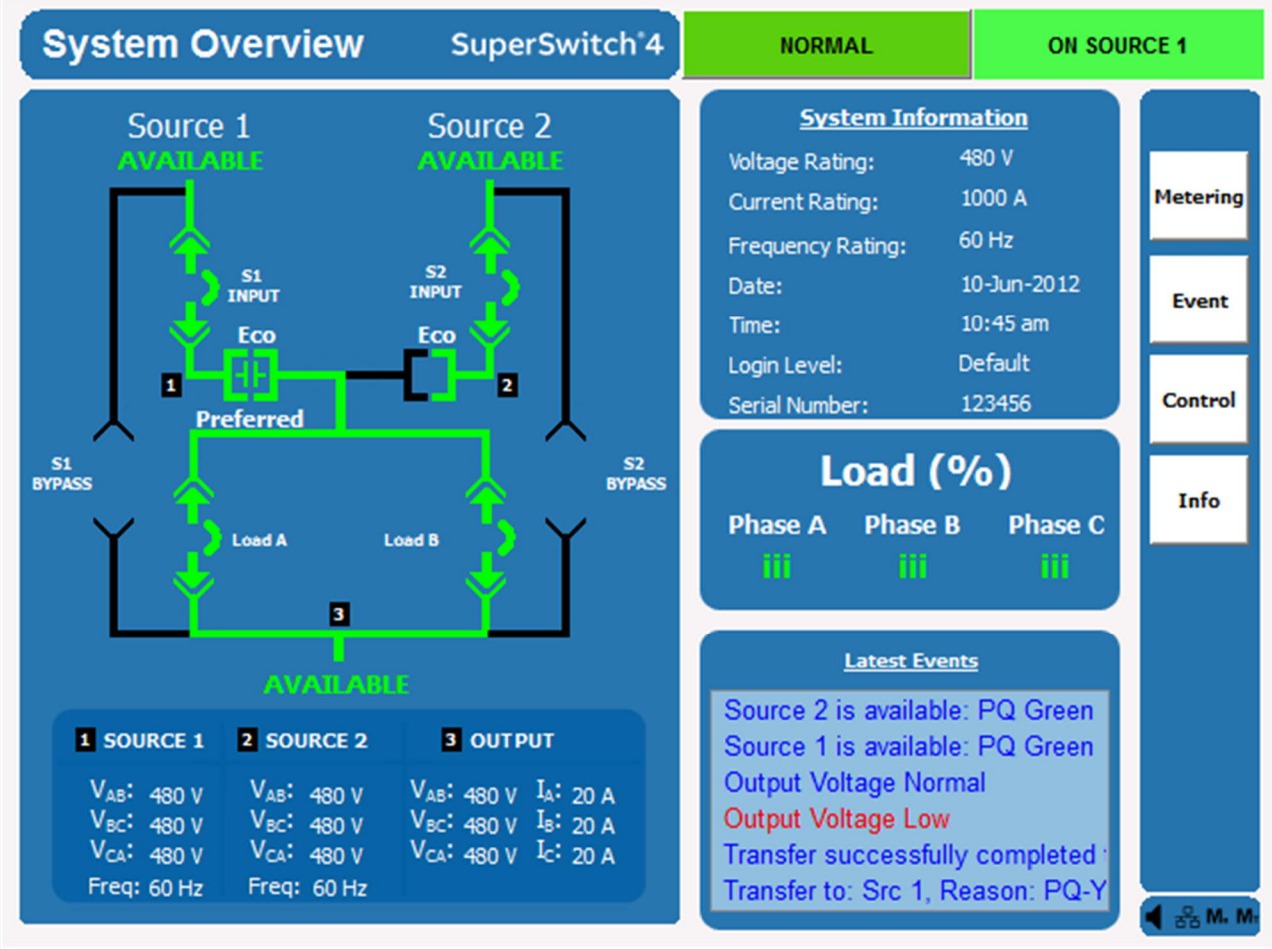
Caution

- Observe caution due to potential inrush currents into downstream transformers.

5. On 1600-2000A STS's only:
    a. Close the S1 SPD breaker (CB103).
6. Close the S1 Input breaker (CB101).
    a. Verify S1 SCR's are gated on prior to continuing.

7. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 Power Stage to the load bus.
8. Open the S1 Bypass breaker (CB102) and turn the Kirk Key to lock in this state.
9. Close the Source 2 upstream breaker, which applies power to the S2 of the SS4.
10. On 1600-2000A STS's only:
    a. Close the S2 SPD breaker (CB203).
11. Close the S2 Input breaker (CB201).
12. The SS4 is now supporting the critical load. The SS4 logic will select the source to connect to the internal SCR bus, based on the quality of the two sources and the present set of parameters contained within the memory of the SS4. The active source will be noted in the upper right corner of the graphic user interface, as shown in Figure 4-1.

Figure 4-1 Home screen



Warning

- Failure to understand and follow these safety instructions may result in equipment malfunction, property damage, upstream safety circuit operation, personal injury, or death.
- Follow all national, local, and site-specific safety procedures.

Note

- Information in Section 4.2 is for three (3) pole models. See Section 11 for four (4) pole model manual bypass procedures.
- These procedures are intended for manual bypass only.
- Are NOT to be used with the guided bypass feature.
- Refer to Section 4.2.3.2 for guided bypass operation.

Before attempting to perform any bypassing procedure on the SS4, the following information must be confirmed:

- The intent/reason for bypassing the SS4.
- The source which the SS4 need to be bypassed on.
- The level which the SS4 needs to be bypassed to.
- The conditions required for the SS4 to be brought out of bypass.

To only bypass the source to the critical load, the following procedure should be followed, but the fuses can be left installed and the logic left in operation.

To bypass the source to the critical load and isolate the SS4 control logic power supply for maintenance or other function, the following procedures would apply:

4.2.1 Bypass load to Source #1

1. Verify Source 1 is the active & preferred source.
2. Open the S2 Input breaker (CB201).
3. On 1600-2000A STS's only:
   a. Open the S2 SPD breaker (CB203).
4. Lock S2 Bypass breaker (CB202) open and remove Interlock Key.
5. Unlock and close the S1 Bypass breaker (CB102).
6. Open Load A, Load B, and S1 Input breakers (CB001, CB002, and CB101 respectively).

   The STS power stage is now bypassed to Source 1.

Note

- To isolate the STS logic & power supplies, proceed to step 7.

7. On 1600-2000A STS's only:
    a. Open SW1.
    b. Verify output voltage is isolated from STS logic.
8. To isolate the control logic power supply, remove all control power fuses. Refer to unit bypass placard for specific fuse callouts.

Warning

WARNING

- Line voltage is still present on S1 of the STS. Recommend performing upstream LOTO when working on S1 power stage components
- On models rated 1200A or less, line voltage will still be present on the analog interface printed circuit board.
- On models rated 1600-2000A, fans will have live terminals even with the device off. Wait 5 minutes after disconnecting to allow for stored energy to be discharged before servicing.

Return to normal operation

1. Install all control power fuses.
2. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
    a. Verify no anomalies in event log and that the system shows green status.
3. On 1600-2000A STS's only:
    a. Close SW1.
    b. Verify output voltage is connected to STS logic.
4. Close the S1 Input breaker (CB101).
    a. Verify S1 SCR's are gated on prior to continuing.
5. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 power stage to the load bus.
6. Open the S1 Bypass breaker (CB102) and turn the Interlock Key to lock in this state.
7. On 1600-2000A STS's only:
    b. Close the S2 SPD breaker (CB203).
8. Close the S2 Input breaker (CB201).

4.2.2 Bypass load to Source #2

1. Verify Source 2 is the active & preferred source.
2. Open the S1 Input breaker (CB101).
3. On 1600-2000A STS's only:
    a. Open the S1 SPD breaker (CB103).
4. Lock S1 Bypass breaker (CB102) open and remove Interlock Key.
5. Unlock and close the S2 Bypass breaker (CB202).
6. Open Load A, Load B, and S2 Input breakers (CB001, CB002, and CB201 respectively).

    The STS power stage is now bypassed to Source 2.

Note

- To isolate the STS logic & power supplies, proceed to step 7.

7. On 1600-2000A STS's only:
    a. Open SW1.
    b. Verify Output Voltage is isolated from STS logic.
8. To isolate the control logic power supply, remove all control power fuses. Refer to unit bypass placard for specific fuse callouts.

Warning

WARNING

- Line voltage is still present on S2 of the STS. Recommend performing upstream LOTO when working on S2 power stage components
- On models rated 1200A or less, line voltage will still be present on the analog interface board.
- On models rated 1600-2000A, fans will have live terminals even with the device off. Wait 5 minutes after disconnecting to allow for stored energy to be discharged before servicing.

Return to normal operation

1. Install all control power fuses.
2. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
    a. Verify no anomalies in event log and that the system shows green status.
3. On 1600-2000A STS's only:
    a. Close SW1.
    b. Verify output voltage is connected to STS logic.
4. Close the S2 Input breaker (CB201).
    a. Verify S2 SCR's are gated on prior to continuing.
5. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 power stage to the load bus.
6. Open the S2 Bypass breaker (CB202) and turn the Interlock Key to lock in this state.
7. On 1600-2000A STS's only:
    a. Close the S1 SPD breaker (CB103).

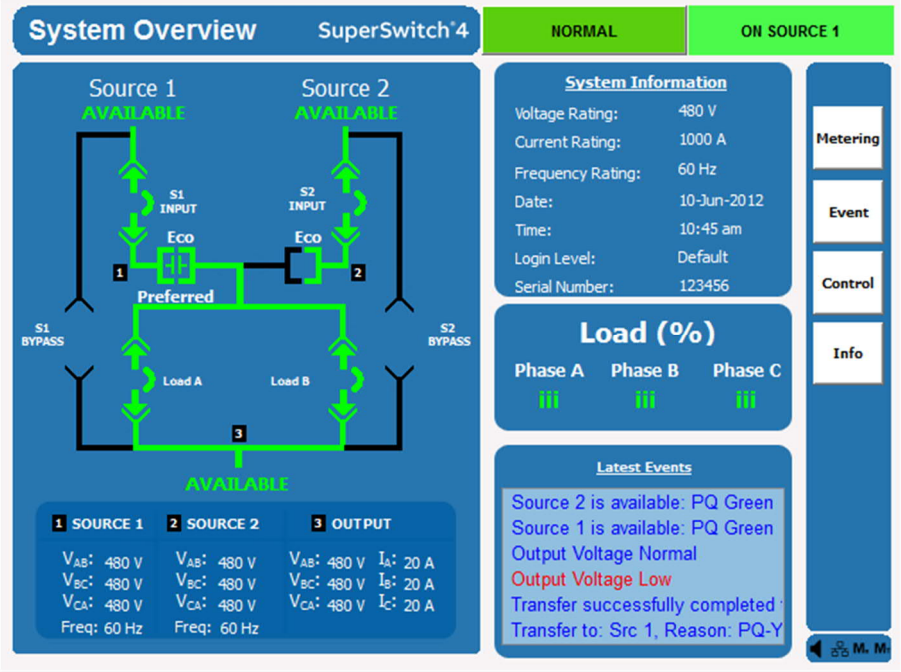
    Close the S1 Input breaker (CB101).

4.3 Graphical user interface

The user interface is a touchscreen LCD. It shows all system status as well as providing a means to set the unit up and control it. This is done through buttons, checkboxes, radio buttons, pull-down menus, and text entry screens.

The GUI consists of a series of screens that the user can navigate between via the touchscreen. A basic description of the home screen follows.

Figure 4-2 Home screen – 3 Pole



The left portion of the Home Screen contains the Mimic. This displays a graphical representation of the state of the SS4. The availability of each source, as well as the state of the SCRs and breakers is shown. The power flow through the SS4 is also shown via the connections between the components. If there is power in a portion of the circuit, those lines will be bright green. Otherwise they are black.

The SS4 status and gating state are shown in the upper right portion of the screen. These indicators are shown on all screens. The gating state is shown on the right. It shows the source that is gating and whether the SS4 is in bypass or if actively gating. The status is on the left. It shows the overall status of the SS4. If it is touched, the Events screen will be shown. System Status indicators are defined in Table 4-1.

Below the status and gating state, the system information is shown.

Immediately below the system information the percentage of rated load is shown. Immediately below this is an abbreviated list of the most recent events.

At the far right of the Home Screen is a vertical set of buttons for navigating to the other sub-screens.

4.3.1 System status indicators

The system status is conveyed by the home screen/mimic, which was described above. Some additional information about the status indicators follows.

The upper right indicator shows the gating state of the SS4.It can have the following values:

Table 4-1 System status indicator - Gating

Indicator	Meaning
ON SOURCE 1	Gated to Source 1 Input
ON SOURCE 2	Gated to Source 2 Input
ERR! LOCK SRC 1	Gated to Source 1 – Transfers disabled until user unlocks unit
ERR! LOCK SRC 2	Gated to Source 2 – Transfers disabled until user unlocks unit
ERR! HOLD SRC 1	Gated to Source 1 – Transfers disabled until fault corrected
ERR! HOLD SRC 2	Gated to Source 2 – Transfers disabled until fault corrected
IN BYPASS 1	The unit is bypassed to Source 1
IN BYPASS 2	The unit is bypassed to Source 2
OVERLD INHIBIT	Transfer are inhibited due to an overload condition
TEST MODE SRC 1	Gated to Source 1 while in Test Mode
TEST MODE SRC 2	Gated to Source 2 while in Test Mode

The other indicator shows the fault status of the SS4. It can have the following values:

Table 4-2 System status indicator - Fault

Indicator	Meaning
NORMAL	System has no faults
WARNING	There is at least one system warning that is active
ALARM	There is at least one system alarm that is active

4.3.2 Menu Tree

Access levels are highlighted as shown below. Access restrictions will only take effect when security is enabled, per Section 4.4.3.1.

4.4 Systems Setup

This screen and subsequent screens allow the setup of all the operating parameters of the SS4. Five (5) buttons in the lower section select specific setup areas. This screen and subsequent screens are only accessible to personnel with login levels ADMIN, when security is enabled.

To enter this screen from the home screen, click any button, then click setup in the right column.

4.4.1 PQ Settings First Screen

This screen and subsequent screens are only accessible to personnel with login levels ADMIN, when security is enabled.

There are two (2) buttons dedicated to power quality setup. PQ and PQ(cont.) select a set of screens that setup the overvoltage and undervoltage thresholds, frequency and phase shock limits, current overload thresholds, and the retransfer and source available delays.

4.4.1.1 PQ level and filter time setup

There are 2 screens dedicated to setting up the Power Quality, or PQ, thresholds for the SS4. The first PQ screen enables setup of the PQ levels and filtering for both sources.

The user can set 2 levels of power quality limits, PQ Red and PQ Yellow. The Transfer limit is the point where the source is declared to have a power quality fault. The Return limit is the point where the PQ fault is cleared. The PQ Yellow limits must fall within the PQ Red limits so there is a clear difference between the 2 fault levels. The filter times can be adjusted to ignore electrical noise on the sources.

Figure 4-3 PQ Screen – Over Voltage Red

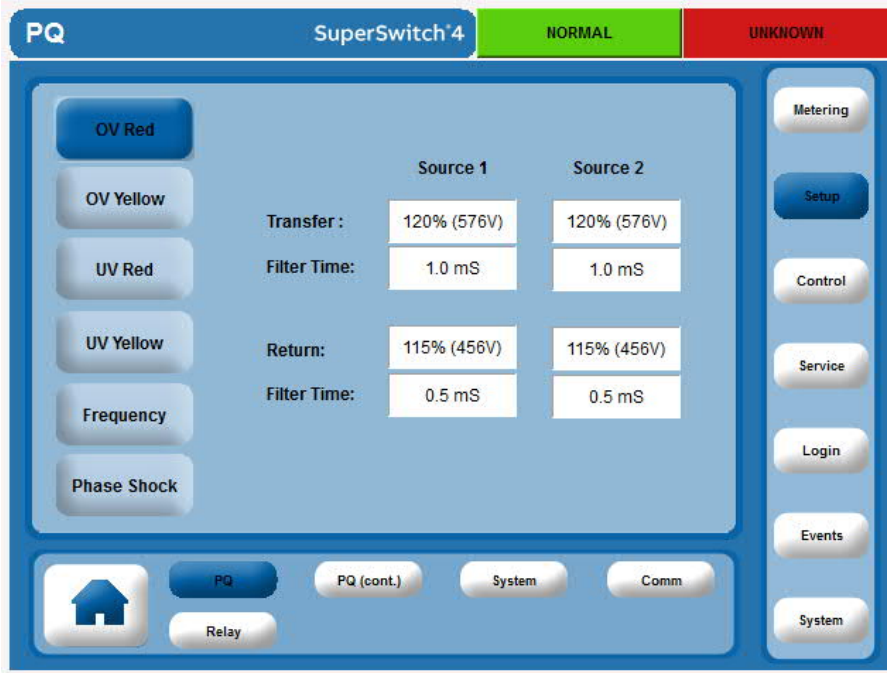


Figure 4-4 Over Voltage Yellow Screen

Figure 4-5 UV Red Screen

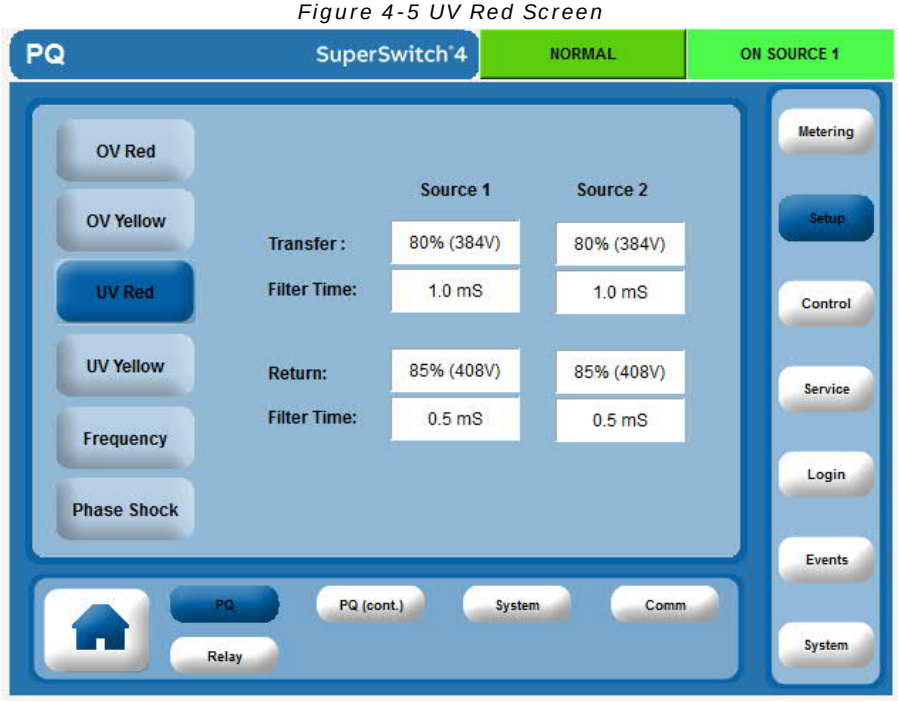
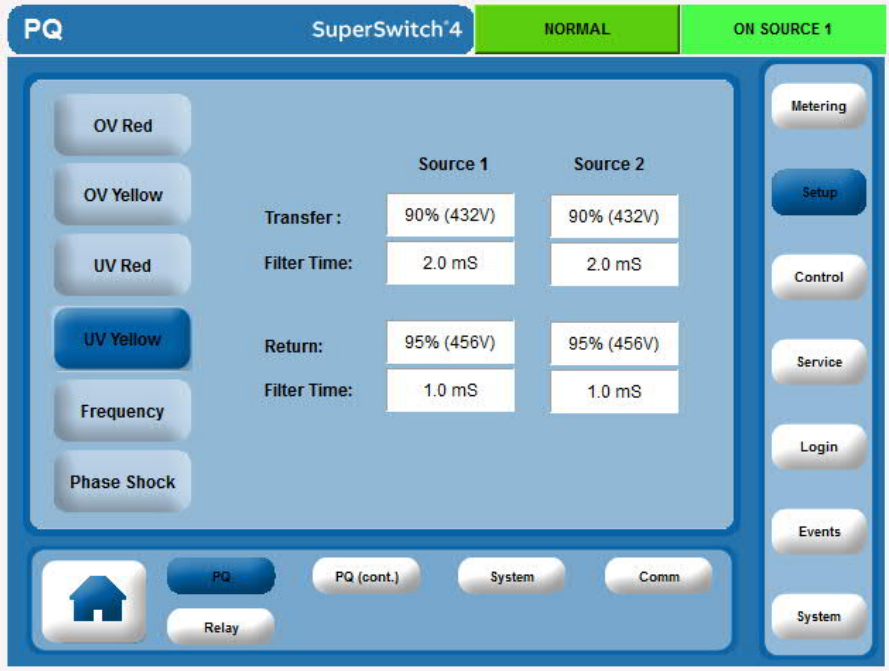


Figure 4-6 UV Yellow Screen

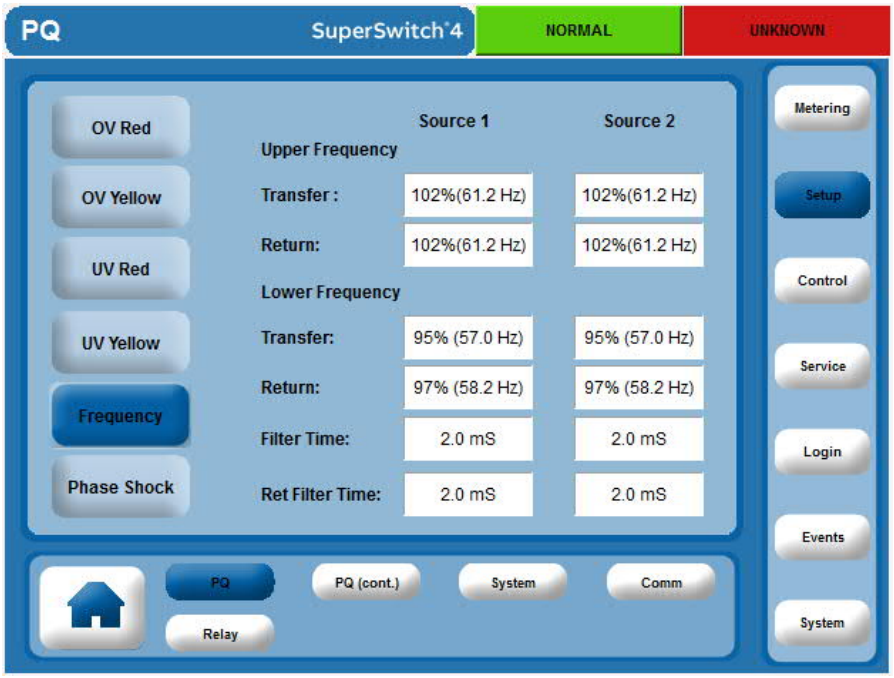


4.4.1.2 Frequency limit setup

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The frequency upper and lower limits can be set from this screen. Separate setups are available for each source. These are the points at which the source's PQ will be considered bad. A Frequency Transfer limit (limit at which the frequency is considered bad) and a Return limit (point at which the frequency is considered normal) can be adjusted to suit the installation's needs. Filter times for the Transfer and Return can also be set to account for system frequency jitter.

Figure 4-7 Frequency limit setup screen

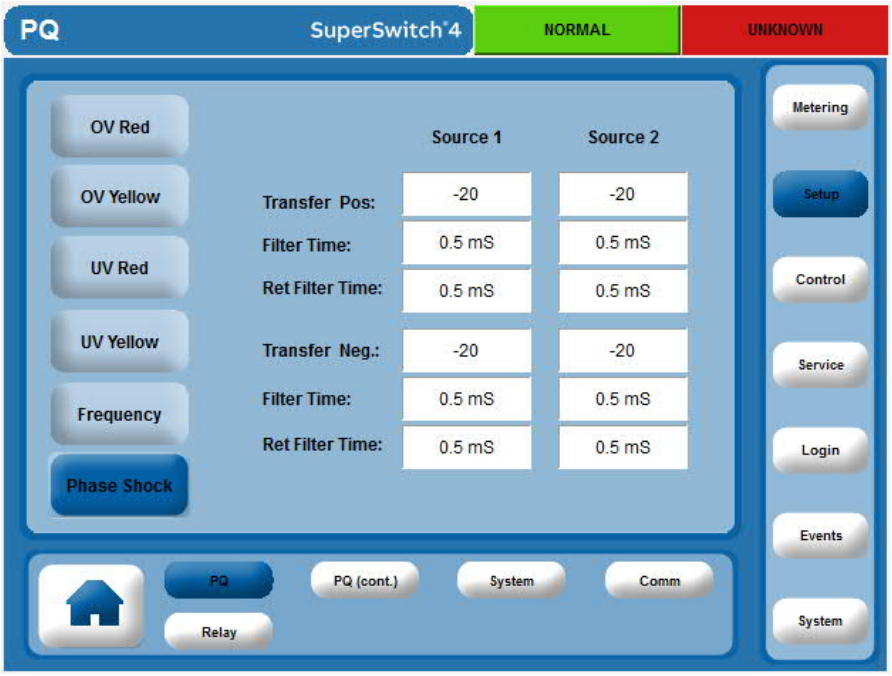


4.4.1.3 Phase shock

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The user can set up a maximum Phase Shock for each source. Phase Shock occurs when the source voltage waveform has a sharp discontinuity from the normal sine wave. The number of degrees of deviation can be set for the fault as well as the return from fault condition. As with other setups, filtering is also included so that system noise can be accounted for.

Figure 4-8 Phase shock screen



4.4.2 PQ Settings Second Screen

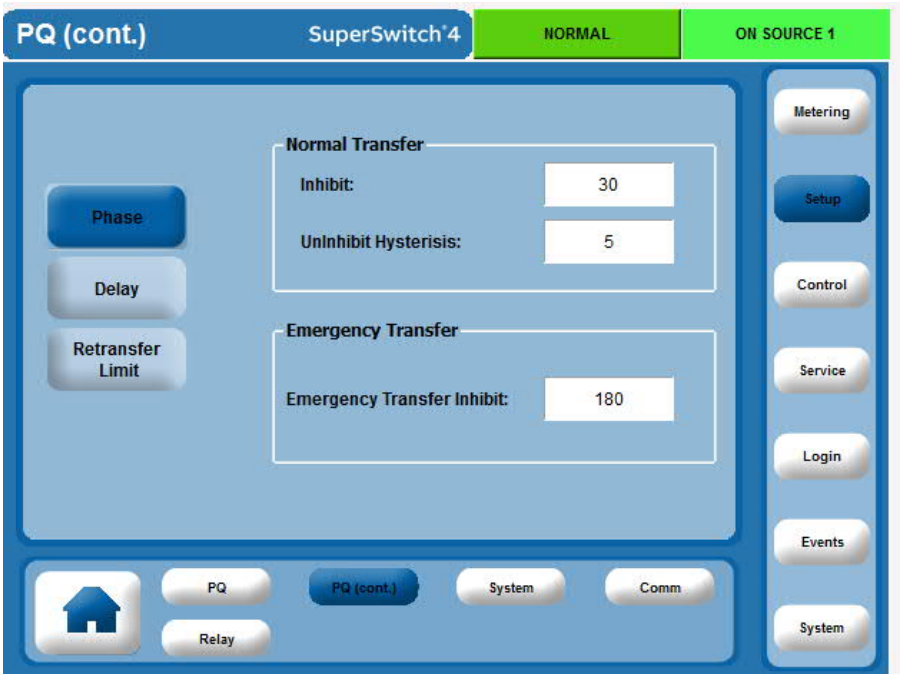
4.4.2.1 Phase window setup

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

In the PQ(cont.) screen, there is a setup for the Phase Windows. A phase window is the phase difference between the 2 source waveforms.

There are separate screens that can be set up for Normal Transfer and Emergency Transfer. Normal Transfer Window is used as the limit for various transfer handling procedures. For example, if the SS4 is set up to perform DIR Limited transfers, then it will perform an A9 transfer when the sources are within the Normal Phase Window. It will perform DIR transfer when the sources are outside the Normal Phase Window. The Emergency Transfer Window defines the limits for performing any transfers at all. If the sources are outside this window No transfers (either normal or emergency) will occur. This window is normally set to 180, which basically means that it is disabled.

Figure 4-9 Phase window setup screen



4.4.2.2 Delay setup

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The Delay Window sets up the Source Available, Retransfer, Reacquisition of Preferred Source, and Ecomode delay times.

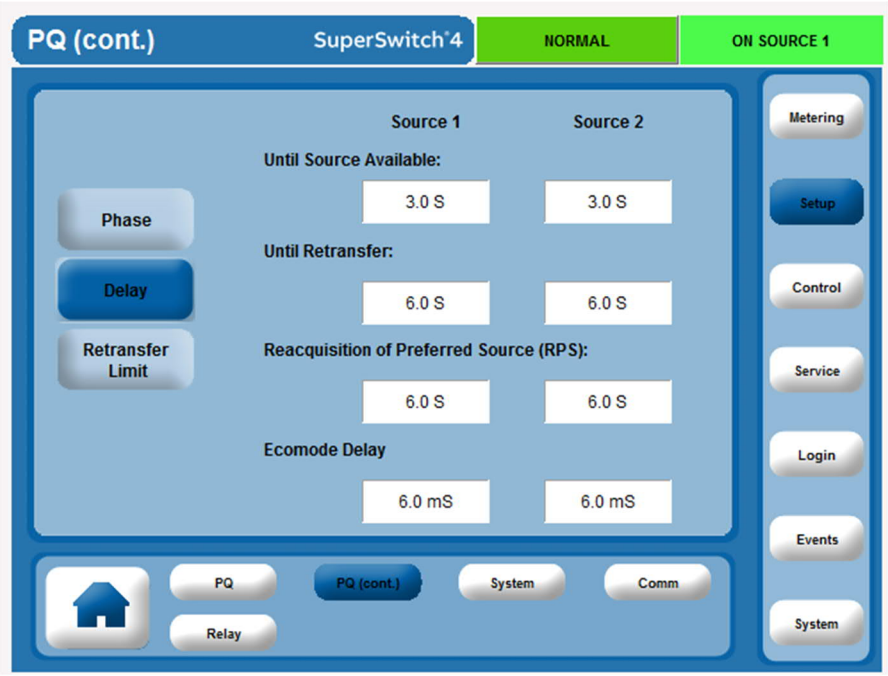
The Until Source Available delay can be set to change the amount of time that the system waits before it declares a source to be available after its PQ is normal. The system will not allow normal transfers (user-initiated or system retransfers) to a source until it is declared available.

The Until Retransfer delay is the amount of time the system waits to transfer back to the preferred source after a transfer (normal or emergency). This timer starts immediately after a transfer occurs, thus limiting how soon the system retransfers.

The Reacquisition of Preferred Source delay is an additional delay that starts from Source available (after Until Source available delay expired) point. Retransfers to preferred side are allowed after this delay expires. This timer will start once PQ status of green is detected on the Preferred Source.

The Ecomode Delay provides the flexibility needed to set any source that is connected to a UPS running in economy mode with an adjustable sensing delay in milliseconds, so the switch can avoid any unnecessary transfers once the upstream UPS returns to double conversion. When the Ecomode delay timer expires normal PQ sense timers will begin. Note that the “EcoMode” checkbox on the Transfer screen (Figure 4-14) must be ticked to enable this feature.

Figure 4-10 Delay setup screen



4.4.2.3 Retransfer Limit window

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

This screen allows the user to limit the number of retransfers to preferred source. Also, note that the "Retransfer Limit" checkbox on the Transfer screen (Figure 4-14) must be ticked to enable this feature.

If the transfer count is met within the time frame of the transfer window (minutes), then retransfer will be disabled.

Retransfer will be re-enabled after the preferred source is changed.

Figure 4-11 Retransfer Limit

4.4.3 Systems settings

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

4.4.3.1 System Settings

Under the Setup screen the Systems button selects this screen.

The user can check the Audible Alarm box to enable audible alarms.

The user can also enable the security mode, where usernames and passwords protect certain setup screens and prevents unauthorized personnel from accessing them. Default usernames are USER and ADMIN. Screens with ADMIN only access are noted throughout the manual.

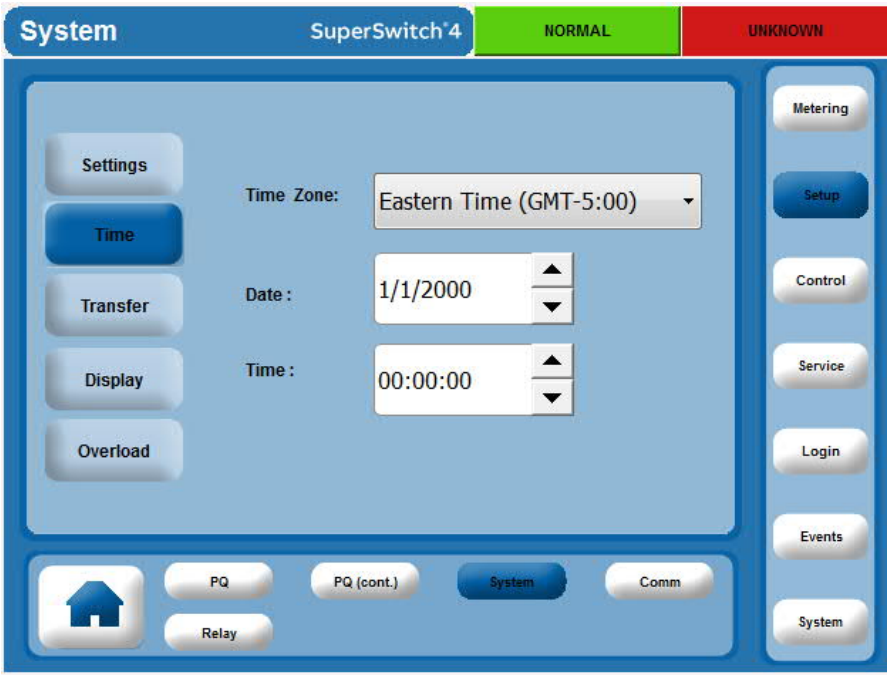
Figure 4-12 System

4.4.3.2 Time

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The user can set the system time from this screen.

Figure 4-13 Time screen



4.4.3.3 Transfer

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The Transfer screen provides setup for several items related to transfers.

The user can enable or disable Retransfer, which is the automatic transfer back to a preferred source after transfer, whether that was a user commanded transfer via the GUI, or an emergency transfer caused by a fault.

The user can select to enable DIR (Dynamic Inrush Reduction) transfers, which will reduce the inrush current that can occur during a transfer when there is a transformer-coupled load. The user can enable Limited or Always. Limited will allow DIR transfers only when the 2 sources are outside the Normal Phase Window. Always causes DIR transfers to always be performed. The user cannot disable this feature via the GUI.

The user can select either source as preferred with the radio buttons provided.

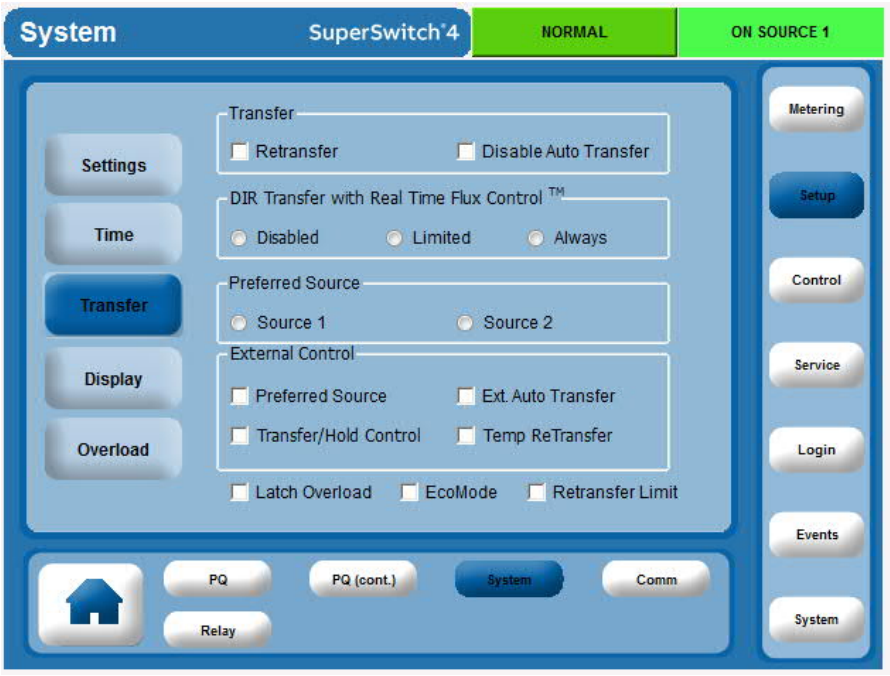
The user can enable external control of Preferred Source selection. When this is enabled, an external signal to the SS4 will determine which source is preferred. The GUI selection is disabled when this is in effect.

The user can enable or disable Auto Transfer. If Auto Transfer is disabled, the SS4 will only perform user-initiated transfers. Note that all fault-initiated transfers are disabled when in this mode.

Finally, the user can enable Latched Overload Inhibit. The SS4 will inhibit transfers when the RMS current or the Peak Current exceed certain limits. (See the section below that explains this operation.) If Latched Overload Inhibit is enabled, the system will continue to inhibit transfers after the current overload has

stopped. The user will need to clear the inhibit manually. If this feature is disabled, then the system will return to normal (non-inhibited) operation after a short timeout.

Figure 4-14 Transfer screen



4.4.3.4 Display setup

This screen is only accessible to personnel with login levels ADMIN when security is enabled.

The Display Setup screen allows the user to adjust the contrast of the GUI LCD screen and set the Screen Saver parameters.

Figure 4-15 Display setup screen

4.4.3.5 Overload setup

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The user can adjust the limits for an RMS current overload and a Peak Current Overload from this screen.

For an RMS Overload condition, the user can set the limit as a percentage of the rated current. The user can also set how long the overload must be in effect before it is declared.

For Peak Overload the user can set the limit as a percentage of the rated (peak) current.

Example: for a 600A system, the rated peak current is 848 amps.

The Overload parameters are set at the factory at 125% RMS for 30 minutes and 300% for peak current. These are the recommended default levels. Increasing the settings above these levels may impact system operation.

Figure 4-16 Overload Setup Screen

4.4.4 Communications

These screens are only accessible to personnel with login levels ADMIN, when security is enabled.

This screen set provides setups for the SS4's networking capabilities, such as IP address and Modbus settings.

4.4.4.1 Communications Network setup

This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

This screen is used to set up the network connection for the SS4. The IP address can be either static or dynamic.

Warning

- Please ensure that the IP is exclusive to this unit.
- Ensure that the LAN is dynamic when configured for dynamic IP.

Figure 4-17 Comm Network Static setup screen

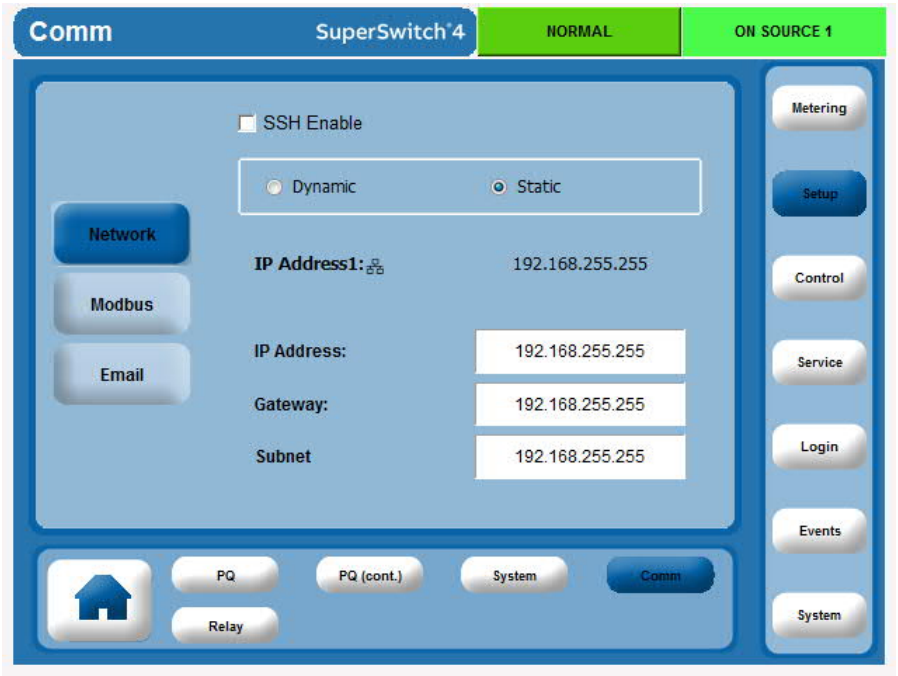
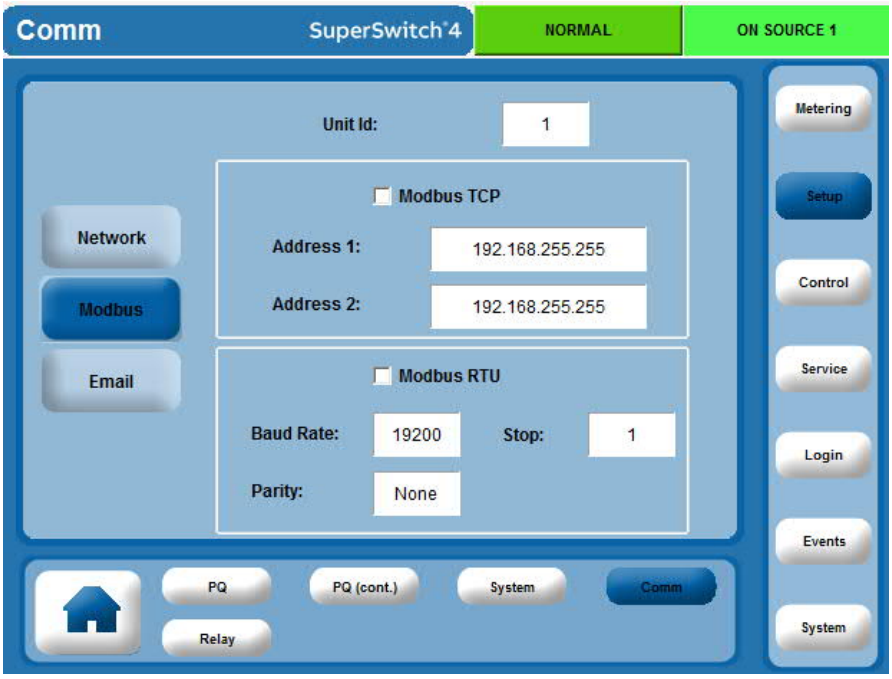


Figure 4-18 Comm Network Dynamic setup screen

4.4.4.2 Communications Modbus Setup

This screen is used to enable or disable either Modbus RTU or Modbus TCP. Depending on which is selected, different parameters must be configured. After the Modbus check boxes are clicked or unclicked and the change is confirmed, the unit will reboot.

Figure 4-19 Comm



4.4.4.3 Communication E-mail setup

This screen allows the user to activate sending information from a selected set of events by e-mail to the e-mail address destinations designated on this screen. Event sets can be all events from the last hour, last day, or the 20 latest events. The local server must be entered in order to send e-mails

Figure 4-20 E-Mail Setup

4.4.5 Relay setup

This screen and subsequent screens are only accessible to personnel with login levels ADMIN, when security is enabled.

There are 16 relay outputs on the SS4; eight (8) are permanently mapped to specific events and the remaining eight (8) can be mapped by the user to one of a selection of events/conditions on the switch.

The eight (8) fixed relays are shown here:

Figure 4-21 Fixed relay setup screen

The eight (8) user selected relays are shown below. The user selects a relay from the left drop-down menu and saves it; then selects the event/condition from the right drop-down menu and saves it. The relay is now mapped to the event or condition and will energize when the condition is true.

Figure 4-22 User selected relay setup screen

The conditions that can be selected are:

Peak Current Overload Inhibit	Sources Out of Sync
Open SCR	Output Voltage Low
Shorted SCR	Gate Drive Opto Fault
Over-Temperature	Source PQ UV Red
Output Unavailable	Source PQ OV Red
Power Supply Fault	Source PQ UV Yellow
TVSS Fault	Source PQ OV Yellow
Fan Failure	Source DSP Communications Lost
MLB Communications Lost	Source 1 Input Breaker Open
Gate Drive Communications Lost	Source 2 Input Breaker Open
Gate lock	Load A Breaker Open
Gate Hold	Load B Breaker Open
Gate Drive Fuse Fault	Source 1 Bypass Breaker Closed
ISOC	Source 2 Bypass Breaker Closed
Door Open	Load on Source 1"
Re-Transfer Disabled	"Load on Source 2"
Auto-Transfer Disabled	"S1 Active"
"Summary Alarm"	"S2 Active"
"Summary Warning"	"Unacknowledge Event"
"S1 Available"	"S2 Available"
"Non-Preferred Source"	

Note that one function condition can take a maximum of two relay settings.

5 System Operations and Monitoring

5.1 Screen Functions

5.1.1 Metering screens

The Metering screens are accessed from the Main Screen via the “Metering” button.

The metering screens display the various metering information on the SS4. The specific metering data is selected via a set of buttons on the bottom of the screen. The user can select voltage, current, power (including power factor), frequency and phase angle, and THD.

The included screens are shown below:

Figure 5-1 Voltage screen

Figure 5-2 Current screen

Figure 5-3 Power screen

Figure 5-4 Frequency screen

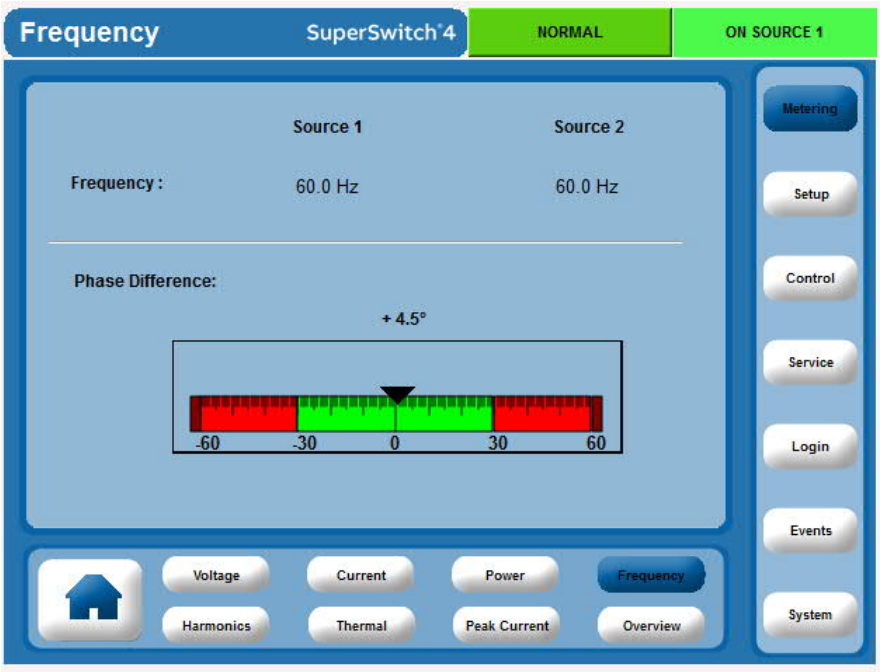
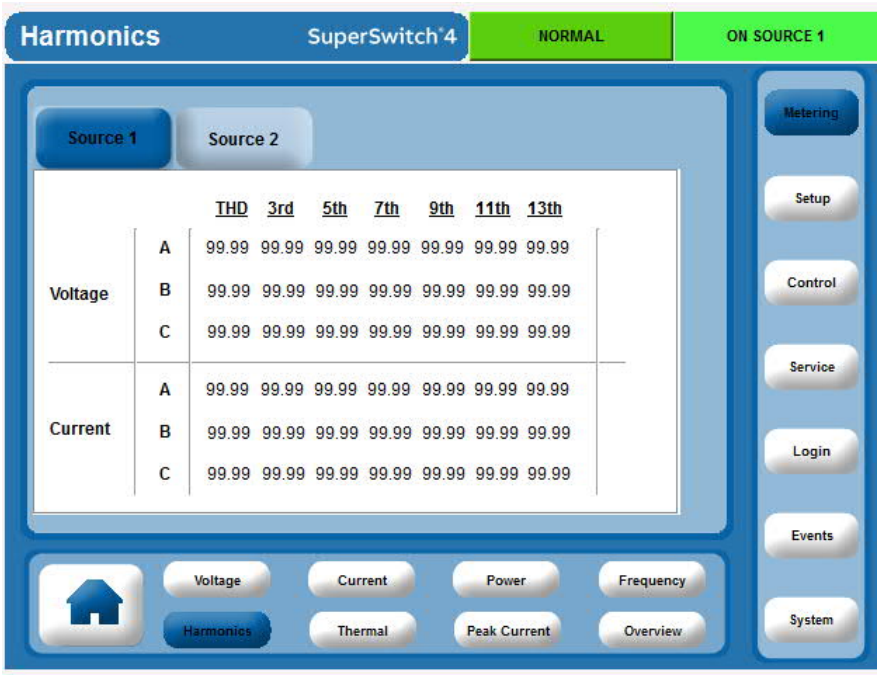
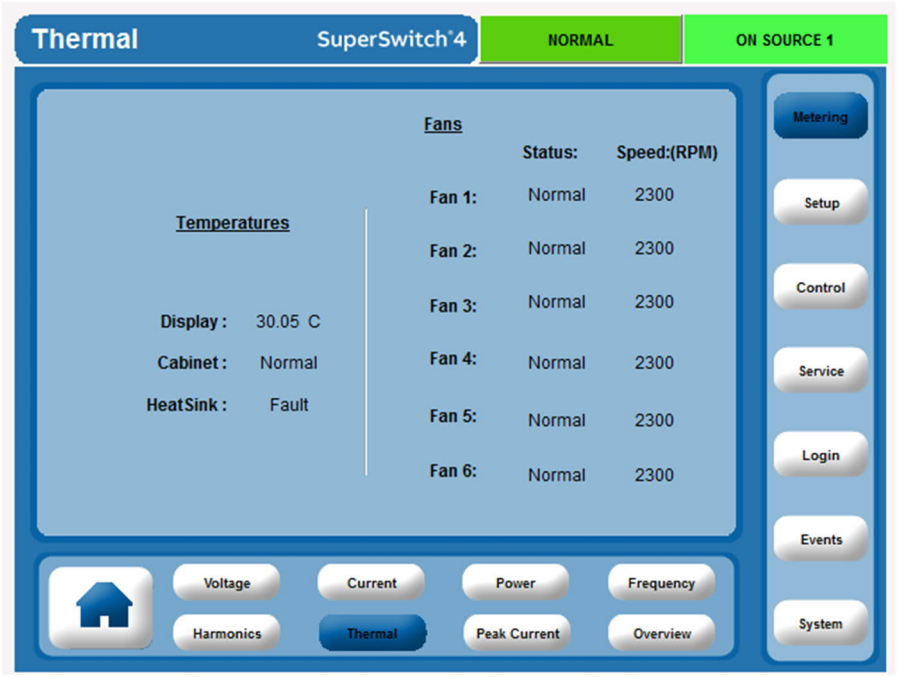


Figure 5-5 Harmonics screen



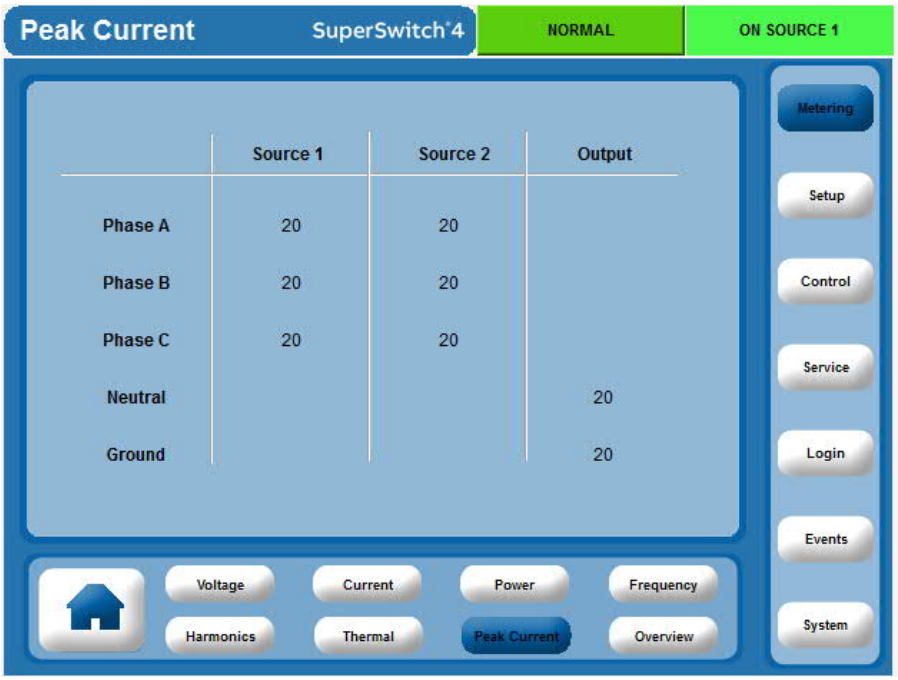
The “Thermal” screen will display the temperature of the cabinet, heatsinks, and the state of the unit’s fans.

Figure 5-6 Thermal screen



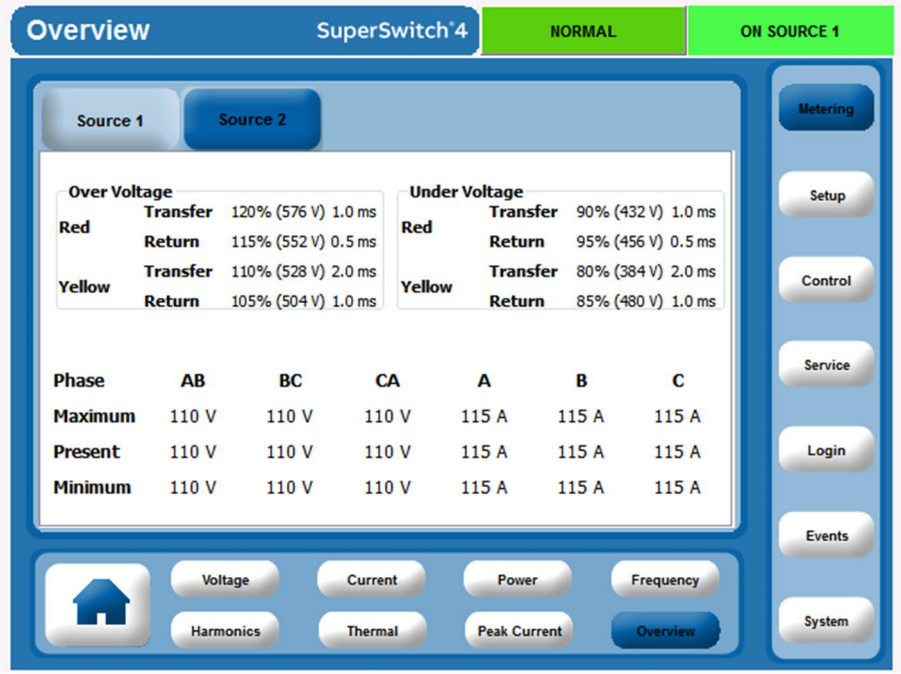
The “Peak Current” button displays the maximum values for phase, neutral, and ground currents.

Figure 5-7 Peak Current screen



The “Overview” button will show the system PQ transfer of Source 1 and Source 2 information screen to appear.

Figure 5-8 Overview screen



The metering screens also have a vertical set of buttons at the right of the screen. These allow the user to navigate to the balance of the screens, which will be described below. They are: “Metering” (this screen), “Setup”, “Control”, “Service”, “Login”, “Events” (also available from the home screen), and “Info” (also available from the home screen). The setup screens are discussed in Section 4.3.2. The other screens are described in the following sections.

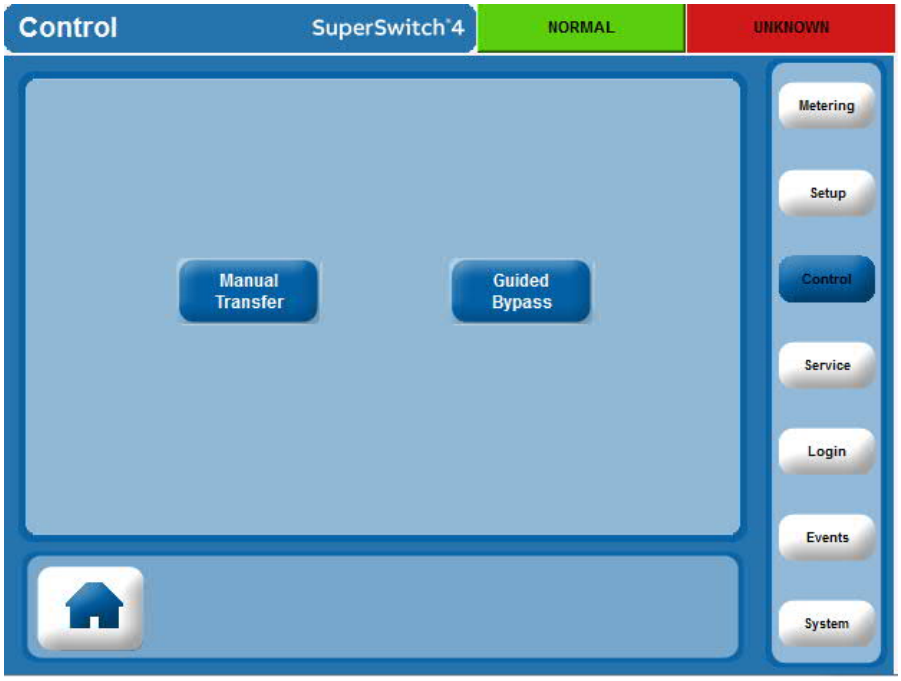
5.1.2 Control

The control screen can be accessed directly from the Home screen, and from the Metering screens. There are two buttons on the Control screen.

The first is Manual Transfer, and it causes the system to transfer from one source to the other. This will only occur if there are no faults that have caused a system transfer hold or lock, or a transfer inhibit due to a current overload. If conditions allow a transfer, a popup will appear asking if the user wants to do the transfer. If the user selects “OK” then the transfer will occur. If Retransfer is enabled the system will transfer back to the preferred source once the Retransfer Delay timer expires. This screen is only accessible to personnel with login levels ADMIN, when security is enabled.

The second button is the Guided Bypass/Unbypass button. If the system is not in bypass this button will be labelled “Guided Bypass” and pressing it will start the Bypass sequence. If the system is in bypass this button will be labelled “Guided Unbypass” and pressing it will start the Unbypass sequence. In each case, a series of screens will prompt the user to perform the steps required to place the SS4 into or out of bypass. Some functions occur automatically, like shunt-tripping certain breakers. Most are manual operations that the user must perform. This screen is only accessible to personnel with login levels USER, ADMIN, when security is enabled.

Figure 5-9 Control Screen



5.1.3 Guided/Guided Unbypass sequence

The following figures show the progression of screens for guided and guided unbypass sequencing.

Figure 5-10 Guided bypass sequence - 1

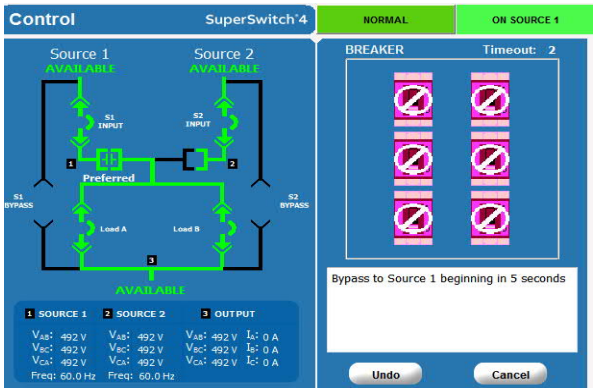


Figure 5-11 Guided bypass sequence - 2

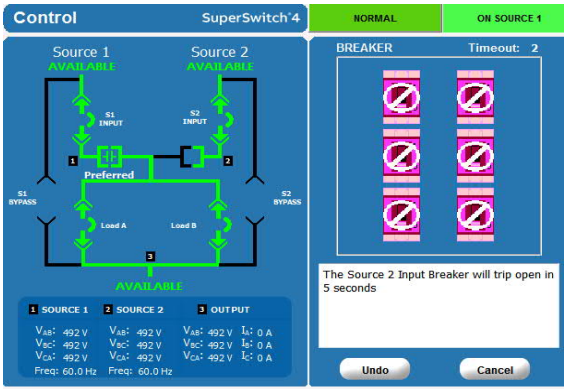


Figure 5-12 Guided bypass sequence - 3

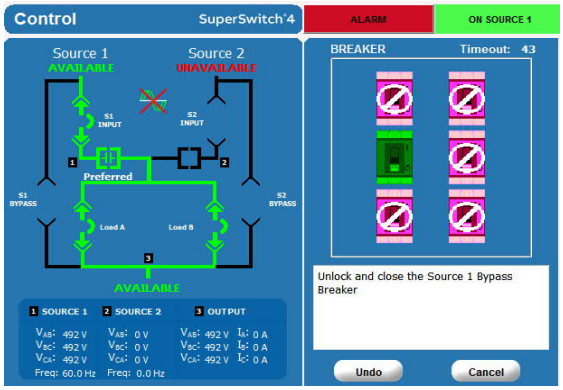


Figure 5-13 Guided bypass sequence - 4

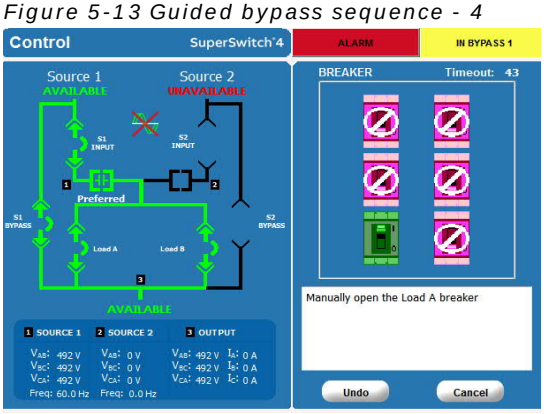


Figure 5-14 Guided bypass sequence - 5

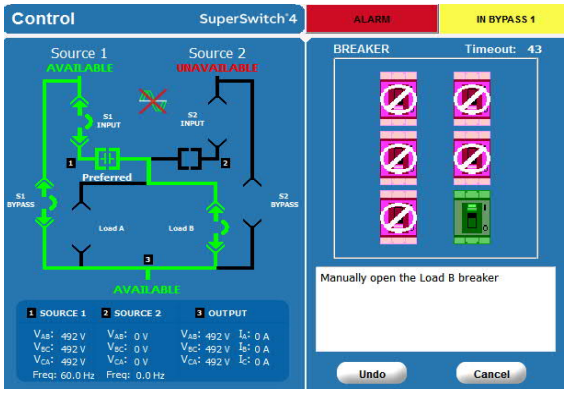


Figure 5-15 Guided bypass sequence - 6

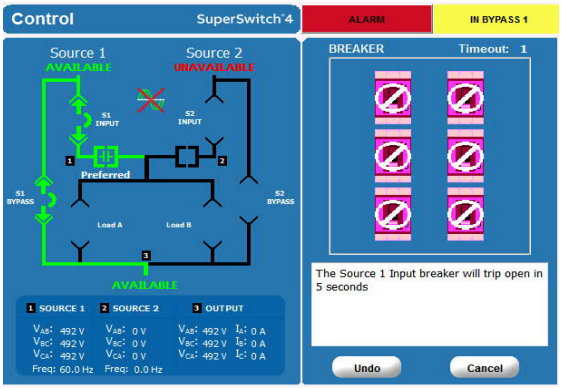


Figure 5-16 Guided bypass sequence - 7

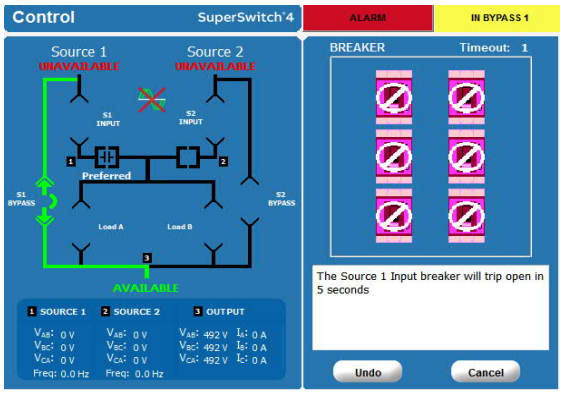


Figure 5-17 Guided bypass sequence - 8

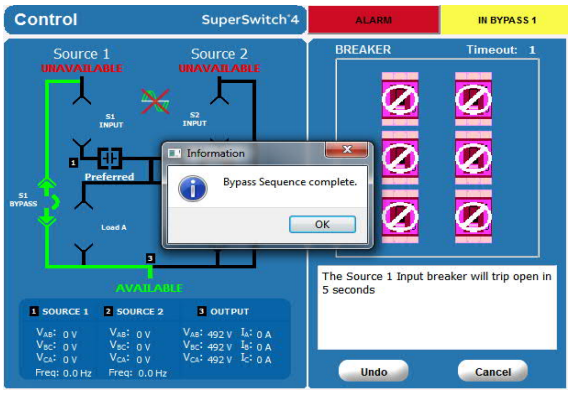


Figure 5-18 Guided unbypass sequence - 1

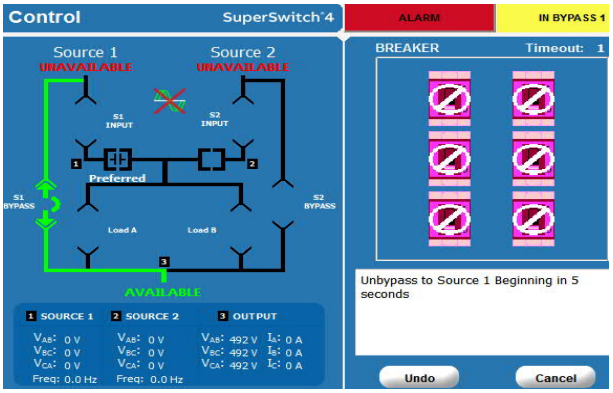


Figure 5-19 Guided unbypass sequence - 2

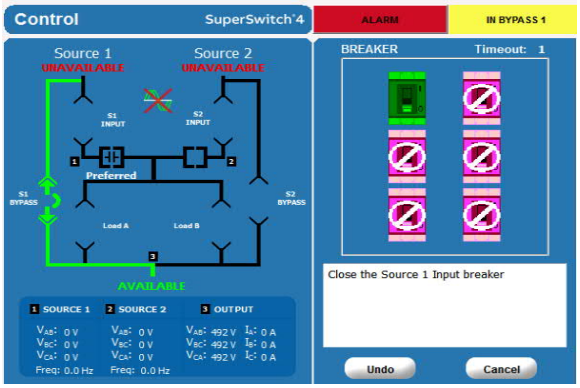


Figure 5-20 Guided unbypass sequence - 3

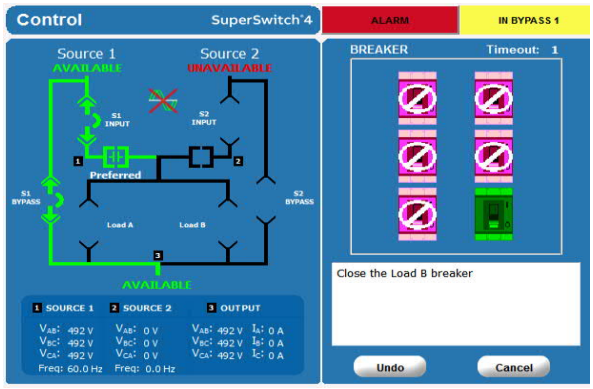


Figure 5-21 Guided unbypass sequence - 4

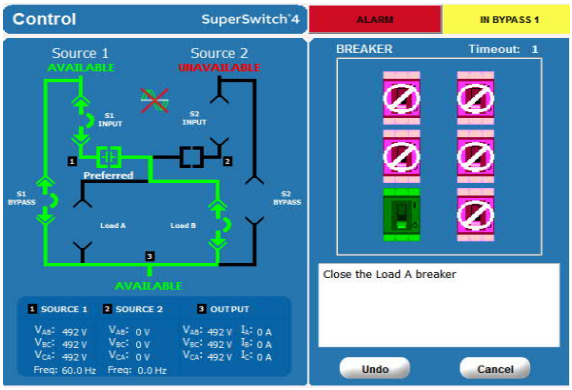


Figure 5-22 Guided unbypass sequence - 5

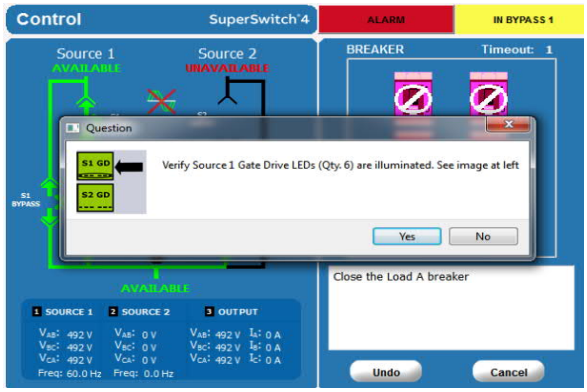


Figure 5-23 Guided unbypass sequence - 6

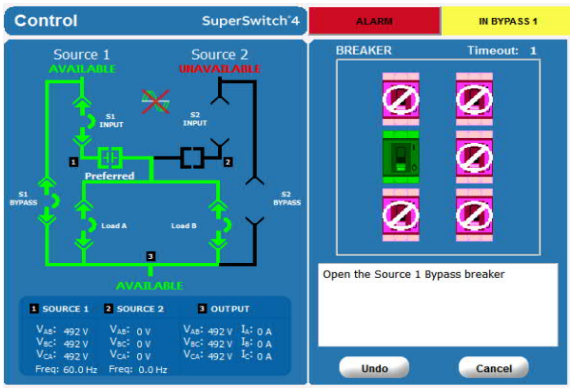


Figure 5-24 Guided unbypass sequence - 7

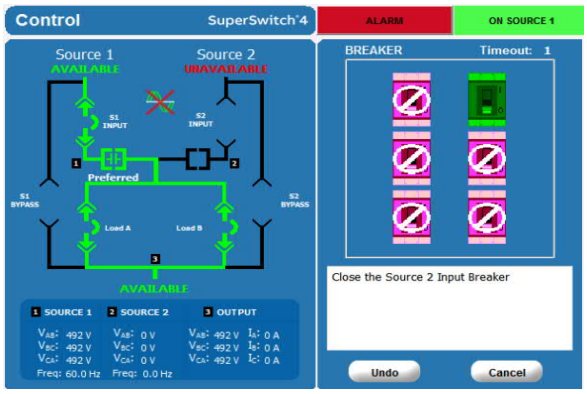
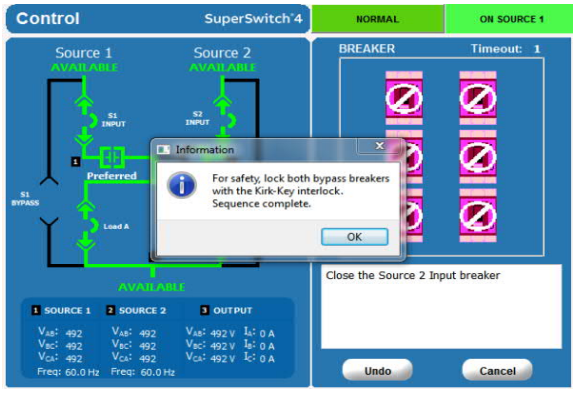


Figure 5-25 Guided unbypass sequence - 8



5.1.4 Service

Caution

– The functions on these screens are accessible only to personnel with the appropriate login level.

The only Service Screen function available to operators with USER or ADMIN access is the reports function. All other functions on this screen are accessible only by authorized service personnel with the appropriate SERVICE login. Contact ABB Service when these other functions to need completed.

5.1.4.1 Reports

This screen is only accessible to personnel with login levels USER, ADMIN, or SERVICE when security is enabled. The “Service Dump” button is enabled only to personnel with the SERVICE login level.

The user must install a USB drive in the USB port under the GUI screen. Then pressing either one of these buttons will cause a file containing the TLM information or event information to be written to the USB drive. The “Unmount” button should be pressed, and the user should wait for confirmation that the drive is unmounted before removing it from the port.

Figure 5-26 Reports Screen

5.1.5 Login

This screen allows the user to login at various levels, which allows for access to appropriate areas of the SS4.

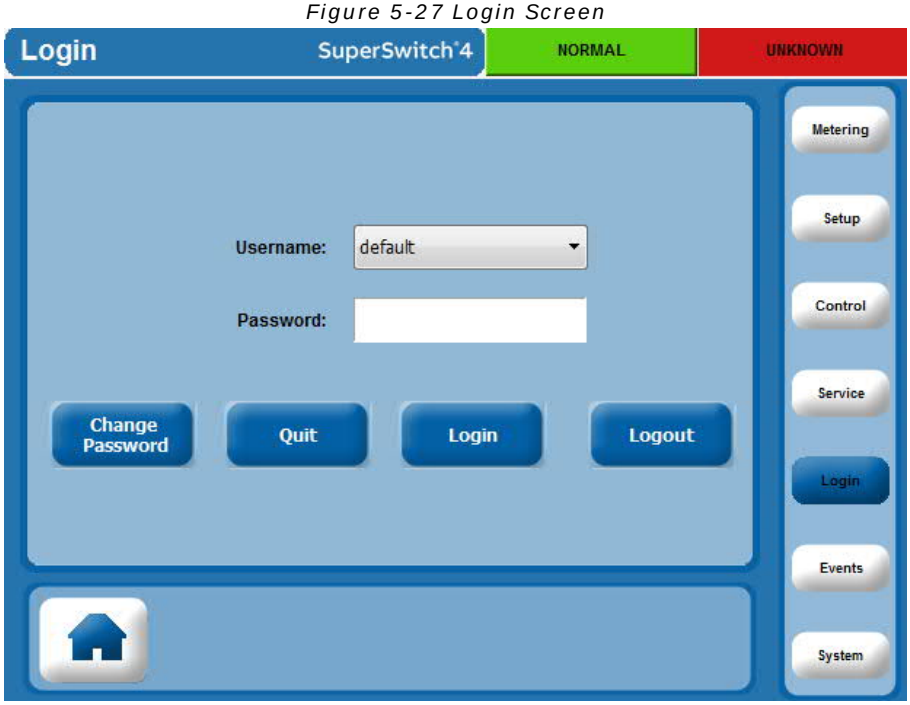
The login screen is enabled if the user has enabled security (see Section 4.4.3.1)

Once Security is enabled, there are two default usernames, USER and ADMIN.

Default passwords for the usernames can be obtained from your ABB representative.

Press the CHANGE PASSWORD button and follow instructions on the screen to update password for each user as required.

Figure 5-27 Login Screen



5.1.6 Events

The Events screen shows any events that occur during the operation of the SS4. This can be accessed from either the home screen or the Metering screen by pressing “Events”.

There are various types of events. Informational events have black text. Warnings are in yellow. These notify of a potential future problem. Alarms are in red and indicate a critical issue.

Certain alarm events must be acknowledged to silence the audible alarm. Unacknowledged events have an exclamation point (!) preceding them. They can be acknowledged via the “Ack All” button if you are logged in as ‘admin’ or if Security is disabled.

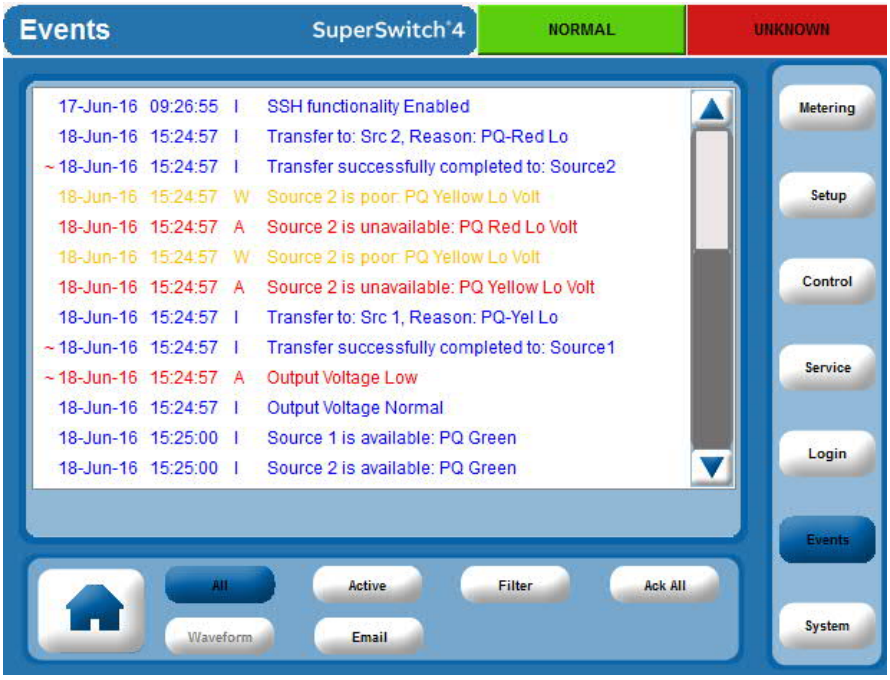
Active events have an asterisk (*) preceding the event’s description.

Some events are only active when the fault condition is present and become inactive automatically when the fault goes away. An example of this is a Red PQ for a source.

Some events (only alarms) remain latched even if the original fault condition clears itself. These must be specifically cleared from the Service->Reset screen. An example of this is a Shorted SCR fault.

Events preceded with a tilde (~) have waveforms associated with it, which can be viewed by selecting the event and pressing the “Waveform” button. No login is required.

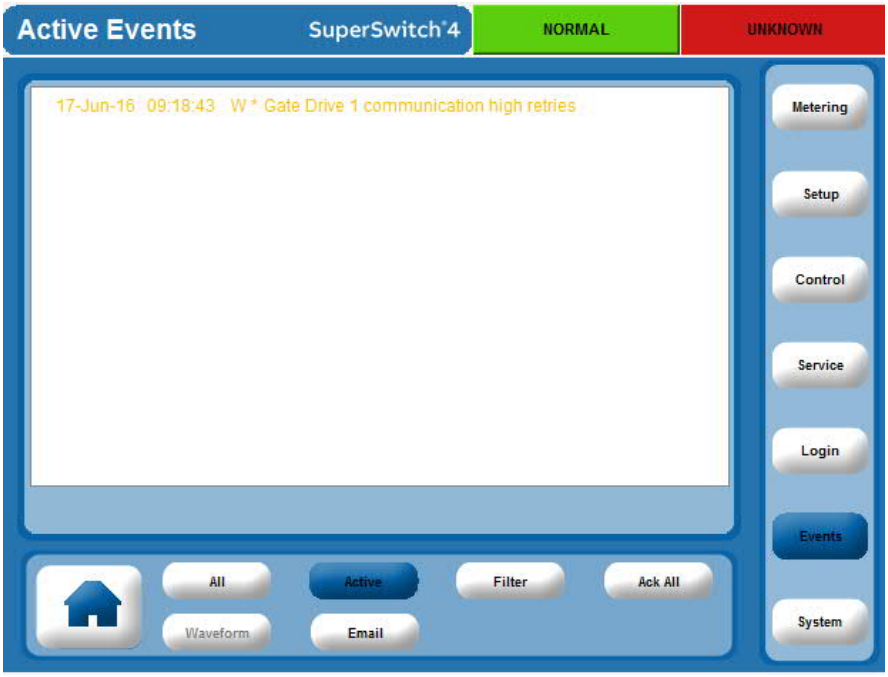
Figure 5-28 Events Screen



5.1.6.1 Active Events

This screen allows the user to view all active events on the screen.

Figure 5-29 Active Alarm Screen



5.1.6.2 Filtered Events

This screen allows the user to filter shown events.

Events can be filtered to Active, Alarm,Warning, Info, and Un-Acknowledge by clicking the check box.

Events can be filtered to Date by clicking the check box and entering the appropriate dates

Events can be filtered by text in results by entering text in the text window, and then click E.

To return to the Events screen, click Exit.

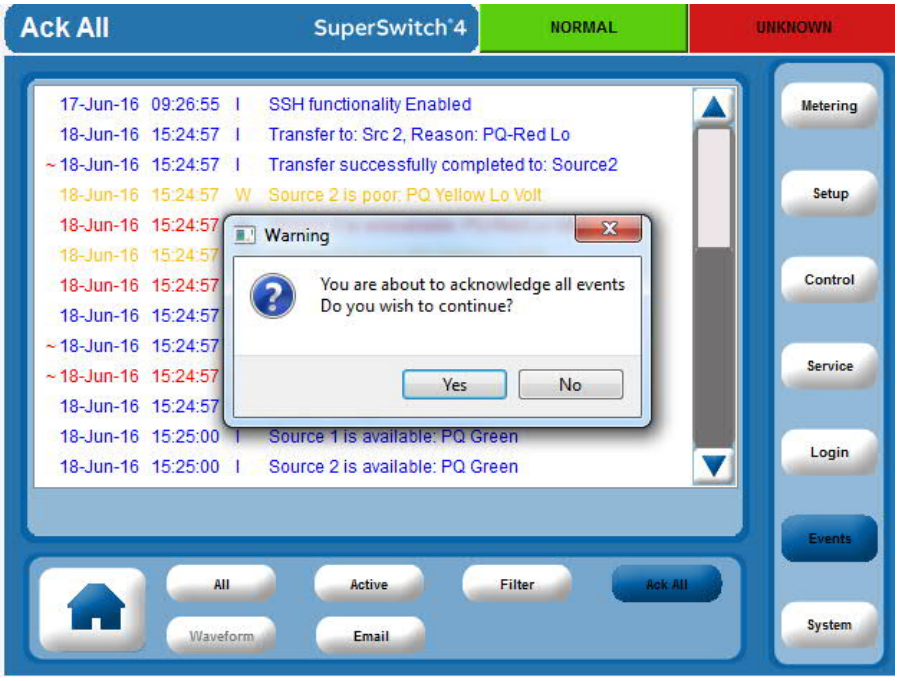
Figure 5-30 Filtered Event Screen

5.1.6.3 Ack All Events

This button allows the user to acknowledge all unacknowledged events, which are indicated by a preceding exclamation mark (!) and by the audible alarm sounding.

To clear these unacknowledged events, the user can press the Ack All button. The confirmation screen will appear as shown below. After the user confirms acknowledgement, the buzzer warning stops, and the exclamation mark is removed from the events. The user must be logged in as 'admin' or Security must be disabled to use this feature.

Figure 5-31 Acknowledge All Events Screen



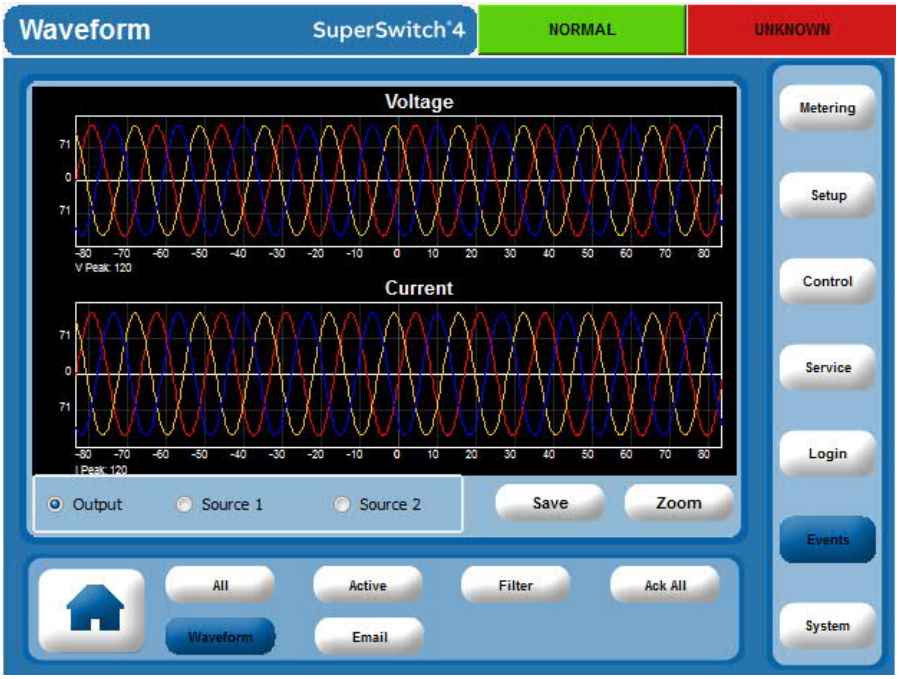
5.1.6.4 Waveform Captures

This screen allows the user to view waveform captures on selected events.

These events are noted on the Events screen when preceded by the tilde (~). The user must first highlight the event, then select WAVEFORM to view the waveform. No login is required.

The user can return to the event list by selecting any of the other buttons.

Figure 5-32 Waveform capture screen



5.1.6.5 Email Screen

This screen allows the user to send a list of all events through email. No login is required.

Email must first be configured per Section 4.4.4.3.

Figure 5-33 E-mail Screen

5.1.7 System/Info

This screen can be accessed from the Home screen by pressing Info, or from the Metering Screen by pressing System. This screen has four (3) sub-screens: “Profile”, “Config”, and “Statistics”

5.1.7.1 Profile

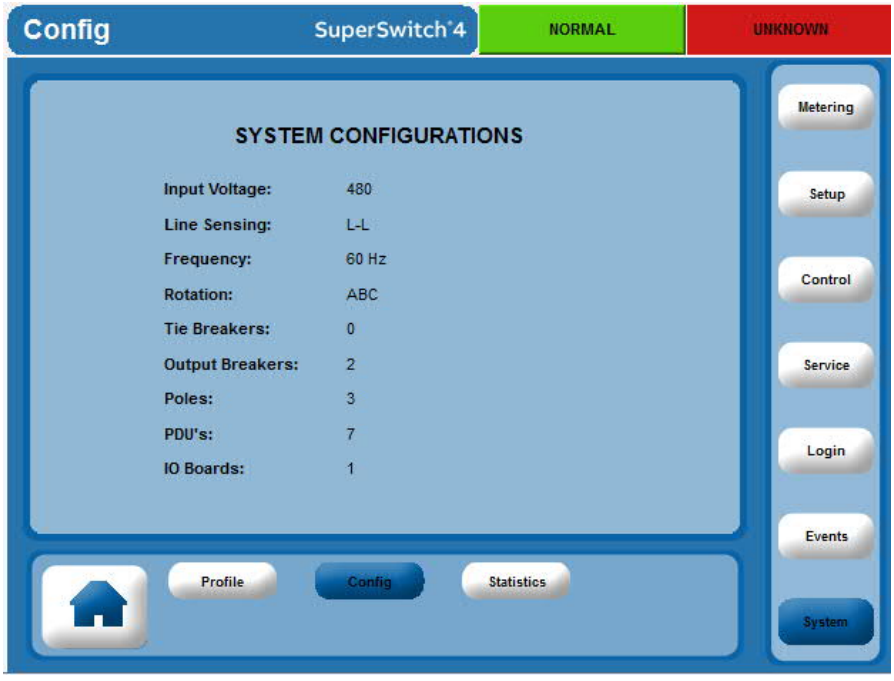
This screen allows the user to see the system profile, which contains the software versions of all the boards in the system.

Figure 5-34 Information screen

5.1.7.2 Config

This screen allows the user to see system configuration, which contains the system voltage rating, frequency, phase rotation, output/tie circuit breakers, numbers of PDUs, and numbers of user interface boards.

Figure 5-35 System configuration



5.1.7.3 System statistics

This screen allows the user to view the PQ status on pie chart, output active status, and system transfers count of total, PQ, manual, and others.

Figure 5-36 PQ status

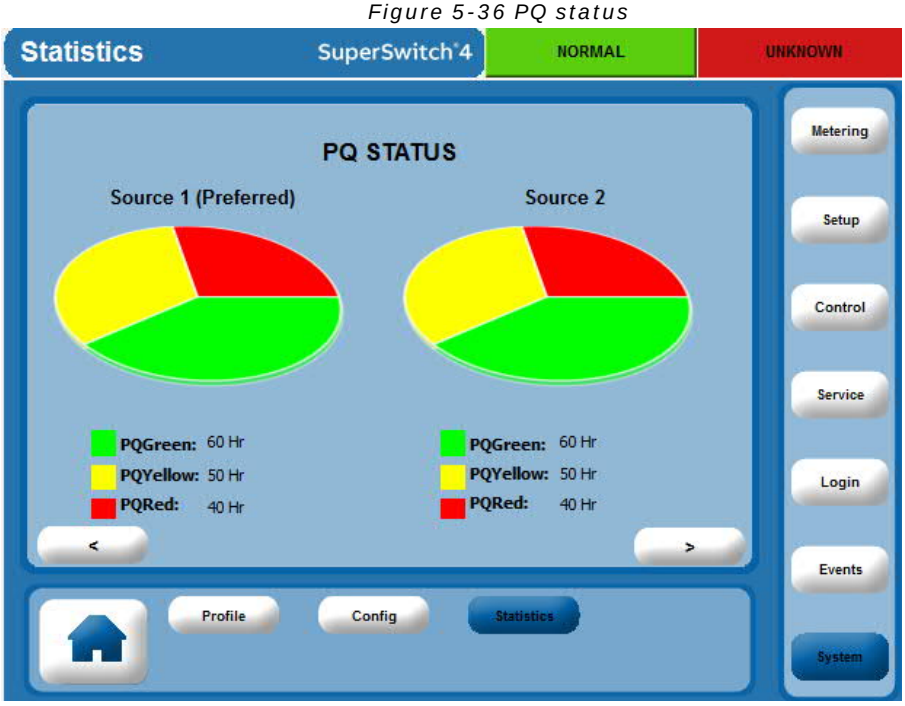


Figure 5-37 Output & active status

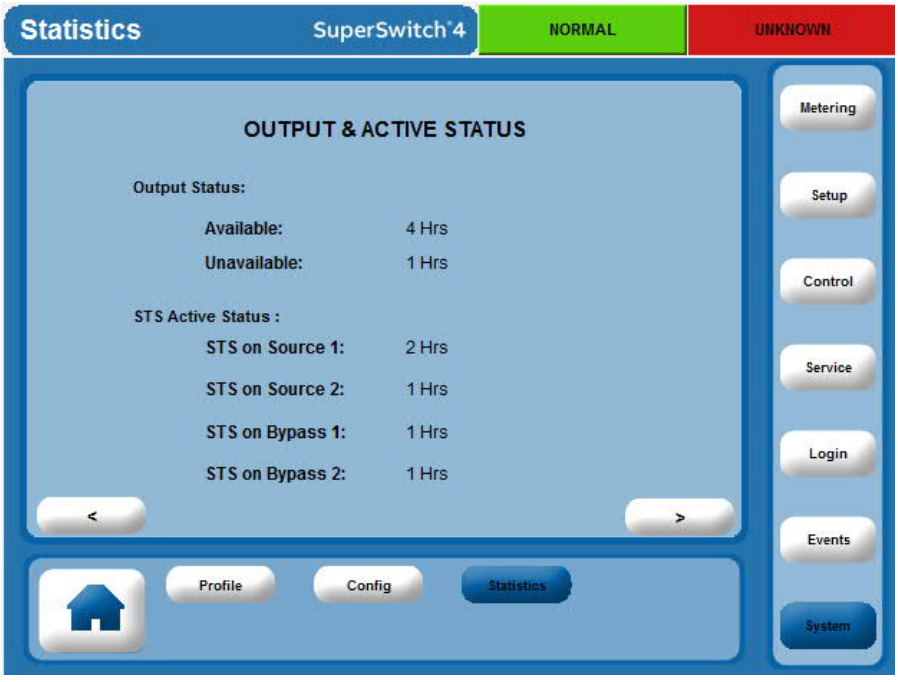
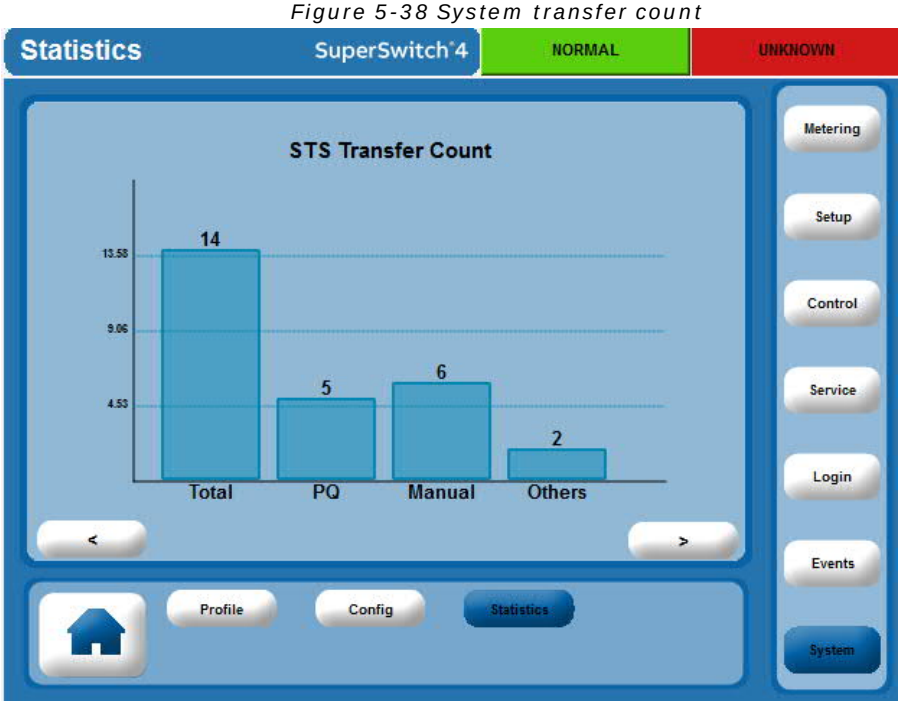


Figure 5-38 System transfer count



6 PCA's and Subassemblies

6.1 Introduction

The essential function of this system is to keep the critical load bus powered with the best available power quality. The SS4 powers the load bus from the preferred source, if it is available and of sufficient power quality. If the preferred source is not available or is of lesser power quality than the alternate source, the SS4 transfers the load bus to the alternate source. In the event of a load side short circuit or over-current, the SS4 logic will inhibit any transfer away from the active source, thereby preventing the fault condition from impacting the power quality on the inactive source.

Dedicated, one (1) per source, sensing circuits continuously monitor the quality of each source connected to the SS4. When the quality of the connected source fails to meet accepted limits, the logic will cause the SS4 to transfer the load to the alternate source, if it is of greater quality. During the transfer, no current flows between sources. The transfer will be completed within requirements of the referenced standards. Refer to Section 4.2.3.9 to set up transfer parameters.

The principal functionality of the SS4 is divided among various printed circuit board assemblies.

- Central Power Supply
- Display Board
- Main Logic Board
- Two (2) Gate Drive Boards
- User Interface Board
- Analog Board
- Neutral Gate Drive (Four (4) Pole only)
- Other board assemblies (TVSS & Snubber)

6.2 Functional Description of the SS4 Circuit Boards

6.2.1 Power Supply

6.2.1.1 Central Power Supply

This power supply is used on most SS4 applications. The Power Supply Board is fed by three (3) individual transformers, which step the voltage down from source voltage to the necessary voltage to feed the power supply board rectifiers.

- Transformer 1 fed by Source 1, Phase A to Phase B
- Transformer 2 fed by Source 2, Phase B to Phase C
- Transformer 3 fed by output bus, Phase C to Phase A

The power supply delivers:

- Four (4) Independent DC buses for the Gate Drives. Two buses are used by each Gate drive for redundancy.
- Two (2) Independent DC buses for Display Board for redundancy.
- One (1) DC bus for the User Interface Board.
- Two (2) Independent DC buses for Main Logic Board for redundancy.
- One (1) DC bus for the Analog Board.
- One (1) redundant 24 VDC power supply for the Analog Board
- Output DC buses will be 28 VDC, unregulated +15%/-30%.
- Power for a minimum of 100 milliseconds after all sources have failed; assumes that at least one (1) source was at nominal voltage immediately prior to the loss of all AC input voltage.

The Power Supply Board features:

- Monitoring differentiates and identifies individual bus and input failures.

- A coded, three (3) bit word will convey fault information to the Main Logic Board. The Main Logic Board will evaluate input failure with source availability to determine the nature of the failure.
- Indicating LEDs aid in identification of faults.
- Each output is fused.
- Each output is supported by sufficient capacitance to blow the output fuse when a short circuit occurs on an individual bus

6.2.1.2 Universal Power Supply Assembly

This power supply is used on SS4 4-pole and 250A applications, and is a modular, fully redundant power supply architecture. The primary components of this system are the three (3) independently supplied Power Supply Boards (PS) and the two (2) Power Distribution Boards (PDB).

Each PS is fed by a separate transformer, which provides galvanic isolation and stepped-down voltage from its source.

- PS1 is connected to Transformer 1 (T1) fed by Source 1, Phase A to Phase B
- PS2 is connected to Transformer 2 (T2) fed by Source 2, Phase B to Phase C
- PS3 is connected to Transformer 3 (T3) fed by the Output bus, Phase C to Phase A

Each PS provides the following standard features:

- One (1) AC input from the output of the transformers, 2P 2W+PE, with fusing.
- One (1) 28VDC output bus, unregulated +15%/-30%.
- One (1) 24VDC output bus, regulated.
- Power for a minimum of 100 milliseconds after all sources have failed; assumes that at least one (1) source was at nominal voltage immediately prior to the loss of all AC input voltage.
- Diagnostic LED for each DC output bus.

Each DC output bus of each PS connects to both PDB's. Each PDB provides true redundancy in the form of diode decoupling for each DC input, preventing backfeed in the event of a PS failure. The PDB provides the following standard features:

- Three (3) 28VDC unregulated input connectors, one (1) from each PS.
- Three (3) 24VDC regulated input connectors, one (1) from each PS.
- One (1) auxiliary 24VDC input connector, for connection to auxiliary power supply (certain models only).
- Five (5) individually fused 28VDC unregulated output connectors.
- One (1) fused 24VDC regulated output connector.
- Monitoring that differentiates and identifies individual bus and input failures.
- A coded, three (3) bit word will convey fault information to the Main Logic Board. The Main Logic Board will evaluate input failure with source availability to determine the nature of the failure.
- Indicating LEDs aid in identification of faults.

Lastly, for complete redundancy, each SS4 circuit board provides individually fused and diode decoupled DC input connections from each PDB.

6.2.2 LCD Display Assembly

The LCD Display Assembly portion of the SS4 provides the User-Interface (UI), communicates with the Main Logic and User Interface Boards, and enables the user to interact with the unit through its touchscreen. The Display Board also supports a USB service connection and allows for data collection or software upgrades through the USB port.

LEDs resident on the board give indication of critical component failures, such as memory. The serial port and event log give indication of non-critical component failures, such as the LCD display.

Additional functions include:

- LCD backlighting circuits
- Contains a real-time clock to provide time stamps for all events
- Ambient temperature circuit.

6.2.3 Main Logic Board (MLB)

The Main Logic Board contains three (3) separate sections: Source 1 Control, Source 2 Control, and Main Control Logic. Each source has a dedicated section to sense, analyze, and respond to conditions pertinent to controlling the SS4 when connected to that source. The key component to this function is a DSP, which monitors the source quality of each source.

Partitioning the Main Logic Board into three (3) sections provides separate "fault-containment" regions. Each section receives its own 24 Volt control power source from the Main Power Supply via the Analog Board. All regulated digital and analog sources required for each section are derived from their own 28 Volt supply. Each section's 24 Volt supply is diode-isolated and fused separately from the others.

The microprocessor in the Main Control Logic Section performs the following functions:

- Serves as a flight recorder and communicator of all SS4 functions.
- Measures SS4 output voltages and currents.

The Main Logic Board detects and responds to the following system fault conditions:

- Open SCR
- Shorted SCR
- Gate Drive power supply failure
- Communication failures
- Main Logic Board power supply failures
- Power quality faults
- Fan failures
- Fault level over-currents
- Cabinet over-temperature
- Heatsink over-temperature by assembly
- Tripped circuit breakers
- Inactive source fault current
- Neutral current excess of user set point
- Ground current excess of user set point

6.2.4 Gate Drive Board

Based on commands from the Main Logic Board, the Gate Drive controls the SCRs that determine which source is connected to the load bus. The Gate Drive Board communicates with the Main Logic Board via fiber optic cables to provide a fast, noise-immune communication link.

The Gate Drive Board produces independent, isolated voltages for the monitoring and firing of the SCRs for each of the three (3) phases of its source.

Caution

CAUTION – Extreme care to avoid equipment damage or injury to personnel.

- High voltages (equal to system source voltage) are present on this board at connectors J2, J3, J4, J5, J6, and J7.
- Observe proper safety measures.

6.2.5 Neutral Gate Drive Board

Neutral Gate Drive Board receive commands from Main Logic Board, Neutral Gate Drive controls the Neutral SCRs of source1 and source2.

Neutral Gate Drive Board produces independent, isolated voltages for the monitoring and firing of neutral SCRs of each sources.

Caution

CAUTION – Extreme care to avoid equipment damage or injury to personnel.

- High voltages (equal to system source voltage) are present on this board at connectors J2, J3, J4, and J5.
- Observe proper safety measures.

6.2.6 User Interface Board

The User Interface Board is the only board available for customer communication connections. Refer to the tables below to identify the inputs and outputs mapped to the User Interface Board.

Outputs

Alarm Relay contacts indicating status of the SS4:

Table 6-1 Fixed alarm relay contacts

Alarm	Terminals	Name	Function
1	J1-1, 2, 3	Summary Alarm	De-energized if any alarm is present
2	J1 – 4, 5, 6	Summary Warning	Energized if any warning is present
3	J1 – 7, 8, 9	S1 Available	Energized when S1 is available
4	J1 – 10, 11, 12	S2 Available	Energized when S2 is available
5	J2 – 1, 2, 3	S1 Active	Energized when S1 is active
6	J2 – 4, 5, 6	S2 Active	Energized when S2 is active
7	J2 – 7, 8, 9	UnAcked Events	Energized whenever there are unacknowledged
8	J2 – 10, 11, 12	On non-preferred Source	Energized when unit is on the non-preferred source

The remaining 8 relays can be assigned to any of the following list of events.

Table 6-2 User selected alarm events

Alarms		
Auto transfer disabled	Open SCR	Source 1 Input Breaker open
Fan failure	Output unavailable	Source 2 Input Breaker open
Gate drive communications lost	Output voltage low	Source DSP communications to Display
Gate drive fuse fault	Over-temperature	Source out of sync
Gate drive opto fault	Peak current inhibit	Source PQ dead
Gate hold	Power supply fault	Source PQ over-voltage red
Gate lock	Re-transfer disabled	Source PQ over-voltage yellow
ISOC	S1 Bypass Breaker closed	Source PQ under-voltage red
Load A Breaker open	S2 Bypass Breaker closed	Source PQ under-voltage yellow
Load B Breaker open	Shorted SCR	TVSS fault
MLB communications to Display lost		

Inputs

These inputs are floating to 24VDC when inactive. The active state = input grounded via a hard contact or an open-collector output. The following table lists the inputs and their functions.

Table 6-3 Relay inputs

Input	Gnd	Name	Function
J15-1	J15-2	EPO	Emergency Power Off
J16-1	J16-2	REPO	Remote Emergency Power Off
J14-1	J14-2	S1 Preferred	When pulsed low, sets Source 1 as preferred
J14-3	J14-4	S2 Preferred	When pulsed low, sets Source 2 as preferred
J14-5	J14-6	Transfer/Hold to S1	Transfer to S1 and remain there, if, input is low. Return to preferred if input is released. (No effect if S1 is already active). See Note 1.
J14-7	J14-8	Transfer/Hold to S2	Transfer to S2 and remain there, if, input is low. Return to preferred if input is released. (No effect if S2 is already active). See Note 1.
J13-1	J13-2	Temporary Retransfer Enable	When pulsed, retransfer will be enabled temporarily for 10 seconds. This will allow the user to allow the unit to retransfer to the preferred source when retransfer is disabled. No effect if retransfer is already enabled. See Note 1
J13-3	J13-4	Auto Transfer Disable	Disable Auto Transfer when input is low. See Note 1.
J13-5	J13-6	Not used	Available for custom applications
J13-7	J13-8	Not used	Available for custom applications

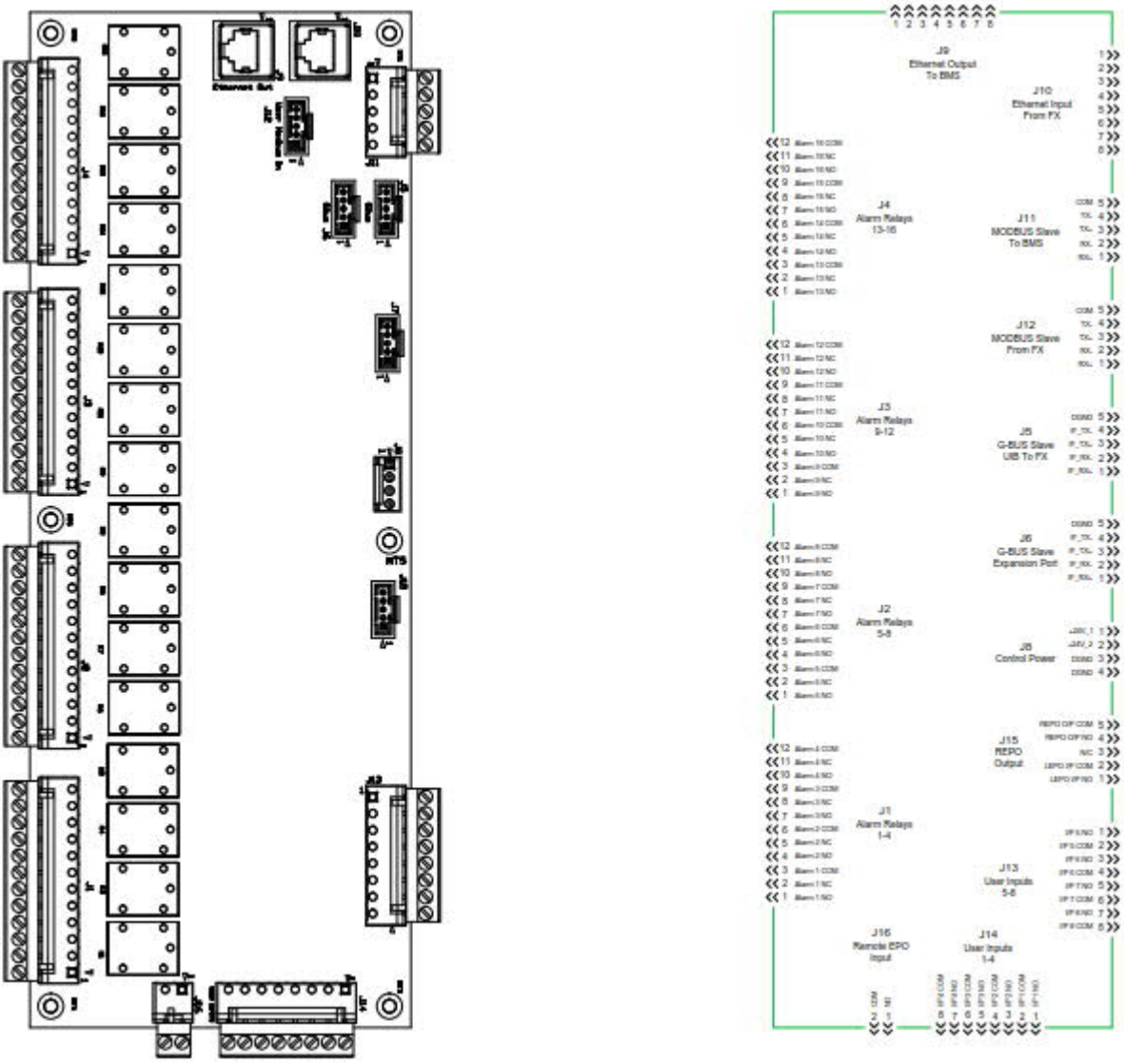
The User can connect to the User Interface Board via Modbus TCP (J12) and Modbus RTU (J9).

Note 1: This feature will be enabled/disabled via a checkbox in the GUI, as well as via the Service Port. In the case of Preferred Source selection and Auto Transfer Disable, the local control of this function will no longer work when the remote control is active. In other words, if Remote Preferred Source control is enabled, then local control via the GUI will be disabled.

This image is for illustrative purposes only and may not reflect the most recent revision of this PCB.

Consult the factory with any further questions.

Figure 6-1 User Interface Board



6.2.7 Analog Board

The Analog Board provides a “patch panel tie point” for various signals that interface between the system control elements (mainly the Main Logic Board) and other devices in the cabinet, such as voltage and current monitoring transducer elements.

The basic function of the Analog Board is to provide a mechanically convenient (for manufacturability, testability, and field serviceability) interconnect means to aggregate signals and cables from a variety of locations to the Main Logic Board. Signal processing circuits are also present on this board, which provide a buffer between MLB logic (or low-level signal levels) and the high-level inputs to or outputs from the MLB to other devices in the system. The principal functions of the Board include:

6.2.7.1 Source 1 sensing

- Each phase voltage (3) sensed line-line or optionally line-neutral
- Each phase current (3)
- Neutral

6.2.7.2 Source 2 sensing

- Each phase voltage (3) sensed line-line or optionally line-neutral
- Each phase current (3)
- Neutral

6.2.7.3 Output sensing

- Each phase voltage sensed line-line or optionally line-neutral
- Each phase current

6.3 Switches/Breakers

SS4 is equipped with four (4) switches to control the power path (Source 1 Input, Source 2 Input, Source 1 Bypass, and Source 2 Bypass) and two (2) redundant output switches to protect the load bus connection. Molded Case switches are used in most models. All switches, except Load A switch, are equipped with shunt trip coils. These are controlled by the SS4 logic to ensure proper and safe operation. Load Switch A is not equipped with a shunt trip coil to ensure that no single point of failure can cause the load bus to be disconnected.

Source 1 and Source 2 Bypass switches are mechanically interlocked by “Kirk-Keys” to guard against the accidental cross-connecting of two (2) sources due to the closure of the wrong bypass device by the operator.

Note: All internal breakers are 100% rated.

Safety consideration

CAUTION

SS4 is equipped with non-automatic switches unless otherwise specified. As such, they provide no long-term over-current protection. Overload and fault protection must be user supplied in the form of upstream breakers or fused disconnect switches. Reference Section 6 for manufacturer’s recommendations.

Note: For the short-circuit interrupt rating of a unit in question, please refer to the unit's nameplate.

Units have been tested and will be marked with maximum short circuit withstand current of 100KAIC at 480V. However, options are available for lower KAIC switch ratings. The nameplate KAIC ratings take precedence and should be referred to for compatibility with your facility.

6.4 Other Assemblies

6.4.1 Power Stage

The Power Stage is comprised of the following elements:

- Heatsink Assemblies
- Cooling Fans
- Snubber Boards

There are three (3) heatsink assemblies, one (1) for each of the three (3) phases of the power sources. Each heatsink assembly contains two (2) pairs of anti-parallel connected SCRs. Each pair of anti-parallel SCRs forms an AC switch. These pairs of switches are connected at the load bus with one end of the first pair connected to A-phase of Source 1 and the remaining end of the AC switch is connected to A-phase of Source 2. B-phase and C-phase are likewise connected on their respective heatsink assemblies. Each heatsink assembly can be removed separately for servicing.

Cooling fans are required to maintain safe operating temperatures on most SS4 models. When required, the fans are located at the top portions of the SS4 cabinet. From this position, the fans create a low velocity of inlet air at the bottom of the cabinet, negating the need for inlet air filters on models less than 1600A. 1600A and 2000A models have air filters replaceable from the front access. It is recommended to remove the air filters every 3 months for cleaning. The air filters installed can be vacuumed or cleaned with water and reinstalled repeatedly. The fans installed in the SS4 2000A unit have a service life of approximately 40,000 hours operating at an ambient temperature of 40°C. Fan replacement is recommended after 4.5 years of use for best serviceability. Contact ABB service center for maintenance and replacement of fans.

The fans are arranged in a redundant configuration. If a fan fails, its failure is sensed, and the condition is shown on the display. The alternate fans are fully rated for all SS4 operating conditions. Fault messages are issued to alert the user when service is needed.

Six (6) Snubber Boards (one [1] for each SCR switch pair) are provided to protect the SS4 from externally generated transient voltages and to limit the dv/dt seen by the SCRs during a transfer.

6.4.2 Surge Protective Devices

Each SS4 is equipped with Surge Protective Devices (SPDs) for each of its power sources. These devices provide protection from externally generated voltage transients. The standard protection level provided is up to a 20,000-volt spike, per IEEE C62.41 Category C3 Standards.

7 External protection

7.1 Introduction

All branch circuits and loads connected to the output bus of the SS4 should be protected and isolated by protective devices supplied by the user in accordance with local codes and ordinances.

Properly selected upstream protection for both sources connected to the SS4 is required to ensure safe operation of the system. The user's upstream protection must supply continuous over-current protection, i.e. a SS4 rated for 400 amps must have long-term protection sized for 400 amps.

Note	
	IMPORTANT – NOTE SS4 has a maximum system short circuit rating of 100kA at 480V.
	IMPORTANT – NOTE Although Molded Case switches supplied internal to the SS4 have trip functions, their operation is not certified by Underwriters Laboratories (UL) and cannot be part of the UL Listed system protection scheme. The user should be aware that these devices will open under fault currents of eight to ten times the rated current of the SS4. SS4 has been approved and UL Listed to operate with the breakers shown on the following charts as upstream protection.
	IMPORTANT – NOTE Breakers listed are 100% rated. Equivalent models of breakers rated at 80% are also acceptable, provided they are sized accordingly; i.e., 100% rated breaker for 400 Amps = 80% rated breaker for 500 Amps.

Table 7-1 External protection breakers current rating 200A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T4HQ200	(100%)	37,000	1.40	2.04	65kA
ABB	T4LQ200	(100%)	40,500	1.60	1.95	100kA
ABB	T4VQ200	(100%)	40,500	1.90	2.32	150kA
Square D	LXI(L)36600	(80%)	43,000	2.80	4.00	200kA
Square D	LI(L)36600	(80%)	48,000	2.45	6.00	200kA
Square D	LC(L)36600	(80%)	92,000	26.40	8.33	65kA
Square D	LLA36600	(80%)	54,000	3.4	10	100kA
GE	SGPA36AT0400	—	62,000	12.50	8.30	100kA
GE	SGPA36AT0600	—	62,000	12.50	8.30	100kA

Table 7-2 External protection breakers current rating 400A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T5HQ400W	(100%)	44,500	2.40	2.42	65kA
ABB	T5LQ400W	(100%)	49,500	2.40	1.96	100kA
ABB	T5VQ400W	(100%)	49,500	2.40	1.96	150kA
Square D	LXI(L)36600	(80%)	43,000	2.80	4.00	200kA
Square D	LI(L)36600	(80%)	48,000	2.45	6.00	200kA
Square D	LC(L)36600	(80%)	92,000	26.40	8.33	65kA
Square D	LLA36600	(80%)	54,000	3.4	10	100kA
GE	SGPA36AT0400	—	62,000	12.50	8.30	100kA
GE	SGPA36AT0600	—	62,000	12.50	8.30	100kA

Table 7-3 External protection breakers current rating 600A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T5V600W	(80%)	49,500	2.40	1.96	150kA
ABB	T6HQ600W	(100%)	60,250	10.80	5.95	65kA
ABB	T6LQ600W	(100%)	75,000	11.30	4.01	100kA
Square D	CKHED36808LI	—	87,000	25.00	7.50	65kA
Square D	LI(L)36600	—	48,000	2.45	6.00	200kA
Square D	LXI(L)36600	—	56,000	2.80	4.80	200kA
Square D	LLA36600	(80%)	54,000	3.4	10	100kA
GE	SGPA36AT0600	—	62,000	12.50	8.30	100kA
GE	SGLA36AT0600	—	55,000	10.30	10.20	65kA

Table 7-4 External protection breakers current rating 800A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T6HQ800W	(100%)	60,250	10.80	5.95	65kA
ABB	T6LQ800W	(100%)	75,000	11.30	4.01	100kA
Square D	CKHED36808LI	—	87,000	25.00	7.50	65kA
Square D	PL 800/1000/1200	—	110,000	41.30	10.20	100kA
Square D	PJ 800/1000/1200	—	100,000	40.00	12.00	65kA
Siemens	CMD63B800	—	115,000	32.00	7.05	100kA
Siemens	CND63B1000	—	115,000	32.00	7.05	100kA
GE	SKPA36AT1200	—	164,000	103.60	11.60	100kA
GE	SKLA36AT1200	—	120,000	73.00	17.50	65kA
GE	SKPA36AT0800	—	164,000	103.60	11.60	100kA
GE	SKLA36AT0800	—	120,000	73.00	17.50	65kA

Table 7-5 External protection breakers current rating 1000A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T7HQ1000W	(100%)	96,000	12.10	2.63	65kA
ABB	T7LQ1000W	(100%)	120,000	14.00	1.95	100kA
Square D	RJF36160U41G	—	131,000	100	17	65kA

Table 7-6 External protection breakers current rating 1200A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (Amps)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T7HQ1200W	(100%)	96,000	12.10	2.63	65kA
ABB	T7LQ1200W	(100%)	120,000	14.00	1.95	100kA
Square D	PLL34120U33A	—	63,180	11.10	6.34	100kA

Table 7-7 External protection breakers current rating 1600A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (kA)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T8VQC3F000000XX (100%)		41.1	11.8	14	100kA
Square D	NW16HL	MCCB	150	90	9	100kA
Square D	NW16HL1	ACB	150	90	9	100kA

Table 7-8 External protection breakers current rating 2000A

Recommended upstream protection breaker MFR	MFR part number		Peak let-through (kA)	I^2T let-through X 1,000,000	Total clearing time (Msec.)	Available source fault current @ 480V AC
ABB	T8VQD3G000000XX (100%)		41.1	11.8	14	100kA
Square D	NW20HL	MCCB	150	90	9	100kA
Square D	NW20HL1	ACB	150	90	9	100kA

8 Specifications

8.1 Standards

The SS4 compliant with the applicable requirements of:

- Listed by ETL to Underwriters Laboratories (UL) 1008S - Solid-State Transfer Switches
- ANSI/NFPA 70 (2002)
- National Electrical Code, 2002
- NEMA ST-20: Dry type transformers
- NEMA AB3-2001: Molded case Circuit Breakers
- NEMA 250: Enclosures for Electrical Equipment
- NEMA ICS 6, 1993: Industrial Controls and Systems Enclosures
- NEMA ICS 1: Industrial Control and Systems General Requirements
- NEMA ICS 10 P2, 1999: Industrial Control and Systems-AC Transfer Switch Equipment-Part 2: Static AC Transfer Equipment
- IEC 62310-1, First Edition, 2005-03 - Static Transfer Systems (STS) Safety
- IEC 62310-2, First Edition, 2006-01 - STS EMC Requirements
- IEC 62310-3, First Edition, 2008-06 - STS Performance Requirements
- IEC 60947-6-1, Second Edition - Transfer Switching Equipment
- Low Voltage Directive 2006/95/EC
- Electromagnetic Compatibility (EMC) Directive 2004/108/EC
- Underwriters Laboratories (UL) 50: Cabinets & Boxes
- Underwriters Laboratories (UL) 489: Molded Case Circuit Breakers and Enclosures
- Underwriters Laboratories (UL) 508, rev 1999: Industrial Control Equipment
- Underwriters Laboratories (UL) 840 for PCB spacing
- IEEE 587 (ANSI C 62.41): Surge/Noise Suppression

8.2 Electrical Characteristics

- Nominal Source Voltages:
  - 208, 380, 400, 415, 480 AC are available, 3 phase + ground and un-switched Neutral
- Source Frequencies: 50/60Hz
- Current Rating:
  - 200, 250, 400, 600, 800, 1000, 1200, 1600, 2000A continuous
- Load Power Factor: Unity to 0.50 lagging or leading
- Overload Rating:
  - 125% for thirty (30) minutes for computer room systems
  - 150% for one (1) minute
  - 200% for ten (10) seconds for computer room systems
  - 1000% for three (3) cycles for computer room systems
  - 1500% for one (1) cycle
- Harmonic Current Feedback from the load: Unlimited
- Source Harmonic Voltage Content in the line feeding the load:
  - Maximum 5% total harmonics or as acceptable to the load
  - Maximum 3% single harmonics or as acceptable to the load
- Voltage Transient Withstand without failure or malfunction, present on the line:
  - Up to 20,000-volt spike, per IEEE C62.41 Category C3 Standards. Such transient levels shall not affect the operation of the STS except to cause a transfer due to over-voltage beyond pre-set limits.
- Over-current Protection: The internal Molded Case are rated for the current rating on nampeplate. All Type II STS devices are non-automatic rated at 100kAIC as standard. However, options are available for lower KAIC switch ratings. The nameplate KAIC ratings take precedence and should be referred to for compatibility with your facility.

8.3 Environmental Characteristics

The SS4 has the capability of withstanding any combinations of environmental conditions listed below without mechanical or electrical damage or degradation of operation.

- Operating ambient temperature: 0 to 40° C
- Non-operating and storage ambient temperature: 0 to 80° C
- Relative humidity: 0 to 95% non-condensing
- Barometric Pressure: At elevations up to 6000 feet above sea level
- Equipment is designated for indoor use in a clean (dust-free), temperature and humidity-controlled environment
- AC to AC efficiency (defined as AC output kW divided by AC input kW at full nominal rating of 0.8 power factor load) is not less than 99%

8.4 Physical and Thermal Properties

The following table details the physical and thermal properties of selected SS4 models. Refer to the outline drawing enclosed with your unit for dimensions specific to your unit.

Table 8-1 Physical and thermal properties

Electrical Ratings		Physical Properties				Thermal Output	
Amps	Voltage	Required Access	Dimensions (WxDxH)	Estimated Weight (lbs.)	Noise Level at 1 meter (dBA)	BTU/Hr (Full Load)	kW (Full Load)
200	280	Front Only	48“W x 34“D x 77“H	1124	<65	3250	0.95
	480	Front Only	48“W x 34“D x 77“H	1124	<65	3250	0.95
250	208	Front Only	48“W x 34“D x 77“H	1124	<65	4650	1.36
	480	Front Only	48“W x 34“D x 77“H	1124	<65	4650	1.36
400	280	Front Only	48“W x 34“D x 77“H	1179	<65	9028	2.65
	480	Front Only	48“W x 34“D x 77“H	1179	<65	9028	2.65
600	280	Left or Right	34"W x 34"D x 74"H	1100	<65	8703	2.55
	480	Left or Right	34"W x 34"D x 74"H	1100	<65	8681	2.54
800	280	Left or Right	46"W x 34"D x 78"H	1600	<65	11604	3.40
	480	Left or Right	46"W x 34"D x 78"H	1600	<65	11574	3.39
1000	280	Left or Right	46"W x 34"D x 78"H	1700	<65	14506	4.25
	480	Left or Right	46"W x 34"D x 78"H	1700	<65	14468	4.24
1200	480	Left or Right	46"W x 34"D x 78"H	1750	73.2	22900	6.70
1600	480	Front Only	90"W x 36"D x 90"H	4795	75	40000	11.75
2000	480	Left & Rear	120"W x 60"D x 77"H	6560	84	64000	18.75

9 System maintenance

Minimal periodic maintenance of the unit is required. As with all electrical distribution components, this system should be regularly inspected for electrical connection integrity, signs of excessive temperature, accumulation of dirt, and proper system operation.

Warning	
	WARNING – Only qualified service personnel should perform maintenance on the SS4. – Exercise extreme care to avoid equipment damage or injury to personnel. – Lethal voltages exist inside the unit during normal operation. – The unit is supplied by multiple sources of AC power. Disconnect and lock out all sources of power before working inside the unit.

Warning	
	WARNING – To provide sufficient isolation protection when working upstream of the STS, open the respective source breaker (S1, S2) contained within the STS. Prescribing to this maintenance method reduces the risk of electric shock due to backfeed.

9.1 Tightening torques

Recommended tightening torque for all nuts and bolts is listed in the table below. As applicable, torque seal has been utilized to indicate bolt torqueing.

Table 9-1 Recommended tightening torque

Thread Size	SAE Grade 5 120,000 psi Medium Carbon Heat T.	
Inch	Lb-ft	N-m
1/4	6	8
5/16	11	15
3/8	20	27
1/2	48	65

All internal bolts are SAE Grade 5.
Note bolt head markings above to distinguish between grades.
All internal machine screws are Grade 2.

9.2 Testing the System

This unit includes comprehensive alarms and fault detection for identification of operational problems. Periodic transfer tests should be performed, including changing the preferred source and switching sources.

Refer to Sections 4.2 and 5.1.2 for specific instructions on source switching, transfers, and preferred source selection.

9.3 IR Ports – Infrared Technology

The Cyberex IR Port is an integrated optional feature that provides visual monitoring of power connections and terminations, which enables early detection and repair of degeneration and other damage that could cause dropped loads. Its integration with the equipment eliminates the need to shut down for inspection. It also eliminates the need to remove panels, which enhances workplace safety by significantly reducing the risk of arc flash incidents, as well as reducing the time needed to conduct inspections.

The location of IR ports varies with each specific production configuration and can be identified with octagonal or rectangular covers on the product doors and deadfronts. All IR ports have an average transmittance of 45%. For accurate temperature readings, the thermal camera must be calibrated to account for current conditions of each specific port. This includes transmittance and the angle of the scanner.

9.4 Status and Fault LEDs

Table 9-2 Display Board (FX) LED Indicators

LED #	Color	Indication (when lit)
LD1	Green	+12V Power Supply Voltage Present
LD2	Green	+5V Power Supply Voltage Present
LD3	Green	3.3V Power Supply Voltage Present
LD4	Green	3.3V uP Power Supply Voltage Present
LD5	Blue	CPLD Heartbeat: OK (when flashing)
LD6	Blue	CPLD Diagnostic LED 1: (Should be ON)
LD7	Blue	CPLD Diagnostic LED 2: (Should be ON)
LD8	Blue	CPLD Diagnostic LED 3: (Should be ON)
LD9	Blue	Processor Heartbeat: OK (when flashing)
LD10	Blue	Processor Diagnostic LED 1: (Should be OFF)
LD11	Blue	Processor Diagnostic LED 2: (Should be OFF)
LD12	Blue	Processor Diagnostic LED 3: (Should be OFF*)
LD13	Green	+3.3V LDO Power Supply Voltage Present

Table 9-3 Analog Interface Board (AIB) LED Indicators

LED#	Color	Indication (when lit)
LD1	Green	+12V_1 Power Supply Voltage Present
LD2	Green	+12V_2 Power Supply Voltage Present
LD3	Green	-12V_1 Power Supply Voltage Present
LD4	Green	-12V_2 Power Supply Voltage Present
LD5	Red	S1 Input CB Shunt Locking Relay: Active
LD6	Red	S1 Input CB Shunt Trip Relay: Active
LD7	Red	S1 Bypass CB Shunt Trip Relay: Active
LD8	Red	Output CB Shunt Trip Relay: Active
LD9	Red	Spare Shunt Trip Relay: Active
LD10	Red	S2 Input CB Shunt Trip Relay: Active
LD11	Red	S2 Bypass CB Shunt Trip Relay: Active
LD12	Red	S2 Input CB Shunt Locking Relay: Active
LD13	Green	24V_CAP Shunt Trip Power Present
LD14	Green	24V Shunt Trip Power Present

Table 9-4 Gate Drive Board (GDB) LED Indicators

LED#	Color	Indication (when lit)
LD8	Green	øB Forward SCR: Active
LD10	Green	øB Reverse SCR: Active
LD14	Green	øC Forward SCR: Active
LD16	Green	øC Reverse SCR: Active
LD18	Green	øA Forward SCR: Active
LD20	Green	øA Reverse SCR: Active
LD22	Blue	Processor Heartbeat (OK when flashing)
LD24	Blue	Source: Active
LD25	Red	Fault Alarm: Active

Table 9-5 Main Logic Board (MLB) LED Indicators

LED#	Color	Indication (when lit)	LED#	Color	Indication (when lit)
LD1	Blue	FPGA OK (when flashing)	LD38	Red	ALARM_SPARE 2
LD2	Blue	FPGA Diagnostic LED 1 (Should be OFF)	LD39	Green	1.8V_S1 Power Supply Status: OK
LD3	Blue	FPGA Diagnostic LED 2 (Should be OFF)	LD43	Red	S2_UV_RED
LD4	Blue	FPGA Diagnostic LED 3 (Should be OFF)	LD44	Red	S2_UV_YEL
LD5	Blue	Main DSP OK (when flashing)	LD45	Red	S2_OV
LD6	Blue	Main DSP Diagnostic LED 1 (Should be OFF)	LD46	Red	S2_OL
LD7	Blue	Main DSP Diagnostic LED 2 (Should be OFF)	LD47	Red	S2_Peak OL
LD8	Blue	Main DSP Diagnostic LED 3 (Should be OFF)	LD48	Red	S2_BYPASS
LD9	Green	+3.85V_1 Power Supply Voltage Present	LD49	Red	S2_INHIBIT
LD10	Green	+5V_1 Power Supply Voltage Present	LD50	Red	S2_PLL_SYNC
LD11	Green	+3.85V_2 Power Supply Voltage Present	LD51	Red	S2_SPARE 1
LD12	Green	+5V_2 Power Supply Voltage Present	LD52	Red	S2_SPARE 2
LD13	Green	1.2V_M Power Supply Status: OK	LD53	Blue	S2 DSP OK (when flashing)
LD14	Green	1.8V_M Power Supply Status: OK	LD54	Red	S2 DSP Diagnostic LED 1: (Should be OFF)
LD15	Green	1.2V_S2 Power Supply Status: OK	LD55	Blue	S2 DSP Diagnostic LED 2: (Should be OFF)
LD16	Green	1.8V_S2 Power Supply Status: OK	LD56	Blue	S2 DSP Diagnostic LED 3: (Should be OFF)
LD17	Green	1.2V_S1 Power Supply Status: OK	LD61	Red	S1_UV_RED
LD18	Green	S1_PREF	LD62	Red	S1_UV_YEL
LD19	Green	S2_PREF	LD63	Red	S1_OV
LD20	Green	FAULT CLR (Faults were cleared by user)	LD64	Red	S1_OL
LD21	Green	RETRANSFER (Auto Retransfer Enabled)	LD65	Red	S1_Peak OL
LD22	Green	S1_ON (STS on S1)	LD66	Red	S1_BYPASS
LD23	Green	S2_ON (STS on S2)	LD67	Red	S1_INHIBIT
LD28	Red	PHASE_ERROR (S1/S2 are out of phase)	LD68	Red	S1_PLL_SYNC
LD29	Red	VCC_FAULT (Loss of control power)	LD69	Red	S1_SPARE 1
LD30	Red	TEMP_FAULT (Over-Temperature)	LD70	Red	S1_SPARE 2
LD31	Red	GATE_LOCK (Transfers Inhibited)	LD71	Blue	S1 DSP OK (when flashing)
LD32	Red	FAN_FAULT	LD72	Blue	S1 DSP Diagnostic LED 1: (Should be OFF)
LD33	Red	FREQ_ERROR	LD73	Blue	S1 DSP Diagnostic LED 2: (Should be OFF)
LD34	Red	GATE_DR_FAULT	LD74	Blue	S1 DSP Diagnostic LED 3: (Should be OFF)
LD35	Red	COMM_ERROR	LD75	Blue	FPGA Diagnostic LED 4: (Should be OFF)
LD36	Red	EPO	LD76	Blue	FPGA Diagnostic LED 5: (Should be OFF)
LD37	Red	ALARM_SPARE 1			

Table 9-6 User-Interface Board (UIB) LED Indicators

LED #	Color	Indication (when lit)
LD1	Green	EPO/REPO: Active
LD2	Green	User Input 7: Active
LD3	Green	User Input 6: Active
LD4	Green	User Input 5: Active
LD5	Green	User Input 4: Active
LD6	Green	User Input 3: Active
LD7	Green	User Input 2: Active
LD8	Green	User Input 1: Active
LD9	Green	Alarm 1 Relay: Active (Summary Alarm Inactive)
LD10	Green	Alarm 8 Relay: Active (On Nonpreferred Source)
LD11	Green	Alarm 2 Relay: Active (Summary Warning Inactive)
LD12	Green	Alarm 3 Relay: Active (Source 1 Available)
LD13	Green	Alarm 4 Relay: Active (Source 2 Available)
LD14	Green	Alarm 5 Relay: Active (Source 1 Active)
LD15	Green	Alarm 6 Relay: Active (Source 2 Active)
LD16	Green	Alarm 7 Relay: Active (Unacknowledged Events Present)
LD17	Green	Alarm 9 Relay: Active
LD18	Green	Alarm 16 Relay: Active
LD19	Green	Alarm 10 Relay: Active
LD20	Green	Alarm 11 Relay: Active
LD21	Green	Alarm 12 Relay: Active
LD22	Green	Alarm 13 Relay: Active
LD23	Green	Alarm 14 Relay: Active
LD24	Green	Alarm 15 Relay: Active
LD25	Blue	Microcontroller: OK (when flashing)
LD26	Green	User Input 8: Active

Table 9-7 Neutral Gate Drive Board (NGDB) LED Indicators – 4 pole only

LED#	Color	Indication (when lit)
LD1	Green	Source2 Neutral Reverse SCR: Active
LD2	Green	Source1 Neutral Forward SCR: Active
LD3	Green	Source1 Neutral Reverse SCR: Active
LD4	Green	Source2 Neutral Forward SCR: Active
LD5	Green	Processor Heartbeat (OK when flashing)
LD10	Green	Power supply status LED (Good)

10 50Hz Application

10.1 System Fans

10.1.1 Auto Mode

The SS4 50Hz is equipped with pulse width modulation (PWM) fans on auto mode. In auto mode, the fans' speed adjusts based on individual load current and total consumed real power kW. While the STS is on bypass, the fans will run on the lowest setting of 20% duty cycle. If a fan fails or the cabinet experiences high temperatures, the fans will run on the highest setting of 100% duty cycle.

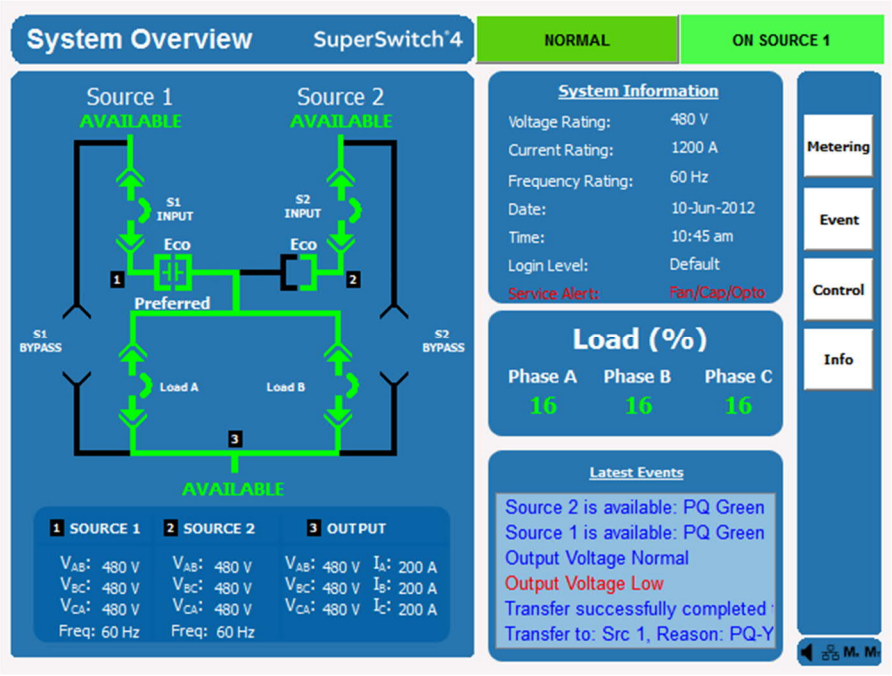
Table 10-1 PWM Fan Speed

PWM Fan Mode	
Load level	Speed RPM
<20%	20%
>20% <40%	40%
>40% <60%	60%
>60% <80%	80%
>80%	100%

10.1.2 System Service

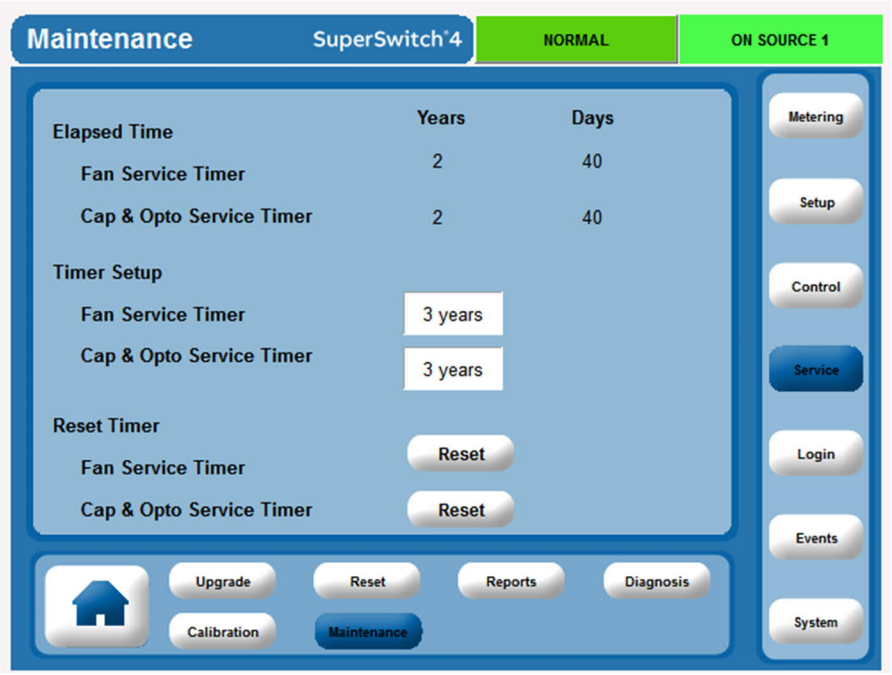
The SS4 50Hz is equipped with a service timer for fans, capacitors, and opto coupler. Service personnel will set a service timer at the time of installation based on the fan configuration. Service personnel will have access to the maintenance screen which will allow them to see the remaining time before service is required. Once the timer is out, a service alert will appear on the main screen and logged as an event. After servicing, the service timer will be reset to the required time.

Figure 10-1 Main Screen with Service Alert



This screen is only accessible to service personnel, when security is enabled.

Figure 10-2 Service Timer



11 4-Pole Application

11.1 Power up – four (4) pole models

Warning

- Failure to understand and follow these safety instructions may result in equipment malfunction, property damage, upstream safety circuit operation, personal injury, or death.
- Follow all national, local, and site-specific safety procedures.

Information in Section 11.1 is for four (4) pole models. See Section 4 for three (3) pole model power up procedures.

For initial power up, the steps below must be followed:

1. Before closing the upstream breakers:
   a. Ensure that the available voltage from Source 1 (S1) and Source 2 (S2) are within the safe operating limits of the SS4.
   b. Confirm that the phase rotations of both sources are the same.
   c. Verify the potential between equivalent phases of both sources is less than 10 Volts (typical).

Note

- If multiple upstream sources are present on either source (e.g. Generator, ATS, UPS, etc.), perform the above steps for them as well.

   d. Verify all circuit breakers within the SS4 are open.
   e. Verify all fuses are installed.
   f. On 1600-2000A STS's only:
      i. Verify SW1 is closed.
2. Close the Source 1 upstream breaker, which applies power to S1 of the SS4.
3. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
4. Unlock and close the S1 Bypass breaker (CB102), which applies power to the SS4 load.

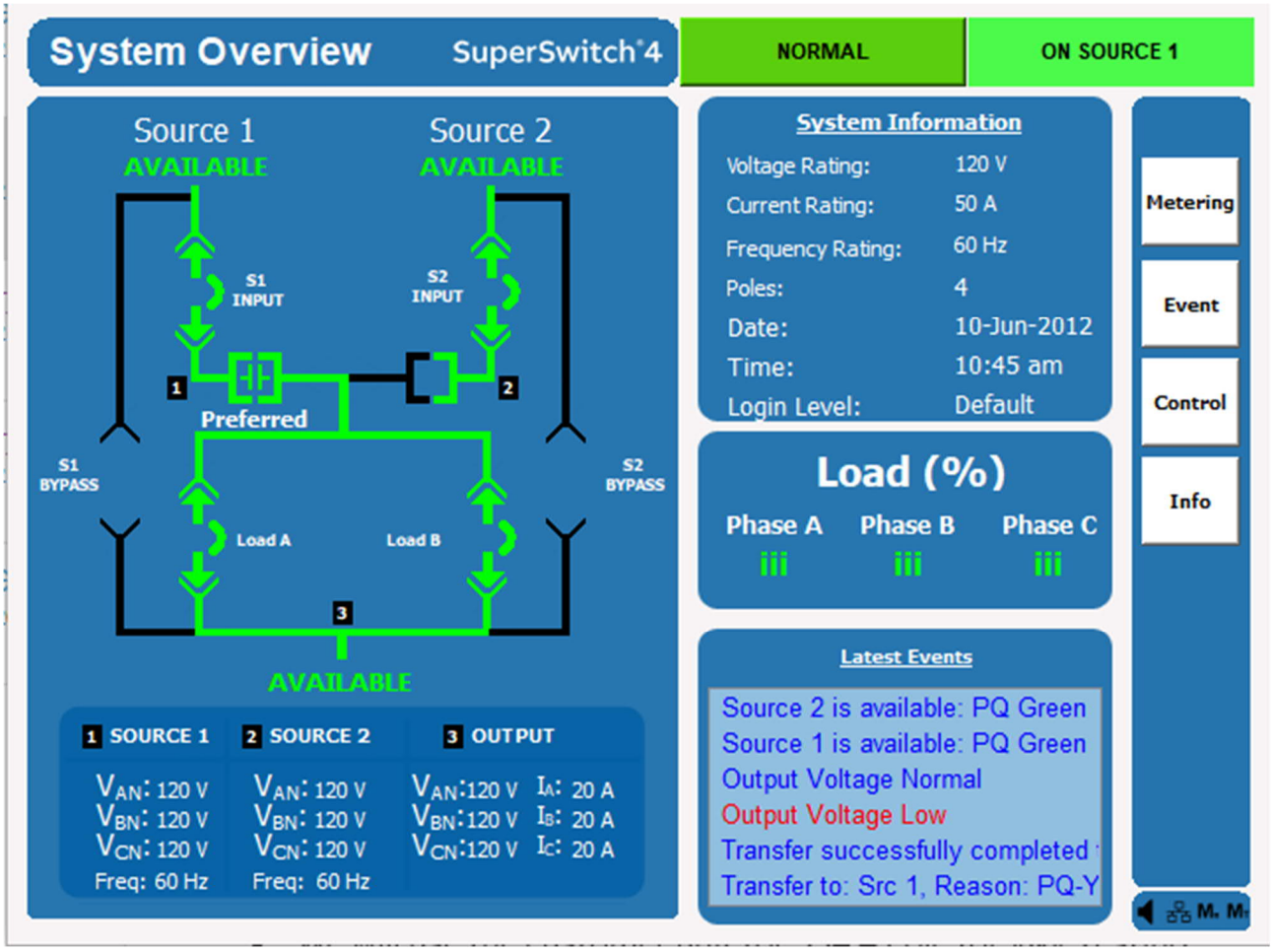
Caution

- Observe caution due to potential inrush currents into downstream transformers.

5. Close the S1 Input breaker (CB101).
   a. Verify S1 SCR's are gated on prior to continuing.
6. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 Power Stage to the load bus.
7. Open the S1 Bypass breaker (CB102) and turn the Kirk Key to lock in this state.
8. Close the Source 2 upstream breaker, which applies power to the S2 of the SS4.
9. Close the S2 Input breaker (CB201).
10. The SS4 is now supporting the critical load. The SS4 logic will select the source to connect to the internal SCR bus, based on the quality of the two sources and the present set of parameters

contained within the memory of the SS4. The active source will be noted in the upper right corner of the graphic user interface, as shown in Figure 4-1.

Figure 11-1 Home screen – 4 pole



11.2 Manual bypass procedures

Warning

- Failure to understand and follow these safety instructions may result in equipment malfunction, property damage, upstream safety circuit operation, personal injury, or death.
- Follow all national, local, and site-specific safety procedures.

Note

- These procedures are intended for manual bypass only.
- Are NOT to be used with the guided bypass feature.
- Refer to Section 4.2.3.2 for guided bypass operation.

Information in Section 11.2 is for four (4) pole models. See Section 11 for three (3) pole model manual bypass procedures.

Before attempting to perform any bypassing procedure on the SS4, the following information must be confirmed:

- The intent/reason for bypassing the SS4.
- The source which the SS4 need to be bypassed on.
- The level which the SS4 needs to be bypassed to.
- The conditions required for the SS4 to be brought out of bypass.

To only bypass the source to the critical load, the following procedure should be followed, but the fuses can be left installed and the logic left in operation.

To bypass the source to the critical load and isolate the SS4 control logic power supply for maintenance or other function, the following procedures would apply:

11.2.1 Bypass load to Source #1

9. Verify Source 1 is the active & preferred source.
10. Open the S2 Input breaker (CB201).
11. Lock S2 Bypass breaker (CB202) open and remove Interlock Key.
12. Unlock and close the S1 Bypass breaker (CB102).
13. Open Load A, Load B, and S1 Input breakers (CB001, CB002, and CB101 respectively).

    The STS power stage is now bypassed to Source 1.

Note

- To isolate the STS logic & power supplies, proceed to step 7.

14. To isolate the control logic power supply, remove all control power fuses. Refer to unit bypass placard for specific fuse callouts.

Warning

WARNING

- Line voltage is still present on S1 of the STS. Recommend performing upstream LOTO when working on S1 power stage components
- On models rated 1200A or less, line voltage will still be present on the analog interface printed circuit board.
- On models rated 1600-2000A, fans will have live terminals even with the device off. Wait 5 minutes after disconnecting to allow for stored energy to be discharged before servicing.

Return to normal operation

9. Install all control power fuses.
10. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
    a. Verify no anomalies in event log and that the system shows green status.
11. Close the S1 Input breaker (CB101).
    a. Verify S1 SCR's are gated on prior to continuing.

12. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 power stage to the load bus.
13. Open the S1 Bypass breaker (CB102) and turn the Interlock Key to lock in this state.
14. Close the S2 Input breaker (CB201).

11.2.2 Bypass load to Source #2

9. Verify Source 2 is the active & preferred source.
10. Open the S1 Input breaker (CB101).
11. Lock S1 Bypass breaker (CB102) open and remove Interlock Key.
12. Unlock and close the S2 Bypass breaker (CB202).
13. Open Load A, Load B, and S2 Input breakers (CB001, CB002, and CB201 respectively).

    The STS power stage is now bypassed to Source 2.

Note

- To isolate the STS logic & power supplies, proceed to step 7.

14. To isolate the control logic power supply, remove all control power fuses. Refer to unit bypass placard for specific fuse callouts.

Warning

WARNING

- Line voltage is still present on S2 of the STS. Recommend performing upstream LOTO when working on S2 power stage components
- On models rated 1200A or less, line voltage will still be present on the analog interface board.
- On models rated 1600-2000A, fans will have live terminals even with the device off. Wait 5 minutes after disconnecting to allow for stored energy to be discharged before servicing.

Return to normal operation

8. Install all control power fuses.
9. Verify logic completely initializes before proceeding – approximately 1.5 minute. See Figure 3-1.
    a. Verify no anomalies in event log and that the system shows green status.
10. On 1600-2000A STS's only:
    a. Close SW1.
    b. Verify output voltage is connected to STS logic.
11. Close the S2 Input breaker (CB201).
    a. Verify S2 SCR's are gated on prior to continuing.
12. Close Load B and Load A breakers (CB002 and CB001, respectively) to connect the SS4 power stage to the load bus.
13. Open the S2 Bypass breaker (CB202) and turn the Interlock Key to lock in this state.
14. On 1600-2000A STS's only:
    a. Close the S1 SPD breaker (CB103).
    b. Close the S1 Input breaker (CB101).

11.3 Guided/Unguided Bypass Sequence

The following figures show the progression of screens for guided and guided unbypass sequencing for 4-pole applications.

Figure 11-2 Guided bypass sequence - 1

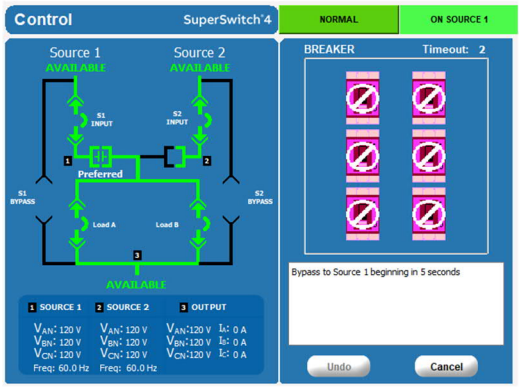


Figure 11-3 Guided bypass sequence - 2

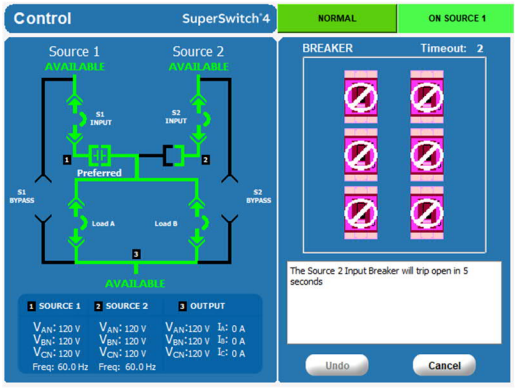


Figure 11-4 Guided bypass sequence - 3

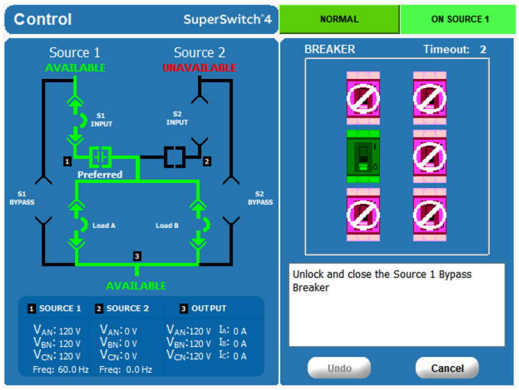


Figure 11-5 Guided bypass sequence - 4

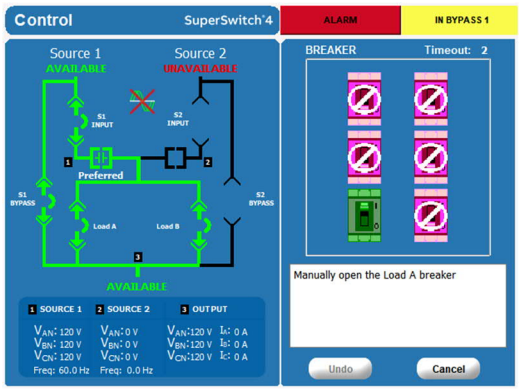


Figure 11-6 Guided bypass sequence - 5

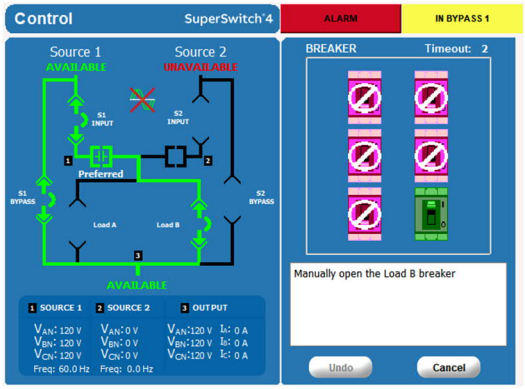


Figure 11-7 Guided bypass sequence - 6

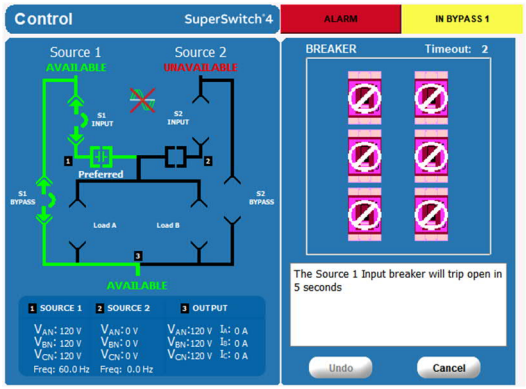


Figure 11-8 Guided bypass sequence - 7

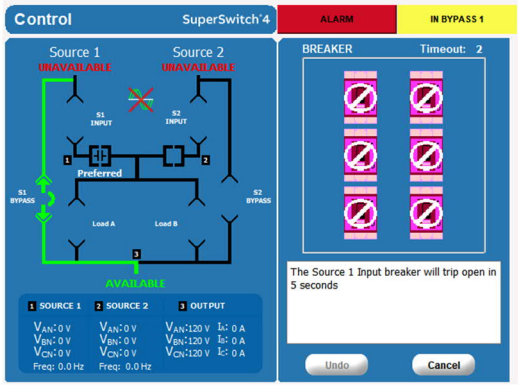


Figure 11-9 Guided bypass sequence - 8

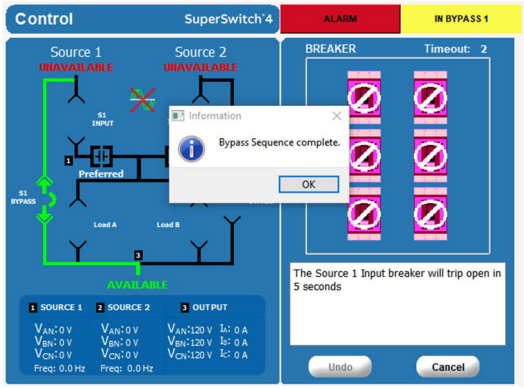


Figure 11-10 Guided unbypass sequence - 1

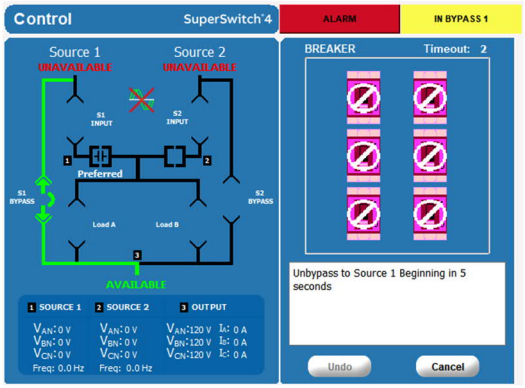


Figure 11-11 Guided unbypass sequence - 2

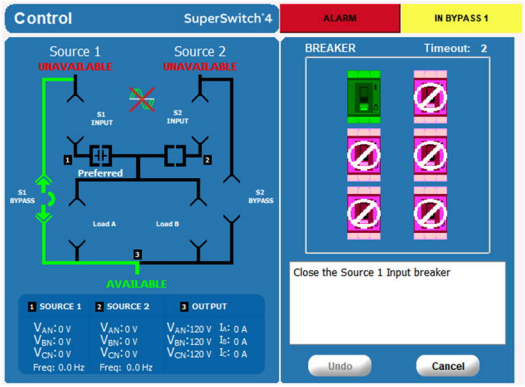


Figure 11-12 Guided unbypass sequence - 3

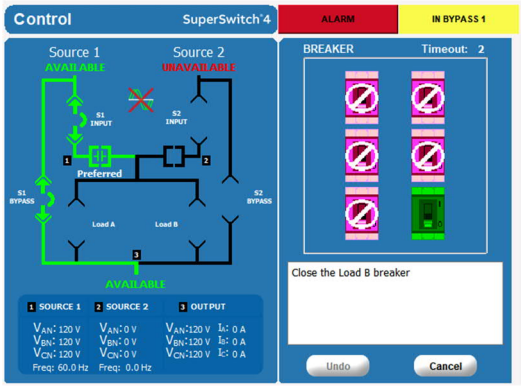


Figure 11-13 Guided unbypass sequence - 4

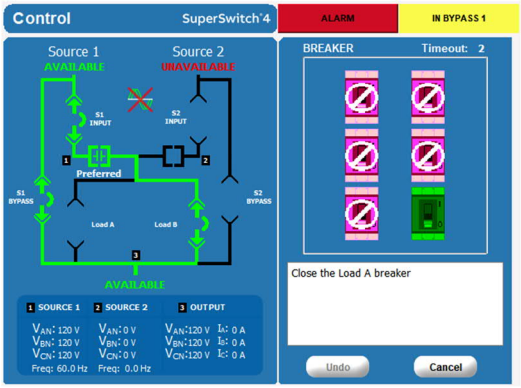


Figure 11-14 Guided unbypass sequence - 5

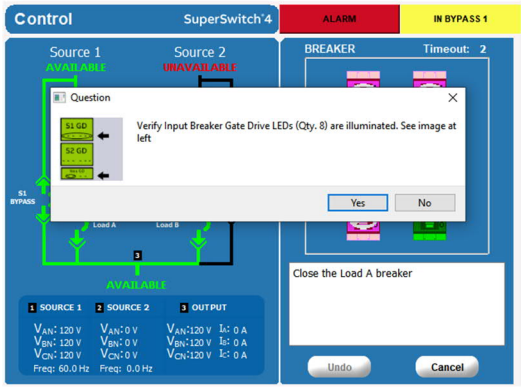


Figure 11-15 Guided unbypass sequence - 6

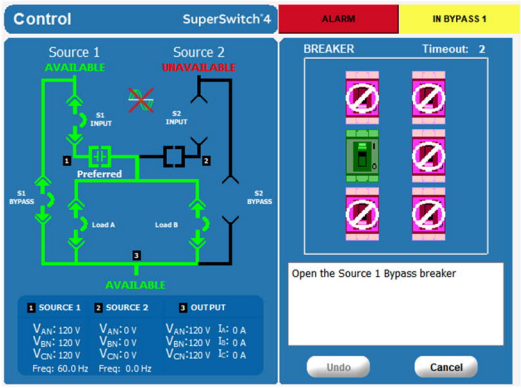


Figure 11-16 Guided unbypass sequence - 7

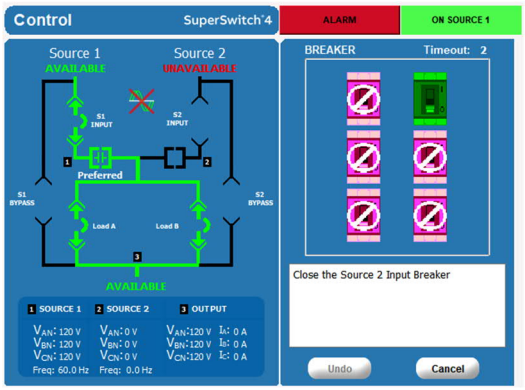
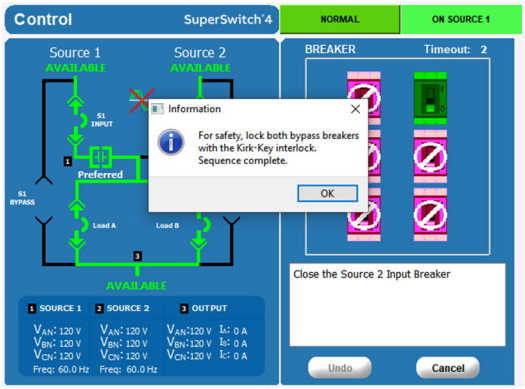


Figure 11-17 Guided unbypass sequence - 8



12 Appendix tables

Appendix Table A-1: Setpoints

Category	Subcategory	Description	Units	Min	Default	Max
OV Red (Source <n> *)	Transfer	Percent of rated voltage over which power quality enters the Red State.	%	115	120	125
	Transfer Filter Time	Time required for voltage to remain at or above the OV Red Transfer threshold before entering the Red State.	mS	0.5	1.0	4.0
	Return	Percent of rated voltage under which power quality exits the Red State.	%	111	115	119
	Return Filter Time	Time required for voltage to remain at or below the OV Red Return threshold before exiting the Red state.	mS	0.2	0.5	2.0
OV Yellow (Source <n> *)	Transfer	Percent of rated voltage over which power quality enters Yellow State.	%	107	110	113
	Transfer Filter Time	Time required for voltage to remain at or above the OV Yellow Transfer threshold before entering the Yellow State.	mS	1.0	2.0	8.0
	Return	Percent of rated voltage under which power quality exits the Yellow State.	%	103	105	107
	Return Filter Time	Time required for voltage to remain at or below the OV Yellow Return threshold before exiting the Yellow State.	mS	0.5	1.0	4.0
UV Red (Source <n> *)	Transfer	Percent of rated voltage under which power quality enters the Red state.	%	50	80	94
	Transfer Filter Time	Time required for voltage to remain at or below the UV Red Transfer threshold before entering the Red State.	mS	0.5	1.0	4.0
	Return	Percent of rated voltage over which power quality exits the Red state.	%	52	85	96
	Return Filter Time	Time required for voltage to remain at or above the UV Red Return threshold before exiting the Red State.	mS	0.2	0.5	2.0
UV Yellow (Source <n> *)	Transfer	Percent of rated voltage under which power quality enters the Yellow State.	%	70	90	95
	Transfer Filter Time	Time required for voltage to remain at or below UV Yellow Transfer threshold before entering the Yellow State.	mS	1.0	2.0	8.0
	Return	Percent of rated voltage over which power quality exits the Yellow State.	%	81	95	97
	Return Filter Time	Time required for voltage to remain at or above the UV Yellow Return threshold before exiting the Yellow State.	mS	0.5	1.0	4.0

Category	Subcategory	Description	Units	Min	Default	Max
Frequency (Source <n> *)	Upper Frequency Transfer	Percent of rated frequency over which power quality enters the Red State.	%	103	105	107
	Upper Frequency Return	Percent of rated frequency under which power quality exits the Red State.	%	101	102	105
	Lower Frequency Transfer	Percent of rated frequency under which power quality enters the Red State.	%	93	95	95
	Lower Frequency Return	Percent of rated frequency over which power quality exits the Red State.	%	95	97	99
	Frequency Filter Time	Time required for frequency to remain outside the Upper/Lower thresholds before entering the Red State.	mS	1.0	2.0	8.0
	Frequency Return Filter Time	Time required for frequency to remain inside the Upper/Lower thresholds before exiting the Red State.	mS	0.5	1.0	4.0
Phase Shock (Source <n> *)	Transfer Positive	Positive phase shock over which power quality enters the Red State.	Degrees	+10	+20	+180
	Transfer Positive Filter Time	Time required for phase shock to remain at or above the Transfer Positive threshold before entering the Red State.	mS	0.2	0.5	4.0
	Transfer Positive Return Filter Time	Time required for phase shock to remain at or below the Transfer Positive threshold before exiting the Red State.	mS	0.2	0.2	4.0
	Transfer Negative	Negative phase shock over which power quality enters the Red State.	Degrees	-180	-20	-10
	Transfer Negative Filter Time	Time required for phase shock to remain at or above the Transfer Negative threshold before entering the Red State.	mS	0.2	0.5	4.0
	Transfer Negative Return Filter Time	Time required for phase shock to remain at or below the Transfer Positive threshold before exiting the Red State.	mS	0.2	0.2	4.0
Phase Angle	Normal Transfer: Inhibit	Absolute Phase Angle at which any transfer from a green or yellow state would be inhibited from occurring.	Degrees	0	30 10 (w/DIR)	180
	Normal Transfer: Uninhibit Hysteresis	Once a transfer is inhibited, Phase Angle Hysteresis at which normal transfers will be uninhibited.	Degrees	0	5	30
	Emergency: Transfer Inhibit	Absolute Phase Angle at which any transfer from a red state would be inhibited.	Degrees	30	180	180
Delay (Source <n> *)	Until Source Available	Amount of time a source holds in a green state before it is available to be a transfer destination.	Sec	0.2	3.0	10.0
	Until Retransfer	Amount of time the unit holds on a non-preferred source before it attempts to transfer back.	Sec	2.0	6.0	360.0

Category	Subcategory	Description	Units	Min	Default	Max
	Reacquisition of Preferred Source (RPS)	Additional delay that starts from Source available (after Source available delay expired) point. Retransfers to preferred side are allowed after this delay expires.	Sec	0.0	0.0 (Disabled)	360.0
	Ecomode Delay	Provides the flexibility needed to set any source that is connected to a UPS running in economy mode with an adjustable delay, so the switch can avoid any unnecessary transfers once the upstream UPS returns to double conversion	mS	0.0	0.0 (Disabled)	8.0
Settings	Audible Alarm	Sound Buzzer when active events		Disable	Enable	Enable
	Security	Enable/Disable Security		Disable	Enable	Enable
Time	Time Zone	Set the Time Zone		EST	EST	HST
	Date	Set the Date		xx	xxx	xxxx
	Time	Set the Time		xx	xxx	xxxx
Transfer	Retransfer	Enable/Transfer or Retransfer		Disable	Enable	Enable
	Disable Auto Transfer	Disable Auto Retransfer		Disable	Disable	Enable
	DIR Settings	Disabled (A9), Limited, Always (This cannot be disabled via the GUI.)		Disabled (A9)	Limited	Always
	Preferred Source	Select Preferred Source		Source 1	Source 1	Source 2
	External Sources	Preferred Source		Disable	Disable	Enable
		Ext Auto Transfer		Disable	Disable	Enable
		Transfer/Hold Control		Disable	Disable	Enable
		Temp Retransfer		Disable	Disable	Enable
	Latch Overload Inhibit	Latch on Overload Inhibit		Disable	Disable	Enable
	Eco Mode	Economy Mode		Disable	Disable	Enable
Display	Screen Saver	Screen Save Enable/Disable		Disable	Enable	Enable
	Screen Saver Timeout	Timeout time for Screen Saver	min	10	30	60
	LCD Contrast	LCD Contrast setting		1	50	100
Overload (Source <n> *)	RMS Transfer Inhibit Limit	% of nominal RMS current to inhibit transfer.	%	120	125	150
	RMS Transfer Inhibit Timer	% time in seconds that source must be above RMS inhibit limit before transfers are limited.	Sec	20	30	40
	Peak Transfer Inhibit Limit	% of nominal peak current that will immediately inhibit transfers.	%	160	300	400

* Note: <n> is source 1 or 2

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