LayerZero Power Systems, Inc.

The Foundation Layer

Series 70: eSTS

1600 A - 4000 A Static Transfer Switch

Product Brochure

eSTS Protects The Power For Critical Operations
Even Entire Buildings

eSTS Automatically Transfers Between Two or Three* Power Sources

LayerZero Power Systems designs and manufactures the world's ***most reliable*** static transfer switch. The Series 70 eSTS is a solid-state transfer switch that automatically or manually provides solid state transfers between two in-phase AC sources in a quarter cycle. The eSTS performs open-transition transfer in such a manner that the connected load disruption is minimized without ever cross-connecting the power sources. One power source is selected to be the preferred source. If the preferred source fails the load is automatically and seamlessly connected to the alternate source by means of an open-transition static transfer. For emergency transfers between asynchronous sources, dynamically phase compensated transfers minimize saturation of downstream transformers in 3-phase, 3-wire eSTS.

*Optional

Standard Features

LayerZero's eSTS Is Equipped Fully-Loaded

Reliability

- ☑ **Optional Triple Modular Redundancy:** TMR Contains Fully-Independent Control Paths With No Single Point-Of-Failure
- ☑ **Safe Bypass Procedure:** Mechanical Bypass Interlock Eliminates Human Error When Performing Bypass Procedures
- ☑ **Voice Guided Bypass:** Step-By-Step Instructions With Audio and Video Guidance To Assist Operators Through Bypass
- ☑ **Epoxy Coated Buswork:** Maximizes Reliability By Eliminating The Possibility of Bus-To-Bus Faults
- ☑ **Silver Plated Terminals:** Silver Has Excellent Conductivity To Provide Superior Electrical Performance and Reliability
- ☑ **Maintenance-Free Joints:** Brazed Joints Are Permanent And Maintenance-Free, Maximizing Product Life
- ☑ **Machined Hardware:** Machined Cap Screws and Engineered Disc Springs Maintain Constant Torque Throughout Product Life
- ☑ **Screw Thread Inserts:** Prevents Screws From Loosening Under Vibration For Long-Term Reliability
- ☑ **Optical Fiber Based Controls:** Eliminates Noise and Interference While Isolating Components from High Voltage
- ☑ **Serialized Critical Board Tracking:** Critical Boards Are Serialized And Cataloged in an Active Database For Traceability

Safety

- ☑ **InSight™ IR Portholes:** Bolted Connections & Critical Boards Can Be IR Scanned With the Dead-Front Doors Closed
- ☑ **Sectionalized Components:** Isolated Sections That Can Be Safely De-Energized For Performing Maintenance
- ☑ **Polycarbonate Windows:** Allows Critical Board LEDs To Be Viewed With The Dead-Front Door Closed
- ☑ **Dead Front Hinged Doors:** Barrier To Provide A Safe Working Area With No Exposed Live Parts

Connectivity

- ☑ **Ethernet Connectivity:** Secure VPN Router Connects To Network For Advanced Remote Monitoring Capabilities
- ☑ **Modbus/TCP:** Open Connectivity to Existing Monitoring Systems Without Proprietary Limitations
- ☑ **NTP Time Clock Synchronization:** Facilitates Timeline-Based Logging For Post-Event Reconstruction
- ☑ **SNMP Connectivity:** Permits Remote Management Via Simple Network Management Protocol

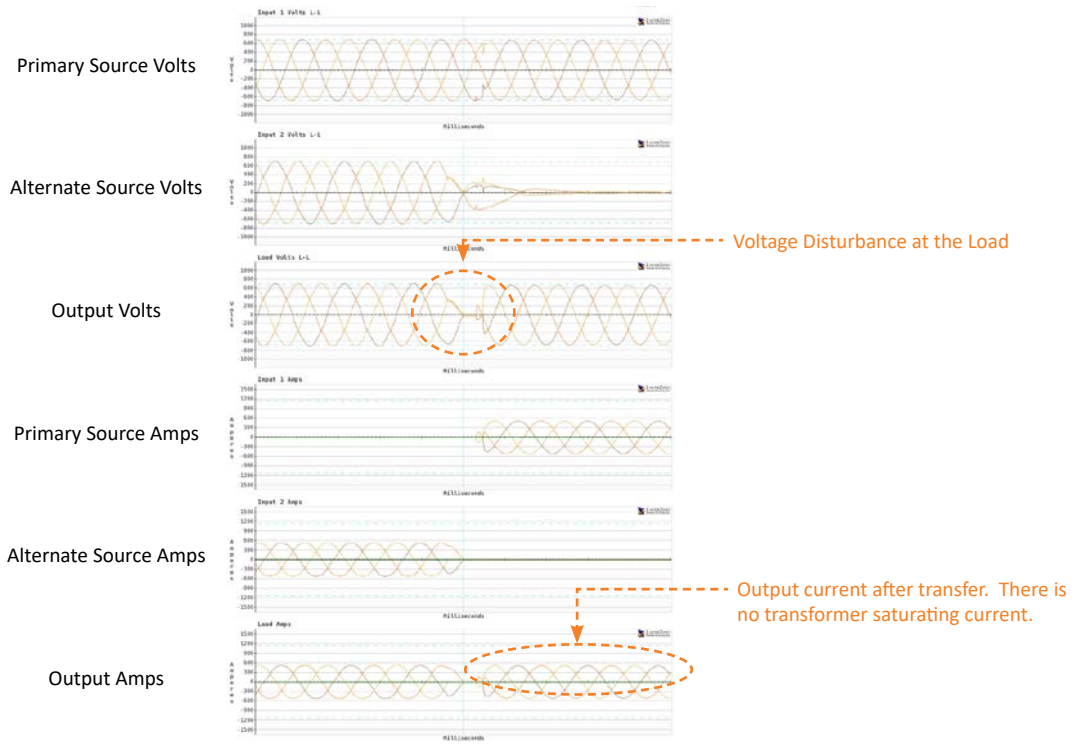
zen SSQM

- ☑ **Real-Time Waveform Capture:** Automatically Captures A Picture Of The Power Three-Cycles Before and After Every Event
- ☑ **Local Touch-Screen Interface:** Password-Protected Color Touch-Screen GUI For Local STS Setup/Operation/Administration
- ☑ **Black-Box Forensics:** eSTS Captures and Records All Events To Provide Vital Information In Root-Cause Analysis
- ☑ **Waveforms Automatically Emailed:** Capability to Send Waveform Captures To Designated Individuals For Every Transfer

All LayerZero Power Systems products have on-board power quality analyzers that break down power sources into samples. If the power quality goes out of specification on a source, eSTS will transfer to the alternate source, automatically generating waveform captures and ITIC curves of the event. This data is remotely accessible by connecting to the unit via web browser.

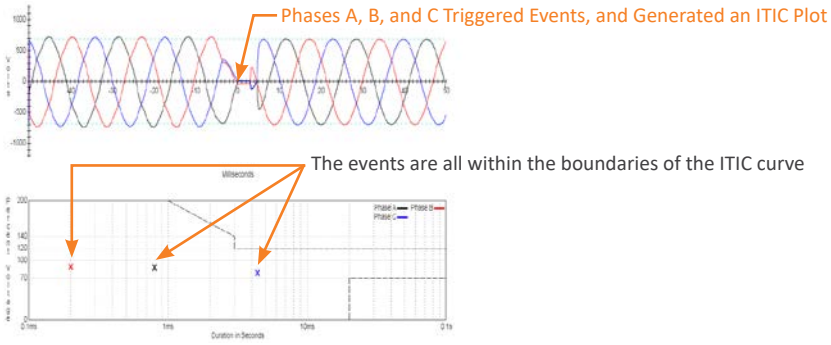
In the test below, the STS was connected to two sources 150 degrees out-of-phase. Source 2 breaker was opened, causing the STS to perform an automatic transfer to the primary source. A delayed transfer occurred, causing events on Phases A, B, and C, automatically generating ITIC plots. Unlike waveform captures, ITIC plots are easy-to-read, and do not require expert analysis to understand.

Example Waveform Capture of Source 2 to Source 1 Transfer Event, 150 Degrees Out-of-Phase



Source 2 to Source 1 Transfer Event, 150 Degrees Out-of-Phase - WFC & ITIC Plot

Dynamic Transfer was enabled during these tests in order to mitigate transformer inrush while completing the transfer within the boundaries set by the Information Technology Industry Council (ITIC).



The ability to keep the transfers within the ITIC limits was verified through the Voltage Disturbance Analysis Tool (VDAT) plot shown above in the captured waveform.

Equipment Layout

Controls Section Contains:

Power electronics

- SCRs (Silicon Control Rectifier) in Convection Cooled Heat Sinks

Control Electronics

- System Control & Data Acqusition Boards
- SCR Gate Drives
- Redundant Power Supply System
- I/O system; VPN Router

Heat SInk Section Contains:

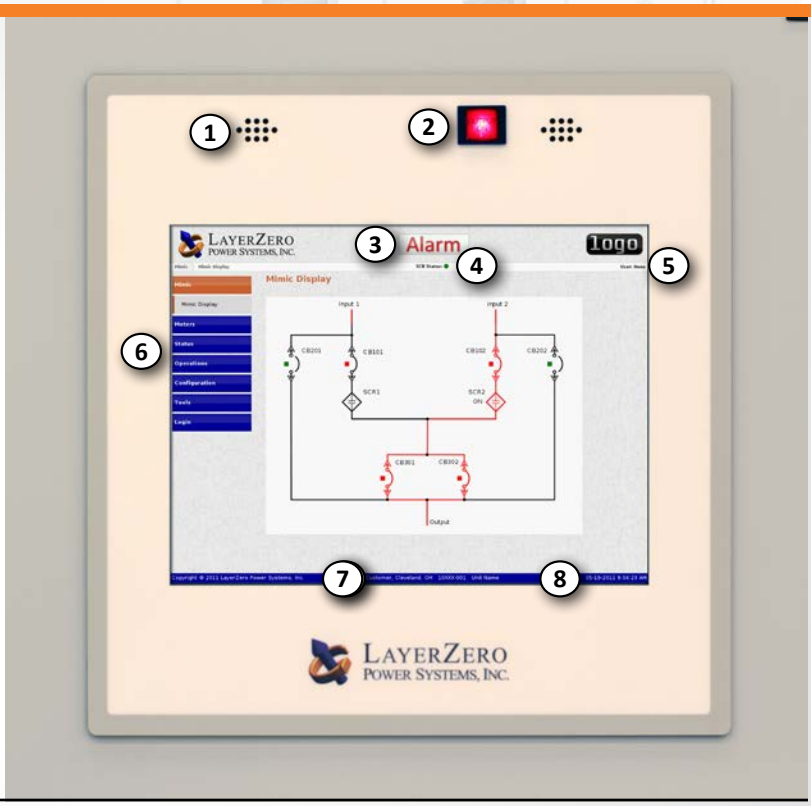
Heat SInks

CB Section Contains:

Input isolation switches
Bypass isolation Switches
Output isolation switches
Source connection terminals
Load connection terminals

15” Color Touch Screen (Standard)

1. Stereo Speakers for Guided Bypass Prompts
2. Output On Light (Remains Lit in Bypass Isolate Mode)
3. Alarm & Bypass Indicator
4. SCB Status Indicator
5. Logged In User
6. Navigation Menu
7. Customer & Project Information
8. Date & Time



LayerZero eSTS Reliability Overview

The LayerZero eSTS Provides Many Dimensions of Reliability:

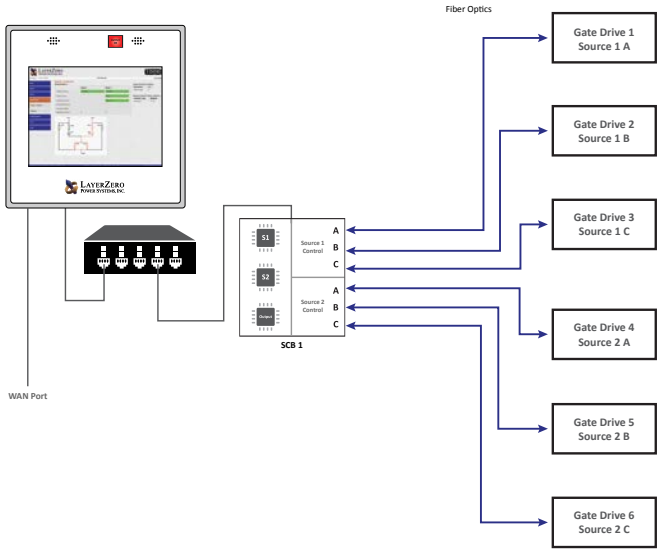
- Control System Reliability
  - SMR (Single Module Redundancy, Standard)
  - TMR (Triple Modular Redundancy, Optional)
- Control Power Supply Reliability
- Signal Reliability
- Operator Procedural Reliability

Single Module Redundancy (SMR) Reliability (Standard)

Single Module Redundancy is a cost-effective topology that provides redundant power paths to mission-critical equipment. In SMR systems, sources each have built-in triple redundancy of processors.

In addition, every phase is controlled with a separate gate drive board.

LayerZero Single Modular Redundant topology is unique that it the system is fail-safe, maintaining full switching functionality even if a critical board were to fail.



Reliability Features: Triple Modular Redundancy (TMR) *Optional

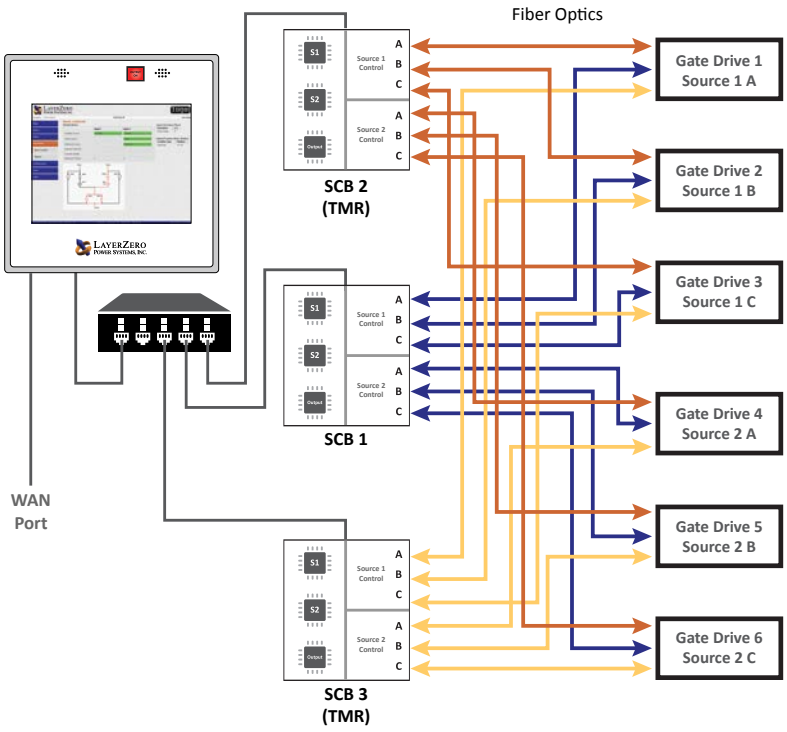
Triple Modular Redundancy (TMR) Reliability (Optional)

LayerZero TMR has all the redundancy of SMR, plus each STS has three independent sets of analog and digital data acquisition and control systems. There is no direct communication between the three systems. The three systems do not even share a common system clock.

Each control system acquires voltage and current data independently
Each control system determines whether a source is good/bad independently
Upon loss of a source, each control system makes decisions to transfer independently

Even if an entire control path or its subcomponent were to fail; and then if the active power source were to fail, the STS is able to complete its mission of transferring to the alternate source.

Triple Modular Redundancy, a proper noun, is a based on proven statistics and stringent mathematics. There are similar sounding terms like, tri- or triple- redundant, used in industry to describe other STS products – but they simply do not yield the same, high level of reliability.



Reliability Features: Single Module Redundant (SMR) Redundancy

eSTS SMR Triple Redundant Power Supply Architecture

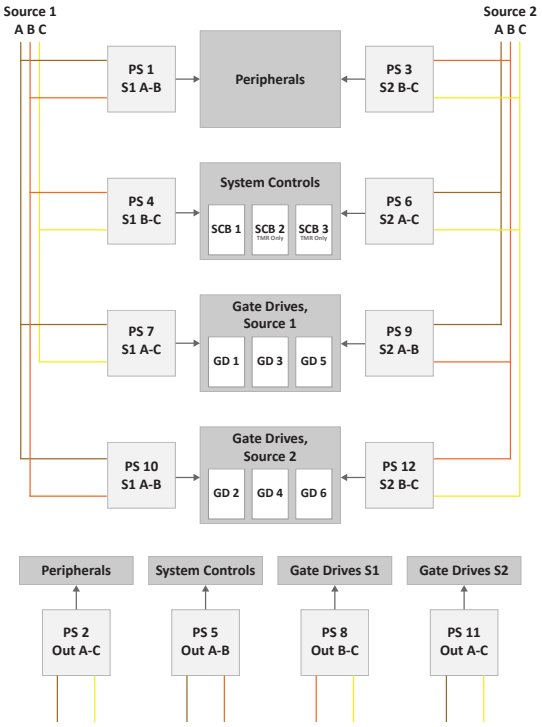
Divided into four (4) logical failure groups:

- System controls
- Source 1 gate drives
- Source 2 gate drives
- Peripherals.

The three (3) available source of power from which to supply control power to each failure group are:

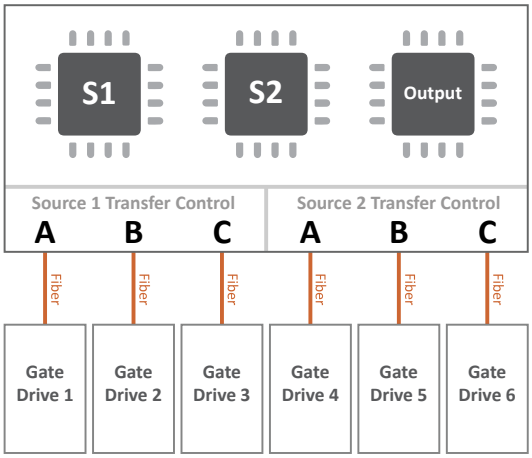
- Source 1
- Source 2
- STS Output.

LayerZero's STS design incorporates twelve (12) power supplies (3 power sources x 4 failure groups.) The resultant control power topology utilizes all possible power paths to the four logical STS failure groups; and is the most comprehensive and redundant power supply system in existence.



eSTS SMR Triple Redundant Processors

- Separate/independent processors for Source 1, Source 2 and Output power quality analysis
- If Source 1 processor malfunctions then system is able to be commanded to transfer to Source 2; & vice versa.
- If main control system fails then STS continues to conduct power to the load from the existing source of power. (However STS is unable to transfer to the other source)
- Each phase of each source is controlled with a separate gate drive circuit board.

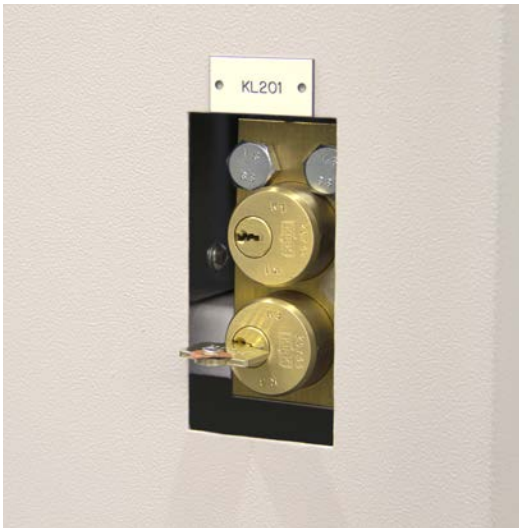


Reliability Features

Safe Bypass Procedure

In order to minimize the possibility of operator error during equipment bypass operations, LayerZero provides:

1. Interlocked breakers
2. Mechanisms to ensure that a source cannot be bypassed without the STS on the correct source.
3. Safeguards to make certain that sources cannot be connected to each other inadvertently.
4. A voice-prompted bypass procedure that guides the operator through the sequence.
5. A step-wise pictorial & video presentation is provided on the touch-screen display during bypass.



Voice Guided Bypass

Operator error during maintenance bypass has been known to be a reliability hazard. To help prevent operators from completing the bypass procedure out-of-sequence, our product features a voice prompted bypass procedure. This instructs the operator in a step-by-step course of action of the process, with only one operation per screen. Visual and audio cues provide clear instructions on the bypassing sequence, reducing the probability of operator error.

Epoxy Coated Buswork/Maintenance Free Joints

Our usage of epoxy coated buswork helps ensure safety, and makes the system inherently more reliable by eliminating the possibility of bus-to-bus faults. Bus joints are permanently brazed and maintenance-free.

Silver Plating

LayerZero utilizes silver plating on all bus joints and terminals to be able to provide the highest performance. Silver has high conductivity and low resistance - which makes for a great contact.

Reliability Features

Machined Hardware

Our bolted connections utilize machined cap screws and engineered disc springs. The result is a flat pressure vs deflection profile to ensure that all bolted connections maintain constant torque through the life of the product.

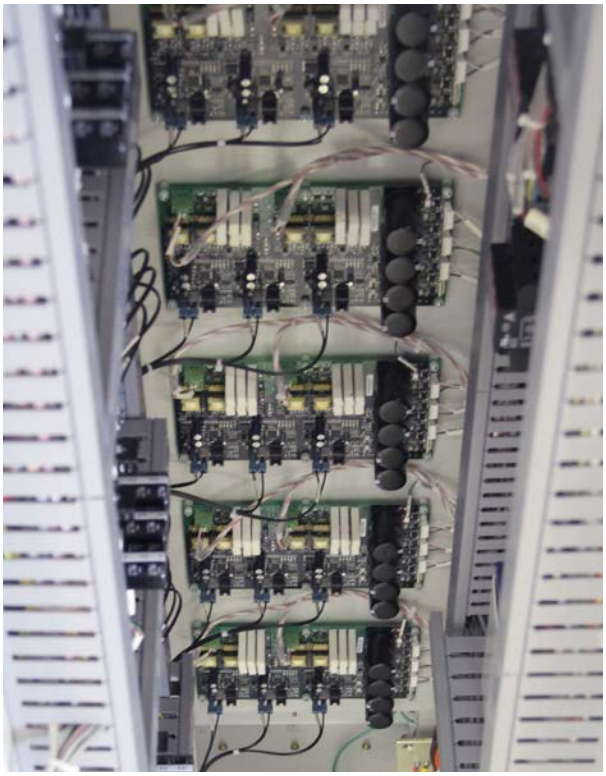
These technologies have been well tested in disparate environments of wide temperature ranges to help ensure that, once connections have been tightened, they stay that way.

Fiber Optic Controls Increase System Reliability

Fiber optic based controls eliminate noise and interference, while isolating components from high voltage.

Optical fiber allows service to be reliably connected, while protecting the equipment.

In LayerZero's eSTS design, the gate drives (at Power Circuit Voltage) receive control signals via optical fibers.



Serialized Critical Board Tracking

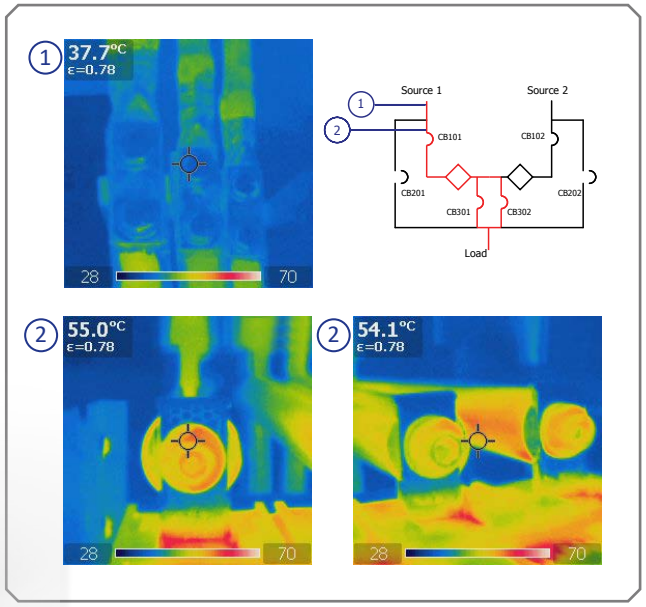
We serialize and track all critical boards and maintain this information in an active, dynamic database.

Ease of Maintenance

InSight™ IR Portholes Permit Scanning of Bolted Connections with Dead-Front Doors Closed

Strategically positioned IR-scan portholes to enable safe thermal scanning of all bolted connections with the deadfront closed, without exposing the operator to power circuit voltage. Thermal scans on 1600 A - 4000 A eSTS are completed from the rear of units.

The IR window swivels upward and unlocks with key-hole access to reveal a mesh, allowing the operator to point-and-shoot thermal cameras to obtain readings.



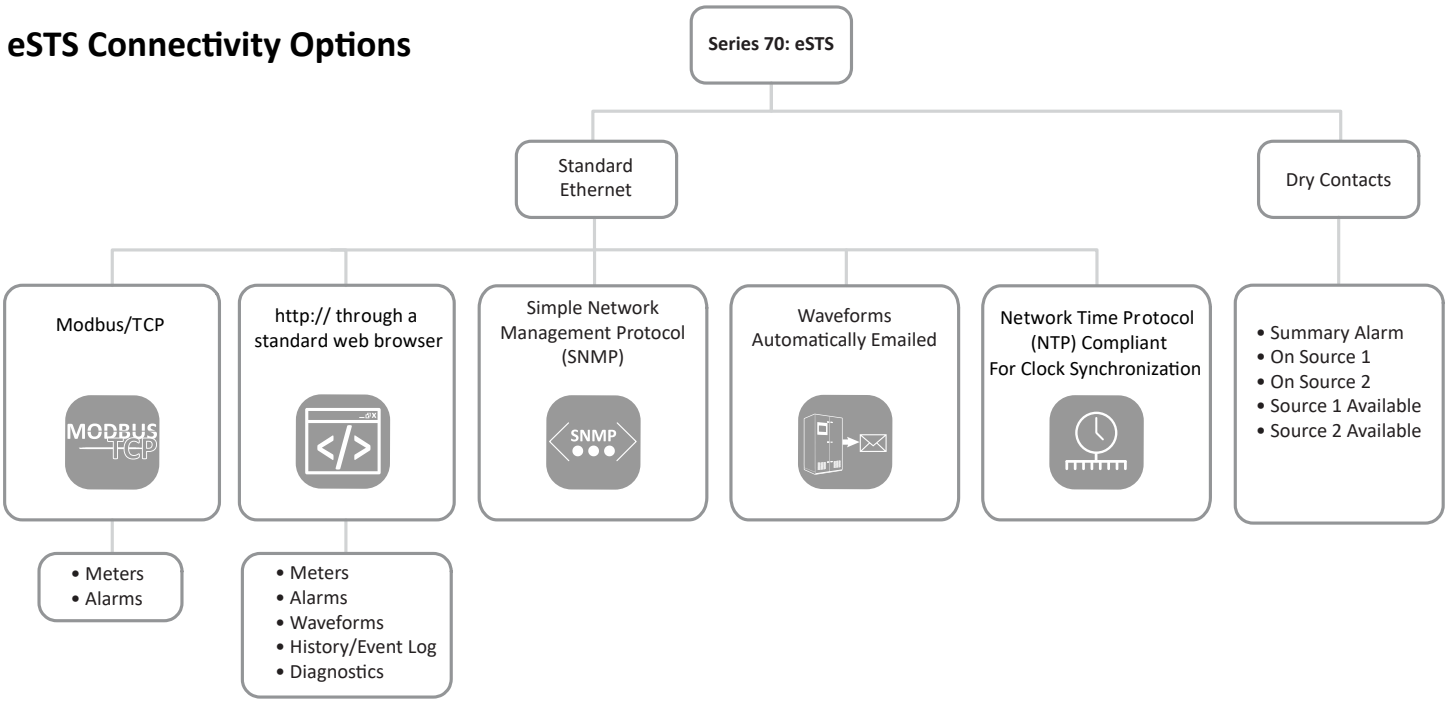
IR Portholes in eSTS

Ease of Maintenance/Connectivity Options

Sectionalized Components Help Maximize Operator Safety

Operators are well-protected from exposed connections. Normal operator sections (breakers/switches) are physically separated from the power electronics and control electronics sections, so that maintenance on a section can be safely performed. If maintenance is required on a particular section, power can be bypassed to another section to allow for safe repairs to be made. All connections are optically isolated to minimize risk.

eSTS Connectivity Options



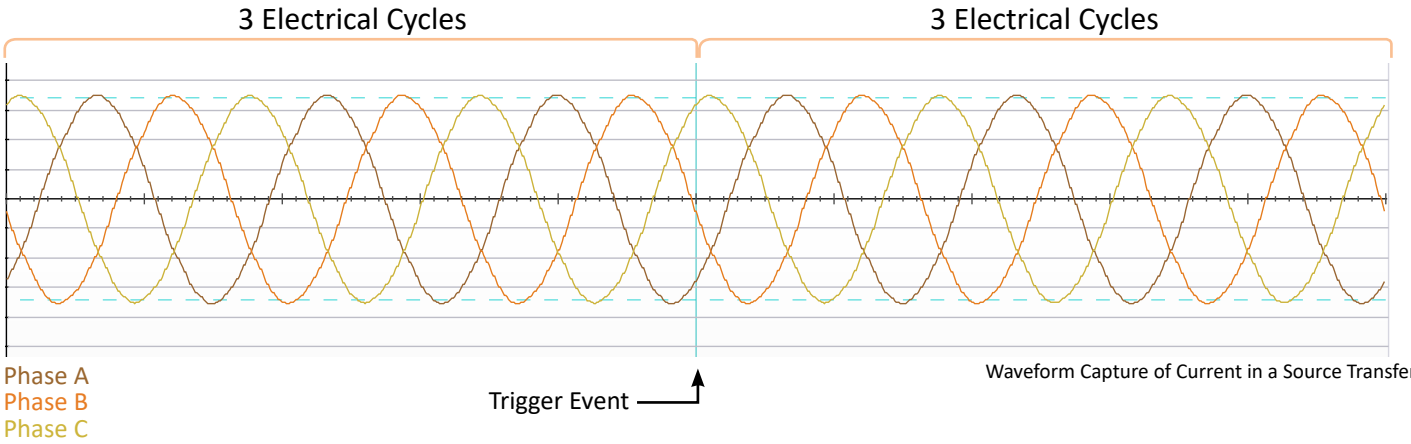
zen SSQM

The Series 70: eSTS is equipped with Zen SSQM (Static Switch Quality Monitoring), an all encompassing monitoring system with local and remote communications options.

From basic monitoring & alarm reporting, to advanced power quality monitoring functionality, Zen SSQM provides a wide-range of options to help you be aware, be vigilant, be proactive in your quest to create a safe, stable and reliable operation.

Zen SSQM Provides Answers

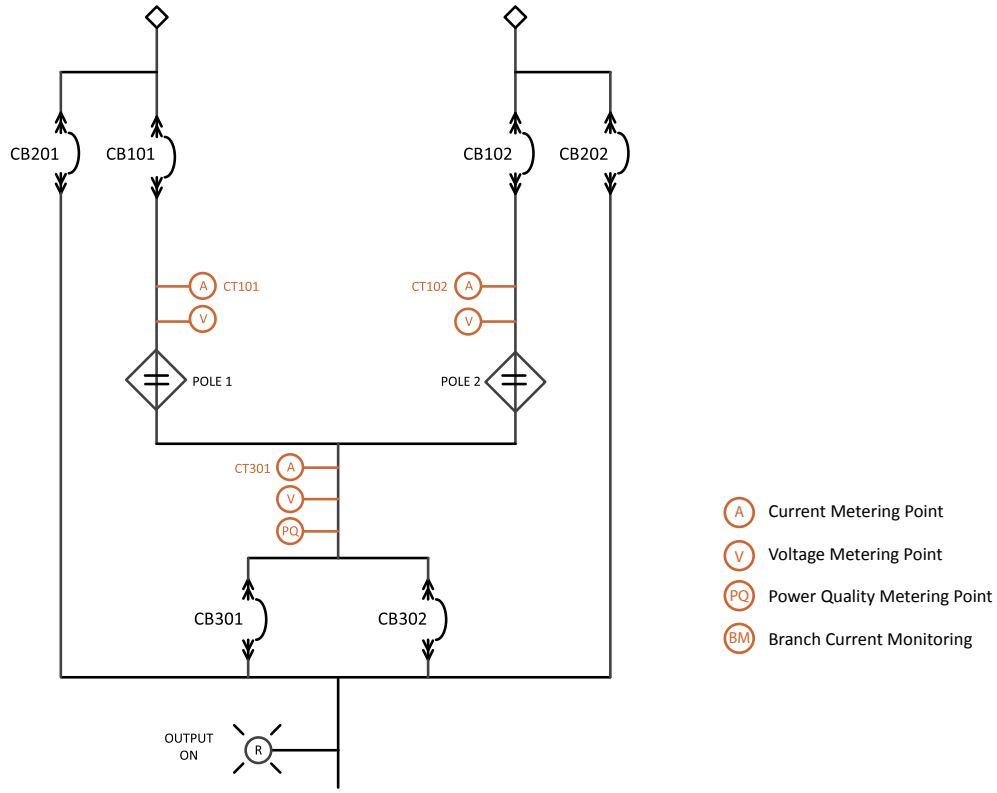
Zen SSQM provides timestamped pictures of waveforms before and after events, providing information that enables facilities to go back in time to methodically identify and correct the root causes of events. Zen actively captures power quality information at the STS, PDU, and RPP - permitting thorough post-event analysis.



Waveform Capture of Current in a Source Transfer

Power Quality Monitoring

zen SSQM



Zen SSQM Technical Specifications

zen SSQM

Zen SSQM Parameters		Mains
Voltage Inputs and Output	Voltage (Volts)	✓
	Voltage Average of Phases (Volts)	✓
	Frequency (Hertz)	✓
	Total Harmonic Distortion (Percent VTHD)	✓
	Phase Rotation	✓
Current Inputs	Current (Amps)	✓
	Current Average of Phases (Amps)	✓
	Current Imbalance (Percent)	✓
	Real Power (kilowatts)	✓
	Apparent Power (kilovolt-amperes)	✓
	Reactive Power (kilovolt-amperes reactive)	✓
	Power Factor	✓
	Crest Factor	✓
	Crest Factor Average of Phases	✓
	Phase Difference Between Sources	✓
	Phase Difference Between Sources and Output	✓
Alarms	Summary Alarm	✓
	On Source (1/2/3)	✓
	Source Fail (1/2/3)	✓
	Source Preferred (1/2/3)	✓
	Source 1st Alternate (1/2/3)	✓
	Source Over/Under Voltage (1/2/3)	✓
	Source Over/Under Frequency (1/2/3)	✓
	Source Not Available (1/2/3)	✓
	Output Failure	✓
	Source Overcurrent (1/2/3)	✓
	Source Exceeds Manual Limit (1/2/3)	✓
	Source Exceeds Automatic Limit (1/2/3)	✓
	Bypassed to Source (1/2/3)	✓

All product specifications are subject to change without notice.

Technical Specifications

eSTS Models with Withstand Ratings			
eSTS Rating (100%)	120/208 V	480 V; 480/277 V; 415/240 V; 400/230 V; 380/220 V	600 V; 600/347 V; 575 V
1600 A	85kAIC; 65kAIC; 42kAIC	85kAIC; 65kAIC; 50kAIC; 42kAIC	65kAIC; 50kAIC; 42kAIC
2000 A	125kAIC; 85kA; 65kA	125kA; 85kAIC; 65kAIC; 50kAIC	85kAIC; 65kAIC; 50kA
3000 A	125kAIC; 85kAIC	125kAIC; 85kAIC; 65kAIC	100kAIC; 85kAIC; 65kAIC
4000 A	150kAIC; 125kA	150kAIC; 125kAIC; 85kAIC	100kAIC; 85kAIC

Mechanical Characteristics *				
	1600 A	2000 A	3000 A	4000 A
Heat Dissipation	24,200 BTU/Hr	31,800 BTU/Hr	47,200 BTU/Hr	62,700 BTU/Hr
Weight	7,600 lbs		11,000 lbs	
Dimensions	152”W x 57”D x 85”H (3861 mm x 1448 mm x 2159 mm)		192”W x 57”D x 91”H (4877 mm x 1448 mm x 2311 mm)	
Frame Construction	Welded Frame			
Electrical Connections	Silver-Plated Solid Busbar			
Color	Textured Powder Coat White (RAL 7035), Blue (RAL 5017), Black, Custom			
Floor Stands	Optional			
Seismic floor stands	Optional			
Junction Boxes	Optional			
Sectionalization	Engineered Composite Insulation, Dead Front Doors			
Electrical Characteristics				
Number of Inputs	2, 3 (3 Optional)			
Number of Output CBs	1, 2			
Frequency	50 Hz, 60 Hz			
Poles	3-pole			
Phases	3 Phase, 3 Wire, 4 Wire + Ground			
Neutral Rating	100%, 150%, 200%			
Transfer Time	Nominal 1/4- cycle for in-phase sources			
Redundancy	Single Module Redundancy, Triple Modular Redundancy (Optional)			
Circuit Breaker Type	Molded Case Switch (Standard), Electronic Trip (Optional)			
Circuit Breaker Mounting Type	Plug-In			
TVSS	Standard			
Power Quality Monitoring				
Power Quality Monitoring Technology	Zen SSQM™ (Static Switch Quality Monitoring)			
Waveform Capture	Local Display, Remote Display via Web Browser, Waveforms Automatically Emailed			
Voltmeter	Input sources and Output, for each phase			
Ammeter	Input sources and Output, for each phase			
Frequency Meter	Both Sources			
Synchroscope	Phase Angle Meter Between Sources			
Metering	Apparent Power, Real Power, Power Factor, Output Total Harmonic Distortion			
Time Stamped Transfer Count	From First Day Use, From Last Reset			
CB Status Indicator	Open/Closed/Tripped Circuit Breaker			
Source Indicator	Preferred Source			
Power Path Indicator	On Live Mimic			

*Dimensional & weight data is only valid for 2-source.

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Technical Specifications

Operational Characteristics	
Transfer Modes	Automatic; Manual (via Preferred Source Selection)
Inrush Mitigation Technology	Patented Dynamic Phase Compensation Algorithm (U.S. Patent 7,589,438 B2)
Cable Access	Top/Bottom
Service Access	Front and Rear Access
Bypass Interlock Mechanism	Kirk Key
Noise & Interference Isolation	Optical Fiber in Critical Control Paths
IR Scan Port Type	InSight™ IR Portholes
SCR Type	Puck
Display Type	15” Color Touch Screen
Display Resolution	1024x768
Bypass Assistance	Voice-Guided Bypass
Audio	Bezel-Mounted Stereo Speakers
Languages	English, French
Mimic Panel	Digital
Setpoints Control	Digital
Power Supplies	Redundant (4 Failure Groups. Triple Redundant Supplies. 12 Power Supplies Provided.)
Connectivity	
Meters	Local Display, Ethernet, Modbus/TCP, http via Web Browser (Non-Proprietary)
Alarms	Local Display, Ethernet, Modbus/TCP, http via Web Browser (Non-Proprietary)
Summary Alarm	Dry Contacts; Local Display; Modbus/TCP; Web Browser
Waveforms	Local Display, Ethernet, http via Web Browser (Non-Proprietary)
History/Event Log	Local Display, Ethernet, http via Web Browser (Non-Proprietary)
Diagnostics	Local Display, Ethernet, http via Web Browser (Non-Proprietary)
Time Synchronization	Network Time Protocol (NTP)

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Learn more at www.LayerZero.com

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