



LAYERZERO
POWER SYSTEMS, INC.

The Foundation Layer

Series 70: eSTS

400 A - 1200 A Static Transfer Switch



Product Brochure

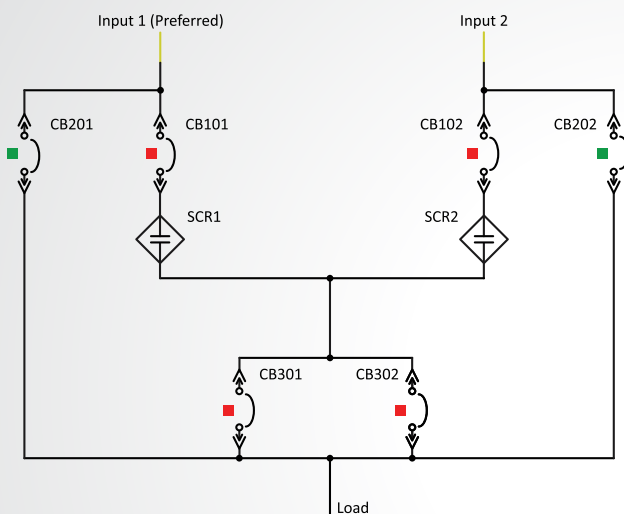
The LayerZero eSTS Static Transfer Switch

Maximizes Power Reliability

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



One Line Diagram



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
- ☑ **Convection Cooling:** Natural Convection-Cooled Heat Dissipation System is Maintenance-Free
- ☑ **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
- ☑ **Front-Only Access:** Installation and Maintenance Can Be Safely Performed Without Side or Rear Access
- ☑ **Dead Front Hinged Doors:** Barrier To Provide A Safe Working Area With No Exposed Live Parts

Connectivity

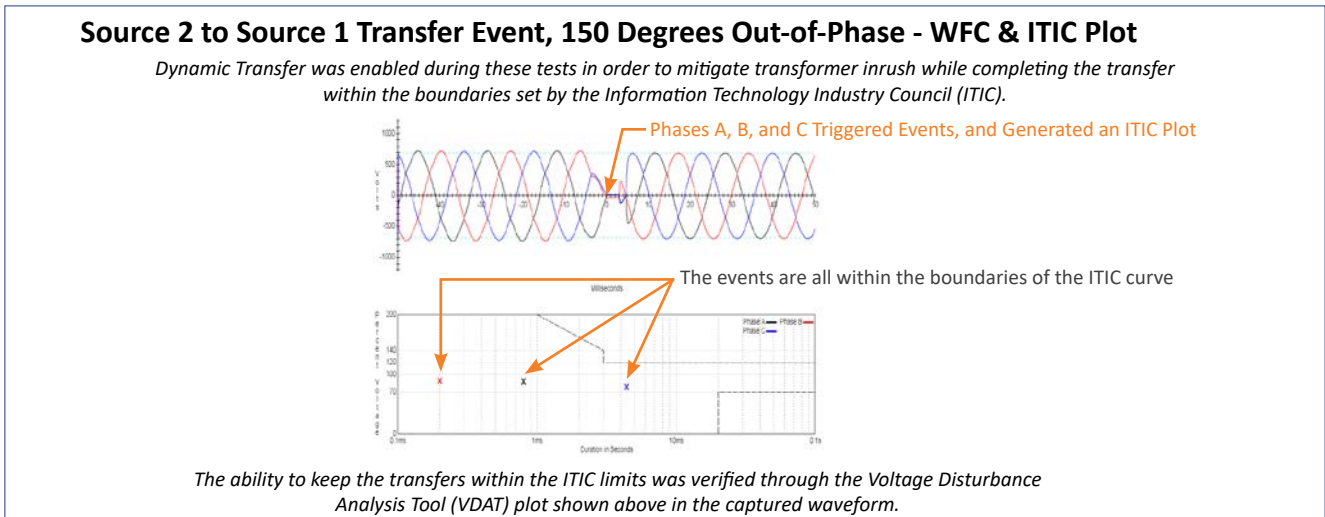
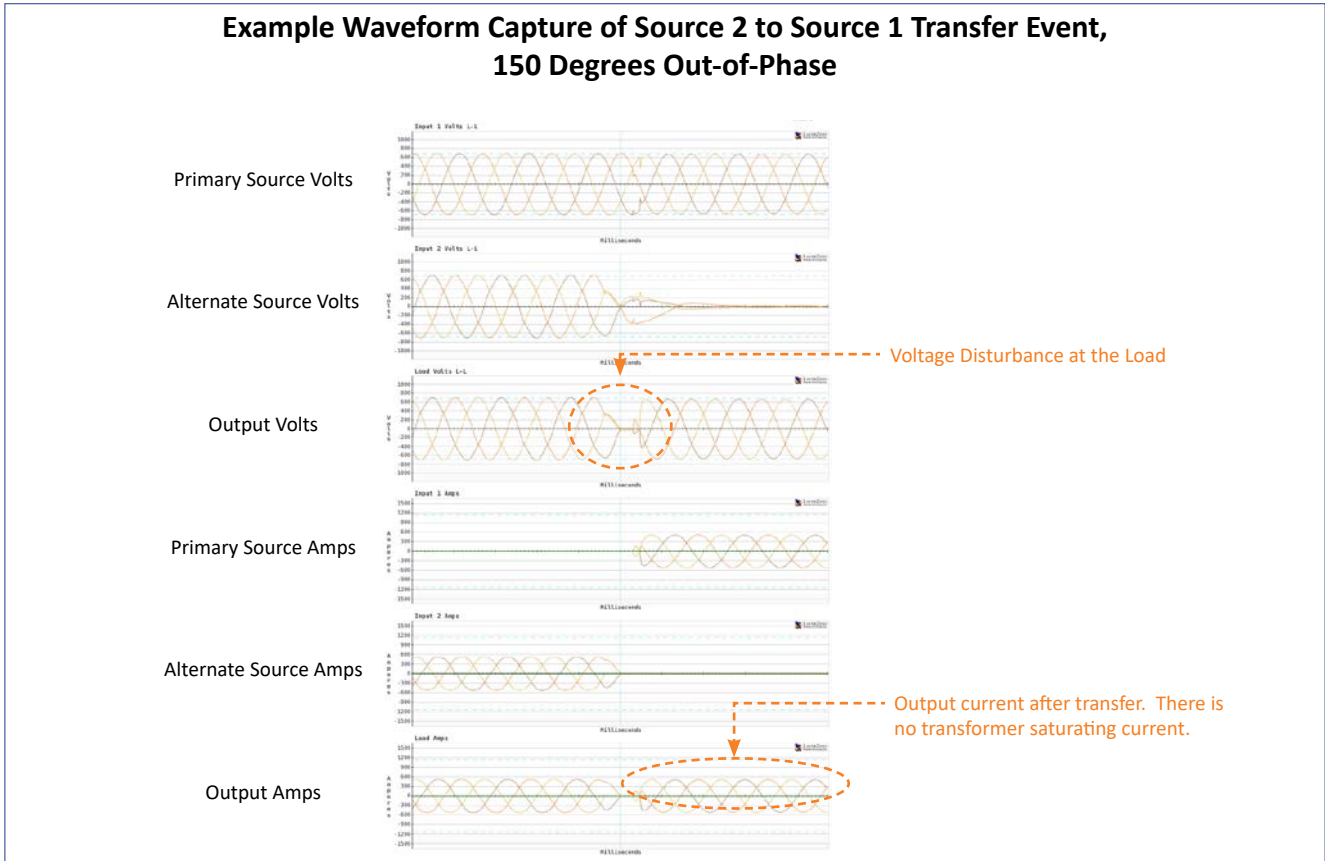
- ☑ **Ethernet Connectivity:** Secure VPN Router Connects To Network For Advanced Remote Monitoring Capabilities
- ☑ **Modbus/TCP:** Open Connectivity to Existing Monitoring Systems Without Proprietary Limitations
- ☑ **NTP Time Clock Synchronization:** Facilitates Timeline-Based Logging For Post-Event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



- ☑ **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:** 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.



150 A - 800 A eSTS Section Overview

Controls Section

Circuit Breaker Section



1200 A eSTS Section Overview

Controls Section

Power Electronics Section

Input/Output Bypass Isolation Section

Source & Load Terminal Section



Equipment Layout (400 A Shown)

Controls Section Contains:

Power electronics

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

Control Electronics

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

CB Section Contains:

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



Source 1 Phase A SCRs

Source 2 Phase A SCRs

Source 2 Phase B SCRs

Source 1 Phase B SCRs

Source 1 Phase C SCRs

Source 2 Phase C SCRs

CB101 Source 1 Isolate

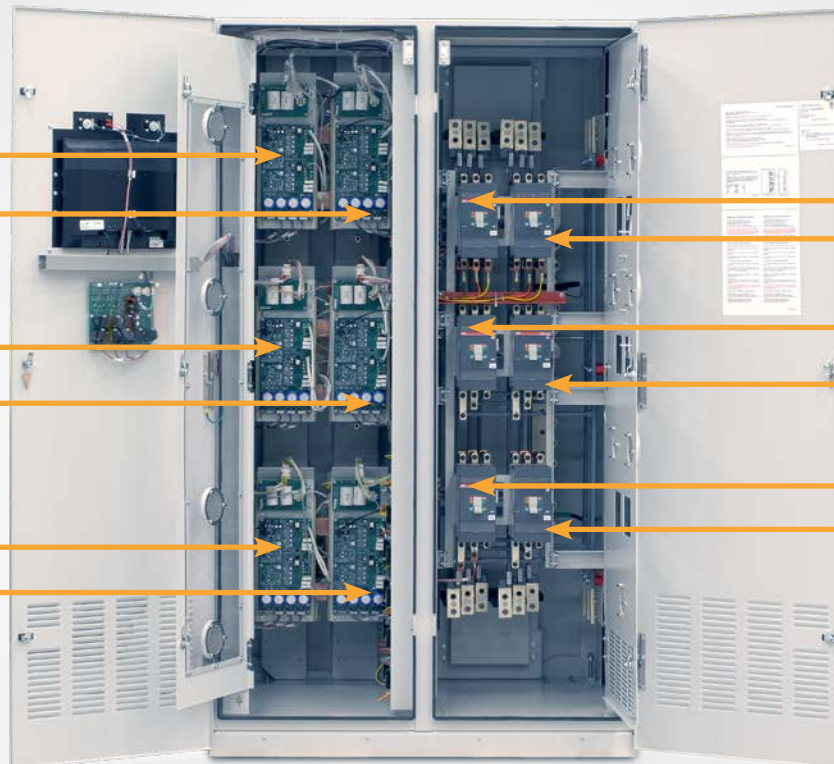
CB102 Source 2 Isolate

CB201 Bypass Isolate, Source 1

CB202 Bypass Isolate, Source 2

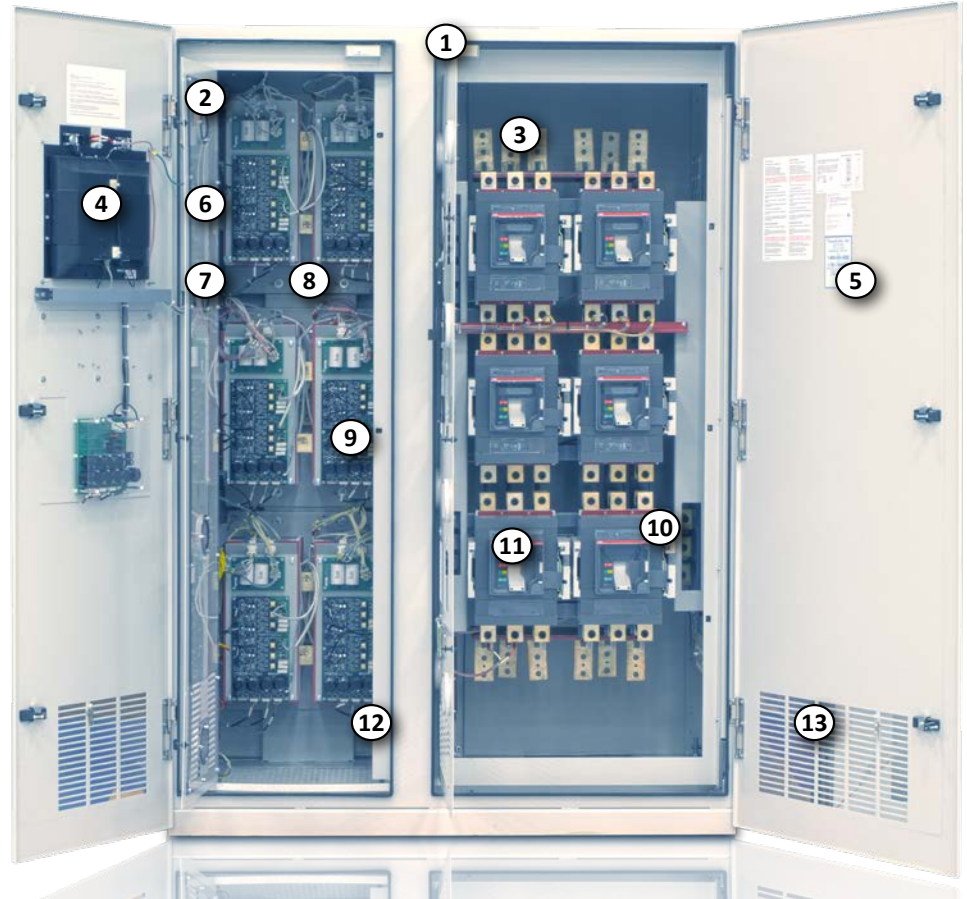
CB301 Output Isolate 1

CB302 Output Isolate 2, (Redundant, Optional)



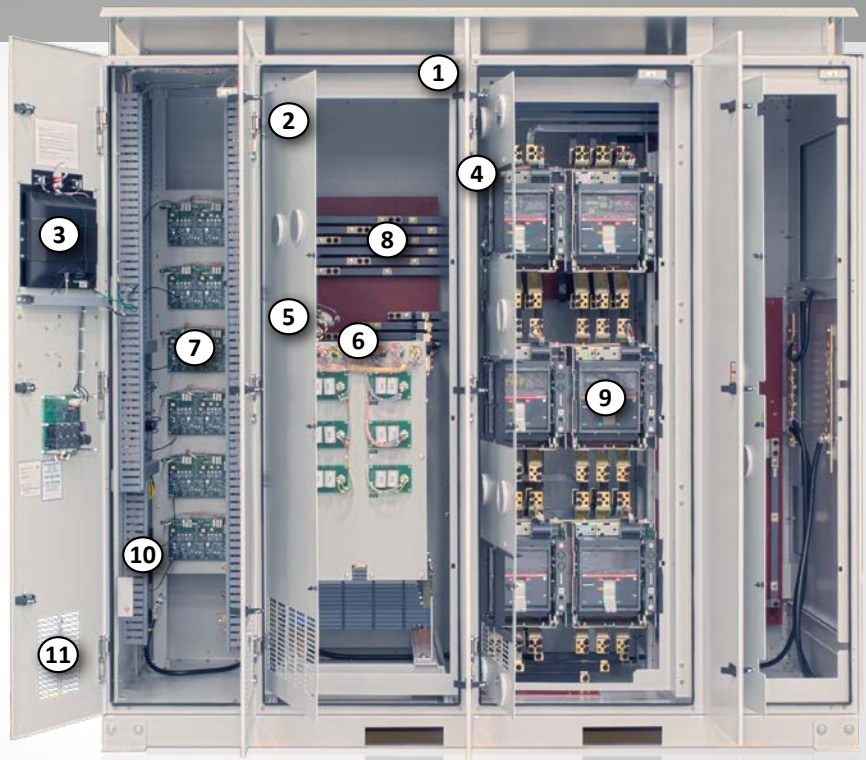
Equipment Construction Detail (800 A Shown)

1. Alarmed Doors
2. Hinged Dead Front Doors
3. Silver Plated Terminals
4. 15" Color Touch Screen GUI
5. Printed Bypass Instructions
6. Polycarbonate Window
7. InSight™ IR Portholes
8. Convection Cooled Heat Sinks
9. Staggered Gate Drive Arrangement
10. Epoxy Coated Buswork
11. Circuit Breakers
12. Redundant Power Supplies
13. Convection Cooled Intake



1200 A Shown

1. Alarmed Doors
2. Hinged Dead Front Doors
3. 15" Color Touch Screen GUI
4. Printed Bypass Instructions
5. InSight™ IR Portholes
6. Convection Cooled Heat Sinks
7. Staggered Gate Drive Arrangement
8. Epoxy Coated Buswork
9. Circuit Breakers
10. Redundant Power Supplies
11. Convection Cooled Intake



Reliability Overview

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

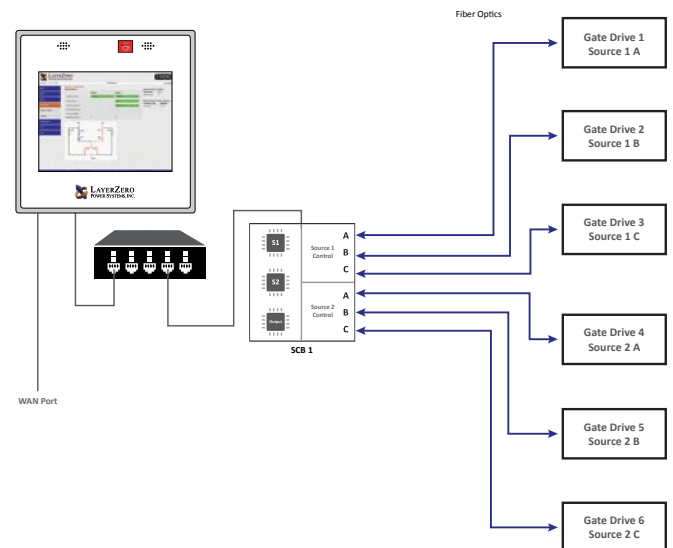


Single Module Redundancy (SMR) Reliability (Standard)

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

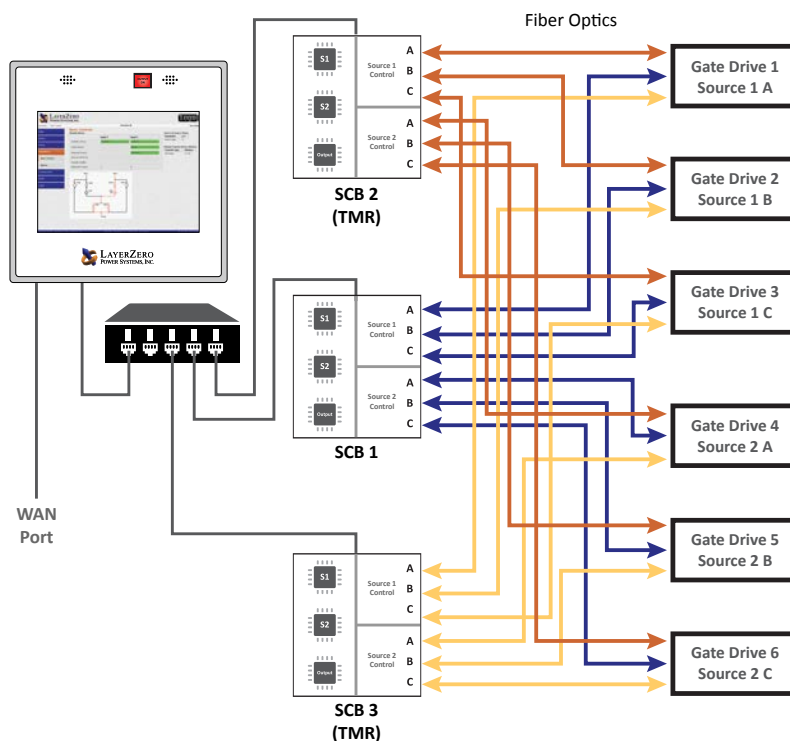
Triple Modular Redundancy (TMR) Reliability (Optional)

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 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

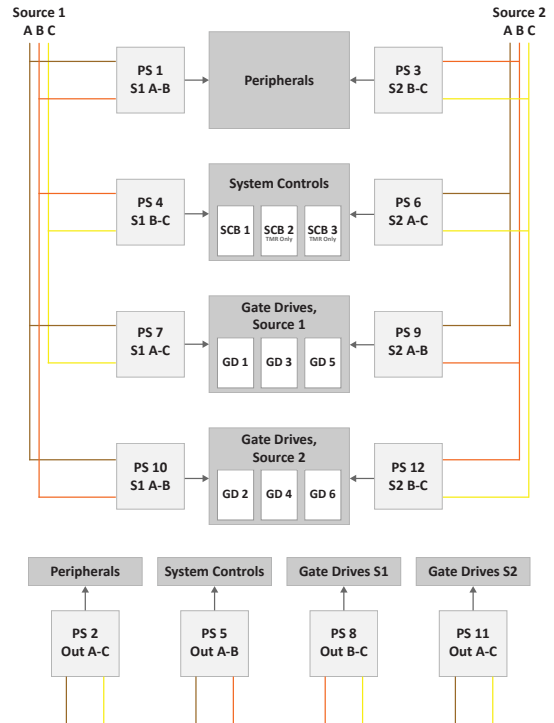
Divided into four (4) logical failure groups:

- 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:

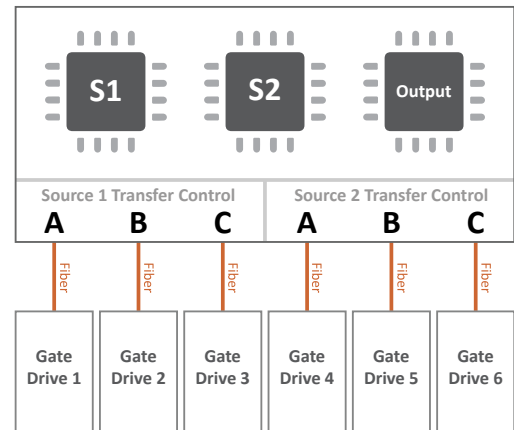
- Source 1
- Source 2
- STS Output.

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.

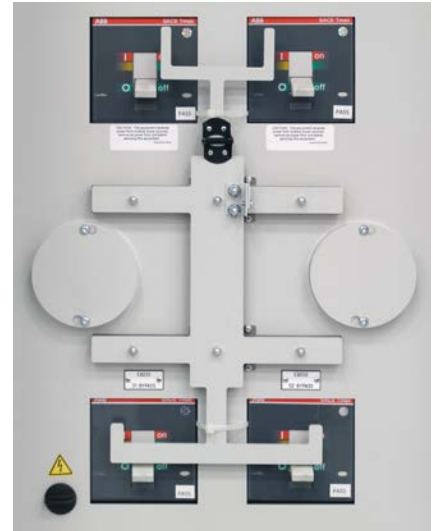


Reliability Features

Mechanical Bypass Interlock

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.

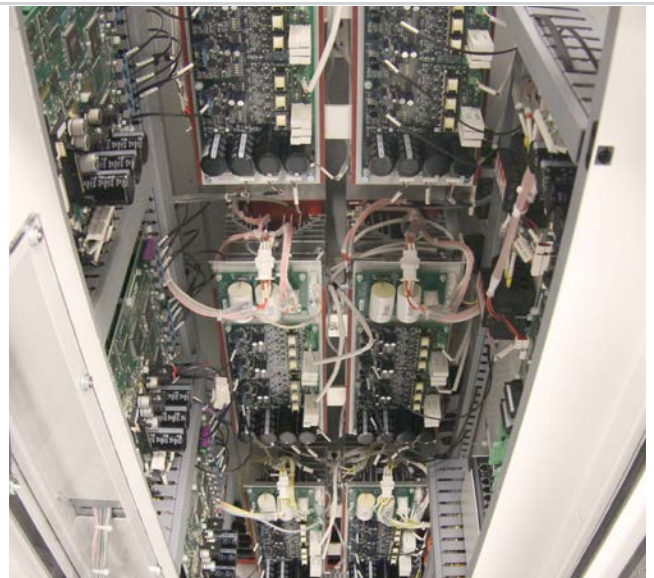


No Fans, Dust Filters, or Fan Fuses

The Series 70: eSTS Static Transfer Switch utilizes a natural convection-cooled heat dissipation system.

Fans and fan sensors are some of the most common components to fail. For maximum uptime, LayerZero's eSTS systems do not contain any fans, dust filters to change, or fan fuses to replace.

The heat sink arrangement is staggered between sources and phases to minimize the creation of extreme thermal gradients between heat sink columns when conducting on one source or the other.



Reliability Features

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.



Machined Hardware

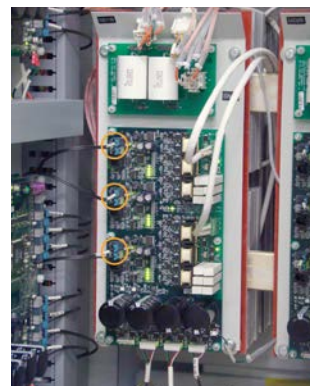
Our bolted connections utilize machined cap screws and engineered disc springs. The result is a flat pressure vs deflection profile to ensure that all bolted connections maintain constant torque through the life of the product.

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.

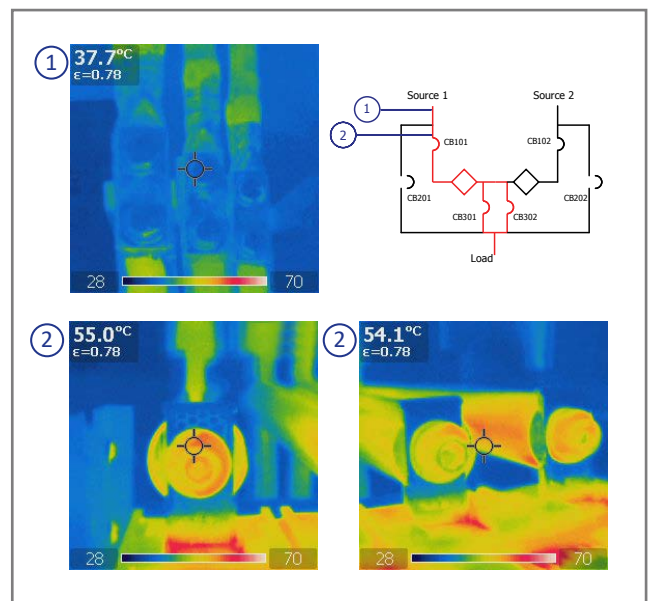


Ease of Maintenance

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 can be done from the front – without ever having to open the dead-front door.

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
(Door and side panel hidden for visibility)

Ease of Maintenance/Connectivity Options

Front Only Access Saves Space

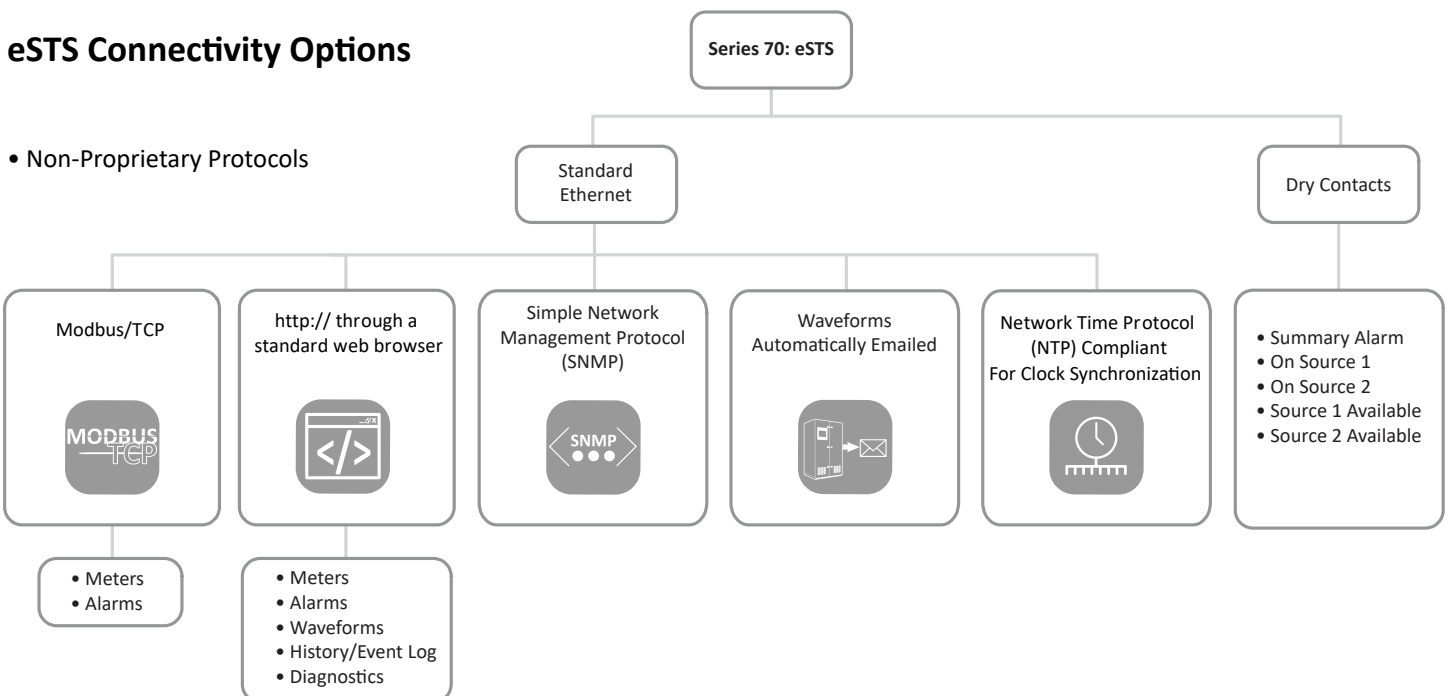
The Series 70: A eSTS is designed to be installed, operated, diagnosed and maintained only from the front. The dead-front panels are hinged, and side or rear covers never have to be removed.

Unhinged covers can be bulky and unwieldy, and operator error during removal and replacement of covers has been known to cause mishaps and compromise load reliability. A safe, non-invasive operation and maintenance regime results in a higher reliability of the critical load.

The Series 70: eSTS utilizes dead-front hinged doors. An alarm notifies when an outer door has been opened.



eSTS Connectivity Options

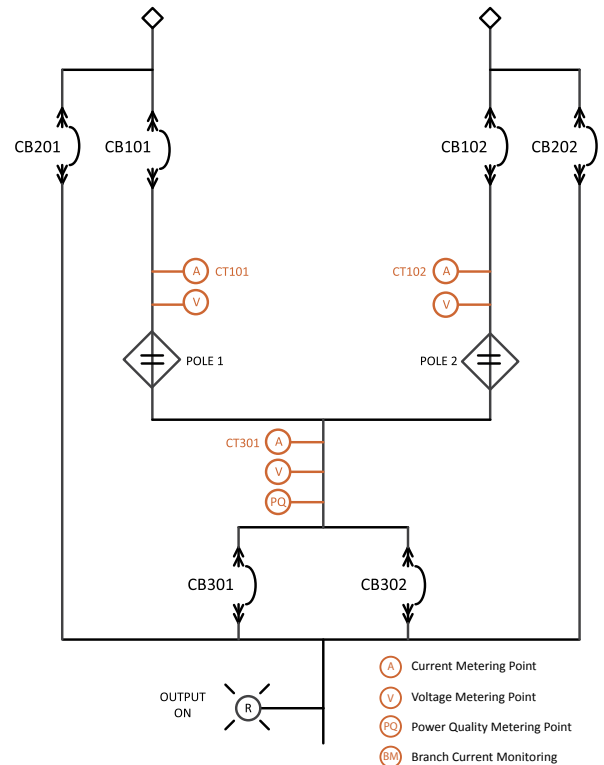


Features/Power Quality Monitoring



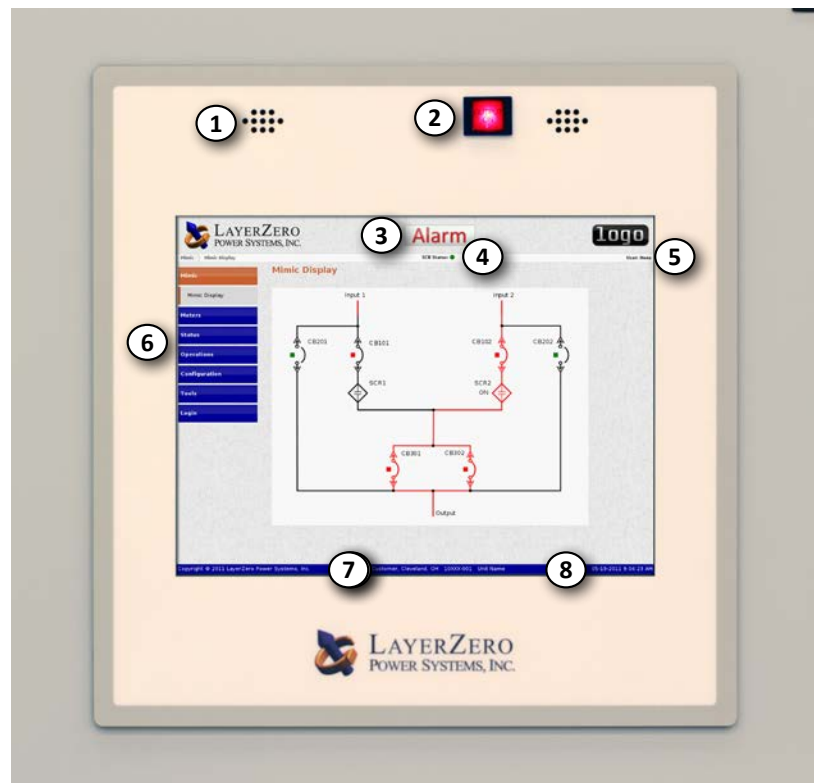
Zen is being aware of all activity in your critical power distribution systems, it is an all encompassing monitoring system with local and remote communications options. From basic monitoring, alarms, to advanced power quality monitoring functionality, Zen SSQM provides a wide-range of options to help you maintain the highest level of reliability.

Zen gives you a vendor-neutral “Birds Eye” view of your entire critical power distribution infrastructure. Zen maximizes reliability, letting you know if a source has quality issues, if a UPS output is bad, or if there are any alarms. In addition, Zen empowers users with the capability to go back in time to retrace the exact sequence of historical events. No other tool in the mission-critical industry empowers users with this robust capability.



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



Power Quality Monitoring

zen SSQM

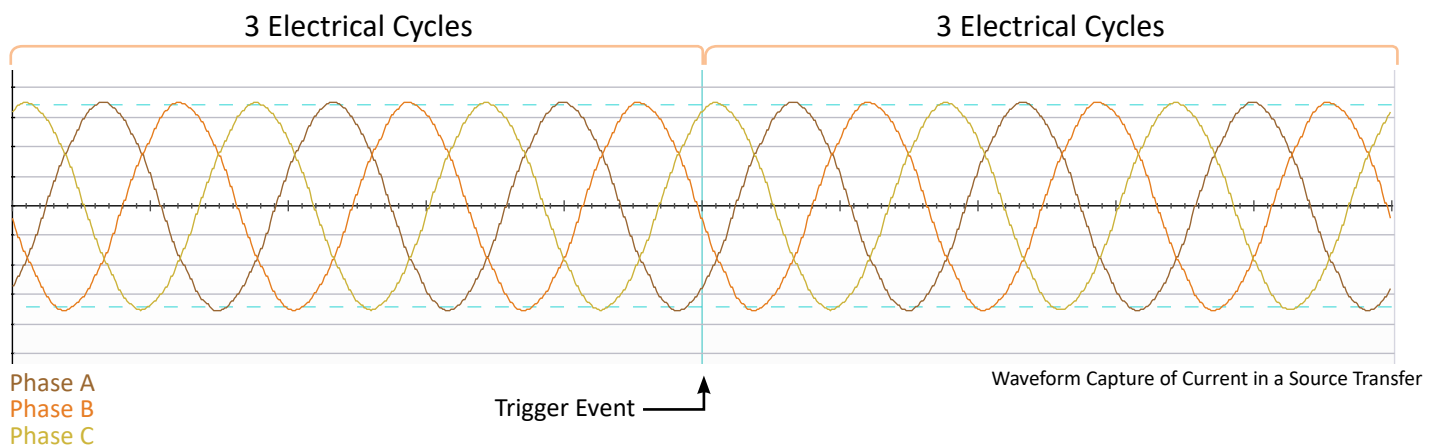
The Series 70: eSTS is equipped with Zen SSQM (Static Switch Quality Monitoring), an all encompassing monitoring system with local and remote communications options.

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.



Zen SSQM Technical Specifications



| 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) | ✓ |

Technical Specifications: 3-Pole Static Transfer Switch

| eSTS Models with Withstand Ratings | | | | | |
|---|--|--|--|--|---|
| eSTS Rating (100%) | 120/208 V | | 480 V; 480/277 V; 415/240 V; 400/230 V; 220/380 V | | 600 V; 600/347 V; 575 V |
| 150 A | 150kA; 100kA; 65kA | | 150kA; 100kA; 65kA; 35kA | | 100kA; 65kA; 35kA; 25kA |
| 250 A | | | | | |
| 400 A | | | | | |
| 600 A | | | | | |
| 800 A | 100kA; 65kA | | 100kA; 65kA; 50kA; 35kA | | 42kA; 35kA; 25kA |
| 1200 A | | | 100kA*; 65kA; 50kA | | 65kA*; 50kA; 25kA |
| * Upgrade to Automatic Circuit Breakers | | | | | |
| Mechanical Characteristics * | | | | | |
| | 150 A - 250 A | 400 A | 600 A | 800 A | 1200 A |
| Heat Dissipation | 4,750 BTU/Hr | 7,000 BTU/Hr | 9,500 BTU/Hr | 12,500 BTU/Hr | 24,000 BTU/Hr |
| Weight | 1,350 lbs (612 kg) | 1,400 lbs (635 kg) | 1,500 lbs (680 kg) | 1,950 lbs (885 kg) | 5,500 lbs (2495 kg) |
| Dimensions | 36"W x 36"D x 80"H (1219 mm x 914 mm x 2032 mm) | 48"W x 36"D x 80"H (1219 mm x 914 mm x 2032 mm) | | 58"W x 36"D x 80"H (1473 mm x 914 mm x 2032 mm) | 96"W x 48"D x 90"H (2438 mm x 1219 mm x 2286 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 up through 600 A; Draw-out 800 A, 1200 A | | | | |
| 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.

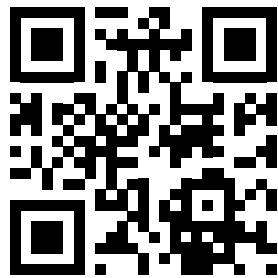
All product specifications are subject to change without notice.

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) |
| Cooling | Convection Cooling |
| Cable Access | Top/Bottom |
| Service Access | Front Only |
| Bypass Interlock Mechanism | Mechanical |
| 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) |
| Standards Conformance | |
| CSA | ETL Listed to C22.22 No 107. |
| UL | ETL Listed to UL 1008S |

All data tables above are for 3-pole only. Contact LayerZero for custom sizes and designs.

All product specifications are subject to change without notice.



Learn more at www.LayerZero.com



LayerZero Power Systems, Inc.
1500 Danner Drive
Aurora, OH 44202 U.S.A.

© 2019 LayerZero Power Systems, Inc.

LayerZero Power Systems, LayerZero.com and the LayerZero logo are registered trademark of LayerZero.
All product specifications are subject to change without notice.

Rev. 4/19 #7