LayerZero Power Systems, LLC.

The Foundation Layer

Series 70: eSTS

2000 A 415/240V 4-Pole Static Transfer Switch

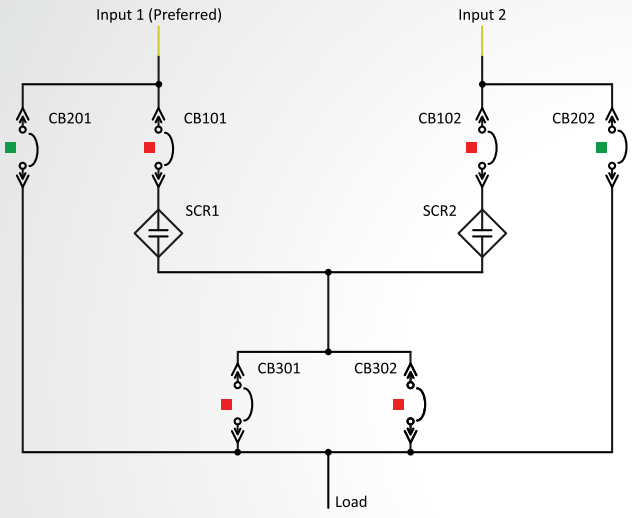
Product Brochure

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 AC sources in a quarter cycle. The eSTS performs open-transition transfers in such a manner that the connected load disruption is minimized without ever cross-connecting the power sources. One power source is selected as 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



eSTS Static Transfer Switch One Line Diagram

Control Electronics

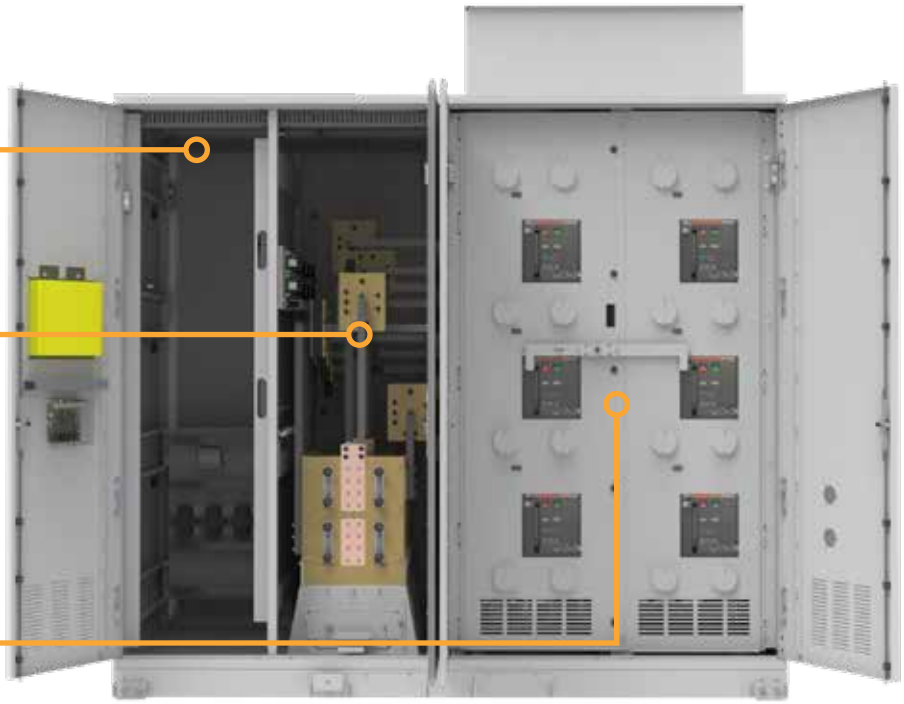
- System Control & Data Acquisition Boards
- SCR Gate Drives
- Redundant Power Supply System
- I/O system; VPN Router

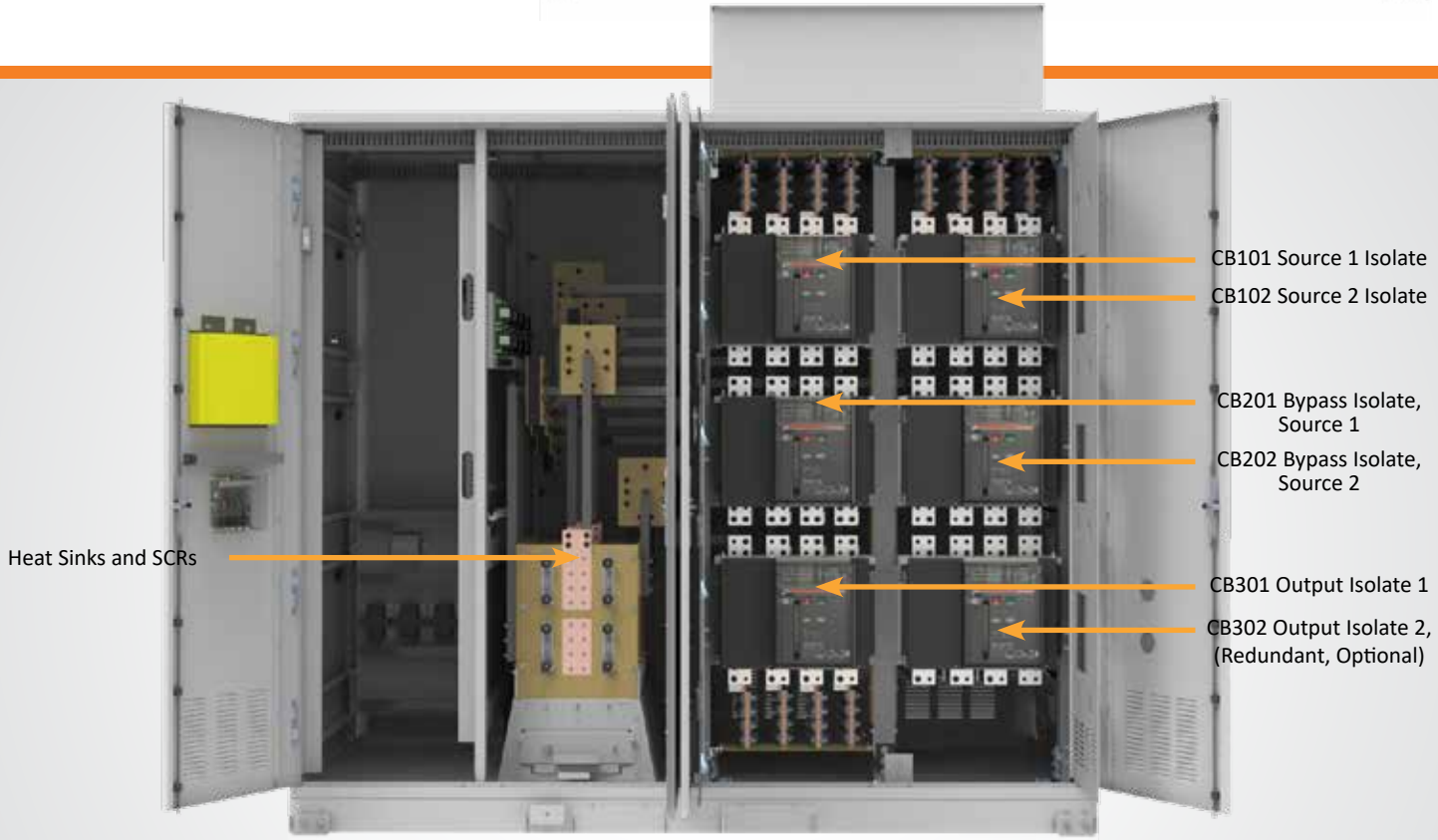
Power electronics

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

CB Section Contains:

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





Standard Features

Every LayerZero Power Systems eSTS comes equipped with a comprehensive suite of standard features designed to maximize power reliability, enhance safety, and improve operational efficiency. Discover the key elements that make LayerZero static transfer switches the preferred choice across the industry.

Reliability

Optional Triple Modular Redundancy:
Fully-independent control paths ensure no single point-of-failure.

Safe Bypass Procedure:
Mechanical bypass interlock prevents human errors during bypass procedures.

Voice Guided Bypass:
Audio-video guidance offers step-by-step instructions for operators.

Convection Cooling:
Natural cooling system is maintenance-free.

Epoxy Coated Buswork:
Eliminates potential bus-to-bus faults.

Silver Plated Terminals:
Superior conductivity for enhanced electrical performance.

Maintenance-Free Joints:
Permanent brazed joints ensure longevity.

Machined Hardware:
Constant torque throughout product life.

Optical Fiber Based Controls:
Noise and interference free controls while ensuring high voltage isolation.

Serialized Critical Board Tracking:
Active database tracking for essential boards.

Safety

INSIGHT IR® Cameras:
Monitor bolted connections for temperature anomalies.

Sectionalized Components:
Allows safe de-energization for maintenance.

Polycarbonate Windows:
View critical board LEDs with closed dead-front door.

Front-Only Access:
Safe installation and maintenance without side/rear access.

Dead Front Hinged Doors:
Ensures a safe work environment with no exposed live parts.

Connectivity

Ethernet Connectivity:
Secure VPN router for remote monitoring.

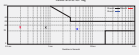
Modbus/TCP:
Connect to existing systems without proprietary restrictions.

NTP Time Clock Synchronization:
Enables timeline-based event logging.

SNMP Connectivity:
Remote management via SNMP.

Power Quality Monitoring

Real-Time Waveform Capture:
Captures a picture of the power three-cycles before and after every event.



ITIC Plotting:
Analyze if equipment was affected by power quality events.

Local Touch-Screen Interface:
Secure interface for local STS operations.

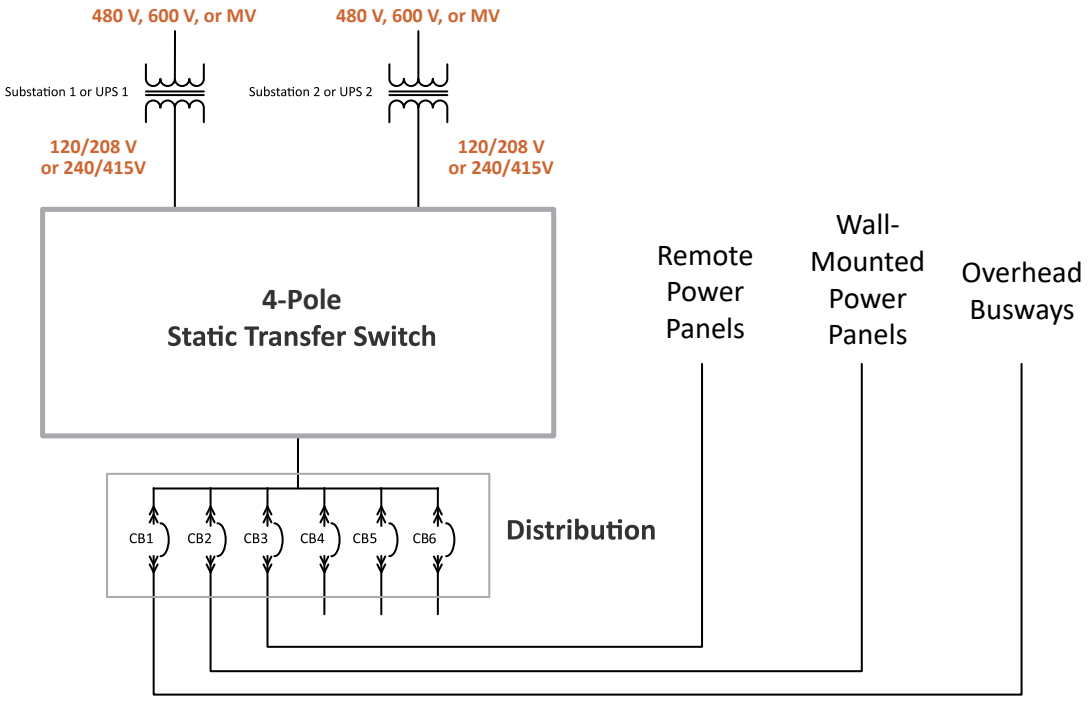
Waveforms Automatically Emailed:
Send waveforms to designated individuals post-transfer.

The 4-Pole eSTS Lowers Infrastructure Costs While Maintaining High Reliability

Increasingly, data center operators are seeking to enhance energy efficiency in order to reduce operating costs. A widely adopted strategy for achieving greater efficiency in critical operations is to minimize the number of AC power transformations between the building entrance and the final critical load. To support this goal, facilities are being designed to step down voltage at the incoming substation to the 240/415 V level. UPS systems are now commonly deployed with native 4-wire, 240/415 V output, and critical loads operate at 240 V line-to-neutral. This approach optimizes cabling costs at higher voltage levels and eliminates the efficiency loss that would result from an additional transformation to 120/208 V.

In this context, and in environments with two independent power sources, if a static transfer switch is required to improve power reliability to the critical load and/or enable concurrent maintainability of the facility's electrical infrastructure, a four-pole static transfer switch is essential. The transfer mechanism must switch the phase conductors (A, B, and C) using an open-transition method while ensuring that the neutral conductor is transferred between sources without any interruption.

LayerZero's 4-pole eSTS is the most reliable, connected, and information-centric solution available for this application. Unlike other systems, LayerZero uniquely employs SCR-based solid-state transfers for phases A, B, C, and Neutral. To further ensure operator safety, the system also utilizes 4-pole breakers for input, output, and bypass isolation.



Reliability Overview

LayerZero eSTS Reliability Overview

The LayerZero eSTS Provides Many Dimensions of Reliability:

- **Control System Reliability:**
  - **SMR (Single Module Redundancy, Standard):** Our foundational architecture ensures reliable and consistent operation under all conditions.
  - **TMR (Triple Modular Redundancy, Optional):** LayerZero's TMR system goes beyond SMR by utilizing three independent control systems. Each operates in complete isolation, individually acquiring and processing voltage and current data. Even if one control path fails, the system seamlessly continues to function. This is not simply "triple redundancy." It is a rigorously designed architecture for unparalleled reliability.
- **Control Power Supply Reliability:** Designed to ensure consistent and uninterrupted control power, preventing unexpected shutdowns.
- **Signal Reliability:** Designed for accurate, interference-resistant signal transmission to reduce the risk of communication errors.
- **Operator Procedural Reliability:** Incorporates intuitive, safety-focused features that promote error-free operation and maintain system integrity.

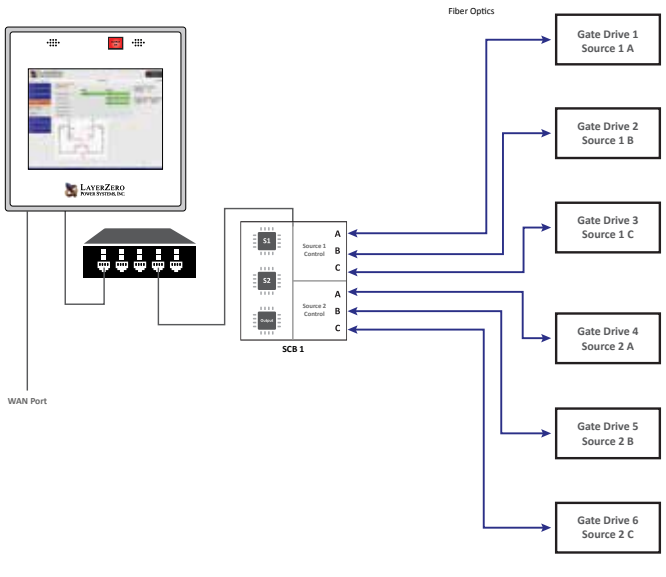
The Series 70: eSTS is designed for maximum reliability

Single Module Redundancy (SMR) Reliability (Standard)

LayerZero's Single Module Redundancy (SMR) topology is a cost-effective solution that provides robust redundancy for mission-critical applications. In SMR systems, each source includes triple-redundant processors for enhanced reliability.

Each phase is also managed by its own dedicated gate drive board, providing independent control and added fault tolerance.

What sets LayerZero's SMR design apart is its fail-safe architecture. In the event of a complete failure of the primary SMR control system, power will continue to flow to the load from the active source, and automatic or manual transfers between sources will not be possible until the control system is restored.



Redundant Control Paths of LayerZero SMR Gate Drives

Reliability Features: Triple Modular Redundancy (TMR) *Optional

Triple Modular Redundancy (TMR) Reliability (Optional)

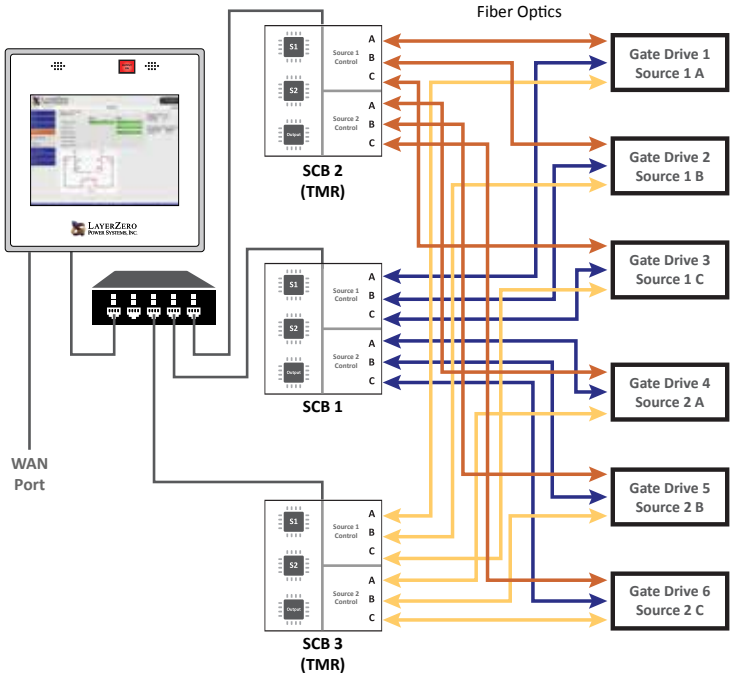
LayerZero's Triple Module Redundancy builds upon the SMR architecture by introducing three independent analog and digital control systems within each STS. These systems do not share a clock, communicate directly, or depend on one another in any way.

Each control module independently acquires real-time voltage and current data, evaluates the health of power sources, and makes transfer decisions autonomously.

In the event of a complete failure of one control path, combined with a failure of the active power source, the STS will still successfully transfer to the alternate source, maintaining continuous power to the load.

LayerZero's TMR is rooted in rigorous statistical modeling and proven engineering principles. While other manufacturers may use similar-sounding terms like "tri-redundant" or "triple-redundant," these do not offer the same depth of isolation and resilience that define true Triple Modular Redundancy as implemented by LayerZero.

Three System Control Boards (SCBs) in a TMR Configuration



Redundant Control Paths of a TMR Configuration

Reliability Features: Single Module Redundant (SMR) Redundancy

eSTS SMR Triple Redundant Power Supply Architecture

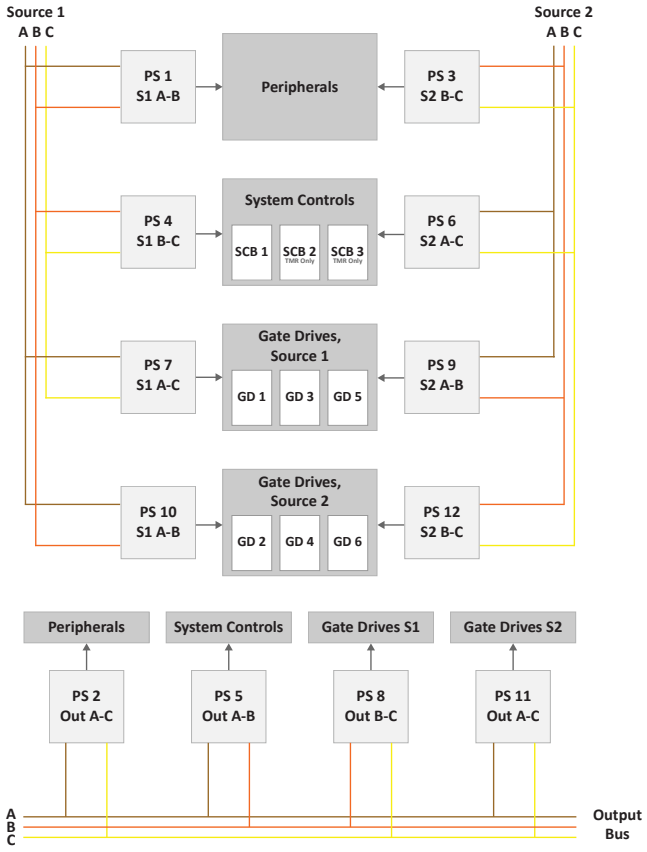
Divided into four (4) logical failure groups:

- 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:

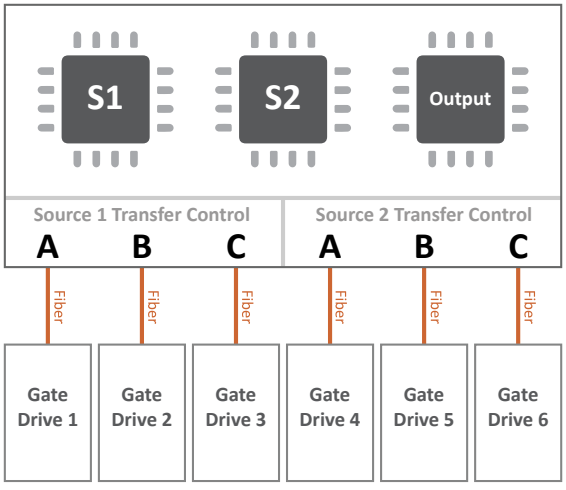
- Source 1
- Source 2
- STS Output.

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

- Independent processors are dedicated to monitoring and analyzing power quality for Source 1, Source 2, and the Output.
- If the processor for Source 1 malfunctions, the system can still be commanded to transfer to Source 2, and vice versa.
- In the event of a complete failure of the main control system, the STS continues to conduct power to the load from the current source. However, transfers between sources are no longer possible until the control system is restored.
- Each phase of each source is managed by an independent gate drive circuit board, providing isolated control for enhanced system reliability.



Reliability Features

Mechanical Bypass Interlock

To minimize the risk of operator error during bypass operation, LayerZero's eSTS includes a comprehensive mechanical interlock system featuring:

1. **Interlocked breakers** to prevent unsafe switching actions.
2. **Source verification mechanisms** ensure that a source cannot be bypassed unless the STS is actively sourcing from it.
3. **Protective safeguards** that prevent the inadvertent cross-connection of power sources.
4. **Voice-guided bypass procedures** that audibly walk the operator through each required step.
5. **Step-by-step pictorial and video guidance** is displayed on the unit's touchscreen interface during the bypass process.

Mechanical Bypass Interlock Design

Voice-Guided Bypass

Operator error during maintenance bypass has long been recognized as a reliability hazard. To address this, the LayerZero eSTS features a voice-prompted bypass procedure that walks the operator through each step of the process. Only one operation is permitted per screen, with both visual and audio cues providing clear guidance. This approach significantly reduces the probability of operator error and enhances procedural safety.

The Voice Guided Bypass Screen in the LZA GUI

No Fans, No Filters, No Fuses

The Series 70 eSTS is designed with a natural convection cooling system, eliminating the need for fans, fan sensors, dust filters, or fan fuses, all of which are common points of failure in conventional systems.

This convection-based design maximizes uptime and reduces maintenance. The heat sinks are strategically staggered between sources and phases, minimizing the creation of extreme thermal gradients between columns during source switching and further enhancing thermal reliability.

Convection-Cooled Design in an eSTS, showing perforated vents on the cabinet bottom

Reliability Features

Epoxy-Coated Buswork and Maintenance-Free Joints

LayerZero's epoxy-coated buswork enhances both safety and reliability by eliminating the risk of bus-to-bus faults. Bus joints are permanently brazed and maintenance-free, ensuring long-term durability and performance.

Silver Plating for High Performance

All bus joints and terminals are silver-plated to achieve the highest possible conductivity and lowest resistance. Silver provides superior electrical performance, resulting in exceptionally efficient and reliable connections.

Cutaway of epoxy coated buswork on a 2000 A eSTS Static Transfer Switch

Precision-Machined Hardware

LayerZero employs machined cap screws and designed disc springs in all bolted connections. This combination delivers a consistent pressure-versus-deflection profile, ensuring that each connection maintains constant torque throughout the product's lifetime. These components have been extensively tested in environments with wide temperature fluctuations to ensure long-term mechanical stability. Once connections are tightened, they stay that way.

Machined Cap Screws and Engineered Disc Springs Utilized in LayerZero Power Systems Products

Fiber Optic Controls Increase System Reliability

Fiber-optic-based controls eliminate electrical noise and interference while isolating components from high voltage. Optical fiber ensures reliable communication between control and power circuits, enhancing both performance and safety. In LayerZero's eSTS design, gate drives operating at power circuit voltage receive control signals via optical fibers, providing precise, noise-free signal transmission and improved overall system reliability.

Fiber Optic Connections (highlighted) in a Gate Drive

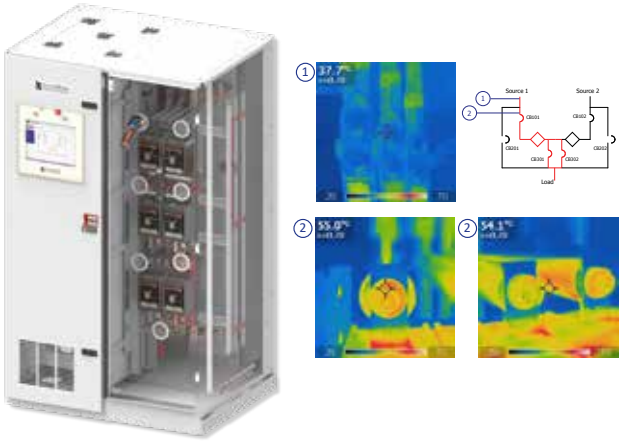
Safety - Ease of Maintenance

INSIGHT IR® Portholes Permit Scanning of Bolted Connections with Dead-Front Doors Closed

Strategically positioned INSIGHT IR® scan portholes enable safe thermal scanning of all bolted connections with the dead-front doors closed, eliminating operator exposure to power circuit voltage. With this design, thermal scans can be safely performed from the front of the equipment.

Each IR window swivels upward and unlocks via keyhole access, revealing a protective mesh that allows technicians to aim and capture accurate thermal readings with standard infrared cameras.

INSIGHT IR® Porthole with cover opened



An IR Camera Scanning an INSIGHT IR Porthole for Source 1 Input
(Door and side panel hidden for visibility)

INSIGHT IR® Cameras - Early Fault Detection in Real Time

INSIGHT IR® is a continuous thermal monitoring system designed to identify temperature irregularities on critical electrical connections before they escalate into potential failures. Utilizing a network of fixed infrared cameras, INSIGHT IR® provides a live, real-time thermal image of every monitored connection. The system allows operators to view temperatures by phase, helping to quickly pinpoint any hotspots or areas of concern.

By detecting issues early, maintenance teams can take corrective action long before a problem leads to unplanned downtime.

INSIGHT IR® live images can be viewed on a local or remote display.

INSIGHT IR® Camera Housing

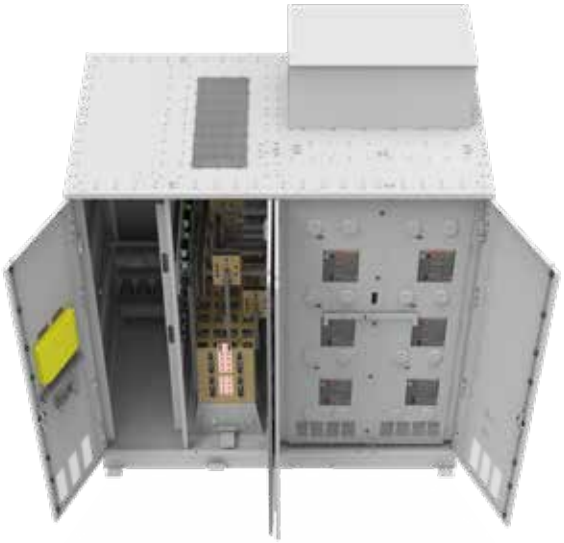
INSIGHT IR® Cameras are installed near bolted connections and critical components, and generates a hybrid heat map over a visible image

Safety

Sectionalization Maximizes Operator Safety

In early data center electrical systems, routine maintenance often exposed operators to energized components, significantly increasing the risk of arc flash incidents, human error, and unplanned downtime. Common tasks such as breaker operation or electronics inspection frequently require working on live equipment.

LayerZero's Series 70 eSTS, designed with inspiration from NFPA 70E safety standards, introduced a sectionalized architecture that physically separates the operator interface from both power and control electronics. This design enables power to be safely bypassed around the section being serviced, minimizing operator exposure to live parts and significantly enhancing safety during maintenance operations.



eSTS with the Outer Doors Open, showing physical separation between the power electronics and control sections

View Status LEDs and Distribution CB Positions With Dead-Front Doors Closed

Traditional systems often required operators to open energized compartments just to verify breaker positions or view system diagnostics, introducing unnecessary risk.

LayerZero's Series 70 resolves this issue with a dead-front design that allows full visibility of status LEDs and distribution circuit breaker positions without accessing live compartments.

This approach improves safety, streamlines inspections, and boosts overall system reliability, supporting safer operations and faster decision-making in critical environments.

Power Electronics Section, allowing visibility of status LEDs.

Ease of Maintenance/Connectivity Options

Front Only Access Saves Space

The Series 70 2000 A 4-Pole eSTS is designed for installation, operation, diagnostics, and maintenance entirely from the front. Its dead-front panels are hinged, eliminating the need to remove side or rear covers.

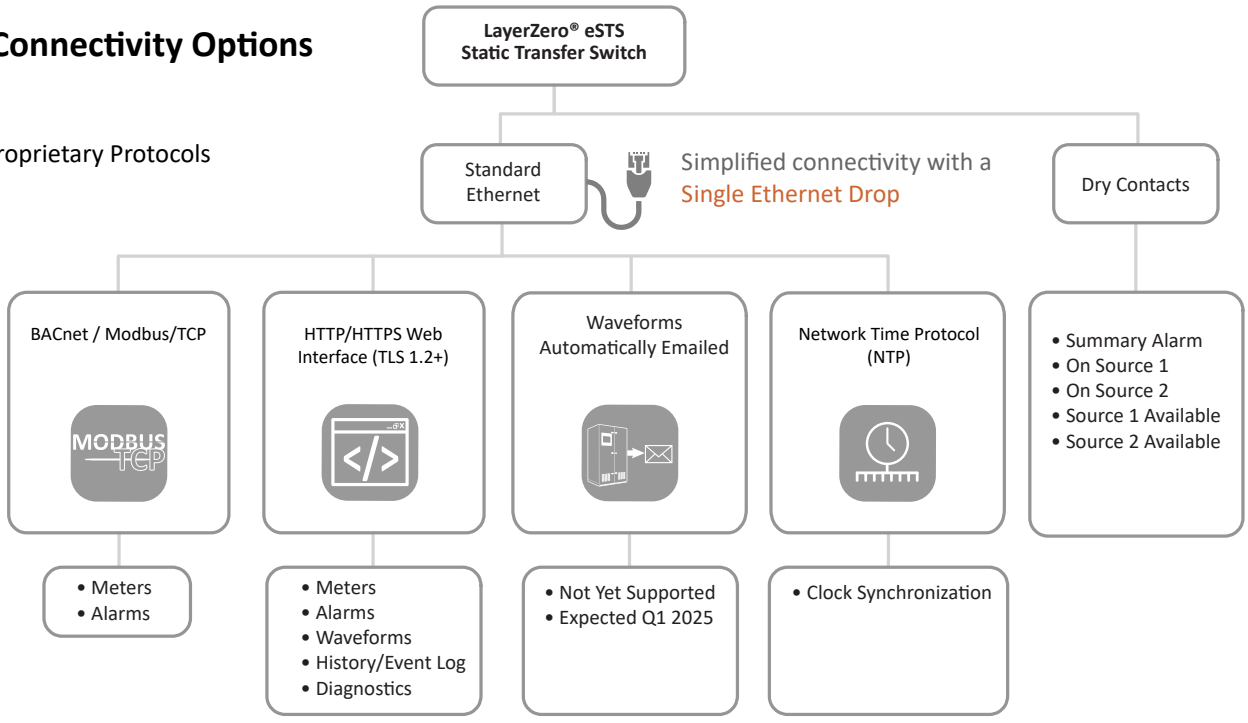
Unhinged covers can be bulky and difficult to handle, and operator errors during their removal or replacement have been known to cause mishaps that compromise load reliability. By enabling safe, non-invasive front-only access, the Series 70 supports a more reliable operation and maintenance process, ultimately enhancing critical load uptime.

Additionally, the Series 70 features dead-front hinged doors equipped with alarms that notify operators whenever an outer door is opened, further promoting safety and security.

Front of the eSTS Static Transfer Switch

eSTS Connectivity Options

- Non-Proprietary Protocols



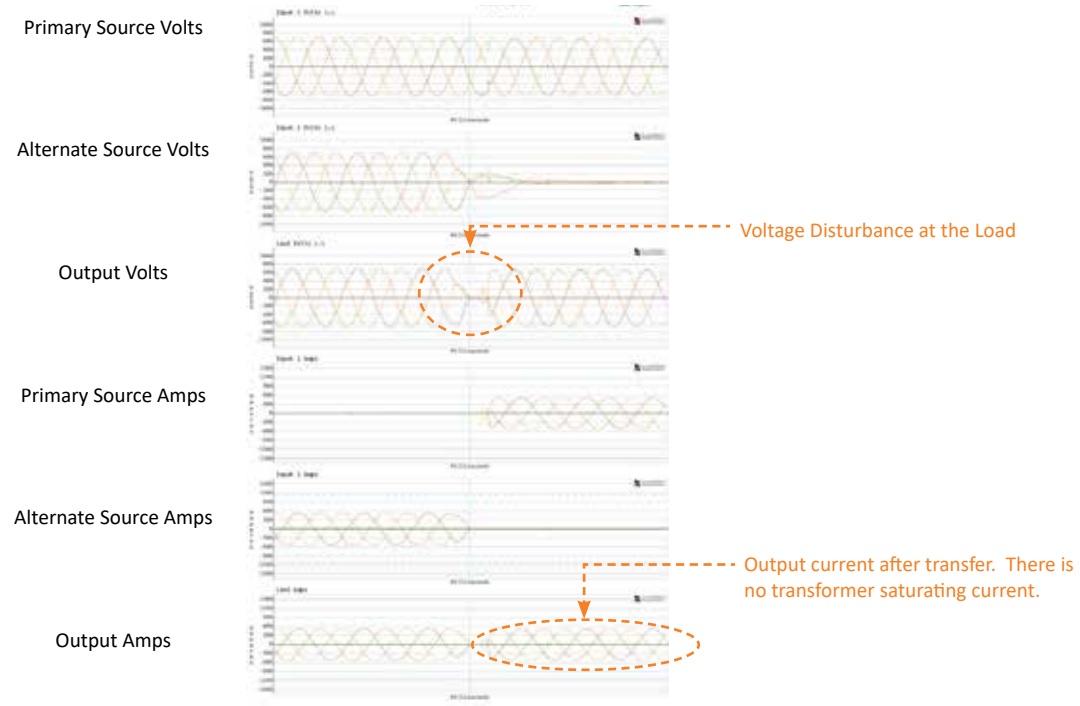
Generate Easy-To-Understand Power Quality Reports with ITIC Plotting

All LayerZero Power Systems products include built-in power quality analyzers that continuously sample power sources. When power quality falls outside specified limits on a source, the eSTS automatically transfers the load to the alternate source, simultaneously capturing waveform data and generating ITIC curves of the event via the Voltage Disruption Analysis Tool (VDAT). This data can be accessed remotely through a secure web browser connection.

VDAT represents a significant advancement in power systems data interpretation. Leveraging innovative algorithms and processing techniques, VDAT converts complex waveform data into clear, actionable insights. It addresses a key industry challenge: while traditional waveform captures are often complex and difficult to interpret, VDAT produces intuitive plots based on Information Technology Industry Council (ITIC) standards, empowering professionals to quickly and confidently assess power events.

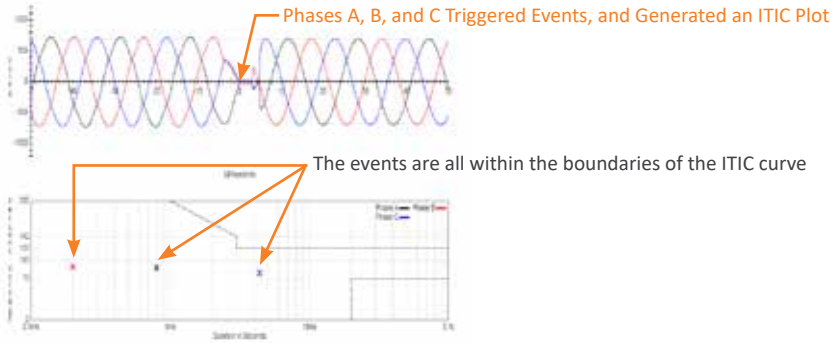
In the example below, the STS was connected to two sources that were 150 degrees out of phase. When the breaker on Source 2 was opened, the STS automatically transferred to the primary source. A delayed transfer caused transient events on Phases A, B, and C, which were captured and automatically plotted using ITIC curves. Unlike raw waveform captures, these ITIC plots are easy to read and require no 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).



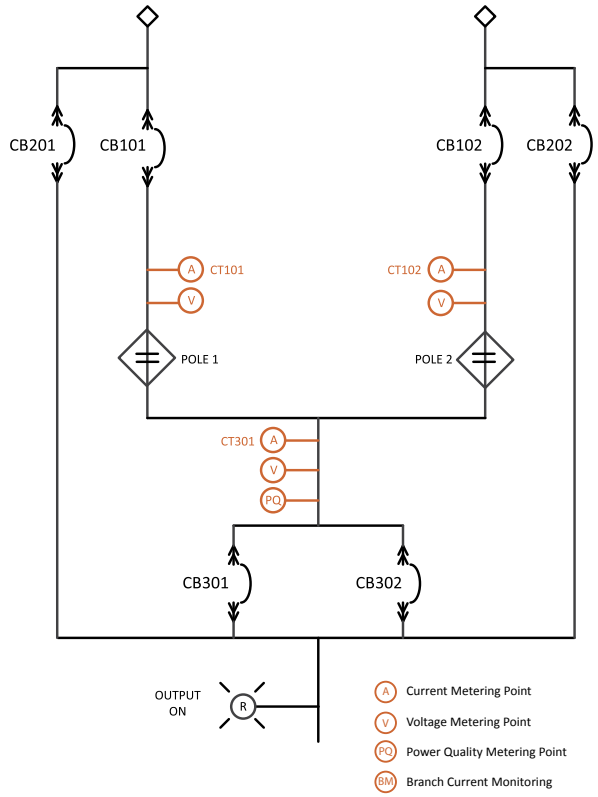
The ability to keep the transfers within the ITIC limits was verified through the Voltage Disruption Analysis Tool (VDAT) plot shown above in the captured waveform.

Features/Power Quality Monitoring

LayerZero Power Quality Monitoring (PQM)

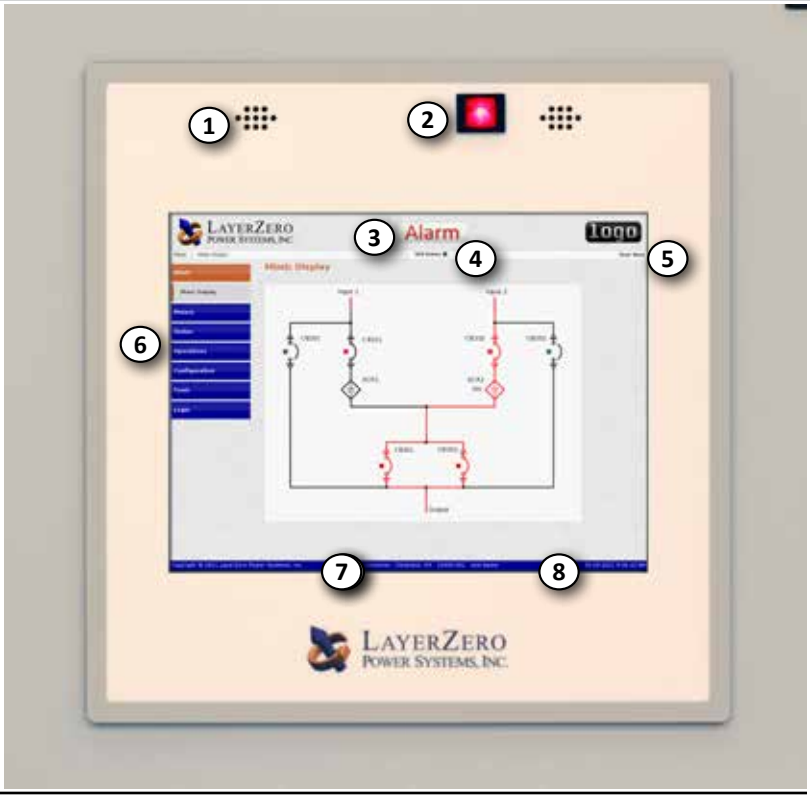
LayerZero PQM provides comprehensive visibility into all activity within your critical power distribution systems. This all-encompassing monitoring solution offers both local and remote communication options, delivering everything from basic alarms and status monitoring to advanced power quality analysis. With LayerZero PQM, you gain a wide range of tools designed to help maintain the highest levels of reliability.

Offering a vendor-neutral “bird’s eye” view of your entire critical power infrastructure, LayerZero PQM maximizes system uptime by alerting you to power quality issues, UPS output anomalies, and any active alarms. Beyond real-time monitoring, LayerZero PQM empowers users with the unique ability to review and retrace the exact sequence of historical events, an industry-leading feature that provides unmatched insight into mission-critical power performance.



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

Static Switch Power Quality Monitoring

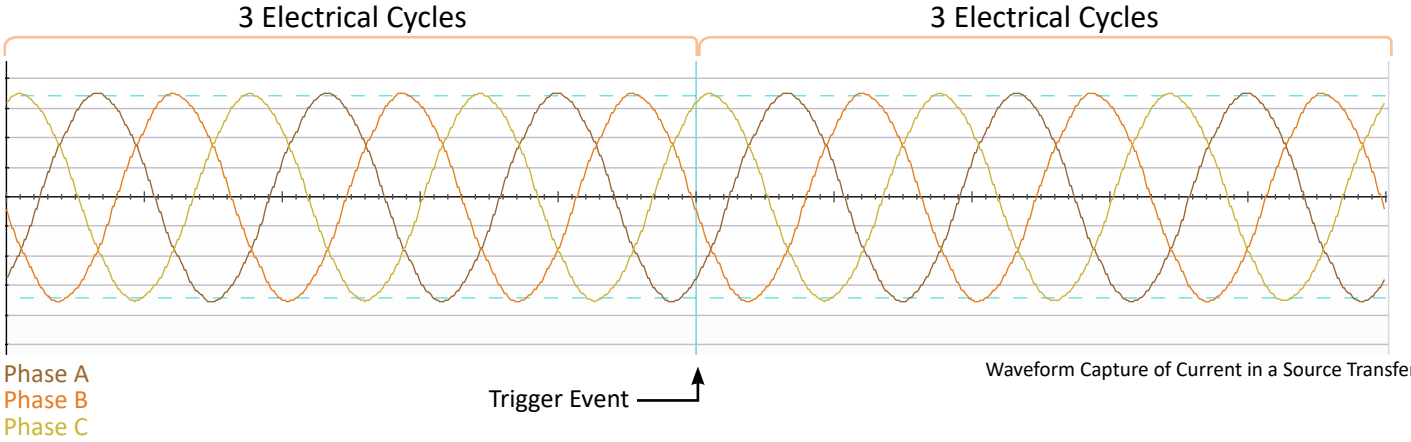
The Series 70: eSTS is equipped with LayerZero Static Switch Power Quality Monitoring (SSQM), an advanced system designed to deliver comprehensive power monitoring with both local and remote access options.

From basic monitoring and alarm reporting to detailed waveform capture and power quality analytics, LayerZero SSQM ensures you remain informed, vigilant, and proactive in maintaining a stable, safe, and reliable power environment.

eSTS Touch Screen GUI showing Real Time Waveform Capture

LayerZero's SSQM Provides Answers

LayerZero SSQM captures timestamped waveform snapshots before and after events, enabling facilities to analyze and identify root causes methodically. By actively monitoring power quality at the STS, PDU, and RPP levels, LayerZero empowers thorough post-event investigations, supporting continuous improvement and enhanced system reliability.



Waveform Capture of Current in a Source Transfer

LayerZero SSQM Technical Specifications

LayerZero 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

Mechanical Characteristics *	
Current/Voltage/Number of Poles	800 A 240/415 V 4-Pole
Heat Dissipation	11,500 Btu/Hr
Weight	3050 lbs (1384kg)
Dimensions	88” x 84” x 48” (2237 mm x 2124 mm x 1206 mm)
Clearances	Front: 42” (1067mm) Rear: 4” (102mm) Sides: 0” Top: 18” (457mm)
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 + Neutral
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	LayerZero Power 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

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