SPIKE ELECTRIC CONTROLS

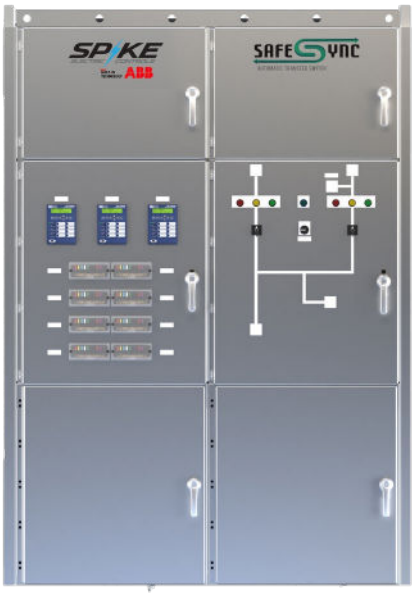
BUILT-IN TECHNOLOGY ABB

SAFE SYNC

AUTOMATIC TRANSFER SWITCH

Medium 5kV & 15kV Voltage Power Transfer Switches

Spike Electric Controls presents innovative solutions that safeguard power integrity - from the conceptual stage right through to deployment, initiation, and sustained usage: all-encompassing protection for uninterrupted energy.



5914 E. Sam Houston Pkwy S. Houston TX 77034 | Toll Free 1.844.279.8295 | Local Factory Support 832.243.5372 | Fax 832.569.5645
sales@spikeelectric.com | spikeelectric.com

Revision Date: 2/2/2024

Microprocessor-Driven Control Center:

At the heart of the Safe Sync SERIES is our state-of-the-art microprocessor-driven Control Center, expertly designed to manage breaker operations, seamlessly transitioning critical loads between power sources.

Encompassing two voltage classifications - 15 kV and 5 kV - our Medium Voltage Transfer Switch can be tailored with a variety of accessories and unique specifications to fulfill distinct installation needs.
Switch mode variants available are:

- Open transition
- Delayed transition
- Closed transition

Our assemblies boast a robust metal-clad design, distinct control barriers, easily removable circuit breakers, and high-quality voltage transformers, ensuring optimal performance across the stipulated amperage and voltage ranges.

SAFE SYNC SERIES MEDIUM 5kV & 15kV VOLTAGE POWER TRANSFER SWITCHES

About Safe Sync:

In an electrified world, the steadiness, caliber, and dependability of energy not only influence everyday life but are paramount for safety, operational excellence, and fiscal prosperity.

Spike Electric Controls presents innovative solutions that safeguard power integrity - from the conceptual stage right through to deployment, initiation, and sustained usage: all-encompassing protection for uninterrupted energy.

Our Safe Sync series has been meticulously crafted to turn potential energy disruptions into unwavering confidence.

Offering a diverse range of configurations, supplementary features, and transfer mechanisms such as prompt, deferred, sealed, and gentle load transitions, the Spike Electric Safe Sync SERIES assures performance that meets and even exceeds industry standards and is UL 1008A compliant.

Applications:

- Data Management Hubs
- Medical Institutions
- Telecommunication Hubs
- Industrial Estates
- Petrochemical Plants
- Production Facilities
- Continuous Operations
- Consumer Business Centers
- Research Laboratories
- Educational Campuses
- Municipal Utilities

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Certifications:

We pride ourselves on meeting and surpassing the following industry benchmarks:

- ANSI/IEEE C37.20.2 – Standard for Metal-Clad Switchgear
- ANSI/NEMA C37.55 – Medium Voltage Metal-Clad Assemblies – Testing & Conformance Procedures

Below is a synopsis of the diverse voltage, current, and interrupt class ratings on offer:

Construction:

Prominent components and attributes encompass:

- Safe Sync Series Advanced Control Center
- Slide-Out, Shuttered Vacuum Circuit Breakers with Optional Protection Systems:
- A Standard Source VCB for the Transfer Switch
- A Backup Source VCB for the Transfer Switch • Dual Standard Source Fused Slide-Out Voltage Transformers (Configured in WYE-WYE
- Dual Backup Source Fused Slide-Out Voltage Transformers (Configured in WYE-WYE)

Spike Electric Safe Sync SERIES 1200 Amp Medium Voltage Power Transfer Switch

Voltage Classes	Interrupt Classes (kA Symm.)	Rated Current (A)	Construction Details
15 KV	25, 40 kA, 50 kA	1200 Amps	Metal-Clad Switchgear adhering to ANSI C37.20.2, UL 1008A listed, featuring draw-out vacuum circuit breakers and high-caliber transformers
5 kV	40 kA, 50 kA	1200 Amps	Metal-Clad Switchgear adhering to ANSI C37.20.2, UL 1008A listed, featuring draw-out vacuum circuit breakers and high-caliber transformers

The Spike Electric Safe Sync SERIES embodies paramount defense, unwavering reliability, and secure maintenance. Our strict adherence to industry standards ensures:

- UL Compliance
- ANSI/IEEE C37.20.2 Benchmark for Metal-Clad Switchgear

Rated for optimal performance at either 5 kV or 15 kV, the Medium Voltage Power Transfer Switch boasts a range from 1200 up to 3000 amperes. As for the interrupt capacity, users can select from the 25, 40, or 50 kA symmetrical class options.

Our base medium voltage transfer switch structure is segmented into two to three vertical sections based on the current rating. Supplementary features, such as expansive metering or relaying, could necessitate additional sections. The fundamental configuration for a 1200 ampere switch integrates a minimum of two sections, while the 2000 or 3000 ampere versions encompass at least three sections. The combined sections cater to specific needs - be it seismic certifications, fortified outdoor casings, or other unique prerequisites, tailoring each assembly to the client's exact specifications.

- Medium Voltage shielded copper bus bar 15kV Bus Boot boots for splices and cable connection points
- Defensive barricades in line with ANSI C37.20.2 and UL 1008A to segregate primary components.
- SIS-type control wiring enhanced with enduring printed markers directly on the insulation layer

A seamlessly unified multi-section metal-clad framework

Codes & Regulations:

- UL 1008A Accredited – Benchmark for Medium Voltage Transfer Switches
- National Electrical Guidelines (ANSI/NFPA 70)
- Article 517 – Medical Care Establishments
- Article 700 – Urgent Power Systems
- Article 701 – Mandated Backup Systems
- Article 702 – Elective Backup Systems
- Article 708 – Vital Operations Power Frameworks

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Certification Highlights:

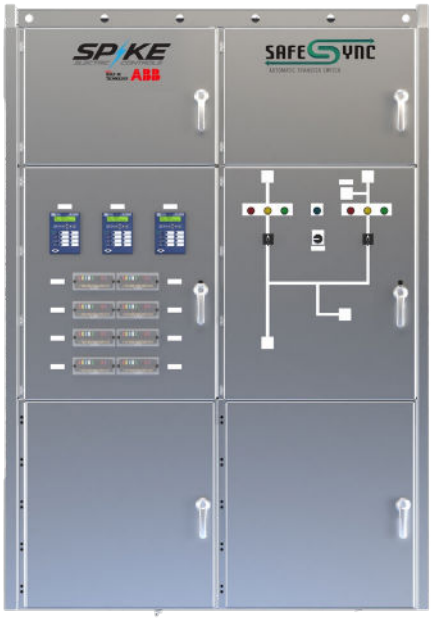
Earthquake Resistance - readily obtainable upon initiation of order

Arc Safety Provisions:

Features aimed at arc safety can encompass arc-protective design and specialized arc detection mechanisms.

Switch Control Unit:

Our Safe Sync Control Center, which epitomizes excellence in directing both low and medium voltage switches, draws upon decades of groundbreaking power transfer insights and expertise.



Circuit Breaker Dynamics:

These circuit breakers overshadow contactors in terms of reliability and ease of upkeep. Each breaker houses three distinct vacuum interrupters equipped with an embedded contact wear gap monitor. Built-in stored energy components ensure swift fault isolation and interruption. Their design promises secure inspections and straightforward maintenance. Both Standard Source and Backup Source breakers are swappable, maintaining uniform ratings and layout. Energy storage facets cover both electric motor recharging and a manual charging lever.

Instrumentation Transformers:

This includes Current Transformers (CT) and Voltage Transformers (VT, also known as Potential Transformers - PT) that measure electrical flow and voltage.

The conventional design features ANSI relay class transformers crafted as per ANSI C57.13 to guarantee uniform and dependable operations. Further enhancements like grounded carriage-mounts ensure secure maintenance, along with fuses for circuit safety.

Customized requirements, be it revenue-grade instruments, testing blocks, or added safety relays, can be integrated seamlessly.

Core Model Specifications & Design Features:

Feature	5 kV / 15 kV (1200 A)	5 kV / 15 kV (2000 A / 3000 A)
Sections (Minimum Count)	2	3
Standard NEMA 1 Sizing	36"Wx92"Dx95"H	36"Wx92"Dx95"H
UL 1008A Compliance	Yes	Yes
ANSI C37.20.2	Yes	Yes
Seismic Certification	On Demand	Yes
Insulated Bus	Yes	Yes
Cable Blockers	Yes	Yes
11 Gauge Steel (Exterior Panels)	Yes	Yes
Slide-Out Breakers	Yes	Yes
Auto Shutters	Yes	Yes
Earthed Dividers	Yes	Yes
Electrostatic Powder Coating	Yes	Yes
Distribution Potential	Yes	Yes
Safety Relays Option	Yes	Yes
NEMA 3R Non-Walk-In Variant	Yes	Yes

Transition Options & Control Modes

Open Transition Transfer Switching:

Safe Sync allows for "non-synchronized" transfer if the preferred source is deemed "unstable" and the alternate source requires time come on-line. Additionally, if conditions require upstream/downstream protective actions to process before aligning loads to the alternate source.

Delayed Transition Transfer Switching:

Safe Sync allows for "non-synchronized" transfer if conditions require controlled transfer of energized loads that can withstand a short loss and return of power such as non-rotational loads, VFD, auto-restart load centers.

Closed Transition Transfer Switching:

Safe Sync allows for "synchronized" transfer if the conditions allow for safe, momentary parallel operations of available sources. Available communication protocols provide seamless integration with generator control systems to allow non-interrupted service for controlled switching evolutions.

User Control Modes:

Automatic & Manual: The mode selector switch empowers users to toggle between automated and manual control effortlessly. The options range from open, delayed, to closed transitions, inclusive of the soft load control. For enhanced safety, electrically safeguarded manual controls are embedded on the front panel for supervised operations.

Breaker Control & Mode Selector Switches:

- Enables users to manually trip or close the breaker, irrespective of the mode.
- Features indicators for easy understanding: Red for Closed, Green for Open, and Amber for Tripped.
- The embedded electrical interlocks ensure that there's no chance of simultaneous activation, guaranteeing utmost safety.

Controller & Protection Relay:

The Safe Sync MV Transfer Switch, equipped with the SEL 700GT+ Relays, serves dual functions as both a controller and a protection relay. This integrated approach not only minimizes potential failure points but also simplifies inventory management. By reducing the need to stock various types of control components, it ensures more efficient and cost-effective maintenance, especially in scenarios where a controller or relay replacement is required.

Green Energy
from Spike Electric Controls

Green Energy Efficient:

As the world pivots towards renewable energy, the MVTS of the future must effortlessly integrate with sources like solar and wind. Spike Electric Controls is leading the charge, innovating MVTS solutions that bridge conventional and renewable power seamlessly.

The Impetus for Green Integration

- Harnessing Renewables: The future MVTS will seamlessly integrate with renewable energy sources, acting as bridges between conventional and green power.
- Smart Grids and MVTS: By aligning with evolving smart grid technologies, future MVTS, especially those of Spike Electrics caliber, will become even more central to sustainable power management.

AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

General Overview:

The AMVAC breaker is a magnetically actuated and latched breaker capable of a high number of operations due to its simplified design. Fully compliant with IEEE Standards C37.04, C37.06 and C37.09, the AMVAC breaker is a great fit for many applications.

Features:

- Mechanical operations counter
- Optional roll-on-floor design
- Open, closed, ready/not ready lights and pushbuttons
- Maintenance-free magnetic actuator

Available AMVAC breaker ratings

Voltage class	Nominal voltages	Continuous current	Short circuit/ with-stand (2 sec)	Close and latch	BIL (lightning impulse withstand)	Low frequency withstand (Hi-Pot)
kV	kV	A	kA, rms	kA, peak	kV, crest	kV, rms
5	2.4, 4.16, 4.8	1200, 2000, 3000	25	65	60	19
			31.5	82		
			40	104		
			50	130		
8.25	4.8, 6.9, 7.2	1200, 2000, 3000	40	104	95	36
15	6.9, 7.2, 8.4, 11, 12, 12.47, 13.2, 13.8, 14.4	1200, 2000, 3000	25	65	95	36
			31.5	82		
			40	104		
			50	130		
27	20.78, 21.6, 22.86, 23, 23.9, 24.94	1200, 2000	16	42	125	60
			25	65		

Construction:

Magnetic Actuator:

Introduced in 1997, the bi-stable magnetic actuator is used in many ABB products, including the AMVAC breaker. Due to its simple design, no maintenance on the actuator is necessary for the lifetime of the product.

The magnetic actuator operates on the principle of shifting magnetic flux and is latched into one of the stable positions by rare-earth magnets which require no power.

Vacuum Interrupters:

ABB vacuum interrupters (VIs) are embedded in a solid insulation material to protect the VIs from collecting dust or moisture and from accidental bumps. The solid insulation also improves tracking resistance making ABB circuit breakers some of the lightest available in the market. Because of the embedded design, these vacuum interrupters are maintenance-free for the life of the VI.

On-board Capacitors:

The on-board capacitors of the AMVAC breaker deliver the current needed for creation of magnetic fields within the mechanism thereby eliminating current draw and voltage drop from the battery bank for the substation.

For more information on the maintenance of the capacitors, please see the AMVAC Installation, Operation and Maintenance Manual.

Magnetic actuator

Vacuum interrupters

On-board capacitors

AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Electronic Control Board:

The electronic control board technology for the AMVAC breaker provides improved reliability due to its self-monitoring functions and features. Featuring coil monitoring, sensor monitoring, optional under-voltage trip and optional energy failure trip, the AMVAC breaker is customizable for any application.

By managing the 45 ms current limited pulse delivered to the mechanism by the on-board capacitors, the electronic control board eliminates one cause of common failures in typical spring mechanism breakers – the burning of trip and close coils.

Electronic control board

Breaker Racking Truck:

ABB's breaker racking truck for switchgear is integral to the breaker itself in lieu of being inside the switchgear breaker cell. Rated for 180 foot-pounds of torque, the breaker racking truck exceeds the industry standard of 50-60 foot-pounds by a factor of three, greatly reducing the possibility of an over-torque condition.

The breaker racking truck is rated for 1000 rack in-rack out operations, exceeding the ANSI Standard of 500 operations.

Breaker lift truck

Capacitor Bank Switch Ratings

Voltage class	Continuous current	Short circuit current	Capacitor switching ratings	
kV	A	kA	Type	Notes
5	1200	25	C0	25 A cable charging
		31.5	C0	25 A cable charging
		40	C0	25 A cable charging
		50	C0	630 A back to back capacitor bank
	2000	25	C0	25 A cable charging
		31.5	C0	25 A cable charging
		40	C0	630 A back to back capacitor bank
		50	C0	630 A back to back capacitor bank
	3000	25	C1	630 A back to back capacitor bank
		31.5	C1	630 A back to back capacitor bank
		40	C1	630 A back to back capacitor bank
		50	C1	630 A back to back capacitor bank
8.25	1200	40	C1	630 A back to back capacitor bank
	2000	40	C1	630 A back to back capacitor bank
	3000	40	C1	630 A back to back capacitor bank
15	1200	25	C0	25 A cable charging
		31.5		25 A cable charging
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
	2000	25		25 A cable charging
		31.5		25 A cable charging
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
	3000	25	C1	630 A back to back capacitor bank
		31.5	C1	630 A back to back capacitor bank
		40	C1	630 A back to back capacitor bank
		50	C1	1000 A back to back capacitor bank
27	1200	16	BTB	400 A back to back capacitor bank
		25	BTB	400 A back to back capacitor bank
	2000	16	BTB	400 A back to back capacitor bank
		25	BTB	400 A back to back capacitor bank

AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Timing Characteristics:

Total interrupting time consists of opening time plus the time required for arc interruption. Total interrupt time is 50 ms or less for three cycle breakers and 83 ms or less for five cycle breakers.

Voltage class	Continuous current	Short circuit current	Interrupt time	Closing time
kV	A	kA	Cycles	ms
5	1200	25	3	45-60
		31.5	3	45-60
		40	5	45-60
		50	5	45-60
	2000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	5	45-60
	3000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	5	45-60
8.25	1200	40	3	45-60
	2000	40	3	45-60
	3000	40	3	45-60
15	1200	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
	2000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
	3000	25	3	45-60
		31.5	3	45-60
		40	3	45-60
		50	3	45-60
27	1200	16	3	45-60
		25	3	45-60
	2000	16	3	45-60
		25	3	45-60

AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Mechanical Endurance Ratings:

Voltage class	Continuous current	Short circuit current	No load mechanical operations
kV	A	kA	
5	1200	25	10000
		31.5	10000
		40	10000
		50	10000
	2000	25	10000
		31.5	10000
		40	10000
		50	10000
	3000	25	10000
		31.5	10000
		40	10000
		50	10000
8.25	1200	40	10000
	2000	40	10000
	3000	40	10000
15	1200	25	10000
		31.5	10000
		40	10000
		50	10000
	2000	25	10000
		31.5	10000
		40	10000
		50	10000
	3000	25	10000
		31.5	10000
		40	10000
		50	10000
27	1200	16	10000
		25	10000
	2000	16	10000
			10000

Power Requirements and Auxiliary Switch Ratings

Power requirements

	Actuator driver
Standby	10 W
Capacitor charging	100 W
Trip/close	0.25 W

Auxilliary contacts	Nominal control power voltage					
	24 Vdc	48 Vdc	125 Vdc	250 Vdc	120 Vac	240 Vac
Rated carrying current	10 A	10 A	10 A	10 A	10 A	10 A
Rated breaking current	10 A	7.6 A	4.4 A	1.8 A	2.6 A	2.3 A
Maximum breaking current	12 A	10 A	6 A	0 A	26 A	23 A

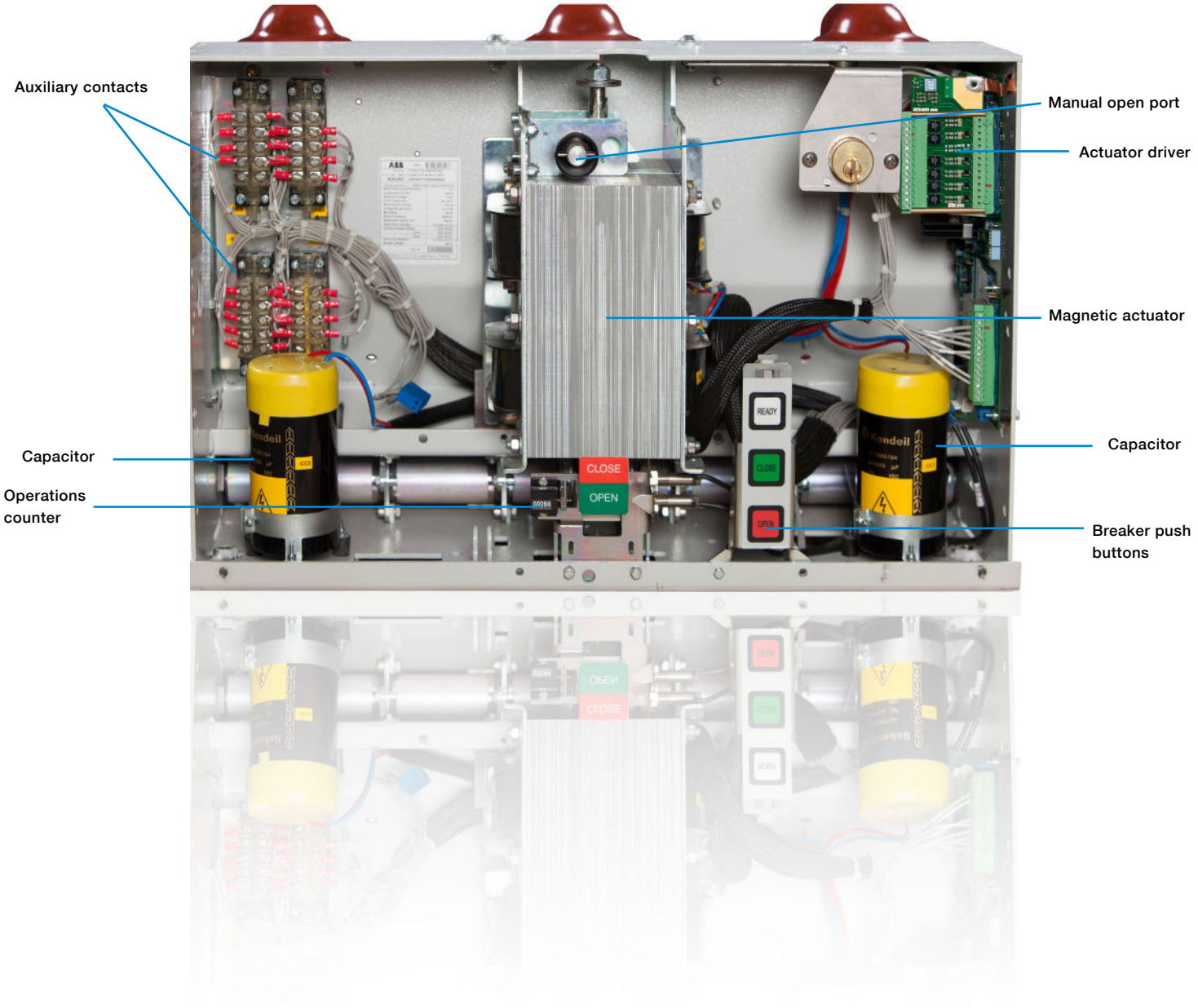
AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Dimensions and Weight:

Voltage class	Continuous current	Short circuit current	Height	Width	Depth	Weight
kV	A	kA	in	in	in	lb
5	1200	25	28	31	27	334
		31.5	28	31	27	334
		40	28	31	27	410
		50	28	31	27	410
	2000	25	28	31	27	419
		31.5	28	31	27	419
		40	28	31	27	419
		50	28	31	27	419
	3000	25	28	31	27	459
		31.5	28	31	27	459
		40	28	31	27	459
		50	28	31	27	459
8.25	1200	40	28	31	27	410
	2000	40	28	31	27	419
	3000	40	28	31	27	459
15	1200	25	28	31	27	334
		31.5	28	31	27	334
		40	28	31	27	410
		50	28	31	27	430
	2000	25	28	31	27	419
		31.5	28	31	27	419
		40	28	31	27	419
		50	28	31	27	430
	3000	25	28	31	27	459
		31.5	28	31	27	459
		40	28	31	27	459
		50	28	31	27	481
27	1200	16	30	31	27	410
		25	30	31	27	410
	2000	16	30	31	27	419
			30	31	27	419

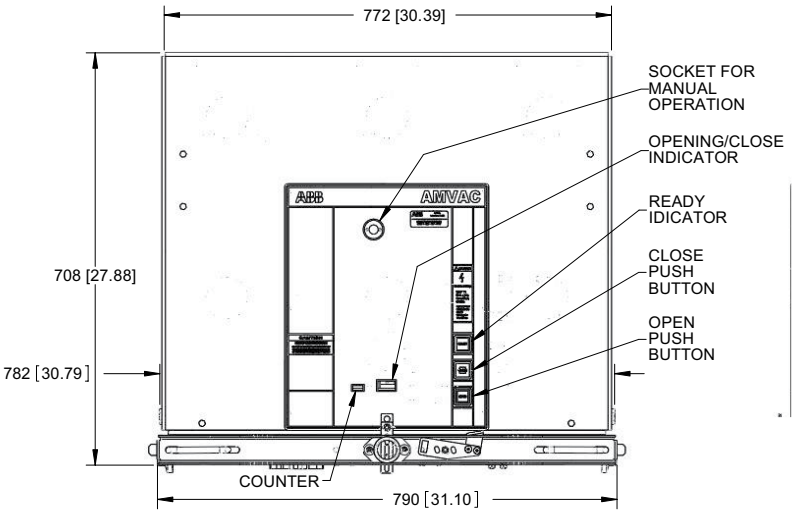
AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

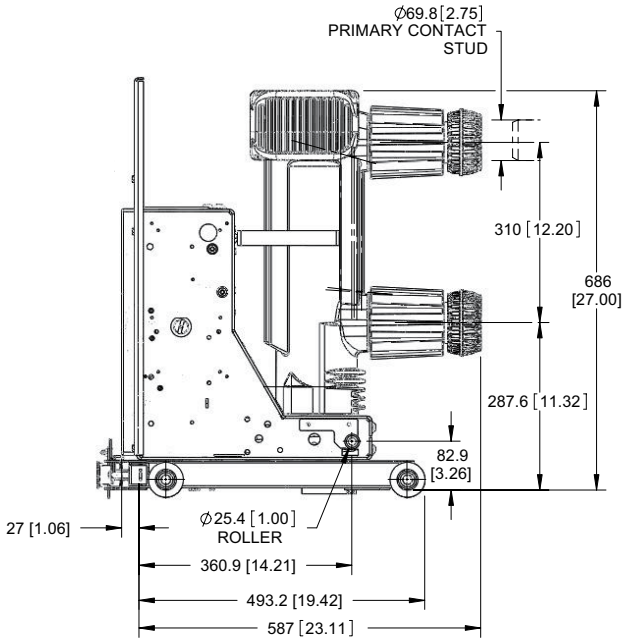
Internal Diagram:

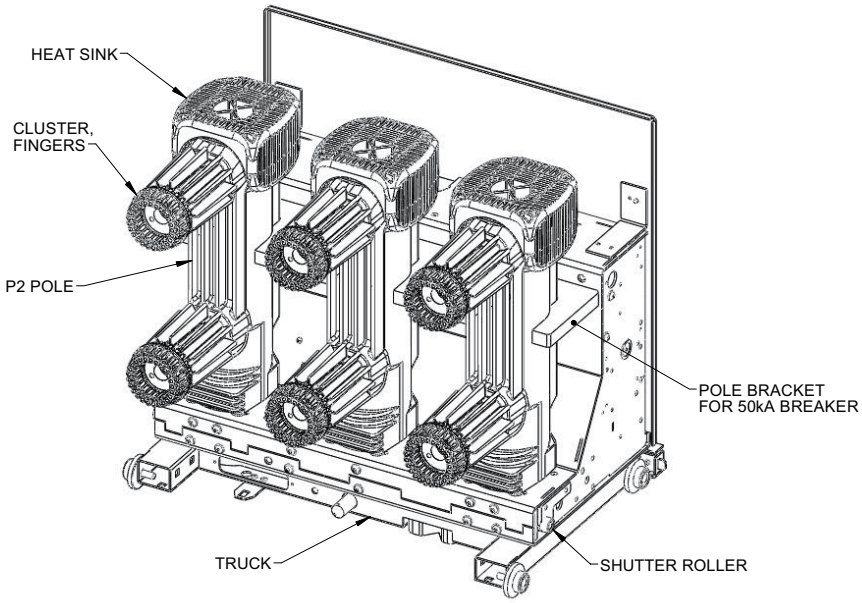


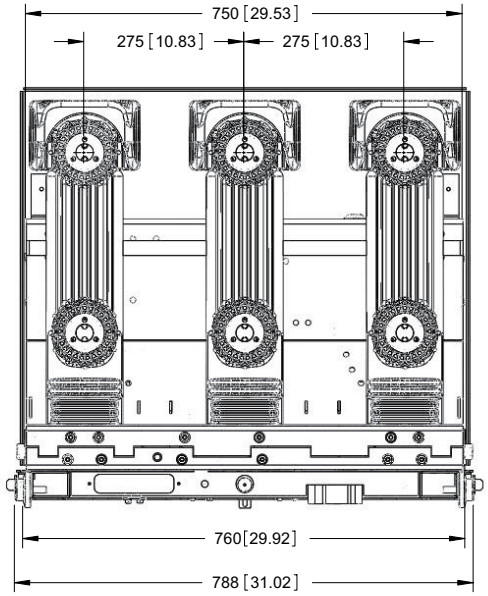
AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Outline Drawing:





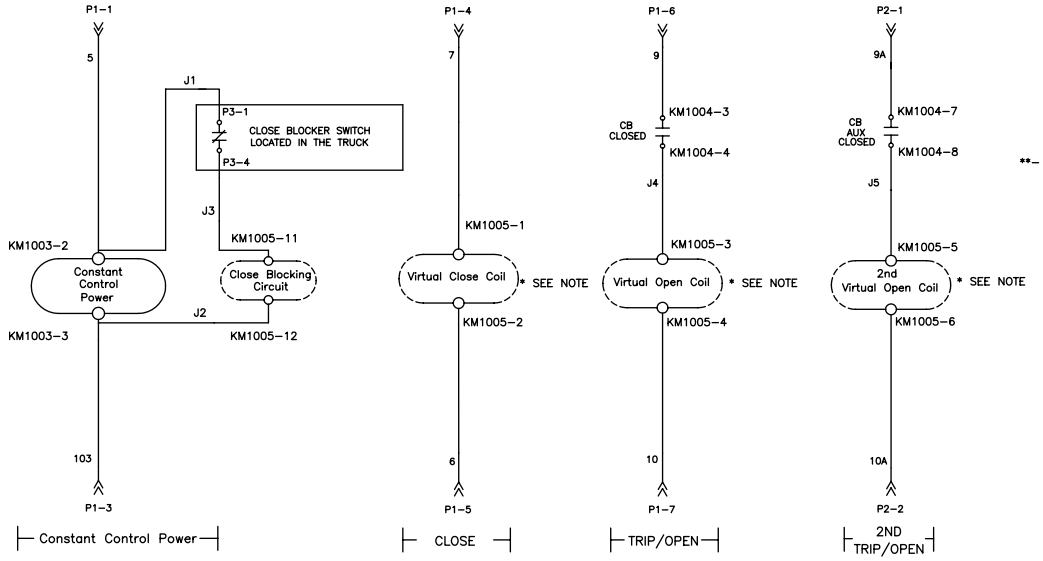


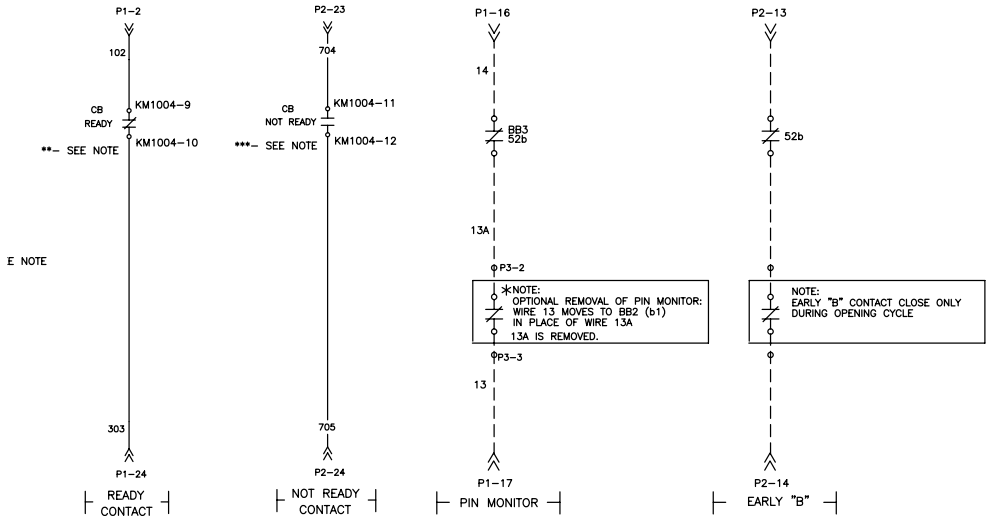


AMVAC™ 5/15/27 kV ANSI Magnetic Mechanism Vacuum Circuit Breaker

Schematic Drawing:

AMVAC circuit breakers are supplied with dual secondary disconnects, which includes 9 normally open “a” contacts and 8 normally closed “b” contacts.





AMVAC™ magnetically actuated circuit breaker

Five year warranty

A five year comprehensive warranty is available on the complete breaker and breaker truck assembly, with 24 hours / 7 days-a-week customer service.

The AMVAC™ breaker is truly the next generation in medium voltage vacuum circuit breaker technology. ABB is the first to combine the unique benefits of embedded vacuum interrupter technology with a magnetic actuator designed to reduce operating costs and increase reliability.

Using a flux-shifting device with integral permanent magnets, the AMVAC mechanism has only one moving part. With simple open and close coils, an electronic controller and capacitors for energy storage, the AMVAC circuit breaker meets or exceeds ANSI mechanical and load operation requirements.

Low maintenance = reduced operating costs

- No maintenance required on the magnetic actuator
- Closing and tripping is a current limited pulse – eliminates failed trip coils

Significantly less moving parts = reliability and safety

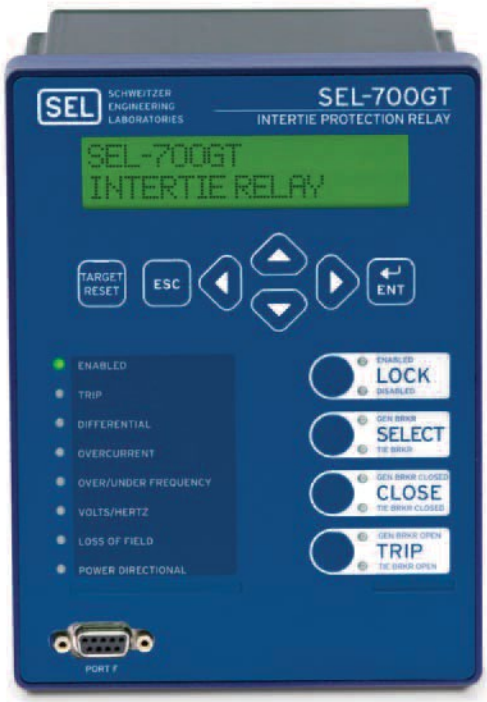
- Simple magnetic actuator with one moving part
- Elimination of close and trip coils, motors, cams, and linkages and the associated spare parts inventory
- Increased safety by eliminating maintenance on mechanically charged components, coils, and motors

Durable design = longer life

- High dielectric strength with embedded vacuum interrupters in solid material insulation

ABB stands ready to work with you to supplement this product offering with technical application experts, spare parts, training and support services intended to reduce your total cost of ownership.

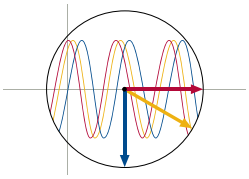
SEL-700GT Intertie Protection Relay



Field-configurable front panel, including display, LEDs, and pushbuttons.

Ethernet, serial, and expanded I/O options.

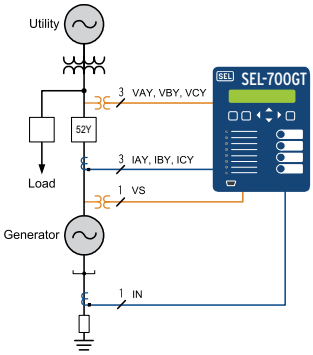
Field-upgradable design.



SEL Synchrophasors®

Complete Intertie and Generator Protection

Distributed Generation Intertie

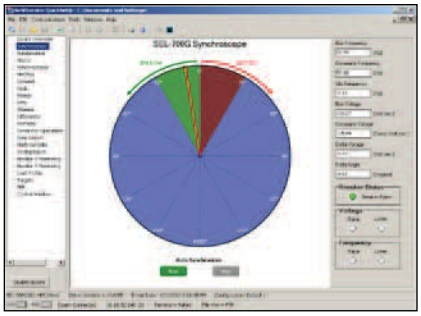


Provides IEEE 1547-compliant protection.

Protects electric grid and distributed generation.

Optional synchronous generator protection.

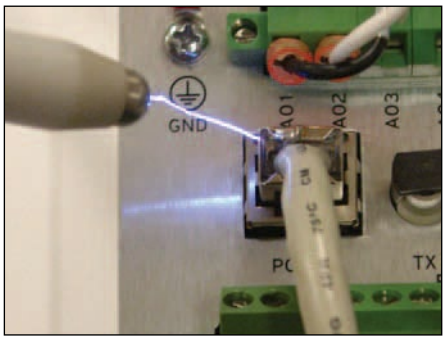
Integrated Automatic Synchronizer Option



Automatically adjusts generator voltage, speed, and phase angle to match line voltage.

Closes breaker when synchronized.

Substation-Hardened Ethernet



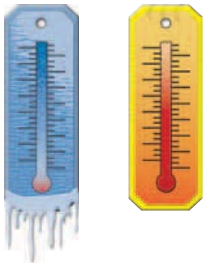
Modbus® TCP, SNTP, DNP3 LAN/WAN, Telnet, FTP, and IEC 61850.

Fiber or copper Ethernet communications port.

Withstands electrostatic air discharge of 15 kV.

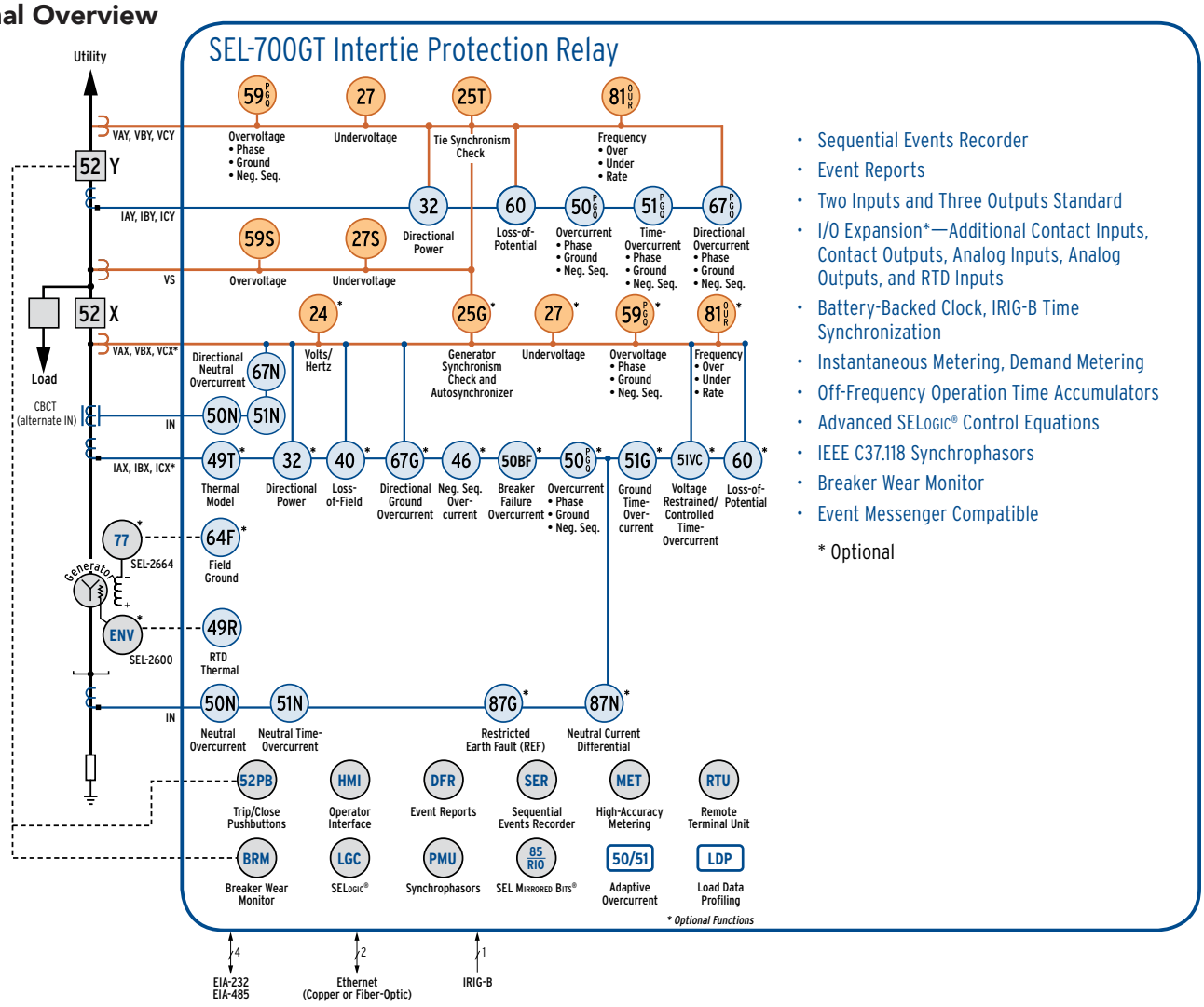
Industry-Leading Quality, Reliability, and Service

−40°C +85°C



WORLDWIDE 10 years WARRANTY

Functional Overview



- Sequential Events Recorder
- Event Reports
- Two Inputs and Three Outputs Standard
- I/O Expansion*—Additional Contact Inputs, Contact Outputs, Analog Inputs, Analog Outputs, and RTD Inputs
- Battery-Backed Clock, IRIG-B Time Synchronization
- Instantaneous Metering, Demand Metering
- Off-Frequency Operation Time Accumulators
- Advanced SELogic® Control Equations
- IEEE C37.118 Synchrophasors
- Breaker Wear Monitor
- Event Messenger Compatible

* Optional

Feature Overview

Use default messages, or program up to 32 custom display labels.

Use default pushbuttons, or program your own pushbutton actions and labels.

Front-panel LEDs can be programmed to indicate custom alarms.

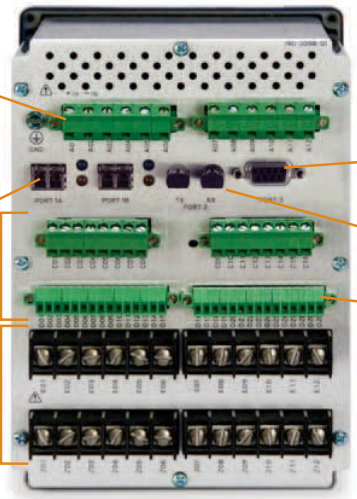
User-configurable label option.

Power supply options include:
24–48 Vdc
110–250 Vdc
110–240 Vac

Single or dual, copper or fiber-optic Ethernet port.

Positions for optional expansion cards.

Voltage and current inputs.



Mirrored Bits® communications.

Fiber-optic serial port.

Optional RTD inputs.

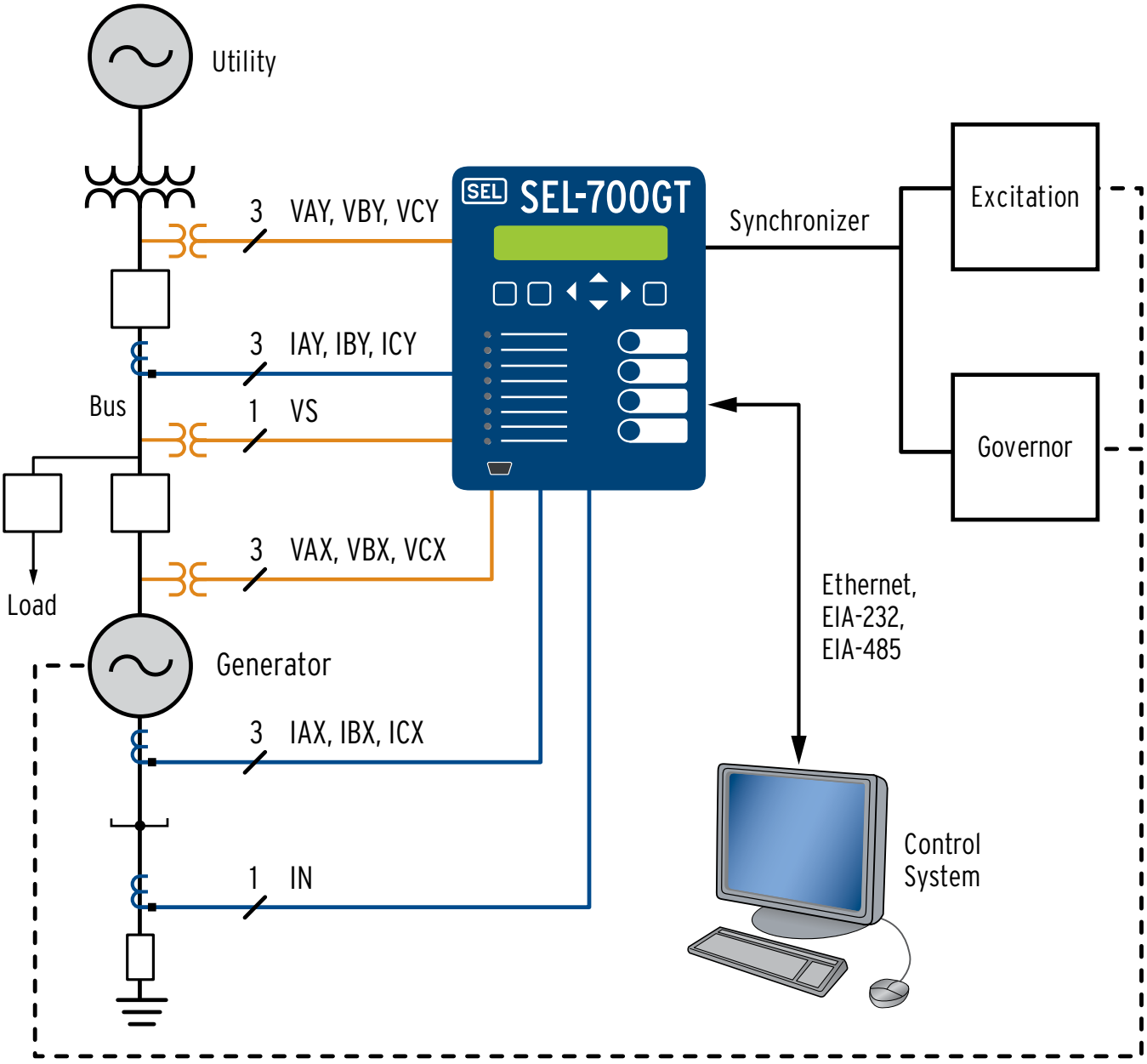
Class I Zone 2 Hazardous Location APPROVED

Applications

Complete Intertie and Generator Protection

The SEL-700GT provides a complete intertie protection solution for distributed generation. Optional synchronous generator protection and synchronization provide complete generator and intertie protection in one compact and economical package.

The optional SEL-2664 Field Ground Module accurately detects field ground faults whether the generator is operating, stopped, or de-energized.

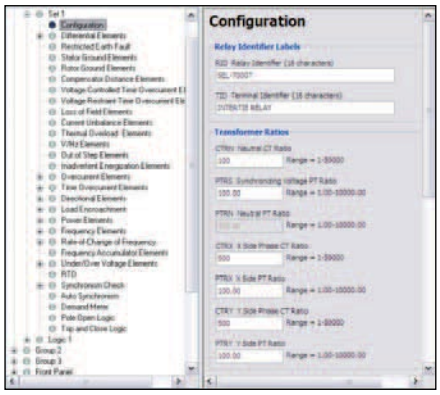


The application shown includes optional generator protection and synchronism-check voltage input (VS). Ethernet and EIA-485 are optional. Also available are RTD and field ground module (SEL-2664) inputs (not shown).

SEL-700GT Intertie Protections Relay"
Easy to Set and Use

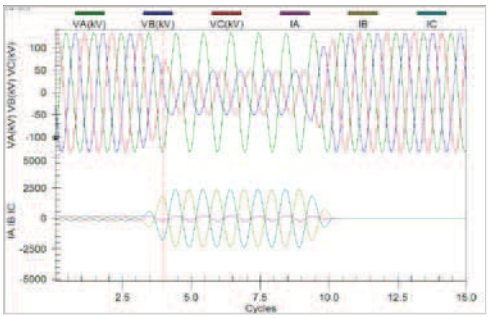
Use ACSELERATOR QuickSet® SEL-5030 Software to Set, Monitor, and Control the SEL-700GT

- Save engineering time while keeping flexibility. Communicate with the SEL-700GT through any ASCII terminal, or use the ACSELERATOR QuickSet graphical user interface.
- Develop settings offline with a menu-driven interface and completely documented help screens. Speed installation by copying existing settings files and modifying application-specific items.
- Simplify the settings procedure with rules-based architecture to automatically check interrelated settings. Out-of-range or conflicting settings are highlighted for correction.
- Use the ACSELERATOR HMI synchroscope to view the real-time synchronization process.
- Initiate the generator synchronization process using an HMI pushbutton.



Use ACSELERATOR Software to Retrieve and Display Event Reports Recorded by the SEL-700GT

- Display event report oscillograms. View each report as a plot of magnitude versus time. Select analog and digital points to build a custom display.
- Display phase and symmetrical component phasors. Display the phasor view of electrical data to better understand asymmetrical, three-phase faults. Build a custom plot using per-phase and symmetrical component sequence currents and voltages.
- Retrieve event reports using serial or Ethernet communications links.



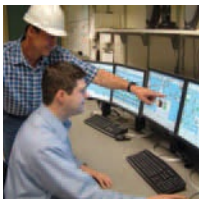
Flexible Communication

Communications Media

- Ethernet 10/100BASE-T
- Ethernet 100BASE-FX
- Single or dual Ethernet ports
- EIA-232 serial
- EIA-485 serial
- Fiber-optic, serial multimode ST®

Communications Protocols

- SEL ASCII
- MIRRORED BITS communications
- IEC 61850
- Modbus RTU/TCP
- Simple Network Time Protocol (SNTP)
- DNP3 serial, LAN/WAN
- DeviceNet™
- Telnet
- FTP
- Synchrophasors (IEEE C37.118)


Central control room.


Field remote terminal.


Engineering access.

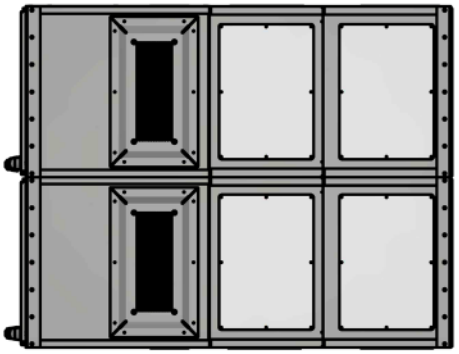
Mounting Options

Retrofit Replacement Kits

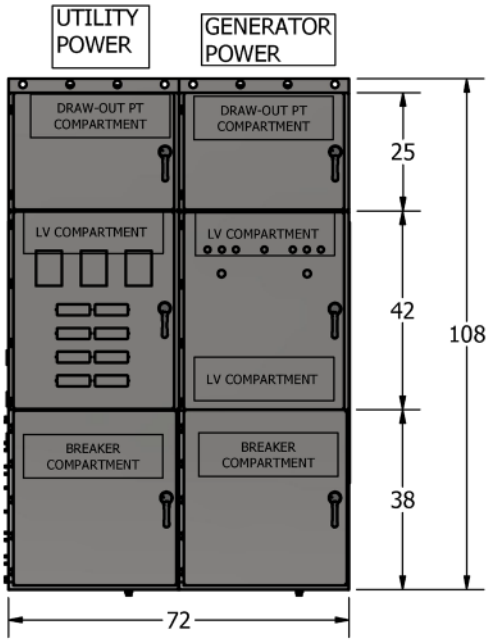
Replace existing generator protection with the SEL-700GT and the applicable mounting kit. These kits provide everything needed to replace many existing generator relays with the SEL-700GT.

No cutting or drilling is required when you use the optional mounting kits. Replacement of existing protection is quick and easy!

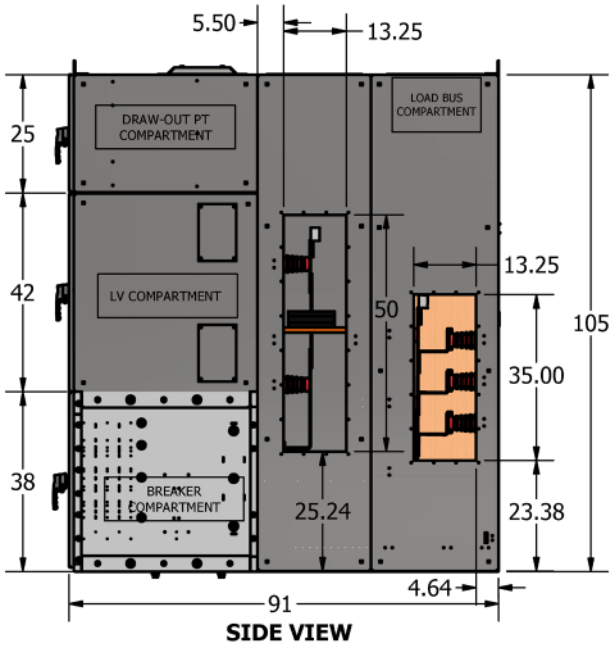
NOTE:
SOME PANELS HIDDEN FOR CLARITY



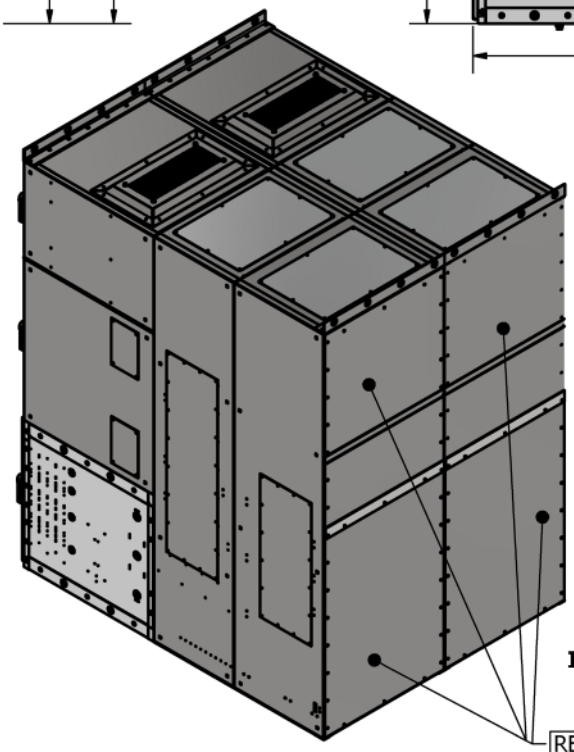
TOP VIEW



FRONT VIEW



SIDE VIEW



ISO VIEW

REMOVABLE REAR COVERS

Functional Design Specification
MV Automatic Transfer Switch (ATS)

TABLE OF CONTENTS

Figures

Tables

ACRONYMS AND ABBREVIATIONS

ATS	Automatic transfer scheme
FDS	Functional Design Specification
GOOSE	Generic Object-Oriented Substation Event
MB	Mirrored Bits
IEC	International Electrotechnical Commission
LED	Light-emitting diode
MTS	Manual transfer scheme
PC	Personal computer
SEL	Schweitzer Engineering Laboratories, Inc.
SEL ES	SEL Engineering Services, Inc.

REFERENCE DOCUMENTS

[1] 12.47 kV switchgear schematic diagram references.

- Spike Electric – Automatic Transfer Switch# Drawings - Rev D

[2] Spike Electric / Magnan Functional Design Specification.

- MVATS - ATS Functional Description Revision E 2023_03_15

[3] Logic Drawings.

- MV ATS Logic Diagram

[4] Samsung Construction Drawing

- 221027_F1M1-EO-0000_SINGLE_LINE_DIAGRAM-OVER_ALL

[5] SEL Automation Communication Architecture

- 017821.807.00 - Architecture Overall Diagram GEN BANK-1 Rev-2 20230503
- 017821.807.00 - Architecture Overall Diagram GEN BANK-2 Rev-2 20230503
- 017821.807.00 - Architecture Overall Diagram GEN BANK-3 Rev-2 20230503

[6] SEL Automation IP Address and GOOSE List

- 017821.807.00 - IP Address_List_Rev1_20230503
- 017821.807.00 - Points_List_REV-2

[7] Documents: SEL instruction manuals

- SEL-700GT Intertie Protection Relay Instruction Manual
- SEL-451 Protection, Automation and Bay Control System Instruction Manual
- SEL-787 Transformer Protection Relay Instruction Manual
- SEL-3555 Real-Time Automation Controller (RTAC) Instruction Manual

SECTION 1 INTRODUCTION

This document is provided by SEL Engineering Services, Inc. (SEL ES). SEL products referred to in this report are manufactured by Schweitzer Engineering Laboratories, Inc. (SEL).

This document is a Functional Design Specification (FDS) of MV Auto Transfer Scheme (12.47kV Emergency Generator and12.47kV Utility Incomer) breakers in the Samsung Taylor facility. The audience for this document includes Samsung, Spike Electric (Switchgear manufacturer), and the electrical system integrators. This document is applicable to 12.47 kV medium-voltage switchgear systems for following switchgear breakers.

Table 1-1: List of MV ATS Switchgear for FAB-I

SWGR. ID	BREAKER ID	SEL-700GT	Electrical Building
1U11G	MTS-1F11SGAQ & MTS-1U11GAQ	3	1F12FL-SWER(S)
	MTS-1F11MGAQ & MTS-1U11GBQ	3	1F12FL-SWER(N)
	MTS-1F12SGBQ & MTS-1U11GCQ	3	1F13FL-SEER(N)
	MTS-1F12MGBQ & MTS-1U11GDQ	3	1F13FL-SEER(S)
1U12G	MTS-1F11SGCQ & MTS-1U12GAQ	3	1F13FL-WER(S)
	MTS-1F11MGCQ & MTS-1U12GBQ	3	1F13FL-WER(N)
	MTS-1F13SGAQ & MTS-1U12GCQ	3	1F12FL-SER(E)
	MTS-1F13MGAQ & MTS-1U12GDQ	3	1F12FL-SER(W)
	MTS-1F13SGCQ & MTS-1U12GEQ	3	1F11FL-NEER(S),Office
	MTS-1F13MGCQ & MTS-1U12GFQ	3	1F11FL-NEER(N),Office
1U13G	MTS-1F11SGBQ & MTS-1U13GAQ	3	1F12FL-WER(S)
	MTS-1F11MGBQ & MTS-1U13GBQ	3	1F12FL-WER(N)
	MTS-1F12SGAQ & MTS-1U13GCQ	3	1F13FL-EER(N)
	MTS-1F12MGAQ & MTS-1U13GDQ	3	1F13FL-EER(S)
	MTS-1F13SGBQ & MTS-1U13GEQ	3	1F13GEQ, GCS
	MTS-1F13MGBQ & MTS-1U13GFQ	3	1F13GFQ, GCS
	TOTAL	48	

SECTION 2 MV-ATS SYSTEM DESCRIPTION

The Samsung Taylor, FAB-I power system consists of total sixteen (16) numbers of 12.47kV MV-ATS switchgear. Each MV-ATS is fed from normally closed utility breaker and can be transferred to normally open emergency generator source breaker manually or automatically using SEL-700GT intertie relays. Figure 2-1 to 2-3 shows the simplified one-line diagram of the MV-ATS and how they are connected to three different generator buses.

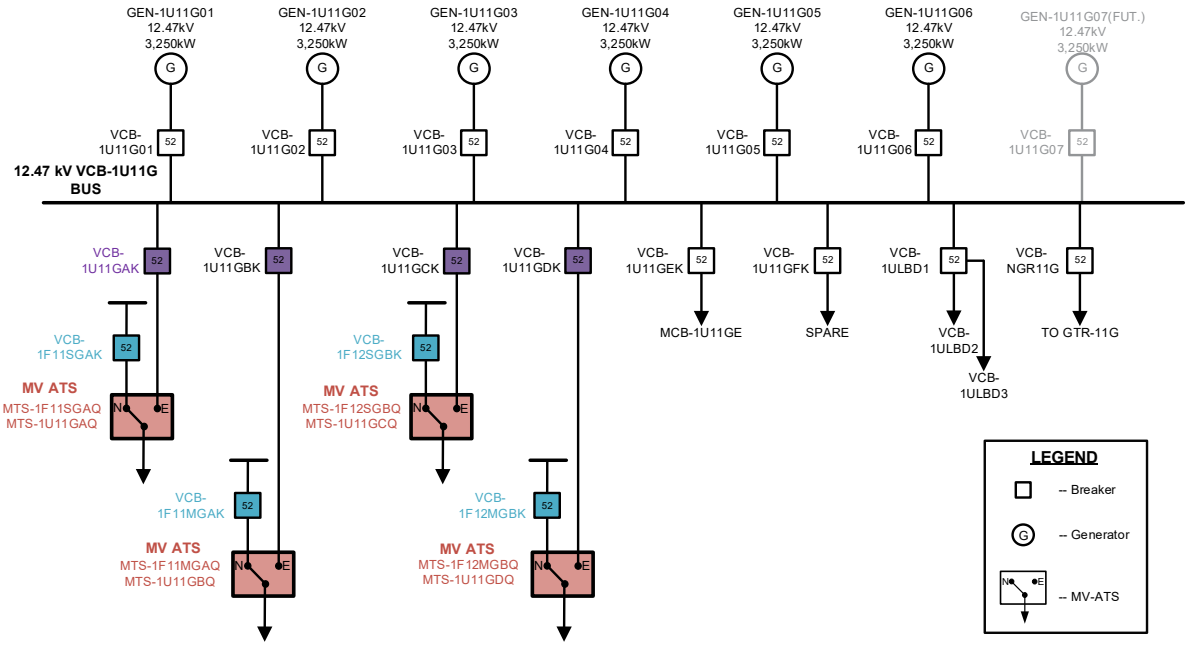


Figure 2-1: Simplified One-Line of VCB - 1U11 Generator System

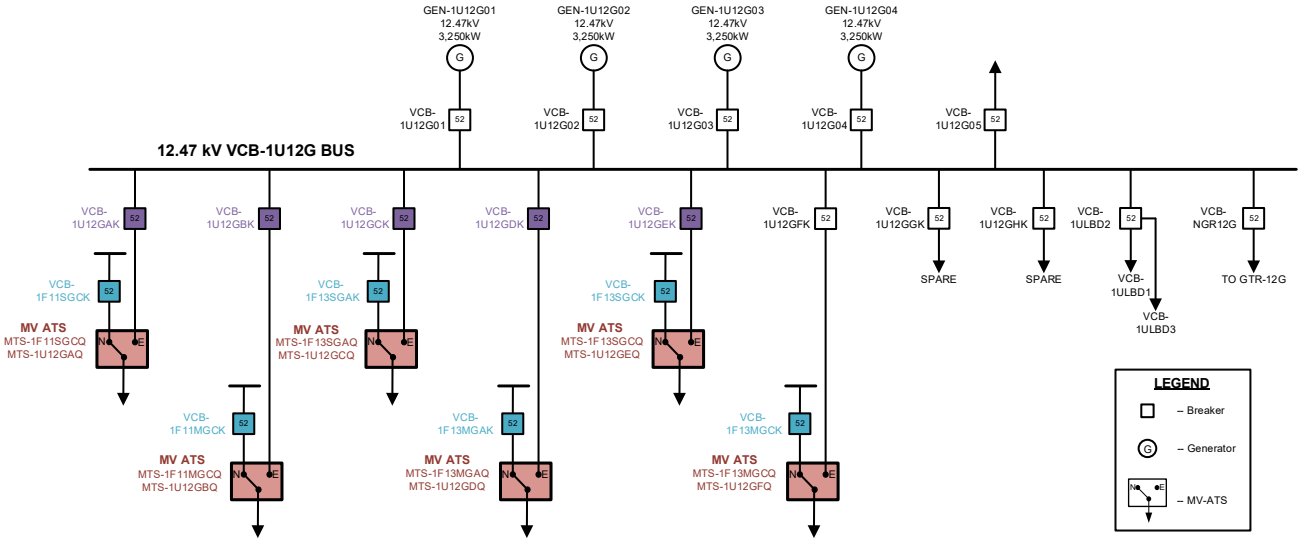


Figure 2-2: Simplified One-Line of VCB - 1U12 Generator System

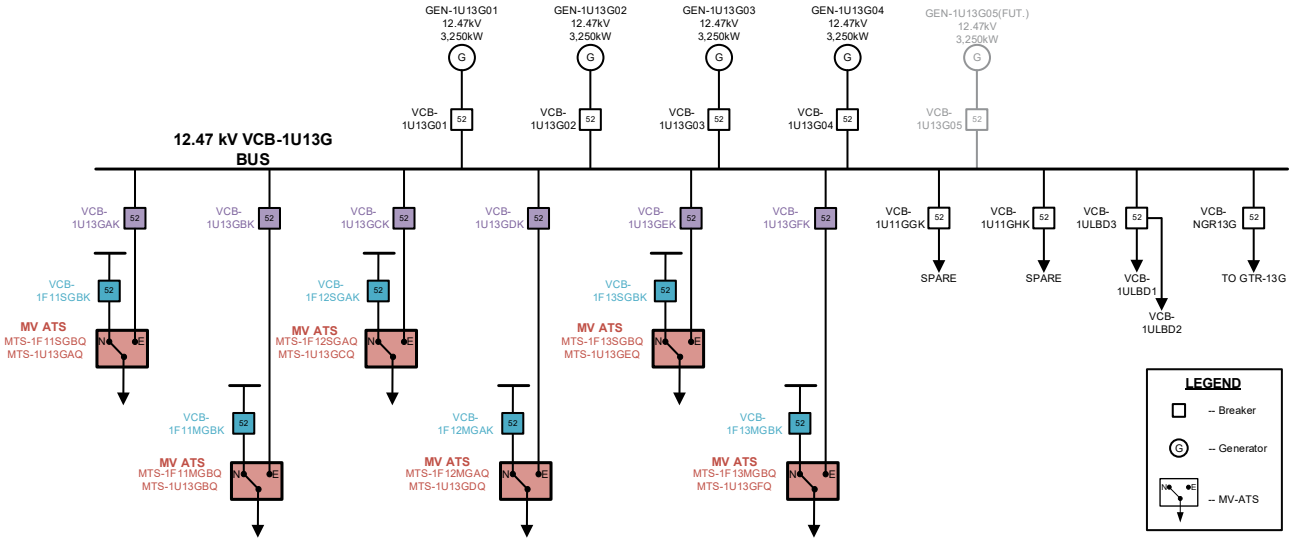


Figure 2-3: Simplified One-Line of VCB - 1U13 Generator System

SECTION 3 AUTO TRANSFER SCHEME OVERVIEW

This document describes the philosophies used in the implementation of a medium-voltage transfer scheme. It also covers the SEL relays and equipment used for protection, control, logic, and algorithms applied to the operation of schemes.

A transfer scheme is defined as transfer of source from one to another in the event of a failure or for maintenance. The transfer scheme is programmed in two different modes: Automatic Transfer when 43-AM switch is placed in automatic mode, and manual transfer when local 43-AM switch is placed in manual mode. Both modes have been programmed in three (3) SEL-700GT Intertie Protection Relays with Utility-Emergency Generator (U-EG) configuration. All these three relays have identical relay settings, but for control, it's using 2 out of 3 voting schemes. Figure 3-1 & Figure 3-2 shows the utility and generator breaker trip & close circuit using 2 out of 3 voting schemes. Figure 3-4 shows the front view of the MV-ATS switchgear lineup.

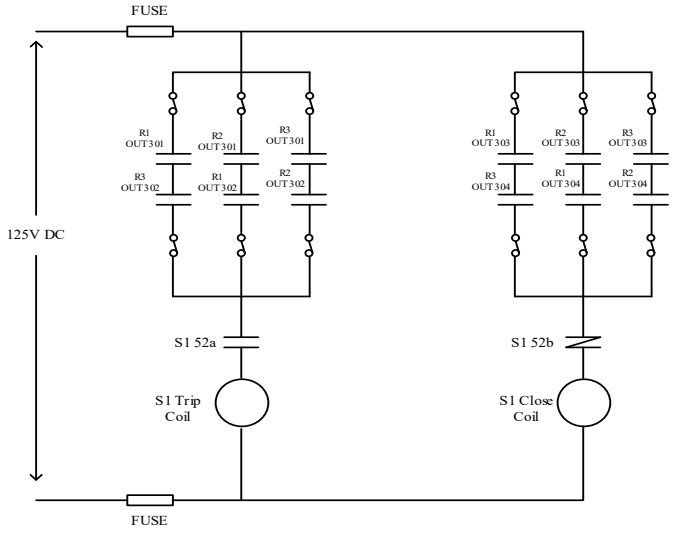


Figure 3-1: Utility Circuit Breaker - 2 Out of 3 Voting Scheme

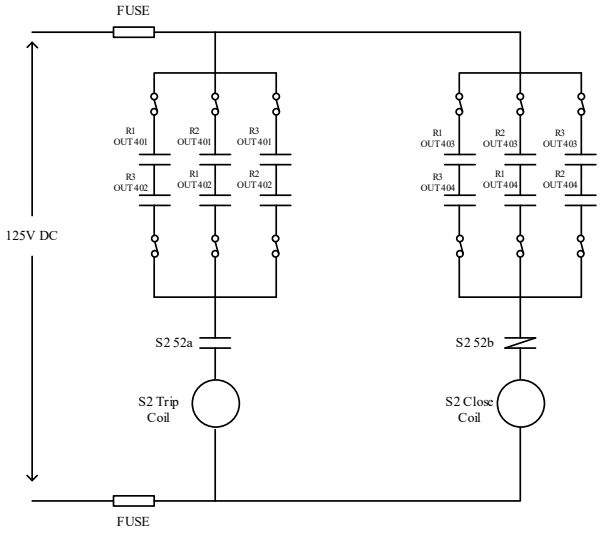


Figure 3-2: Generator Circuit Breaker - 2 Out of 3 Voting Scheme

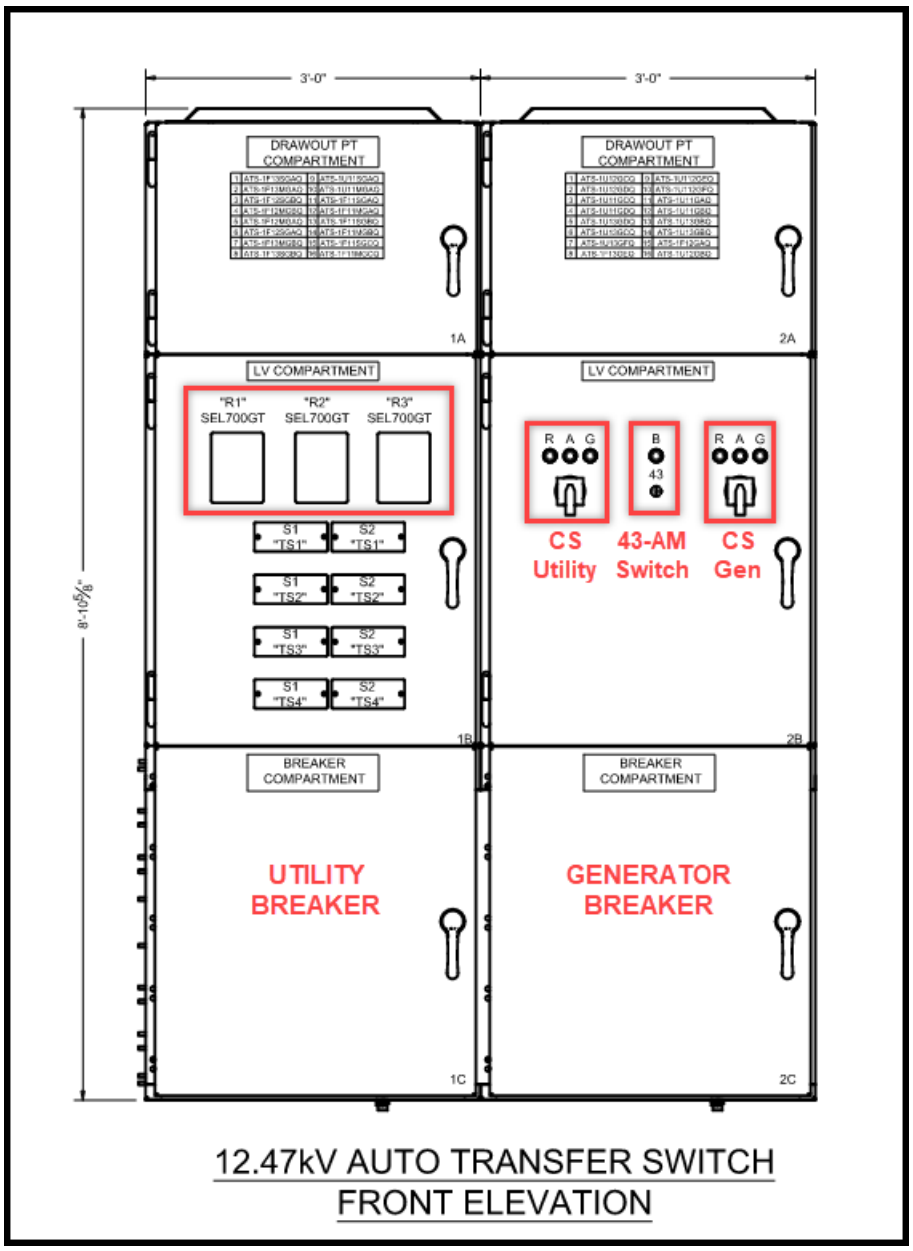


Figure 3-3: MV-ATS Switchgear Front Panel View

SECTION 4 COMMUNICATION, PT & CT CONNECTIONS TO SEL-700GT RELAYS

This section describes the SEL-700GT communication to other devices involved in the MV ATS transfer scheme and CT & PT configuration for each SEL-700GT relays. Refer to Figure 4-1 for communication architecture.

4.1 SEL Equipment

The SEL devices involved in the transfer scheme are:

- SEL-787 Transformer Protection Relay: Used for cable differentiation protection and transmitting fault and other transfer trip information to SEL-700GT using MIRRORED BITs protocol.
- SEL-451 Protection, Automation, and Bay Control System: Used for Downstream ATO Scheme and sending generator call signal to upstream.
- SEL-700GT Intertie Protection Relay: The core logic for Automatic / Manual Transfer Scheme resides in the 700GT relay.
- SEL-3555 Real-Time Automation Controller (RTAC): Generator system controller located in generator control panel.

4.2 Sources

There are two types of sources available for the 12.47kV MV ATS:

- 12.47kV Utility Incomer
- 12.47kV Emergency Generator(s) Incomer

4.3 Communications

Communications among relays are essential for ATS operations and are provided via Mirrored Bits (MB) and GOOSE messaging:

- SEL-700GTs communicates with the upstream SEL-787s via Mirrored Bits protocol (CHANNEL-A).
- SEL-700GTs communicates with the downstream SEL-451s via Mirrored Bits protocol (CHANNEL-B).
- SEL-700GT and SEL-3555 (RTAC) communicate with each other via IEC 61850 GOOSE messaging protocol for faster transfer scheme related critical commands. Also, MODBUS TCP communication protocol is also used between SEL-700GT & RTACs for HMI metering and commands.
- Each SEL-700GT communicate with each other via IEC 61850 GOOSE messaging protocol.

4.4 PT AND CT CONNECTIONS

Table 4-1: PT & CT Connections to SEL-700GT

Relays	Voltage Level	Utility Line PT	Generator Line PT	Load Line PT
SEL-700GT (Qty =3)	12.47kV	3-Phase Wye connected 14400/120V Connected to Y Voltage Inputs in the relays	3-Phase Wye connected 14400/120V Connected to X Voltage Inputs in the relays	1-Phase 14400/120V Connected to Sync (Vs, Ns) Voltage Inputs in the relays. (Phase-B)

Relays	Voltage Level	Utility Line CT	Generator Line CT
SEL-700GT (Qty= 3)	12.47kV	3-Phase Wye connected 1200/5 Connected to Y Current Inputs in the relays	3-Phase Wye connected 1200/5 Connected to X Current Inputs in the relays

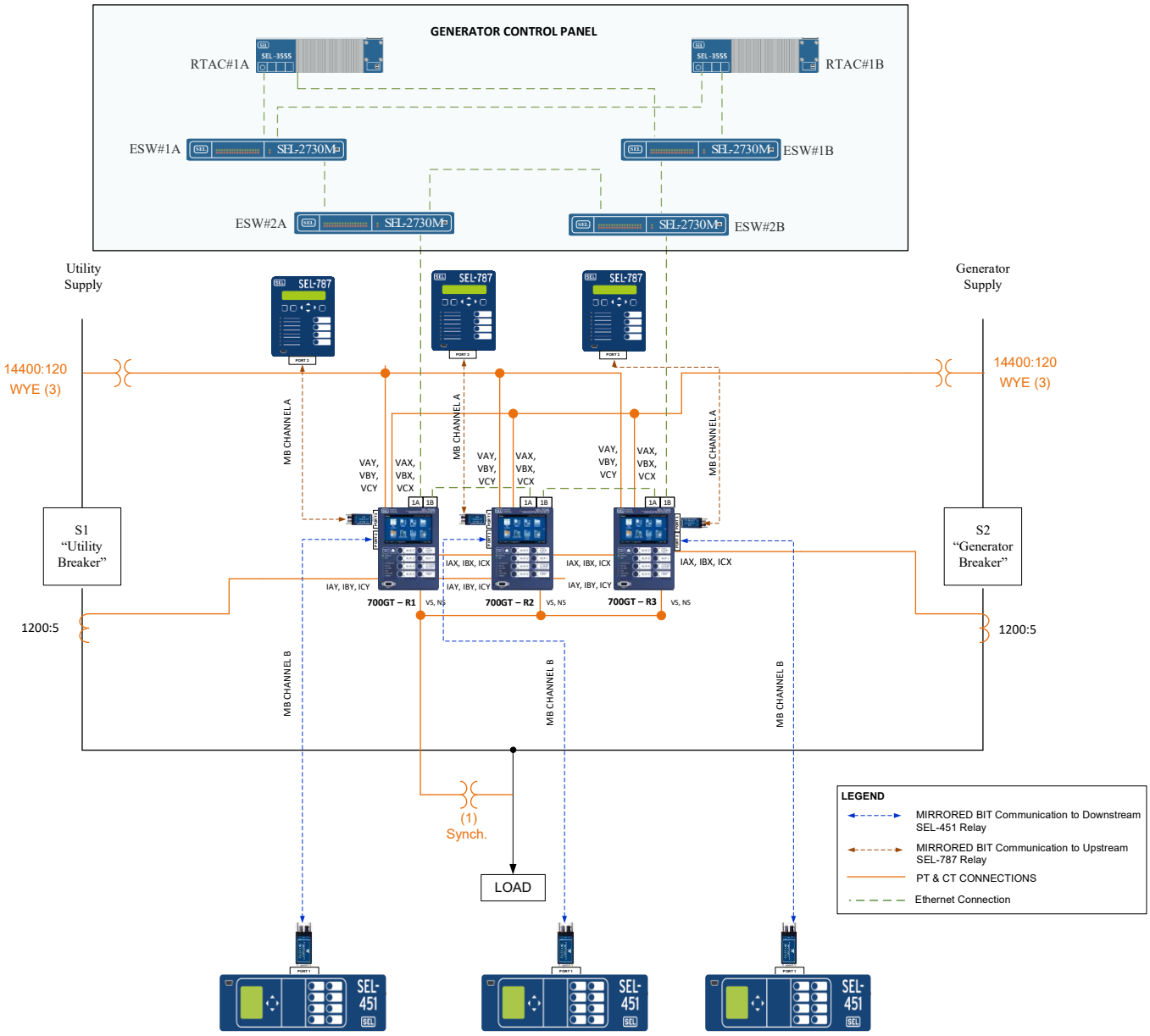


Figure 4-1: Communication, PT and CT Connections

SECTION 5 RELAY FRONT PANEL CONFIGURATION

5.1 SEL-700GT TARGET LEDS AND FRONT PANEL PUSHBUTTONS

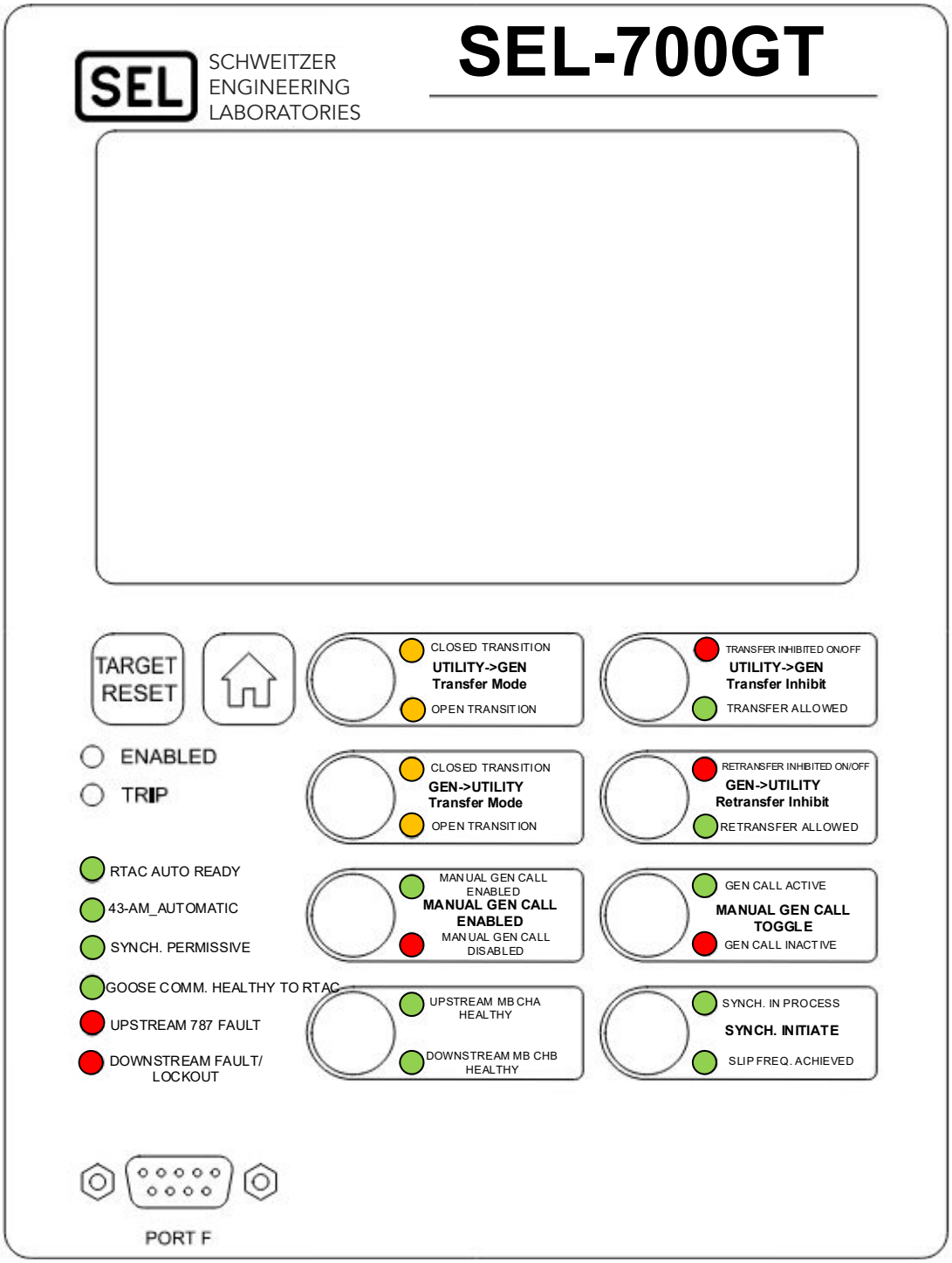


Figure 5-1: Relay Front Panel

* This is our standard push button configuration that can be customized and relabeled for various applications.

The SEL-700GT front panel shows the statuses of the transfer schemes.

Table 5-1: SEL-700GT Relay Status and Target LEDs

Target LED	Label	LED Color	LED Function
-	ENABLED	GREEN	Indicates the relay is enabled
-	TRIP	RED	Indicates a protection trip. This LED does not indicate/light up for automatic transfer or manual trip.
T01_LED	RTAC AUTO READY	GREEN	Indicates communication to RTAC is healthy, Generator Panel master control switch is in Auto, and RTAC is ready to turn on the generators.
T02_LED	43-AM_AUTOMATIC	GREEN	Indicates 43-AM switch is placed in Auto Mode
T03_LED	SYNCH. PERMISSIVE	GREEN	This LED would turn on when both utility and generator source voltages are in synch.
T04_LED	GOOSE COMM. HEALTHY TO RTAC	GREEN	Indicates healthy GOOSE communication is healthy with at least one of the RTACs.
T05_LED	UPSTREAM 787 FAULT	RED	Indicates an upstream fault in the system detected by SEL-787
T06_LED	DOWNSTREAM FAULT / LOCKED OUT	RED	Indicates downstream fault detected by SEL-451 ATO relay.

IMPORTANT NOTE: All three (3) SEL-700GT relays are programmed identically, and operator has to press pushbutton only in one of the relays. Other two relays would follow the same operation since all three relays are communicating with each other using IEC-61850 GOOSE communication. For example, pressing Pushbutton#5 in SEL-700GT-1 relay for closed transition transfer, would also put SEL-700GT-2 and SEL-700GT-3 relays in closed transition transfer mode.

Only TARGET RESET front panel pushbutton has to be pressed in all three(3) relays for clearing Alarms on bay screens since TARGET RESET command is NOT sent via GOOSE communication among three relays.

Table 5-2: SEL-700GT Relay Operator Pushbutton and LED Functions

Pushbutton Number	Pushbutton Label	Pushbutton Function	LED Label	LED Color	LED Function
PB1	**UTILITY→GEN TRANSFER INHIBIT**	Press this pushbutton to inhibit the automatic transfer operation from utility to generator.	TRANSFER INHIBITED ON/OFF	RED	When this LED is lit, auto transfer from utility to generator is inhibited. When this LED is OFF, transfer inhibited is removed.
			TRANSFER ALLOWED	GREEN	When this LED is lit, it indicates that the Automatic Transfer is allowed. When it's off, the automatic transfer is blocked.
PB2	**GEN→ UTILITY RETRANSFER INHIBIT**	Press this pushbutton to inhibit the automatic retransfer operation from generator to utility.	RETRANSFER INHIBITED ON/OFF	RED	When this LED is lit, auto retransfer from generator to utility is inhibited. When this LED is OFF, retransfer inhibited is removed.
			RETRANSFER ALLOWED	GREEN	When this LED is lit, it indicates that the Automatic Transfer is allowed. When it's off, the automatic transfer is blocked.
PB3	**MANUAL GEN CALL TOGGLE**	Press this pushbutton to call the generators manually. Operator has to	MANUAL GEN CALL ACTIVE	GREEN	This LED indicates that manual generator call is activated, and generator call signal is being sent to generator panel RTAC.

Pushbutton Number	Pushbutton Label	Pushbutton Function	LED Label	LED Color	LED Function
		make sure that the PB7 pushbutton is ENABLED before enabling manual generator call. Pressing this PB3 pushbutton again will make manual generator call inactive.	MANUAL GEN CALL INACTIVE	RED	This LED indicates that the Manual generator call is deactivated.
PB4	**SYNCH. INITIATE**	Press this pushbutton to initiate the synchronization between generator and utility during closed transition transfer.	SYNCH. IN PROGRESS	GREEN	This LED indicates that e synchronization is in process and generator is adjusting the frequency to bring it within synch. window.
			SLIP FREQ. ACHIEVED	GREEN	When this LED is lit, the desired slip frequency will be achieved between generator and utility source.
PB5	**UTILITY → GEN TRANSFER MODE**	Press this pushbutton to toggle between Closed transition transfer and Open transition transfer for the utility to generator transfer mode..	CLOSED TRANSISTION	AMBER	This LED indicates that automatic transfer from utility to generator source would be in closed transition mode.
			OPEN TRANSISTION	AMBER	This LED indicates that automatic transfer from utility to generator source would be in open transition mode.
PB6	**GEN → UTILITY RETRANSFER MODE**	Press this pushbutton to toggle between Closed transition transfer and Open transition transfer for the generator to utility transfer mode.	CLOSED TRANSISTION	AMBER	This LED indicates that automatic retransfer from generator to utility source would be in closed transition mode.
			OPEN TRANSISTION	AMBER	This LED indicates that automatic retransfer from generator to utility source would be in open transition mode.

Pushbutton Number	Pushbutton Label	Pushbutton Function	LED Label	LED Color	LED Function
PB7	**MANUAL GEN CALL ENABLE/DISABLE**	Press this pushbutton to enable/disable the MANUAL GEN CALL mode. The button can be pressed again to disable/re-enable the MANUAL GEN CALL mode. **Note:** This pushbutton is provided as a safety feature. Meaning, pressing this PB7 pushbutton will not call the generator. Operator has to press the PB3 pushbutton once the PB7 is kept in ENABLE mode.	MANUAL GEN CALL ENABLE	GREEN	This LED indicates that the Manual generator call is enabled.
			MANUAL GEN CALL DISABLE	RED	This LED indicates that the Manual generator call is disabled.
PB8	**NOT USED**	**NOT USED**	UPSTREAM MB CH-A HEALTHY	GREEN	This LED indicates that MIRRORED BITs Channel-A communication is healthy to upstream SEL-787 relay.
			DOWNSTREAM MB CH-B HEALTHY	GREEN	This LED indicates that MIRRORED BITs Channel-B communication is healthy to downstream SEL-451 relay.

5.2 SEL-700GT Bay Screen Configuration

Following two figure shows the SEL-700GT touch screen bay screen configuration. Bay Scree#1 is designed to show the breaker status, metering, and ALARM. If any alarm is active, "Alarm Raised. Check Alarm Display Screen" text would appear on the bay screen#1.

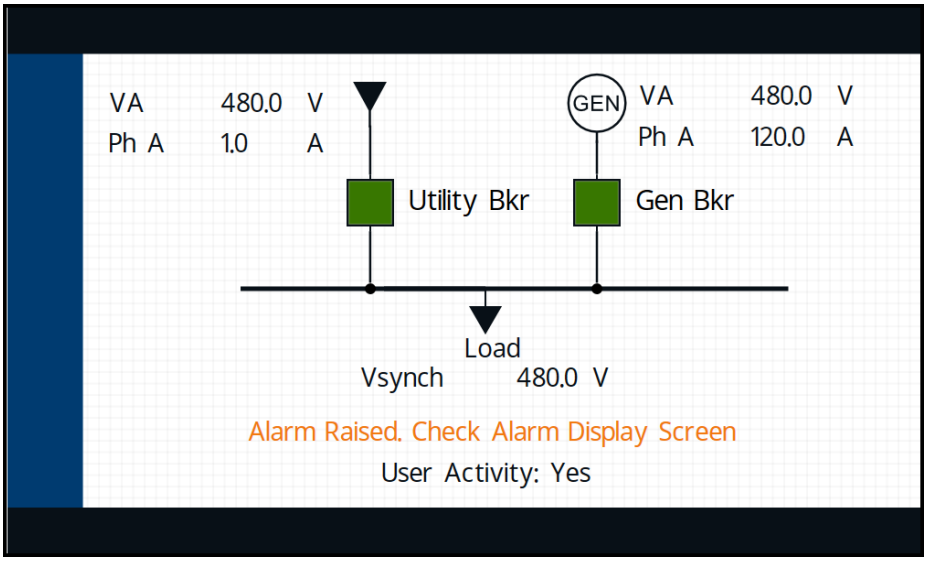


Figure 5-2: SEL-700GT Bay Screen#1

Bay screen#2 is designed to show the specific alarm conditions. If the alarm is active, 'YES' text would appear for the relevant alarm condition. Pressing the TARGET RESET pushbutton would reset the alarm if active alarms were not present. If no alarm is active, 'NO' text would appear for the relevant alarm conditions.

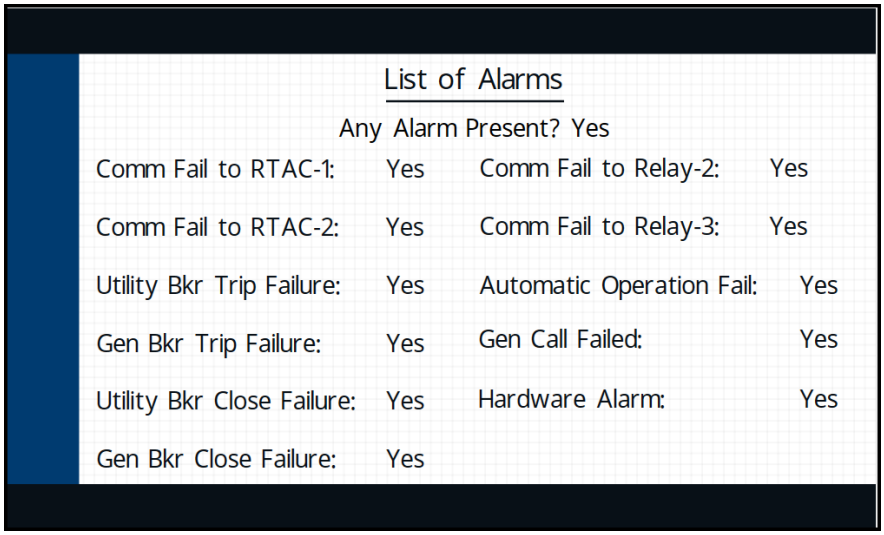


Figure 5-3: SEL-700GT Bay Screen#2

SECTION 6 PROTECTION FUNCTIONS

Table 6-1: Protection Functions of SEL-700GT Relay

Protection Element	Function	Action
Voltage Controlled Time Overcurrent (51CP)	Standard Voltage Controlled Time OC Protection for generator side	Trip the Generator Breaker
Y Side Phase Time Overcurrent Trip Level (51PYP)	Standard Phase Time OC Protection	Trip the Utility Breaker
Phase Undervoltage Trip Level (27PX1P)	Standard Phase Undervoltage Protection (Gen. side)	For detecting generator source dead condition (set at 25% of nominal voltage) – Phase to Ground
Phase - Phase Undervoltage Trip Level (27PPX1P)	25% of Secondary Nominal Voltage (Gen. side)	For detecting generator source dead condition (set at 25% of nominal voltage) – Phase to Phase
Phase Overvoltage Trip Level (59PX1P)	Standard Phase Overvoltage Protection (Gen. side)	For detecting generator source live condition (set at 90% of nominal voltage) - Phase to Ground
Phase - Phase Overvoltage Trip Level (59PPX1P)	90% of Secondary Nominal Voltage (Gen. side)	For detecting generator source live condition (set at 90% of nominal voltage) - Phase to Phase
Phase Undervoltage Trip Level (27PY1P)	Standard Phase Undervoltage Protection (Utility side)	For detecting utility source dead condition (set at 25% of nominal voltage) – Phase to Ground
Phase - Phase Undervoltage Trip Level (27PPY1P)	25% of Secondary Nominal Voltage (Utility side)	For detecting utility source dead condition (set at 25% of nominal voltage) – Phase to Phase
Phase Overvoltage Trip Level (59PY1P)	Standard Phase Overvoltage Protection (Utility side)	For detecting utility source live condition (set at 90% of nominal voltage) - Phase to Ground
Phase - Phase Overvoltage Trip Level (59PPY1P)	90% of Secondary Nominal Voltage (Utility side)	For detecting utility source live condition (set at 90% of nominal voltage) - Phase to Phase
Synchronism Undervoltage Trip Level (27S1P)	Standard Synchronism Undervoltage Protection	Dead bus voltage (25% of nominal line to ground)
Synchronism Check (25)	Check synchronism between the Utility voltage and Generator Voltage	For Close Permissive Logic
Loss of Potential (LOP)	-	For Alarm only

SECTION 7 TRANSFER SCHEME DEFINITIONS

Based on the capability of the source available, four types of transfers are defined in this document. A

- **Closed transition transfer (Only in Manual Mode / 43-AM = Manual):** These transfers avoid the momentary power interruption to the loads downstream when there is loss of utility source by automatically closing the emergency generator breaker, after successful generator start initiation. During this period, the generator is momentarily running in parallel with the utility before tripping utility incoming circuit breaker (after successful source transfer to generator). They are also known as make-before-break transfer.
- **Open transition transfer (Both in Manual and Automatic Mode, 43-AM = Manual or Auto):** These transfers break the connection to the power source before transferring over to the emergency generator. The utility breaker is tripped and then the emergency generator breaker is closed after successful generator start initiation.
- **Closed transition retransfer (Both in Manual and Automatic Mode, 43-AM = Manual or Auto):** These are in line with “Closed transition transfer” but, transferring source from emergency generator to utility.
- **Open transition retransfer (Both in Manual and Automatic Mode, 43-AM = Manual or Auto):** These are in line with “Open transition transfer” but, transferring source from emergency generator to utility.

SECTION 8 MANUAL OPERATIONS

This section discusses the manual operation of transfer scheme initiated by operator when 43-AM (Automatic/Manual) switch is placed in manual mode. In this mode, no transfer or generator automatic operations would take place unless it's initiated by operator. User can use this mode during planned utility outages or for periodic maintenance when loads need to be transferred to generators from utility.

8.1 Manual Breaker Operations

Both utility and generator breakers can be operated in Manual Mode using respective control switches. The outputs of control switches are wired to SEL-700GT relay inputs for closing and opening breakers.

Manual Breaker Open:

Once the input IN403 for gen breaker or IN303 for utility breaker is received by SEL-700GTs from control switch operation, breakers would get open without any logic supervision by SEL-700GT relays. Following figure shows the logic for opening breaker manually using control switch.

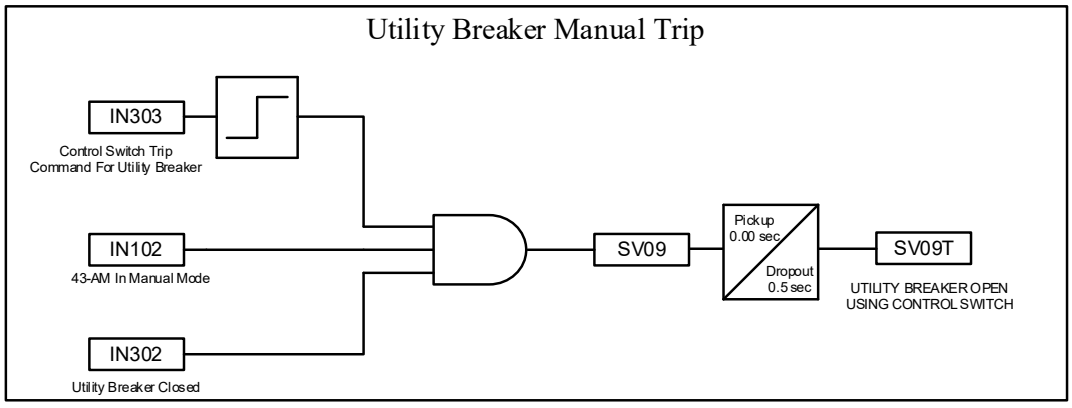


Figure 8-1: Utility Breaker Manual Trip Logic

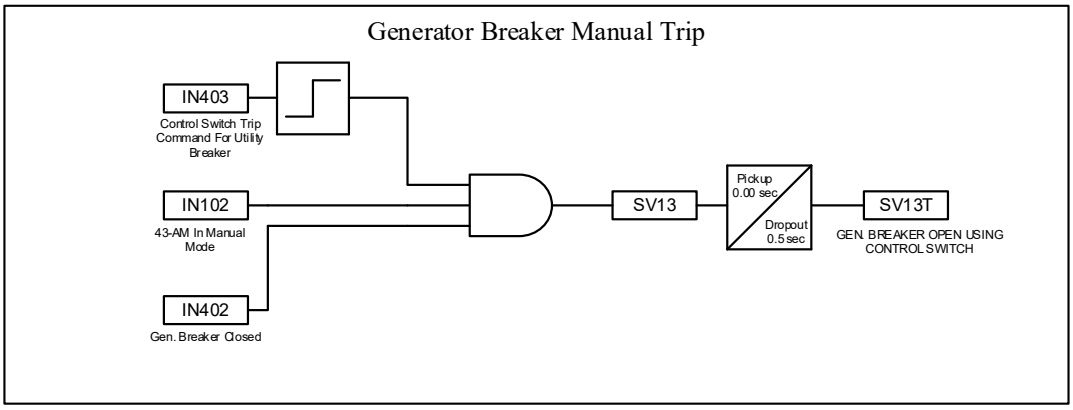


Figure 8-2: Generator Breaker Manual Trip Logic

Manual Breaker Close:

Once SEL-700GT receives input IN404 for generator breaker close or IN304 for utility breaker close, 700GTs play a supervisory role by verifying that the logical and protection conditions are correct (SV16T and SV17T). Following figure shows the logic for closing breaker manually using control switch.

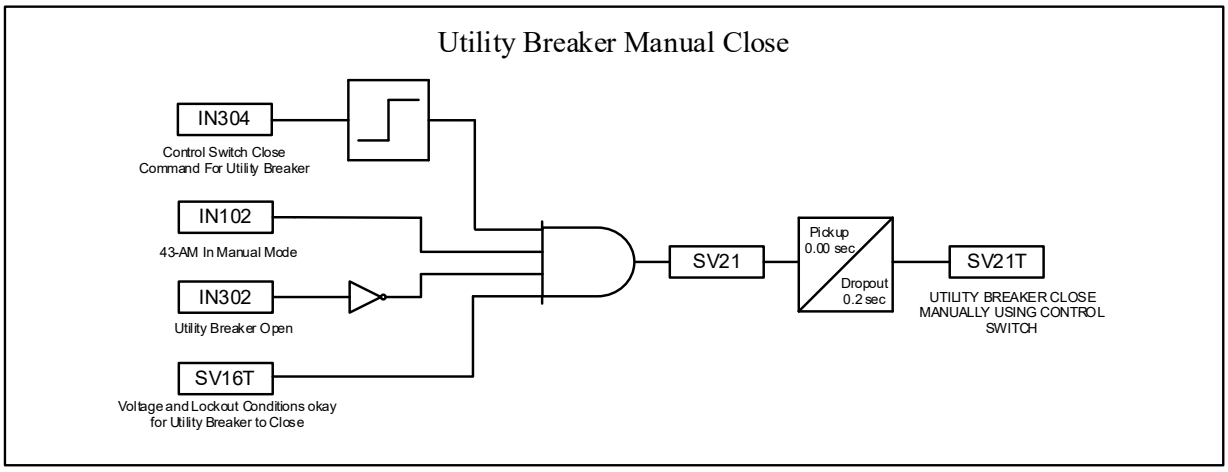


Figure 8-3: Utility Breaker Manual Close Logic

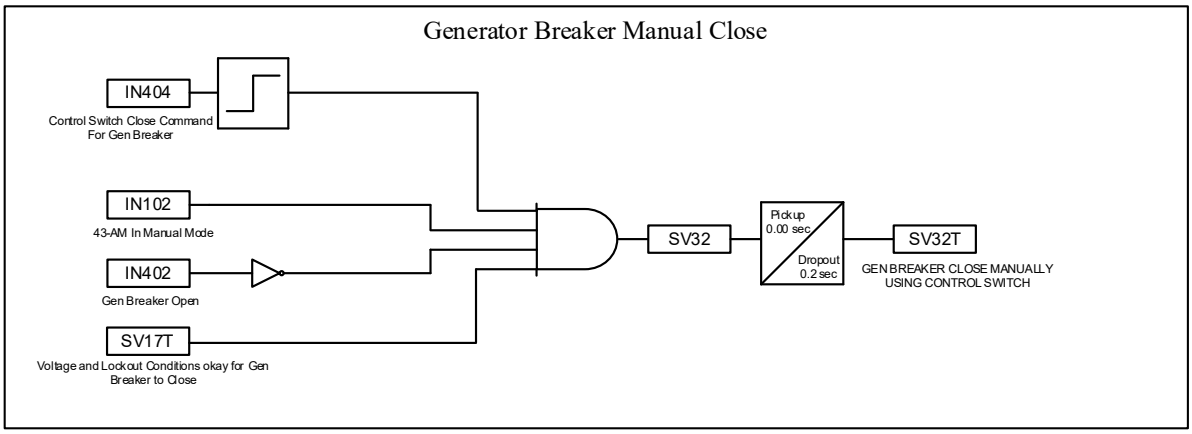


Figure 8-4: Generator Breaker Manual Close Logic

8.2 Manual Generator Call

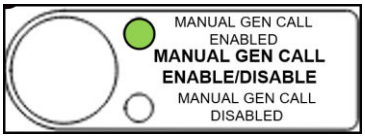
Manual generator call can be initiated using front panel pushbutton or from HMI to turn on the generators manually during periodic maintenance, testing purpose, or during controlled outage.

Important Note:

1. Manual generator call can be initiated in both 43-AM Automatic & Manual modes.
2. Please note that during manual generator call, the generators will turn on, however MV ATS generator circuit breaker will not be allowed to close automatically even if 43-AM switch is kept in Automatic mode.
3. During manual generator call, if the real generator is received, the real generator call would take priority and manual generator call will get deactivated.

- For initiating manual generator call,

STEP-1: Press pushbutton#7 'Manual generator call Enable/Disable' or use generator HMI push button (Remote bit RB11 via Modbus communication) to Enable the manual generator call. This pushbutton acts as a lock or security before actually executing generator start command mentioned in step-2 below.

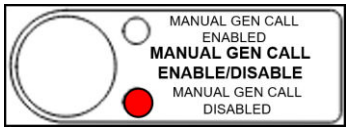


STEP-2: Press pushbutton#3 'Manual generator call Toggle' or use generator HMI push button (Remote bit RB05 via Modbus communication) to activate generator call. When this pushbutton is pressed, SEL-700GT relay would send generator start command to SEL-3555 (RTAC) generator controller. SEL-3555 in turn would initiate start signal to generator controllers, and close respective upstream generator switchgear feeder breakers. Once the upstream generator switchgear feeder breaker gets closed, 700GT at MV ATS line PT would see a generator nominal voltage (VAX, VBX, VCX) on its terminals.

- To stop manual generator call,

  Option-1: Press again pushbutton#3 'Manual generator call Toggle' to make it inactive or use generator HMI push button (Remote bit RB06 via Modbus communication).

  Option-2: Pressing pushbutton#7 'Manual generator call Enable/Disable' to Disable use generator HMI push button (Remote bit RB12 via Modbus communication) would also stop manual generator call.



8.3 Sequence of Operation For Manual "Open Transition" Transfer (From Utility to Generator)

For manual open transition transfer from utility to generator breakers, the loads would be interrupted momentarily. Follow the steps below,

Step-1: Put 43-AM switch in manual mode,

Step-2: Select "UTILITY → GEN Transfer Mode" to Open transition by pressing pushbutton#5 or use HMI pushbutton (RB08 via Modbus communication),

Step-3: Make sure the "UTILITY → GEN Transfer Inhibit" is selected to OFF by pressing pushbutton#1 or using HMI pushbutton (RB02 via Modbus communication),

Step-4: Enable Manual Gen call using pushbutton#7 or using HMI pushbutton (RB11 via Modbus communication),

(If the generator source is healthy from real generator call, skip steps#4 & 5)

Step-5: Toggle Manual Gen call pushbutton #3 or use HMI pushbutton (RB05 via Modbus communication),to call the generator. SEL-700GT relay will send the generator signal to RTAC (SEL-3555) for turning on the generators.

Step-6: Verify the generator voltages (VAX, VBX, VCX) are healthy,

Step-7: Open the utility breaker using control switch,

Step-8: Once the utility breaker is open and dead bus is achieved, close the generator breaker using control switch on live generator source and dead bus.

8.4 Sequence of Operation For Manual "Closed Transition" Transfer (From Utility to Generator)

During normal operations, utility breaker remains closed, and the generator breaker remains open. If operator wants to perform transfer from utility source to generator source without dropping loads, follow the steps below:

Step-1: Put 43-AM switch in manual mode,

Step-2: Select "UTILITY → GEN Transfer Mode" to Closed transition by pressing pushbutton#5 or use HMI pushbutton (RB08 via Modbus communication),

Step-3: Make sure the "UTILITY → GEN Transfer Inhibit" is selected to OFF by pressing pushbutton#1 or using HMI pushbutton (RB02 via Modbus communication),

Step-4: Enable Manual Gen call using pushbutton#7,

(If the generator source is healthy from real generator call, skip steps#4 & 5)

Step-5: Toggle Manual Gen call pushbutton #3 to call the generator. SEL-700GT relay will send the generator signal to RTAC (SEL-3555) for turning on the generators.

Step-6: Wait for generator to get to the nominal voltage and frequency,

Step-7: Initiate synch. using pushbutton#4. By pressing synch. initiate, SEL-700GT will send the signal to SEL-3555 RTAC to bring generator frequency lower to achieve the slip.

Step-8: Wait for pushbutton#4 LED 'SLIP FREQ ACHIEVED' to light up.

Step-9: Wait for front panel LED (Synch Permissive) and then close the generator breaker using control switch.

Step-10: Anti parallel logic will open the utility breaker as soon as the generator breaker gets closed.

8.5 Sequence of Operation For Manual Retransfer (From Generator To Utility – Open Transition)

For manual open transition retransfer from generator to utility source, the loads would be interrupted momentarily. Follow the steps below,

Step-1: Put 43-AM switch in manual mode,

Step-2: Select "GEN → UTILITY Retransfer Mode" to Open transition by pressing pushbutton#6 or use HMI pushbutton (RB10 via Modbus communication),

Step-3: Make sure the "GEN → UTILITY Retransfer Inhibit" is selected to OFF by pressing pushbutton#2 or using HMI pushbutton (RB04 via Modbus communication),

Step-4: Verify nominal utility source voltage and frequency values (VAY, VBY, VCY),

Step-5: Open the generator breaker using control switch,

Step-6: Once the generator breaker is open and dead bus is achieved, close the utility breaker using control switch on live utility source and dead bus.

8.6 Sequence of Operation For Retransfer Operations (From Generator To Utility)

When the loads are connected to generators and if operator wants to perform retransfer operations from generator source to utility without dropping loads, follow the steps below:

Step-1: Put 43-AM switch in manual mode,

Step-2: Select "GEN → UTILITY Retransfer Mode" to Closed transition by pressing pushbutton#6 or use HMI pushbutton (RB10 via Modbus communication),,

Step-3: Make sure the "GEN → UTILITY Retransfer Inhibit" is selected to OFF by pressing pushbutton#2 or using HMI pushbutton (RB04 via Modbus communication),

Step-4: Verify nominal utility source voltage and frequency values,

Step-5: Initiate synch. using pushbutton#4. By pressing synch. initiate, SEL-700GT will send the signal to SEL-3555 RTAC to bring generator frequency lower to achieve the slip.

Step-6: Wait for pushbutton#4 LED 'SLIP FREQ ACHIEVED' to light up.

Step-7: Wait for front panel LED (Synch Permissive) and then close the utility breaker using control switch.

Step-8: Anti parallel logic will open the generator breaker as soon as the utility breaker gets closed.

8.7 Failure Conditions for Manual Transfer/ Retransfer

Manual transfers will fail for the following conditions,

- Utility breaker fails to open for UTILITY → GEN transfer,
- Generator breaker fails to close during UTILITY → GEN transfer,
- Generator breaker fails to open during GEN → UTILITY retransfer,
- Utility breaker fails to close during GEN → UTILITY retransfer,

If any of the conditions happens, SEL-700GT will display respective breaker failure alarms on the bay screen #2.

SECTION 9 AUTOMATIC OPERATIONS

This section describes the automatic operations of the MV ATS when 43-AM switch is placed in Automatic mode.

9.1 Real Generator Call

MV ATS SEL-700GT relays would receive real generator signals from downstream SEL-451 relays when one of the following conditions are detected by SEL-451 main incomer relays,

- Both upstream incomer utility sources are lost for more than 1 sec.,
- Downstream SEL-451 relay fails to transfer to other source when one of the utility sources is lost.

For one of the above conditions, SEL-451 relay sends the 'Real Generator Call' command via MIRRORED BITs (TMB1B in SEL-451) for at least 10 seconds. In SEL-700GT, this command will be received as RMB1B and keep it will be latched.

This latch signal then will be sent from 700GT relays to upstream SEL-3555 RTACs via GOOSE communication to turn on the generators.

Note:

1. The Real Generator Call signal to SEL-3555 will be a continuous signal and will be latched until the utility returns and the breaker comes in normal position. The user will be able to reset the real gen. call if the 43-AM switch is turned from Auto to manual.

2. The real gen call can take place irrespective of the status of Manual Gen Call. Meaning, even if the manual gen call is active, Real gen call will take precedence and the system will be able to perform the transfer automatically by closing breakers.

3. Gen call will reset after 5 mins. if the generator fails to turn on.

Following figure shows the logic for 'Real Generator Call' signal from SEL-700GT to SEL-3555 (RTACs).

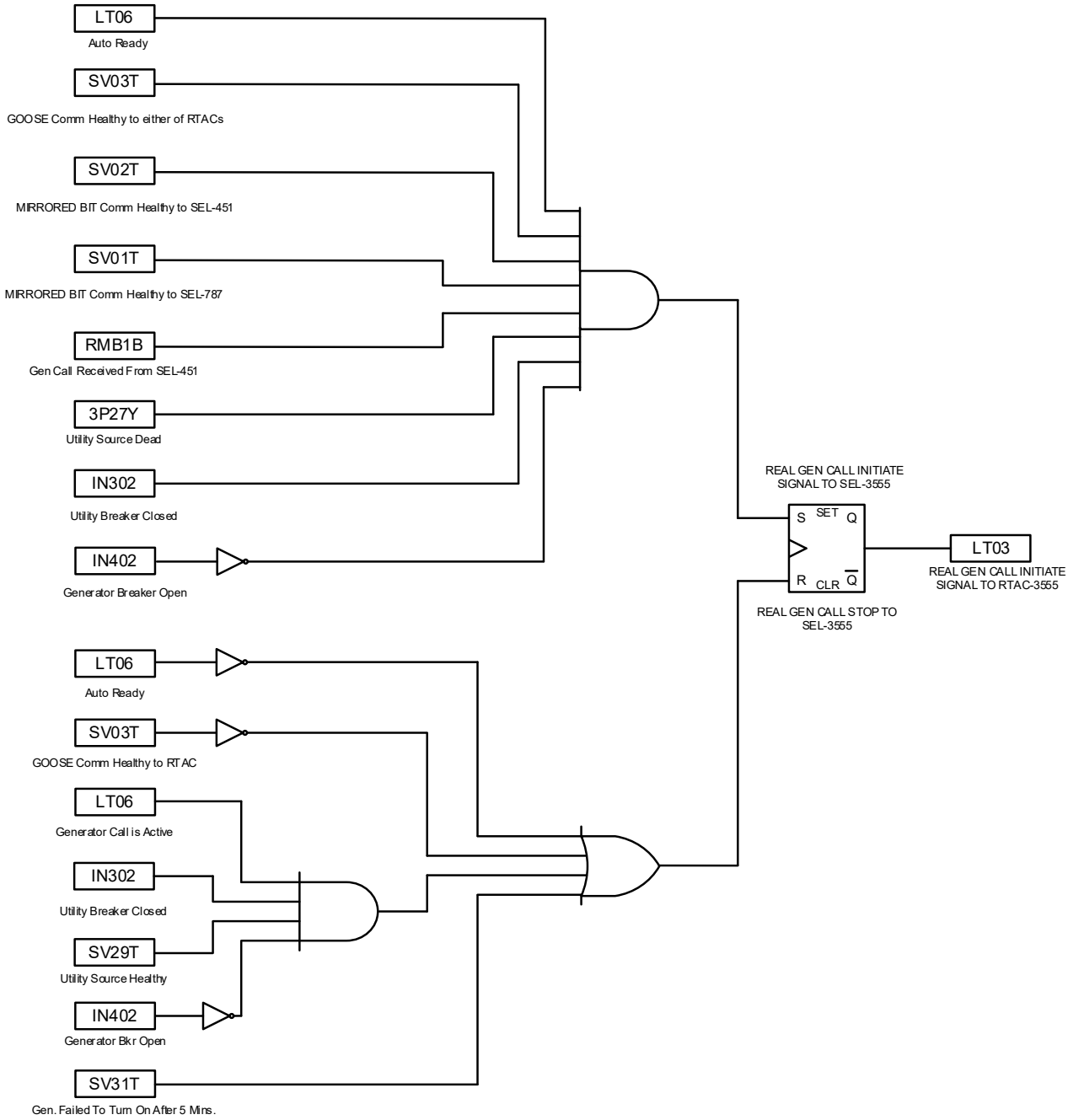


Figure 9-1: Real Generator Call Initiate Logic

9.2 Automatic Transfer & Retransfer Conditions

Automatic transfer gets enabled and disabled by the physical 43-AM switch located on the ATS switchgear door. Even when the 43-AM switch is in Automatic position, automatic operations may not be allowed because of various blocking conditions, stated further.

9.3 Automatic Transfer & Retransfer Allowed Conditions

Automatic transfers/retransfers occur only when the automatic transfer scheme is in allowed condition. In this application, the scheme will always be allowed unless some blocking condition is present. When there is no condition blocking automatic transfer, the 'TRANSFER ALLOWED' and 'RETRANSFER ALLOWED' statuses will be GREEN on the front panel of all three relays on pushbutton#1 & 2 respectively. Note that while the scheme is by default enabled, transfers will be blocked by certain conditions as described below. When automatic transfer is blocked, the 'TRANSFER ALLOWED' & 'RETRANSFER ALLOWED' pushbutton#1 & 2 LED will remain OFF.

The scheme is ready for an automatic transfer when all of the following conditions are true:

- 43-AM Switch in Automatic for more than 10 SEC,
- MIRRORED BITs Communication Healthy to SEL-787 relay,
- GOOSE Communication Healthy to at least one of the SEL-3555 (RTACs),
- Utility Breaker Racked In,
- Generator Breaker Racked In,
- Utility Breaker Closed for transfer / Utility Breaker Open for Retransfer,
- Generator Breaker Open for transfer / Generator Breaker Closed for Retransfer,
- Utility or Generator Breakers don't have active close and trip failure,
- No Protection Trip,
- No Fault Conditions (overcurrent pickup),
- No Fault Conditions detected by SEL-787 relays upstream.

9.4 Automatic Transfer & Retransfer Blocked Conditions

The scheme is automatically blocked if any of the following conditions is true:

- 43-AM Switch in Manual,
- MIRRORED BITs Communication loss to SEL-787 relay,
- GOOSE Communication loss to both SEL-3555 (RTACs),
- Utility Breaker is Racked Out,
- Generator Breaker is Racked Out,
- Utility Breaker Open for transfer / Utility Breaker Closed for Retransfer,
- Generator Breaker Closed for transfer / Generator Breaker Open for Retransfer,

- Utility or Generator Breakers have close and trip failure,
- Protection Trip,
- Fault Conditions (overcurrent pickup),
- Fault detected by SEL-787 relays.

9.5 Sequence of Operations for Automatic Transfer In Open Transition– (Utility to Emergency Generator)

Auto transfer from utility to emergency generator initiates automatically when 43-A/M pushbutton is in automatic mode, and all the qualifying conditions are met indicated by 'TRANSFER ALLOWED' psuhbutton#1 LED.

Note: When in 43-AM Automatic mode, transfer operation from utility to generator happens only in open transition mode. Due to possibility of emergency generator supply back feed through utility circuit breaker, Closed Transition Automatic Transfer is not permissive.

Following automatic operations will take place during open transition transfer:

Step-1: SEL-700GT detects the loss of source (voltage below 25% of nominal) AND receives the real generator call signal from SEL-451 relay downstream,

Step-2: SEL-700GT relay will send the 'Generator Call Initiate' GOOSE signal to SEL-3555 to turn on the generators.

Step-3: Once SEL-3555 receives the 'Generator Call Initiate' command, it will turn on all the generators on the respective buses and perform calculations for the ATS priority.

Step-4: As soon as the priority for the ATS is met, SEL-3555 will close the respective generator switchgear feeder breaker and also apply the 'Retransfer Inhibit' signal. The 'Retransfer Inhibit' signal would make sure that the scheme will not try to retransfer back to utility if the utility source returns.

Step-5: Once the upstream generator feeder breaker gets closed, SEL-700GT will detect healthy generator voltage (above 90% nominal).

Step-6: SEL-700GT will open the utility breaker first and close the generator breaker once the utility breaker is confirmed open.

9.6 Failure Conditions for Automatic Transfer

Automatic transfers will fail for the following conditions:

- During open transition automatic transfer, if utility circuit breaker fails to trip or emergency generator circuit breaker fails to close, an automatic transfer fail alarm is declared in SEL-700GT Bay Screen#2. The transfer fail alarm is latched until it is reset through the SEL-700GT front panel TARGET RESET pushbutton. All transfers are blocked while a transfer fail alarm is active.
- Emergency generator fails to start within 5 minutes time period.

front panel pushbutton#6 or from RTAC HMI, and all the qualifying conditions are met with 'RETRANSFER ALLOWED' pushbutton#2 LED is lit.

Following operations would take place when the emergency generator is feeding the load with generator breaker closed and utility breaker open,

Step-1: Utility source is restored and healthy for more than **10 seconds**,

Step-2: Operator would remove the already applied 'Retransfer Inhibit' from front panel pushbutton#2 or using RTAC HMI.

Step-3: As soon as the retransfer inhibit is removed, generator breaker will open first, and utility breaker will get closed after confirming generator breaker open with live line-dead bus and other close permissive conditions.

9.8 Sequence of Operations for Automatic Retransfer In Closed Transition– (Emergency Generator to Utility)

The automatic closed transition retransfer initiates when the 'CLOSE TRANSITION' is selected using front panel pushbutton#6 or from RTAC HMI, and all the qualifying conditions are met with 'RETRANSFER ALLOWED' pushbutton#2 LED is lit.

Following operations would take place when the emergency generator is feeding the load with generator breaker closed and utility breaker open,

Step-1: Utility source is restored and healthy for more than **10 seconds**,

Step-2: Initiate synch. using pushbutton#4. By pressing synch. initiate, SEL-700GT will send the signal to SEL-3555 RTAC to bring generator frequency lower to achieve the slip (59.85 Hz).

Step-3: Wait for pushbutton#4 LED 'SLIP FREQ ACHIEVED' to light up.

Step-4: Once the slip frequency is achieved, operator can remove already applied 'Retransfer Inhibit' from front panel pushbutton#2 or using RTAC HMI.

Step-5: SEL-700GT will automatically close the utility breaker first once Synch. check conditions are fulfilled and open the generator breaker.

9.9 Failure Conditions for Automatic Retransfer

Automatic retransfers will fail for the following conditions:

- Any breaker involved in an ATS fail to open or close during the operation.
- Generators will fail to achieve the slip frequency window.

breaker which close last.

For example, during closed transition retransfer, if the generator breaker fails to open after utility breaker close, generator breaker will open back again to avoid paralleling of two sources.

9.11 Live Source Seeking Logic

Live source seeking logic is programmed in SEL-700GT relays which would allow the breakers to seek the live source when placed in automatic mode.

1. During open transition retransfer, if the utility breaker fails to close after generator breaker confirms open and if the generator source is still healthy, generator breaker will get closed again to seek live source.

2. If utility source is healthy and generator source is dead, the utility breaker will get closed automatically provided the retransfer inhibit condition and other fault conditions are not present and utility breaker is allowed to close.

Table 10-1: SEL-700GT Relay Part Number and Selected Options

Summary

Sales Item Number	700G#FMG5
Part Number	0700GT1A1A1A7585A8D0

Selected Options

Model Options	700GT+, Intertie and Basic Generator Protection plus Auto Synchronizer
User Interface	English
Front Panel	5-inch Color Touchscreen with 8 Pushbuttons
Slot A Power Supply Voltage	110-250 Vdc (110-240 Vac); 50/60 Hz
Slot A Digital Input Voltage	125 Vdc/Vac
Slot B Ethernet (Port 1)	Dual 100BASE-FX MM LC Ethernet *The protocols SNTP, IEEE 1588-2008 firmware-based PTP, PRP, and Modbus TCP are included.*
Slot B Rear Serial Port (Port 3)	EIA-232
IEC 61850 Protocol	Yes
DNP3 Protocol	No
IEC 60870-5-103 Protocol	Yes
EtherNet/IP Protocol	Yes
Slot C	4 DI / 4 DO Electromechanical (Form A)
Slot C Digital Input Voltage	125 Vdc/Vac
Slot D	4 DI / 4 DO Electromechanical (Form A)
Slot D Digital Input Voltage	125 Vdc/Vac
Slot E	3-Phase 5 Amp AC Current Input / 3-Phase AC Voltage (300 Vac) Input and Vsync Input (SELECT 3 ACI / 4 AVI)
Slot E Digital Input Voltage	NA
Slot Z Current and/or Voltage Inputs	3-Phase 5 Amp AC Current Input / 5 Amp Neutral AC Current Input / 3-Phase AC Voltage (300 Vac) (SELECT 4 ACI / 3 AVI)
Conformal Coat	No

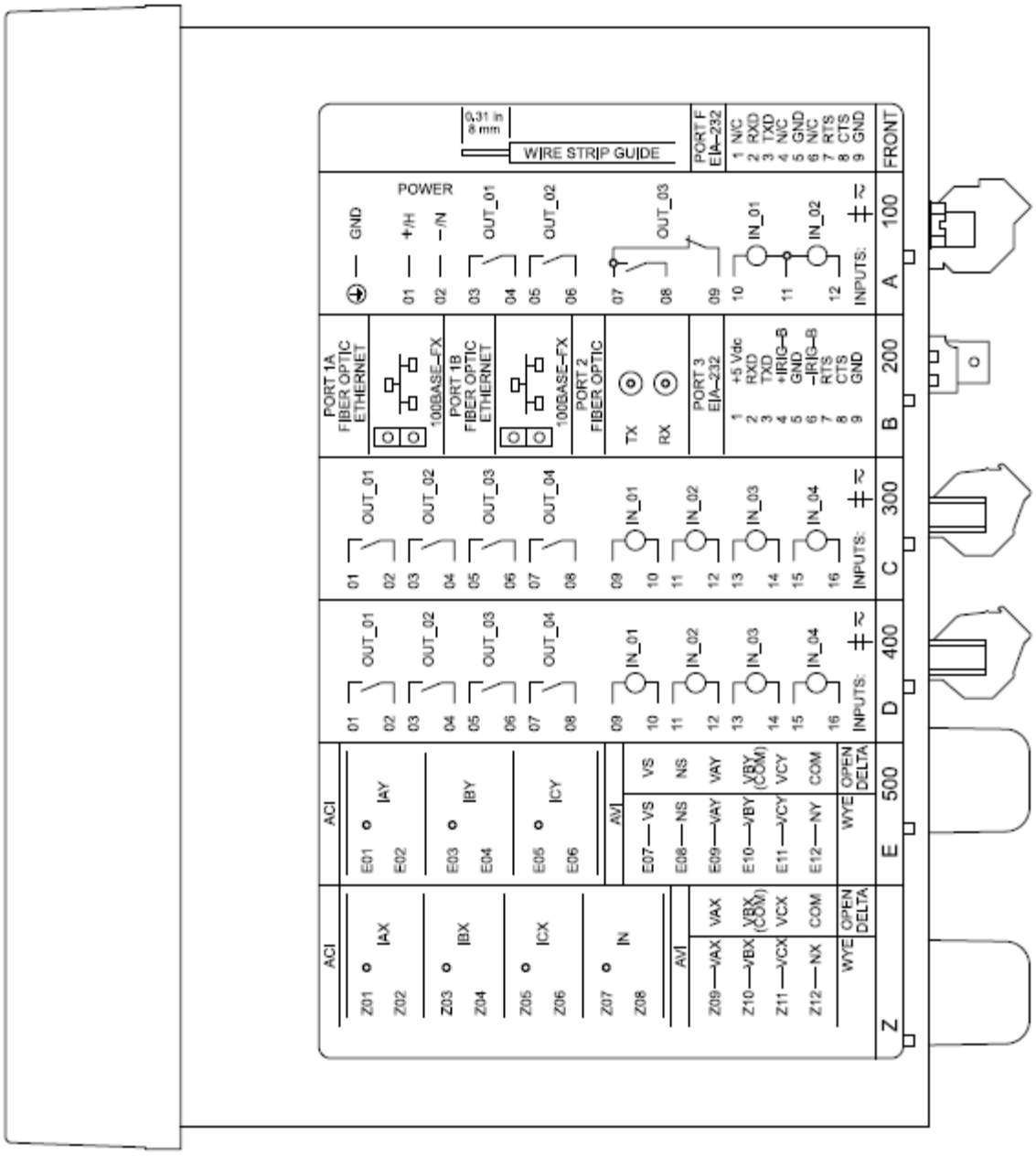


Figure 10-1: SEL-700GT Relay Side View

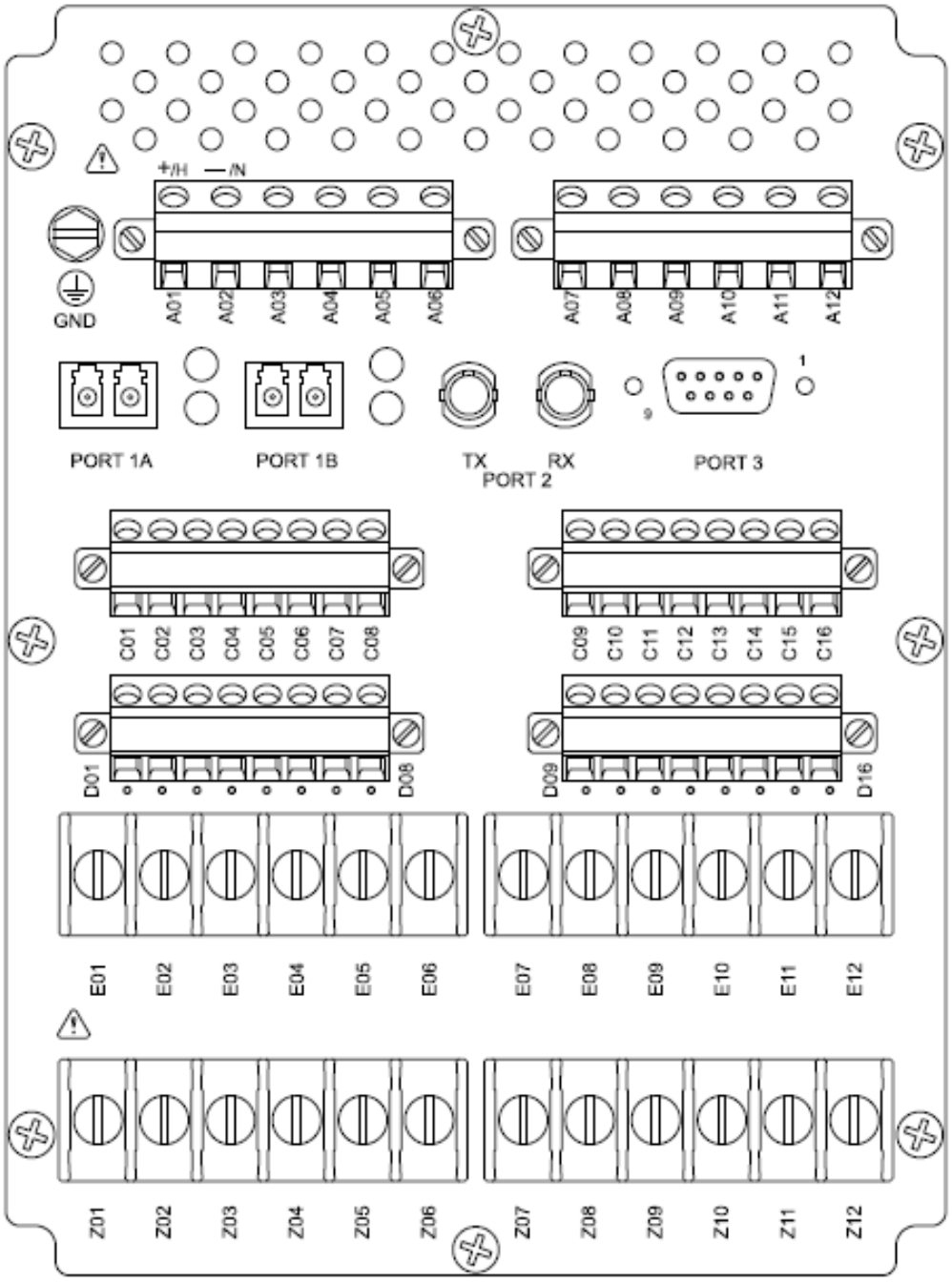


Figure 10-2: SEL-700GT Relay Rear View

ASSIGNMENT

Table 11-1: SEL-700GT Relay – CT/PT Connections

Generator SEL-700GT Relay - Generator Switchgear		
Relay Card	**Designation**	**Description**
Current		
SLOT Z	IAX	Emergency Generator Phase-A Current
	IBX	Emergency Generator Phase-B Current
	ICX	Emergency Generator Phase-C Current
	IN	Neutral Current
SLOT E	IAY	Utility Incomer Phase-A Current
	IBY	Utility Incomer Phase-B Current
	ICY	Utility Incomer Phase-C Current
Voltage		
SLOT Z	VAX	Emergency Generator Phase-A Voltage
	VBX	Emergency Generator Phase-B Voltage
	VCX	Emergency Generator Phase-C Voltage
	NX	Neutral
SLOT E	VS	Load Bus Phase-B Voltage
	NS	Neutral
	VAY	Utility Incomer Phase-A Voltage
	VBY	Utility Incomer Phase-B Voltage
	VCY	Utility Incomer Phase-C Voltage
	NY	Neutral

Table 11-2: SEL-700GT Relay – Input / Output Assignments

Generator SEL-700GT Relay - Generator Switchgear		
Relay Card	**Designation**	**Description**
Inputs		
SLOT A	IN101	ATS Automatic Mode (Auto Mode Selected = 1, No Mode Selected = 0)
	IN102	ATS Manual Mode (Manual Mode Selected = 1, No Mode Selected = 0)
SLOT C	IN301	S1 (Incoming Utility Breaker) Truck Operating Switch (Breaker Connected to Bus = 1, Breaker in Test Position = 0)
	IN302	S1 (Incoming Utility Breaker) Breaker Status 52a (Breaker Closed = 1, Breaker Open = 0)
	IN303	S1 (Incoming Utility Breaker) Control Switch Trip Request (Trip Requested = 1, No Request = 0)
	IN304	S1 (Incoming Utility Breaker) Control Switch Close Request (Close Requested = 1, No Request = 0)
SLOT D	IN401	S2 (Incoming Generator Breaker) Truck Operating Switch (Breaker Connected to Bus = 1, Breaker in Test Position = 0)
	IN402	S2 (Incoming Generator Breaker) Breaker Status 52a (Breaker Closed = 1, Breaker Open = 0)
	IN403	S2 (Incoming Generator Breaker) Control Switch Trip Request (Trip Requested = 1, No Request = 0)
	IN404	S2 (Incoming Generator Breaker) Control Switch Close Request (Close Requested = 1, No Request = 0)
Outputs		
SLOT A	OUT101 to OUT103	SPARE
SLOT C	OUT301	S1 (Incoming Utility Breaker) Trip Vote #1 (Trip Requested = 1, No Vote = 0)
	OUT302	S1 (Incoming Utility Breaker) Trip Vote #2 (Trip Requested = 1, No Vote = 0)
	OUT303	S1 (Incoming Utility Breaker) Close Vote #1 (Close Requested = 1, No Vote = 0)
	OUT304	S1 (Incoming Utility Breaker) Close Vote #2 (Close Requested = 1, No Vote = 0)
SLOT D	OUT401	S2 (Incoming Generator Breaker) Trip Vote #1 (Trip Requested = 1, No Vote = 0)
	OUT402	S2 (Incoming Generator Breaker) Trip Vote #2 (Trip Requested = 1, No Vote = 0)
	OUT403	S2 (Incoming Generator Breaker) Close Vote #1 (Close Requested = 1, No Vote = 0)
	OUT404	S2 (Incoming Generator Breaker) Close Vote #2 (Close Requested = 1, No Vote = 0)

SECTION 12 SEL-700GT – MIRRORED BITS, GOOSE, AND MODBUS COMMUNICATION MAP

Table 12-1: SEL-700GT & SEL-787 Mirrored Bits – ID Assignments

Comm Port In SEL-700GT	To SEL Remote Device	Port In Remote SEL-787	Protocol	Relay 1		Relay 2		Relay 3	
				TX ID	RX ID	TX ID	RX ID	TX ID	RX ID
PORT 3	SEL-787	PORT 2	MB8A	4	2	3	1	1	4

Table 12-2: SEL-700GT Mirrored Bits Transmit to SEL-787

Transmit Bits in SEL-700GT	Description	Receiving Destination Device	Comment
TMB1A to TMB8A	SPARE	SEL-787	NOT USED

Table 12-3: SEL-700GT Mirrored Bits Received From SEL-787

Receive Bits in SEL-700GT	Transmitting Device SEL-787	Description	Comment
RMB1A	SEL-787	Fast/Staggered Transfer signal from SEL-787 originated from E-House SEL-411L Relays	This bit is essentially passed through SEL-700GT, with utility undervoltage supervision, from SEL-787 to SEL-451. This will trigger a downstream transfer in the ATO downstream from the MV-ATS.
RMB2A	SEL-787	SEL-411L MTTM ATO Failed	This bit indicates SEL-411L ATO failed.
RMB3A	SEL-787	Fast Transfer locally from SEL-787	This bit is passed through SEL-700GT relay indicating fast transfer from SEL-787 to downstream SEL-451 device.
RMB4A	SEL-787	Fault detected by SEL-787	This bit communicates that a fault is detected by SEL-787.

Table 12-4: SEL-700GT & SEL-451 Mirrored Bits – ID Assignments

Comm Port In SEL-700GT	To SEL Remote Device	Port In Remote Device	Protocol	Relay 1		Relay 2		Relay 3	
				TX ID	RX ID	TX ID	RX ID	TX ID	RX ID
PORT 2	SEL-451	PORT 1	MB8B	1	3	2	4	3	2

Table 12-5: SEL-700GT Mirrored Bits Transmit to SEL-451

Transmit Bits	Description	Destination	Comment
TMB1B	Fast/Staggered Transfer from E-House 411L Relays	SEL-451	
TMB2B	SEL-411L MTTM ATS Failed	SEL-451	
TMB3B	(Fast Transfer locally from SEL-787) OR (700GT protection TRIP) OR (UTILITY BKR OPEN USING CONTROL SWITCH)	SEL-451	
TMB4B	Automatic Generator call from downstream SEL-451 is ON and Gen. source is available feedback to downstream SEL-451 relay.	SEL-451	
TMB5B	SPARE	SPARE	-
TMB6B	SPARE	SPARE	-
TMB7B	SPARE	SPARE	-
TMB8B	SPARE	SPARE	-

Table 12-6: SEL-700GT Mirrored Bits Received From SEL-451

Receive Bits	Publisher Device	Description	Comment
RMB1B	SEL-451	Generator Call Signal from Downstream ATO	SEL-451 relay at downstream will send the generator call signal as soon as the SEL-451 detects ATS failed to transfer or both sources are lost for more than 1 sec. (Note: The time delay of 1 sec. is enough to restore power from upstream SEL-411 based transfer scheme.) This generator call signal will be sent for at least 10 sec. So, dropout time of 10 sec. to be programmed in SEL-451 relay.
RMB2B	SEL-451	Fault Detected on SEL-451	Any protection trip detected by SEL-451 relay will be sent to SEL-700GT for front panel LED indication purpose only.

Table 12-7: SEL-700GT_1 IEC-61850 GOOSE Message Transmit to SEL-3555(RTAC_1,RTAC_2), 700GT_2, and 700GT_3 Relays.

RELAY WORD BIT	DESCRIPTION	DESTINATION	Comment
LT10	Total alarm to RTAC	RTAC_1, RTAC_2	Alarm=1 Normal=0
IN302	Utility source breaker status to RTAC	RTAC_1, RTAC_2	Closed=1 Open=0
IN402	Generator source breaker status to RTAC	RTAC_1, RTAC_2	Closed=1 Open=0
LT03	Real generator call initiate signal to RTAC	RTAC_1, RTAC_2	Gen call=1 Normal=0
SV04T	Real generator call received from downstream SEL-451	RTAC_1, RTAC_2	Gen call=1 Normal=0
LT08	Utility ->Gen Transfer	700GT_2, 700GT_3	Inhibit=1 Not Inhibit=0
LT09	Gen->Utility Re-Transfer	700GT_2, 700GT_3	Inhibit=1 Not Inhibit=0
LT05	Manual generator call	700GT_2, 700GT_3, RTAC_1, RTAC_2	Manual Gen call=1, Normal=0
LT01	Utility->Gen Transfer mode	700GT_2, 700GT_3, RTAC_1, RTAC_2	Close Transition=1, Open Transition=0
LT02	Gen->Utility Re-Transfer mode	700GT_2, 700GT_3, RTAC_1, RTAC_2	Close Transition=1, Open Transition=0
LT04	Manual generator call Enable	700GT_2, 700GT_3	Enable=1, Disable=0
LT11	Synch. In Process/Stop	RTAC_1, RTAC_2	Synch. In Process = 1 Synch. Stop = 0
P3X	Real 3-phase Power	RTAC_1, RTAC_2	
VB003	RTAC1 to Relay GOOSE OK feedback	RTAC_1	GOOSE OK=0 GOOSE offline=1
VB004	RTAC2 to Relay GOOSE OK feedback	RTAC_2	GOOSE OK=0 GOOSE offline=1

Table 12-8: SEL-700GT_1 IEC-61850 GOOSE Message Receive From SEL-3555(RTAC_1,RTAC_2), 700GT_2, and 700GT_3 Relays.

RECEIVE BIT	SENDING DEVICE	DESTINATION
VB001	700GT_2	Quality bit from R2
VB002	700GT_3	Quality bit from R3
VB003	RTAC_1	Quality bit from RTAC1
VB004	RTAC_2	Quality bit from RTAC2
VB005		
VB006		
VB007		
VB008		
VB009		
VB010	RTAC_1	Generator control ready/Scheme enable
VB011	RTAC_1	Retransfer inhibit
VB012		
VB013		-
VB014		-
VB015		
VB016		
VB017		
VB018		
VB019	-	
VB020	RTAC_2	Generator control ready/Scheme enable
VB021	RTAC_2	Retransfer inhibit
VB022		
VB023		
VB024		
VB025		
VB026		
VB027		
VB028		
VB029		
VB030	700GT_2	(S1->S2) Transfer inhibit from R2
VB031	700GT_2	(S2->S1) Re-transfer inhibit from R2
VB032	700GT_2	Close/Open transition (S1->S2) from R2
VB033	700GT_2	Close/Open transition (S2->S1) from R2
VB034	700GT_2	Manual gen call enable from R2
VB035	700GT_2	Manual gen call toggle from R2
VB036		
VB037		
VB038		
VB039		
VB040	700GT_3	(S1->S2) Transfer inhibit from R3
VB041	700GT_3	(S2->S1) Re-transfer inhibit from R3
VB042	700GT_3	Close/Open transition (S1->S2) from R3
VB043	700GT_3	Close/Open transition (S2->S1) from R3
VB044	700GT_3	Manual gen call enable from R3
VB045	700GT_3	Manual gen call toggle from R3

Table 12-9: MODBUS Communication Map Between SEL-700GT Relays and SEL-3555 (RTAC)

Relay Type	Relay Point	Units/State	Point Description	Data Type
SEL-700GT	IAXRMS	A	Gen (X-side) Phase A Line RMS Current	AI
SEL-700GT	IBXRMS	A	Gen (X-side) Phase B Line RMS Current	AI
SEL-700GT	ICXRMS	A	Gen (X-side) Phase C Line RMS Current	AI
SEL-700GT	IAYRMS	A	Utility (Y-side) Phase A Line RMS Current	AI
SEL-700GT	IBYRMS	A	Utility (Y-side) Phase B Line RMS Current	AI
SEL-700GT	ICYRMS	A	Utility (Y-side) Phase C Line RMS Current	AI
SEL-700GT	INRMS	A	Neutral RMS Current	AI
SEL-700GT	VAX_MAG	kV	Voltage A Gen (X-side) Magnitude	AI
SEL-700GT	VBX_MAG	kV	Voltage B Gen (X-side) Magnitude	AI
SEL-700GT	VCX_MAG	kV	Voltage C Gen (X-side) Magnitude	AI
SEL-700GT	VAY_MAG	kV	Voltage A (Y-side)e Magnitude	AI
SEL-700GT	VBY_MAG	kV	Voltage B (Y-side) Magnitude	AI
SEL-700GT	VCY_MAG	kV	Voltage C (Y-side) Magnitude	AI
SEL-700GT	VS_MAG	kV	Synchronism check Voltage	AI
SEL-700GT	FREQY	Hz	Utility (Y-side) Voltage Frequency	AI
SEL-700GT	PF3Y		Power Factor Utility (Y-side)	AI
SEL-700GT	P3Y	kW	3-Phase Real Power Utility (Y-side)	AI
SEL-700GT	Q3Y	kVar	3-Phase Reactive Power Utility (Y-side)	AI
SEL-700GT		Sec	Retransfer inhibit timer (RTI) (Spare)	AI
SEL-700GT		Sec	Transfer inhibit timer (TI) (Spare)	AI
SEL-700GT	ENABLED	NORMAL=1 ALARM=0	Relay Front Panel LED - Relay is Enabled	DI
SEL-700GT	TRIP_LED	LED ON=1 LED OFF=0	Relay Front Panel LED - Relay Tripped	DI
SEL-700GT	TLED_01	LED ON=1 LED OFF=0	RTAC Auto OK	DI
SEL-700GT	TLED_02	LED ON=1 LED OFF=0	43AM Automatic	DI
SEL-700GT	TLED_03	LED ON=1 LED OFF=0	SYNCH PERMISSIVE	DI
SEL-700GT	TLED_04	LED ON=1 LED OFF=0	COMM. Healthy to RTAC	DI
SEL-700GT	TLED_05	LED ON=1 LED OFF=0	Upstream 787 Fault	DI
SEL-700GT	TLED_06	LED ON=1 LED OFF=0	Downstream Fault - Lockout	DI
SEL-700GT	PB1A_LED	LED ON=1 LED OFF=0	Transfer Inhibit	DI
SEL-700GT	PB1B_LED	LED ON=1 LED OFF=0	Transfer Allowed	DI
SEL-700GT	PB2A_LED	LED ON=1 LED OFF=0	Retransfer Inhibit	DI
SEL-700GT	PB2B_LED	LED ON=1 LED OFF=0	Retransfer Allowed	DI
SEL-700GT	PB3A_LED	LED ON=1 LED OFF=0	Manual Gen Call Active	DI
SEL-700GT	PB3B_LED	LED ON=1 LED OFF=0	Manual Gen Call Inactive	DI

SEL-700GT	PB4B_LED	LED ON=1 LED OFF=0	Slip Freqency Achived	DI
SEL-700GT	PB5A_LED	LED ON=1 LED OFF=0	S1 to S2 Close Trasnsition (Utility to Generator)	DI
SEL-700GT	PB5B_LED	LED ON=1 LED OFF=0	S1 to S2 OpenTrasnsition (Utility to Generator)	DI
SEL-700GT	PB6A_LED	LED ON=1 LED OFF=0	S2 to S1 Close Trasnsition (Generator to Utility)	DI
SEL-700GT	PB6B_LED	LED ON=1 LED OFF=0	S2 to S1 OpenTrasnsition (Generator to Utility)	DI
SEL-700GT	PB7A_LED	LED ON=1 LED OFF=0	Manual Gen Call PB Enabled	DI
SEL-700GT	PB7B_LED	LED ON=1 LED OFF=0	Manual Gen Call PB Disabled	DI
SEL-700GT	PB8A_LED	LED ON=1 LED OFF=0	Upstream MB CH-A Healthy	DI
SEL-700GT	PB8B_LED	LED ON=1 LED OFF=0	Downstream MB CH-B Healthy	DI
SEL-700G	SALARM	ALARM=1 NORMAL=0	Software Alarm	DI
SEL-700G	HALARM	ALARM=1 NORMAL=0	Hardware Alarm	DI
SEL-700GT	IN101	Auto=1 Normal=0	43AM Automatic	DI
SEL-700GT	IN102	Manual=1 Normal=0	43AM Manual	DI
SEL-700GT	IN301	Raked In=1 Normal=0	S1 (Utility) Racked In	DI
SEL-700GT	IN302	Closed=1 Open=0	S1 (Utility) Breaker closed	DI
SEL-700GT	IN303	Trip=1 Normal=0	S1 (Utility) Breaker control switch trip	DI
SEL-700GT	IN304	Closed=1 Normal=0	S1 (Utility) Breaker control switch close	DI
SEL-700GT	IN401	Raked In=1 Normal=0	S2 (generator) Racked In	DI
SEL-700GT	IN402	Closed=1 Open=0	S2 (generator) Breaker closed	DI
SEL-700GT	IN403	Trip=1 Normal=0	S2 (generator) Breaker control switch trip	DI
SEL-700GT	IN404	Closed=1 Normal=0	S2 (generator) Breaker control switch close	DI
SEL-700GT	51CT	Trip=1 Normal=0	X-Side Voltage controlled Time Overcurrent	DI
SEL-700GT	50PX1T	Trip=1 Normal=0	X-Side Phase overcurrent	DI
SEL-700GT	25AX1	Sych ok=1 Normal=0	Synck ok	DI
SEL-700GT	SV14T	Fail=1 Normal=0	Utility Breaker trip fail	DI
SEL-700GT	SV15T	Fail=1 Normal=0	Generator breaker trip fail	DI

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SEL-700GT	SV24T	Fail=1Normal=0	Utility Breaker close fail	DI
SEL-700GT	SV25T	Fail=1 Normal=0	Generator breaker close fail	DI
SEL-700GT	SV28T	Ready=1 Normal=0	Generator source Ready	DI
SEL-700GT	SV29T	Ready=1 Normal=0	Normal source Ready	DI
SEL-700GT	LT10	ALARM=1 Normal=0	TOTAL ALARM	DI
SEL-700GT	RB01	Inhibit=1 No action=0	Transfer Inhibit	DO
SEL-700GT	RB02	Allowed=1 No action=0	Transfer Allowed	DO
SEL-700GT	RB03	Inhibit=1 No action=0	Retransfer Inhibit	DO
SEL-700GT	RB04	Allowed=1 No action=0	Retransfer Allowed	DO
SEL-700GT	RB05	Active=1 No action=0	Gen Call Active	DO
SEL-700GT	RB06	Inactive=1 No action=0	Gen Call Inactive	DO
SEL-700GT	RB07	Enable=1 No action=0	S1 to S2 Close Transition (Utility to Generator)	DO
SEL-700GT	RB08	Enable=1 No action=0	S1 to S2 Open Transition (Utility to Generator)	DO
SEL-700GT	RB09	Enable=1 No action=0	S2 to S1 Close Transition (Generator to Utility)	DO
SEL-700GT	RB10	Enable=1 No action=0	S2 to S1 Open Transition (Generator to Utility)	DO
SEL-700GT	RB11	Enable=1 No action=0	Manual Gen PB Enabled	DO
SEL-700GT	RB12	Disable=1 No action=0	Manual Gen PB Disabled	DO
SEL-700GT	COM	ALARM=1 HEALTHY=0	Communication Error with RTAC	DI

SECTION 13 SEL-700GT – IP ADDRESS LIST

Table 13-1: IP Address List for Generator Bus #1

GENERATOR BUS – 1 Subnet Mask: 255.255.255.0 Gateway:192.168.14.1 (dummy address) | Primary NTP Address - 192.168.14.15 | Secondary NTP Address - 192.168.14.16			
Device ID	**Device Type**	**Location**	**IP Address**
1U11_GAQ_R1	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.62
1U11_GAQ_R2	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.63
1U11_GAQ_R3	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.64
1U11_GBQ_R1	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.65
1U11_GBQ_R2	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.66
1U11_GBQ_R3	SEL-700GT	MVSW-1F12FL-SWER_MV ATS	192.168.14.67
1U11_GCQ_R1	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.68
1U11_GCQ_R2	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.69
1U11_GCQ_R3	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.70
1U11_GDQ_R1	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.71
1U11_GDQ_R2	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.72
1U11_GDQ_R3	SEL-700GT	MVSW-1F13FL-SEER_MV ATS	192.168.14.73

Table 13-2: IP Address List for Generator Bus #2

GENERATOR BUS – 2 Subnet Mask: 255.255.255.0 Gateway:192.168.15.1 (dummy address) | Primary NTP Address - 192.168.15.15 | Secondary NTP Address - 192.168.15.16			
Device	**Device Type**	**Location**	**IP Address**
1U12_GAQ_R1	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.65
1U12_GAQ_R2	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.66
1U12_GAQ_R3	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.67
1U12_GBQ_R1	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.68
1U12_GBQ_R2	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.69
1U12_GBQ_R3	SEL-700GT	MVSW-1F13FL-WER_MV ATS	192.168.15.70
1U12_GCQ_R1	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.71
1U12_GCQ_R2	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.72
1U12_GCQ_R3	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.73
1U12_GDQ_R1	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.74
1U12_GDQ_R2	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.75
1U12_GDQ_R3	SEL-700GT	MVSW-1F12FL-SER_MV ATS	192.168.15.76
1U12_GEQ_R1	SEL-700GT	OFFICE	192.168.15.77
1U12_GEQ_R2	SEL-700GT	OFFICE	192.168.15.78
1U12_GEQ_R3	SEL-700GT	OFFICE	192.168.15.79
1U12_GFQ_R1	SEL-700GT	OFFICE	192.168.15.80
1U12_GFQ_R2	SEL-700GT	OFFICE	192.168.15.81
1U12_GFQ_R3	SEL-700GT	OFFICE	192.168.15.82

Table 13-3: IP Address List for Generator Bus #3

GENERATOR BUS – 3 Subnet Mask: 255.255.255.0 Gateway:192.168.16.1 (dummy address) | Primary NTP Address - 192.168.16.15 | Secondary NTP Address - 192.168.16.16			
Device	**Device Type**	**Location**	**IP Address**
1U13_GAQ_R1	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.66
1U13_GAQ_R2	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.67
1U13_GAQ_R3	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.68
1U13_GBQ_R1	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.69
1U13_GBQ_R2	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.70
1U13_GBQ_R3	SEL-700GT	MVSW-1F12FL-WER_MV ATS	192.168.16.71
1U13_GCQ_R1	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.72
1U13_GCQ_R2	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.73
1U13_GCQ_R3	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.74
1U13_GDQ_R1	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.75
1U13_GDQ_R2	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.76
1U13_GDQ_R3	SEL-700GT	MVSW-1F13FL-EER_MV ATS	192.168.16.77
1U13_GEQ_R1	SEL-700GT	GCS	192.168.16.78
1U13_GEQ_R2	SEL-700GT	GCS	192.168.16.79
1U13_GEQ_R3	SEL-700GT	GCS	192.168.16.80
1U13_GFQ_R1	SEL-700GT	GCS	192.168.16.81
1U13_GFQ_R2	SEL-700GT	GCS	192.168.16.82
1U13_GFQ_R3	SEL-700GT	GCS	192.168.16.83

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