

SEL POWERMAX[®] for Mobile Microgrids



Energy assurance and resiliency to keep vital systems online

- No single point of failure, which ensures forward operating base (FOB) power grid resiliency.
- Parallel generation to reduce fuel consumption from 30 to 60 percent while significantly reducing maintenance.
- Plug-and-play configuration that requires no specialized training.
- Compliance with MIL-STD-TMS (Department of Defense Tactical Microgrid Standard).
- Construction with electronics that meet risk management framework (RMF) cybersecurity control policies.
- Interoperability with all makes, models, and sizes of military and commercial off-the-shelf (COTS) generators.





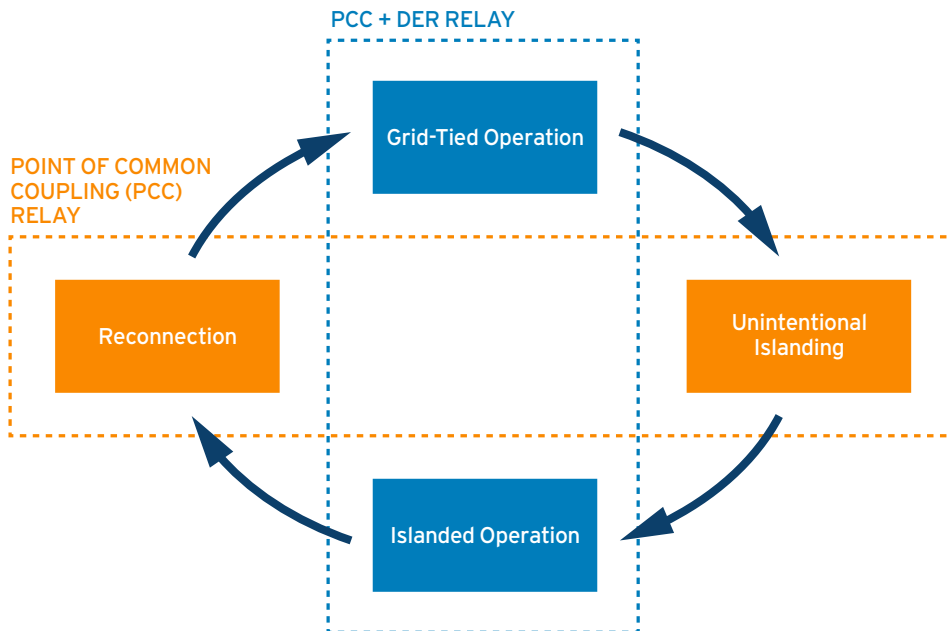
Keeping the Power On

Mobile FOBs require highly available power in expeditionary locations and through adverse events to maintain the effectiveness of operations. SEL microgrid systems ensure reliable power for mission-critical operations by automatically adapting to system conditions. Some of the advanced system capabilities include:

- Parallel generation that reduces fuel consumption from 30 to 60 percent while also mitigating wet stacking and the need for corresponding maintenance.
- Interchangeable parts configured only with dual inline (DIP) switches.
- Zero-setting configuration with publish-subscribe data distribution service (DDS) methods.
- Fully functional MIL-STD-TMS-compliant microgrid system using both COTS and military gen-sets.
- Conversion of Tactical Quiet Generators (TQGs) in 30 minutes to MIL-STD-TMS compliance.
- Interoperation with any proprietary parallel generator load-sharing system (e.g., Advanced Medium Mobile Power Source [AMMPS]).
- Compliance with NERC CIP, RMF, NIST, or other standards as required.
- Collocation of SEL hardware at any photovoltaic, battery, or generator site for full control and monitoring.
- Support for any combination of power system topology (e.g., ring, radial, or ladder).
- Remote monitoring and visualization from a secure embedded and whitelisted real-time automation controller.
- Condition monitoring that shows the health of generators, loads, cables, and distribution points.
- Survival of the power system after the destruction of any generator, cable, or load.
- Automatic topology detection that finds every nested microgrid island and handles all grid configurations (ring or radial bus).
- Products that are designed and manufactured in Pullman, Washington, USA.

Eliminate Single Points of Failure

The POWERMAX control system shares the load between generators and can be located anywhere within the base, allowing you to be more strategic with the base layout. If a generator or communications are lost, the system reroutes power to keep the lights on. If the generation does not meet the load requirements, POWERMAX prioritizes loads and minimizes load shedding to maintain your critical loads.



SEL relay-based microgrid systems provide seamless controls between all host-nation (grid-tied) power and islanded modes of operation.

Save Fuel and Reduce Maintenance

POWERMAX reduces diesel fuel consumption by 30 to 60 percent compared to typical methods. This is achieved through our intelligent, adaptive, real-time state space controls, which can parallel generators of different capacities and manufacturers. The POWERMAX system allows you to unevenly dispatch generators, operating some at higher loads while others rest. This reduces wet stacking and the associated maintenance costs, including time, effort, and damage from overuse, while increasing fuel efficiency and prolonging mission operations.

Expand or Contract Your FOB With Proven Interoperability

All gen-sets have inherent restrictions dictating their interoperability with gen-sets of differing sizes and manufacturers. However, the POWERMAX system doesn't have these restrictions. It has a simple plug-and-play configuration, and it can make gen-sets of any size or manufacturer work together, even when gen-sets are hundreds of meters apart. This interoperability makes the FOB's power grid dynamic; it can expand or contract as needs change, even from day to day.

Furthermore, the POWERMAX system unifies all gen-sets into one grid to share resources more efficiently throughout the base. POWERMAX can also rotate surplus gen-sets into the base's power grid, maximizing their life span.



Military Generator

We can convert TQGs to meet MIL-STD-TMS requirements—in 30 minutes.



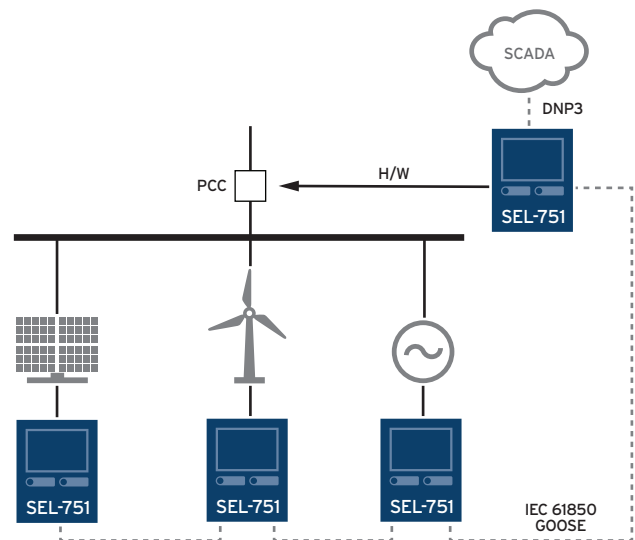
Generic Generator

Predesigned solutions are available for many COTS generators.



Load

Integrate your load and generation with man-portable intelligent power distribution boxes.



SEL relays at every power source provide system reconnection, load shedding, protection, IEEE compliance, power and power factor control, load sharing, dispatch, decoupling, synchronization, and frequency and voltage regulation.

Improve Situational Awareness

Communications, mechanical, and power data are typically displayed on separate screens that operators must scroll through to find. POWERMAX displays all of this information on one screen so operators have instant access to diagnostics. POWERMAX also shows predictive, condition-based maintenance indicators, which alert operators to potentially hazardous situations before they become a hazard. Our microgrid control system allows the operators to dispatch preventative maintenance remotely without affecting the stability of the grid.



Understand gen-set health in a glance with SEL-5078-2 SYNCHROWAVE[®] Central Software's condition-monitoring system.

Proven Technology and Modular Design Ease Deployment

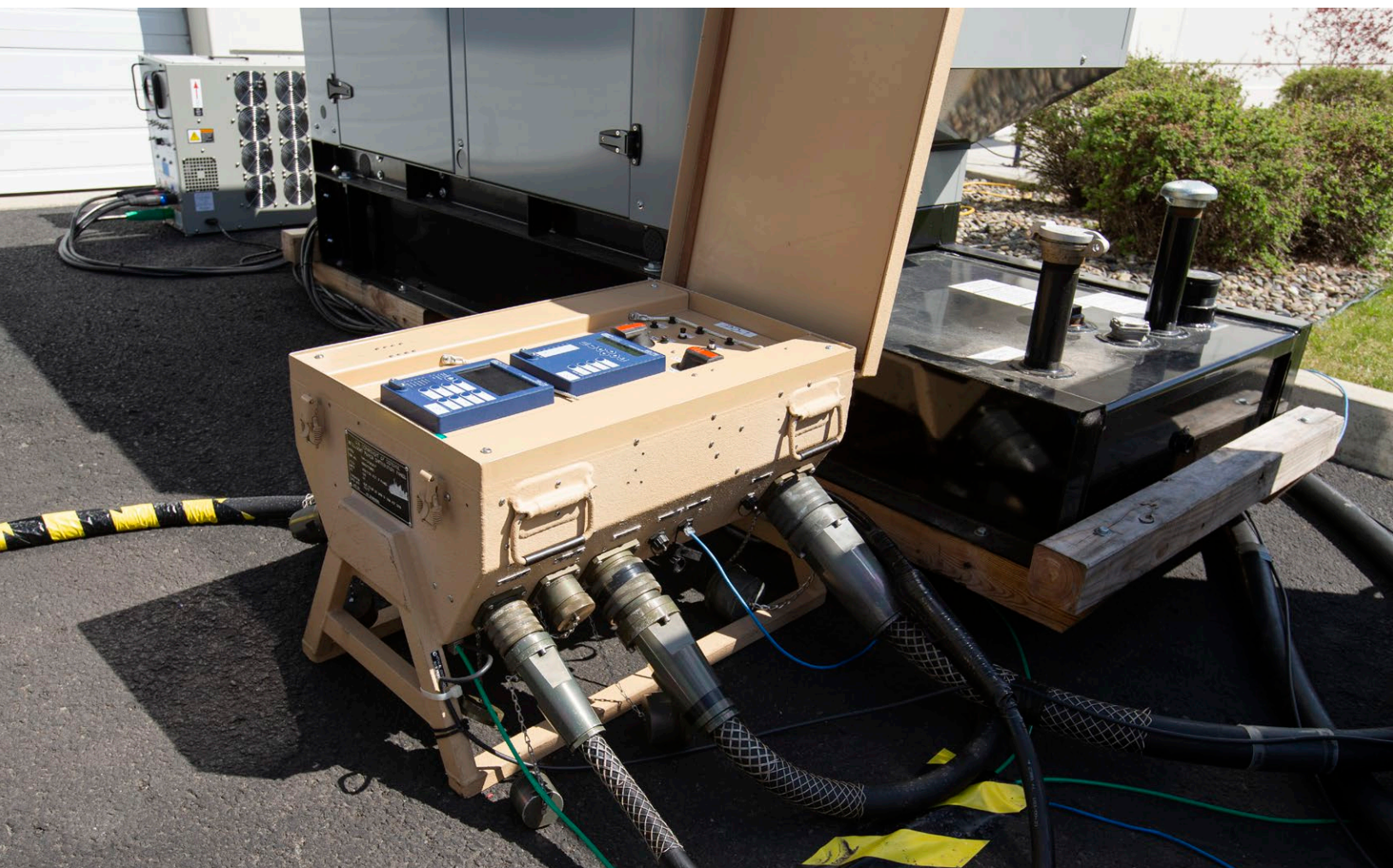
SEL microgrid systems combine dependable and deterministic computing, communications, and protective relays in a modular design to make system deployment straightforward and easy. The system uses SEL technology that has more than ten years of field-proven performance. The result is a highly robust microgrid control system optimized for FOBs that is easy to deploy and easy to use. Benefits of the system include:

Innovative and Proven Technology

- A fast, deterministic microgrid controller makes control decisions to provide stable system operation.
- Load-shedding systems balance the load and generation on the first power swing.
- Governor droop and automatic voltage regulator (AVR) reactive compensation controls maintain transient short-term generator balance.
- Advanced paralleling controls with frequency control and load-sharing maintain long-term load and generation balance.

Ease of Deployment

- SEL microgrid systems are preconfigured and pretested at our factory.
- Personnel without engineering experience can build a microgrid.
- No field configuration is required.
- Small, light, and modular SEL COTS equipment is embedded in generators, inverters, and distribution boxes.
- SEL equipment is environmentally rated for the most severe conditions.
- Identical controller settings at all locations mean there are zero configuration differences between any site or location.
- Use of vendor-neutral DDS communications protocols allows interoperability between vendors.
- The modular design allows you to connect controllers to scale the system from company- to regiment-sized FOBs.



Designed With Robust Cybersecurity

SEL's designs, processes, and culture ensure best-in-class security against human error, malware, or malicious attacks, including advanced nation-state zero-day attacks. Since 1984, we have designed security into our products, ensuring the safe, secure, and reliable operation of the power system. Our engineering teams use proven cybersecurity best practices, system architectures, monitoring methods, and defense-in-depth techniques. SEL systems offer encrypted communications, exe-GUARD® embedded whitelisting technology, and a layered cybersecurity architecture. SEL systems meet NERC CIP, NIST, and RMF compliance requirements.

Root-Cause Analysis

All SEL relays, controllers, gateways, and networking equipment provide time-stamped data collection. These data include Sequence of Events (SOE) records, oscillography, customer reports, or Simple Network Management Protocol (SNMP) alerts. Time-synchronized data collection ensures you get to the root cause of events every time.

Made in the USA

All SEL devices and microgrid systems are designed, tested, and manufactured in the USA. SEL is the preferred protective relay provider for a majority of utilities in the United States and is a recognized leader in the electric power industry. Our commitment to making electric power safer, more reliable, and more economical allows us to provide innovative products and solutions, outstanding customer support, and experienced engineers who are committed to your success.

Industry-Leading Support and Quality

Simplify your maintenance with guaranteed support from SEL experts and 24/7 availability. We provide personalized, regional technical support from more than 75 regional technical service centers worldwide. Our commitment to quality extends through a product's installation and life cycle as part of your critical infrastructure. The SEL ten-year, no-questions-asked, worldwide product warranty is proof of our confidence in the quality of products we manufacture. In our company's history, we have never charged to replace or repair a product.

SEL SCHWEITZER ENGINEERING LABORATORIES

SEL Engineering Services
+1.509.332.1890 | esinfo@selinc.com | selinc.com/solutions/microgrids-fob

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