RSS Products for Three-Phase 208V Commercial Applications

Flexible, Scalable, and Safe Solar+Storage Solutions for Three-Phase Systems

solaredge

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Executive Summary

SolarEdge's innovative solutions leverage single-phase inverters to deliver exceptional scalability and efficiency for three-phase, 208VAC projects. This application note explores the integration of our Residential Storage System (RSS) components—including inverters, batteries, and Power Optimizers—into three-phase, 208VAC configurations commonly found in demanding commercial applications.

These SolarEdge products are fully certified to the latest standards, including UL 1741 SB, UL 9540, and NEC requirements. The RSS offers enhanced safety, reliability, and seamless grid compatibility. Its modular design provides unparalleled flexibility, allowing precise tailoring of energy capacity and easy future scalability. Furthermore, designated RSS products are proudly U.S.-manufactured, enabling customers to work towards qualifying for the Domestic Content bonus tax credit (as currently guided by IRS Notice 2024-41 or 2025-08)* while achieving superior performance and compliance.

Ideal applications include: Multi-Dwelling Units (MDU) and small to medium commercial projects.

The System

Our RSS product line enables the simplified implementation of robust three-phase applications. The RSS has 4 main building blocks: the inverter, the Power Optimizers, the batteries, and the metering. As with any project, streamlined design and successful commissioning phases are more likely when stakeholders adhere to certain parameters, which we will cover in this application note.

* SolarEdge does not provide tax and/or legal advice. The forward-looking statements herein are accurate as of the date herein and are subject to change. You should consult with your own legal and/or tax advisor(s) regarding the eligibility of your project for the ITC or PTC, including the 10% Domestic Content bonus, to determine how the applicable rules apply to your project. Eligibility is subject to the installation of qualified USA-Manufactured inverters and Power Optimizers in the same project. For more information, please contact your local SolarEdge sales representative.

Why Use Residential Products for Commercial Applications?

The SolarEdge residential product line offers a proven, comprehensive portfolio of products.

There are many reasons to use residential products for commercial applications:

- SolarEdge residential products include design features that accommodate a wide range of project types
- Because they're designed to be mounted and affixed to people's homes, all SolarEdge residential products must be certified and compliant with the latest safety standards and codes to ensure safe, reliable operation
- SolarEdge's inverters and Power Optimizers are designed from the ground up to prioritize safety and optimization

Modularity and flexibility are essential for any product portfolio intended to meet the needs of light commercial applications and systems.

Commercial projects include many installation types and factors, including AC voltage interconnection, roof size limitations, varied mounting locations, export restrictions, and many more. Commercial project capacities can also range from 10kW to over 1MW of power, highlighting the value of a wide-ranging portfolio.

SolarEdge Home Hub inverters offer AC power ranging from 3.3kW to 10kW (at 208VAC). Each Home Hub inverter can accommodate up to three SolarEdge Home batteries, offering designers, installers, and stakeholders enhanced project flexibility and future expandability.

Residential products are easy to install and mount to a wall or a standalone frame, conserving real estate for space-constrained projects.

Many energy products currently available on the market require dedicated space for a skid-mounted energy storage system (ESS). These products often need a parking space or green area, which may pose a challenge to compliance with building codes that mandate a minimum allocation of parking spaces for a given size and building type. Residential products make efficient use of space to help system designers satisfy both compliance requirements and system size goals.

Below is an example single-line diagram (SLD) of a three-phase, 208VAC project utilizing RSS products. Let's go through each building block and explore the parameters for each.

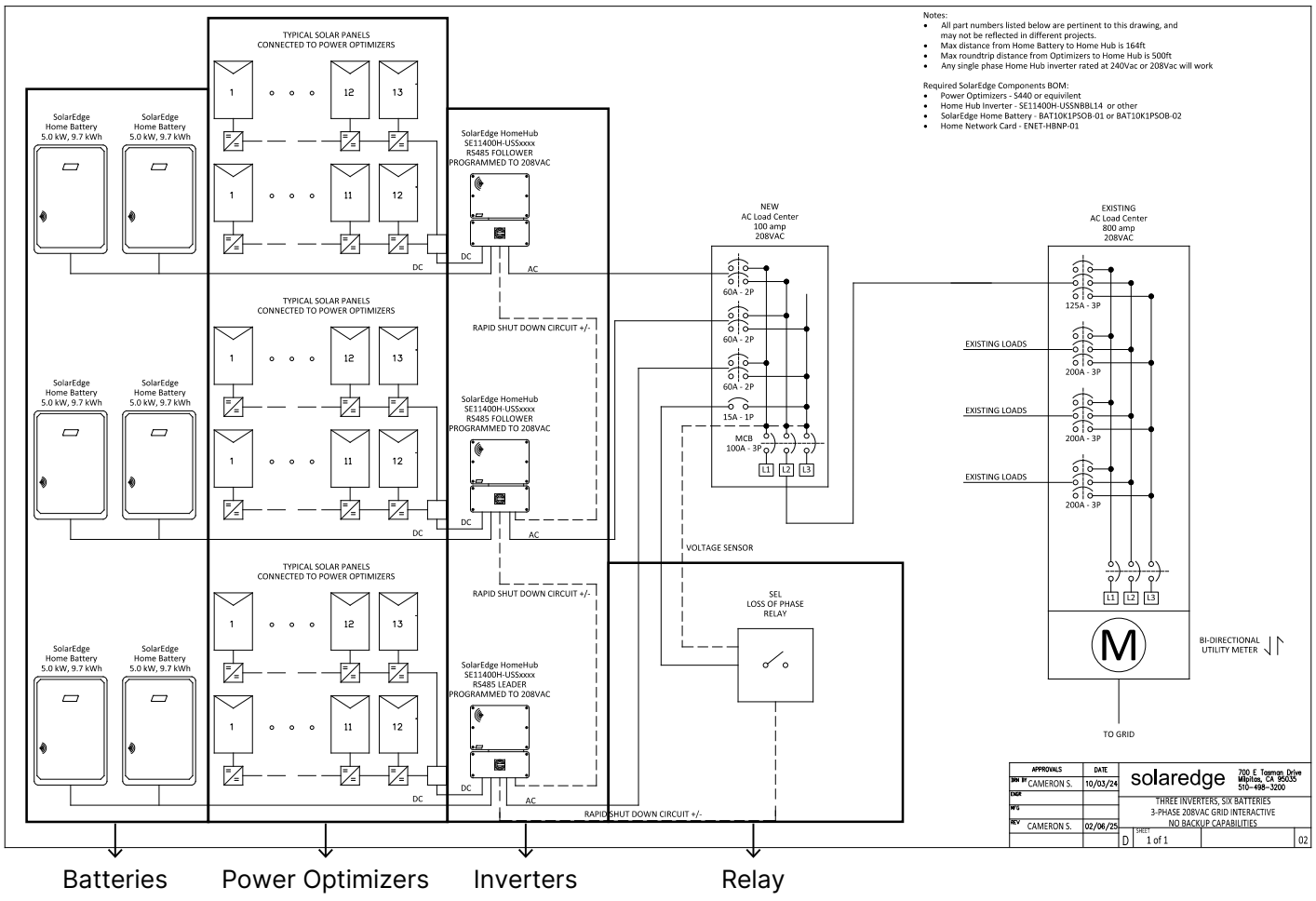

Figure 1. Example Single-line Diagram of a Three-Phase 208VAC Project Using RSS Products

SolarEdge Home Hub Inverter

The SolarEdge Home Hub Inverter is a single-phase, outdoor-rated, residential photovoltaic inverter designed specifically for use with SolarEdge's Power Optimizer.

U.S.-manufactured inverters have a "U" in front of the product number (i.e. USE11400H-US).

The Home Hub Inverter main features include:

- Record-breaking 99% weighted efficiency with up to 200% DC oversizing
- Module-level monitoring and visibility of battery status, PV production, and self-consumption data
- Fast, easy installation and reduced commissioning time facilitated by a compact, lightweight unit design
- Advanced safety features with integrated arc fault protection and rapid shutdown for NEC 690.11 and NEC 690.12

Figure 2. Home Hub Inverter

- Advanced reliability through the use of automotive-grade components
- Embedded revenue-grade production data per ANSI C12.20 Class 0.5
- NEMA 4X-rated for indoor and outdoor installations
- Embedded Power Control System (PCS) that allows the installation of larger systems while avoiding main panel upgrades
- A scalable solution that supports future customer needs through easy connection to a growing ecosystem of products

Home Hub Inverters are available in three power classes ranging from 3.3kW to 10kW (AC power at 208VAC). This broad range maximizes design flexibility when planning systems around arrays that may have strings of different lengths. Note that Home Hub Inverters in power classes 7.6kW and 10kW are currently not certified for 208VAC operation.

SolarEdge's SetApp mobile app allows the streamlined configuration of an inverter for 208VAC operation. For more information on the technical specifications and how to install and commission a Home Hub Inverter, please visit:
https://www.solaredge.com/us/products/residential/pv-inverters/solaredge-home-hub-inverters

SolarEdge Power Optimizers

The Power Optimizer serves as the central component in systems built around the SolarEdge residential product portfolio. It performs local maximum power point tracking (MPPT) via software-controlled DC/DC conversion on a PV module level, allowing the system to operate as efficiently as possible, especially during events like shading and module-mismatch.

The Power Optimizer also manages many of the system's crucial safety functions, allowing the array to operate reliably without compromising safety.

Figure 3. U.S.-Manufactured Power Optimizer

U.S.-manufactured Power Optimizers have a "U" in front of the product number (i.e. U650). Let's look at some of the Power Optimizer's key features:

- Specifically designed to work with SolarEdge residential inverters
- Detects abnormal PV connector behavior, preventing potential safety issues
- Module-level voltage shutdown ensures installer and firefighter safety
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch loss, from manufacturing tolerance to partial shading
- Faster installations with simplified wire management and easy assembly using a single bolt
- Flexible system design for maximum space utilization
- Compatible with bifacial PV modules
- Meets NEC requirements governing arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)

For more information on the technical specifications and how to install and commission SolarEdge Power Optimizers, please visit:
https://www.solaredge.com/us/products/residential/power-optimizers

SolarEdge Home Battery

Figure 4. SolarEdge Home Battery

SolarEdge Home Battery is a DC-coupled battery system designed with maximum installer flexibility in mind. Up to three Home Batteries can be connected to a single Home Hub Inverter, designed for 29.1kWh of usable energy per inverter.

The SolarEdge Home Battery 400V is outdoor rated and supports mounting to a wall or framed structure. It's also tested per UL 9540A unit-level test methods, permitting convenient indoor installation.

Please note that backup applications are not available for three-phase installations. U.S.-manufactured Home Batteries have a "U" in front of the product number (i.e. UBAT-10K1PS0B-03).

U.S.-manufactured Power Optimizers have a "U" in front of the product number (i.e. U650). Let's look at some of the Power Optimizer's key features:

- DC-coupled battery featuring outstanding overall system efficiency, generating more energy to store and use
- Integrates seamlessly with the complete SolarEdge Home ecosystem using SolarEdge Home Network, streamlining logistics and operations by offering a single source for warranty, support, and training
- Incorporates multiple battery-protection safety features, including Rapid Shutdown and SafeDC™
- Qualified per the latest and most stringent UL fire safety standards
- Simple plug-and-play installation with automatic configuration using the convenient SetApp mobile app
- Flexible indoor or outdoor installation via wall or floor mount, also allowing for AC coupling
- Wireless mesh communication with the inverter reduces wiring, labor, and installation

For more information on the technical specifications and how to install and commission a SolarEdge Home Battery, please visit:
https://www.solaredge.com/us/products/residential/storage-and-backup/solaredge-home-battery

System Controls

The SolarEdge system is capable of performing two main control functions for utilizing DC-coupled storage: Time-scheduled dispatch for Time-of-Use (ToU), and Self-consumption.

Time-Scheduled Dispatch* Feature for Peak Shaving
It can be an advantage for utility costs to discharge the battery during preset times to coincide with peak and super-peak rates in a Time-of-Use (ToU) utility tariff scheme.

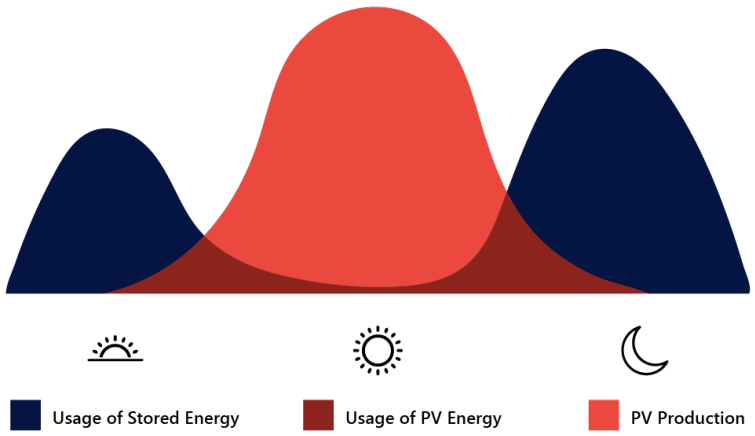

Figure 5. Time-of-Use Graph

For more information on Time-of-Use functionality, please visit:

https://marketing.solaredge.com/tou-mode

*Time-of-Use feature is a beta version which is still undergoing final testing before its official release, is not yet available for all users and is offered on a pilot basis for select system owners. SolarEdge makes no warranties whether expressed or implied as to the suitability or usability of the feature and will not be liable for any loss suffered by any party as a result of the use of the feature or its content.

Self-Consumption

Self-consumption in residential solar PV systems involves using solar energy to power household loads while storing surplus energy in a battery for later use. The system utilizes the built-in energy management system from SolarEdge to manage energy flow. The inverter optimizes battery charging and discharging based on real-time load demand, battery state-of-charge (SOC), and grid parameters.

The picture below shows what self-consumption looks like in a real operating system.

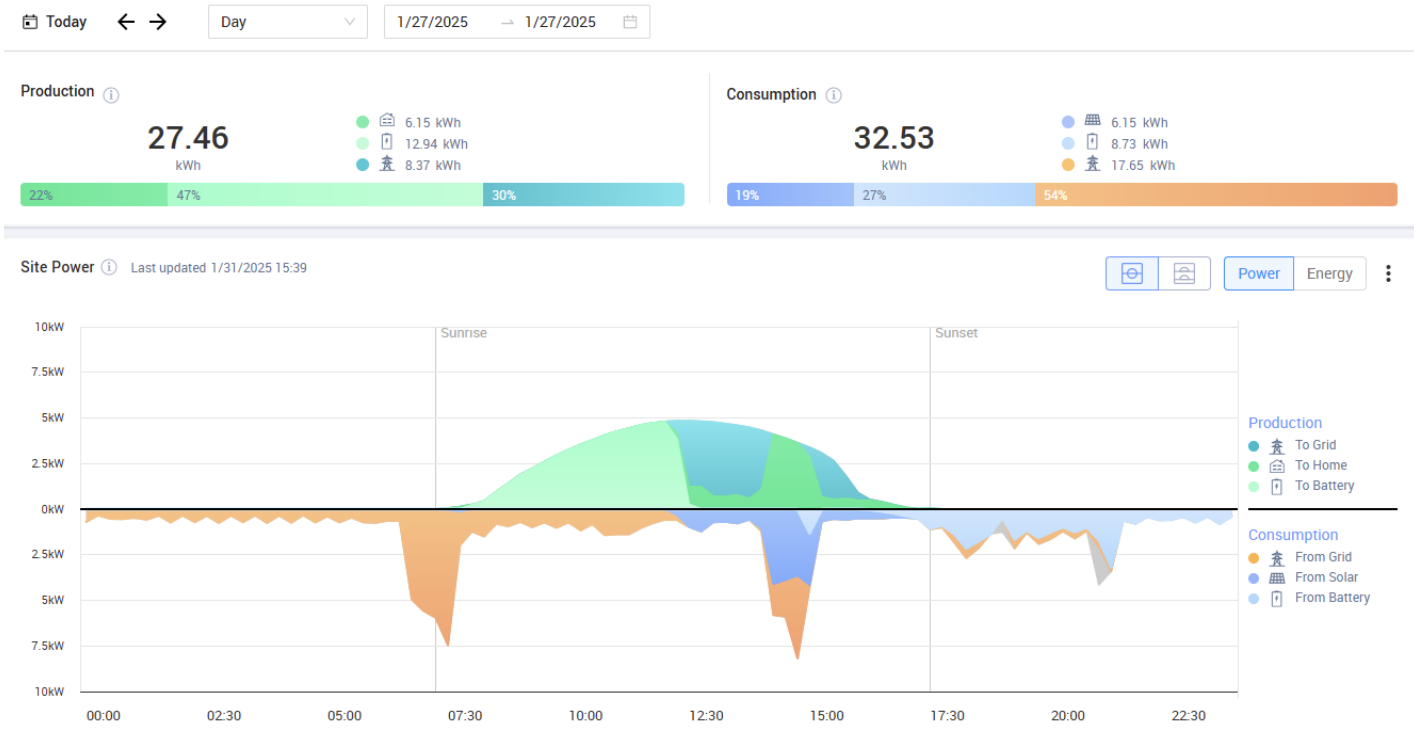

Figure 6. Self-Consumption Monitoring Visual from Built-in Management Software

System Design Parameters

Let's look at the design parameters for connecting single-phase inverters in a three-phase application.

Power Optimizers

There are no additional constraints, so you can use normal, standard design practices when utilizing the single-phase inverter with a Power Optimizer. Keep in mind that you must design the system using 600VDC stringing conventions, just as you would for residential-type projects.

For more information on designing a system with SolarEdge Power Optimizers, visit https://www.solaredge.com/us/products/residential/power-optimizers

Inverters

Home Hub Inverters present very few usage constraints.

Inverter chaining: You can use up to 32 inverters per phase for a total of 96 inverters per three-phase system and up to 960kW of AC power at 208VAC. **Please note that each inverter must be on its own, separate DC bus from other inverters.**

Monitoring and RS485: When connecting multiple native three-phase SolarEdge inverters to the same AC bus, do not connect the inverters to each other per RS485. Single-phase inverters must be monitored independently from the native three-phase units.

If using a mix of single-phase inverters with native three-phase inverters, do not connect their MODBUS RTU/RS485 ports together. Single- and three-phase inverters have different firmware versions and therefore cannot communicate with each other. Each inverter should have a dedicated cellular modem installed, precluding the need for MODBUS RTU chaining.

Each inverter should be connected to two phases: L1-L2, L2-L3, or L3-L1. Make connections via 2-pole circuit breakers in either the main load panel or sub-panel. No neutral connection is needed, and the inverter should be programmed to 208V.

AC coupling: It is possible to AC couple using the Home Hub Inverter and connected batteries without any connected PV. This can be useful for installations where it would be impractical to DC couple the batteries.

Make sure to enable grid charging when commissioning AC-coupled Home Hub Inverters. A three-phase meter must be installed to ensure the system does not export energy to the grid.

For more information on designing with the Home Hub Inverter, please visit: https://www.solaredge.com/us/products/residential/pv-inverters/solaredge-home-hub-inverters

Batteries

Each Home Hub Inverter can support up to three connected SolarEdge Home batteries. At 9.7kWh of usable capacity per battery, this equates to up to 2,793.6kWh of usable energy capacity per Home Hub Inverter cluster, assuming 96 inverters are installed.

Backup is not supported when using single-phase inverters in a 208VAC configuration because the loads are connected at 120VAC phase to neutral, whereas the inverters are connected phase to phase.

Metering

You must install a three-phase meter if you need the system to perform anything other than a pre-scheduled simple TOU discharge application. This meter must have:

- Three (3) CTs (Current Transformers), one for each phase conductor in the main panel
- Voltage-sense leads for each phase via a three-pole circuit breaker in the main panel
- A hardwired RS485 cable connection directly to the Home Hub Inverter

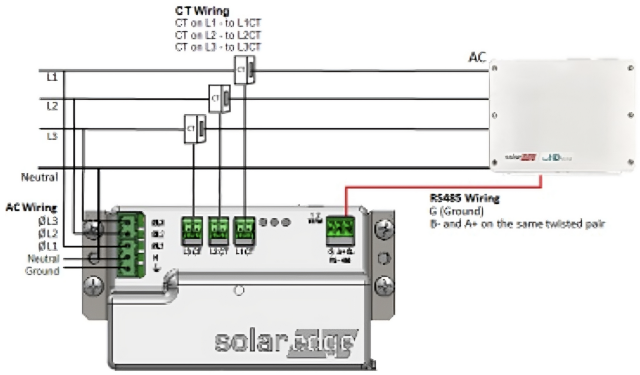

Figure 7. Multi-Line Diagram of Meter Connection with Inverter

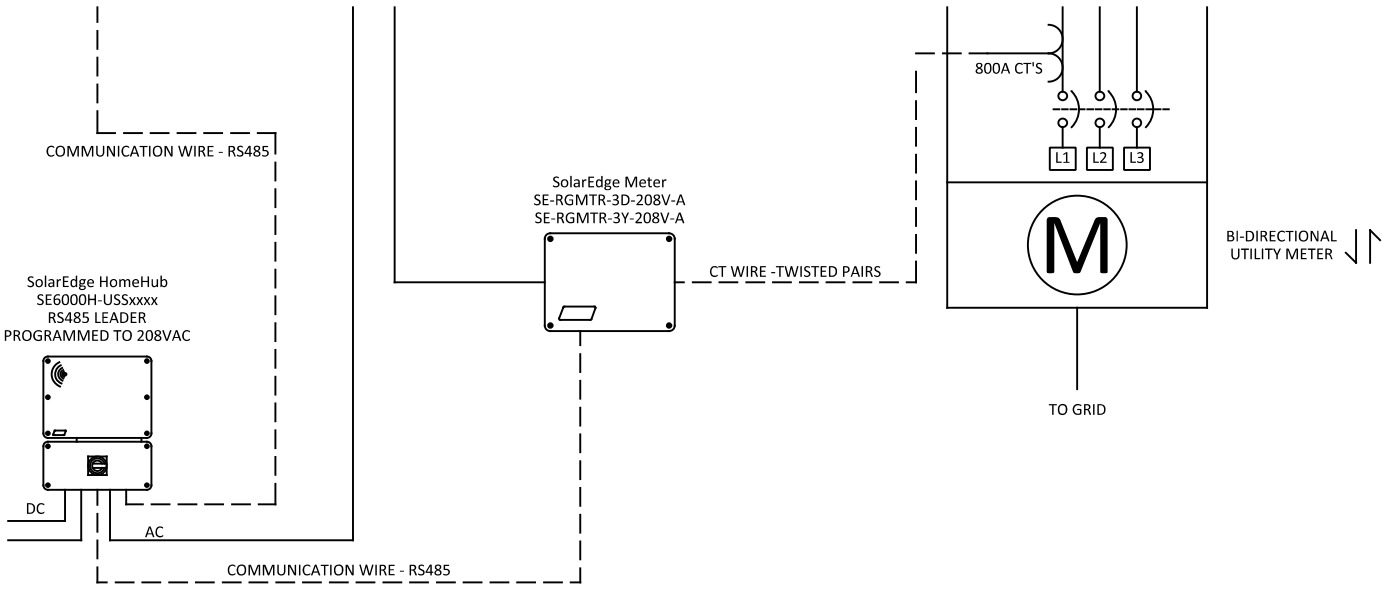

Figure 8. Example System Single-Line Diagram of Meter Connection

Interconnection-Ready Phase-Loss Detection Relay

The last main building block of a SolarEdge system is the metering and controls.

When utilizing single-phase inverters in a three-phase application it's important to note that phase loss detection may need to be added to comply with some utility interconnections.

SolarEdge single-phase inverters will detect losses of the phases they are connected to and are designed to properly disconnect in such cases. However, an external controller or "feeder relay" may still be required to trigger, via its dry-contact output, the rapid shutdown circuits of the other inverters, thus safely shutting down the entire system.

Once the grid fault clears, the feeder relay will re-engage the rapid shutdown circuit via the dry-contact signal. Then, the inverters will resynchronize to the grid and begin normal operation again. Typical relays recommended are the SEL-751 (left) or SEL-849 (right, programmed as a feeder relay)

Figures 9 and 10. Typical recommended relays are the SEL-751 (left) or SEL-849 (right, programmed as a feeder relay).

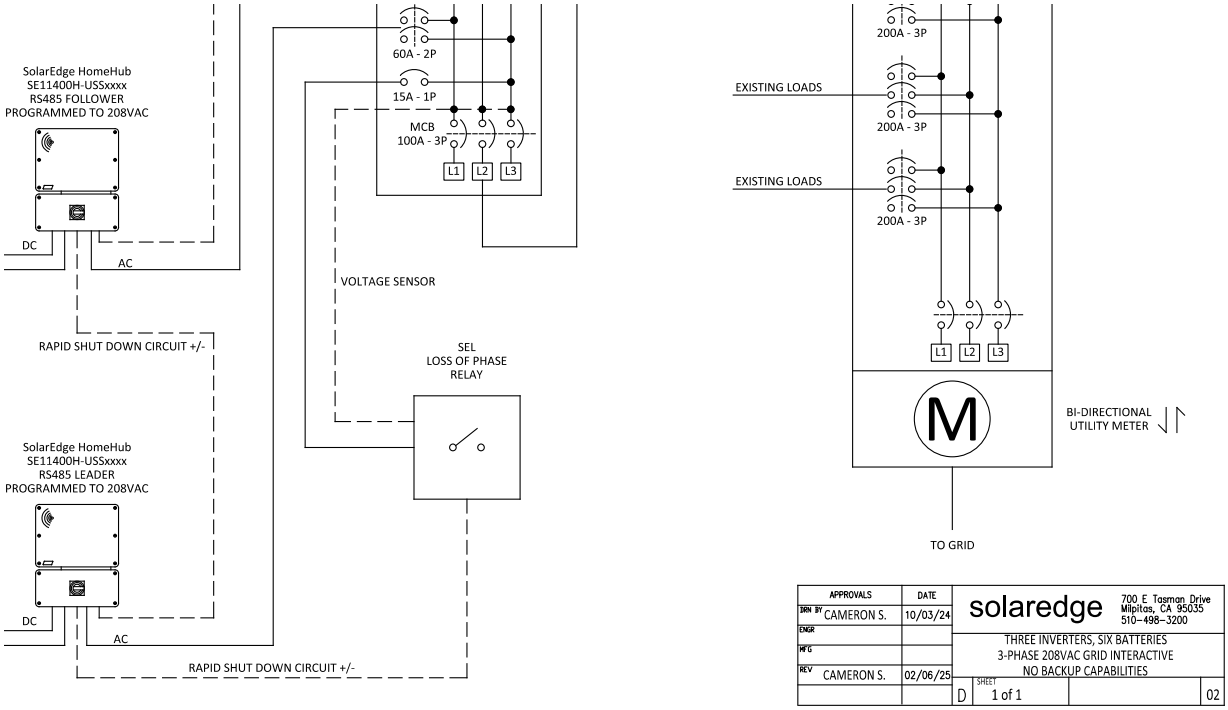

Figure 11. Example System Single-Line Diagram Showing Feeder Relay Connection

The external feeder relay has three main connection points: a power connection, a voltage sense connection, and a rapid-shutdown circuit connection. The voltage sense port measures for a loss of phase, and the rapid shutdown circuit connection point opens the normally closed signal as needed.

You must mount relays in an environmentally appropriate enclosure.

Conclusion

The SolarEdge residential product line offers a proven, comprehensive portfolio of products. This line provides the modularity and flexibility that are essential for light commercial applications and systems, and are easy to install on a wall or a standalone frame, conserving space for projects where it's at a premium. Our RSS components can be integrated—including inverters, batteries, and Power Optimizers—into three-phase, 208VAC configurations commonly found in demanding commercial applications.

These SolarEdge products are fully certified to the latest standards, including UL 1741 SB, UL 9540, and NEC requirements. The RSS offers enhanced safety, reliability, and seamless grid compatibility. Its modular design provides unparalleled flexibility, allowing precise tailoring of energy capacity and easy future scalability. Furthermore, designated RSS products are proudly manufactured in our U.S. facilities, enabling customers to work towards qualifying for the Domestic Content bonus tax credit (as currently guided by IRS Notice 2024-41 or 2025-08)* while achieving superior performance and compliance.

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