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FranklinWH Generator Solution

Integrated Smart Power Supply Solution with Generator and Energy Storage

Contents

Challenges

As natural disasters become more frequent throughout the world, the reliability of household power supply has come under increasing threat. Power outages can severely disrupt daily life, and many households have turned to generators as an emergency backup power solution. However, traditional generator systems come with a series of drawbacks that limit their overall effectiveness:

- **Interruption during Switch-over from Grid to Generator:** The delay during the switch from grid power to generator causes a brief power outage, which can disrupt household appliances and devices, negatively affecting the homeowner experience.
- **Inefficient Operation:** Generators often do not run at their optimal efficiency point, resulting in higher fuel consumption and reduced fuel economy, leading to unnecessary operational costs.
- **Noise Pollution:** Generators are typically noisy during operation, which can disturb homeowners, especially during nighttime or rest periods.
- **Frequent Maintenance:** Generators require routine maintenance, usually every 1-2 weeks of engine runtime, involving oil changes and system inspections. This process can be both inconvenient and time-consuming for homeowners.
- **Fuel Supply:** During prolonged outages, access to fossil fuels can become difficult and the price can skyrocket. Integrating generators with a robust energy management system can extend generator life and lower costs during these critical times.

To overcome these challenges, FranklinWH introduces an advanced integrated smart power supply solution that seamlessly combines a generator with energy storage and management. This system ensures a stable, efficient, and high-quality power supply while promoting energy independence. At its core, the aGate acts as the microgrid interconnect device, enabling smooth and efficient coordination of energy flows between the generator, battery storage, and the grid. This cutting-edge approach optimizes power distribution, providing homeowners with reliable, autonomous energy management for an enhanced experience.

Why Use a Generator When You Already Have a Battery?

While most renewable energy systems (such as solar PV paired with energy storage systems, or PV+ESS) are optimized for efficiency and cost in grid-connected scenarios, integrating a fuel generator adds a valuable layer of resilience. In ideal conditions, PV+ESS can provide both utility cost savings and backup power. However, during severe weather events or extended outages—when solar production is low—a fuel generator can provide essential auxiliary support. This eliminates the need for an oversized, more expensive battery system while ensuring continued power availability.

Overview of the Generator Solution

FranklinWH's integrated solution combines advanced generator technology with energy storage and intelligent energy management. The aGate utilizes an Energy Management System (EMS) to oversee battery storage and provide automatic start and stop control for a standby generator. This innovative approach optimizes the traditional generator setup, enhancing its efficiency, reliability, and environmental sustainability.

Key Features

- **Seamless Switching:** The system ensures that there is no interruption when switching between grid power, battery backup, and the generator. This seamless transition ensures a stable power supply without noticeable disruptions, even during power outages.

- **Smart Energy Management:** The system uses intelligent energy scheduling to determine the optimal time for the generator to operate, ensuring it runs at its most efficient point. The battery dynamically matches the load and adjusts the charging power, ensuring that the combined load and battery charging power align with the generator's optimal operating point, which can be set in the FranklinWH App as the “run duty.” This not only reduces fuel consumption but also improves fuel economy by preventing unnecessary generator runtime.

- **Customizable Generator Runtime:** Homeowners have the flexibility to schedule the times when the generator will run, allowing them to avoid any noise disturbance during the night or when they are resting. Through the FranklinWH App, they can set upper and lower battery state-of-charge (SOC) levels to control when the generator starts and stops. This customization enhances the overall convenience and comfort of using a backup power system.

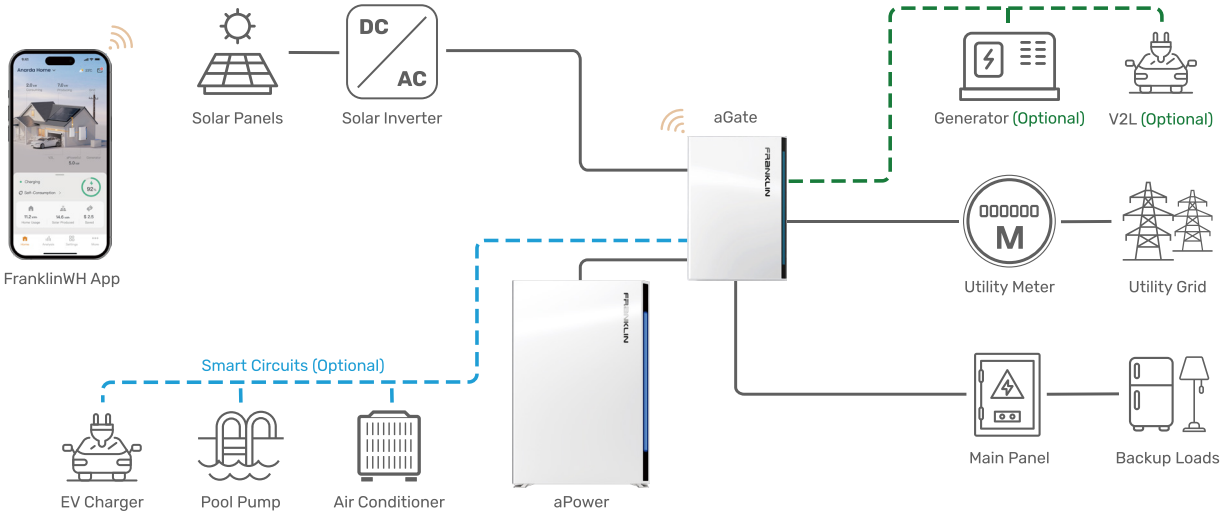
- **Automatic Exercise Mode:** The generator is automatically cycled on and off according to a preset schedule, typically every 1-2 weeks, without requiring manual intervention. This exercise mode ensures the generator is kept in good working condition while extending its lifespan.

- **Smart Pre-Heating and Cooling:** The system includes automatic pre-heating and cooling mechanisms to manage the generator before and after use. This feature not only improves the generator’s operational efficiency but also helps reduce wear and tear, ultimately prolonging the life of the generator.

Solution Introduction

System Composition

FranklinWH's solution utilizes an open EMS that integrates multiple energy sources, including electric vehicles (EVs), generators, energy storage, and photovoltaics (PV), into a unified management framework. This approach enables reliable, continuous power backup for the entire household and optimizes the use of various energy sources.



The system uses advanced control technology to coordinate the operation of each energy source, ensuring that the overall power supply remains both stable and efficient. The flexibility of the system allows homeowners to incorporate multiple energy sources to meet their specific needs, whether it be through the generator, energy storage, or solar power.

Grounding and GFCI Requirements

It is important to note that EVPE (Electric Vehicle Power Export Equipment) is the equipment, including the outlet on the vehicle, that is used solely to provide electrical power to loads external to the vehicle, using the vehicle as the source of supply. This is contrasted with EVSE (Electric Vehicle Supply Equipment) which is used for the charging of the EV.

As mobile generators and V2L (EVPE) use cases are considered non-fixed source inputs to the FranklinWH System Generator Module, the requirements for direct grounding electrode connections are unique to them and are specifically outlined in NFPA 70 (the NEC).

See 2023 NFPA 70 Article 625 “Electric Vehicle Power Transfer System.” EVs equipped with a receptacle(s) for the purposes of exporting power to supply utilization equipment must follow similar safety requirements as required by the NEC for other sources, such as portable generators.

Regarding the specifics of an EVPE outlet as mentioned above and used in accordance with Article 625.60 “AC Receptacle Outlets Used for EVPE,” and Article 250 for “Grounding and Bonding,” the details of Article 250.34 “System Grounding for Portable, Vehicle-Mounted, and Trailer-Mounted Generators” apply directly. The frame of a vehicle shall not be required to be connected to a grounding electrode (Article 250.52), as defined for a system supplied by a generator located on the vehicle under the conditions as mentioned in Article 250.34(B), and as shown in the FranklinWH Installation Guide.

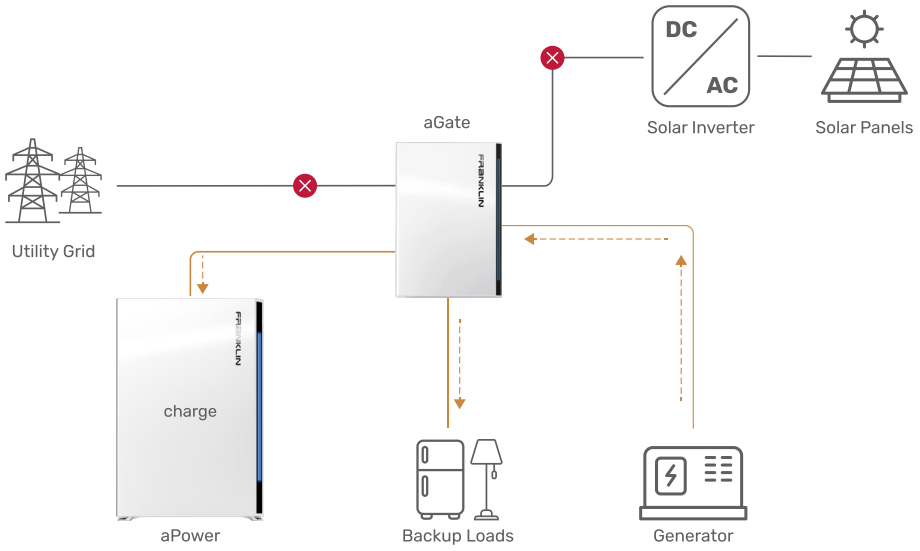
To provide for GFCI requirements under Article 625.60(D), “various methods” can be used (e.g. the EVPE certified/integrated circuit protection, trip indicator, and reset control button). For more information on GFCI components and considerations, please contact the EV manufacturer. Please see the FranklinWH installation manual for all wiring details.

Generator Operating Modes

Off-Grid Generator Integration with FranklinWH System

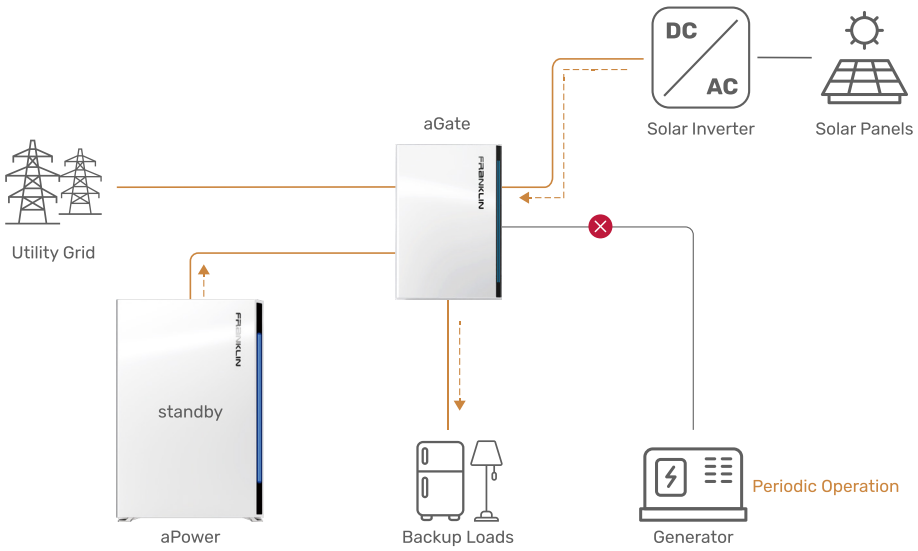
During an outage or in off-grid systems, if the batteries reach a low state of charge and there’s no available PV generation, the generator can automatically be brought online based on the battery’s low state of charge. Once online, the generator will prioritize powering the home’s loads first and any remaining capacity will then be used to charge the batteries. To prioritize battery charging, home loads should be minimized. Once the batteries reach the designated state of charge, the generator will shut off, and the aPower system along with PV, if available, will resume powering the home. This mode is ideal for situations where the load is large, and the generator can operate at its optimal fuel efficiency without the need for additional energy sources.

In certain scenarios, integrating a generator into off-grid systems is recommended, as it provides an additional layer of redundancy when PV is unavailable and enhances the overall reliability of the microgrid.



Generator Exercise Mode (Self-Consumption Example)

In this mode, the generator is scheduled to run at regular intervals, typically every 1-2 weeks. This exercise mode ensures that the generator remains in good working condition, regardless of whether the system is on-grid or off-grid. It also helps to reduce the likelihood of malfunctions during emergencies by keeping the generator operational.



Supported Generator Types & Connection Methods

When choosing a generator solution for the FranklinWH System, there are several options to consider, each providing different levels of automation and control to suit a variety of power needs.

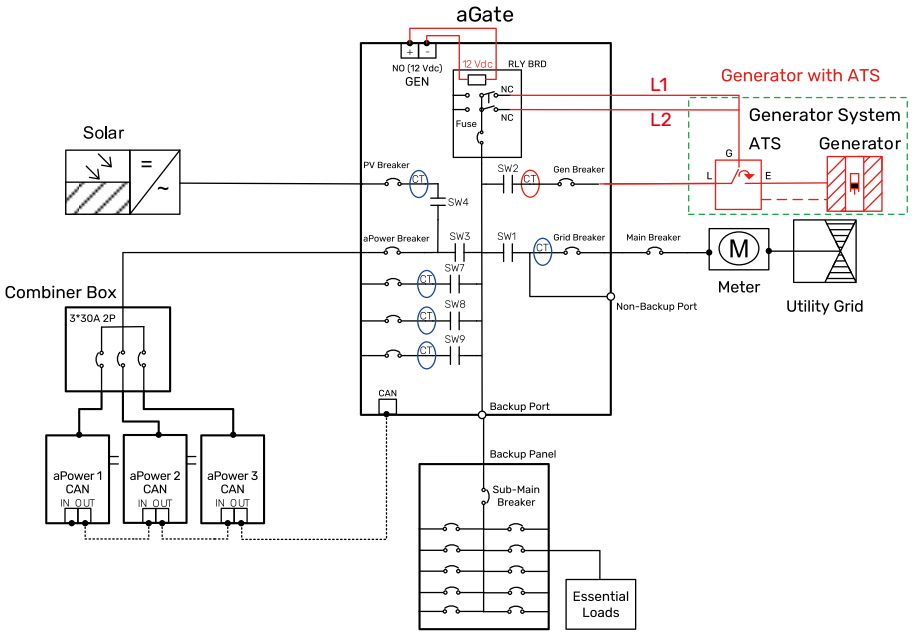
- **ATS (Automatic Transfer Switch)** offers full automation for seamless power transfer between grid and generator supply, ensuring uninterrupted power.
- **Voltage Sensing** provides real-time monitoring of voltage levels, automatically starting and stopping the generator to maintain stability.
- **Two-Wire Dry Contact**, the preferred option, uses dry contact signals to enable simple, reliable automatic control of two-wire generators, while also ensuring the generator's battery remains charged.
- **Portable Generators** provide flexibility but require manual operation for starting and managing power.

The selection of the appropriate generator solution depends on the specific requirements of the homeowner, whether the priority is seamless automation, straightforward connections, or flexibility. The following sections provide an overview of each control option to assist in identifying the most suitable choice for a given application.

Homeowners can also consider cleaner portable generator alternatives, such as lithium-based portable power stations. These can be integrated to our solution as long as they are 240 V, 60 Hz and sized appropriately based on the number of FranklinWH batteries installed.

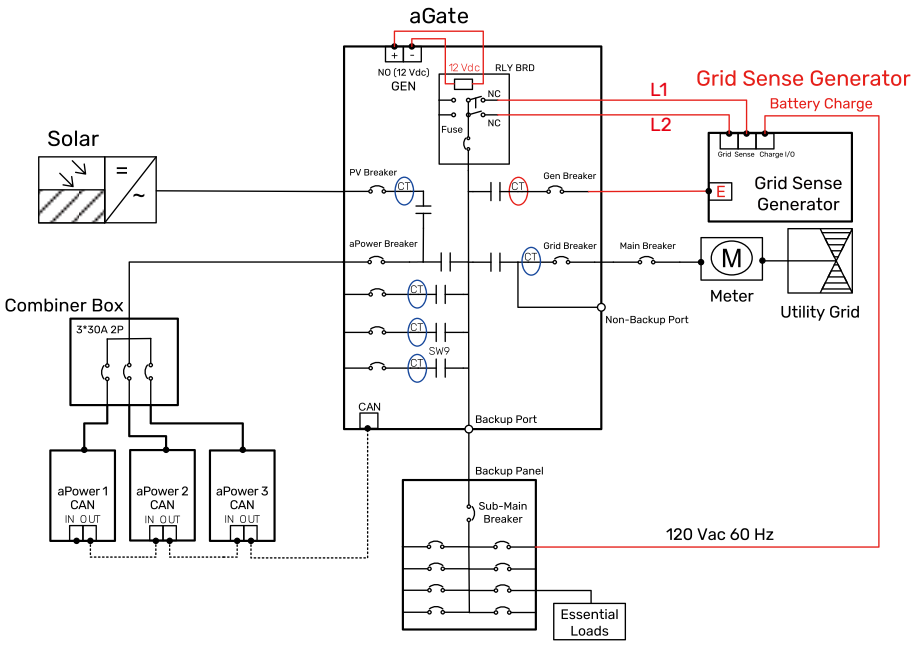
ATS (Automatic Transfer Switch) Control

The FranklinWH System can automatically control the generator using the backup power bus's AC voltage, allowing for automatic switching between grid power and generator supply. This seamless switching ensures uninterrupted power supply.



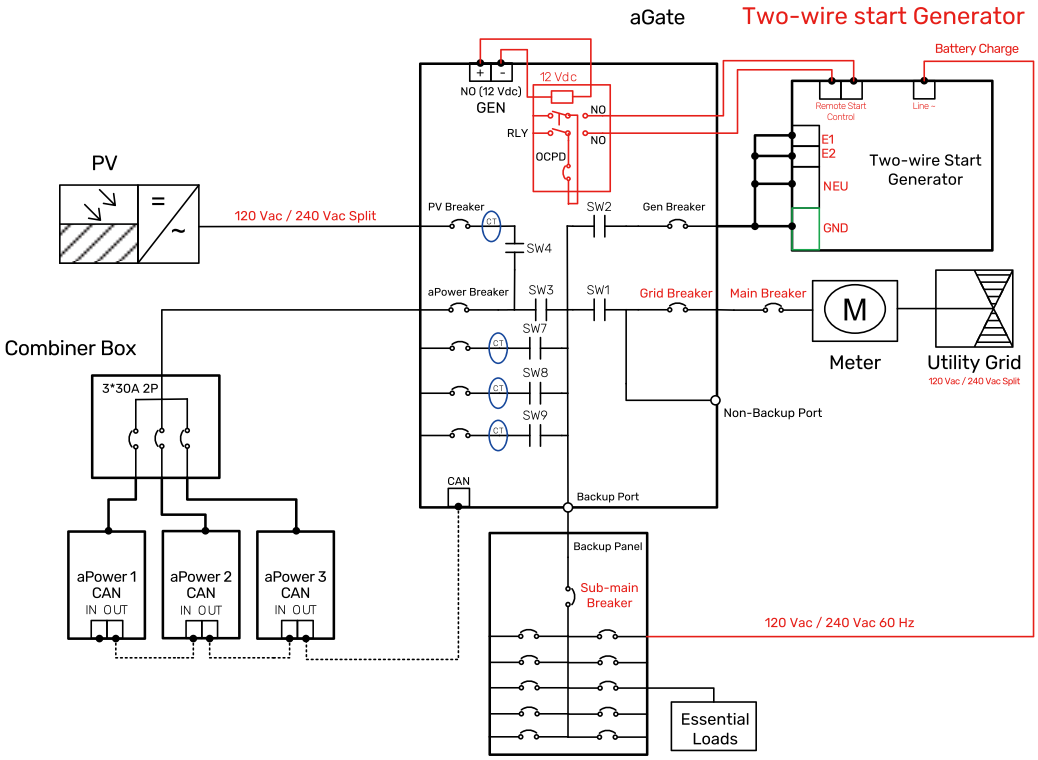
Voltage Sensing Control

The system connects to the generator's voltage sensing interface to monitor voltage levels and automatically start and stop the generator as needed. Additionally, a charging interface ensures the generator's battery remains charged for optimal operation.



Two-Wire Control

The system uses dry contact signals to connect to two-wire generators, allowing for automatic control of the generator. The system also includes a charging interface to prevent the battery from being depleted.

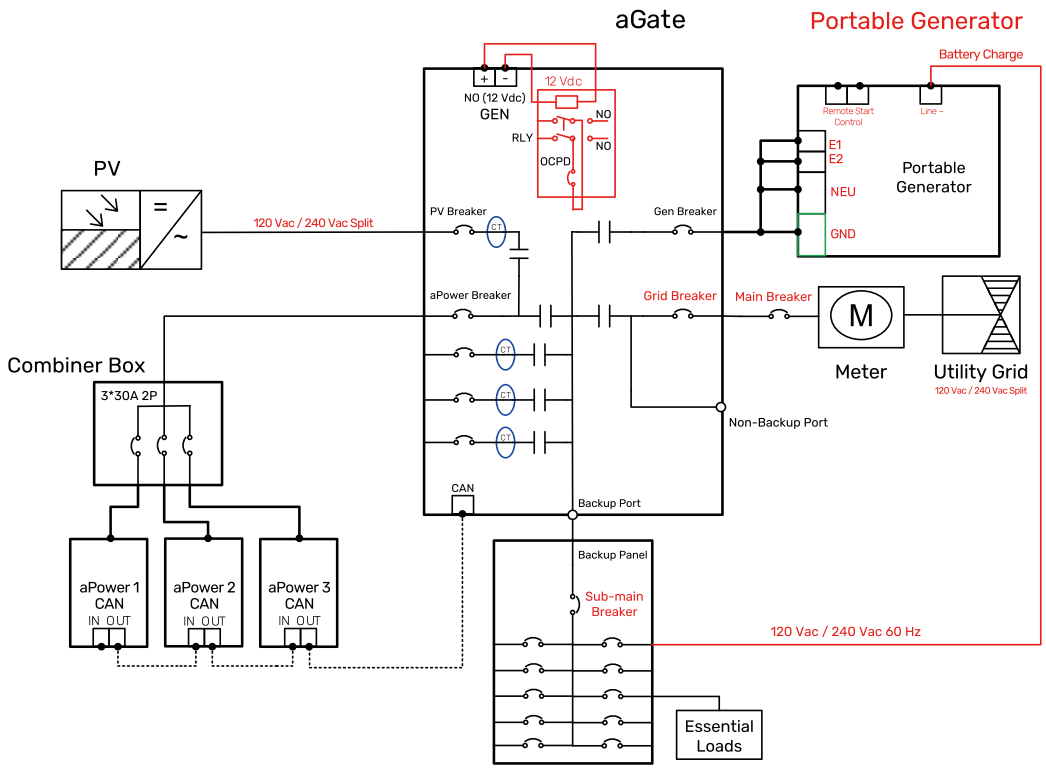


DO/DO port on the Generator Module

Utility voltage port on the Generator Module

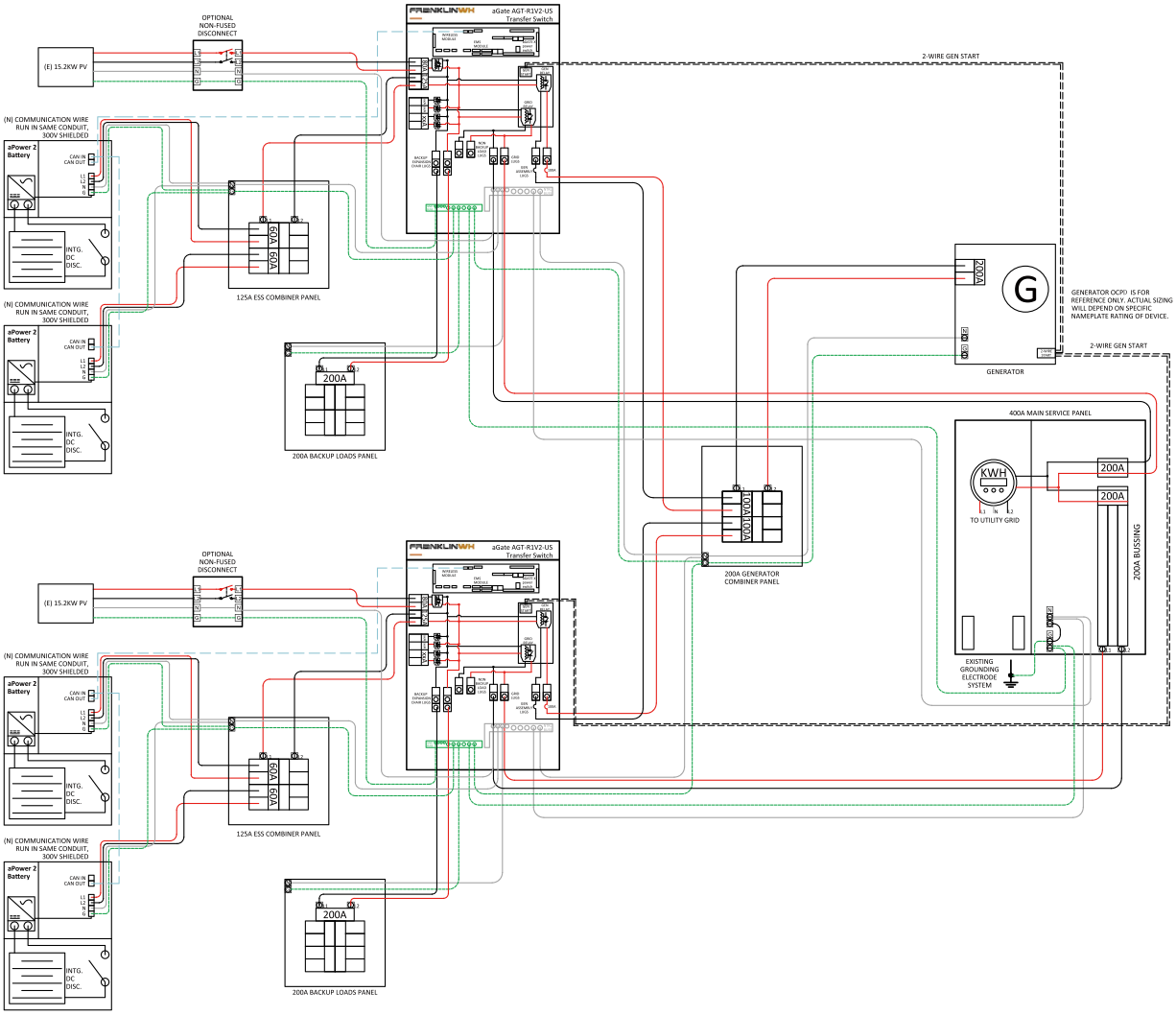
Portable Generators

Portable generators typically do not support automatic control features. Homeowners simply need to connect the power and ground wires to the FranklinWH System's aGate interface and manually start the generator when needed. For more detailed information, please refer to the installation manual available online.



Generator integration for a 400A or larger services

When integrating a generator with a 400 A or larger services with multiple aGates installed, we recommend setting up the generator via two-wire dry contact. By setting up the generator like that, each aGate can independently call for the generator based on the state of charge of the batteries downstream of the aGate. For more information, please consult us at engineering@franklinwh.com.



Recommended Generator Sizing per FranklinWH aPower 2 Unit

When selecting the appropriate generator size for a power system, it's essential to ensure that the generator operates efficiently without overloading. The optimal running capacity for different generators varies, typically around 50% of its nameplate rating. Operating within this range helps to minimize Total Harmonic Distortion (THD) and prevent surging, which can negatively affect both the generator and connected appliances.

The table below outlines the recommended generator sizes for 1, 2, and 3-unit configurations of the aPower 2 battery, taking into account typical household needs and operational efficiency.

Configuration	Generator Power (kW)	Suitable for Household Size
Single Unit	12 kW	Small to medium household
Two Units	23 kW	Medium to large household
Three Units	≥23 kW	Large household

Disclaimer: When integrating external standby generator to augment the backup circuit, all connected PV sources must be connected via relay curtailment device input (aGate PV input, aPbox, PowerLink).

Homeowner Value

Energy Savings and Smart Management

The FranklinWH System enhances energy efficiency by intelligently managing the operation of generators, batteries, and renewable energy sources. The smart energy management system optimizes fuel consumption, reducing costs for homeowners and ensuring that the generator operates only when necessary.

Robust Energy Expansion Capabilities

The FranklinWH System offers flexibility and scalability, supporting a wide range of energy sources beyond generators and batteries. It can integrate with EVs, wind energy, fuel cells, and other emerging energy technologies. This flexibility ensures that the system can evolve with the homeowner's changing energy needs, offering long-term sustainability.

Key Takeaways

- A generator can add further resilience to a PV+ESS system that is optimized for energy savings and typical grid outages, or for fully offgrid systems.
- Any generator including portable and compatible EVs can be integrated with the FranklinWH solution as long as it's 240 V, 60 Hz and sized appropriately to the number of batteries installed.
- Generators can be integrated via two-wire dry contact, utility voltage sensing or existing ATS. We recommend the two-wire method from an ease of integration standpoint.
- A generator module (additional accessory) is needed for all generator integrations. Please ensure you have the correct generator module depending on the aGate version.
- Best to have preventative maintenance performed on the generator before the integration so there is the highest probability of a successful installation on the first try.
- When the generator is online, it is the primary and only power (voltage) source feeding to the home loads. PV and aPower batteries (discharge) will be disengaged (relay opened) when the generator is online.
- When the generator is online, it will first supply power to the home's loads. Any remaining capacity will then be diverted to charging the aPower batteries.
- To prioritize battery charging, home loads should be kept to a minimum, ensuring sufficient generator capacity is available for aPower charging.

Conclusion

FranklinWH's integrated generator and energy storage solution is a forward-thinking energy management system that combines advanced smart technology with efficient power solutions. By integrating various power sources, the system provides a reliable, sustainable, and cost-effective energy solution. This smart system not only meets the diverse power needs of modern households but also ensures seamless integration of renewable energy sources like solar power and electric vehicles.

As energy systems evolve and the demand for intelligent, eco-friendly energy solutions grows, the FranklinWH System represents the future of smart power management. The system provides homeowners with the independence, efficiency, and convenience required for modern living, offering a comprehensive solution for today's energy challenges.

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