

Generator Integration with the Enphase Energy System

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Overview

This document provides site surveyors and design engineers the information needed to evaluate a site and plan the design, installation, and support of AC home standby generators with the Enphase Energy System. This is not a commissioning and operations guide. The information provided in this document supplements the information in the datasheets, quick install guides, and product manuals. Diagrams and information in this document are illustrative of example system configurations and installations. However, they may not include all requirements from additional state and local codes, standards, and other Authorities Having Jurisdiction (AHJs), applicable to a site.

NOTE: Only AC home standby generators that are hardwired and meet the requirements listed in the section “Generators that can be integrated with the ” on Page 6 are supported. Do not use a portable generator (that is not hardwired) instead of the standby generators. If you need to use a portable generator to recover battery charge in the event of an emergency follow the instructions in the [State of Charge Recovery for an Enphase Storage System](#) tech brief.

NOTE: The term “IQ System Controller” when used in this document means both IQ System Controller 1 and IQ System Controller 2, unless otherwise specified.

Introduction

With Enphase Energy System, homeowners have power when the grid goes down and can save money when the grid is up. The Enphase Energy System includes the following Enphase products:

- IQ Battery™ to store energy and form a microgrid in the absence of the utility grid.
- IQ System Controller™ to enable the batteries to form a microgrid safely by isolating the home from the utility grid in the event of an outage.
- Envoy-S Metered or IQ Gateway communications gateway to talk to the Enphase Cloud. The IQ Gateway includes the system controller software.
- Enphase™ Communications Kit to enable the IQ Battery, the IQ System Controller, and the IQ Gateway to communicate securely.
- M or IQ-series solar microinverters to convert DC power from the solar panels to AC power.
- Enphase Mobile Connect™ cellular modem to provide a backup internet connection in the absence of broadband over Wi-Fi or Ethernet.
- A pair of Enphase’s split-core current transformers (CTs) for monitoring current consumed from the utility grid and an additional pair for monitoring current consumed from the generator.

Enphase Energy System now supports third party standby generators. The IQ System Controller includes a built-in generator port which eliminates the need for an external automatic or manual transfer switch for the generator. IQ System Controller takes care of turning on and controlling auto-start generators when the utility grid is down, without any intervention from homeowners. The generator reduces dependency on environment variables (irradiance for solar power production) and provides an additional power source while the system is off grid. The generator can be used to supply power to loads and/or charge batteries. The ability to use the generator and PV + storage is a key differentiator of the Enphase solution versus competitors, that support either a generator or PV + storage solution. The addition of generator support feature to the Enphase storage system helps in creating a highly resilient, grid-independent solution.

Key features

- The generator only runs in the off-grid mode and does not operate in parallel to the grid.
- The generator can run in parallel with IQ-Series microinverters and IQ batteries while the system is off-grid.
- The system supports the following user preferences for starting the generator:
 - a. Automatic: The IQ System Controller ensures a seamless transition from on-grid to off-grid state without a loss of power. The generator is turned on automatically when the system is off grid. The generator supplies power to loads and battery until the utility grid returns and is deemed stable.
 - b. Eco-friendly: The generator is started and stopped automatically based on battery State of Charge (SOC). This mode reduces generator run time leading to lesser fuel consumption and consequently reduces generator maintenance requirements. For

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example, the generator is turned on if battery SOC drops below 20% and is turned off if the battery SOC goes above 40%.

- The generator configurations can be modified or the unit can be disabled using the Enphase Installer App.
- The “Quiet Time” feature provides the user a way to select a period during which the generator stays off unless battery SOC drops below a critical charge threshold.
- The Enphase Installer App provides an user configurable Generator Exercise Mode option. For example, the generator runs for 15 mins occasionally to keep its engine in good operating condition, as required by the manufacturer.

NOTE: If you use the exercise mode provided by Enphase, you need to disable manufacturer provided exercise mode (if present).

Comparison of Enphase Systems with other solutions

Generator support with typical competitor solar + storage solutions

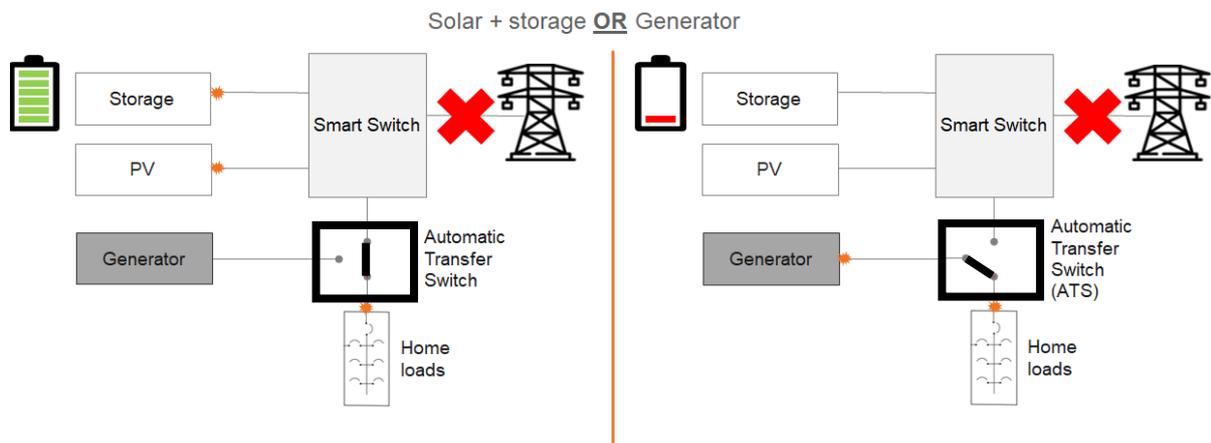


Figure 1: Typical competitor solution: **Generator OR PV + storage**

The typical solution available in the market is “**Generator OR PV + storage**”, meaning that when there is an outage, the homeowner will get their power from either the generator or the renewables; they cannot get backup power from both at the same time. Such a design is inefficient, complicated, and difficult to operate.

The typical generator + PV and storage solutions requires an external ATS (Automatic Transfer Switch). The external ATS is normally installed between the smart switch and the home loads. The generator powers up the whole house or a backup load panel in case of grid outage, after the battery is fully discharged. These solutions do not allow concurrent operation of the generator and PV + storage system. In some cases, the PV and battery systems are connected to a protected load subpanel via a manual transfer switch, which means the homeowner needs to manually transfer these loads to generator if the battery energy is depleted to get power from the generator. **The homeowner always experiences a power interruption during transitions with external transfer switch-based generator solutions.**

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Generator support with Enphase Energy System

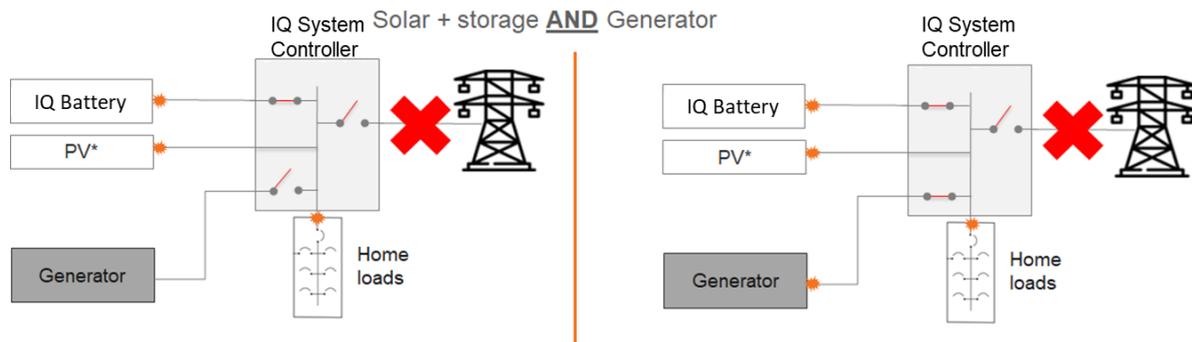


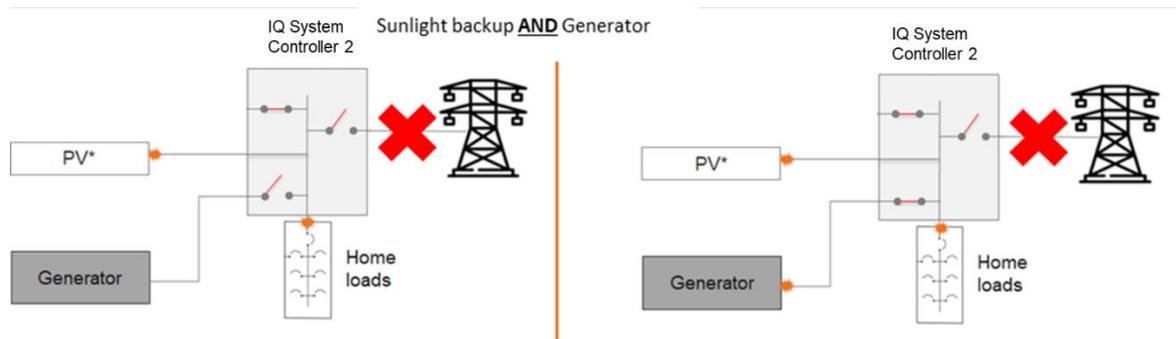
Figure 2: Enphase Energy System: **Generator AND PV + storage**

Enphase’s generator support solution is “**Generator AND PV + storage**,” meaning generator and renewables (PV and IQ Battery) can operate at the same time providing backup power for the homeowners seamlessly. There is no external ATS, as the IQ System Controller has a built-in port for generator connection. IQ System Controller ensures that the generator is never connected to the home when the system is on-grid i.e., connected to the utility grid. IQ System Controller also integrates a control port to signal the generator to turn on based on user preferences. The IQ Gateway in the system measures the generator, the PV, and the battery storage outputs to avoid back feeding power from PV or storage systems to the generator. Enphase’s generator support capability is efficient, simple, and user friendly.

Integrating a generator with the Enphase Energy System has the following benefits:

- Allows generator to charge batteries and serve loads
- Automatically starts and stops the generator based on user preferences or user command via Enphase Installer App.
- Ensures back feed protection for the generator.
- Integrated warm up and cool-down periods for generator operation.
- Provides a single integrated interface (Enphase Installer App) for controlling and monitoring PV, storage, and generator at the homeowner’s fingertips.
- Sends reminders (for maintenance) and other important notifications associated with the generator to homeowners via the Enphase Installer App.

Generator support with IQ8-series microinverters in Sunlight Backup configuration



The Enphase Energy System provides backup using IQ8 series microinverters when the sun is shining. The Sunlight backup system does not include any IQ Batteries. The system can support PV branch circuits rated for up to 64A continuous current output. Integrating a generator with a Sunlight backup system provides a reliable source of power that does not depend on irradiance available.

This configuration must be used with an Essential Loads Solution. An Essential Loads Solution consists of:

- An off-the-shelf panel with a maximum of four pre-selected, essential load circuits that are backed up by the system.

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- Two IQ Load Controllers, each enabling fine-grained, circuit-level control for two of the essential load circuits.

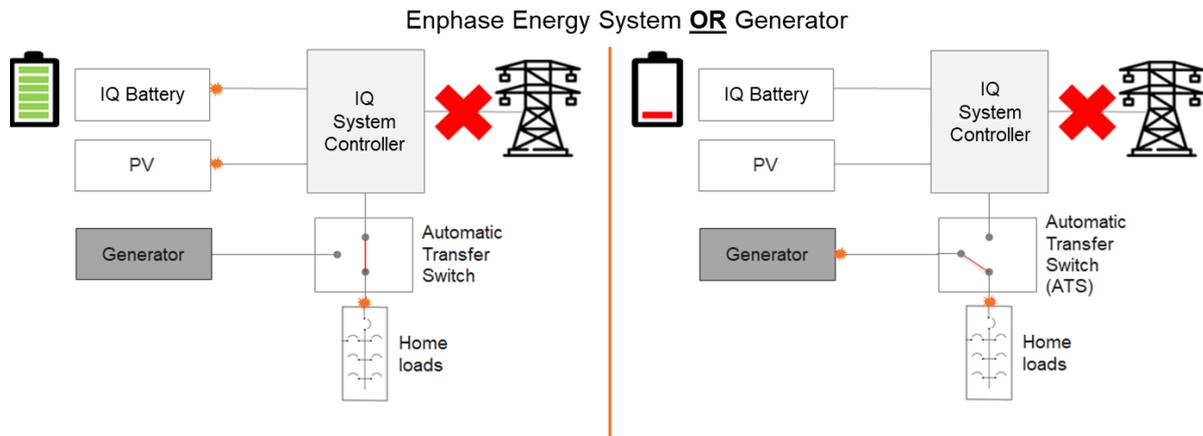
Using this configuration for backing up an entire home will lead to a poor customer experience and is not a use case supported by Enphase.

NOTE: Only use utility sense generators with Sunlight Backup systems. If a 2-wire start generator is used, the system will not be able to start the generator when the system itself is powered off, for example if the grid fails during night. Utility sense generators will be able to sense a grid outage and start on their own.

Unsupported or undersized generator connections

Enphase deems a generator model as unsupported if the generator model is either out of spec with the required parameters or it does not meet the minimum sizing requirements. In such cases, the generator can be used only as a backup to the Enphase Energy System.

In this configuration, the system must have an ATS (Automatic Transfer Switch) located after the IQ System Controller that will allow the generator to turn on if the microgrid stops providing power. The ATS will also ensure that when the microgrid returns the generator will be turned off and there will be no parallel power sources in operation.



Generators that can be integrated with the Enphase Energy System

Different generators have different governor responses to changes in load. Enphase Energy System also responds to changes in loads. To ensure smooth operation in a microgrid, Enphase has tested various generators and tuned its software to ensure that these responses to changes in loads do not destabilize a microgrid. Generators compatible with the Enphase Energy System are listed in Table 1. **Installers must pick generators from the table below to ensure that the generator is compatible with the Enphase Energy system.** Enphase requires installers to select a generator make and model during system commissioning using the Enphase Installer App. Only generators that are compatible with Enphase Energy System are available for selection in the Enphase Installer App.

NOTE: Depending on the microinverter series used in the system, a minimum generator size may be required based on the number of IQ Batteries in the system. The “Generator nameplate to storage nameplate” section on Page 6 of this tech brief provides the minimum generator size corresponding to the number of IQ Batteries in the system to ensure stable microgrid operation.

NOTE: Only use Utility sense generators with Sunlight Backup systems. If a 2-wire start generator is used, the system will not be able to start the generator when the system itself is powered off, for example if the grid fails during night. Utility sense generators will be able to sense a grid outage and start on their own.

Table 1: List of Generators recommended by Enphase

Model	Manufacturer Name	Generator Type	Start Type	Control Type	Nameplate Rating
76153 (48kW)	Briggs and Stratton	standby	Auto	Two Wire	48
040590 (12kW)	Briggs and Stratton	Standby	Auto	Two Wire	12
40586 (20kW)	Briggs and Stratton	Standby	Auto	Two Wire	20
40303 (15kW)	Briggs and Stratton	Standby	Auto	Two Wire	15
C20N6H-A061C601 (20kW)	Cummins	Standby	Auto	Two Wire	20
RS13A/C13N6H (13kW)	Cummins	Standby	Auto	Two Wire	13
G007171-0, G007172-0 (10 kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	10
G007173-0, G007174-0, G007175-0 (13kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	13
G007176-0, G007177-0, G007178-0 (16kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	16
G007038-1, G007039-1 (20kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	20
G007042-2, G007043-2 (22kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	22
G007038-3, G007039-3 (20kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	20
G007042-3, G007043-3 (22kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	22
G0064371 (11kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	11
G0055050 (17kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	17
G007035-0, G007036-0, G007037-0 (16kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	16
G0070400 (22kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	22
G0072269 (18kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	18

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G007226-0, G007228-0 (18kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	18
G00072090, G00072101 (24kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	24
QT03624ANAX Protector QS Series (36kW)	Generac	Standby	Auto	Two Wire	36
G0058750 (20kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	20
G0062561 (16kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	16
G007035-1, G007036-1, G007037-1 (16kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	16
G0052141 (25kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	25
G007223-0, G007224-0, G007225-0 (14kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	14
G0065510 (22kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	22
G0052440	Generac	Standby	Auto	Utility sense-based start 240 VAC	16
69981 (7.5kW)	Generac	Standby	Auto	Utility sense-based start 240 VAC	7
G0062602 (17kW)	Honeywell	Standby	Auto	Utility sense-based start 240 VAC	17
G007060 (17kW)	Honeywell	Standby	Auto	Utility sense-based start 240 VAC	17
G007065-2 (22kW)	Honeywell	Standby	Auto	Utility sense-based start 240 VAC	22
G007063-2 (20kW)	Honeywell	Standby	Auto	Utility sense-based start 240 VAC	20
14RESA (14kW)	Kohler	Standby	Auto	Two Wire	14
20RESA (20kW)	Kohler	Standby	Auto	Two Wire	20
24RCL (24kW)	Kohler	Standby	Auto	Two Wire	24
10RESV (10kW)	Kohler	Standby	Auto	Two Wire	10
12RESV (12kW)	Kohler	Standby	Auto	Two Wire	12
Kohler 20RESCL (20kW)	Kohler	Standby	Auto	Two Wire	20
20RESCL (20kW)	Kohler	Standby	Auto	Two Wire	20
20RCA (20kW)	Kohler	Standby	Auto	Two Wire	20
20RESC (20kW)	Kohler	Standby	Auto	Two Wire	20
14RCA (14kW)	Kohler	Standby	Auto	Two Wire	14
30REYG	Kohler	Standby	Auto	Two Wire	27

A generator that is not listed above will not be supported by the Enphase Energy System. Enphase tests standby generators as part of its system before it lists them above. Generators tested by Enphase are selected based on the criteria specified below:

1. 240V L-L, Split phase with neutral¹
2. Voltage regulation: Within -12% to +10% i.e., 211.2 Volts (Full Load) to 264 Volts (No Load)²
3. Frequency regulation Less than +/- 5% i.e., 58.15 Hz (Full Load) to 61.85 Hz (No Load)²
4. Generator start-up types:
 - Two-wire start
 - Utility sense-based start

¹ Enphase does not support 3-phase generators or 120V single-phase generators. Only 240V split-phase generators with a 4-wire connection i.e., L1, L2, neutral and ground are supported.

² Generator voltage and frequency must not vary erratically in the specified range to ensure seamless operation with the Enphase system.

5. Total Harmonic Distortion < 25%³

Enphase cannot test every generator. Installers must select generators listed above to ensure they can integrate and operate with the Enphase Energy System. Generators not listed above will not be supported. See *Unsupported or Undersized Generator Connections* section in this document on how to incorporate non-supported generators.

Generator nameplate to storage nameplate pairing

The Enphase Energy System limits the usable generator power based on the type of IQ System Controller used in the system.

For system using an IQ System Controller 1, the maximum generator current is limited to 48A continuous (60A overcurrent protection) to protect the associated power relays in the IQ System Controller 1 for the generator position.

For system using an IQ System controller 2, the maximum generator current is limited to 64A continuous (80A overcurrent protection) to protect the associated power relays in the IQ System Controller 2 for the generator position.

Generator sizes beyond the values mentioned above will not result in any improvement in terms of current or battery charging speed.

The system design also puts limits on the minimum generator nameplate for pairing with a given number of IQ Battery units. This limit varies depending on the microinverter family on the roof. **The minimum generator size must be maintained to ensure a stable microgrid when operating with IQ Battery and PV. This is to ensure the generator can be safely operated and does not get damaged by inadvertent back-feed from the PV and/or storage.**

NOTE: Sufficiently size the Generator power rating to power loads and charge the IQ Batteries at the same time. The minimum generator size should be used as a starting point in design.

For systems with IQ8 Series Microinverters in Sunlight Backup mode, the minimum generator nameplate rating must be at least 100% of the PV array rated AC power output. The table below shows some examples of this pairing.

Table 2: Minimum Generator nameplate rating for a Sunlight Backup systems

Microinverter Type	Rated output (W) of one microinverter	No. of microinverters	Minimum Generator Nameplate (kW)
IQ8	240	16 (1 branch circuit)	3.84
IQ8	240	32 (2 branch circuits)	7.68
IQ8PLUS	290	13 (1 branch circuit)	3.77
IQ8PLUS	290	20 (2 branch circuits)	5.8
IQ8H-240	380	15 (2 branch circuits)	5.7

For systems with IQ8 series microinverters and IQ Batteries, the minimum generator nameplate rating must be a) 100% of the PV array rated AC power output or b) 143% of the IQ Battery array **whichever is higher**. The table below shows some examples of generator pairing with an Enphase Energy System with IQ8 series microinverters and IQ Battery.

³ The generator's Total Harmonic Distortion (THD) must be less than 25% to ensure quality of power and minimize the chances of damaging sensitive electronic equipment in a microgrid.

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Table 3: Minimum Generator nameplate rating for an Enphase Energy Systems with IQ8 series microinverters and IQ Battery

Microinverter Type	Rated output (W) of one microinverter	No. of microinverters	Rated output power output of the PV array (kW)	IQ Battery 3/3T units	IQ Battery 10/10T units	IQ Battery Power (kW)	Minimum Generator Nameplate (kW)
IQ8	240	16 (1 branch circuit)	3.84	1	-	1.28	3.84
IQ8	240	32 (2 branch circuits)	7.68	2	-	2.56	7.68
IQ8PLUS	290	13 (1 branch circuit)	3.77	3	(1x IQ Battery 10/10T)	3.84	5.49
IQ8PLUS	290	20 (2 branch circuits)	5.8	4	-	5.12	7.31
IQ8H-240	380	15 (2 branch circuits)	5.7	5	-	6.4	9.14
IQ8H-240	380	40 (4 branch circuits)	15.2	6	(2x IQ Battery 10/10T)	7.68	15.2
IQ8H-240	380	40 (4 branch circuits)	15.2	12	(2x IQ Battery 10/10T)	15.36	21.94

The Enphase Installer App allows you to connect to the system a lower or higher nameplate rated generator than the recommended generator capacity. **However as mentioned earlier using smaller generators than stated herein may compromise microgrid stability and can damage the generator due to inadvertent back-feed.**

For IQ6/IQ7 or M-series microinverters, the minimum generator nameplate rating for pairing with the given number of IQ Battery units is shown in Table .

NOTE:

- When using IQ System Controller 1 with 20kWH energy storage (i.e., more than 2x IQ Battery 10 units) the generator nameplate rating required exceeds the usable power from the generator port (i.e., 11.52kW or 48A at 240V) from the generator.
- When using IQ System Controller 2 with 30kWH energy storage or more (i.e., 3x IQ Battery 10 units or more) the generator nameplate rating required exceeds the usable power from the generator port (i.e., 15.36kW or 64A at 240V) from the generator.

The Enphase Installer App allows you to connect to the system a lower or higher name plate rated generator than this value of generator capacity. **However as mentioned earlier using smaller generators than stated herein may compromise microgrid stability and can damage the generator due to inadvertent back-feed.**

The nameplate value and maximum continuous generator current can be set in the Enphase Installer App while commissioning the generator. The IQ Gateway will ensure that the system does not draw more than the generator nameplate rating and keeps generator usage below the maximum continuous generator current.

Table 4: Minimum Generator nameplate rating for a given number of IQ Battery units with IQ6/IQ7 series

IQ Battery 3/3T units	IQ Battery 10/10T units	IQ Battery Energy (kWh)	IQ Battery Power (kW)	Minimum Generator Nameplate (kW)
1		3.36	1.28	1.83
2		6.72	2.56	3.66
3	(1x IQ Battery 10)	10.08	3.84	5.49
4		13.44	5.12	7.31
5		16.8	6.4	9.14
6	(2x IQ Battery 10)	20.16	7.68	10.97
7		23.52	8.96	12.80
8		26.88	10.24	14.63
9	(3x IQ Battery 10)	30.24	11.52	16.46
10		33.6	12.8	18.29
11		36.96	14.08	20.11
12	(4x IQ Battery 10)	40.32	15.36	21.94

System configuration

When the system is on grid the use of a generator is not allowed. The PV on the roof along with IQ Battery is optimized to minimize the grid tariff. When the system goes into backup mode, the generator can operate. The generator can be used to charge the batteries and/or serve excess loads.

The supported system configurations are listed below:

1. Generator with IQ Battery and IQ-series microinverters
2. Generator with IQ Battery and M-series microinverters
3. Generator with IQ8-series microinverters in Sunlight Backup

The system works well for Sunlight Backup, Home Essentials, and Full Energy Independence configurations.

Generator with IQ Battery and IQ 6/7-series microinverters

A generator can be added to an Enphase Energy System that has IQ-series microinverters on the roof, IQ Combiner, or standalone IQ Gateway, IQ Batteries, and IQ System Controller. It can be connected in a Home Essentials and Full Energy Independence back up configuration.

NOTE: Enphase Energy System with IQ6/7-series microinverters can use both IQ System Controller 1 and IQ System Controller 2. The continuous current rating for the generator port is 48 A for IQ System Controller 1 and 64A for IQ System Controller 2.

In the Full Energy Independence backup configuration, the IQ System Controller is installed on the line-side of the main load panels rated up to 200A. This allows a properly sized Enphase Energy System to provide power to all loads in the event of a grid outage. In this configuration, you can configure the IQ System Controller with the main breaker to act as the service disconnecting means. You can interconnect the PV system to the IQ System Controller on a dedicated breaker or interconnect it to the load panel. A generator is also wired into the generator port on the IQ System Controller. An overcurrent protection device i.e., a breaker (up to 60A for IQ System controller 1, up to 80A for IQ System Controller 2) must be populated inside the IQ System Controller on the designated spot. This configuration typically supports larger PV and storage system sizes and may allow you to avoid expensive utility service and/or main service panel upgrades. One example of this Full Energy Independence configuration is shown in the below figure:

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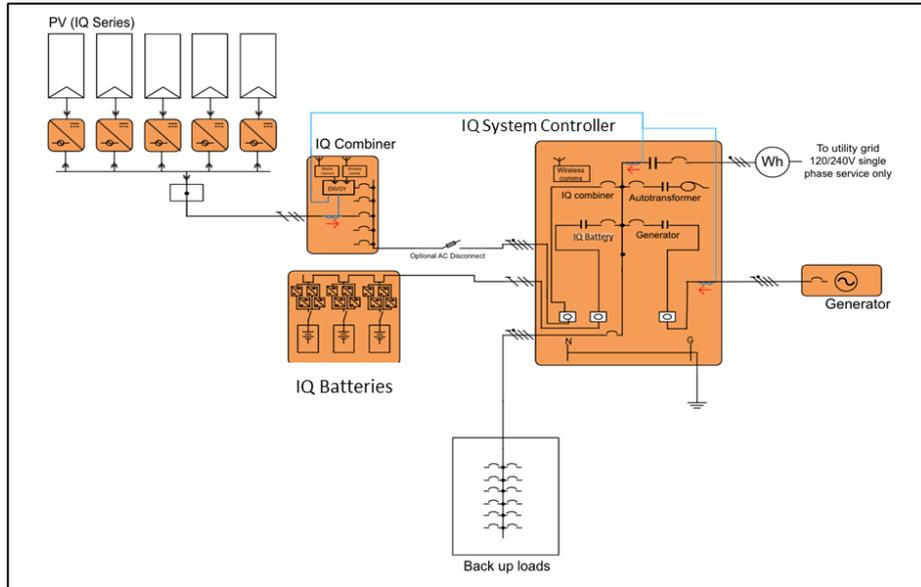


Figure 3: Enphase Energy System in Full Energy Independence configuration for IQ6/7-series PV microinverters. The IQ System Controller is installed as a service equipment on the line-side of the main load panel and PV, IQ Battery and Generator are connected to the IQ System Controller.

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

You can also install the IQ System Controller on the load side of the existing main load panel or service equipment. The generator is connected to the IQ System Controller in the same way as in the Full Energy Independence configuration. Use this configuration when the Enphase Energy System is configured to provide backup to several pre-selected load circuits. This configuration is recommended when an IQ Battery system with smaller energy and power capacity and some basic load backup is desired by the customer, or when existing constraints prevent main panel backup or other installation methods. The following figure shows an example of an Home Essentials backup configuration.

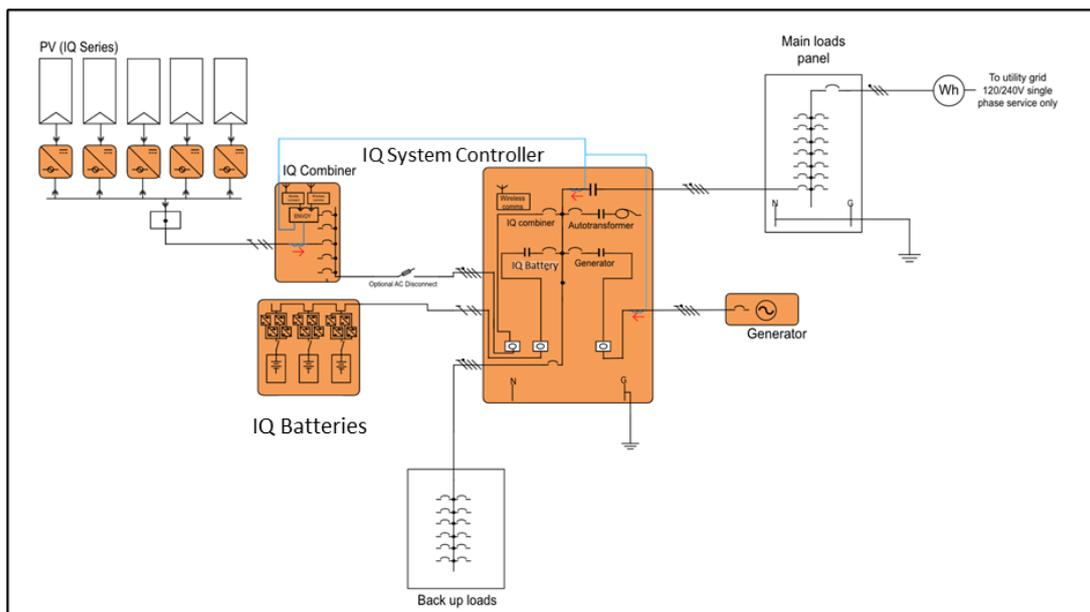


Figure 4: Enphase Energy System in Home Essentials configuration for IQ6/7-series PV microinverters. IQ System Controller is installed on the load side of the main load panel with select loads backed up in a backup subpanel. The generator is wired in onto the generator port on the IQ System Controller.

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NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

NOTE: Whenever a generator is installed, the consumption CTs for L1 and L2 must be placed inside the IQ System Controller on the L1 and L2 conductors feeding the grid breaker (if present) or the grid side lugs as described in the [IQ System Controller 2 Quick Install Guide](#). The arrows on the CTs must point upwards to ensure correct polarity.

Generator with IQ Battery and M- series microinverters

NOTE: Enphase Energy System with M-series microinverters can use both IQ System Controller 1 and IQ System Controller 2. The continuous current rating for the generator port is 48 A for IQ System Controller 1 and 64A for IQ System Controller 2.

Envoy-S metered must be used as the communications gateway with M-series microinverters to work with IQ Battery. The generator is wired in onto the generator port on the IQ System Controller. An overcurrent protection device i.e., breaker up to 60A for IQ System Controller 1 and up to 80A for IQ System Controller 2 must be populated inside the IQ System Controller on the designated spot. Also required is to wire an external double pole contactor (to be purchased separately) to the PV branch circuit connecting to the Envoy-S metered to break the L1 and L2 connection and shed PV when the generator is operating as shown in Figure 5 and Figure 6.. This will eliminate the possibility of PV back feeding the generator, in an uncontrolled manner, that could occur with the M-Series microinverters. The system works well for both Full Energy Independence and Home Essentials configurations as shown in Figure 5 and Figure 6.

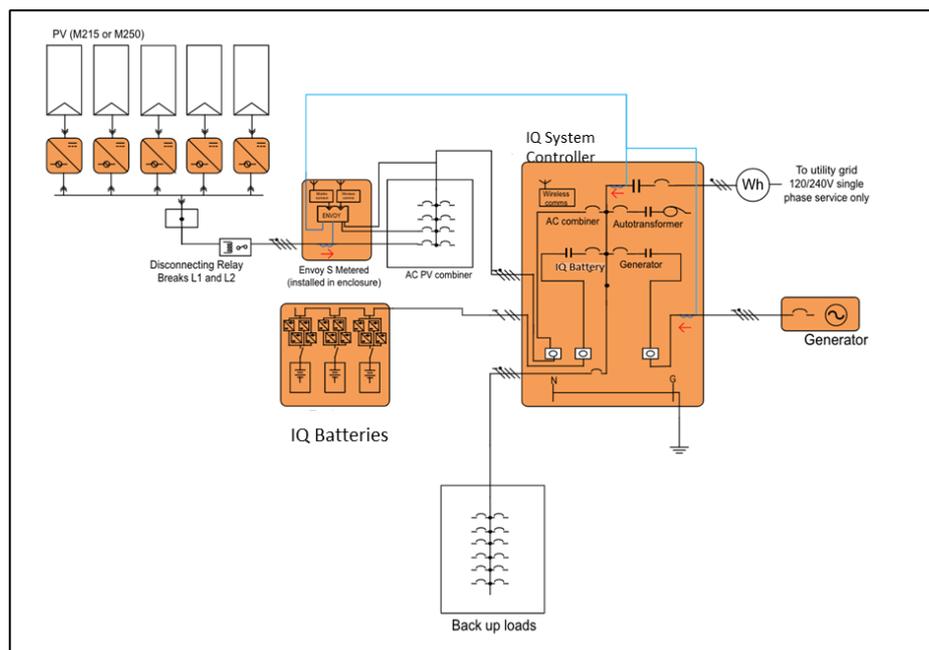


Figure 5: Enphase Energy System in Full Energy Independence configuration for M-Series PV microinverters. The IQ System Controller is installed on the line-side of the main load panel, and PV, IQ Battery storage system, and generator are connected to the IQ System Controller.

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

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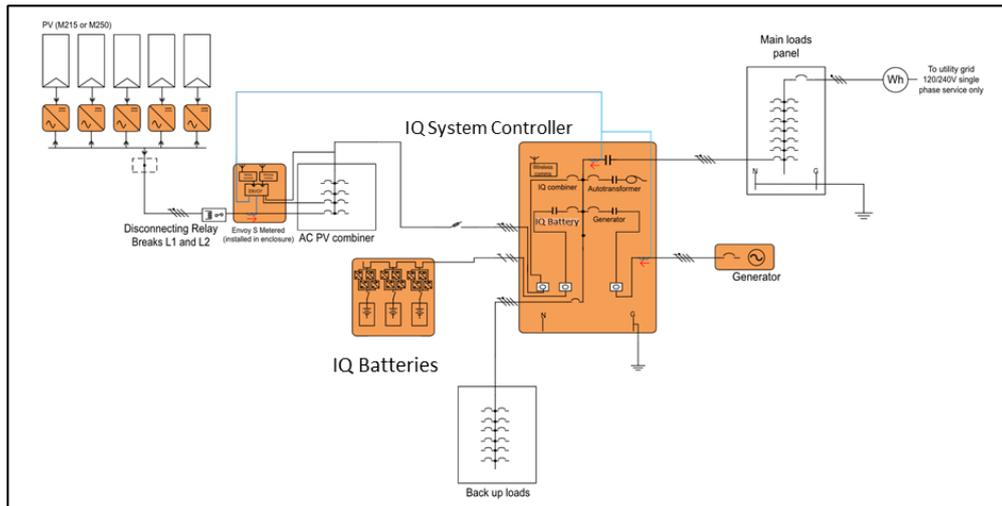


Figure 6: Enphase Energy System in Home Essentials configuration for M-Series PV microinverters. IQ System Controller is installed on the load side of the main load panel with select loads backed up in a backup subpanel. The generator is wired in onto the generator port on the IQ System Controller.

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

NOTE: Whenever a generator is installed, the consumption CTs for L1 and L2 must be placed inside the IQ System Controller on the L1 and L2 conductors feeding the grid breaker (if present) or the grid side lugs as described in the [IQ System Controller 2 Quick Install Guide](#). The arrows on the CTs must point upwards to ensure correct polarity.

Generator with IQ Battery and IQ8-series microinverters

WARNING: IQ8-series microinverters in backup configurations need IQ System Controller 2 to function properly. **IQ System Controller 1 will not work and is not safe to use with IQ8 Series Microinverters.**

A generator can be added to an Enphase Energy System that has IQ8 series microinverters on the roof, IQ Combiner 4C, or standalone IQ Gateway, IQ Batteries, and **IQ System Controller 2**. It can be connected in Home Essentials or Full Energy Independence configurations.

In the Full Energy Independence backup configuration, the IQ System Controller 2 is installed on the line-side of the main load panels rated up to 200A. This allows a properly sized Enphase Energy System to provide power to all loads in the event of a grid outage. In this configuration, you can configure the IQ System Controller with the main breaker to act as the service disconnecting means. You can interconnect the PV system to the IQ System Controller on a dedicated breaker or interconnect it to the load panel. A generator is also wired into the generator port on the IQ System Controller 2. An overcurrent protection device i.e., a breaker up to 80A must be populated inside the IQ System Controller 2 on the designated spot. This configuration typically supports larger PV and storage system sizes and may allow you to avoid expensive utility service and/or main service panel upgrades. One example of this Full Energy Independence backup configuration is shown in the below figure.

Generator Integration with the Enphase Energy System – North America

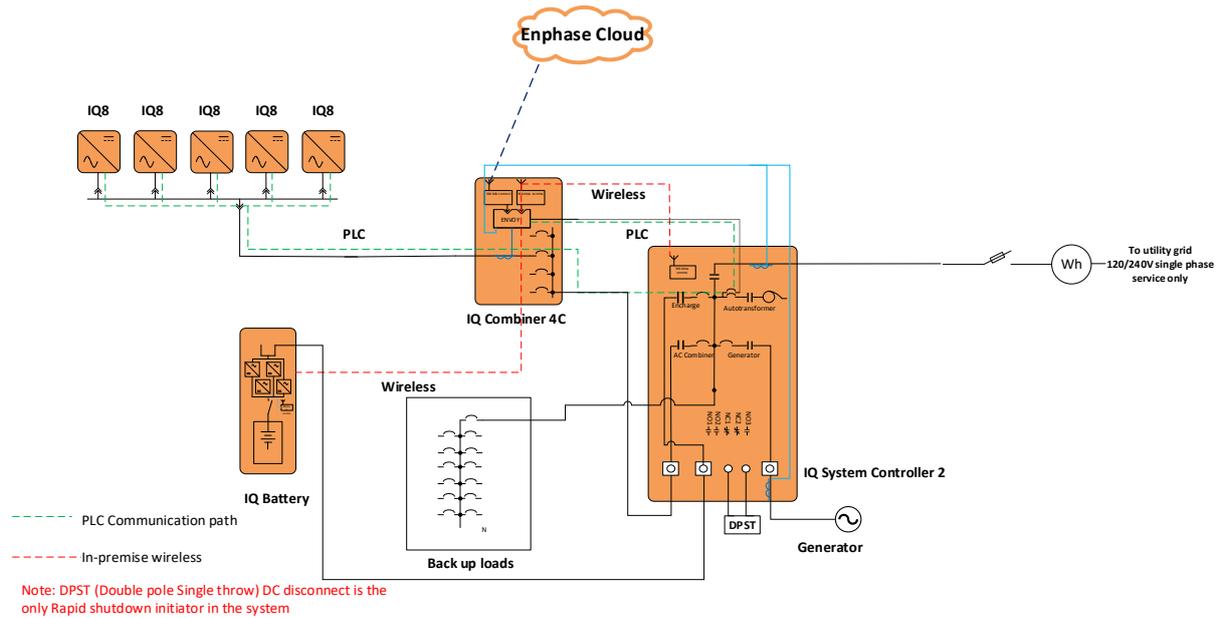


Figure 7: Enphase Energy System in Full Energy Independence configuration for IQ8-series PV microinverters. The IQ System Controller 2 is installed as a service equipment on the line-side of the main load panel and PV, IQ Battery storage system and generator are connected to the IQ System Controller 2.

You can also install the Enphase Energy System in Home Essentials configuration. In this configuration, IQ System Controller 2 on the load side of the existing main load panel or service equipment. The generator is connected to the IQ System Controller 2 in the same way as in the Full Energy Independence backup configuration. Use this configuration when the Enphase Energy System is configured to provide backup to several pre-selected load circuits. This configuration is recommended when an IQ Battery system with smaller energy and power capacity and some basic load backup is desired by the customer, or when existing constraints prevent main panel backup or other installation methods. The following figure shows an example of an Home Essentials backup configuration.

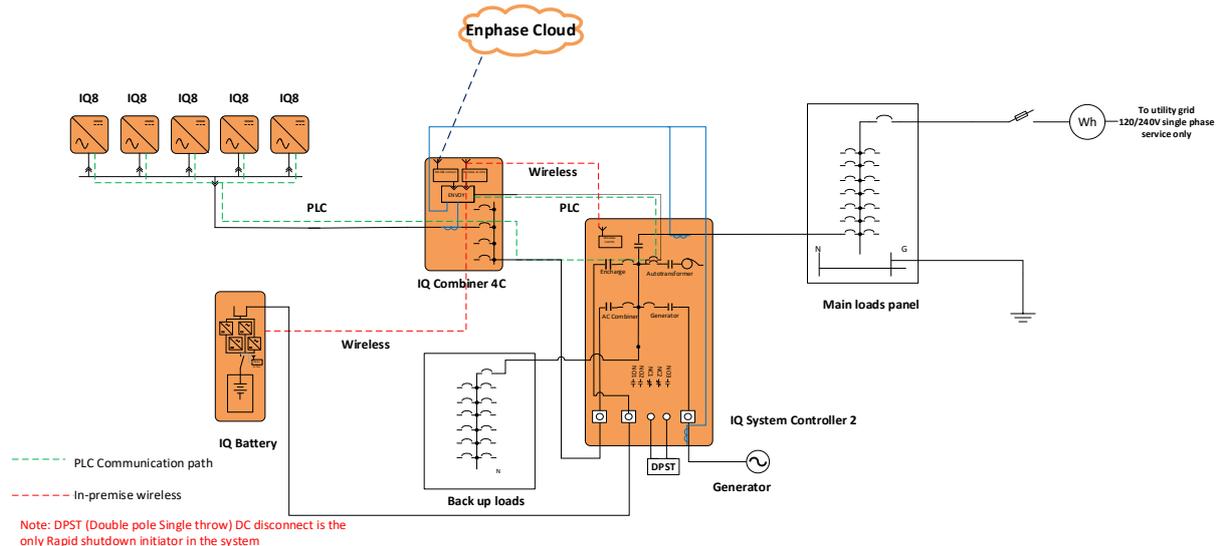


Figure 8: Enphase Energy System in Home Essentials configuration for IQ8-series PV microinverters. IQ System Controller 2 is installed on the load side of the main load panel with select loads backed up in a backup subpanel. The generator is wired in onto the generator port on the IQ System Controller 2.

Generator with IQ8-series microinverters in Sunlight Backup configuration

You can also install an IQ8 backup system in Sunlight Backup configuration, where the Enphase Energy System provides backup using IQ8 series microinverters when the sun is shining. The system does not include any IQ Batteries. The system can support PV branch circuits rated for up to 64A continuous current output. The IQ System Controller 2 is installed on the load side of an existing main load panel.

This configuration must be used with an Essential Loads Solution. An Essential Loads Solution consists of:

- An off-the-shelf panel with a maximum of four pre-selected, essential load circuits that are backed up by the system.
- Two IQ Load Controllers, each enabling fine-grained, circuit-level control for two of the essential load circuits.

Using this configuration for backing up an entire home will lead to a poor customer experience and is not a use case supported by Enphase.

NOTE: Only use utility sense generators with Sunlight Backup systems. If a 2-wire start generator is used, the system will not be able to start the generator when the system itself is powered off, for example if the grid fails during night. Utility sense generators will be able to sense a grid outage and start on their own.

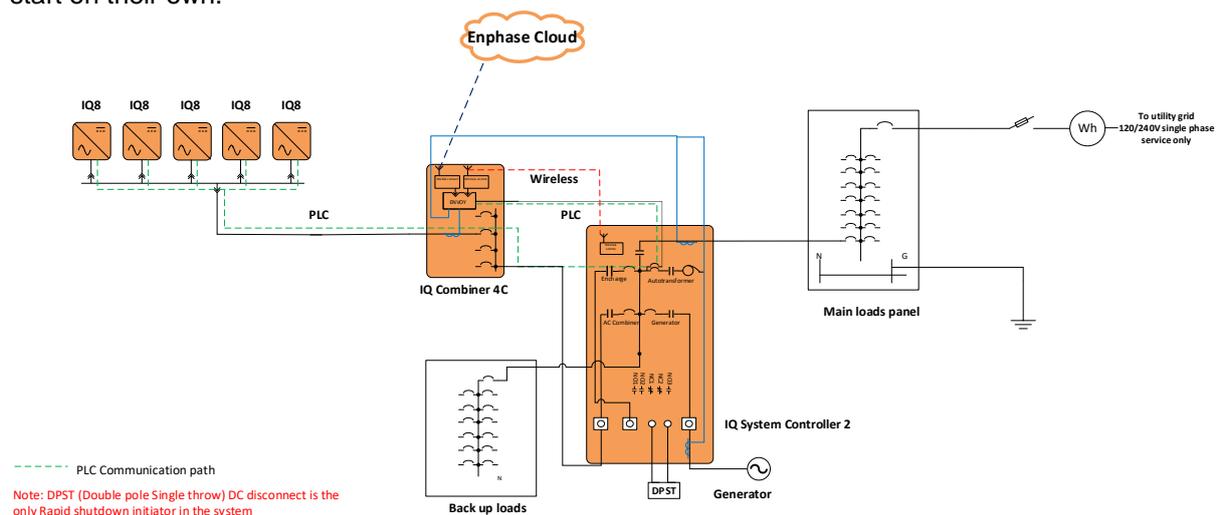


Figure 9: Enphase Energy System in Sunlight Backup configuration for IQ8-series PV microinverters. IQ System Controller 2 is installed on the load side of the main load panel with select loads backed up in a backup subpanel. The generator is wired in onto the generator port on the IQ System Controller 2.

NOTE: Whenever a generator is installed, the consumption CTs for L1 and L2 must be placed inside the IQ System Controller on the L1 and L2 conductors feeding the grid breaker (if present) or the grid side lugs as described in the [IQ System Controller 2 Quick Install Guide](#). The arrows on the CTs must point upwards to ensure correct polarity.

Connecting a generator to Enphase Energy System

The Enphase Energy System supports the addition of a third-party generator. Note that the system only supports two-wire or utility sense-based auto-start generators. L1 and L2 AC lines from the generator land on the generator lugs on the IQ System Controller shown in Figure 10. Ensure you also connect the neutral and earth lines of the generator to the neutral and earth terminal strips within the IQ System Controller. Generator auxiliary contact for two-wire or utility-sense-based start is the Gen I/O port also shown in Figure 10. Generator parallel consumption CTs should be connected maintaining the same polarity and phase assignment as the other CTs in the system. The usage of these ports is described in further detail in the succeeding sections of the Tech Brief.

WARNING: Do not connect generator directly to IQ System Controller Generator breaker, connect only to indicated terminals. Ensure the neutral of the generator is connected to the IQ System Controller's neutral bar. Ensure that the ground terminal of the generator is connected to the ground bar inside IQ System Controller. Size the generator's equipment grounding conductor as per NEC T250.122 and generator manufacturer's instructions.

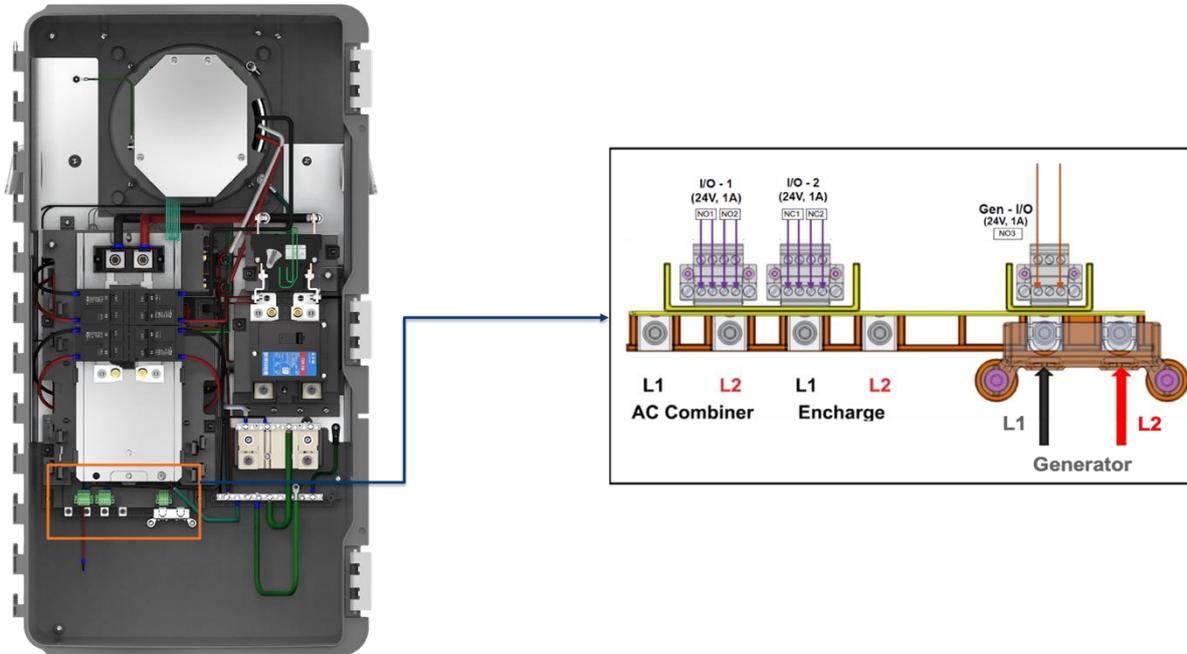


Figure 10: Enlarged view of generator lugs and auxiliary contact.

Auxiliary contact connections

IQ System Controller has auxiliary contact control to shed excess load and excess PV when going off-grid. IQ System Controller also has auxiliary contacts for the generator which can be wired to the generator for remote start. Steps for using the IQ System Controller Generator auxiliary contacts are as listed below:

1. Feed through headers ship with IQ System Controller as part of Lit kit (EP200G-LITKIT)
2. Generator auto-start via 2-wire interface or utility sense is wired using the Generator I/O port on IQ System Controller.
3. Insert the 2 wires (Supports AWG 28 to AWG 16 wire sizes) from auto start interface into feed through headers and tighten the screws (torque 0.22Nm/ (1.9 lb•in) to 0.25Nm/ 2.2 lb•in))
4. Insert feed through header into Generator I/O port on IQ System Controller and tighten the screws on the side.

NOTE: Ensure you use the Generator I/O or **Gen - I/O** terminals for generator auto-start. Using I/O – 1 or I/O -2 terminals will not work for generator auto-start.

Generator Integration with the Enphase Energy System – North America

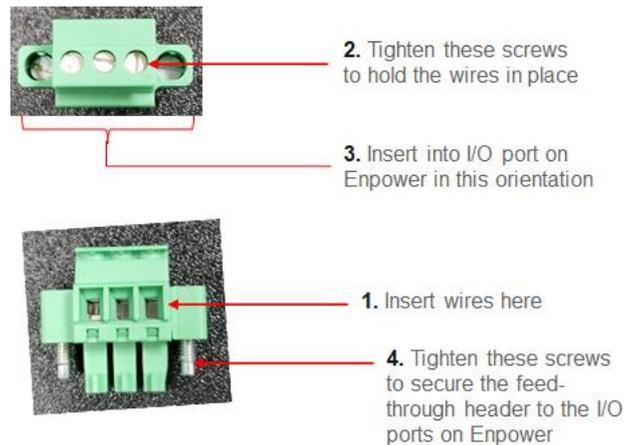


Figure 11: IQ System Controller Generator Auxiliary Contact Usage

Installation of standby generators with two-wire remote start

NOTE: This system is only compatible with permanently installed generators that are non-separately derived as per NEC 250.35(B)

1. Wire the generator auxiliary contact in IQ System Controller to the 2-wire remote start terminals of the generator.
2. Wire the L1 and L2 AC wires from the generator into the generator lugs on the IQ System Controller.
3. Connect the neutral wire from generator to an appropriately sized position on the neutral bar inside IQ System Controller.
4. Ensure that the ground terminal of the generator is connected to the ground bar inside IQ System Controller. Size the generator's equipment grounding conductor as per NEC 250.122 and generator manufacturer's instructions.
5. Buy and install an appropriately sized breaker for the generator on the IQ System Controller's busbar and connect the L1 and L2 generator cables from IQ System Controller's ATS board to this breaker.

NOTE: The maximum allowed breaker size for IQ System Controller 1 is 60A and for IQ System Controller 2 is 80A. Select an Eaton BR breaker model that has the hole for the additional fastener as per NEC 480.36(D). Available models: BR220B, BR230B, BR240B, BR250B. Eaton breaker BR260 and BR280 also has the hole for the hold-down kit.

6. Purchase and install an Eaton type BR circuit breaker hold-down screw kit (model BRHDK125) to secure the Generator breaker.
7. If the generator requires a constant 120 Vac for battery charger connect this to the backup load panel with a fuse if required as specified by the generator manufacturer
8. Have a certified contractor install the gas line required to supply the unit.
9. Install parallel generator CTs (CT-200-SPLIT) for L1 and L2 at the IQ System Controller's Generator input terminal for power monitoring when the generator is running. Refer to [IQ System Controller 1 Quick Install Guide](#) or [IQ System Controller 2 Quick Install Guide](#). on how to wire the generator CTs in parallel to the IQ Gateway's consumption CTs and how to connect the CT leads to the IQ Gateway terminals.
10. Use Enphase Installer mobile application to commission and program IQ System Controller to control the generator.

Generator Integration with the Enphase Energy System – North America

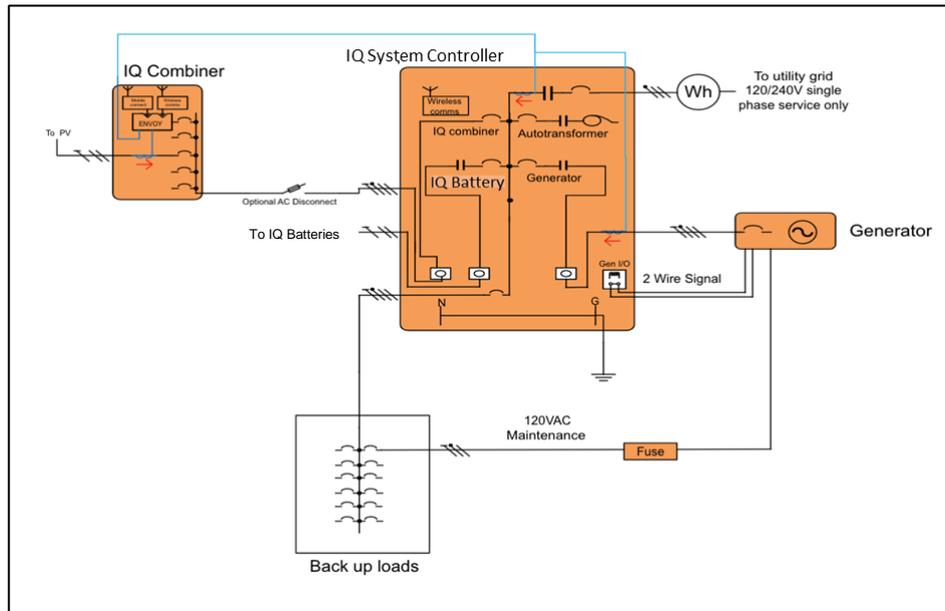


Figure 12: Generator auxiliary contact wiring for 2-wire remote start generator

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Installation of standby generators with utility sense-based remote start

NOTE: This system is only compatible with permanently installed generators that are non-separately derived as per NEC 250.35(B)

1. Wire the L1 and L2 AC wires from the generator into the generator lugs on the IQ System Controller.
2. Connect the neutral wire from generator to an appropriately sized position on the neutral bar inside IQ System Controller.
3. Ensure that the ground terminal of the generator is connected to the ground bar inside IQ System Controller. Size the generator's equipment grounding conductor as per NEC T250.122 and generator manufacturer's instructions.
4. Buy and install an appropriately sized breaker for the generator on the IQ System Controller's busbar and connect the L1 and L2 generator cables from the ATS board to this breaker.

NOTE: The maximum allowed breaker size for IQ System Controller 1 is 60A and for IQ System Controller 2 is 80A. Select an Eaton BR breaker model that has the hole for the additional fastener as per NEC 480.36(D). Available models: BR220B, BR230B, BR240B, BR250B. Eaton breaker BR260 and BR280 also has the hole for the hold-down kit.

5. Purchase and install an Eaton type BR circuit breaker hold-down screw kit (model BRHDK125) to secure the Generator breaker.
6. If the Generator requires a constant 120 Vac for battery charger connect this to the backup load panel with a fuse if required as specified by the generator manufacturer
7. Review the Utility Sense based generator diagram shown in Figure 14 and make the connections for the utility sensing generator start/stop control circuit as outlined in the next section.
8. Have a certified contractor install the gas line required to supply the unit.
9. Install parallel generator consumption CTs (CT-200-SPLIT) for L1 and L2 at the IQ System Controller's Generator input terminal for power monitoring when the generator is running. Refer to [IQ System Controller 1 Quick Install Guide](#) or [IQ System Controller 2 Quick Install Guide](#) on how to wire the generator CTs in parallel to the consumption CTs and how to connect the CT leads to the IQ Gateway terminals.

- Use Enphase Installer App mobile application to commission and program IQ System Controller to control the generator.

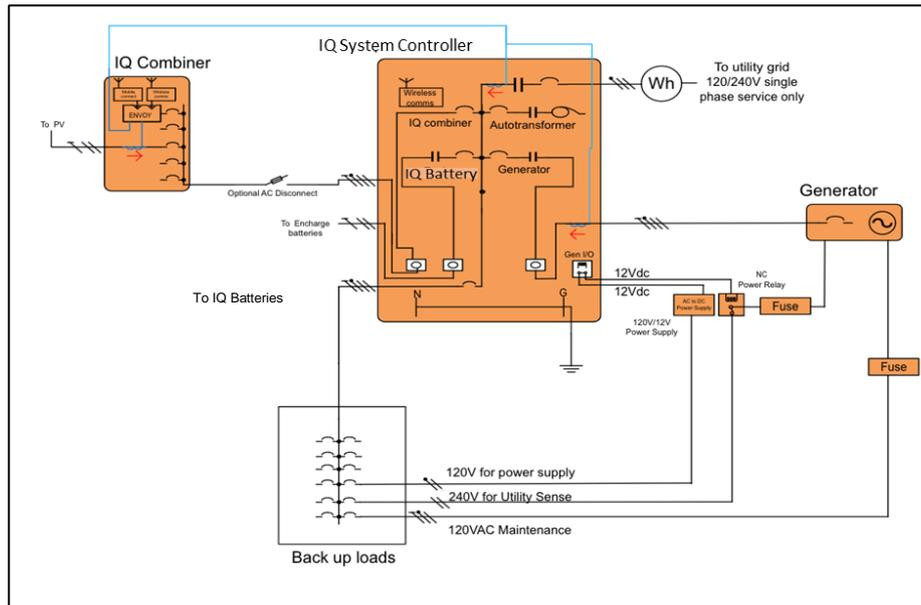


Figure 13: Generator Auxiliary Contact Wiring for Utility Sense-Based Remote Start Generator

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Equipment needed and wiring instructions for controlling a utility sensing generator using an external relay

The auxiliary contacts within the IQ Systems Controller 1&2 have a max input voltage of 24V AC or DC and a maximum of 1A current limit, exceeding these parameters will damage the circuitry within the IQ System Controller and is not a warranted failure. The BOM below contains tested power supplies in the 12V DC range that can be used to provide the power needed to control the utility sense relay for control of those units, also below is a diagram that will assist in the wiring needed for the utility sense connections. Note that the power for all the utility sense devices must come from the backup loads panel to have proper operation. This will ensure that a loss of power or micro grid collapse will also start the generator. The generator's AUTO/OFF/MANUAL switch must be in the AUTO position to ensure it automatically starts up.

Make the connections for the utility sensing generator start/stop control circuit as outlined below:

- Wire the input of a 12V DC power supply to the backup loads panel.
- Wire the one end of the DC power supply output to one of the terminals of the generator auxiliary contact (NO3) on the IQ System Controller.
- Wire the other terminal of the generator auxiliary contact (NO3) to the coil of an external Normally Closed (NC) power relay.
- Wire the other end of the DC power supply output to the other end of the coil of the Normally Closed (NC) power relay.
- Wire one terminal of the external Normally Closed (NC) power relay to one of the poles of a double pole breaker on the backup loads panel.
- Wire the other terminal of the external Normally Closed (NC) power relay to one of the utility sense terminals on the generator through a fuse.
- Wire the 2nd pole of the double pole breaker on backup loads panel to the 2nd utility sense terminal on the generator via a fuse.

Generator Integration with the Enphase Energy System – North America

WARNING: During IQ System Controller service it will be necessary to put the generator soft key from Auto to OFF for safety.

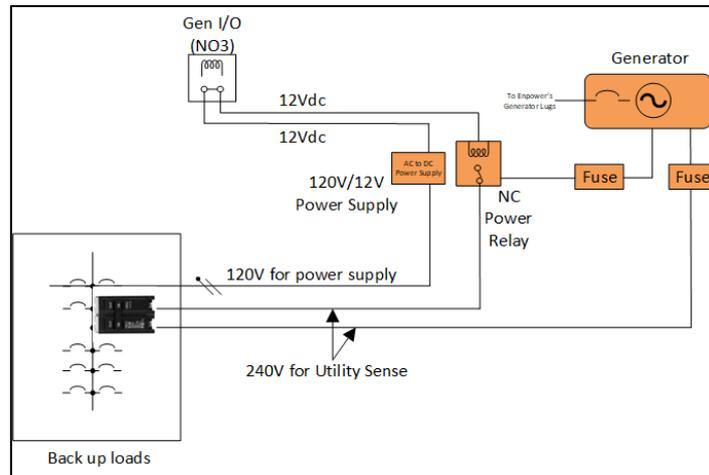


Figure 14: Utility sense wiring

Table 3: Equipment needed for utility sense generator support

Equipment	Recommendations
Power Relay	<ul style="list-style-type: none"> American Zettler AZ2280-1C-12DEF Schneider W9AS5D52-12
12V DC power supply	<ul style="list-style-type: none"> Meanwell Apv-12-12 Meanwell IRM-05-12
Mounting box	<ul style="list-style-type: none"> Kraloy JBOX JBX12128 Cantex Junction Box 5133713 NEMA 3R 8 in. x 8 in. x 6 in. Carbon Steel Weatherproof Screw Cover Wall-Mount
Fuse	Use generator manufacturer specified rated fuse. For example, <ul style="list-style-type: none"> You can select a class G fuse from Eaton with appropriate rating as recommended by manufacturer here Or you can select 2AG, 3AG or 5x20mm Fuses for inline fuse holders from Little Fuse
Fuse holder	You can select <ul style="list-style-type: none"> Fuse blocks from Little Fuse compatible with class G fuses. Example LFR250301P (single pole), LFR250302P (double pole), LFR250303P (three pole) or choose a Class G fuse block from Eaton here 150 Series - In-Line Fuse holder for 2AG, 3AG or 5x20mm Fuses

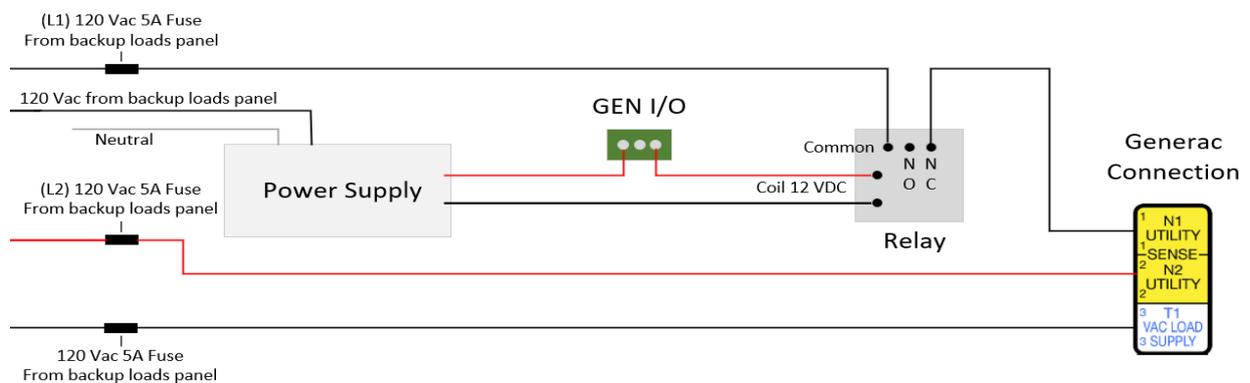


Figure 15: Wiring diagram for utility sense generator support



Figure 16: Sample equipment for utility sense generator support

Back feed protection for remote start generator with M-series

This section provides information about the solution to enable installers to understand and plan for generator support into M-series microinverter-based systems.

You will need to wire an external double pole contactor to the Envoy-S Metered to enable shedding of PV when the generator is operating. This is to eliminate the possibility of generator back feeding that could occur with M-series microinverters. The normally open contact within the Envoy-S Metered can be used to drive an external contactor to provide this protection.

As shown in the diagram below, L2 from the backed-up loads panel comes into the normally open contact terminal of the Envoy-S Metered via a 3A fuse. The C-terminal of the Envoy-S Metered is connected to one of the ends of an external contactor's coil enabling the Envoy-S Metered to control the external contactor/power relay. The other end of the external contactor's coil must be connected to the Neutral bar in the backed-up loads panel. L1 and L2 of the aggregate PV output going into the IQ System Controller is switched by the external contactor. Note that normally open terminals are utilized on the external contactor. When Envoy-S Metered closes the internal contact/pilot relay, the external contactor's coil is energized. The external contactor then closes ensuring the M-series microinverters can see the grid reference signal and therefore produce power. When required Envoy-S Metered opens the internal contact that in turn results in the external contactor disconnecting L1 and L2. This results in the M-series microinverters stopping power production since they can no longer see the grid reference signal.

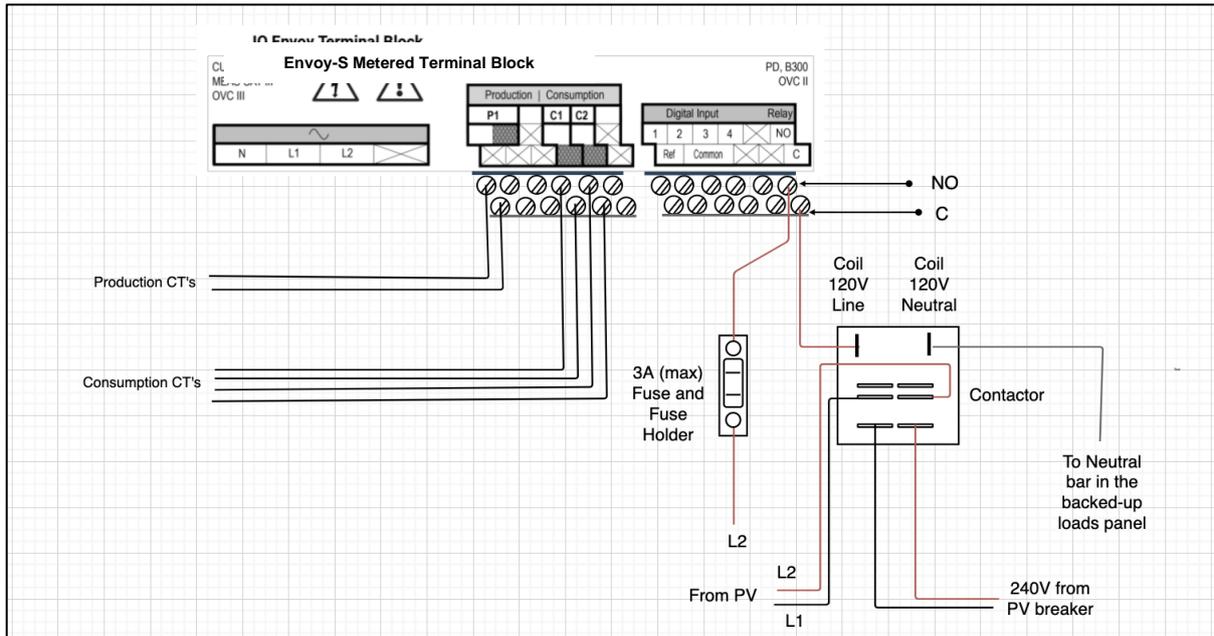


Figure 17: Wiring Envoy-S Metered for backfeed protection

Relay examples:

1. Dayton 1EJG7A (DPDT), double-pole, double-throw, 30A, encapsulated relay
2. Dayton 5X847N (DPDT), double-pole, double-throw, 40A, open contact relay

Configuration of different generator models

Remote start generators can be connected to an Enphase Energy System. Remote start generators can be either two-wire start or utility-sense. The following sections contain the schematics from the manuals of supported generators that have been tested with the Enphase Energy System. These diagrams show the location and type of signaling needed to work with the auxiliary contacts from IQ System Controller.

Note: Always consult the generator’s installation manual before installation

Supported Generator Models	Page No. in this tech brief
Kohler	23
Generac	24
Briggs & Stratton	26

Kohler

All models of the generator from Kohler are 2-wire start generators. The line diagram for connecting a Kohler generator to an Enphase Energy System is as shown in the below figure. Connect 2-wire remote start terminals of the generator (pin 3 and 4) to the generator auxiliary contact in IQ System Controller. Wire the generator output into the IQ System Controller’s generator input lugs. Supply 120 Vac from the backup loads panel to the utility terminals for the battery charger and accessories.

Example of a compatible Kohler Generator model

14RESAL: <http://www.kohlerpower.com/home/home-generators/products?prodNum=14RESAL>

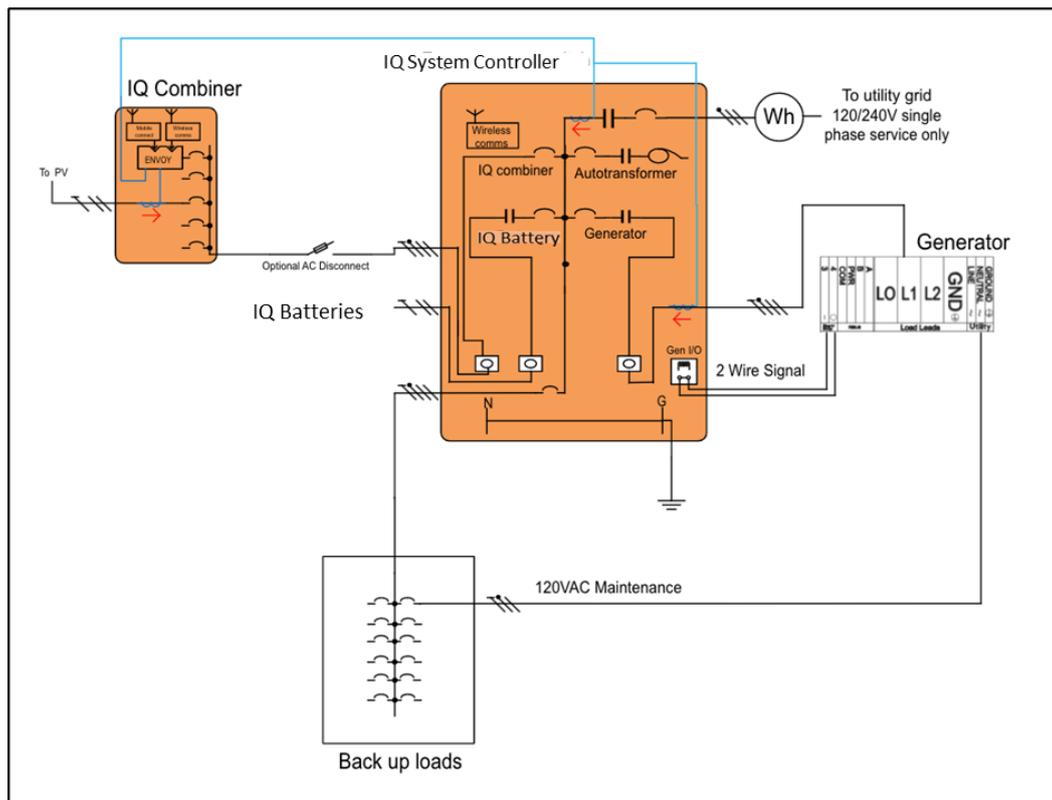


Figure 18: Kohler– Two-Wire Connection

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Generator Integration with the Enphase Energy System – North America

Generac

Generac provides a wide range of remote-start generators that automatically supply power to the house in case of a grid outage. The two main series of generators from Generac that we have considered here are the Guardian series and the EcoGen series.

Generac Guardian

The Generac Guardian series are utility-sense based start generators. Examples of compatible Generac Guardian generators are listed in Table 4. The line diagram for connection of these generators to an Enphase Energy System is as shown in Figure 19.

Generac provides a remote-start kit ([Part number 7109](#)) that allows their generators with an LCD display to be converted to a two-wire start. You can buy this kit to convert your Generac Guardian to a two-wire start generator to simplify the installation of controls for the generator. You can also purchase a Generac recommended kit for 120V Maintenance/Battery charger from [here](#).

NOTE: If you choose to use the above mentioned method, please contact Generac for any technical support needed.

Table 4: Examples of Compatible generators from Generac Guardian Series

Model Number	Details
7173	https://www.generac.com/all-products/generators/home-backup-generators/guardian-series/13kw-7173-wifi-enabled
7176	https://www.generac.com/all-products/generators/home-backup-generators/guardian-series/16kw-7176-wifi-enabled
7038	https://www.generac.com/all-products/generators/home-backup-generators/guardian-series/20kw-7038-wifi-enabled
7042	https://www.generac.com/all-products/generators/home-backup-generators/guardian-series/22kw-7042-wifi-enabled

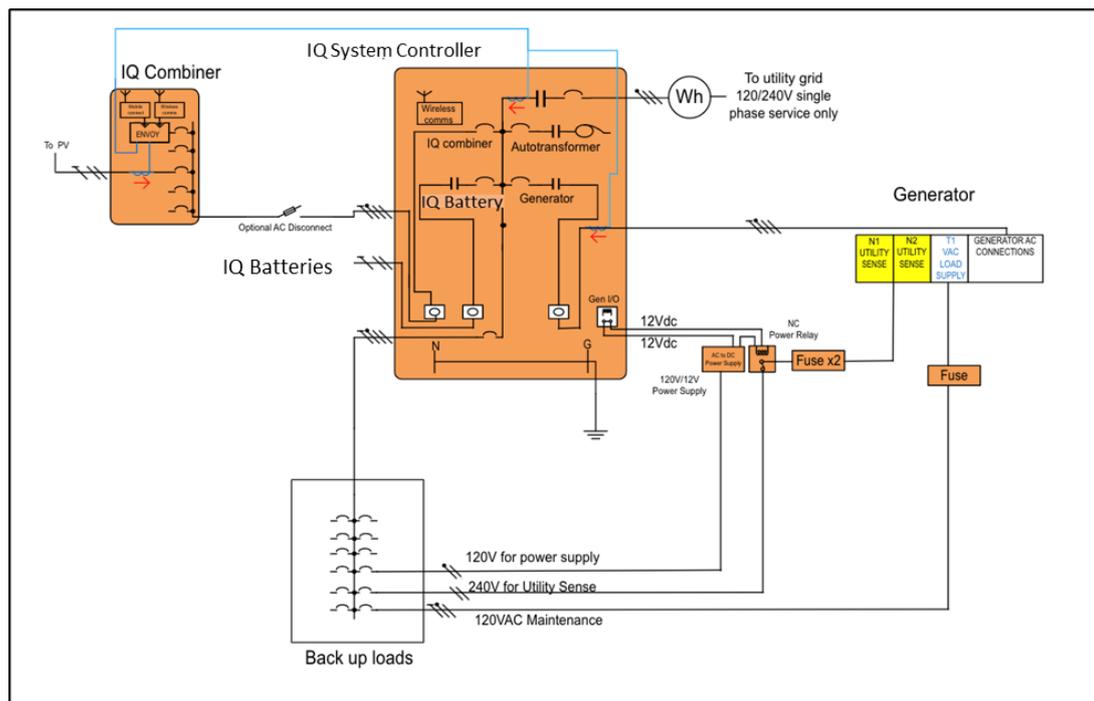


Figure 19: Generac Guardian- Utility Sense Connection

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Generac EcoGen (two wire or utility sense)

The Generac EcoGen model generator can be started by a two-wire start or utility-sense-based start. The utility-sense based start connections are same as that for Generac Guardian connections shown in below figure. The connections for two-wire start are as shown in Figure 20.

Example of a compatible generator model

7163: <https://www.generac.com/all-products/generators/home-backup-generators/ecogen/15kw-7034-wifi-enabled>

Table 5: Location of two-wire remote start connection in Generac 7163 Eco-Gen

Remote Start Connection		
Wire	Connection	Location
178	Female Faston	Hanging from controller above battery compartment
183	Female Faston	

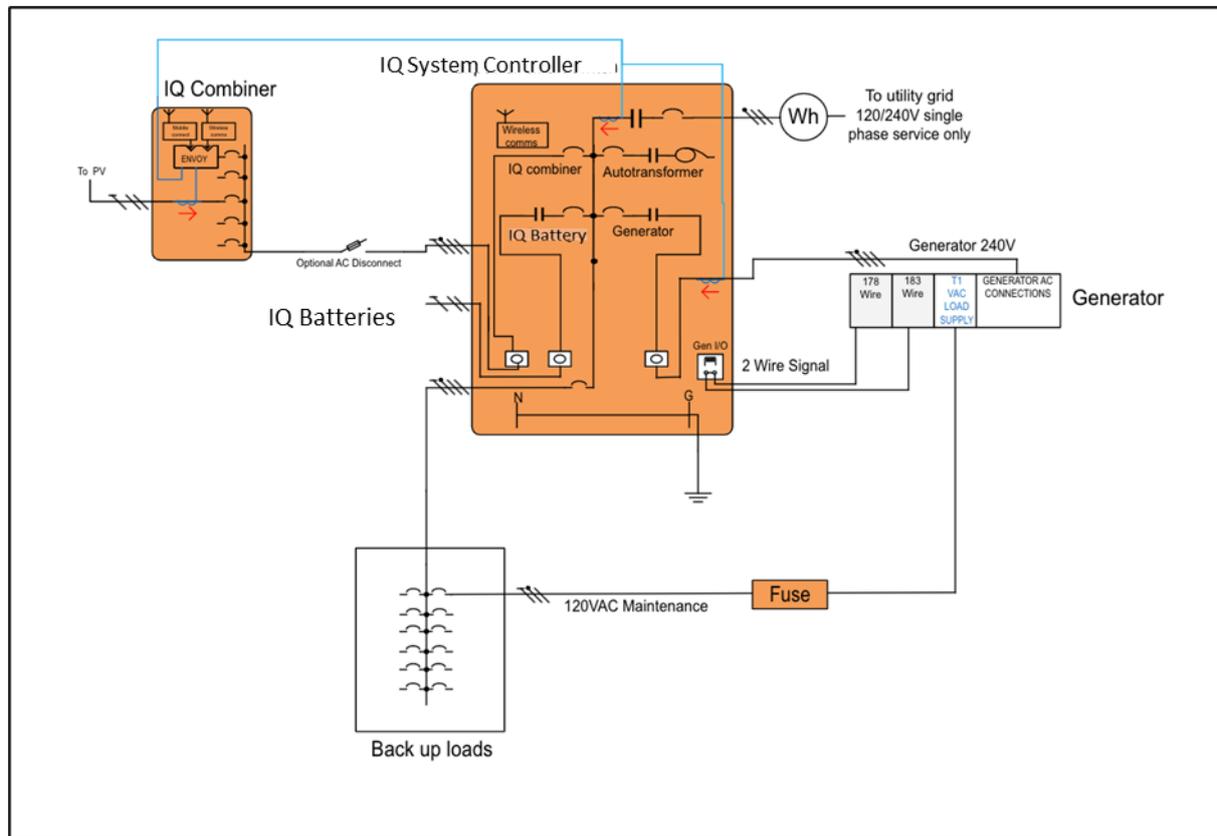


Figure 20: Generac EcoGen – Two Wire Connection

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Briggs & Stratton

The generators from Briggs and Stratton are auto-start based. The 040590 Series of generators from Briggs and Stratton have two-wire remote start capability. The terminals 4/5 on the generator are reserved for TxRx which can be used for communication with an Automatic Transfer Switch (ATS).

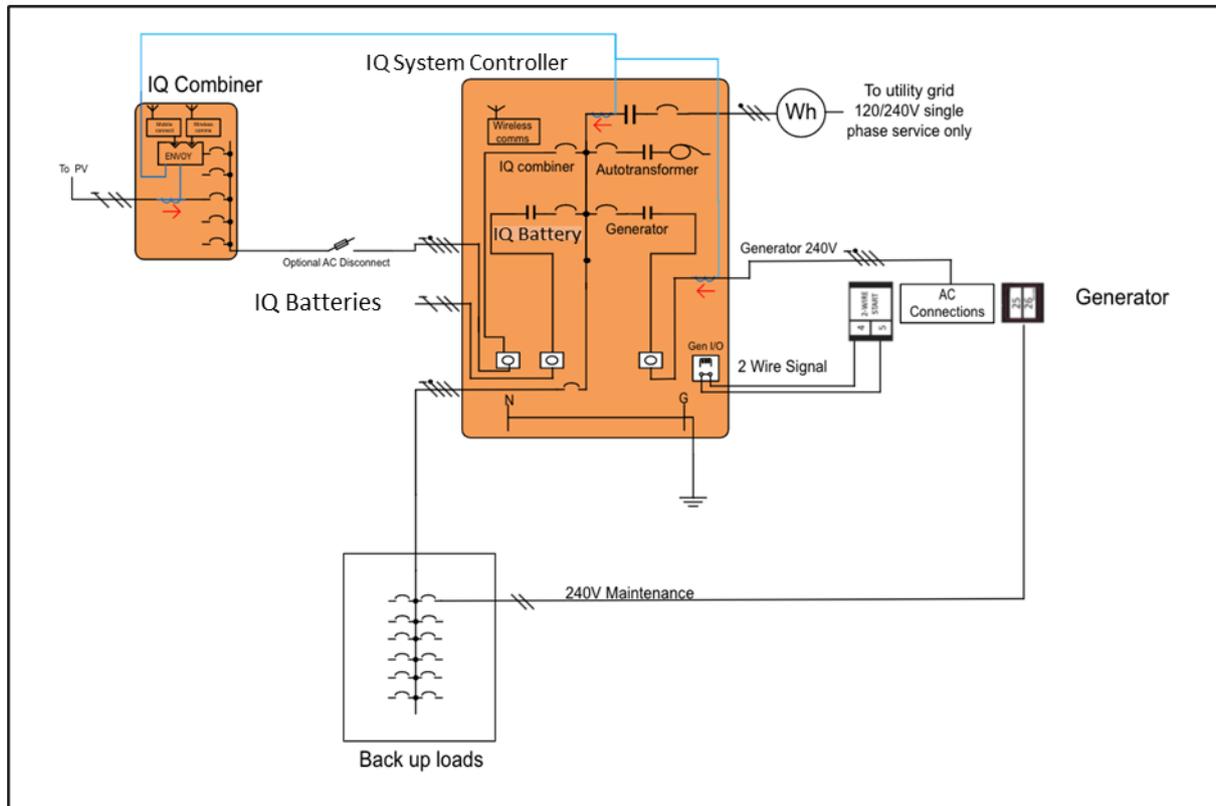


Figure 21: Briggs & Stratton – Two Wire Connection

NOTE: The above figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2. For more details, refer to [IQ System Controller 2 Quick Install Guide](#).

Generator settings

For remote start generators, the various settings provided in the Enphase Installer App are as listed below:

1. Two mutually exclusive smart profiles selectable in the app:
 - a. Eco-friendly – Turns on generator based on the battery charge level.
 - b. Automatic – Turns on generator immediately when the grid is down.
2. User overrides:
 - a. User can use the Automatic smart profile to start the generator anytime while the system is off grid.
 - b. User can stop/disable the generator at any time
3. Maintenance Window: Predefined by installer and editable by homeowners. Enables scheduling exercise cycles for the generator
4. Live real-time monitoring capability for generator, PV, and storage using 'Live status'

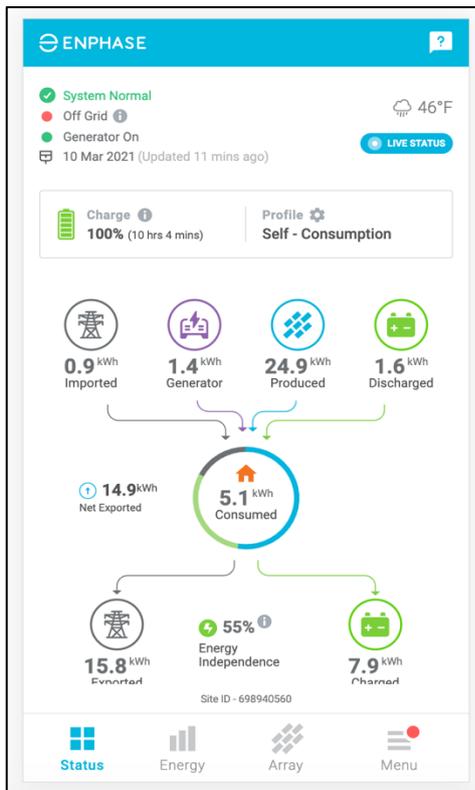


Figure 22: Status screen with generator

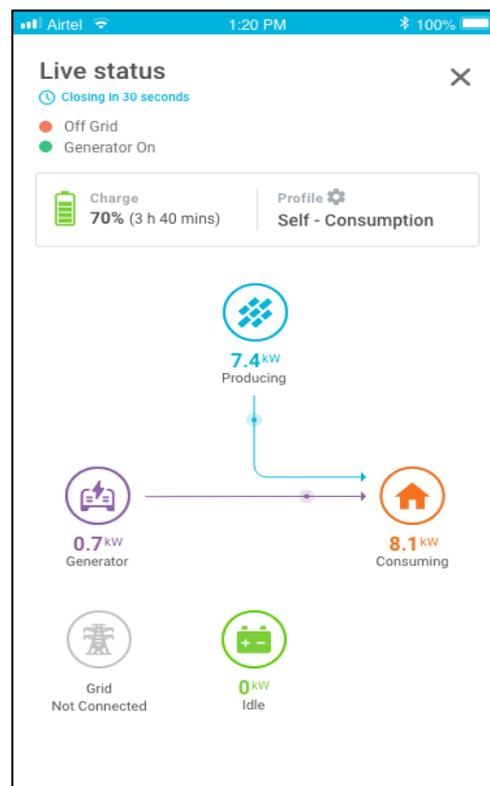


Figure 23: Live status screen with generator

Smart Profile

The Enphase Installer App provides various options that the homeowner can use to configure the generator operation as per his needs. Generator has two mutually exclusive smart profiles – Automatic and Ecofriendly which are selectable in the app as shown in the figure below:

Note: Generator 'Enabled' means that the generator will turn ON and turn OFF based on the selected profile and grid availability.

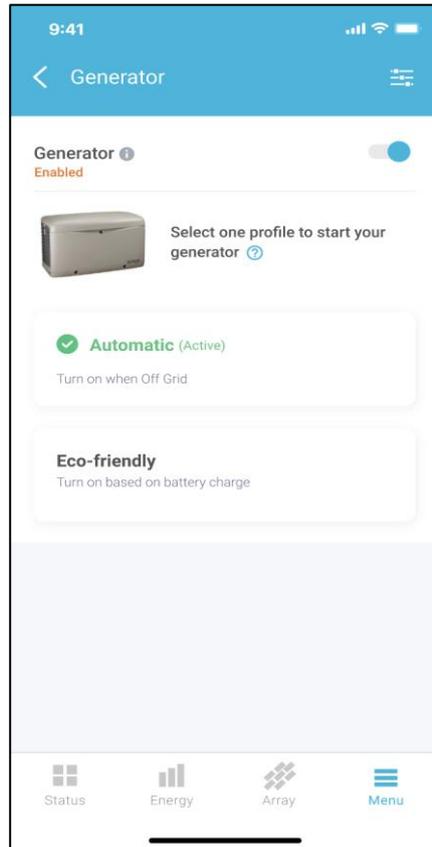


Figure 24: Smart profiles in the Enphase Installer App

Automatic

Select the 'Automatic' smart profile and tap on 'Activate' to turn on the generator immediately when the system goes off-grid. If the backup loads running during this duration is greater than the PV + Storage capacity, then there is a possibility of microgrid shutdown. To avoid this situation, use external contactors with IQ System Controller's auxiliary contacts (i.e., Load Control feature) to ensure all large loads are shed when going off-grid. These loads can be reconnected when the system is back on the grid.

NOTE: Transfer to generator can take up to 30 seconds after the grid is down

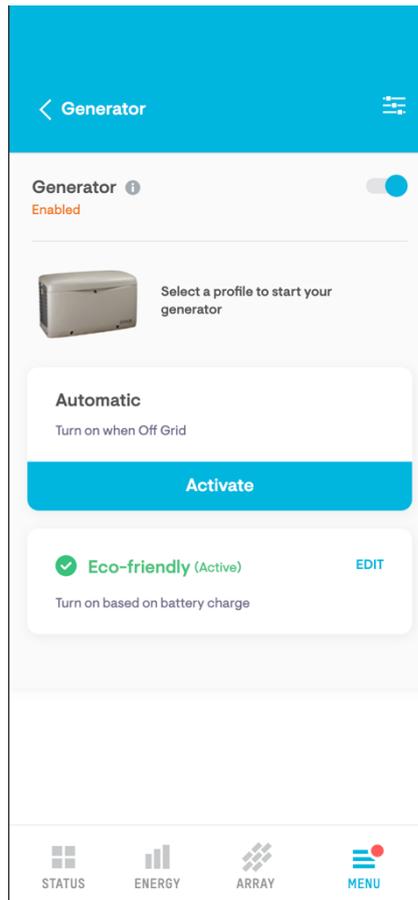


Figure 25: Automatic smart profile in Enphase Installer App

Eco-friendly

Select the 'Eco-friendly' smart profile to turn on the generator based on battery charge. Homeowner sets the lower and upper limit for battery charge. The lower limit corresponds to the generator start condition and the upper limit corresponds to the generator stop condition. When the system goes off-grid the generator is automatically started if the battery charge is less than or equal to the lower battery charge limit set by the homeowner. The generator in this scenario continues serving loads and charging batteries. When the battery charge equals the upper limit set by the homeowner, the generator is automatically stopped. The generator is also automatically stopped if the grid is back during this time and the system goes on grid.

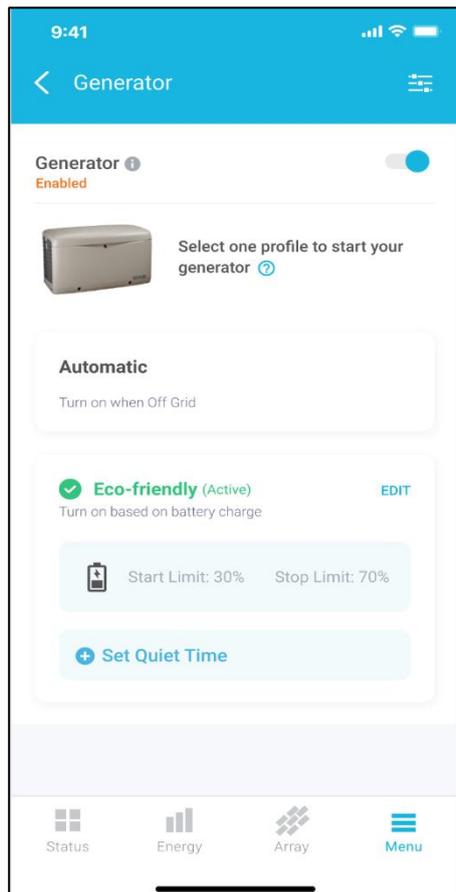


Figure 26: Eco-friendly smart profile in Enphase Installer App

Quiet time

Under Eco-friendly smart profile in the Enphase Installer App, there is an option given to the Homeowner called 'Set Quiet Time' to add periods during which generator operation is allowed only when battery charge falls below a critical limit. This feature is especially useful during nighttime to avoid noise that arises from generator operation. In this feature, the homeowner can set the critical charge settings i.e., homeowner can set the battery charge threshold at which the generator may be started, even during quiet time, to ensure the homeowner does not lose power. The generator turns off when the battery charge reaches the upper limit set by the homeowner.

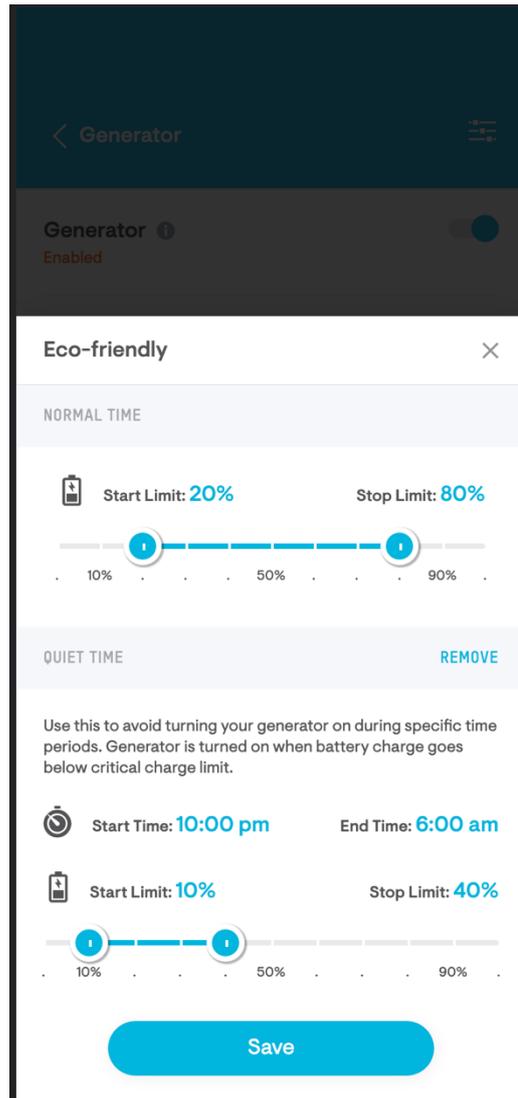


Figure 27: Quiet Time settings in Enphase Installer App

Advanced settings

Tap on the Settings icon on the upper right corner of the screen to access the Advanced Settings options that the Enphase Installer App provides

- **Exercise Settings:** This option allows exercise cycles to be scheduled to run the generator at regular intervals to keep it in a good working condition. Generator is started and exercised as per these settings. Note that the exercise mode is with no load and generator not connected to the microgrid

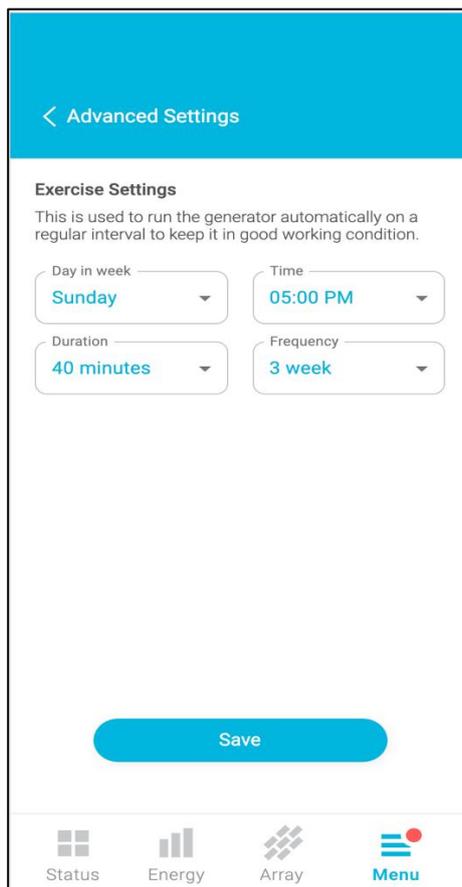


Figure 28: Advanced Settings in Enphase Installer App

Disable or suspend generator

There is an option to disable or suspend an auto-start generator at any time using the Enphase Installer App. Click on the toggle button to disable the generator as shown in the below figure. If this option is used while the generator is running, then the generator stops immediately. This feature is useful when undertaking any maintenance works such as generator servicing, replacement, etc. This option works only for generators that were auto-started. If an auto-start generator was turned on manually, then it must be turned off manually.

NOTE: In case of a microgrid collapse, utility-sense generators will turn on and try to blackstart the system even if the generator was disabled from the app.

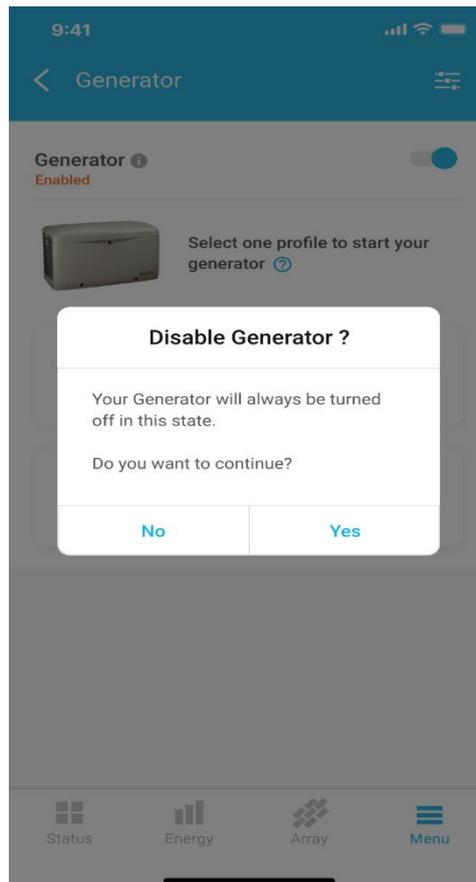


Figure 29: Disable generator option in Enphase Installer App

Adding a generator to a system using Enphase Installer App

Follow the below steps to add a generator to the Enphase Energy System using Enphase Installer App:

1. Launch the Enphase Installer App and tap Systems.
2. Select the system you are working with or tap [+] to add a system.
3. Make sure that the system details are added (Enphase Installer App Step 1)
4. Go to Devices & Array (Enphase Installer App Step 2) and add the total number of devices of each type in the system. Tap **'Add Device'** if you need to edit previously entered data.
5. Tap on device type Generator and add all the generator details such as manufacturer name, model, serial number etc.
6. Enter the maximum continuous gen amps value, generator efficiency set point⁴ and generator nameplate rating.
7. If you select a generator of auto-start type, you need to select the mode of operation and can also set values for advanced settings such as exercise Mode etc.
8. Tap on 'Done'
9. Connect to the IQ Gateway/Envoy-S Metered and start provisioning devices. Once provisioned, you can see the line "Generator details updated" in Enphase Installer App.
10. In step 6 **"Meter Configuration"**, follow the wizard to enable the generator meter

NOTE: You must wait for the IQ Battery firmware upgrade to finish before you start enabling the generator meter.

11. In Step 7 **"Complete Functional validation"** by following the steps shown in Enphase Installer App.
12. Confirm that the system summary report generated in step 8 includes generator details

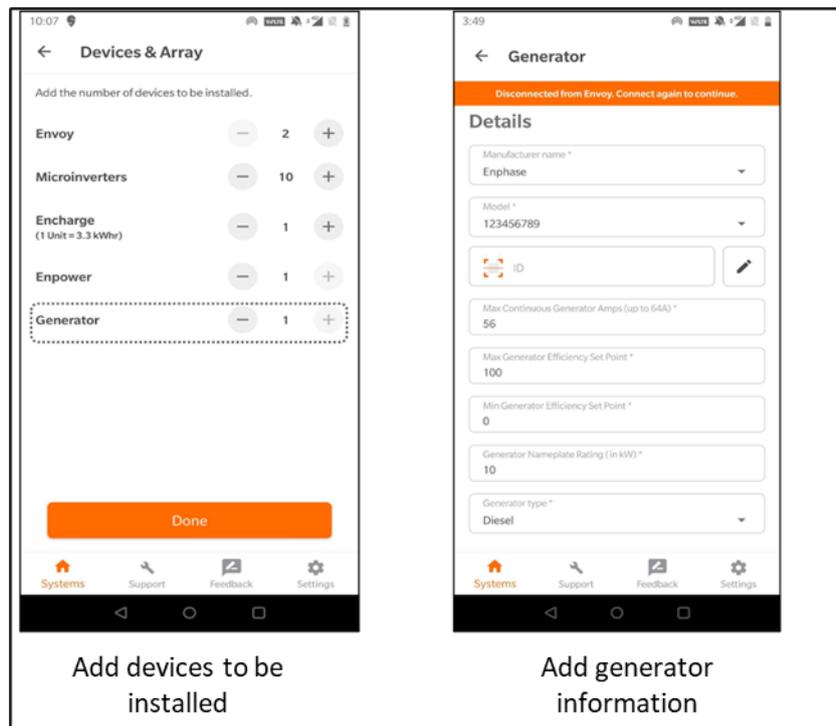


Figure 30: Adding a generator to a system using the Enphase Installer App

⁴ Max generator efficiency set point is calculated as a percentage of the value entered in Max Continuous Generator Amps field in the Enphase Installer App. System will try to ensure that the use of generator is within this limit. If the generator is loaded beyond this limit, then the system stops charging batteries. If the limit is exceeded even after stopping the charging of batteries, then the batteries start discharging to support the loads.

Generator Integration with the Enphase Energy System – North America

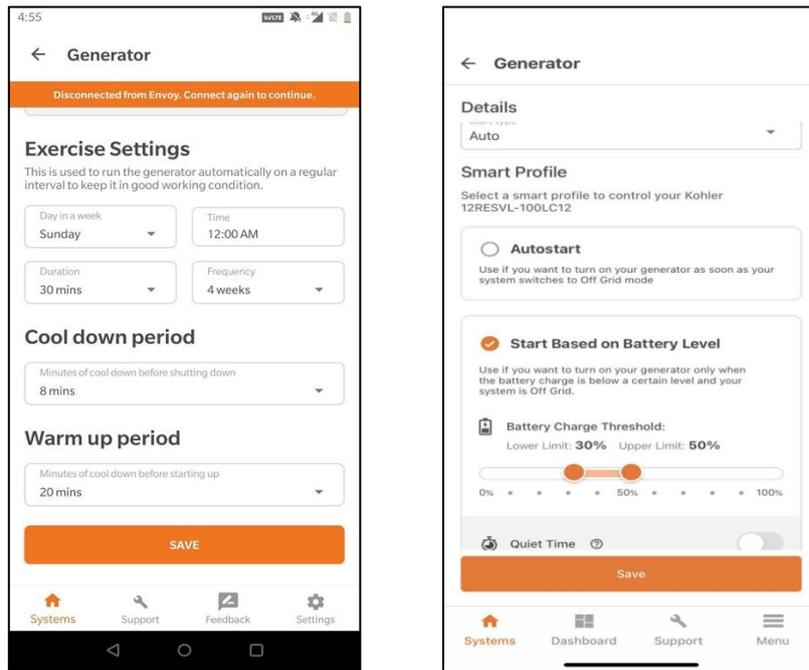
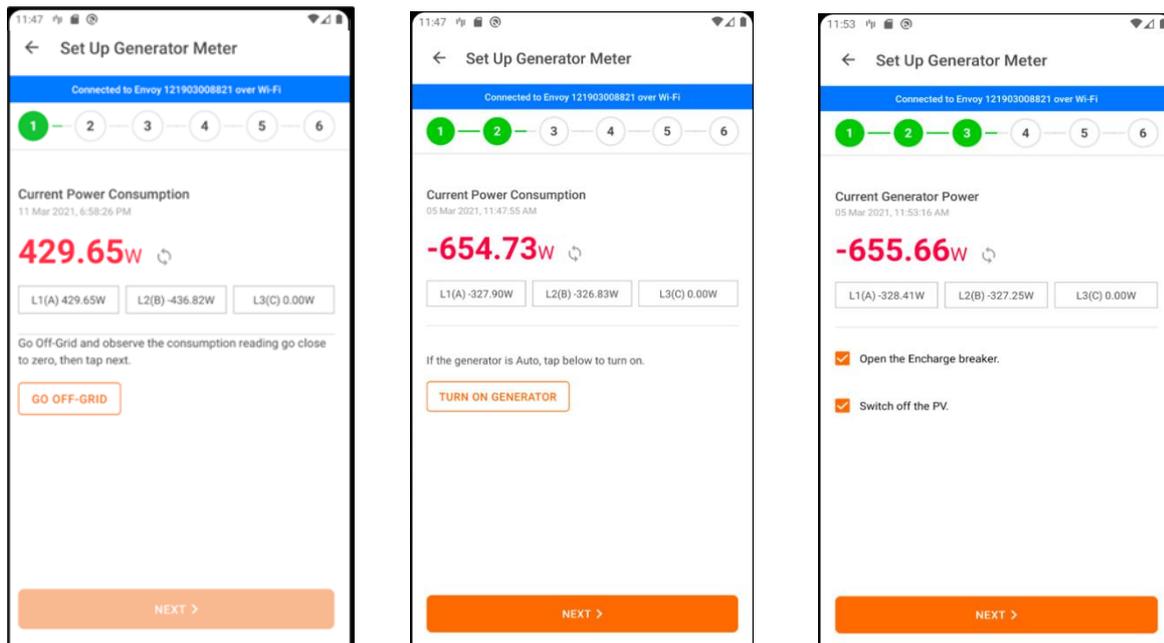
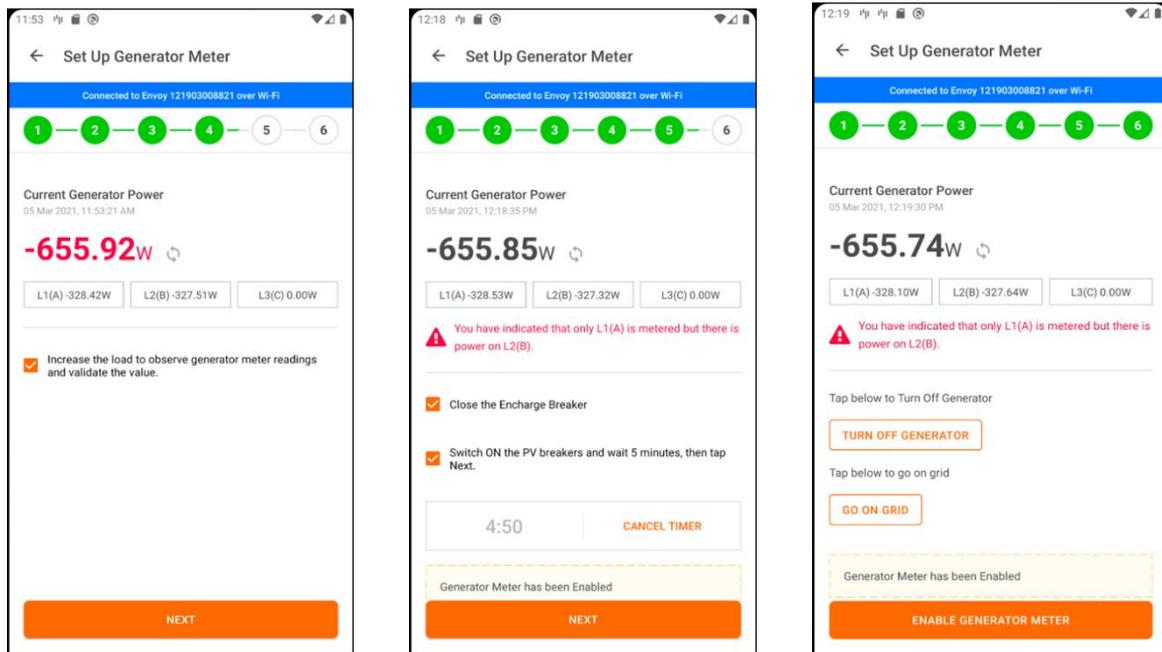


Figure 31: Adding a generator to a system using the Enphase Installer App continued

Generator meter configuration in the Enphase Installer App



Generator Integration with the Enphase Energy System – North America



Generator meter configuration steps:

NOTE: You must wait for the IQ System Controller firmware upgrade to finish before you start enabling the generator meter.

1. Ensure the DC switch on IQ Batteries is turned ON before going to generator meter.
2. Go to Step 6 **meter configuration** in the Enphase Installer App and tap on the **Generator Meter** to configure it. Tap on 'Go off-grid' and observe the consumption reading drop close to zero. Tap on 'Next' once it is enabled ('Next' button gets enabled once the system goes off-grid. It might take up to 40s for the system to go off-grid)
3. If the generator is not ON, tap on 'Turn On Generator' to automatically turn on the generator. If the generator is not turning on, set the mode to 'Autostart' in Step 2 and re-provision.
4. Open the IQ Battery breaker, switch off PV. Select the check boxes on the screen and tap on Next
5. Increase the load and observe generator meter readings rise. Validate the readings, select the checkbox and tap on 'Next'
6. Close the IQ Battery breaker and select the checkbox. Switch ON the PV breakers and wait for 5 mins. Once the timer expires, tap on 'Next'
7. Tap on 'Turn off generator' -> 'Go on grid', 'Enable generator meter'

Generator details and settings in the Enphase Installer Platform

The generator that is added in the Enphase Installer App will be available in the Enphase Installer Platform in Devices section.

Production Meter						
Meter Type	Part Number	Serial #	Lifetime Energy	Last Report	Status	
Enphase Integrated Production Meter Single-Phase (L-L)	800-00655-r08	202040004942EIM1	2.19 MWh	12/22/2020 03:00 AM PST	<input checked="" type="checkbox"/> Normal	

Consumption Meter						
Meter Type	Part Number	Serial #	Config Type	Lifetime Energy	Last Report	Status
Enphase Integrated Consumption Meter Single-Phase (L-L)	800-00655-r08	202040004942EIM2	Load with Solar production	678 kWh	12/22/2020 03:00 AM PST	<input checked="" type="checkbox"/> Normal

[Request access to consumption data](#) You already have access to this system's consumption data.

Generator Meter						
Meter Type	Part Number	Serial #	Lifetime Energy	Last Report	Status	
Enphase Integrated Generator Meter Single-Phase (L-L)	800-00655-r08	202040004942EIM3	186 kWh	12/18/2020 05:30 PM PST	<input checked="" type="checkbox"/> Normal	

Figure 32: Generator details and setting in the Enphase Installer Platform (Production Meter, Consumption Meter, and Generator Meter)

Generator								
Model	Manufacturer	ID	Generator Type	Start Type	Status	Max Continuous Gen Amps	Nameplate Rating	Created
generac	generac		auto	Auto	Auto	55	4	2020/11/30 20:39:54 -0800 (PST)

Figure 33: Generator Summary

Click on model name and the generator details section will open.

Generator Integration with the Enphase Energy System – North America

Status : Auto ID : Operation Mode : Battery Optimization Max Continuous Gen Amps : 55 A Max Generator Efficiency SetPoint : 70 % Min Generator Efficiency SetPoint : 10 % Nameplate Rating : 4 kW Generator Type : auto Start Type : Auto Manufacturer : generac Model : generac Created : 2020/11/30 20:39:54	Edit Details	
SOC threshold value Start SOC : 55 % Stop SOC : 70 %	Quiet time Start time : Stop time : Start SOC : Stop SOC :	Exercise mode Day in a week : Monday Time : 09:00 AM Duration : 2 mins Interval : 4 weeks
Cool down period Minutes of cool down before : 1 min shutting down	Warm up period Minutes of warm up before: 1 min starting up	
Generator control settings <div style="display: flex; justify-content: space-between;"> Disable Generator Remove Generator </div>		

Figure 34: Generator details

“Enable Generator” and “Disable Generator” will act like the functionality in the Enphase Installer App. “Remove Generator” will delete the generator from the system.

Click on “Edit Details” to configure operation mode. All the settings in below page will act like the settings in the Enphase Installer App.

Name	Value
Manufacturer Name	<input type="text" value="generac"/>
Model	<input type="text" value="generac"/>
ID	<input type="text"/>
Operation mode	<input type="text" value="Battery Optimization"/>
Max Continuous Gen Amps (up to 64A)	<input type="text" value="55"/>
Max Generator Efficiency Set Point (up to 100%)	<input type="text" value="70"/>
Min Generator Efficiency Set Point (up to 100%)	<input type="text" value="10"/>
Nameplate Rating (in kW)	<input type="text" value="4"/>
Generator type	<input type="text" value="auto"/>
Start type	<input type="text" value="Auto"/>
EXERCISE MODE	
Day in a week	<input type="text" value="Monday"/>
Time	<input type="text" value="09:00 AM"/>
Duration(up to 60 mins)	<input type="text" value="2"/>
Interval	<input type="text" value="4"/>

Figure 35: Generator edit table

Generator Integration with the Enphase Energy System – North America

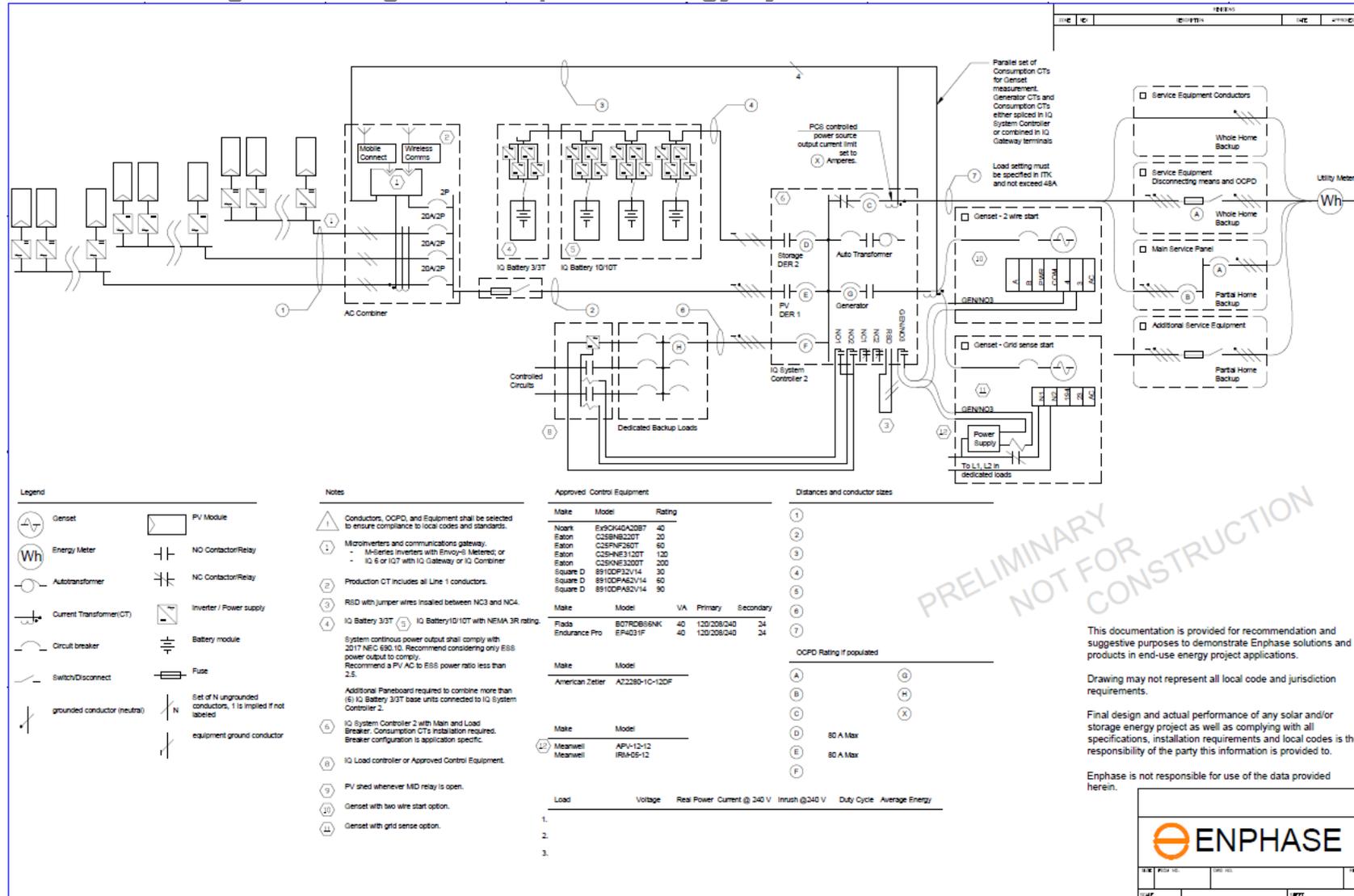
COOL DOWN PERIOD	
Minutes of cool down before shutting down (up to 60 mins)	<input type="text" value="1"/>
WARM UP PERIOD	
Minutes of warm up before starting up (up to 60 mins)	<input type="text" value="1"/>
SOC THRESHOLD VALUE	
Start SOC	<input type="text" value="55"/>
Stop SOC	<input type="text" value="70"/>
QUIET TIME	
Start Time	<input type="text"/>
Stop Time	<input type="text"/>
Start SOC	<input type="text"/>
Stop SOC	<input type="text"/>

Figure 36: Generator edit table continued

Generator troubleshooting

#	Error/Event	Impact	Recommended Action
1	Event: <ul style="list-style-type: none"> GeneratorVoltageImbalance OR GeneratorComBusPhaseDifferenceOOR 	Generator was overloaded. Generator breaker in IQ System Controller tripped, and the generator is disconnected. The homeowner would see a loss of power for 6 seconds. The system will then restart using IQ Battery and power should be restored.	The system will try to reconnect the generator in 5 minutes. You should: <ul style="list-style-type: none"> Open IQ System Controller door, turn off the generator breaker and turn it on again. (When you open IQ System Controller, the generator breaker lever will not be in ON position) Ensure you do not overload the system while the generator is running.
2	Generator voltage and/or frequency out of spec while in generator mode and generator is connected Event: <ul style="list-style-type: none"> EnpowerGeneratorVoltHighTrip EnpowerGeneratorVoltLowTrip EnpowerGeneratorFreqHighTrip EnpowerGeneratorFreqLowTrip 	The generator gets disconnected	Generator maintenance required
3	Generator not starting Event: GeneratorStartFailed	The generator does not start as selected in user preferences.	Check if the generator 2-wire start/stop wiring to IQ System Controller is loose. Check whether the generator breaker at the unit was tripped (if so turn the breaker off and then on. Also switch the controller to the auto position), whether the generator is out of fuel, or the starting battery of the generator was dead. Contact your installer or Enphase customer support if the problem persists.
4	Generator not stopping Event: GeneratorStopFailed	Generator continues to run even though user preferences indicate it should have stopped.	Check if the generator 2-wire start/stop wiring to IQ System Controller is loose. Turn off the generator manually and contact installer or Enphase customer support.
5	High Total Harmonic Distortion (THD) Measured THD is above 25% Event: GenTHDHigh	Generator power output is not stable and having high THD (THD means total harmonic distortion, which is a metric to measure the power quality. If the THD is high, the performance of your electronics will be affected; for example, you may see flickering lights).	The generator is connected to the system, but to protect your home appliances, disable the generator and contact generator manufacturer or installer to get the generator checked or switch to another generator.
6	The generator load is above the allowed limit Event: HighLoad	The generator power output has exceeded the optimum efficiency point specified. Fuel consumption will be higher than usual and if the grid comes back the system may collapse while going back on grid. This can happen when the power being drawn from the system while the generator is connected exceeds the IQ Battery nameplate.	Reduce loads.
7	Generator CT missing or in error state Event: EnsembleConsumptionCTError	The generator is connected to the system however the system has no way of monitoring the generator's power output since the current transformers (CTs) are missing or have not been properly connected.	The generator CTs must be installed and wired correctly. Turn off the generator manually and contact installer or Enphase customer support.

APPENDIX- Single line diagram of Enphase Energy System with IQ6/7/M-series microinverters and generator



PRELIMINARY NOT FOR CONSTRUCTION

This documentation is provided for recommendation and suggestive purposes to demonstrate Enphase solutions and products in end-use energy project applications. Drawing may not represent all local code and jurisdiction requirements. Final design and actual performance of any solar and/or storage energy project as well as complying with all specifications, installation requirements and local codes is the responsibility of the party this information is provided to. Enphase is not responsible for use of the data provided herein.

DATE	PROJECT NO.	DATE REV.	REV.

APPENDIX – Single line diagram of Enphase Energy System with IQ8-series microinverters and generator

