Generator integration with Enphase Energy System

February 2024
TEB-00003-3.0

Contents

Overview

This document provides site surveyors and design engineers with 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 data sheets, quick install guides, and product manuals. Diagrams and information in this document are illustrative examples of 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 Enphase Energy System 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 Technical Brief.

NOTE: The third generation IQ System Controller features the IQ System Controller 3 (SC200D111C240US01) and the IQ System Controller 3G (SC200G111C240US01). The IQ System Controller 3G supports one PV and one IQ Battery 5P port. A third distributed energy resource (DER) port is dedicated to generator integration, which is interlocked via hardware with the MID. The IQ System Controller 3 and IQ System Controller 3G are not interchangeable in the field. The generator integration feature remains the same across IQ System Controller 2 and IQ System Controller 3G.

NOTE: The term IQ System Controller, when used in this document, refers to IQ System Controller 1, IQ System Controller 2, and IQ System Controller 3G unless otherwise specified.

NOTE: To integrate a generator into an Enphase Energy System, mandatory generator training is required from Enphase University at https://university.enphase.com.

Introduction

With the Enphase Energy System, homeowners will 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 without 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 system controller software.
- Enphase Communications Kit enables the IQ Battery, the IQ System Controller, and the IQ Gateway to communicate securely.
- M Series or IQ Series solar microinverters convert DC power from the solar panels to AC power.
- Enphase Mobile Connect cellular modem to provide a backup internet connection without 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, eliminating the need for an external automatic or manual transfer switch. The IQ System Controller turns on and controls auto-start generators when the utility grid is down without any intervention from homeowners. The generator reduces dependency on environmental variables (irradiance for solar power production) and provides an additional power source while the system is off-grid. The generator can 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, which support either a generator or PV + storage solution. Adding generator support to the Enphase storage system helps create a highly resilient, grid-independent solution.

Key features

- The generator runs in the off-grid mode and does not operate in parallel with the grid.
- The generator can run 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 an on-grid to an off-grid state without loss of power. The generator is turned on automatically when the system is off-grid. The generator supplies power to loads and batteries 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 less fuel consumption, and consequently reduces generator maintenance requirements. For example, the generator is turned on if the 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 allows the user to select a period during which the generator stays off unless battery SOC drops below a critical charge threshold.
- The Enphase Installer App provides a user-configurable Generator Exercise Mode option. For example, the generator runs for 15 minutes 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 the manufacturer-provided exercise mode (if present).

Comparison of Enphase Energy Systems with typical solutions

Generator support with typical competitor solar + storage solutions

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 simultaneously. Such a design is inefficient, complicated, and difficult to operate.

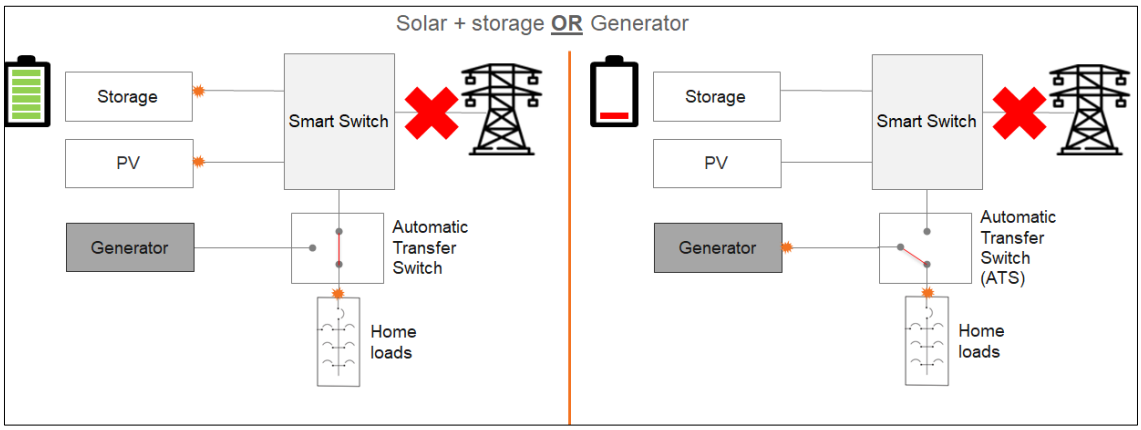


*Figure 1: Typical solution: **generator or PV + storage***

The typical generator or PV + storage solution requires an external automatic transfer switch (ATS). 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 a grid outage after the battery is fully discharged. These solutions do not allow concurrent generator and PV + storage system operation. 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 the 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.

Generator support with Enphase Energy System

Enphase generator support solution is **generator AND PV + storage**, meaning the generator and renewables (PV and IQ Battery) can operate simultaneously, 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. The 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. The generator support capability is efficient, simple, and user-friendly.

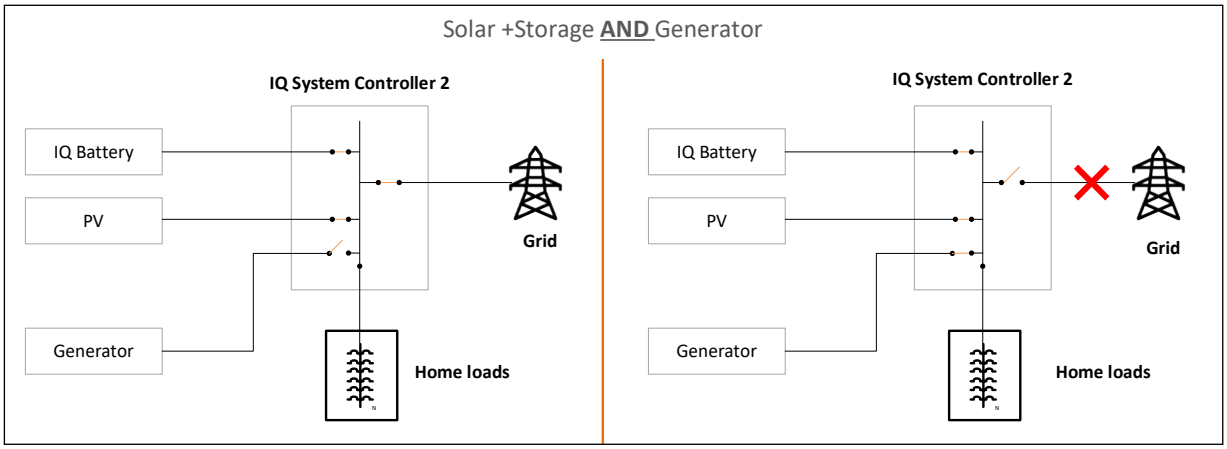


Figure 2: Enphase Energy System: Generator AND PV + storage

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

- Allows the generator to charge batteries and serve loads.
- Automatically starts and stops the generator based on user preferences or user commands via the 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 App) for controlling and monitoring PV, storage, and generator at the homeowner's fingertips.
- Sends maintenance reminders 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 shines. The Sunlight Backup system does not include any IQ Batteries. The system can support PV branch circuits rated for up to 64 A continuous current output. Integrating a generator with a Sunlight Backup system provides a reliable source of power that does not depend on the irradiance available.

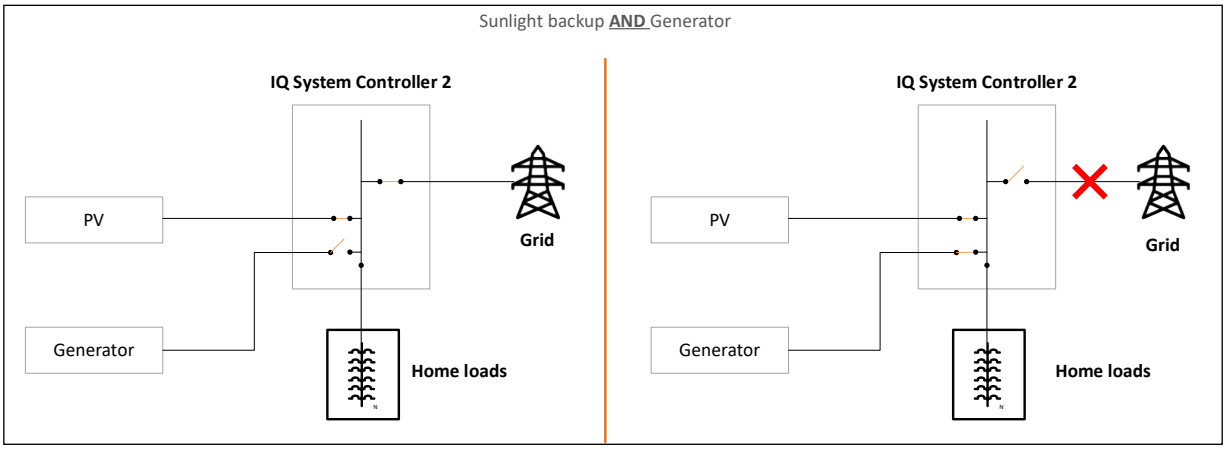


Figure 3: Enphase Energy System: Sunlight backup and generator

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 240 V or eight 120 V pre-selected, essential load circuits backed up by the system. Additional breakers are needed to power the IQ Load Controllers.

- Up to two IQ Load Controllers, each enabling fine-grained, circuit-level control for two 240 V or four 120 V essential load circuits. Each 240 V load can be controlled independently, but the 120 V loads can be controlled in groups of up to two. Sunlight Backup system needs at least one IQ Load Controller installed on-site.
  This configuration is not a use case supported by Enphase.

NOTE:

- Using this configuration for backing up an entire home is not a use case supported by Enphase.
- Only use utility sense generators with Sunlight Backup systems. If a two-wire start generator is used, the system will not be able to start the generator when it is powered off—for example, if the grid fails at night. Utility sense generators can 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 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 located after the IQ System Controller, allowing 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 no parallel power sources will be in operation.

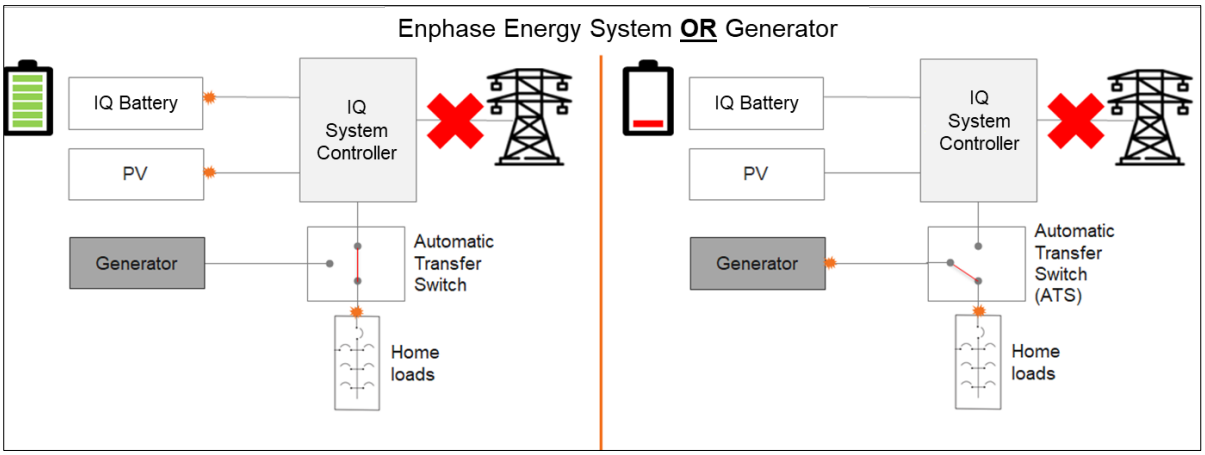


Figure 4: Enphase Energy system or generator

Generators that can be integrated with the Enphase Energy System

Different generators have different governor responses to changes in load. The Enphase Energy System also responds to changes in loads. Enphase has tested various generators and tuned its software to ensure smooth operation in a microgrid 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 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 compatible with the 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 section of this technical brief provides the minimum generator size corresponding to the number of IQ Batteries in the system to ensure stable microgrid operation.

Table 1: List of generators recommended by Enphase[1]

Model	Manufacturer name	Generator type	Start type	Nameplate rating
76153 (48 kW)	Briggs and Stratton	Standby	Auto	48
040336 (20 kW)	Briggs and Stratton	Standby	Auto	20
040590 (12 kW)	Briggs and Stratton	Standby	Auto	12
40586 (20 kW)	Briggs and Stratton	Standby	Auto	20
40303 (15 kW)	Briggs and Stratton	Standby	Auto	15
C20N6H-A061C601 (20 kW)	Cummins	Standby	Auto	20
RS13A/C13N6H (13 kW)	Cummins	Standby	Auto	13
C30N6H (30 kW)	Cummins	Standby	Auto	30
G007171-0, G007172-0 (10 kW)	Generac	Standby	Auto	10
G007173-0, G007174-0, G007175-0 (13 kW)	Generac	Standby	Auto	13
G007176-0, G007177-0, G007178-0 (16 kW)	Generac	Standby	Auto	16
G007038-1, G007039-1 (20 kW)	Generac	Standby	Auto	20
G007042-2, G007043-2 (22 kW)	Generac	Standby	Auto	22
G007038-3, G007039-3 (20 kW)	Generac	Standby	Auto	20
G007042-3, G007043-3 (22 kW)	Generac	Standby	Auto	22
G0064371 (11 kW)	Generac	Standby	Auto	11

[1] Generac Guardian models are also white-labeled and sold as Honeywell generators.

Model	Manufacturer name	Generator type	Start type	Nameplate rating
G0055050 (17 kW)	Generac	Standby	Auto	17
G007035-0, G007036-0, G007037-0 (16 kW)	Generac	Standby	Auto	16
G0070400 (22 kW)	Generac	Standby	Auto	22
G0072269 (18 kW)	Generac	Standby	Auto	18
G007226-0, G007228-0 (18 kW)	Generac	Standby	Auto	18
G00072090, G00072101 (24 kW)	Generac	Standby	Auto	24
QT03624ANAX Protector QS Series (36 kW)	Generac	Standby	Auto	36
G0058750 (20 kW)	Generac	Standby	Auto	20
G0062561 (16 kW)	Generac	Standby	Auto	16
G007035-1, G007036-1, G007037-1 (16 kW)	Generac	Standby	Auto	16
G0052141 (25 kW)	Generac	Standby	Auto	25
G007223-0, G007224-0, G007225-0 (14 kW)	Generac	Standby	Auto	14
G0065510 (22 kW)	Generac	Standby	Auto	22
G0052440	Generac	Air-cooled	Auto	16
QT02525ANAN (25 kW)	Generac	Standby	Auto	25
G007163-0 (15 kW)	Generac	Standby	Auto	15
G007223-9 (14 kW)	Generac	Standby	Auto	14
G007043-10 (22 kW)	Generac	Standby	Auto	22
G0072109 (24 kW)	Generac	Standby	Auto	24
G0060551 (20 kW)	Generac	Standby	Auto	20
G0065512 (22 kW)	Generac	Standby	Auto	22
RG02224ANAX (22 kW)	Generac	Standby	Auto	22
G00072900, G0072910 (26 kW)	Generac	Standby	Auto	26
G0070311 (11 kW)	Generac	Standby	Auto	11
RG027 (27 kW) Protector QS Series	Generac	Standby	Auto	27
RG022 (22kW) Protector QS Series	Generac	Standby	Auto	22
G006244-0, G006250-0 (20 kW)	Generac	Standby	Auto	20
G0072101 (24 kW)	Generac	Standby	Auto	24
G0070430 (22 kW)	Generac	Standby	Auto	22

Model	Manufacturer name	Generator type	Start type	Nameplate rating
G007042-9 (22 kW)	Generac	Standby	Auto	22
G007033-0 (11 kW)	Generac	Automatic	Auto	11
0055592 (27 kW) 1800 RPM Model	Generac	Standby	Auto	27
0062810 (15 kW) Centurion	Generac	Standby	Auto	15
G0007042-0 (22 kW)	Generac	Standby	Auto	22
RG02724ANAX Protector QS Series (27 kW)	Generac	Standby	Auto	27
G0070438 (22 kW)	Generac	Standby	Auto	22
G0072100 (24 kW)	Generac	Standby	Auto	24
69981 (7.5 kW)	Generac	Standby	Auto	7.5
G0065511 (22 kW)	Generac	Standby	Auto	22
QTO2224ANAX QS Series (22 kW)	Generac	Automatic	Auto	22
HYW-14M6SAE240 120 V 60 Hz M6 (12 kW)	HiPower	Water-cooled diesel	Auto	12
G0062602 (17 kW)	Honeywell	Standby	Auto	17
G007060 (17 kW)	Honeywell	Standby	Auto	17
G007065-2 (22 kW)	Honeywell	Automatic	Auto	22
G007063-2 (20 kW)	Honeywell	Standby	Auto	20
G0070580 (11 kW)	Honeywell	Standby	Auto	11
G0070650 (22 kW)	Honeywell	Standby	Auto	22
G0070591 (16 kW)	Honeywell	Automatic	Auto	16
14RESA (14 kW)	Kohler	Standby	Auto	14
20RESA (20 kW)	Kohler	Standby	Auto	20
24RCL (24 kW)	Kohler	Standby	Auto	24
10RESV (10 kW)	Kohler	Standby	Auto	10
12RESV (12 kW)	Kohler	Standby	Auto	12
Kohler 20RESCL (20 kW)	Kohler	Standby	Auto	20
20RESCL (20 kW)	Kohler	Standby	Auto	20
20RCA (20 kW)	Kohler	Standby	Auto	20
20RESC (20 kW)	Kohler	Standby	Auto	20
14RCA (14 kW)	Kohler	Standby	Auto	14

Model	Manufacturer name	Generator type	Start type	Nameplate rating
30REYG	Kohler	Water-cooled ADC 2100 digital controller	Auto	27
12 RES (12 kW)	Kohler	Standby	Auto	12
8RESVL (8 kW)	Kohler	Standby	Auto	8
20RESL (20 kW)	Kohler	Standby	Auto	20

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:

- 240 V L-L, split-phase with neutral[2]
- Voltage regulation: Within -12% to +10%, i.e., 211.2 V (full load) to 264 V (no load)[3]
- Frequency regulation less than ± 5%, i.e., 57 Hz (full load) to63 Hz (no load)[3]
- Generator start-up types:
  - Two-wire start
  - Utility sense–based start
- Total harmonic distortion <25%[4]

Enphase cannot test every generator. Installers must select the above generators to ensure they can integrate and operate with the Enphase Energy System. Generators not listed above will not be supported. See this document's Unsupported or undersized generator connections for details on incorporating 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.
For a system using an IQ System Controller 1, the maximum generator current is limited to 48 A continuous (60 A overcurrent protection) to protect the associated power relays in the IQ System Controller 1 for the generator position.
For a system using an IQ System Controller 2 or IQ System Controller 3G, the maximum generator current is limited to 64 A continuous (80 A overcurrent protection) to protect the associated power relays in the IQ System Controller 2/IQ System Controller 3G 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 limits 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 operating with IQ Battery and PV. This ensures the generator can be safely operated and not damaged by inadvertent back-feed from the PV and/or storage.

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

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

[4] 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.

NOTE: Sufficiently size the generator to support loads and charge the IQ Batteries simultaneously. The minimum generator size should be used as a starting point during design.

NOTE: To prevent microgrid collapse, no single load may exceed the output capabilities of the battery system, even when a generator is installed (NEC 710.15A). But during the off-grid transition, before the generator fully turns on, the battery and/or PV system will carry the entirety of the load. The battery plus PV array in the system must be sized appropriately to support the backup loads before the generator connects to the microgrid. Load control must be used to shed any loads that the system cannot support until the generator is connected.

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

Table 2: Examples of minimum generator nameplate rating calculation for a Sunlight Backup system

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 either 100% of the PV array's rated AC power output or 143% of the IQ Batteries' total rated power, whichever is higher. The following table shows some examples of generator pairing with an Enphase Energy System with IQ8 Series Microinverters and IQ Battery.

Table 3: Examples of minimum generator nameplate rating calculation for Enphase Energy Systems with IQ8 Series Microinverters and IQ Battery 3/3T/10/10T

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	(One 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	(Two IQ Battery 10/10T)	7.68	15.2
IQ8H-240	380	40 (4 branch circuits)	15.2	9	(Three IQ Battery 10/10T)	11.52	16.47
IQ8H-240	380	40 (4 branch circuits)	15.2	12	(Four IQ Battery 10/10T)	15.36	21.94

The Enphase Installer App allows you to connect a lower or higher nameplate-rated generator to the system 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.

NOTE: In the following table, when the number of batteries is five or above, the battery oversubscription power control system will operate to limit the total power from the batteries to equal that of four batteries. Hence, the IQ Battery power column value does not increase after the row for four IQ Battery 5P batteries.

Table 4: Examples of minimum generator nameplate rating calculation for an Enphase Energy System with IQ8 Series Microinverters, IQ Battery 5P, and IQ System Controller 3G

Microinverter type	Rated output (W) of one microinverter	No. of microinverters	Rated power output of the PV array (kW)	IQ Battery 5P units	IQ Battery power (kW)	Minimum generator nameplate (kW)
IQ8	240	16 (1 branch circuit)	3.84	1	3.84	5.49
IQ8	240	32 (2 branch circuits)	7.68	1	3.84	7.68
IQ8PLUS	290	13 (1 branch circuit)	3.77	2	7.68	10.98
IQ8PLUS	290	20 (2 branch circuits)	5.8	3	11.52	16.47
IQ8H-240	380	15 (2 branch circuits)	5.7	4	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	4	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	4	15.36	21.96
IQ8H-240	380	20 (2 branch circuits)	7.6	5	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	5	15.36	21.96
IQ8H-240	380	20 (2 branch circuits)	7.6	6	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	6	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	7	15.36	21.96
IQ8H-240	380	40 (4 branch circuits)	15.2	8	15.36	21.96

For systems with IQ6/IQ7 or M Series Microinverters and IQ Batteries, the minimum generator nameplate rating must be 143% of the IQ Batteries' total rated power. The following table shows a few examples of generator pairing with an Enphase Energy System with IQ6/IQ7 or M Series Microinverters and IQ Battery.

NOTE:

- The total power from the PV array with IQ6/IQ7 or M series Microinverters cannot exceed 150% of the continuous power rating of the batteries.
- When using IQ System Controller 1 with more than 20 kWh energy storage (i.e., more than two IQ Battery 10 units), the generator nameplate rating required exceeds the

power allowed by the generator port (i.e., 11.52 kW or 48 A at 240 V). Generator sizes beyond this value will not result in any improvement in terms of current or battery charging speed. 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.

- When using IQ System Controller 2 with more than 30 kWh energy storage (i.e., three or more IQ Battery 10 units), the generator nameplate rating required exceeds the power allowed by the generator port (i.e., 15.36 kW or 64 A at 240 V). Generator sizes beyond this value will not result in any improvement in terms of current or battery charging speed. 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.

The Enphase Installer App allows you to connect a lower or higher nameplate-rated generator to the system 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.

Table 5: Minimum generator nameplate rating for a given number of IQ Battery 3/3T/10/10T 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	(One IQ Battery 10)	10.08	3.84	5.49
4		13.44	5.12	7.31
5		16.8	6.4	9.14
6	(Two IQ Battery 10)	20.16	7.68	10.97
7		23.52	8.96	12.80
8		26.88	10.24	14.63
9	(Three IQ Battery 10)	30.24	11.52	16.46
10		33.6	12.8	18.29
11		36.96	14.08	20.11
12	(Four IQ Battery 10)	40.32	15.36	21.94

NOTE: In the following table, when the number of batteries is five or above, the battery oversubscription power control system will operate to limit the total power from the batteries to equal that of four batteries. Hence, the IQ Battery power column value does not increase after the row for four IQ Battery 5P batteries.

Table 6: Minimum generator nameplate rating for a system with IQ6, IQ7, or M Series Microinverters and IQ Battery 5P

IQ Battery 5P units	IQ Battery energy (kWh)	IQ Battery power (kW)	Minimum generator nameplate (kW)
1	5	3.84	5.49
2	10	7.68	10.98
3	15	11.52	16.47
4	20	15.36	21.96
5	25	15.36	21.96
6	30	15.36	21.96
7	35	15.36	21.96
8	40	15.36	21.96

System configuration

When the system is on-grid, using a generator is not allowed. When the system goes into backup mode, the generator can operate. The generator can charge the batteries and/or serve excess loads.

The supported system configurations are:

- Generator with IQ Battery and IQ6/IQ7/IQ8 Series Microinverters
- Generator with IQ Battery and M Series Microinverters
- Generator with IQ8 Series Microinverters in Sunlight Backup

The system works well for Sunlight Backup with Partial Home Backup only, Partial Home Backup, and Whole Home Backup configurations.

NOTE: Any configuration not specified in this technical brief is not supported.

NOTE: An Enphase Energy System with M Series, IQ6/IQ7, and IQ8 series Microinverters can use IQ System Controller 1, IQ System Controller 2, or IQ System Controller 3G. The continuous current rating for the generator port is 48 A for IQ System Controller 1 and 64 A for IQ System Controller 2 and IQ System Controller 3G.

NOTE: The system configuration in this section represents a system with IQ System Controller 3G. The system configuration will remain the same for a system using IQ System Controller 2 or IQ System Controller 1.

NOTE: Systems with a generator connected will need an additional pair of Consumption CTs (called generator CTs) to monitor the consumption from the generator. These generator CTs must be connected in parallel to the Consumption CTs.

Generator with IQ Battery and IQ6/IQ7 Series Microinverters

A generator can be added to an Enphase Energy System with IQ6/IQ7 Series Microinverters on the roof, IQ Combiner (or a stand-alone IQ Gateway), IQ Batteries, and IQ System Controller. It can be connected in Partial Home Backup and Whole Home Backup configurations.

NOTE: An Enphase Energy System with IQ6/IQ7 Series Microinverters can use the IQ System Controller 1, the IQ System Controller 2, and the IQ System Controller 3G. The continuous current rating for the generator port is 48 A for IQ System Controller 1 and 64 A for IQ System Controller 2 and IQ System Controller 3G.

NOTE: An overcurrent protection device, i.e., a breaker (up to 60 A for IQ System Controller 1, up to 80 A for IQ System Controller 2, and IQ System Controller 3G), must be populated inside the IQ System Controller on the designated spot.

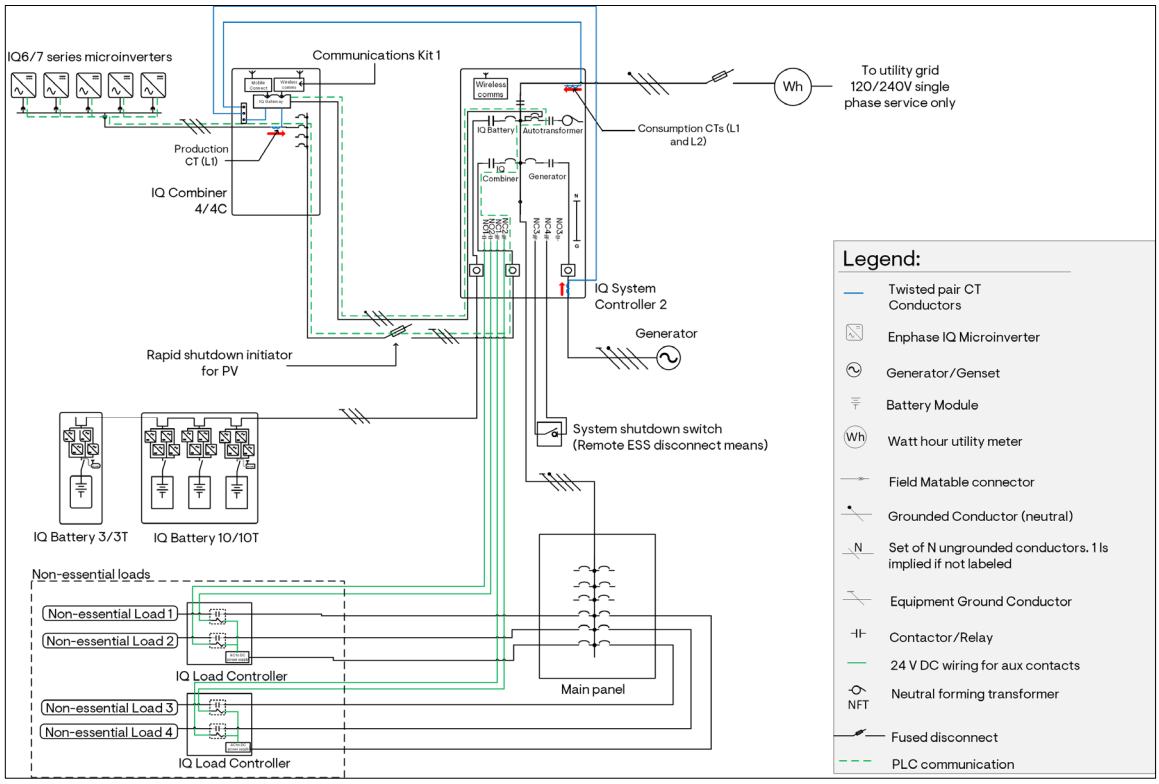


Figure 5: Enphase Energy System in Whole Home Energy Backup configuration for IQ6/IQ7 Series Microinverters and IQ System Controller 1 and IQ System Controller 2.

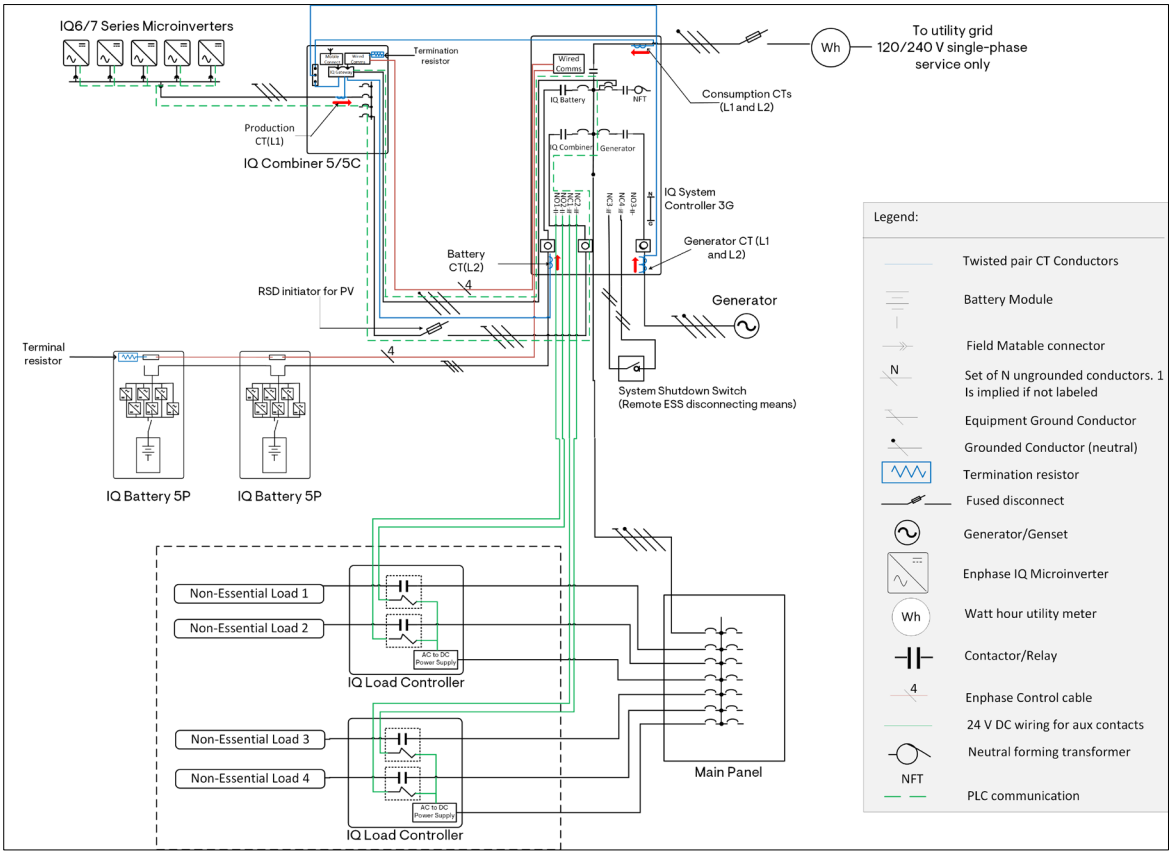


Figure 6: Enphase Energy System in Whole Home Backup configuration for IQ6/IQ7 Series PV Microinverters with IQ System Controller 3G

The IQ System Controller is installed as service equipment on the line side of the main load panel, and PV, IQ Battery, and generator are connected to the IQ System Controller.

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

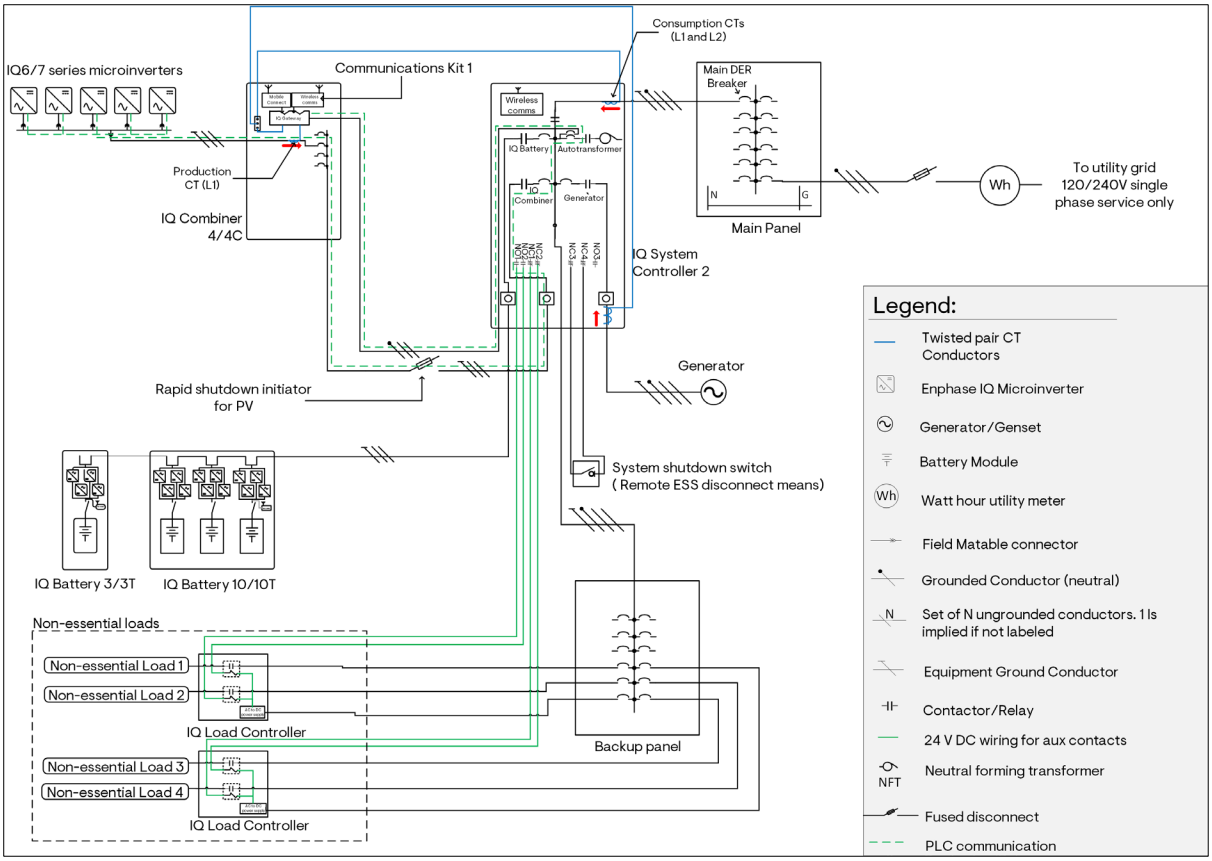


Figure 7: Enphase Energy System in Partial Home Backup configuration for IQ6/IQ7 Series Microinverters and IQ System Controller 1 or IQ System Controller 2

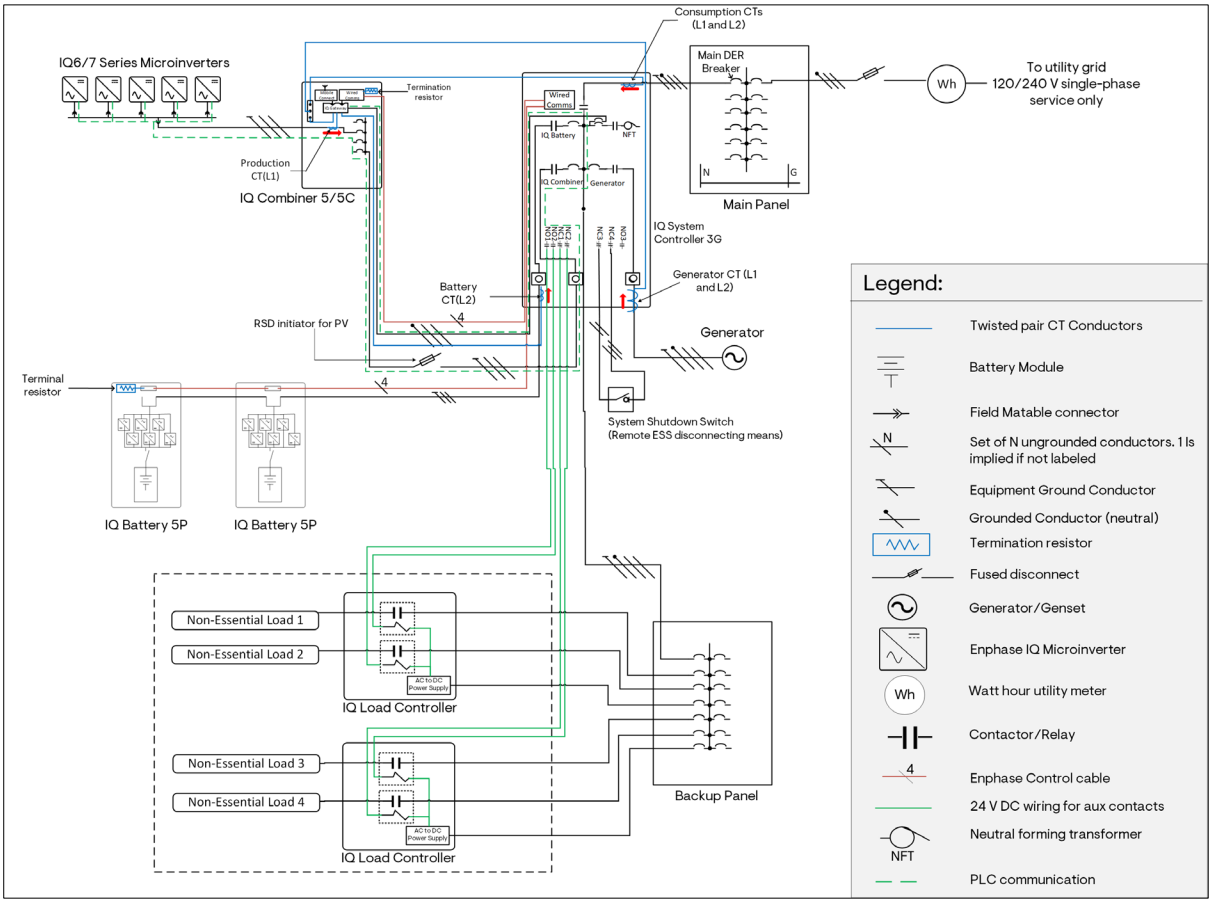


Figure 8: Enphase Energy System in Partial Home Backup configuration for IQ6/IQ7 Series PV Microinverters with IQ System Controller 3G

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 into the IQ System Controller. The Consumption CTs should not be installed between the main panel and utility meter. An additional pair of generator CTs must be placed on the Generator L1 and L2 feeding into the IQ System Controller and must be made parallel with the consumption CTs. The arrows on the CTs must point upward to ensure correct polarity.

Generator with IQ Battery and M Series Microinverters

Envoy S Metered must be the communications gateway with M Series Microinverters to work with IQ Battery. To work with the IQ Battery 5P, an extra Communications Kit 2 will also be needed. The generator is wired into the generator port on the IQ System Controller. An overcurrent protection device, i.e., breaker up to 60 A for IQ System Controller 1 and up to 80 A for IQ System Controller 2 and IQ System Controller 3G, must be populated inside the IQ System Controller on the designated spot. An external double pole contactor (to be purchased separately) on the PV branch circuit connecting to the Envoy S Metered is required to break the L1 and L2 connection and shed PV when the generator is operating, as shown in Figure 9, Figure 10, Figure 11 and Figure 12. This will eliminate the possibility of PV back-feeding the generator in an uncontrolled manner, which could occur with the M Series Microinverters. The system works well for both Whole Home Backup and Partial Home Backup configurations, as shown in Figure 9, Figure 10, Figure 11 and Figure 12.

NOTE: Enphase Energy System with M Series Microinverters can use IQ System Controller 1, IQ System Controller 2, and IQ System Controller 3G. The continuous current rating for the generator port is 48 A for IQ System Controller 1 and 64 A for IQ System Controller 2 and IQ System Controller 3G.

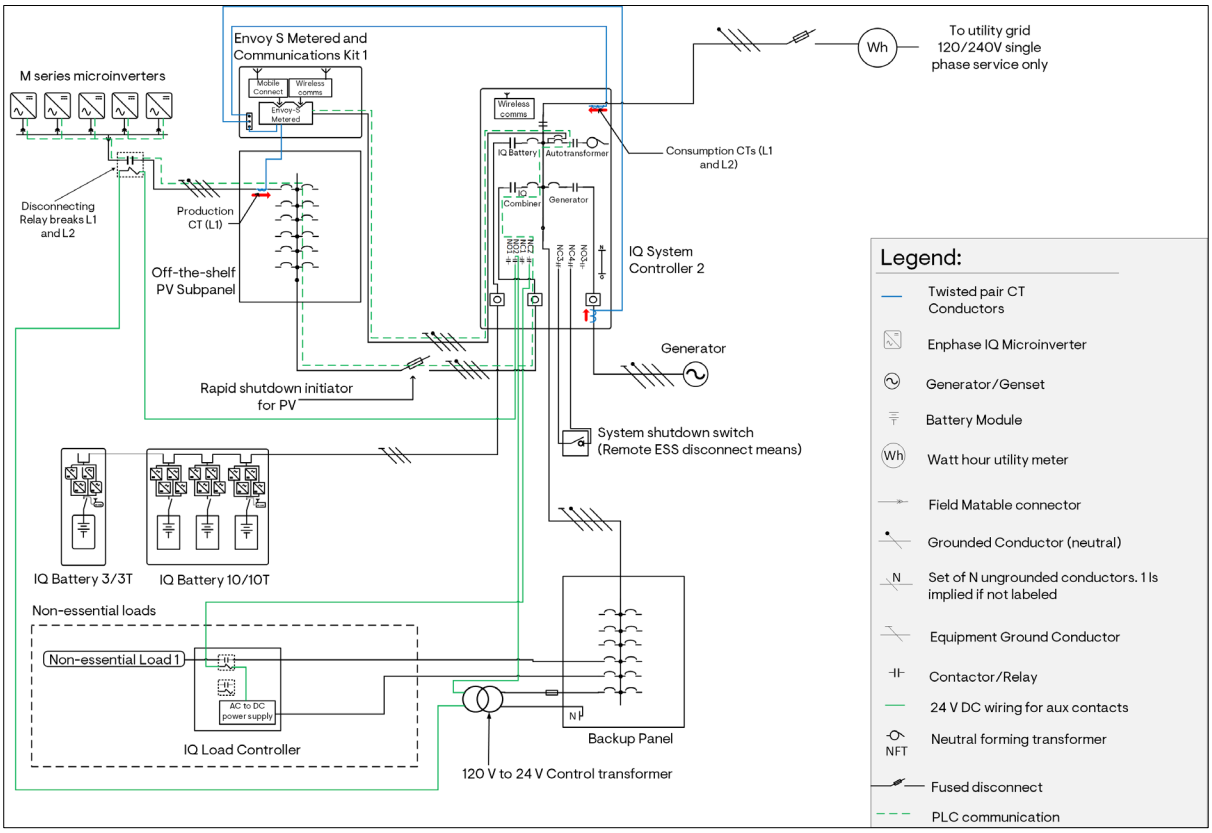


Figure 9: Enphase Energy System in Whole Home Backup Configuration for M Series PV Microinverters and IQ System Controller 1 or IQ System Controller 2

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.

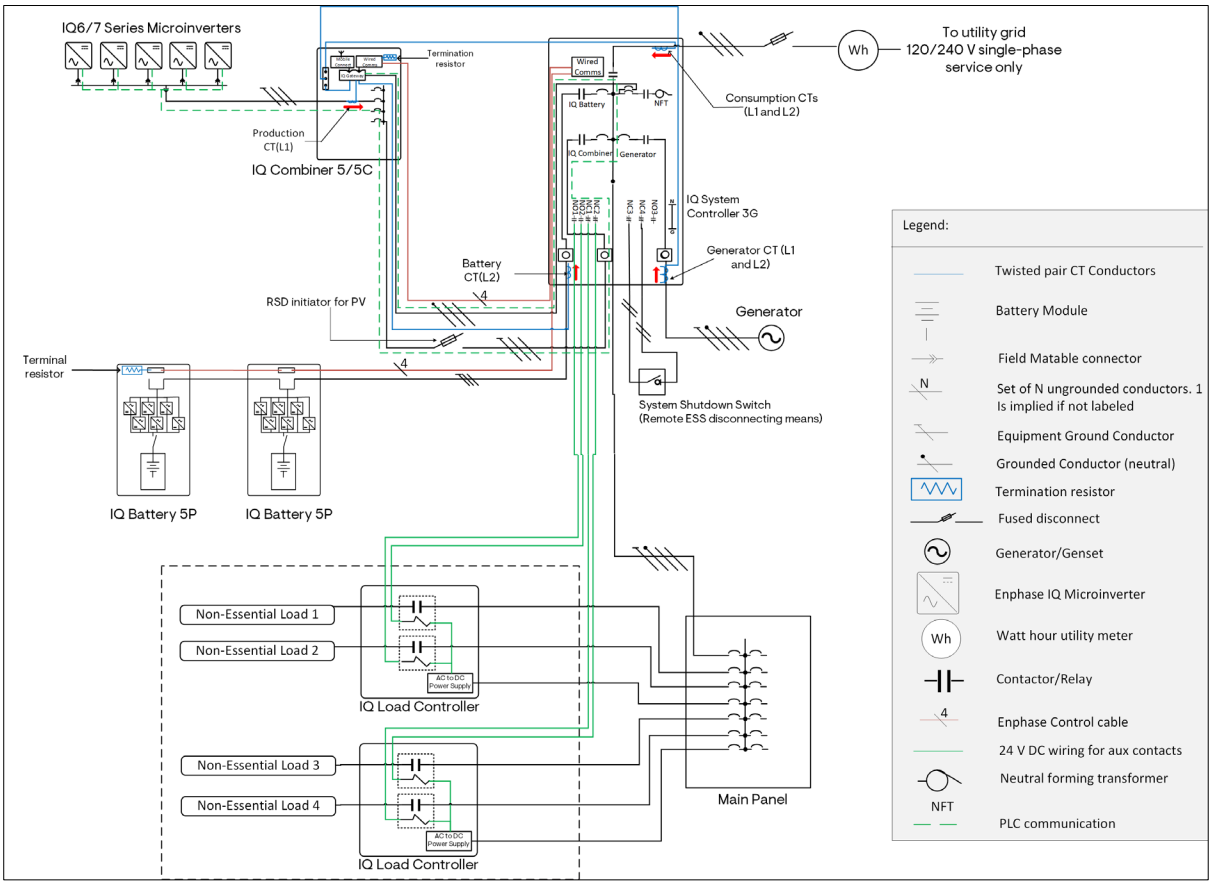


Figure 10: Enphase Energy System in Whole Home Backup configuration for M Series PV Microinverters and IQ System Controller 3G

For Partial Home Backup, the 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 into the generator port on the IQ System Controller.

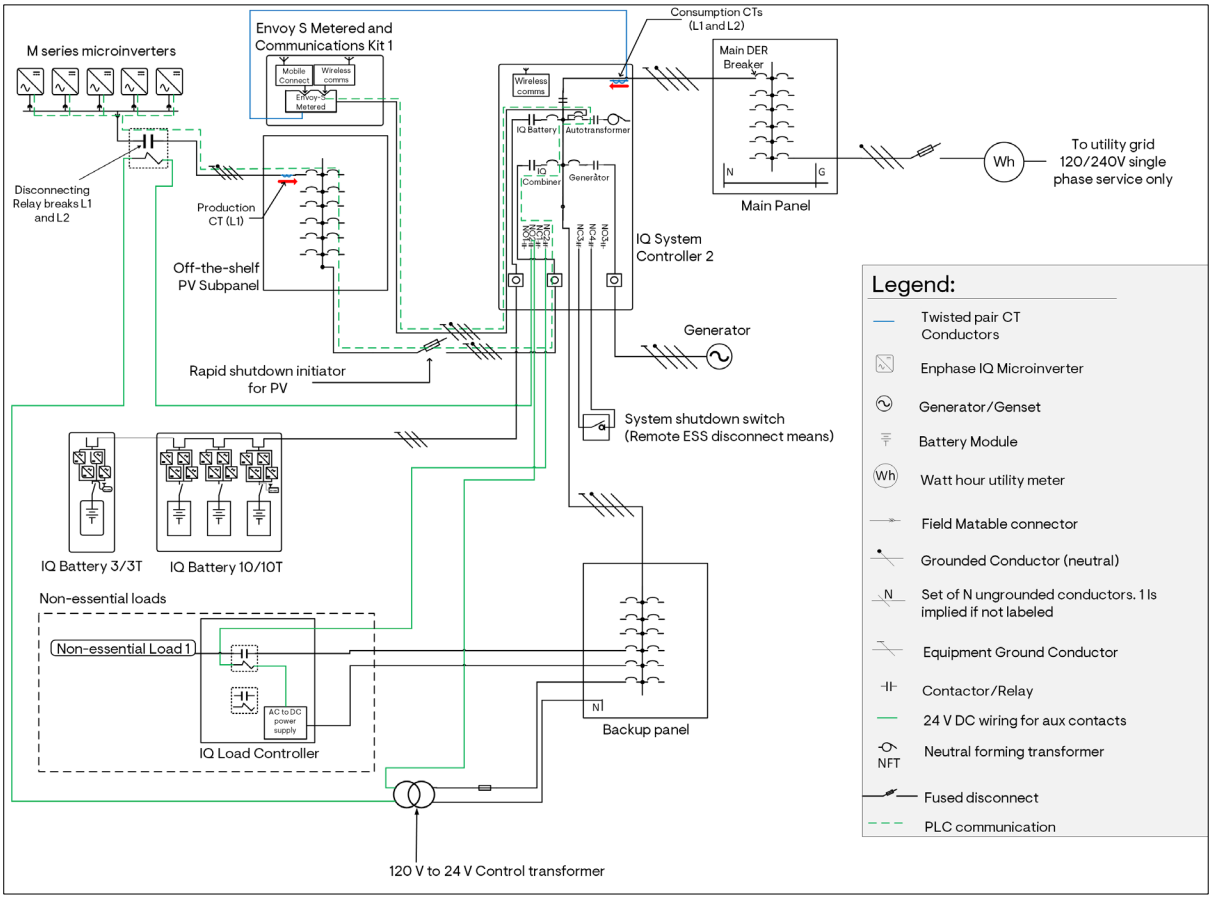


Figure 11: Enphase Energy System in Partial Home Backup for M Series PV Microinverters and IQ System Controller 1 or IQ System Controller 2

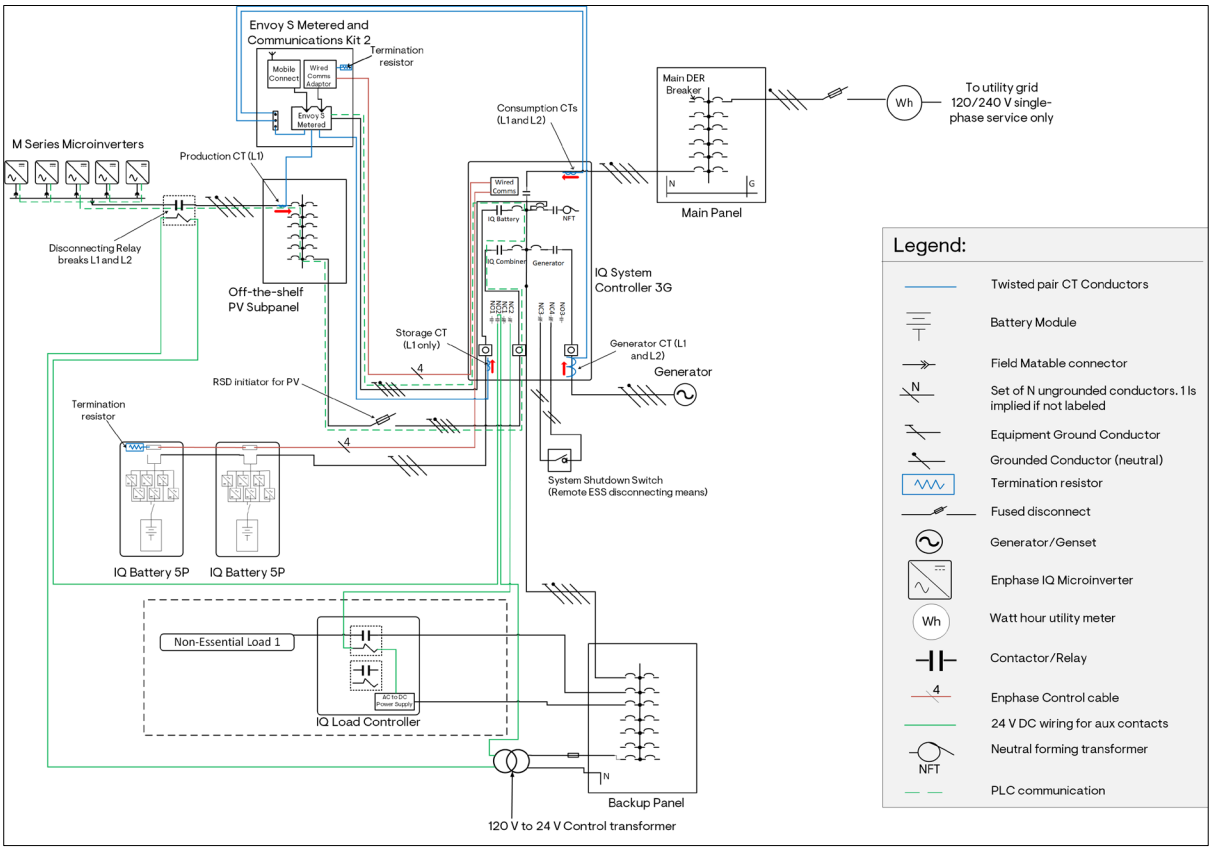


Figure 12: Enphase Energy System in Partial Home Backup for M Series PV Microinverters and IQ System Controller 3G

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 into the IQ System Controller. The Consumption CTs should not be installed between the main panel and the utility meter. An additional pair of generator CTs must be placed on the Generator L1 and L2 feeding into the IQ System Controller and must be made parallel with the consumption CTs. The arrows on the CTs must point upward to ensure correct polarity.

Generator with IQ Battery and IQ8 Series Microinverters

WARNING: IQ8 Series Microinverters in backup configurations need IQ System Controller 2 or IQ System Controller 3G to function properly. **IQ System Controller 1 will not work and is unsafe to use with IQ8 Series Microinverters.**

A generator can be added to an Enphase Energy System with IQ8 Series Microinverters. It can be connected in Partial Home Backup or Whole Home Backup configurations.

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 connect the PV system to the IQ System Controller on a dedicated breaker or connect it to the load panel. A generator is also wired into the generator port on the IQ System Controller 2/IQ System Controller 3G. An overcurrent protection device, i.e., a breaker up to 80 A, must be populated inside the IQ System Controller 2/IQ System Controller 3G 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 Whole Home Backup configuration is shown in the following figure:

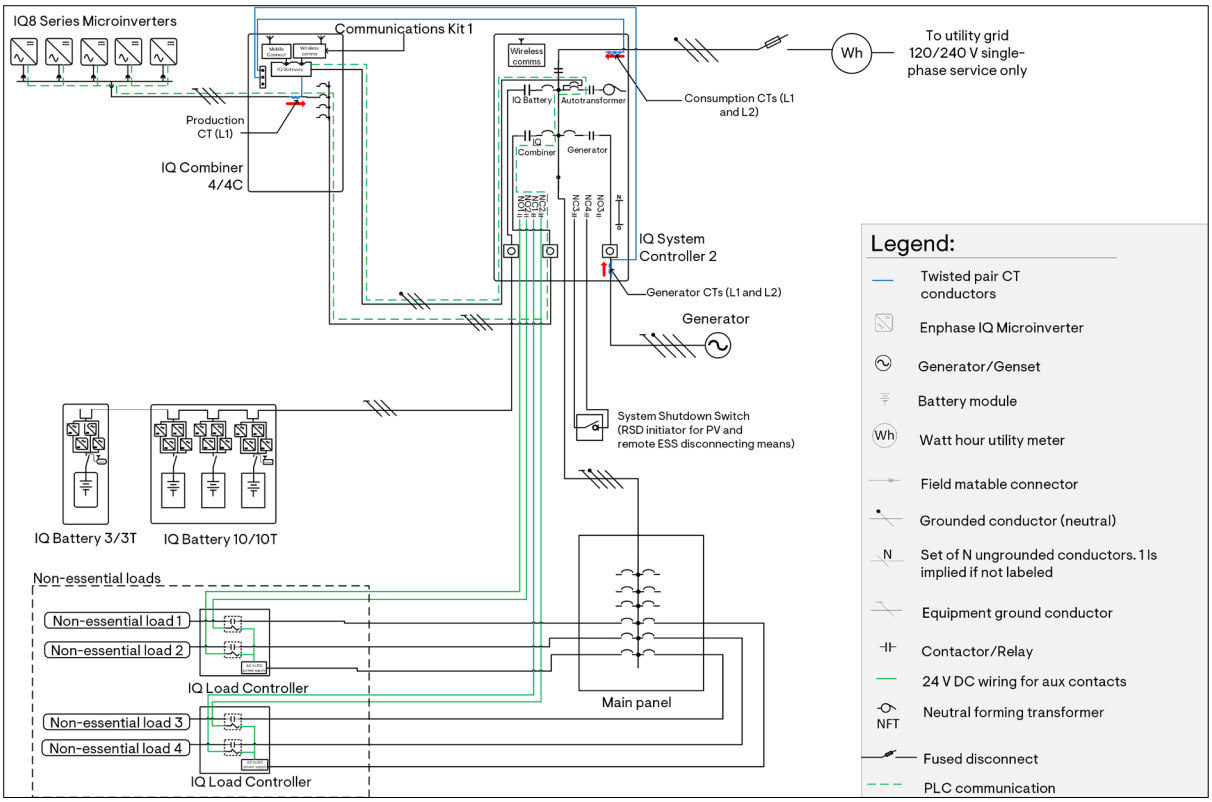


Figure 13: Enphase Energy System in Whole Home Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 2

The IQ System Controller 2/IQ System Controller 3G is installed as 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/IQ System Controller 3G.

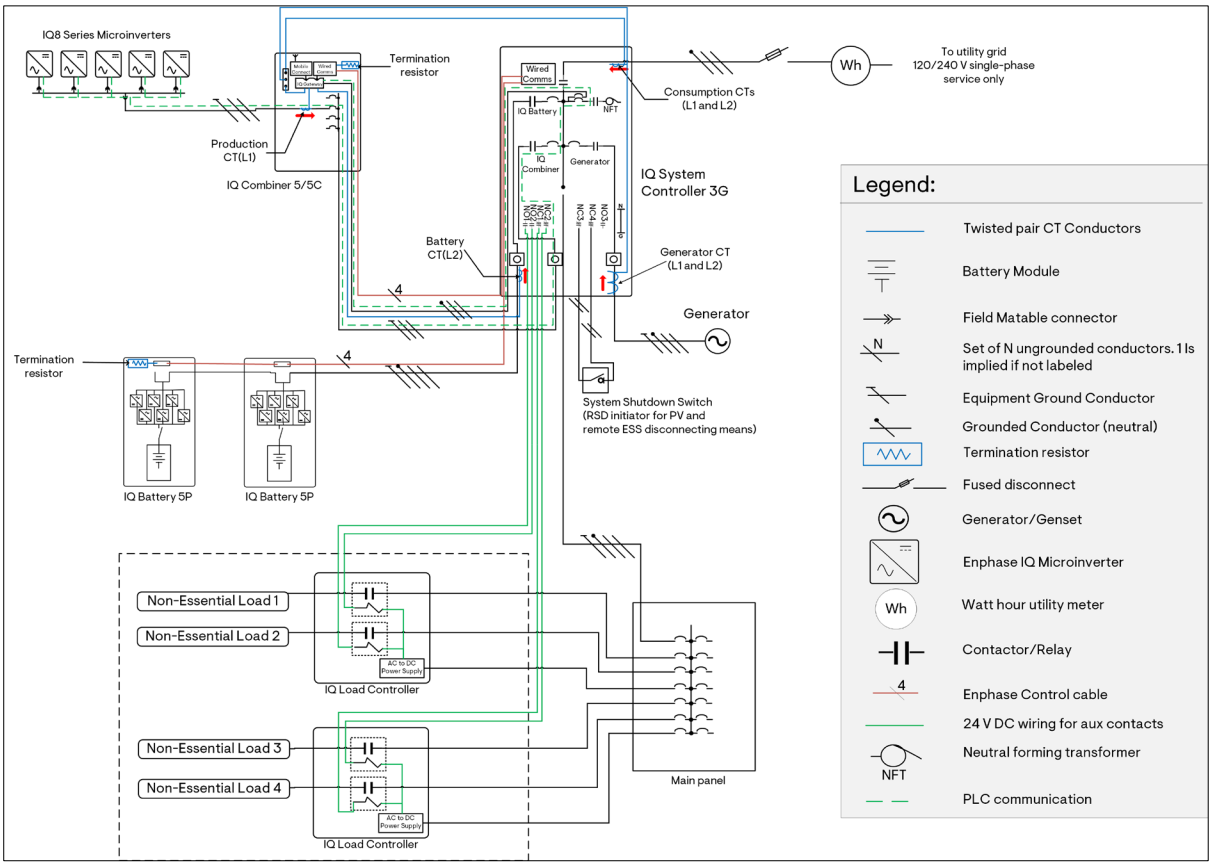


Figure 14: Enphase Energy System in Whole Home Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 3G

You can also install the Enphase Energy System in the Partial Home Backup configuration. In this configuration, IQ System Controller 2/IQ System Controller 3G is on the load side of the existing main load panel or service equipment. The generator is connected to the IQ System Controller 2/IQ System Controller 3G in the same way as in the Whole Home Backup configuration. Use this configuration when configuring the Enphase Energy System to provide backup to several pre-selected load circuits. This configuration is recommended when the customer desires an IQ Battery system with smaller energy and power capacity and some basic load backup or when existing constraints prevent main panel backup or other installation methods. The following figure shows an example of a Partial Home Backup configuration.

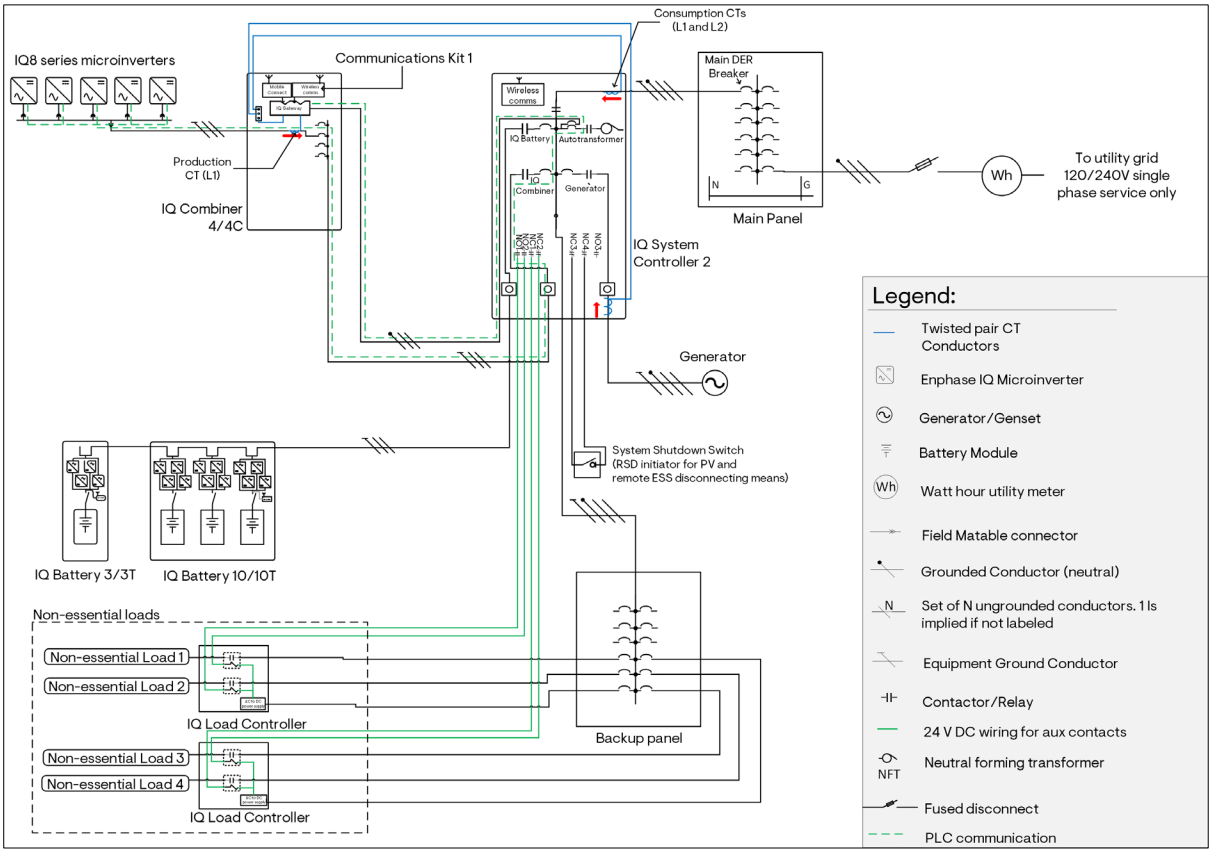


Figure 15: Enphase Energy System in Partial Home Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 2

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 into the generator port on the IQ System Controller 2.

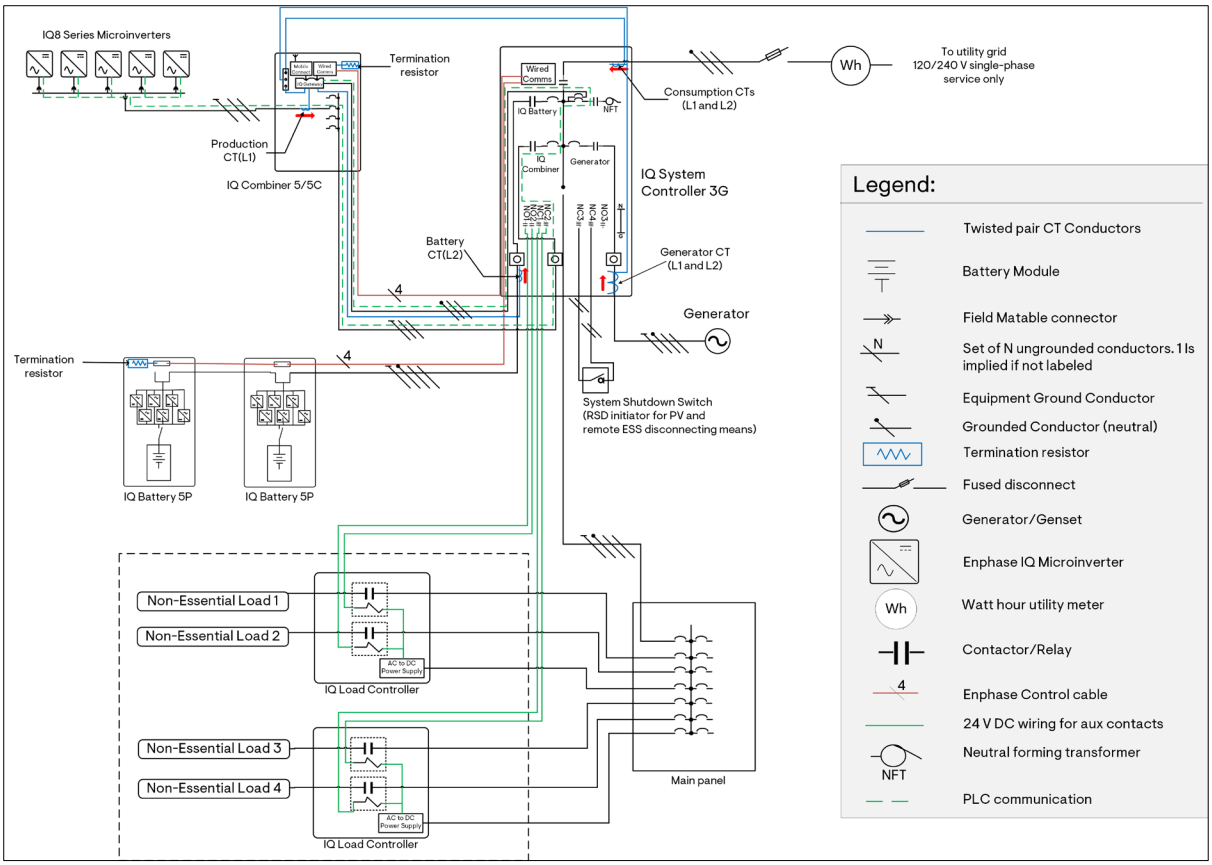


Figure 15: Enphase Energy System in Partial Home Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 3G

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 64 A continuous current output. The IQ System Controller 2/IQ System Controller 3G is installed on the load side of an existing main load panel. The generator is connected to the generator port of the IQ System Controller 2/IQ System Controller 3G.

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 240 V or eight 120 V pre-selected, essential load circuits backed up by the system. Additional breakers are needed to power the IQ Load controllers.
- Up to two IQ Load Controllers, each enabling fine-grained, circuit-level control for two 240 V or four 120 V essential load circuits. Each 240 V load can be controlled independently, but the 120 V loads must be controlled in groups of up to two. Sunlight Backup system needs at least one IQ Load Controller installed on-site.

Using this configuration for backing up an entire home is not a use case supported by Enphase. Refer to Understanding Sunlight Backup System for installers and system designers for details on Sunlight Backup system design and limitations.

NOTE: Use only utility sense generators with Sunlight Backup systems. If a two-wire start generator is used, the system will not be able to start the generator when it is powered off—

for example, if the grid fails at night. Utility sense generators can sense a grid outage and start on their own.

NOTE: The generator's AUTO/OFF/MANUAL switch must be in the AUTO position to ensure it automatically starts up.

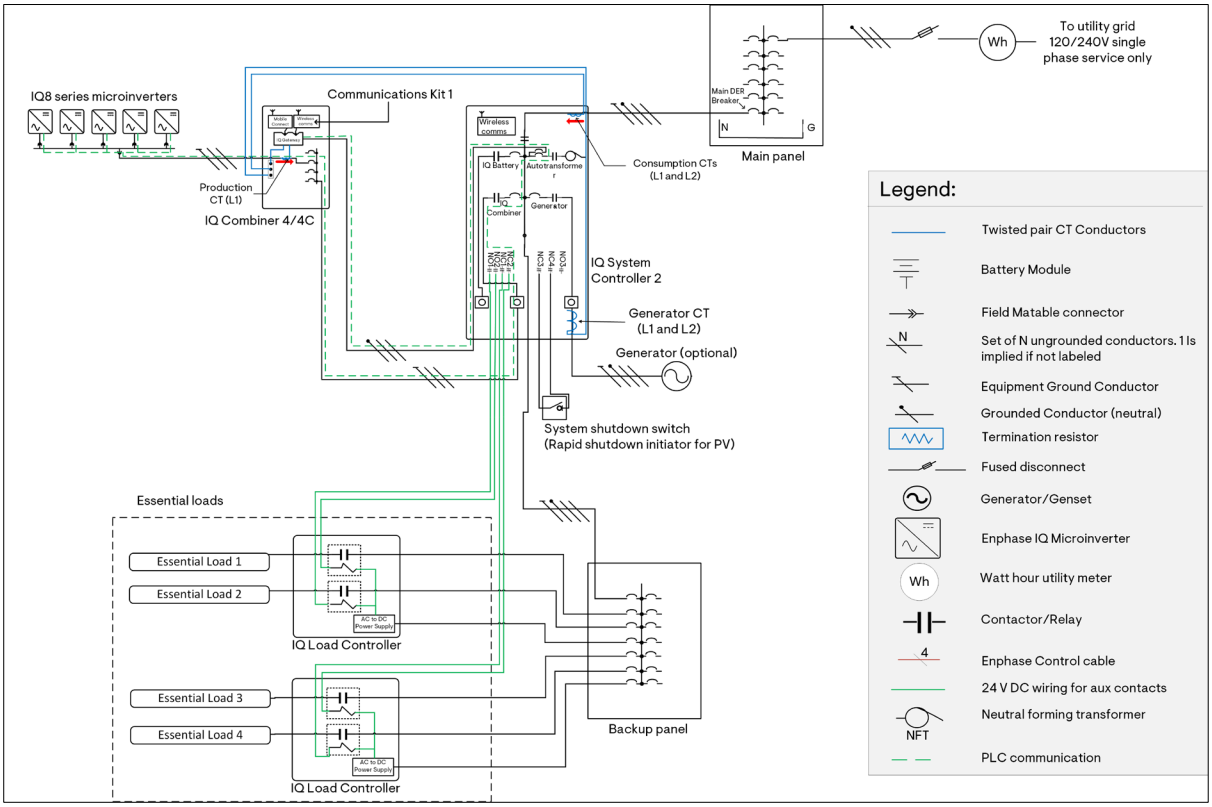


Figure 16: Enphase Energy System in Sunlight Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 2

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 into the generator port on the IQ System Controller 2.

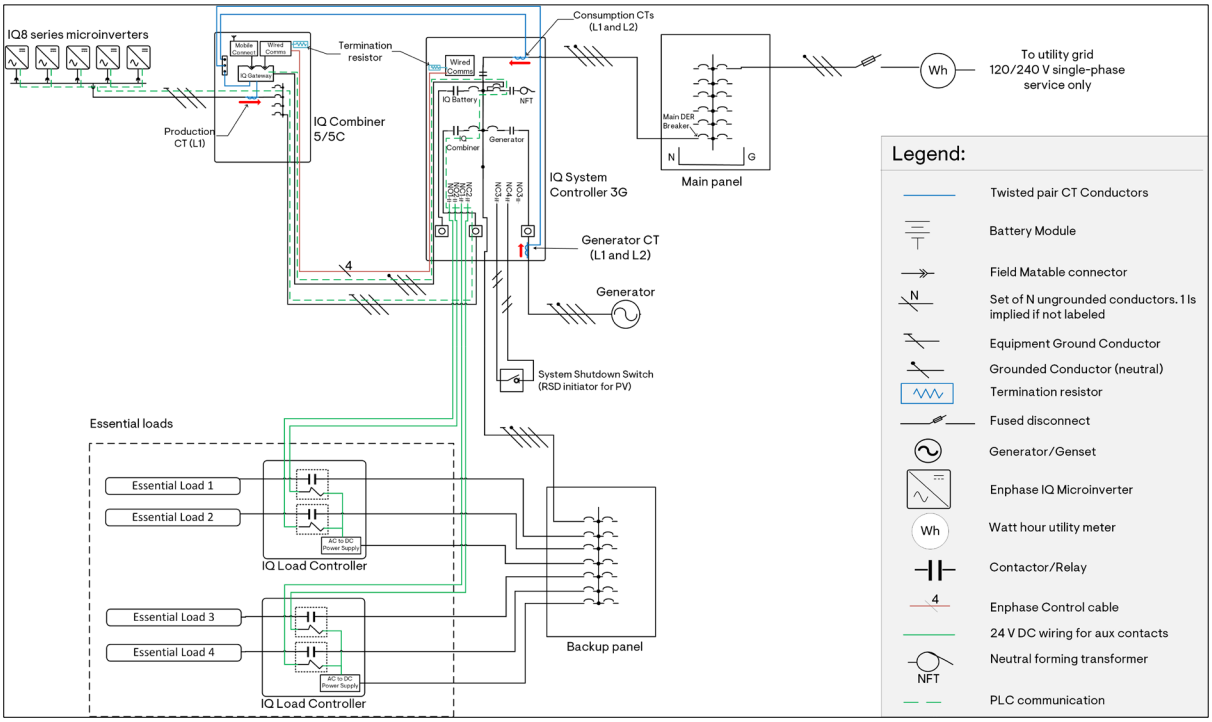


Figure 17: Enphase Energy System in Sunlight Backup configuration for IQ8 Series PV Microinverters and IQ System Controller 3G

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 into the IQ System Controller. The Consumption CTs should not be installed between the main panel and the utility meter. An additional pair of generator CTs must be placed on the Generator L1 and L2 feeding into the IQ System Controller and must be made parallel with the consumption CTs. The arrows on the CTs must point upward to ensure correct polarity.

Connecting a generator to the 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 the following figure. Ensure you also connect the neutral and earth lines of the generator to the neutral and earth terminal strips within the IQ System Controller. The generator auxiliary contact for a two-wire or utility-sense-based start is the Gen I/O port, also shown in the following figure. 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 a generator directly to the 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 the IQ System Controller. Size the generator's equipment grounding conductor as per NEC T250.122 and the generator manufacturer's instructions.

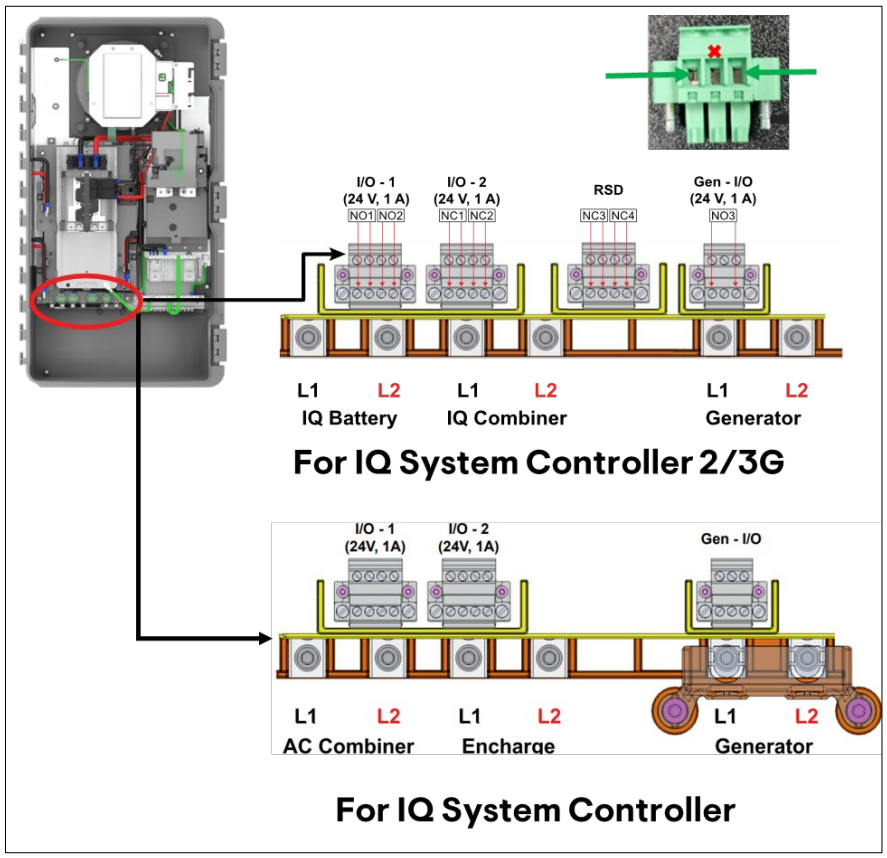


Figure 18: Enlarged view of generator lugs and auxiliary contact

IQ System Controller 1/IQ System Controller 2/IQ System Controller 3G allows generator integration with the Enphase Energy System. The breaker on the bottom right slot can integrate the generator and should be sized appropriately.

NOTE: As indicated, the Quad breaker requirement shown in the following pictures applies only to IQ System Controller 2/IQ System Controller 3G. In IQ System Controller 1, IQ Gateway is powered by the IQ Combiner; hence, a Quad Breaker is not required.

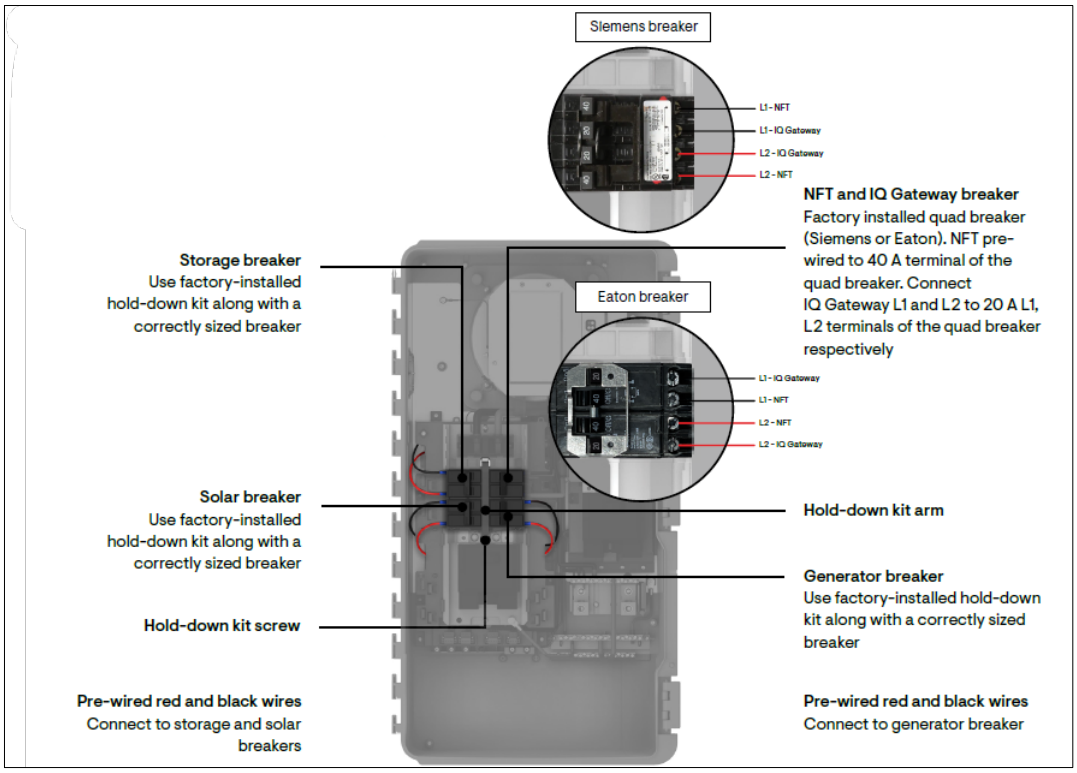


Figure 20: IQ System Controller 2 breaker mounting positions while integrating with a generator

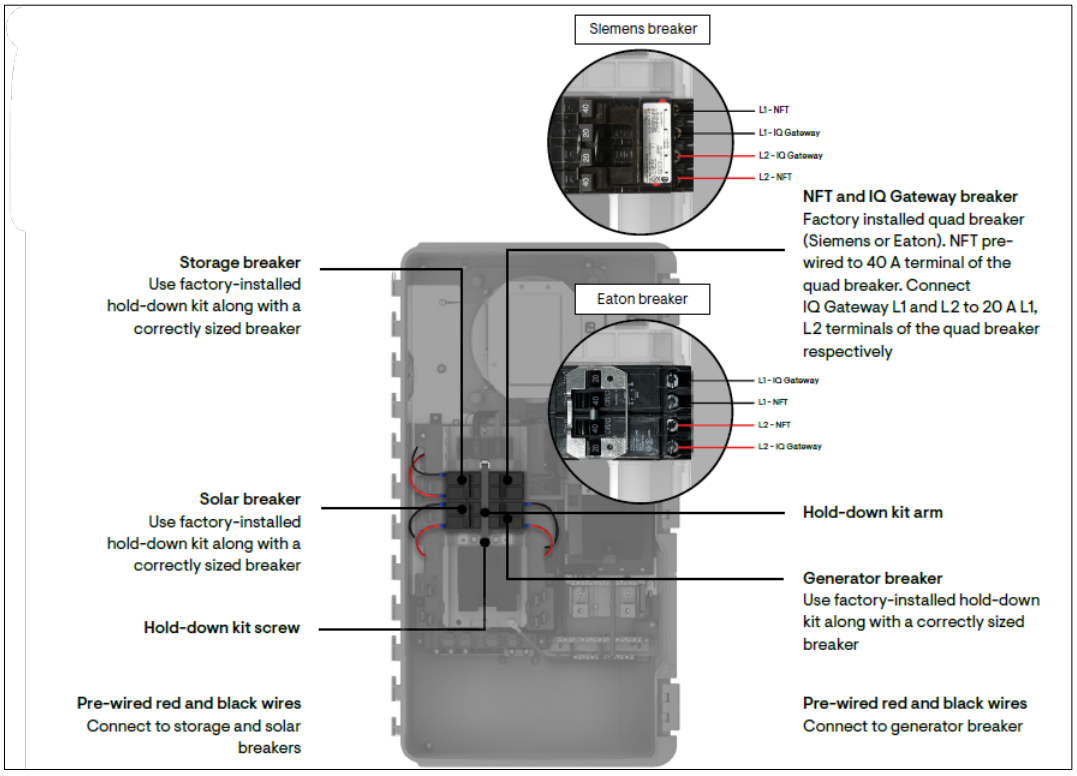


Figure 21: IQ System Controller 3G breaker mounting positions while integrating with a generator

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 listed below:

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

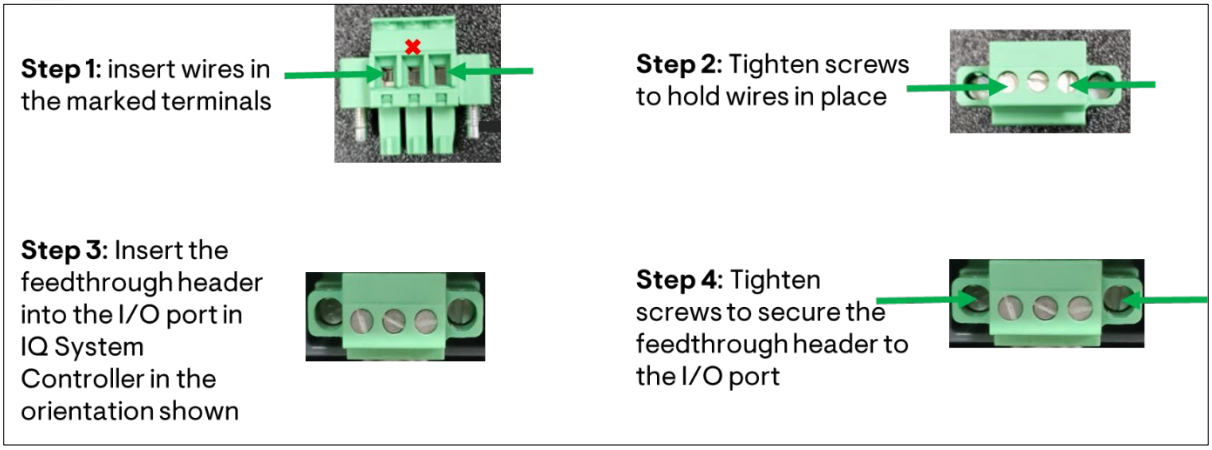


Figure 22: IQ System Controller generator auxiliary contact usage

Installation of standby generators with two-wire remote start

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

1. Wire the generator auxiliary contact in the IQ System Controller to the two-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 the generator to an appropriately sized position on the neutral bar inside the IQ System Controller.
4. Ensure that the ground terminal of the generator is connected to the ground bar inside the IQ System Controller. Size the generator's equipment grounding conductor as per NEC 250.122 and the 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 the IQ System Controller's ATS board to this breaker.

   NOTE: The maximum allowed breaker size for IQ System Controller 1 is 60 A, and for IQ System Controller 2/IQ System Controller 3G is 80 A. Select an Eaton BR breaker model with the hole for the additional fastener as per NEC 480.36(D). Available models: BR220B, BR230B, BR240B, BR250B. Eaton breakers BR260 and BR280 also have 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 V AC for the 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.
   See IQ System Controller 1 Quick Install Guide or IQ System Controller 2 Quick Install Guide or IQ System Controller 3G Quick Install Guide for how to wire the generator CTs in parallel with the IQ Gateway's Consumption CTs and how to connect the CT leads to the IQ Gateway terminals.
10. Use the Enphase Installer App to commission and program the IQ System Controller to control the generator.

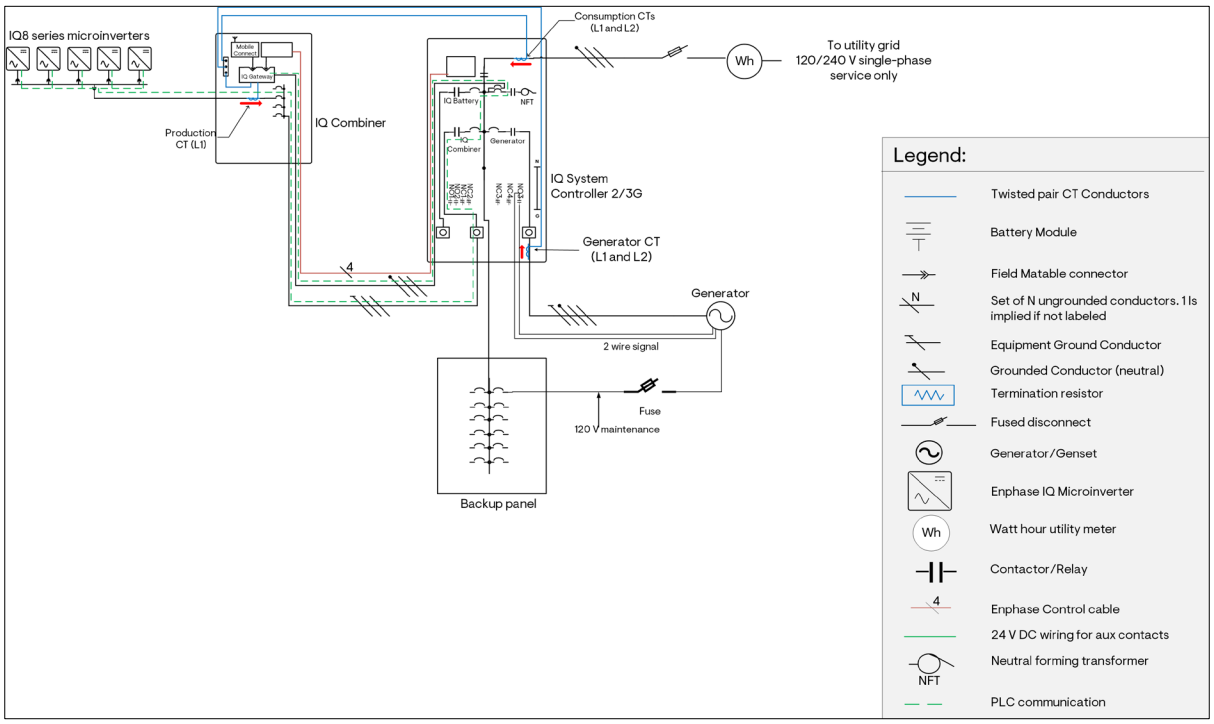


Figure 23: Generator auxiliary contact wiring for two-wire remote-start generator

Installation of standby generators with utility sense–based remote start

NOTE: This system is only compatible with permanently installed non-separately derived generators 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 the generator to an appropriately sized position on the neutral bar inside the 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 the 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 60 A, and for IQ System Controller 2/IQ System Controller 3G is 80 A. Select an Eaton BR breaker model with the hole for the additional fastener as per NEC 480.36(D). Available models: BR220B, BR230B, BR240B, BR250B. Eaton breakers BR260 and BR280 also have 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 the battery charger, connect this to the backup load panel with a fuse specified by the generator manufacturer.
7. Review the utility–based generator diagram shown in the following figure 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 or IQ System Controller 3G Quick Install Guide for how to wire the generator CTs in parallel with the Consumption CTs and connect the CT leads to the IQ Gateway terminals.
10. Use the Enphase Installer App to commission and program IQ System Controller to control the generator.

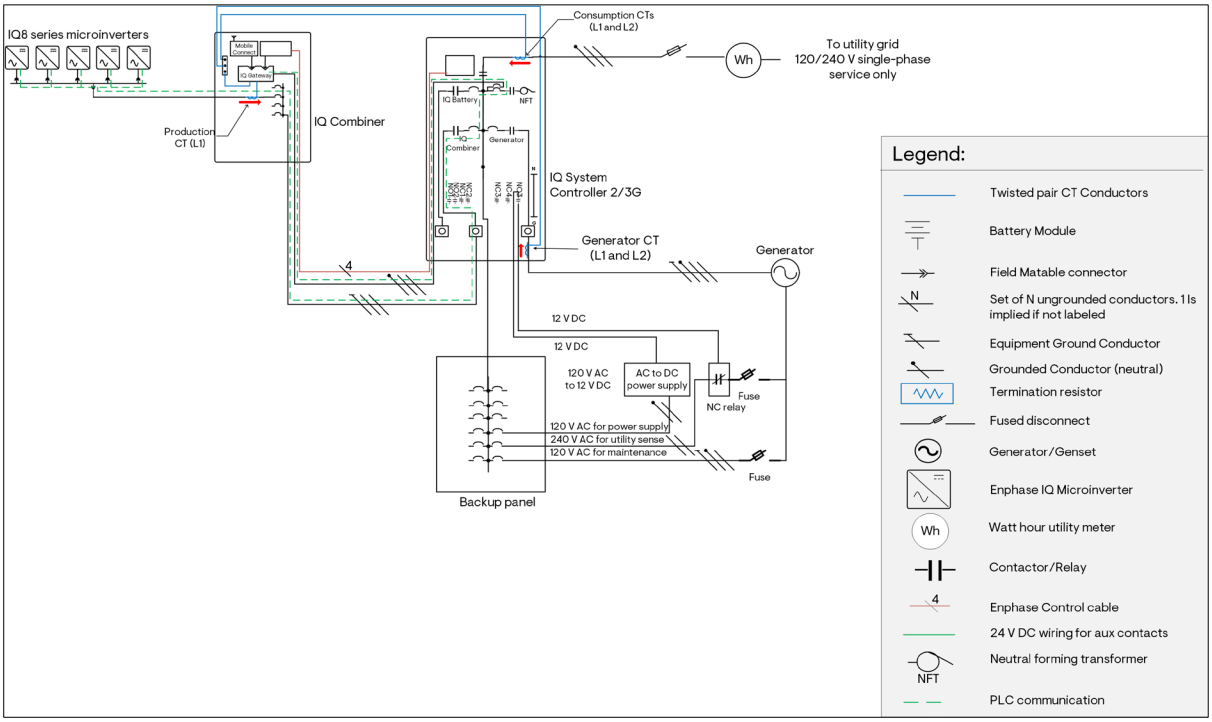


Figure 24: Generator auxiliary contact wiring for utility sense–based remote-start generator

NOTE: The preceding figure represents a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2/IQ System Controller 3G. For more details, refer to IQ System Controller 3G Quick Install Guide.

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

The IQ System Controllers 1, 2, and 3G auxiliary contacts have a maximum input voltage of 24 V AC or DC and a maximum of 1 A current limit. Exceeding these parameters will damage the circuitry within the IQ System Controller and is not a warrantied failure. The bill of materials below contains tested power supplies in the 12 VDC range that can provide the power needed to control the utility sense relay for control of those units. Also, a diagram below 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 for proper operation. This will ensure that a loss of power or microgrid 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:

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

WARNING: During IQ System Controller service, it is necessary to turn the generator soft key from AUTO to OFF for safety.

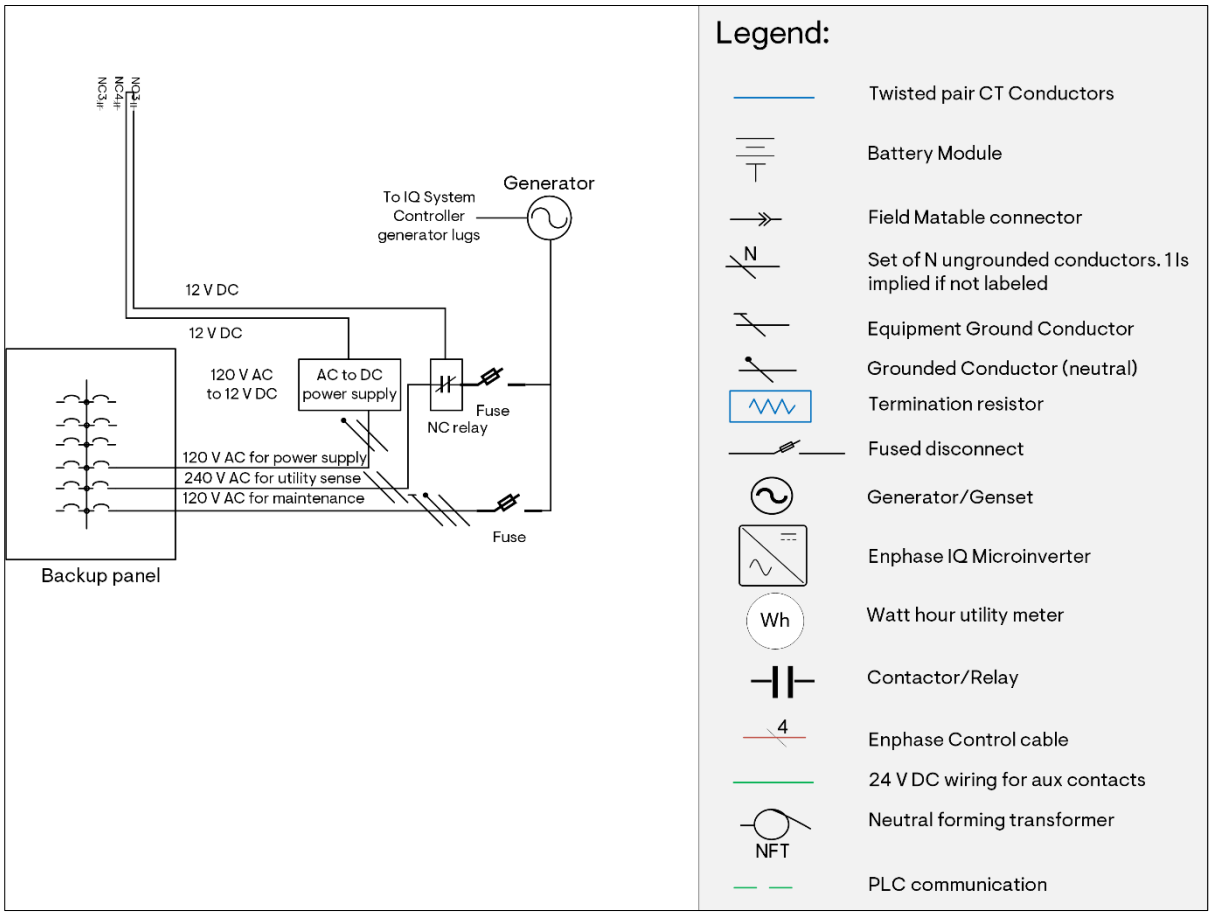


Figure 25: Utility sense wiring

NOTE: To verify the utility-sense wiring, switch off the double pole breaker in the backup loads panel.

Table 7: Equipment needed for utility sense generator support

Equipment	Recommendations
Power relay	• American Zettler AZ2280-1C-12DEF • Schneider W9AS5D52-12
12 V DC power supply	• Meanwell Apv-12-12
Mounting box	• Kraloy JBOX JBX12128 • Cantex Junction Box 5133713 • NEMA 3R 8 in. × 8 in. × 6 in. Carbon Steel Weatherproof Screw Cover Wall-Mount
Fuse	Use generator manufacturer-specified rated fuse. For example, • You can select a class G fuse from Eaton with the appropriate rating as recommended by the manufacturer here. • Or you can select 2AG, 3AG, or 5x20 mm fuses for inline fuse holders from Little Fuse.
Fuse holder	You can select: • Fuse blocks from Little Fuse compatible with class G fuses. Examples: LFR250301P (single pole), LFR250302P (double-pole), LFR250303P (three poles), or choose a Class G fuse block from Eaton here. • 150 Series - In-Line Fuse holder for 2AG, 3AG, or 5×20 mm fuses.

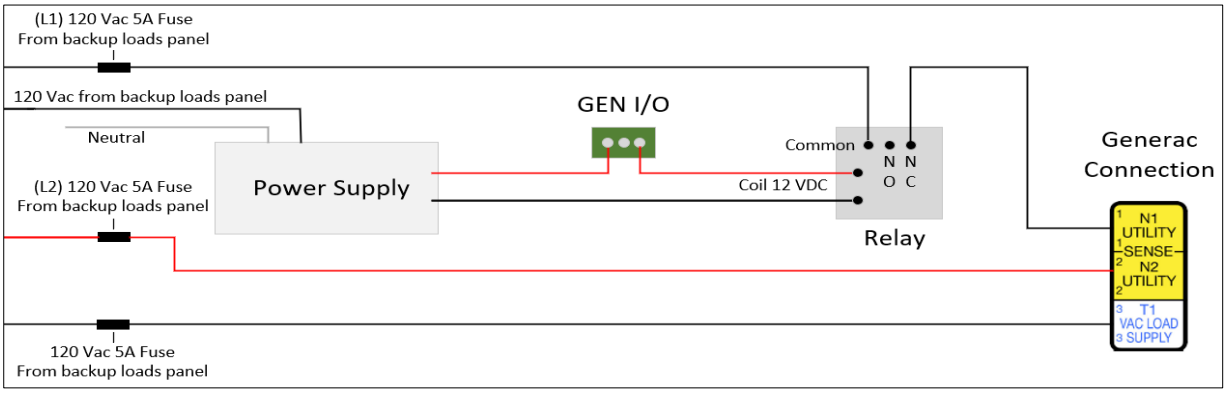


Figure 26: Wiring diagram for utility sense generator support

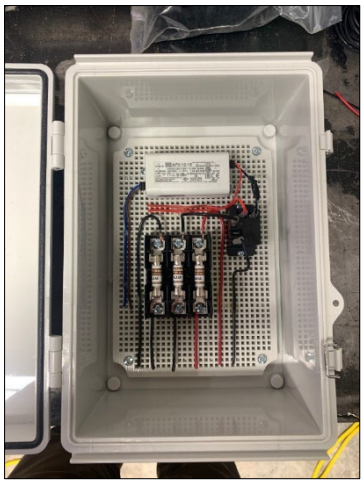


Figure 27: Sample equipment for utility sense generator support

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 for M Series Microinverter-based systems.

You will need to wire an external double pole contactor to the Envoy S Metered to enable the shedding of PV when the generator is operating. This eliminates the possibility of generating backfeeding 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.

The L2 from the backed-up loads panel comes into the normally open contact terminal of the Envoy-S Metered via a 3 A 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. The external contactor switches the L1 and L2 terminals of the aggregate PV output going into the IQ System Controller. Typically, 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 and ensures the M Series Microinverters can see the grid reference signal and 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 as they cannot see the grid reference signal.

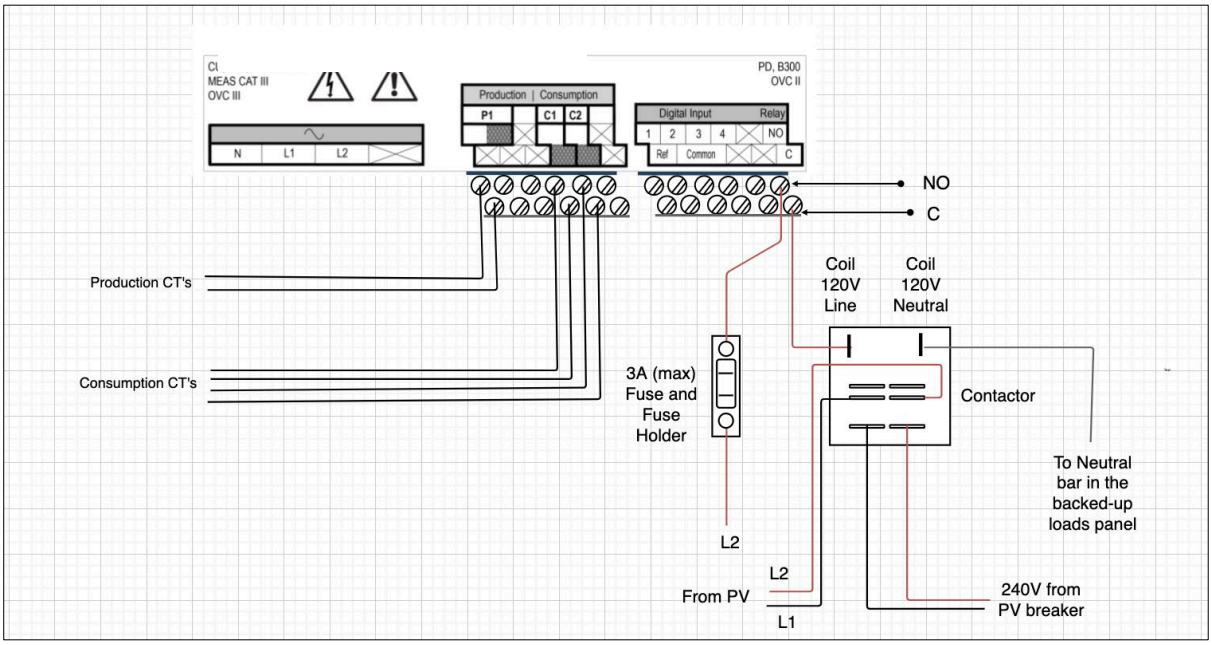


Figure 28: Wiring Envoy-S Metered for back feed protection

Relay examples:

1. Dayton 1EJG7A (DPDT), double-pole, double-throw, 30 A, encapsulated relay
2. Dayton 5X847N (DPDT), double-pole, double-throw, 40 A, 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 tested with the Enphase Energy System. These diagrams show the location and type of signaling needed to work with the auxiliary contacts from the IQ System Controller.

Always consult the generator's installation manual before installation. Supported generator models are:

- Kohler
- Generac
- Briggs & Stratton

NOTE: The configurations of different generator models in this document represent a system with IQ System Controller 1. The system configuration will remain the same for a system using IQ System Controller 2 and IQ System Controller 3G. For more details, refer to IQ System Controller 3G Quick Install Guide.

Kohler

All models of the generator from Kohler are two-wire start generators. The line diagram for connecting a Kohler generator to an Enphase Energy System is shown in the following figure. Connect two-wire remote start terminals of the generator (pins 3 and 4) to the generator auxiliary contact in the 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:

14RESA(L): https://www.kohler.com/en/home-energy/home-generators/products/14resa

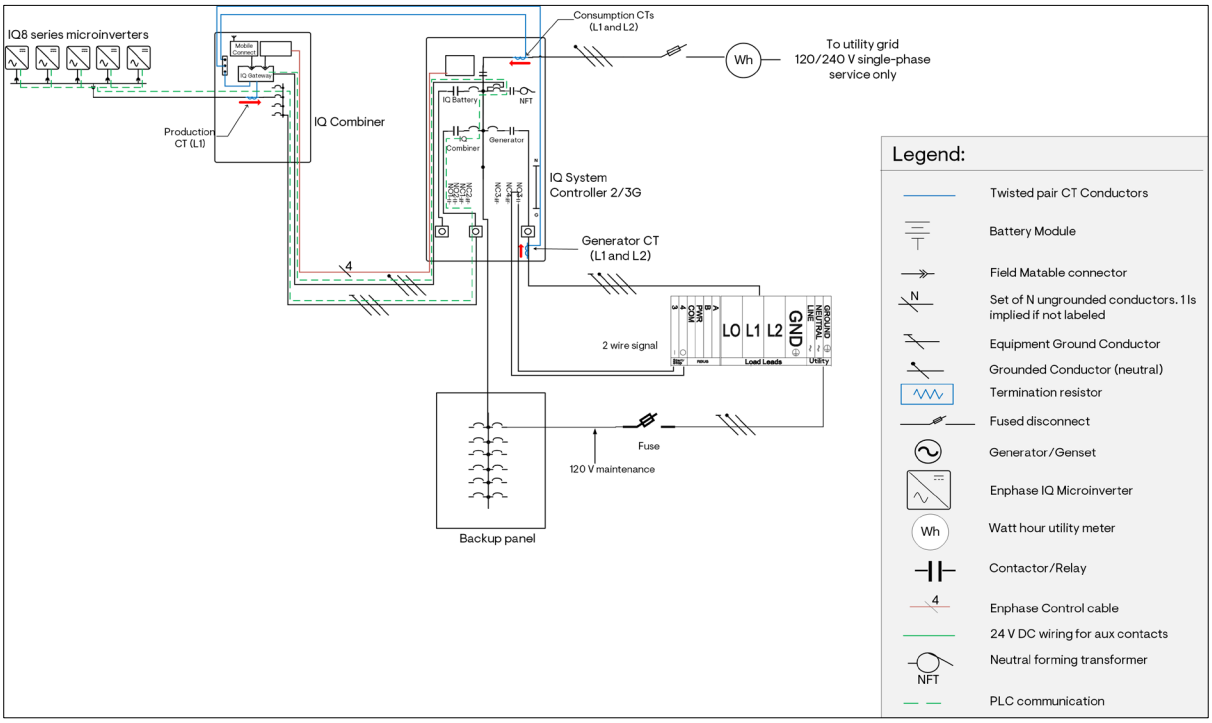


Figure 29: Kohler– Two-wire Connection

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 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. The line diagram for the connection of these generators to an Enphase Energy System is shown in the following figure

Generac provides a remote-start kit (Part number 7109) that allows their generators with an LCD 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 120 V Maintenance/Battery charger kit from here.

Generac QT & QS series generators can be operated as either utility sense or two two-wire start. The generators come configured as grid sense by default. Refer to Generac instructions or contact Generac support to convert the generator to a two-wire start.

If an external ATS is being used along with the generator at the site, then wires 195, 23, and 0 need not be connected.

If you choose to use the formerly mentioned method, contact Generac for any technical support needed.

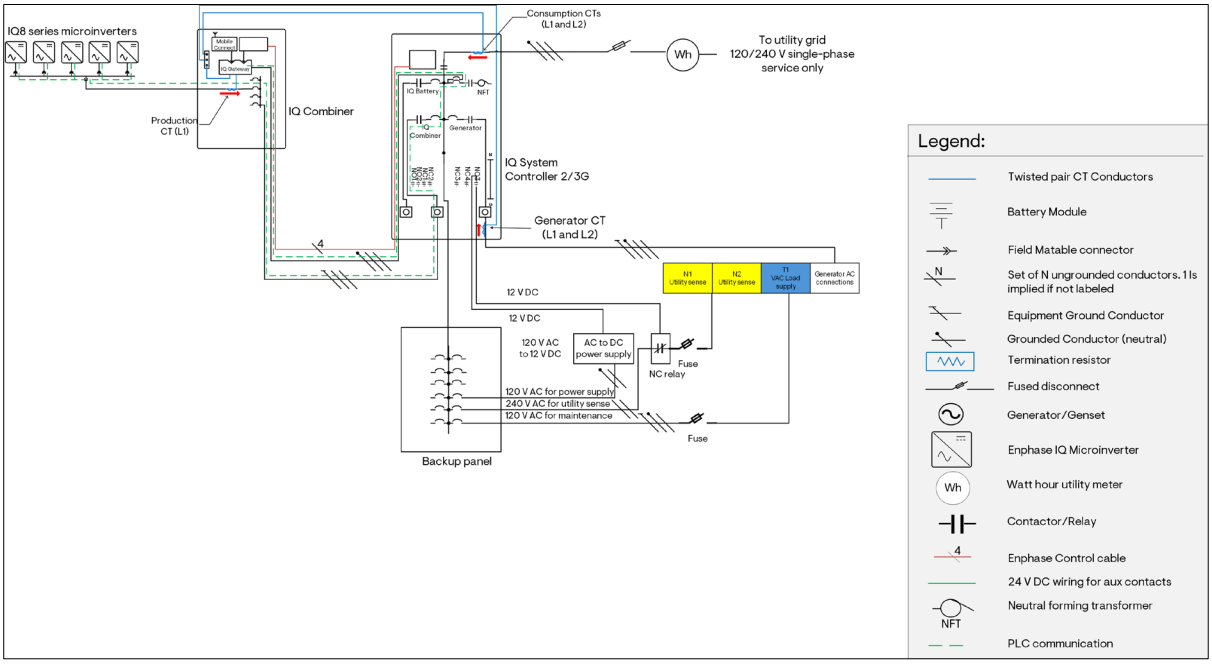


Figure 30: Generac Guardian- Utility Sense connection

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 the same Generac Guardian connections shown in the following figure.

An example of a compatible generator model:

7163

Table 8: Location of two-wire remote start connection in Generac 7163 Eco-Gen

Remote start connection		
Wire	**Connection**	**Location**
178	Female Faston	Hanging from the controller above the battery compartment
183	Female Faston	

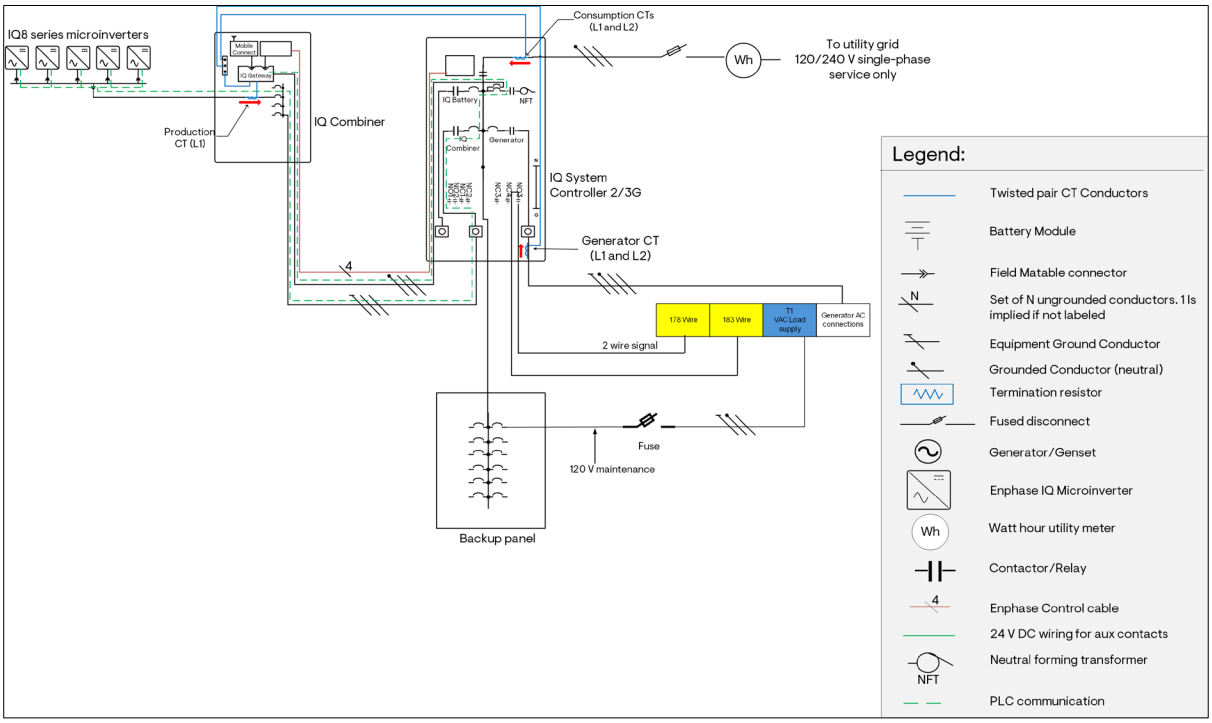


Figure 31: Generac EcoGen – Two-wire connection

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).

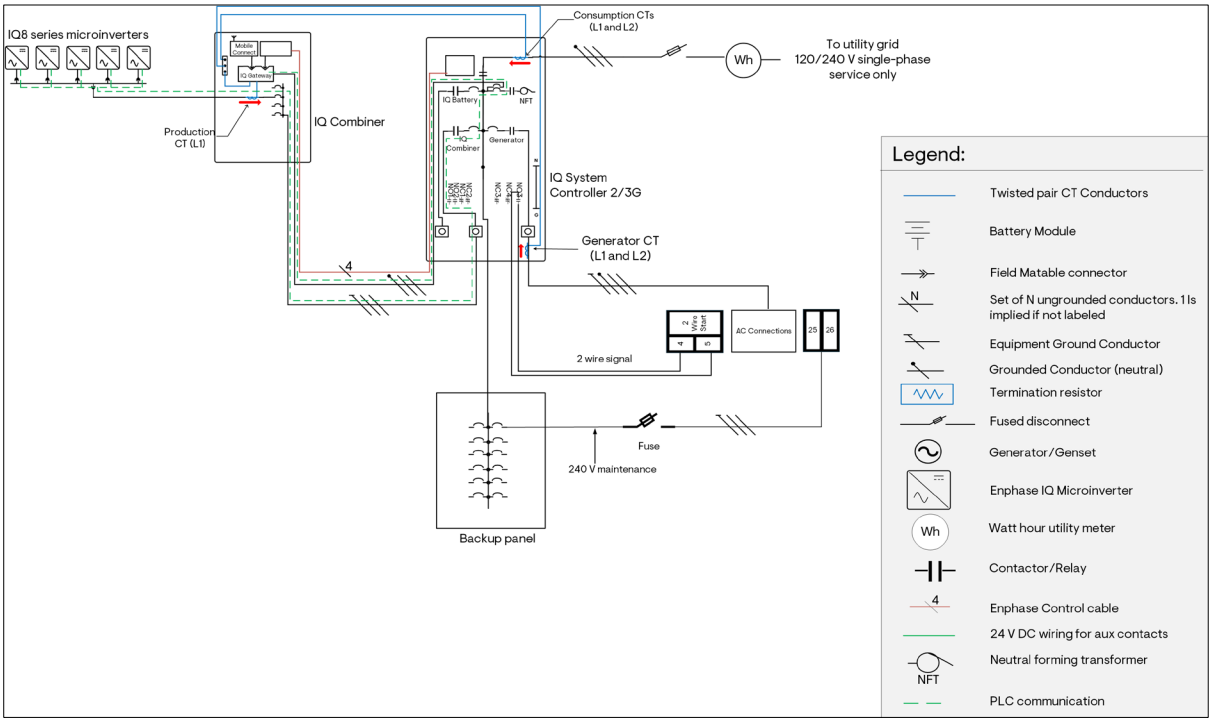


Figure 32: Briggs & Stratton – Two wire connection

Generator settings

For remote start generators, the various settings provided in the Enphase App are:

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

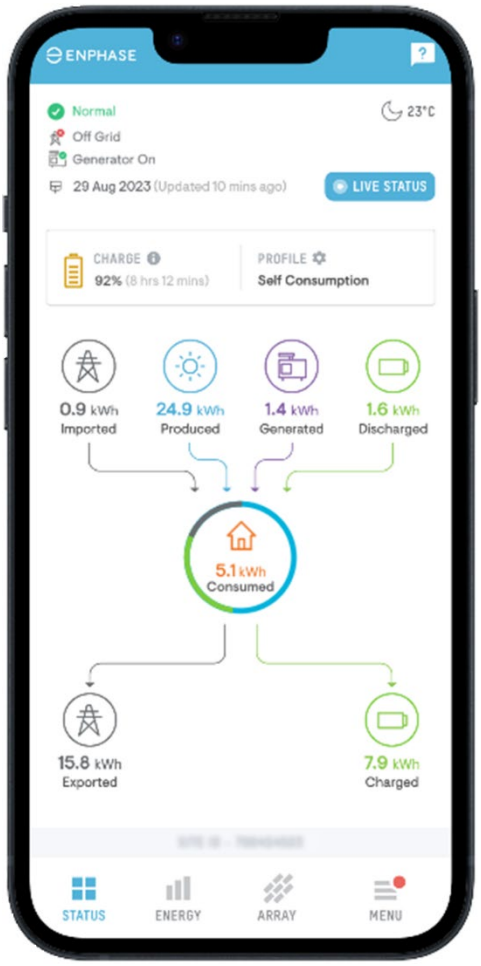


Figure 33: Status screen with generator

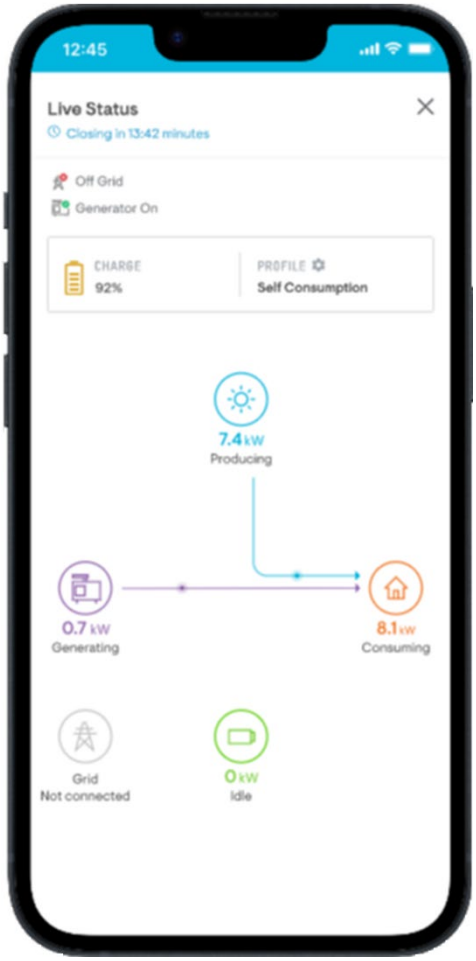


Figure 34: Live status screen with generator

Smart profile

The Enphase App provides various options for the homeowner to configure the generator operation as per his needs. The generator has two mutually exclusive smart profiles – Automatic and Ecofriendly, which are selectable in the app.

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

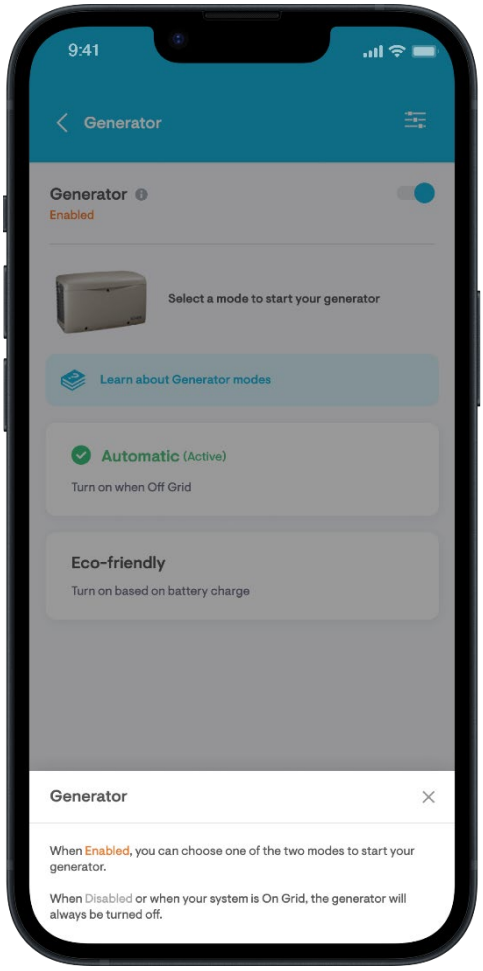


Figure 35: Smart profiles in the Enphase App

Automatic

Select the **Automatic** smart profile and tap **Activate** to turn on the generator immediately when the system goes off-grid. If the backup loads running during this duration are greater than the PV + Storage capacity, microgrid shutdown is possible. 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 the generator can take up to 30 seconds after the grid is down

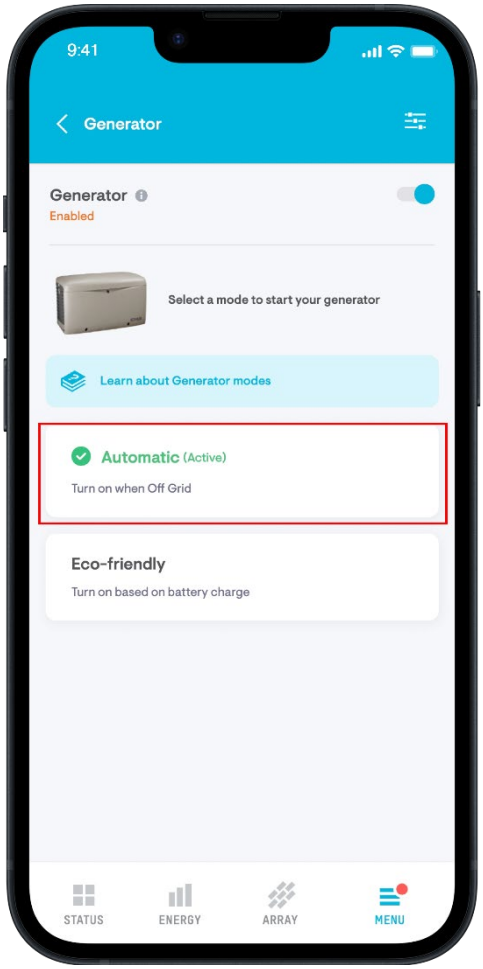


Figure 36: Automatic smart profile in the Enphase App

Eco-friendly

Select the **Eco-friendly** smart profile to turn on the generator based on the battery charge. Homeowners set the lower and upper limits 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 the grid.

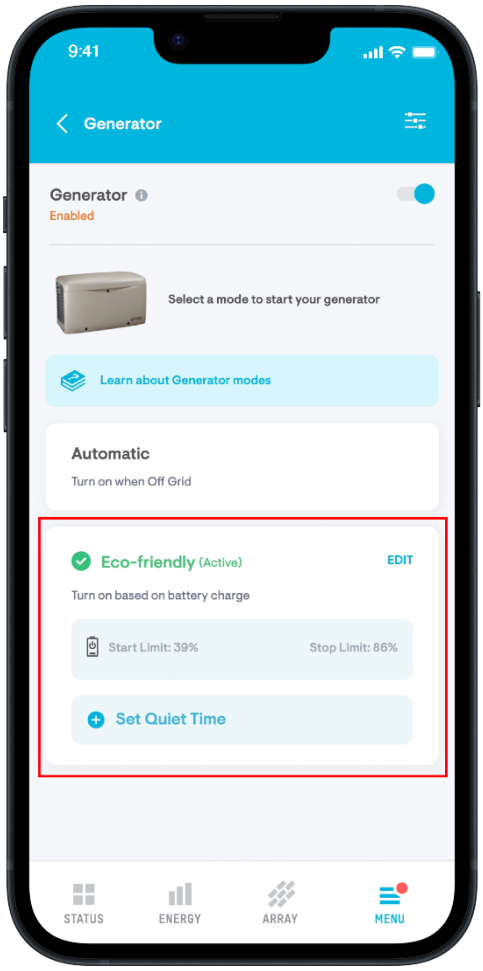


Figure 37: Eco-friendly smart profile in the Enphase App

Quiet time

Under the Eco-friendly smart profile in the Enphase App, there is an option given to the Homeowner called **Set Quiet Time** to add periods during which generator operation is allowed only when the battery charge falls below a critical limit. This feature is especially useful during the night to avoid noise that arises from generator operation. In this feature, the homeowner can set the critical charge settings, i.e., the 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.

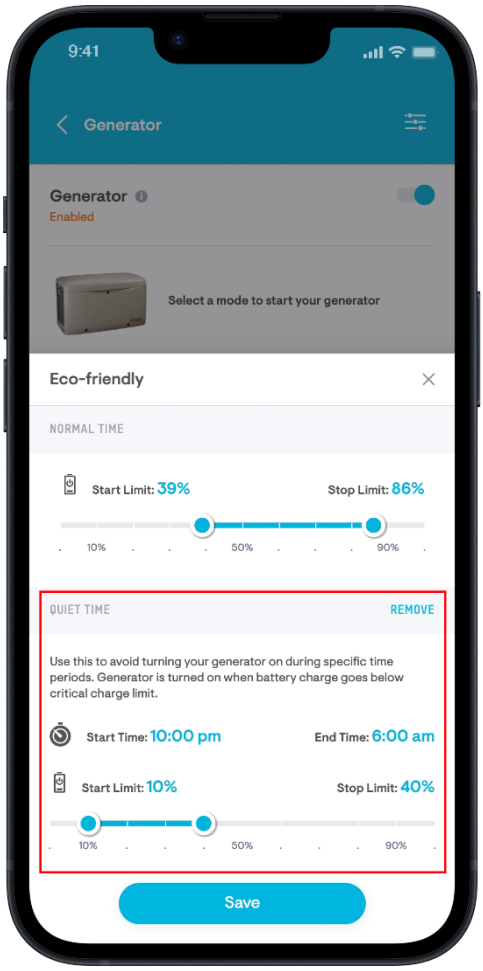


Figure 38: Quiet Time settings in the Enphase App

Advanced settings

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

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

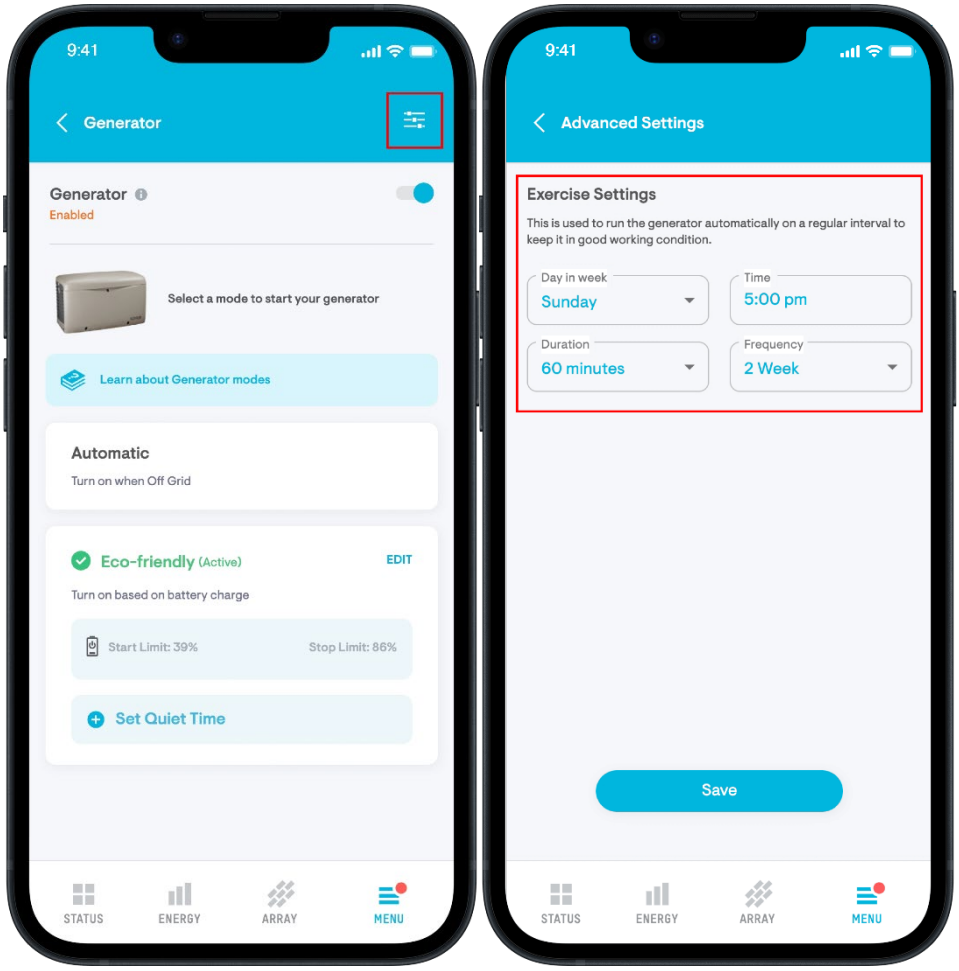


Figure 39: Advanced settings in the Enphase App

Disable or suspend the generator

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

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

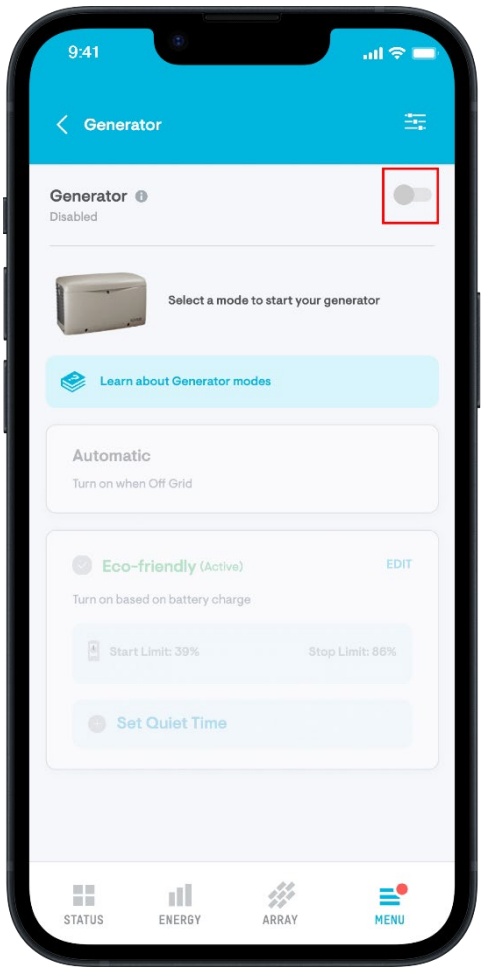
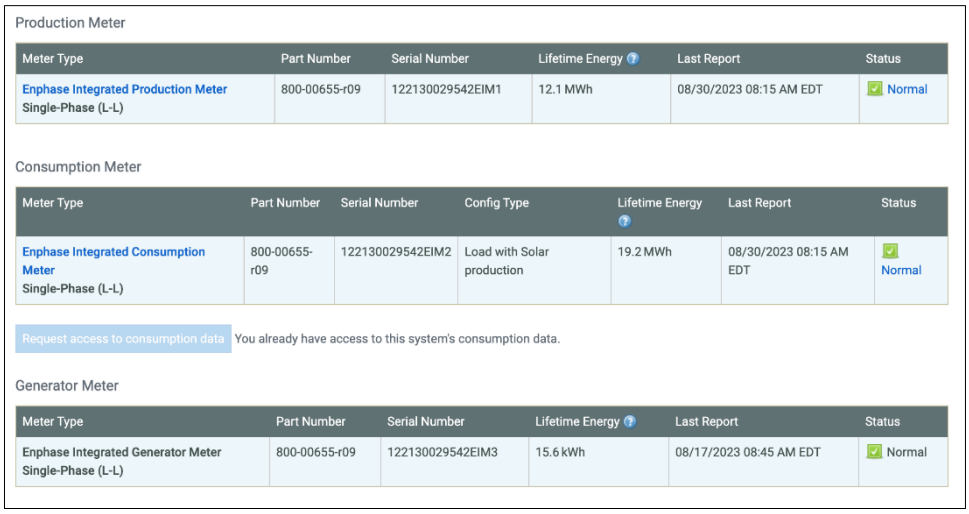


Figure 40: Disable the generator option in the Enphase App

For details on how to add a generator to a system using the Enphase Installer App and for generator meter configuration in the Enphase Installer App, see Commissioning Guide.

Generator details and settings in the Enphase Admin Platform

The generator added to the Enphase App will be available in the Enphase Admin Platform in the Devices section.



Production Meter

Meter Type	Part Number	Serial Number	Lifetime Energy	Last Report	Status
Enphase Integrated Production Meter Single-Phase (L-L)	800-00655-r09	122130029542EIM1	12.1 MWh	08/30/2023 08:15 AM EDT	Normal

Consumption Meter

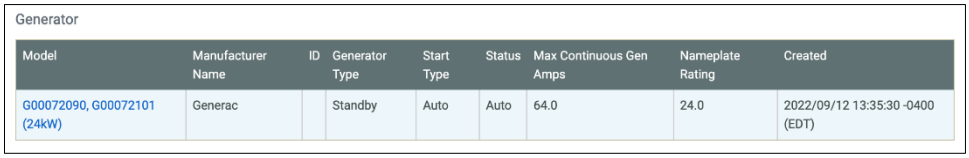
Meter Type	Part Number	Serial Number	Config Type	Lifetime Energy	Last Report	Status
Enphase Integrated Consumption Meter Single-Phase (L-L)	800-00655-r09	122130029542EIM2	Load with Solar production	19.2 MWh	08/30/2023 08:15 AM EDT	Normal

Request access to consumption data | You already have access to this system's consumption data.

Generator Meter

Meter Type	Part Number	Serial Number	Lifetime Energy	Last Report	Status
Enphase Integrated Generator Meter Single-Phase (L-L)	800-00655-r09	122130029542EIM3	15.6 kWh	08/17/2023 08:45 AM EDT	Normal

Figure 41: Generator details and setting in the Enphase Admin Platform (production meter, consumption meter, and generator meter)

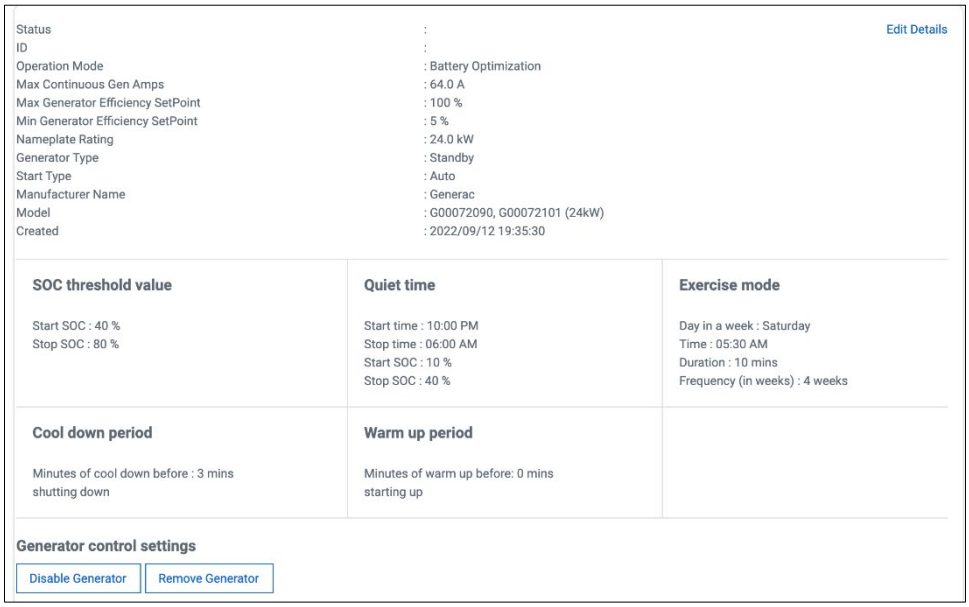


Generator

Model	Manufacturer Name	ID	Generator Type	Start Type	Status	Max Continuous Gen Amps	Nameplate Rating	Created
G00072090, G00072101 (24kW)	Generac		Standby	Auto	Auto	64.0	24.0	2022/09/12 13:35:30 -0400 (EDT)

Figure 42: Generator summary

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



Status :
ID :
Operation Mode : Battery Optimization
Max Continuous Gen Amps : 64.0 A
Max Generator Efficiency SetPoint : 100 %
Min Generator Efficiency SetPoint : 5 %
Nameplate Rating : 24.0 kW
Generator Type : Standby
Start Type : Auto
Manufacturer Name : Generac
Model : G00072090, G00072101 (24kW)
Created : 2022/09/12 19:35:30

Edit Details

SOC threshold value
Start SOC : 40 %
Stop SOC : 80 %

Quiet time
Start time : 10:00 PM
Stop time : 06:00 AM
Start SOC : 10 %
Stop SOC : 40 %

Exercise mode
Day in a week : Saturday
Time : 05:30 AM
Duration : 10 mins
Frequency (in weeks) : 4 weeks

Cool down period
Minutes of cool down before : 3 mins shutting down

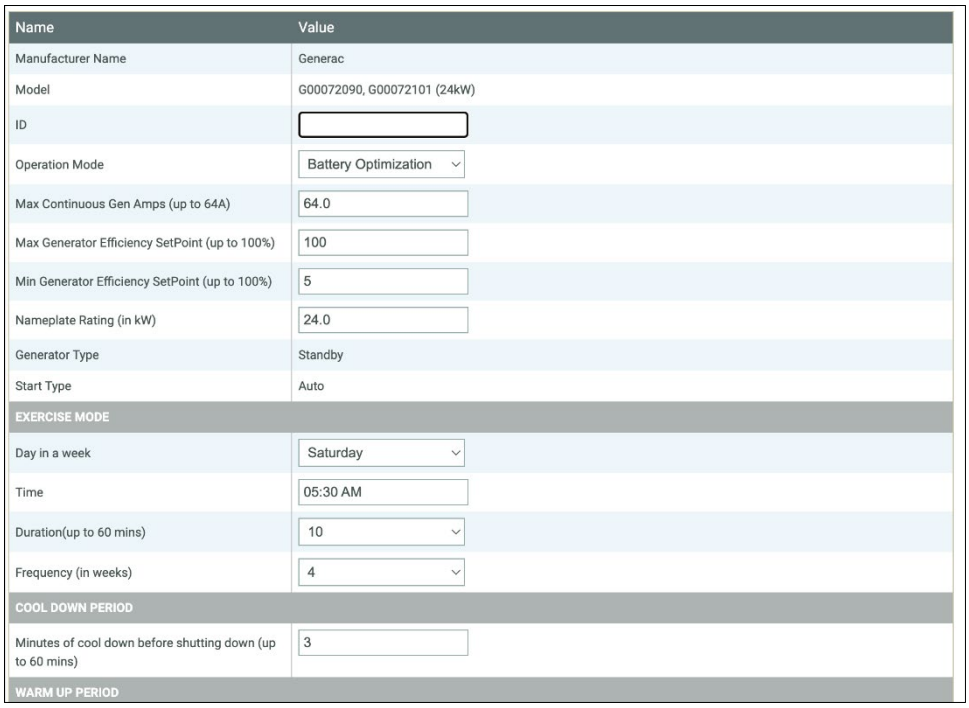
Warm up period
Minutes of warm up before: 0 mins starting up

Generator control settings
Disable Generator | Remove Generator

Figure 43: Generator details

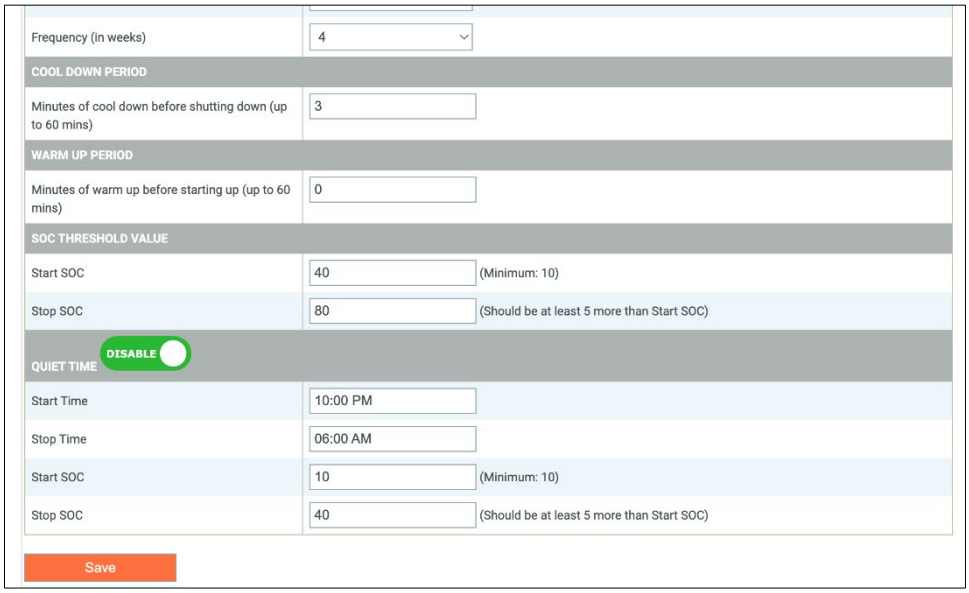
Enable Generator and **Disable Generator** buttons will enable or disable the generators. **Remove Generator** will delete the generator from the system.

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



Name	Value
Manufacturer Name	Generac
Model	G00072090, G00072101 (24kW)
ID	
Operation Mode	Battery Optimization
Max Continuous Gen Amps (up to 64A)	64.0
Max Generator Efficiency SetPoint (up to 100%)	100
Min Generator Efficiency SetPoint (up to 100%)	5
Nameplate Rating (in kW)	24.0
Generator Type	Standby
Start Type	Auto
EXERCISE MODE	
Day in a week	Saturday
Time	05:30 AM
Duration(up to 60 mins)	10
Frequency (in weeks)	4
COOL DOWN PERIOD	
Minutes of cool down before shutting down (up to 60 mins)	3
WARM UP PERIOD	

Figure 36: Generator edit table



Frequency (in weeks)	4	
COOL DOWN PERIOD		
Minutes of cool down before shutting down (up to 60 mins)	3	
WARM UP PERIOD		
Minutes of warm up before starting up (up to 60 mins)	0	
SOC THRESHOLD VALUE		
Start SOC	40	(Minimum: 10)
Stop SOC	80	(Should be at least 5 more than Start SOC)
QUIET TIME DISABLE		
Start Time	10:00 PM	
Stop Time	06:00 AM	
Start SOC	10	(Minimum: 10)
Stop SOC	40	(Should be at least 5 more than Start SOC)

Save

Figure 37: Generator edit table continued

Generator troubleshooting

This section lists various errors/events for generator troubleshooting. These events will be shown in the Enphase Installer Platform.

Table 10: Generator troubleshooting

#	Error/Event	Impact	Recommended Action
1	**System controller Generator Mode Com Bus Voltage Imbalance Error** or **System controller Generator Com Bus Phase Diff Out Of Range**	Generator was overloaded. Generator breaker in the 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: • Open the 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 the ON position). • Ensure you do not overload the system while the generator is running.
2	**System controller Generator THD High** High Total Harmonic Distortion (THD) Measured THD is above 25%	Generator power output is unstable and has high THD (THD means total harmonic distortion), 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 the generator manufacturer or installer to get the generator checked or switch to another generator.
3	**Generator High Load** The generator load is above the allowed limit.	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 the grid. This can happen when the power is drawn from the system while the generator is connected to the IQ Battery nameplate.	Reduce loads.
4	**Consumption CT Error** Generator CT missing or in error state. Also shown in the Enphase App.	The generator is connected to the system. However, the system cannot monitor 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 the installer or Enphase Support.

Revision history

Revision	Date	Description
TEB-00003-3.0	February 2024	Included support for IQ System Controller 3G and IQ Battery 5P. Updated the figures; the default figures in the figure use the IQ System Controller 3G and the IQ Battery 5P. The product names were updated to new Enphase product names.
TEB-00003-2.0	April 2023	Editorial updates.
TEB-00003-1.0	April 2023	Internal release.
Previous releases		