

Understanding Sunlight Backup system for installers and system designers

This document describes the Sunlight Backup configuration using IQ8 Microinverters. Below are the sections in the document:

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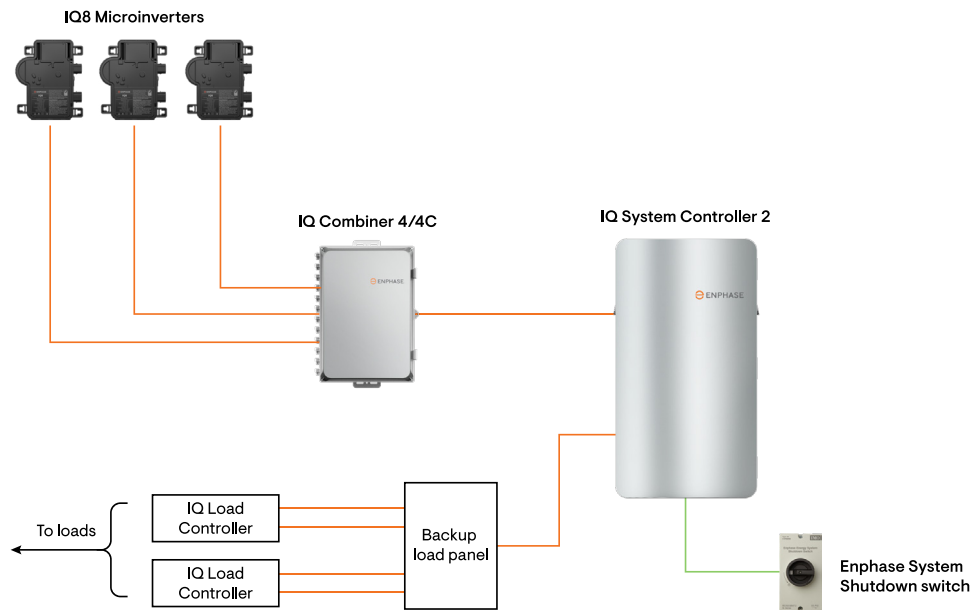
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Introduction

An Enphase Sunlight Backup system provides backup when the sun is shining. The system provides backup for up to 4x 240V or 8x 120V circuits. The system consists of IQ8 Series Microinverters, IQ System Controller 2, IQ Combiner 4C, up to 2x IQ Load controllers and other accessories as needed. Sunlight backup needs at least one IQ Load Controller installed on site.

NOTE: Sunlight should only be used for the essential loads in the home. Using the solution to back up the entire home will lead to poor experience and is not supported by Enphase.

System components



The system consists of IQ8 Series Microinverters, IQ System Controller 2, IQ Combiner 4C, up to 2x IQ Load Controllers and other accessories as needed.

- **IQ8 Series Microinverters and accessories** Ensemble technology is fully compatible with IQ8 Microinverters and makes retrofit upgrades as simple as new installations. The Sunlight Backup system supports up to 64A continuous AC output i.e., 15.4 kW AC nameplate aggregate from the IQ8 Microinverters.
- **IQ Combiner 4/4C** consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. IQ Combiner 4/4C includes Enphase IQ Gateway with the latest software needed to support IQ8. Install the communication kit, COMMS-CELLMODEM-M1-06 or COMMS-KIT-01, with IQ Combiner 4 or 4C respectively, to enable wireless communication with IQ Battery and IQ System Controller 2.
- **IQ System Controller 2** automatically detects utility power outages and seamlessly transitions you to backup power. It enables grid forming IQ8 Microinverters, IQ Batteries and even third-party AC standby generators to be connected to your home. IQ System Controller 2 is the certified rapid shutdown device for IQ8 Microinverters operating in backup configurations.

NOTE: IQ System Controller 1 will not work and is not safe to use with IQ8 Series Microinverters.

- **Enphase Energy System Shutdown Switch** must be used in an Enphase Energy system with grid forming IQ8 PV Microinverters to comply with 2017 NEC 690.12 and act as the rapid shutdown initiator for the system. IQ8 PV Microinverters become grid forming when commissioned with an IQ System Controller 2.
- **IQ Load Controller** Each IQ Load Controller unit can enable circuit-level control for 2x 240V loads or 4x 120V loads. Dedicated loads up to 36A resistive/25A inductive or branch circuits with multiple loads up to 32A resistive/25A inductive are supported by the IQ Load Controller. Sunlight backup needs at least one IQ Load Controller installed on site.

Refer to “[System use cases for IQ8 Microinverters](#)” tech brief for the single line diagram and bill of materials for a Sunlight Backup system.

NOTE: Third party backup generators can be added to a Sunlight Backup system. Refer to “Generator Tech brief” to add a generator to the system. A generator in a Sunlight Backup system must be in **Automatic** mode. The system starts the generator and connects it to the home loads whenever there is a grid outage. However, it would use power from generator only if the power produced by microinverters is insufficient to support the home loads.

Essential loads solution

Power produced in a Sunlight Backup system depends on the solar irradiance at the site location, which can vary depending on cloud cover, shading on the PV panels, time of the year etc. The system may collapse if the power produced is less than what is needed to power the loads.

Load control is a mandatory component in any IQ8 Sunlight Backup system. In any Sunlight Backup system Enphase requires installers to ensure that there is an Essential Loads solution. An Essential Loads solution consists of:

- An off-the-shelf panel with up to 4x 240V or 8x 120V essential load circuits that are backed up by the system.
- Up to Two IQ Load Controllers - Each IQ Load Controller can enable circuit-level control for 2x 240V loads or 4x 120V loads. The product is rated for dedicated loads up to 36A resistive/25A inductive or branch circuits with multiple loads up to 32A resistive/25A inductive.

Note: a) At least one IQ Load Controller is necessary for this solution.
b) Each IQ Load Controller must be installed per instructions in its [Quick Install Guide](#). Each IQ Load Controller contains two contactors and a power supply. The input of the power supply must be connected to the backup loads panels and the output is connected to the coil of both contactors via auxiliary contacts in the IQ System Controller 2. This enables the system to control the loads connected to the IQ Load Controllers.

The Essential Loads solution provides homeowners and the Enphase System control of all essential loads. This ensures that one or more of the essential loads can be shed, if required, to successfully form a microgrid when limited power is available.

Essential load selection

Work with the homeowner to select the essential loads. Keep the following points in mind while selecting the essential loads.

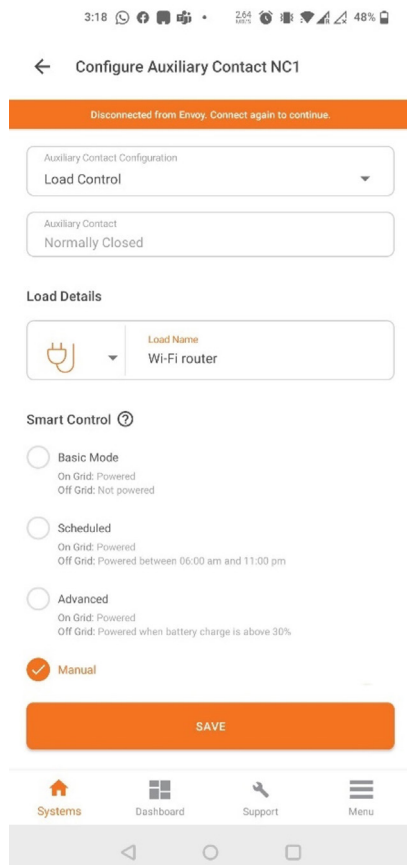
1. Enphase recommends the backup loads do not exceed 30% of the power of the IQ8 Microinverters. For example, the rated power output for a system with 24 IQ8 Microinverters is 5.7 kW AC. The backup loads should not exceed 1.7 kW AC (30% of 5.7 kW AC).
2. The system can backup up to 4x 240V or 8x 120V circuits. While backing up 4x 240V circuits, it controls each of the backed-up circuits individually. While backing up 8x 120V circuits, the backed-up circuits are divided into 4 groups with 2 circuits each, and the system can control each group (of two circuits). In case a single Load Controller is used the 120V loads are grouped into 2 groups.
3. Ensure that each auxiliary contact is named in a way that reflects the loads controlled by that contact. These names are shown to the homeowner and proper naming ensure homeowner can understand the priority of loads and the system behavior when looking at the Enphase App.
4. Ensure that the branch circuit with the Wi-Fi router and modem is always an essential load and has the highest priority amongst the essential load circuits.
5. If another load is added to the auxiliary contact that controls the branch circuit for Wi-Fi, ensure that it is a light load. Overloading this auxiliary contact will result in very poor homeowner experience since they will lose internet connectivity and consequently lose the ability to control loads in their system.

Configuring a Sunlight Backup system

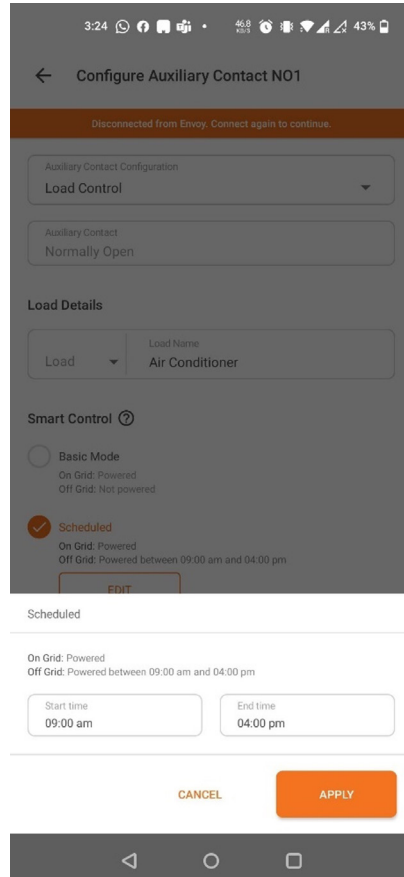
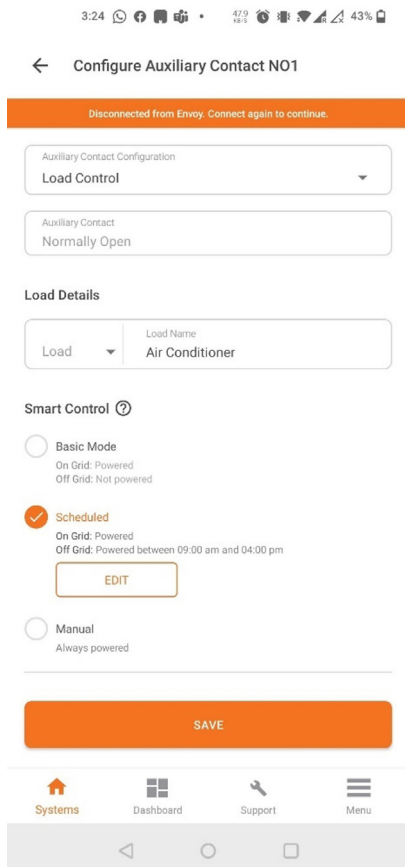
When commissioning a gateway running software version 7.0 or higher with Installer App version 3.24.0 or higher:

- The Installer App automatically detects a Sunlight Backup use case by the presence of grid forming IQ8 Solar Microinverters and the IQ System Controller 2, as well as the absence of IQ Batteries.
- Once the app has detected a Sunlight Backup use case it requires you to scan up to 2x IQ Load Controller(s) and have at least one auxiliary contact configured to proceed with commissioning.

- Connect your internet modem & router branch circuit to the NC1 auxiliary contact to ensure it is the highest priority. Change the mode of this circuit to **Manual** in the Installer App. This ensures that the circuit is powered on as soon as power is available when running off-grid.
- If you are backing up more than 4 loads, avoid using the contactor controlled by the NC1 auxiliary contact unless you must (i.e., in a scenario where you have used up all other contactors). Use NC1 for multiple load branch circuits only if all other contactors/ auxiliary contacts have been completely utilized. If forced to add another load to the NC1 auxiliary contact, ensure it is a low-power load like lights etc.



- For a Sunlight Backup use case the Installer App will automatically set all controlled loads to the **Scheduled** mode with a default time window of 9am to 4pm local time. This means all essential loads (controlled by NC1, NC2, NO1 and NO2) are available only between 9am to 4pm local time if the system is running off-grid i.e., during a grid outage. This is to ensure that the system provides backup to loads only during time periods where there is typically adequate sunlight and avoids multiple system restarts. You can change the time window to any time between 7am to 8pm to match your local sunrise/sunset conditions and available irradiance depending on the season. Note that as instructed previously NC1 must be used for the Wi-Fi modem and router and must be changed to the Manual mode.



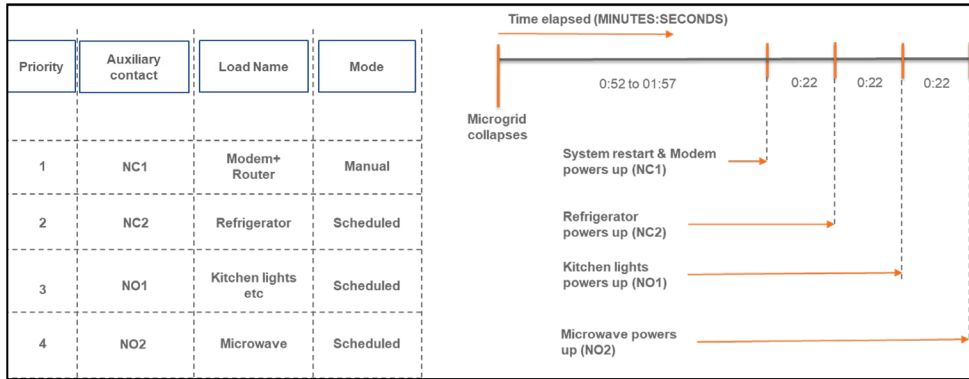
- Enphase recommends you stagger the turn on and turn off times of various loads so that the heaviest loads operate when solar power produced is maximum, typically between 11am and 3pm. The homeowner can also change this to match the system’s solar power production using the Enphase App. Power production data per day can be seen in the Enphase App Energy tab. Refer “[Understanding Sunlight Backup system for Homeowners](#)”.

System behavior

This section provides timing details and priorities of controlled loads for system designers.

- When the system shuts down i.e., microgrid collapses, all the essential loads are powered off since there is no power in the system.
- If sunlight is available, the system can take up to two minutes to restart (also referred to as black start) and power on the loads. At this point any loads in **Manual** mode that are configured to be powered on, will turn on. The next steps followed by the system are outlined below:
 - The IQ System Controller 2 will power the remaining loads in a pre-determined order. Loads controlled by the remaining auxiliary contacts (NC2, NO1, NO2 – in that order) are powered on, with a 22 second gap in between. If a load is in **Scheduled** mode, it will turn on only if the current time falls in the scheduled time window.
 - If there is a system shutdown within 22 seconds of a load being powered on, then system considers that load to be responsible for the collapse.
 - If a load causes five system shutdowns – the system disables that load i.e., the load is powered off and will not be automatically powered on while the system is off-grid. The homeowner can use the Enphase App to turn the load on when irradiance increases (for example in the afternoon). Refer “[Understanding Sunlight Backup system for Homeowners](#)”.
 - If the load is successfully powered for more than five minutes, the system will reset the system shutdown counter for that load. This means if a load is added to the microgrid and does not cause a collapse for at least five minutes - its system shutdown counter is reset.
 - If all the loads are blacklisted, the system will retry the above sequence after one hour.
- All loads will be powered on automatically when the system connects back to the grid or connects to a generator.
- If a system black starts from PV in the morning, the system will reset the shutdown counters of all loads from the previous day.

The illustration below shows a timeline from system shutdown until the point when all loads are connected back to the system. Note that this illustration assumes all loads are powered on the first system restart. The sequence below will repeat if there are successive failures.



EVENT	TIME TAKEN (HOURS: MINUTES: SECONDS)	TIME ELAPSED SINCE SYSTEM SHUTDOWN (HOURS: MINUTES: SECONDS)
System shutdown/Microgrid collapse	N/A	00:00:00
System restart IQ8 Microinverters restart and provide 240V output Load controlled by NC1 is powered on (if in Manual mode)	00:00:52 to 00:01:57	00:00:52 to 00:01:57
Load controlled by NC2 is powered on	00:00:22	00:01:14 to 00:02:19
Load controlled by NO1 is powered on	00:00:22	00:01:36 to 00:02:41
Load controlled by NO2 is powered on	00:00:22	00:01:58 to 00:03:03

The system takes between 52 seconds to 1:57 minutes to power up after a microgrid collapse. Loads in Scheduled mode are powered on only if the current time falls in the scheduled time window.