Sunlight Backup with IQ8 and Load Control enhancements

Sunlight Backup requires an Essential Loads Solution

Load control is a mandatory component in any IQ8 Sunlight Backup system. This is a system with grid forming IQ8 Microinverters on the roof, and an IQ System Controller 2. The system does not have an IQ Battery but can remain powered during a grid outage using the IQ8 solar microinverters, if the sun is shining.

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 a maximum of four pre-selected, essential load circuits that are backed up by the system
- Two IQ Load Controllers - Each IQ Load Controller can enable fine-grained, 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: 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 granular control of all essential loads. Granular control ensures that one or more of the essential loads can be shed, if required, to successfully form a microgrid when limited power is available.

Load Control software enhancements with Gateway software 7.0

Gateway software 7.0 brings in support for IQ8-based systems and includes enhancements to the load control feature. These enhancements are only available when using IQ System Controller 2.

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 installers to scan 2x IQ Load Controllers to proceed with commissioning
- For a Sunlight Backup use case the Installer app will automatically set all controlled loads to the Scheduled mode with a fixed time window of 9am to 4pm local time. This means all essential loads 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 restarts of loads

The new scheduled mode for Load Control is also available to use with other backup use cases with IQ8 and IQ Batteries.

- For backup use cases that include IQ Batteries (Home Essentials Backup and Full Grid Independence) the homeowner can change the schedule to any preferred time using the Enphase App
- For the Sunlight Backup use case the homeowner can change the schedule to a time within 9am to 4pm local time

Even with the scheduled mode there can be instances when load power requirements exceed available power from the sun. This can be due to a cloudy day, shading due to trees etc. The system software has been built to intelligently handle microgrid collapses and provide the maximum chance of successfully restoring power to the home.

- When the system is running off-grid, the system will shutdown if the available power is not sufficient to meet requirements
- After a short delay the system will restart or blackstart using the power available from IQ8 solar microinverters
- The system software uses the granular control of loads to try each load individually after restarting
- Loads that repeatedly cause a system shutdown are shed automatically after a few tries so that the homeowner gets the microgrid back with the loads that can be supported
- The homeowner can manually reconnect a load that was shed if they believe that the power available has increased (for example during noon time when irradiance from the sun increases)
- All loads are connected back to the system when the system connects back to the utility grid

System restart timing and Load Control priority

This section provides timing details and Load Control priorities 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 there is sunlight available, the system can take up to ~2 minutes to restart (also referred to as blackstart) and power on the loads. At this point any loads backed-up by the IQ System Controller 2, that do not have Load Control, will turn on. To avoid heavy loads from repeatedly collapsing the system it is vital to use load control with such loads
- Next IQ System Controller 2 will power controlled loads in a pre-determined order
  - Within a few milliseconds of the loads directly connected to the IQ System Controller 2 being powered on, the load controlled by the NC1 auxiliary contact will also be powered on. Enphase recommends using NC1 to control the branch circuit that has the internet modem and router
  - Loads controlled by the remaining auxiliary contacts (NC2, NO1, NO2 – in that order) are then powered on, with 22 seconds of gap in between
  - 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 5 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)
  - If the load is successfully powered for more than 5 minutes, the system will reset the collapse/shutdown counter for that load. For example, consider a load that has already caused the system to shutdown 3 times. During the next blackstart, the microgrid does not collapse for 5 minutes after adding the load to the microgrid. In this case, the system will reset the shutdown counter for the load and will shed the load only if it causes a fresh set of 5 system shutdowns
  - All loads that have been automatically shed will be powered on automatically when the system connects back to the grid or connects to a generator

The table below shows a timeline from system shutdown till the point when all loads are connected back to the system. Note that this table assume all loads can be successfully powered on the first try post system restart. The sequence below will repeat if there are successive failures. If any load causes up to 5 system shutdowns that particular load will be skipped and the 22 seconds delay associated with that load will also be skipped during the next system restart.

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 with highest priority loads powered on • IQ8 Microinverters restart and provide 240V output • All loads directly backed-up without load control are powered on • Load controlled by NC1 is powered on	**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**