Planning an Enphase Energy System

Contents

Applicable countries

- Australia
- New Zealand

Overview

This document provides site surveyors and design engineers with the information required to evaluate a site and plan the installation of the Enphase Energy System. The information provided in this document supplements the information in the data sheets, quick installation guides, and product manuals. Diagrams and information in this document are illustrative examples of system configurations and installations. However, they may only include some requirements from additional local codes, standards, and Authorities Having Jurisdiction (AHJs) applicable to a site.

The Enphase Energy System is a residential solar PV and energy storage solution. The energy storage system with IQ Battery 5P and IQ System Controller 3 INT is a high-performance, reliable, modular, and scalable AC-coupled solution that can be installed at homes to complement the IQ Microinverters and provide a complete energy solution. The IQ System Controller 3 INT is the integrated smart microgrid interconnect device (MID) that controls the operation of all the devices and ensures seamless power supply to the home.

Enphase Energy System overview

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

- **Enphase IQ Battery 5P** is an all-in-one AC-coupled storage system with embedded, grid-forming multimode microinverters. You can connect multiple IQ Batteries to maximize potential backup for homes. The IQ Battery 5P storage system allows customers to start small and add capacity incrementally.
- **Enphase IQ System Controller 3 INT** connects the home to grid power, the IQ Battery 5P, and PV. It provides MID functionality by automatically detecting and seamlessly transitioning the system from grid power to backup power in the event of a grid failure.
- **IQ Gateway** is a communications gateway that can communicate with IQ Batteries (over wired control and communication cables) and the IQ Microinverters (over powerline wires via PLC communication). It collects system performance information and transmits it over the internet to the Enphase Cloud. IQ Gateway is included inside the IQ System Controller 3 INT.
- **Enphase IQ Microinverters** are the inverters that can be part of the AC solar modules. They are modular and scalable to meet the desired capacity of the house. The combined circuits of IQ Series and S Series Microinverters are connected to the IQ System Controller 3 INT.

Enphase Energy Systems - Standard configurations

The Enphase Energy System follows AC-coupled system architecture, as shown in Figure 1. Supported configurations for each case are explained in the following sections.

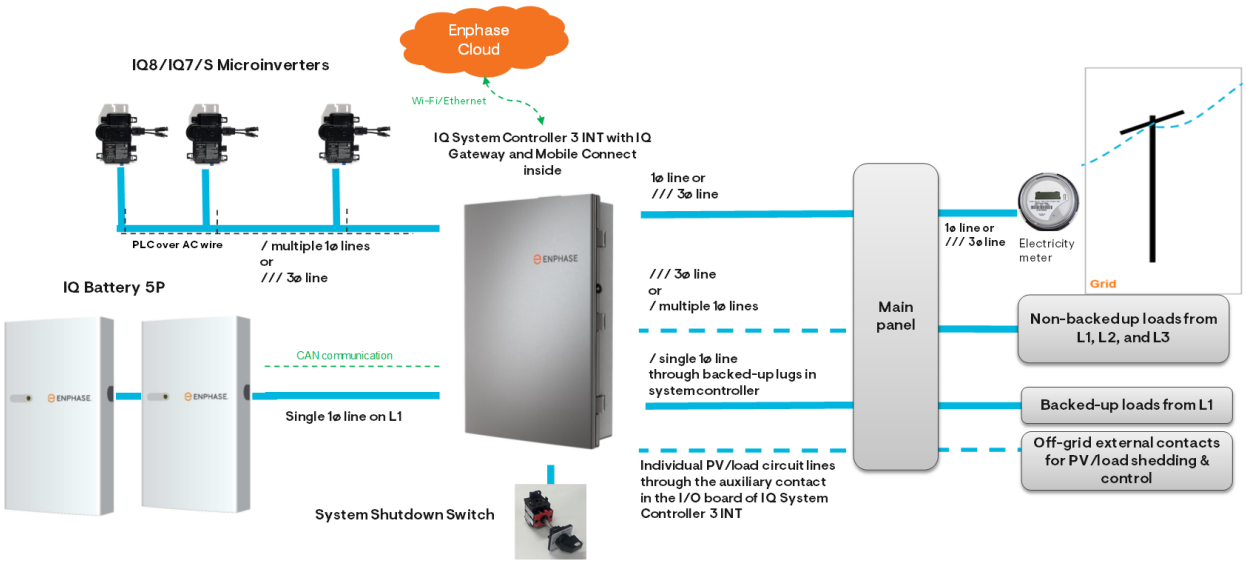

Figure 1: Enphase Energy System with component block diagram

System and backup configurations

The Enphase Energy System enables backup configurations for different customer goals and needs. Depending on the grid supply, whether single-phase or three-phase, the backup configurations can be done as shown in the following sections:

Single-phase system whole home backup using backup lugs in IQ System Controller 3 INT

In a system with a single-phase supply from the grid side and a single-phase PV installed, all the loads in the home on this L1 (one-phase) line can be backed up from the IQ System Controller 3 INT. All loads must be connected to backup lugs in the IQ System Controller 3 INT. There will be no loads connected to the non-backup lugs. The single-phase PV will be connected to the L1 lug marked for PV and the neutral lug through the preinstalled PV breaker. The IQ Batteries must be connected to the IQ Battery L1 lug and neutral bar on the IQ System Controller 3 INT. Figure 2 shows the electric circuit diagram.

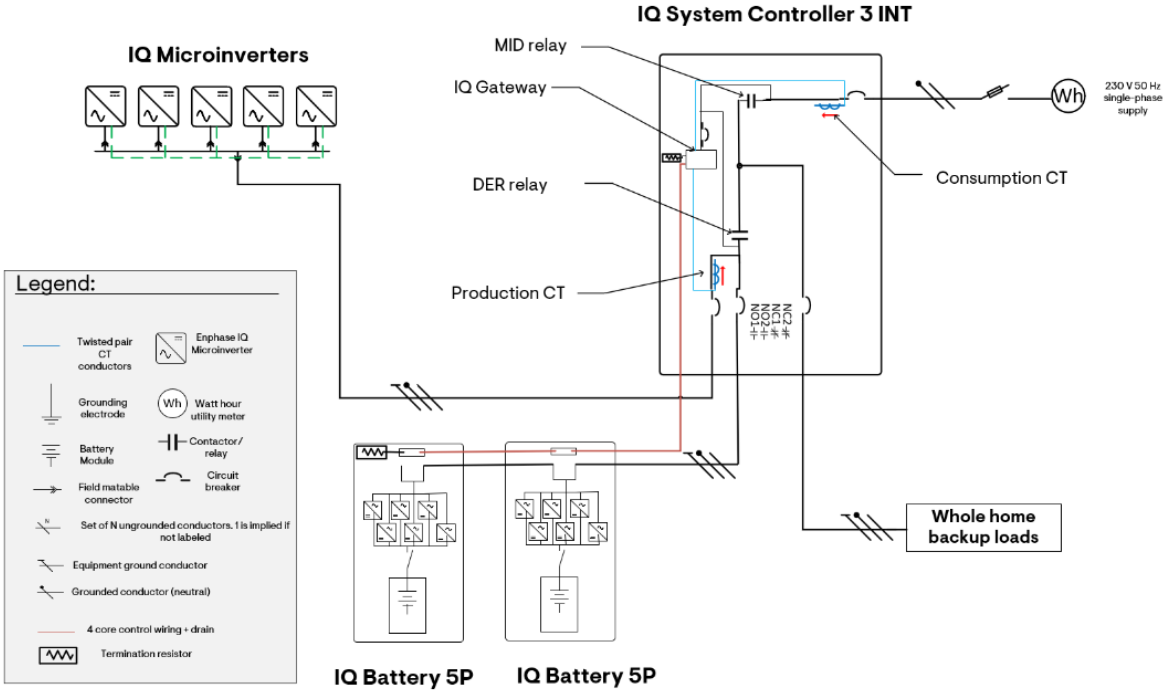

Figure 2: Enphase Energy System for single-phase configuration with a whole home backup

WARNING: For wiring the PV circuit in the Enphase Energy System, the pre-installed 4-pole 25 A PV breaker in the IQ System Controller 3 INT is to be used with the PV neutral wire connected to the pre-wired N-line in the 4-pole breaker. Connecting the PV neutral to the neutral bar of the IQ System Controller 3 INT may hamper power line communication (PLC) in the system.

Single-phase system partial home backup using backup and non-backup lugs in IQ System Controller 3 INT

In a system with a one-phase supply from the grid side and a single-phase PV installed, the essential loads of the home on this L1 (one-phase) line can be backed up from the IQ System Controller 3 INT. Connect the essential loads of L1 to backup lugs and non-essential loads of L1 to the non-backup lugs in IQ System Controller 3 INT. Connect the single-phase PV to the L1 lug marked for PV and neutral lug through the pre-installed PV breaker, and connect the IQ Batteries to the IQ Battery L1 and neutral bar on the IQ System Controller 3 INT. Figure 3 shows the electric circuit diagram.

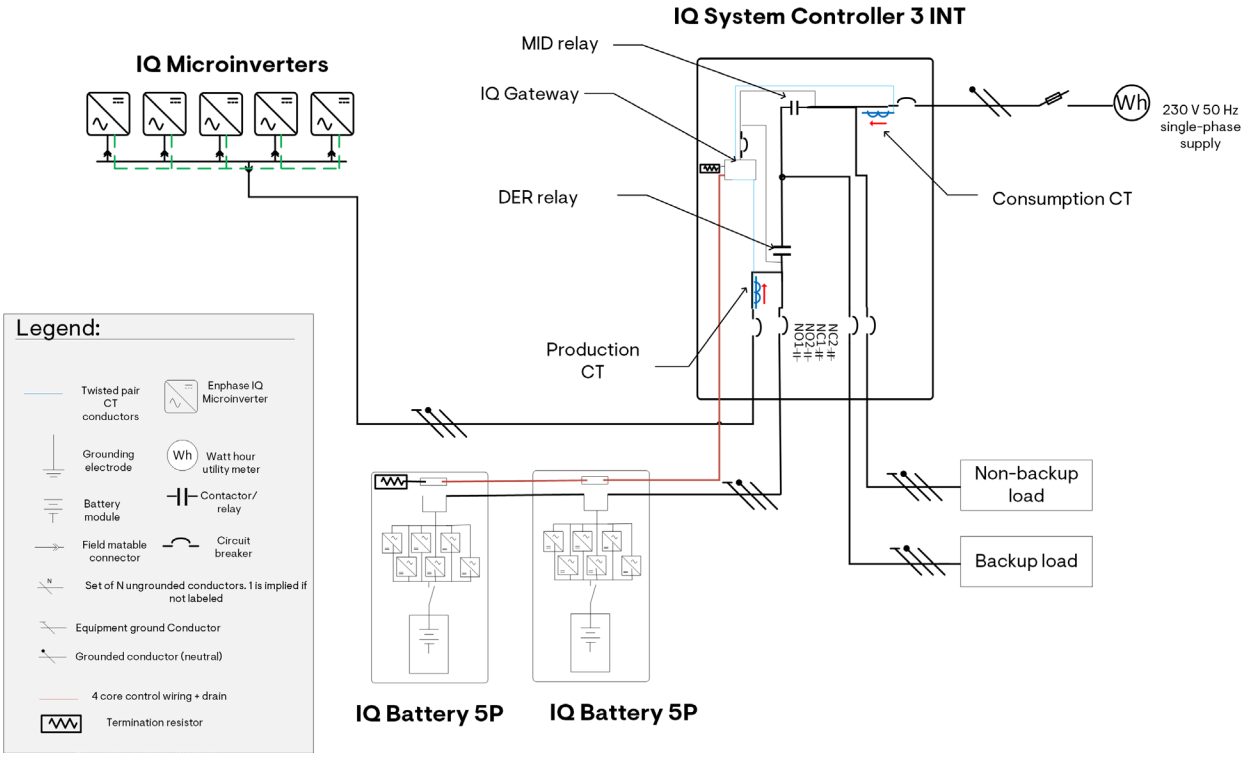

Figure 3: Enphase Energy System for single-phase configuration with partial home backup

WARNING: For wiring the PV circuit in the Enphase Energy System, the pre-installed 4-pole 25 A PV breaker in the IQ System Controller 3 INT is to be used with the PV neutral wire connected to the pre-wired N-line in the 4-pole breaker. Connecting the PV Neutral to the neutral bar of the IQ System Controller 3 INT may hamper power line communication (PLC) in the system.

Three-phase system grid supply with three-phase PV and storage on all three phases, having L1 phase backup, using backup and non-backup lugs in IQ System Controller 3 INT

NOTE: The IQ Battery support on all three phases will be introduced soon. At present, IQ Battery can be connected only to the L1 phase in IQ System Controller 3 INT.

NOTE: For NZ, multi-phase sites with Enphase Energy System are currently unsupported until further notice due to issues with per-phase metering. It is recommended to install IQ Battery 5P only on single-phase sites.

In a system with a three-phase supply from the grid side and a three-phase PV installed, the loads in the home on the L1 (one-phase) line can be backed up from the IQ System Controller 3 INT. Connect all loads of L1 or essential loads of L1 to backup lugs and all other loads of L2, L3, and remaining L1 loads (if any) to the non-backup lugs of IQ System Controller 3 INT. Connect the three-phase PV to the L1, L2, and L3 lugs marked for PV and neutral lugs through the pre-installed PV breaker, and connect the IQ Batteries to the IQ Battery L1, L2, and L3 and neutral bar on the IQ System Controller 3 INT. Figure 4 shows the electric circuit diagram.

WARNING: Do not daisy chain the neutral wire of the batteries from multiple phase branches of the IQ Battery; connect the neutral wire from every phase of the IQ Battery separately on the neutral bar on the IQ System Controller 3 INT.

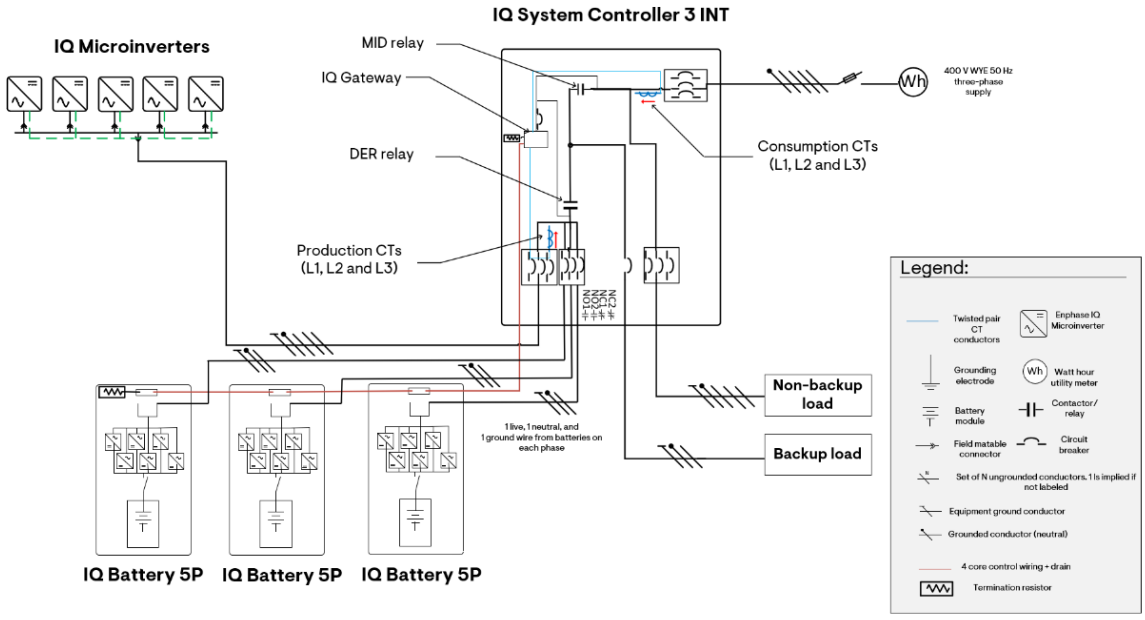

Figure 4: Enphase Energy System with three-phase supply and three-phase PV and IQ Battery on all three-phases

WARNING: For wiring the PV circuit in the Enphase Energy System, the pre-installed 4-pole 25 A PV breaker in the IQ System Controller 3 INT is to be used with the PV neutral wire connected to the pre-wired N-line in the 4-pole breaker. Connecting the PV neutral to the neutral bar of the IQ System Controller 3 INT may hamper power line communication (PLC) in the system.

Three-phase system grid supply with one-phase PV and L1 phase backup using backup and non-backup lugs in IQ System Controller 3 INT

In a system with a three-phase supply from the grid side and a one-phase PV installed, the loads in the home on the L1 (one-phase) line can be backed up from the IQ System Controller 3 INT. Connect all loads of L1 or essential loads of L1 to backup lugs and all other loads of L2, L3, and remaining L1 loads (if any) to the non-backup lugs. Connect the one-phase PV to the L1 lug marked for PV and neutral lug through the pre-installed PV breaker, and connect the IQ Batteries to the IQ Battery L1 and neutral bar on the IQ System Controller 3 INT. Figure 5 shows the electric circuit.

NOTE: For NZ, multi-phase sites with Enphase Energy System are currently unsupported until further notice due to issues with per-phase metering. It is recommended to install IQ Battery 5P only on single-phase sites.

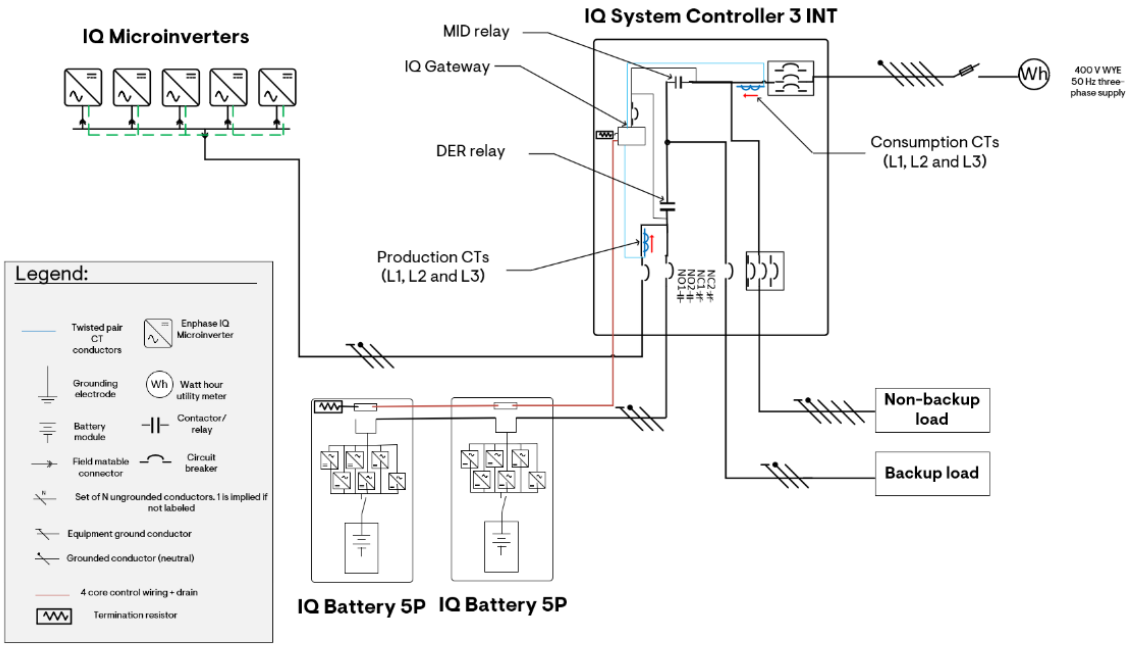

Figure 5: Enphase Energy System with three-phase supply and one-phase PV with single-phase L1 backup

WARNING: For wiring the PV circuit in the Enphase Energy System, the pre-installed 4-pole 25 A PV breaker in the IQ System Controller 3 INT is to be used with the PV neutral wire connected to the pre-wired N-line in the 4-pole breaker. Connecting the PV neutral to the neutral bar of the IQ System Controller 3 INT may hamper power line communication (PLC) in the system.

Use cases and sizing

Load analysis

The first step in correctly sizing a system is a comprehensive load analysis. If an IQ Gateway with correctly configured production CTs is installed at a site, you can use data from the Enphase Cloud to size the system properly. A site survey, electricity bills, and third-party consumption meters can also provide useful load data for system sizing.

Backup use case

A backup system provides power to loads when the grid is down. It is essential to differentiate the terms power and energy. Power is a measure of the instantaneous electricity used and is expressed in units of

watts (W) or kilowatts (kW). Energy is the accumulated or integrated power used over time and is expressed in units of watt-hours (Wh) or kilowatt-hours (kWh). When running in the backup operation, any power or energy capacity shortages will result in a loss of power to loads and should be avoided. Therefore, it is essential to properly size the system for both power and energy capacities in each installation.

Sufficiently size the IQ Battery power rating to power loads and charge from PV power generation. You can increase the power rating by adding additional IQ Batteries, which also provide extra energy, improving the customer user experience. Each battery will add 3.84 kW of power and 5 kWh of energy capacity.

- **Power** (kW) capacity from IQ Battery must not exceed the maximum single load. The total IQ Microinverter AC power rating connected to the microgrid may not exceed 150% of the entire IQ Battery continuous power rating. Refer to the Table 1.
- **Energy** storage (kWh) capacity should be sized to supply the estimated backup loads for a user-defined period.

Sizing Enphase Energy System for whole home (central panel) backup

For whole home backup in a single-phase system, when all the loads are connected to the backup lugs in the IQ System Controller 3 INT, at minimum, the number of IQ Battery 5P units to meet the PV system to IQ Battery pairing is recommended.

Sizing Enphase Energy System for partial home backup

For partial home backup in a single-phase system or a three-phase system with single-phase backup, when only essential loads of the L1 phase are connected to backup lugs in IQ System Controller 3 INT, follow the steps to size an IQ Battery:

1. Identify the most oversized maximum single load power rating (kW) you want to back up and select the absolute minimum number of IQ Batteries required to power that load. You can go for more IQ Batteries for higher power based on load profile information from the previously installed IQ Gateway at the site.
2. Calculate the total microinverter's maximum continuous output power in the system connected to the L1 phase. Then select the required IQ Batteries so that the entire PV system output AC power is not greater than 150% of the total IQ Battery system power rated capacity. This limitation is not present when IQ8 Microinverters are used; this applies to S Series and IQ7 Series Microinverters.
3. Based on the estimated backup loads for the user-defined period, calculate the required IQ Battery energy storage (kWh) capacity and the minimum IQ Batteries.
4. Based on a site's load analysis of both power (kW) and energy capacity (kWh), determine the total number of IQ Batteries required for the storage system.
    a. The minimum IQ Battery units required is the largest of the calculated values in steps 1 and 2.
    b. The desired number of IQ Batteries is the value calculated in step 3.
    c. The maximum number of IQ Battery 5P units connected to a single IQ System Controller 3 INT is four units per phase.

Enphase IQ Microinverter system to IQ Battery pairing

The following table identifies the maximum power of an IQ Microinverter system that can be connected to a given IQ Battery size. The total PV system output power cannot exceed 150% of the IQ Battery power capacity unless the system has IQ8 Microinverters in it, for which this limitation does not apply.

The IQ Microinverters and IQ Battery circuits are connected to the same DER relay inside the IQ System Controller 3 INT, which can support a maximum continuous current of 80 A passing through the

combined circuits of IQ PV and IQ Battery per phase. The IQ Microinverter and IQ Battery connected per phase can have a total rated current of more than 80 A, as the total connected load allowed per phase can draw a maximum of 63 A. The total IQ Microinverters and each IQ Battery unit must be connected to the IQ System Controller 3 INT with circuit breakers of appropriate rating as mentioned in the quick install guide.

The following table shows examples of Enphase Energy System configurations with IQ Microinverters and IQ Battery connected to the IQ System Controller 3 INT on the L1 phase.

The IQ Microinverters can be installed in L2 and L3, depending on the site requirement and DER imbalance allowed per the grid profile and region.

NOTE*:* The feature of IQ Battery 5P support on all three phases is coming soon; at present, IQ Battery can be connected only to the L1 phase in IQ System Controller 3 INT.

Table 1: Maximum power of IQ PV inverter for Enphase Energy System for backup operation

IQ Battery 5P units	IQ Battery energy capacity	IQ Battery power	Max PV capacity supported on L1 phase with IQ Battery	IQ Battery L1 line current	IQ PV L1 line current	Total DER system L1 line current	Maximum number of microinverters on L1 in backup					
	(kWh)	(kWac)	(kWac)	(A)	(A)	(A)	S230	S270	IQ7	IQ7+	IQ7X	IQ7 A
1	5	3.84	5.76	17	25	42	24	21	24	19	18	16
2	10	7.68	11.52	33	50	83	49	42	48	39	36	33
3	15	11.52	17.28	50	75	125	74	63	72	58	54	49
4	20	15.36	17.28	67	75	142	74	63	72	58	54	49

WARNING: Under-sizing or oversizing the power and energy capacity of the storage system may lead to a poor user experience and failures in the system. User education and reasonable system performance expectations are essential for backup storage systems. In case of complexity or a query not covered in this document, installers must contact the Enphase Field Application Engineering team.

Allowable as per the total DER circuit on L1 phase capacity.

The oversizing of the DER circuit on the L1 phase is acceptable. However, reduce the PV and storage power output through software control, also known as generation limiting, if this is acceptable by the local DNSP in accordance with section 6 of AS4777.2 grid standard. Alternatively, reduce the number of IQ Microinverters or IQ Battery 5P connected to the L1 phase.

The oversizing of the DER circuit on the L1 phase is exceedingly high. Reduce the PV and storage power output through software control, also known as generation limiting, if this is acceptable by the local DNSP in accordance with section 6 of AS4777.2 grid standard. It is also recommended to reduce the number of IQ Microinverters and IQ Battery 5P connected to the L1 phase.

PV and load-shedding control through auxiliary contacts in the system controller

In case more PV capacity must be connected to the L1 line where the PV power capacity is more than 150% of the connected IQ Battery power output capacity connected to L1, then the excess PV over 150% capacity can be connected through an appropriate contactor via the auxiliary contact in the system controller. This restriction is not applicable when the IQ8 Microinverter is used in the system. The same auxiliary contact can be configured to shed the PV when the system goes off-grid (backup mode) via installer app commissioning.

Similarly, some heavy loads of the house can be configured to be shed during off-grid (backup mode) or when IQ Battery aggregate SoC falls below a specific percentage value. These loads can also be configured by connecting through an appropriate contactor via the auxiliary contact in the system controller, with the values configured via the installer app during commissioning. Refer to the tech brief PV and load shedding configuration in Enphase Energy System.

Allowable DER imbalance between phases

The permitted difference in the power capacity of the IQ Microinverter and IQ Battery connected to each phase in a three-phase system is 21.7 A (5 kVA) as per the grid standard AS/NZS4777.2:2020.

The IQ Microinverter system installed in L1, L2, and L3 and the IQ Battery system installed in L1, L2, and L3 should conform to this interconnection DNSP limit.

NOTE: The feature of IQ Battery 5P support on all three phases is coming soon. At present, IQ Battery can be connected only to the L1 phase in IQ System Controller 3 INT.

Supported grid profiles

When the system functions on-grid, the PV inverter and the Enphase Energy System should be on the same grid profile. The grid profiles of the PV inverter that can be supported are AS/NZS4777.2:2020 and its derived variants.

Smart profiles and IQ Battery use cases

The IQ Battery supports three smart battery profiles to implement the Full Backup, Self-Consumption, and Savings use cases. Those are:

1. **Full Backup mode**: 100% of the battery capacity is reserved for backup, and the battery does not discharge while on-grid.
2. **Self-Consumption mode:** The battery discharges until reserved capacity or VLS (very low SoC) state, whichever is set to be higher by the user, to ensure the home loads are served with PV and storage as far as possible. Effectively, the system tries to reduce imports from the grid whenever possible. The battery only discharges until the reserve charge limit (if the reserve SoC set is higher than VLS) while on-grid. The battery discharges below the reserve charge limit only when the grid is down.
3. **Savings:** This profile is for the economical use case wherein the battery discharges when the rates are at the peak and charges using PV before peak tariff periods (in a time-of-use tariff rate structure). Note that the IQ Battery does not export to the grid. PV is exported to the grid during peak tariff periods, and the battery is discharged to serve loads. The battery only discharges until the reserve charge limit (if the reserve SoC set is higher than VLS) while on-grid. The battery discharges below the reserve charge limit only when the grid is down. During off-peak periods, if the off-peak import rate exceeds the feed-in tariff incentive for export, the system will function like in the Self-Consumption mode, with PV supporting the home loads and not exporting to the grid.

NOTE: In all modes, the battery will charge from the grid until the reserve charge limit if charging from the grid is enabled by the user in the Enphase App to ensure the desired amount of battery charge for backup is guaranteed to be available. If charging from the grid is turned off by the user, the battery will not charge from the grid even when the SoC is lower than the reserve SoC. Enphase recommends enabling charging from the grid to ensure the battery can support home loads when the grid is down, or the system goes off-grid. Users can also set a schedule to charge batteries from the grid till 100% state of charge if they want to do so during periods when energy costs from the grid are very low.

Key planning considerations

To ensure optimal wired control communication cable and power line communication between Enphase Energy System products and the installation, consider the following:

- Identify a suitable environment for temperature, enclosure ratings, and wall area for secure mounting of the weight of the required IQ Battery and IQ System Controller 3 INT units.
- Determine the electrical interconnection points and required breakers for IQ System Controller 3 INT, IQ Battery circuit, and combined PV branch circuits. The IQ Gateway with both Production and Consumption CT is preinstalled inside the IQ System Controller 3 INT.
- Size conductors appropriately for ampacity and voltage regulation given conductor lengths.
- IQ Battery units can be daisy-chained up to three units on a single-phase and connected via a single breaker on IQ System Controller 3 INT. This depends on the location and distance of IQ Battery units from the IQ System Controller 3 INT. If located far apart, daisy-chaining is better as the wiring required is less. If located close, then wiring an individual IQ Battery through a separate circuit breaker could make service easier.
- Do not daisy chain the neutral wire of the batteries from multiple phase branches of the IQ Battery. Connect the neutral wire from every phase of the IQ Battery separately on the neutral bar on the IQ System Controller 3 INT.
- Connect the neutral wire of the PV circuit to the pre-installed PV breaker on the IQ System Controller. Refer to the IQ System Controller 3 INT Quick Install Guide for wiring details of various system configurations.
- Use additional circuit breakers on the IQ System Controller 3 INT DIN rail or in an external electrical box to disconnect the PV or storage circuit with a single switch as required by local regulatory requirements in case of multiple PV and storage branch circuits.
- Always ensure the IQ Gateway is connected to the internet via Wi-Fi or Ethernet. Use Enphase Mobile Connect as a backup connection for internet connectivity.
- Use control communication cables for connecting the IQ System Controller 3 INT and each IQ Battery 5P unit at the connection board. The recommended control communication cable make and model are Electra EAS. Use control communication cables to connect the IQ System Controller 3 INT and each IQ Battery 5P unit to the connection board 7302PHV, EAS7502PHV, or the LAPP 1270802. Refer to the IQ Battery 5P and IQ System Controller 3 INT Quick Install Guide for control cable connection details.
- To connect the IQ System Controller and IQ Battery units with control communication wiring, ensure the total length of the control communication cable is within 100 m.
- To support the different types of IQ Microinverters together in one site, refer to the section on How to support a mix of existing Enphase products at the site.

Physical installation considerations

- For all products, always follow the instructions in the Enphase installation manuals. The Enphase Energy System installation compliance guide has been created to help you comply with AS/NZS 5139.
- Following local standards, choose a well-ventilated location where the ambient temperature and humidity are within equipment specifications, preferably out of direct sunlight. The IQ Battery does not require additional ventilation as lithium iron phosphate (LFP) chemical used in battery cells does not off-gas.
- Ensure the mounting location can sustain the weight of the equipment, mounting equipment, and accessory equipment.
- Plan the mounting location of the IQ Battery:
    - The minimum horizontal distance between IQ Battery 5P units should be 76 mm (3 inches).
    - The minimum mounting bracket horizontal spacing of IQ Battery 5P and any adjacent unit should be 92 mm (3.63 inches), as shown in Figure 6. The vertical spacing between IQ Battery and any other unit installed on the wall should be a minimum of 150 mm (6 inches) as shown in Figure 7. Values are specified in Table 2.
    - Indoors: at least 150 mm (6 inches) off the ground and 150 mm (6 inches) from the ceiling.
    - Outdoors: at least 150 mm (6 inches) off the ground.
    - If mounted in the path of a motor vehicle, we recommend a minimum mounting height of 910 mm (3 feet).
- Plan the mounting location of the IQ System Controller:
    - Indoors: at least 150 mm (6 inches) off the ground and 150 mm (6 inches) from the ceiling.
    - Outdoors: at least 910 mm (3 feet) off the ground.
    - Indoors: at least 150 mm (6 inches) off the ground and 150 mm (6 inches) from the ceiling.
    - Outdoors: at least 150 mm (6 inches) off the ground.
    - If mounted in the path of a motor vehicle, we recommend a minimum mounting height of 910 mm (3 feet).
- Ensure no pipes or electrical wires are where you plan to drill.
- Plan to maintain at least 910 mm (3 feet) of clearance in front of Enphase Energy System equipment for working space.
- For ease of installation, better access to tools, and servicing of the units, the horizontal and vertical spacing between the units mentioned in points 4 and 5 can be increased to 300 mm or more as deemed fit.
- Consider the dimensions of the Enphase equipment, easy access, height and length of system conductors, and conduit requirements between products and the system interconnection location when selecting the equipment location. The minimum spacing is shown in the following figure and table. Conduit options are as follows: IQ System Controller – main supply conductors may enter IQ System Controller from the bottom, bottom-left side, bottom-right side, or back. Backup load conductors may enter the IQ System Controller from the bottom, bottom-right side, bottom-left side, or back. IQ Battery and PV circuit conductors may enter from the bottom, bottom-left side, bottom-right side, or back of the IQ System Controller. IQ Battery – conduit may enter from the top-right side, top-left side, or back of the IQ Battery at the predefined knockout locations. Do not block vents.

- The IQ Battery and IQ System Controller bracket orientation and minimum spacing data are shown in the following image. The green line outside the bracket image shows the footprint of the IQ Battery outer cover, which will be mounted on the bracket.

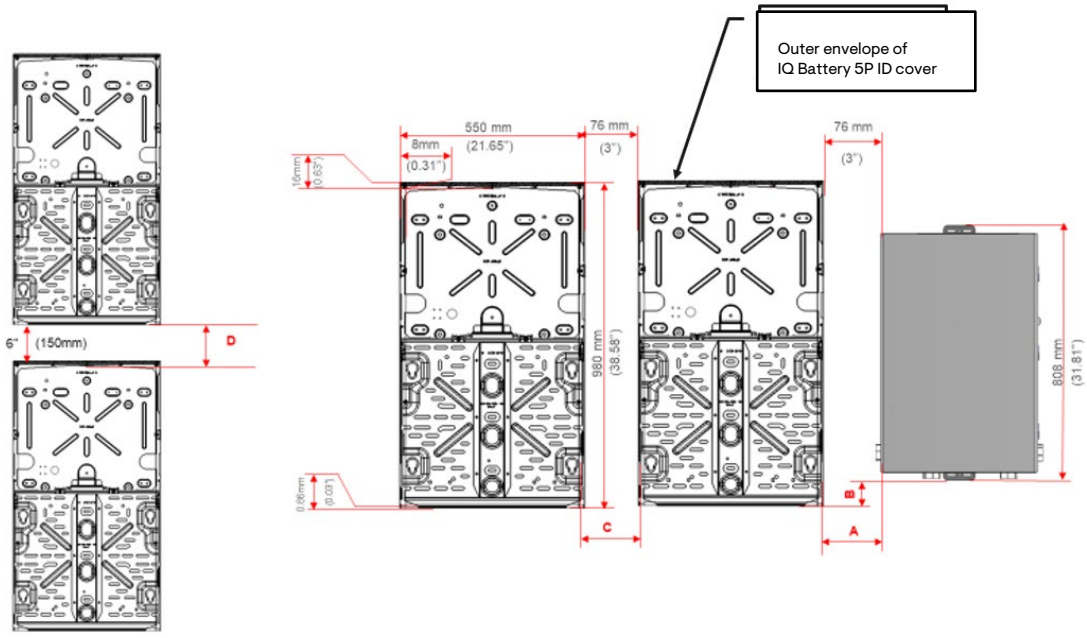

Figure 6: IQ Battery 5P bracket and IQ System Controller unit wall-mounting and vertical space between units

Table 2: Minimum required spacing between units shown in horizontal and vertical arrangements on the wall

Dimension	Description	Minimum distance
A	IQ System Controller and IQ Battery horizontal bracket spacing	84.2 mm (3.315 inches)
B - Bottom aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	0 mm (0.00 inches)
B - Center aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	86 mm (3.38 inches)
B - Top aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	172 mm (6.77 inches)
C	IQ Battery wall bracket horizontal spacing	92.2 mm (3.63 inches)
D - Vertical	IQ Battery wall bracket vertical spacing	166.83 mm (6.57 inches)

How to support a mix of existing Enphase products at site

If any site has multiple types of Enphase microinverters or existing AC batteries. The layouts in Table 3 and Figure 7 are helpful as a guideline on how those various series of IQ Microinverters can be connected to the system with IQ System Controller 3 INT and IQ Battery 5P.

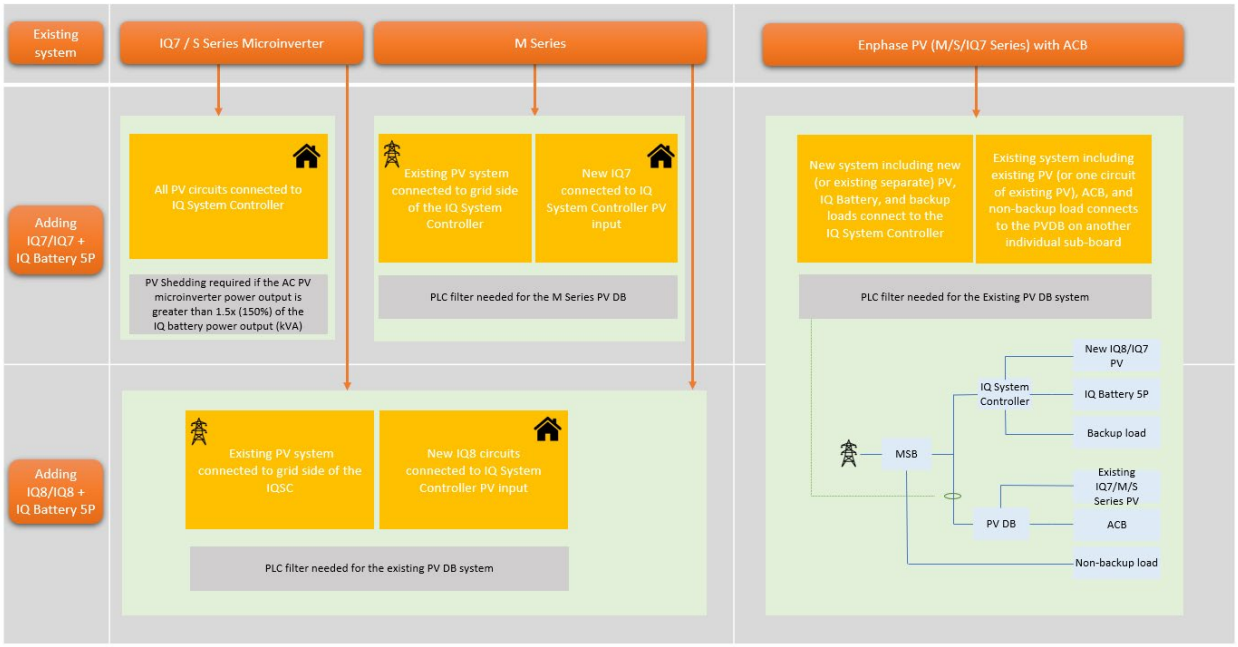

Figure 7: Wiring different types of existing Enphase products at the site

Recommended PLC line filter: [Bialon 63 A-Line filter]

Read through Table 3 for more details.

Table 3: A mix of existing Enphase products at the site

Existing PV or legacy system at the site	New PV system	New Enphase Energy System (IQ Battery 5P + IQ System Controller 3 INT)	Existing IQ Gateway/ IQ Combiner at the site	How to connect to the new IQ System Controller 3 INT	Overall Enphase system after installation
IQ7, S Series	IQ8 PV new circuit	IQ Battery 5P and IQ System Controller 3 INT	Retain existing IQ Gateway/IQ Combiner with the connected IQ7/S Series	Connect the existing PV circuit on the grid side of IQ System Controller 3 INT and do NOT to the IQ System Controller 3 INT's PV lugs. Only newly installed PV circuits are to be connected to IQ System Controller 3 INT. Ensure a PLC line filter between the existing PV system with gateway and the grid side lugs of the IQ System Controller	Two separate Enphase systems are present at the site with different site IDs: the existing Enphase PV site and the new Enphase Energy System site

Existing PV or legacy system at the site	New PV system	New Enphase Energy System (IQ Battery 5P + IQ System Controller 3 INT)	Existing IQ Gateway/ IQ Combiner at the site	How to connect to the new IQ System Controller 3 INT	Overall Enphase system after installation
	IQ7 PV new circuit	IQ Battery 5P and IQ System Controller	Remove existing IQ Gateway/ IQ Combiner from the site	All PV can be on the system controller PV lugs. Keep the existing gateway for future system expansion if needed. Ensure a PLC line filter between the existing PV system with Gateway and the grid side lugs of the IQ System Controller (if system separation is required due to battery power ratio)	One Enphase system with all PV connected to IQ System Controller 3 INT has a common IQ Gateway inside. All PV circuits can be used in microgrids for backup during the day
M Series	IQ8/IQ7 PV new circuit	IQ Battery 5P and IQ System Controller 3 INT	Retain existing IQ Gateway/ IQ Combiner with the connected M Series	Connect the existing PV circuit on the grid side of IQ System Controller 3 INT and NOT to the IQ System Controller 3 INT's PV lugs. Only newly installed IQ8 PV circuits are to be connected to IQ System Controller 3 INT. Ensure a PLC line filter between the existing PV system with Gateway and the grid side lugs of the IQ System Controller	Two separate Enphase systems are to be present at the site with different site IDs: the existing Enphase PV site and the new Enphase Energy System site
IQ7/S Series/M Series PV with AC Batteries	IQ8/IQ7 new circuit	IQ Battery 5P and IQ System Controller 3 INT	Retain existing IQ Gateway/ IQ Combiner with the connected IQ7/S Series with AC Batteries	Connect the existing PV and ACB circuit on the grid side of IQ System Controller 3 INT and NOT to the IQ System Controller 3 INT's PV lugs. Only newly installed PV circuits will be connected to IQ System Controller 3 INT.	Two separate Enphase systems should be present at the site with different site IDs: the existing Enphase PV site and the new Enphase Energy System site

Existing PV or legacy system at the site	New PV system	New Enphase Energy System (IQ Battery 5P + IQ System Controller 3 INT)	Existing IQ Gateway/ IQ Combiner at the site	How to connect to the new IQ System Controller 3 INT	Overall Enphase system after installation
				Ensure a PLC line filter between the existing PV system with Gateway and the grid side lugs of the IQ System Controller	

Temperature considerations

Unlike other battery chemistries, an IQ Battery does not require ventilation for off-gassing and does not require active cooling. IQ Batteries perform best when not subjected to extreme hot or cold temperatures and remain within the optimal temperature range of 0°C to 30°C (32°F to 86°F). The temperature may be affected by location, exposure, and ventilation. Consider factors that may result in undesirable temperature swings outside the optimal range. For example, the temperature may be higher than the outdoor ambient in enclosed, unconditioned spaces such as garages or utility closets.

Electrical installation requirements

For complete installation instructions, always refer to the Enphase Installation Manuals, including the following documents:

- Enphase IQ Battery 5P
- Enphase IQ System Controller 3 INT

Current Transformers (CTs)

All Production and Consumption CTs are pre-wired inside the IQ System Controller at the locations, as shown in Figure 8.

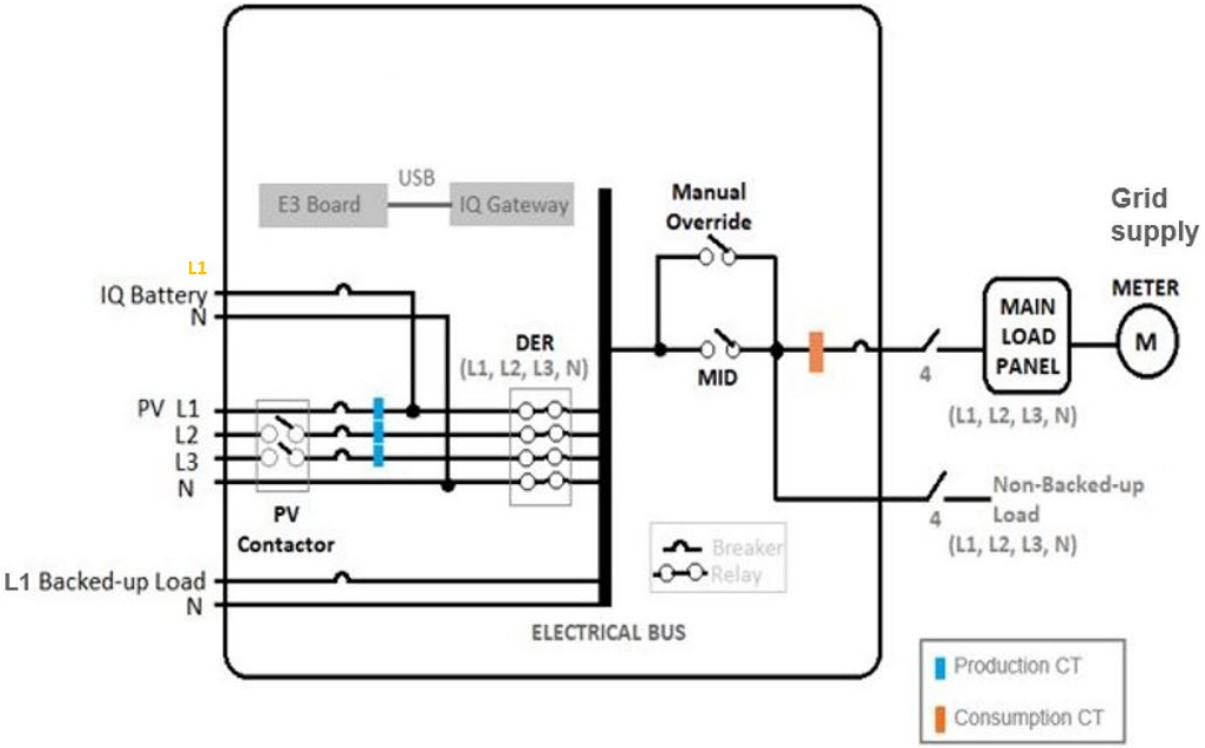

Figure 8: CTs pre-wired in the IQ System Controller on the PV and mains supply lines

IQ System Controller connections

The IQ System Controller can accept a maximum of 80 A of continuous output current per phase from combined PV and IQ Battery circuits. The IQ System Controller's busbar can receive an 80 A breaker for the total DER circuit overcurrent protection.

The system sizing for IQ PV and IQ Battery circuits must be done as per Table 1. The IQ System Controller 3 INT has a pre-installed PV 4-pole breaker and pre-wired neutral and Earth wiring for the neutral and Earth bars on the bottom. Refer to the IQ System Controller 3 INT Quick Install Guide for the wiring instructions and common system configurations.

While wiring the N lines of the PV, IQ Battery, Mains, Backup, and Non-backup loads, follow Table 4. Do not daisy chain the neutral wire of the batteries from multiple phase branches of the IQ Battery; connect the neutral wire from every phase of the IQ Battery separately on the neutral bar on the IQ System Controller.

Table 4: Neutral cable wiring for all circuits of the Enphase Energy System

Circuit/components	Neutral wiring
PV circuit	Wire through the 4-pole PV breaker to the N-lug on DER.
IQ Battery 5P	Each IQ Battery N wire phase is connected to the N-bar on the bottom of IQ System Controller 3 INT.
Mains supply	Connect the N wire from the main supply to the N-bar on the bottom of IQ System Controller 3 INT.
Backup loads	Connect the N wire of the backup loads to the N-bar on the bottom of IQ System Controller 3 INT.

Circuit/components	Neutral wiring
Non-backup loads	Connect the non-backup loads' N wire to the N-bar on the bottom of IQ System Controller 3 INT.

Voltage regulation considerations

When the IQ Battery charges, it acts like a load, and the voltage decreases at the battery's terminals based on Ohm's law and wire resistance. When the IQ Battery discharges to feed loads, it behaves like a source, and the voltage increases at the battery's terminals.

The voltage rises to the voltage drop delta divided by the nominal voltage, which is roughly equivalent to voltage regulation. Since the peak charge and discharge values for IQ Battery are the same, voltage rise and voltage drop will be the same.

Voltage regulation in the Enphase Energy System is calculated as $Percent\ VR = \frac{2 \cdot |V_d|}{V_{nom}}$

Where:

V_d is the voltage change from 0 to max current out of IQ Battery, and

V_{nom} is the nominal RMS voltage.

Ensure the IQ Battery conductors are sized correctly for the number of units on the circuit and that voltage regulation does not exceed 1% between the first IQ Battery and IQ System Controller.

System shutdown procedure

In case of any failure in the Enphase Energy System or the DER circuits (PV or battery), the user can operate and engage the manual override switch, which is accessible by opening the door of the IQ System Controller. It is the red-colored Manual Over Ride switch on the top-right side. This will initiate a system shutdown.

The manual override switch will bypass the complete Enphase Energy System, disconnecting both the PV and storage system from the home circuit and connecting the home loads directly to the main grid supply line. The home will be powered only from the grid upon engaging the manual override switch.

Additionally, for service access to the Enphase PV system wiring, the System Shutdown Switch connected with the IQ System Controller 3 INT must be turned OFF. This would ensure the PV circuits are shut down and are at touch-safe voltage levels.

PV and storage power generation limiting

As per section 6 of the 4777.2:2020 grid compliance requirement, the power output of PV and storage systems installed at any house must be controlled to be within limits for approval with the network provider. These are the DNSP interconnection limits applicable at Australia's respective state/region for customers subscribed to networks like Endeavour, Ausgrid, CitiPower, Energex, and so on.

This limit is on the output power of the PV system in kVA per phase and on the output power of the IQ Battery system in kVA.

After the system commissioning is complete with the Enphase Installer App, go to the "Storage Power Limiting" section in the Enphase Installer portal and set the values as required. For more information, refer to the tech brief Enphase Energy System PV and storage power limiting.

System design review checklist

Refer to the following checklist to install and commission an Enphase Energy System in Australia.

Table 5: Design review checklist for Enphase Energy System-Australia

Item/Particular	Parameter	Considerations	Completed (Yes/No)
IQ Battery 5P wall bracket and IQ System Controller 3 INT installation	Required distance to be kept as per physical installation considerations and compliance requirements as per Product QIG	Wiring from every unit, tool access, IQ Battery handles access and clearance from adjacent walls and objects. Correctly rated AC wiring for IQ Battery circuits to IQ System Controller. Minimum access requirements for each device's side, top, bottom, and front as per QIG and regulations	
Conduit wiring in the units	Product QIG to be referred	Observe IP rating requirements for installation wiring locations. Mechanical protection is required for chosen wiring locations	
IQ PV system wired as per Table 3 guideline into the IQ System Controller 3 INT	Connection to backup and non-backup parts of the IQ System Controller	IQ System Controller is the central point and requires incoming mains, backup, PV, and storage circuits to all run directly to the IQ System Controller The existing Enphase PV system is to be wired as per Table 3 with the Bialon 63 A-Line filter.	
PV to storage power ratio as per installed capacity (Only for S Series/IQ7 Series Microinverters)	Power ratio to be maintained as mentioned in PV to battery pairing	Oversizing the PV power as compared to IQ Battery system power. Ensure a maximum ratio of 1.5x PV array power capacity (W) to total storage capacity continuous output (W) when the Enphase Energy System operates in the backup	
DER system imbalance check	The installed capacity of the PV and IQ Battery system in a multiphase system is to be as per grid connection requirements	Allowed imbalance of 21.7 A (5 kVA) per phase	
Wiring the PV shedding line and other load shedding line	External contactors and auxiliary contacts in the IO board of the IQ System Controller	Excess PV, which is more than the oversizing limit, can be wired to shed during off-grid/backup operations.	
Control communication cable wiring	Only recommended cables to be used for warranty	Product QIG is to be referred to for the correct wiring process.	

Item/Particular	Parameter	Considerations	Completed (Yes/No)
	compliance. Electra EAS7302PHV, EAS7502PHV, or the LAPP 1270802	The control communication cable shall be interconnected to all IQ Batteries and IQ System Controller	
Backup and non-backup lug wiring	Loads wired as per system configuration wiring per Table 4	Partial or whole home backup is required. Whether the site is single-phase, two-phase, or three-phase	
Neutral and Earth wiring in IQ System Controller 3 INT	As per the TN-C-S grounding method. PV, battery, and loads N-wiring	The wiring diagram on IQ System Controller 3 INT is to be referred to. PV, battery, and load wiring are to be done as per Table 4	

Component list

The following table lists the required components for the installation of new systems and retrofitting an existing Enphase Energy System:

Table 6: Component list for the installation of new systems and retrofitting an existing Enphase Energy System

Component	Name (model/SKU number)	New system with IQ Microinverter (quantity)	Retrofit IQ Microinverter (quantity)
Enphase Energy System (EES)	**IQ Battery 5P:** IQBATTERY-5P-1P-ROW B05-T05-ROW00-1-2	As needed for the site, considering the requirements and limitations stated in the above section, max five units in L1	As needed for the site, considering the requirements and limitations stated in the above section, max five units in L1
Microgrid interconnection device (MID)	**IQ System Controller 3 INT:** SC100G-M230ROW	One unit is required per site	One unit is required per site
IQ Microinverters	**IQ7 Series Microinverters:** IQ7A-72-2-INT IQ7-60-2-INT IQ7PLUS-72-E-INT IQ7X-96-2-INT IQ7A-72-E-ACM-INT IQ7-60-M-INT IQ7PLUS-72-M-INT IQ7X-96-M-INT IQ7A-72-M-INT **S Series Microinverters (only retrofit)**	As required for the site, considering the battery and PV pairing limits specified in the above section	As existing at the site, considering the battery and PV pairing limits specified in the above section

Component	Name (model/SKU number)	New system with IQ Microinverter (quantity)	Retrofit IQ Microinverter (quantity)
	S230-60-LN-2-AU S230-60-LN-5-AU S270-72-LN-2-AU S270-72-LN-5-AU S230LN-IQ7-2-AU-RMA S270LN-IQ7-2-AU-RMA S230LN-IQ7-2-RMA S270LN-IQ7-2-RMA		
IQ System Controller Switch main breaker and load breaker	**IQ System Controller main breakers:** To be purchased and installed as identified and selected by the installer	As applicable	As applicable
IQ System Controller switch circuit breakers for PV and IQ Battery circuits	**IQ System Controller circuit breakers:** 4-pole PV breaker pre-installed on DIN rail IQ Battery breaker to be purchased and installed as identified and selected by the installer	As applicable	As applicable
Accessories of Enphase Energy System (IQ Battery)	**IQ Battery pedestal ground mount** B05-PM-0550-O **IQ Battery handles** IQBATTERY-HNDL-5	Purchase a pedestal mount for each battery for the ground mount Purchase battery handles to lift and mount the IQ Battery on the wall bracket separately. Refer to the IQ Battery 5P Quick Install Guide for details	Purchase a pedestal mount for each battery for the ground mount Purchase battery handles to lift and mount the IQ Battery on the wall bracket separately. Refer to the IQ Battery 5P Quick Install Guide for details
Accessories of MID (IQ System Controller)	**IQ System Controller door** SC-COV-SUB-ROW **IQ System Controller latch** SC-LAT-SUB-ROW	If needed, purchase part of the IQ System Controller assembly separately	If needed, purchase part of the IQ System Controller assembly separately

Component	Name (model/SKU number)	New system with IQ Microinverter (quantity)	Retrofit IQ Microinverter (quantity)
	System Shutdown Switch SC-INT-SSD-KIT **Mobile Connect** CELLMODEM-M1-06-AT-05-CM		
Consumption CTs	**Current Transformers**	Pre-wired inside the IQ System Controller	Pre-wired inside the IQ System Controller

Replaceable and field-serviceable components of the system

The following table lists the components of the IQ Battery and IQ System Controller, which can be replaced in the field in case of a warranty claim and RMA process.

These component replacement and installation guides are part of the individual RMA SKU unit Quick Install Guide.

Table 7: Components list of the IQ Battery and IQ System Controller for replacement in the field

Component	Name (model/SKU number)	Remarks
Components inside the IQ Battery can be replaced in the field and claimed through the RMA process	**IQ Battery 5P RMA unit** B05-T02-ROW00-1-2-RMA **IQ Battery PCU** IQ8D-BAT-RMA **IQ Battery cover kit** B05-CX-0550-O **IQ Battery wall bracket** B05-WB-0543-O **IQ Battery conduit cover plates** B05-CP-096-O **IQ Battery AC filter board** B05-ACFB-080-O **IQ Battery BMCC board** B05-BMSB-0490-O **IQ Battery Control communication board** B05-CANBR-063-O **IQ Battery Control Switch board** B05-RICS-0524-O	Each of the components can be replaced in the IQ Battery 5 unit. The RMA Quick Install Guide for replacement comes along with the RMA unit. The individual board replacements inside the IQ Battery 5P will be available by the end of the year 2023.

Components inside the IQ System Controller assembly can be replaced in the field and claimed through the RMA process	**IQ System Controller control board** SC-ECB-PCBA-ROW **IQ System Controller power relay board** SC-PRB-SUB-ROW **IQ System Controller Gateway PCBA board** SC-IQG-PCBA-ROW **IQ System Controller input output board** SC-IOB-PCBA-ROW **IQ System Controller relay board** SC-MRA-SUB-ROW **IQ System Controller door** SC-COV-SUB-ROW **IQ System Controller latch** SC-LAT-SUB-ROW **System Shutdown Switch** SC-INT-SSD-KIT **Mobile Connect** CELLMODEM-M1-06-AT-05-CM	The individual board replacements inside the IQ System Controller 3 INT will be available by the end of the year 2023

Glossary

Distributed energy resource (DER): A source of electric power not directly connected to a bulk power system. DER includes generators and energy storage technologies capable of exporting active power to an EPS. An interconnection system or a supplemental DER device necessary for compliance with this standard is part of a DER (IEEE 1547-2018).

Main load panel: Also referred to as the main load center or main panelboard, this is the unit where most load circuits for the premises have overcurrent protection.

Microgrid interconnect device (MID): A device that allows a microgrid system to separate from and reconnect to a primary power source.

Microgrid system: A premises wiring system that has generation, energy storage, and load(s), or any combination thereof, that includes the ability to disconnect from and parallel with the primary source (NEC 705.2).

Multimode inverter: Equipment having the capabilities of both the interactive inverter and the stand-alone inverter.

Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served (NEC CMP-4).

Service equipment: The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service conductors to a building or other structure or an otherwise designated area and intended to constitute the main control and cutoff of the supply (NEC CMP-4).

Voltage regulation: The measure of change of voltage magnitude in a component such as a feeder. Poor voltage regulation may result in unwanted behavior, such as dimming lights or flickering.

Appendix A: Single-line diagrams for Enphase Energy System

Three-phase system with single-phase/three-phase PV and storage and single-phase backup

NOTE: For NZ, multi-phase sites with Enphase Energy System are currently unsupported until further notice due to issues with per-phase metering. It is recommended to install IQ Battery 5P only on single-phase sites.

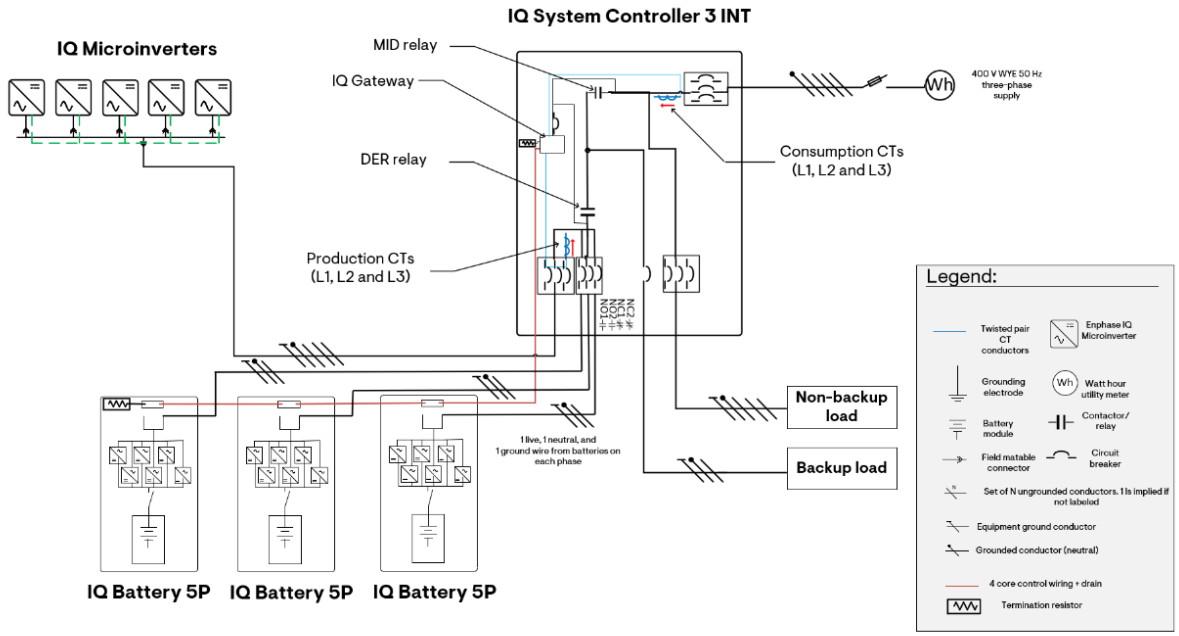

Figure 9: Three-phase system with single-phase/three-phase PV and storage and single-phase backup

Single-phase system with a whole home backup

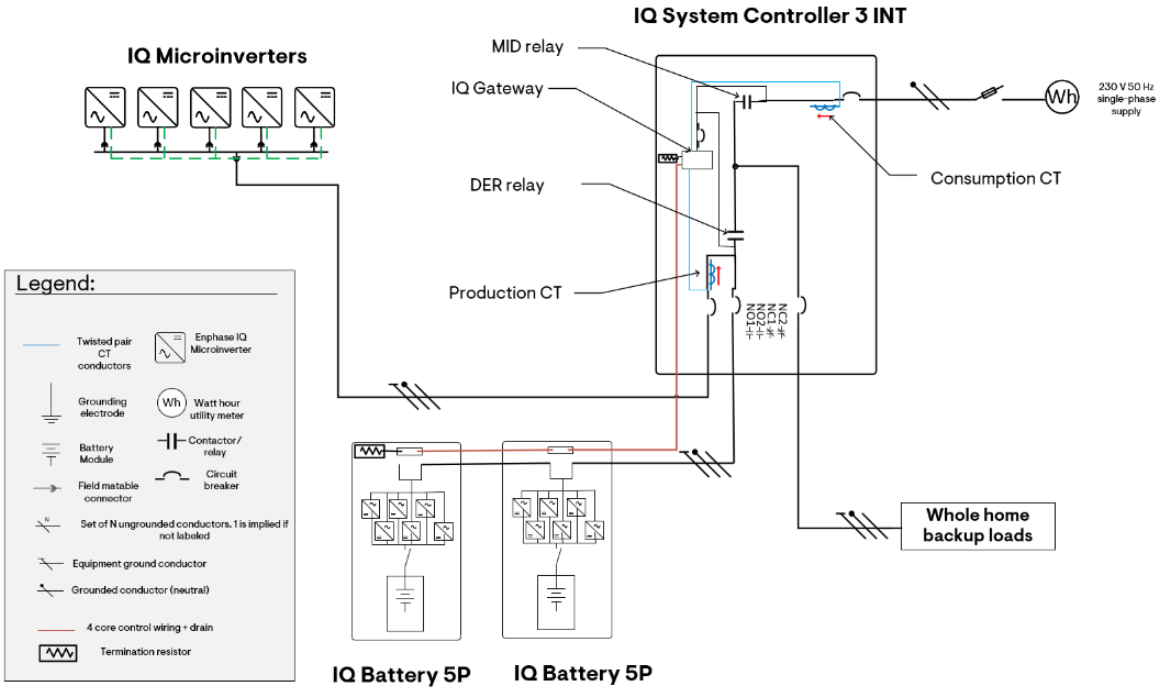

Figure 10: Single-phase system with a whole home backup

Single-phase system with a partial home backup

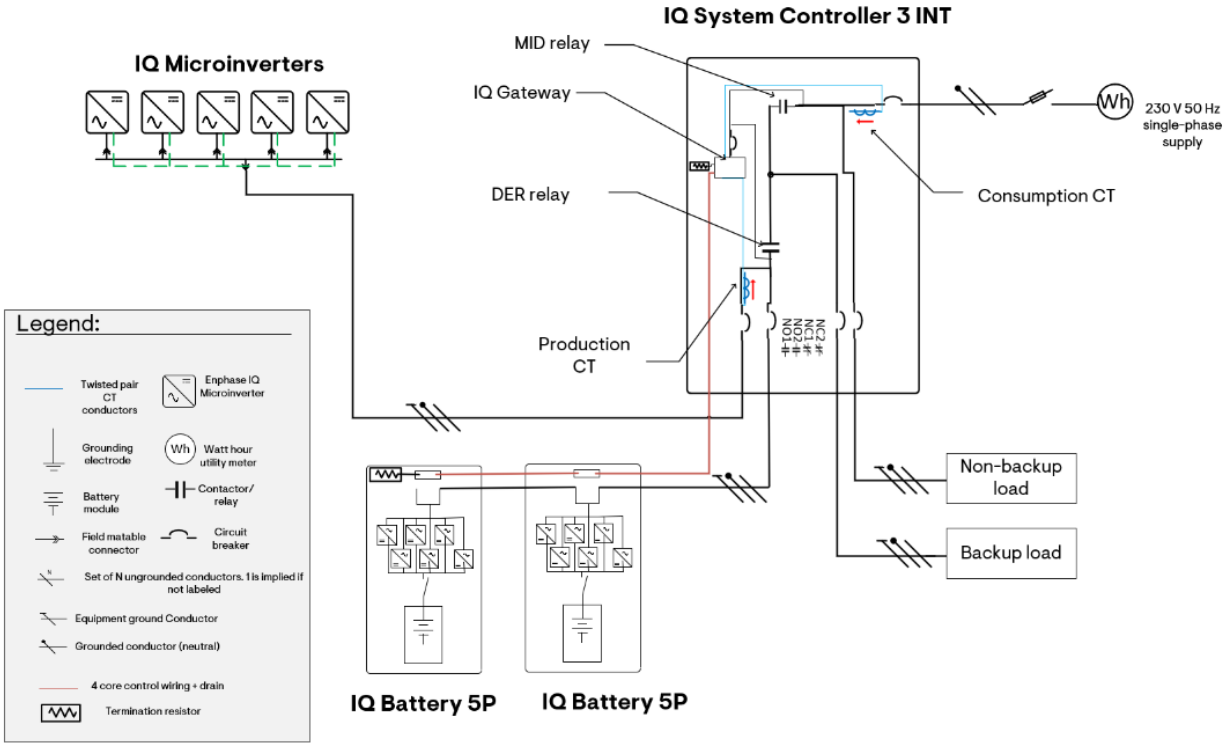

Figure 11: Single-phase system with a partial home backup

Revision history

Revision	Date	Description
TEB-00051-2.0	February 2024	Added a note on installing multi-phase sites in NZ.
TEB-00051-1.0	August 2023	Initial release.