

Planning grid-tied IQ Battery system without backup

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Overview

This technical brief document provides installers and designers with the information required to plan the installation of a grid-tied Enphase Energy System.

Grid-tied systems in this document refer to a system with an Enphase IQ Battery without an IQ System Controller to isolate the microgrid. These batteries do not have a backup for grid outages and are used for Savings-mode or Self-Consumption-focused customers.

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 of example system configurations and installations. However, they may not include all requirements from additional local codes and standards and Authorities Having Jurisdiction (AHJs) applicable to a site.



NOTE: The IQ Battery oversubscription feature is not supported currently. A software upgrade will soon make this function available.



NOTE: IQ8MC-72-M-US, IQ8AC-72-M-US, and IQ8HC-72-M-US are not available currently.

Enphase Energy System overview

All Enphase Energy Systems fall into one of the following groups, depending on the energy sources used in the system:

- Solar Only
- Battery
- Solar + Battery

The system can also be divided into grid-tied and grid-forming systems based on its ability to form a microgrid.

This document only covers the Solar + Battery grid-tied system configurations. Refer to [Planning an Enphase Energy System tech brief](#) for other configurations.

Product generation and interoperability

The Enphase Energy System is made up of three product generations. Generations 1 and 2 products use wireless communication, while Generation 3 products use wired communication. The system design and installation instructions differ depending on the product generation. In all three generations, microinverters connect with the IQ Gateway or IQ Combiner 5/5C via power line communication (PLC). Different components may not work together or support certain system features. Enphase is shipping Generation 2 and Generation 3 products at this time. Check the following table to see if the various system components are interoperable.

Table 1: Product generation and interoperability

	SOLAR + BATTERY WITHOUT BACKUP	
	Produce and save energy only when the grid is up	
	With IQ Battery 3T/10T	With IQ Battery 5P
IQ8 Microinverter	Yes	Yes

	SOLAR + BATTERY WITHOUT BACKUP	
	Produce and save energy only when the grid is up	
IQ6/IQ7 Microinverter	Yes	Yes
M Series Microinverter*	Yes With Envoy S Metered	Yes With Envoy S Metered
IQ Combiner 5/5C	Yes ¹	Yes
IQ Combiner 4/4C	Yes With COMMS-KIT-01	Yes With COMMS-KIT-02

*M Series Microinverters are not IEEE 1547:2018 compliant. If the site is in an area that requires IEEE 1547:2018, then upgrade to IQ8 Series Microinverters.

Power Control Systems (PCS)

Power Control Systems (PCS), as defined in NFPA 70 and NEC 2020 705.13, control the output of one or more power production sources, energy storage systems (ESS), and other equipment. PCS systems limit current and loading on the busbars and conductors supplied by the power production sources and/or energy storage systems.

Enphase Energy Systems have interconnected electric power production sources such as microinverters and/or IQ Batteries. The amount of power production sources that can be connected to a system is generally governed by various sections of the NEC. PCS Integration allows the Enphase Energy System to install more batteries and provides features to adhere to special compliance requirements in certain jurisdictions.

PCS enables the following features in the Enphase Energy System:

- IQ Battery oversubscription mode:** This feature is available on systems that use IQ Battery 5P. It allows for more IQ Battery 5P units to be installed against a given battery breaker by reducing the maximum continuous current rating to comply with NEC rating requirements such as 2020 NEC 705.28, thereby increasing the energy storage capacity of the site. Battery oversubscription can increase the energy capacity of the battery array by up to 200%. The system supports battery oversubscription on one battery breaker in an IQ Combiner and up to two battery breakers in an off-the-shelf combiner. The ampacity of each breaker can be up to 80 A (64 A continuous).



NOTE: IQ Battery oversubscription can only be enabled on systems that use IQ Battery 5P.

- Battery import-only mode:** This PCS feature ensures the Enphase IQ Battery never exports power to the grid. This is the default mode for all IQ Batteries (IQ Battery 3T/10T and IQ Battery 5P). This feature allows the homeowner to avoid the installation of an additional net generation output meter (NGOM) without transformer upgrades on undersized feeders in several cases.

¹Software updated for enabling IQ Battery 3T/10T with IQ Combiner 5/5C will be released soon.



NOTE: Support for systems with grid-tied IQ8 Microinverter PV and grid-tied IQ Battery 5P/3T/10T with battery in import-only mode is already available. The PV microinverters can also support export limiting in this configuration. Energy storage system (ESS) export only for systems with grid-tied IQ8 microinverters and grid-tied IQ Battery 5P/3T/10T is under development and will be available soon.

- **Main panel upgrade (MPU) avoidance mode:** This PCS feature limits the back feed current of the Enphase Energy System to the main panel to avoid costly panel upgrades.



NOTE: Only IQ8 Series Microinverters used will support this feature². M Series and IQ 6/7 Microinverters do not support this feature.

- **Aggregate power export limit mode:** This PCS feature ensures that the aggregate PV power exported to the grid is limited to the aggregate power export limit (PEL) value set by the installer. This ensures the aggregate power export is below the level defined, as measured at the Consumption CTs. The batteries do not export to the grid because they support Energy Storage System (ESS) import-only mode today.



NOTE: Aggregate power export limit mode is supported for grid-tied IQ8 PV-only systems and grid-forming IQ Battery systems. Support for grid-tied systems with IQ8 PV and IQ Battery 5P/3T/10T will be available soon.

For further information, refer to the [Power Control Systems \(PCS\)](#) tech brief.

Economic use cases

There are many economic goals that the Enphase Energy System supports. These include reducing the utility bill by charging the IQ Batteries during low tariff periods and saving energy to ensure that loads can be served through the batteries during the peak tariff period. Power from PV can be exported to the grid, especially during peak tariff periods.

The system also supports the special case of power export limiting, where the utility does not allow a homeowner to export power from the PV system to the grid. Examples are the Hawaii self-supply and NEM+ programs, where no export is allowed, which is called zero export.

System profiles

The Enphase Energy System supports the following two profiles in grid-tied systems:

- **Self-Consumption:** The battery discharges until reserved capacity 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. This profile is not available in battery-only systems.
- **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.



NOTE: A Full Backup profile is not available in a grid-tied configuration.

² This feature will be available soon for IQ8 Series Microinverters via a software upgrade.



NOTE: IQ Battery does not export to the grid as it supports import-only mode and does not support export mode currently. PV is exported to the grid during the peak tariff period, and the battery is discharged to serve loads.



NOTE: PCS settings such as MPU avoidance and IQ Battery oversubscription will change the power available to the system and may affect the performance of system profiles.

System sizing

Optimal system sizing for a grid-tied system depends on multiple factors, such as solar irradiance at the location, energy usage patterns, and energy tariffs. Enphase recommends using the Solargraf tool to size the system.

Grid-tied (without backup) system configurations

Grid-connected systems can generate energy, supply it to home loads, and store it for later use, but only when the grid is available.



NOTE: Refer to [Guidelines for current transformer \(CT\) installation](#) for comprehensive CT placement guidelines.

With IQ Battery 5P

With IQ Series Microinverters and IQ Combiner 5/5C

Figure 1: The Solar + Battery grid-tied configuration with IQ Combiner 5C, IQ8 or IQ7/IQ6 Series Microinverters and IQ Battery 5P configuration #1

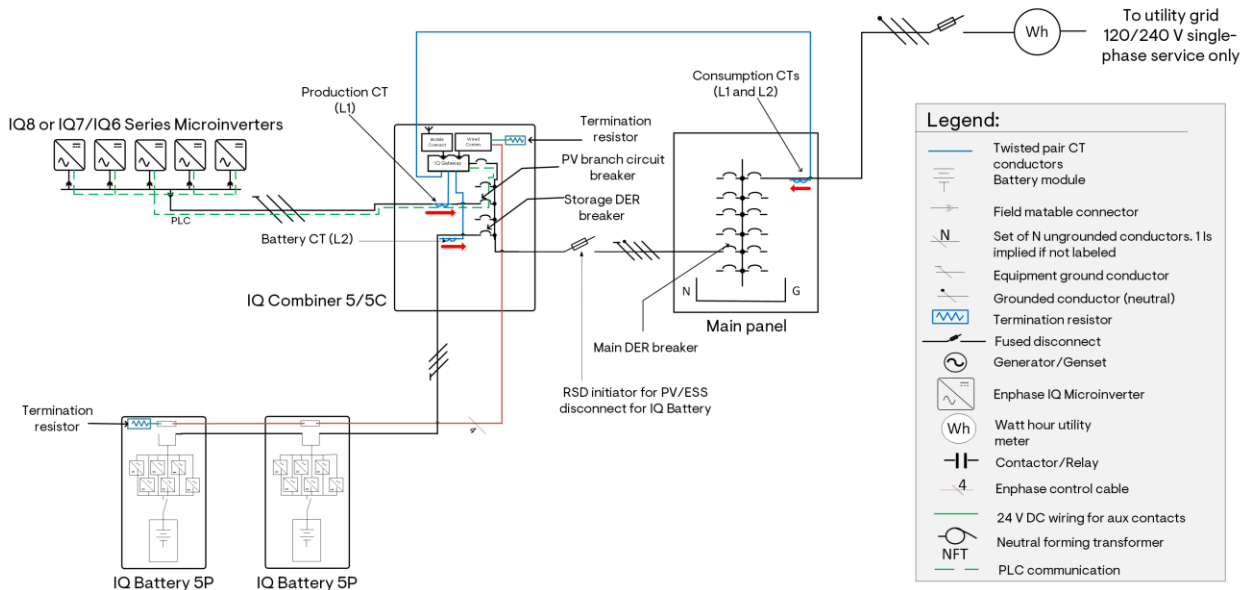
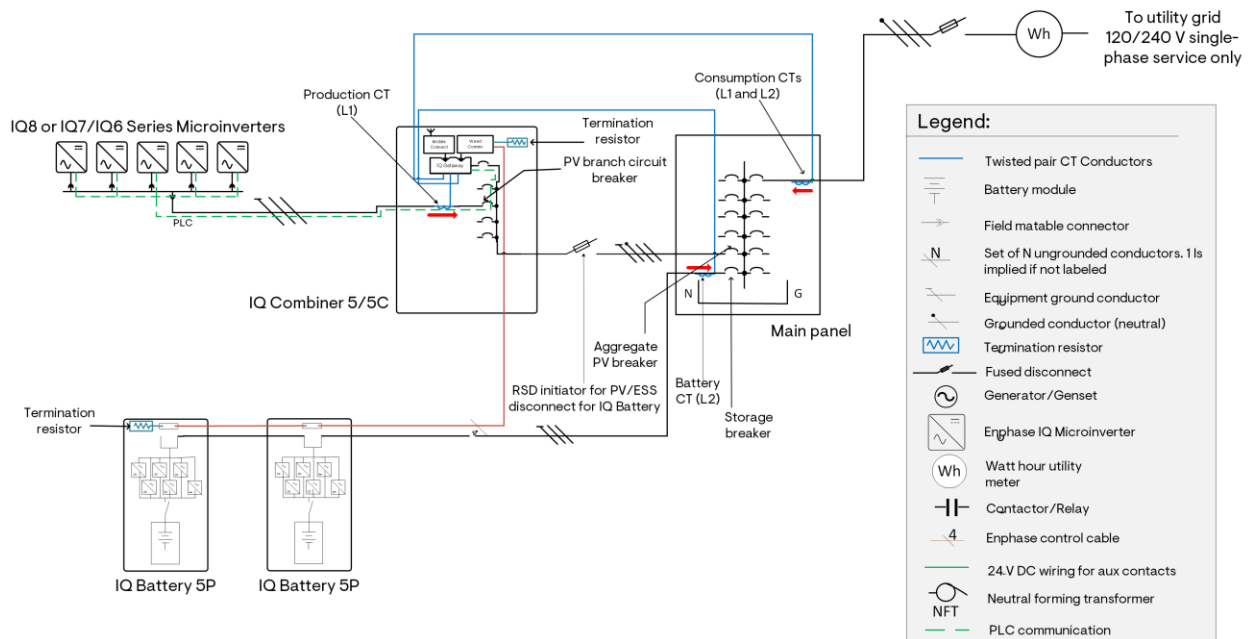


Figure 2: The Solar + Battery grid-tied configuration with IQ Combiner 5C, IQ8 or IQ7/IQ6 Series Microinverters and IQ Battery 5P configuration #2



NOTES:

- IQ8 Series Microinverters cannot be mixed with other Enphase microinverters as they are incompatible with older generations of Enphase microinverters, including IQ6 and IQ7 Series Microinverters. This applies to all system configurations, with and without storage.
- The sum of the microinverter and IQ Battery circuit-rated continuous currents must not exceed 64 A for configuration #1 in [Figure 1](#).
- IQ Combiner 5/5C can support DER breakers totaling up to 80 A. Each breaker slot on the combiner can accommodate a breaker rating of up to 60 A.
- On the IQ Combiner 5/5C, the system supports PCS for battery oversubscription on one breaker. By limiting the continuous current from the battery branch, battery oversubscription can double the battery storage capacity that can be connected to that breaker.
- Systems with IQ Battery 5P require IQ Gateway software version 8.X or later. If an update is needed, it will be automatically applied during the commissioning process.
- The main DER breaker (aggregate DER breaker on the main panel) can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if the main panel is readily accessible.
- Any system with an IQ Battery 5P must have Wi-Fi or Ethernet as the primary mode of internet connectivity and an Enphase Mobile Connect as a backup mode of internet connectivity.

With IQ Series Microinverters and IQ Combiner 4/4C

IQ Combiner 4C can be paired with COMMS-KIT-02 to support IQ8/IQ7/IQ6 Series Microinverters and IQ Battery 5P in Solar + Battery grid-tied configuration. The sum of the maximum current from the PV branches and the IQ Battery branches should not exceed 80 A. IQ Combiner 4C supports DER breakers totaling up to 80 A.

Figure 3: The Solar + Battery grid-tied configuration with IQ Combiner 4/4C, IQ8/IQ7/IQ6 Series Microinverters and IQ Battery 5P configuration #1

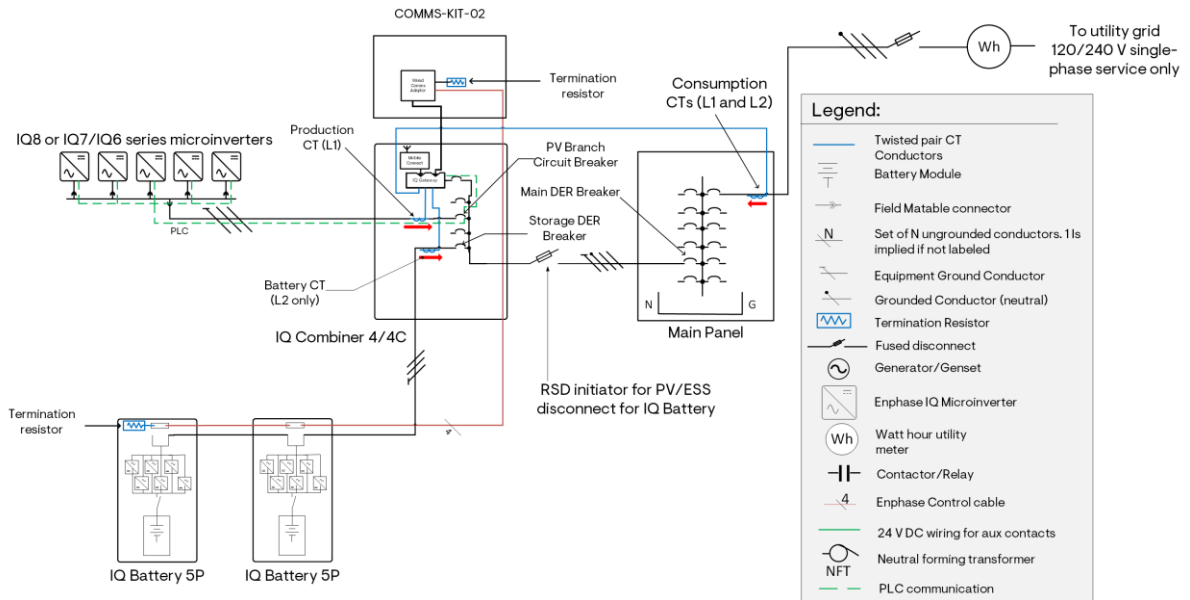
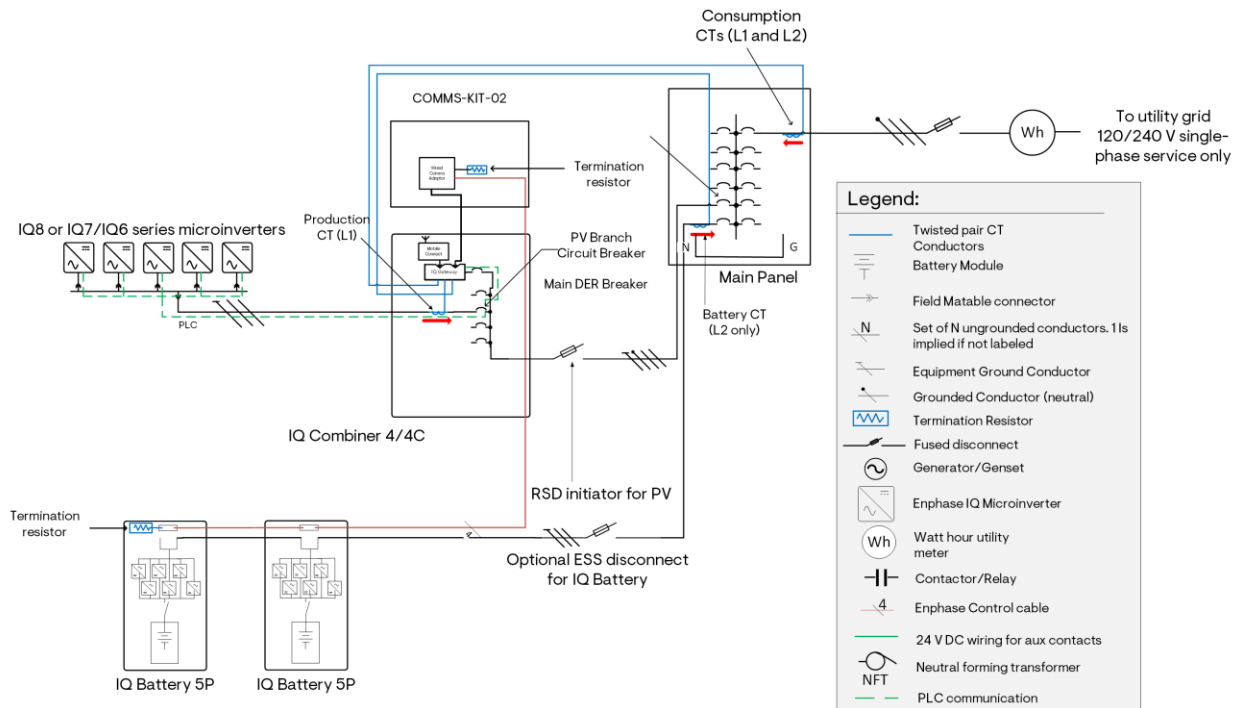


Figure 4: The Solar + Battery grid-tied configuration with IQ Combiner 4/4C, IQ8/IQ7/IQ6 Series Microinverters and IQ Battery 5P configuration #2



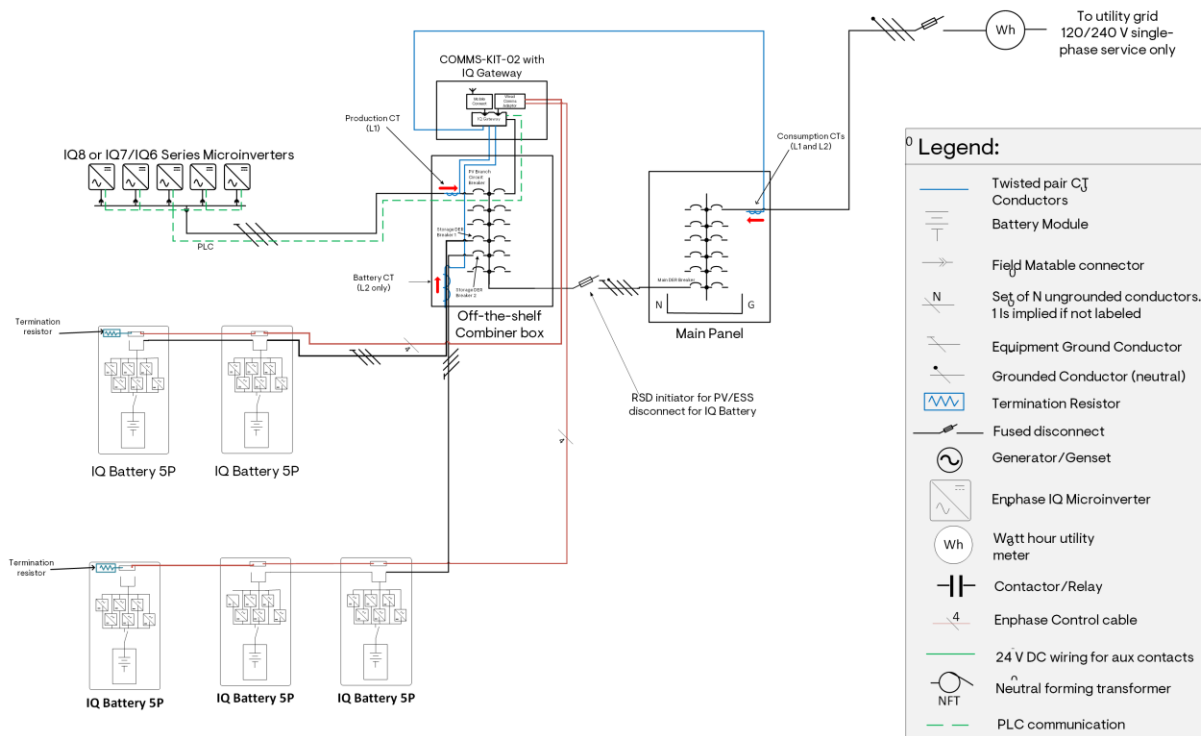
NOTES:

- IQ8 Series Microinverters are incompatible with previous generations of Enphase microinverters, such as IQ6, IQ7, and M Series Microinverters, and cannot be installed together. This holds for all system configurations, both with and without storage.
- The sum of the microinverter and IQ Battery circuit-rated continuous currents must not exceed 64 A for configuration in [Figure 3](#).
- IQ Combiner 4/4C can support DER breakers totaling up to 80 A. Each breaker slot on the combiner can accommodate a breaker rating of up to 60 A.
- Battery oversubscription PCS is not available with the IQ Combiner 4/4C currently.
- Use the power jumper provided with the Communications Kit 2 (COMMS KIT 02) to short the L2 and L3 terminals (marked “L2” and “X,” respectively) on the power terminal block in the IQ Gateway.
- Systems with IQ Battery 5P require IQ Gateway software version 8.X or later. If an update is needed, it will be automatically applied during the commissioning process.
- Any system with an IQ Battery 5P must have Wi-Fi or Ethernet as the primary mode of internet connectivity and an Enphase Mobile Connect as a backup mode of internet connectivity.

Solar + Battery grid-tied configuration with IQ8/IQ6/IQ7 Series Microinverters, IQ Battery 5P and off-the-shelf DER sub-panel

Use the below configuration if the sum of the maximum current from the PV branches and the IQ Battery 5P branches exceed 64 A.

Figure 5: Solar + Battery grid-tied configuration with IQ8/IQ7/IQ6 Microinverters, IQ Battery 5P, COMMS-KIT-02, Mobile Connect cell modem and off-the-shelf combiner box configuration #3



NOTES:

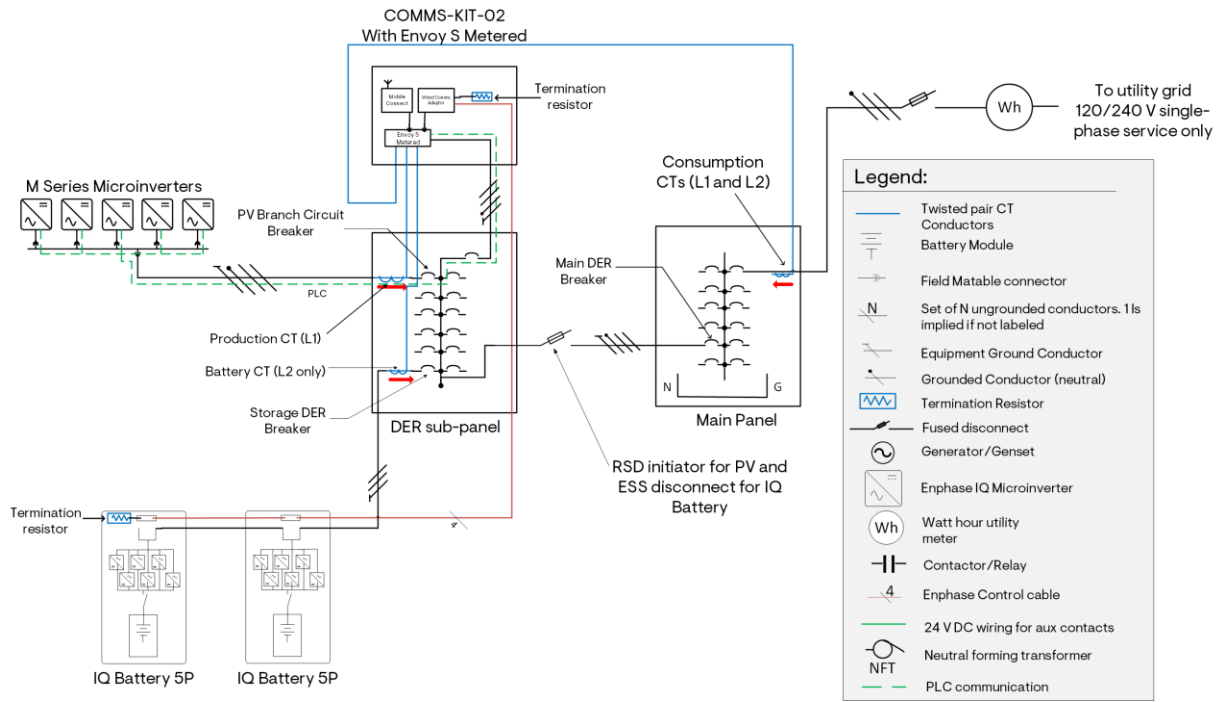
- Systems with IQ8 Series Microinverters must contain only IQ8 Series Microinverters as they are incompatible with older generations of Enphase microinverters, including IQ6 and IQ7 Series Microinverters. This applies to all system configurations, with and without storage.
- IQ Gateway and Mobile Connect can be housed in the COMMS-KIT-02 box. The IQ Gateway and Mobile Connect cell modem must be purchased independently from the COMMS-KIT-02.
- Systems with IQ Battery 5P require an IQ Gateway software version of 8.X or later. If an update is needed, it will be automatically applied during the commissioning process.
- The battery current transformer (CT) must clamp L2 conductors on both IQ Battery 5P branches.
- The main DER breaker (off-the-shelf combiner box breaker on the main panel) can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if it is readily accessible.



NOTE: The main panel upgrade avoidance feature using PCS will be enabled in this configuration in the future.

With M Series Microinverters, Envoy S Metered, and COMMS-KIT-02

Figure 6: The Solar + Battery grid-tied configuration with M Series Microinverters, IQ Battery 5P, Envoy S Metered, Enphase COMMS-KIT-02, Enphase Mobile Connect, and third-party combiner box



NOTES:

- Enphase COMMS-KIT-02 and Enphase Mobile Connect can be added to existing M Series Microinverters to enable IQ Battery 5P installation.
- M Series Microinverters are incompatible with newer IQ8 or IQ6/IQ7 Microinverters. This applies to all system configurations with and without storage.
- Up to 16 IQ Battery 5P (80 kWh) can be installed in a system. However, the maximum battery breaker size for a single battery circuit is limited to 80 A.
- Use a jumper cable to connect the L2 and L3 terminals in the Envoy S Metered power terminal block. These terminals are marked “B” and “C” respectively.
- Systems with IQ Battery 5P require IQ Gateway software version 8.X or later. If an update is needed, it will be automatically applied during the commissioning process.
- The DER sub-panel breaker (main DER breaker) on the main panel can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if the main panel is readily accessible.
- The Mobile Connect cell modem has to be purchased separately from COMMS-KIT-02.
- Any system with an IQ Battery 5P must have Wi-Fi or Ethernet as the primary mode of internet connectivity and an Enphase Mobile Connect as a backup mode of internet connectivity.

With IQ Battery 3T/10T

With IQ Series Microinverters and IQ Combiner 4/4C/5/5C

Figure 7: Solar + Battery grid-tied configuration with IQ Battery 10/10T and IQ Combiner 4/4C/5/5C configuration #1

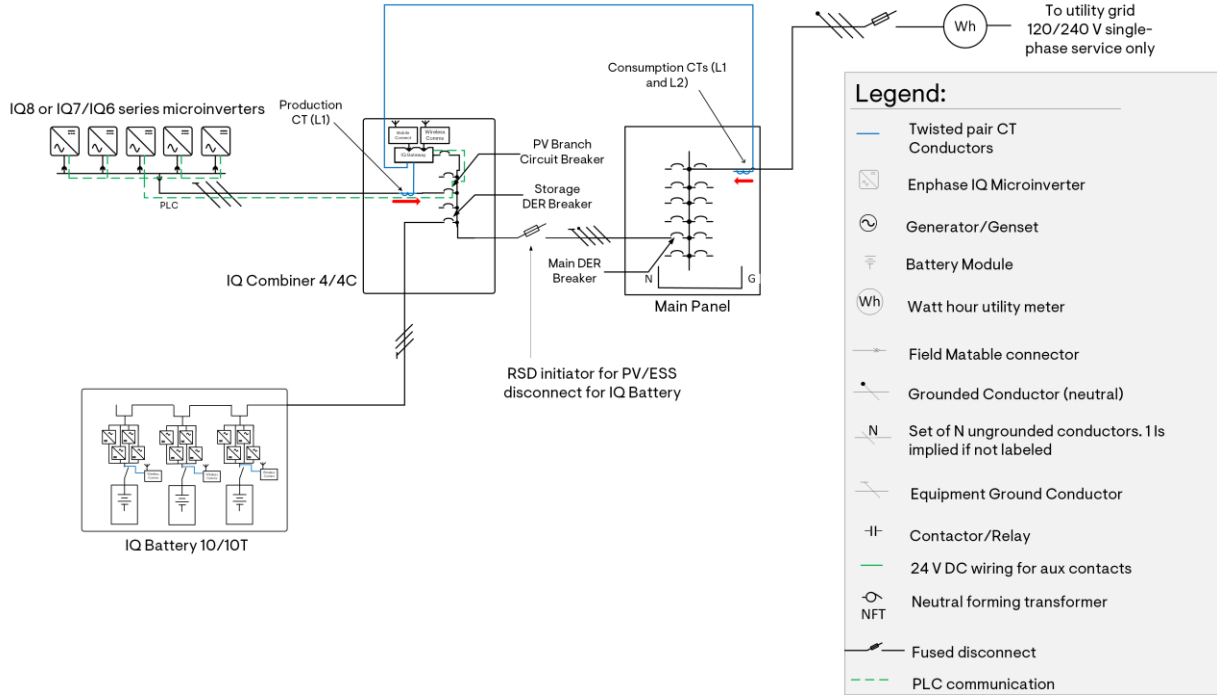
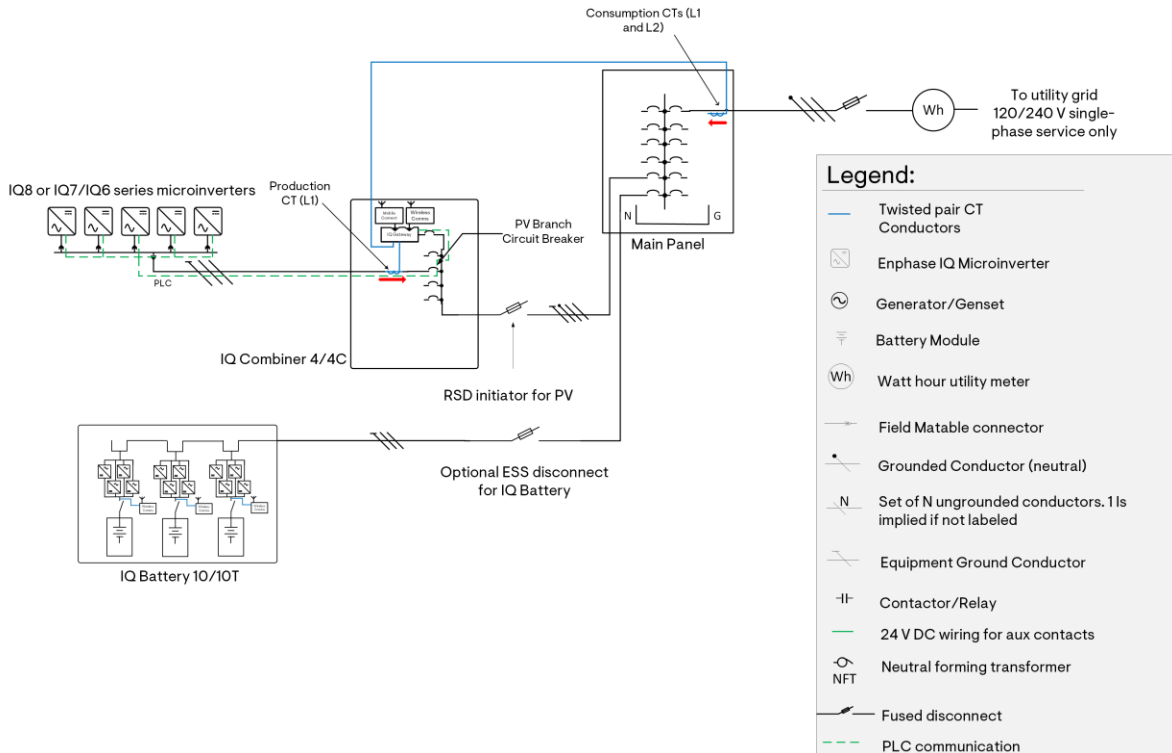


Figure 8: Solar + Battery grid-tied configuration with IQ Battery 10/10T and IQ Combiner 4/4C/5/5C configuration #2



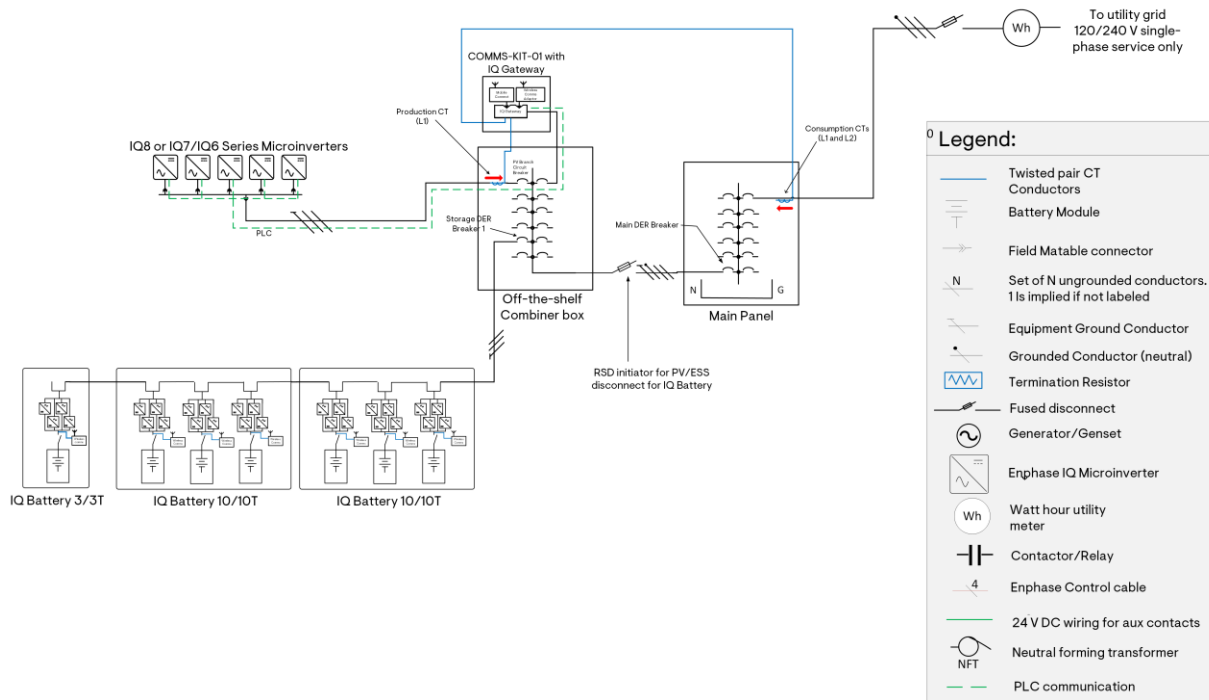
NOTES:

- IQ Combiner 5/5C needs COMMS-KIT-01 as well as a software update to operate with IQ Battery 3/3T/10/10T. Refer to [How to make the IQ Combiner 5/5C compatible with IQ Battery 3T/10T](#) tech brief for installing COMMS-KIT-01 in IQ Combiner 5/5C. The software update to support this configuration will be made available soon.
- IQ8 Series Microinverters are incompatible with previous generations of Enphase microinverters, such as IQ6, IQ7, and M Series Microinverters, and cannot be installed together. This holds for all system configurations, both with and without storage.
- The sum of the microinverter and IQ Battery circuit-rated continuous currents must not exceed 64 A for configuration #1 in Figure 7.
- The maximum breaker sizing for a battery circuit is 40 A. So, each battery circuit can accommodate up to six IQ Battery 3/3T or two IQ Battery 10/10T.
- The maximum battery array size for a system using IQ Battery 3/3T/10/10T is 40 kWh.
- IQ Combiner 4/4C/5/5C can support DER breakers totaling up to 80 A. Each breaker slot on the combiner can accommodate a breaker rating of up to 60 A.
- The aggregate DER breaker on the main panel can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if the main panel is readily accessible.
- Any system with an IQ Battery 3/3T/10/10T must have Wi-Fi or Ethernet as the primary mode of internet connectivity and an Enphase Mobile Connect as a backup mode of internet connectivity.

Solar + Battery grid-tied configuration with IQ8/IQ6/IQ7 Series Microinverters, IQ Battery 3/3T/10/10T and off-the-shelf DER sub-panel

If the sum of the maximum current from the PV branches and the IQ Battery 3/3T/10/10T branches exceeds 64 A, then use one of the configurations below.

Figure 9: Solar + Battery grid-tied configuration with IQ8/IQ7/IQ6 Microinverters, IQ Battery 3/3T/10/10T, COMMS-KIT-01, Mobile Connect cell modem and off-the-shelf combiner box configuration #3

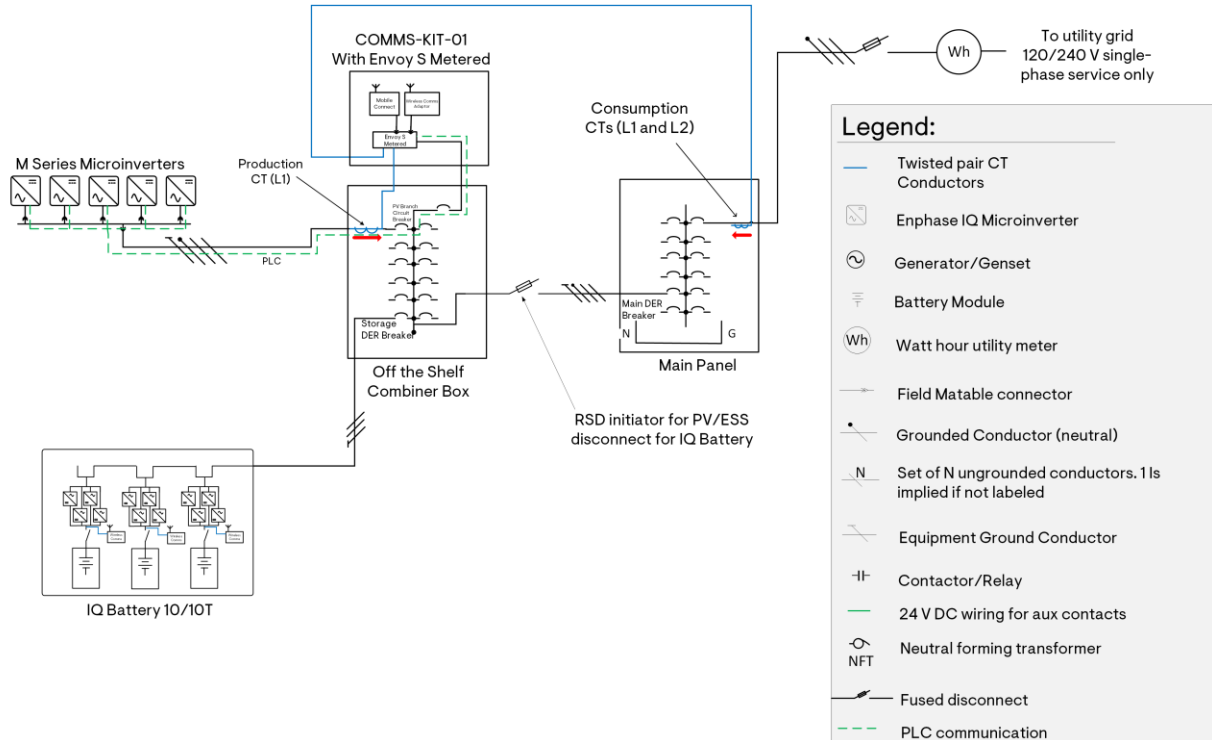


NOTES:

- Systems with IQ8 Series Microinverters must contain only IQ8 Series Microinverters as they are incompatible with older generations of Enphase microinverters, including IQ6 and IQ7 Series Microinverters. This applies to all system configurations, with and without storage.
- IQ Gateway, COMMS-KIT-01, and Mobile Connect can be housed in an off-the-shelf box.
- The main DER breaker (off-the-shelf combiner box breaker on the main panel) can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if it is readily accessible.

With M Series Microinverters, Envoy S Metered, and COMMS-KIT-01

Figure 10: The Solar + Battery configuration with M Series, third-party combiner box, COMMS-KIT-01, and Enphase Mobile Connect cell modem



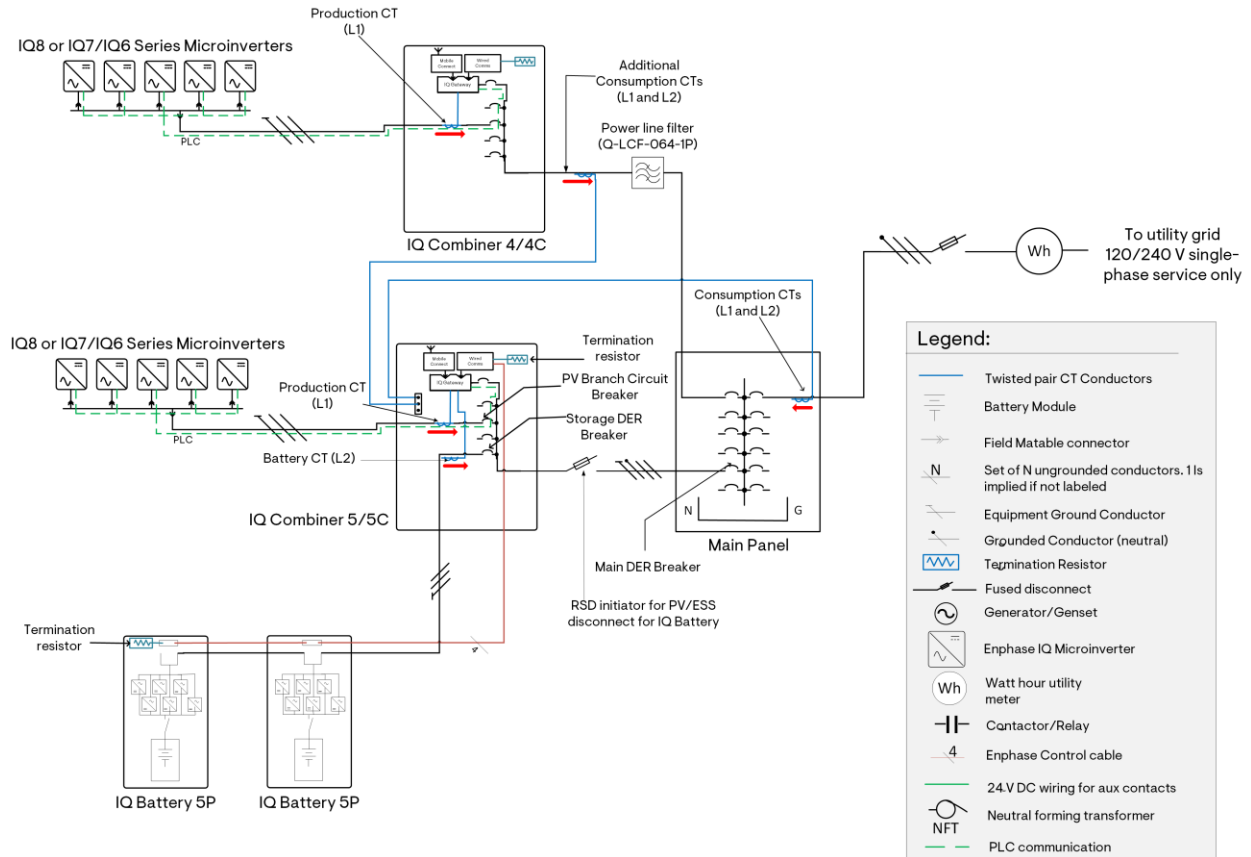
NOTES:

- If the existing Gateway installed at the site is Envoy-S or Envoy-R, then the Gateway must be upgraded to Envoy-S Metered.
- Enphase COMMS-KIT-01 and Enphase Mobile Connect can be added to existing M Series Microinverters to enable IQ Battery 3/3T/10/10T installation.
- M Series Microinverters are incompatible with newer IQ8 or IQ6/IQ7 Microinverters. This applies to all system configurations with and without storage.
- Each battery circuit can accommodate up to six IQ Battery 3/3T or two IQ Battery 10/10T. As a result, the maximum breaker sizing for a battery circuit is 40 A.
- The maximum battery array size for a system using IQ Battery 3/3T/10/10T is 40 kWh.
- The main DER breaker on the main panel can act as the rapid shutdown initiator for PV and ESS disconnecting means in grid-tied configuration if the main panel is readily accessible.
- Any system with an IQ Battery 3/3T/10/10T must have Wi-Fi or Ethernet as the primary mode of internet connectivity and an Enphase Mobile Connect as a backup mode of internet connectivity.

Multiple gateway systems

Multiple gateway systems are supported at the same site. Each gateway will be mapped to an independent system.

Figure 11: Multiple gateway system

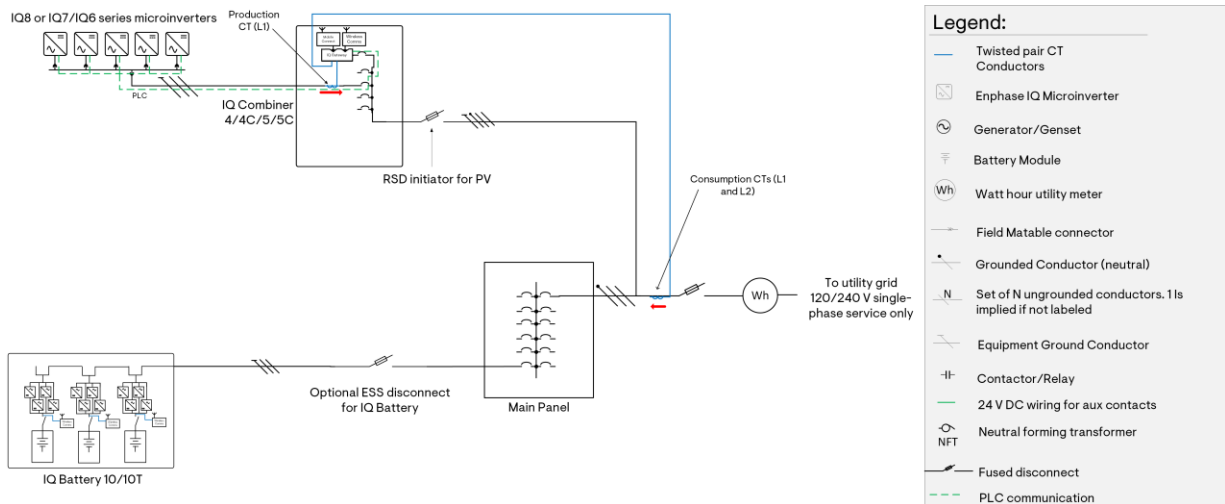


NOTES:

- An equivalent configuration using IQ Gateway instead of IQ Combiner 4/4C/5/5C is supported. Similarly, configurations using M Series Microinverters and Envoy S Metered are also supported.
- A similar configuration is also supported with IQ Battery 3T/10T.
- Appropriate line filters must be installed to isolate the PLC domains between both systems. Refer to the [Enphase Energy System planning tech brief](#) for details.

Special configurations

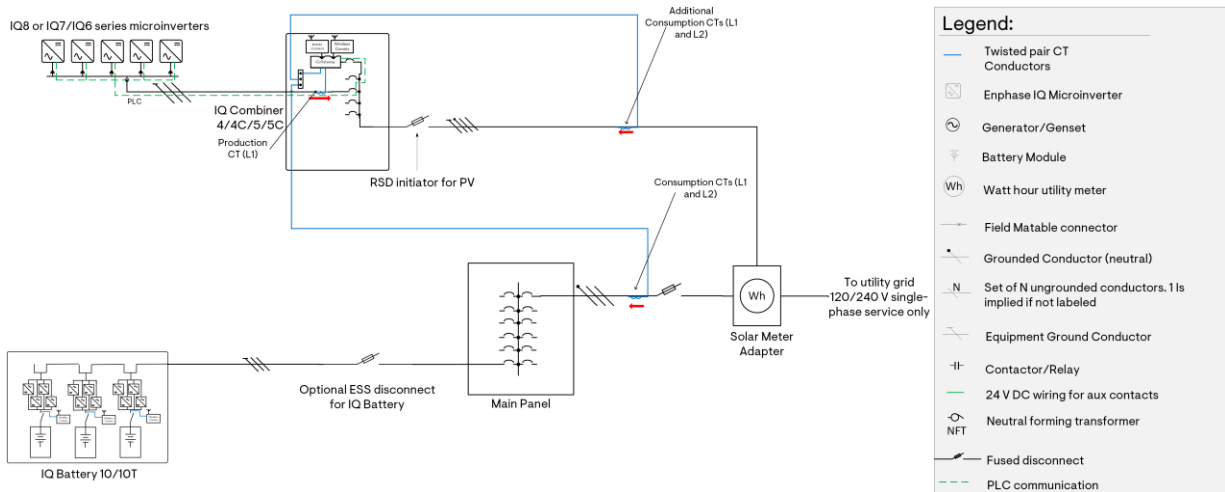
Figure 12: Example of line side tap



NOTES:

- Similar configurations using M Series Microinverters and Envoy S Metered are also supported.
- A similar configuration is also supported with IQ Battery 5P. IQ Battery 5P enables main panel upgrade avoidance by using IQ Battery oversubscription as well.

Figure 13: Example of system with solar meter adapter



NOTES:

- Similar configurations using M Series Microinverters and Envoy S Metered are also supported.
- A similar configuration is also supported with IQ Battery 5P. IQ Battery 5P enables main panel upgrade avoidance by using IQ Battery oversubscription as well.

Abbreviations

Abbreviation	Description
DER	Distributed energy resource
ESS	Energy storage system
kW	Kilowatt
kVA	Kilovolt-ampere
MID	Microgrid interconnect device
NEC	National electric code
NFT	Neutral forming transformer
OCPD	Overcurrent protection device
PV	Photo voltaic
RSD	Rapid shutdown device
RDE	Rapid shutdown equipment
SKU	Stock keeping unit

Revision history

Revision	Date	Description
TEB-00067-1.0	October 2023	Initial release