

# Enphase Energy System planning guide

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## 1 Overview

This guide contains information for site surveyors and design engineers to analyse a site and plan the design, installation, and support of home energy systems using the Enphase Energy System (EES). This guide is not for installation and operation. This document supplements the information in the data sheets, quick install guides (QIGs), and product manuals. The diagrams and information demonstrate system configurations and installations. However, they may not include all additional local standards and regulations applicable to a site.

## 2 Enphase Energy System overview

The following table lists the three use cases supported by EES.

Table 1: Use cases

Energy sources at the site	Description
Solar only	<p>This configuration is ideal for homeowners who want to go solar and maximize their electricity bill savings.</p> <p>By producing and consuming the electricity generated from their solar plant, homeowners reduce their dependence on the grid and go green.</p>
Solar plus Battery	<p>Pairing IQ Microinverters with IQ Batteries, this grid-tied configuration combines solar and storage to help maximize financial benefits.</p> <p>A Solar plus Battery system makes a home more energy-independent and can offer significant long-term savings by minimizing the homeowner's electricity bills. In this configuration, the microinverters power the house with solar energy when the sun shines. Excess solar energy is used to charge the IQ Batteries. Once the battery is fully charged, the extra solar energy is exported back to the grid in exchange for electricity bill credits (in countries that allow it).</p>
Battery upgrade (installed on existing PV site)	<p>If a home has an existing solar system—Enphase solar or a string inverter system—adding IQ Batteries can help maximize financial benefits by storing excess solar power. Once the sun sets, this stored energy can be used to power the home.</p>

## 3 Product overview

- IQ Gateway:** This communications gateway can communicate with IQ Series Microinverters and IQ Batteries. IQ Gateway is the brain that controls the entire system, collects performance information, and transfers it to the Enphase Cloud.
- IQ Series Microinverters and accessories:** IQ Series Microinverters pack more power into less space than other rooftop solar systems and make rooftop solar more productive, reliable, smart, and safe.
- IQ Battery 5P:** This is an all-in-one AC-coupled IQ Battery system. It has a total usable energy capacity of 5 kWh with a continuous power rating of 3.2 kW. It communicates with the IQ Gateway over a wired communication interface via the Communications Kit 2.

- **Enphase Communications Kit 2:** Enables the IQ Gateway Metered to communicate with IQ Battery 5P using wired control (CTRL) communication. The Communications Kit 2 is connected via USB to the IQ Gateway.
- **Current transformers:** Required to monitor PV production and home energy consumption. They are essential for the Enphase Energy System to operate correctly.

## 4 Product generation and interoperability

Table 2: Product interoperability

Product	M Series	IQ7 Series	IQ8 Series	String inverter	IQ Battery 5P —grid-tied
M Series	—	Yes	No	Yes	No*
IQ7 Series	Yes	—	No	Yes	Yes
IQ8 Series	No	No	—	Yes	Yes
String inverter	Yes	Yes	Yes	—	Yes
IQ Battery 5P - grid-tied	No*	Yes	Yes	Yes	—

Table 3: Supported and unsupported configurations with the IQ Battery 5P

Product	Compatible with IQ Battery 5P
IQ7 Series	Yes
IQ8 Series	Yes
String inverter	Yes
String + IQ7/IQ8/M Series	No
M Series	No*
IQ7 Series + M Series	No*
IQ7 Series + IQ8 Series	No**
AC Battery	No

\* Install the IQ Battery 5P battery on these sites on a separate Gateway.

\*\* The IQ Battery 5P can be installed on either the Gateway with the IQ7 Series or the Gateway with the IQ8 Series. However, two different gateways are needed, and a PLC filter is required after one of the gateways.

## 5 Design an Enphase Energy System

### 5.1 System modes

The Enphase Energy System supports the following system modes of operation:

- **Self-Consumption:** The PV system and battery are optimized to enable maximum self-consumption of energy produced by the PV system. The battery's capacity caters to home loads to minimise energy import from the grid.
- **Charge-from-grid:** This is an advanced setting in which the battery can charge from the grid according to a specific schedule the user sets.

## 5.2 System considerations

- The IQ Gateway can monitor up to 300 IQ Microinverters.
- Four IQ Battery 5P units can be connected in a single 80 A circuit, with up to 12 IQ Battery 5P units supported across three phases. When designing a system, follow local regulations for system sizing. Ensure the following while installing solar and storage systems:
  1. Read each product's quick install guides (QIG) for detailed information about installing the IQ Microinverter and the Battery system.
  2. For all new installations with the IQ Microinverter and the IQ Battery 5P, installers should procure the bundled SKU (ENV-IQ-GWM-CK2-INT-KIT) consisting of an IQ Gateway Metered and a Communications Kit 2. In addition, installers must procure a suitable length of control cable for the installation. Belcom makes the tested and supported control cable; the model is 4302P2254-01.
  3. Per the local electrical regulations, determine the length and cross-section of the AC conductor between the end of the IQ Cable and the electrical panel. It is recommended that the voltage drop across these conductors not exceed 1% and that the overall voltage drop in the PV circuit from the point of connection to the most remote microinverter not exceed 2%.
  4. A 20 A B-curve circuit breaker usually protects the 2.5 mm<sup>2</sup> IQ Cable. However, it is essential to understand and follow local regulations where this may not be the case.
  5. Install any equipotential bonding between PV module frames, array mounting structures, and metal microinverter mounting brackets per local electrical regulations.
  6. Install surge protection devices (SPDs) and residual current devices (RCDs) per local electrical regulations.
  7. In three-phase systems, microinverters and batteries should be balanced across the three phases to avoid phase imbalance.
  8. The IQ Gateway Metered ships with two Current Transformers (CTs)—one for production metering and the other for consumption metering. Ordering and using four additional CT-100-SPLIT-ROW or CT-100-SPLIT (two each for monitoring the additional production and consumption channels) is essential for three-phase systems. CT-100-SPLIT-ROW is optimal for smaller consumer units with cable sizes up to 16 mm<sup>2</sup>; CT-100-SPLIT can be used for larger cable sizes up to 25 mm<sup>2</sup>.
  9. Any system with an IQ Battery must have Wi-Fi or Ethernet as the primary mode of internet connectivity.
  10. For systems with an installed capacity greater than 17 kW per phase, use a G99-approved third-party network protection relay, as directed by the distribution network operator (DNO). This is only required for three-phase installations.
  11. For the IQ Gateway to communicate with all the microinverters in a three-phase application, the power line communication signal must be **coupled** between the three phases. This requires the addition of an aftermarket phase coupler device. See the [Phase Couplers for Three-Phase Enphase Systems \(Europe\) Detailed technical brief](#) for details.

As a reference for electrical symbols, refer to the following legend to comprehend the system diagrams better. The following sample Enphase Energy System diagrams help you design your PV and storage systems.

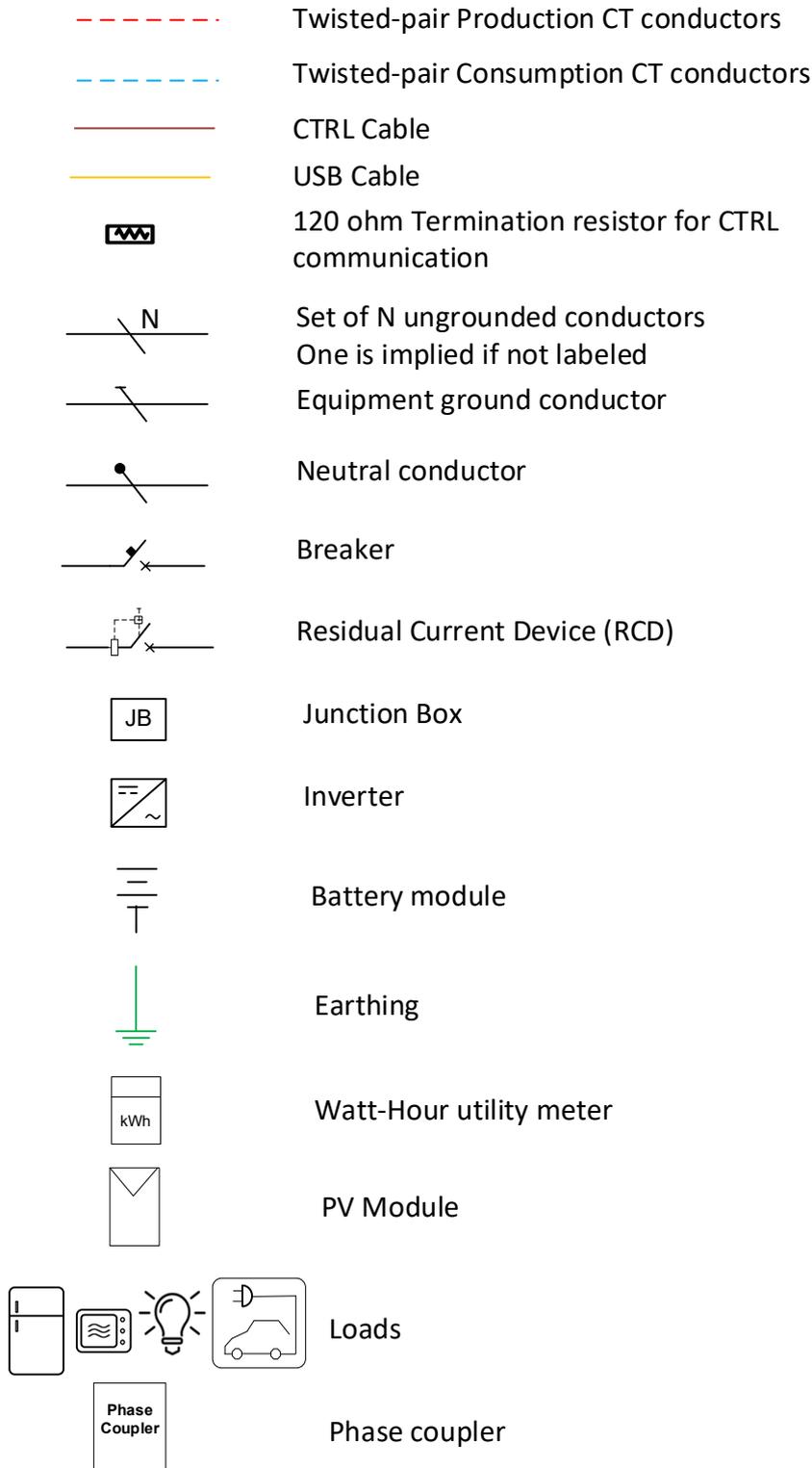


Figure 1: System diagram: Legends

The following sample Enphase Energy System diagrams help you design your PV and storage systems.

### 5.2.1 Solar PV only: Single-phase IQ7/IQ8 Series Microinverters

System size: PV: 3.68 kW AC

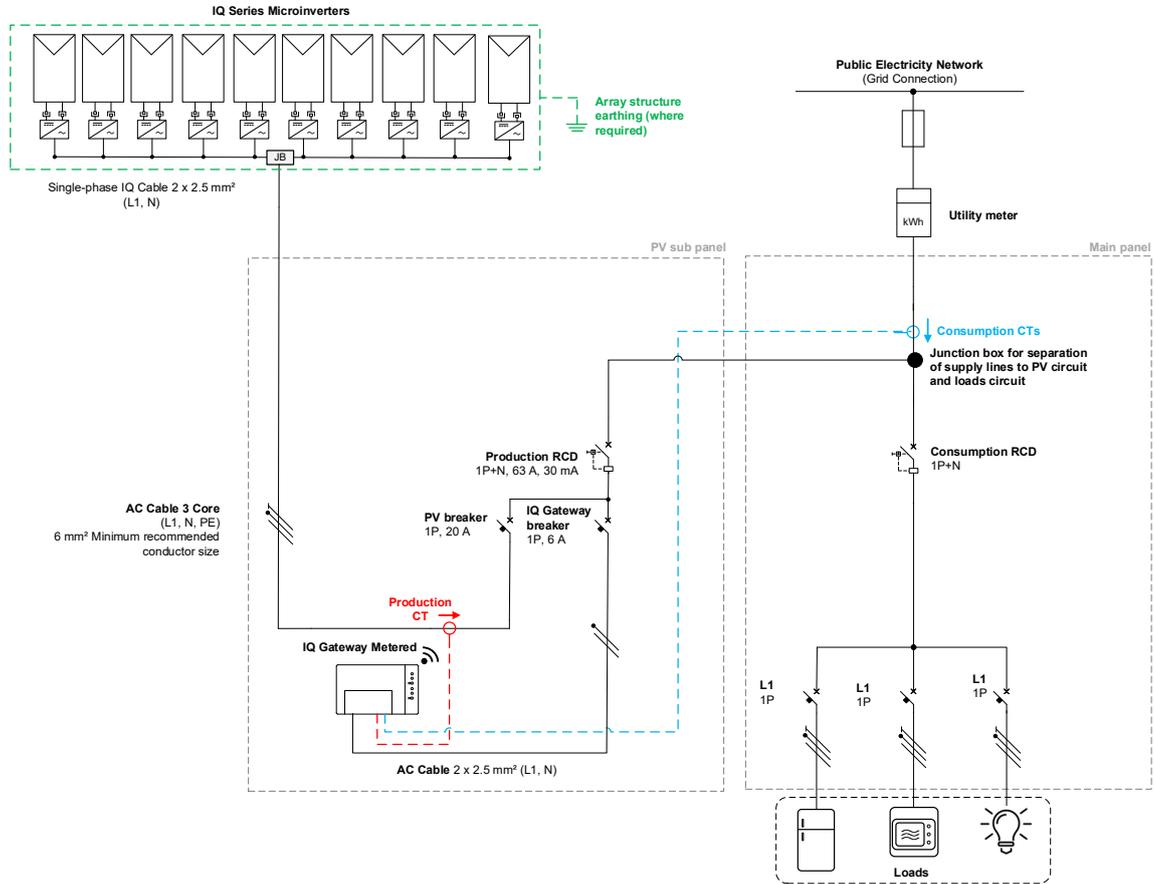


Figure 2: Single-phase IQ7/IQ8 Series PV only system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.2 Solar PV + Battery: Single-phase IQ7/IQ8 Series Microinverters and single-phase IQ Battery 5P

System size: PV: 3.68 kW AC. Storage: 5 kWh.

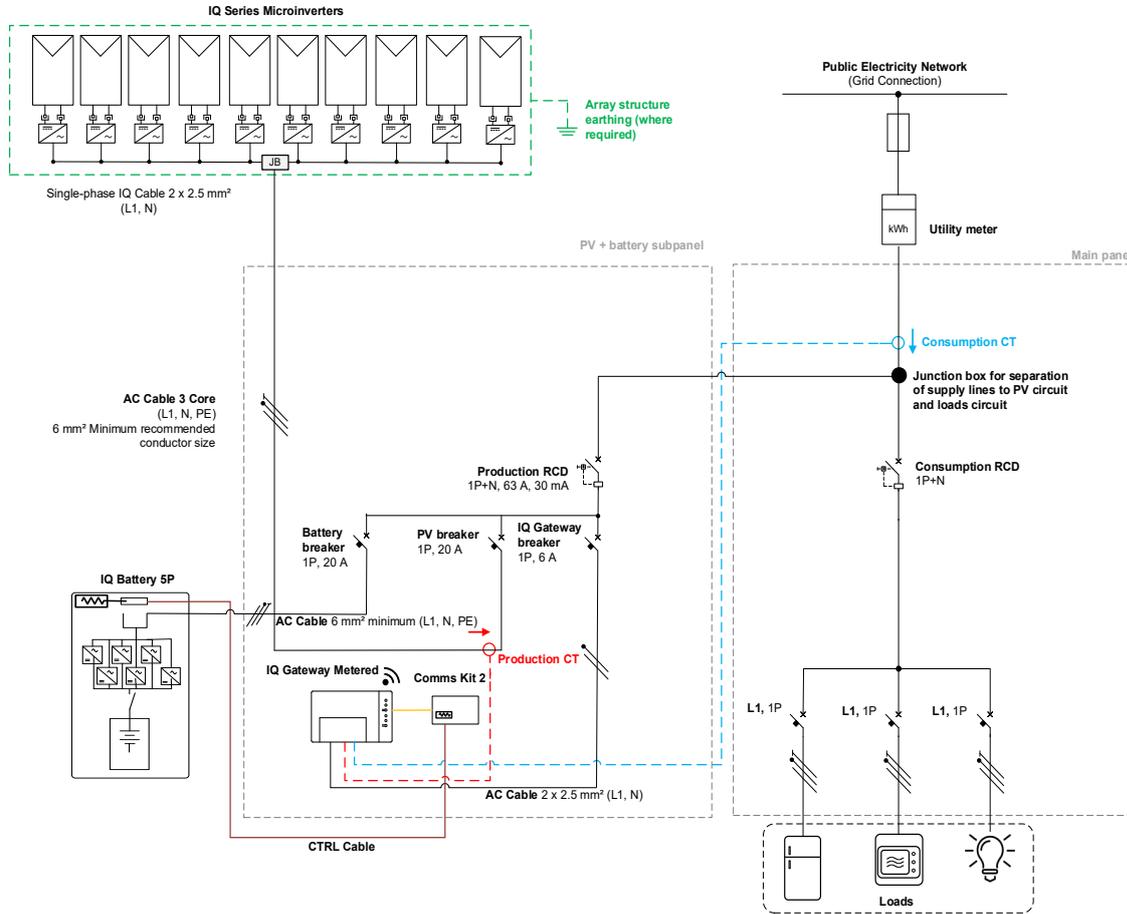


Figure 3: Single-phase IQ7/IQ8 Series PV and IQ Battery 5P system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.3 Solar PV + Batteries: Single-phase IQ7/IQ8 Series Microinverters (multiple branches) and single-phase IQ Battery 5P (four IQ Battery 5Ps in a circuit)

System size: PV: 7.36 kW AC. Storage: 20 kWh.

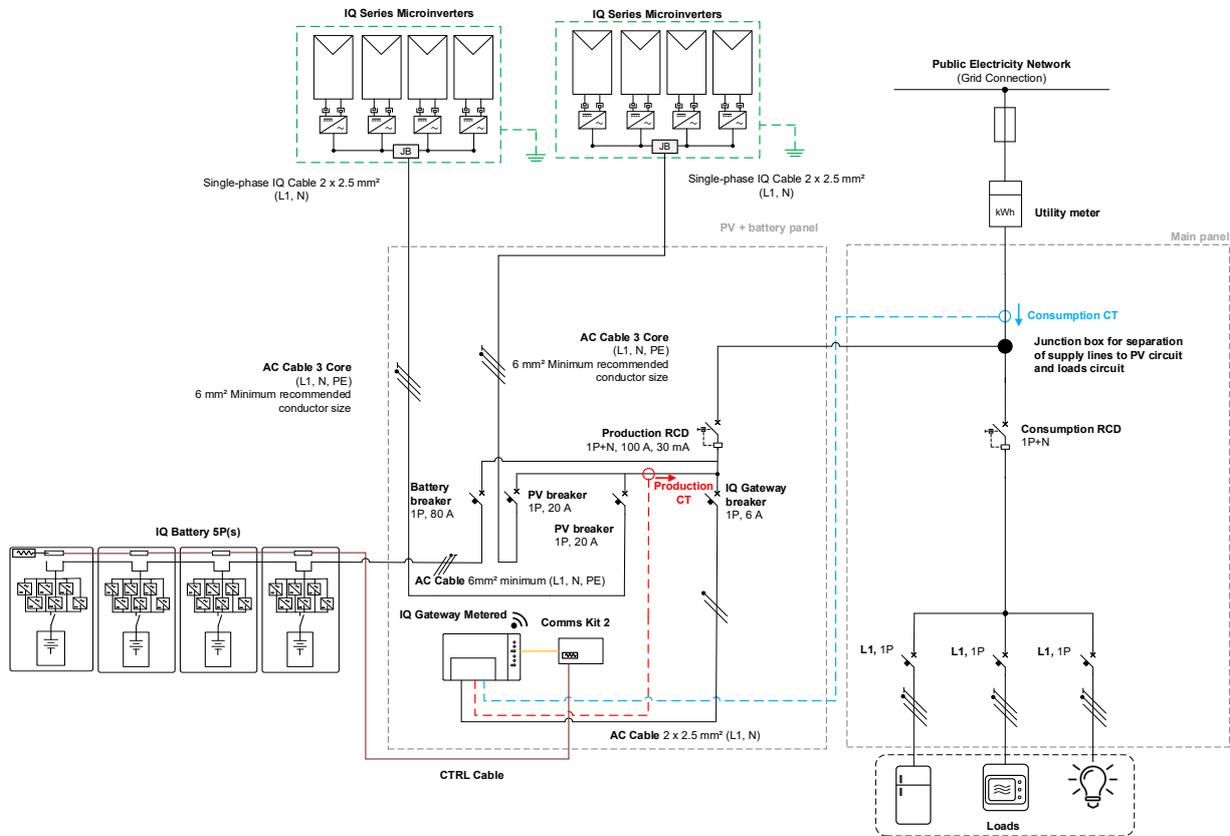


Figure 4: Single-phase IQ7/IQ8 Series PV (multiple branches) and IQ Battery 5P (daisy chain) system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.4 Solar PV + Battery: Single-phase string inverter and single-phase IQ Battery 5P

System size: PV: 3.68 kW AC. Storage: 5 kWh

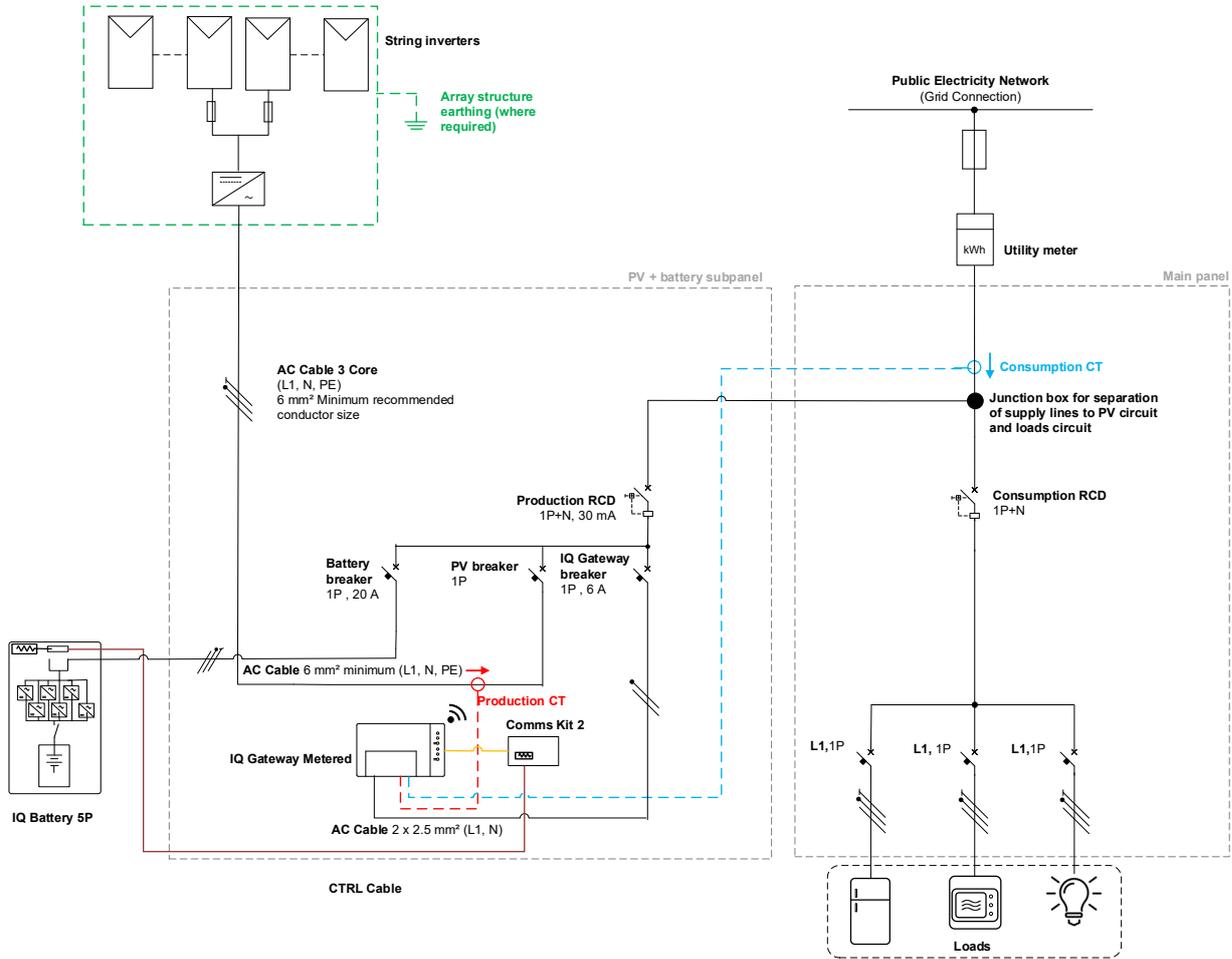


Figure 5: Single-phase string inverter PV and IQ Battery 5P system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.5 Solar PV + Battery: Existing single-phase M-Series PV and single-phase IQ Battery 5P each on their own separate IQ Gateways

System size: PV: 3.68 kW AC. Storage: 5 kWh.

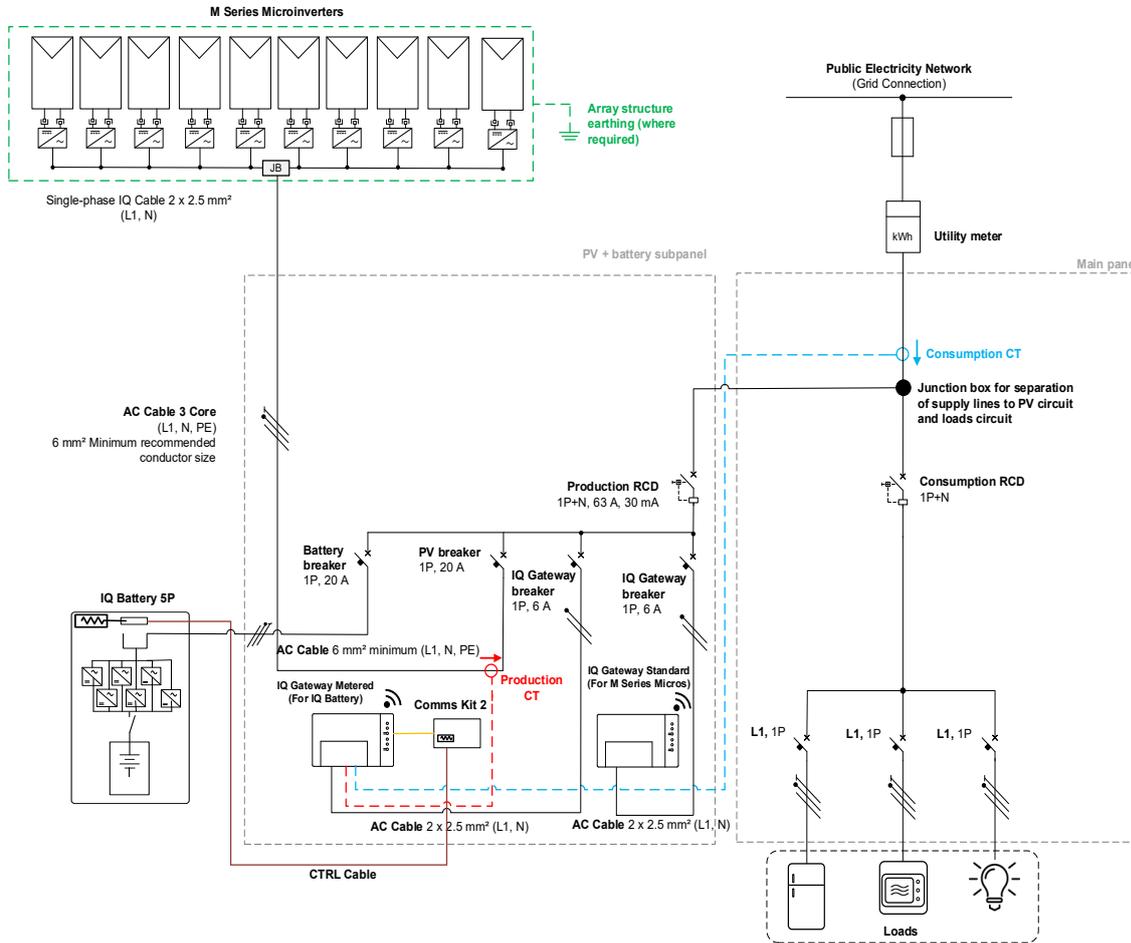


Figure 6: Single-phase M-Series PV and IQ Battery 5P system on separate IQ Gateways diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.6 Solar PV + Battery: Existing single-phase M-series/IQ7 PV on its own IQ Gateway and single phase IQ8 PV + IQ Battery 5P system on its own IQ Gateway

System size: PV: 7.68 kW AC. Storage: 15 kWh.

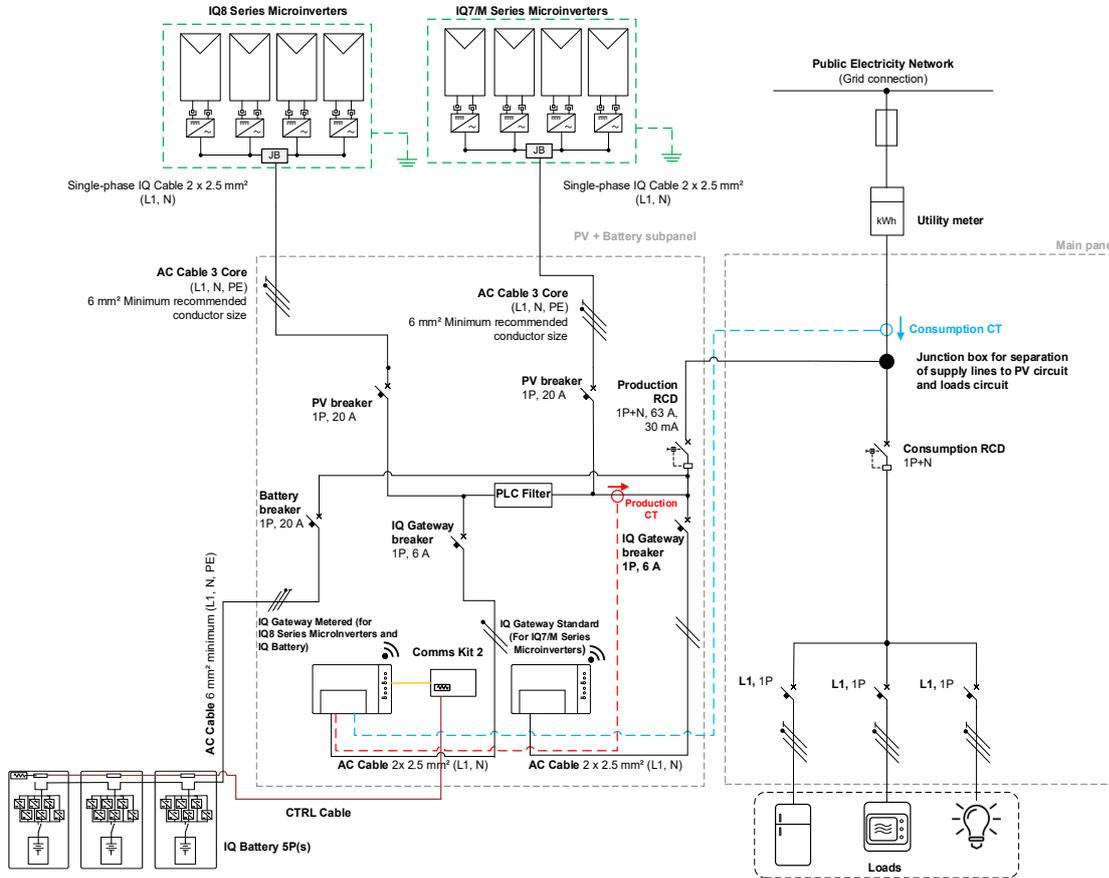


Figure 7: Existing single-phase IQ7/M-Series PV on existing IQ Gateway and single-phase IQ8 PV and IQ Battery 5P system on its own IQ Gateway diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.7 Solar PV only: Three-phase IQ7/IQ8 Series Microinverters

System size: PV: 11 kW AC

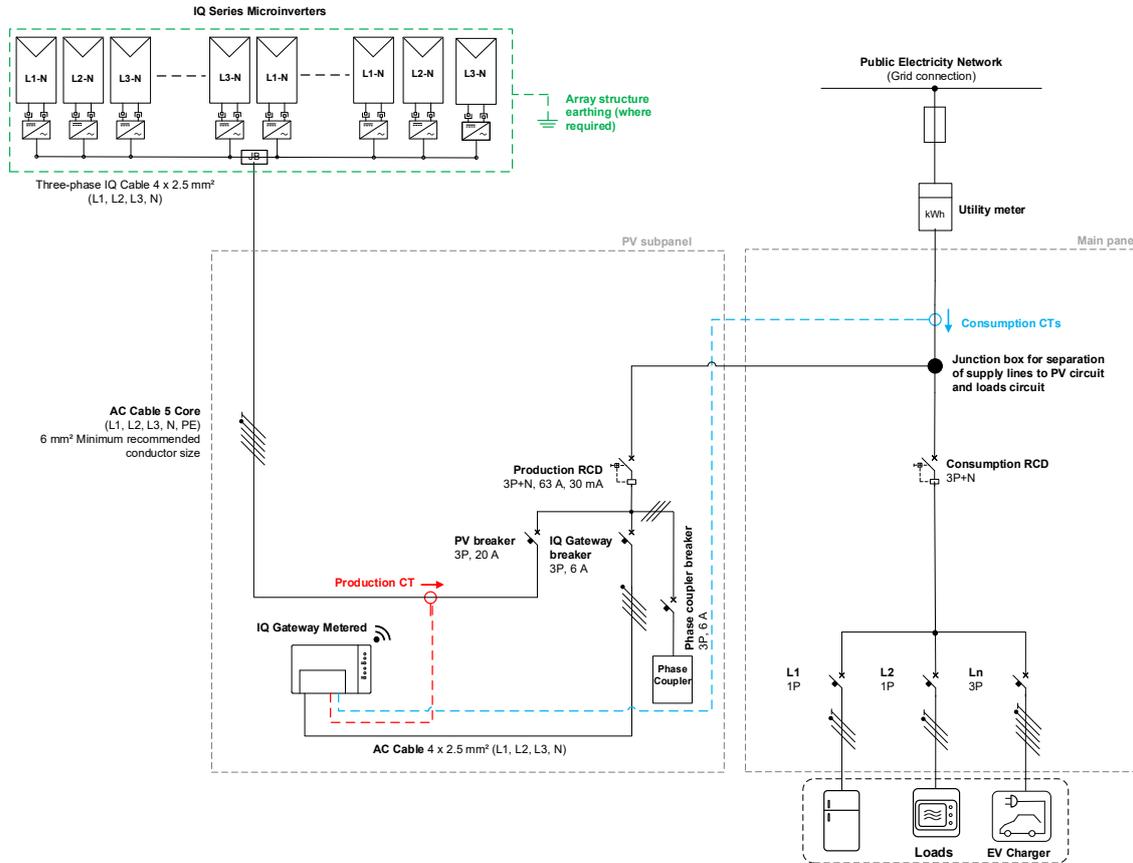


Figure 8: Three-phase IQ7/IQ8 Series PV only system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.8 Solar PV + Battery: Three-phase IQ7/IQ8 Series Microinverters and three-phase IQ Battery 5P (three IQ Battery 5Ps across three-phases)

System size: PV: 11 kW AC. Storage: 15 kWh.

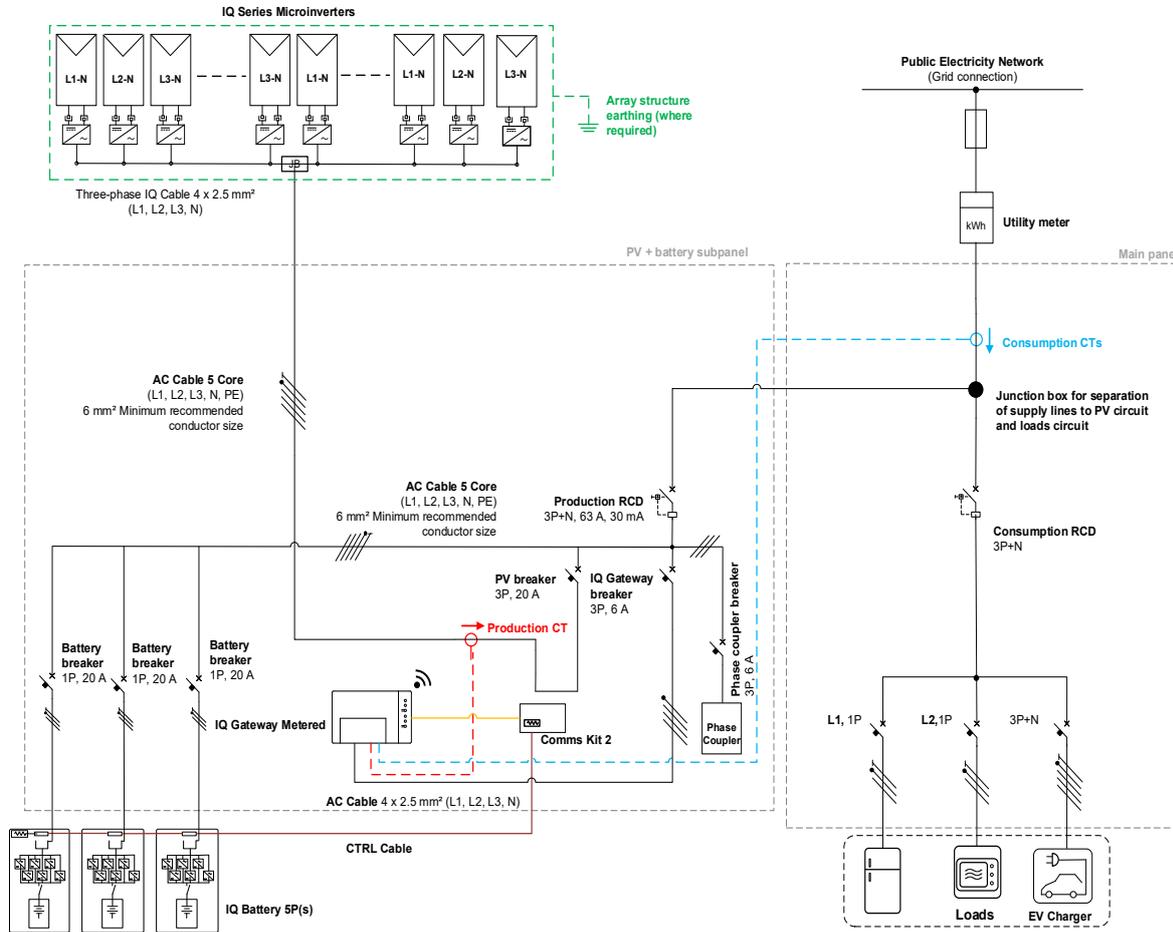


Figure 9: Three-phase IQ7/IQ8 Series PV and IQ Battery 5P system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

### 5.2.9 Solar PV + Battery: Three-phase string inverter and three-phase IQ Battery 5P (three IQ Battery 5Ps across three-phases)

System size: PV: 11 kW AC. Storage: 15 kWh.

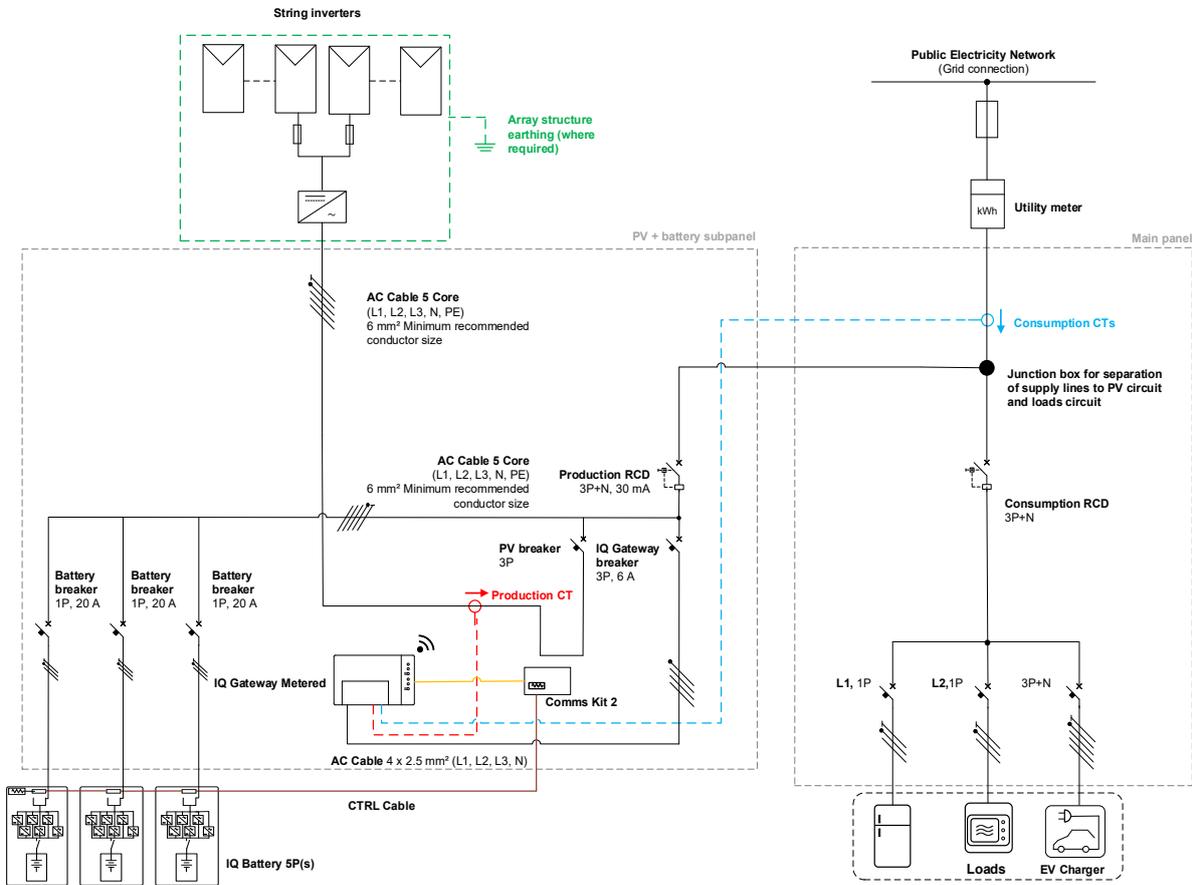


Figure 10: Three-phase string inverter PV and IQ Battery 5P system diagram



**NOTE:** Size the production RCD to the production circuit size or higher.

## 6 Control wiring

An Enphase Energy System communicates over a wired communications interface and needs control wiring between the IQ Gateway and the IQ Battery 5P via the Communications Kit 2.

[Belcom 4302P2254-01](#) is the Enphase-tested and qualified control cable. The use of non-approved cables can result in issues in system performance.

The following figure shows the guidance for correctly stripping the control (CTRL) cable.

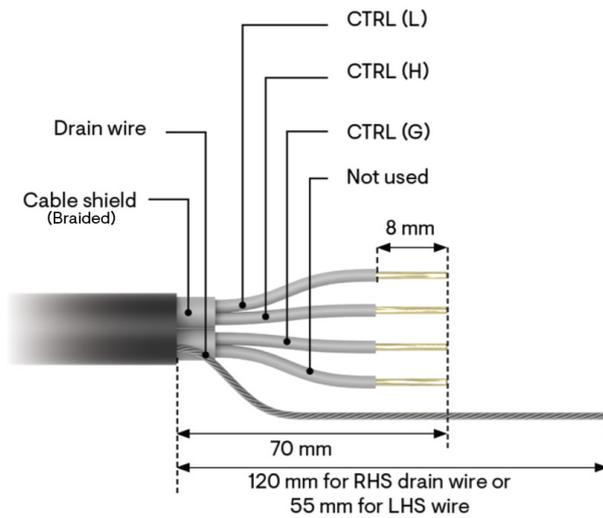


Figure 11: CTRL cable wire stripping guidance

[Table 4](#) lists the guidance for landing the CTRL cable wires into the CTRL header for the IQ Battery 5P and the Communications Kit 2.

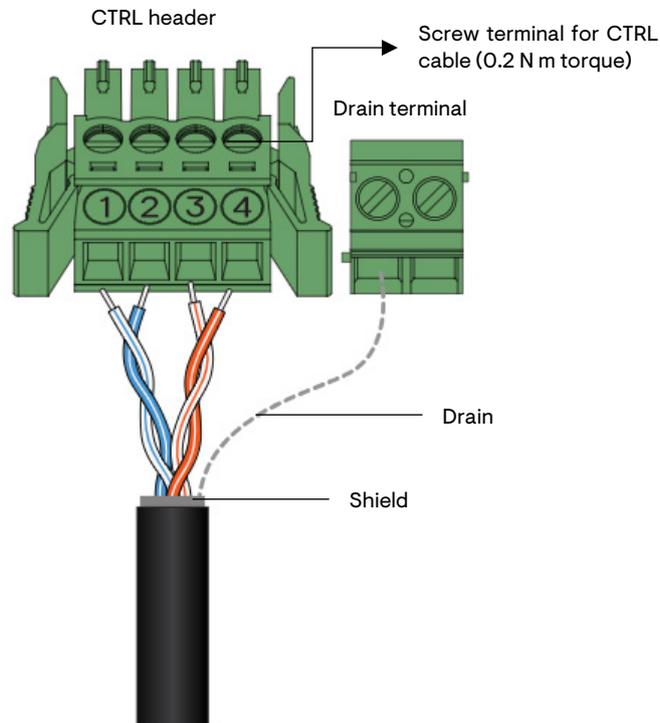


Figure 12: CTRL cable wire landing guidance

Table 4: CTRL cable wire termination guidance

CTRL header numbers	CTRL signals	Wire designation
Screw terminal 1	CTRL L	White with blue stripe
Screw terminal 2	CTRL H	Blue with white stripe
Screw terminal 3	CTRL G	White with orange stripe
Screw terminal 4	Not used	Orange with white stripe

Control wiring guidance for installing IQ Battery 5P with a Communications Kit 2 INT:  
 Refer to the following wiring scenarios to understand the position of the header with termination resistor, wiring order, and drain wire termination location.



**NOTE:** To ensure optimal system performance, the total length of CTRL wiring across the system must not exceed 100 m.



**NOTE:** Follow the guidelines to avoid failures during system commissioning:

- Each component at the extreme end of the control network should have one header with a termination resistor installed.
- The drain wire should be terminated only at one end of each control wiring section or length.
- Terminating the drain wire at the component from which the control wiring for the section is initiated is recommended.

Following are the wiring sequences:

**Sequence: IQ Battery 5P–Communications Kit 2 INT–IQ Battery 5P**

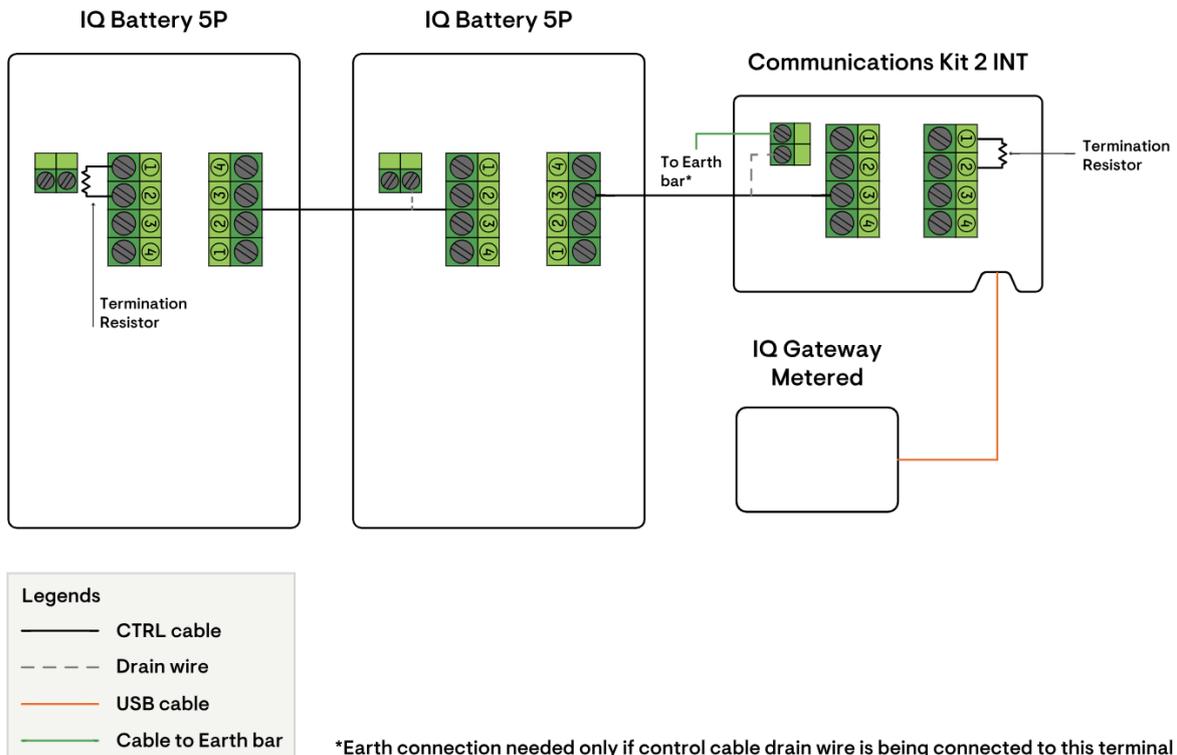


Figure 14: CTRL cable wire sequence 2

**Sequence 2: IQ Battery 5P – Communications Kit 2 INT-IQ Battery 5P**

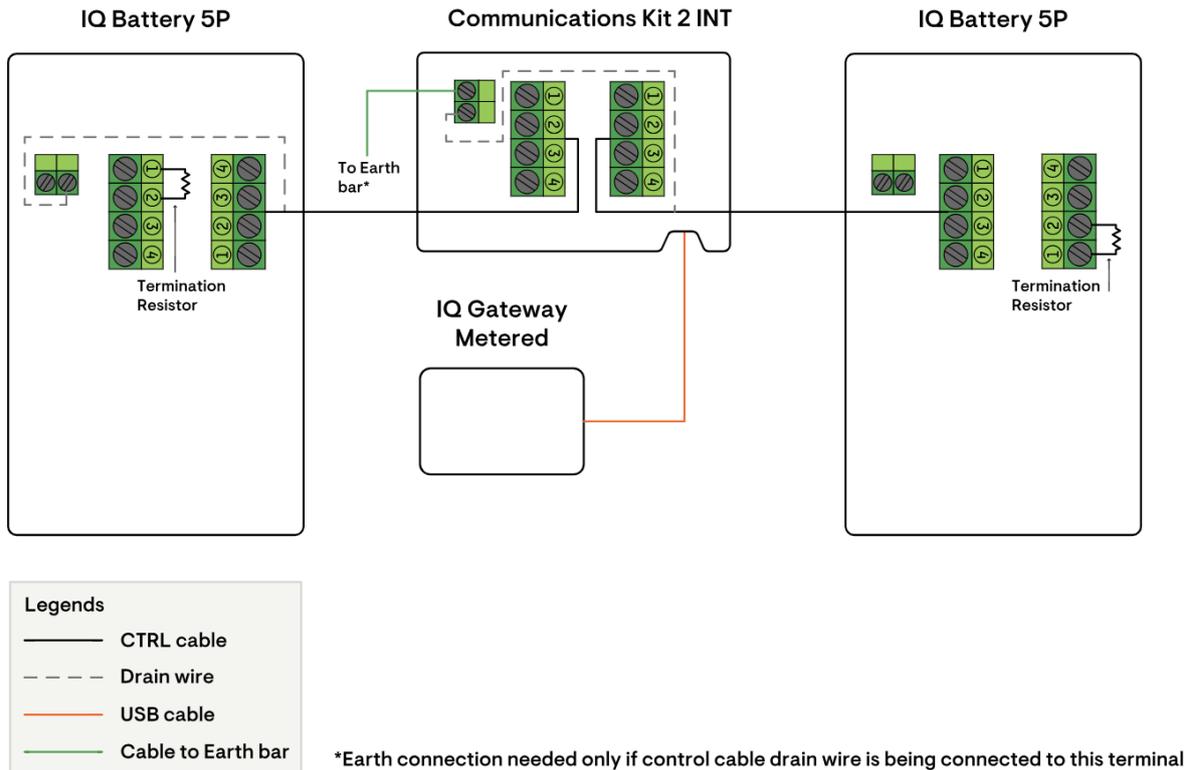


Figure 15: CTRL cable wire sequence 2

The following table lists the termination resistor locations for the preceding sequences.

Table 5: Termination resistor position guidance

Control wiring sequence	Termination resistor location
IQ Battery 5P(s) - Communications Kit 2 INT	Resistor 1: First IQ Battery 5P in the control bus Resistor 2: Communications Kit 2
IQ Battery 5P - Communications Kit 2 INT - IQ Battery 5P	Resistors 1 and 2: The two IQ Battery 5P units at each end of the control bus

**Appendix**

The following table lists the order code for the Enphase components needed to complete a PV and Battery installation. Refer to the IQ7/IQ8 PV and the IQ Battery 5P QIG and data sheet at the [Enphase Documentation Center](#) to ensure you select the appropriate components for your installation.

Table 6: Enphase components

Product type	Product	SKU
Enphase microinverters	IQ7 Microinverter	IQ7-60-2-INT
		IQ7-60-M-INT
		IQ7A-72-2-INT
		IQ7A-72-M-INT
		IQ7PLUS-72-2-INT

Product type	Product	SKU
		IQ7PLUS-72-M-INT IQ7X-96-2-INT
	IQ8 Microinverter	IQ8MC-72-M-INT IQ8AC-72-M-INT IQ8HC-72-M-INT
Microinverter accessories	IQ Cable	Single-phase: Q-25-17-240 Three-phase: Q-25-17-3P-160 2.5 mm <sup>2</sup> IQ Cable for 60/96 cells, 1.7 m landscape module pitch
		Single-phase: Q-25-20-200 Three-phase: Q-25-20-3P-160 2.5 mm <sup>2</sup> IQ Cable for 72 cells, 2.0 m landscape module pitch
		Single-phase: Q-25-10-240 Three-phase: Q-25-10-3P-200 2.5 mm <sup>2</sup> IQ Cable for 60/72/96 cells, 1.0 m portrait module pitch
	IQ Terminator	Single-phase: Q-TERM-R-10 Three-phase: Q-TERM-3P-10
	IQ Sealing Cap	Q-SEAL-10
	IQ Field Wireable Connectors (female)	Single-phase: Q-CONN-R-10F Three-phase: Q-CONN-3P-10F
	IQ Field Wireable Connectors (male)	Three-phase: Q-CONN-3P-10M
	IQ Raw Cable (metres)	Single-phase: Q-25-RAW-300 Three-phase: Q-25-RAW-3P-300
	IQ Cable Clips	ET-CLIP-100
	IQ Disconnect Tool	Single-phase: Q-DISC-10 Three-phase: Q-DISC-3P-10
*Enphase Gateway	IQ Gateway Metered	ENV-S-EM-230
Enphase Battery	IQ Battery 5P	IQBATTERY-5P-1P-INT
*Enphase Communications Kit	Communications Kit 2	COMMS-KIT-INT-02

\* For all new installations with IQ PV and IQ Battery 5P, installers should procure the bundled SKU (ENV-IQ-GWM-CK2-INT-KIT) consisting of IQ Gateway Metered and the Communications Kit 2.

For existing IQ PV installs that are being upgraded with an IQ Battery 5P and have an existing IQ Gateway Metered with Production and Consumption CTs installed, installers must procure a standalone Communications Kit 2 (COMMS-KIT-INT-02) to enable wired control communications.

## Revision history

Revision	Date	Description
TEB-00076-3.0	April 2024	Added M Series support and included phase coupling for three-phase installations.
TEB-00076-2.0	November 2023	Initial release.
TEB-00076-1.0	September 2023	Preliminary release.