

Planning an Enphase Energy System

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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 install 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: This guide describes an Enphase Energy System with IQ-Series or M-Series Microinverters. Please pay particular attention to the equipment requirement for each type of microinverter.

NOTE: New product naming

Enphase has simplified our product names to make it easier to navigate and remember our system, product, and service offerings. We believe that our new names more accurately describe product function, are easier to remember, and will benefit homeowners and installers alike.

From	To
Ensemble	Enphase Energy System
Encharge Storage	IQ Battery
IQ Envoy	IQ Gateway
Empower	IQ System Controller
Load Control	IQ Load Controller
Enlighten App	Enphase App
Enlighten Manager	Enphase Installer Portal
Enlighten Installer Toolkit	Enphase Installer App
Enlighten Cloud	Enphase Cloud

Enphase Energy System Overview

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

IQ8™ Series Microinverters and Accessories: The Enphase Energy System is fully compatible with IQ 8 Microinverters and makes retrofit upgrades as simple as new installations.

- **IQ 6™ / IQ 7™ Series Microinverters and accessories:** The Enphase Energy System is compatible with IQ 7 and IQ 6 Series Microinverters and makes retrofit upgrades as simple as new installations.



WARNING: The Enphase Energy System does not support mixing IQ6/IQ7 Series Microinverters with IQ8 Series Microinverters. If both are present on the same site follow guidelines in the *Split Enphase Systems on a Single Site with IQ6/7/8 or M-series microinverters* section to avoid issues.

- **Enphase M-Series Microinverters and Accessories:** The Enphase Energy System is compatible with Enphase M215 and M250 Microinverters and makes retrofit upgrades simple.



NOTE: The Enphase Energy System is only compatible with M215 and M250 Series Microinverters. Other legacy Microinverters are not supported.



WARNING: Enphase system does not support mixing M-Series microinverters with IQ8 Series microinverters or IQ6/7 Series Microinverters. If installing an Enphase Energy system on a site where IQ6/7 and M series inverters will co-exist read the *Split Enphase Systems on a Single Site with IQ6/7/8 or M-series microinverters* carefully and install as outlined to avoid issues. If installing an Enphase Energy system on a site where IQ8 and M series inverters will co-exist read *Split Enphase Systems on a Single Site with IQ6/7/8 or M-series microinverters* section carefully and install as outlined to avoid issues.

- **Enphase IQ Battery** is an all-in-one AC coupled storage system that includes embedded, grid forming multimode Microinverters. You can connect multiple IQ Batteries to maximize potential backup for homes. The IQ Battery 3/3T/10/10T storage system provides flexibility to customers to start small and add capacity incrementally.
- **IQ™ Combiner 3/3C** consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. It includes the Enphase IQ Gateway. Install the new communication kit in any IQ Combiner to enable wireless communication with IQ Battery and IQ System Controller. This series supports hold down kits on only 2 PV circuits.
- **IQ™ Combiner 4/4C** consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. IQ™ Combiner 4/4C includes Enphase IQ Gateway with the latest software needed to support IQ8™. Install the new communication kit COMMS-CELLMODEM-M1-06 with IQ™ Combiner 4/4C to enable wireless communication with IQ Battery and IQ System Controller. IQ Combiner 4/4C supports hold down kits on all 4 PV circuits.
- **IQ Gateway™**, a communications gateway that can communicate with IQ-Series Microinverters, IQ batteries, and the IQ System Controller. It collects system performance information and transmits that information over the internet to Enphase Cloud. An IQ Gateway is required for Enphase Energy Systems with IQ-Series Microinverters. Note the IQ Gateway is included in an Enphase IQ Combiner. For retrofit sites, an IQ Gateway may already be present.



WARNING: IQ Gateway will not communicate with M-Series Microinverters.

- **Envoy-S Metered** is a communications gateway that can communicate with M-Series Microinverters, IQ batteries and the IQ System Controller. It collects system performance information and transmits that information over the internet to Enphase Cloud. An Envoy-S Metered is required for every Enphase Energy System with M-Series Microinverters.



WARNING: Legacy Gateway/EMU SKUs (ENV-120-01 or ENV-120-02, IEMU-03 or IEMU-01 or IEMU02) will not work with an Enphase Energy System. You must replace these legacy SKUs with an Envoy-S Metered during the Enphase Energy System installation.

- **Enphase IQ System Controller** connects the home to grid power, the IQ Battery, and PV. It provides microgrid interconnect device (MID) functionality by automatically detecting and seamlessly transitioning the system from grid power to backup power in the event of a grid failure. It allows IQ Battery and/or an IQ6/7 Series PV array to form an intentional island (per IEEE 1547.4 definition) and contains a neutral-forming transformer (NFT) to enable 120/240 V operation in backup mode.



WARNING: IQ System Controller 1 does not support IQ8 series microinverters. Use IQ System Controller 2 for grid forming sites with IQ8 series microinverters.

- **Enphase IQ System Controller 2** connects the home to grid power, the IQ Battery, and PV. It provides microgrid interconnect device (MID) functionality by automatically detecting and seamlessly transitioning the system from grid power to backup power in the event of a grid failure. It allows IQ Battery and/or an IQ6/7/8 Series PV array to form an intentional island (per IEEE 1547.4 definition) and contains a neutral-forming transformer (NFT) to enable 120/240 V operation in backup mode.
- **Enphase System Shutdown switch** is the only rapid shutdown switch per 2017 NEC 690.12 for an IQ8 grid agnostic system.



NOTE: Enphase System Shutdown switch is not needed in an Enphase Energy System with IQ6/7-Series or M-Series Microinverters. Enphase System Shutdown switch is only NEC and UL 1741 PV RSE complaint for IQ8 grid forming systems. It must not be installed or placarded as the rapid shutdown initiator for IQ6/7 or M series microinverters.



WARNING: When IQ System Controller 2 is used with IQ6, IQ7 or M-Series Microinverters, the Enphase Energy System Shutdown switch (EP200G-NA-02-RSD) should not be used as a rapid shutdown initiator. The installers need to connect the RSD auxiliary contacts of IQ System Controller 2 using jumper wires to make the system operational. Refer Installer memo – [Wiring the Rapid Shutdown Switch with IQ System Controller 2](#)

- **IQ Load Controller** Each IQ Load Controller unit can enable fine-grained, circuit-level control for 2x 240V loads or 4x 120V loads. Dedicated loads up to 36A resistive/25A inductive or branch circuits with multiple loads up to 32A resistive/25A inductive are supported by the IQ Load Controller.
- **Enphase Wireless communication kit** enables direct communication between IQ Battery, IQ System Controller, and the IQ Gateway using 2.4 GHz frequency. The kit is connected to one of the USB ports on the IQ Gateway.
- An **Enphase Mobile Connect™** cellular modem is required unless already present to ensure the best performance of your system. The cellular modem connects to a USB port on the IQ Gateway.
- **Enphase Consumption CTs** enable home energy consumption monitoring and are required for Enphase Energy System to operate correctly.

Enphase Energy Systems Common Configurations

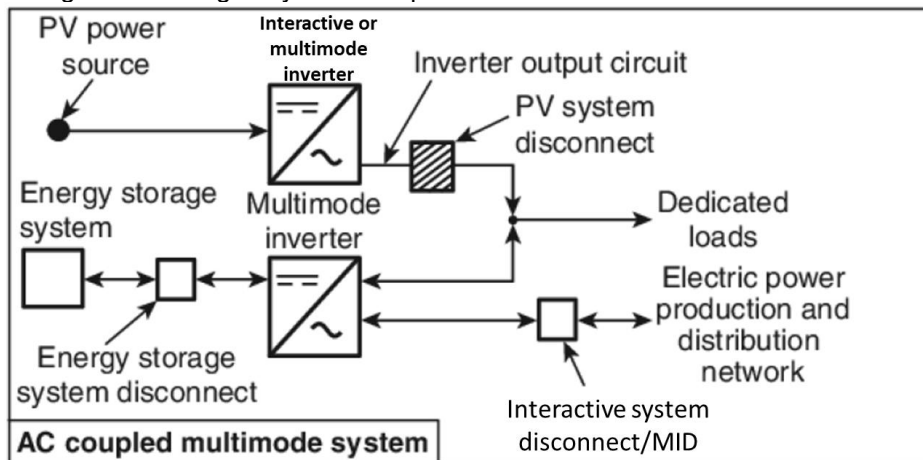
Regulatory Background – National Electrical Code

A microgrid system, as defined by the National Electric Code Article 705 Part II, is permitted to disconnect from the utility grid and operate in island mode--forming an intentional island or microgrid that provides backup power. Multimode refers to the ability for an inverter to switch between interactive and island mode. To prevent a multimode inverter from islanding while connected to the utility grid, a system requires a microgrid interconnect device (MID) to disconnect and reconnect to the primary power source or grid.

IQ System Controller contains an MID that allows disconnecting from the area electric power system and IQ8 to form an intentional island or operate in island mode. In addition, it contains distributed energy resource (DER) relays to disconnect and reconnect the microinverter array and battery storage array from both loads and the utility grid when a fault condition exists.

Figure 1 below shows a drawing of an AC coupled multimode system based on 2017 NEC section 690 and 705.

Figure 1: Microgrid system components based on 2017 NEC 690 and 705



Backup Configurations

Enphase Energy system can be classified into partial home backup and full home backup configurations.

1. **Partial home backup:** This is the preferred configuration for backup of essential loads. When the grid goes down, the Enphase Energy system will power down your main electrical panel and energize the back-up electrical panel. All the circuits that run through the back-up electrical panel will transition to off-grid operation. Typical back-up loads panels are configured to power essential loads during an outage.
2. **Whole home backup:** This is the preferred configuration for entire home backup. When the grid goes down, the Enphase Energy system will transition all the electrical circuits to back-up power. There are no excluded circuits in an entire home back-up configuration.

The Enphase Energy System with IQ8 Microinverters, supports four use cases that are described below:

Use Case	Configuration	Description
Sunlight backup	Partial home backup	<ul style="list-style-type: none"> - The system provides backup when the sun is shining for Up to four essential loads. - Only IQ8-Series Microinverters support this configuration.
Home Essentials	Partial home backup	<ul style="list-style-type: none"> - The system provides backup during day or night for essential loads. - Both PV and storage capacity is required to meet NEC 710.15(a). - Load control is recommended for any backup load that exceeds storage capacity
Full Energy Independence	Whole home backup	<ul style="list-style-type: none"> - The system provides backup during day or night for the whole home. - Storage capacity is sized so that it is sufficient to meet NEC 710.15(a) on its own. - Load control is recommended for energy management and to improve resilience.

Sunlight Backup Configuration

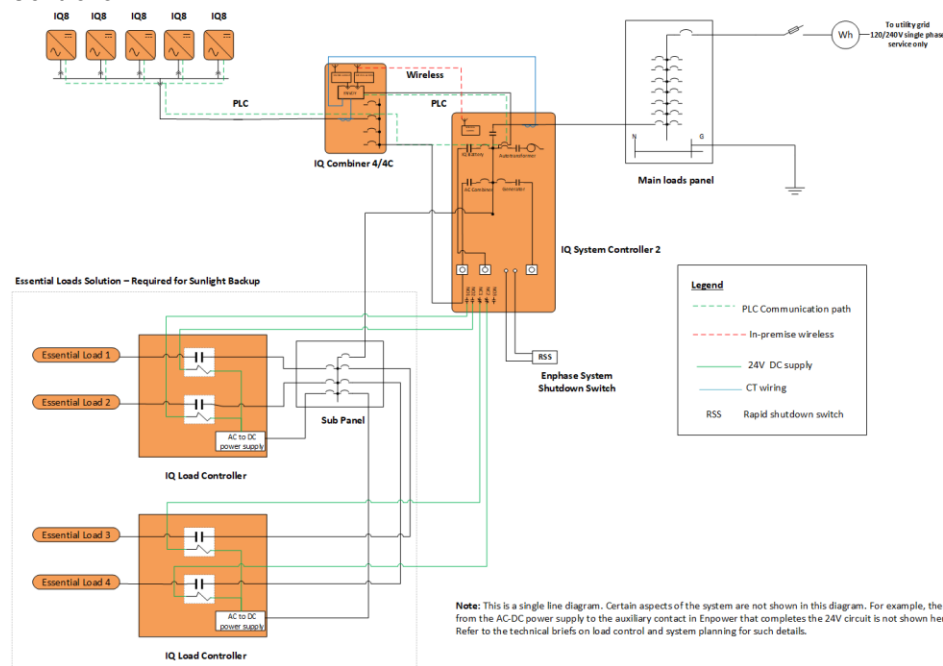
Only IQ8 Series Microinverters support this configuration. In this configuration, the Enphase Energy System provides backup when the sun is shining. The system does not include any IQ Batteries. The system can support PV branch circuits rated for up to 64A continuous current output.

IQ System Controller 2 is installed on the load side of an existing main load panel. This configuration must be used with an Essential Loads Solution. An Essential Loads Solution consists of:

- An off-the-shelf panel with a maximum of 4 pre-selected, essential load circuits that are backed up by the system.
- Up to 2 IQ Load Controllers, each enabling fine-grained, circuit-level control for 2x 240V or 4x 120V essential load circuits. Sunlight backup needs at least one IQ Load Controller to be installed on site.

Enphase Energy System does not support using this configuration for backing up an entire home as this will lead to poor customer experience.

Figure 2: *Enphase Energy System in Sunlight Backup configuration with IQ8-Series Microinverters & System Controller 2.*



Home Essentials Configuration

M-Series, IQ6, IQ7 and IQ8-Series Microinverters support this configuration. The Enphase Energy System provides backup during the day or night for essential loads. The system has at least one IQ Battery 3/3T. IQ System Controller is installed on the load side of an existing main load panel or service equipment. This use case can be used when the Enphase Energy system is configured to provide backup to a few pre-selected, essential load circuits. Up to 2 IQ Load Controllers are strongly recommended to reject high power loads.

Figure 3 Enphase Energy System in Home Essentials configuration with IQ8-Series Microinverters & System Controller 2.

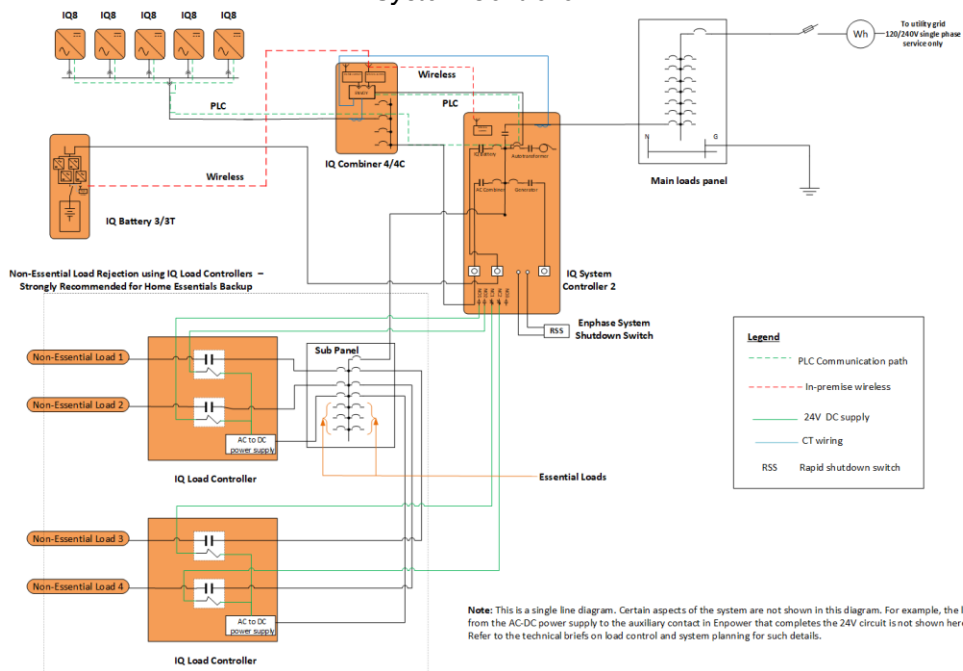
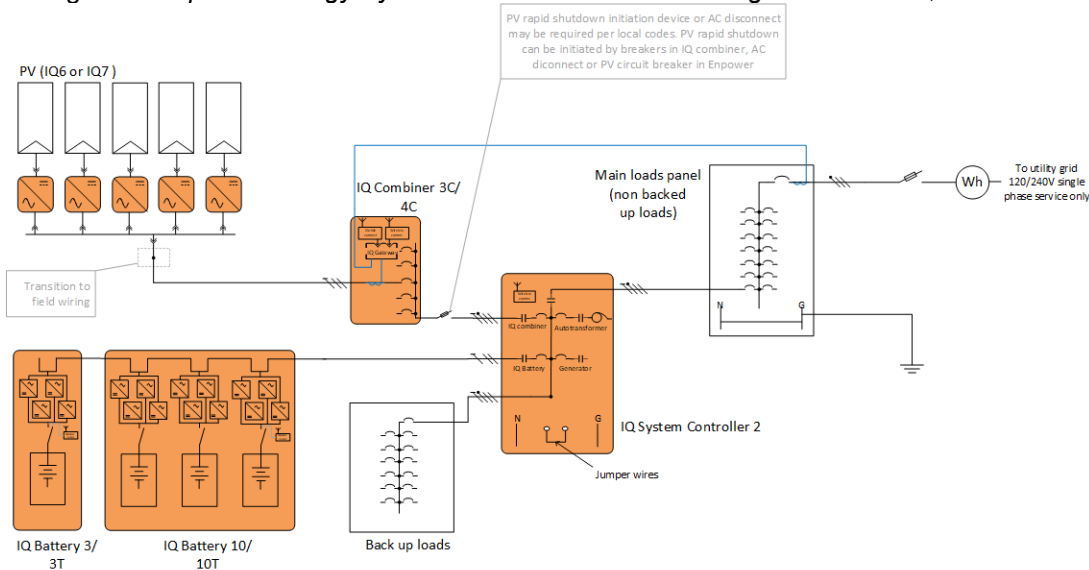
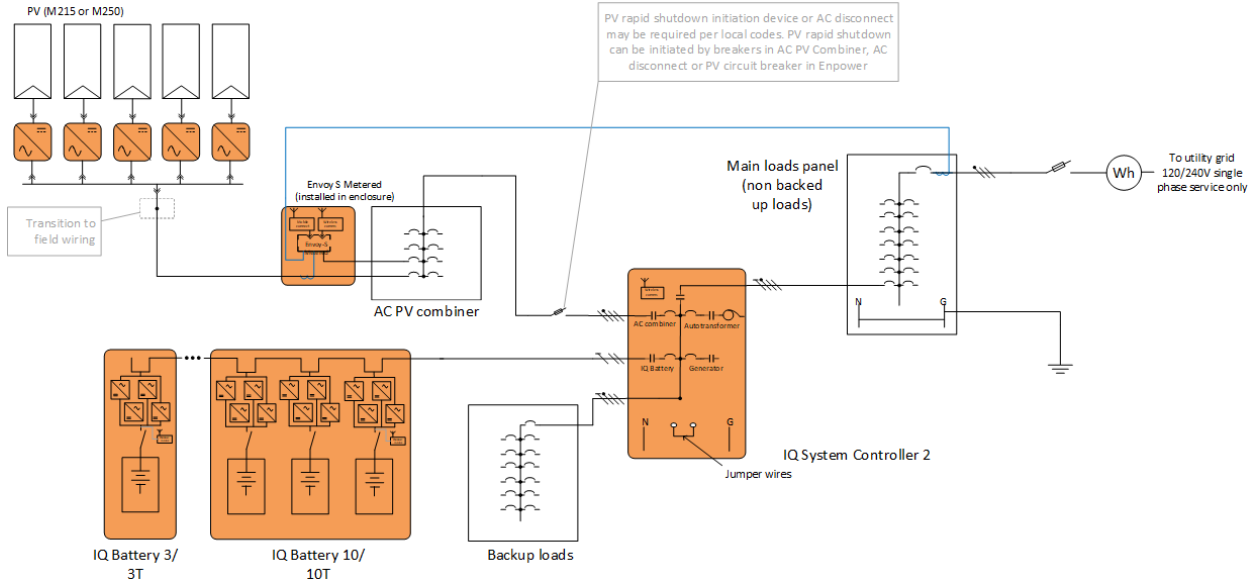


Figure 4: Enphase Energy System in Home Essentials configuration with IQ6/7-Series



NOTE: IQ System Controller can also be used instead of IQ System Controller 2. IQ System Controller does not need jumper wires

Figure 5: Enphase Energy System in Home Essentials configuration with M-Series Microinverters



NOTE: IQ System Controller can also be used instead of IQ System Controller 2. IQ System Controller does not need jumper wires

Full Energy Independence Configuration

M-Series, IQ6, IQ7 and IQ8-Series Microinverters support this configuration. The Enphase Energy System provides backup during day or night. The system must have at least 10 kWh of IQ Batteries installed i.e., at least an IQ Battery 10/10T. Depending on the IQ Battery sizing, the system will be able to sustain off grid operation for extended periods of time. This use case supports whole home backup i.e., backing up all the loads in the home. Note that the batteries must be sized correctly to supply the loads. Up to 2 IQ Load Controllers can be used to enable fine-grained control of backed-up loads.

Figure 6 Enphase Energy System in Full Energy Independence configuration with IQ8 Microinverters

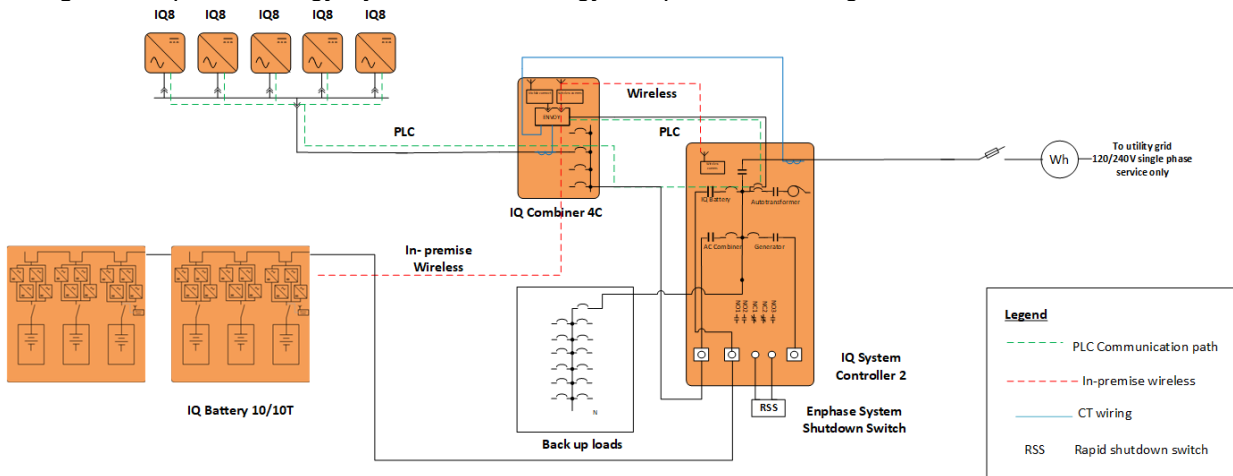
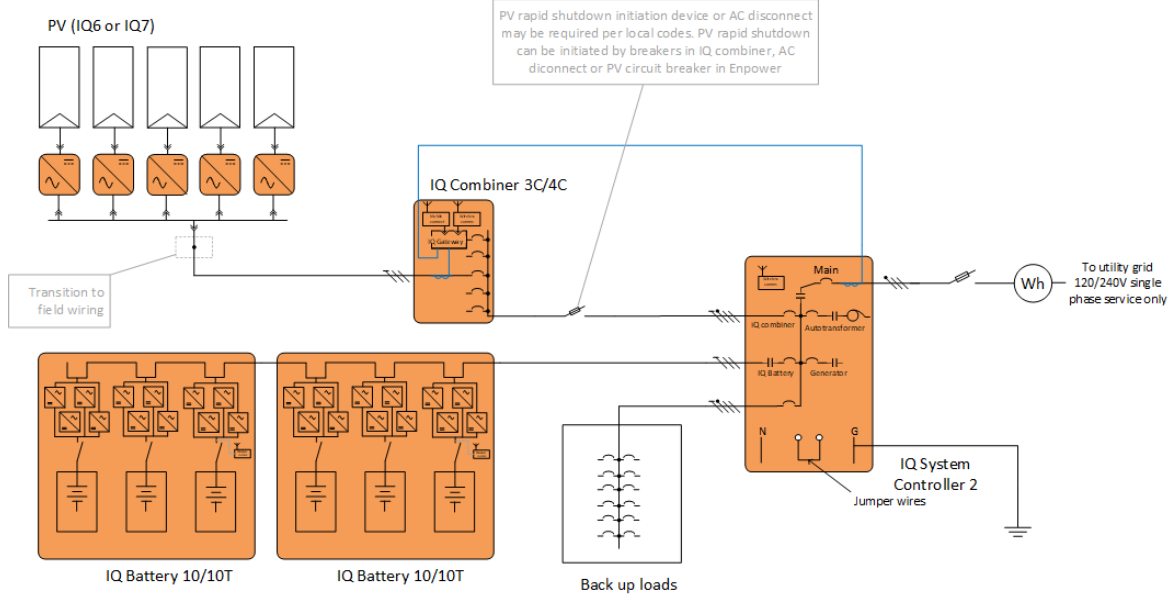
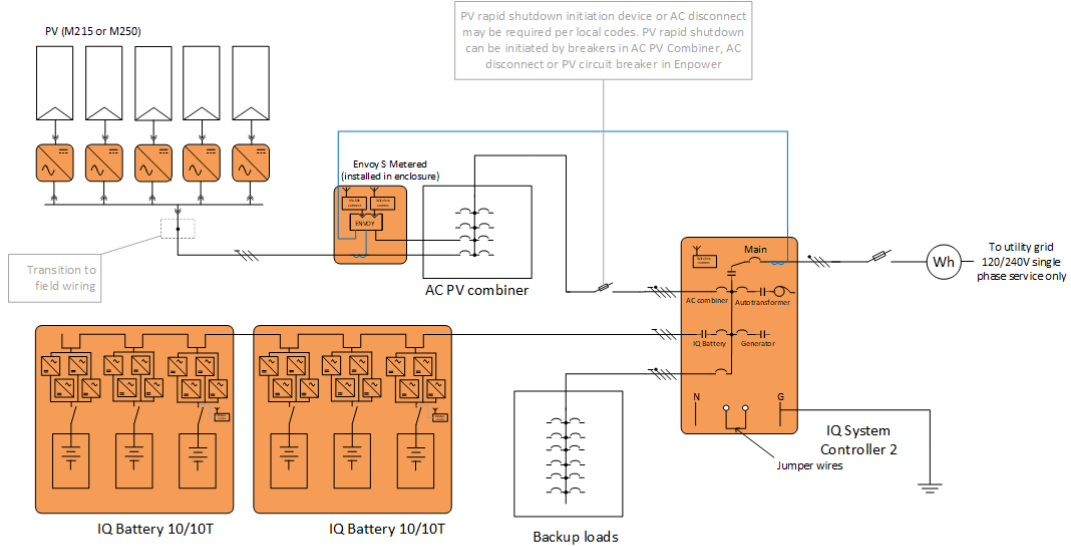


Figure 7 *Enphase Energy System in Full Energy Independence configuration with IQ6 or IQ7 Microinverters*



NOTE: IQ System Controller can also be used instead of IQ System Controller 2. IQ System Controller does not need jumper wires

Figure 8: *Enphase Energy System in Full Energy Independence configuration with M-Series Microinverters*



NOTE: IQ System Controller can also be used instead of IQ System Controller 2. IQ System Controller does not need jumper wires

Component List for IQ6/7 or M-Series backup systems

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

Energy Essentials/Full Energy Independence configuration

Component	Name (Model Number)	New System (Quantity)	Retrofit IQ System (Quantity)	Retrofit M215/M250 System (Quantity)	Retrofit Enphase Non-IQ6/7 and Non-M215/M250 System (Quantity)
Energy Storage System (ESS)	IQ Battery: Encharge-3-1P-NA Encharge-3T-1P-NA Encharge-10-1P-NA Encharge-10T-1P-NA	IQ Battery 3/3T and IQ Battery 10/10T units (See pairing chart for minimums)	IQ Battery 3/3T and IQ Battery 10/10T units (See pairing chart for minimums)	IQ Battery 3/3T and IQ Battery 10/10T units (See pairing chart for minimums)	IQ Battery 3/3T and IQ Battery 10/10T units (See pairing chart for minimums)
Smart switch with Microgrid Interconnection Device (MID)	IQ System Controller 1: EP200G101-M240US00	1	1	1	1
	IQ System Controller 2: EP200G101-M240US01	1	1	1	1
Load control	IQ Load Controller EP-NA-LK02-040	0,1 or 2	0,1 or 2	0,1 or 2	0,1 or 2
IQ System Controller Switch Main Breaker and/or Load Breaker	IQ System Controller Main Breakers: BRK-200A-2P-240V BRK-175A-2P-240V BRK-150A-2P-240V BRK-125A-2P-240V BRK-100A-2P-240V	0, 1 or 2	0, 1 or 2	0, 1 or 2	0, 1 or 2
IQ System Controller Switch Circuit Breakers for PV and IQ Battery Circuits	IQ System Controller Circuit Breakers: BRK-20A-2P-240V-B BRK-30A-2P-240V BRK-40A-2P-240V BRK-50A-2P-240V BRK-60A-2P-240V BRK-80A-2P-240V	2	2	2	2
Enphase Energy System Communications (between ESS, MID and Combiner)	Enphase Communications Kit: COMMS-CELLMODEM-M1 OR COMMS-KIT-01 (if system already has cellular modem or if using an IQ Combiner SKU that already has a cellular modem)	1	1	1	1
IQ Combiner	IQ Combiner: X-IQ-AM1-240-3-ES OR X-IQ-AM1-240-3C-ES	1	0	0	1

Component	Name (Model Number)	New System (Quantity)	Retrofit IQ System (Quantity)	Retrofit M215/M250 System (Quantity)	Retrofit Enphase Non-IQ6/7 and Non-M215/M250 System (Quantity)
Standalone Gateway	IQ Gateway for IQ Series ENV-IQ-AM1-240	1 (If not using IQ Combiner)	0	1 (If not already present on site)	0
	Envoy-S Metered for M-Series ENV-S-AM1-120	0	0	1 (If not already present on site)	0
Consumption CTs	Current Transformers: CT-200-SPLIT	2 (If not using a new IQ Combiner that ships with consumption CTs)	2 (one for each phase) (If system doesn't already have CTs)	2 (one for each phase) (If system doesn't already have CTs)	2 (one for each phase) (If system doesn't already have CTs)
Microinverters	IQ7 Series or IQ6 Series	As needed per system design	None needed unless expanding or replacing existing Microinverters (comply with pairing ratio)	N/A	Upgrade to IQ7 or IQ 6 Series Microinverters needed (comply w/ pairing ratio)
	M215/M250 M-Series RMA SKUs: M215240-IQ7-S22-US M215240-IQ7-S25-US M250240-IQ7-S22-US M250240-IQ7-S25-US	N/A	N/A	None needed unless expanding or replacing existing Microinverters (Comply with pairing ratio)	N/A
PV Modules	Any	As needed per system design	None needed unless expanding	None needed unless expanding	Existing or new panels

Component list for IQ8-Series backup systems

Component Type	Product Name and Model Number	Solar Only	Sunlight Backup	Home Essentials Backup	Full Energy Independence Backup
Microinverters	IQ8 Series IQ8-60-2-US IQ8PLUS-72-2-US IQ8M-72-2-US IQ8A-72-2-US IQ8H-240-72-2-US	As needed per system design	As needed per system design (Up to 64A continuous)	As needed per system design (Up to 64A continuous)	As needed per system design (Up to 64A continuous)
Batteries	IQ Batteries ENCHARGE-3-1P-NA ENCHARGE-10-1P-NA ENCHARGE-3T-1P-NA ENCHARGE-10T-1P-NA	0	0	At least one ENCHARGE-3-1P-NA or ENCHARGE-3T-1P-NA	At least one ENCHARGE-10-1P-NA or ENCHARGE-10T-1P-NA

Component Type	Product Name and Model Number	Solar Only	Sunlight Backup	Home Essentials Backup	Full Energy Independence
	IQ8 Series IQ8H-208 -72-2-US	As needed per system design	Not supported	Not Supported	Not supported
AC Combiner	IQ Combiner 4/4C X-IQ-AM1-240-4 OR X-IQ-AM1-240-4C-ES (Includes IQ Gateway and 2 consumption CTs)	1	1	1	1
Gateway	IQ Gateway for IQ Series ENV-IQ-AM1-240	1 (If not using IQ Combiner)	0	0	0
Smart Switch with Microgrid Interconnection Device (MID)	IQ System Controller 2 EP200G101-M240US01	0	1	1	1
Load Control	IQ Load Controller: EP-NA-LK02-040	0	1 or 2	0, 1 or 2	0, 1 or 2
Enphase System Shutdown switch	For use with IQ System Controller 2 for IQ8 PV rapid shutdown and system shutdown EP200G-NA-02-RSD	0	1	1	1
Enphase Energy System Communications (between IQ Batteries, IQ System Controller 2 and IQ Gateway)	Enphase Communications Kit COMMS-CELLMODEM-M1-06 (COMMS-KIT-01 and CELLMODEM-M1-06-SP-05) OR COMMS-KIT-01 (if system already has cellular modem or if using an IQ Combiner SKU that already has a cellular modem)	0	1	1	1
Mobile Connect	Enphase Mobile Connect CELLMODEM-M1-06-SP-05 (T Mobile/Sprint 5yr data plan) CELLMODEM-M1-06-AT-05 (AT&T 5yr data plan)	0 or 1 (If not using a Combiner with cell modem built-in)	0 (Part of COMMS-CELLMODEM-M1-06)	0 (Part of COMMS-CELLMODEM-M1-06)	0 (Part of COMMS-CELLMODEM-M1-06)
Consumption CTs	Current Transformers CT-200-SPLIT	2 (If not using a new IQ Combiner that ships with consumption CTs)	0	0	0

Component Type	Product Name and Model Number	Solar Only	Sunlight Backup	Home Essentials Backup	Full Energy Independence
Main Breaker and/or Load Breaker for IQ System Controller 2	IQ System Controller Main Breakers BRK-200A-2P-240V (Eaton SKU: CSR2200N) BRK-175A-2P-240V (Eaton SKU: CSR2175N) BRK-150A-2P-240V (Eaton SKU: CSR2150N) BRK-125A-2P-240V (Eaton SKU: CSR2125N) BRK-100A-2P-240V (Eaton SKU: CSR2100)	0	0,1 or 2	0,1 or 2	0,1 or 2
Circuit Breakers for IQ8 PV, IQ Battery, and generator Circuits in IQ System Controller 2	IQ System Controller 2 Circuit Breakers BRK-20A-2P-240V-B (Eaton SKU: BR220B) BRK-30A-2P-240V (Eaton SKU: BR230B) BRK-40A-2P-240V (Eaton SKU: BR240B) BRK-60A-2P-240V (Eaton SKU: BR260) BRK-80A-2P-240V (Eaton SKU: BR280)	0	1 or 2 (For PV and generator)	2 or 3 (For PV, batteries, and generator)	2 or 3 (For PV, batteries, and generator)
Circuit Breakers for PV in IQ Combiner 4/4C	IQ Combiner 4/4C Circuit Breakers¹ BRK-20A-2P-240V-B (Eaton SKU: BR220B) BRK-15A-2P-240V-B (Eaton SKU: BR215B)	1, 2, 3 or 4	1, 2, 3 or 4	1, 2, 3 or 4	1, 2, 3 or 4
Hold down kits	For IQ Combiner 4/4C X-IQ-NA-HD-125A	0	1 or 2	1 or 2	1 or 2
	For IQ System Controller 2 EP200G-NA-HD-200A	0	1	2	2
Off-the shelf panel	For essential loads backup	No	Yes (Up to 4 essential loads)	Yes	No
PV Modules	Any	As needed per system design	As needed per system design	As needed per system design	As needed per system design

Split Enphase Systems on a Single Site with IQ6/7/8 or M-series microinverters

It is necessary to “split” the PV systems into a microgrid, and a non-microgrid PV system, each with their own IQ Gateway in the following scenarios:

- Prevent mixing of multiple microinverter Series** – Due to technical limitations, M-Series Microinverters cannot be installed in the same system as IQ6/IQ7 Series Microinverters. Similarly, IQ6/IQ7 Series Microinverters cannot be installed with IQ8 Series Microinverters.
- IQ8 Series microinverter output exceeding 64A continuous at site** – IQ System Controller 2 supports only 64A continuous PV at the AC combiner port. If the PV array exceeds 64A continuous

¹ Enphase recommends using breakers compatible with hold down kits in IQ Combiner 4/4C for IQ8 solar only use case to enable an easy upgrade to a backup use case when the homeowner decides to add backup.

output, the installer can configure an additional grid tied system with an IQ Gateway/IQ Combiner 3/3C/4/4C.



WARNING: Each system's communication must be isolated from the other systems. The isolation involves the guidelines described below and illustrated in subsequent diagrams

- PLC communication occurs in AC cables at very high frequencies, over 100KHz and can inductively couple to any adjacent cable running in the same conduit or duct. Such coupling is avoided by physically separating cables from different domains or running them in separate grounded conduits. Where grounded conduits cannot be installed, these cables need to be physically separated by at least 1 meter.
- A PLC line filter needs to be installed to prevent coupling over the common AC line (Grid). A suitable filter SKU with 64A ampacity is Q-LCF-064-1P. Enphase is developing a 200A line filter which, when available, can be used in the IQ8 system.
- Never install a PLC line filter between an IQ Gateway and the micro inverters. It will severely impair communication inside a system.



NOTE: We no longer recommend splitting the system if the total PV system size exceeds what can be supported by the total IQ Battery system size. PV shedding shall be used to address this scenario. For guidance PV system size pairing with an IQ Battery, see the sections: *Sizing an IQ6, IQ7 or M-series backup system, Sizing of backup systems with IQ8-Series Microinverters, IQ8 Microinverter PV System to IQ Battery Pairing.*

NOTE: This configuration does not support power export limiting.

The following items are needed to create a split system.

1. Two Gateways:
 - Multiple IQ-Gateways (or Envoy-S Metered for M-series microinverters) are required for split systems, because the microgrid and non-microgrid PV Microinverters operate with different grid profiles and parameters.
2. Installation of a power line filter:
 - When multiple IQ Gateways exist on site, a power line filter must be installed to prevent cross domain communication.
 - The [Q-LCF-064-1P](#) is a tested solution that is compatible with Enphase IQ6/7/8 series microinverters and IQ Gateway for up to 64A of continuous current.
 - Similarly, the [RP220](#), [RP225](#), [RP230](#), or [RP240](#) Series from Radius Power can be used with M215/M250 Microinverters and the Envoy-S Metered.
 - For systems with IQ6, IQ7 and M-Series microinverters, Enphase recommends installing the power line filter with the microgrid IQ Gateway and all microgrid PV Microinverters on the "Load" input of the filter and the IQ System Controller 1 or IQ System Controller 2 source on the "Line" input of the filter.
 - For systems with IQ8 series microinverters, always install the power line filter with the non-microgrid IQ Gateway and all the non-microgrid microinverters on the "Load" input of the filter and the main load panel on the "Line" input of the filter. This must be done irrespective of whether the non-microgrid microinverters are IQ6, IQ7 and M-Series microinverters. Do not install the power line filter in the microgrid with IQ8 series microinverters as it will disrupt the PLC path between the microgrid IQ Gateway and grid forming IQ8 series microinverters.
3. Installation of additional Consumption CTs:

- Depending on the configuration of the split system, an additional pair of Consumption CTs may need to be added. See the following for details.

The consumption CTs in split systems can be installed in the following configurations. The system behavior in these configurations will be different:

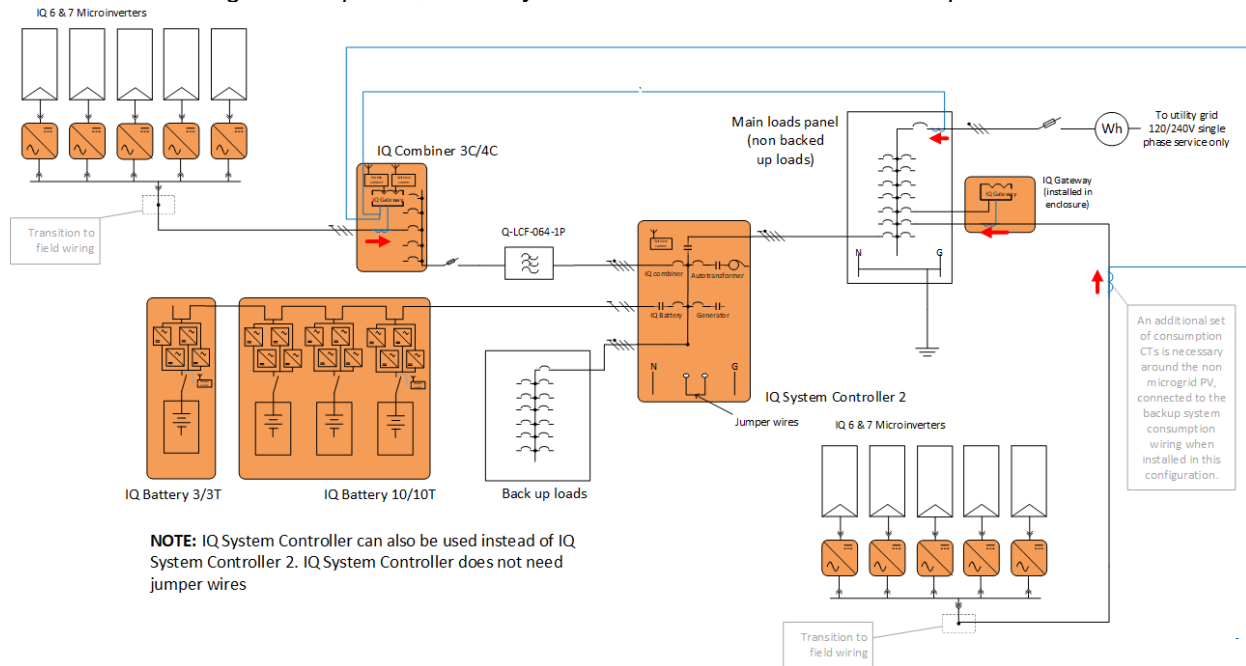
Table 1 CT placement and behavior of “split” system configurations

Location of microgrid consumption CTs	Location where non microgrid PV interconnects	Additional consumption CTs	System Behavior	Reference Line Diagram
Between main panel and energy meter	Load side of microgrid consumption CT or in the main panel	Yes	If using Self-Consumption or Savings battery profiles in the scenario illustrated above the battery is prioritized to discharge to serve loads on the main panel and the grid tied PV is dispositioned to export to grid.	Figure 9, Figure 10, Figure 11
Between main panel and energy meter	Line side of microgrid consumption CT	No		Figure 12, Figure 13, Figure 14
Between IQ System Controller and main panel	In the main panel	No	Battery is prioritized to discharge only to serve loads on the backup panel the grid tied PV is dispositioned to serve loads on the main panel or to export to grid.	Figure 15, Figure 16, Figure 17

Split systems with additional Consumption CTs

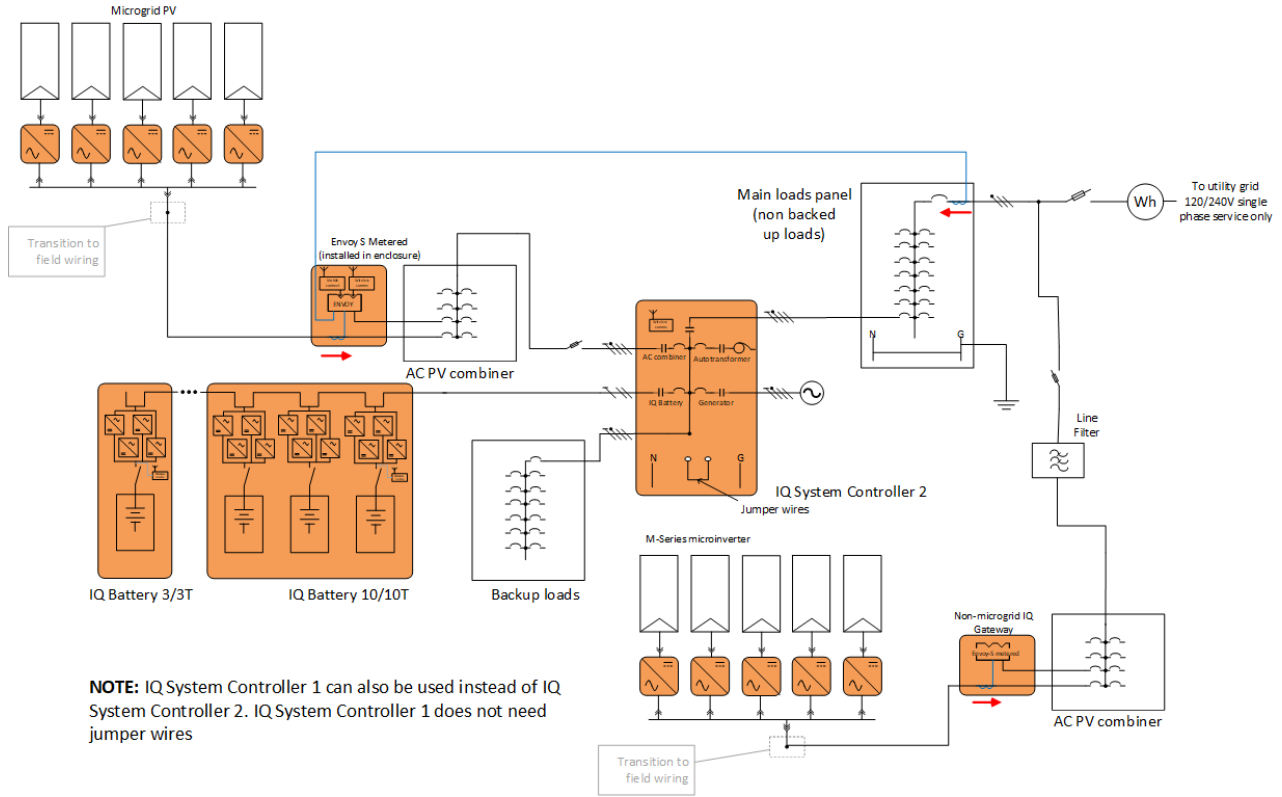
If the non-microgrid PV system is interconnected on the load side of the primary microgrid IQ Gateway’s Consumption CT, a second set of Consumption CTs must be added around the non-microgrid PV conductors and connected in parallel with the primary microgrid Consumption CT wiring to the microgrid IQ Gateway. Please refer to Figure 9 for more details and the orientation of the CTs.

Figure 9: “Split” IQ6/7 PV system with additional set of Consumption CTs



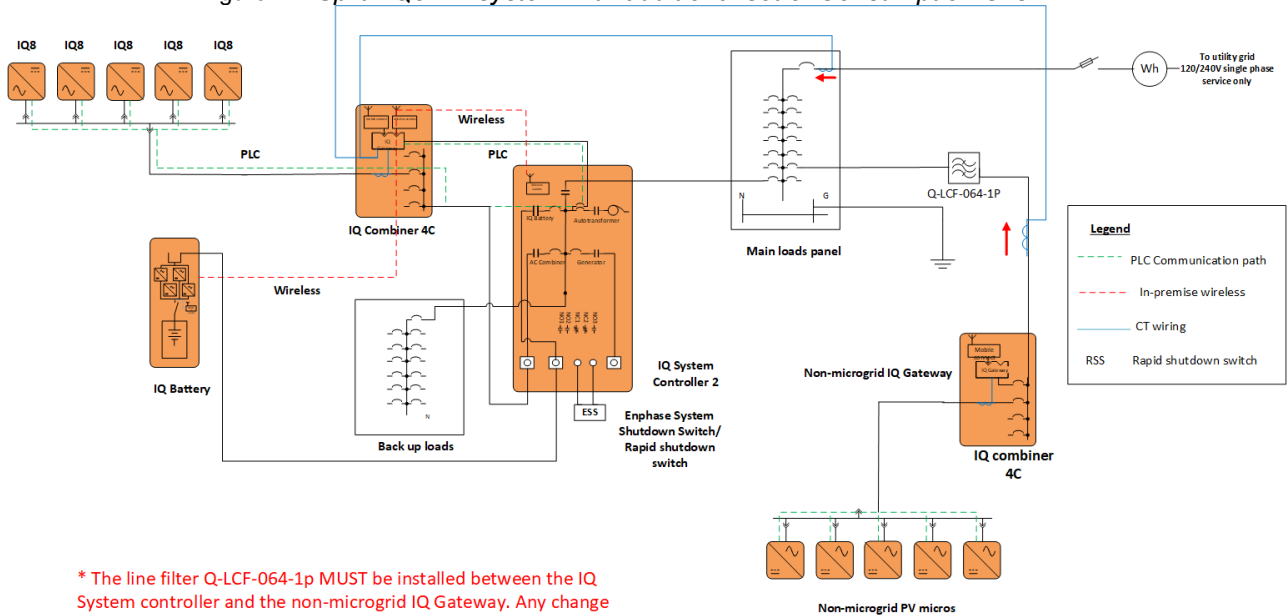
NOTE: If using Self-Consumption or Savings battery profiles in the scenario illustrated above the battery is prioritized to discharge to serve loads on the main panel and the grid tied PV is dispositioned to export to grid. To avoid this behavior, look at the alternate system configurations provided in Figure 15 “Split” PV system without additional set of Consumption CTs – Configuration to prevent battery from discharging to serve loads on main panel.

Figure 10 “Split” M-series PV system with additional set of Consumption CTs



NOTE: If using Self-Consumption or Savings battery profiles in the scenario illustrated above the battery is prioritized to discharge to serve loads on the main panel and the grid tied PV is dispositioned to export to grid. To avoid this behavior, look at the alternate system configurations provided in Figure 15 “Split” PV system without additional set of Consumption CTs – Configuration to prevent battery from discharging to serve loads on main panel.

Figure 11 “Split” IQ8 PV system with additional set of Consumption CTs



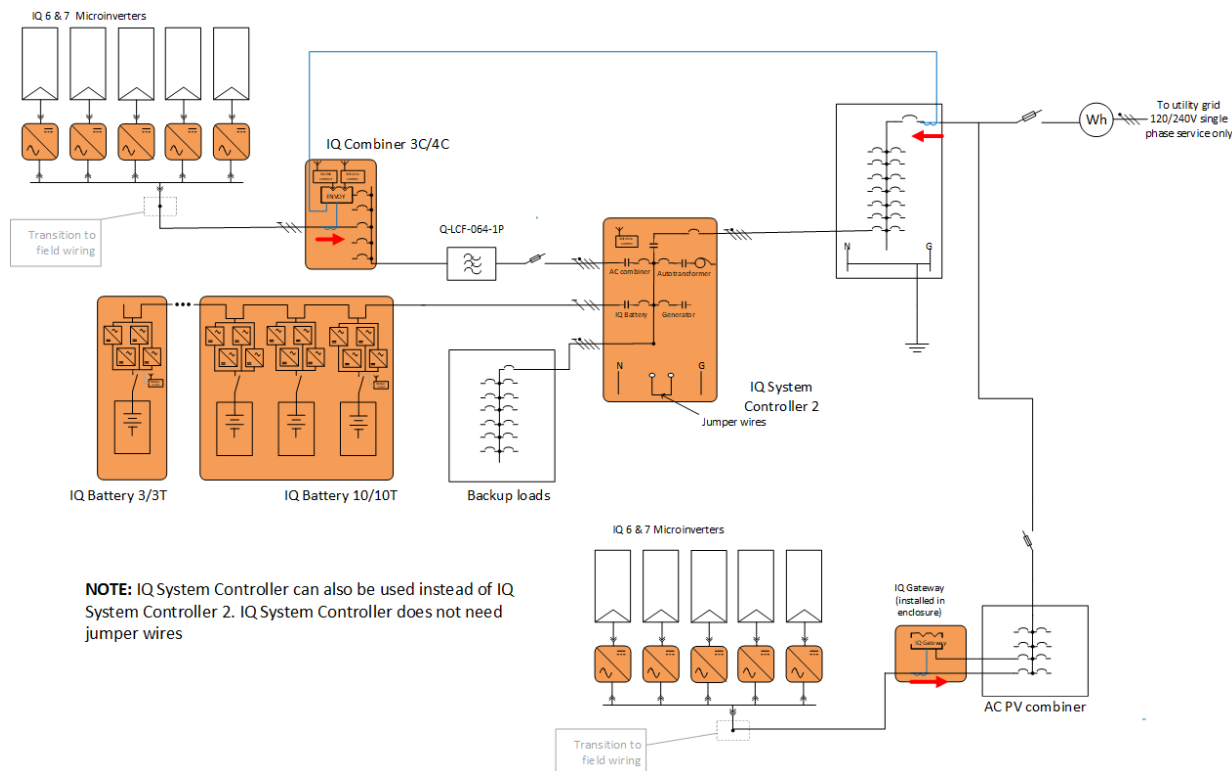


NOTE: If using Self-Consumption or Savings battery profiles in the scenario illustrated above the battery is prioritized to discharge to serve loads on the main panel and the grid tied PV is dispositioned to export to grid. To avoid this behavior, look at the alternate system configurations provided in Figure 15 “Split” PV system without additional set of Consumption CTs – Configuration to prevent battery from discharging to serve loads on main panel.

Split systems without additional Consumption CTs

For Enphase Energy systems where the non-microgrid PV system is interconnected on the utility side of the primary microgrid Gateway’s Consumption CTs, NO additional Consumption CTs are needed. See Figure 12 for this configuration.

Figure 12: “Split” IQ6/7 series PV system without additional set of Consumption CTs



NOTE: IQ System Controller can also be used instead of IQ System Controller 2. IQ System Controller does not need jumper wires



NOTE: If using Self-Consumption or Savings battery profiles in the scenario illustrated above the battery is prioritized to discharge to serve loads on the main panel and the grid tied PV is dispositioned to export to grid. To avoid this behavior, look at the alternate system configurations provided below.

Figure 13: “Split” M-series PV system without additional set of Consumption CTs

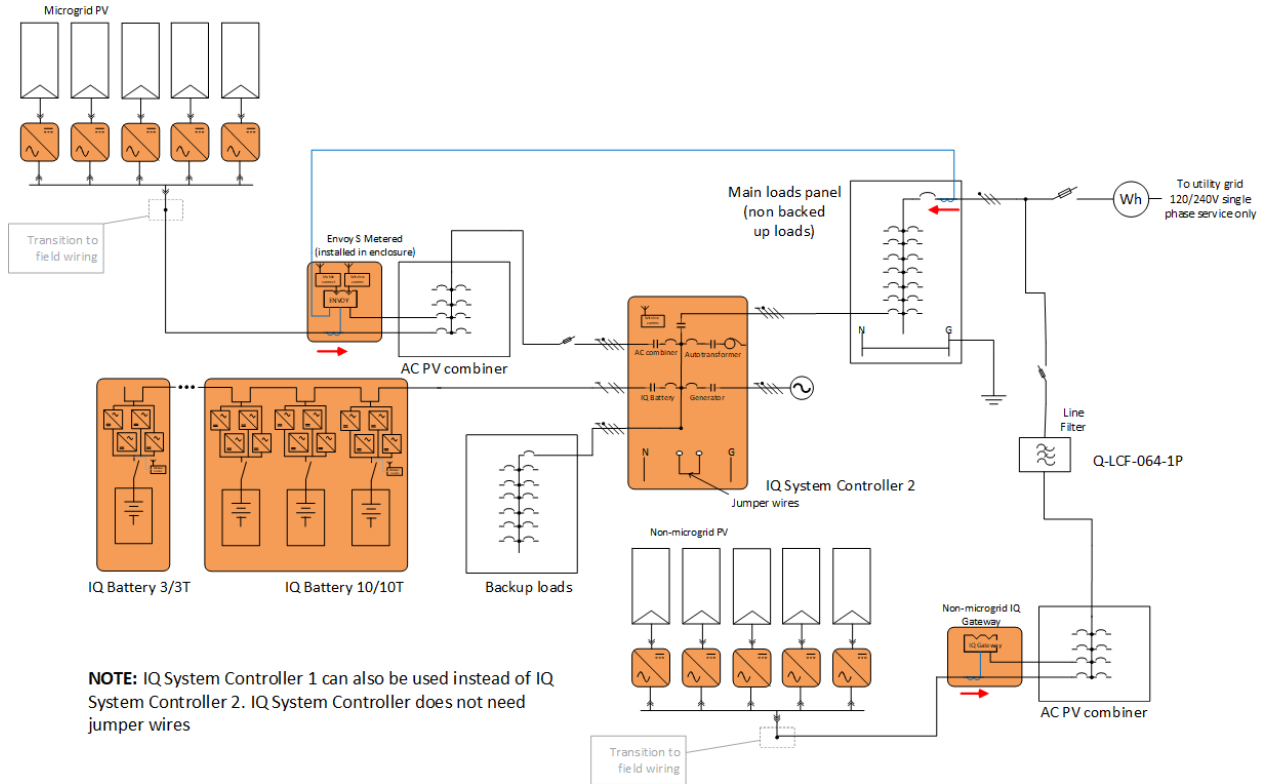
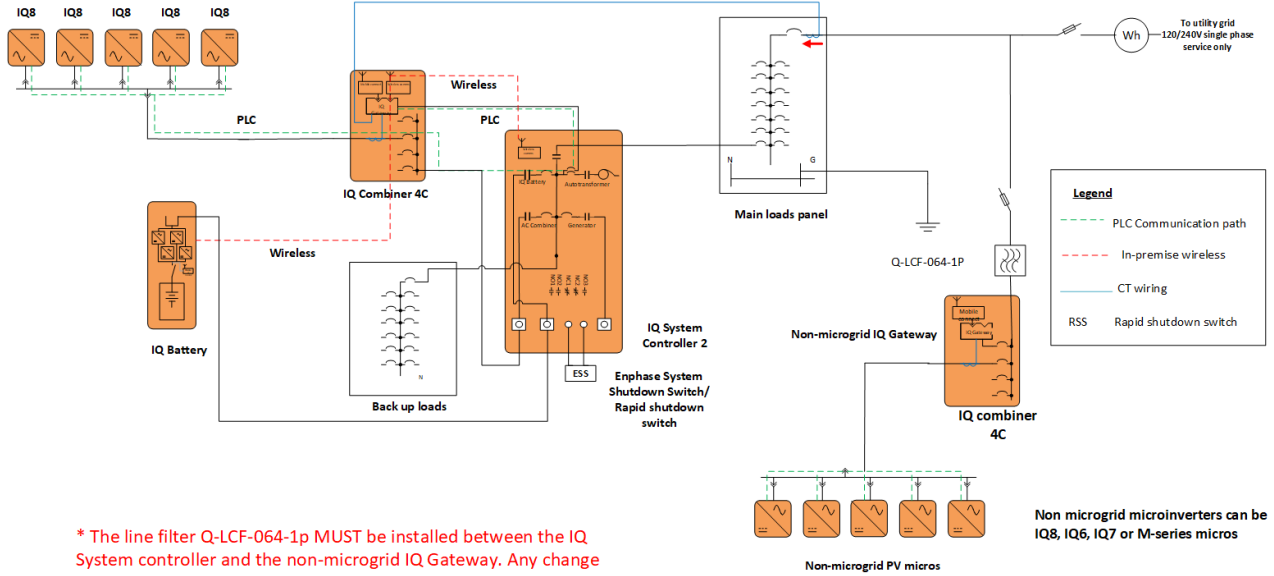


Figure 14 “Split” IQ8 series PV system without additional set of Consumption CTs



Split system without additional consumption CTs where batteries prioritize backup loads only

Figure 15 “Split” PV system without additional set of Consumption CTs – Configuration to prevent battery from discharging to serve loads on main panel

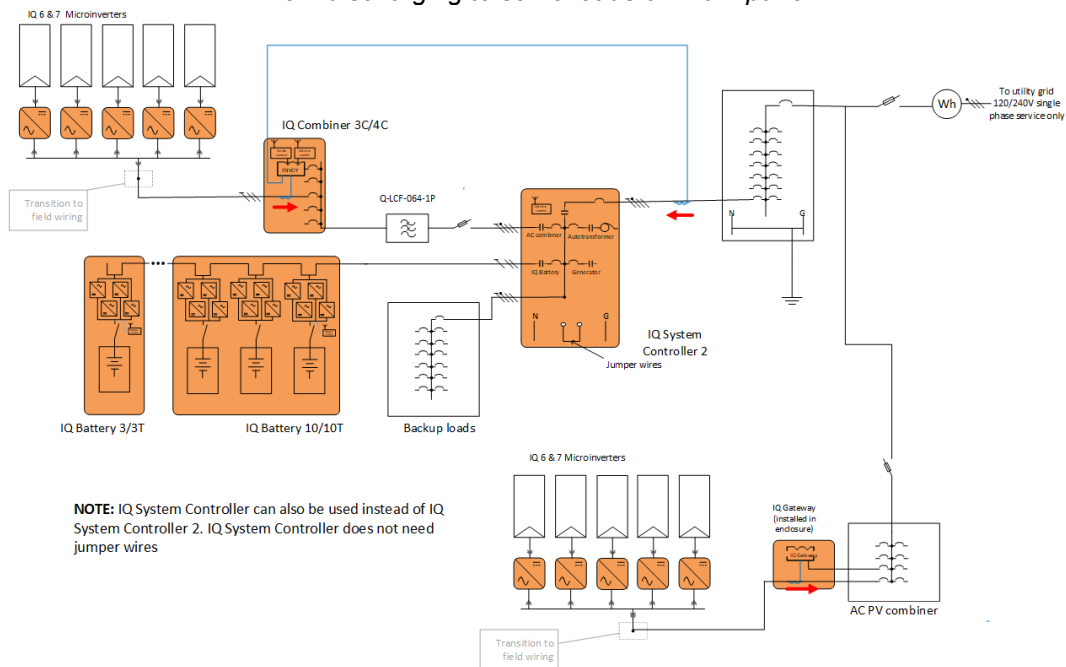


Figure 16 M-Series “split” PV system without additional set of Consumption CTs - Configuration to prevent battery from discharging to serve loads on main panel

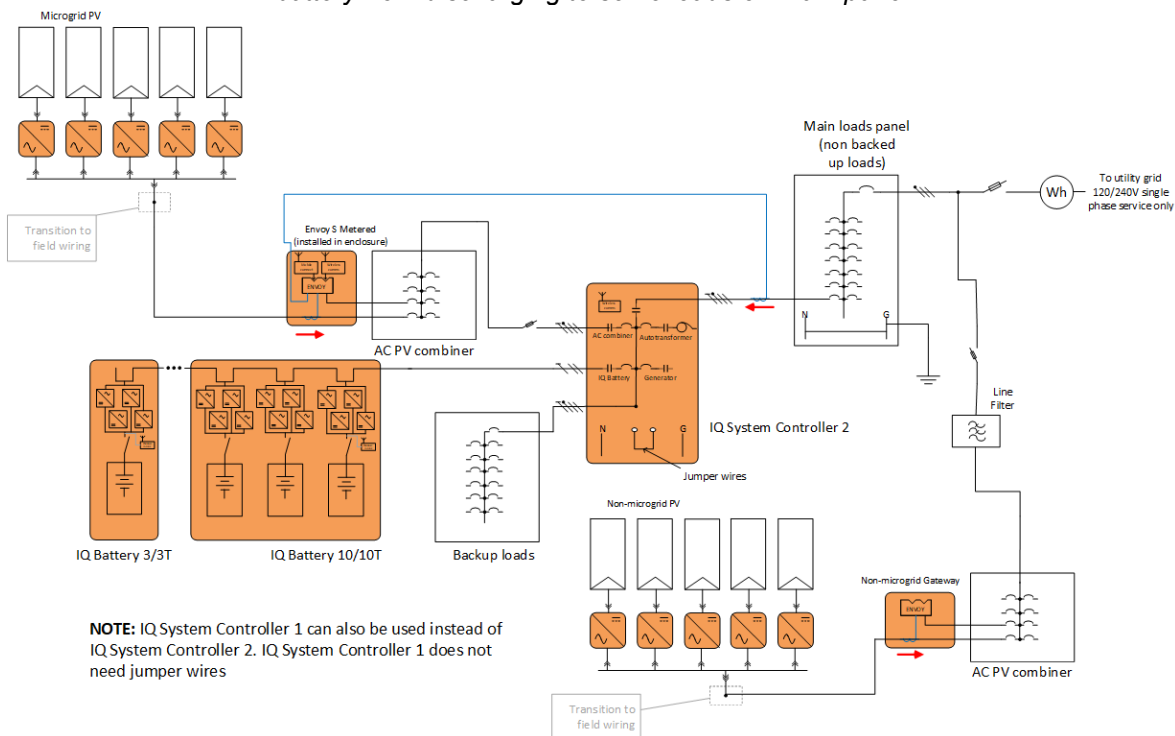
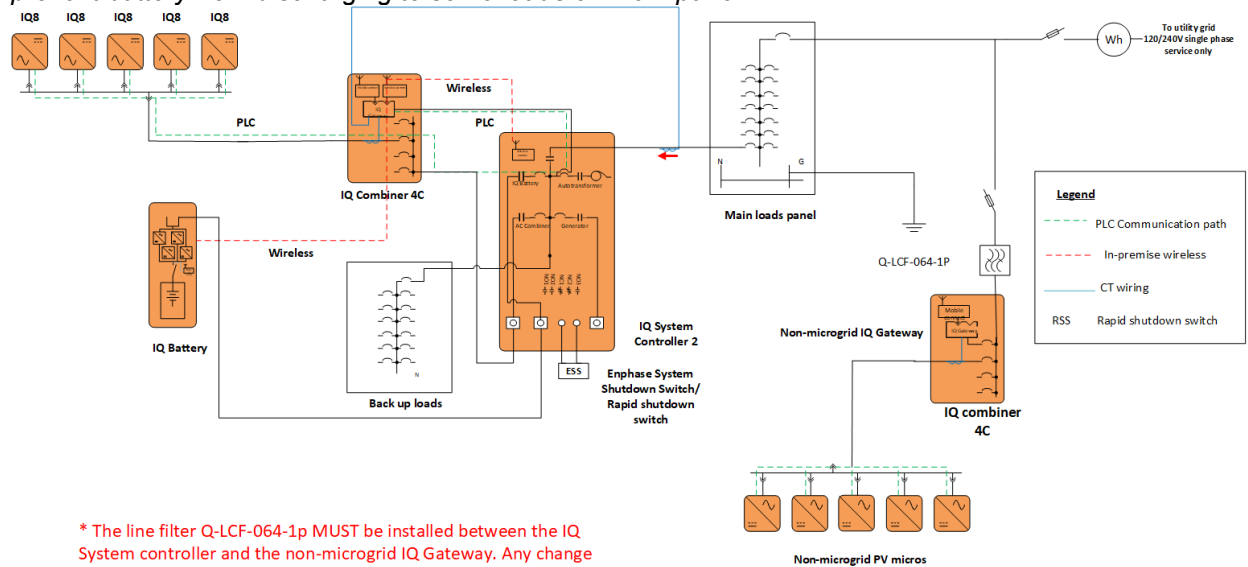


Figure 17 IQ8-Series “split” PV system without additional set of Consumption CTs - Configuration to prevent battery from discharging to serve loads on main panel



Non-backup Configuration - Installing Enphase Energy System without IQ System Controller

The IQ Battery can be added to an existing system without using an IQ System Controller, however, it will not provide backup power. When installed in this configuration, the IQ Battery is treated as a distributed energy resource (DER), equivalent to a PV system, and cannot form an intentional island. It may be connected in the IQ Combiner or on a user-provided distribution point in compliance with the NEC. Ensure that the consumption CTs are installed on the line-side of IQ Battery interconnection point and that IQ Battery circuits are not included in the production CT. Figure 18 and

Figure 19 show this configuration for IQ6/7/8 and M215/250 Microinverters, respectively.

Figure 18: Grid interactive IQ Battery installation with no backup on IQ6/7/8 Microinverter sites

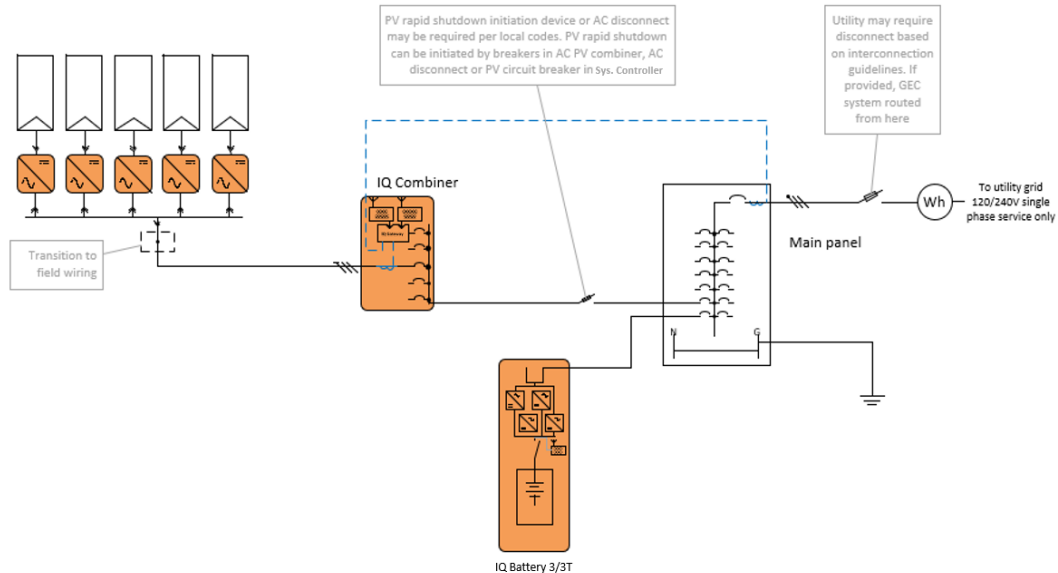
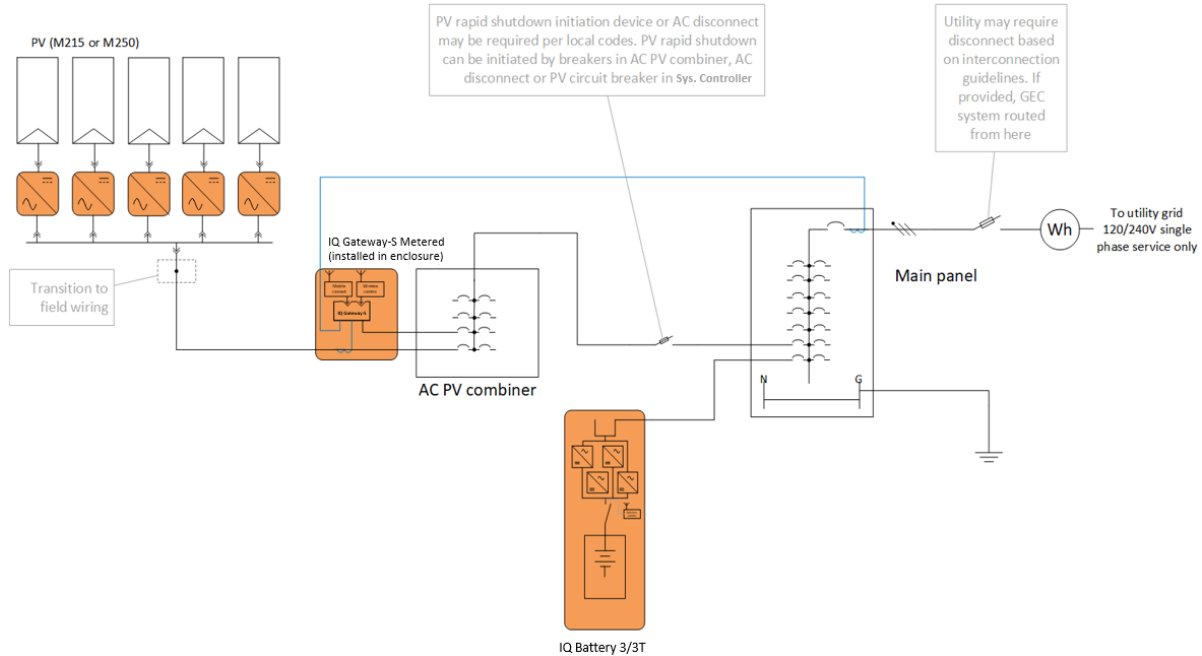


Figure 19: Grid interactive IQ Battery installation with no backup on M-Series Microinverter sites



System Sizing for different configurations

Load Analysis

The first step in correctly sizing a system is a proper load analysis. If an IQ Gateway with correctly configured consumption CTs is already installed at a site, you can use data from Enphase Cloud to properly size the system. A site survey, electric bills, and third-party consumption meters can also provide useful load data for system sizing. Also, review the *Enphase Energy System Project Survey* document and System Planner at estimator.enphaseenergy.com.

IQ Battery and PV System Sizing

A backup system provides power to loads when the grid is down.

It is important 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 capacity shortages or energy capacity shortages will result in a loss of power to loads and should be avoided. Therefore, it is important to properly size the system for both power and energy capacities in each installation.

Sufficiently size the total IQ Battery **power** rating to **power** loads and charge from PV power generation. You can increase the power rating by adding additional IQ Battery units, which also provide additional energy, improving the customer user experience.

The standalone or micro-grid power sources must be sufficient to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements.

- **2017 NEC 690.10 -> 710.15 (A) Supply Output.** Power supply to premises wiring systems shall be permitted to have less capacity than the calculated load. The capacity of the stand-

alone supply shall be equal to or greater than the load posed by the largest single utilization equipment connected to the system. Calculated general lighting loads shall not be considered as a single load.

- **Power** (kW) capacity from IQ Battery system *must* exceed the largest single load.
- **Energy** storage (kWh) capacity should be sized to supply to the estimated backup loads for a user-defined period.

Sizing an IQ6, IQ7 or M-series backup system

1. Identify the largest single load power rating (kW) that you want to backup and select the absolute minimum number of IQ Battery units required to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements.
2. Select the minimum number of IQ Battery storage units required so that the total PV system AC power output is not greater than 150% of the total IQ Battery storage system power capacity. Refer to Table 1 and 2 on the maximum number of microinverters that can be installed for a battery array size.
3. If the system’s PV System output pushes the ratio above 150%, use auxiliary contact in IQ System Controller to shed certain PV circuits to maintain the ratio to below 150% when the system transitions to off-grid. Refer [Load and Solar Circuit Control using IQ System Controller Auxiliary Contacts](#) for more details.
4. IQ Load Controller is recommended for all backup load circuits that exceed the storage capacity.

Table 2: Maximum number of IQ Microinverters for IQ Battery for backup operation

IQ Battery 3/3T units	Equivalent IQ Battery 10/10T units	IQ Battery energy capacity (kWh)	IQ Battery power capacity (kWAC)	Max PV system power (kWAC)	Maximum number of Microinverters					
					IQ6	IQ6+	IQ7	IQ7+	IQ7X	IQ7A
1		3.36	1.28	1.92	8	6	8	6	6	5
2		6.72	2.56	3.84	16	13	16	13	12	11
3	(1x IQ Battery 10/10T)	10.08	3.84	5.76	25	20	24	19	18	16
4		13.44	5.12	7.68	33	27	32	26	24	22
5		16.8	6.4	9.6	41	34	40	33	30	27
6	(2 x IQ Battery 10/10T)	20.16	7.68	11.52	50	41	48	39	36	33
7		23.52	8.96	13.44	58	48	56	46	42	38
8		26.88	10.24	15.36	66	54	64	52	48	44
9	(3 x IQ Battery 10/10T)	30.24	11.52	17.28	75	61	72	59	54	49
10		33.6	12.8	19.2	83	68	80	66	60	54
11		36.96	14.08	21.12	91	75	88	72	67	60
12	(4 x IQ Battery 10/10T)	40.32	15.36	23.04	100	82	96	79	73	66



WARNING: Under sizing power and energy capacity of the storage system may lead to a poor user experience. User education and setting reasonable expectations of system performance is essential with systems involving backup storage.

Table 3: Maximum number of M-Series Microinverters for IQ battery for backup operation

IQ Battery 3/3T units	Equivalent IQ Battery 10/10T units	IQ Battery energy capacity (kWh)	IQ Battery continuous power (kWAC)	Max PV system power (kWAC)	# of Microinverters	
					M215	M250
1		3.26	1.28	1.92	8	8
2		6.52	2.56	3.84	17	16
3	(1x IQ Battery 10/10T)	9.78	3.84	5.76	26	24
4		13.04	5.12	7.68	35	32
5		16.30	6.40	9.6	44	40
6	(2 x IQ Battery 10/10T)	19.56	7.68	11.52	53	48
7		22.81	8.96	13.44	62	56
8		26.07	10.24	15.36	71	64
9	(3 x IQ Battery 10/10T)	29.33	11.52	17.28	80	72
10		32.59	12.80	19.2	89	80
11		35.85	14.08	21.12	98	88
12	(4 x IQ Battery 10/10T)	39.11	15.36	23.04	107	96



WARNING: Under sizing power and energy capacity of the storage system may lead to a poor user experience. User education and setting reasonable expectations of system performance are essential with systems involving backup storage.

Sizing of backup systems with IQ8-Series Microinverters

IQ8 Microinverter PV System to IQ Battery Pairing

IQ8 Series microinverter systems don't have any PV output to IQ Battery power capacity ratio limitation. If you are using only one IQ Battery 3/3T, then the number of IQ8 Series Microinverters permitted in the PV array should be 48, irrespective of the microinverter type.

The table below lists the maximum number of microinverters that can be installed on a system with only one IQ battery 3/3T. The limit is the lesser of 48 microinverters or the number of microinverters needed to achieve a nameplate rating of 64A continuous for the PV array.

Figure 20 Maximum number of microinverters installed in a system with one IQ Battery 3/3T

Microinverter model	Current per micro (A)	Max Number of micros	PV system size	
			A	kW
IQ8-60-2-US	1	48	48	11.5
IQ8PLUS-72-2-US	1.21	48	58	13.9
IQ8M-72-2-US	1.35	47	63	15.2
IQ8A-72-2-US	1.45	44	64	15.31
IQ8H-240-72-2-US	1.58	40	63	15.2

If an IQ Combiner 4/4C is used in the system, the maximum number of microinverters is limited by the rating of a circuit breaker string, 20A.

Figure 21 Maximum number of microinverters installed in a system with one IQ Battery 3/3T and with IQ Combiner 4/4C

Microinverter model	Max micros per 20A breaker string	Max Number of micros	PV system size	
			A	kW
IQ8-60-2-US	16	48	48	11.5
IQ8PLUS-72-2-US	13	48	58	13.9
IQ8M-72-2-US	11	44	59	14.3
IQ8A-72-2-US	11	44	64	15.3
IQ8H-240-72-2-US	10	40	63	15.2

Sunlight Backup

1. Identify the largest maximum single load power rating (kW) that you want to backup and select the absolute minimum number of IQ Battery units required to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements, after factoring in 30% of the PV AC apparent power as standalone supply. In an IQ8 PV system, the IQ8 PV capacity can be added to the stand-alone supply of the system to meet **2017 NEC 690.10 / 2020 NEC 710.15(A)**. However, since the solar resource is highly variable, Enphase recommends a safety margin to improve customer experience. 30% of the PV AC apparent power is suggested as a starting point for design. For example, with a 6 kVA AC PV system, Enphase suggests that the largest single load not exceed 2 kVA.
2. Only 4 essential loads can be backed up in this configuration. **All these loads must be controlled using IQ Load controller.** Refer [Load and Solar Circuit Control using IQ System Controller Auxiliary Contacts](#) for more details.

Energy Essentials configuration

1. Identify the largest single load power rating (kW) that you want to backup and select the absolute minimum number of IQ Battery units required to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements.
2. IQ8 Series microinverter systems don't have any PV output to IQ Battery power capacity ratio limitation. If you are using only one IQ Battery 3/3T, then the number of IQ8 Series Microinverters permitted in the PV array is limited to 48, irrespective of the microinverter type. Use a higher rated panel and microinverter in case 48 Microinverters do not maximize the PV array size. For example, a PV array with 48 IQ8 Microinverters has a maximum continuous current rating of 48 A. Since the AC Combiner port in IQ System Controller 2 is rate for 64 A continuous current input, use 40 IQ8H instead.
3. Based on the estimated backup loads for the user-defined period, calculate the required energy storage (kWh) capacity and the minimum number of IQ Battery required.
4. Based on a site's load analysis of both power (kW) and energy capacity (kWh) needed, determine the total number of IQ Battery units required for the storage system.
 - a. The minimum number of IQ Battery units required is the largest of the calculated values in steps 1,2 and 3.
 - b. The desired number of IQ Battery units is the value calculated in step 4.
5. The maximum allowed number of IQ Battery 3/3T units that can be connected to a single IQ System Controller is 12 (four IQ Battery 10/10T).
6. IQ Load Controller is recommended for all backup load circuits that exceed the storage capacity. Refer [Load and Solar Circuit Control using IQ System Controller Auxiliary Contacts](#) for more details.

Full Energy Independence configuration

Identify the largest maximum single load power rating (kW) that you want to backup and select the absolute minimum number of IQ Battery units required to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements.

1. Identify the largest single load power rating (kW) that you want to backup and select the absolute minimum number of IQ Battery units required to meet the **2017 NEC 690.10 / 2020 NEC 710.15(A)** requirements.
2. IQ8 Series microinverter systems don't have any PV output to IQ Battery power capacity ratio limitation. If you are using only one IQ Battery 3/3T, then the number of IQ8 Series Microinverters permitted in the PV array is limited to 48, irrespective of the microinverter type. Use a higher rated panel and microinverter in case 48 Microinverters do not maximize the PV array size. For example, a PV array with 48 IQ8 Microinverters has a maximum continuous current rating of 48 A. Since the AC Combiner port in IQ System Controller 2 is rated for 64 A continuous current input, use 40 IQ8H instead.
3. For Full Energy Independence configuration, a minimum of two IQ battery 10/10T units is recommended.
4. Based on the estimated backup loads for the user-defined period, calculate the required energy storage (kWh) capacity and the minimum number of IQ Battery required.
5. Based on a site's load analysis of both power (kW) and energy capacity (kWh) needed, determine the total number of IQ Battery units required for the storage system.
 - a. The minimum number of IQ Battery units required is the largest of the calculated values in steps 1,2,3 and 4.
 - b. The desired number of IQ Battery units is the value calculated in step 5.
- The maximum allowed number of IQ Battery 3/3T units that can be connected to a single IQ System Controller is 12 (four IQ Battery 10/10T)

Battery Storage Modes

1. **Battery storage mode is “Self-Consumption”** with a reserve State of Charge (SoC) limit for backup (set by customer or 0 if not set). When system is connected to the utility grid:
 - A. During the day:
 - i. When the battery SoC is greater than the reserve SoC limit -
 - a) If house loads exceed photovoltaic power, batteries discharge to service loads, based on the location of the consumption CTs, until SoC reaches the reserve SoC limit. Battery power is not exported to the grid.
 - b) If house loads exceed photovoltaic and battery discharge power, utility power is imported to service excess loads.
 - c) If photovoltaic power exceeds house loads, photovoltaic power may be export to grid depending on the interconnection agreement.
 - ii. When the battery SoC is less than or equal to the reserve SoC limit -
 - a) Batteries do not discharge to serve house loads. Photovoltaic power is used to charge batteries at the maximum rate supported by the batteries till the batteries reach reserve SoC limit.
 - b) Any photovoltaic power not consumed by the batteries is used to service loads. If photovoltaic power exceeds the loads, then the excess photovoltaic power may be exported to grid depending on the interconnection agreement.
 - c) If house loads exceed the photovoltaic power, utility power is imported to service excess loads.
 - B. At night:
 - i. When the battery SoC is greater than the reserve SoC limit -
 - a) Photovoltaic power is not available, and batteries discharge to service loads, based on the location of the consumption CTs, until SoC reaches the reserve SoC limit. Battery power is not exported to the grid.
 - b) If house loads exceed the battery discharge power, utility power is imported to service excess loads.

- ii. When the battery SoC is less than or equal to the reserve SoC limit -
 - a) Batteries do not discharge, and utility power is imported to service all loads.
- 2. **Battery storage mode is “Savings”** with a Time of Use tariff and reserve State of Charge (SoC) limit for backup (set by customer or 0 if not set). When the system is connected to the utility grid:
 - A. During peak rates:
 - i. When the battery SoC is greater than the reserve SoC limit -
 - a) If house loads are less than battery discharge power, batteries discharge to service loads until SoC reaches the reserve SoC limit and photovoltaic power is exported to the grid to maximize economic benefit. Battery power is not exported to the grid.
 - b) If house loads exceed battery discharge power, battery discharge power and photovoltaic power is used to service loads, until SoC reaches the reserve SoC limit. Battery power is not exported to the grid. Any excess photovoltaic power is exported to the grid to maximize economic benefit.
 - c) If house loads exceed photovoltaic and battery discharge power, utility power is imported to service excess loads.
 - ii. When the battery SoC is less than or equal to the reserve SoC limit -
 - a) Batteries do not discharge to serve house loads. Photovoltaic power is used to charge batteries at the maximum rate supported by the batteries till the batteries reach reserve SoC limit.
 - b) Any photovoltaic power not consumed by the batteries is used to service loads. If photovoltaic power exceeds the loads, then the excess photovoltaic power may be exported to grid depending on the interconnection agreement.
 - c) If house loads exceed the photovoltaic power, utility power is imported to service excess loads.
 - B. During off-peak rates:
 - i. Batteries will remain idle if at maximum i.e. 100% SoC. If battery SoC is less than 100%, photovoltaic power is used to charge batteries.
 - ii. Excess photovoltaic power is used to service house loads.
 - iii. Any surplus photovoltaic power is exported to grid depending on the interconnection agreement.
 - iv. If house loads exceed photovoltaic power, utility power is imported to service all loads.
 - C. During off-peak rates with “Energy Independence after peak hours” enabled:
 - i. Between 7am and 7pm:
 - a) Batteries will remain idle if at maximum i.e., 100% SoC. If battery SoC is less than 100%, photovoltaic power is used to charge batteries.
 - b) Excess photovoltaic power is used to service house loads.
 - c) Any surplus photovoltaic power is exported to grid depending on the interconnection agreement.
 - d) If house loads exceed photovoltaic power, utility power is imported to service all loads.
 - i. At night:
 - a) If battery SoC is above reserve limit battery discharges till it reaches the reserve limit to serve loads.
- 3. **Battery storage mode is “Full Backup”**. When the system is connected to the utility grid:
 - i. Batteries do not discharge to service loads.

- ii. If batteries have SoC below maximum SoC i.e., 100% (due to discharging to service loads when the utility grid was offline), photovoltaic power is used to charge batteries.
- iii. Excess photovoltaic power is used to service house loads. If photovoltaic power exceeds house loads then photovoltaic power is exported to the grid depending on interconnection agreement with utility.
- iv. If house loads exceed photovoltaic power, utility power is imported to service loads.

Description of these modes with screenshots of how homeowners can select the same is available in the [Enphase Storage system owner's guide](#). Note in all modes the battery will charge from the grid until the reserve charge limit to ensure that the desired amount of battery charge for backup is guaranteed to be available.

Economic Use Cases

There are many economic goals that the IQ Battery supports. These include **reducing the utility bill** by charging during low tariff periods and saving charge to ensure that loads can be served through the battery(ies) 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**.

Optimizing energy storage capacity sizing for economic use cases is beyond the scope of this document. You can use simulation tools like NREL SAM (System Advisor Model) or Energy Tool base to assist with sizing in these use cases.

Enphase Energy System Products

IQ System Controller



The Enphase IQ System Controller consolidates interconnection equipment into a single enclosure and streamlines grid-independent capabilities of PV and storage distributed energy resources (DER) installations by providing a consistent, prewired solution for residential applications. IQ System Controller is a service entrance rated microgrid interconnect device that includes a neutral-forming transformer for single-phase backup operation and an Eaton BR bus bar assembly.

- Centered mounting brackets support single stud mounting
- Supports conduit entry from the lower sides, back, or bottom
- Up to 200A rating
- Includes neutral-forming transformer for single-phase backup operation
- Includes lugs and circuits for interconnection of line-side power, PV combiner, IQ battery system, backup load panel, and generator

Mechanical Data	IQ System Controller 1 EP200G101-M240US00	IQ System Controller 2 EP200G101-M240US01
Dimensions (WxHxD):	19.7 in x 36 in x 9.7 in (50 cm x 91.6 cm x 24.6 cm)	19.7 in x 36 in x 9.7 in (50 cm x 91.6 cm x 24.6 cm)
Weight:	38.5 kg (85 lbs)	39.4 kg (87 lbs)
Ambient temperature range:	-40° C to +50° C (-40° to 122° F)	-40° C to +50° C (-40° to 122° F)

Model Number	Description	Shipment Contents
EP200G101-M240US00	Enphase IQ System Controller 1 with 200A capacity, neutral-forming transformer providing microgrid interconnect device (MID) functionality. Supports M-Series, IQ6 and IQ7 Series Microinverters	One box of one unit
EP200G101-M240US01	Enphase IQ System Controller 2 smart switch with 200A capacity, neutral-forming transformer providing microgrid interconnect device (MID) functionality. Supports IQ8 as well as M-Series, IQ6 and IQ7 Series Microinverters	One box of one unit



NOTE: When IQ System Controller 2 is used with IQ6, IQ7 or M-Series Microinverters, the Enphase Energy System Shutdown switch (EP200G-NA-02-RSD) should not be used as a rapid shutdown initiator. The installers need to short the RSD auxiliary contacts of IQ System Controller 2 to make the system operational. Refer Installer memo - [Wiring the Rapid Shutdown Switch with IQ System Controller 2](#)

Main and Load Breakers

For wire sizes accepted by each terminal, see the IQ System Controller data sheet. IQ System Controller supports optional circuit breakers on both the input (line-side) and output (load side) of the MID relay. IQ System Controller can be configured with the following main circuit breakers to support different field requirements in compliance with NEC 705.12. Pay special attention to conductor ampacity rating when selecting the main breakers for the line-side and load side. Breakers are not included in the IQ System Controller and must be ordered separately.

Model Number	Description	Shipment Contents
BRK-200A-2P-240V	Main breaker, 2-pole, 200A, 25kAIC, CSR2200N for IQ System Controller	One box of one unit
BRK-175A-2P-240V	Main breaker, 2-pole, 175A, 25kAIC, CSR2175N for IQ System Controller	One box of one unit
BRK-150A-2P-240V	Main breaker, 2-pole, 150A, 25kAIC, CSR2150N for IQ System Controller	One box of one unit
BRK-125A-2P-240V	Main breaker, 2-pole, 125A, 25kAIC, CSR2125N for IQ System Controller	One box of one unit
BRK-100A-2P-240V	Main breaker, 2-pole, 100A, 25kAIC, CSR2100N for IQ System Controller	One box of one unit

Main Breaker and Load Breaker Installed in the IQ System Controller

When installed on a new or existing electrical service as the service equipment disconnecting means and over current protection device, IQ System Controller typically needs a circuit breaker installed for a main breaker and another breaker for the load breaker. The main and load breakers should be of equivalent rating of the service for whole-home (main panel) backup configurations. For example, a 200 A service would typically have two 200 A rated Eaton CSR2200N (BRK-200A-2P-240V) installed.

When IQ System Controller is used as the service disconnect with a main bonding jumper installed, all equipment grounding conductors and neutrals on downstream feeders and panel boards must be separated.

Load Breaker Installed in the IQ System Controller

If there is an existing service equipment such as an existing fusible disconnect on the line-side of IQ System Controller, a main breaker may not be required on the line-side input of IQ System Controller. However, a load breaker may still be required. Size the load breaker with the same rating as the system over current protection device for the whole-home (main panel) backup configuration. For example, if there is an existing 200 A meter disconnect combo feeding a main lug panel board, IQ System Controller would be installed with a 200 A rated Eaton CSR2200N (Enphase SKU: BRK-200A-2P-240V) as a load breaker inside IQ System Controller.

Main Breaker Installed in the IQ System Controller

For the whole-home (main panel) backup configuration, if the service rating is less than 200 A, a load breaker may not be required. For example, a 100 A service has DER over current protection totaling less than 100A. In this case, IQ System Controller would be installed with a 100 A rated Eaton CSR2100N (BRK-100A-2P-240V) as a main breaker on the line-side of the main load panel. Ensure that the sum of load and DER breakers does not exceed 200 A rating of the busbar and IQ System Controller load conductors are rated appropriately.

IQ System Controller Without Main or Load Breakers Installed

When IQ System Controller is installed on the load side of the service equipment disconnect means, main and load breakers may not need to be installed in the IQ System Controller. For example, an IQ System Controller is installed with total of 40 A of DER over current protection and that is back feeding a 200 A main breaker load center. In this case, it necessary to install main or load breakers in the IQ System Controller. Ensure that the sum of the load and DER over current protection is less than 200 A and that conductors are sized to comply with 2017 NEC 705.12(B)(2)(1).

IQ battery System, IQ Combiner or Generator Breakers

When connecting the IQ Battery, IQ Combiner, or generator to the IQ System Controller, use one of the following circuit breakers depending on system requirements.

Model Number	Description	Shipment Contents
BRK-80A-2P-240V	Circuit breaker, 2-pole, 80A, 10kAIC, BR280 for IQ System Controller	One box of one unit
BRK-60A-2P-240V	Circuit breaker, 2-pole, 60A, 10kAIC, BR260 for IQ System Controller	One box of one unit
BRK-40A-2P-240V	Circuit breaker, 2-pole, 40A, 10kAIC, BR240B for IQ System Controller	One box of one unit
BRK-30A-2P-240V	Circuit breaker, 2-pole, 30A, 10kAIC, BR230B for IQ System Controller	One box of one unit
BRK-20A-2P-240V-B	Circuit breaker, 2-pole, 20A, 10kAIC, BR220B for IQ System Controller	One box of one unit

IQ Battery and generator breakers may require a BRHDK125 hold down kit in accordance with 408.36(D) as referenced in NEC 710.15(E). This hold down is not required for the IQ Combiner circuits with IQ 6 / IQ 7 Series Microinverters since these inverters are still interactive inverters and are permitted to omit the additional fastener 2017 NEC 705.12(B)(5). **However, PV breakers used in IQ Combiner 4/4C in a system with IQ8 series microinverters require BRHDK125 hold down kit.** This aligns with the AC coupled multimode system diagram, Figure 1, in 2017 NEC 690.1(b), which shows both an interactive and multimode inverter. IQ Battery includes the multimode inverters forming an intentional local EPS island, and IQ 6 / IQ 7 Series Microinverters are utility-interactive inverters.

Generator Interface

The IQ System Controller 2 includes a 80 A (60A for IQ System Controller) generator connection for qualified generators. This document does not address this function, as the software functionality is not yet released. The IQ System Controller does not support integration with third-party automatic transfer switches (ATS) for the interconnection of generators. Third-party transfer switches and unqualified generators may be connected on the load side of the IQ System Controller in compliance with NEC 705.2 and require isolating the Enphase DER equipment from the electrical system powered by unqualified generators. Such third-party transfer switches and accompanying generators cannot operate at the same time as IQ batteries and charge them.

Note that M-Series, Microinverter-based Enphase Energy Systems, when used with a generator, require all PV to be wired via an external contactor. The contactor’s coil must be connected to Line 2 through the control terminals of the Envoy-S Metered. This is similar to how the Envoy-S Metered is used with M-Series Microinverters for Power Export Limiting in the case of customer self-supply. Details can be seen in the [Secondary Protection for Customer Self Supply](#) Tech Brief.

IQ Battery System

The Enphase IQ Battery 3/3T and IQ Battery 10/10T units are reliable, smart, simple, and safe. They provide the lowest lifetime energy costs with backup for both new and retrofit solar customers. As an installer, you can quickly design the right system size to meet the needs of the homeowner.



Each IQ Battery consists of a mounting bracket, battery unit with disconnecting means, and cosmetic cover.

Model Number	Description	Shipment Contents
ENCHARGE-3-1P-NA or ENCHARGE-3T-1P-NA	Enphase IQ Battery 3/3T base kit with one 1.28 kVA, 3.36* kWh, single phase battery unit with four integrated IQ8X-BAT Microinverters and backup feature	One box of IQ Battery 3/3T base kit
	Enphase IQ Battery 3/3T cover kit with IQ Battery 3/3T cover, mounting bracket, and screws	One box of IQ Battery 3/3T cover kit
ENCHARGE-10-1P-NA or ENCHARGE-10T-1P-NA	Enphase IQ Battery 10/10T base kit with three 1.28 kVA, 3.36 kWh, single phase battery units with 12 integrated IQ8X-BAT Microinverters and backup feature	Three boxes of IQ Battery 3/3T base kits
	Enphase IQ Battery 10/10T cover kit with IQ Battery 10/10T cover, mounting bracket, screws, two raceway joiners, set of wires for daisy chaining the three battery units	One box of IQ Battery 10/10T cover kit



***NOTE:** When used with M-Series Microinverters, the IQ Battery 3/3T has a usable capacity of 3.26kWh. The IQ Battery 10/10T with 3x IQ Battery 3/3T units, therefore, has a usable capacity of 9.78kWh.



Mechanical Data	IQ Battery 3	IQ Battery 3T	IQ Battery 10	IQ Battery 10T
Dimensions (WxHxD)	14.45 in x 26.14 in x 12.56 in (36.7 cm x 66.4 cm x 31.9 cm)	16.77 in x 30.19 in x 7.2 in (42.6 cm x 76.7 cm x 18.3 cm)	42.13 in x 26.14 in x 12.56 in (107.0 cm x 66.4 cm x 31.9 cm)	50.3 in x 30.19 in x 7.2 in (127.8 cm x 76.7cm x 18.3 cm)
Weight	One each 44.2 kg (97.4 lbs) base unit plus 8.4 kg (18.6 lbs) cover and mounting bracket; total 52.6 kg (116 lbs)	One each 40.5 kg (89.3 lbs) base unit plus 8.4 kg (18.6 lbs) cover and mounting bracket; total 48.8 kg (107.6 lbs)	Three each 44.2 kg (97.4 lbs) base units plus 24.4 kg (53.8 lbs) cover and mounting bracket; total 156.9 kg (346 lbs)	Three each 40.5 kg (89.3 lbs) base units plus 24.4 kg (53.8 lbs) cover and mounting bracket; total 143.6 kg (316.5 lbs)
Enclosure	Outdoor - NEMA 3R			
Ambient operating temperature range	-15° C to 55° C (5° F to 131° F) non-condensing			
Optimum operating temperature range	0° C to 30° C (32° F to 86° F)			
Altitude	Up to 2500 meters (8200 feet)			
Chemistry	Lithium iron phosphate LiFePO ₄			

IQ Combiner or IQ Gateway standalone for IQ-Series Microinverters

An Enphase solar system with IQ Series Microinverters needs an IQ Combiner with an IQ Gateway or a discrete IQ Gateway. An IQ Combiner consolidates interconnection equipment for the system and houses the following:

- Multiple PV branch circuits to ensure a streamlined installation and interconnection
- IQ Gateway – This collects production and performance data from the IQ Batteries and from the IQ Series Microinverters. It then transmits the data to Enphase Cloud through ethernet, Wi-Fi, and cellular.

A standalone IQ Gateway can also be used if needed.

The IQ Combiners listed below include the consumption CTs. However, if using an existing IQ Gateway or IQ Combiner on a site that does not have the consumption CTs, a pair of consumption CTs (CT-200-SPLIT) must be procured and installed.

The IQ Combiner 3C-ES and IQ Combiner 4C includes a cellular modem, so an Enphase Communications Kit without a cellular modem (i.e., COMMS-KIT-01) can be used with this combiner for Enphase Energy System installations

Model Number	Description	Shipment Contents
IQ Combiner 3-ES (X-IQ-AM1-240-3-ES)	AC combiner with IQ Gateway PCB, 80A, 240V split-phase Includes a pair of consumption CT's (CT-200-SPLIT - Split-core current transformer, accuracy +/- 2.5%) Also includes a solar shield (XA-SOLARSHIELD-ES) that matches with the Enphase Energy System aesthetics and deflects heat	1 Box of 1 Unit
IQ Combiner 3C-ES (X-IQ-AM1-240-3C-ES)	AC combiner with IQ Gateway CR PCBA, 80A, 240V split-phase, with integrated CELLMODEM-M1, silver solar shield and includes 2x CT-200-SPLIT	1 Box of 1 Unit
IQ Combiner 4 (X-IQ-AM1-240-4)	AC Combiner Box with IQ Gateway PCB, 80A, 240V split-phase Includes a pair of consumption CT's (CT-200-SPLIT - Split-core current transformer, accuracy +/- 2.5%). These support BRHDK125 hold down kit required to comply with NEC 705.12(B)(5) for IQ8 Series microinverter installations in multimode.	1 Box of 1 Unit
IQ Combiner 4C (X-IQ-AM1-240-4C)	AC Combiner Box with IQ Gateway CR PCBA, 80A, 240V split-phase, with integrated CELLMODEM-M1-06-SP-05, silver solar shield and includes 2x CT-200-SPLIT. These support BRHDK125 hold down kit required to comply with NEC 705.12(B)(5) for IQ8 Series microinverter installations in multimode.	1 Box of 1 Unit
ENV-IQ-AM1-240	Enphase IQ Gateway, single phase, metered. Revenue grade accuracy (ANSI C12.20 +/- 0.5%) with calibrated solid-core CT. Compatible with other Enphase IQ products.	1 Box of 1 Unit

Envoy-S Metered For M-Series Microinverters

The Enphase Envoy-S Metered communications gateway delivers solar production and energy consumption data to Enphase Cloud monitoring and analysis software for comprehensive, remote maintenance and management of the Enphase Microinverter System.



The Envoy-S Metered is packaged with one production current transformer to enable accurate production monitoring with an accuracy of +/-2.5%. For consumption monitoring, two consumption current transformers (CT-200-SPLIT) must be purchased by the installer.

Model Number	Description	Shipment Contents
Envoy-S Metered (ENV-S-AM1-120)	Enphase Envoy-S, Metered. Single phase, Revenue grade accuracy (ANSI C12.20 +/- 0.5%) with Production CT	1 Box of 12 Units

Enphase Communications Kit



The Enphase communications kit includes the COMMS-KIT-01 and the CELLMODEM-M1. The COMMS-KIT-01 is plugged into a USB port on IQ Gateway or Envoy-S Metered. It enables direct communication between the IQ Battery system, the IQ System Controller, and the Envoy-S Metered using 2.4 GHz frequency. The CELLMODEM-M1 is an LTE CAT-M1 cellular modem with a five-year AT&T data plan for Enphase Energy Systems. It acts as a backup for a broadband Wi-Fi or Ethernet connection and ensures connectivity to the Enphase Cloud.

If the site already has a cellular modem the COMMS-KIT-01 is also available independently.

Model Number	Description	Shipment Contents
COMMS-CELLMODEM-M1	<p>COMMS-KIT-01: USB adapter kit for Gateway. Enables wireless communication with IQ Battery and IQ System Controller</p> <p>CELLMODEM-M1: LTE CAT M1 cellular modem. When purchased as part of COMMS-KIT-M1 it includes a five-year data plan for Enphase Energy Systems with up to 60 Microinverters, 12 IQ Battery 3/3T batteries and one IQ System Controller. Works in US, Puerto Rico, US Virgin Islands, Canada, and Mexico.</p>	1 Box of 1 Unit
COMMS-CELLMODEM-M1-06	<p>COMMS-KIT-01: USB adapter kit for Gateway. Enables wireless communication with IQ Battery and IQ System Controller</p> <p>CELLMODEM-M1-06-SP-05: LTE CAT M1 cellular modem. When purchased as part of COMMS-KIT-M1 it includes a five-year data plan for Enphase Energy Systems with up to 60 Microinverters, 12 IQ Battery 3/3T batteries and one IQ System Controller. Works in US, Puerto Rico, US Virgin Islands, Canada.</p>	1 Box of 1 Unit
COMMS-KIT-01	USB adapter kit for IQ Gateway. Enables wireless communication with IQ Battery and IQ System Controller	1 Box of 1 Unit

M-Series Microinverters Replacements

Enphase provides M-Series RMA SKUs based in the IQ7 hardware platform to replace M-Series Microinverters that have failed or to expand an existing M-Series site. Note that you cannot mix IQ6- and IQ7-Series Microinverters SKUs with M-Series Microinverters at a site. Only use the SKUs provided below with M-Series Microinverters at a site.

SKU	Description
M215240-IQ7-S22-US	M215 240VAC Microinverter based on 7th generation IQ Series; MC locking connector, for existing M215 system expansion or replacing out-of-warranty M215 Microinverters
M215240-IQ7-S25-US	M215 240VAC Microinverter based on 7th generation IQ Series; Amphenol H4 connector, for existing M215 system expansion or replacing out-of-warranty M215 Microinverters
M250240-IQ7-S22-US	M250 240VAC Microinverter based on 7th generation IQ Series; MC locking connector, for existing M250 system expansion or replacing out-of-warranty M250 Microinverters
M250240-IQ7-S25-US	M250 240VAC Microinverter based on 7th generation IQ Series; Amphenol H4 connector, for existing M250 system expansion or replacing out-of-warranty M250 Microinverters

When using the M-Series RMA SKUs you must use the Engage Cable and associated accessories. The following table lists these.

SKU	Description
ET10-240-BULK	Voltage type and conductor count: 240 VAC, four conductors Connector count: 240 Connector spacing: 1.025m (40") PV module orientation: Portrait
ET17-240-BULK	Voltage type and conductor count: 240 VAC, four conductors Connector count: 240 Connector spacing: 1.7m (67") PV module orientation: Landscape
ET-SPLK-05	Pack of five Engage couplers. Used to connect two Engage Cables
ET-CLIP-100	Pack of 100 steel clips to fasten the Engage Cable to racking
ET-INSTL	Includes: <ul style="list-style-type: none"> • Pack of four ET-TERM terminators for Engage Cables • One ET-DISC disconnect tool used to disconnect M-Series Microinverters from Engage Cable • Pak of five ET-SEAL sealing caps for unused connectors on the Engage Cable

Note that the cables and accessories listed above are available only through the Enphase store.

IQ Load Controller



The Enphase IQ Load Controller (EP-NA-LK02-040), when used in conjunction with the IQ System Controller, enables control of up to two dedicated loads or shedding of up to two solar circuits when operating in an off-grid mode with the Enphase Energy System.

The IQ Load Controller is an outdoor-rated, NRTL-certified NEMA type 4X enclosure with a DIN rail that contains two contactors, a power supply, wire for control connections and other wiring accessories. Use the IQ Load Controller for controlling dedicated, heavy, split-phase loads or for solar circuit shedding when solar power exceeds allowed solar to storage ratios. Heavy loads are those that exceed the power or surge capabilities of your energy

management system.

The IQ Load Controller supports control of 2 split-phase loads i.e., loads wired L1-L2 and running at 240V nominal AC voltage or 4 loads running at 120V nominal AC voltage.

Enphase Energy System Shutdown switch



EP200G-NA-02-RSD is the Enphase Energy System Shutdown switch which also provide Rapid shutdown capability for System Controller 2 as required by NEC standard. This component is certified by UL1741 PVRSE requirement. The component also contains necessary labels which are required as per the NEC to identify the Rapid Shut down switch.



WARNING: Install the Enphase System shutdown switch before powering on IQ System Controller 2. If the live wire to the Enphase System shutdown switch from IQ System Controller 2 touches metal surfaces or ground or neutral conductors, the resulting current surge will damage the IQ System Controller components. The IQ System Controller 2 will be damaged and needs to be replaced.



NOTE: When IQ System Controller 2 is used with IQ6, IQ7 or M-Series Microinverters, the Enphase Energy System Shutdown switch (EP200G-NA-02-RSD) should not be used as a rapid shutdown initiator. The installers must short the RSD auxiliary contacts of IQ System Controller 2 to make the system operational. Refer Installer memo - [Wiring the Rapid Shutdown Switch with IQ System Controller 2](#)

Key Planning Considerations

To ensure optimal wireless and power line communication between Enphase Energy System products and cleanest installation, consider the following:

1. 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 units.
2. For wireless communications between the IQ Gateway, IQ Battery, and IQ System Controller, the best practice is to have a line-of-sight between them.
3. For power line communications, the best practice is to have the IQ Gateway located closest to PV branch circuit collection, for example in an IQ Combiner or near/in an off-the shelf PV combiner.
4. Determine the electrical interconnection points and required breakers for IQ System Controller, IQ Battery circuit, PV combiner branch circuits, and the IQ Gateway.
5. Ensure that the IQ Gateway with both production and consumption CTs can be installed at the site.
6. In case of an IQ8 based system, the IQ Gateway must now be connected directly to IQ System Controller or another location on the load side of IQ System Controller.
7. Size conductors properly for ampacity and voltage regulation given conductor lengths.
8. Identify the location the PV system disconnect for rapid shutdown initiation and labeling.
9. Always ensure that the IQ Gateway is connected to the internet via a Wi-Fi or ethernet connection. Note that the cellular modem is provided as a **backup** connection for internet connectivity.

The following sections detail each of these considerations:

Physical Installation Considerations

1. For all products, always follow the instructions in the Enphase installation manuals.
2. 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) chemistry used in battery cells does not off-gas.
3. Ensure that the mounting location can sustain the weight of the equipment, mounting equipment, and accessory equipment.
4. Plan the mounting location of IQ Battery:
 - Minimum distance between IQ Battery 3/3T units shall be 1 inch.
 - Minimum distance between IQ Battery 10 and IQ Battery 3/3T or another IQ Battery 10 shall be 6 inches.
 - Minimum distance between IQ Battery 10T and IQ Battery 3/3T or another IQ Battery 10 shall be 3feet. For an IQ Battery 10T to be exempt from the 3 ft spacing requirements, it must be installed using second-generation wall mount parts B10T-AWM-1280-O and B10T-MWM-1280-O.
 - Indoors: at least 15 cm (6 inches) off the ground and 15 cm (6 inches) from the ceiling.
 - Outdoors: at least 15 cm (6 inches) off the ground.
 - If mounted in the path of a motor vehicle, we recommend a 91cm (36 inches) minimum mounting height
5. Plan the mounting location of IQ System Controller:
 - Indoors: at least 15 cm (6 inches) off the ground and 15 cm (6 inches) from the ceiling.
 - Outdoors: at least 91cm (3 feet) off the ground.
 - Indoors: at least 15 cm (6 inches) off the ground and 15 cm (6 inches) from the ceiling.
 - Outdoors: at least 15 cm (6 inches) off the ground.
 - If mounted in the path of a motor vehicle, we recommend a 91cm (36 inches) minimum mounting height
6. Ensure that there are no pipes or electrical wires where you plan to drill.
7. Plan to maintain at least 90 cm (three feet) of clearance in front of Enphase Energy System equipment for working space.

8. 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 location of equipment. The recommended 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 or from the bottom-left side. Backup load conductors may enter IQ System Controller from the bottom or bottom-right side. IQ Battery and PV combiner and generator conductors may enter from the bottom, bottom-left or bottom-right sides.
 - IQ Battery– Conduit may enter from the top right or top left of the IQ Battery at the pre-defined knockout locations.
 - IQ Combiner Series – Conduit may enter at the bottom and sides or rear entry below the busbar assembly.
9. Do not block vents.

IQ Battery 3 and IQ Battery 10 Bracket Data

Figure 22: Bracket spacing for IQ Battery 3 or IQ Battery 10

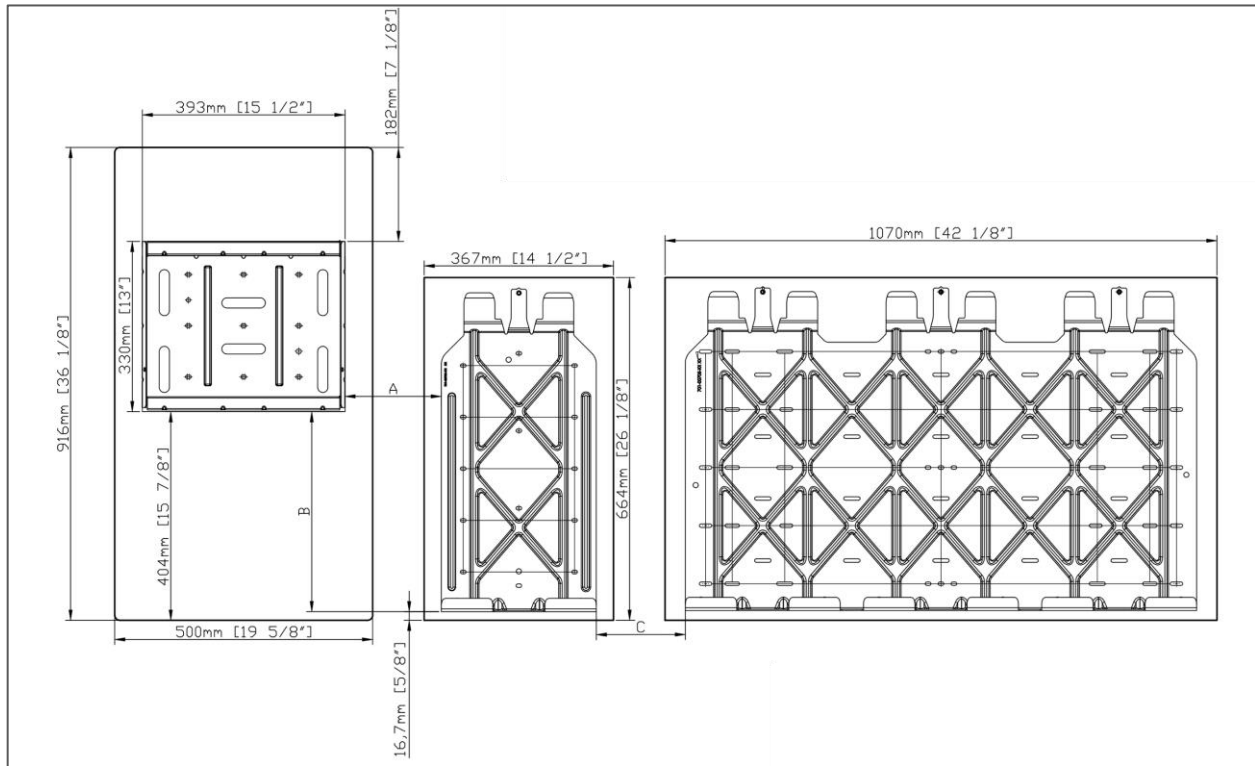


Table 4: Bracket spacing for IQ Battery 3 or IQ Battery 10

Dimension	Description	Recommended Minimum
A	IQ System Controller and IQ Battery horizontal bracket spacing	152 mm (6")
B - Bottom aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	387 mm (15 1/4")
B - Center aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	261 mm (10 5/16")
B - Top aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	135 mm (5 5/16")
C	IQ Battery wall horizontal bracket spacing	152 mm (6")

IQ Battery 3T and IQ Battery 10T Bracket Data

Figure 23: Bracket spacing for IQ Battery 3T or IQ Battery 10T

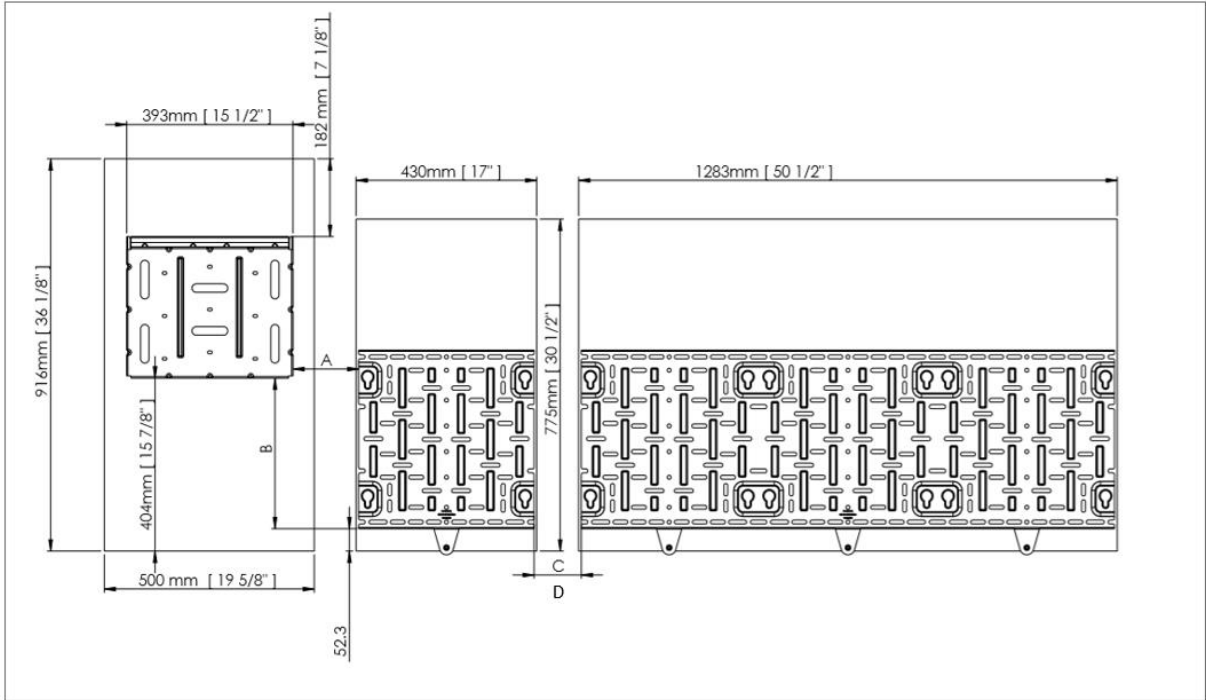


Table 5: Bracket spacing for IQ Battery 3T or IQ Battery 10T

Dimension	Description	Recommended Minimum
A	IQ System Controller and IQ battery horizontal bracket spacing	152 mm (6")
B - Bottom aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	352 mm (13 14/16")
B - Center aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	281 mm (11 1/16")
B - Top aligned	IQ System Controller wall mount bracket bottom to IQ Battery wall mount bracket bottom	211 mm (8 5/16")
C	IQ Battery wall horizontal bracket spacing between 3T and 10T	914 mm (36")*
D	IQ Battery wall horizontal bracket spacing between adjacent 10T units	914 mm (36")*

* For an IQ Battery 10T to be exempt from the 3 ft spacing requirements, it must be installed using second-generation wall mount parts B10T-AWM-1280-O and B10T-MWM-1280-O.

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). Temperature may be affected by location, exposure, and ventilation. Consider factors that may result in undesirable temperature swings outside the optimal temperature range. For example, in enclosed unconditioned spaces such as garages or utility closets, the temperature may be higher than the outdoor ambient.

Electrical Installation Requirements

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

- *Quick Install Guide – Install the Enphase IQ Battery*
- *Quick Install Guide – Install the Enphase IQ System Controller*

Current Transformers (CTs)

It is critical that installers correctly configure the IQ Gateway, with the combined solar PV output passing through the production CT. The production CT monitors **only** the PV output circuit(s) and must not have IQ battery circuit(s) installed on it. Install the IQ Battery circuit(s) on the load side of the production CTs on the correct terminals in IQ System Controller.

Installers may extend the consumption CT leads, but not the production CT leads. Therefore, it is best to locate the IQ Gateway close to the Microinverter output circuits and then extend consumption CT wires if necessary. Refer to the [IQ Gateway Installation and Operations Manual](#) or the [Enphase Envoy-S Installation and Operation Manual](#) when installing and/or extending consumption CTs. Refer also to the [Tech Brief: Four Guidelines for Successful Current Transformer \(CT\) Installation](#).

IQ System Controller Connections

The IQ System Controller can accept a maximum of 64 A of continuous output current (maximum 80A breaker) of a combined PV subpanel or IQ Combiner (labeled AC Combiner). The busbar in the IQ System Controller can accept a maximum of an 80 A breaker for the IQ Combiner over current protection.

The IQ System Controller can accept a maximum of 64 A of rated output current (maximum 80A breaker) of combined IQ Battery circuits. The busbar in the IQ System Controller can accept a maximum of an 80 A breaker for the IQ Battery circuit over current protection. This equates to a maximum of twelve IQ Battery 3/3T storage units **or** four IQ Battery 10/10T units per IQ System Controller. Up to six IQ Battery 3/3T storage units **or** two IQ Battery 10/10T units, equal to 32 A of rated output current, can be connected in Series prior to landing on the IQ Battery terminal in the IQ System Controller and protected by a no higher than a 40 A over current protection breaker. If more than six IQ battery 3/3T (or more than two IQ Battery 10/10T) are to be connected to IQ System Controller, an external subpanel must be used to combine each circuit of up to 32 A of rated output current IQ Battery circuits. You should size conductors appropriately for the overcurrent protection selected for the application.

Voltage Regulation Considerations

When the IQ Battery is charging, it acts like a load, and the voltage decreases at the terminals of the battery based upon Ohm's law and wire resistance. When the IQ Battery is discharging to feed loads, it behaves like a source, and the voltage increases at the terminals of the battery.

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

Voltage regulation in Enphase Energy System is calculated as

$$\text{Percent VR} = \frac{2 \cdot |V_d|}{V_{nom}}$$

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

Rapid Shutdown Considerations

2017 NEC 690.12 requires a rapid shutdown for PV Systems on buildings by an initiation device in a readily accessible location. In grid interactive systems this is often the service disconnecting means or PV system disconnect. Rapid shutdown requirements do not apply to optional standby systems such as energy storage and as seen in Figure 1, the PV system disconnect can still initiate rapid shutdown.

The rapid shutdown initiation device can be either:

- the PV system breaker in IQ System Controller,
- an additional disconnect such as a fusible disconnect between IQ System Controller and the IQ Combiner, or
- the circuit breakers in the IQ Combiner since these breakers are less than six and grouped.

The rapid shutdown initiator must be labeled in accordance with 2017 NEC 690.56.

Enphase IQ 6 / 7 Series and M215 and M250 Microinverters comply with the rapid shutdown requirements per the UL certifications.

For an Enphase Energy system with IQ8 Series Microinverters in grid agnostic mode, the **Enphase System shutdown switch (EP200G-NA-02-RSD)** must be installed with IQ System Controller 2, to act as the only rapid shutdown device of the system. Refer to *QIG of Enphase System shutdown switch* for instructions on wiring the rapid shutdown device.

SAFETY: IQ System Controller 2 and Enphase System shutdown switch can enforce rapid shutdown **ONLY** on PV Microinverters connected the AC Combiner port in IQ System Controller 2.

System override using Enphase System shutdown switch for backup systems with IQ8-Series Microinverters

Steps for Initiating System Shutdown (Tied to Grid)

1. Put the remote rapid shutdown switch to **OFF** state.
2. **OPEN** the breakers for PV, IQ Battery, generator, and NFT in IQ System Controller R2.
3. Open the cover of the manual override switch and turn the manual override toggle to the **LEFT** to manually **CLOSE** the MID relay.
4. The IQ System Controller system is now in manual override mode and grid tied.

Steps for Exiting System Shutdown:

1. Put the remote rapid shutdown switch to **ON** state.
2. Turn the manual override toggle to the **RIGHT** to manually **OPEN** the MID relay.
3. **CLOSE** the PV, IQ Battery, generator, and NFT breakers in IQ System Controller.

The IQ System Controller system is now no longer in manual override mode and is fully functional.



WARNING: Install the Enphase System shutdown switch before powering on IQ System Controller 2. If the live wire to the Enphase System shutdown switch from IQ System Controller 2 touches metal surfaces or ground or neutral conductors, the resulting current surge will damage the IQ System Controller components. The IQ System Controller 2 will be damaged and needs to be replaced.

Glossary

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

intentional island: An intentionally planned electrical island that is capable of being energized independently of the area electric power system (EPS). IQ System Controller and IQ Battery comprise a microgrid system that forms an intentional island totally within the bounds of the Local EPS. (2017 NEC/IEEE 1547-2018/IEEE 1547.1-2011)

main load panel: Also referred to as the main load center or main panelboard, this is the unit where the majority of load circuits for the premises have over current protection.

microgrid interconnect device (MID): A device that allows a microgrid system to separate from and reconnect to a primary power source. (NEC 705.2)

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. (NEC 705.2)

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 flicker.

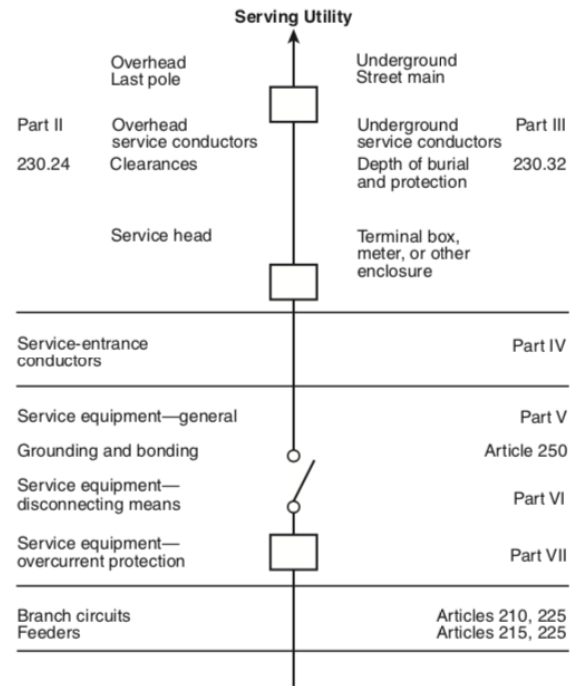
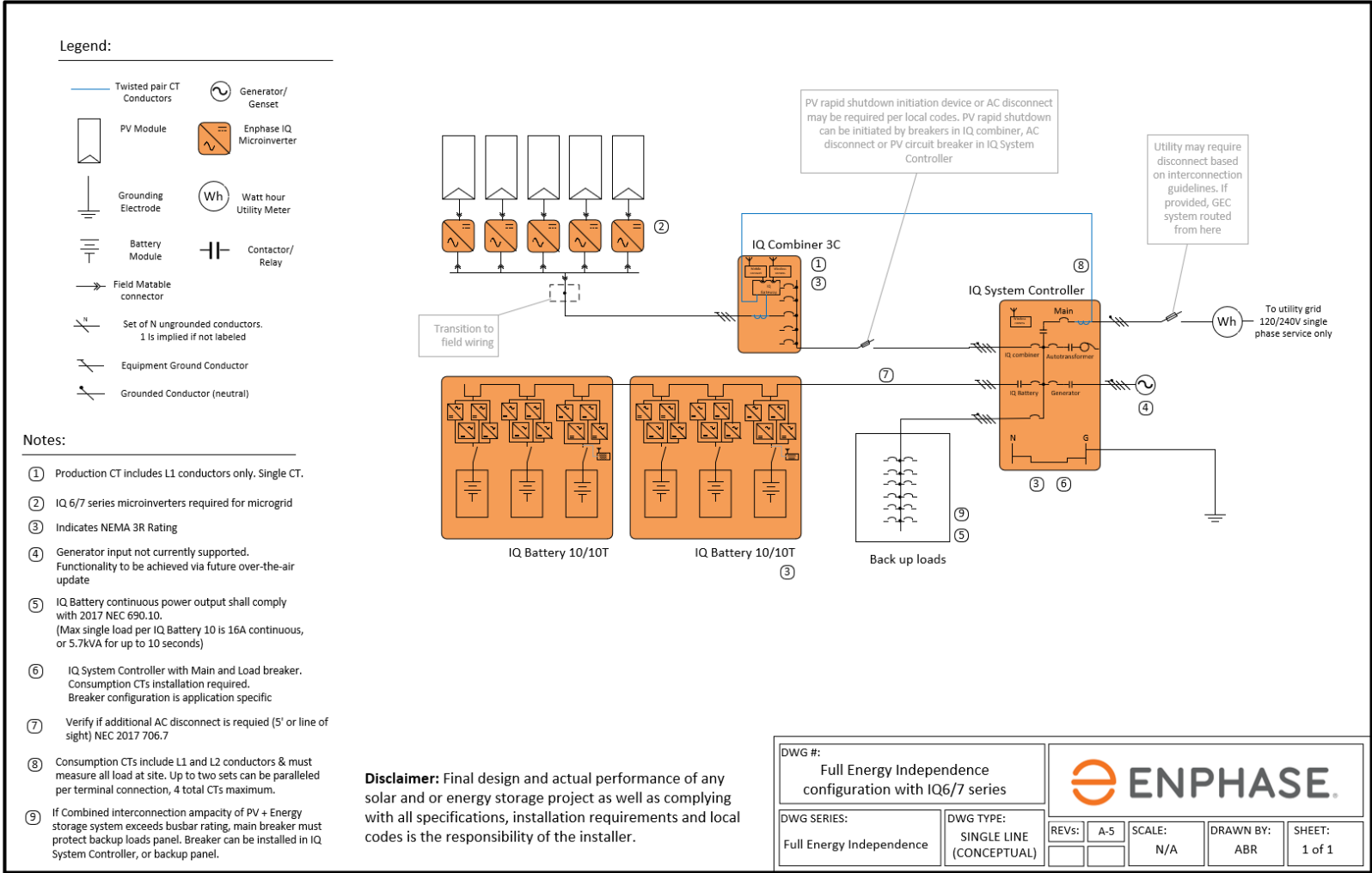


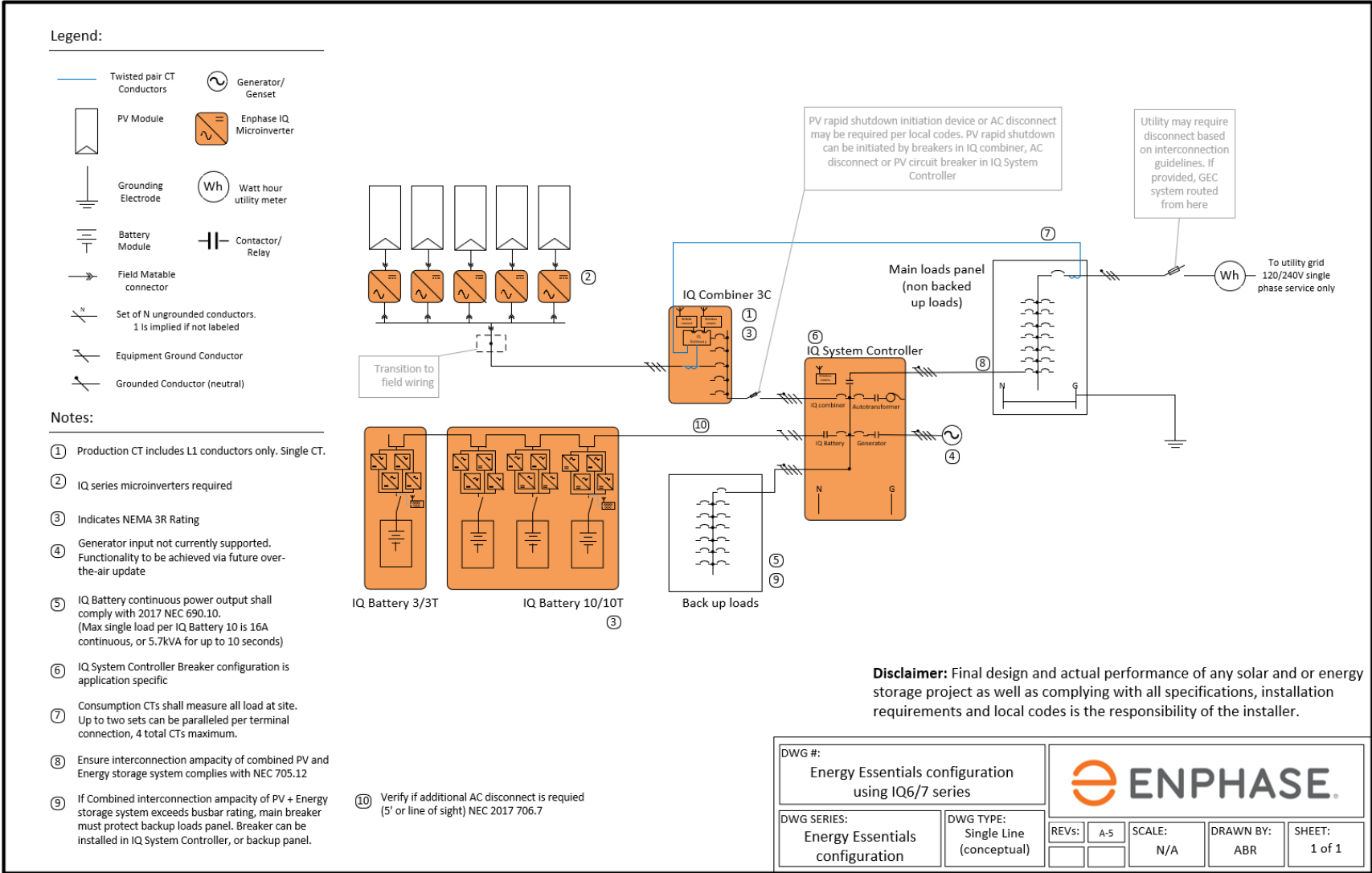
Figure 12: NEC 2017 Figure 203.1 Services © NFPA

Appendix A – Single line diagrams for IQ6/7-Series systems

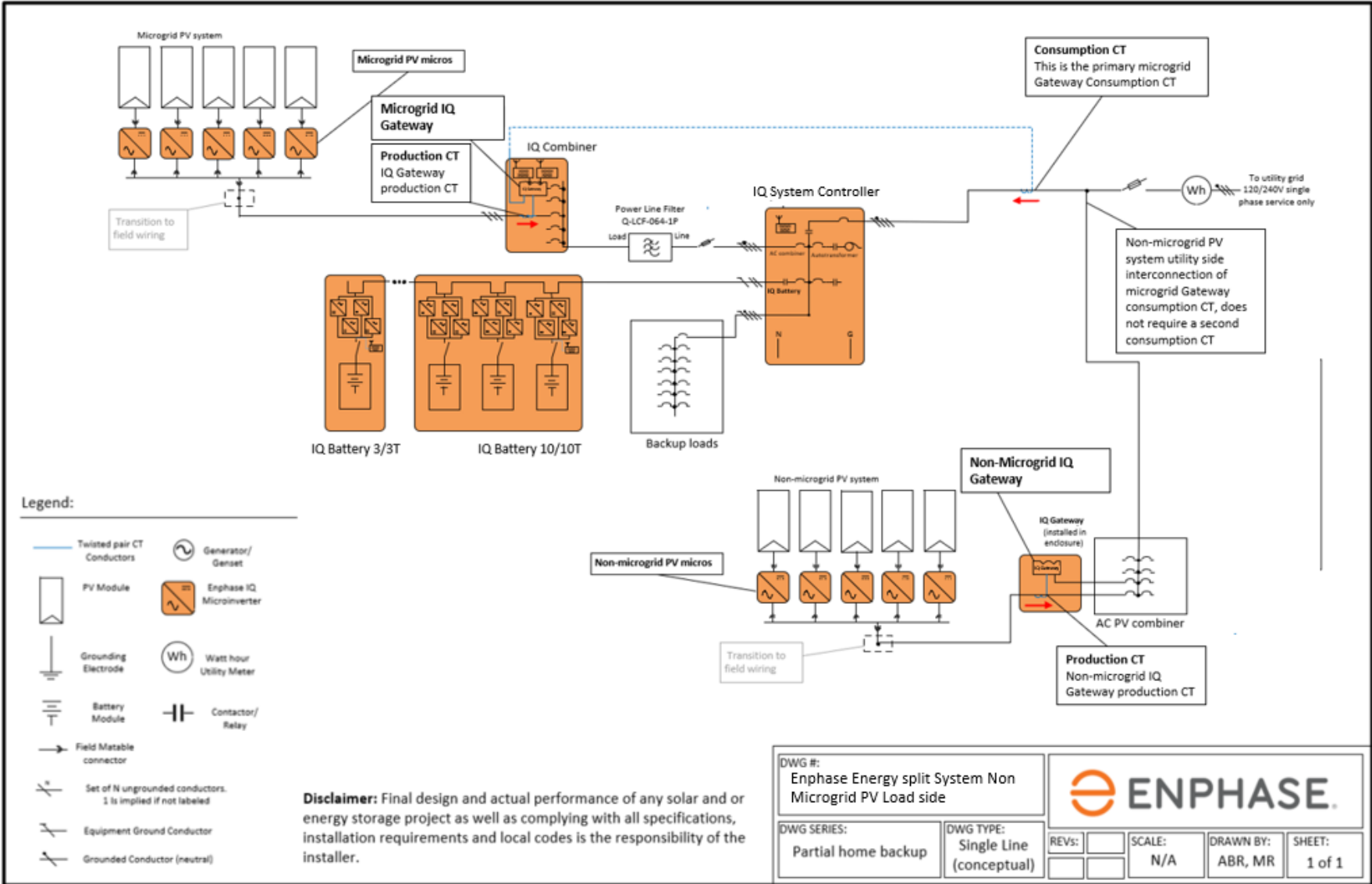
Full Energy Independence configuration



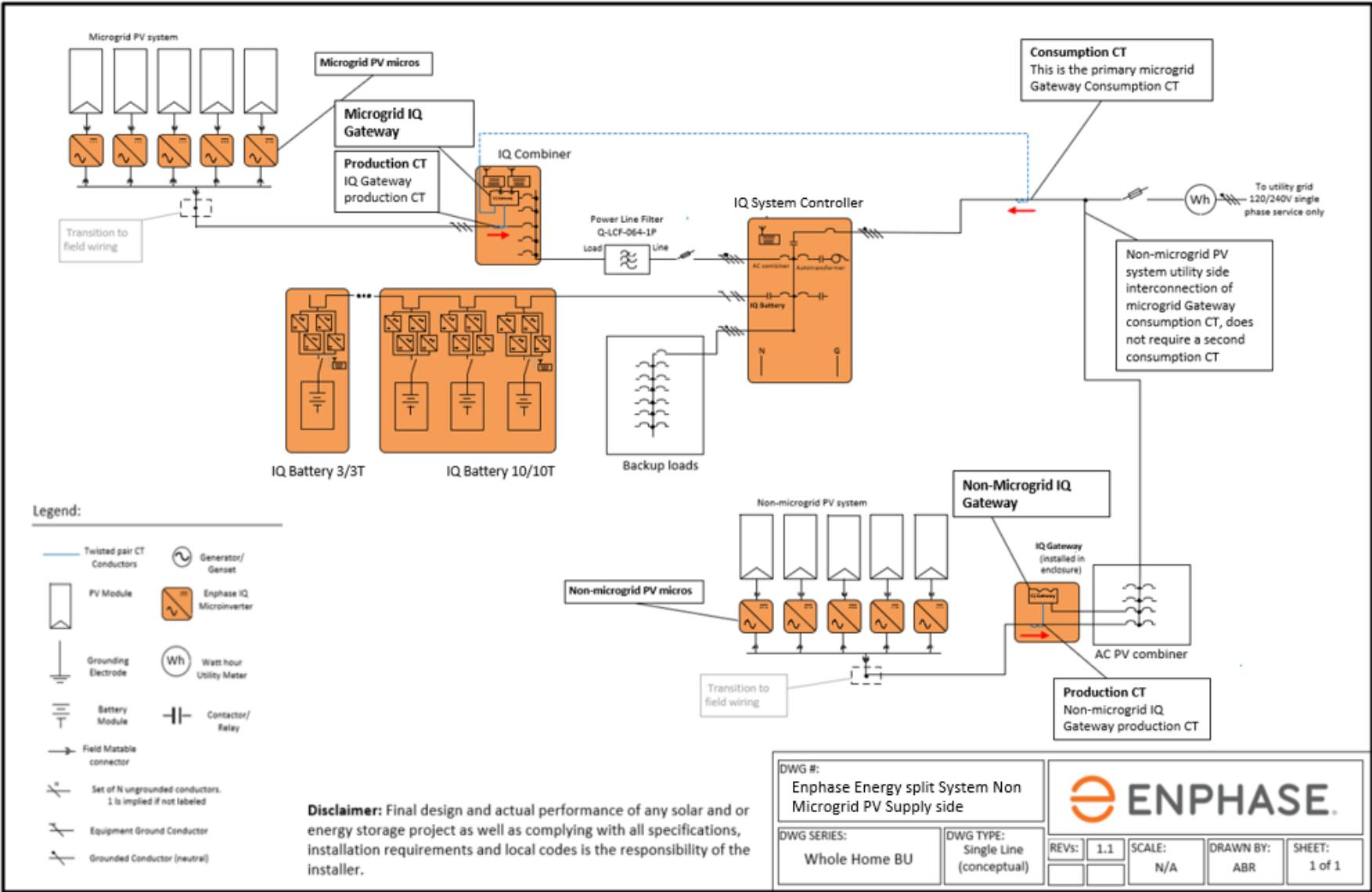
Energy Essentials configuration



Energy Essentials configuration, split system with additional consumption CTs



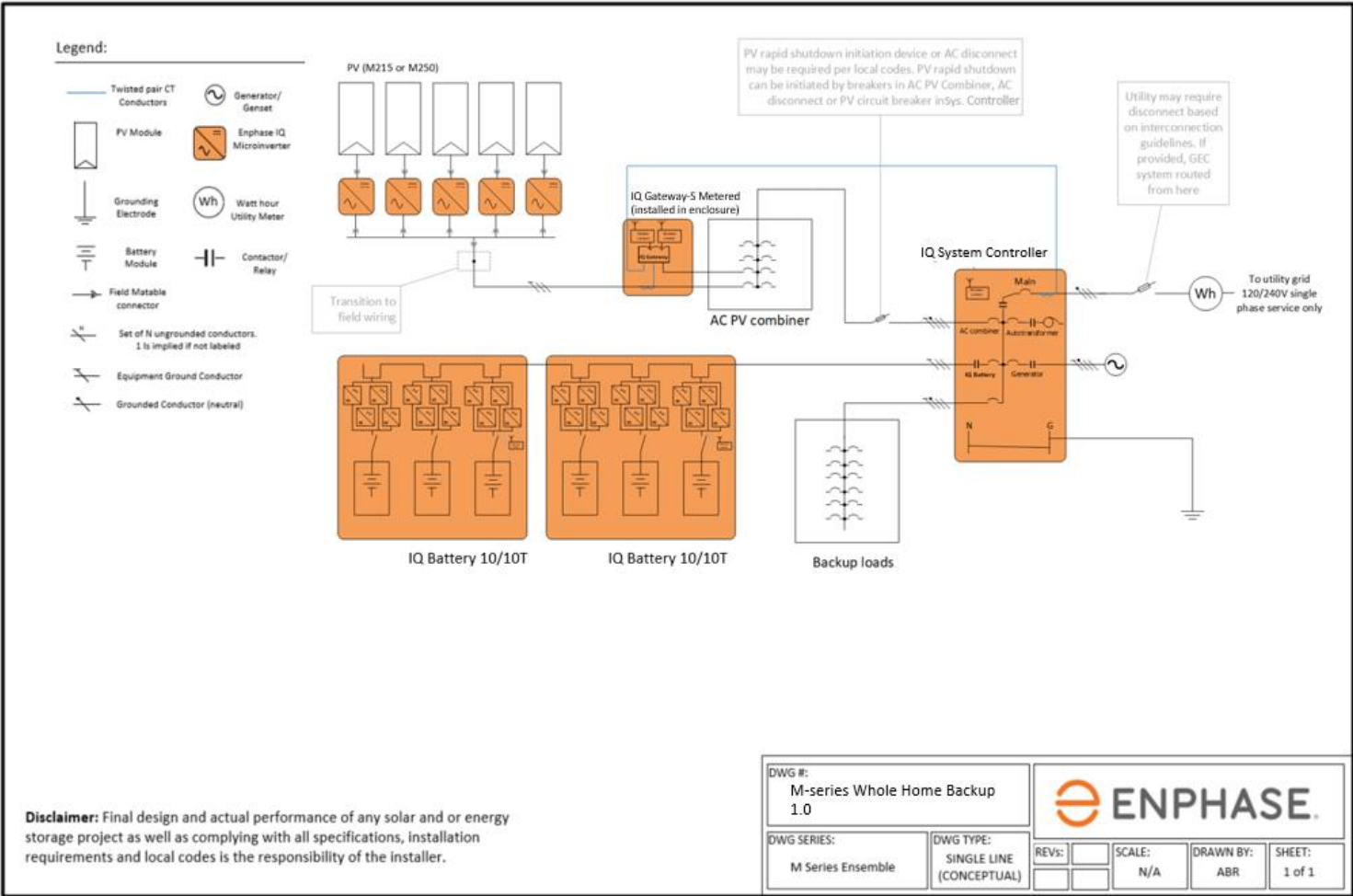
Energy Essentials configuration, split system with NO additional consumption CTs



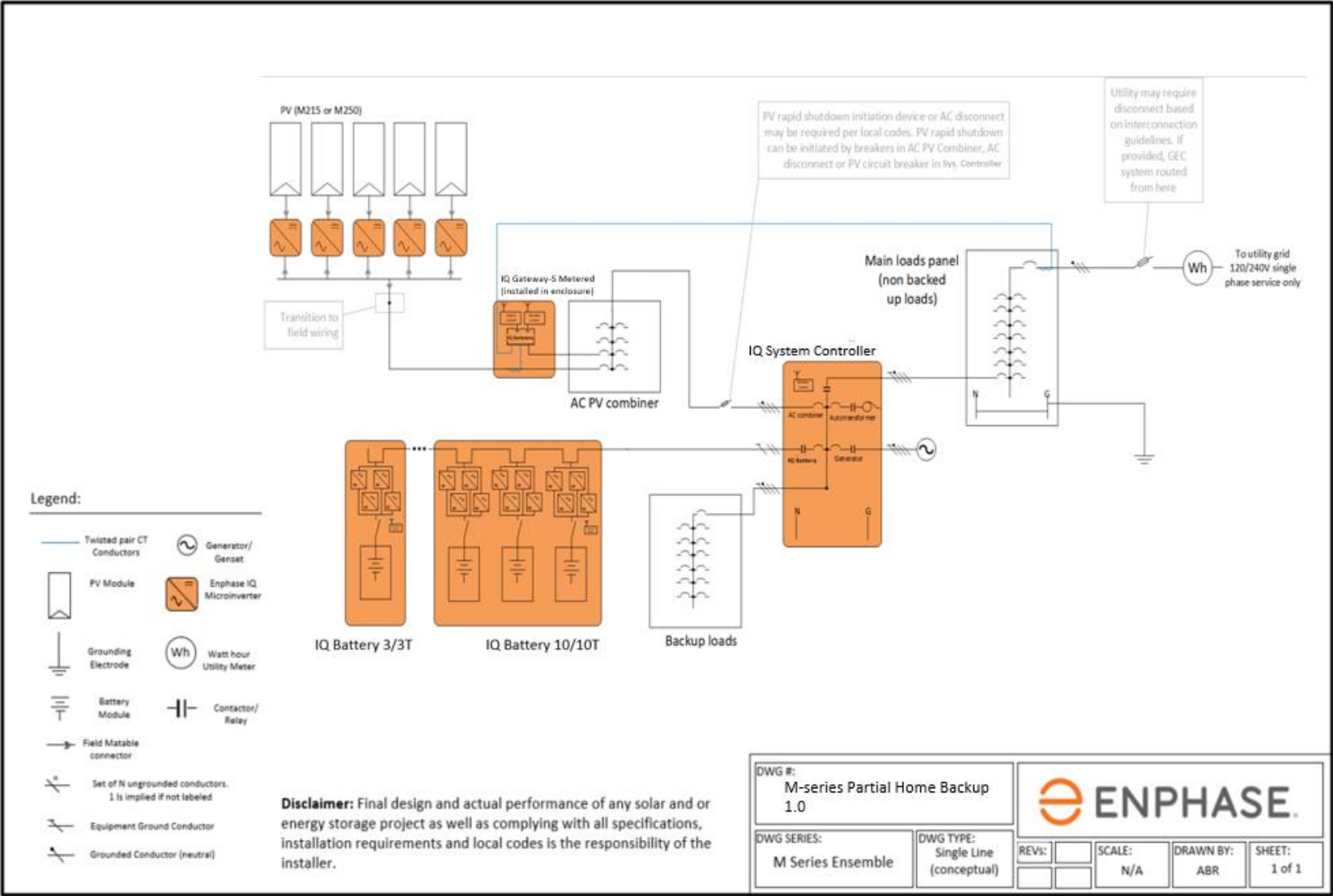
Appendix B – Single line diagrams for M-Series systems

(Download [here](#))

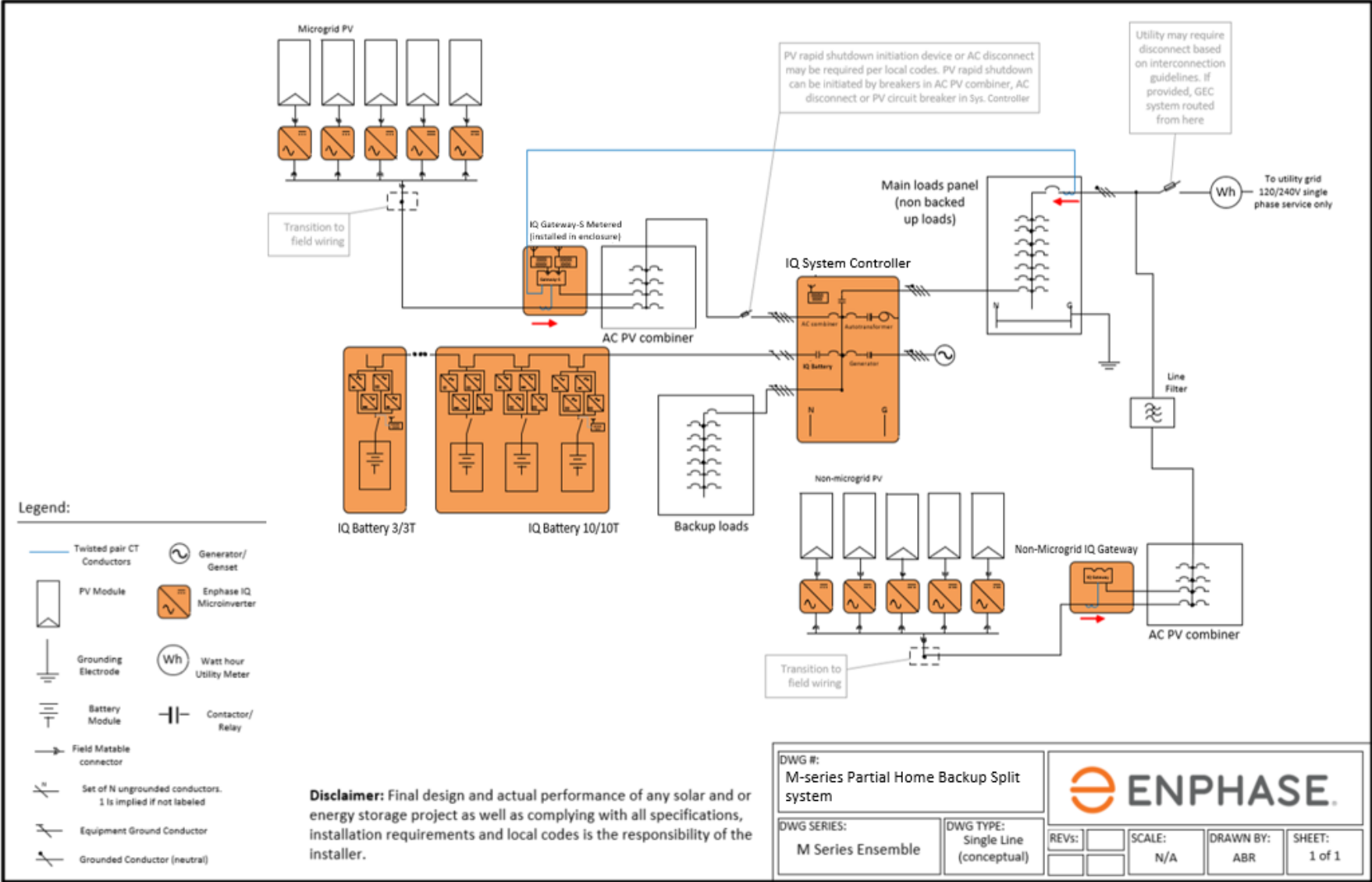
Full Energy Independence configuration



Energy Essentials configuration

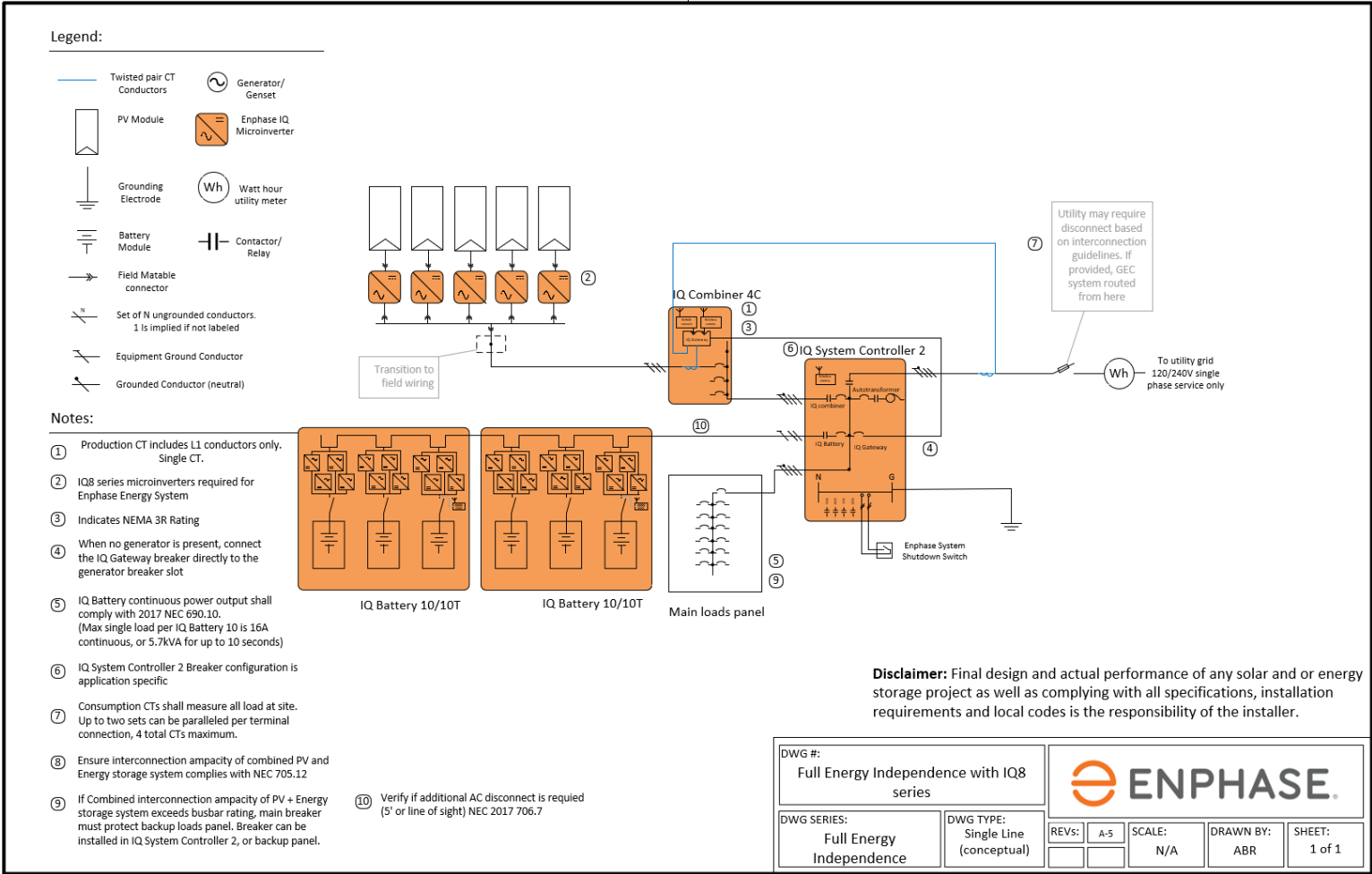


Energy Essentials configuration, split system with NO additional consumption CTs

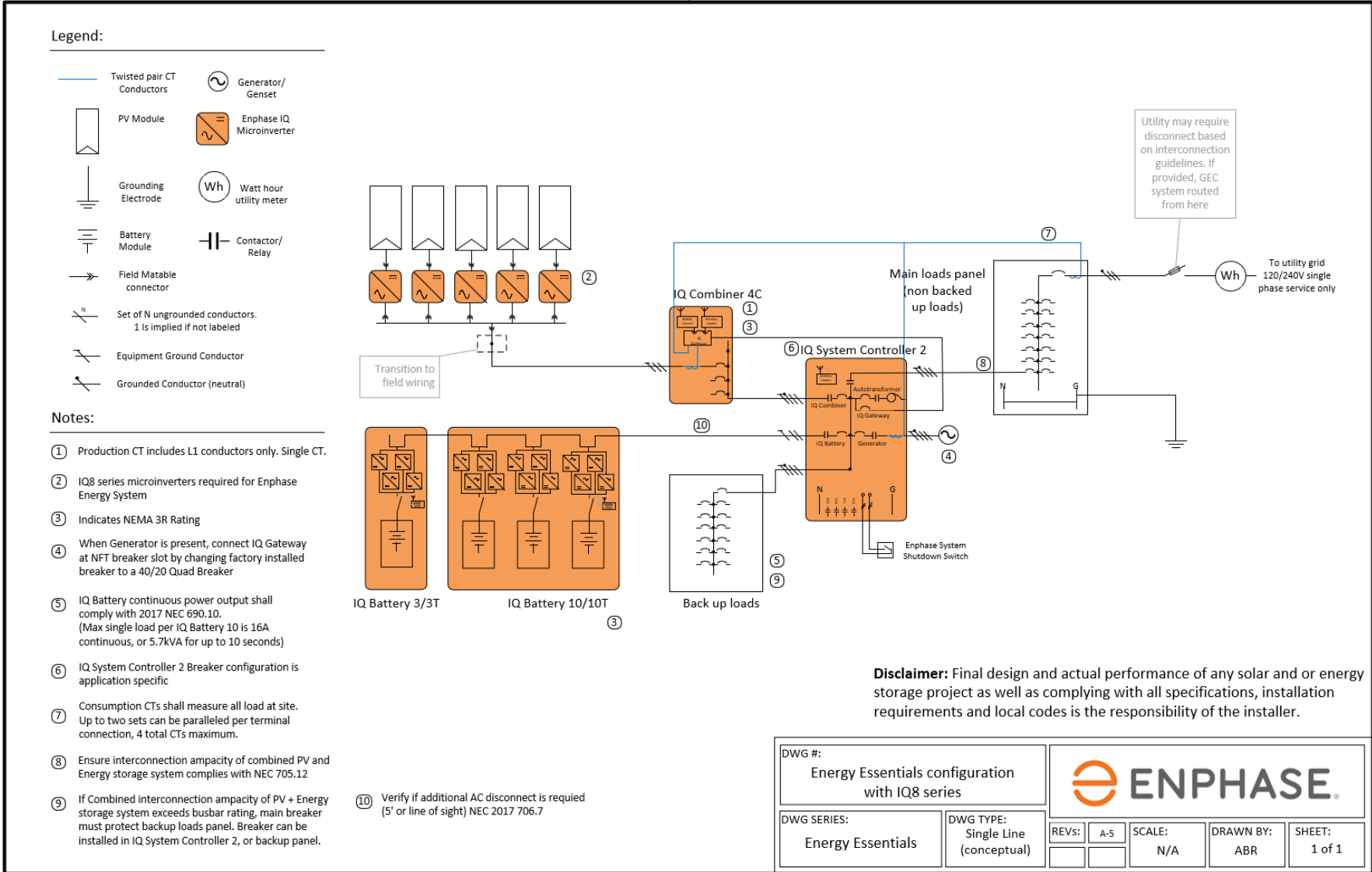


Appendix C – Single line diagrams for IQ8-Series systems

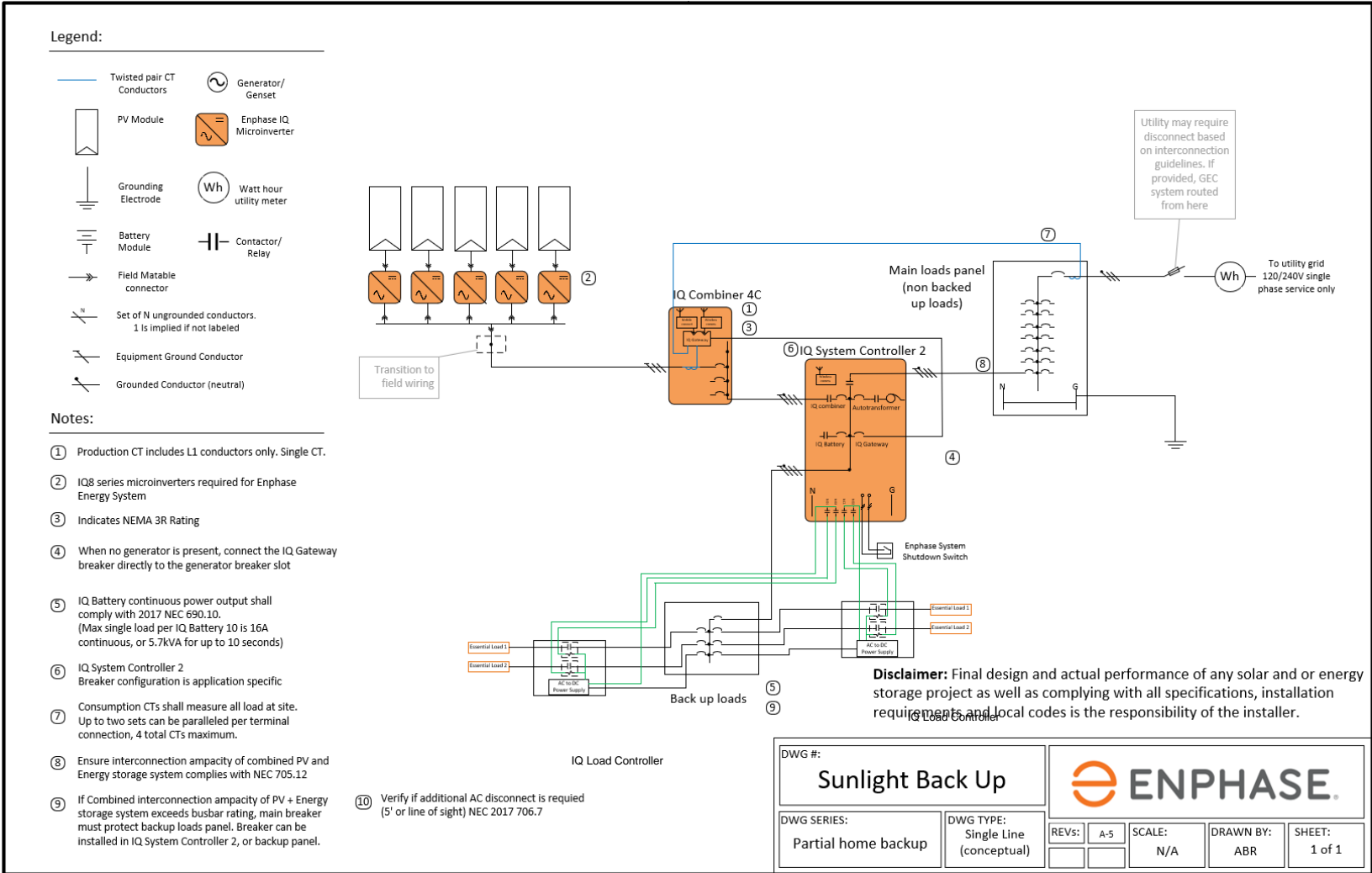
Full Energy Independence configuration



Energy Essentials configuration



Sunlight Backup configuration



Energy Essentials configuration, split system with NO additional consumption CTs

