TECHNICAL BRIEF

Enphase Energy System shutdown with IQ Battery 10C, IQ Combiner 6C, and IQ Meter Collar

Applicable regions: North America

Contents

1. About this guide

This document contains information for site surveyors and design engineers to analyze a site and plan the design, installation, and support of home energy backup systems using the 4th-generation Enphase Energy System, IQ Battery 10C, IQ Combiner 6C, IQ Meter Collar, and IQ Microinverters. This document is not an installation or operation guide. It supplements the information provided in data sheets and quick install guides. The diagrams and examples included are illustrative of system configurations and installations, but they may not account for all applicable state and local codes, standards, or requirements from Authorities Having Jurisdiction (AHJ).

The document is intended to provide a brief overview of the system shutdown details, applicability, and functioning of the 4th-generation Enphase Energy System.

2. Enphase Energy System overview

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

- Solar Only
- Battery Only
- Solar Plus Battery

The system can also be categorized into grid-tied and grid-forming systems, depending on its capability to establish a microgrid.

For information on systems and concept of operation, refer to *Enphase Energy System planning with IQ Battery 10C/10CS and IQ Combiner 6C* and *Concept of operations: 4th-generation Enphase Energy System with IQ Meter Collar tech brief* on the documentation center https://enphase.com/installers/resources/documentation/storage.

2.1 Grid-tied (non-backup) system

Grid-tied (non-backup) systems can generate energy, supply it to home loads, and store it for later use if a battery is present, but only when the grid is available. The system doesn't require the installation of an IQ Meter Collar for grid-tied systems.

For information on systems, refer to *Enphase Energy System planning with IQ Battery 10C/10CS and IQ Combiner 6C* on the documentation center https://enphase.com/installers/resources/documentation/storage.

A typical grid-tied system includes an IQ Combiner 6C and an IQ Battery. Installation of the IQ Meter Collar is not required for grid-tied configurations.

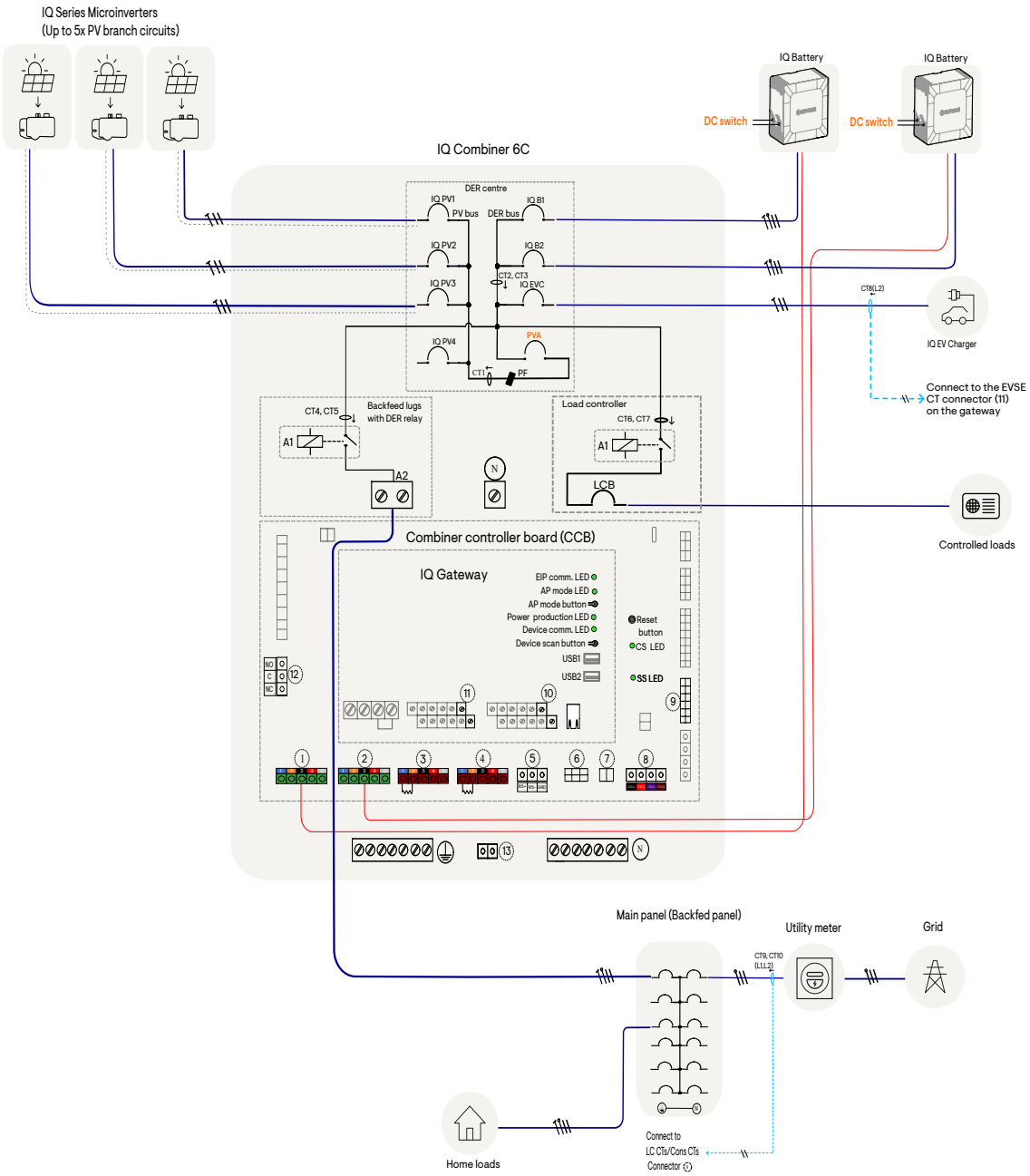


Figure 1: Grid-tied, Solar Plus Battery (without IQ Meter Collar)

2.2 Grid-forming (backup) system

A grid-forming (backup) system offers enhanced capabilities compared to a grid-tied system. While grid-tied systems depend on external grid support for stability, grid-forming systems can operate autonomously and establish a microgrid when necessary. They are capable of supporting electrical loads even during utility grid outages.

For information on systems, refer to *Enphase Energy System planning with IQ Battery 10C/10CS and IQ Combiner 6C* on the documentation center https://enphase.com/installers/resources/documentation/storage.

Grid-forming systems can be categorized as whole-home or partial home backup systems.

2.2.1 Whole home backup

When the power grid fails, the Enphase Energy System switches all electrical circuits to backup power. The system must have sufficient backup power and energy capacity to support all the loads in a home.

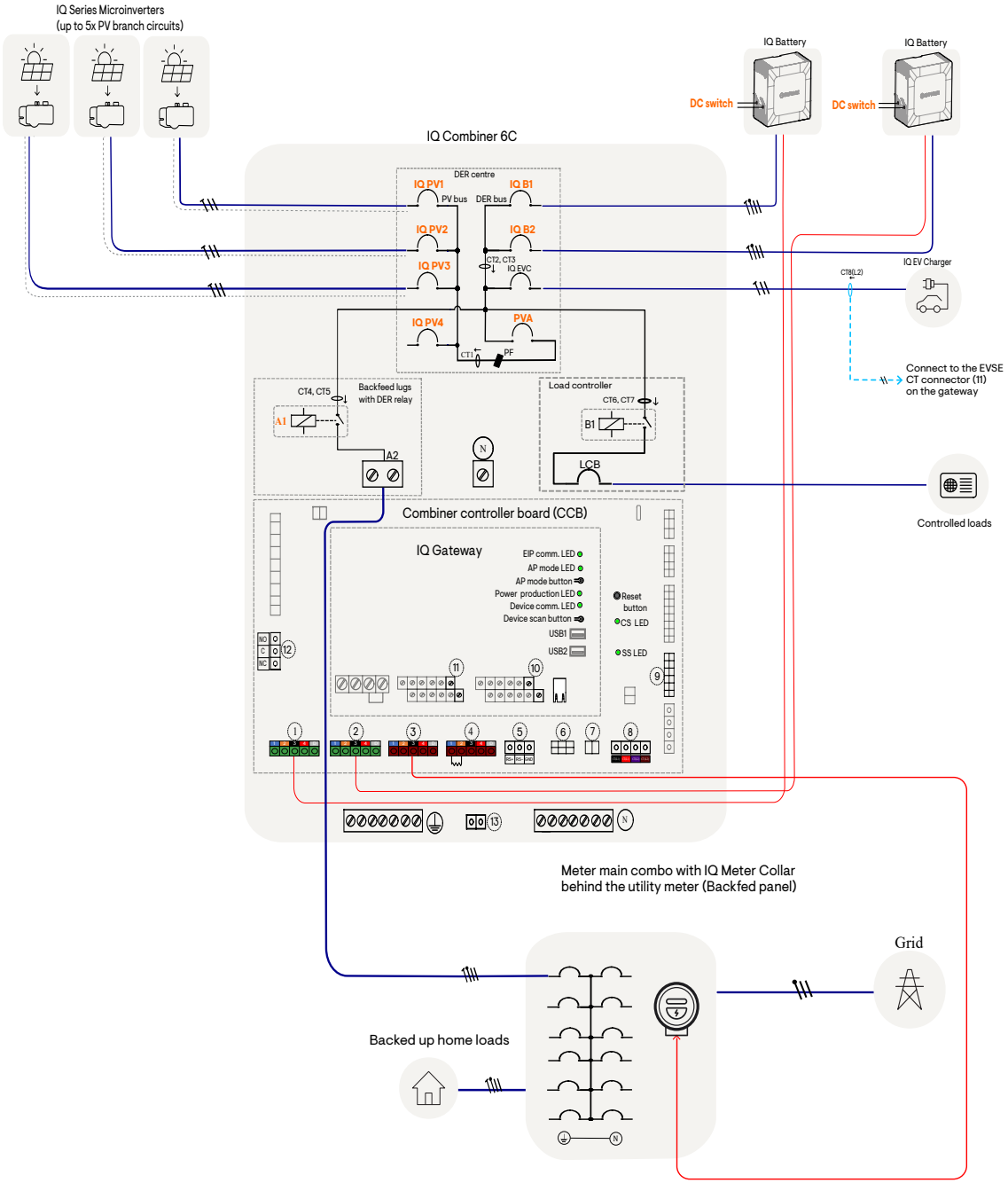


Figure 2: Grid-forming, whole home backup (with IQ Meter Collar behind the utility meter)

The system typically includes an IQ Meter Collar, IQ Combiner 6C, and IQ Battery. The installation of the IQ Meter Collar varies based on the required configuration. As illustrated in the image above, the IQ Meter Collar is installed behind the meter pan, but it can also be installed on a separate meter pan.

2.2.2 Partial home backup

The home loads are segregated into backed-up and non-backed-up loads. The backup load panel is set up to power essential loads. When the power goes out, the Enphase Energy System powers the backup electrical panel while leaving the main load panel unpowered.

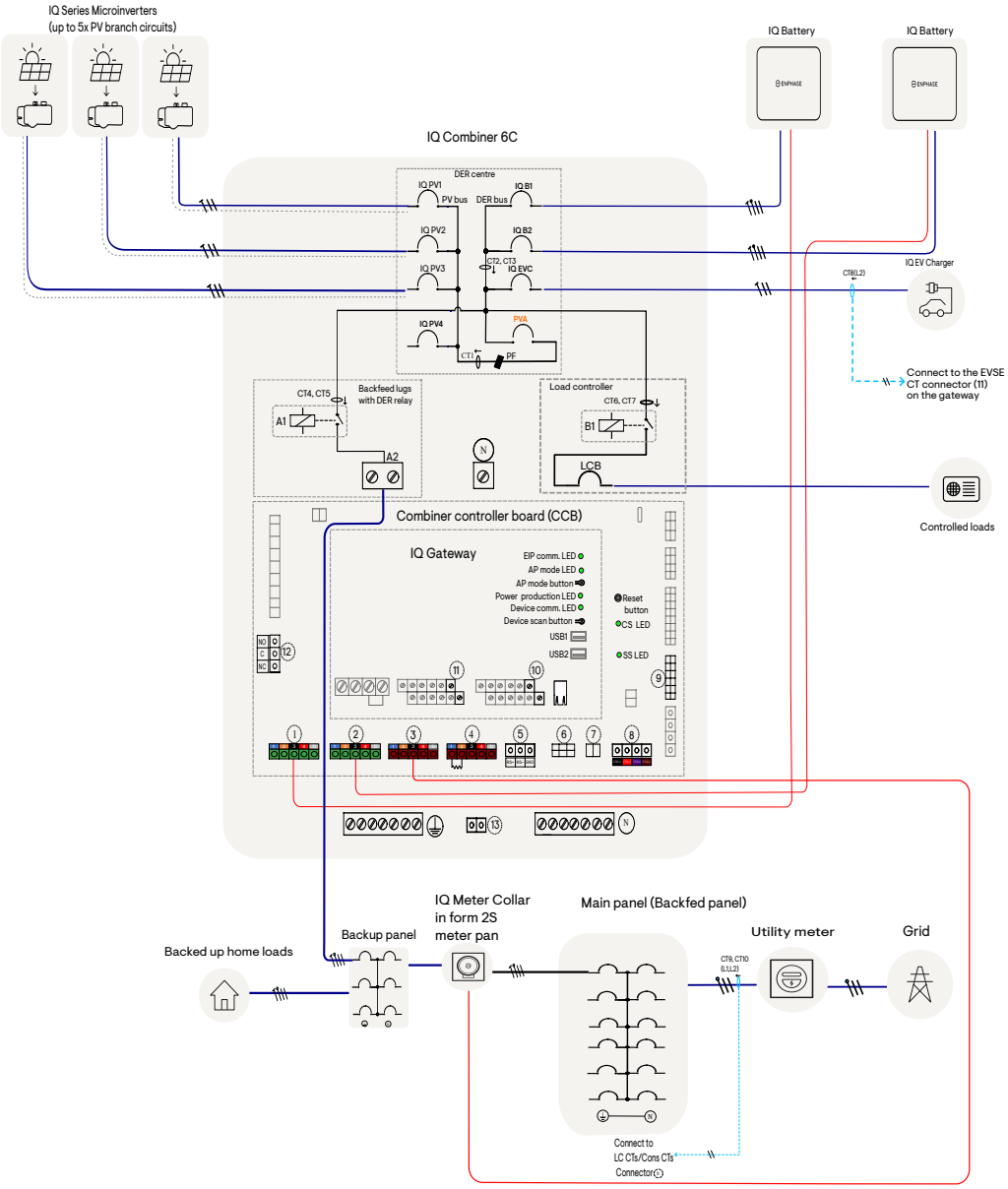


Figure 3: Grid-forming, partial home backup (IQ Meter Collar in a discrete meter pan)

NOTE: The IQ Combiner 6C unit includes an integrated load controller that utilizes the load controller CT connector. In this configuration, to add Consumption CTs, remove the connection to the load control CT from connector 8. For more information, refer to the IQ Combiner 6C quick install guide.

2.3 Isolation and shutdown mechanisms in 4th-generation Enphase Energy Systems

The 4th-generation Enphase Energy Systems offer multiple isolation and shutdown mechanisms within the system. The following legends indicate the isolation/shutdown mechanisms for the grid-tied and grid-forming configurations:

- Photovoltaic (PV) and battery breakers: The IQ Combiner 6C provides a disconnecting mechanism for all connected distributed energy resources (DER) through PV and battery breakers located within the lockable enclosure, preventing unauthorized access to the DER breakers.

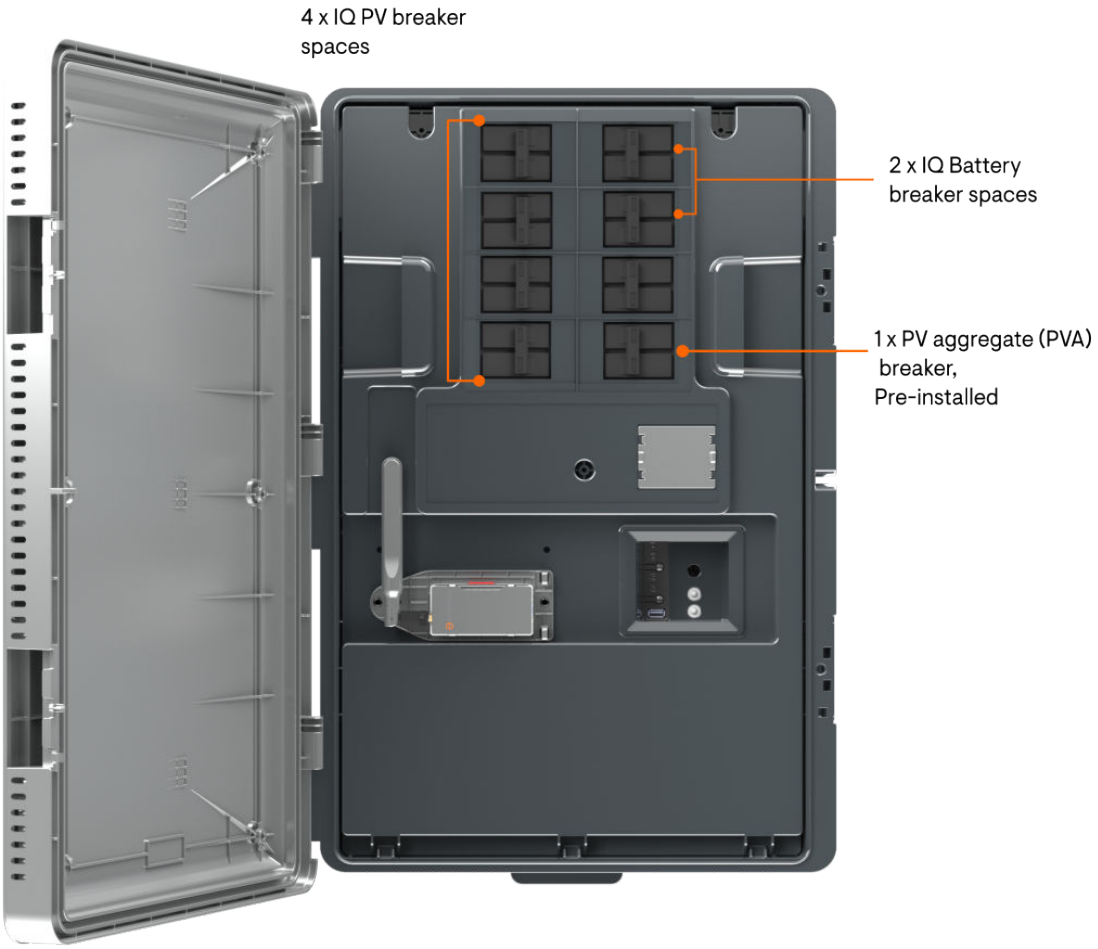


Figure 4: Photovoltaic (PV) and battery breakers

- PV aggregate (PVA) breaker: The PV bus and DER bus are internally connected through the preinstalled PV aggregate breaker, which serves as the default rapid shutdown initiator. The PVA breaker isolates the PV bus and DER bus when turned off.
- DER relay: The bus connecting the PV and battery to the backfeed panel is connected through a DER relay on the backfeed lugs. This latching DER relay isolates the PV, batteries, EV chargers, and loads connected to the load controller position in the IQ Combiner 6C from the home or utility. The relay is controlled internally by the combiner controller board (CCB), with no manual control.
- Battery switches: Switches are located on the cover of each 5 kWh battery. The battery cover is lockable, preventing any unauthorized access to the switches. The switches on the battery cover are lockable. In addition, the cover is secured to the battery using two screws, one on each side of

the battery. The cover can only be removed by using a tool to unscrew two screws and by using a tool to open the flap below the switches and disconnect the switch from the battery.

The following figure shows an internal view of the IQ Combiner 6C.

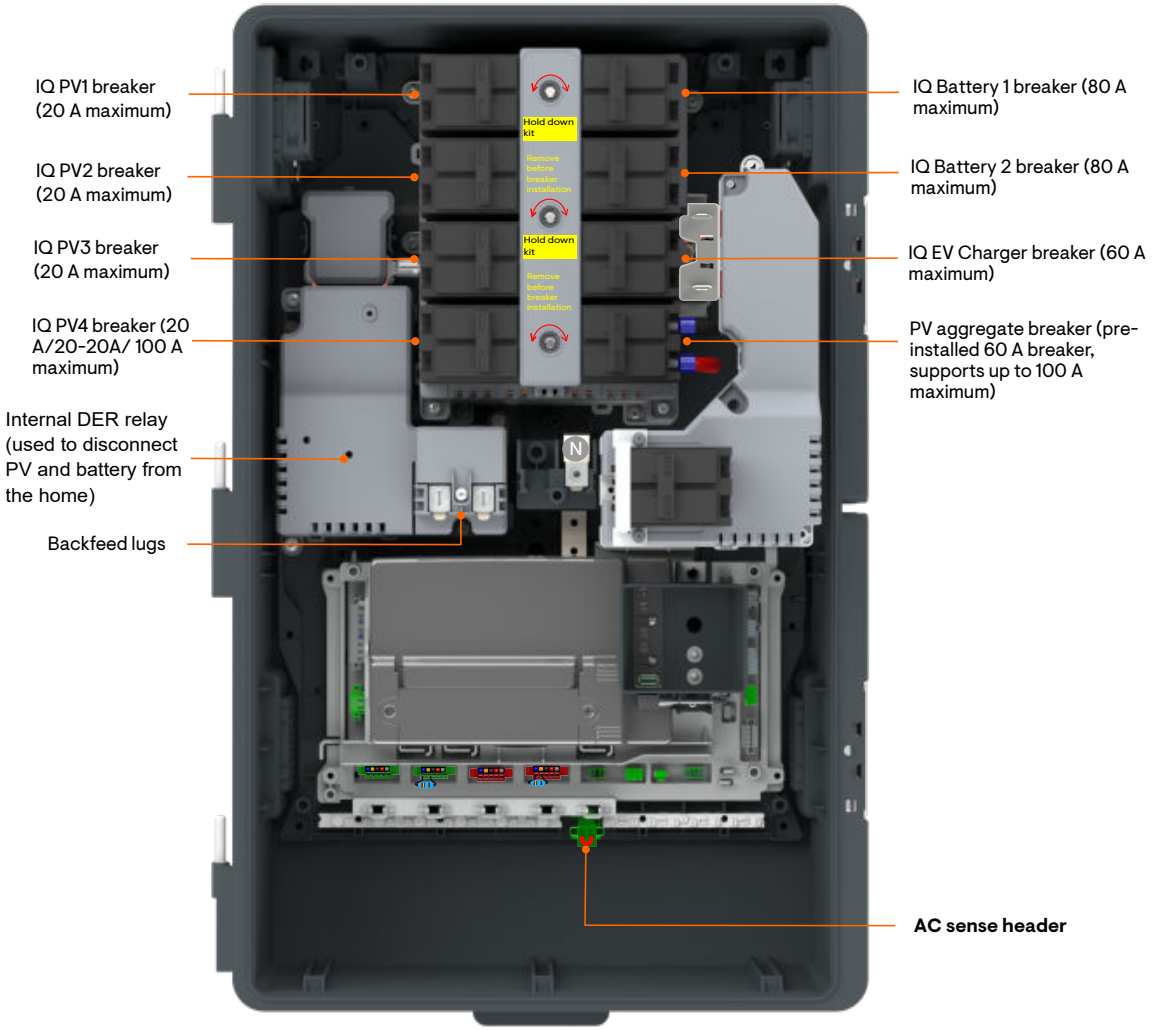


Figure 5: IQ Combiner internal view

The following figure shows IQ Battery 10C with the switches locked to prevent unauthorized turn ON.

Figure 6: Battery switches

3. Shutdown initiators in the system

In an Enphase Energy System, multiple initiators are involved in system shutdown and isolation. These include:

- PV breakers labeled as IQ PV1, IQ PV2, IQ PV3, and IQ PV4 are used to isolate PV circuits.
- Battery breakers labeled IQ B1 and IQ B2 are used to isolate battery circuits.
- A PV aggregate breaker labeled as PVA, which also functions as a shutdown initiator.
- Battery DC switches are used to disconnect batteries.
- Backfeed breakers are used to disconnect the IQ Combiner 6C from the main panel.

External disconnects

- Grid-side disconnect (on the backfeed to the backup panel)
- PV-side disconnect inline with the PV aggregate breaker (2-pole)
- PV disconnect inline with external combiners (2-pole or 3-pole)

3.1 External shutdown initiators and disconnect options

If the IQ Combiner 6C is installed in a readily accessible outdoor location, the PV aggregate breaker also functions as the rapid shutdown (RSD) initiator for grid-forming systems. However, if the IQ Combiner 6C is not installed in an accessible outdoor location, or if local regulations require a visible blade disconnect, an external disconnect should be installed to serve as the RSD initiator.

The following are externally installed isolation/shutdown means supported for grid-tied/grid-forming systems:

- Grid-side disconnect (on backfeed to backup panel)
- PV disconnect in line with the PV aggregate breaker
- PV disconnect in line with external combiner (2-pole)
- PV disconnect in line with external combiner (3-pole)

Refer to the System shutdown behavior on page 18 section to understand the system shutdown behavior for grid-tied and grid-forming systems, and to learn which components are shut down or disconnected by each initiator.

3.1.1 Grid-side disconnect (on the backfeed to the backup panel)

A 3-pole disconnect is placed on the backfeed from the combiner to the backup panel, with the 2-pole connected to the backfeed panel, and the third pole connected to the AC sense header on the IQ Combiner 6C.

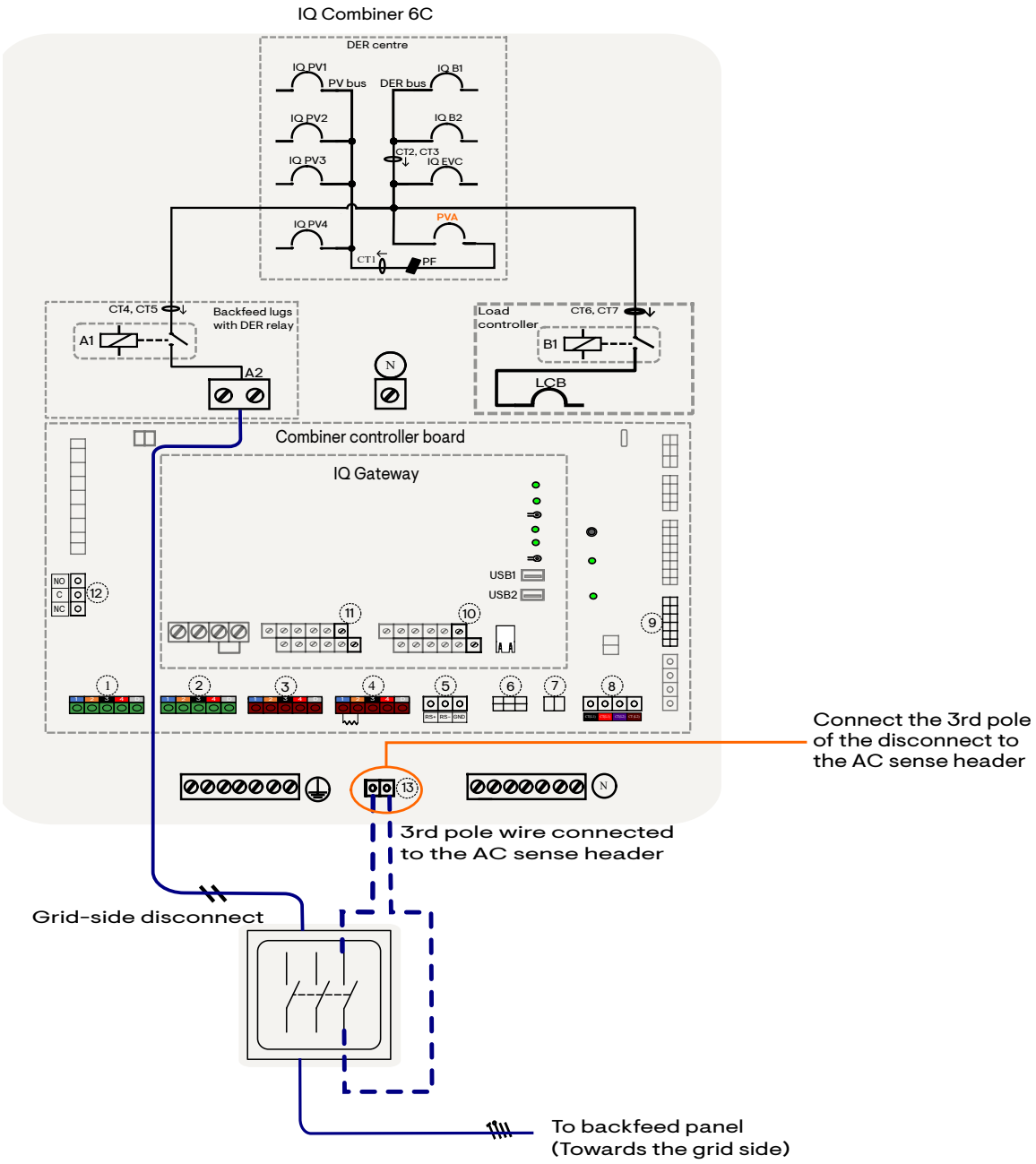


Figure 7: Grid-side disconnect (on the backfeed to the backup panel)

3.1.2 PV disconnect in line with the PV aggregate breaker

The 2-pole disconnect is placed between the IQ Combiner 6C and the PV branch circuits.

Install a 2-pole disconnect by looping the wire from the PV aggregate breaker to the disconnect. Connect the wires from the PV aggregate breaker to the external disconnect using insulated inline splice connectors.

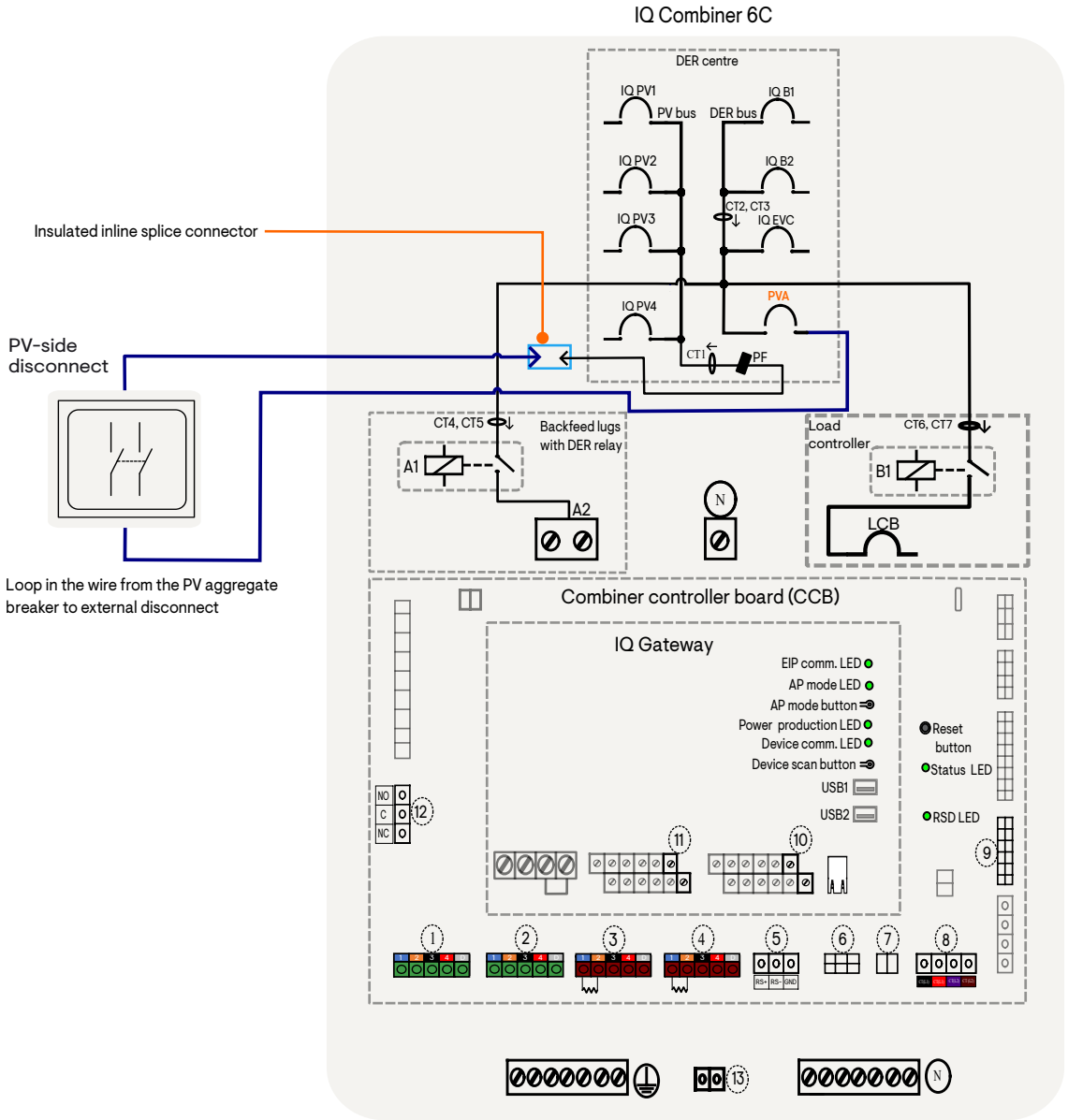


Figure 8: PV disconnect in line with PV aggregate breaker

3.1.3 PV disconnect in line with the external combiner (2-pole)

The 2-pole disconnect is placed between the IQ Combiner 6C and the external combiner, with the external combiner aggregation landing on PV4 spaces within IQ Combiner 6C.

NOTE: A 2-pole grid-side disconnect can be used for a grid-tied (non-backup) system, without a connection to the AC sense header.

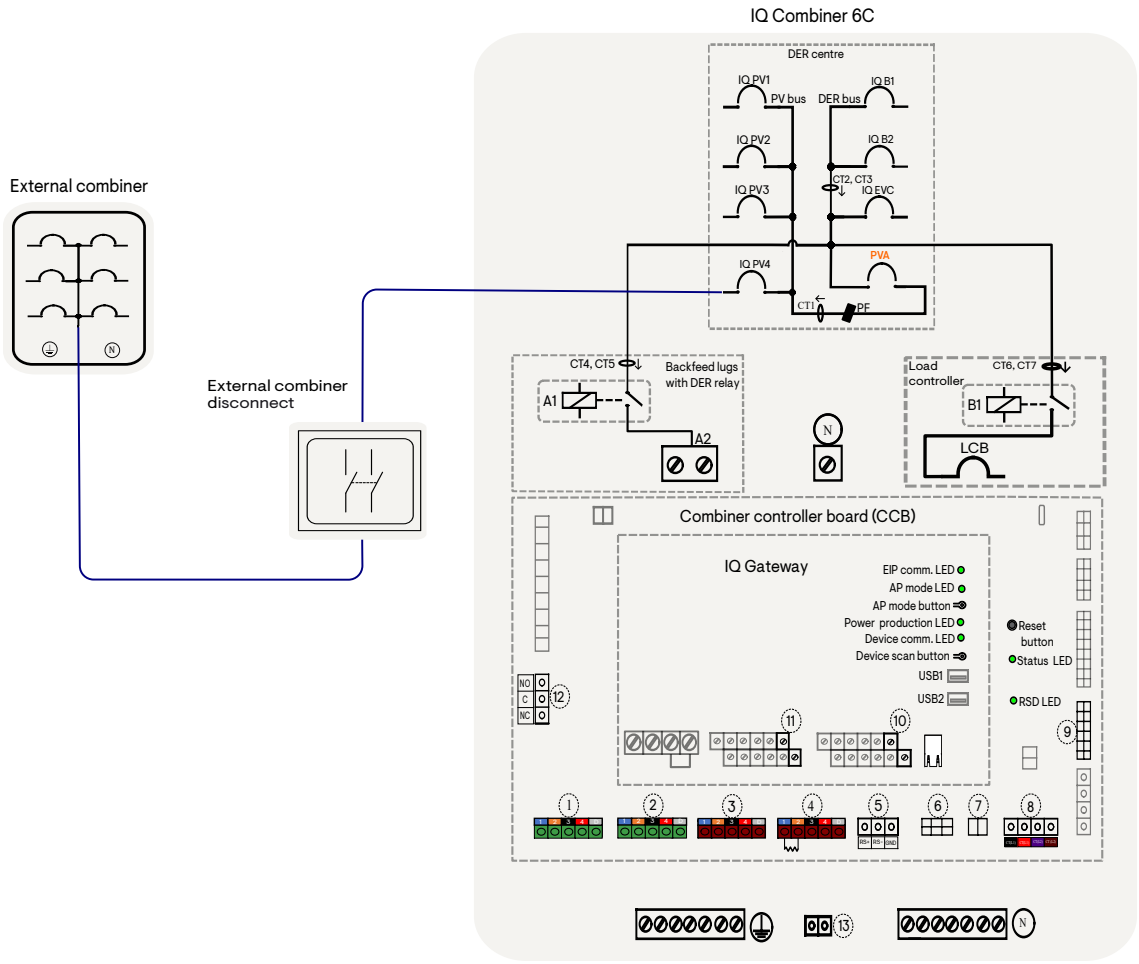


Figure 9: PV disconnect in line with external combiner (2-pole)

3.1.4 PV disconnect in line with the external combiner (3-pole)

The 3-pole disconnect is placed between the IQ Combiner 6C and the external combiner, with the external combiner aggregation landing on PV4 spaces within IQ Combiner 6C. Two poles are wired to the external combiner, and the third pole is wired to the AC sense header, facilitating the energy storage system (ESS) emergency shutdown.

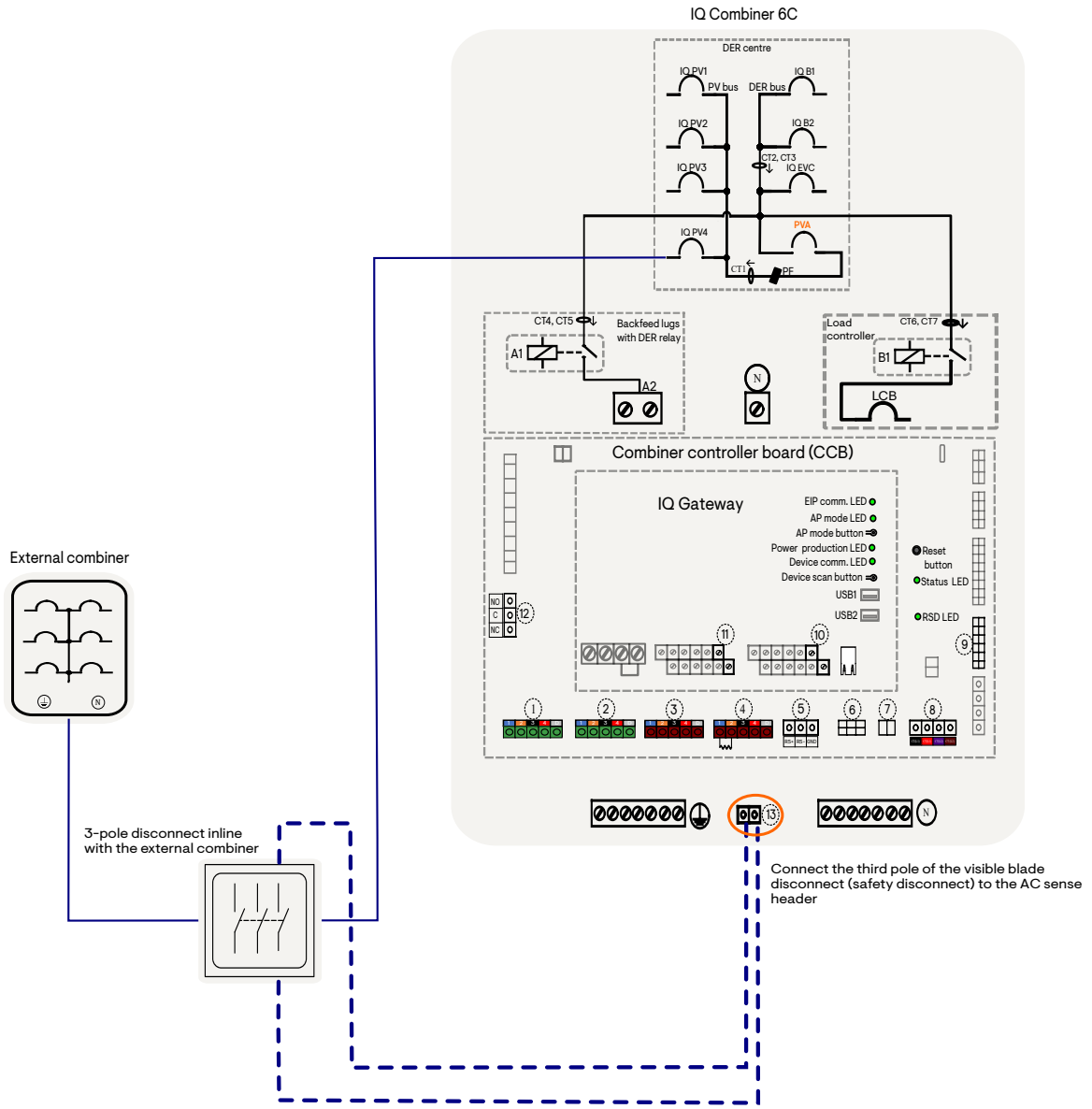


Figure 10: PV disconnect in line with external combiner (3-pole)

4. First responder shutdown procedure for PV systems

For a grid-tied system, in case of emergencies, the first responder should turn off any of the following:

- PV aggregate breaker[1]
- Backfeed breaker in the main panel
- Grid-side disconnect (3-pole)
- PV disconnect in line with the PV aggregate breaker (2-pole)[1]
- PV disconnect in line with the external combiner (2-pole)[1]
- PV disconnect in line with the external combiner (3-pole)[1]

[1] Only applicable for PVs and not for batteries.

For a grid-forming system, in case of emergencies, the first responder should turn off any of the following:

- PV aggregate breaker
- Grid-side disconnect (3-pole)
- PV disconnect in line with the PV aggregate breaker (2-pole)
- PV disconnect in line with the external combiner (2-pole)
- PV disconnect in line with the external combiner (3-pole)

5. Maintenance shutdown procedure

For maintenance on specific sections of the distributed energy resources (DER) systems, follow the procedure below to disconnect the related circuitry. This ensures that only the failed system is isolated and disconnected, while the rest of the circuitry remains functional, maintaining power to the home.

5.1 Maintenance on PV lines

For maintenance on the microinverters or their related circuitry, open the PV breakers (IQ PV1, IQ PV2, IQ PV3, IQ PV4, PVA) to isolate and disconnect the PV wiring from the premises wiring. Isolation can also be achieved through a PV disconnect (2-pole) if installed at the site.

NOTE: Turning off the PVA aggregate breaker will also shut down the batteries for grid-forming systems.

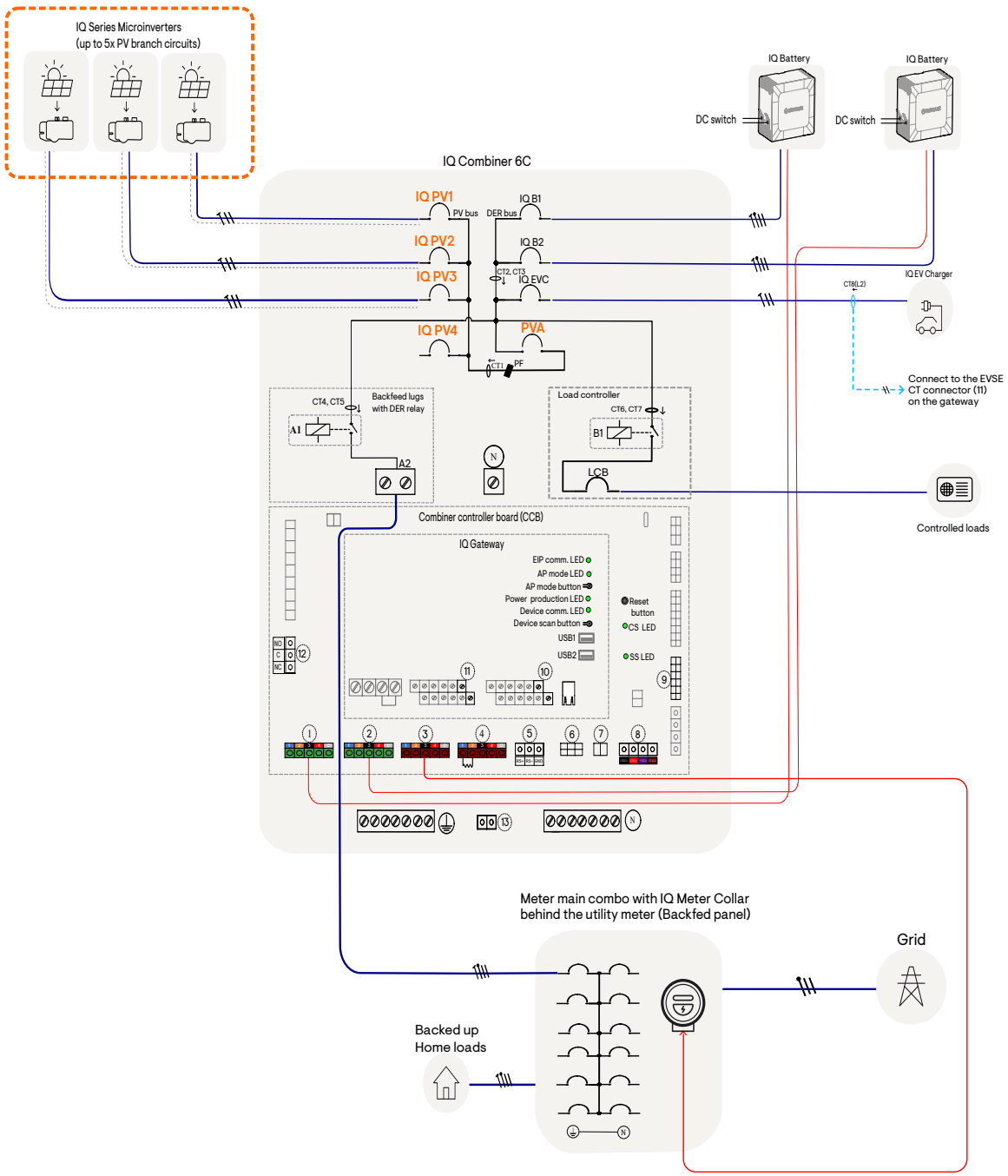


Figure 11: Maintenance on PV lines

5.2 Maintenance on battery lines

For maintenance of batteries and their related circuitry, open the battery breakers (IQ B1 and IQ B2, as mentioned in the following figure) to isolate and disconnect the battery wiring from the premises wiring. Additionally, ensure to turn off the battery switches to completely power down the batteries.

NOTE: Ensure that the battery DC switches are held for more than 5 seconds to turn them off.

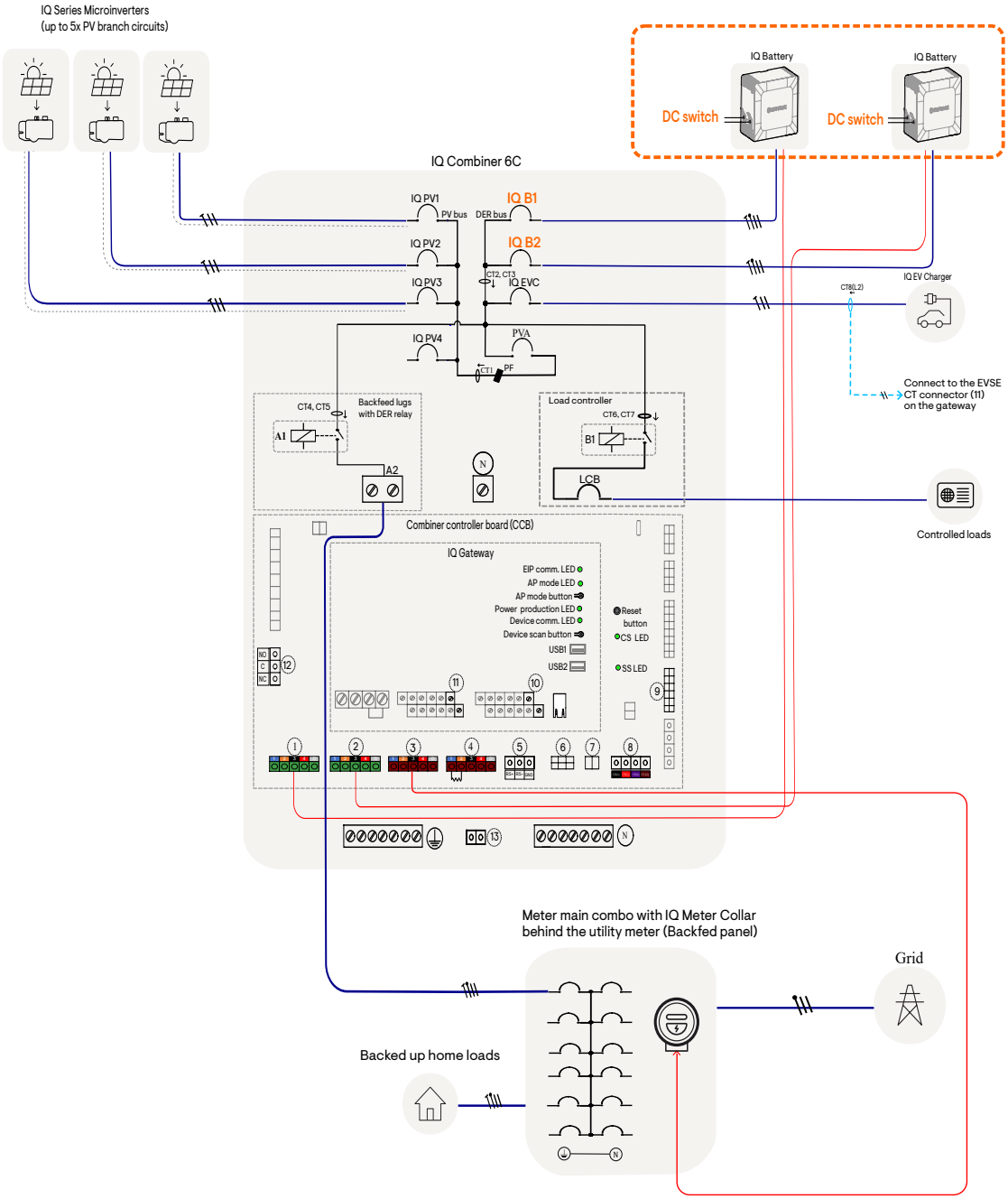


Figure 12: Maintenance on battery lines

6. System shutdown procedure

Initiate system shutdown:

- Turn OFF the PV aggregate breaker. If using a grid-side or PV-side disconnect as a rapid shutdown device (RSD) device, ensure it is turned OFF.
- Turn OFF the PV, battery, EVSE, and load controller breakers.
- Turn OFF the switches in the batteries.

NOTE: Switch OFF the backfeed breaker in the main/load panel.

NOTE: Confirm that the combiner status (CS) and shutdown status (SS) LEDs are OFF.

Exit system shutdown:

- Turn ON the switch in the batteries.
- Turn ON the PV, battery, EVSE, and load controller breakers.
- Turn ON the PV aggregate breaker. If using a grid-side or PV-side disconnect as an RSD device, ensure it is turned ON.

NOTE: Switch ON the backfeed breaker in the main/load panel.

NOTE: Combiner status (CS) and shutdown status (SS) LEDs will be illuminated.

7. System shutdown behavior

The 4th-generation Enphase Energy Systems provide various methods for achieving isolation and system shutdown. The behavior of the system in providing these functions varies depending on the installed configuration and the disconnect options chosen.

7.1 Grid-tied (non-backup) system shutdown behavior

7.1.1 Normal behavior

A grid-tied system operates with microinverters that follow the grid reference voltage. Any loss of grid reference voltage due to an outage or abnormality causes the microinverters and batteries to stop producing power.

7.1.2 Initiators in the grid-tied system

In an Enphase Energy System, multiple initiators are involved in system shutdown and isolation. These include:

- PV breakers labeled as IQ PV1, IQ PV2, IQ PV3, and IQ PV4, used to isolate PV circuits.
- Battery breakers labeled IQ B1 and IQ B2, used to isolate battery circuits.
- A PV aggregate breaker labeled as PVA, which also functions as a shutdown initiator.
- Battery DC switches, used to disconnect batteries.
- A backfeed breaker, used to disconnect the IQ Combiner 6C from the main panel.
- External disconnects.
    - Grid-side disconnect (on the backfeed to the backup panel).
    - PV-side disconnect inline with the PV aggregate breaker (2-pole).
    - PV disconnect inline with external combiners (2-pole or 3-pole).

NOTE: The following figure illustrates a site setup utilizing a PV-side disconnect inline with the PV aggregate breaker. However, other configurations may be used depending on site-specific requirements.

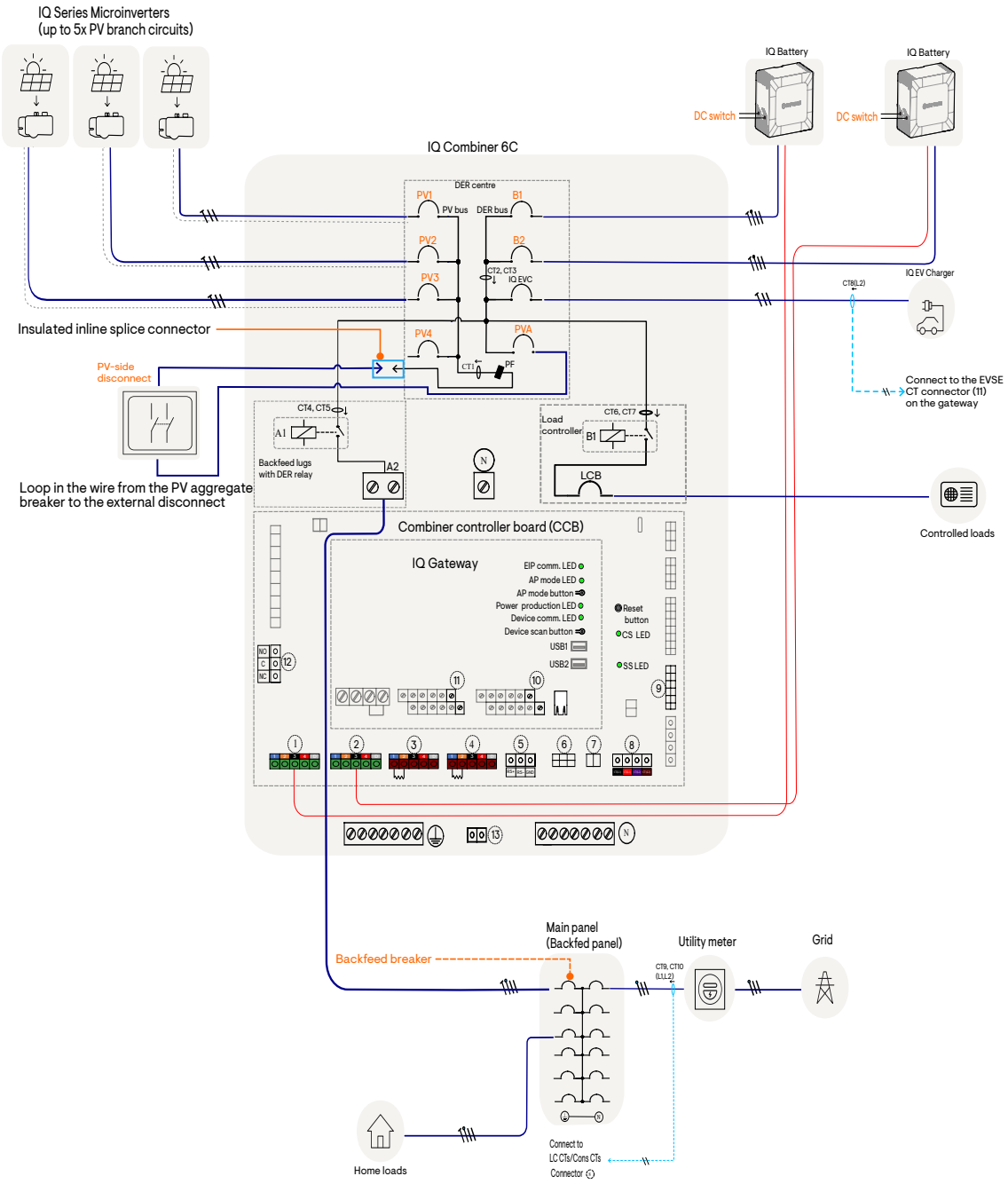


Figure 13: A site setup utilizing a PV-side disconnect inline with the PV aggregate breaker

7.1.3 Shutdown mechanism

For shutdown, the system senses the opening and closing of the PV aggregate breaker to initiate the shutdown procedure. The combiner also detects any loss of continuity between the two terminals on the AC sense header when a third pole of the disconnect is connected to it.

7.1.4 Grid-tied system behavior

The following table illustrates the system's behavior when any of the initiators is used for system shutdown, assuming the grid is available, and the battery State of Charge (SoC) is within normal limits.

Table 1: Grid-tied (non-backup) system shutdown behavior

Location in the system	Initiators	PV isolated from the grid	PV isolated from batteries	Batteries isolated from the grid	DER relay status post initiation	Battery output voltage (V)[2]	PV voltage post initiation (V)[3]
IQ Combiner 6C	PV aggregate breaker	Yes	Yes	No	Closed	240	0
	All PV branch circuit breakers (IQ PV1/PV2/PV3/PV4)	Yes	Yes	No	Closed	240	0
	Battery breaker(s)	No	Yes	Yes	Closed	0	240
Battery	Battery switch(s)	No	Yes	Yes	Closed	0[4]	240
Main panel	Backfeed breaker	Yes	No	Yes	Closed	0	0
External disconnect [5]	Grid-side disconnect (on backfeed to backup panel)	Yes	No	Yes	Closed	0	0
	PV disconnect in line with the PV aggregate breaker	Yes	Yes	No	Closed	0[4]	0
	PV disconnect in line with the external combiner (2-pole)	Yes	Yes	No	Closed	240	0
	PV disconnect in line with the external combiner (3-pole)	Yes	Yes	No	Closed	240	0

For example, when the PV aggregate breaker is turned OFF in a grid-tied system, the following occurs:

- Rapid shutdown events are triggered by the system.
- DER relay remains closed.
- The battery's AC terminals will remain energized when grid power is present. However, the battery system will not export energy to the grid and cannot operate independently in the absence of grid power.
- The photovoltaic (PV) system is electrically isolated from both the battery storage and the premises wiring.

[2] Voltage measured at the battery AC terminals.
[3] Voltage measured at PV inverter AC terminals.
[4] Battery will not energize its AC terminals; however, these may still remain energized by the utility grid.
[5] Location and option of disconnects may vary based on system configurations.

7.2 Grid-forming (backup) system shutdown behavior

7.2.1 Normal behavior

When connected to the grid, microinverters and batteries follow the grid reference voltage. During microgrid formation, batteries establish their own grid, and the PV system uses the battery as a reference.

7.2.2 Initiators in the grid-forming system

In an Enphase Energy System, multiple initiators are involved in system shutdown and isolation. These include:

- PV breakers labeled as IQ PV1, IQ PV2, IQ PV3, and IQ PV4, used to isolate PV circuits.
- Battery breakers labeled IQ B1 and IQ B2, used to isolate battery circuits.
- A PV aggregate breaker labeled as PVA, which also functions as a shutdown initiator.
- Battery DC switches, used to disconnect batteries.
- A backfeed breaker, used to disconnect the IQ Combiner 6C from the main panel.
- External disconnects.
  - Grid-side disconnect (on the backfeed to the backup panel).
  - PV-side disconnect inline with the PV aggregate breaker (2-pole).
  - PV disconnect inline with external combiners (2-pole or 3-pole).

NOTE: The following figure illustrates a site setup utilizing a grid-side disconnect (on the backfeed to the backup panel). However, other configurations may be used depending on site-specific requirements.

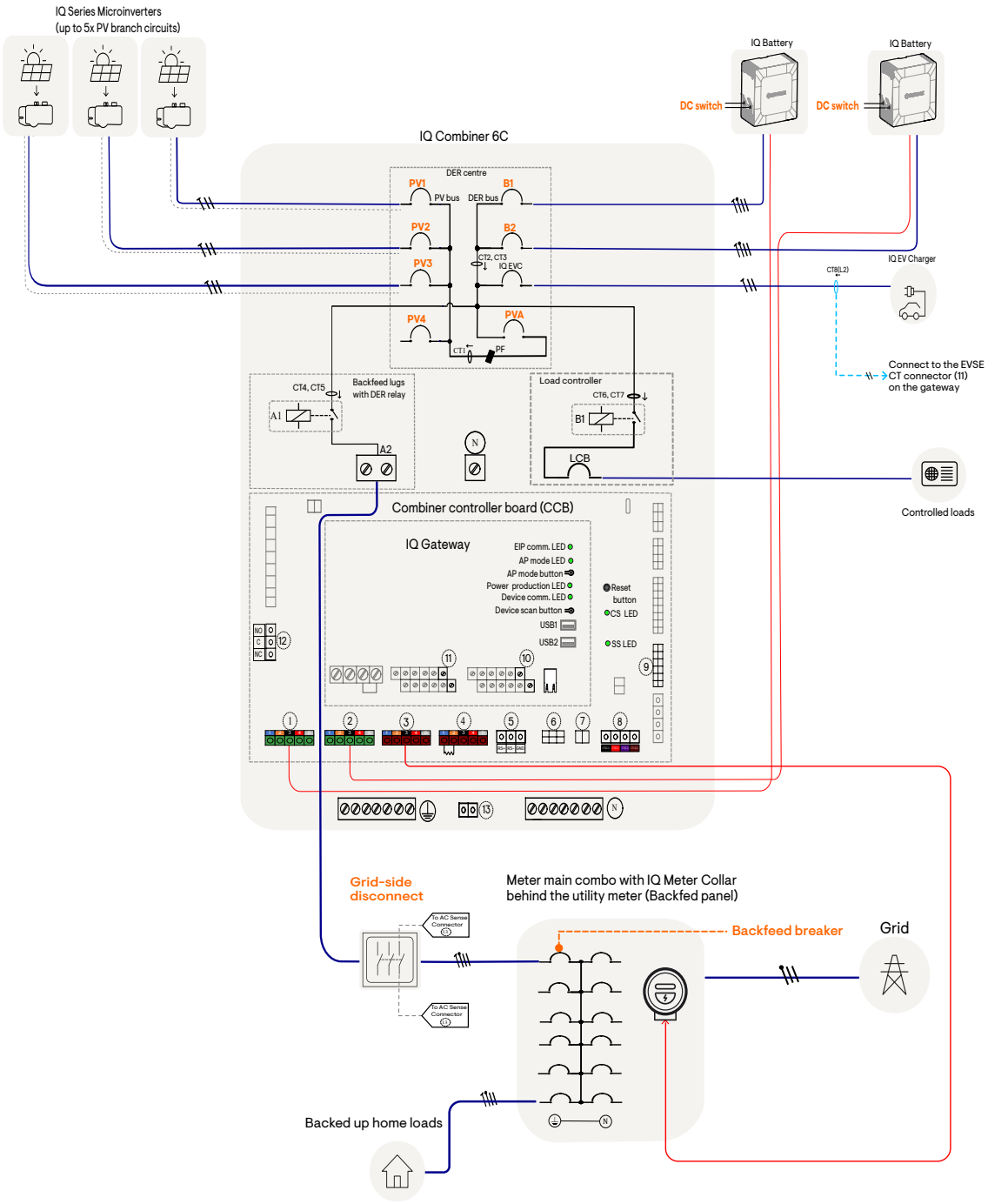


Figure 14: A site setup utilizing a grid-side disconnect

7.2.3 Shutdown mechanism

The system senses the opening and closing of the PV aggregate breaker to initiate the shutdown procedure. The combiner detects any loss of continuity between the two terminals of the AC sense header when a third pole of the disconnect is connected to it.

7.2.4 Grid-forming system behavior

The following table illustrates the system's behavior when any of the initiators is used for system shutdown, assuming the grid is available, the battery State of Charge (SoC) is within normal limits, and the system includes an IQ8 Microinverter or higher.

Table 2: Grid-forming (backup) system shutdown behavior

Location in the system	Initiators	PV isolated from the grid	PV isolated from batteries	Batteries isolated from the grid	DER relay status after initiation	Battery output voltage (V) [6]	PV voltage (V) [7]
IQ Combiner 6C	PV aggregate breaker	Yes	Yes	Yes	Open	<30	<30
	All PV branch circuit breakers (IQ PV1/PV2/PV3/PV4)	Yes	Yes	No	Closed	240	<30
	Battery breaker(s)	No	Yes	Yes	Closed	<30	240
Battery	Battery switch(s)	No	Yes	Yes	Closed	0	240
Main panel	Backfeed breaker	Yes	No	Yes	Open	<30	<30
External disconnect[8]	Grid-side disconnect (on backfeed to backup panel)	Yes	No	Yes	Open	<30	<30
	PV disconnect in line with the PV aggregate breaker	Yes	Yes	Yes	Open	<30	<30
	PV disconnect in line with the external combiner (2-pole)	Yes	Yes	No	Closed	240	<30
	PV disconnect in line with the external combiner (3-pole)	Yes	Yes	Yes	Open	<30	<30

IMPORTANT: Use battery breakers in addition to this shutdown initiator if doing maintenance on battery AC wires.

For example, when shutdown is initiated through a PV aggregate breaker for a grid-forming system, the following occurs:

6 Voltage measured at the battery AC terminals.
7 Voltage measured at PV inverter AC terminals.
8 Location and options of disconnects may vary based on system configurations.

- Rapid shutdown events are triggered by the system.
- The DER relay opens for grid-forming systems.
- The battery voltage drops to a touch-safe level, completely stopping power export from the terminals.
- The photovoltaic (PV) system is electrically isolated from both the battery storage and the premises wiring. Upon losing reference signals from the battery and the grid, the PV system reaches a touch-safe voltage level, enhancing safety for maintenance personnel and first responders.

8. NEC and utility-compliant disconnect options

8.1 Applicable NEC 2023 codes

- PV rapid shutdown (2023 NEC 690.12): Rapid shutdown is an essential safety feature for PV systems installed on buildings. It ensures that in emergencies, such as fires, the voltage of solar panels is quickly reduced to a safe level. This greatly helps protect firefighters and other emergency responders from electrical hazards, making it safer for them to perform their duties. The initiator labeled as "Rapid Shutdown" must be located in a readily accessible outdoor location.
- ESS Emergency Shutdown (2023 NEC 706.15B): Energy storage system (ESS) emergency shutdown is a safety feature that allows you to quickly and safely turn off your energy storage system in case of an emergency. It ceases the ESS from exporting power to the grid or any other load. This helps protect the home and ensures the safety of emergency responders. The initiation device for the ESS emergency shutdown must be located in a readily accessible outdoor location.
- PV system disconnecting means (2023 NEC 690.13): A PV System disconnecting means is a safety feature in the solar power system. It allows you to quickly and safely disconnect the solar panels from the rest of the electrical system. This is important for maintenance, repairs, or in case of an emergency.
- ESS disconnecting means (2023 NEC 706.15): An ESS system disconnecting means is a safety feature for all energy storage systems. It allows for the quick and safe disconnection of the energy storage system from all other electrical systems. This is important for maintenance, repairs, or in case of an emergency.
- Visible break for the DER system (only required by AHJ or utility): This may be mandated by the Authority Having Jurisdiction (AHJ) or utility company to ensure safe maintenance and operation of the system. It allows for clear, visible confirmation that the electrical connection has been disconnected.

8.2 Compliance matrix: Grid-tied system

The IQ Combiner 6C supports NEC 2023 initiators and utility or AHJ requirements for grid-tied systems under different system configurations.

Initiators for various NEC or utility requirements	In IQ Combiner 6C		In IQ Battery 10C	In the main panel	External disconnects			
Applicable NEC sections	PV aggregate breaker	Battery breakers	Battery switches	Back-feed breaker	3-pole, grid-side disconnect	2-pole PV disconnect in line with PV aggregate breaker	2-pole PV disconnect in line with external combiner	3-pole PV disconnect in line with external combiner
PV rapid shutdown (2023 NEC 690.12)	Yes	No	No	Yes	Yes	Yes	Yes	Yes
ESS emergency shutdown (2023 NEC 706.15B)	No	Yes	Yes	Yes	Yes	Yes	No	No
PV System disconnecting means (2023 NEC 690.13)	Yes	No	No	No	No	Yes	Yes	Yes
ESS disconnecting means (2023 NEC 706.15)	No	Yes	Yes	No	No	No	No	No
Visible break for the DER system (Only if required by AHJ or utility)	No	No	No	No	No	No	No	No

NOTE: The list applies when the IQ Combiner 6C, IQ Battery, and main panel are installed in readily accessible outdoor locations. If any of these system components are not installed in readily accessible outdoor locations, the respective initiators within the components shall not be considered as PV rapid shutdown or ESS emergency shutdown requirements.

8.3 Compliance matrix: Grid-forming system

The IQ Combiner 6C supports NEC 2023 initiators and utility or AHJ requirements for grid-tied systems under different system configurations.

Initiators for various NEC or utility requirements	**In IQ Combiner 6C**		**In IQ Battery 10C**	**In the main panel**	**External disconnects**			
Applicable NEC sections	PV aggregate breaker	Battery breakers	Battery switches	Back-feed breaker	3-Pole, grid-side disconnect	2-Pole PV disconnect in line with PV aggregate breaker	2-Pole PV disconnect in line with external combiner	3-Pole PV disconnect in line with external combiner
PV rapid shutdown (2023 NEC 690.12)	Yes	No	No	Yes	Yes	Yes	Yes	Yes
ESS emergency shutdown (2023 NEC 706.15B)	Yes	Yes	Yes	No	Yes	Yes	No	Yes
PV system disconnecting means (2023 NEC 690.13)	Yes	No	No	No	Yes	Yes	Yes	Yes
ESS disconnecting means (2023 NEC 706.15)	No	Yes	Yes	No	Yes	No	No	No
Visible break for the DER system (Only if required by AHJ or utility)	No	No	No	No	Yes	No	No	No

NOTE: The list applies when the IQ Combiner 6C, IQ Battery, and main panel are installed in readily accessible outdoor locations. If any of these system components are not installed in readily accessible outdoor locations, the respective initiators within the components shall not be considered as PV rapid shutdown or ESS emergency shutdown.

9. Disconnect models

9.1 3-pole disconnect models

When selecting a 3-pole disconnect for PV disconnect or grid-side disconnect, ensure the disconnect meets the rating requirements, has the proper environmental rating, and can accept the conductor sizes for both the current-carrying conductors and AC sense conductors. Some generally available models of outdoor located 3-pole visible blade disconnects used as PV-side disconnects or grid-side disconnects are mentioned in the IQ Combiner 6C quick install guide.

9.2 2-pole disconnect models

When selecting a 2-pole disconnect for a PV disconnect, ensure the disconnect meets the rating requirements and has the proper environmental rating. Some generally available models of outdoor located 2-pole visible blade disconnects used as PV-side disconnects are mentioned in the IQ Combiner 6C quick install guide.

10. System Shutdown Switch for IQ Combiner 6C

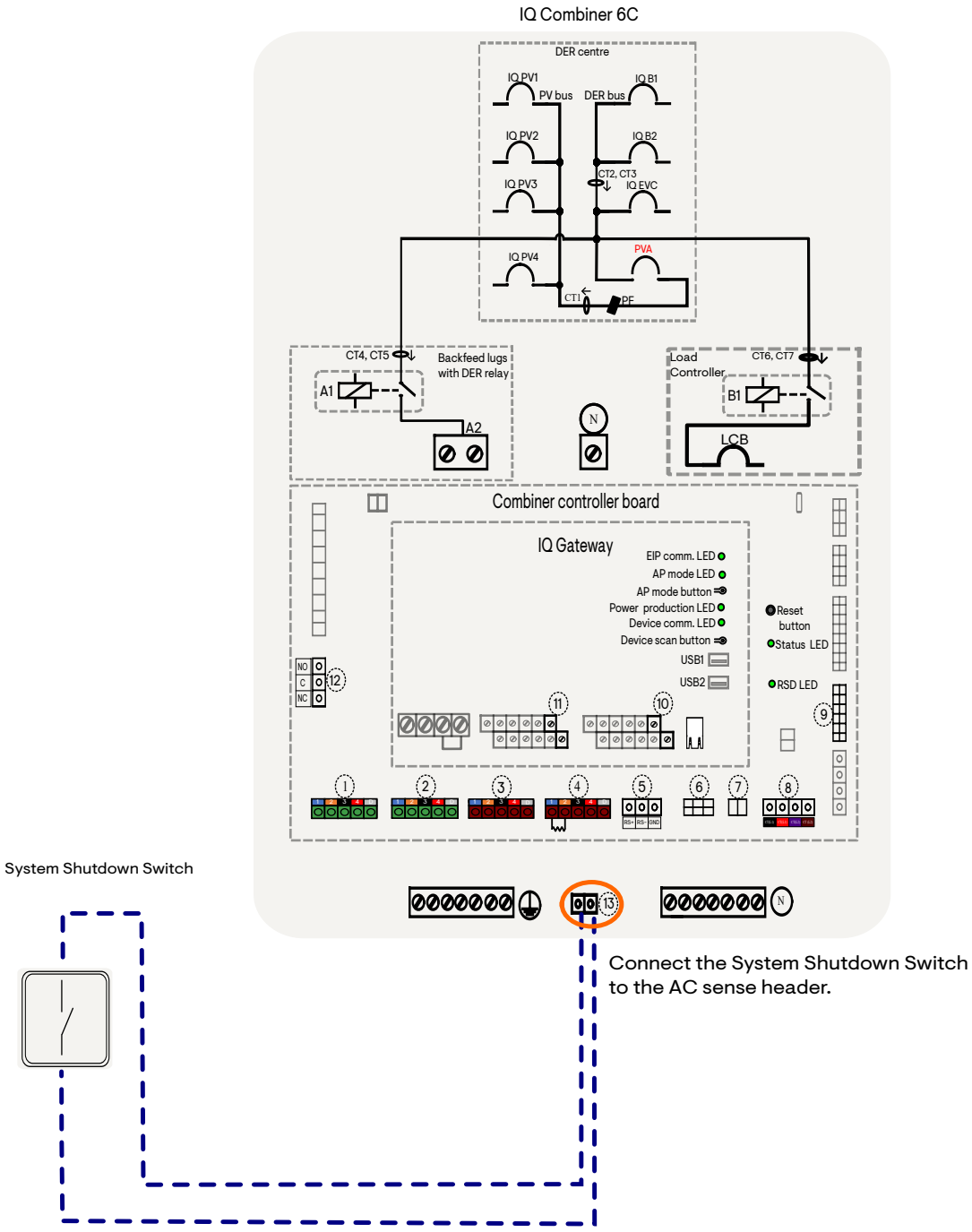
The 4th-generation Enphase Energy System, equipped with the IQ Battery 10C and IQ Combiner 6C, supports a System Shutdown Switch in addition to the disconnects mentioned earlier. A UL-approved, single-pole AC-rated switch[9] can be connected to the IQ Combiner 6C to enable system shutdown.

NOTE:

1. The System Shutdown Switch is applicable for grid-forming (backup) systems only; it cannot be used with a grid-tied (non-backup) system.
2. Ensure compliance with local and national codes and standards when using the material provided in this brief and other Enphase-provided installation guides.
3. The System Shutdown Switch must not be used as the sole means of isolation during maintenance. Always ensure that turning OFF this switch is accompanied by opening all DER breakers, PV breakers, and battery breakers in the IQ Combiner 6C.

The switch is wired to the IQ Combiner 6C as shown in the following image.

[9] 2-pole or higher may be used with the AC sense header being connected to one of the poles.



Connect the System Shutdown Switch to the AC sense header.

The System Shutdown Switch must always be installed in an outdoor, visible, and readily accessible location. The switch must be lockable in the OFF or open position.

When the switch is turned to the OFF position, the IQ Combiner 6C will open DER relay[10] to disconnect the output of the IQ Combiner 6C from the backup panel (main or subpanel that is backfed by the IQ Combiner 6C).

This ensures:

[10] Opening of the DER relay applicable for grid-forming and backup systems only.

- All PV microinverters (IQ6, IQ7, or IQ8 Series) that are wired to the PV breakers of the IQ Combiner 6C are disconnected and isolated.[11]
- All Enphase IQ Batteries wired to the battery breakers of the IQ Combiner 6C are disconnected and isolated.
- IQ Combiner 6C, in addition, senses the switch turn-off and ensures that multi-mode functionality in PV microinverters and IQ Batteries is turned off.

Note that the AC wire from the AC sense header to the switch is not touch safe and cannot be used to supply any load. The header has internal fuses rated at 600 V AC RMS and 1.25 A to protect against faults. Therefore, no external overcurrent protection is required on the sense circuit.

The shorting jumper on the AC sense header must be removed, and a System Shutdown Switch is wired to the header. When the switch is turned off, and the utility grid is also off, then the voltage at the lugs to the main panel (as indicated above) can be measured and will be de-energized, i.e., 0 V.

To perform equipment maintenance, isolating specific parts of the system, i.e., PV or ESS, may be required. The means for such isolation, along with relevant code sections, are provided below:

1. PV System disconnecting means (2023 NEC 690.13): An Aggregate PV breaker or a disconnect in line with the aggregate PV breaker can be used.
2. ESS disconnecting means (2023 NEC 706.15): Battery breakers or a disconnect inline with battery breakers or the lockable switch on each IQ Battery 10C can be used.

Details of the above, as well as alternate means of initiating PV Rapid Shutdown and ESS Emergency Shutdown, are outlined in the IQ Combiner 6C quick install guide.

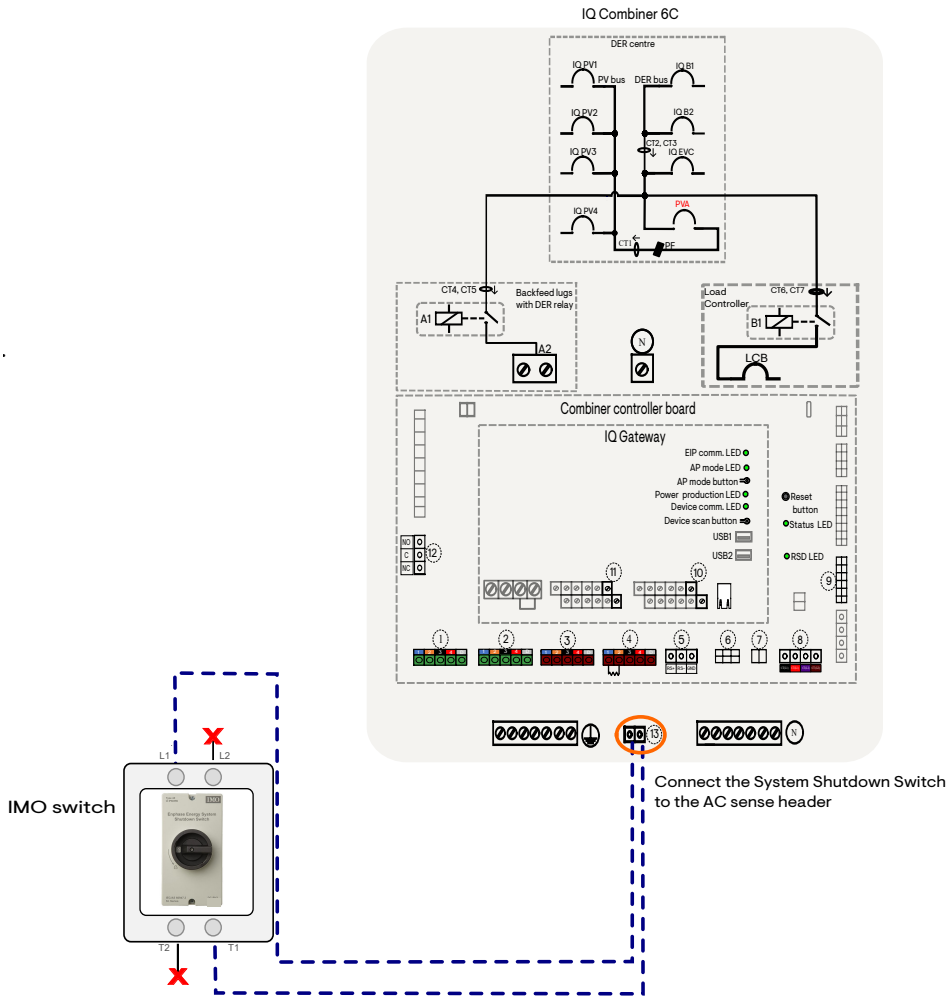
10.1 Potential options for shutdown switch wiring

Option 1: Enphase system shutdown switch

Connect the AC sense header in IQ Combiner 6 to the L1 and T1 terminals on the System Shutdown Switch.

NOTE: This switch has two pairs of terminals, with each diagonally opposite pair forming a common pole. The AC sense wires must be connected to a diagonally opposite pair (e.g., L1 and T1). Do not connect the wires to adjacent terminals, as those belong to the same side of the switch and will cause improper operation.

[11] Disconnection and isolation rely on the opening of the relay, which cannot always be assured under all conditions. Always use additional means of disconnection and isolation to ensure safety.



The System Shutdown Switch from IMO Precision Controls Ltd. can be used for both AC and DC applications, as it is OEM-certified and UL-approved (up to 600 VAC/16 A), confirming its suitability for system shutdown functionality.

NOTE: Ensure that the DC-PV2 marking, as stated by the manufacturer, is covered.

IMO

To whom it may concern.

Subject: IMO P/N: SI16-PEL64R-2-ENP

IMO Precision Controls Ltd.
The Interchange
Frobisher Way
Hatfield
Hertfordshire
AL10 9TG

We IMO, hereby declare that the Si16-PEI64R-2-ENP is UL approved to 600v AC/16amps. Any loads below these ratings are covered and ok to use, based on the self-cleaning contact design. Customer can choose to cover the "DC-PV2" marking in the field when used with AC voltages within the aforementioned rating to avoid confusion in the field.

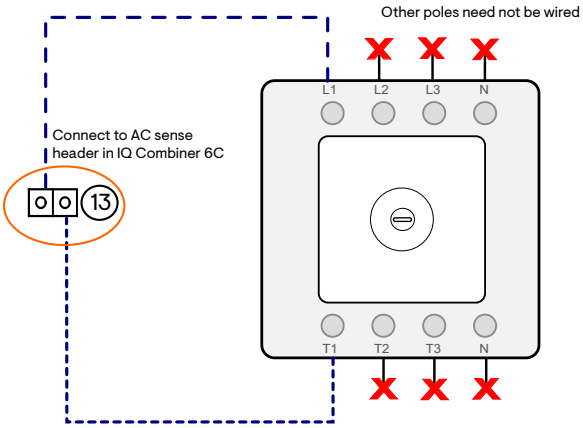
Joe Duignam
Quality Manager
IMO Precision Controls Ltd.
11 March 2026.

Option 2: 3 or 4-pole enclosed isolator switches

Use any standard 3-pole (or 4-pole), 20 A or lower enclosed, isolator switches.

Example: IMO PE69-3020L https://imoautomation.com/imo_us_usd_view/isolator-3-pole-20a-6249f2ee77dfd.html.

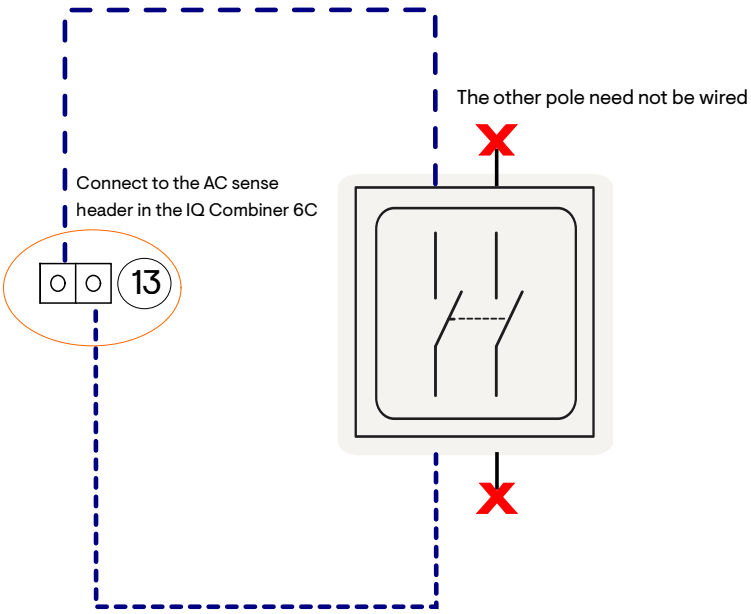
Only a single pole needs to be wired; the others can be left open, as shown in the following figure.



Option 3: 2-pole blade disconnect switch

Use any 2-pole knife-blade disconnect switch. Example: Siemens General Duty 30 A 2-Pole Safety Switch. This could be useful for AHJs that don't accept a switch and want a visible break. Wiring this would be similar to the safety switch, i.e., only one pole needs to be wired.

NOTE: It is recommended to use switches rated at 20 A or 30 A or lower, as the AC header supports wire gauges from 16–12 AWG. Larger switches may not be compatible with these smaller wire sizes.

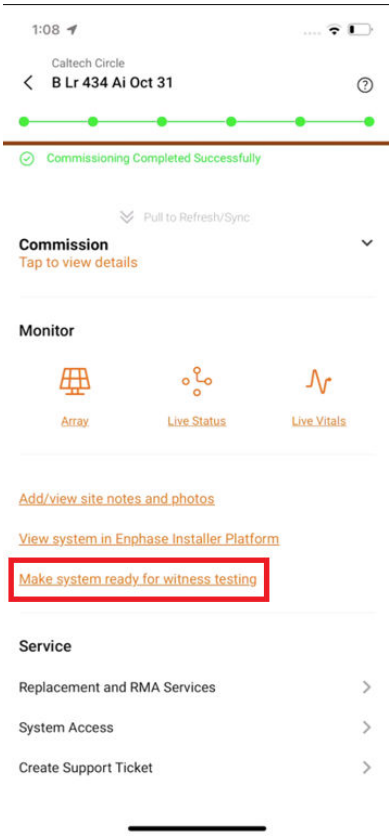


11. Utility witness test procedure

11.1 Pre-witness test system readiness checks

During commissioning, the Enphase Installer App temporarily sets certain grid-related parameters, such as enter-service delay and ramp rate to zero, to speed up microinverter production and battery charge/discharge. While this accelerates commissioning, it can cause compliance failures if witness testing begins before these parameters automatically revert to their grid-specific values.

To remove this dependency on timing, Enphase Installer App now includes a **Make system ready for witness testing** action. This feature immediately restores compliant settings, rather than requiring users to wait several hours after commissioning.



NOTE: For 4th-generation Enphase Energy Systems, the **Make system ready for witness testing** option is available in eSW version 8.3.4041 or later.

11.2 Grid-tied (non-backup) system - rapid shutdown test procedure

In a grid-tied PV system, rapid shutdown can be triggered through different disconnecting devices.

- PV aggregate breaker – See figure Grid-tied, Solar Plus Battery (without IQ Meter Collar)
- Backfeed breaker in the main panel – See figure Grid-tied, Solar Plus Battery (without IQ Meter Collar)
- Grid-side disconnect (2-pole/3-pole) – See figure Grid-side disconnect (on the backfeed to the backup panel)
- PV disconnect in line with the PV aggregate breaker (2-pole) – See figure PV disconnect in line with PV aggregate breaker
- PV disconnect in line with the external combiner (2-pole) – See figure PV disconnect in line with external combiner (2-pole)
- PV disconnect in line with the external combiner (3-pole) – See figure PV disconnect in line with external combiner (3-pole)

The following procedure describes how to verify rapid shutdown:

1. Turn off any applicable initiation device in the system.
2. Measure the voltage at the terminals listed in the table. The voltage should read zero volts.
3. Check and verify the status of the LED indicators.

Initiation device	Measure voltages at terminals
PV aggregate breaker	PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breaker, external combiner or PV-side of external PV disconnect
Backfeed breaker in the main panel	Backfeed lugs, PV aggregate terminals, IQ PV1/PV2/PV3/PV4 breaker, external combiner or PV-side of external PV disconnect
Grid-side disconnect (3-pole)	Backfeed lugs, PV aggregate terminals, IQ PV1/PV2/PV3/PV4 breaker, IQ B1/B2 breakers, external combiner or PV-side of external PV disconnect
PV disconnect in line with the PV aggregate breaker (2-pole)	PV aggregate terminals, IQ PV1/PV2/PV3/PV4 breaker, external combiner or PV-side of external PV disconnect
PV disconnect in line with the external combiner (2-pole)	External combiner or PV-side of external PV disconnect
PV disconnect in line with the external combiner (3-pole)	PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breaker

4. Verify the voltage at the devices according to the following table:

Initiation device (initiate any of them based on the site installation needs)	External combiner or PV-side of external PV disconnect	PV aggregate breaker terminals	IQ PV1/PV2/PV3/PV4 breaker terminals	Battery breaker terminals (IQ B1/B2)	Backfeed lugs
PV aggregate breaker	0 V	0 V	0 V	240 V	240 V
Backfeed breaker in the main panel	0 V	0 V	0 V	0 V	0 V
Grid-side disconnect (3-pole)	0 V	0 V	0 V	0 V	0 V
PV disconnect in line with the PV aggregate breaker (2-pole)	0 V	0 V	0 V	240 V	240 V

Initiation device (initiate any of them based on the site installation needs)	External combiner or PV-side of external PV disconnect	PV aggregate breaker terminals	IQ PV1/PV2/PV3/PV4 breaker terminals	Battery breaker terminals (IQ B1/B2)	Backfeed lugs
PV disconnect in line with the external combiner (2-pole)	0 V	240 V	240 V	240 V	240 V
PV disconnect in line with the external combiner (3-pole)	0 V	0 V	0 V	240 V	240 V

NOTE: The system shutdown (SS) LED alone should not be used to verify the rapid shutdown (RSD) status for either grid-tied or grid-forming systems. LED behavior may vary depending on the system configuration and the type of initiation device used to trigger RSD. Therefore, LED indication alone is not a reliable method for determining the RSD state unless it is accompanied by physical verification of the voltage at the terminals, as specified.

11.3 Grid-forming (backup) system - rapid shutdown test procedure

In a grid-forming PV system, rapid shutdown can be triggered through several different disconnecting devices.

- PV aggregate breaker – See figure Grid-forming, whole home backup (with IQ Meter Collar behind the utility meter)
- Grid-side disconnect (2-pole/3-pole) – See figure Grid-side disconnect (on the backfeed to the backup panel)
- PV disconnect in line with the PV aggregate breaker (2-pole) – See figure PV disconnect in line with PV aggregate breaker
- PV disconnect in line with the external combiner (2-pole) – See figure PV disconnect in line with external combiner (2-pole)
- PV disconnect in line with the external combiner (3-pole) – See figure PV disconnect in line with external combiner (3-pole)

The following procedure describes how to verify rapid shutdown:

1. Turn off any applicable initiation device in the system.
2. Measure the voltage at the terminals listed in the table. The voltage should read less than 30 V.
3. Check and verify the status of the LED indicators.

Initiation device	Measure voltage at terminals
PV aggregate breaker	PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breaker, external combiner or PV-side of external PV disconnect
Grid-side disconnect (3-pole)	Backfeed lugs, PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breaker, IQ B1/B2 breakers, external combiner or PV-side of external PV disconnect
PV disconnect in line with the PV aggregate breaker (2-pole)	PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breaker, external combiner or PV-side of external PV disconnect
PV disconnect in line with the external combiner (2-pole)	External combiner or PV-side of external PV disconnect
PV disconnect in line with the external combiner (3-pole)	PV aggregate breaker, IQ PV1/PV2/PV3/PV4 breakers, IQ B1/B2 breaker, external combiner or PV-side of external PV disconnect

4. Verify the voltage at the devices according to the following table:

Initiation device (initiate any of them based on the site installation needs)	External combiner or PV-side of the external PV disconnect	PV aggregate breaker terminals	IQ PV1/PV2/PV3/PV4 breaker terminals	Battery breaker terminals (IQ B1/B2)	Backfeed lugs
PV aggregate breaker	<30 V	<30 V	<30 V	<30 V	240 V
Backfeed breaker in the main panel	<30 V	<30 V	<30 V	<30 V	<30 V
Grid-side disconnect (3-pole)	<30 V	<30 V	<30 V	<30 V	0 V
PV disconnect in line with the PV aggregate breaker (2-pole)	<30 V	<30 V	<30 V	<30 V	240 V
PV disconnect in line with the external	<30 V	240 V	240 V	240 V	240 V

Initiation device (initiate any of them based on the site installation needs)	External combiner or PV-side of the external PV disconnect	PV aggregate breaker terminals	IQ PV1/PV2/PV3/PV4 breaker terminals	Battery breaker terminals (IQ B1/B2)	Backfeed lugs
combiner (2-pole)					
PV disconnect in line with the external combiner (3-pole)	<30 V	<30 V	<30 V	<30 V	240 V

NOTE: The system shutdown (SS) LED alone should not be used to verify the rapid shutdown (RSD) status for either grid-tied or grid-forming systems. LED behavior may vary depending on the system configuration and the type of initiation device used to trigger RSD. Therefore, LED indication alone is not a reliable method for determining the RSD state unless it is accompanied by physical verification of the voltage at the terminals, as specified.

11.4 Anti-islanding test procedure

Objective

The purpose of the anti-islanding test is to demonstrate that the system detects a loss of grid voltage and stops energizing the utility conductors within 2 seconds while continuing to provide backup to the home.

Test conditions before initiation

Before simulating grid loss, ensure the following:

1. Split-phase voltage (L1–L2) reads approximately 240 V.
2. If batteries are installed, the state of charge is within normal operating limits.
3. A clamp meter or power analyzer is installed on the service conductors to monitor export current.

Anti-islanding test procedure

The anti-islanding test shall be conducted as follows:

1. In grid-tied systems, isolation can be achieved using either the backfeed breaker in the main panel or a grid-side disconnect. In such cases, one of these devices shall be opened.
2. For grid-forming systems with an IQ Meter Collar, the preferred method is opening the grid-side 3-pole disconnect.
3. For grid-forming systems with IQ Meter Collar in a separate pan, open the upstream disconnect or breaker.

4. Observe the export current at the service conductors. The system must detect the loss of grid reference voltage and cease exporting power.
5. Measure the voltage on the utility-side conductors to verify that the system is not energizing the grid.

Expected system behaviour

Grid-tied (non-backup) system:

- As described in the shutdown behavior table, microinverters lose grid reference and stop producing power. Battery ceases exporting.
- The DER relay remains closed.
- No island is formed.
- No voltage is present on the utility conductors.

Grid-forming (backup with IQ Meter Collar) system:

- As described in the grid-forming shutdown behavior, the DER relay opens.
- Utility conductors are fully isolated.
- The system forms a microgrid supplying only the backup loads.
- PV and battery voltages drop to touch-safe levels if shutdown is initiated through appropriate devices.

Appendix A

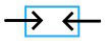
Abbreviations

Abbreviation	Description
DER	Distributed energy resource
EES	Enphase Energy System
ESS	Energy storage system
kW	Kilowatt
kVA	Kilovolt-ampere
AHJ	Authority Having Jurisdiction
SoC	State of Charge
MID	Microgrid interconnect device
NEC	National Electrical Code
OCPD	Overcurrent protection device
PV	Photovoltaic
RSD	Rapid shutdown device
SKU	Stock keeping unit

Appendix B

Legend

The following table lists the symbols used in the diagrams.

Symbols	Description
	Branch circuit breaker
	All unmarked connections are intended for factory use only
	Latching relay
	Ethernet connection
	Insulated in-line splice connector (for connecting PV disconnect to the PV aggregator board)
	Field-wired ground conductor
	Field-wired neutral conductor
	Field-wired line conductor
	Single-line representation
	Control wiring between system components

The following table lists the connectors used in the diagrams.

Connectors	Description
1	IQ Battery control header – 1
2	IQ Battery control header – 2
3	IQ Collar control header – 3
4	Spare control header – 4 (not to be used)
5	RS485
6	Ride-through (RT) power supply accessory
7	Rope CT – power supply
8	Load/Consumption CT connector
9	Load relay connector (accessory)

Connectors	Description
10	NO dry contact relay
11	EVSE CT
12	NO/NC dry contact relay
13	AC sense

The following table lists the labels used in the diagrams.

Label	Description
A1	DER relay
A2	Backfeed lugs
B1	Load control relay
LCB	Up to 1 × 80 A load control breaker
PVA	Permitted load (PV aggregator) breaker
IQBUS	Rapid shutdown device (RSD)
IQ B1/2/3	Up to 2 × 60 A IQ Battery (IQB) breaker
IQ EVSE	Up to 1 × 60 A IQ EV Charger breaker
PV-FE/CTFE	PV or PV aggregator (PVA) CT connection
USB1	Mobile Connect connection
USB2	Factory-wired connection to the gateway

14. Revision history

Revision	Date	Description
TEB-00315-3.0	April 2026	Added the "Utility witness test procedure" section. Updated the following sections: "Enphase Energy System overview", "Maintenance shutdown procedure", and "Potential options for shutdown switch wiring".
TEB-00315-2.0	January 2026	Updated the following sections: "Shutdown initiators in the system" and "System Shutdown Switch for IQ Combiner 6C".
TEB-00315-1.0	November 2025	Initial release.