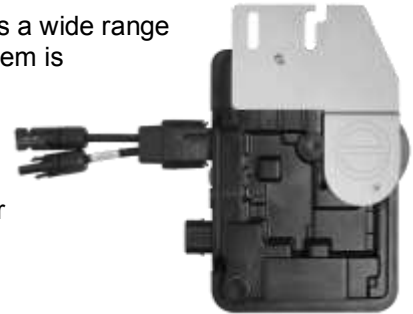


## Planning for a Commercial IQ Microinverter System

The Enphase IQ Microinverter system is inexpensive to install and provides a wide range of new installation options to solar professionals. The IQ Microinverter system is available for single-phase and three-phase applications. New components available as part of this system provide additional options for reducing Balance of System (BOS) costs and installation complexity. This planning brief introduces solar installation professionals to the new components, provides guidance on component selection, and gives tips for various system design and installation scenarios.



The Enphase Commercial IQ Microinverter system includes the following:

- Enphase IQ 6 and IQ 6+ Microinverters and Enphase Energized AC Modules
- Enphase IQ Envoy
- Enphase Q Cable and accessories
- Enphase Enlighten and apps
- Additional commercial components coming in late 2017

This brief includes the following sections:

IQ 6 and IQ 6+ Microinverters.....	1
IQ Envoy .....	2
Q Cable and IQ Microinverter Accessories.....	2
Commercial IQ System Design.....	5
Splicing Q Cable and Raw Q Cable with Junction Boxes .....	15
Wire Management of AC and DC Cables Under Array.....	16
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Installing IQ Microinverters with Frame Mount Bracket .....	18
Q Commercial Relay Controller (Q-RELAY-3P-NA) for Dropped Phase and Neutral Protection.....	19

### IQ 6 and IQ 6+ Microinverters

The IQ 6 and IQ 6+ Microinverters have a 97% CEC efficiency for split phase applications and are available at peak output power ratings of 240 watts and 290 watts respectively. The maximum number of microinverters per 20A branch circuit is detailed below. For a three-phase, 208V, and 240V systems, Enphase Microinverters may be installed on two-pole circuit breakers and following the maximums listed in the table below. See the IQ product data sheets for complete product specifications at [Enphase.com](http://Enphase.com).

Maximum IQ Microinverters per AC branch circuit	IQ 6 Microinverters (single-phase 240 VAC)	IQ 6+ Microinverters (single-phase 240 VAC)
	<b>16</b>	<b>13</b>
Maximum IQ Microinverters per AC branch circuit	IQ 6 Microinverters (single-phase 208 VAC)	IQ 6+ Microinverters (single-phase 208 VAC)
	<b>14</b>	<b>11</b>

**IMPORTANT:** The Enphase IQ Envoy and IQ 6 and IQ 6+ Microinverters do not communicate with, and should not be used with, previous generation Enphase Microinverters, AC Batteries, and Envoys.

## IQ Envoy

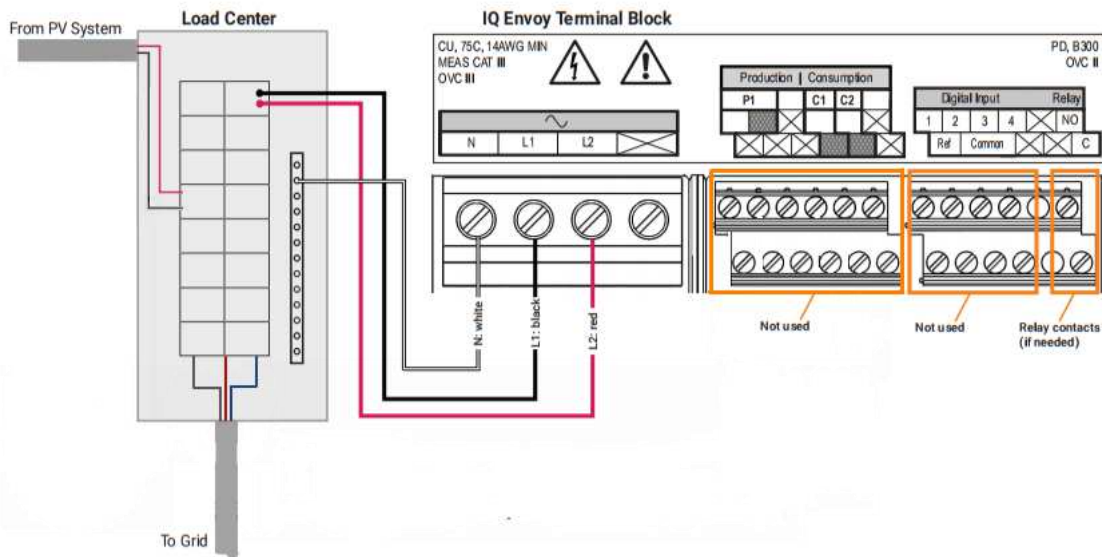
When designing a three-phase, commercial scale system, it is critical to install the IQ Envoy (model ENV-IQ-AM1-240 M). The IQ Envoy communicates with up to 600 IQ Series Microinverters in a single-phase or three-phase applications. Do not install an IQ Combiner Box; it is only for single-phase applications.



### Wiring the IQ Envoy for Three-Phase Applications

The production and consumption CTs are not currently supported for three-phase applications, so should not be installed and should not be enabled. The IQ Microinverter system does not use a neutral, and a neutral is not required on the roof. However, a neutral is required for operation of the IQ Envoy. In addition, two hot conductors from any two of the three-phases must be terminated at the IQ Envoy for communicating with the microinverters.

The diagram below shows how to properly wire an Envoy into a three-phase system.



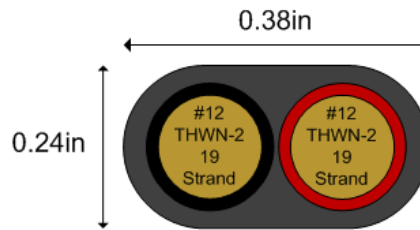
## Q Cable and IQ Microinverter Accessories

The IQ Microinverter system uses a new and improved cabling system. Q Cable is lighter than previous generation cabling systems and easier to manage, thus driving down overall system costs. Q Cable is a purpose built single-phase cable containing two 12 AWG conductors with integrated AC connectors. You can use the cable in single-phase or three-phase applications. The Q Cable male connectors plug directly into the IQ Microinverters, whose double insulated rating requires no neutral or ground conductors.

Q CABLE SPECIFICATIONS	
Voltage rating	600V (connector rating 250 V)
Cable temperature rating	90° C (194° F)
Certification	UL3003, DG cable
Flame test rating	FT4
Compliance	RoHS, OIL RES I, CE, UV resistant, combined UL for Canada and United States
Conductor rating	THHN/THWN-2 dry/wet

Q Cable is a UL3003 DG (Distributed Generation) listed cabling system. The DG cable standard, UL3003, is based upon the construction specifications (wet rated) of TC-ER cable, which may be installed in raceway as per NEC 336.10(3). The Q Cable and raw Q Cable are manufactured with DG cable to the following specifications and listed under the UL 3003 standard:

- E481333 (UL) DG 600V THHN/THWN-2 90°C DRY/WET 2/C 12AWG -40C OIL RES I FT4 CABLEPLUS
- 19 strand conductors



Refer to the UL guide card for DG cable: [http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?name=QHZR.GuideInfo&ccnshorttitle=Distributed+Generation+Cable&objid=1085285873&cfgid=1073741824&version=versionless&parent\\_id=1085285872&sequence=1](http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/showpage.html?name=QHZR.GuideInfo&ccnshorttitle=Distributed+Generation+Cable&objid=1085285873&cfgid=1073741824&version=versionless&parent_id=1085285872&sequence=1)





Q-cable is available in three connector-spacing options: 1.0M, 1.7, and 2.0M to accommodate portrait, 60-cell landscape, and 72-cell landscape applications respectively. Raw Q Cable without integrated AC connectors may be used for runs between separated arrays or to a junction box located some distance away from an array.

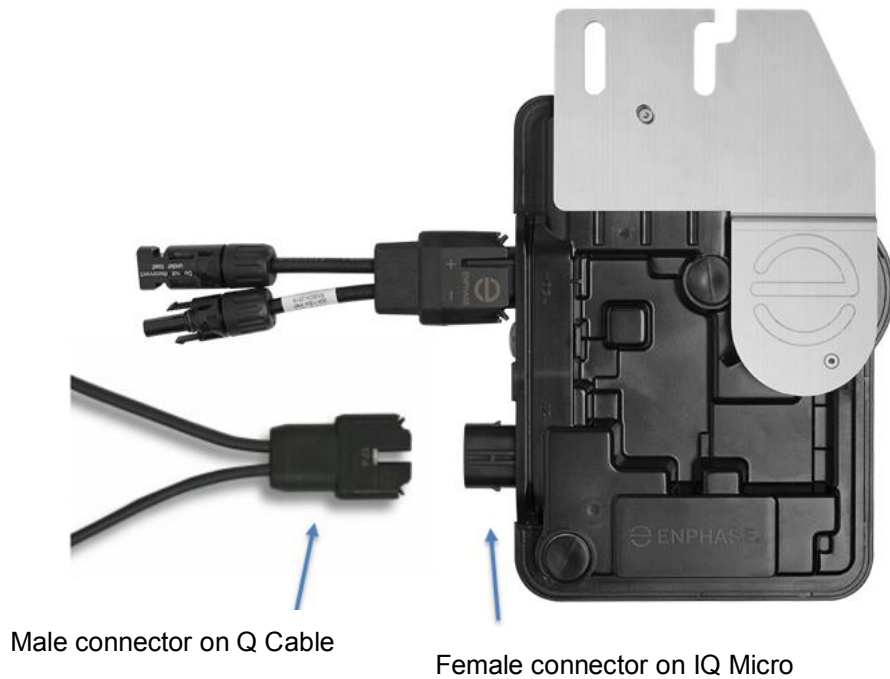
You must install supports (clips, etc.) for the Q Cable and raw Q Cable at six-foot intervals or less. Installation requirements for wet-rated cable allow Q Cable and raw Q Cable to be installed in conduits, cable trays, and other raceways.

Q CABLE TYPES / ORDERING OPTIONS				
Model Number	Description	Connector spacing	PV module orientation	Connector count per box
Q-12-10-240	Q Cable for 60/72 cell 1.0m portrait module	1.3 m (4.2 ft.)	Portrait	240
Q-12-17-240	Q Cable for 60-cell 1.7m landscape module	2.0 m (6.5 ft.)	Landscape (60-cell)	240
Q-12-20-200	Q Cable for 72-cell 2.0m landscape module	2.3 m (7.5 ft.)	Landscape (72-cell)	200
Q-12-RAW-300	Q Cable, 12 AWG, no connectors, 300m length		Not applicable	

**ENPHASE Q CABLE ACCESSORIES**

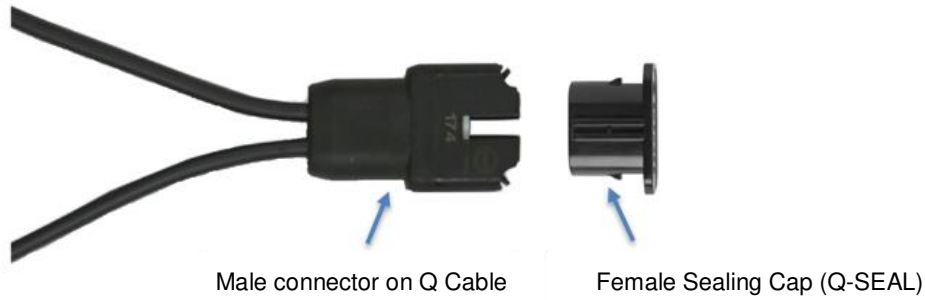
Name	Model Number	Description
Q Aggregator	Q-BA-3-1P-60	Combines up to three microinverter AC branch circuits into one home run
Field Wireable Q Connector (male)	Q-CONN-10M	Make Q Cable connections to any Q Aggregator open connector or female Field Wireable Q Connector
Field Wireable Q Connector (female)	Q-CONN-10F	Make Q Cable connections to any Q Cable open connector or male Field Wireable Q Connector
Q Clip	Q-CLIP-100	Used to fasten cabling to the racking or to secure looped cabling
Q Cable Disconnect Tool	Q-DISC-10	Disconnect tool for Q Cable connectors, DC connectors, and AC module mount
Q Aggregator Sealing Caps (male)	Q-BA-CAP-10	Male sealing cap for unused Q Aggregator connectors
Q Sealing Caps (female)	Q-SEAL-10	Female sealing cap for unused Q Cable connectors
Q Cable Terminator	Q-TERM-10	Terminator for unused Q Cable ends
IQ Replacement DC Adapter (MC4)	Q-DCC-2	IQ Microinverter replacement adaptor for MC4 DC connector
IQ Replacement DC Adapter (UTX)	Q-DCC-5	IQ Microinverter replacement adaptor for UTX DC connector

	<p><b>Q Cable Terminator</b> Terminator for unused cable ends, sold in packs of ten (Q-TERM-10)</p>		<p><b>Q Sealing Caps</b> Sealing caps for unused aggregator and cable connections (Q-BA-CAP-10 and Q-SEAL-10)</p>
	<p><b>Q Cable Disconnect Tool</b> Plan to use at least one per installation, sold in packs of ten (Q-DISC-10)</p>		<p><b>Q Clip</b> Used to fasten cabling to the racking or to secure looped cabling, sold in packs of ten (Q-CLIP-100)</p>



### Sealing Caps

Unused Q Cable connectors must be sealed with a watertight sealing cap (Q-SEAL).



Seal each unused connector on the Q Aggregator with a male sealing cap. Also, use male sealing caps to temporarily seal any exposed IQ Microinverter connectors not connected to the Q Cable to protect against moisture or water damage at the exposed connector during construction.



### Q Terminator

Install a terminator on any cut end of Q Cable that is not terminated with a Field Wireable Q Connector.



## Commercial IQ System Design

The new IQ system provides the lowest installed cost of any three-phase microinverter system. The IQ system can be interconnected to a three-phase, 208Y/120V utility system or to a 240 high-leg delta (with stinger) without any transformers! Other utility voltages are supported with the installation of a transformer.

Each IQ Envoy can support up to 600 Enphase Microinverters communicating over power line communication, and an unlimited number of Envoys may be installed on a system, allowing for limitless scalability. For systems larger than 600 microinverters, or for systems with multiple IQ Envoys on a common transformer, some filtering must be provided for electrical isolation between each IQ Envoy communication domain. The communication domain is the fundamental building block in an Enphase Microinverter system, and the maximum number of microinverters per communication domain is 600. For more on wiring IQ Envoys for three-phase applications see “Wiring the IQ Envoy for Three-Phase Applications” on page 2.

### Three-phase, 208Y/120V System Design

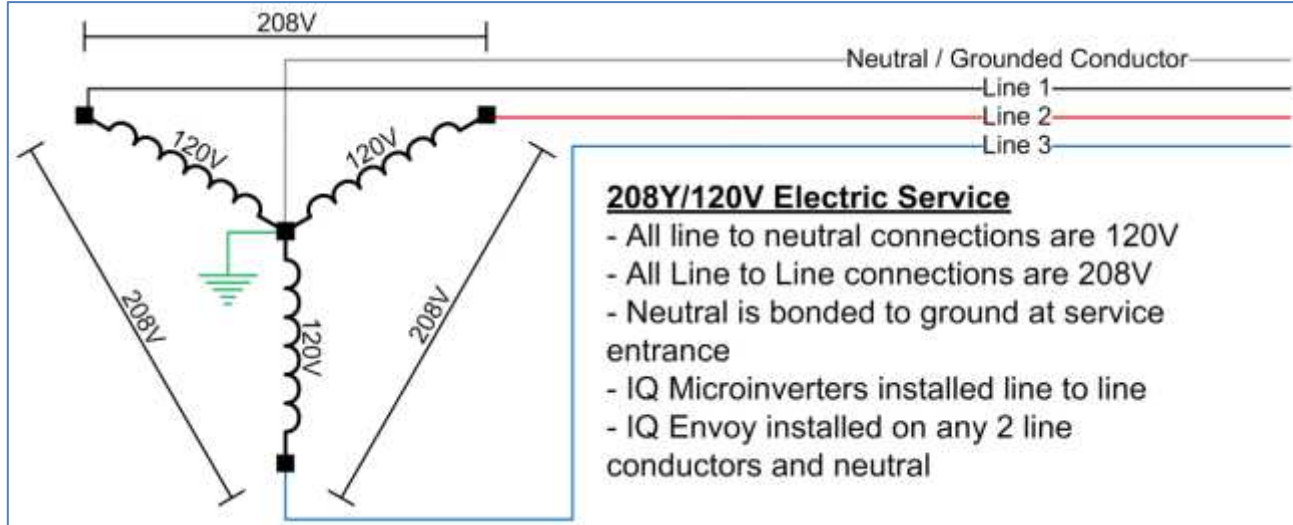
Designing a three-phase, 208Y/120V system is straight-forward and simple. Design the system much like you would design a residential system, using two-pole circuit breakers. The two-pole circuit breakers are installed in a three-phase, 208Y/120V panel board. Take care to balance the number of microinverters across the three phases.

A neutral is not required to the roof with the microinverter branch circuits, and the IQ Microinverters do not have a neutral connection. However, a 120V line to neutral connection is required to power the IQ Envoy. Therefore, it makes sense to install a neutral conductor at the solar subpanel and to power the Envoy from a

branch circuit breaker wired directly off the solar subpanel. Wire the IQ Envoy with two hot conductors and a neutral.

A 208Y/120V interconnection is a Wye type interconnection. A Wye utility service requires a neutral ground bond at the center point of the transformer.

**208Y/120V Electrical Service Conceptual Schematic**



**Ampacity Calculations for 208V Branch Circuits on Two-Pole Circuit Breakers**

Calculate the ampacity of a two-pole branch circuit as follows:

$$\# \text{ of Microinverters} * \text{Inverter Continuous Output Current Rating} = \text{Branch Circuit Output Current}$$

	IQ 6 (208V)	IQ 6+ (208V)
Continuous Output Current Rating	1.11A	1.35A

For a fully populated branch circuit of 11 IQ 6+ Microinverters, the continuous output current rating is:

$$11 * 1.35A = 14.85A$$

NEC Article 690.9(B) requires a 125% factor be applied to the continuous output current for sizing overcurrent protection of the branch circuit:

$$14.85A * 1.25 \text{ safety factor} = 18.6A$$

A 20A branch circuit overcurrent protection device (OCPD) is required for 11 IQ 6+ Microinverters at 208V.



**Ampacity Calculations for Three-Phase Feeders to 208Y/120V Solar Subpanel**

Calculate the ampacity of the three-phase, 208Y/120V solar subpanel feeders from the continuous output power rating as follows:

$$\begin{aligned} \# \text{ of Microinverters} * \text{ Inverter Continuous Output Power Rating} &= \text{ Total Continuous Output Power} \\ \text{Total Continuous Output Power} / 208V / 1.732 &= \text{ Solar Subpanel Continuous Ampacity} \end{aligned}$$

	IQ 6 (208V)	IQ 6+ (208V)
Continuous Output Power Rating	230VA	280VA

For a solar subpanel with 231 IQ 6+ Microinverters, the continuous output current rating is:

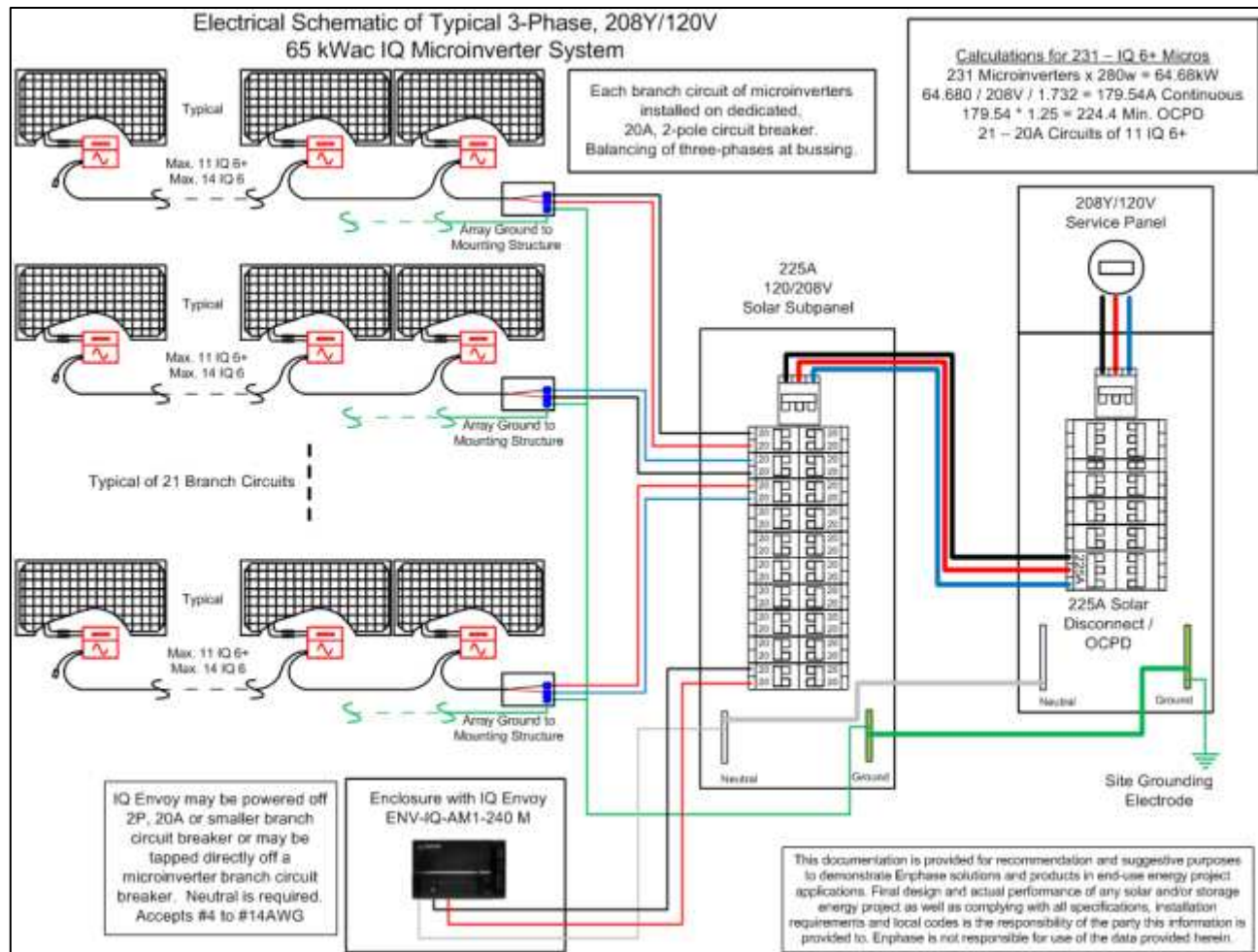
$$\begin{aligned} 231 * 280VA &= 64,680VA \\ 64,680VA / 208V / 1.732 &= 179.54A \end{aligned}$$

NEC Article 690.9(B) requires a 125% factor be applied to the continuous output current for sizing overcurrent protection of the branch circuit:

$$179.54A * 1.25 \text{ safety factor} = 224.4A$$

A 225A overcurrent protection device (OCPD) is required for 231 - IQ 6+ Microinverters at 208Y/120V.

**208Y/120V Electrical Schematic**



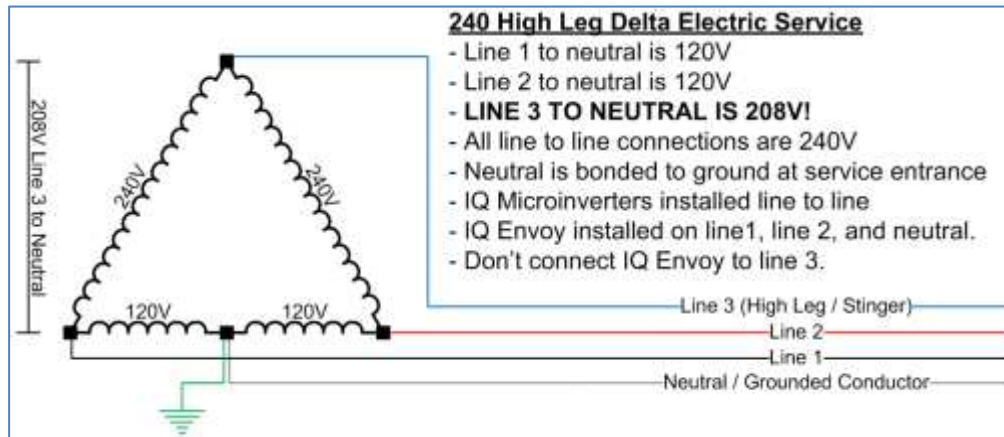
### Three-phase, 240V High-Leg Delta System Design

Designing a three-phase, 240V high-leg delta (also known as 240V delta with stinger) system is very simple with Enphase IQ Microinverters and does not require a transformer. IQ Microinverters do not require a neutral connection, so can be installed on all three phases in a 240V system.

When interconnecting an IQ Microinverter system to a 240V high-leg delta system, the IQ Envoy (Model ENV-IQ-AM1-240 M) must be connected to the two hot conductors that are 120V line to neutral. The high-leg (or stinger leg) will measure 208V from line to neutral. That stinger leg can damage sensitive electronics and should not be connected to the Envoy.

For 240V delta systems without a neutral, use an inexpensive (~\$40) auto-transformer to generate a neutral for powering the Envoy. Follow the installation recommendations for interconnecting to a 240V delta system.

#### 240V High Leg Delta Electrical Service Conceptual Schematic



#### Ampacity Calculations for 240V Branch Circuits on Two-Pole Circuit Breakers

Calculate the ampacity of a two-pole branch circuit as follows:

$$\# \text{ of Microinverters} * \text{Inverter Continuous Output Current Rating} = \text{Branch Circuit Output Current}$$

	IQ 6 (240V)	IQ 6+ (240V)
Continuous Output Current Rating	0.96A	1.17A

For a fully populated branch circuit of 13 IQ 6+ Microinverters, the continuous output current rating is:

$$13 * 1.17A = 15.21A$$

NEC Article 690.9(B) requires a 125% factor be applied to the continuous output current for sizing overcurrent protection of the branch circuit:

$$15.21A * 1.25 \text{ safety factor} = 19.0A$$

A 20A branch circuit overcurrent protection device (OCPD) is required for 13 IQ 6+ Microinverters at 240V.



**Ampacity Calculations for Three-Phase Feeders to 240V High-Leg Delta Solar Subpanel**

Calculate the ampacity of the 240V high-leg delta three-phase solar subpanel feeders from the continuous output power rating as follows:

$$\# \text{ of Microinverters} * \text{Inverter Continuous Output Power Rating} = \text{Total Continuous Output Power}$$

$$\text{Total Continuous Output Power} / 240V / 1.732 = \text{Solar Subpanel Continuous Ampacity}$$

	IQ 6 (208V)	IQ 6+ (208V)
Continuous Output Power Rating	230VA	280VA

For a solar subpanel with 267 IQ 6+ Microinverters, the continuous output current rating is:

$$267 * 280VA = 74,760VA$$

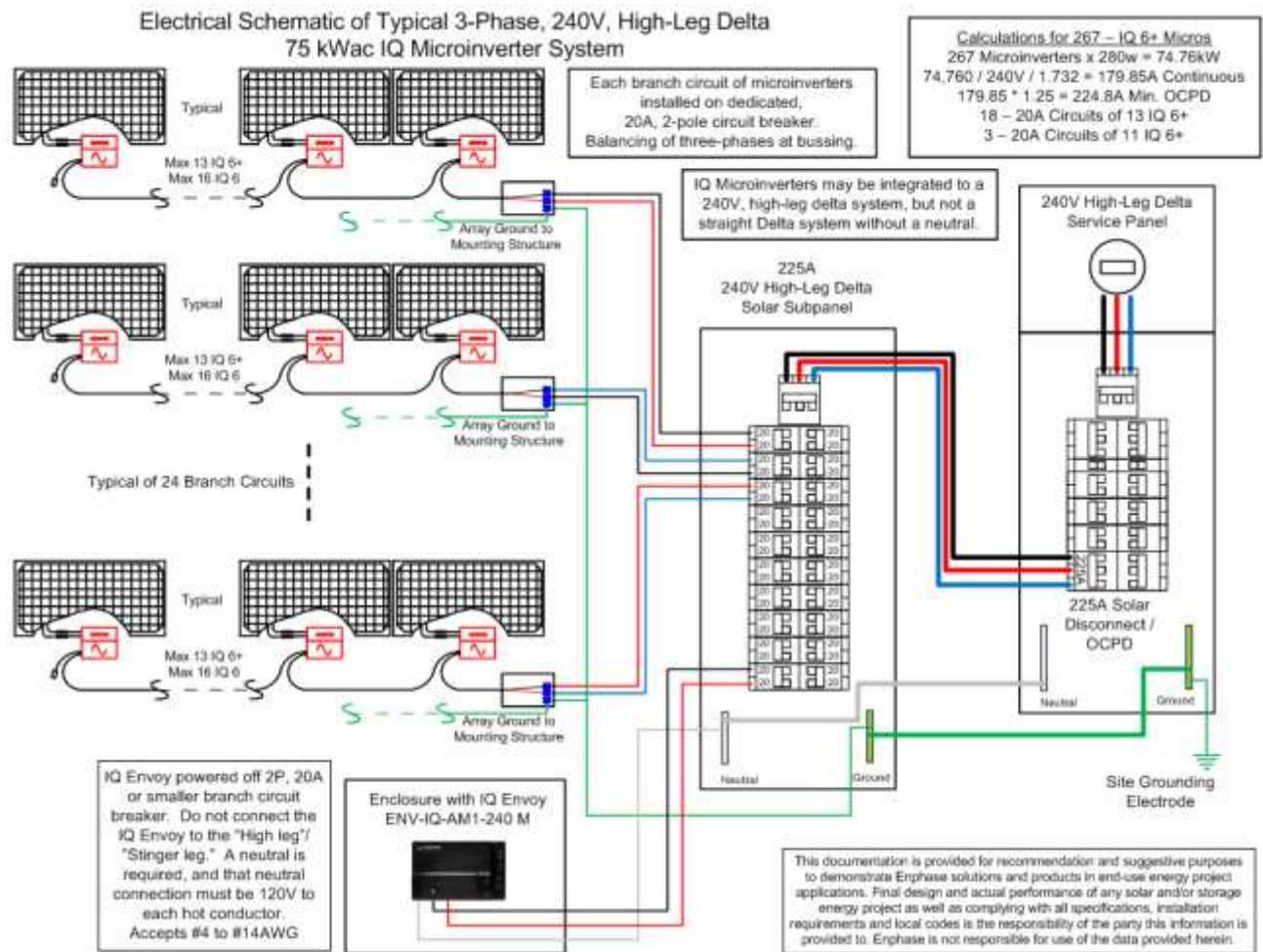
$$74760VA / 240V / 1.732 = 179.85A$$

NEC Article 690.9(B) requires a 125% factor be applied to the continuous output current for sizing overcurrent protection of the branch circuit:

$$179.85 * 1.25 \text{ safety factor} = 224.8A$$

A 225A overcurrent protection device (OCPD) is required for (267) IQ 6+ Microinverters.

**240V High-Leg Delta Electrical Schematic**



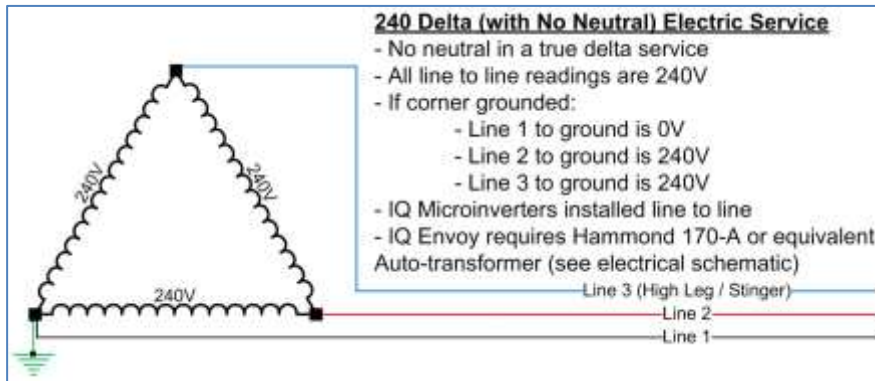
### Three-Phase, 240V Delta with No Neutral

All of the recommendations related to a 240V system apply to a 240V delta, with the exception that you must use a small auto-transformer to provide a 120V connection to power the Envoy.

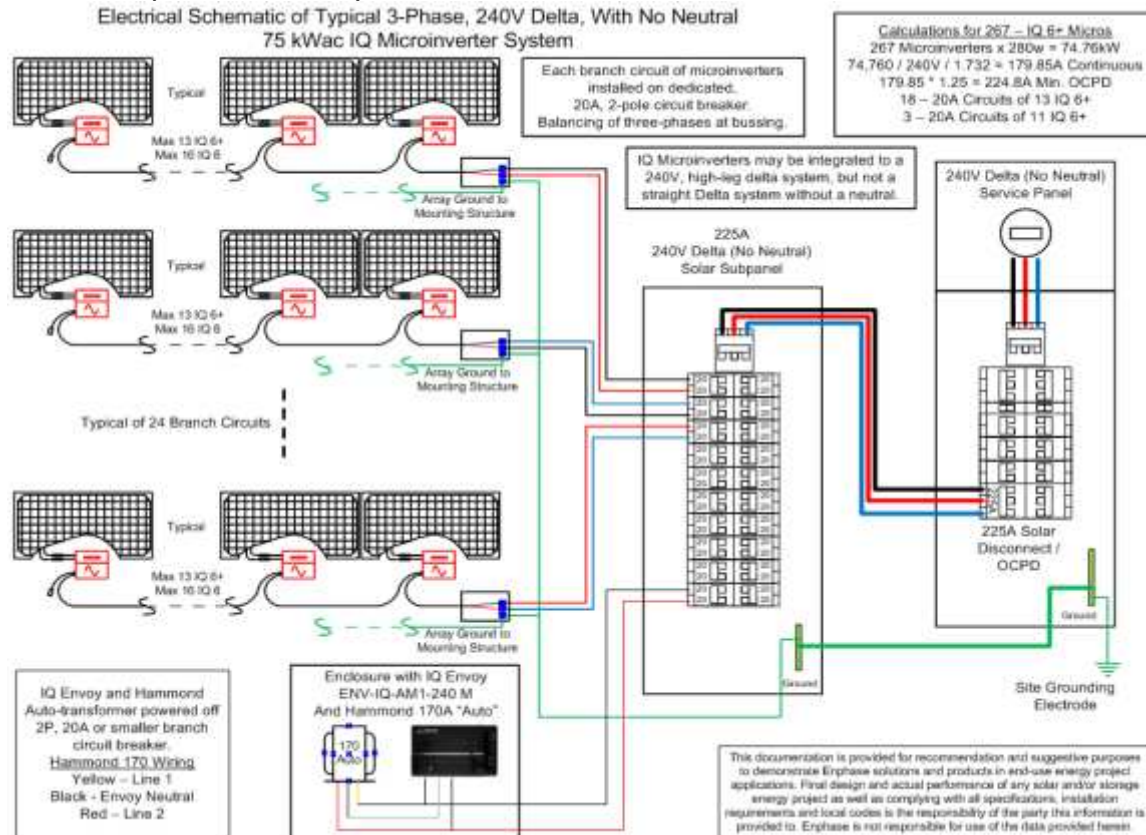
#### Generating a Neutral for 240V Delta Interconnections

In the case that the site is 240V delta without a neutral, use an auto-transformer for generating a 120V connection to power the Envoy. The Hammond 170 Auto line of auto-transformers is affordable and immediately available in sizes starting at 50 watts. The 170A, 170B, and 170C are all listed by CSA. The Envoy is less than three watts, so the smallest auto-transformer in the Hammond 170 Auto line is sufficient. More information is available at <http://www.hammondmfg.com/168.htm>

#### 240V Delta (with No Neutral) Electrical Service Conceptual Schematic



#### 240V Delta (With No Neutral) Electrical Schematic



## Interconnecting IQ Microinverters to Other Voltages

For interconnection to system voltages other than 120/240V single-phase, 120/208 single-phase, 208Y/120V three-phase, and 240V high-leg delta three-phase, a transformer is required to interconnect to the grid.

While transformers interconnect Enphase Microinverter Systems to any utility power voltage, they also offer other benefits.

- For many projects, it is cost effective to distribute the power at the higher utility voltages and then step down the voltage to 208Y/120V or 240V high-leg delta at each sub-system. This practice results in more transformers, but can be cost effective when wire runs are greater than 250 feet.
- Choose transformers with adjustable taps. Use the tap to make minor adjustments when the utility-provided voltage is high or when optimizing conductor sizing versus expected voltage rise for the value engineered PV system.

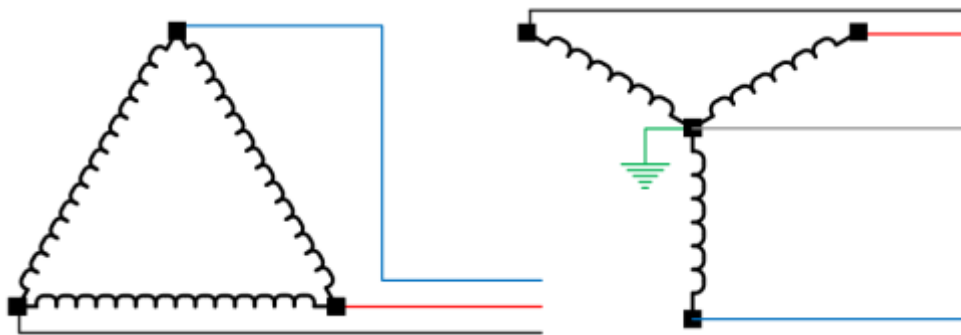
It is common to specify high-efficiency or ultra-high efficiency, general purpose, dry-type transformers for an Enphase Microinverter System. It is not necessary to specify power factor correcting transformers or K-factor transformers.

Specify the transformer kVA size to meet the inverter output in kW AC. Some additional deratings, such as adjustments for power factor and temperature may apply. Refer to the transformer manufacturer's specifications for transformer sizing.

Most transformers for Enphase systems are specified as delta on the primary/utility side and as 208/120 Wye or 240V high-leg delta on the secondary/PV side. Even if the utility voltage is Wye, such as a 480Y/277V service, it is still best to provide a delta configuration with no neutral to the primary/utility side of the transformer. This configuration works well, lowers wire costs, and is recommended by the manufacturers of transformers for improved performance and reduced harmonics.



**Delta and Wye Wiring**



The following table lists utility voltage values and transformer requirements.

**Transformer Specification (Table of Various Voltage Configurations)**

Utility voltage configurations	Nominal voltages between the lines and neutral/ground					
	L1 to L2	L2 to L3	L3 to L1	L1 to N/G	L2 to N/G	L3 to N/G
208Y/120V	208	208	208	120	120	120
No transformer would be specified for interconnection						
480Y/277V	480	480	480	277	277	277
Specify a 480 delta:208Y/120V transformer or 480 delta:240 high-leg delta transformer						
480 delta (*corner grounded)	480	480	480	-	-	-
Specify a 480 delta:208Y/120V transformer or 480 delta:240 high-leg delta transformer						
240 delta	240	240	240	-	-	-
Install a 240V to 120/240V auto-transformer for powering the Envoy (Hammond 170 "Auto")						
240 high-leg delta	240	240	240	120	120	208
No transformer would be required for interconnection of IQ System						
600Y/347V	600	600	600	347	347	347
Specify a 600 delta:208Y/120V transformer or 600 delta:240 high-leg delta transformer						

**Multiple IQ Envoys on a Single Site — Filtering Communication Domains**

Enphase IQ Microinverter systems use power line communications (PLC) to communicate module level data between the microinverters and the IQ Envoy. Each IQ Envoy can communicate with a maximum of 600 IQ Microinverters. The PLC signal is at 110kHz in an IQ System. In a commercial scale system, the IQ Envoy is continuously polling the microinverters for their recent power production, temperature, voltage, amperage, and frequency data. To ensure good communication between the IQ microinverters and the IQ Envoy, install power line filters or transformers to:

- Prevent cross-domain communications between multiple IQ Envoys.
- Minimize electrical noise at frequencies near 110kHz.
- Minimize the distances between the IQ Microinverters and the IQ Envoys.

When multiple IQ Envoys are on a single utility transformer, use a filter to isolate each IQ Envoy and its associated microinverters from the other IQ Envoys and IQ Microinverters. This is particularly important for large-scale projects.

In a large-scale project, each sub-system or communication domain generally consists of a single IQ Envoy, a single panel board, a power line filter, and the branch circuits off that panel board. A filter prevents power-line communication signals from one IQ Envoy communication domain from interfering with other communication domains. The filter also eliminates electrical noise from site loads.

With multiple communication domains, the total number of filters can be one less than the total number of communication domains. For example, if all other communication domains have filters, the last communication domain can be installed without a filter (n – 1).

If the system contains fewer than 600 microinverters with a single IQ Envoy on-site (a single communication domain), a filter is not required to isolate communication domains from each other, but may be used to ensure a clean PLC environment free of electrical noise.

For sites with multiple IQ Envoys, the conductors and conduits of each communication domain must be kept physically separated from the conductors and wiring of other communications domains by at least 12 inches. Coupling of the signals can occur between the conductors and conduits when run together, especially on long conduit and wire runs.

## Filtering with Enphase Q-LCF-250-3P

Enphase provides a 250A power line filter. You can use it to filter electrical noise or signals between multiple IQ Envoy's and their respective communication domains. The filter must be protected by a 250A or smaller OCPD. When installing a power line filter in an IQ System, the microinverters and the IQ Envoy must all be located on the load side of the filter. A 250A limit of the filter limits the communication domain to 72kW AC at 208Y/120V or 83kW AC at 240 delta. For communication domains larger than this, use an isolation transformer to filter the communication domain.

## Filtering with transformers

Utility transformers such as 480 delta to 240 high-leg delta transformers also provide noise filtering and signal filtering between IQ Envoy communication domains. For a system with multiple IQ Envoy's, it may be most practical to distribute power at a higher voltage and then step down to the IQ System voltage at each communication domain.

## IQ Envoy Installation Options

For three-phase applications, the IQ Envoy should be procured as a stand-alone component, model ENV-IQ-AM1-240 M. The IQ Envoy communicates with all of microinverters in a three-phase system. The production CT and consumption CTs must not be enabled or installed.

Locate the IQ Envoy adjacent to the solar subpanel and wire it directly off that solar subpanel. The IQ Envoy requires two hot conductors and one neutral conductor.

### *Installing IQ Envoy in an Outdoor Enclosure*

The IQ Envoy must be installed inside of an electrical enclosure, keeping the operating temperature of the IQ Envoy in mind. This enclosure must be large enough to house the IQ Envoy. If you use a power line bridge or other networking component, make sure the enclosure can accommodate a receptacle. The enclosure can be metal or non-metallic, but should be non-metallic if Wi-Fi or cellular networks are used for the IQ Envoy Internet connection. The enclosure must meet the following requirements:

- Use a NEMA type 3R, 4, or better rated outdoor enclosure with hinged cover or screw cover of suitable dimensions. Typical enclosure dimensions are in the range of 10" x 10" x 4" to 12" x 12" x 6".
- Connect the IQ Envoy to two lines and a neutral. A neutral is required for powering the IQ Envoy. It does not ship with a plug-in style power cord, so a receptacle is not required in the enclosure for powering the IQ Envoy.
- Install a receptacle inside the enclosure if an Ethernet over power line communication (PLC) bridge is desired. The enclosures listed below provide adequate room for a receptacle.
- Install the enclosure in a location that is shaded from extensive periods of direct sunlight. The IQ Envoy is rated for ambient temperatures of -40°F to 115°F when installed in an enclosure.
- **Do not** drill holes on the top of the enclosure or anywhere that allows moisture ingress if the enclosure is outdoors. If top entry is performed, a water-tight conduit hub, like a Myers Hub or other suitable hub product must be used.
- Place in a location that is accessible to service personnel.



### **Enclosure Options for the IQ Envoy**

#### **Arlington EB1212-BP Enclosure with Back Plate**

- Lockable unit dimensions are 12"x12"x4"
- Easily accommodates the addition of a field-wired receptacle, if needed
- Outdoor rated with hinged door opening upward, but indoor rated with hinge to side



#### **Orbit 57905 Timer Cabinet**

- Back plate included, NEMA3R, lockable
- Approximate dimensions are 11"x10"x5"
- Includes a receptacle pre-installed (not wired)
- Mounting plate and IQ Envoy must be removed to install back mounting screws
- Tight wiring space for IQ Envoy with PLC bridge



#### **Integra H12104H\*\*\* Enclosures**

- Strong metal or poly backplate options, NEMA4, lockable
- Approximate dimensions are 10"x12"x5"
- Easily accommodates addition of a field wired receptacle, if needed
- Manufacturer provides a wide variety of enclosure options, including mounting tabs, and vents



#### **Attabox AH12106 Enclosure with BP1210A Back Plate**

- Strong metal or poly backplate options, NEMA4, lockable
- Approximate dimensions are 10"x12"x5"
- Easily accommodates the addition of a field wired receptacle, if needed
- Manufacturer provides a wide variety of enclosure options, including mounting tabs, and vents

#### **Cantex 5133714 Enclosure with Cover and Gasket**

- NEMA4, PVC electrical enclosure
- Approximate dimensions are 12"x12"x6"
- Requires eight screws to install or remove cover and gasket



## Splicing Q Cable and Raw Q Cable with Junction Boxes

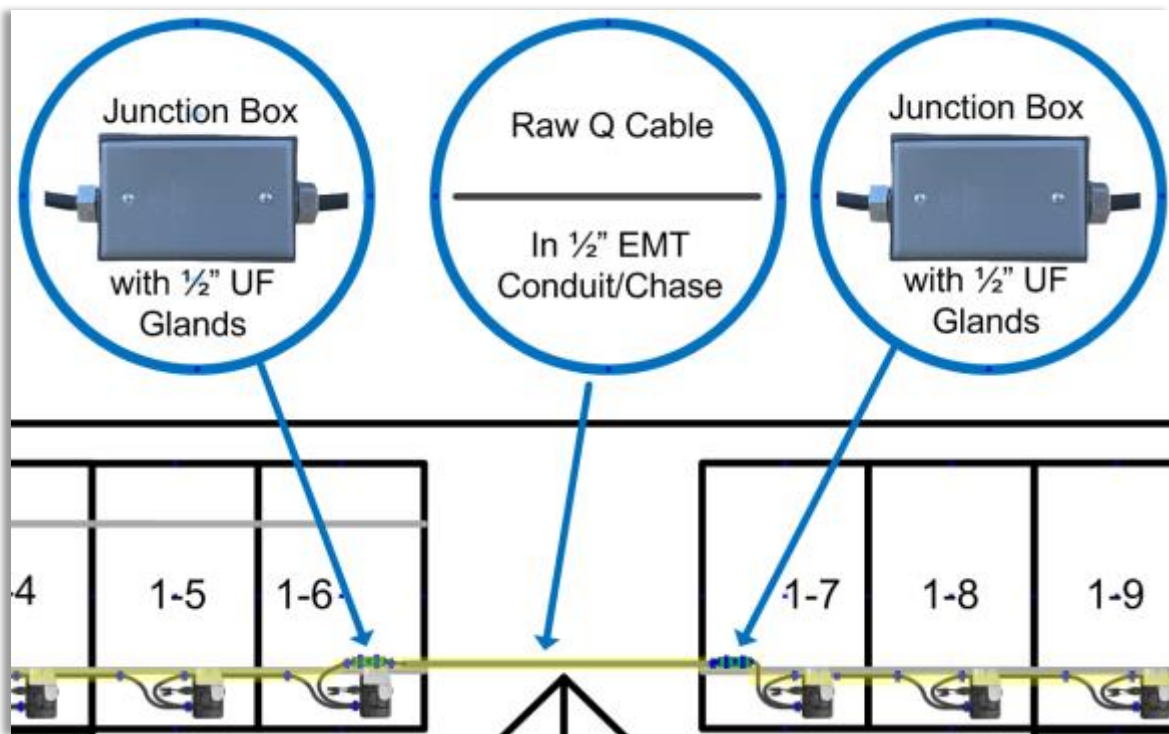
For complex installations that include multiple arrays, it is possible to use raw Q Cable (Q-12-RAW-300) to service the arrays and branch circuits that originate directly at the primary roof mounted junction box. In the case that Field Wireable Q Connectors are not readily available, you can use a small junction box to splice two sections of Q Cable together or to splice Q Cable to raw Q Cable.



The raw Q Cable is available in 300m (984ft) cable rolls (Q-12-RAW-300).

Terminate the raw Q Cable in one of the following manners:

- Into a junction box using a ½" service entrance (SE) strain reliefs or UF cable glands
- With a Field Wireable Q Connector (male or female)



## Wire Management of AC and DC Cables Under Array

Since the Q Cable contains only two conductors, it is smaller and lighter than the previous generation Engage Cable. For this reason, we use cable clips with a reduced wire retention area for the Q Cable. The outer dimensions of the Q Cable allow it to be supported by many of the existing PV cable clips and USE-2 cable clips that are frequently used for supporting the DC module leads today.

Enphase has evaluated and developed wire clips for a wide variety of applications, including rail based applications, rail-less applications, and AC Module applications. These clips are listed later in this section.

### DC Cable Adapters for IQ Microinverters

The IQ 6 and IQ 6+ Microinverters ship with MultiContact MC4 DC connectors. You can order Amphenol UTX DC connectors, if needed. Remove the DC connector assembly on the microinverter and replace it using the Enphase Disconnect Tool for Q Cable connectors (Q-DISC). This tool can disconnect both the AC and DC connectors on the microinverter and disconnect MC4 and UTX connectors. When installing the AC Module with Enphase IQ Microinverter, the Disconnect Tool also provides the means to release the microinverter snaps to lower the microinverter into shipping position if needed.

Replacement adaptors are available for IQ Microinverters:

Q-DCC-2	IQ Microinverter Replacement Adaptor for MultiContact MC4 DC Connector
Q-DCC-5	IQ Microinverter Replacement Adaptor for Amphenol UTX DC Connector

Disconnect Tool



### Wire Management Clips for Attaching Q Cable to Solar Mounting Rails


The Enphase Q Clip (Q-CLIP-100) can manage one or two Q Cables or raw Q Cables to a solar mounting rail. This clip has been evaluated with a large selection of racking systems and works with most available rail based racking systems. These clips support the cable along the rail and may be adequate for supporting the cabling during row to row transitions (depending on cable length), but additional support may be provided from module frame clips. Use at least one clip or other support for every six feet of cable.



### Wire Management Clips for Attaching Q Cable to Module Frames for Rail-less and AC Module Applications

There are a variety of products available for supporting DC module leads off the roof. Most of the wire clips available for PV cable and for USE-2 cable can also be used to attach Q Cable to module frames. Attaching Q Cable to module frames can be useful for rail-less racking systems since there is no rail on which to support the cabling. Also, for AC Module installations, it is often more convenient to clip the Q Cable to the module frame than to clip the Q Cable to the racking system (if available).

Q Cable and raw Q Cable must be supported at intervals not to exceed 6 feet, ensuring the cable does not touch the roof surface.

Manufacturer	Model	Image
Nine Fasteners	DCS-1307 PV cable clip DCS-1306 USE-2 cable clip	
Burndy / Wiley Electronics	ACME ACC-PV PV cable clip	
Heyco Products	SunRunner PV cable clip	

### Supporting the DC Module Leads

Prepare the modules using clips on the DC module leads to prevent the leads from resting on the roof. It is best to prepare the modules on the ground before installation. Install the wire clips and DC module leads to allow for easy connection to the microinverter while also supporting the conductors off the roof.



Once the modules are prepared, install them on the racking. Secure any loose wires or cables to the module frames with properly sized wire clips. Ensure that all conductors are supported off the roof.

## AC Wire Management at the Junction Box

Wire management practices at the junction box are critical to the long-term reliability of any PV system. Installers often install the roof-mounted junction box on the side of a rail.

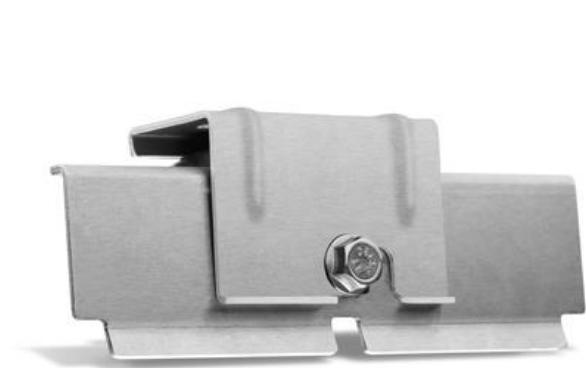
### *For Junction Box Applications*

Follow these recommendations to prevent moisture from accumulating in the junction box. This helps to improve system reliability while ensuring that the wiring connections last for the life of the system.

- Make sure that cables enter the junction box from the side or from the bottom, never from the top where water can enter the enclosure.
- Install cables with a drip loop. Secure the cable so that water drains away from the cable entry.
- Use properly sized strain reliefs and cord grips. Note that the Q Cable is elliptical, so the cable gland securing the Q Cable must contain an inner gland designed for elliptical cable. These cable glands are commonly available from electrical distributors or home improvement stores and are often available under the following names:
  - ½” Service Entrance (SE) watertight connectors
  - UF cable gland (such as the Arlington UF50 Cable Connector)
- Properly tighten the strain reliefs to prevent cable movement and to prevent water ingress.
- Install the junction box to meet the manufacturer’s recommended mounting and orientation requirements. Use NEMA 4 enclosures. (NEMA 3 enclosures have a limited mounting orientation range and may not accommodate typical rooftop installations.)
- Consider drilling a small drain hole in the bottom, lowermost corners of the junction box, so that moisture or condensate can drain out of the junction box.

## Installing IQ Microinverters with Frame Mount Bracket

The Enphase Frame Mount attaches the Enphase Microinverters directly to module frames. This is an ideal solution for rail-less racking solutions, whether residential or commercial. When using the Enphase Frame Mount product, support the Q Cable to keep it off the roof by clipping it to the module frames using module edge wire clips that work with PV cable and USE-2 cable.





## Q Commercial Relay Controller (Q-RELAY-3P-NA) for Dropped Phase and Neutral Protection

The Enphase Q Commercial Relay Q-RELAY-3P-NA monitors line and neutral voltages and signals the coil of a contactor in case of a dropped phase or opened neutral. The relay controller is field selectable with support for 120/208Y and for 240V high-leg delta applications.

The Q Commercial Relay is not required for the IQ microinverter to function, but may be required by some AHJs and/or utilities.

You must use a “normally opened” contactor sized for the power rating of the PV system. A 120V coil is shown in the following schematic. For this example, a 350A continuous rated contactor with 400A max circuit breaker rating is shown. The contactor was sized based upon the kW rating.

Contactor shown for 65kW, 208V system:

ABB Contactor AF260-30-11-12



### Sample Schematic of 208Y/120V System with Q Commercial Relay

