Calculating AC Line Voltage Rise for IQ-Series Micros with Q Cable

Overview

This technical brief presents voltage rise guidelines for dedicated PV branch circuits and methods for calculating the AC line voltage rise when using the Enphase IQ Microinverters™ and the Enphase Q Cable™.

Applying proper voltage rise calculations in your system design helps prevent nuisance voltage out-of-range trip issues due to high line voltage conditions. Less resistance in conductors also results in less power loss, less heat at the terminals, and improves performance of the PV system.

When designing circuits for electrical loads, these calculations are commonly called voltage drop (VDrop). Since PV systems with inverters generate electricity instead of consuming it, voltage rises at the AC terminals of each inverter. Therefore, this brief refers to these calculations as voltage rise (VRise).

Recommendations

To minimize voltage rise, Enphase recommends that you apply these guidelines when planning your system:

- The total VRise in the AC wiring should stay below 2% in all wire sections from the point of common coupling (PCC) to the last microinverter on each branch or sub-branch circuit (as described in “Voltage Rise by Wire Section” on page 3). A good practice is to maintain less than 1% VRise in the Q Cable.
- Center-feed the branch circuit to minimize voltage rise in a fully-populated branch. Since the VRise is nonlinear, reducing the number of microinverters on a Q Cable from the junction box to the last inverter by center feeding and creating sub-branch circuits greatly reduces the voltage measured at the last microinverter in each sub-branch. To center-feed a branch, divide the circuit into two sub-branch circuits protected by a single overcurrent protection device (OCPD). Find out more in “Advantages of Center-Feeding the AC Branch Circuits” on page 6.
- Use the correct wire size in each wire section. Using undersized conductors can result in nuisance tripping of the microinverter anti-islanding function when an AC voltage out-of-range condition occurs. “What Contributes to Voltage Rise?” on page 2 provides more information.
- Use the calculation methods in “Calculating Total Voltage Rise” on page 7 to determine voltage rise values for your project.

Background

The IEEE 1547 standard requires that grid-tied or utility-interactive inverters cease power production if voltage measured at the inverter terminal exceeds +10% or -12% of nominal. Enphase Microinverters, like all utility-interactive inverters, sense voltage and frequency from the AC grid and cease exporting power when voltage or frequency from the grid is too high or too low.

If the voltage measured is outside of the limit, the Enphase Microinverter enters an AC Voltage Out-Of-Range (ACVOOR) condition and ceases to export power until this condition clears. Besides voltage variations from the AC grid, voltage changes within the system wiring can also contribute to VRise and could cause microinverters to sense an over-voltage condition and cease operation.

The Enphase Microinverter reference point for voltage measurement is at the microinverter AC output. Since the microinverter is located at the array, and the point of common coupling (PCC) is generally at the site load center, the distance from the microinverter AC output to the PCC could be substantial.

All components within system wiring contribute to resistance and must be considered when calculating the total VRise. The main factors that determine voltage rise in an Enphase Microinverter system are: 1) distance from the microinverters to the PCC, and 2) conductor size. “What Contributes to Voltage Rise?” on page 2 provides details.

Typically, you can quantify the voltage rise of three distinct wire sections and several wire terminations, as described in “Voltage Rise by Wire Section” on page 3. There is also some resistance associated with each OCPD, typically a circuit breaker, but this is generally not taken into account.

What Contributes to Voltage Rise?

Enphase Microinverter systems are installed as dedicated branch circuits with each branch circuit protected by a 20 A OCPD. The following points must be considered for each branch circuit when calculating VRise.

- **Wire size:** Improper wire size can result in nuisance tripping of the utility-protective functions in the microinverter. Undersized conductors can cause the voltage measured at the microinverter to fall outside of the IEEE limits, triggering an ACVOOR condition. This results in loss of energy harvest. Although the National Electric Code recommends that branch circuit conductors be sized for a maximum of 3% VRise (Article 210.19, FPN 4.), this value in practice is generally not low enough for a utility-interactive inverter.

  There is a tradeoff made between increased wire size and increased cost. You can often increase wire size by one AWG trade size with minimal cost impact. At some point, increasing the wire size necessitates increases in the conduit and/or terminal size, thus further increasing costs. However, the increased wiring and conduit costs can be offset by the increase in energy production over the lifetime of the system. These are important to invest in, especially for long wire runs.

- **Circuit current:** Circuit current varies depending on which “wire section” is being considered in the installation. “Voltage Rise by Wire Section” on page 3 describes a typical installation containing three wire sections where current is considered. With Q Cable, current increases with each inverter added to the circuit.

- **Circuit length:** There is often little control over circuit length, but center-feeding the dedicated branch circuit significantly reduces voltage rise within the branch, as described in “Advantages of Center-Feeding the AC Branch Circuits” on page 6.

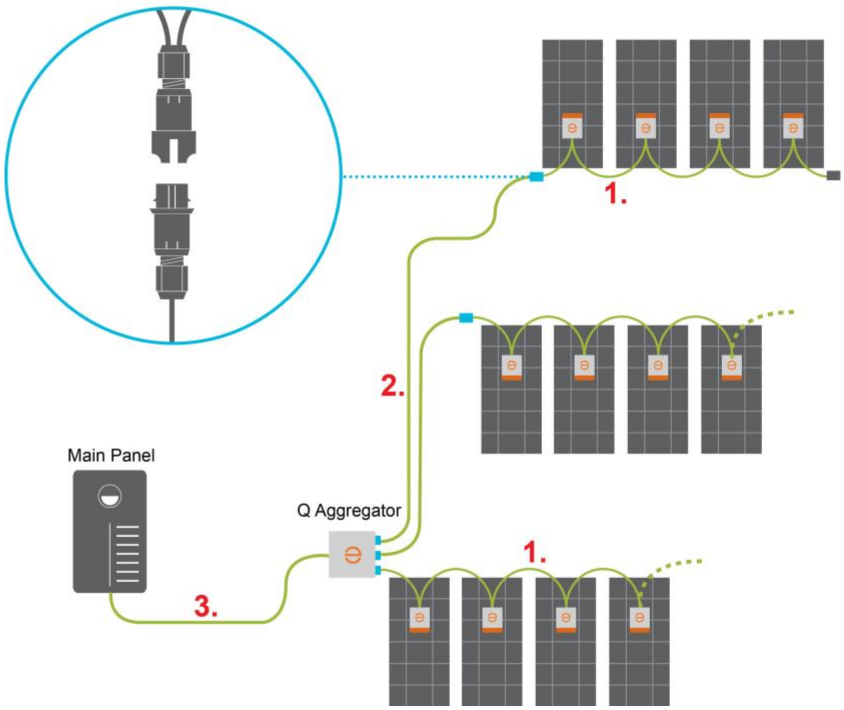
- **Voltage margin**: If service voltage is chronically high, the utility will sometimes perform a tap change on the distribution transformer. This can provide a percent or two of additional voltage margin.

- **Utility voltage:** The utility should maintain voltage at the PCC within +/- 5% of nominal and in some states within +/- 3% of nominal. The protective functions of the microinverters are set to +10% / -12% by default. The high voltage end of the tolerance is of most concern because the inverters are a *source* and not a *load*. If the utility is consistently 5% high, that leaves less than 5% for all wiring and interconnection losses as well as inverter measurement accuracy. If you are concerned about the utility voltage, you may request that your utility place a data logger at the PCC and make a record of the voltages available to you at the site.

Voltage Rise by Wire Section

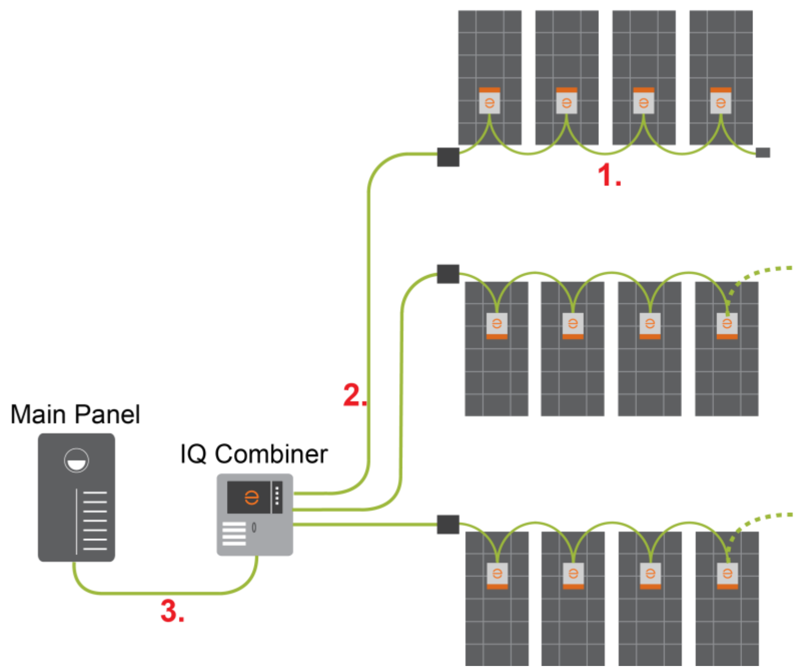
In this section, two typical system configurations are discussed: 1) IQ Microinverter system using the Branch Aggregator, 2) IQ Microinverter system using an Enphase IQ Combiner (or IQ Combiner+) or PV subpanel.

1) IQ Microinverter system using the Branch Aggregator



IQ Microinverter system using the Branch Aggregator	
Section	**Description**
1	Internal voltage rise within the Q Cables to rooftop junction box. See internal VRise values for IQ Micros in Tables 1.1 through 1.15. Only the Q Cable with microinverter connectors is addressed in this section.
2	Q Extension voltage rise from Q Cable to the Q Aggregator. The #12 AWG row in “Conductor Lengths by Wire Section” on page 18 lists maximum distances that maintain a 1% voltage rise for this wire section.
3	Voltage rise from the Q Aggregator to the Main Panel. The tables in “Conductor Lengths by Wire Section” on page 18 list maximum distances that maintain a 1% voltage rise for this wire section.

2) IQ Microinverter system using an Enphase IQ Combiner or PV subpanel



IQ Microinverter system using an Enphase IQ Combiner or PV subpanel	
Section	**Description**
1	Internal voltage rise within the Q Cables to rooftop junction box. See internal VRise values for IQ Micros in Tables 1.1 through 1.15. Only the Q Cable with microinverter connectors is addressed in this section.
2	Voltage rise from the array-mounted AC junction box, along the AC branch circuits, to the load center containing the dedicated microinverter OCPDs (circuit breakers). The tables in "Conductor Lengths by Wire Section" on page 18 list maximum distances that maintain a 1% voltage rise for this wire section.
3	Enphase AC Combiner or PV subpanel to the PCC. Voltage rise from the load center to the PCC. The tables in "Conductor Lengths by Wire Section" on page 18 list maximum distances that maintain a 1% voltage rise for this wire section.

Calculate each component individually and verify that the total voltage rise is less than 2%. "Calculating Total Voltage Rise" lists formulas to determine voltage rise. Additional losses exist at the terminals, connectors, and in circuit breakers; however, if you design for a 2% total voltage rise, these other factors may be ignored.

Q Cable and Internal Voltage Rise

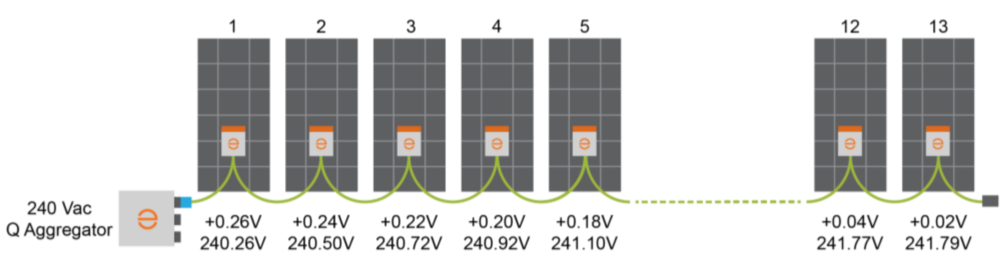
The Q Cable is a continuous length of 12 AWG stranded copper, outdoor-rated cable, with integrated connectors for IQ-Series Microinverters. The following table lists the Q Cable types for single phase projects.

Voltage type and conductor count	Model	Connector spacing	PV module orientation
240 VAC, 2 conductor	Q-12-10-240	1.3 m (51")	Portrait
240 VAC, 2 conductor	Q-12-17-240	2 m (79")	60-cell Landscape
240 VAC, 2 conductor	Q-12-20-200	2.3 m (91")	72-cell Landscape

Regardless of the application, Enphase recommends that the total percentage of voltage rise in the AC wiring be less than 2%, with (an inclusive) less than 1% voltage rise in the Q Cable. Although the Q Cable is optimized for minimal VRise, it is still important to calculate total VRise for the entire system for the array from the last microinverter on each branch of sub-branch to the PCC.

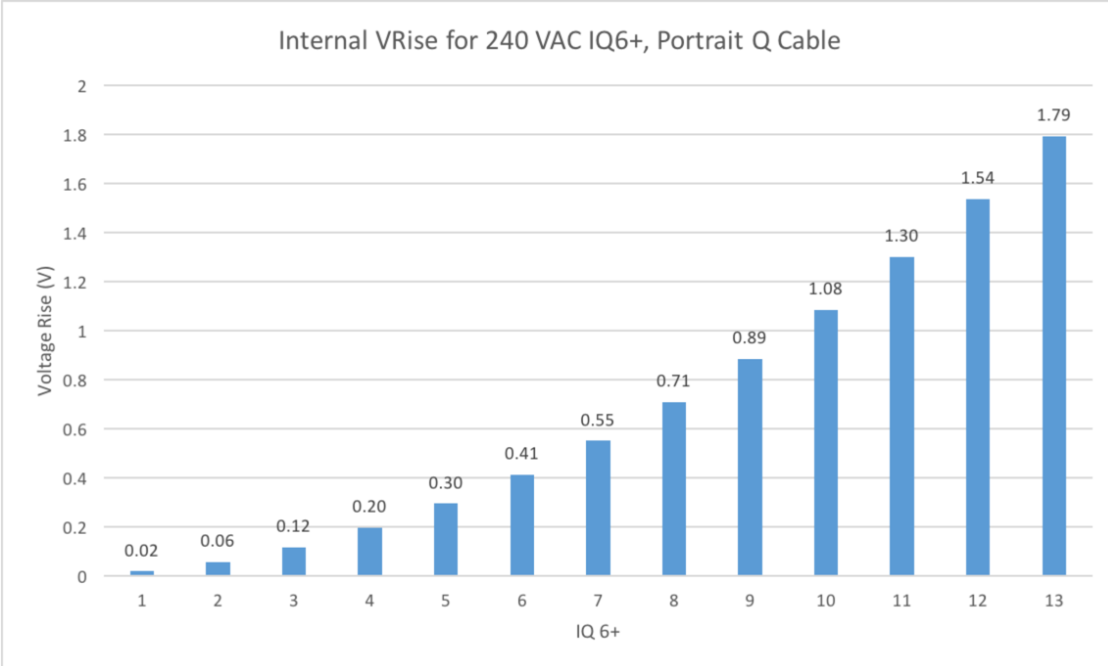
Determining VRise Within a Microinverter Branch Circuit

It is not difficult to determine VRise within the microinverter branch circuit. Tables 1.1 through 1.15 provide VRise values for the available IQ Micros and Q Cable types. Use these values to help calculate total VRise for your project. The following diagram represents a 240 VAC system with a fully populated end-fed branch circuit of IQ 6+ Micros. It illustrates how voltage measured at an individual microinverter increases by position in the branch circuit. As the number of microinverters in a branch circuit increase, the voltage at each microinverter rises in a non-linear manner.



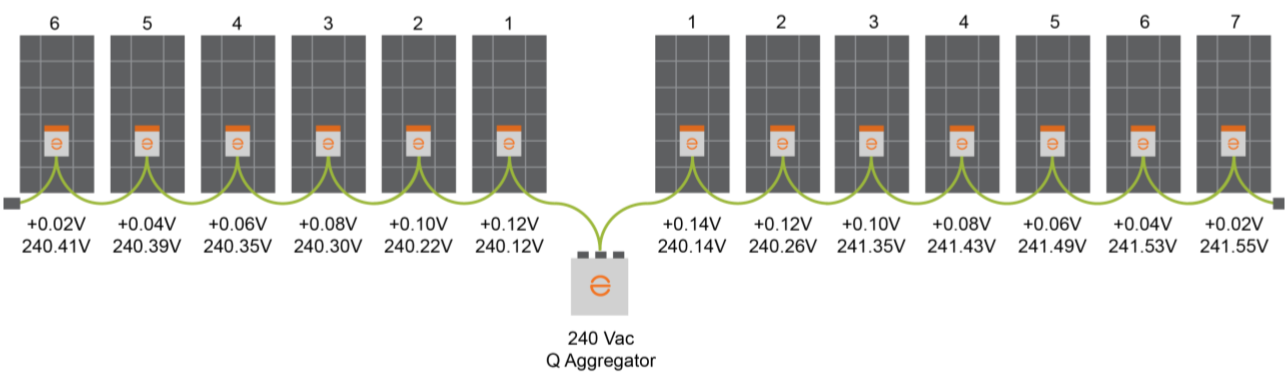
The top row of numbers is the incremental voltage rise from one microinverter to the next, and the bottom row is the cumulative line-to-line voltage overall.

The following graph illustrates how the number of microinverters connected to a portrait-oriented Q Cable causes a non-linear voltage rise when operating at 240 VAC.



Advantages of Center-Feeding the AC Branch Circuits

Since voltage rise is non-linear, reducing the number of microinverters in the branch circuit greatly reduces the voltage measured at the last microinverter in the branch. One way to minimize this voltage rise is to center-feed the branch, that is, divide the circuit into two sub-branch circuits protected by a single OCPD. The following diagram illustrates the center-fed method.



A fully populated IQ 6+ branch circuit has 13 microinverters. If center-fed, there will be seven microinverters on one sub-branch circuit and six on the other sub-branch circuit. All microinverters are parallel connected to a single circuit, either at a junction box or Q Aggregator connector, and run back to the circuit breaker panel. As an example, a fully populated branch circuit with 13 IQ 6+ microinverters and 72-cell landscape cabling would measure 1.32% voltage rise to the last inverter if the circuit was end-fed. If this same circuit was center-fed, the voltage rise within the Q Cable would be reduced to 0.52%. This analysis assumes that the circuit was equally center-fed, however, since the AC connections in this case will be parallel connected, equal sub-circuits are not a requirement, and center-feeding can be used in a way that is more convenient at the site. When calculating the VRise of the total circuit, the larger of the sub-branches should be used when determining internal Q Cable VRise.

Q Extension Cable Lengths

When using the Q Extension Cable (P/N: Q-RAW-300), use Tables 2.1 through 2.5 to determine the voltage rise for this section of cable. Reference the number of IQ Micros and the length of cable to find the voltage rise for this section.

Conductor Lengths for Wire Sections

Use the calculations in Tables 3.1 through 3.5 to determine the proper conductor size for a given section of wire. These tables list the maximum conductor lengths from the roof back to the main service panel for maintaining a 1% voltage rise. With the IQ system there is the option to locate a Q Aggregator on the roof to combine up to three 20A microinverter branch circuits, or each microinverter branch circuit can be kept separate if using a PV Subpanel or Enphase AC Combiner. Use these tables as a quick reference to determine the appropriate conductor size for a single circuit of IQ Microinverter or up to three circuits if installing with the Q Aggregator or AC Combiner. Keep in mind that a single wire section may only represent a single section of the overall system, and that all sections should maintain a total voltage rise of 2%.

Calculating Total Voltage Rise

Voltage Rise Formulas

All resistances of the system components are in series and are cumulative. Since the same current is flowing through each resistance, the total VRise is simply the total current times the total resistance.

The VRise percentage for an Enphase Microinverter system is:

% of Total VRise = % VRise Section 1 + % VRise Section 2 + % VRise Section 3

Where,

% VRise Section 1 = % by number of microinverters in Internal VRise of Q Cable with IQ-Series Microinverters

% VRise Section 2 = VRise Section 2 ÷ System Voltage (either 240 or 208)

% VRise Section 3 = VRise Section 3 ÷ System Voltage (either 240 or 208)

VRise Formula for a 240 VAC, Single-Phase Installation

In a 240 VAC single-phase system, the total resistance is equal to two times the one-way resistance.

VRise of Section = *(amps/inverter x number of inverters) x (Ω/ft x 2-way wire length of Section 2 (or 3))*

Sample Calculations for Single-Phase 240 VAC Installations

As part of this analysis, we calculate VRise for a sample scenario of a fully populated Q Aggregator with 48 IQ 6 Microinverters. Each 20 A circuit has 16 IQ 6 microinverters. Each branch circuit has been center-fed into two sub-branch circuits of eight microinverters each.

Section 1: IQ 6 Internal VRise for 240 VAC Q Cable

Refer to the following table to find the Q Cable VRise appropriate for your project.

Table 1.1: Internal Q Cable VRise (IQ 6 – 240V / Portrait Cable, Q-12-10-240)

	IQ 6 Microinverters per branch (Portrait)															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Current (A)	0.96	1.92	2.88	3.83	4.79	5.75	6.71	7.67	8.63	9.58	10.54	11.50	12.46	13.42	14.38	15.33
VRise (V)	0.02	0.05	0.10	0.16	0.24	0.34	0.45	0.58	0.73	0.89	1.07	1.26	1.47	1.70	1.94	2.20
VRise (%)	0.01	0.02	0.04	0.07	0.10	0.14	0.19	0.24	0.30	0.37	0.45	0.53	0.61	0.71	0.81	0.92

For a sub-branch circuit of eight IQ 6 Micros, the voltage rise on the 240 VAC Q Cable is 0.24%.

Section 2: Voltage Rise from Q Cable to Q Aggregator

In some cases, it may not be possible to connect the Q Cable directly to the Q Aggregator. For instance, when an array is located some distance from the Q Aggregator. In this case, use the Q Extension cable and male and female Field-Wireable Connectors to make this configuration possible. Use Tables 2.1 through 2.4 to determine the maximum length of Q extension cable to maintain 1% voltage rise for this section. To further reduce voltage rise, you may increase the conductor size and use the following calculation. Here we calculate the voltage rise from an array of 16 IQ 6 Microinverters back to the location of the Q Aggregator. This run uses 20 feet of Q extension cabling.

VRise = (amps/inverter × number of inverters) × (resistance in Ω/ft) × (2-way wire length in ft)

The following example is for a fully populated circuit of 16 IQ 6 Microinverters.

- IQ 6 full load AC current = 0.96 amp
- Wire gauge for Q Extension cable = #12 AWG THWN-2 CU
- #12 AWG THWN-2 CU resistance = 0. 00198 /ft (from NEC 2008, Chapter 9, Table 8)
- Length of individual branch circuit = 20 feet, with two-way wire length = 40 feet

VRise = (0.96 amp × 16) × (0. 00198 Ω/ft) × (20 ft × 2)

= 15.36 amps × 0.00198 Ω/ft × 40 ft

= 1.22 volts

%VRise = 1.22 volts ÷ 240 volts = 0.51%

The voltage rise from the array to the Q Aggregator is 0.51%.

Section 3: Voltage Rise from the Q Aggregator to Main Panel

Use Tables 3.1 through 3.5 as a quick reference to determine an adequate wire size. To calculate the voltage rise in this portion of the circuit, multiply the combined current of the microinverters in the branch by the total resistance of the wire run.

VRise = (amps/inverter × number of inverters) × (resistance in Ω/ft) × (2-way wire length in ft)

The following example is for a fully populated Q Aggregator of 48 IQ 6 Microinverters.

- IQ 6 full load AC current = 0.96 amp
- Wire gauge for individual branch circuit = #10 AWG THWN-2 CU
- #6 AWG THWN-2 CU resistance = 0. 000491 /ft (from NEC 2008, Chapter 9, Table 8)
- Length of individual branch circuit = 40 feet, with two-way wire length = 80 feet

VRise = (0.96 amp × 48) × (0. 000491 Ω/ft) × (40 ft × 2)

= 46 amps × 0.000491 Ω/ft × 80 ft

= 2.86 volts

%VRise = 1.81 volts ÷ 240 volts = 0.75%

The voltage rise from the Q Aggregator to the Main Panel is 0.75%.

Summary of Wire Section Calculations for Single-Phase 240 VAC Applications

With the utility operating at the upper limit of their allowable tolerance (+5%) and the microinverters having a measurement accuracy of 2.5%, we are left with a voltage rise budget of 5.4 volts (2.25%) for all wiring to the PCC. The calculated VRise for all three portions of the system must be 5.4 volts or less. For systems with very long branch circuit runs and/or very long runs from the PV load center to the PCC, it is best to make the VRise in the Q Cable as small as possible. As we have already determined, 5.4 volts is equal to 2.25% of the nominal voltage. After accounting for additional losses within connections, terminals, circuit breakers, and unexpected increases in wire length, we recommend implementation of a total system voltage rise of less than 2%.

Section 1: Voltage rise in Q Cable from the microinverters to the AC junction box	= 0.24%
Section 2: Voltage rise from the AC junction box to the microinverter subpanel	= 0.51%
Section 3: Voltage rise from the microinverter subpanel to the main service panel (PCC)	= 0.75%
Total system voltage rise for all three wire sections	= 1.5%

Conclusion

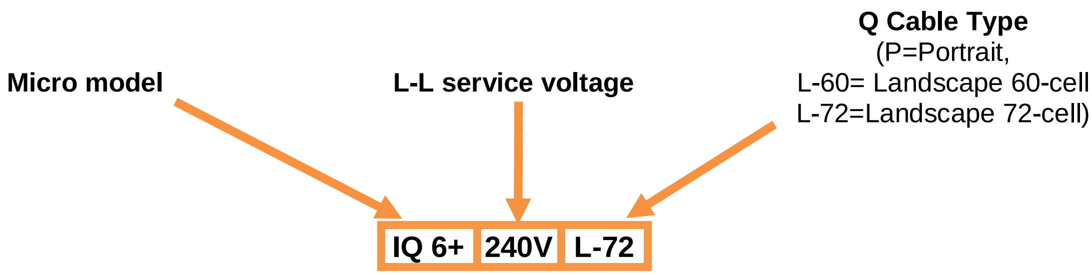
Center-feeding is a great way to decrease home run conductor costs, improve production, and increase system reliability. Follow the guidelines and calculations in this document to help minimize voltage rise issues with your installation and increase system production. Use the tables in the following Appendix to determine voltage rise and conductor size for your installations.

Appendix: VRise and Conductor Length Tables

Internal VRise of Q Cables with IQ Series Microinverters 240V

Use the following tables to determine the voltage rise attributed to the Q Cable when the IQ Micros are connected to 240 Volts. Reference the IQ Micro and Q Cable type (model numbers provided) to find the appropriate table. For end fed circuits reference the number of microinverters in the circuit to find the voltage rise attributed to the Q Cable. For center-fed circuits, reference the number of microinverters in the longer of the two sub-branches.

Table Key Explained



IQ 6 – IQ6-60-*-US

Table 1.1: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 6 | **240V** | **P**

	IQ 6 Microinverters per branch															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Current (A)	0.96	1.92	2.88	3.83	4.79	5.75	6.71	7.67	8.63	9.58	10.54	11.50	12.46	13.42	14.38	15.33
VRise (V)	0.02	0.05	0.10	0.16	0.24	0.34	0.45	0.58	0.79	0.89	1.07	1.26	1.47	1.70	1.94	2.20
VRise (%)	0.01	0.02	0.04	0.07	0.10	0.14	0.19	0.24	0.30	0.37	0.45	0.53	0.61	0.71	0.81	0.92

Table 1.2: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 6 | **240V** | **L-60**

	IQ 6 Microinverters per branch															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Current (A)	0.96	1.92	2.88	3.83	4.79	5.75	6.71	7.67	8.63	9.58	10.54	11.50	12.46	13.42	14.38	15.33
VRise (V)	0.02	0.07	0.15	0.25	0.37	0.52	0.70	0.90	1.12	1.37	1.64	1.94	2.27	2.61	2.99	3.37
VRise (%)	0.01	0.03	0.06	0.10	0.16	0.22	0.29	0.37	0.47	0.57	0.68	0.81	0.94	1.09	1.25	1.41

Table 1.3: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)*

IQ 6 | **240V** | **L-72**

	IQ 6 Microinverters per branch															
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Current (A)	0.96	1.92	2.88	3.83	4.79	5.75	6.71	7.67	8.63	9.58	10.54	11.50	12.46	13.42	14.38	15.33
VRise (V)	0.03	0.09	0.17	0.29	0.43	0.60	0.80	1.03	1.29	1.58	1.89	2.23	2.61	3.10	3.44	3.89
VRise (%)	0.01	0.04	0.07	0.12	0.18	0.25	0.33	0.43	0.54	0.66	0.79	0.93	1.09	1.25	1.43	1.62

***Note that IQ 6 Micros are compatible with 60-cell PV modules only but can be used with Q-12-20-200 cable.**

IQ 6+ - IQ6PLUS-72-*-US

Table 1.4: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 6+ | 240V | P

	IQ 6+ Microinverters per branch												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.17	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.00	15.17
VRise (V)	0.02	0.06	0.12	0.20	0.30	0.41	0.55	0.71	0.89	1.08	1.30	1.54	1.79
VRise (%)	0.01	0.02	0.05	0.08	0.12	0.17	0.23	0.30	0.37	0.45	0.54	0.64	0.75

Table 1.5: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 6+ | 240V | L-60

	IQ 6+ Microinverters per branch												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.17	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.00	15.17
VRise (V)	0.03	0.09	0.18	0.30	0.45	0.64	0.85	1.09	1.36	1.67	2.00	2.36	2.76
VRise (%)	0.01	0.04	0.08	0.13	0.19	0.27	0.35	0.45	0.57	0.69	0.83	0.99	1.15

Table 1.6: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 6+ | 240V | L-72

	IQ 6+ Microinverters per branch												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.17	2.33	3.50	4.67	5.83	7.00	8.17	9.33	10.50	11.67	12.83	14.00	15.17
VRise (V)	0.03	0.10	0.21	0.35	0.52	0.73	0.98	1.26	1.57	1.92	2.30	2.72	3.17
VRise (%)	0.01	0.04	0.09	0.15	0.22	0.31	0.41	0.52	0.65	0.80	0.96	1.13	1.32

IQ 7 - IQ7-60-*-US

Table 1.7: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7 | 240V | P

IQ 7 Microinverters per branch																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Current (A)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
VRise (V)	0.02	0.05	0.10	0.17	0.25	0.35	0.47	0.61	0.76	0.93	1.11	1.32	1.54	1.77	2.03	2.30
VRise (%)	0.01	0.02	0.04	0.07	0.11	0.15	0.20	0.25	0.32	0.39	0.46	0.55	0.64	0.74	0.84	0.96

Table 1.8: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7 | 240V | L-60

IQ 7 Microinverters per branch																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Current (A)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
VRise (V)	0.03	0.08	0.16	0.26	0.39	0.55	0.73	0.94	1.17	1.43	1.71	2.03	2.36	2.73	3.12	3.53
VRise (%)	0.01	0.03	0.06	0.11	0.16	0.23	0.30	0.39	0.49	0.60	0.71	0.84	0.99	1.14	1.30	1.47

Table 1.9: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)*

IQ 7 | 240V | L-72

IQ 7 Microinverters per branch																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Current (A)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0
VRise (V)	0.03	0.09	0.18	0.30	0.45	0.63	0.84	1.08	1.34	1.64	1.97	2.33	2.72	3.14	3.59	4.06
VRise (%)	0.01	0.04	0.07	0.12	0.19	0.26	0.35	0.45	0.56	0.68	0.82	0.97	1.13	1.31	1.49	1.69
*Note that IQ 7 Micros are compatible with 60-cell PV modules only but can be used with Q-12-20-200 cable.																

IQ 7+ - IQ7PLUS-72-*-US

Table 1.10: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7+ | 240V | P

IQ 7+ Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.2	2.4	3.6	4.8	6.0	7.3	8.5	9.7	10.9	12.1	13.3	14.5	15.7
VRise (V)	0.02	0.06	0.12	0.20	0.31	0.43	0.57	0.73	0.92	1.12	1.35	1.59	1.86
VRise (%)	0.01	0.03	0.05	0.09	0.13	0.18	0.24	0.31	0.38	0.47	0.56	0.66	0.77

Table 1.11: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7+ | 240V | L-60

IQ 7+ Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.2	2.4	3.6	4.8	6.0	7.3	8.5	9.7	10.9	12.1	13.3	14.5	15.7
VRise (V)	0.03	0.09	0.19	0.31	0.47	0.66	0.88	1.13	1.41	1.73	2.07	2.45	2.86
VRise (%)	0.01	0.04	0.08	0.13	0.20	0.27	0.37	0.47	0.59	0.72	0.86	1.02	1.19

Table 1.12: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 7+ | 240V | L-72

IQ 7+ Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.2	2.4	3.6	4.8	6.0	7.3	8.5	9.7	10.9	12.1	13.3	14.5	15.7
VRise (V)	0.04	0.11	0.22	0.36	0.54	0.76	1.01	1.30	1.62	1.99	2.38	2.82	3.29
VRise (%)	0.02	0.05	0.09	0.15	0.23	0.32	0.42	0.54	0.68	0.83	0.99	1.17	1.37

IQ 7X - IQ7X-96-*-US

Table 1.13: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7X	240V	P

	IQ 7X Microinverters per branch											
	1	2	3	4	5	6	7	8	9	10	11	12
Current (A)	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5	11.8	13.1	14.4	15.8
VRise (V)	0.02	0.07	0.13	0.22	0.33	0.47	0.62	0.80	1.00	1.22	1.46	1.73
VRise (%)	0.01	0.03	0.06	0.09	0.14	0.19	0.26	0.33	0.42	0.51	0.61	0.72

Table 1.14: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7X	240V	L-60

	IQ 7X Microinverters per branch											
	1	2	3	4	5	6	7	8	9	10	11	12
Current (A)	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5	11.8	13.1	14.4	15.8
VRise (V)	0.03	0.10	0.20	0.34	0.51	0.72	0.95	1.23	1.53	1.88	2.25	2.66
VRise (%)	0.01	0.04	0.09	0.14	0.21	0.30	0.40	0.51	0.64	0.78	0.94	1.11

Table 1.15: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 7X	240V	L-72

	IQ 7X Microinverters per branch											
	1	2	3	4	5	6	7	8	9	10	11	12
Current (A)	1.3	2.6	3.9	5.3	6.6	7.9	9.2	10.5	11.8	13.1	14.4	15.8
VRise (V)	0.04	0.12	0.24	0.39	0.59	0.82	1.10	1.41	1.76	2.16	2.59	3.06
VRise (%)	0.02	0.05	0.10	0.16	0.25	0.34	0.46	0.59	0.74	0.90	1.08	1.27

Q Extension Cable Lengths

When using the Q Extension Cable (Model: Q-RAW-300), use the following tables to determine the voltage rise for this section of cable. Reference the number of IQ Micros and the length of cable to find the voltage rise for this section.

Table 2.1: Q Extension Cable (IQ 6)

Feet	IQ 6 Microinverters per branch 240V															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
10	0.02%	0.03%	0.05%	0.06%	0.08%	0.09%	0.11%	0.13%	0.14%	0.16%	0.17%	0.19%	0.21%	0.22%	0.24%	0.25%
15	0.02%	0.05%	0.07%	0.09%	0.12%	0.14%	0.17%	0.19%	0.21%	0.24%	0.26%	0.28%	0.31%	0.33%	0.36%	0.38%
20	0.03%	0.06%	0.09%	0.13%	0.16%	0.19%	0.22%	0.25%	0.28%	0.32%	0.35%	0.38%	0.41%	0.44%	0.47%	0.51%
25	0.04%	0.08%	0.12%	0.16%	0.20%	0.24%	0.28%	0.32%	0.36%	0.40%	0.43%	0.47%	0.51%	0.55%	0.59%	0.63%
30	0.05%	0.09%	0.14%	0.19%	0.24%	0.28%	0.33%	0.38%	0.43%	0.47%	0.52%	0.57%	0.62%	0.66%	0.71%	0.76%
40	0.06%	0.13%	0.19%	0.25%	0.32%	0.38%	0.44%	0.51%	0.57%	0.63%	0.70%	0.76%	0.82%	0.89%	0.95%	1.01%
50	0.08%	0.16%	0.24%	0.32%	0.40%	0.47%	0.55%	0.63%	0.71%	0.79%	0.87%	0.95%	1.03%	1.11%	1.19%	1.27%
60	0.09%	0.19%	0.28%	0.38%	0.47%	0.57%	0.66%	0.76%	0.85%	0.95%	1.04%	1.14%	1.23%	1.33%	1.42%	1.52%
70	0.11%	0.22%	0.33%	0.44%	0.55%	0.66%	0.77%	0.89%	1.00%	1.11%	1.22%	1.33%	1.44%	1.55%	1.66%	1.77%
80	0.13%	0.25%	0.38%	0.51%	0.63%	0.76%	0.89%	1.01%	1.14%	1.27%	1.39%	1.52%	1.64%	1.77%	1.90%	2.02%
90	0.14%	0.28%	0.43%	0.57%	0.71%	0.85%	1.00%	1.14%	1.28%	1.42%	1.57%	1.71%	1.85%	1.99%	2.13%	2.28%
100	0.16%	0.32%	0.47%	0.63%	0.79%	0.95%	1.11%	1.27%	1.42%	1.58%	1.74%	1.90%	2.06%	2.21%	2.37%	2.53%

Table 2.2: Q Extension Cable (IQ 6+)

Feet	IQ 6+ Microinverters per branch 240V												
	1	2	3	4	5	6	7	8	9	10	11	12	13
10	0.02%	0.04%	0.06%	0.08%	0.10%	0.12%	0.13%	0.15%	0.17%	0.19%	0.21%	0.23%	0.25%
15	0.03%	0.06%	0.09%	0.12%	0.14%	0.17%	0.20%	0.23%	0.26%	0.29%	0.32%	0.35%	0.38%
20	0.04%	0.08%	0.12%	0.15%	0.19%	0.23%	0.27%	0.31%	0.35%	0.39%	0.24%	0.46%	0.50%
25	0.05%	0.10%	0.14%	0.19%	0.24%	0.29%	0.34%	0.39%	0.43%	0.48%	0.53%	0.58%	0.63%
30	0.06%	0.12%	0.17%	0.23%	0.29%	0.35%	0.40%	0.46%	0.52%	0.58%	0.64%	0.69%	0.75%
40	0.08%	0.15%	0.23%	0.31%	0.39%	0.46%	0.54%	0.62%	0.69%	0.77%	0.85%	0.92%	1.00%
50	0.10%	0.19%	0.29%	0.39%	0.48%	0.58%	0.67%	0.77%	0.87%	0.96%	1.06%	1.16%	1.25%
60	0.12%	0.23%	0.35%	0.46%	0.58%	0.69%	0.81%	0.92%	1.04%	1.16%	1.27%	1.39%	1.50%
70	0.13%	0.27%	0.40%	0.54%	0.67%	0.81%	0.94%	1.08%	1.21%	1.35%	1.48%	1.62%	1.75%
80	0.15%	0.31%	0.46%	0.62%	0.77%	0.92%	1.08%	1.23%	1.39%	1.54%	1.69%	1.85%	2.00%
90	0.17%	0.35%	0.52%	0.69%	0.87%	1.04%	1.21%	1.39%	1.56%	1.73%	1.91%	2.08%	2.25%
100	0.19%	0.39%	0.58%	0.77%	0.96%	1.16%	1.35%	1.54%	1.73%	1.93%	2.12%	2.31%	2.50%

Table 2.3: Q Extension Cable (IQ 7)

Feet	IQ 7 Microinverters per branch 240V															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
10	0.02%	0.03%	0.05%	0.07%	0.08%	0.10%	0.12%	0.13%	0.15%	0.17%	0.18%	0.20%	0.21%	0.23%	0.25%	0.26%
15	0.02%	0.05%	0.07%	0.10%	0.12%	0.15%	0.17%	0.20%	0.22%	0.25%	0.27%	0.30%	0.32%	0.35%	0.37%	0.40%
20	0.03%	0.07%	0.10%	0.13%	0.17%	0.20%	0.23%	0.26%	0.30%	0.33%	0.36%	0.40%	0.43%	0.46%	0.50%	0.53%
25	0.04%	0.08%	0.12%	0.17%	0.21%	0.25%	0.29%	0.33%	0.37%	0.41%	0.45%	0.50%	0.54%	0.58%	0.62%	0.66%
30	0.05%	0.10%	0.15%	0.20%	0.25%	0.30%	0.35%	0.40%	0.45%	0.50%	0.54%	0.59%	0.64%	0.69%	0.74%	0.79%
40	0.07%	0.13%	0.20%	0.26%	0.33%	0.40%	0.46%	0.53%	0.59%	0.66%	0.73%	0.79%	0.86%	0.92%	0.99%	1.06%
50	0.08%	0.17%	0.25%	0.33%	0.41%	0.50%	0.58%	0.66%	0.74%	0.83%	0.91%	0.99%	1.07%	1.16%	1.24%	1.32%
60	0.10%	0.20%	0.30%	0.40%	0.50%	0.59%	0.69%	0.79%	0.89%	0.99%	1.09%	1.19%	1.29%	1.39%	1.49%	1.58%
70	0.12%	0.23%	0.35%	0.46%	0.58%	0.69%	0.81%	0.92%	1.04%	1.16%	1.27%	1.39%	1.50%	1.62%	1.73%	1.85%
80	0.13%	0.26%	0.40%	0.53%	0.66%	0.79%	0.92%	1.06%	1.19%	1.32%	1.45%	1.58%	1.72%	1.85%	1.98%	2.11%
90	0.15%	0.30%	0.45%	0.59%	0.74%	0.89%	1.04%	1.19%	1.34%	1.49%	1.63%	1.78%	1.93%	2.08%	2.23%	2.38%
100	0.17%	0.33%	0.50%	0.66%	0.83%	0.99%	1.16%	1.32%	1.49%	1.65%	1.82%	1.98%	2.15%	2.31%	2.48%	2.64%

Table 2.4: Q Extension Cable (IQ 7+)

Feet	IQ 7+ Microinverters per branch 240V												
	1	2	3	4	5	6	7	8	9	10	11	12	13
10	0.02%	0.04%	0.06%	0.08%	0.10%	0.12%	0.14%	0.16%	0.18%	0.20%	0.22%	0.24%	0.26%
15	0.03%	0.06%	0.09%	0.12%	0.15%	0.18%	0.21%	0.24%	0.27%	0.30%	0.33%	0.36%	0.39%
20	0.04%	0.08%	0.12%	0.16%	0.20%	0.24%	0.28%	0.32%	0.36%	0.40%	0.44%	0.48%	0.52%
25	0.05%	0.10%	0.15%	0.20%	0.25%	0.30%	0.35%	0.40%	0.45%	0.50%	0.55%	0.60%	0.65%
30	0.06%	0.12%	0.18%	0.24%	0.30%	0.36%	0.42%	0.48%	0.54%	0.60%	0.66%	0.72%	0.78%
40	0.08%	0.16%	0.24%	0.32%	0.40%	0.48%	0.56%	0.64%	0.72%	0.80%	0.88%	0.96%	1.04%
50	0.10%	0.20%	0.30%	0.40%	0.50%	0.60%	0.70%	0.80%	0.90%	1.00%	1.10%	1.20%	1.30%
60	0.12%	0.24%	0.36%	0.48%	0.60%	0.72%	0.84%	0.96%	1.08%	1.20%	1.32%	1.44%	1.56%
70	0.14%	0.28%	0.42%	0.56%	0.70%	0.84%	0.98%	1.12%	1.26%	1.40%	1.54%	1.67%	1.81%
80	0.16%	0.32%	0.48%	0.64%	0.80%	0.96%	1.12%	1.28%	1.44%	1.60%	1.75%	1.91%	2.07%
90	0.18%	0.36%	0.54%	0.72%	0.90%	1.08%	1.26%	1.44%	1.61%	1.79%	1.97%	2.15%	2.33%
100	0.20%	0.40%	0.60%	0.80%	1.00%	1.20%	1.40%	1.60%	1.79%	1.99%	2.19%	2.39%	2.59%

Table 2.5: Q Extension Cable (IQ 7X)

Feet	IQ 7X Microinverters per branch 240V											
	1	2	3	4	5	6	7	8	9	10	11	12
10	0.02%	0.04%	0.06%	0.09%	0.11%	0.13%	0.15%	0.17%	0.19%	0.22%	0.24%	0.26%
15	0.03%	0.06%	0.10%	0.13%	0.16%	0.19%	0.23%	0.26%	0.29%	0.32%	0.36%	0.39%
20	0.04%	0.09%	0.13%	0.17%	0.22%	0.26%	0.30%	0.35%	0.39%	0.43%	0.48%	0.52%
25	0.05%	0.11%	0.16%	0.22%	0.27%	0.32%	0.38%	0.43%	0.49%	0.54%	0.60%	0.65%
30	0.06%	0.13%	0.19%	0.26%	0.32%	0.39%	0.45%	0.52%	0.58%	0.65%	0.71%	0.78%
40	0.09%	0.17%	0.26%	0.35%	0.43%	0.52%	0.61%	0.69%	0.78%	0.87%	0.95%	1.04%
50	0.11%	0.22%	0.32%	0.43%	0.54%	0.65%	0.76%	0.87%	0.97%	1.08%	1.19%	1.30%
60	0.13%	0.26%	0.39%	0.52%	0.65%	0.78%	0.91%	1.04%	1.17%	1.30%	1.43%	1.56%
70	0.15%	0.30%	0.45%	0.61%	0.76%	0.91%	1.06%	1.21%	1.36%	1.52%	1.67%	1.82%
80	0.17%	0.35%	0.52%	0.69%	0.87%	1.04%	1.21%	1.39%	1.56%	1.73%	1.91%	2.08%
90	0.19%	0.39%	0.58%	0.78%	0.97%	1.17%	1.36%	1.56%	1.75%	1.95%	2.14%	2.34%
100	0.22%	0.43%	0.65%	0.87%	1.08%	1.30%	1.52%	1.73%	1.95%	2.17%	2.38%	2.60%

Conductor Lengths by Wire Section

Use the following tables to help determine the proper wire size based on the number of microinverters in the circuit and the length of the wire section. Use these tables for either individual microinverter branch circuits or combined branch circuits that use the Q Aggregator. The tables list the maximum length a particular conductor can be run to maintain 1% voltage rise for this section of wire. Keep in mind that if multiple sections are combined, then the conductor size should be increased appropriately.

Table 3.1: Maximum Distance (in feet) to Maintain 1% VRise for 240 VAC (IQ 6)

AWG	Number of IQ 6 Micros																
	3	6	9	12	15	16	18	21	24	27	30	33	36	39	42	45	48
#12	211	105	70	53	42	40	35	30	26	23	21	19	18	16	15	14	13
#10	337	168	112	84	67	63	56	48	42	37	34	31	28	26	24	22	21
#8	536	268	179	134	107	101	89	77	67	60	54	49	45	41	38	36	34
#6	850	425	283	213	170	159	142	121	106	94	85	77	71	65	61	57	53
#4	1355	678	452	339	271	254	226	194	169	151	136	123	113	104	97	90	85
	Single Branch Circuit						Q Aggregator Combined Quantity of IQ 6										

Table 3.2: Maximum Distance (in feet) to Maintain 1% VRise for 240 VAC (IQ 6+)

AWG	Number of IQ 6+ Micros													
	3	6	9	12	13	15	18	21	24	27	30	33	36	39
#12	173	87	58	43	40	35	29	25	22	19	17	16	14	13
#10	276	138	92	69	64	55	46	39	35	31	28	25	23	21
#8	441	220	147	110	102	88	73	63	55	49	44	40	37	34
#6	698	349	233	175	161	140	116	100	87	78	70	63	58	54
#4	1113	557	371	278	257	223	186	159	139	124	111	101	93	86
	Single Branch Circuit					Q Aggregator Combined Quantity of IQ 6+								

Table 3.3: Maximum Distance (in feet) to Maintain 1% VRise for 240 VAC (IQ 7)

AWG	Number of IQ 7 Micros																
	3	6	9	12	15	16	18	21	24	27	30	33	36	39	42	45	48
#12	202	101	67	51	40	38	34	29	25	22	20	18	17	16	14	13	13
#10	323	161	108	81	65	60	54	46	40	36	32	29	27	25	23	22	20
#8	514	257	171	129	103	96	86	73	64	57	51	47	43	40	37	34	32
#6	815	407	272	204	163	153	136	116	102	91	81	74	68	63	58	54	51
#4	1299	649	433	325	260	244	216	186	162	144	130	118	108	100	93	87	81
	Single Branch Circuit						Q Aggregator combined quantity of IQ 7										

Table 3.4: Maximum Distance (in feet) to Maintain 1% VRise for 240 VAC (IQ 7+)

AWG	Number of IQ 7+ Micros													
	3	6	9	12	13	15	18	21	24	27	30	33	36	39
#12	167	84	56	42	39	33	28	24	21	19	17	15	14	13
#10	267	133	89	67	62	53	44	38	33	30	27	24	22	21
#8	425	213	142	106	98	85	71	61	53	47	43	39	35	33
#6	674	337	225	169	156	135	112	96	84	75	67	61	56	52
#4	1075	537	358	269	248	215	179	154	134	119	107	98	90	83
	Single Branch Circuit					Q Aggregator combined quantity of IQ 7+								

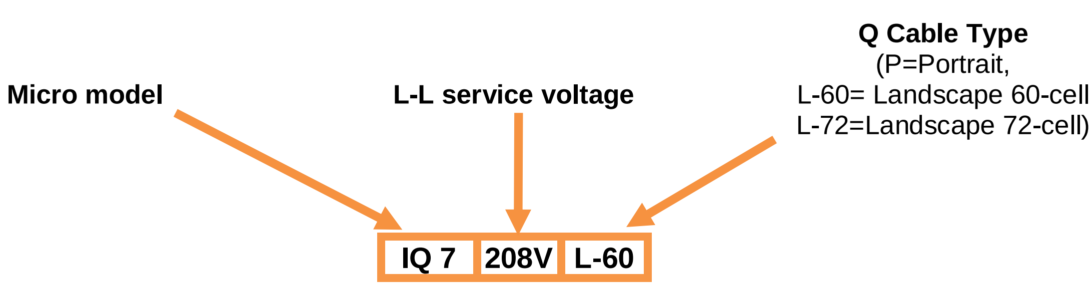
Table 3.5: Maximum Distance (in feet) to Maintain 1% VRise for 240 VAC (IQ 7X)

AWG	Number of IQ 7X Micros											
	3	6	9	12	15	18	21	24	27	30	33	36
#12	154	77	51	38	31	26	22	19	17	15	14	13
#10	246	123	82	61	49	41	35	31	27	25	22	20
#8	392	196	131	98	78	65	56	49	44	39	36	33
#6	621	310	207	155	124	103	89	78	69	62	56	52
#4	989	495	330	247	198	165	141	124	110	99	90	82
	Single Branch Circuit				Q Aggregator combined quantity of IQ 7X							

Internal VRise of Q Cables with IQ Series Microinverters 208V

Use the following tables to determine the voltage rise attributed to the Q Cable when the IQ Micros are connected to 208/120V services. Reference the IQ Micro and Q Cable type (model numbers provided) to find the appropriate table. For end fed circuits reference the number of microinverters in the circuit to find the voltage rise attributed to the Q Cable. For center-fed circuits, reference the number of microinverters in the longer of the two sub-branches.

Table Key Explained



IQ 6 – IQ6-60-*-US

Table 4.1: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 6 | **208V** | **P**

IQ 6 Microinverters per branch														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Current (A)	1.11	2.21	3.32	4.42	5.53	6.63	7.74	8.85	9.95	11.06	12.16	13.27	14.38	15.48
VRise (V)	0.02	0.06	0.11	0.19	0.28	0.39	0.52	0.67	0.84	1.03	1.23	1.46	1.70	1.96
VRise (%)	0.01	0.03	0.05	0.09	0.13	0.19	0.25	0.32	0.40	0.49	0.59	0.70	0.82	0.94

Table 4.2: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 6 | **208V** | **L-60**

IQ 6 Microinverters per branch														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Current (A)	1.11	2.21	3.32	4.42	5.53	6.63	7.74	8.85	9.95	11.06	12.16	13.27	14.38	15.48
VRise (V)	0.03	0.09	0.17	0.29	0.43	0.60	0.81	1.04	1.29	1.58	1.90	2.24	2.62	3.02
VRise (%)	0.01	0.04	0.08	0.14	0.21	0.29	0.39	0.50	0.62	0.76	0.91	1.08	1.26	1.45

Table 4.3: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)*

IQ 6 | **208V** | **L-72**

IQ 6 Microinverters per branch														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Current (A)	1.11	2.21	3.32	4.42	5.53	6.63	7.74	8.85	9.95	11.06	12.16	13.27	14.38	15.48
VRise (V)	0.03	0.10	0.20	0.33	0.50	0.69	0.93	1.19	1.49	1.82	2.18	2.58	3.01	3.47
VRise (%)	0.02	0.05	0.10	0.16	0.24	0.33	0.45	0.57	0.72	0.87	1.05	1.24	1.45	1.67
*Note that IQ 6 Micros are compatible with 60-cell PV modules only but can be used with Q-12-20-200 cable.														

IQ 6+ - IQ6PLUS-72-*-US

Table 4.4: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 6+ | 208V | P

IQ 6+ Microinverters per branch											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.35	2.69	4.04	5.38	6.73	8.08	9.42	10.77	12.12	13.46	14.81
VRise (V)	0.02	0.07	0.14	0.23	0.34	0.48	0.64	0.82	1.02	1.25	1.50
VRise (%)	0.01	0.03	0.07	0.11	0.16	0.23	0.31	0.39	0.49	0.60	0.72

Table 4.5: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 6+ | 208V | L-60

IQ 6+ Microinverters per branch											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.35	2.69	4.04	5.38	6.73	8.08	9.42	10.77	12.12	13.46	14.81
VRise (V)	0.04	0.11	0.21	0.35	0.53	0.74	0.98	1.26	1.58	1.93	2.31
VRise (%)	0.02	0.05	0.10	0.17	0.25	0.35	0.47	0.61	0.76	0.93	1.11

Table 4.6: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 6+ | 208V | L-72

IQ 6+ Microinverters per branch											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.35	2.69	4.04	5.38	6.73	8.08	9.42	10.77	12.12	13.46	14.81
VRise (V)	0.04	0.12	0.24	0.40	0.60	0.85	1.13	1.45	1.81	2.21	2.66
VRise (%)	0.02	0.06	0.12	0.19	0.29	0.41	0.54	0.70	0.87	1.06	1.28

IQ 7 - IQ7-60-*-US

Table 4.7: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7 | 208V | P

IQ 7 Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.15	2.31	3.46	4.62	5.77	6.92	8.08	9.23	10.38	11.54	12.69	13.85	15.00
VRise (V)	0.02	0.06	0.12	0.20	0.29	0.41	0.55	0.70	0.88	1.07	1.29	1.52	1.77
VRise (%)	0.01	0.03	0.06	0.09	0.14	0.20	0.26	0.34	0.42	0.52	0.62	0.73	0.85

Table 4.8: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7 | 208V | L-60

IQ 7 Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.15	2.31	3.46	4.62	5.77	6.92	8.08	9.23	10.38	11.54	12.69	13.85	15.00
VRise (V)	0.03	0.09	0.18	0.30	0.45	0.63	0.84	1.08	1.35	1.65	1.98	2.34	2.73
VRise (%)	0.01	0.04	0.09	0.14	0.22	0.30	0.40	0.52	0.65	0.79	0.95	1.13	1.31

Table 4.9: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)*

IQ 7 | 208V | L-72

IQ 7 Microinverters per branch													
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Current (A)	1.15	2.31	3.46	4.62	5.77	6.92	8.08	9.23	10.38	11.54	12.69	13.85	15.00
VRise (V)	0.03	0.10	0.21	0.35	0.52	0.72	0.97	1.24	1.55	1.90	2.28	2.69	3.14
VRise (%)	0.02	0.05	0.10	0.17	0.25	0.35	0.46	0.60	0.75	0.91	1.09	1.29	1.51
***Note that IQ 7 Micros are compatible with 60-cell PV modules only but can be used with Q-12-20-200 cable.**													

IQ 7+ - IQ7PLUS-72-*-US

Table 4.10: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7+	208V	P

	IQ 7+ Microinverters per branch										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.39	2.79	4.18	5.58	6.97	8.37	9.76	11.15	12.55	13.94	15.34
VRise (V)	0.02	0.07	0.14	0.24	0.35	0.49	0.66	0.85	1.06	1.30	1.56
VRise (%)	0.01	0.03	0.07	0.11	0.17	0.24	0.32	0.41	0.51	0.62	0.75

Table 4.11: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7+	208V	L-60

	IQ 7+ Microinverters per branch										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.39	2.79	4.18	5.58	6.97	8.37	9.76	11.15	12.55	13.94	15.34
VRise (V)	0.04	0.11	0.22	0.36	0.54	0.76	1.02	1.31	1.63	1.99	2.39
VRise (%)	0.02	0.05	0.10	0.17	0.26	0.37	0.49	0.63	0.78	0.96	1.15

Table 4.12: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 7+	208V	L-72

	IQ 7+ Microinverters per branch										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Current (A)	1.39	2.79	4.18	5.58	6.97	8.37	9.76	11.15	12.55	13.94	15.34
VRise (V)	0.04	0.13	0.25	0.42	0.63	0.88	1.17	1.50	1.88	2.29	2.75
VRise (%)	0.02	0.06	0.12	0.20	0.30	0.42	0.56	0.72	0.90	1.10	1.32

IQ 7X - IQ7X-96-*-US

Table 4.13: Internal Q Cable VRise (Portrait Cable, Q-12-10-240)

IQ 7X	208V	P

	IQ 7X Microinverters per branch									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Current (A)	1.51	3.03	4.54	6.06	7.57	9.09	10.60	12.12	13.63	15.14
VRise (V)	0.03	0.08	0.15	0.26	0.38	0.54	0.72	0.92	1.15	1.41
VRise (%)	0.01	0.04	0.07	0.12	0.18	0.26	0.34	0.44	0.55	0.68

Table 4.14: Internal Q Cable VRise (Landscape 60-Cell Cable, Q-12-17-240)

IQ 7X	208V	L-60

	IQ 7X Microinverters per branch									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Current (A)	1.51	3.03	4.54	6.06	7.57	9.09	10.60	12.12	13.63	15.14
VRise (V)	0.04	0.12	0.24	0.39	0.59	0.83	1.10	1.42	1.77	2.17
VRise (%)	0.02	0.06	0.11	0.19	0.28	0.40	0.53	0.68	0.85	1.04

Table 4.15: Internal Q Cable VRise (Landscape 72-Cell Cable, Q-12-20-200)

IQ 7X	208V	L-72

	IQ 7X Microinverters per branch									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Current (A)	1.51	3.03	4.54	6.06	7.57	9.09	10.60	12.12	13.63	15.14
VRise (V)	0.05	0.14	0.27	0.45	0.68	0.95	1.27	1.63	2.04	2.49
VRise (%)	0.02	0.07	0.13	0.22	0.33	0.46	0.61	0.78	0.98	1.20