Circuit Calculations for the M250 Microinverter

Overview

Use this document as a reference guide to properly size conductors for M250 Microinverter branch circuit home runs. This supplements the more comprehensive technical brief, *Calculating AC Line Voltage Drop for M250 Microinverters with Engage Cables*. Enphase Energy recommends maintaining the total voltage drop on all wiring sections to 2% or less. This includes the Enphase Engage™ Cable, the home run wiring from the junction box to the microinverter subpanel, and the section from the microinverter subpanel to the main service panel or Point of Common Coupling (PCC).

This document lists the maximum conductor lengths from the array-located junction box back to the main service panel, assuming that a 1% voltage drop is maintained.

240 VAC Single-Phase

External Branch (Home Run) Wiring Maximum Distance to Maintain 1% V_{Drop} for 240 VAC Single-Phase

	M250 Microinverters per Branch															
AWG	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Maximum One-Way Wire Length (in Feet) to Maintain 1% V_{DROP}															
#12	585	293	195	146	117	98	84	73	65	59	53	49	45	42	39	37
#10	930	465	310	233	186	155	133	116	103	93	85	78	72	66	62	58
#8	1483	742	494	371	297	247	212	185	165	148	135	124	114	106	99	93
#6	2353	1176	784	588	471	392	336	294	261	235	214	196	181	168	157	147
#4	3738	1869	1246	935	748	623	534	467	415	374	340	312	288	267	249	234

V_{Drop} Calculation

The typical formula to calculate the percent of voltage drop for 240 VAC single-phase is:

$$\%\ Vdrop = \frac{(Amps/Inverter \times \#\ of\ Inverters) \times (Resistance/feet \times 2\text{-}way\ wire\ length)}{240\ Volts}$$

Circuit Current Calculation

The formula to calculate the circuit current of a branch is:

Amps/Branch = Maximum Output Power ÷ 240 V x # of Microinverters

For example, if the maximum output power is 240 Watts AC and there are 16 microinverters, then:

240 W ÷ 240 V x 16 = 16 Amps/Branch

Overcurrent Protection Calculation

Use the value of 1.25 and the result of the Circuit Current Calculation on page 1 to determine the overcurrent protection value. For example, if the circuit calculation is 16 Amps, then:

16 X 1.25 = 20 Amps

Conclusions for 240 VAC Single-Phase

For less than 1% voltage drop in a fully populated branch circuit home run for 240 VAC single-phase:

- Install 1 to 16 M250 Microinverters per branch circuit, up to 3840 Watts AC
- Install a maximum 2 Pole 20 Amp circuit breaker
- Use a minimum 12 AWG wire size
- Engage Cable required

208 VAC Three-Phase

External Branch (Home Run) Wiring Maximum Distance to Maintain 1% V_{Drop} for 208 VAC Three-Phase

	Microinverters per Branch							
AWG	3	6	9	12	15	18	21	24
	Maximum One-Way Wire Length (in Feet) to Maintain 1% V_{DROP}							
#12	293	147	98	73	59	49	42	37
#10	501	250	167	125	100	83	72	63
#8	770	385	257	193	154	128	110	96
#6	1226	613	409	307	245	204	175	153
#4	1938	969	646	485	388	323	277	242

V_{Drop} Calculation

The typical formula to calculate the percent of voltage rise for 208 VAC three-phase is:

$$\%\ Vdrop = \frac{(Watts/Inverter \times \#\ of\ Inverters) \times (Resistance/feet \times 1\text{-}way\ wire\ length) \div 208\ Volts}{208\ Volts}$$

Circuit Current Calculation

The formula to calculate the circuit current of a 208 VAC three-phase branch is:

Amps/Branch = Maximum Output Power ÷ 208 Volts ÷ √3 x # of Microinverters

For example, if the maximum output power is 240 Watts AC and there are 24 microinverters, then:

240W ÷ 208V ÷ 1.732 x 24 = 15.99A

Overcurrent Protection Calculation

Use the value of 1.25 and the result of the Circuit Current Calculation on page 2 to determine the overcurrent protection value. For example, if the circuit calculation is 15.99 Amps, then:

15.99 X 1.25 = 19.99A

Conclusions for 208 VAC Three-Phase

For less than 1% voltage drop in a fully populated branch circuit home run for 208 VAC three-phase:

- Install 3 to 24 M250 Microinverters per branch circuit, up to 5760 Watts AC
- Install a maximum 3 Pole 20 Amp circuit breaker
- Use a minimum 12 AWG wire size
- Engage Cable Required

Summary

To minimize any installation difficulties, please adhere to the tables in this document and the information in the Enphase technical brief, *Calculating AC Line Voltage Drop for M250 Microinverters with Engage Cables* on http://www.enphase.com/support).