Circuit Calculations for the M215 Microinverter

Overview

This document serves as a reference guide for properly sizing conductors for M215 microinverter branch circuit home runs. This supplements the more comprehensive Enphase Energy technical brief, Calculating AC Line Voltage Drop for M215 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 Cabling, the homerun 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

<table>
<thead>
<tr>
<th>AWG</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td></td>
<td>Maximum One-Way Wire Length (in Feet) to Maintain 1% V_Drop</td>
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<td>260</td>
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V_Drop Calculation

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

\[
\% V_{Drop} = \frac{(Amps/Inverter \times \# \ of \ Inverters) \times (Resistance \ \Omega/ft) \times (2 \ way \ wire \ length \ feet)}{240 \ Volts}
\]

Circuit Current Calculation

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

\[
Amps/\text{Branch} = \frac{\text{Maximum Output Power}}{240 \ V \times \# \ of \ Microinverters}
\]

For example, if the maximum output power is 215 Watts AC and there are 17 microinverters, then:

\[
215 \ W \div 240 \ V \times 17 = 15.3 \ Amps/\text{Branch}
\]
Overcurrent Protection Calculation

Use the value of 1.25 and the Circuit Current Calculation on page 1 to determine the overcurrent protection value. For example, if the circuit calculation is 15.3 Amps, then:

$$15.3 \times 1.25 = 19.1 \text{ Amps}$$

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 17 M215 microinverters per branch circuit, up to 3655 Watts AC
- Install a maximum 2 Pole 20 Amp circuit breaker
- Use a minimum 12AWG 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

<table>
<thead>
<tr>
<th>AWG</th>
<th>#12</th>
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<th>#6</th>
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<td>70</td>
<td>93</td>
<td>171</td>
<td>270</td>
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</table>

$V_{Drop}$ Calculation

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

$$\% V_{Drop} = \frac{(\text{Watts/Inverter}) \times (\# \text{ of Inverters}) \times (\text{Resistance} \ \Omega/\text{ft}) \times 1 \ \text{way wire length feet}) \times 100}{208 \ \text{Volts}}$$

Circuit Current Calculation

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

$$\text{Amps/Branch} = \frac{\text{Maximum Output Power}/208 \ \text{Volts}}{1.732 \ (\text{value of } \sqrt{3} \text{ for three phase})}$$

For example, if the maximum output power is 215 Watts AC and there are 25 microinverters, then:

$$215 \ \text{W} \div 208 \ \text{V} \times 25 \div 1.732 = 14.92 \ \text{Amps/Branch}$$
Overcurrent Protection Calculation

Use the value of 1.25 and the Circuit Current Calculation value on page 2 to determine the overcurrent protection value. For example, if the circuit calculation is 14.92 Amps, then:

\[14.92 \times 1.25 = 18.65 \text{ Amps}\]

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 25 M215 Microinverters per branch circuit, up to 5160 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 M215 Microinverters with Engage™ Cables (refer to www.enphase.com/support/downloads).