Open Energy for All

Technical Note

Selection and Installation of AC End Cables for HMS Series Microinverter

Version: V1.0

Release date: 2022-06-22

Contents

1. Introduction **1**

2. Cable Selection **2**

2.1 Conductor Number and Material 2

2.2 Cable Size and Ampacity 3

2.3 Nominal Voltage 4

2.4 The Environment and Dress Method 4

2.5 Conductor Insulation Color 5

2.6 Cable Diameter 6

2.6.1 Overall diameter 6

2.6.2 Inner Conductor Diameter 7

3. Installation Method **8**

This document covers the details about selecting and installing an appropriate AC End Cable for Hoymiles microinverter system.

1. Introduction

In Hoymiles microinverter system, the AC branch is generally comprised of two key elements:

- Microinverter
- Trunk Cable

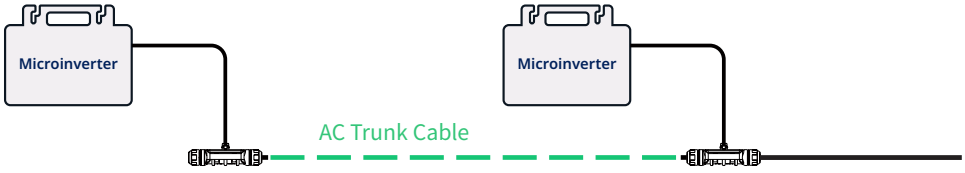


Figure 1 AC Branch

The Trunk Cable refers to a cable to which all the AC Trunk Connectors can be connected. The HMS series microinverters are arranged in parallel on the AC side via a Trunk Cable. Each AC branch needs to be connected to the junction box. And the AC End Cable is designed to run between the AC Trunk Cable and the junction box. Generally, the specifications of the AC End Cable and the AC Trunk Cable should be the same.

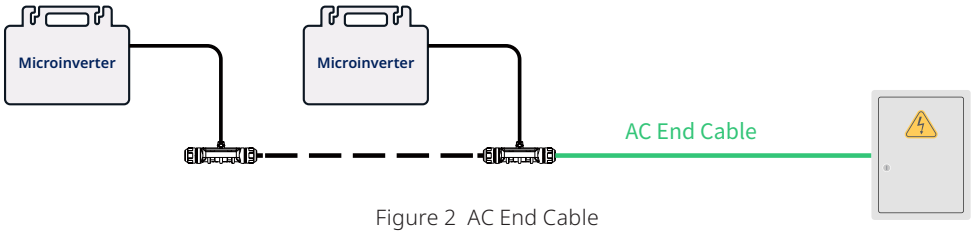


Figure 2 AC End Cable

Since the AC End Cable is not supplied by Hoymiles due to different installations requiring different length cables, the following part lists six key factors to consider when selecting an AC End Cable.

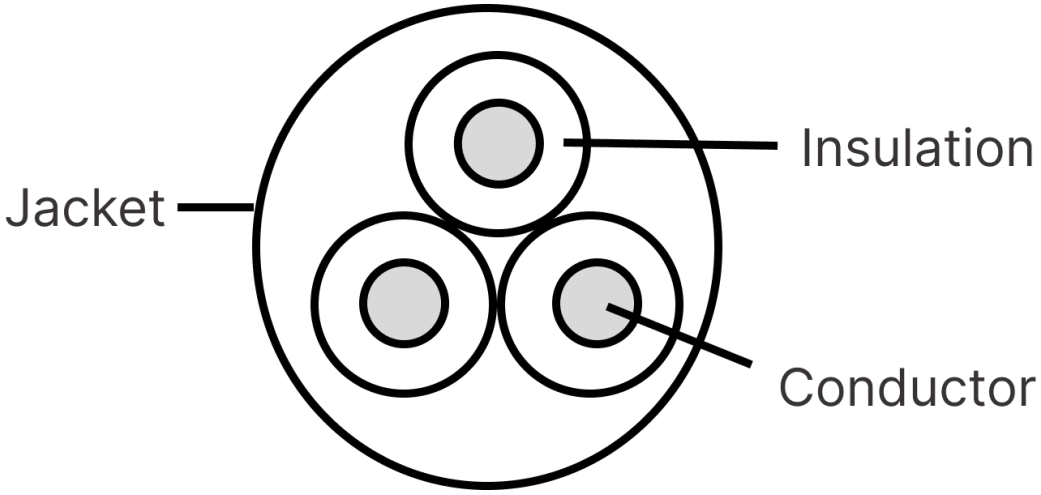
© 2022 Hoymiles Power Electronics Inc. All rights reserved.

2. Cable Selection

To correctly select an AC End Cable, cable type (involving the conductor number, conductor material, conductor insulation color as well as cable diameters), load current, voltage level, and operation environment matter a lot. This section of the document deals with six aspects of cable selection.

2.1 Conductor Number and Material

The Trunk Cable Hoymile adopted is a three-core cable, which typically comprises three individually insulated solid cores for a neutral, live, and earth conductor. The cross drawing of a three-core cable is shown below.



The Trunk Cable, supplied by Hoymiles, is made of copper. Considering copper is commonly used as a conducting material because it can effectively reduce the effect of voltage drop, a three-core cable is Hoymiles' recommendation for the microinverter system.

Note:

The electrical resistance of different materials varies and will affect the current-carrying capacity (ampacity) of the conductor. In this document, the ampacity is calculated assuming that the conductor material is copper, thus this calculation method presented here does not apply to other conductor materials.

© 2022 Hoymiles Power Electronics Inc. All rights reserved.

2.2 Cable Size and Ampacity

In this section, the cable selection depends on the cable ampacity[1] .

Because of variations in project specifications, the nominal output current of the AC branch varies with the number or the model of microinverters per branch. Consequently, conductors in this project also come in various sizes and are specified as mm² or AWG (American Wire Gauge). To match the Hoymiles Trunk cable, the size of the AC End Cable is limited to 4 mm² (12 AWG in America) or 6 mm² (10 AWG in America).

Note:

1. The total output current of the AC branch is the summation of all the output currents of the microinverters in all of the AC branches.

2. Both mm^2 and AWG are basically a measure of conductor diameter. A metric mm^2 is virtually used around the world while AWG is only predominantly used as a standard method to note the diameter in North America.

Each cable size has a maximum current limit that a cable can handle to prevent overheating. Below are two tables that show the current capacity that a 4 mm² (12 AWG in America) or 6 mm² (10 AWG in America) can handle. Before selecting the AC End Cable, please evaluate the cable ampacity to make sure the AC End Cable's maximum current rating is equal to or greater than the total output current of the AC branch.

Table 1 For installers Around the World

Diameter (mm²)	4	6
Current Capacity (A)	0-20	0-32

Table 2 For installers in America

AWG	12	10
Maximum Over Current Protection Device (OCPD) [A]	20	30
Current Capacity (A)	0-16	0-24

Note:

1. Some local regulations dictate that if the AC End Cable length is too long, oversizing the cable or reducing inverters per branch is recommended to limit voltage drop.

2. Both NEC 2017 and NEC 2020 have required the branch-circuit conductors and equipment shall be protected by overcurrent protective devices that have a rating or setting that complies with NEC codes. Specifically, the overcurrent device rating of 12 AWG is 20 amperes while 10 AWG is 30 amperes. And the conductor's continuous load should be no more than 80 percent of the circuit protection. So the maximum current capacity of a 12 AWG cable rates 16 A, 20 A × 80% = 16 A, while the maximum current capacity of a 10 AWG cable rates 24 A, 30A × 80% = 24 A.

1 Ampacity: Heat will be produced when an electric current flows through a conductor. And the ampacity refers to the maximum current limit that a cable can handle to prevent overheating.

© 2022 Hoymiles Power Electronics Inc. All rights reserved.

2.3 Nominal Voltage

The nominal voltage of a cable refers to the optimum voltage level which guarantees the cable can work normally for a long time.

The output voltage of the HMS series microinverter is generally 220 V single-phase AC (240 V in North America). Hence, the nominal voltage of the cable should be equal to or greater than 240V.

This document recommends choosing a low-voltage AC cable with a nominal voltage of up to 1000 V (600 V in North America).

2.4 The Dress Method and Environment

Running the AC End Cable from the roof to the exterior wall of a house means that the AC End Cable will be laid inside a metallic sheathed cable or installed in a cable tray or just directly exposed in the open air.

Considering long-term exposure to the sunlight and rain-wash, the cable should be resistant to UV, fire, as well as high temperatures of forty to ninety degrees. And the other parameter index of the cable should be satisfied local regulations.

Following is the technical data of a Trunk Cable selected by Hoymiles, which can be used as references.

Region	Europe	North America
Model	PV07AC-F	TC-ER[2]
Standard	2PFG 1940[1]	UL1277

Note:

1. 2PFG 1940: This standard does not include specific requirements for outdoor wiring. The Trunk Cable Hoymile supplies can be used in the open air. Therefore, before choosing the AC End Cable from the other manufacturers, please consult the manufacturer about whether the cable can be used outdoors. If the cable cannot be used outdoors, please use a cable tray or a metallic sheathed cable.

2. TC-ER: TC is short for "Tray Cable" and is the name given to cables that may be installed in a cable rack or cable tray. the cable racks/trays must, in principle, be enclosed or the cables must be laid inside conduits. To simplify the installation process, cables suitable for exposed installation, according to UL 1277, NFPA 79 and NEC, are increasingly being used. This is also known as "Exposed Run" (ER). TC-ER cables do not need to be protected by enclosed trays or conduits, and therefore simplify cable installation from the roof to the distribution box without compromising on quality and safety. If selecting the TC cable, the cable must be laid inside conduits.

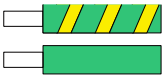
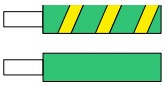
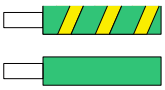
© 2022 Hoymiles Power Electronics Inc. All rights reserved.

2.5 Conductor Insulation Color

Currently, AC wires are color-coded for safety. And the conductor insulation color is used to identify different power conductors. For avoiding the wrong conductor connection, it is quite essential to correctly match conductors in the junction box of the same color code.

Since the cable color code is specified based on region or country, usage of the right conductor color code which is abiding by local government regulations is recommended for safety. The conductor color code is listed in Table 3 below.

Table 3 Wiring Color Codes Infographic

Standards	Region / Country	Protective Earth	Neutral	Live 1	Live 2	Live 3
IEC 60446 EN 60446 BS 7671	The European Union, U K , S i n g a p o r e , Kazakhstan,India, Pakistan, Malaysia					
AS/NZS 3000	Australia, New Zealand					
GB 50303 GB 50258	China					
NEC	America					
CEC	Canada					
JIS	Japan					
	Korea					

© 2022 Hoymiles Power Electronics Inc. All rights reserved.

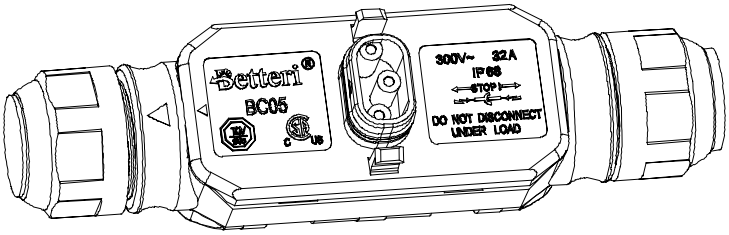
2.6 Cable Diameter

With regard to the situation that the AC End Cable needs to be connected to the last Trunk Connector of the AC branch, the cable size such as overall diameter and inner conductor diameter should be given consideration.

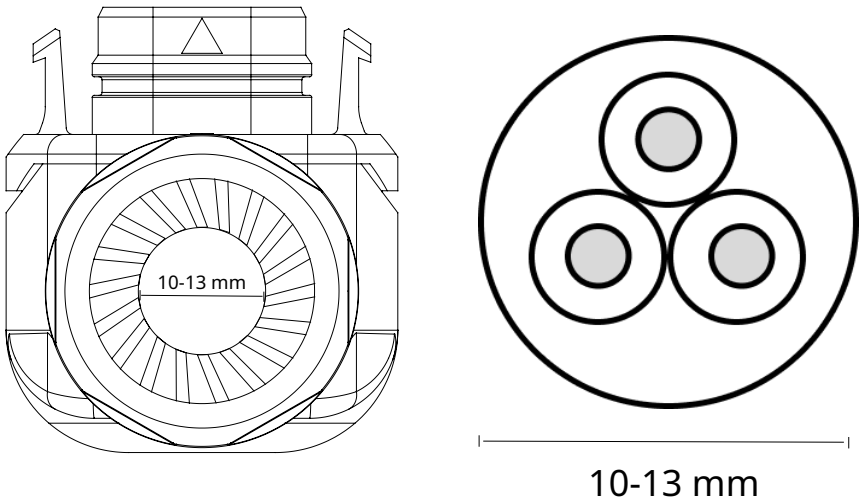
2.6.1 Overall Diameter

Considering Trunk Connectors are destined to be installed on the roof, the combination of the cable and the connector should be waterproof to prevent moisture intrusion and water damage.

The Trunk connector of the Hoymiles microinverter has been equipped with a waterproof conductor port (for joining the conductor end to end). To ensure good sealing of the cable, it is essential to select an appropriate overall diameter sized AC end cable.



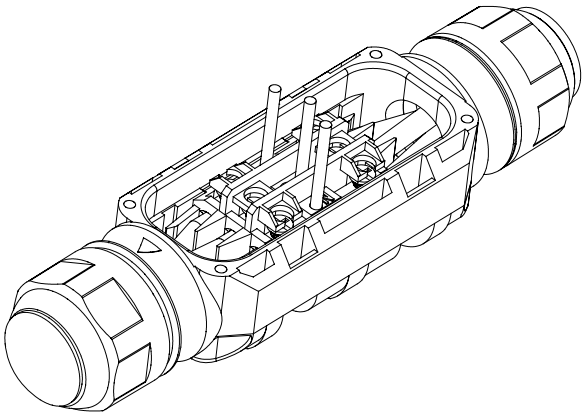
Usually, a Trunk connector comes in a variety of sizes to accommodate different cable sizes. When tightening the screw cap and the housing of the Hoymiles Single-Phase Waterproof Trunk Connector, its port shrinks into a circle with a diameter range of 10-13 mm. Therefore, the outer diameter range of the cable needs to be 10mm to 13 mm.

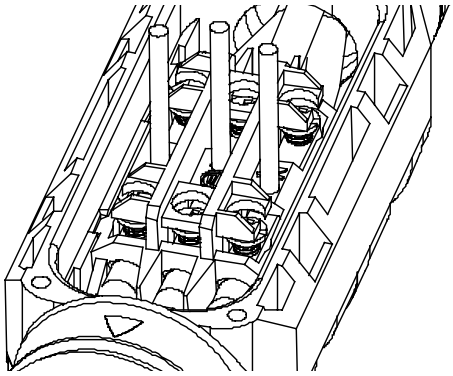


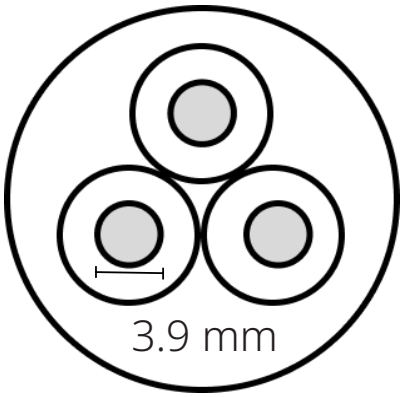
© 2022 Hoymiles Power Electronics Inc. All rights reserved.

2.6.2 Inner Conductor Diameter

The inner conductor of the cable will be crimped in the Trunk connector, and the diameter of the crimp hole is 3.9 mm. Consequently, the diameter of the inner conductor of the cable cannot exceed the diameter of the crimp hole.







Note:

1. Typically, the conductor diameter of a 12 AWG cable is 2.36 mm while a 10 AWG cable is 2.97 mm.

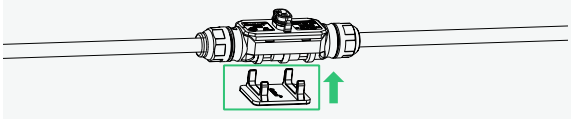
2. "Crimp" means crimped connection here. After removing the insulation, insert the constructor into the connector. Then use a crimping plier to compress the crimp fitting around the conductor until fully tightened.

© 2022 Hoymiles Power Electronics Inc. All rights reserved.

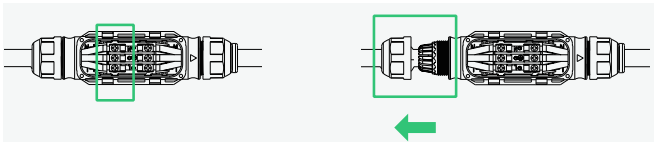
3. Installation Method

Install AC end cable on the AC Trunk（connected to the distribution box）.

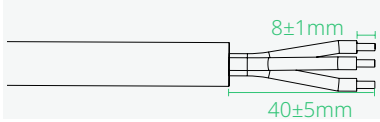
- Unlock the port upper cove.



- Loose the screws with the screwdriver and remove the extra cable. (If there is no cable at this side, skip the cable removal.)

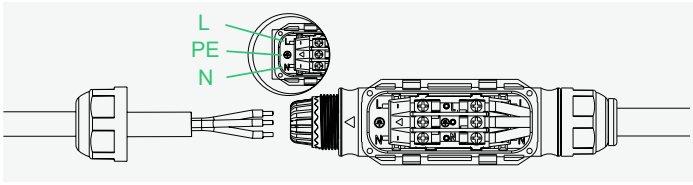


- Prepare a suitable length of the AC cable to connect to the distribution box, with stripping requirements.

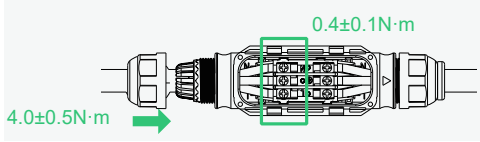


Note: *To prevent bad connection, please tin dip each end of the multi strand copper cable in solder before inserting .*

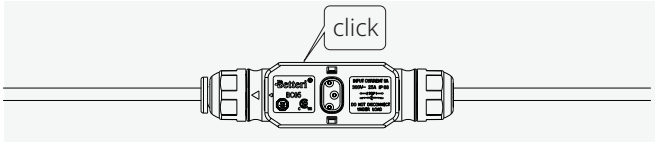
- Insert the cable into the cap. Match the L, N, and PE into the corresponding slots.



- Tighten the screws, and then tighten the cap back to the port.



- Plug the upper cover back into the Trunk connector.



Note:

1. Tighten torque of the cap: 4.0±0.5N·m, do not over-torque.

2. Torque of locking screw: 0.4±0.1N·m.

3. Take care not to damage the sealing ring in the AC Trunk Connector during disassembly and assembly.

4. For more information, please see the microinverter's Quick Installation Guide or User Manual.

Important: The data in this document is for reference only. Since regulations vary from region to region, and different manufacturers produce different cables, the installing should be done according to local electrical codes.

© 2022 Hoymiles Power Electronics Inc. All rights reserved.