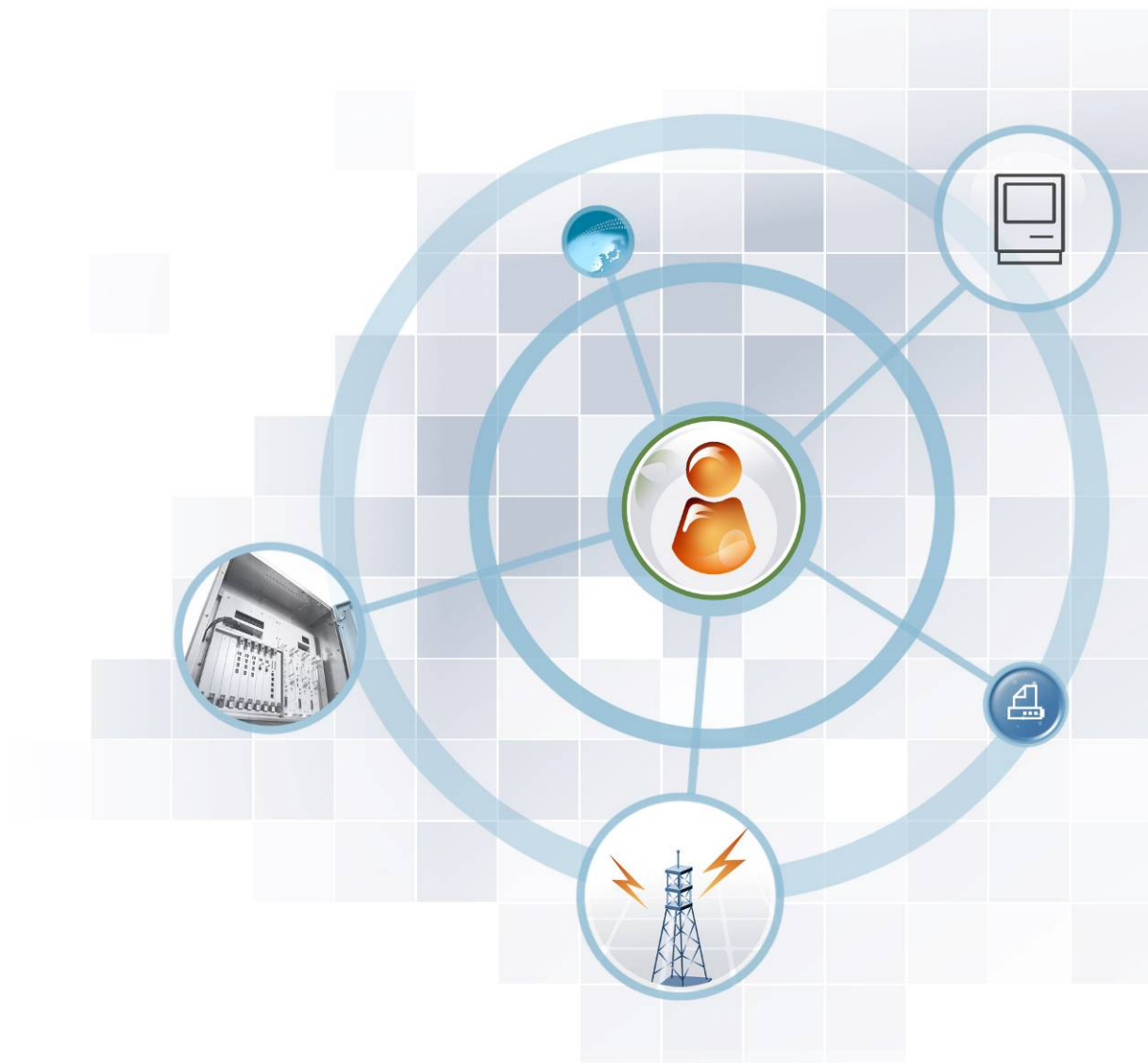


LTE 1.9 GHz Outdoor Pico eNB

Installation Manual



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This manual should be read and used as a guideline for properly installing and operating the product.

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Homepage: <http://www.samsungdocs.com>

INTRODUCTION

Purpose

This manual describes how to install the 1.9 GHz Outdoor Pico, which is a LTE eNB, and how to connect cables.

Document Content and Organization

This document consists of 4 Chapters, 6 Annex and Abbreviation, which are summarized as follows:

CHAPTER 1. Before Installation

This chapter introduces the safety rules that must be understood for installing the Outdoor Pico and describes the block diagram of the Outdoor Pico.

CHAPTER 2. Installing System

This chapter describes the procedures to install the Outdoor Pico.

CHAPTER 3. Connecting Cables

This chapter describes the procedures to connect the cables to the Outdoor Pico installed.

CHAPTER 4. Checking Installation Status

This chapter describes the procedures of inspecting installation status after Outdoor Pico installation and cabling is completed.

ANNEX A. GPS Antenna Installation

This annex describes the GPS antenna configurations and its installation requirements.

ANNEX B. Sector Antenna Installation

This annex describes the sector antenna configurations and its installation requirements.

ANNEX C. Installing Feeder Cable

This annex describes cautions and allowed radius of curvature when installing feeder line.

ANNEX D. Connector Assembly

This annex describes the procedure of assembling the connector.

ANNEX E. Pressure Terminal Assembly

This annex describes the procedure of assembling the pressure terminal.

ANNEX F. Standard Torque

This annex describes the standard torque when tightening the bolt.

ABBREVIATION

Describes the acronyms used in this manual.

Conventions

The following types of paragraphs contain special information that must be carefully read and thoroughly understood. Such information may or may not be enclosed in a rectangular box, separating it from the main text, but is always preceded by an icon and/or a bold title.



WARNING

Provides information or instructions that the reader should follow in order to avoid personal injury or fatality.



CAUTION

Provides information or instructions that the reader should follow in order to avoid a service failure or damage to the system.



CHECKPOINT

Provides the operator with checkpoints for stable system operation.



NOTE

Indicates additional information as a reference.

Product Safety Information

WARNING

This product contains chemicals known to the State of California to cause cancer and reproductive toxicity.

CALIFORNIA USA ONLY

This Perchlorate warning applies only to primary CR (Manganese Dioxide) Lithium coin cells in the product sold or distributed ONLY in California USA

"Perchlorate Material - special handling may apply,
See www.dtsc.ca.gov/hazardouswaste/perchlorate. "

Installation Regulation

Installation shall be in accordance with the applicable parts of Chapter 8 of ANSI/NFPA 70 (for USA).

The installation regulation should be checked for each country. (It can be different from each other.)

Revision History

VERSION	DATE OF ISSUE	REMARKS
1.0	05. 2014.	First Version

SAFETY CONCERNS

The purpose of the Safety Concerns section is to ensure the safety of users and prevent property damage. Please read this document carefully for proper use.

Symbols

**Caution**

Indication of a general caution

**Restriction**

Indication for prohibiting an action for a product

**Instruction**

Indication for commanding a specifically required action



WARNING

Power and Grounding



Cautions When Using Insulation Tester

Pay attention to the followings to prevent any personal injury caused by an electric shock when using an insulation tester.

- Make sure the polarity is correct when connecting the Earth COM (black) and AC.V (red) lead lines. And do not touch the connected probes inspecting part of the lead line) with a hand and avoid body contact.
- Avoid body contact to the system when measuring an insulation resistance.



Watches, rings, and other metallic accessories

Do not wear accessories such as watches and rings in order to prevent electrical short-circuit.



Power Switch Off

Make sure the power switch of power supplier is off when installing the system. Installing the system with power switch on may cause system damage or fatal human injury when cables are not correctly connected.



Connecting Ground Cable

When connecting the cables, always connect the ground cable first. If worker contacts the equipment, connect a cable or perform maintenance without connecting the ground cable, the system can be damaged or a worker may be injured due to static electricity and short circuit.



Turning Off the Circuit Breaker before Connecting the Power Cable

Since power is applied to the system where the power cable is connected by manipulating the circuit breaker of the AC distributor, be sure to check the AC distributor's breaker and the system switch are turned off (open) before connecting the power cable to the power connector. If the system is installed while the circuit breaker and system switch is on, the worker may be critically injured as soon as the cable is connected in the wrong way.

Installation



Protection gloves and goggles

Make sure that worker wears protection gloves and goggles to prevent damage from debris while drilling holes in a wall or ceiling.



CAUTION

Power and Feeder line



Cautions while Cleaning Power Supply

While cleaning the power supply device, take caution that the device does not come in contact with alien bodies that may cause power failure.



Precautions While Measuring Insulation Resistance

Observe the followings to prevent any system damage when measuring insulation resistance because there is a very high voltage.

- Before measuring insulation resistance, disconnect all the cables connected to the system.
- Do not measure insulation resistance when power is on.
- Do not measure insulation resistance at any other positions such as system internal units or parts other than the targeted insulation resistance measuring points.

**System Grounding Method**

Ground bar for lightning protector/power/communication must be isolated from each other. These three ground bars can be grounded as the isolation grounding method, or branched from ground mesh buried in the underground as common grounding method.

**Precautions When Connecting Power Cable**

To secure rainproof performance of a cable gland, min. 11.81 in. (300 mm) straight section must be maintained. Here, the radius of curvature must be considered according to the cable specification.

**When Using Power Cables**

- When handling the power cable, ensure the power switch of a rectifier is turned off to prevent the risk from the power cable and electric short-circuit of related cables.
- Because a power accident may occur when fixing parts get loosened, make sure that fasteners to fix the power cable should be firmly fastened.
- The resistance temperature of power cable should be higher than 194°F (90°C).

**AC Power cable**

In case of using AC power cable (AWG 14, F-FR-8 1.5 mm² × 3C), it is applicable up to 721.8 ft (220 m). When the distance is 721.8 ft (220 m), followings should be considered.

- Do not rapid ON/OFF (within one second): The voltage loss value caused by the cable resistance, and the Outdoor Pico could be damaged by the counter electromotive force caused by the cable inductance.
- Do not use the power cables linked: Using the power cables linked each other, the loss will be increased.
- For the length of the AC power cable, follow the safety regulation of the installation site.

**Cautions When Connecting AC Power**

When connecting the AC power cable to the L1-GND-L2, check the polarity of each phase at the L1-GND-L2 single-phase connection area of AC power distributor to ensure that correct polarity is connected to the L1-GND-L2 of the system's input end. Check if the 120V-240 V between L1 and L2 is within the allowable range (with tolerance of +/-10%).

**Connection of Feeder Cable Connector**

Connecting the feeder cable connector is critical process, so the qualified workers who finished the related education should perform.

**Installing the Antenna**

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.

**Cautions on the Min. Radius of Curvature of GPS Cable and Its Length Limitation**

If the GPS cable min. radius of curvature or its length limitation is violated, a GPS signal may not be received seamlessly and it may cause abnormal system operation. Therefore, the min. radius of curvature and length limitation of a GPS cable proposed in the above table must be observed.

**Checking VSWR for Minimum Cable Bend Radius and Length of RF Cable**

If the VSWR value for minimum cable bend radius and length of RF cable is not applied, system may not work properly because RF signals cannot transmit or receive smoothly. So, the VSWR value for minimum cable bend radius and length of RF cable must be checked and applied.

**Cautions When Measuring VSWR**

When measuring VSWR, if you open the antenna port when the transmission output is not completely off, a spike signal may flow into the reception path, which may cause damage to LNA. Make sure the transmission output is completely off when measuring VSWR.

**Cautions When Connecting Feeder Lines**

If you install the feeder line which is connected to the system, it may damage the system and cable connection. Therefore, it is recommended to install the feeder line up to the system's input port before connecting the feeder line to the system.

General Installation



When Cleaning the System

Be careful not to damage the cables when cleaning the system.



Do not Work by Yourself

Worker must not work alone in any key process.



Finishing the System Input/output Port and Cable Inlet

To prevent foreign substances, outdoor air and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed Port and Cable Inlet
After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.



Checking Marking (horizontal/vertical) When Mounting the System on Wall

If you do the drilling or anchoring on a wall when the positions are not marked to be horizontal or vertical, only limited range of tuning is allowed for leveling after the system is mounted.

To mount the system on a wall, perform the leveling test by referring to 'System Leveling' to check the positions are marked to be horizontal or vertical before drilling. If the result shows they are not horizontal or vertical, modify the marking positions.



Considerations when Cutting the Cable after Installation

When cutting the cable after installation, make sure that the connector is disconnected. Installation of the cable with the connector connected to the system may cause contact failure or damage to the connector assembled to the system and the cable due to cable tension or the operator's mistakes.

**Management of Unused Ports**

Cover the unused ports (conduit, cable gland, etc.) with waterproof cap (sealing cap) to prevent infiltration of foreign material such as dust, moisture, or bug.

**Installing the Concrete Block**

A concrete block should be installed that satisfies the specification regarding size and strength. When installing the concrete block, and before forming the concrete, steel reinforcement bars should be arranged in a mesh layout at 100 mm intervals before forming the concrete. (Either an anchor bolt assembly or a concrete anchor can be used.)

**Installation Location of 'System' the Outdoor pico eNB**

When you install this equipment in the field, it should be installed in a Restricted Access Location

California USA Only

~~This Perchlorate warning applies only to primary CR (Manganese Dioxide) Lithium coin cells in the product sold or distributed ONLY in California USA. 'Perchlorate Material special handling may apply. See www.dtsc.ca.gov/hazardouswaste/perchlorate.'~~

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CHAPTER 1. Before Installation

1.1 System Configuration

Outdoor Pico Configuration

The configuration of Outdoor Pico is as follows:

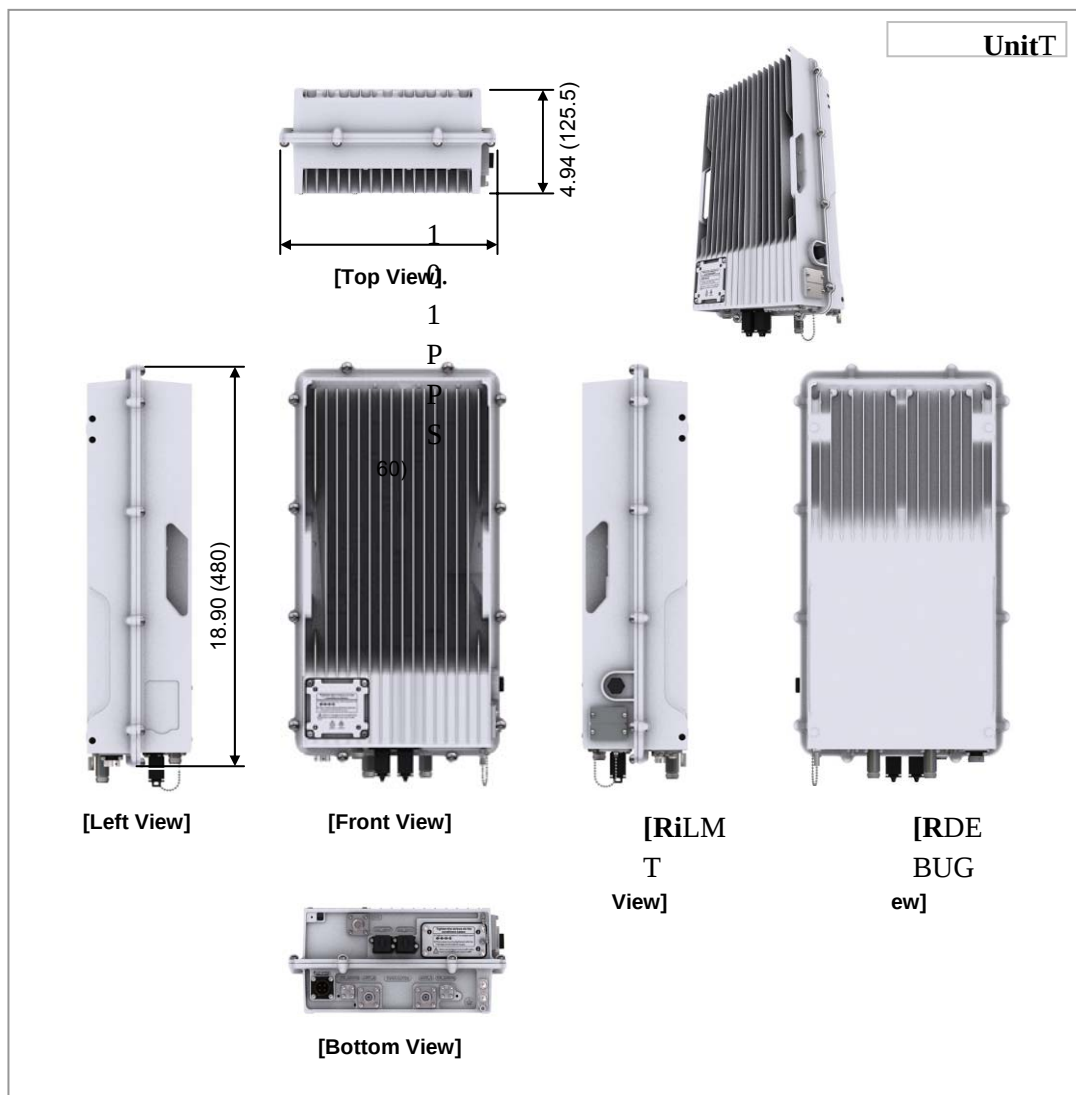


Figure 1. Outdoor Pico Configuration

External Interface of Outdoor Pico

The external interface structure of Outdoor Pico is as follows:

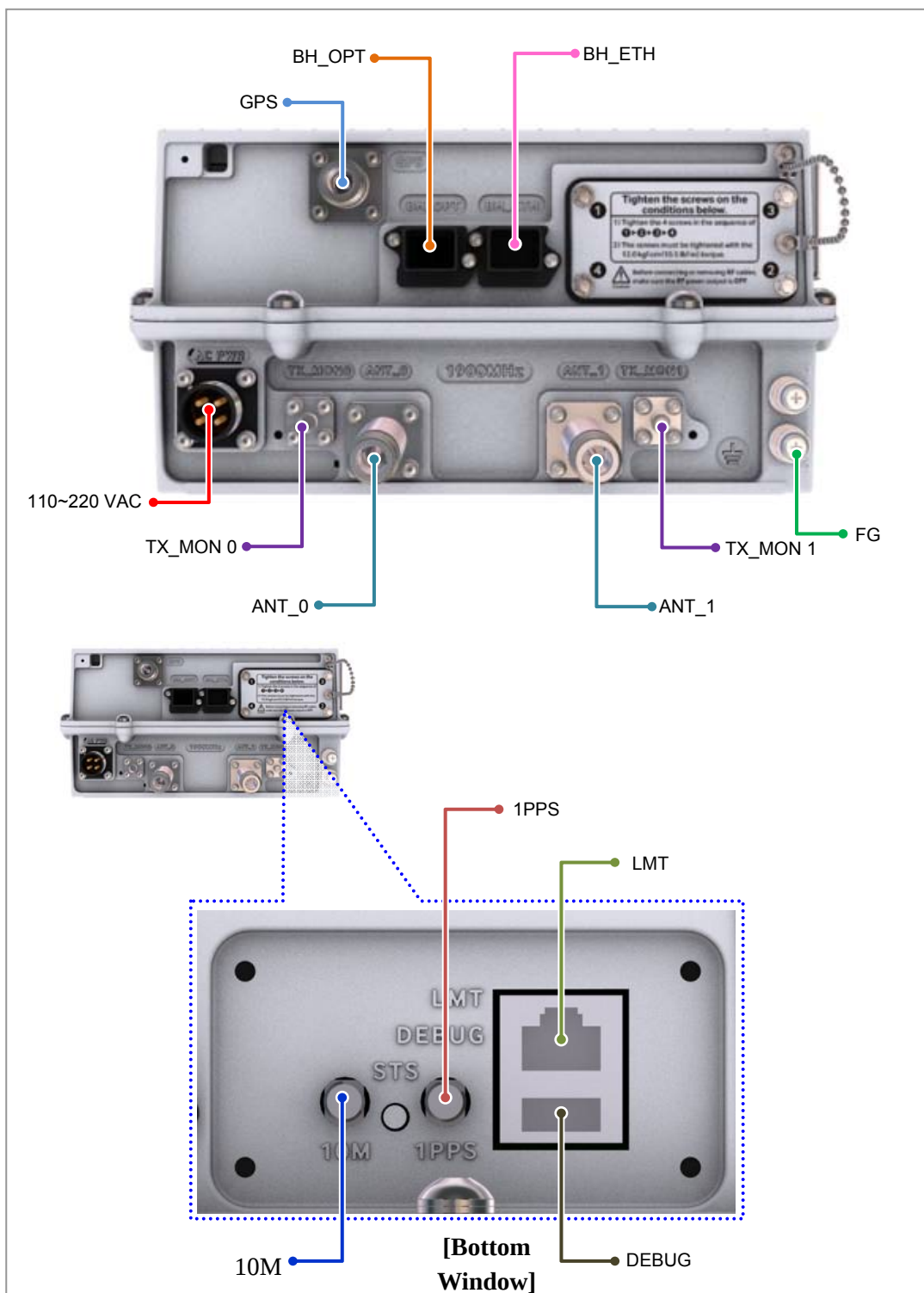


Figure 2. External Interface of Outdoor Pico

1.2 Specifications

Key Specifications

The key specifications of the Outdoor Pico are as follows:

Table 1. Key Specifications

Category	Specification
Air specification	FDD LTE
Operating Frequency	1.9 GHz (Band 25)
Channel Bandwidth	5/10 MHz
Peak Throughput (with Category 3 UE)	- 5 MHz BW: DL 32.1 Mbps (2x2 MIMO), UL 8.0 Mbps (1x2 SIMO) - 10 MHz BW: DL 65.2 Mbps (2x2 MIMO), UL 18.3 Mbps (1x2 SIMO) - Calculation condition: DL 0 % PHY error, UL 1 % PHY error
Tx Power	4 W/Path (Total 8 W)
Antenna Configuration	2Tx/2Rx
Backhaul	Gigabit Ethernet 1 port (Copper)
Holdover	8 h

Power Specifications

The power specifications of the Outdoor Pico are as follows:

Table 2. Power Specifications

Category	Standard
Rated voltage	120-240 V With tolerance +/- 10%
Rated current	2A

Dimensions and Weight

The dimensions and weight of the Outdoor Pico are as follows:

Table 3. Dimensions and Weight

Item	Specification
Size [in.(mm)], W × D × H	10.24 × 4.96 × 18.90 (260 × 126 × 480) or less
Weight	22 lb (10 kg) @ 1.9 GHz

GPSR Specifications

The specifications of the Outdoor Pico's GPS receiver (GPSR) are as follows:

Table 4. GPSR Specifications

Item	Specification
Received Signal from GPS	GPS L1 Signal
Accuracy/Stability	0.05 PPM

Environmental Condition

The table below lists the environmental conditions and related standards such as operational temperature and humidity

Table 5. Ambient Specifications

Category	Range
Temperature Condition	- (-30)~50°C (without solar load) - (-30)~45°C (with solar load)
Humidity Condition	0 ~99 % (Relative humidity), not to exceed 30g/m³ absolute humidity
Altitude	- Without sunlight 196~5,905 ft@122°F (-60)~1,800 m@50°C 5,905~13,123 ft@104°F (1,800~4,000 m@40°C) - With sunlight 196~5,905 ft@113°F (-60)~1800 m@45°C 5,905~13,123 ft@95°F (1,800~4,000 m@35°C)
Earthquake	Telcordia GR-63-Core (Zone4)
Sound Pressure Level	Noise level is 45 dBA or lower at the location where is 3.28 ft (1 m) away from the system (Sound level meter: based on IEC 61672)
Dust and waterproof rating	IEC 60529 IP55
EMC	FCC Title 47 Part 15 & 24

1.3 Cautions for Installation

Observe the following safety instructions when installing the Outdoor Pico:

Before Installing

- Post warning signs in areas where high-voltage cables are installed.
- Post 'off limit' signs in areas where accidents are most expected.
- With guardrails or fences, block open areas such as connecting parts, roof, and scaffold.

While Installing

- The system power must be cut off before installing.
- Be careful that boards mounted on the system and the cables among the boards are damaged or scratched when the system is transported or installed.



Power Switch Off

Make sure the power switch of power supply is off when installing the system. Installing the system with power switch on may cause system damage or fatal human injury when cables are not correctly connected.



Protection gloves and goggles

Make sure that worker wears protection gloves and goggles to prevent damage from debris while drilling holes in a wall or ceiling.



Do Not Wear Metal Things such as Watch, Ring, Etc.

Do not let the electric short circuit occur due to metal things such as watch or ring.



Management of Unused Ports

Cover the unused ports (conduit, cable gland, etc.) with waterproof cap (sealing cap) to prevent infiltration of foreign material such as dust, moisture, or bug.



Do not use base station antenna within the distance of **100 cm** from people and also do not co-locate nor operate in conjunction with any other antenna or transmitter for the protection of general public from exposure to radio frequency electromagnetic field.



CAUTION

Finishing the System Input/output Port and Cable Inlet

To prevent foreign substances, outdoor air and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed Port and Cable Inlet
After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.



CAUTION

Do not Work by Yourself

Worker must not work alone in any key process.



CHECK

Outdoor Fastening Materials

The outdoor fastening materials such as stud bolts, hex. nuts, spring washers and Plain washers must be made of stainless steel (STS 304).

Otherwise, it may cause corrosion and rust to fixing materials.

After Installing

- Cover the cable holes drilled on the floor with a solid cover.
- Remove any debris produced during the work and clean up the installation site.



CAUTION

Cautions while Cleaning the System

Make sure that worker does not damage installed cables while cleaning the system.



CAUTION

Cautions while Cleaning Power Supply

While cleaning the power supply device, take caution that the device does not come in contact with foreign objects that may cause power failure.

1.4 Installation Tools

The basic tools for installation are listed in the table below. The additional tools required for each site need to be identified and prepared during a site survey before starting installation.

Table 6. Basic Installation Tools

No.	Name	Specification	Remarks
1	Torque Driver Set	No.0~+No.3 (M2.6~M6 '+' Driver) 0.07~4.34 lbf·ft (1.0~60 kgf·cm)	
2	Torque Wrench Set	M6~M12 0.72~2.17 lbf·ft (10~30 kgf·cm), 7.23~36.15 lbf·ft (100~500 kgf·cm), Replaceable head	
3	Drill/Bit Set	0.24~0.67 in. (6~17 mm)	
4	Heating Gun	122~572 °F (50~300 °C)	
5	Power Extension Cable	98.42 ft (30 m)	
6	Tape Measure	16.4 ft/164 ft (5 m/50 m)	
7	Cable Cutter	325 mm	
8	Silicon Gun/Silicon	Normal/Gray & Colorless	
9	Hammer Set	Still/Rubber/PVC	
10	Spanner	0.75 in., 0.94 in., 1.42 in. (19 mm, 24 mm, 36 mm)	
11	Wire Stripper	0.24~0.94 in. (6 mm~24 mm)	



NOTE

Precautions when Using the Installation Tools:

The required installation tools may vary depending on the conditions at the site. In addition to the basic tools, a protractor, compass, GPS receiver, ladder, safety equipment, cleaning tools etc. should also be prepared in consideration of the site conditions.

CHAPTER 2. Installing System

2.1 Installing the Outdoor Pico

The procedure to install the Outdoor Pico is listed in the flow chart below.

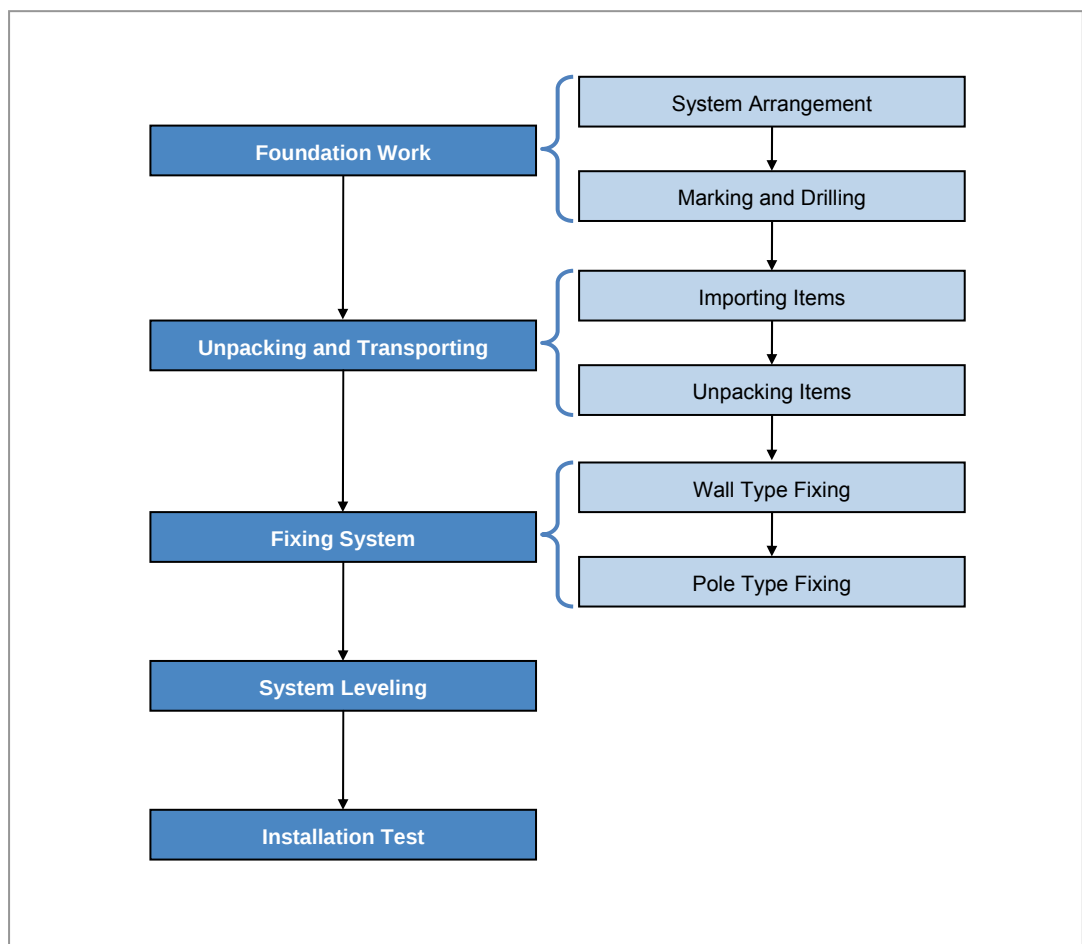


Figure 3. Procedure to Install the System

2.2 Foundation Work

2.2.1 System Arrangement

A minimum distance must be secured around the Outdoor Pico, in each direction for installation and maintenance.

Table 7. Recommended Distances for System

Category	Recommended Distances
Front/Rear	31.5 in. (800 mm) or more
Side	7.87 in. (200 mm) or more
Top/Bottom	39.37 in. (1,000 mm) or more

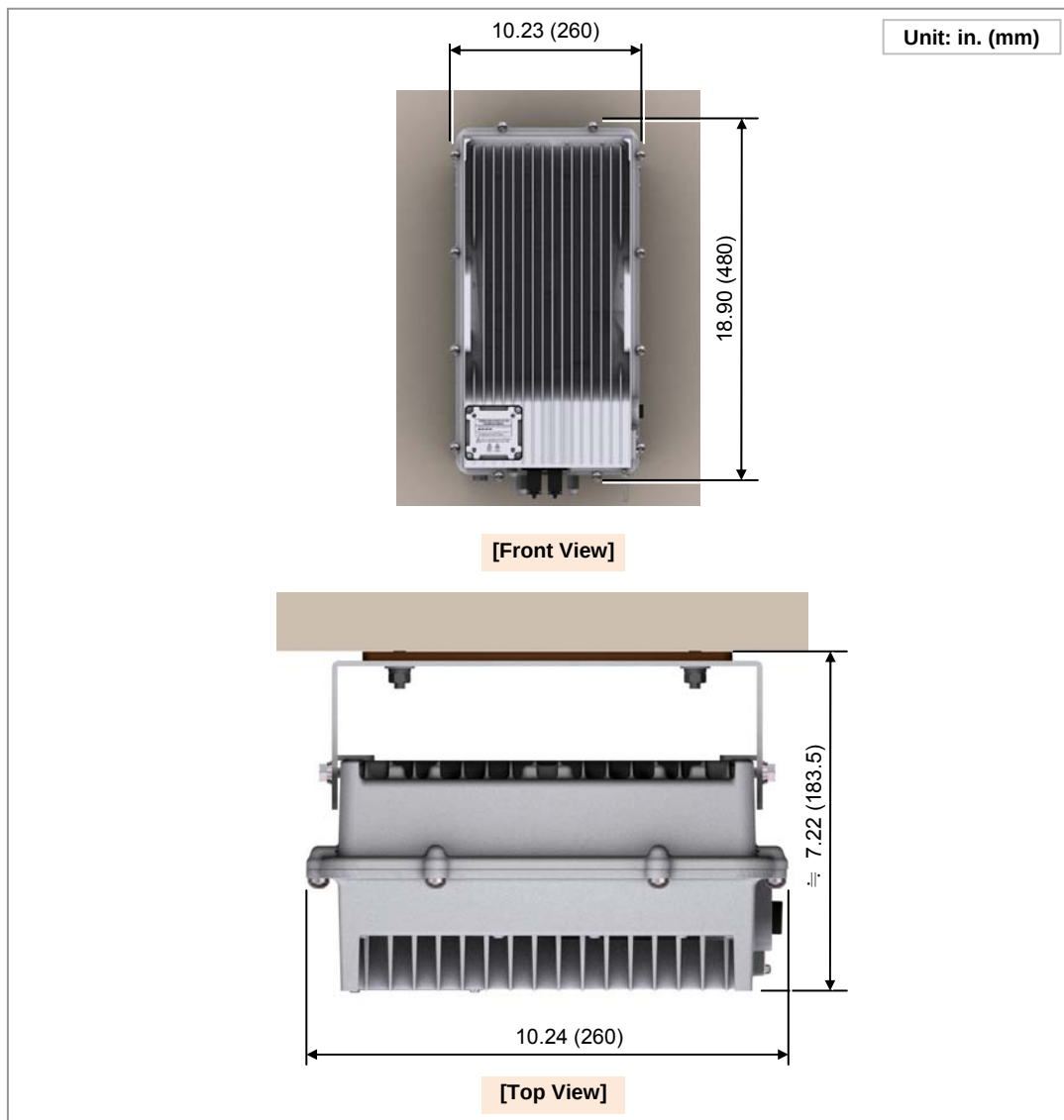


Figure 4. Outdoor Pico Arrangement(Wall Type)

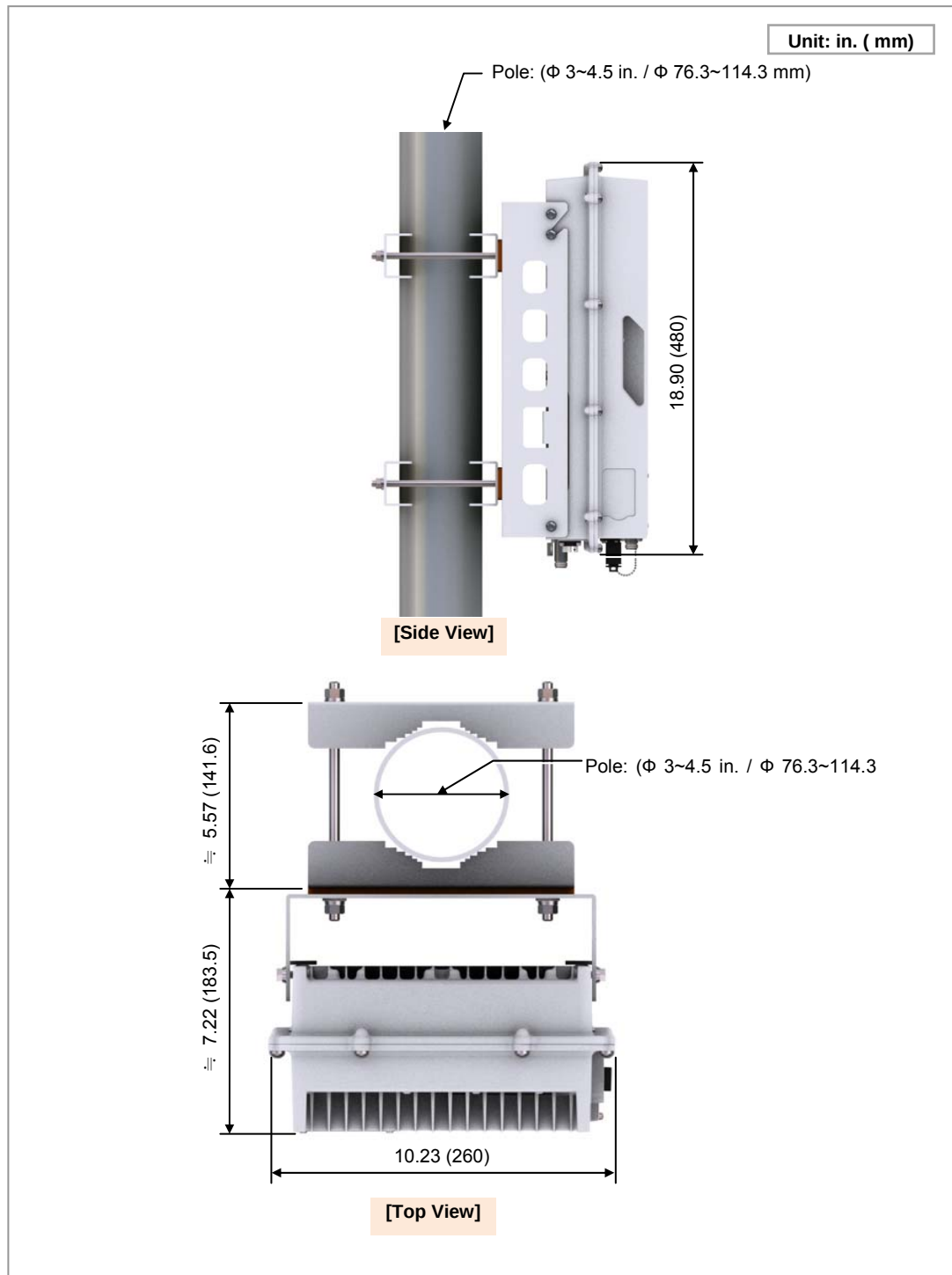


Figure 5. Outdoor Pico Arrangement(Pole Type)

2.2.2 Marking and Drilling

Marking

Before placing the system, mark the position where the system will be installed and also the positions where anchor bolts will be fixed using a ink line or a pen.



CAUTION

Checking Marking (horizontal/vertical) When Mounting the System on Wall

If you do the drilling or anchoring on a wall when the positions are not marked to be horizontal or vertical, only limited range of tuning is allowed for leveling after the system is mounted.

To mount the system on a wall, perform the leveling test by referring to 'System Leveling' to check the positions are marked to be horizontal or vertical before drilling. If the result shows they are not horizontal or vertical, modify the marking positions.



CHECK

Position, Specifications and Marking of Anchor Bolt

Before starting work, be sure to check the fixing method for the Outdoor Pico because the marking and drilling positions and specifications may differ per the fixing method.



NOTE

Marking Using the System

When the position where the system will be placed is determined, place the system on the position and then mark the positions where anchor bolts will be fixed using a pen. This will reduce marking error range caused by a worker.

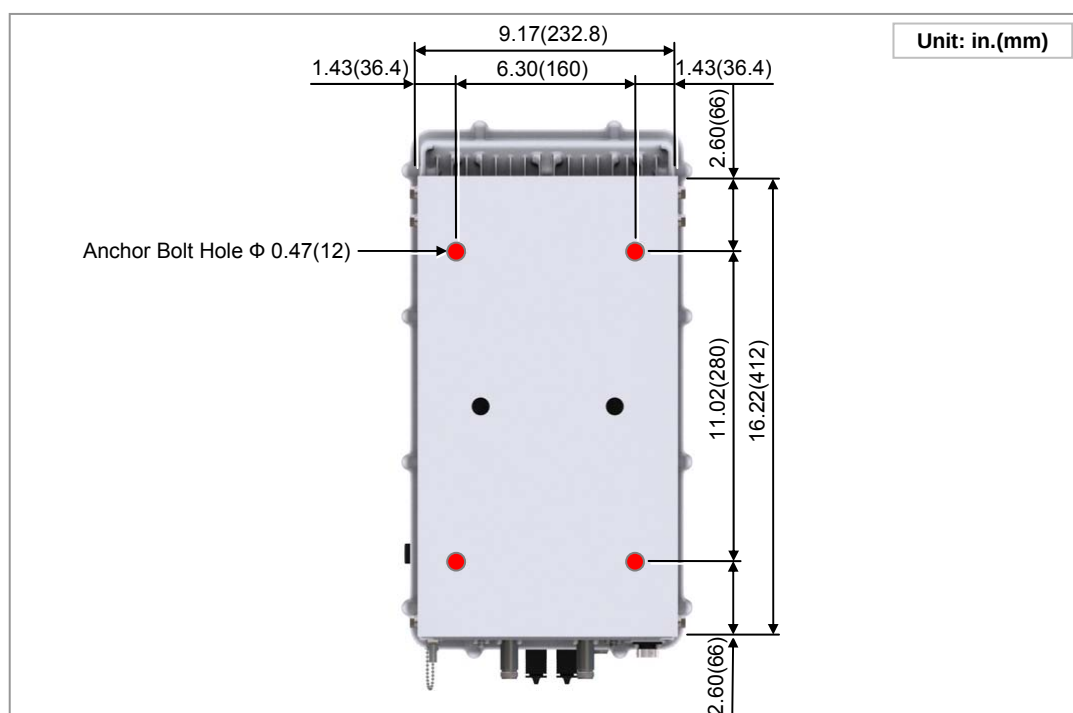


Figure 6. System Marking-Wall Type

Drilling

When marking is completed, drill holes for anchor bolts.

Table 8. Anchor Bolt Drill Bits and Hole Depth

Category	Anchor Bolt	Drill Bits	Hole Depth
Wall Type	M4	0.24 in. (6 mm)	1.18 in. (30 mm)

2.3 Unpacking and Transporting

This paragraph describes the work to unpack cabinets and other components and transport them to the place to be installed.

2.3.1 Bringing in Items

Bring in items, taking care of the followings:

- Carry boards in packing boxes, and unpack them when installing or mounting.
- Tighten the system firmly not to exceed the proper vibration level from 1 to 500 Hz.
- Use a lift or cart to prevent accidents. However, if the system must be carried by people, make sure that there are enough people to carry the system safely.
- Before moving the system, check the storage place and remove obstacles in advance.
- While moving system, boards and other devices should not be damaged caused by physical shock, dust, moisture, and static electricity.

2.3.2 Unpacking Items

The procedure to unpack items is as follows:

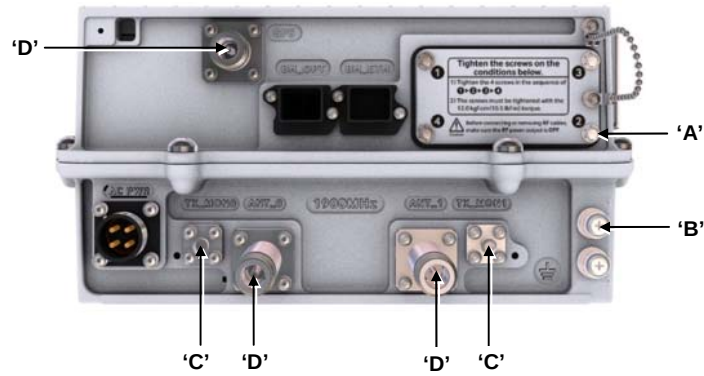
- The items should be packed until they reach the installation place.
- The items are classified in accordance with each job specification and stored on a place that does not interfere with the working area.
- Unpacked systems should be installed immediately. If not installed immediately, the systems should be stored in the installation place temporarily.
- Unpack the inner packaging after each system is placed on its installation location.
- Do not recycle packaging waste. Dispose of it in accordance with waste management rule.

2.4 Fixing System

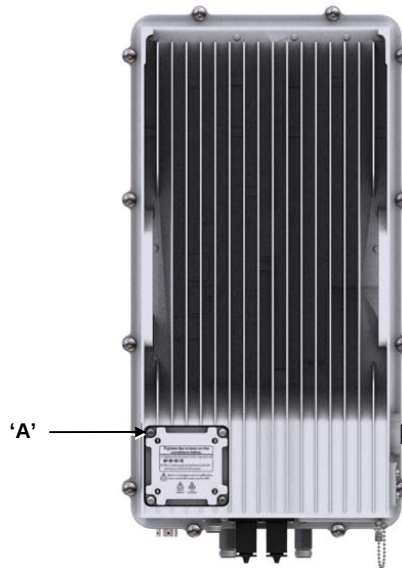
The installation tools and assembly torque required to install and maintain the Outdoor Pico are as follows:

Table 9. Outdoor Pico Installation Tools and Torque Value

Category		Installation Tools	Torque Value
A	Maintenance Window Screw	Star Pole Type Screw Driver : M4	0.87 lbf·ft(12 kgf·cm)
B	M6 SEMS	Driver(+) : M6	1.45~2.17 lbf·ft (20~30 kgf·cm)
C	SMA	Hexagon: 0.39 in.(10 mm)	0.36 lbf·ft(5.0 kgf·cm)
D	N-Type	Hexagon: 0.75 in.(19 mm)	0.87 lbf·ft(12.0 kgf·cm)



[Bottom View]



[Front View]

Table 10. Tightening Parts for Outdoor Pico

Category		Installation Tools	Torque Value
M8	Hex. Bolt	Hexagon: 0.51 in. (13 mm)	8.82 lbf·ft (122.0 kgf·cm)
	Hex. Nut		



CHECK

Outdoor Fastening Materials

The outdoor fastening materials such as stud bolts, hex. nuts, spring washers and Plain washers must be made of stainless steel (STS 304).

2.4.1 Assembling Tightening Parts for Outdoor Pico

The figure below shows how to assemble the tightening parts to the fixing holes at the top of left/right sides to install the Outdoor Pico to the mounting bracket.

Table 11. Tightening Parts and Tools for Installing Outdoor Pico

Category	Description	
Fastener	M8 × 16L Hex. Bolt	2 EA
	M8 Spring Washer	2 EA
	M8 Plain Washer	2 EA
Working Tools	Spanner(Hexagon : 13 mm), Steel Ruler	

Tighten the fasteners to the second fixing holes on the left and right sides of the top of the Outdoor Pico, leaving about 0.24 in. (6 mm) clearance.

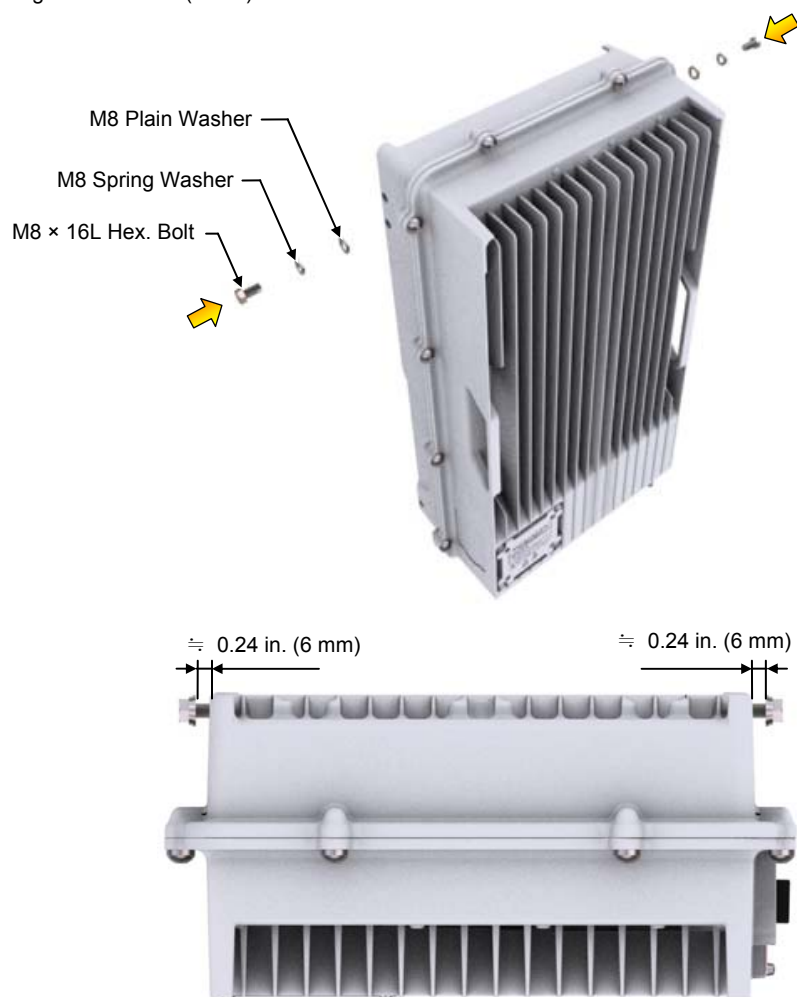


Figure 7. Assembling Tightening Parts for Installing Outdoor Pico

2.4.2 Fixing the Outdoor Pico(Wall Type)

The procedure for fixing the Outdoor Pico on the wall is as follows:

Fixing Unit Mounting Bracket

The procedure for fixing the unit mounting bracket is as follows:

Table 12. Unit Mounting Bracket Fixing Parts and Tool (Wall Type)

Category	Description	
Parts	Unit Mounting Bracket	1 EA
	Bakelite (5T)	2 EA
	Fastener	M8 Anchor Bolt Assembly
		- M8 Anchor Bolt
		- M8 Plain Washer
		- M8 Spring Washer
Recommended Torque Value	M8 Hex. Nut	4 set
		1 EA/set
Working Tools	Drill, Hammer, Torque Wrench, and Level	1 EA/set
		1 EA/set

- 1) Fix anchor bolts at the marked locations on the wall.
- 2) Fit the bakelite and unit mounting bracket to the fixed anchor bolts.
- 3) Firmly fix the anchor bolts and unit mounting bracket using the fasteners.

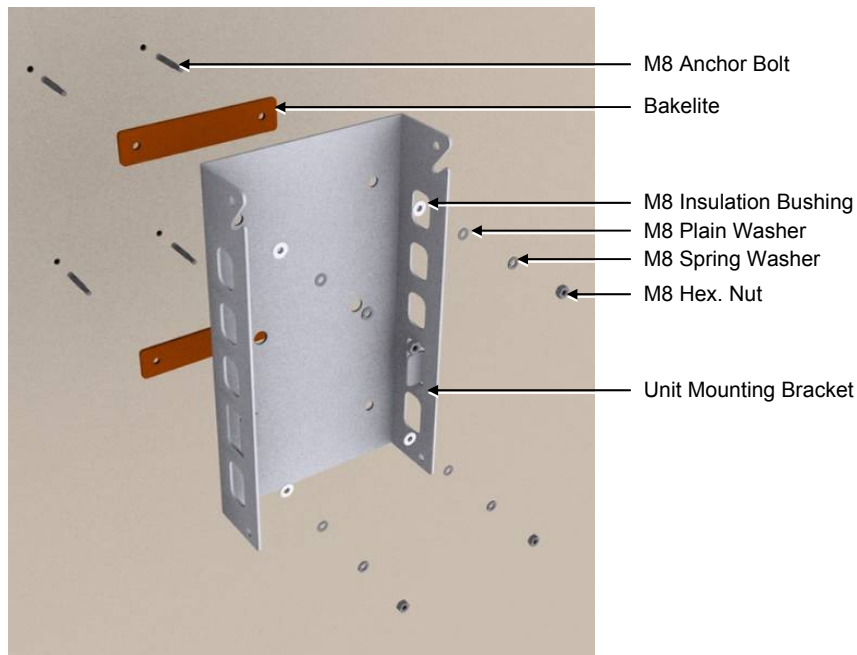


Figure 8. Fixing Unit Mounting Bracket (Wall Type)

Fixing the Outdoor Pico

Mount Outdoor Pico to the unit mounting brackets as shown below.

Table 13. Outdoor Pico Fixing Parts and Tools (Wall Type)

Category	Description	
Parts	M8 × 16L Hex. Bolt	4 EA
	M8 Spring Washer	4 EA
	M8 Plain Washer	4 EA
Recommended Torque Value	M8 Hex. Bolt	8.82 lbf·ft(122 kgf·cm)
Working Tools	Torque Wrench and Level	

- 1) Hang M8 hex. bolts, which are installed in the second fixing holes on left/right sides of Outdoor Pico, can on the groove at the top of the unit mounting bracket. At this point, the plain washer and spring washer should be located outside of the unit mounting bracket.
- 2) Fix the product securely by tightening fasteners on the remaining holes of the unit mounting bracket.
- 3) Tighten completely and securely the M8 hex. bolts attached to the second fixing holes on the top of the Outdoor Pico.

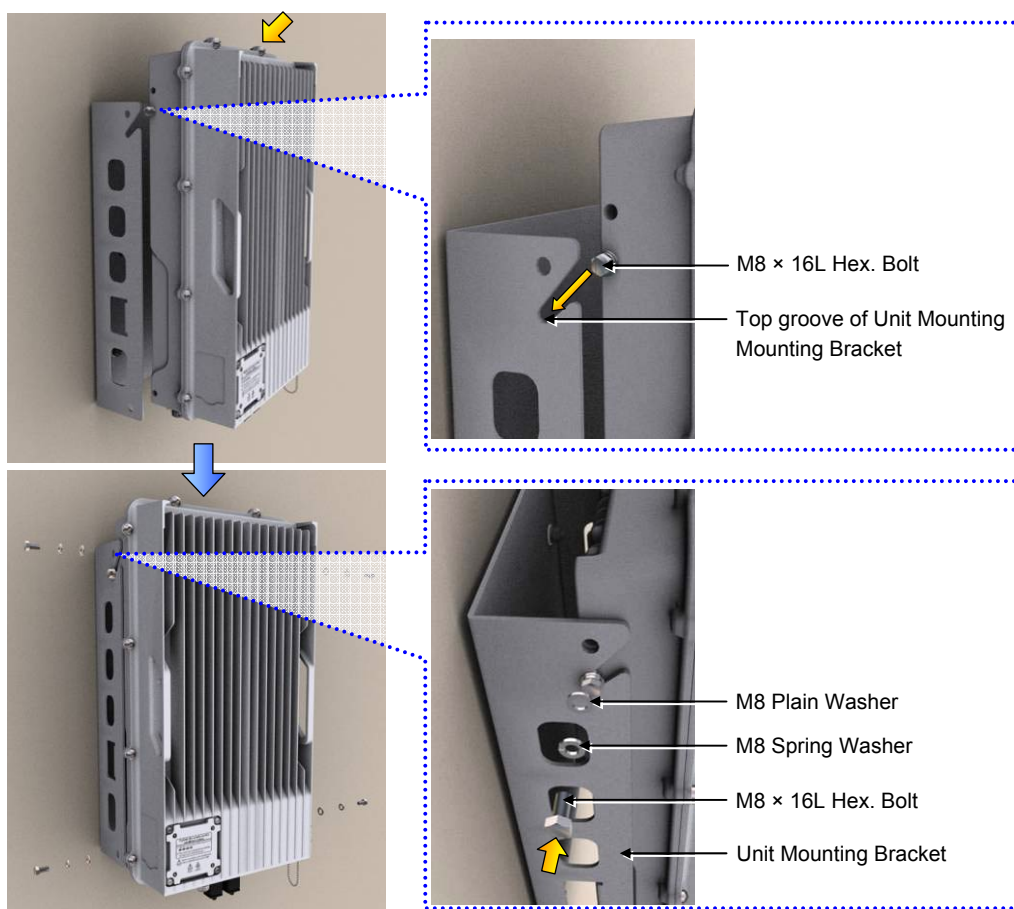


Figure 9. Fixing the Outdoor Pico (Wall Type)

2.4.3 Fixing the Outdoor Pico (Pole Type)

The procedure for fixing the Outdoor Pico on the 1 sector pole type is as follows:

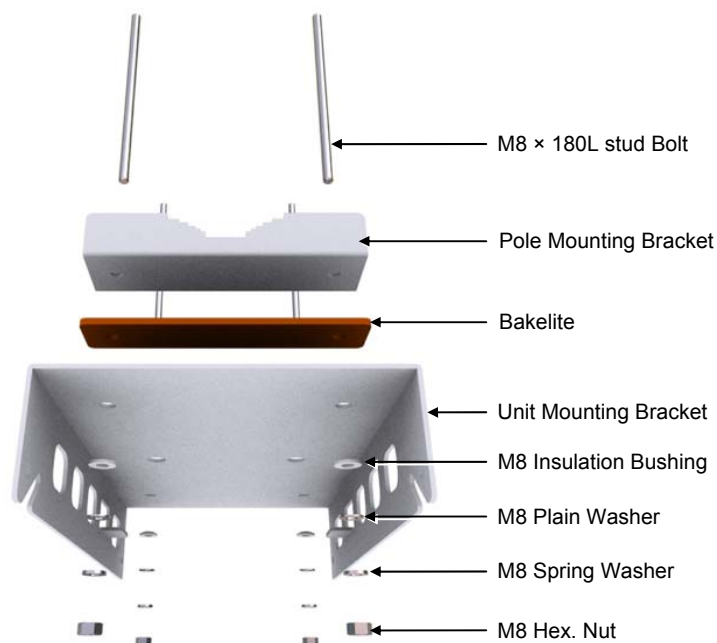
Fixing Unit Mounting Bracket and Pole Mounting Bracket

The procedure for fixing the unit mounting bracket and pole mounting bracket is as follows:

Table 14. Unit/Pole Mounting Bracket Fixing Parts And Tool

Category	Description		
Parts	Pole Mounting Bracket		4 EA
	Unit Mounting Bracket		1 EA
	Bakelite (5T)		2 EA
	Fastener	M8 × 180L Stud Bolt	4 EA
		M8 Plain Washer	8 EA
		M8 Spring Washer	8 EA
		M8 Hex. Nut	8 EA
		M8 Insulation Bushing	4 EA
Recommended Torque Value	M8 Hex. Nut		8.82 lbf·ft(122 kgf·cm)
Working Tools	Torque Wrench, and Level		

- 1) Align the holes on the unit mounting bracket, bakelite and pole mounting bracket, and assemble the unit mounting bracket using the fasteners.



- 2) Place the assembled Outdoor Pico mounting bracket assembly over the pole fixing location, adjust the pole mounting bracket to fit the M8 × 180L hex.bolts from the opposite side, and fix it securely using the fasteners.

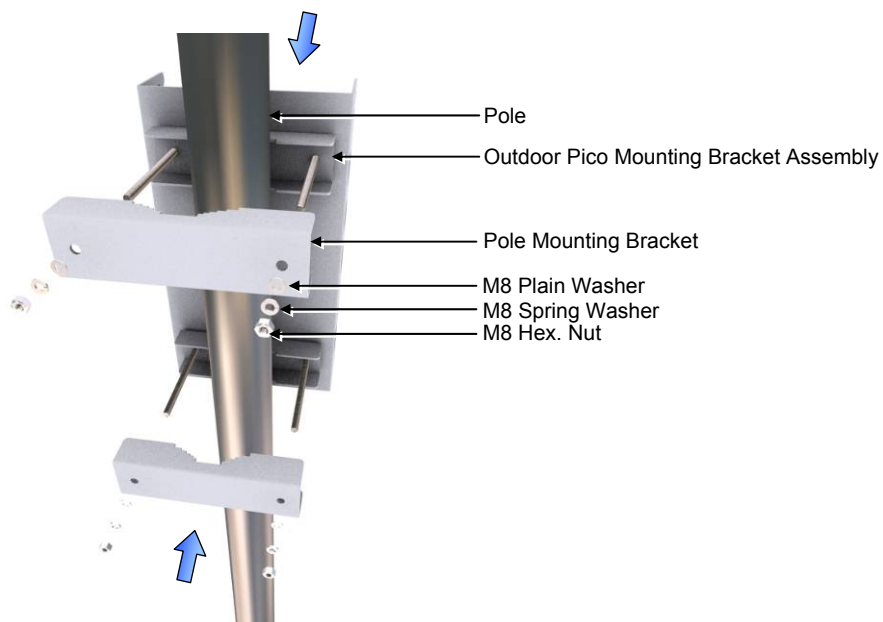


Figure 10. Fixing Unit Mounting Bracket and Pole Mounting Bracket

Fixing the Outdoor Pico

Mount Outdoor Pico to the unit mounting brackets as shown below.

Table 15. Outdoor Pico Fixing Parts and Tools (Pole Type)

Category	Description	
Parts	M8 × 16L Hex. Bolt	4 EA
	M8 Spring Washer	4 EA
	M8 Plain Washer	4 EA
Recommended Torque Value	M8 Hex. Bolt	8.82 lbf·ft(122 kgf·cm)
Working Tools	Torque Wrench and Level	

- 1) Hang M8 hex. bolts, which are installed in the second fixing holes on left/right sides of Outdoor Pico, can on the groove at the top of the unit mounting bracket. At this point, the plain washer and spring washer should be located outside of the unit mounting bracket.

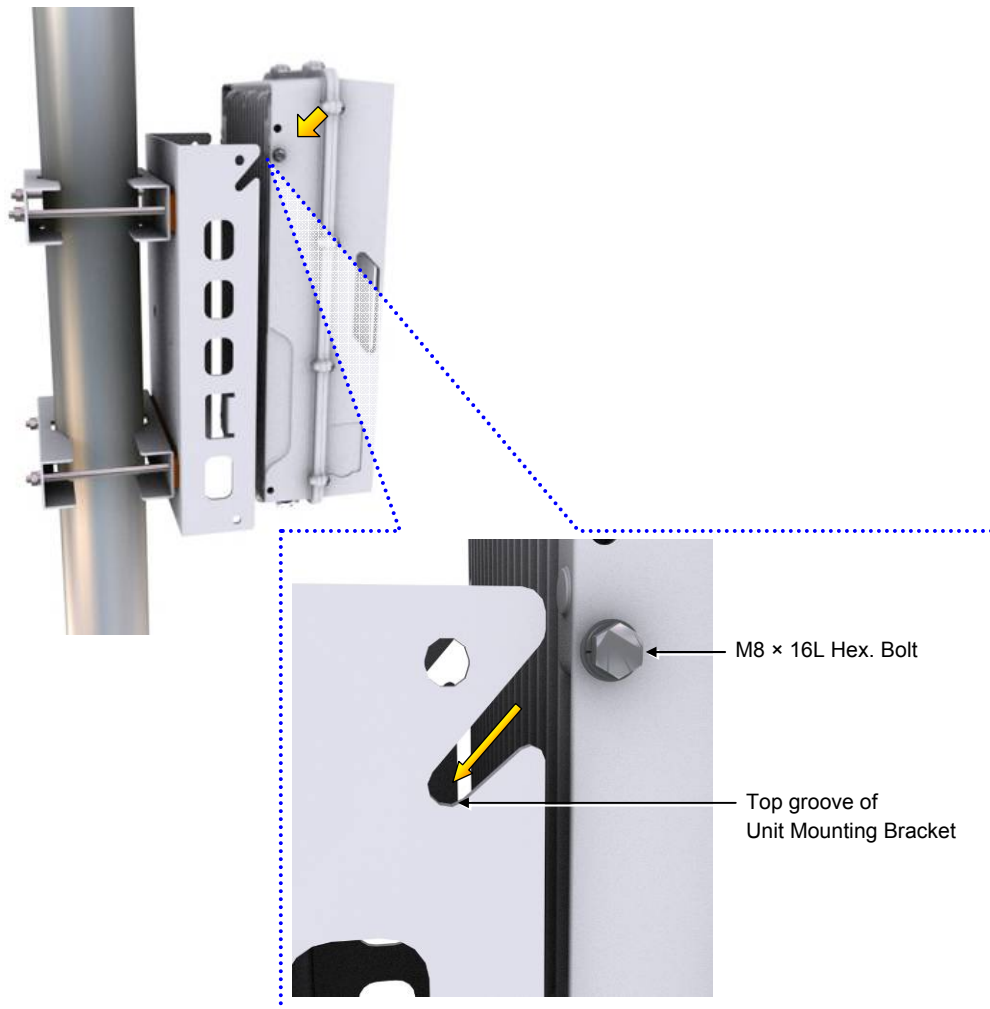


Figure 11. Fixing the Outdoor Pico_Pole Type (1)

- 2) Fix the product securely by tightening fasteners on the remaining holes of the unit mounting bracket.
- 3) Tighten completely and securely the M8 hex. bolts attached to the second fixing holes on the top of the Outdoor Pico.

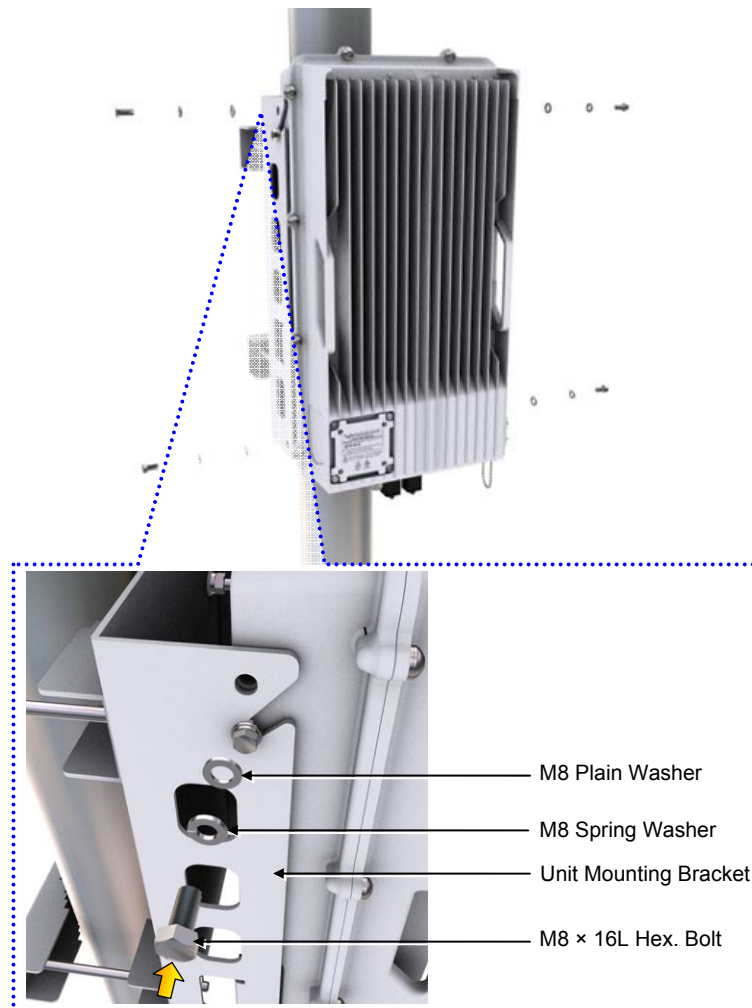


Figure 12. Fixing the Outdoor Pico_Pole Type (2)

2.5 System Leveling

Leveling refers to compensating for the level difference on the floor that is generated during floor work to install devices horizontally or vertically. Leveling can be carried out using a vinyl hose, a balance weight, or a level.

In this manual, a commonly used method, which uses a spirit level, is described.

Leveling Using a Level

Leveling method using a level is as follows:

Table 16. Leveling Using a Level

Classification	Description	
Test method	The level is measured based on the position of a bubble after attaching the spirit level to the top and side of the system.	
Evaluation criteria	Good	Poor
		
	If it is leveled, the bubble of the spirit level is positioned at the center of both lines.	
Corrective measures for poor leveling	Use an aid such as bakelite on the back side of the system or an auxiliary fixtures to adjust the height. Adjust the position of fasteners used to fix the system or its leveling status.	

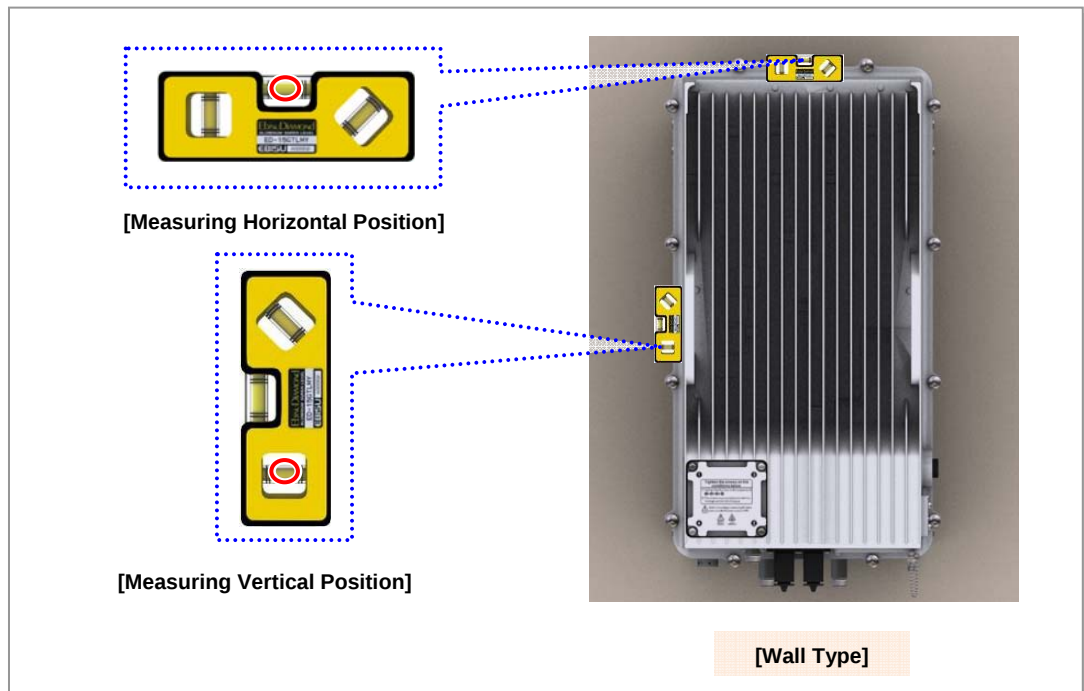


Figure 13. Leveling Using a Level (Wall Type)

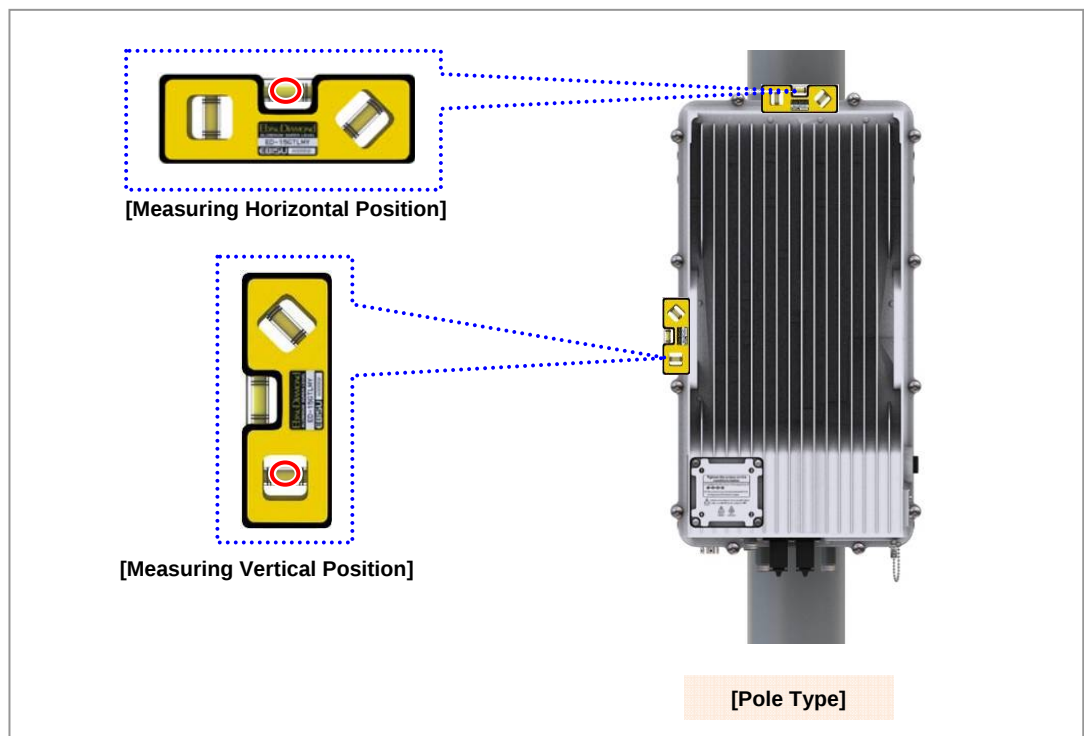


Figure 14. Leveling Using a Level (Pole Type)

2.6 Insulation Test

Insulation test procedure is as follows:

Table 17. Insulation Test

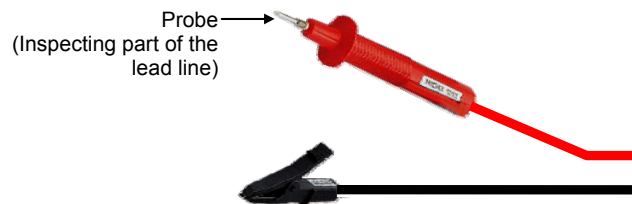
Classification	Description			
Test method	The insulation tester (Megger) is used for measurement.			
	Position of lead line of insulation tester	Wall Type	Lead line_A	Anchor Bolt
			Lead line_B	Outdoor Pico Fixing Hex. Bolt
		Pole Type	Lead line_A	M8 × 180L Stud Bolt
			Lead line_B	Outdoor Pico Fixing Hex. Bolt
Evaluation criteria	Good			Poor
	500 V/100 MΩ or more			Less than 500 V/100 MΩ
Corrective measures for poor leveling	- Check the contact between the system and anchor bolt and re-assemble it. (But, the anchor bolt must be shielded using an insulator such as an insulation bushing, etc.) - Check damage of an insulator such as an insulation busing or bakelite, etc. and replace it.			



Cautions When Using Insulation Tester

Pay attention to the followings to prevent any personal injury caused by an electric shock when using an insulation tester.

- Make sure the polarity is correct when connecting the Earth COM (black) and AC.V (red) lead lines. And do not touch the connected probes inspecting part of the lead line) with a hand and avoid body contact.
- Avoid body contact to the system when measuring an insulation resistance.



Precautions While Measuring Insulation Resistance

Observe the followings to prevent any system damage when measuring insulation resistance because there is a very high voltage.

- Before measuring insulation resistance, disconnect all the cables connected to the system.
- Do not measure insulation resistance when power is on.
- Do not measure insulation resistance at any other positions such as system internal units or parts other than the targeted insulation resistance measuring points.

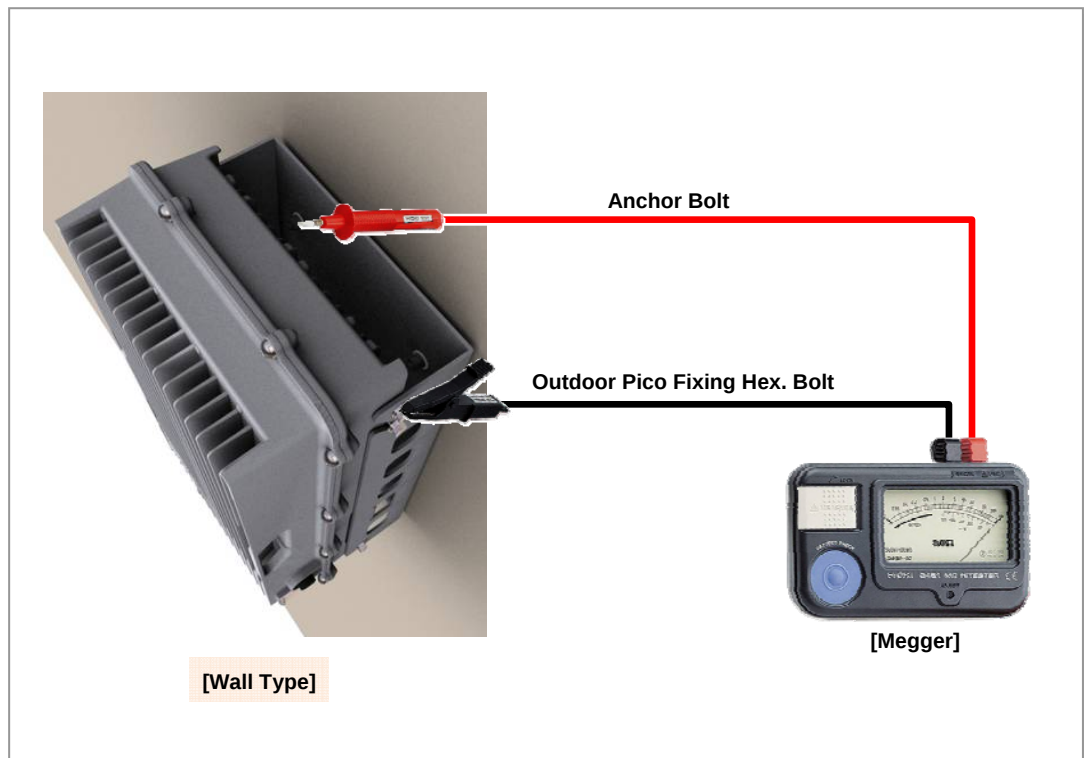


Figure 15. Schematic Diagram for Insulation Test (Wall Type)

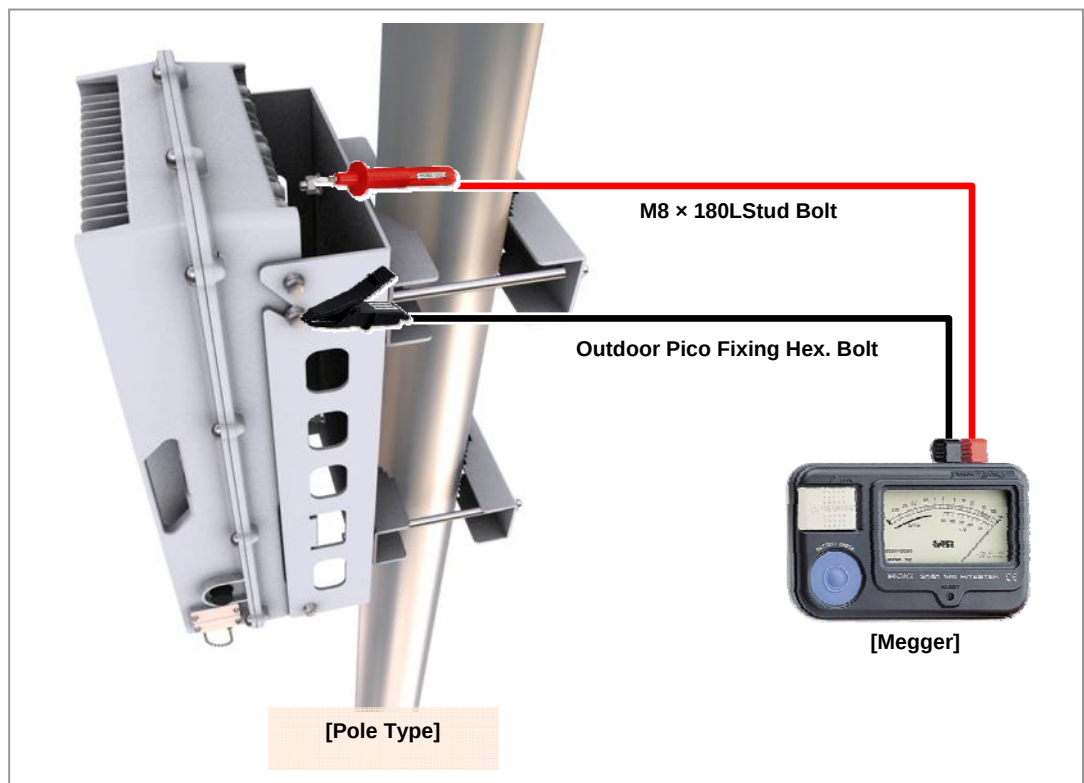


Figure 16. Schematic Diagram for Insulation Test (Pole Type)

CHAPTER 3. Connecting Cables

3.1 Work Flow for Cabling

The cable workflow for the system is as follows:

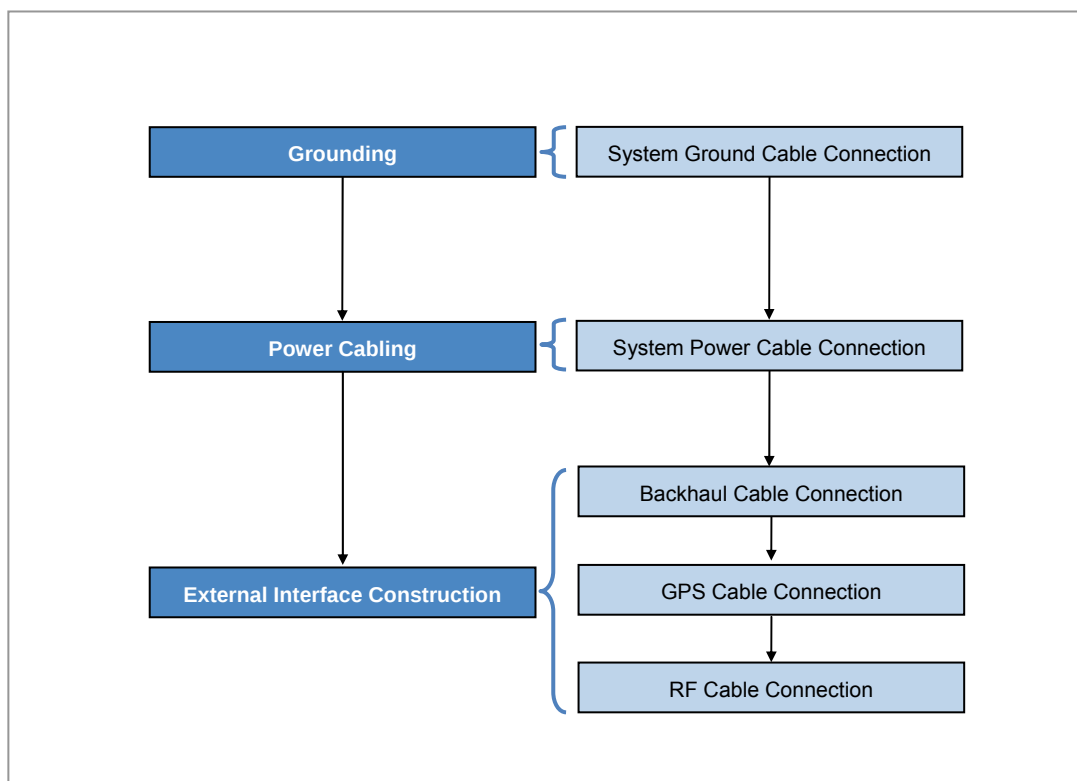


Figure 17. Work Flow for System Cabling

The detailed procedure of cabling is as follows:

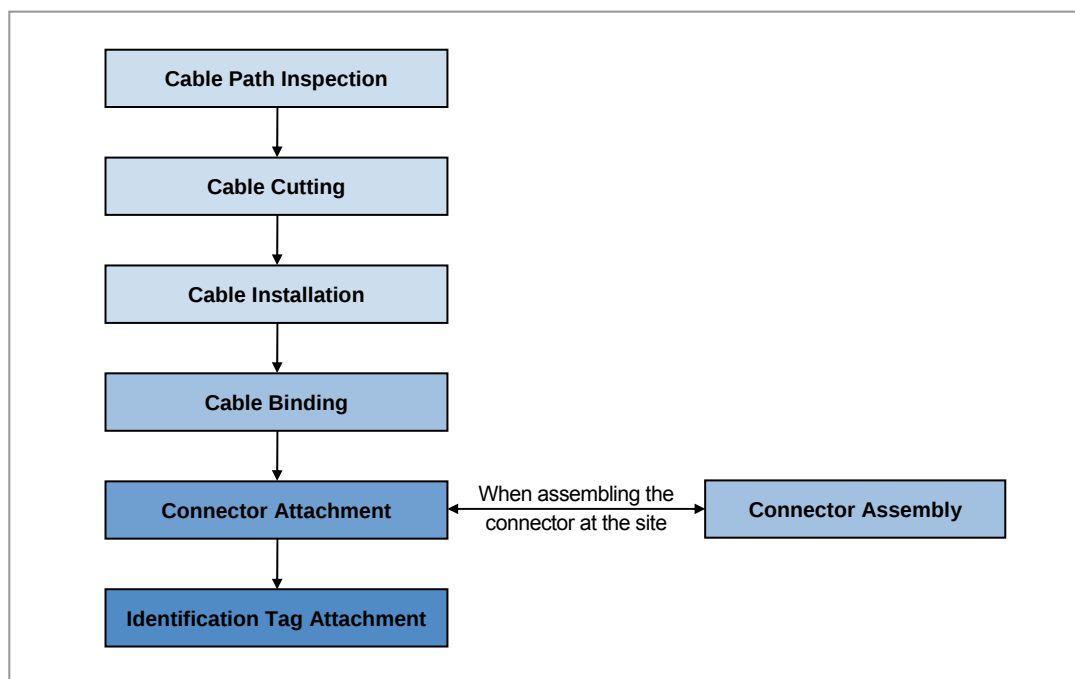


Figure 18. Detailed Cabling Procedure



CAUTION

Considerations when Cutting the Cable after Installation

When cutting the cable after installation, first make sure that the connector is disconnected from the equipment. Installation of the cable with the connector connected to the system may cause contact failure or damage to the connector assembled to the system and the cable due to cable tension or the operator's mistakes.



NOTE

Cabling Workflow

The sequence of cable cutting and installation of the cable workflow can be changed depending on the field situation such as 'cutting after installing' or 'installing after cutting'.

Cable Path Inspection

When installing a cable that connects between the rectifier, Main Ground Bar (MGB), and backhaul device, etc. within the system, the cable path, length and the cable installation method, etc. must be inspected.

Follow these guidelines when inspecting the cabling path.

- A minimum cable length must be selected provided that it does not affect the cable installation and maintenance.
- The cable must be placed in a location where it will not be damaged by external factors. (power line, flooding, footpaths, etc.)
- In areas where the cable may be damaged by external factors, ensure that measures are taken to prevent damage to the cable. (cable tray, ducts, flexible pipe, etc.)

Cable Cutting

Measure the exact distance, carefully checking the route, and cut the cable using a cutting tool. Follow these guidelines when cutting the cable.

- Cut the cable to the length determined in the Cable Path Inspection step.
- Use a cable cutting tool specific to the cable.
- Cut the cable at right angles.
- Be careful to keep the cable away from any moisture, iron, lead, dust or other foreign material when cutting.
- Remove any foreign material attached to the cable using solvent and a brush.

Cable Installation

Cable installation involves running the cable along the cabling path to the target connector of the system or an auxiliary device after cable path inspection and cable cutting have been completed.

Follow these guidelines when installing a cable.

- Be careful not to damage the cable.
- If the cable is damaged, cut out the damaged section before installing, or replace the cable.
- Run the cable so that it is not tangled. In particular, when installing a cable from a horizontal section to a vertical section, be careful not to reverse the upper and lower lines of the cable.
- Always use the maximum curvature radius possible, and make sure that the minimum curvature radius specification is complied with.
- If the cable needs to be protected, use a PVC channel, spiral sleeve, flexible pipe, and cable tray, etc.

Table 18. Recommended Minimum Allowed Cable Bend Radius

No	Type	Allowed Cable Bend Radius	Remark
1	F-GV/F-CV/FR-8	8 times of the cable external diameter	0.6/1 KV Cable
2	Optic Cable	20 times of the cable external diameter	-
3	UTP/FTP/S-FTP Cable	4 times of the cable external diameter	PVC/LSZH, 4 Pair
4	1/2 in. Feeder Line (Indoor)	1.26 in. (32 mm)	RFS, LS
5	1/2 in. Feeder Line (Outdoor)	4.92 in. (125 mm)	RFS, LS
6	7/8 in. Feeder Line (Outdoor)	9.84 in. (250 mm)	RFS, LS
7	1-1/4 in. Feeder Line (Outdoor)	14.96 in. (380 mm)	RFS, LS
8	1-5/8 in. Feeder Line (Outdoor)	19.69 in. (500 mm)	RFS, LS
9	RG-316D	0.59 in. (15 mm)	-

※ If the allowed cable bend radius is specified by the manufacturer, comply with the bend radius specified.

Cable Binding

Cable binding involves fixing and arranging an installed cable using binding thread, cable ties, binding wire, and ram clamps, etc.

Follow these guidelines when binding a cable.

- Be careful not to damage the cable during binding.
- Use appropriate cable binding tools according to the target location (indoor or outdoor, etc.) and the use of the cable (power supply cable, optical cable, feeder line, etc.).
- Do not let the cutting section of a cable tie and binding line, etc. be exposed to the outside. This may cause damage to cables or personal injury. Make sure that the cutting sections of cables are not exposed to the outside.
- Cut off the remainder of the cable binding thread by leaving about 1.97 in. (50 mm) of extra length and put it through the knot so that the knot does not get untied.
- If there is a danger that contact failure may occur in a connector connection due to tension, install the cable as short as possible.

Connector Attachment

Connector attachment involves assembling a connector to an installed cable or to a device on the site.

Follow these guidelines when attaching a connector.

- Make sure you are fully aware of the connector assembly method before assembling a connector. Assemble the connector in accordance with its pin map.
- Each connector has a latch to prevent its core positions from being changed.
- Check the corresponding grooves before connecting a connector to another connector.
- Use a heat shrink tube at a connector connection for cables that are installed outdoor, such as feeder lines, to prevent water leakage and corrosion from occurring at the part exposed to the outside.

- Connect each cable of the connector assembly in a straight line.
- Make sure there is no cable strain by using extra cable length or cable ties.

Identification Tag Attachment

Identification tag attachment involves attaching a marker cable tie, nameplate, and label, etc. to the both ends of a cable (connections to a connector) to identify its use and cabling path.



NOTE

Marker Cable Tie

On the marker cable tie, a label can be attached.
The appearance and specification may differ depending on the type and manufacturer.



Follow these guidelines when attaching an identification tag.

- When installing a cable outdoor, use relief engraving and coated labels, etc. to prevent the markings from being erased.
- Since the form and attachment method for identification tags are different for each provider, consult with the provider before attaching them.



WARNING

Connecting Ground Cable

When connecting the cables, always connect the ground cable first. If worker contacts the equipment, connects a cable or performs maintenance without connecting the ground cable, the system can be damaged or a worker may be injured due to static electricity and short circuit.



CAUTION

Management of Unused Ports

Cover the unused ports (conduit, cable gland, etc.) with waterproof cap (sealing cap) to prevent infiltration of foreign material such as dust, moisture, or bug.



CHECK

Cable Installation Checklist

When installing, take care not to overlap or tangle the cables; also, consider future expansion. Install the DC power cable and data transmission cable away from the AC power cable to prevent electromagnetic induction.



NOTE

Cable Works

Make sure the work is done by personnel properly trained for the job.

3.2 Cabling

The cabling diagram of the Outdoor Pico is as follows:

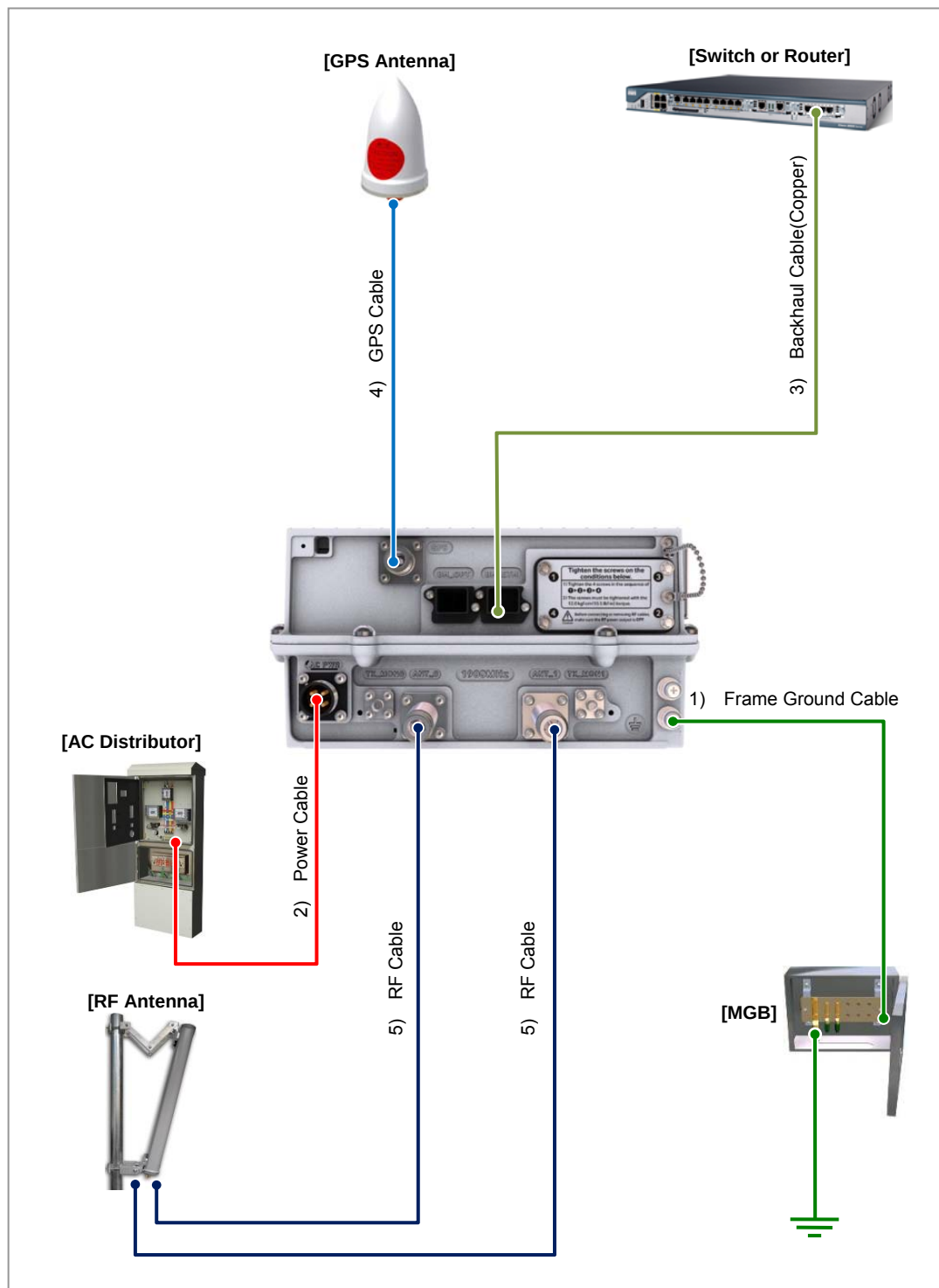


Figure 19. Cabling Diagram

Table 19. Outdoor Pico Connection Cable

From	To	Cable
MGB	Outdoor Pico	1) Frame Ground Cable : AWG8, F-GV 6 mm ² × 1C
Outdoor Pico	AC Distributor	2) Power Cable : AWG14, F-FR-8 1.5 mm ² × 3C
	Switch or Router	3) Backhaul Cable (Copper) : S-FTP Cat.5e or Cat.6 4Pair #24
	GPS Antenna	4) GPS Cable : 1/2 in. Coaxial Cable
	RF Antenna	5) RF Cable : 1/2 in. Feeder Line

3.3 Grounding

Grounding is required for protecting complex electronic or electric systems such as power system, communication system, and control system from lightning, over-current, over-voltage, and electric noise. Thus, the systems can operate properly and protect human life from electrical shock. Ground equipment minimizes the electrical potential of the electronic device to that of the ground, which is zero electrical potential, so that it can prevent the device from occurring electrification.

The purposes of the ground construction are as follows:

- To prevent human life and the system from over-current, over-voltage, and lightning
- To provide a discharge path for surge voltage generated by lightning and power switch
- To protect the system from static electricity
- To eliminate or minimize the high-frequency potential in the system housing
- To provide a conductor for the balance and stability of high-frequency current
- To stabilize the potential of the circuit against the ground



Connecting Ground Cable

In cabling, the connection of cables without the connection to the ground cable may cause the damage of the equipment or the bodily injury of the worker. Connect the ground cable first.



System Grounding Method

Ground bar for lightning protector/power/communication must be isolated from each other. These three ground bars can be grounded as the isolation grounding method, or branched from ground mesh buried in the underground as common grounding method.

3.3.1 Grounding the Outdoor Pico

The way to connect the ground cable of Outdoor Pico is as follows:

Table 20. Grounding the Outdoor Pico

Category	Description	
Installation Section	MGB~Outdoor Pico Grounding Terminal	
Cable	AWG8, F-GV 6 mm ² × 1C/1 EA	
Heat Shrink Tube (Spec/Color/Length)	Φ 0.63 in. (16 mm)/Green/2.76 in. (70 mm)	
Pressure Terminal	MGB	Checking MGB specifications per site and preparing connecting parts
	Outdoor Pico	6 mm ² , 2 Hole, 90°, Hole Dia.: 1/4 in. (6.3 mm), Hole Dist.: 0.63 in. (16 mm)
Fastener	MGB	Checking MGB specifications per site and preparing connecting parts
	Outdoor Pico	M6 × 12L SEMS/2 EA
Recommended Torque Value	M6 SEMS	1.45 lbf·ft (20~30 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Compressor, Heating Gun, Torque Driver (+), Torque Wrench, Nipper	



CHECK

Pressure Terminal for Grounding

As for the pressure terminal or the cable, the UL certified products or equivalent should be used.

Ex) Manufacturer: Panduit

Outdoor Pico: 6 mm² Pressure Terminal (LCD8-14AF-L)



NOTE

Assembling a Pressure Terminal and a Heat Shrink Tube

Refer to the 'ANNEX F' to see how to assemble a pressure terminal and a heat shrink tube to a cable.

- 1) Install the ground cable from the MGB to the Outdoor Pico ground terminal.
- 2) Assemble a pressure terminal and a heat shrink tube at the end of the Outdoor Pico ground cable.
- 3) Align the pressure terminal assembled to a ground cable to the mounting hole of the Outdoor Pico ground terminal.
- 4) Firmly fix the pressure terminal onto the Outdoor Pico ground terminal using fasteners.

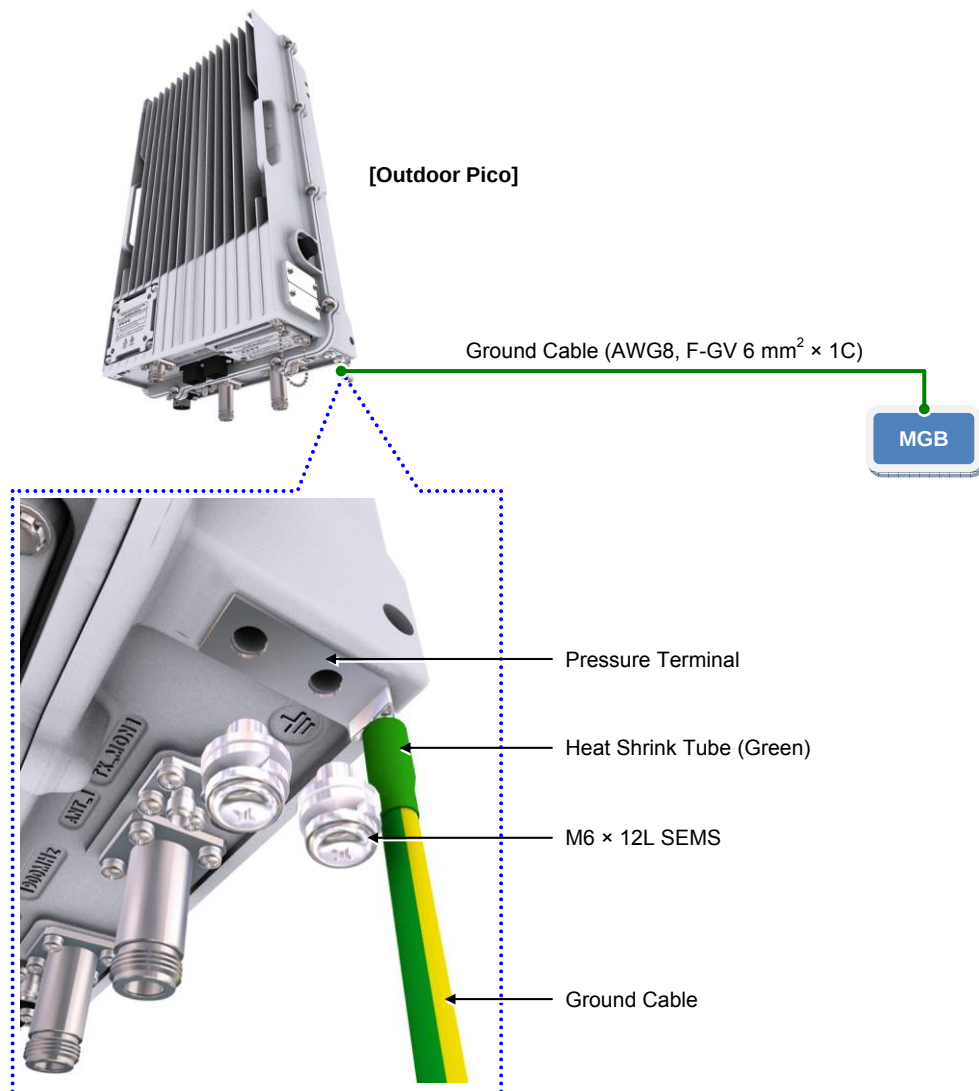


Figure 20. Connection of the Outdoor Pico Ground Cable

3.4 Power Cabling

The power supply is configured as follows.

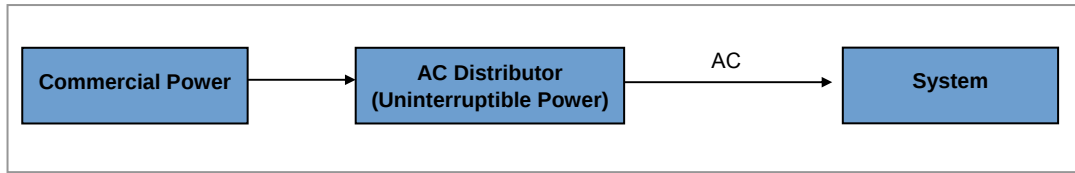


Figure 21. Power Equipment Diagram



WARNING

Turning Off the Circuit Breaker before Connecting the Power Cable

Since power is applied to the system where the power cable is connected by manipulating the circuit breaker of the AC distributor, be sure to check the AC distributor's circuit breaker is turned off (open) before connecting the power cable to the power connector. If the system is installed while the circuit breaker is on, the worker may be critically injured as soon as the cable is connected in the wrong way.



CAUTION

When Using Power Cables

- When handling the power cable, ensure the power switch of a rectifier or the system is turned off to prevent the risk from the power cable and electric short-circuit of related cables.
- Because a power accident may occur when fixing parts get loosened, make sure that fasteners to fix the power cable should be firmly fastened.
- For supply connections, use wires suitable for at least 90 °C.

3.4.1 Connecting the AC Power Cable

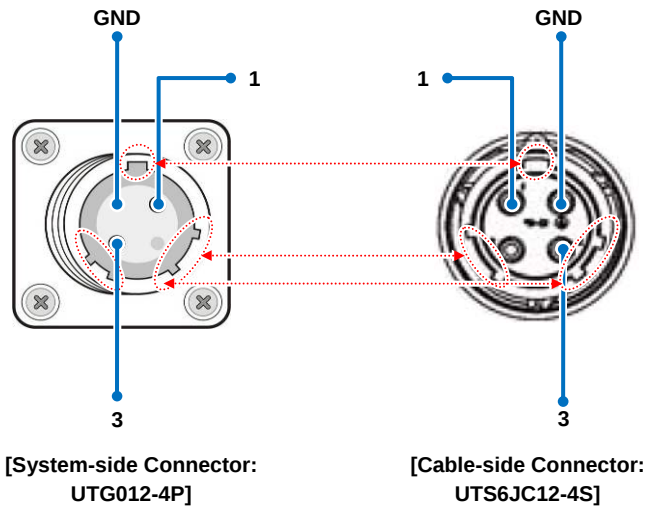
Follow the steps below to connect the AC power cable to the Outdoor Pico.

Table 21. Connecting the AC Power Cable

Category	Description		
Installation Section	AC Distributor~Outdoor Pico Power Input Terminal		
Cable	L1	AWG14, F-FR-8 1.5 mm ² × 3C/1 EA	Red (Colorless and Red Band)
	L2(or N)		Black (Colorless and Black Band)
	GND		White (Colorless)
Heat Shrink Tube (Spec/Color/Length)	L1	Φ 0.31 in. (Φ 8 mm)/Red/1.18 in. (30 mm)	
	L2(or N)	Φ 0.31 in. (Φ 8 mm)/Black/1.18 in. (30 mm)	
	GND	Φ 0.31 in. (Φ 8 mm)/Green/1.18 in. (30 mm)	
	Junction	Φ 0.59 in. (15 mm)/Black/1.97 in. (50 mm)	
Connector	AC Distributor	Check the specification of AC distributor output terminal and prepare fasteners.	
	Outdoor Pico	SOURIAU/UTS6JC12-4S	
Working Tools	Cable Cutter, Wire Stripper, Compressor, Heating Gun, Torque Driver (+), Torque Wrench, Nipper, Soldering Iron, and Lead		

Table 22. Power Cable/Connector Pin Map

Power Connector Pin No.		Description	Heat Shrink Tube
120 VAC	1	L1	Red
	2	N.C	-
	3	N	White
	GND	GND	Green
240 VAC	1	L1	Red
	2	N.C	-
	3	L2	Black
	GND	GND	Green



CAUTION

AC Power cable

In case of using AC power cable (AWG 14, F-FR-8 1.5 mm² × 3C), it is applicable up to 721.8 ft (220 m). When the distance is 721.8 ft (220 m), followings should be considered.

- Do not rapid ON/OFF (within one second): The voltage loss value caused by the cable resistance, and the Outdoor Pico could be damaged by the counter electromotive force caused by the cable inductance.
- Do not use the power cables linked: Using the power cables linked each other, the loss will be increased.
- For the length of the AC power cable, follow the safety regulation of the installation site.



CAUTION

Cautions When Connecting AC Power

When connecting the AC power cable to the L1-GND-L2, check the polarity of each phase at the L1-GND-L2 single-phase connection area of AC power distributor to ensure that correct polarity is connected to the L1-GND-L2 of the system's input end. Check if the 120V-240 V between L1 and L2 is within the allowable range (with tolerance of +/-10%).



CAUTION

Finishing the System Input/output Port and Cable Inlet

To prevent foreign substances, outdoor air and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed Port and Cable Inlet
After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.



NOTE

Power Cable Color

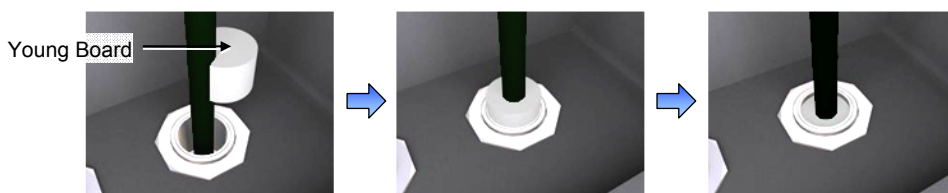
In the table above, the cable color is based on local code that inner wire of F-FR-8 × 3 core cable. The color of the inner wires may vary depending on the type and manufacturer of the cable used.



NOTE

Finishing the Holes on AC Distributor

When laying the power cable through the input/output port (conduit) at the bottom of the AC distributor, a young board should be used to prevent foreign substances from coming into the inside.



- 1) Install a power cable from the AC distributor to the power input port (120-240 VAC) of the Outdoor Pico.
- 2) Assemble a connector to the end of power cable (Outdoor Pico-side).

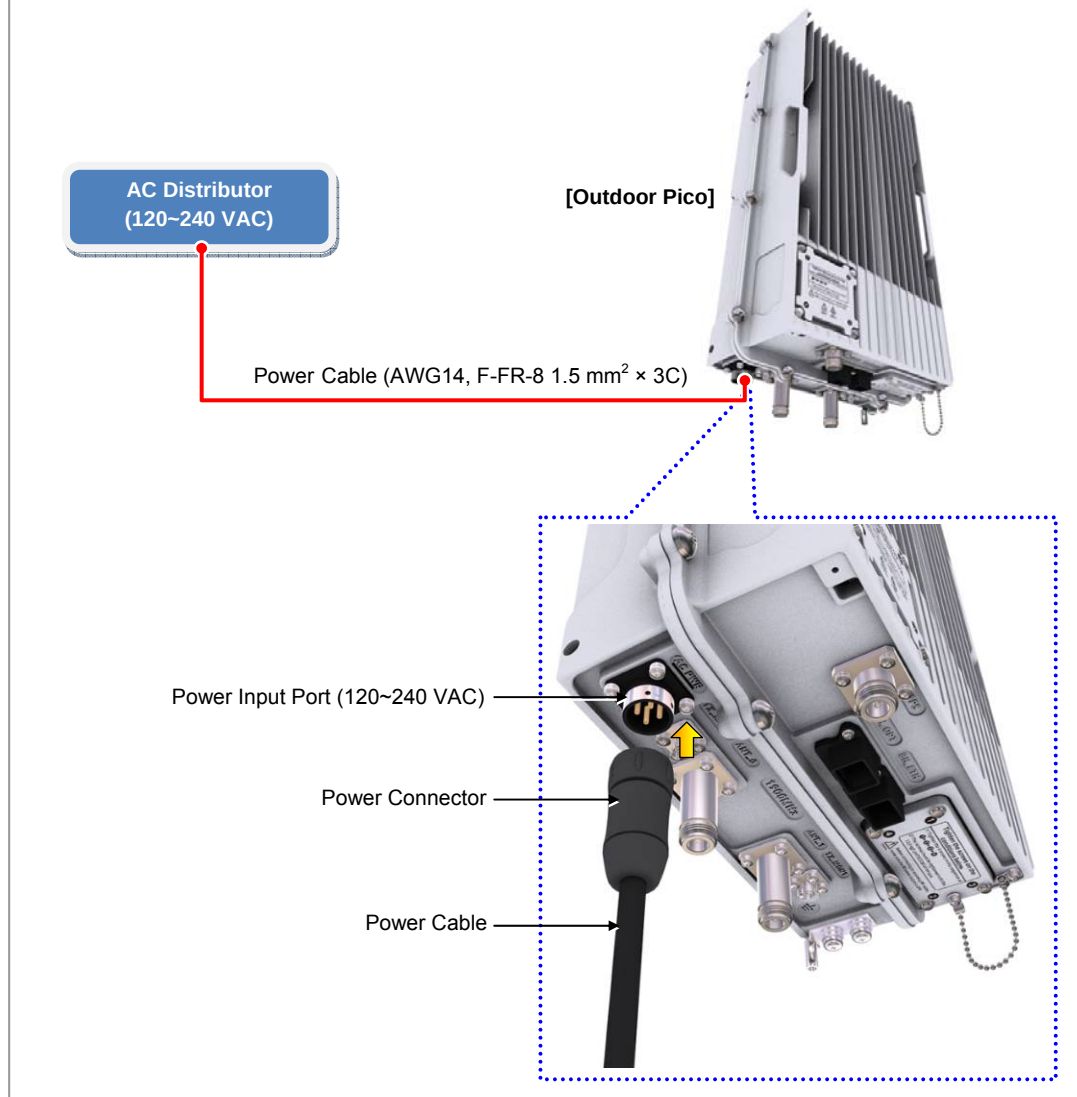


Figure 22. Connecting the Outdoor Pico Power Cable (1)

- 4) Once the connector is connected, wrap up the connector with a butyl tape two fold or more from 1.97 in. (50 mm) off the bottom to the system-side connector.
- 5) Wrap up the butyl taping section with insulation tape twofold or more in the same way as for the butyl tape.
- 6) Bind the end of the insulation tape with a cable tie or apply bond or silicone to prevent it from loosening.

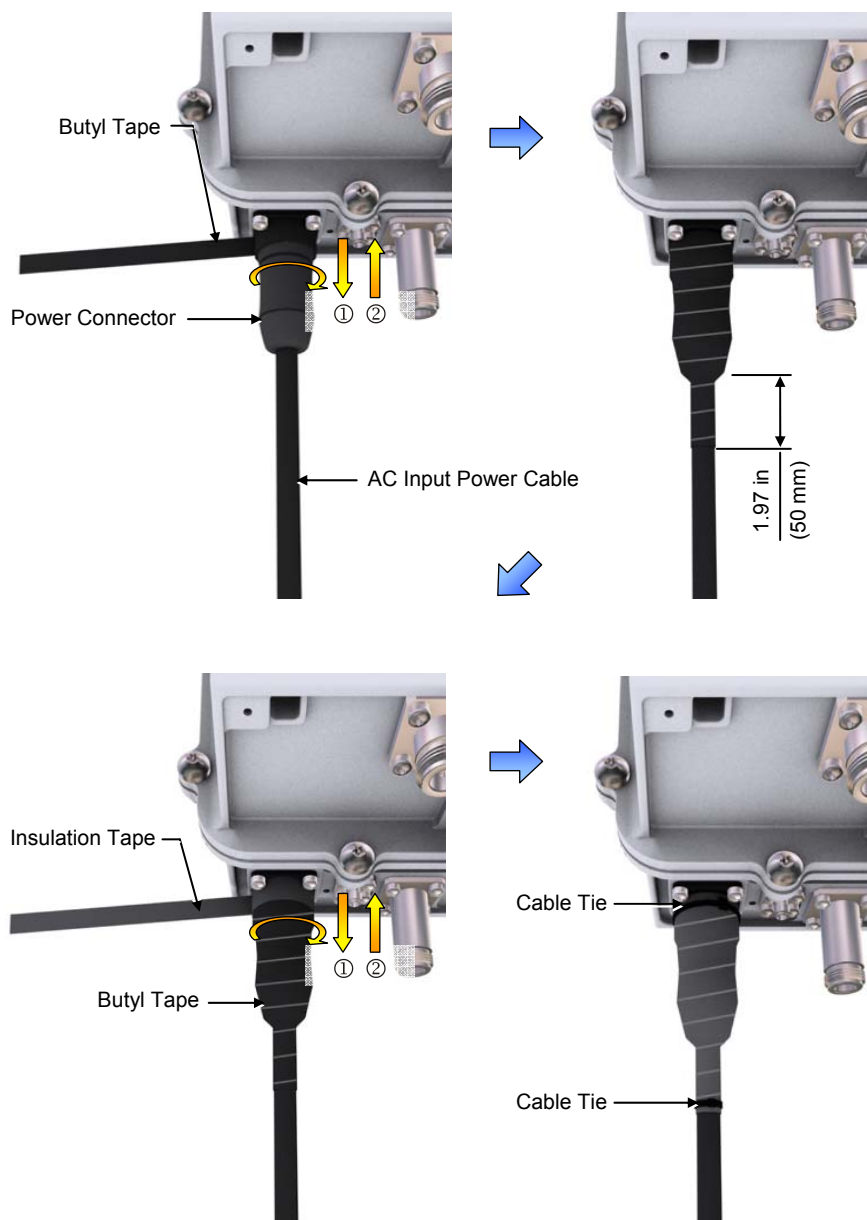


Figure 23. Connecting the Outdoor Pico Power Cable (2)

3.5 External Interface Construction

3.5.1 Backhaul Cable Connection

Follow the steps below to connect the backhaul cable (copper type) to the Outdoor Pico.



Checking Backhaul Cable Connection Type

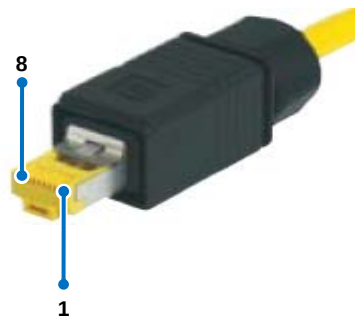
The optic type and copper type have different parts and installation methods so prepare installation after checking the type with a service provider.

Table 23. Table 3.6 Backhaul Cable Connection (Copper Type)

Category	Description	
Installation Section	Switch or Router~Outdoor Pico_Backhaul (BH_ETH) Port	
Cable	S-FTP, Cat.5e or Cat.6, 4Pair, #24/for Outdoor	
Connector	Switch or Router	RJ-45 (Shield Type)
	Outdoor Pico	Harting 0945 145 1560, RJ-45
Working Tools	LAN Tool, LAN Tester, Nipper, Wire Stripper, and Cable Cutter	

Table 24. Table 3.7 Backhaul Cable (Copper Type)/Connector Pin Map

Pin No.	10 Base-T/100 Base-TX	1000 Base-T	Color	Pair No.
1	Output signal positive	BI Data 2 positive	Orange/White	2
2	Output signal negative	BI Data 2 negative	Orange	2
3	Input signal positive	BI Data 3 positive	Green/White	3
4	N.C	BI Data 1 positive	Blue	1
5	N.C	BI Data 1 negative	Blue/White	1
6	Input signal negative	BI Data 3 negative	Green	3
7	N.C	BI Data 4 positive	Brown/White	4
8	N.C	BI Data 4 negative	Brown	4



[System-side Connector: Harting 0945 245 1102 001]

[Cable-side Connector: Harting 0945 145 1560]

**CAUTION****Cautions When Assembling a Cable Connector**

The pin map provided by this manual is based on the connectors on the system side, so it is necessary to check the pin connection positions when connecting to the cable side.

**CAUTION****Finishing the System Input/output Port and Cable Inlet**

To prevent foreign substances, outdoor air and moisture from entering the system input/output port and cable inlet (including cable gland and conduit), finish it as follows:

- Unused inlet
Use the hole finishing materials including waterproof cap and rubber packing.
- Cable-installed Port and Cable Inlet
After cable installation, block any space in the inlet with tape, compressed sponge, rubber packing, and silicon.

**NOTE****Assembling the RJ-45 Connector**

To see how to connect a RJ-45 connector to a cable, refer to 'ANNEX D'.

- 1) Install a backhaul cable from the switch (or router) to the backhaul port (BH_ETH) of the Outdoor Pico.
- 2) Connect the connector of a backhaul cable to the backhaul port (BH_ETH) of the Outdoor Pico.

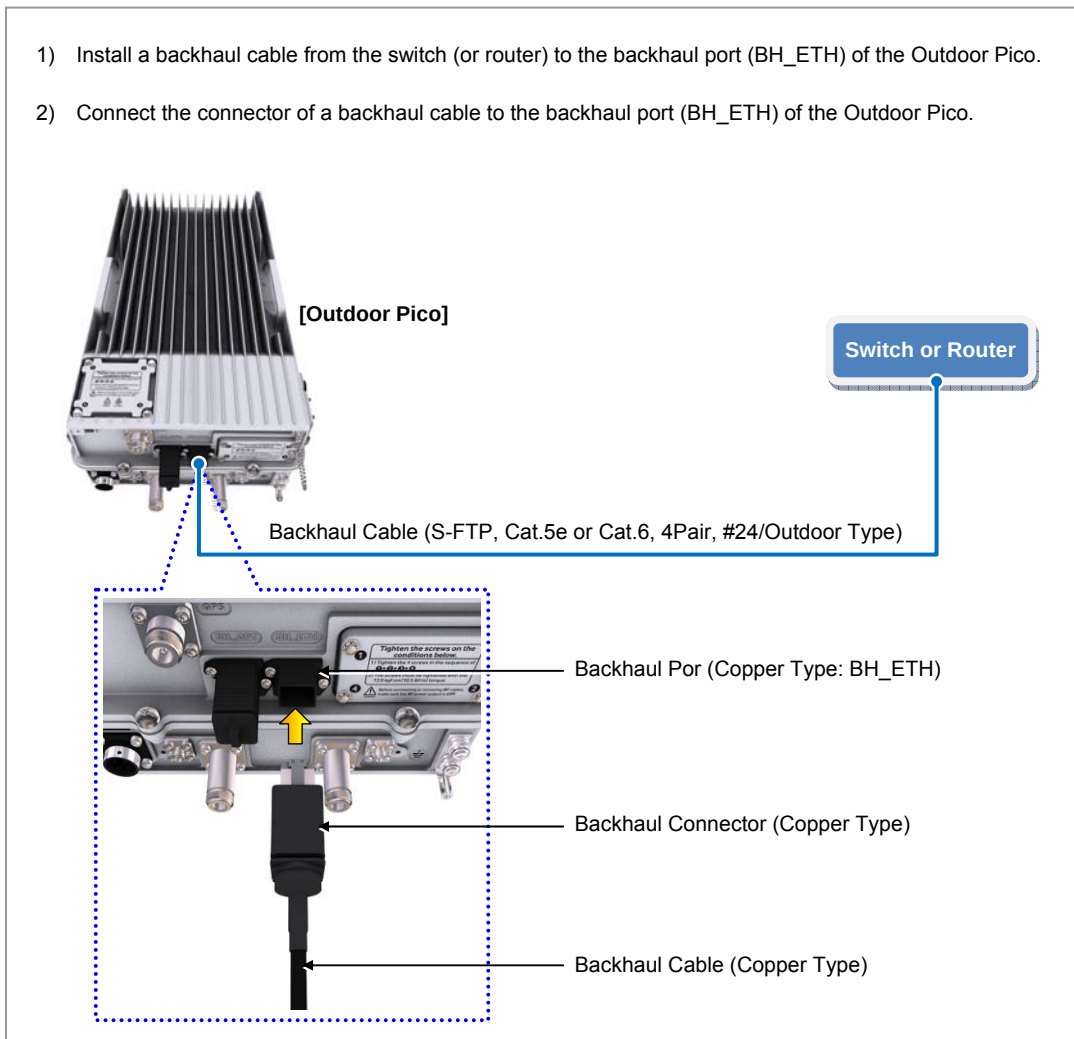


Figure 24. Backhaul Cable Connection_Copper Type

3.5.2 GPS Cable Connection

Follow the steps below to connect the GPS cable.

Table 25. GPS Cable Connection

Category	Description	
Installation Section	Outdoor Pico~GPS Antenna	
Cable	1/2 in. Coaxial Cable	
Connector	Outdoor Pico	N Type-Male
	Line Amplifier	N Type-Male
	GPS Antenna	TNC-Male
Recommended Torque Value	N Type-Male	1.45 lbf·ft (20 kgf·cm)
	TNC-Male	0.65 lbf·ft (9 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Nipper, Torque Wrench, Spanner, Knife, Soldering Iron, Lead	

Table 26. GPS Cable Min. Radius of Curvature and Length Limitation

Category	Description		
GPS cable min. radius of curvature	1/2 in. Coaxial Cable	Installation	2 in. (50.8mm)
		Repeated	5 in. (127 mm)
Length limitation of GPS cable	When a line amplifier is not used	1/2 in. Coaxial Cable	98.42 ft. (30 m or less)
	When using one line amplifier	1/2 in. Coaxial Cable	492.12 ft. (150 m or less)

※ When using Line Amplifier (Symmetricom/58529A) and GPS antenna (PCTEL, GPS-TMG-HR-26N').



CAUTION

Cautions on the Min. Radius of Curvature of GPS Cable and Its Length Limitation

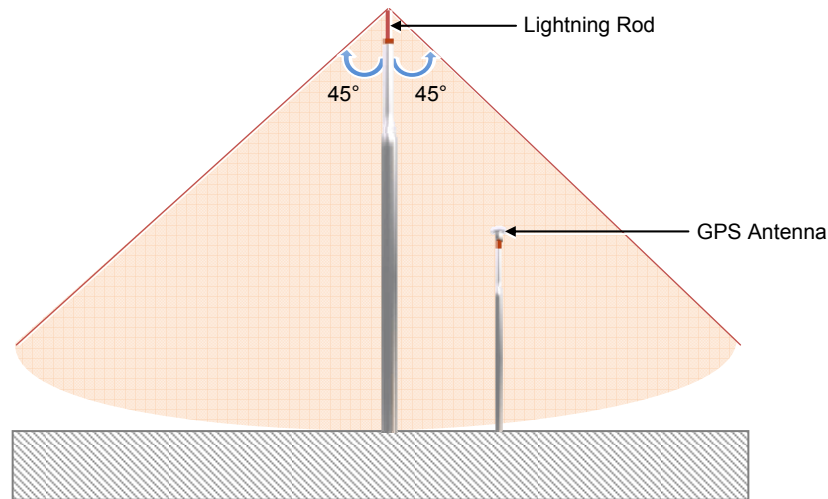
If the GPS cable min. radius of curvature or its length limitation is violated, a GPS signal may not be received seamlessly and it may cause abnormal system operation. Therefore, the min. radius of curvature and length limitation of a GPS cable proposed in the above table must be observed.



CAUTION

Installing the Antenna

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.



CHECK

Installing GPS Antenna

When installing the GPS antenna, you must check the antenna installation location, restriction and installing method in the 'ANNEX A'.



CHECK

Checking the Specifications of Antenna/Line Amplifier

Depending on the supplier or manufacturer of antenna/line amplifier the connector type may be different. Also, the detail specifications of a connector may be different depending on cable type even for the same connector type. Therefore, check the detail specifications of a connector before preparing parts.

Ex) N Type-Male: for 1/2 in. Coaxial Cable



CHECK

Specification of GPS Line Amplifier

GPS line amplifier specification is 'Symmetricom-58529A' or equivalent.
(<http://www.symmetricom.com/products/gps-solutions/accessories/58529A-GPS-Line-Amplifier-with-L1-Bandpass-Filter/>)



CHECK

GPS Antenna Specifications

For GPS antenna, 'PCTEL, GPS-TMG-HR-26N' or equivalent must be used.



GPS-TMG-HR-26N

Parameters	Specifications
Frequency Band	1575.42 ± 1.2 MHz
Amplifier Gain	26.5 ± 3 dB
Output VSWR	≤ 2.0:1
Noise Figure (including pre-selector)	≤ 4.0 dB @ +25°C(typ.) ≤ 4.5 dB @ +25°C(max.)
Operating DC Voltage	3.3~12.0 V(regulated)
Survival DC Voltage	24 V
DC Current	≤ 40 mA @ 5 V
Filtering	4-stage filtering including pre-selector
Out of Band Rejection	≥ 65 dB @ 1559 MHz ≥ 65 dB @ 1625 MHz

GPS Cable Identification Tag Installation

Attach the identification tape in the below table to the GPS cable.

Table 27. Identification Tag of GPS Cable

Classification	Description
Installation position	Attach the identification tag to the ends of GPS antenna and arrestor.
Materials	Use the material of aluminum coated by vinyl for the identification tag.
Fixing method	Fix the GPS cable to the 2 holes on the identification tag with the black cable tie.
Identification method	The markings must be prevented from being erased by using relief engraving or coated labels.

GPS Cable Configuration

The configuration of GPS cable is shown in the figure below.

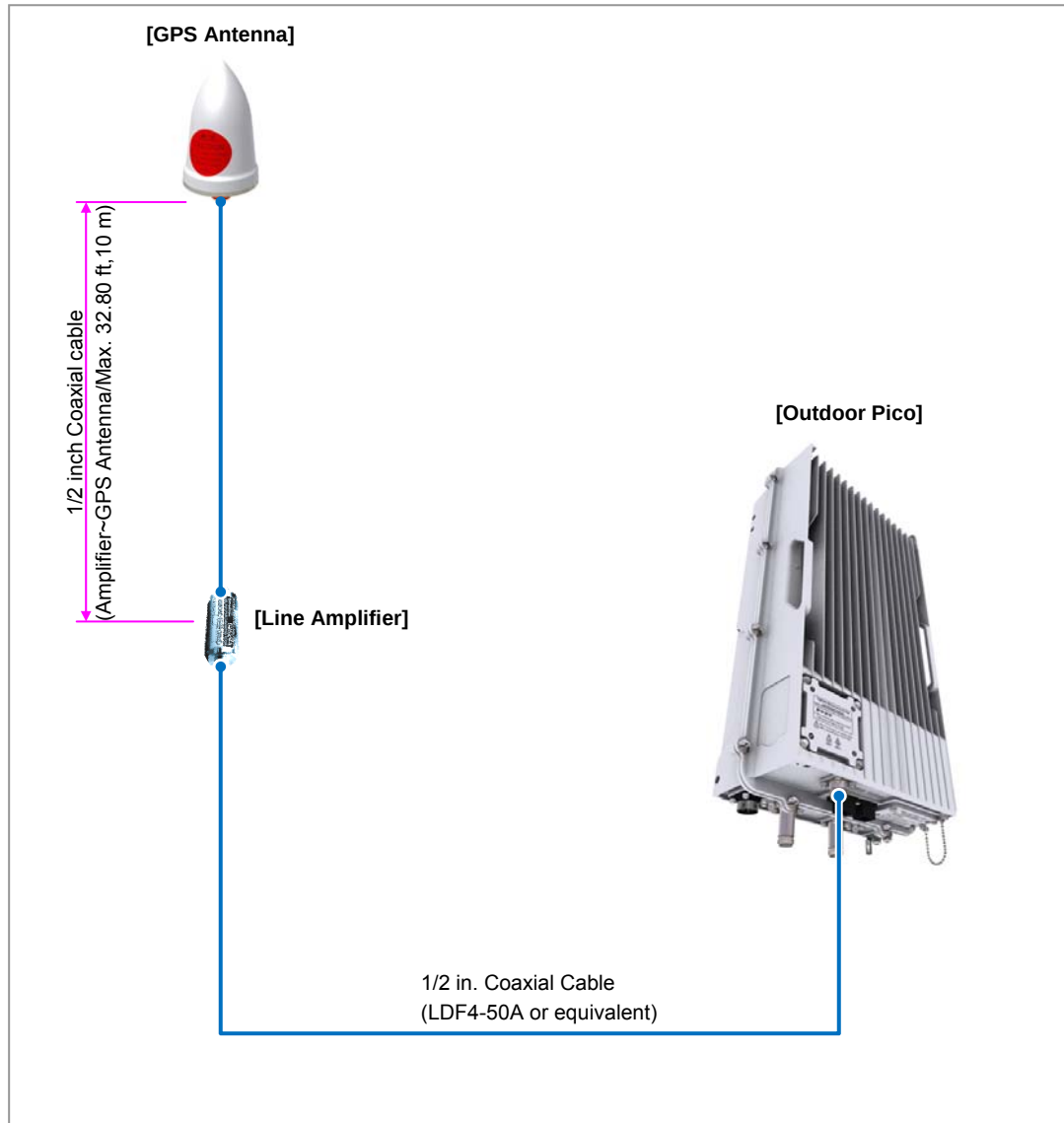


Figure 25. GPS Cable Configuration

- 1) Install a GPS cable (LMR-400) from the GPS port of the Outdoor Pico to the GPS antenna.
- 2) Assemble the connector to the GPS cable.
 - Outdoor Pico-side Connector: N Type-Male
 - GPS Antenna-side Connector: N Type-Male
- 3) Connect the N type male connector assembled to the end of the GPS cable to the GPS port of the Outdoor Pico.

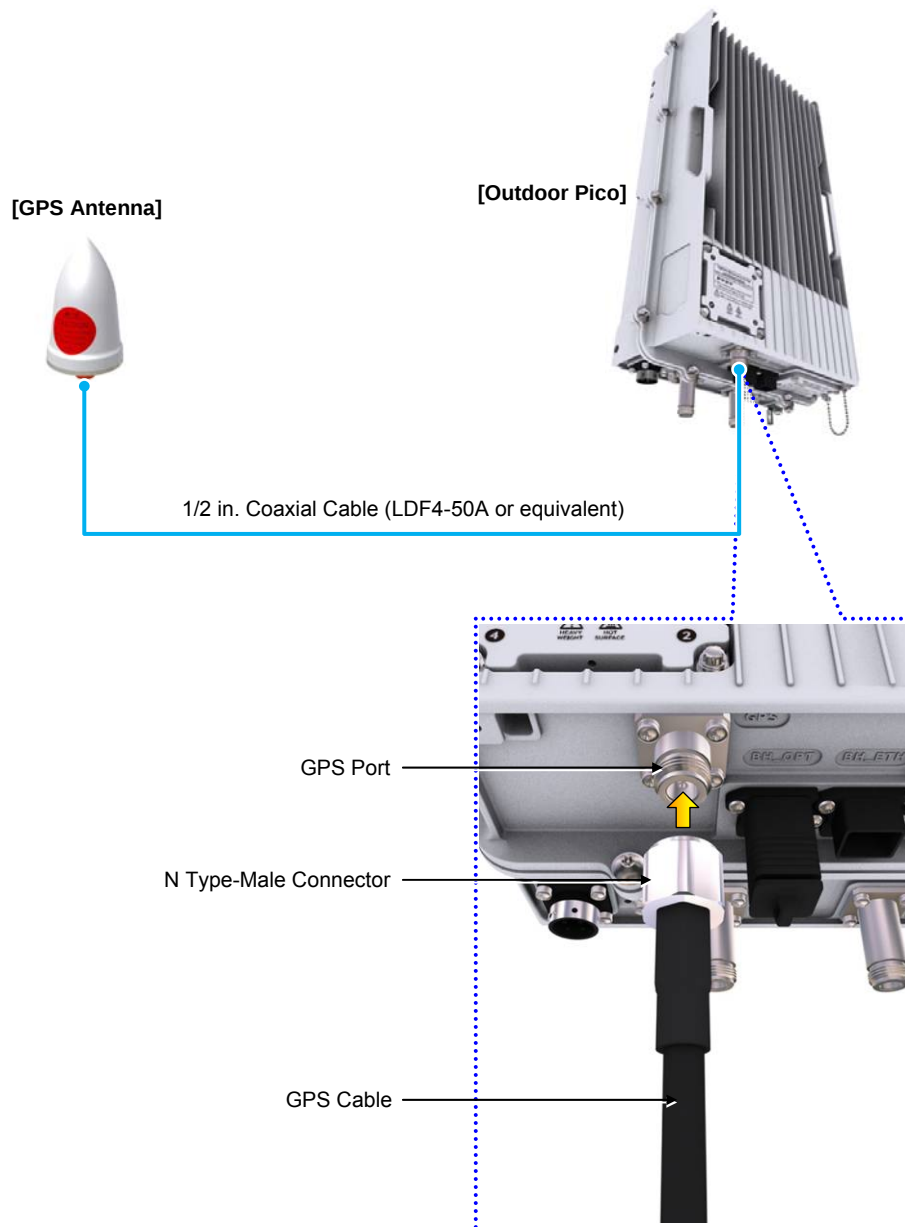


Figure 26. GPS Cable Connection (1)

- 4) Once the connector is connected, wrap up the connector with a butyl tape two fold or more from 1.97 in. (50 mm) off the bottom to the system-side connector.
- 5) Wrap up the butyl taping section with insulation tape twofold or more in the same way as for the butyl tape.
- 6) Bind the end of the insulation tape with a cable tie or apply bond or silicone to prevent it from loosening.

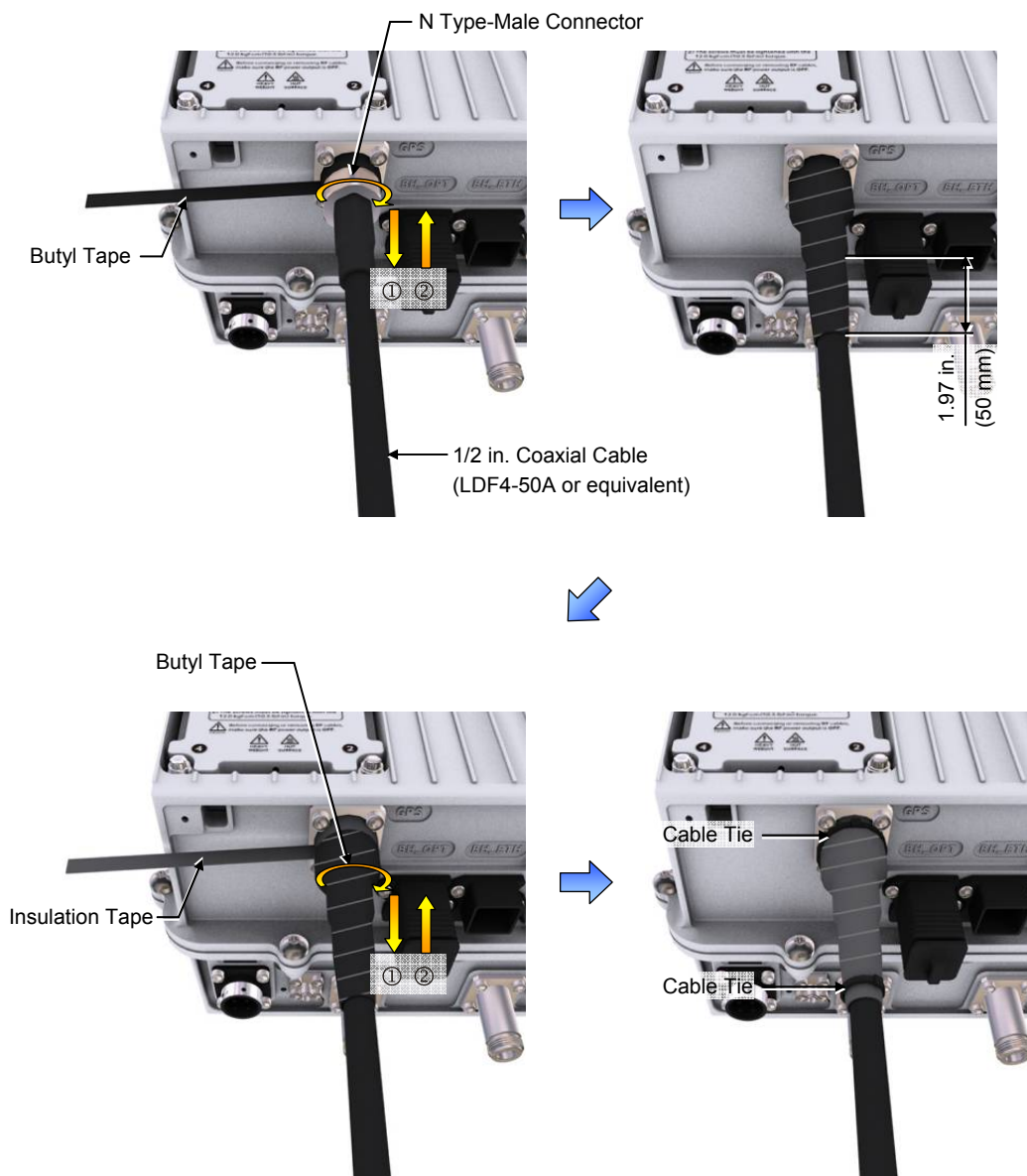


Figure 27. GPS Cable Connection (2)

- 7) Connect the N type-male connector (assembled to the end of GPS cable) to the GPS antenna port.

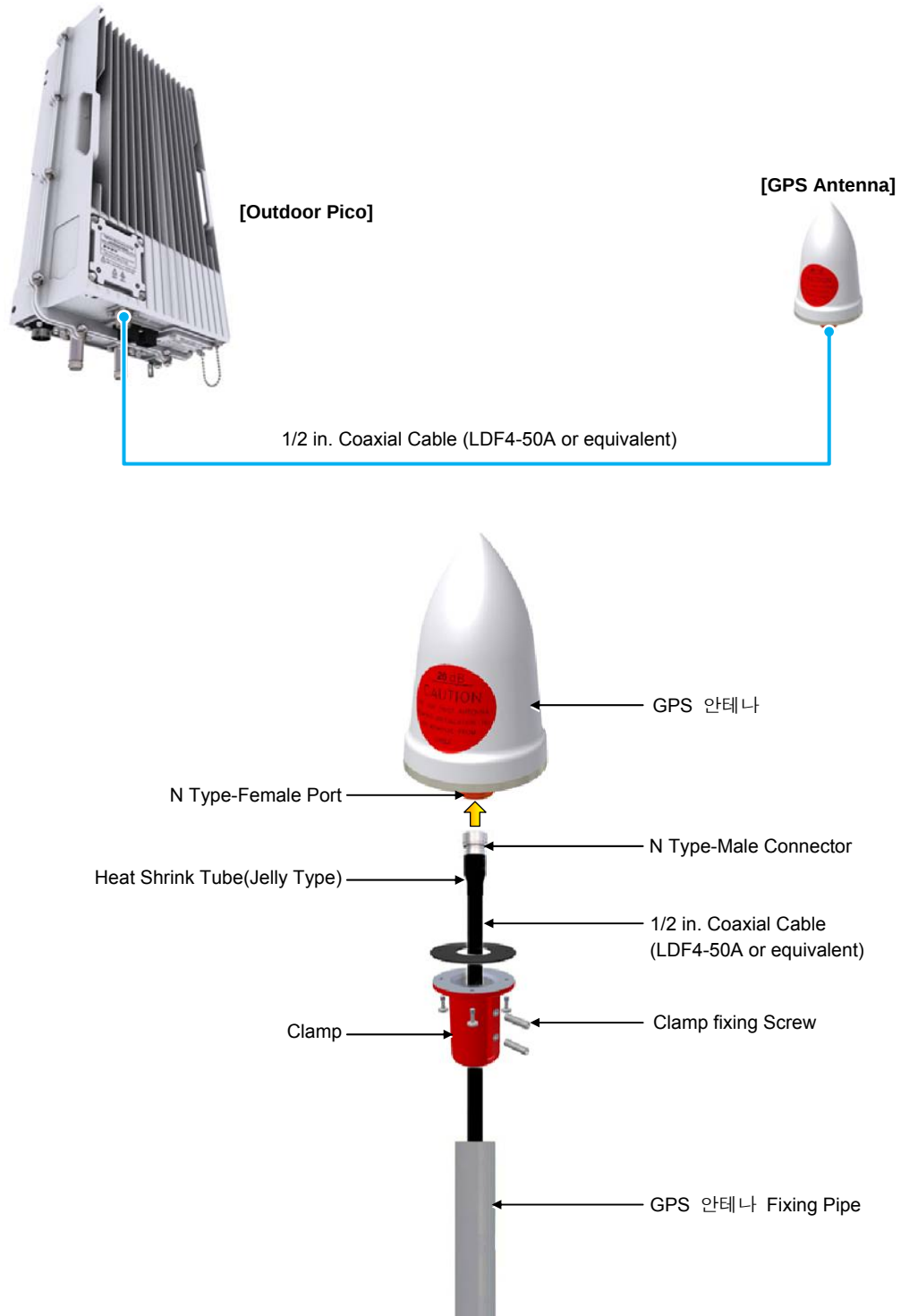


Figure 28. GPS Cable Connection (3)

3.5.3 RF Cable Connection

Follow the steps below to connect the RF cable.

Table 28. RF Cable Connection

Category	Description	
Installation Section	Outdoor Pico RF Antenna Port (ANT)~RF Antenna	
Cable	1/2 in. Feeder Line	
Connector	Outdoor Pico	N Type-Male
	RF Antenna	N Type-Male (Checking RF antenna specifications and preparing connector)
Recommended Torque Value	N Type-Male	1.45 lbf·ft (20 kgf·cm)
	Din Type-Male	14.46 lbf·ft (200 kgf·cm)
Working Tools	Cable Cutter, Wire Stripper, Nipper, Torque Wrench, Spanner, Knife, Soldering Iron, Lead	

Table 29. RF Cable Min. Radius of Curvature

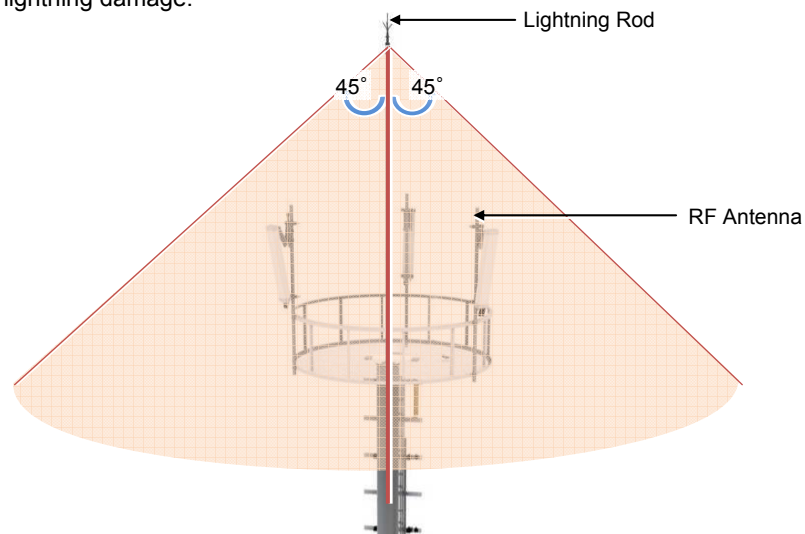
Category	Description		
RF cable min. radius of curvature	1/2 in. Feeder Line (for Indoor)	LS/HFSC-12D	1.26 in.(32 mm)
		RFS/SCF-12-50	1.26 in.(32 mm)
	1/2 in. Feeder Line (for Outdoor)	LS/HFC-12D	4.92 in.(125 mm)
		RFS/LCF12-50	4.92 in.(125 mm)



CAUTION

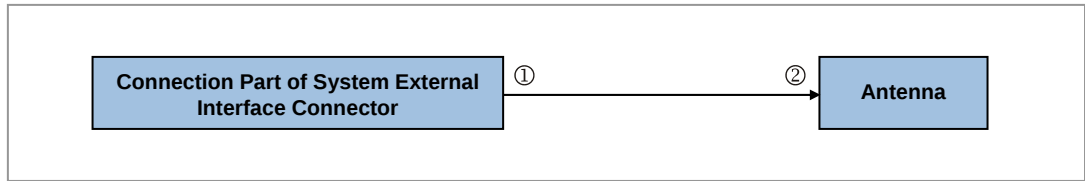
Installing the Antenna

When you install the antenna, the antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.



Checking RF Cable Connection

After connecting the RF cables, perform the continuity test and feeder cable return loss to check if the RF cable is changed and measure VSWR of antenna and RF cable.



Measure all cables of section ①~②. The measured VSWR should be the specification value or less. If the VSWR exceeds the specification value, disassemble the connector and measure each section separately.



CAUTION

Checking VSWR for Minimum Cable Bend Radius and Length of RF Cable

If the VSWR value for minimum cable bend radius and length of RF cable is not applied, system may not work properly because RF signals cannot transmit or receive smoothly. So, the VSWR value for minimum cable bend radius and length of RF cable must be checked and applied.



CAUTION

Cautions When Measuring VSWR

When measuring VSWR, if you open the antenna port when the transmission output is not completely off, a spike signal may flow into the reception path, which may cause damage to LNA. Make sure the transmission output is completely off when measuring VSWR.



CAUTION

Cautions When Connecting Feeder Lines

If you install the feeder line which is connected to the system, it may damage the system and cable connection. Therefore, it is recommended to install the feeder line up to the system's input port before connecting the feeder line to the system.



CHECK

Checking the Specifications of Antenna Connector

Depending on the supplier or manufacturer of antenna, the connector type may be different. Also, the detail specifications of a connector may be different depending on cable type even for the same connector type.

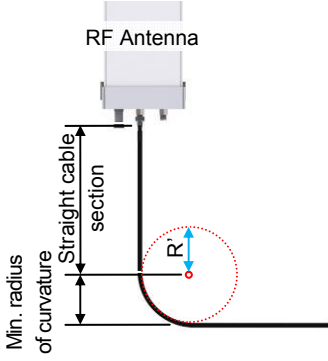
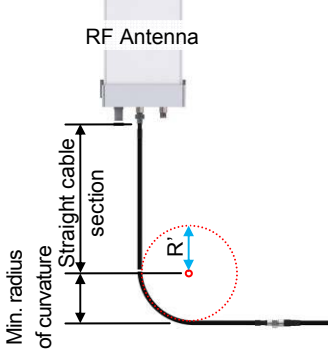
Therefore, check the detail specifications of a connector before preparing parts.

Ex) Din Type-Male: for 1/2 in. Feeder line, for 7/8 in. Feeder Line

RF Cable Configuration

The RF cable is connected in the following two methods. Prepare and install parts based on the method agreed by a service provider or the site conditions.

Table 30. RF Cable Connection at Antenna Connection Area

Case	Description
Case #1	 Connect a 7/8 in. or longer feeder line directly to the RF antenna. - If a space for min. radius of curvature can be secured when a 7/8 in. or longer feeder line is used. - If no excessive force is applied to the connector assembled to the antenna port or cable because the straight cable section is long enough.
Case #2	 Connect a 1/2 in. feeder line (jumper cable) to the RF antenna. - If a space for min. radius of curvature cannot be secured when a 7/8 in. or longer feeder line is used. - If excessive force is applied to the connector assembled to the antenna port or cable and it may cause poor contact or damage because the straight cable section is not long enough.

※ 7/8 in. or longer feeder line: 7/8 in./1 1/4 in./1 5/8 in. feeder line, etc.

※ The RF cable must be connected based on the method agreed by a provider or the site conditions.

RF Cable Identification Tag Installation

Attach the identification tape in the below table to the RF cable.

Table 31. RF Cable Identification Tag

Category	Description
Installation position	Attach the identification tag to the both ends of the antenna.
Materials	Use the material of aluminum coated by vinyl for the identification tag.
Fixing method	- Antenna side: Attach the tag to the feeder line using binding strings through the two holes on the tag. - Equipment Side: Cover up the feeder line with the tag and fix it using binding strings through the two holes on the tag.
Identification method	The markings must be prevented from being erased by using relief engraving or coated labels.

RF Cable Connection

Follow the steps below to connect the cable between Outdoor Pico and RF antenna.

- 1) Connect the connectors to the RF ports (N type-female) at the bottom of Outdoor Pico.
- 2) Assemble a connector at the end of the RF cable. (The specifications of the antenna and supplier-specific connector, and the tightening method are subject to change.)
 - Outdoor Pico-side Connector: N Type-Male
 - RF Antenna-side Connector: N Type-Male
- 3) Connect the connector assembled at the end of the RF cable (Outdoor Pico-side) to the RF antenna port of the Outdoor Pico.

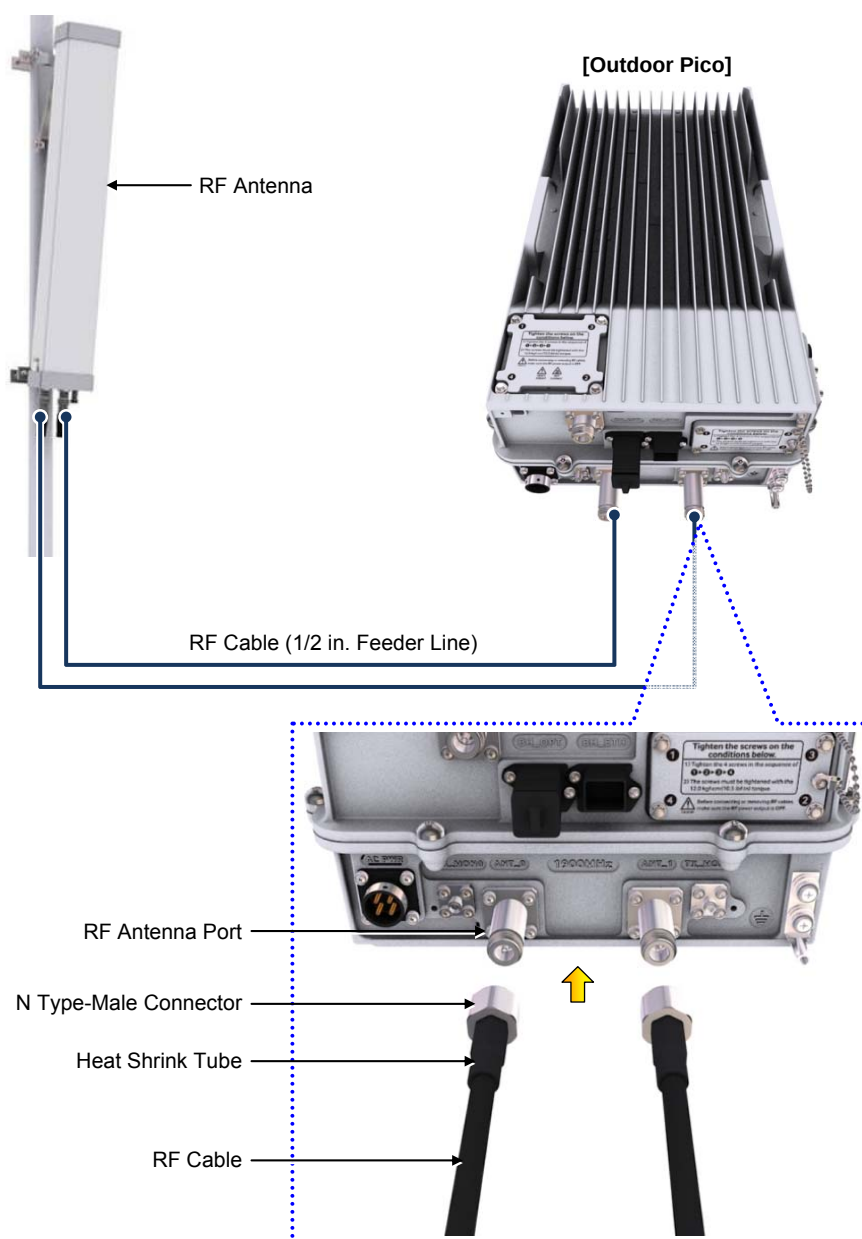


Figure 29. RF Cable Connection (1)

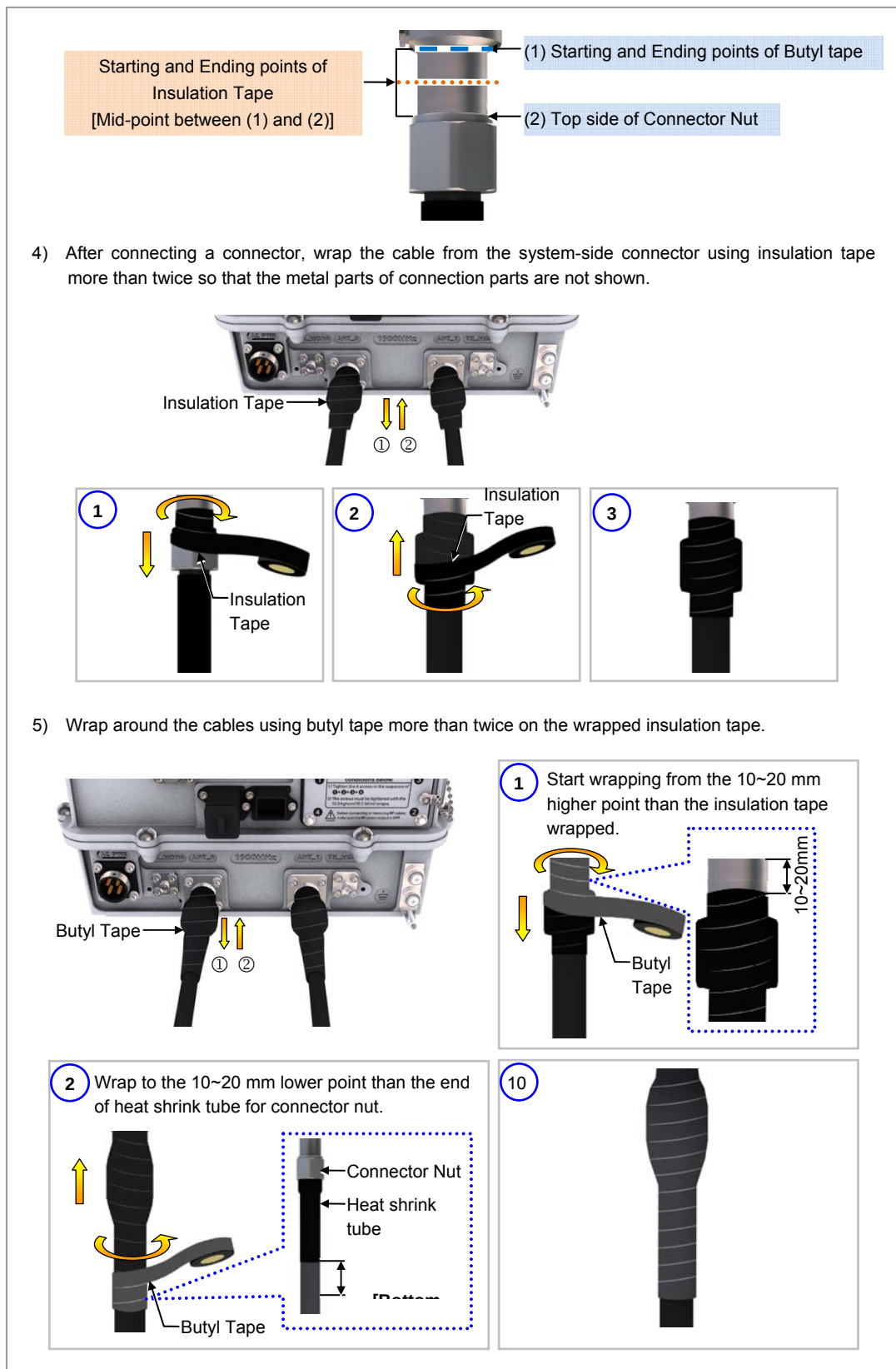


Figure 30. RF Cable Connection (2)

- 6) Wrap around the cable using insulation tape more than twice on the wrapped butyl tape.



- 7) Bind cable ties at the both ends of insulation tapes not to be released.

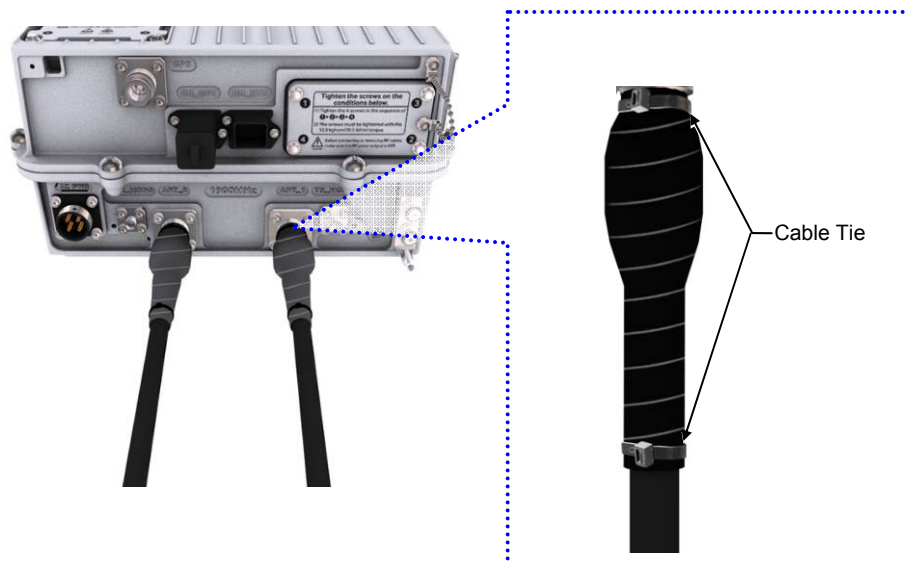
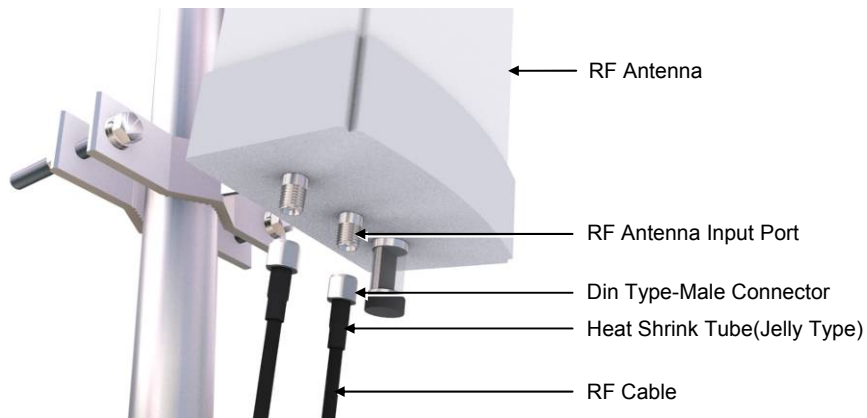


Figure 31. RF Cable Connection (3)

- 8) Connect the connector (assembled to the end of the cable on the RF antenna side) to the RF antenna port.



- 9) After connecting a connector, wrap the cable from the system-side connector using insulation tape more than twice so that the metal parts of connection parts are not shown.

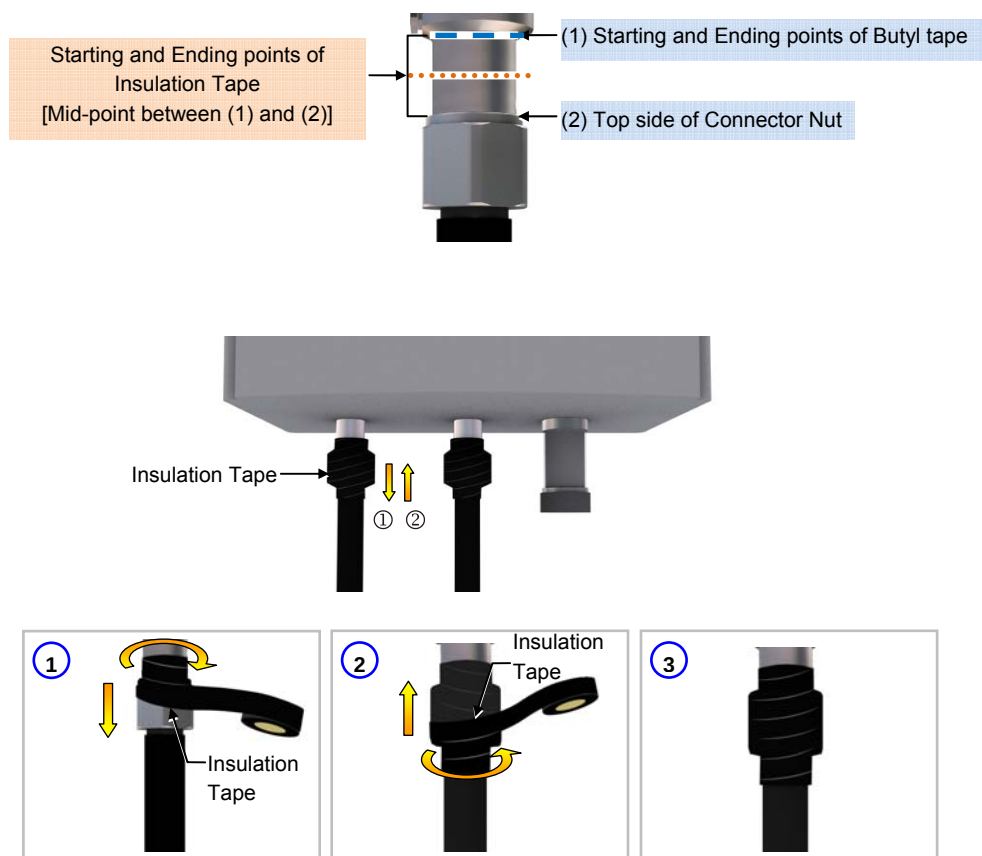
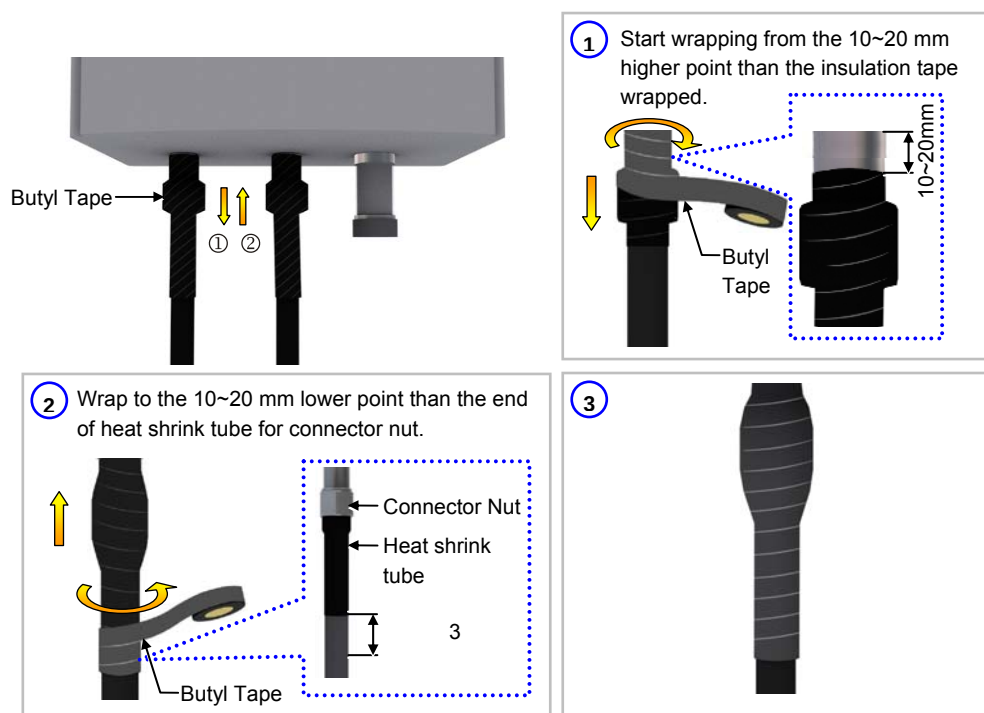


Figure 32. RF Cable Connection (4)

- 10) Wrap around the cables using butyl tape more than twice on the wrapped insulation tape.



- 11) Wrap around the cable using insulation tape more than twice on the wrapped butyl tape.

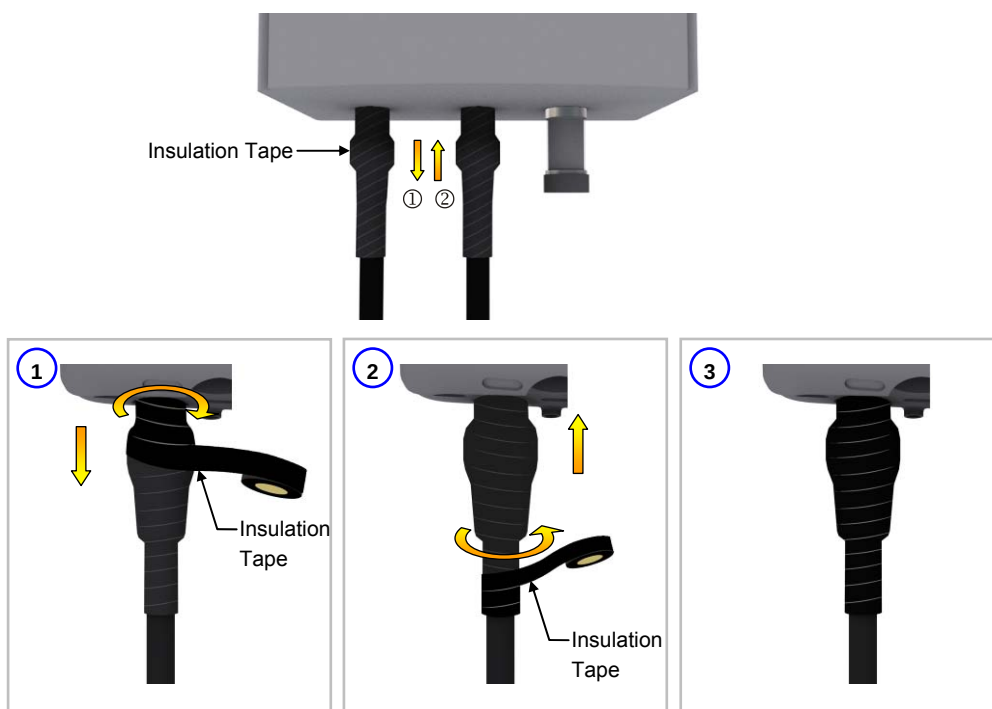


Figure 33. RF Cable Connection (5)

- 12) Bind cable ties at the both ends of insulation tapes not to be released.

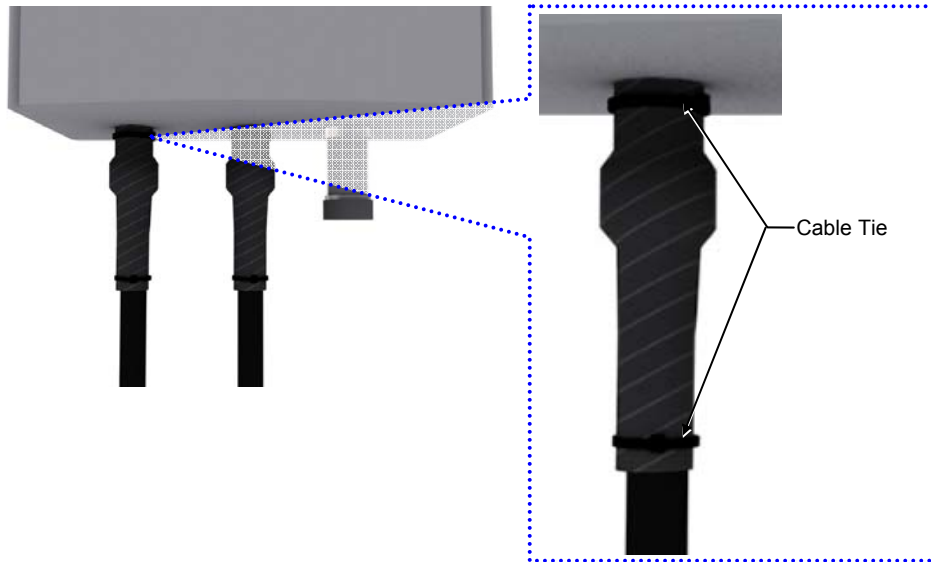


Figure 34. RF Cable Connection (6)

CHAPTER 4. Checking Installation Status

4.1 Installation Checking Procedure

Below is the procedure to check installation status.

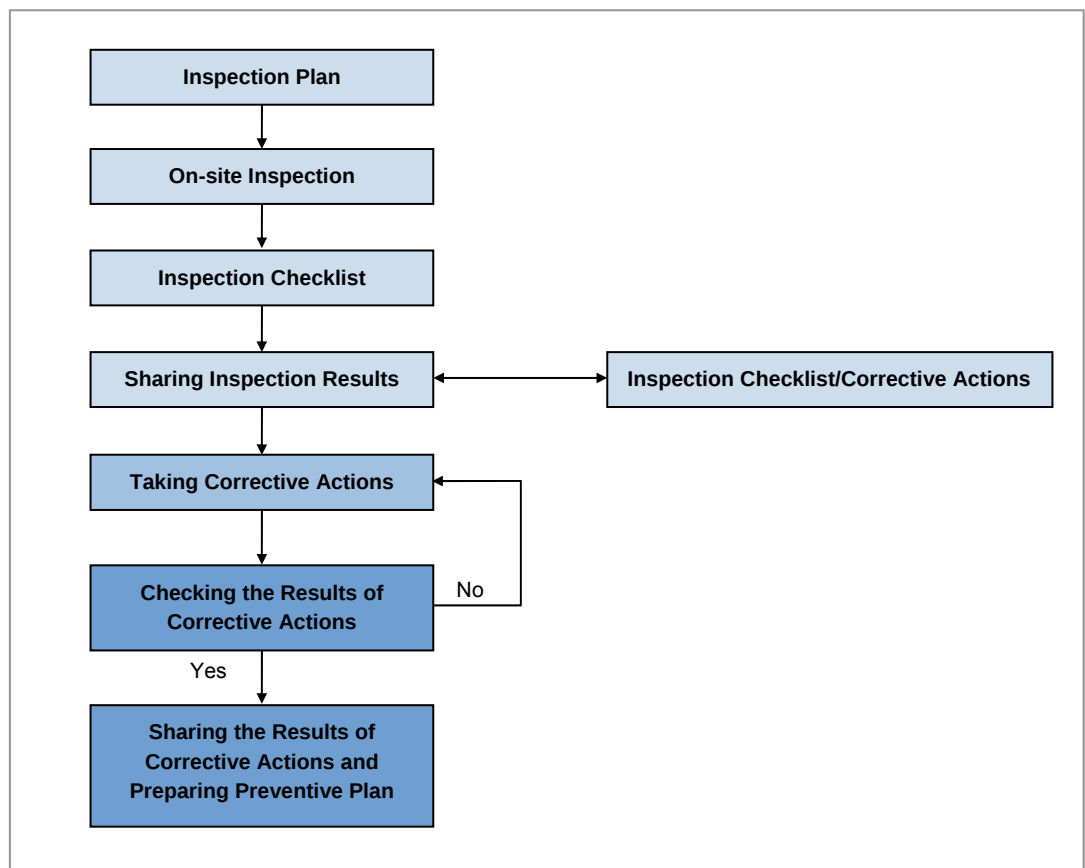


Figure 35. Installation Checking Procedure

Inspection Plan

Create an inspection sheet per system and select an inspector to set an inspection schedule per site.

On-site Inspection and Inspection Checklist

The on-site inspection is to perform inspection visually or using instruments for each specification, standard, and installation status, etc. based on the inspection checklist actually at a site where the system is installed.

The inspector must record the results onto the inspection checklist during or after field inspection.

Sharing Inspection Results and Taking Corrective Actions

The inspector must share the inspection results (inspection checklist/corrective actions) with a installation operator and the installation operator must take the corrective actions if necessary after reviewing the requirements.

Checking the Results of Corrective Actions

The inspector must check if the corrective actions are properly taken. If they are not sufficient, the inspector must ask the installation operator to take the corrective actions again.

Sharing the Results of Corrective Actions and Preparing Preventive Plan

After the corrective actions are all completed, the inspector must share the results with the installation operator and relevant departments and prepare a preventive plan to prevent the same or similar problems from re-occurring.

Table 32. Construction Situation Checklist

Category	Check Items	Criteria	Result	
			Pass	Fail
Installing Equipment	Appearance of equipment and mechanical parts	Equipment damage such as Dent, scratch and crack, etc.		
	Placement of equipment and mechanical parts	Maintenance and horizontal/vertical placement		
	Leveling condition of equipment and mechanical parts	Horizontal/vertical fixing (level, weight, rubber hose, etc.)		
	Validity of status and specifications of tightening bolt/nut/washer, etc.	Visual inspection and magnet check Compliance with tightening torque value		
	Other works (cable duct installation status, etc.)	Checking position and installation status		
Grounding	Status of ground bar installation per usage	Checking the separation of communication/power/lightning grounding		
	Cable Size	Checking specifications such as thickness, etc.		

Category	Check Items	Criteria	Result	
			Pass	Fail
	Cabling and binding status	Cable damage/properness installation route Checking binding interval and the condition of used materials		
	Cable connection	Assembly and tightening condition of a pressure terminal Checking compliance with tightening torque value		
	Installation status of cable tag	Checking position, marking, and tag installation type		
Power	Installation status of power supply and circuit breaker	Power supply capacity/input voltage (tester) Checking circuit breaker type and capacity		
	Cable Size	Checking thickness and length limitation		
	Cabling and binding status	Cable damage/properness installation route Checking binding interval and the condition of used materials		
	Cable connection	Cable damage/properness installation route Checking binding interval and the condition of used materials		
	Installation status of cable tag	Checking position, marking, and tag installation type		
Other data cables	Cable size	Checking cable specifications per usage		
	Cabling and binding status	Checking cable damage/properness installation route, binding distance and condition of used materials		
	Cable connection	Checking cable connection (Pin Map), assembly and tightening status of a connector and compliance with tightening torque value		
	Installation status of cable tag	Checking position, marking, and tag installation type		
RF/GPS	GPS signal reception status (number of GPS reception satellites)	More than 6 reception satellites (C/N 40 or higher) Checking in-band or out-band jamming		
	Antenna installation status	Checking specifications, installation position, fixing status, and gap between antennas		

Category	Check Items	Criteria	Result	
			Pass	Fail
	Installation status of arrestor/ line amplifier/ splitter, etc.	Checking specifications, installation position, and fixing status		
	Cabling and binding status	Checking cable damage/properness of installation route/binding distance and the condition of used materials		
	Cable connection	Checking cable connection status, connector assembly and tightening status, compliance with tightening torque value, and finishing		
	Installation of cable tag	Checking position, marking, and tag installation type		
Others	Reserved ports and cable inlet status	Finishing (Water-proof cap, etc.)		
	Connection of equipment I/O port (Conduit/Cable Gland)	Checking tightening status		
	Installation of cable installation route	Installation of cable tray and duct, etc.		
	Status of inside/outside of the equipment and system surrounding area	Checking the stocking condition of waste parts, waste materials, packing materials, etc.		
Opinion				

ANNEX A. GPS Antenna Installation

A.1 GPS Antenna System Configuration

The GPS antenna system is commonly configured as shown below:

Table 33. GPS Antenna System Configuration

Category	Description
GPS Antenna	Device receiving a signal from a GPS satellite
GPS Line amplifier (Option)	Device amplifying the GPS signal received from the GPS antenna (used to compensate the GPS signal loss caused by GPS antenna, GPS arrestor, cable and connector)
GPS (Lightning) Arrestor	Device protecting people or system from lightning

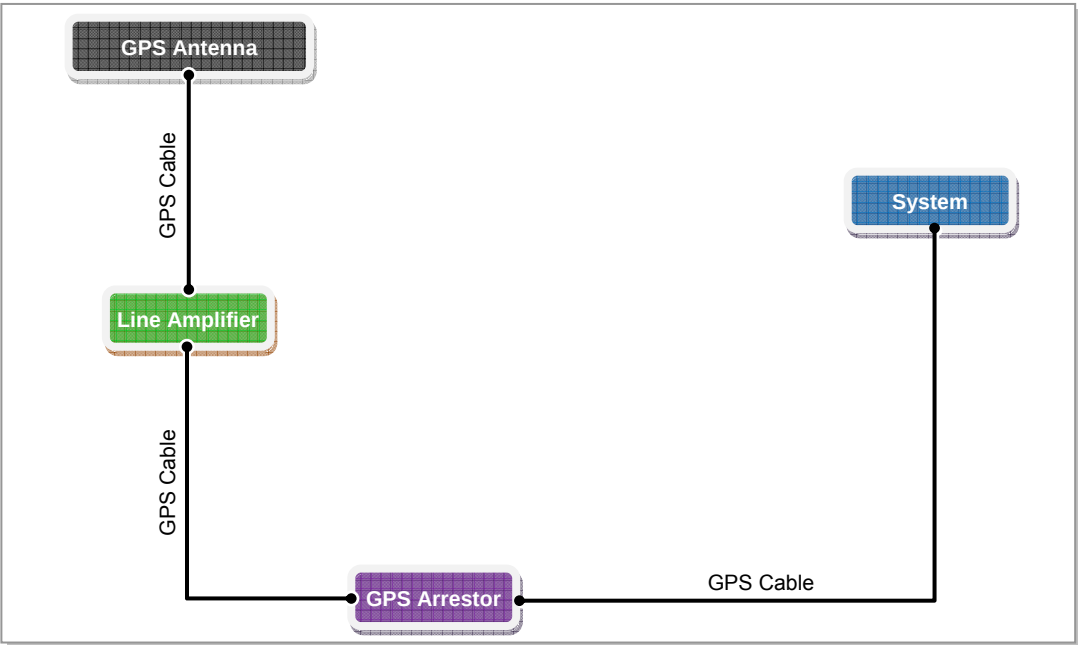


Figure 36. Example of a Common GPS Antenna System Configuration

To satisfy the GPS specifications and operate the GPS antenna in a stable manner, the following GPS antenna configuration and installation requirements must be met.

A.1.1 GPS Antenna

Installation Requirements for the GPS Antenna

The GPS antenna must be installed in a location where it has the maximum amount of open sky. The ideal position is one where there are no obstacles that interfere with the antenna within 10 degrees or more of the horizon (the Elevation Angle). This allows the GPS receiver to select the best combination or distribution of GPS satellites which gives optimal performance.

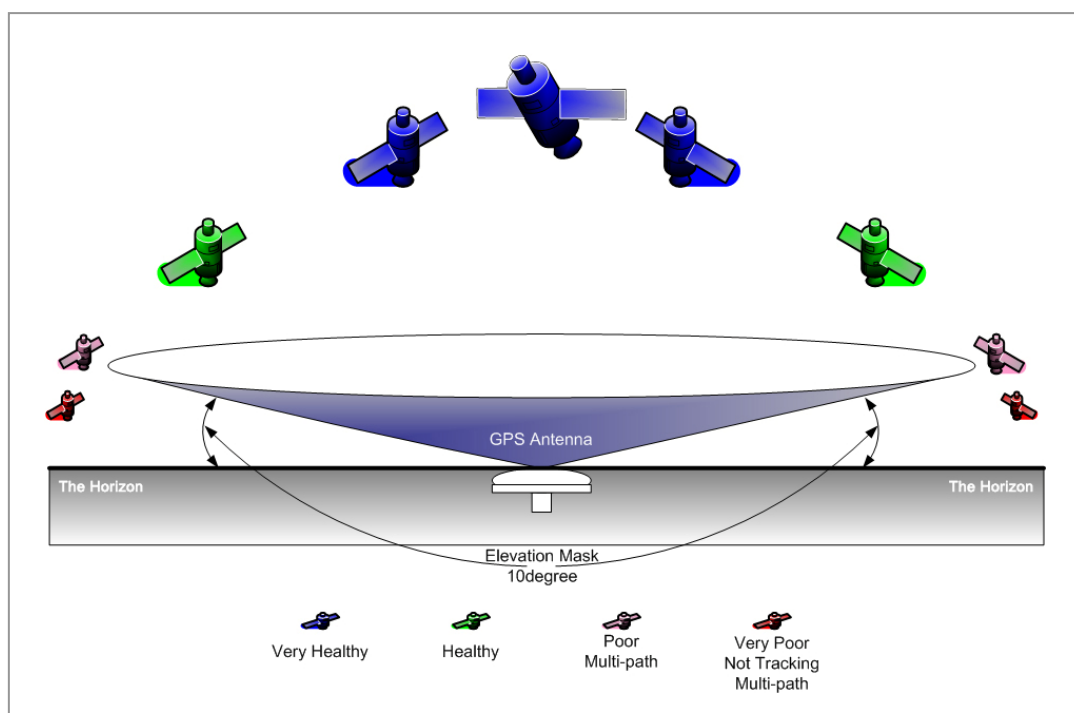


Figure 37. Elevation Mask and Satellites

For good signal strength, you don't have to place the GPS antenna on a high pole or building, which is often required for RFs and microwaves.

Any place where there are no obstacles blocking the GPS antenna from the sky and where it is protected from the elements such as outside interference is suitable. In this case, you can even install it on the ground.

However, you can prevent the GPS antenna from malfunctioning by installing it in a place where it does not receive reflected satellite signals. As multi-path interference greatly affects the accuracy of the GPS receiver, it is better to minimize reflected satellite signals entering through the top of the GPS antenna.

Therefore, the GPS antenna installation location must meet the following three conditions.

- Location that can avoid effect of obstacle/building that interferes with reception of GPS signal or causes multi-path
- Location that can avoid interference of RF signal that is transmitted/received at the surrounding other RF antenna (including steel-framed structure for RF antenna) or microwave signal
- Location as low as possible that avoid damage from lightning within coverage area of lightning rod



NOTE

Considerations for Elevation Mask

Considering the elevation mask, make the GPS antenna take the signals received at a valid elevation angle only.



NOTE

Countermeasures for External Interference and Multi-path Influences

If a GPS antenna is influenced by external interference signals or multi-paths at a certain place, it is best to re-install the antenna at another place. Anti-jamming GPS antenna is recommended if it is not possible to change the location of the antenna.

GPS Antenna Sharing

To ensure the GPS receiver works properly, it is recommended you install one GPS antenna per GPS receiver. It is also recommended you use a GPS-specific splitter only if absolutely necessary.

Installing the GPS Antenna

The signals from a GPS satellite have a very low level (-130 dBm). Because of this, the GPS antenna to receive them should be installed in a place where it can receive signals as directly as possible from as many satellites as possible.

Therefore, it is important to ensure there is maximum open sky (the visual field angle must be 360 degrees, and there must be 160 degrees or more above the horizon). This means that the antenna is mostly installed on a high place, such as a roof. If there is an obstacle within those angles, it decreases the performance and functionality of the GPS receiver.

The GPS satellites are distributed so that eight of them can always be tracked from any one place across the world, as long as there is no obstacle to them in that particular place.

For the GPS receiver to operate at its best, there must be always six GPS satellites with a healthy status (i.e., there is no obstacle directly between it and the GPS antenna).

If the position hold operation has been completed, the GPS receiver can only perform its operations stably if at least one satellite can be tracked continually.



NOTE

GPS Satellite Tracking and Position Hold

The survey of an object's position using GPS satellites is based on triangulation. Three satellites are enough to survey the position of an object by triangulation. However, to calculate the correct time deviation, a total of four satellites are required.

Usually, the GPS antenna is installed in a high place, such as on a roof. It must be installed away from protruding objects, such as trees or buildings. In addition, it must be positioned away from any obstacle which covers part of the sky around the horizon of the building where it is installed.

If it is impossible to ensure a completely open sky, you should install the GPS antenna facing the equator providing a maximum view of the Southern sky (Northern sky in the Southern hemisphere).

Furthermore, when installing the GPS antenna using a steel cylinder structure shared by other RF antennas, it must be separated by more than 1 m from that steel structure.

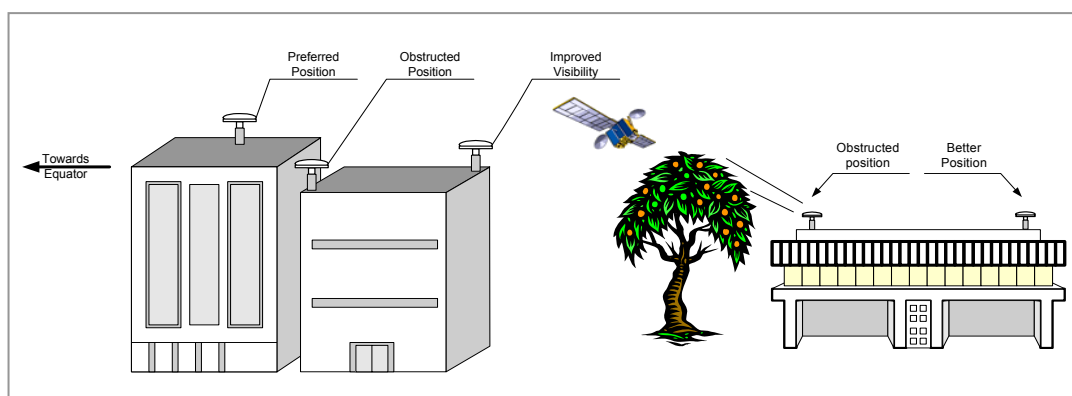


Figure 38. GPS Antenna Installation

A.1.2 Lightning Arrestor

A lightning arrestor is required when there is a danger of lightning striking a cable or related part. The lightning arrestor must be installed in a place where the antenna cable or set of combined cables enters a building or station, or a place inside the building or station. The purpose of this is to protect the people and equipment inside the building or station.

If struck directly by lightning, the lightning arrestor, antenna, or cable must be replaced. Furthermore, you must inspect the lightning arrestor periodically, and replace the antenna and cable periodically to ensure protection if lightning occurs frequently at the site. The lightning arrestor must be well grounded so that it can transmit a large current quickly.

A.2 Interference Signal

The GPS system is designed so that it has a strong immunity to noise and can endure interference.

The Samsung GPS receiver provides a quality timing clock in most installations. However, to ensure that the GPS receiver performs locking successfully and guarantees uninterrupted timing performance, an interference-free environment is required for frequencies near the GPS L1 frequency (1575.42 ± 1 MHz).

Interference Types

There are two types of interference which affect the GPS L1 frequency.

- **Narrow band (inband) interference**
When a frequency deviation (3.5 kHz), such as an FM wave, inflows in around the GPS L1 frequency (1575.42 MHz). This is called narrow band (inband) interference. Narrow band interference is monitored by the spectrum analyzer. But because it has a time lag, a locking failure or a different type of alarm can occur.
- **Wideband interference**
When around the GPS L1 frequency (1575.42 MHz), the frequency deviation is more than 7 kHz. This is called wide band interference.
Wideband interference includes the interference induced by the harmonics from a communication service with a different frequency bandwidth, increased thermal noise from communication services around the L1 band, inflow of interference due to unauthorized communication, saturation due to oscillation of an accessory device etc. You cannot monitor these kinds of interferences with a device such as a spectrum analyzer. If the system has a wideband interference problem, you should consult an expert in this area.

For other bandwidths except the GPS L1 frequency (1575.42 ± 1 MHz), a GPS Band Pass Filter (BPF) must be included within the GPS antenna to remove the interference from the GPS bandwidth. No outband interference must affect the GPS signals.

Avoiding Interferences

If more than one antenna for other communications, such as an antenna for a base station or satellite communication, is installed in the surroundings, the GPS antenna must be installed in a location to which no interference signals flow in.

If interference exists within the GPS L1 frequency bandwidths (1575.42 ± 1 MHz), you should use a band pass filter to prevent them from affecting it.

Furthermore, if the GPS antenna is installed by a transmitter which operates with a bandwidth similar to the GPS L1 frequency, the possibility of interference increases (in this case, interference is caused by harmonics). If the GPS antenna has a problem due to interference, you must move it to a different location where interference signals can be avoided or minimized in strength.



NOTE

Inband Noise

Inband noise includes narrow band noise and wide band noise that occur in an inband width. (L1, 1575.42 ± 1 MHz)

- Narrow band noise in an inband width: If it is higher than 108 dBm it can affect the operation of the GPS receiver.
- Wideband noise in an inband width: It may not be detected by a measuring instrument and impair the sensitivity of the GPS receiver, and thus affect its operation.

If there is an outband interference problem, you can reduce the effects of interference on the GPS receiver by applying one or more L1 GPS band pass filters.

The filter should be installed at the following locations:

- The input connector of the Samsung GPS receiver
- Behind the antenna or the front end of a line amplifier

The filters above are used to reject jamming tones for outband signals. If interferences actually occur in the inband signals, they will result in serious consequences.

A.3 GPS Antenna Installation

The GPS antenna can be fixed to a wall, floor, tower, pole, etc.

Ensure you are safe when fixing an anchor bolt to a wall and treat the anchor bolt fixing area with a silicon or waterproof finishing material.



CAUTION

Installing the Concrete Block

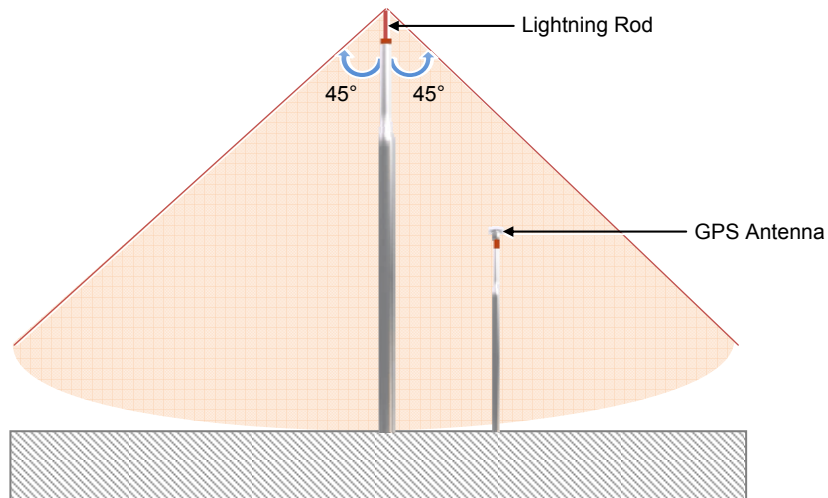
A concrete block should be installed that satisfies the specification regarding size and strength. When installing the concrete block, and before forming the concrete, steel reinforcement bars should be arranged in a mesh layout at 3.93 in. (100 mm) intervals before forming the concrete. (Either an anchor bolt assembly or a concrete anchor can be used.)



CAUTION

Installing the Antenna

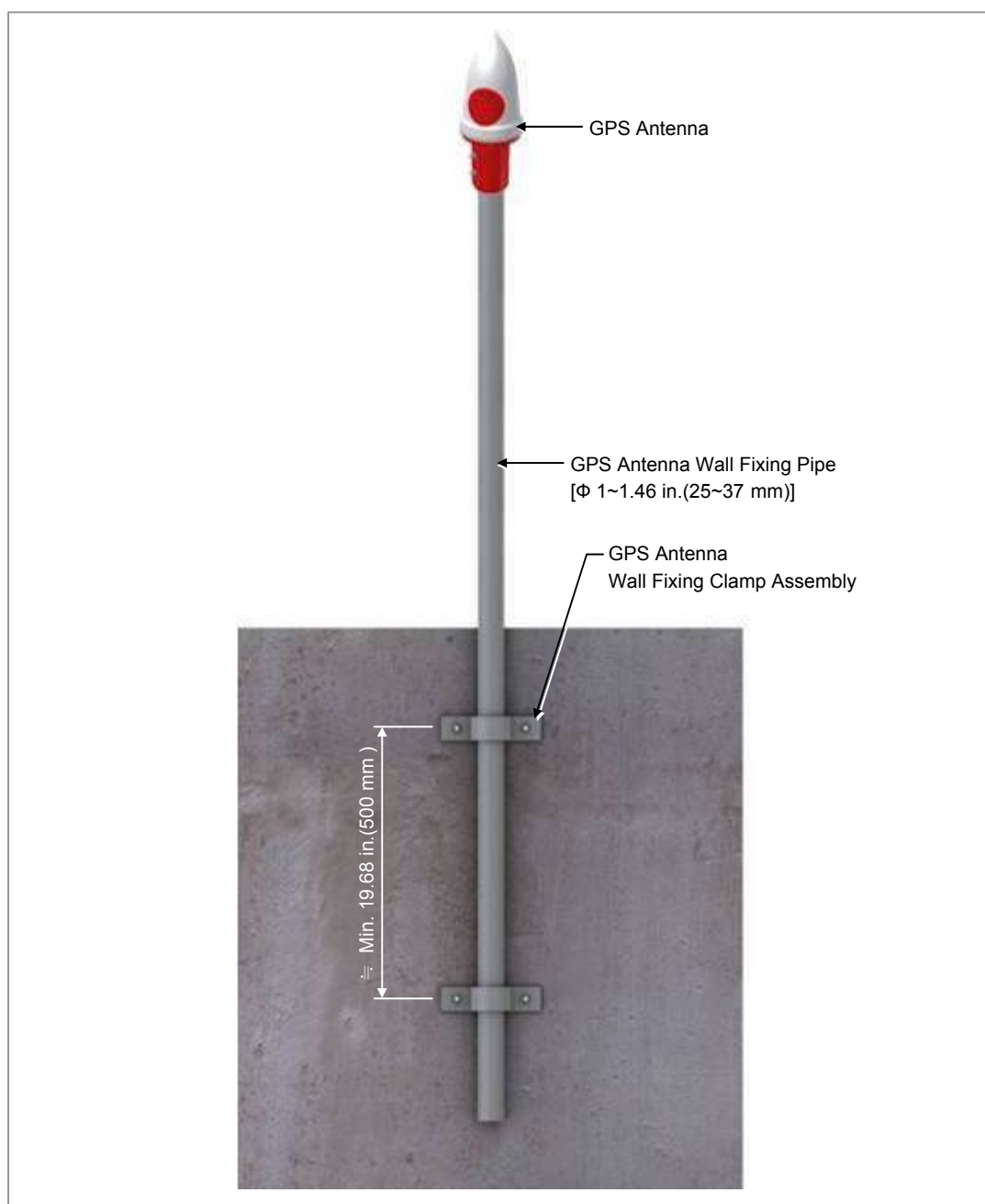
When you install the antenna, antenna must be within the protective angle (left/right side 45° each from the central axis) to prevent the antenna from lightning damage.



CHECK

Distance between the Antennas

When installing antenna, 3.28~4.92 ft (1~1.5 m) distance must be secured between the antennas for preventing interference.

Wall**Figure 39. GPS Antennal Installation (Wall)**

Floor

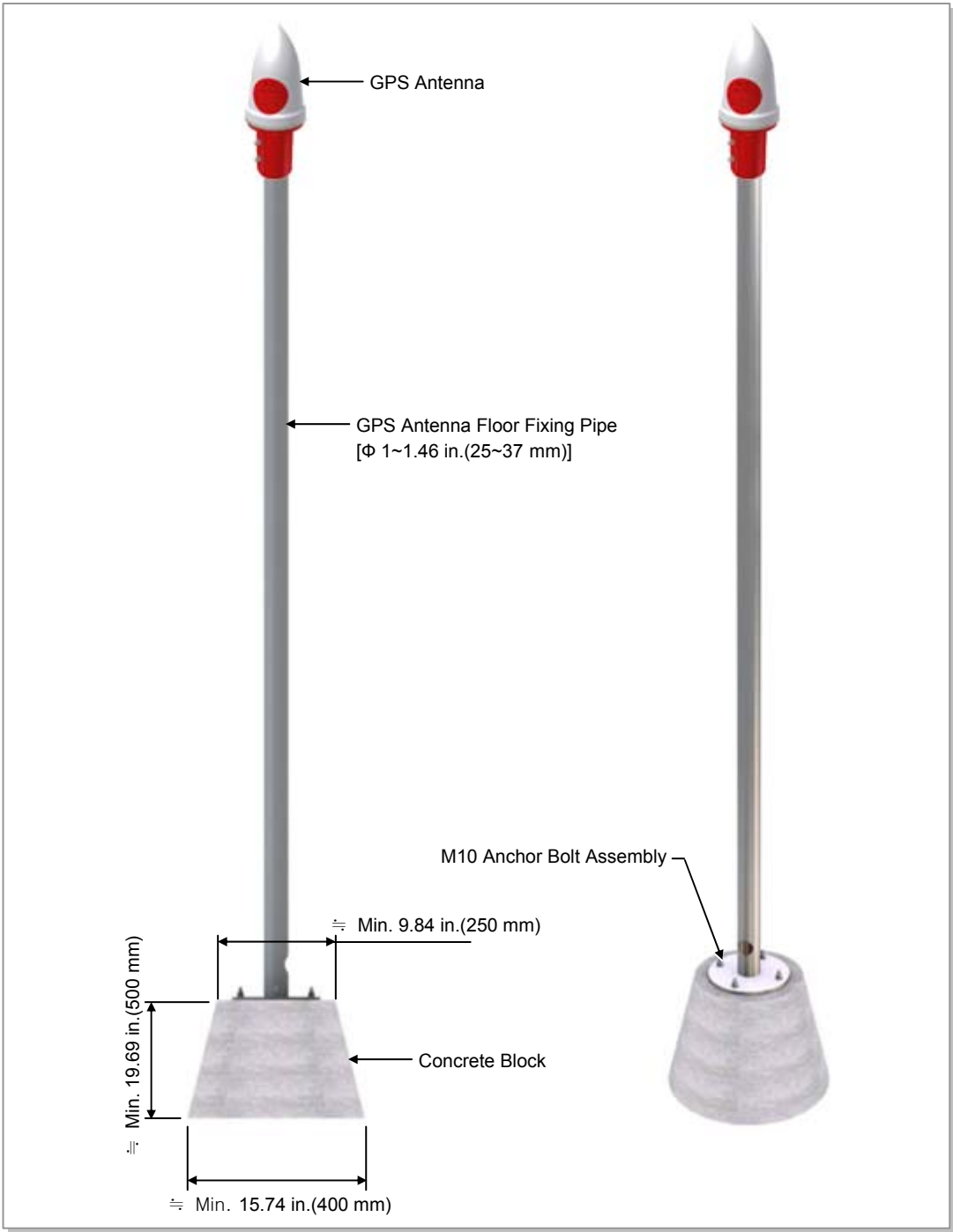


Figure 40. GPS Antennal Installation (Floor)

ANNEX B. Installing Feeder Cable

B.1 Cautions When Installing Feeder Cable

When installing the feeder cable (GPS/RF cable), the following cautions shall be considered:

- Put a plate to work not to make damage for the surface of the feeder cable.
If there is external damage of the feeder cable, cut the damaged part and work wiring.
- After connecting the antenna to the feeder cable, finish the connection part of the contracted pipe using the contracted tube.
- Attach the cognitive tapes to the both ends of the feeder cable, which makes it easy to recognize.
- When connecting cabinet, antenna and lightening arrestor, etc. to the feeder cable, connect strongly to prevent from generating reflected wave.
- The curvature radius should be maximized, keep the minimum curvature radius.

Table 34. Curvature Radius of Feeder Cable for Outdoor

Specification			Allowed Radius of Curvature	Remark
LS Feeder Line	HFC-12D	1/2 in.	4.02 in. (125 mm)	Outdoor
	HFC-22D	7/8 in.	9.84 in. (250 mm)	
	HFC-33D	1-1/4 in.	14.96 in. (380 mm)	
	HFC-42D	1-5/8 in.	20.08 in. (510 mm)	
RFS Feeder Line	LCF12-50	1/2 in.	4.92 in. (125 mm)	
	LCF78-50	7/8 in.	9.84 in. (250 mm)	
	LCFS114-50	1-1/4 in.	14.96 in. (380 mm)	
	LCF158-50	1-5/8 in.	19.69 in. (500 mm)	



Table 35. Curvature Radius of Feeder Cable for Indoor (Based on LS Feeder Line)

Specification			Allowed Radius of Curvature	Remark
LS Feeder Line	HFSC 6D	1/4 in.	0.98 in. (25 mm)	Indoor
	HFSC 10D	3/8 in.	0.98 in. (25 mm)	
	HFSC 12D	1/2 in.	1.26 in. (32 mm)	
	HFSC 22D	7/8 in.	4.92 in. (125 mm)	
RFS Feeder Line	SCF14-50	1/4 in.	0.98 in. (25 mm)	
	SCF38-50	3/8 in.	0.98 in. (25 mm)	
	SCF12-50	1/2 in.	1.26 in. (32 mm)	
	UCF78-50	7/8 in.	4.92 in. (125 mm)	



1/4 in.



3/8 in.



1/2 in.



7/8 in.

Table 36. Curvature Radius of LDF4-50A

Specification	Allowed Radius of Curvature	Remark
LDF4-50A	2 inch (50.8 mm)	Installation
	5 inch (127.0 mm)	Repeated



CAUTION

Radius of Curvature of Feeder Line

When installing a feeder line, the radius of curvature of the sections where cables bent should be larger than the allowed radius of curvature. If the radius of curvature for the feeder line installation is less than the allowed radius of curvature, it may affect the performance of the system.

- Ensure that the feeder cable does not interfere with steel towers, ladders and in the areas chiefly used by people.
- Connect the connector to the antenna in a straight line and after connecting, do not apply excessive force.
- Use the vinyl tape for electricity and heat shrink tube for the external exposed part of the connector not to avoid leak water.
- Wind the self-bonding rubber tape overlapping (keep a distance as the half size of rubber tape) to the connector connection part and wind the vinyl tape for electricity to the 2 times or more and then cover with the jelly type heat shrink tube.



Connection of Feeder Cable Connector

Connecting the feeder cable connector is critical process, so the qualified workers who finished the related education should perform.

Table 37. Connector Connection Torque Value

Connector	Torque Value
SMA connector	0.18 lbf·ft (2.5 kgf·cm)
TNC connector	0.65 lbf·ft (9 kgf·cm)
N-type connector	1.45 lbf·ft (20 kgf·cm)
Din-type connector	14.46 lbf·ft (200 kgf·cm)

ANNEX C. Connector Assembly

C.1 RJ-45 (Shield Type)

Procedure that assembles the RJ-45 (shield type) connector is as follows:

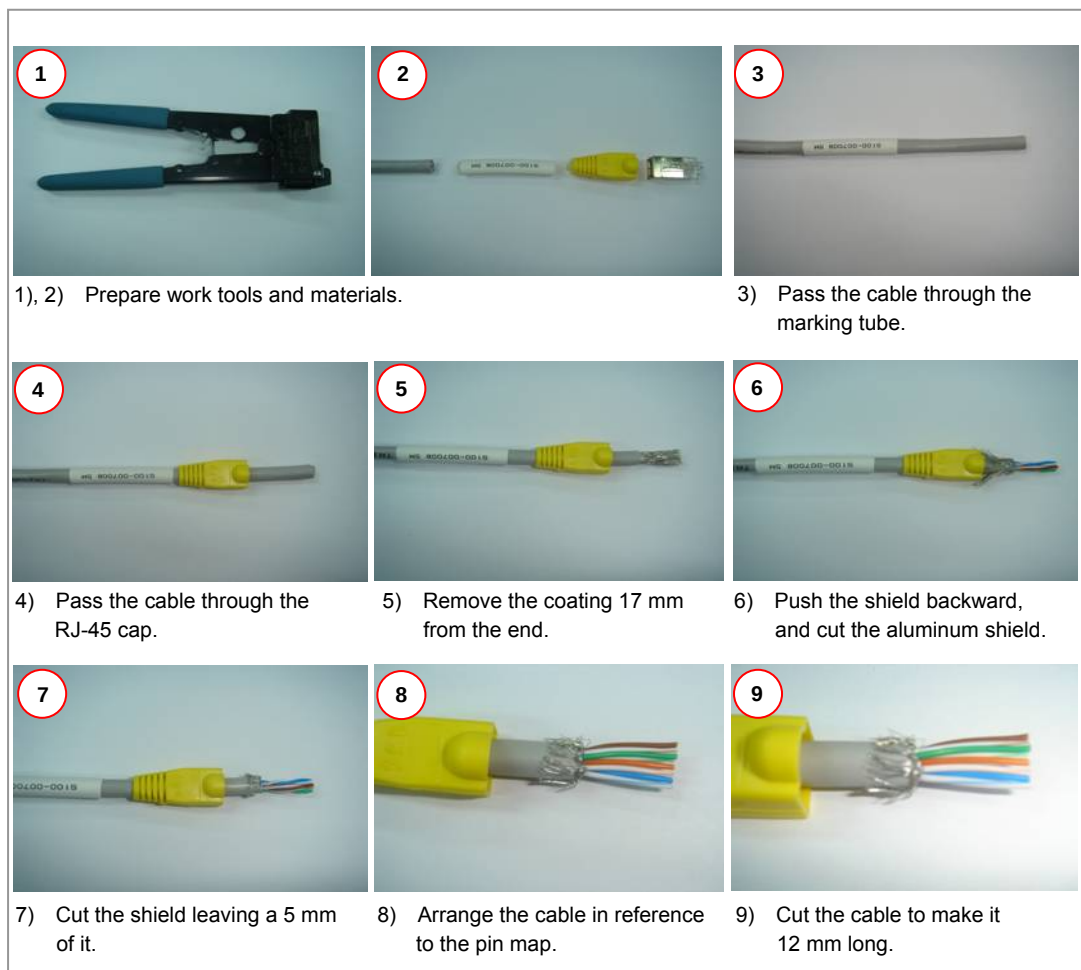


Figure 41. Assembling the RJ-45 Connector (Shield Type) (1)

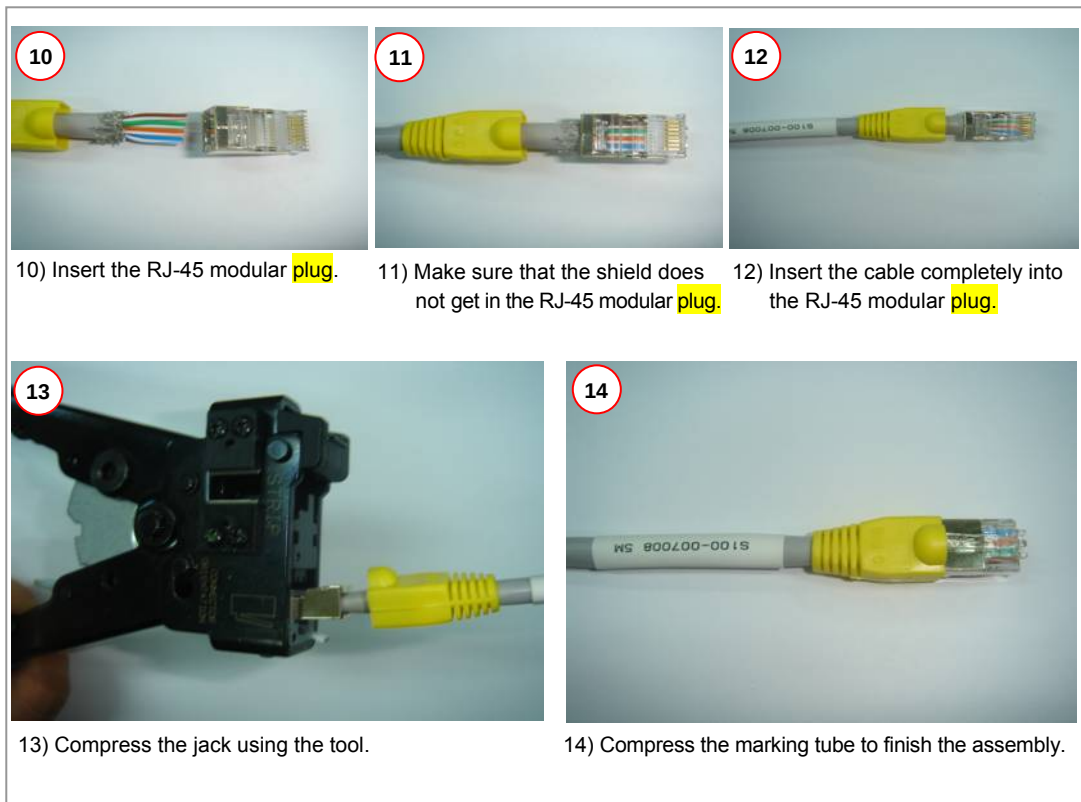


Figure 42. Assembling the RJ-45 Connector (Shield Type) (2)

C.2 RJ-45 (Normal Type)

Procedure that assembles the RJ-45 (normal type) connector is as follows:

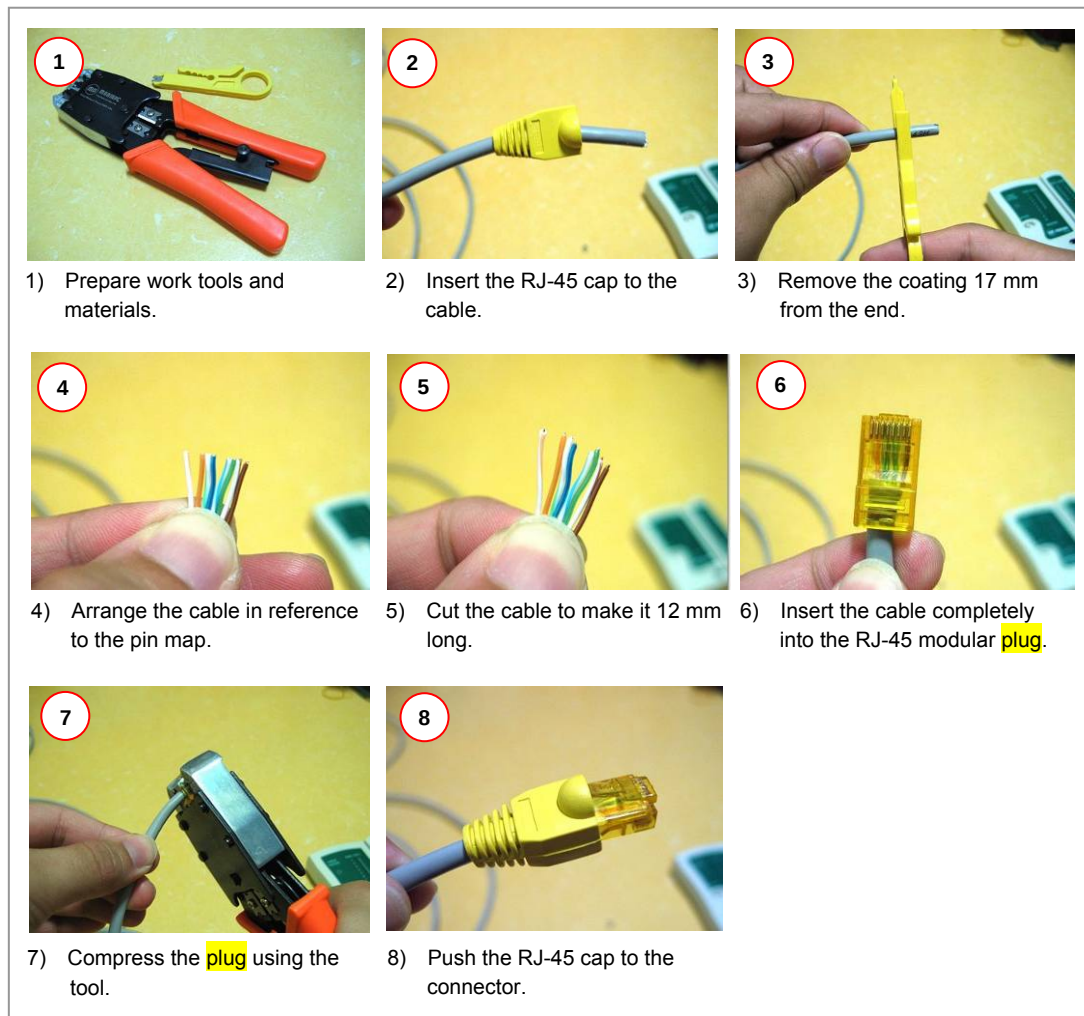


Figure 43. Assembling the RJ-45 Connector (Normal Type)

C.3 Finishing the Connector Connection Part by Tape

Check Items for Finishing the Connector Connection Part

Check following items before finishing the connector connection part by tape.

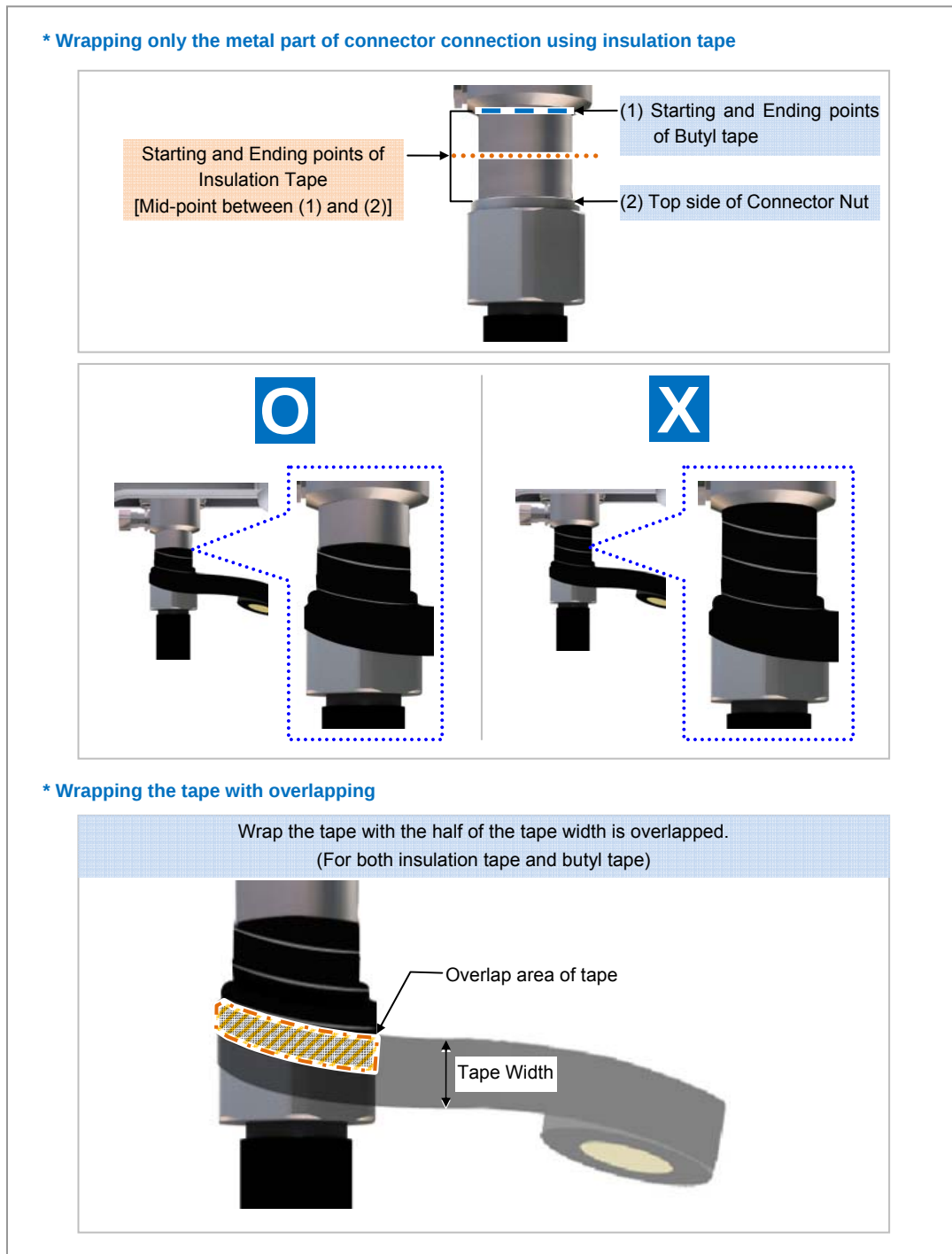


Figure 44. Check Items for Finishing the Connector Connection Part

Finishing the Connector Connection Part by Tape

Finishing the connector connection part by tape (insulation tape, rubber tape, etc.) in the outdoor environment is as follows:

- 1) Overlap the exposed part of the connector connection part using rubber tape (Keep a distance as the half size of rubber tape) and press it with your hands lightly to make rubber tape adhere well.
- 2) Wrap the part where the rubber tape is attached using insulation tape two times or more. When cutting off the tape, cut it off neatly using a cutting device such as scissors or a knife.
- 3) Bind the end part of the insulation tape using cable tie to prevent slips.

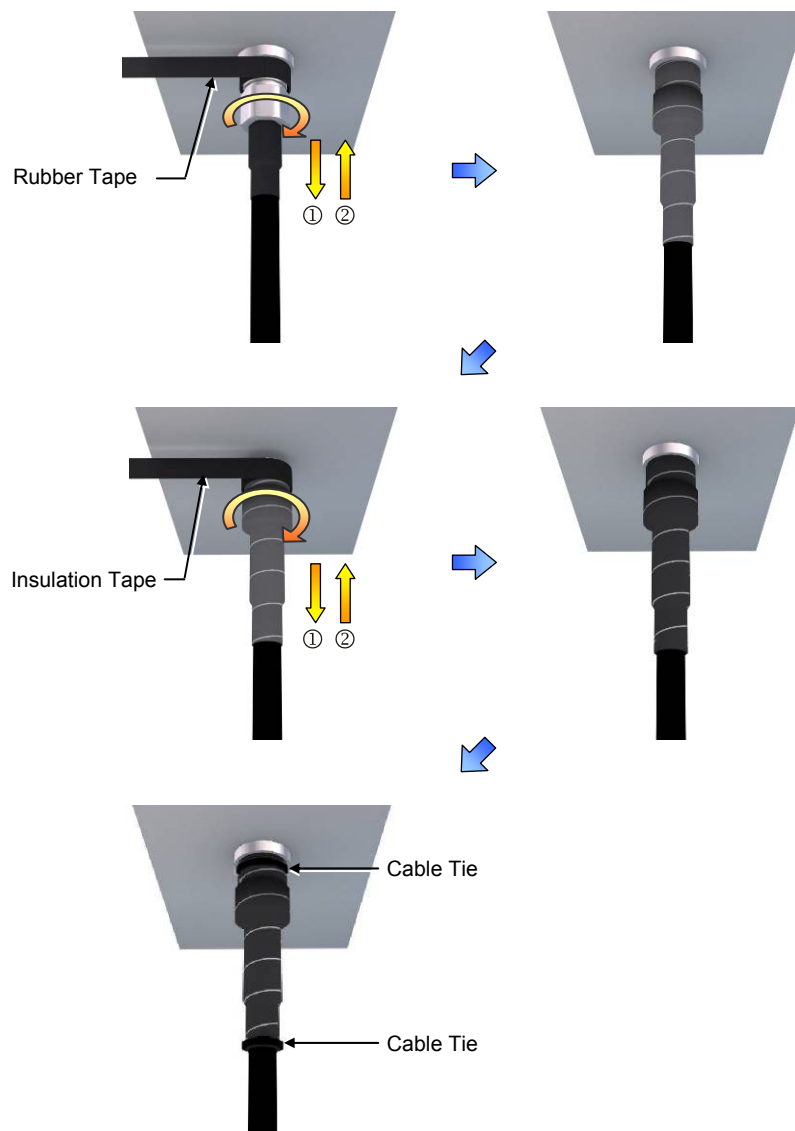


Figure 45. Finishing the Connector Connection Part by Tape

ANNEX D. Pressure Terminal Assembly

D.1 Preparations

The followings must be prepared to connect a pressure terminal to a cable.

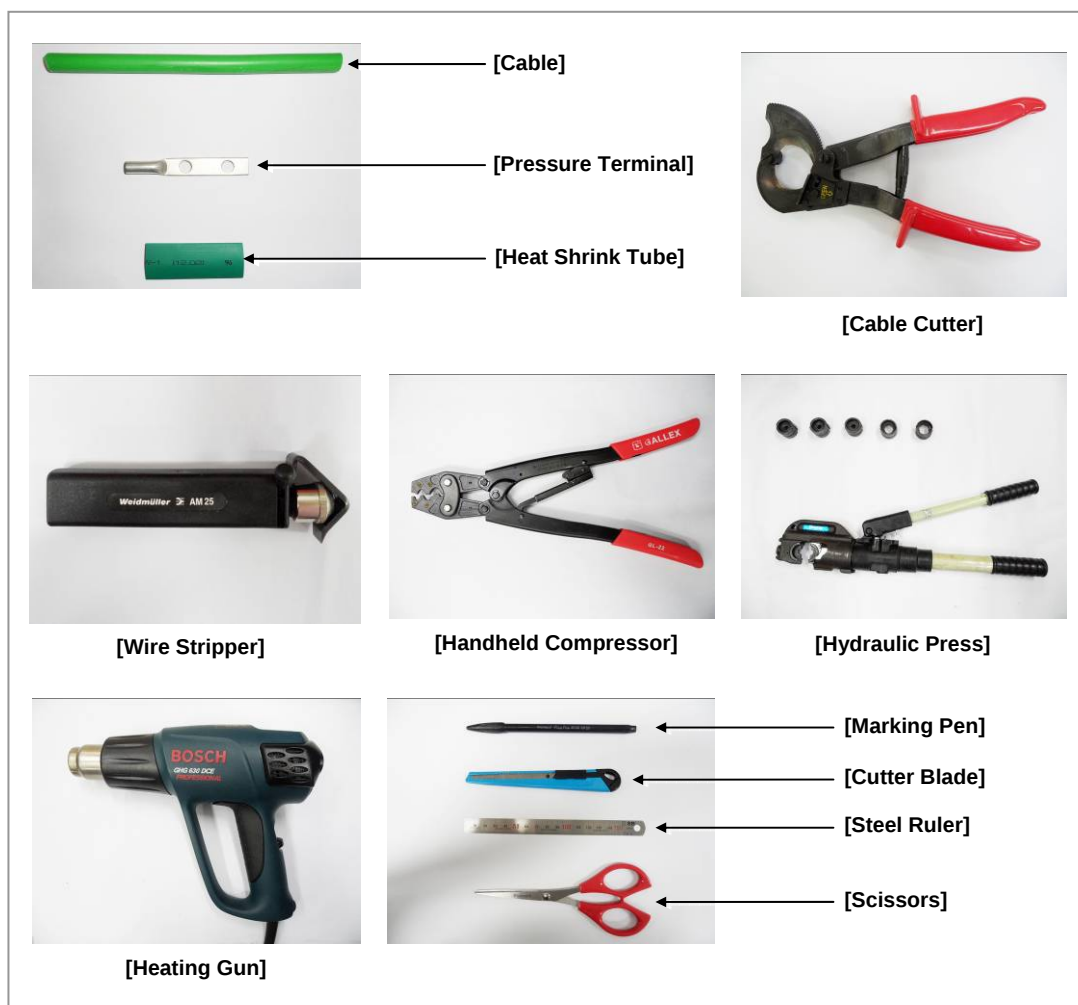


Figure 46. Preparations

D.2 Pressure Reference Table

The pressure reference table used to assemble a pressure terminal to a cable is shown below.

Table 38. Pressure Reference Table for Pressure Terminal

Category	Copper tube length of a pressure terminal		Number of pressure points
	mm	In.	
Hand	11 mm or less	0.43 in.	1
Hand	12~15 mm	0.47~0.59 in.	2
Hand	16~23 mm	0.63~0.91 in.	3
Hand	24~32 mm	0.94~1.26 in.	4
Hand	33 mm or more	1.3 in. or more	5
Hydraulic	30 mm or less	1.18 in. or less	2
Hydraulic	31~47 mm	1.22~1.85 in.	3
Hydraulic	48~63 mm	1.89~2.48 in.	4
Hydraulic	64 mm or more	2.52 in. or more	5

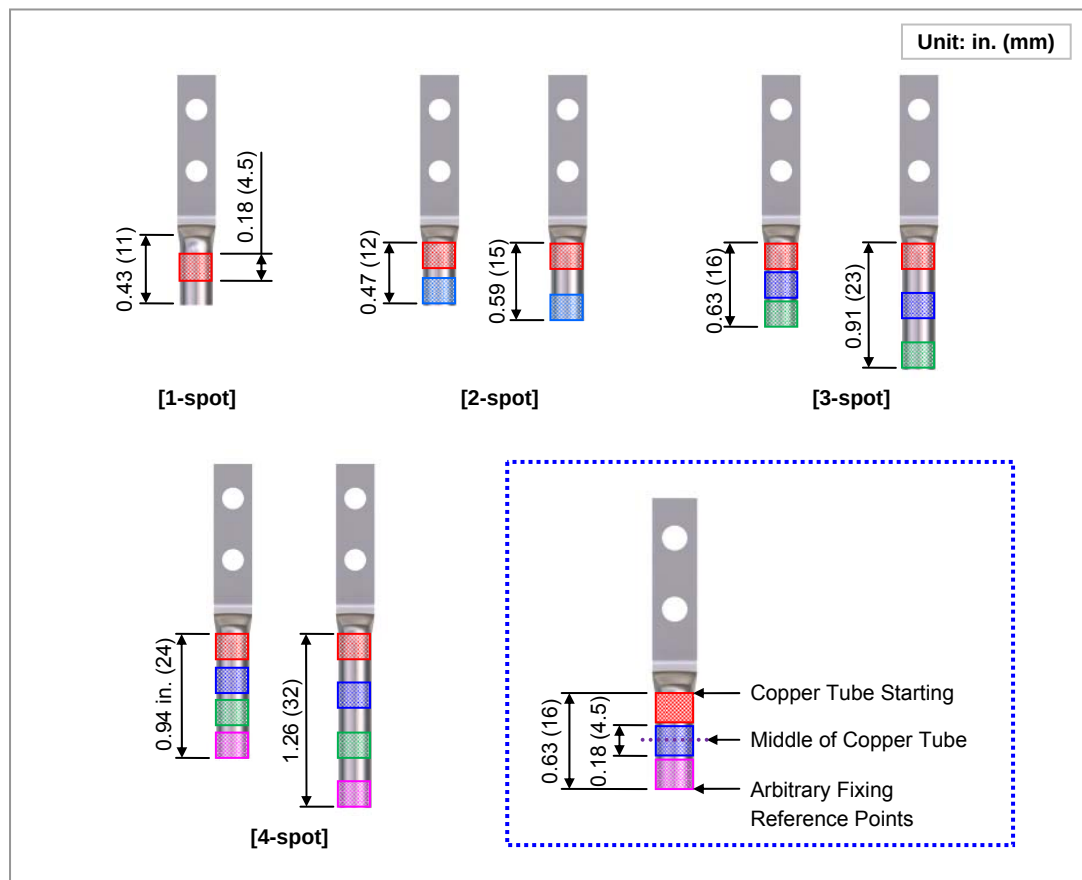


Figure 47. Pressure Reference Drawing (Handheld Compressor)

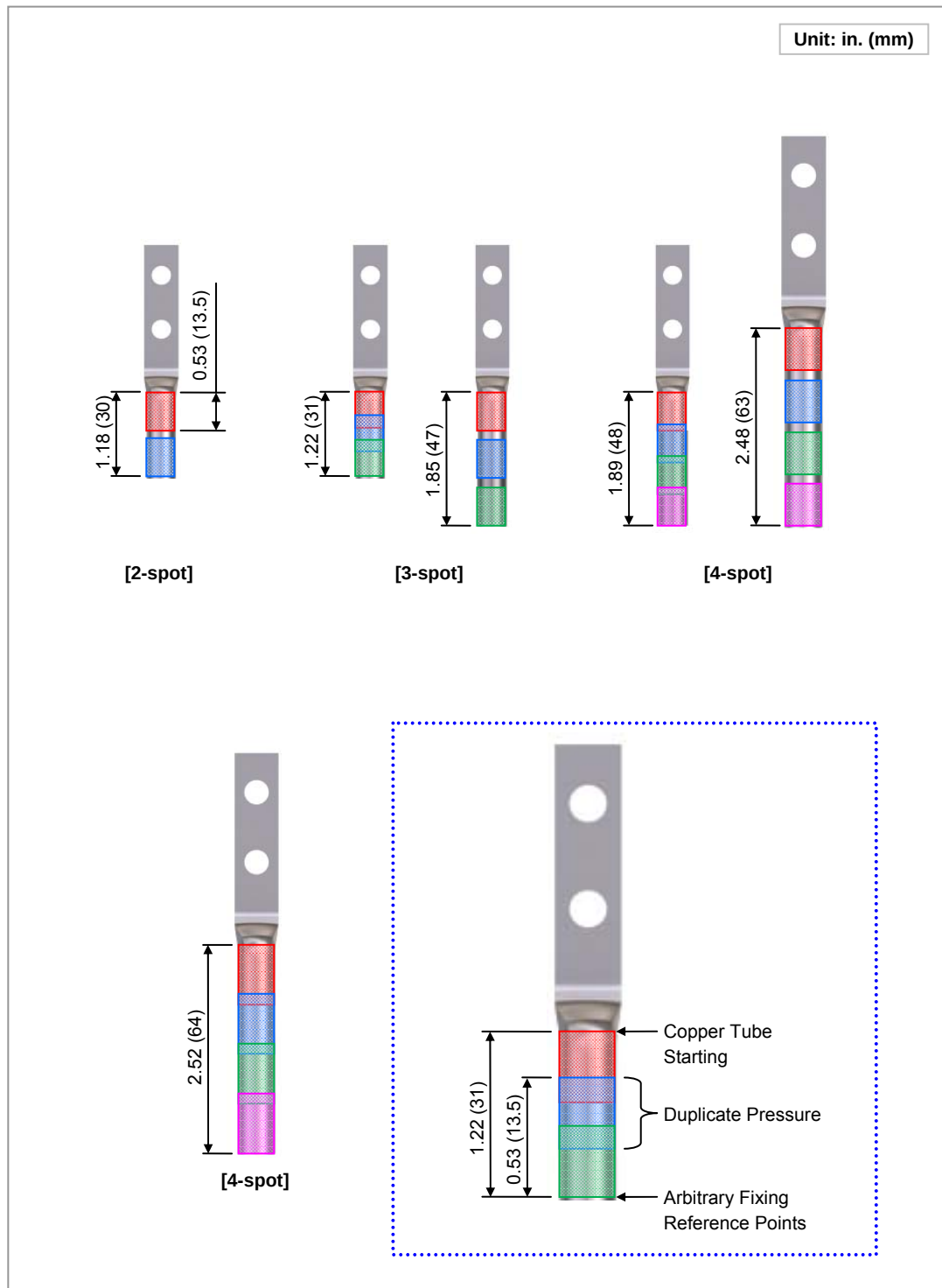


Figure 48. Pressure Reference Drawing (Hydraulic Press)

Table 39. Compressor Specifications per Cable Thickness

Cable Size (mm ²)	Press Size		
	Small Handheld Press	Large Handheld Press (AK-38, 100)	Hydraulic Press (IZUMI Hexagonal Dies)
2.5	2	X	X
4	2	X	X
6	5.5	X	X
10	8	8	X
16	14	14	16
25	22	22	25
35	38	38	35
50	X	60	50
70	X	80	70
95	X	100	95~300

D.3 Assembling Pressure Terminal

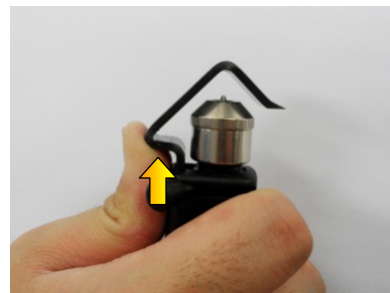
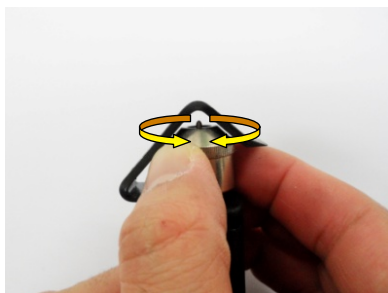
The procedures for assembling a pressure terminal to a cable are as follows:

Strip the Cable Sheath

- 1) After checking the inside length of a pressure terminal, mark the cable.



- 2) Adjust the length of a cutter blade according to the sheath thickness of the cable.
- 3) Push the clamp with a thumb according to the cable size to secure a space for the cable.



- 4) Put a cable into a clamp, locate a blade on a marking position, and push it into the sheath.
- 5) Align the stripper to be perpendicular to the cable and rotate it more than two laps.

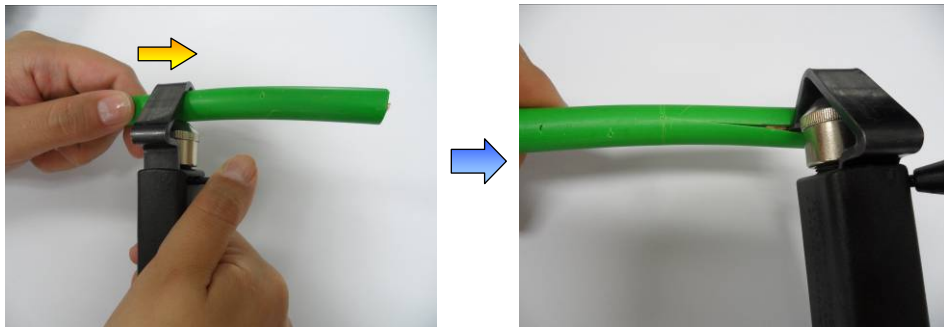


Figure 49. Stripping Cable Sheath (1)

- 6) Push the lever of the stripper to the right to turn its blade at 90°.



- 7) Move the stripper up to the end of cable while maintaining the stripper to be perpendicular to the cable.



- 8) Remove the sheath.

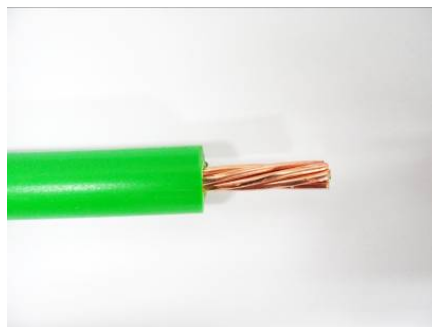


Figure 50. Stripping Cable Sheath (2)



CHECK

Checking When Using A Wire Stripper

A wire stripper is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.



The specifications and cautions of a wire stripper described in this manual are as follows:



- Vender: Weidmuller
- Model: Weidmuller-AM25
(Order No-9001080000)
- Specifications: For outer diameter 6-24 mm
PVC sheath Up to 4.5 mm
sheath cutting depth

- To prevent the cutter blade of a wire stripper from touching the cable conductor, adjust the length of cutter blade by checking the cable sheath thickness.
- Make sure that the cutter blade goes into the cable sheath completely.
- Rotate the wire stripper perpendicularly to the cable.

[X]

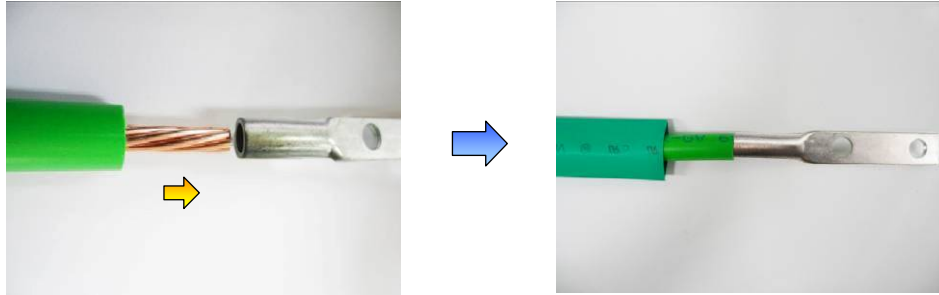


[O]



Fixing Pressure Terminal (Handheld Compressor)

- 1) Insert the conductor of the cable with the sheath stripped to the internal end of pressure terminal. For a ring type pressure terminal, push it in until the conduct comes out 1 mm from the end of the terminal.



- 2) From the holes of handheld compressor, select one that fits to the pressure terminal.



- 3) Insert the pressure terminal to the selected hole.
- 4) Fix the pressure terminal and cable temporarily so the position can be changed later by pressing the compressor.

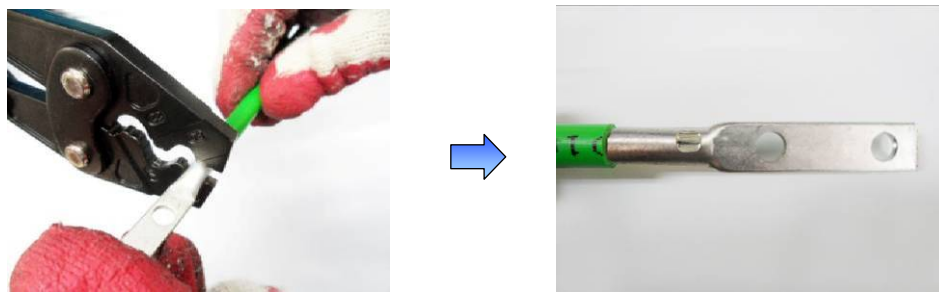
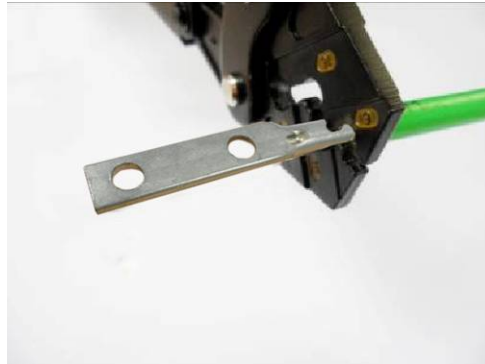


Figure 51. Fixing Pressure Terminal_Handheld Compressor (1)

- 5) After complementary of the cable which is temporary fixed, align it to the hole and firmly compress the pressure terminal to secure fix it.



- 6) Separate the pressure terminal from the handheld compressor. Press down the handle of compressor until a clicking sound is heard to be unlocked.

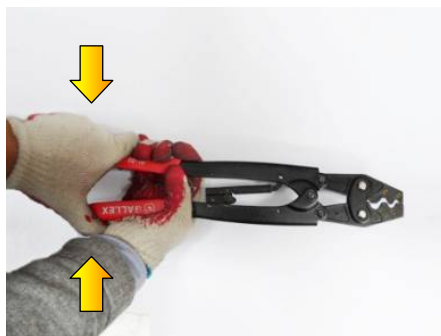


Figure 52. Fixing Pressure Terminal_Handheld Compressor (2)



CHECK

Checking When Using A Handheld Compressor

A handheld compressor is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.



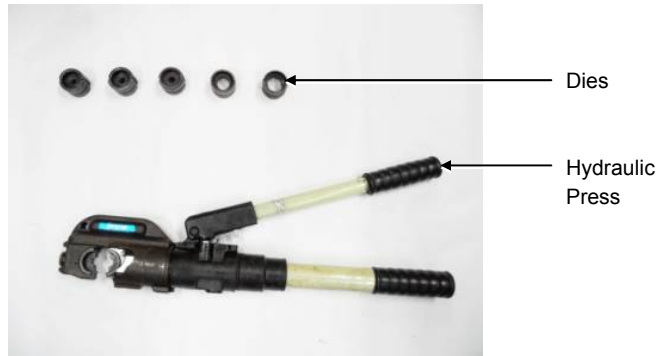
The specifications and cautions of a handheld compressor described in this manual are as follows:



- Vender: GALLEX
- Model: GL-2045A-22
- Specification: 5.5 mm², 8 mm², 14 mm², 22 mm² (JIS)
6 mm², 10 mm², 16 mm², 25 mm² (DIN)

Fixing Pressure Terminal (Hydraulic Press)

- 1) Among the dies of the hydraulic press, select one that fits to the pressure terminal.



- 2) Assemble the dies to the pressing area of the compressor.



- 3) Insert the pressure terminal into the pressing area and fix it slightly by aligning it to the end of cable sheath.

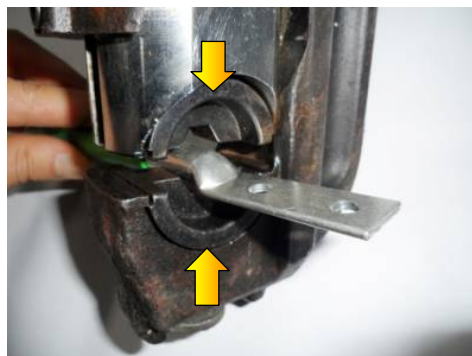
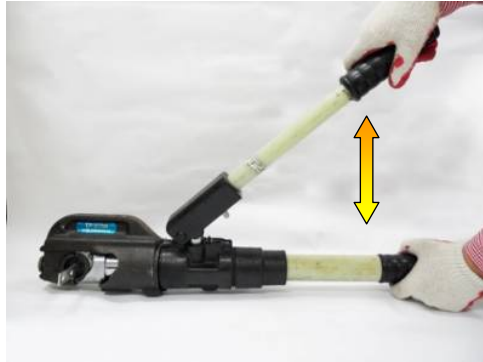


Figure 53. Fixing Pressure Terminal_Hydraulic Press (1)

- 4) Move the compressor lever up and down to press the pressure terminal firmly.



- 5) Turn the top compressing lever clockwise and then push it down. When the pressing area of compressor is loosened, remove the pressure terminal.

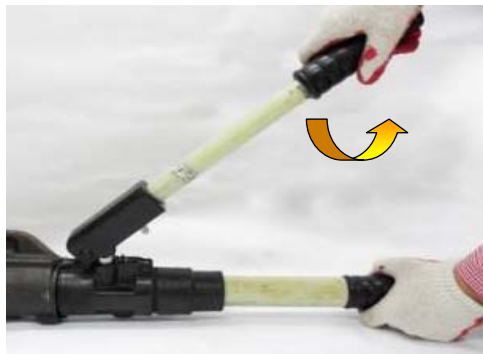


Figure 54. Fixing Pressure Terminal_Hydraulic Press (2)



CHECK

Checking When Using a Hydraulic Press

A hydraulic press is used differently depending on its manufacturer or type. Therefore, refer to the user manual enclosed with the product.



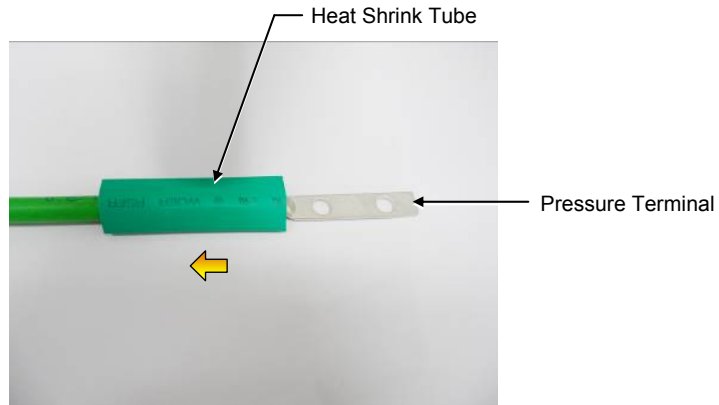
The specifications and cautions of a hydraulic press described in this manual are as follows:



- Vender: IZUMI
- Model: IZUMI-EP-510B
- Specification: Circular 32~160 (SQ)
Hex 14~325 (SQ)

Assembling Heat Shrink Tube

- 1) After assembling a pressure terminal, move the heat shrink tube, inserted to the cable, to the end of pressure terminal copper tube.



- 2) Set the temperature of the heat gun to 180-200°C.
- 3) Locate a heat shrink tube to cover the entire copper tube of the pressure terminal.
- 4) Rotate a heat gun 360° to apply heat evenly to shrink the tube.
(Because the pressure terminal and the cable is hot due to the heat of a heating gun, be careful not to have a burn.)

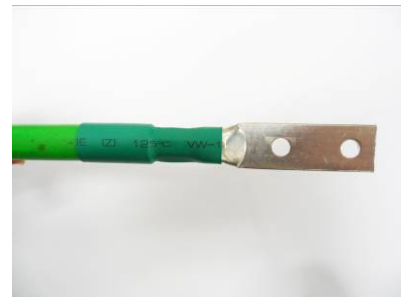


Figure 55. Assembling Heat Shrink Tube

ANNEX E. Standard Torque

When you tighten the bolt, refer to the standard torque value below to prevent the equipment and bolt from damage and secure by tightening. When the torque value for each connection part is defined already, refer to the defined value.

Table 40. Standard Torque Value for Tightening Bolts

Bolt Spec.	Torque Value (kgf·cm)	Torque Value (N.m)	Torque Value (lbf·ft)
M3	4.08~6.12	0.40~0.60	0.29~0.44
M4	9.52~14.28	0.93~1.40	0.69~1.03
M5	20.0~30.0	1.96~2.94	1.45~2.17
M6	33.28~49.92	3.26~4.90	2.41~3.61
M8	82.4~123.6	8.08~12.12	5.96~8.94
M10	166.4~249.6	16.32~24.48	12.03~18.05
M12	292.0~438.0	28.64~42.65	21.11~31.67

Table 41. Brass Bolts Torque Value

Bolt Spec.	Torque Value (kgf·cm)	Torque Value (N.m)	Torque Value (lbf·ft)
M6	29.98 ± 10 %	2.94 ± 10 %	2.17 ± 10 %
M8	64.26 ± 10 %	6.3 ± 10 %	4.16 ± 10 %



Checking Standard Torque Value

Torque value can be different, depending on the material, characteristic and specification of the equipment and fastener. Make sure to check the proper torque value for each specification of the equipment and fastener.

ABBREVIATION

D

DL Downlink

E

EMC Electromagnetic Compatibility

F

FDD Frequency Division Duplex

G

GPS Global Positioning System
GPSR Global Positioning System Receiver

L

LTE Long Term Evolution

M

MGB Main Ground Bar
MIMO Multiple Input Multiple Output

R

RF Radio Frequency

S

SIMO Single Input Multiple Output

U

UL Uplink

LTE 1.9 GHz Outdoor Pico Installation Manual

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