



# ESCoS Roadside Unit

Installation Manual

PIM312-003, Version 1.4.25

Intelligent Traffic Systems

**SIEMENS**



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## Change History

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V0.1	2016-09-22	Initial version	M. Venus
V1.0	2017-12-21	Release version	M. Venus
V1.1	2018-07-18	Update antennas	T. Golden
V1.2	2018-09-04	POE SPD Install	T. Golden
V1.2.1	2019-10-10	Best practice	I. Nemirovski
V1.2.2	2019-10-28	Added shield grounding recommendation	I. Nemirovski
V1.2.3	1/15/2020	Add C-V2X Notes	I. Nemirovski

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## Abbreviations and Definitions

Abbreviation	Comment
C-V2X	Cellular Vehicle to Everything Communication Standard
DSRC	Dedicated Short Range Communication (V2x communication standard)
EPR	Ethylene Propylene
ESCoS	Ecosystem for cooperative systems
MPE	Maximum Permissible Exposure
PIB	Polyisobutylene
PoE	Power over Ethernet
RSU	Roadside Unit
SPD	Surge Protection Device

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# Preface

## Notes on safety and environmental protection

### Safety notice

The devices/systems are only to be employed for their intended use in accordance with the product documentation; the warning labels and product documentation are to be adhered to. The installation and initial startup of the devices may only be performed by authorized professional personnel (electrically qualified persons with the appropriate training for these devices/systems through the Siemens Academy, Traffic Systems Segment).

If not sufficiently trained personnel are working on the devices, substantial bodily damage and property damage can come as a consequence.

The devices/systems are to be tested regularly by authorized professional personnel. The test intervals and the checks to be performed can be found in the specifications of the product standards. If there are no product standards with information about regular checks for the devices, then the tests are to be performed in accordance with the standards VDE 0100-600, VDE 0105-100 and BGV A3.

### Occupational safety, environmental protection

It goes without saying that all legal regulations regarding occupational safety and environmental protection are to be complied with during the course of production. We design our products (parts, devices, systems) in such a way that these present no health hazards to the user or hazards the environment according to the current state of information if properly and predictably used.

### Recycling, disposal

The information above makes it possible to assess to a large extent the possible potential for hazards to people and the environment, even at the

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end of the product's life cycle. The regulations for recycling and disposal procedures must be observed here.

All information has been given to the best of our knowledge and belief. It is in accordance with the current state of the art. The information does not constitute a guarantee in the legal sense of a warranty.

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# 1. Introduction

This document describes the assembly and installation of the ESCoS series of Road Side Units (RSU).

The ESCoS RSU typically comprises an IP67 housing and connectors to which are attached six antennas. The unit is typically operated with the antennas connected directly to the connectors on the housing but can be remotely cabled taking into account cable loss and protection devices.

## 1.1. Important Information

Throughout the document there may be sections that require particular attention. These are marked and have meaning as exemplified below:



A warning/condition that contains important information that **MUST** be read and understood.

It may often contain health or safety information.

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## 2.Assembly of Units

The units typically come in the PoE+ configuration.

The sections below will outline the assembly of the default PoE+ configuration with indications where differences may occur if dealing with the AC Mains version.

Assembly of the units typically proceeds in the following order:

1. Mounting bracket and earthing cable attachment
2. Attach antennas according to the labels next of the connectors
3. Attach communication cables (if required)
4. Attach power cable (will be sole communication cable in default PoE+ configuration)



It is important that all antennas are connected before power is applied to the unit in any power supply configuration.



**The worst case of all transmitters operational in this unit results in a MPE of  $\leq 1.0 \text{ mW/cm}^2$  for 50cm separation.**

**Please ensure that installers and technicians maintain their distance from powered and operational units and take this into consideration when locating the unit to avoid public exposure.**

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## 2.1. Overview

### 2.1.1. Isometric Views

The two images below show the ESCoS RSU isometric views. The mounting bracket is shown in the horizontal pole/gantry mounting mode.

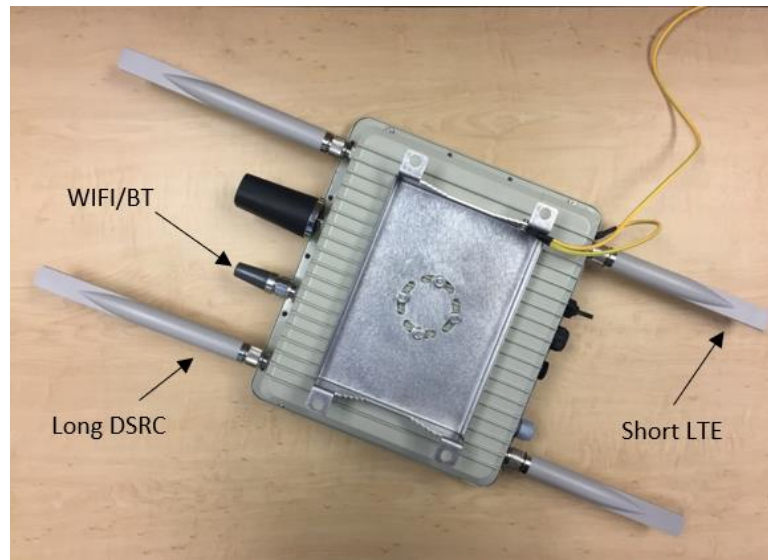
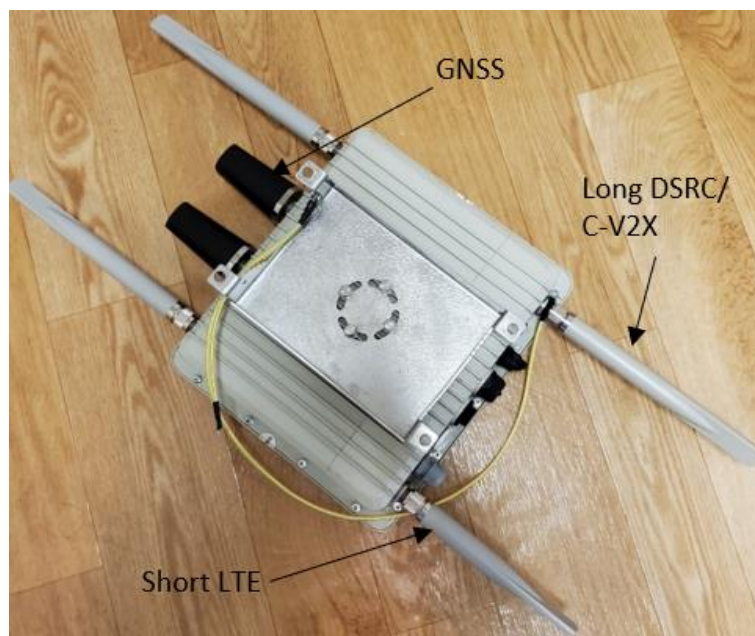


Figure 1: ESCoS DSRC RSU Right-Bottom-Back view



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Figure 2: ESCoS Dual Mode DSRC/C-V2X RSU Right-Bottom-Back view

### 2.1.2. Top and Bottom View



Figure 3: ESCoS Dual Mode DSRC/C-V2X RSU top view



Figure 4: ESCoS Dual Mode DSRC/C-V2X RSU top view

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## 2.2. Mechanical Details

Mass of default (PoE+) configured unit (mounting bracket, antennas and enclosure)	4.1 kg
Mass of AC Mains configured unit (mounting bracket, antennas and enclosure)	4.4 kg
Bounding Box of default unit including bracket (Any supply)	65 cm x 31cm x 12 cm
Lid to Body screws	<p>18 x M4 x 0.7 10mm Cap Head Hexalobular screw plus</p> <p>M4 lock washer spilt</p> <p>M4 flat washer</p> <p>All Stainless Steel A2-70 or A4-70</p> <p>Typical torque is 3.5 Nm.</p>

## 2.3. Mounting Bracket and Earthing Cables

The mounting bracket is used to connect the RSU to the desired mounting site. The bracket accommodates pole diameters between 90 mm and 110 mm typically.

The bracket provides 3 pairs of slots for stainless steel strapping on the long edge. Use 1/2" wide, 201 Stainless Steel light gauge band, 0.030" or 0.020" thick.

The bracket provides 4 x Ø10 mm holes to allow affixing to walls or other structures.

The bracket also provides the electrical path between the enclosure base and lid and from there to an earthing point on the mounting pole/surface.

### 2.3.1. Earthing Cables and Paths

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The mounting bracket serves the important purpose of providing an earthing point for the enclosure.



**The PoE+ supply –VE output inside the enclosure connects directly to the internal mounting plate and also to the body of the enclosure.**

**The AC Mains GND point and –VE supply output are connected together on the AC Supply and to the mounting plate and enclosure body.**

**The shield contact points on the external Ethernet connector ports are electrically connected to the mounting plate and enclosure body.**

**The lid is electrically connected to the bracket body by the shorter 220 mm earth cable. Grounding by the lid screws alone to the enclosure is not guaranteed.**

**The bracket is connected electrically to the enclosure body by the 4 M6 x 1.0 A2-70 hex bolts.**

**The bracket/enclosure/lid MUST be connected by the longer earthing cable to a customer provided earthing point on the mounting pole or by some other suitable means on other mounting options. It is up to the customer to follow local electrical rules and regulations in this regard.**

### 2.3.2. Bracket Use and Securing

The bracket is designed to be used with horizontal or vertical mounting positions with around  $\pm 30$  degrees of adjustable rotation from nominal.

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The RSU is required to be mounted with the antenna vertically orientated to within  $\pm 5$  degrees maximum.



Note there is a built in 1-2 degree offset toward the back of the RSU through the draft angle of the die cast enclosure. In situations where DSRC/C-V2X radio range needs to be maximized then this needs to be taken into account together with the antenna radiation pattern and local topography.



The provided M6 x 1.0 13 mm A2-70 hex head bolts should be lightly lubricated before tightening to reduce the likelihood of galling and limit electrochemical reactions by exclusion of water and oxygen. A product similar to Tef-Gel™ or other should be used.  
Recommended torque for A2-70 M6 is 5 Nm lubricated.

There are 3 sets of slots on the mounting bracket intended for use by appropriately rated banding systems. Maximum band size is a single 16 mm wide by 0.75 mm thick band. A double wrap is possible with 12.7 mm wide by 0.75 mm thick bands. The slots are spaced at approximately 82 mm to across the wider sides of the bracket.

Tensioning on these bands is up to the installer to determine based upon the rated wind loading at 240 km/h (67 m/s). The enclosure and mount bracket have been tested in both horizontal and vertical mounting bracket orientations with the following forces applied as a static wind test.

The Static Wind Loading test had 436 N applied to the front face. The side faces had 99 N applied. Forces were not applied to the top and bottom faces as the unit is intended to be mounted in the vertical orientation and wind loading tests only consider horizontal wind forces. In this configuration with 3 bands strapping used the system passed all tests.

Installation of the bracket by the 4 x  $\varnothing 10$  mm mount holes requires a suitable site and fixtures to enable the unit to be safely fastened. The grounding cable must be attached to a suitable earthing point with a

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minimum of cable. If the provided cable has to be extended please ensure reliable cable connections or remake the cable set to the required length.

The bracket's mounting holes centers are located on a rectangle  $226 \pm 0.2$  mm and  $120 \pm 0.2$  mm. Use M8 bolts to allow for this positioning variation. The use of a drilling template is recommended.

See 5. Appendix 1 - Mounting Bracket Drawing for details of the bracket.

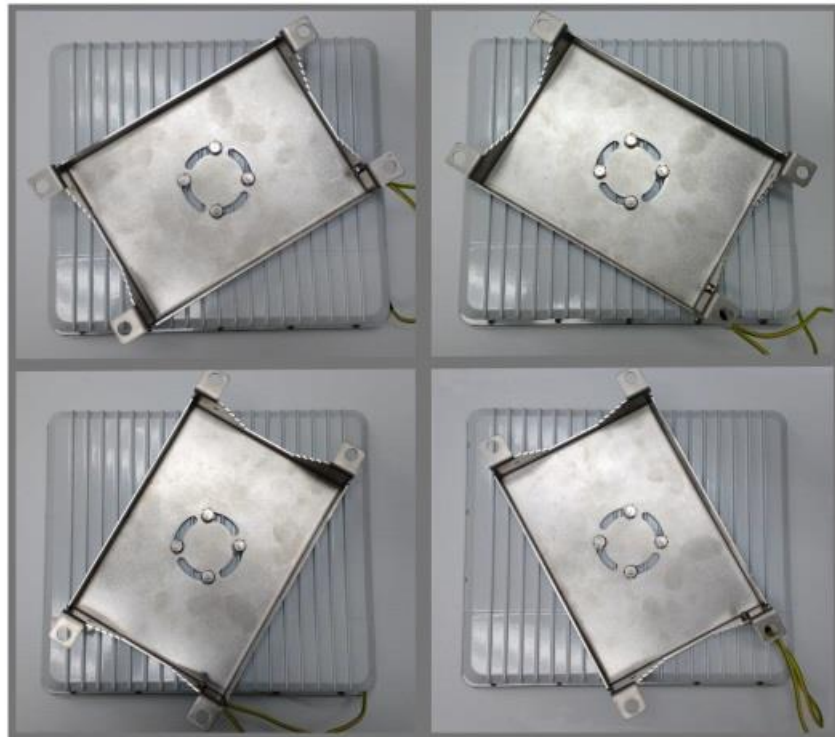


Figure 5: Mounting Bracket adjustment ranges


## 2.4. Antennas

Per default the ESCoS RSU supplied with seven antennas.

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Port	Model	Manufacturer	Siemens Part Number
DSRC1	5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	V24707-Z100-A5
DSRC2	5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	V24707-Z100-A5
C-V2X	5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	V24707-Z100-A5
LTE 2	4G external Triton dipole terminal antenna (TG.80.4H31)	Taoglas	V24707-Z100-A6
GNSS	Shockwave Active GPS Antenna (TLS.40.1F11)	Taoglass	V24707-Z100-A3
GNSS	Shockwave Active GPS Antenna (TLS.40.1F11)	Taoglass	V24707-Z100-A3
Wifi/BT	SENCITY® Omni-S broad band WiFi Antenna (1399.17.0224)	Huber&Suhner	V24707-Z100-A4

For detailed specifications of the antenna please consult the data sheets.


ALL antenna ports are N type Female 50 Ω on the ESCoS RSU enclosure.

### 2.4.1. Torqueing and Sealing of the Antennas

Typical N type connector is used with a torque of around 2 Nm max. The data sheets for the supplied antenna list the required torques for their products and are given in below.

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Port	Model	Manufacturer	Manufacturer's Torque (Nm)
DSRC1	5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	0.8 max
DSRC2	5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	0.8 max
LTE 1	4G external Triton dipole terminal antenna (TG.80.4H31)	Taoglas	0.8 max
LTE 2/ or C-V2X	4G external Triton dipole terminal antenna (TG.80.4H31)/ 5.9G external Triton dipole terminal antenna (TD.80.6H31)	Taoglas	0.8 max
GNSS	Shockwave Active GPS Antenna (TLS.40.1F11)	Taoglass	4 nom, 10 max
Wifi/BT	SENCITY® Omni-S broad band WiFi Antenna (1399.17.0224)	Huber&Suhner	1 nom, 3 max

The lock nuts on the N type female bulkhead are typically torqued to approximately 4.5Nm.



Care should be taken to ensure that the N type threads are NOT cross threaded on application. This is a possibility with DD type N connectors.

The nominal design of the N type connectors and the supplied antenna do not normally require sealing other than that inherent in the design. Site Installation

This section discusses the factors that should be taken into account in the positioning and orientation of the ESCoS RSU in typical use cases with regard to target coverage area, local topography and nearby structures.

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This section does not cover all possible situations. The Customer and Installers must discuss and agree to these local installations to ensure performance of the system.

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## 3.Site Installation

### 3.1.Location and Orientation



DO NOT Install RSU against/near flat metallic surfaces unless separated by more than 2 meters!

The RSU should be placed to ensure the following.

- RSUs must be separated from another at least 1 m horizontally when co-located. Vertical offset is required to be the same.
- The RSU must be located more than 3 m above the road surface to be covered. The RSU should not be placed in a location where a member of public may be able to easily touch the device with outstretched arm.
- The poles for vertical mounting of the RSU shall be between 90 mm and 120 mm diameter. Any larger and the use of the supplied bracket is not allowed due to placement of the antenna too close to the pole which degrades antenna performance and line of sight. If mounting on vertical poles larger than this with adapter plates/brackets (not supplied) then care must be taken to ensure that the pole is more than 300 mm away from the antenna to minimize impedance and other effects.
- Horizontal poles may be up to 200 mm diameter if located along the centerline of the RSU without obscuring performance toward the lid side. Horizontal poles larger than this will have a significant effect on the DSRC, C-V2X, GPS, Wifi/BT and LTE performance towards the mounting side of the unit.
- Antenna vertical alignment: Ideally the RSU should be vertical  $\pm 5$  degrees at most. Non vertical installation may be required to obtain

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maximum range in some circumstances where the road is non horizontal.

- When installing the RSU against flat surfaces ensure that the surface does not have internal metallic structures within the limits laid out above. If the building is inhabited ensure minimum separation for human safety. See MPE limits for the country/region in which this device is installed for appropriate limits/requirements. The RSU under worst case conditions provides MPE of  $\leq 1.0 \text{ mW/cm}^2$  for 50 cm separation.

### 3.2. Power Supplies and Earthing



**The Installer is responsible for the selection and installation of all associated equipment and cabling. They must adhere to all electrical and safety codes as required in the country/region of the installation.**

**The Installer MUST be an appropriately skilled electrician (according to EN 50110 in Europe and local legal requirements elsewhere)!**

The Installer shall ensure the following:

1. PoE+ supply equipment must be 802.3at Type2 equipment capable of supplying 30 W at PSE (25.5 W at PE)
2. The PSE equipment is built and approved to the appropriate electrical safety standards of the country or region into which it will be installed. In Europe this requires a valid EU declaration of Conformity.
3. The CAT6 or CAT5e shielded cable run between RSU and the switch/destination must be less than 100 m and optimally as short as practical.
4. The RSU accepts Mode A or B PoE wiring for the ETH0 port in the PSE supply configuration.
5. The AC Mains option rated voltage is 100-240 V 50/60 Hz 30W. Internal Input fuse is T2A250V Littlefuse 215 family part number 0215002.

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Refer “LS25-150 Series INSTRUCTION MANUAL” Page 11. This fuse is NOT user replaceable and replacement of the entire supply is required if blown.

6. External AC Mains supply option fuse in remote cabinet to be next size down in the family, a 1.6A slow blow fuse part number 021501.6

See : [http://www.littelfuse.com/products/fuses/cartridge-fuses/5x20mm-fuses/215/21501\\_6.aspx](http://www.littelfuse.com/products/fuses/cartridge-fuses/5x20mm-fuses/215/21501_6.aspx). Alternately a suitable circuit breaker or other similar device may be used as appropriate to local electrical rules and standards to provide similar protection.

7. The earthing cables connecting the Bracket to the Lid and the bracket to the earthed mounting pole MUST be correctly installed with appropriate hardware by a suitably qualified person to ensure electrical safety.

### 3.3.Cabling

1. Cables should be brought back toward the body leaving a loop below the connector to allow water to drop off at the loop rather than flow down the cable and into the connector body. Cables should as soon as practical move away from antenna.
2. Follow local regulations about separation of AC Mains from other communication cables.
3. Shielded Ethernet cable to be used. CAT6 preferred for lower resistive losses however shielded 5e may be used over short runs. Thus both ends of the shielded cabled are earthed, at the PSE and RSU ends.
4. Maximum 100m run for Ethernet. Minimize run for PoE+ cable.

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## 4. POE Surge Protection Installation

### 4.1. First Rule of Installation

POE Surge Protection Device (SPD) installation starts just like any other type of circuit protection with a good connection to a known earth ground. This can be done by bonding to a properly grounded cabinet chassis directly connected to an earth ground.

Properly designed SPD's will always provide the path of least resistance to ground if properly installed and grounded. That is what they are designed to do. Some may have higher tolerances than others, but they still all do the same thing.

Start your installation with ground as your priority and end with ground as your priority. The least resistance to ground should always be the goal of your installation.

Install Preference #1

Install the POE SPD via a 12AWG or better ground conductor connected to the ground lug provided.

Install Preference #2

Install the POE SPD via the connection provided to a properly grounded DIN Rail. Ensure that the DIN Rail is grounded to a known earth reference or that the cabinet it is connected to is grounded. Please see diagram in the installation instructions provided with the SPD.

Install Preference #3

Install the POE SPD via the connection provided to a properly grounded earthing plate. It does no good if the plate is not properly grounded to a known earth ground or chassis. Please see diagram in the installation instructions provided with the SPD.

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## 5. Best Practice Lighting Protection Installation

- Perform continuity test of the grounding electrode system at each site. NEC 250.50 requires that all grounding electrodes (e.g., ground rods, ground rings) present at each building or structure be bonded together to form the grounding electrode system. Bonding can be checked using a two-point test (i.e. continuity test) or a clamp-on ohmmeter.
- Insulate the RSU enclosure from the pole and mast arm by inserting non-conductive material between RSU and bracket or bracket and pole / mast arm.
- Connect the ground wire to the ground rod at the base of the pole
- Install the equipment grounding conductor that is connected to the RSU inside the traffic light pole and mast with very limited or no outside exposure to the electromagnetic fields occurring during lightning storms. The grounded traffic light poles and masts provide an excellent shield from electromagnetic fields for conductors inside these metallic enclosures.
- If SPD is installed in a DIN Rail insulate the DIN Rails from the cabinet by using isolating standoffs.
- Use shielded Cat5e or Cat6 cable between SPD and RSU. Connect shield to a local ground either at the RSU or at SPD, preferably on the SPD side.
- In the high lightning activity areas install additional mast or pole mounted SPD between RSU and the SPD in the cabinet. Locate the SPD close to the RSU.

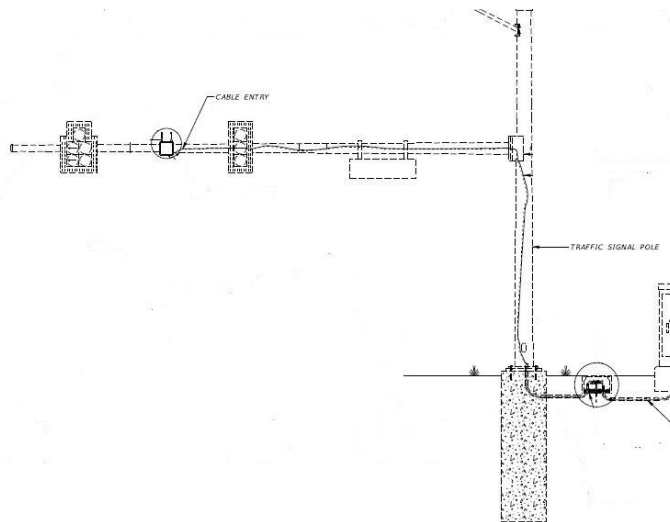


Figure 6 Typical RSU Installation

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## 5. Appendix 1 - Mounting Bracket Drawing

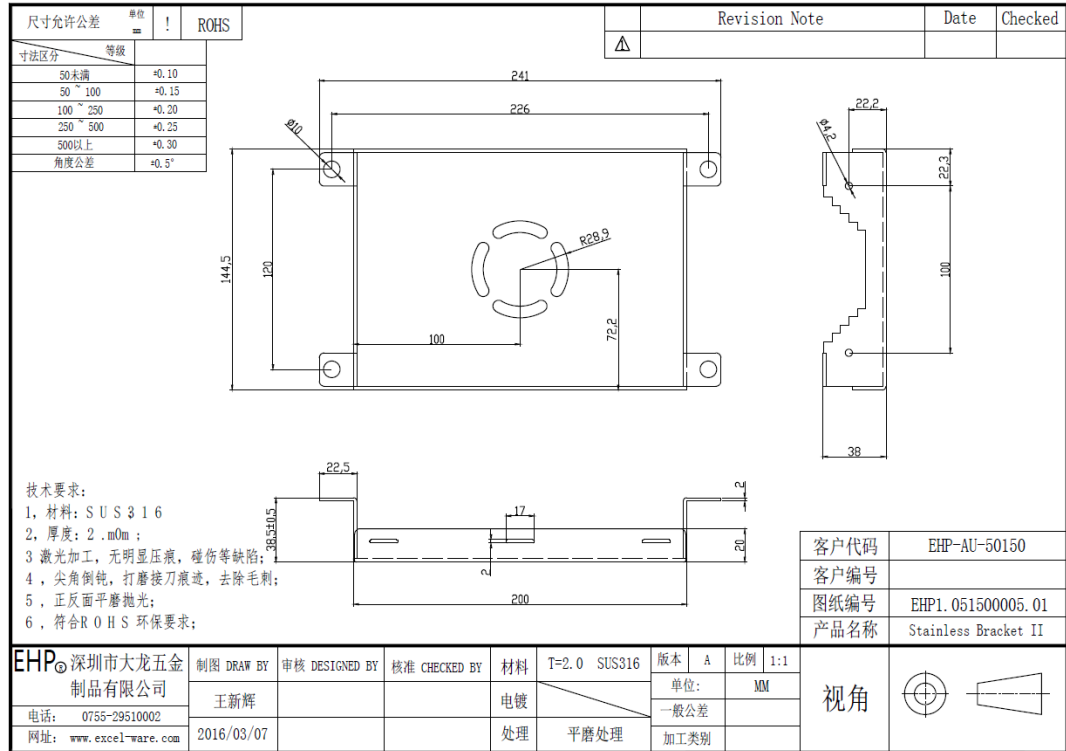


Figure 7: Mounting Bracket drawing

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## 6. Appendix 2 – 5.9 GHz Antenna Radiation Pattern

### XY Plane

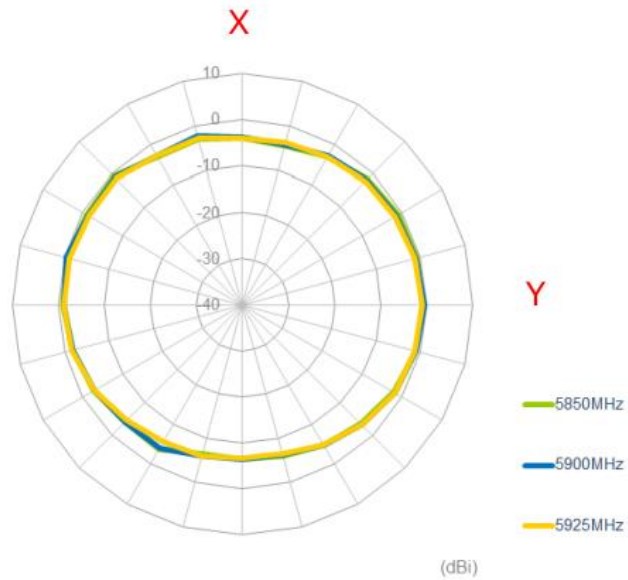


Figure 8: 5.9 GHz Antenna Radiation Pattern XY Plane

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**XZ Plane**

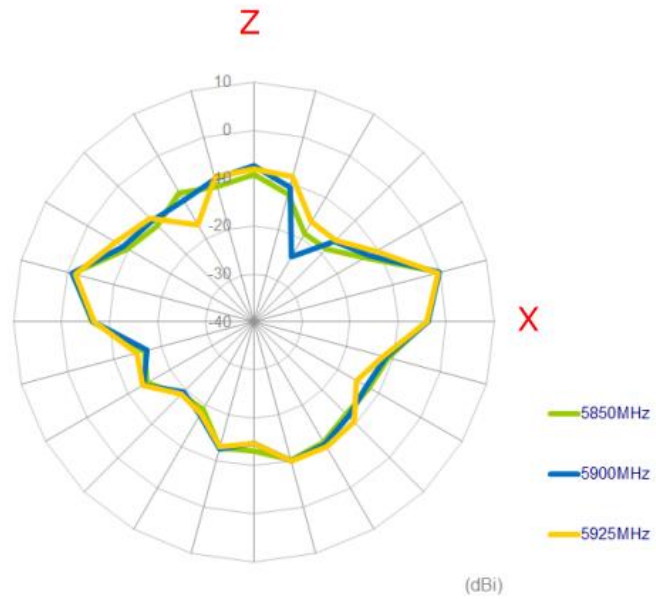


Figure 8: 5.9 GHz Antenna Radiation Pattern XZ Plane

**YZ Plane**

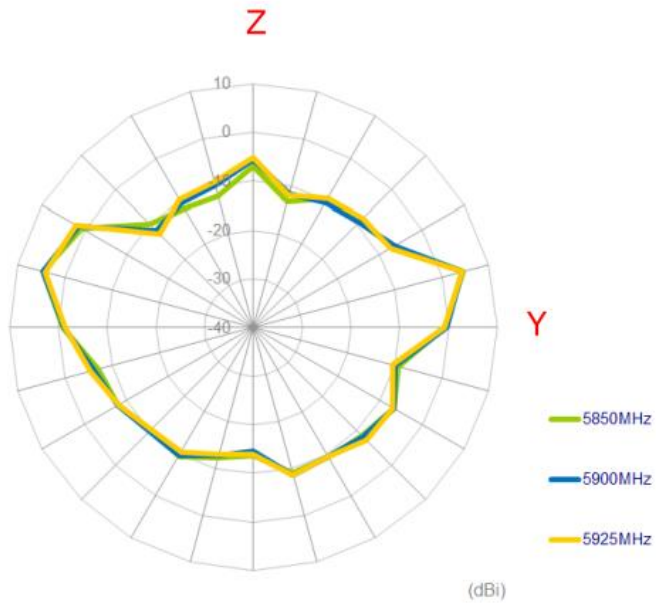


Figure 9: 5.9 GHz Antenna Radiation Pattern YZ Plane

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