

# Compliance and Safety Manual RRU3936

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# 1 Safety

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- 1.3 [Electromagnetic Field Exposure](#)

## 1.1 Health and Safety

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### 1.1.1 Overview

#### Introduction

This section describes the safety precautions you must take before installing or maintaining Huawei equipment.

- To ensure safety of humans and the equipment, pay attention to the safety symbols on the equipment and all the safety instructions in this document.
- The "NOTE", "CAUTION", and "WARNING" marks in other documents do not represent all the safety instructions. They are only supplements to the safety instructions.
- Installation and maintenance personnel must understand basic safety precautions to avoid hazards.
- When operating Huawei equipment, in addition to following the general precautions in this document, follow the specific safety instructions given by Huawei.

- Only trained and qualified personnel are allowed to install, operate, and maintain Huawei equipment.

## Local Safety Regulations

When operating Huawei equipment, you must follow the local laws and regulations. The safety instructions in this document are only supplements to the local laws and regulations.

## General Requirements

To minimize risk of personal injury and damage to equipment, read and follow all the precautions in this document before performing any installation or maintenance.

Ensure that the instructions provided in this document are followed completely. This section also provides guidelines for selecting the measuring and testing devices.

## Installation

- The device (or system) must be installed in an access-controlled location.
- Tighten the thumbscrews by using a tool after initial installation and subsequent access to the panel.

## Ground

- Do not damage the ground conductor or operate the device in the absence of a properly installed ground conductor. Conduct the electrical inspection carefully.
- The device (or system) must be connected permanently to the protection ground before an operation. The cross-sectional area of the protective ground conductor must be at least  $1.5 \text{ mm}^2$ .
- The device must be fixed securely on the floor or other reliable objects, such as the walls and the mounting racks before operation.
- When installing the unit, always make the ground connection first and disconnect it last

## Power Supply

- For DC-supplied model: The device applies to DC power source that complies with the Safety Extra-Low Voltage (SELV) requirements in IEC 60950-1 based safety standards.
- Prepared conductors are connected to the terminal block, and only the appropriate AWG/Type of wire is secured with the lug terminals.
- This device relies on the building's installation for short-circuit (overcurrent) protection. Ensure that a fuse or circuit breaker no larger than 80 VDC, 30 A for DC supplied model is used on the phase conductors (all current-carrying conductors).
- For this device, a readily accessible disconnect device shall be incorporated external to the equipment

## Human Safety

- Do not operate the device or cables during lightning strikes.
- To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telecommunication network voltage (TNV) circuits.

- Move or lift the chassis by holding its lower edge. Do not hold the handles on certain modules such as power supply, fans, and boards because they cannot support the weight of the device.
- Do not look into the optical port without eye protection.
- Do not wear jewelry or watches when you operate the device.
- Reinforced insulation or double insulation must be provided to isolate DC source from AC mains supply.

## Operator

- Only qualified professional personnel are allowed to install, configure, operate, and disassemble the device.
- Only the personnel authenticated or authorized by Huawei are allowed to replace or change the device or the parts of the device (including the software).
- Any fault or error that might cause safety problems must be reported immediately to a supervisor.
- Only qualified personnel are allowed to remove or disable the safety facilities and to troubleshoot and maintain the device.

## 1.1.2 Electrical Safety

### High Voltage



#### **DANGER**

The high voltage power supply provides power for the device operation. Direct or indirect contact (through damp objects) with high voltage and AC mains supply may result in fatal danger.

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- During the installation of the AC power supply facility, follow the local safety regulations. The personnel who install the AC facility must be qualified to perform high voltage and AC operations.
  - Do not wear conductive articles, such as watches, hand chains, bracelets, and rings during the operation.
  - When water is found in the rack or the rack is damp, switch off the power supply immediately.
  - When the operation is performed in a damp environment, make sure that the device is dry.



#### **WARNING**

Non-standard and improper high voltage operations may result in fire and electric shock. Therefore, you must abide by the local rules and regulations when bridging and wiring AC cables. Only qualified personnel are allowed to perform high voltage and AC operations.

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### **WARNING**

Before powering on a device, ground the device. Otherwise, personal injury or device damage may be caused by high leakage current.

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## **Thunderstorm**



### **DANGER**

Do not perform any operation, including high voltage and AC operations, on a steel tower or mast during a thunderstorm.

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## **Tools**



### **WARNING**

Dedicated tools must be used during high voltage and AC operations. Avoid using ordinary tools.

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## **High Electrical Leakage**



### **WARNING**

Ground the device before powering it on. Otherwise, personal injury or device damage may be caused by high leakage current.

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If a "high electrical leakage" tag is present on the power terminal of the device, you must ground the device before powering it on.

## **Power Cable**



### **WARNING**

Do not install or remove power cables when the device is on. Transient contact between the core of the power cable and the conductor may generate electric arcs or sparks, which may cause fire or hurt human eyes.

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- Before installing or removing the power cable, turn off the power switch.
- Before connecting a power cable, check that the label on the power cable is correct.



**CAUTION**

- If the device is connected with the DC power supply, use 1.25 mm<sup>2</sup> or 16 AWG minimum power supply cord.
  - Use type H03VV-F or light PVC-sheathed flexible cord according to IEC 60227.
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### 1.1.3 Inflammable Environment

Operating the electrical device in an inflammable environment can be fatal.

**DANGER**

Do not place the device in an environment that has inflammable and explosive air or gas. Do not perform any operation in this environment.

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### 1.1.4 Radiation

#### Electromagnetic Field Exposure

**WARNING**

Radio-frequency signals with high intensity are harmful to human body.

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Before installing or maintaining an antenna on a steel tower or a mast with a large number of transmitter antennas, coordinate with the parties concerned to shut down the transmitter antennas.

#### Laser

The laser hazard level of this device is Class 1.

**WARNING**

When handling optical fibers, do not stand close to or look at the optical fiber outlet directly with unprotected eyes.

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#### General Laser Information

Laser transceivers or transmitters are used in optical transmission systems and associated test tools. The wavelength of the laser is between 780 nm and 1600 nm. The laser transmitted through optical fibers has very high power density and is invisible to human eyes. A beam of light causes damage to the retina.

Laser of wavelengths used in telecommunications causes thermal damage to the retina.

Lasers used in lightwave systems have a larger beam divergence, typically 10 to 20 degrees. Looking at an un-terminated fiber or damaged fiber with unprotected eyes at a distance greater than 150 mm (6 inches) does not cause eye injury. Eye injury, however, may be caused if an optical tool such as a microscope, magnifying glass, or eye loupe is used to view the energized fiber end.

A lightwave system in normal operating mode is totally enclosed and presents no risk of eye injury. The automatic laser shutdown (ALS) feature of the lightwave system also ensures safety. The ALS, however, can be applied to bi-directional transmission only. If the receiver side does not detect the laser from the transmitter side, it sends the transmitter side a signal. Upon receiving the signal, the ALS shuts down the laser emission within 100 ms.

## Safety Guidelines

Follow the following guidelines to avoid laser radiation:

- Read the instructions before installing, operating, and maintaining the device. Ignoring the instructions can cause exposure to dangerous laser radiation.
- Wear a pair of eye-protective glasses when you are handling lasers or fibers.
- Only qualified personnel are allowed to perform laser-related operations.
- Make sure that the optical source is switched off before disconnecting optical fiber connectors.
- Before opening the front door of an optical transmission system, make sure that you are not exposed to laser radiation.
- Do not look at the end of an exposed fiber or an open connector when you are not sure whether the optical source is switched off or not.
- Use an optical power meter to check that the optical source is switched off and verify that it is off by measuring the optical power.
- Do not use an optical tool such as a microscope, a magnifying glass, or an eye loupe to view the optical connector or fiber.

## Handling Fibers

Read the instructions before handling fibers:

- Only trained and qualified personnel can cut or splice fibers.
- Before cutting or splicing a fiber, ensure that the fiber is disconnected from the optical source. After disconnecting the fiber, use protecting caps to protect all the optical connectors.

### 1.1.5 Working at Heights



#### **WARNING**

Avoid object falling when you work at heights.

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When working at heights, fulfill the following requirements:

- Only trained personnel can work at heights.

- Prevent the devices and tools that you carry from falling down.
- Take safety and protection measures, for example, wear a helm and safety belt.
- Wear warm clothes when working at heights in a cold region.
- Before working at heights, check that all the lifting facilities are in good condition.

## Hoisting Heavy Objects

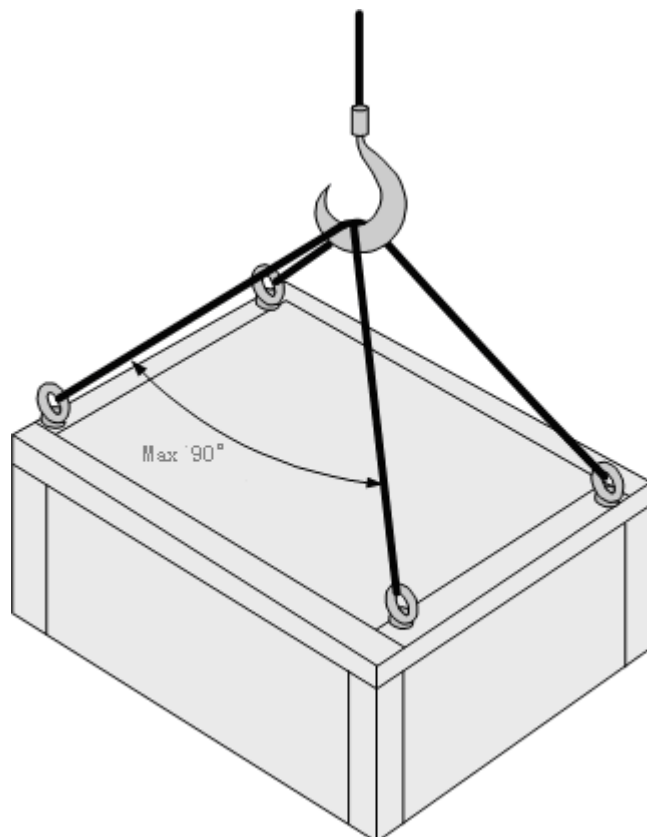


### WARNING

Do not walk below the cantilever or hoisted objects when heavy objects are being hoisted.

- Only trained and qualified personnel can perform hoisting operations.
- Before hoisting heavy objects, check that the hoisting tools are complete and in good condition.
- Before hoisting heavy objects, ensure that the hoisting tools are fixed to a secure object or wall with good weight capacity.
- Issue orders with short and explicit words to avoid misoperations.
- Ensure that the angle formed by two cables is not larger than 90 degrees. See [Figure 1-1](#).

**Figure 1-1** Hoisting heavy objects



## Using Ladders

### Checking a Ladder

- Before using a ladder, check whether the ladder is damaged. Only the ladder in good condition can be used.
- Before using a ladder, you should know the maximum weight capacity of the ladder. Avoid overweighing the ladder.

### Placing a Ladder

The recommended gradient of ladders is 75 degrees. You can measure the gradient of the ladder with an angle square or your arms. When using a ladder, ensure that the wider feet of the ladder are downward, or take protection measures for the ladder feet to prevent the ladder from sliding. Ensure that the ladder is placed securely.

### Climbing Up a Ladder

When climbing up a ladder, note the following:

- Ensure that the center of gravity of your body does not deviate from the edges of the two long sides.
- To minimize the risk of falling, hold your balance on the ladder before any operation.
- Do not climb higher than the fourth rung of the ladder (counted from up to down).
- If you want to climb up a roof, ensure that the ladder top is at least one meter higher than the roof.

## 1.1.6 Mechanical Safety

### Drilling Holes



#### **WARNING**

Do not drill the cabinet at will. Drilling holes without complying with the requirements affects the electromagnetic shielding performance of the cabinet and damages the cables inside the cabinet. In addition, if the scraps caused by drilling enter the cabinet, the printed circuit boards (PCBs) may be short circuited.

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- Before you drill a hole in the cabinet, wear insulated gloves and remove the internal cables from the cabinet.
  - Wear an eye protector when drilling holes. This is to prevent your eyes from being injured by the splashing metal scraps.
  - Ensure that the scraps caused by drilling do not enter the cabinet.
  - Drilling holes without complying with the requirements affects the electromagnetic shielding performance of the cabinet.
  - After drilling, clean the metal scraps immediately.

## Sharp Objects



### WARNING

Before you hold or carry a device, wear protective gloves to avoid getting injured by sharp edges of the device.

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## Lifting Heavy Objects



### WARNING

When heavy objects are being lifted, do not stand or walk under the cantilever or the lifted object.

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## 1.1.7 Bundling Signal Cables



### CAUTION

- Do not bundle signal cables with high current cables or high voltage cables.
  - Maintain a minimum space of 150 mm between adjacent ties.
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## 1.2 Equipment Safety

[1.2.1 Electricity Safety](#)

[1.2.2 Electrostatic Discharge](#)

[1.2.3 Installing and Removing a Board](#)

[1.2.4 Laying Cables](#)

### 1.2.1 Electricity Safety

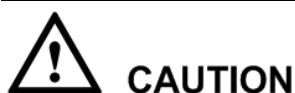
#### Thunderstorm



During thunderstorms, the electromagnetic field generated in the thunderstorm area may damage the electronic parts. To prevent damage to the device during lightning, ground the device properly.

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## High Electrical Leakage



If the "high electrical leakage" tag is present on the power terminal of the device, you must ground the device before powering it on.

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## Fuse



If a fuse is to be replaced, the new fuse must be of the same type and specifications.

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## 1.2.2 Electrostatic Discharge



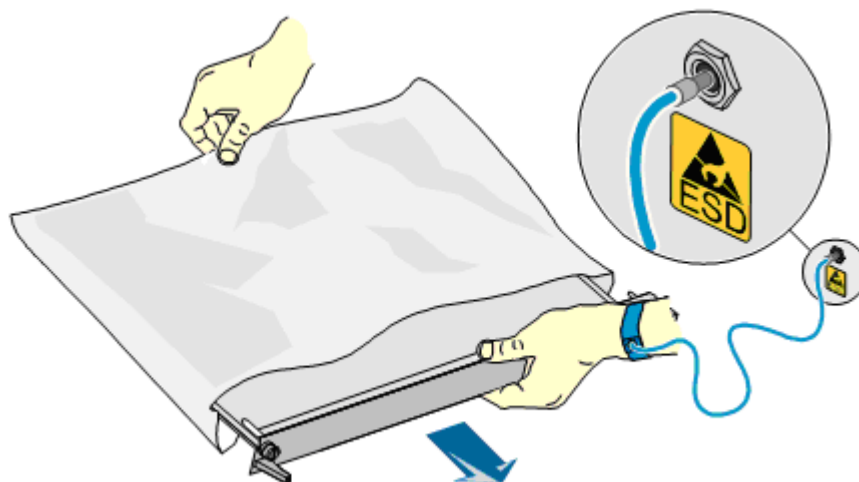
The static electricity generated by human bodies may damage the electrostatic-sensitive components on boards, for example, the large-scale integrated (LSI) circuits.

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Human body movement, friction between human bodies and clothes, friction between shoes and floors, or handling of plastic articles causes static electromagnetic fields on human bodies. These static electromagnetic fields cannot be eliminated until the static is discharged.

To prevent electrostatic-sensitive components from being damaged by the static on human bodies, you must wear a well-grounded ESD wrist strap when touching the device or handling boards or application-specific integrated circuits (ASICs).

[Figure 1-2](#) shows how to wear an ESD wrist strap.

**Figure 1-2** Wearing an ESD wrist strap

## 1.2.3 Installing and Removing a Board

### CAUTION

When installing a board, use proper force to prevent the pins on the backplane from being leaned.

When installing or removing a board, note the following:

- Insert the board along the guide rails.
- Prevent the surface of a board from contacting the surface of another board. This is to prevent the boards from being short-circuited or scratched.
- To prevent electrostatic-sensitive devices from being damaged by the ESD, do not touch the circuits, components, connectors, or connection slots on boards.

## 1.2.4 Laying Cables

When the temperature is very low, violent strike or vibration may damage the cable sheathing. To ensure safety, comply with the following requirements:

- Cables can be laid or installed only when the temperature is higher than 0°C.
- Before laying cables which have been stored in a temperature lower than 0°C, move the cables to an environment of the ambient temperature and store them at the ambient temperature for at least 24 hours.
- Handle cables with caution, especially at a low temperature. Do not drop the cables directly from the vehicle.

## 1.3 Electromagnetic Field Exposure

### Introduction

The Base Transceiver Station (BTS) emits Radio Frequency (RF) radiation. Follow the local safety regulations when installing and operating the BTS to avoid radiation hazard.

### Guidelines on Limiting Exposure to Electromagnetic Fields

There are a number of international regulations, standards, and guidelines for exposure to electromagnetic fields. Some European countries have adopted the recommendation of the council of the European Union (1999/519/EC), released on July 12, 1999, focusing on the hazards of exposure to electromagnetic fields. The recommendation is based on the guideline published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP).

### Location of Base Station Antennas

Base station antennas, the source of the radiation, are usually mounted:

- On freestanding towers, with a height up to 30 m
- On a tower on the top of buildings
- To the side of buildings, on rare occasions

Generally, the antenna cannot be located in a position lower than 10 m. The energy usually forms a horizontal main beam and is slightly tilted downwards. The remaining energy forms into weaker beams on both sides of the main beam. The main beam, however, does not reach the ground if the antenna is around 50–200 m away from the ground.

The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

### Exclusion Zones

The requirements for exclusion zones are as follows:

- The antenna should be properly located to prevent the public from accessing the area where the RF radiation exceeds the previously mentioned limits.
- If areas with excessive RF radiation are accessible to the operation and maintenance (O&M) personnel, ensure that they know the source of radiation and can power off or shut down the transmitters before entering high radiation areas. In addition, such areas must be confined within a distance of 10 m from the antennas.
- Each exclusion zone should be defined by a physical barrier and by a recognizable sign warning the public or O&M personnel.

### Guidelines on Choosing Antenna Sites

The guidelines on choosing the antenna sites are as follows:

- For roof-mounted antennas, raise the antennas above the height of the personnel who may have to work on the rooftop.
- For roof-mounted antennas, keep the transmitter antennas away from the areas accessible to the public, such as roof access points, telephone service points, and HVAC devices.



- For roof-mounted directional antennas, place the antennas near the periphery, and do not make the antennas face the building.
- Consider the trade-off between large aperture antennas (lower maximum RF) and small aperture antennas (lower visual impact).
- Keep higher-power antennas away from accessible areas.
- Keep the antennas in a site that is far away from urban areas, though this may contradict the coverage area requirements.
- Exercise extra caution when designing co-location sites, that is, antennas owned by different companies are located in the same site or are co-sited. This applies particularly to sites that include high-power broadcast (FM/TV) antennas. Local zone often favors co-location, but co-location may cause safety problems.
- Take special precautions for antenna sites near hospital and schools.

## Location of BTS

The BTS is shielded from RF radiation hazards. The device has been tested to comply with the radioactive spurious emission requirements of international standards or local regulations. Therefore, the BTS under normal operating conditions does not cause danger to the public and O&M engineers. However, the limits for RF radiation might be exceeded due to faulty antenna cables or for other causes.

- BTS sites shall not be accessible to the public. Only authorized and trained personnel can access BTS sites or equipment rooms.
- A sign of excessive RF radiation must be present on the doors of the sites or equipment rooms to warn the personnel inside the site or equipment room of excessive RF radiation.
- BTS sites must be regularly monitored and inspected after installation.

## Prediction of the Exposure to Electromagnetic Fields

This section provides a theoretical approach to calculate possible exposure to electromagnetic radiation around a BTS antenna. Precise statements are possible either with measurements or complex calculations considering the complexity of the environment, such as soil conditions, nearby buildings and other obstacles. The complexity may cause reflection, deflection, and scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a BTS is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = (P(W) \times G_{\text{numeric}}) / (4 \times R^2(m) \times \pi)$$

Where,

P = Maximum output power at antenna port of the BTS in W

$G_{\text{numeric}}$  = Numeric gain (see below)

R = Distance between the antenna and the point of exposure in meters

For the calculation of the  $G_{\text{numeric}}$ ,

$$G_{\text{numeric}} = 10^{\text{GdB}/10}$$

$$\text{GdB} = G_{\text{antenna}}(\text{dB}) - B_{\text{cable}}(\text{dB}) - B_{\text{vertical-attenuation}}(\text{dB}) - B_{\text{horizontal-attenuation}}(\text{dB})$$

B = attenuation in dB

This product shall be installed R meter away from human at least, please see the following detail for R value.

Cellular band:

RF Source	Calculation
RF Source #1:	$f = 869 \text{ MHz to } 894 \text{ MHz}$ $S_{Limit,i} = f / 150 = 869 / 150 = 5.79 \text{ W/m}^2$ $P = 100.69 \text{ W (worst case)}$ $\theta, \phi = \text{the worst condition is considered, i.e. the maximum } G \text{ is used.}$ $G = 10 \text{ dBi} = 10$ $S_i = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2} = 80.13 / R^2 \text{ W/m}^2$ $\frac{S_i}{S_{Limit,i}} = 13.84 / R^2$
Combination	$\sum_i \frac{S_i}{S_{Limit,i}} = 13.84 / R^2 \leq 1$ $R \geq 3.7 \text{ m (the minimum Safe Distance)}$

PCS band:

RF Source	Calculation
RF Source #1:	$f = 1930 \text{ MHz to } 1990 \text{ MHz}$ $S_{Limit,i} = 10 \text{ W/m}^2$ $P = 100.69 \text{ W (worst case)}$ $\theta, \phi = \text{the worst condition is considered, i.e. the maximum } G \text{ is used.}$ $G = 10 \text{ dBi} = 10$ $S_i = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2} = 80.13 / R^2 \text{ W/m}^2$
	$\frac{S_i}{S_{Limit,i}} = 8.01 / R^2$
Combination	$\sum_i \frac{S_i}{S_{Limit,i}} = 8.01 / R^2 \leq 1$ $R \geq 2.8 \text{ m (the minimum Safe Distance)}$