FCC Electromagnetic Field Health Compliance Report

Product Name: Distributed Base Station Remote Radio Unit

Product Model: RRU3201

Report Number: SYBH(R)002012012EB-2

FCC ID: QISRRU3201-2600M

Reliability Laboratory of Huawei Technologies Co., Ltd.

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Notice

1. The laboratory has passed the accreditation by China National Accreditation Service for Conformity Assessment (CNAS). The accreditation number is L0310.
2. The laboratory has passed the accreditation by The American Association for Laboratory Accreditation (A2LA). The accreditation number is 2174.01.
3. The laboratory has been listed by the US Federal Communications Commission to perform electromagnetic emission measurements. The site recognition number is 97456.
4. The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The site recognition number is 6369A-1.
5. The laboratory has been listed by the VCCI to perform EMC measurements. The accreditation numbers are R2364, C2583, and T256.
6. The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
7. The test report is invalid if there is any evidence of erasure and/or falsification.
8. The test report is only valid for the test samples.
9. Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

Applicant:	Huawei Technologies Co., Ltd.
Address:	Huawei Base, Bantian, Longgang District, Shenzhen 518129, P.R. China
Product Name:	Distributed Base Station Remote Radio Unit
Product Model:	RRU3201
Version:	V200R013

Date of Receipt Sample:	2011-12-16
Start Date of Test:	2012-01-07
End Date of Test:	2012-01-07

Result: Compliant

Approved by Senior Engineer:	2012-01-07	Zhang Xinghai	Zhang Xing hai
	Date	Name	Signature

Prepared by:	2012-01-07	Zhang Weimin	
	Date	Name	Signature

Modification Record

No.	Last Report No.	Modification Description
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CONTENT

1 General Information

1.1 Applied Standard

Applied Rules:	47CFR FCC Part 1 (10-1-10 Edition)
Test Method:	OET Bulletin 65 (Edition 97-01)

1.2 Test Location

Test Location 1:	Reliability Laboratory of Huawei Technologies Co., Ltd.
Address:	Huawei Base, Bantian, Longgang District, Shenzhen 518129, P.R. China

1.3 Test Environment Condition

Ambient Temperature:	Not applicable
Ambient Relative Humidity:	Not applicable
Atmospheric Pressure:	Not applicable

2 Description of the Equipments/Site under Estimation

2.1 General Description

HUAWEI Base Station DBS3900 LTE is a distributed eNodeB with 3GPP LTE FDD protocols. The eDBS3900 LTE supports CPRI interfaces and contains BBU and RRU two parts:

- Baseband unit (BBU): processes baseband signals.
- Radio remote unit (RRU): processes RF signals.

RRU3201 (Band 7) is the outdoor radio remote unit. It can be mounted close to the antenna on a metal pole or a wall.

For RRU3201 (Band 7), the downlink frequency is 2620 MHz – 2640 MHz and the uplink frequency is 2500 MHz – 2520 MHz.

RRU3201 (Band 7) has a highly integrated structure. The components of RRU3201 are describes as follows:

1. Power supply: leads the external -48 VDC power to supply power for RRU3201.
2. Duplexer: multiplexes RX signals and RX signals, which enables the RX signals and TX signals to share the same antenna path. The duplexer also filters RX signals and TX signals.
3. Low noise amplifier: amplifiers received signals to avoid loss of signals.]
4. Power amplifier: amplifiers transmission signals to reinforce the power of the signals. It has the power of 40 W per port.
5. TRX: includes two receive channels, two transmission channels and one feedback channel.

2.2 Technical Description

NOTE: A typical application configuration is used here. When different configurations are used, the report should be re-estimated.

Table 1 Technical Description

RF Source	Technical Parameter	Description
RF Source #1	Operating frequency for Transmitter (TX)	2620 to 2640 MHz
	Output power at the antenna port	Rated max.: 40 W (per port) 80 W (two ports) Measured max.: 45.29 W (per port) 90.58 W (two ports) NOTE: refer to FCC RF Test Report for the measured output power.
	Antenna information	Antenna type: Directional Antenna gain (max): 18 dBi

3 Electromagnetic Field Health Requirements

3.1 FCC Routine Environmental Evaluation

Base Transceiver Station (BTS) emit RF radiation (Radiation Hazard). Although there is no scientific evidence of possible health risks to persons living near to BTSs some recommendations are giving below for the installation and operation of BTSs. Operators of BTSs are required to obey the local regulation for erecting base station transceivers.

The Federal Communications Commission (FCC) 47CFR §1.1307 requires operator to perform an Environmental Assessment. The objective of the Environmental Evaluation is to ensure that human exposure to RF energy does not go beyond the maximum permissible levels stated in the standard.

As specified in 47CFR §1.1307 and OET Bulletin 65, the Environmental Evaluations are required if the BTS fall into the categories listed in Table 1 of 47CFR §1.1307 and Table 2 of OET Bulletin 65, also summarized and listed in Table 2 below. Other BTS s are categorically excluded from making such studies or preparing an EA, except as indicated in paragraphs (c) and (d) of §1.1307.

Table 2 BTSs Subject To Routine Environmental Evaluation

BTSs Subject To Routine Environmental Evaluation	
Service (title 47 CFR rule part)	Evaluation required if:
Cellular Radiotelephone Service (subpart H of part 22)	Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP). Building-mounted antennas: total power of all channels > 1000 W ERP (1640 W EIRP).
Personal Communications Services (part 24)	(1) Narrowband PCS (subpart D): Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP). Building-mounted antennas: total power of all channels > 1000 W ERP (1640 W EIRP). (2) Broadband PCS (subpart E): Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP). Building-mounted antennas: total power of all channels > 2000 W ERP (3280 W EIRP).

BTSs Subject To Routine Environmental Evaluation	
Miscellaneous Wireless Communications Services (part 27 except subpart M).	(1) For the 1390–1392 MHz, 1392–1395 MHz, 1432–1435 MHz, 1670–1675 MHz, and 2385–2390 MHz bands: Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP). Building-mounted antennas: total power of all channels > 2000 W ERP (3280 W EIRP). (2) For the 698–746 MHz, 746–764 MHz, 776–794 MHz, 2305–2320 MHz, and 2345–2360 MHz bands: Total power of all channels > 1000 W ERP (1640 W EIRP).
Broadband Radio Service and Educational Broadband Service (subpart M of part 27).	Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and power > 1640 W EIRP. Building-mounted antennas: power > 1640 W EIRP. BRS and EBS licensees are required to attach a label to subscriber transceiver or transverter antennas that: (1) provides adequate notice regarding potential radiofrequency safety hazards, e.g., information regarding the safe minimum separation distance required between users and transceiver antennas; and (2) references the applicable FCC-adopted limits for radiofrequency exposure specified in §1.1310.

Note 1: “Building-mounted antennas” means antennas mounted in or on a building structure that is occupied as a workplace or residence.

Note 2: The term “power” refers to total operating power of the transmitting operation in question in terms of ERP, EIRP or PEP.

Note 3: For the case of the Cellular Radiotelephone Service (47CFR Part 22 subpart H), the Personal Communications Service (47CFR Part 24) and the Specialized Mobile Radio Service (47CFR Part 90), the phrase “total power of all channels” means the sum of the ERP or EIRP of all co-located simultaneously operating transmitters owned and operated by a single licensee.

Note 4: When applying the criteria of this table, radiation in all directions should be considered. For the case of transmitting facilities using sectorized transmitting antennas, applicants and licensees should apply the criteria to all transmitting channels in a given sector, noting that for a highly directional antenna there is relatively little contribution to ERP or EIRP summation for other directions.

3.2 Maximum Permissible Exposure (MPE)

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

The FCC's MPE limits for field strength and power density are given in 47CFR §1.1310 (also in Table 1 of OET Bulletin 65). These limits (also list in Table 3 below) are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

Table 3 Limits for Maximum Permissible Exposure (MPE)

Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	($900/f^2$)*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6

(B) Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm^2)	Averaging Time $\|E\|^2$, $\|H\|^2$ or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	($180/f^2$)*	30
30-300	27.5	0.073	0.2	30
300-1500	--	--	f/1500	30
1500-100,000	--	--	1.0	30

f = frequency in MHz *Plane-wave equivalent power density

4 Electromagnetic Field Health Estimation

4.1 Calculation Model

As mentioned in OET Bulletin 65, a theoretical approach to calculate possible exposure to electromagnetic radiation around BTS antenna. Precise statements are basically only possible either with measurements or complex calculations considering the complexity of the environment (e.g. soil conditions, near buildings and other obstacles) which causes reflections, 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:

$$S = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2}$$

Where:

P = input power of the antenna.

G = antenna gain relative to an isotropic antenna.

θ, ϕ = elevation and azimuth angles.

R = distance from the antenna to the point of investigation.

For single or multiple RF sources, the calculated power density should comply with following:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Where:

S_i = the power density when the f is i.

$S_{Limit,i}$ = the reference level requirement for power density when f is i.

4.2 Cylindrical Boundary Model and Safe Distance

Calculations can be made on a site by site basis to ensure the power density is below the limits given in clause 3, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning. According to clause 4.1, the distance from the antenna to the point of investigation:

$$R = \sqrt{\frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times S}}$$

For the beamed antenna, see Figure 1, the mostly safe way is that the cylindrical boundary model is chosen for simple description of the compliance boundaries of the site. In the case, the power usually is focused into a main beam and the remaining power goes into the weaker beams on both side of the main beam. For the up and down direction (R_{up}

and R_{down}), the antenna is considered to have no gain as derived from the vertical pattern of the antenna (i.e. the antenna gain is 1.0).

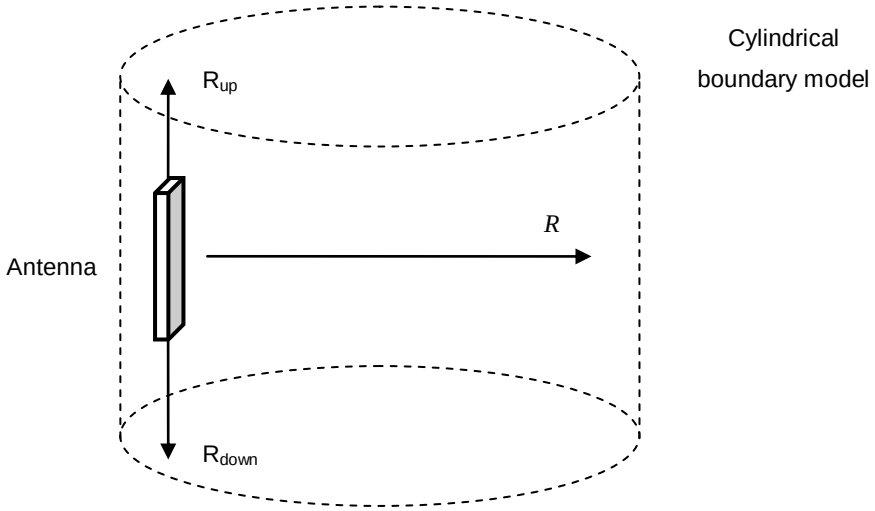

Figure 1 Cylindrical boundary model for the compliance boundary

4.3 Location of Antennas

The BTSs antennas, the source of the radiation, are usually mounted on freestanding towers, with a height up to 30 m or more or on a tower on the top of buildings or in less case to the side of the building. Generally the height of the antenna position does not fall below 10 m. The power usually is focused into a horizontal main beam and slightly downward tilted. The remaining power goes into the weaker beams on both side of the main beam. The main beam however does not reach ground level until the distance from the antenna position is around 50 - 200 m. The highest level of emission would be expected in close vicinity of the antenna and in line of sight to the antenna.

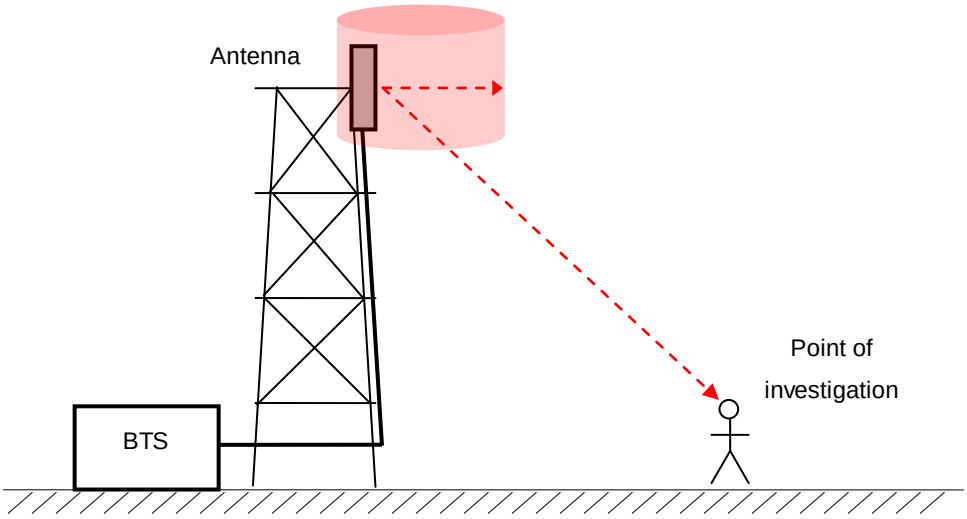

Figure 2 Location of Antennas

4.4 Calculation of the Power Density or Safe Distance

NOTE 1: The RF exposure evaluation is base on the far-field and the radiation exposure is over-estimated.

NOTE 2: The maximum output power level is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

NOTE 3: The minimum antenna feed cable loss (assumed no cable loss) is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

NOTE 4: The maximum antenna radiation exposure orientation and maximum antenna gain is taken into account as a worst case for the purpose of the calculation of power density or safe distance.

NOTE 5: The limits for General Population/Uncontrolled Exposure are considered in this report.

Table 4 Calculation of the Power Density or Safe Distance

RF Source	Calculation
RF Source #1:	f = 2620 to 2640 MHz $S_{Limit,i}$ = 10 W/m^2 P = 90.58 W θ, ϕ = the worst condition is considered, i.e. the maximum G is used. G = 18 dBi = 63.1 S_i = $\frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2}$ = 455.1 / R^2 W/m^2 $\frac{S_i}{S_{Limit,i}}$ = 45.51 / R^2
Combination	$\sum_i \frac{S_i}{S_{Limit,i}}$ = 45.51 / $R^2 \leq 1$ R $\geq$ 6.8 m So, the Safe Distance should be more than **6.8 m**

END