



# **FCC Maximum Permissible Exposure (MPE) Estimation Report**

**Product Name: WiMAX Indoor Pico Base Station  
Model Number: BTS3701B**

**Report No: SYBH (R) 002082010EB-2  
FCC ID: QISBTS3701B-2500M**

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**REGULATION** FCC 47CFR Part 1 (10-1-07 Edition)  
OET Bulletin 65 (Edition 97-01)

**CONCLUSION** **COMPLIANT**

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Date (y-m-d)

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# 1 EUT Information

## 1.1 Product Description

The BTS3701B is a compact integrated indoor BTS. It receives and transmits radio signals to enable communication between the WiMAX network and the MS/SS.

The BTS3701B communicates with the MS/SS through the R1 interface and communicates with the ASN-GW through the R6 interface.

The BTS3701B supports 2T2R MIMO, IP-CS, Eth-CS, idle mode, sleep mode, hard handover, power control, and the Profile C structure.

## 1.2 Technical Description of EUT

Table 1. Service and Test Mode List

Operating frequency band:	BRS&EBS Band: Uplink (RX): 2496 to 2690 MHz Downlink (TX): 2496 to 2690 MHz
Maximum power input to the antenna:	BRS&EBS Band: Rated max.: 23 dBm (Note: refer to FCC/RF test report for the measured output power)
Antenna Information:	BRS&EBS Band: Antenna gain (typical): 2 dBi



## 2 FCC RF Exposure Requirements

### 2.1 FCC Routine Environmental Evaluation

WiMAX indoor Pico Base Station (BTS3701B) emit RF radiation (Radiation Hazard). Although there is no scientific evidence of possible health risks to persons living near to BTS some recommendations are giving below for the installation and operation of BTS. 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

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).
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.



## 2.2 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)

<b>(A) Limits for Occupational/Controlled Exposure</b>				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time ( E  <sup>2</sup> ,  H  <sup>2</sup> or S) (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time ( E  <sup>2</sup> ,  H  <sup>2</sup> or S) (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f <sup>2</sup> )*	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		

## 3 RF Exposure Evaluation

### 3.1 Prediction of the Exposure to Electromagnetic Fields

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:

$$S = \frac{P \times G}{4 \times \pi \times R^2} \quad (1)$$

Where:

S = power density

P = power input to the antenna

G = numeric gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the centre of radiation of the antenna

### 3.2 Calculation of the Safe Distance

Calculations can be made on a site by site basis to ensure the power density is below the limits given in section 2.2, or guidelines can be done beforehand to ensure the minimum distances from the antenna is maintained through the site planning.

According the equation in 3.1, the distance to the centre of radiation of the antenna:

$$R = \sqrt{\frac{P \times G}{4 \times \pi \times S}} \quad (2)$$

Refer to Figure 1, for the beamed antennas, 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 could be looked as 1.0).

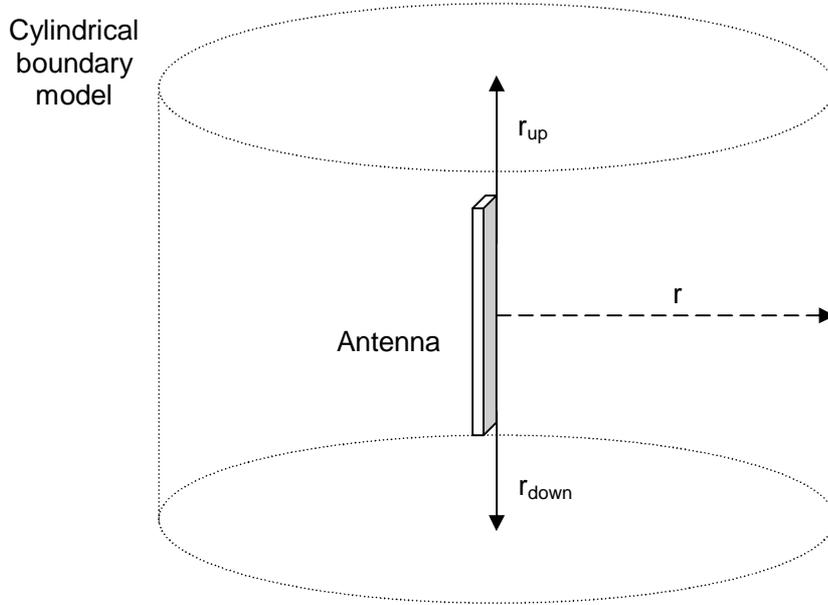


Figure 1 Cylindrical boundary model for the compliance boundary

For the EUT (refer to section 1), the safe distance R can be calculated as Table 4:

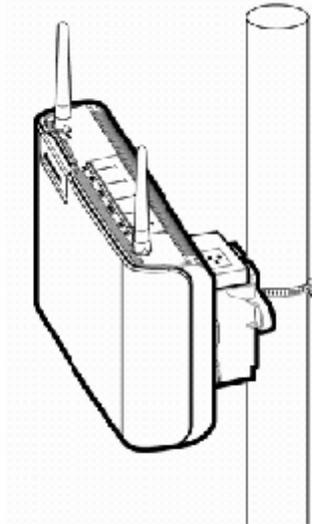
Table 4. Safe distance calculation

<p>BRS&amp;EBS Band:</p>	<p><math>f(TX) = 2496-2690</math> MHz  <math>P = 23</math> dBm = 200mW=0.2W  <math>G = 2</math>.dBi = 1.58 numeric</p> <p>Population/uncontrolled exposure:  <math>S = 1</math> mW/cm<sup>2</sup> =10 W/m<sup>2</sup>  <math>R = 5</math>cm=0.05m</p>
<p>Note 1: The minimum antenna feed line loss is taken into account.          Note 2: It is assumed that the RF exposure evaluation is base on the far-field and the MPE is over-estimated.          Note 3: MPE limits that are provided to the customer and only serve as a guideline. The site license holder is ultimately responsible for MPE compliance at a given site.</p>	

## 4 LOCATION OF BTS ANTENNAS

The BTS3701B is light and small because it integrates units of main control, baseband, transmission, and RF into one module, and thus one site requires only one cabinet (like a case). This facilitates site acquisition and installation.

The installation of the BTS3701B does not require any equipment room, air conditioner, or dedicated tower. To install a BTS3701B, you only need to fix it to the pole, ceiling, or wall and then install the external cables, thus facilitating installation and network deployment.



### 4.1 Exclusions Zones

1. The antenna location should be designed so that the public cannot access areas where the RF radiation exceeds the exposure levels as described above.
2. If there are areas accessible to workers where RF radiation exceeds the levels as described above make sure that workers know where these areas are, and that they can (and do) power-down (or shut down) the transmitters when entering these areas. Such areas may not exist; but if they do, they will be confined to areas within 10 m of the antennas
3. Each Exclusion zone should be defined by a physical barrier and by an easy recognizable sign warning the public or workers that inside the exclusion zone the RF radiation might exceed exposure limits.

### 4.2 Guidelines on Arranging Antenna Sites

1. For roof-mounted antennas, elevate the transmitting antennas above the height of people who may have to be on the roof.
2. For roof-mounted antennas, keep the transmitting antennas away from the areas where people are most likely to be (e.g., roof access points, telephone service points, HVAC equipment).
3. For roof-mounted directional antennas, place the antennas near the periphery and point them away from the building.
4. Consider the trade off between large aperture antennas (lower maximum RF) and small



- aperture antennas (lower visual impact).
5. Take special precautions to keep higher-power antennas away from accessible areas.
  6. Keep antennas at a site as far apart as possible; although this may run contrary to local zoning requirements.
  7. Take special precautions when designing "co-location" sites, where multiple antennas owned by different operators are on the same structure. This applies particularly to sites that include high-power broadcast (FM/TV) antennas and for example co-siting of GSM and CDMA antennas. Local zoning often favors co-location, but co-location can provide "challenging" RF safety problems.
  8. Take special precautions for antenna sites near hospital and schools.