

5.6. RF EXPOSURE REQUIREMENTS [§§ 1.1310 & 2.1091]

5.6.1. Limits

- **FCC 1.1310:-** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
1500-100,000	5.0	6
(B) Limits for General Population/Uncontrolled Exposure				
1500-100,000	1.0	30

5.6.2. Method of Measurements

Refer to FCC @ 1.1310 and 2.1091

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:
 - (1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
 - (2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
 - (3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
 - (4) Any other RF exposure related issues that may affect MPE compliance

- All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

Calculation Method of RF Safety Distance:

$$S = PG/4\pi r^2 = EIRP/4\pi r^2$$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm²
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{PG/4\pi S}$$

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones, an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

5.6.3. Test Data

Antenna Gain Limit specified by Manufacturer:

- Downlink: 5 dBi (Indoor Omni type or similar antenna)
- Uplink: 15 dBi (Outdoor Yagi or similar type directional antenna)

Frequency Band (MHz)	Highest Conducted Power at the Antenna Terminal (dBm)	Maximum Antenna Gain (dBi)	Maximum EIRP (dBm)	Minimum RF Safety Distance r (cm)
Downlink				
1930 – 1990	37.00	5	42.00	35.51
Uplink				
1850 – 1910	25.09	15	40.09	28.50

Remarks:

- (1) The calculation is based on the lowest frequency and the highest conducted power in the frequency band for the worst case.
- (2) The minimum separation distance between the antenna and bodies of users are calculated using the following equation:

$$\text{RF EXPOSURE DISTANCE LIMITS: } r = (PG/4\pi S)^{1/2} = (EIRP/4\pi S)^{1/2}$$

Sample calculation: $EIRP = 42.00 \text{ dBm} = 10^{(42.00/10)} \text{ mW} = 15849 \text{ mW}$
 $S = 1 \text{ mW/cm}^2$ (General Population/ Uncontrolled Exposure)

$$r = (EIRP/4\pi S)^{1/2} = (15849 / 4\pi)^{1/2} = 35.51 \text{ cm}$$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	Compliance with FCC Rules
Minimum calculated separation distance between antenna and persons required: 35.51 cm (Downlink) & 28.50 cm (Uplink)	Manufacturer' instruction for separation distance between antenna and persons required: 36 cm (Downlink) & 29 cm (Uplink)
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	See User's Manual for details.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	See User's Manual for RF Exposure Information.
Any other RF exposure related issues that may affect MPE compliance	None.

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OUTDOOR BDA INSTALLATION PROCEDURE

IMPORTANT: DO NOT APPLY A.C. OR DC POWER TO THE BDA UNTIL CABLES ARE CONNECTED TO BOTH PORTS OF THE BDA AND THE ANTENNAS.

1. Mount the BDA on the structure with the RF connectors pointing DOWN. Using appropriate screws and anchors, attach the BDA to the structure using the six mounting holes on the side flanges.
2. Ensure that the isolation between the donor antenna and the service antenna is at least 12 dB greater than the BDA gain. (Use the higher of the Uplink and Downlink gains reported on the BDA test data sheet).
3. Connect the cable from the donor antenna to the BDA connector labeled "BASE" and the cable from the service antennas to the BDA connector labeled "MOBILE".
4. Open the access door on the BDA and verify that the Uplink and Downlink ALC switches are in their factory preset "ON" positions and attenuation is positioned to its maximum setting.
5. Connect the AC power cord to the BDA and then to the power source. Turn the power switch to its "ON" position. Verify that the "Power On" indicator is lit. Close the access door.

Installation of the BDA is now complete. To adjust the gain controls to suit the specific signal environment, refer to "Outdoor BDA Operation".

Note: For repeat installations of existing equipment, make sure the attenuation is positioned to its maximum setting (30 dB). After verification of the attenuation, follow the above steps starting with step 1.

RF EXPOSURE WARNING

The antenna used for this transmitter must be fixed-mounted on outdoor permanent structures. In order to satisfy the FCC RF exposure requirements, the BDA/antenna installation must comply with the following:

The downlink indoor antenna (Omni type or similar antenna) must be installed so as to provide a minimum separation distance of 0.36 meters (36 cm) between the antenna and persons within the area. (This assumes a typical antenna with maximum gain of [5 dBi, VSWR $> 1.5:1$, $Z_o = 50$ ohms, and a cable attenuation of between 2-10 dB)

The uplink outdoor antenna (Yagi type or similar directional antenna) must be installed so as to provide a minimum separation distance of 0.29 meters (29 cm) between the antenna and persons within the area. (This assumes a typical antenna with maximum gain of [15 dBi, VSWR $> 1.5:1$, $Z_o = 50$ ohms, and a cable attenuation of between 2-10 dB).

Appendix 1: Antenna Gain Guidelines For Compliant Radiation Exposure

FOR

RBDA-PCSX-1/25W-90-A

BI-DIRECTIONAL AMPLIFIERS

To be in compliance with the separation distances between the antennas and persons in the area recommended in the *RF Exposure Warning* section of the BDA manual, installers must be sure to use antennas with isotropic gains less than or equal to those listed in Table 1.

Table 1

**Maximum Antenna Gain for Compliant Radiation
Exposure Levels at
20 cm from Downlink Antenna or 30 cm from Uplink
Antenna**

Frequency Band	Downlink Maximum Ant. Gain (dBi)	Uplink Maximum Ant. Gain (dBi)
PCS A	2	15.5
PCS B	2	15.5
PCS C	2	15.5
PCS D	2	15.5
PCS E	2	15.5
PCS F	2	15.5