

RF Hazard Distance Calculation

1. Introduction

This document proves that the CATC Merlin Bluetooth protocol analyzer does not cause harm to the human body.

The maximum total power input to the antenna has been measured as part of the regular FCC test report for part 15 intentional radiators. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of Maximum Permissible Exposure (MPE; as specified in FCC 1.1310) is reached.

2. Classification

The antenna of the product, under normal use condition, is at least 20 cm away from the body of the user. A warning statement for keeping 20 cm separation distance and the prohibition of operating next to a person has been printed in the users manual. Therefore this product is classified as a **Mobile Device**.

3. RF Exposure Limits

According to 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				
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				
30-300	27.5	0.073	0.2	30
300-1500	...	...	F/1500	30
1500-100,000	...	...	1.0	30

F = Frequency in MHz

4. Friis Formula

$$\text{Friis transmission formula : } P_d = (P_{\text{out}} * G) / (4 * \pi * R^2)$$

where

P_d = power density in mW/cm^2

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

$\pi = 3.1416$

R = distance between observation point and center of the radiator in cm

P_d is the limit of MPE, $1 \text{ mW}/\text{cm}^2$

If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance R where the MPE limit is reached.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

5. Test Results

Max RF Power P_{out} , dBm (mW)	TX Antenna G, dBi (linear)	MPE Safe Distance R, cm	
-4.2 (0.4)	2.00 (1.26)	0.2	Measured value P at antenna connector
4.5 (2.8)	2.00 (1.26)	0.6	Maximum P according to radio datasheet