

Maximum Permissible Exposure Report

1. Product Information

FCC ID:	2AQO7MTCR-001
Product name	Multi-tech Card Reader
Model number	DAC-MTCR-001
Power supply	Input: DC 12V, 350mA
Modulation Type	GFSK for Bluetooth V4.0 (BT LE)
Antenna Type	PCB antenna
Antenna Gain	2.80 dBi (maximum)
Hardware version	HY-254101
Software version	T1CC2541_test.HEX YCKJ_TC_V3.2. hex
Operation frequency	Bluetooth V4.0: 2402MHz-2480MHz
Extreme temp. Tolerance	-20°C to +50°C
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Device Type	Mobile Device

2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Limit

3. 1 Refer evaluation method

[ANSI C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.](#)

[FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06:](#) Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

[FCC CFR 47 part1 1.1310:](#) Radiofrequency radiation exposure limits.

[FCC CFR 47 part2 2.1091:](#) Radiofrequency radiation exposure evaluation: mobile devices

3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
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

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm ²)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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. MPE Calculation Method

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S=power density

P=power input to antenna

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

R=distance to the center of radiation of the antenna

5. Antenna Information

DAC-MTCR-001 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 0	PCBI Antenna	2000 MHz – 2500 MHz	2.80 dBi
Antenna 1	PCBI Antenna	13.56 MHz	0.50 dBi

6. Conducted Power

Test Mode	Channel	Frequency (MHz)	Measured Peak Output Power (dBm)
GFSK	0	2402	-1.263
	19	2440	-2.083
	39	2480	-2.494

Test Mode	Channel	Frequency (MHz)	Field Strength of Fundamental (dBuV/m)
NFC	1	13.56	67.65

7. Manufacturing Tolerance

GFSK (Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	-2.0	-2.0	-2.0
Tolerance \pm (dB)	1.0	1.0	1.0

8. Measurement Results**8.1 Standalone MPE**

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r = 20\text{cm}$, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

Antenna 0

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW					
GFSK	-1.00	0.7943	2.80	1.9055	100%	0.0003	1.0000

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

Antenna 1

According to KDB 412172 D01 Determining ERP and EIRP format;

$$\text{eirp} = p_t \times g_t = (E \times d)^2 / 30$$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$\text{EIRP} = -37.90 \text{ dBm} = 0.000016 \text{ dBm}$

Modulation Type	EIRP Output power		Duty Cycle	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW			
NFC	-27.58	0.0017	100%	<0.0001	0.9789

8.2 Simultaneous Transmission MPE

The sample support one BT modular and NFC modular, they supports difference antenna, need consider simultaneous transmission;

Maximum Simultaneous transmission MPE Ratio for BT and NFC.

Maximum MPE Ratio _{2.4G WLAN}	Maximum MPE Ratio _{NFC}	$\sum \text{MPE ratios}$	Limit	Results
0.0003	<0.0001	<0.1	1.0	PASS

Remark:

1. Output power including tune-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

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