

RF Exposure Evaluation For FCC ID: 2AZF4-S19Y01

Refer user manual this device is a Communication board, and this device was designed used in Mobile devices that the minimum distance between human's body is **20 cm**. Based on the 47CFR 2.1091, this device belongs to Mobile device. The definition of the category as following:

Mobile Derives:

CFR Title 47 §2.1091(b)

(b) For purposes of this section, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons.

FCC KDB 447498 D01 General RF Exposure Guidance v06 Limit

Devices operating in standalone mobile exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When the categorical exclusion provision of § 2.1091(c) applies, the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to FCC Part 1.1307, systems operating under the provisions of this 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.

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)
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f ²)*
30-300	27.5	0.073	0.2
300-1500			f/1500
1500-100,000			1.0

MPE calculation formula

$$S = \frac{PG}{4\pi R^2}$$

Where:

S = power density

P = output power (mW)

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

R = Separation distance between radiator and human body (cm)

Output Power Test Data

GSM				
Mode	GSM 850		GSM 1900	
	Conducted Power (dBm)	Frame-Averaged power (dBm)	Conducted Power (dBm)	Frame-Averaged power (dBm)
GSM (1-Slot) (dBm)	35.00	25.81	32.00	22.81
GPRS (1-Slot) (dBm)	35.00	25.81	32.00	22.81
GPRS (2-Slot) (dBm)	33.50	27.37	30.50	24.37
GPRS (3-Slot) (dBm)	31.50	27.08	28.50	24.08
GPRS (4-Slot) (dBm)	30.50	27.32	27.50	24.32
EGPRS (1-Slot) (dBm)	29.00	19.81	29.00	19.81
EGPRS (2-Slot) (dBm)	28.00	21.87	28.00	21.87
EGPRS (3-Slot) (dBm)	27.00	22.58	26.00	21.58
EGPRS (4-Slot) (dBm)	26.00	22.82	25.00	21.82

Note 1: This report listed the worst case output power value, please refer to report MPE Information Requirements issued by cetecom.

Note 2: The frame-averaged power is linearly proportion to the slot number configured and it is linearly scaled the maximum burst-averaged power based on time slots. The calculated method is shown as below:

Frame-averaged power = Burst averaged power (1 Tx Slot) – 9.19 dB

Frame-averaged power = Burst averaged power (2 Tx Slots) – 6.13 dB

Frame-averaged power = Burst averaged power (3 Tx Slots) - 4.42dB

Frame-averaged power = Burst averaged power (4 Tx Slots) – 3.18 dB

LTE CatM1					
Mode	Band 2	Band 4	Band 5	Band 12	Band 13
Conducted Power (dBm)	22.00	22.00	22.00	22.00	22.00
Mode	Band 25	Band 26	Band 66	Band 85	
Conducted Power (dBm)	22.00	22.00	22.00	22.00	

Note: This report listed the worst case output power value, please refer to report MPE Information Requirements issued by cetecom.

LTE NB2					
Mode	Band 2	Band 4	Band 5	Band 12	Band 13
Conducted Power (dBm)	22.00	22.00	22.00	22.00	22.00
Mode	Band 25	Band 66	Band 85		
Conducted Power (dBm)	22.00	22.00	22.00		

Note: This report listed the worst case output power value, please refer to report MPE Information Requirements issued by cetecom.

Bluetooth	
Mode	BLE
Conducted Power (dBm)	10.00
Antenna Gain(dBi)	1.8
EIRP(dBm)	11.80

Note: This report listed the worst case output power value, please refer to report MPE Information Requirements issued by cetecom.

Bluetooth Assessment result

Mode		Max. EIRP (dBm)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Exposure Ratio (Power Density/ Limit)	Verdict
Bluetooth	BLE	11.80	1.80	20	0.0030	1.000	0.0030	Pass

WWAN Assessment result

Mode		Max. Conducted power (dBm)	EIRP Limit (dBm)	Margin 1 (dB)	Bluetooth Exposure Ratio	WWAN Max. Permissible Exposure Ratio	WWAN Permissible Power Density Limit (mW/cm ²)	WWAN Power Density Exposure Max. Ratio Limit (mW/cm ²)	WWAN Exposure Ratio Max. EIRP (dBm)	Margin 2 (dB)	Final Margin (dB)
GSM	850	25.81	40.601	14.791	0.003	0.997	0.549	0.547	34.393	8.583	8.583
	1900	22.81	33.010	10.200	0.003	0.997	1.000	0.997	37.000	14.190	10.200
GPRS	850(1-Slot)	25.81	40.601	14.791	0.003	0.997	0.549	0.547	34.393	8.583	8.583
	850(2-Slot)	27.37	40.601	13.231	0.003	0.997	0.549	0.547	34.393	7.023	7.023
	850(3-Slot)	27.08	40.601	13.521	0.003	0.997	0.549	0.547	34.393	7.313	7.313
	850(4-Slot)	27.32	40.601	13.281	0.003	0.997	0.549	0.547	34.393	7.073	7.073
	1900(1-Slot)	22.81	33.010	10.200	0.003	0.997	1.000	0.997	37.000	14.190	10.200
	1900(2-Slot)	24.37	33.010	8.640	0.003	0.997	1.000	0.997	37.000	12.630	8.640
	1900(3-Slot)	24.08	33.010	8.930	0.003	0.997	1.000	0.997	37.000	12.920	8.930
	1900(4-Slot)	24.32	33.010	8.690	0.003	0.997	1.000	0.997	37.000	12.680	8.690
LTE CatM1	Band 2	22.00	33.010	11.010	0.003	0.997	1.000	0.997	37.000	15.000	11.010
	Band 4	22.00	30.000	8.000	0.003	0.997	1.000	0.997	37.000	15.000	8.000
	Band 5	22.00	40.601	18.601	0.003	0.997	0.549	0.547	34.393	12.393	12.393
	Band 12	22.00	36.921	14.921	0.003	0.997	0.466	0.465	33.687	11.687	11.687
	Band 13	22.00	36.921	14.921	0.003	0.997	0.518	0.516	34.139	12.139	12.139
	Band 25	22.00	33.010	11.010	0.003	0.997	1.000	0.997	37.000	15.000	11.010
	Band 26	22.00	40.601	18.601	0.003	0.997	0.543	0.541	34.345	12.345	12.345
	Band 66	22.00	30.000	8.000	0.003	0.997	1.000	0.997	37.000	15.000	8.000
	Band 85	22.00	36.921	14.921	0.003	0.997	0.465	0.464	33.678	11.678	11.678
LTE NB2	Band 2	22.00	33.010	11.010	0.003	0.997	1.000	0.997	37.000	15.000	11.010
	Band 4	22.00	30.000	8.000	0.003	0.997	1.000	0.997	37.000	15.000	8.000
	Band 5	22.00	40.601	18.601	0.003	0.997	0.549	0.547	34.393	12.393	12.393
	Band 12	22.00	36.921	14.921	0.003	0.997	0.466	0.465	33.687	11.687	11.687
	Band 13	22.00	36.921	14.921	0.003	0.997	0.518	0.516	34.139	12.139	12.139
	Band 25	22.00	33.010	11.010	0.003	0.997	1.000	0.997	37.000	15.000	11.010
	Band 66	22.00	30.000	8.000	0.003	0.997	1.000	0.997	37.000	15.000	8.000
	Band 85	22.00	36.921	14.921	0.003	0.997	0.465	0.464	33.678	11.678	11.678

Note:

1. The Maximum allowed antenna gain per Band should be less than or equal to the **Final Margin** which is the allowable maximum gain value to comply with limits for maximum permissible exposure (MPE).
2. The Final Margin is determined and selected to the worst-case of Margin1 and Margin2.

3. Margin1=EIRP Limit(dBm)-Maximum Conducted Power (dBm). EIRP limit reference standard part22/ part24/part27and part90 for each band, EIRP = ERP + 2.15 (dB).
4. Margin2=Power density Limit(dBm)-Maximum Conducted Power (dBm). Power density Limit (dBm): The max. obtained by MPE with 20cm.
5. WWAN Max. Permissible Exposure Ratio Limit = 1.0 - Bluetooth Exposure Ratio.

WWAN Maximum Permissible Gain for each frequency band

Mode		Maximum Permissible Gains (dBi)
GSM	850	7.02
	1900	8.64
LTE CatM1	Band 2	11.01
	Band 4	8.00
	Band 5	12.39
	Band 12	11.69
	Band 13	12.14
	Band 25	11.01
	Band 26	12.35
	Band 66	8.00
	Band 85	11.68
LTE NB2	Band 2	11.01
	Band 4	8.00
	Band 5	12.39
	Band 12	11.69
	Band 13	12.14
	Band 25	11.01
	Band 66	8.00
	Band 85	11.68

Note: The maximum permissible gains is determined and selected to the worst-case of Margin1 and Margin2 from the table above.

IMPORTANT NOTE: To comply with the FCC RF exposure compliance requirements, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. No change to the antenna or the device is permitted. Any change to the antenna or the device could result in the device exceeding the RF exposure requirements and void user's authority to operate the device.