

RF Exposure Evaluation for FCC ID: 2AMLFJM-LL03S

Refer user manual this device is a LTE GPS Condition Tracker, and this device was designed used in Mobile devices that the minimum distance between human's body is 20cm. 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)

Test data

GSM		
Mode	GSM 850	GSM 1900
EIRP/ERP (dBm)	32.26	31.60

Note: This report listed the worst case EIRP/ERP power value, please refer to Report No. BL-SZ2160023-501 for more details.

LTE-M1							
Mode	Band 2	Band 4	Band 5	Band 12	Band 13	Band 26	Band 66
EIRP/ERP (dBm)	20.65	20.36	19.86	19.81	19.59	19.37	21.52

Note: This report listed the worst case EIRP/ERP power value, please refer to Report No. BL-SZ2160023-501 for more details.

LTE-NB-IoT						
Mode	Band 2	Band 4	Band 5	Band 12	Band 13	Band 66
EIRP/ERP (dBm)	20.20	20.26	19.40	19.35	19.49	20.77

Note: This report listed the worst case EIRP/ERP power value, please refer to Report No. BL-SZ2160023-501 for more details.

Bluetooth						
Mode	GFSK(BLE 1Mbps)			GFSK(BLE 2Mbps)		
Channel	Low	Mid	High	Low	Mid	High
Peak Power (dBm)	2.86	2.59	1.67	2.87	2.64	1.70
Antenna Gain (dBi)	1.0					
EIRP (dBm)	3.86	3.59	2.67	3.87	3.64	2.70

Note: This report listed the worst case EIRP power value, please refer to Report No. BL-SZ2160023-601 for more details.

2.4G WIFI				
Mode	802.11b	802.11g	802.11n20	802.11n40
Peak Power (dBm)	18.47	22.26	22.46	22.24
Antenna Gain (dBi)	1.0			
EIRP (dBm)	19.47	23.26	23.46	23.24

Note: This report listed the worst case EIRP power value, please refer to Report No. BL-SZ2160023-602 for more details.

5G WIFI						
Test Band	U-NII-1			U-NII-2A		
Mode	802.11a	802.11n20	802.11n40	802.11a	802.11n20	802.11n40
Conducted Power (dBm)	14.90	14.84	15.05	15.20	15.16	15.21
Antenna Gain (dBi)	1.0					
EIRP (dBm)	15.90	15.84	16.05	16.20	16.16	16.21
Test Band	U-NII-2C			U-NII-3		
Mode	802.11a	802.11n20	802.11n40	802.11a	802.11n20	802.11n40
Conducted Power (dBm)	15.07	15.11	15.51	15.16	15.26	15.25
Antenna Gain (dBi)	1.0					
EIRP (dBm)	16.07	16.11	16.51	16.16	16.26	16.25

Note: This report listed the worst case EIRP power value, please refer to Report No. BL-SZ2160023-603 for more details.

Tune-up power

Mode		Range
GSM	GSM 850	24.50-32.50
	GSM 1900	26.50-32.00
LTE-M1	Band 2	18.00-21.00
	Band 4	17.50-20.50
	Band 5	17.00-20.00
	Band 12	17.00-20.00
	Band 13	18.00-20.00
	Band 26	16.50-19.50
	Band 66	18.00-22.00
LTE-NB-IoT	Band 2	18.00-20.50
	Band 4	17.50-20.50
	Band 5	17.00-19.50
	Band 12	16.50-19.50
	Band 13	17.00-19.50
	Band 66	18.50-21.00
Bluetooth		2.00-4.00
2.4G WIFI		19.00-23.50
5G WIFI	U-NII-1	14.50-16.50
	U-NII-2A	14.50-16.50
	U-NII-2C	15.00-17.00
	U-NII-3	14.50-16.50

Test result

Evolution mode		Maximum EIRP/ERP power (dBm)	Antenna Gain (dBi)	Total Power (mw)	Distance (cm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Power Density / Limit	Verdict
GSM	GSM 850	32.50	2.5	1778.28	20	0.354	0.549	0.645	Pass
	GSM 1900	32.00	2.0	1584.89	20	0.315	1.000	0.315	Pass
LTE-M1	Band 2	21.00	2.0	125.89	20	0.025	1.000	0.025	Pass
	Band 4	20.50	1.8	112.20	20	0.022	1.000	0.022	Pass
	Band 5	20.00	2.5	100.00	20	0.020	0.549	0.036	Pass
	Band 12	20.00	2.9	100.00	20	0.020	0.466	0.043	Pass
	Band 13	20.00	2.6	100.00	20	0.020	0.518	0.039	Pass
	Band 26	19.50	2.5	89.13	20	0.018	0.543	0.033	Pass
	Band 66	22.00	2.4	158.49	20	0.032	1.000	0.032	Pass
LTE-NB-IoT	Band 2	20.50	2.0	112.20	20	0.022	1.000	0.022	Pass
	Band 4	20.50	1.8	112.20	20	0.022	1.000	0.022	Pass
	Band 5	19.50	2.5	89.13	20	0.018	0.549	0.033	Pass
	Band 12	19.50	2.9	89.13	20	0.018	0.466	0.039	Pass
	Band 13	19.50	2.6	89.13	20	0.018	0.518	0.035	Pass
	Band 66	21.00	2.4	125.89	20	0.025	1.000	0.025	Pass
Bluetooth		4.00	1.0	2.51	20	0.001	1.000	0.001	Pass
2.4G WIFI		23.50	1.0	223.87	20	0.045	1.000	0.045	Pass
5G WIFI	U-NII-1	16.50	1.0	44.67	20	0.009	1.000	0.009	Pass
	U-NII-2A	16.50	1.0	44.67	20	0.009	1.000	0.009	Pass
	U-NII-2C	17.00	1.0	50.12	20	0.010	1.000	0.010	Pass
	U-NII-3	16.50	1.0	44.67	20	0.009	1.000	0.009	Pass

Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of WWAN + Bluetooth	Verdict
GSM 850	824MHz ~ 849MHz	0.645	0.646	Pass
Bluetooth	2400MHz ~ 2483.5MHz	0.001		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	Σ (Power Density / Limit) of WWAN + WLAN	Verdict
GSM 850	824MHz ~ 849MHz	0.645	0.690	Pass
2.4G WIFI	2412MHz ~ 2462MHz	0.045		Pass

Note:

1. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WWAN + WLAN or WWAN + Bluetooth.
2. Both of the WWAN and WLAN or Bluetooth can transmit simultaneously, the formula of calculated the MPE is
CPD1 / LPD1 + CPD2 / LPD2 +etc. < 1
CPD = Calculation power density
LPD = Limit of power density
3. Both of the 2.4GHz and 5GHz can't transmit simultaneously at same time.
4. The worst-case situation is 0.690, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.
5. More power list please refer to RF test report.

Conclusion:

RF exposure Evaluation Results: **Compliance**