

## **RF Exposure Evaluation For FCC ID: 2AKNO-CT200LTE50**

Refer user manual this device is a CENTAURI 200 Enterprise/Industrial IoT Gateway, 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  $\geq 20$  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 the 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 <sup>2</sup> )
0.3-1.34	614	1.63	(100)*
1.34-30	824/f	2.19/f	(180/f <sup>2</sup> )*
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

LTE					
Mode	Band 2	Band 4	Band 5	Band 12	Band 13
EIRP/ERP (dBm)	26.209	26.007	22.859	24.052	19.776
Note: This report listed the worst case EIRP/ERP value, please refer to RF test report for more details.					

Bluetooth			
Mode	BLE		
	Low	Middle	High
EIRP/ERP (dBm)	9.292	9.105	9.044
Note: This report listed the worst case EIRP/ERP value, please refer to RF test report for more details.			

WIFI									
Mode	802.11b			802.11g			802.11n20		
	Low	Middle	High	Low	Middle	High	Low	Middle	High
EIRP/ERP (dBm)	17.18	16.74	16.46	22.80	22.52	22.64	22.82	22.71	22.69

Note: This report listed the worst case EIRP/ERP value, please refer to RF test report for more details.

Z-Wave			
With filter			
Mode	Low	Middle	High
EIRP/ERP (dBm)	-2.011	-2.093	-4.134
Without filter			
Mode	Low	Middle	High
EIRP/ERP (dBm)	-0.120	-0.370	0.120

### Tune-up power

Mode		Range (dBm)
LTE	Band 2	22.50-26.50
	Band 4	23.00-26.50
	Band 5	20.00-23.00
	Band 12	21.00-24.50
	Band 13	18.00-20.00
Bluetooth		9.00-9.50
2.4G WIFI	802.11b	16.00-17.50
	802.11g	22.50-23.00
	802.11n20	22.50-23.00
Z-Wave		(-5.00)-1.00

### Test result

Evolution mode	Maximum EIRP/ERP (dBm)	Antenna Gain (typical) (dBi)	Total Power (mw)	Distance (cm)	Limit of Power Density (mW/cm <sup>2</sup> )	Power Density (mW/cm <sup>2</sup> )	Power Density/Limit	Verdict
LTE Band 2	26.50	4.0	446.68	20	1.00	0.0889	0.0889	Pass
LTE Band 4	26.50	4.0	446.68	20	1.00	0.0889	0.0889	Pass
LTE Band 5	23.00	4.0	199.53	20	0.55	0.0397	0.0722	Pass
LTE Band 12	24.50	4.0	281.84	20	0.47	0.0561	0.1193	Pass
LTE Band 13	20.00	4.0	100.00	20	0.50	0.0199	0.0398	Pass
Bluetooth	9.50	4.0	8.91	20	1.00	0.0018	0.0018	Pass
WIFI	23.00	3.2	199.53	20	1.00	0.0397	0.0397	Pass
Z-Wave	1.00	1.0	1.26	20	0.61	0.0003	0.0005	Pass

### Collocated Power Density Calculation

Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of LTE + Bluetooth	Verdict
LTE Band 2	1850 MHz ~ 1910 MHz	0.0889	0.0907	Pass
Bluetooth	2400 MHz ~ 2483.5 MHz	0.0018		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of LTE + WIFI	Verdict
LTE Band 2	1850 MHz ~ 1910 MHz	0.0889	<b>0.1286</b>	Pass
WIFI	2400 MHz ~ 2483.5 MHz	0.0397		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of Bluetooth + WIFI	Verdict
Bluetooth	2400 MHz ~ 2483.5 MHz	0.0018	0.0415	Pass
WIFI	2400 MHz ~ 2483.5 MHz	0.0397		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of LTE + Z-Wave	Verdict
LTE Band 2	1850 MHz ~ 1910 MHz	0.0889	0.0894	Pass
Z-Wave	908.40 MHz ~ 916.00 MHz	0.0005		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of Bluetooth + Z-Wave	Verdict
Bluetooth	2400 MHz ~ 2483.5 MHz	0.0018	0.0023	Pass
Z-Wave	908.40 MHz ~ 916.00 MHz	0.0005		Pass
Evolution mode	Frequency(MHz)	Power Density/Limit	$\Sigma$ (Power Density / Limit) of WIFI + Z-Wave	Verdict
WIFI	2400 MHz ~ 2483.5 MHz	0.0397	0.0403	Pass
Z-Wave	908.40 MHz ~ 916.00 MHz	0.0005		Pass

#### Note:

- $\Sigma$  (Power Density / Limit): This is a summation of [(power density for each transmitter/ antenna included in the simultaneous transmission)/ (corresponding MPE limit)].
- The formula of calculated the MPE is  

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density  
LPD = Limit of power density
- The worst-case situation is 0.1286, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.
- The CENTAURI 200 Enterprise/Industrial IoT Gateway work frequency range used is 1850 MHz ~ 1910 MHz, 2400 MHz ~ 2483.5 and 908.40 MHz ~ 916.00 MHz the result close to the limit by the above formula so, we select worst case power to calculate the exclusion power threshold.
- More power list please refer to RF test report.

**Conclusion:**

RF exposure Evaluation Results: **Compliance**