

1. RF Exposure Requirements

1.1 General Information

Client Information

Applicant: ST Engineering Urban Solutions Ltd.
Address of applicant: 100 Jurong East Street 21. Singapore 609602

Manufacturer: ZHEJIANG FONDA TECHNOLOGY CO.,LTD
Address of manufacturer: 9TH FLOOR SHUYU BUILDING, NO.98 WENYI WEST ROAD, XIHU DISTRICT, HANGZHOU, ZHEJIANG, CHINA

General Description of EUT:

Product Name: NBIoT Meter Interface Unit
Trade Name: AGIL
Model No.: AGIL WRPMIU 301
Adding Model(s): /
Rated Voltage: DC3.6V
Battery: Built-in battery DC3.6V
Battery: /
Adapter Model: /
FCC ID: 2BEVP-AGILWRPMIU301
Equipment Type: Mobile device

Technical Characteristics of EUT:	
4G	
Support Networks:	FDD-LTE
Support Band:	FDD-LTE Band 2, 4, 5, 12, 13, 17, 25, 66
Uplink Frequency:	FDD-LTE Band 2: Tx: 1850-1910MHz, FDD-LTE Band 4: Tx: 1710-1755MHz, FDD-LTE Band 5: Tx: 824-849MHz, FDD-LTE Band 12: Tx: 699-716MHz, FDD-LTE Band 13: Tx: 777-787MHz, FDD-LTE Band 17: Tx: 704-716MHz FDD-LTE Band 25: Tx: 1850-1915MHz FDD-LTE Band 66:Tx: 1710-1780MHz
Downlink Frequency:	FDD-LTE Band 2: Rx: 1930-1990MHz, FDD-LTE Band 4: Rx: 2110-2155MHz, FDD-LTE Band 5: Rx: 869-894MHz, FDD-LTE Band 12: Rx: 729-746MHz, FDD-LTE Band 13: Rx: 746-756MHz, FDD-LTE Band 17: Rx: 734-746MHz FDD-LTE Band 25: Rx: 1930-1995MHz FDD-LTE Band 66: Rx: 2110-2200MHz

RF Output Power:	FDD-LTE Band 2: 23.42dBm, FDD-LTE Band 4: 23.85dBm, FDD-LTE Band 5: 23.98dBm, FDD-LTE Band 12: 24.07dBm, FDD-LTE Band 13: 23.92dBm, FDD-LTE Band 17: 24.12dBm FDD-LTE Band 25: 23.63dBm, FDD-LTE Band 66: 24.08dBm
Type of Emission:	FDD-LTE Band 2: 177KG7D, 177KW7D FDD-LTE Band 4: 179KG7D, 179KW7D FDD-LTE Band 5: 178KG7D, 178KW7D FDD-LTE Band 12: 178KG7D, 178KW7D FDD-LTE Band13: 177KG7D, 177KW7D FDD-LTE Band 17: 177KG7D, 177KW7D FDD-LTE Band 25: 177KG7D, 177KW7D FDD-LTE Band 66: 179KG7D, 179KW7D
Type of Modulation:	BPSK, QPSK
Antenna Type:	Integral Antenna
Antenna Gain:	FDD-LTE Band 2: 4.18dBi, FDD-LTE Band 4: 3.5dBi, FDD-LTE Band 5: 3.12dBi, FDD-LTE Band 12: -1.52dBi, FDD-LTE Band 13: 2.90dBi, FDD-LTE Band 17: -1.52dBi FDD-LTE Band 25: 4.18dBi FDD-LTE Band 66: 3.68dBi
<i>Note: The Antenna Gain is provided by the customer and can affect the validity of results.</i>	

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and KDB 447498 D04 Interim General RF Exposure Guidance v01, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Option A: FCC Rule Part 1.1307 (b)(3)(i)(A): The available maximum time-averaged power is no more than 1mW, regardless of separation distance.

Option B: FCC Rule Part 1.1307 (b)(3)(i)(B): The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. P_{th} is given by:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases}$$

Where

$$x = -\log_{10} \left(\frac{60}{ERP_{20 \text{ cm}} \sqrt{f}} \right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases}$$

d = the separation distance (cm);

Option C: FCC Rule Part 1.1307 (b)(3)(i)(C): The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	$1,920 R^2$
1.34-30	$3,450 R^2/f^2$
30-300	$3.83 R^2$
300-1,500	$0.0128 R^{2f}$
1,500-100,000	$19.2R^2$

For Multiple RF sources: FCC Rule Part 1.1307(b)(3)(ii):

- (A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).
- (B) In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{Exposure Limit_k} \leq 1$$

1.3 Calculated Result

Radio Access Technology	Prediction Frequency	Output Power	Antenna Gain	Tune-up Power	ERP
	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)
LTE Band 2	1850	23.42	4.18	24.00	26.03
LTE Band 4	1710	23.85	3.5	24.00	25.35
LTE Band 5	824	23.98	3.12	24.00	24.97
LTE Band 12	699	24.07	-1.52	24.50	20.83
LTE Band 13	777	23.92	2.90	24.00	24.75
LTE Band 17	704	24.12	-1.52	24.50	20.83
LTE Band 25	1850	23.63	4.18	24.00	26.03
LTE Band 66	1710	24.08	3.68	24.50	26.03

Radio Access Technology	Option	Min. Distance	Max. Power		Exposure Limit	Ratio	Result
		(cm)	(dBm)	(mW)	(mW)		Pass/Fail
LTE Band 2	C	20.00	26.03	400.87	768.00	0.52	Pass
LTE Band 4	C	20.00	25.35	342.77	768.00	0.45	Pass
LTE Band 5	C	20.00	24.97	314.05	421.89	0.74	Pass
LTE Band 12	C	20.00	20.83	121.06	357.89	0.34	Pass
LTE Band 13	C	20.00	24.75	298.54	397.82	0.75	Pass
LTE Band 17	C	20.00	20.83	121.06	360.45	0.34	Pass
LTE Band 25	C	20.00	26.03	400.87	768.00	0.52	Pass
LTE Band 66	C	20.00	26.03	400.87	768.00	0.52	Pass

Note: 1. Tune-up time-average power = Tune-up Power - Duty cycle factor in dB

2. Output Power=EIRP- Antenna Gain; ERP=EIRP-2.15dB

3. Option A, B and C refers as clause 1.2.

4. For option B, Max (time-averaged power, effective radiated power (ERP)) converts to Max. Power. For

option C, ERP converts to Max. Power;

5. For option B, P_{th} (mW) converts to Exposure Limit (mW); For option C, ERP (W) converts to Exposure Limit (mW).

6. Ratio= Tune-up ERP (mW)/ Exposure Limit (mW)

Mode for Simultaneous Multi-band Transmission:

Radio Access Technology	Ratio 1	Ratio 2	Simultaneous Ratio	Limit	Result
					Pass/Fail
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Result: Pass