RF Exposure Evaluation Report

APPLICANT	:	**Fibocom Wireless Inc**
EQUIPMENT	:	**LTE module**
BRAND NAME	:	**Fibocom**
MODEL NAME	:	**NL668-AM-00**
FCC ID	:	**ZMONL668AM00**
STANDARD	:	**47 CFR Part 2.1091** **FCC KDB 447498 D01 v06**

We, Sporton International (Shenzhen) Inc., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and FCC KDB 447498 D01 v06, and pass the limit. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.

Mark Qu

Approved by: Mark Qu / Manager

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TESTING
NVLAP LAB CODE 600156-0

Sporton International (Shenzhen) Inc.
1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China

Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA8O1914	Rev. 01	Initial issue of report	Nov. 28, 2018

1. Administration Data

1.1. Testing Laboratory

Testing Laboratory	
Test Site	Sporton International (Shenzhen) Inc.
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen City, Guangdong Province 518055, China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595

Applicant	
Company Name	Fibocom Wireless Inc
Address	5/F, Tower A, Technology Building II, 1057 Nanhai Avenue, Shenzhen, China

Manufacturer	
Company Name	Fibocom Wireless Inc
Address	5/F, Tower A, Technology Building II, 1057 Nanhai Avenue, Shenzhen, China

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	LTE module
Brand Name	Fibocom
Model Name	NL668-AM-00
FCC ID	ZMONL668AM00
IMEI Code	866857032754141
Wireless Technology and Frequency Range	WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WCDMA Band IV: 1712.4 MHz ~ 1752.6 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz LTE Band 2: 1850.7 MHz ~ 1909.3 MHz LTE Band 4: 1710.7 MHz ~ 1754.3 MHz LTE Band 5: 824.7 MHz ~ 848.3 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 66: 1710.7 MHz ~1779.3 MHz LTE Band 71: 665.5 MHz ~ 695.5MHz
Mode	• RMC12.2Kbps • HSDPA • HSUPA • DC-HSDPA • HSPA+(16QAM uplink is not supported) • LTE
Antenna Type	Dipole Antenna
HW Version	V1.0.1
SW Version	19006.1000.00.02.77.07
EUT Stage	Production Unit
Note: This device has no voice function	

3. Maximum RF average output power among production units

Mode	Average Power (dBm)		
	WCDMA Band II	WCDMA Band IV	WCDMA Band V
RMC 12.2Kbps	24.50	24.50	24.50
HSDPA Subtest-1	24.00	23.50	24.00
HSDPA Subtest-2	24.00	23.50	24.00
HSDPA Subtest-3	23.50	23.00	23.50
HSDPA Subtest-4	23.50	23.00	23.50
DC-HSDPA Subtest-1	24.00	23.50	24.00
DC-HSDPA Subtest-2	24.00	23.50	24.00
DC-HSDPA Subtest-3	23.50	23.00	23.50
DC-HSDPA Subtest-4	23.50	23.00	23.50
HSUPA Subtest-1	24.00	23.50	24.00
HSUPA Subtest-2	22.00	21.50	22.00
HSUPA Subtest-3	23.00	22.50	23.00
HSUPA Subtest-4	22.00	21.50	22.00
HSUPA Subtest-5	24.00	23.50	24.00

Average Power (dBm)											
Modulation	BW (MHz)	RB size	MPR	LTE Band 2	LTE Band 4	LTE Band 5	LTE Band 12	LTE Band 13	LTE Band 17	LTE Band 66	LTE Band 71
QPSK	20	≤ 18	0	24.00	24.00					24.00	24.00
QPSK	20	> 18	0-1	23.00	23.00					23.00	23.00
16QAM	20	≤ 18	0-1	23.00	23.00					23.00	23.00
16QAM	20	> 18	0-2	22.00	22.00					22.00	22.00
QPSK	15	≤ 16	0	24.00	24.00					24.00	24.00
QPSK	15	> 16	0-1	23.00	23.00					23.00	23.00
16QAM	15	≤ 16	0-1	23.00	23.00					23.00	23.00
16QAM	15	> 16	0-2	22.00	22.00					22.00	22.00
QPSK	10	≤ 12	0	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
QPSK	10	> 12	0-1	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
16QAM	10	≤ 12	0-1	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
16QAM	10	> 12	0-2	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
QPSK	5	≤ 8	0	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
QPSK	5	> 8	0-1	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
16QAM	5	≤ 8	0-1	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00
16QAM	5	> 8	0-2	22.00	22.00	22.00	22.00	22.00	22.00	22.00	22.00
QPSK	3	≤ 4	0	24.00	24.00	24.00	24.00			24.00	
QPSK	3	> 4	0-1	23.00	23.00	23.00	23.00			23.00	
16QAM	3	≤ 4	0-1	23.00	23.00	23.00	23.00			23.00	
16QAM	3	> 4	0-2	22.00	22.00	22.00	22.00			22.00	
QPSK	1.4	≤ 5	0	24.00	24.00	24.00	24.00			24.00	
QPSK	1.4	> 5	0-1	23.00	23.00	23.00	23.00			23.00	
16QAM	1.4	≤ 5	0-1	23.00	23.00	23.00	23.00			23.00	
16QAM	1.4	> 5	0-2	22.00	22.00	22.00	22.00			22.00	

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

The MPE was calculated at 20 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Maximum Output Power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
WCDMA Band II	1852.4	7.00	24.50	31.50	1.41	2.00	1584.89	0.315	1.000
WCDMA Band IV	1712.4	5.00	24.50	29.50	0.89	1.00	891.25	0.177	1.000
WCDMA Band V	826.4	7.00	24.50	31.50	1.41	7.00	1412.54	0.281	0.551
LTE Band 2	1850.7	7.00	24.00	31.00	1.26	2.00	1258.93	0.251	1.000
LTE Band 4	1710.7	5.00	24.00	29.00	0.79	1.00	891.25	0.158	1.000
LTE Band 5	824.7	7.00	24.00	31.00	1.26	7.00	1258.93	0.251	0.550
LTE Band 12	699.7	7.00	24.00	31.00	1.26	3.00	1258.93	0.251	0.466
LTE Band 17	706.5	7.00	24.00	31.00	1.26	3.00	1258.93	0.251	0.471
LTE Band 13	779.5	7.00	24.00	31.00	1.26	3.00	1258.93	0.251	0.520
LTE Band 66	1710.7	5.00	24.00	29.00	0.79	2.00	891.25	0.158	1.000
LTE Band 71	665.5	7.00	24.00	31.00	1.26	2.00	1258.93	0.251	0.444

5.2. Collocated Power Density Calculation

General Note:

1. This MPE analysis is applicable to any collocated transmitters with EIRP for WLAN is less than or equal to 29dBm and EIRP for Bluetooth is less than or equal to 28dBm.
2. A maximum antenna gain of 6dBi for WLAN/BT has been assumed for all collocated antennas.

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit
WCDMA Band II	1852.4	5.00	24.50	29.5	891.25	0.177	1.000	0.177
WCDMA Band IV	1712.4	5.00	24.50	29.5	891.25	0.177	1.000	0.177
WCDMA Band V	826.4	4.50	24.50	29.0	794.33	0.158	0.551	0.287
LTE Band 2	1850.7	5.00	24.00	29.0	794.33	0.158	1.000	0.158
LTE Band 4	1710.7	5.00	24.00	29.0	794.33	0.158	1.000	0.158
LTE Band 5	824.7	4.50	24.00	28.5	707.95	0.141	0.550	0.256
LTE Band 12	699.7	7.00	24.00	31.0	1258.93	0.251	0.466	0.537
LTE Band 17	706.5	7.00	24.00	31.0	1258.93	0.251	0.471	0.532
LTE Band 13	779.5	7.00	24.00	31.0	1258.93	0.251	0.520	0.482
LTE Band 66	1710.7	5.00	24.00	29.0	794.33	0.158	1.000	0.158
LTE Band 71	665.5	7.00	24.00	31.0	1258.93	0.251	0.444	**0.565**
WLNA2.4GHz Band	2412	6.0	23.0	29.0	794.33	0.158	1.000	**0.158**
WLNA5GHz Band	5180	6.0	23.0	29.0	794.33	0.158	1.000	**0.158**
Bluetooth	2402	6.0	22.0	28.0	630.96	0.126	1.000	**0.126**

<Collocated analysis>

General Note:

1. For colocation analysis, LTE Band 71 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. ∑(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 + Bluetooth
3. Considering the WWAN module collocation with the other transmitters of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 3 collocated transmitters is compliant.

Max WWAN Power Density / Limit	Max WLAN Power Density / Limit	Max Bluetooth Power Density / Limit	∑(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.565	0.158	0.126	0.849

Conclusion:

Based on 47 CFR §2.1091 and FCC KDB 447498 D01 v06, the analysis concludes that this product when transmitting in standalone within a host device, is compliant with the FCC RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits for each given frequency band per wireless technology as follow table:

Device	Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Stanalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
NL668-AM-00	WCDMA	1852.4	24.50	7.00	5.00
		1712.4	24.50	5.00	5.00
		826.4	24.50	7.00	4.50
	LTE Band 2	1850.7	24.00	7.00	5.00
	LTE Band 4	1710.7	24.00	5.00	5.00
	LTE Band 5	824.7	24.00	7.00	4.50
	LTE Band 12	699.7	24.00	7.00	7.00
	LTE Band 13	779.5	24.00	7.00	7.00
	LTE Band 66	1710.7	24.00	5.00	5.00
	LTE Band 71	665.5	24.00	7.00	7.00
Collocated Transmitters	WLNA2.4GHz Band	2412	23.0		6.0
	WLNA5GHz Band	5180	23.0		6.0
	Bluetooth	2402	22.0		6.0