

RF Exposure Evaluation Report

APPLICANT : Quectel Wireless Solutions Co., Ltd
EQUIPMENT : LTE Module
BRAND NAME : Quectel
MODEL NAME : AG35-NA
FCC ID : XMR201905AG35NA
STANDARD : 47 CFR Part 2.1091
FCC KDB 447498 D01 v06

We, Sporton International (Kunshan) 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 (Kunshan) Inc., the test report shall not be reproduced except in full.



Approved by: Mark Qu / Manager



Sporton International (Kunshan) Inc.
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**Revision History**

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA912203	Rev. 01	Initial issue of report	Apr. 09, 2019

**1. Administration Data****1.1. Testing Laboratory**

Testing Laboratory	
Test Site	Sporton International (Kunshan) Inc.
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China TEL : 86-512-57900158 FAX : 86-512-57900958

Applicant	
Company Name	Quectel Wireless Solutions Co., Ltd
Address	7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China

Manufacturer	
Company Name	Quectel Wireless Solutions Co., Ltd
Address	7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China

**2. Description of Equipment Under Test (EUT)**

Product Feature & Specification	
EUT Type	LTE Module
Brand Name	Quectel
Model Name	AG35-NA
FCC ID	XMR201905AG35NA
IMEI Code	864506031013023
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz 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 7: 2502.5 MHz ~ 2567.5 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz
Mode	GSM/GPRS/EGPRS RMC/AMR 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ (downlink only) LTE: QPSK, 16QAM, 64QAM (downlink only)
HW Version	V3.1
SW Version	AG35NAVAMR08A01T4G
EUT Stage	Identical Prototype
Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.	

**3. Maximum RF average output power among production units****<GSM>**

Mode	Burst Average Power (dBm)	
	GSM 850	GSM 1900
GSM 1 Tx slot	34.00	30.50
GPRS 1 Tx slot	34.00	30.50
GPRS 2 Tx slots	32.50	30.50
GPRS 3 Tx slots	30.50	29.00
GPRS 4 Tx slots	30.00	28.00
EDGE 1 Tx slot	28.00	27.00
EDGE 2 Tx slots	27.00	24.50
EDGE 3 Tx slots	25.50	25.00
EDGE 4 Tx slots	24.50	24.00

<WCDMA>

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

<LTE>

Average Power (dBm)										
Modulation	BW (MHz)	RB Size	Target MPR	LTE Band 2	LTE Band 4	LTE Band 5	LTE Band 7	LTE Band 12	LTE Band 13	LTE Band 17
QPSK	20	≤ 18	0	24.00	24.50		24.00			
QPSK	20	> 18	0-1	23.00	23.50		23.00			
16QAM	20	≤ 18	0-1	23.00	23.50		23.00			
16QAM	20	> 18	0-2	22.00	22.50		22.00			
QPSK	15	≤ 16	0	24.00	24.50		24.00			
QPSK	15	> 16	0-1	23.00	23.50		23.00			
16QAM	15	≤ 16	0-1	23.00	23.50		23.00			
16QAM	15	> 16	0-2	22.00	22.50		22.00			
QPSK	10	≤ 12	0	24.00	24.50	24.50	24.00	24.00	24.00	24.00
QPSK	10	> 12	0-1	23.00	23.50	23.50	23.00	23.00	23.00	23.00
16QAM	10	≤ 12	0-1	23.00	23.50	23.50	23.00	23.00	23.00	23.00
16QAM	10	> 12	0-2	22.00	22.50	22.50	22.00	22.00	22.00	22.00
QPSK	5	≤ 8	0	24.00	24.50	24.50	24.00	24.00	24.00	24.00
QPSK	5	> 8	0-1	23.00	23.50	23.50	23.00	23.00	23.00	23.00
16QAM	5	≤ 8	0-1	23.00	23.50	23.50	23.00	23.00	23.00	23.00
16QAM	5	> 8	0-2	22.00	22.50	22.50	22.00	22.00	22.00	22.00
QPSK	3	≤ 4	0	24.00	24.50	24.50		24.00		
QPSK	3	> 4	0-1	23.00	23.50	23.50		23.00		
16QAM	3	≤ 4	0-1	23.00	23.50	23.50		23.00		
16QAM	3	> 4	0-2	22.00	22.50	22.50		22.00		
QPSK	1.4	≤ 5	0	24.00	24.50	24.50		24.00		
QPSK	1.4	> 5	0-1	23.00	23.50	23.50		23.00		
16QAM	1.4	≤ 5	0-1	23.00	23.50	23.50		23.00		
16QAM	1.4	> 5	0-2	22.00	22.50	22.50		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/f ²)	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/f ²)	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)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)
GSM 850 (1 Tx slot)	824.2	4.00	34.00	38.00	6.31	794.33	0.158	0.549
GPRS 850 (1 Tx slot)	824.2	4.00	34.00	38.00	6.31	794.33	0.158	0.549
GPRS 850 (2 Tx slots)	824.2	4.00	32.50	36.50	4.47	1116.71	0.222	0.549
GPRS 850 (3 Tx slots)	824.2	4.00	30.50	34.50	1.72	1056.82	0.210	0.549
GPRS 850 (4 Tx slots)	824.2	4.00	30.00	34.00	1.53	1258.93	0.251	0.549
EGPRS 850 (1 Tx slot)	824.2	4.00	28.00	32.00	0.97	199.53	0.040	0.549
EGPRS 850 (2 Tx slots)	824.2	4.00	27.00	31.00	1.26	314.73	0.063	0.549
EGPRS 850 (3 Tx slots)	824.2	4.00	25.50	29.50	0.89	334.22	0.067	0.549
EGPRS 850 (4 Tx slots)	824.2	4.00	24.50	28.50	0.71	353.97	0.070	0.549
GSM 1900 (1 Tx slot)	1850.2	2.00	30.50	32.50	1.78	223.87	0.045	1.000
GPRS 1900 (1 Tx slot)	1850.2	2.00	30.50	32.50	1.78	223.87	0.045	1.000
GPRS 1900 (2 Tx slots)	1850.2	2.00	30.50	32.50	1.78	444.57	0.088	1.000
GPRS 1900 (3 Tx slots)	1850.2	2.00	29.00	31.00	1.26	472.06	0.094	1.000
GPRS 1900 (4 Tx slots)	1850.2	2.00	28.00	30.00	1.00	501.19	0.100	1.000
EGPRS 1900 (1 Tx slot)	1850.2	2.00	27.00	29.00	0.79	100.00	0.020	1.000
EGPRS 1900 (2 Tx slots)	1850.2	2.00	24.50	26.50	0.45	111.67	0.022	1.000
EGPRS 1900 (3 Tx slots)	1850.2	2.00	25.00	27.00	0.50	187.95	0.037	1.000
EGPRS 1900 (4 Tx slots)	1850.2	2.00	24.00	26.00	0.40	199.05	0.040	1.000
WCDMA Band 2	1852.4	2.00	24.50	26.50	0.45	446.68	0.089	1.000
WCDMA Band 4	1712.4	5.00	24.50	29.50	0.89	891.25	0.177	1.000
WCDMA Band 5	826.4	4.00	24.50	28.50	0.71	707.95	0.141	0.551
LTE Band 2	1850.7	2.00	24.00	26.00	0.40	398.11	0.079	1.000
LTE Band 4	1710.7	5.00	24.50	29.50	0.89	891.25	0.177	1.000
LTE Band 5	824.7	4.00	24.50	28.50	0.71	707.95	0.141	0.550
LTE Band 7	2502.5	8.00	24.00	32.00	1.58	1584.89	0.315	1.000
LTE Band 12	699.7	8.00	24.00	32.00	1.58	1584.89	0.315	0.466
LTE Band 13	779.5	8.00	24.00	32.00	1.58	1584.89	0.315	0.520
LTE Band 17	706.5	8.00	24.00	32.00	1.58	1584.89	0.315	0.471

Note: For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.

5.2. Collocated Power Density Calculation

Note:

1. This MPE analysis is applicable to any collocated transmitters with transmit power for WLAN is less than or equal to 28dBm and for Bluetooth is less than or equal to 27dBm.
2. A maximum antenna gain of 5dBi for WLAN/BT has been assumed for all collocated antennas.

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm ²)	Limit (mW/cm ²)	Power Density / Limit
GSM 850 (1 Tx slot)	824.2	1.50	34.00	35.50	3.55	446.68	0.089	0.549	0.162
GPRS 850 (1 Tx slot)	824.2	1.50	34.00	35.50	3.55	446.68	0.089	0.549	0.162
GPRS 850 (2 Tx slots)	824.2	1.50	32.50	34.00	2.51	627.97	0.125	0.549	0.227
GPRS 850 (3 Tx slots)	824.2	1.50	30.50	32.00	1.58	594.29	0.118	0.549	0.215
GPRS 850 (4 Tx slots)	824.2	1.50	30.00	31.50	1.41	707.95	0.141	0.549	0.256
EGPRS 850 (1 Tx slot)	824.2	1.50	28.00	29.50	0.89	112.20	0.022	0.549	0.041
EGPRS 850 (2 Tx slots)	824.2	1.50	27.00	28.50	0.71	176.99	0.035	0.549	0.064
EGPRS 850 (3 Tx slots)	824.2	1.50	25.50	27.00	0.50	187.95	0.037	0.549	0.068
EGPRS 850 (4 Tx slots)	824.2	1.50	24.50	26.00	0.40	199.05	0.040	0.549	0.072
GSM 1900 (1 Tx slot)	1850.2	2.00	30.50	32.50	1.78	223.87	0.045	1.000	0.045
GPRS 1900 (1 Tx slot)	1850.2	2.00	30.50	32.50	1.78	223.87	0.045	1.000	0.045
GPRS 1900 (2 Tx slots)	1850.2	2.00	30.50	32.50	1.78	444.57	0.088	1.000	0.088
GPRS 1900 (3 Tx slots)	1850.2	2.00	29.00	31.00	1.26	472.06	0.094	1.000	0.094
GPRS 1900 (4 Tx slots)	1850.2	2.00	28.00	30.00	1.00	501.19	0.100	1.000	0.100
EGPRS 1900 (1 Tx slot)	1850.2	2.00	27.00	29.00	0.79	100.00	0.020	1.000	0.020
EGPRS 1900 (2 Tx slots)	1850.2	2.00	24.50	26.50	0.45	111.67	0.022	1.000	0.022
EGPRS 1900 (3 Tx slots)	1850.2	2.00	25.00	27.00	0.50	187.95	0.037	1.000	0.037
EGPRS 1900 (4 Tx slots)	1850.2	2.00	24.00	26.00	0.40	199.05	0.040	1.000	0.040
WCDMA Band II	1852.4	2.00	24.50	26.50	0.45	446.68	0.089	1.000	0.089
WCDMA Band IV	1712.4	5.00	24.50	29.50	0.89	891.25	0.177	1.000	0.177
WCDMA Band V	826.4	1.50	24.50	26.00	0.40	398.11	0.079	0.551	0.144
LTE Band 2	1850.7	2.00	24.00	26.00	0.40	398.11	0.079	1.000	0.079
LTE Band 4	1710.7	5.00	24.50	29.50	0.89	891.25	0.177	1.000	0.177
LTE Band 5	824.7	1.50	24.50	26.00	0.40	398.11	0.079	0.550	0.144
LTE Band 7	2502.5	6.00	24.00	30.00	1.00	1000.00	0.199	1.000	0.199
LTE Band 12	699.7	4.00	24.00	28.00	0.63	630.96	0.126	0.466	0.269
LTE Band 13	779.5	4.00	24.00	28.00	0.63	630.96	0.126	0.520	0.242
LTE Band 17	706.5	4.00	24.00	28.00	0.63	630.96	0.126	0.471	0.267
WLNA2.4GHz Band	2412	5.00	23.0	27.00	0.63	630.96	0.126	1.000	0.126
WLNA5GHz Band	5180	5.00	23.0	27.00	0.63	630.96	0.126	1.000	0.126
Bluetooth	2402	5.00	22.0	26.00	0.50	501.19	0.100	1.000	0.100

WWAN Power Density / Limit	WLAN Power Density / Limit	Bluetooth Power Density / Limit	Σ(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.269	0.126	0.100	0.495

Note:

1. For collocation analysis, LTE Band 12 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. 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 + Bluetooth.
3. Considering the WWAN module collocation with the WLAN and Bluetooth transmitter 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.

**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	Band	Frequency (MHz)	Maximum Conducted Power (dBm)	Standalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
LTE Module	GSM850	824.2	34.00	4.00	1.50
	GSM1900	1850.2	30.50	2.00	2.00
	WCDMA Band II	1852.4	24.50	2.00	2.00
	WCDMA Band IV	1712.4	24.50	5.00	5.00
	WCDMA Band V	826.4	24.50	4.00	1.50
	LTE Band 2	1850.7	24.00	2.00	2.00
	LTE Band 4	1710.7	24.50	5.00	5.00
	LTE Band 5	824.7	24.50	4.00	1.50
	LTE Band 7	2502.5	24.00	8.00	6.00
	LTE Band 12	699.7	24.00	8.00	4.00
	LTE Band 13	779.5	24.00	8.00	4.00
	LTE Band 17	706.5	24.00	8.00	4.00
Collocated Transmitters	WLAN2.4GHz	2412.0	23.00		5.00
	WLAN5GHz	5180.0	23.00		5.00
	Bluetooth	2402.0	22.00		5.00