RF Exposure Evaluation Report

APPLICANT	:	Sierra Wireless, Inc.
EQUIPMENT	:	Wireless Module
BRAND NAME	:	AirPrime
MODEL NAME	:	EM9190
FCC ID	:	N7NEM91
STANDARD	:	47 CFR Part 2.1091 FCC KDB 447498 D01 v06

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

Hank Huang

Reviewed by: Hank Huang / Supervisor

Johnny Chen

Approved by: Johnny Chen / Manager

ACCREDITED Cert #5145.01

Sporton International Inc. (Shenzhen)
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People's Republic of China

Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA1N1001	Rev. 01	Initial issue of report.	Feb. 18, 2022
FA1N1001	Rev. 02	Revised LTE Band 42 Frequency typo on page 5	Feb. 24, 2022
FA1N1001	Rev. 02	Updated 5GNR n66 antenna gain value.	Mar. 02, 2022

1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Shenzhen) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.01.

Testing Laboratory			
Test Firm	Sporton International Inc. (Shenzhen)		
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan, Shenzhen, 518055 People's Republic of China TEL: +86-755-86379589 FAX: +86-755-86379595		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-SZ	CN1256	421272

Applicant	
Company Name	Sierra Wireless, Inc.
Address	13811 Wireless Way, Richmond, BC, Canada V6A 3A4

Manufacturer	
Company Name	Sierra Wireless, Inc.
Address	13811 Wireless Way, Richmond, BC, Canada V6A 3A4

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Wireless Module
Brand Name	AirPrime
Model Name	EM9190
IMEI	351735110001030
FCC ID	N7NEM91
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2: 1850 MHz ~ 1910 MHz LTE Band 4: 1710 MHz ~ 1755 MHz LTE Band 5: 824 MHz ~ 849 MHz LTE Band 7: 2500 MHz ~ 2570 MHz LTE Band 12: 699 MHz ~ 716 MHz LTE Band 13: 777 MHz ~ 787 MHz LTE Band 14: 788 MHz ~ 798 MHz LTE Band 17: 704 MHz ~ 716 MHz LTE Band 25: 1850 MHz ~ 1915 MHz LTE Band 26: 824 MHz ~ 849 MHz LTE Band 30: 2305 MHz ~ 2315 MHz LTE Band 41: 2500 MHz ~ 2690 MHz LTE Band 42: 3450 MHz ~ 3550 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 66: 1710 MHz ~ 1780 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n2 : 1850 MHz ~ 1910 MHz 5G NR n5 : 824 MHz ~ 849 MHz 5G NR n7 : 2500 MHz ~ 2570 MHz 5G NR n12 : 699 MHz ~ 716 MHz 5G NR n25 : 1850 MHz ~ 1915 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n66 : 1710 MHz ~ 1780 MHz 5G NR n71 : 663 MHz ~ 698 MHz 5G NR n77: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz 5G NR n78: 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3800 MHz
Mode	RMC 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+ (16QAM uplink is not supported) LTE: QPSK, 16QAM, 64QAM, 256QAM DFT-s-OFDM (PI/2 BPSK / QPSK / 16QAM / 64QAM / 256QAM) CP-OFDM (QPSK / 16QAM / 64QAM / 256QAM)
HW Version	1.0
SW Version	00.15.01.00
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This device supports HPUE for LTE band 41 with class 2 power level, so HPUE has been performed standalone power density calculation.
3. For DFT-s-OFDM and CP-OFDM output power measurement reduction, according to maximum power reduction for the CP-OFDM mode will not higher than DFT-s-OFDM mode, therefore, CP-OFDM measurement

is unnecessary. We always chose higher power (DFT-s-OFDM mode) to perform MPE analysis.

4. 5GNR n2 / n5 / n7 / n12 / n25 / n41 / n66 / n71 / n77 / n78 supports NSA and SA mode.

5. The EN-DC mode combination could be referred to the product spec.

Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

3. Maximum RF average output tune up power among production units

<WCDMA>

Mode		Maximum Average power(dBm)
WCDMA	Band II	24.50
	Band IV	24.50
	Band V	24.50

<LTE>

Mode		Maximum Average power(dBm)
LTE	Band 2	24.00
	Band 4	24.00
	Band 5	24.00
	Band 7	24.80
	Band 12	24.00
	Band 13	24.00
	Band 14	24.00
	Band 17	24.00
	Band 25	24.00
	Band 26	24.00
	Band 30	24.00
	Band 41	24.80
	Band 41-HPUE	26.00
	Band 42	24.80
	Band 48	24.80
	Band 66	24.00
	Band 71	24.00

<5G NR>

Mode		Maximum Average power(dBm)
5G NR	n2	24.50
	n5	24.50
	n7	24.50
	n12	24.50
	n25	24.50
	n41	24.50
	n66	24.50
	n71	24.50
	n77	24.50
	n78	24.50

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)	Average EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
WCDMA Band 2	1852.4	8.5	24.50	33.000	1995.262	0.397	1.000
WCDMA Band 4	1712.4	5.5	24.50	30.000	1000.000	0.199	1.000
WCDMA Band 5	826.4	6.0	24.50	30.500	1122.018	0.223	0.551
LTE Band 2	1850.7	8.5	24.00	32.500	1778.279	0.354	1.000
LTE Band 4	1710.7	5.5	24.00	29.500	891.251	0.177	1.000
LTE Band 5	824.7	6.0	24.00	30.000	1000.000	0.199	0.550
LTE Band 7	2502.5	8.0	24.80	32.800	1905.461	0.379	1.000
LTE Band 12	699.7	6.0	24.00	30.000	1000.000	0.199	0.466
LTE Band 13	779.5	6.0	24.00	30.000	1000.000	0.199	0.520
LTE Band 14	790.5	6.0	24.00	30.000	1000.000	0.199	0.527
LTE Band 17	706.5	6.0	24.00	30.000	1000.000	0.199	0.471
LTE Band 25	1850.7	8.5	24.00	32.500	1778.279	0.354	1.000
LTE Band 26	814.7	6.0	24.00	30.000	1000.000	0.199	0.543
LTE Band 30	2307.5	0.0	24.00	24.000	251.189	0.050	1.000
LTE Band 41	2498.5	7.0	24.80	31.800	1513.561	0.301	1.000
LTE Band 41-HPUE	2498.5	7.0	26.00	33.000	1995.262	0.397	1.000
LTE Band 42	3452.5	5.0	24.80	29.800	954.993	0.190	1.000
LTE Band 48	3552.5	-1.8	24.80	23.000	199.526	0.040	1.000
LTE Band 66	1710.7	6.0	24.00	30.000	1000.000	0.199	1.000
LTE Band 71	665.5	6.0	24.00	30.000	1000.000	0.199	0.444
5G NR n2	1850.0	8.5	24.50	33.000	1995.262	0.397	1.000
5G NR n5	824.0	6.0	24.50	30.500	1122.018	0.223	0.549
5G NR n7	2500.0	8.0	24.50	32.500	1778.279	0.354	1.000
5G NR n12	699.0	6.0	24.50	30.500	1122.018	0.223	0.466
5G NR n25	1850.0	8.5	24.50	33.000	1995.262	0.397	1.000
5G NR n41	2496.0	7.0	24.50	31.500	1412.538	0.281	1.000
5G NR n66	1710.0	5.5	24.50	30.000	1000.000	0.199	1.000
5G NR n71	663.0	5.5	24.50	30.000	1000.000	0.199	0.442
5G NR n77	3450.0	5.5	24.50	30.000	1000.000	0.199	1.000
5G NR n78	3450.0	5.5	24.50	30.000	1000.000	0.199	1.000

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. This device supports HPUE for LTE band 41 with class 2 power level, so HPUE has been performed standalone power density calculation.

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 28.0dBm and EIRP for Bluetooth is less than or equal to 22.0dBm.
2. A maximum antenna gain of 8dBi for WLAN and 5dBi for Bluetooth 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 2	1852.4	8.0	24.50	32.500	1778.279	0.354	1.000	0.354
WCDMA Band 4	1712.4	5.5	24.50	30.000	1000.000	0.199	1.000	0.199
WCDMA Band 5	826.4	5.5	24.50	30.000	1000.000	0.199	0.551	0.361
LTE Band 2	1850.7	8.0	24.00	32.000	1584.893	0.315	1.000	0.315
LTE Band 4	1710.7	5.5	24.00	29.500	891.251	0.177	1.000	0.177
LTE Band 5	824.7	6.0	24.00	30.000	1000.000	0.199	0.550	0.362
LTE Band 7	2502.5	8.0	24.80	32.800	1905.461	0.379	1.000	0.379
LTE Band 12	699.7	5.5	24.00	29.500	891.251	0.177	0.466	0.380
LTE Band 13	779.5	5.5	24.00	29.500	891.251	0.177	0.520	0.341
LTE Band 14	790.5	6.0	24.00	30.000	1000.000	0.199	0.527	0.378
LTE Band 17	706.5	5.5	24.00	29.500	891.251	0.177	0.471	0.377
LTE Band 25	1850.7	8.0	24.00	32.000	1584.893	0.315	1.000	0.315
LTE Band 26	814.7	6.0	24.00	30.000	1000.000	0.199	0.543	0.366
LTE Band 30	2307.5	0.0	24.00	24.000	251.189	0.050	1.000	0.050
LTE Band 41	2498.5	7.0	24.80	31.800	1513.561	0.301	1.000	0.301
LTE Band 41-HPUE	2498.5	7.0	26.00	33.000	1995.262	0.397	1.000	0.397
LTE Band 42	3452.5	5.0	24.80	29.800	954.993	0.190	1.000	0.190
LTE Band 48	3552.5	-1.8	24.80	23.000	199.526	0.040	1.000	0.040
LTE Band 66	1710.7	6.0	24.00	30.000	1000.000	0.199	1.000	0.199
LTE Band 71	665.5	5.5	24.00	29.500	891.251	0.177	0.444	0.400
LTE Band 71-ENDC	665.5	5.5	21.00	26.500	446.684	0.089	0.444	0.200
5G NR n2	1850.0	8.0	24.50	32.500	1778.279	0.354	1.000	0.354
5G NR n5	824.0	5.5	24.50	30.000	1000.000	0.199	0.549	0.362
5G NR n7	2500.0	8.0	24.50	32.500	1778.279	0.354	1.000	0.354
5G NR n12	699.0	5.0	24.50	29.500	891.251	0.177	0.466	0.381
5G NR n25	1850.0	8.0	24.50	32.500	1778.279	0.354	1.000	0.354
5G NR n41	2496.0	7.0	24.50	31.500	1412.538	0.281	1.000	0.281
5G NR n66	1710.0	5.5	24.50	30.000	1000.000	0.199	1.000	0.199
5G NR n71	663.0	5.0	24.50	29.500	891.251	0.177	0.442	0.401
5G NR n71-ENDC	663.0	5.0	21.50	26.500	446.684	0.089	0.442	0.201
5G NR n77	3450.0	5.5	24.50	30.000	1000.000	0.199	1.000	0.199
5G NR n78	3450.0	5.5	24.50	30.000	1000.000	0.199	1.000	0.199
WLAN2.4GHz Band	2412	5.0	20.00	25.000	316.228	0.063	1.000	0.063
WLAN5GHz Band	5180	8.0	20.00	28.000	630.957	0.126	1.000	0.126
Bluetooth	2402	5.0	17.00	22.000	158.489	0.032	1.000	0.032

WWAN Power Density / Limit	WLAN Power Density / Limit	Bluetooth Power Density / Limit	Σ(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.401	0.126	0.032	0.559

ENDC：

LTE Power Density / Limit	5NR Power Density / Limit	WLAN Power Density / Limit	Bluetooth Power Density / Limit	Σ(Power Density / Limit) of LTE + 5NR + WLAN + Bluetooth
0.200	0.201	0.126	0.032	0. 559

Note:

1. For colocation analysis, 5GNR n71 is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. For colocation analysis, LTE band 71 is chosen for summation due to the highest (power density/limit) among all LTE wireless modes.
3. For colocation analysis, 5GNR n71 is chosen for summation due to the highest (power density/limit) among all 5GNR wireless modes.
4. For colocation analysis, LTE band 71 and 5GNR n71 is chosen for summation due to the highest (power density/limit) among all LTE and 5GNR modes. For EN-DC mode, the total power (P total) is the same as LTE or NR transmission standalone power. When calculated EN-DC mode, LTE and 5GNR total power minus 3dB used to do EN-DC summed power density calculation.
5. Chose the worst power density among WLAN2.4/5GHz to do co-located.
6. 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, LTE + 5NR + WLAN + Bluetooth.
7. Considering the WWAN/5GNR 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 3/4 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)
EM9190	WCDMA Band 2	1852.4	24.50	8.5	8.0
	WCDMA Band 4	1712.4	24.50	5.5	5.5
	WCDMA Band 5	826.4	24.50	6.0	5.5
	LTE Band 2	1850.7	24.00	8.5	8.0
	LTE Band 4	1710.7	24.00	5.5	5.5
	LTE Band 5	824.7	24.00	6.0	6.0
	LTE Band 7	2502.5	24.80	8.0	8.0
	LTE Band 12	699.7	24.00	6.0	5.5
	LTE Band 13	779.5	24.00	6.0	5.5
	LTE Band 14	790.5	24.00	6.0	6.0
	LTE Band 17	706.5	24.00	6.0	5.5
	LTE Band 25	1850.7	24.00	8.5	8.0
	LTE Band 26	814.7	24.00	6.0	6.0
	LTE Band 30	2307.5	24.00	0.0	0.0
	LTE Band 41	2498.5	24.80	7.0	7.0
	LTE Band 41-HPUE	2498.5	26.00	7.0	7.0
	LTE Band 42	3452.5	24.80	5.0	5.0
	LTE Band 48	3552.5	24.80	-1.8	-1.8
	LTE Band 66	1710.7	24.00	6.0	6.0
	LTE Band 71	665.5	24.00	6.0	5.5
	5G NR n2	1850.0	24.50	8.5	8.0
	5G NR n5	824.0	24.50	6.0	5.5
	5G NR n7	2500.0	24.50	8.0	8.0
	5G NR n12	699.0	24.50	6.0	5.0
	5G NR n25	1850.0	24.50	8.5	8.0
	5G NR n41	2496.0	24.50	7.0	7.0
	5G NR n66	1710.0	24.50	5.5	5.5
	5G NR n71	663.0	24.50	5.5	5.0
	5G NR n77	3450	24.50	5.5	5.5
	5G NR n78	3450	24.50	5.5	5.5
Collocated Transmitters	WLAN2.4GHz	2412	20.00		5.0
	WLAN5GHz	5180	20.00		8.0
	Bluetooth	2402	17.00		5.0

------THE END------