

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 (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.



Reviewed by: Long Liang / Supervisor



Approved by: Johnny Chen / Manager



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People's Republic of China



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**Revision History**

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA021501	Rev. 01	Initial issue of report.	May 25, 2020
FA021501	Rev. 02	Updated FCC ID information.	Jun. 04, 2020
FA021501	Rev. 03	Updated antenna gain value for LTE band 30 and LTE band42/48.	Jan. 26, 2021
FA021501	Rev. 04	Updated 5G NR maximum tune up power.	Mar. 16, 2021



1. Administration Data

1.1. Testing Laboratory

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

Testing Laboratory		
Test Firm	Sporton International (Shenzhen) Inc.	
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.	FCC Designation No.	FCC Test Firm Registration No.
	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: 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 ~ 2567.5MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 14: 790.5 MHz ~ 795.5 MHz LTE Band 17: 706.5 MHz ~ 713.5 MHz LTE Band 25: 1850.7 MHz ~ 1914.3 MHz LTE Band 26: 814.7 MHz ~ 848.3 MHz LTE Band 30: 2307.5 MHz ~ 2312.5 MHz LTE Band 38: 2572.5 MHz ~ 2617.5 MHz LTE Band 41: 2498.5 MHz ~ 2687.5 MHz LTE Band 42: 3552.5 MHz ~ 3597.5 MHz LTE Band 48: 3552.5 MHz ~ 3697.5 MHz LTE Band 66: 1710.7 MHz ~ 1779.3 MHz LTE Band 71: 665.5 MHz ~ 695.5 MHz 5G NR n2 : 1852.5 MHz ~ 1907.5 MHz 5G NR n5 : 826.5 MHz ~ 846.5 MHz 5G NR n41 : 2506.02 MHz ~ 2679.99 MHz 5G NR n66 : 1712.5 MHz ~ 1777.5 MHz 5G NR n71 : 665.5 MHz ~ 695.5 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. LTE band 42 covered by LTE band 48 with the same power level, so only chose LTE band 48 to perform standalone power density calculation.
3. This device supports HPUE for LTE band 41 with class 2 power level, so HPUE has been performed standalone power density calculation.
4. 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.
5. 5GNR supports NSA mode.



6. The device implanted DPS (Dynamic Power Share) function to achieve higher uplink data rate keeping the total power unchanged in 5G NR NSA EN-DC mode according to 3GPP 38.213, when the equipment has a dynamic power sharing capability, it adjusts the LTE or NR transmission power so that the instantaneous total power does not exceed the specified value, when the maximum transmission power of NR (P_{LTE} , P_{NR}) and the specified total power (P_{total}) have been set and the instantaneous calculated total transmission power exceeds P_{total} , the NR transmission power is reduced so that the actual transmission power of the user equipment will not exceed P_{total} power. So if the LTE and NR standalone SAR is testing at total power level, the EN-DC combine MPE(LTE+NR) will not higher than the each standalone LTE and NR MPE, therefore, the simultaneous transmission analysis is used standalone MPE at total power level to show compliance.

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 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 38	24.80
	Band 41	24.80
	Band 41-HPUE	26.00
	Band 42	24.80
	Band 48	24.80
	Band66	24.00
	Band71	24.00



<5G NR>

Mode		Maximum Average power(dBm)
5G NR	n2	24.50
	n5	24.50
	N41	24.50
	n66	24.50
	n71	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/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)	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	5.5	24.80	30.300	1071.519	0.213	1.000
LTE Band 12	699.7	5.5	24.00	29.500	891.251	0.177	0.466
LTE Band 13	779.5	5.5	24.00	29.500	891.251	0.177	0.520
LTE Band 14	790.5	5.5	24.00	29.500	891.251	0.177	0.527
LTE Band 17	706.5	5.5	24.00	29.500	891.251	0.177	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 38	2572.5	7.0	24.80	31.800	1513.561	0.301	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 48	3552.5	-1.8	24.80	23.000	199.526	0.040	1.000
LTE Band 66	1710.7	5.5	24.00	29.500	891.251	0.177	1.000
LTE Band 71	665.5	5.5	24.00	29.500	891.251	0.177	0.444
5G NR n2	1852.5	8.5	24.50	33.000	1995.262	0.397	1.000
5G NR n5	826.5	6.0	24.50	30.500	1122.018	0.223	0.551
5G NR n41	2506.02	7.0	24.50	31.500	1412.538	0.281	1.000
5G NR n66	1712.5	5.5	24.50	30.000	1000.000	0.199	1.000
5G NR n71	665.5	5.5	24.50	30.000	1000.000	0.199	0.444

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. LTE band 42 covered by LTE band 48 with the same power level, so only chose LTE band 48 to perform standalone power density calculation.
3. 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	5.5	24.00	29.500	891.251	0.177	0.550	0.323
LTE Band 7	2502.5	5.5	24.80	30.300	1071.519	0.213	1.000	0.213
LTE Band 12	699.7	5.0	24.00	29.000	794.328	0.158	0.466	0.339
LTE Band 13	779.5	5.0	24.00	29.000	794.328	0.158	0.520	0.304
LTE Band 14	790.5	5.0	24.00	29.000	794.328	0.158	0.527	0.300
LTE Band 17	706.5	5.0	24.00	29.000	794.328	0.158	0.471	0.336
LTE Band 25	1850.7	8.0	24.00	32.000	1584.893	0.315	1.000	0.315
LTE Band 26	814.7	5.5	24.00	29.500	891.251	0.177	0.543	0.327
LTE Band 30	2307.5	0.0	24.00	24.000	251.189	0.050	1.000	0.050
LTE Band 38	2572.5	7.0	24.80	31.800	1513.561	0.301	1.000	0.301
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 48	3552.5	-1.8	24.80	23.000	199.526	0.040	1.000	0.040
LTE Band 66	1710.7	5.5	24.00	29.500	891.251	0.177	1.000	0.177
LTE Band 71	665.5	5.0	24.00	29.000	794.328	0.158	0.444	0.356
5G NR n2	1852.5	8.0	24.50	32.500	1778.279	0.354	1.000	0.354
5G NR n5	826.5	5.5	24.50	30.000	1000.000	0.199	0.551	0.361
5G NR n41	2506.02	7.0	24.50	31.500	1412.538	0.281	1.000	0.281
5G NR n66	1712.5	5.5	24.50	30.000	1000.000	0.199	1.000	0.199
5G NR n71	665.5	5.0	24.50	29.500	891.251	0.177	0.444	0.400
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
0.397	0.126	0.032	0.555

5NR Power Density / Limit	WLAN Power Density / Limit	Bluetooth Power Density / Limit	Σ (Power Density / Limit) of WWAN + WLAN + Bluetooth
0.400	0.126	0.032	0.558

Note:

1. For colocation analysis, LTE Band41-HPUE 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. The device implanted DPS (Dynamic Power Share) function to achieve higher uplink data rate keeping the total power unchanged in 5G NR NSA EN-DC mode according to 3GPP 38.213, when the equipment has a dynamic power sharing capability, it adjusts the LTE or NR transmission power so that the instantaneous total power does not exceed the specified value, when the maximum transmission power of NR (P_{LTE}, P_{NR}) and the specified total power (P_{total}) have been set and the instantaneous calculated total transmission power exceeds P_{total}, the NR transmission power is reduced so that the actual transmission power of the user equipment will not exceed P_{total} power. So if the LTE and NR standalone SAR is testing at total power level, the EN-DC combine MPE(LTE+NR) will not higher than the each standalone LTE and NR MPE, therefore, the simultaneous transmission analysis is used standalone MPE at total power level to show compliance.
4. For colocation analysis, 5GNR n71 is chosen for summation due to the highest (power density/limit) among all 5GNR modes.
5. Σ (Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for 5GNR + WLAN + Bluetooth.
6. 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 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	5.5
	LTE Band 7	2502.5	24.80	5.5	5.5
	LTE Band 12	699.7	24.00	5.5	5.0
	LTE Band 13	779.5	24.00	5.5	5.0
	LTE Band 14	790.5	24.00	5.5	5.0
	LTE Band 17	706.5	24.00	5.5	5.0
	LTE Band 25	1850.7	24.00	8.5	8.0
	LTE Band 26	814.7	24.00	6.0	5.5
	LTE Band 30	2307.5	24.00	0.0	0.0
	LTE Band 38	2572.5	24.80	7.0	7.0
	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 48	3552.5	24.80	-1.8	-1.8
	LTE Band 66	1710.7	24.00	5.5	5.5
	LTE Band 71	665.5	24.00	5.5	5.0
	5G NR n2	1852.5	24.50	8.5	8.0
	5G NR n5	826.5	24.50	6.0	5.5
	5G NR n41	2506.02	24.50	7.0	7.0
	5G NR n66	1712.5	24.50	5.5	5.5
	5G NR n71	665.5	24.50	5.5	5.0
Collocated Transmitters	WLAN2.4GHz	2412	20.00		5.0
	WLAN5GHz	5180	20.00		8.0
	Bluetooth	2402	17.00		5.0

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