RF Exposure Evaluation Report

APPLICANT	:	**Sierra Wireless Inc.**
EQUIPMENT	:	**Embedded module**
BRAND NAME	:	**AirPrime**
MODEL NAME	:	**HL8528**
FCC ID	:	**N7NHL8528**
IC	:	**2417C-HL8528**
STANDARD	:	**47 CFR Part 2.1091** **IC RSS-102 Issue 5 (2015)**

We, SPORTON INTERNATIONAL (SHENZHEN) INC., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091 and IC RSS-102 Issue 5, and pass the limit. Without written approval of SPORTON INTERNATIONAL (SHENZHEN) INC., the test report shall not be reproduced except in full.

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA5O0917	Rev. 01	Initial issue of report	Jan. 12, 2016

1. Administration Data

1.1. Testing Laboratory

Testing Laboratory	
Test Site	SPORTON International (SHENZHEN) Inc.
Test Site Location	1F & 2F, Building A, Morning Business Center, No. 4003 ShiGu Rd., Xili Town, Nanshan District, Shenzhen, Guangdong, P. R. China TEL: 86-755-8637-9589 FAX: 86-755-8637-9595

Applicant	
Company Name	Sierra Wireless Inc.
Address	13811 Wireless Way, Richmond, British Columbia V6V 3A4

Manufacturer	
Company Name	Sierra Wireless Inc.
Address	13811 Wireless Way, Richmond, British Columbia V6V 3A4

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	Embedded module
Brand Name	AirPrime
Model Name	HL8528
FCC ID	N7NHL8528
IC	2417C-HL8528
IMEI Code	004999010640000
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz
Mode	• GSM/GPRS/EGPRS (Downlink Only) • AMR/RMC12.2Kbps • HSDPA • HSUPA
HW Version	1
SW Version	AHL85xx.5.14.3.1.20150720.x6255_3
EUT Stage	Production Unit
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. The device supports GPRS/EGPRS Class 12 and EGPRS downlink only.	

3. Maximum RF average output power among production units

Band/Mode	GMSK Burst Average Power(dBm)			
	1TX Slot	2TX Slot	3TX Slot	4TX Slot
GSM 850	34.0	34.0	33.0	32.0
GSM 1900	31.0	31.0	31.0	30.0

Band/Mode	Average Power(dBm)	
UMTS	Band V	24.0
	Band II	25.0

4. RF Exposure Limit Introduction for FCC

FCC limit:

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

IC limit:

IC has adopted the RF field strength limits established in Health Canada's RF exposure guideline. The limits are shown in Table 4 below per RSS-102.

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
$0.003\text{-}10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

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:

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

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

General Note:

1. For the host which integrates HL8528 only and connects the antenna with antenna gain less or equal the figures in the table below, if the distance between the antenna and the user is equal or larger than 20cm, the power density calculation below shows compliance.

<Standalone Calculated for FCC>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum ERP (dBm)	Maximum ERP (W)	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)
GSM 850 (1 Tx slot)	824-849	2.1	34.0	33.950	2.489	36.100	4.074	7.000	512.861	0.102	0.549
GPRS 850 (1 Tx slot)	824-849	2.1	34.0	33.950	2.489	36.100	4.074	7.000	512.861	0.102	0.549
GPRS 850 (2 Tx slots)	824-849	2.1	34.0	33.960	2.489	36.100	4.074	7.000	1018.451	0.203	0.549
GPRS 850 (3 Tx slots)	824-849	2.1	33.0	32.950	1.977	35.100	1.972	7.000	1213.389	0.242	0.549
GPRS 850 (4 Tx slots)	824-849	2.1	32.0	31.950	1.570	34.100	1.567	7.000	1288.250	0.256	0.549
GSM 1900 (1 Tx slot)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	251.189	0.050	1.000
GPRS 1900 (1 Tx slot)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	251.189	0.050	1.000
GPRS 1900 (2 Tx slots)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	498.816	0.099	1.000
GPRS 1900 (3 Tx slots)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	748.170	0.149	1.000
GPRS 1900 (4 Tx slots)	1850-1910	2.0	30.0	29.860	0.968	32.000	1.585	2.000	794.328	0.158	1.000
WCDMA Band V	824-849	2.1	24.0	23.960	0.249	26.100	0.407	7.000	407.380	0.081	0.536
WCDMA Band II	1850-1910	2.0	25.0	24.860	0.306	27.000	0.501	2.000	501.187	0.100	1.000

<Standalone Calculated for IC>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum ERP (dBm)	Maximum ERP (W)	Maximum EIRP (dBm)	Maximum EIRP (W)	Maximum Output Power Limit (W)	Average EIRP (mW)	Power Density at 20cm (W/m^2)	Limit (W/m^2)
GSM 850 (1 Tx slot)	824-849	2.1	34.0	33.950	2.489	36.100	4.074	7.000	512.861	1.021	2.576
GPRS 850 (1 Tx slot)	824-849	2.1	34.0	33.950	2.489	36.100	4.074	7.000	512.861	1.021	2.576
GPRS 850 (2 Tx slots)	824-849	2.1	34.0	33.960	2.489	36.100	4.074	7.000	1018.451	2.027	2.576
GPRS 850 (3 Tx slots)	824-849	2.1	33.0	32.950	1.977	35.100	1.972	7.000	1213.389	2.415	2.576
GPRS 850 (4 Tx slots)	824-849	2.1	32.0	31.950	1.570	34.100	1.567	7.000	1288.250	2.564	2.576
GSM 1900 (1 Tx slot)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	251.189	0.500	4.477
GPRS 1900 (1 Tx slot)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	251.189	0.500	4.477
GPRS 1900 (2 Tx slots)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	498.816	0.993	4.476
GPRS 1900 (3 Tx slots)	1850-1910	2.0	31.0	30.860	1.219	33.000	1.995	2.000	748.170	1.489	4.477
GPRS 1900 (4 Tx slots)	1850-1910	2.0	30.0	29.860	0.968	32.000	1.585	2.000	794.328	1.581	4.477
WCDMA Band V	824-849	2.1	24.0	23.960	0.249	26.100	0.407	7.000	407.380	0.811	2.533
WCDMA Band II	1850-1910	2.0	25.0	24.860	0.306	27.000	0.501	2.000	501.187	0.998	4.476

5.2. Collocated Power Density Calculations

General Note:

1. This MPE analysis is applicable to any collocated transmitters with EIRP for WLAN is less than or equal to 24dBm and EIRP for Bluetooth is less than or equal to 19dBm.
2. A maximum antenna gain of 4 dBi for WLAN/BT has been assumed for all collocated antennas.

<Collocated Calculation for FCC>

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)	824-849	1.5	34.0	35.5	3.55	446.68	0.089	0.549	0.162
GPRS 850 (1 Tx slot)	824-849	1.5	34.0	35.5	3.55	446.68	0.089	0.549	0.162
GPRS 850 (2 Tx slots)	824-849	1.5	34.0	35.5	3.55	887.03	0.177	0.549	0.321
GPRS 850 (3 Tx slots)	824-849	1.5	33.0	34.5	2.82	1056.82	0.210	0.549	0.383
GPRS 850 (4 Tx slots)	824-849	1.5	32.0	33.5	2.24	1122.02	0.223	0.549	**0.406**
GSM 1900 (1 Tx slot)	1850-1910	2.0	31.0	33.0	2.00	251.19	0.050	1.000	0.050
GPRS 1900 (1 Tx slot)	1850-1910	2.0	31.0	33.0	2.00	251.19	0.050	1.000	0.050
GPRS 1900 (2 Tx slots)	1850-1910	2.0	31.0	33.0	2.00	498.82	0.099	1.000	0.099
GPRS 1900 (3 Tx slots)	1850-1910	2.0	31.0	33.0	2.00	748.17	0.149	1.000	0.149
GPRS 1900 (4 Tx slots)	1850-1910	2.0	30.0	32.0	1.58	794.33	0.158	1.000	0.158
WCDMA Band 5	824-849	1.5	24.0	25.5	0.35	354.81	0.071	0.536	0.132
WCDMA Band 2	1850-1910	2.0	25.0	27.0	0.50	501.19	0.100	1.000	0.100
WLNA2.4GHz Band	2400 - 2500	4.0	20.0	24.0	0.25	251.19	0.050	1.000	**0.050**
WLNA5GHz Band	5150 – 5850	4.0	20.0	24.0	0.25	251.19	0.050	1.000	0.050
Bluetooth	2400 - 2500	4.0	15.0	19.0	0.08	79.43	0.016	1.000	**0.016**

<Collocated Calculation for IC>

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (W)	Average EIRP (mW)	Power Density at 20cm (W/m^2)	Limit (W/m^2)	Power Density / Limit
GSM 850 (1 Tx slot)	824-849	1.5	34.0	35.5	3.55	446.68	0.89	2.576	0.345
GPRS 850 (1 Tx slot)	824-849	1.5	34.0	35.5	3.55	446.68	0.89	2.576	0.345
GPRS 850 (2 Tx slots)	824-849	1.5	34.0	35.5	3.55	887.03	1.77	2.576	0.686
GPRS 850 (3 Tx slots)	824-849	1.5	33.0	34.5	2.82	1056.82	2.10	2.576	0.817
GPRS 850 (4 Tx slots)	824-849	1.5	32.0	33.5	2.24	1122.02	2.23	2.576	**0.867**
GSM 1900 (1 Tx slot)	1850-1910	2.0	31.0	33.0	2.00	251.19	0.50	4.477	0.112
GPRS 1900 (1 Tx slot)	1850-1910	2.0	31.0	33.0	2.00	251.19	0.50	4.477	0.112
GPRS 1900 (2 Tx slots)	1850-1910	2.0	31.0	33.0	2.00	498.82	0.99	4.476	0.222
GPRS 1900 (3 Tx slots)	1850-1910	2.0	31.0	33.0	2.00	748.17	1.49	4.477	0.333
GPRS 1900 (4 Tx slots)	1850-1910	2.0	30.0	32.0	1.58	794.33	1.58	4.477	0.353
WCDMA Band 5	824-849	1.5	24.0	25.5	0.35	354.81	0.71	2.533	0.279
WCDMA Band 2	1850-1910	2.0	25.0	27.0	0.50	501.19	1.00	4.476	0.223
WLNA2.4GHz Band	2400 - 2500	4.0	20.0	24.0	0.25	251.19	0.500	5.366	**0.093**
WLNA5GHz Band	5150 – 5850	4.0	20.0	24.0	0.25	251.19	0.500	9.047	0.055
Bluetooth	2400 - 2500	4.0	15.0	19.0	0.08	79.43	0.158	5.351	**0.030**

<Collocated analysis>

General Note:

1. For colocation analysis, GPRS850 (2TX slot) 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.

<Analysis for FCC>

Max WWAN Power Density / Limit	Max Bluetooth Power Density / Limit	Max WLAN Power Density / Limit	∑(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.406	0.016	0.050	0.472

<Analysis for IC>

Max WWAN Power Density / Limit	Max Bluetooth Power Density / Limit	Max WLAN Power Density / Limit	∑(Power Density / Limit) of WWAN + WLAN + Bluetooth
0.867	0.030	0.093	0.990

Conclusion:

Based on 47 CFR§2.1091 and IC RSS-102 Issue 5, the analysis concludes that this product is compliant with the RF exposure requirements in mobile exposure condition, provided the peak gain of the connected WWAN antenna, the conducted power and the antenna gain of the collocated transmitter, do not exceed the limits for each frequency band listed below.

Device	Technology	Frequency (MHz)	Maximum Conducted Power (dBm)	Stanalone Maximum Antenna Gain (dBi)	Collocated Maximum Antenna Gain (dBi)
HL8528	GSM	824 - 249	35.0	2.1	1.5
		1850 -1910	31.0	2.0	2.0
	WCDMA	824 - 249	24.0	2.1	1.5
		1850 -1910	25.0	2.0	2.0
Collocated Transmitters	WLAN	2400 - 2500	24.0		4.0
	WLAN	5150 - 5850	24.0		4.0
	BT	2400 - 2500	15.0		4.0