

RF EXPOSURE EVALUATION REPORT

Product Name: WIFI Module
Trade Mark: RF-LINK
Model No.: RL-UM02SPC-8812BU-V1.0
Report Number: 180327015RFC-3
Test Standards: FCC 47 CFR Part 1 Subpart I
FCC ID: QCIIDXMOD1
Test Result: PASS
Date of Issue: March 27, 2018

Prepared for:

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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	SMART Technologies Inc.
Address of Applicant:	3636 Research Road NW Calgary, AB T2L 1Y1, Canada
Manufacturer:	SMART Technologies Inc.
Address of Manufacturer:	3636 Research Road NW Calgary, AB T2L 1Y1, Canada

1.2 EUT INFORMATION

Product Name:	WIFI Module		
Model No.:	RL-UM02SPC-8812BU-V1.0		
Add. Model No.:	N/A		
Trade Mark:	RF-LINK		
DUT Stage:	Identical Prototype		
EUT Supports Function:	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
	5 GHz U-NII Bands:	5150 MHz to 5250 MHz	IEEE 802.11a/n/ac
		5250 MHz to 5350 MHz	IEEE 802.11a/n/ac
		5470 MHz to 5725 MHz	IEEE 802.11a/n/ac

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

For 2.4 GHz ISM Band of Wi-Fi		
Frequency Range:	2400 MHz to 2483.5 MHz	
Support Standards:	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n-HT20, IEEE 802.11n-HT40	
Type of Modulation:	IEEE 802.11b: DSSS(CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM(64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT20: OFDM(64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n-HT40: OFDM(64-QAM, 16-QAM, QPSK, BPSK)	
Data Rate:	IEEE 802.11b: Up to 11 Mbps IEEE 802.11g: Up to 54 Mbps IEEE 802.11n-HT20: Up to MCS15 IEEE 802.11n-HT40: Up to MCS15	
Number of Channels:	IEEE 802.11b: 11 IEEE 802.11g: 11 IEEE 802.11n-HT20: 11 IEEE 802.11n-HT40: 7	
Channel Separation:	5 MHz	
Antenna Type:	Chain 0	Diple Antenna
	Chain 1	Diple Antenna
Antenna Gain:	Chain 0	5.03 dBi
	Chain 1	5.03 dBi
Directional gain:	8.04 dBi	
Maximum Peak Power:	STBC_ Chain 0+1	IEEE 802.11b: 10.43dBm IEEE 802.11g: 17.68 dBm
	CCD_ Chain 0+1	IEEE 802.11b: 11.23 dBm IEEE 802.11g: 18.65 dBm
	MIMO_ Chain 0+1	IEEE 802.11n-HT20: 18.99 dBm IEEE 802.11n-HT40: 20.58 dBm

For 5 GHz U-NII Bands of Wi-Fi		
Frequency Range:	5150 MHz to 5250 MHz	
	5250 MHz to 5350 MHz	
	5470 MHz to 5600 MHz	
	5650 MHz to 5725 MHz	
Support Standards:	IEEE 802.11a/n/ac	
TPC Function:	Not Support	
DFS Operational mode:	Slave without radar Interference detection function	
Type of Modulation:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11n: OFDM(64QAM, 16QAM, QPSK, BPSK)	
	IEEE 802.11ac: OFDM(256QAM, 64QAM, 16QAM, QPSK, BPSK)	
Channel Spacing:	IEEE 802.11a/n-HT20/ac-VHT20: 20 MHz	
	IEEE 802.11n-HT40/ac-VHT40: 40 MHz	
	IEEE 802.11ac-VHT80: 80 MHz	
Data Rate:	IEEE 802.11a: Up to 54 Mbps	
	IEEE 802.11n-HT20: Up to MCS15	
	IEEE 802.11n-HT40: Up to MCS15	
	IEEE 802.11ac-VHT20: Up to MCS8	
	IEEE 802.11ac-VHT40: Up to MCS9	
	IEEE 802.11ac-VHT80: Up to MCS9	
Number of Channels:	5150 MHz to 5250 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80	
	5250 MHz to 5350 MHz: 4 for IEEE 802.11a/n-HT20/ac-VHT20 2 for IEEE 802.11n-HT40)/ac-VHT40 1 for IEEE 802.11acVHT80	
	5470 MHz to 5725 MHz: 8 for IEEE 802.11a/n-HT20/ac-VHT20 3 for IEEE 802.11n-HT40/ac-VHT40 1 for IEEE 802.11ac-VHT80	
Antenna Type:	Chain 0 Diple Antenna	
	Chain 1 Diple Antenna	
Antenna Gain:	Chain 0 5150 MHz to 5250 MHz: 3.20 dBi 5250 MHz to 5350 MHz: 3.40 dBi 5470 MHz to 5725 MHz: 5.36 dBi	
	Chain 1 5150 MHz to 5250 MHz: 3.20 dBi 5250 MHz to 5350 MHz: 3.40 dBi 5470 MHz to 5725 MHz: 5.36 dBi	
		5150 MHz to 5250 MHz: 6.21 dBi 5250 MHz to 5350 MHz: 6.41 dBi 5470 MHz to 5725 MHz: 8.37 dBi
	Directional gain:	5150 MHz to 5250 MHz: 6.21 dBi
		5250 MHz to 5350 MHz: 6.41 dBi
5470 MHz to 5725 MHz: 8.37 dBi		

Maximum conducted output power (dBm):	Maximum Avg Conducted Power(dBm)			
	Mode	Chain 0	Chain 1	Total Power Chain 0+1
	IEEE 802.11b(STBC):	8.56	8.89	11.74
	IEEE 802.11g(CCD):	7.92	8.41	11.18
	IEEE 802.11n-HT20(MIMO):	6.38	7.71	10.11
IEEE 802.11n-HT40(MIMO):	8.61	8.41	11.52	

Maximum conducted output power (dBm):	CCD_Chain 0+1	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11a:	12.44	12.18	10.98	N/A
	MIMO_Chain 0+1	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
	IEEE 802.11n-HT20:	11.21	11.72	11.15	N/A
	IEEE 802.11n-HT40:	9.72	9.57	9.63	N/A
	IEEE 802.11ac-VHT80:	9.46	9.33	10.97	N/A

1.4 OTHER INFORMATION

Test channels for 2.4 GHz ISM Band of Wi-Fi				
Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11b	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11g	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT20	2412 MHz to 2462 MHz	Channel 1	Channel 6	Channel 11
		2412 MHz	2437 MHz	2462 MHz
IEEE 802.11n-HT40	2422 MHz to 2452 MHz	Channel 3	Channel 6	Channel 9
		2422 MHz	2437 MHz	2452 MHz

Test channels for 5 GHz Band of Wi-Fi

Mode	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
IEEE 802.11a IEEE 802.11n-HT20	5150 MHz to 5250 MHz	Channel 36	Channel 44	Channel 48
		5180 MHz	5220 MHz	5240 MHz
	5250 MHz to 5350 MHz	Channel 52	Channel 60	Channel 64
		5260 MHz	5300 MHz	5320 MHz
	5470 MHz to 5725 MHz	Channel 100	Channel 116	Channel 140
		5500 MHz	5580 MHz	5700 MHz
IEEE 802.11n-HT40	5150 MHz to 5250 MHz	Channel 38	--	Channel 46
		5190 MHz	--	5230 MHz
	5250 MHz to 5350 MHz	Channel 54	--	Channel 62
		5270 MHz	--	5310 MHz
	5470 MHz to 5725 MHz	Channel 102	Channel 110	Channel 134
		5510 MHz	5550 MHz	5670 MHz
IEEE 802.11ac-VHT80	5150 MHz to 5250 MHz	--	Channel 42	--
		--	5210 MHz	--
	5250 MHz to 5350 MHz	--	Channel 58	--
		--	5290 MHz	--
	5470 MHz to 5725 MHz	Channel 106	--	--
		5530 MHz	--	--

1.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product, according to the specifications of the manufacturers. It must comply with the requirements of the following standards:

FCC 47 CFR Part 1 Subpart I

All test items have been performed and recorded as per the above standards

1.6 DEVIATION FROM STANDARDS

None.

1.7 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.8 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

2. EQUIPMENT LIST

Please refer to the RF test report.

3. MPE EVALUATION

3.1 REFERENCE DOCUMENTS FOR EVALUATION

No.	Identity	Document Title
1	FCC 47 CFR Part 1 Subpart I	PROCEDURES IMPLEMENTING THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969
2	KDB 447498 D01 General RF Exposure Guidance v06	RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES

3.2 MPE COMPLIANCE REQUIREMENT

3.2.1 Limits

3.2.1.1 FCC 47 CFR Part 1 Subpart I

According to §1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

Limits for General Population / Uncontrolled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: * = Plane-wave equivalent power density.

3.2.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

3.3 MPE CALCULATION METHOD

3.3.1 FCC 47 CFR Part 1 Subpart I

$$S = PG/4\pi R^2 = EIRP/4\pi R^2$$

S = power density (in appropriate units, e.g., mw/cm²)

P = power input to the antenna (in appropriate units, e.g., mw)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor is normally numeric gain.

R = distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

3.4 MPE CALCULATION RESULTS

Note: For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3.4.1 For WLAN

For Wi-Fi function, operating at 2412MHz to 2462 MHz for IEEE802.11b/g/n and
 operating at 5150 MHz to 5250 MHz for IEEE802.11a/n/ac and
 operating at 5250 MHz to 5350 MHz for IEEE802.11a/n/ac and
 operating at 5470 MHz to 5725 MHz for IEEE802.11a/n/ac and

3.4.1.1 Antenna Type:

Chain 0: External Antenna

Chain 1: External Antenna

3.4.1.2 Antenna Gain:

Chain 0: 2412MHz to 2462 MHz: 5.03 dBi
 5150 MHz to 5250 MHz: 3.20 dBi
 5250 MHz to 5350 MHz: 3.40 dBi
 5470 MHz to 5725 MHz: 5.36 dBi

Chain 1: Same as chain 0

For MIMO mode (2Tx/2Rx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports can be used alone. The transmit signals are correlated with each other.

For 2.4 GHz WIFI

$$\text{The directional gain} = G_{ANT} + 10 \log(N_{ANT}) \text{ dBi} = 5.03 + 10 \log(2) = 8.04 \text{ dBi}$$

For 5 GHz WIFI

$$\text{U-NII-1: The directional gain} = G_{ANT} + 10 \log(N_{ANT}) \text{ dBi} = 3.20 + 10 \log(2) = 6.21 \text{ dBi}$$

$$\text{U-NII-2A: The directional gain} = G_{ANT} + 10 \log(N_{ANT}) \text{ dBi} = 3.40 + 10 \log(2) = 6.41 \text{ dBi}$$

$$\text{U-NII-2C: The directional gain} = G_{ANT} + 10 \log(N_{ANT}) \text{ dBi} = 5.36 + 10 \log(2) = 8.37 \text{ dBi}$$

For SISO mode (1Tx/1Rx), there are two transmission antennas. Both Chain 0 and Chain 1 used at the same time and antenna ports have uniform output powers. The Chain 0 and Chain 1 antenna ports cannot be used alone

For 2.4 GHz WIFI

$$\text{The antenna gain} = \text{Chain 0 or Chain 1} = 5.03 \text{ dBi}$$

For 5 GHz WIFI

$$\text{U-NII-1: The antenna gain} = \text{Chain 0 or Chain 1} = 3.20 \text{ dBi}$$

$$\text{U-NII-2A: The antenna gain} = \text{Chain 0 or Chain 1} = 3.40 \text{ dBi}$$

$$\text{U-NII-2C: The antenna gain} = \text{Chain 0 or Chain 1} = 5.36 \text{ dBi}$$

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3.4.1.3 Results for FCC 47 CFR Part 1 Subpart I

Operating Mode	Freq.	Declared maximum conducted average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
	(MHz)	(dBm)		(dBi)	(dBm)	(mW)	(mW/cm ²)	
2.4G band	2412-2462	12	2	8.04	22.08	161.44	1	0.032
5G band	5180-5240	12	2	6.21	20.21	104.95	1	0.021
	5260-5320	12	2	6.41	20.41	109.90	1	0.022
	5500-5700	12	2	8.37	22.37	172.58	1	0.034

3.4.2 Simultaneous Multi-band Transmission MPE Analysis

3.4.4.1 List of Mode for Simultaneous Multi-band Transmission

No.	Configurations	Support/Not Support
1	2.4G_WLAN+5G_WLAN	Not Support

3.4.4.2 Results for transmit simultaneously

Not Applicable

APPENDIX 1 PHOTOGRAPHS OF TEST SETUP

N/A

APPENDIX 2 PHOTOGRAPHS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photographs.

*** End of Report ***

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