Shenzhen CTL Testing Technology Co., Ltd.
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TEST REPORT

FOR FCC PART 15 SUBPART C 15.249

Report Reference No. .....: **CTL1807131023-WF**

Compiled by: (position+printed name+signature)	Allen Wang (File administrators)	Allen Wang
Tested by: (position+printed name+signature)	Nice Nong (Test Engineer)	Nice Nong
Approved by: (position+printed name+signature)	Ivan Xie (Manager)	Ivan Xie

Product Name.....:	RF Module
Model/Type reference .....:	RF8920N-M
Trade Mark.....:	AFX
FCC ID.....:	2AR7I-RF8920N-M
Applicant's name .....:	**AFX Inc.**
Address of applicant .....:	2345 N. Ernie Krueger Circle Waukegan, IL 60087 USA
Test Firm .....:	**Shenzhen CTL Testing Technology Co., Ltd.**
Address of Test Firm .....:	Floor 1-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, China 518055
Test specification.....:	
Standard.....:	**FCC Part 15.249:**Operation within the bands 920-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0 - 24.25 GHz.
TRF Originator .....:	Shenzhen CTL Testing Technology Co., Ltd.
Master TRF .....:	Dated 2011-01
Date of Receipt.....:	Oct. 09, 2018
Date of Test Date.....:	Oct. 09, 2018–Nov. 05, 2018
Data of Issue.....:	Nov. 05, 2018
Result.....:	**Pass**

TEST REPORT

Test Report No. :	CTL1807131023-WF	Nov. 05, 2018
		Date of issue

Equipment under Test	:	RF Module
Model /Type	:	RF8920N-M
Applicant	:	**AFX Inc.**
Address	:	2345 N. Ernie Krueger Circle Waukegan, IL 60087 USA
Manufacturer	:	**Quicklite Electronics Co. Ltd.**
Address	:	Yuxing Industrial Park, Yanjiang East Road, Zhongshan Torch Development Zone, Guangdong, China

Test result	**Pass ***

* In the configuration tested, the EUT complied with the standards specified page 5.

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

** Modified History **

Revision	Description	Issued Data	Report No.	Remark
Version 1.0	Initial Test Report Release	Nov. 5, 2018	CTL1807131023-WF	Tracy Qi

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1. SUMMARY

1.1. TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.249: Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 - 24.25 GHz.

ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

1.2. Test Description

FCC PART 15.249		
FCC Part 15.249(a)	Field Strength of Fundamental	PASS
FCC Part 15.209	Spurious Emission	PASS
FCC Part 15.209	Band edge	PASS
FCC Part 15.215(c)	20dB bandwidth	PASS
FCC Part 15.207	Conducted Emission	PASS
FCC Part 15.203	Antenna Requirement	PASS

1.3. Test Facility

1.3.1 Address of the test laboratory

Shenzhen CTL Testing Technology Co., Ltd.
Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

1.3.2 Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

FCC-Registration No.: 399832

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 399832, December 08, 2017.

1.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen CTL Testing Technology Co., Ltd. quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CTL laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10dB	(1)
Radiated Emission	Above 1GHz	4.32dB	(1)
Conducted Disturbance	0.15~30MHz	3.20dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

2. GENERAL INFORMATION

2.1. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2. General Description of EUT

Product Name:	RF Module
Model/Type reference:	RF8920N-M
Power supply:	DC 3.3V
2.4GHz Wireless	
Modulation:	GFSK
Operation frequency:	2442MHz
Channel number:	1
Channel separation:	1MHz
Antenna type:	PCB antenna
Antenna gain:	0dBi

Note: For more details, please refer to the user's manual of the EUT.

2.3. Description of Test Modes and Test Frequency

The Applicant provides communication tools software to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing ..

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.12	2018/05/20	2019/05/19
LISN	R&S	ESH2-Z5	860014/010	2018/05/20	2019/05/19
Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2018/05/20	2019/05/19
EMI Test Receiver	R&S	ESCI	103710	2018/05/20	2019/05/19
Spectrum Analyzer	Agilent	E4407B	MY41440676	2018/05/20	2019/05/19
Spectrum Analyzer	Agilent	N9020	US46220290	2018/05/20	2019/05/19
Controller	EM Electronics	Controller EM 1000	N/A	2018/05/20	2019/05/19
Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2018/05/20	2019/05/19
Active Loop Antenna	SCHWARZBECK	FMZB1519	1519-037	2018/05/20	2019/05/19
Amplifier	Agilent	8349B	3008A02306	2018/05/20	2019/05/19
Amplifier	Agilent	8447D	2944A10176	2018/05/20	2019/05/19
Temperature/Humidity Meter	Gangxing	CTH-608	02	2018/05/20	2019/05/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2018/05/20	2019/05/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	N/A	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-10M	10m	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/20	2019/05/19
Coaxial Cables	HUBER+SUHNER	SUCOFLEX 104PEA-3M	3m	2018/05/20	2019/05/19
RF Cable	Megalon	RF-A303	N/A	2018/05/20	2019/05/19

The calibration interval was one year

2.5. Related Submittal(s) / Grant(s)

This submittal(s) (test report) is intended to comply with Section 15.249 of the FCC Part 15, Subpart C Rules.

2.6. Modifications

No modifications were implemented to meet testing criteria.

3. TEST CONDITIONS AND RESULTS

3.1. Conducted Emissions Test

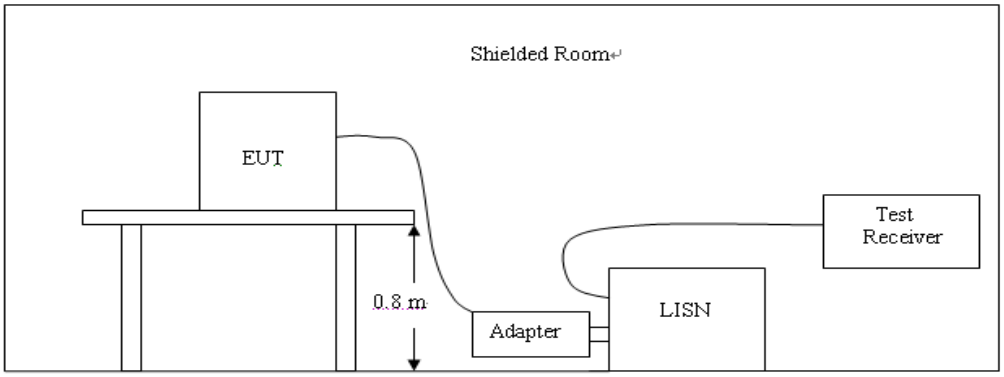
LIMIT

FCC CFR Title 47 Part 15 Subpart C Section 15.207

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST CONFIGURATION



TEST PROCEDURE

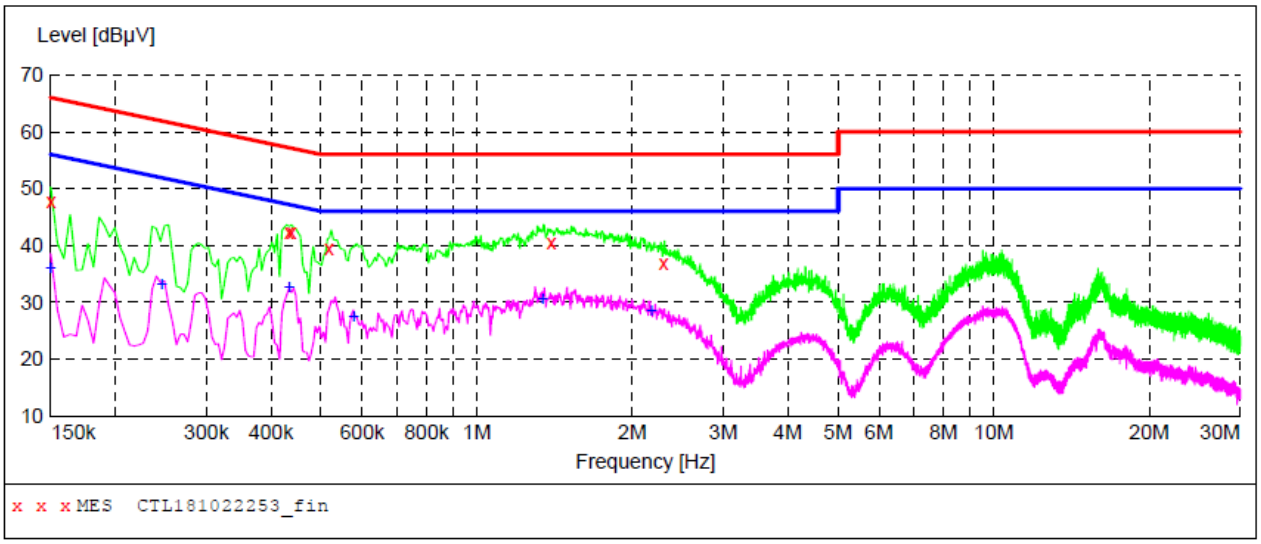
1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10:2013.
2. Support equipment, if needed, was placed as per ANSI C63.10:2013.
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10:2013.
4. If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipments received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

TEST RESULTS

Remark: All modes were test at Low, Middle, and High channel; only the worst result of High Channel was reported as below:

SCAN TABLE: "Voltage (9K-30M) FIN"

Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL181022253_fin"

2018-10-22 03:47??

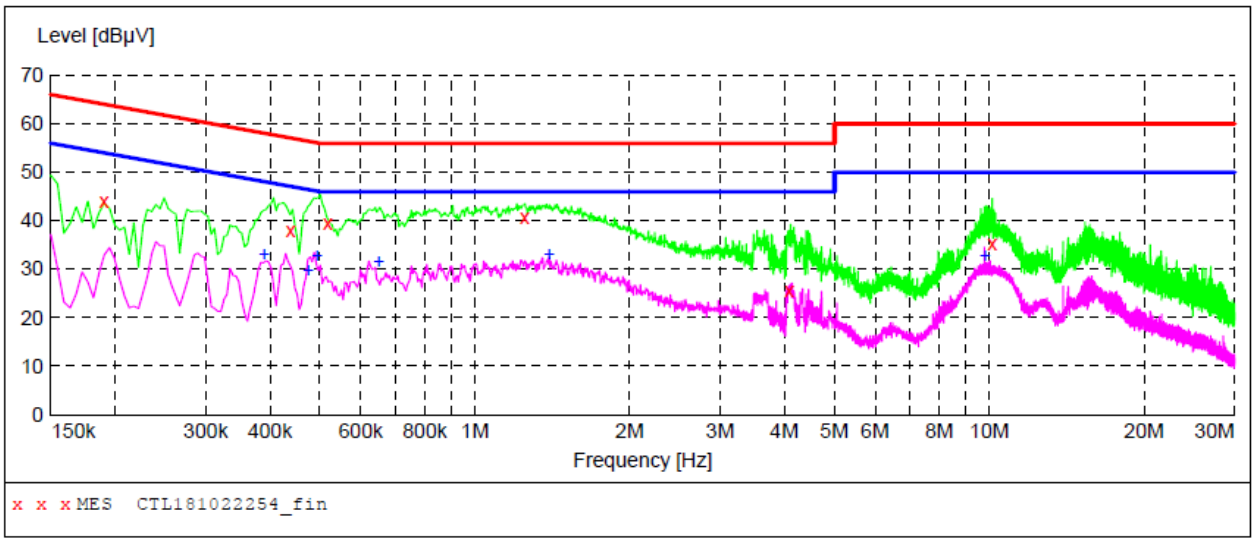
Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	47.80	10.2	66	18.2	QP	L1	GND
0.434000	42.40	10.2	57	14.8	QP	L1	GND
0.438000	42.40	10.2	57	14.7	QP	L1	GND
0.518000	39.60	10.2	56	16.4	QP	L1	GND
1.394000	40.60	10.3	56	15.4	QP	L1	GND
2.300000	36.80	10.4	56	19.2	QP	L1	GND

MEASUREMENT RESULT: "CTL181022253_fin2"

2018-10-22 03:47??

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.150000	36.20	10.2	56	19.8	AV	L1	GND
0.246000	33.20	10.2	52	18.7	AV	L1	GND
0.434000	32.80	10.2	47	14.4	AV	L1	GND
0.578000	27.60	10.2	46	18.4	AV	L1	GND
1.340000	30.60	10.3	46	15.4	AV	L1	GND
2.174000	28.60	10.4	46	17.4	AV	L1	GND

SCAN TABLE: "Voltage (9K-30M)FIN"
Short Description: 150K-30M Voltage



MEASUREMENT RESULT: "CTL181022254_fin"

2018-10-22 03:50??

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.190000	44.20	10.2	64	19.8	QP	N	GND
0.438000	38.10	10.2	57	19.0	QP	N	GND
0.518000	39.60	10.2	56	16.4	QP	N	GND
1.250000	40.60	10.3	56	15.4	QP	N	GND
4.088000	25.70	10.4	56	30.3	QP	N	GND
10.130000	35.40	10.6	60	24.6	QP	N	GND

MEASUREMENT RESULT: "CTL181022254_fin2"

2018-10-22 03:50??

Frequency MHz	Level dBµV	Transd dB	Limit dBµV	Margin dB	Detector	Line	PE
0.390000	33.10	10.2	48	15.0	AV	N	GND
0.474000	29.80	10.2	46	16.6	AV	N	GND
0.494000	32.80	10.2	46	13.3	AV	N	GND
0.650000	31.60	10.2	46	14.4	AV	N	GND
1.394000	33.20	10.3	46	12.8	AV	N	GND
9.812000	33.00	10.6	50	17.0	AV	N	GND

Note:
1. Margin = Limit – level
2. Peripheral device during the Testing

No.	Product	Manufacturer	Model	Length	Certification	Note
1	Notebook	Dell	H57	--	SDOC	--
2	Adapter	Dell	PA-1650-05D	--	SDOC	--
3	USB line	--	--	90cm	--	Not shield

3.2. Radiated Emissions and Band Edge

Limit

According 15.249, the field strength of emissions from intentional radiators operated within 2400MHz-2483.5 MHz shall not exceed 94dBμV/m (50mV/m):

FCC PART 15.249(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

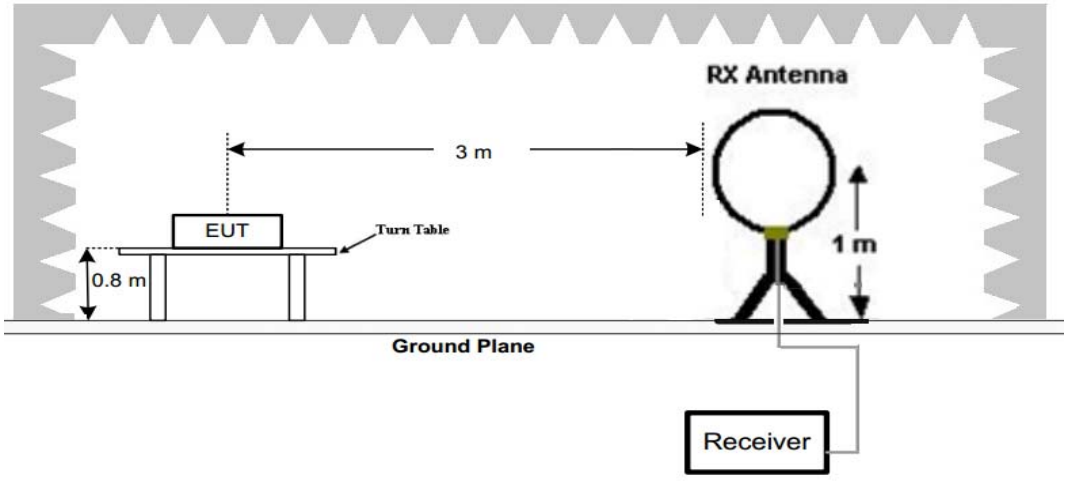
In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

Radiated emission limits

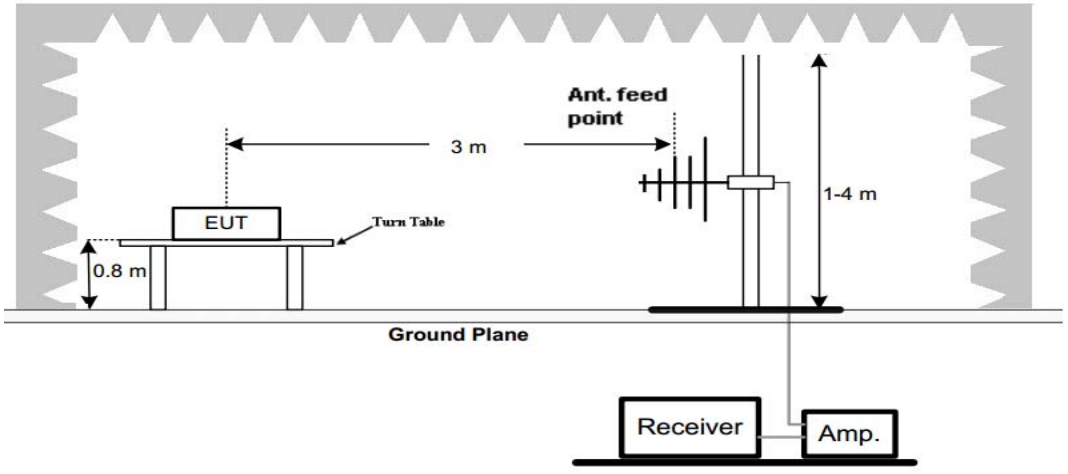
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

TEST CONFIGURATION

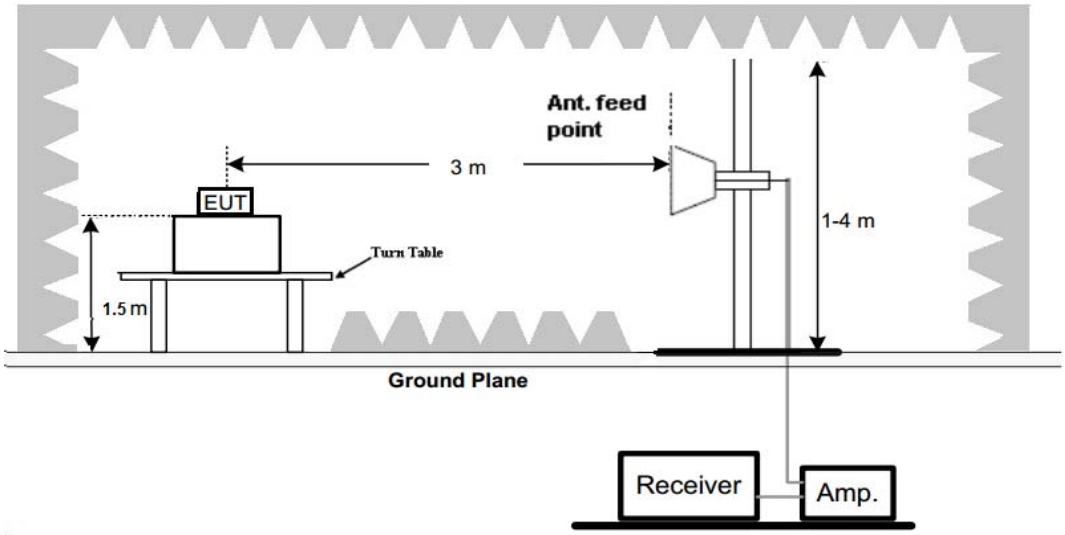
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



Test Procedure

1. Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.

TEST RESULTS

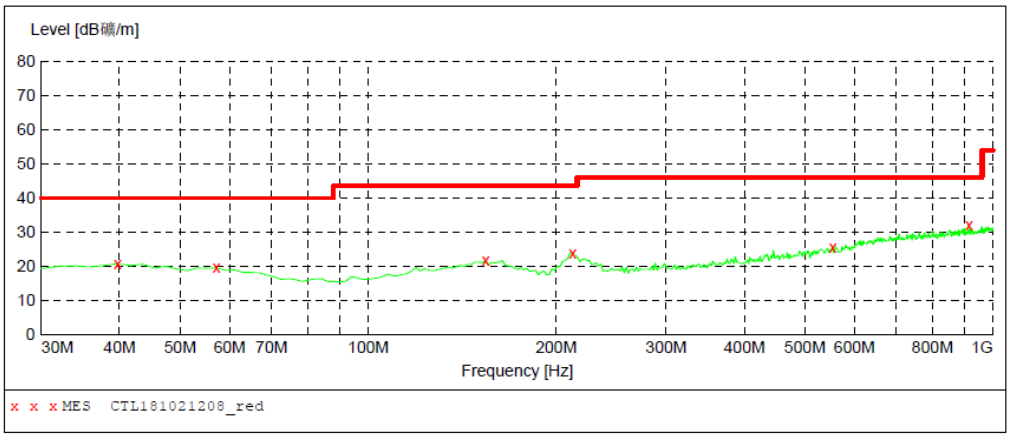
Remark:
1. We measured Radiated Emission at GFSK mode from 9 KHz to 25GHz and recorded worst case.
2. For below 1GHz testing recorded worst at GFSK low channel.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

Horizontal

SWEEP TABLE: "test (30M-1G)"

Short Description:			Field Strength		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	200.0 ms	120 kHz	VULB 9168



MEASUREMENT RESULT: "CTL181021208_red"

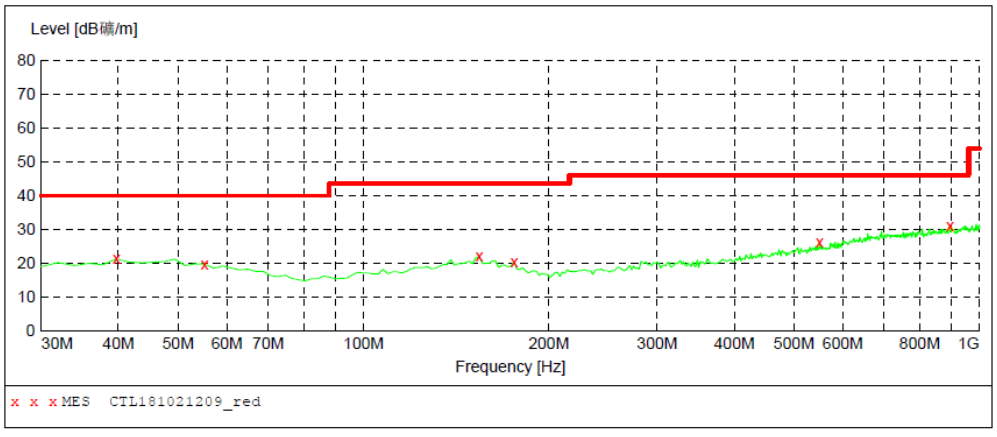
2018-10-23 9:38

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
39.700000	20.70	14.8	40.0	19.3	---	0.0	0.00	HORIZONTAL
57.160000	19.50	13.6	40.0	20.5	---	0.0	0.00	HORIZONTAL
154.160000	21.60	15.2	43.5	21.9	---	0.0	0.00	HORIZONTAL
212.360000	23.90	11.4	43.5	19.6	---	0.0	0.00	HORIZONTAL
553.800000	25.50	19.2	46.0	20.5	---	0.0	0.00	HORIZONTAL
914.640000	31.90	23.9	46.0	14.1	---	0.0	0.00	HORIZONTAL

Vertical

SWEEP TABLE: "test (30M-1G)"

Short Description:			Field Strength		
Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	200.0 ms	120 kHz	VULB 9168



MEASUREMENT RESULT: "CTL181021209_red"

2018-10-23 9:41

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.	Height cm	Azimuth deg	Polarization
39.700000	21.20	14.8	40.0	18.8	---	0.0	0.00	VERTICAL
55.220000	19.70	13.8	40.0	20.3	---	0.0	0.00	VERTICAL
154.160000	21.90	15.2	43.5	21.6	---	0.0	0.00	VERTICAL
175.500000	20.30	13.4	43.5	23.2	---	0.0	0.00	VERTICAL
549.920000	26.10	19.1	46.0	19.9	---	0.0	0.00	VERTICAL
895.240000	31.00	23.7	46.0	15.0	---	0.0	0.00	VERTICAL

Note:

1. Margin = Limit - level

For 1GHz to 25GHz

Frequency(MHz):			2442		Polarity:			HORIZONTAL	
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4884.00	48.78	PK	74.00	25.22	42.53	33.60	6.95	34.30	6.25
4884.00	--	AV	54.00	--	--	--	--	--	--
5210.75	43.35	PK	74.00	30.65	35.72	34.57	7.16	34.10	7.63
5210.75	--	AV	54.00	--	--	--	--	--	--
7326.00	47.91	PK	74.00	26.09	36.22	37.46	9.23	35.00	11.69
7326.00	--	AV	54.00	--	--	--	--	--	--

Frequency(MHz):			2442		Polarity:			VERTICAL	
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4884.00	49.04	PK	74.00	24.96	42.79	33.60	6.95	34.30	6.25
4884.00	--	AV	54.00	--	--	--	--	--	--
5210.75	43.78	PK	74.00	30.22	36.14	34.58	7.16	34.10	7.64
5210.75	--	AV	54.00	--	--	--	--	--	--
7326.00	48.03	PK	74.00	25.97	36.34	37.46	9.23	35.00	11.69
7326.00	--	AV	54.00	--	--	--	--	--	--

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.

Results of Band Edges Test (Radiated)

Frequency(MHz):	2442				Polarity:			HORIZONTAL	
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2442.00	98.07	PK	--	--	64.68	28.78	4.61	0.00	33.39
2442.00	91.42	AV	--	--	58.03	28.78	4.61	0.00	33.39
2483.50	43.85	PK	74	30.15	10.22	28.93	4.70	0.00	33.63
2483.50	--	AV	54	--	--	--	--	--	--
2390.00	42.92	PK	74.00	31.08	9.60	28.72	4.60	0.00	33.32
2390.00	--	AV	54.00	--	--	--	--	--	--
2400.00	43.14	PK	74.00	30.86	9.75	28.78	4.61	0.00	33.39
2400.00	--	AV	54.00	--	--	--	--	--	--

Frequency(MHz):	2442				Polarity:			VERTICAL	
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2442.00	97.68	PK	--	--	64.29	28.78	4.61	0	33.39
2442.00	91.41	AV	--	--	58.02	28.78	4.61	0	33.39
2483.50	43.87	PK	74	30.13	10.24	28.93	4.70	0.00	33.63
2483.50	--	AV	54	--	--	--	--	--	--
2390.00	42.65	PK	74	31.35	9.33	28.72	4.60	0	33.32
2390.00	--	AV	54	--	--	--	--	--	--
2400.00	43.79	PK	74	30.21	10.4	28.78	4.61	0	33.39
2400.00	--	AV	54	--	--	--	--	--	--

REMARKS:

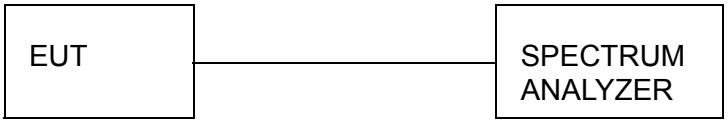
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.
6. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is for AV value.
7. For fundamental frequency, RBW 3MHz VBW 3MHz Peak detector is for PK Value; RMS detector is for AV value.

3.3. Occupied Bandwidth Measurement

Limit

N/A

Test Configuration



Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 30 KHz RBW and 100 KHz VBW.

The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

Test Results

Modulation	Frequency(MHz)	99% OBW (MHz)	20dB bandwidth (MHz)	Result
GFSK	2442	1.1740	1.266	PASS

Test plot as follows:

GFSK Modulation

3.4. Antenna Requirement

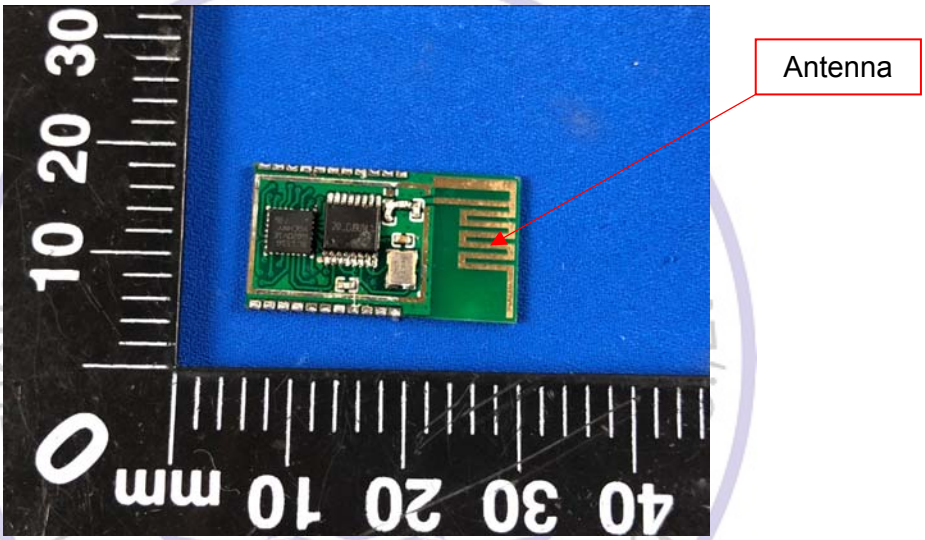
Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Refer to statement below for compliance.
The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

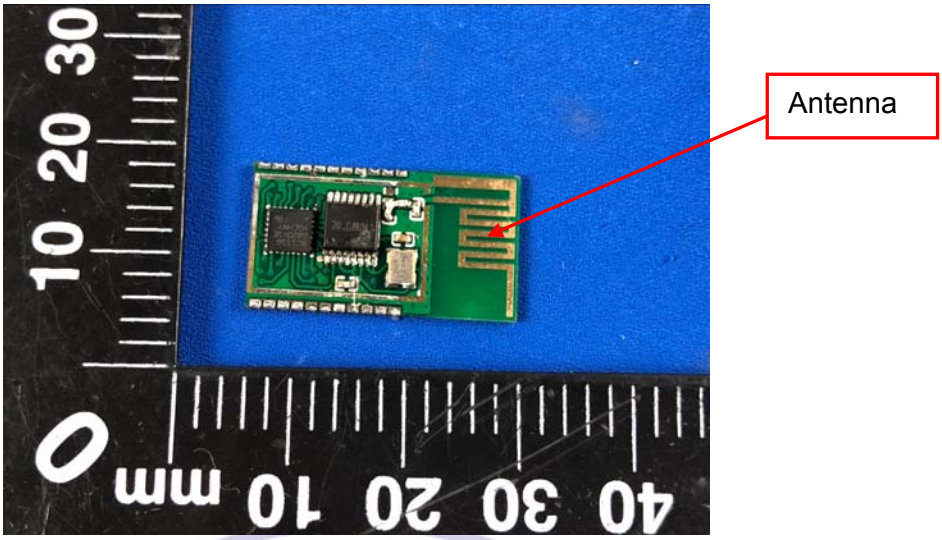
Antenna Connected Construction

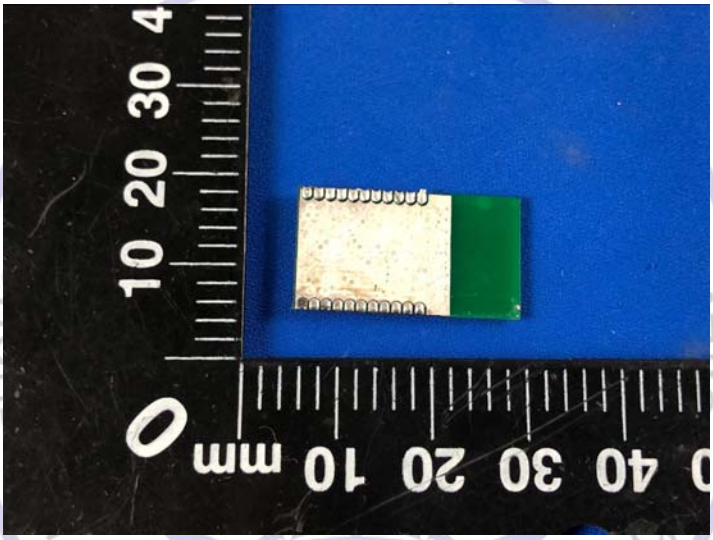
The antenna used in this product is PCB Antenna, The directional gains of antenna used for transmitting is 0dBi.



4. Test Setup Photos of the EUT

5. External and Internal Photos of the EUT





********** End of Report **********