Microtest
微测检测

Test Report

FCC ID: Z52NAS-WS02Z

Date of issue: July 25, 2019

Report Number:	MTi19070303-1E1
Sample Description:	Water Sensor
Model(s):	NAS-WS02Z
Applicant:	SHENZHEN NEO ELECTRONICS CO., LTD
Address:	East 6/F, Building 2LaoBing Industry, No.44TieZai Road, Baoan District, Shenzhen
Date of Test:	July 11, 2019 to July 25, 2019

Shenzhen Microtest Co., Ltd.
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Table of Contents

Test Result Certification

Applicant's name:	SHENZHEN NEO ELECTRONICS CO., LTD
Address:	East 6/F, Building 2LaoBing Industry, No.44TieZai Road, Baoan District, Shenzhen
Manufacture's Name:	SHENZHEN NEO ELECTRONICS CO., LTD
Address:	East 6/F, Building 2LaoBing Industry, No.44TieZai Road, Baoan District, Shenzhen
Product name:	Water Sensor
Trademark:	NEO
Model name:	NAS-WS02Z
Standards:	FCC Part 15.249
Test Procedure:	ANSI C63.10-2013

This device described above has been tested by Shenzhen Microtest Co., Ltd. and the test results show that the equipment under test (EUT) compliance with the FCC requirements. And it is applicable only to the tested sample identified in the report.

Tested by:	Jone Lee	July 25, 2019
Reviewed by:	Blue Zheng	July 25, 2019
Approved by:	Smith Chen	July 25, 2019

1 General description

1.1 Feature of equipment under test (EUT)

Equipment:	Water Sensor
Trade Name:	NEO
Model Name:	NAS-WS02Z
Serial Model:	N/A
Model Difference:	N/A
Operation Frequency:	908.4MHz
Modulation Type:	GFSK
Antenna Type:	TX/RX:PCB antenna
Antenna Gain:	1.2dBi
Power Source:	DC 3V by battery
Battery:	DC 3V
Hardware Version:	NAS-WS01&02&03ZU-1 V2 20190222
Software Version:	S2 W2019.04.22

1.2 Operation channel list

Channel	Frequency(MHz)
1	908.4

1.3 Test Frequency Channel

Channel	Frequency(MHz)
1	908.4

1.4 EUT operation mode

During testing, RF test program provided by the manufacture to control the Tx operation followed the test requirement.

1.5 Ancillary equipment list

Equipment	Model	S/N	Manufacturer
/	/	/	/
/	/	/	/

2 Summary of Test Result

Test procedures according to the technical standards:

Item	FCC Part No.	Description of Test	Result
1	FCC Part15.203	Antenna Requirement	Pass
2	FCC Part15.207	AC power line conducted emission	N/A
3	FCC Part15.249(d)	Radiated spurious emission	Pass
4	FCC Part 15.215	20dB and 99% Bandwidth	Pass

3 Test Facilities and Accreditations

3.1 Test laboratory

Test Laboratory	Shenzhen Microtest Co., Ltd
Location	No.102A & 302A, East Block, Hengfang Industrial Park, Xingye Road, Xixiang, Bao'an District, Shenzhen, Guangdong, China
FCC Registration No.	448573

3.2 Environmental conditions

Temperature:	15ºC~35ºC
Humidity	20%~75%
Atmospheric pressure	98kPa~101kPa

3.3 Measurement uncertainty

The reported uncertainty of measurement y ± U，where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2，providing a level of confidence of approximately 95 %

RF frequency	1 x 10-7
RF power, conducted	± 1 dB
Conducted emission(150kHz~30MHz)	± 2.5 dB
Radiated emission(30MHz~1GHz)	± 4.2 dB
Radiated emission (above 1GHz)	± 4.3 dB
Temperature	±1 degree
Humidity	± 5 %

3.4 Test software

Software Name	Manufacturer	Model	Version
RF Test System	Shenzhen JS tonscend co., ltd	JS1120-3	2.5.77.0418

4 List of test equipment

Equipment No.	Equipment Name	Manufacturer	Model	Serial No.	Calibration date	Due date
MTI-E004	EMI Test Receiver	Rohde&schwarz	ESPI7	100314	2018/10/09	2019/10/08
MTI-E006	TRILOG Broadband Antenna	schwarabeck	VULB 9163	9163-872	2018/10/15	2020/10/14
MTI-E014	amplifier	Hewlett-Packard	8447D	3113A06150	2018/10/09	2019/10/08
MTI-E036	Single path vehicle AMN(LISN)	Schwarzbeck	NNBM 8124	01175	2018/10/09	2019/10/08
MTI-E038	Low noise active vertical monopole antenna	Schwarzbeck	VAMP 9243	#565	2018/10/16	2019/10/15
MTI-E039	Biconical antenna	Schwarzbeck	BBA 9106	#164	2018/10/15	2019/10/14
MTI-E041	MXG Vector Signal Generator	Agilent	N5182A	MY49060455	2019/04/16	2020/04/15
MTI-E042	ESG Series Analog signal generator	Agilent	E4421B	GB40051240	2019/05/21	2020/05/20
MTI-E044	Thermometer clock humidity monitor	-	HTC-1	/	2019/04/17	2020/04/16
MTI-E062	Log Periodic Antenna	Schwarzbeck	VUSLP 9111B	#312	2018/04/11	2020/04/10
MTI-E063	Log Periodic Dipole Array Antenna	ETS-LINDGREN	3148B	00224524	2018/04/11	2020/04/10
MTI-E065	Amplifier	EMtrace	RP06A	00117	2019/04/29	2020/04/28
MTI-E066	Comprehensive test instrument	Rohde&schwarz	CMW500	149155	2019/04/16	2020/04/15
MTI-E071	PXA Signal Analyzer	Agilent	N9030A	MY51350296	2018/10/25	2019/10/24
MTI-E076	EMI Test Receiver	Rohde&schwarz	ESIB26	100273	2019/04/16	2020/04/15
MTI-E078	Synthesized Sweeper	Agilent	83752A	3610A01957	2019/04/16	2020/04/15
MTI-E079	DC Power Supply	Agilent	E3632A	MY40027695	2019/04/16	2020/04/15
MTI-E093	Artificial mains network	3ctest	LISN J50	ES3911805	2019/04/16	2020/04/15
MTI-E096	Power amplifier	Space-Dtroniccs	EWLNA0118G-P40	1852001	2019/04/29	2020/04/28
MTI-E097	Current Probe	SOLAR ELECTRONICS CO.	9207-1	220095-1	2019/04/17	2020/04/16
MTI-E098	Loop Sensor	SOLAR ELECTRONICS CO.	7334-1	220095-2	2019/04/21	2020/04/20
Note: the calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).						

5 Test Result

5.1 Antenna requirement

5.1.1 Standard requirement

FCC PART 15.203 and 15.247(b);

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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

5.1.2 EUT Antenna

The antenna is a PCB antenna, which was permanently affixed to the device and un-replaced, complies with 15.203. In addition, the maximum antenna gain is 1.2dBi.

5.2 Conducted emission

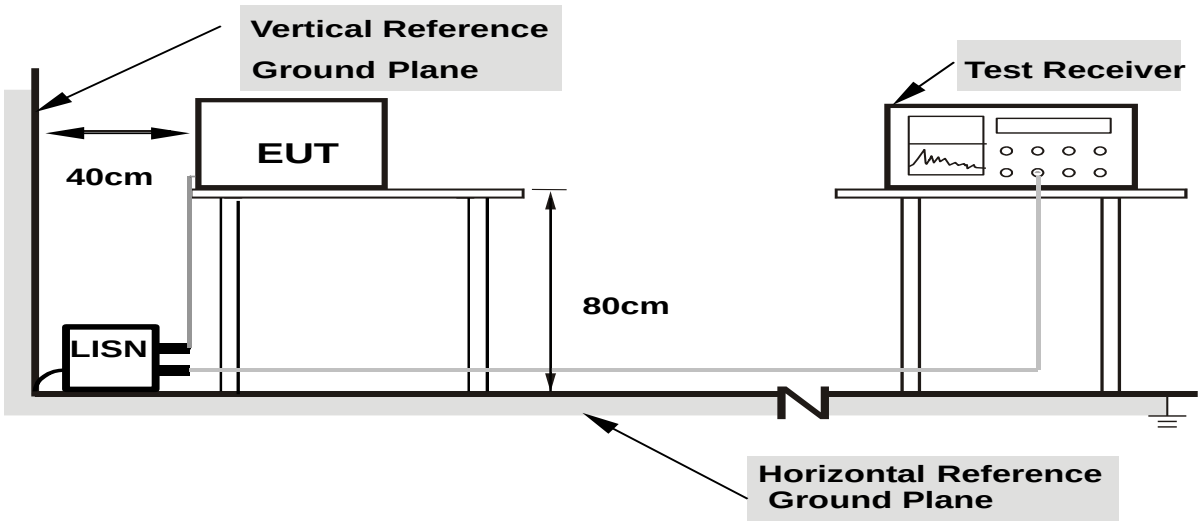
5.2.1 Limits

FCC §15.207;

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency (MHz)	Quasi-peak	Average
0.15 -0.5	66 - 56 note2	56 - 46 note2
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00
Note1: The tighter limit applies at the band edges. *Note2: The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.*		

5.2.2 Test setup



Note: 1.Support units were connected to second LISN.
2.Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

5.2.3 Test procedure

a. EUT Operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

b. The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

c. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipments powered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.

d. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

e. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

f. LISN at least 80 cm from nearest part of EUT chassis.

For the actual test configuration, please refer to the related Item –EUT Test Photos.

5.2.4 Test results

EUT：	Water Sensor	Model Name. ：	NAS-WS02Z
Temperature：	26 ℃	Relative Humidity：	54%
Pressure：	1010hPa	Phase :	L
Test Voltage ：	N/A	Test Mode：	N/A

Note: The device is a DC power supply and does not apply to conducted emissions.

5.3 Radiated spurious emission

5.3.1 Limit

FCC PART 15.249(a);

Except as provided in paragraph (a) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
902-928	50	500
2400-2483.5	50	500
5725-5875	50	500

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.

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

5.3.2 Test method

a) The EUT is placed on a turntable, which is 0.8m above ground plane for test frequency range blew 1GHz, and 1.5m above ground plane for test frequency range above 1GHz.

b) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.

c) Use the following spectrum analyzer settings:

   1) Span = wide enough to fully capture the emission being measured

   2) RBW = 1 MHz for f ≥ 1GHz, 100 kHz for f < 1 GHz

   3) VBW ≥ RBW, Sweep = auto

   4) Detector function = peak

   5) Trace = max hold

d) Follow the guidelines in ANSI C63.4-2014 with respect to maximizing the emission by rotating the EUT, adjusting the measurement antenna height and polarization, etc. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, submit this data. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

e) The peak level, once corrected, must comply with the limit specified in Section 15.209. Set the RBW = 1MHz, VBW = 10Hz, Detector = PK for AV value, while maintaining all of the other instrument settings.

5.3.3 Test Result

Note: If the PK measured values lower than average mode limit, the EUT shall be deemed to meet average limits and then no additional average mode measurement performed.

Below 30MHz

EUT：	Water Sensor	Model Name. ：	NAS-WS02Z
Temperature：	20 ℃	Relative Humidtity：	48%
Pressure：	1010 hPa	Test Voltage：	DC 3V by battery
Test Mode：	TX	Polarization :	--

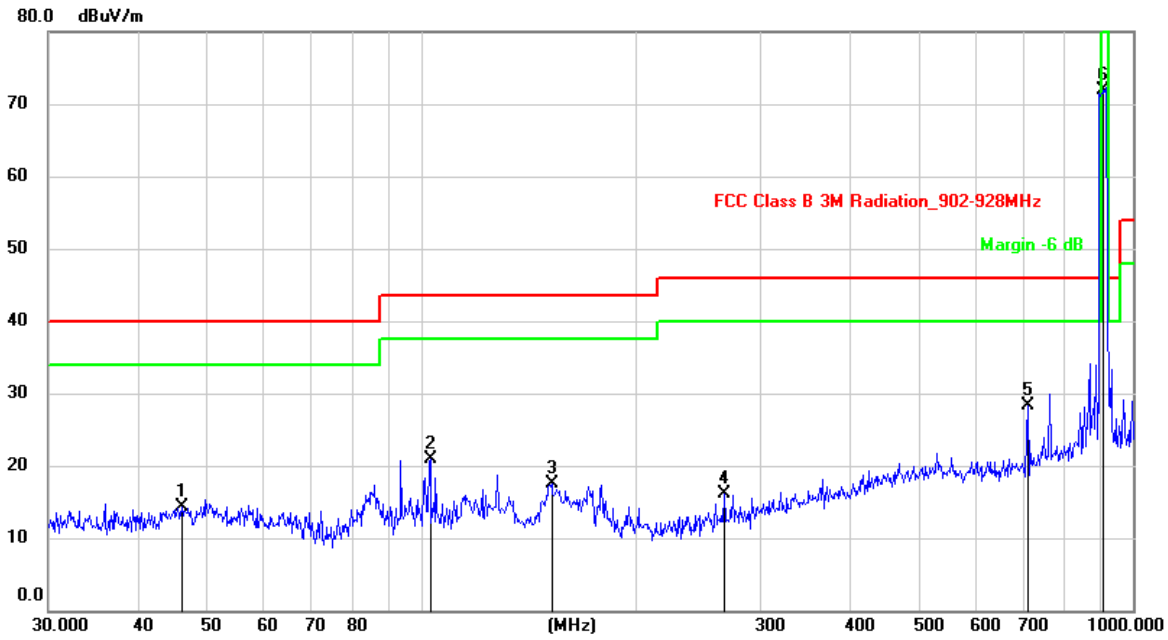
Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	Pass
--	--	--	--	Pass

Note:
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
Distance extrapolation factor =40 log (specific distance/test distance)(dB);
Limit line = specific limits(dBuV) + distance extrapolation factor.
Test data limits above 6G are below 20dB, so no evaluation is required.

5.3.4 Test Result

Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Horizontal
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz

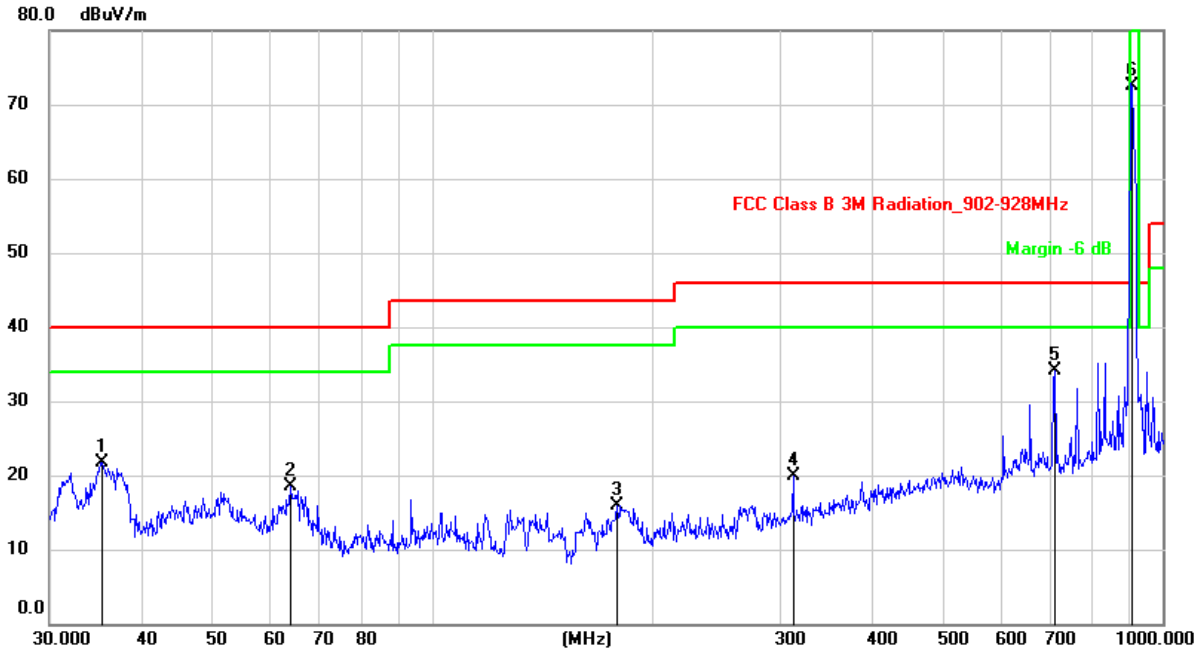
30MHz-1GHz



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		46.1779	24.00	-9.69	14.31	40.00	-25.69	QP
2		103.0800	32.44	-11.44	21.00	43.50	-22.50	QP
3		152.6639	31.96	-14.37	17.59	43.50	-25.91	QP
4		266.6089	25.72	-9.56	16.16	46.00	-29.84	QP
5	*	711.6734	32.27	-4.05	28.22	46.00	-17.78	QP
6		908.4000	73.13	-1.21	71.92	94.00	-22.08	QP

Note: Exceeding the emission limit is the main frequency.

Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Vertical
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz

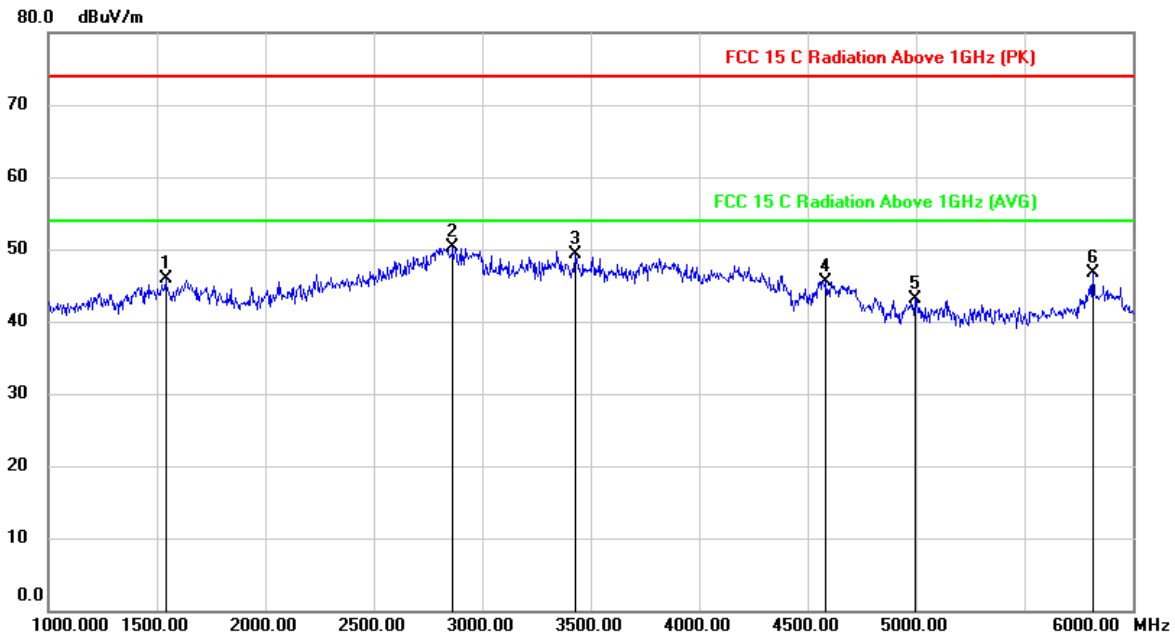


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		35.3750	32.95	-11.24	21.71	40.00	-18.29	QP
2		63.9827	30.61	-12.18	18.43	40.00	-21.57	QP
3		179.3863	27.75	-11.82	15.93	43.50	-27.57	QP
4		312.1792	28.20	-8.36	19.84	46.00	-26.16	QP
5	*	711.6734	38.22	-4.05	34.17	46.00	-11.83	QP
6		908.4000	73.77	-1.21	72.56	94.00	-21.44	QP

Note: Exceeding the emission limit is the main frequency.

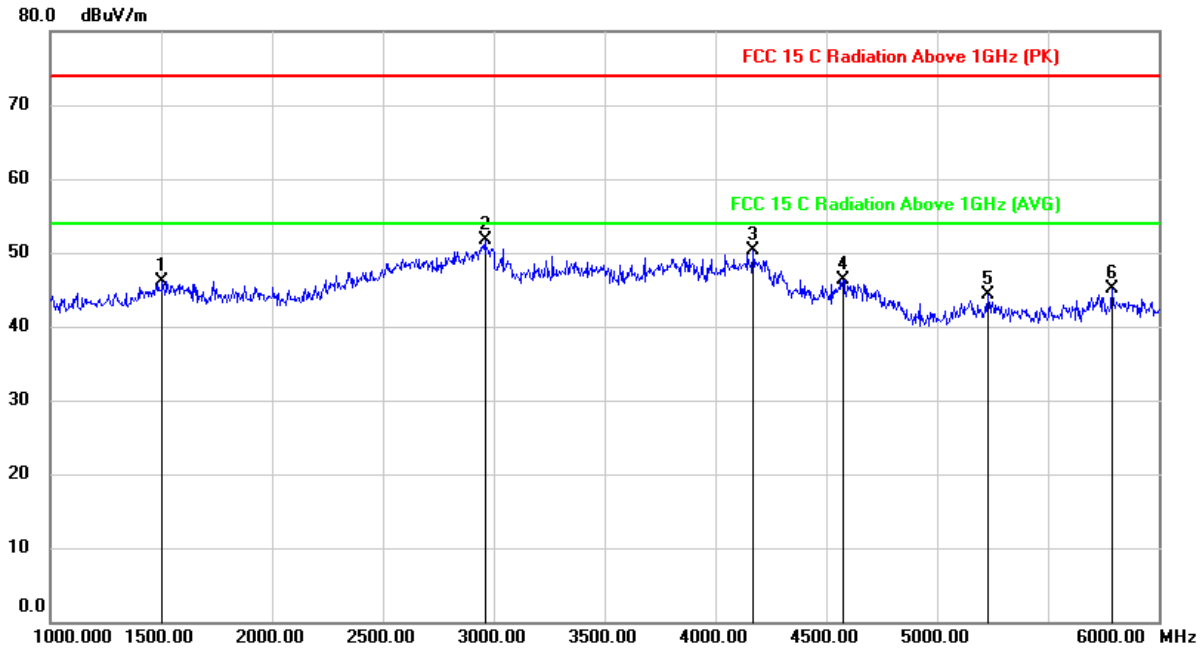
Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Horizontal
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz

1G-6G:



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		1540.000	61.06	-15.25	45.81	74.00	-28.19	peak
2	*	2865.000	56.03	-5.81	50.22	74.00	-23.78	peak
3		3430.000	53.88	-4.64	49.24	74.00	-24.76	peak
4		4585.000	51.52	-5.92	45.60	74.00	-28.40	peak
5		4995.000	51.32	-8.25	43.07	74.00	-30.93	peak
6		5815.000	53.15	-6.38	46.77	74.00	-27.23	peak

Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Vertical
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz

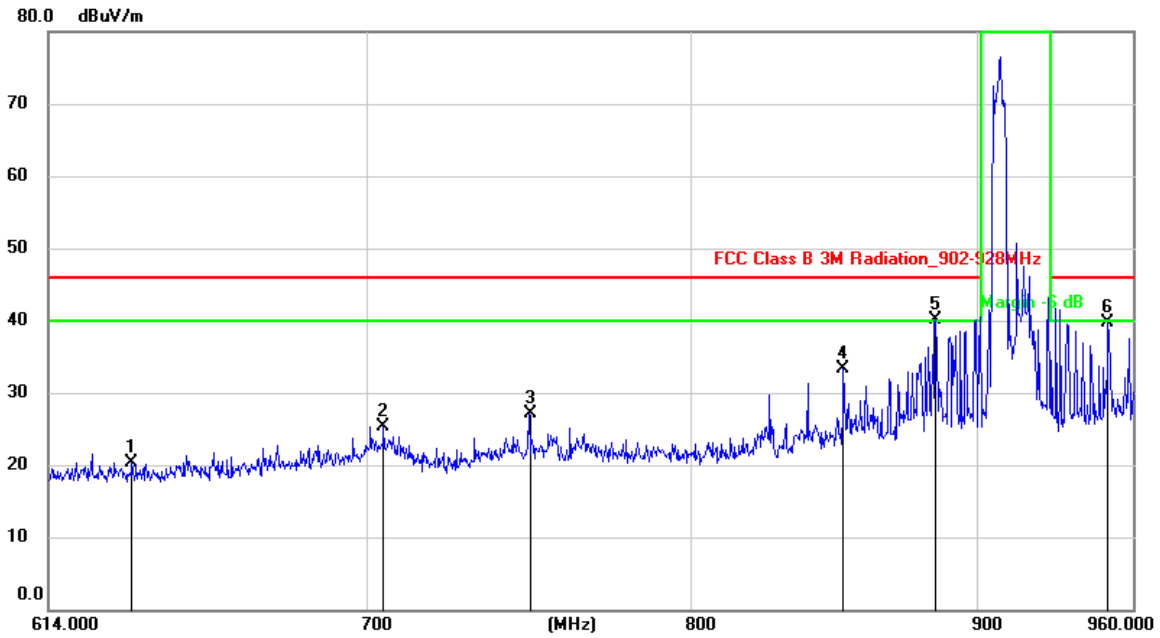


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		1505.000	61.88	-15.82	46.06	74.00	-27.94	peak
2	*	2960.000	58.63	-6.95	51.68	74.00	-22.32	peak
3		4170.000	55.56	-5.24	50.32	74.00	-23.68	peak
4		4575.000	53.87	-7.65	46.22	74.00	-27.78	peak
5		5230.000	53.87	-9.58	44.29	74.00	-29.71	peak
6		5790.000	53.31	-8.22	45.09	74.00	-28.91	peak

5.3.5 Band edge-radiated

Note: (1) All Readings are Peak Value (VBW=3MHz) and AV Value (VBW=10Hz).
(2)Emission Level= Antenna Factor + Cable Loss + Read Level - Preamp Factor
(3) All other emissions more than 20dB below the limit.

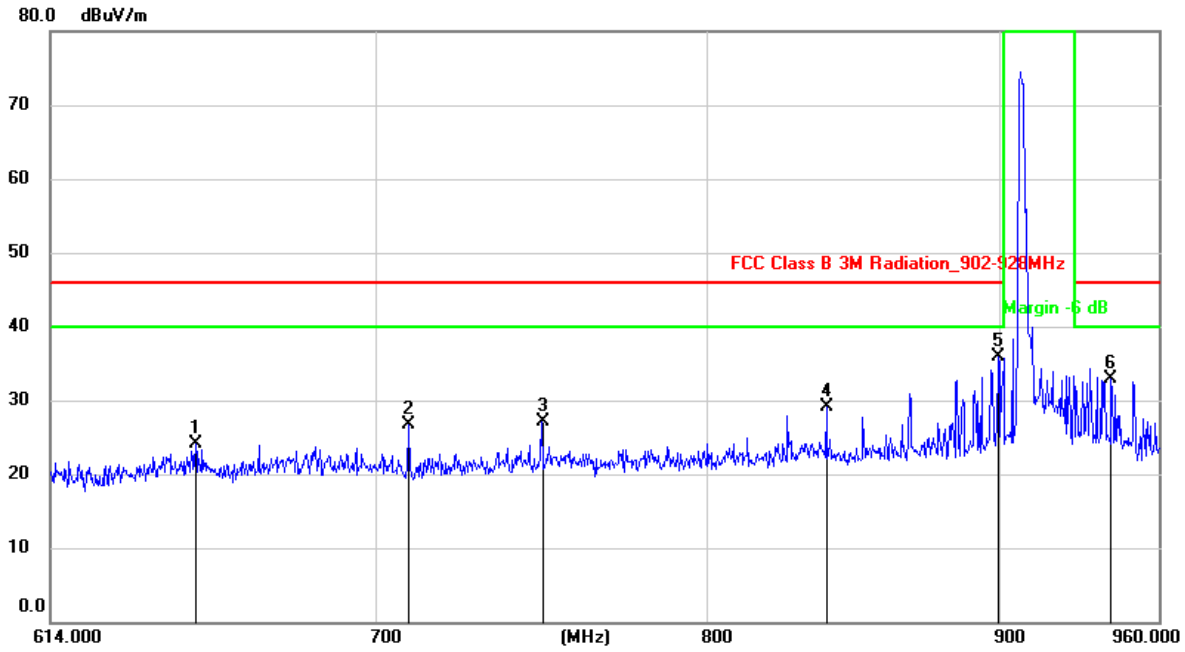
Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Horizontal
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		635.4981	25.31	-4.94	20.37	46.00	-25.63	QP
2		704.9302	29.51	-4.16	25.35	46.00	-20.65	QP
3		748.4382	30.59	-3.54	27.05	46.00	-18.95	QP
4		852.0121	35.31	-2.01	33.30	46.00	-12.70	QP
5	*	885.0025	41.66	-1.51	40.15	46.00	-5.85	QP
6		950.1820	40.59	-0.81	39.78	46.00	-6.22	QP

Note: Exceeding the emission limit is the main frequency.

Temperature:	25℃	Relative Humidity:	44%
Pressure:	101kPa	Polarization:	Vertical
Test voltage:	DC 3V by battery	Test Mode ：	TX-908.4MHz



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector
1		651.0221	28.80	-4.76	24.04	46.00	-21.96	QP
2		709.3549	30.87	-4.09	26.78	46.00	-19.22	QP
3		748.4382	30.68	-3.54	27.14	46.00	-18.86	QP
4		839.5380	31.38	-2.20	29.18	46.00	-16.82	QP
5	*	899.7590	37.13	-1.28	35.85	46.00	-10.15	QP
6		941.7264	33.82	-0.90	32.92	46.00	-13.08	QP

Note: Exceeding the emission limit is the main frequency.

All the modulation modes have been tested, and the worst result was report as below:

Frequency	Meter Reading	Cable Loss	Antenna Factor	Preamp Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	dB/m	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
GFSK									
2310.00	63.79	2.97	27.80	43.80	50.76	74	-23.24	Pk	Horizontal
2310.00	43.39	2.97	27.80	43.80	30.36	54	-23.64	AV	Horizontal
2310.00	60.85	2.97	27.80	43.80	47.82	74	-26.18	Pk	Vertical
2310.00	41.76	2.97	27.80	43.80	28.73	54	-25.27	AV	Vertical
2390.00	63.79	3.14	27.21	43.80	50.34	74	-23.66	Pk	Vertical
2390.00	44.03	3.14	27.21	43.80	30.58	54	-23.42	AV	Vertical
2390.00	63.77	3.14	27.21	43.80	50.32	74	-23.68	Pk	Horizontal
2390.00	42.47	3.14	27.21	43.80	29.02	54	-24.98	AV	Horizontal
2400.00	64.38	3.21	27.49	44.00	51.08	74	-22.92	Pk	Vertical
2400.00	42.30	3.21	27.49	44.00	29.00	54	-25.00	AV	Vertical
2400.00	65.04	3.21	27.49	44.00	51.74	74	-22.26	Pk	Horizontal
2400.00	41.66	3.21	27.49	44.00	28.36	54	-25.64	AV	Horizontal
2483.50	63.31	3.58	27.70	44.00	50.59	74	-23.41	Pk	Vertical
2483.50	44.05	3.58	27.70	44.00	31.33	54	-22.67	AV	Vertical
2483.50	65.64	3.58	27.70	44.00	52.92	74	-21.08	Pk	Horizontal
2483.50	44.33	3.58	27.70	44.00	31.61	54	-22.39	AV	Horizontal

5.4 20dB and 99% bandwidth

5.4.1 Limits

FCC §15.215(c)

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

5.4.2 Test method

Use the following spectrum analyzer settings:

For 20 dB bandwidth

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥1% of the 20 dB bandwidth
VBW ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold

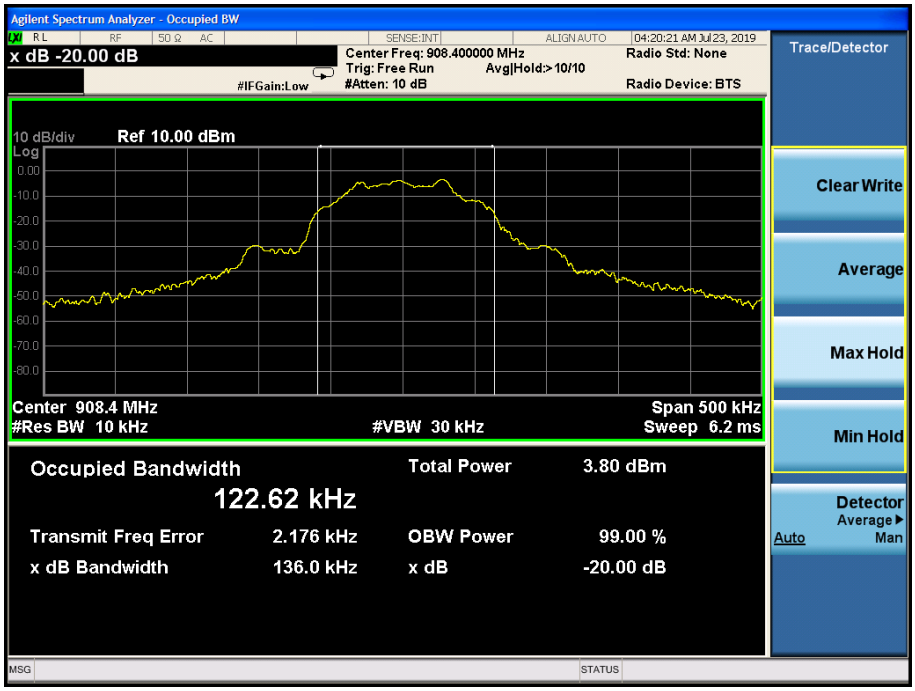
The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth and 99% occupied bandwidth of the emission

5.4.3 Test result

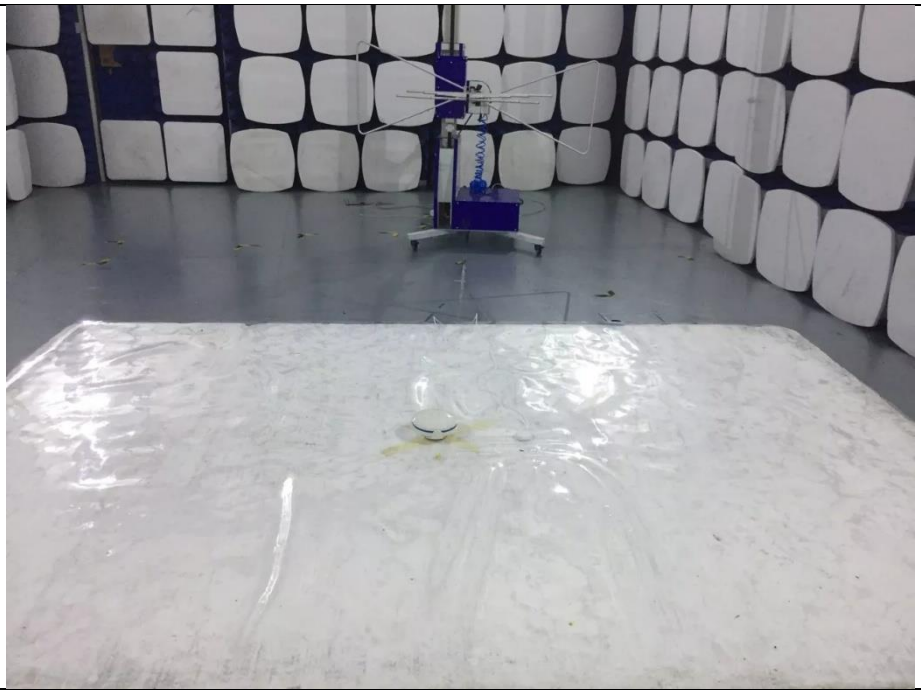
Frequency (MHz)	20dB bandwidth (MHz)
908.4	0.1360

Test plots

908.4MHz



Photographs of the Test Setup

Radiated emission – below 1GHz

Radiated emission – above 1GHz


Photographs of the EUT

See the APPENDIX 1: EUT PHOTO in the report No.: MTi19070303-1E1-1.

----END OF REPORT----