

FCC Radio Test Report

FCC ID: 2ACSPNST-BS1

Original Grant

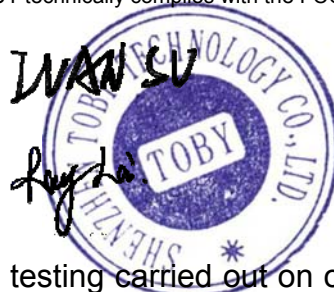
Report No. : TB-FCC141138
Applicant : Beijing Natural Smart-Tech Co., Ltd.
Equipment Under Test (EUT)
EUT Name : Bluetooth Speaker
Model No. : NST-BS1
Series Model No. : N/A
Brand Name : O'xon
Receipt Date : 2014-07-04
Test Date : 2014-07-05 to 2014-07-23
Issue Date : 2014-09-02
Standards : FCC Part 15, Subpart C (15.225/15.215)
Test Method : ANSI C63.4:2003
Conclusions : **PASS**

In the configuration tested, the EUT complied with the standards specified above,

The EUT technically complies with the FCC and IC requirements

Test/Witness Engineer :

Approved& Authorized :



This report details the results of the testing carried out on one sample. The results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in the report.

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1. General Information about EUT

1.1 Client Information

Applicant : Beijing Natural Smart-Tech Co., Ltd.
Address : Room 11C, Building B, No.28 Xinxu Road, Haidian District, Beijing, China
Manufacturer : Beijing Natural Smart-Tech Co., Ltd.
Address : Room 11C, Building B, No.28 Xinxu Road, Haidian District, Beijing, China

1.2 General Description of EUT (Equipment Under Test)

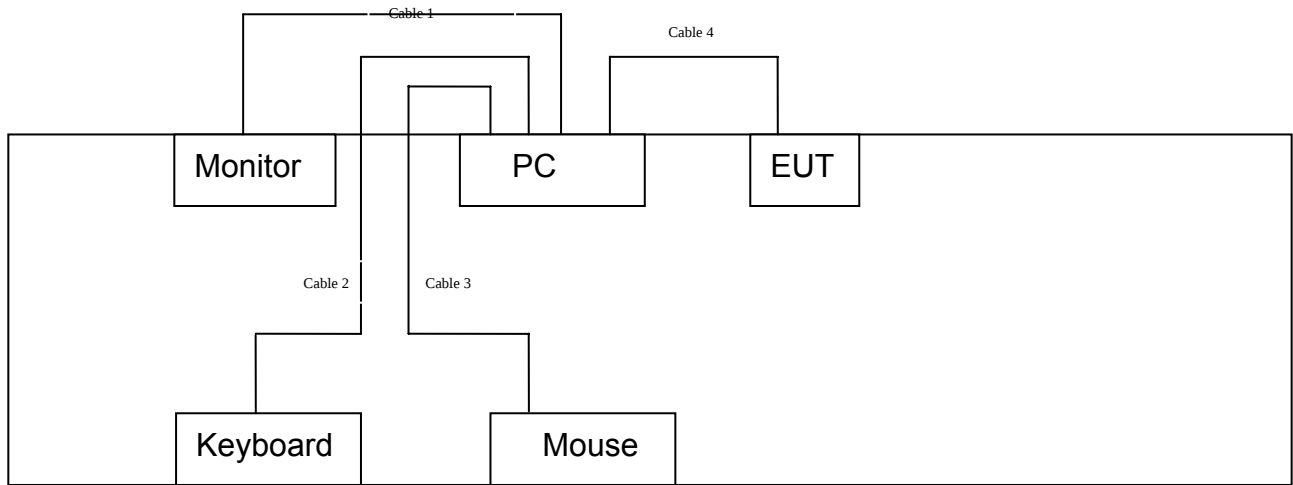
EUT Name	:	Bluetooth Speaker	
Models No.	:	NST-BS1	
Model Difference	:	N/A.	
Product Description	:	Operation Frequency: 13.56 MHz	
		Number of Channel:	1 channel
		Antenna Type:	Loop Antenna
		Modulation Type:	ASK
Power Supply	:	DC Voltage supplied from Host System by USB cable DC power by Li-ion Battery	
Power Rating	:	DC 5.0V by USB cable. DC 3.7V 1000mAh Li-ion Battery	
Connecting I/O Port(S)	:	Please refer to the User's Manual	

Note:

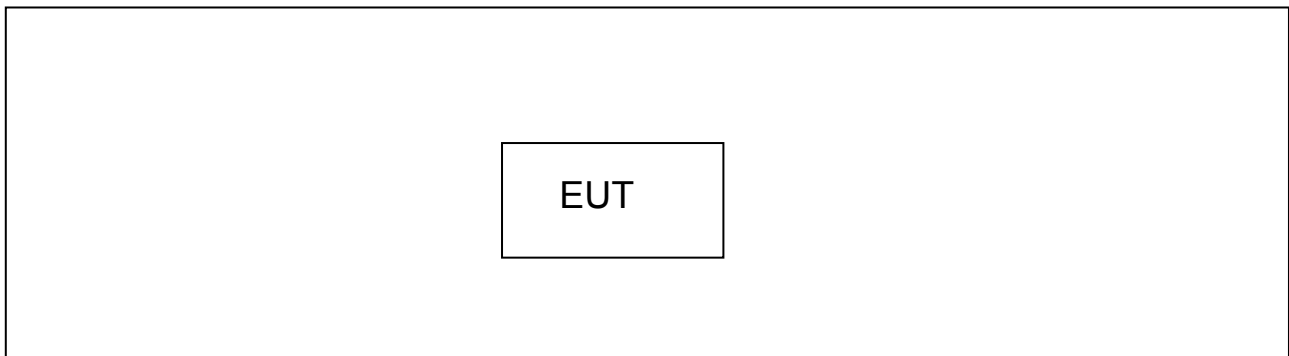
- (1) This Test Report is FCC Part 15.225 and 15.215 for NFC (13.56 MHz).
- (2) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
- (3) Antenna information provided by the applicant.

1.3 Block Diagram Showing the Configuration of System Tested

USB Charging Mode



TX Mode



1.4 Description of Support Units

Equipment Information				
Name	Model	S/N	Manufacturer	Used “√”
LCD Monitor	E170Sc	DOC	DELL	√
PC	OPTIPLEX380	DOC	DELL	√
Keyboard	L100	DOC	DELL	√
Mouse	M-UARDEL7	DOC	DELL	√
Cable Information				
Number	Shielded Type	Ferrite Core	Length	Note
Cable 1	YES	YES(2)	1.8M	
Cable 2	YES	NO	1.5M	
Cable 3	YES	NO	1.5M	
Cable 4	YES	NO	0.5M	Accessories

1.5 Description of Test Mode

To investigate the maximum EMI emission characteristics generates from EUT, the test system was pre-scanning tested base on the consideration of following EUT operation mode or test configuration mode which possible have effect on EMI emission level. Each of these EUT operation mode(s) or test configuration mode(s) mentioned follow was evaluated respectively.

For Conducted Test	
Final Test Mode	Description
Mode 1	USB Charging with TX Mode

For Radiated Test	
Final Test Mode	Description
Mode 2	USB Charging with TX Mode
Mode 3	TX Mode

Note:

- (1) For all test, we have verified the construction and function in typical operation. And all the test modes were carried out with the EUT in transmitting operation in maximum power with all kinds of data rate.
According to ANSI C63.4 standards, the measurements are performed at the below mode:
NFC Mode: ASK Modulation 13.56 MHz Transmitting mode.
- (2) During the testing procedure, the continuously transmitting with the maximum power mode was programmed by the customer.
- (3) The EUT is considered a mobile unit; in normal use it was positioned on X-plane. The worst case was found positioned on X-plane. Therefore only the test data of this X-plane was used for radiated emission measurement test.

1.6 Description of Test Software Setting

During testing channel& Power controlling software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product power parameters of RF setting.

1.7 Test Facility

The testing was performed by the Shenzhen Toby Technology Co., Ltd., in their facilities located at:

1A/F., Bldg.6, Yusheng Industrial Zone, The National Road No.107 Xixiang Section 467, Xixiang, Bao'an, Shenzhen, Guangdong, China.

At the time of testing, the following bodies accredited the Laboratory:

The Laboratory has been accredited by CNAS to ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories for the competence in the field of testing. And the Registration No.: CNAS L5813.

The Laboratory is listed in the United States of American Federal Communications Commission (FCC), and the registration number is 811562.

2. Test Summary

FCC Part 15 Subpart C(15.22515.215)			
Standard Section FCC	Test Item	Judgment	Remark
15.203	Antenna Requirement	PASS	N/A
15.207	Conducted Emission	PASS	N/A
15.225(a)	Field strength of any emissions within band 13.553~13.567 MHz	PASS	N/A
15.225(d)/15.209	Field strength of any emissions appearing outside of the 13.110~14.010 MHz band	PASS	N/A
15.225(e)	Frequency tolerance	PASS	N/A
15.215(C)	20 dB Bandwidth	PASS	N/A
Note: "/" for no requirement for this test item. N/A is an abbreviation for Not Applicable.			

3. Conducted Emission Test

3.1 Test Standard and Limit

3.1.1 Test Standard

FCC Part 15.207

3.1.2 Test Limit

Conducted Emission Test Limit

Frequency	Maximum RF Line Voltage (dB μ V)	
	Quasi-peak Level	Average Level
150kHz~500kHz	66 ~ 56 *	56 ~ 46 *
500kHz~5MHz	56	46
5MHz~30MHz	60	50

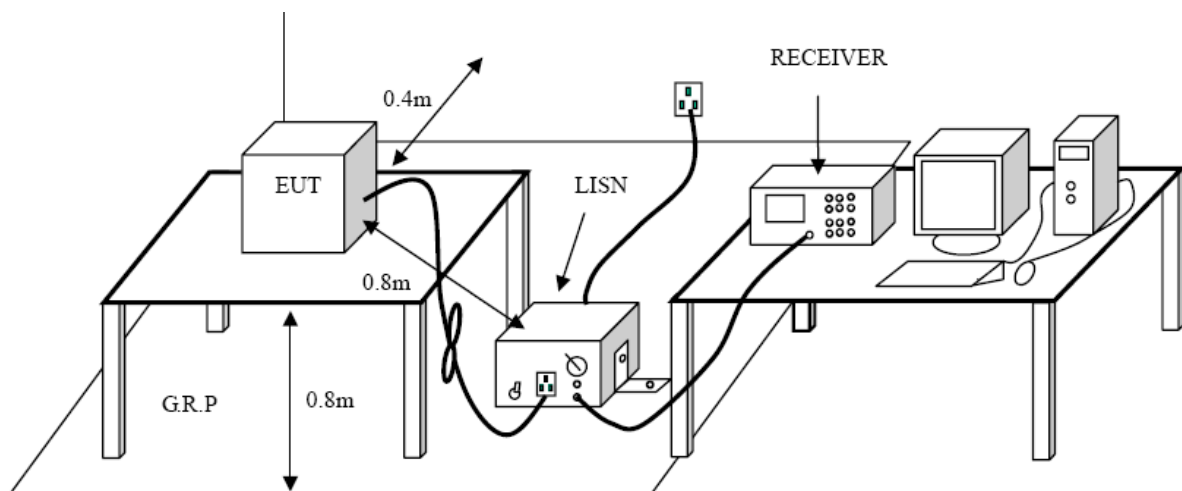
Notes:

(1) *Decreasing linearly with logarithm of the frequency.

(2) The lower limit shall apply at the transition frequencies.

(3) The limit decrease in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

3.2 Test Setup



3.3 Test Procedure

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.

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.

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.

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

The bandwidth of EMI test receiver is set at 9kHz, and the test frequency band is from 0.15MHz to 30MHz.

3.4 Test Equipment Used

Description	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due Date
EMI Test Receiver	ROHDE& SCHWARZ	ESCI	100321	2013-08-10	2014-08-09
50ΩCoaxial Switch	Anritsu	MP59B	X10321	2013-08-10	2014-08-09
L.I.S.N	Rohde & Schwarz	ENV216	101131	2013-08-10	2014-08-09
L.I.S.N	SCHWARZBECK	NNBL 8226-2	8226-2/164	2013-08-10	2014-08-09

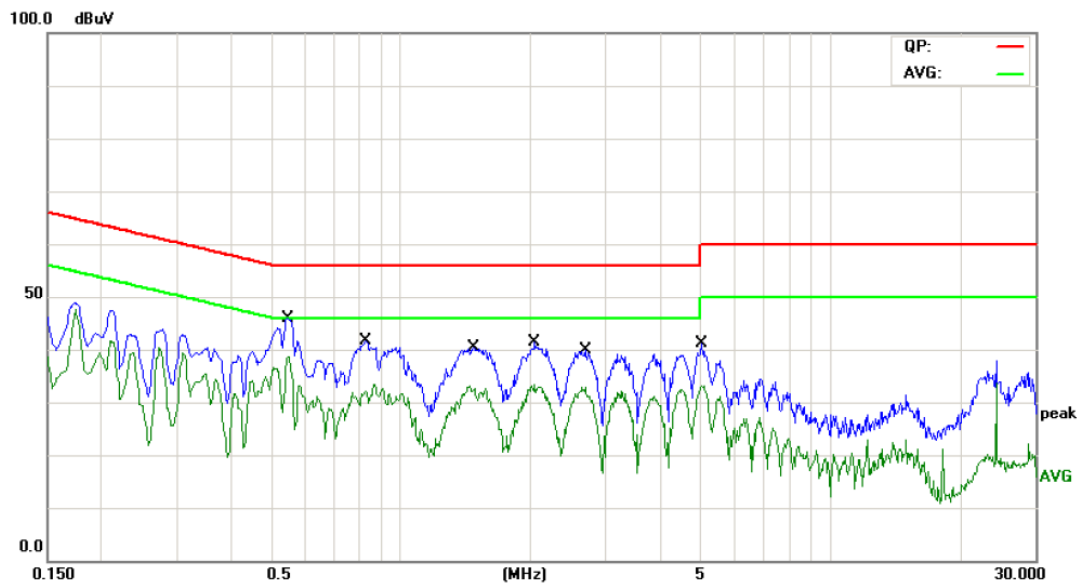
3.5 EUT Operating Mode

Please refer to the description of test mode.

3.6 Test Data

Please see the next page.

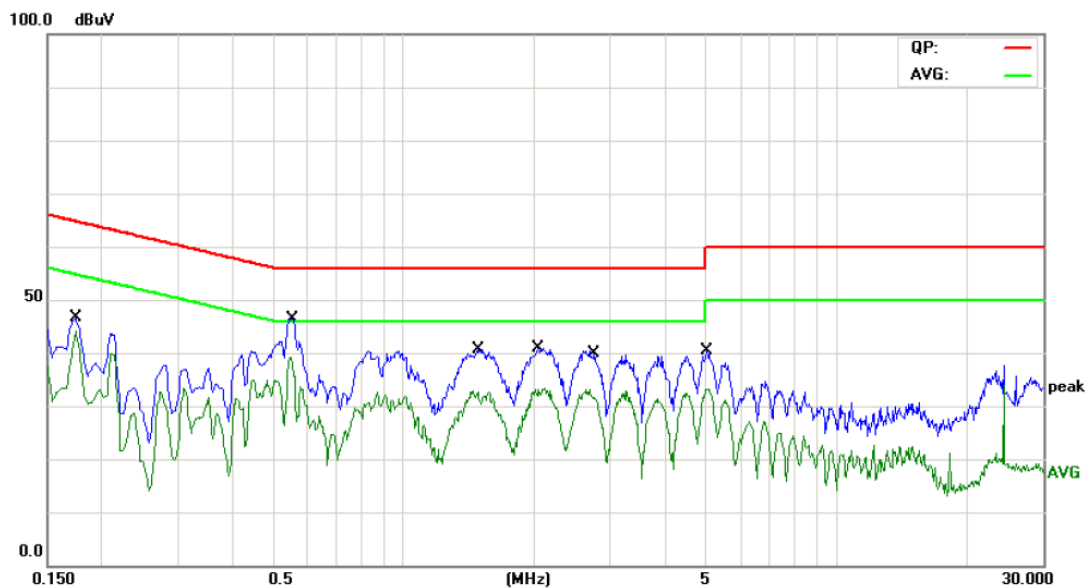
EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Line		
Test Mode:	USB Charging with TX Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.5460	35.42	10.04	45.46	56.00	-10.54	QP	
2	*	0.5460	28.51	10.04	38.55	46.00	-7.45	AVG	
3		0.8300	30.69	10.09	40.78	56.00	-15.22	QP	
4		0.8300	21.90	10.09	31.99	46.00	-14.01	AVG	
5		1.4780	28.58	10.06	38.64	56.00	-17.36	QP	
6		1.4780	22.22	10.06	32.28	46.00	-13.72	AVG	
7		2.0500	29.02	10.06	39.08	56.00	-16.92	QP	
8		2.0500	23.16	10.06	33.22	46.00	-12.78	AVG	
9		2.6860	27.04	10.04	37.08	56.00	-18.92	QP	
10		2.6860	22.67	10.04	32.71	46.00	-13.29	AVG	
11		5.0140	27.19	9.96	37.15	60.00	-22.85	QP	
12		5.0140	22.98	9.96	32.94	50.00	-17.06	AVG	

Emission Level= Read Level+ Correct Factor

EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	AC 120V/60 Hz		
Terminal:	Neutral		
Test Mode:	USB Charging with TX Mode		
Remark:	Only worse case is reported		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector Comment
1		0.1740	34.69	10.12	44.81	64.76	-19.95	QP
2		0.1740	33.99	10.12	44.11	54.76	-10.65	AVG
3		0.5540	35.96	10.02	45.98	56.00	-10.02	QP
4	*	0.5540	28.17	10.02	38.19	46.00	-7.81	AVG
5		1.4819	28.12	10.11	38.23	56.00	-17.77	QP
6		1.4819	22.04	10.11	32.15	46.00	-13.85	AVG
7		2.0500	28.83	10.06	38.89	56.00	-17.11	QP
8		2.0500	22.91	10.06	32.97	46.00	-13.03	AVG
9		2.7580	25.37	10.06	35.43	56.00	-20.57	QP
10		2.7580	20.99	10.06	31.05	46.00	-14.95	AVG
11		5.0060	25.81	10.06	35.87	60.00	-24.13	QP
12		5.0060	22.67	10.06	32.73	50.00	-17.27	AVG

Emission Level= Read Level+ Correct Factor

4. Radiated Emission Test

4.1 Test Standard and Limit

4.1.1 Test Standard

FCC Part 15.209/15.225(a)/15.225(d)

4.1.2 Test Limit

- (a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

Frequency (MHz)	Field Strength Limit 30 m	Field Strength Limit 3m
13.553~13.567	15,848 (uV/m)	124 dBuV/m

Mask Limit:

Rules	FCC Part 15 Section 15.225(a)-(d)			
Compliance with the spectrum mask is tested using a spectrum analyzer with RB set to a 1kHz for the Band 13.553~13.567 MHz.				
	Frequency of Emission (MHz)	Field Strength (uV/m) at 30m	Field Strength (dBuV/m) at 30m	Field Strength (dBuV/m) at 3m
Limit	1.705~13.110	30	29.5	69.5
	13.110~13.410	106	40.5	80.5
	13.410~13.553	334	50.5	90.5
	13.553~13.567	15848	84.00	124.0
	13.567~13.710	334	50.5	90.5
	13.710~14.010	106	40.5	80.5
	14.010~30.00	30	29.5	69.5

- (e) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

Radiated Emission Limits (9kHz~1000MHz)

Frequency (MHz)	Field Strength (microvolt/meter)	Measurement Distance (meters)
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

Radiated Emission Limit (Above 1000MHz)

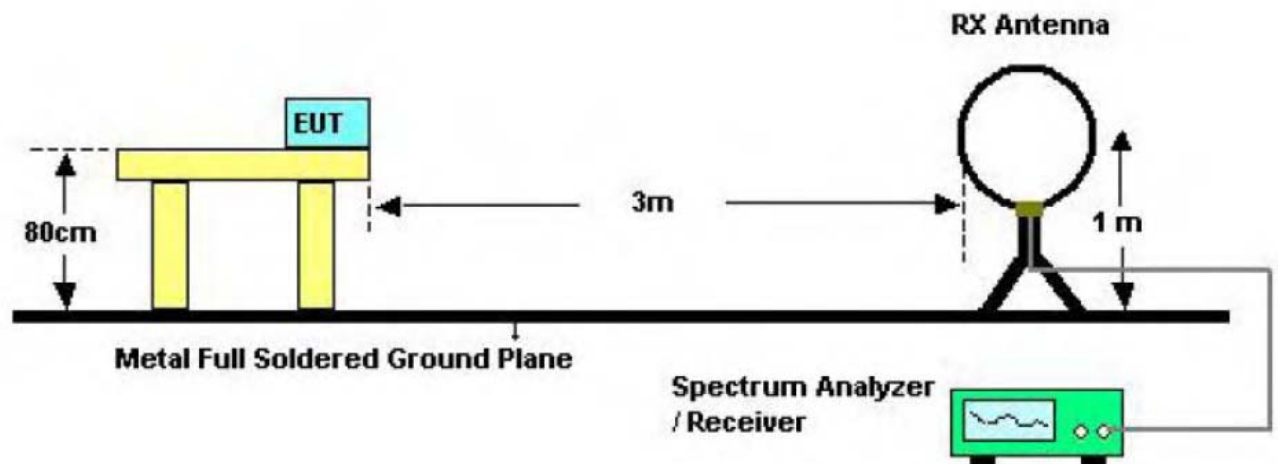
Frequency (MHz)	Class A (dBuV/m)(at 3 M)		Class B (dBuV/m)(at 3 M)	
	Peak	Average	Peak	Average
Above 1000	80	60	74	54

Note:

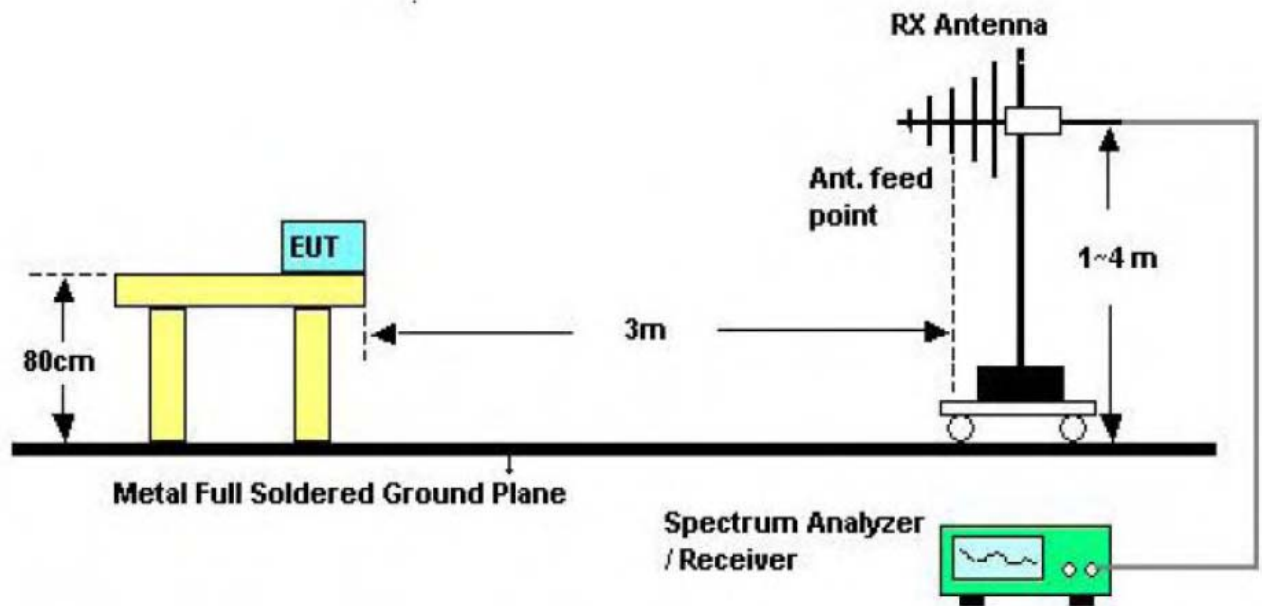
(1) The tighter limit applies at the band edges.

(2) Emission Level(dBuV/m)=20log Emission Level(uV/m)

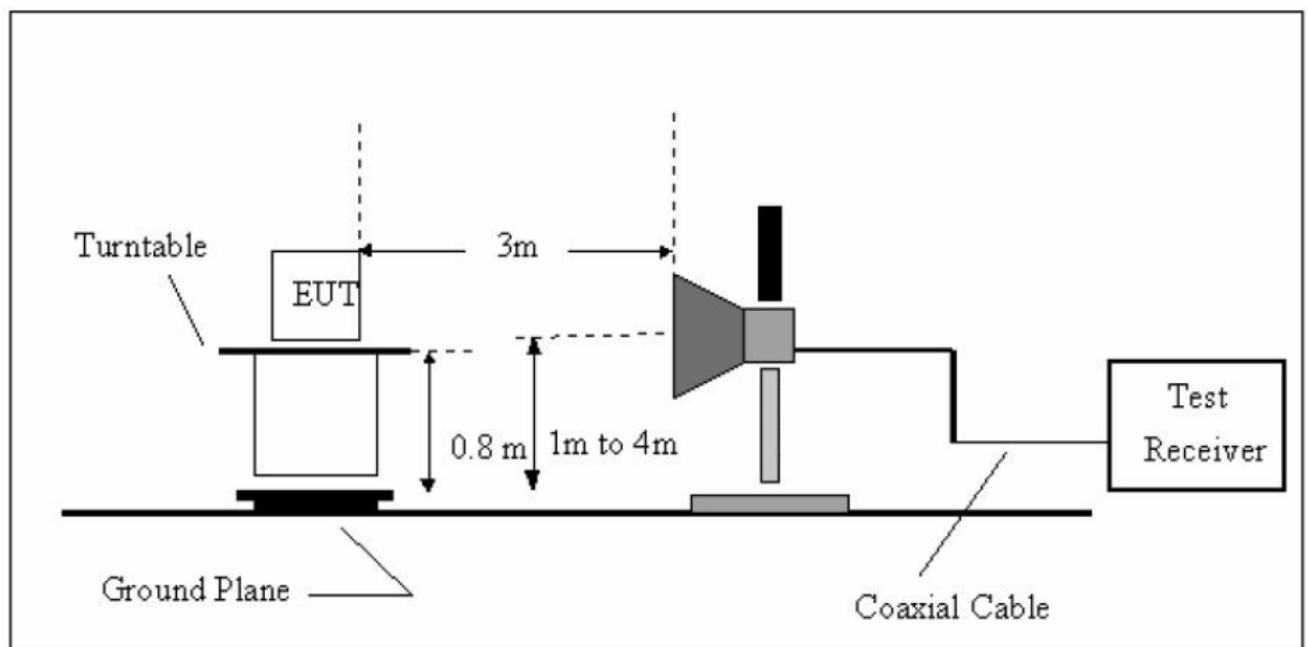
4.2 Test Setup



Below 30MHz Test Setup



Below 1000MHz Test Setup



Above 1GHz Test Setup

4.3 Test Procedure

- (1) The measuring distance of 3m shall be used for measurements at frequency up to 1GHz and above 1 GHz. The EUT was placed on a rotating 0.8m high above the ground, the table was rotated 360 degrees to determine the position of the highest radiation.
- (2) The Test antenna shall vary between 1m and 4m, Both Horizontal and Vertical antenna are set to make measurement.
- (3) The initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- (4) If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit Bellow 1 GHz, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed. But the Peak Value and average value both need to comply with applicable limit above 1 GHz.
- (5) For the actual test configuration, please see the test setup photo.

4.4 EUT Operating Condition

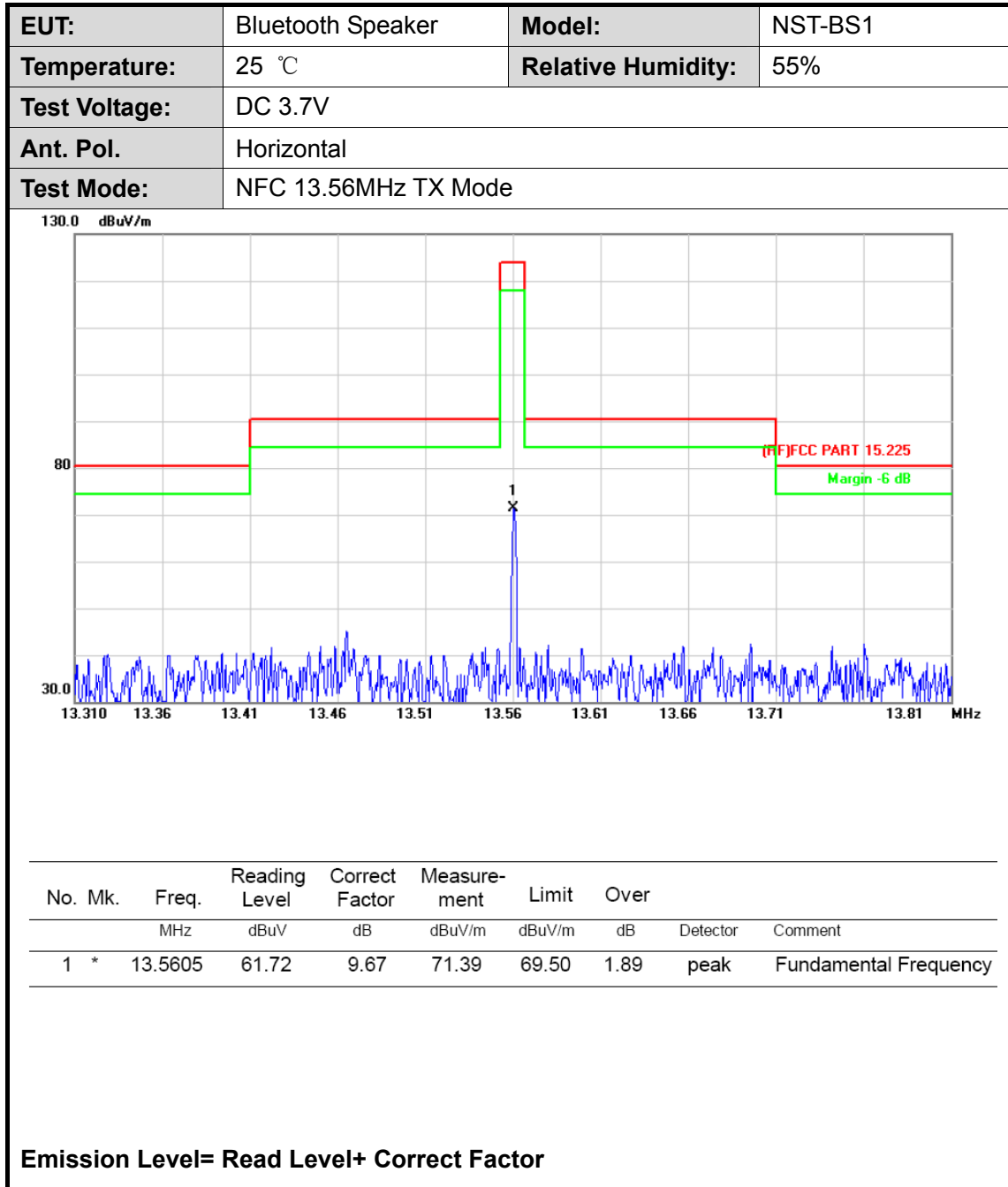
The Equipment Under Test was set to Continual Transmitting in maximum power.

4.5 Test Equipment

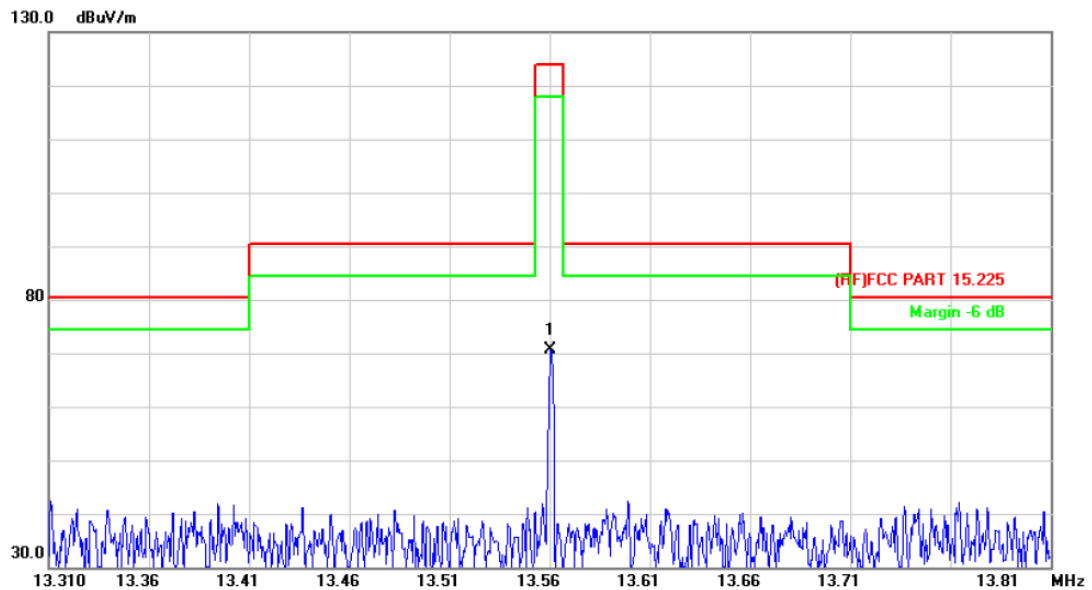
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
Spectrum Analyzer	Agilent	E4407B	MY45106456	Mar. 20, 2014	Mar. 19, 2015
Spectrum Analyzer	Rohde & Schwarz	FSP30	DE25181	Aug. 10, 2013	Aug.09, 2014
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 10, 2013	Aug.09, 2014
Bilog Antenna	ETS-LINDGREN	3142E	00117537	Mar. 07, 2014	Mar.06, 2015
Bilog Antenna	ETS-LINDGREN	3142E	00117542	Mar. 07, 2014	Mar.06, 2015
Horn Antenna	ETS-LINDGREN	3117	00143207	Mar. 07, 2014	Mar.06, 2015
Horn Antenna	ETS-LINDGREN	3117	00143209	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	11909A	185903	Mar. 07, 2014	Mar.06, 2015
Pre-amplifier	HP	8447B	3008A00849	Mar. 07, 2014	Mar.06, 2015
Cable	HUBER+SUHNE R	100	SUCOFLEX	Mar. 07, 2014	Mar.06, 2015
Signal Generator	Rohde & Schwarz	SML03	IKW682-054	Feb. 11, 2014	Feb.10, 2015
Positioning Controller	ETS-LINDGREN	2090	N/A	N/A	N/A
Loop Antenna	Laplace Instrument	RF300	EMC0701	Aug. 12, 2013	Aug. 11, 2014

4.6 Test Data

Fundamental Emissions



EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	NFC 13.56MHz TX Mode		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector	Comment
1	*	13.5605	60.98	9.67	70.65	69.50	1.15	peak	Fundamental Frequency

Emission Level= Read Level+ Correct Factor

Radiated Emissions (9kHz~30MHz)

EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	NFC 13.56MHz TX Mode		
Remark:			



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		2.6500	40.19	9.62	49.81	69.50	-19.69	peak	
2		9.5600	40.09	9.60	49.69	69.50	-19.81	peak	
3		10.2600	40.66	9.61	50.27	69.50	-19.23	peak	
4		17.2800	40.26	9.75	50.01	69.50	-19.49	peak	
5		21.0400	40.26	9.89	50.15	69.50	-19.35	peak	
6	*	27.5600	40.48	10.48	50.96	69.50	-18.54	peak	

Emission Level= Read Level+ Correct Factor

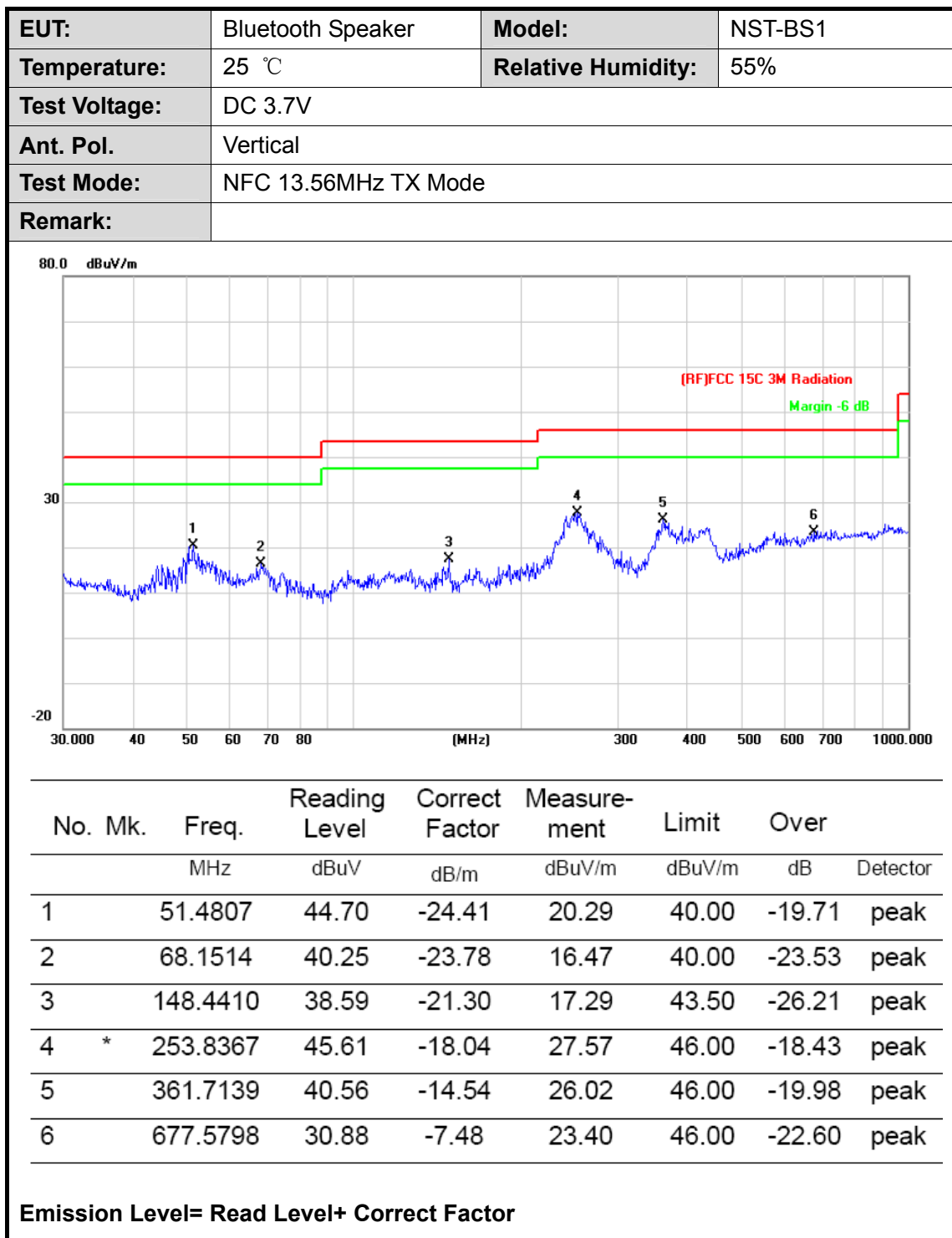
EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Vertical		
Test Mode:	NFC 13.56MHz TX Mode		
Remark:			



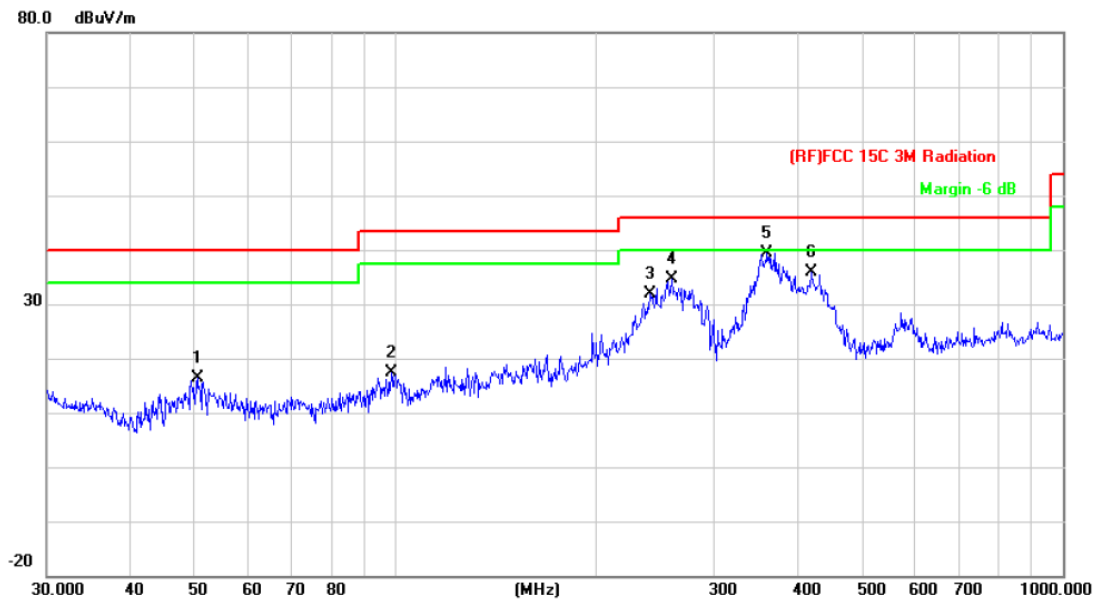
No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector	Comment
1		2.5500	40.00	9.62	49.62	69.50	-19.88	peak	
2		9.8500	40.00	9.60	49.60	69.50	-19.90	peak	
3		10.0600	40.85	9.60	50.45	69.50	-19.05	peak	
4	*	16.0500	40.84	9.72	50.56	69.50	-18.94	peak	
5		20.1500	40.36	9.81	50.17	69.50	-19.33	peak	
6		27.5400	40.00	10.48	50.48	69.50	-19.02	peak	

Emission Level= Read Level+ Correct Factor

Radiated Emissions (30MHz~1000MHz)



EUT:	Bluetooth Speaker	Model:	NST-BS1
Temperature:	25 °C	Relative Humidity:	55%
Test Voltage:	DC 3.7V		
Ant. Pol.	Horizontal		
Test Mode:	NFC 13.56MHz TX Mode		
Remark:			



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB/m	Measure- ment dBuV/m	Limit dBuV/m	Over dB	Detector
1		50.4089	40.68	-24.40	16.28	40.00	-23.72	peak
2		98.4866	39.29	-21.95	17.34	43.50	-26.16	peak
3		240.8304	50.52	-18.56	31.96	46.00	-14.04	peak
4		259.2338	52.44	-17.92	34.52	46.00	-11.48	peak
5	*	360.4476	54.01	-14.55	39.46	46.00	-6.54	peak
6		419.1081	48.81	-12.89	35.92	46.00	-10.08	peak

Emission Level= Read Level+ Correct Factor

5. Frequency Stability

5.1 Test Standard and Limit

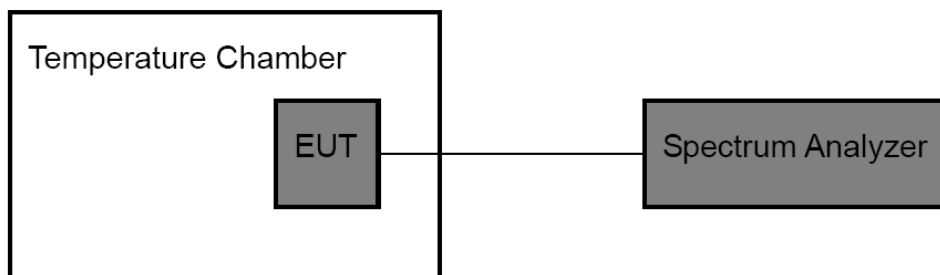
5.1.1 Test Standard

FCC Part 15.225(e)

5.1.2 Test Limit

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

5.2 Test Setup



5.3 Test Procedure

- (1) The EUT was placed inside the Temperature Chamber and powered by nominal DC Voltage.
- (2) Turn the EUT on and couple its output to a spectrum analyzer.
- (3) Turn the EUT off and set the chamber to the highest temperature specified.
- (4) Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5 and 10 minutes.
- (5) Repeat the step 3 and 4 with the temperature chamber set to the lowest temperature.
- (6) The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 80% to 115% range and the frequency record.

5.4 EUT Operating Condition

The Equipment Under Test was set to Continual Transmitting in maximum power.

5.5 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 10, 2013	Aug.09, 2014

Temp. & Humidity Chamber	ZHONG ZHI	CZ-A-225D	HW08053	Aug. 10, 2013	Aug.09, 2014
DC Power Supply	MATRIX	MPS-3005L-3	D806050W	Aug. 10, 2013	Aug.09, 2014

5.6 Test Data

Please see the next page.

(1) Frequency Stability Versus Temperature

Frequency Stability Versus Temperature			
Temperature(℃)	Power Supply(V)	Measured Frequency	Frequency Drift
		(MHz)	%
50	DC 3.7	13.560536	0.003953
40		13.560532	0.003923
30		13.560533	0.003931
20		13.560530	0.003908
10		13.560535	0.003945
0		13.560537	0.003960
-10		13.560531	0.003916
-20		13.560538	0.003968
Frequency Stability Versus Temperature			
Temperature(℃)	Power Supply(V)	Measured Frequency	Frequency Drift
		(MHz)	%
20	DC 4.25	13.560035	0.003945
	DC 3.70	13.560530	0.003908
	DC 2.96	13.560038	0.003968

6. Bandwidth Test

6.1 Test Standard and Limit

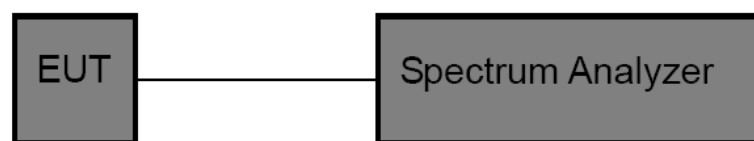
6.1.1 Test Standard

FCC Part 15.215 (c)

6.1.2 Test Limit

The 20dB bandwidth shall be specified in operating frequency band.

6.2 Test Setup



6.3 Test Procedure

- (1) The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram above.
- (2) Measure the channel separation the spectrum analyzer was set to Resolution Bandwidth:1 kHz, and Video Bandwidth:3 kHz, Detector: Peak, Sweep Time set auto.
- (3) The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20 dB

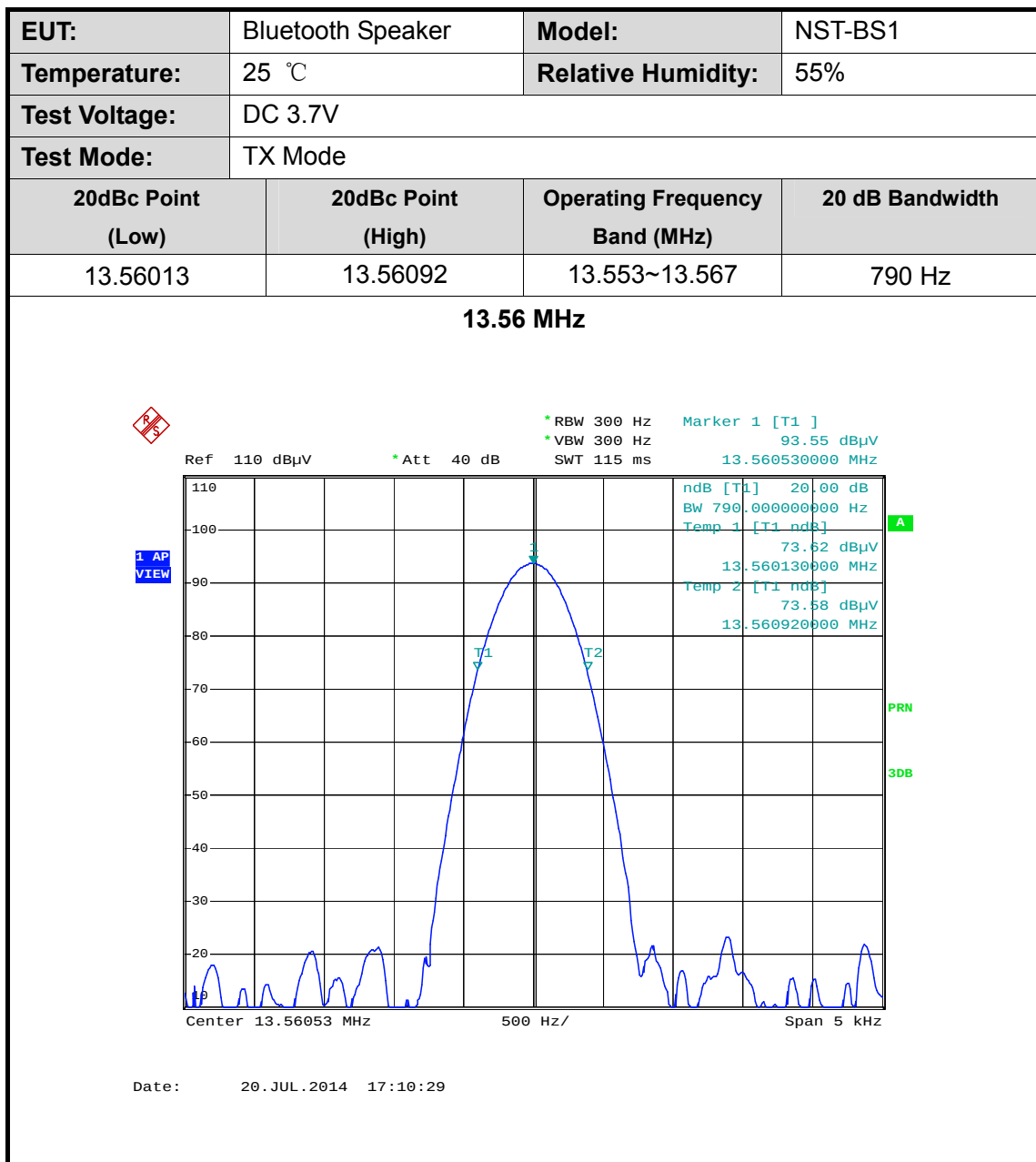
6.4 EUT Operating Condition

The EUT was set to continuously transmitting in each mode .

6.5 Test Equipment

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESCI	101165	Aug. 10, 2013	Aug.09, 2014

6.6 Test Data



7. Antenna Requirement

7.1 Standard Requirement

7.1.1 Standard

FCC Part 15.203

7.1.2 Requirement

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.

7.2 Antenna Connected Construction

The directional gains of the antenna used for transmitting is Loop antenna, and the antenna de-signed with permanent attachment and no consideration of replacement. Please see the EUT photo for details.

7.3 Result

The EUT antenna is a Loop Antenna. It complies with the standard requirement.