FCC Report (NFC)

Applicant:	Zhejiang Hanshow Technology Co., Ltd.
Address of Applicant:	Bld. 33, No. 966 xiuyuan Rd., BeiKeJian Innovation Park, XiuZhou District, Jiaxing, Zhejiang, China
Manufacturer:	Zhejiang Hanshow Technology Co., Ltd.
Address of Manufacturer:	Bld. 33, No. 966 xiuyuan Rd., BeiKeJian Innovation Park, XiuZhou District, Jiaxing, Zhejiang, China

Equipment Under Test (EUT)

Product Name:	Electronic shelf label
Model No.:	Stellar-L3N@, Stellar-L3YN@, Stellar-LN@
Trade Mark:	Hanshow
FCC ID:	2AHB5-L3N
Applicable standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.225:2017
Date of sample receipt:	April 23, 2018
Date of Test:	April 23, 2018-May 10, 2018
Date of report issued:	May 10, 2018
Test Result :	PASS *

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

Authorized Signature:

Robinson Lo
Laboratory Manager

2 Version

Version No.	Date	Description
00	*May 10, 2018*	*Original*

Prepared By: ***Date:*** ***May 10, 2018***

Project Engineer

Check By: ***Date:*** ***May 10, 2018***

Reviewer

3 Contents

Page

4 Test Summary

Test Item	Section in CFR 47	Result
Antenna Requirement	15.203	Pass
AC Power Line Conducted Emission	15.207	Pass
Field Strength of Fundamental Emissions and Mask Measurement	15.225	Pass
Radiated Emission	15.209	Pass
20dB Emission Bandwidth	15.225	Pass
Frequency Stability Measurement	15.225	Pass

Pass: The EUT complies with the essential requirements in the standard.

Remark: Test according to ANSI C63.10 2013 and ANSI C63.4: 2014.

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	± 4.34dB	(1)
Radiated Emission	30MHz ~ 1000MHz	± 4.24dB	(1)
Radiated Emission	1GHz ~ 26.5GHz	± 4.68dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	± 3.45dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

	Product Name:	Electronic shelf label
	Model No.:	Stellar-L3N@, Stellar-L3YN@, Stellar-LN@
	Test Model No:	Stellar-L3N@
Remark: All above models are identical in the same PCB layout, interior structure and electrical circuits. The differences are Screen color and model name for commercial purpose.		
	Quantity of tested samples	1
	Serial No.:	N/A
	Tested Sample(s) ID:	N/A
	Hardware Version:	N/A
	Software Version:	N/A
	Operation Frequency:	13.56MHz
	Channel Number:	1
	Modulation:	ASK
	Antenna type:	PCB Antenna
	Antenna gain:	20dBi
	Power supply:	DC 3V*2 by battery

5.2 Test mode

Transmitter mode	Keep the EUT in continuously transmitting. New battery is used during all test .

5.3 Test Facility

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

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fuly described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383, January 08, 2018.

● **Industry Canada (IC) —Registration No.: 9079A-2**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A-2, August 15, 2016

5.4 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

6 Test Instruments list

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July 03 2015	July 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	Spectrum Analyzer	Agilent	N9020A	GTS533	June 29 2017	June 28 2018
4	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June 29 2017	June 28 2018
5	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June 29 2017	June 28 2018
6	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	9120D-829	GTS208	June 29 2017	June 28 2018
7	Horn Antenna	ETS-LINDGREN	3160	GTS217	June 29 2017	June 28 2018
8	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
9	Coaxial Cable	GTS	N/A	GTS213	June 29 2017	June 28 2018
10	Coaxial Cable	GTS	N/A	GTS211	June 29 2017	June 28 2018
11	Coaxial cable	GTS	N/A	GTS210	June 29 2017	June 28 2018
12	Coaxial Cable	GTS	N/A	GTS212	June 29 2017	June 28 2018
13	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June 29 2017	June 28 2018
14	Amplifier(2GHz-20GHz)	HP	8349B	GTS206	June 29 2017	June 28 2018
15	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June 29 2017	June 28 2018
16	Band filter	Amindeon	82346	GTS219	June 29 2017	June 28 2018
17	Power Meter	Anritsu	ML2495A	GTS540	June 29 2017	June 28 2018
18	Power Sensor	Anritsu	MA2411B	GTS541	June 29 2017	June 28 2018

Conducted Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.16 2014	May.15 2019
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 29 2017	June. 28 2018
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 29 2017	June. 28 2018
4	Artificial Mains Network	SCHWARZBECK MESS	NSLK8127	GTS226	June. 29 2017	June. 28 2018
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 29 2017	June. 28 2018

General used equipment:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Barometer	ChangChun	DYM3	GTS257	June 29 2017	June 28 2018

7 Test results and Measurement Data

7.1 Antenna requirement:

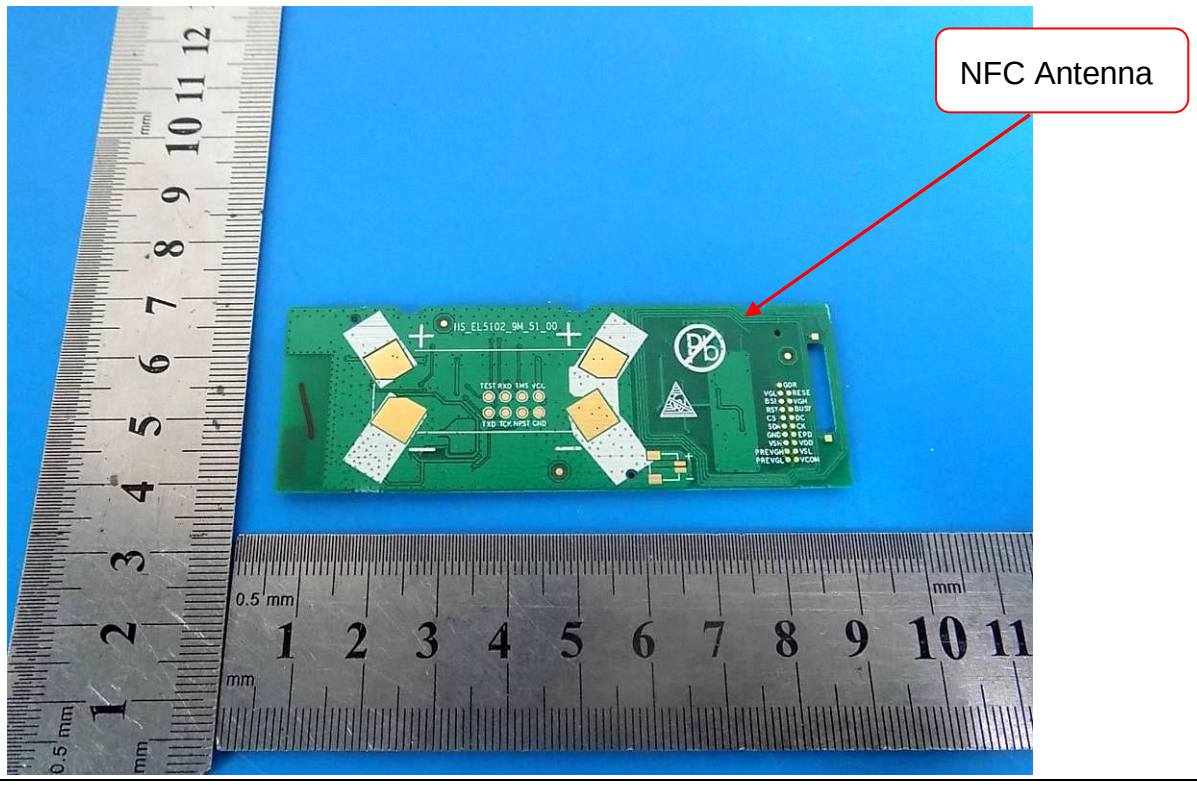
Standard requirement:	FCC Part15 C Section 15.203

15.203 requirement:

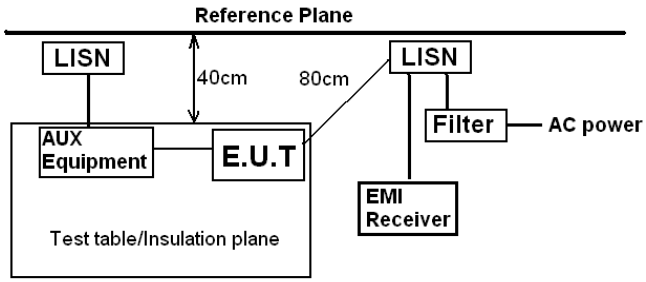
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

E.U.T Antenna:

The antenna is I Internal Antenna the best case gain of the antenna is 20dBi



7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207
Test Method:	ANSI C63.10:2013
Test Frequency Range:	150KHz to 30MHz
Class / Severity:	Class B
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto
Limit:	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 setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.3 for details
Test results:	EUT power supply by battery, so the test not applicable.

7.3 Field Strength of Fundamental Emissions and Mask Measurement

Test Requirement:	FCC Part15 C Section 15.225 and 15.209
Test Method:	ANSI C63.10:2013
Test site:	Measurement Distance: 3m
Receiver setup:	RBW=1KHz, VBW=3KHz, Sweep time=Auto

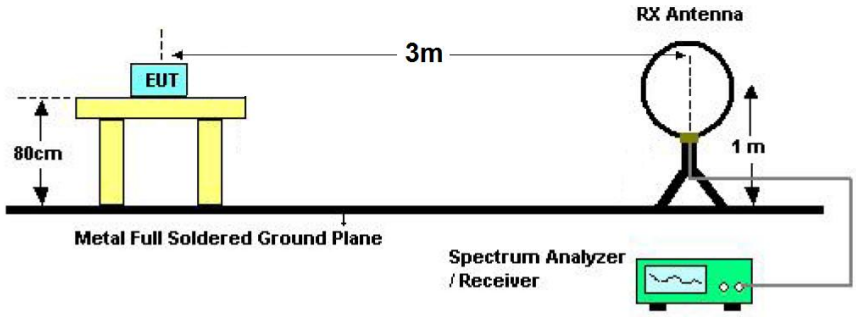
Limit:

Frequency (MHz)	Field Strength (microvolts/meter) at 30m	Field Strength (dBuV/m) at 3m
13.553~13.567	15848	124 (QP)

Mark limit:

Frequency (MHz)	Field Strength (microvolts/meter) at 30m	Field Strength (dBuV/m) at 3m
1.705~13.110	30	69.5
13.110~13.410	106	80.5
13.410~13.553	334	90.5
13.553~13.567	15848	124.0
13.567~13.710	334	90.5
13.710~14.010	106	80.5
14.010~30.000	30	69.5

Test setup:



Test Procedure:

1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT, the turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the receiving antenna was fixed at one meter above ground to find the maximum emissions field strength.
4. For Fundamental emissions, use the receiver to measure QP reading.
5. When the radiated emissions limits are expressed in terms of the average value of the emissions and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field

	strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. 6. Compliance with the spectrum mask is tested using a spectrum analyzer with RB set to a 1KHz for the band 13.553~13.567MHz.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

Measurement data:

Freq. (MHz)	Position H/V	Detector Mode (PK/QP)	Reading (dBuV)	Factor (dB)	Actual FS (dBuV/m)	Limits 3m (dBuV/m)	
13.560	H	Peak	104.13	-13.94	90.19	104	
13.560	H	AV	90.31	-13.94	76.37	84	
13.110	H	Peak	42.87	-13.94	28.93	69.5	
13.410	H	Peak	44.07	-13.94	30.13	80.5	
13.553	H	Peak	42.31	-13.94	28.37	90.5	
13.567	H	Peak	46.34	-13.93	32.41	90.5	
13.710	H	Peak	43.59	-13.93	29.66	80.5	
14.010	H	Peak	44.85	-13.93	30.92	69.5	
Freq. (MHz)	**Position H/V**	**Detector Mode (PK/QP)**	**Reading (dBuV)**	**Factor (dB)**	**Actual FS (dBuV/m)**	**Limits 3m (dBuV/m)**	
13.560	V	Peak	95.51	-13.94	81.57	104	
13.560	V	AV	87.48	-13.94	73.54	84	
13.110	V	Peak	42.99	-13.94	29.05	69.5	
13.410	V	Peak	45.60	-13.94	31.66	80.5	
13.553	V	Peak	43.90	-13.94	29.96	90.5	
13.567	V	Peak	43.79	-13.93	29.86	90.5	
13.710	V	Peak	43.76	-13.93	29.83	80.5	
14.010	V	Peak	44.75	-13.93	30.82	69.5	

Note:

1: 30m to 3m correction factor calculation:

40*Log(30m/3m)=40

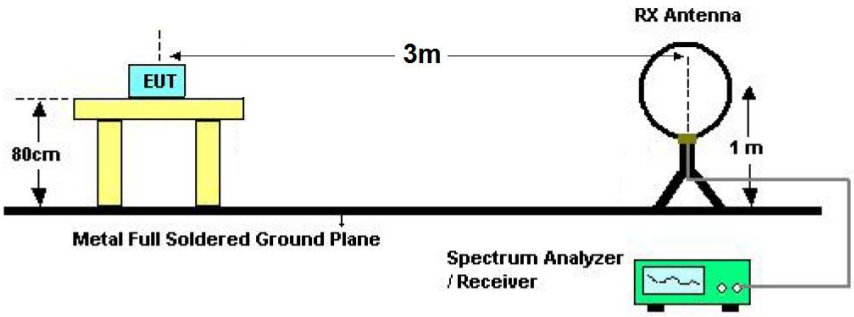
2: --Means other frequency and mode comply with standard requirements and at least have 20dB margin.

3: Correct Factor=Cable Loss+ Antenna Factor- Amplifier Gain

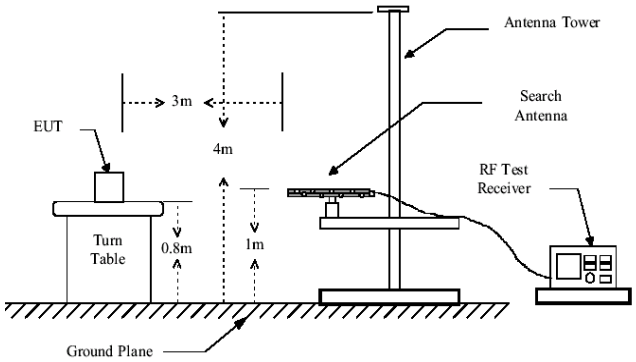
Measurement Result=Reading + Correct Factor

Margin=Measurement Result-Limit

7.4 Radiated Emission

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10: 2013</td></tr>
<tr><td>Test Frequency Range:</td><td>9KHz to 1000MHz</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><th>Frequency (MHz)</th><th>RBW(KHz)</th><th>Detector</th></tr>
<tr><td>0.009~0.15</td><td>0.2</td><td>QP</td></tr>
<tr><td>0.15~30</td><td>9</td><td>QP</td></tr>
<tr><td>30~1000</td><td>120</td><td>QP</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>The Field strength of any emissions which appear outside of 13.553~13.567MHz band shall not exceed the general radiated emissions limits
<table>
<tr><th>Frequency (MHz)</th><th>Field strength (micorvolts/meter)</th><th>Measurement distance (meters)</th></tr>
<tr><td>0.009~0.490</td><td>2400/F(KHz)</td><td>300</td></tr>
<tr><td>0.490~1.705</td><td>24000/F(KHz)</td><td>30</td></tr>
<tr><td>1.705~30</td><td>30</td><td>30</td></tr>
<tr><td>30~88</td><td>100</td><td>3</td></tr>
<tr><td>88~216</td><td>150</td><td>3</td></tr>
<tr><td>216~960</td><td>200</td><td>3</td></tr>
<tr><td>960~1000</td><td>500</td><td>3</td></tr>
</table>
</td></tr>
<tr><td>Test setup:</td><td>Below 30MHz
 

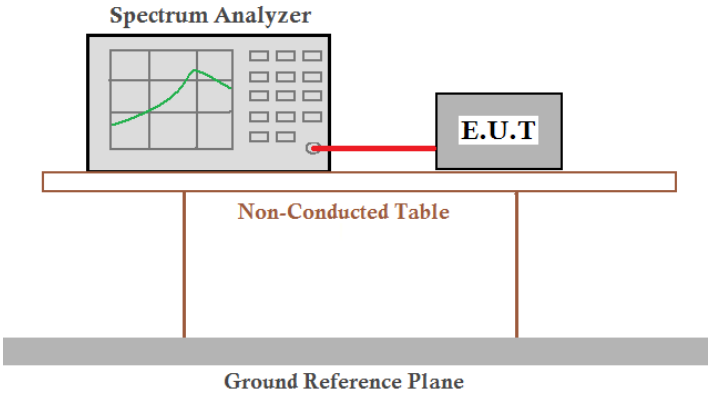
Above 30MHz</td></tr>
</table>

	
Test Procedure:	1. Configure the EUT according to ANSI C63.4. The EUT was placed on the top of the turntable 0.8meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable. 2. Power on the EUT, the turntable was rotated by 360 degrees to determine the position of the highest radiation. 3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization. 4. For each suspected emissions, the antenna tower was scan (from 1M to 4M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading. 5. Set the test-receiver system to Peak or CISPR quasi-peak detect function with specified bandwidth under maximum hold mode. 6. When the radiated emissions limits are expressed in terms of the average value of the emissions and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. 7. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

Measurement data:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	QP Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
35.62	36.22	11.20	0.62	30.07	17.97	40.00	-22.03	Vertical
51.84	31.53	12.20	0.79	29.98	14.54	40.00	-25.46	Vertical
98.14	27.16	11.73	1.18	29.71	10.36	43.50	-33.14	Vertical
219.85	25.38	10.88	1.96	29.39	8.83	46.00	-37.17	Vertical
382.59	24.75	15.15	2.77	29.58	13.09	46.00	-32.91	Vertical
793.40	24.34	21.21	4.43	29.20	20.78	46.00	-25.22	Vertical
39.72	33.47	12.30	0.66	30.04	16.39	40.00	-23.61	Horizontal
89.59	29.03	10.60	1.11	29.75	10.99	43.50	-32.51	Horizontal
147.92	30.75	7.50	1.56	29.42	10.39	43.50	-33.11	Horizontal
302.48	23.92	13.56	2.37	29.98	9.87	46.00	-36.13	Horizontal
485.61	25.42	17.20	3.24	29.33	16.53	46.00	-29.47	Horizontal
897.00	23.44	22.17	4.83	29.10	21.34	46.00	-24.66	Horizontal

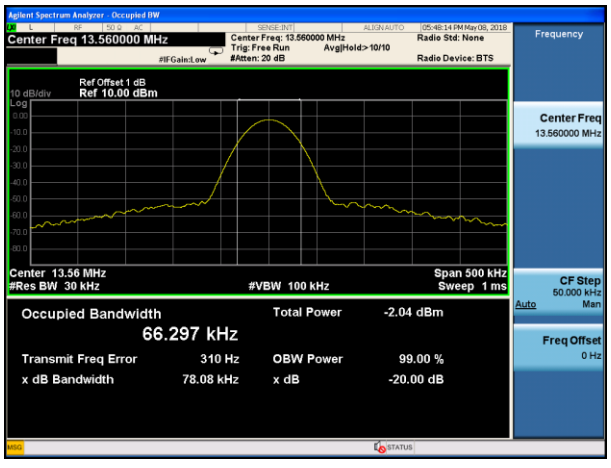
7.5 20dB Emission Bandwidth

Test Requirement:	FCC Part15 C Section 15.225 and 15.215
Test Method:	ANSI C63.10:2013
Limit:	N/A
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

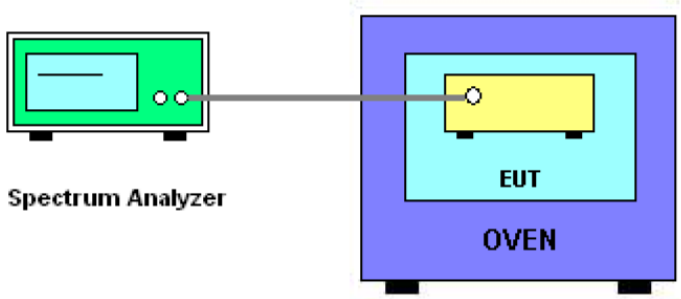
Measurement Data

Frequency (MHz)	20dB Bandwidth (KHz)	99% OBW (KHz)	Frequency range (MHz) fL>13.553MHz	Frequency range (MHz) fH<13.567MHz	Result
13.56MHz	78.08	66.297	13.555	13.561	Pass

Test plot as follows:



7.6 Frequency Stability Measurement

Test Requirement:	FCC Part15 C Section 15.225
Test Method:	ANSI C63.10: 2013
Receiver setup:	RBW=1KHz, VBW=1KHz, Sweep time=Auto
Limit:	The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, 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.
Test setup:	
Test Procedure:	1. The transmitter output (antenna port) was connected to the spectrum analyzer. 2. EUT have transmitted absence of modulation signal and fixed channelize 3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth. 4. Set RBW=1KHz, VBW=1KHz with peak detector and maxhold settings. 5. fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc x10^6 ppm and the limit is less than ±100ppm. 6. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value 7. Extreme temperature rule is -20℃ ~50℃
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.3 for details
Test results:	Pass

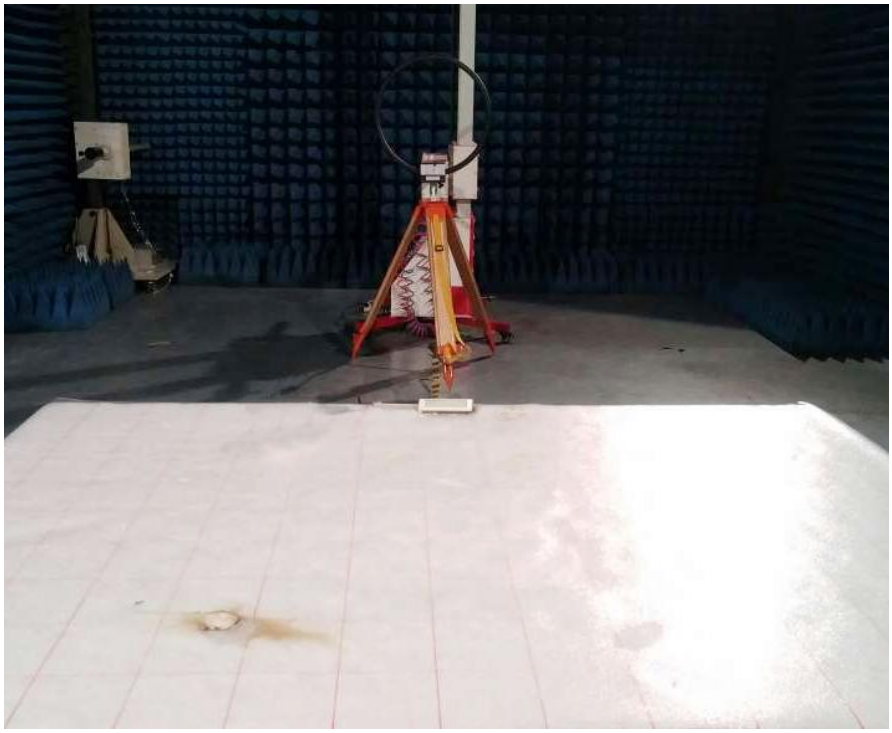
Measurement data:

Reference Frequency: 13.56MHz					
Power supplied (Vdc)	Temperature (℃)	Frequency error		Limit	Result
		Hz	ppm (%)		
6.0	-20	51	0.00037	+/- 0.01%	Pass
	-10	51	0.00037		
	0	59	0.00044		
	10	53	0.00039		
	20	51	0.00038		
	30	53	0.00039		
	40	63	0.00046		
	50	69	0.00051		

Reference Frequency: 13.56MHz					
Temperature (℃)	Power supplied (Vdc)	Frequency error		Limit	Result
		Hz	ppm (%)		
20	5.1	41	0.00031	+/- 0.01%	Pass
	6.0	51	0.00038		
	6.9	71	0.00053		

8 Test Setup Photo

Radiated Emission



EUT Constructional Details

Reference to the test report No. GTS201805000126F01

------ End ------