



Report No.: PTC19102504301E-FC01

FCC TEST REPORT

FCC ID: 2AHB5-NOWA-154

Product Name	:	Electronic shelf label
Model Name	:	Nowa-154R-NM, Nowa-154R-N Nowa-154Y-N Nowa-154-N Nowa-154Y-NM Nowa-154-NM
Brand Name	:	Hanshow
Report No.	:	PTC19102504301E-FC01
Prepared for		
Zhejiang Hanshow Technology Co., Ltd.		
Bld. 33, No. 966 xiuyuan Rd., BeiKeJian Innovation Park, XiuZhou District, Jiaxing, Zhejiang, China		
Prepared by		
Dongguan Precise Testing & Certification Corp., Ltd.		
Building D, Baoding Technology Park, Guangming Road 2, Guangming Community, Dongcheng District, Dongguan, Guangdong, China		



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1TEST RESULT CERTIFICATION

Applicant's name : Zhejiang Hanshow Technology Co., Ltd.
Address : Bld. 33, No. 966 xiuyuan Rd., BeiKeJian Innovation Park, XiuZhou District, Jiaxing, Zhejiang, China
Manufacture's name : Zhejiang Hanshow Technology Co., Ltd.
Address : Bld. 33, No. 966 xiuyuan Rd., BeiKeJian Innovation Park, XiuZhou District, Jiaxing, Zhejiang, China
Product name : Electronic shelf label
Model name : Nowa-154R-NM
Additional model : Nowa-154R-N Nowa-154Y-N Nowa-154-N Nowa-154Y-NM Nowa-154-NM
Brand Name : Hanshow
Standards : FCC CFR47 Part 15 Section 15.249
Test procedure : ANSI C63.10:2013
Test Date : Nov 19, 2019 to Nov 23, 2019
Date of Issue : Nov 23, 2019
Test Result : Pass

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

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Test Engineer:

A handwritten signature in black ink that reads "Leo Yang" with a checkmark at the end.

Leo Yang / Engineer

Technical Manager:

A handwritten signature in black ink that appears to read "Chris Du".

Chris Du / Manager

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2 Test Summary

Test Items	Test Requirement	Result
AC Power Conducted Emission	15.207	N/A
20dB Bandwidth	15.215(c)	PASS
Band edge	15.249 15.205	PASS
Field Strength of Fundamental Emissions	15.249(a)	PASS
Radiated Spurious Emissions	15.205(a) 15.249(a) (d)	PASS
Antenna Requirement	15.203	PASS

Remark:

N/A: Not Applicable



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3 TEST FACILITY

Dongguan Precise Testing & Certification Corp., Ltd.

Building D, Baoding Technology Park, Guangming Road2, Dongcheng District, Dongguan, Guangdong,
China, Dongguan, 523129

China

FCC Registration Number: 790290



4 General Information

4.1 General Description of E.U.T.

Product Name	: Electronic shelf label
Model Name	: Nowa-154R-NM ,Nowa-154R-N Nowa-154Y-N Nowa-154-N Nowa-154Y-NM Nowa-154-NM (The differences are when product at work of EPD Screen color,Appearance color and name for commercial purpose, this repot performs the model Nowa-154-Nm)
Operating frequency	: 2.402-2.480GHZ
Numbers of Channel	: 157
Channel Space	: 0.5MHz
Antenna Type:	: PCB Print Antenna
Antenna Gain:	: 0dBi
Type of Modulation	: GFSK
Power supply	: DC 3V



4.2 Test Mode

For Radiated: The EUT's antenna was pre-tested under the following modes:

Test Mode	Description
Mode A	X-Y axis
Mode B	Y-Z axis
Mode C	X-Z axis

From the above modes, the worst case was found in Mode A, Therefore only the test data of the mode was recorded in this report.

Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	16	2409.5	--	--	--	--
2	2402.5	--	--	--	--	--	--
3	2403	--	--	--	--	--	--
4	2403.5	--	--	--	--	--	--
5	2404	--	--	--	--	--	--
6	2404.5	--	--	--	--	--	--
7	2405	--	--	--	--	--	--
8	2405.5	79	2441	--	--	--	--
9	2406	--	--	--	--	--	--
10	2406.5	--	--	--	--	--	--
11	2407	--	--	--	--	153	2478
12	2407.5	--	--	--	--	154	2478.5
13	2408	--	--	--	--	155	2479
14	2408.5	--	--	--	--	156	2479.5
15	2409	--	--	--	--	157	2480

The 3 channels of lower, middle and higher were chosen for test.

Channel	Frequency(MHz)
1	2402
79	2441
157	2480



5 Equipment During Test

5.1 Equipments List

RF Conducted Test

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
MXG Signal Analyzer	Agilent	N9020A	SER MY5111038	10Hz-30GHz	Aug. 21, 2020
Coaxial Cable	CDS	79254	46107086	10Hz-30GHz	Aug. 21, 2020
Power Meter	Anritsu	ML2495A	0949003	300MHz-40GHz	Aug. 28, 2020
Power Sensor	Anritsu	MA2411B	0917017	300MHz-40GHz	Aug. 28, 2020

Remark: The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

Radiated Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 28, 2020
Loop Antenna	Schwarzbeck	FMZB 1519	012	9 KHz -30MHz	Aug. 28, 2020
Bilog Antenna	SCHWARZBECK	VULB9160	9160-3355	25MHz-2GHz	Aug. 22, 2020
Preamplifier (low frequency)	SCHWARZBECK	BBV 9475	9745-0013	1MHz-1GHz	Aug. 21, 2020
Cable	Schwarzbeck	PLF-100	549489	9KHz-3GHz	Aug. 21, 2020
Spectrum Analyzer	Agilent	E4407B	MY45109572	9KHz-40GHz	Aug. 28, 2020
Horn Antenna	SCHWARZBECK	9120D	9120D-1246	1GHz-18GHz	Apr. 13, 2020
Power Amplifier	LUNAR EM	LNA1G18-40	J10100000081	1GHz-26.5GHz	Aug. 21, 2020
Horn Antenna	SCHWARZBECK	BBHA 9170	9170-181	14GHz-40GHz	Apr. 13, 2020
Amplifier	SCHWARZBECK	BBV 9721	9721-205	18GHz-40GHz	Aug. 21, 2020
Cable	H+S	CBL-26	N/A	1GHz-26.5GHz	Aug. 21, 2020



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RF Cable	R&S	R204	R21X	1GHz-40GHz	Aug. 21, 2020
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Conducted Emissions

Name of Equipment	Manufacturer	Model	Serial No.	Characteristics	Calibration Due
EMI Test Receiver	Rohde&Schwarz	ESCI	101417	9KHz-3GHz	Aug. 28, 2020
Artificial Mains Network	Rohde&Schwarz	ENV216	102453	9KHz-300MHz	Aug. 21, 2020
Artificial Mains Network	Rohde&Schwarz	ENV216	101342	9KHz-300MHz	Aug. 21, 2020



5.2 Measurement Uncertainty

Parameter	Uncertainty
RF output power, conducted	$\pm 1.0\text{dB}$
Power Spectral Density, conducted	$\pm 2.2\text{dB}$
Radio Frequency	$\pm 1 \times 10^{-6}$
Bandwidth	$\pm 1.5 \times 10^{-6}$
Time	$\pm 2\%$
Duty Cycle	$\pm 2\%$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 3\%$
Conducted Emissions (150kHz~30MHz)	$\pm 3.64\text{dB}$
Radiated Emission(30MHz~1GHz)	$\pm 5.03\text{dB}$
Radiated Emission(1GHz~25GHz)	$\pm 4.74\text{dB}$
Remark: The coverage Factor (k=2), and measurement Uncertainty for a level of Confidence of 95%	



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5.3 Description of Support Units

Equipment	Model No.	Series No.
Adapter	N/A	N/A

6 Conducted Emission

Test Requirement:	: FCC CFR 47 Part 15 Section 15.207
Test Method:	: ANSI C63.10:2013
Test Result:	: PASS
Frequency Range:	: 150kHz to 30MHz
Class/Severity:	: Class B
Detector:	: Peak for pre-scan (9kHz Resolution Bandwidth)

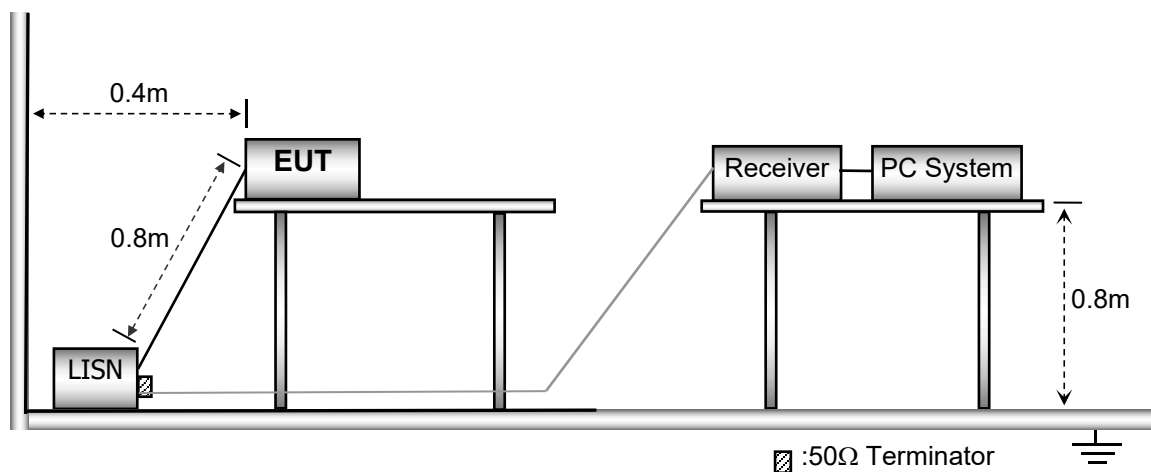
6.1 E.U.T. Operation

Operating Environment :

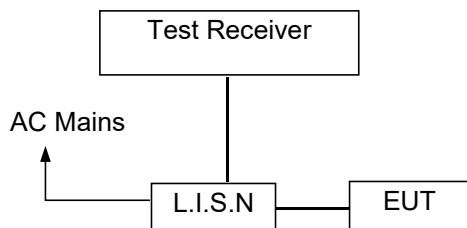
Temperature:	: 25.5 °C
Humidity:	: 51 % RH
Atmospheric Pressure:	: 101.2kPa
EUT Operation :	: Refer to section 3.3
Test Voltage	: AC 120V/60Hz

6.2 EUT Setup

The conducted emission tests were performed using the setup accordance with the ANSI C63.10: 2013



6.3 Test SET-UP (Block Diagram of Configuration)



6.4 Measurement Procedure:

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured was complete.

6.5 Conducted Emission Limit

Conducted Emission

Frequency(MHz)	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

Note:

1. The lower limit shall apply at the transition frequencies
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

6.6 Measurement Description

The maximised peak emissions from the EUT was scanned and measured for both the Live and Neutral Lines. Quasi-peak & average measurements were performed if peak emissions were within 6dB of the average limit line.

6.7 Conducted Emission Test Result

N/A

N/A: Not Applicable



7 Field Strength of Fundamental Emission and Radiated Spurious Emissions

Test Requirement: : FCC CFR47 Part 15 Section 15.209 & 15.247
 Test Method: : ANSI C63.10:2013
 Test Result: : PASS
 Measurement Distance: : 3m
 Limit: : See the follow table

Frequency (MHz)	Field Strength		Field Strength Limit at 3m Measurement Dist	
	uV/m	Distance (m)	uV/m	dBuV/m
0.009 ~ 0.490	2400/F(kHz)	300	10000 * 2400/F(kHz)	20log ^{(2400/F(kHz))} + 80
0.490 ~ 1.705	24000/F(kHz)	30	100 * 24000/F(kHz)	20log ^{(24000/F(kHz))} + 40
1.705 ~ 30	30	30	100 * 30	20log ⁽³⁰⁾ + 40
30 ~ 88	100	3	100	20log ⁽¹⁰⁰⁾
88 ~ 216	150	3	150	20log ⁽¹⁵⁰⁾
216 ~ 960	200	3	200	20log ⁽²⁰⁰⁾
Above 960	500	3	500	20log ⁽⁵⁰⁰⁾

Note: 1. Emission level in dBuV/m=20 log (uV/m)

2. Measurement was performed at an antenna to the closed point of EUT distance of meters.

The field strength of emission from intentional radiators operated within these frequency bands shall comply with the following:

Frequency(MHz)	Filed Strength of Fundamental(at 3m)		Filed Strength of Harmonics(at 3m)	
	PEAK	AVERAGE	PEAK	AVERAGE
902-928	114	94	74.0	54.0
2400-2483.5	114	94	74.0	54.0
5725-5875	114	94	74.0	54.0
24000-24250	128	108	88.0	68.0

7.1 EUT Operation

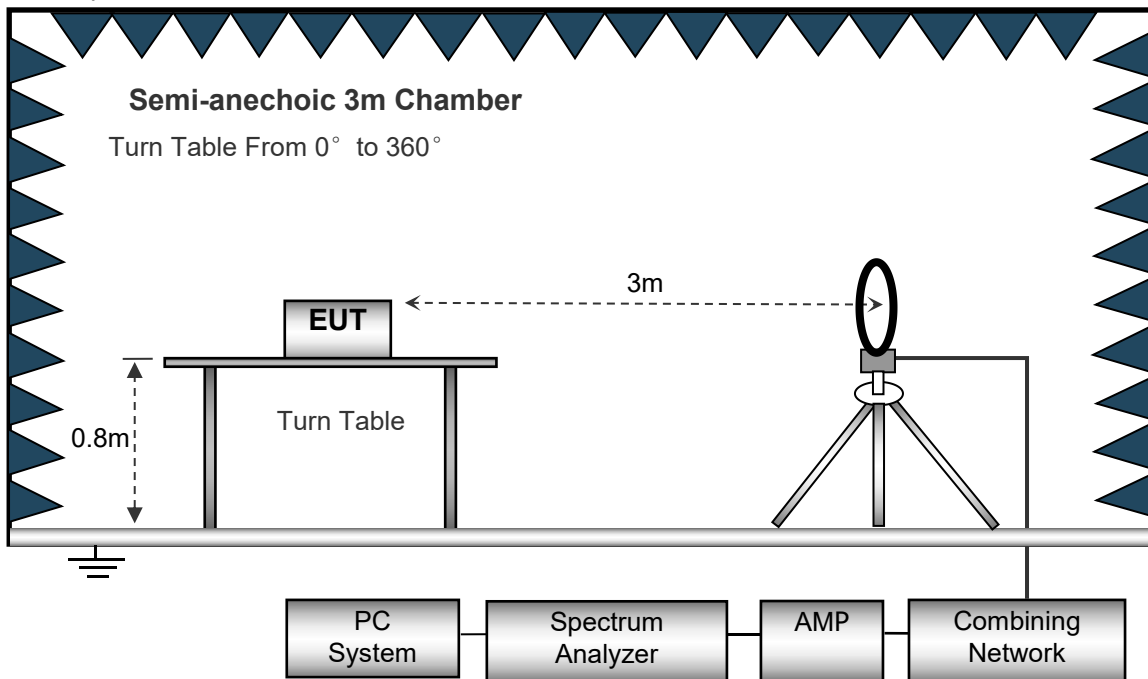
Operating Environment :

Temperature:	: 23.5 °C
Humidity:	: 51.1 % RH
Atmospheric Pressure:	: 101.2kPa
EUT Operation :	: Refer to section 3.3
Test Voltage	: AC 120V/60Hz

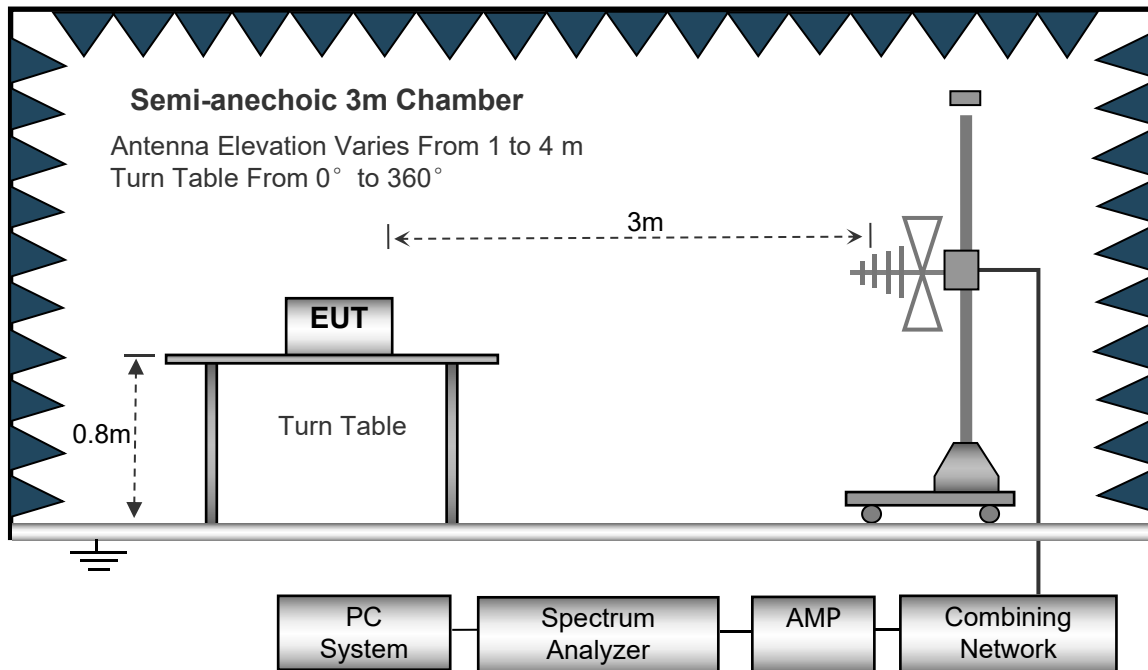
7.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site

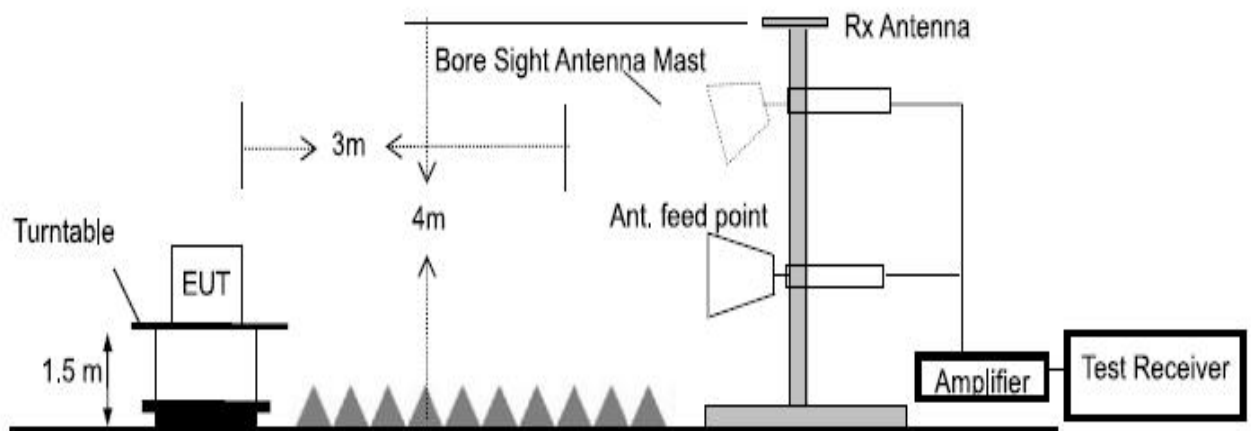
The test setup for emission measurement below 30MHz.



The test setup for emission measurement from 30 MHz to 1 GHz.



The test setup for emission measurement above 1 GHz.





7.3 Spectrum Analyzer Setup

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP



7.4 Test Procedure

1. The testing follows the guidelines in Spurious Radiated Emissions of ANSI C63.10-2013.
2. Below 1000MHz, The EUT was placed on a turn table which is 0.8m above ground plane. And above 1000MHz, The EUT was placed on a styrofoam table which is 1.5m above ground plane.
3. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
4. For each suspected emission, the EUT was arranged to its worst case and then tune the Antenna tower (From 1m to 4m) and turntable (from 0 degree to 360 degree) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level to comply with the guidelines.
5. Set to the maximum power setting and enable the EUT transmit continuously.
6. Final measurement (Above 1GHz): The frequency range will be divided into different sub ranges depending of the frequency range of the used horn antenna. The EMI Receiver set to peak and average mode and a resolution bandwidth of 1MHz. The measurement will be performed in horizontal and vertical polarization of the measuring antenna and while rotating the EUT in its vertical axis in the range of 0 degree to 360 degree in order to have the antenna inside the cone of radiation.
7. Test Procedure of measurement (For Above 1GHz):
 - 1) Monitor the frequency range at horizontal polarization and move the antenna over all sides of the EUT(if necessary move the EUT to another orthogonal axis).
 - 2) Change the antenna polarization and repeat 1) with vertical polarization.
 - 3) Make a hardcopy of the spectrum.
 - 4) Measure the frequency of the detected emissions with a lower span and resolution bandwidth to increase the accuracy and note the frequency value.
 - 5) Change the analyser mode to Clear/ Write and found the cone of emission.
 - 6) Rotate and move the EUT, so that the measuring distance can be enlarged to 3m and the antenna will be still inside the cone of emission.
 - 7) Measure the level of the detected frequency with the correct resolution bandwidth, with the antenna polarization and azimuth and the peak and average detector, which causes the maximum emission.
 - 8) Repeat steps 1) to 7) for the next antenna spot if the EUT is larger than the antenna beamwidth.
7. The radiation measurements are tested under 3-axes(X,Y,Z) position(X denotes lying on the table, Y denotes side stand and Z denotes vertical stand), After pre-test, It was found that the worse radiation emission was get at the X position. So the data shown was the X position only.



7.5 Summary of Test Results

Test Frequency: Below 30MHz

The measurements were more than 20 dB below the limit and not reported.

The low frequency, which started from 9KHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

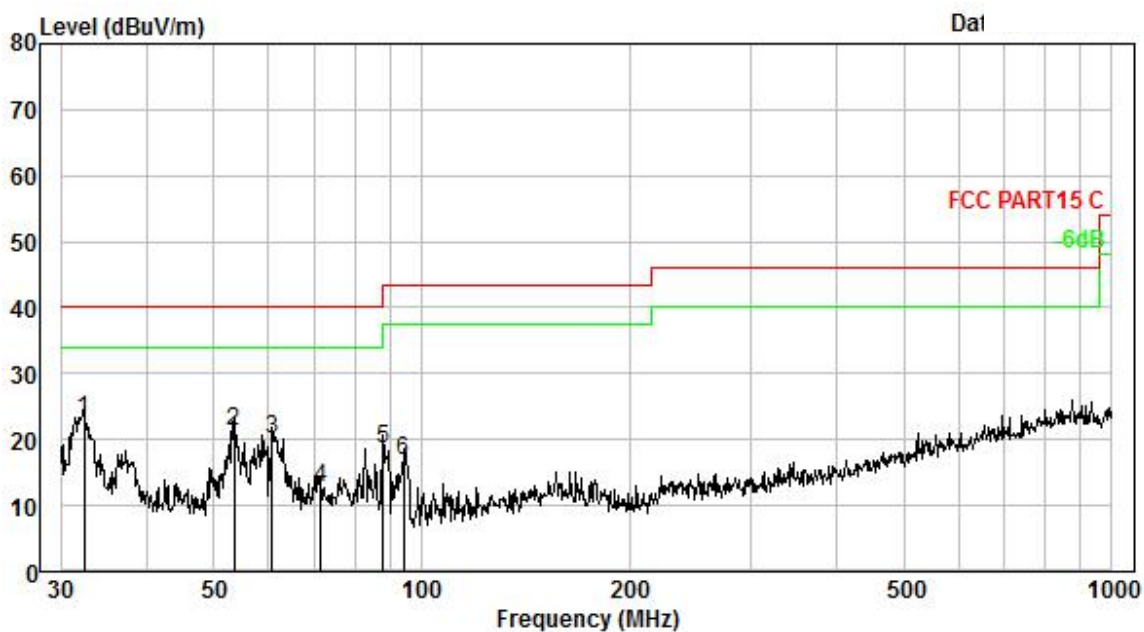
Test Frequency: 30MHz ~ 1GHz

Remark: only the worst data were reported.



Test plot for Horizontal: 2402MHz

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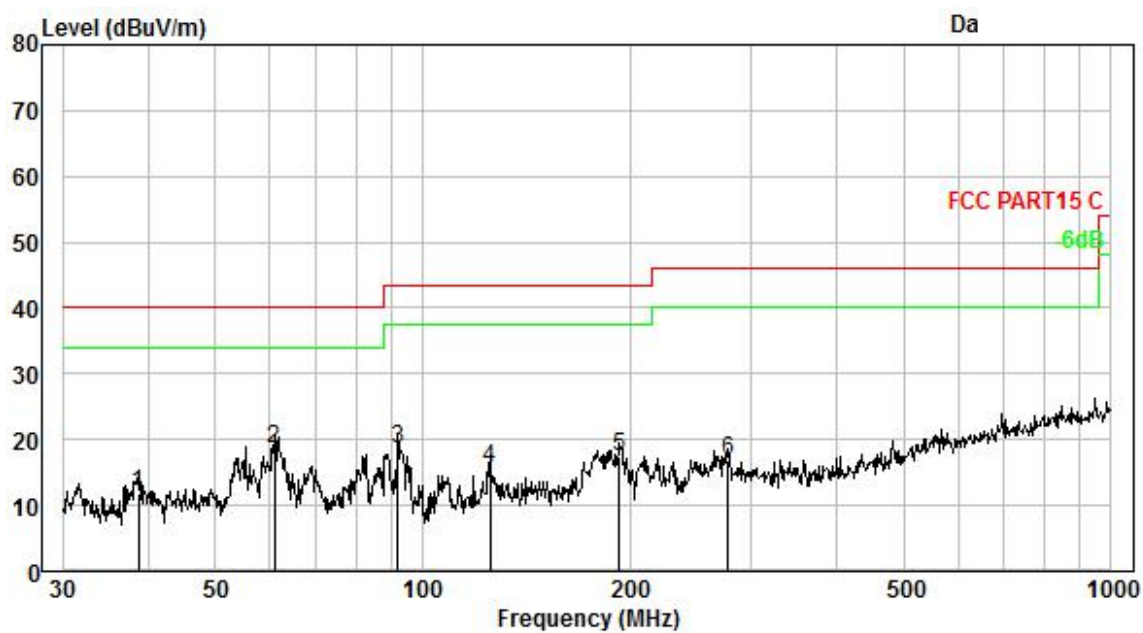


No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	32.406	1.33	11.95	39.67	29.90	23.05	40.00	-16.95	QP
2.	53.505	2.20	12.10	36.97	29.93	21.34	40.00	-18.66	QP
3.	60.704	2.41	11.60	35.88	29.94	19.95	40.00	-20.05	QP
4.	71.330	2.69	9.91	29.97	29.96	12.61	40.00	-27.39	QP
5.	88.033	3.05	9.01	36.58	29.98	18.66	43.50	-24.84	QP
6.	94.098	3.17	9.12	34.42	29.98	16.73	43.50	-26.77	QP



Test plot for Vertical: 2402MHz

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No.	Freq MHz	Cable Loss dB	ANT Factor dB/m	Receiver Reading dBuV	Preamp Factor dB	Emission Level dBuV/m	Limit dBuV/m	Over Limit dB	Remark
1.	38.616	1.64	12.13	28.07	29.91	11.93	40.00	-28.07	QP
2.	60.918	2.42	11.57	34.65	29.94	18.70	40.00	-21.30	QP
3.	92.139	3.13	9.16	36.41	29.98	18.72	43.50	-24.78	QP
4.	125.446	3.66	12.37	29.65	30.01	15.67	43.50	-27.83	QP
5.	193.095	4.40	11.50	31.50	30.04	17.36	43.50	-26.14	QP
6.	278.067	5.03	12.91	29.01	30.27	16.68	46.00	-29.32	QP



Above 1000MHz-10th Harmonics:

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Operation Mode: GFSK (CH1: 2402MHz)

Freq. (MHz)	Ant. Pol.	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
2402(F)	V	90.56	85.43	114	94	-23.44	-8.57
4804	V	56.89	43.32	74	54	-17.11	-10.68
7206	V	55.51	42.07	74	54	-18.49	-11.93
9608	V	56.18	42.42	74	54	-17.82	-11.58
12010	V	56.62	42.58	74	54	-17.38	-11.42
14412	V	56.16	42.21	74	54	-17.84	-11.79
16821	V	56.34	42.37	74	54	-17.66	-11.63
2402(F)	H	88.59	83.14	114	94	-25.41	-10.86
4804	H	56.91	43.06	74	54	-17.09	-10.94
7206	H	55.42	42.37	74	54	-18.58	-11.63
9608	H	56.19	42.25	74	54	-17.81	-11.75
12010	H	56.64	42.44	74	54	-17.36	-11.56
14412	H	56.71	42.52	74	54	-17.29	-11.48
16814	H	56.23	42.05	74	54	-17.77	-11.95



Operation Mode: GFSK (CH79: 2441MHz)

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Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
2441(F)	V	90.06	84.88	114	94	-23.94	-9.12
4882	V	56.83	43.14	74	54	-17.17	-10.86
7323	V	55.72	42.68	74	54	-18.28	-11.32
9764	V	56.33	42.52	74	54	-17.67	-11.48
12205	V	56.15	42.34	74	54	-17.85	-11.66
14646	V	56.71	42.15	74	54	-17.29	-11.85
17087	V	56.32	42.44	74	54	-17.68	-11.56
2441(F)	H	89.31	84.06	114	94	-24.69	-9.94
4882	H	56.53	43.11	74	54	-17.47	-10.89
7323	H	55.39	42.27	74	54	-18.61	-11.73
9764	H	56.81	42.64	74	54	-17.19	-11.36
12205	H	56.15	42.42	74	54	-17.85	-11.58
14646	H	56.76	42.08	74	54	-17.24	-11.92
17087	H	56.28	42.17	74	54	-17.72	-11.83



Operation Mode: GFSK (CH157: 2480MHz)

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Freq. (MHz)	Ant. Pol. H/V	Emission Level(dBuV/m)		Limit 3m(dBuV/m)		Margin(dB)	
		PK	AV	PK	AV	PK	AV
2480(F)	V	89.35	84.24	114	94	-24.65	-9.76
4960	V	56.58	43.07	74	54	-17.42	-10.93
7440	V	55.08	42.41	74	54	-18.92	-11.59
9920	V	56.34	42.26	74	54	-17.66	-11.74
12400	V	56.51	42.42	74	54	-17.49	-11.58
14880	V	56.65	42.08	74	54	-17.35	-11.92
17360	V	56.34	42.11	74	54	-17.66	-11.89
2480(F)	H	88.72	83.15	114	94	-25.28	-10.85
4960	H	56.42	42.85	74	54	-17.58	-11.15
7440	H	55.91	42.24	74	54	-18.09	-11.76
9920	H	56.05	42.31	74	54	-17.95	-11.69
12400	H	56.29	41.76	74	54	-17.71	-12.24
14880	H	56.38	42.01	74	54	-17.62	-11.99
17360	H	56.53	42.28	74	54	-17.47	-11.72

8 BAND EDGE EMISSION

8.1 TEST PROCEDURE

The EUT was placed on a styrofoam table which is 1.5m above ground plane.

The measurement procedure at the band edges was simplified by performing the measurement in just one plot. Both, the in-band-emission and the unwanted emission were encompassed by the span. After trace stabilization, the maximum peak was determined by a peak detector and the value was marked by an appropriate limit line. The second limit line, which is 20dB below the first, marks the limit for the emissions in the unrestricted band. A maximum-peak-detector marks the highest emission in the unrestricted band next to the band edge.

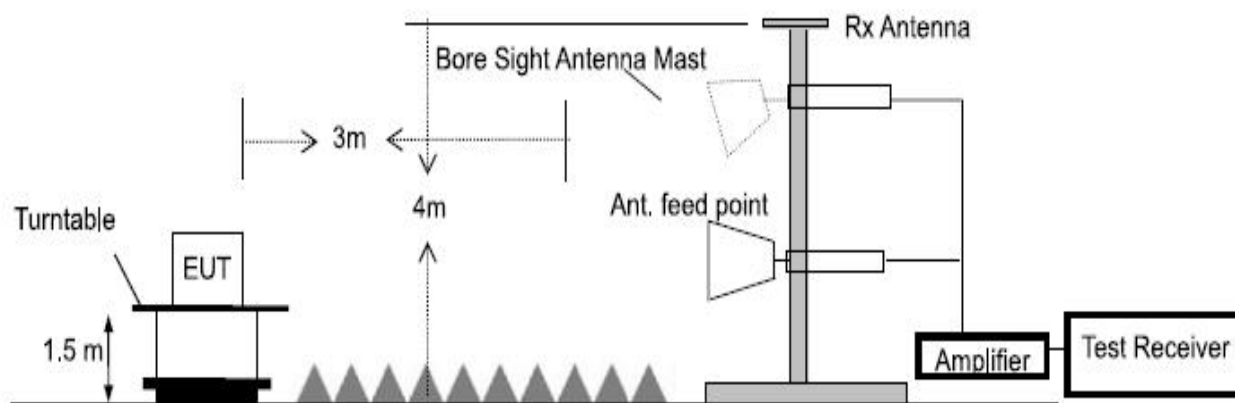
The measurements were performed at the lower end of the 2.4GHz band.

Use the following spectrum analyzer settings:

When spectrum scanned above 1GHz setting resolution bandwidth 1MHz, video bandwidth 3MHz:

EMI Test Receiver	Setting
Attenuation	Auto
RBW	1MHz
VBW	3MHz
Detector	Peak
Trace	Max hold

8.2 TEST SETUP





8.3 TEST RESULTS

Frequency (MHz)	Antenna polarization (H/V)	Emission (dBuV/m)		Band edge Limit (dBuV/m)		Margin (dB)	
		PK	AV	PK	AV	PK	AV
2400	H	44.96	36.25	74	54	-29.04	-17.75
2400	V	44.03	35.74	74	54	-29.97	-18.26
2483.5	H	44.16	35.05	74	54	-29.84	-18.95
2483.5	V	44.22	34.59	74	54	-29.78	-19.41



9 20 dB Bandwidth Measurement

Test Requirement : FCC Part 15C Section 15.215(c)/Part 2 J Section 2.1049

Test Method : ANSI C63.10:2013

Test Mode : Refer to section 3.3

9.1 Test Procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer: RBW = 100kHz, VBW = 300kHz

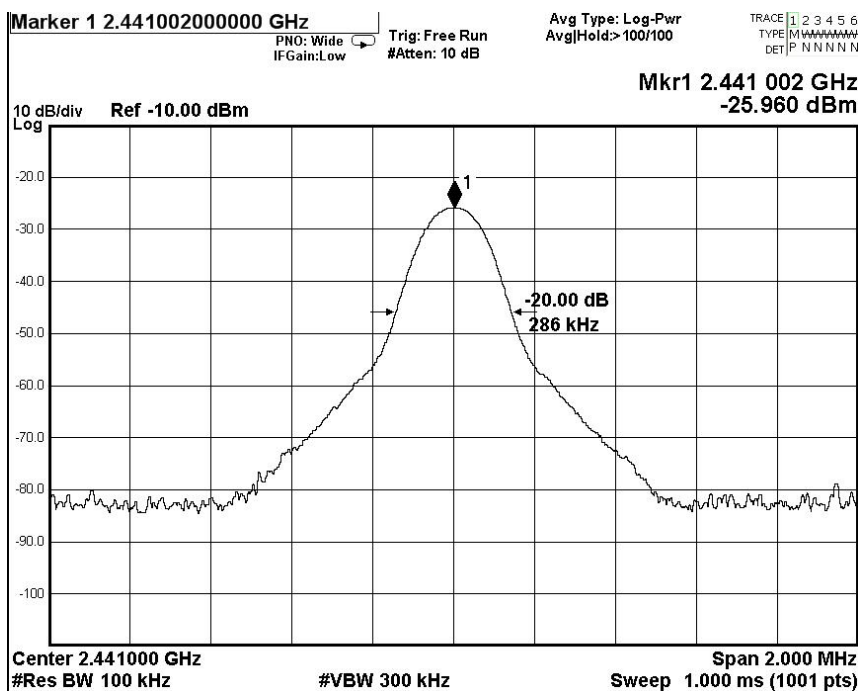
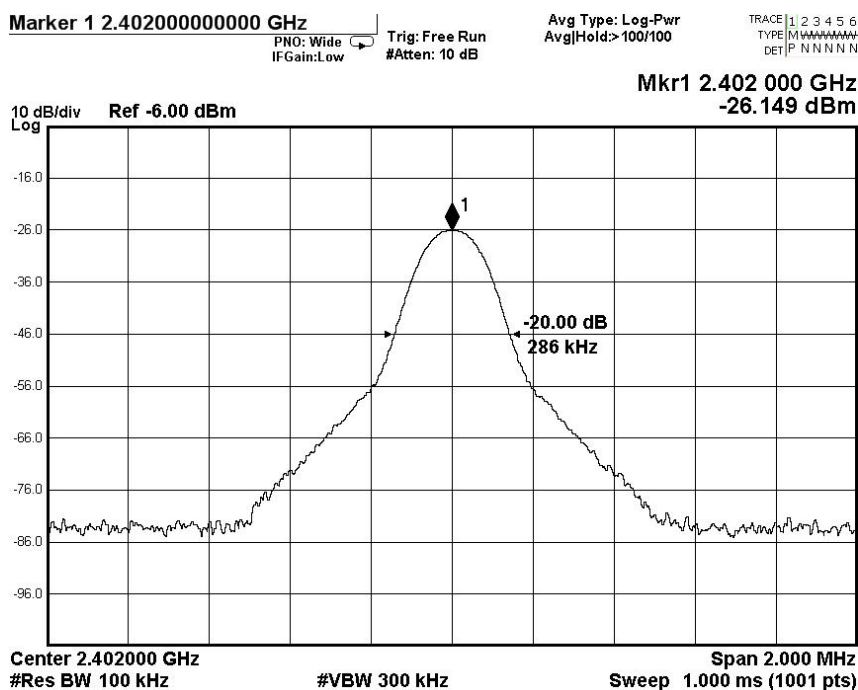
9.2 Test Result

Test Mode: Low / Middle / High Mode

Channel number	Channel frequency (MHz)	20dB Down BW(kHz)
Low	2402	286
Middle	2441	286
High	2480	286

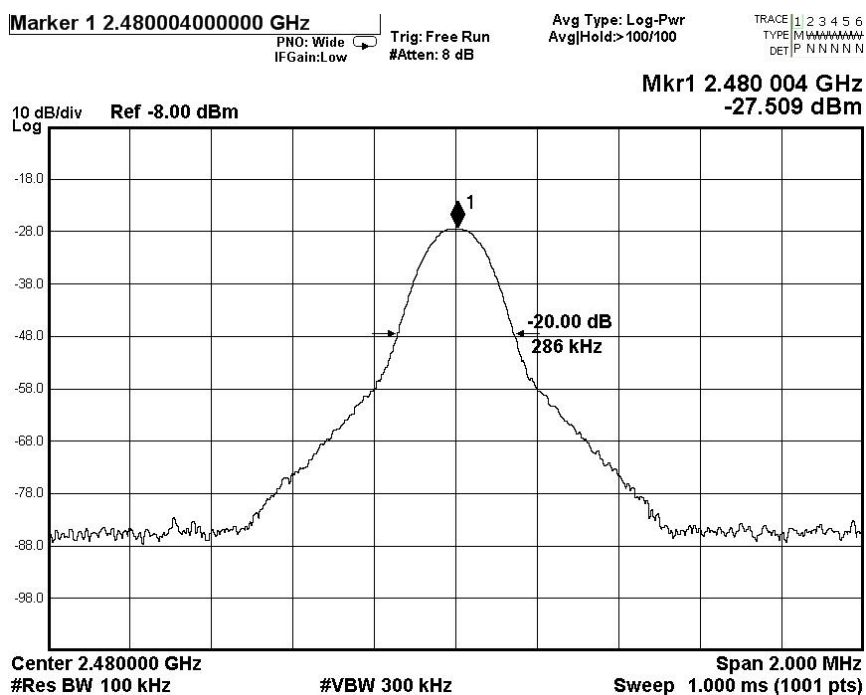


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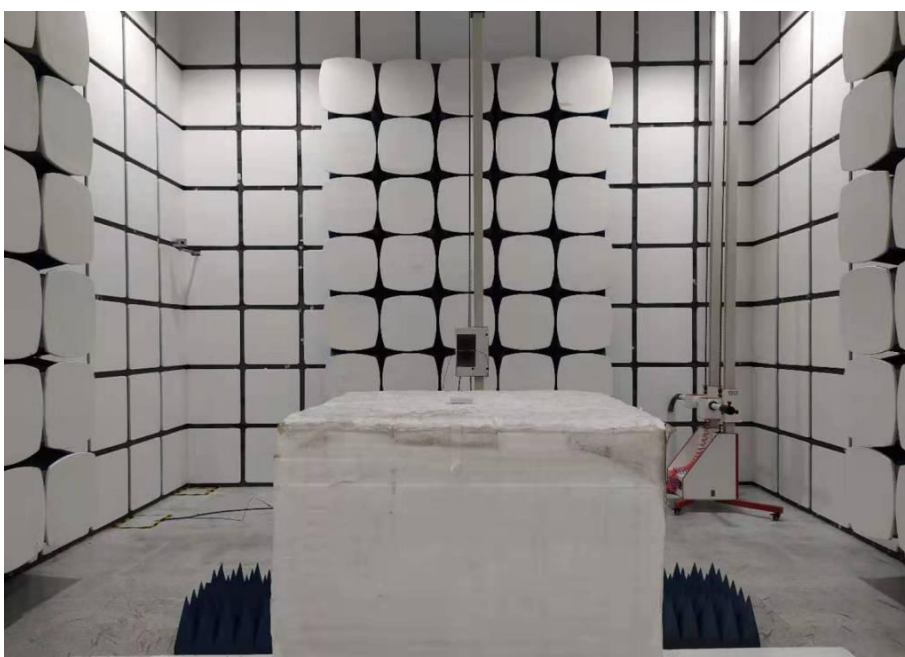
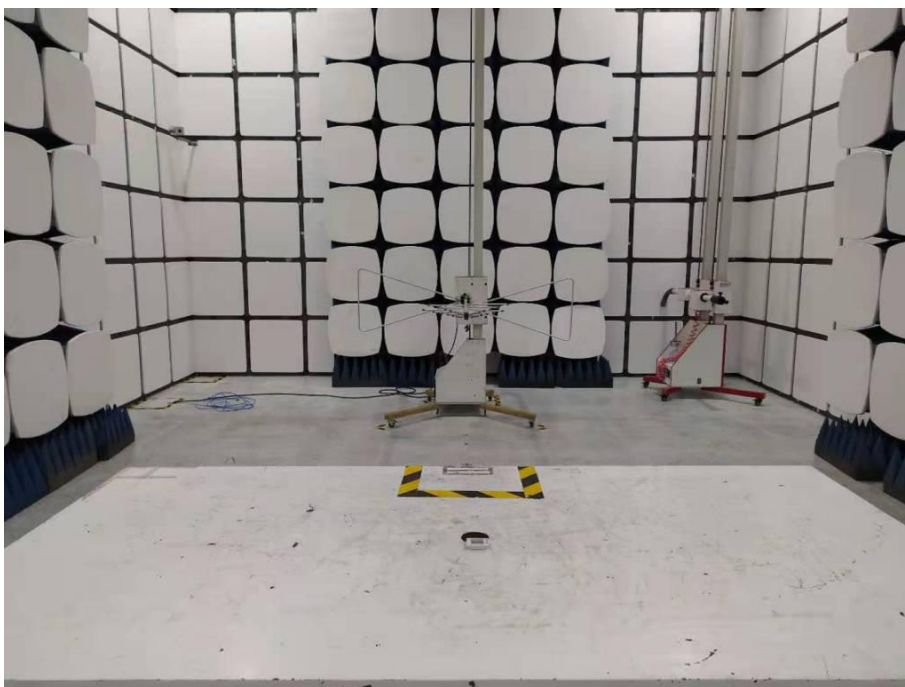


10 Antenna Requirement

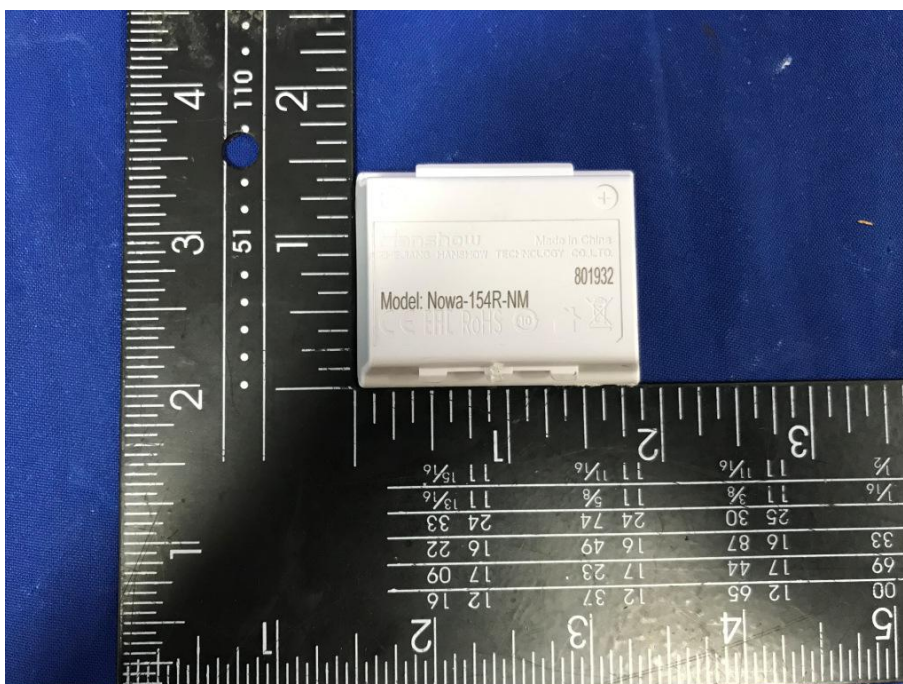
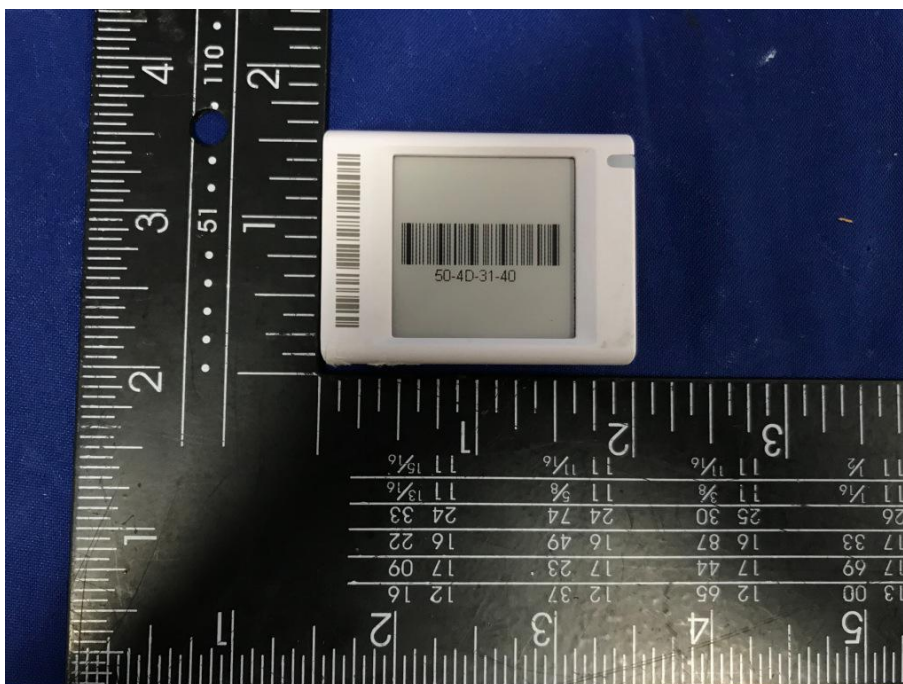
According to the FCC part15.203, a transmitter can only be sold or operated with antennas with which it was approved. This product has an internal PCB Antenna, it meet the requirement of this section.

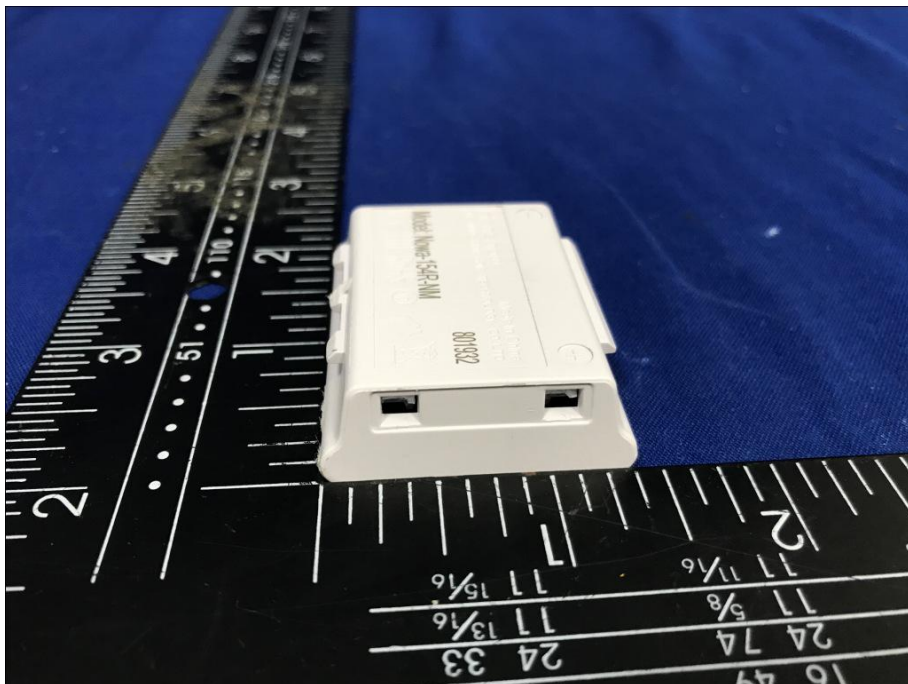
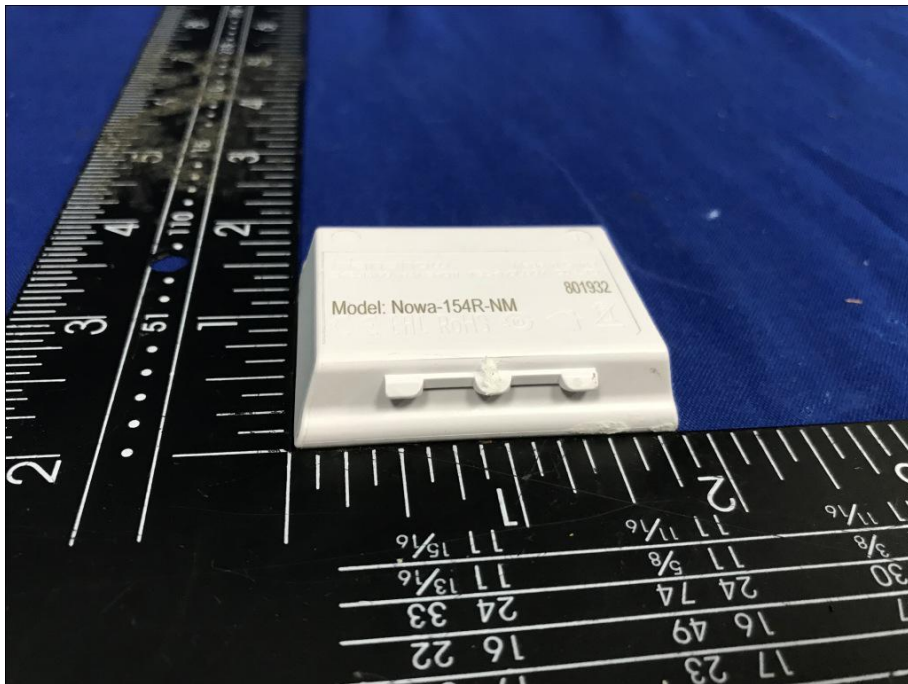


11 TEST PHOTOS

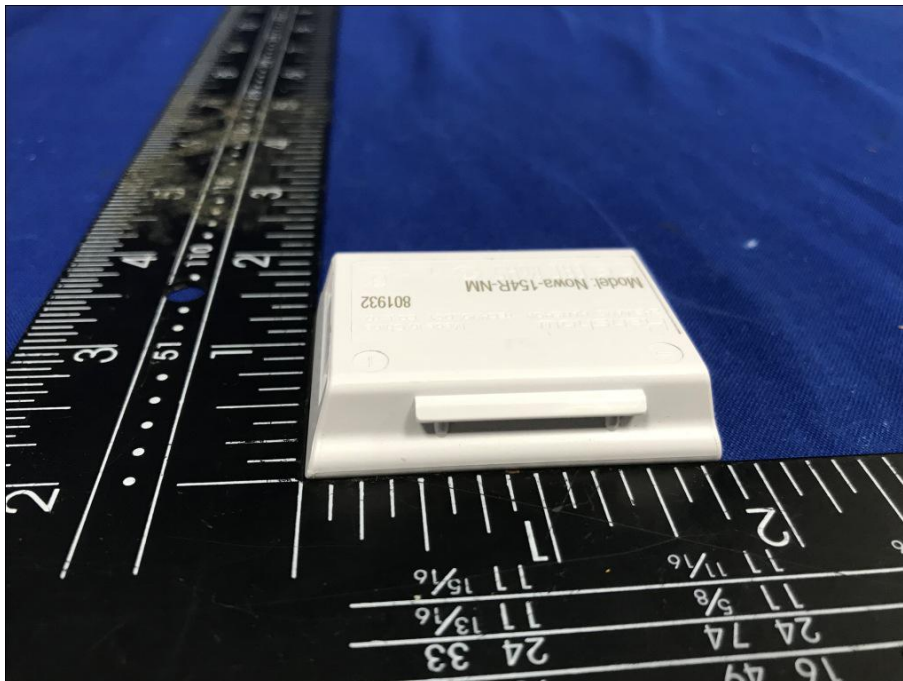


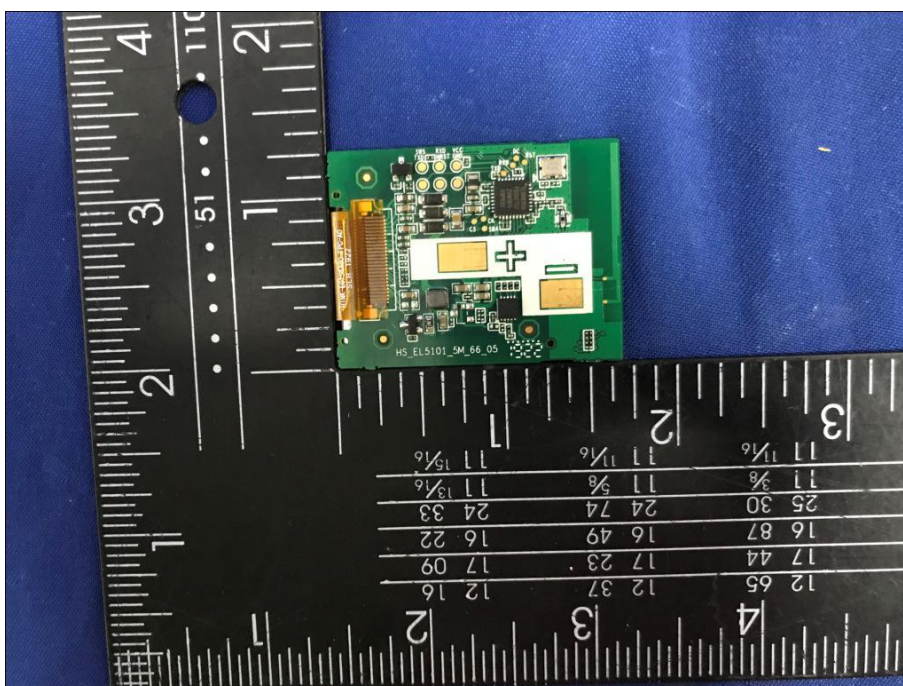
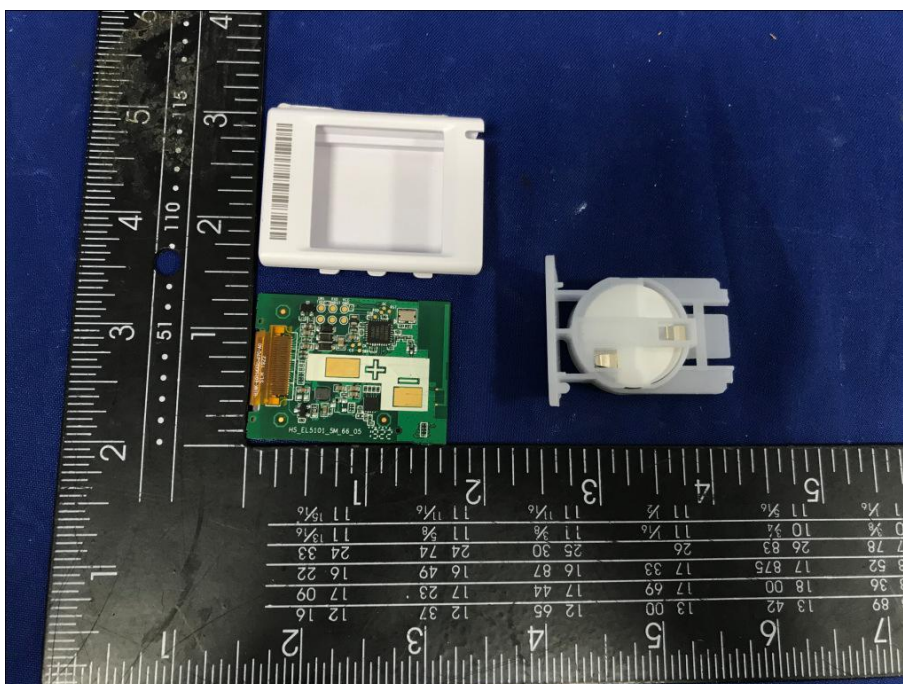
12 EUT PHOTOS

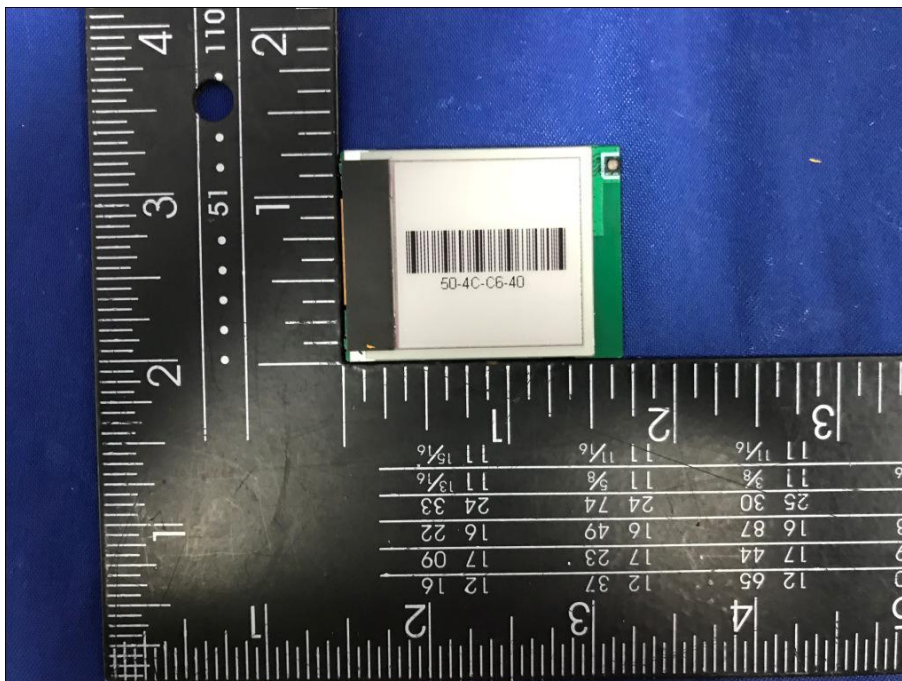


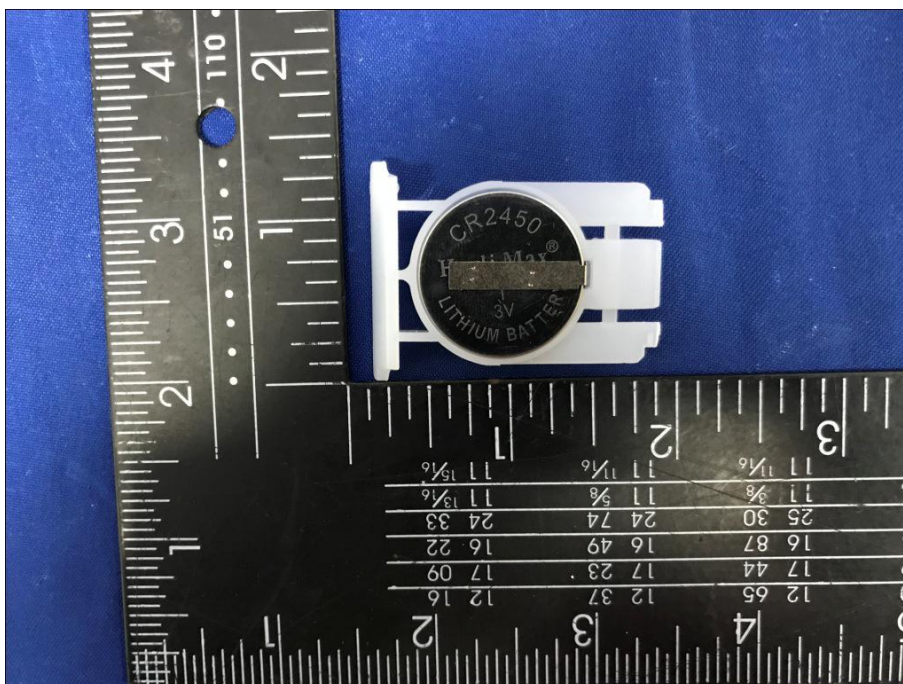


I









*****THE END REPORT*****