TEST REPORT

Reference No.	:	WTF19F07046508W
FCC ID.....	:	2ATWA-SENSAM
Applicant.....	:	Light Engineering Design srl
Address.....	:	via San Marco 11C int.56 -35129Padova (PD)-ITALY
Manufacturer.....	:	Nexta Tech, brand of TEAM srl
Address.....	:	Via G. Oberdan, 90 – 33074 Fontanafredda (PN)-ITALY
Product Name.....	:	RF transmitter
Model No.	:	SENSA-M, SENSA-T
Standards.....	:	FCC CFR47 Part 15 Subpart C (Section 15.231): 2017
Date of Receipt sample....	:	2019-07-11
Date of Test.....	:	2019-08-22
Date of Issue.....	:	2019-08-22
Test Result.....	:	**Pass**

Remarks:
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

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Compiled by:

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1 Test Summary

Test Items	Test Requirement	Result
Radiated Spurious Emissions	15.205(a) 15.209 15.231(a)	Pass
Periodic Operation	15.231(a)	Pass
Emission Bandwidth	15.231(c)	Pass
Antenna Requirement	15.203	Pass

Remark:

Pass	Test item meets the requirement
Fail	Test item does not meet the requirement
N/A	Test case does not apply to the test object

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3 General Information

3.1 General Description of E.U.T.

Product Name .....: RF transmitter

Model No. .....: SENSA-M, SENSA-T

Model Difference.....: Both models are identical except for the accessory included in the package. Therefore the full tests were performed on model SENSA-M.

Type of Modulation .....: ASK

Frequency Range .....: 433.92 MHz

The Lowest Oscillator .....: 8 MHz

Antenna installation .....: PCB Printed Antenna

3.2 Details of E.U.T.

Technical Data .....: Battery CR2450 3V

3.3 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Lower channel	Middle channel	Upper channel
Transmitting	433.92MHz	/MHz	/MHz

3.4 Test Facility

The test facility has a test site registered with the following organizations:

- **IC – Registration No.: 21895-1**

Waltek Services (Foshan) Co., Ltd. has been registered and fully described in a report filed with the Industry Canada. The acceptance letter from the Industry Canada is maintained in our files. Registration IC number:21895-1, Nov. 14, 2016.

- **FCC – Registration No.: 820106**

Waltek Services (Foshan) 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 820106, August 16, 2018

- **FCC – Designation No.: CN5034**

Waltek Services (Foshan) 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. Designation No. CN5034.

- **NVLAP – Lab Code: 600191-0**

Waltek Services (Foshan) Co., Ltd. EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 600191-0.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

3.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☐ Yes ☒ No

If Yes, list the related test items and lab information:

Test items:---

Lab information:---

3.6 Abnormalities from Standard Conditions

None.

4 Equipment Used during Test

4.1 Equipment List

Conducted Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Cal Date**	**Cal Due Date**
1.	EMI Test Receiver	RS	ESCI	101178	2019-01-18	2020-01-17
2.	LISN	RS	ENV216	101215	2019-01-10	2020-01-09
3.	Cable	HUBER+SUHNER	CBL2-NN-3M	223NN322	2019-01-10	2020-01-09
4.	Test Software	FARATRONIC	EZ-EMC	EMEC-3AA	-	-
3m Semi-anechoic Chamber for Radiation Emissions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	EMC Analyzer	Agilent	N9020A	MY48011796	2019-01-26	2020-01-25
2.	Active Loop Antenna	SCHWARZBECK	FMZB1519B	00004	2019-03-10	2020-03-09
3.	Trilog Broadband Antenna	SCHWARZBECK	VULB 9162	9162-117	2019-01-26	2020-01-25
4.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	01561	2019-04-28	2020-04-27
5.	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9170	335	2019-01-10	2020-01-09
6.	Amplifier	Lunar E M	LNA1G18-40	20160501002	2019-04-03	2020-04-02
7.	Coaxial Cable (below 1GHz)	H+S	CBL3-NN-12+3 m	214NN320	2019-01-10	2020-01-09
8.	Coaxial Cable (above 1GHz)	Times-Micorwave	CBL5-NN	-	2019-01-10	2020-01-09
9.	Test Software	FARATRONIC	EZ-EMC	EMEC-3AA	-	-
RF Conducted Testing						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1.	Spectrum Analyzer	Agilent	N9020A	MY48011796	2019-01-26	2020-01-25
2.	Spectrum Analyzer	R&S	FSP40	100501	2018-11-13	2019-11-12
3.	Vector Signal Generator	Agilent	N5182A	MY50141533	2018-03-05	2019-03-04
4.	Analog Signal Generator	Agilent	N5181A	MY48180720	2019-01-26	2020-01-26
5.	Environmental Chamber	KSON	THS-D4C-100	5244K	2019-01-26	2020-01-26
6.	Test Software	FARATRONIC	EZ-EMC	EMEC-3AA	-	-

4.2 Measurement Uncertainty

Conducted Emission (150kHz-30MHz)

Input quantity	X_i	Uncertainty of x_i		$u(X_i)$	C_i	$C_i u(X_i)$ (dB)
		dB	Probability distribution function			
Receiver reading	V_r	±0.36	K=2	0.18	1	0.18
Attenuation: AMN-receiver	a_c	±0.20	K=2	0.10	1	0.10
AMN voltage division factor	F_{AMN}	±0.20	K=2	0.10	1	0.10
Receiver corrections:						
Sine wave voltage	δV_{sw}	±1.0	K=2	0.50	1	0.50
Pulse amplitude response	δV_{pa}	±0.0		0.00	1	0.00
Pulse repetition rate response	δV_{pr}	±0.0		0.00	1	0.00
Noise floor proximity	δV_{nf}	±0.05		0.00	1	0.00
Mismatch: AMN-receiver	δM	+0.7/-0.8	U-shaped	0.53	1	0.53
AMN impedance	δZ	+2.6/-2.7	Triangular	1.08	1	1.08
Note: $V = V_r + a_c + F_{AMN} + \delta F_{AMN} + \delta V_{sw} + \delta V_{pa} + \delta V_{pr} + \delta V_{nf} + \delta M + \delta Z$ $U(V)=2u_c(V)=$ ***2.66*** *dB*						

Radiated Emission (30MHz-1GHz)

Input quantity	X_i	Uncertainty of x_i		$u(X_i)$	C_i	$C_i u(X_i)$ (dB)
		dB	Probability distribution function			
Receiver reading	V_r	±0.36	K=2	0.18	1	0.18
Attenuation: antenna-receiver	a_c	±0.10	K=2	0.05	1	0.05
Antenna facotr	F_a	±1.6	K=2	0.8	1	0.8
Receiver corrections:						
Sine wave voltage	δV_{sw}	±1.0	K=2	0.5	1	0.5
Pulse amplitude response	δV_{pa}	±0.6	Rectangular	0.35	1	0.35
Pulse repetition rate response	δV_{pr}	±1.5	Rectangular	0.87	1	0.87
Noise floor proximity	δV_{nf}	±0.5	K=2	0.25	1	0.25
Mismatch: antenna-receiver	δM	+0.9/-1.0	U-shaped	0.67	1	0.67
Antenna corrections:						
AF frequency interpolation	δF_{af}	±0.3	Rectangular	0.17	1	0.17
AF variation due to FAR influence	δF_{ah}	±0.5	Rectangular	0.29	1	0.29
Directivity difference	δF_{adir}	±0.0		0.00	1	0.00
Phase centre location	δF_{aph}	±0.0		0.00	1	0.00
Cross-polarization	δF_{acp}	±0.0		0.00	1	0.00
Balance	δF_{abal}	±0.3	Rectangular	0.17	1	0.17
Site corrections:						
Site imperfections	δA_N	±4.0	Triangular	1.63	1	1.63
Separation distance	δd	±0.3	Rectangular	0.17	1	0.17
Table height	δh	±0.1	K=2	0.05	1	0.05
Note: E= $V_r + a_c + F_a + \delta V_{sw} + \delta V_{pa} + \delta V_{pr} + \delta V_{nf} + \delta M + \delta F_{af} + \delta F_{ah} + \delta F_{adir} + \delta F_{aph} + \delta F_{acp} + \delta F_{abal} + \delta A_N + \delta d + \delta h$ $U(E)=2u_c(E)=$**4.56**dB						

Radiated Spurious Emissions (25MHz-1GHz)

Input quantity	X_i	Uncertainty of x_i		$u(x_i)$ dB	c_i	$c_i u(x_i)$ dB
		dB	Probability distribution function			
Receiver reading	V_r	±0.4	k=2	0.20	1	0.20
Attenuation: antenna-receiver	a_c	±0.5	k=2	0.25	1	0.25
Cable loss and correction	L_{ac}	±1.6	k=2	0.80	1	0.80
Receiver corrections:						
Sine wave voltage	δV_{sw}	±0.9	k=2	0.45	1	0.45
Pulse amplitude response	δV_{pa}	±0.6	Rectangular	0.35	1	0.35
Pulse repetition rate response	δV_{pr}	±0.6	Rectangular	0.35	1	0.35
Noise floor proximity	δV_{nf}	+1.0/0.0	U-shaped	0.58	1	0.58
Mismatch: antenna-receiver	δM	+0.9/--1.0	U-shaped	0.67	1	0.67
Site imperfections	δMD	±3.0	Triangular	1.14	1	1.23
Reproducibility of measurement operation	δp	±0.60	k=2	0.30	1	0.30
Separation distance	δd	±0.3	Rectangular	0.17	1	0.17
Table height	δh	±0.1	k=2	0.05	1	0.05
Note: $E = V_r + a_c + L_{ac} + \delta V_{sw} + \delta V_{pa} + \delta V_{pr} + \delta V_{nf} + \delta M + \delta MD + \delta p + \delta d + \delta h$ $U(E) = 2u_c(E) = \mathbf{3.80}$dB						

Radiated Spurious Emissions (1GHz-18GHz)

Input quantity	X_i	Uncertainty of x_i		$u(x_i)$ dB	c_i	$c_i u(x_i)$ dB
		dB	Probability distribution function			
Receiver reading	V_r	±0.40	k=2	0.20	1	0.20
Attenuation: antenna-receiver	a_c	±0.80	k=2	0.40	1	0.40
Cable loss and correction	L_{ac}	±2.40	k=2	1.20	1	1.20
Mismatch: Preamplifiers - Signal Analyzers	δM_{ps}	+1.2/-1.4	U-shaped	0.92	1	0.92
Mismatch:antenna-receiver	δM_{ac}	+1.3/-1.5	U-shaped	1.00	1	1.00
Receiver corrections:						
Sine wave voltage	δV_{sw}	±0.9	k=2	0.45	1	0.45
Pulse amplitude response	δV_{pa}	±0.6	Rectangular	0.35	1	0.35
Pulse repetition rate response	δV_{pr}	±0.6	Rectangular	0.35	1	0.35
Noise floor proximity	δV_{nf}	+1.0/0.0	U-shaped	0.58	1	0.58
Site imperfections	$\delta Svswr$	±3.0	Triangular	1.22	1	1.22
Effect of setup table material	δANT	±1.0	Rectangular	0.58	1	0.58
Reproducibility of measurement operation	δp	±0.60	k=2	0.30	1	0.30
Note: $E = V_r + a_c + L_{ac} + \delta M_{ps} + \delta M_{ac} + \delta V_{sw} + \delta V_{pa} + \delta V_{pr} + \delta V_{nf} + \delta Svswr + \delta ANT + \delta p$ $U(E) = 2u_c(E) = \mathbf{4.97}$dB						

5 Radiated Spurious Emissions

Test Requirement .....: FCC Part15 Paragraph 15.231(a)

Test Method .....: ANSI C63.10:2013

Test Result .....: PASS

Measurement Distance .....: 3m

Limit:

Fundamental Frequency (MHz)	Field Strength of Fundamental (uV/m)	Field Strength of Fundamental (dBuV/m)	Field Strength of Spurious Emission (uV/m)	Field Strength of Spurious Emission (dBuV/m)
44.66-40.70	2250	67	225	47
70-130	1250	62	125	42
130-174	1250 to 3750	62 to 71.48	125 to 375	42 to 51.48
174-260	3750	71.48	375	51.48
260-470	3750 to 12500	71.48 to 81.94	375 to 1250	51.48 to 61.94
Above 470	12500	81.94	1250	61.94
aa** linear interpolations				

5.1 EUT Operation

Operating Environment:

Temperature.....: 23.5 °C

Humidity .....: 51.1 % RH

Atmospheric Pressure .....: 101.2kPa

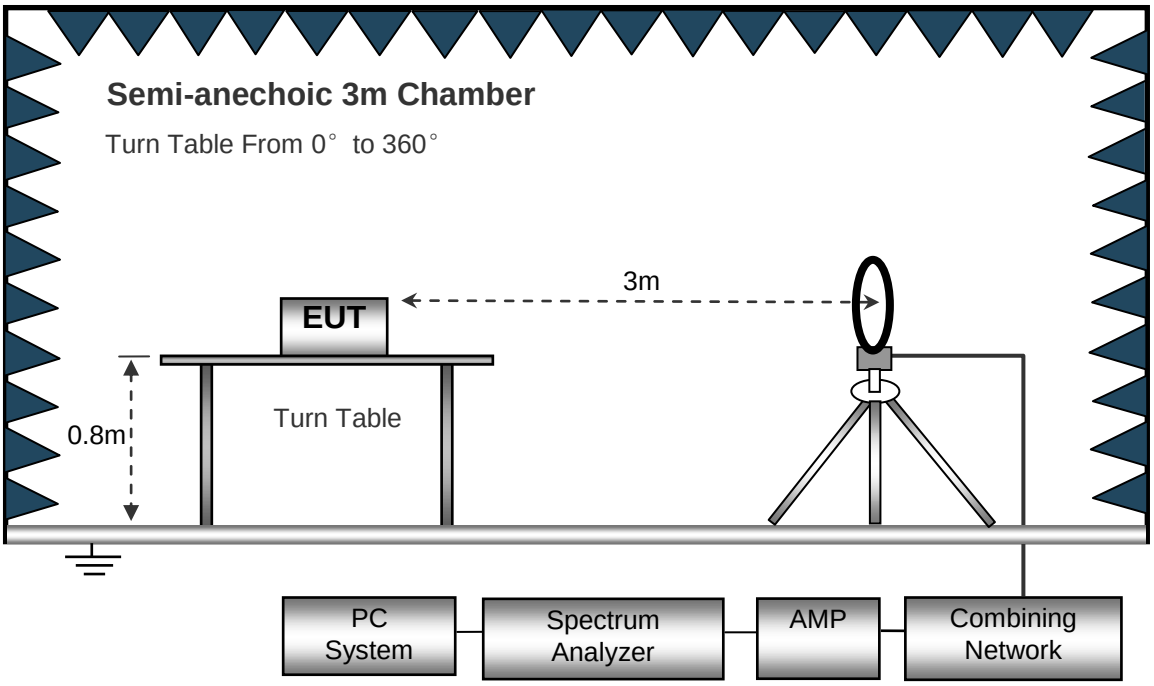
EUT Operation:

The test was performed in transmitting mode, the test data were shown in the report.

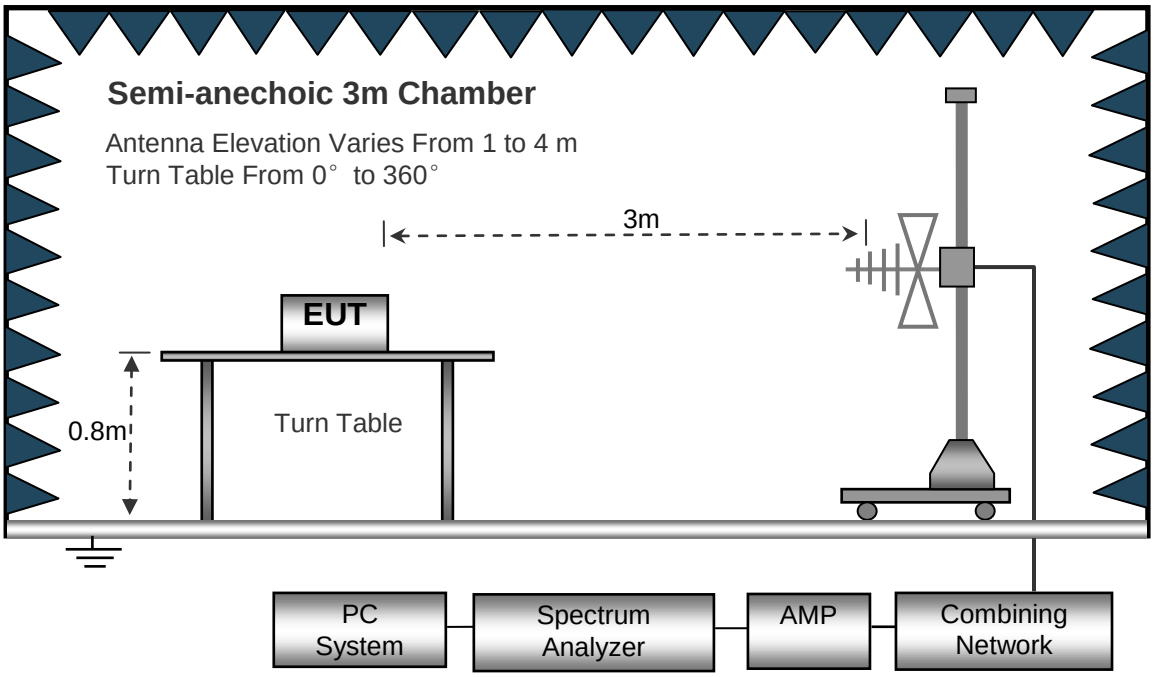
5.2 Test Setup

The radiated emission tests were performed in the 3m Semi- Anechoic Chamber test site, using the setup accordance with the ANSI C63.10.

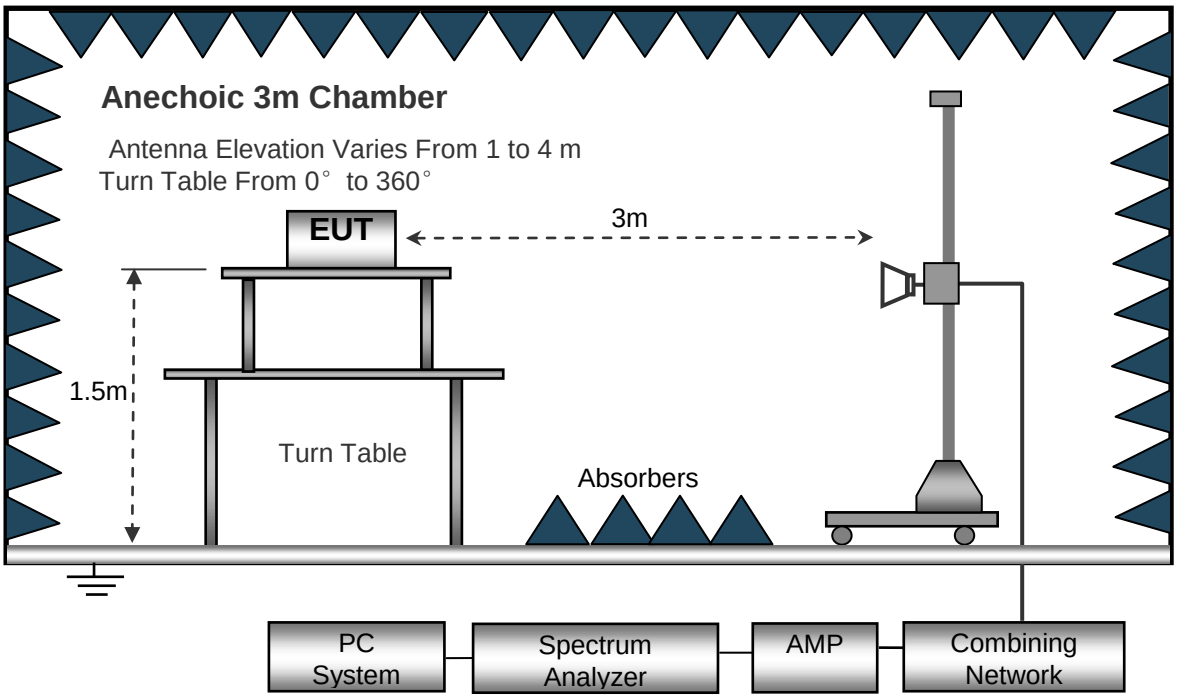
The test setup for emission measurement below 30MHz.



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



The test setup for emission measurement above 1 GHz.



5.3 Spectrum Analyzer Setup

Below 30MHz

Sweep Speed	:	Auto
IF Bandwidth	:	10kHz
Video Bandwidth	:	10kHz
Resolution Bandwidth	:	10kHz

30MHz ~ 1GHz

Sweep Speed	:	Auto
Detector	:	PK
Resolution Bandwidth	:	100kHz
Video Bandwidth	:	300kHz

Above 1GHz

Sweep Speed	:	Auto
Detector	:	PK
Resolution Bandwidth	:	1MHz
Video Bandwidth	:	3MHz

5.4 Test Procedure

1) The EUT is placed on a turntable. For below 1GHz, the EUT is 0.8m above ground plane;For above1GHz, the EUT is 1.5m above ground plane.

2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.

3) EUT is set 3m away from the receiving antenna, which is moved from 1m to 4m to find out the maximum emissions. The spectrum was investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4) Maximum procedure was performed on the six highest emissions to ensure EUT compliance.

5) And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

6) Repeat above procedures until the measurements for all frequencies are complete.

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.

5.5 Summary of Test Results

Test Frequency : 30MHz ~ 5GHz

Single Channel: 433.92MHz

Frequency	Receiver Reading (PK)	Turn table Angle	RX Antenna		Corrected Factor	Corrected Amplitude (PK)	FCC Part 15.231/15.209/205	
			Height	Polar			Limit	Margin
(MHz)	(dBμV)	Degree	(m)	(H/V)	(dB/m)	(dBμV/m)	(dBμV/m)	(dB)
434.07	62.98	288	1.1	H	19.31	82.29	100.82	-18.53
434.07	64.76	201	1.9	V	19.51	84.27	100.82	-16.55
869.13	33.68	141	1.4	H	25.59	59.27	80.82	-21.55
869.13	36.98	248	1.6	V	25.98	62.96	80.82	-17.86
1734.38	69.37	264	1.3	H	-13.41	55.96	74.00	-18.04
1734.38	68.07	283	1.2	V	-12.95	55.12	74.00	-18.88
3467.50	59.78	277	1.5	H	-9.59	50.19	74.00	-23.81
3467.50	62.07	243	1.8	V	-7.49	54.58	74.00	-19.42

AV = Peak +20Log$_{10}$(duty cycle) =PK+(-5.87) [refer to section 7 for more detail]

Frequency	PK	RX Antenna Polar	Duty cycle Factor	Calculated AV	FCC Part 15.231/209/205	
					Limit	Margin
(MHz)	(dBμV/m)	(H/V)	(dB)	(dBμV/m)	(dBμV/m)	(dB)
434.07	82.29	H	-5.87	76.42	80.82	-4.40
434.07	84.27	V	-5.87	78.40	80.82	-2.42
869.13	59.27	H	-5.87	53.40	60.82	-7.42
869.13	62.96	V	-5.87	57.09	60.82	-3.73
1734.38	55.96	H	-5.87	50.09	54.00	-3.91
1734.38	55.12	V	-5.87	49.25	54.00	-4.75
3467.50	50.19	H	-5.87	44.32	54.00	-9.68
3467.50	54.58	V	-5.87	48.71	54.00	-5.29

6 Periodic Operation

The duty cycle was determined by the following equation:

To calculate the actual field intensity, The duty cycle correction factor in decibel is needed for later use and can be obtained from following conversion

Duty Cycle(%)=Total On interval in a complete pulse train/ Length of a complete pulse train * %

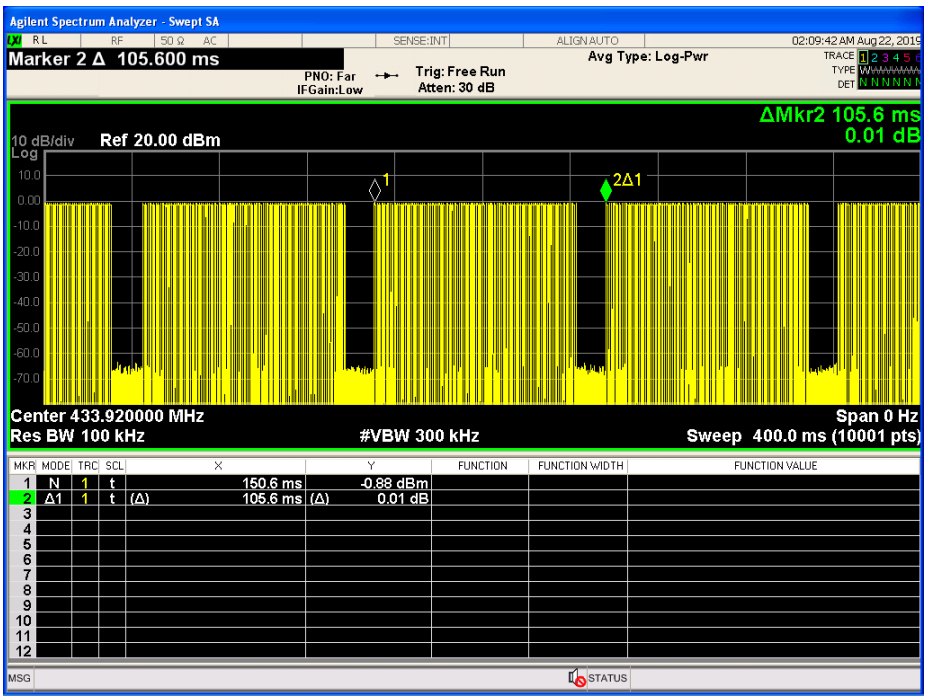
Duty Cycle Correction Factor(dB)=20 * Log_{10}(Duty Cycle(%))

Total transmission time(ms)	0.678*71+0.216*26=53.754
Length of a complete transmission period(ms)	105.6
Duty Cycle(%)	50.90
Duty Cycle Correction Factor(dB)	-5.87

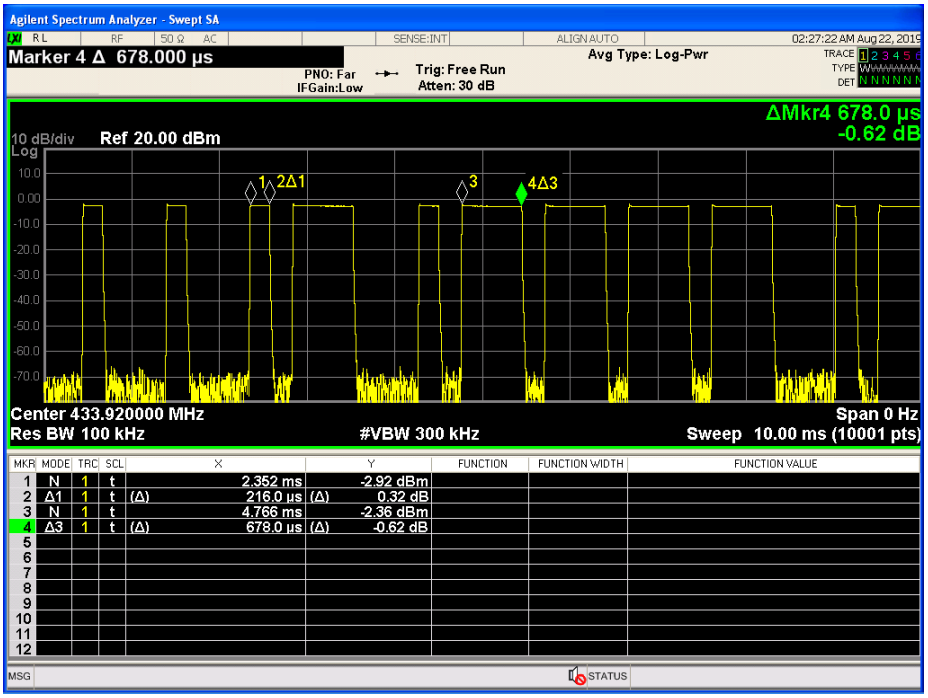
Refer to the duty cycle plot (as below),This device meets the FCC requirement.

Length of a complete pulse train:

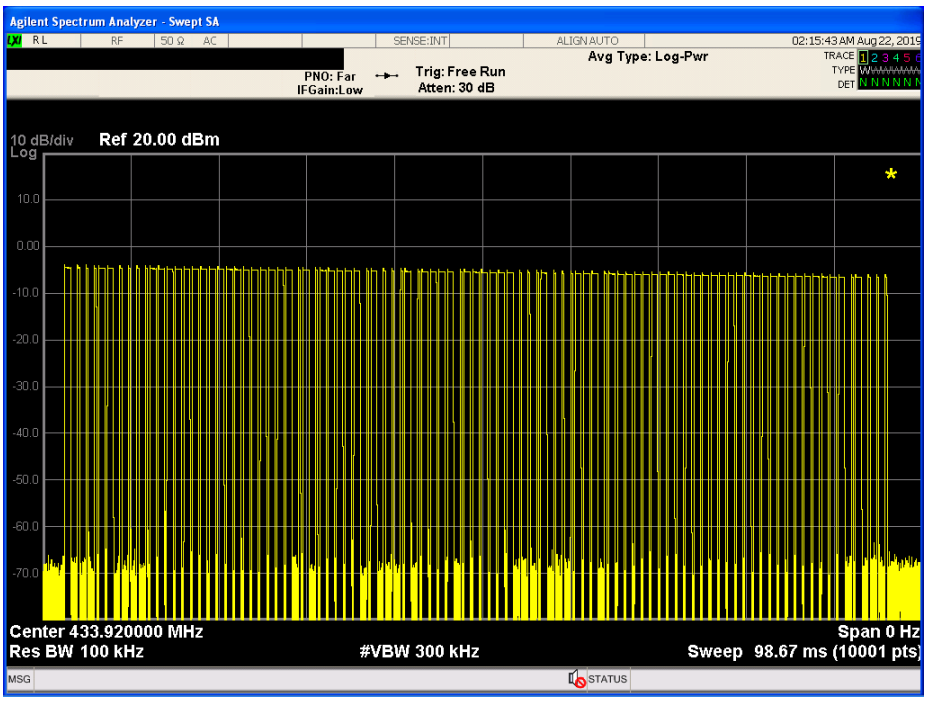
Remark: FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.



Pulse 1

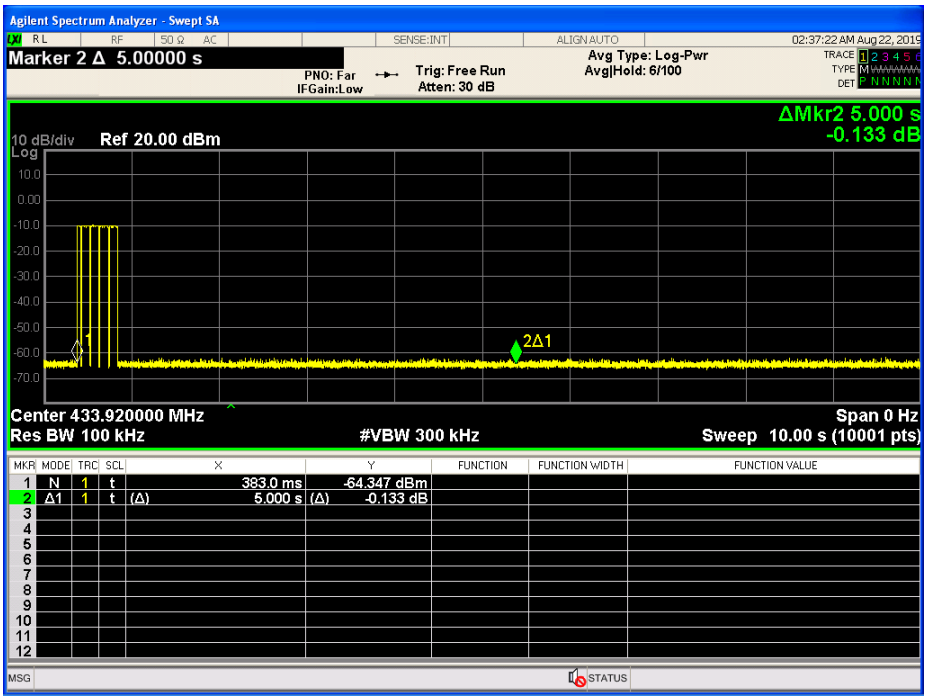


Pulse 2



FCC Part15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2)A transmitter activated automatically shall cease transmission within 5 seconds after activation.



7 Emission Bandwidth

Test Requirement .....: FCC Part15.231(c)

Test Method .....: FCC Part15.231(c)

Limit .....: The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

7.1 Test Procedure

1) The transmitter output (antenna port) was connected to the spectrum analyzer.EUT and its simulators are placed on a table, let EUT working in test mode, then test it.

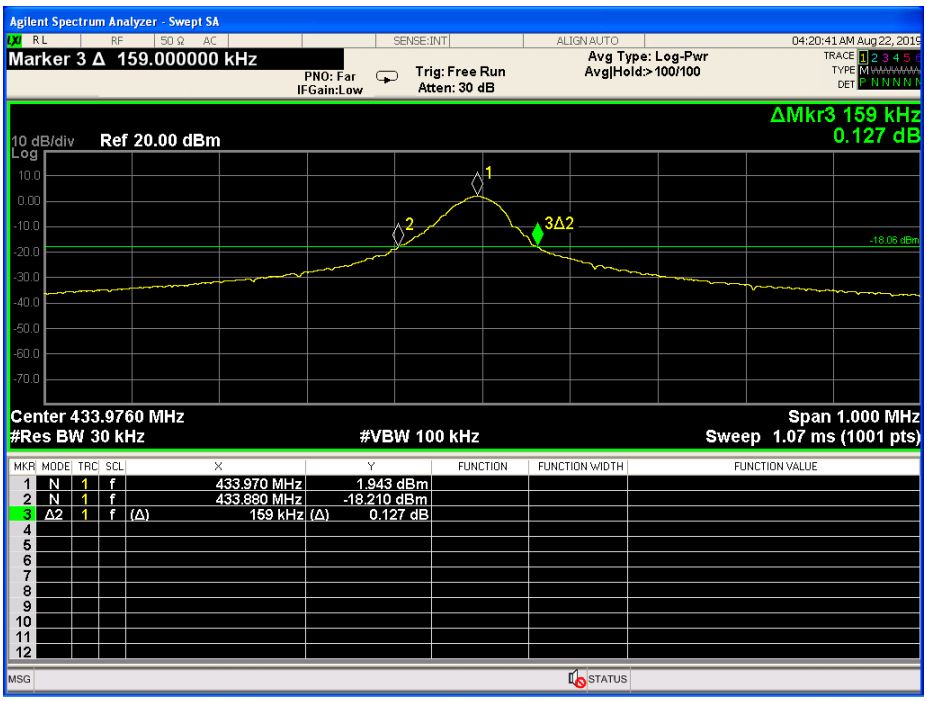
2) The bandwidth of the fundamental frequency was measure by spectrum analyser with 30kHz RBW and 100kHz VBW. The 20 dB bandwidth was recorded.

7.2 Test Result

Frequency (MHz)	20dB Bandwidth Emission(KHz)	Limit (KHz)	Result
433.92	159	1084.05	Pass

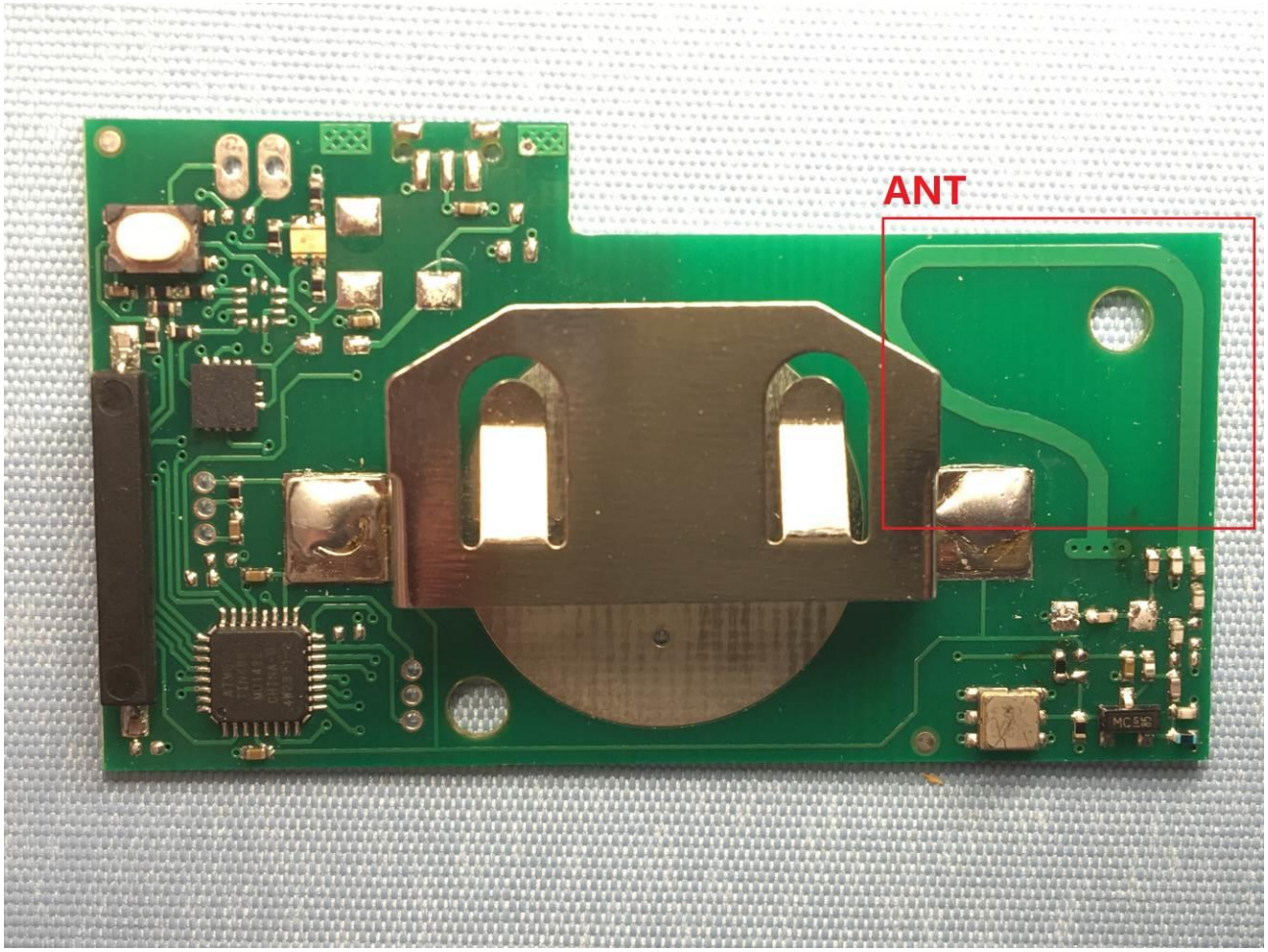
Limit=Center Frequency*0.25%

Test result plots as follows:



8 Antenna Requirement

According to the FCC Part 15 Paragraph 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. The use of a permanently attached antenna to the intentional radiator shall be considered sufficient to comply with the provisions of this section. This product use a Dipole antenna, it only apply to this model, fulfill the requirement of this section.

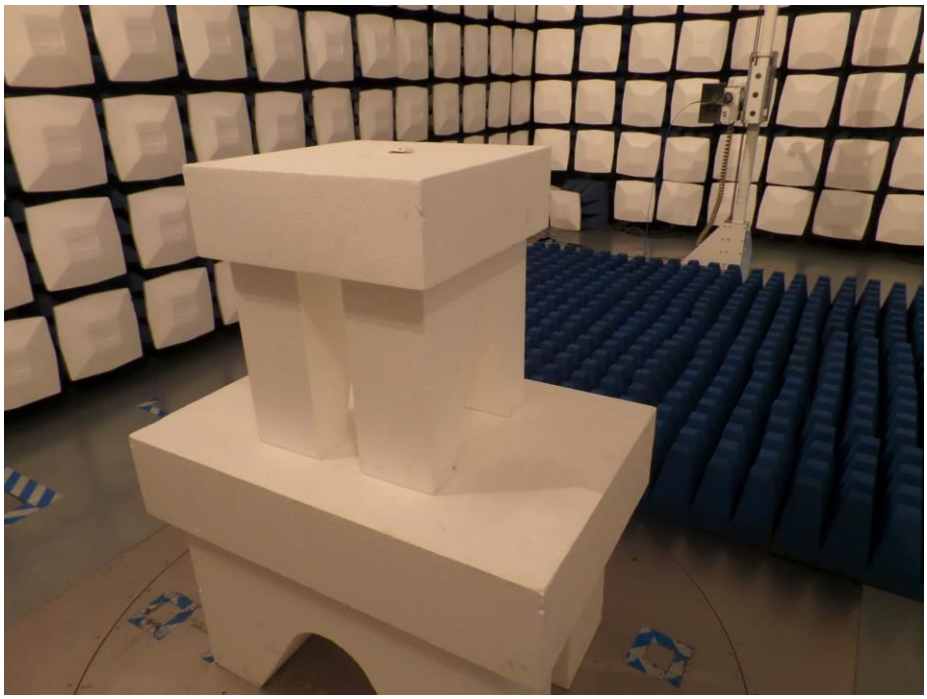


9 Photographs –Test Setup

9.1 Photograph – Radiation Spurious Emission Test Setup

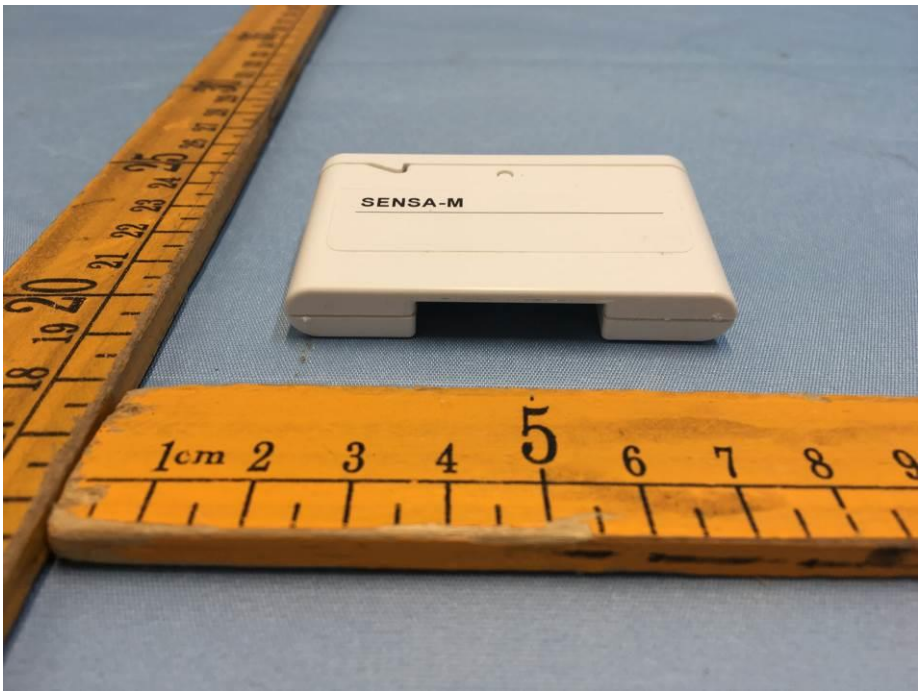
From 30MHz to 1GHz

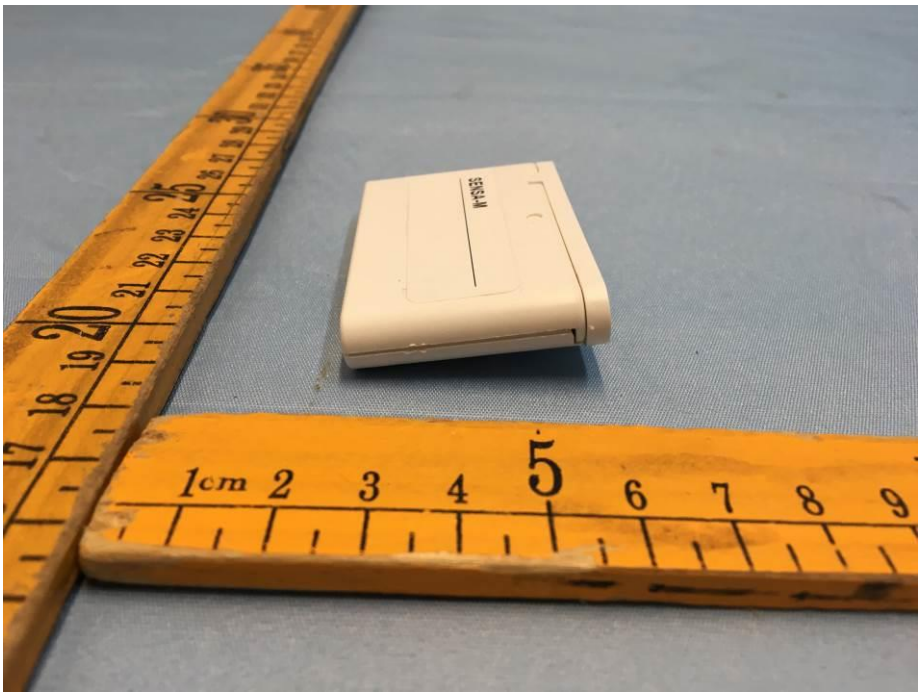
Above 1GHz

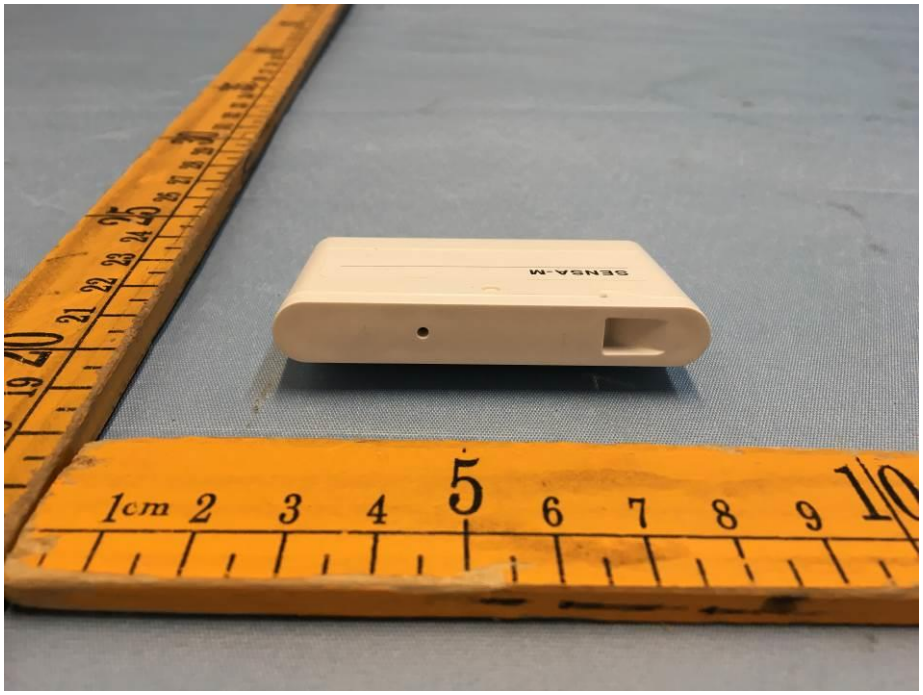


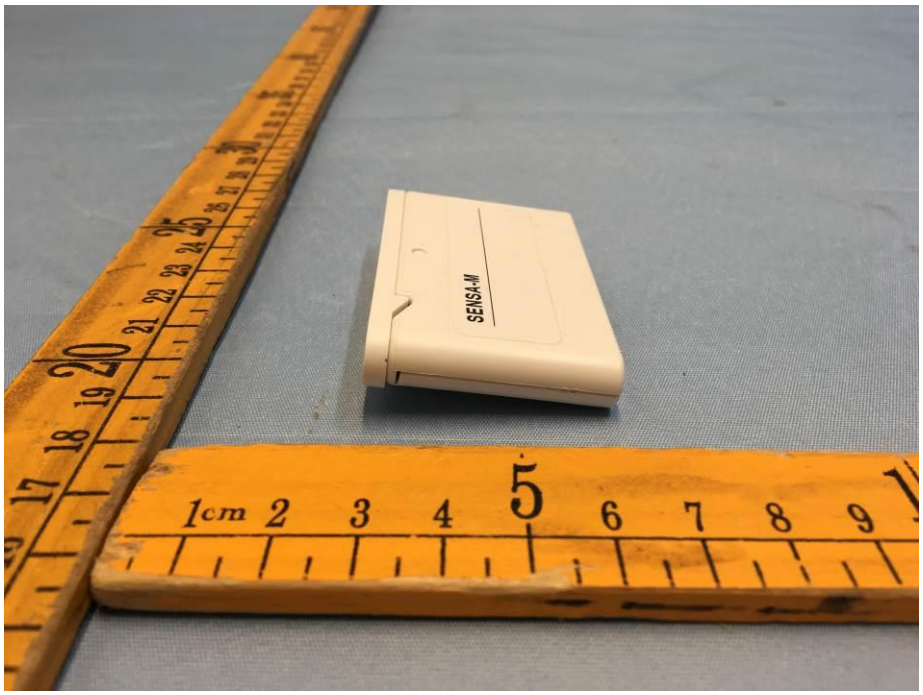
10 Photographs - Constructional Details

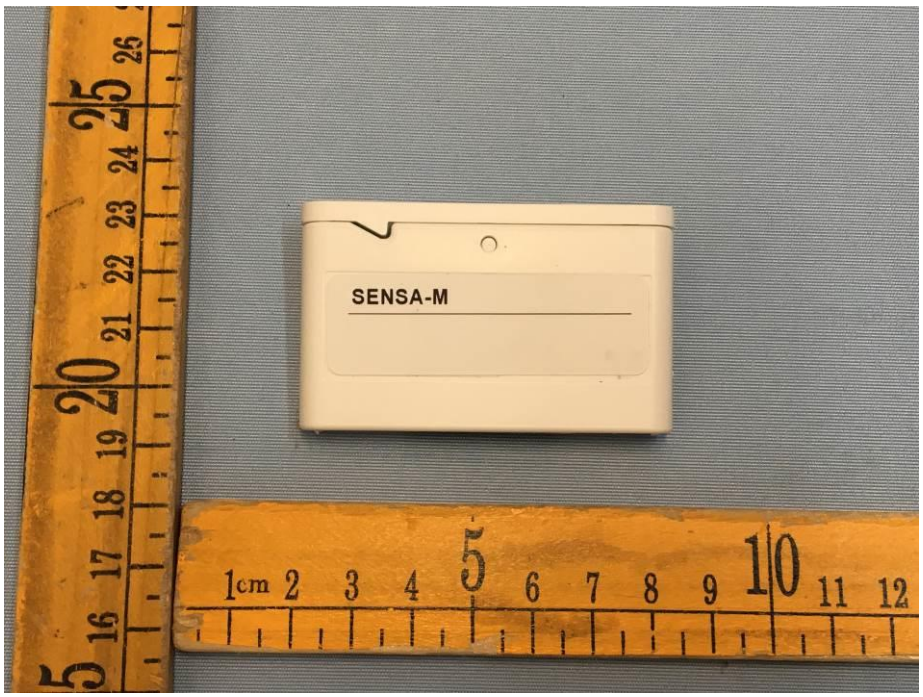
10.1 EUT - External Photos

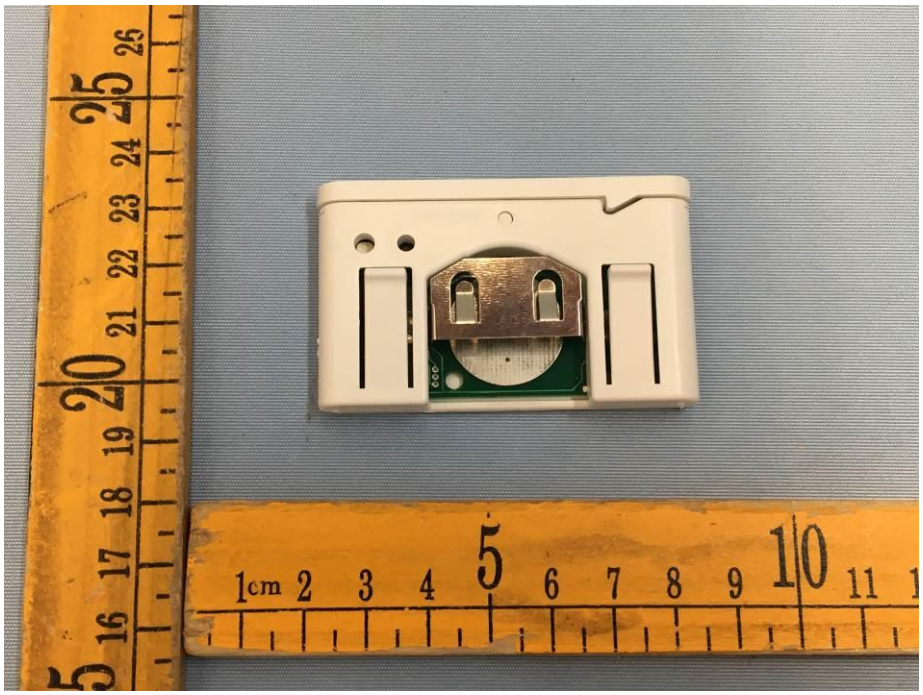




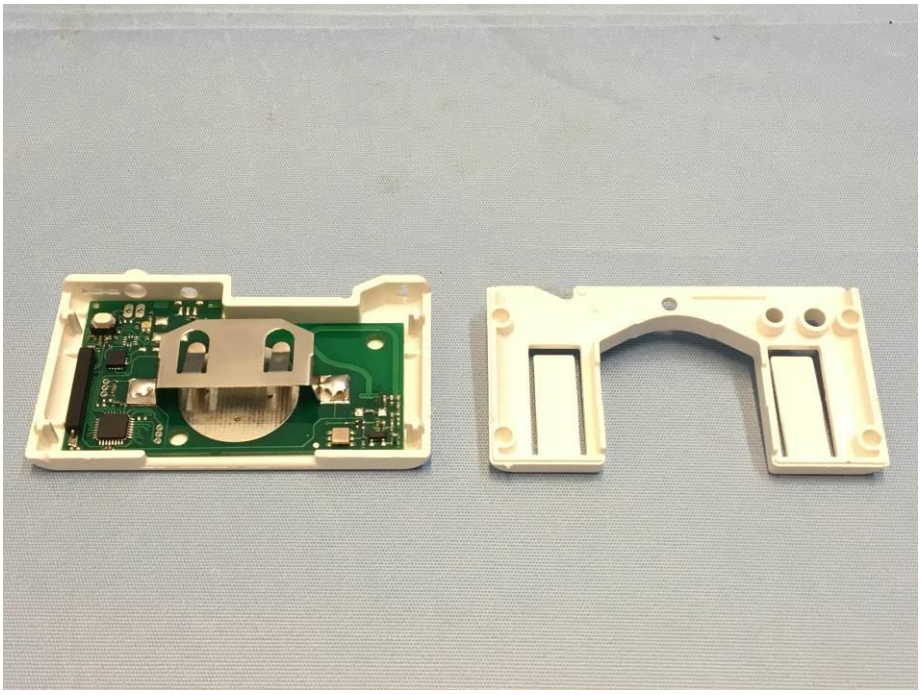

SENSA-M
1cm 2 3 4 5 6 7 8 9

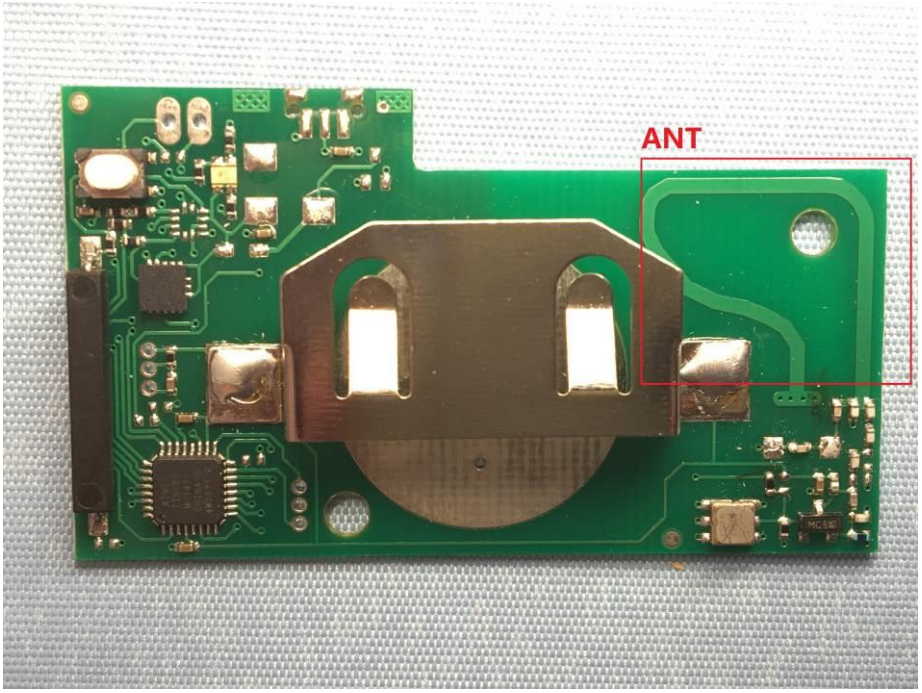

SENSA-M
1cm 2 3 4 5 6 7 8 9

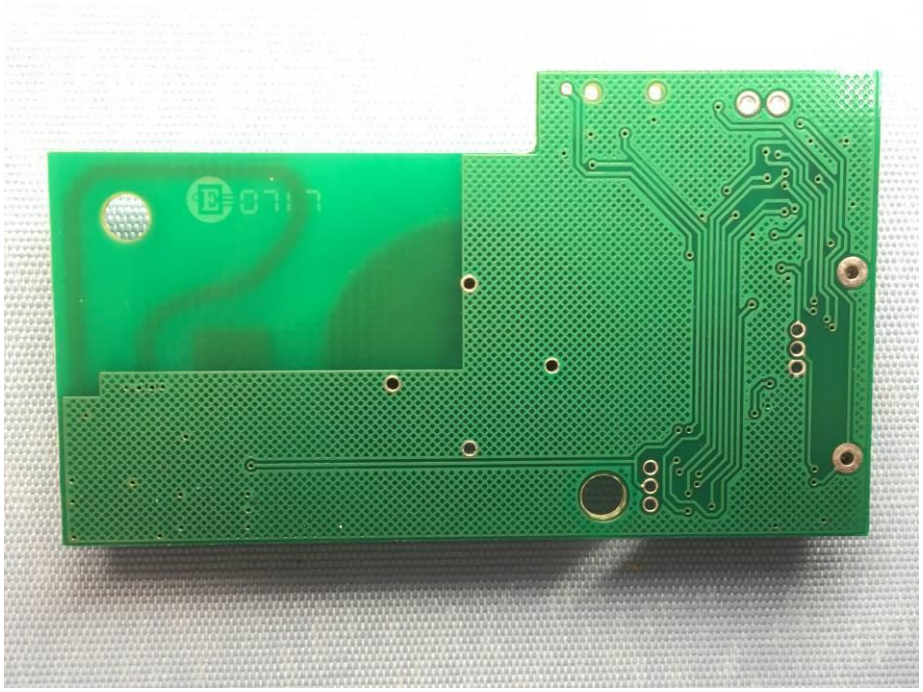

SENSA-M

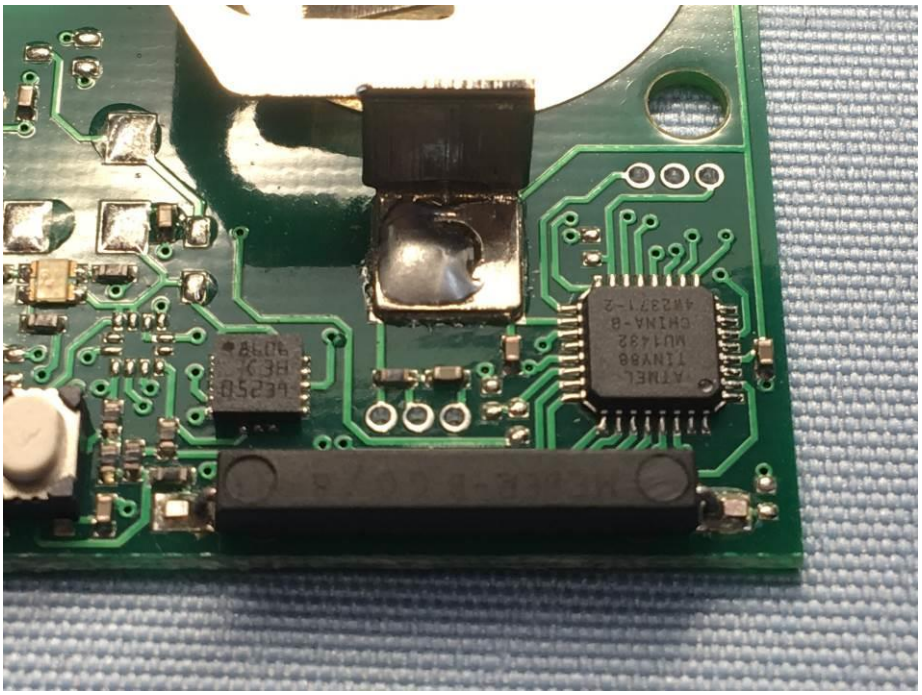


10.2 EUT - Internal Photos









======End of Report======