RADIO TESTREPORT

Report No: STS1902052W01

Issued for

Cao Gadgets, LLC

50 Tesla, Irvine, California 92618, United States

Product Name:	External Power Temp/RH/Lux Sensor
Brand Name:	Wireless Sensor Tag
Model Name:	ZGW15
Series Model:	N/A
FCC ID:	ZGW15
Test Standard:	FCC Part 15.231

Shenzhen STS Test Services Co., Ltd.
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TEST REPORT CERTIFICATION

Applicant's Name.....: Cao Gadgets, LLC

Address .....: 50 Tesla, Irvine, California 92618, United States

Manufacture's Name..... : Cao Gadgets, LLC

Address ..... : 50 Tesla, Irvine, California 92618, United States

Product Description

Product Name.....: External Power Temp/RH/Lux Sensor

Brand Name .....: Wireless Sensor Tag

Model Name .....: ZGW15

Series Model.....:

Test Standards.....: FCC Part 15.231

Test Procedure .....: ANSI C63.10-2013

This device described above has been tested by STS, 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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Date of Test .....:

Date of performance of tests.....: 20 Feb. 2019 ~ 29 Apr. 2019

Date of Issue .....: 30 Apr. 2019

Test Result.....: **Pass**

Testing Engineer : Chris Chen

(Chris Chen)

Technical Manager : Sunday Hu

(Sunday Hu)

Authorized Signatory : Vita Li

(Vita Li)

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	30 Apr. 2019	STS1902052W01	ALL	Initial Issue

1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:

FCC Part15.231,Subpart C			
Standard Section	Test Item	Judgment	Remark
15.207	Conducted Emission	PASS	--
15.205(a)/15.209/ 15.231.(b)	Radiated Spurious Emission	PASS	--
15.231(a)(1)/ 15.231(b)(2)	Transmission requirement	PASS	--
15.231(C)	20 dB Bandwidth	PASS	--
15.203	Antenna Requirement	PASS	--

NOTE:(1)"N/A" denotes test is not applicable in this Test Report

(2) All tests are according to ANSI C63.10-2013

1.1 TEST FACTORY

Shenzhen STS Test Services Co., Ltd.
1/F., Building B, Zhuoke Science Park, No.190, Chongqing Road,
Fuyong Street, Bao'an District, Shenzhen, Guangdong, China

FCC test Firm Registration Number: 625569

A2LA Certificate No.: 4338.01;

1.2 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** %.

No.	Item	Uncertainty
1	RF output power, conducted	±0.71dB
2	Unwanted Emissions, conducted	±0.63dB
3	All emissions, radiated 30-200MHz	±3.43dB
4	All emissions, radiated 200MHz-1GHz	±3.57dB
5	All emissions, radiated>1G	±4.13dB
6	Conducted Emission (9KHz-150KHz)	±3.18dB
7	Conducted Emission (150KHz-30MHz)	±2.70dB

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	External Power Temp/RH/Lux Sensor
Trade Name	Wireless Sensor Tag
Model Name	ZGW15
Series Model	N/A
Model Difference	N/A
Frequency band	431.04~439.36MHz
Adapter	Input :100-240V,100mA,50/60Hz Output: DC 5V,550mA
Modulation Type	FSK
Hardware version number	N/A
Software version number	N/A

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications orthe User's Manual.

2. Table for filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	Wireless Sensor Tag	ZGW15	PCB	N/A	0	Antenna

3.Channel list

channel	Frequency(MHz)	channel	Frequency(MHz)	channel	Frequency(MHz)
01	431.04	….	….	95	438.56
02	431.12	….	….	96	438.64
03	431.20	….	….	97	438.72
04	431.28	….	….	98	438.80
05	431.36	51	435.04	99	438.88
06	431.44	52	435.12	100	438.96
07	431.52	53	435.20	101	439.04
08	431.60	54	435.28	102	439.12
09	431.68	….	….	103	439.20
10	431.76	….	….	104	439.28
11	431.84	….	….	105	439.36

4. Test channel

Test channel	Frequency(MHz)
01	431.04
53	435.28
105	439.36

2.2 DESCRIPTION OF THE TEST MODES

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 above was evaluated respectively.

Pretest Mode	Description
Mode 1	TX Mode(Low Channel)
Mode 2	TX Mode(Middle Channel)
Mode 3	TX Mode(High Channel)

	For Radiated Emission
Final Test Mode	Description
Mode 1	TX Mode(Low Channel)
Mode 2	TX Mode(Middle Channel)
Mode 3	TX Mode(High Channel)

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

During test, Keep EUT is in continuous transmission mode, Both open button and closed button have been tested, The two keys were tested to assess and only record the worst case in the report (Open botton).

2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

Necessary accessories

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note
E2	Adapter	Phihong	PSM03A-050Q-3	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note
S1	Controller	Wireless Sensor Tag	ZGW04	N/A	N/A

Note:

(1)The support equipment was authorized by Declaration of Confirmation.

(2)For detachable type I/O cable should be specified the length in cm in『Length』column.

2.5 EQUIPMENTS LIST

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2018.10.13	2019.10.12
Signal Analyzer	Agilent	N9020A	MY51110105	2019.03.02	2020.03.01
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.1
Horn Antenna	SCHWARZBECK	BBHA 9120D(1201)	9120D-1343	2018.10.19	2021.10.18
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2018.03.11	2021.03.10
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2018.10.13	2019.10.12
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2018.10.13	2019.10.12
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11	2019.10.10
turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2018.10.13	2019.10.12
LISN	R&S	ENV216	101242	2018.10.11	2019.10.10
LISN	EMCO	3810/2NM	23625	2018.10.11	2019.10.10
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11	2019.10.10

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2018.10.13	2019.10.12
Signal Analyzer	Agilent	N9020A	MY49100060	2018.10.13	2019.10.12
Temperature & Humidity	HH660	Mieo	N/A	2018.10.11	2019.10.10

Note: 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.

3. EMC EMISSION TEST

3.1 CONDUCTED EMISSION MEASUREMENT

3.1.1 POWER LINE CONDUCTED EMISSION LIMITS

Operating frequency band. In case the emission fall within the restricted band specified on Part 15. 207(a) limit in the table below has to be followed.

FREQUENCY (MHz)	Class B (dBuV)		Standard
	Quasi-peak	Average	
0.15 -0.5	66 - 56 *	56 - 46 *	CISPR
0.50 -5.0	56.00	46.00	CISPR
5.0 -30.0	60.00	50.00	CISPR

0.15 -0.5	66 - 56 *	56 - 46 *	FCC
0.50 -5.0	56.00	46.00	FCC
5.0 -30.0	60.00	50.00	FCC

Note:

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

(2) The limit of " * " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

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

3.2 TEST PROCEDURE

a. 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.

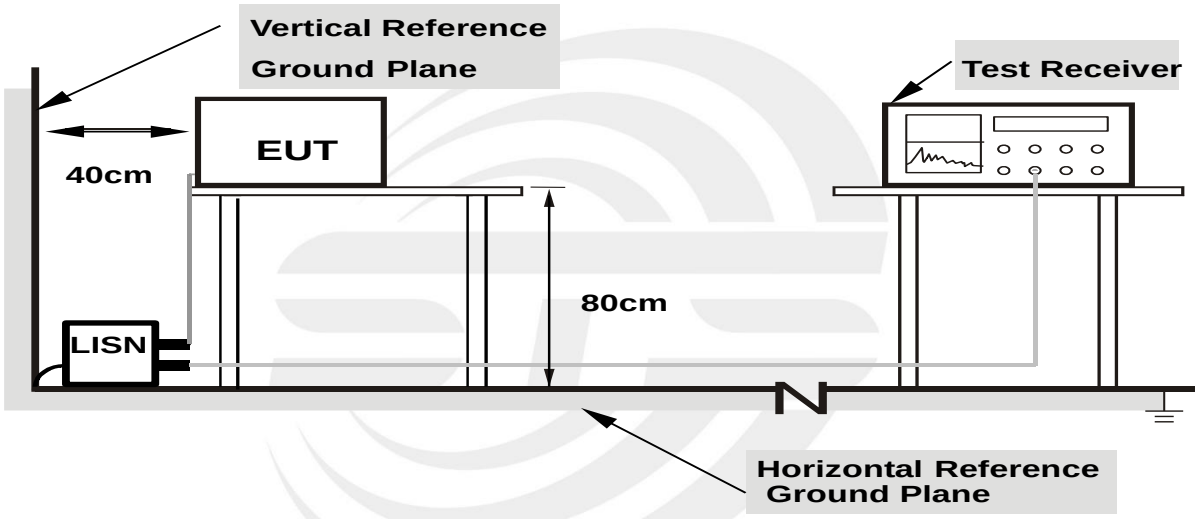
b. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

c. 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.

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

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

3.3 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

3.4 EUT OPERATING CONDITIONS

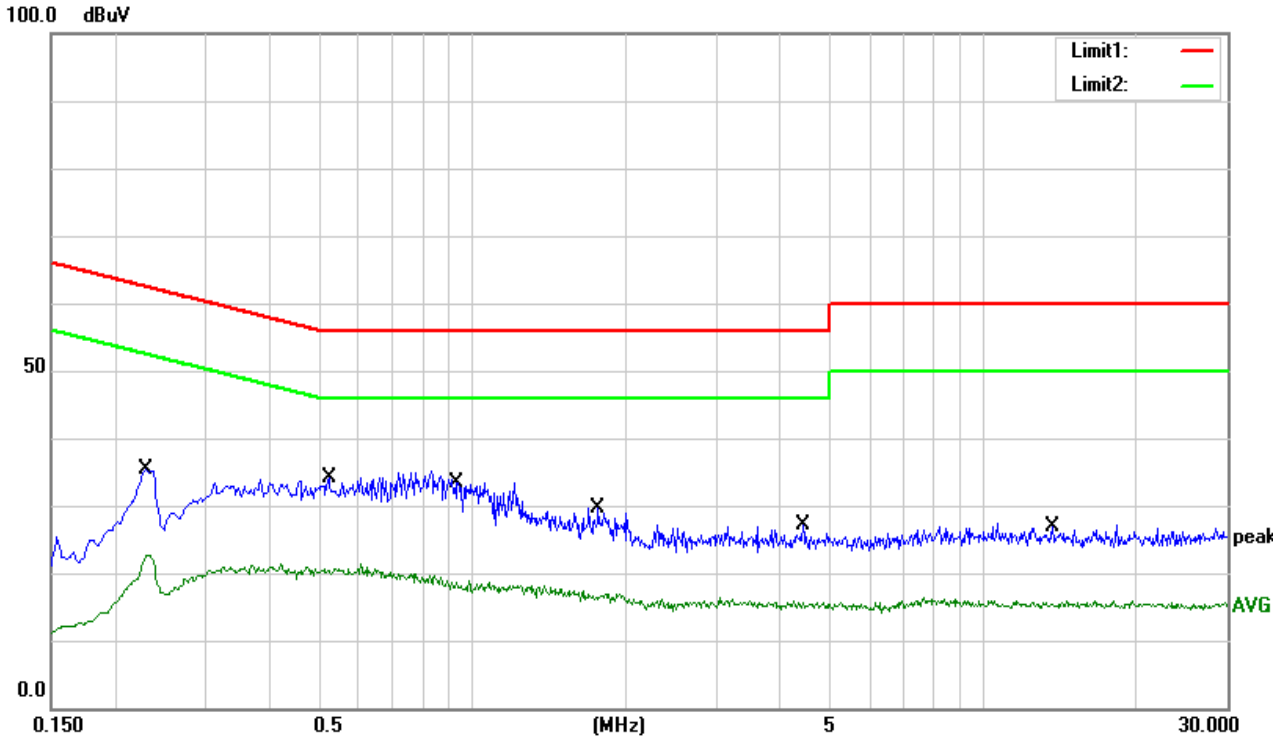
The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

3.5 TEST RESULTS

Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase :	L
Test Mode:	Mode1		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.2300	15.02	20.38	35.40	62.45	-27.05	QP
0.2300	2.01	20.38	22.39	52.45	-30.06	AVG
0.5260	13.71	20.45	34.16	56.00	-21.84	QP
0.5260	0.98	20.45	21.43	46.00	-24.57	AVG
0.9340	13.22	20.18	33.40	56.00	-22.60	QP
0.9340	-1.61	20.18	18.57	46.00	-27.43	AVG
1.7660	9.58	20.08	29.66	56.00	-26.34	QP
1.7660	-3.09	20.08	16.99	46.00	-29.01	AVG
4.4540	7.22	19.95	27.17	56.00	-28.83	QP
4.4540	-4.27	19.95	15.68	46.00	-30.32	AVG
13.6260	6.91	20.01	26.92	60.00	-33.08	QP
13.6260	-4.15	20.01	15.86	50.00	-34.14	AVG

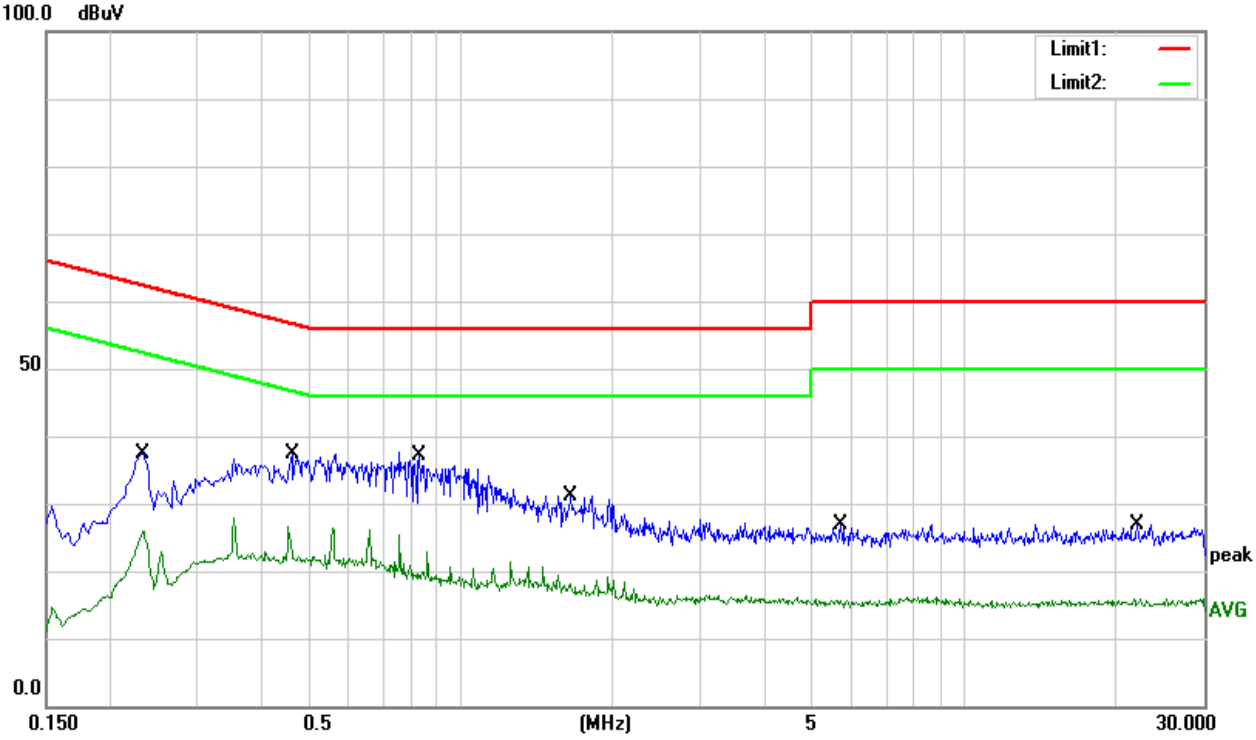
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit



Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase :	N
Test Mode:	Mode1		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.2340	17.02	20.40	37.42	62.31	-24.89	QP
0.2340	4.81	20.40	25.21	52.31	-27.10	AVG
0.4620	17.00	20.48	37.48	56.66	-19.18	QP
0.4620	5.86	20.48	26.34	46.66	-20.32	AVG
0.8300	16.79	20.22	37.01	56.00	-18.99	QP
0.8300	2.54	20.22	22.76	46.00	-23.24	AVG
1.6620	10.93	20.10	31.03	56.00	-24.97	QP
1.6620	-1.05	20.10	19.05	46.00	-26.95	AVG
5.7060	6.97	19.91	26.88	60.00	-33.12	QP
5.7060	-3.67	19.91	16.24	50.00	-33.76	AVG
22.0780	7.13	19.72	26.85	60.00	-33.15	QP
22.0780	-3.81	19.72	15.91	50.00	-34.09	AVG

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit



Note: All modes has been tested, only show the worst case, the worst case is mode 1.

4. RADIATED EMISSION MEASUREMENT

4.1 RADIATED EMISSION LIMITS

In case the emission fall within the restricted band specified on Part 15.205(a), then the Part 15.209(a)and Part 15.231(b) limit in the table below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (0.009MHz - 1000MHz)

Frequencies (MHz)	Field Strength (micorvolts/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
30~40.66	100	3
40.70~70	100	3

Fundamental Frequency (MHz)	Field Strength of fundamental (microvolts/meter)	Field Strength of Unwanted Emissions (microvolts/meter)
40.66~40.70	2,250	225
70~130	1,250	125
130~174	1,250 to 3,750**	125 to 375**
174~260	3750	375
260~470	3,750 to 12,500**	375 to 1,250**
Above 470	12,500	1,250

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Class B (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

NOTE:
(1)The limit for radiated test was performed according to FCC PART 15C.
(2)Emission level (dBuV/m)=20log Emission level (uV/m).

Spectrum Parameter	Setting
Detector	Peak
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (emission in restricted band)	1MHz / 3MHz

Receiver Parameter	**Setting**
Attenuation	Auto
Start ~ Stop Frequency	9kHz~90kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	90kHz~110kHz / RB 200Hz for QP
Start ~ Stop Frequency	110kHz~490kHz / RB 200Hz for PK & AV
Start ~ Stop Frequency	490kHz~30MHz / RB 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RB 120kHz for QP

4.2 TEST PROCEDURE

a. The test is performed in a 3m Semi-Anechoic Chamber; the antenna factor, cable loss and so on of the site (factors) is calculated to correct the reading.The EUT is placed on a 0.8m high insulating Turn Table, and keeps 3m away from theTest Antenna, which is mounted onavariable-height antenna master tower.
During test,The table was rotated 360 degrees to determine the position of the highest radiation.

b. In the frequency range of 9KHz to 30MHz, magnetic field is measured with Loop Test Antenna. The Test Antenna is positioned with its plane vertical at 1m distance from the EUT. The center of the Loop Test Antenna is 1m above the ground. During the measurement the Loop Test Antenna rotates about its vertical axis for maximum response at each azimuth about the EUT.

c. In the frequency range 30MHz-1GHz, Bi-Log Test Antenna used. Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength. The emission levels at both horizontal and vertical polarizations should be tested.

d. In the frequency above1GHz,Place the measurement antenna 3m away from the EUT for each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

f. 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.

g. If the Peak Mode measured value compliance with and lower than Quasi Peak Mode Limit, the EUT shall be deemed to meet QP Limits and then no additional QP Mode measurement performed.

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

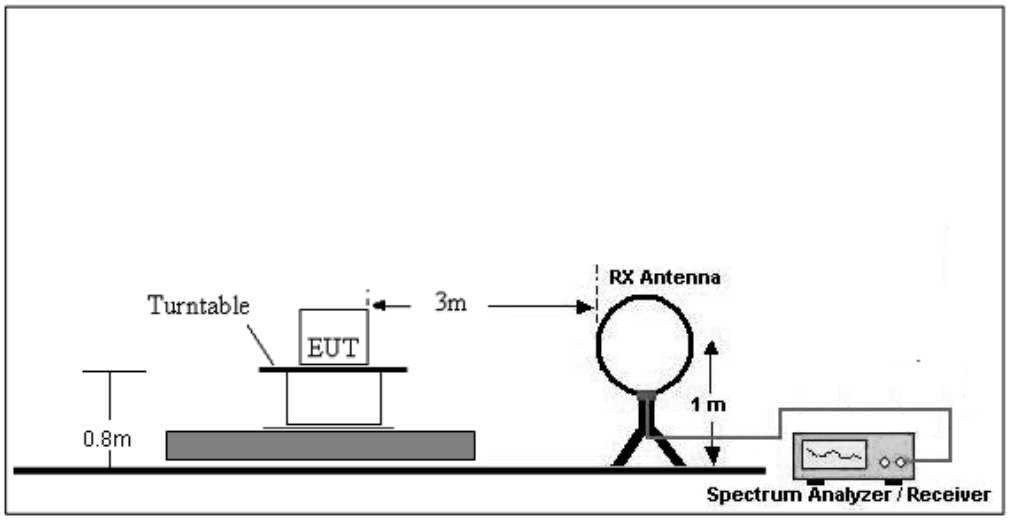
Both horizontal and vertical antenna polarities and performed pretest to three orthogonal axis were tested. The worst case emissions were reported

4.3 DEVIATION FROM TEST STANDARD

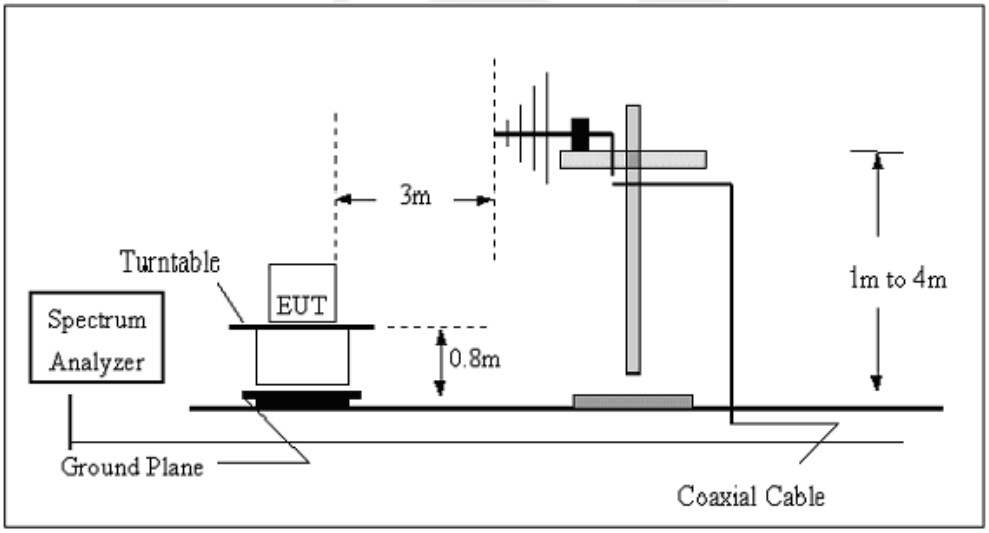
No deviation

4.4 TEST SETUP

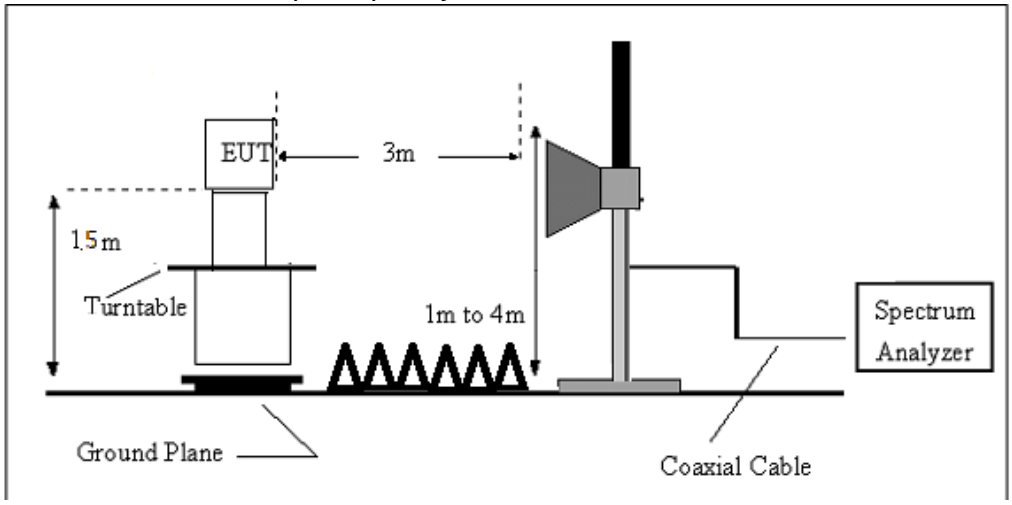
（A）Radiated Emission Test-Up Frequency Below 30MHz



（B）Radiated Emission Test-Up Frequency 30MHz~1GHz



（C）Radiated Emission Test-Up Frequency Above 1GHz



4.5 EUT OPERATING CONDITIONS

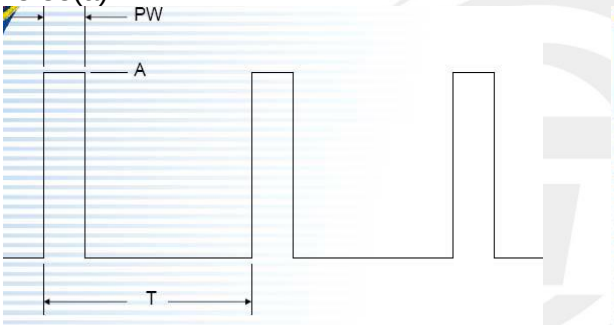
The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

4.6 TEST RESULTS

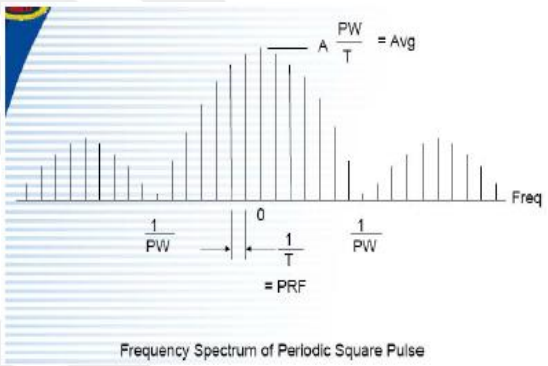
INTRODUCTION TO PDCF

Reference: (§15.35 Measurement detector functions and bandwidths.)

a. Part 15 of the FCC Rules provides for the operation of low power communication devices without an individual license (e.g., intrusion detectors, pulsed water tank level gauges, etc.), subject to certain requirements. Some of these devices use extremely narrow pulses to generate wideband emissions, which are measured to determine compliance with the rules. These measurements are typically performed with a receiver or spectrum analyzer. Depending on a number of factors (e.g., resolution bandwidth, pulsewidth, etc.), the spectrum analyzer may not always display the true peak value of the measured emission. This effect, called "pulse desensitization," relates to the capabilities of the measuring instrument. For the measurement and reporting of the true peak of pulsed emissions, it may be necessary to apply a "pulse desensitization correction factor" (PDCF) to the measured value, pursuant to 47 CFR 15.35(a).



Periodic Square Pulse



Frequency Spectrum of Periodic Square Pulse

If using spectrum analyzer to measure pulse signal, it have to make sure the RBW use is at least 2/PW.

•When RBW is less than 2/PW, you are able to measure the true peak level of the pulse signal. If this is the case, PDCF is required to compensate to determine true peak value.

Pulse desensitization:

For 431.04MHz:

PW =36200usec,Period=100000usec, Level=A ;RBW>2/PW=0.055K , 1/T=0.01K

For 435.28MHz:

PW =35900usec,Period=100000usec, Level=A ;RBW>2/PW=0.056K , 1/T=0.02K

For 439.36MHz:

PW =35900usec,Period=100000usec, Level=A ;RBW>2/PW=0.056K , 1/T=0.02K

NOTE: 2 / PW < RBW, first don't need

b. For the actual test, please refer to the ANSI C63.10,Annex C
refer to section 6. for more detail

4.7 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting theAmplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where

FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

For example

Frequency	FS	RA	AF	CL	AG	Factor
(MHz)	(dBμV/m)	(dBμV/m)	(dB)	(dB)	(dB)	(dB)
300	40	58.1	12.2	1.6	31.9	-18.1

Factor=AF+CL-AG

4.8TEST RESULTS

(Radiated Emission<30MHz (9KHz-30MHz, H-field))

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.

Between 30MHz – 5000 MHz

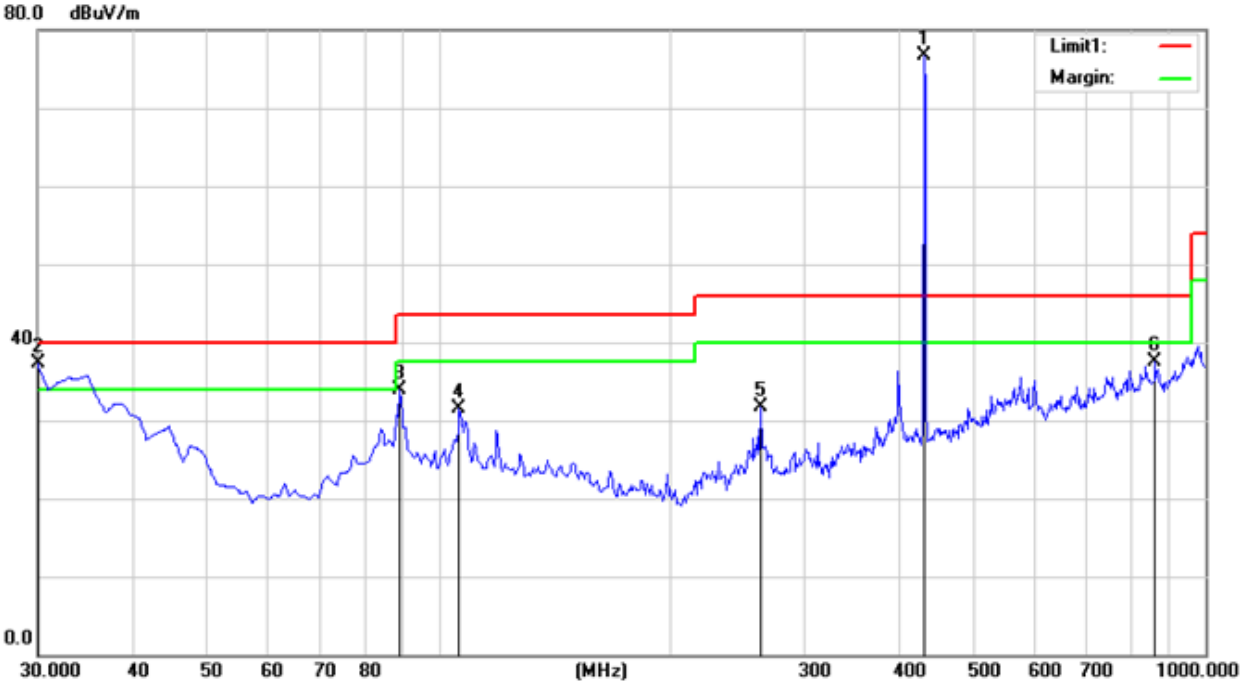
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Horizontal
Test Mode:	Mode 1		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
2	30.0000	52.53	-15.32	NA	37.21	40.00	-2.79	QP
3	89.1700	58.09	-24.28	NA	33.81	43.50	-9.69	QP
4	106.6300	53.79	-22.22	NA	31.57	43.50	-11.93	QP
5	263.7700	49.57	-17.96	NA	31.61	46.00	-14.39	QP
6	862.0800	41.70	-4.14	NA	37.56	80.72	-43.16	Peak
8	862.0800	37.56	NA	-8.83	28.73	60.72	-31.99	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	431.0400	90.53	-13.91	NA	76.62	100.72	-24.10	peak
7	431.0400	76.62	NA	-8.83	67.79	80.72	-12.93	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



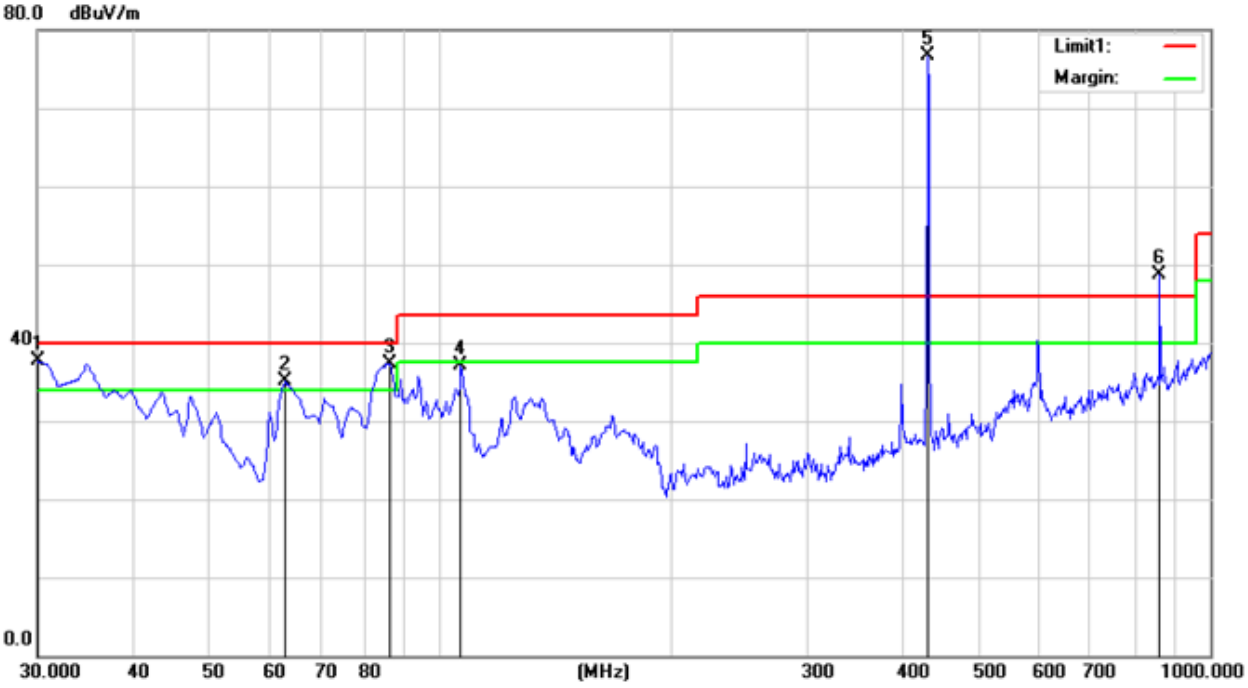
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Vertical
Test Mode:	Mode 1		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	30.0000	52.96	-15.32	NA	37.64	40.00	-2.36	QP
2	62.9800	63.13	-28.09	NA	35.04	40.00	-4.96	QP
3	86.2600	61.91	-24.64	NA	37.27	40.00	-2.73	QP
4	106.6300	59.27	-22.22	NA	37.05	43.50	-6.45	QP
6	862.0800	52.93	-4.14	NA	48.79	80.72	-31.93	peak
8	862.0800	48.79	NA	-8.83	39.96	60.72	-20.76	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
5	431.0400	90.54	-13.91	NA	76.63	100.72	-24.09	peak
7	431.0400	76.63	NA	-8.83	67.8	80.72	-12.92	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



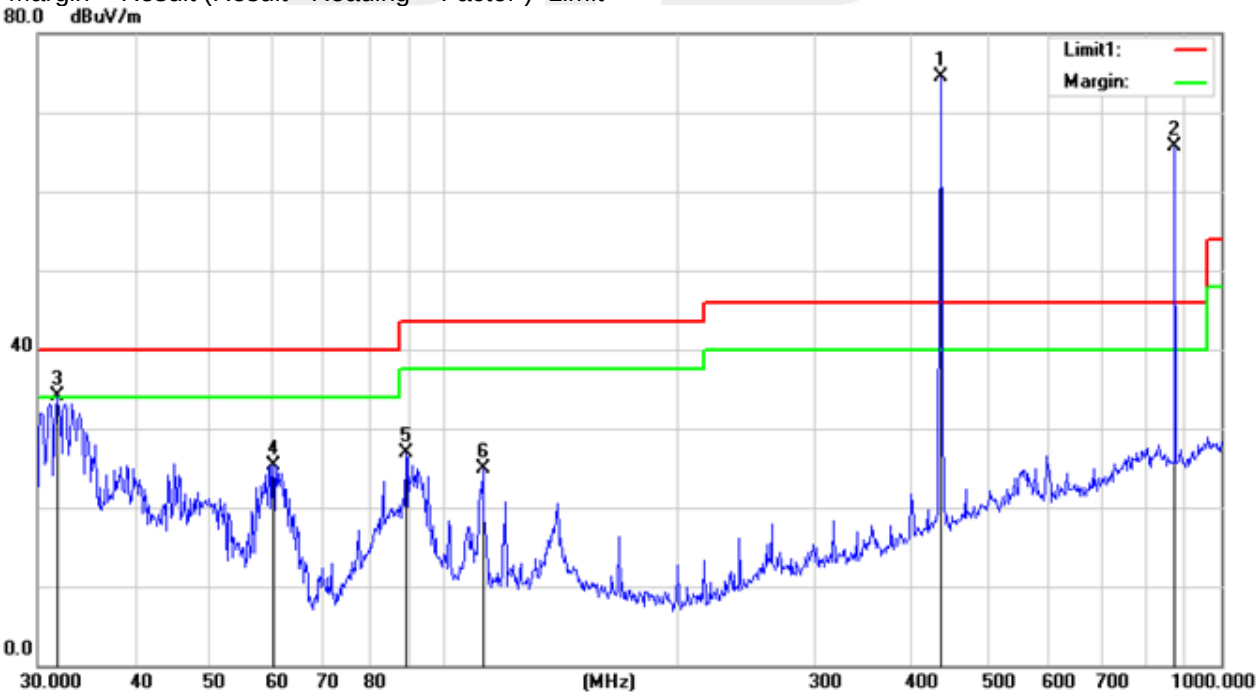
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Horizontal
Test Mode:	Mode 2		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
3	31.8427	46.26	-12.14	NA	34.12	40.00	-5.88	QP
4	60.2800	49.69	-24.33	NA	25.36	40.00	-14.64	QP
5	89.2762	47.18	-20.37	NA	26.81	43.50	-16.69	QP
6	112.1303	43.01	-18.20	NA	24.81	43.50	-18.69	QP
2	870.5600	68.22	-2.59	NA	65.63	80.88	-15.25	peak
8	870.5600	65.63	NA	-8.90	56.73	60.88	-4.15	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	435.2800	85.30	-10.89	NA	74.41	100.88	-26.47	peak
7	435.2800	74.41	NA	-8.90	65.51	80.88	-15.37	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



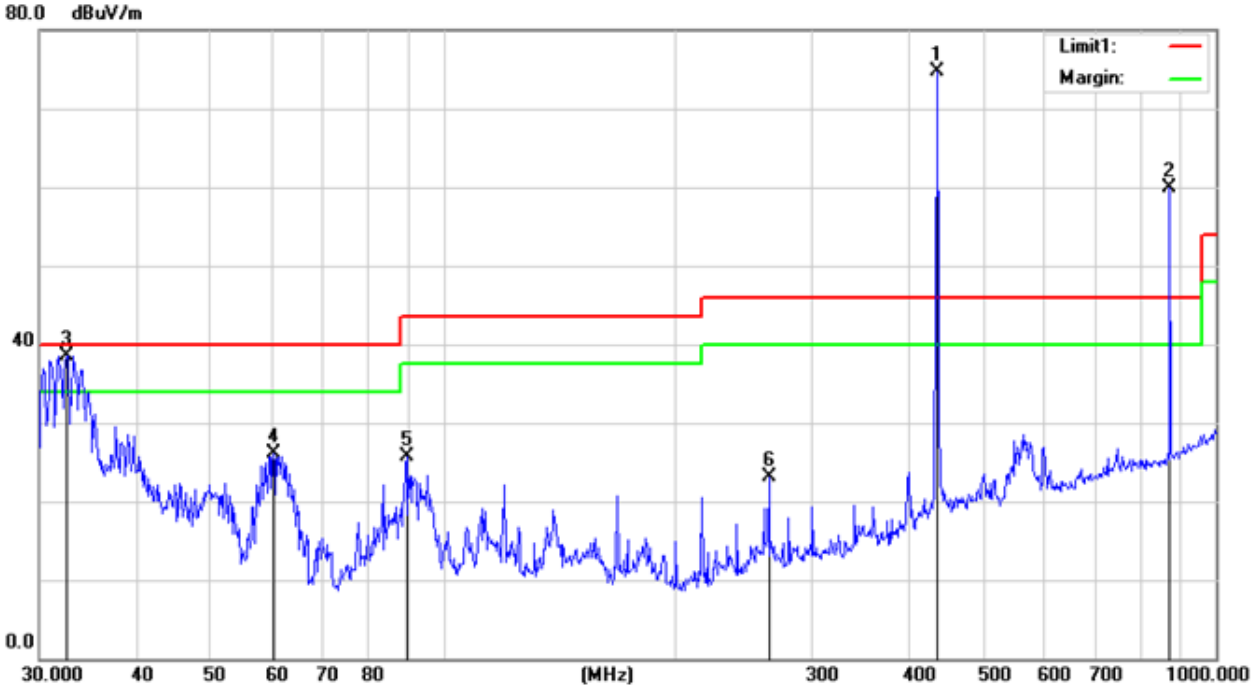
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Vertical
Test Mode:	Mode 2		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
3	32.5197	51.06	-12.48	NA	38.58	40.00	-1.42	QP
4	60.2800	50.35	-24.33	NA	26.02	40.00	-13.98	QP
5	89.5900	46.07	-20.30	NA	25.77	43.50	-17.73	QP
6	263.8190	38.26	-15.22	NA	23.04	46.00	-22.96	QP
2	870.5600	62.49	-2.59	NA	59.90	80.88	-20.98	peak
8	870.5600	59.90	NA	-8.90	51	60.88	-9.88	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	435.2800	85.67	-10.89	NA	74.78	100.88	-26.10	peak
7	435.2800	74.78	NA	-8.90	65.88	80.88	-15.00	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



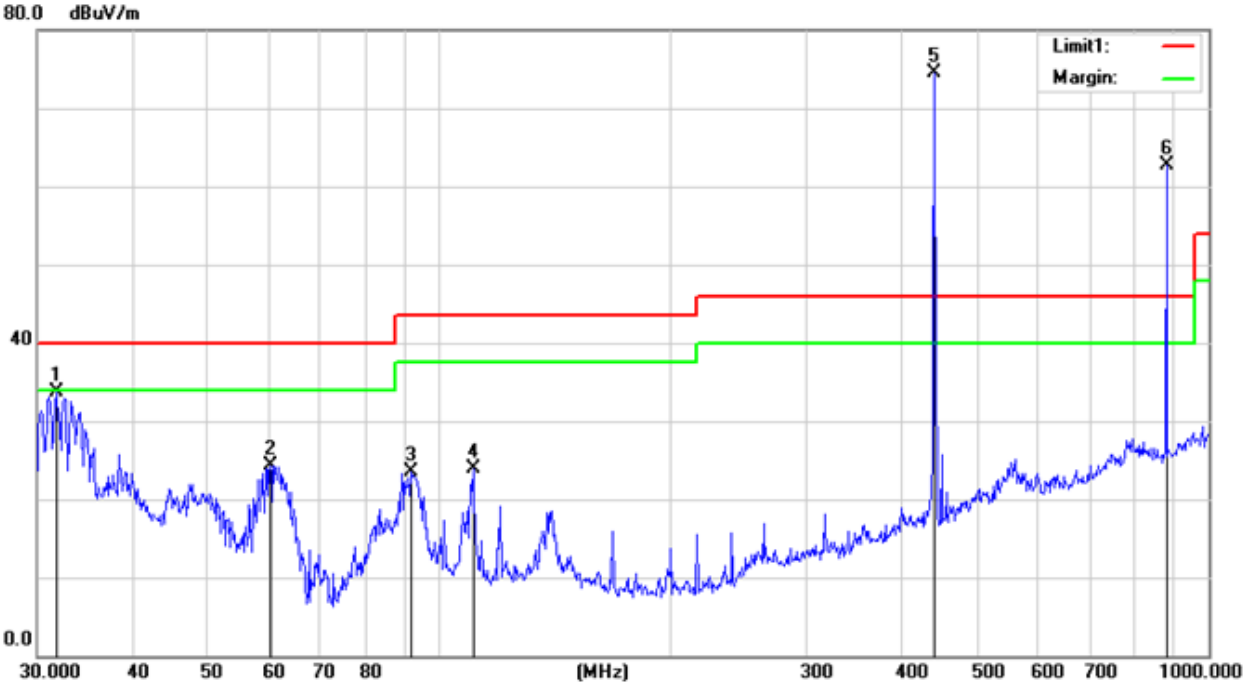
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Horizontal
Test Mode:	Mode 3		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	31.7313	45.71	-12.08	NA	33.63	40.00	-6.37	QP
2	60.2800	48.72	-24.33	NA	24.39	40.00	-15.61	QP
3	91.8161	43.59	-20.02	NA	23.57	43.50	-19.93	QP
4	110.5687	42.26	-18.31	NA	23.95	43.50	-19.55	QP
6	878.7200	65.27	-2.51	NA	62.76	81.03	-18.27	Peak
8	878.7200	62.76	NA	-8.83	53.93	61.03	-7.10	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
5	439.3600	85.46	-10.89	NA	74.57	101.03	-26.73	peak
7	439.3600	74.57	NA	-8.83	65.74	81.03	-15.29	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



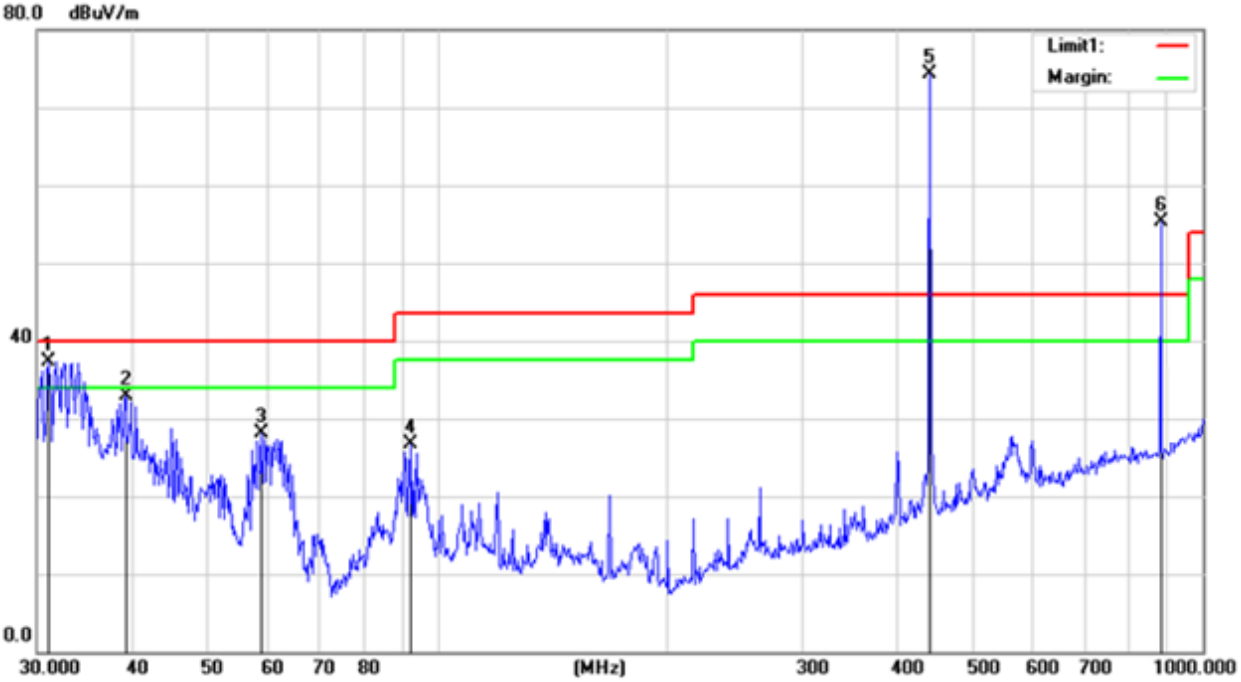
Temperature:	26 ℃	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	Vertical
Test Mode:	Mode 3		

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	31.0702	49.09	-11.74	NA	37.35	40.00	-2.65	QP
2	39.1613	48.80	-15.89	NA	32.91	40.00	-7.09	QP
3	58.8185	52.08	-24.00	NA	28.08	40.00	-11.92	QP
4	92.4624	46.58	-19.95	NA	26.63	43.50	-16.87	QP
6	878.7200	57.85	-2.51	NA	55.34	81.03	-25.69	peak
8	878.7200	55.34	NA	-8.83	46.51	61.03	-14.52	AV

Fundamental Frequency

No.	Frequency	Reading	Correct	Duty cycle	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB/m)	(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
5	439.3600	85.26	-10.88	NA	74.38	101.03	-26.65	peak
7	439.3600	74.38	NA	-8.83	65.55	81.03	-15.48	AV

Remark:
1. All readings are Quasi-Peak and Average values.
2. Margin = Result (Result =Reading + Factor)–Limit



PEAK TEST RESULTS:

Mode 1: 431.04MHz

Frequency	Reading	Detector	Amplifier	Loss	Antenna Factor	Corrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	（dB）	（dB）	（dB）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1293.17	65.21	PK	45.1	4.0	25.1	-16.00	49.21	74	-24.79	H
1293.17	65.73	PK	45.1	4.0	25.1	-16.00	49.73	74	-24.27	V
1724.19	63.07	PK	44.1	5.3	25	-13.80	49.27	74	-24.73	H
1724.19	64.16	PK	44.1	5.3	25	-13.80	50.36	74	-23.64	V
2155.17	61.35	PK	43.8	5.4	25.9	-12.47	48.88	74	-25.12	H
2155.17	62.08	PK	43.8	5.4	25.9	-12.47	49.61	74	-24.39	V
2586.44	57.09	PK	44.4	6.0	27.6	-10.77	46.32	74	-27.68	H
2586.44	57.52	PK	44.4	6.0	27.6	-10.77	46.75	74	-27.25	V

Note: 1. Correded Factor=Antenna Factor+Loss-Amplifier

2. Corrected Amplitude= Reading+ Corrected Factor

3. Above 2.6 GHz The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

AVG TEST RESULTS:

AV = Peak +20Log10(duty cycle) =PK+(-8.83) [refer to section 6 for more detail]

Frequency	PK Reading	Duty cycle Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
					Limit	Margin	Polar
(MHz)	(dBμV/m)	(dB)	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1293.17	65.21	-8.83	-16.00	40.38	54	-13.62	H
1293.17	65.73	-8.83	-16.00	40.90	54	-13.10	V
1724.19	63.07	-8.83	-13.80	40.44	54	-13.56	H
1724.19	64.16	-8.83	-13.80	41.53	54	-12.47	V
2155.17	61.35	-8.83	-12.47	40.05	54	-13.95	H
2155.17	62.08	-8.83	-12.47	40.78	54	-13.22	V
2586.44	57.09	-8.83	-10.77	37.49	54	-16.51	H
2586.44	57.52	-8.83	-10.77	37.92	54	-16.08	V

Mode 2:435.28MHz

Frequency	Reading	Detector	Amplifier	Loss	Antenna Factor	Corrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	（dB）	（dB）	（dB）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1305.87	65.17	PK	45.1	4.0	25.1	-16.00	49.17	74	-24.83	H
1305.87	65.71	PK	45.1	4.0	25.1	-16.00	49.71	74	-24.29	V
1741.38	62.87	PK	44.1	5.3	25	-13.80	49.07	74	-24.93	H
1741.38	64.46	PK	44.1	5.3	25	-13.80	50.66	74	-23.34	V
2176.38	61.73	PK	43.8	5.4	25.9	-12.47	49.26	74	-24.74	H
2176.38	62.23	PK	43.8	5.4	25.9	-12.47	49.76	74	-24.24	V
2611.63	57.19	PK	44.4	6.0	27.6	-10.77	46.42	74	-27.58	H
2611.63	57.27	PK	44.4	6.0	27.6	-10.77	46.50	74	-27.50	V

Note: 1. Correded Factor=Antenna Factor+Loss-Amplifier
2. Corrected Amplitude= Reading+ Corrected Factor
3. Above 2.6 GHz The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

AVG TEST RESULTS:

AV = Peak +20Log10(duty cycle) =PK+(-8.9) [refer to section 6 for more detail]

Frequency	PK Reading	Duty cycle Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
					Limit	Margin	Polar
(MHz)	(dBμV/m)	(dB)	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1305.87	65.17	-8.9	-16.00	40.27	54	-13.73	H
1305.87	65.71	-8.9	-16.00	40.81	54	-13.19	V
1741.38	62.87	-8.9	-13.80	40.17	54	-13.83	H
1741.38	64.46	-8.9	-13.80	41.76	54	-12.24	V
2176.38	61.73	-8.9	-12.47	40.36	54	-13.64	H
2176.38	62.23	-8.9	-12.47	40.86	54	-13.14	V
2611.63	57.19	-8.9	-10.77	37.52	54	-16.48	H
2611.63	57.27	-8.9	-10.77	37.60	54	-16.40	V

Mode 3:439.36MHz

Frequency	Reading	Detector	Amplifier	Loss	Antenna Factor	Corrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
								Limit	Margin	Polar
(MHz)	(dBμV/m)	(PK/QP/AV)	（dB）	（dB）	（dB）	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1318.1	65.04	PK	45.1	4.0	25.1	-16.00	49.04	74	-24.96	H
1318.1	65.43	PK	45.1	4.0	25.1	-16.00	49.43	74	-24.57	V
1757.35	62.87	PK	44.1	5.3	25	-13.80	49.07	74	-24.93	H
1757.35	64.49	PK	44.1	5.3	25	-13.80	50.69	74	-23.31	V
2196.94	61.41	PK	43.8	5.4	25.9	-12.47	48.94	74	-25.06	H
2196.94	61.90	PK	43.8	5.4	25.9	-12.47	49.43	74	-24.57	V
2636.41	56.87	PK	44.4	6.0	27.6	-10.77	46.10	74	-27.90	H
2636.41	57.48	PK	44.4	6.0	27.6	-10.77	46.71	74	-27.29	V

Note: 1. Correded Factor=Antenna Factor+Loss-Amplifier
2. Corrected Amplitude= Reading+ Corrected Factor
3. Above 2.6 GHz The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

AVG TEST RESULTS:

AV = Peak +20Log10(duty cycle) =PK+(-8.9) [refer to section 6 for more detail]

Frequency	PK Reading	Duty cycle Factor	Orrected Factor	Corrected Amplitude	FCC Part 15.231/15.209/205		RX Antenna
					Limit	Margin	Polar
(MHz)	(dBμV/m)	(dB)	（dB）	(dBμV/m)	(dBμV/m)	(dB)	(H/V)
1318.10	65.04	-8.9	-16.00	40.14	54	-13.86	H
1318.10	65.43	-8.9	-16.00	40.53	54	-13.47	V
1757.35	62.87	-8.9	-13.80	40.17	54	-13.83	H
1757.35	64.49	-8.9	-13.80	41.79	54	-12.21	V
2196.94	61.41	-8.9	-12.47	40.04	54	-13.96	H
2196.94	61.90	-8.9	-12.47	40.53	54	-13.47	V
2636.41	56.87	-8.9	-10.77	37.20	54	-16.80	H
2636.41	57.48	-8.9	-10.77	37.81	54	-16.19	V

5. BANDWIDTH TEST

5.1 LIMIT

FCC Part15.231,Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.231(C)	20 Bandwidth	The20dB bandwidth of the emissions shall not exceed 0.25% of the center frequency	431.04-439.36	PASS

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth
RB	10 kHz (20dB Bandwidth)
VB	30 kHz (20dB Bandwidth)
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

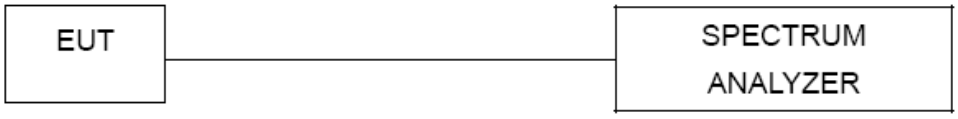
5.2 TEST REQUIREMENTS

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. Bandwidth is determined at the points 20 dB down from the modulated carrier.

5.3 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 10KHz, VBW=30KHz, Sweep time = Auto.

5.4 TEST SETUP



5.5 EUT OPERATION CONDITIONS

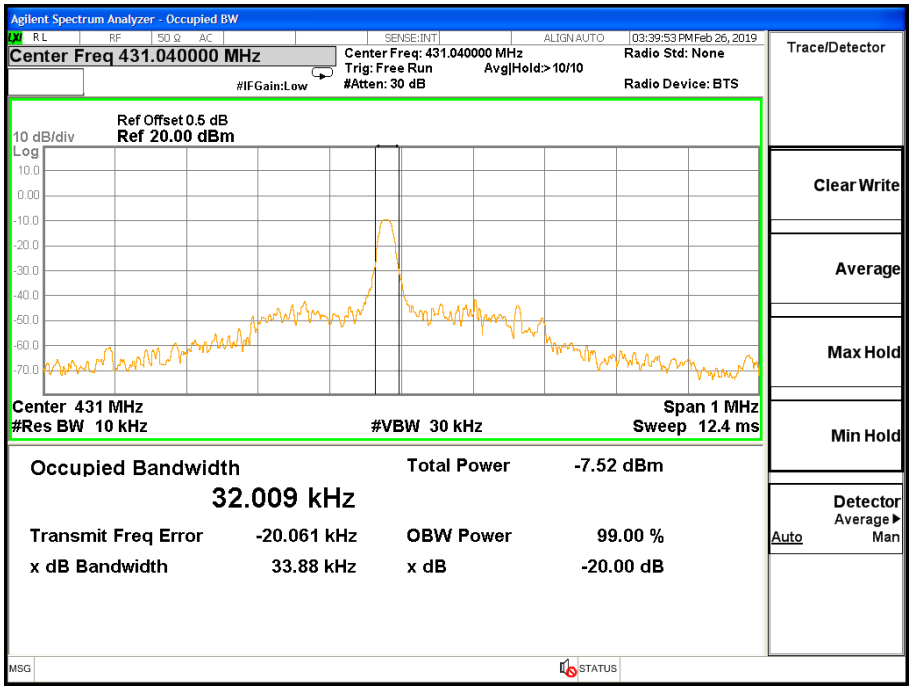
TX mode.

5.6 TEST RESULTS

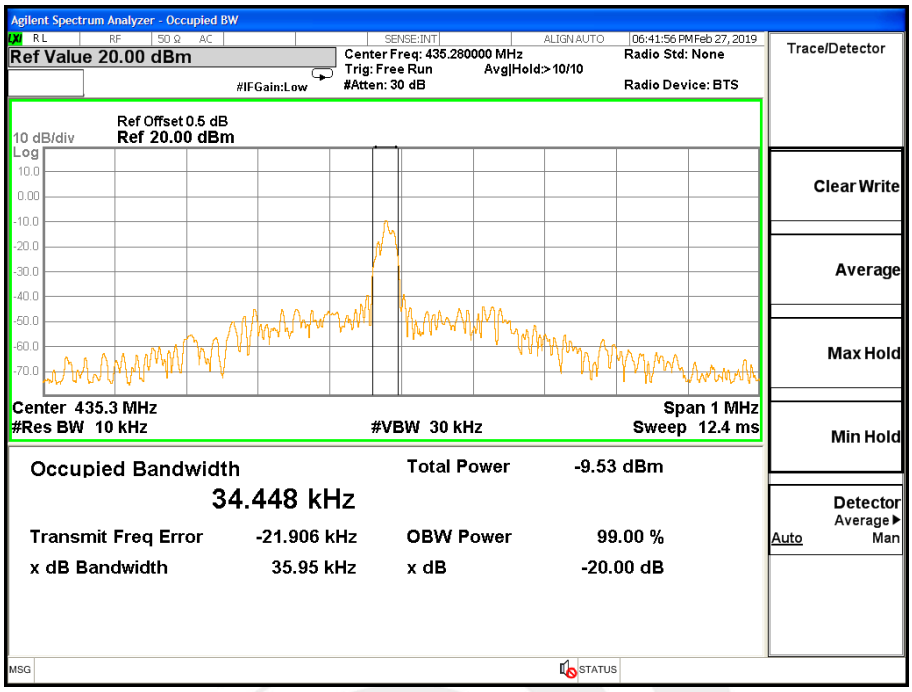
For send acknowledgement to Tag Manager

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
431.04 MHz	33.88	1077.6	PASS
435.28 MHz	35.95	1088.2	PASS
439.36 MHz	35.10	1098.4	PASS

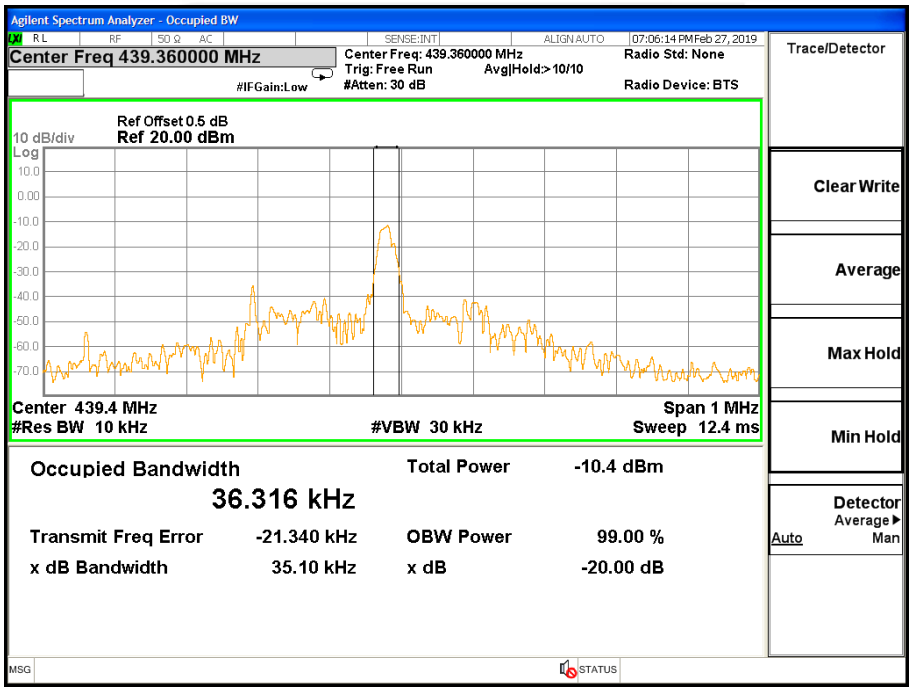
431.04 MHz



435.28 MHz



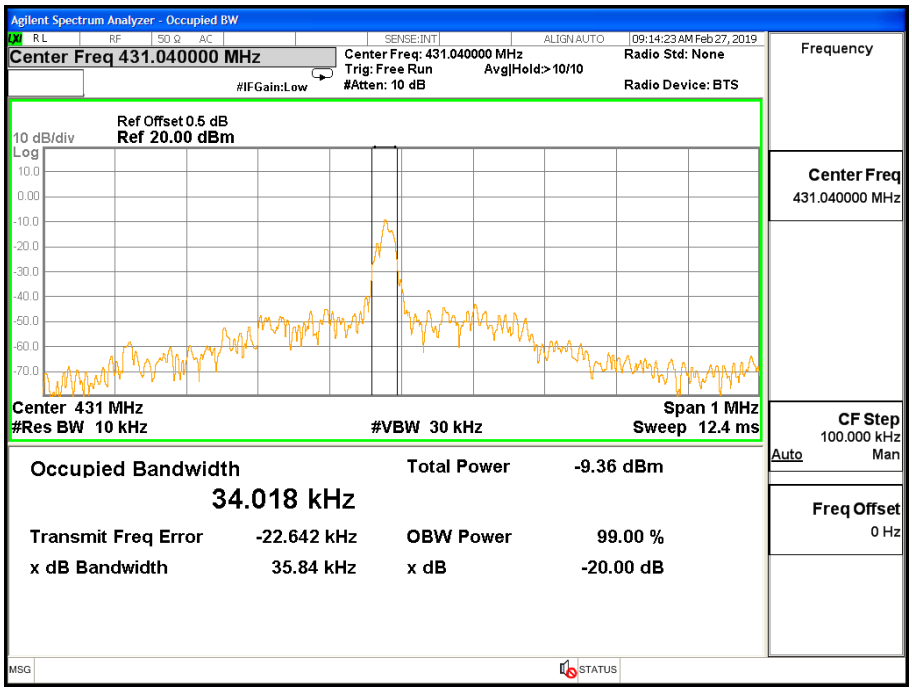
439.36 MHz



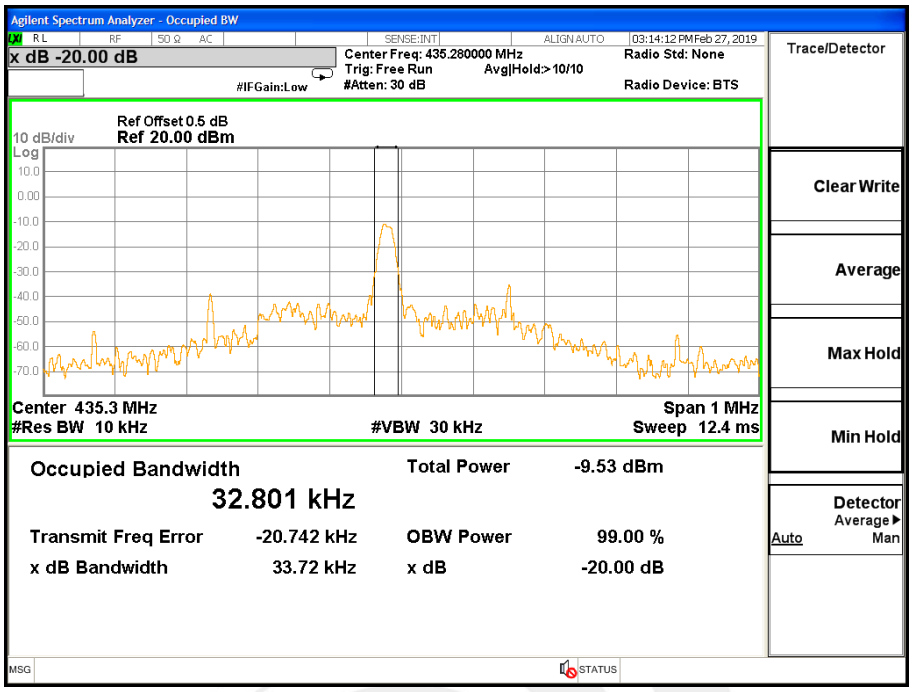
For transmit the entire sensor reading information

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
431.04 MHz	35.84	1077.6	PASS
435.28 MHz	33.72	1088.2	PASS
439.36 MHz	34.14	1098.4	PASS

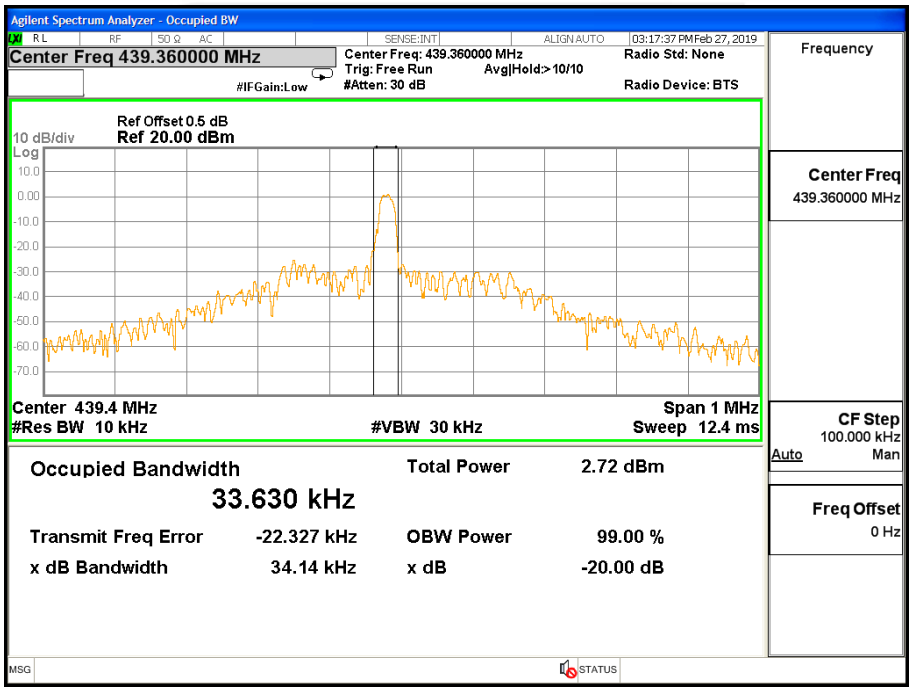
431.04 MHz



435.28 MHz



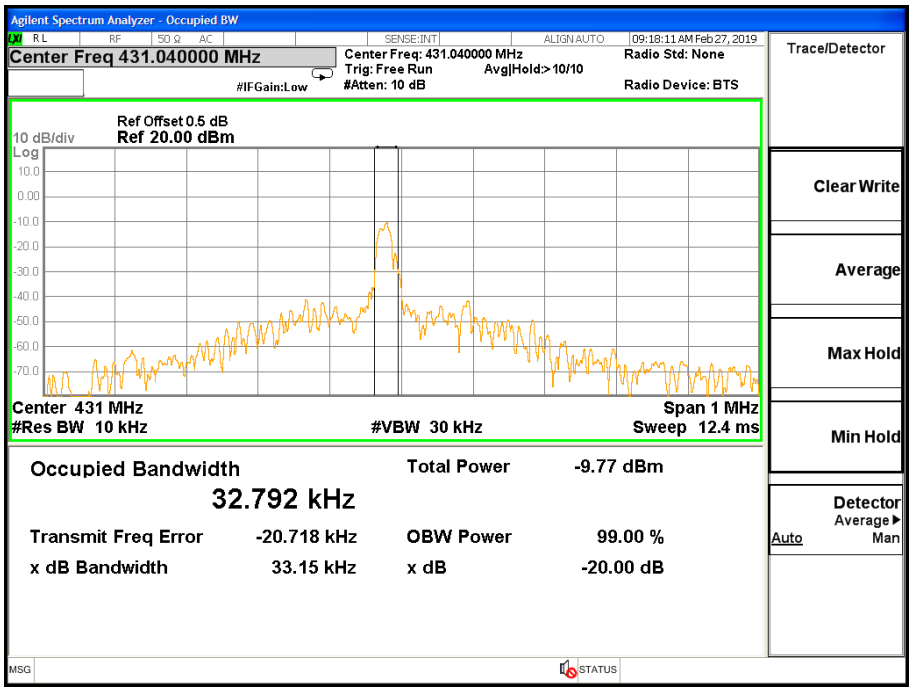
439.36 MHz



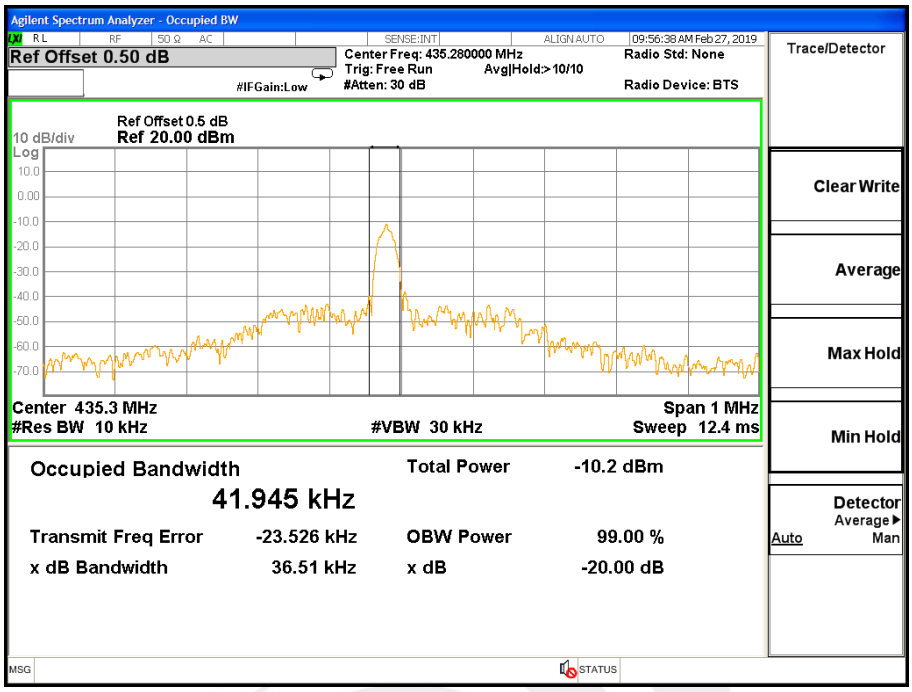
For initiate transmission to Tag Manager to notify abnormal readings

Centre Frequency	Measurement		
	20dB Bandwidth (KHz)	Limit(kHz)	Frequency Range (MHz)
431.04 MHz	33.15	1077.6	PASS
435.28 MHz	36.51	1088.2	PASS
439.36 MHz	35.40	1098.4	PASS

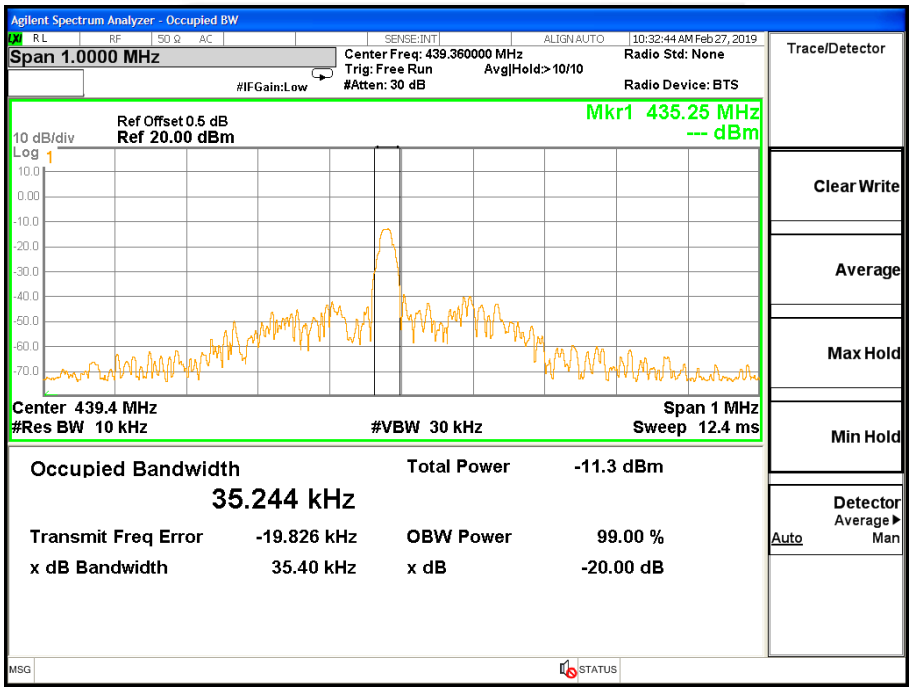
431.04 MHz



435.28 MHz



439.36 MHz



6. DUTY CYCLE

6.1 TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
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 * Log10(Duty Cycle(%)

6.2 TEST SETUP

6.3 EUT OPERATION CONDITIONS

TX mode.

6.4 TEST RESULTS

Refer to the duty cycle plot (as below),This device meets the FCC requirement. Length of a complete pulse train

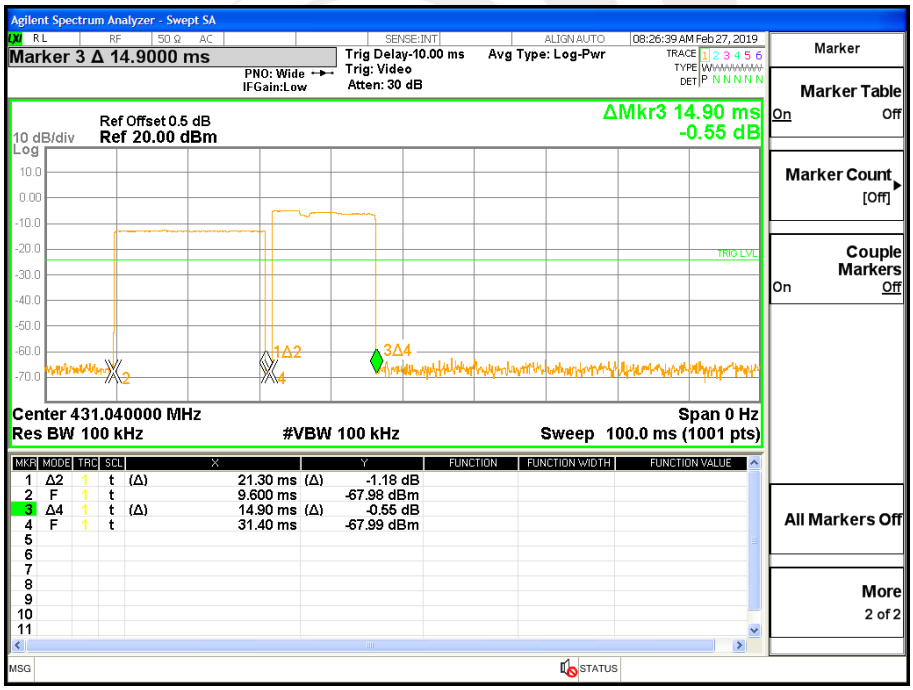
Remark:FCC part15.35(c) required that a complete pulse train is more than 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

Note: scan with three emissions of send acknowledgement to Tag Manager, transmit the entire sensor reading information, and initiate transmission to Tag Manager to notify abnormal readings,

For send acknowledgement to Tag Manager

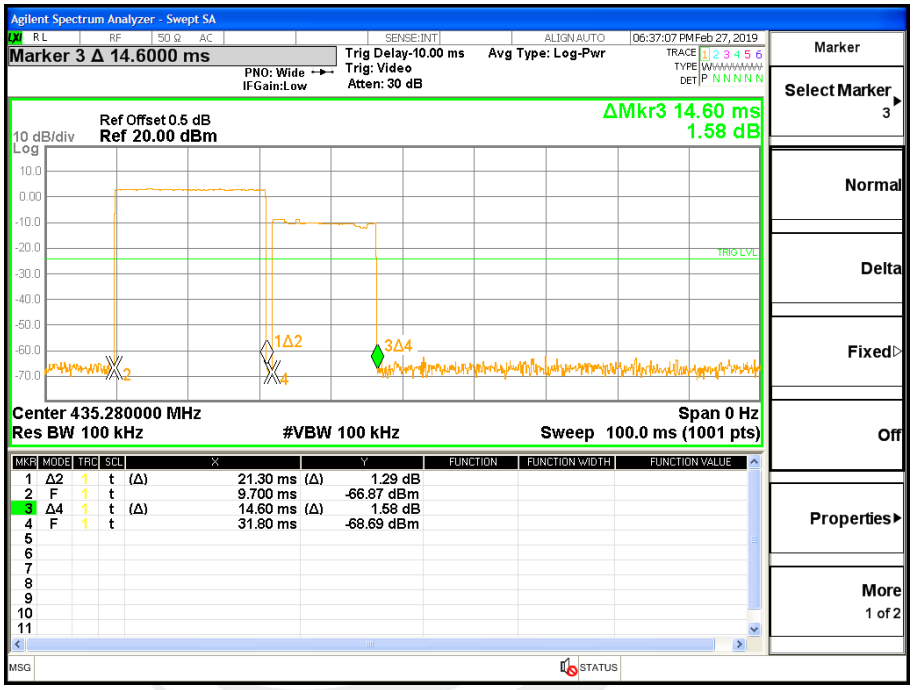
431.04MHz	
Total On interval in a complete pulse train(ms)	36.2
Length of a complete pulse train(ms)	100
Duty Cycle(%)	36.20%
Duty Cycle Correction Factor(dB)	-8.83

TX Mode



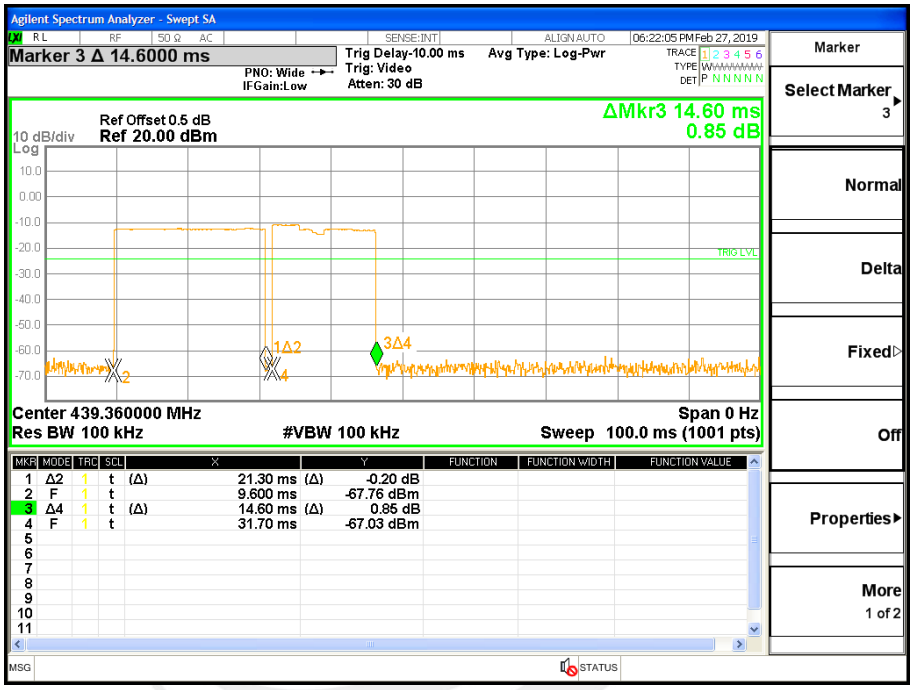
435.28MHz	
Total On interval in a complete pulse train(ms)	35.9
Length of a complete pulse train(ms)	100
Duty Cycle(%)	35.90%
Duty Cycle Correction Factor(dB)	-8.90

TX Mode



439.36MHz	
Total On interval in a complete pulse train(ms)	35.9
Length of a complete pulse train(ms)	100
Duty Cycle(%)	35.90%
Duty Cycle Correction Factor(dB)	-8.90

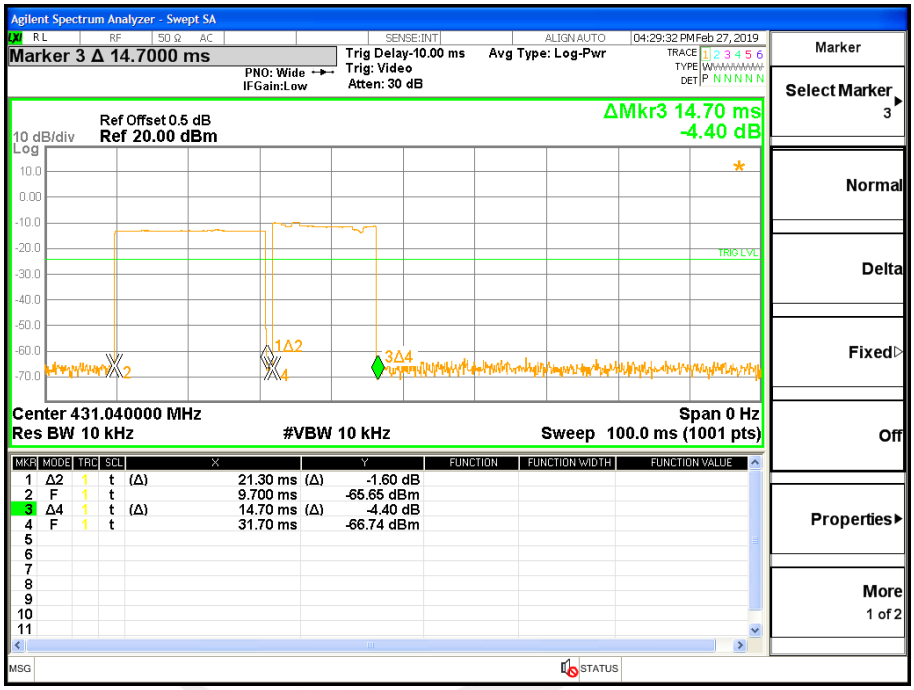
TX Mode



For transmit the entire sensor reading information

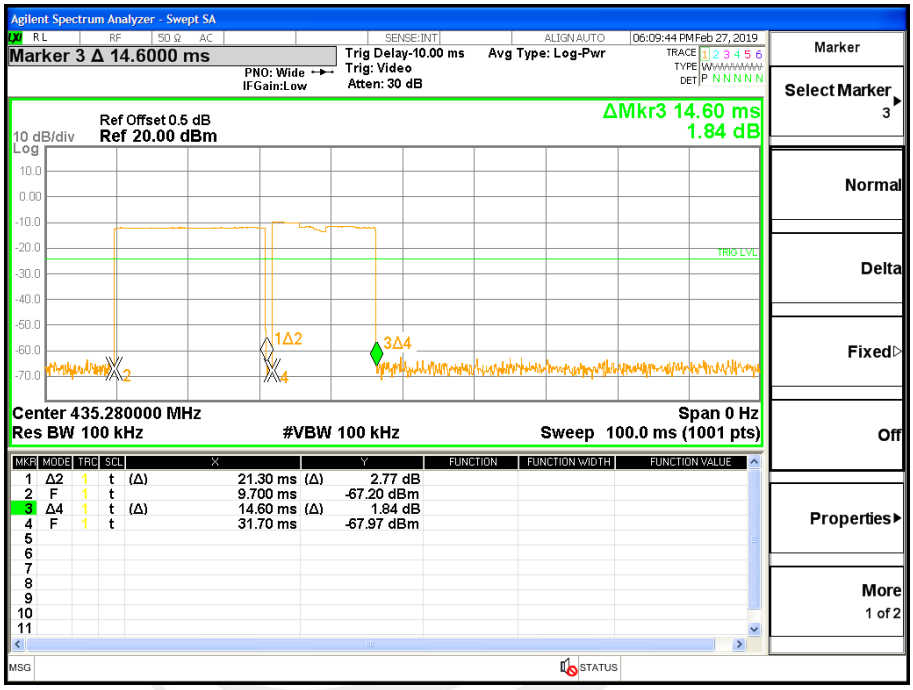
431.04MHz	
Total On interval in a complete pulse train(ms)	36
Length of a complete pulse train(ms)	100
Duty Cycle(%)	36.00%
Duty Cycle Correction Factor(dB)	-8.87

TX Mode



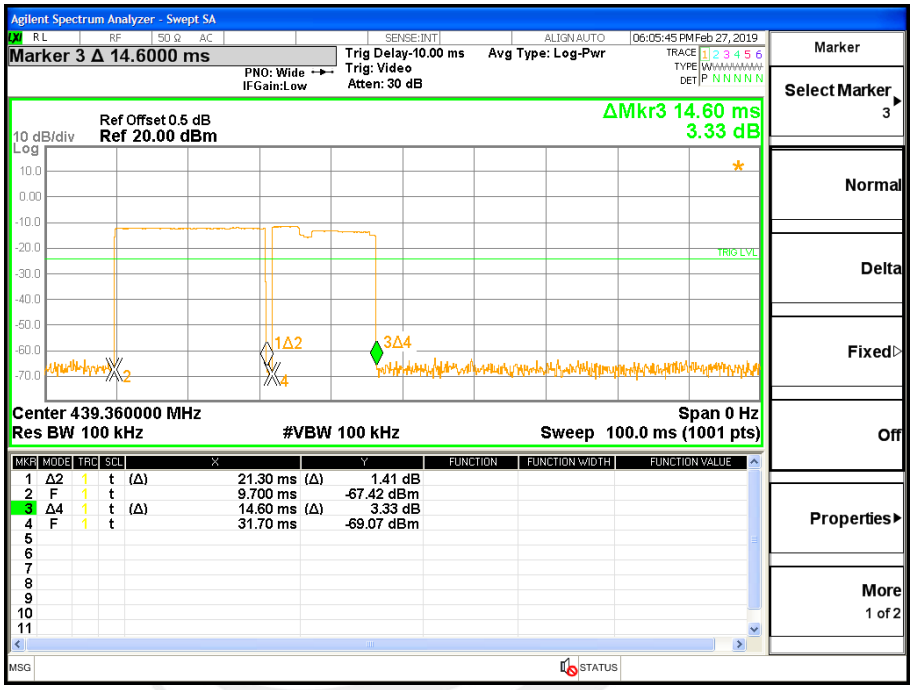
435.28MHz	
Total On interval in a complete pulse train(ms)	35.9
Length of a complete pulse train(ms)	100
Duty Cycle(%)	35.90%
Duty Cycle Correction Factor(dB)	-8.90

TX Mode



439.36MHz	
Total On interval in a complete pulse train(ms)	35.9
Length of a complete pulse train(ms)	100
Duty Cycle(%)	35.90%
Duty Cycle Correction Factor(dB)	-8.90

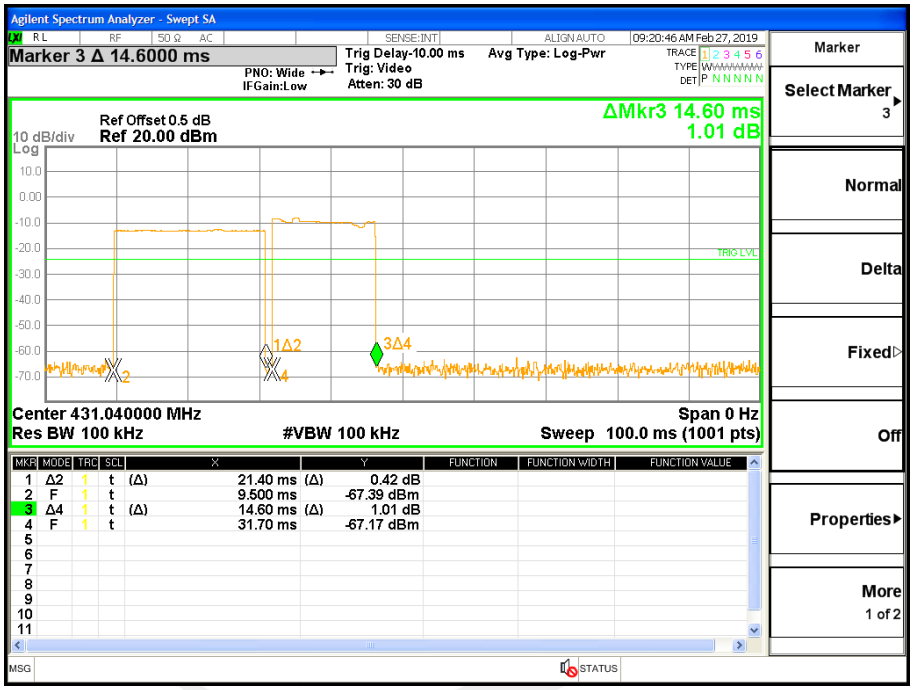
TX Mode



For initiate transmission to Tag Manager to notify abnormal readings

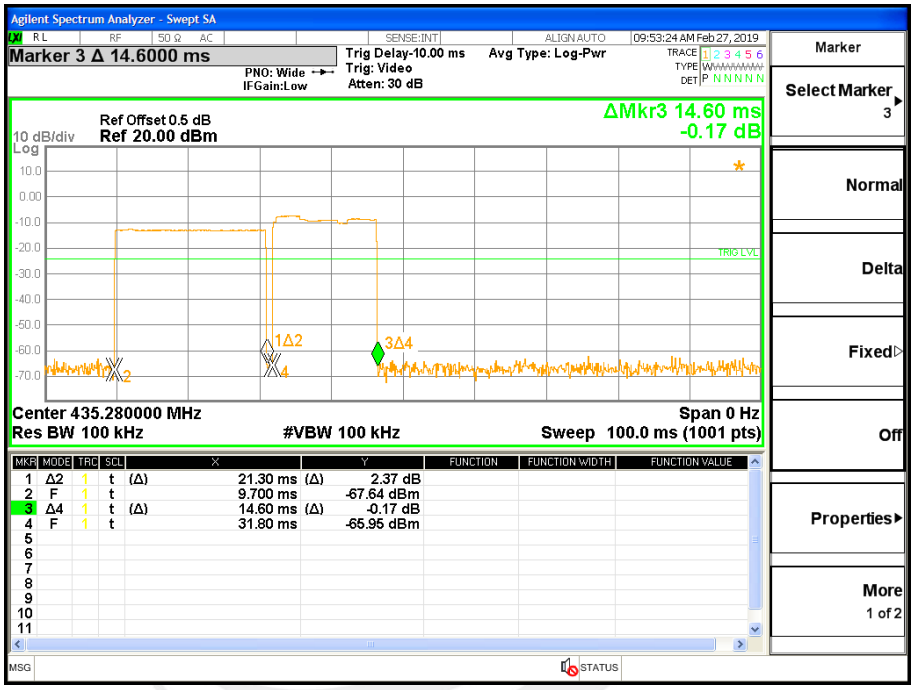
431.04MHz	
Total On interval in a complete pulse train(ms)	36
Length of a complete pulse train(ms)	100
Duty Cycle(%)	36.00%
Duty Cycle Correction Factor(dB)	-8.87

TX Mode



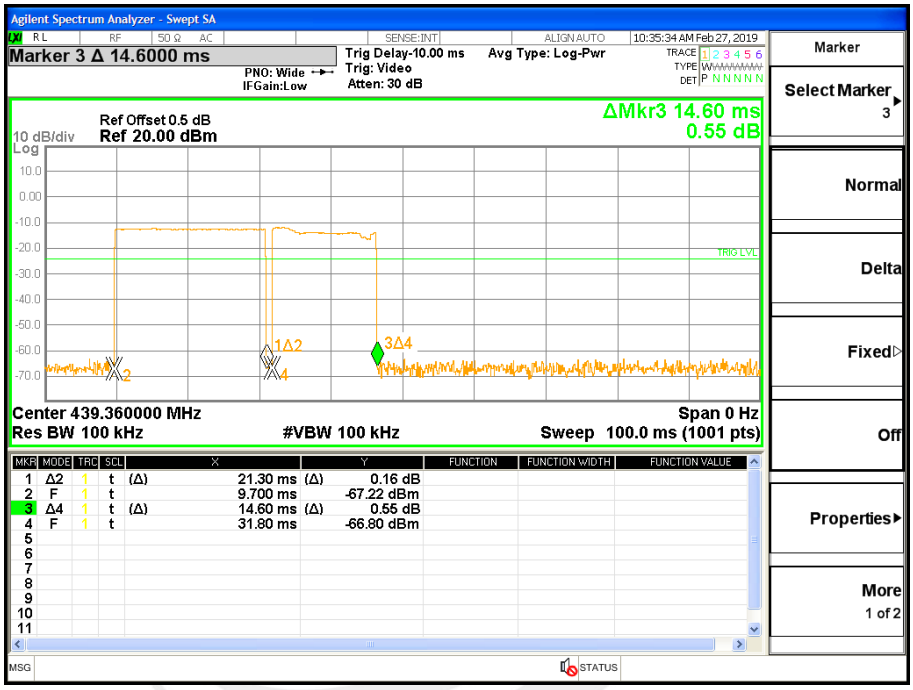
435.28MHz	
Total On interval in a complete pulse train(ms)	36
Length of a complete pulse train(ms)	100
Duty Cycle(%)	36.00%
Duty Cycle Correction Factor(dB)	-8.87

TX Mode



439.36MHz	
Total On interval in a complete pulse train(ms)	35.9
Length of a complete pulse train(ms)	100
Duty Cycle(%)	35.90%
Duty Cycle Correction Factor(dB)	-8.90

TX Mode



7. AUTOMATICALLY DEACTIVATE

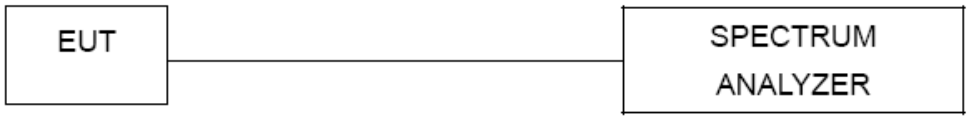
7.1 STANDARD REQUIREMENT

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

7.2 TEST PROCEDURE

The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
Spectrum Setting : RBW= 100KHz, VBW=300KHz, Sweep time = Auto.
Note: Only press launch about 0.15 s
Note:
(1)Refer to the plot (As Below),We find a manually operated transmitter shall employ a switch that will automatically deactivate the transmitteri immediately, within not more than 5 seconds of being released.
(2)The EUT is comply with FCC PART 15 clause 15.231(a)(1).manually working mode are pre-tested.and only the worst result is reported.

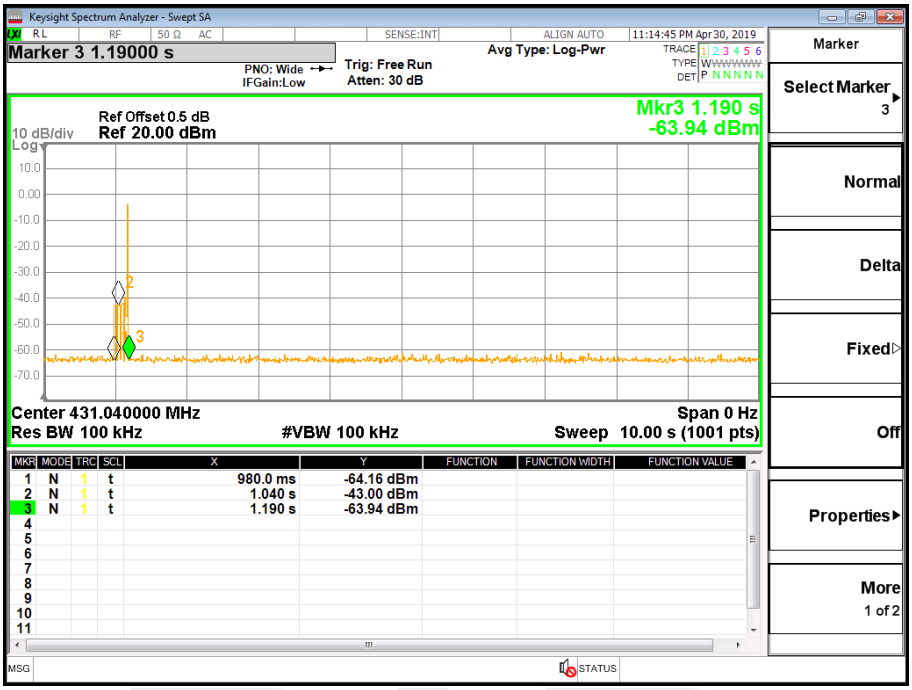
7.3 TEST SETUP



7.4 TEST RESULTS

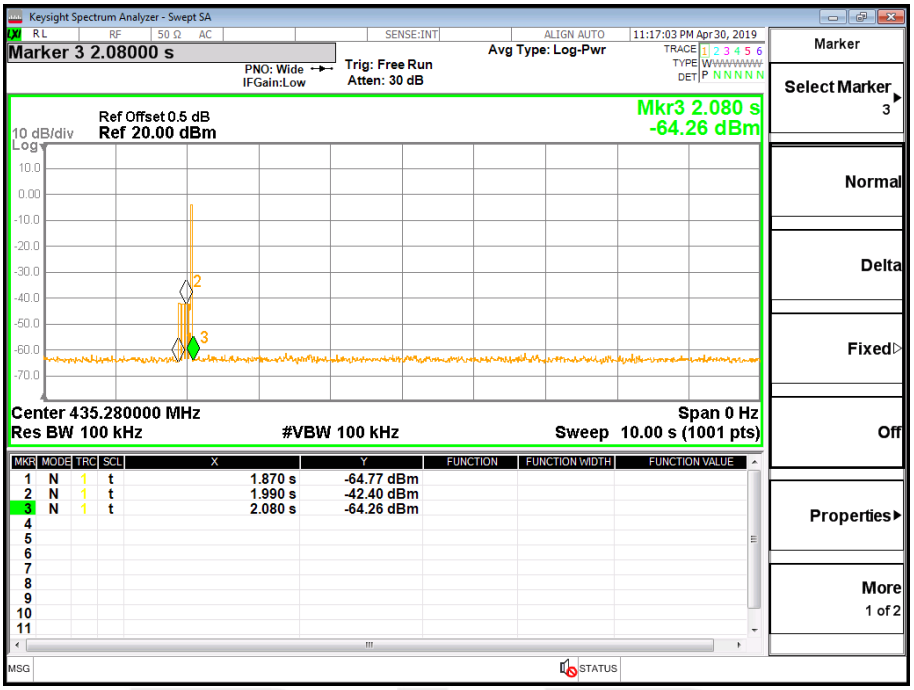
For send acknowledgement to Tag Manager

Test Channel(MHz0	Activation time	Limit(Sec)	Result
431.04	0.21 s	5 s	Pass



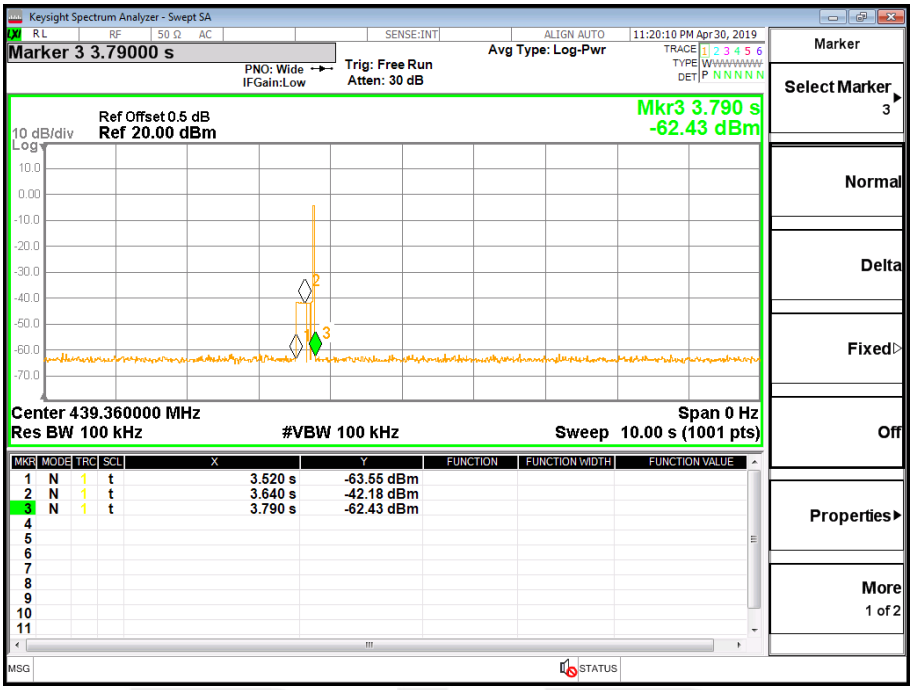
Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=1.190-0.98=0.21s

Test Channel(MHz0	Activation time	Limit(Sec)	Result
435.28	0.21s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=2.080-1.870=0.21s

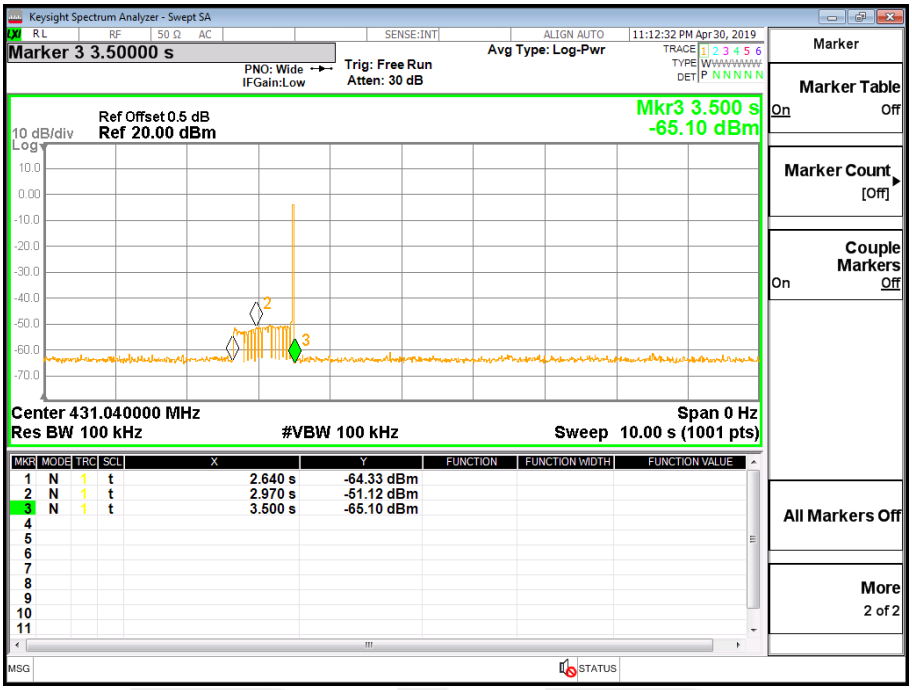
Test Channel(MHz0	Activation time	Limit(Sec)	Result
439.36	0.27s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=3.790-3.520=0.27s

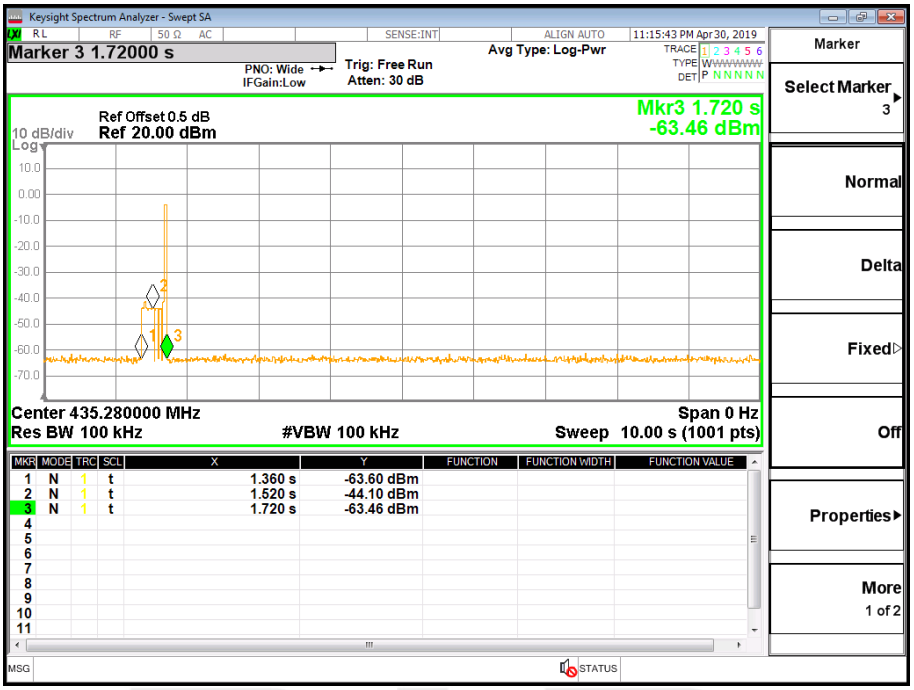
For transmit the entire sensor reading information

Test Channel(MHz0	Activation time	Limit(Sec)	Result
431.04	0.86 s	5 s	Pass



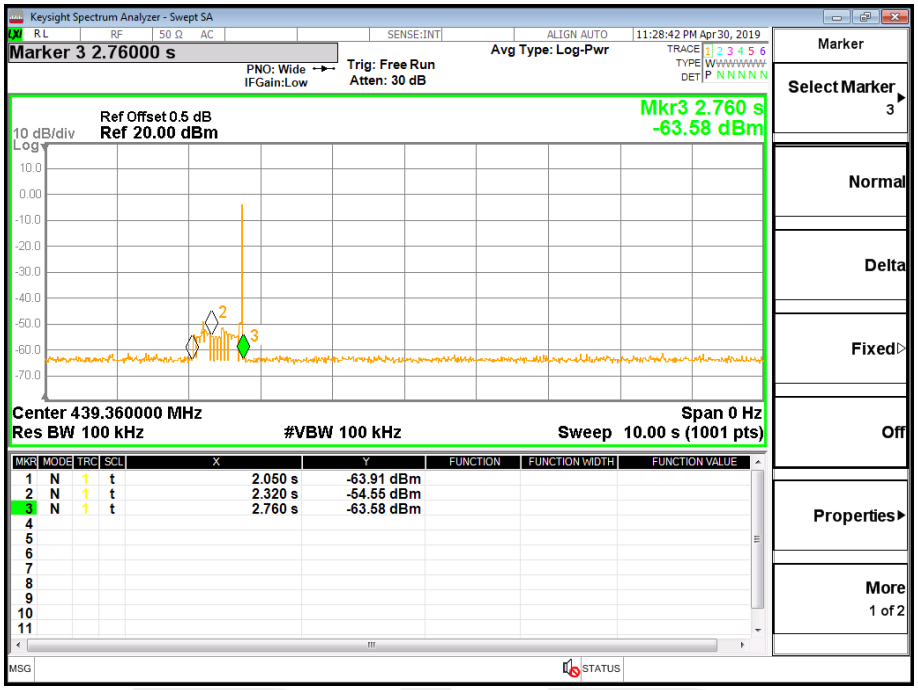
Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=3.500-2.640=0.86s

Test Channel(MHz0	Activation time	Limit(Sec)	Result
435.28	0.36s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=1.720-1.360=0.36s

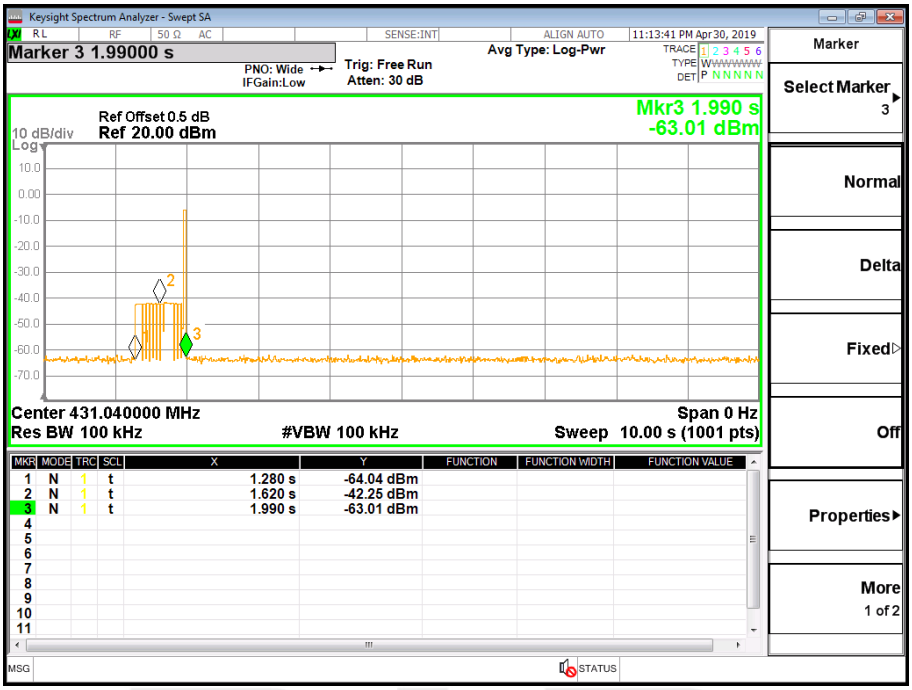
Test Channel(MHz0	Activation time	Limit(Sec)	Result
439.36	0.71s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=2.760-2.050=0.71s

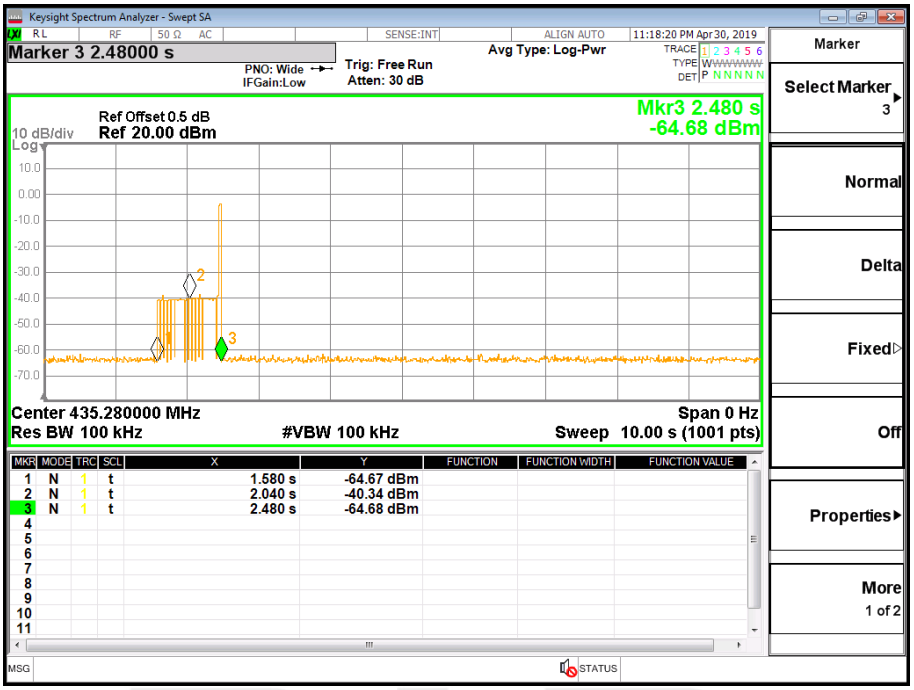
For initiate transmission to Tag Manager to notify abnormal readings

Test Channel(MHz0	Activation time	Limit(Sec)	Result
431.04	0.71 s	5 s	Pass



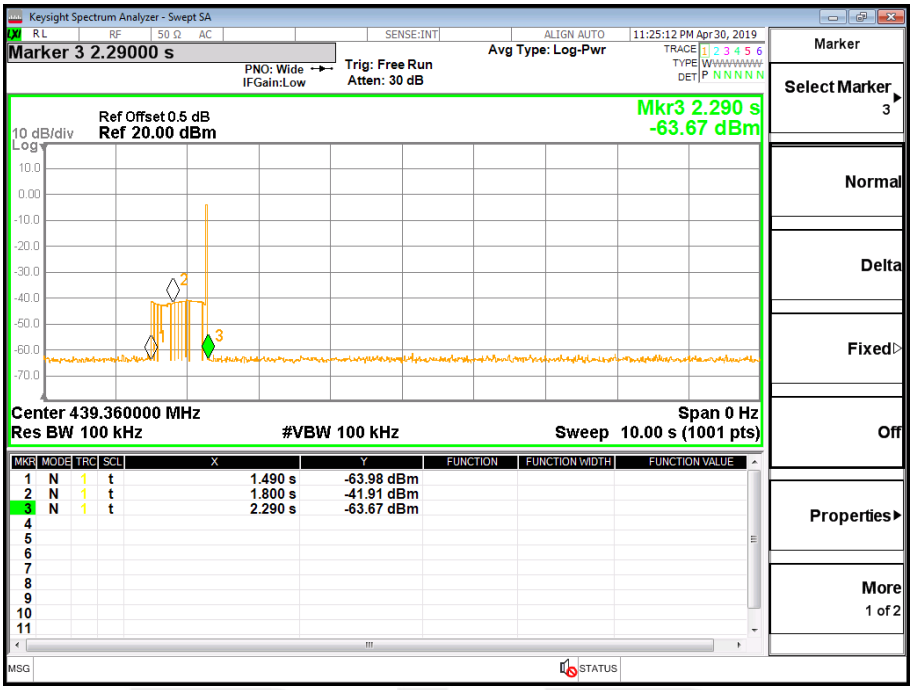
Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=1.990-1.280=0.71s

Test Channel(MHz0	Activation time	Limit(Sec)	Result
435.28	0.9s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=2.480-1.580=0.9s

Test Channel(MHz0	Activation time	Limit(Sec)	Result
439.36	0.80s	5 s	Pass



Mark 1: Start transmitting
Mark 3: Stop transmitting
Activation time= Mark 3- Mark 1=2.290-1.490=0.80s

8. ANTENNA REQUIREMENT

8.1 STANDARD 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.

8.2 EUT ANTENNA

The EUT antenna is PCB Antenna.It conforms to the standard requirements.

APPENDIX 1-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※