



RADIO TEST REPORT

Report No.: STS2009231W02

Issued for

Nortek Security & Control LLC

5919 Sea Otter Place, STE 100, Carlsbad CA 92010, United States

Product Name:	Video Doorbell
Brand Name:	2GIG
Model Name:	2GIG-VBELL-1
Series Model:	N/A
FCC ID:	EF400191
IC:	1078A-00191
Test Standard:	FCC Part 15.247 RSS-247 Issue 2, February 2017 RSS-Gen Issue 5 ,March 2019

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TEST RESULT CERTIFICATION

Applicant's Name : Nortek Security & Control LLC
Address : 5919 Sea Otter Place, STE 100, Carlsbad CA 92010, United States

Manufacture's Name : Shenzhen Aoni Electronic Co.,Ltd
Address : Building 5, Honghui Industrial Park, 2nd Road Liuxian, Baoan District, Shenzhen, P.R. China, 518101

Product Description

Product Name : Video Doorbell
Brand Name : 2GIG
Model Name : 2GIG-VBELL-1
Series Model : N/A

Test Standards : FCC Part15.247
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5 ,March 2019

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/IC requirements. And it is applicable only to the tested sample identified in the report.

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Date of Test..... :
Date of receipt of test item..... : 16 Sept. 2020
Date (s) of performance of tests..... : 16 Sept. 2020 ~ 22 Sept. 2020
Date of Issue : 22 Sept. 2020
Test Result : **Pass**

Testing Engineer : *Chris Chen*

(Chris Chen)

Technical Manager : *Sean She*

(Sean she)

Authorized Signatory : *Vita Li*

(Vita Li)





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Revision History

Rev.	Issue Date	Report No.	Effect Page	Contents
00	22 Sept. 2020	STS2009231W02	ALL	Initial Issue





1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 15.247 Meas Guidance v05r02.

FCC Part 15.247, Subpart C RSS-247 Issue 2			
Standard Section	Test Item	Judgment	Remark
15.207 RSS-Gen 8.8	Conducted Emission	PASS	--
15.247 (a)(2) RSS-Gen 6.7 RSS-247 5.2 (a)	6dB&99% Bandwidth	PASS	--
15.247 (b)(3) RSS-247 5.4 (d)	Output Power	PASS	--
15.247 (c) RSS-Gen 8.9/8.10	Radiated Spurious Emission	PASS	--
15.247 (d) RSS-247 5.5 RSS-Gen 8.9/8.10	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e) RSS-247 5.2 (b)	Power Spectral Density	PASS	--
15.205 RSS-Gen 8.9/8.10	Restricted bands of operation	PASS	--
Part 15.247(d)/part 15.209(a) RSS-247 5.5 RSS-Gen 8.9/8.10	Band Edge Emission	PASS	--
15.203 RSS-Gen 6.8	Antenna Requirement	PASS	--
RSS-Gen 6.11/8.11	Frequency Stability	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

Add. : A 1/F, Building B, Zhuoke Science Park, No.190 Chongqing Road, HepingShequ, Fuyong Sub-District, Bao'an District, Shenzhen, Guang Dong, China

FCC test Firm Registration Number: 625569

IC test Firm Registration Number: 12108A

A2LA Certificate No.: 4338.01

1.2 MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement $y \pm U$, where expanded 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	$\pm 0.68\text{dB}$
2	Unwanted Emissions, conducted	$\pm 2.988\text{dB}$
3	All emissions, radiated 30-1GHz	$\pm 6.7\text{dB}$
4	All emissions, radiated 1G-6GHz	$\pm 5.5\text{dB}$
5	All emissions, radiated >6G	$\pm 5.8\text{dB}$
6	Conducted Emission (9KHz-150KHz)	$\pm 3.37\text{dB}$
7	Conducted Emission (150KHz-30MHz)	$\pm 3.83\text{dB}$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Video Doorbell	
Trade Name	2GIG	
Model Name	2GIG-VBELL-1	
Series Model	N/A	
Model Difference	N/A	
Product Description	The EUT is a Video Doorbell	
	Operation Frequency:	802.11b/g/n 20: 2412~2462 MHz 802.11n(40MHz):2422~2452MHz
	Modulation Type:	802.11b(DSSS):CCK,DQPSK,DBPSK 802.11g(OFDM):BPSK,QPSK,16-QAM,64-QAM 802.11n(OFDM):BPSK,QPSK,16-QAM,64-QAM
	Number of Channel:	802.11b/g/n20: 11CH 802.11n 40: 7CH
	Antenna Designation:	PIFA
	Antenna Gain (dBi):	Antenna number: 2 Antenna A gain : 3dBi Antenna B gain : 3dBi MIMO technology Directional gain=6.01dBi Please refer to the Note 3.
	Duty Cycle:	>98%
Channel List	Please refer to the Note 2.	
Power Rating	Input: AC 8-24V, 50/60Hz 1A	
Battery	Rated Voltage: DC 3.8V Charge Limit: DC 4.35V Capacity: 300mAh	
Hardware version number	V1.5	
Software versionnumber	2020.08.14	
Connecting I/O Port(s)	Please refer to the Note 1.	

802.11b/g : SISO mode only, 802.11n H20 /H40: MIMO mode only.

Note:

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



2.

Operation Frequency of channel			
802.11b/g/n(20MHz)		Channel List for 802.11n(40MHz)	
Channel	Frequency	Channel	Frequency
01	2412	03	2422
02	2417	04	2427
03	2422	05	2432
04	2427	06	2437
05	2432	07	2442
06	2437	08	2447
07	2442	09	2452
08	2447		
09	2452		
10	2457		
11	2462		

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Carrier Frequency Channel

2.4GHz Test Frequency:

For 802.11b/g/n (HT20)		For 802.11n (HT40)	
Channel	Freq.(MHz)	Channel	Freq.(MHz)
01	2412	03	2422
06	2437	06	2437
11	2462	09	2452

3. KDB 662911 D01 Multiple Transmitter Output v02r01

2) Directional Gain Calculations for In-Band Measurements

a) Basic methodology with NANT transmit antennas, each with the same directional gain GANT dBi, being driven by NANT transmitter outputs of equal power. Directional gain is to be computed as follows:

(i) If any transmit signals are correlated with each other,

$$\text{Directional gain} = GANT + 10 \log(NANT) \text{ dBi}$$

(ii) If all transmit signals are completely uncorrelated with each other,

$$\text{Directional gain} = GANT$$

Antenna number: 2

Antenna A gain : 3dBi

Antenna B gain : 3dBi

$$GANT + 10 \log(NANT) \text{ dBi}$$

$$\text{MIMO technology Directional gain} = 3 + 10 \log 2 = 6.01 \text{ dBi}$$



2.2 DESCRIPTION OF THE TEST MODES

Each of these EUT operation mode(s) or test configuration mode(s) mentioned above was evaluated respectively.

Worst Mode	Description	Data Rate
Mode 1	TX IEEE 802.11b CH1	1 Mbps
Mode 2	TX IEEE 802.11b CH6	1 Mbps
Mode 3	TX IEEE 802.11 b CH11	1 Mbps
Mode 4	SISO mode	1 Mbps
Mode 5	TX IEEE 802.11g CH1	6 Mbps
Mode 6	TX IEEE 802.11g CH6	6 Mbps
Mode 7	TX IEEE 802.11g CH11	6 Mbps
Mode 8	SISO mode	6 Mbps
Mode 9	TX IEEE 802.11n HT20 CH1	MCS 0
Mode 10	TX IEEE 802.11n HT20 CH6	MCS 0
Mode 11	TX IEEE 802.11n HT20 CH11	MCS 0
Mode 12	keeping MIMO TX mode	MCS 0
Mode 13	TX IEEE 802.11n HT40 CH3	MCS 0
Mode 14	TX IEEE 802.11n HT40 CH6	MCS 0
Mode 15	TX IEEE 802.11n HT40 CH9	MCS 0
Mode 16	keeping MIMO TX mode	MCS 0

Note:

- (1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported.
- (2) The battery is fully-charged during the radiated and RF conducted test.

AC Conducted Emission

Test Case	
AC Conducted Emission	Mode17: Keeping TX + WLAN Link



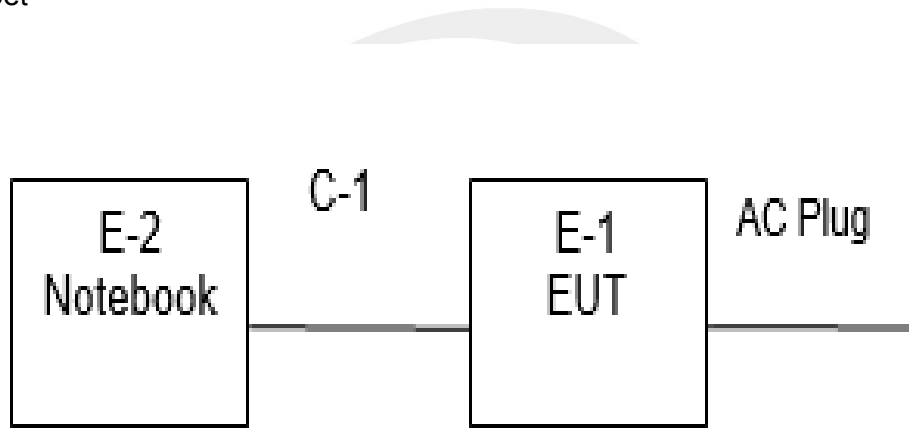
2.3 TEST SOFTWARE AND POWER LEVEL

During testing channel & power controlling software provided by the customer was used to control the operating channel as well as the output power level.

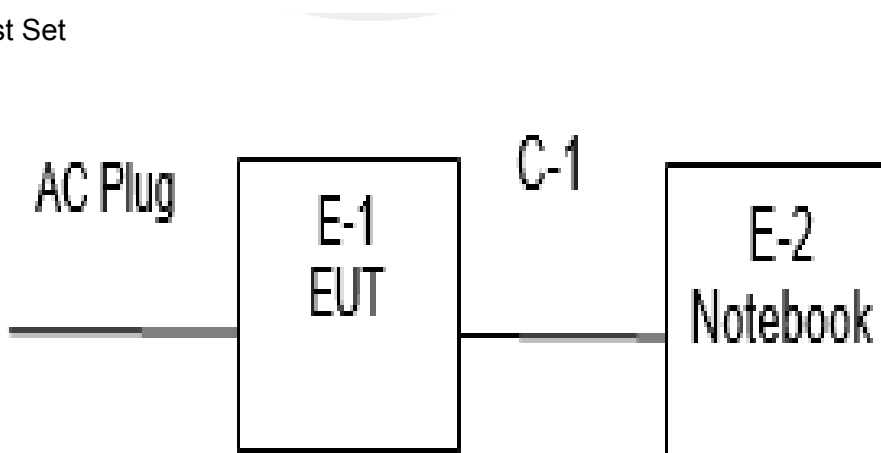
RF Function	Type	Mode Or Modulation type	Ant Gain(dBi)	Ant_A Power Class	Ant_B Power Class	Software For Testing
WIFI(2.4G)	2.4G WIFI	802.11b	Ant A: 3 Ant B: 3 MIMO: 6.01	default	default	SecureCRT
		802.11g		default	default	
		802.11n(HT20)		default	default	
		802.11n(HT40)		default	default	

2.4 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiation Test Set



conduction Test Set





2.5 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.	Length	Note
N/A	N/A	N/A	N/A	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Length	Note
E-2	Notebook	DELL	VOSTRO.3800	N/A	N/A
C-1	USB Cable	N/A	N/A	100cm	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.



2.6 EQUIPMENTS LIST FOR ALL TEST ITEMS

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY51110105	2020.03.05	2021.03.04
Active loop Antenna	ZHINAN	ZN30900C	16035	2018.03.11	2021.03.10
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2020.11.01
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	2019.10.09	2020.10.08
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2019.10.12	2020.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2019.10.12	2020.10.11
Temperature & Humidity	HH660	Mieo	N/A	2019.10.17	2020.10.16
turn table	EM	SC100_1	60531	N/A	N/A
Antenna mast	EM	SC100	N/A	N/A	N/A
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			

Conduction Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2019.10.09	2020.10.08
LISN	R&S	ENV216	101242	2019.10.09	2020.10.08
LISN	EMCO	3810/2NM	23625	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.12	2020.10.11
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 CE)			

RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2019.10.09	2020.10.08
Signal Analyzer	Agilent	N9020A	MY49100060	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.12	2020.10.11
Test SW	FARAD	LZ-RF /LzRf-3A3			



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)&RSS-Gen Issue 5 limit in the table below has to be followed.

FREQUENCY (MHz)	Conducted Emissionlimit (dBUV)	
	Quasi-peak	Average
0.15 -0.5	66 – 56 *	56 – 46 *
0.50 -5.0	56.00	46.00
5.0 -30.0	60.00	50.00

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.

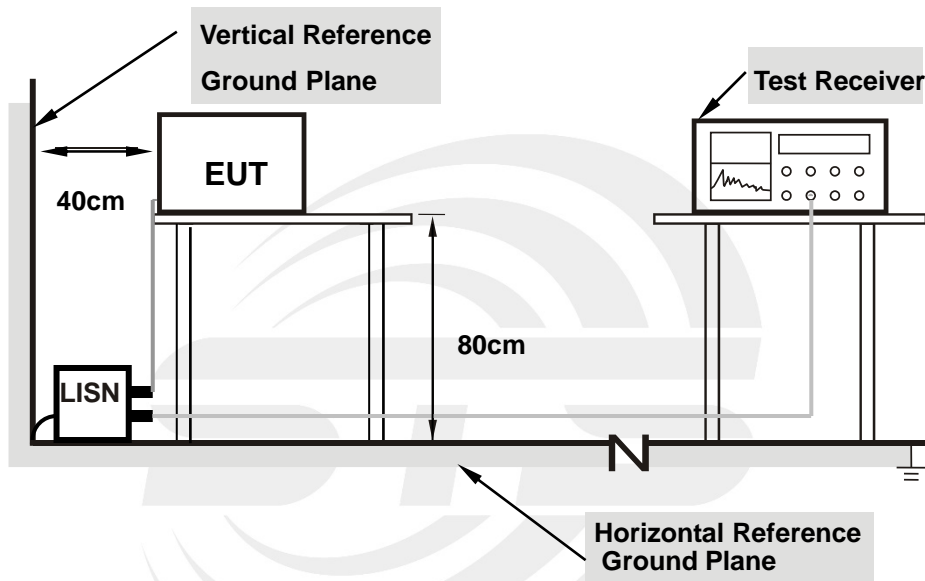
The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 Db
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

3.1.2 TEST PROCEDURE

- a. The EUT was 0.8 meters from the horizontal ground plane and 0.4 meters from the vertical 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.

3.1.3 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 cm from other units and other metal planes**

3.1.4 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.



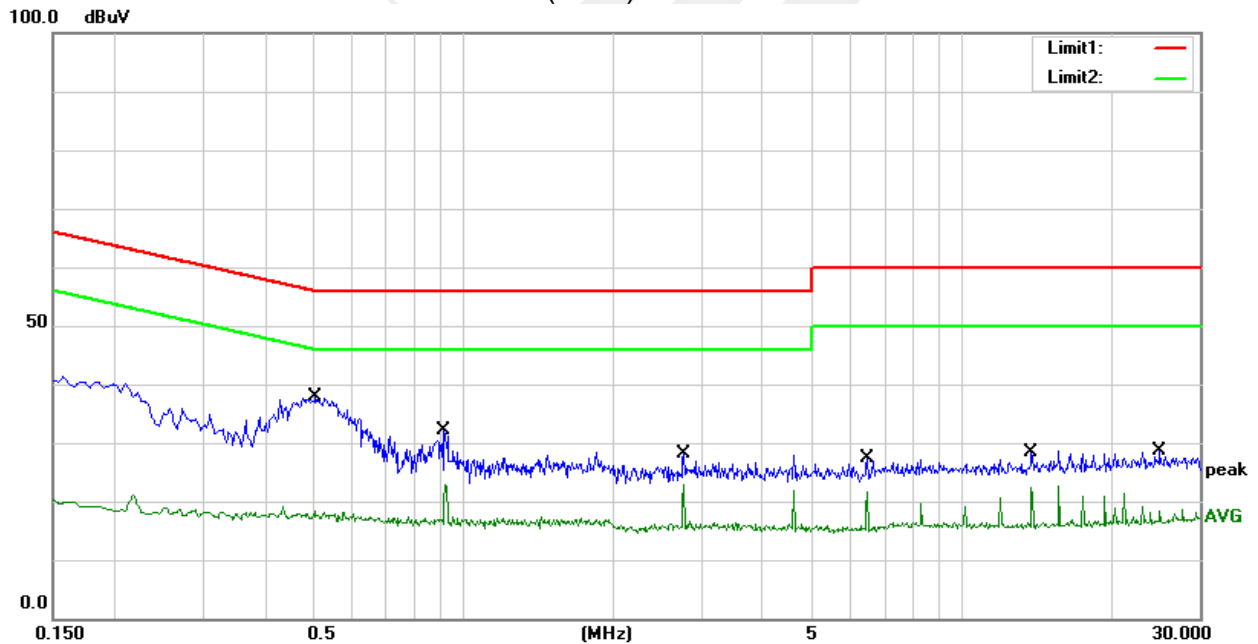
3.1.5 TEST RESULT

Temperature:	26.81	Relative Humidity:	66%RH
Test Voltage:	AC 16V/60Hz	Phase:	L
Test Mode:	Mode 17		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(Db)	Result (dBuV)	Limit (dBuV)	Margin (Db)	Remark
1	0.5060	17.51	20.43	37.94	56.00	-18.06	QP
2	0.5060	-2.01	20.43	18.42	46.00	-27.58	AVG
3	0.9180	11.86	20.19	32.05	56.00	-23.95	QP
4	0.9180	2.68	20.19	22.87	46.00	-23.13	AVG
5	2.7660	7.94	20.09	28.03	56.00	-27.97	QP
6	2.7660	2.72	20.09	22.81	46.00	-23.19	AVG
7	6.4540	7.58	19.91	27.49	60.00	-32.51	QP
8	6.4540	1.73	19.91	21.64	50.00	-28.36	AVG
9	13.8380	8.43	20.00	28.43	60.00	-31.57	QP
10	13.8380	2.35	20.00	22.35	50.00	-27.65	AVG
11	24.9340	8.05	20.67	28.72	60.00	-31.28	QP
12	24.9340	-2.24	20.67	18.43	50.00	-31.57	AVG

Remark:

1. All readings are Quasi-Peak and Average values
2. Margin = Result (Result =Reading + Factor)–Limit
3. Factor=LISN factor+Cable loss+Limiter (10Db)



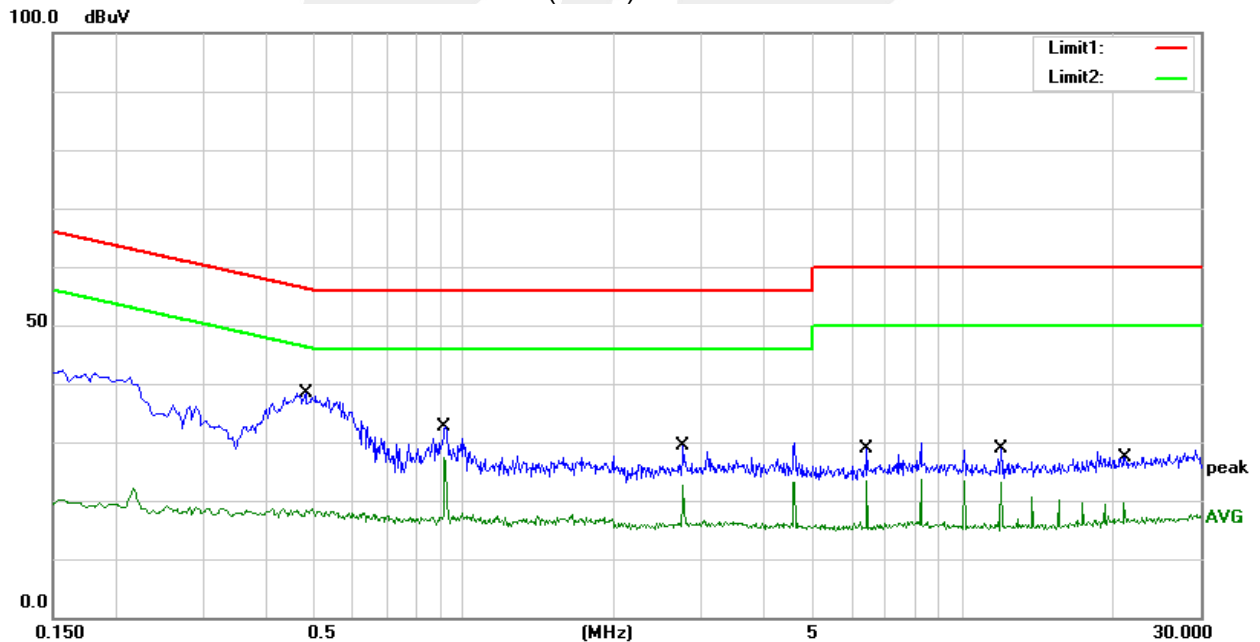


Temperature:	26.8l	Relative Humidity:	66%RH
Test Voltage:	AC 16V/60Hz	Phase:	N
Test Mode:	Mode 17		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(D b)	Result (dBuV)	Limit (dBuV)	Margin (Db)	Remark
1	0.4820	18.03	20.44	38.47	56.30	-17.83	QP
2	0.4820	-1.78	20.44	18.66	46.30	-27.64	AVG
3	0.9220	12.42	20.19	32.61	56.00	-23.39	QP
4	0.9220	7.07	20.19	27.26	46.00	-18.74	AVG
5	2.7620	9.30	20.09	29.39	56.00	-26.61	QP
6	2.7620	2.66	20.09	22.75	46.00	-23.25	AVG
7	6.4260	9.04	19.92	28.96	60.00	-31.04	QP
8	6.4260	3.41	19.92	23.33	50.00	-26.67	AVG
9	11.9420	9.05	19.90	28.95	60.00	-31.05	QP
10	11.9420	3.31	19.90	23.21	50.00	-26.79	AVG
11	21.1500	6.79	20.65	27.44	60.00	-32.56	QP
12	21.1500	-1.15	20.65	19.50	50.00	-30.50	AVG

Remark:

1. All readings are Quasi-Peak and Average values
2. Margin = Result (Result =Reading + Factor)–Limit
3. Factor=LISN factor+Cable loss+Limiter (10Db)





3.2 RADIATED EMISSION MEASUREMENT

3.2.1 RADIATED EMISSION LIMITS

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the Restricted band specified on Part15.205(a)&209(a), RSS-Gen Issue 5 and RSS-247 Issue 2, February 2017 (5.5) limit in the table and according to ANSI C63.10-2013 below has to be followed.

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

Frequencies (MHz)	Field Strength (micovolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (1000MHz-25GHz)

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

Notes:

- (1) The limit for radiated test was performed according to FCC PART 15C.
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (Uv/m).

LIMITS OF RESTRICTED FREQUENCY BANDS

FCC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			



IC:

FREQUENCY (MHz)	FREQUENCY (MHz)	FREQUENCY (GHz)
0.090 – 0.110	149.9 – 150.05	9.0 – 9.2
0.495 – 0.505	156.52475 – 156.52525	9.3 – 9.5
2.1735 – 2.1905	156.7 – 156.9	10.6 – 12.7
3.020 – 3.026	162.0125 – 167.17	13.25 – 13.4
4.125 – 4.128	167.72 – 173.2	14.47 – 14.5
4.17725 – 4.17775	240 – 285	15.35 – 16.2
4.20725 – 4.20775	322 – 335.4	17.7 – 21.4
5.677 – 5.683	399.9 – 410	22.01 – 23.12
6.215 – 6.218	608 – 614	23.6 – 24.0
6.26775 – 6.26825	960 – 1427	31.2 – 31.8
6.31175 – 6.31225	1435 – 1626.5	36.43 – 36.5
8.291 – 8.294	1645.5 – 1646.5	Above 38.6
8.362 – 8.366	1660 – 1710	
8.37625 – 8.38675	1718.8 – 1722.2	
8.41425 – 8.41475	2200 – 2300	
12.29 – 12.293	2310 – 2390	
12.51975 – 12.52025	2483.5 – 2500	
12.57675 – 12.57725	2655 – 2900	
13.36 – 13.41	3260 – 3267	
16.42 – 16.423	3332 – 3339	
16.69475 – 16.69525	3345.8 – 3358	
16.80425 – 16.80475	3500 – 4400	
25.5 – 25.67	4500 – 5150	
37.5 – 38.25	5350 - 5460	
73 – 74.6	7250 – 7750	
74.8 – 75.2	8025 – 8500	
108 – 138		



For Radiated Emission

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP/AV
Start Frequency	9 KHz/150KHz(Peak/QP/AV)
Stop Frequency	150KHz/30MHz(Peak/QP/AV)
RB / VB (emission in restricted band)	200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz); 200Hz (From 9kHz to 0.15MHz)/ 9KHz (From 0.15MHz to 30MHz)

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/QP
Start Frequency	30 MHz(Peak/QP)
Stop Frequency	1000 MHz (Peak/QP)
RB / VB (emission in restricted band)	120 KHz / 300 KHz

Spectrum Parameter	Setting
Attenuation	Auto
Detector	Peak/AV
Start Frequency	1000 MHz(Peak/AV)
Stop Frequency	10 th carrier 20ntenna20(Peak/AV)
RB / VB (emission in restricted band)	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)

For Restricted band

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2310 to 2430 MHz Upper Band Edge: 2445 to 2500 MHz
RB / VB	1 MHz / 3 MHz(Peak) 1 MHz/1/T MHz(AVG)



Receiver Parameter	Setting
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

3.2.2 TEST PROCEDURE

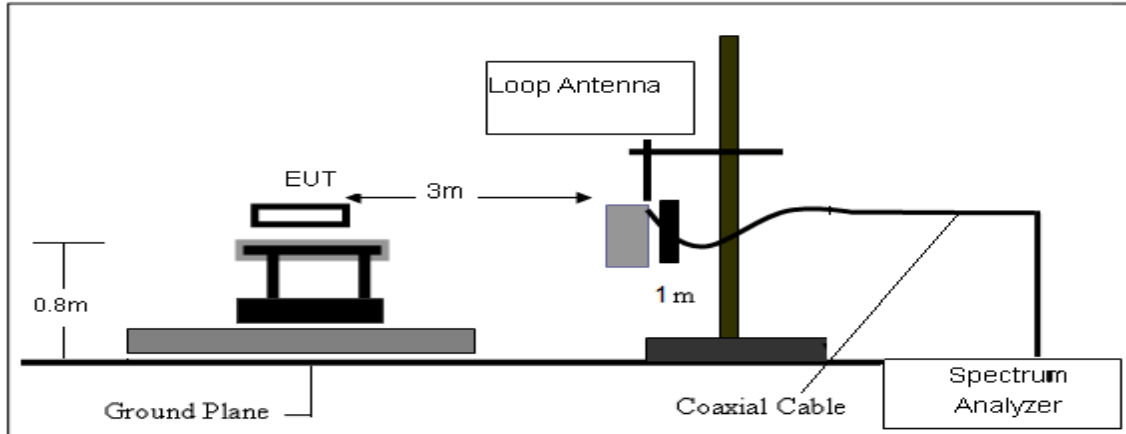
- a. The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- b. The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The height of the equipment shall be 0.8 m(above 1GHz is 1.5 m); the height of the test antenna shall vary between 1 m to 4 m. Horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. 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.
- e. 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.
- f. For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

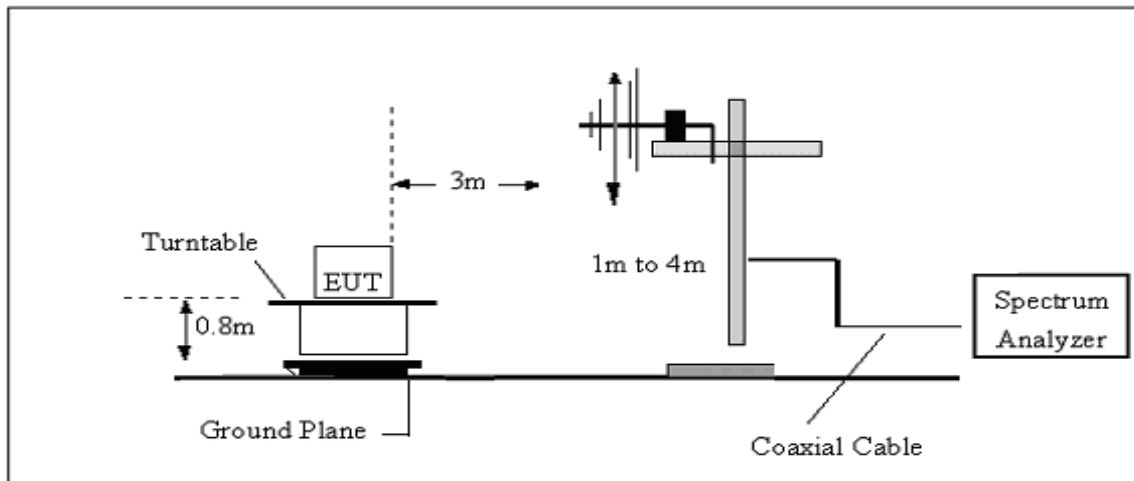
Both horizontal and vertical antenna polarities were tested and performed test to three orthogonal axis. The worst case emissions were reported.

3.2.3 TEST SETUP

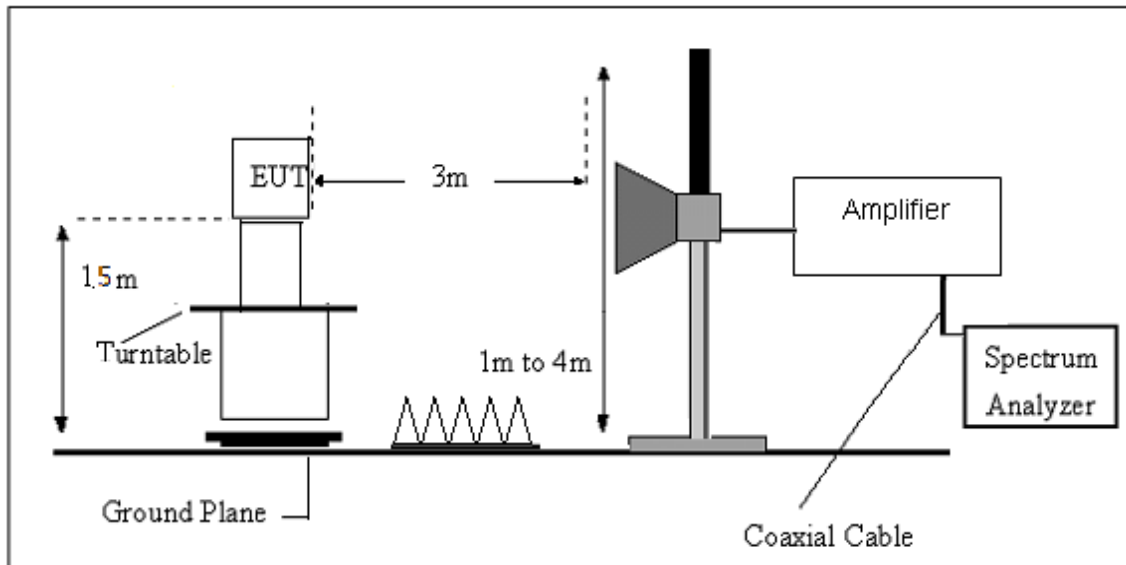
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



3.2.4 EUT OPERATING CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



3.2.5 FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier 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 (MHz)	FS (dB μ V/m)	RA (dB μ V/m)	AF (Db)	CL (Db)	AG (Db)	Factor (Db)
300	40	58.1	12.2	1.6	31.9	-18.1

$$\text{Factor} = \text{AF} + \text{CL} - \text{AG}$$





3.2.6 TEST RESULT

9KHz-30MHz

Temperature:	23.3l	Relative Humidity:	60%RH
Test Voltage:	DC 3.8V	Polarization:	--
Test Mode:	TX Mode		

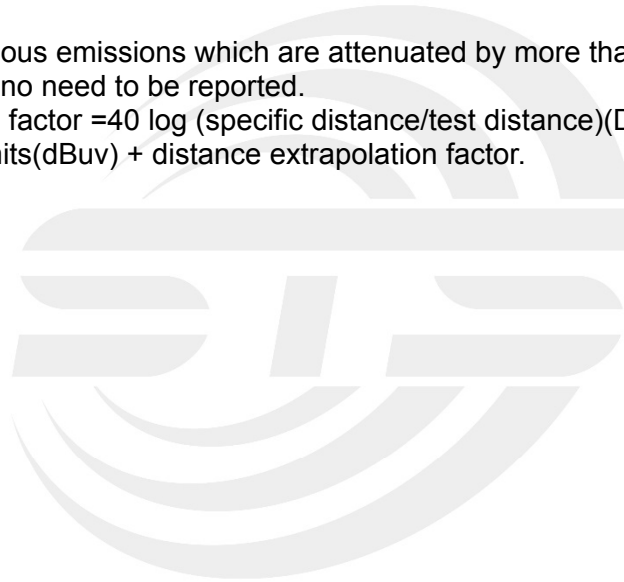
Freq. (MHz)	Reading (dBuV/m)	Limit (dBuV/m)	Margin (Db)	State P/F	Test Result
--	--	--	--	--	PASS
--	--	--	--	--	PASS

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 = $40 \log (\text{specific distance}/\text{test distance})$ (Db);

Limit line = specific limits(dBuv) + distance extrapolation factor.





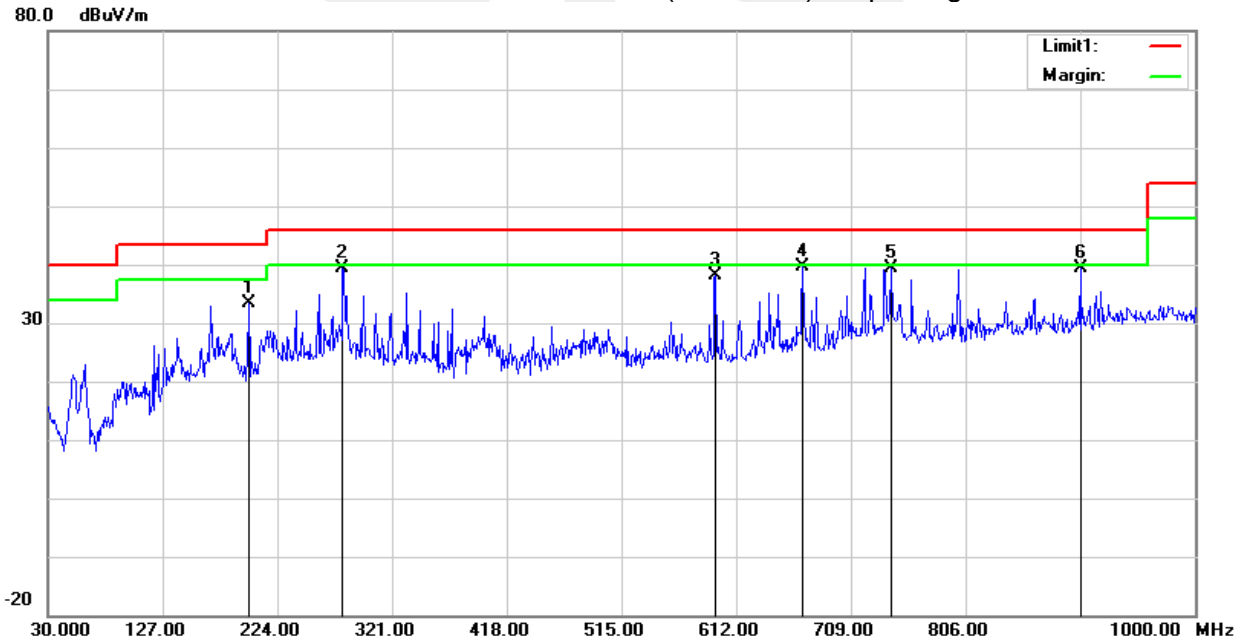
(30MHz – 1000MHz)

Temperature:	23.3l	Relative Humidity:	60%RH
Test Voltage:	DC 3.8V	Phase:	Horizontal
Test Mode:	Mode 1-16 (Mode 12 worst mode)		

No.	Frequency (MHz)	Reading (dBUV)	Correct Factor (Db/m)	Result (dBUV/m)	Limit (dBUV/m)	Margin (Db)	Remark
1	199.7500	54.59	-21.11	33.48	43.50	-10.02	QP
2	279.2900	54.93	-15.58	39.35	46.00	-6.65	QP
3	594.5400	44.06	-5.84	38.22	46.00	-7.78	QP
4	668.2600	44.28	-4.62	39.66	46.00	-6.34	QP
5	742.9500	41.47	-2.13	39.34	46.00	-6.66	QP
6	903.0000	39.76	-0.37	39.39	46.00	-6.61	QP

Remark:

- Margin = Result (Result = Reading + Factor) – Limit
- Factor = Antenna factor + Cable attenuation factor (cable loss) – Amplifier gain





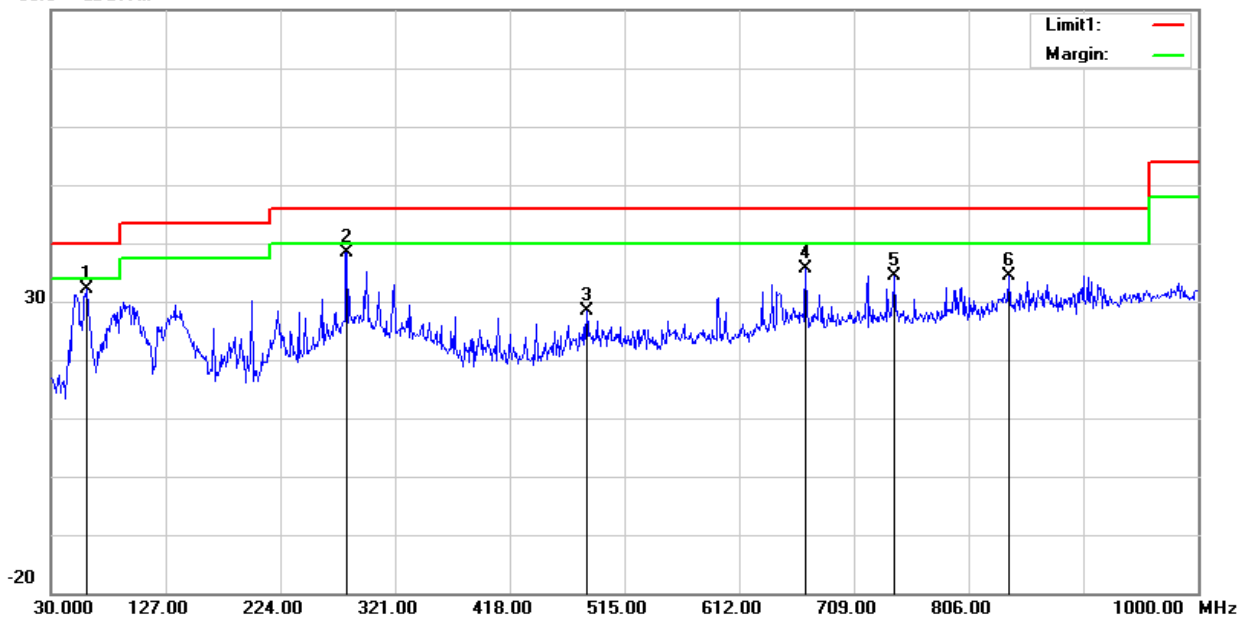
Temperature:	23.3l	Relative Humidity:	60%RH
Test Voltage:	DC 3.8V	Phase:	Vertical
Test Mode:	Mode 1-16 (Mode 12 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (Db/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (Db)	Remark
1	60.0700	57.91	-25.86	32.05	40.00	-7.95	QP
2	280.2600	53.97	-15.60	38.37	46.00	-7.63	QP
3	482.9900	36.97	-8.52	28.45	46.00	-17.55	QP
4	668.2600	40.31	-4.62	35.69	46.00	-10.31	QP
5	742.9500	36.44	-2.13	34.31	46.00	-11.69	QP
6	839.9500	34.80	-0.34	34.46	46.00	-11.54	QP

Remark:.

- Margin = Result (Result =Reading + Factor)-Limit
- Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain

80.0 dBuV/m





(1000MHz-25GHz) Restricted band and Spurious emission Requirements

802.11 n(HT20)

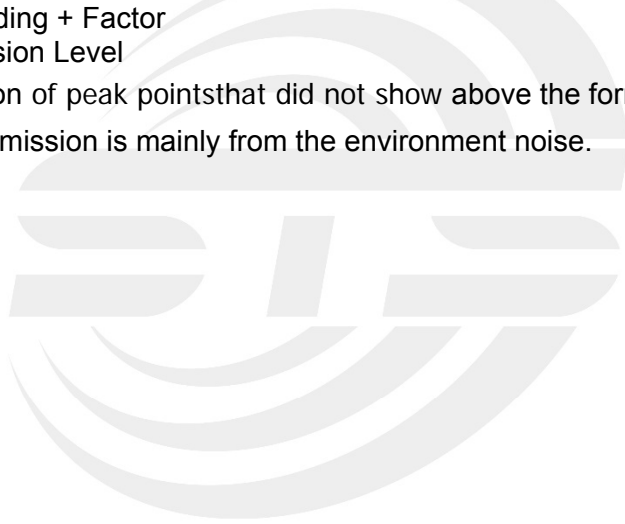
Frequency (MHz)	Meter Reading (dBμV)	Amplifier (Db)	Loss (Db)	Antenna Factor (Db/m)	Orrected Factor (Db)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (Db)	Detector Type	Comment
Low Channel (802.11n20/2412 MHz)										
3264.79	62.02	44.70	6.70	28.20	-9.80	52.22	74.00	-21.78	PK	Vertical
3264.79	50.04	44.70	6.70	28.20	-9.80	40.24	54.00	-13.76	AV	Vertical
3264.80	61.67	44.70	6.70	28.20	-9.80	51.87	74.00	-22.13	PK	Horizontal
3264.80	51.21	44.70	6.70	28.20	-9.80	41.41	54.00	-12.59	AV	Horizontal
4824.45	59.41	44.20	9.04	31.60	-3.56	55.85	74.00	-18.15	PK	Vertical
4824.45	49.50	44.20	9.04	31.60	-3.56	45.94	54.00	-8.06	AV	Vertical
4824.41	58.16	44.20	9.04	31.60	-3.56	54.60	74.00	-19.40	PK	Horizontal
4824.41	49.91	44.20	9.04	31.60	-3.56	46.35	54.00	-7.65	AV	Horizontal
5359.61	48.17	44.20	9.86	32.00	-2.34	45.83	74.00	-28.17	PK	Vertical
5359.61	39.27	44.20	9.86	32.00	-2.34	36.93	54.00	-17.07	AV	Vertical
5359.64	47.32	44.20	9.86	32.00	-2.34	44.98	74.00	-29.02	PK	Horizontal
5359.64	38.77	44.20	9.86	32.00	-2.34	36.43	54.00	-17.57	AV	Horizontal
7235.70	53.60	43.50	11.40	35.50	3.40	57.00	74.00	-17.00	PK	Vertical
7235.70	44.09	43.50	11.40	35.50	3.40	47.49	54.00	-6.51	AV	Vertical
7235.70	53.73	43.50	11.40	35.50	3.40	57.13	74.00	-16.87	PK	Horizontal
7235.70	44.53	43.50	11.40	35.50	3.40	47.93	54.00	-6.07	AV	Horizontal
Middle Channel (802.11n20/2437 MHz)										
3264.88	61.91	44.70	6.70	28.20	-9.80	52.11	74.00	-21.89	PK	Vertical
3264.88	50.10	44.70	6.70	28.20	-9.80	40.30	54.00	-13.70	AV	Vertical
3264.81	61.28	44.70	6.70	28.20	-9.80	51.48	74.00	-22.52	PK	Horizontal
3264.81	51.24	44.70	6.70	28.20	-9.80	41.44	54.00	-12.56	AV	Horizontal
4874.40	59.43	44.20	9.04	31.60	-3.56	55.87	74.00	-18.13	PK	Vertical
4874.40	49.34	44.20	9.04	31.60	-3.56	45.78	54.00	-8.22	AV	Vertical
4874.58	58.87	44.20	9.04	31.60	-3.56	55.31	74.00	-18.69	PK	Horizontal
4874.58	49.33	44.20	9.04	31.60	-3.56	45.77	54.00	-8.23	AV	Horizontal
5359.62	48.69	44.20	9.86	32.00	-2.34	46.35	74.00	-27.65	PK	Vertical
5359.62	39.67	44.20	9.86	32.00	-2.34	37.33	54.00	-16.67	AV	Vertical
5359.75	47.60	44.20	9.86	32.00	-2.34	45.26	74.00	-28.74	PK	Horizontal
5359.75	39.17	44.20	9.86	32.00	-2.34	36.83	54.00	-17.17	AV	Horizontal
7310.72	54.58	43.50	11.40	35.50	3.40	57.98	74.00	-16.02	PK	Vertical
7310.72	44.08	43.50	11.40	35.50	3.40	47.48	54.00	-6.52	AV	Vertical
7310.78	54.64	43.50	11.40	35.50	3.40	58.04	74.00	-15.96	PK	Horizontal
7310.78	43.58	43.50	11.40	35.50	3.40	46.98	54.00	-7.02	AV	Horizontal



High Channel (802.11n20/2462 MHz)										
3264.82	61.56	44.70	6.70	28.20	-9.80	51.76	74.00	-22.24	PK	Vertical
3264.82	51.03	44.70	6.70	28.20	-9.80	41.23	54.00	-12.77	AV	Vertical
3264.79	61.37	44.70	6.70	28.20	-9.80	51.57	74.00	-22.43	PK	Horizontal
3264.79	50.00	44.70	6.70	28.20	-9.80	40.20	54.00	-13.80	AV	Horizontal
4924.50	59.37	44.20	9.04	31.60	-3.56	55.81	74.00	-18.19	PK	Vertical
4924.50	50.49	44.20	9.04	31.60	-3.56	46.93	54.00	-7.07	AV	Vertical
4924.46	58.32	44.20	9.04	31.60	-3.56	54.76	74.00	-19.24	PK	Horizontal
4924.46	50.13	44.20	9.04	31.60	-3.56	46.57	54.00	-7.43	AV	Horizontal
5359.74	49.16	44.20	9.86	32.00	-2.34	46.82	74.00	-27.18	PK	Vertical
5359.74	39.29	44.20	9.86	32.00	-2.34	36.95	54.00	-17.05	AV	Vertical
5359.83	48.14	44.20	9.86	32.00	-2.34	45.80	74.00	-28.20	PK	Horizontal
5359.83	39.22	44.20	9.86	32.00	-2.34	36.88	54.00	-17.12	AV	Horizontal
7385.91	54.78	43.50	11.40	35.50	3.40	58.18	74.00	-15.82	PK	Vertical
7385.91	43.76	43.50	11.40	35.50	3.40	47.16	54.00	-6.84	AV	Vertical
7385.87	54.08	43.50	11.40	35.50	3.40	57.48	74.00	-16.52	PK	Horizontal
7385.87	44.36	43.50	11.40	35.50	3.40	47.76	54.00	-6.24	AV	Horizontal

Remark:

- Factor = Antenna Factor + Cable Loss – Pre-amplifier.
- Scan with 802.11b, 802.11g, 802.11n (HT-20), 802.11n (HT-40) all have been tested the antenna A, antenna B and antenna A+B, the worst case is 802.11n(HT20) of the antenna A+B.
Emission Level = Reading + Factor
Margin = Limit – Emission Level
- The frequency emission of peak points that did not show above the forms are at least 20Db below the limit, the frequency emission is mainly from the environment noise.

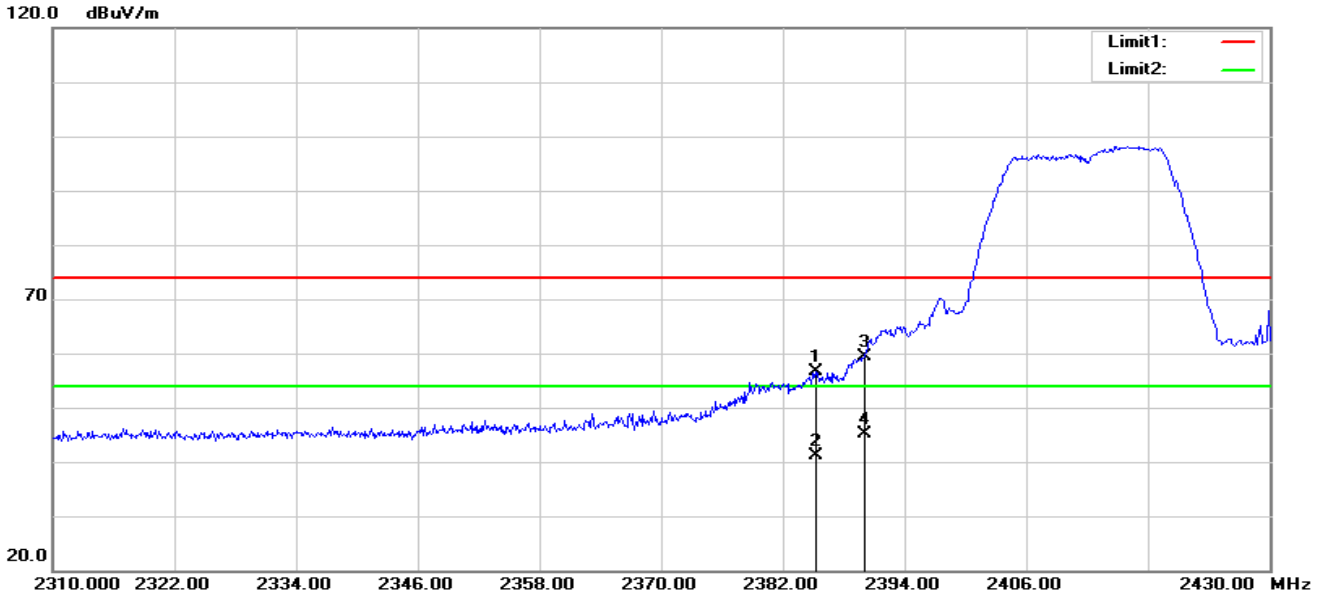




3.2.6 TEST RESULTS(Restricted band Requirements)

802.11 n(HT20)-Low

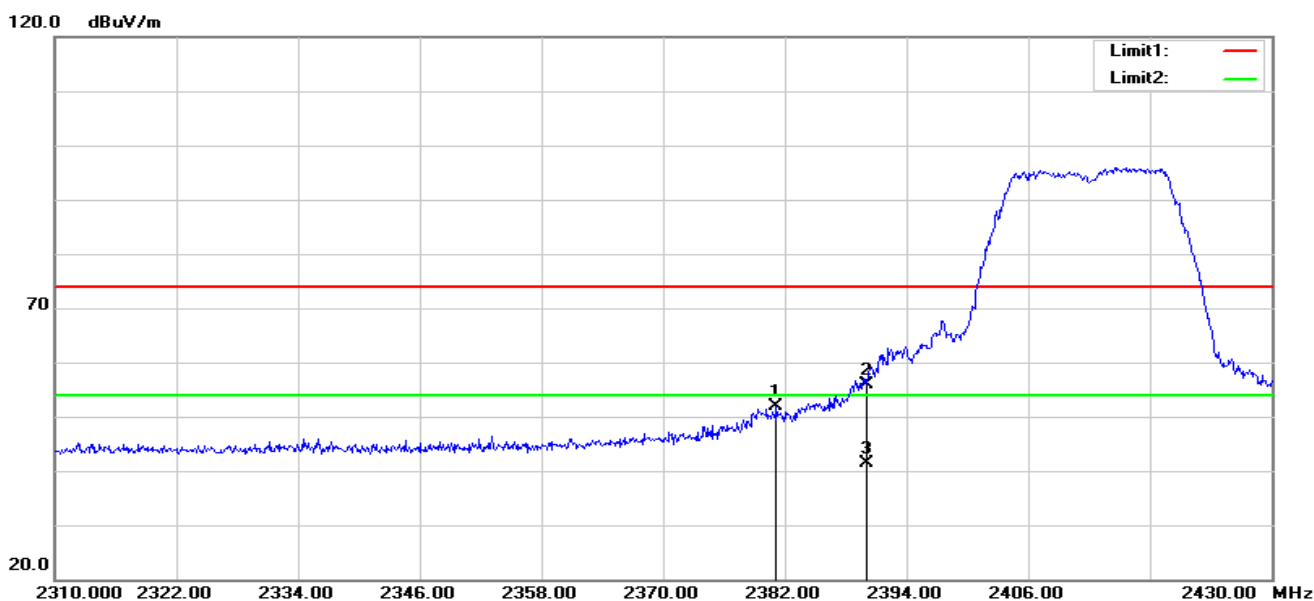
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(Db/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (Db)	Remark
1	2385.240	52.36	4.27	56.63	74.00	-17.37	peak
2	2385.240	36.83	4.27	41.10	54.00	-12.90	AVG
3	2390.000	55.16	4.34	59.50	74.00	-14.50	peak
4	2390.000	40.82	4.34	45.16	54.00	-8.84	AVG



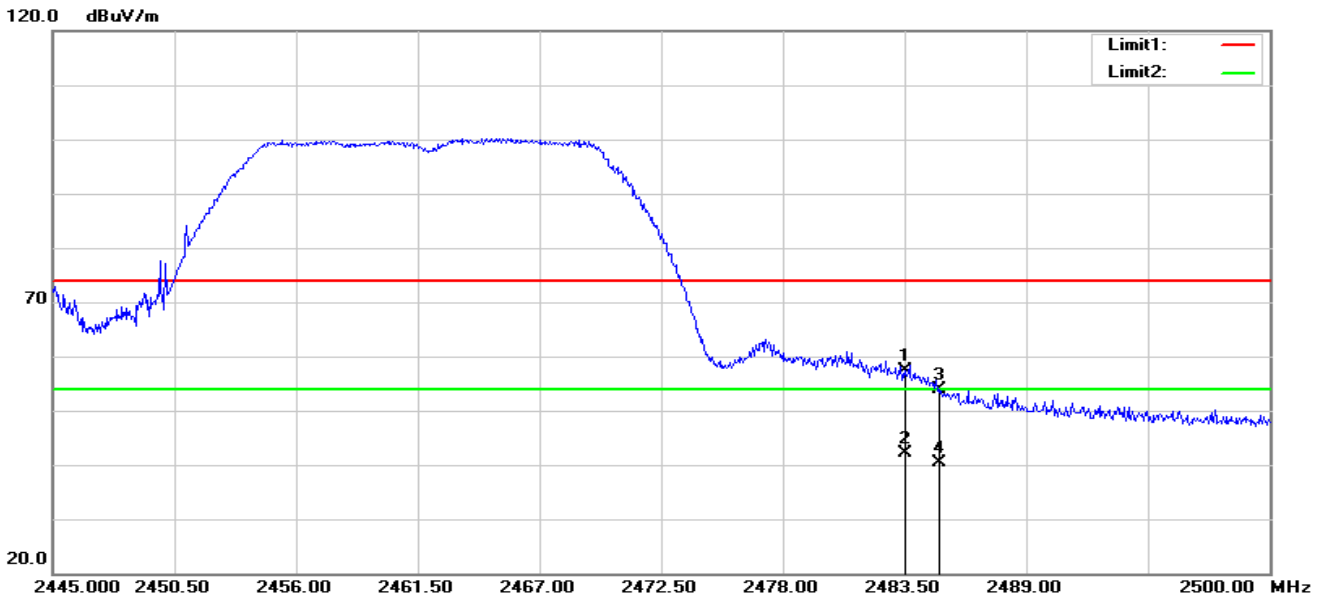
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(Db/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (Db)	Remark
1	2381.160	47.60	4.21	51.81	74.00	-22.19	peak
2	2390.000	51.57	4.34	55.91	74.00	-18.09	peak
3	2390.000	37.14	4.34	41.48	54.00	-12.52	AVG



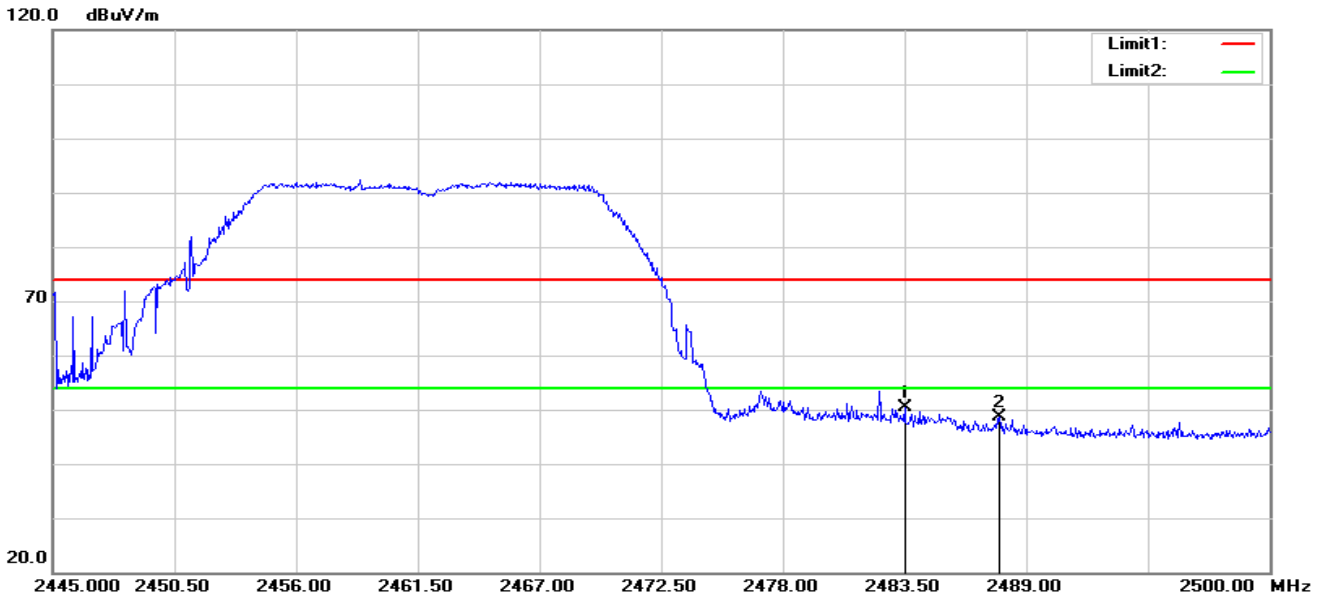
802.11 n(HT20)-High
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(Db/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (Db)	Remark
1	2483.500	52.84	4.60	57.44	74.00	-16.56	peak
2	2483.500	37.49	4.60	42.09	54.00	-11.91	AVG
3	2485.095	49.22	4.61	53.83	74.00	-20.17	peak
4	2485.095	35.65	4.61	40.26	54.00	-13.74	AVG



Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(Db/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (Db)	Remark
1	2483.500	45.71	4.60	50.31	74.00	-23.69	peak
2	2487.790	43.91	4.62	48.53	74.00	-25.47	peak

Note: 802.11b, 802.11g, 802.11n (HT-20), 802.11n (HT-40), all have been tested the antenna A, antenna B and antenna A+B, the worst case is 802.11 n(HT20) of the antenna A+B.

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d) & RSS-247 Issue 2, in any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20Db below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

4.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10 th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

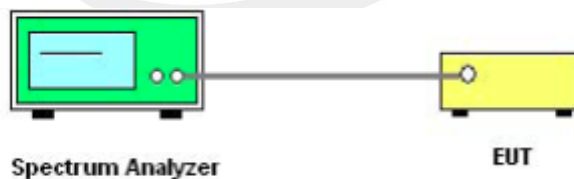
For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 to 2432 MHz Upper Band Edge: 2442 to 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

4.3 DEVIATION FROM STANDARD

No deviation.

4.4 TEST SETUP



The EUT which is powered by the Battery, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading.

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW.

4.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.

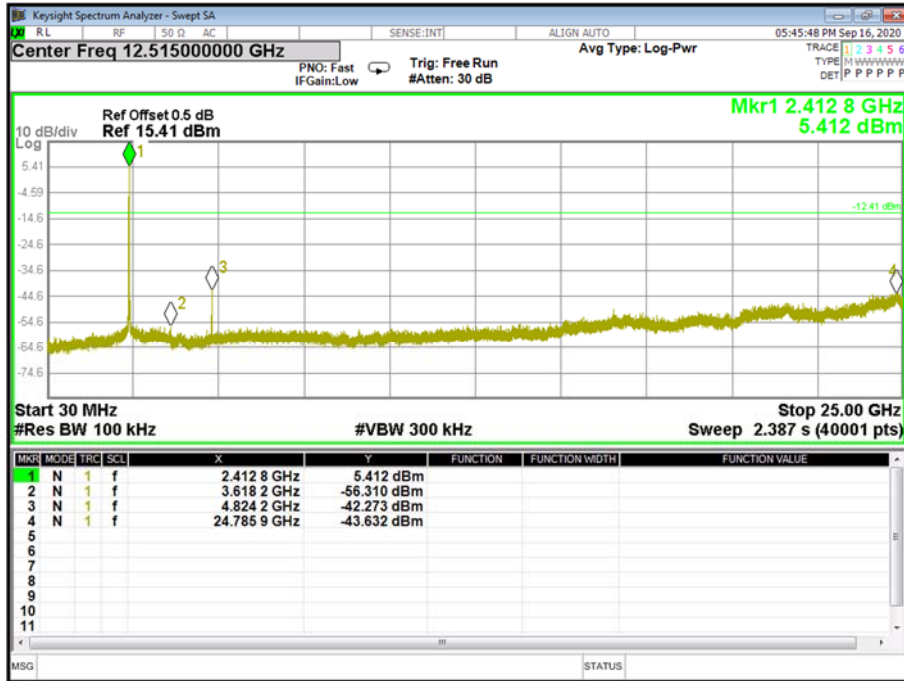


4.6 TEST RESULTS

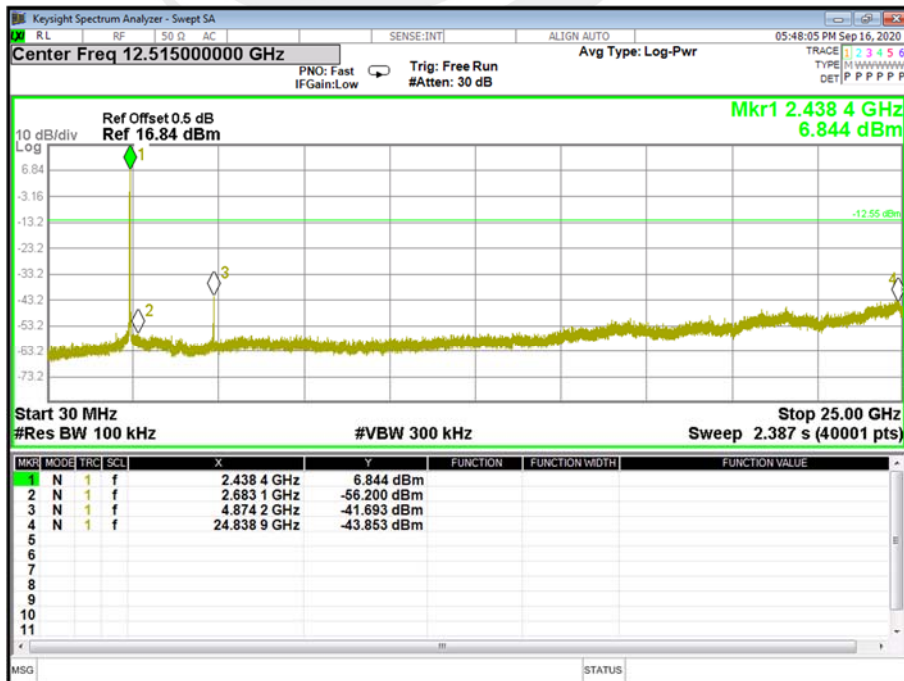
Note: Antenna A Power > Antenna B Power, Both antenna A and B have been test, Only show the worst data of Antenna A

Temperature:	25°C	Relative Humidity:	60%
Test Voltage:	DC 3.8V	Test Mode:	TX b Mode /CH01, CH06, CH11

Antenna A
CH 01

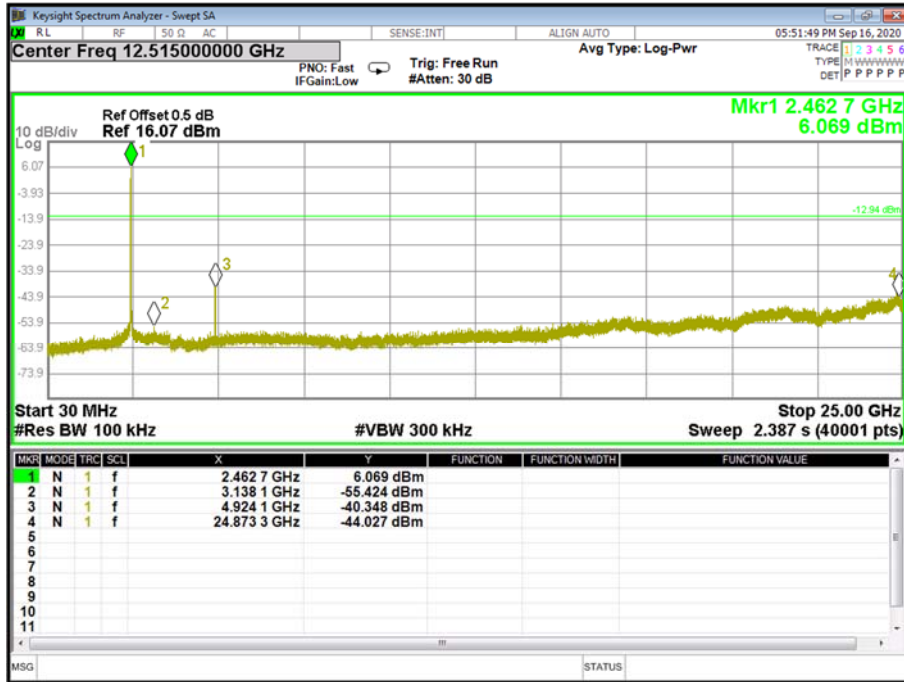


CH 06





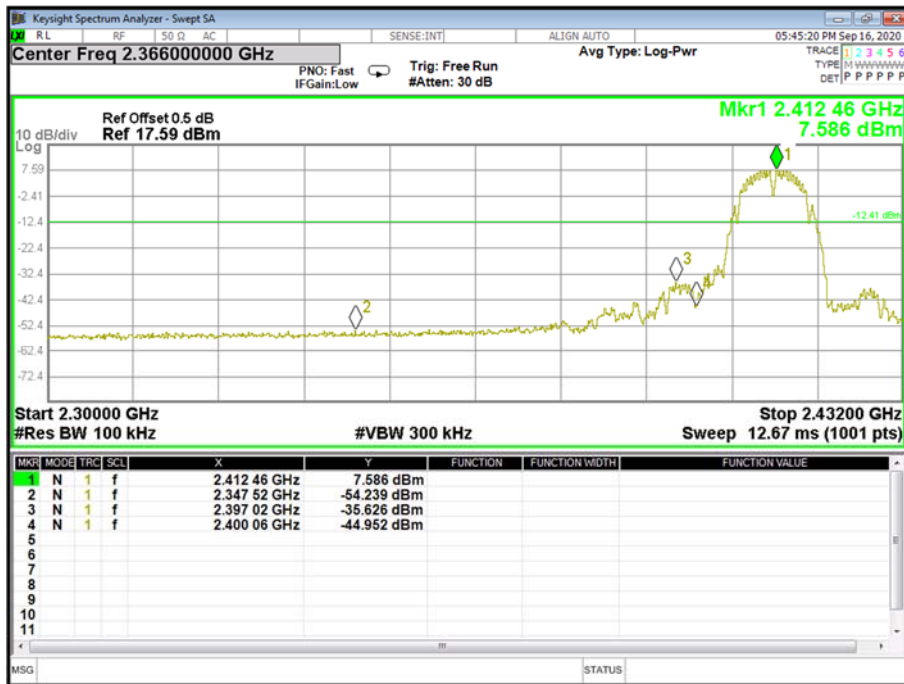
CH 11



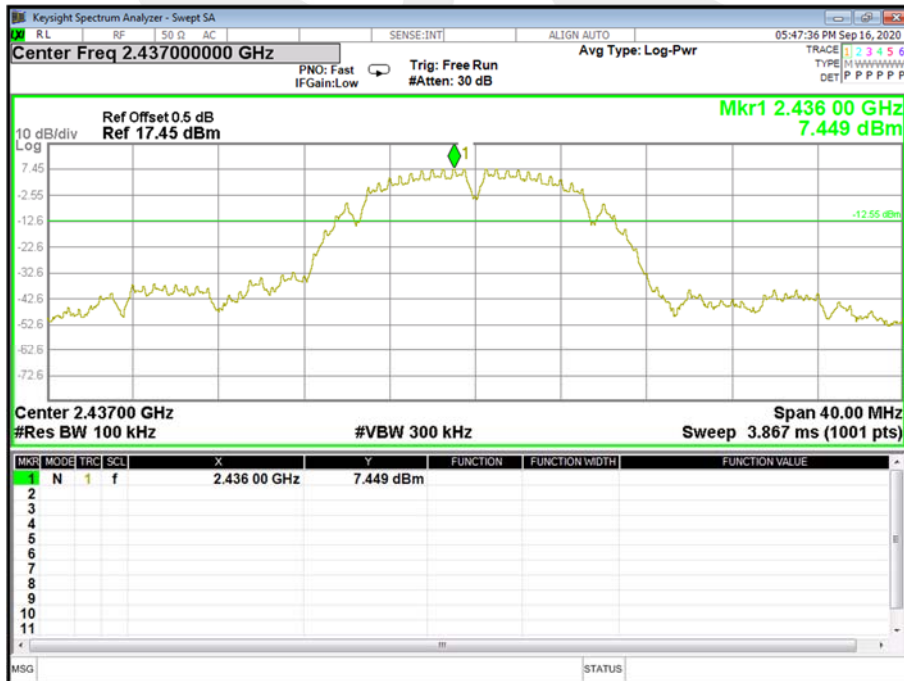


Band edge(it's also the reference level for conducted spurious emission)

CH 01

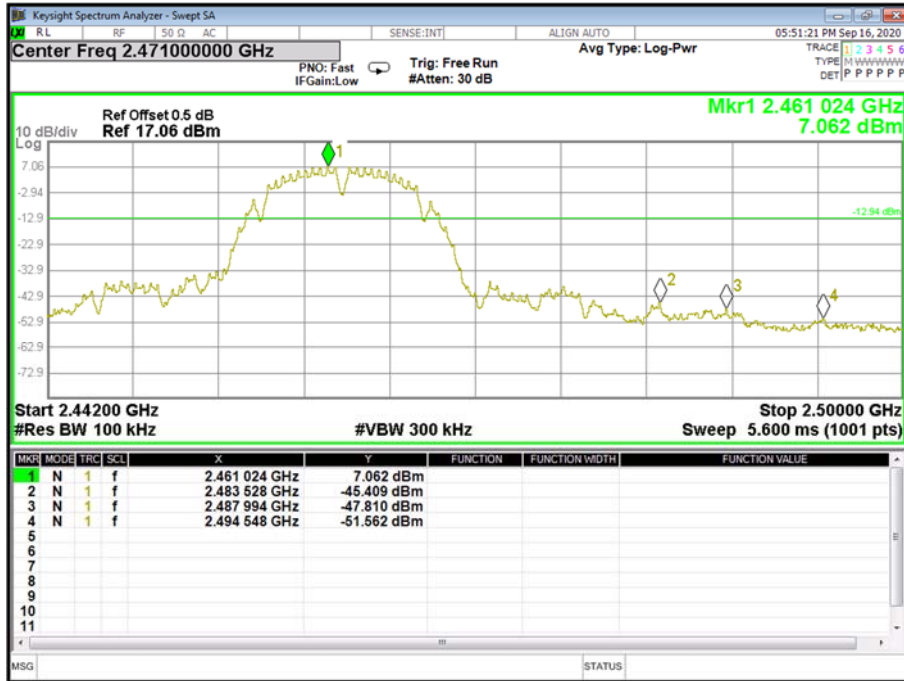


CH 06





CH 11



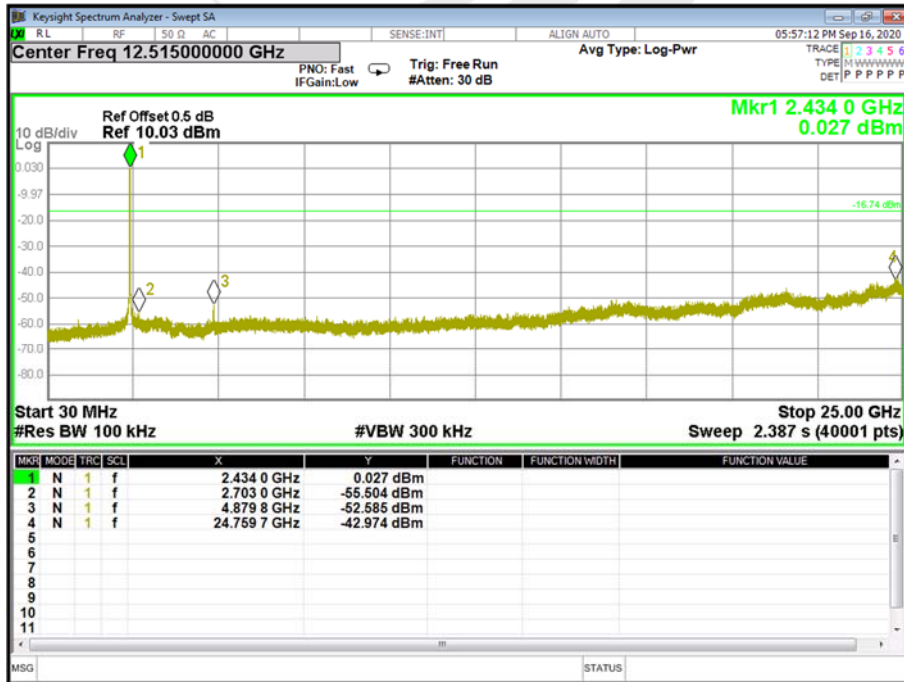


Temperature:	25°C	Relative Humidity:	60%
Test Voltage:	DC 3.8V	Test Mode:	TX g Mode /CH01, CH06, CH11

Antenna A
CH 01

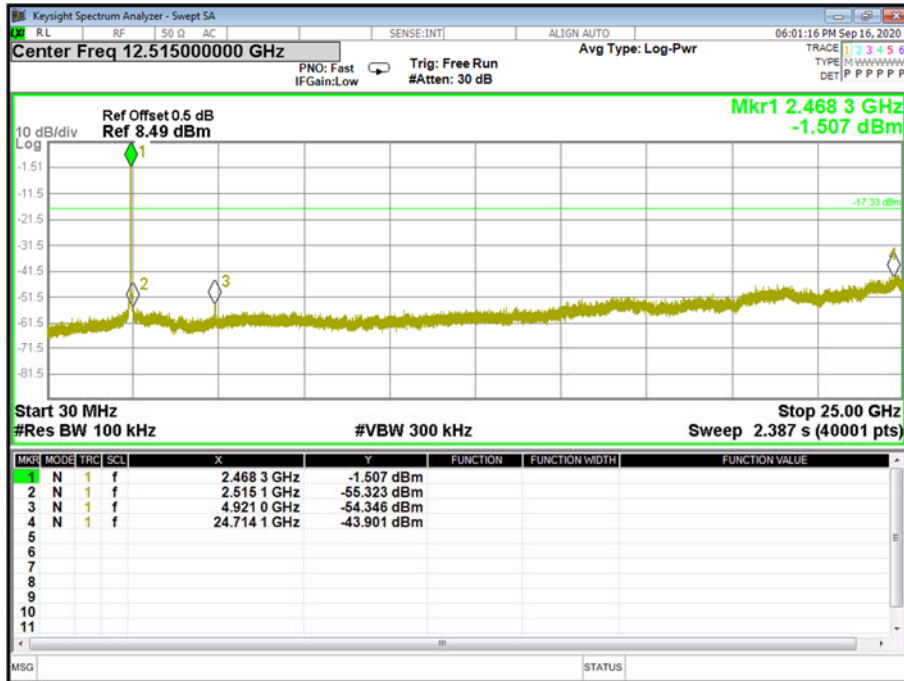


CH06





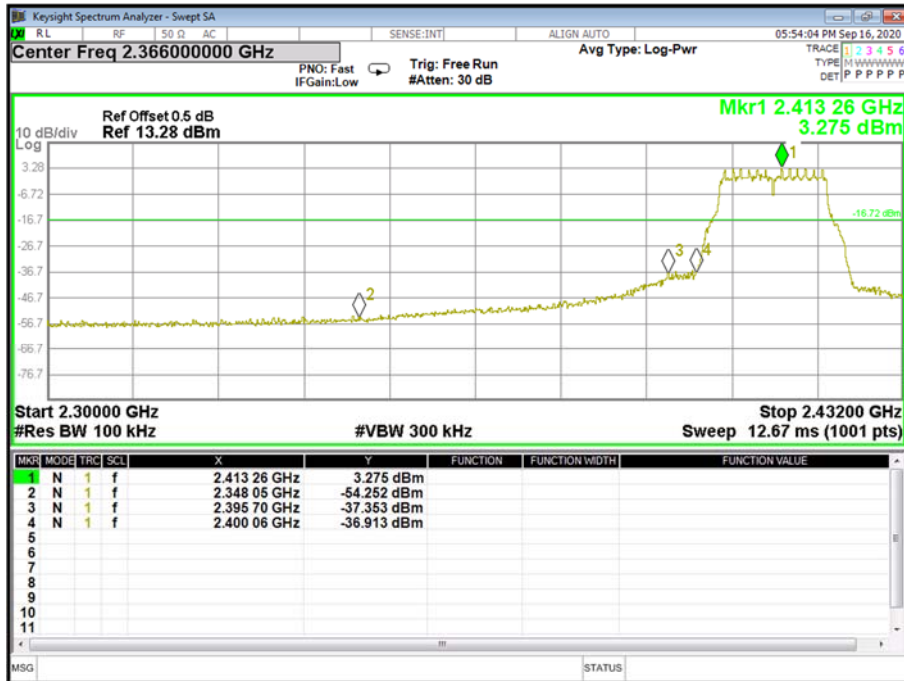
CH 11



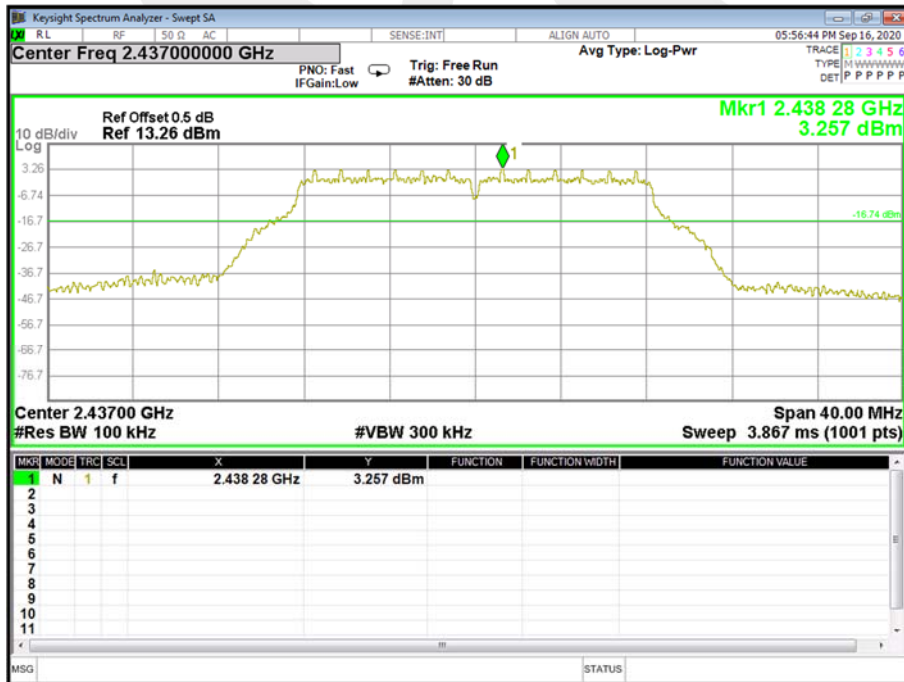


Band edge(it's also the reference level for conducted spurious emission)

CH 01

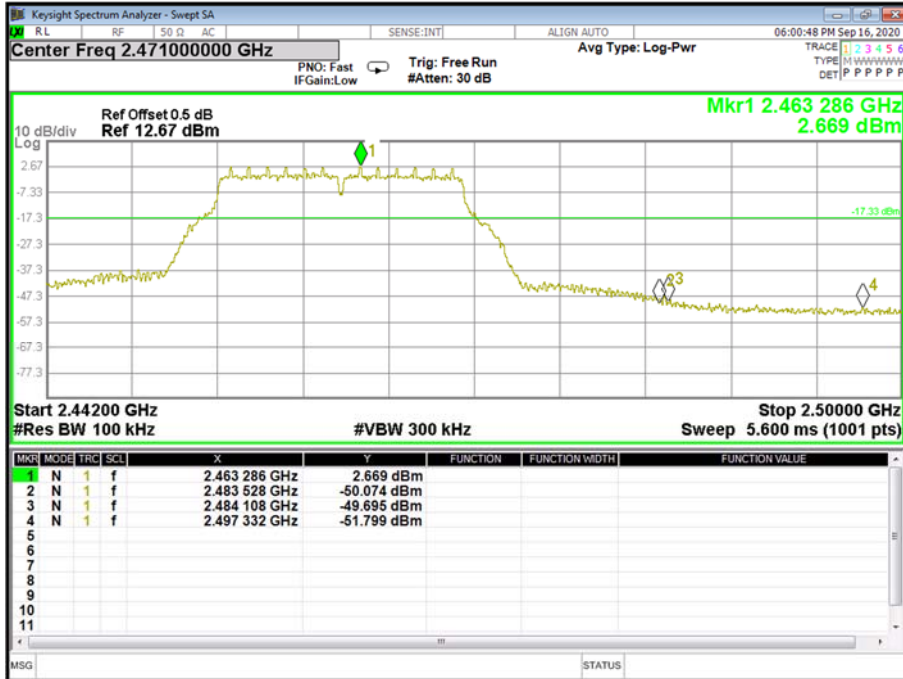


CH06





CH11

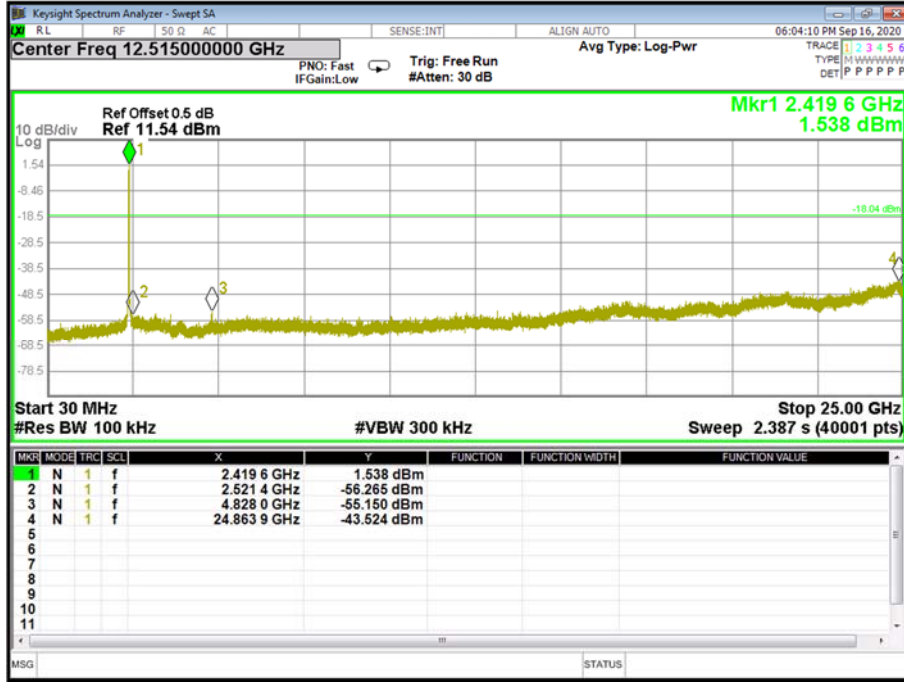




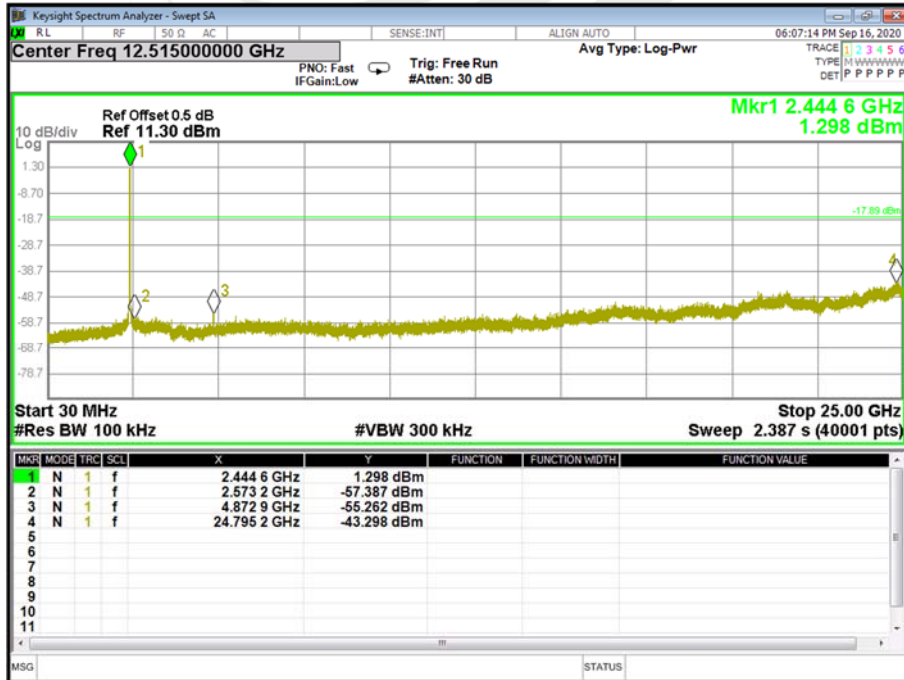
Temperature:	25°C	Relative Humidity:	60%
Test Voltage:	DC 3.8V	Test Mode:	TX n Mode(20M) /CH01, CH06, CH11

Antenna A

CH 01

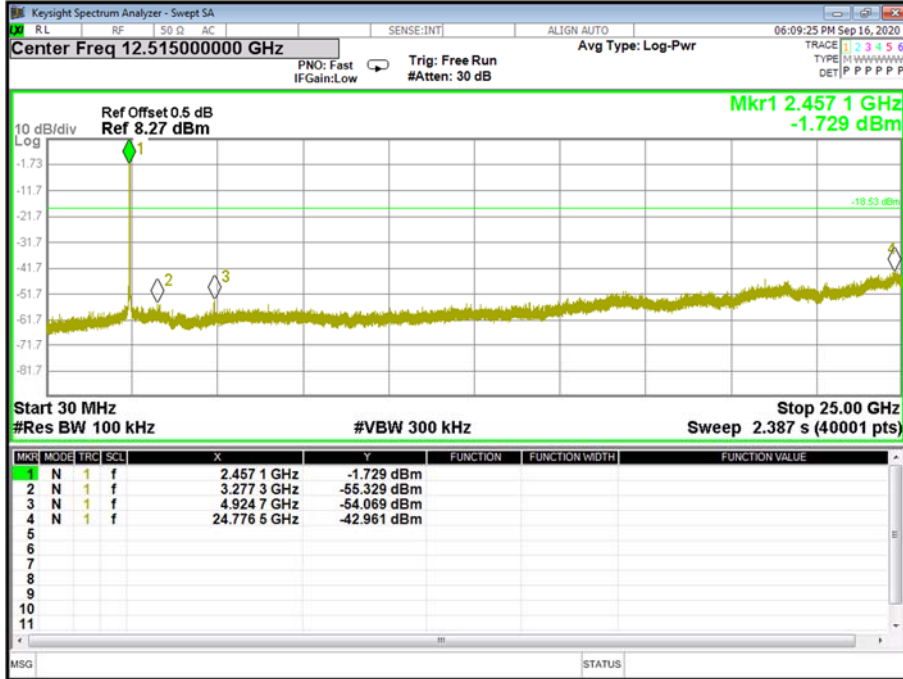


CH 06





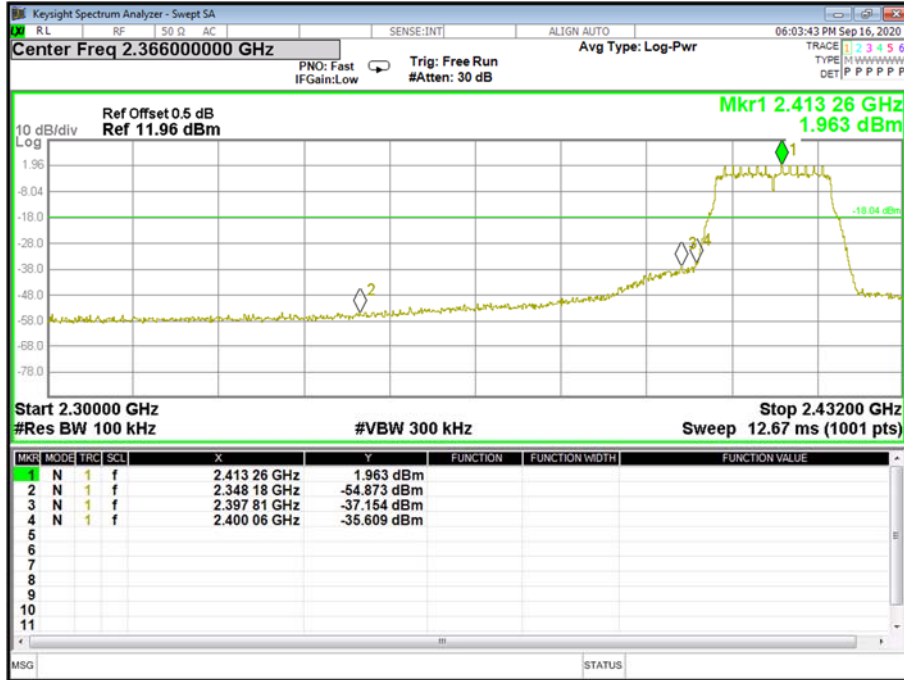
CH 11





Band edge(it's also the reference level for conducted spurious emission)

CH 01



CH 06





CH 11

