

S

T

S

L

A

B



RADIO TEST REPORT

Report No:STS1910134W04

Issued for

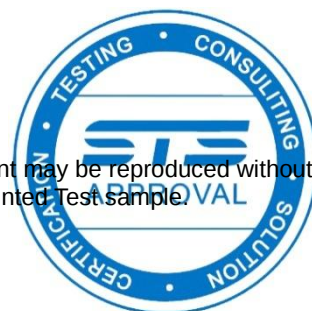
LM Technologies Ltd.

Unit 19, Spectrum House, 32-34 Gordon House Road, NW5 1LP
London, UK

Product Name:	Bluetooth 5.0 Dual Mode RS232 Serial Adapter
Brand Name:	LM Technologies
Model Name:	LM068
Series Model:	N/A
FCC ID:	VVXLM068
IC:	10531A-LM068
Test Standard:	FCC Part 15.247
	RSS-247 Issue 2, February 2017

Any reproduction of this document must be done in full. No single part of this document may be reproduced without permission from STS, All Test Data Presented in this report is only applicable to presented Test sample.

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
TEL: +86-755 3688 6288 FAX: +86-755 3688 6277 E-mail: sts@stsapp.com





TEST RESULT CERTIFICATION

Applicant's Name..... : LM Technologies Ltd.

Address : Unit 19, Spectrum House, 32-34 Gordon House Road, NW5 1LP
London, UK

Manufacture's Name..... : LM Technologies Ltd.

Address : Unit 19, Spectrum House, 32-34 Gordon House Road, NW5 1LP
London, UK

Product Description

Product Name : Bluetooth 5.0 Dual Mode RS232 Serial Adapter

Brand Name : LM Technologies

Model Name : LM068

Series Model : N/A

Test Standards..... : FCC Part15.247
RSS-247 Issue 2, February 2017

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.

This report shall not be reproduced except in full, without the written approval of STS, this document may be altered or revised by STS, personal only, and shall be noted in the revision of the document.

Date of Test..... :

Date (s) of performance of tests..... : 14 Oct. 2019 ~ 11 Nov. 2019

Date of Issue..... : 12 Nov. 2019

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

Testing Engineer :

(Chris Chen)

Technical Manager :

(Sunday Hu)

Authorized Signatory :

(Vita Li)





Table of Contents

1. SUMMARY OF TEST RESULTS	6
1.1 TEST FACTORY	7
1.2 MEASUREMENT UNCERTAINTY	7
2. GENERAL INFORMATION	8
2.1 GENERAL DESCRIPTION OF THE EUT	8
2.2 DESCRIPTION OF THE TEST MODES	10
2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED	11
2.4 DESCRIPTION OF NECESSARY ACCESSORIES AND SUPPORT UNITS	12
2.5 EQUIPMENTS LIST	13
3. EMC EMISSION TEST	14
3.1 CONDUCTED EMISSION MEASUREMENT	14
3.2 TEST PROCEDURE	15
3.3 TEST SETUP	15
3.4 EUT OPERATING CONDITIONS	15
3.5 TEST RESULTS	16
4. RADIATED EMISSION MEASUREMENT	18
4.1 RADIATED EMISSION LIMITS	18
4.2 TEST PROCEDURE	19
4.3 TEST SETUP	20
4.4 EUT OPERATING CONDITIONS	20
4.5 FIELD STRENGTH CALCULATION	21
4.6 TEST RESULTS	22
5. CONDUCTED SPURIOUS & BAND EDGE EMISSION	29
5.1 LIMIT	29
5.2 TEST PROCEDURE	29
5.3 TEST SETUP	29
5.4 EUT OPERATION CONDITIONS	29
5.5 TEST RESULTS	30
6. POWER SPECTRAL DENSITY TEST	34
6.1 LIMIT	34
6.2 TEST PROCEDURE	34
6.3 TEST SETUP	34



Table of Contents

6.4 EUT OPERATION CONDITIONS	34
6.5 TEST RESULTS	35
7. BANDWIDTH TEST	37
7.1 LIMIT	37
7.2 TEST PROCEDURE	37
7.3 TEST SETUP	37
7.4 EUT OPERATION CONDITIONS	37
7.5 TEST RESULTS	38
8. PEAK OUTPUT POWER TEST	42
8.1 LIMIT	42
8.2 TEST PROCEDURE	42
8.3 TEST SETUP	42
8.4 EUT OPERATION CONDITIONS	42
8.5 TEST RESULTS	43
9. ANTENNA REQUIREMENT	44
9.1 STANDARD REQUIREMENT	44
9.2 EUT ANTENNA	44
10. FREQUENCY STABILITY	45
10.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT	45
10.2 TEST PROCEDURE	45
10.3 TEST RESULT	45
11. EUT TEST PHOTO	46

**Revision History**

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	12 Nov. 2019	STS1910134W04	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 Issue 5	Conducted Emission	PASS	--
15.247 (a)(2)	6dB Bandwidth	PASS	--
RSS-GEN clause 6.7	99% Bandwidth	PASS	--
15.247 (b)(3) RSS-247 Issue 2, February 2017 (5.4)	Output Power	PASS	--
15.247 (d) RSS-247 Issue 2, February 2017 (5.5)	Radiated Spurious Emission	PASS	--
15.247 (d) RSS-247 Issue 2, February 2017 (5.5)	Conducted Spurious & Band Edge Emission	PASS	--
15.247 (e) RSS-247 Issue 2, February 2017	Power Spectral Density	PASS	--
15.209 15.205	Restricted Band Edge Emission	PASS	--
Part 15.247(d)/part 15.209(a) RSS-247 Issue 2, February 2017	Band Edge Emission	PASS	--
15.203 RSS-Gen Issue 5 6.8	Antenna Requirement	PASS	--
RSS-Gen Issue 5 6.11	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 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	$\pm 0.68\text{dB}$
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)	$\pm 4.43\text{dB}$
7	Conducted Emission (150KHz-30MHz)	$\pm 5\text{dB}$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF THE EUT

Product Name	Bluetooth 5.0 Dual Mode RS232 Serial Adapter	
Trade Name	LM Technologies	
Model Name	LM068	
Series Model	N/A	
Model Difference	N/A	
Product Description	The EUT is a Bluetooth 5.0 Dual Mode RS232 Serial Adapter	
	Operation Frequency:	2402~2480 MHz
	Modulation Type:	GFSK
	Radio Technology:	BLE
	Bluetooth Version:	5.0
	Bluetooth Configuration:	LE
	Number Of Channel:	40
	Antenna Designation:	Please see Note 3.
	Antenna Gain (dBi)	3 dBi
Channel List	Please refer to the Note 2.	
Power Rating	Input: DC 5V/0.5A	
Hardware version number	rev02	
Software version number	SPPC_02XX	
Radio Hardware version	MPLY.LR9.W1444,MD.LWTG.MP.V79.P4	
Radio Software version	SC6531_W13.04.05_Release	
Test Software	3.18.19	
RF Power Setting TEST Software (power class)	(1)2.4 GHz:GFSK(1Mbps):-6.5	
Connecting I/O Port(s)	Please refer to the User's Manual	

Note:

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



2.

Channel List							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	10	2422	20	2442	30	2462
01	2404	11	2424	21	2444	31	2464
02	2406	12	2426	22	2446	32	2466
03	2408	13	2428	23	2448	33	2468
04	2410	14	2430	24	2450	34	2470
05	2412	15	2432	25	2452	35	2472
06	2414	16	2434	26	2454	36	2474
07	2416	17	2436	27	2456	37	2476
08	2418	18	2438	28	2458	38	2478
09	2420	19	2440	29	2460	39	2480

3.

Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)	NOTE
1	LM Technologies	LM068	Ceramic	N/A	3 dBi	BLE ANT.





2.2 DESCRIPTION OF THE TEST MODES

For conducted test items and radiated spurious emissions

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

Worst Mode	Description	Data/Modulation
Mode 1	TX CH00(2402MHz)	1 MHz/GFSK
Mode 2	TX CH19(2440MHz)	1 MHz/GFSK
Mode 3	TX CH39(2480MHz)	1 MHz/GFSK

Note:

(1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported

(2) We have be tested for all available U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/60Hz is shown in the report

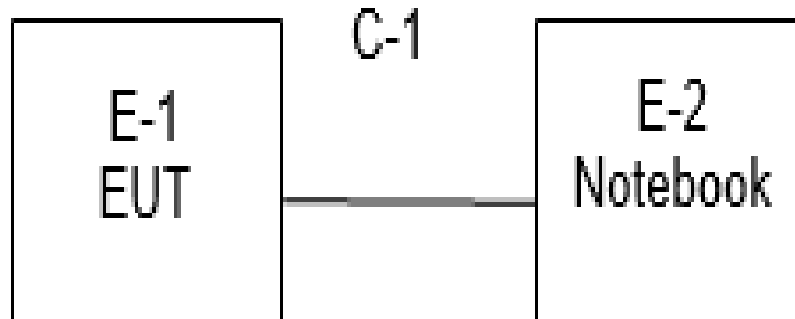
(3) Controlled using a bespoke application on the laptop PC supplied by the customer. The application was used to enable a continuous transmission mode and to select the test channels, data rates and modulation schemes as required.

For AC Conducted Emission

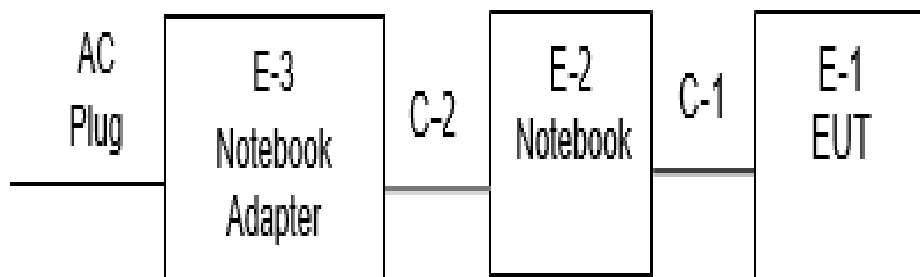
Test Case	
AC Conducted Emission	Mode 4 : Keeping BT TX

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conducted Emission Test





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
E-3	Adapter	N/A	N/A	N/A	N/A
C-2	DC Cable	N/A	110cm	N/A	N/A

Support units

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note
E-2	Notebook	DELL	VOSTRO.3800	N/A	N/A
C-1	USB Cable	N/A	100cm	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.
- (3) “YES” is means “shielded” “with core”; “NO” is means “unshielded” “without core”.



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	2019.07.29	2020.07.28
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	2020.11.01
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-3G Hz)	EM	EM330	060665	2019.10.09	2020.10.08
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK201808090 1	2019.10.09	2020.10.08
Temperature & Humidity	HH660	Mieo	N/A	2019.10.09	2020.10.08
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	2019.07.29	2020.07.28
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 207(a) and RSS-Gen Issue 5 limit in the table below has to be followed.

FREQUENCY (MHz)	Conducted Emission limit (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.

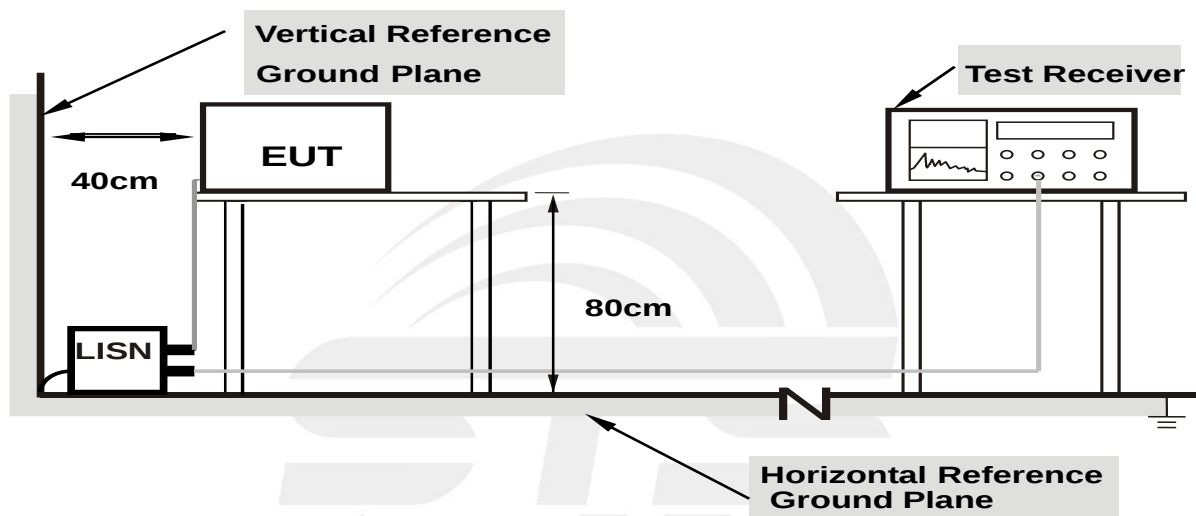
The following table is the setting of the receiver

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

3.2 TEST PROCEDURE

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



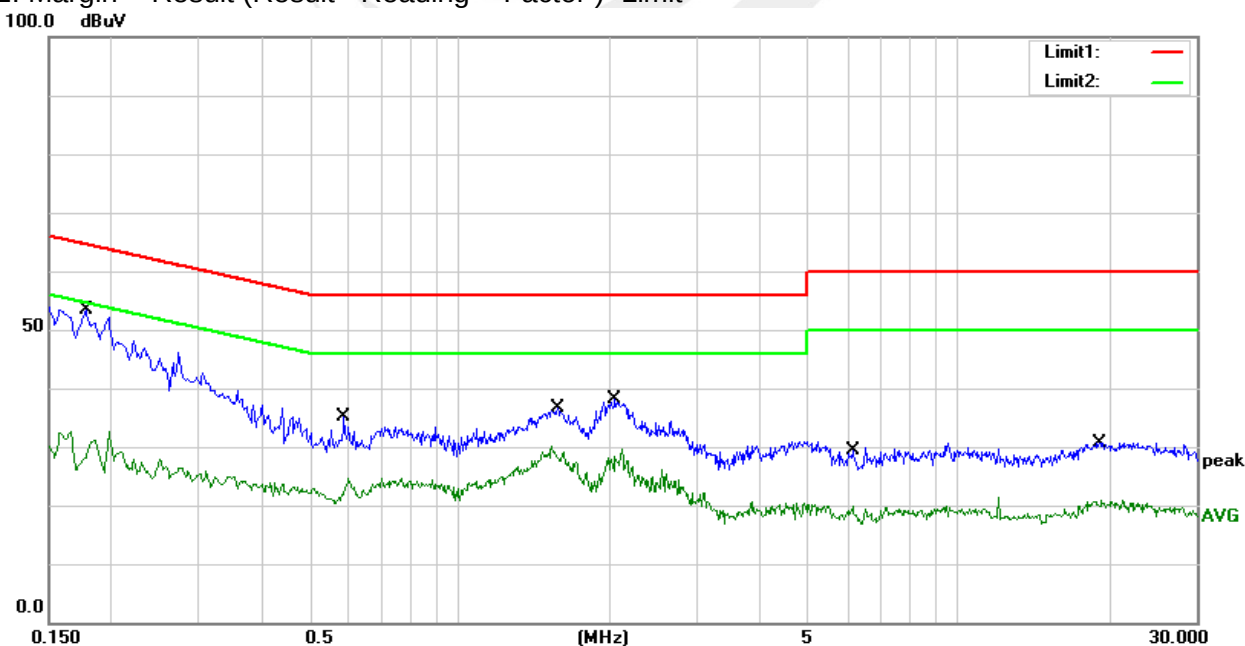
3.5 TEST RESULTS

Temperature:	26.7(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4		

No.	Frequen cy	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(d B)	(dBuV)	(dBuV)	(dB)	
1	0.1780	32.78	20.54	53.32	64.58	-11.26	QP
2	0.1780	10.53	20.54	31.07	54.58	-23.51	AVG
3	0.5860	15.11	20.07	35.18	56.00	-20.82	QP
4	0.5860	4.43	20.07	24.50	46.00	-21.50	AVG
5	1.5740	16.94	19.71	36.65	56.00	-19.35	QP
6	1.5740	10.37	19.71	30.08	46.00	-15.92	AVG
7	2.0540	18.20	19.94	38.14	56.00	-17.86	QP
8	2.0540	9.70	19.94	29.64	46.00	-16.36	AVG
9	6.1380	9.11	20.33	29.44	60.00	-30.56	QP
10	6.1380	-0.57	20.33	19.76	50.00	-30.24	AVG
11	19.1740	9.31	21.37	30.68	60.00	-29.32	QP
12	19.1740	-0.44	21.37	20.93	50.00	-29.07	AVG

Remark:

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



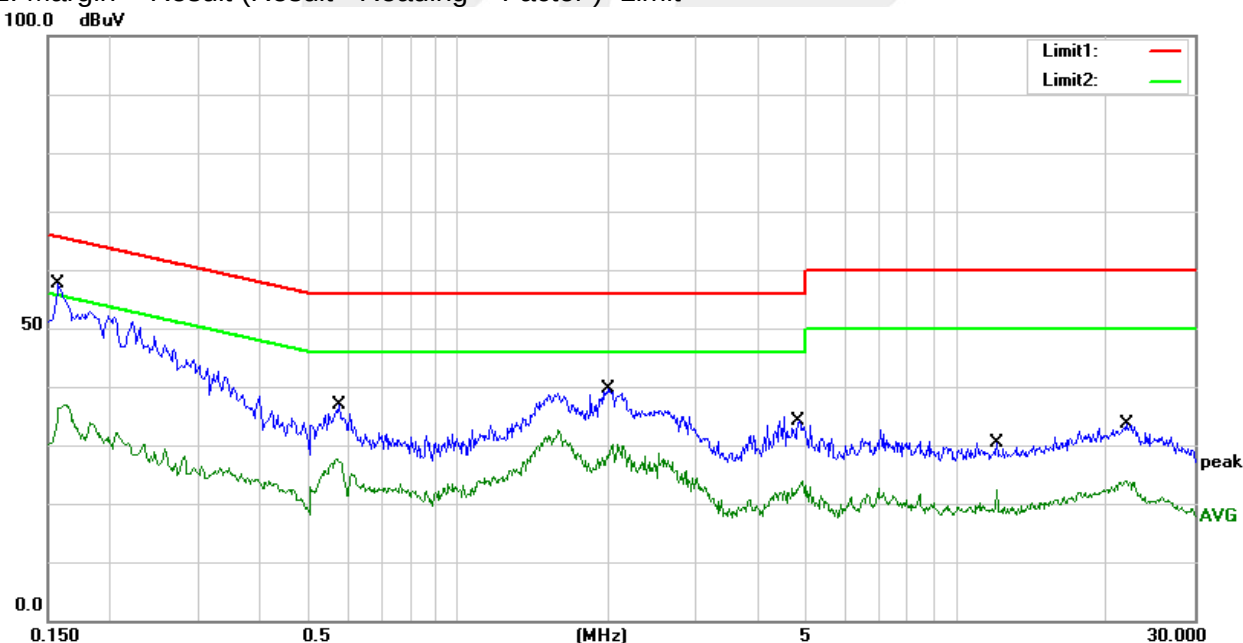


Temperature:	26.7(C)	Relative Humidity:	60%RH
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4		

No.	Frequen cy	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(d B)	(dBuV)	(dBuV)	(dB)	
1	0.1580	37.07	20.54	57.61	65.57	-7.96	QP
2	0.1580	16.36	20.54	36.90	55.57	-18.67	AVG
3	0.5780	16.93	20.06	36.99	56.00	-19.01	QP
4	0.5780	7.57	20.06	27.63	46.00	-18.37	AVG
5	1.9940	19.68	19.93	39.61	56.00	-16.39	QP
6	1.9940	10.13	19.93	30.06	46.00	-15.94	AVG
7	4.8460	13.71	20.39	34.10	56.00	-21.90	QP
8	4.8460	3.46	20.39	23.85	46.00	-22.15	AVG
9	12.0020	9.79	20.60	30.39	60.00	-29.61	QP
10	12.0020	1.80	20.60	22.40	50.00	-27.60	AVG
11	21.8860	12.27	21.38	33.65	60.00	-26.35	QP
12	21.8860	2.55	21.38	23.93	50.00	-26.07	AVG

Remark:

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





4. RADIATED EMISSION MEASUREMENT

4.1 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) and RSS-247 Issue 2 limit in the table and according to ANSI C63.10-2013 below has to be followed.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequencies (MHz)	Field Strength (microvolts/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 (Above 1000MHz)

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).

For Radiated Emission

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

For Band edge

Spectrum Parameter	Setting
Detector	Peak/AV
Start/Stop Frequency	Lower Band Edge: 2300 to 2403 MHz Upper Band Edge: 2479 to 2500 MHz
RB / VB (emission in restricted band)	1 MHz / 3 MHz



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 / RB 9kHz 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

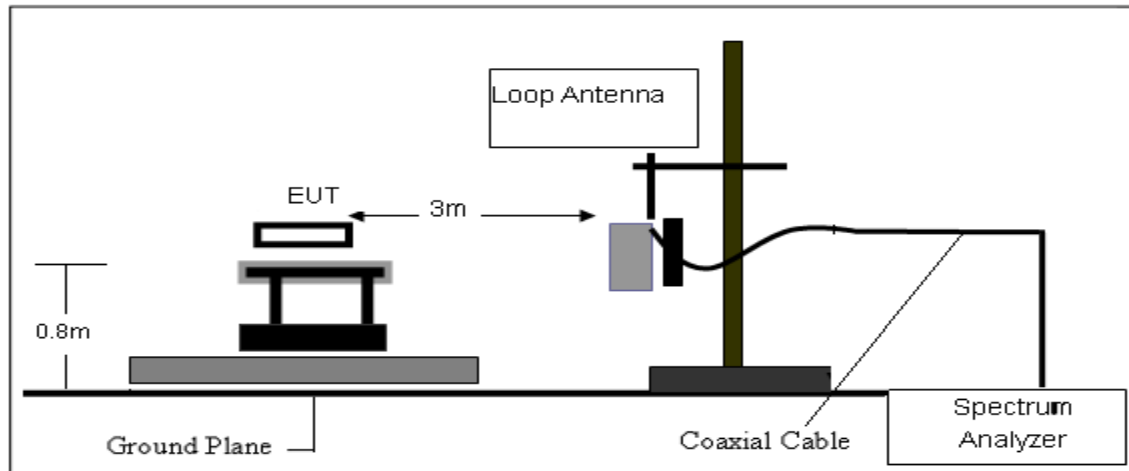
- The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 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
- 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.
- 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.
- For the actual test configuration, please refer to the related Item –EUT Test Photos.

Note:

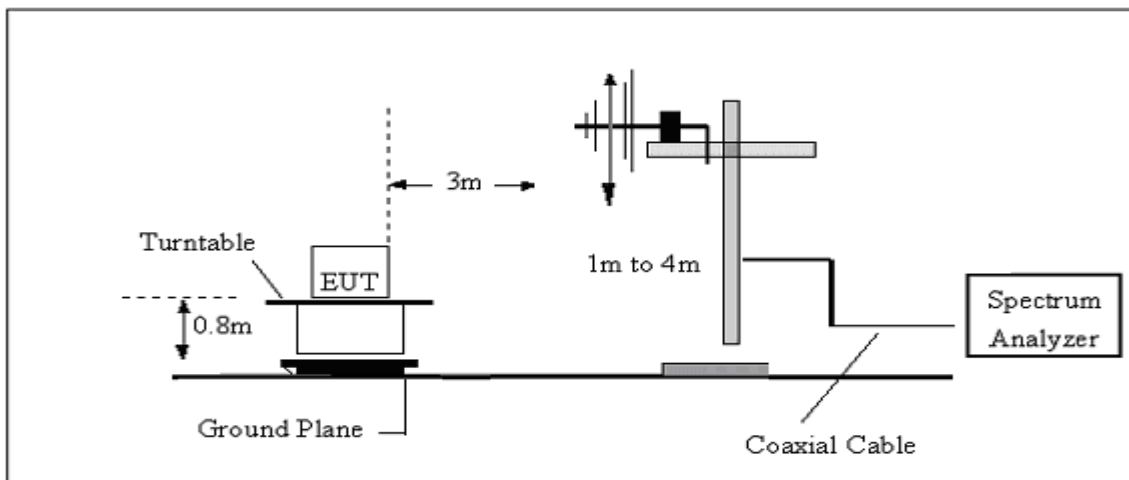
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

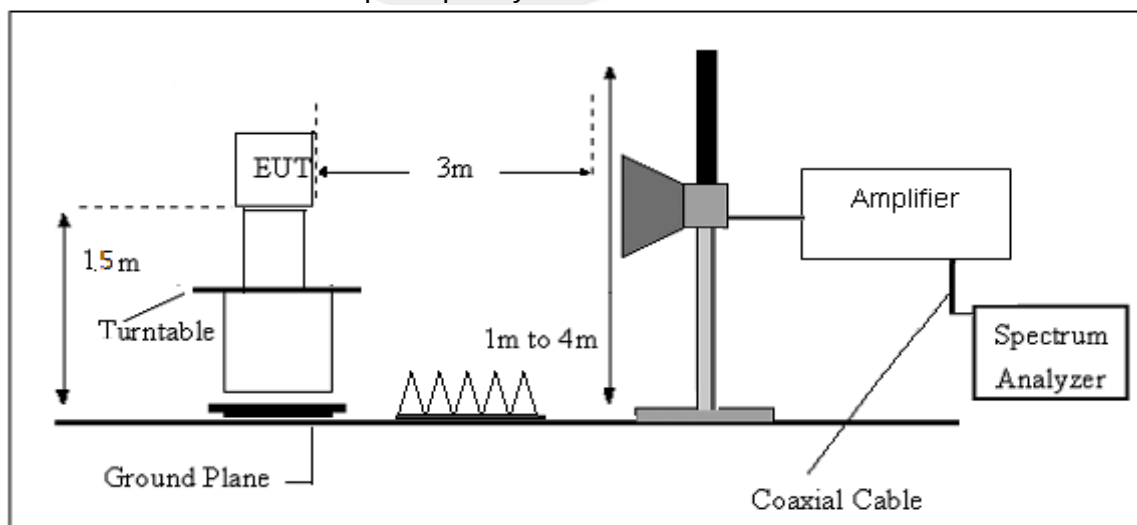
(A) Radiated Emission Test-Up Frequency Below 30MHz



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



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



4.4 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.



4.5 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	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

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





4.6 TEST RESULTS

(Between 9KHz – 30 MHz)

Temperature:	24.8(C)	Relative Humidity:	60%RH
Test Voltage:	DC 5V	Polarization:	--
Test Mode:	TX Mode		

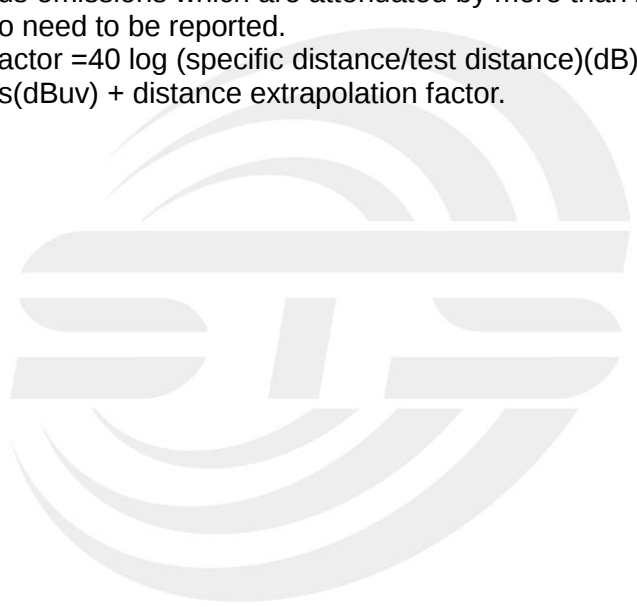
Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	PASS
--	--	--	--	PASS

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

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





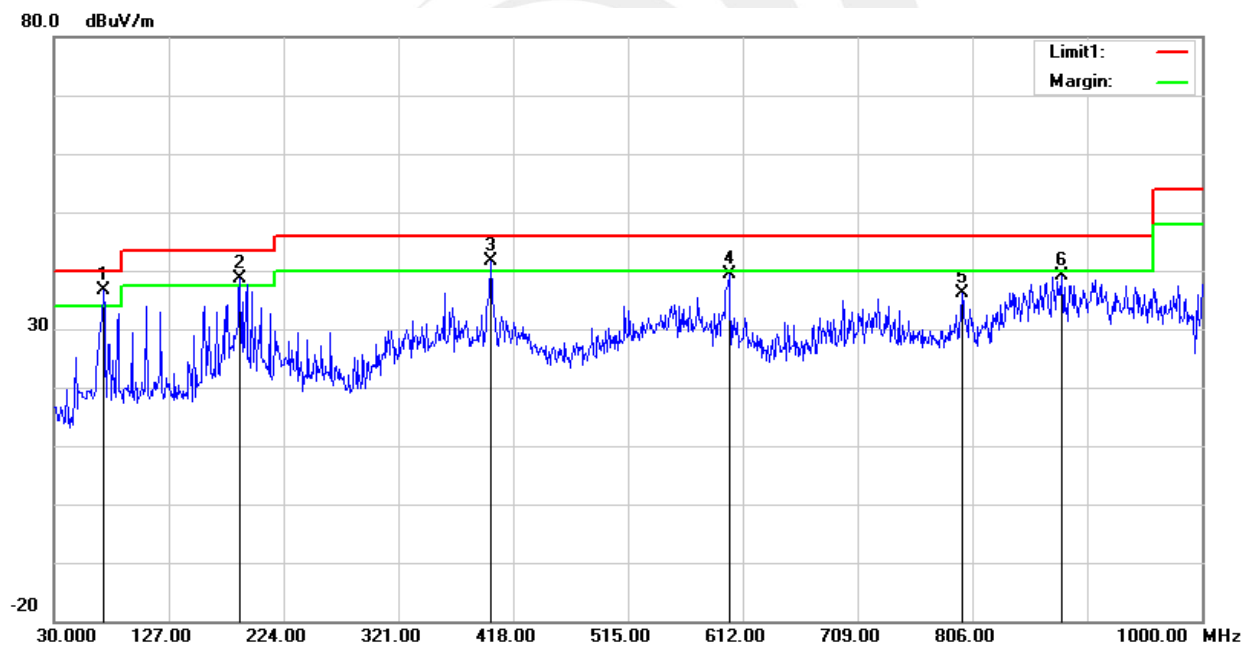
(30MHz -1000MHz)

Temperature:	24.8(C)	Relative Humidity:	60%RH
Test Voltage:	DC 5V	Phase:	Horizontal
Test Mode:	Mode 1/2/3 (Mode 2 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/ m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	71.7100	61.19	-24.56	36.63	40.00	-3.37	QP
2	187.1400	59.32	-20.64	38.68	43.50	-4.82	QP
3	399.5700	52.74	-11.16	41.58	46.00	-4.42	QP
4	600.3600	45.12	-5.84	39.28	46.00	-6.72	QP
5	797.2700	38.08	-2.03	36.05	46.00	-9.95	QP
6	881.6600	39.78	-0.66	39.12	46.00	-6.88	QP

Remark:

1. Margin = Result (Result =Reading + Factor)-Limit



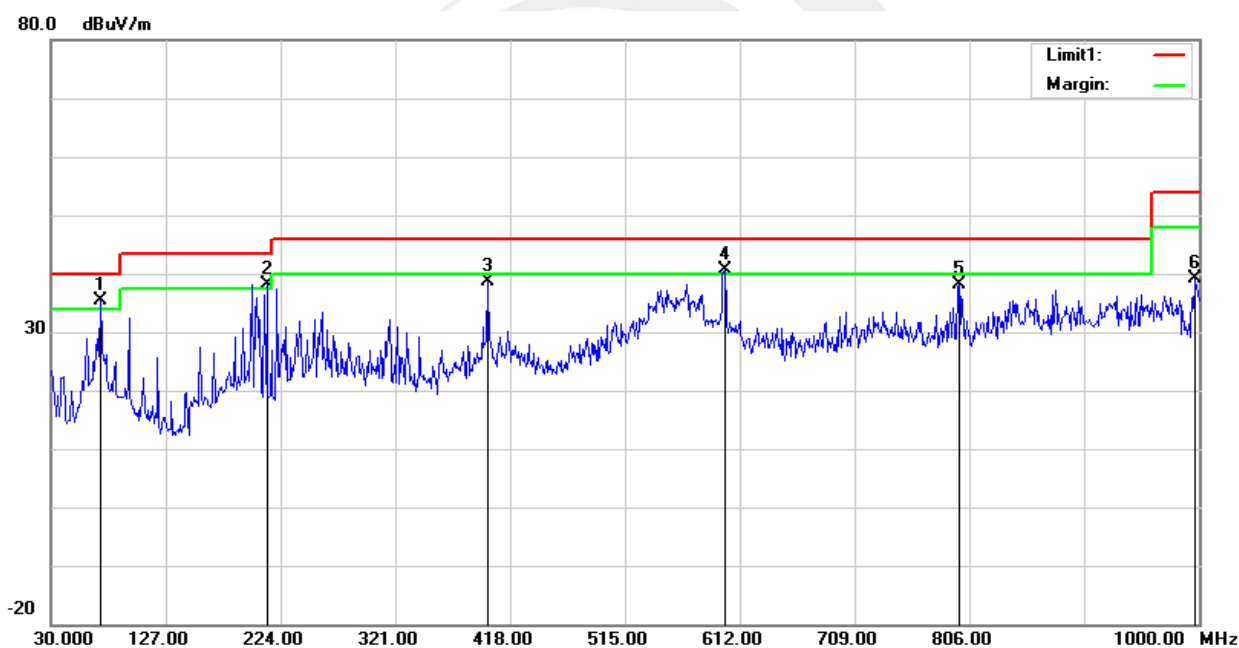


Temperature:	24.8(C)	Relative Humidity:	60%RH
Test Voltage:	DC 5V	Phase:	Vertical
Test Mode:	Mode 1/2/3 (Mode 2 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/ m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	71.7100	59.98	-24.56	35.42	40.00	-4.58	QP
2	212.3600	58.52	-20.27	38.25	43.50	-5.25	QP
3	398.6000	49.91	-11.20	38.71	46.00	-7.29	QP
4	599.3900	46.57	-5.84	40.73	46.00	-5.27	QP
5	797.2700	40.10	-2.03	38.07	46.00	-7.93	QP
6	997.0900	37.04	2.04	39.08	54.00	-14.92	QP

Remark:

1. Margin = Result (Result =Reading + Factor)-Limit





(1GHz-25GHz)Restricted band and Spurious emission Requirements

GFSK

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Orrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (2402 MHz)										
3264.77	61.21	44.70	6.70	28.20	-9.80	51.41	74.00	-22.59	PK	Vertical
3264.77	49.92	44.70	6.70	28.20	-9.80	40.12	54.00	-13.88	AV	Vertical
3264.59	61.79	44.70	6.70	28.20	-9.80	51.99	74.00	-22.01	PK	Horizontal
3264.59	50.74	44.70	6.70	28.20	-9.80	40.94	54.00	-13.06	AV	Horizontal
4804.55	59.32	44.20	9.04	31.60	-3.56	55.76	74.00	-18.24	PK	Vertical
4804.55	50.17	44.20	9.04	31.60	-3.56	46.61	54.00	-7.39	AV	Vertical
4804.45	58.98	44.20	9.04	31.60	-3.56	55.42	74.00	-18.58	PK	Horizontal
4804.45	49.13	44.20	9.04	31.60	-3.56	45.57	54.00	-8.43	AV	Horizontal
5359.61	48.90	44.20	9.86	32.00	-2.34	46.56	74.00	-27.44	PK	Vertical
5359.61	39.99	44.20	9.86	32.00	-2.34	37.65	54.00	-16.35	AV	Vertical
5359.73	47.60	44.20	9.86	32.00	-2.34	45.26	74.00	-28.74	PK	Horizontal
5359.73	38.53	44.20	9.86	32.00	-2.34	36.19	54.00	-17.81	AV	Horizontal
7205.81	54.93	43.50	11.40	35.50	3.40	58.33	74.00	-15.67	PK	Vertical
7205.81	44.72	43.50	11.40	35.50	3.40	48.12	54.00	-5.88	AV	Vertical
7205.74	54.78	43.50	11.40	35.50	3.40	58.18	74.00	-15.82	PK	Horizontal
7205.74	44.17	43.50	11.40	35.50	3.40	47.57	54.00	-6.43	AV	Horizontal
Middle Channel (2440 MHz)										
3264.73	61.46	44.70	6.70	28.20	-9.80	51.66	74.00	-22.34	PK	Vertical
3264.73	50.01	44.70	6.70	28.20	-9.80	40.21	54.00	-13.79	AV	Vertical
3264.67	61.81	44.70	6.70	28.20	-9.80	52.01	74.00	-21.99	PK	Horizontal
3264.67	51.15	44.70	6.70	28.20	-9.80	41.35	54.00	-12.65	AV	Horizontal
4880.47	58.22	44.20	9.04	31.60	-3.56	54.66	74.00	-19.34	PK	Vertical
4880.47	50.53	44.20	9.04	31.60	-3.56	46.97	54.00	-7.03	AV	Vertical
4880.43	59.17	44.20	9.04	31.60	-3.56	55.61	74.00	-18.39	PK	Horizontal
4880.43	49.82	44.20	9.04	31.60	-3.56	46.26	54.00	-7.74	AV	Horizontal
5359.68	49.24	44.20	9.86	32.00	-2.34	46.90	74.00	-27.10	PK	Vertical
5359.68	39.38	44.20	9.86	32.00	-2.34	37.04	54.00	-16.96	AV	Vertical
5359.68	47.31	44.20	9.86	32.00	-2.34	44.97	74.00	-29.03	PK	Horizontal
5359.68	38.75	44.20	9.86	32.00	-2.34	36.41	54.00	-17.59	AV	Horizontal
7320.69	54.74	43.50	11.40	35.50	3.40	58.14	74.00	-15.86	PK	Vertical
7320.69	44.37	43.50	11.40	35.50	3.40	47.77	54.00	-6.23	AV	Vertical
7320.76	54.74	43.50	11.40	35.50	3.40	58.14	74.00	-15.86	PK	Horizontal
7320.76	43.60	43.50	11.40	35.50	3.40	47.00	54.00	-7.00	AV	Horizontal



High Channel (2480 MHz)										
3264.84	60.88	44.70	6.70	28.20	-9.80	51.08	74.00	-22.92	PK	Vertical
3264.84	51.67	44.70	6.70	28.20	-9.80	41.87	54.00	-12.13	AV	Vertical
3264.82	62.10	44.70	6.70	28.20	-9.80	52.30	74.00	-21.70	PK	Horizontal
3264.82	50.71	44.70	6.70	28.20	-9.80	40.91	54.00	-13.09	AV	Horizontal
4960.29	58.35	44.20	9.04	31.60	-3.56	54.79	74.00	-19.21	PK	Vertical
4960.29	49.44	44.20	9.04	31.60	-3.56	45.88	54.00	-8.12	AV	Vertical
4960.47	59.20	44.20	9.04	31.60	-3.56	55.64	74.00	-18.36	PK	Horizontal
4960.47	49.44	44.20	9.04	31.60	-3.56	45.88	54.00	-8.12	AV	Horizontal
5359.67	48.14	44.20	9.86	32.00	-2.34	45.80	74.00	-28.20	PK	Vertical
5359.67	39.51	44.20	9.86	32.00	-2.34	37.17	54.00	-16.83	AV	Vertical
5359.59	48.30	44.20	9.86	32.00	-2.34	45.96	74.00	-28.04	PK	Horizontal
5359.59	38.62	44.20	9.86	32.00	-2.34	36.28	54.00	-17.72	AV	Horizontal
7439.89	54.40	43.50	11.40	35.50	3.40	57.80	74.00	-16.20	PK	Vertical
7439.89	43.56	43.50	11.40	35.50	3.40	46.96	54.00	-7.04	AV	Vertical
7439.67	53.80	43.50	11.40	35.50	3.40	57.20	74.00	-16.80	PK	Horizontal
7439.67	43.87	43.50	11.40	35.50	3.40	47.27	54.00	-6.73	AV	Horizontal

Note:

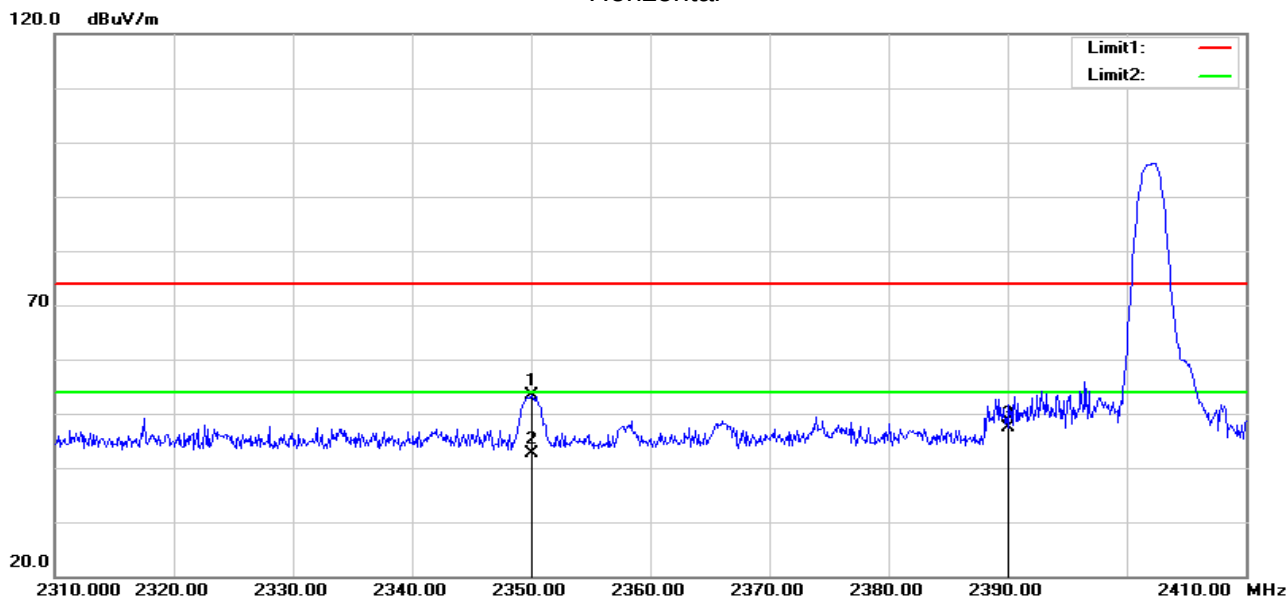
1) Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Emission Level = Reading + Factor

2) 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.

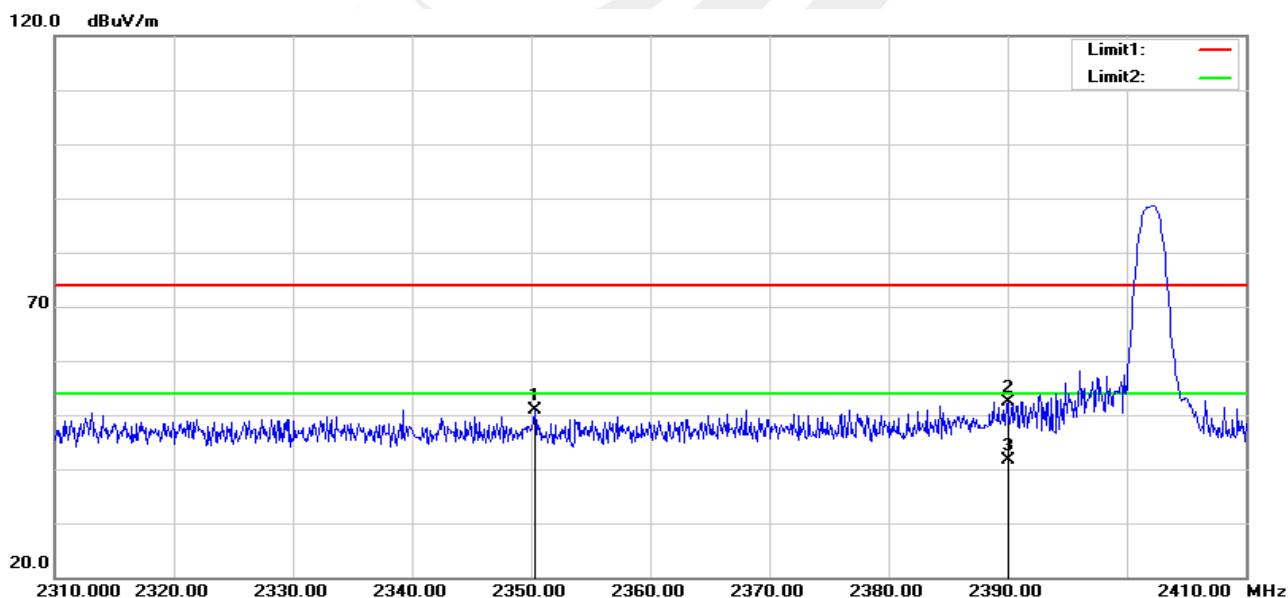


4.6 TEST RESULTS (Restricted Bands Requirements)

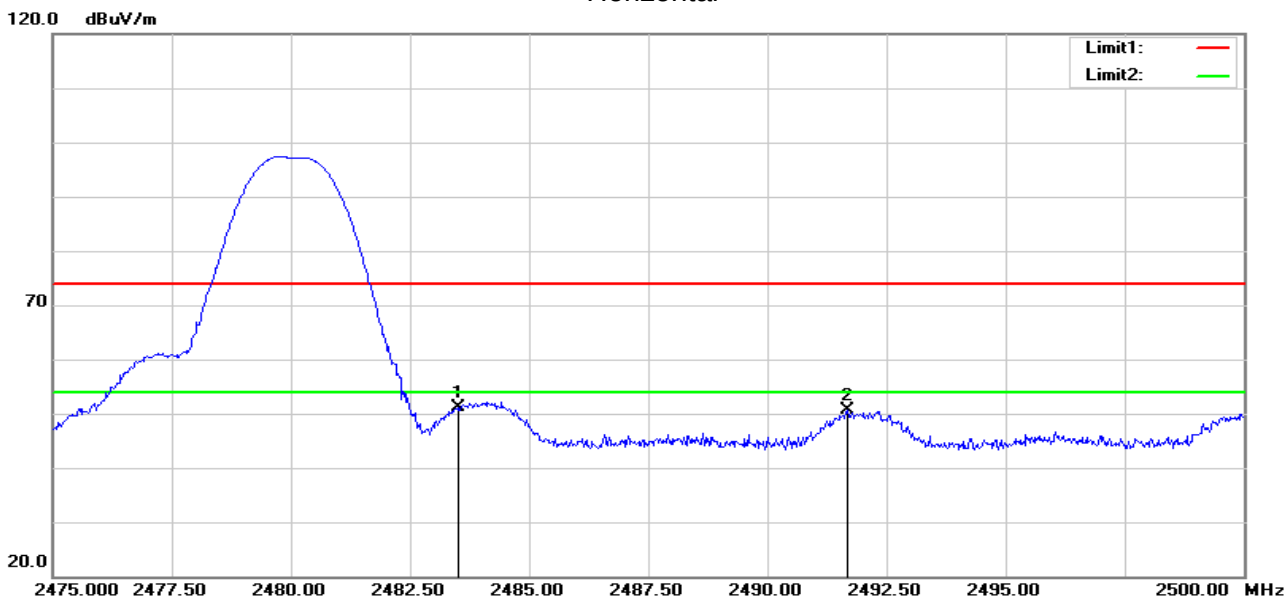
GFSK-Low
Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2350.000	49.63	3.74	53.37	74.00	-20.63	peak
2	2350.000	38.97	3.74	42.71	54.00	-11.29	AVG
3	2390.000	43.11	4.34	47.45	74.00	-26.55	peak

Vertical

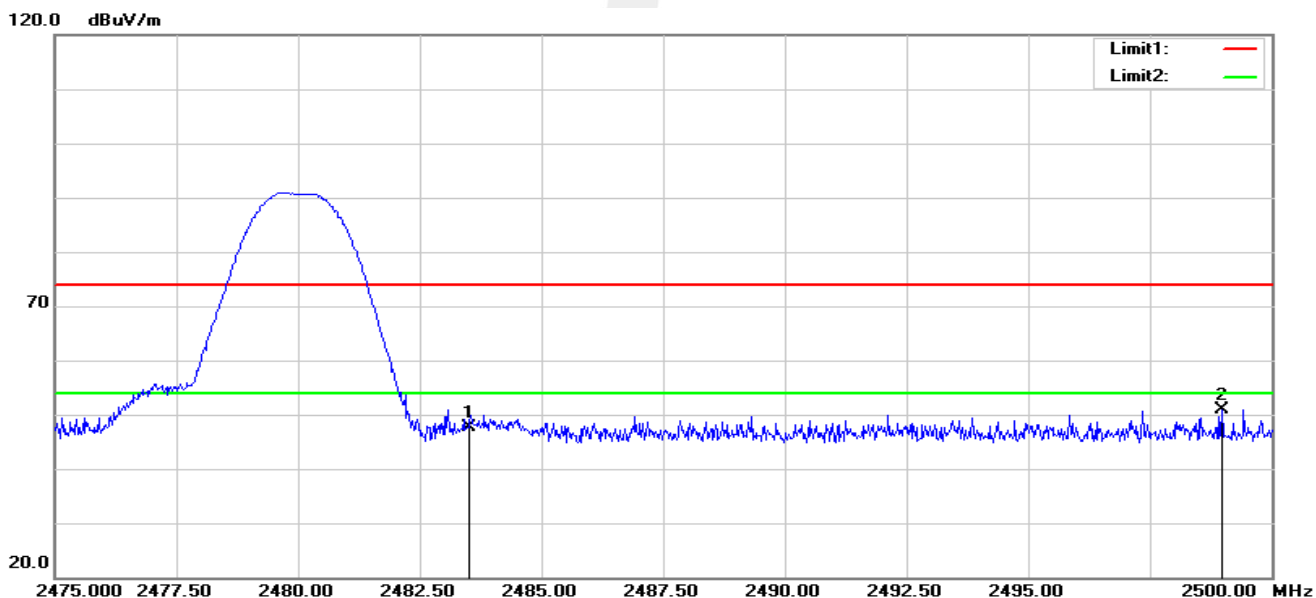


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2350.300	47.15	3.74	50.89	74.00	-23.11	peak
2	2390.000	47.95	4.34	52.29	74.00	-21.71	peak

**GFSK-High**
Horizontal

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	46.55	4.60	51.15	74.00	-22.85	peak
2	2491.675	46.04	4.63	50.67	74.00	-23.33	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	43.14	4.60	47.74	74.00	-26.26	peak
2	2498.975	46.19	4.65	50.84	74.00	-23.16	peak

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 LIMIT

According to FCC section 15.247(d) and 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.

5.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th 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 – 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

5.3 TEST SETUP



The EUT which is powered by the DC Power, is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50 Ohm; 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.

5.4 EUT OPERATION CONDITIONS

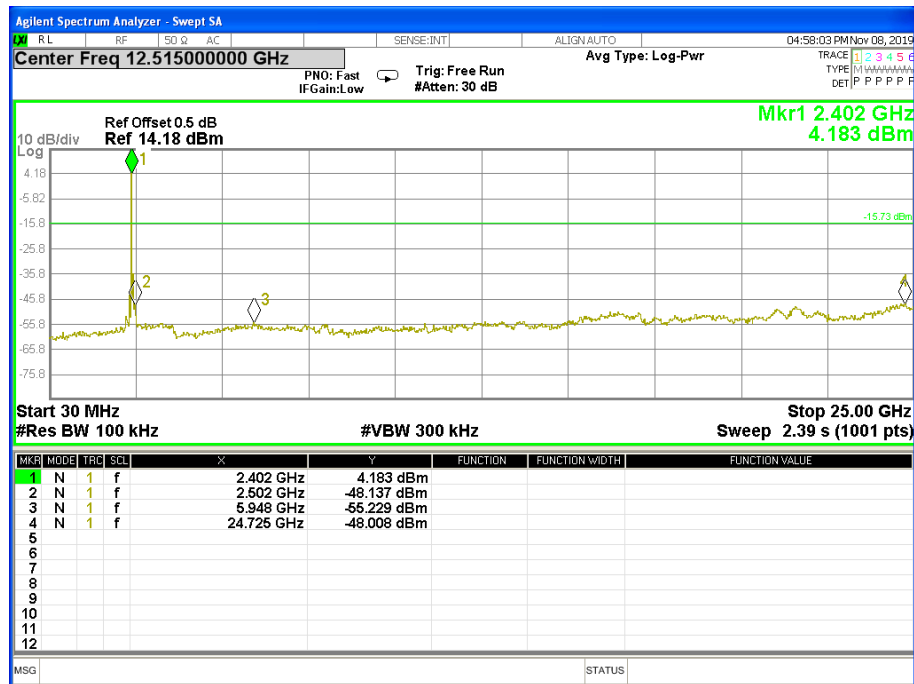
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



5.5 TEST RESULTS

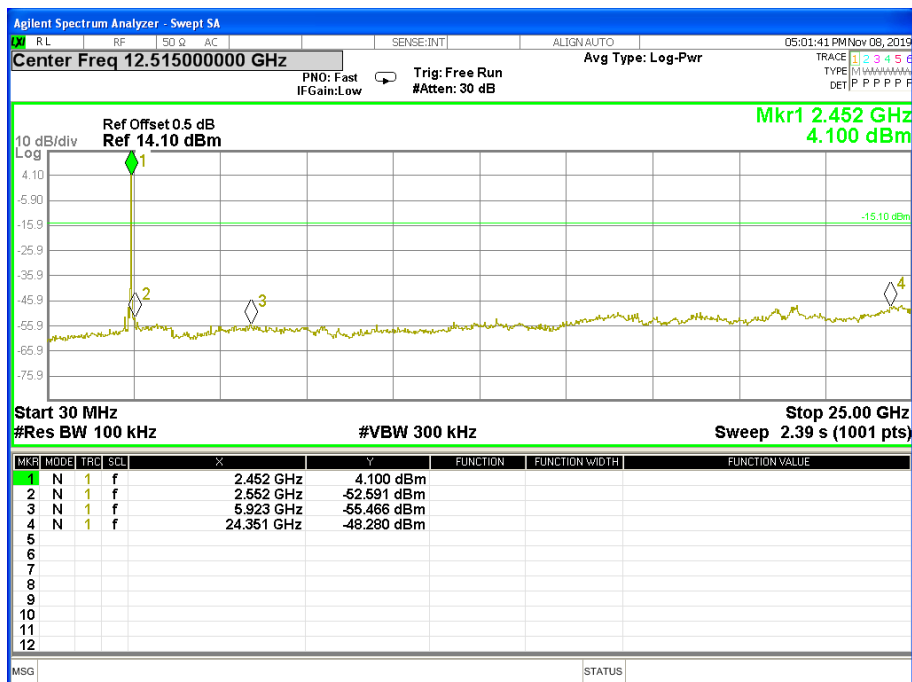
Temperature:	25 °C	Relative Humidity:	50%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH00, CH19, CH39

00 CH

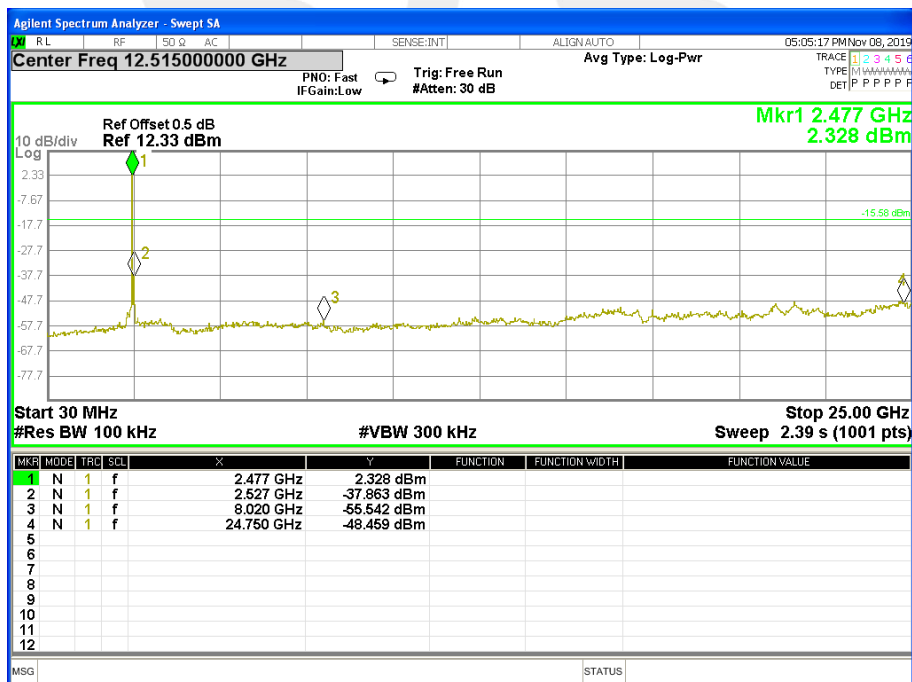




19 CH



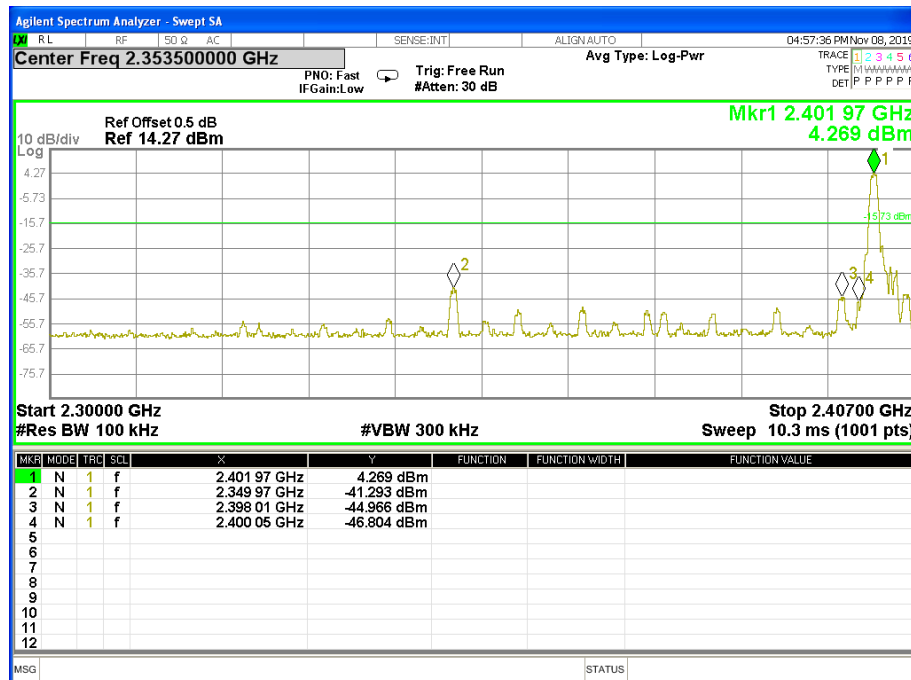
39 CH



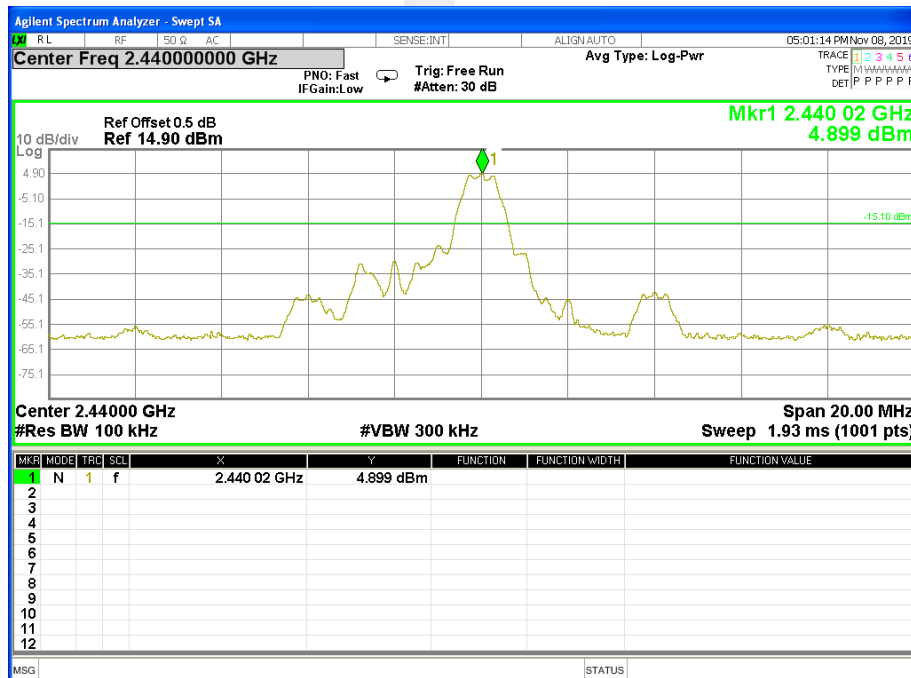


For Band edge

00 CH

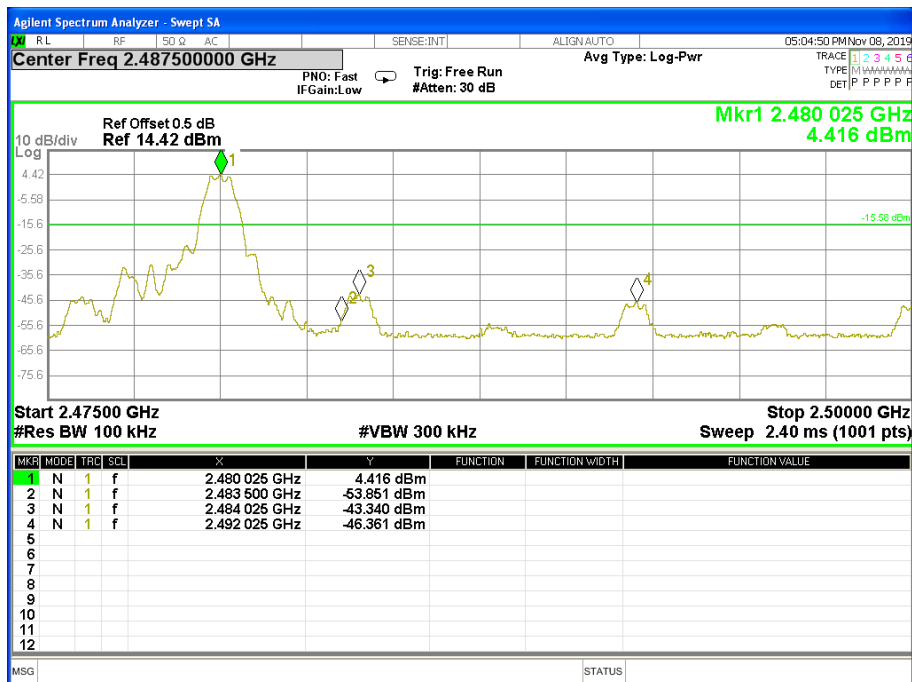


19 CH





39 CH





6. POWER SPECTRAL DENSITY TEST

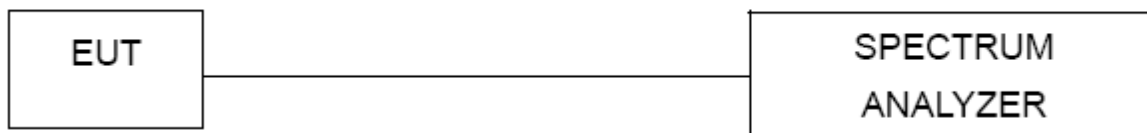
6.1 LIMIT

FCC Part 15.247, Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(e) RSS-247 Issue 2	Power Spectral Density	≤ 8 dBm (RBW ≥ 3 KHz)	2400-2483.5	PASS

6.2 TEST PROCEDURE

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW to: $100 \text{ kHz} \geq \text{RBW} \geq 3 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3 TEST SETUP



6.4 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.

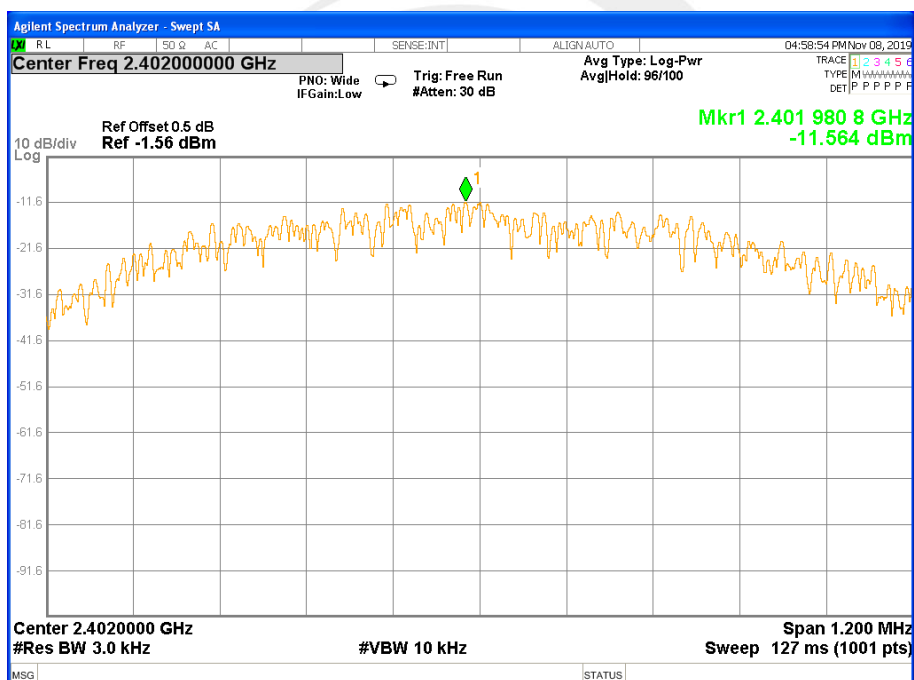


6.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH00, CH19, CH39

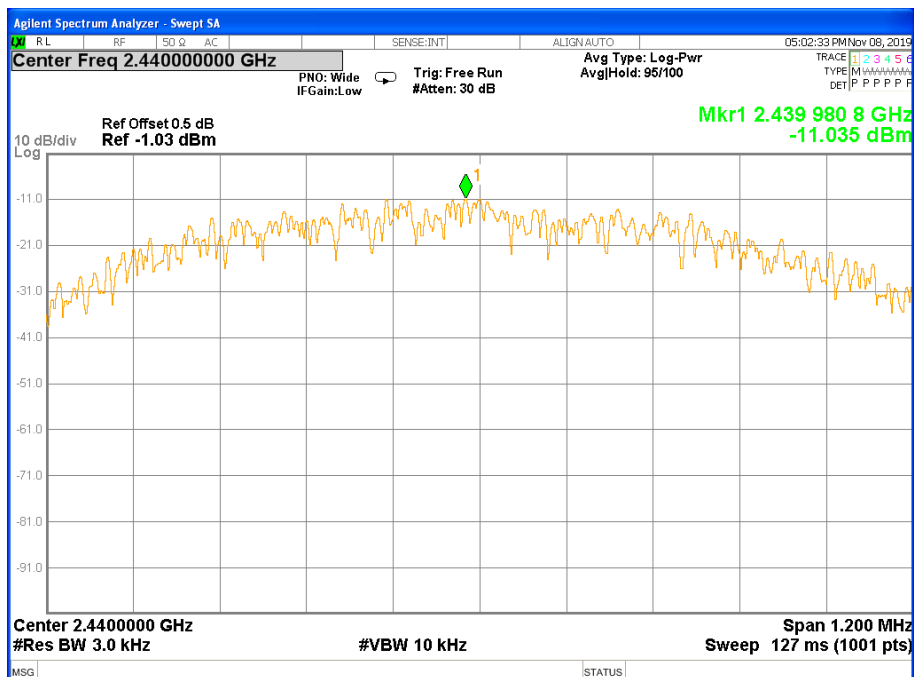
Frequency	Power Density	Limit (dBm/3KHz)	Result
	(dBm/3kHz)		
2402 MHz	-11.564	≤8	PASS
2440 MHz	-11.035	≤8	PASS
2480 MHz	-11.417	≤8	PASS

TX CH00

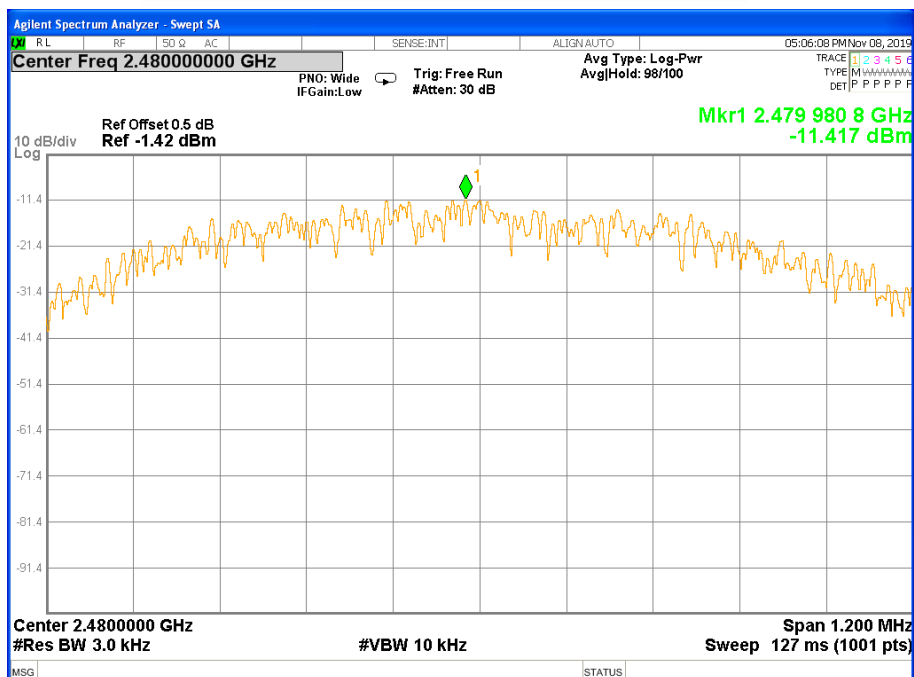




TX CH19



TX CH39





7. BANDWIDTH TEST

7.1 LIMIT

FCC Part 15.247, Subpart C RSS-Gen Clause 6.7				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	6dB Bandwidth	$\geq 500\text{KHz}$	2400-2483.5	PASS
RSS-Gen Clause 6.7	99% Bandwidth	For reporting purposes only.	2400-2483.5	PASS

7.2 TEST PROCEDURE

Connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6 dB Bandwidth : 100KHz For 99% Bandwidth : 1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth : $\geq 3 \times \text{RBW}$ For 99% Bandwidth : approximately $3 \times \text{RBW}$
Trace	Max hold
Sweep	Auto

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB and 99% relative to the maximum level measured in the fundamental emission.

7.3 TEST SETUP



7.4 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.

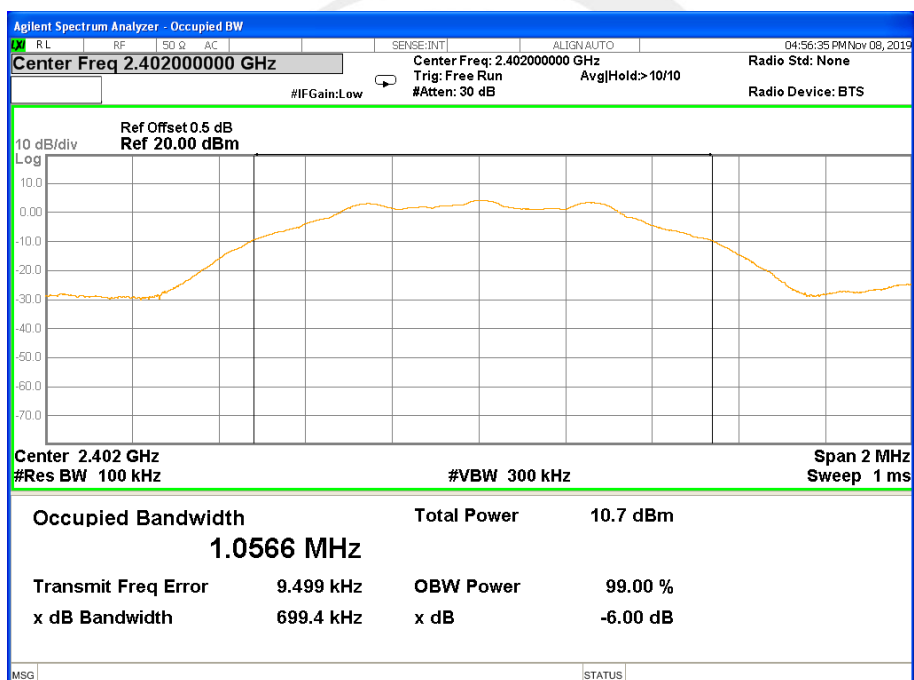


7.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH00, CH19, CH39

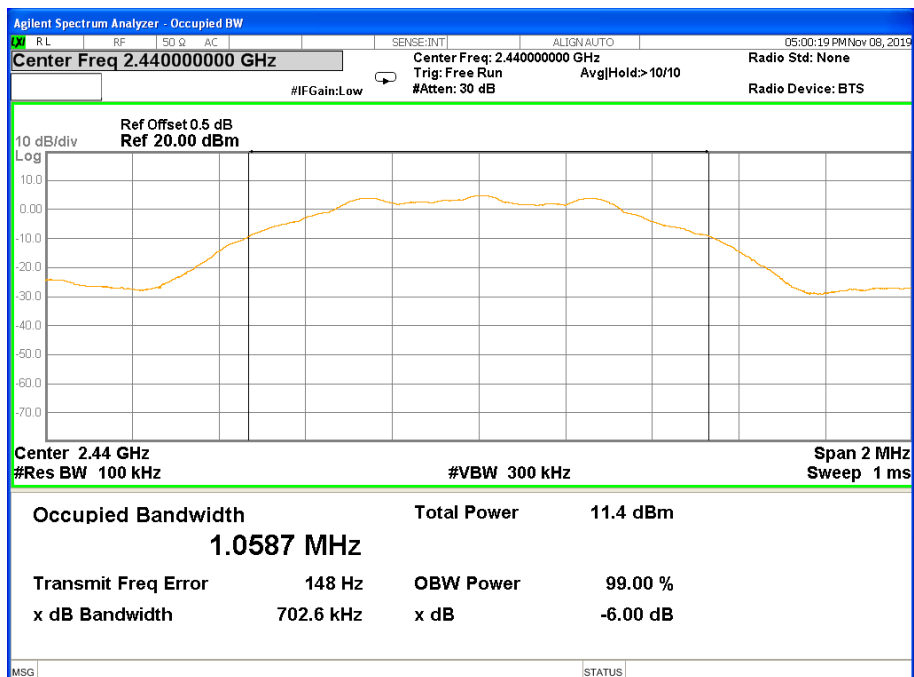
Frequency	6dB Bandwidth (KHz)	99% Bandwidth (KHz)	Channel Separation (KHz)	Result
2402 MHz	699.400	1028.700	≥500KHz	PASS
2440 MHz	702.600	1029.600	≥500KHz	PASS
2480 MHz	703.900	1029.200	≥500KHz	PASS

6dB Bandwidth TX CH 00

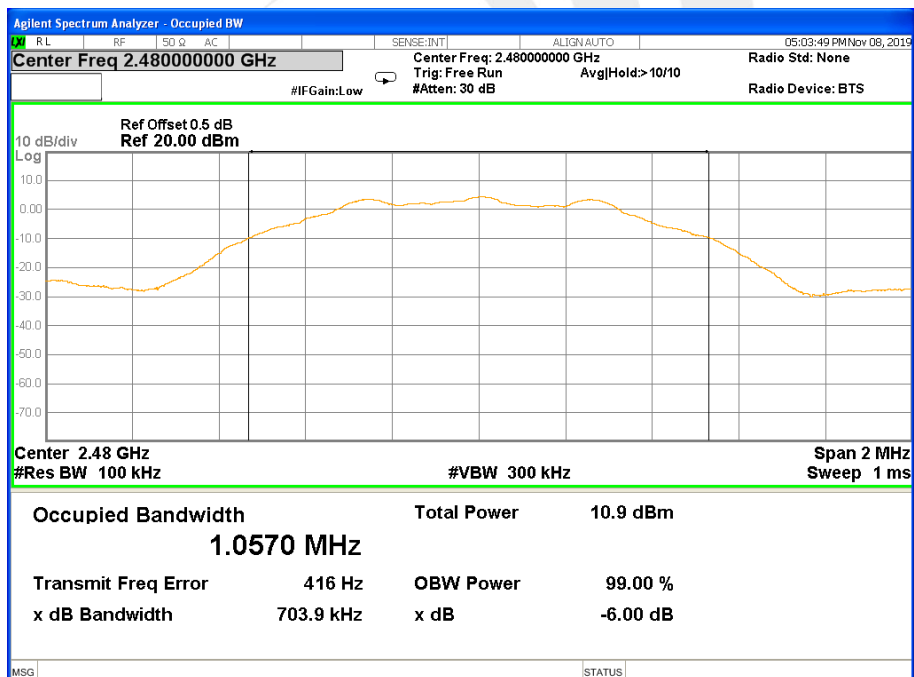




6dB Bandwidth TX CH 19

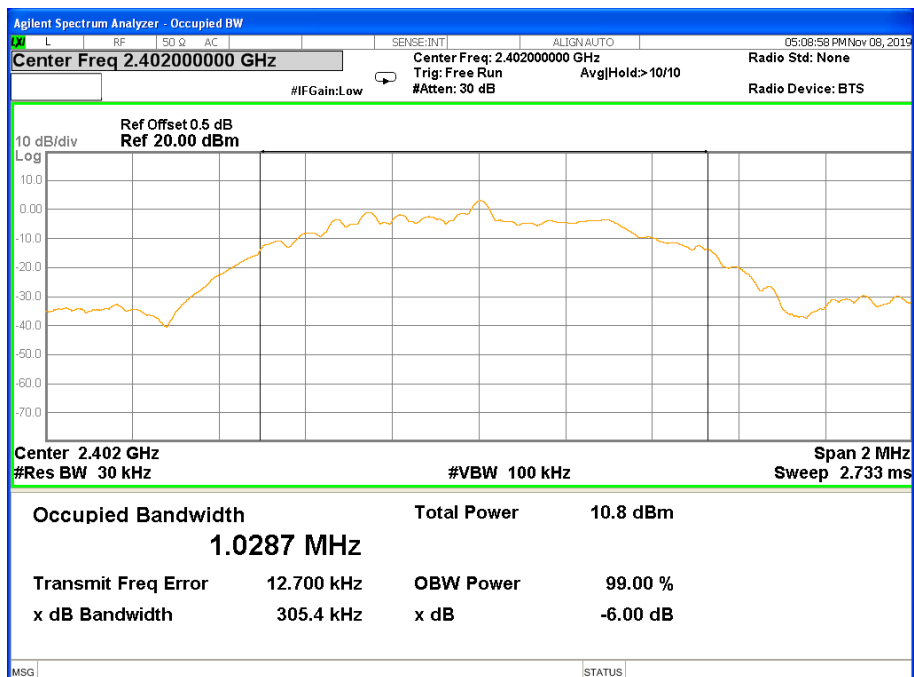


6dB Bandwidth TX CH 39

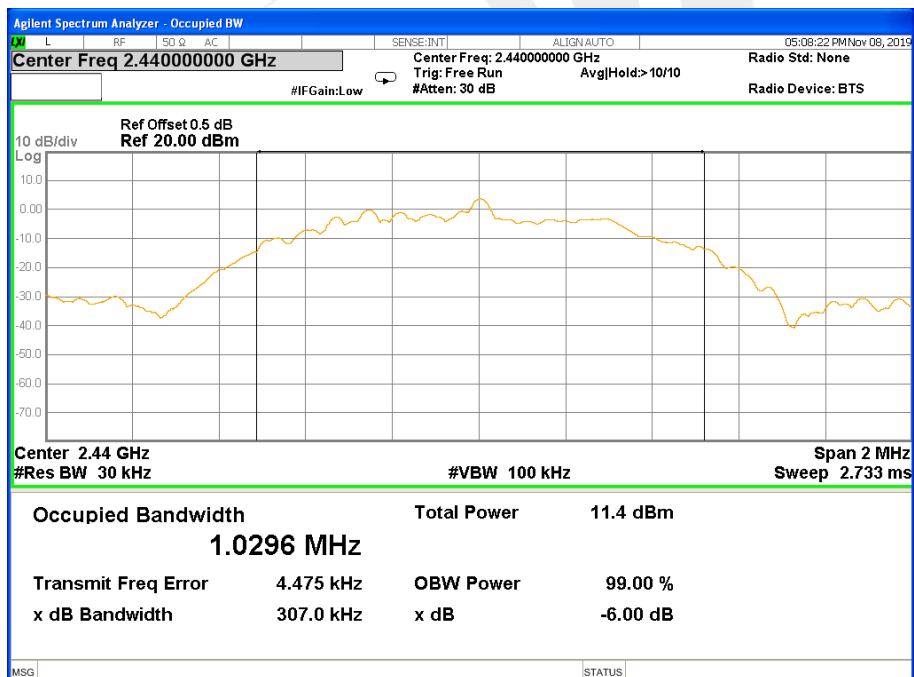




99% Bandwidth TX CH 00

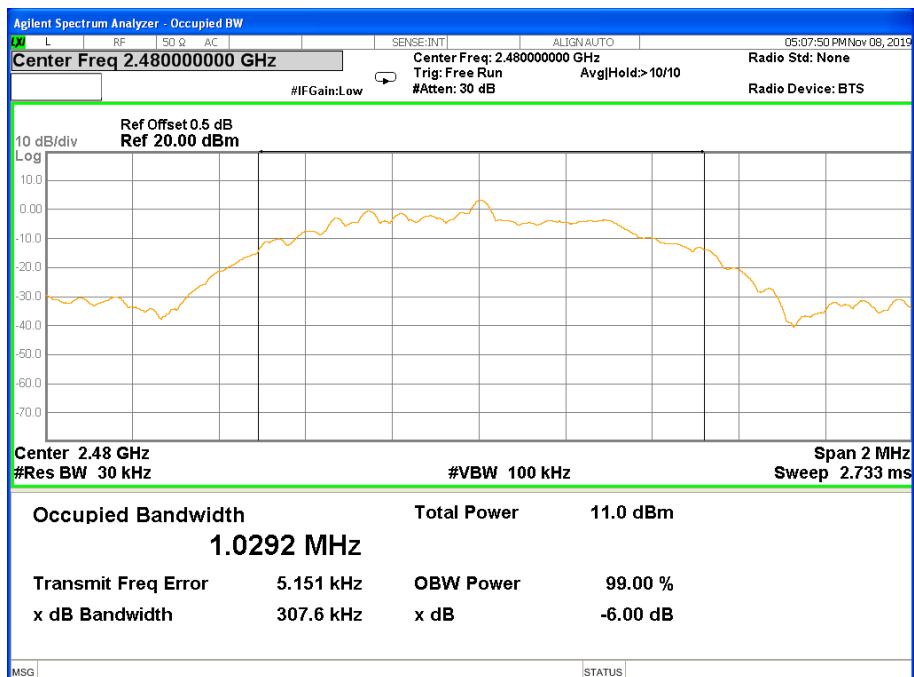


99% Bandwidth TX CH 19





99% Bandwidth TX CH 39





8. PEAK OUTPUT POWER TEST

8.1 LIMIT

FCC Part 15.247, Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3) RSS 247 Issue 2	Output Power	1 watt or 30dBm	2400-2483.5	PASS

8.2 TEST PROCEDURE

- a. The EUT was directly connected to the Power Sensor&PC

8.3 TEST SETUP



8.4 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.



8.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Voltage:	DC 5V	Test Mode:	TX Mode /CH00, CH19, CH39

Test Channe	Frequency	Peak Conducted Output Power	Average Conducted Output Power	LIMIT
	(MHz)	(dBm)	(dBm)	dBm
CH0	2402	4.61	2.09	30
CH19	2440	5.70	3.18	30
CH39	2480	4.73	2.21	30





9. ANTENNA REQUIREMENT

9.1 STANDARD REQUIREMENT

15.203 and RSS-GenIssue 5 requirement: For intentional device, according to 15.203 and RSS-GenIssue 5: 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.

9.2 EUT ANTENNA

The EUT antenna is Ceramic Antenna. It comply with the standard requirement.





10. FREQUENCY STABILITY

10.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.02\%$ of the operating frequency over a temperature variation of -30 degrees to 50 degrees C at normal supply voltage, and for a variation in primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees.

10.2 TEST PROCEDURE

1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

10.3 TEST RESULT

Channel 19 (2440MHz)

Voltage vs. Frequency Stability

Voltage(V)	Measurement Frequency(MHz)
5.75	2440.0020
5	2440.0012
4.25	2440.0016
Max.Deviation(MHz)	0.0020
Max.Deviation(ppm)	0.82

Rated working voltage: DC 5V

Temperature vs. Frequency Stability

Temperature(°C)	Measurement Frequency(MHz)
-30	2440.0026
-20	2440.0024
-10	2440.0017
0	2440.0019
10	2440.0025
20	2440.0017
30	2440.0022
40	2440.0023
50	2440.0025
Max.Deviation(MHz)	0.0026
Max.Deviation(ppm)	1.07



11. EUT TEST PHOTO

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

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

