



RADIO TEST REPORT

Report No:STS2104043W01

Issued for

DewertOkin GmbH

Weststr. 1, 32278 Kirchlengern, Germany

Product Name:	CU155+
Brand Name:	N/A
Model Name:	A1232
Series Model:	N/A
FCC ID:	O3YCU155PAPL
IC:	10744A-CU155PAPL
Test Standard:	FCC Part 15.247
	RSS-247 Issue 2, February 2017

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TEST RESULT CERTIFICATION

Applicant's name : DewertOkin GmbH
 Address : Weststr. 1, 32278 Kirchlingern, Germany
Manufacturer's Name : DewertOkin GmbH
 Address : Weststr. 1, 32278 Kirchlingern, Germany

Product description

Product Name : CU155+
 Brand Name : N/A
 Model Name : A1232
 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.

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Date of Test..... :

Date (s) of performance of tests..... : 21 Aug. 2018~ 30 July 2021

Date of Issue..... : 30 July 2021

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	31 Aug. 2018	STS1808188W05	ALL	Initial Issue
00	30 July 2021	STS2104043W01	ALL	Add a chip manufacturer and Power supply circuit changes, updated emission data and standard.





1. SUMMARY OF TEST RESULTS

Test procedures according to the technical standards:
KDB 558074 D01 DTS Meas Guidance v04

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	--
15.209 (a) 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 9K-30MHz	$\pm 2.84\text{dB}$
4	All emissions, radiated 30M-1GHz	$\pm 4.39\text{dB}$
5	All emissions, radiated 1G-6GHz	$\pm 5.10\text{dB}$
6	All emissions, radiated >6G	$\pm 5.48\text{dB}$
7	Conducted Emission (9KHz-150KHz)	$\pm 2.79\text{dB}$
8	Conducted Emission (150KHz-30MHz)	$\pm 2.80\text{dB}$



2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

Product Name/PMN	CU155+	
Trade Name	N/A	
Model Name/HVIN	A1232	
Series Model	N/A	
Model Difference	N/A	
Product Description	The EUT is a CU155+	
	Operation Frequency:	2402~2480 MHz
	Modulation Type:	GFSK
	Radio Technology	BLE
	Number Of Channel	40
	Antenna Designation:	Please see Note 3.
	Antenna Gain (dBi)	0 dBi
Channel List	Please refer to the Note 2.	
Power Rating	Input: DC 30V, 6A max Output: DC 30V	
Hardware version number	1003841	
Software version number	R33	
Radio Hardware version	1003841	
Radio Software version/FVIN	R33	
Serial Numbers		
Test Software	putty-0.70cn	
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	N/A	A1232	PCB Antenna	N/A	0	BLE ANT.





2.2 DESCRIPTION OF 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:

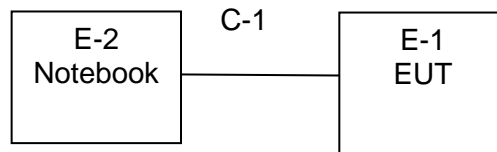
- (1) The measurements are performed at all Bit Rate of Transmitter, the worst data was reported
- (2) We have be tested for all avaiable U.S. voltage and frequencies(For 120V,50/60Hz and 240V, 50/60Hz) for which the device is capable of operation, and the worst case of 120V/60Hz is shown in the report
- (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

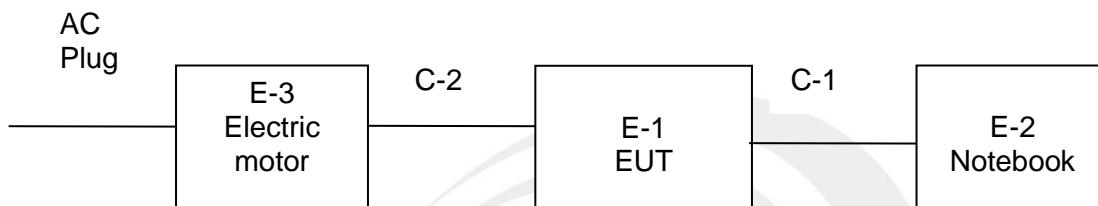
Test Case	
AC Conducted Emission	Mode 4 : Keeping BT TX

2.3 BLOCK DIGRAM SHOWING THE CONFIGURATION OF SYSTEM TESTED

Radiated Spurious Emission Test



Conduction Test Set



Note: The EUT doesn't connect directly to the computer, Is through the tool board welding PCB and computer connection, and Continue to transmit.



2.4 DESCRIPTION OF SUPPORT UNITS(CONDUCTED MODE)

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.

Item	Equipment	Mfr/Brand	Model/Type No.	Serial No.	Note
E-2	Notebook	HP	500-320cx	N/A	N/A
E-3	Electric motor	N/A	N/A	N/A	N/A

Item	Shielded Type	Ferrite Core	Length	Note
C-1	USB Cable	NO	100cm	N/A
C-2	DC Cable	NO	110cm	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 FOR ALL TEST ITEMS

Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
EMI Test Receiver	R&S	ESCI	102086	2017.10.15	2018.10.14
Bilog Antenna	TESEQ	CBL6111D	34678	2017.11.02	2018.11.01
Horn Antenna	Schwarzbeck	BBHA 9120D	9120D-1343	2017.10.27	2018.10.26
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	N/A	2018.03.11	2019.03.10
Temperature & Humidity	HH660	Mieo	N/A	2017.10.15	2018.10.14
Temperature & Humidity	HH660	Mieo	N/A	2017.10.15	2018.10.14
Pre-mpplier (0.1M-3GHz)	EM	EM330	60538	2018.03.11	2019.03.10
PreAmplifier (1G-26.5GHz)	Agilent	8449B	60538	2017.10.15	2018.10.14
Passive Loop (9K--30MHz)	ZHNAN	ZN3090C	16035	2018.03.11	2019.03.10
Low frequency cable	EM	R01	N/A	2018.03.11	2019.03.10
Low frequency cable	EM	R06	N/A	2018.03.11	2019.03.10
High frequency cable	SCHWARZBECK	R04	N/A	2018.03.11	2019.03.10
High frequency cable	SCHWARZBECK	R02	N/A	2018.03.11	2019.03.10
Semi-anechoic chamber	Changling	966	N/A	2017.10.15	2018.10.14
trun table	EM	SC100_1	60531	N/A	N/A
Antnna mast	EM	SC100	N/A	N/A	N/A
Max-full Antenna Corp	MF	MFA-440H	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	2017.10.15	2018.10.14
LISN	R&S	ENV216	101242	2017.10.15	2018.10.14
conduction Cable	EM	C01	N/A	2018.03.11	2019.03.10
Temperature & Humidity	Mieo	HH660	N/A	2017.10.15	2018.10.14



RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
USB RF power sensor	DARE	RPR3006W	15I00041SNO03	2017.10.15	2018.10.14
Power Meter	R&S	NRP	100510	2017.10.15	2018.10.14
Spectrum Analyzer	Agilent	N9020A	MY51110105	2018.03.08	2019.03.07
Signal Analyzer	Agilent	N9020A	MY49100060	2017.10.15	2018.10.14





Radiation Test equipment

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Test Receiver	R&S	ESCI	101427	2020.10.12	2021.10.11
Signal Analyzer	R&S	FSV 40-N	101823	2020.10.10	2021.10.09
Active loop Antenna	ZHINAN	ZN30900C	16035	2021.04.11	2023.04.10
Bilog Antenna	TESEQ	CBL6111D	34678	2020.10.12	2022.10.11
Horn Antenna	SCHWARZBECK	BBHA 9120D	02014	2019.10.15	2021.10.14
SHF-EHF Horn Antenna (18G-40GHz)	A-INFO	LB-180400-KF	J211020657	2020.10.12	2022.10.11
Pre-Amplifier (0.1M-3GHz)	EM	EM330	060665	2020.10.12	2021.10.11
Pre-Amplifier (1G-18GHz)	SKET	LNPA-01018G-45	SK2018080901	2020.10.12	2021.10.11
Pre-Amplifier (18G-40GHz)	SKET	LNPA-1840-50	SK2018101801	2020.10.10	2021.10.09
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
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	2020.10.12	2021.10.11
LISN	R&S	ENV216	101242	2020.10.12	2021.10.11
LISN	EMCO	3810/2NM	23625	2020.10.12	2021.10.11
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 CE)			



RF Connected Test

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
Power Sensor	Keysight	U2021XA	MY55520005	2020.10.10	2021.10.09
			MY55520006	2020.10.10	2021.10.09
			MY56120038	2020.10.10	2021.10.09
			MY56280002	2020.10.10	2021.10.09
Signal Analyzer	Agilent	N9020A	MY51110105	2021.03.04	2022.03.03
Temperature & Humidity	HH660	Mieo	N/A	2020.10.13	2021.10.12
Test SW	FARAD	EZ-EMC(Ver.STSLAB-03A1 RE)			





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.

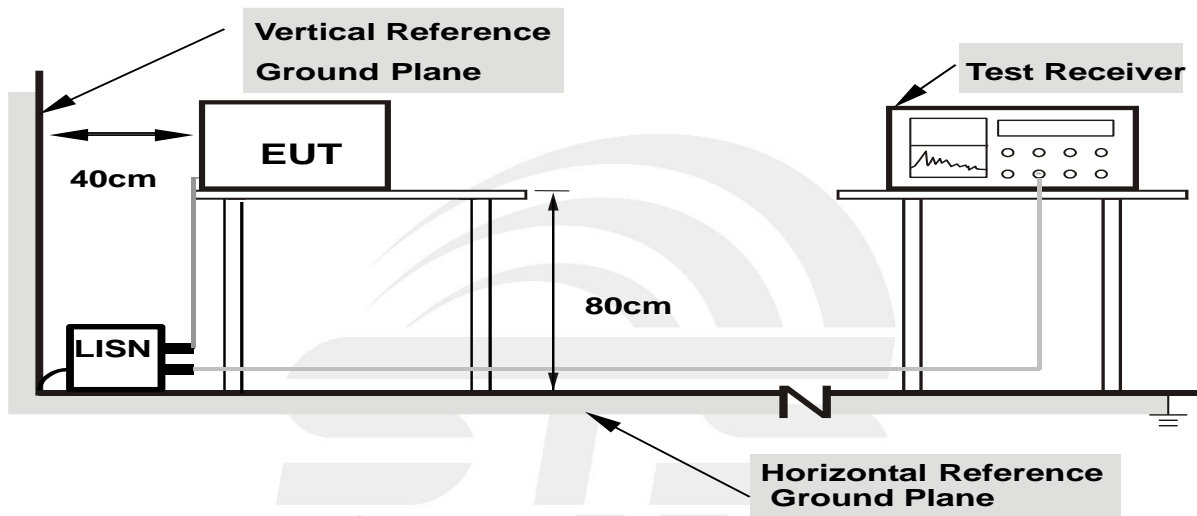
The following table is the setting of the receiver

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

3.2 TEST PROCEDURE

- 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.

3.3 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.



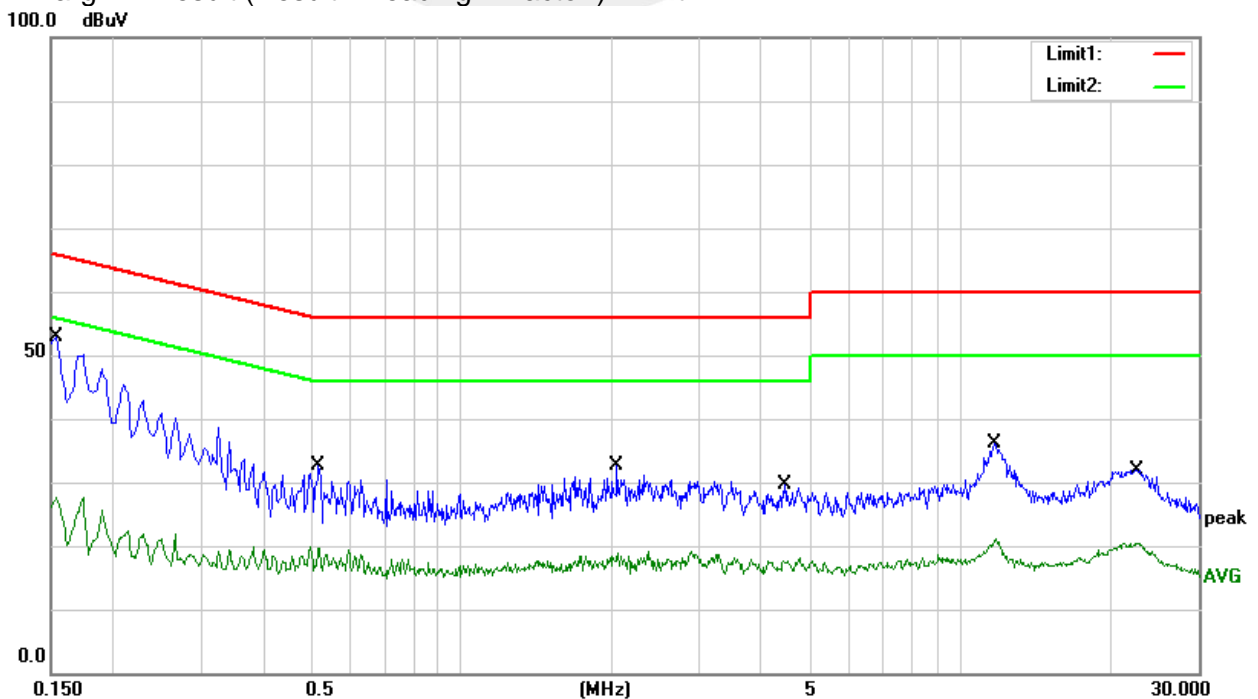
3.5 TEST RESULTS

Temperature:	26.5 °C	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4	Chip Manufacture:	STMicroelectronics
Chip Model:	ST32F030C6T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1540	32.63	20.30	52.93	65.78	-12.85	QP
0.1540	7.34	20.30	27.64	55.78	-28.14	AVG
0.5180	12.18	20.48	32.66	56.00	-23.34	QP
0.5180	-0.69	20.48	19.79	46.00	-26.21	AVG
2.0460	12.31	20.39	32.70	56.00	-23.30	QP
2.0460	-1.55	20.39	18.84	46.00	-27.16	AVG
4.4460	9.07	20.52	29.59	56.00	-26.41	QP
4.4460	-2.82	20.52	17.70	46.00	-28.30	AVG
11.7340	14.90	21.15	36.05	60.00	-23.95	QP
11.7340	0.08	21.15	21.23	50.00	-28.77	AVG
22.5980	9.11	22.82	31.93	60.00	-28.07	QP
22.5980	-2.36	22.82	20.46	50.00	-29.54	AVG

Remark:

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





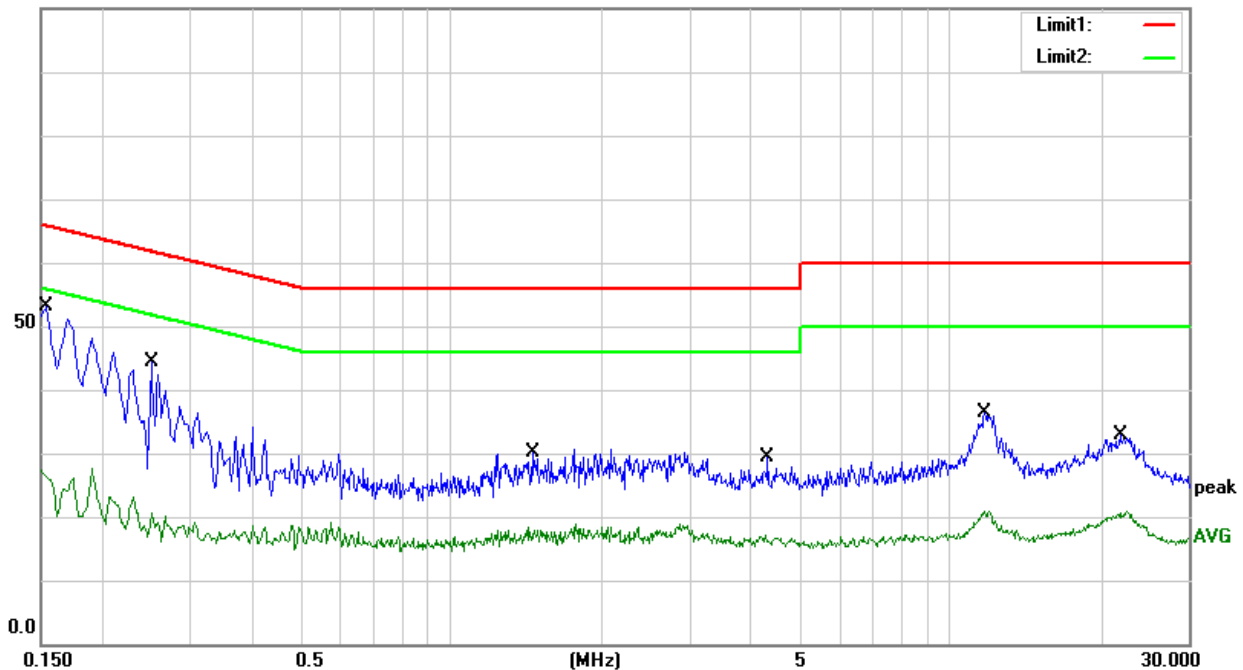
Temperature:	26.5 °C	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4	Chip Manufacture:	STMicroelectronics
Chip Model:	ST32F030C6T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1540	32.82	20.30	53.12	65.78	-12.66	QP
0.1540	7.06	20.30	27.36	55.78	-28.42	AVG
0.2500	23.65	20.60	44.25	61.76	-17.51	QP
0.2500	0.12	20.60	20.72	51.76	-31.04	AVG
1.4500	9.74	20.34	30.08	56.00	-25.92	QP
1.4500	-2.38	20.34	17.96	46.00	-28.04	AVG
4.3060	8.89	20.52	29.41	56.00	-26.59	QP
4.3060	-3.30	20.52	17.22	46.00	-28.78	AVG
11.7020	15.21	21.14	36.35	60.00	-23.65	QP
11.7020	-0.26	21.14	20.88	50.00	-29.12	AVG
21.9140	9.96	22.84	32.80	60.00	-27.20	QP
21.9140	-1.86	22.84	20.98	50.00	-29.02	AVG

Remark:

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

100.0 dBuV



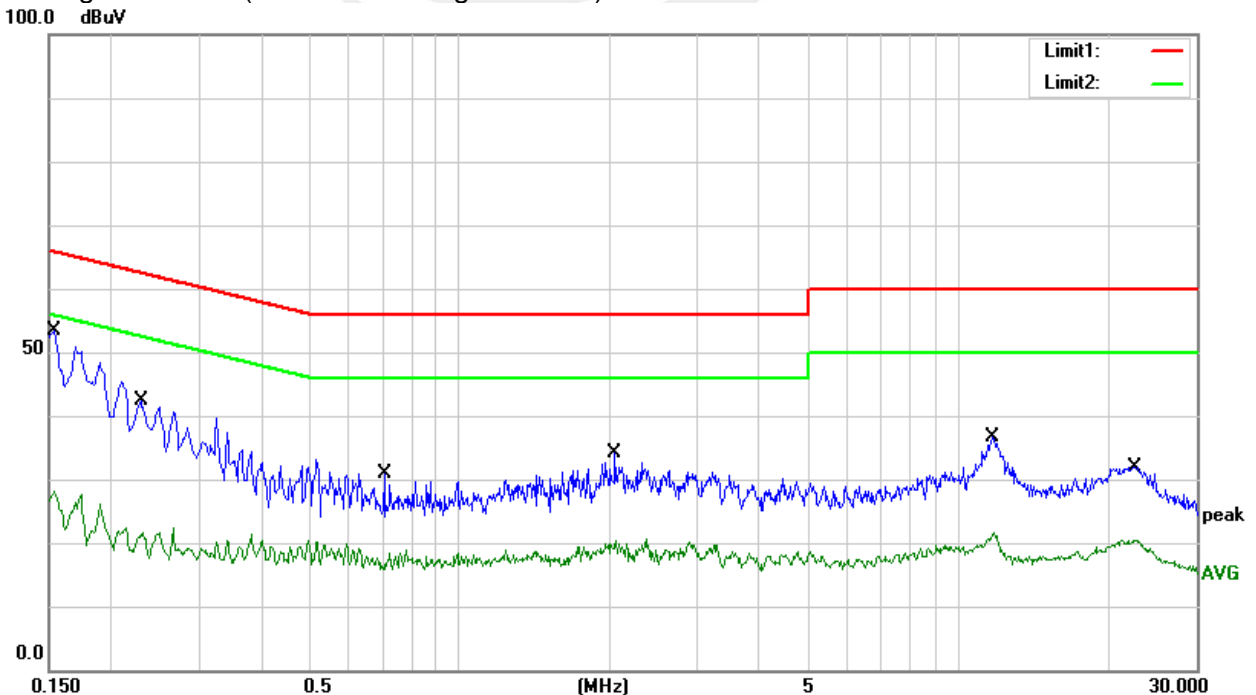


Temperature:	26.5 °C	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	L
Test Mode:	Mode 4	Chip Manufacture:	Geehy Semiconductor Co.,Ltd.
Chip Model:	APM32F030C8T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1540	33.13	20.30	53.43	65.78	-12.35	QP
0.1540	7.84	20.30	28.14	55.78	-27.64	AVG
0.2300	21.81	20.52	42.33	62.45	-20.12	QP
0.2300	1.87	20.52	22.39	52.45	-30.06	AVG
0.7060	10.54	20.37	30.91	56.00	-25.09	QP
0.7060	-1.32	20.37	19.05	46.00	-26.95	AVG
2.0460	13.81	20.39	34.20	56.00	-21.80	QP
2.0460	-0.05	20.39	20.34	46.00	-25.66	AVG
11.7340	15.40	21.15	36.55	60.00	-23.45	QP
11.7340	0.58	21.15	21.73	50.00	-28.27	AVG
22.5980	9.11	22.82	31.93	60.00	-28.07	QP
22.5980	-2.36	22.82	20.46	50.00	-29.54	AVG

Remark:

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





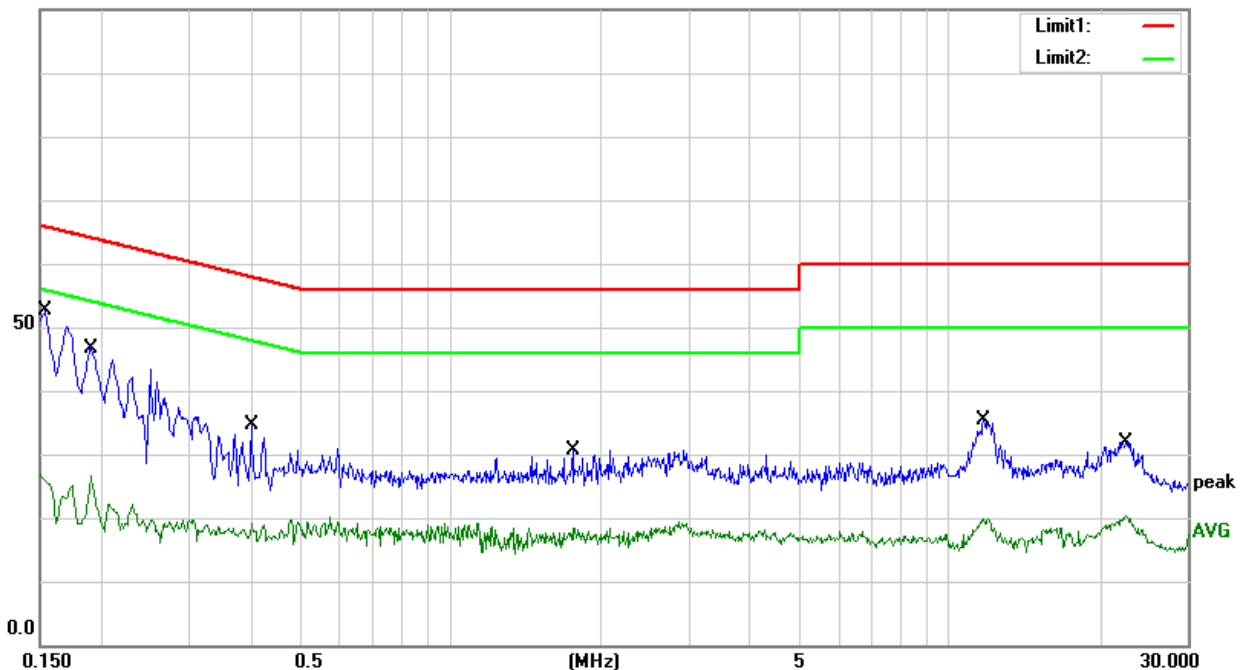
Temperature:	26.5 °C	Relative Humidity:	54%
Test Voltage:	AC 120V/60Hz	Phase:	N
Test Mode:	Mode 4	Chip Manufacture:	Geehy Semiconductor Co.,Ltd.
Chip Model:	APM32F030C8T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
0.1540	32.32	20.30	52.62	65.78	-13.16	QP
0.1540	6.56	20.30	26.86	55.78	-28.92	AVG
0.1922	25.03	20.38	45.41	63.94	-18.53	QP
0.1922	6.24	20.38	26.62	53.94	-27.32	AVG
0.3980	13.97	20.57	34.54	57.90	-23.36	QP
0.3980	-1.53	20.57	19.04	47.90	-28.86	AVG
1.7580	10.18	20.37	30.55	56.00	-25.45	QP
1.7580	-2.01	20.37	18.36	46.00	-27.64	AVG
11.7020	14.21	21.14	35.35	60.00	-24.65	QP
11.7020	-1.26	21.14	19.88	50.00	-30.12	AVG
22.6460	9.16	22.81	31.97	60.00	-28.03	QP
22.6460	-2.33	22.81	20.48	50.00	-29.52	AVG

Remark:

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

100.0 dBuV





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 (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
30~88	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
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
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 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

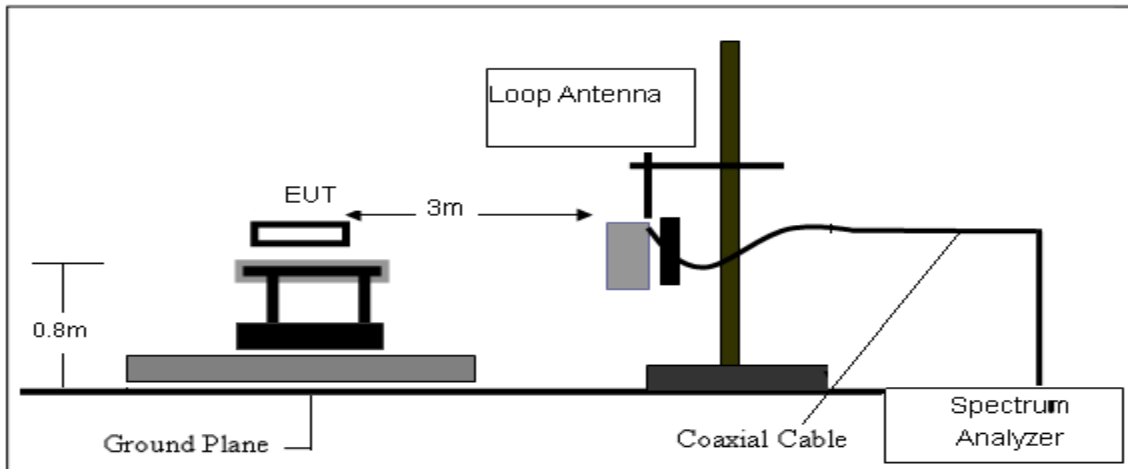
- The measuring distance of at 3 m shall be used for measurements at frequency 0.009MHz up to 1GHz, and above 1GHz.
- The EUT was placed on the top of a rotating table 0.8 meters(above 1GHz is 1.5 m) above the ground at a 3 meter anechoic chamber. The table was rotated 360 degrees to determine the position 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:

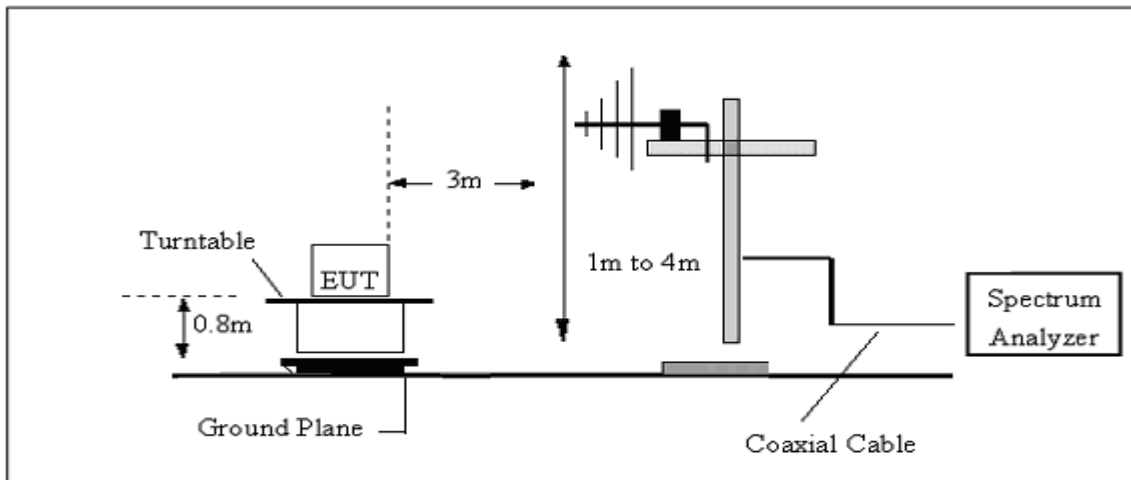
Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

4.3 TEST SETUP

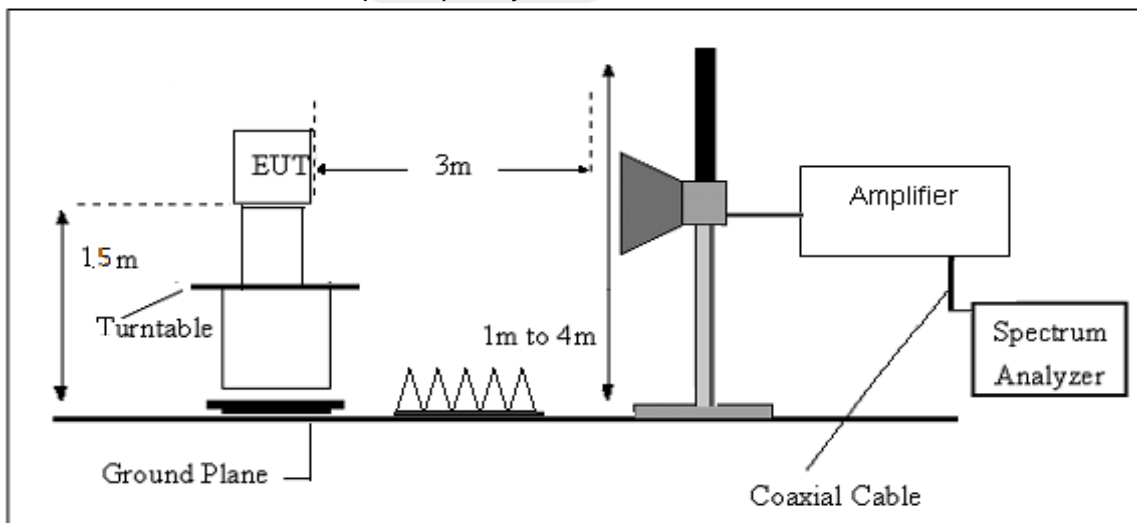
(A) Radiated Emission Test-Up Frequency Below 30MHz



(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 (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

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





4.6 TEST RESULTS

(Between 9KHz – 30 MHz)

Temperature:	25.2 °C	Relative Humidity:	50%
Test Voltage:	DC 30V	Polarization:	--
Test Mode:	TX Mode		

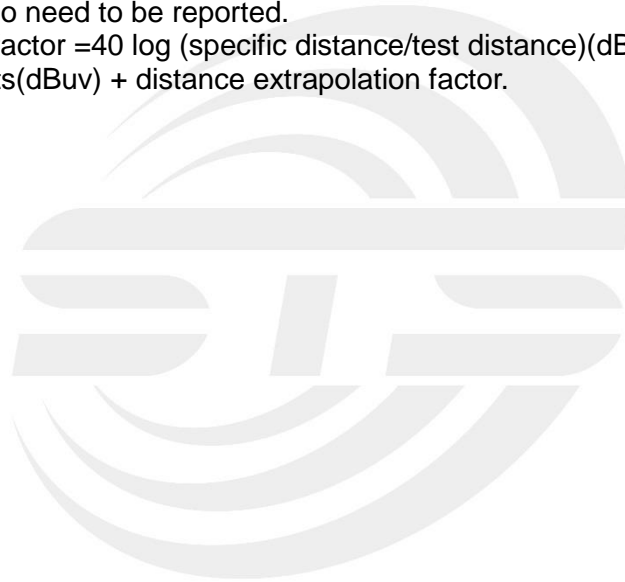
Freq. (MHz)	Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	State P/F
--	--	--	--	PASS
--	--	--	--	PASS

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

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





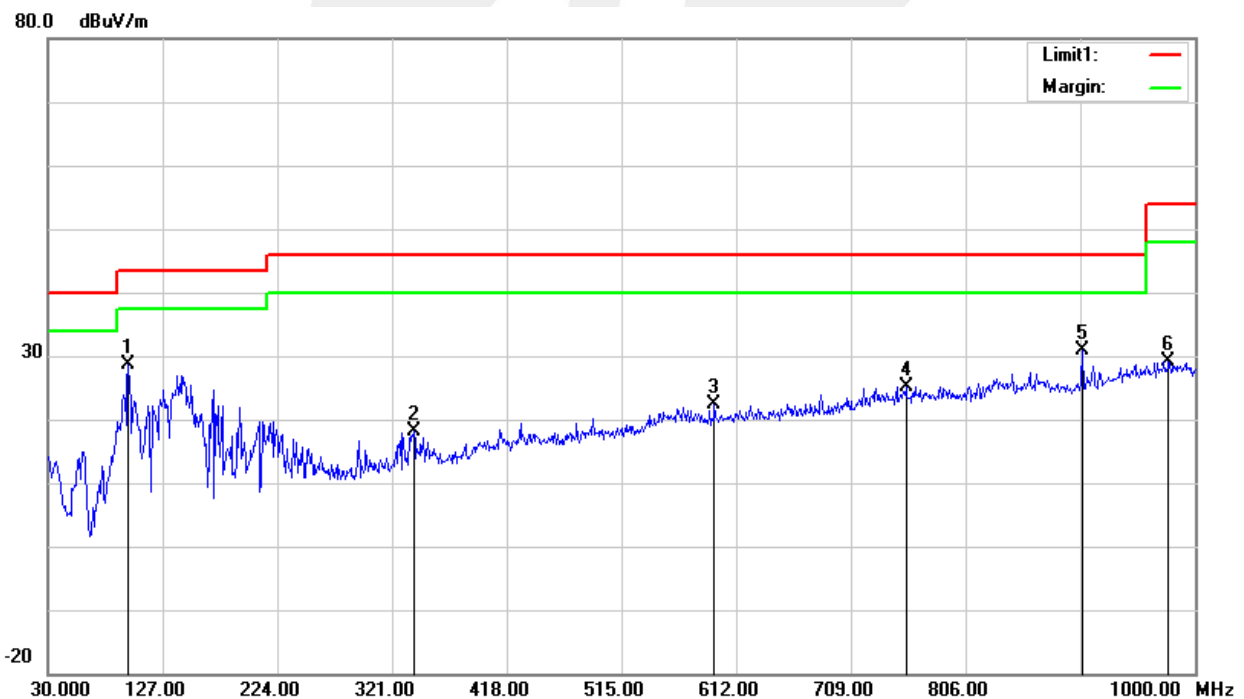
(30MHz -1000MHz)

Temperature:	23.1 °C	Relative Humidity:	60%
Test Voltage:	DC 30V	Phase:	Horizontal
Test Mode:	Mode1/2/3(Mode 2-1M worst mode)	Chip Manufacture:	STMicroelectronics
Chip Model:	ST32F030C6T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
97.9000	49.01	-20.46	28.55	43.50	-14.95	QP
339.4300	31.64	-13.43	18.21	46.00	-27.79	QP
593.5700	28.17	-5.83	22.34	46.00	-23.66	QP
755.5600	27.23	-2.17	25.06	46.00	-20.94	QP
904.9400	31.09	-0.32	30.77	46.00	-15.23	QP
977.6900	26.68	2.52	29.20	54.00	-24.80	QP

Remark:

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





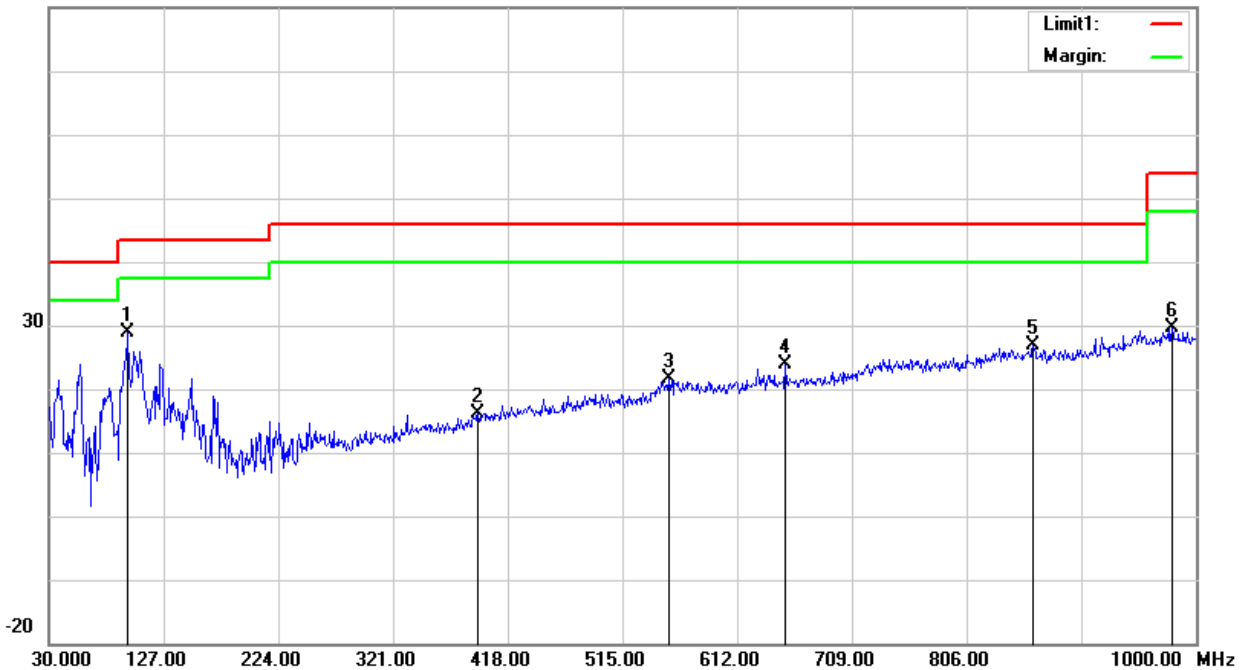
Temperature:	23.1 °C	Relative Humidity:	60%
Test Voltage:	DC 30V	Phase:	Vertical
Test Mode:	Mode1/2/3(Mode 2-1M worst mode)	Chip Manufacture:	STMicroelectronics
Chip Model:	ST32F030C6T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
96.9300	49.53	-20.57	28.96	43.50	-14.54	QP
392.7800	27.68	-11.46	16.22	46.00	-29.78	QP
553.8000	27.40	-5.67	21.73	46.00	-24.27	QP
652.7400	28.70	-4.87	23.83	46.00	-22.17	QP
862.2600	27.33	-0.44	26.89	46.00	-19.11	QP
979.6300	27.06	2.65	29.71	54.00	-24.29	QP

Remark:

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

80.0 dBuV/m



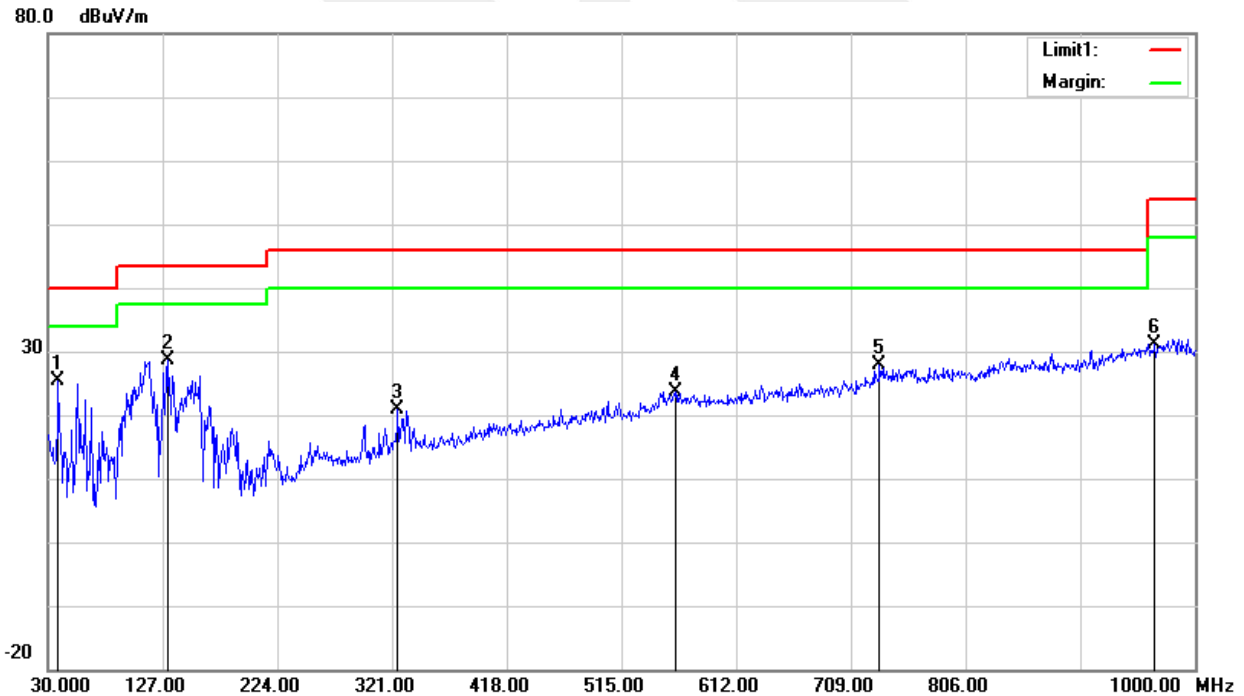


Temperature:	23.1 °C	Relative Humidity:	60%
Test Voltage:	DC 30V	Phase:	Horizontal
Test Mode:	Mode1/2/3(Mode 2-1M worst mode)	Chip Manufacture:	Geehy Semiconductor Co.,Ltd.
Chip Model:	APM32F030C8T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
38.7300	42.69	-17.36	25.33	40.00	-14.67	QP
130.8800	46.86	-18.23	28.63	43.50	-14.87	QP
325.8500	34.61	-13.83	20.78	46.00	-25.22	QP
560.5900	29.12	-5.50	23.62	46.00	-22.38	QP
733.2500	30.15	-2.35	27.80	46.00	-18.20	QP
966.0500	29.34	1.90	31.24	54.00	-22.76	QP

Remark:

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





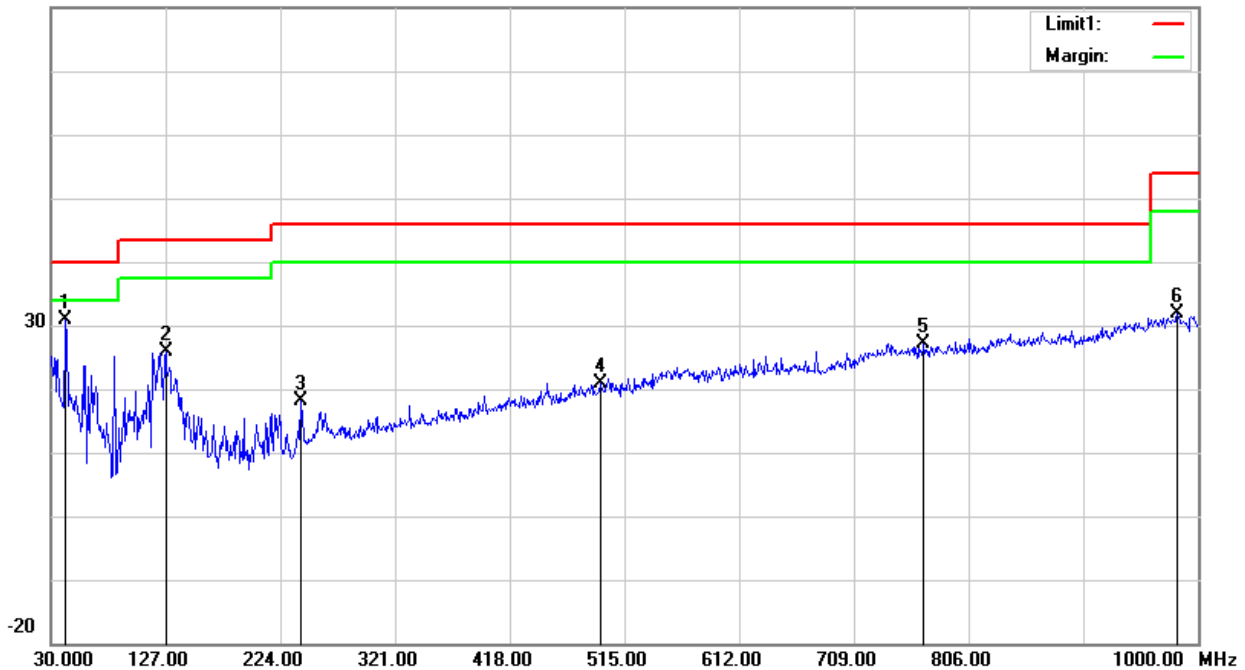
Temperature:	23.1 °C	Relative Humidity:	60%
Test Voltage:	DC 30V	Phase:	Vertical
Test Mode:	Mode1/2/3(Mode 2-1M worst mode)	Chip Manufacture:	Geehy Semiconductor Co.,Ltd.
Chip Model:	APM32F030C8T6		

Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
42.6100	50.29	-19.44	30.85	40.00	-9.15	QP
127.0000	44.18	-18.23	25.95	43.50	-17.55	QP
241.4600	35.84	-17.73	18.11	46.00	-27.89	QP
494.6300	28.90	-8.12	20.78	46.00	-25.22	QP
768.1700	29.44	-2.30	27.14	46.00	-18.86	QP
982.5400	29.32	2.52	31.84	54.00	-22.16	QP

Remark:

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

80.0 dBuV/m





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

Low Channel

Frequency (MHz)	Reading (dBμV)	Amplifier (dB)	Loss (dB)	Antenna Factor (dB/m)	Corrected Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
Low Channel (2402 MHz)										
3264.60	48.94	44.70	6.70	28.20	-9.80	39.14	74.00	-34.86	PK	Vertical
3264.60	39.62	44.70	6.70	28.20	-9.80	29.82	54.00	-24.18	AV	Vertical
3264.86	48.49	44.70	6.70	28.20	-9.80	38.69	74.00	-35.31	PK	Horizontal
3264.86	38.58	44.70	6.70	28.20	-9.80	28.78	54.00	-25.22	AV	Horizontal
4804.33	59.46	44.20	9.04	31.60	-3.56	55.90	74.00	-18.10	PK	Vertical
4804.33	38.96	44.20	9.04	31.60	-3.56	35.40	54.00	-18.60	AV	Vertical
4804.38	58.80	44.20	9.04	31.60	-3.56	55.24	74.00	-18.76	PK	Horizontal
4804.38	39.23	44.20	9.04	31.60	-3.56	35.67	54.00	-18.33	AV	Horizontal
5359.67	45.43	44.20	9.86	32.00	-2.34	43.09	74.00	-30.91	PK	Vertical
5359.67	38.04	44.20	9.86	32.00	-2.34	35.70	54.00	-18.30	AV	Vertical
5359.75	46.40	44.20	9.86	32.00	-2.34	44.06	74.00	-29.94	PK	Horizontal
5359.75	37.19	44.20	9.86	32.00	-2.34	34.85	54.00	-19.15	AV	Horizontal
7205.72	51.03	43.50	11.40	35.50	3.40	54.43	74.00	-19.57	PK	Vertical
7205.72	33.06	43.50	11.40	35.50	3.40	36.46	54.00	-17.54	AV	Vertical
7205.86	50.51	43.50	11.40	35.50	3.40	53.91	74.00	-20.09	PK	Horizontal
7205.86	32.81	43.50	11.40	35.50	3.40	36.21	54.00	-17.79	AV	Horizontal



Mid Channel

Frequency (MHz)	Reading (dBμV)	Amplifier (dB)	Loss (dB)	Antenna	Corrected	Emission		Margin (dB)	Detector Type	Comment
				Factor (dB/m)	Factor (dB)	Level (dBμV/m)	Limits (dBμV/m)			
Mid Channel (2440 MHz)										
3264.69	48.08	44.70	6.70	28.20	-9.80	38.28	74.00	-35.72	PK	Vertical
3264.69	38.02	44.70	6.70	28.20	-9.80	28.22	54.00	-25.78	AV	Vertical
3264.77	49.02	44.70	6.70	28.20	-9.80	39.22	74.00	-34.78	PK	Horizontal
3264.77	38.68	44.70	6.70	28.20	-9.80	28.88	54.00	-25.12	AV	Horizontal
4880.35	58.56	44.20	9.04	31.60	-3.56	55.00	74.00	-19.00	PK	Vertical
4880.35	39.16	44.20	9.04	31.60	-3.56	35.60	54.00	-18.40	AV	Vertical
4880.47	58.79	44.20	9.04	31.60	-3.56	55.23	74.00	-18.77	PK	Horizontal
4880.47	39.07	44.20	9.04	31.60	-3.56	35.51	54.00	-18.49	AV	Horizontal
5359.78	45.43	44.20	9.86	32.00	-2.34	43.09	74.00	-30.91	PK	Vertical
5359.78	37.94	44.20	9.86	32.00	-2.34	35.60	54.00	-18.40	AV	Vertical
5359.85	46.18	44.20	9.86	32.00	-2.34	43.84	74.00	-30.16	PK	Horizontal
5359.85	37.07	44.20	9.86	32.00	-2.34	34.73	54.00	-19.27	AV	Horizontal
7310.80	51.83	43.50	11.40	35.50	3.40	55.23	74.00	-18.77	PK	Vertical
7310.80	33.31	43.50	11.40	35.50	3.40	36.71	54.00	-17.29	AV	Vertical
7310.81	51.48	43.50	11.40	35.50	3.40	54.88	74.00	-19.12	PK	Horizontal
7310.81	33.89	43.50	11.40	35.50	3.40	37.29	54.00	-16.71	AV	Horizontal



High Channel

Frequency (MHz)	Reading (dBμV)	Amplifier (dB)	Loss (dB)	Antenna	Corrected	Emission				
				Factor (dB/m)	Factor (dB)	Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type	Comment
High Channel (2480 MHz)										
3264.77	48.22	44.70	6.70	28.20	-9.80	38.42	74.00	-35.58	PK	Vertical
3264.77	38.01	44.70	6.70	28.20	-9.80	28.21	54.00	-25.79	AV	Vertical
3264.81	48.83	44.70	6.70	28.20	-9.80	39.03	74.00	-34.97	PK	Horizontal
3264.81	38.15	44.70	6.70	28.20	-9.80	28.35	54.00	-25.65	AV	Horizontal
4960.30	59.50	44.20	9.04	31.60	-3.56	55.94	74.00	-18.06	PK	Vertical
4960.30	38.29	44.20	9.04	31.60	-3.56	34.73	54.00	-19.27	AV	Vertical
4960.58	59.47	44.20	9.04	31.60	-3.56	55.91	74.00	-18.09	PK	Horizontal
4960.58	38.66	44.20	9.04	31.60	-3.56	35.10	54.00	-18.90	AV	Horizontal
5359.78	45.69	44.20	9.86	32.00	-2.34	43.35	74.00	-30.65	PK	Vertical
5359.78	37.97	44.20	9.86	32.00	-2.34	35.63	54.00	-18.37	AV	Vertical
5359.87	46.07	44.20	9.86	32.00	-2.34	43.73	74.00	-30.27	PK	Horizontal
5359.87	37.95	44.20	9.86	32.00	-2.34	35.61	54.00	-18.39	AV	Horizontal
7439.71	51.33	43.50	11.40	35.50	3.40	54.73	74.00	-19.27	PK	Vertical
7439.71	33.66	43.50	11.40	35.50	3.40	37.06	54.00	-16.94	AV	Vertical
7439.84	51.72	43.50	11.40	35.50	3.40	55.12	74.00	-18.88	PK	Horizontal
7439.84	32.89	43.50	11.40	35.50	3.40	36.29	54.00	-17.71	AV	Horizontal

Note:

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

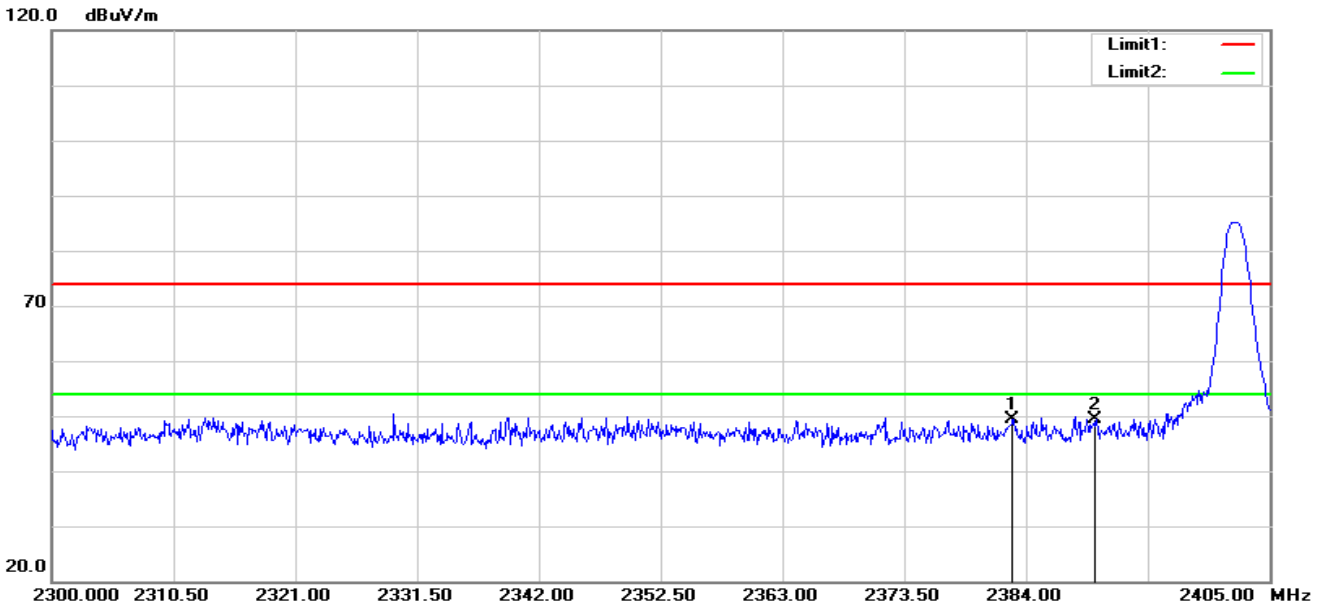
Emission Level = Reading + Factor

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.



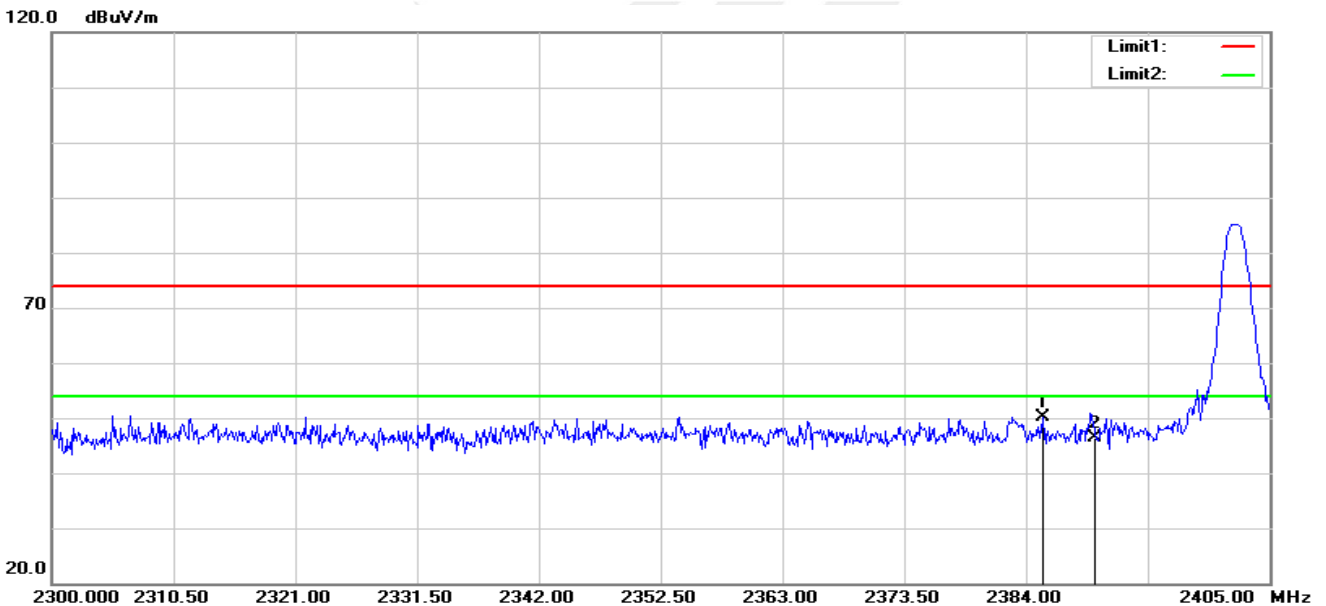
4.6 TEST RESULTS (Restricted Bands Requirements)

GFSK-Low
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2382.845	51.54	-2.07	49.47	74.00	-24.53	peak
2	2390.000	51.41	-2.02	49.39	74.00	-24.61	peak

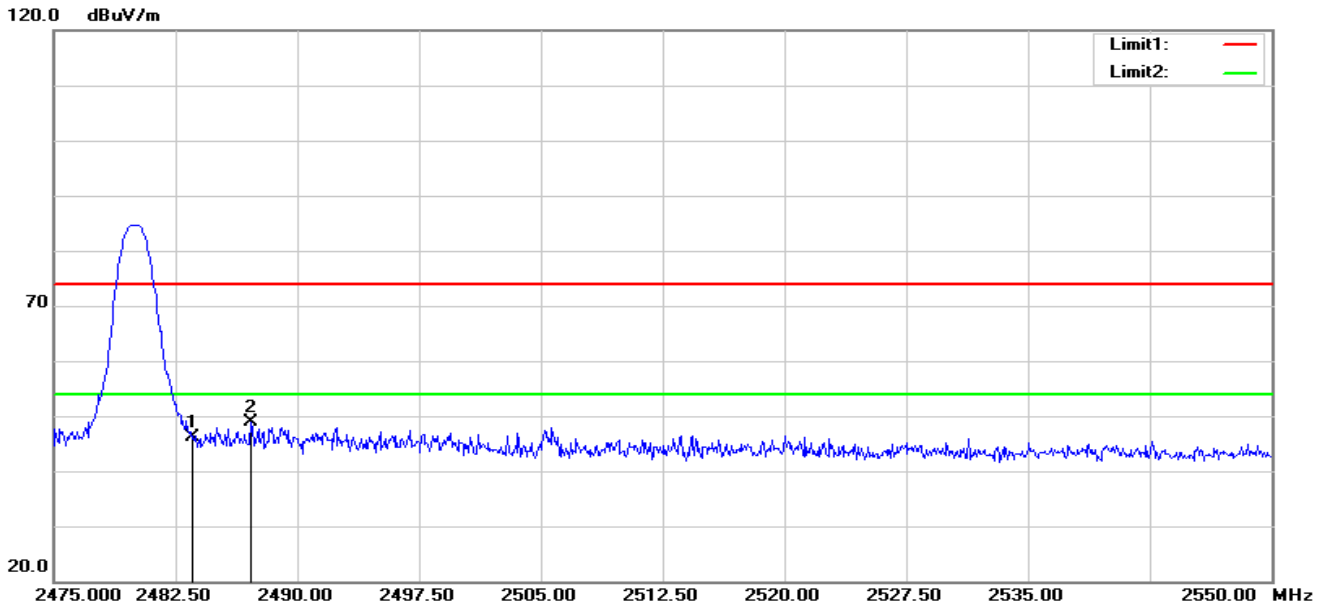
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2385.470	52.28	-2.05	50.23	74.00	-23.77	peak
2	2390.000	48.31	-2.02	46.29	74.00	-27.71	peak

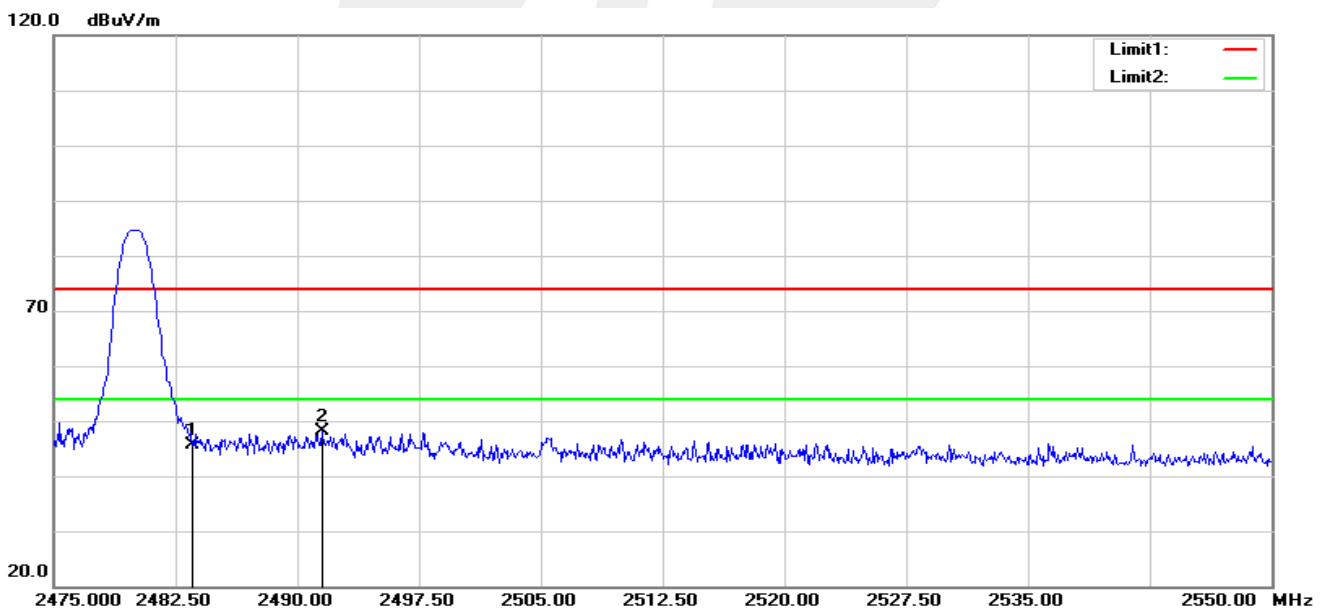


GFSK-High
Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	47.68	-1.50	46.18	74.00	-27.82	peak
2	2487.150	50.43	-1.48	48.95	74.00	-25.05	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	47.20	-1.50	45.70	74.00	-28.30	peak
2	2491.500	49.56	-1.46	48.10	74.00	-25.90	peak

5. CONDUCTED SPURIOUS & BAND EDGE EMISSION

5.1 REQUIREMENT

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.

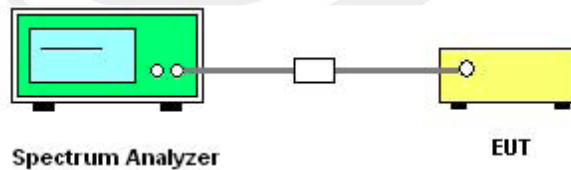
5.2 TEST PROCEDURE

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 Battery, is coupled 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

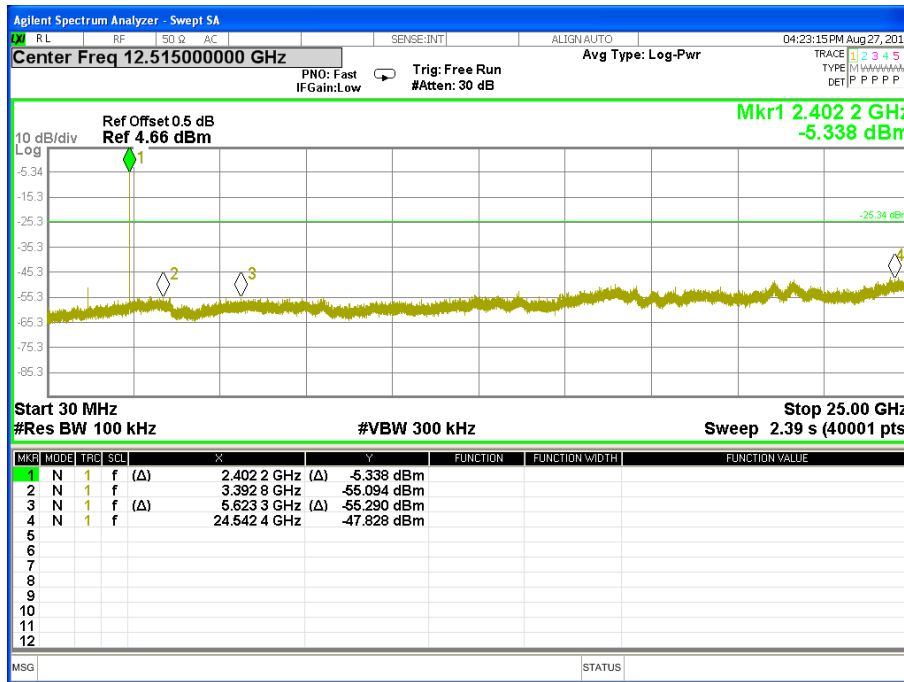
The EUT tested system was configured as the statements of 2.3 Unless otherwise a special operating condition is specified in the follows during the testing.



5.5 TEST RESULTS

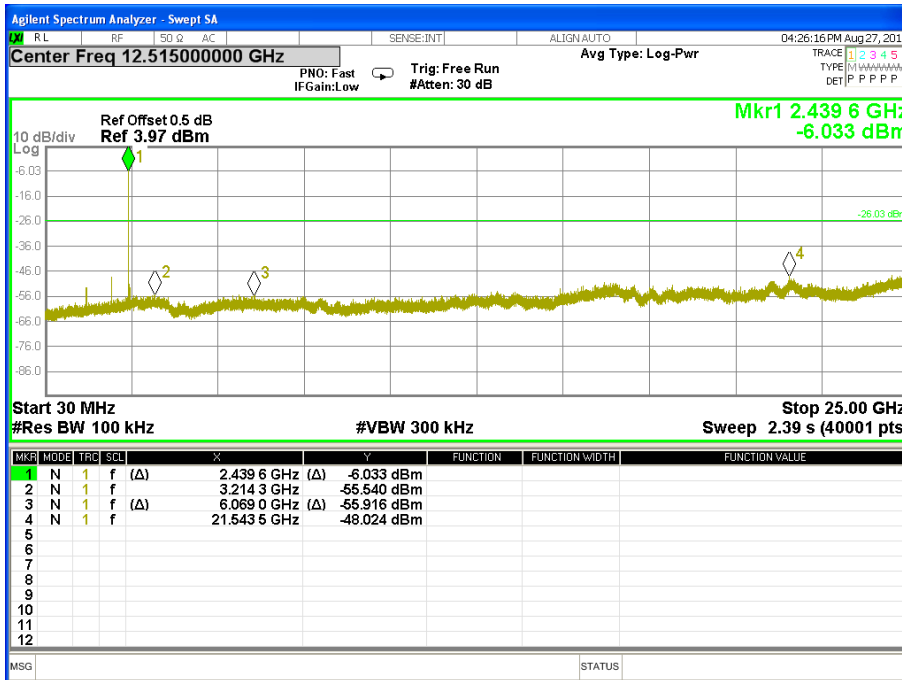
Temperature:	25 °C	Relative Humidity:	50%
Test Voltage:	DC 30V	Test Mode:	TX Mode /CH00, CH19, CH39

00 CH

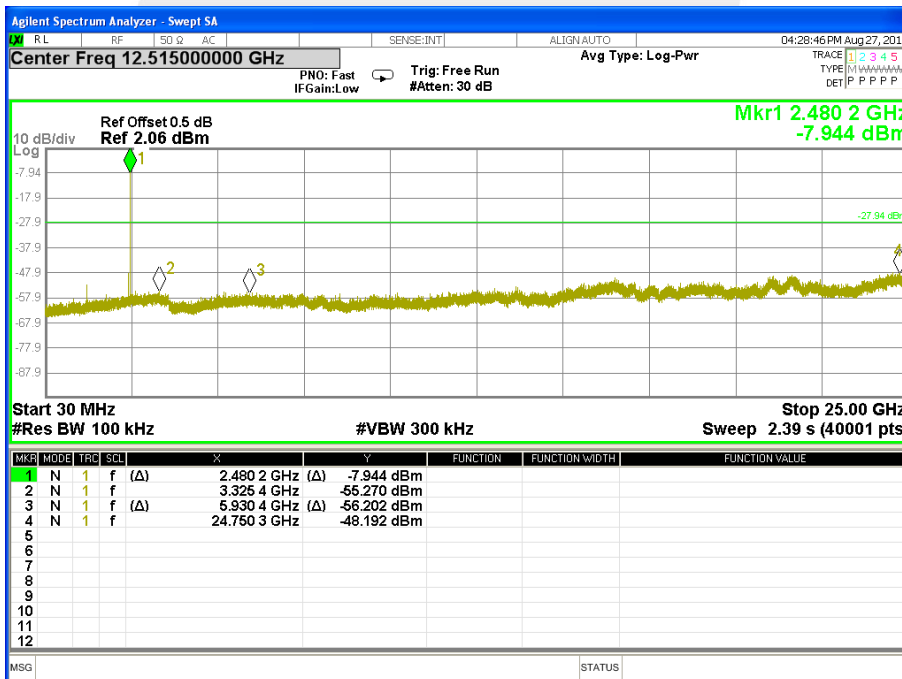




19 CH



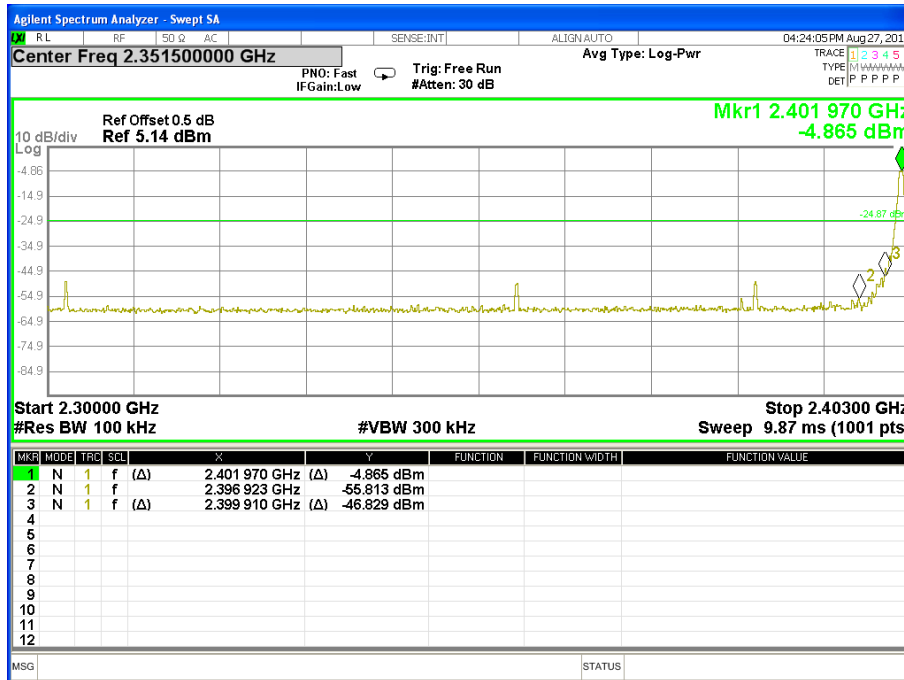
39 CH



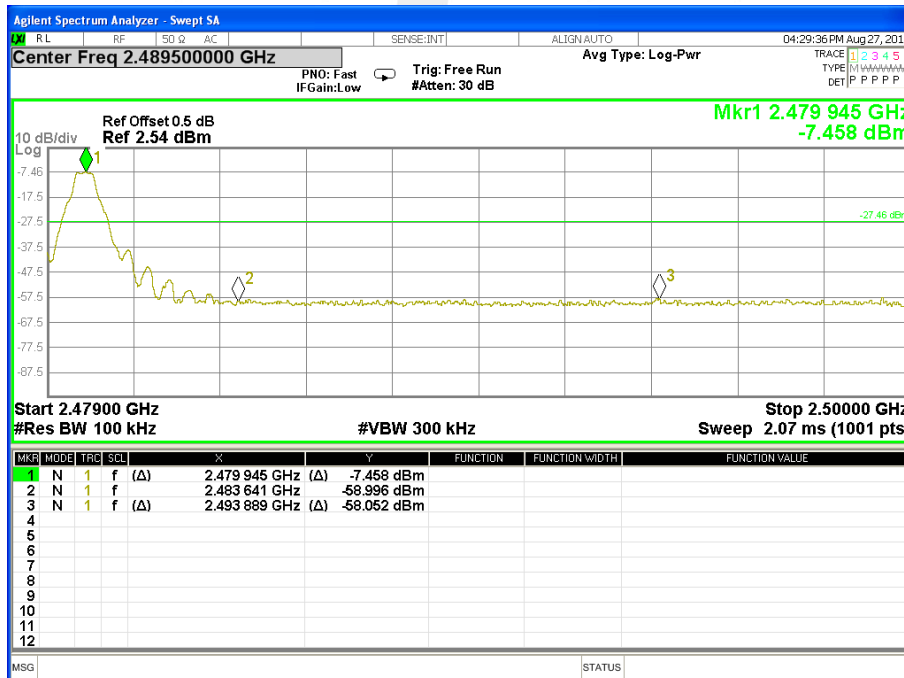


For Band edge

00 CH



39 CH





6. POWER SPECTRAL DENSITY TEST

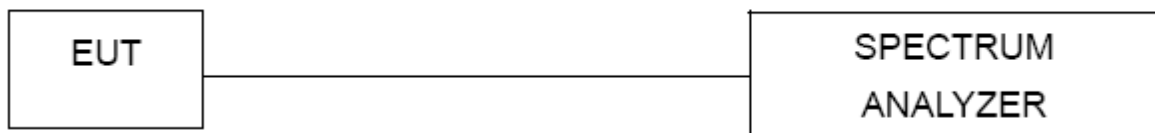
6.1 APPLIED PROCEDURES / LIMIT

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 30V	Test Mode:	TX Mode /CH00, CH19, CH39

Frequency	Power Density (dBm/3kHz)	Limit (dBm/3KHz)	Result
2402 MHz	-14.879	≤8	PASS
2440 MHz	-15.820	≤8	PASS
2480 MHz	-16.535	≤8	PASS

TX CH00

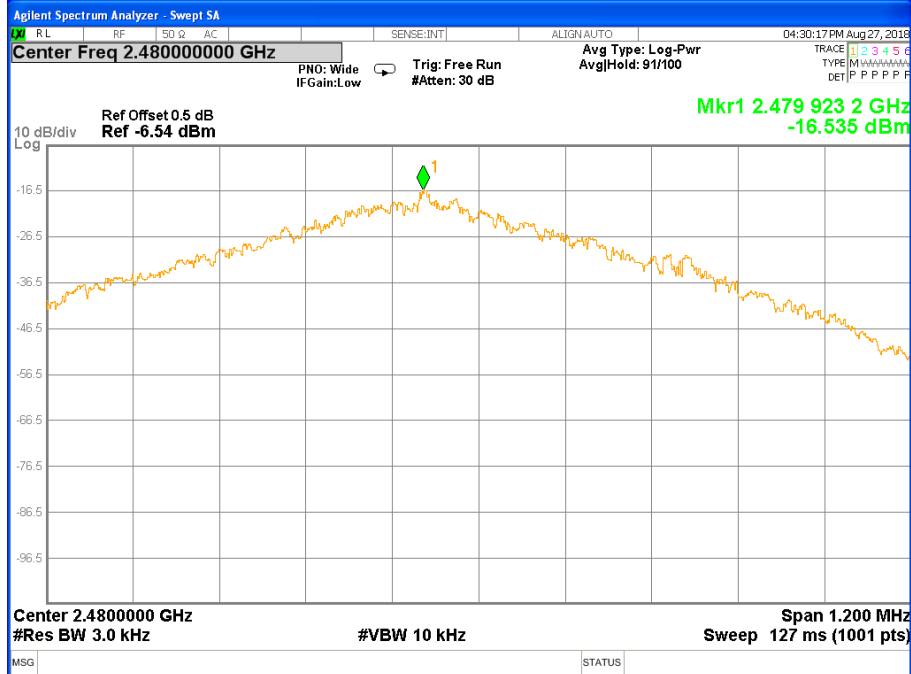




TX CH19



TX CH39





7. BANDWIDTH TEST

7.1 APPLIED PROCEDURES / LIMIT

FCC Part 15.247, Subpart C RSS-247 Issue 2				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2) RSS-247 Issue 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 : 100K 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.

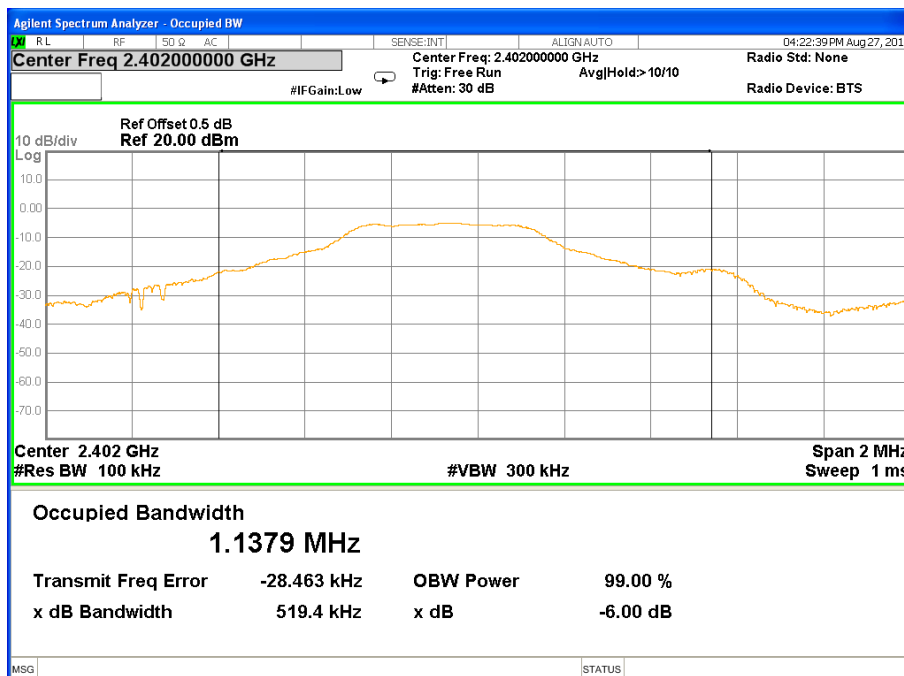


7.5 TEST RESULTS

Temperature:	25 °C	Relative Humidity:	60%
Test Voltage:	DC 30V	Test Mode:	TX Mode /CH00, CH19, CH39

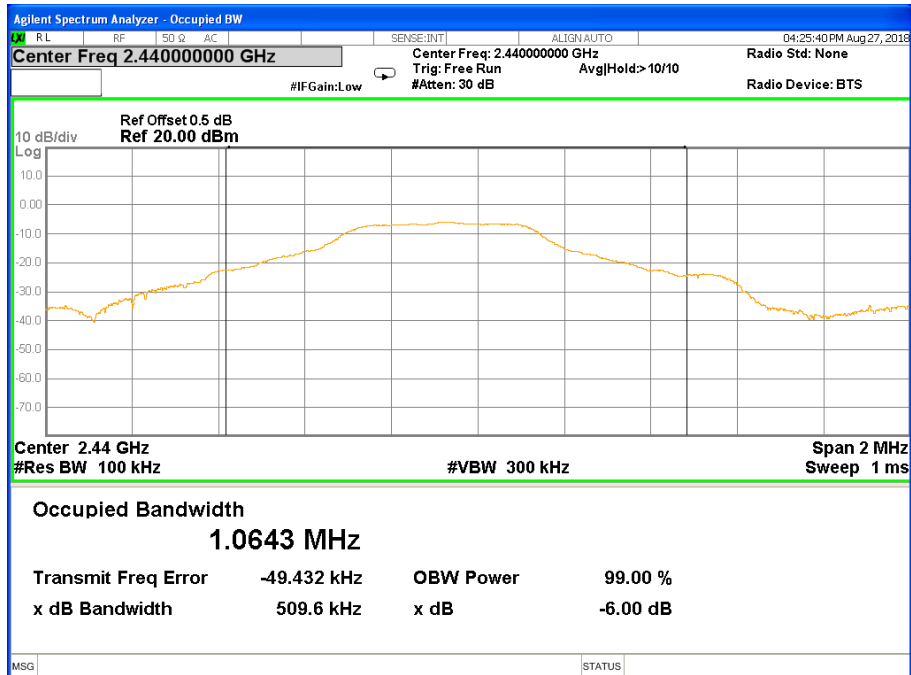
Frequency	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Channel Separation (MHz)	Result
2402 MHz	0.519	1.0322	>=500KHz	PASS
2440 MHz	0.510	1.0330	>=500KHz	PASS
2480 MHz	0.516	1.0274	>=500KHz	PASS

6dB Bandwidth TX CH 00

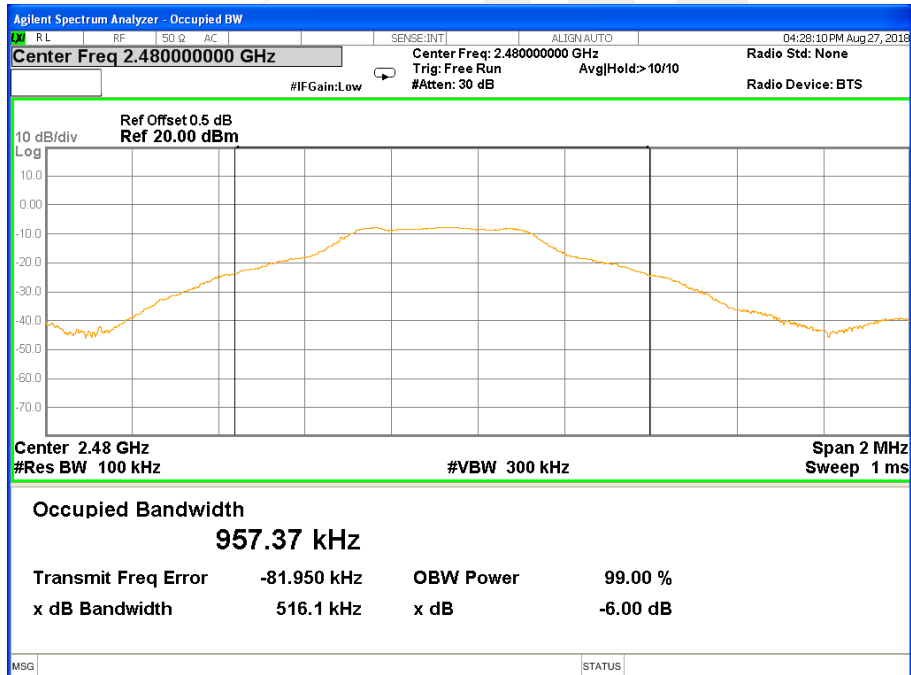




6dB Bandwidth TX CH 19

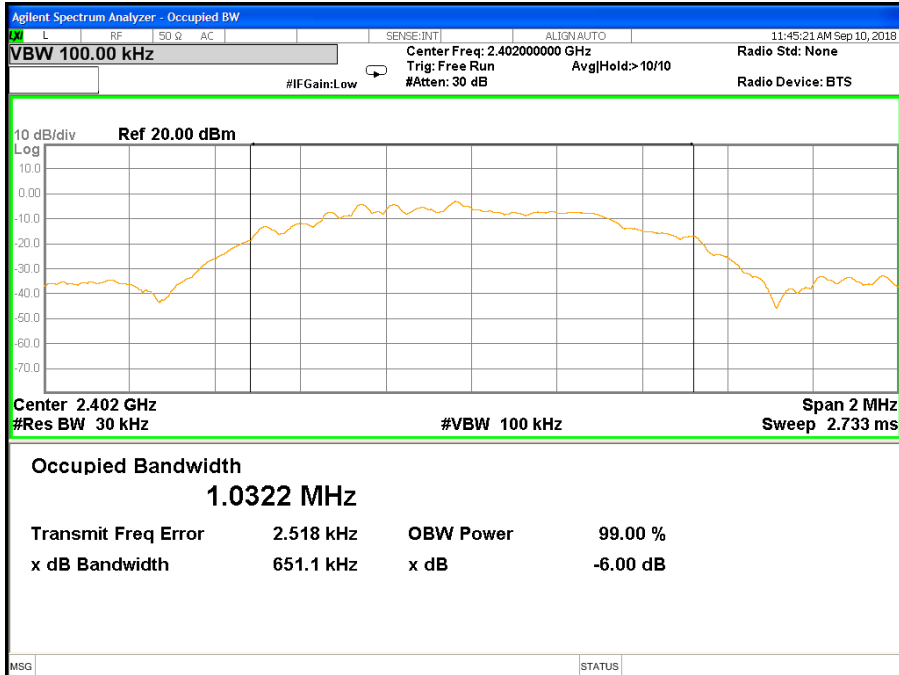


6dB Bandwidth TX CH 39

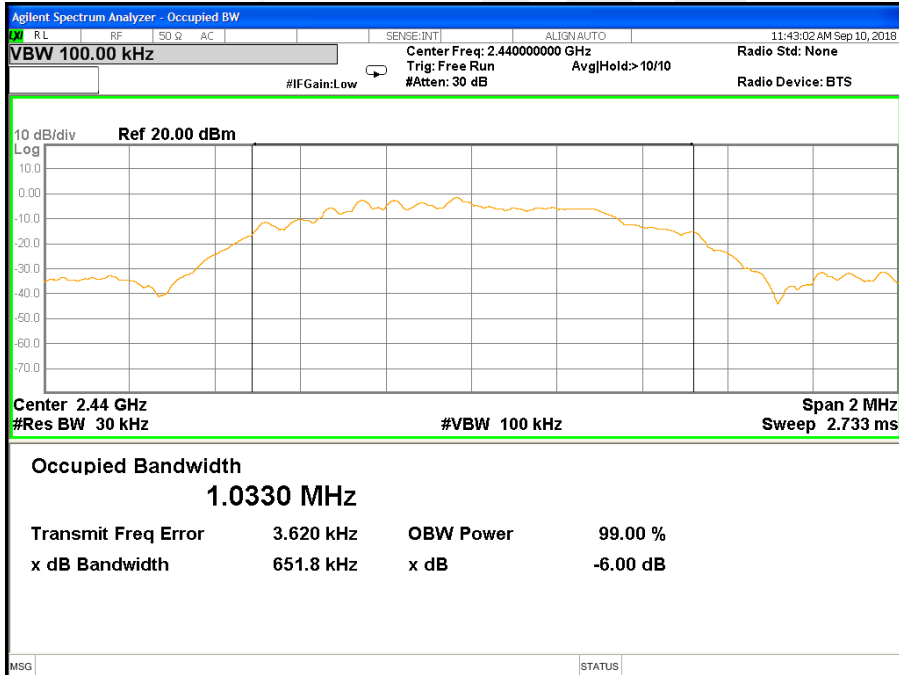




99% Bandwidth TX CH 00

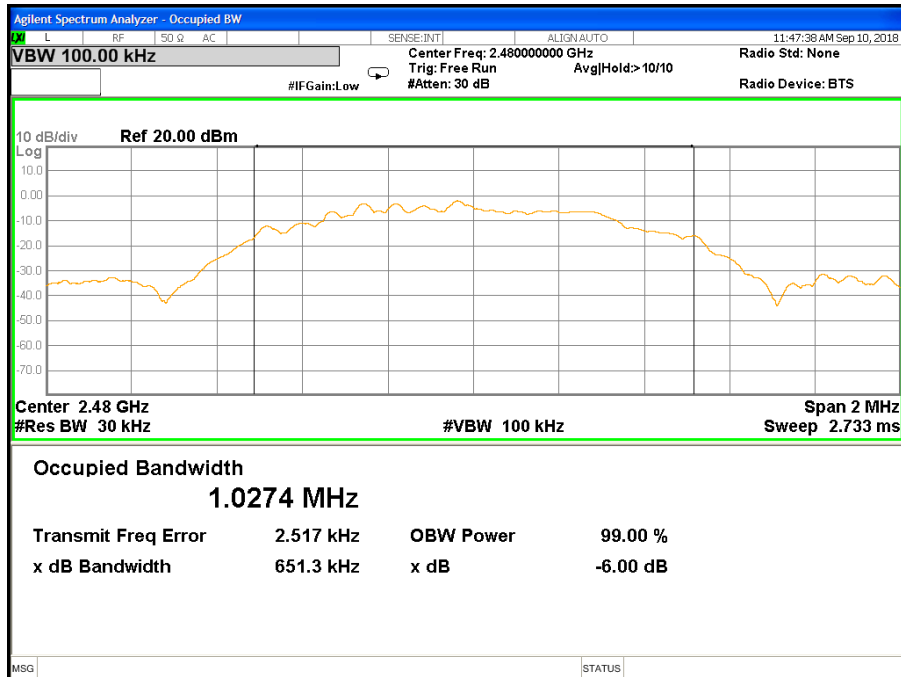


99% Bandwidth TX CH 19





99% Bandwidth TX CH 39





8. PEAK OUTPUT POWER TEST

8.1 APPLIED PROCEDURES / 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 Meter

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 30V	Test Mode:	TX Mode /CH00, CH19, CH39

TX Mode				
Test Channel	Frequency	Conducted Output Power		LIMIT
	(MHz)	Peak (dBm)	AVG (dBm)	dBm
CH00	2402	-3.25	-5.39	30
CH19	2440	-4.58	-6.84	30
CH39	2480	-5.39	-7.66	30

TX Mode					
Test Channel	Frequency	Conducted Output Power	Antenna gain	EIRP Power	LIMIT
	(MHz)	Peak (dBm)	dBi	dBm	dBm
CH00	2402	-3.25	0	-3.25	30
CH19	2440	-4.58	0	-4.58	30
CH39	2480	-5.39	0	-5.39	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 PCB 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 +/-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 vs. Frequency Stability Voltage(V)	Measurement Frequency(MHz)
34.5	2440.0019
30	2440.0014
25.5	2440.0012
Max.Deviation(MHz)	0.0019
Max.Deviation(ppm)	0.78

Rated working voltage: DC 30V

Temperature vs. Frequency Stability

Temperature(°C)	Measurement Frequency(MHz)
-30	2440.0025
-20	2440.0025
-10	2440.0017
0	2440.0022
10	2440.0022
20	2440.0019
30	2440.0017
40	2440.0015
50	2440.0025
Max.Deviation(MHz)	0.0025
Max.Deviation(ppm)	1.02



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※※※※

