



CFR 47 FCC PART 15 SUBPART C

CERTIFICATION TEST REPORT

For

Chipper BT

MODEL NUMBER: Chipper BT

FCC ID: 2AB7X-CHIPPERBT2

REPORT NUMBER: 4789176224-10

ISSUE DATE: January 11, 2020

Prepared for

**BBPOS International Limited
Suite 1903-04, Tower 2, Nina Tower, 8 Yeung Uk Road, Tsuen Wan, NT, Hong Kong**

Prepared by

**UL Verification Services (Guangzhou) Co., Ltd, Song Shan Lake Branch
Building 10, Innovation Technology Park, No. 1, Li Bin Road, Song Shan Lake
Hi-Tech Development Zone Dongguan, People's Republic of China**

Tel: +86 769 22038881

Fax: +86 769 33244054

Website: www.ul.com



Revision History

Rev.	Issue Date	Revisions	Revised By
V0	1/11/2020	Initial Issue	



Summary of Test Results			
Clause	Test Items	FCC Rules	Test Results
1	20dB Bandwidth and 99% Occupied Bandwidth	FCC 15.247 (a) (1)	Pass
2	Conducted Output Power	FCC 15.247 (b) (1)	Pass
3	Carrier Hopping Channel Separation	FCC 15.247 (a) (1)	Pass
4	Number of Hopping Frequency	15.247 (a) (1) III	Pass
5	Time of Occupancy (Dwell Time)	15.247 (a) (1) III	Pass
6	Conducted Bandedge	FCC 15.247 (d)	Pass
7	Radiated Bandedge and Spurious	FCC 15.247 (d) FCC 15.209 FCC 15.205	Pass
8	Conducted Emission Test For AC Power Port	FCC 15.207	Pass
9	Antenna Requirement	FCC 15.203	Pass
Note: This test report is only published to and used by the applicant, and it is not for evidence purpose in China.			



TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	6
2. TEST METHODOLOGY	7
3. FACILITIES AND ACCREDITATION	7
4. CALIBRATION AND UNCERTAINTY	8
4.1. MEASURING INSTRUMENT CALIBRATION	8
4.2. MEASUREMENT UNCERTAINTY	8
5. EQUIPMENT UNDER TEST	9
5.1. DESCRIPTION OF EUT	9
5.2. MAXIMUM OUTPUT POWER.....	9
5.3. PACKET TYPE CONFIGURATION	9
5.4. CHANNEL LIST	10
5.5. TEST CHANNEL CONFIGURATION.....	10
5.6. THE WORSE CASE POWER SETTING PARAMETER.....	10
5.7. DESCRIPTION OF AVAILABLE ANTENNAS	11
5.8. WORST-CASE CONFIGURATIONS.....	11
5.9. DESCRIPTION OF TEST SETUP.....	12
6. MEASURING INSTRUMENT AND SOFTWARE USED	13
7. ANTENNA PORT TEST RESULTS	15
7.1. ON TIME AND DUTY CYCLE.....	15
7.2. 20 dB OCCUPIED BANDWIDTH AND 99% OCCUPIED BANDWIDTH.....	17
7.2.1. GFSK MODE	18
7.3. CONDUCTED OUTPUT POWER.....	22
7.3.1. GFSK MODE	23
7.4. CARRIER HOPPING CHANNEL SEPARATION.....	24
7.4.1. GFSK MODE	25
7.5. NUMBER OF HOPPING FREQUENCY.....	26
7.5.1. GFSK MODE	27
7.6. TIME OF OCCUPANCY (DWELL TIME).....	28
7.6.1. GFSK MODE	29
7.7. CONDUCTED SPURIOUS EMISSION.....	32
7.7.1. GFSK MODE	33
8. RADIATED TEST RESULTS.....	40
8.1. LIMITS AND PROCEDURE	40



8.2.	<i>RESTRICTED BANDEDGE</i>	45
8.2.1.	GFSK MODE	45
8.3.	<i>SPURIOUS EMISSIONS (1~3GHz)</i>	51
8.3.1.	GFSK MODE	51
8.4.	<i>SPURIOUS EMISSIONS (3~18GHz)</i>	57
8.4.1.	GFSK MODE	57
8.5.	<i>SPURIOUS EMISSIONS 18G ~ 26GHz</i>	63
8.5.1.	GFSK MODE	63
8.6.	<i>SPURIOUS EMISSIONS 30M ~ 1 GHz</i>	65
8.6.1.	GFSK MODE	65
8.7.	<i>SPURIOUS EMISSIONS BELOW 30M</i>	67
8.7.1.	GFSK MODE	67
9.	AC POWER LINE CONDUCTED EMISSIONS	70
9.1.1.	GFSK MODE	71
10.	ANTENNA REQUIREMENTS	73



1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: BBPOS International Limited
Address: Suite 1903-04, Tower 2, Nina Tower, 8 Yeung Uk Road, Tsuen Wan, NT, Hong Kong

Manufacturer Information

Company Name: BBPOS International Limited
Address: Suite 1903-04, Tower 2, Nina Tower, 8 Yeung Uk Road, Tsuen Wan, NT, Hong Kong

EUT Description

Product Name: Chipper BT
Model Name: Chipper BT
Series Model: CHB70
Model Difference: See section 5.1 of this report for detail.
Brand: BBPOS
Sample Status: Normal
Sample ID: 2668174
Sample Received date: November 05, 2019
Date Tested: November 11, 2019-January 11, 2020

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 FCC PART 15 SUBPART C	PASS

Prepared By:

Checked By:

Kebo Zhang
Engineer Project Associate

Shawn Wen
Laboratory Leader

Approved By:

Stephen Guo
Laboratory Manager



2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with KDB 558074 D01 15.247 Meas Guidance v05r02, 414788 D01 Radiated Test Site v01r01, CFR 47 FCC Part 2, CFR 47 FCC Part 15, ANSI C63.10-2013.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	<p>A2LA (Certificate No.: 4102.01) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA.</p> <p>FCC (FCC Designation No.: CN1187) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. Has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules</p> <p>ISED(Company No.: 21320) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been registered and fully described in a report filed with ISED. The Company Number is 21320.</p> <p>VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011) UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with VCCI, the Membership No. is 3793. Facility Name: Chamber D, the VCCI registration No. is G-20019 and R-20004 Shielding Room B , the VCCI registration No. is C-20012 and T-20011</p>
---------------------------	---

Note 1: All tests measurement facilities use to collect the measurement data are located at Building 10, Innovation Technology Park, Song Shan Lake Hi tech Development Zone, Dongguan, 523808, China

Note 2: The test anechoic chamber in UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.

Note 3: For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30MHz had been correlated to measurements performed on an OFS.



4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Conduction emission	3.62dB
Radiation Emission test(include Fundamental emission) (9kHz-30MHz)	2.2dB
Radiation Emission test(include Fundamental emission) (30MHz-1GHz)	4.00dB
Radiation Emission test (1GHz to 26GHz)(include Fundamental emission)	5.78dB (1GHz-18Gz)
	5.23dB (18GHz-26Gz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	



5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Equipment	Chipper BT		
Model Name	Chipper BT		
Series Model	CHB70		
Model Difference	Chipper BT have the same technical construction including circuit diagram, PCB Layout, components and component layout, all electrical construction and mechanical construction with CHB70. The difference lies only the model number.		
Product Description (Bluetooth)	Operation Frequency	2402 MHz ~ 2480 MHz	
	Modulation Type	Data Rate	
	GFSK	1Mbps	
Supply Voltage	DC 3.7V		

5.2. MAXIMUM OUTPUT POWER

Bluetooth Mode	Frequency (MHz)	Channel Number	Max Output Power (dBm)	EIRP (dBm)
GFSK	2402-2480	0-78[79]	-0.284	0.266

5.3. PACKET TYPE CONFIGURATION

Test Mode	Packet Type	Setting(Packet Length)
GFSK	DH1	27
	DH3	183
	DH5	339



5.4. CHANNEL LIST

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	20	2422	40	2442	60	2462
01	2403	21	2423	41	2443	61	2463
02	2404	22	2424	42	2444	62	2464
03	2405	23	2425	43	2445	63	2465
04	2406	24	2426	44	2446	64	2466
05	2407	25	2427	45	2447	65	2467
06	2408	26	2428	46	2448	66	2468
07	2409	27	2429	47	2449	67	2469
08	2410	28	2430	48	2450	68	2470
09	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461	\	\

5.5. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel Number	Test Channel
GFSK	CH 0, CH 39, CH 78/ Low, Middle, High ;	2402MHz, 2441MHz, 2480MHz

5.6. THE WORSE CASE POWER SETTING PARAMETER

The Worst Case Power Setting Parameter under 2400 ~ 2483.5MHz Band				
Test Software		FCC TestTool		
Modulation Type	Transmit Antenna Number	Test Software Setting Value		
		CH 00	CH 39	CH 78
GFSK	1	Default	Default	Default



5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2402-2480	meandered printed inverted-F antenna	0.55

Test Mode	Transmit and Receive Mode	Description
GFSK	1TX, 1RX	Chain 1 can be used as transmitting/receiving antenna.

5.8. WORST-CASE CONFIGURATIONS

Bluetooth Mode	Modulation Technology	Modulation Type	Data Rate (Mbps)
BR	FHSS	GFSK	1Mbit/s

Note: 1.Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates.

TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests	
Relative Humidity	45 ~ 70%	
Atmospheric Pressure:	1025Pa	
Temperature	TN	22 ~ 28°C
Voltage :	VL	N/A
	VN	DC 3.7V
	VH	N/A

Note: VL= Lower Extreme Test Voltage
VN= Nominal Voltage
VH= Upper Extreme Test Voltage
TN= Normal Temperature



5.9. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
1	Laptop	ThinkPad	T460S	SL10K24796 JS
2	UART	/	/	/

I/O CABLES

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	USB	/	/	1.0	/

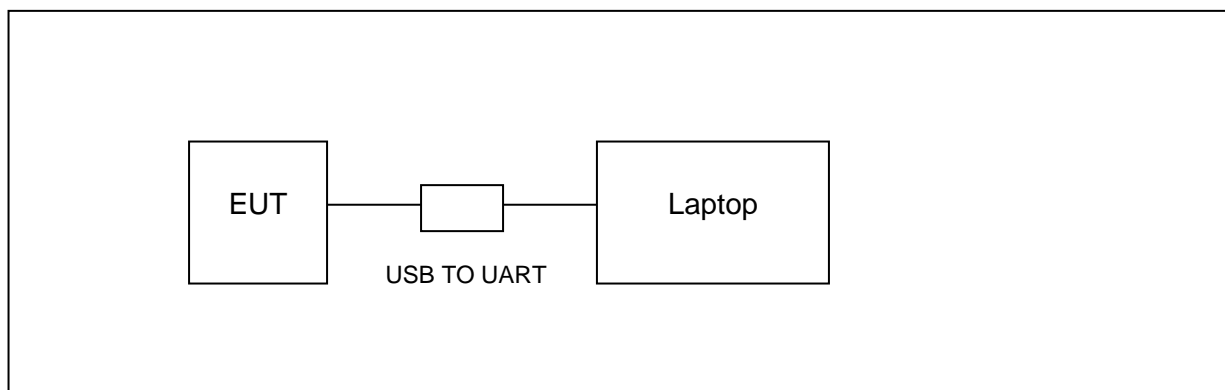
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	/	/	/	/

TEST SETUP

The EUT can work in engineering mode with a software through a Laptop.

SETUP DIAGRAM FOR TESTS





6. MEASURING INSTRUMENT AND SOFTWARE USED

Conducted Emissions							
Instrument							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	EMI Test Receiver	R&S	ESR3	101961	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Two-Line V-Network	R&S	ENV216	101983	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Dec.10,2018	Dec.05,2019	Dec.05,2020
Software							
Used	Description			Manufacturer	Name	Version	
<input checked="" type="checkbox"/>	Test Software for Conducted disturbance			Farad	EZ-EMC	Ver. UL-3A1	
Radiated Emissions							
Instrument							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Dec.10,2018	Dec.06,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Hybrid Log Periodic Antenna	TDK	HLP-3003C	130960	Sep.17, 2018	Sep.17,2018	Sep.17,2021
<input checked="" type="checkbox"/>	Preamplifier	HP	8447D	2944A09099	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	EMI Measurement Receiver	R&S	ESR26	101377	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Horn Antenna	TDK	HRN-0118	130939	Sep.17,2018	Sep.17,2018	Sep.17,2021
<input checked="" type="checkbox"/>	High Gain Horn Antenna	Schwarzbeck	BBHA-9170	691	Aug.11,2018	Aug.11,2018	Aug.11,2021
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-0118	TRS-305-00067	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Preamplifier	TDK	PA-02-2	TRS-307-00003	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Loop antenna	Schwarzbeck	1519B	00008	Jan.07,2019	Jan.07,2019	Jan.07,2022
<input checked="" type="checkbox"/>	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	Dec.10,2018	Dec.05,2019	Dec.05,2020
<input checked="" type="checkbox"/>	High Pass Filter	Wi	WHKX10-2700-3000-18000-40SS	23	Dec.10,2018	Dec.05,2019	Dec.05,2020
Software							
Used	Description			Manufacturer	Name	Version	
<input checked="" type="checkbox"/>	Test Software for Radiated disturbance			Farad	EZ-EMC	Ver. UL-3A1	



Other instruments							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030A	MY55410512	Dec.10,2018	Dec.06,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Power Meter	Keysight	N1911A	MY55416024	Dec.10,2018	Dec.06,2019	Dec.05,2020
<input checked="" type="checkbox"/>	Power Sensor	Keysight	U2021XA	MY58100022	Dec.10,2018	Dec.06,2019	Dec.05,2020



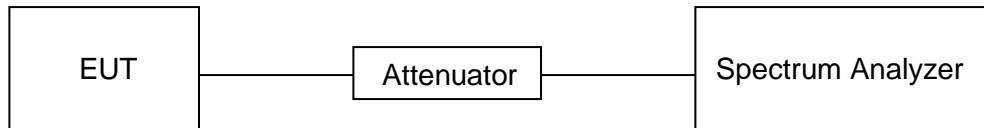
7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only

TEST SETUP



TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

RESULTS

Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)	Final setting For VBW (kHz)
GFSK	1.632	1.764	0.925	92.5	0.339	0.61	1

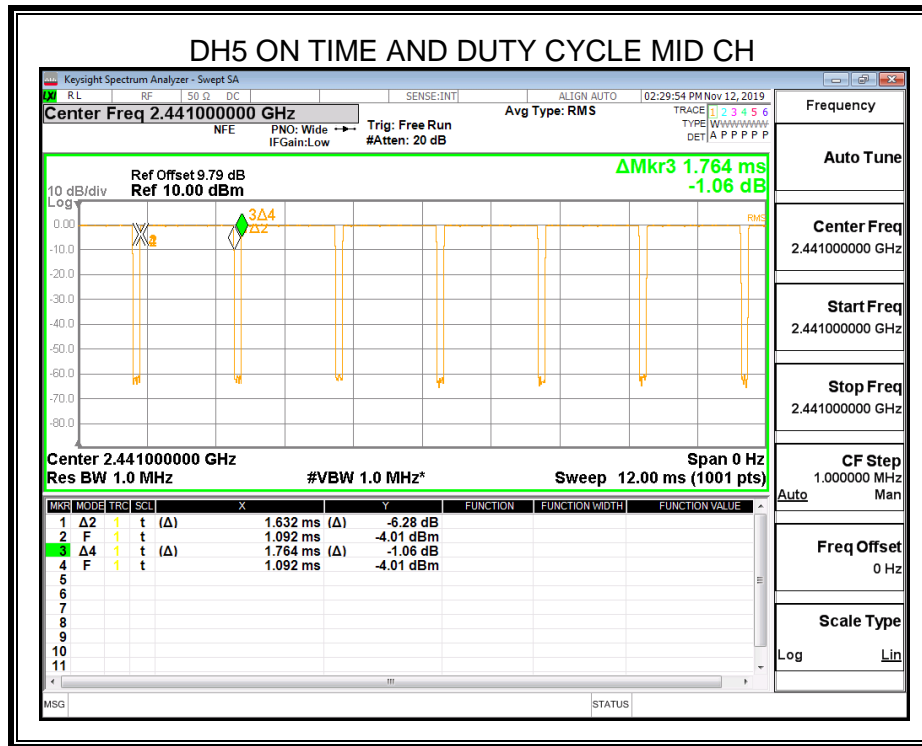
Note:

Duty Cycle Correction Factor=10log (1/x).

Where: x is Duty Cycle (Linear)

Where: T is On Time

If that calculated VBW is not available on the analyzer then the next higher value should be used.





7.2. 20 dB OCCUPIED BANDWIDTH AND 99% OCCUPIED BANDWIDTH

LIMITS

CFR 47FCC Part15 (15.247) Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (a) (1)	20dB Occupied Bandwidth	N/A	2400-2483.5

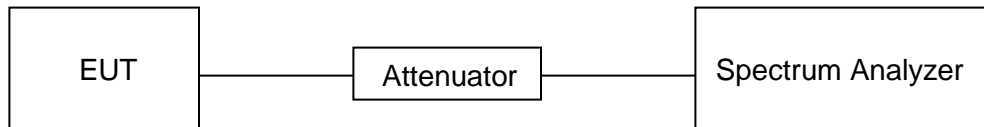
TEST PROCEDURE

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 20dB Occupied Bandwidth: 1% to 5% of the 20 dB bandwidth For 99% Occupied Bandwidth: 1% to 5% of the occupied bandwidth
VBW	For 20dB Occupied Bandwidth: approximately 3×RBW For 99% Occupied Bandwidth: ≥ 3×RBW
Span	approximately 2 to 3 times the 20 dB bandwidth
Trace	Max hold
Sweep	Auto couple

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 20 dB and 99% relative to the maximum level measured in the fundamental emission.

TEST SETUP





TEST ENVIRONMENT

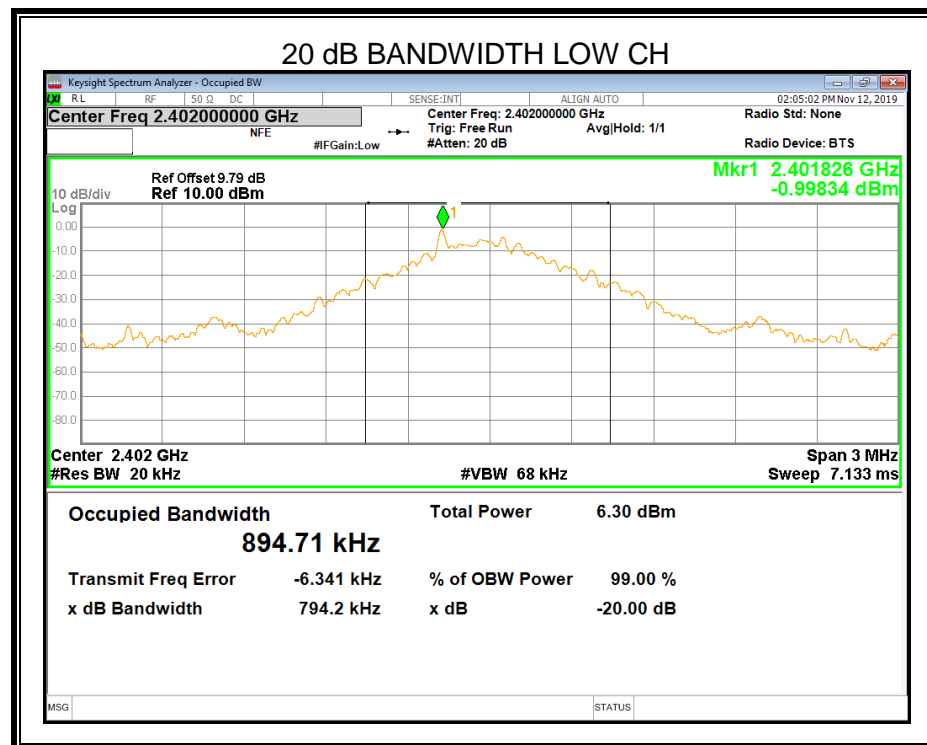
Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

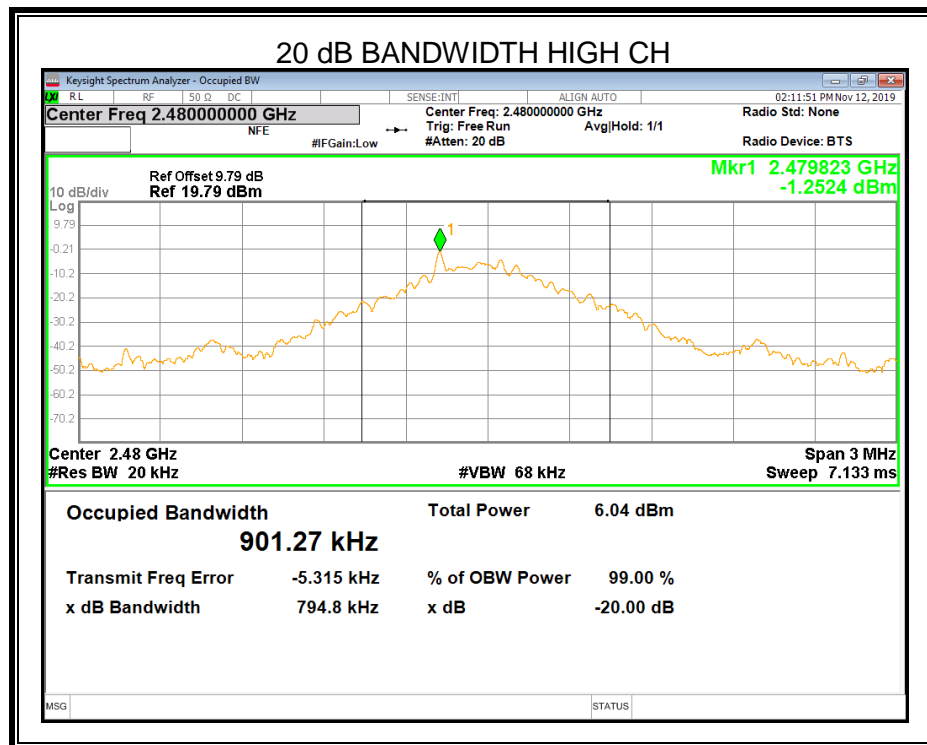
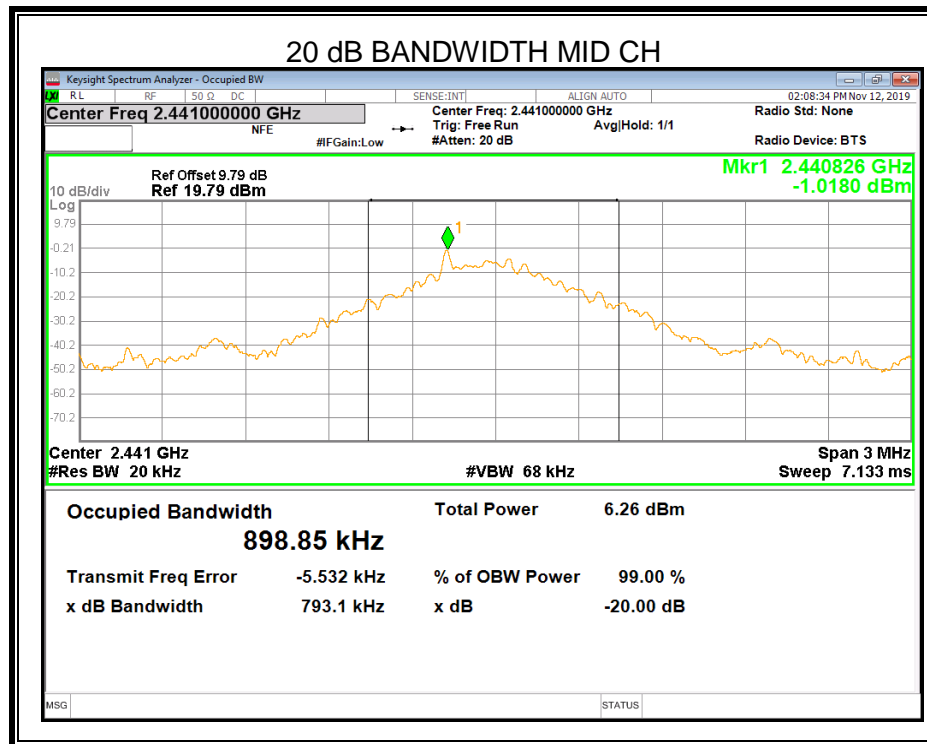
RESULTS

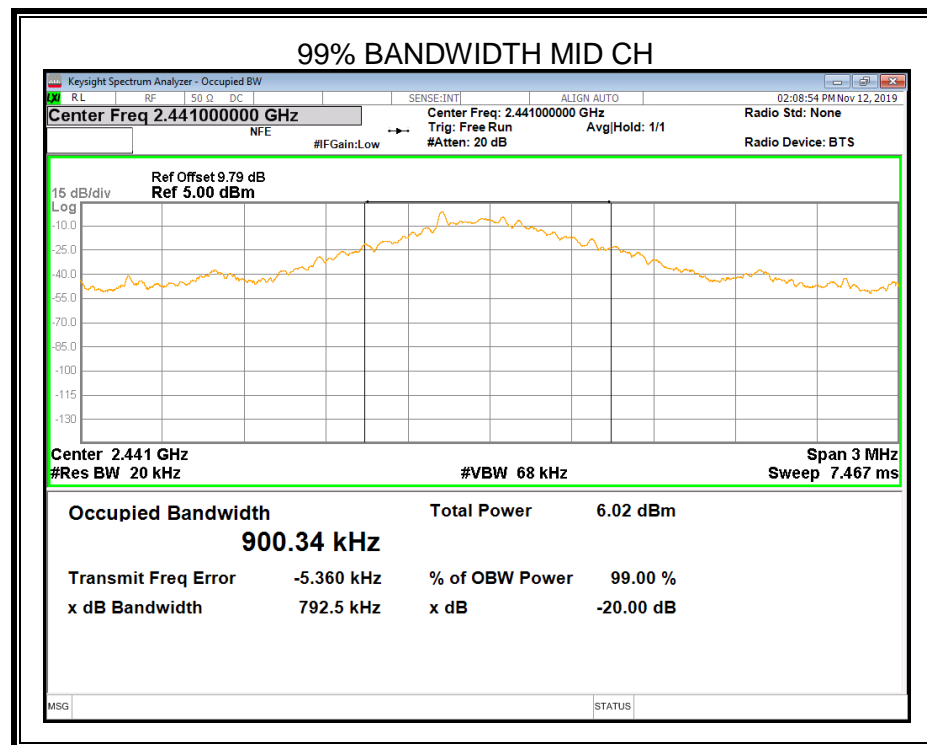
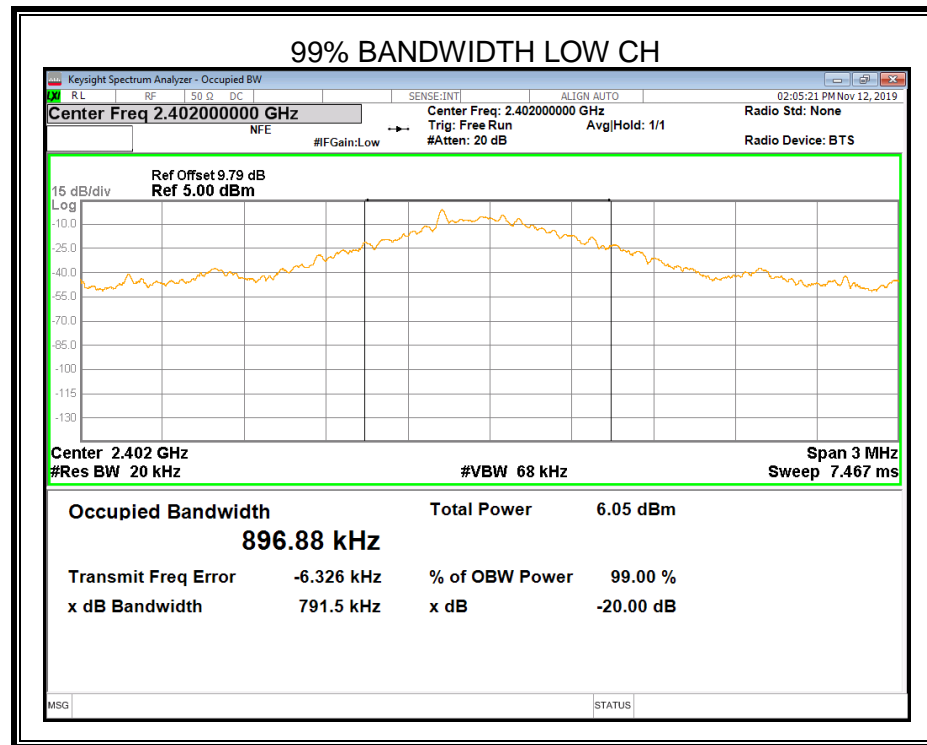
7.2.1. GFSK MODE

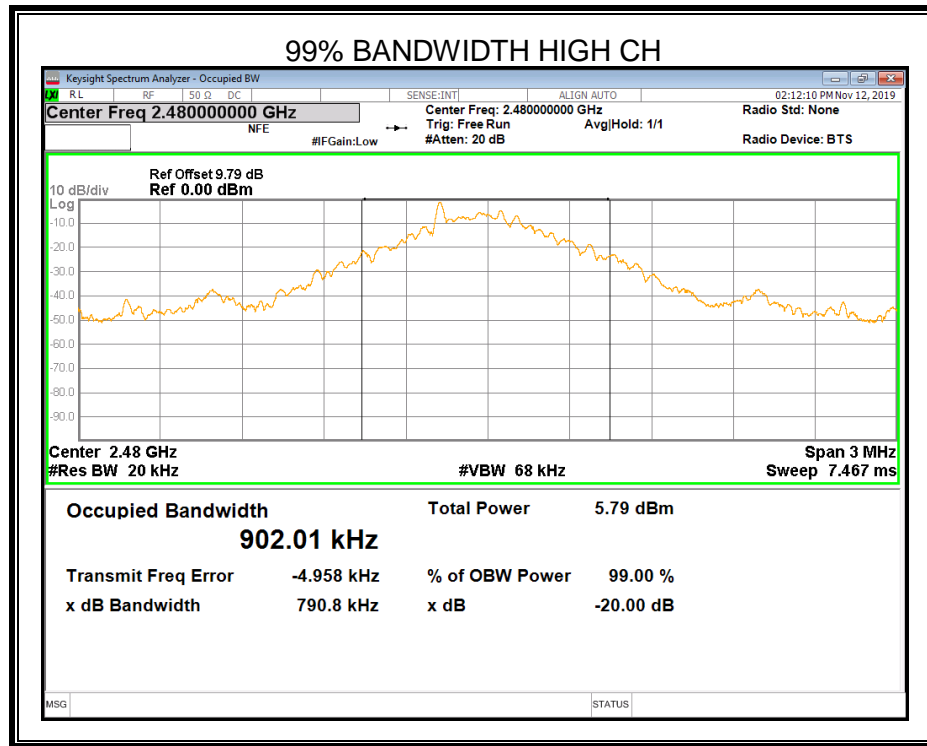
Channel	Frequency (MHz)	20dB Occupied bandwidth (MHz)	99% Occupied bandwidth (MHz)	Result
Low	2402	0.7942	0.89688	PASS
Middle	2441	0.7931	0.90034	PASS
High	2480	0.7948	0.90201	PASS

Test Graph











7.3. CONDUCTED OUTPUT POWER

LIMITS

CFR 47 FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (b) (1)	Peak Conducted Output Power	Hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel : 1 watt or 30dBm; Hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel : 125 mW or 21dBm	2400-2483.5

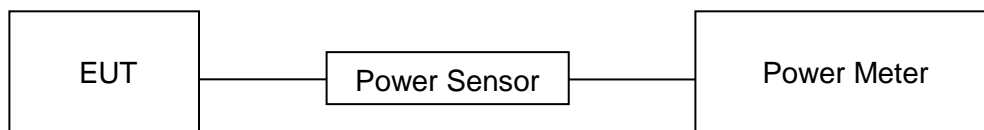
TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.

Measure peak power each channel.

TEST SETUP





TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

RESULTS

7.3.1. GFSK MODE

Channel	Frequency	Maximum Conducted Output Power(PK)	EIRP	Limit	Result
	(MHz)	(dBm)	(dBm)	(dBm)	
Low	2402	-0.284	0.266	30	Pass
Middle	2441	-0.309	0.241	30	Pass
High	2480	-0.522	0.028	30	Pass

Note: EIRP= Maximum Conducted Output Power + Antenna Gain

Note: The channel separation is 1MHz and the 20dB Bandwidth is less than 1MHz.



7.4. CARRIER HOPPING CHANNEL SEPARATION

LIMITS

CFR 47 FCC Part15 (15.247) , Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (a) (1)	Carrier Hopping Channel Separation	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel.	2400-2483.5

TEST PROCEDURE

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

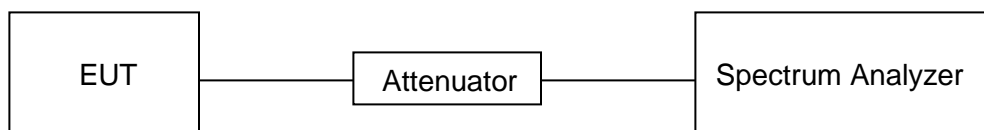
Center Frequency	The center frequency of the channel under test
Span	wide enough to capture the peaks of two adjacent channels
Detector	Peak
RBW	Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
VBW	≥RBW
Trace	Max hold
Sweep time	Auto couple

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

Compliance of an EUT with the appropriate regulatory limit shall be determined.

A plot of the data shall be included in the test report.

TEST SETUP





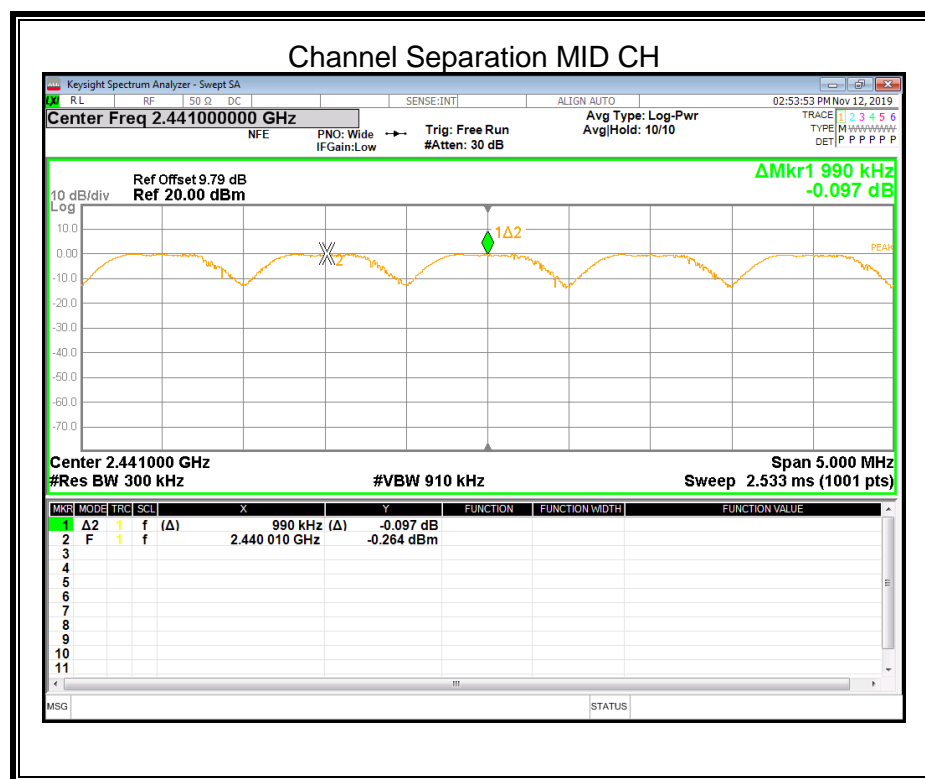
TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

RESULTS

7.4.1. GFSK MODE

Channel	Carrier Hopping Channel Separation (MHz)	Limit (MHz)	Result
Middle	0.990	≥ 20 dB Bandwidth Of The Hopping Channel	PASS



Note: For 20 dB Bandwidth of The Hopping Channel, please refer to clause 7.2.1.



7.5. NUMBER OF HOPPING FREQUENCY

LIMITS

CFR 47 FCC Part15 (15.247) , Subpart C		
Section	Test Item	Limit
CFR 47 15.247 (a) (1) III	Number of Hopping Frequency	at least 15 hopping channels

TEST PROCEDURE

Connect the EUT to the spectrum Analyzer and use the following settings:

Detector	Peak
RBW	To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
VBW	≥RBW
Span	The frequency band of operation
Trace	Max hold
Sweep time	Auto couple

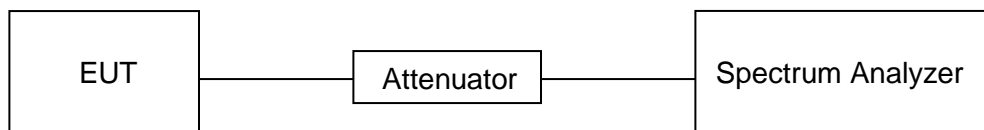
Set EUT to transmit maximum output power and switch on frequency hopping function. then set enough count time (larger than 5000 times) to get all the hopping frequency channel displayed on the screen of spectrum analyzer.

Count the quantity of peaks to get the number of hopping channels.

FHSS Mode: 79 Channels observed.

AFHSS Mode: 20 Channels declared.

TEST SETUP





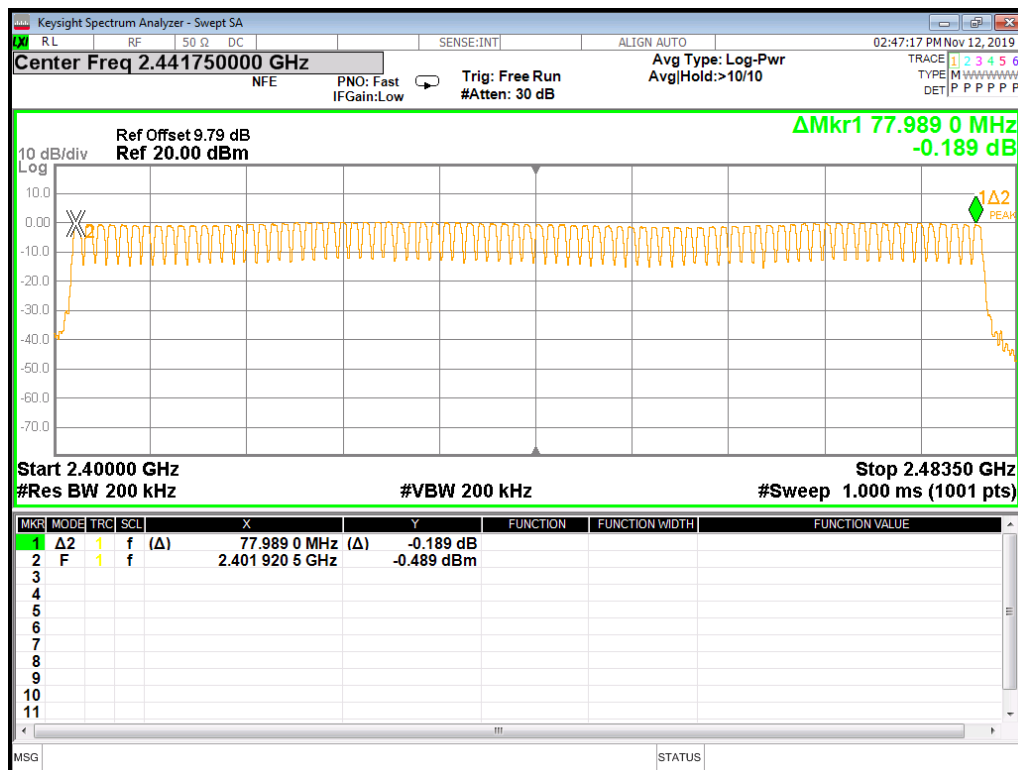
TEST ENVIRONMENT

Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

RESULTS

7.5.1. GFSK MODE

Hopping numbers	Limit	Results
79	≥ 15	Pass





7.6. TIME OF OCCUPANCY (DWELL TIME)

LIMITS

CFR 47 FCC Part15 (15.247) , Subpart C		
Section	Test Item	Limit
CFR 47 15.247 (a) (1) III	Time of Occupancy (Dwell Time)	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

TEST PROCEDURE

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

Center Frequency	The center frequency of the channel under test
Detector	Average
RBW	1 MHz
VBW	≥RBW
Span	zero span
Trace	Clear Write
Sweep time	As necessary to capture the entire dwell time per hopping channel

- The transmitter output (antenna port) was connected to the spectrum analyzer
- Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
- Set the center frequency on any frequency would be measure and set the frequency span to zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.
 $A \text{ Period Time} = (\text{channel number}) \times 0.4$

For FHSS Mode (79 Channel):

DH1 Time Slot: Reading * (1600/2)*31.6/(channel number)

DH3 Time Slot: Reading * (1600/4)*31.6/(channel number)

DH5 Time Slot: Reading * (1600/6)*31.6/(channel number)

For AFHSS Mode (20 Channel):

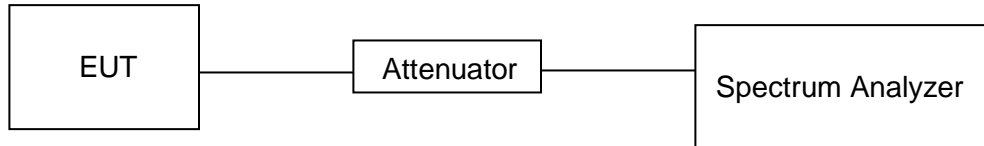
DH1 Time Slot: Reading * (800/2)*8/(channel number)

DH3 Time Slot: Reading * (800/4)*8/(channel number)

DH5 Time Slot: Reading * (800/6)*8/(channel number)



TEST SETUP



TEST ENVIRONMENT

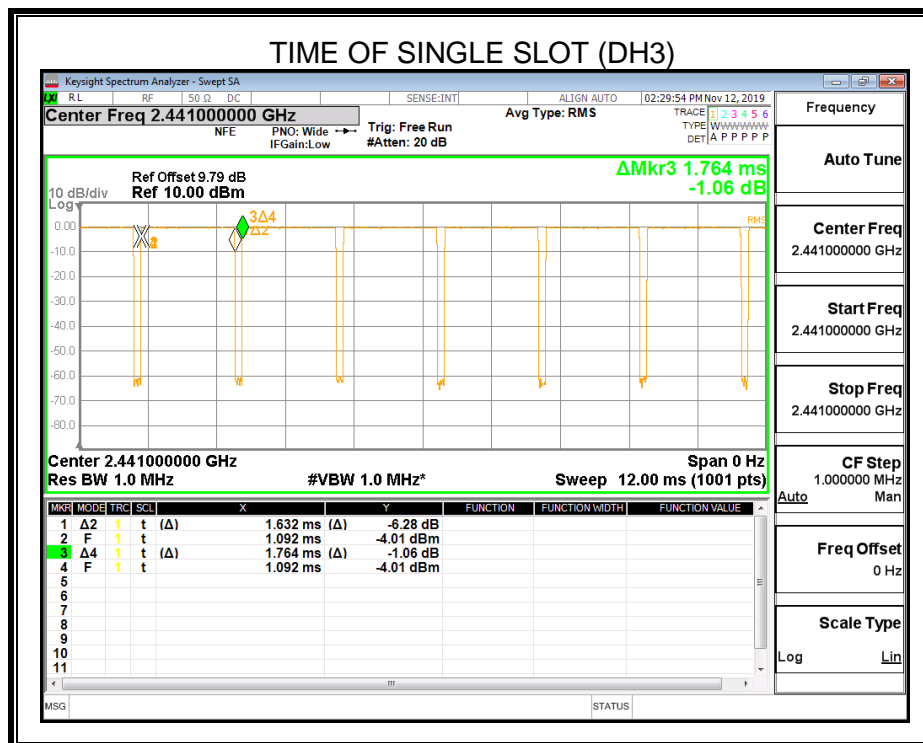
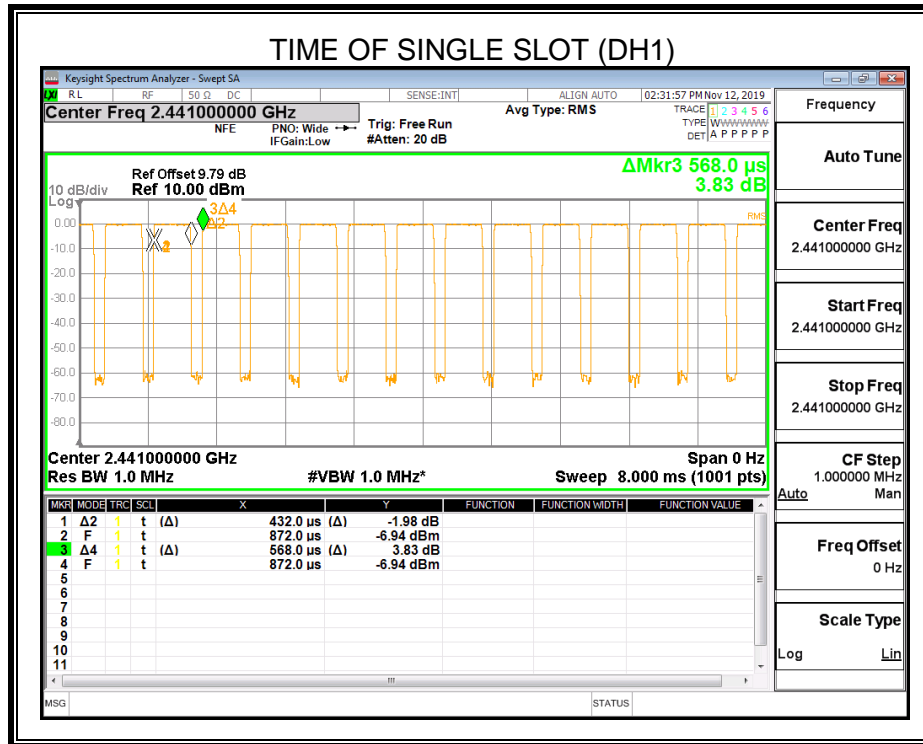
Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V

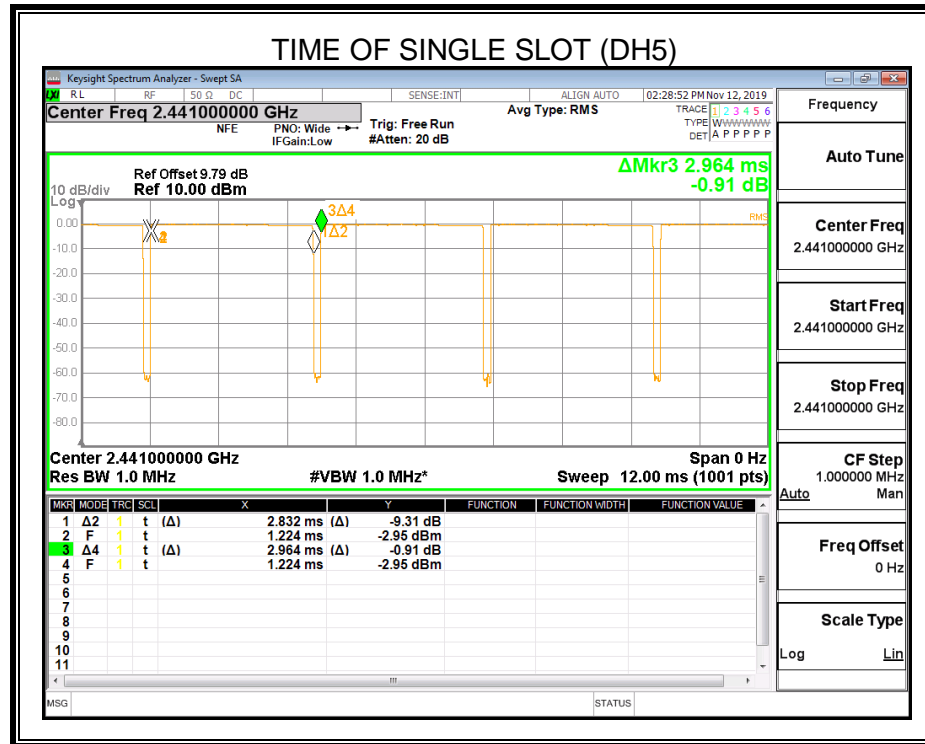
RESULTS

7.6.1. GFSK MODE

FHSS Mode				
Packet	Channel	Burst Width [ms/hop/ch]	Dwell Time [ms]	Results
DH1	MCH	0.432	0.1382	PASS
DH3	MCH	1.632	0.2611	PASS
DH5	MCH	2.832	0.3021	PASS
AFHSS Mode				
DH1	MCH	0.432	0.0691	PASS
DH3	MCH	1.632	0.1306	PASS
DH5	MCH	2.832	0.1510	PASS

Test Graph







7.7. CONDUCTED SPURIOUS EMISSION

LIMITS

CFR 47 FCC Part15 (15.247) , Subpart C		
Section	Test Item	Limit
CFR 47 FCC §15.247 (d)	Conducted Spurious Emission	at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power

TEST PROCEDURE

Please refer to the ANSI C63.10 section 6.10.

For Bandedge use the following settings:

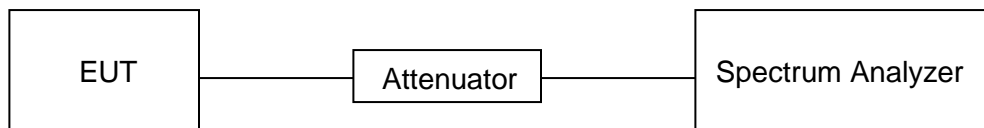
Detector	Peak
RBW	100kHz
VBW	300kHz
Span	wide enough to fully capture the emission being measured
Trace	Max hold
Sweep time	Auto couple.

For Spurious Emission use the following settings:

Detector	Peak
RBW	100kHz
VBW	300kHz
Span	wide enough to fully capture the emission being measured
Trace	Max hold
Sweep time	Auto couple.

Use the peak marker function to determine the maximum amplitude level.

TEST SETUP



TEST ENVIRONMENT

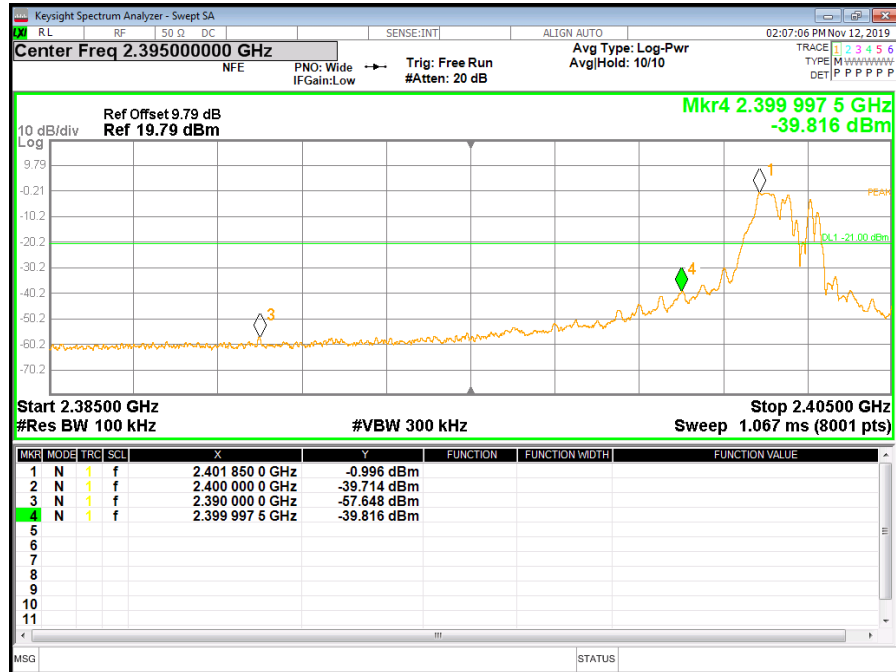
Temperature	25.5°C	Relative Humidity	52%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V



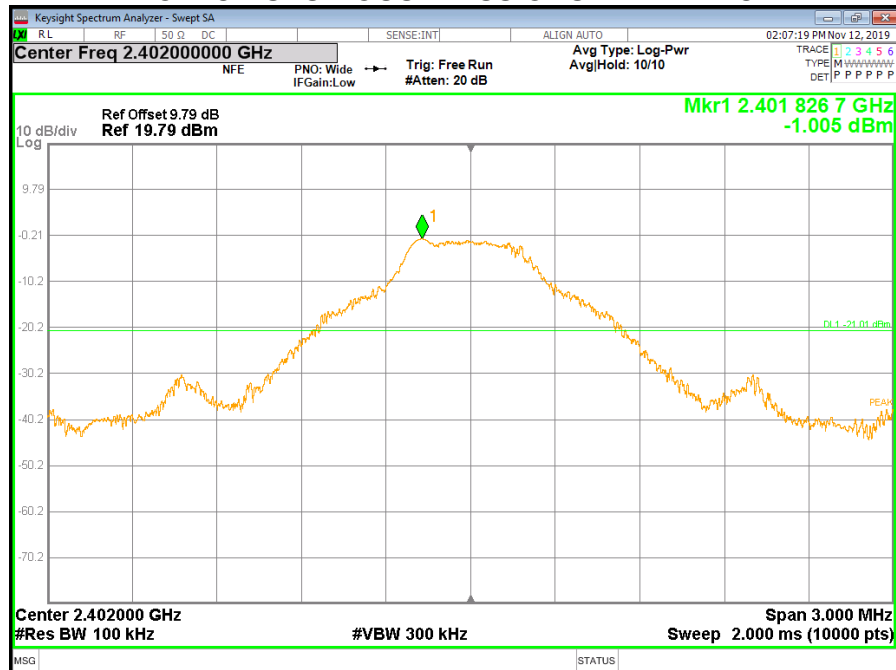
RESULTS

7.7.1. GFSK MODE

LOW CH BANDEDGE

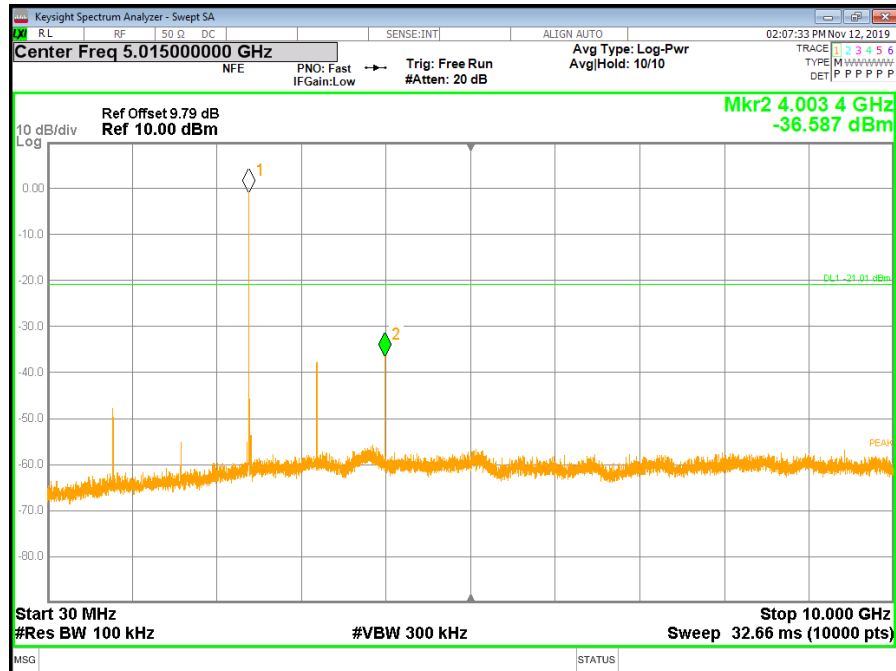


LOW CH SPURIOUS EMISSIONS REFERENCE

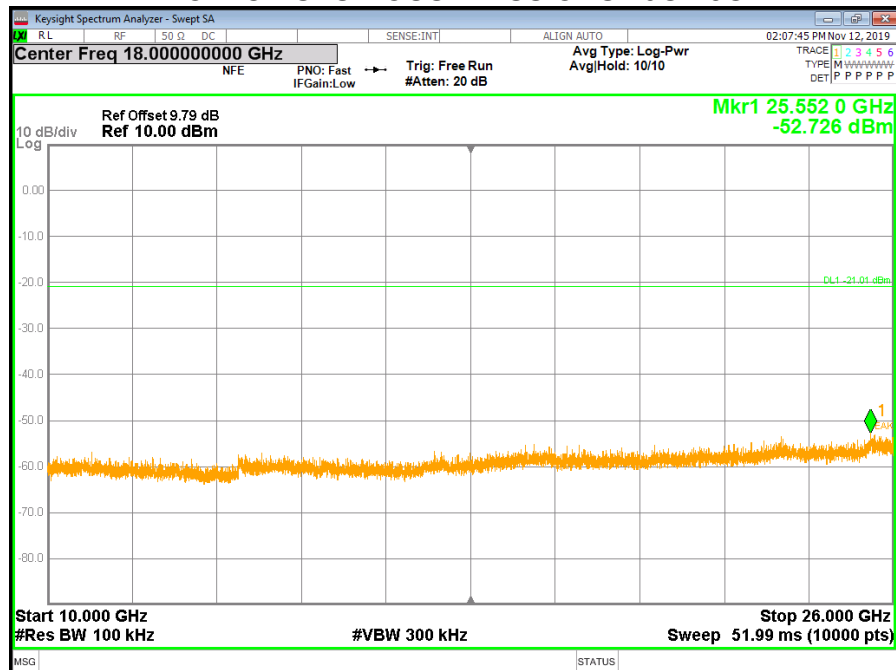




LOW CH SPURIOUS EMISSIONS 30M-10G

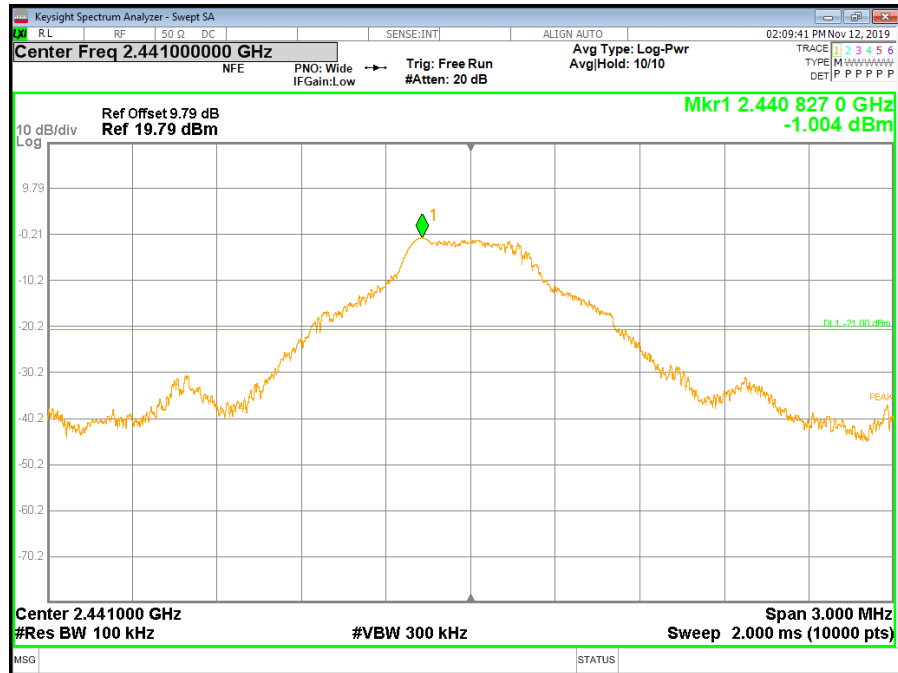


LOW CH SPURIOUS EMISSIONS 10G-26G

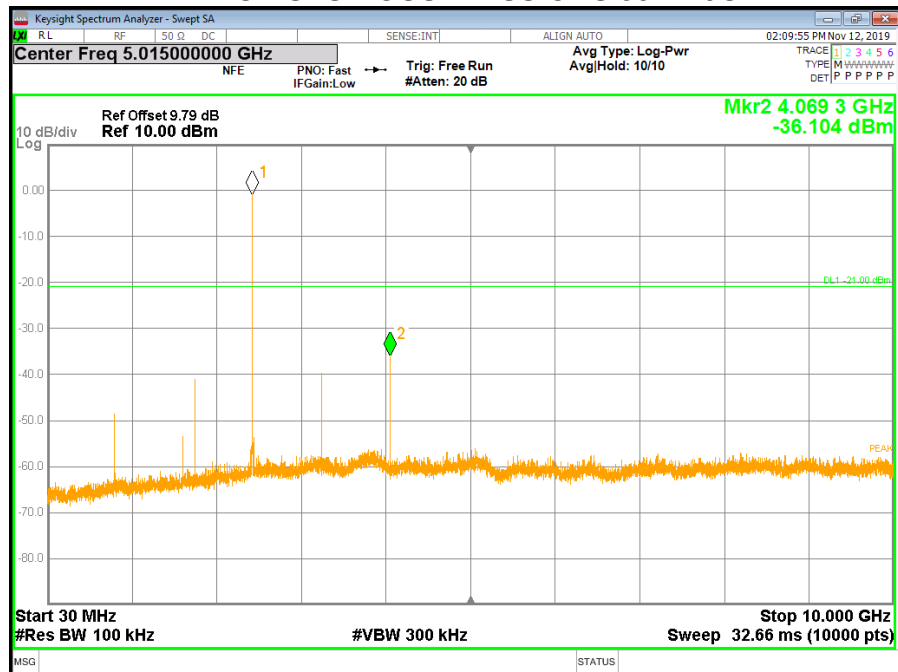




MID CH SPURIOUS EMISSIONS REFERENCE



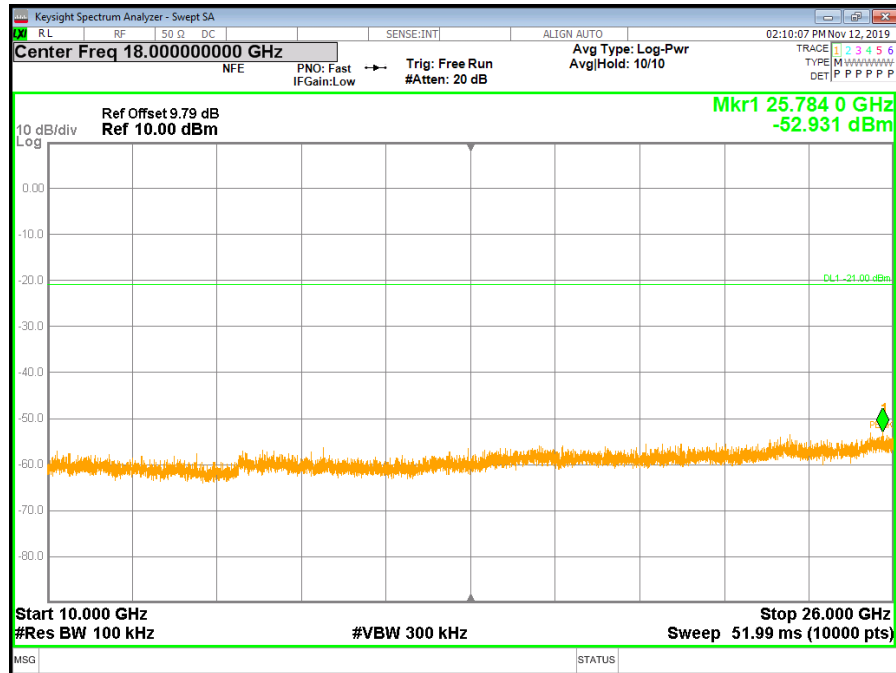
MID CH SPURIOUS EMISSIONS 30M-10G



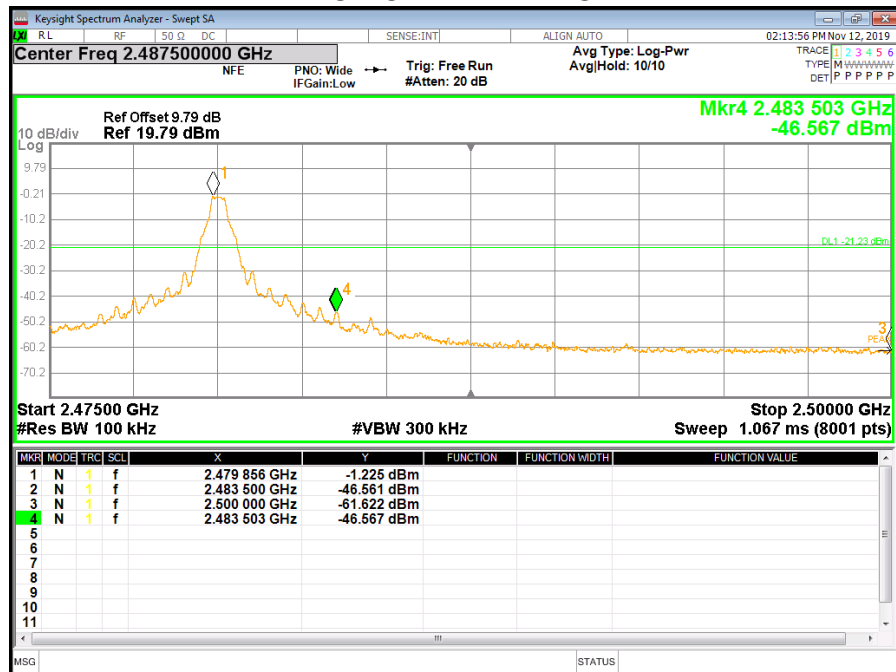
Note: The point 1 is 2.4G main carrier.



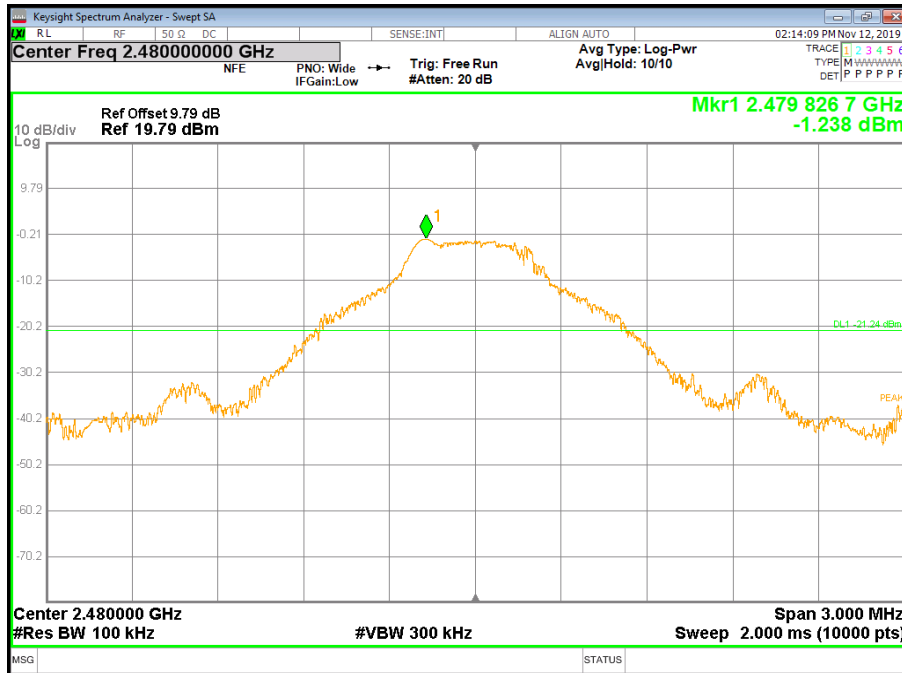
MID CH SPURIOUS EMISSIONS 10G-26G



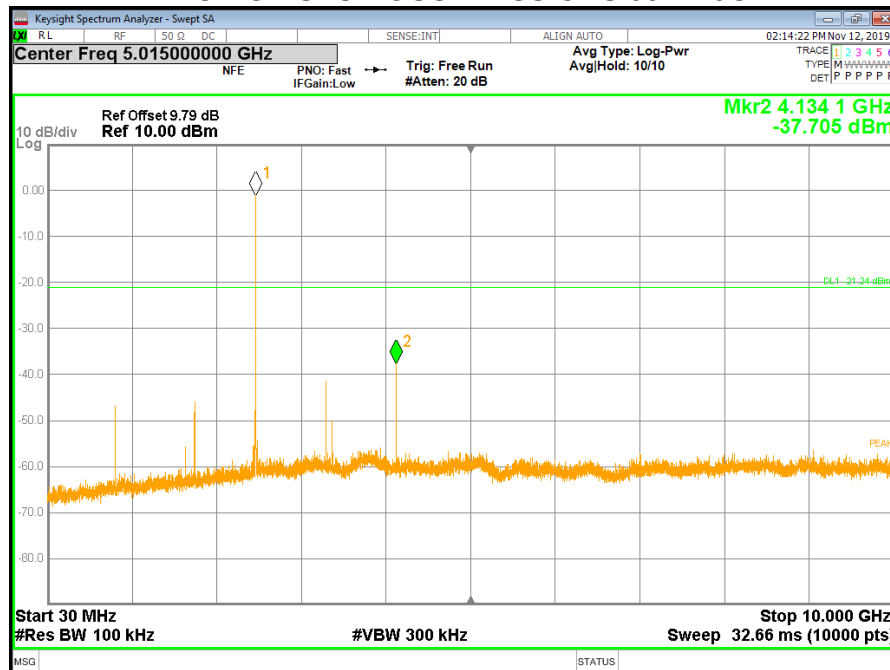
HIGH CH BANDEDAGE



HIGH CH SPURIOUS EMISSIONS REFERENCE



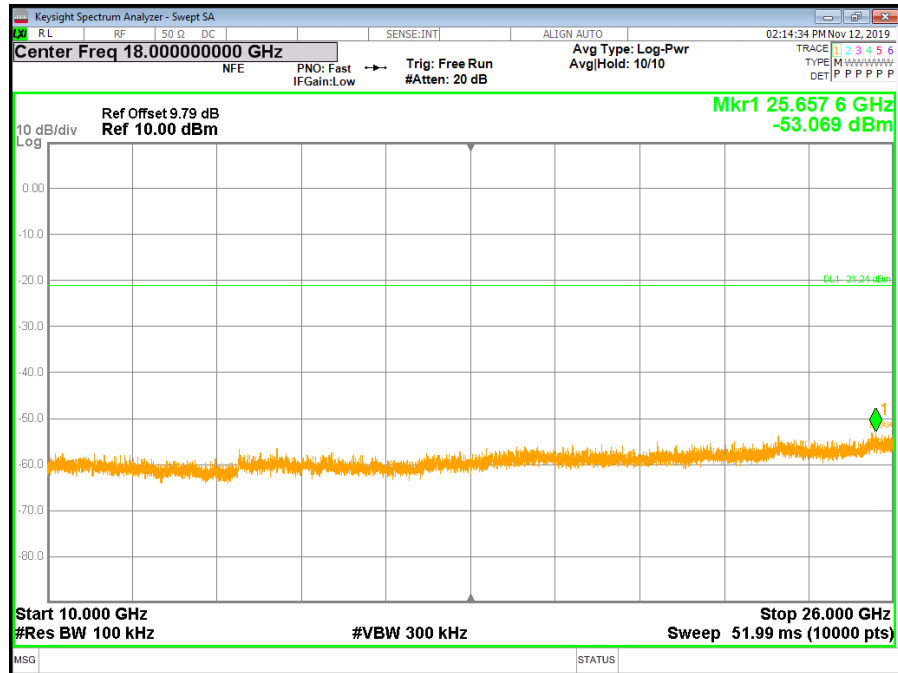
HIGH CH SPURIOUS EMISSIONS 30M-10G



Note: The point 1 is 2.4G main carrier.



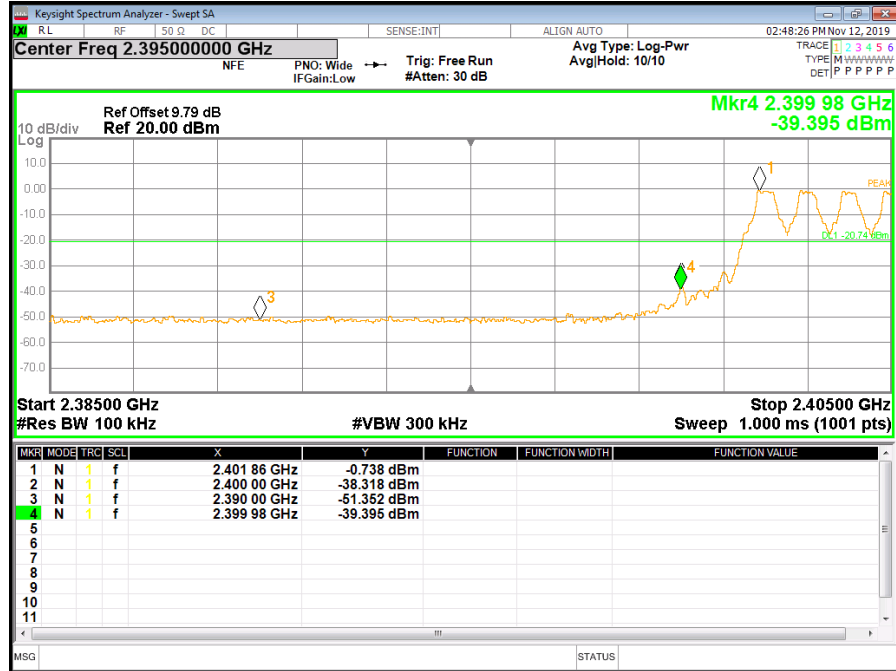
HIGH CH SPURIOUS EMISSIONS 10G-26G



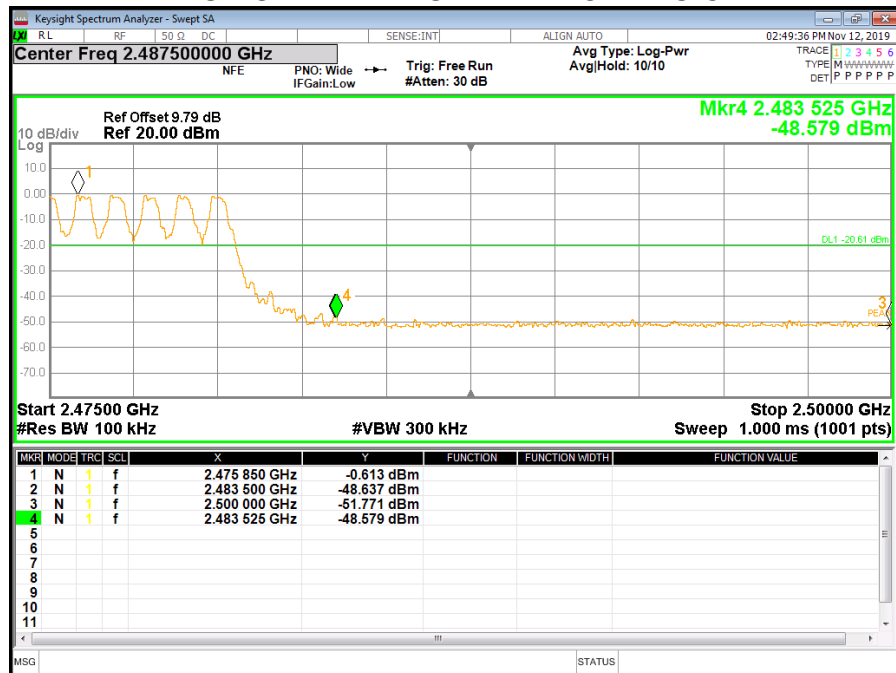


SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

LOW CH BANDEDGE WITH HOPPING ON



HIGH CH BANDEDGE WITH HOPPING ON





8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

Please refer to CFR 47 FCC §15.205 and §15.209

Please refer to ISED RSS-GEN Clause 8.9 and Clause 8.10

Radiation Disturbance Test Limit for FCC (Class B)(9kHz-1GHz)

Frequency (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
960~1000	500	3

Note: 1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

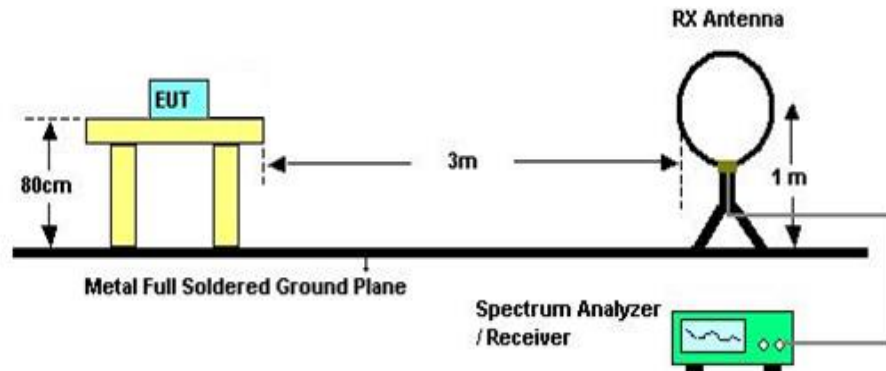
(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

Radiation Disturbance Test Limit for FCC (Above 1G)

Frequency (MHz)	dB(uV/m) (at 3 meters)	
	Peak	Average
Above 1000	74	54

About Restricted bands of operation please refer to RSS-Gen section 8.10 and FCC §15.205 (a)

TEST SETUP AND PROCEDURE Below 30MHz

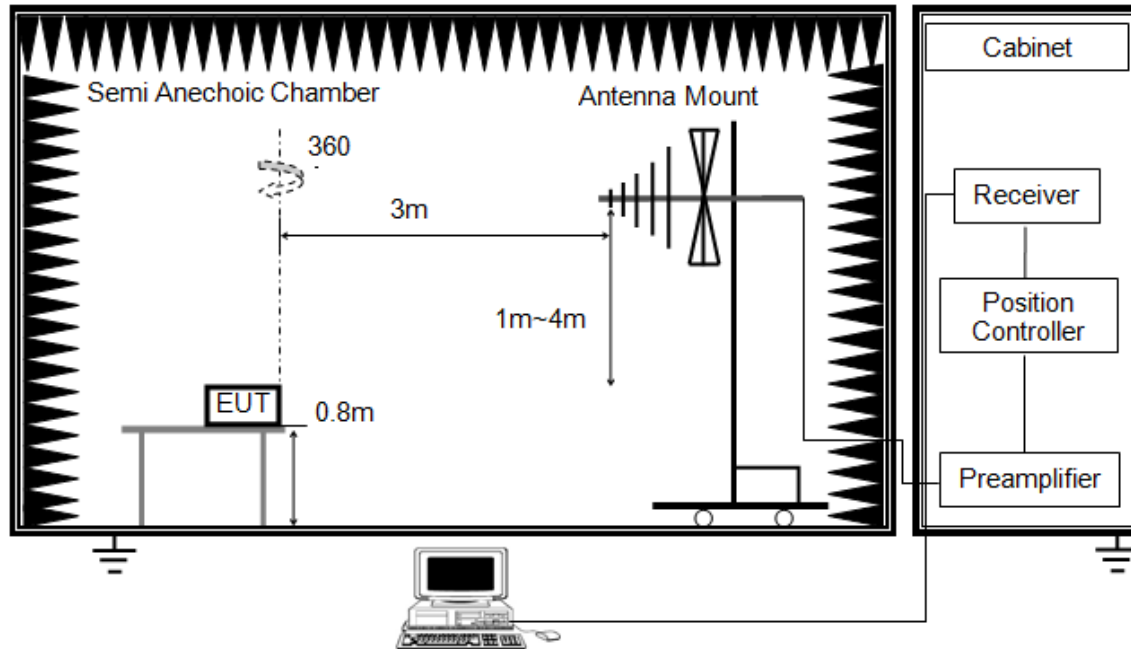


The setting of the spectrum Analyzer

RBW	200Hz (From 9kHz to 0.15MHz)/ 9kHz (From 0.15MHz to 30MHz)
VBW	200Hz (From 9kHz to 0.15MHz)/ 9kHz (From 0.15MHz to 30MHz)
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013
2. The EUT was arranged to its worst case and then turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both Horizontal, Face-on and Face-off polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 80cm meter above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of 1 meter height antenna tower.
5. The radiated emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
6. For measurement below 1GHz, 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 emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field site based on KDB 414788.

Below 1G and above 30MHz

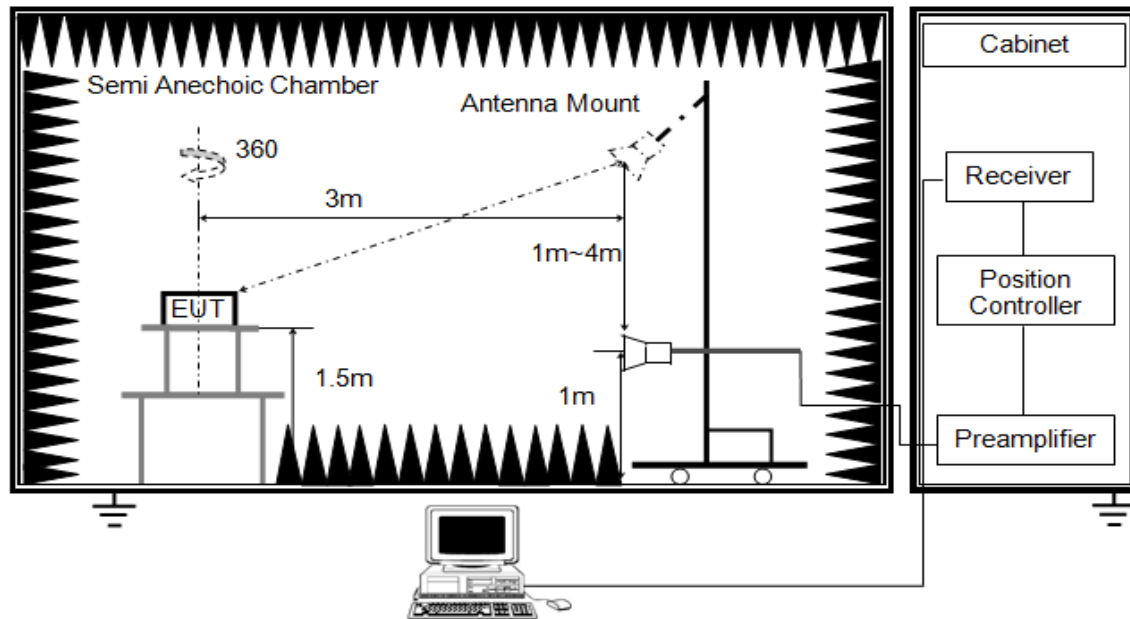


The setting of the spectrum Analyzer

RBW	120kHz
VBW	300kHz
Sweep	Auto
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 80cm above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement below 1GHz, 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 emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

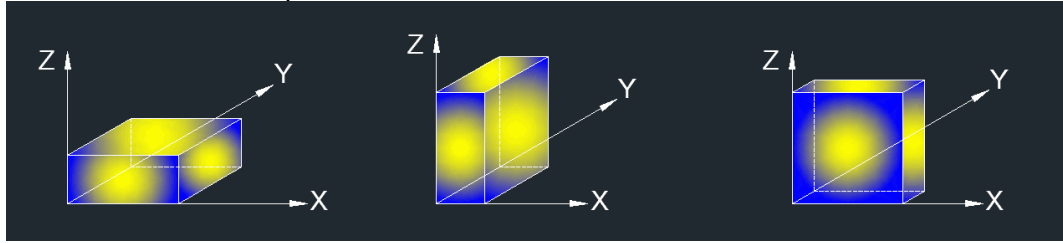
Above 1G



RBW	1MHz
VBW	PEAK: 3MHz AVG: see note 6
Sweep	Auto
Detector	Peak
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
3. The EUT was placed on a turntable with 1.5m above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. For measurement above 1GHz, the emission measurement will be measured by the peak detector. This peak level, once corrected, must comply with the limit specified in Section 15.209.
6. For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T video bandwidth with peak detector for AVG measurements. For the Duty Cycle please refer to clause 7.1.ON TIME AND DUTY CYCLE.

X axis, Y axis, Z axis positions:



Note 1: For all radiated test, EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report.

Note 2: The EUT was fully exercised with external accessories during the test. In the case of multiple accessory external ports, an external accessory shall be connected to one of each type of port.

TEST ENVIRONMENT

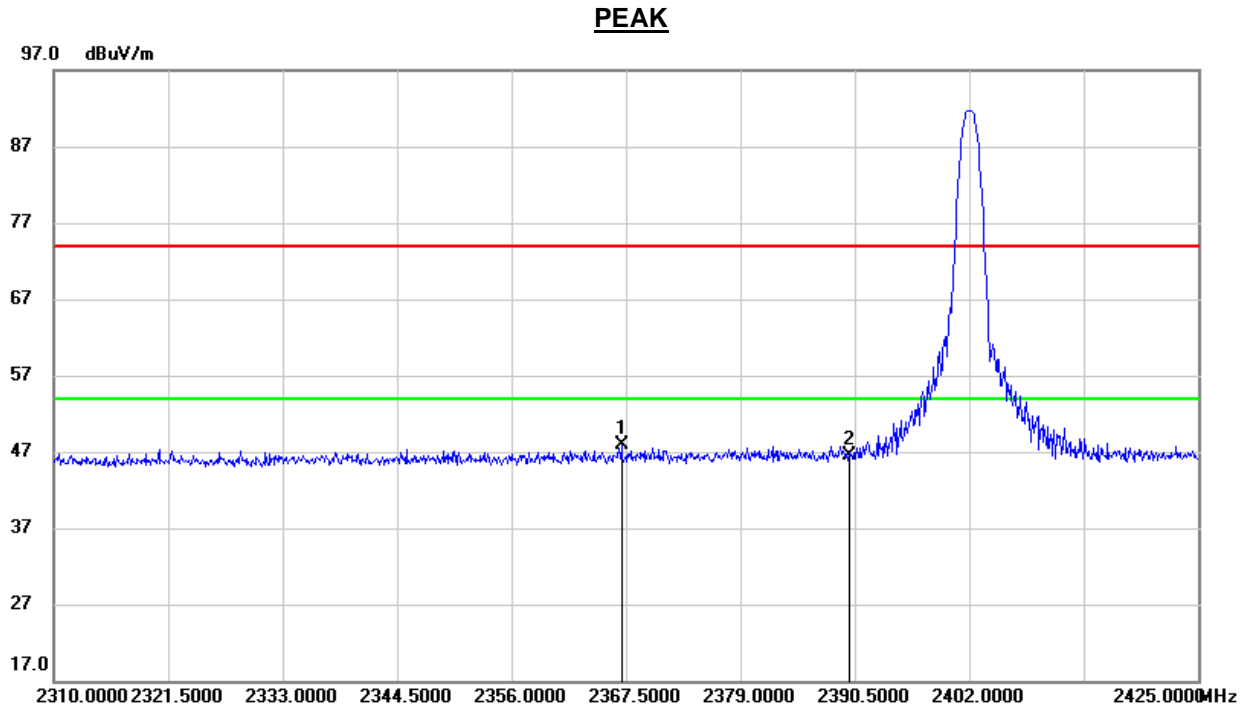
Temperature	24.1°C	Relative Humidity	51%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V



8.2. RESTRICTED BANDEDGE

8.2.1. GFSK MODE

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



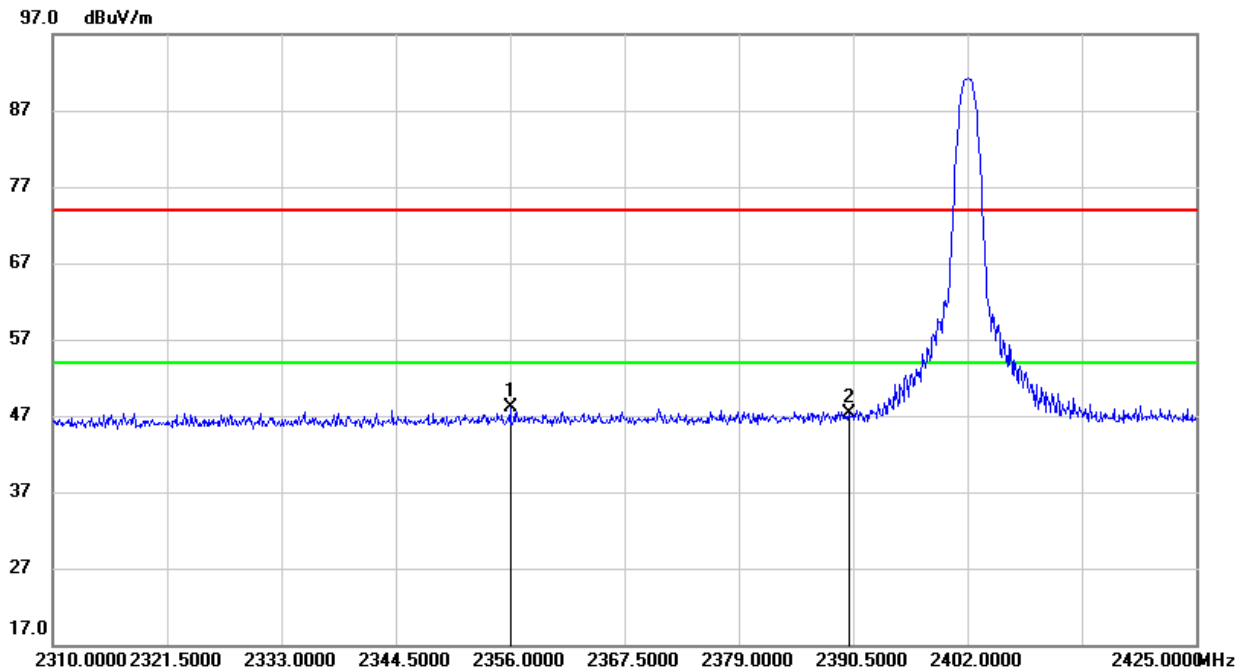
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2367.040	15.05	32.87	47.92	74.00	-26.08	peak
2	2390.000	13.55	32.94	46.49	74.00	-27.51	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Only the worst emission was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.



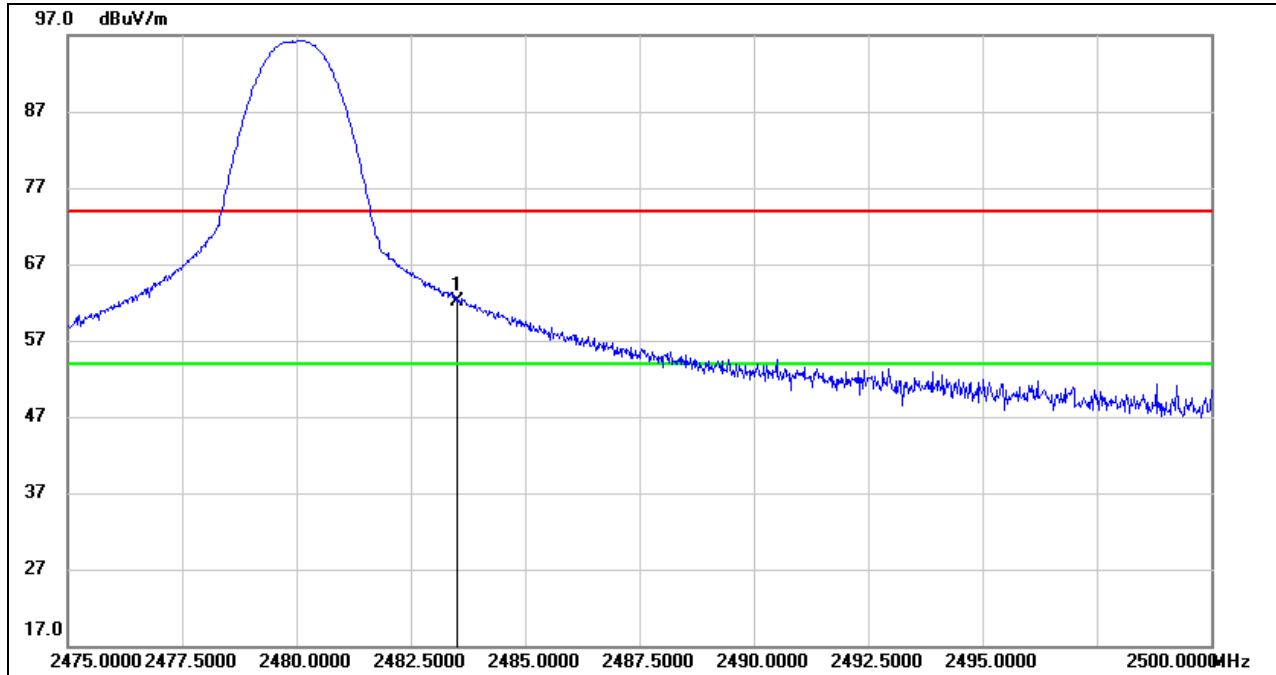
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

PEAK



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2356.000	15.29	32.83	48.12	74.00	-25.88	peak
2	2390.000	14.39	32.94	47.33	74.00	-26.67	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Only the worst case emission was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.

**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	28.48	33.58	62.06	74.00	-11.94	peak

Note: 1. Measurement = Reading Level + Correct Factor.

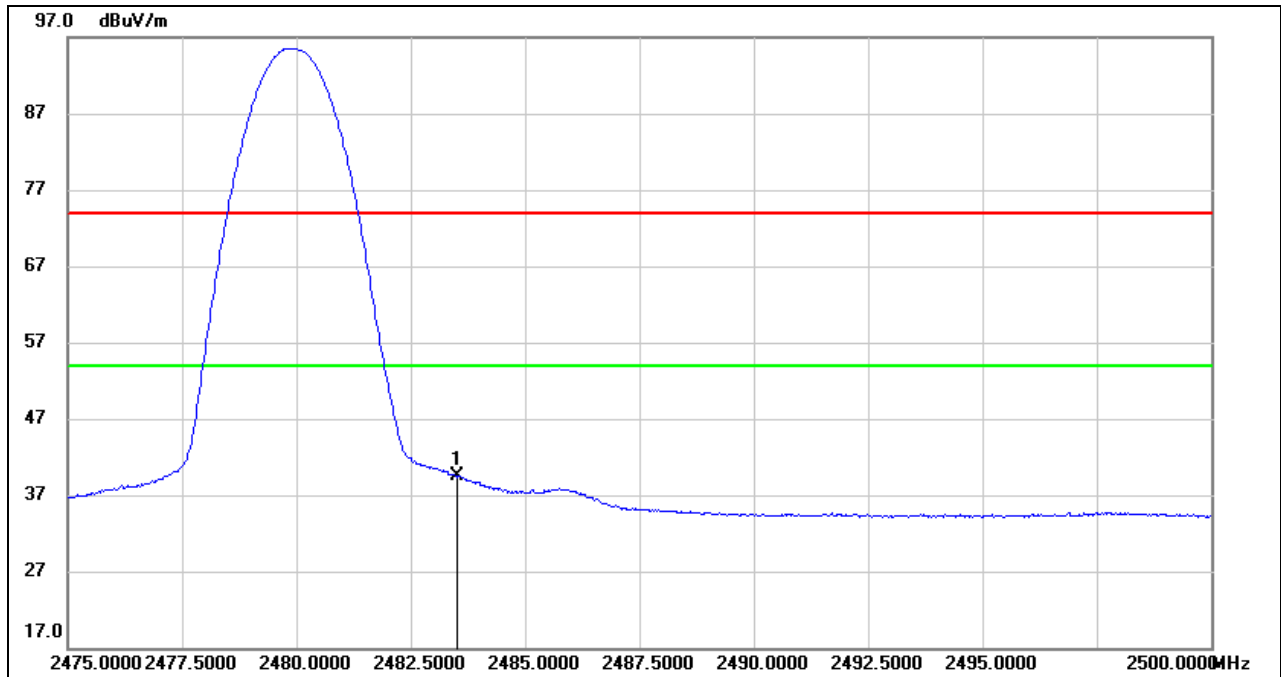
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Peak: Peak detector.

4. Only the worst case emission will be recorder, if it complies with the limit, the other emissions deemed to comply with the limit.



AVG



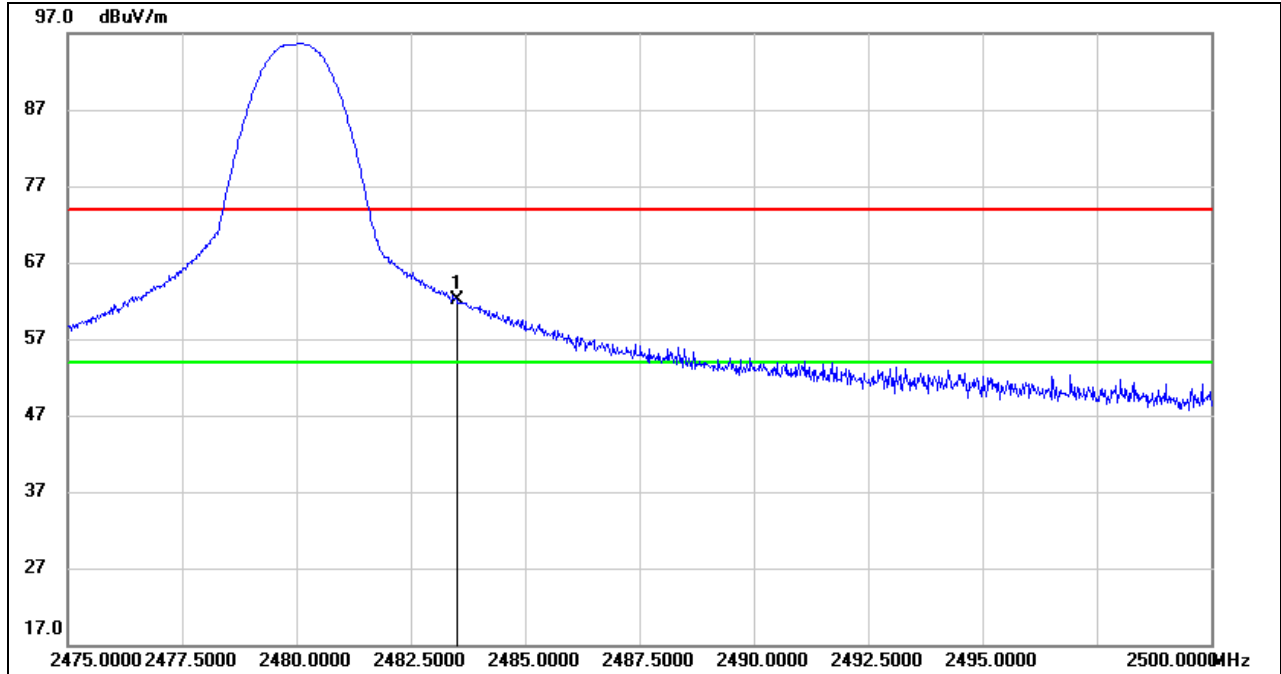
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	5.84	33.58	39.42	54.00	-14.58	AVG

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. AVG: $VBW=1/Ton$ where: ton is transmit duration.
4. For transmit duration, please refer to clause 7.1.
5. Only the worst case emission was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.



RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

PEAK

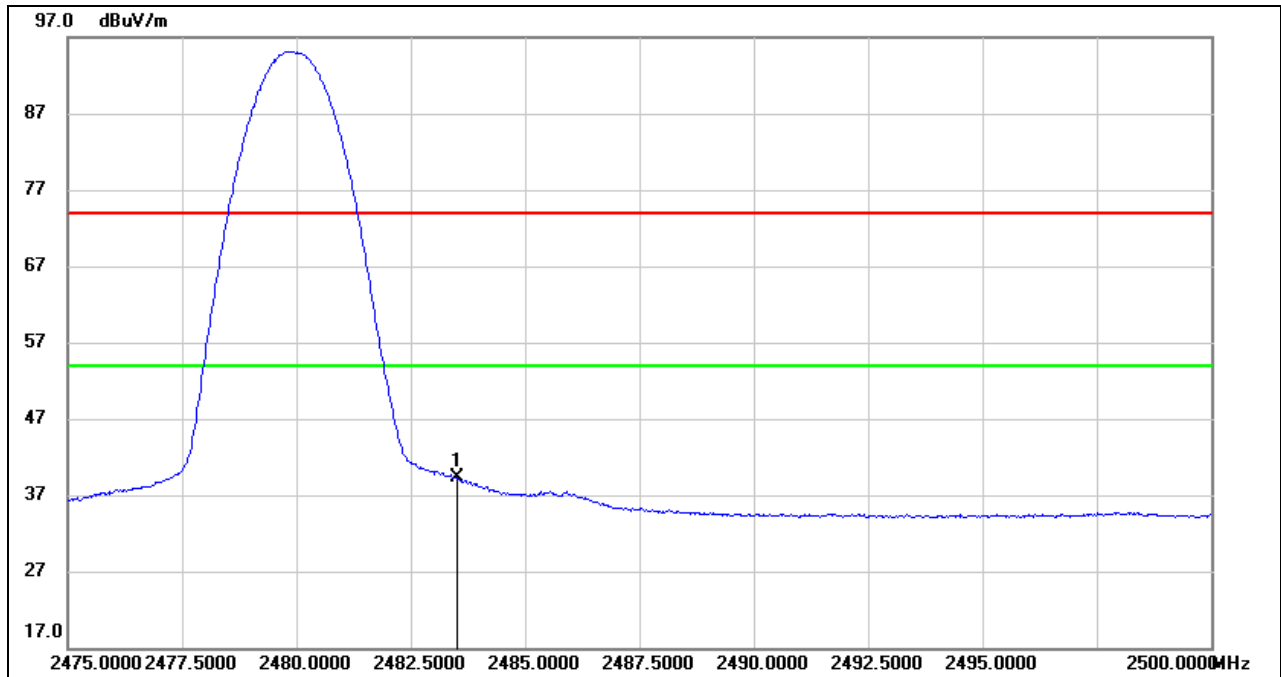


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	28.55	33.58	62.13	74.00	-11.87	peak

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Only the worst case emission will be recorder, if it complies with the limit, the other emissions deemed to comply with the limit.



AVG



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	5.69	33.58	39.27	54.00	-14.73	AVG

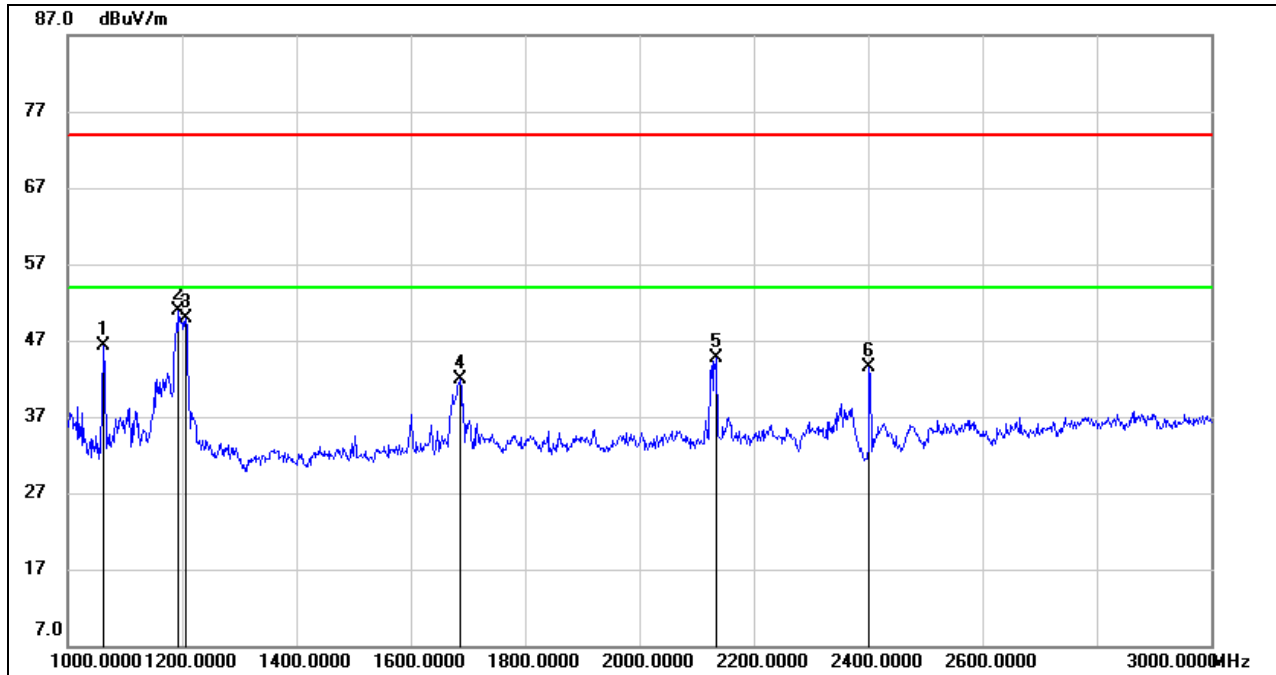
Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. AVG: $VBW=1/Ton$ where: ton is transmit duration.
4. For transmit duration, please refer to clause 7.1.
5. Only the worst case emission was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.



8.3. SPURIOUS EMISSIONS (1~3GHz)

8.3.1. GFSK MODE

HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, HORIZONTAL)

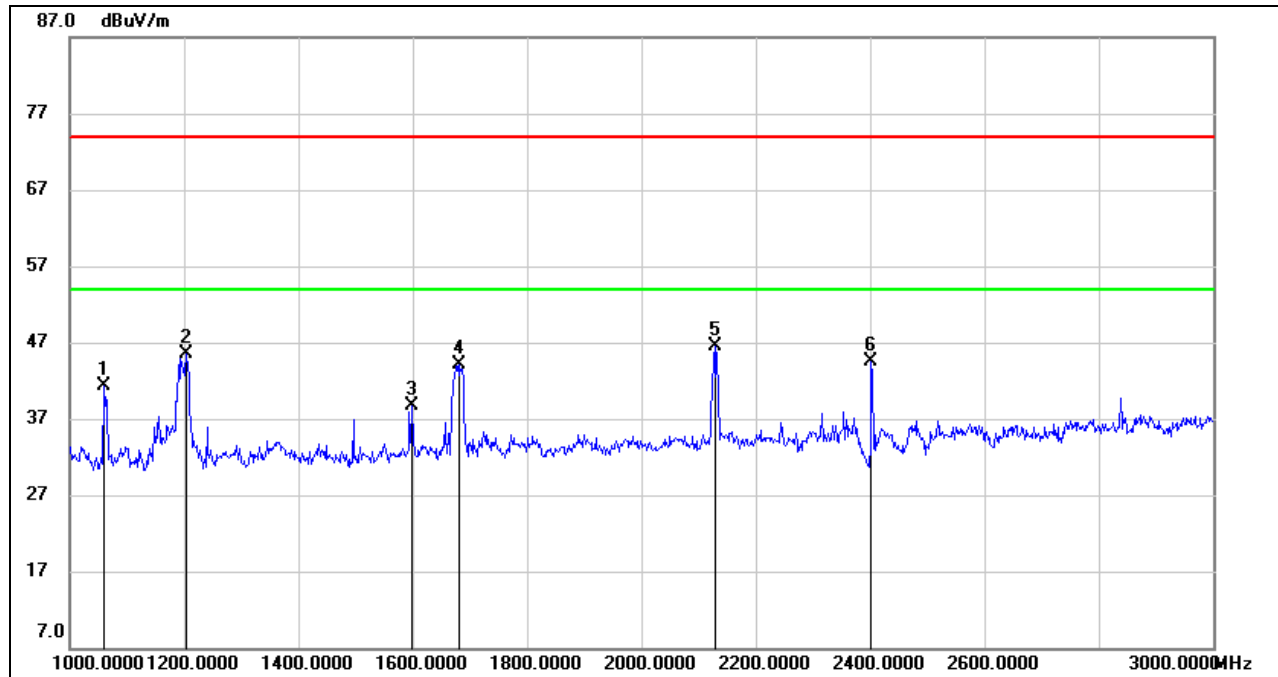


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1062.000	60.12	-13.81	46.31	74.00	-27.69	peak
2	1194.000	63.87	-12.97	50.90	74.00	-23.10	peak
3	1206.000	62.89	-12.90	49.99	74.00	-24.01	peak
4	1686.000	53.16	-11.18	41.98	74.00	-32.02	peak
5	2134.000	53.94	-9.14	44.80	74.00	-29.20	peak
6	2402.000	51.47	-7.95	43.52	/	/	fundamental

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, VERTICAL)

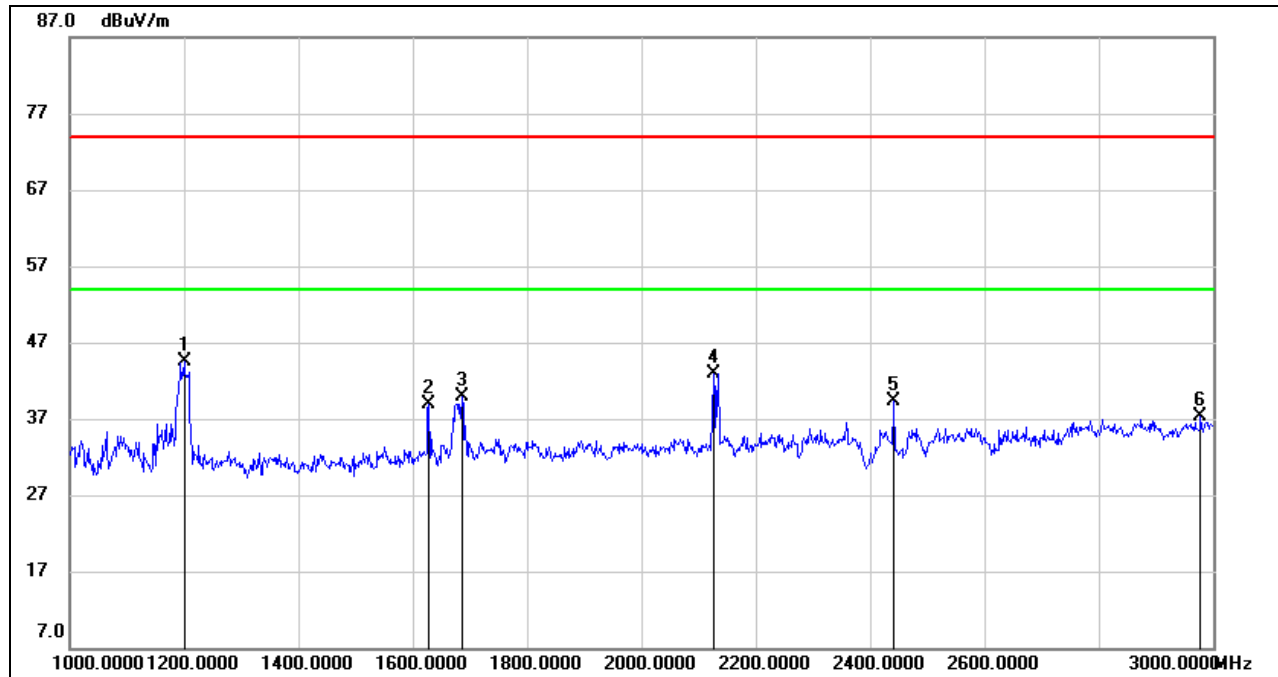


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1060.000	55.02	-13.80	41.22	74.00	-32.78	peak
2	1204.000	58.42	-12.90	45.52	74.00	-28.48	peak
3	1598.000	50.26	-11.63	38.63	74.00	-35.37	peak
4	1682.000	55.21	-11.20	44.01	74.00	-29.99	peak
5	2128.000	55.71	-9.18	46.53	74.00	-27.47	peak
6	2402.000	52.45	-7.95	44.50	/	/	fundamental

- Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)

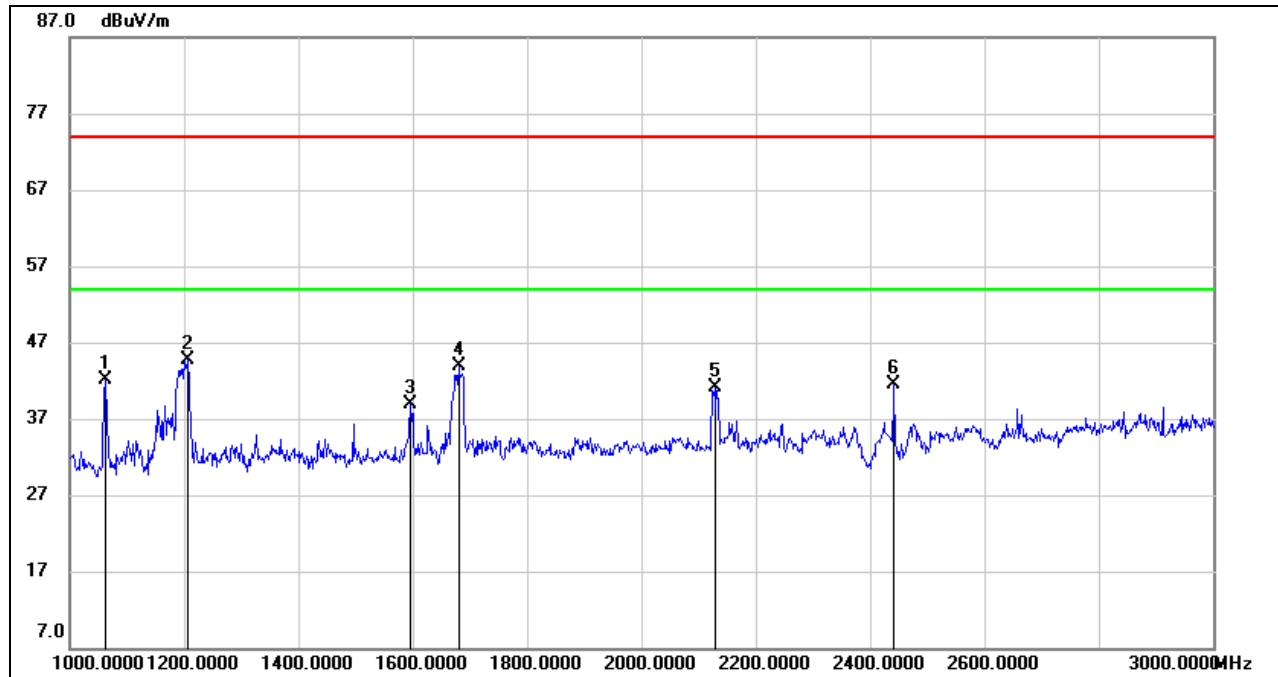


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1200.000	57.52	-12.92	44.60	74.00	-29.40	peak
2	1628.000	50.30	-11.46	38.84	74.00	-35.16	peak
3	1686.000	51.03	-11.18	39.85	74.00	-34.15	peak
4	2126.000	52.16	-9.18	42.98	74.00	-31.02	peak
5	2441.000	47.03	-7.67	39.36	/	/	fundamental
6	2978.000	42.60	-5.34	37.26	74.00	-36.74	peak

- Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, VERTICAL)

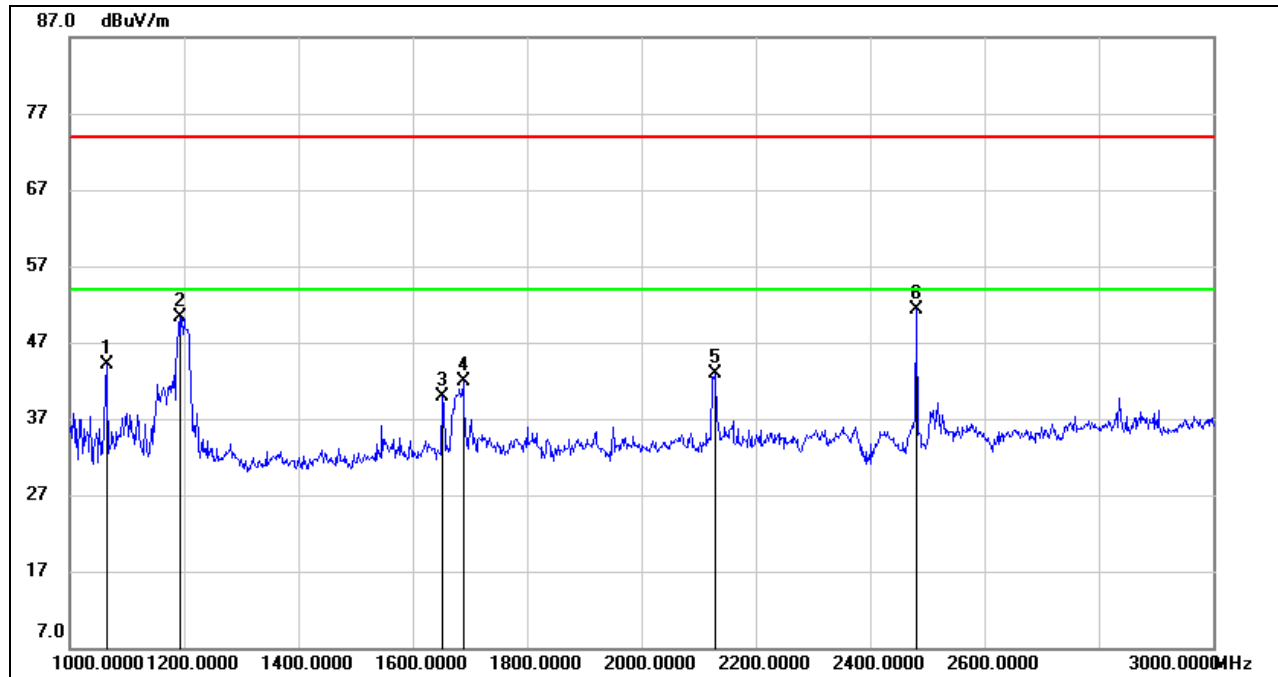


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1062.000	56.01	-13.81	42.20	74.00	-31.80	peak
2	1206.000	57.70	-12.90	44.80	74.00	-29.20	peak
3	1596.000	50.60	-11.65	38.95	74.00	-35.05	peak
4	1680.000	55.05	-11.22	43.83	74.00	-30.17	peak
5	2128.000	50.32	-9.18	41.14	74.00	-32.86	peak
6	2441.000	49.10	-7.67	41.43	/	/	fundamental

- Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, HORIZONTAL)

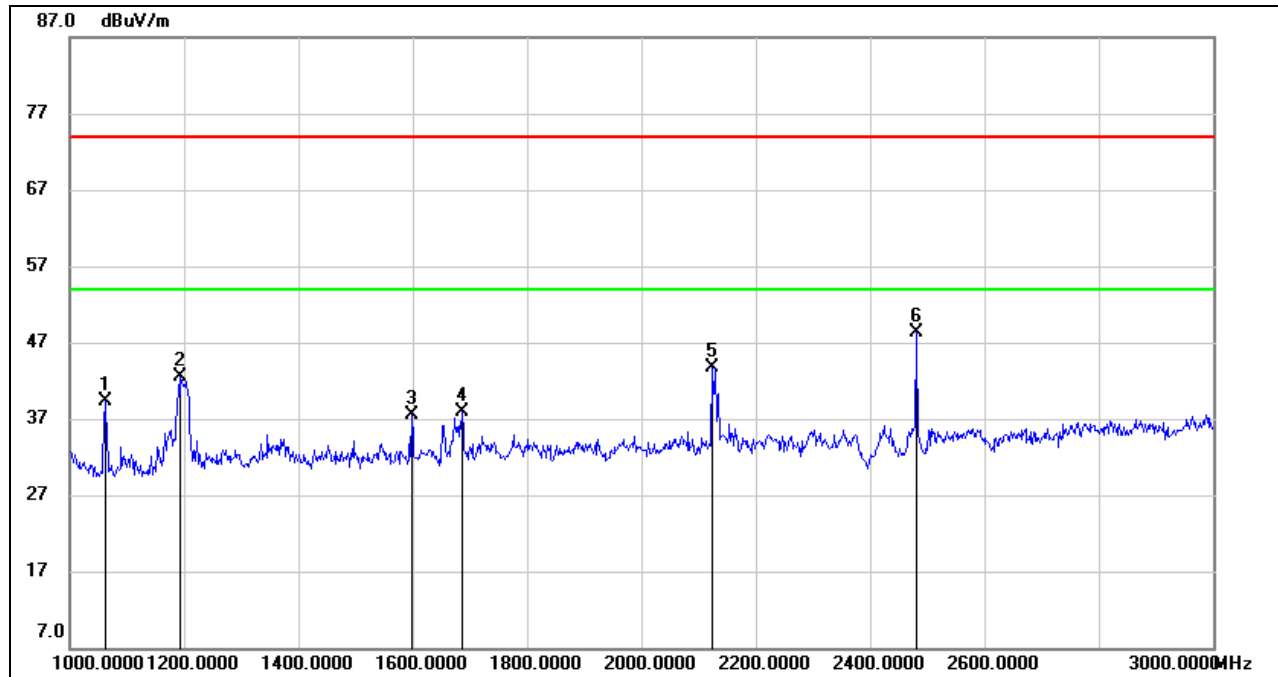


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1064.000	57.83	-13.80	44.03	74.00	-29.97	peak
2	1194.000	63.28	-12.97	50.31	74.00	-23.69	peak
3	1652.000	51.26	-11.35	39.91	74.00	-34.09	peak
4	1688.000	53.08	-11.18	41.90	74.00	-32.10	peak
5	2128.000	52.00	-9.18	42.82	74.00	-31.18	peak
6	2480.000	58.76	-7.39	51.37	/	/	fundamental

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1062.000	53.10	-13.81	39.29	74.00	-34.71	peak
2	1194.000	55.47	-12.97	42.50	74.00	-31.50	peak
3	1598.000	49.05	-11.63	37.42	74.00	-36.58	peak
4	1686.000	49.10	-11.18	37.92	74.00	-36.08	peak
5	2124.000	52.96	-9.20	43.76	74.00	-30.24	peak
6	2480.000	55.78	-7.39	48.39	/	/	fundamental

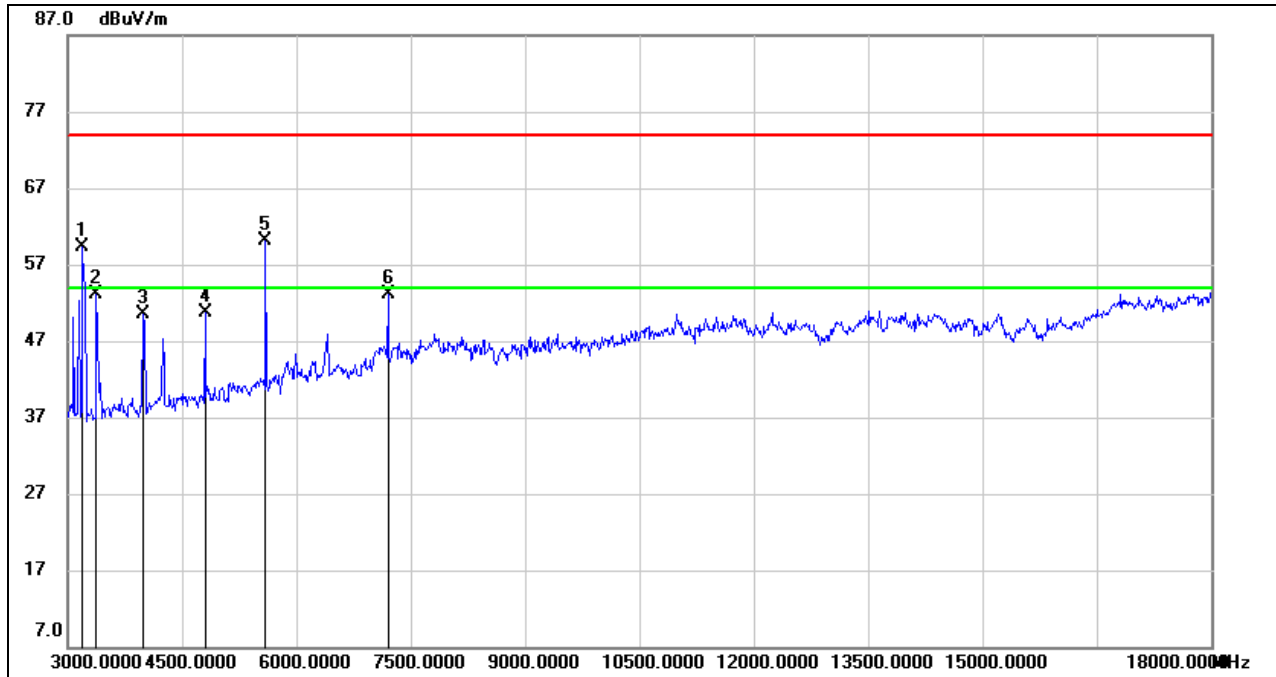
- Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band Reject Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.



8.4. SPURIOUS EMISSIONS (3~18GHz)

8.4.1. GFSK MODE

HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3202.692	63.65	-4.42	59.23	/	/	peak
2*	3375.000	57.39	-4.31	53.08	/	/	peak
3	3990.000	53.25	-2.80	50.45	74.00	-23.55	peak
4	4800.000	50.87	-0.14	50.73	74.00	-23.27	peak
5*	5604.970	57.31	2.84	60.15	/	/	peak
6*	7200.000	46.00	7.05	53.05	/	/	peak

Note: 1. Peak Result = Reading Level + Correct Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Peak: Peak detector.

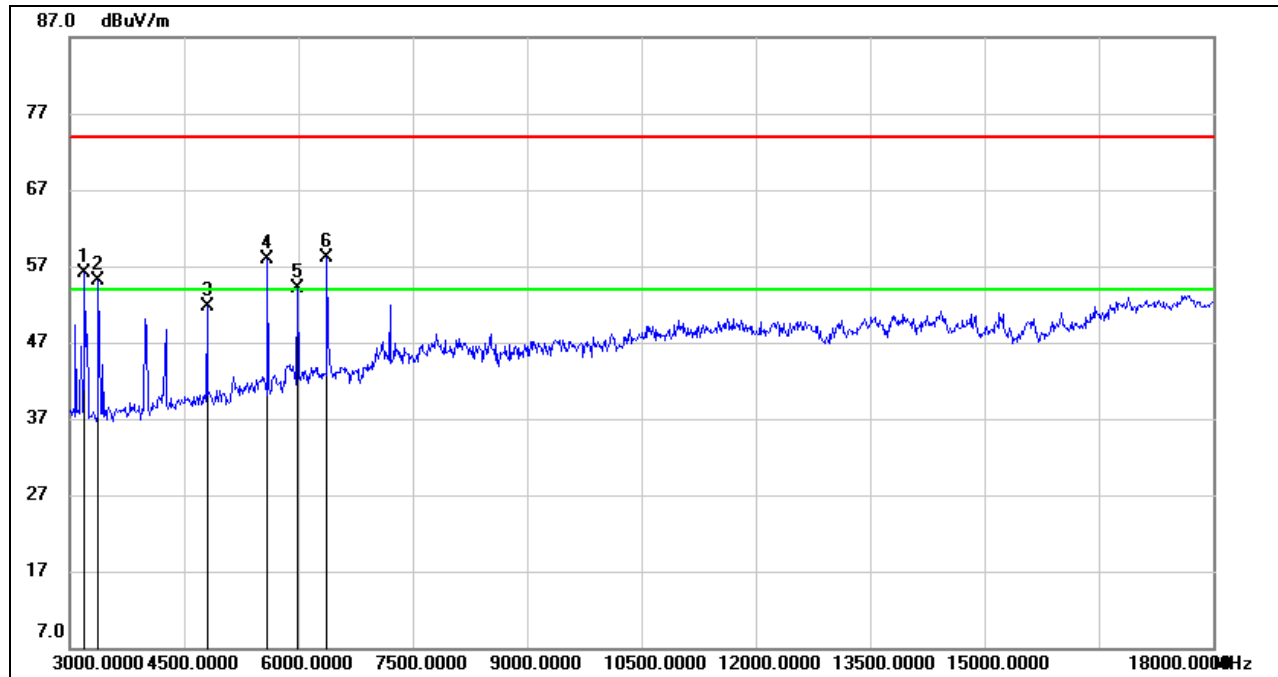
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.

5. Proper operation of the transmitter prior to adding the filter to the measurement chain.

6. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247 (d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



HARMONICS AND SPURIOUS EMISSIONS (LOW CHANNEL, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3202.842	60.52	-4.42	56.10	/	/	peak
2*	3381.853	59.43	-4.31	55.12	/	/	peak
3	4800.000	51.90	-0.14	51.76	74.00	-22.24	peak
4*	5604.290	54.99	2.84	57.83	/	/	peak
5*	5985.000	49.90	4.20	54.10	/	/	peak
6*	6376.658	53.05	5.09	58.14	/	/	peak

Note: 1. Peak Result = Reading Level + Correct Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Peak: Peak detector.

4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.

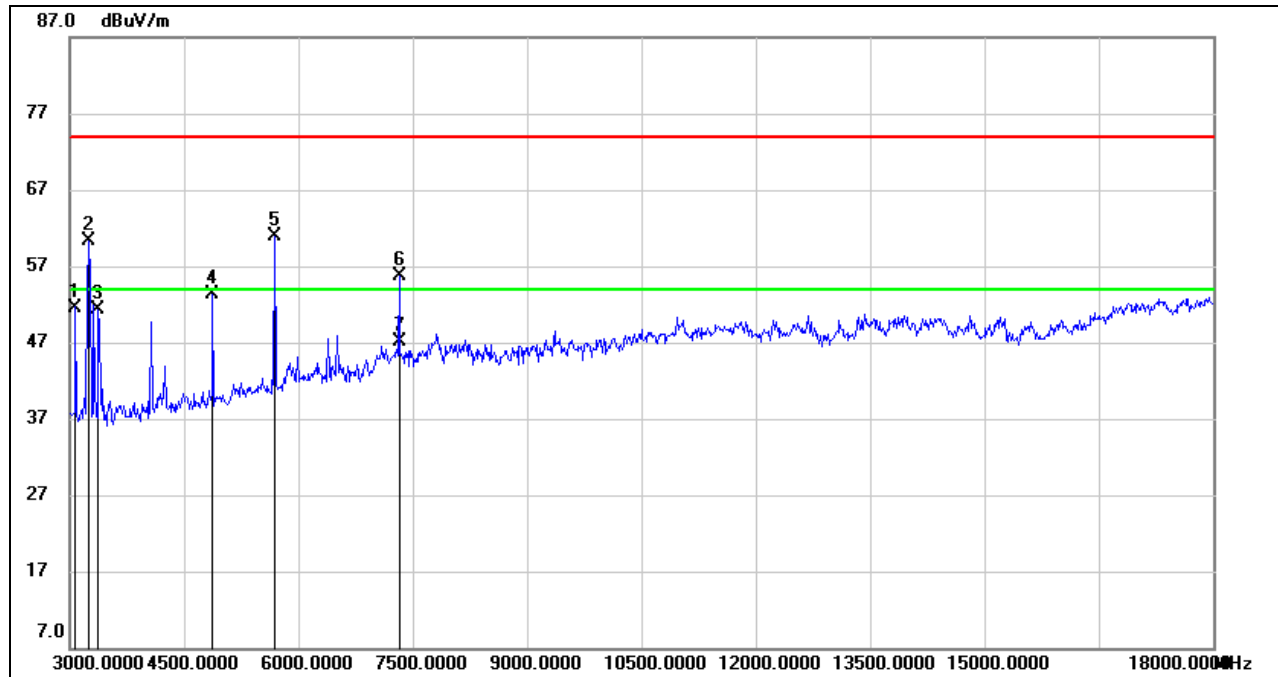
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.

6. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247

(d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)

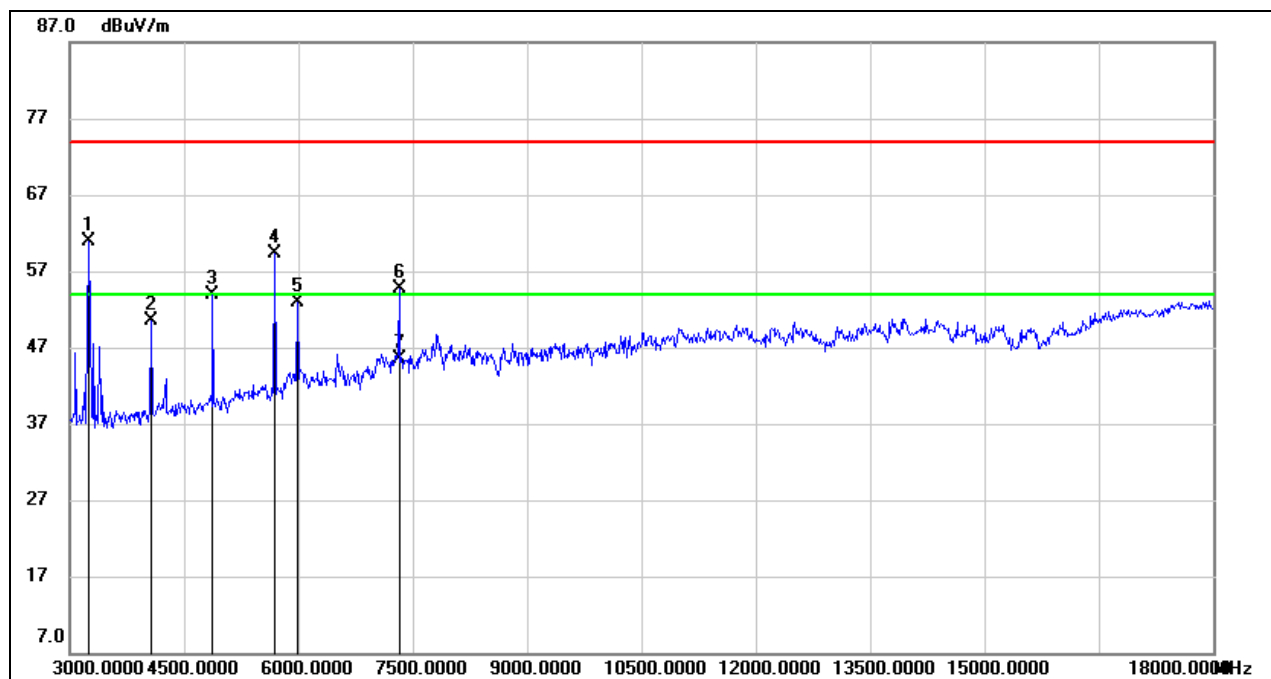


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3075.000	55.48	-3.88	51.60	/	/	peak
2*	3254.740	64.52	-4.30	60.22	/	/	peak
3*	3375.000	55.61	-4.31	51.30	/	/	peak
4	4875.000	53.20	0.10	53.30	74.00	-20.70	peak
5*	5695.629	57.94	2.97	60.91	/	/	peak
6	7322.797	48.32	7.44	55.76	74.00	-18.24	peak
7	7322.797	39.66	7.44	47.10	54.00	-6.90	AVG

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. AVG: VBW=1/Ton, where: Ton is the transmitting duration.
5. For the transmitting duration, please refer to clause 7.1.
6. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.
7. Proper operation of the transmitter prior to adding the filter to the measurement chain.
8. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247 (d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, VERTICAL)

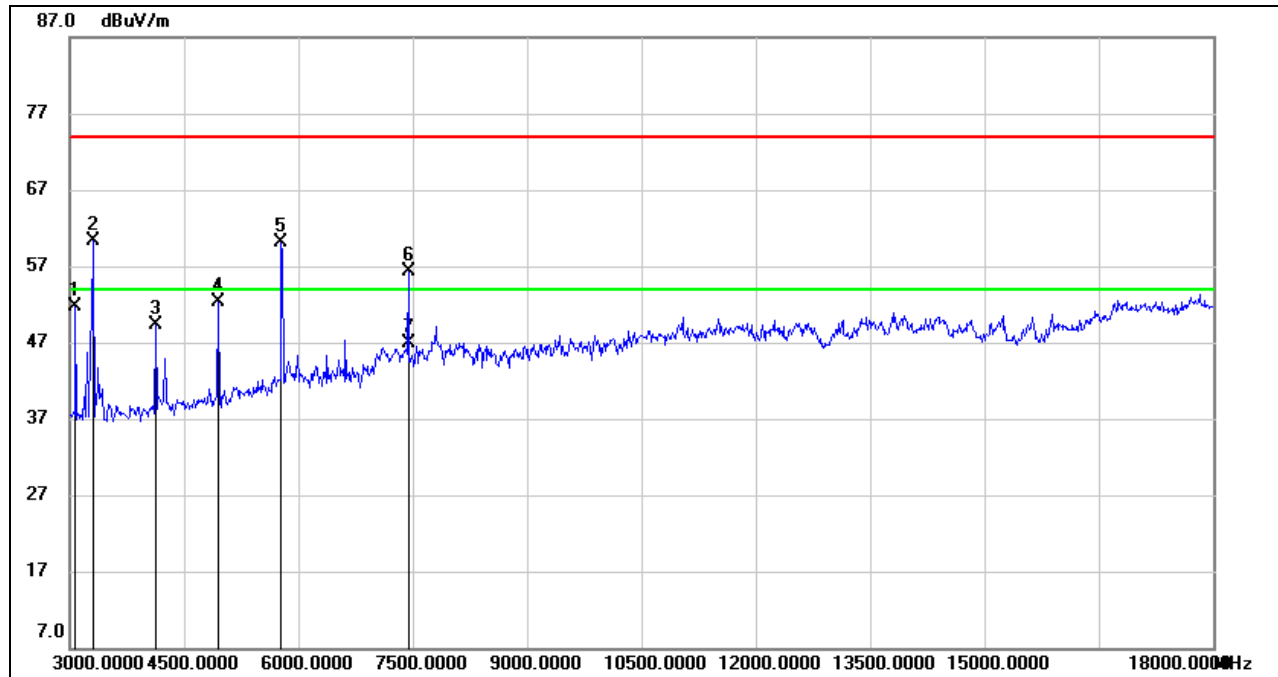


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3254.700	65.13	-4.30	60.83	/	/	peak
2	4065.000	53.38	-2.84	50.54	74.00	-23.46	peak
3	4875.000	53.79	0.10	53.89	74.00	-20.11	peak
4*	5695.769	56.39	2.97	59.36	/	/	peak
5*	5985.000	48.77	4.20	52.97	/	/	peak
6	7323.137	47.27	7.44	54.71	74.00	-19.29	peak
7	7323.137	38.10	7.44	45.54	54.00	-8.46	AVG

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. AVG: $VBW=1/Ton$, where: Ton is the transmitting duration.
5. For the transmitting duration, please refer to clause 7.1.
6. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.
7. Proper operation of the transmitter prior to adding the filter to the measurement chain.
8. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247 (d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, HORIZONTAL)

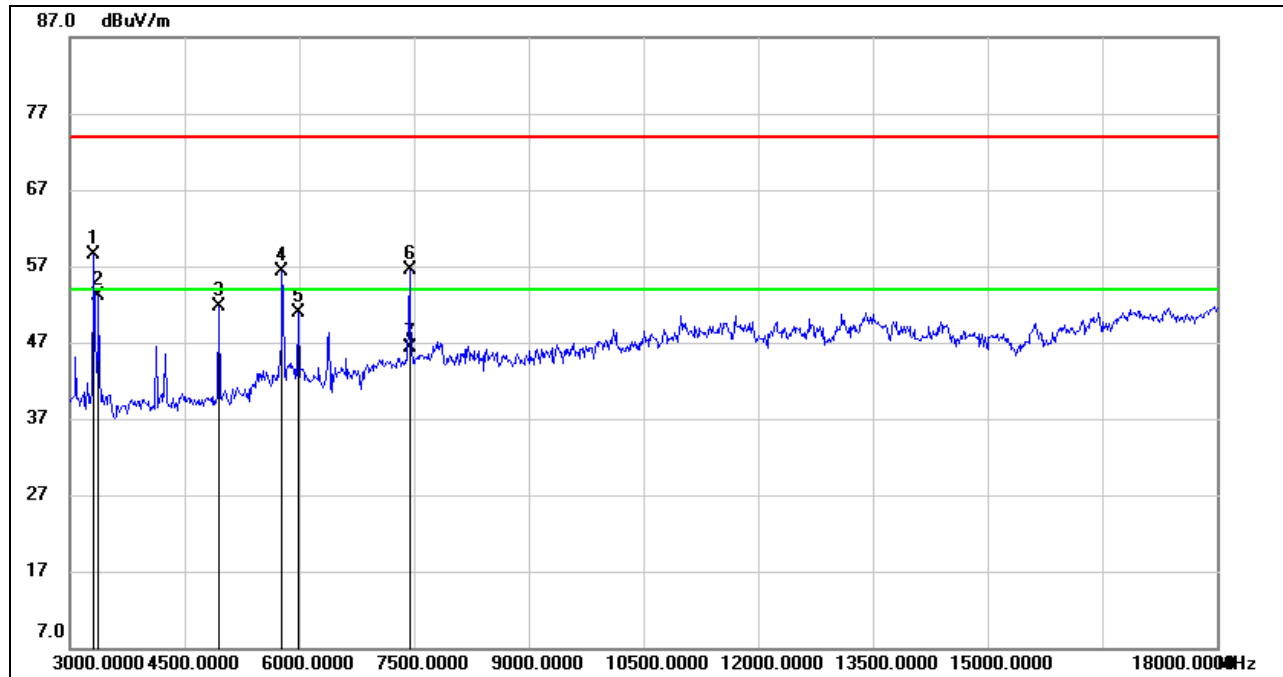


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3075.000	55.53	-3.88	51.65	/	/	peak
2*	3306.643	64.47	-4.20	60.27	/	/	peak
3	4125.000	51.71	-2.48	49.23	74.00	-24.77	peak
4	4950.000	52.00	0.40	52.40	74.00	-21.60	peak
5*	5786.449	56.71	3.41	60.12	/	/	peak
6	7440.000	48.72	7.65	56.37	74.00	-17.63	peak
7	7440.000	39.18	7.65	46.83	54.00	-7.17	AVG

Note: 1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. AVG: $VBW=1/Ton$, where: Ton is the transmitting duration.
5. For the transmitting duration, please refer to clause 7.1.
6. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.
7. Proper operation of the transmitter prior to adding the filter to the measurement chain.
8. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247 (d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



HARMONICS AND SPURIOUS EMISSIONS (HIGH CHANNEL, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1*	3306.000	62.78	-4.22	58.56	/	/	peak
2*	3375.000	57.38	-4.31	53.07	/	/	peak
3	4950.000	51.40	0.40	51.80	74.00	-22.20	peak
4*	5775.000	52.96	3.36	56.32	/	/	peak
5*	5985.000	46.70	4.20	50.90	/	/	peak
6	7440.000	48.81	7.65	56.46	74.00	-17.54	peak
7	7440.000	38.63	7.65	46.28	54.00	-7.72	AVG

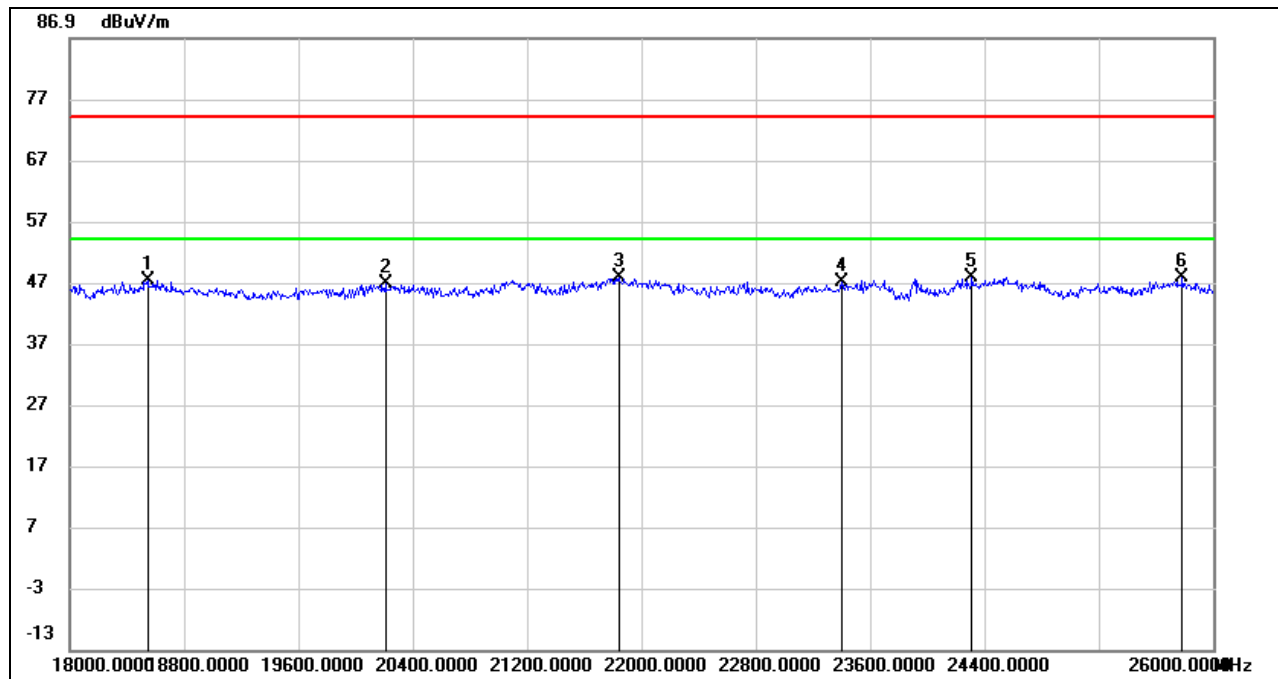
Note: 1. Peak Result = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.
5. Proper operation of the transmitter prior to adding the filter to the measurement chain.
6. *indicates the frequency is out of the restricted bands and the limit is referring to 15.247 (d). We had already performed the conducted non-restricted bands test, please refer to clause 7.7.



8.5. SPURIOUS EMISSIONS 18G ~ 26GHz

8.5.1. GFSK MODE

SPURIOUS EMISSIONS (LOW CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	18544.000	51.76	-4.46	47.30	74.00	-26.70	peak
2	20208.000	51.60	-4.79	46.81	74.00	-27.19	peak
3	21840.000	53.59	-5.93	47.66	74.00	-26.34	peak
4	23400.000	51.92	-4.96	46.96	74.00	-27.04	peak
5	24312.000	51.10	-3.35	47.75	74.00	-26.25	peak
6	25784.000	49.23	-1.49	47.74	74.00	-26.26	peak

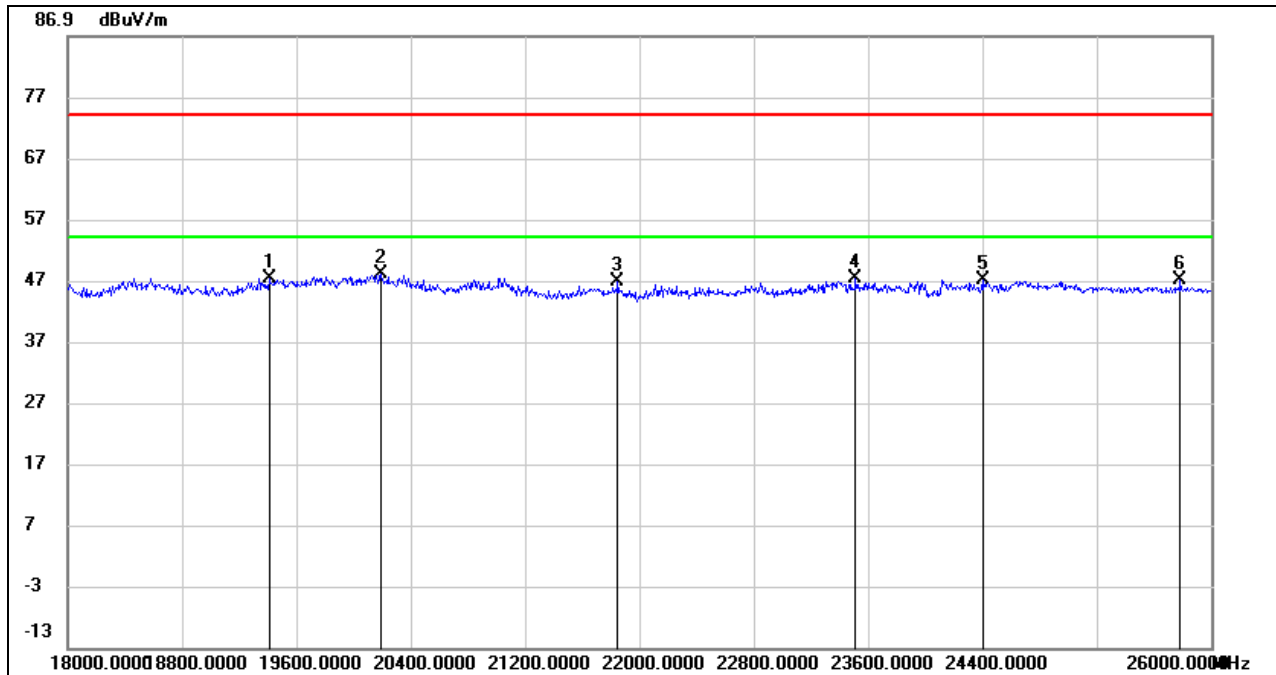
Note: 1. Peak Result = Reading Level + Correct Factor.

2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

3. Peak: Peak detector.



SPURIOUS EMISSIONS (LOW CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	19408.000	52.23	-4.89	47.34	74.00	-26.66	peak
2	20192.000	52.87	-4.76	48.11	74.00	-25.89	peak
3	21848.000	52.76	-5.95	46.81	74.00	-27.19	peak
4	23512.000	52.01	-4.76	47.25	74.00	-26.75	peak
5	24400.000	50.14	-2.99	47.15	74.00	-26.85	peak
6	25784.000	48.58	-1.49	47.09	74.00	-26.91	peak

Note: 1. Peak Result = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.

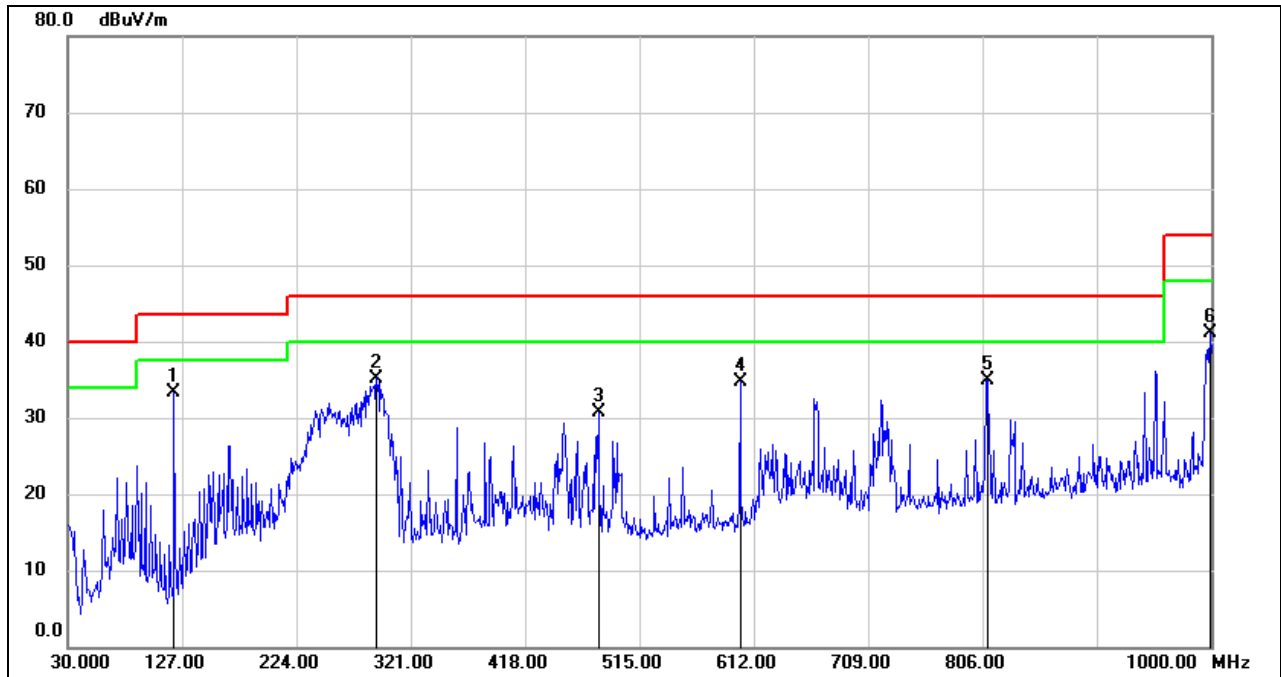
Note: All test mode has been tested, only the worst data record in the report.



8.6. SPURIOUS EMISSIONS 30M ~ 1 GHz

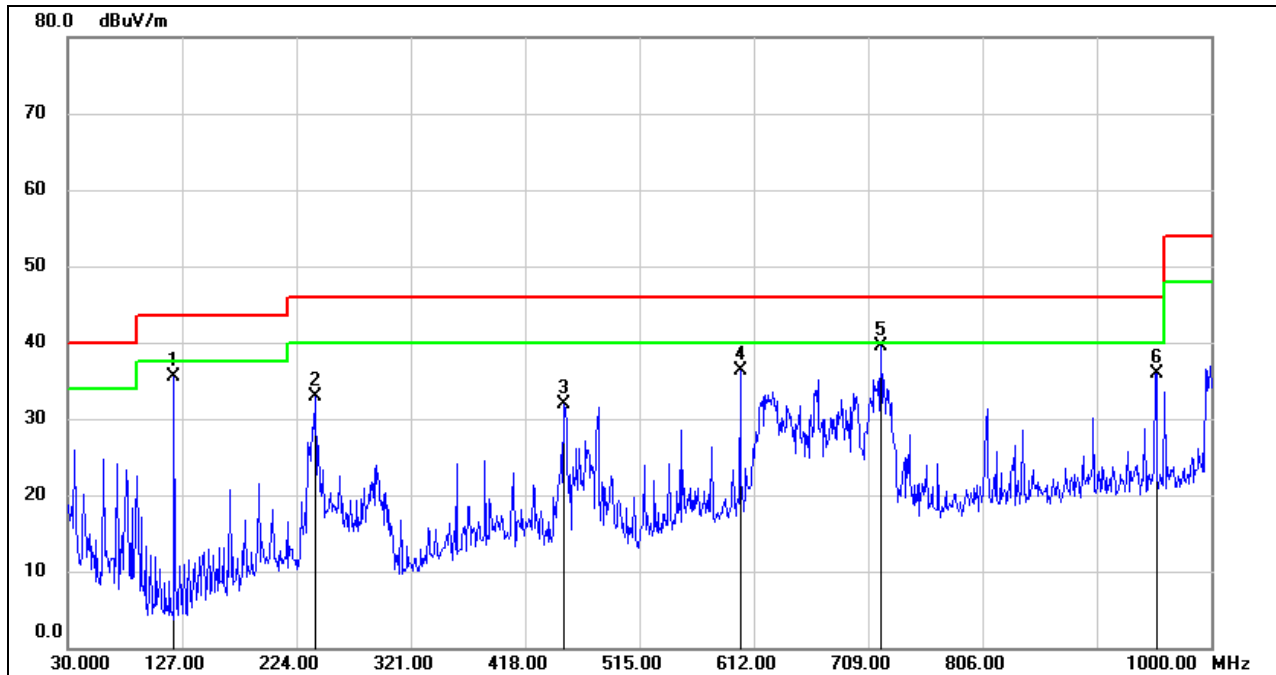
8.6.1. GFSK MODE

SPURIOUS EMISSIONS (LOW CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	120.2100	53.85	-20.60	33.25	43.50	-10.25	QP
2	291.9000	49.54	-14.34	35.20	46.00	-10.80	QP
3	480.0800	41.61	-10.84	30.77	46.00	-15.23	QP
4	600.3600	43.15	-8.42	34.73	46.00	-11.27	QP
5	809.8800	40.23	-5.27	34.96	46.00	-11.04	QP
6	999.0300	44.01	-2.86	41.15	54.00	-12.85	QP

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.
2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

**SPURIOUS EMISSIONS (LOW CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	120.2100	56.07	-20.60	35.47	43.50	-8.03	QP
2	240.4900	49.91	-16.97	32.94	46.00	-13.06	QP
3	450.9800	43.33	-11.41	31.92	46.00	-14.08	QP
4	600.3600	44.76	-8.42	36.34	46.00	-9.66	QP
5	719.6700	45.56	-6.09	39.47	46.00	-6.53	QP
6	953.4400	39.25	-3.37	35.88	46.00	-10.12	QP

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto

Note: All the test modes has been tested, only the worst data record in the report

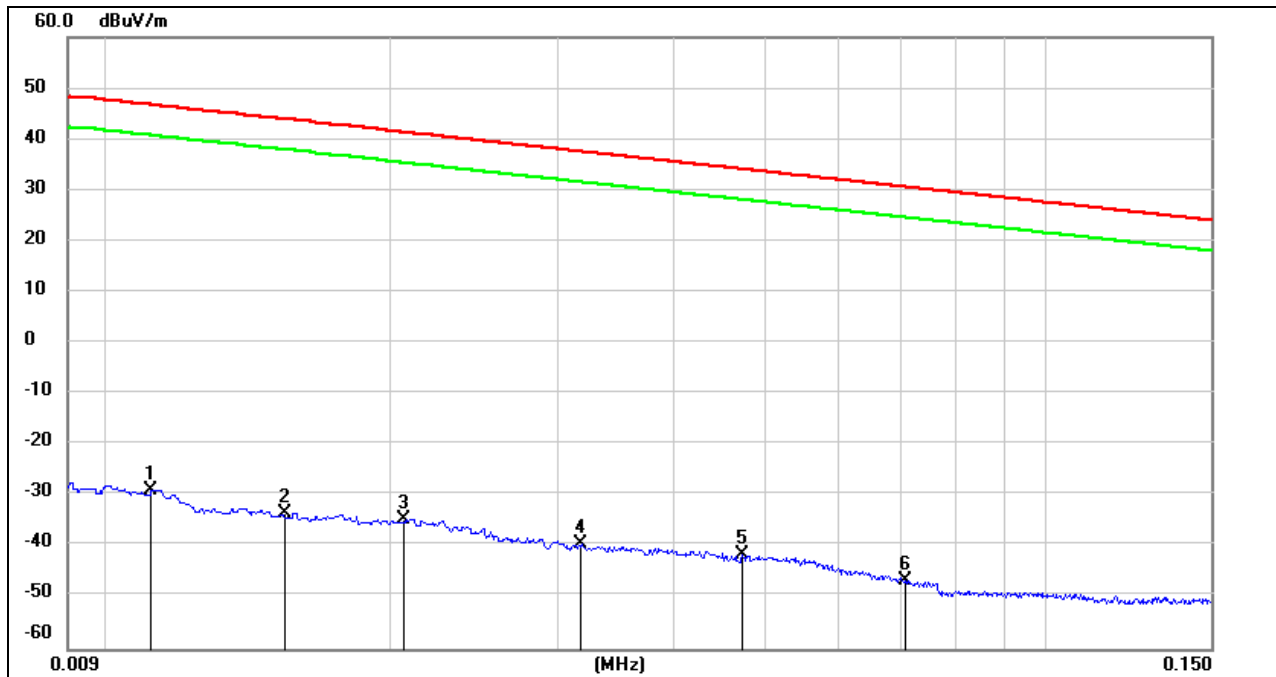


8.7. SPURIOUS EMISSIONS BELOW 30M

8.7.1. GFSK MODE

(LOW CHANNEL, LOOP ANTENNA FACE ON TO THE EUT, WORST-CASE CONFIGURATION)

9kHz~ 150kHz



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.0111	72.45	-101.39	-28.94	46.69	-75.63	peak
2	0.0154	67.94	-101.37	-33.43	43.85	-77.28	peak
3	0.0206	66.71	-101.35	-34.64	41.32	-75.96	peak
4	0.0318	61.84	-101.40	-39.56	37.55	-77.11	peak
5	0.0473	59.84	-101.47	-41.63	34.10	-75.73	peak
6	0.0709	54.91	-101.57	-46.66	30.59	-77.25	peak

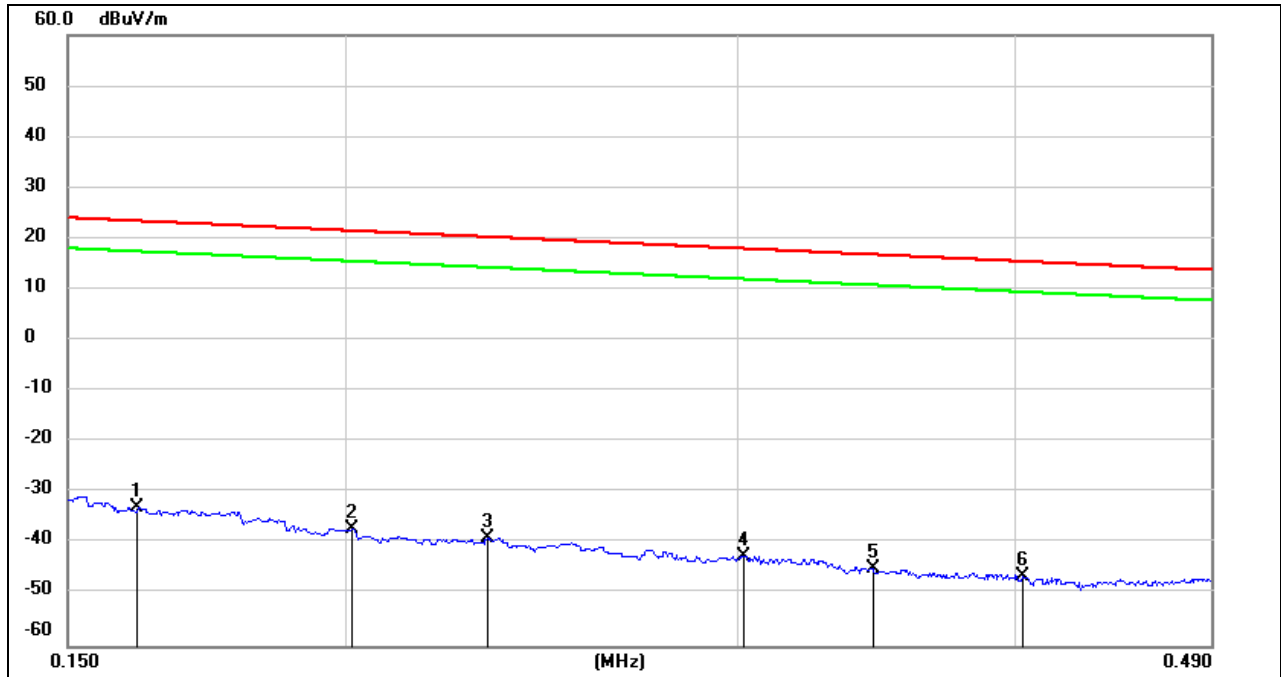
Note: 1. Measurement = Reading Level + Correct Factor.

2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.

3. All 3 polarizations(Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.



150kHz ~ 0.49MHz

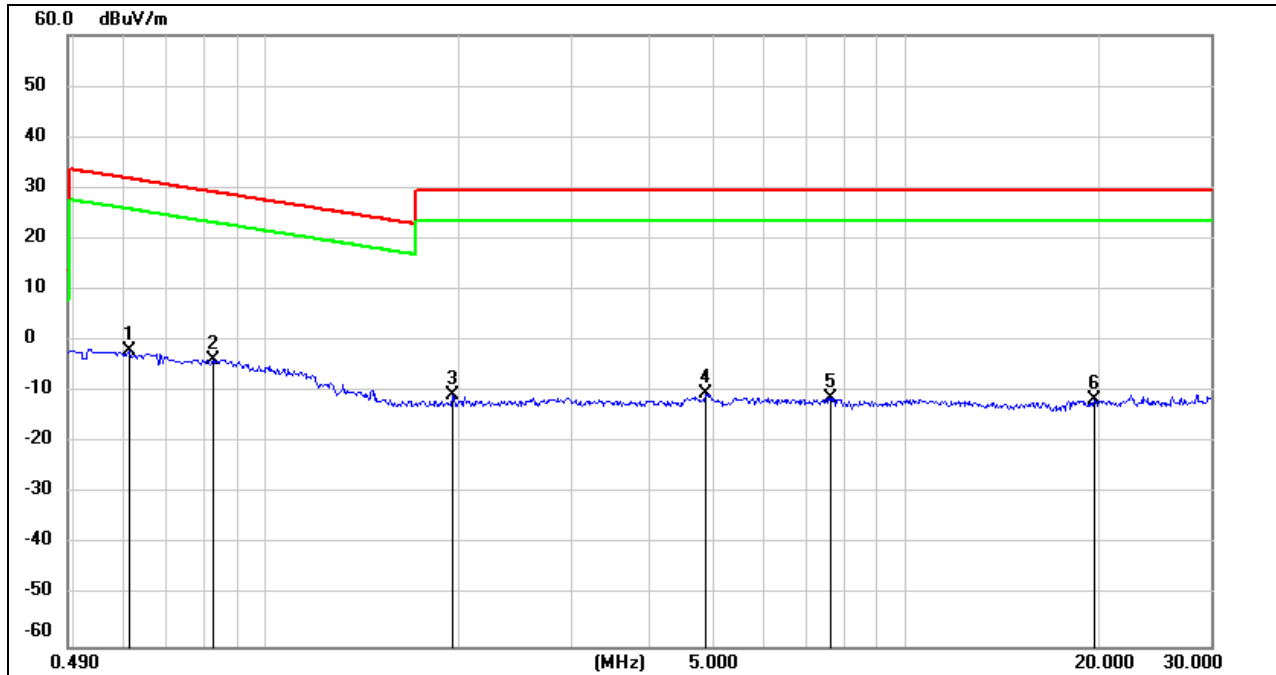


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.1612	68.78	-101.65	-32.87	23.46	-56.33	peak
2	0.2013	64.56	-101.72	-37.16	21.52	-58.68	peak
3	0.2316	63.02	-101.77	-38.75	20.31	-59.06	peak
4	0.3019	59.43	-101.85	-42.42	18.00	-60.42	peak
5	0.3452	56.99	-101.90	-44.91	16.84	-61.75	peak
6	0.4032	55.47	-101.96	-46.49	15.49	-61.98	peak

Note: 1. Measurement = Reading Level + Correct Factor.

2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.

3. All 3 polarizations(Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.

0.49MHz ~ 30MHz

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	0.6118	60.01	-62.09	-2.08	31.87	-33.95	peak
2	0.8263	58.34	-62.16	-3.82	29.26	-33.08	peak
3	1.9521	51.11	-61.84	-10.73	29.54	-40.27	peak
4	4.8868	51.23	-61.48	-10.25	29.54	-39.79	peak
5	7.6314	50.01	-61.12	-11.11	29.54	-40.65	peak
6	19.7895	49.42	-60.84	-11.42	29.54	-40.96	peak

Note: 1. Measurement = Reading Level + Correct Factor.

2. If Peak Result complies with AV and QP limit, AV and QP Result are deemed to comply with AV limit.

3. All 3 polarizations(Horizontal, Face-on and Face-off) of the loop antenna had been tested, but only the worst data recorded in the report.

Note: All test mode has been tested, only the worst data record in the report.

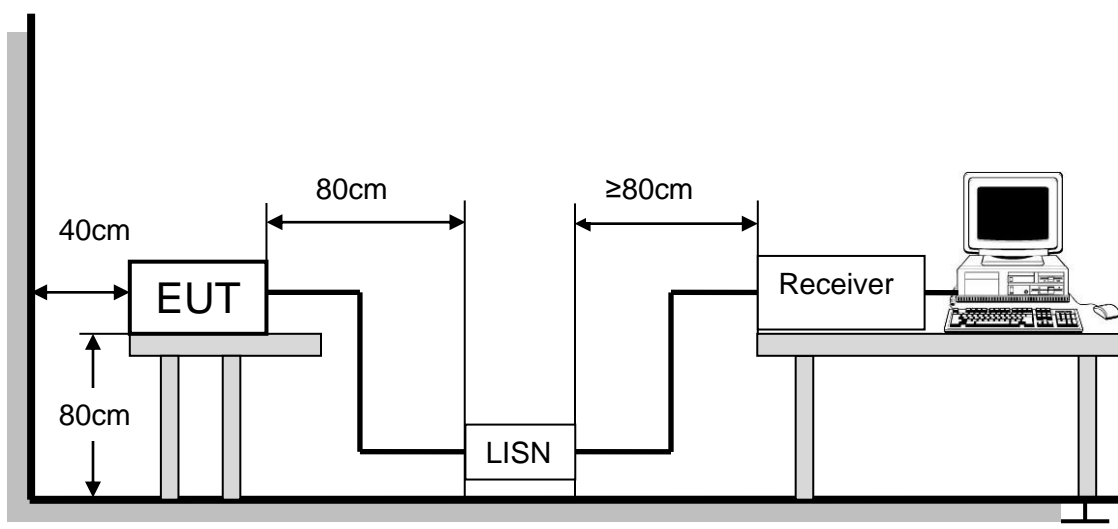
9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

Please refer to CFR 47 FCC §15.207 (a) and ISED RSS-Gen Clause 8.8.

FREQUENCY (MHz)	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

TEST SETUP AND PROCEDURE



The EUT is put on a table of non-conducting material that is 80cm high. The vertical conducting wall of shielding is located 40cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver ESR3) is used to test the emissions from both sides of AC line. According to the requirements in Section 6.2 of ANSI C63.10-2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9kHz.

The arrangement of the equipment is installed to meet the standards and operating in a manner, which tends to maximize its emission characteristics in a normal application.

TEST ENVIRONMENT

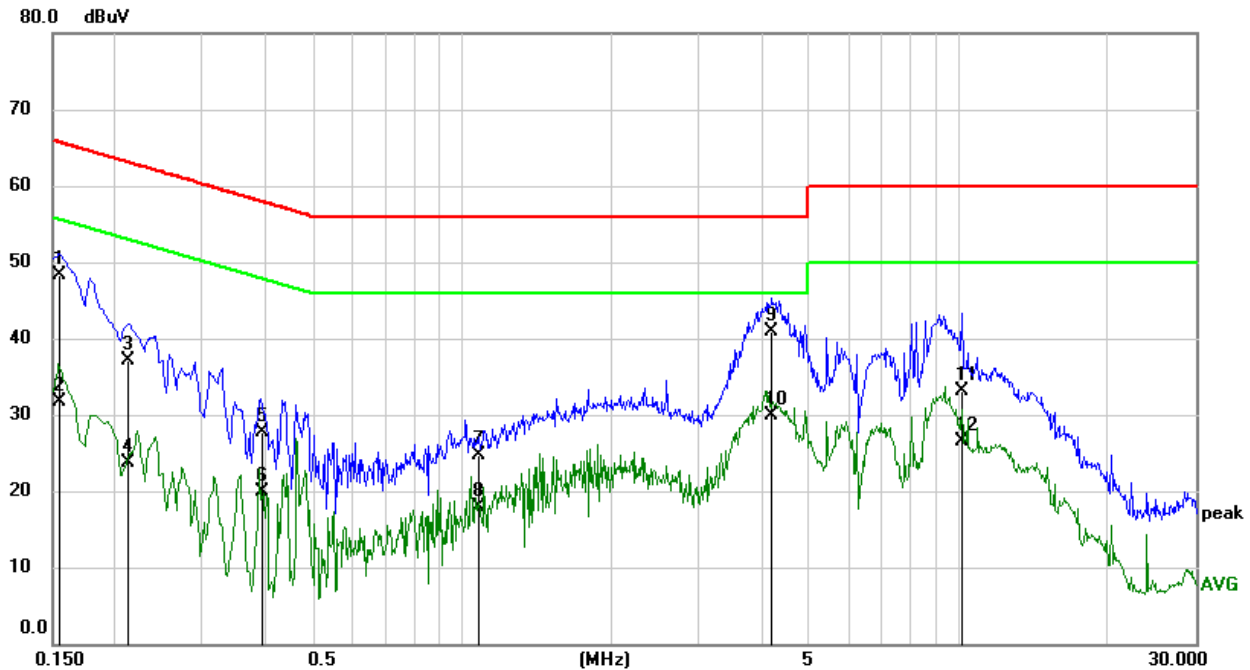
Temperature	24.3°C	Relative Humidity	55%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.7V



9.1.1. GFSK MODE

TEST RESULTS (LOW CHANNEL, WORST-CASE CONFIGURATION)

LINE N RESULTS

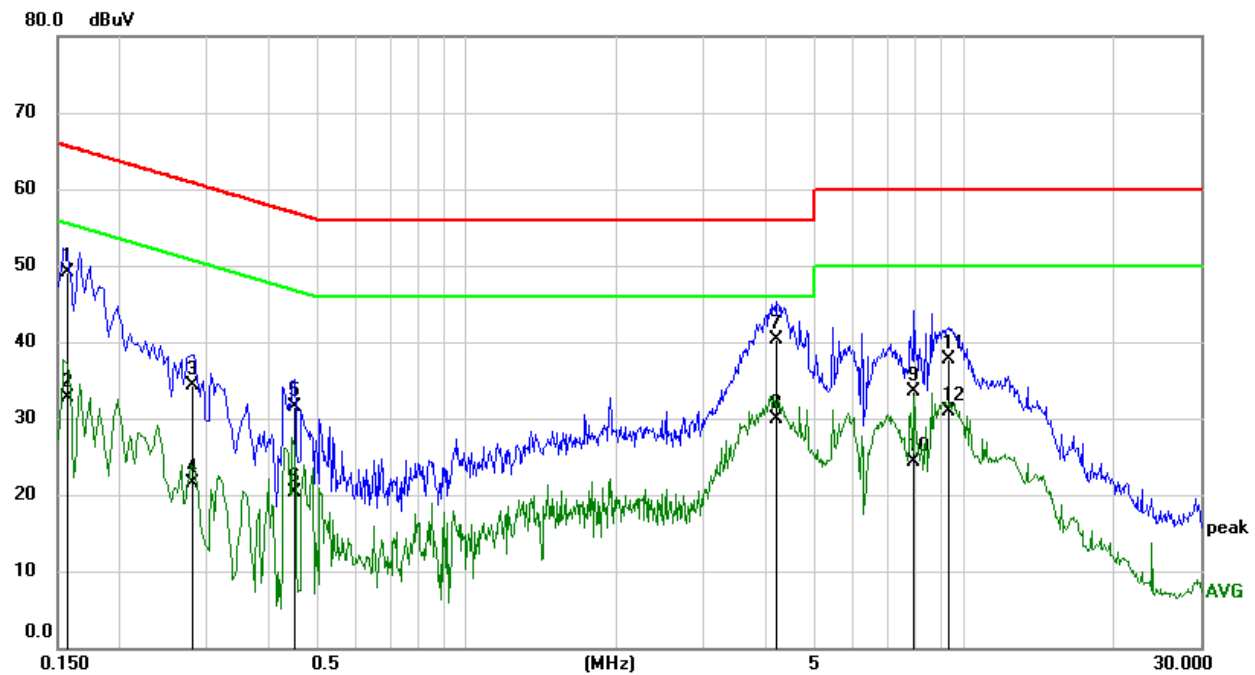


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1556	38.73	9.60	48.33	65.70	-17.37	QP
2	0.1556	22.05	9.60	31.65	55.70	-24.05	AVG
3	0.2127	27.53	9.60	37.13	63.10	-25.97	QP
4	0.2127	14.20	9.60	23.80	53.10	-29.30	AVG
5	0.3975	18.08	9.60	27.68	57.91	-30.23	QP
6	0.3975	10.29	9.60	19.89	47.91	-28.02	AVG
7	1.0814	15.00	9.61	24.61	56.00	-31.39	QP
8	1.0814	8.32	9.61	17.93	46.00	-28.07	AVG
9	4.2006	31.17	9.66	40.83	56.00	-15.17	QP
10	4.2006	20.16	9.66	29.82	46.00	-16.18	AVG
11	10.1217	23.34	9.76	33.10	60.00	-26.90	QP
12	10.1217	16.82	9.76	26.58	50.00	-23.42	AVG

- Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz-150 kHz), 9 kHz (150 kHz-30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.



LINE L RESULTS



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1577	39.47	9.61	49.08	65.58	-16.50	QP
2	0.1577	23.15	9.61	32.76	55.58	-22.82	AVG
3	0.2794	24.78	9.60	34.38	60.83	-26.45	QP
4	0.2794	11.83	9.60	21.43	50.83	-29.40	AVG
5	0.4472	21.85	9.60	31.45	56.93	-25.48	QP
6	0.4472	10.72	9.60	20.32	46.93	-26.61	AVG
7	4.1984	30.71	9.66	40.37	56.00	-15.63	QP
8	4.1984	20.34	9.66	30.00	46.00	-16.00	AVG
9	7.9643	23.83	9.72	33.55	60.00	-26.45	QP
10	7.9643	14.62	9.72	24.34	50.00	-25.66	AVG
11	9.3204	28.00	9.74	37.74	60.00	-22.26	QP
12	9.3204	21.17	9.74	30.91	50.00	-19.09	AVG

- Note: 1. Result = Reading +Correct Factor.
2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Test setup: RBW: 200 Hz (9 kHz-150 kHz), 9 kHz (150 kHz-30 MHz).
4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

Note: All test mode has been tested, only the worst data record in the report



10. ANTENNA REQUIREMENTS

APPLICABLE REQUIREMENTS

Please refer to FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Please refer to FCC §15.247(b)(4)

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RESULTS

Complies

END OF REPORT