



**CFR 47 FCC PART 15 SUBPART C  
ISED RSS-247 ISSUE 2**

**CERTIFICATION TEST REPORT**

*For*

**Wireless Slim full-size scissor keyboard**

**MODEL NUMBER: NS-PK4KBB23  
Serial Model NUMBER: NS-PK4KBB23-C**

**FCC ID: V4P-KB671**

**IC: 12487A-KB671**

**REPORT NUMBER: 4790692220-RF-3**

**ISSUE DATE: Feb. 17, 2023**

*Prepared for*

**FCC**

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**ISED**

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	Feb. 17, 2023	Initial Issue	\



Summary of Test Results			
Clause	Test Items	FCC/ISED Rules	Test Results
1	20dB Bandwidth and 99% Occupied Bandwidth	FCC 15.247 (a) (1) RSS-247 Clause 5.1 (a) RSS-Gen Clause 6.7	Pass
2	Conducted Output Power	FCC 15.247 (b) (1) RSS-247 Clause 5.1 (b)	Pass
3	Carrier Hopping Channel Separation	FCC 15.247 (a) (1) RSS-247 Clause 5.1 (b)	Pass
4	Number of Hopping Frequency	15.247 (a) (1) III RSS-247 Clause 5.1 (d)	Pass
5	Time of Occupancy (Dwell Time)	15.247 (a) (1) III RSS-247 Clause 5.1 (d)	Pass
6	Conducted Bandedge	FCC 15.247 (d) RSS-247 Clause 5.5	Pass
7	Radiated Bandedge and Spurious	FCC 15.247 (d) FCC 15.209 FCC 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9 RSS-GEN Clause 8.10	Pass
8	Conducted Emission Test for AC Power Port	FCC 15.207 RSS-GEN Clause 8.8	Pass
9	Antenna Requirement	FCC 15.203 RSS-GEN Clause 6.8	Pass
<p>Note:</p> <p>1. This test report is only published to and used by the applicant, and it is not for evidence purpose in China.</p> <p>2. The measurement result for the sample received is &lt;Pass&gt; according to &lt; CFR 47 FCC PART 15 SUBPART C &gt;&lt; ISED RSS-247 &gt; when &lt;Accuracy Method&gt; decision rule is applied.</p>			

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## 1. ATTESTATION OF TEST RESULTS

### FCC Applicant Information

**Company Name:** Dongguan Newmen Electronics Technology Co., LTD  
**Address:** No. 5, Xifa Road, Lin Village, Tangxia Town, Dongguan China

### FCC Manufacturer Information

**Company Name:** Dongguan Newmen Electronics Technology Co., LTD  
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### ISED Applicant Information

**Company Name:** Dongguan Newmen Electronics Tech.CO., LTD  
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### ISED Manufacturer Information

**Company Name:** Dongguan Newmen Electronics Tech.CO., LTD  
**Address:** No.5, Xifa Road, Lin Village, Tangxia Town Dongguan China (Peoples Republic Of)

### EUT Information

**EUT Name:** Wireless Slim full-size scissor keyboard  
**Model:** NS-PK4KBB23  
**Serial Model:** NS-PK4KBB23-C  
**Model Difference:** All the same except the model name  
**Brand:** Insignia  
**Sample Received Date:** Jan. 5, 2023  
**Sample Status:** Normal  
**Sample ID:** 5680686  
**Date of Tested:** Jan. 5, 2023~ Feb. 8, 2023

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 FCC PART 15 SUBPART C	PASS
ISED RSS-247 Issue 2	PASS
ISED RSS-GEN Issue 5	PASS

Prepared By:

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Checked By:

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Approved By:

A handwritten signature in black ink that reads "Stephen Guo".

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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, KDB 414788 D01 Radiated Test Site v01r01, CFR 47 FCC Part 2, CFR 47 FCC Part 15, ANSI C63.10-2013, ISED RSS-247 Issue 2 and ISED RSS-GEN Issue 5.

## 3. FACILITIES AND ACCREDITATION

Accreditation Certificate	<p><b>A2LA (Certificate No.: 4102.01)</b> UL Verification Services (Guangzhou) Co., Ltd. Song Shan Lake Branch. has been assessed and proved to be in compliance with A2LA.</p> <p><b>FCC (FCC Designation No.: CN1187)</b> 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><b>ISED (Company No.: 21320)</b> 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 and the test lab Conformity Assessment Body Identifier (CABID) is CN0046.</p> <p><b>VCCI (Registration No.: G-20019, R-20004, C-20012 and T-20011)</b> 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>
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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 30 MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. And these measurements below 30 MHz 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 recognize 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	3.62 dB
Radiated Emission (Included Fundamental Emission) (9 kHz ~ 30 MHz)	2.2 dB
Radiated Emission (Included Fundamental Emission) (30 MHz ~ 1 GHz)	4.00 dB
Radiated Emission (Included Fundamental Emission) (1 GHz to 26 GHz)	5.78 dB (1 GHz ~ 18 GHz)
	5.23 dB (18 GHz ~ 26 GHz)
Duty Cycle	±0.028%
DTS and 99% Occupied Bandwidth	±0.0196%
Maximum Conducted Output Power	±0.686 dB
Maximum Power Spectral Density Level	±0.743 dB
Conducted Band-edge Compliance	±1.328 dB
Conducted Unwanted Emissions In Non-restricted Frequency Bands	±0.746 dB (9 kHz ~ 1 GHz)
	±1.328dB (1 GHz ~ 26 GHz)
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

EUT Name	Wireless Slim full-size scissor keyboard
Model	NS-PK4KBB23, NS-PK4KBB23-C
Technology	2.4 GHz SRD
Transmit Frequency Range	2403 MHz ~ 2480 MHz
Modulation	GFSK
Battery	DC 3.7 V

Modulation	Bit Rate	Operation Frequency	Number of Channels
GFSK	2Mbps	2403 MHz-2480 MHz	16



## 5.2. MAXIMUM OUTPUT POWER

Modulation	Bit Rate	Transmit Frequency Range	Maximum Conducted PEAK Output Power (dBm)
GFSK	2Mbps	2403 MHz-2480 MHz	-0.92



### 5.3. CHANNEL LIST

Channel No.	1	2	3	4	5	6	7	8
Frequency (MHz)	2403	2426	2441	2463	2407	2422	2445	2466
Channel No.	9	10	11	12	13	14	15	16
Frequency (MHz)	2414	2436	2459	2473	2419	2439	2453	2480

### 5.4. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel	Frequency
GFSK-2Mbps	CH 1(Low Channel), CH 3(MID Channel), CH 16(High Channel)	2403 MHz, 2441 MHz, 2480 MHz



## 5.5. THE WORSE CASE1 POWER SETTING PARAMETER

The Worse Case Power Setting Parameter				
Test Software		\		
Test Mode	Transmit Antenna Number	Test Software Setting Value		
		Low	Middle	High
GFSK-2Mbps	1	Default	Default	Default



## **5.6. THE WORSE CASE CONFIGURATIONS**

The EUT was tested in the following configuration(s):

Controlled in test mode using a software application on the EUT supplied by customer. The application was used to enable a continuous transmission and to select the mode, test channels, bandwidth, data rates as required.

Test channels referring to section 5.4.

Maximum power setting referring to section 5.5.

The measured additional path loss was included in any path loss calculations for all RF cable used during tested.



## 5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Antenna	Frequency (MHz)	Antenna Type	MAX Antenna Gain (dBi)
1	2403-2480	PCB Antenna	2.58

Test Mode	Transmit and Receive Mode	Description
GFSK-2Mbps	<input checked="" type="checkbox"/> 1TX, 1RX	Antenna 1 can be used as transmitting/receiving antenna.

Note: The value of the antenna gain was declared by customer.



## 5.8. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	P/N
/	Laptop	ThinkPad	ThinkPad T41 Gen 1	PF-39TXGN

### I/O CABLES

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

### ACCESSORIES

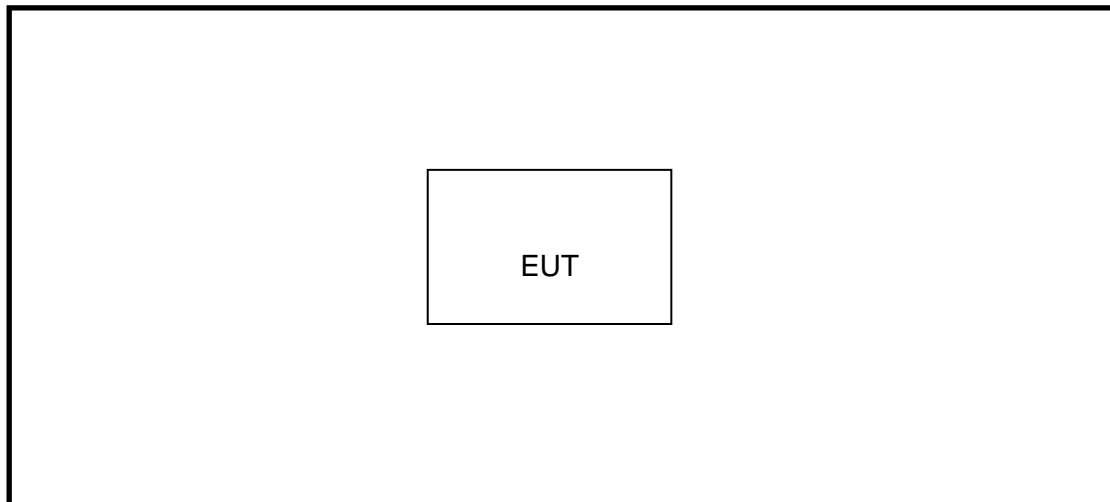
No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
/	/	/	/	/	/

### TEST SETUP

The EUT can work in engineering mode by pressing the key combination defined by the manufacturer.

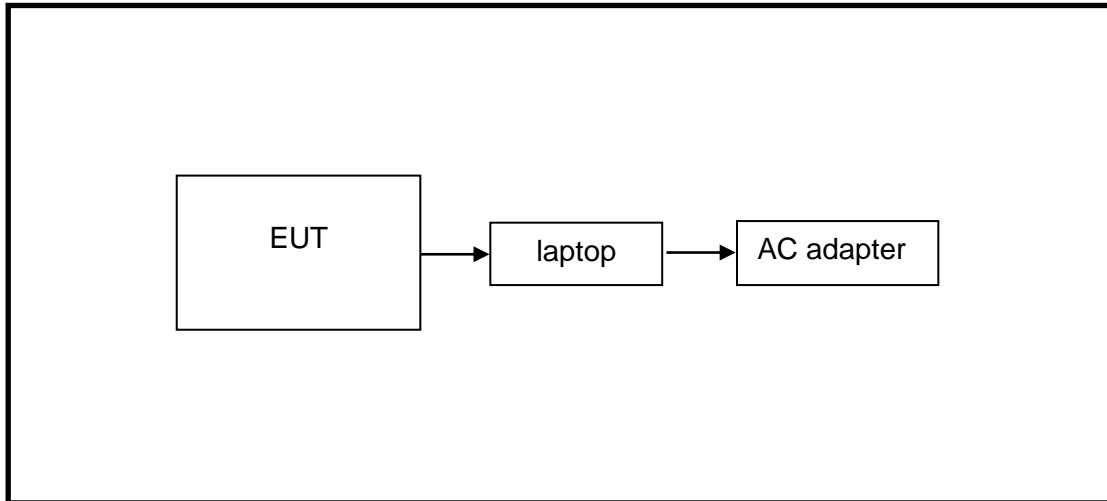
### SETUP DIAGRAM FOR TESTS

For others:





For AC POWER LINE CONDUCTED EMISSIONS only:





## 6. MEASURING INSTRUMENT AND SOFTWARE USED

R&S TS 8997 Test System					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
Power sensor, Power Meter	R&S	OSP120	100921	Apr.02,2022	Apr.01,2023
Vector Signal Generator	R&S	SMBV100A	261637	Oct.17, 2022	Oct.16, 2023
Signal Generator	R&S	SMB100A	178553	Oct.17, 2022	Oct.16, 2023
Signal Analyzer	R&S	FSV40	101118	Oct.17, 2022	Oct.16, 2023
Software					
Description	Manufacturer		Name		Version
For R&S TS 8997 Test System	Rohde & Schwarz		EMC 32		10.60.10
Tonsend RF Test System					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due. Date
Wideband Radio Communication Tester	R&S	CMW500	155523	Oct.17, 2022	Oct.16, 2023
Wireless Connectivity Tester	R&S	CMW270	1201.0002N75-102	Sep.28, 2022	Sep.27, 2023
PXA Signal Analyzer	Keysight	N9030A	MY55410512	Oct.17, 2022	Oct.16, 2023
MXG Vector Signal Generator	Keysight	N5182B	MY56200284	Oct.17, 2022	Oct.16, 2023
MXG Vector Signal Generator	Keysight	N5172B	MY56200301	Oct.17, 2022	Oct.16, 2023
DC power supply	Keysight	E3642A	MY55159130	Oct.17, 2022	Oct.16, 2023
Temperature & Humidity Chamber	SANMOOD	SG-80-CC-2	2088	Oct.17, 2022	Oct.16, 2023
Software					
Description	Manufacturer	Name		Version	
Tonsend SRD Test System	Tonsend	JS1120-3 RF Test System		2.6.77.0518	



Conducted Emissions					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
EMI Test Receiver	R&S	ESR3	101961	Oct.17, 2022	Oct.16, 2023
Two-Line V-Network	R&S	ENV216	101983	Oct.17, 2022	Oct.16, 2023
Artificial Mains Networks	Schwarzbeck	NSLK 8126	8126465	Oct.17, 2022	Oct.16, 2023
Software					
Description			Manufacturer	Name	Version
Test Software for Conducted Emissions			Farad	EZ-EMC	Ver. UL-3A1

Radiated Emissions					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
MXE EMI Receiver	KESIGHT	N9038A	MY56400036	Oct.17, 2022	Oct.16, 2023
Hybrid Log Periodic Antenna	TDK	HLP-3003C	130959	Aug.02, 2021	Aug.01, 2024
Preamplifier	HP	8447D	2944A09099	Oct.17, 2022	Oct.16, 2023
EMI Measurement Receiver	R&S	ESR26	101377	Oct.17, 2022	Oct.16, 2023
Horn Antenna	TDK	HRN-0118	130940	July 20, 2021	July 19, 2024
Preamplifier	TDK	PA-02-0118	TRS-305-00067	Oct.17, 2022	Oct.16, 2023
Horn Antenna	Schwarzbeck	BBHA9170	697	July 20, 2021	July 19, 2024
Preamplifier	TDK	PA-02-2	TRS-307-00003	Oct.17, 2022	Oct.16, 2023
Preamplifier	TDK	PA-02-3	TRS-308-00002	Oct.17, 2022	Oct.16, 2023
Loop antenna	Schwarzbeck	1519B	00008	Dec.14, 2021	Dec.13, 2024
Preamplifier	TDK	PA-02-001-3000	TRS-302-00050	Oct.17, 2022	Oct.16, 2023
Preamplifier	Mini-Circuits	ZX60-83LN-S+	SUP01202035	Oct.17, 2022	Oct.16, 2023
High Pass Filter	Wi	WHKX10-2700-3000-18000-40SS	23	/	/
Highpass Filter	Wainwright	WHKX10-5850-6500-1800-40SS	4	/	/
Band Reject Filter	Wainwright	WRCJV12-5695-5725-5850-5880-40SS	4	/	/



Band Reject Filter	Wainwright	WRCJV20-5120-5150-5350-5380-60SS	2	/	/
Band Reject Filter	Wainwright	WRCJV20-5440-5470-5725-5755-60SS	1	/	/
Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	4	/	/
Band Reject Filter	Wainwright	WRCD5-1879-1879.85-1880.15-1881-40SS	1	/	/
Notch Filter	Wainwright	WHJ10-882-980-7000-40SS	1	/	/
Software					
Description			Manufacturer	Name	Version
Test Software for Radiated Emissions			Farad	EZ-EMC	Ver. UL-3A1

Other Instrument					
Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Due Date
Temperature humidity probe	OMEGA	ITHX-SD-5	18470007	Oct.22, 2022	Oct.21, 2023
Barometer	Yiyi	Baro	N/A	Oct.24, 2022	Oct.23, 2023
Attenuator	Agilent	8495B	2814a12853	Oct.18, 2022	Oct.17, 2023



## 7. ANTENNA PORT TEST RESULTS

### 7.1. ON TIME AND DUTY CYCLE

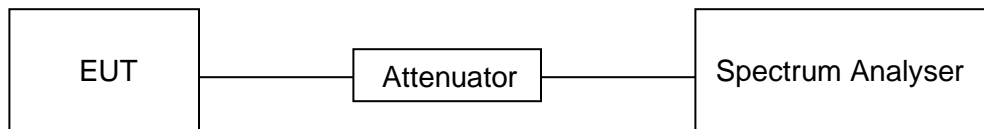
#### LIMITS

None; for reporting purposes only

#### PROCEDURE

Refer to ANSI C63.10-2013 clause 11.6 Zero – Span Spectrum Analyzer method.

#### TEST SETUP



#### TEST ENVIRONMENT

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

#### RESULTS

Please refer to appendix I.

## 7.2. 20 dB BANDWIDTH AND 99 % OCCUPIED BANDWIDTH

### LIMITS

CFR 47FCC Part15 (15.247) Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (a) (1) RSS-247 Clause 5.1 (a)	20 dB Bandwidth	None; for reporting purposes only.	2403-2480
ISED RSS-Gen Clause 6.7	99 % Occupied Bandwidth	None; for reporting purposes only.	2403-2480

### TEST PROCEDURE

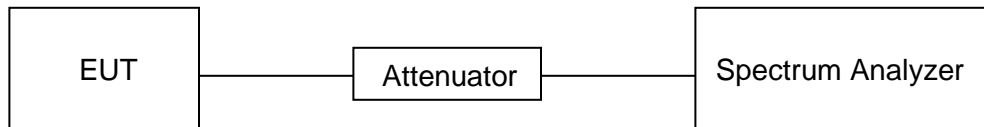
Refer to ANSI C63.10-2013 clause 6.9.2.

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

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	For 20 dB Bandwidth: 1 % to 5 % of the 20 dB bandwidth For 99 % Occupied Bandwidth: 1 % to 5 % of the occupied bandwidth
VBW	For 20 dB Bandwidth: approximately 3×RBW For 99 % Occupied Bandwidth: ≥ 3×RBW
Span	Approximately 2 to 3 times the 20dB bandwidth
Trace	Max hold
Sweep	Auto couple

a) Use the occupied bandwidth function of the instrument, allow the trace to stabilize and report the measured 99 % occupied bandwidth and 20 dB Bandwidth.

### TEST SETUP



**TEST ENVIRONMENT**

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

**RESULTS**

Please refer to appendix A&B.



### 7.3. CONDUCTED OUTPUT POWER

#### LIMITS

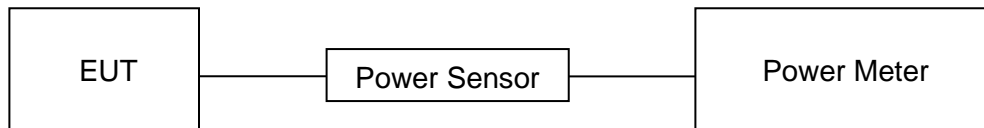
CFR 47 FCC Part15 (15.247), Subpart C ISED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (b) (1) ISED RSS-247 Clause 5.4 (b)	Peak Conducted Output Power	Hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel: 1 watt or 30 dBm; 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 21 dBm	2400-2483.5

#### TEST PROCEDURE

Connect the EUT to a low loss RF cable from the antenna port to the power sensor (video bandwidth is greater than the occupied bandwidth).

Measure peak emission level, the indicated level is the peak output power, after any corrections for external attenuators and cables.

#### TEST SETUP



#### TEST ENVIRONMENT

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

#### RESULTS

Please refer to appendix C.



## 7.4. CARRIER FREQUENCY SEPARATION

### LIMITS

CFR 47 FCC Part15 (15.247), Subpart C ISSED RSS-247 ISSUE 2			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247 (a) (1) ISED RSS-247 Clause 5.1 (b)	Carrier Frequency 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

Refer to ANSI C63.10-2013 clause 7.8.2.

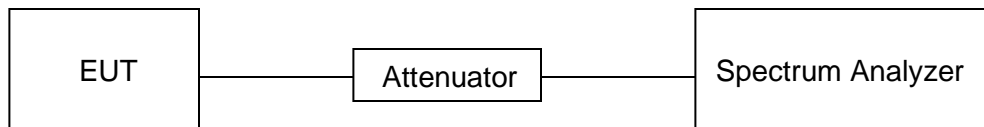
Connect the EUT to the spectrum analyzer and use the following settings:

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 and 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.

### TEST SETUP



**TEST ENVIRONMENT**

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

**RESULTS**

Please refer to Appendix D.

## 7.5. NUMBER OF HOPPING FREQUENCIES

### LIMITS

CFR 47 FCC Part15 (15.247), Subpart C ISED RSS-247 ISSUE 2		
Section	Test Item	Limit
CFR 47 15.247 (a) (1) III ISED RSS-247 Clause 5.1 (d)	Number of Hopping Frequency	at least 15 hopping channels

### TEST PROCEDURE

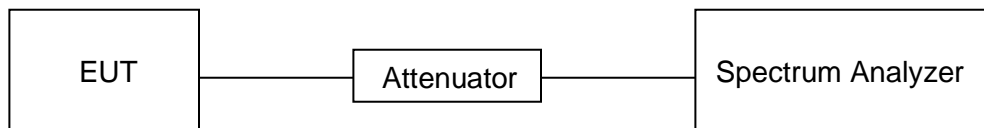
Refer to ANSI C63.10-2013 clause 7.8.3.

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. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
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.

### TEST SETUP



### TEST ENVIRONMENT

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V



## **RESULTS**

Please refer to appendix F.

## 7.6. TIME OF OCCUPANCY (DWELL TIME)

### LIMITS

CFR 47 FCC Part15 (15.247), Subpart C ISED RSS-247 ISSUE 2		
Section	Test Item	Limit
CFR 47 15.247 (a) (1) III ISED RSS-247 Clause 5.1 (d)	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

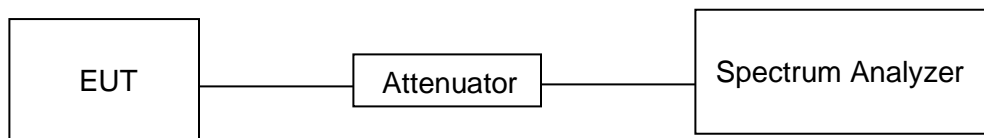
Refer to ANSI C63.10-2013 clause 7.8.4.

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

Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	$\leq$ channel spacing and where possible RBW should be set $\gg 1 / T$ , where T is the expected dwell time per channel.
VBW	$\geq$ RBW
Span	Zero span, centered on a hopping channel
Trace	Max hold
Sweep time	As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel

Use the marker-delta function to determine the transmit time per hop (Burst Width). If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

### TEST SETUP



### TEST ENVIRONMENT



Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

**RESULTS**

Please refer to appendix E.



## 7.7. CONDUCTED BANDEdge AND SPURIOUS EMISSION

### LIMITS

CFR 47 FCC Part15 (15.247), Subpart C ISED RSS-247 ISSUE 2		
Section	Test Item	Limit
CFR 47 FCC §15.247 (d) ISED RSS-247 5.5	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

Refer to ANSI C63.10-2013 clause 7.8.6 and 7.8.8.

Connect the EUT to the spectrum analyser and use the following settings for reference level measurement:

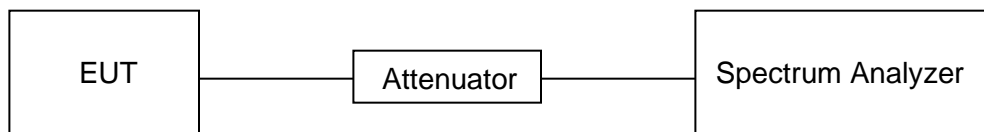
Center Frequency	The center frequency of the channel under test
Detector	Peak
RBW	100 kHz
VBW	$\geq 3 \times \text{RBW}$
Span	1.5 x DTS bandwidth
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum PSD level.

Change the settings for emission level measurement:

Span	Set the center frequency and span to encompass frequency range to be measured
Detector	Peak
RBW	100 kHz
VBW	$\geq 3 \times \text{RBW}$
measurement points	$\geq \text{span}/\text{RBW}$
Trace	Max hold
Sweep time	Auto couple.

Allow trace to fully stabilize and use the peak marker function to determine the maximum PSD level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements.

**TEST SETUP****TEST ENVIRONMENT**

Temperature	23.3 °C	Relative Humidity	62.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

**RESULTS**

Please refer to appendix G&H.





## 8. RADIATED TEST RESULTS

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) (9 kHz ~ 1 GHz)

Emissions radiated outside of the specified frequency bands above 30 MHz			
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m	
		Quasi-Peak	
30 - 88	100	40	
88 - 216	150	43.5	
216 - 960	200	46	
Above 960	500	54	
Above 1000	500	Peak	Average
		74	54

FCC Emissions radiated outside of the specified frequency bands below 30 MHz		
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

ISED General field strength limits at frequencies below 30 MHz

Table 6 – General field strength limits at frequencies below 30 MHz		
Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement distance (m)
9 - 490 kHz <sup>Note 1</sup>	6.37/F (F in kHz)	300
490 - 1705 kHz	63.7/F (F in kHz)	30
1.705 - 30 MHz	0.08	30

**Note 1:** The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.



ISED Restricted bands please refer to ISED RSS-GEN Clause 8.10

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

**Note 1:** Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

FCC Restricted bands of operation refer to FCC §15.205 (a):

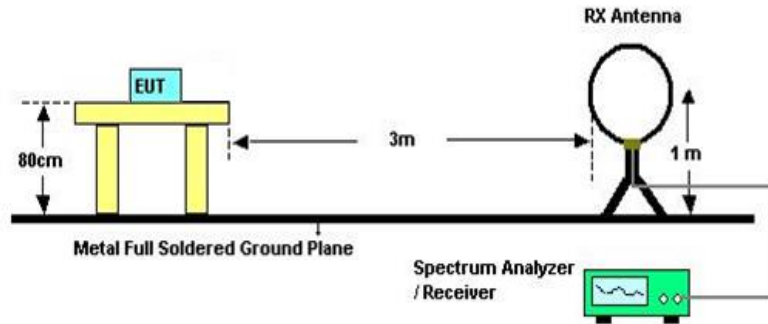
MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
<sup>1</sup> 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	( <sup>2</sup> )
13.36-13.41			

Note: <sup>1</sup>Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

<sup>2</sup>Above 38.6c

## TEST SETUP AND PROCEDURE

Below 30 MHz

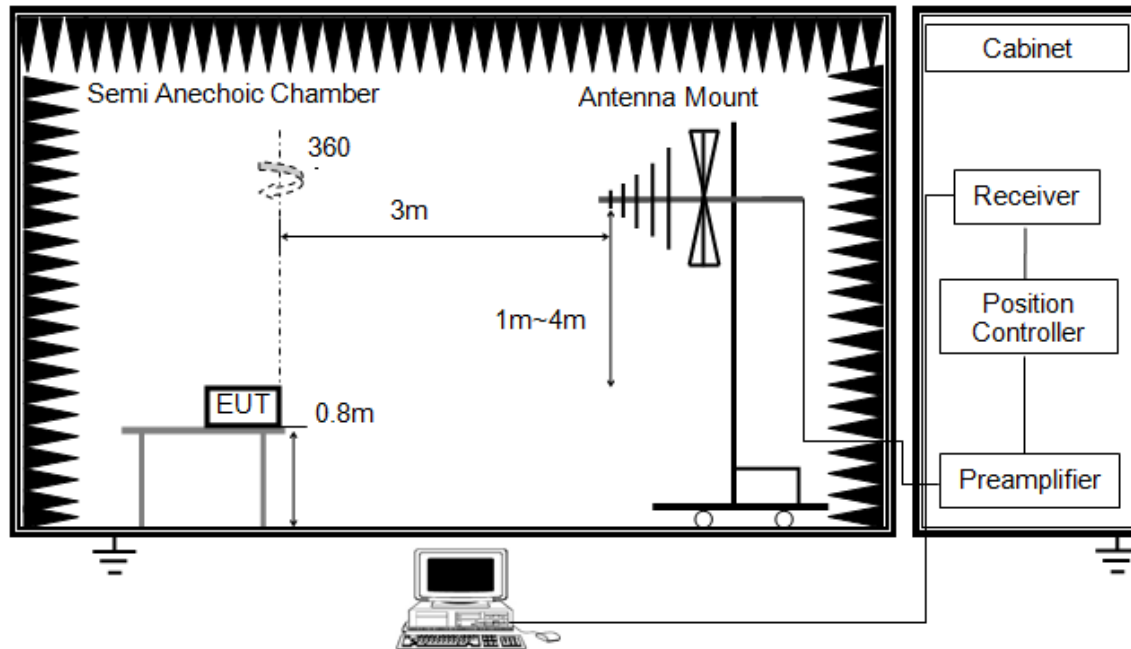


The setting of the spectrum analyser

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

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.4.
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 80 cm above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a 1 m 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 1 GHz, 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 and average 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 and average 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.
8. The limits in CFR 47, Part 15, Subpart C, paragraph 15.209 (a), are identical to those in RSS-GEN Section 8.9, Table 6, since the measurements are performed in terms of magnetic field strength and converted to electric field strength levels (as reported in the table) using the free space impedance of 377  $\Omega$ ; For example, the measurement frequency X kHz resulted in a level of Y dBuV/m, which is equivalent to  $Y-51.5 = Z$  dBuA/m, which has the same margin, W dB, to the corresponding RSS-GEN Table 6 limit as it has to be 15.209(a) limit.

Below 1 GHz and above 30 MHz

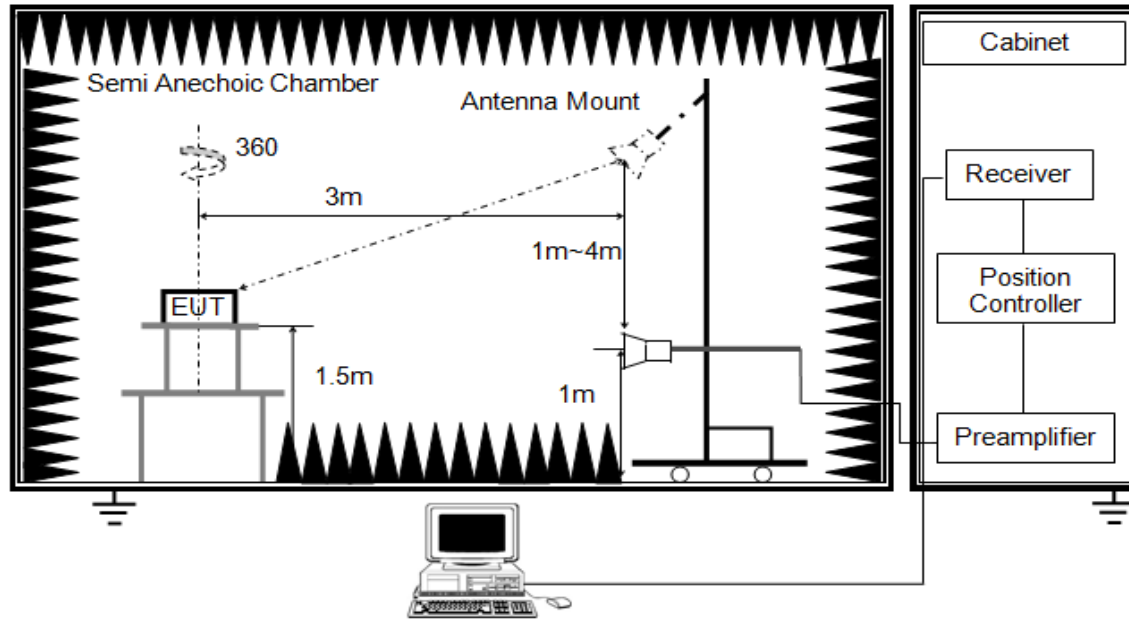


The setting of the spectrum analyser

RBW	120 kHz
VBW	300 kHz
Sweep	Auto
Detector	Peak/QP
Trace	Max hold

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.5.
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 80 cm 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 1 GHz, 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 1 GHz

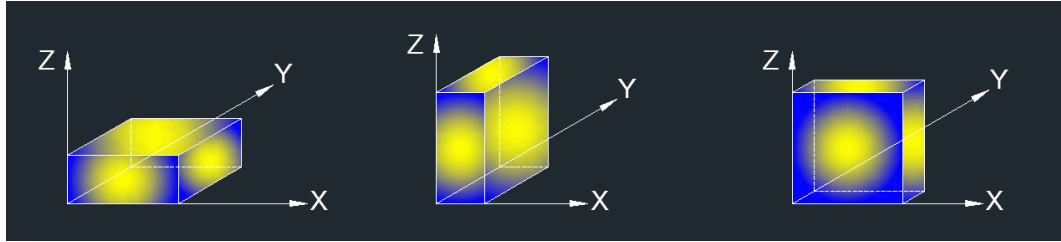


The setting of the spectrum analyser

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

1. The testing follows the guidelines in ANSI C63.10-2013 clause 6.6.
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 1.5 m 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 1 GHz, 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 average 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: The manufacturer has recommended that the EUT only be used in the desktop (horizontal) orientation; therefore, all radiated testing was performed in desktop orientation. The EUT was placed on normal orientation and all radiated emissions were performed with the EUT shown on the setup photo.

## TEST ENVIRONMENT

Temperature	24.4 °C	Relative Humidity	61.1 %
Atmosphere Pressure	101 kPa	Test Voltage	DC 3.7 V

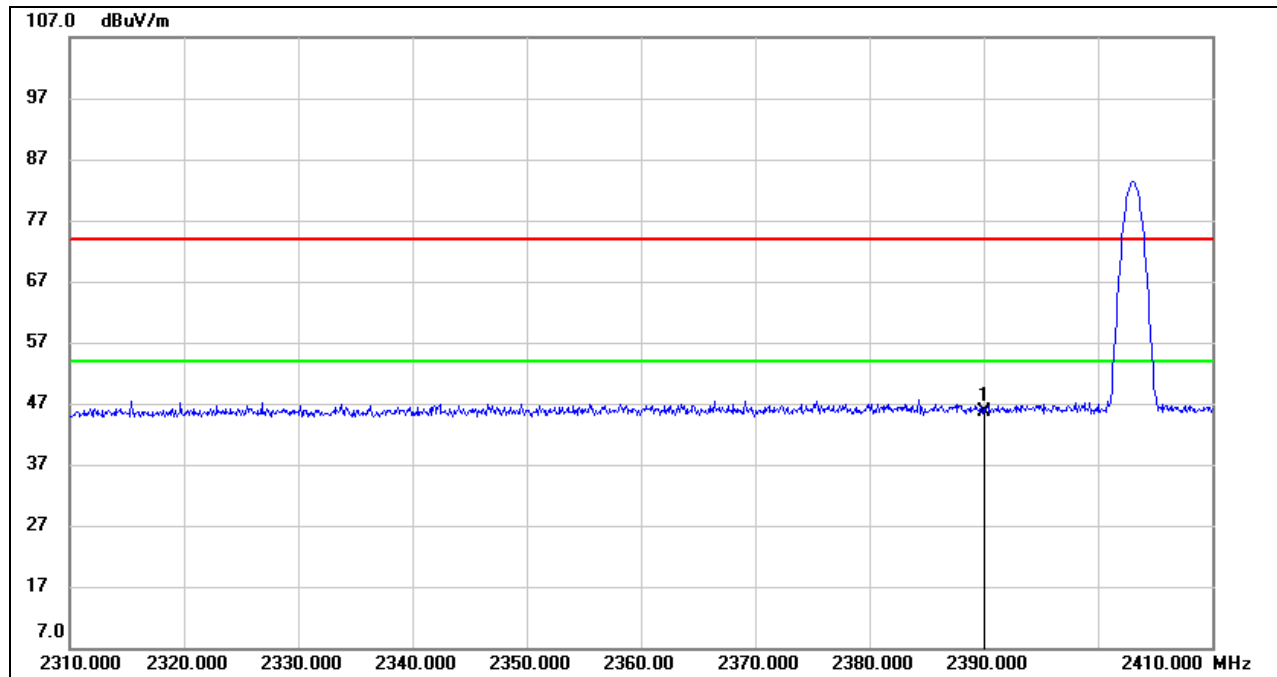
## RESULTS

## 8.1. RESTRICTED BANDEDGE

### 8.1.1. GFSK-2Mbps MODE

#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

#### PEAK



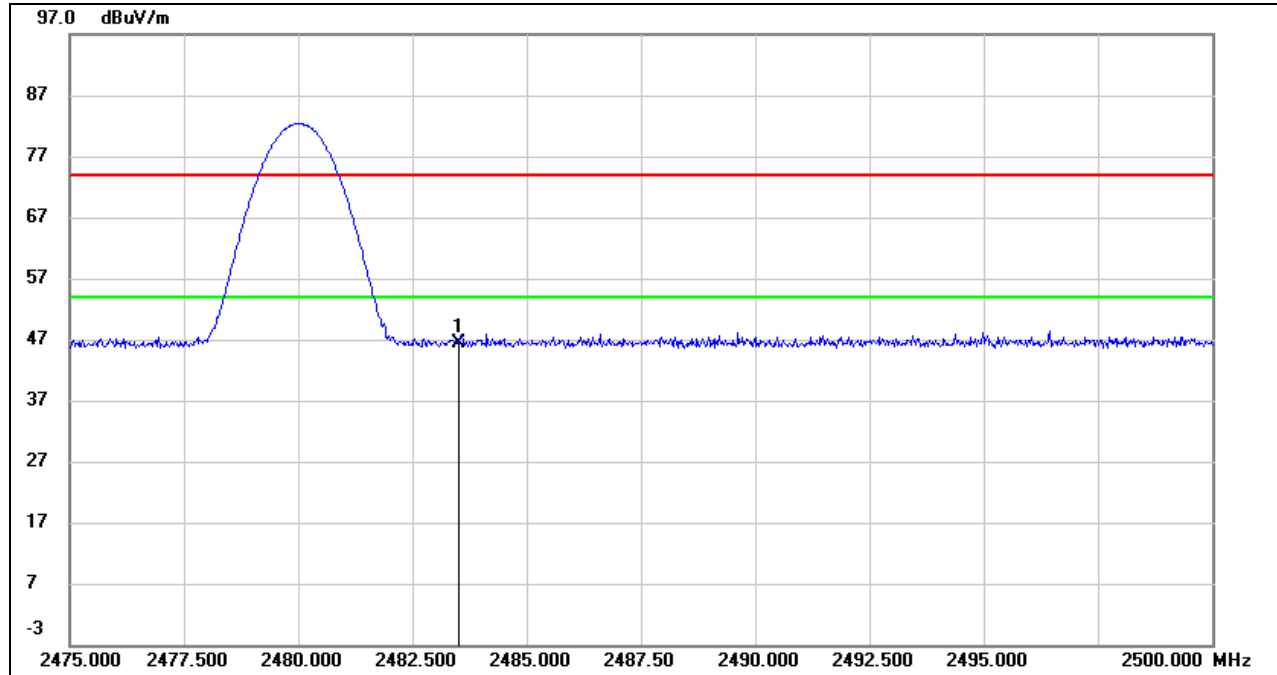
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2390.000	13.42	32.16	45.58	74.00	-28.42	peak

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 data was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.
5. All the polarities (Vertical & Horizontal) had been tested, only the worst data was recorded in the report.

# RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

## PEAK



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	13.87	32.44	46.31	74.00	-27.69	peak

Note:

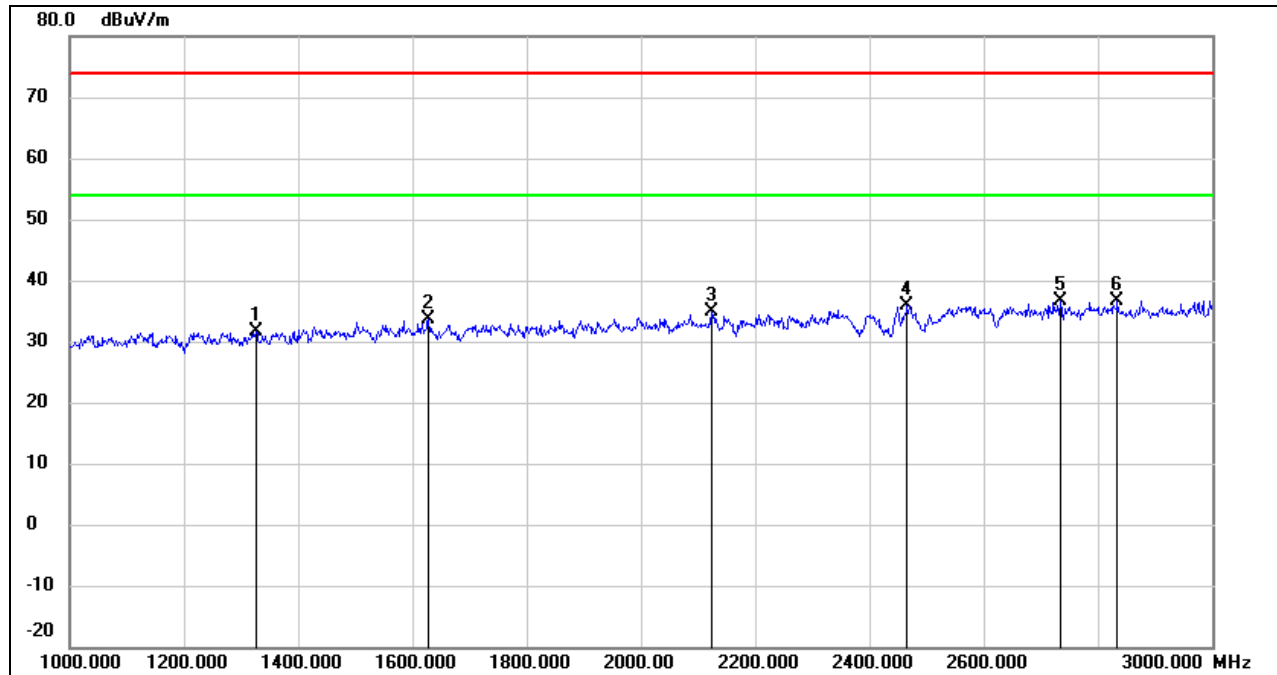
1. Measurement = Reading Level + Correct Factor.
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.
3. Peak: Peak detector.
4. Only the worst data was recorded, if it complies with the limit, the other emissions deemed to comply with the limit.
5. All the polarities (Vertical & Horizontal) had been tested, only the worst data was recorded in the report.



## 8.2. SPURIOUS EMISSIONS (1 GHz ~ 3 GHz)

### 8.2.1. GFSK-2Mbps 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	1326.000	45.22	-13.52	31.70	74.00	-42.30	peak
2	1628.000	46.00	-12.28	33.72	74.00	-40.28	peak
3	2124.000	45.21	-10.42	34.79	74.00	-39.21	peak
4	2466.000	44.64	-8.66	35.98	74.00	-38.02	peak
5	2734.000	44.42	-7.79	36.63	74.00	-37.37	peak
6	2834.000	44.23	-7.49	36.74	74.00	-37.26	peak

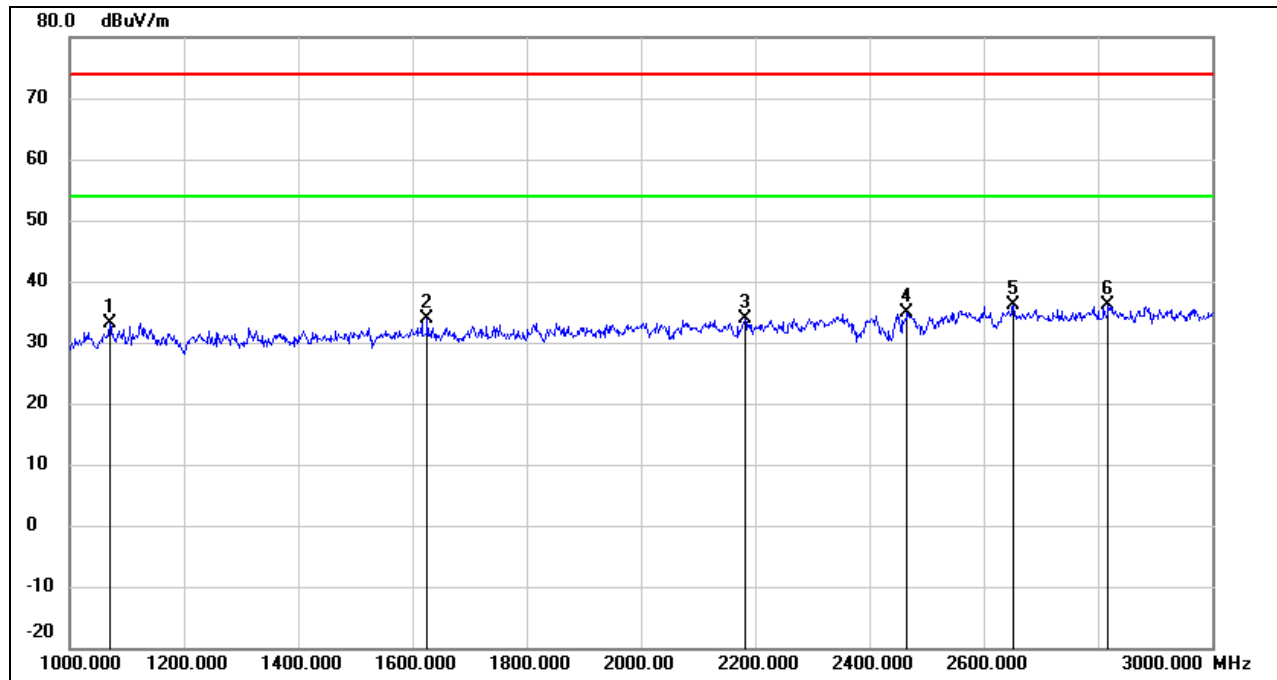
Note: 1. Measurement = Reading Level + Correct Factor.

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 (LOW CHANNEL, VERTICAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1070.000	47.82	-14.70	33.12	74.00	-40.88	peak
2	1626.000	46.18	-12.30	33.88	74.00	-40.12	peak
3	2182.000	43.89	-10.13	33.76	74.00	-40.24	peak
4	2466.000	43.53	-8.66	34.87	74.00	-39.13	peak
5	2652.000	44.05	-8.03	36.02	74.00	-37.98	peak
6	2818.000	43.63	-7.53	36.10	74.00	-37.90	peak

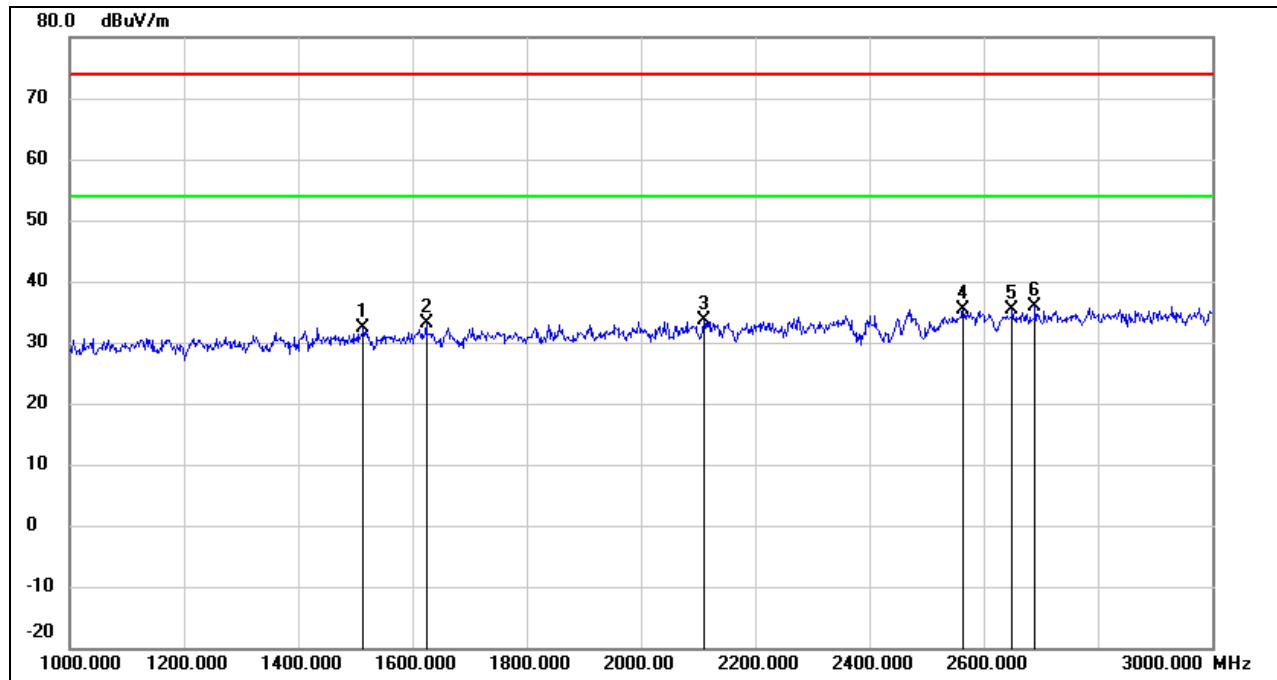
Note: 1. Measurement = Reading Level + Correct Factor.

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

3. Peak: Peak detector.

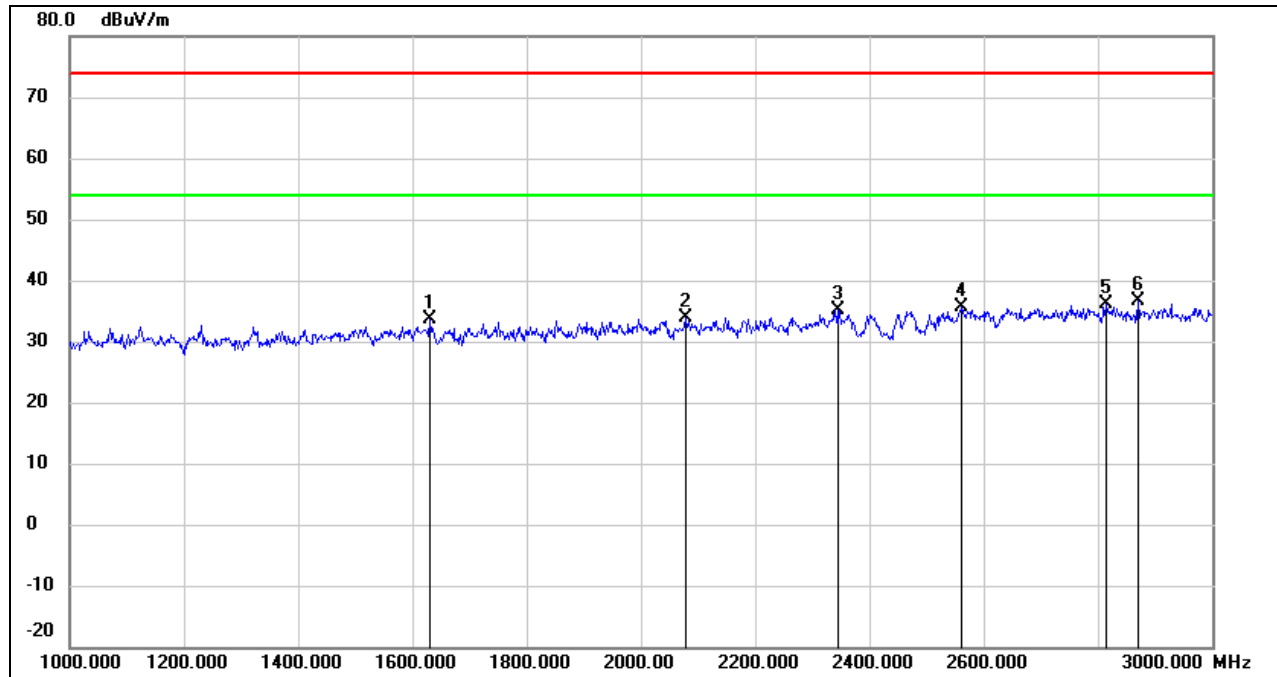
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band reject filter losses.

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

**HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1514.000	45.07	-12.67	32.40	74.00	-41.60	peak
2	1624.000	45.53	-12.30	33.23	74.00	-40.77	peak
3	2110.000	44.07	-10.49	33.58	74.00	-40.42	peak
4	2564.000	43.74	-8.30	35.44	74.00	-38.56	peak
5	2650.000	43.49	-8.03	35.46	74.00	-38.54	peak
6	2690.000	43.92	-7.92	36.00	74.00	-38.00	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	1630.000	45.82	-12.28	33.54	74.00	-40.46	peak
2	2078.000	44.48	-10.67	33.81	74.00	-40.19	peak
3	2344.000	44.46	-9.30	35.16	74.00	-38.84	peak
4	2562.000	43.82	-8.31	35.51	74.00	-38.49	peak
5	2814.000	43.69	-7.54	36.15	74.00	-37.85	peak
6	2870.000	44.07	-7.37	36.70	74.00	-37.30	peak

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

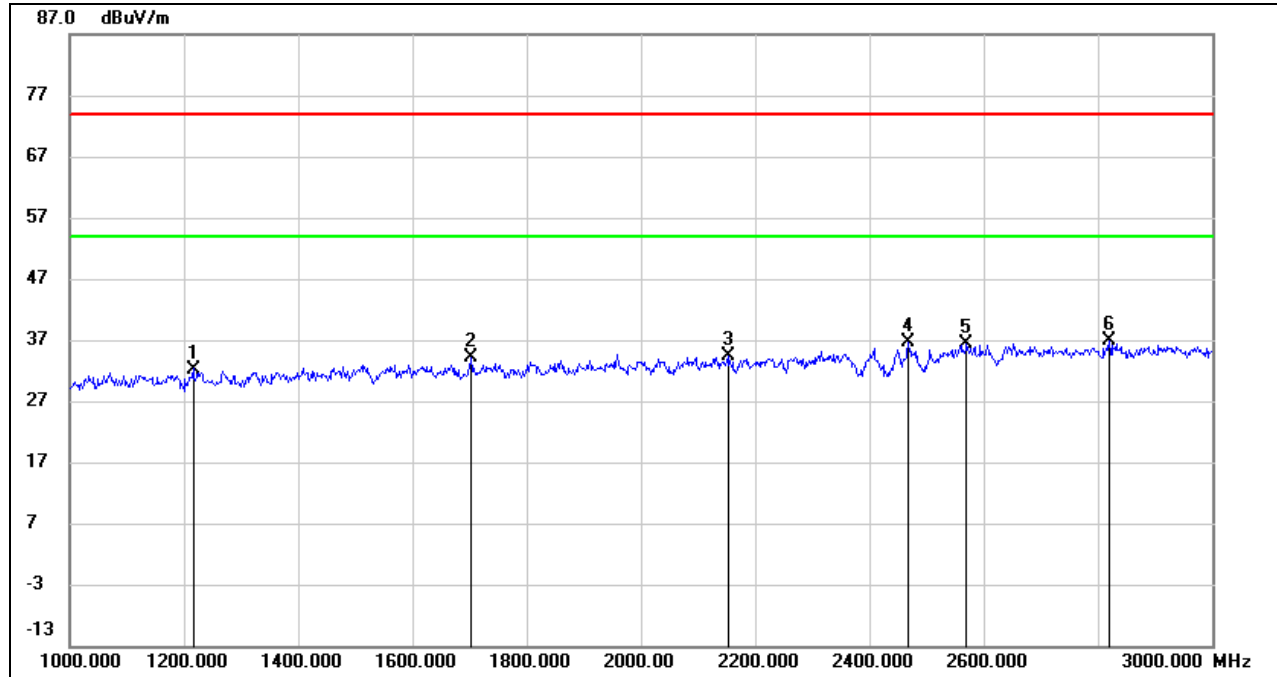
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.

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 (HIGH CHANNEL, HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1216.000	46.28	-14.03	32.25	74.00	-41.75	peak
2	1702.000	46.15	-12.05	34.10	74.00	-39.90	peak
3	2152.000	44.70	-10.27	34.43	74.00	-39.57	peak
4	2468.000	45.19	-8.65	36.54	74.00	-37.46	peak
5	2570.000	44.76	-8.27	36.49	74.00	-37.51	peak
6	2820.000	44.33	-7.52	36.81	74.00	-37.19	peak

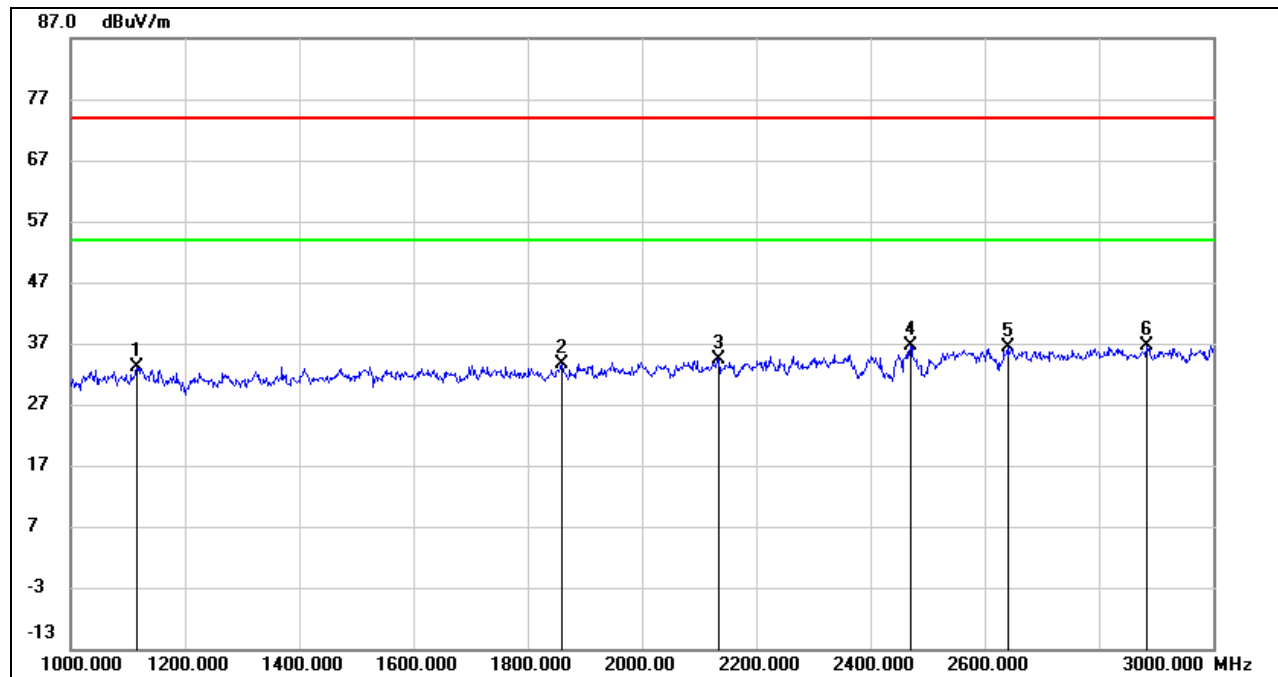
Note: 1. Measurement = Reading Level + Correct Factor.

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 (HIGH CHANNEL, VERTICAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	1116.000	47.66	-14.50	33.16	74.00	-40.84	peak
2	1860.000	45.08	-11.53	33.55	74.00	-40.45	peak
3	2134.000	44.84	-10.37	34.47	74.00	-39.53	peak
4	2470.000	45.20	-8.65	36.55	74.00	-37.45	peak
5	2640.000	44.56	-8.07	36.49	74.00	-37.51	peak
6	2884.000	43.96	-7.33	36.63	74.00	-37.37	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.

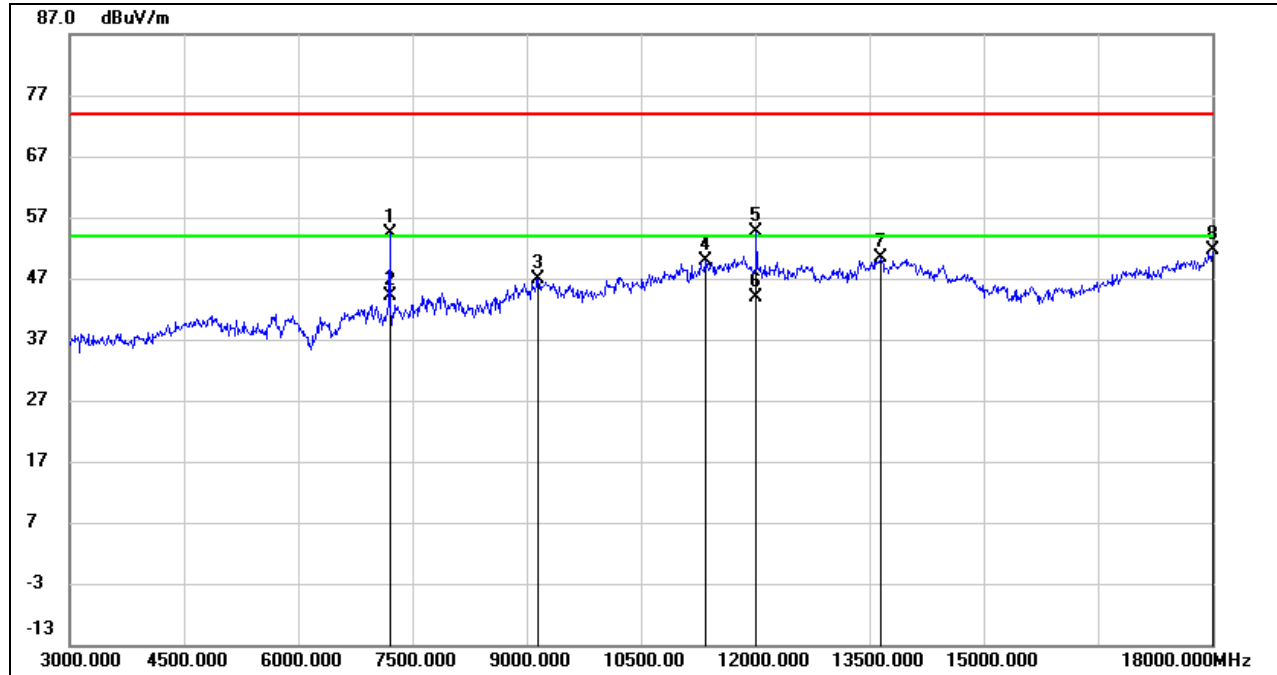
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for Band reject filter losses.

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

### 8.3. SPURIOUS EMISSIONS (3 GHz ~ 18 GHz)

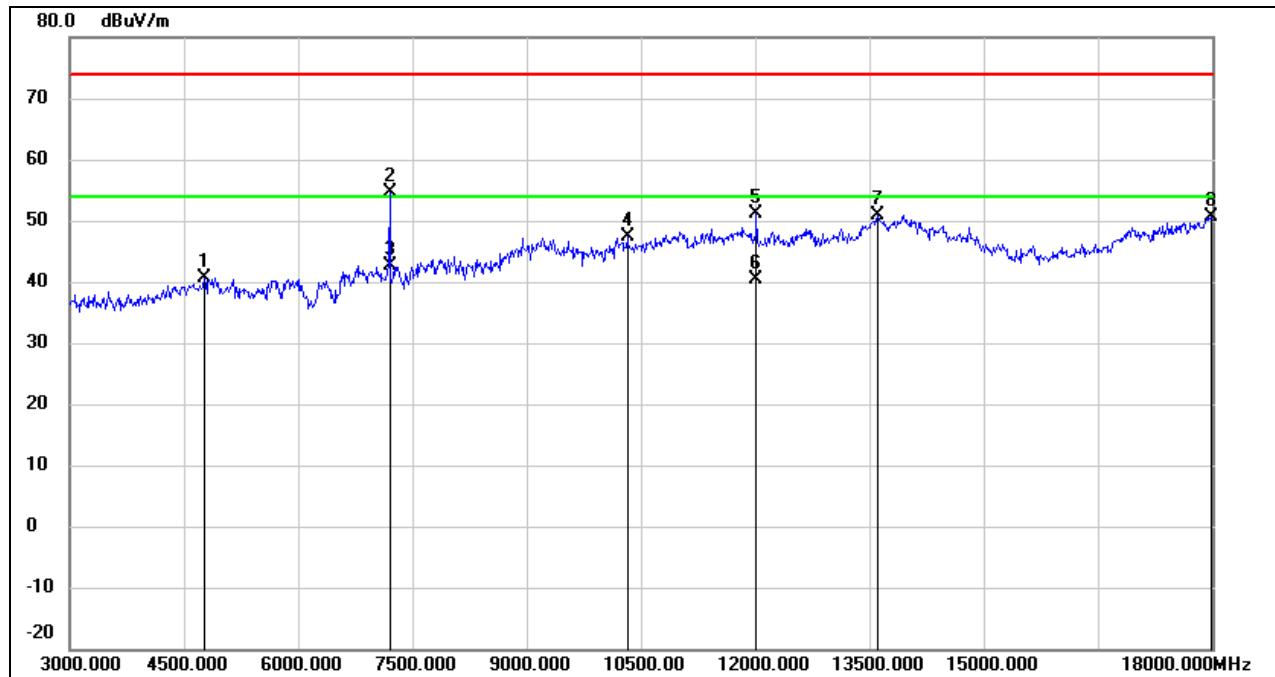
#### 8.3.1. GFSK-2Mbps MODE

##### 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	7200.000	47.73	6.55	54.28	74.00	-19.72	peak
2	7200.000	37.57	6.55	44.12	54.00	-9.88	AVG
3	9150.000	36.31	10.54	46.85	74.00	-27.15	peak
4	11340.000	33.99	16.01	50.00	74.00	-24.00	peak
5	12015.000	36.79	17.95	54.74	74.00	-19.26	peak
6	12015.000	25.91	17.95	43.86	54.00	-10.14	AVG
7	13650.000	29.11	21.21	50.32	74.00	-23.68	peak
8	18000.000	25.86	25.69	51.55	74.00	-22.45	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. 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.

**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	4770.000	41.08	-0.43	40.65	74.00	-33.35	peak
2	7200.000	47.99	6.55	54.54	74.00	-19.46	peak
3	7200.000	36.05	6.55	42.60	54.00	-11.40	AVG
4	10320.000	34.65	12.64	47.29	74.00	-26.71	peak
5	12015.000	33.18	17.95	51.13	74.00	-22.87	peak
6	12015.000	22.35	17.95	40.30	54.00	-13.70	AVG
7	13605.000	29.87	21.12	50.99	74.00	-23.01	peak
8	17985.000	25.10	25.60	50.70	74.00	-23.30	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.

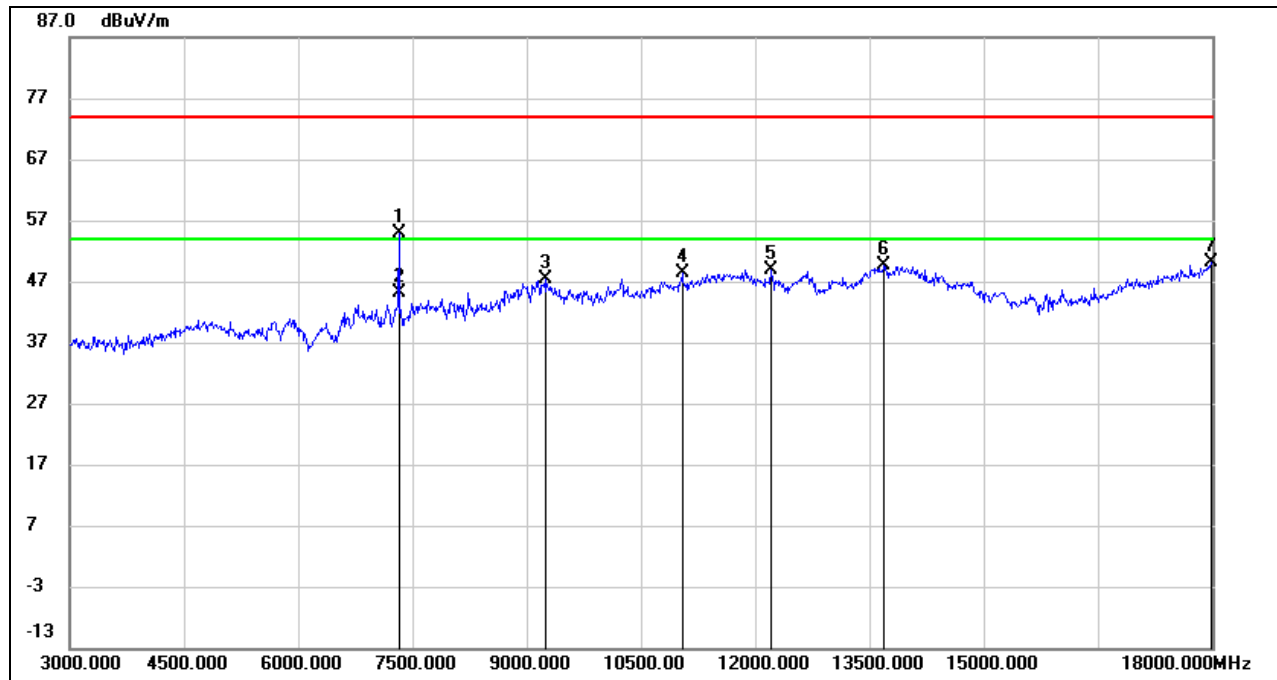
4. AVG:  $VBW=1/Ton$ , where: Ton is the transmitting duration.

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.

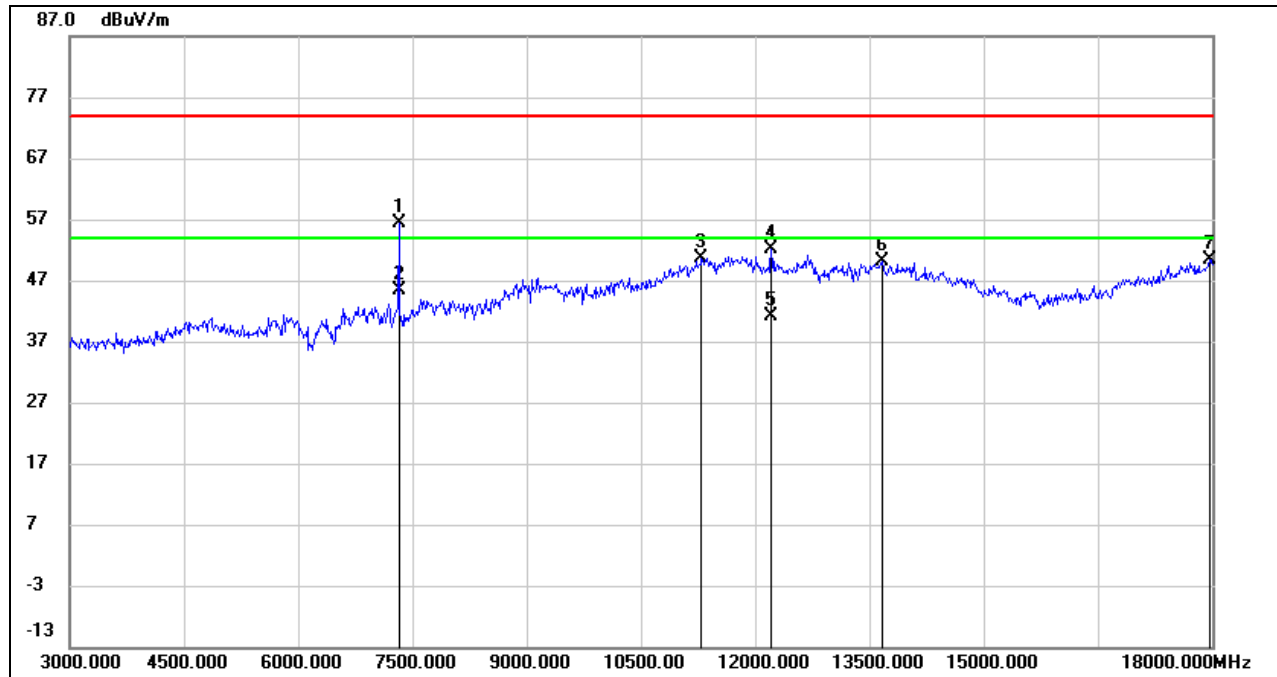


**HARMONICS AND SPURIOUS EMISSIONS (MID CHANNEL, HORIZONTAL)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	7320.000	48.48	6.46	54.94	74.00	-19.06	peak
2	7320.000	38.60	6.46	45.06	54.00	-8.94	AVG
3	9255.000	36.69	10.59	47.28	74.00	-26.72	peak
4	11040.000	33.47	14.91	48.38	74.00	-25.62	peak
5	12210.000	31.04	17.81	48.85	74.00	-25.15	peak
6	13695.000	28.26	21.31	49.57	74.00	-24.43	peak
7	17985.000	24.47	25.60	50.07	74.00	-23.93	peak

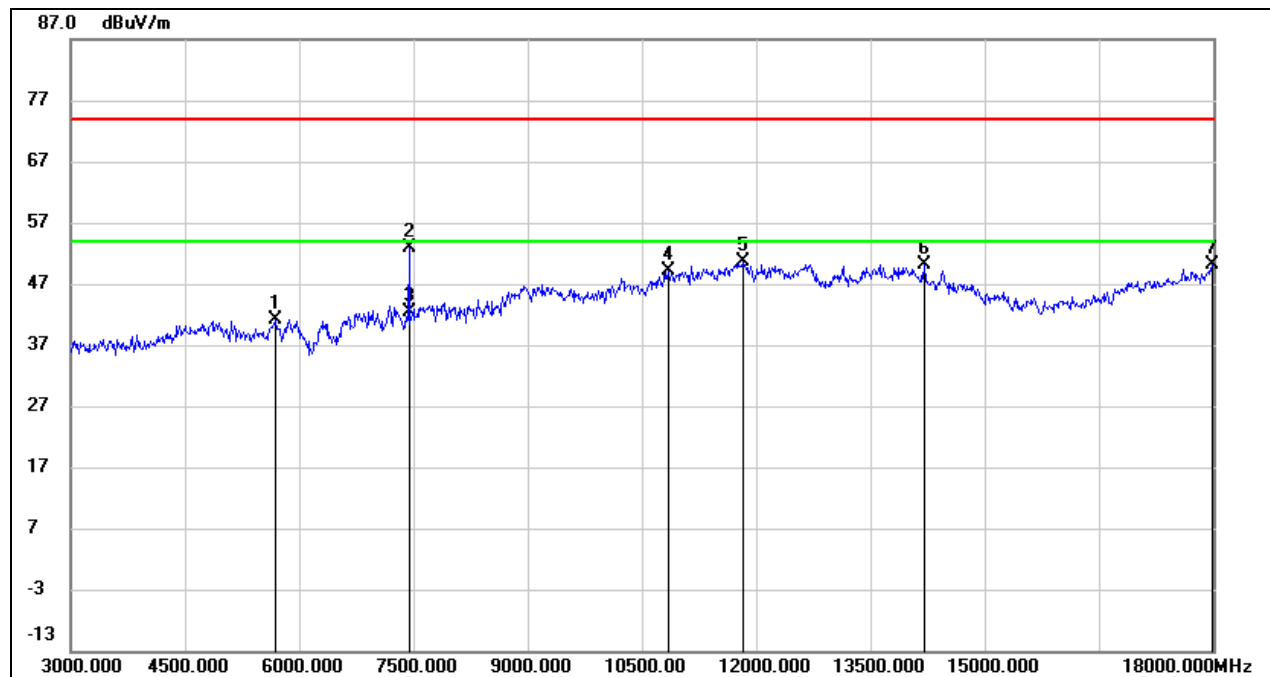
- Note: 1. Peak Result = Reading Level + Correct Factor.  
2. If Peak Result complies with AV limit, AV Result is deemed to comply with AV limit.  
3. Peak: Peak detector.  
4. AVG: VBW=1/Ton, where: Ton is the transmitting duration.  
5. For the transmitting duration, please refer to clause 7.1.  
6. 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.

### 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	7320.000	49.97	6.46	56.43	74.00	-17.57	peak
2	7320.000	38.83	6.46	45.29	54.00	-8.71	AVG
3	11295.000	34.76	15.85	50.61	74.00	-23.39	peak
4	12210.000	34.29	17.81	52.10	74.00	-21.90	peak
5	12210.000	23.44	17.81	41.25	54.00	-12.75	AVG
6	13665.000	28.77	21.25	50.02	74.00	-23.98	peak
7	17970.000	24.87	25.51	50.38	74.00	-23.62	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. AVG:  $VBW=1/T_{on}$ , where:  $T_{on}$  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.

**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	5685.000	39.64	1.37	41.01	74.00	-32.99	peak
2	7440.000	46.60	6.38	52.98	74.00	-21.02	peak
3	7440.000	36.12	6.38	42.50	54.00	-11.50	AVG
4	10845.000	34.86	14.21	49.07	74.00	-24.93	peak
5	11820.000	33.09	17.47	50.56	74.00	-23.44	peak
6	14205.000	28.96	21.11	50.07	74.00	-23.93	peak
7	17985.000	24.63	25.60	50.23	74.00	-23.77	peak

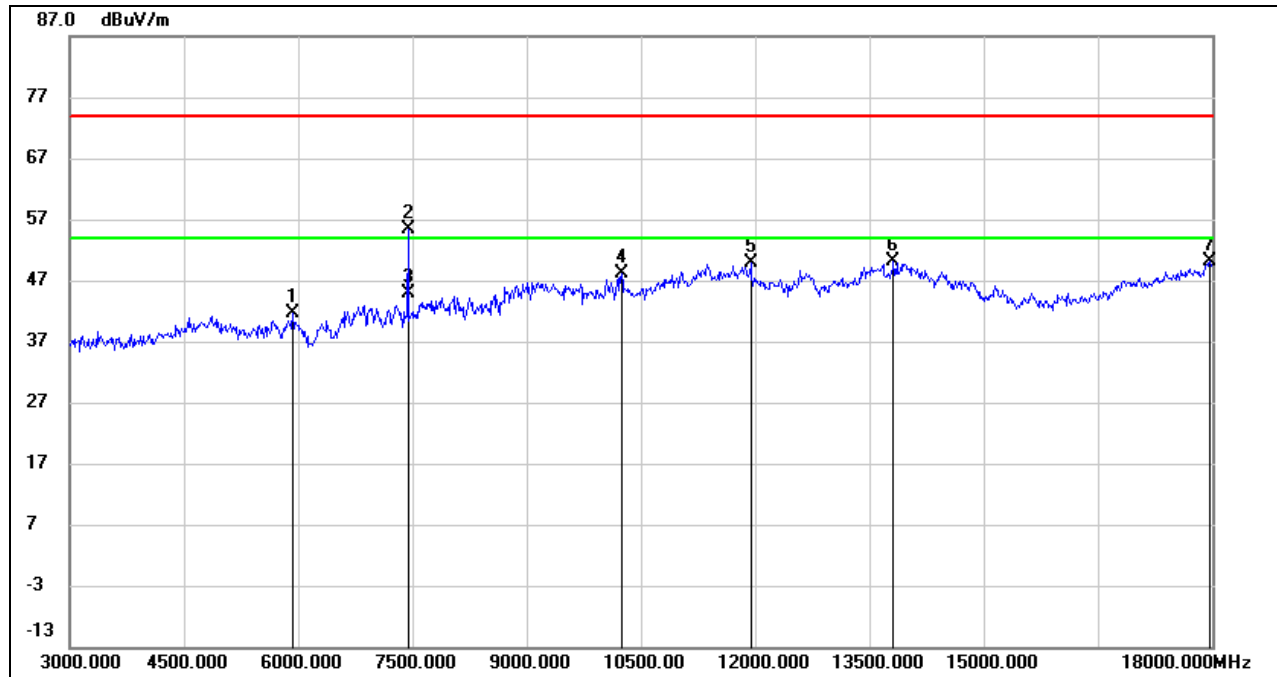
Note: 1. Peak Result = Reading Level + Correct Factor.

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.

**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	5925.000	39.50	2.04	41.54	74.00	-32.46	peak
2	7440.000	48.99	6.38	55.37	74.00	-18.63	peak
3	7440.000	38.38	6.38	44.76	54.00	-9.24	AVG
4	10245.000	35.68	12.48	48.16	74.00	-25.84	peak
5	11940.000	32.16	17.80	49.96	74.00	-24.04	peak
6	13815.000	28.66	21.56	50.22	74.00	-23.78	peak
7	17970.000	24.63	25.51	50.14	74.00	-23.86	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.

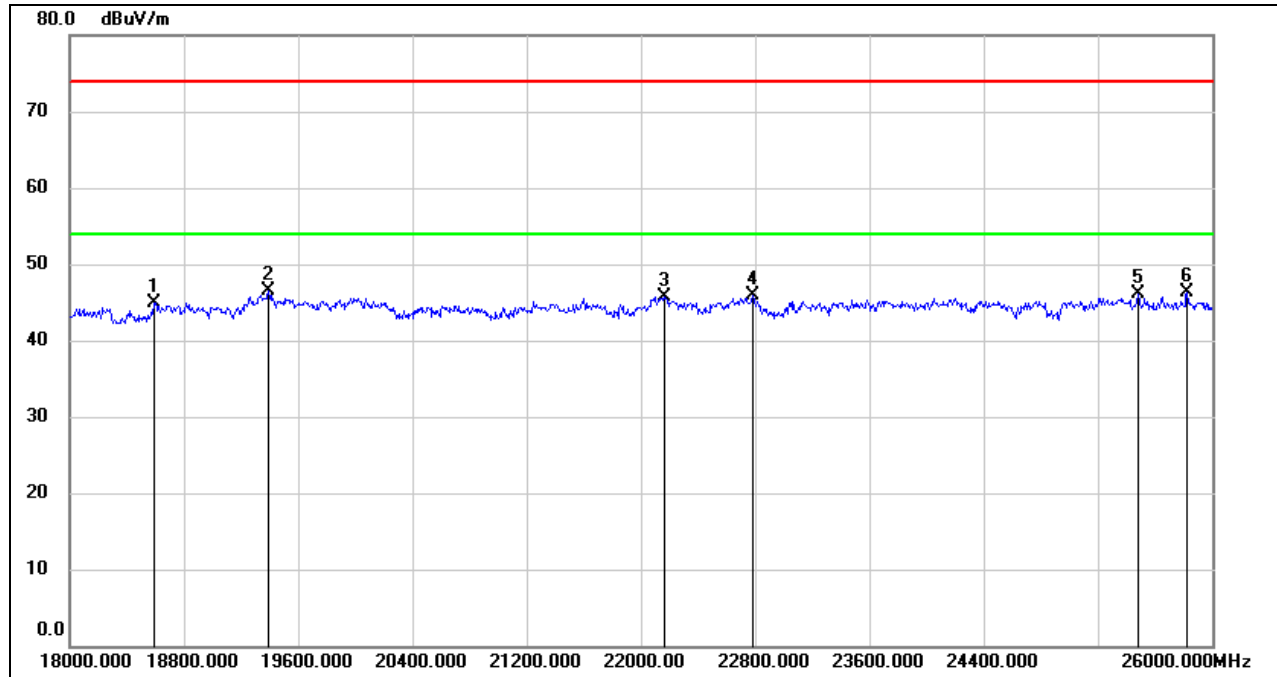
4. Filter losses were only considered in the spurious frequency bands and the authorized band was not corrected for High Pass Filter losses.

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

## 8.4. SPURIOUS EMISSIONS (18 GHz ~ 26 GHz)

### 8.4.1. GFSK-2Mbps MODE

#### SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)



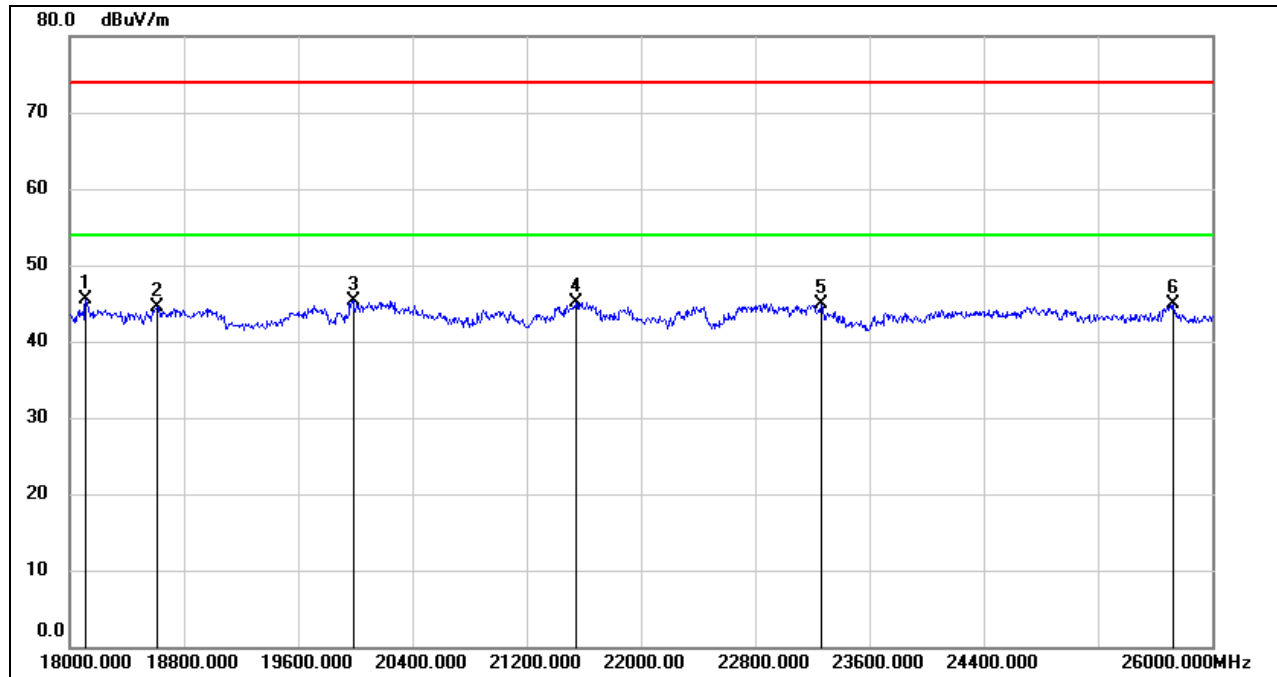
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	18592.000	50.25	-5.31	44.94	74.00	-29.06	peak
2	19392.000	52.12	-5.57	46.55	74.00	-27.45	peak
3	22160.000	50.08	-4.31	45.77	74.00	-28.23	peak
4	22784.000	49.48	-3.65	45.83	74.00	-28.17	peak
5	25480.000	47.82	-1.77	46.05	74.00	-27.95	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.

### SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	18112.000	50.96	-5.47	45.49	74.00	-28.51	peak
2	18616.000	49.89	-5.34	44.55	74.00	-29.45	peak
3	19984.000	50.71	-5.44	45.27	74.00	-28.73	peak
4	21544.000	49.76	-4.63	45.13	74.00	-28.87	peak
5	23264.000	48.26	-3.36	44.90	74.00	-29.10	peak
6	25728.000	45.61	-0.72	44.89	74.00	-29.11	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.

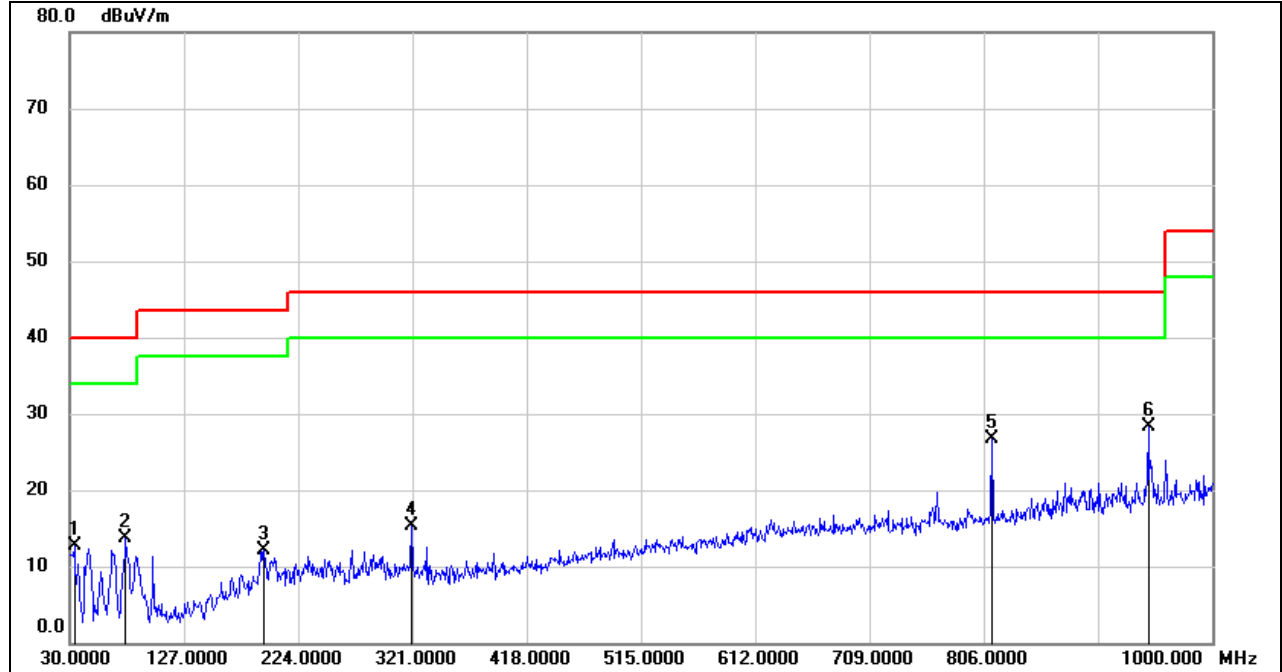
3. Peak: Peak detector.

Note: All the modes had been tested, but only the worst data was recorded in the report.

## 8.5. SPURIOUS EMISSIONS (30 MHz ~ 1 GHz)

### 8.5.1. GFSK-2Mbps MODE

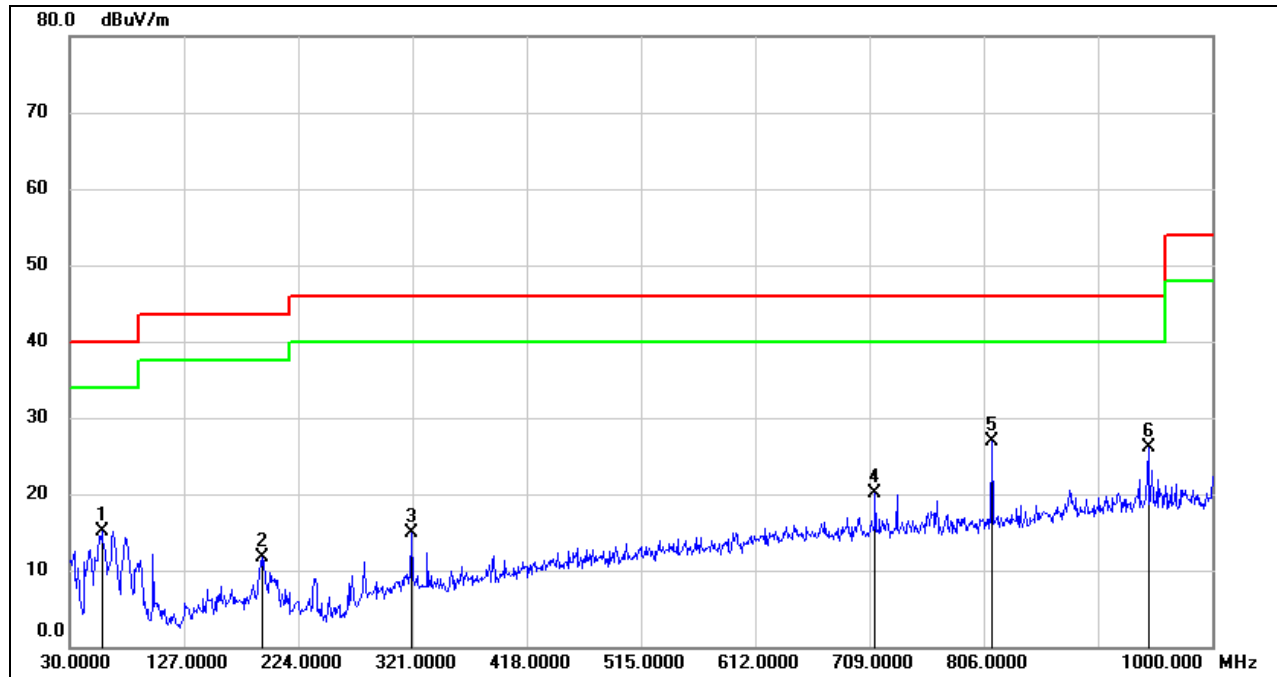
#### SPURIOUS EMISSIONS (MID CHANNEL, WORST-CASE CONFIGURATION, HORIZONTAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	33.8800	32.01	-19.22	12.79	40.00	-27.21	QP
2	77.5300	34.75	-21.14	13.61	40.00	-26.39	QP
3	194.9000	28.50	-16.31	12.19	43.50	-31.31	QP
4	320.0300	30.26	-14.86	15.40	46.00	-30.60	QP
5	812.7900	33.82	-7.18	26.64	46.00	-19.36	QP
6	945.6800	32.87	-4.60	28.27	46.00	-17.73	QP

Note: 1. Result Level = Read Level + Correct Factor.  
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 (MID CHANNEL, WORST-CASE CONFIGURATION, VERTICAL)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	57.1600	35.58	-20.53	15.05	40.00	-24.95	QP
2	192.9600	28.02	-16.36	11.66	43.50	-31.84	QP
3	320.0300	29.71	-14.86	14.85	46.00	-31.15	QP
4	713.8500	28.35	-8.29	20.06	46.00	-25.94	QP
5	812.7900	34.13	-7.18	26.95	46.00	-19.05	QP
6	945.6800	30.76	-4.60	26.16	46.00	-19.84	QP

Note: 1. Result Level = Read Level + Correct Factor.

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 modes had been tested, but only the worst data was recorded in the report.

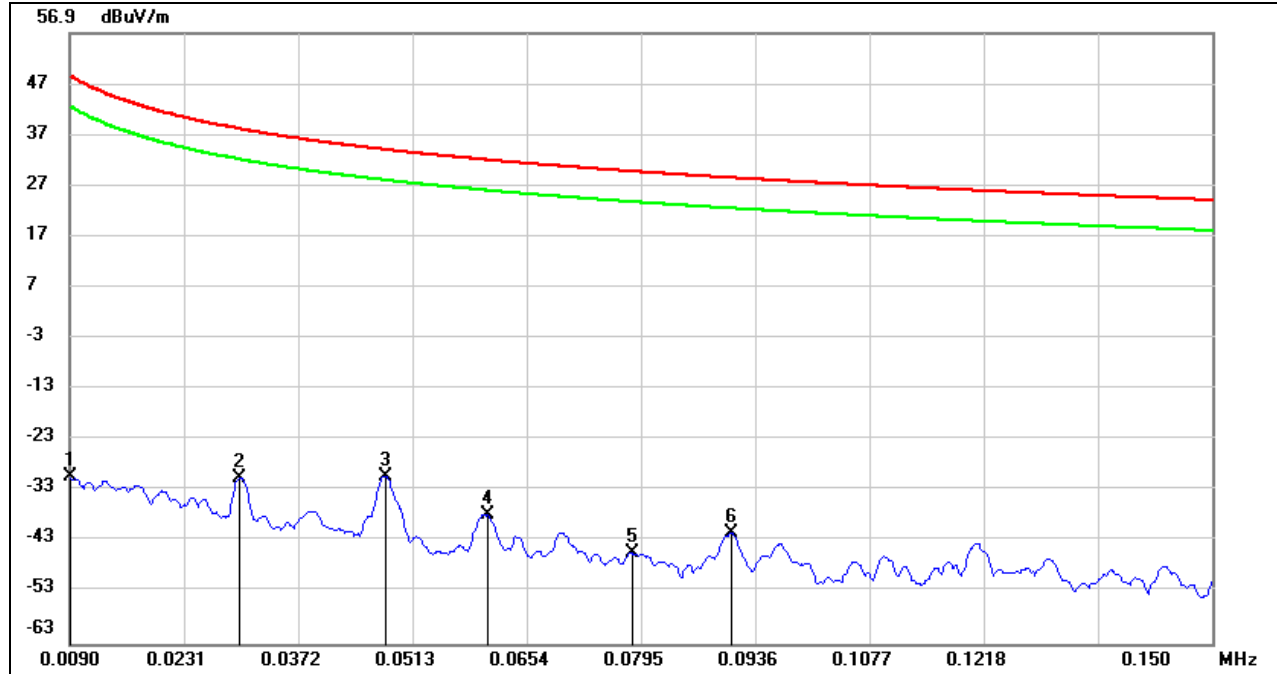


## 8.6. SPURIOUS EMISSIONS BELOW 30 MHz

### 8.6.1. GFSK-2Mbps MODE

#### SPURIOUS EMISSIONS (MID CHANNEL, LOOP ANTENNA FACE ON TO THE EUT, WORST-CASE CONFIGURATION)

9 kHz ~ 150 kHz

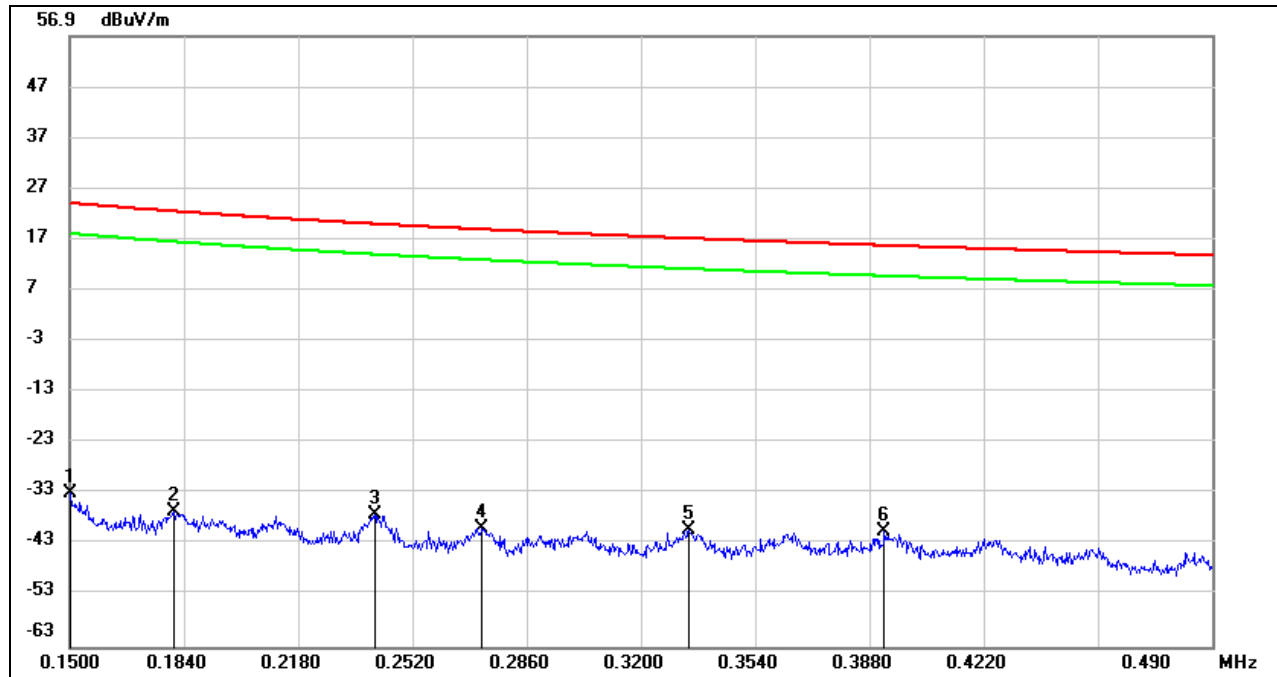


No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	FCC Result (dBuV/m)	FCC Limit (dBuV/m)	ISED Result (dBuA/m)	ISED Limit (dBuA/m)	Margin (dB)	Remark
1	0.0090	70.85	-101.16	-30.31	48.36	-81.81	-3.14	-78.67	QP
2	0.0300	70.63	-101.11	-30.48	38.06	-81.98	-13.44	-68.54	QP
3	0.0478	71.15	-101.35	-30.20	34.01	-81.7	-17.49	-64.21	QP
4	0.0606	63.54	-101.17	-37.63	31.95	-89.13	-19.55	-69.58	QP
5	0.0785	55.81	-100.94	-45.13	29.70	-96.63	-21.8	-74.83	QP
6	0.0904	59.77	-101.13	-41.36	28.48	-92.86	-23.02	-69.84	QP

Note: 1. Measurement = Reading Level + Correct Factor (dBuA/m= dBuV/m- 20Log10[120π] = dBuV/m- 51.5).

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.

150 kHz ~ 490 kHz

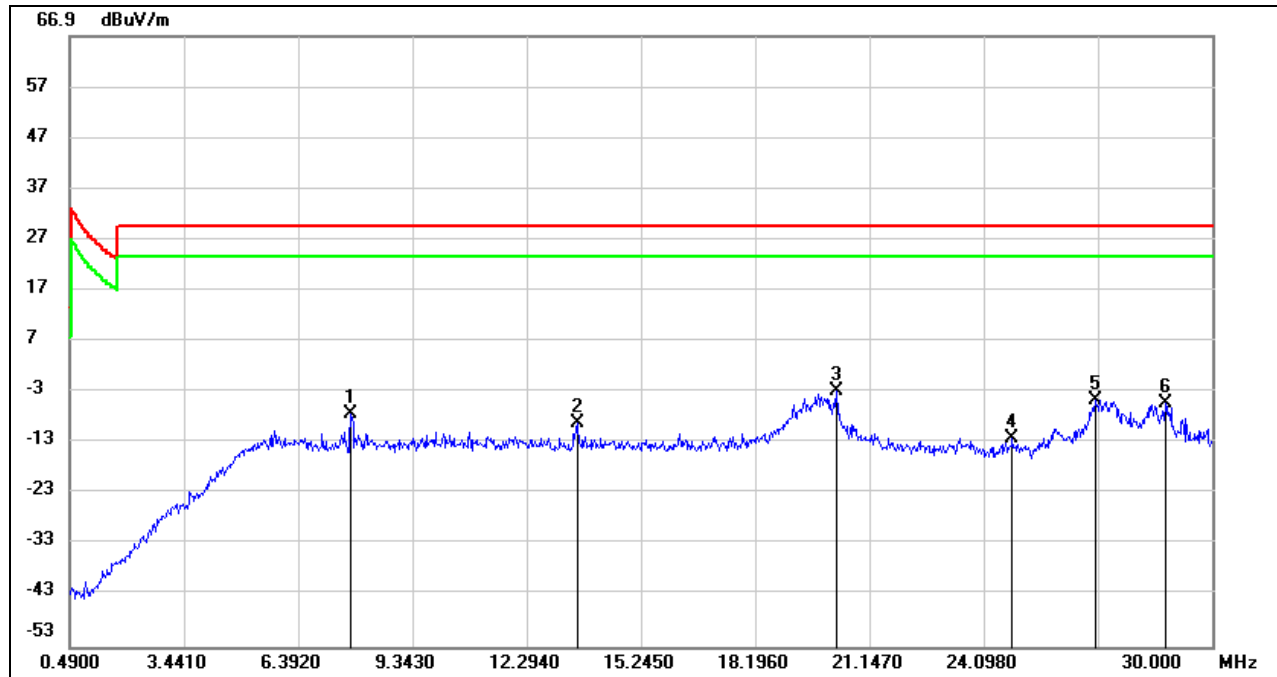
No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	FCC Result (dBuV/m)	FCC Limit (dBuV/m)	ISED Result (dBuA/m)	ISED Limit (dBuA/m)	Margin (dB)	Remark
1	0.1502	69.01	-101.89	-32.88	24.07	-84.38	-27.43	-56.95	QP
2	0.1809	65.33	-101.86	-36.53	22.46	-88.03	-29.04	-58.99	QP
3	0.2406	64.62	-101.80	-37.18	19.98	-88.68	-31.52	-57.16	QP
4	0.2726	61.96	-101.78	-39.82	18.89	-91.32	-32.61	-58.71	QP
5	0.3341	61.68	-101.77	-40.09	17.12	-91.59	-34.38	-57.21	QP
6	0.3924	61.26	-101.74	-40.48	15.73	-91.98	-35.77	-56.21	QP

Note: 1. Measurement = Reading Level + Correct Factor (dBuA/m= dBuV/m- 20Log10[120π] = dBuV/m- 51.5).

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.

490 kHz ~ 30 MHz



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB/m)	FCC Result (dBuV/m)	FCC Limit (dBuV/m)	ISED Result (dBuA/m)	ISED Limit (dBuA/m)	Margin (dB)	Remark
1	7.7493	54.09	-61.53	-7.44	29.54	-58.94	-21.96	-36.98	QP
2	13.5923	52.18	-61.41	-9.23	29.54	-60.73	-21.96	-38.77	QP
3	20.2911	58.24	-61.08	-2.84	29.54	-54.34	-21.96	-32.38	QP
4	24.8356	48.68	-60.97	-12.29	29.54	-63.79	-21.96	-41.83	QP
5	26.9900	56.15	-60.84	-4.69	29.54	-56.19	-21.96	-34.23	QP
6	28.7900	55.36	-60.73	-5.37	29.54	-56.87	-21.96	-34.91	QP

Note: 1. Measurement = Reading Level + Correct Factor (dBuA/m= dBuV/m- 20Log10[120π] = dBuV/m- 51.5).

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 the modes had been tested, but only the worst data was recorded in the report.

## 9. AC POWER LINE CONDUCTED EMISSIONS

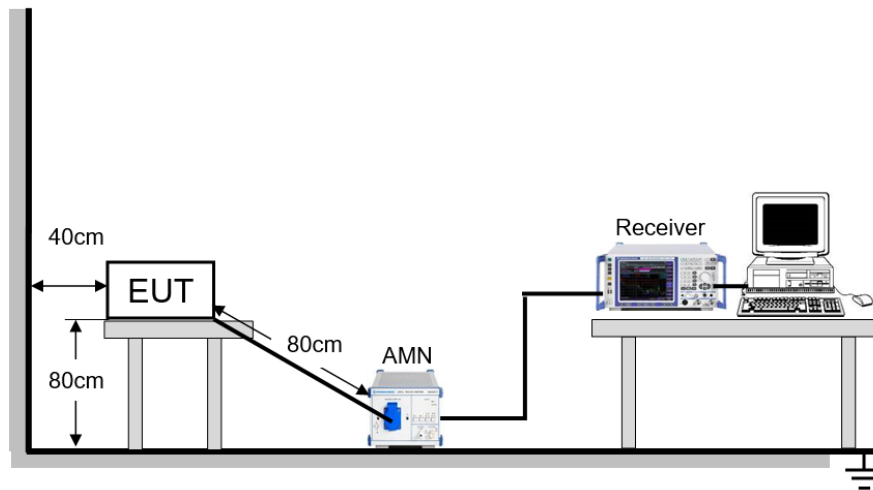
### LIMITS

Please refer to CFR 47 FCC §15.207 (a).

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

Refer to ANSI C63.10-2013 clause 6.2.

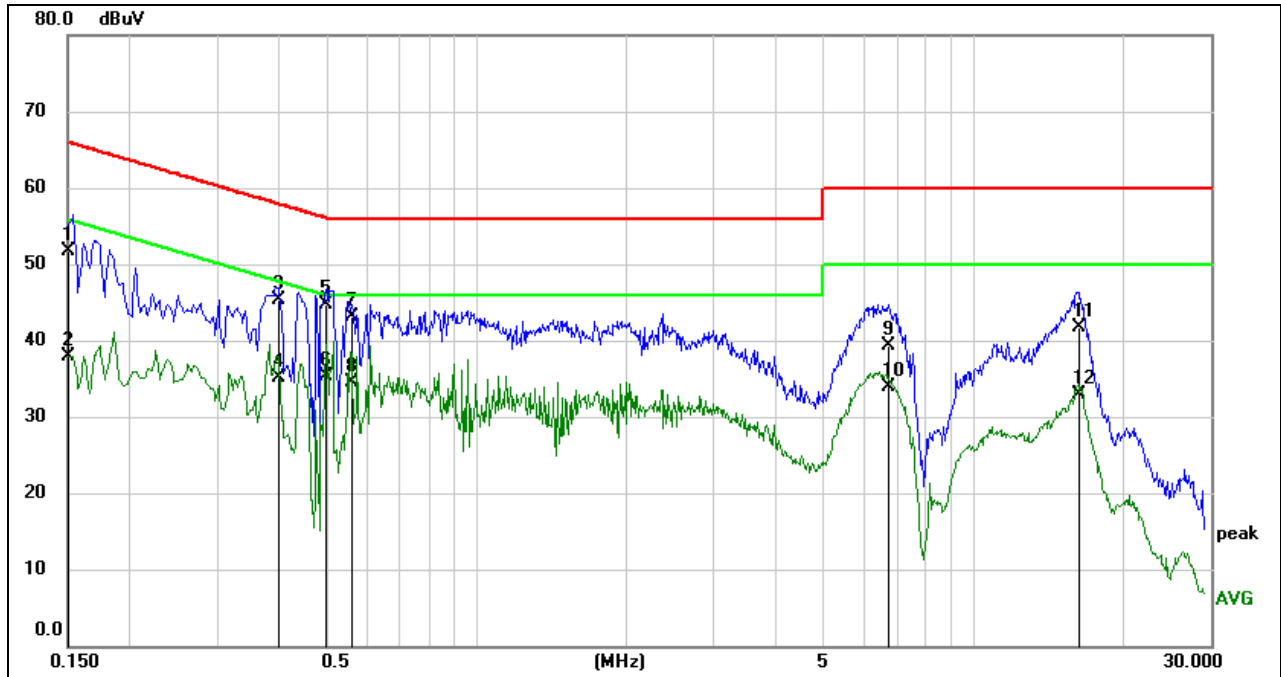


The EUT is put on a table of non-conducting material that is 80 cm high. The vertical conducting wall of shielding is located 40 cm to the rear of the EUT. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.). A EMI Measurement Receiver (R&S Test Receiver 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 30 MHz using CISPR Quasi-Peak and average detector mode. The bandwidth of EMI test receiver is set at 9 kHz.

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	23.5 °C	Relative Humidity	61.2 %
Atmosphere Pressure	101 kPa	Test Voltage	AC 120 V/60 Hz

**RESULTS****9.1.1. GFSK-2Mbps MODE****LINE L RESULTS (MID CHANNEL, WORST-CASE CONFIGURATION)**

No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1502	42.22	9.49	51.71	65.99	-14.28	QP
2	0.1502	28.50	9.49	37.99	55.99	-18.00	AVG
3	0.3993	35.70	9.52	45.22	57.87	-12.65	QP
4	0.3993	25.53	9.52	35.05	47.87	-12.82	AVG
5	0.4969	35.16	9.50	44.66	56.05	-11.39	QP
6	0.4969	25.80	9.50	35.30	46.05	-10.75	AVG
7	0.5596	33.63	9.50	43.13	56.00	-12.87	QP
8	0.5596	24.99	9.50	34.49	46.00	-11.51	AVG
9	6.7146	29.75	9.63	39.38	60.00	-20.62	QP
10	6.7146	24.35	9.63	33.98	50.00	-16.02	AVG
11	16.1884	32.08	9.65	41.73	60.00	-18.27	QP
12	16.1884	23.22	9.65	32.87	50.00	-17.13	AVG

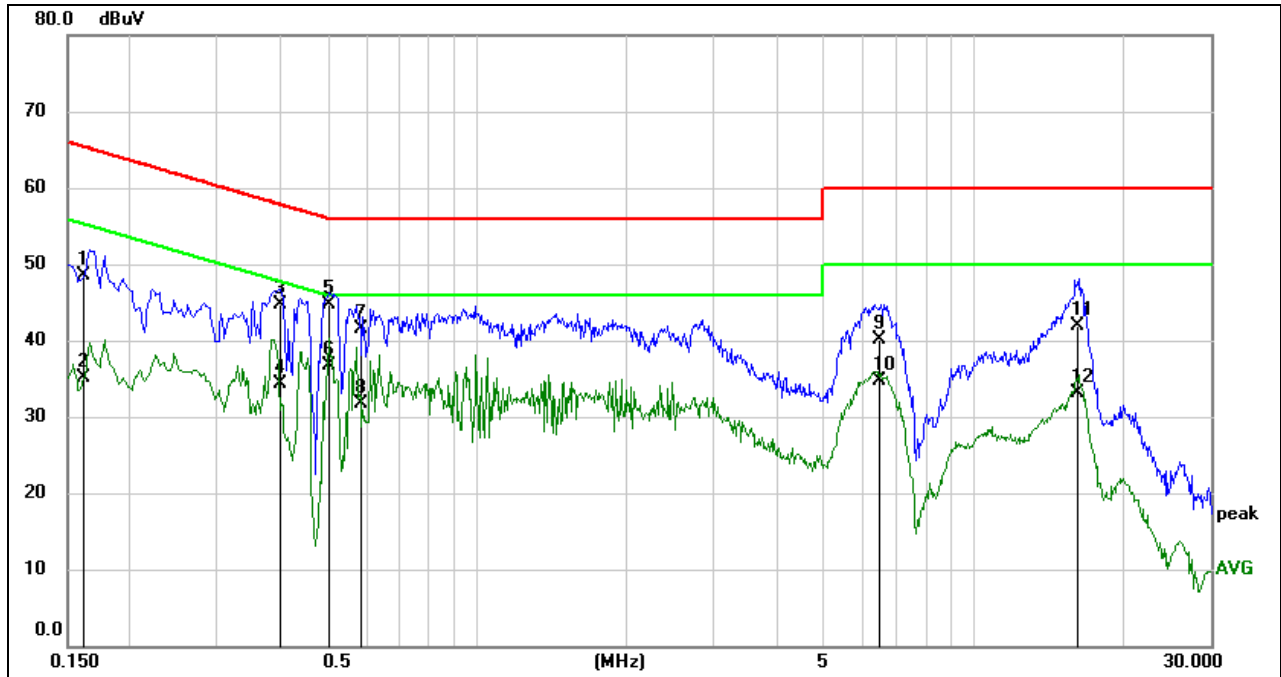
Note: 1. Result = Reading +Correct Factor.

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: 80 Hz (0.009 MHz ~ 0.15 MHz), 4 kHz (0.15 MHz ~ 30 MHz), Scan time: auto.

### LINE N RESULTS (MID CHANNEL, WORST-CASE CONFIGURATION)



No.	Frequency (MHz)	Reading (dBuV)	Correct (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1618	39.03	9.51	48.54	65.37	-16.83	QP
2	0.1618	25.51	9.51	35.02	55.37	-20.35	AVG
3	0.4052	35.24	9.53	44.77	57.75	-12.98	QP
4	0.4052	24.77	9.53	34.30	47.75	-13.45	AVG
5	0.5089	35.11	9.50	44.61	56.00	-11.39	QP
6	0.5089	27.15	9.50	36.65	46.00	-9.35	AVG
7	0.5829	32.10	9.50	41.60	56.00	-14.40	QP
8	0.5829	22.27	9.50	31.77	46.00	-14.23	AVG
9	6.4574	30.51	9.64	40.15	60.00	-19.85	QP
10	6.4574	25.06	9.64	34.70	50.00	-15.30	AVG
11	16.2989	32.35	9.65	42.00	60.00	-18.00	QP
12	16.2989	23.36	9.65	33.01	50.00	-16.99	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: 80 Hz (0.009 MHz ~ 0.15 MHz), 4 kHz (0.15 MHz ~ 30 MHz), Scan time: auto.

Note: All the modes had been tested, but only the worst data was recorded 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



## 11. Appendix

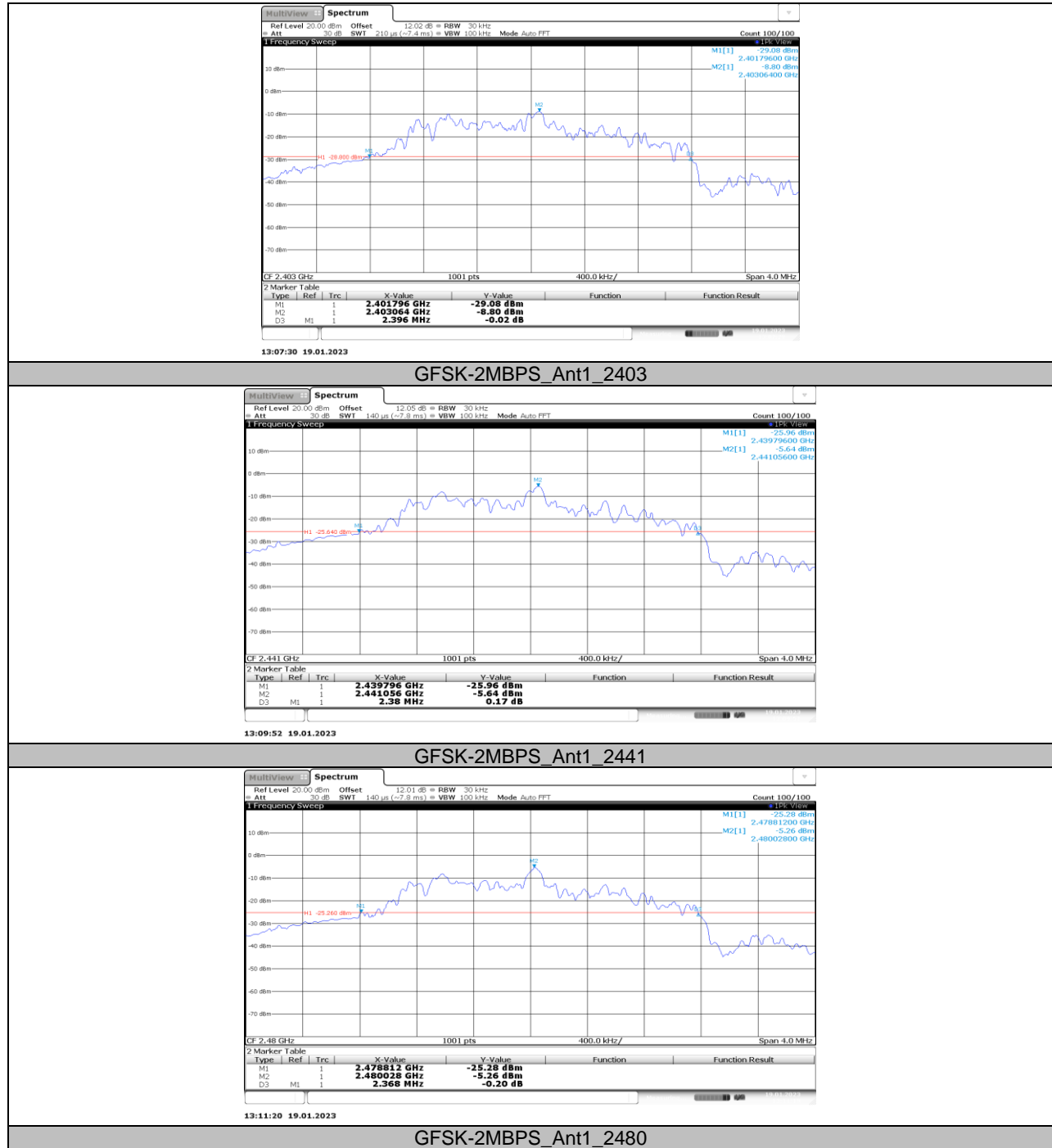
### 11.1. Appendix A: 20dB Emission Bandwidth

#### 11.1.1. Test Result

Test Mode	Antenna	Channel	20db EBW[MHz]	FL[MHz]	FH[MHz]	Verdict
GFSK-2Mbps	Ant1	2403	2.40	2401.80	2404.19	PASS
		2441	2.38	2439.80	2442.18	PASS
		2480	2.37	2478.81	2481.18	PASS



## 11.1.2. Test Graphs





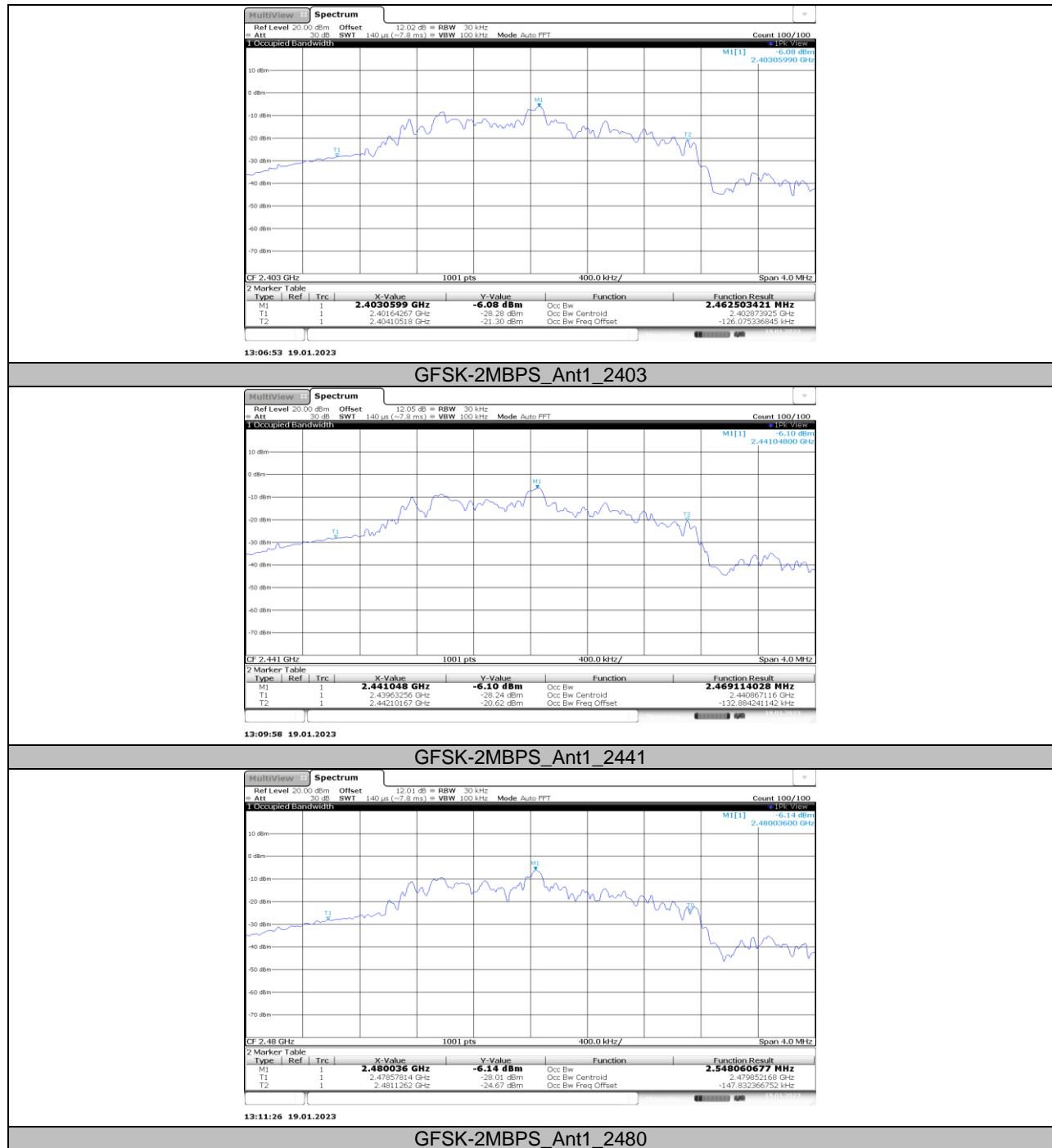
## 11.2. Appendix B: Occupied Channel Bandwidth

### 11.2.1. Test Result

Test Mode	Antenna	Channel	OCB [MHz]	FL[MHz]	FH[MHz]	Verdict
GFSK-2Mbps	Ant1	2403	2.463	2401.6427	2404.1052	PASS
		2441	2.469	2439.6326	2442.1017	PASS
		2480	2.548	2478.5781	2481.1262	PASS



## 11.2.2. Test Graphs





### 11.3. Appendix C: Maximum conducted output power

#### 11.3.1. Test Result

Test Mode	Antenna	Channel	Result[dBm]	Limit[dBm]	Verdict
GFSK-2Mbps	Ant1	2403	-1.03	≤20.97	PASS
		2441	-0.92	≤20.97	PASS
		2480	-1.47	≤20.97	PASS

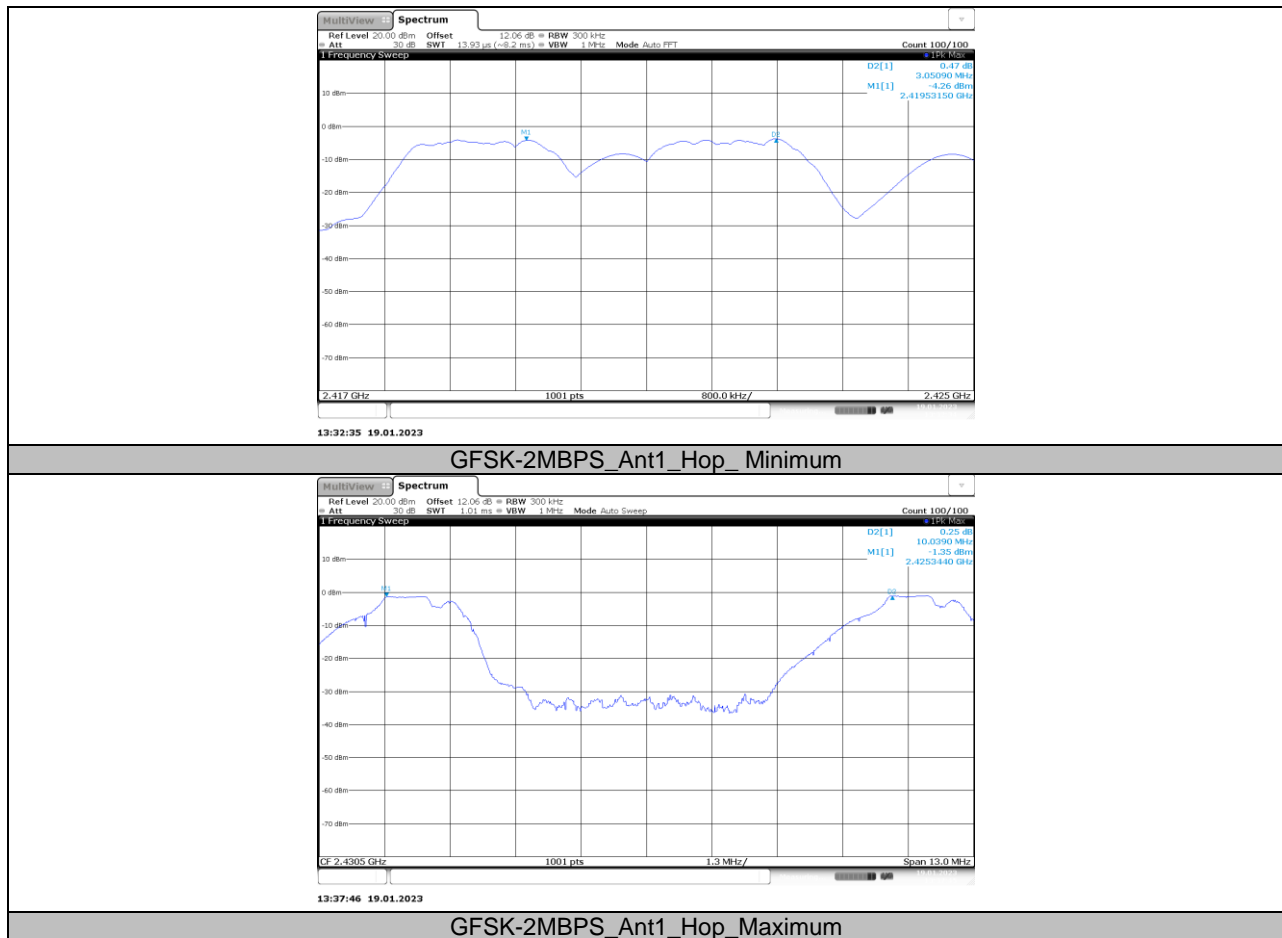


## 11.4. Appendix D: Carrier frequency separation

### 11.4.1. Test Result

Test Mode	Antenna	Channel	Result[MHz]	Limit[MHz]	Verdict	Remarks
GFSK-2Mbps	Ant1	Hop	3.051	$\geq 0.687$	PASS	Minimum
GFSK-2Mbps	Ant1	Hop	10.039	$\geq 0.687$	PASS	Maximum

## 11.4.2. Test Graphs



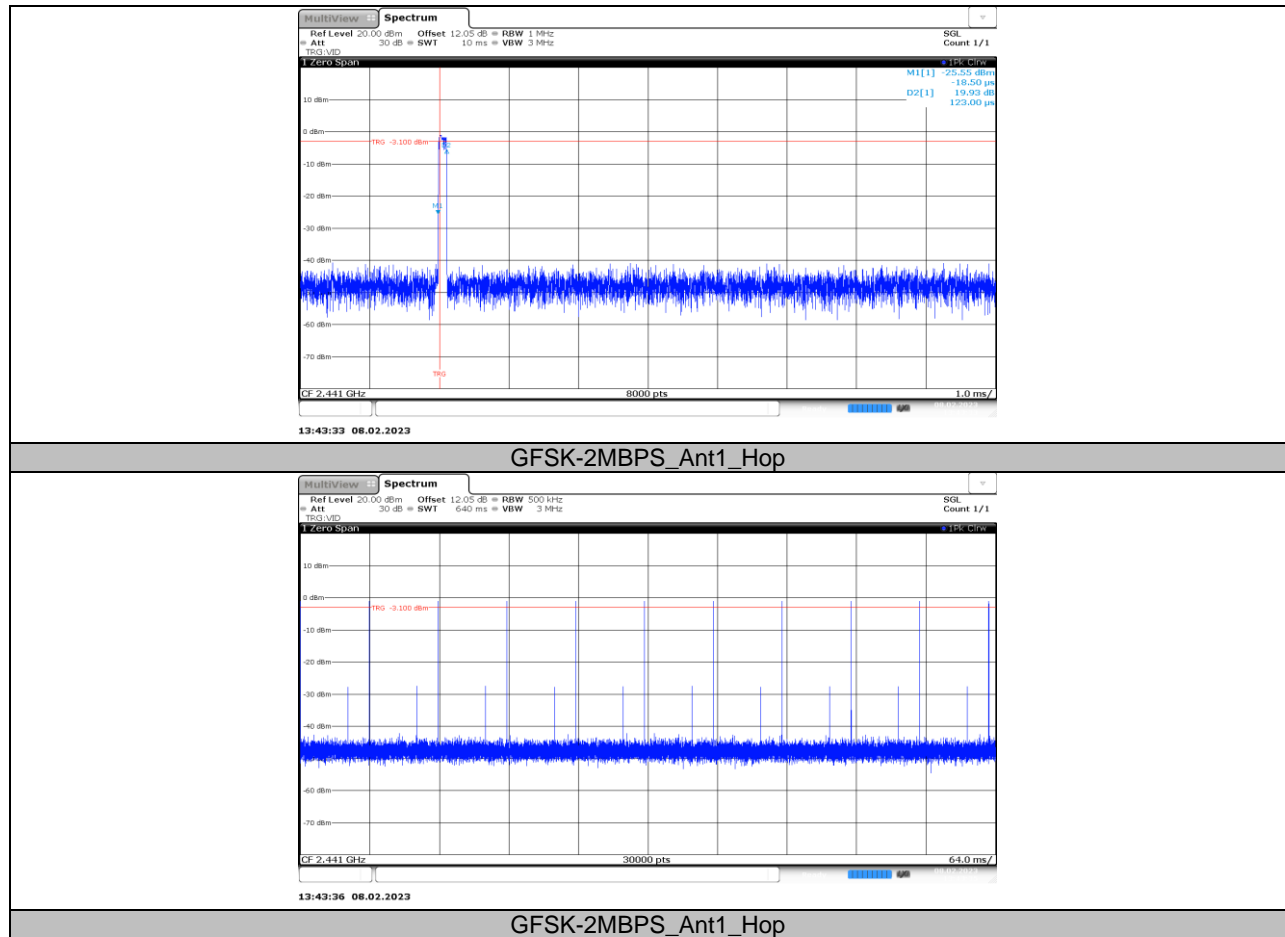


## 11.5. Appendix E: Time of occupancy

### 11.5.1. Test Result

Test Mode	Antenna	Channel	BurstWidth [ms]	Result[s]	Limit[s]	Verdict
GFSK-2Mbps	Ant1	Hop	0.123	0.012	≤0.4	PASS

## 11.5.2. Test Graphs





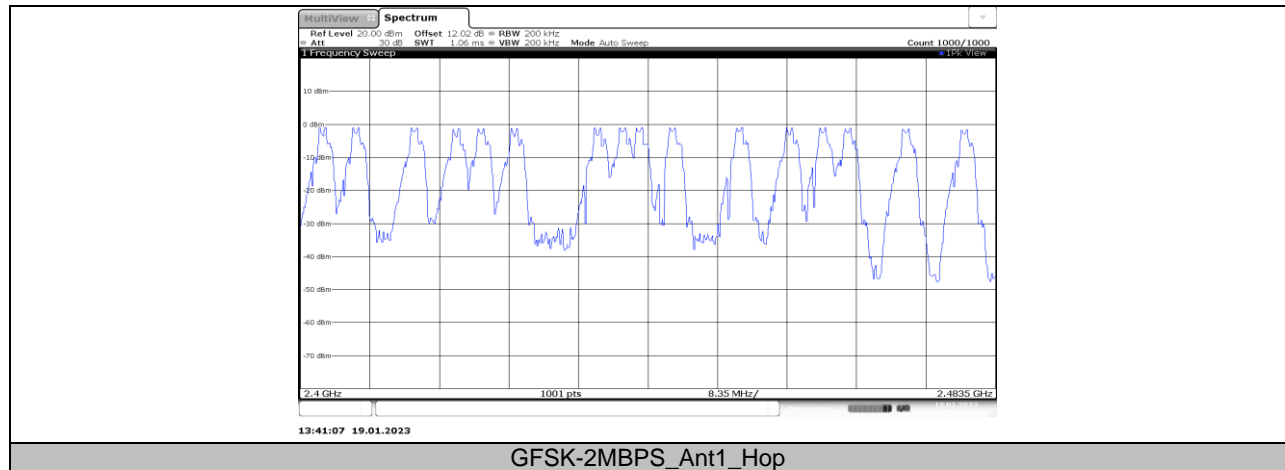
## 11.6. Appendix F: Number of hopping channels

### 11.6.1. Test Result

Test Mode	Antenna	Channel	Result[Num]	Limit[Num]	Verdict
GFSK-2Mbps	Ant1	Hop	16	$\geq 15$	PASS

Note: the total hops are obtained by counting the number of each entire TX period.

## 11.6.2. Test Graphs



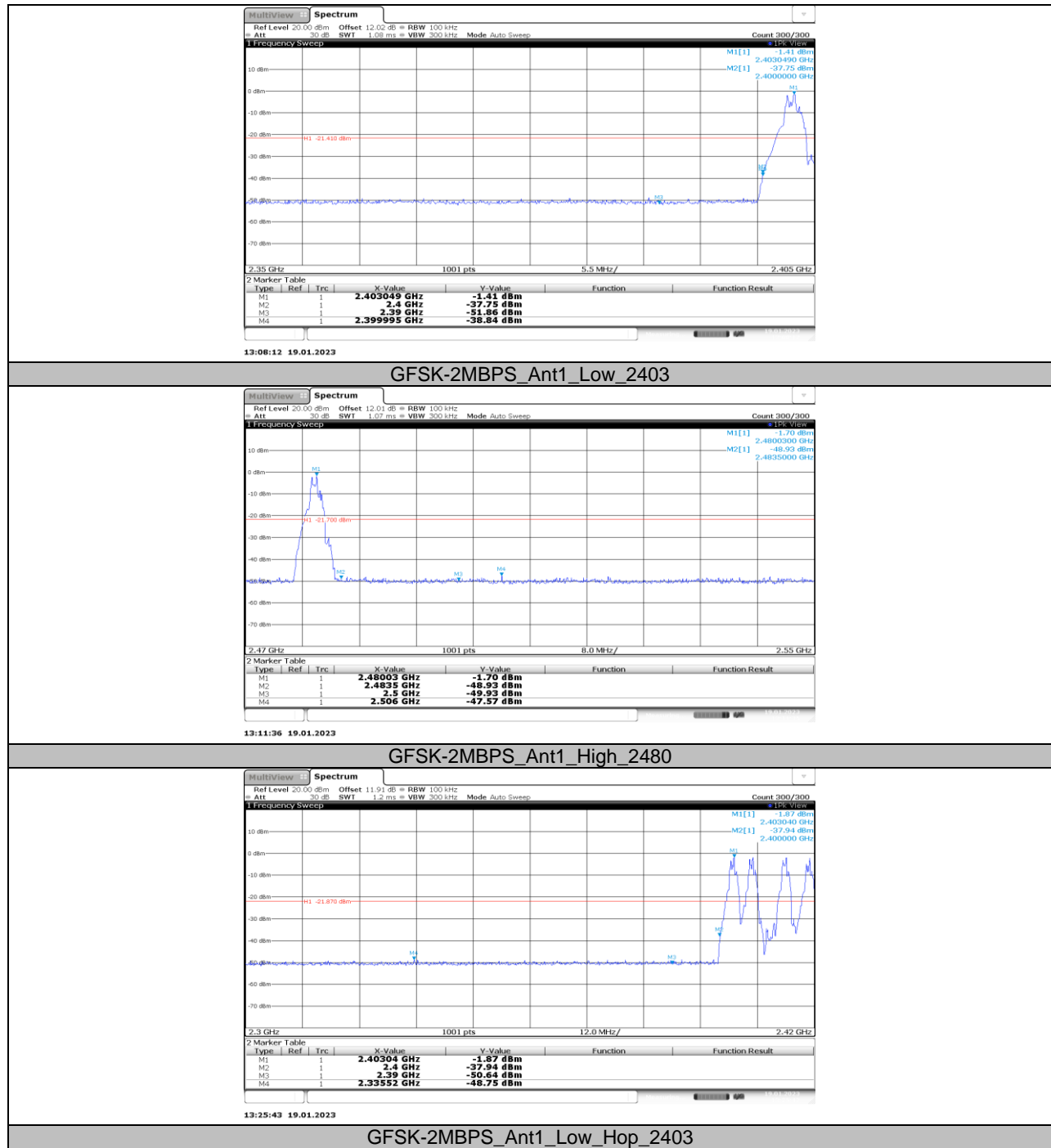


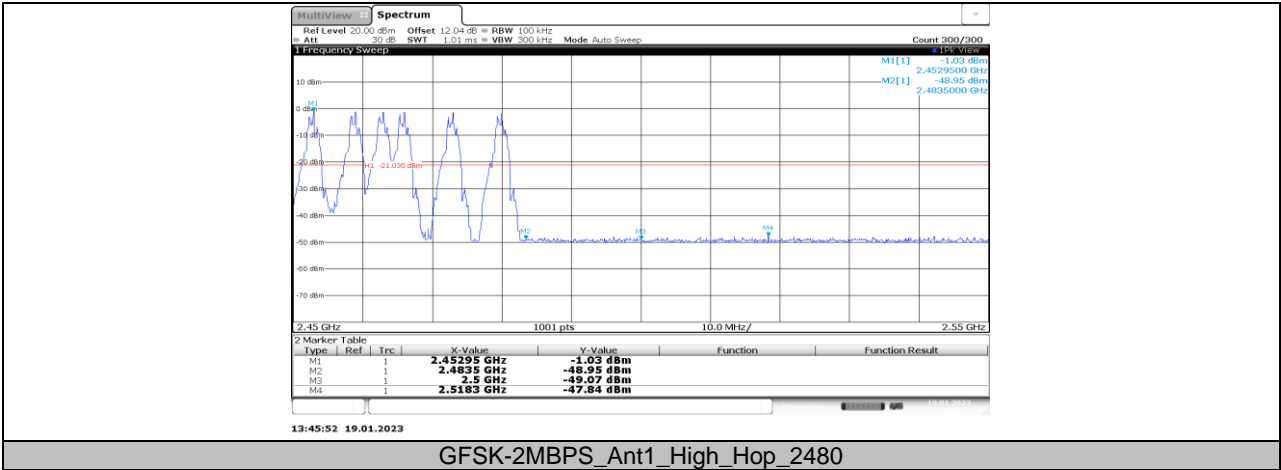
## 11.7. Appendix G: Band edge measurements

### 11.7.1. Test Result

Test Mode	Antenna	ChName	Channel	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
GFSK- 2Mbps	Ant1	Low	2403	-1.41	-38.84	$\leq -21.41$	PASS
		High	2480	-1.70	-47.57	$\leq -21.7$	PASS
		Low	Hop_2403	-1.87	-48.75	$\leq -21.87$	PASS
		High	Hop_2480	-1.03	-47.84	$\leq -21.03$	PASS

## 11.7.2. Test Graphs



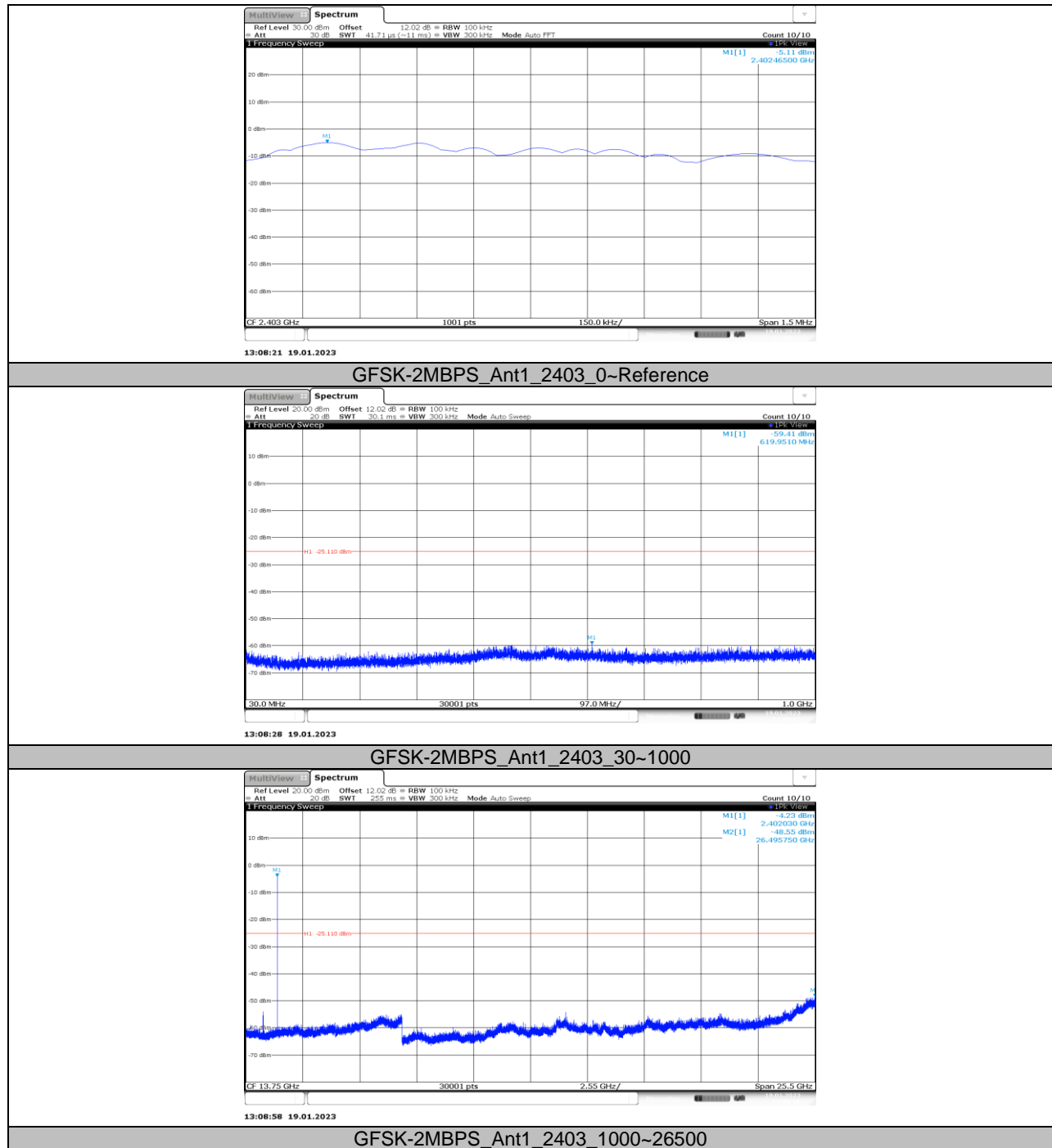


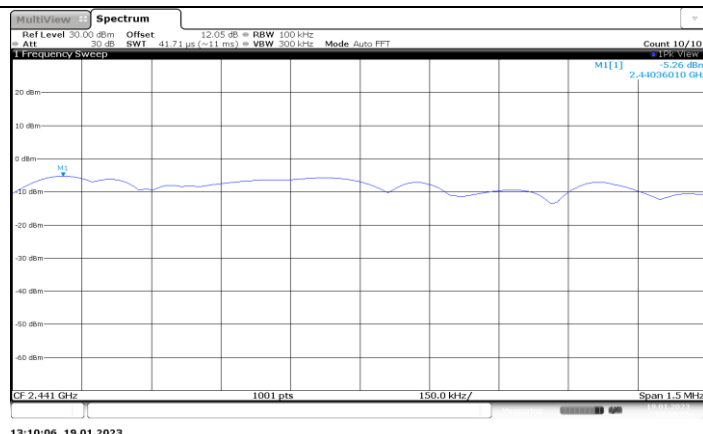
## 11.8. Appendix H: Conducted Spurious Emission

### 11.8.1. Test Result

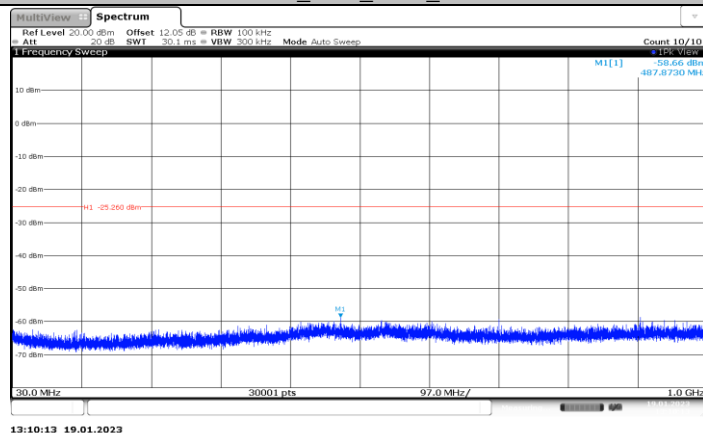
Test Mode	Antenna	Channel	FreqRange [MHz]	Result [dBm]	Limit [dBm]	Verdict
GFSK-2Mbps	Ant1	2403	Reference	-5.11	---	PASS
			30~1000	-59.41	$\leq -25.11$	PASS
			1000~26500	-48.55	$\leq -25.11$	PASS
		2441	Reference	-5.26	---	PASS
			30~1000	-58.66	$\leq -25.26$	PASS
			1000~26500	-49.17	$\leq -25.26$	PASS
		2480	Reference	-4.40	---	PASS
			30~1000	-59.5	$\leq -24.4$	PASS
			1000~26500	-47.9	$\leq -24.4$	PASS

## 11.8.2. Test Graphs

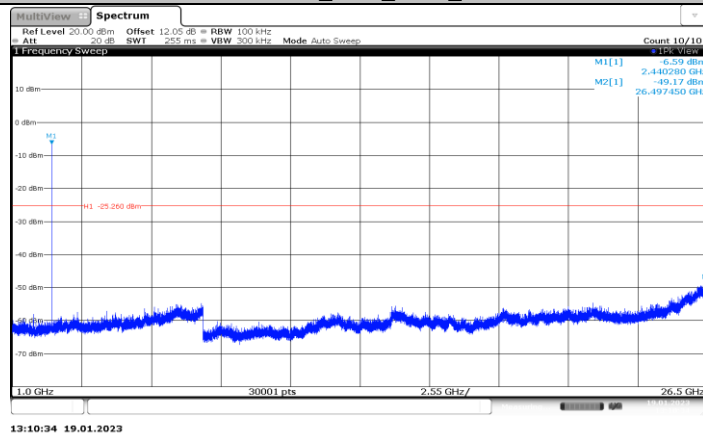




GFSK-2MBPS\_Ant1\_2441\_0~Reference

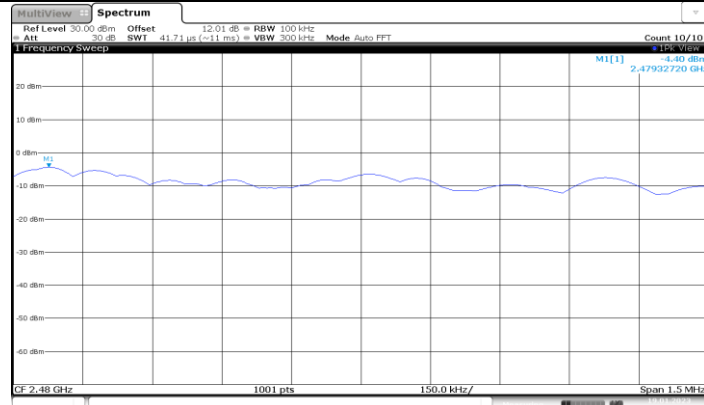


GFSK-2MBPS\_Ant1\_2441\_30~1000



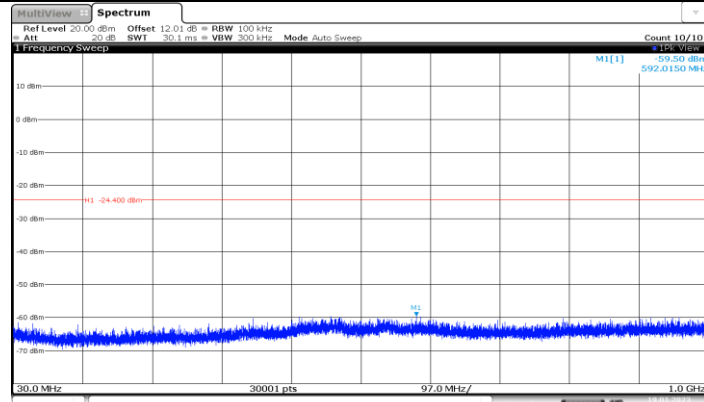
GFSK-2MBPS\_Ant1\_2441\_1000~26500





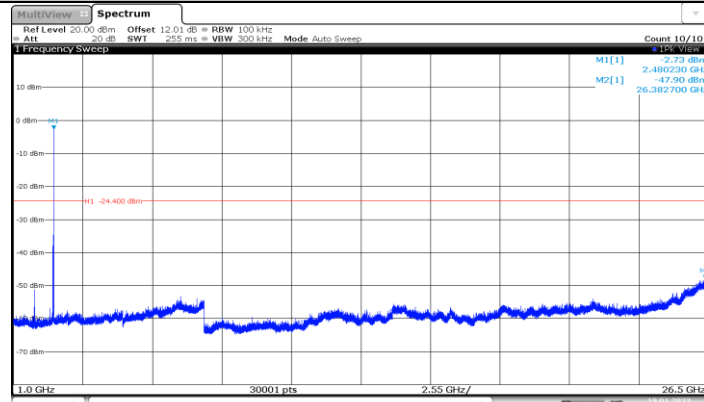
13:16:13 19.01.2023

GFSK-2MBPS\_Ant1\_2480\_0~Reference



13:16:19 19.01.2023

GFSK-2MBPS\_Ant1\_2480\_30~1000



13:20:40 19.01.2023

GFSK-2MBPS\_Ant1\_2480\_1000~26500

**11.9. Appendix I: Duty Cycle****11.9.1. Test Result**

Test 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-2Mbps	0.12	3.96	0.0303	3.03	15.19	8.33	9

Note:

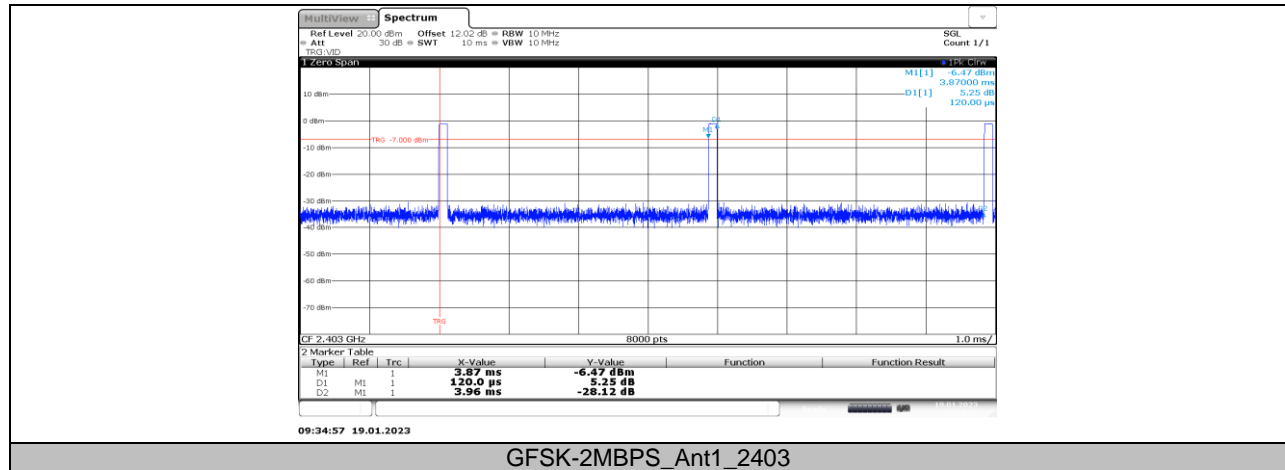
Duty Cycle Correction Factor= $10\log(1/x)$ .

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.

## 11.9.2. Test Graphs



END OF REPORT