



FCC CFR47 Part 15 Subpart C Certification Test Report

For the

Product : 2.4GHz LoRa Modem
Model : PLS100WF
FCC ID : 2AUV6-PLS100WF
Applicant : PLNetworks, Inc.
FCC Rule : CFR 47 Part 15 Subpart C

We hereby certify that the above product has been tested by us with the listed rules and found in compliance with the regulation. The test data and results are issued on the test report no. **TR-W1910-007**

Signature

A handwritten signature in black ink, appearing to be 'Choi Yeong-min', written over a horizontal line.

Choi, Yeong-min / Technical Manager

Date: 2019-10-31

Test Laboratory: ENG Co., Ltd.

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W1910-007	2019-10-31	Initial Release
-	-	-

1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation (Hereafter referred to as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	Description	Result			
		P	F	N.T.	Note
15.247(a)(2)	6 dB Bandwidth Occupied Bandwidth	P			
15.247(b)(3)	Maximum peak output power	P			
15.247(d)	Band Edge Conducted spurious emission	P			
15.247(e)	Power spectral density	P			
15.205(a) 15.209(a)	Radiated spurious emissions	P			
15.207(a)	AC power line conducted emissions			N.T.	Note 1

Remark:

P means Passed

F means Failed

N.T. means Not Tested

Note1. The EUT is operated by battery only. (used Lithium Primary Battery)

1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013.

KDB 558074 D01DTS Meas. Guidance v05r02: Measurement Procedure PK is used for power measurement.

1.3 Additions, deviations, exclusions from standards








No additions, deviations or exclusions have been made from standard.

1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart C Section 15.247.

1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Our test facilities are accredited as a Conformity Assessment Body (CAB) by the FCC and ISED Canada, designated by the RRA (National Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland, TUV SÜD and Korean Register of Shipping according to the requirement of ISO/IEC 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED Canada	12721A	
RRA	KR0160	
TUV Rheinland	UA 50314109-0002	
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The PLNetworks, Inc., Model PLS100WF (referred to as the EUT in this report) is a 2.4GHz LoRa Modem. The EUT is a device for transferring GFSK signal to a Wireless Device through wireless communication. The product specification described herein was obtained from product data sheet or user's manual.

Operating Frequency	2 412 ~ 2 472 MHz
Kind of Class	DTS – Digital Transmission System
Max. RF Output Power	6.01 dBm
Modulation Types	GFSK
Number of Channels	31 CH
Channel Bandwidth	2 MHz
Generated or used Freq. in EUT	32.768 kHz, 32 MHz, 52 MHz
Type of Antenna	<input checked="" type="checkbox"/> Integrated Type <input type="checkbox"/> Dedicated Type
Antenna Gain	3.49 dBi
Operating Temperature	- 30 °C ~ + 70 °C
Normal Test Voltage	DC 3.6 V
Electrical Rating	DC 3.6 V
Test SW Version	Tera Term Version 4.91
RF power setting in TEST SW	13
Software Version	V1.0
Hardware Version	V1.0

2.2 Additional Model

None

2.3 Available channel number and frequency

Operating Mode: GFSK, 2 MHz Channel Spacing					
Channel	Frequency(MHz)	Channel	Frequency(MHz)	Channel	Frequency(MHz)
0	2 412	14	2 440	28	2 468
1	2 414	15	2 442	29	2 470
2	2 416	16	2 444	30	2 472
3	2 418	17	2 446		
4	2 420	18	2 448		
5	2 422	19	2 450		
6	2 424	20	2 452		
7	2 426	21	2 454		
8	2 428	22	2 456		
9	2 430	23	2 458		
10	2 432	24	2 460		
11	2 434	25	2 462		
12	2 436	26	2 464		
13	2 438	27	2 466		

3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
2.4GHz LoRa Modem (EUT)	PLS100WF	N/A	PLNetworks, Inc.
Notebook PC	E5470	ZU10190-15008	DELL
Adapter for Notebook PC	LA65NM130	N/A	DELL

3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is GFSK.

3.3 Preliminary Testing for Worst case configuration

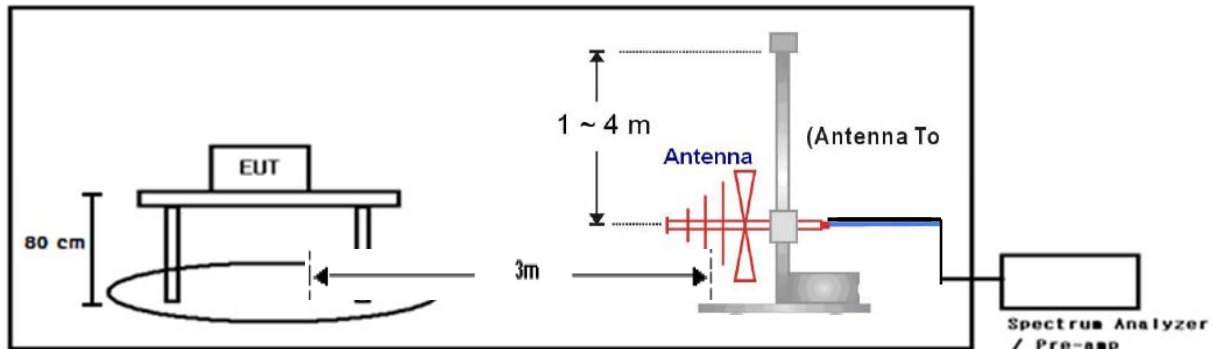
For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And the worst Y-axis (Below 1 GHz), Z-axis (1 GHz ~ 18 GHz), X-axis (18 GHz ~ 25 GHz) test condition was recorded in this test report.

Based on preliminary testing following operating modes were selected for the final test as listed below.

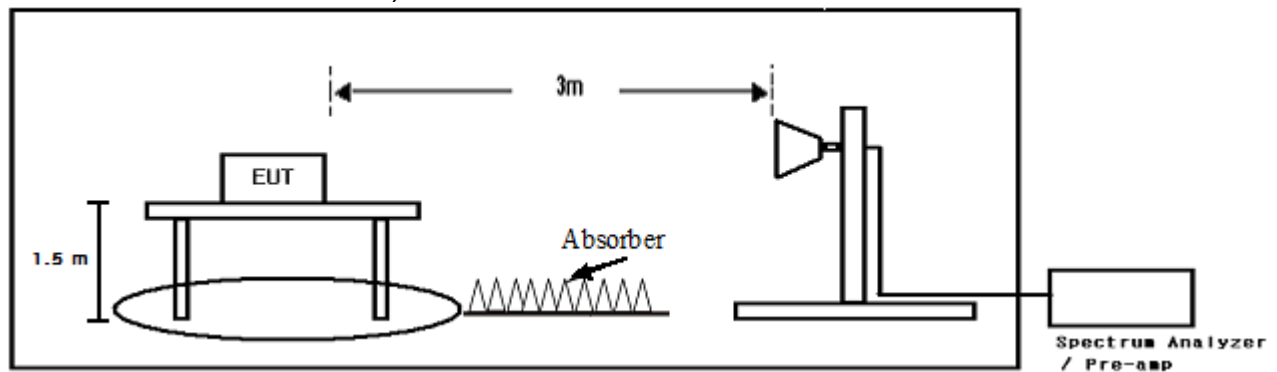
3.3.1 Test Channel and Frequency

Operating Mode	Test Channel	Frequency
GFSK	Low Channel	2 412 MHz
	Middle Channel	2 442 MHz
	High Channel	2 472 MHz

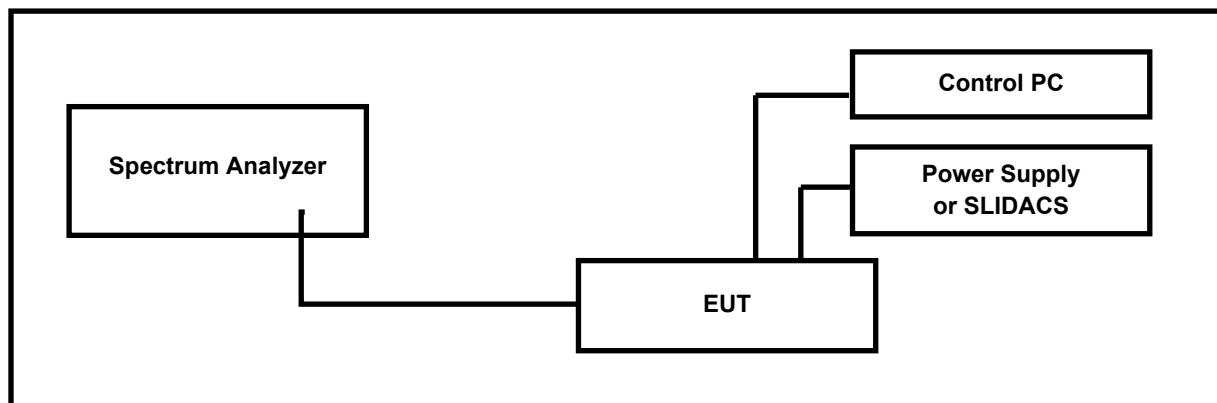
3.4 Test Setup Drawing (Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



(Conducted Test)



3.5 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

4. ANTENNA REQUIREMENT

According to FCC CFR 47 Part 15 section 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 provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4	Chip Antenna	3.49	-

4.2 Conclusion

The antenna connector type of the EUT is Chip Antenna, so the EUT met the requirement.

5. TEST RESULT

5.1 6 dB Bandwidth

5.1.1 Limit

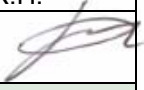
The minimum 6 dB bandwidth shall be at least 500 kHz acc to Section 15.247 (a) (2).

5.1.2 Method of Measurement

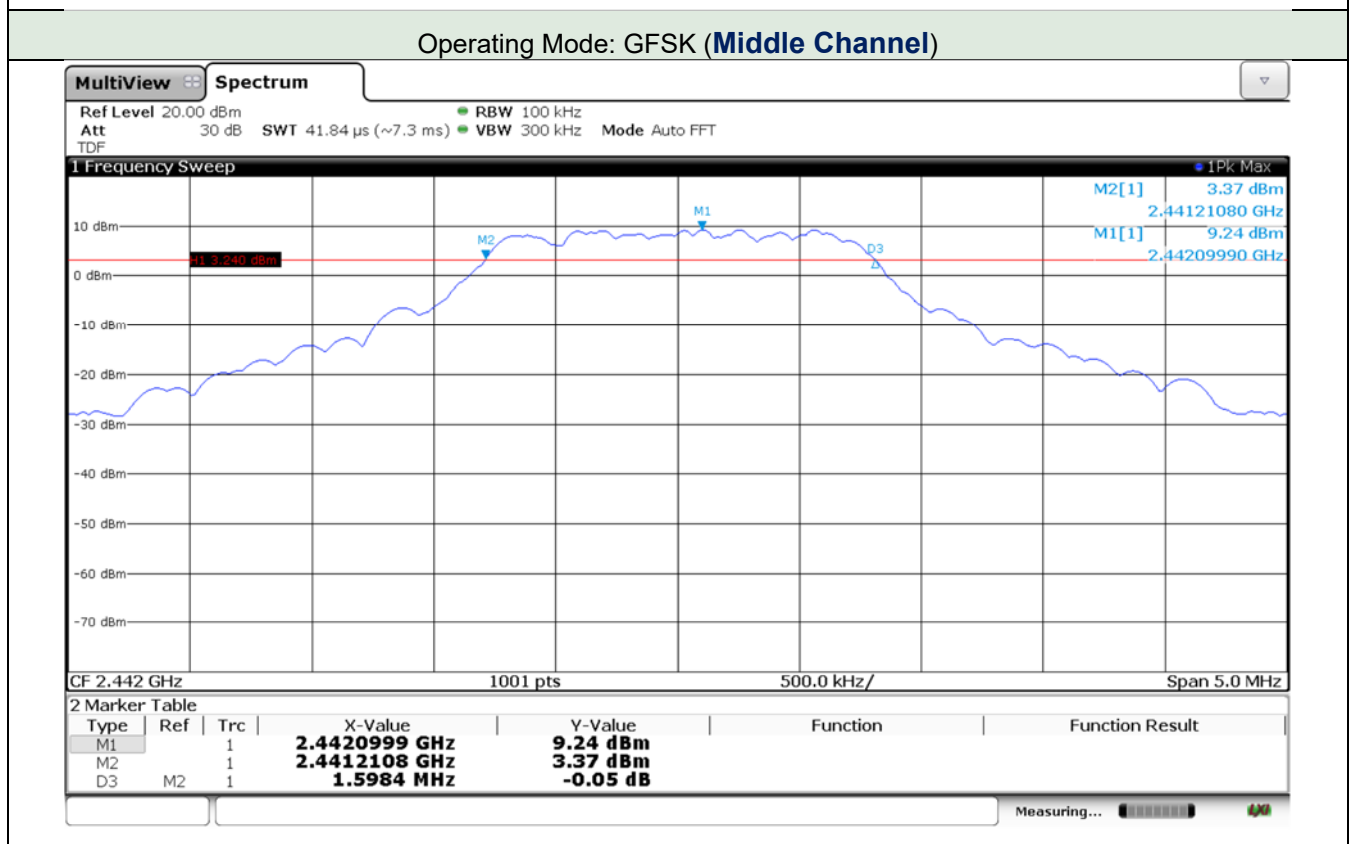
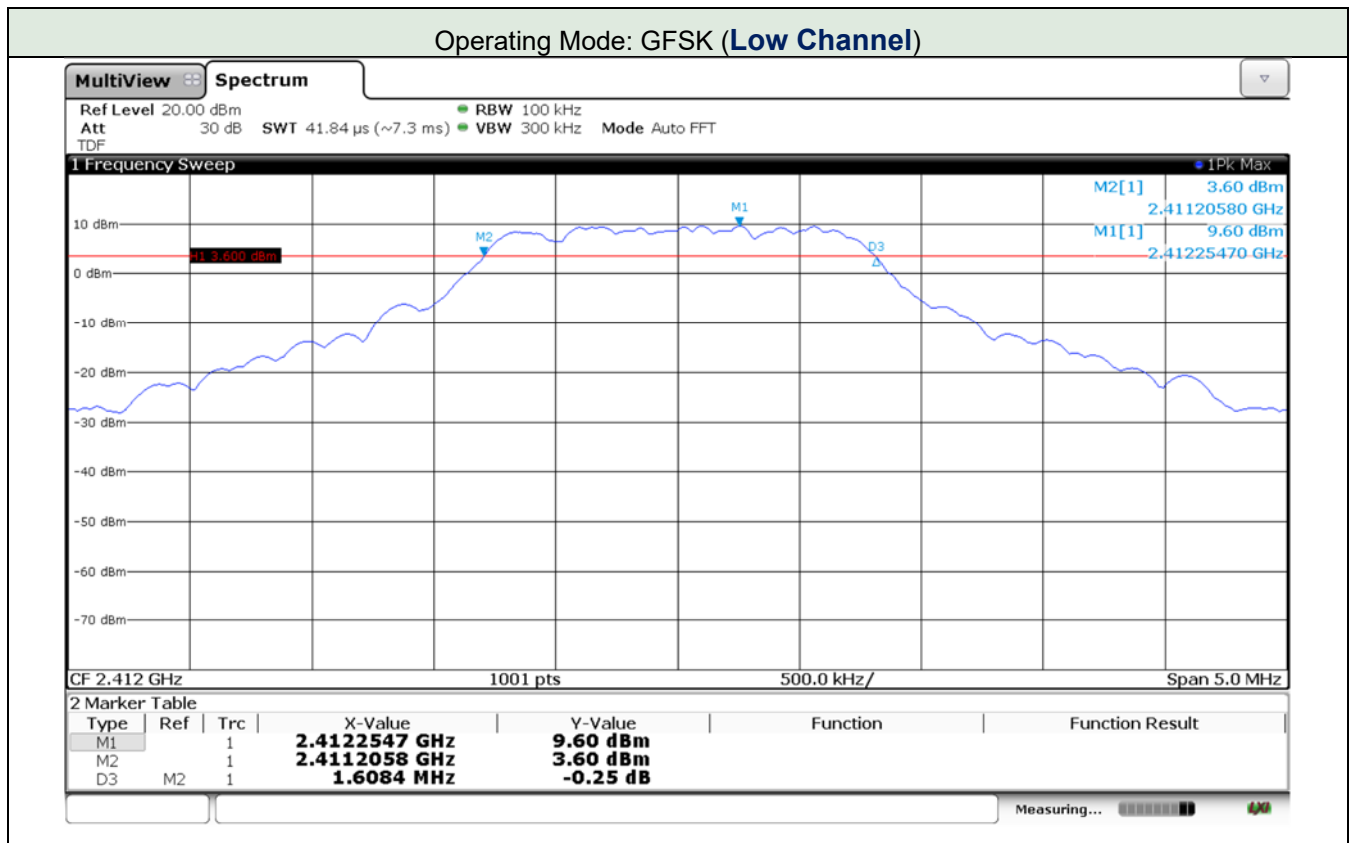
Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.2

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold.

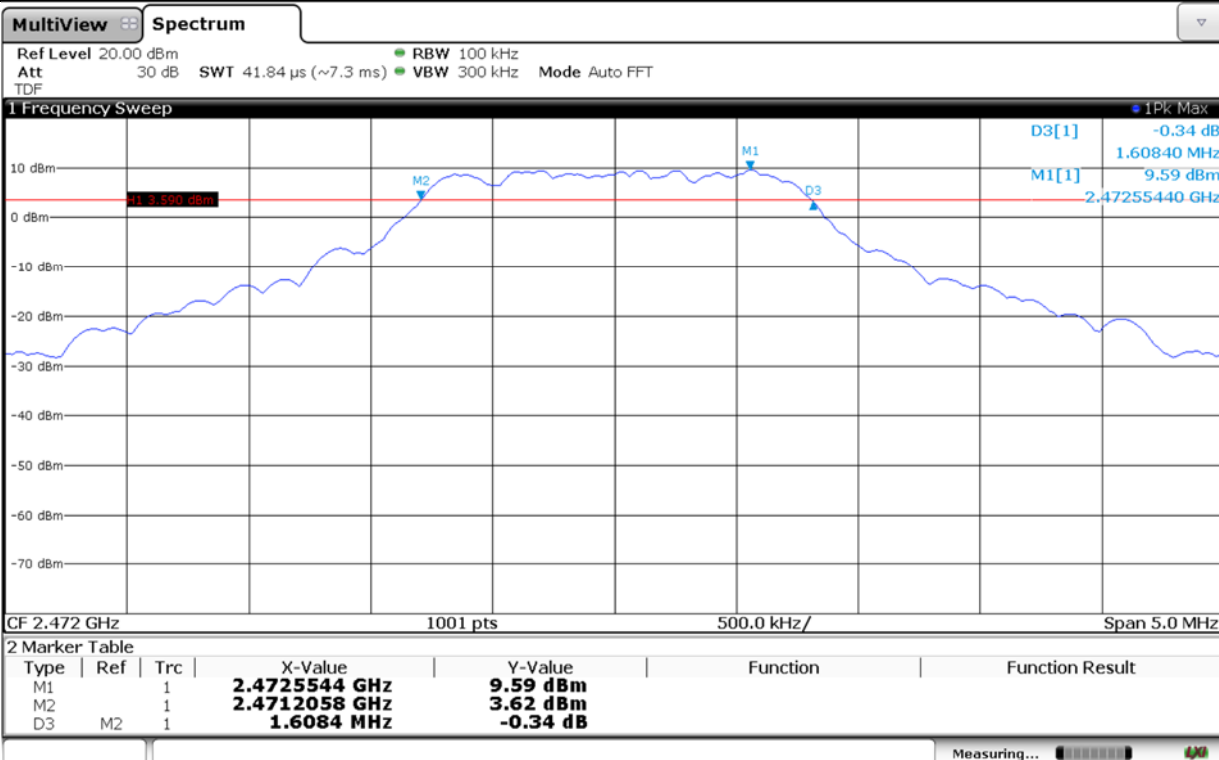
5.1.3 Test Data

Date of Test	2019-10-15	Temperature	(24.1 \pm 0.5) °C
		Relative humidity	(40.2 \pm 3.1) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 
Operating Mode: GFSK			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 412	1.61	0.5
Middle	2 442	1.60	
High	2 472	1.61	

5.1.4 Test Plots



Operating Mode: GFSK (High Channel)



5.2 99 % Bandwidth

5.2.1 Limit

Not applicable. For reporting purpose only.

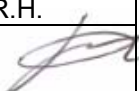
5.2.2 Method of Measurement

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1 % to 5 % of the OBW.

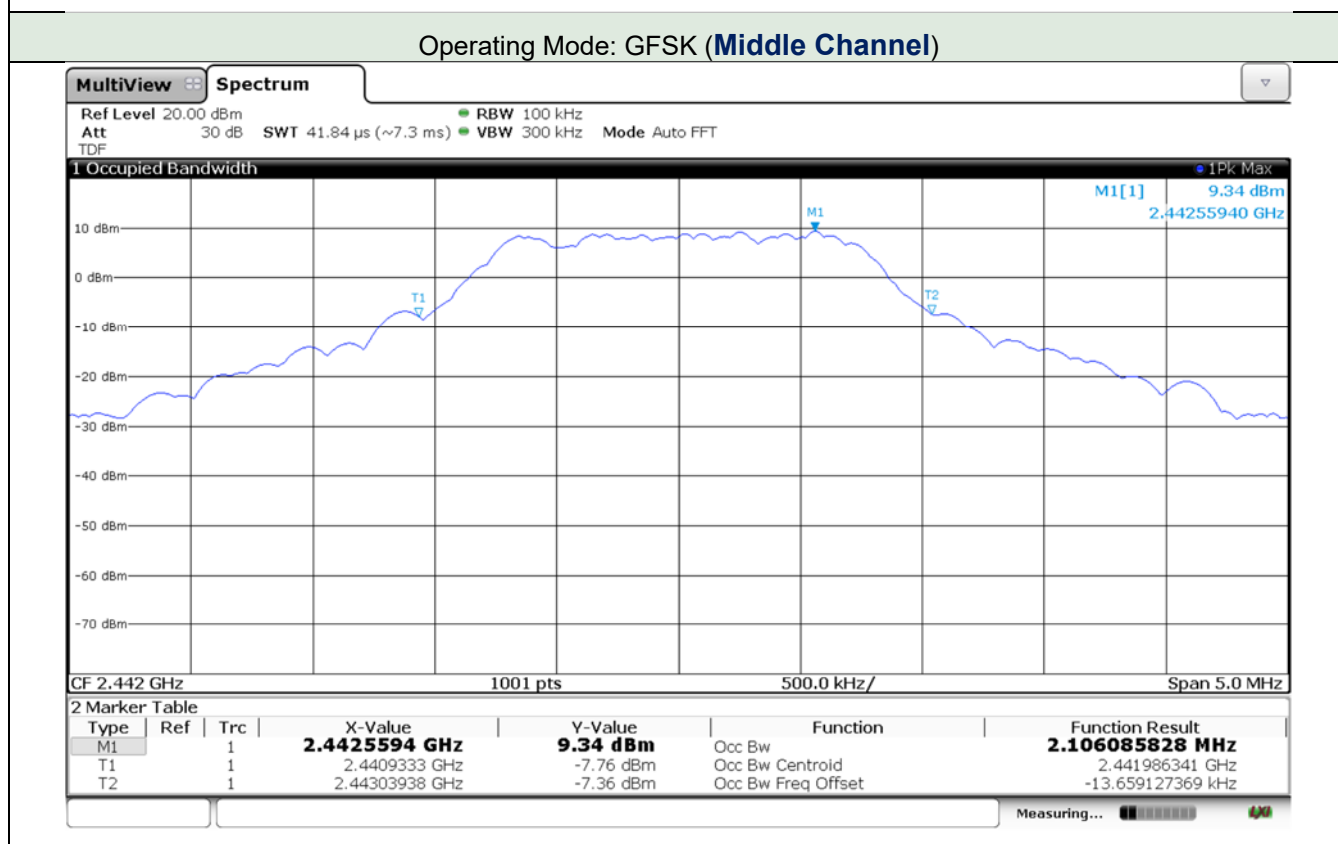
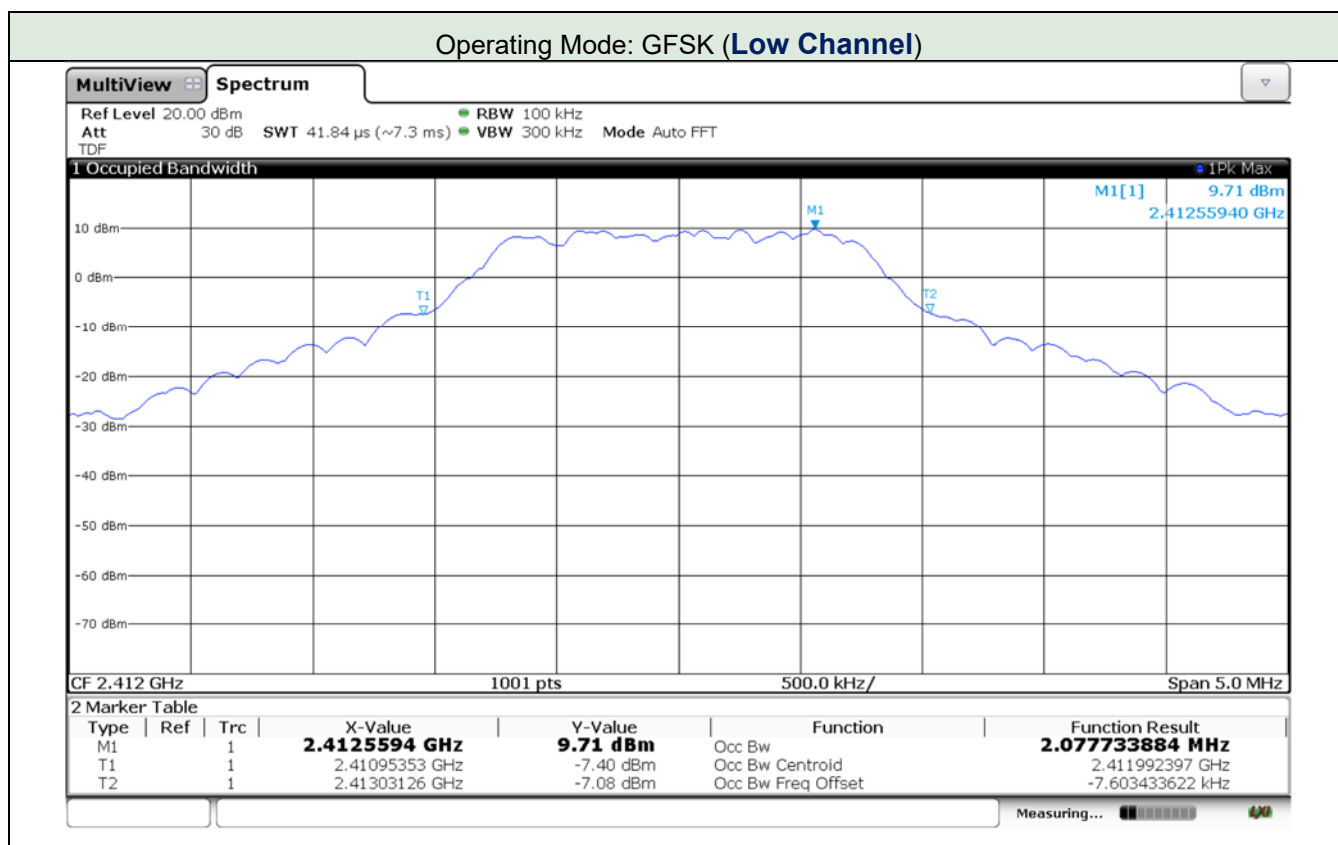
The span is set to capture all products of the modulation process, including the emission skirts.

The VBW is set to 3 times the RBW. The sweep time is coupled and peak detection and max hold mode is used. The spectrum analyzer internal 99% bandwidth function is utilized.

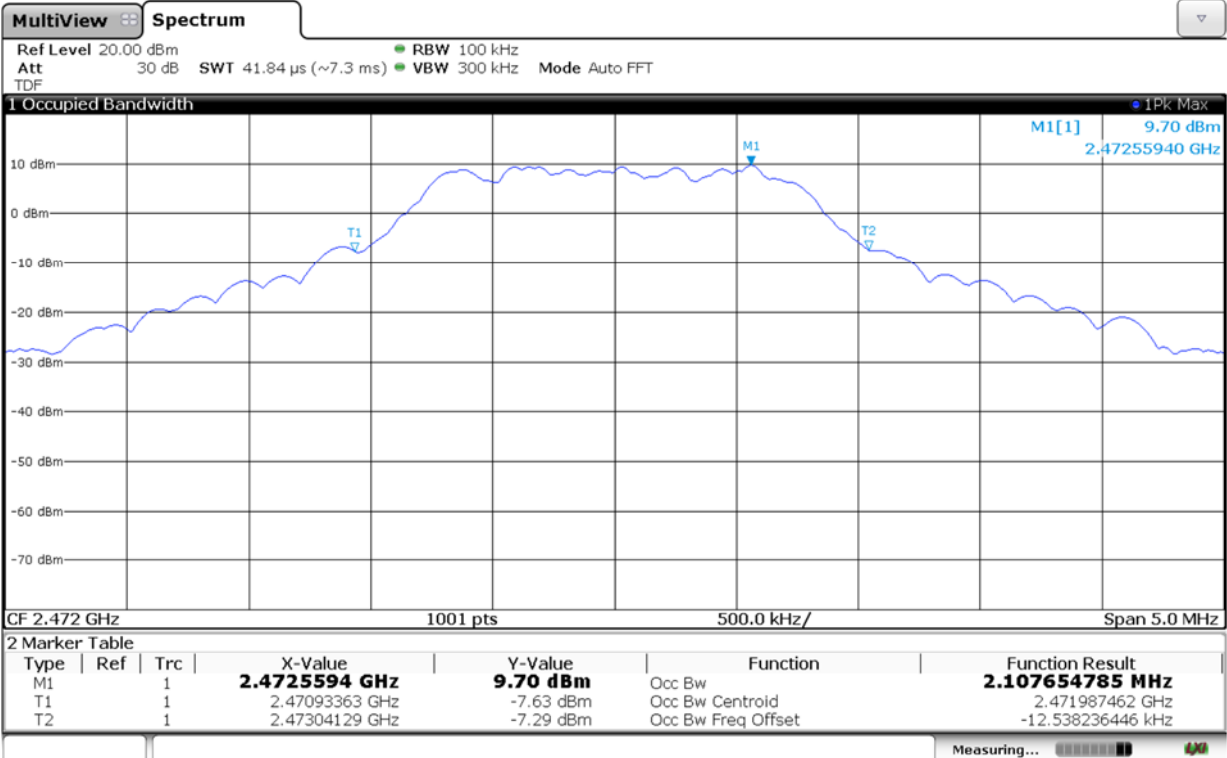
5.2.3 Test Data

Date of Test	2019-10-15	Temperature	(24.1 ± 0.5) °C
		Relative humidity	(40.2 ± 3.1) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 
Operational Mode: GFSK			
Channel	Frequency (MHz)		99 % Bandwidth (MHz)
Low	2 412		2.08
Middle	2 442		2.11
High	2 472		2.11

5.2.4 Test Plots



Operating Mode: GFSK (High Channel)



5.3 Maximum Peak Output Power

5.3.1 Limit


Acc. To section 15.247, For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.3.1.3

The cable assembly insertion loss was entered as an offset in the spectrum analyzer to allow for direct reading of power.

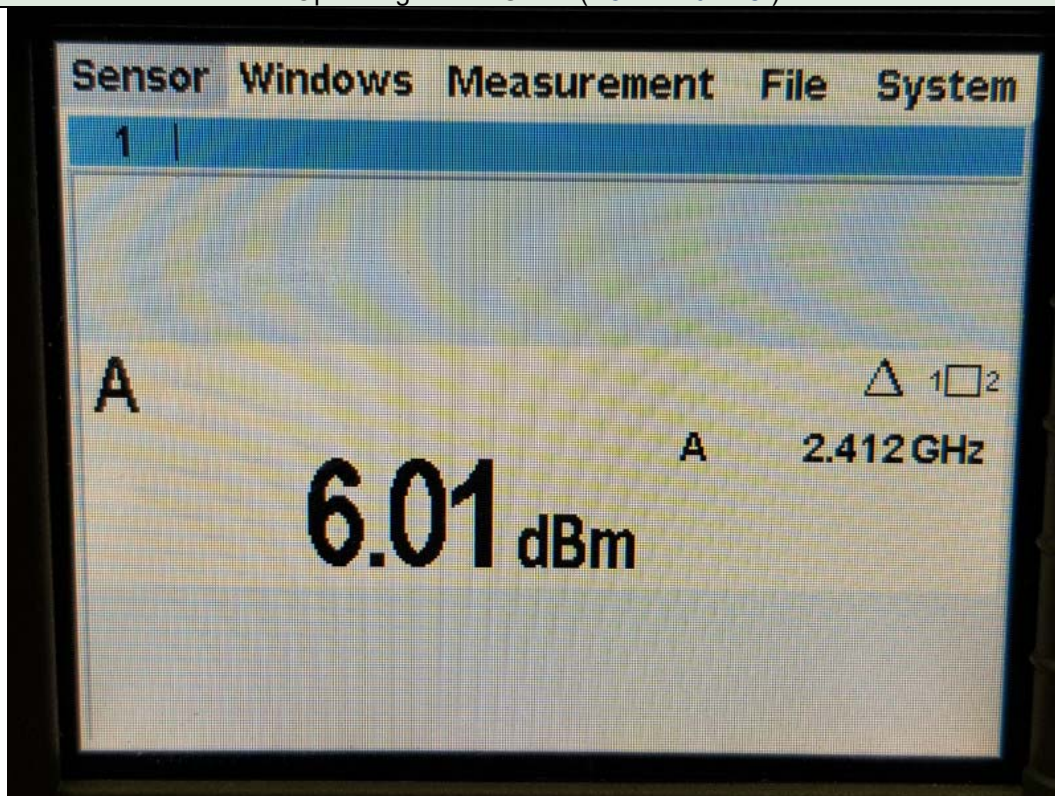
5.3.3 Test Data for Output Power

Date of Test		2019-10-15	Temperature	(24.1 ± 0.5) °C	
			Relative humidity	(40.2 ± 3.1) % R.H.	
Test Result		PASS	Tested by	Do-heon Kim 	
Operating Mode: GFSK					
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)		Margin (dB)
Low	2 412	6.01	30		23.99
Middle	2 442	5.85			24.15
High	2 472	6.01			23.99

Remark. Margin = Limit – Measured Value

5.3.4 Test Plots

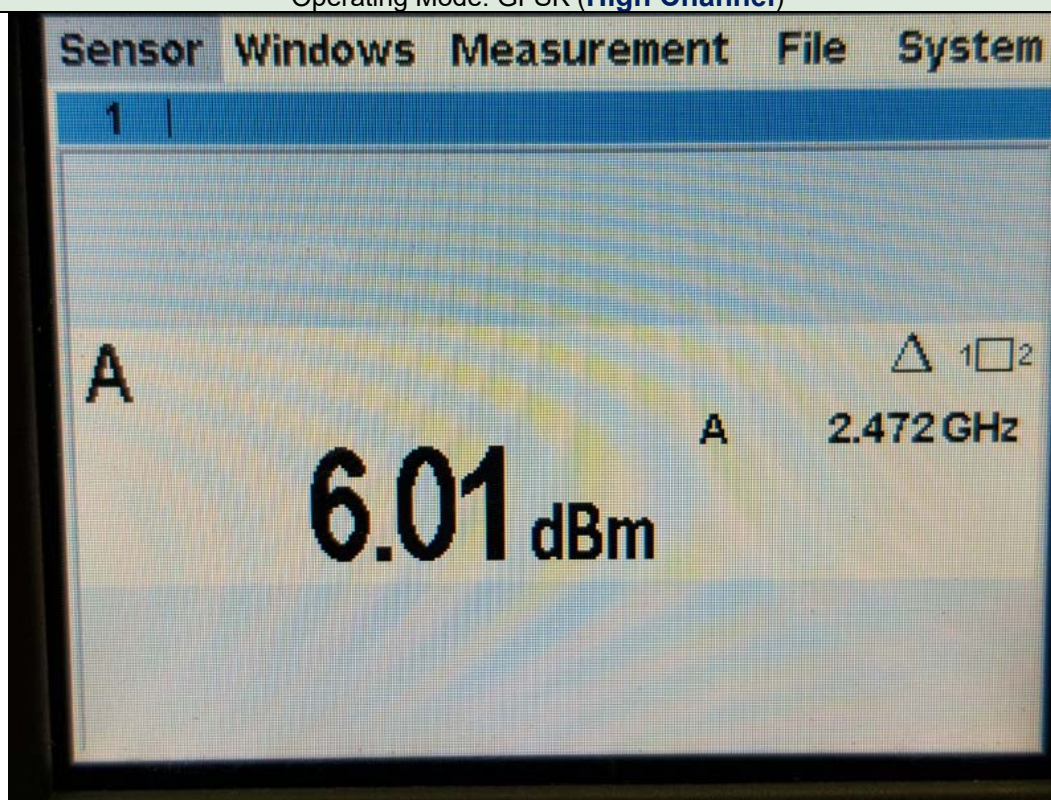
Operating Mode: GFSK (**Low Channel**)



Operating Mode: GFSK (**Middle Channel**)



Operating Mode: GFSK (**High Channel**)



5.4 Peak Power Spectral Density

5.4.1 Limit

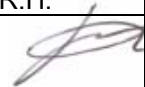
Acc. To section 15.247, the power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.4.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.4 Method PKPSD (peak PSD).

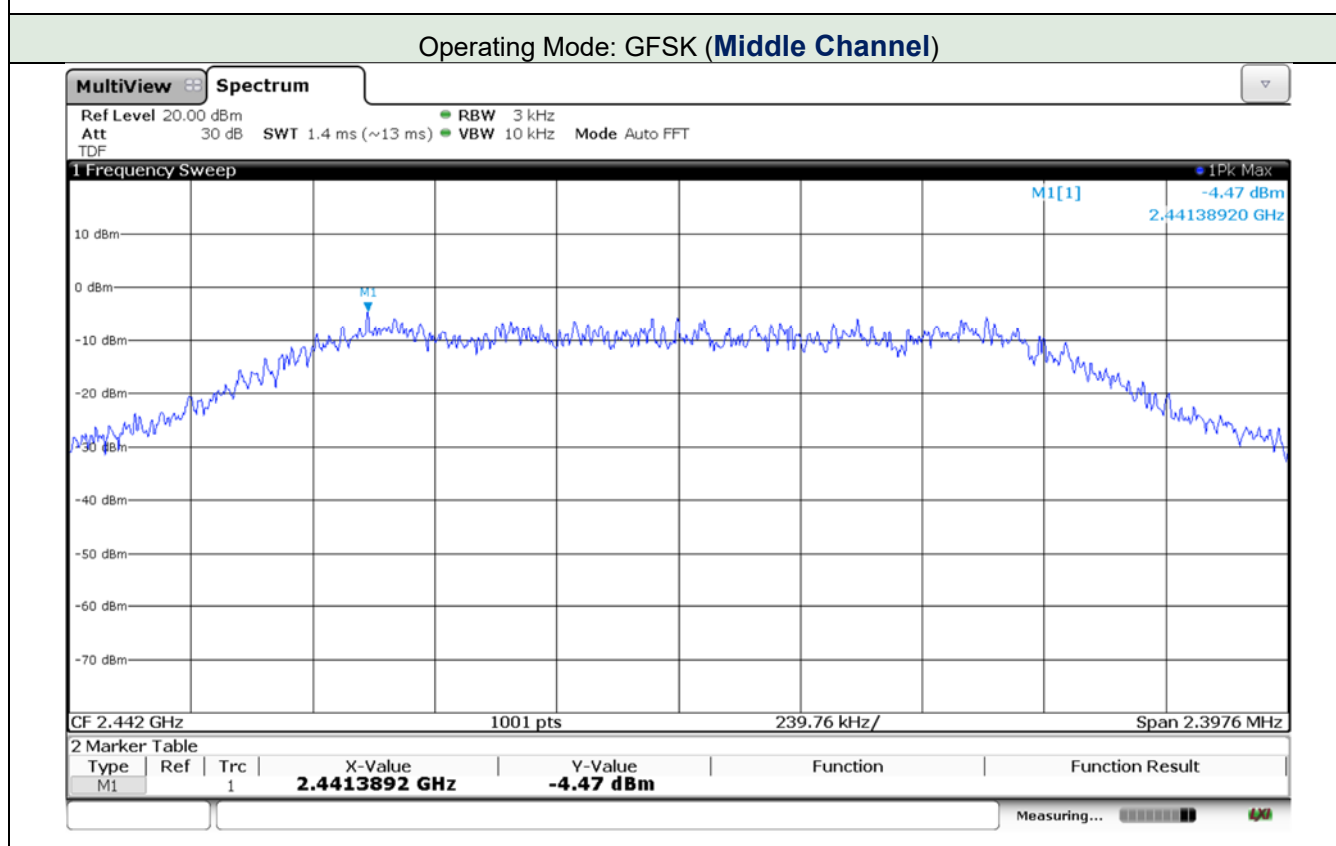
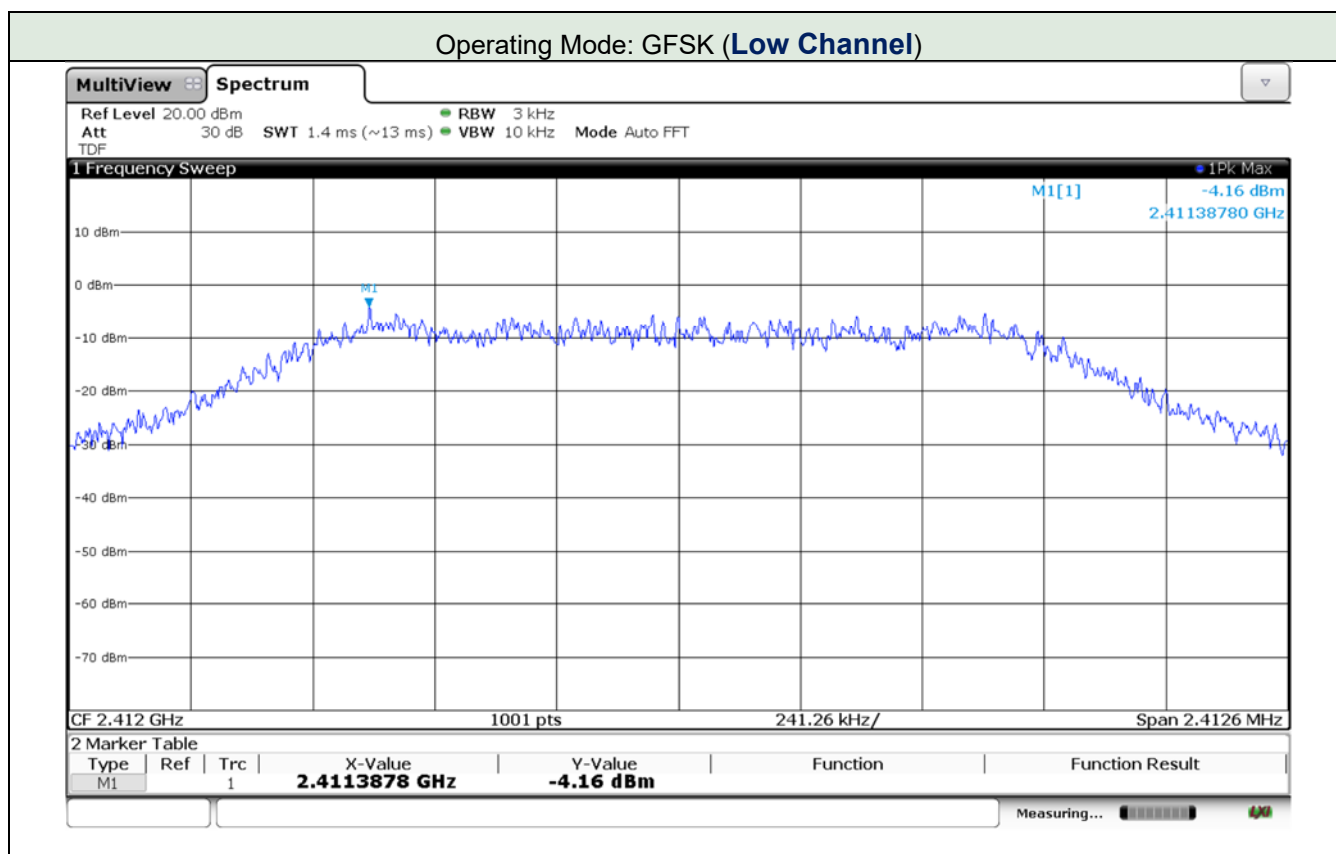
The transmitter output is connected to a spectrum analyzer with the RBW set from 3 kHz to 100 kHz,
VBW \geq 3 X RBW, peak detector and max hold.

5.4.3 Test Data

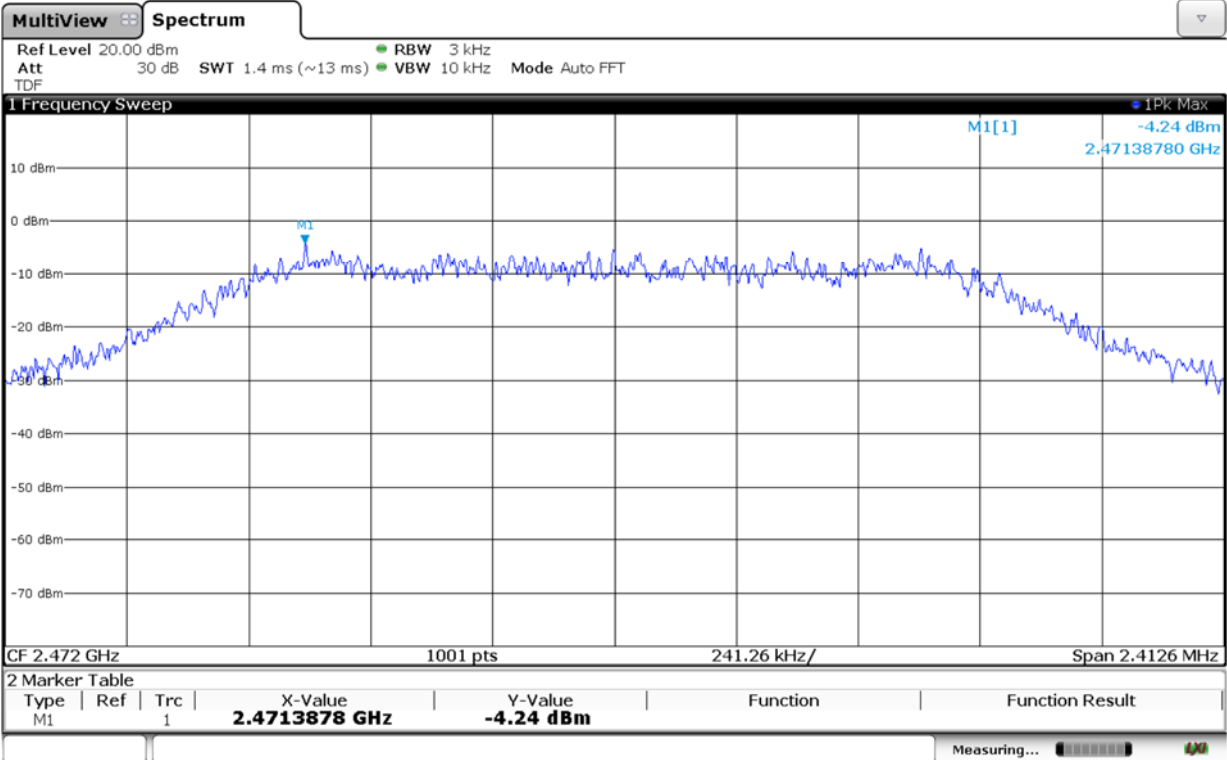
Date of Test		2019-10-15	Temperature	(24.1 ± 0.5) °C	
			Relative humidity	(40.2 ± 3.1) % R.H.	
Test Result		PASS	Tested by	Do-heon Kim 	
Operating Mode: GFSK					
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)	
Low	2 412	-4.16	8	12.16	
Middle	2 442	-4.47		12.47	
High	2 472	-4.24		12.24	

Remark. Margin = Limit – Measured Value

5.4.4 Test Plots



Operating Mode: GFSK (High Channel)



5.5 Out of Band Emission

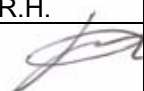
5.5.1 Limit

Acc. To section 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

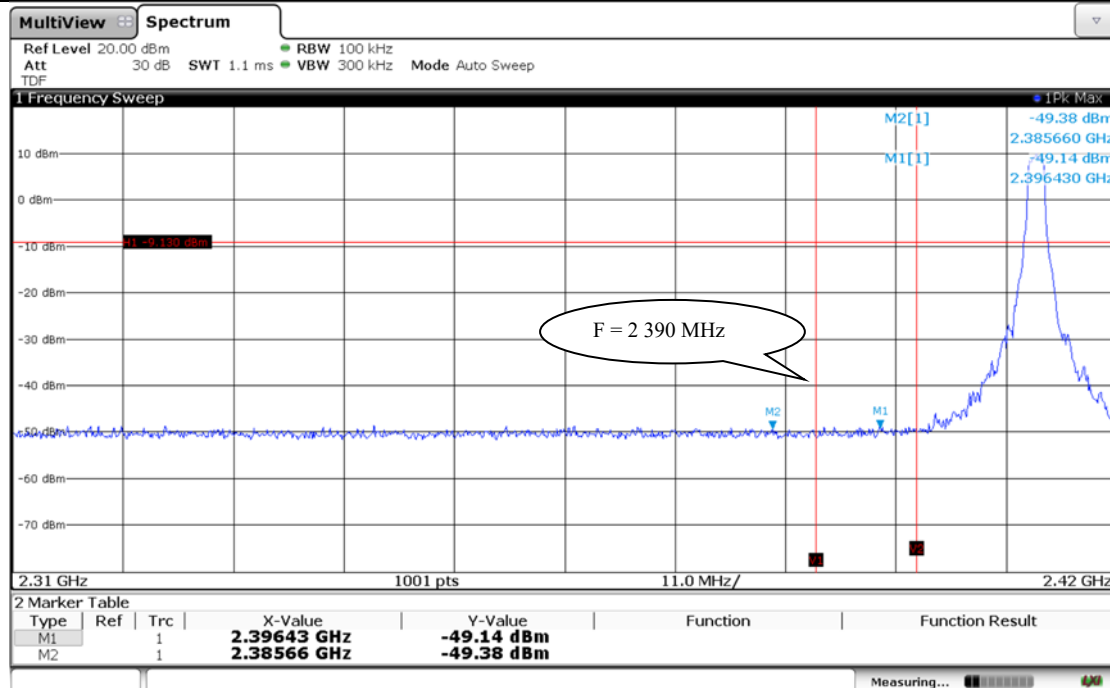
5.5.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.5 Emissions in non-restricted frequency bands. The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold. Measurements utilizing these settings are made of the in-band reference level, band-edge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

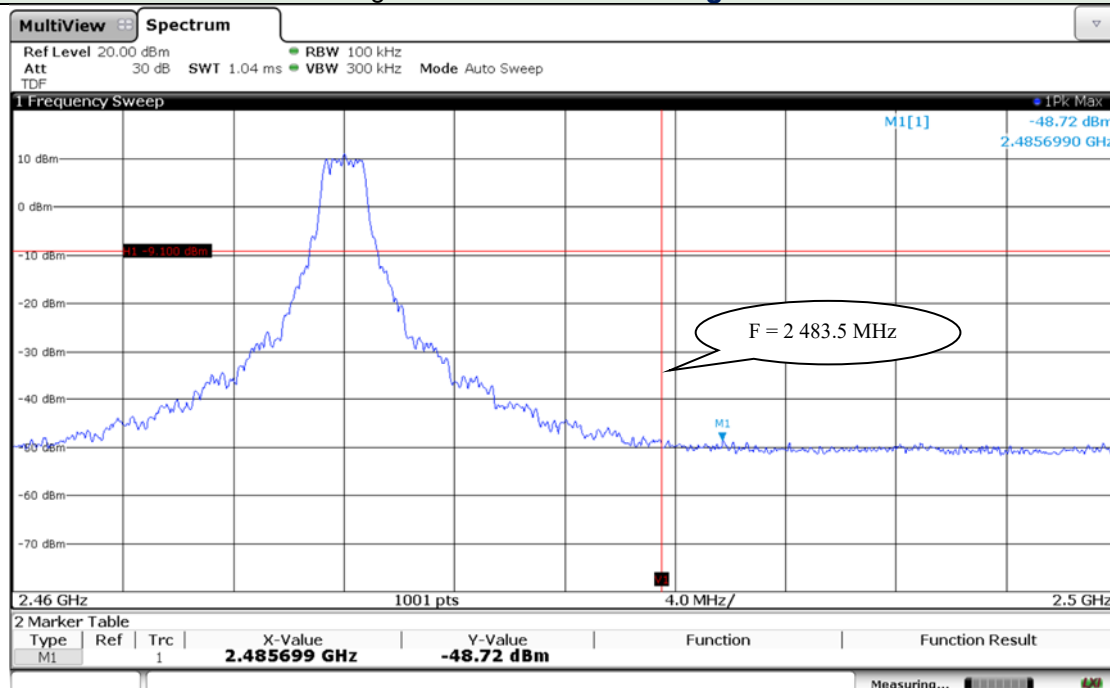
5.5.3 Test Data for Operating mode: GFSK

Date of Test	2019-10-15	Temperature	(24.1 ± 0.5) °C
		Relative humidity	(40.1 ± 3.1) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

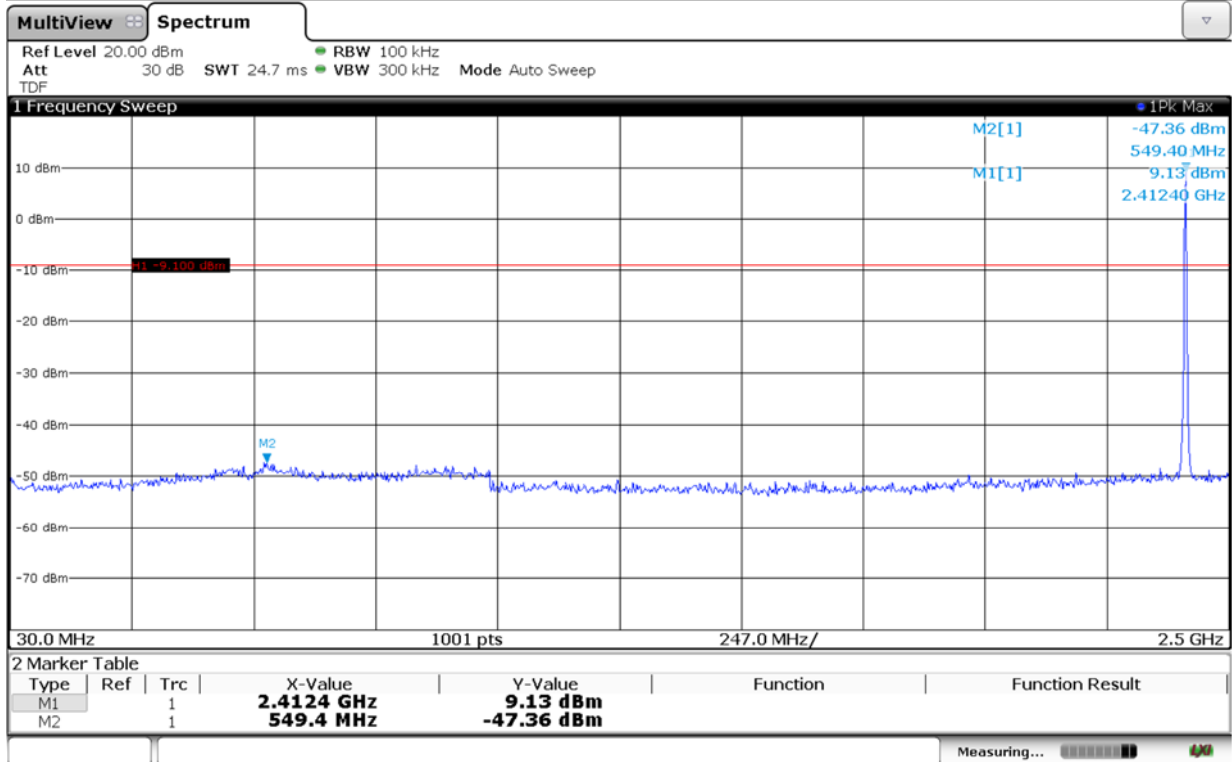
Band-edge and Restricted band – Low channel



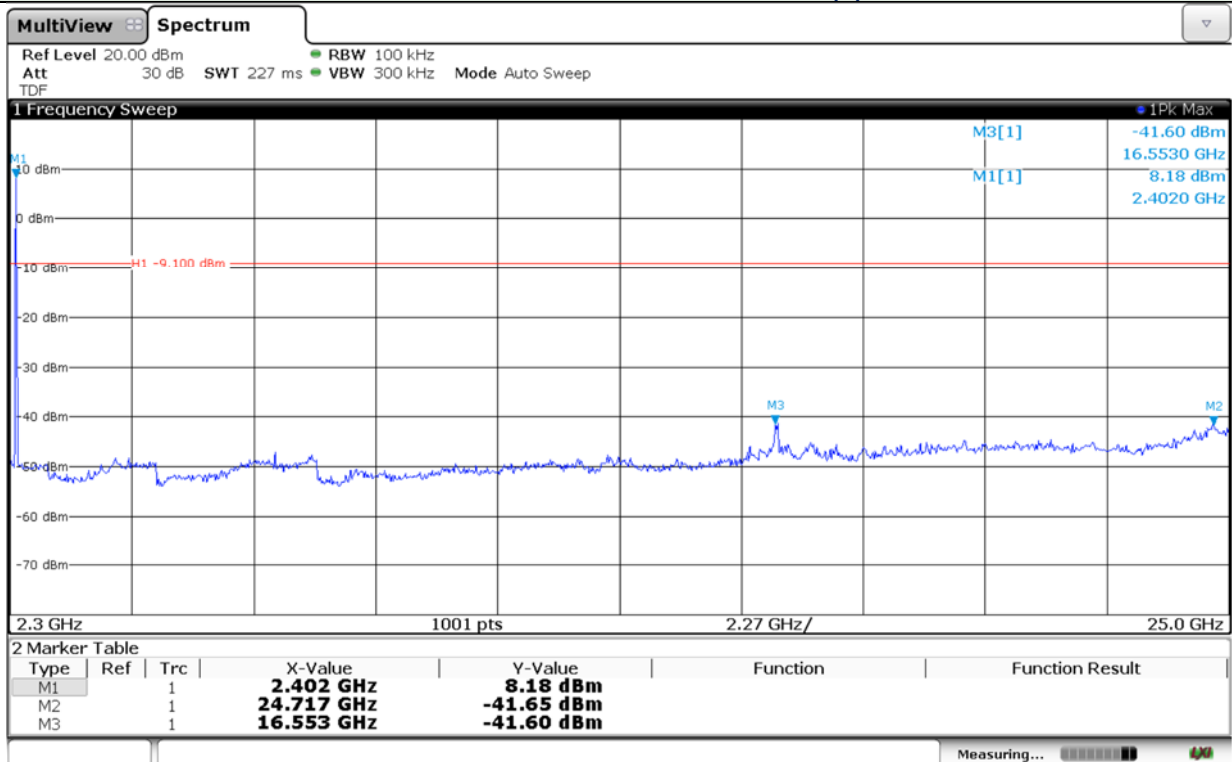
Band-edge and Restricted band – High channel



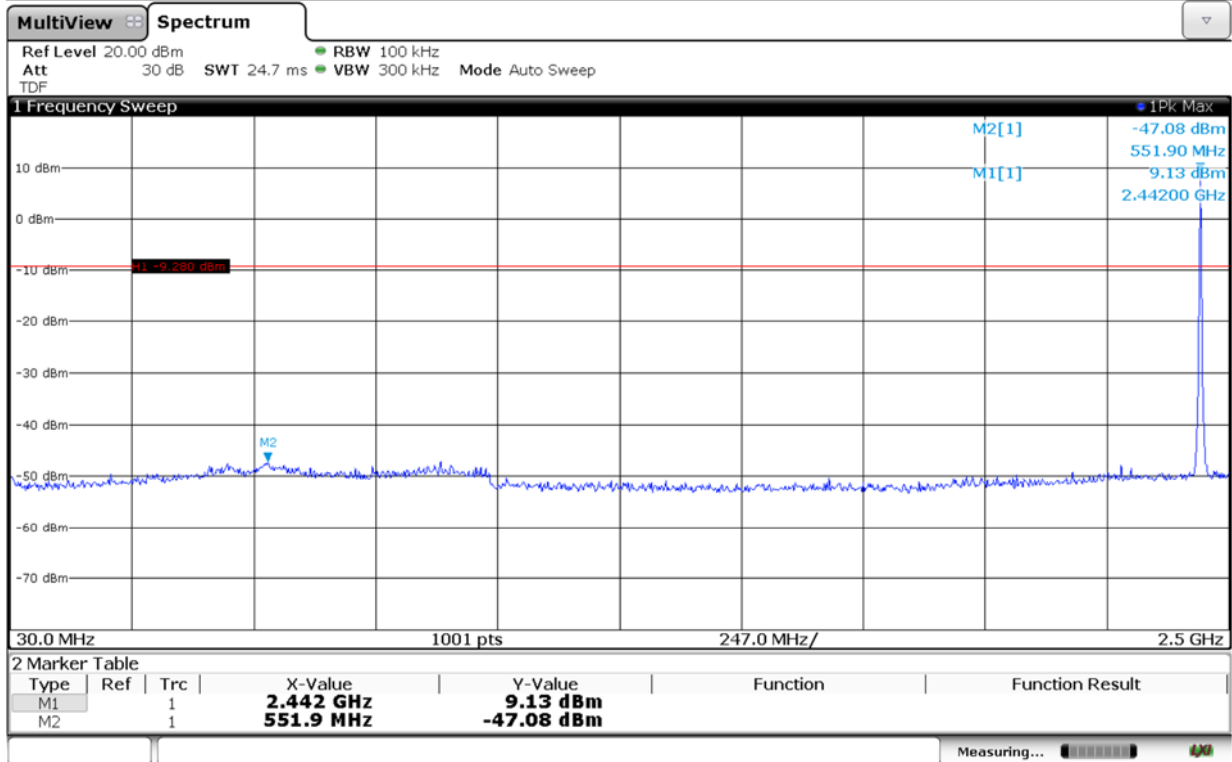
Non-restricted band – Low Channel (1)



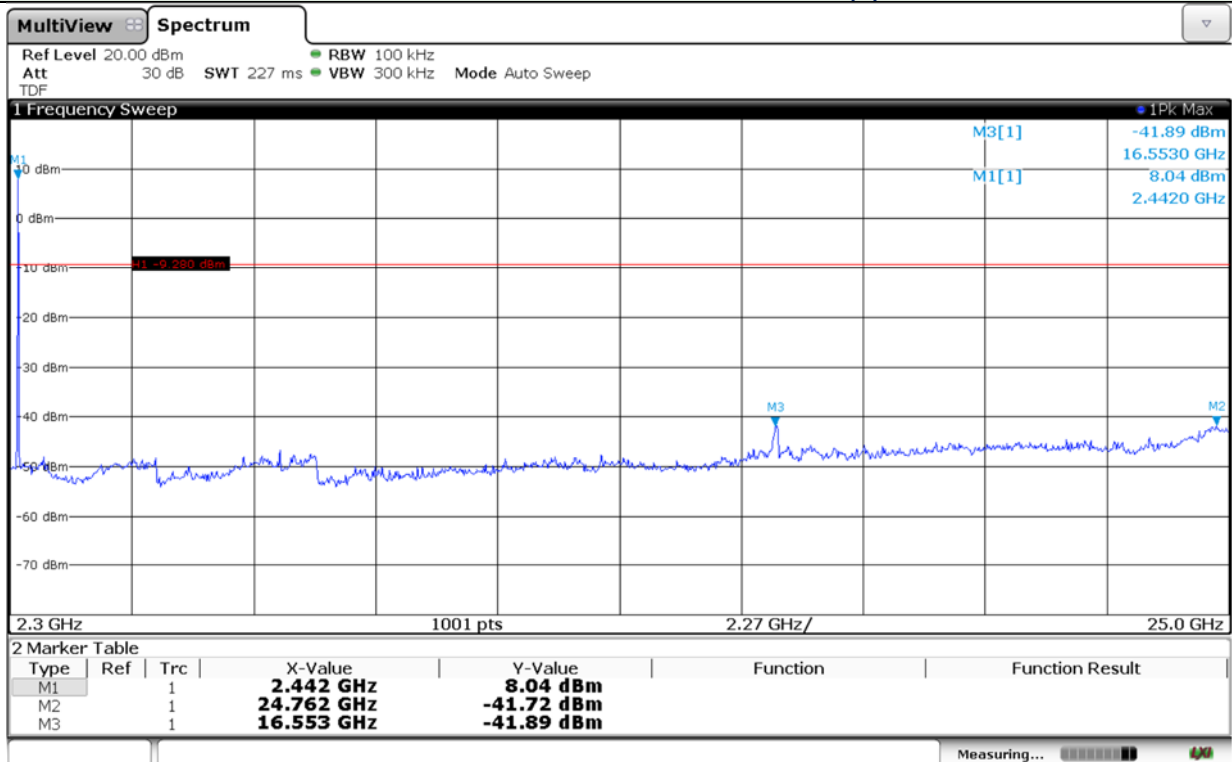
Non-restricted band – Low Channel (2)



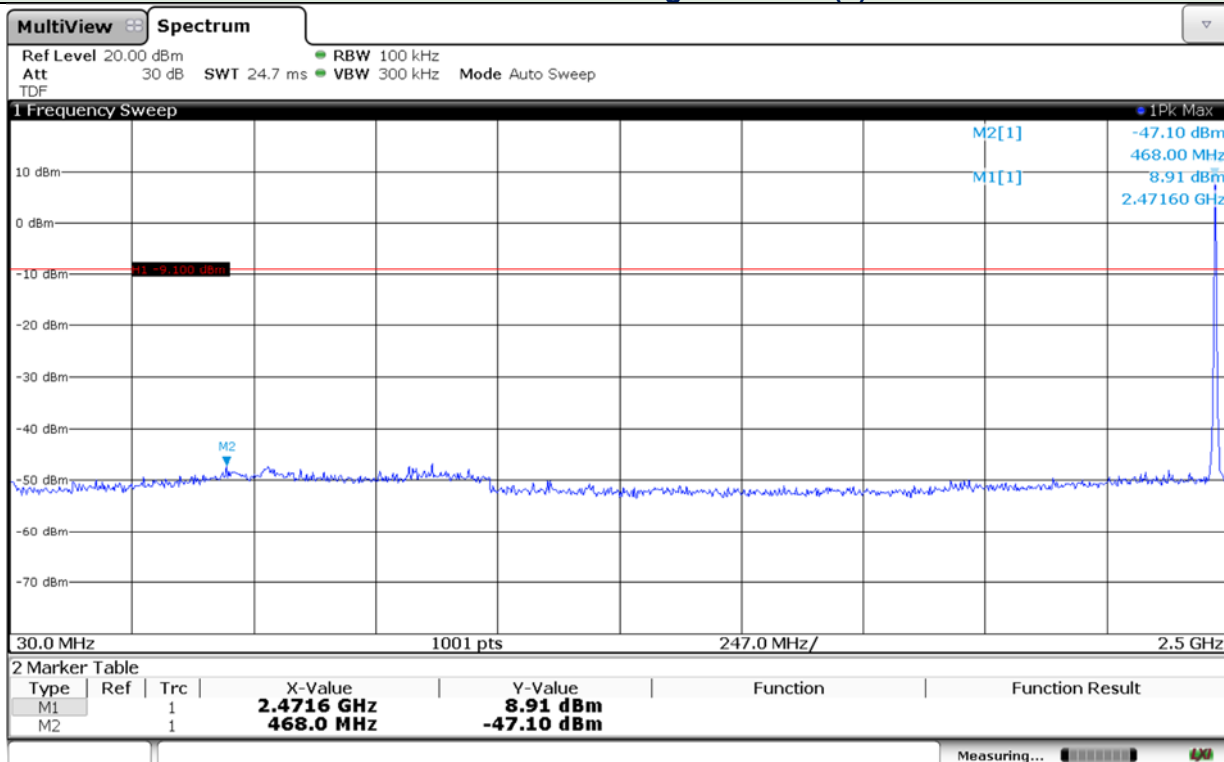
Non-restricted band – Middle Channel (1)



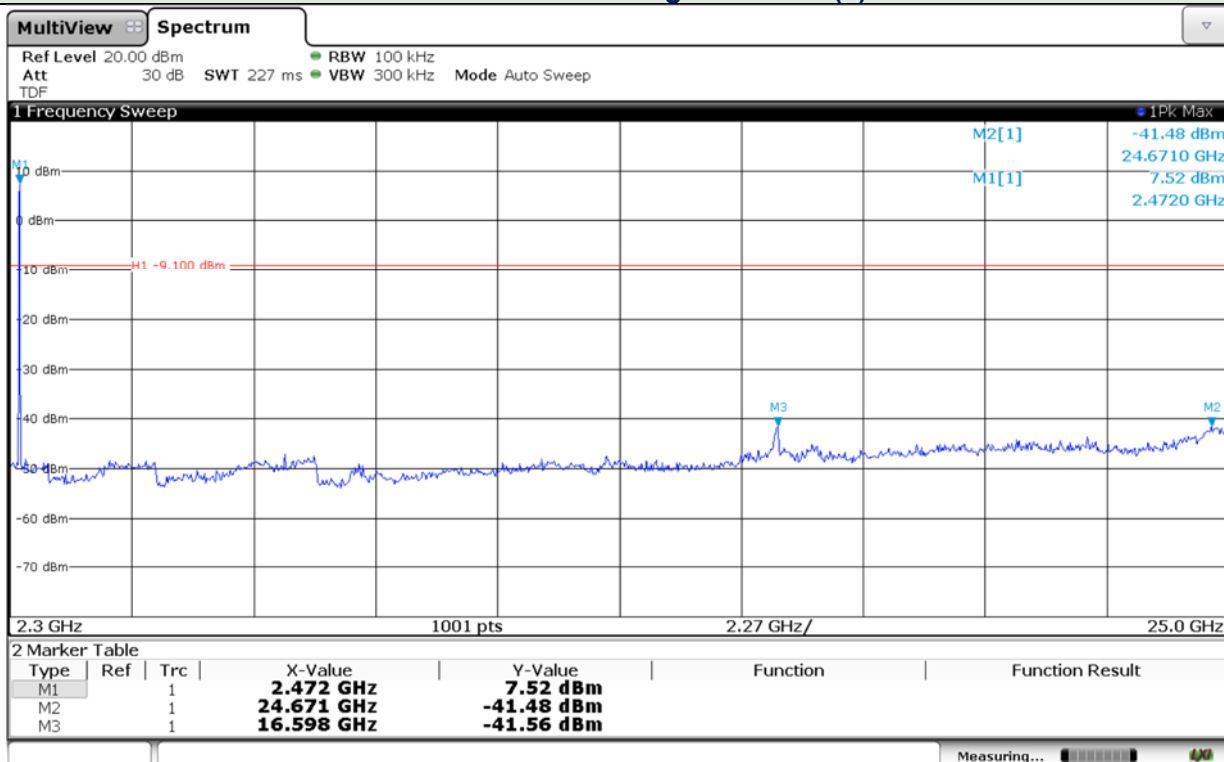
Non-restricted band – Middle Channel (2)



Non-restricted band – High Channel (1)



Non-restricted band – High Channel (2)



5.6 Radiated Emission

5.6.1 Limit

Acc. To section 15.205,15.209, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

5.6.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.6 Radiated emission measurements.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 25 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to $\geq 1/T$, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz. The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

5.6.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we ***declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01.***

5.6.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.6 dB	30 MHz ~ 1 GHz	± 4.5 dB
1 GHz ~ 18 GHz	± 5.0 dB	18 GHz ~25 GHz	± 5.2 dB

5.6.5 Sample Calculated Example

At 80 MHz

Limit = 40.0 dBuV/m


Result (dBuV/m)

= Receiver Reading (dBuV) + Antenna Factor (dB/m) - Pre-amplifier Gain (dB) + Cable Loss (dB) = 30

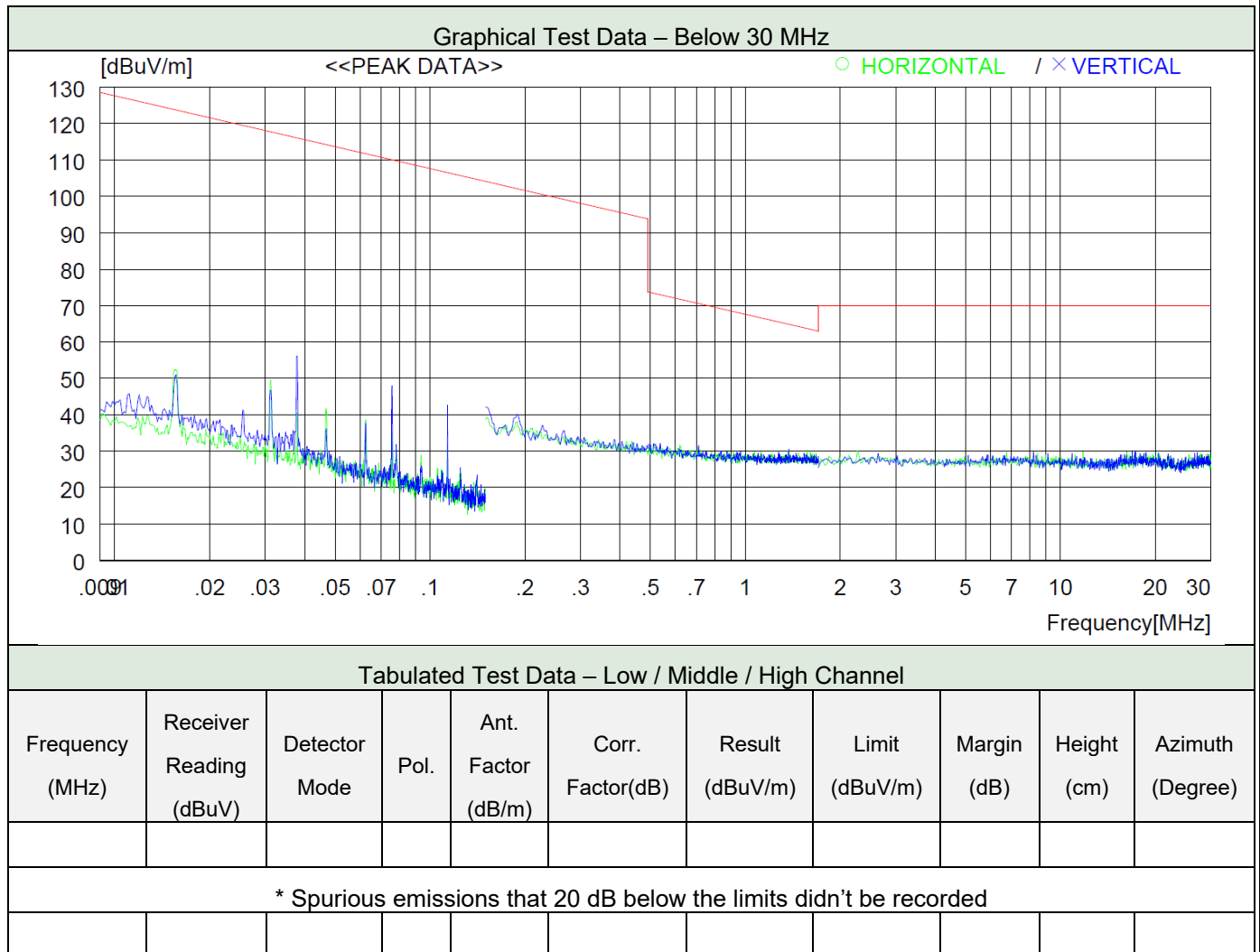
Margin = Limit – Result = 40 – 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

5.6.6 Test Data

Date of Test	2019-10-16	Temperature	(24.9 ± 2.7) °C			
		Relative humidity	(44.8 ± 5.9) % R.H.			
Measurement Frequency Range		9 kHz ~ 25 GHz				
Test Result	PASS	Tested By		Do-heon Kim 		
Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance	
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m	
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m	
Above 1 GHz	Peak	1 MHz	3 MHz		3 m	
	Average	1 MHz	3 MHz		3 m	

5.6.6.1 Test Data below 30 MHz



5.6.6.2 Test Data from 30 MHz to 1 GHz



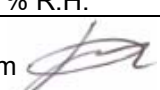
Note: “H” means Horizontal polarity, “V” means Vertical polarity.

GFSK lowest channel is worst case configuration, so test data is reported for lowest channel only.

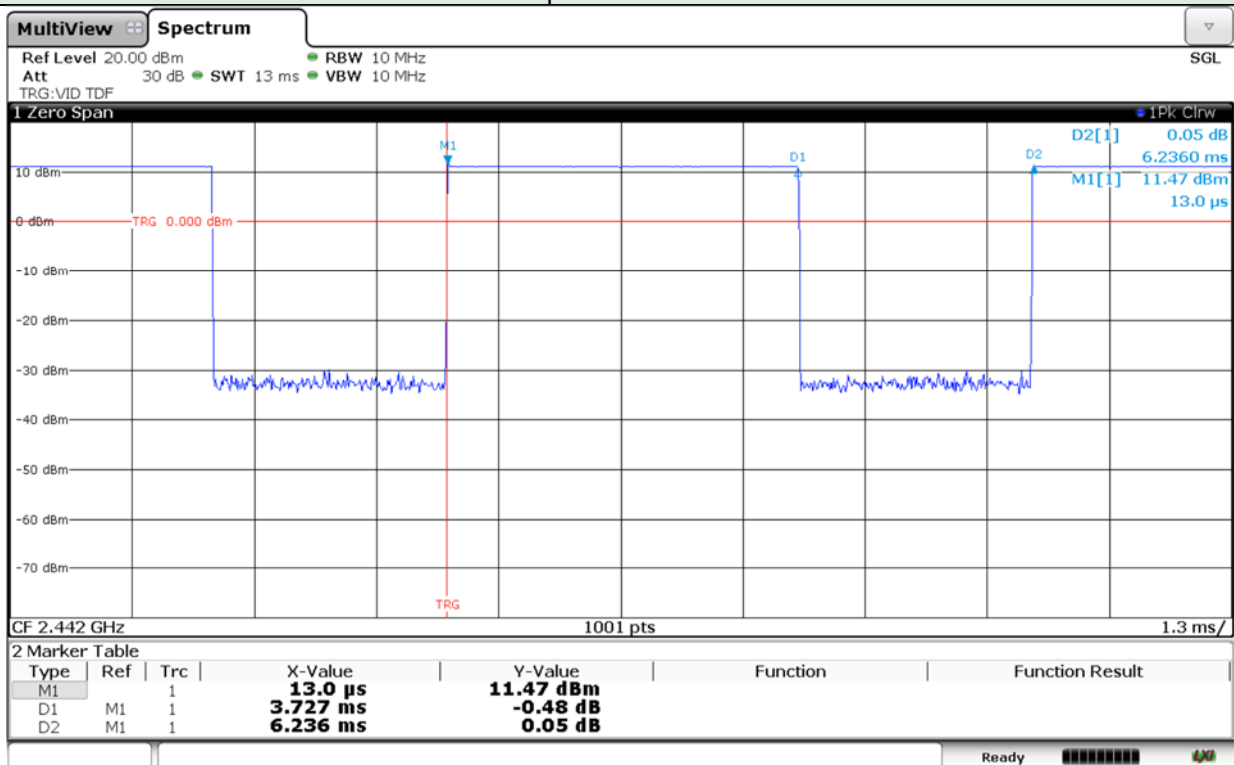
Quasi-peak measurements are omitted because the peak data meets the limit.

5.6.6.3 Test Data above 1 GHz

5.6.6.3.1 Duty Cycle

Date of Test	2019-10-17	Temperature	(24.6 ± 2.7) °C
		Relative humidity	(46.3 ± 5.9) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



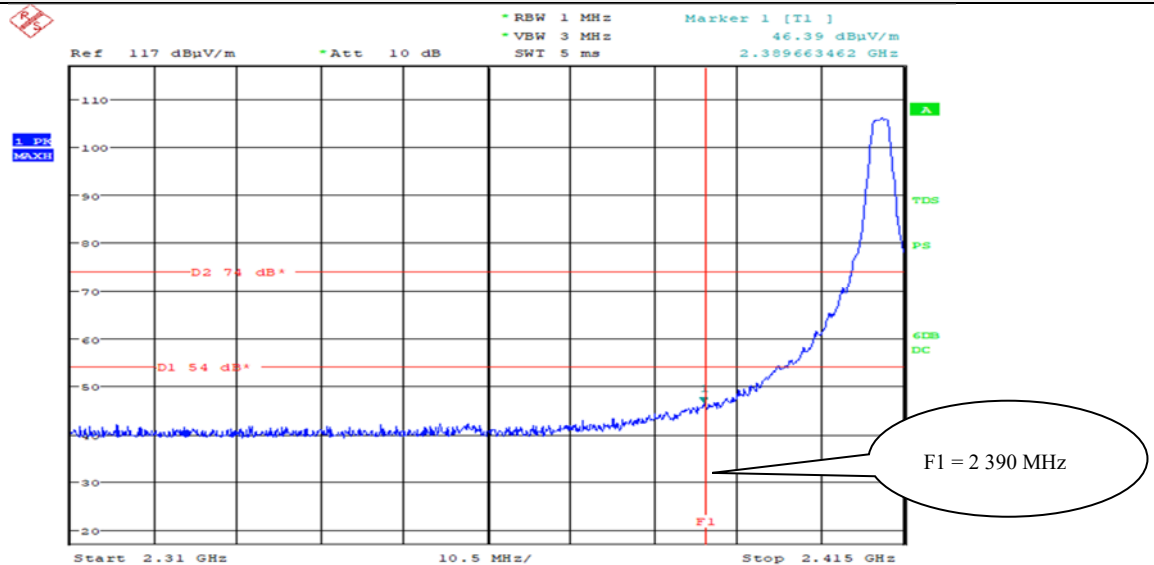
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
GFSK	3.727	6.236	59.77	2.24

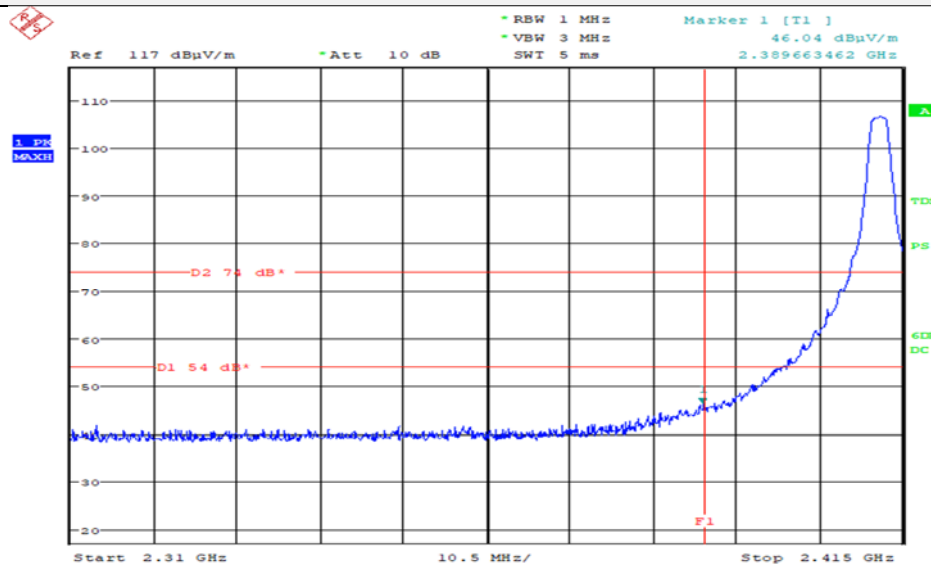
5.6.6.3.2 Test Data for Band edge (Restricted band)

Graphical Test Data – Low Channel (Peak)

Horizontal



Vertical



Tabulated Test Data – Low Channel

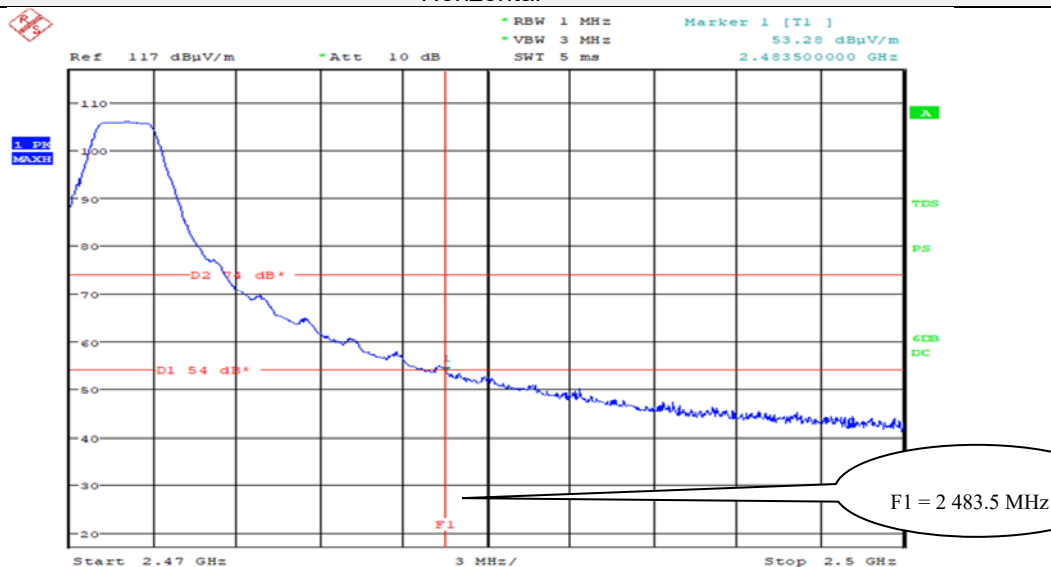
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 389.7	Peak	H	46.39	-	46.39	74.00	27.61	150	120
2 389.7	Peak	V	46.04	-	46.04	74.00	27.96	180	280

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

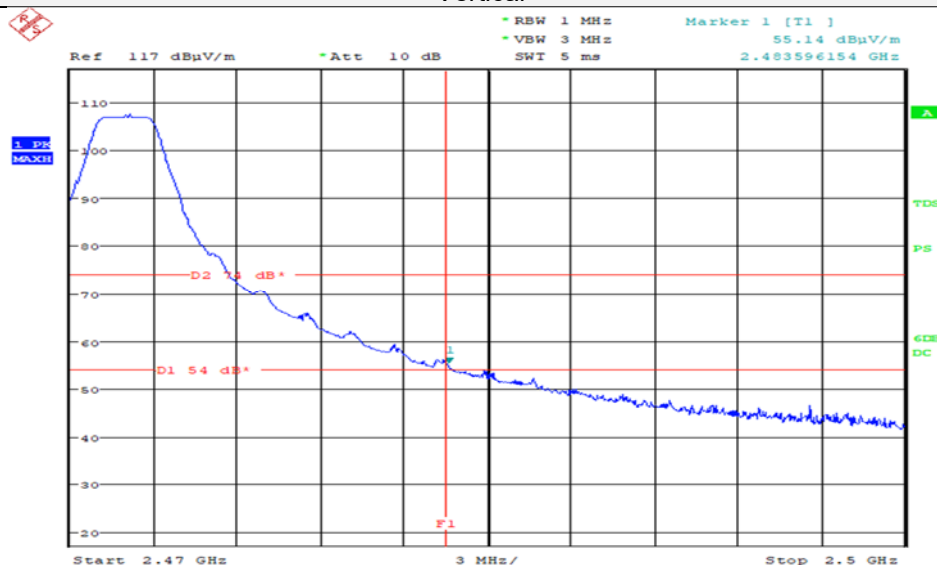
Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Graphical Test Data – High Channel (Peak)

Horizontal



Vertical



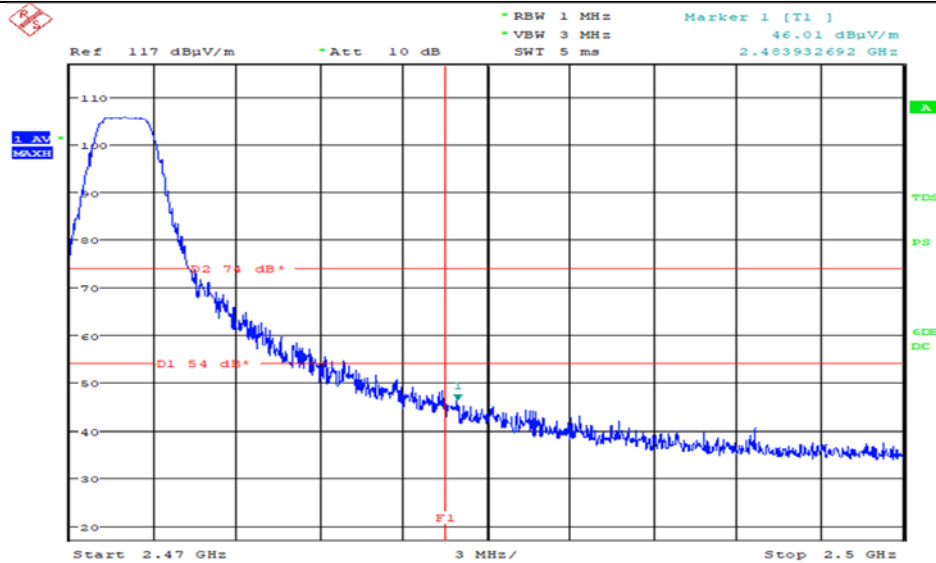
Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	53.28	-	53.28	74.00	20.72	140	110
2 483.6	Peak	V	55.14	-	55.14	74.00	18.86	200	280

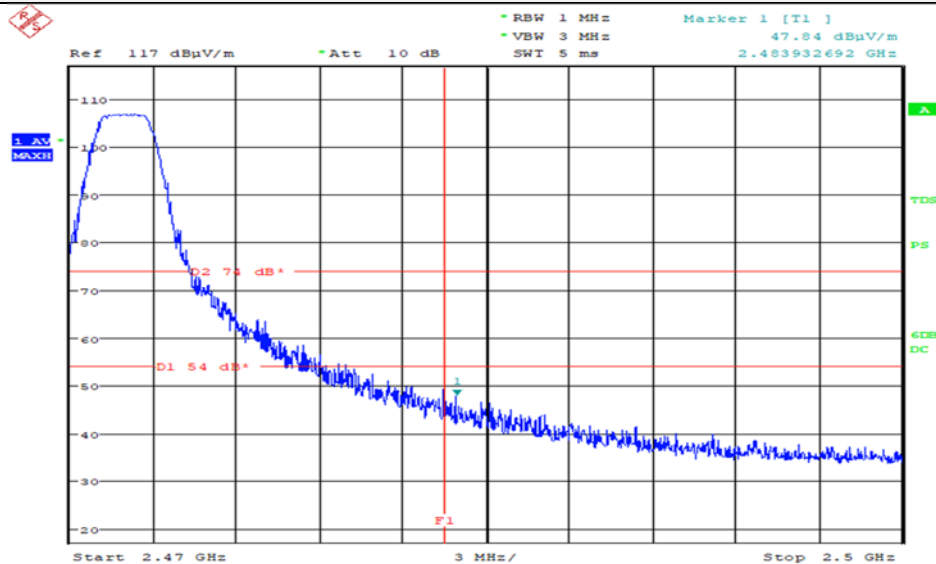
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Graphical Test Data – High Channel (Average)

Horizontal



Vertical



Tabulated Test Data – High Channel

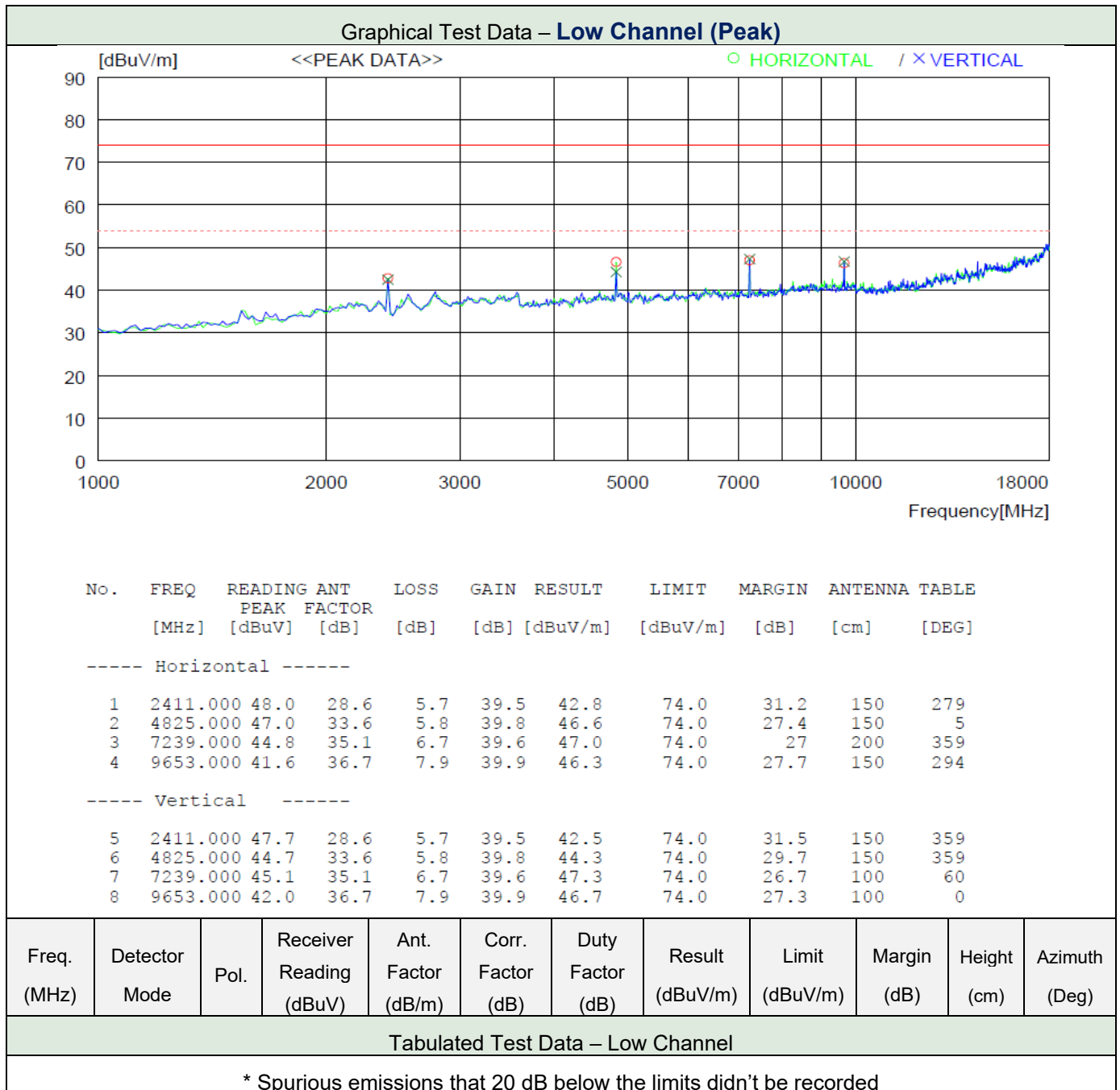
Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.9	Average	H	46.01	2.24	48.25	54.00	5.75	140	110
2 483.9	Average	V	47.84	2.24	50.08	54.00	3.92	200	280

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Result = Measured Value + Duty Factor

5.6.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)

5.6.6.4.1 Operating mode: GFSK



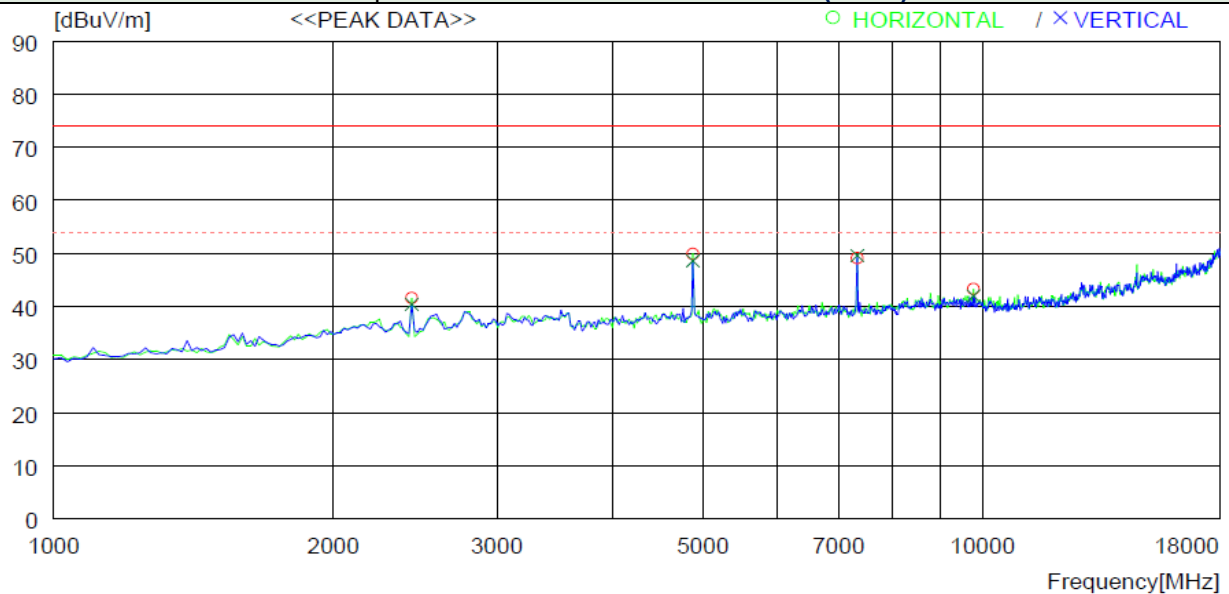
Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Graphical Test Data – Middle Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2428.000	46.8	28.6	5.7	39.5	41.6	74.0	32.4	200	359
2	4876.000	50.2	33.7	5.8	39.8	49.9	74.0	24.1	100	27
3	7324.000	46.8	35.2	6.7	39.6	49.1	74.0	24.9	100	355
4	9772.000	38.6	36.7	7.9	39.9	43.3	74.0	30.7	150	0
----- Vertical -----										
5	2428.000	45.6	28.6	5.7	39.5	40.4	74.0	33.6	100	0
6	4876.000	48.9	33.7	5.8	39.8	48.6	74.0	25.4	150	359
7	7324.000	47.3	35.2	6.7	39.6	49.6	74.0	24.4	200	0
8	9772.000	37.3	36.7	7.9	39.9	42.0	74.0	32	150	174

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Tabulated Test Data – Middle Channel

* Spurious emissions that 20 dB below the limits didn't be recorded

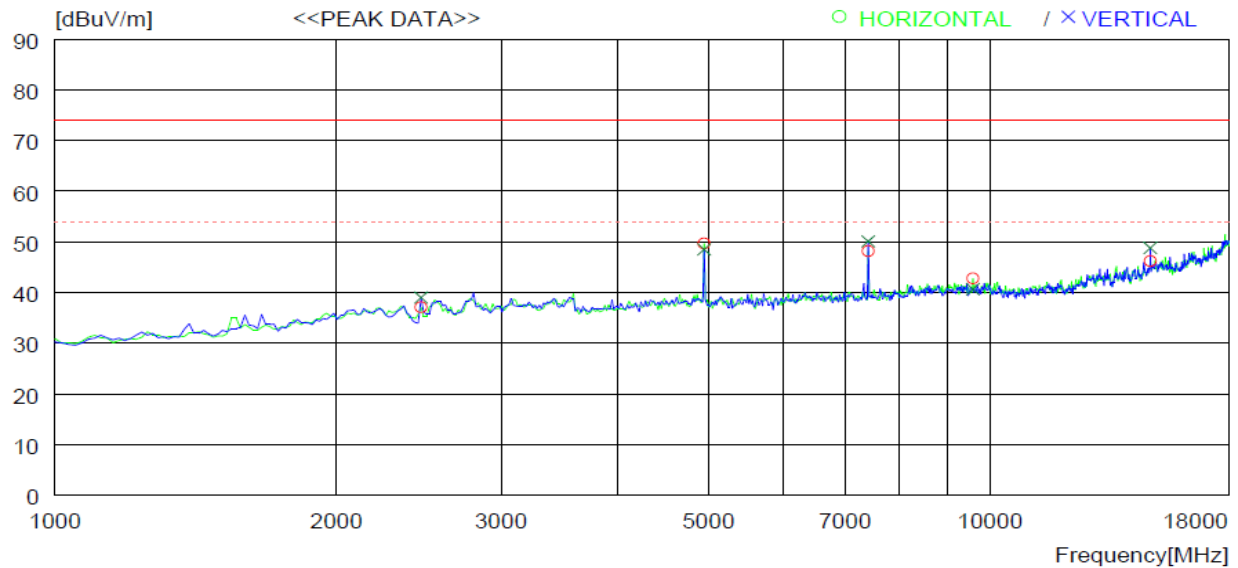
Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit - Result

Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2462.000	42.0	28.7	5.9	39.5	37.1	74.0	36.9	100	359
2	4944.000	49.9	33.8	5.8	39.8	49.7	74.0	24.3	100	65
3	7409.000	45.9	35.2	6.7	39.6	48.2	74.0	25.8	150	16
4	9585.000	38.3	36.6	7.9	40.0	42.8	74.0	31.2	200	197
5	14838.000	37.0	40.3	10.1	41.2	46.2	74.0	27.8	200	359
----- Vertical -----										
6	2462.000	43.9	28.7	5.9	39.5	39.0	74.0	35	100	0
7	4944.000	48.7	33.8	5.8	39.8	48.5	74.0	25.5	100	0
8	7409.000	47.8	35.2	6.7	39.6	50.1	74.0	23.9	150	12
9	9585.000	36.2	36.6	7.9	40.0	40.7	74.0	33.3	150	130
10	14838.000	39.6	40.3	10.1	41.2	48.8	74.0	25.2	200	0

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Tabulated Test Data – High Channel

* Spurious emissions that 20 dB below the limits didn't be recorded

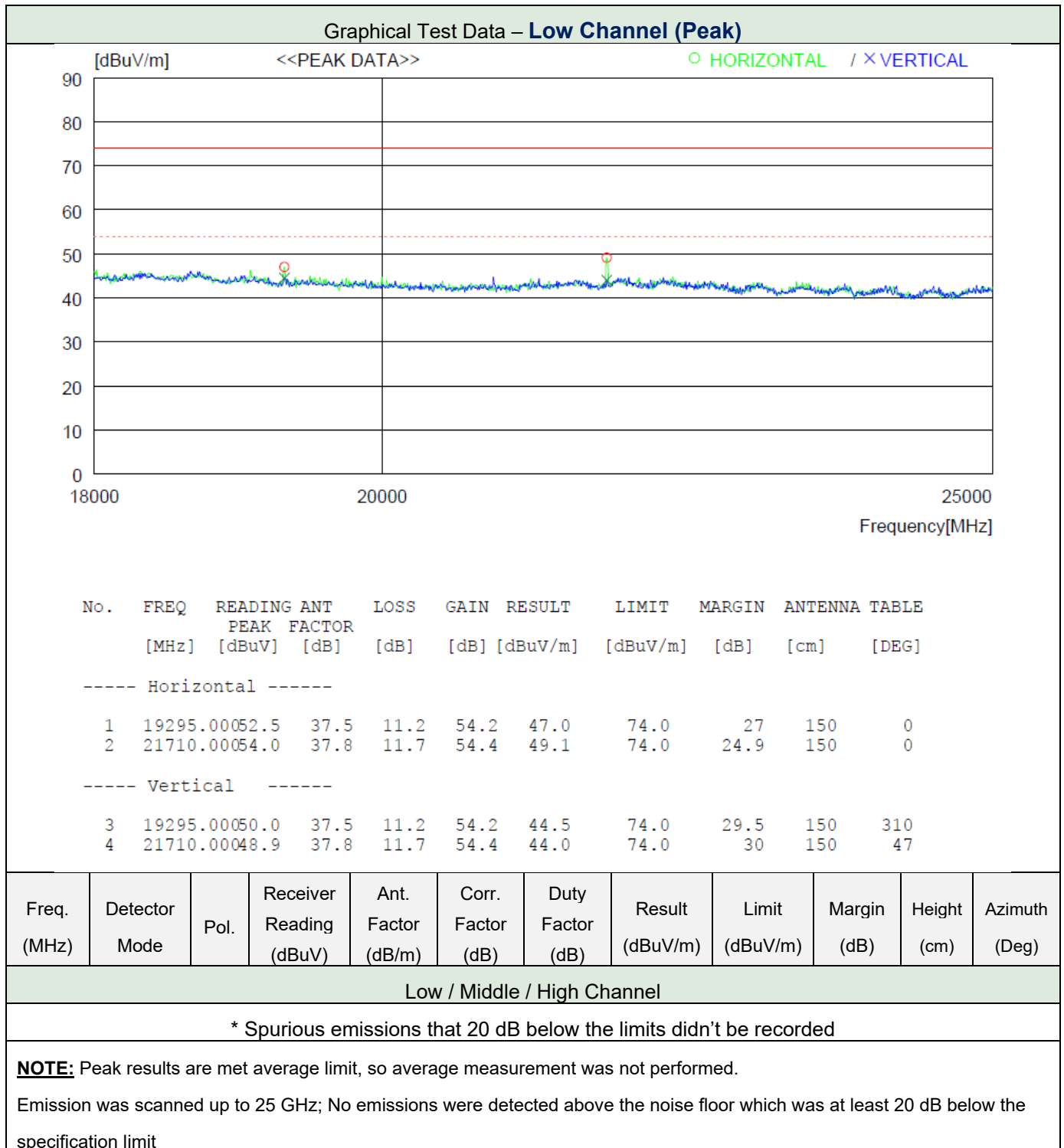
Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

5.6.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)



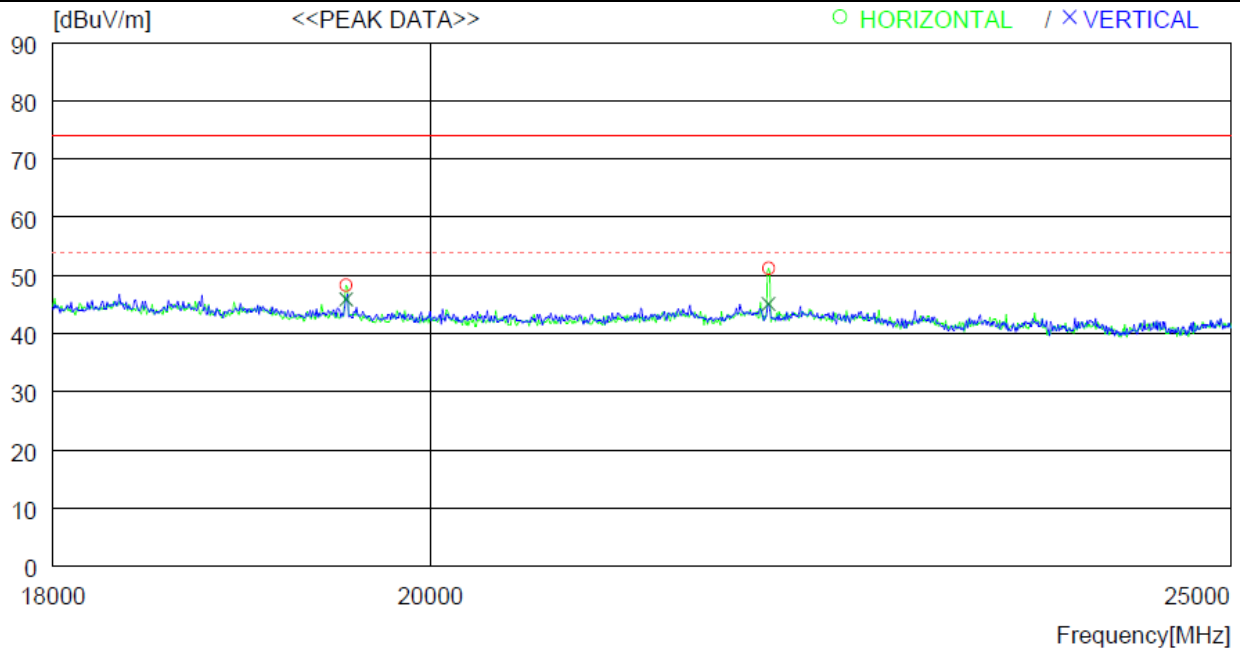
Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Graphical Test Data – Middle Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	19533.000	53.8	37.5	11.2	54.2	48.3	74.0	25.7	150	0
2	21976.000	55.9	37.9	11.9	54.5	51.2	74.0	22.8	150	0
----- Vertical -----										
3	19533.000	51.4	37.5	11.2	54.2	45.9	74.0	28.1	150	0
4	21976.000	49.8	37.9	11.9	54.5	45.1	74.0	28.9	100	54

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Low / Middle / High Channel

* Spurious emissions that 20 dB below the limits didn't be recorded

NOTE: Peak results are met average limit, so average measurement was not performed.

Emission was scanned up to 25 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

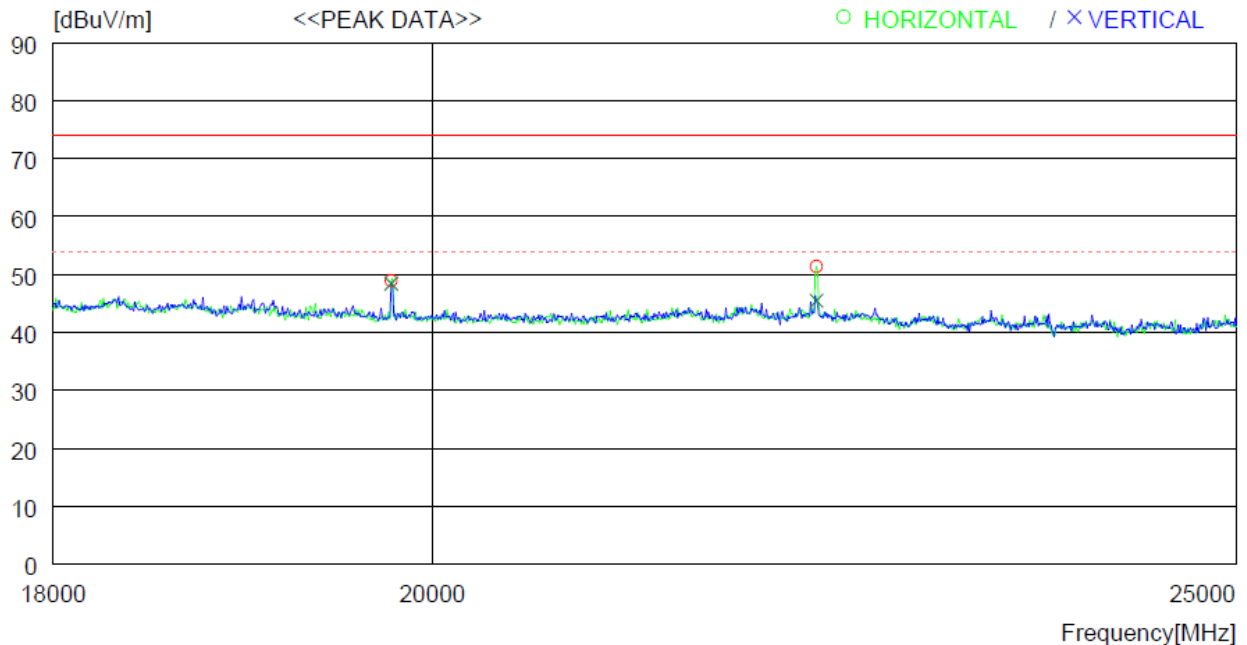
Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	TABLE [DEG]
----- Horizontal -----										
1	19771.00054.5	37.4	37.4	11.3	54.3	48.9	74.0	25.1	150	0
2	22249.00055.7	38.0	38.0	11.9	54.2	51.4	74.0	22.6	150	0
----- Vertical -----										
3	19771.00054.0	37.4	37.4	11.3	54.3	48.4	74.0	25.6	150	199
4	22249.00049.8	38.0	38.0	11.9	54.2	45.5	74.0	28.5	150	0

Freq. (MHz)	Detector Mode	Pol.	Receiver Reading (dBuV)	Ant. Factor (dB/m)	Corr. Factor (dB)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
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Low / Middle / High Channel

* Spurious emissions that 20 dB below the limits didn't be recorded

NOTE: Peak results are met average limit, so average measurement was not performed.

Emission was scanned up to 25 GHz; No emissions were detected above the noise floor which was at least 20 dB below the specification limit

Note. "H" means Horizontal polarity, "V" means Vertical polarity.

Corr. Factor (dB) = Pre-amplifier gain - Cable Loss

Result = Receiver Reading + Antenna Factor - Corr. Factor + Duty factor

Margin = Limit – Result

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal. Date	Cal. Interval
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2020-04-24	1 Y
Attenuator	56-10	58769	WEINSCHL	2020-01-22	1 Y
Test Receiver	ESU 26	100303	Rohde & Schwarz	2020-01-18	1 Y
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2021-04-22	2 Y
DC Power Supply	6032A	SG41000637	Agilent	2020-03-29	1 Y
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2021-09-17	2 Y
Horn Antenna	HF 907	102426	Rohde & Schwarz	2020-11-20	2 Y
Horn Antenna	BBHA 9170	BBHA 9170 #783	Schwarzbeck	2020-11-26	2 Y
Notch Filter	BRM50702	G318	MICRO-TRONICS	2019-11-08	1 Y
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2020-01-18	1 Y
Pre-Amplifier	310N	344015	Sonoma Instrument	2020-01-18	1 Y
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2020-04-19	1 Y
Pre-Amplifier	CBL18265035	28706	CERNEX	2020-04-01	1 Y
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	N/A	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	N/A	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/34130814/L	INNCO SYSTEM	N/A	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/34130814/L	INNCO SYSTEM	N/A	N/A

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