FCC Part 15
EMI TEST REPORT

of

E.U.T. : GS Digital Voice Pager
Model No. : GSX6XXX
FCC ID : LEA-GSX6XXX

for

APPLICANT : Unication Co., Ltd.
ADDRESS : 5F, No. 6, Wu-Kung 5Rd., Xinzhuang Dist., New Taipei City, Taiwan (R.O.C.)

Test Performed by

Taiwan Testing and Certification Center

No.34, Dingfu, Linkou Dist., New Taipei City 244, Taiwan (R.O.C.)

Tel:(02)26023052 Fax:(02)26010910

http://www.etc.org.tw ; e-mail : emc@etc.org.tw

Report Number :23-11-RBF-013-03

TEST REPORT CERTIFICATION

Applicant	:	Unication Co., Ltd. 5F, No. 6, Wu-Kung 5Rd., Xinzhuang Dist., New Taipei City, Taiwan (R.O.C.)
Manufacture	:	Unication Co., Ltd. 5F, No. 6, Wu-Kung 5Rd., Xinzhuang Dist., New Taipei City, Taiwan (R.O.C.)
Description of Device	:	
a) Type of EUT	:	GS Digital Voice Pager
b) Trade Name	:	Unication
c) Model No.	:	GSX6XXX
d) Power Supply	:	Input:100-240V, 50/60Hz, 0.28A Output:5V, 2A Li-Ion Bttery：DC 3.8V, 2800mAh, 10.64Wh
e) Frequency Range	:	BR 2402~2480MHz EDR 2402~2480MHz
g) Antenna Gain	:	1 dBi (chip ANT)
h) Modulation Type	:	FHSS

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C

I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.10-2013, and the energy emitted by the device was found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these data.

Note: 1. The result of the testing report relates only to the item tested.
2. The testing report shall not be reproduced except in full, without the written approval of ETC.

Summary of Tests

Test	Results
Radiated Emission	**Pass**
Conducted Emission	**Pass**
Hopping Channel Separation	**Pass**
Number of Hopping frequencies used	**Pass**
Hopping Channel Bandwidth	**Pass**
Dwell Time of each frequency	**Pass**
Output Power Requirement	**Pass**
100 kHz Bandwidth of Frequency Band Edges Requirement	**Pass**
Out-of-Band Conducted Emission Requirement	**Pass**
Duty Cycle	**Pass**

Date Test Item Received **:** *Nov. 22, 2023*
Date Test Campaign Completed **:** *Nov. 29, 2023*
Date of Issue **:** *Jan. 24, 2023*

Test Engineer **:** Vincent Chang
(Vincent Chang, Engineer)

Approve & Authorized **:** Kevin Lee
Kevin Lee, Section Manager
EMC Dept. II of TAIWAN TESTING AND CERTIFICATION CENTER

Table of Contents Page

1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT	:	GS Digital Voice Pager
b) Trade Name	:	Unication
c) Model No.	:	GSX6XXX
d) Power Supply	:	Input:100-240V , 50/60Hz , 0.28A Output:5V , 2A Li-Ion Bttery：DC 3.8V , 2800mAh , 10.64Wh
e) Frequency Range	:	BR 2402~2480MHz EDR 2402~2480MHz
f) Modulation	:	FHSS (DQPSK and 8DPSK)
g) Antenna Type/Gain	:	Chip Antenna ; 1 dBi

1.2 Test Methodology

Both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.10-2013. Other required measurements were illustrated in separate sections of this test report for details. For RF test the measurement procedure was refered to FCC KDB 558074 D01 15.247 Meas Guidance v05r02

Measueement Software

Software	Version	Note
e3	Version 6.100618f	Radiated Emission Test
e3	Version 6.100421	Conducted Emission Test

1.3 Test Facility

Location of the Test site: No.34, Lin 5, Dingfu Vil., Linkou Dist., New Taipei City, Taiwan 24442, R.O.C.
Designation Number: TW2628.

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:
A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:
A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :
A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency MHz	Quasi Peak dBμV	Average dBμV
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

* Decreases with the logarithm of the frequency

For intentional device, according to §15.207(a) Line Conducted Emission Limits is same as above table.

(2) Radiated Emission Requirement

For unintentional device, according to §15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dBμV/m	Radiated μV/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
Above 960	3	54.0	500

For intentional device, according to §15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to §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.

(4) Hopping Channel Separation

According to 15.247(a)(1), 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, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

(5) Number of Hopping frequencies used

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

(6) Hopping Channel Bandwidth

For frequency hopping system operating in the 2400–2483.5 MHz band, there is no requirement for the maximum 20dB bandwidth of the hopping channel. The measurement of the hopping channel bandwidth is for the reference of the hopping channel separation requirement.

(7) Dwell Time of each frequency

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2400-2483.5 band, 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.

(8) Output Power Requirement

According to 15.247(b)(1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

(9) 100 kHz Bandwidth of Frequency Band Edges Requirement

According to 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.

(10) Out-of-Band Conducted Emission Requirement

According to 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.

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
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	2655-2900	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	3360-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

In the users manual, the Federal Communications Commission Radio Frequency Interference Statement

includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-- Reorient or relocate the receiving antenna.

-- Increase the separation between the equipment and receiver.

-- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

-- Consult the dealer or an experienced radio / TV technician for help.

2.6 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	Frequency	Uncertainty
Conducted emissions	9kHz ~ 30MHz	±2.22dB (Mains)(LISN)
Radiated emissions	9kHz ~ 30MHz	±4.22dB
Radiated emissions	30MHz ~ 1GHz	±4.2dB (30MHz≦f≦300MHz)
		±4.44dB (300MHz＜f≦1GHz)
	Above 1GHz	±4.44dB (1GHz≦f≦18GHz)
		±3.02dB (18GHz≦f≦40GHz)
Conducted Measurement	9kHz ~ 40GHz	±0.88dB (9kHz≦f≦30MHz)
		±0.88dB (30MHz＜f≦1GHz)
		±1.04dB (1GHz≦f≦18GHz)
		±1.2dB (18GHz≦f≦40GHz)
Frequencies Tolerance	9kHz ~ 40GHz	$\pm 4.04\times10^{-8}$
Occupied Bandwidth	9kHz ~ 40GHz	±5%

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
The test result(s) does not consider the uncertainty of measurement when the test standard(s) and/or test method which refer by the labs has the limit or judgments for the test result(s).

3 SYSTEM TEST CONFIGURATION

3.1 Justification

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in

☐ lie-down position (X axis) /
☐ lie-down position (Y axis) /
■ stand-up position (Z axis) /

and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate or Mode below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

Band	Mode
Bluetooth	BR
Bluetooth	EDR

For conducted and radiated spurious emissions, whichever RF channel is operated, the digital circuits function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with BR channel 2480MHz (Max Power) by transmitting mode.

3.2 Devices for Tested System

EUT & accessories.

Device	Manufacture	Model	Description
GS Digital Voice Pager *	Unication Co., Ltd.	GSX6XXX	---
Li – Ion Battery	Unication	T65G428001A-R	DC 3.8V , 2800mAh , 10.64Wh
USB-A to Type-B Cable	Showell	SWLS107-150702	2.0m Unshielded 2-Core Cable
Charge ADAPTER	GME	GME10C-050200FUu	Input:100-240V , 50/60Hz , 0.28A Output:5V , 2A

Remark "*" means equipment under test.

The EUT connected with the following peripheral devices.

Device	Manufacture	Model	Description
NoteBook	Lenovo YOGA 310-11IAP	80U2	1.5m Unshielded Adapter

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For unintentional radiator, the radiated emission shall comply with §15.109(a).
For intentional radiators, according to §15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with §15.247 (c)

4.2 Measurement Procedure

A. Preliminary Measurement For Portable Devices

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

B. Final Measurement

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz and above 1 GHz, testing in a 966 RF shielded chamber #2.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0◦ to 360◦ with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

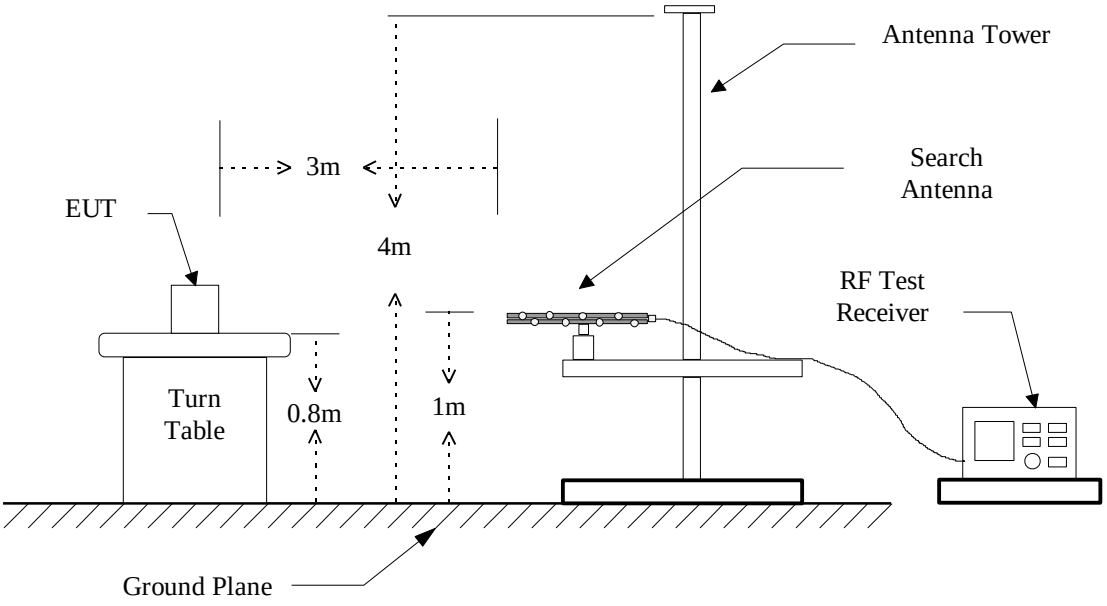
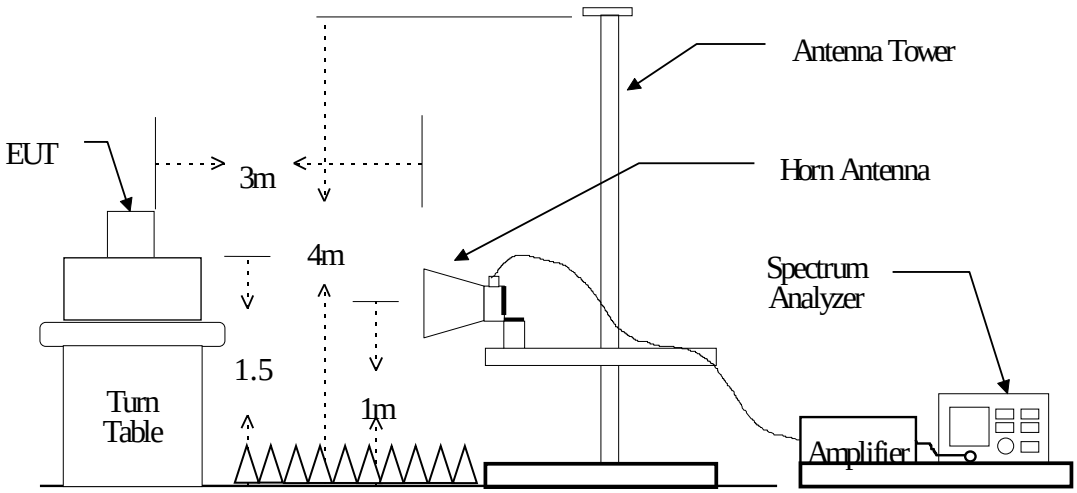


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESU 40	2023/03/03	2024/03/02
Bi-Log Antenna	ETC	MCTD 2786 & FATS-NM5NF5S3 G2W5	2023/09/13	2024/09/12
Horn Antenna	ETS-Lindgren	3117	2023/03/23	2024/03/22
Horn Antenna	EMCO	3116	2023/08/21	2024/08/20
Amplifier	HP	8447D	2023/07/17	2024/07/16
Amplifier	HP	8449B	2023/10/17	2024/10/16

Measuring instrument setup in measured frequency band when specified detector function is used :

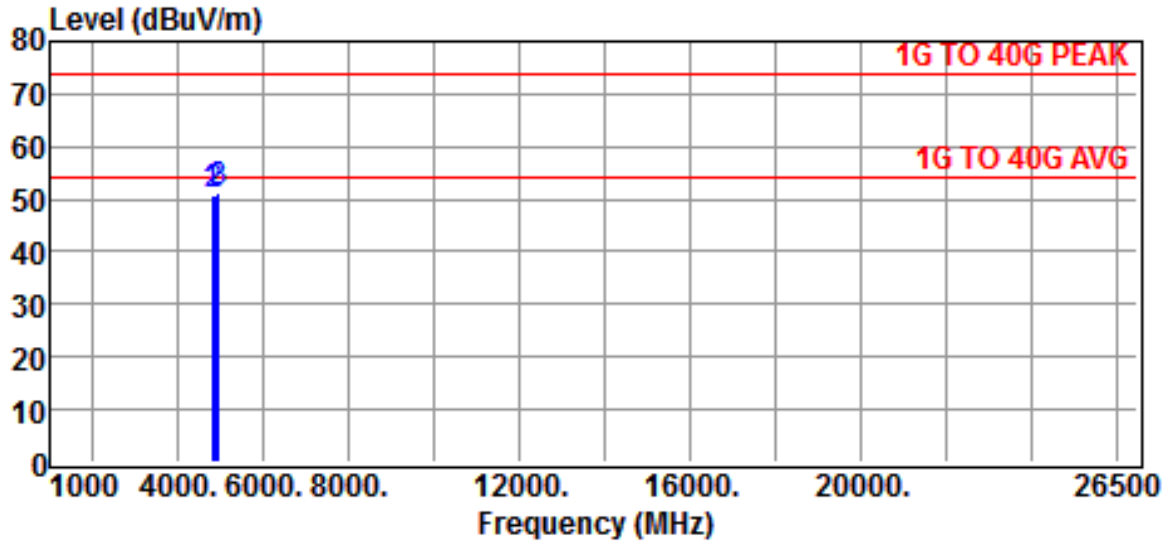
Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz or ≥ 1/T (Note 1)

Note 1:
VBW = 10 Hz, when the duty cycle is no less than 98%.
VBW ≥ 1/T, when duty cycle is less than 98% 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.

4.4 Radiated Emission Data

4.4.1 Tx Portion

A. BR



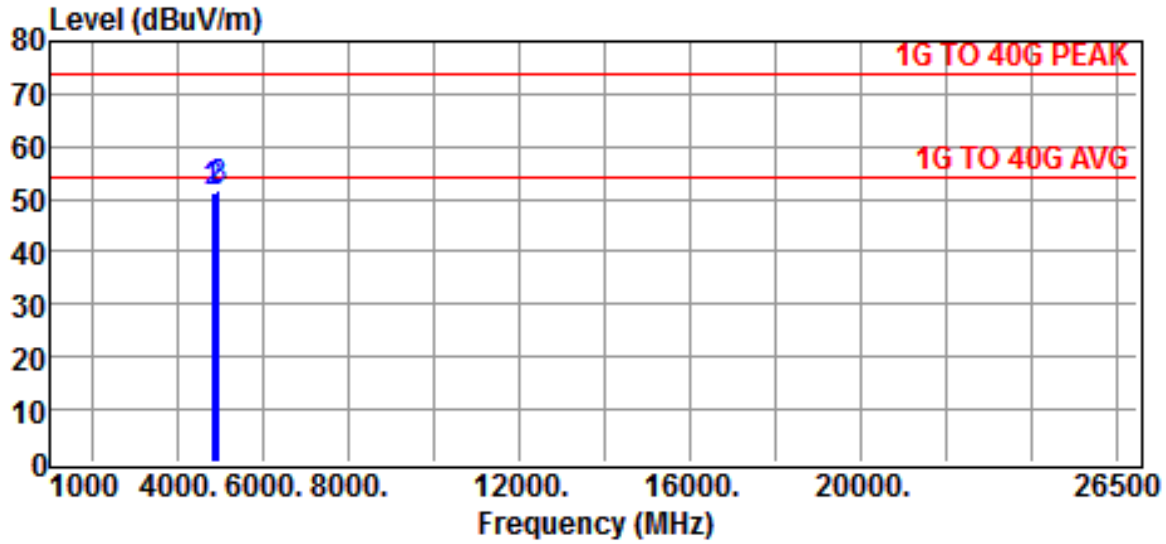
Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:BR		

TX RX - 2402 / 2441 / 2480MHz

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	4804.0000	46.75	4.04	50.79	74.00	-23.21	Peak
	4882.0000	46.73	4.08	50.81	74.00	-23.19	Peak
*	4960.0000	46.80	4.28	51.08	74.00	-22.92	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.



Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:BR		

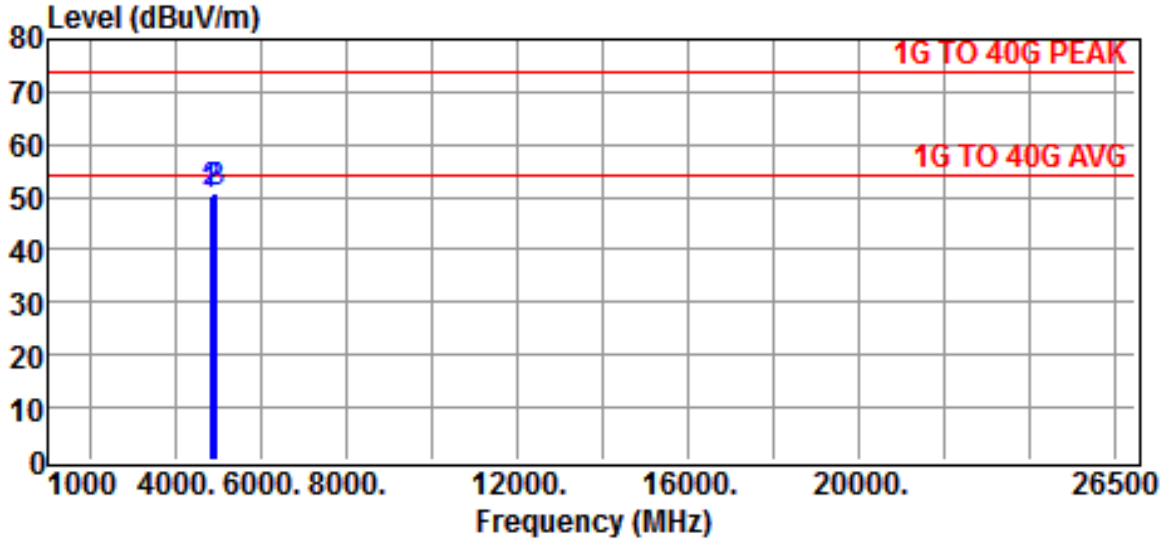
TX RX - 2402 / 2441 / 2480MHz

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	4804.0000	47.03	4.04	51.07	74.00	-22.93	Peak
	4882.0000	47.03	4.08	51.11	74.00	-22.89	Peak
*	4960.0010	47.49	4.28	51.77	74.00	-22.23	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

B. EDR



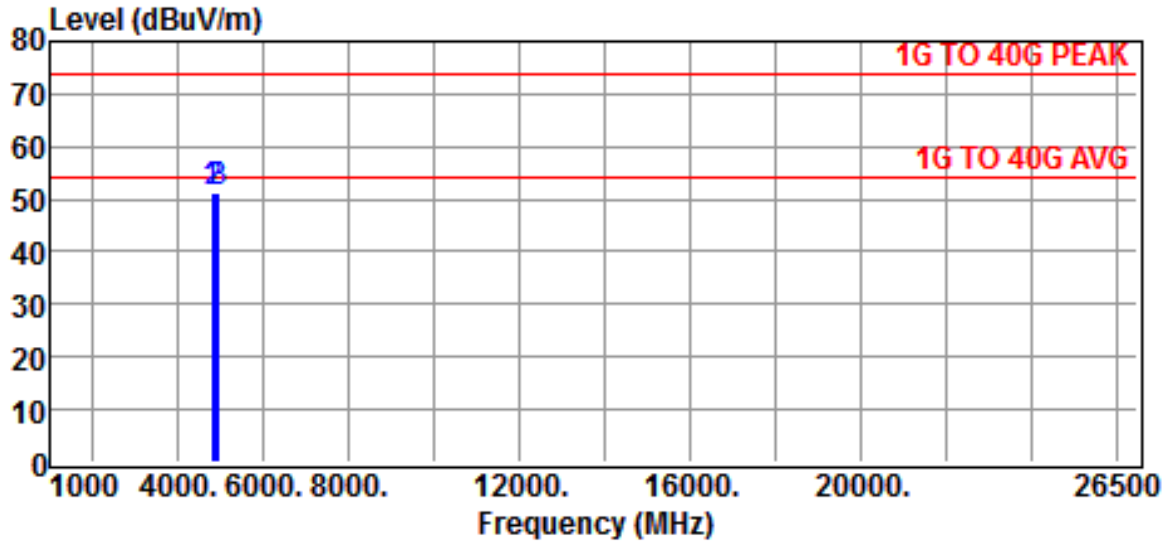
Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:EDR		

TX RX - 2402 / 2441 / 2480MHz

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	4804.0000	46.47	4.04	50.51	74.00	-23.49	Peak
	4882.0000	46.54	4.08	50.62	74.00	-23.38	Peak
*	4960.0000	46.60	4.28	50.88	74.00	-23.12	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.



Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:EDR		

TX RX - 2402 / 2441 / 2480MHz

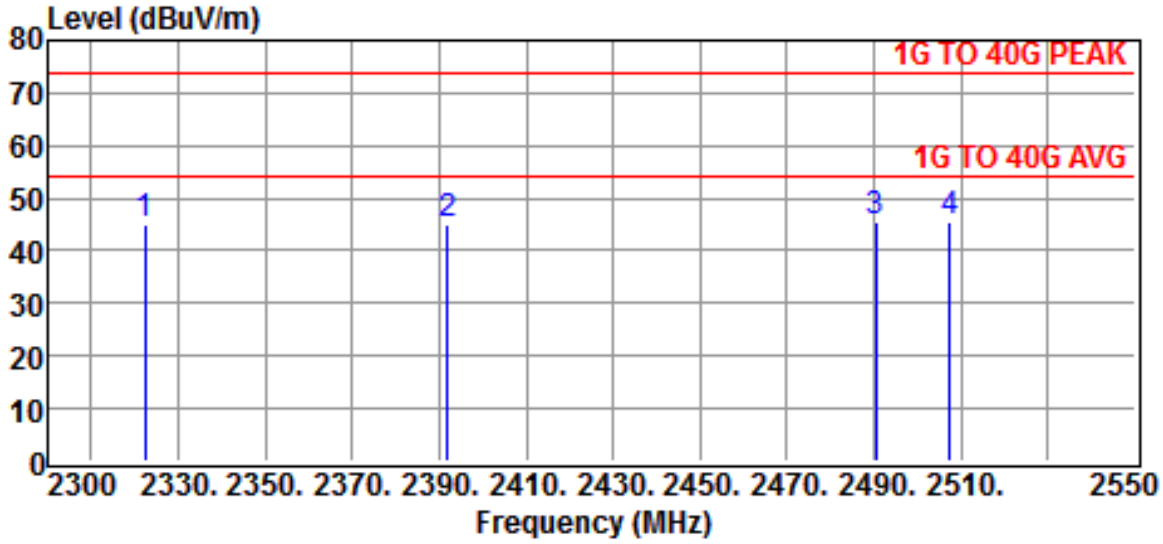
	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	4804.0000	47.15	4.04	51.19	74.00	-22.81	Peak
	4882.0000	47.23	4.08	51.31	74.00	-22.69	Peak
*	4960.0000	47.18	4.28	51.46	74.00	-22.54	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

4.4.2 Radiated Emissions in Restricted Bands

A. BR



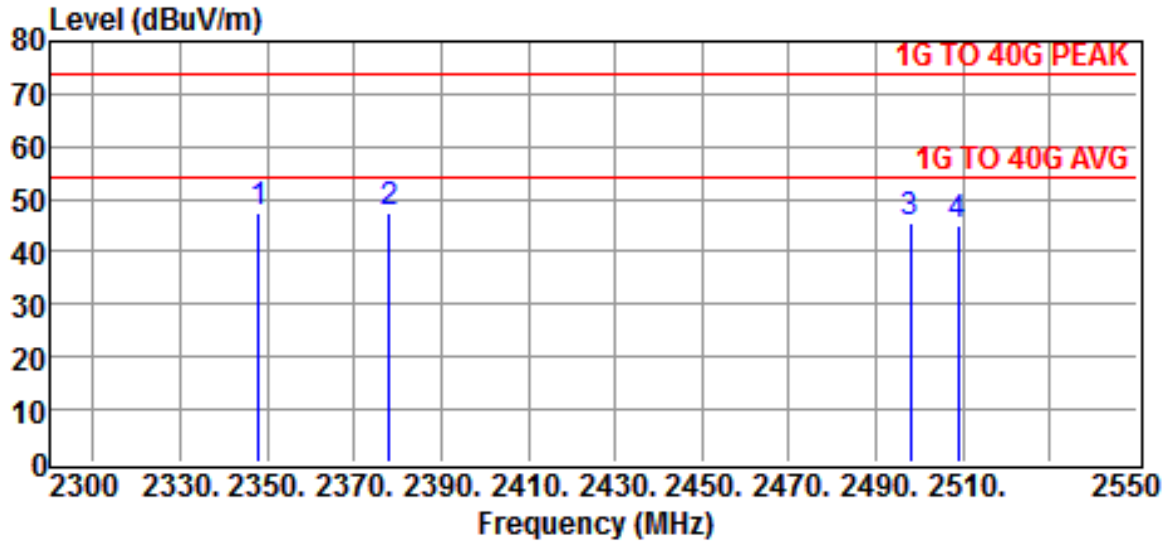
Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23 ˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:BR		

Restricted bands

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	2322.5000	45.60	-0.72	44.88	74.00	-29.12	Peak
	2392.0000	45.65	-0.62	45.03	74.00	-28.97	Peak
	2490.5000	46.38	-0.94	45.44	74.00	-28.56	Peak
*	2507.5000	46.37	-0.77	45.60	74.00	-28.40	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.



Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:BR		

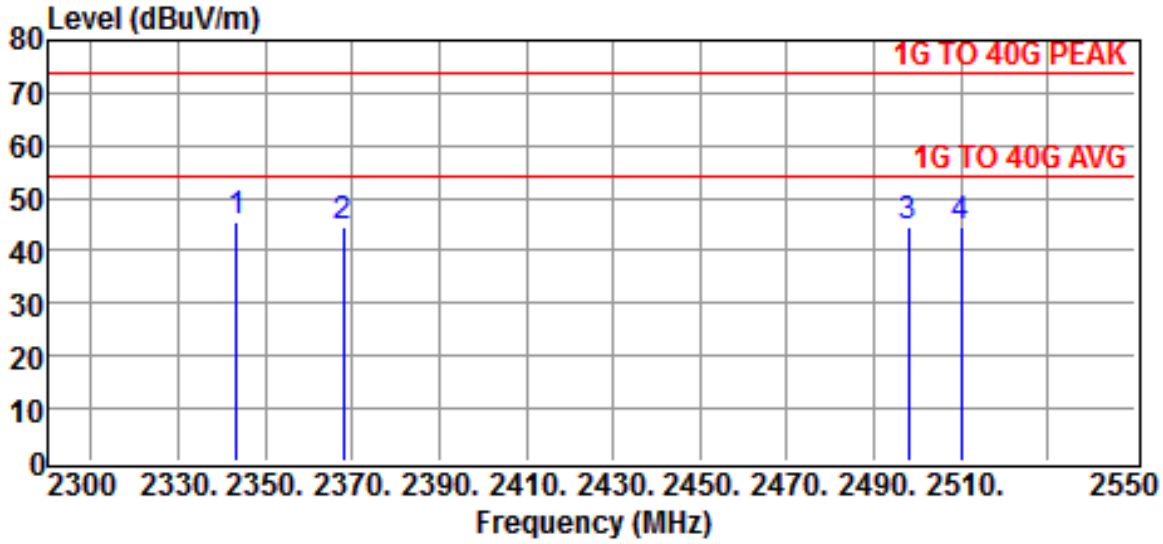
Restricted bands

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	2348.0000	47.87	-0.61	47.26	74.00	-26.74	Peak
*	2378.0000	48.05	-0.59	47.46	74.00	-26.54	Peak
	2498.0000	46.42	-0.86	45.56	74.00	-28.44	Peak
	2509.0000	45.99	-0.74	45.25	74.00	-28.75	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

B. EDR



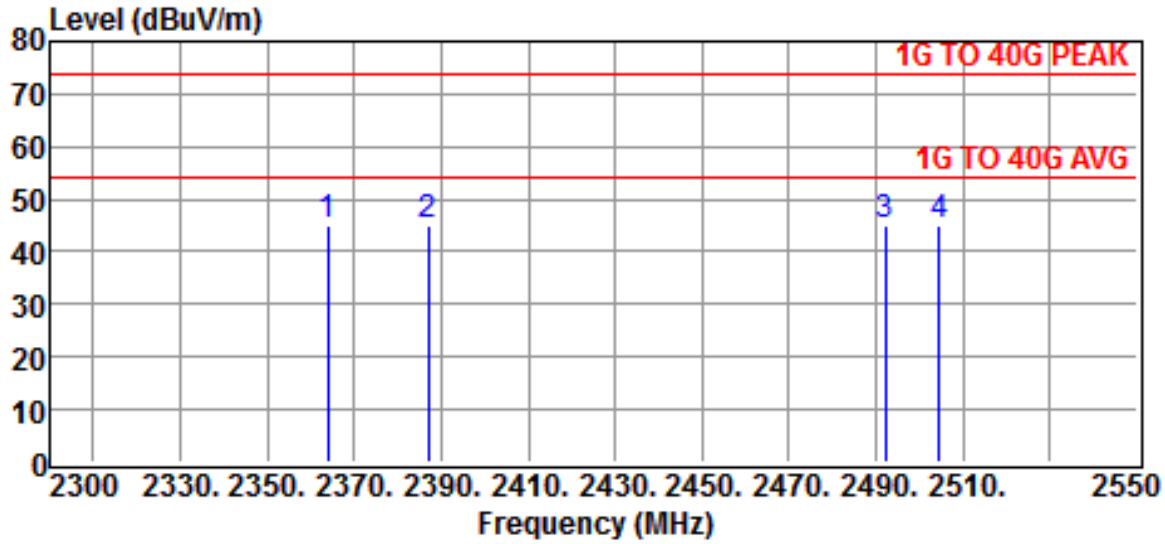
Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23 ˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:EDR		

Restricted bands

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
*	2343.5000	45.96	-0.61	45.35	74.00	-28.65	Peak
	2368.0000	45.23	-0.62	44.61	74.00	-29.39	Peak
	2498.0000	45.51	-0.86	44.65	74.00	-29.35	Peak
	2510.0000	45.47	-0.73	44.74	74.00	-29.26	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.



Site	:Chamber #2	Date	:2023-11-29
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:68 %
Test Mode	:EDR		

Restricted bands

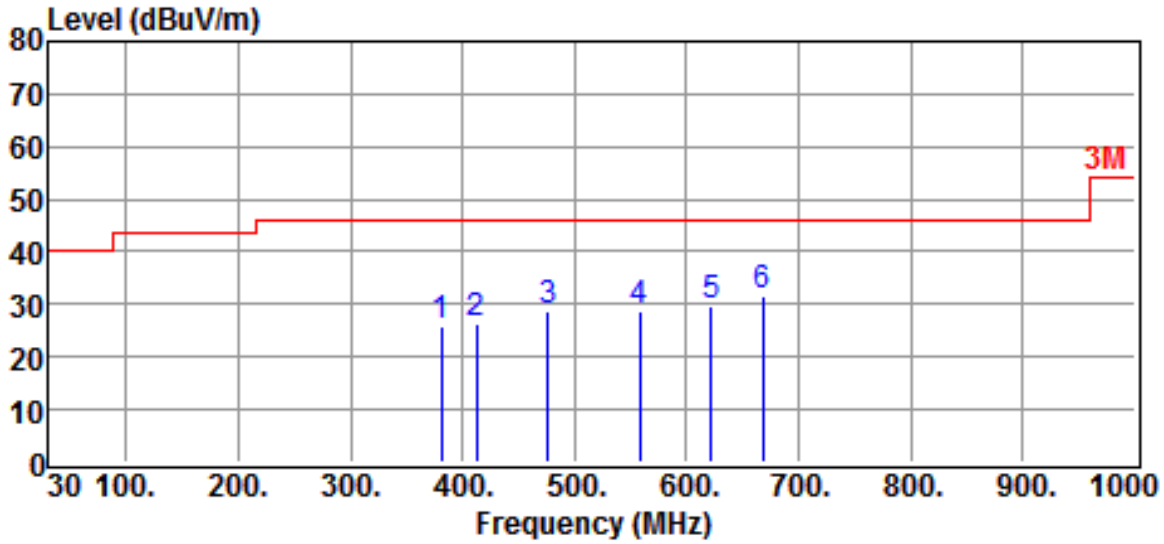
	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
*	2364.0000	45.75	-0.66	45.09	74.00	-28.91	Peak
	2387.0000	45.59	-0.58	45.01	74.00	-28.99	Peak
	2492.0000	45.75	-0.92	44.83	74.00	-29.17	Peak
	2504.5000	45.80	-0.80	45.00	74.00	-29.00	Peak

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

4.4.3 Other Emissions

a) Emission frequencies below 1 GHz

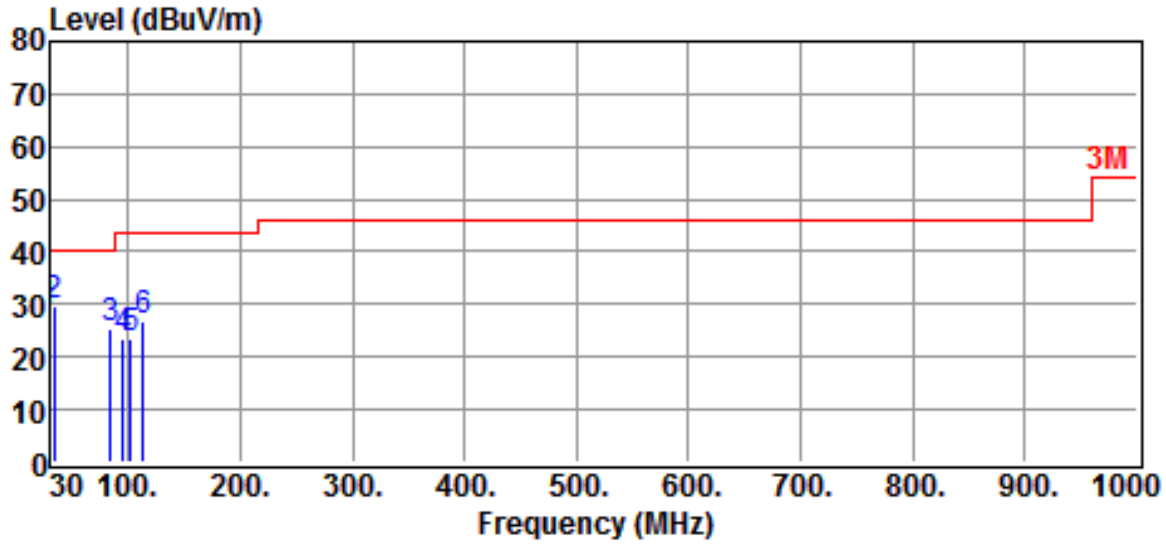


Site	:Chamber #2	Date	:2023-11-23
Limit	:3M	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:65 %
Test Mode	:Charge Mode		

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	381.1400	30.47	-4.62	25.85	46.00	-20.15	QP
	412.1800	30.47	-4.24	26.23	46.00	-19.77	QP
	476.2000	31.84	-3.29	28.55	46.00	-17.45	QP
	557.6800	30.63	-2.05	28.58	46.00	-17.42	QP
	621.7000	30.68	-1.07	29.61	46.00	-16.39	QP
*	668.2600	30.85	0.61	31.46	46.00	-14.54	QP

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

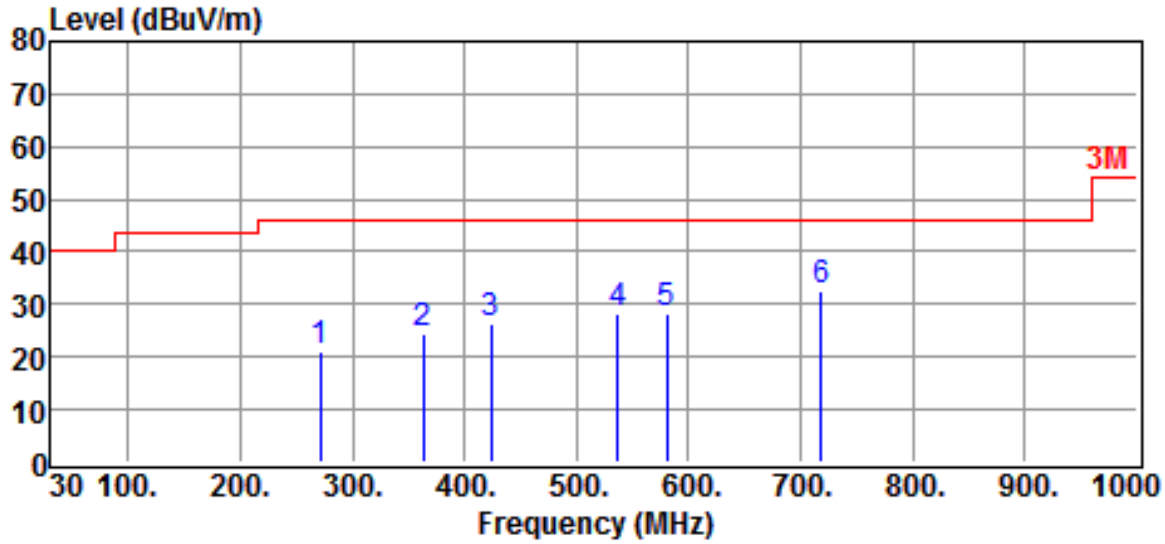


Site	:Chamber #2	Date	:2023-11-23
Limit	:3M	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:65 %
Test Mode	:Charge Mode		

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	30.0000	32.45	-3.93	28.52	40.00	-11.48	QP
*	33.8800	35.67	-5.76	29.91	40.00	-10.09	QP
	84.3200	40.82	-15.21	25.61	40.00	-14.39	QP
	95.9600	37.14	-13.55	23.59	43.50	-19.91	QP
	101.7800	36.57	-12.95	23.62	43.50	-19.88	QP
	113.4200	38.54	-11.90	26.64	43.50	-16.86	QP

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

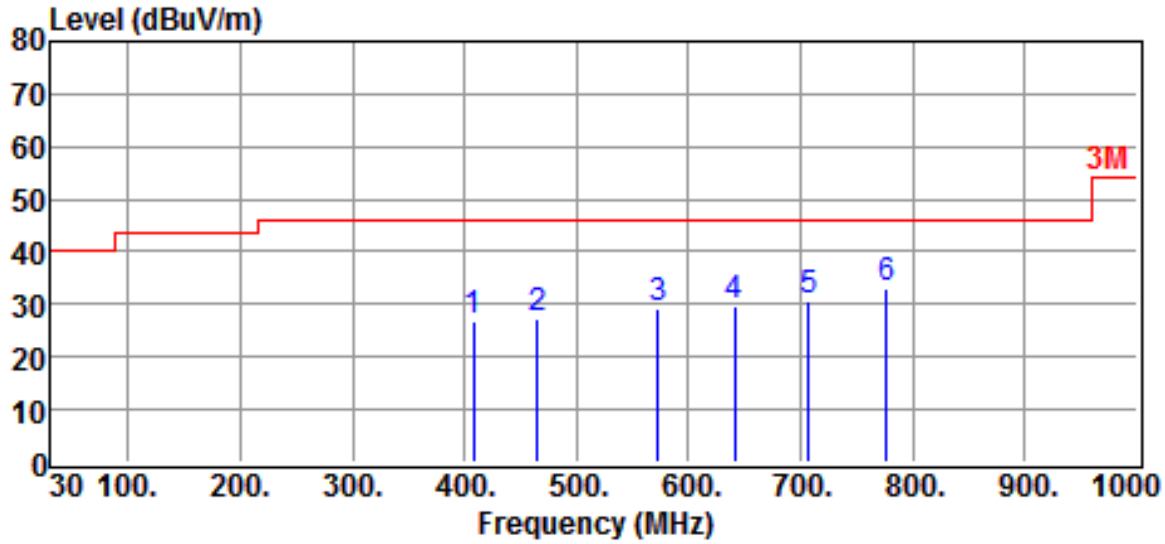


Site	:Chamber #2	Date	:2023-11-23
Limit	:3M	Ant. Pol.	:HORIZONTAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:65 %
Test Mode	:BT (BR 2480MHz - Worse)		

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	271.5300	29.22	-8.22	21.00	46.00	-25.00	QP
	363.6800	29.55	-5.18	24.37	46.00	-21.63	QP
	423.8200	30.69	-4.18	26.51	46.00	-19.49	QP
	536.3400	30.98	-2.59	28.39	46.00	-17.61	QP
	580.9600	30.55	-2.20	28.35	46.00	-17.65	QP
*	718.7000	31.63	0.85	32.48	46.00	-13.52	QP

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.



Site	:Chamber #2	Date	:2023-11-23
Limit	:3M	Ant. Pol.	:VERTICAL
EUT	:GS Digital Voice Pager	Model	:GSX6XXX
Power Rating	:Battery	Temp.	:23˚C
Engineer	:Vincent	Humi.	:65 %
Test Mode	:BT (BR 2480MHz - Worse)		

	Freq MHz	Reading dBuV	Correction Factor dB/m	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
	408.3000	31.19	-4.31	26.88	46.00	-19.12	QP
	465.5300	30.75	-3.63	27.12	46.00	-18.88	QP
	573.2000	31.26	-2.15	29.11	46.00	-16.89	QP
	641.1000	30.31	-0.39	29.92	46.00	-16.08	QP
	707.0600	30.12	0.68	30.80	46.00	-15.20	QP
*	776.9000	31.46	1.53	32.99	46.00	-13.01	QP

Note :

1. Result = Reading + Correction Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Correction Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
4. The margin value=Limit - Result
5. Above 1Ghz : Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.
6. ” * ” mean this data is the worst emission level.

b) Emission frequencies above 1 GHz

According to exploratory test no any obvious emission were detected from above 1 GHz.

c) Emission frequencies below 30MHz (9kHz - 30MHz)

According to exploratory test no any obvious emission were detected from 9kHz to 30MHz. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test 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 based on KDB 414788.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss (if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

Result = Reading + Corrected Factor

where Corrected Factor

= Antenna FACTOR + Cable Loss + High Pass Filter Loss - Amplifier Gain

5 CONDUCTED EMISSION MEASUREMENT

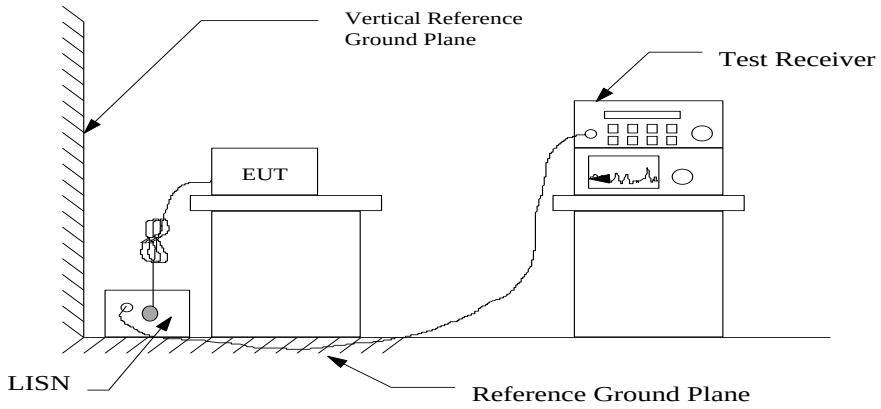
5.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to §15.107(a) and §15.207(a) respectively. Both Limits are identical specification.

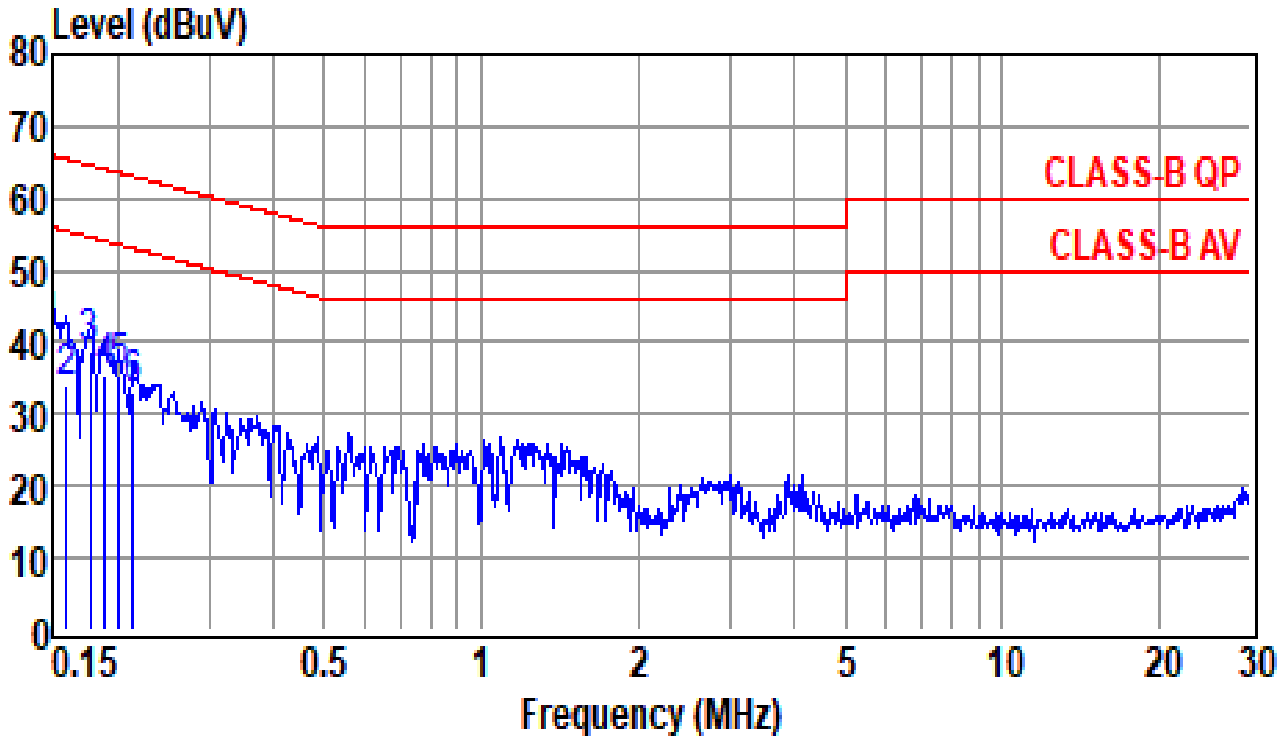
5.2 Measurement Procedure

1. Setup the configuration per figure 3.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 6 or 8 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 3 : Conducted emissions measurement configuration



5.3 Conducted Emission Data

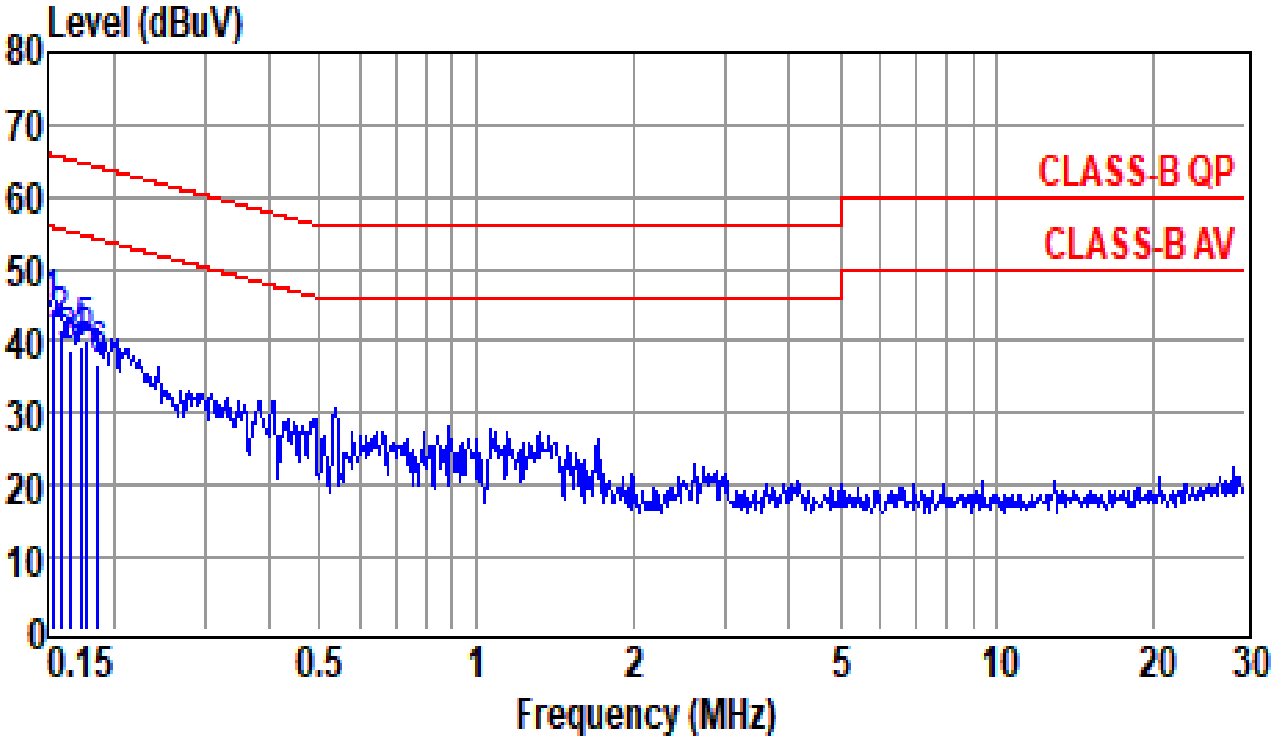


Site	: conducted #1	Date	: 2023-11-23
Condition	: CLASS-B QP	LISN	: NEUTRAL
Tem / Hum	: 21 ℃ / 68%	Test Mode	: Charge Mode
EUT	: GS Digital Voice Pager	Power Rating	: 120V / 60Hz
Model	: GSX6XXX	Engineer	: Vincent

	Freq (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Remark
*	0.1500	31.49	9.63	41.12	66.00	-24.88	QP
	0.1599	24.56	9.64	34.20	65.47	-31.27	QP
	0.1777	28.94	9.63	38.57	64.59	-26.02	QP
	0.1894	26.02	9.63	35.65	64.06	-28.41	QP
	0.2018	25.64	9.63	35.27	63.54	-28.27	QP
	0.2151	23.21	9.63	32.84	63.01	-30.17	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss
3. ” * ” mean this data is the worst emission level



Site	: conducted #1	Date	: 2023-11-23
Condition	: CLASS-B QP	LISN	: LINE
Tem / Hum	: 21 ℃ / 68%	Test Mode	: Charge Mode
EUT	: GS Digital Voice Pager	Power Rating	: 120V / 60Hz
Model	: GSX6XXX	Engineer	: Vincent

	Freq (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Remark
*	0.1532	34.34	9.62	43.96	65.82	-21.86	QP
	0.1590	32.15	9.62	41.77	65.52	-23.75	QP
	0.1650	28.97	9.62	38.59	65.21	-26.62	QP
	0.1731	29.43	9.62	39.05	64.81	-25.76	QP
	0.1777	30.68	9.62	40.30	64.59	-24.29	QP
	0.1874	27.19	9.62	36.81	64.15	-27.34	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss
3. ” * ” mean this data is the worst emission level

5.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

RESULT = READING + LISN FACTOR

Assume a receiver reading of 22.5 dBμV is obtained, and LISN Factor is 0.1 dB, then the total of disturbance voltage is 22.6 dBμV.

RESULT = 22.5 + 0.1 = 22.6 dBμV
Level in μV = Common Antilogarithm[(22.6 dBμV)/20]
= 13.48 μV

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCI	2023/11/13	2024/11/12
LISN	Schwarzbeck	ENV 216	2023/05/18	2024/05/17
LISN	Shibasoku	563	2023/03/08	2024/03/06

6 ANTENNA REQUIREMENT

6.1 Standard Applicable

For intentional device, according to 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.

6.2 Antenna Construction

The chip antenna is permanently mounted on the main PCB.

Name: BT-Chip Antenna CAD01042440H11K
Brand: CHTTL
Antenna Type: Chip antenna
Peak Gain: 1 dBi
Part No.: CAD01042440H11K

For the more detail, please refer to the internal photos and the antenna specifications.

7 HOPPING CHANNEL SEPARATION

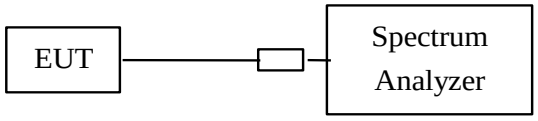
7.1 Standard Applicable

According to 15.247(a)(1), 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, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled. Then set it to any one convenient frequency within its operating range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peaks of two adjacent channels
   Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span
   Video (or Average) Bandwidth (VBW) ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

Figure 4 : Measurement configuration.



7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

7.4 Measurement Data

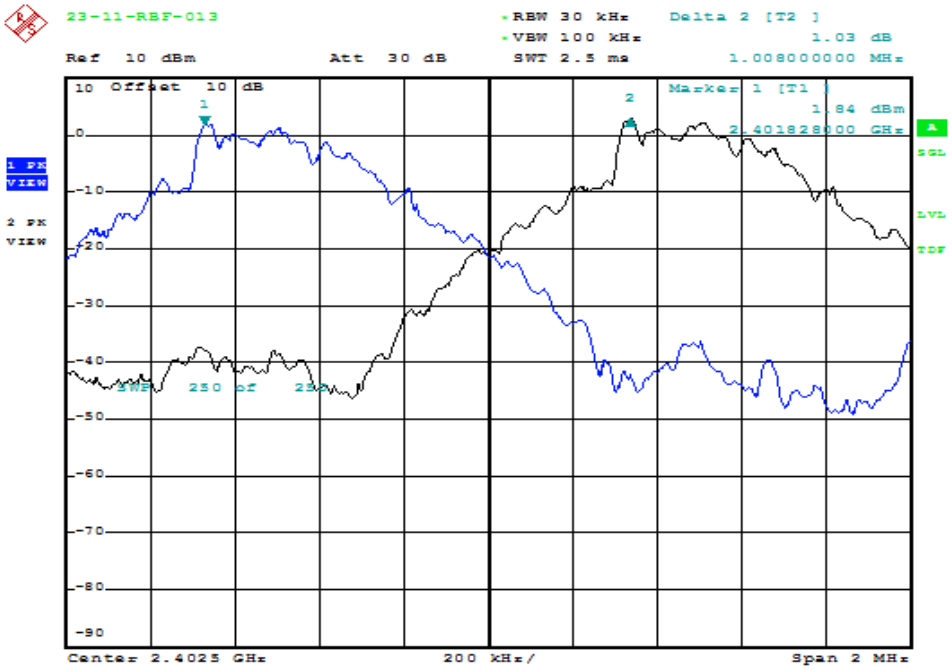
Test Date : Nov. 27 2023 Temperature : 23.2 °C Humidity : 71 %

Wireless Standards	Channel Low-Channel Separation (MHz)	Channel Middle-Channel Separation (MHz)	Channel High-Channel Separation (MHz)
Bluetooth-BR	1.008	0.996	1.000

Wireless Standards	Channel Low-Channel Separation (MHz)	Channel Middle-Channel Separation (MHz)	Channel High-Channel Separation (MHz)
Bluetooth-EDR	1.002	1.002	1.002

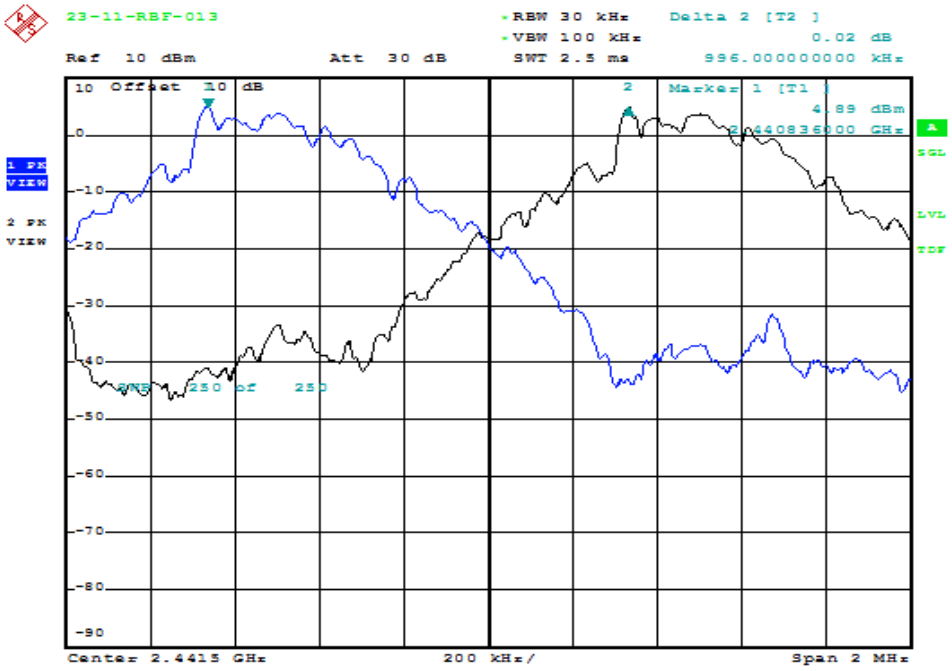
Mode: Bluetooth BR

Channel Low



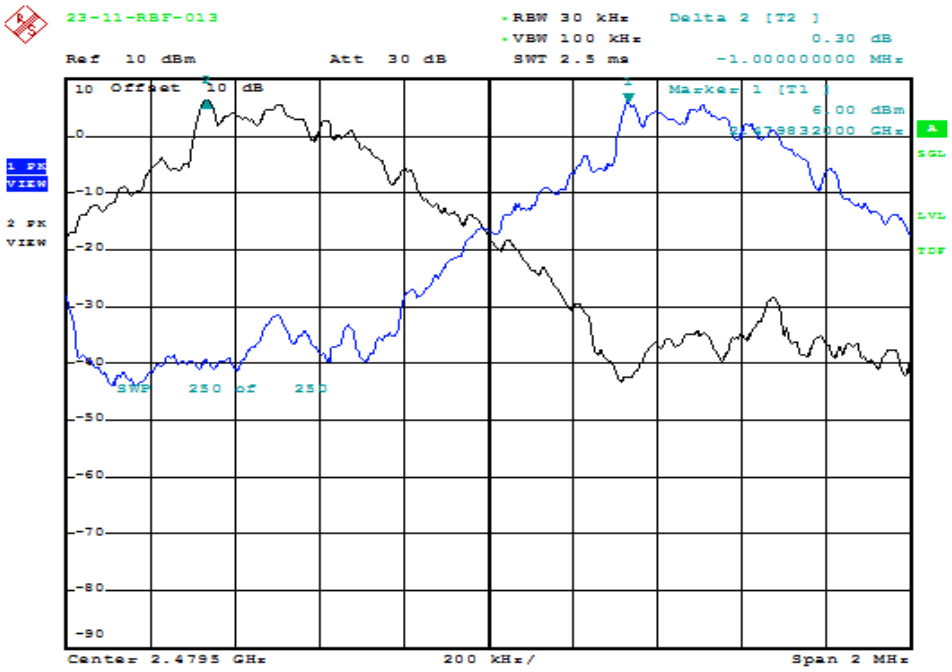
Date: 27.NOV.2023 08:32:46

Channel Middle



Date: 27.NOV.2023 08:39:13

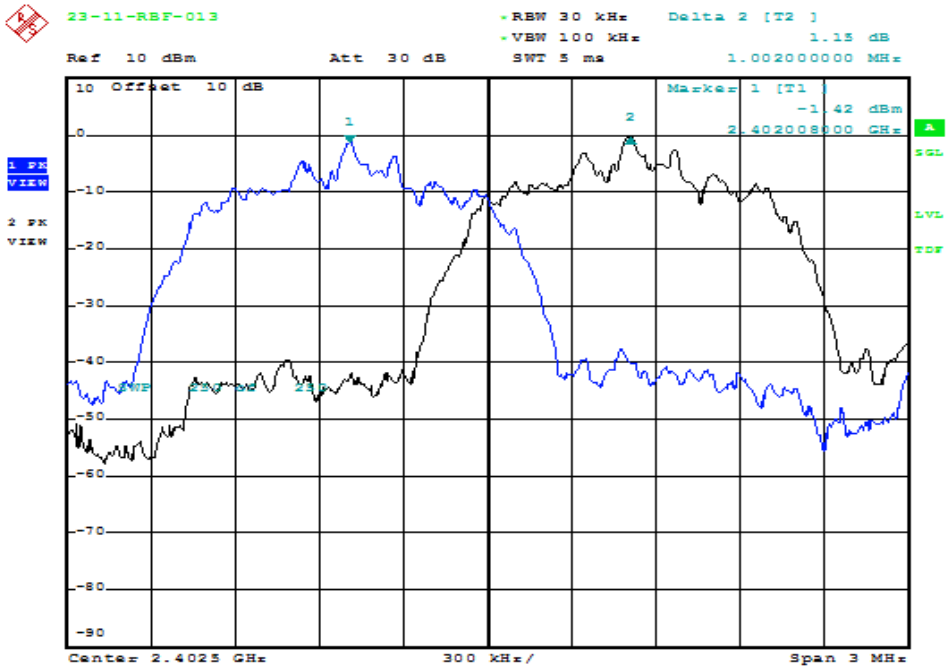
Channel High



Date: 27.NOV.2023 08:43:17

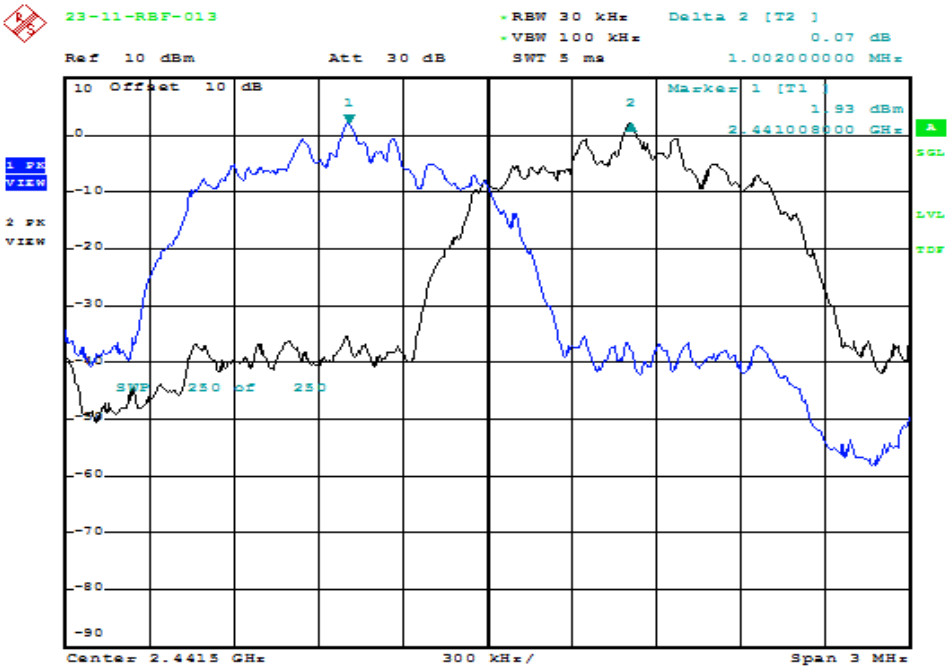
Mode: Bluetooth EDR

Channel Low



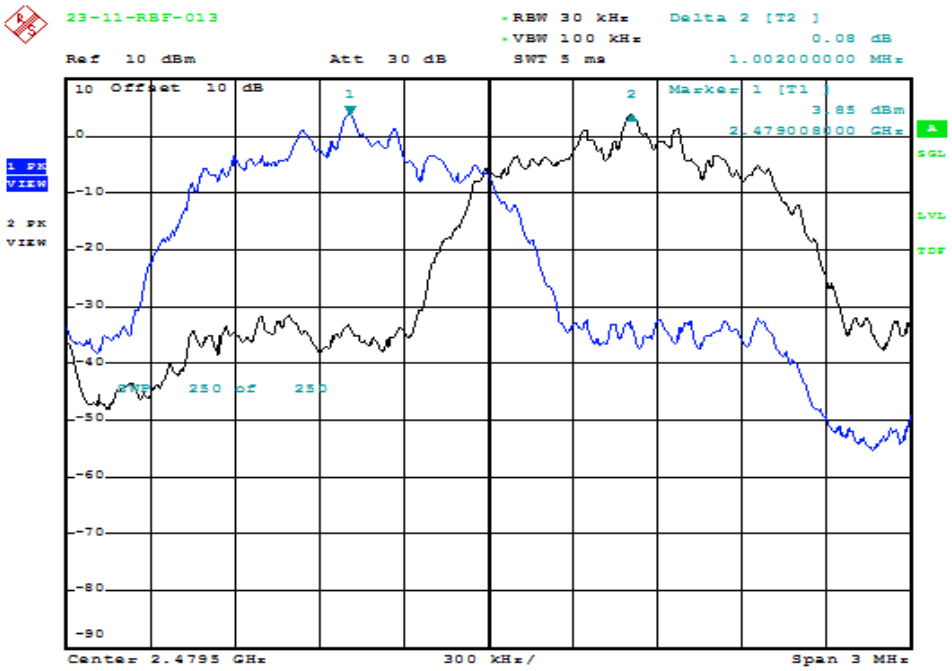
Date: 27.NOV.2023 09:13:48

Channel Middle



Date: 27.NOV.2023 09:21:35

Channel High



Date: 27.NOV.2023 09:24:51

8 NUMBER OF HOPPING FREQUENCY USED

8.1 Standard Applicable

According to 15.247(a)(1)(iii), frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:
   Span = the frequency band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

8.4 Measurement Data

Test Date : Nov. 27, 2023 Temperature : 23.2 °C Humidity : 71 %

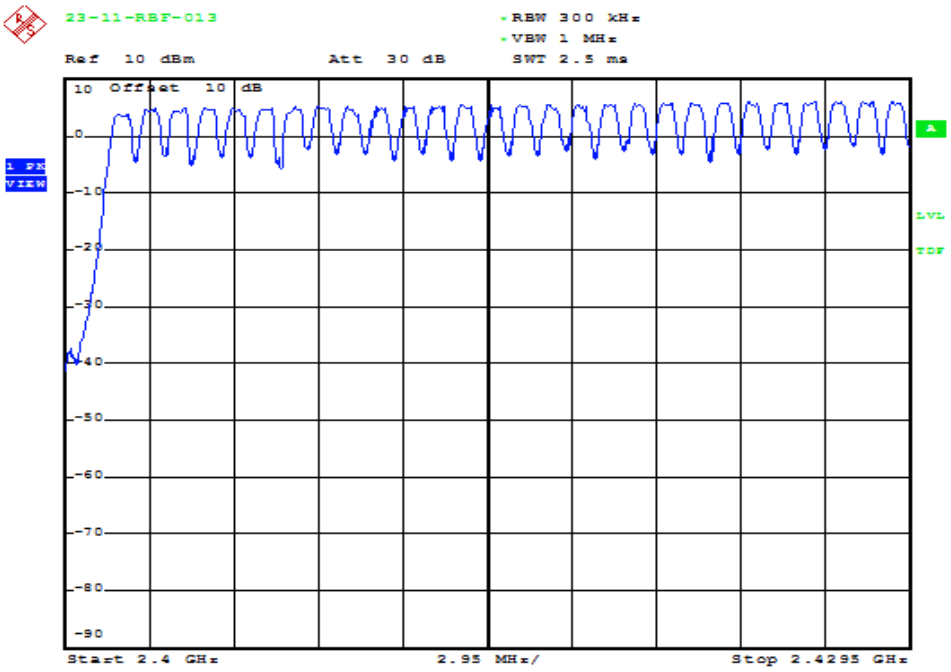
A. BR
There are 79 hopping frequencies used.

B. EDR
There are 79 hopping frequencies used.

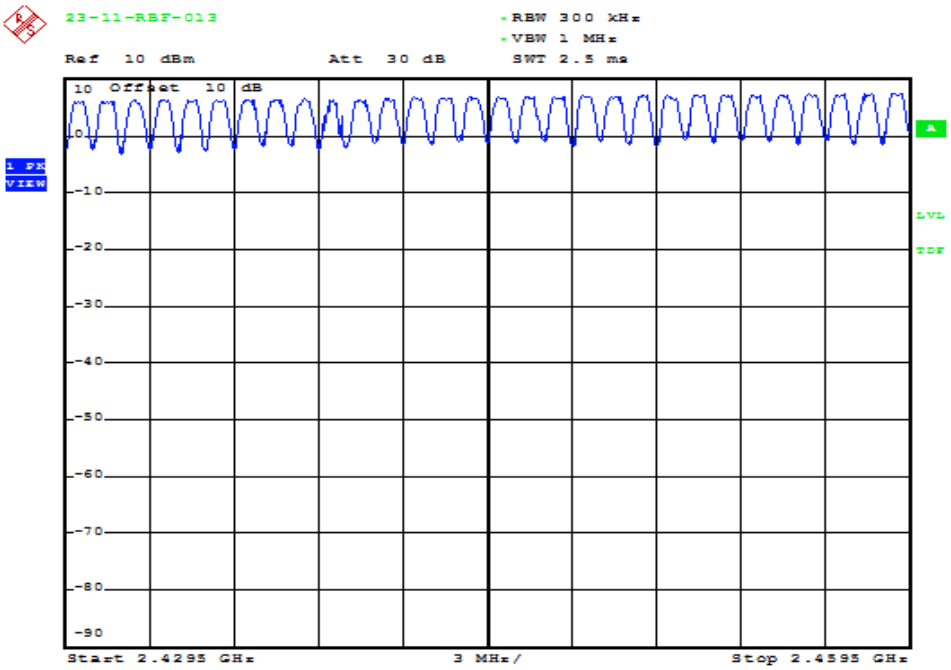
Justification on AFH mode:

Adaptive Frequency Hopping (AFH) means that a device can hop over a reduced set of frequencies. The frequencies hopped may reduced in AFH mode but at least 15 channels will be used, normally AFH mode has 20 channels.

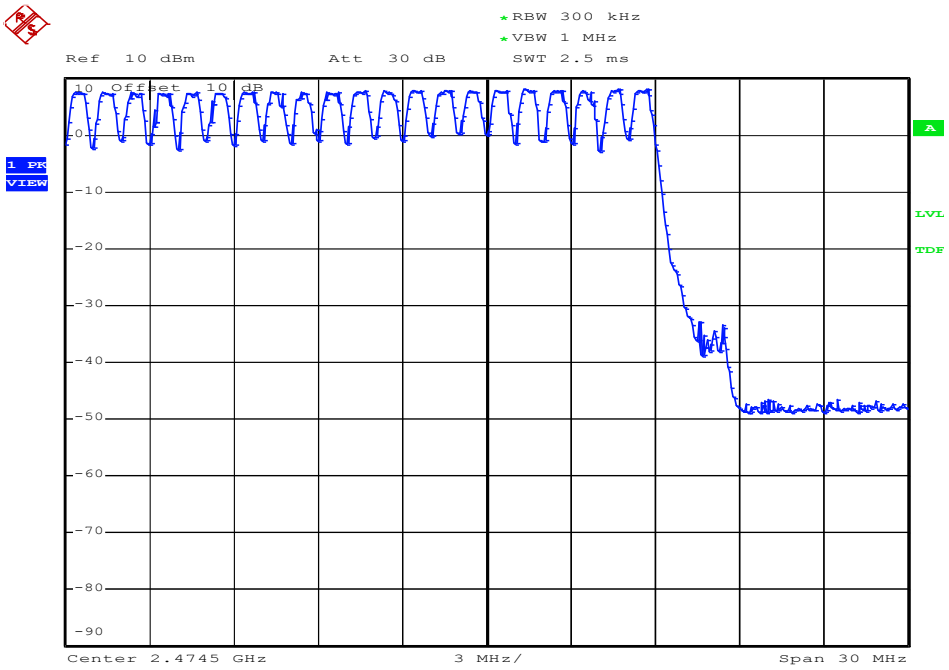
Mode: BR



Date: 27.NOV.2023 08:46:45

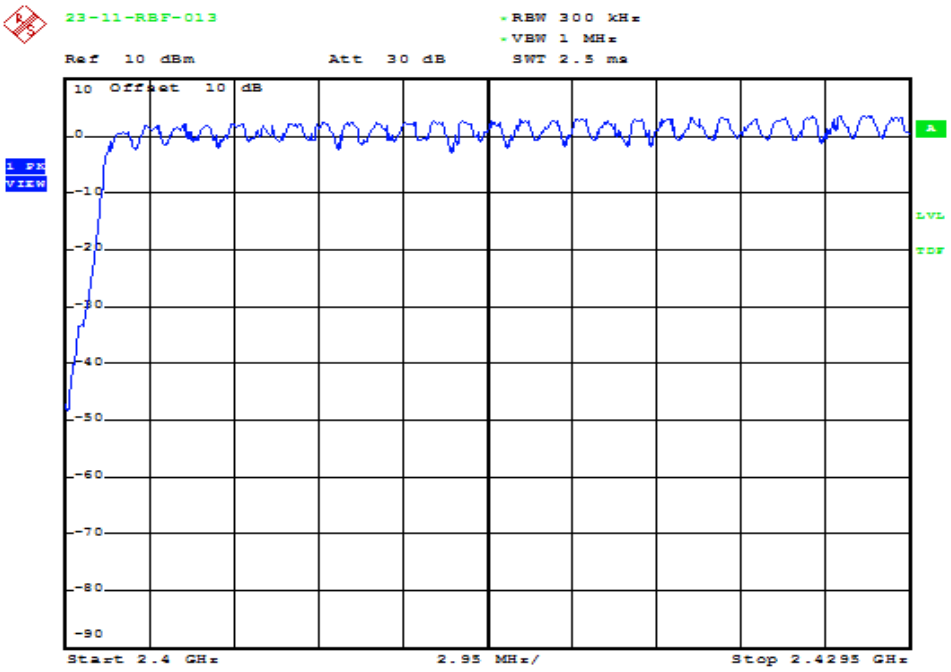


Date: 27.NOV.2023 08:47:19

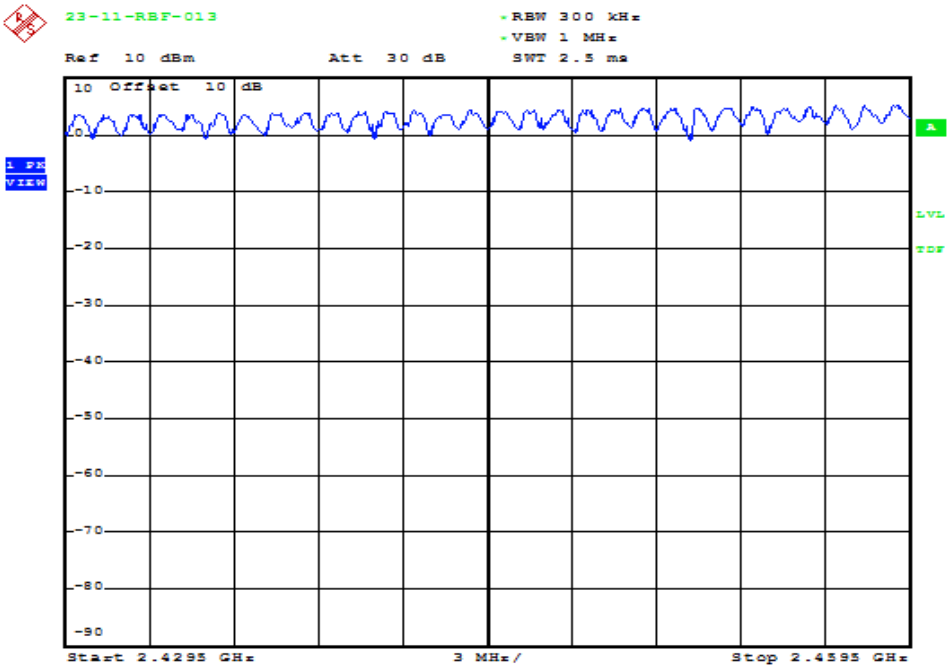


Date: 27.NOV.2023 08:49:10

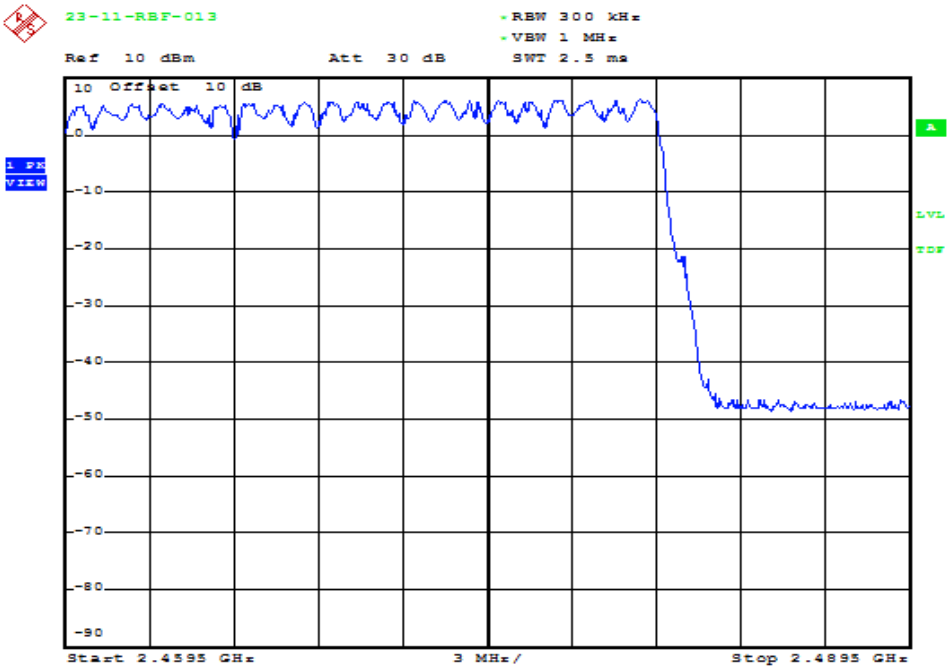
Mode:EDR



Date: 27.NOV.2023 09:30:30



Date: 27.NOV.2023 09:31:24



Date: 27.NOV.2023 09:32:18

9 CHANNEL BANDWIDTH

9.1 Standard Applicable

For frequency hopping system operating in the 2400–2483.5 MHz band, there is no requirement for the maximum 20dB bandwidth of the hopping channel. The measurement of the hopping channel bandwidth is for the reference of the hopping channel separation requirement.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
3. Use the following spectrum analyzer settings:
   Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
   RBW ≥ 1% of the 20 dB bandwidth
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

9.4 Measurement Data

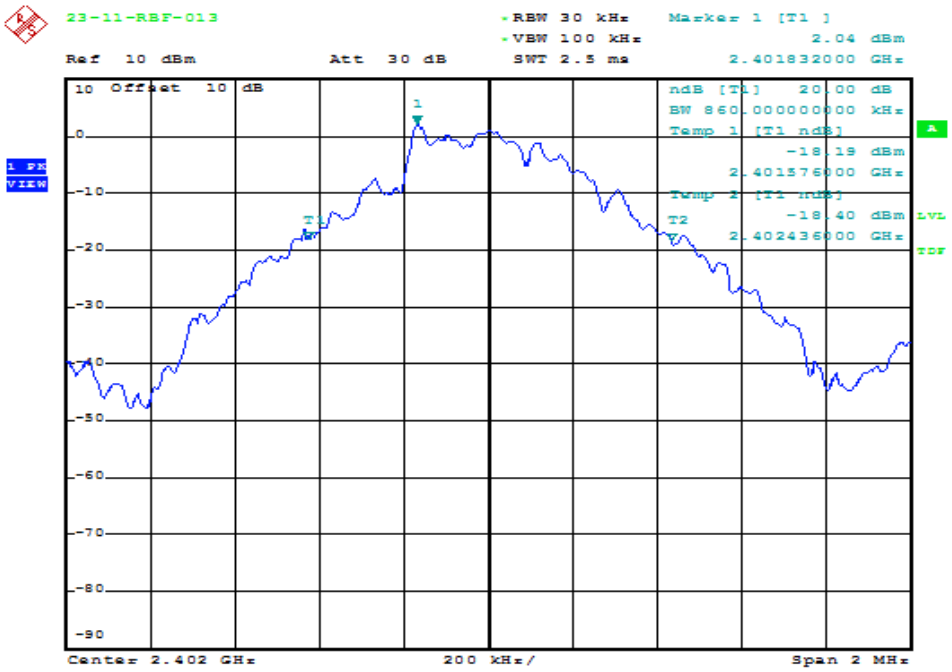
Test Date : Nov. 27, 20233 Temperature : 23.2 °C Humidity : 71 %

Wireless Standards	Carrier Frequency (MHz)	99% bandwidth (MHz)	Minimum 20 dB bandwidth (MHz)
Bluetooth-BR	2402	---	0.860
	2441	---	0.888
	2480	---	0.868

Wireless Standards	Carrier Frequency (MHz)	99% bandwidth (MHz)	Minimum 20 dB bandwidth (MHz)
Bluetooth-EDR	2402	---	1.220
	2441	---	1.240
	2480	---	1.224

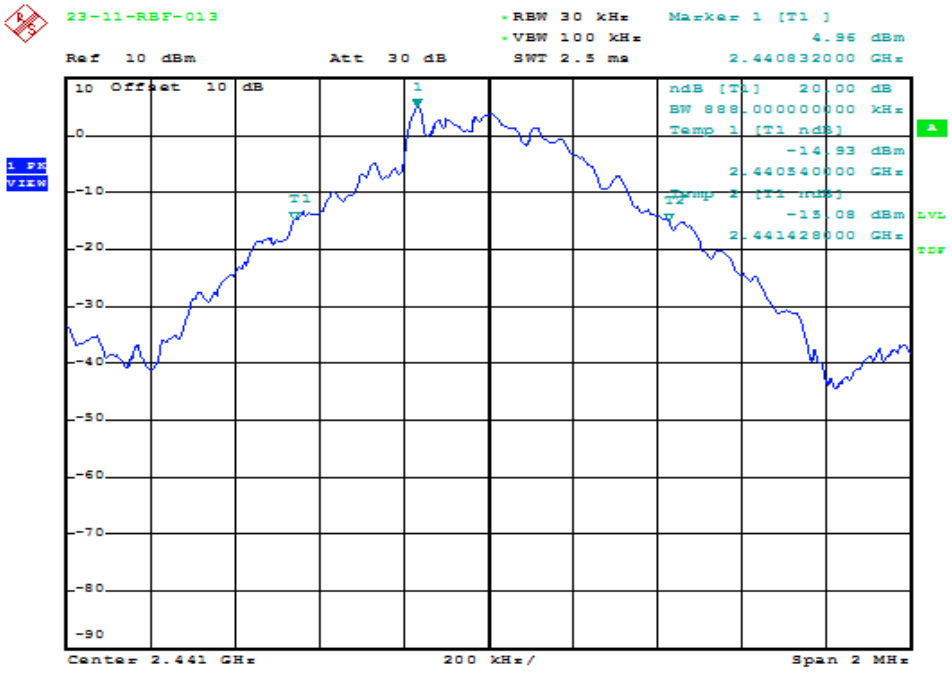
Mode:Bluetooth BR

Channel Low



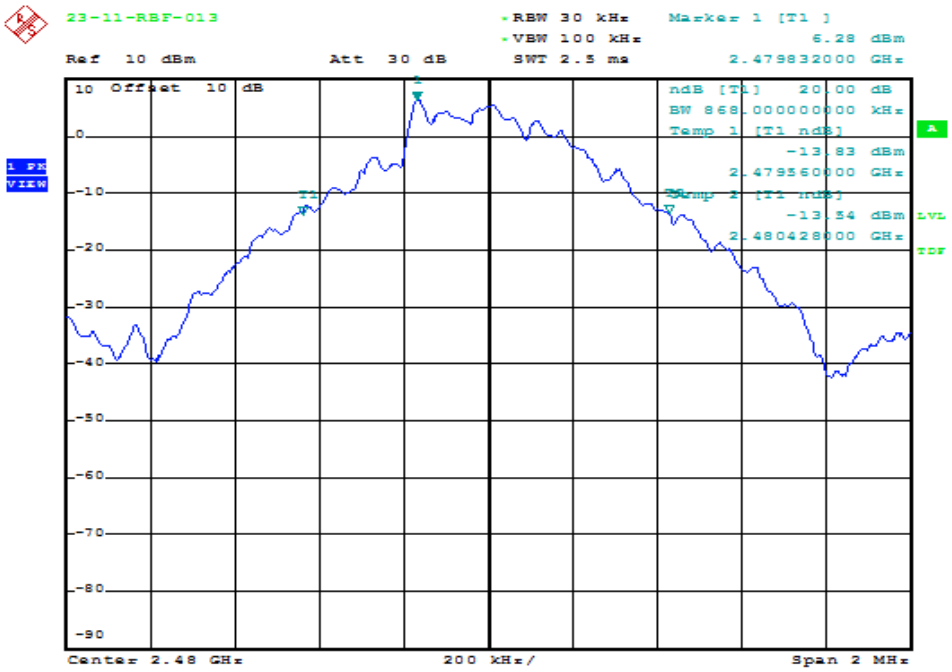
Date: 27.NOV.2023 08:31:27

Channel Middle



Date: 27.NOV.2023 08:37:56

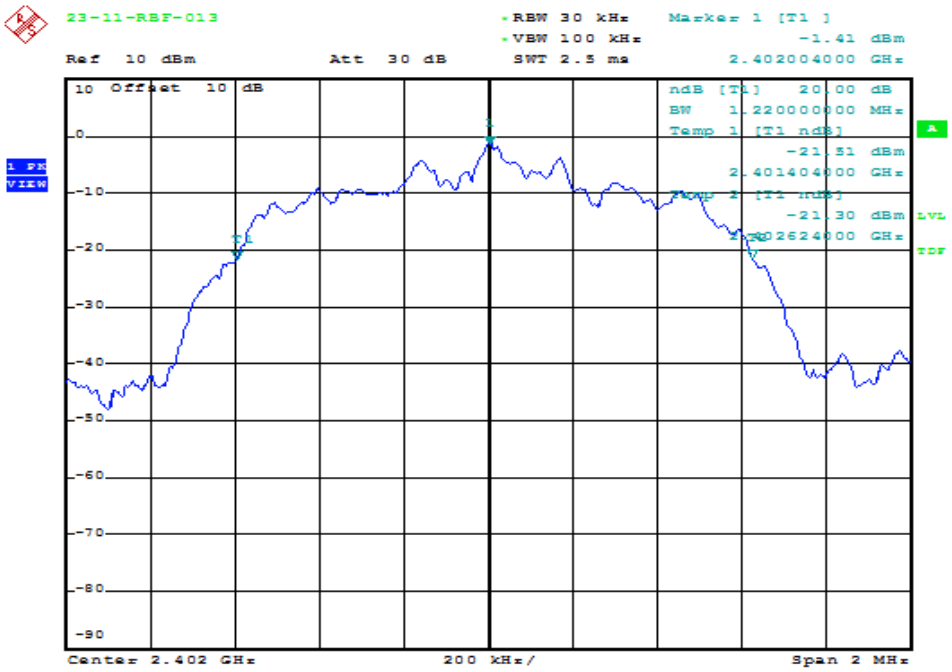
Channel High



Date: 27.NOV.2023 08:42:05

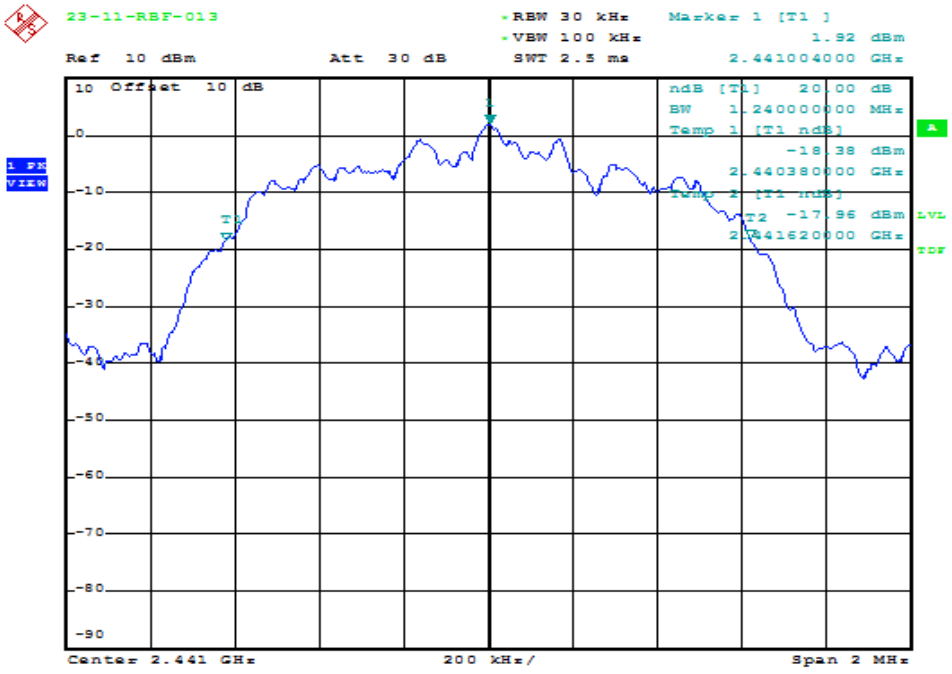
Mode: Bluetooth EDR

Channel Low



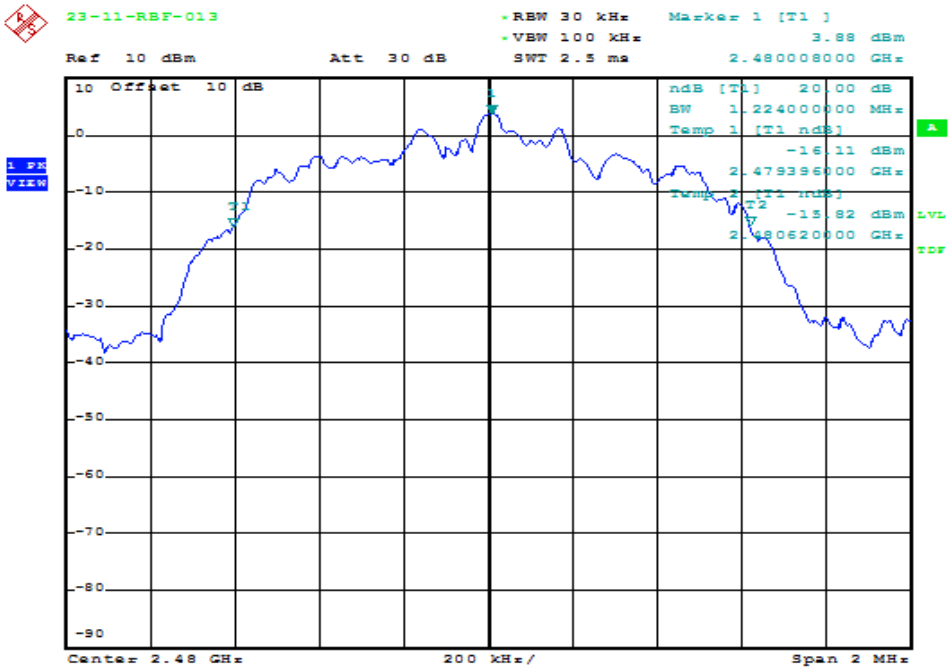
Date: 27.NOV.2023 09:12:36

Channel Middle



Date: 27.NOV.2023 09:17:40

Channel High



Date: 27.NOV.2023 09:23:21

10 DWELL TIME ON EACH CHANNEL

10.1 Standard Applicable

According to 15.247(a)(1)(iii), for frequency hopping system operating in the 2400-2483.5 band, 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.

10.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. The EUT must have its hopping function enabled.
3. Use the following spectrum analyzer settings:
   Span = zero span, centered on a hopping channel
   RBW = 1 MHz
   VBW ≥ RBW
   Sweep = as necessary to capture the entire dwell time per hopping channel
   Detector function = peak
   Trace = max hold
4. Use the marker-delta function to determine the dwell time. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

Justification on AFH mode:
Adaptive Frequency Hopping (AFH) means that a device can hop over a reduced set of frequencies. The frequencies hopped may reduced in AFH mode but at least 15 channels will be used, normally AFH mode has 20 channels.

10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

10.4 Measurement Data

Test Date : Nov. 27, 2023 Temperature : 23.2 °C Humidity : 71 %

Period = 0.4(seconds) x 79(channels) = 31.6 seconds

A. DH1 Mode

The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second. The DH1 data rate operates on a one-slot transmission and one-slot receiving basis. Thus there are 1600/(1+1) = 800 transmissions per second. In one period for each particular channel there are 10.13 x 31.6 = 320.1 times of transmissions.

Wireless Standards	Mode	Carrier Frequency (MHz)	Transmission duration (T) (ms)	Period (times)	Result-Dwell Time (ms)	Limit (ms)
Bluetooth-BR	DH1	2402	0.45	320.10	144.045	400
		2441	0.45	320.10	144.045	400
		2480	0.45	320.10	144.045	400
Bluetooth-EDR	DH1	2402	0.45	320.10	144.045	400
		2441	0.48	320.10	153.648	400
		2480	0.45	320.10	144.045	400

The maximum time of occupancy for a particular channel is 153.648 ms in any 31.6 second period, which is less than the 400ms allowed by the rules; therefore, it meets the requirements of this section.

B. DH3 Mode

The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second. The DH3 data rate operates on a three-slot transmission and one-slot receiving basis. Thus there are 1600/(3+1) = 400 transmissions per second. In one period for each particular channel there are 5.06 x 31.6 = 159.9 times of transmissions.

Wireless Standards	Mode	Carrier Frequency (MHz)	Transmission duration (T) (ms)	Period (times)	Result-Dwell Time (ms)	Limit (ms)
Bluetooth-BR	DH3	2402	1.80	159.90	287.820	400
		2441	1.80	159.90	287.820	400
		2480	1.80	159.90	287.820	400
Bluetooth-EDR	DH3	2402	1.80	159.90	287.820	400
		2441	1.80	159.90	287.820	400
		2480	1.80	159.90	287.820	400

The maximum time of occupancy for a particular channel is 287.820 ms in any 31.6 second period, which is less than the 400 ms allowed by the rules; therefore, it meets the requirements of this section.

C. DH5 Mode

The Bluetooth system hops at a rate of 1600 times per second. This means there are 1600 timeslots in one second. The DH5 data rate operates on a five-slot transmission and one-slot receiving basis. Thus there are 1600/(5+1) = 266.7 transmissions per second. In one period for each particular channel there are 3.38 x 31.6 = 106.81 times of transmissions.

Wireless Standards	Mode	Carrier Frequency (MHz)	Transmission duration (T) (ms)	Period (times)	Result-Dwell Time (ms)	Limit (ms)
Bluetooth-BR	DH5	2402	3.04	106.81	324.702	400
		2441	3.04	106.81	324.702	400
		2480	3.12	106.81	333.247	400
Bluetooth-EDR	DH5	2402	3.12	106.81	333.247	400
		2441	3.12	106.81	333.247	400
		2480	3.04	106.81	324.702	400

The maximum time of occupancy for a particular channel is 333.247 ms in any 31.6 second period, which is less than the 400 ms allowed by the rules; therefore, it meets the requirements of this section.

11 OUTPUT POWER MEASUREMENT

11.1 Standard Applicable

According to 15.247(b)(1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
   RBW > the 20 dB bandwidth of the emission being measured
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all frequencies measured were complete.

11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

11.4 Measurement Data

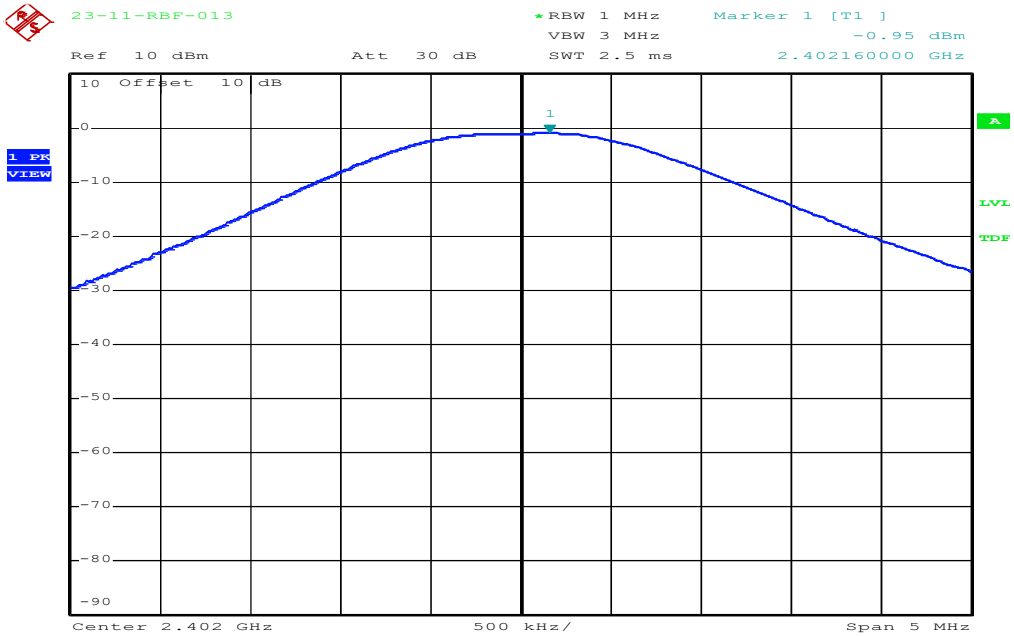
Test Date : Apr. 24, 2024 Temperature : 26.9 °C Humidity : 58 %

Wireless Standards	Carrier Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	Limit (dBm)
Bluetooth-BR	2402	1.00	-0.95	0.80	30
	2441	1.00	-0.41	0.91	30
	2480	1.00	-0.03	0.99	30

Wireless Standards	Carrier Frequency (MHz)	Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	Limit 1W (30 dBm)
Bluetooth-EDR	2402	1.00	-1.35	0.73	30
	2441	1.00	-1.23	0.75	30
	2480	1.00	-0.83	0.83	30

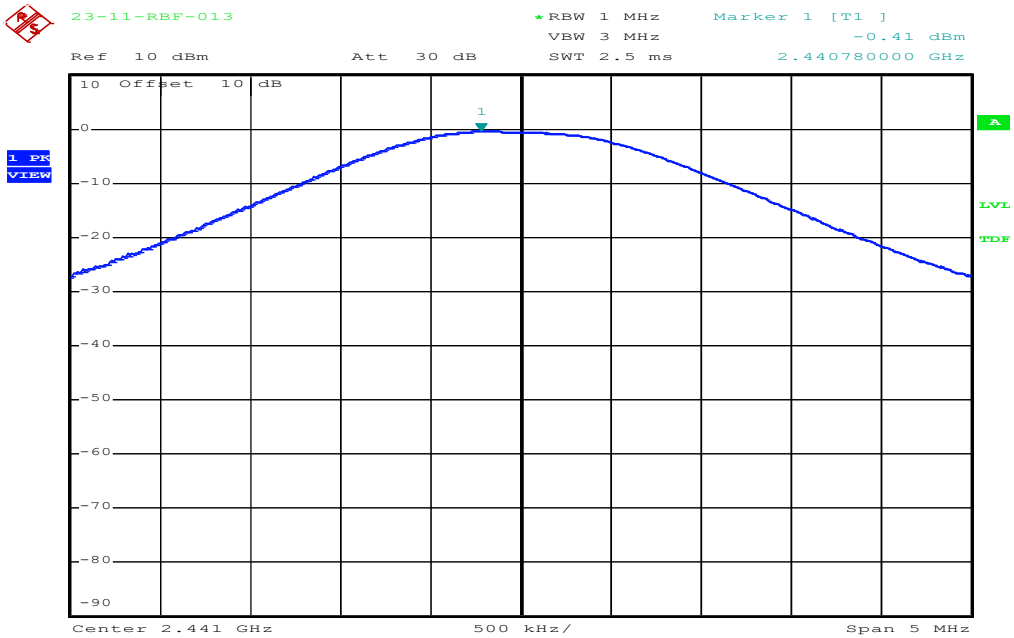
Mode: Bluetooth BR

Channel Low



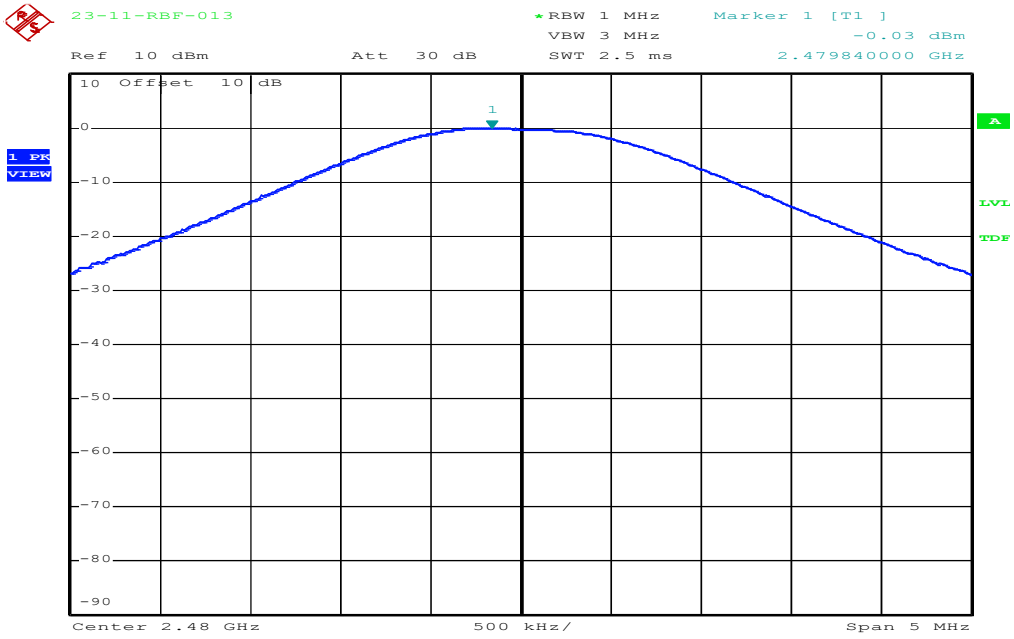
Date: 24.APR.2024 14:37:18

Channel Middle



Date: 24.APR.2024 14:38:37

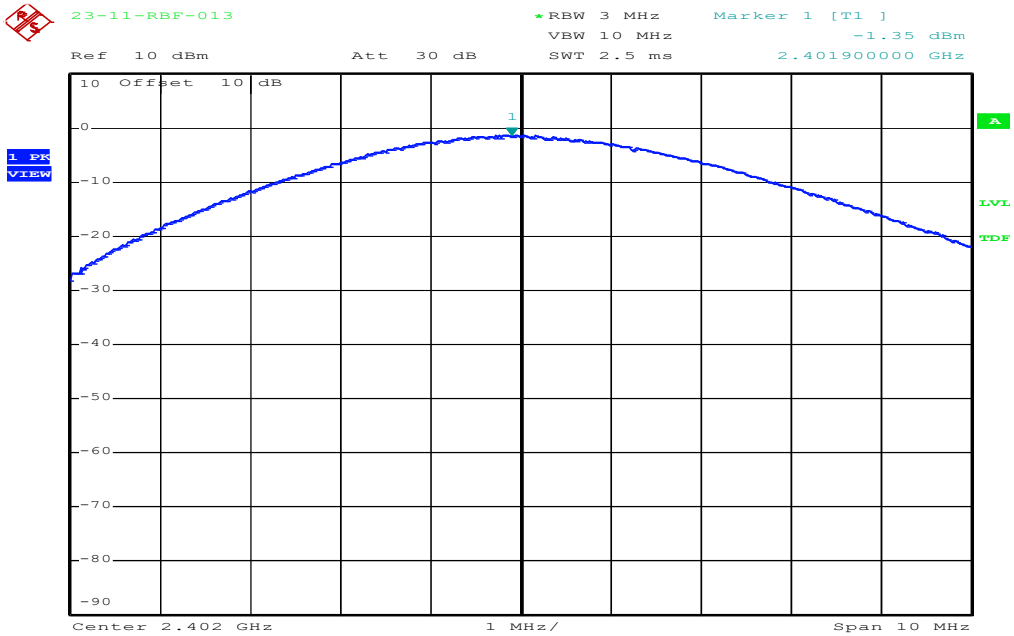
Channel High



Date: 24.APR.2024 14:39:23

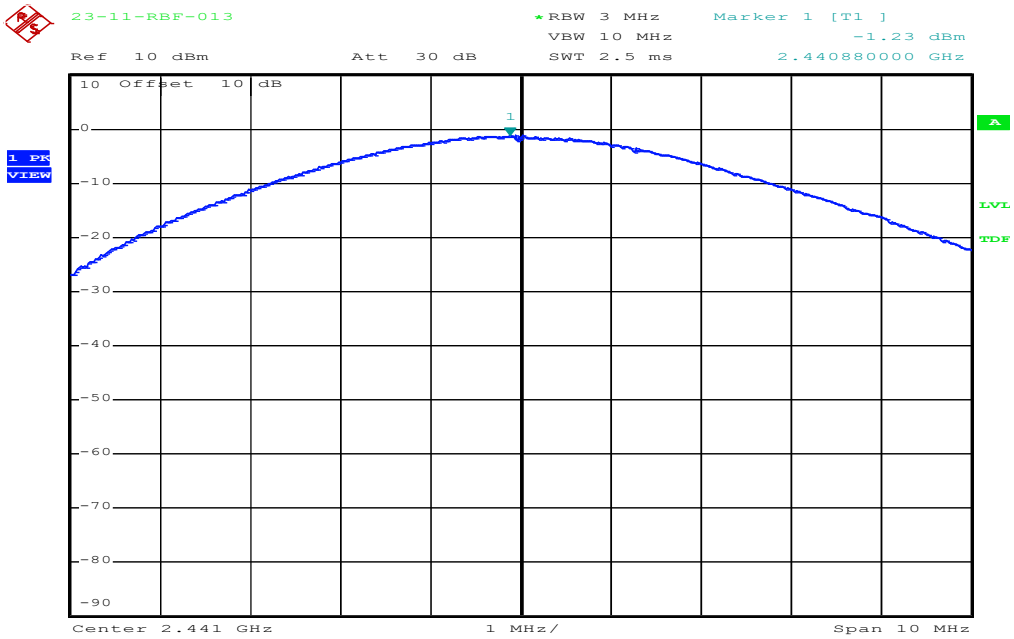
Mode: Bluetooth EDR

Channel Low



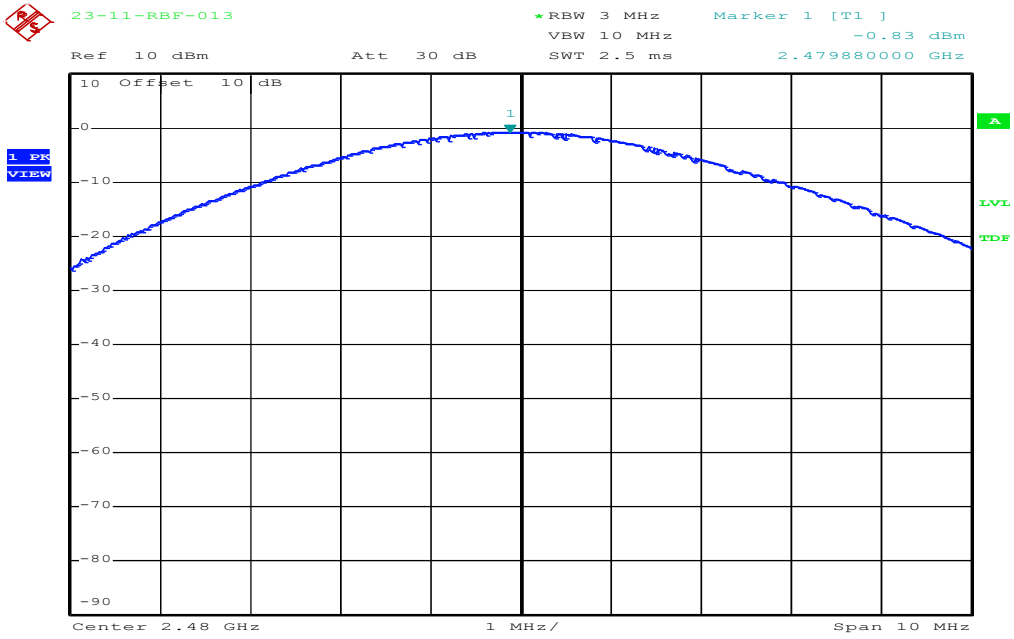
Date: 24.APR.2024 14:43:58

Channel Middle



Date: 24.APR.2024 14:46:15

Channel High



Date: 24.APR.2024 14:47:35

12 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

12.1 Standard Applicable

According to 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 FM RDS/AM DIGITAL TUNING CLOCK RADIO WITH BLUETOOTH PLAYBACK 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.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
4. Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

12.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

12.4 Measurement Data

Test Date : Nov. 27, 2023 Temperature : 23.2 °C Humidity : 71 %

Mode: BR

a) 100kHz PSD Reference Level
b) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.
c) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

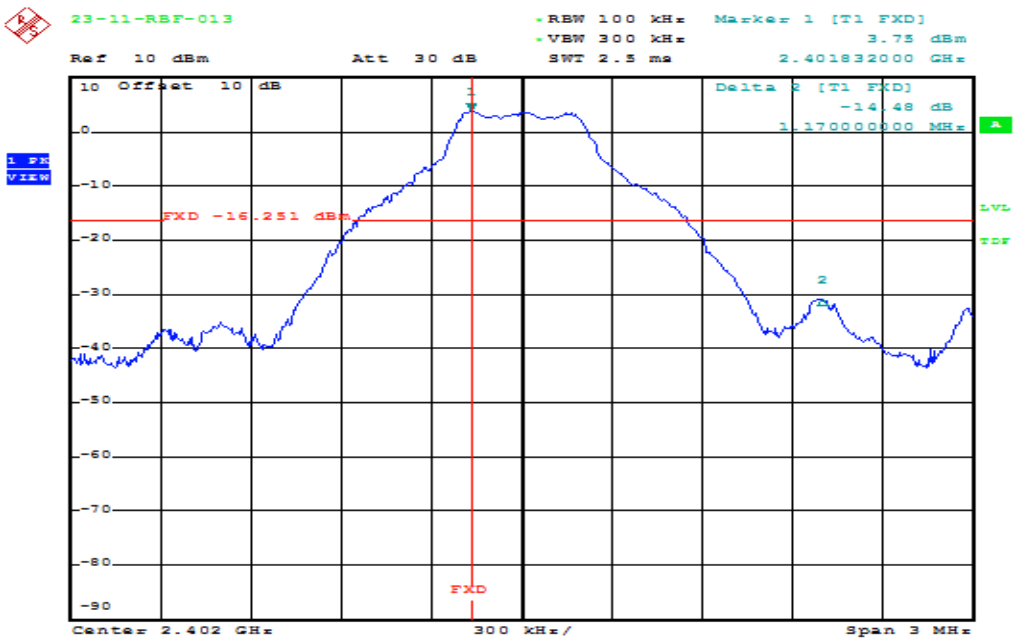
Mode: EDR

a) 100kHz PSD Reference Level
b) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.
c) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

Mode: Bluetooth BR

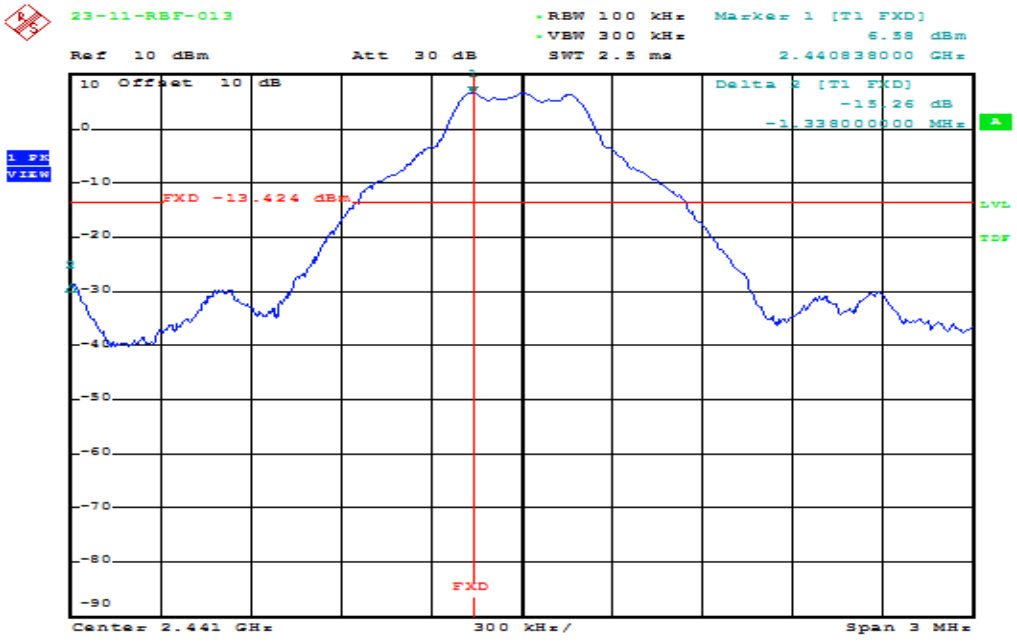
100kHz PSD Reference Level

2402MHz



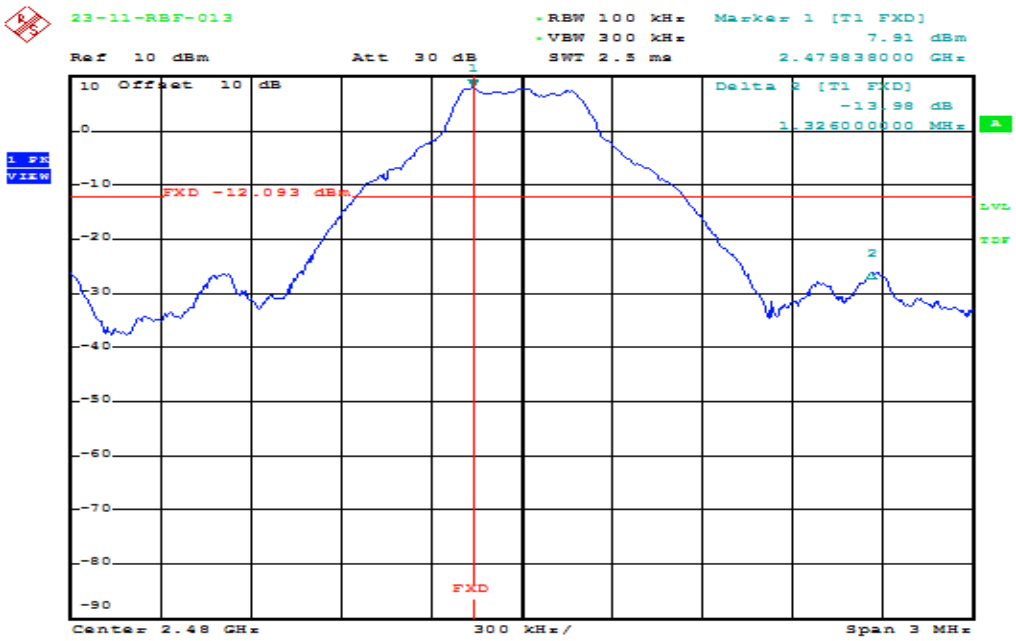
Date: 27.NOV.2023 08:34:26

2441MHz



Date: 27.NOV.2023 08:40:04

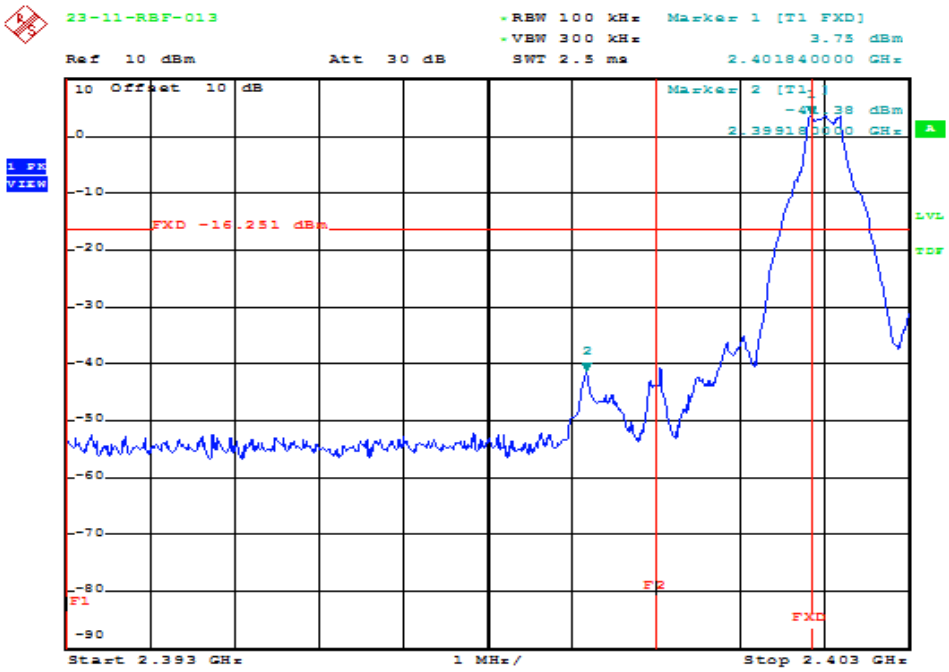
2480MHz



Date: 27.NOV.2023 08:44:10

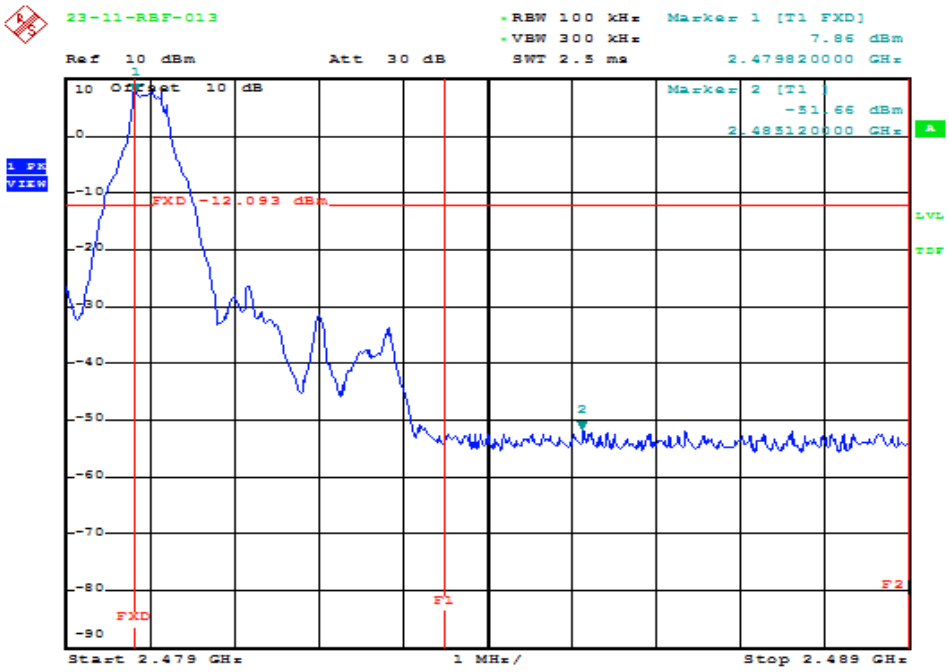
Mode: Bluetooth BR

Lower Band Edge (Hoppin off)



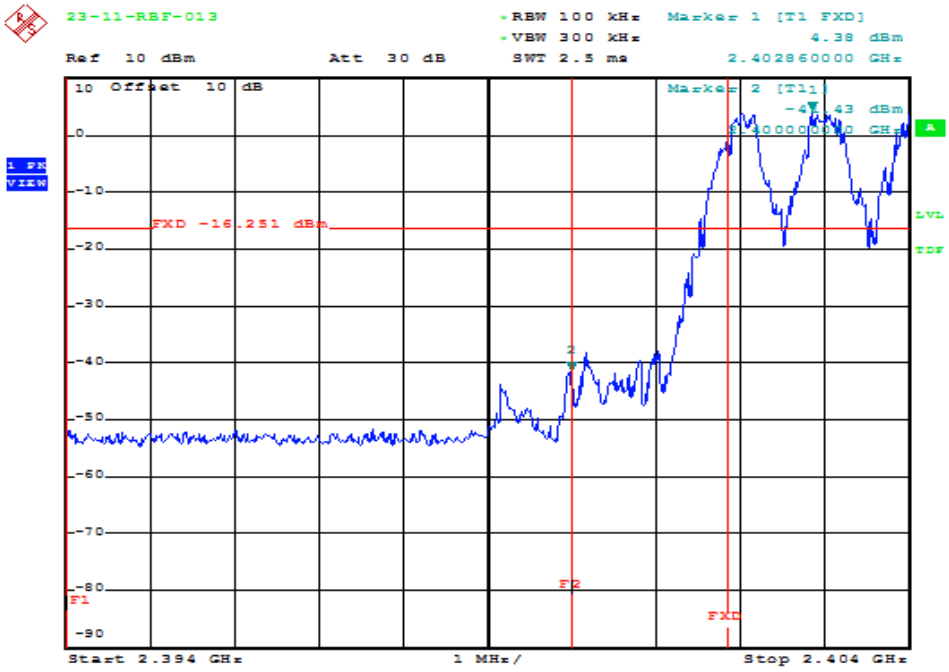
Date: 27.NOV.2023 08:34:36

Upper Band Edge (Hoppin off)



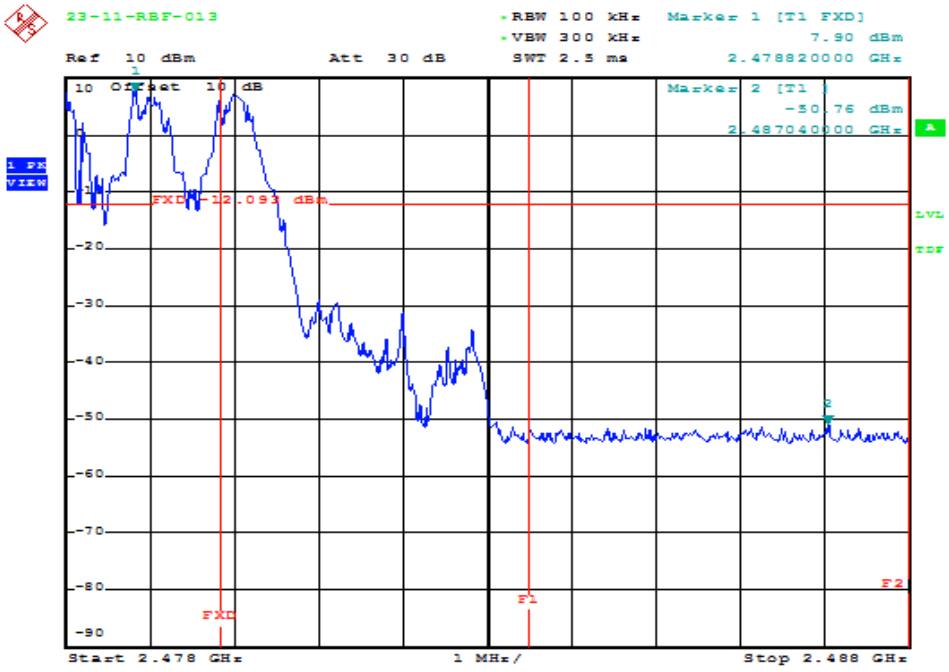
Date: 27.NOV.2023 08:44:20

Lower Band Edge (Hoppin on)



Date: 27.NOV.2023 08:37:01

Upper Band Edge (Hoppin on)

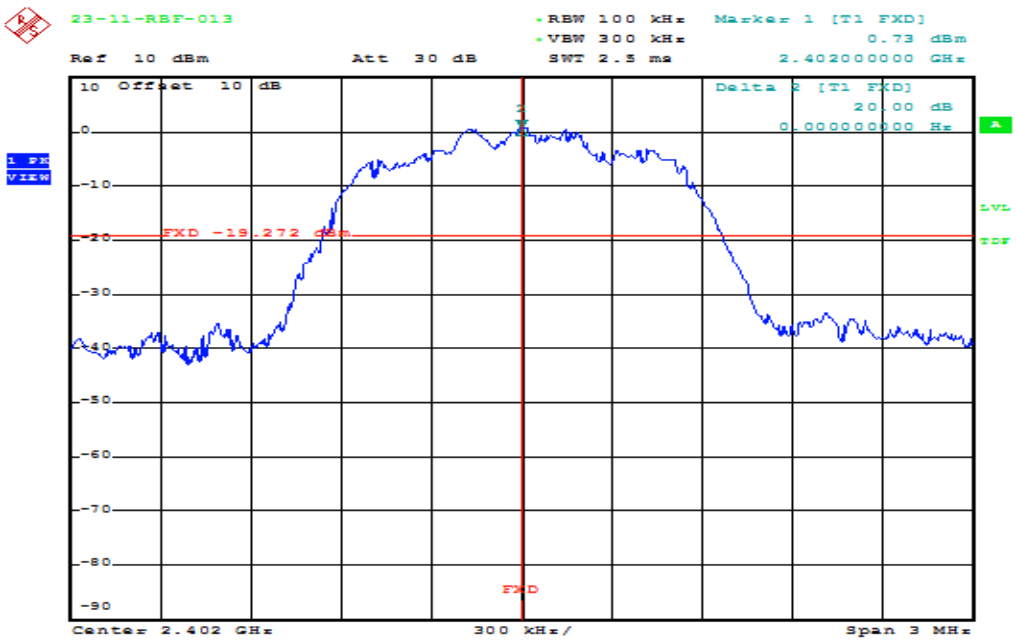


Date: 27.NOV.2023 08:46:05

Mode: Bluetooth EDR

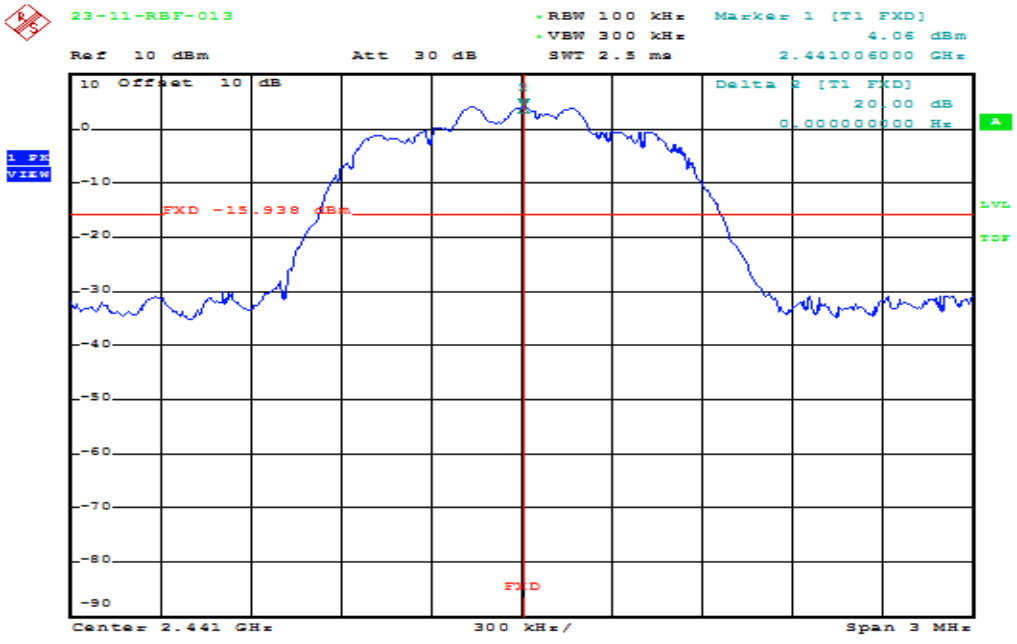
100kHz PSD Reference Level

2402MHz



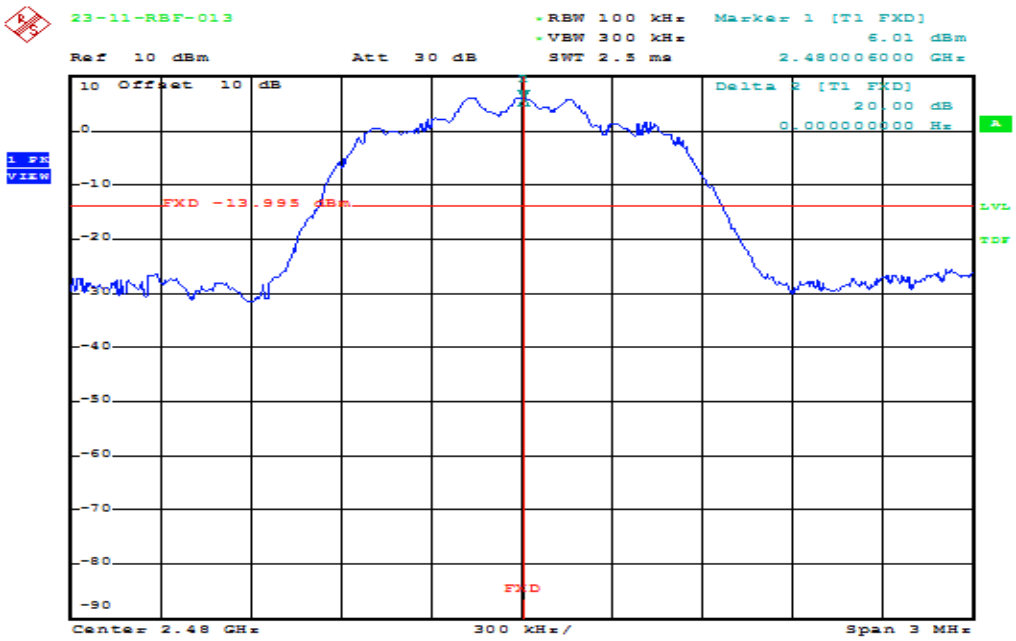
Date: 27.NOV.2023 09:14:36

2441MHz



Date: 27.NOV.2023 09:22:10

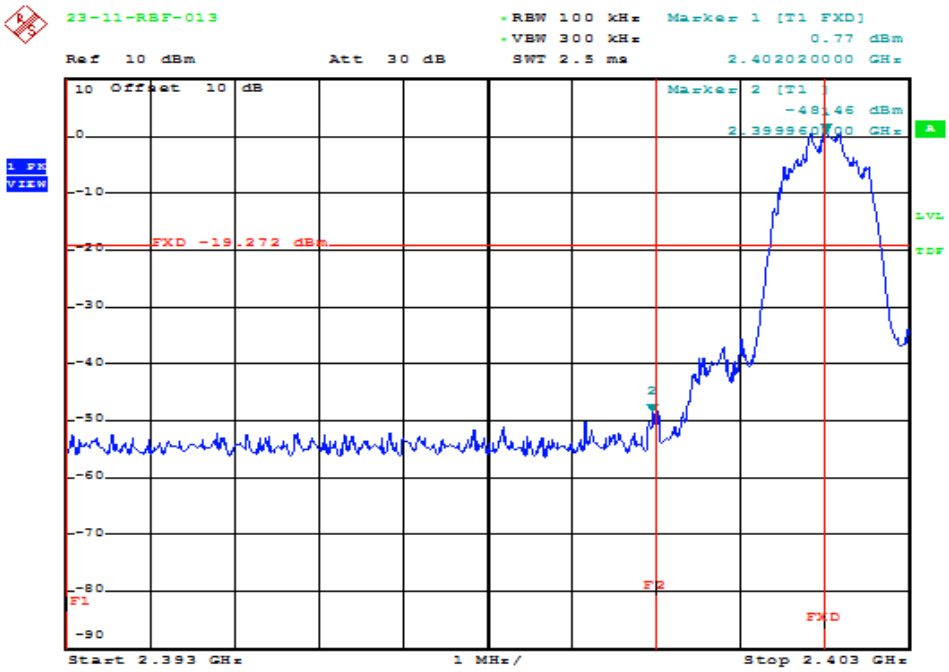
2480MHz



Date: 27.NOV.2023 09:25:04

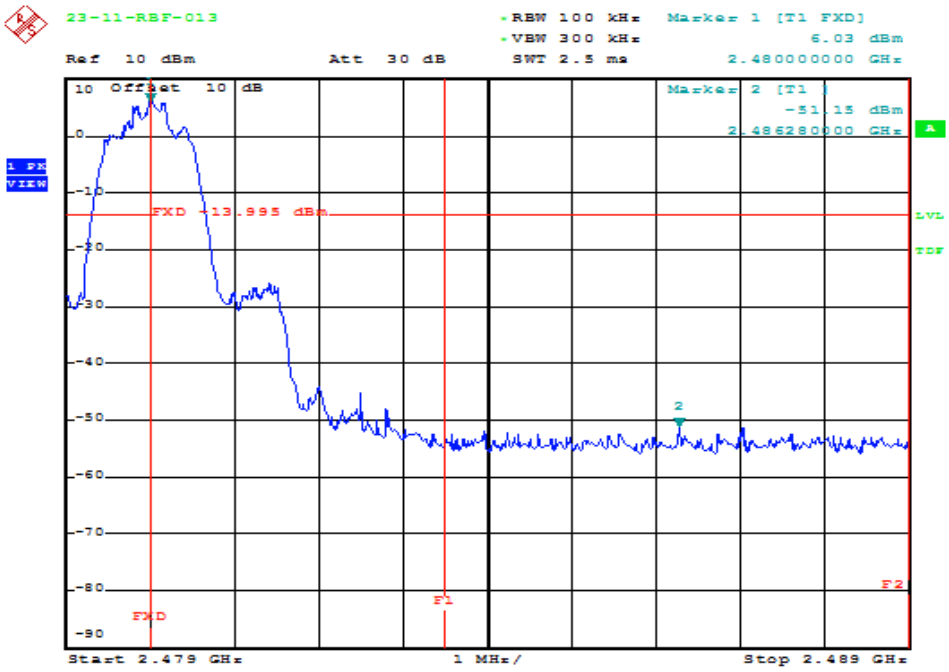
Mode: EDR

Lower Band Edge (Hoppin off)



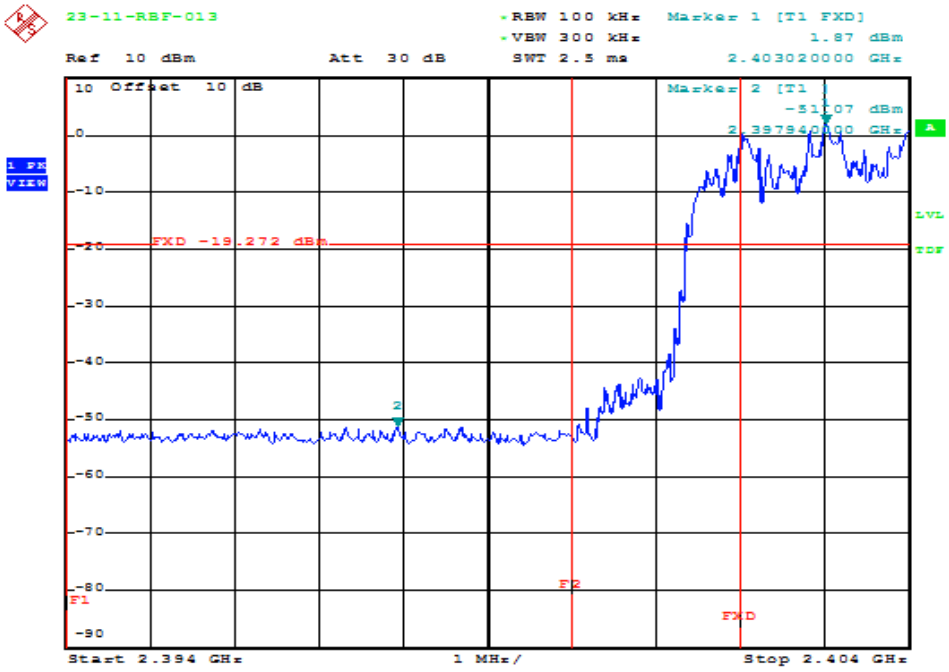
Date: 27.NOV.2023 09:14:46

Upper Band Edge (Hoppin off)



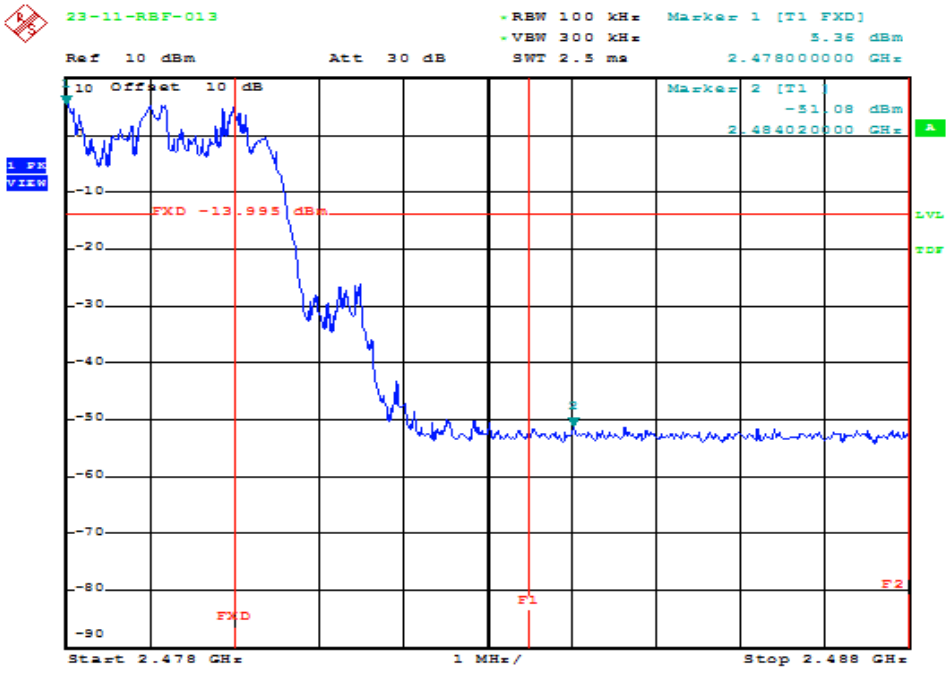
Date: 27.NOV.2023 09:25:14

Lower Band Edge (Hoppin on)



Date: 27.NOV.2023 09:16:53

Upper Band Edge (Hoppin on)



Date: 27.NOV.2023 09:26:57

13 CONDUCTED SPURIOUS EMISSION MEASUREMENT

13.1 Standard Applicable

According to 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 FM RDS/AM DIGITAL TUNING CLOCK RADIO WITH BLUETOOTH PLAYBACK 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.

13.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Use the following spectrum analyzer settings:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold.
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

13.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

13.4 Measurement Data

Test Date : Nov. 27, 2023 Temperature : 23.2 °C Humidity : 71 %

Mode: BR
Low Channel/ Mid Channel/ Hi Channel

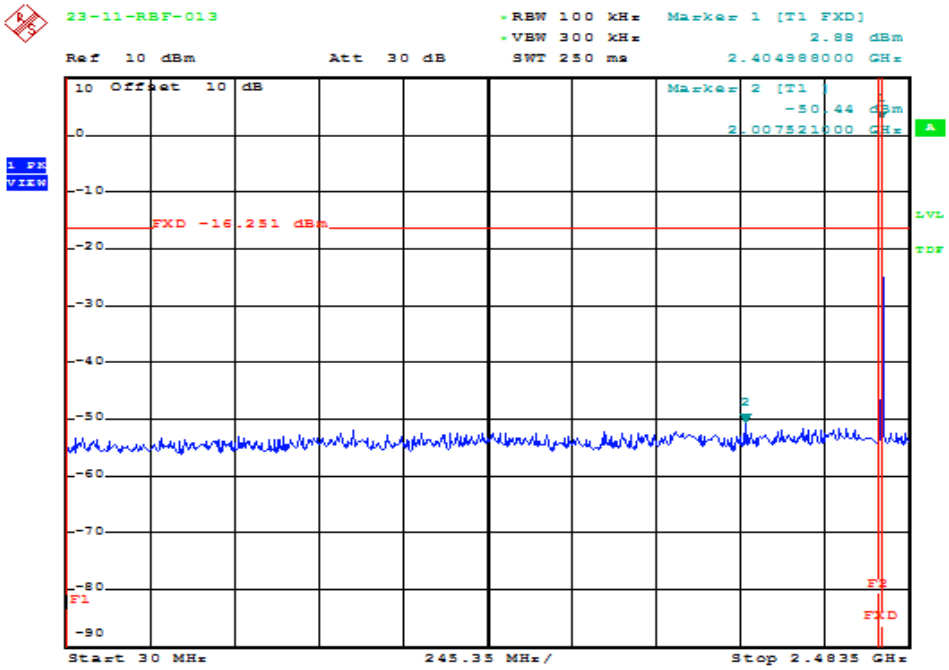
a) 30MHz to 26.5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Mode: EDR
Low Channel/ Mid Channel/ Hi Channel

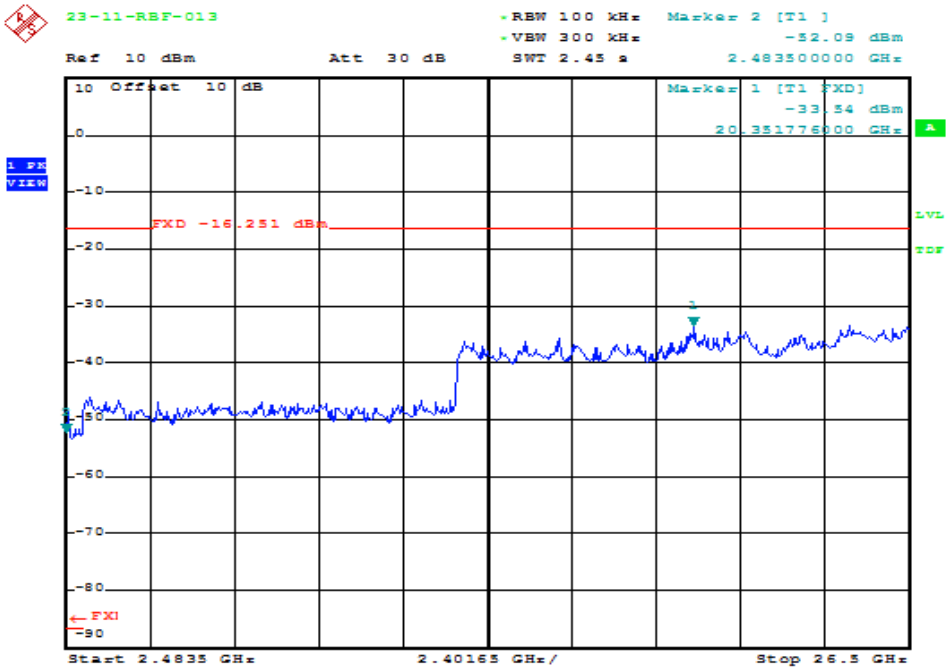
a) 30MHz to 26.5 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Mode: Bluetooth BR

Low Channel

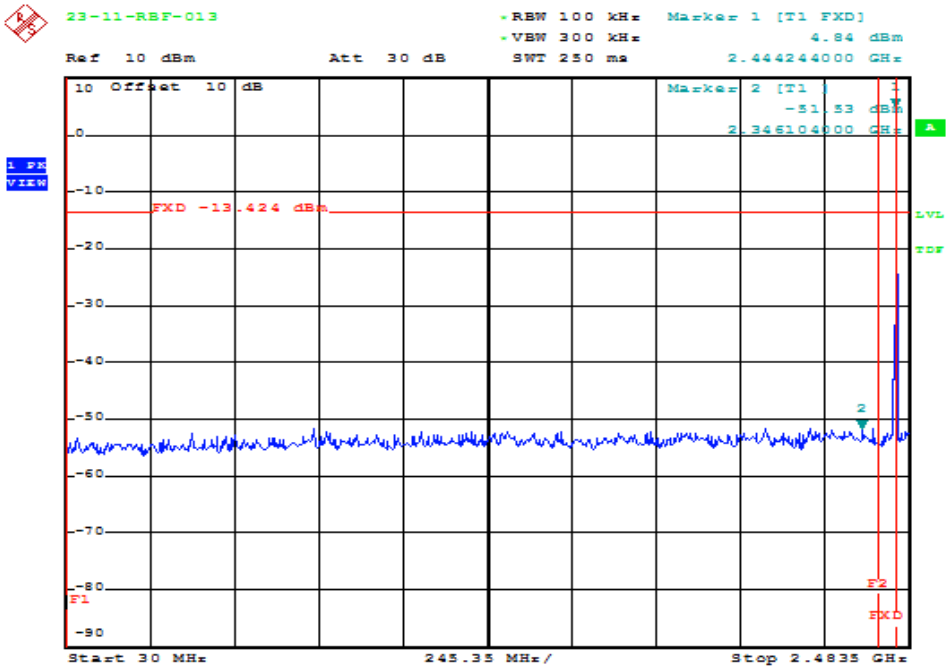


Date: 27.NOV.2023 08:34:49

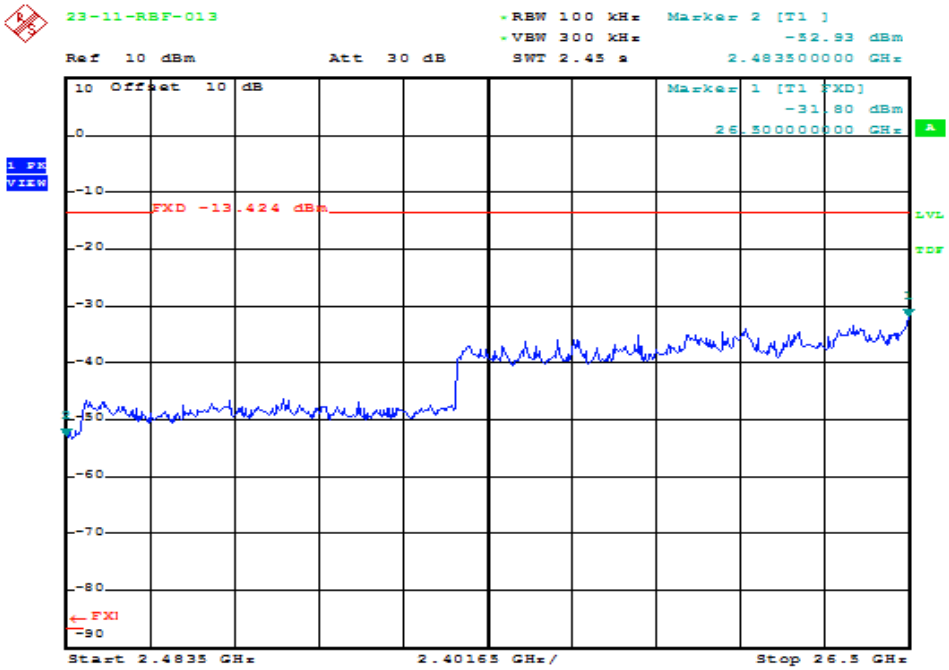


Date: 27.NOV.2023 08:35:13

Mid Channel

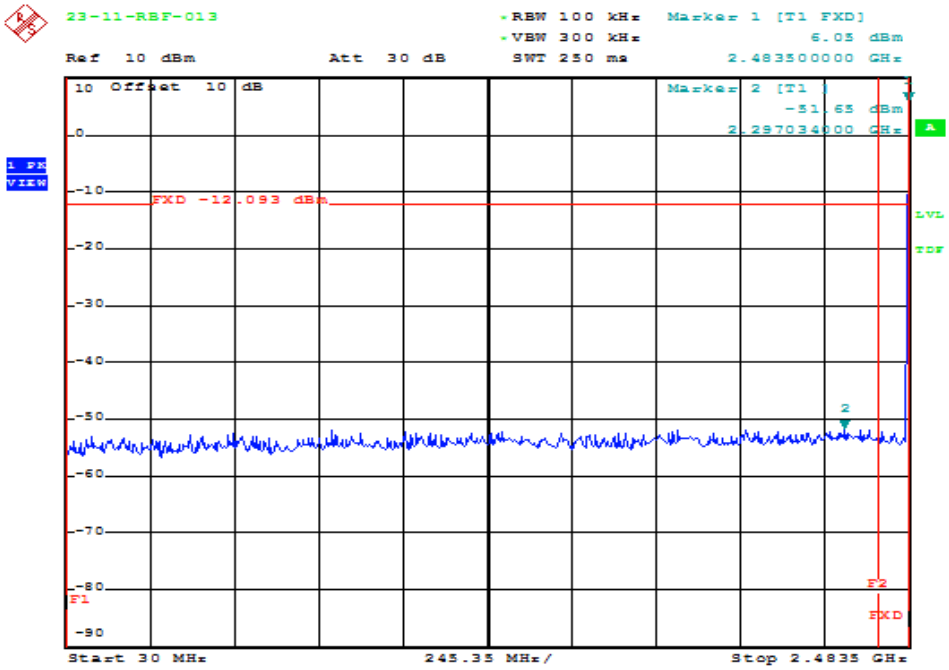


Date: 27.NOV.2023 08:40:35

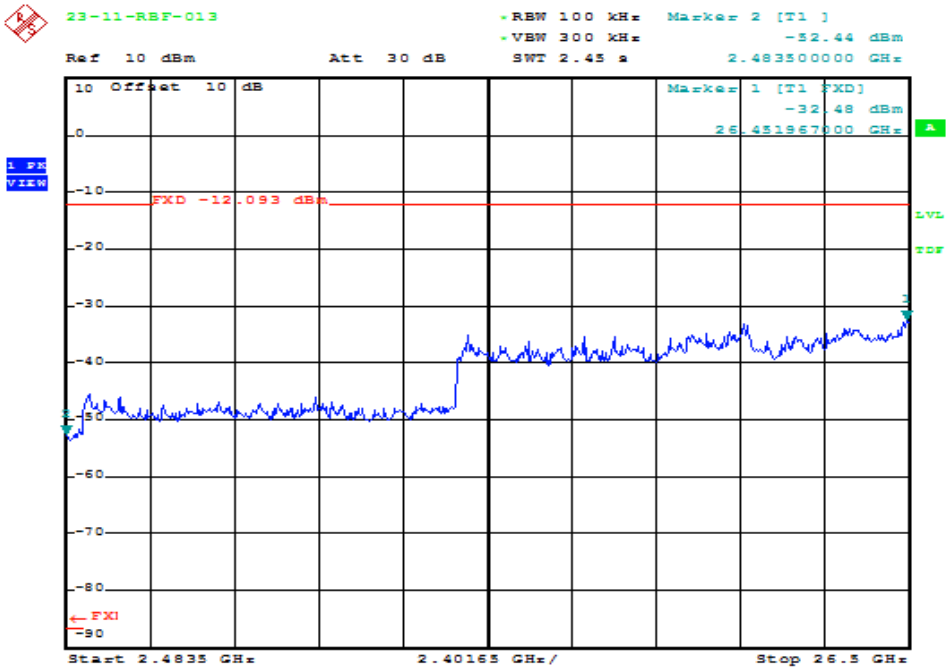


Date: 27.NOV.2023 08:40:52

Hi Channel



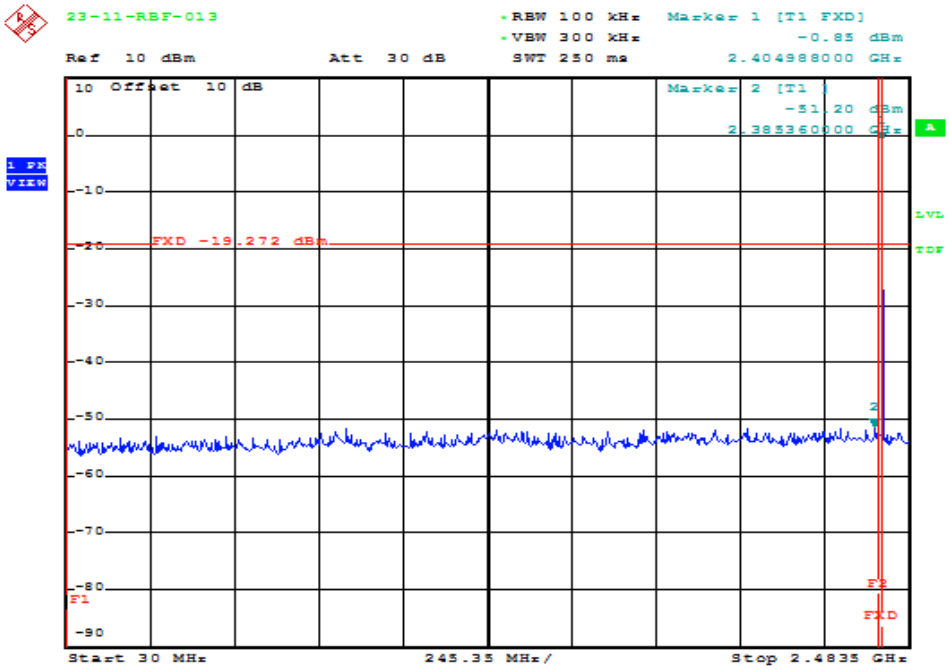
Date: 27.NOV.2023 08:44:33



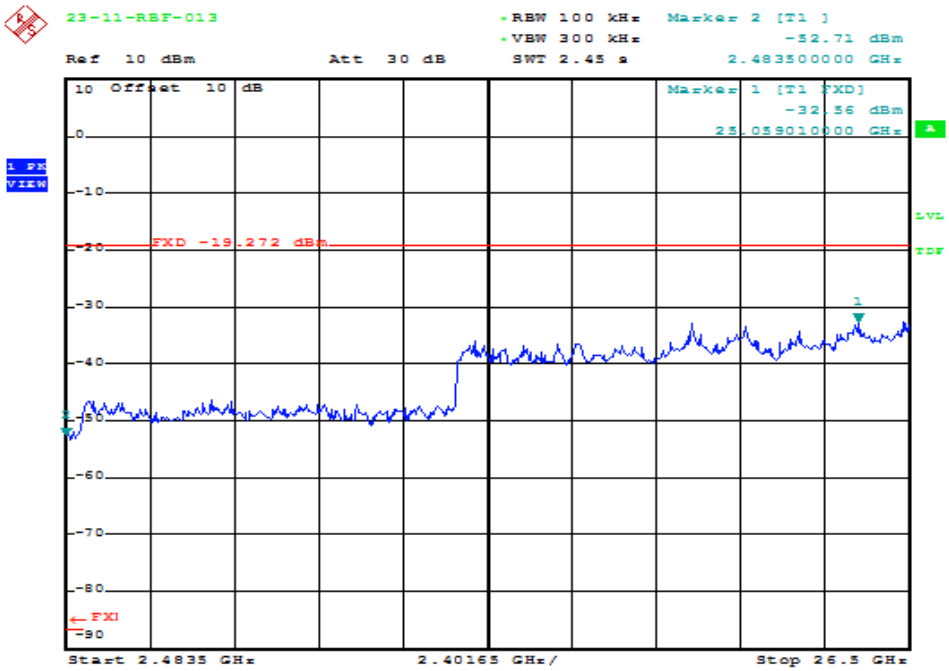
Date: 27.NOV.2023 08:45:02

Mode: EDR

Low Channel

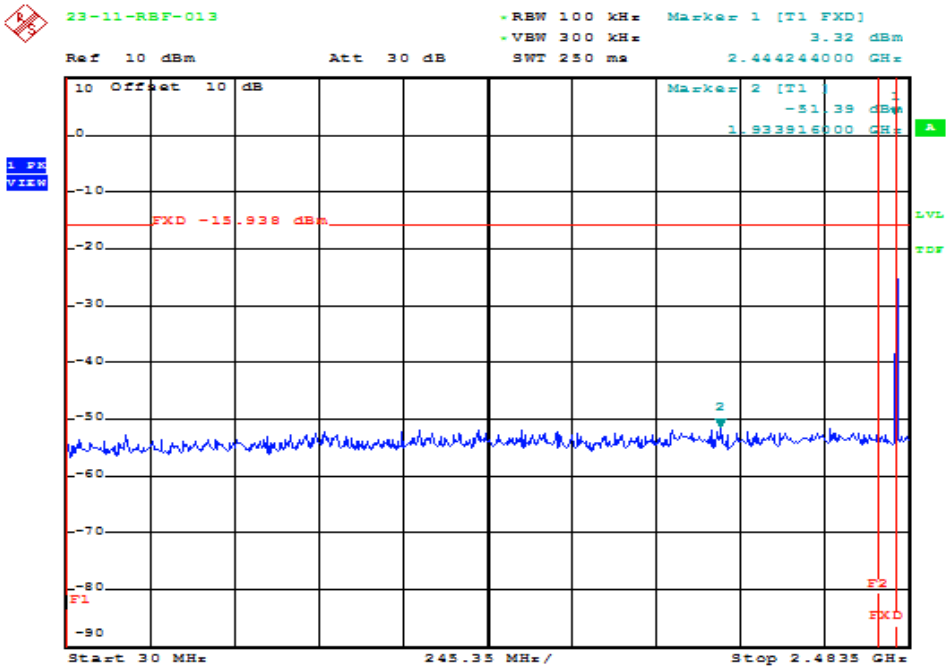


Date: 27.NOV.2023 09:14:58

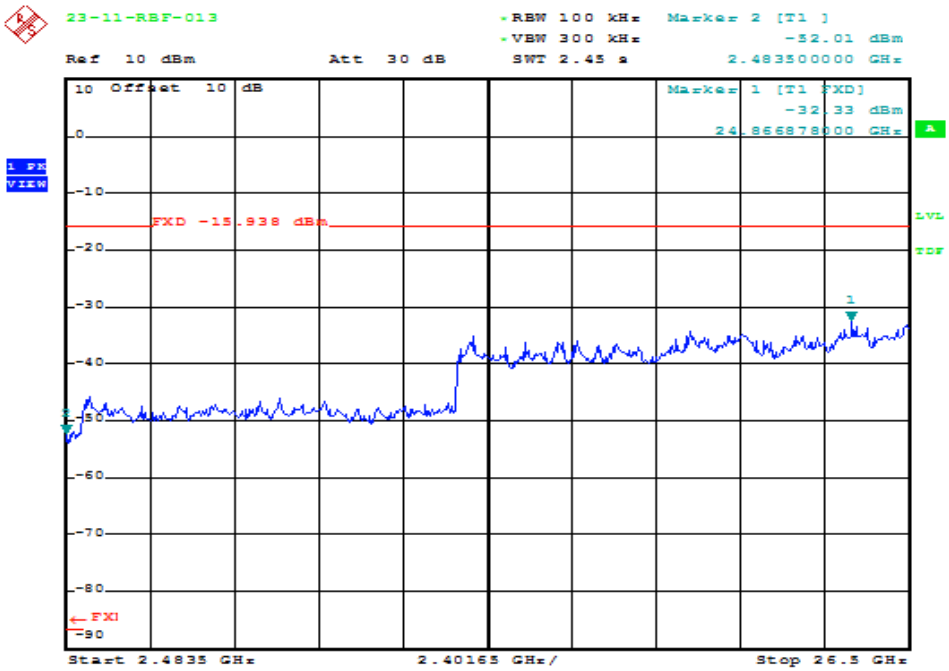


Date: 27.NOV.2023 09:15:20

Mid Channel

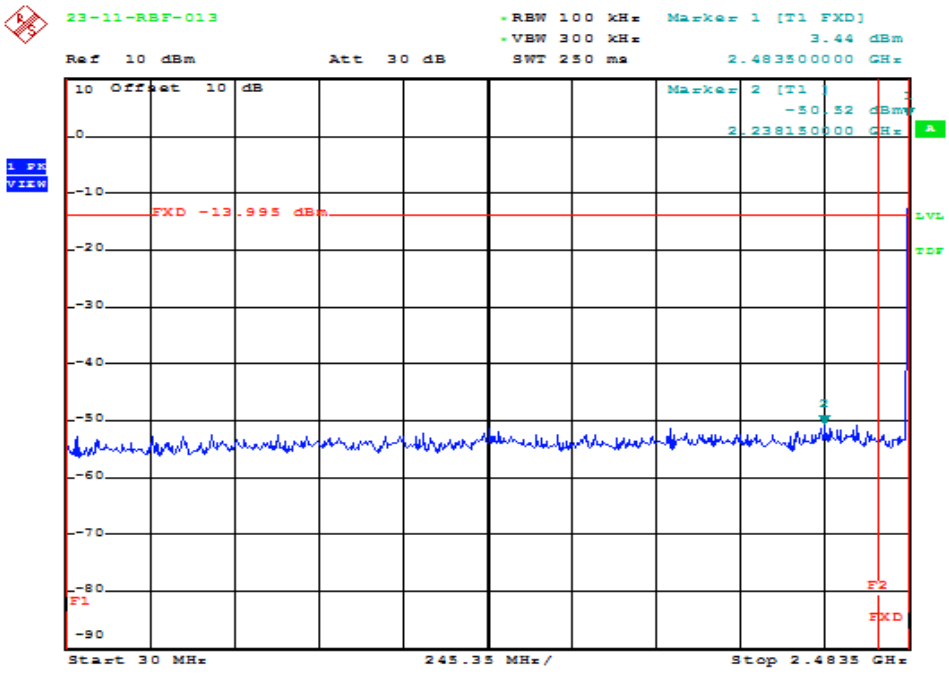


Date: 27.NOV.2023 09:22:23

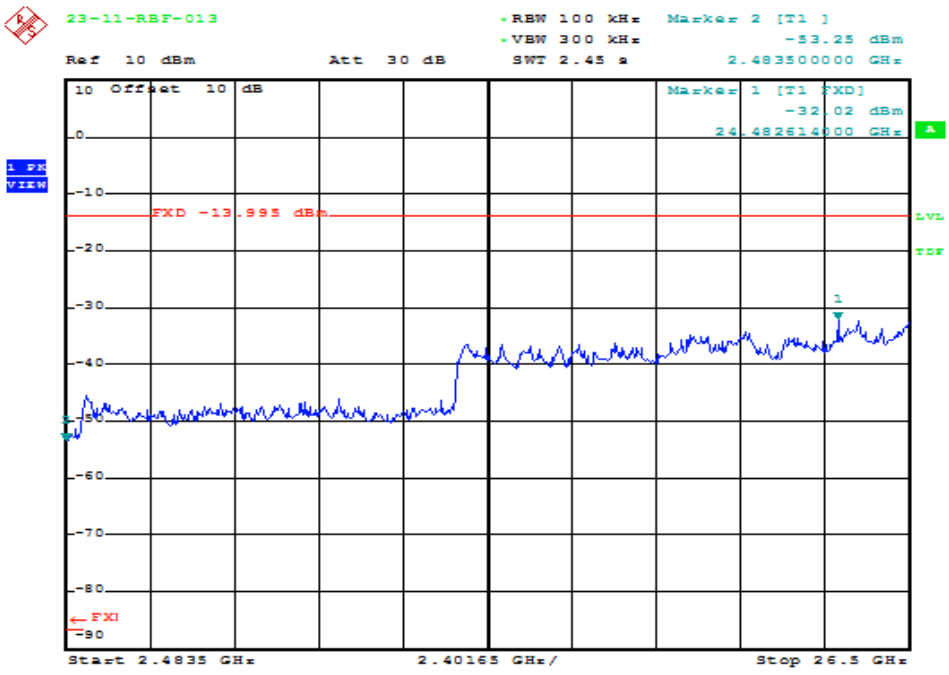


Date: 27.NOV.2023 09:22:39

Hi Channel



Date: 27.NOV.2023 09:25:26



Date: 27.NOV.2023 09:25:43

14. DUTY CYCLE

14.1 Standard Applicable

None. Refereency only.

14.2 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP 40	2023/06/16	2024/06/15
Attenuator	Mini-Circuits	BW-S10W2+/	2023/10/17	2024/10/16

14.3 Measurement Data

Test Date : Nov. 27, 2023 Temperature : 23.2 °C Humidity : 71 %

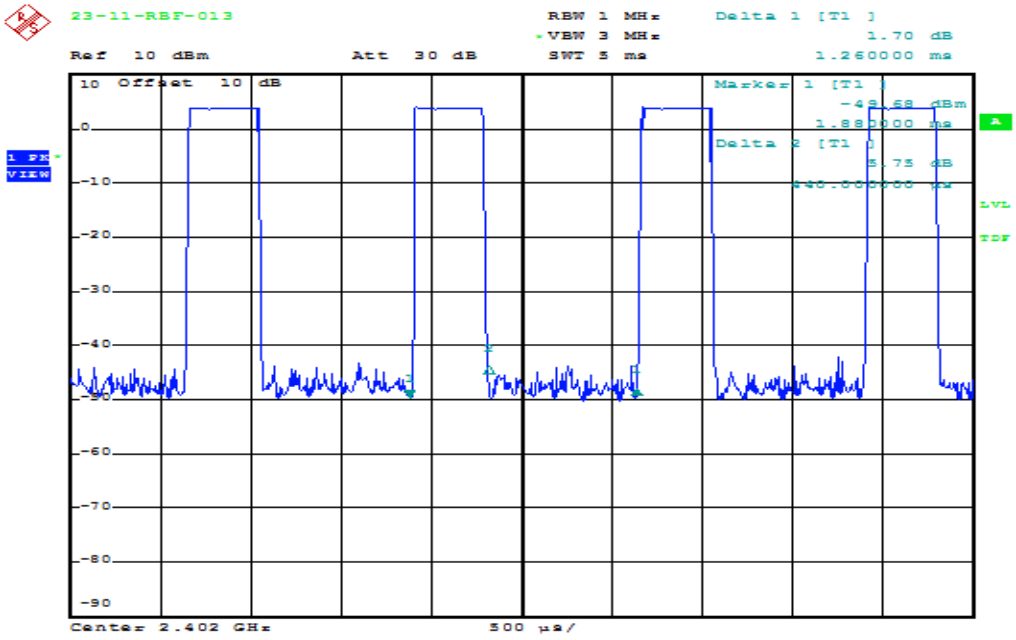
Duty Cycle Calculation

Mode	Period (ms)	Transmission duration (T) (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T (kHz)	VBW setting (kHz)
BR-DH1	1.26	0.44	34.92	4.57	2.273	3
BR-DH3	2.50	1.72	68.80	1.62	0.581	1
BR-DH5	3.75	2.97	79.20	1.01	0.337	1
EDR-DH1	1.26	0.45	35.71	4.47	2.222	3
EDR-DH3	2.50	1.72	68.80	1.62	0.581	1
EDR-DH5	3.75	2.97	79.20	1.01	0.337	1

Note:

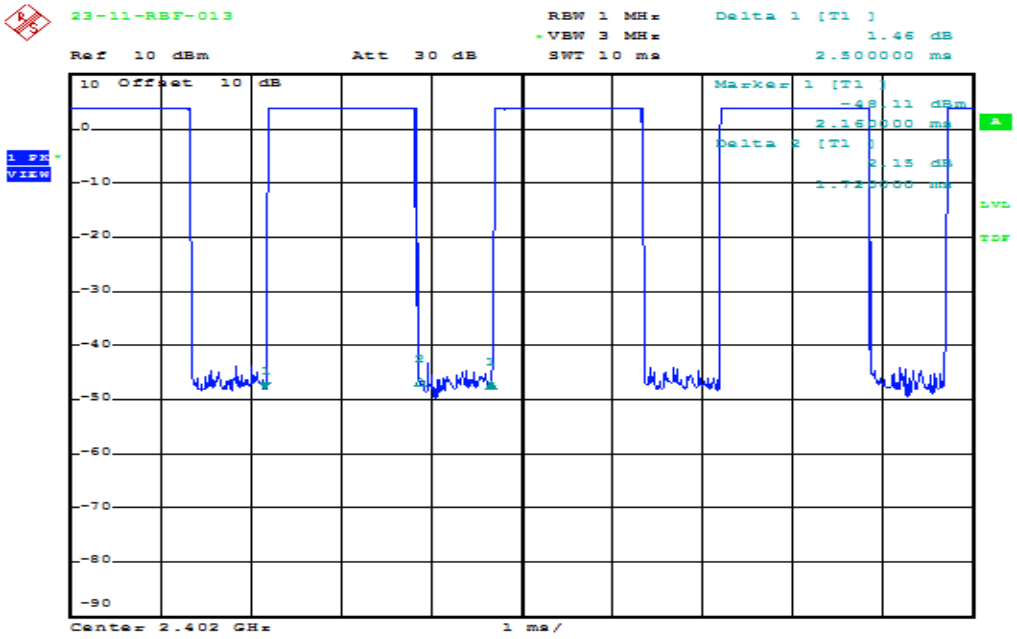
1. When Duty Cycle > 98% , Duty Cycle Correction Factor not required (0.00 dB).
2. When Duty Cycle > 98% , VBW = 10 Hz .
3. When the Duty Cycle is less than 98%, for the average measurement of the radiated emission test, the VBW setting is >1/T where the T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

BR / DH1



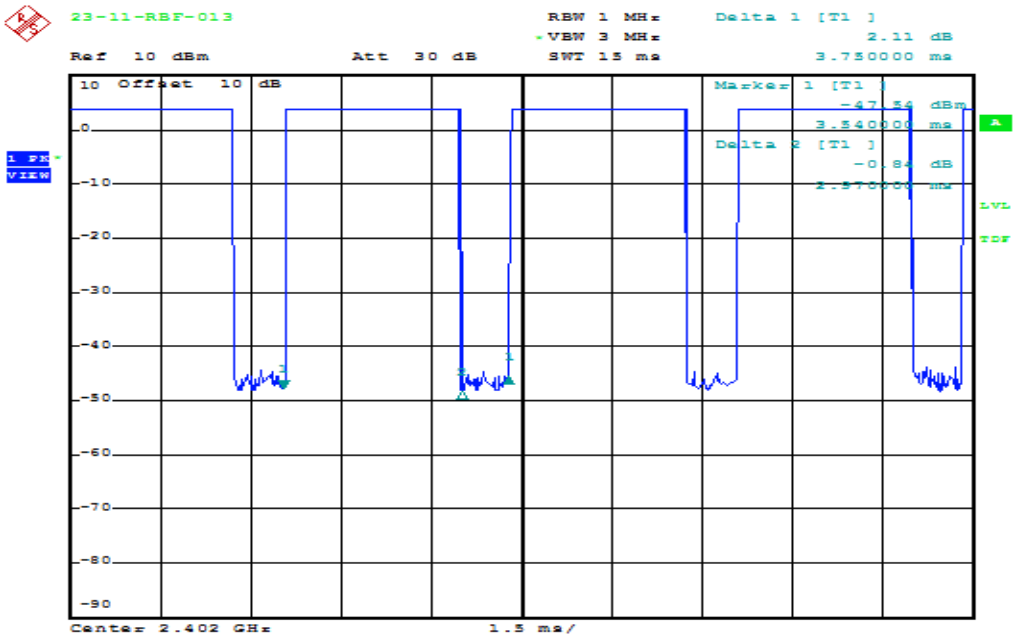
Date: 27.NOV.2023 08:18:40

BR / DH3



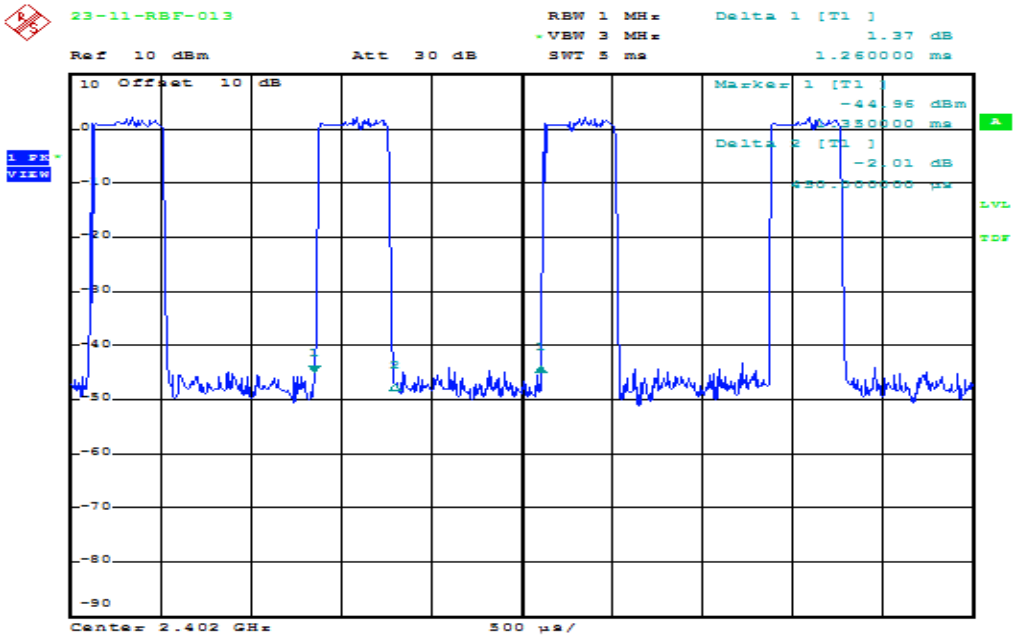
Date: 27.NOV.2023 08:20:18

BR / DH5



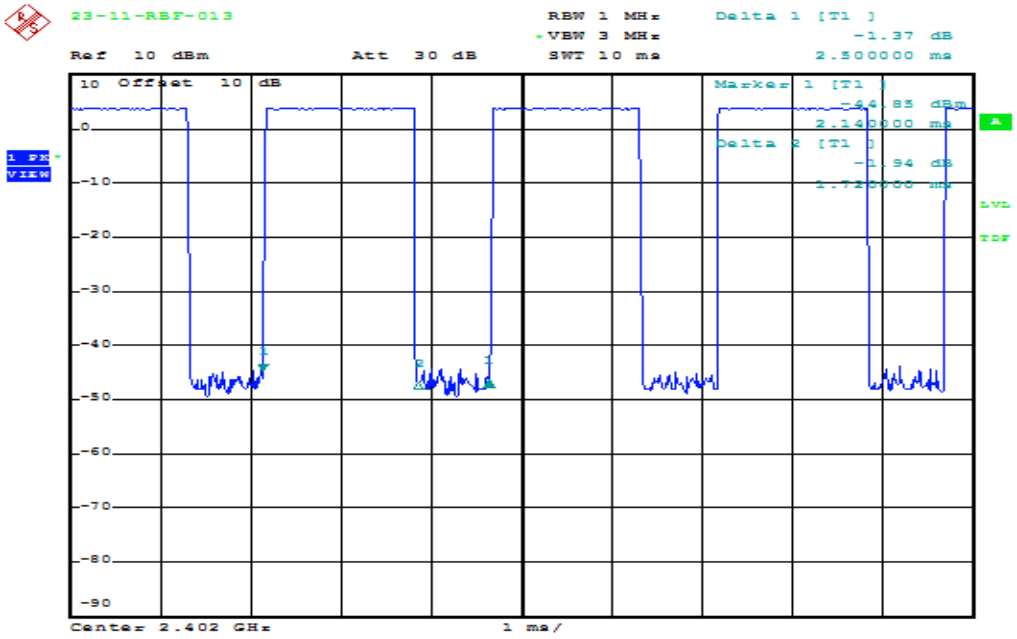
Date: 27.NOV.2023 08:24:13

EDR / DH1



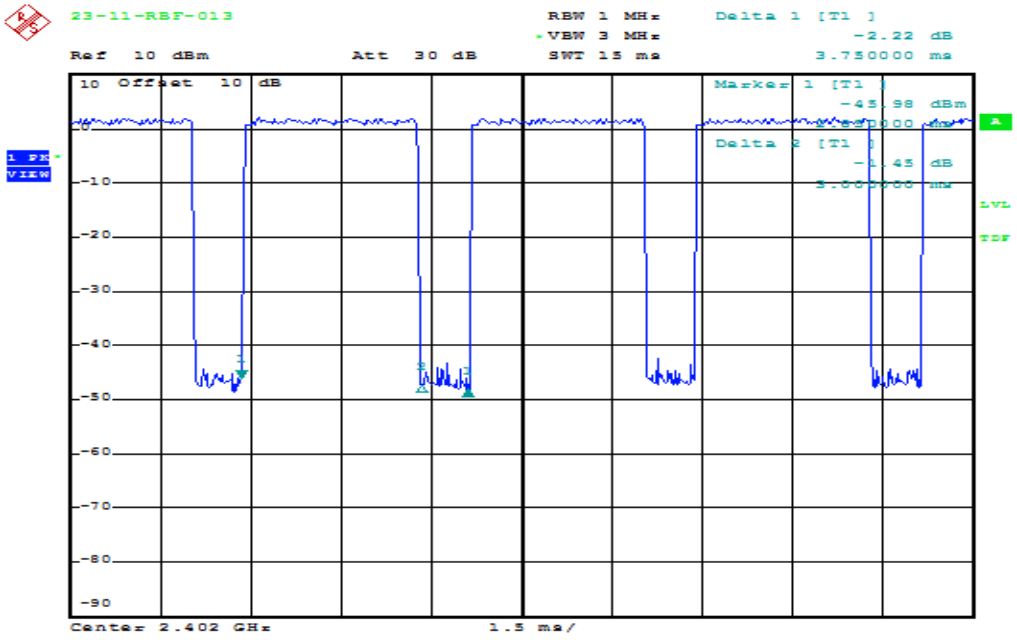
Date: 27.NOV.2023 09:08:16

EDR / DH3



Date: 27.NOV.2023 09:09:35

EDR / DH5



Date: 27.NOV.2023 09:10:27