FCC Part 15
EMI TEST REPORT

of

E.U.T. : JOBSITE BLUETOOTH RADIO
Model No. : DCR028
Serial Model : ---
FCC ID : YJ7DCR028

for

APPLICANT : Stanley Black & Decker

ADDRESS : 701 East Joppa Road Towson, MD 21286

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
NO. 34. LIN 5, DINGFU VIL., LINKOU DIST.,
NEW TAIPEI CITY, TAIWAN, 24442, R.O.C.
Tel:(02)26023052 Fax:(02)26010910
http://www.etc.org.tw ; e-mail : emc@etc.org.tw
Report Number :20-02-RBF-007-01

TEST REPORT CERTIFICATION

Applicant	:	Stanley Black & Decker
		701 East Joppa Road Towson, MD 21286
Manufacture	:	PHIHONG TECHNOLOGY CO., LTD.
		No. 568, Fuxing 3rd Rd., Guishan Dist.,Taoyuan City 33383, Taiwan (R.O.C.)
Description of Device	:	
a) Type of EUT	:	JOBSITE BLUETOOTH RADIO
b) Trade Name	:	--
c) Model No.	:	DCR028
d) Serial Model	:	--
e) Power Supply	:	120Vac 60Hz 0.72A
f) Frequency Range	:	BR 2402~2480MHz
		EDR 2402~2480MHz

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 founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note: 1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect 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 : *Feb. 03, 2020*
Date Test Campaign Completed : *Feb. 12, 2020*
Date of Issue : *Apr. 16, 2020*

Test Engineer : Kazuma Ho
(Kazuma Ho, Engineer)

Approve & Authorized : Vincent Chang
Vincent Chang, Supervisor
EMC Dept. II of ELECTRONICS TESTING CENTER, TAIWAN

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1 GENERAL INFORMATION

1.1 Product Description

a) Type of EUT	:	JOBSITE BLUETOOTH RADIO
b) Trade Name	:	--
c) Model No.	:	DCR028
d) Power Supply	:	120Vac 60Hz 0.72A
e)Receiving Frequency	:	BR 2402~2480MHz EDR 2402~2480MHz

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.

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.

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.

3 SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set to maximum allowed by EUT. Three highest emissions were verified with varying placement of the transmitting antenna connected to EUT (if applicable) to maximize the emission from EUT.

For conducted and radiated emissions, whichever RF channel is operated, the digital circuits' function identically. As the reason, measurement of emissions from digital circuits is performed with the highest, middle and the lowest channel by transmitting mode.

The following modes were invastegated and the worst cases (mode 1 and 3) were chosen for final test.

1. Basic Rate (BR) 1 Mbps uses GFSK modulation
2. Enhanced Data Rate (EDR) 2Mbps uses pi/4-DQPSK modulation
3. Enhanced Data Rate (EDR) 3Mbps uses 8DPSK modulation

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Description
JOBSITE BLUETOOTH RADIO*	PHIHONG TECHNOLOGY CO., LTD.	DCR028	1.4m Unshielded AC Power cord 1.0m Unshielded AUX Cable 1.0m Unshielded USB Cable
Smart Phone	OPPO	CPH1605	---

Remark "*" means equipment under test.

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

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively.

2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.

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 associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

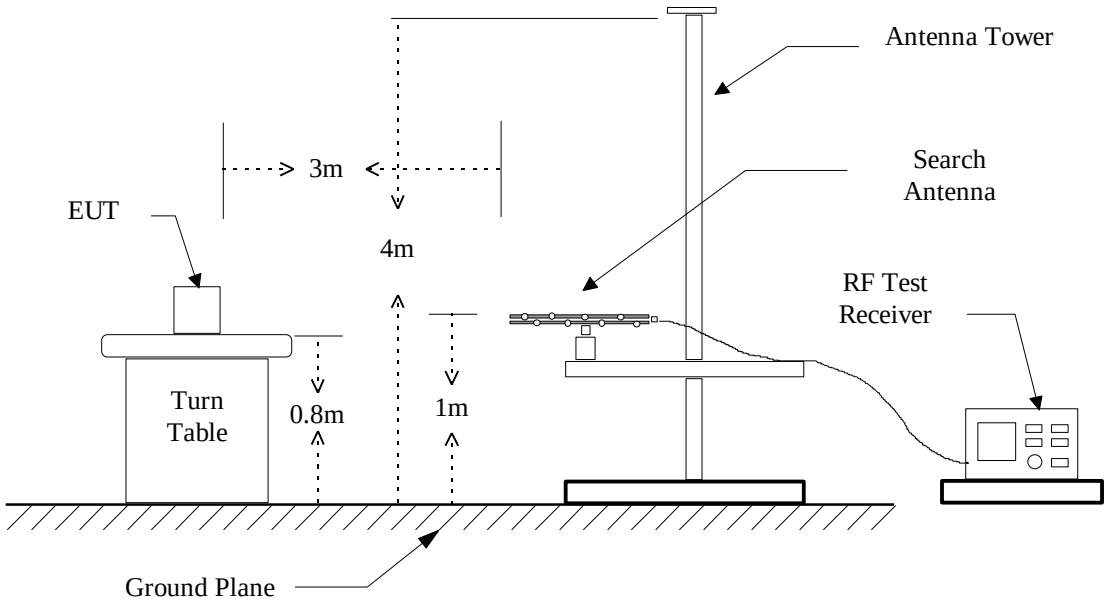
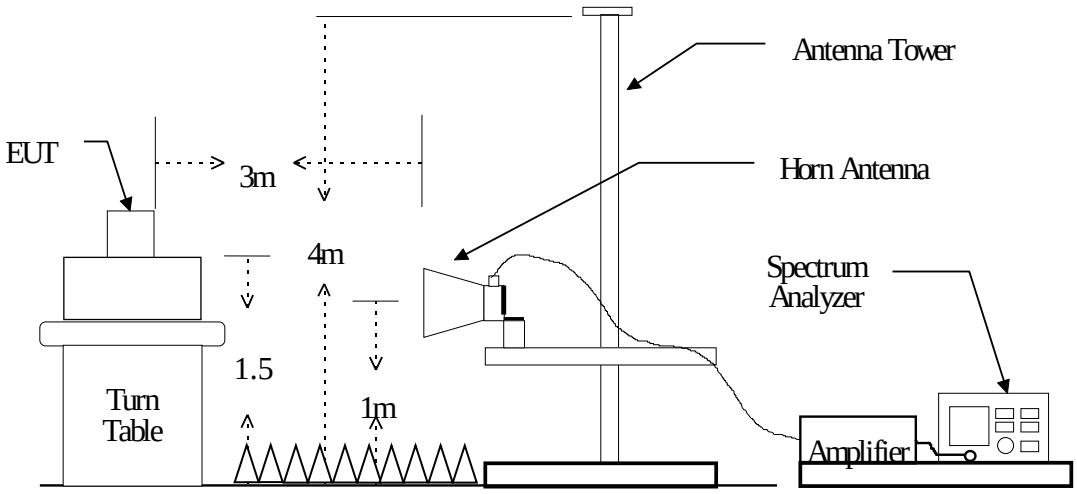


Figure 2 : Frequencies measured above 1 GHz configuration



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	Keysight	N9038A	2019/11/21	2020/11/20
Bi-Log Antenna	ETC & JYEBAO	MCTD 2786 & FAT-NM5NF5T3 G2W6	2019/08/20	2020/08/19
Amplifier	HP	8447D	2019/10/04	2020/10/03
Horn Antenna (1-18G)	EMCO	3117	2019/03/13	2020/03/12
Amplifier (1G-18G)	HP	8449B	2019/10/04	2020/10/03
Horn Antenna (18-40G)	EMCO	3116	2019/11/26	2020/11/25
Amplifier (1G-40G)	Keysight	83051A	2019/09/02	2020/09/01

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

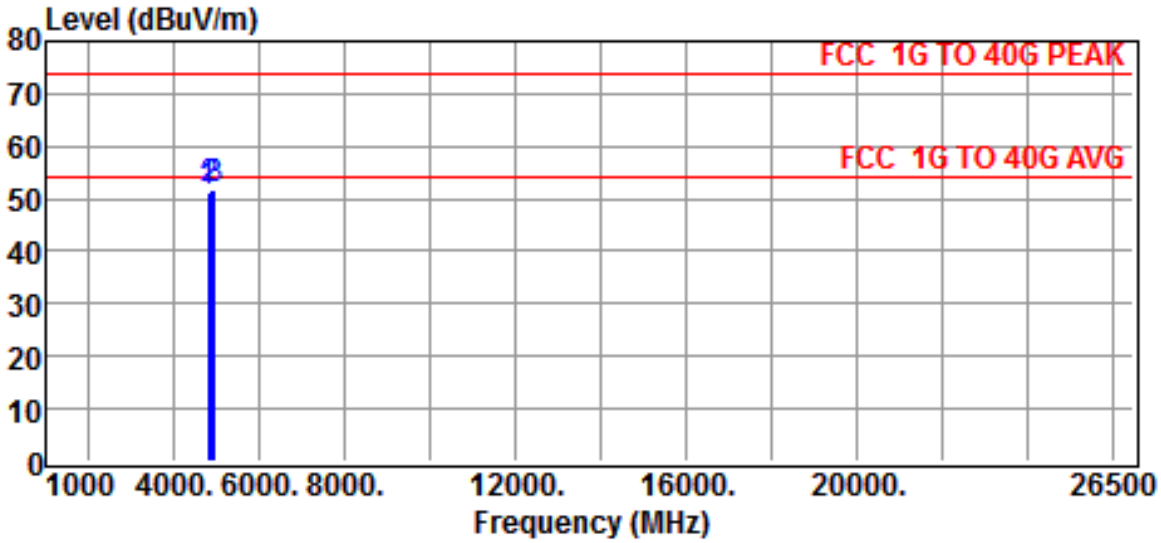
Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz or ≥ 1/T (Note 1)

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. Bluetooth BR

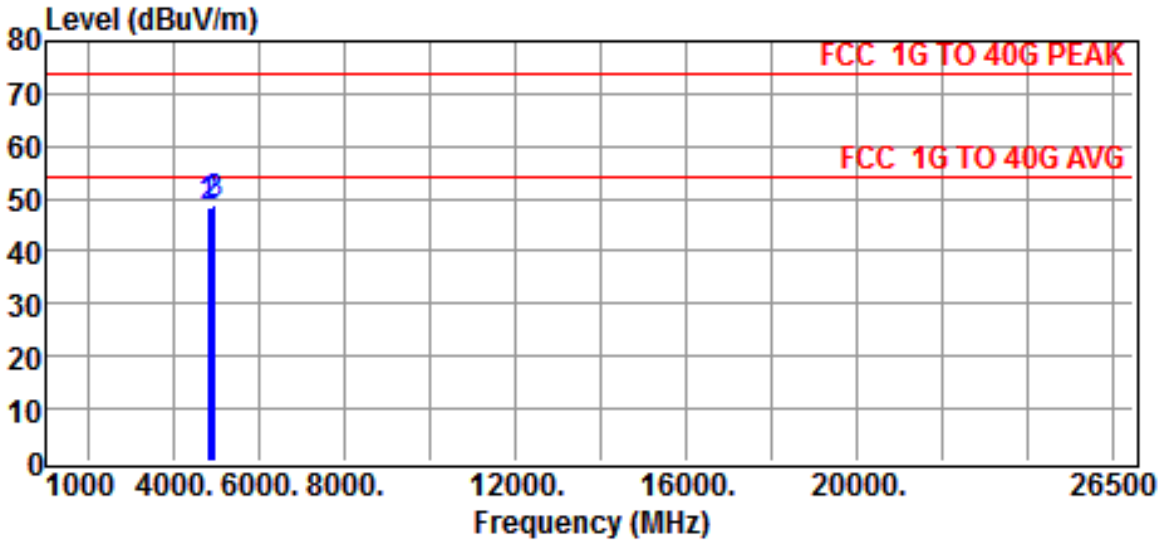


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:BR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4804.0000	47.20	4.07	51.27	74.00	-22.73	Peak
4882.0000	47.46	4.09	51.55	74.00	-22.45	Peak
4960.0000	47.64	4.17	51.81	74.00	-22.19	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



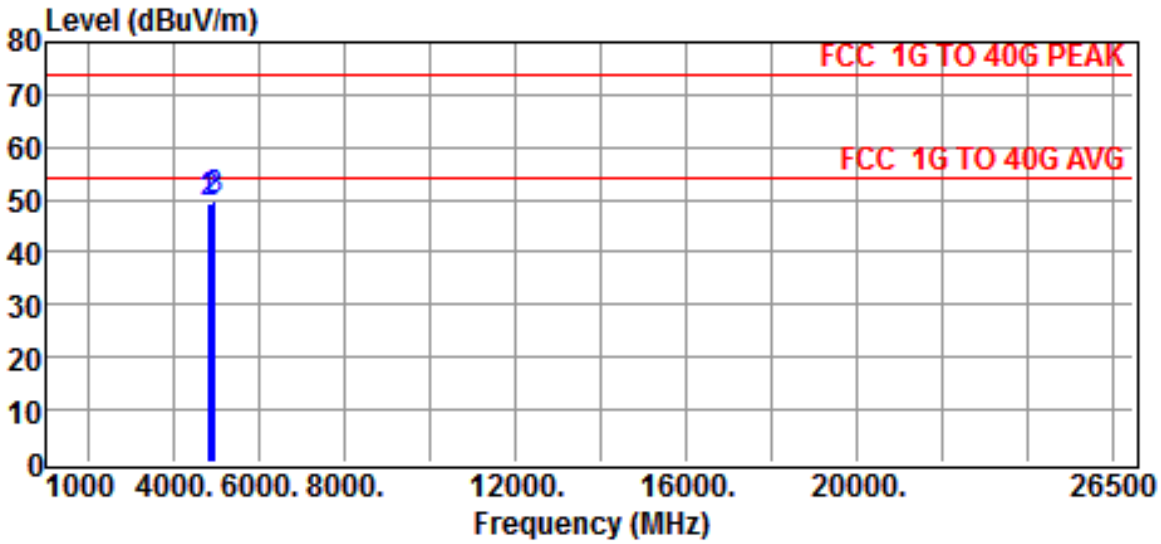
Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:BR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4804.0000	44.26	4.07	48.33	74.00	-25.67	Peak
4882.0000	44.45	4.09	48.54	74.00	-25.46	Peak
4960.0000	44.62	4.17	48.79	74.00	-25.21	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

B. Bluetooth EDR

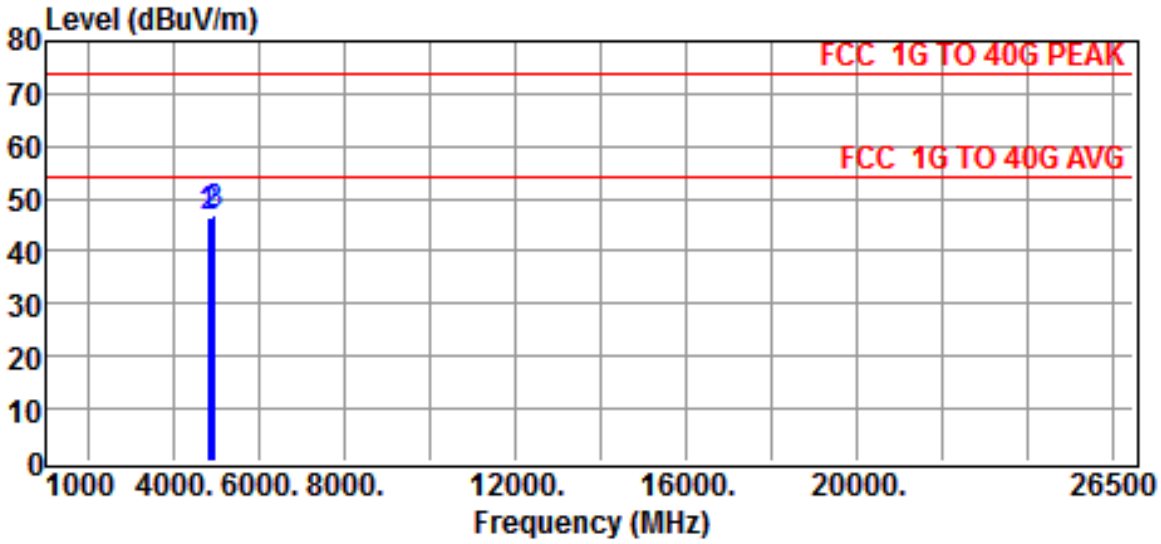


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:EDR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4804.0000	45.15	4.07	49.22	74.00	-24.78	Peak
4882.0000	45.34	4.09	49.43	74.00	-24.57	Peak
4960.0000	45.50	4.17	49.67	74.00	-24.33	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:EDR		
Test Mode	:		

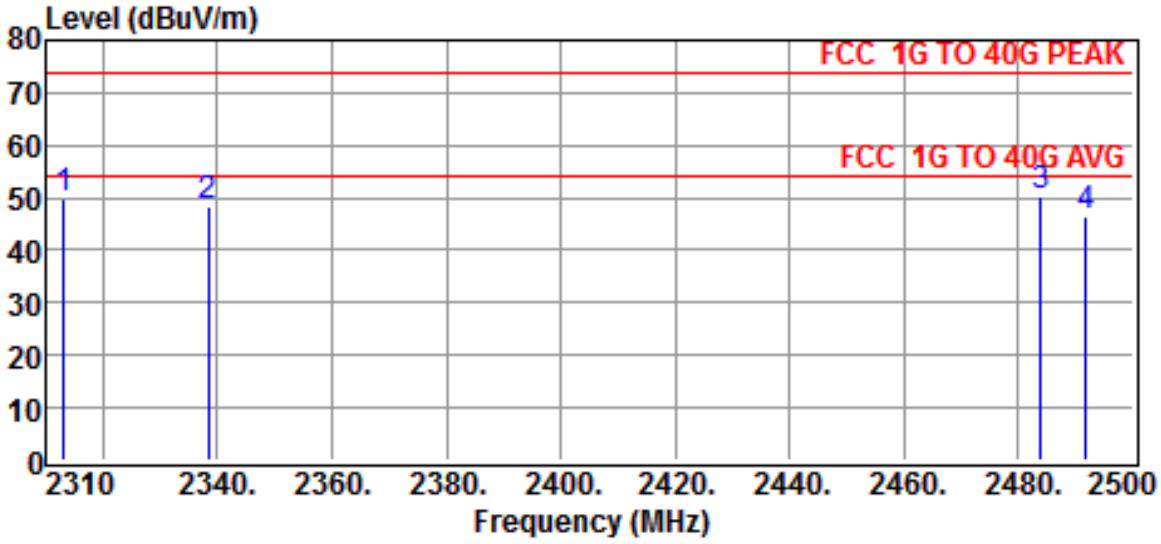
Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
4804.0000	42.22	4.07	46.29	74.00	-27.71	Peak
4882.0000	42.44	4.09	46.53	74.00	-27.47	Peak
4960.0000	42.61	4.17	46.78	74.00	-27.22	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

4.4.2 Radiated Emissions in Restricted Bands

A. Bluetooth BR

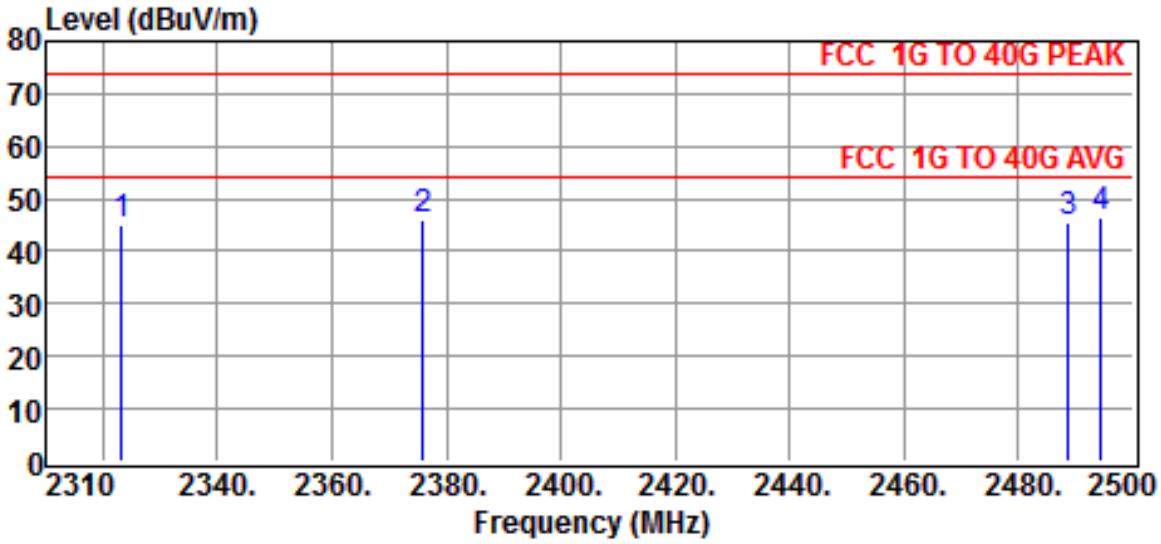


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:BR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2313.2000	51.28	-1.25	50.03	74.00	-23.97	Peak
2338.4800	49.26	-1.06	48.20	74.00	-25.80	Peak
2483.8120	50.54	-0.47	50.07	74.00	-23.93	Peak
2491.6920	47.14	-0.46	46.68	74.00	-27.32	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



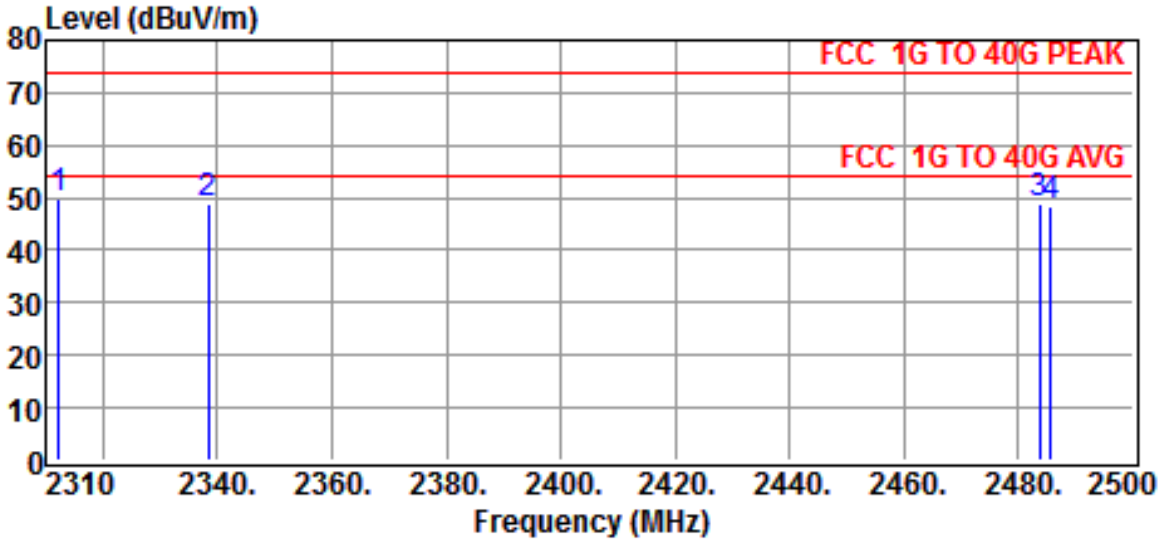
Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:BR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2323.2800	46.38	-1.17	45.21	74.00	-28.79	Peak
2375.8400	46.85	-0.88	45.97	74.00	-28.03	Peak
2488.7860	45.87	-0.47	45.40	74.00	-28.60	Peak
2494.4340	46.75	-0.46	46.29	74.00	-27.71	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

B. Bluetooth EDR

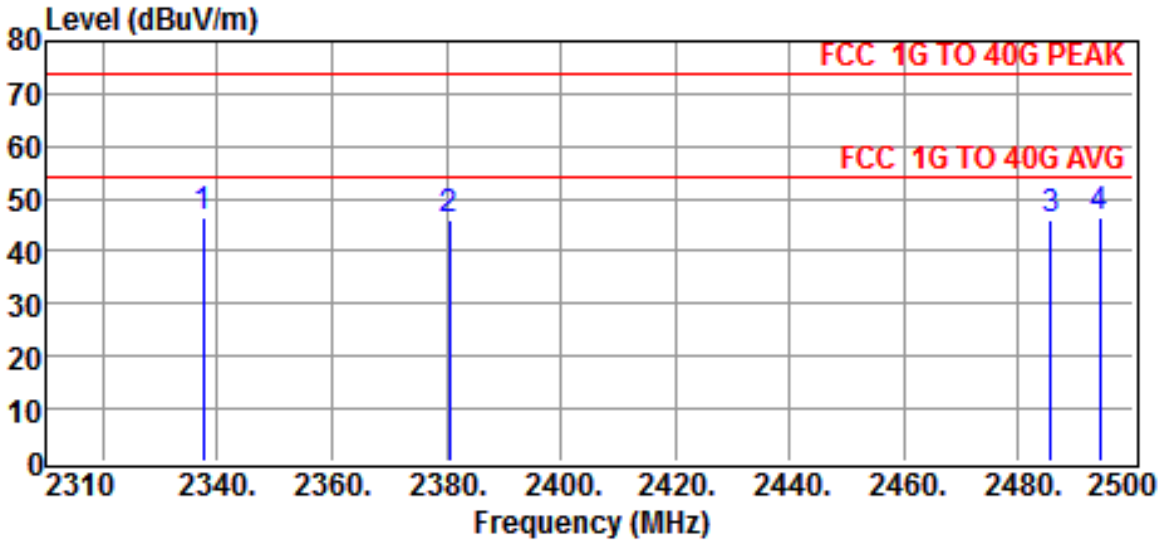


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:EDR		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2312.2400	51.03	-1.26	49.77	74.00	-24.23	Peak
2338.3200	49.74	-1.06	48.68	74.00	-25.32	Peak
2483.5500	49.52	-0.47	49.05	74.00	-24.95	Peak
2485.5950	48.64	-0.47	48.17	74.00	-25.83	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:5Vdc(Power from PC)	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:EDR		
Test Mode	:		

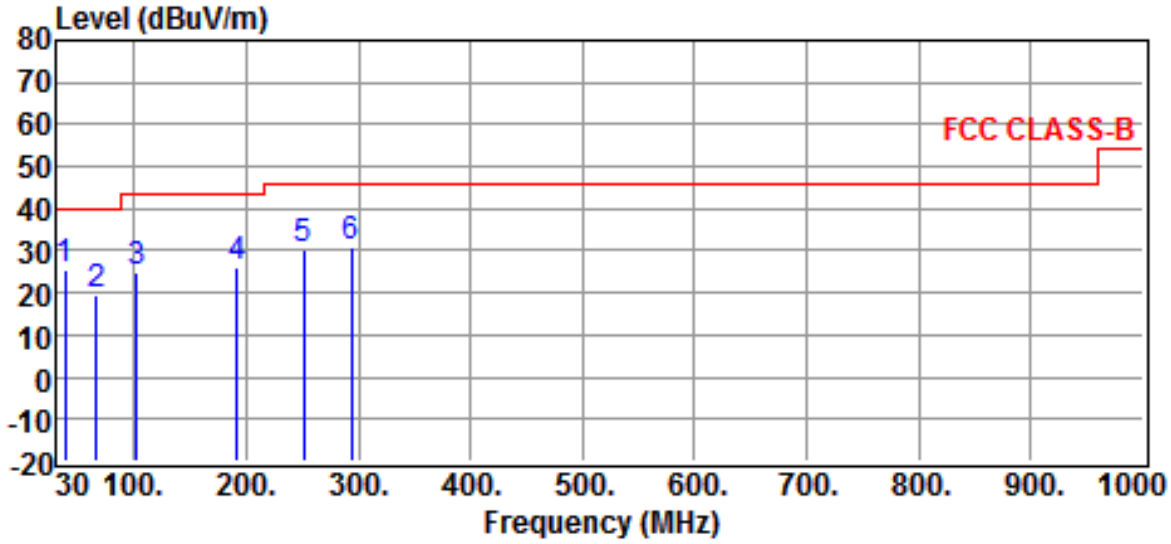
Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
2337.4400	47.45	-1.07	46.38	74.00	-27.62	Peak
2380.4800	47.09	-0.86	46.23	74.00	-27.77	Peak
2485.5460	46.45	-0.47	45.98	74.00	-28.02	Peak
2494.0930	47.03	-0.46	46.57	74.00	-27.43	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

4.4.3 Other Emissions

a) Emission frequencies below 1 GHz

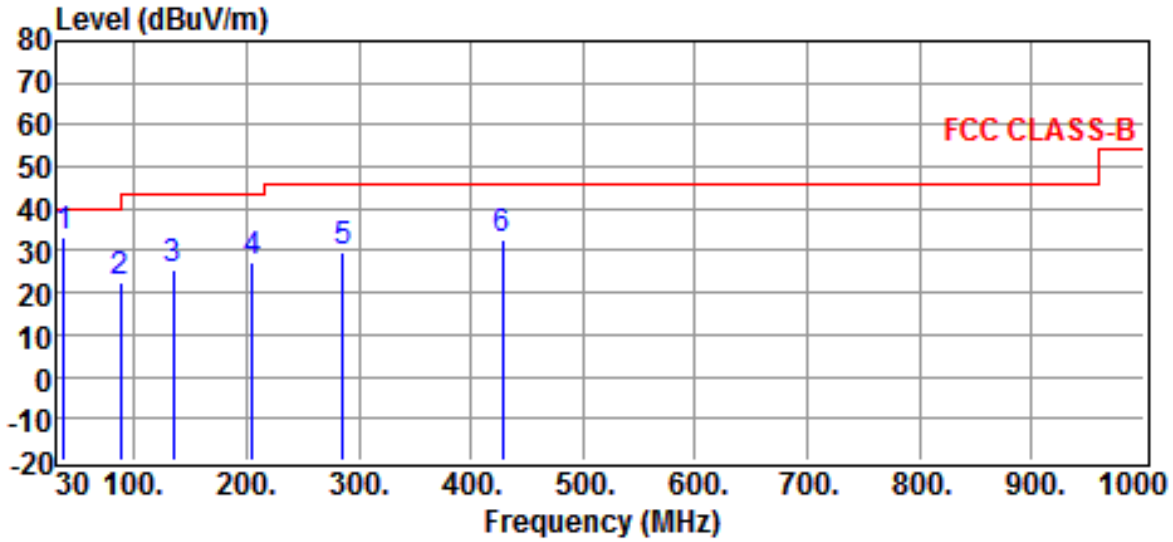


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC CLASS-B	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:120Vac 60Hz	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 1-AC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
38.7300	32.11	-6.63	25.48	40.00	-14.52	QP
66.8600	34.26	-14.58	19.68	40.00	-20.32	QP
101.7800	34.36	-9.54	24.82	43.50	-18.68	QP
191.9900	35.35	-9.41	25.94	43.50	-17.56	QP
251.1600	35.01	-4.96	30.05	46.00	-15.95	QP
293.8400	34.04	-3.17	30.87	46.00	-15.13	QP

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

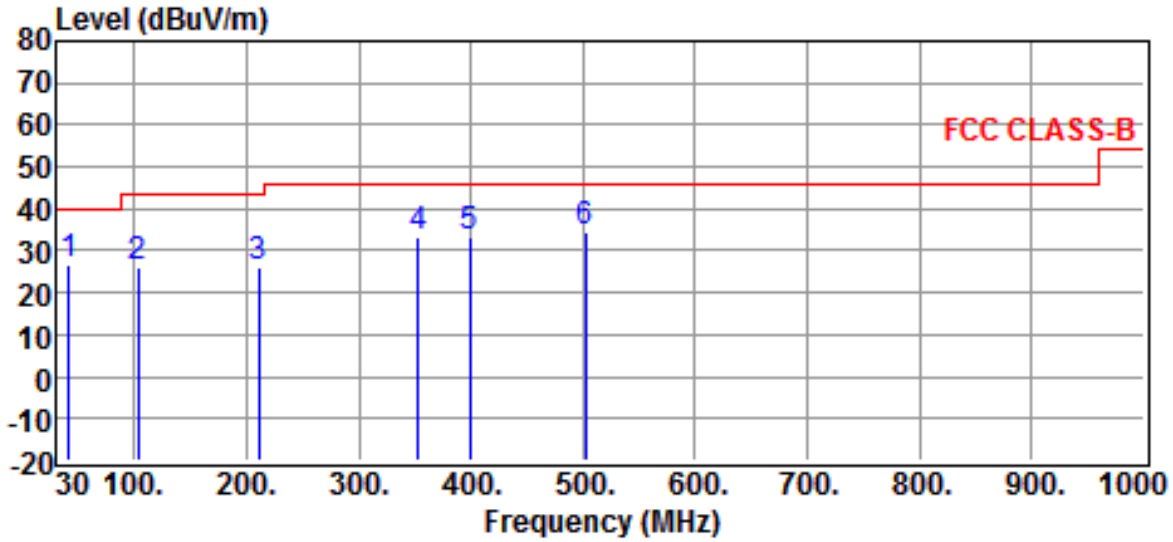


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC CLASS-B	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:120Vac 60Hz	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 1-AC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
37.7600	39.41	-5.98	33.43	40.00	-6.57	QP
87.2300	33.69	-11.47	22.22	40.00	-17.78	QP
134.7600	33.30	-7.55	25.75	43.50	-17.75	QP
205.5700	34.16	-6.85	27.31	43.50	-16.19	QP
286.0800	33.33	-3.70	29.63	46.00	-16.37	QP
427.7000	33.72	-0.82	32.90	46.00	-13.10	QP

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

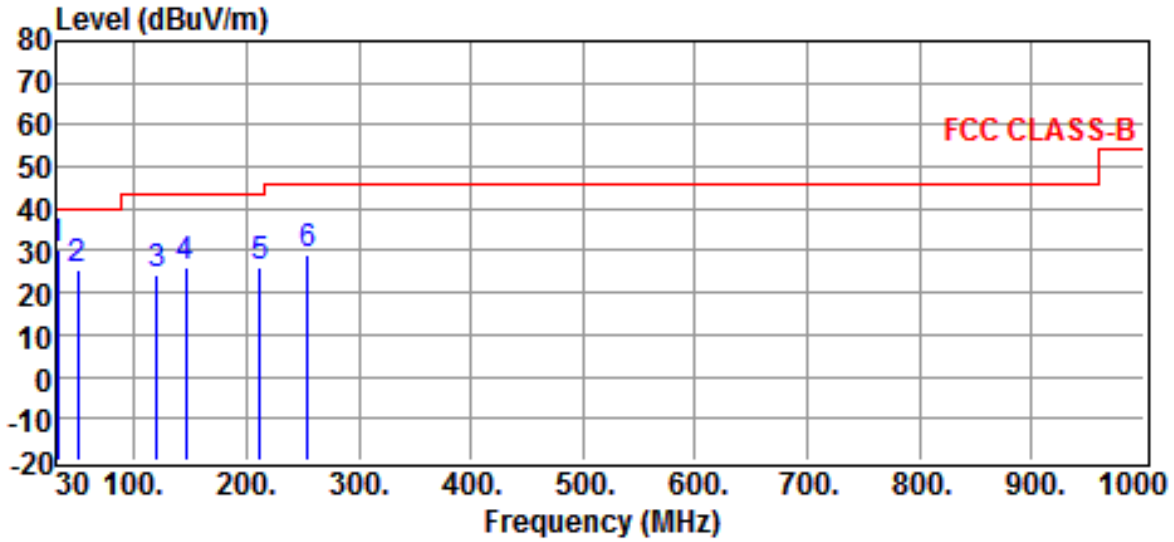


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC CLASS-B	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:20Vdc Battery	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 2-DC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
41.6400	34.78	-8.00	26.78	40.00	-13.22	QP
103.7200	35.45	-9.43	26.02	43.50	-17.48	QP
210.4200	33.02	-6.66	26.36	43.50	-17.14	QP
353.0100	35.41	-2.20	33.21	46.00	-12.79	QP
399.5700	34.00	-0.98	33.02	46.00	-12.98	QP
502.3900	34.53	0.19	34.72	46.00	-11.28	QP

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



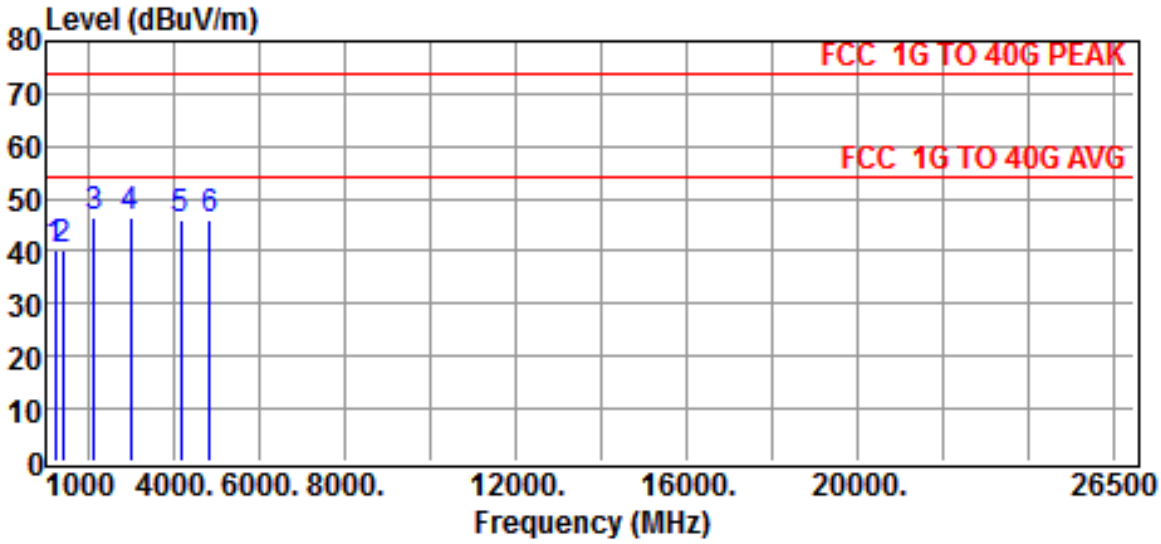
Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC CLASS-B	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:20Vdc Battery	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 2-DC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
31.9400	31.68	-1.64	30.04	40.00	-9.96	QP
49.4000	35.82	-10.42	25.40	40.00	-14.60	QP
120.2100	32.62	-8.06	24.56	43.50	-18.94	QP
146.4000	33.44	-7.41	26.03	43.50	-17.47	QP
212.3600	33.13	-6.80	26.33	43.50	-17.17	QP
255.0400	33.73	-4.70	29.03	46.00	-16.97	QP

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

b) Emission frequencies above 1 GHz

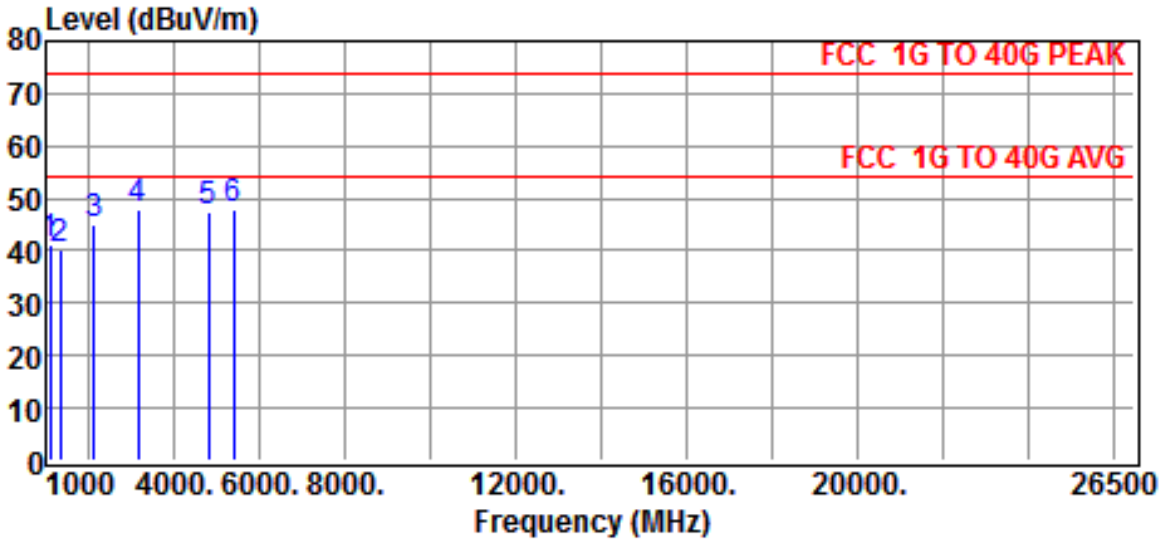


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:120Vac 60Hz	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 1-AC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
1229.5000	47.50	-7.27	40.23	74.00	-33.77	Peak
1408.0000	46.73	-6.67	40.06	74.00	-33.94	Peak
2147.5000	48.26	-1.67	46.59	74.00	-27.41	Peak
2989.0000	45.76	0.69	46.45	74.00	-27.55	Peak
4162.0000	43.20	2.98	46.18	74.00	-27.82	Peak
4850.5000	41.93	4.20	46.13	74.00	-27.87	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

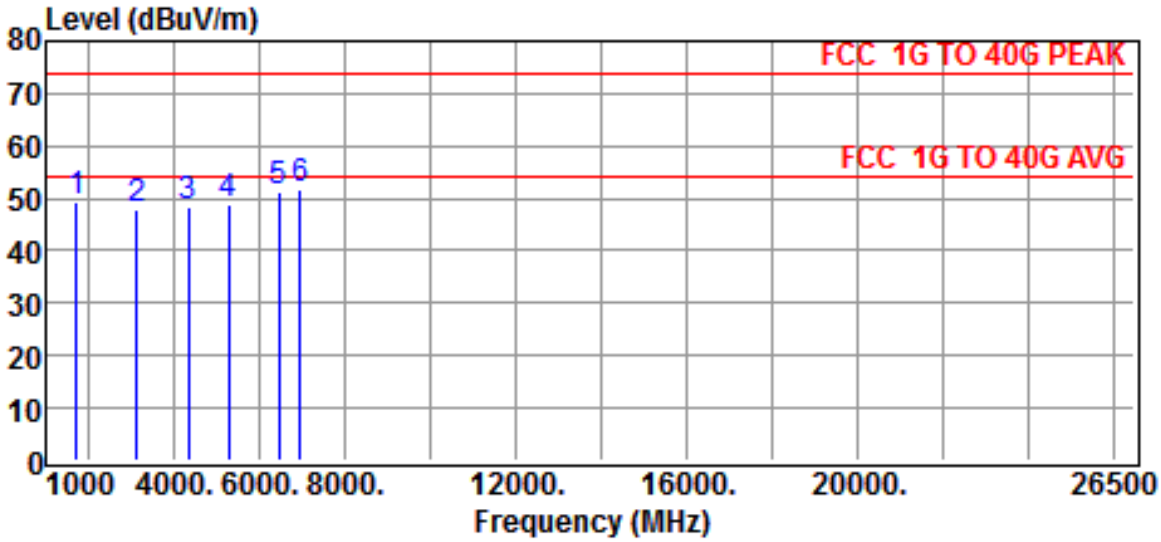


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:120Vac 60Hz	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 1-AC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
1102.0000	49.12	-7.84	41.28	74.00	-32.72	Peak
1331.5000	47.30	-6.85	40.45	74.00	-33.55	Peak
2147.5000	46.81	-1.67	45.14	74.00	-28.86	Peak
3167.5000	45.53	2.45	47.98	74.00	-26.02	Peak
4799.5000	43.57	4.06	47.63	74.00	-26.37	Peak
5411.5000	42.79	5.02	47.81	74.00	-26.19	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

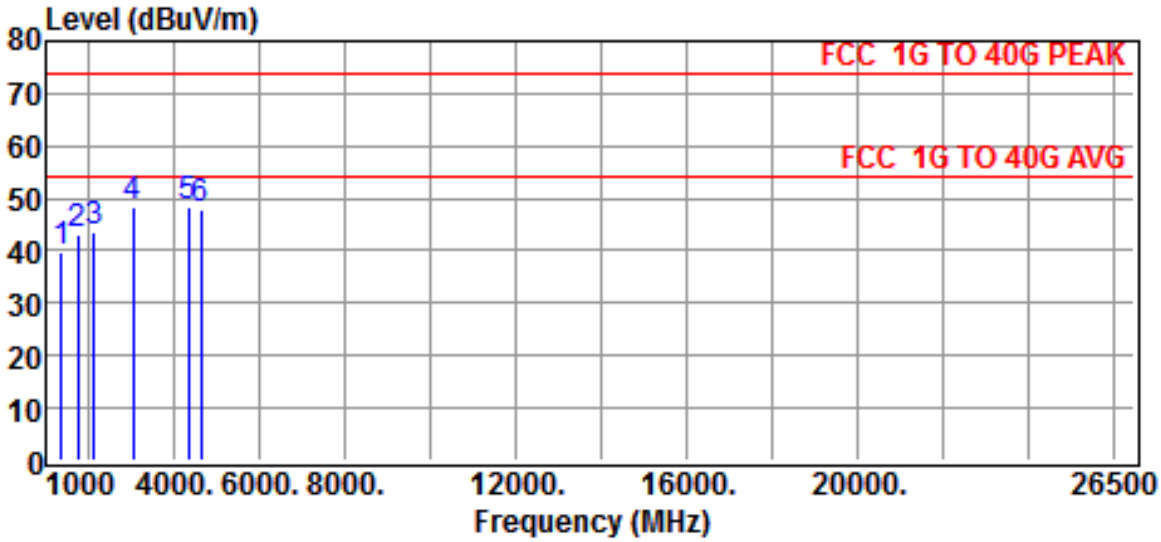


Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:20Vdc Battery	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 2-DC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
1714.0000	53.25	-4.14	49.11	74.00	-24.89	Peak
3142.0000	45.24	2.75	47.99	74.00	-26.01	Peak
4340.5000	45.20	3.37	48.57	74.00	-25.43	Peak
5284.0000	44.50	4.57	49.07	74.00	-24.93	Peak
6457.0000	44.32	6.86	51.18	74.00	-22.82	Peak
6967.0000	44.57	7.14	51.71	74.00	-22.29	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.



Site	:Chamber #2	Date	:2020-02-10
Limit	:FCC 1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:JOBSITE BLUETOOTH RADIO	Model	:DCR028
Power Rating	:20Vdc Battery	Temp.	:14°C
Engineer	: Kazuma Ho	Humi.	:71 %
Test Mode	:Mode 2-DC+BT+DC Out		
Test Mode	:		

Freq MHz	Reading dBuV	Correction Factor dB	Result dBuV/m	Limits dBuV/m	Over limit dB	Detector
1357.0000	46.58	-6.64	39.94	74.00	-34.06	Peak
1765.0000	46.73	-3.78	42.95	74.00	-31.05	Peak
2147.5000	45.40	-1.67	43.73	74.00	-30.27	Peak
3040.0000	47.57	0.71	48.28	74.00	-25.72	Peak
4340.5000	45.03	3.37	48.40	74.00	-25.60	Peak
4646.5000	43.83	4.14	47.97	74.00	-26.03	Peak

Note :

1. Result = Reading + Corrected Factor
2. Average Result = Peak Result + Duty Factor ( )
3. Corrected 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.

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

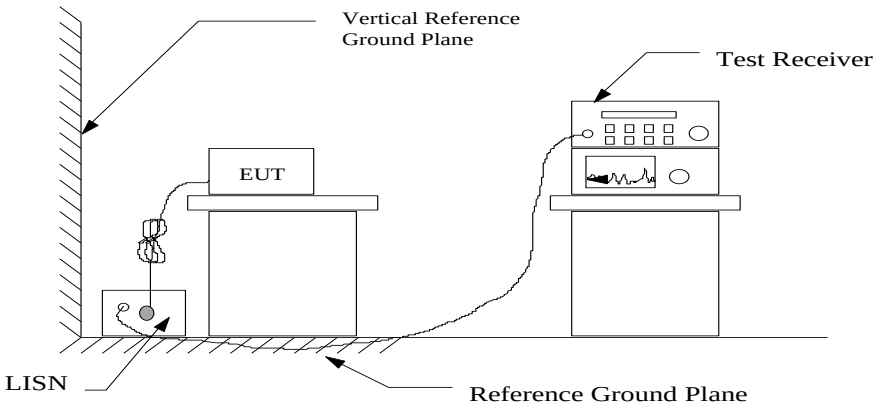
5.1 Standard Applicable

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.

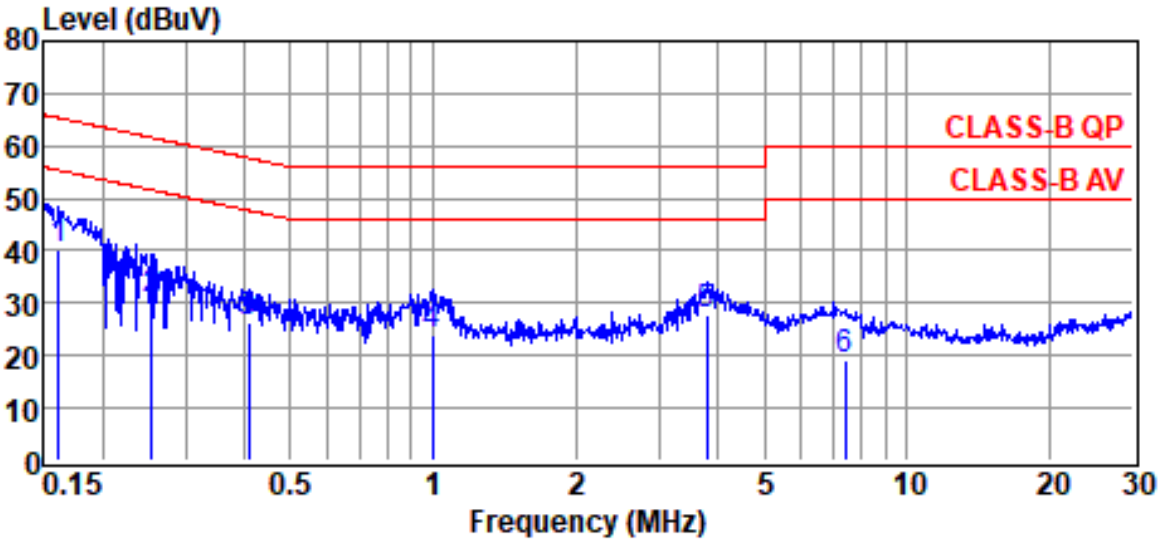
5.2 Measurement Procedure

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

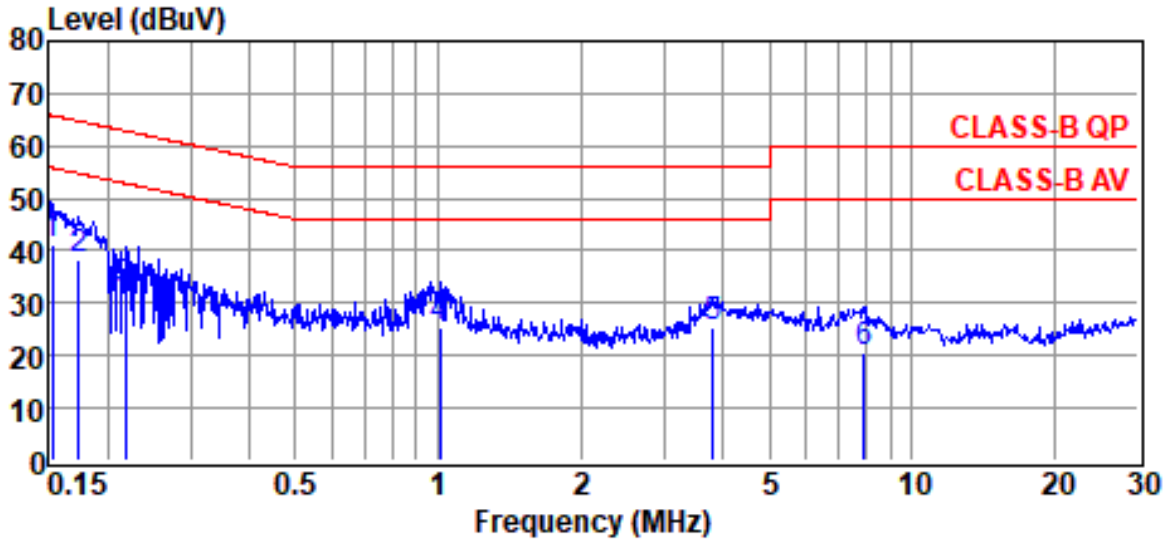


Site	: conducted #1	Date	: 2020-02-12
Condition	: CLASS-B QP	LISN	: NEUTRAL
Tem / Hum	: 20 ℃ / 71%		
Test Mode	: Mode 1-AC+BT+DC Out		
EUT	: JOBSITE BLUETOOTH RADIO	Power Rating	: 120Vac 60Hz
Engineer	: Kazuma Ho	Memo	:

Freq (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Remark
0.1616	30.31	9.98	40.29	65.38	-25.09	QP
0.2548	20.79	9.97	30.76	61.60	-30.84	QP
0.4083	16.61	9.97	26.58	57.68	-31.10	QP
0.9944	14.04	10.01	24.05	56.00	-31.95	QP
3.7790	17.81	10.11	27.92	56.00	-28.08	QP
7.4070	9.15	10.14	19.29	60.00	-40.71	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss+ Pulse Limiter Factor



Site	: conducted #1	Date	: 2020-02-12
Condition	: CLASS-B QP	LISN	: LINE
Tem / Hum	: 20 ℃ / 71%		
Test Mode	: Mode 1-AC+BT+DC Out		
EUT	: JOBSITE BLUETOOTH RADIO	Power Rating	: 120Vac 60Hz
Engineer	: Kazuma Ho	Memo	:

Freq (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV)	Limit Line (dBuV)	Over Limit (dB)	Remark
0.1532	31.08	9.97	41.05	65.82	-24.77	QP
0.1740	28.21	9.96	38.17	64.77	-26.60	QP
0.2185	22.73	9.95	32.68	62.88	-30.20	QP
1.0100	15.30	9.98	25.28	56.00	-30.72	QP
3.7990	15.13	10.08	25.21	56.00	-30.79	QP
7.9350	10.72	10.09	20.81	60.00	-39.19	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss+ Pulse Limiter Factor

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	2020/01/08	2021/01/07
LISN	Schwarzbeck	NSLK 8127 PLC	2019/12/17	2020/12/16
PLUSE LIMITER (10dB)	Schwarzbeck	VTSD 9561 F-N	2019/05/07	2020/05/06

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 antenna is permanently mounted on main PCB, no consideration of replacement.
Please see internal photos and the antenna specifications.

7 HOPPING CHANNEL SEPARATION

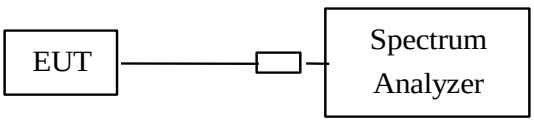
7.1 Standard Applicable

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	FSP40	2020/01/14	2021/01/13

7.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Mode: Bluetooth BR

a) Channel Low : Adjacent Hopping Channel Separation is 1.000 MHz
b) Channel Middle : Adjacent Hopping Channel Separation is 1.004 MHz
c) Channel High : Adjacent Hopping Channel Separation is 1.000 MHz

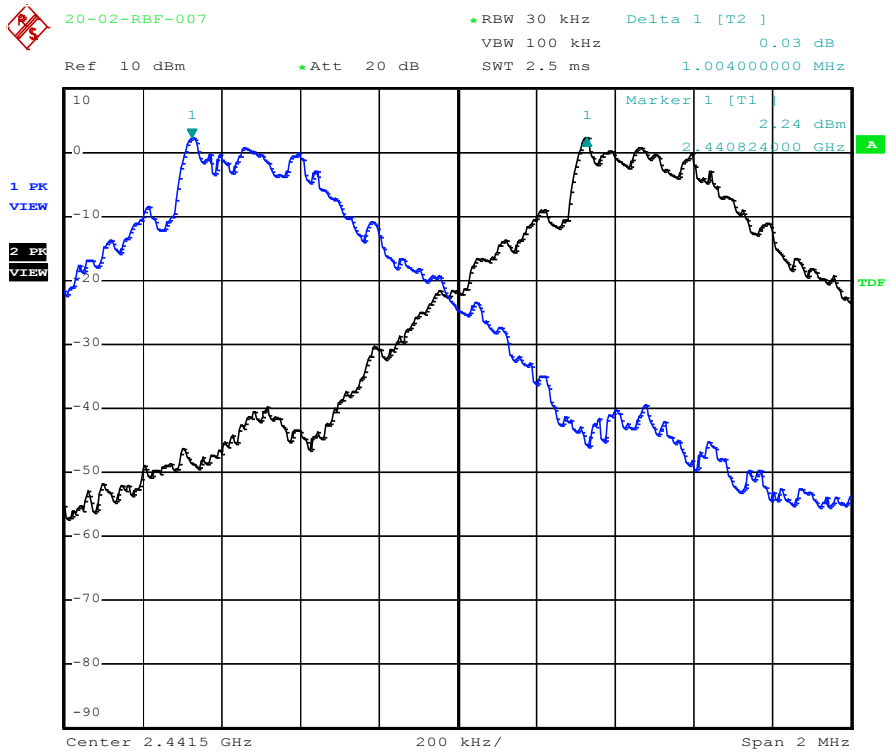
Mode: Bluetooth EDR

a) Channel Low : Adjacent Hopping Channel Separation is 1.002 MHz
b) Channel Middle : Adjacent Hopping Channel Separation is 1.002 MHz
c) Channel High : Adjacent Hopping Channel Separation is 1.008 MHz

Note : The expanded uncertainty: frequency × 1.65×10^{-6} (1 GHz < f ≤ 18 GHz).

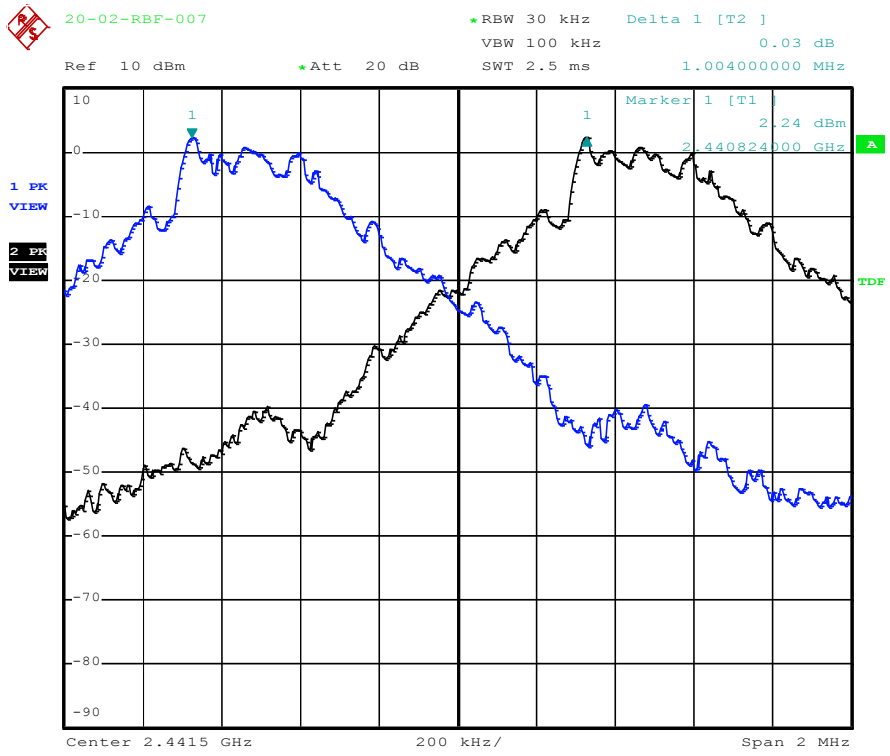
Mode: Bluetooth BR

Channel Low



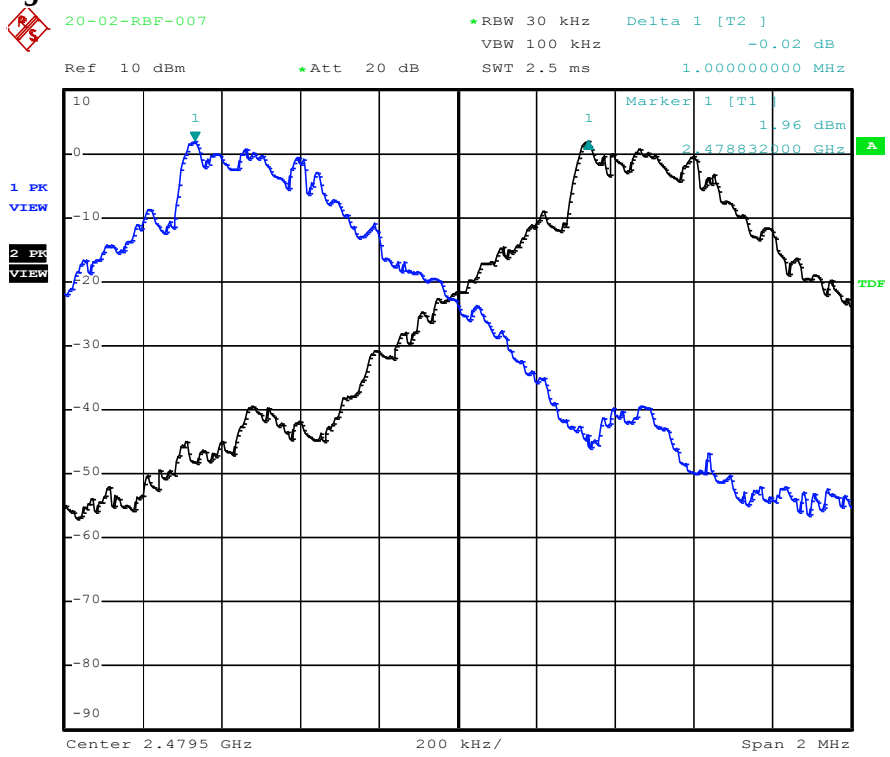
Date: 11.FEB.2020 10:54:13

Channel Middle



Date: 11.FEB.2020 10:54:13

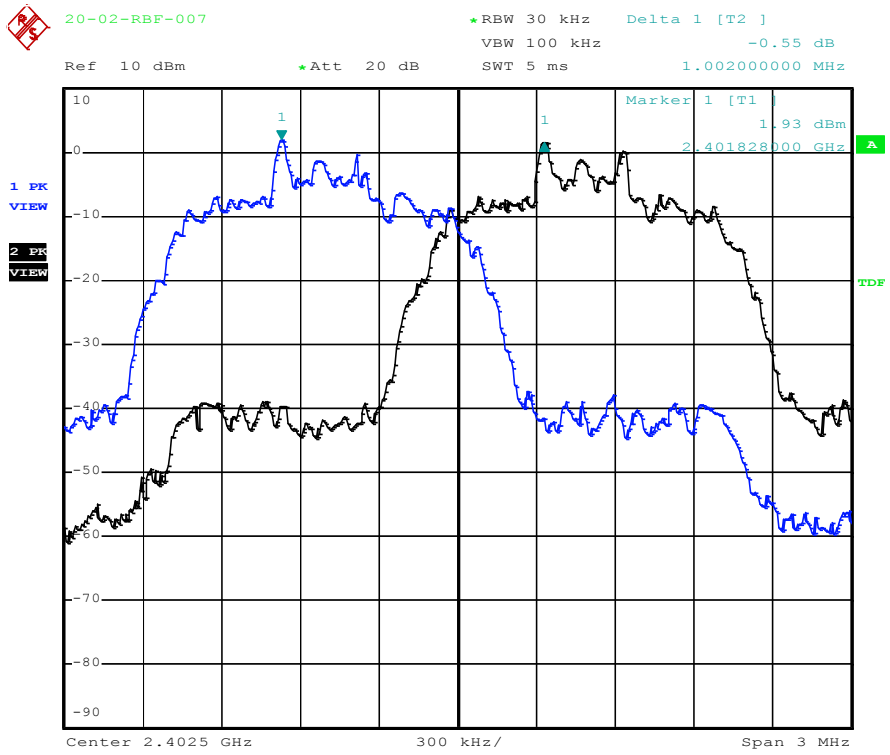
Channel High



Date: 11.FEB.2020 10:55:12

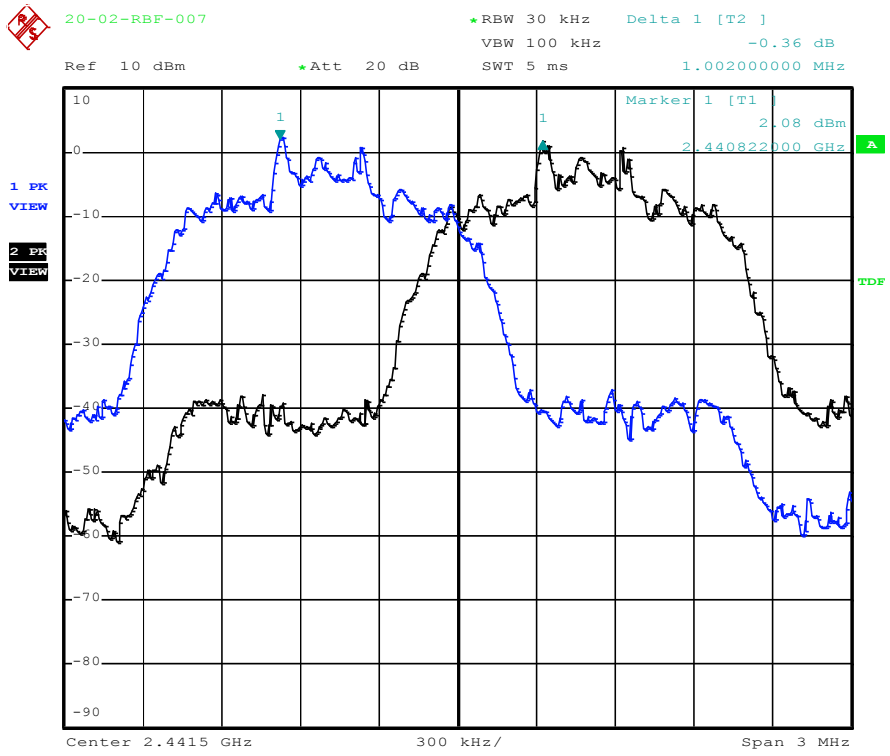
Mode: Bluetooth EDR

Channel Low



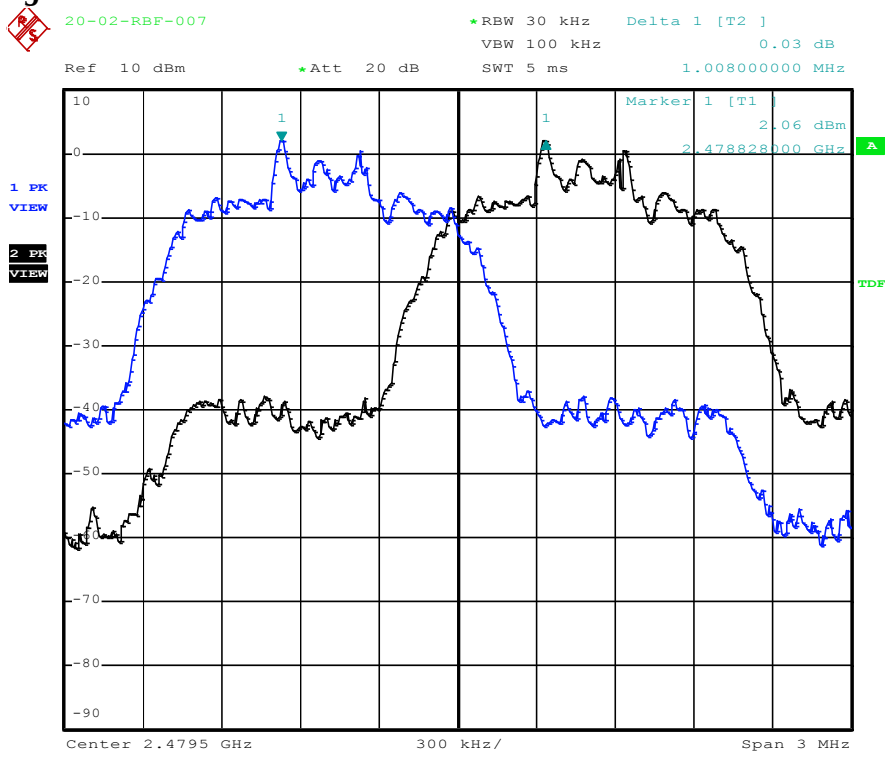
Date: 11.FEB.2020 12:04:57

Channel Middle



Date: 11.FEB.2020 13:11:14

Channel High



Date: 11.FEB.2020 13:12:17

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	FSP40	2020/01/14	2021/01/13

8.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

A. Bluetooth BR
There are 79 hopping frequencies used.

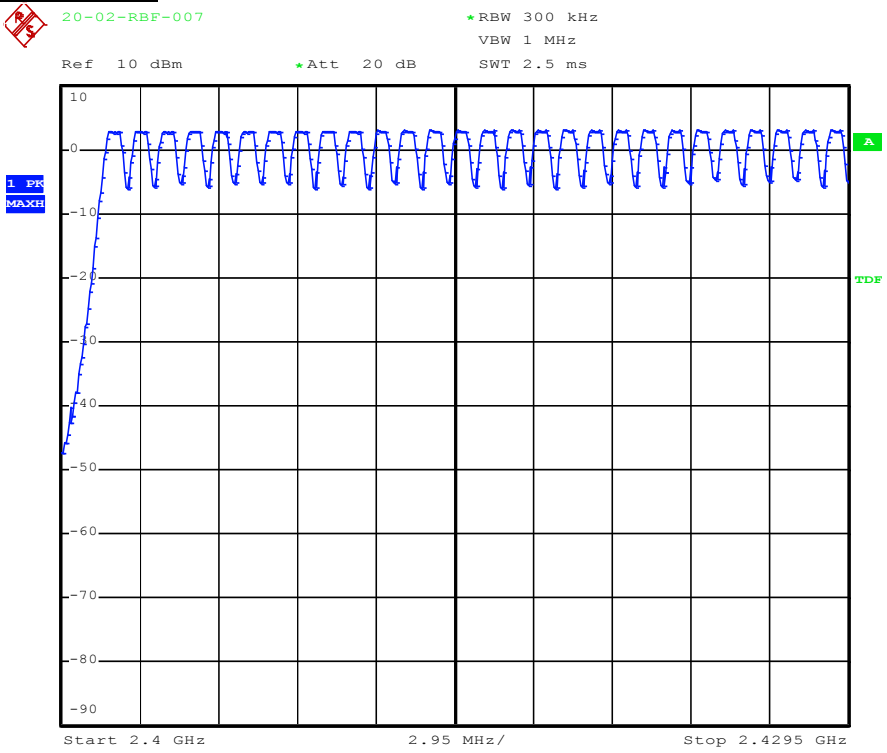
B. Bluetooth EDR
There are 79 hopping frequencies used.

Justification on AFH mode:

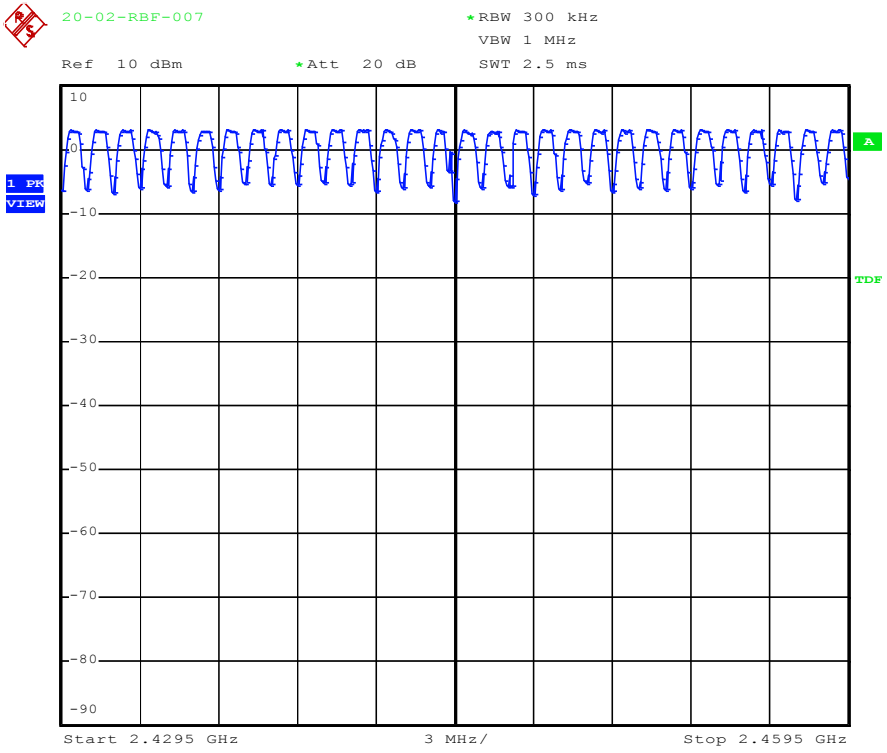
Adaptive Frequency Hopping (AFH) means that a device can hop over a reduced set of frequencies. The frequencies hopped may reduced in AFH mode but at least 15 channels will be used, normally AFH mode has 20 channels.

Note : The expanded uncertainty: frequency × 1.65×10^{-6} (1 GHz < f ≤ 18 GHz).

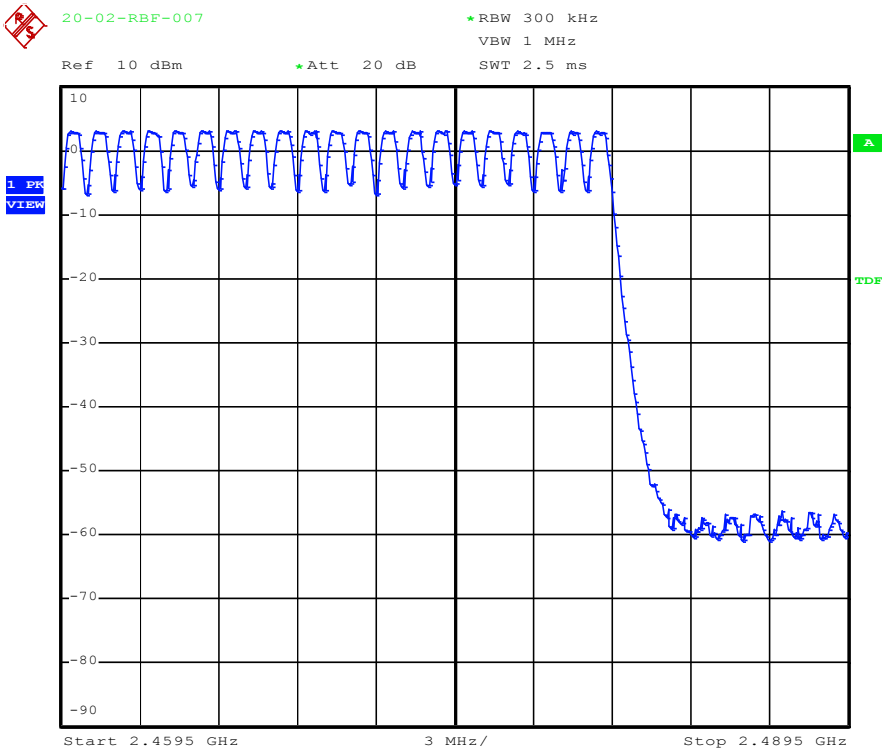
Mode: Bluetooth BR



Date: 11.FEB.2020 11:25:57

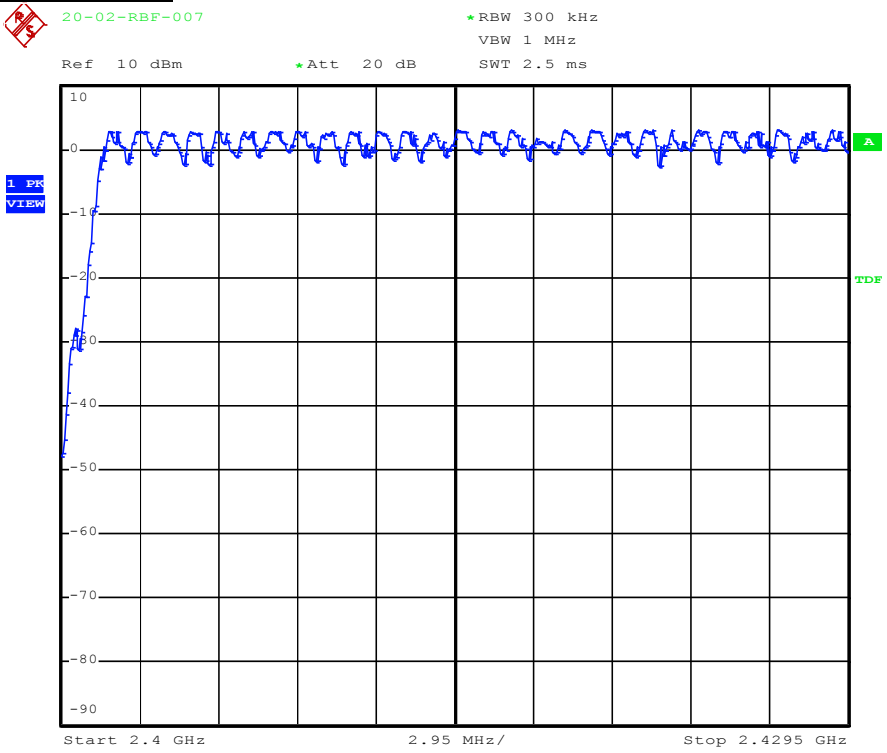


Date: 11.FEB.2020 11:26:53

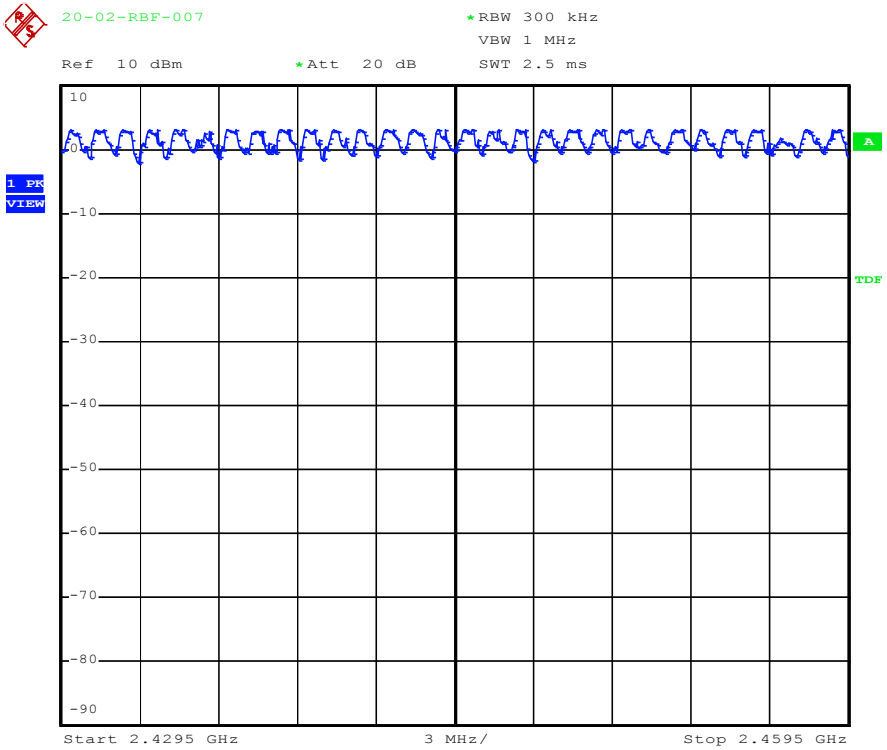


Date: 11.FEB.2020 11:28:11

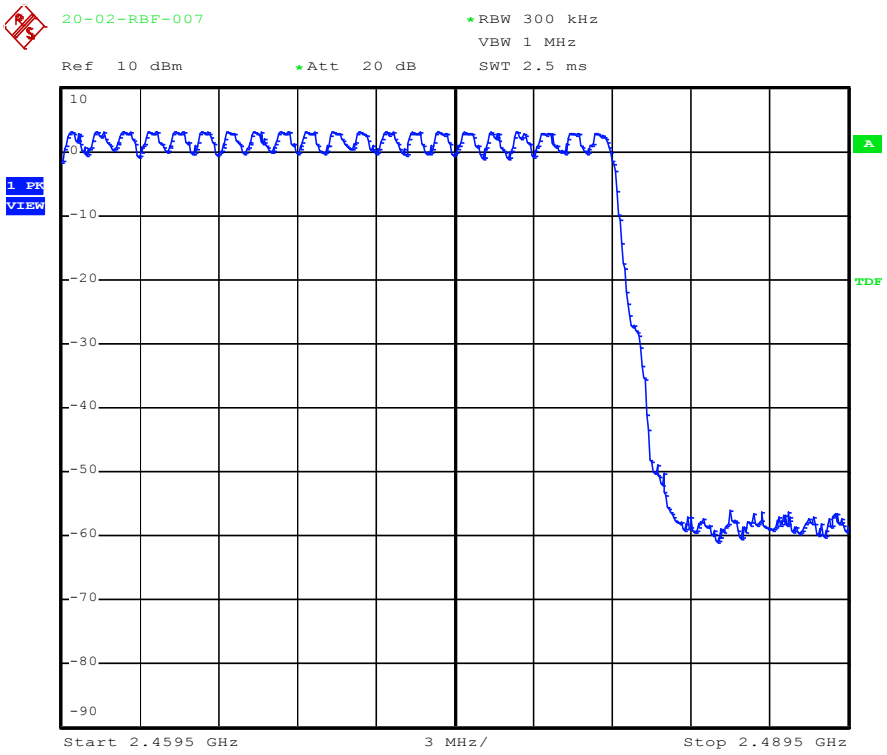
Mode: Bluetooth EDR



Date: 11.FEB.2020 13:14:06



Date: 11.FEB.2020 13:15:12



Date: 11.FEB.2020 13:17:08

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	FSP40	2020/01/14	2021/01/13

9.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Mode: Bluetooth BR

a) Channel Low : Channel Bandwidth is 0.848 MHz
b) Channel Middle : Channel Bandwidth is 0.832 MHz
c) Channel High : Channel Bandwidth is 0.800 MHz

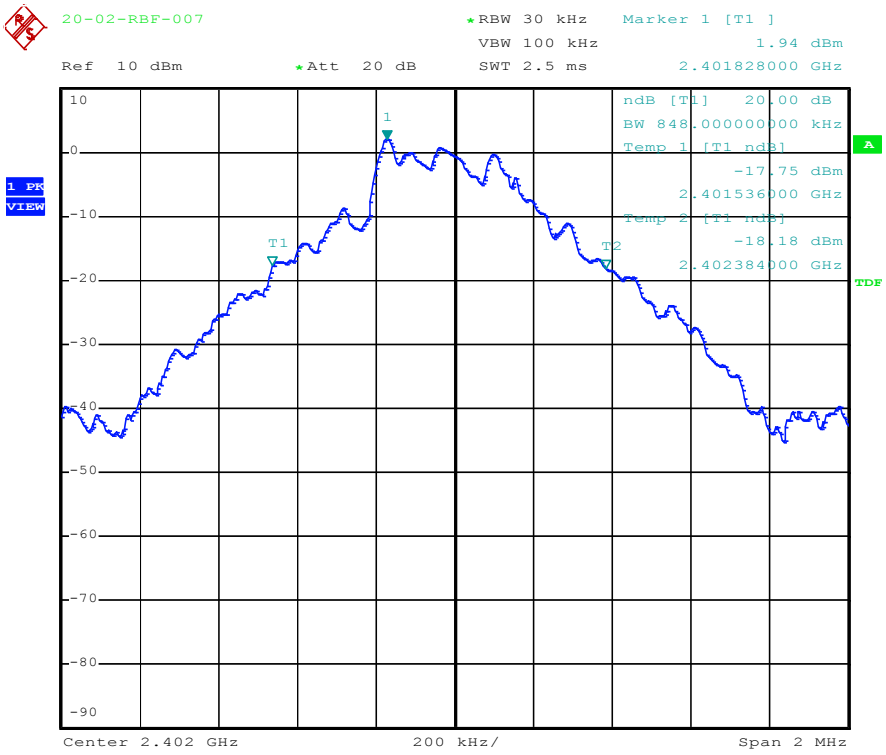
Mode: Bluetooth EDR

a) Channel Low : Channel Bandwidth is 1.208 MHz
b) Channel Middle : Channel Bandwidth is 1.216 MHz
c) Channel High : Channel Bandwidth is 1.216 MHz

Note : The expanded uncertainty: frequency × 1.65×10^{-6} (1 GHz < f ≤ 18 GHz).

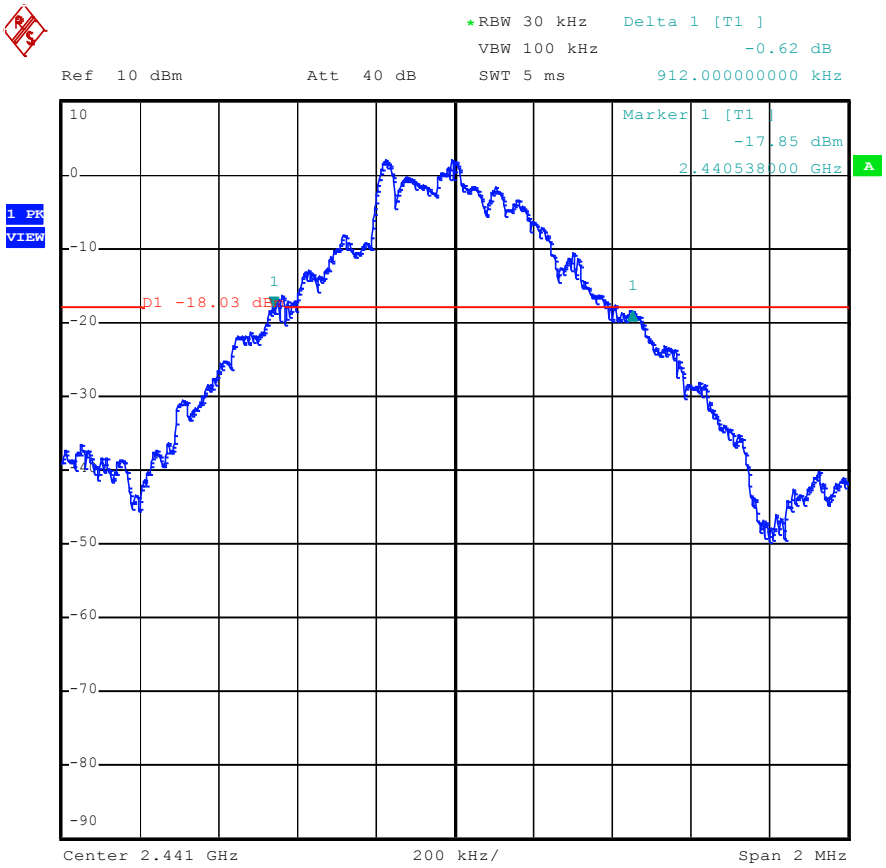
Mode:Bluetooth BR

Channel Low

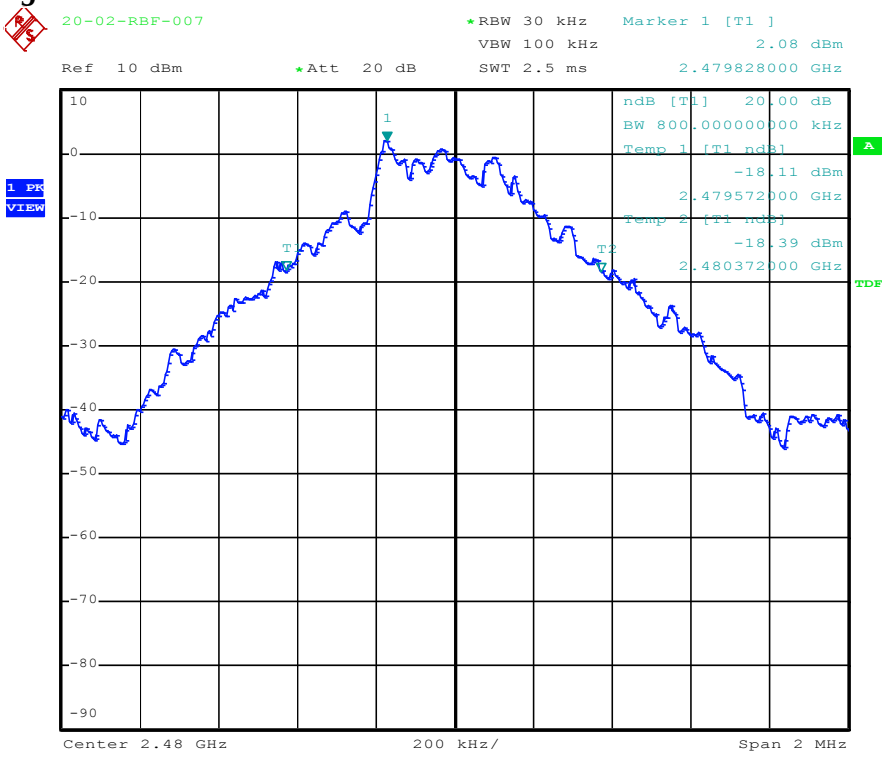


Date: 11.FEB.2020 10:34:58

Channel Middle



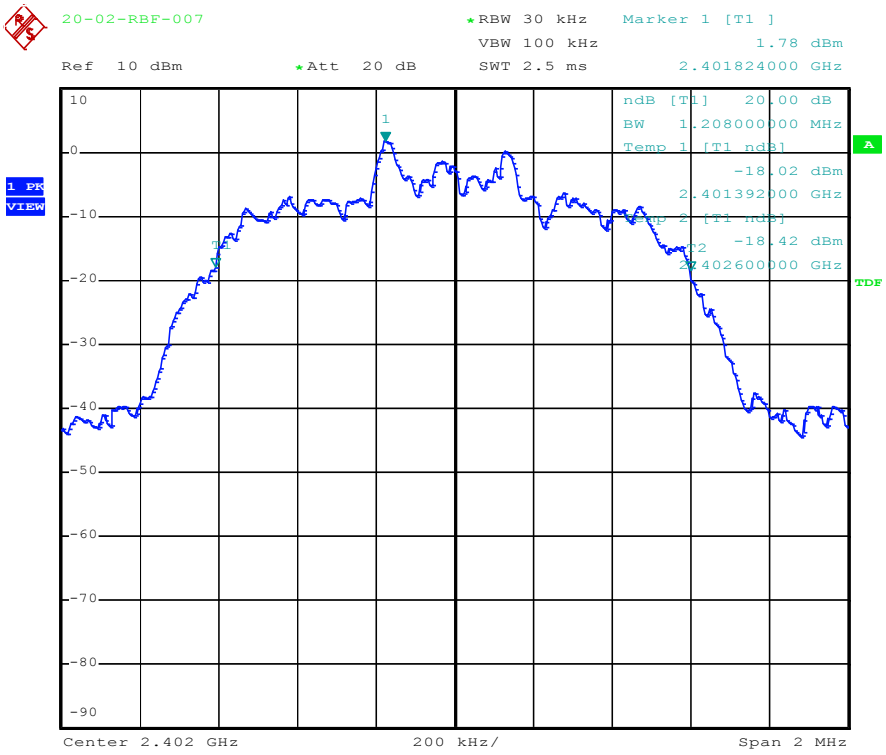
Channel High



Date: 11.FEB.2020 10:47:06

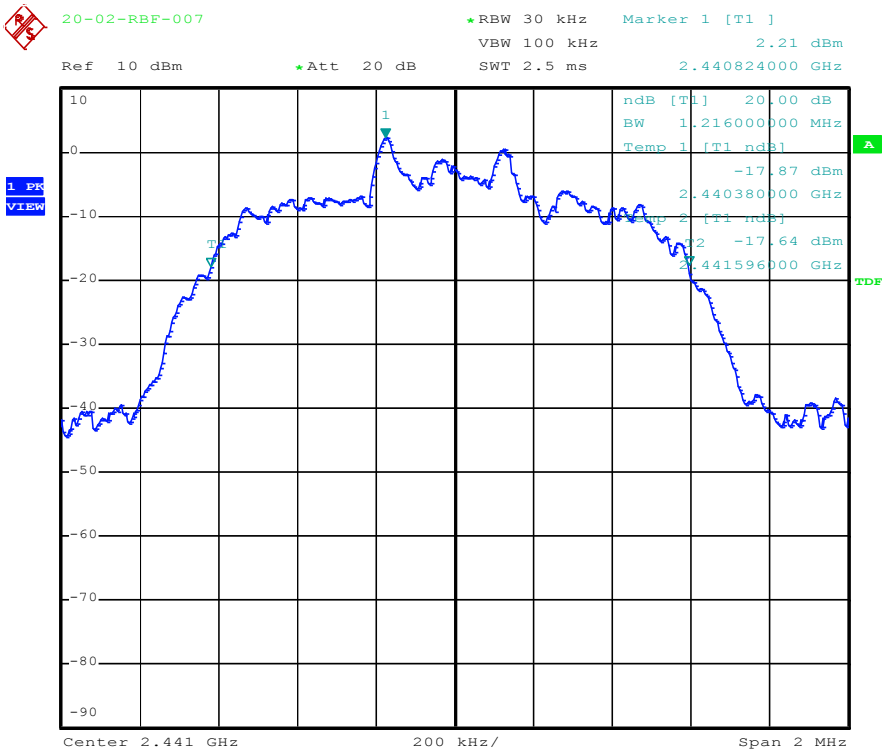
Mode: Bluetooth EDR

Channel Low



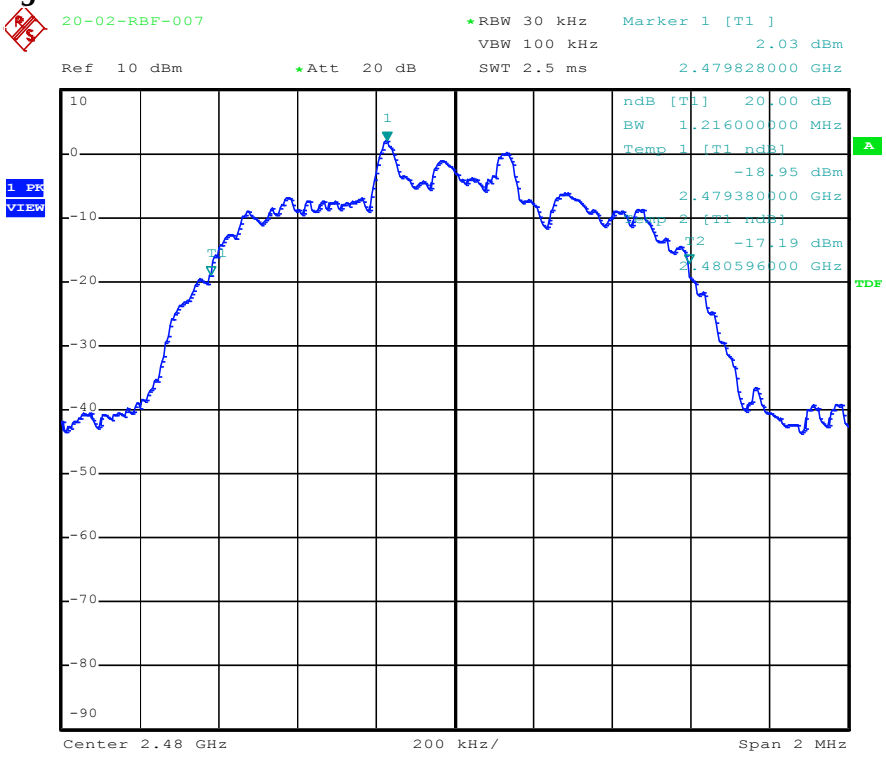
Date: 11.FEB.2020 11:58:29

Channel Middle



Date: 11.FEB.2020 12:00:15

Channel High



Date: 11.FEB.2020 12:00:50

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	FSP40	2020/01/14	2021/01/13

10.4 Measurement Data

Test Mode: Bluetooth BR

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

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.

a)	Channel Low	: the dwell time is	0.46	ms x 320.1 =	147.246	ms
b)	Channel Middle	: the dwell time is	0.45	ms x 320.1 =	144.045	ms
c)	Channel High	: the dwell time is	0.46	ms x 320.1 =	147.246	ms

The maximum time of occupancy for a particular channel is 147.246ms 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.

a)	Channel Low	: the dwell time is	1.72	ms x 159.9 =	275.028	ms
b)	Channel Middle	: the dwell time is	1.72	ms x 159.9 =	275.028	ms
c)	Channel High	: the dwell time is	1.72	ms x 159.9 =	275.028	ms

The maximum time of occupancy for a particular channel is 275.028ms 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.

a)	Channel Low	: the dwell time is	3.08	ms x106.81 =	328.975	ms
b)	Channel Middle	: the dwell time is	3.04	ms x106.81 =	324.702	ms
c)	Channel High	: the dwell time is	3.00	ms x106.81 =	320.430	ms

The maximum time of occupancy for a particular channel is 328.975ms 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.

Note : The expanded uncertainty of dwell time on each channel tests is 2dB.

Test Mode:Bluetooth EDR

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

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.

a) Channel Low : the dwell time is 0.44 ms x 320.1＝ 140.844 ms
b) Channel Middle : the dwell time is 0.45 ms x 320.1＝ 144.045 ms
c) Channel High : the dwell time is 0.46 ms x 320.1＝ 147.246 ms

The maximum time of occupancy for a particular channel is 147.246ms 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.

a) Channel Low : the dwell time is 1.72 ms x 159.9＝ 275.028 ms
b) Channel Middle : the dwell time is 1.72 ms x 159.9＝ 275.028 ms
c) Channel High : the dwell time is 1.74 ms x 159.9＝ 278.226 ms

The maximum time of occupancy for a particular channel is 278.226ms 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.

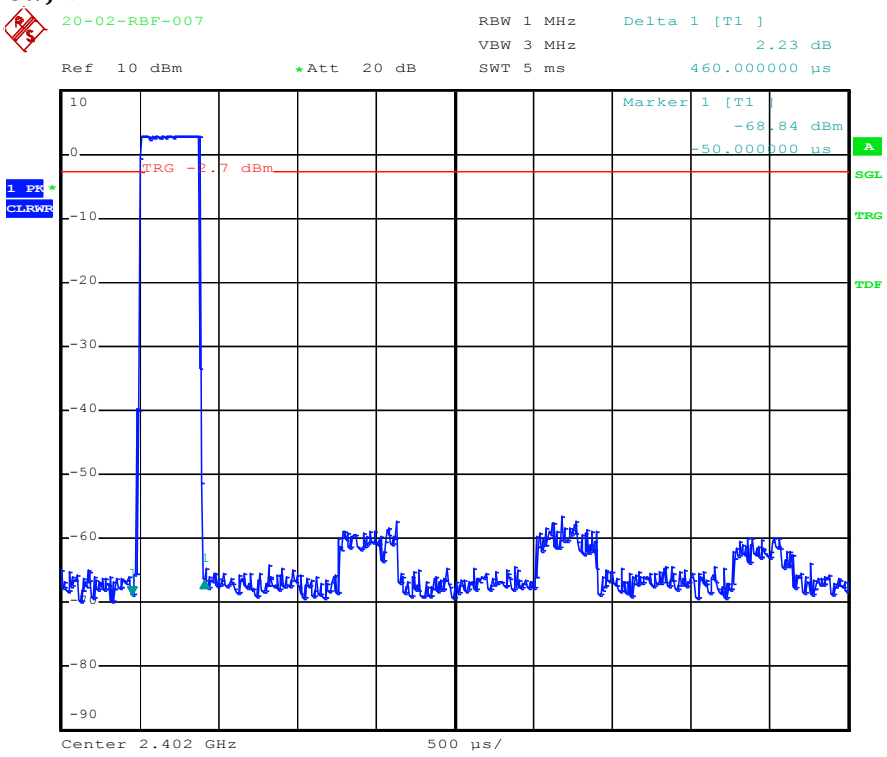
a) Channel Low : the dwell time is 3.00 ms x106.81＝ 320.430 ms
b) Channel Middle : the dwell time is 3.00 ms x106.81＝ 320.430 ms
c) Channel High : the dwell time is 3.04 ms x106.81＝ 324.702 ms

The maximum time of occupancy for a particular channel is 324.702ms 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.

Note : The expanded uncertainty of dwell time on each channel tests is 2dB.

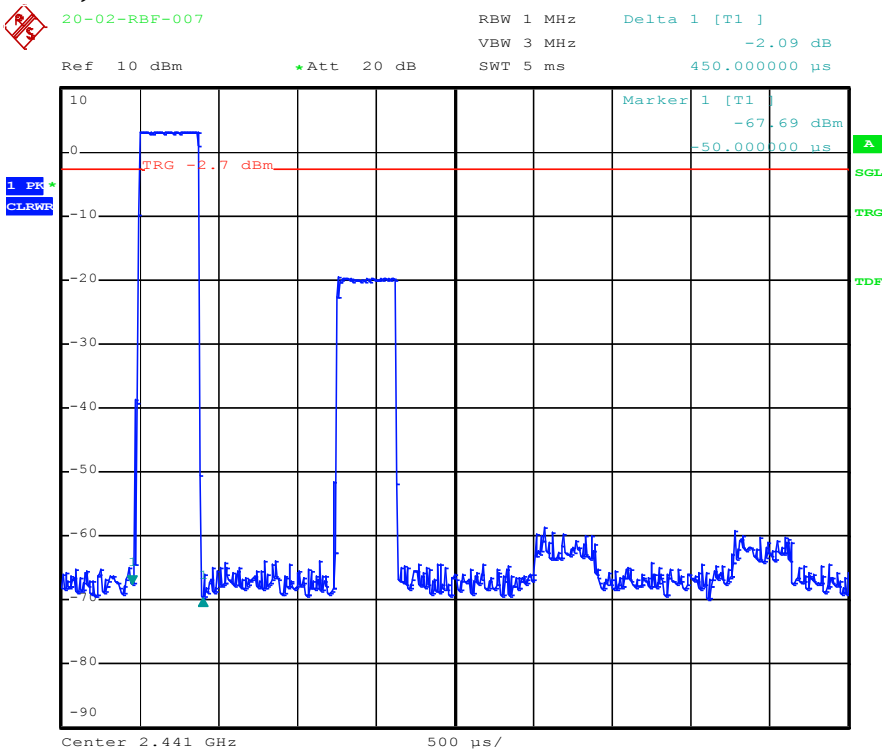
Mode: Bluetooth BR

Channel Low; DH1



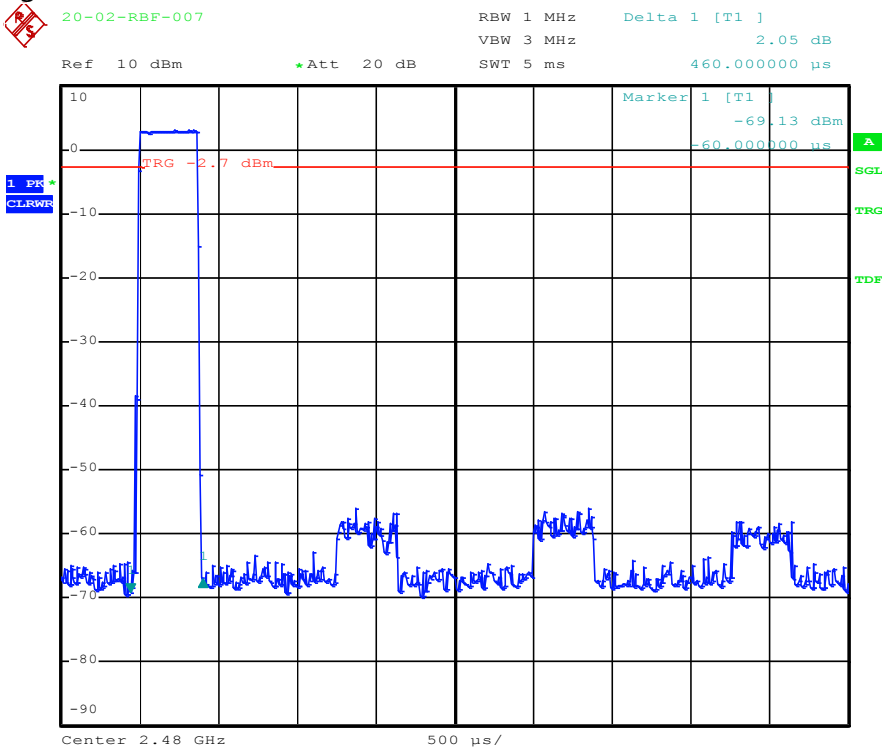
Date: 11.FEB.2020 10:32:30

Channel Middle; DH1



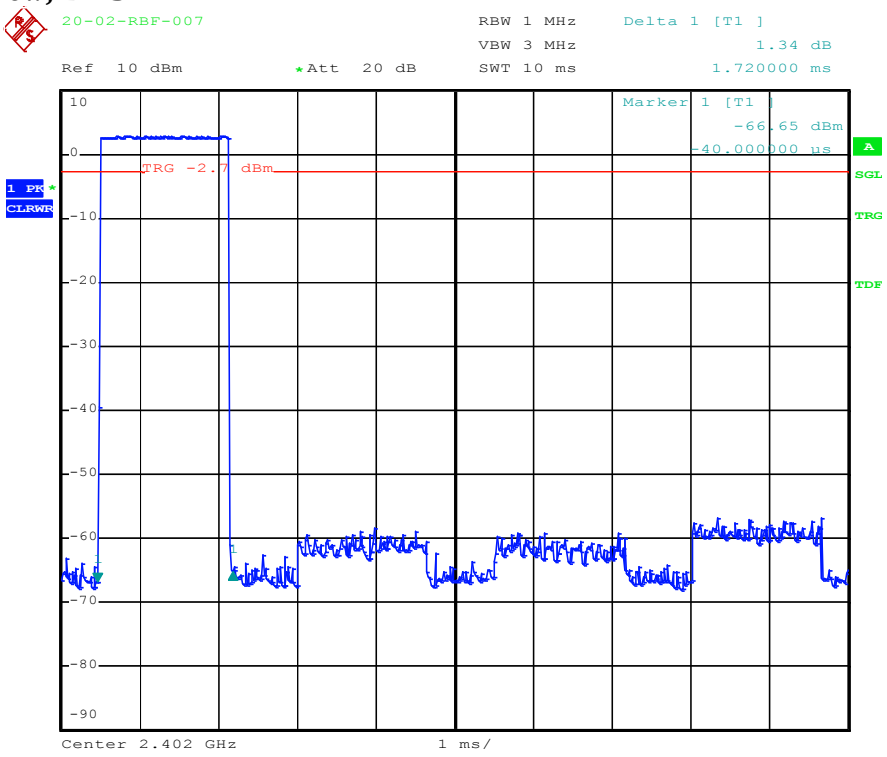
Date: 11.FEB.2020 10:32:58

Channel High; DH1



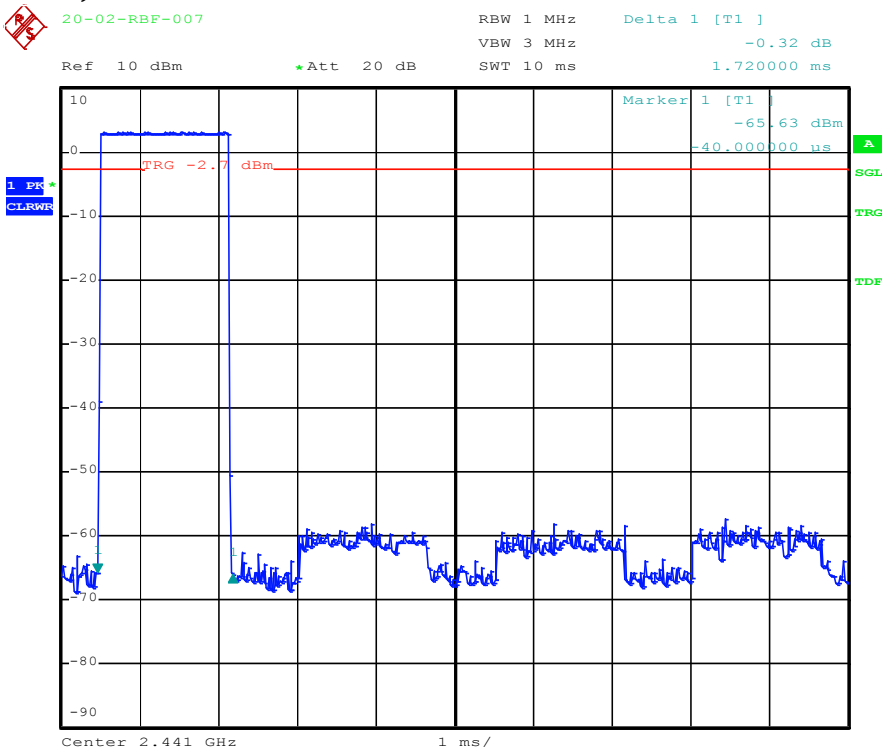
Date: 11.FEB.2020 10:33:21

Channel Low; DH3



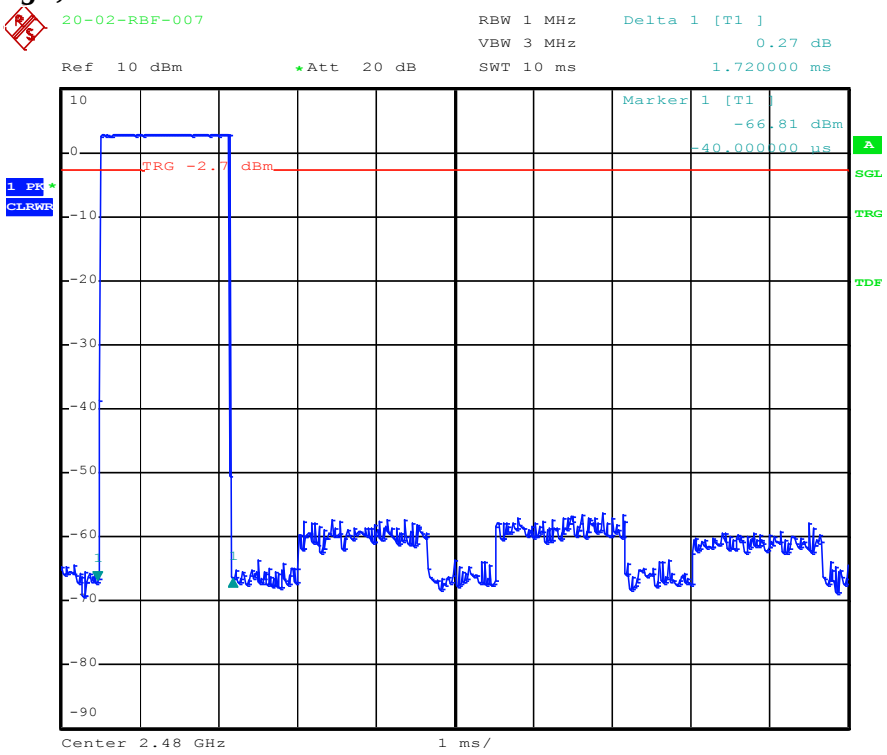
Date: 11.FEB.2020 10:31:51

Channel Middle; DH3



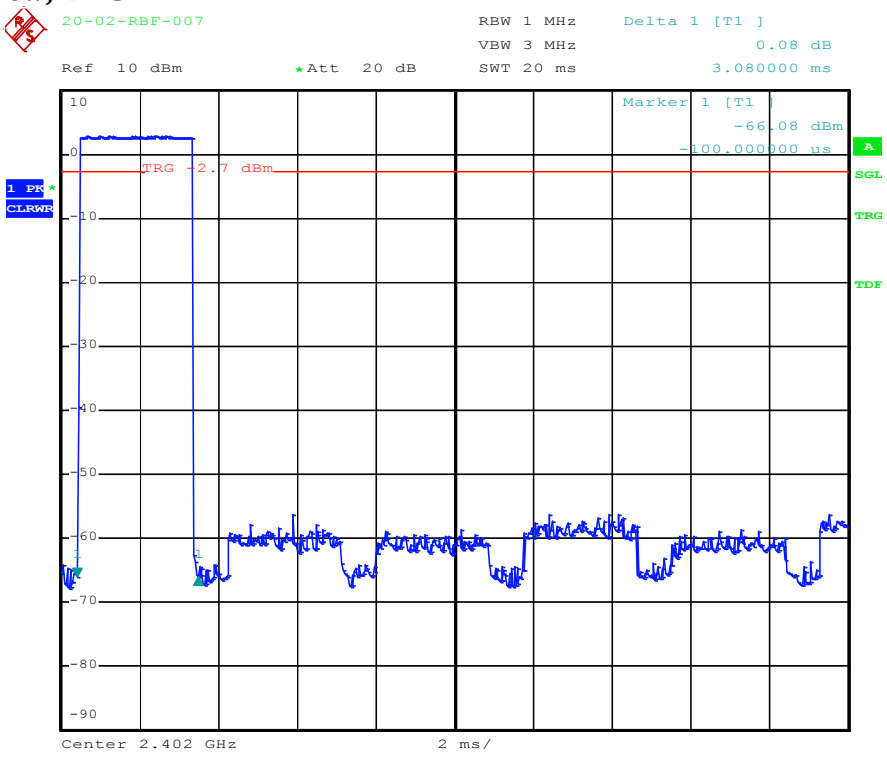
Date: 11.FEB.2020 10:31:22

Channel High; DH3



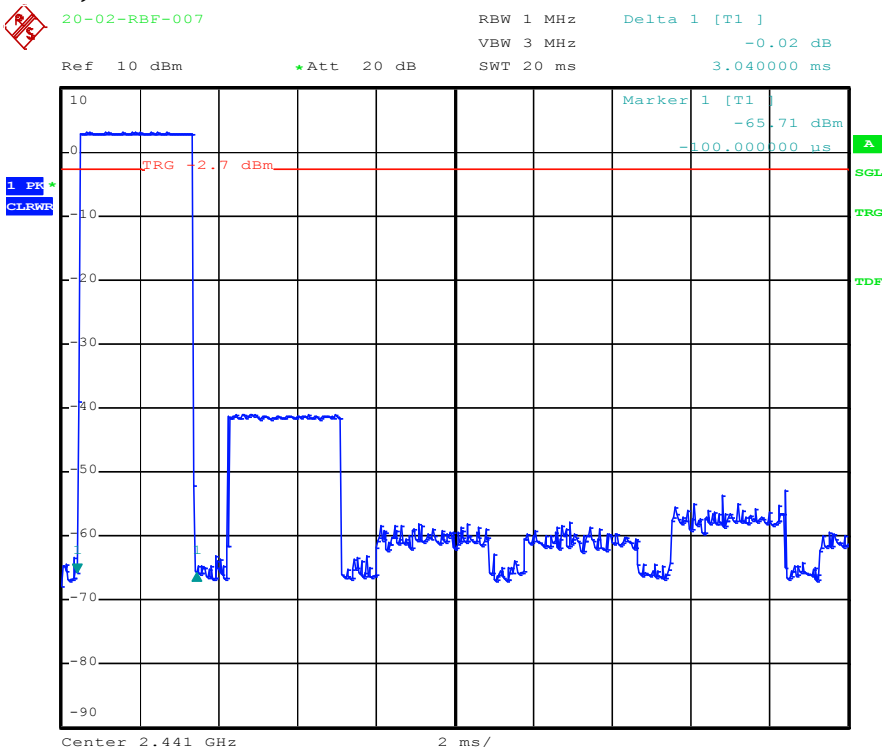
Date: 11.FEB.2020 10:21:03

Channel Low; DH5



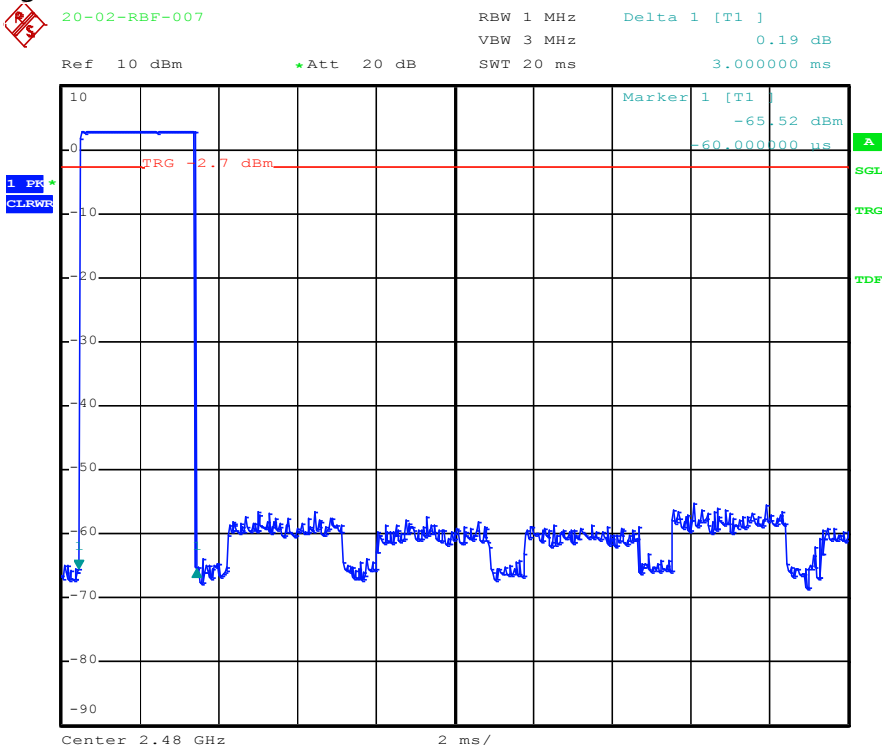
Date: 11.FEB.2020 10:18:51

Channel Middle; DH5



Date: 11.FEB.2020 10:19:54

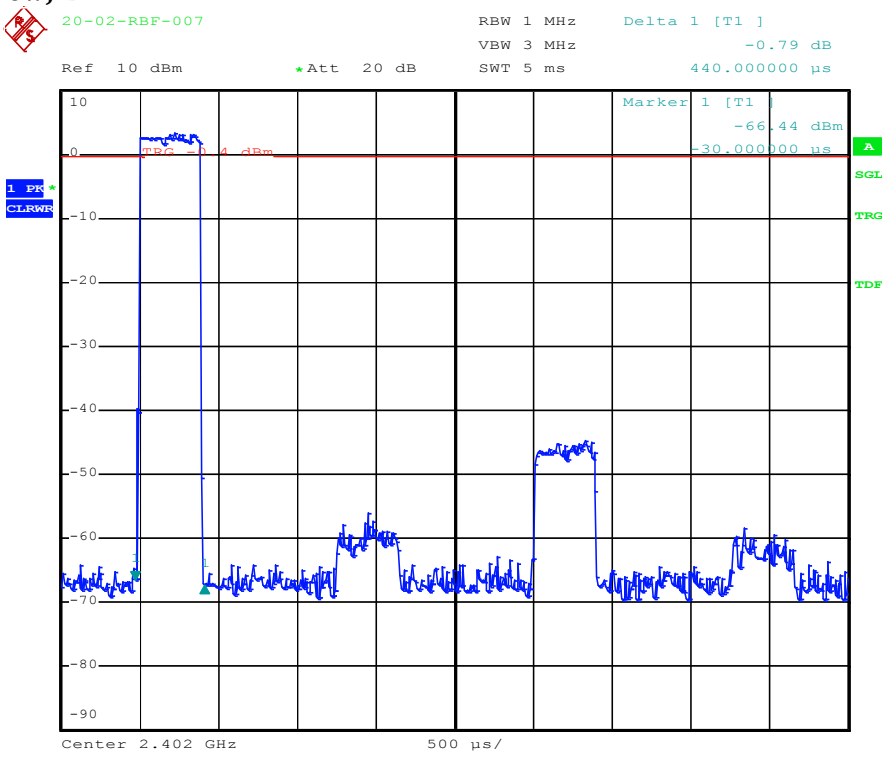
Channel High; DH5



Date: 11.FEB.2020 10:20:25

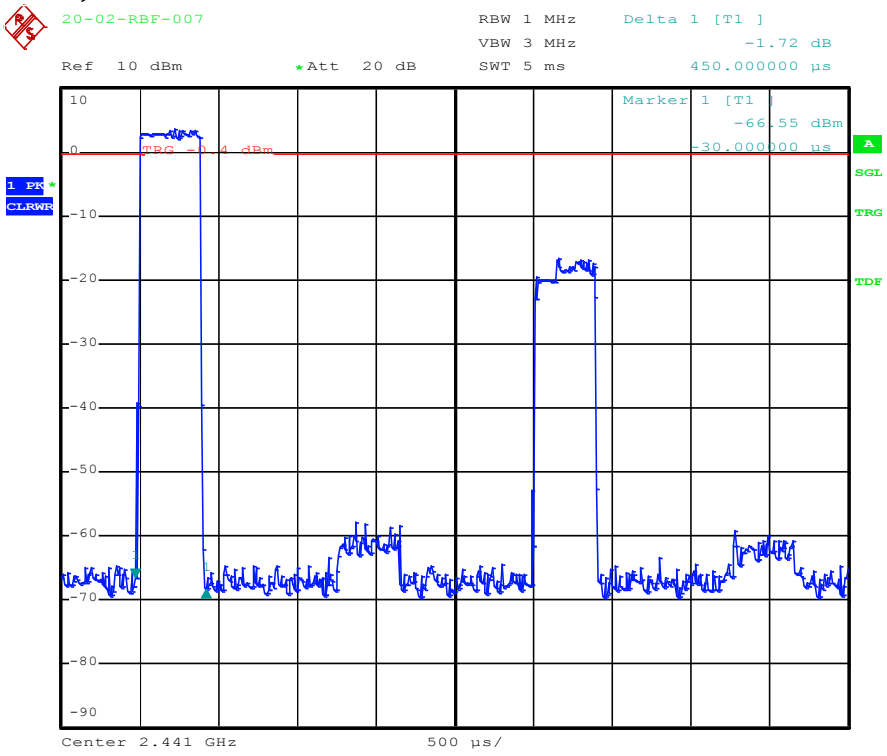
Mode: Bluetooth EDR

Channel Low; DH1



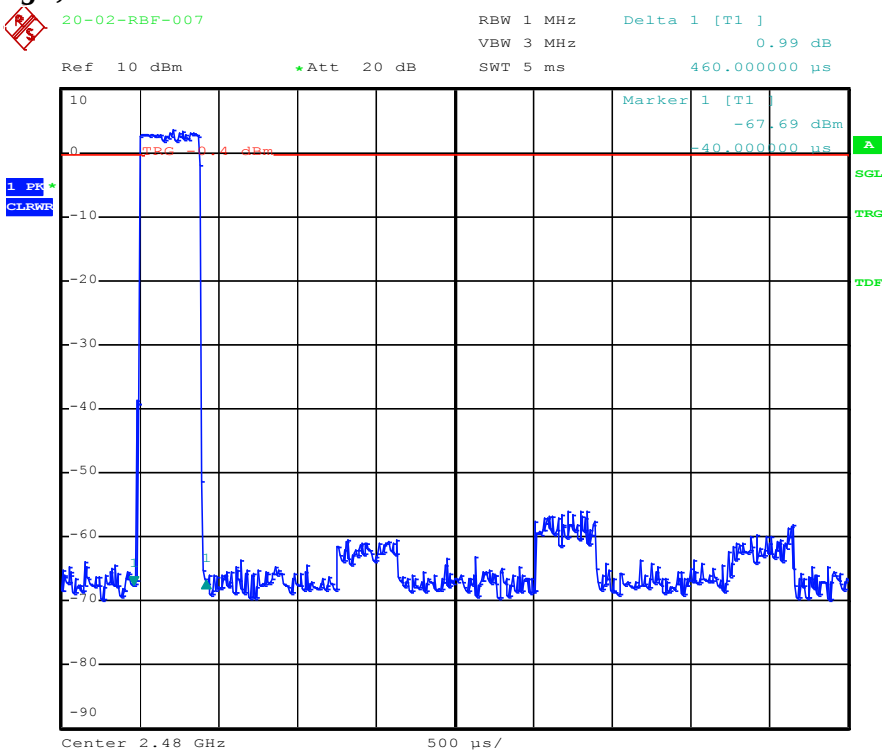
Date: 11.FEB.2020 11:55:48

Channel Middle; DH1



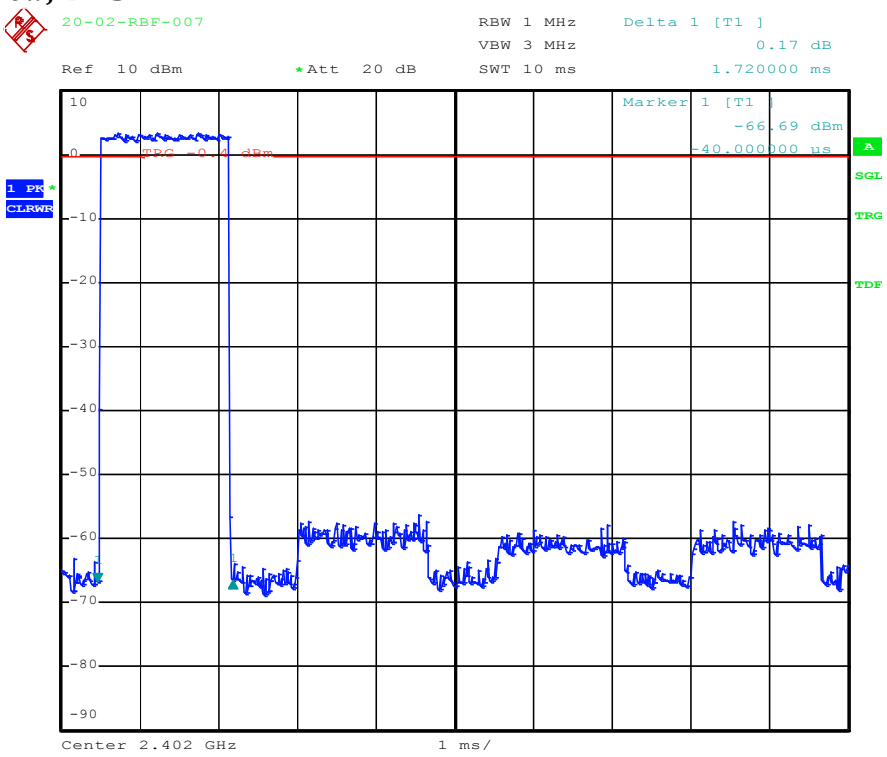
Date: 11.FEB.2020 11:56:09

Channel High; DH1



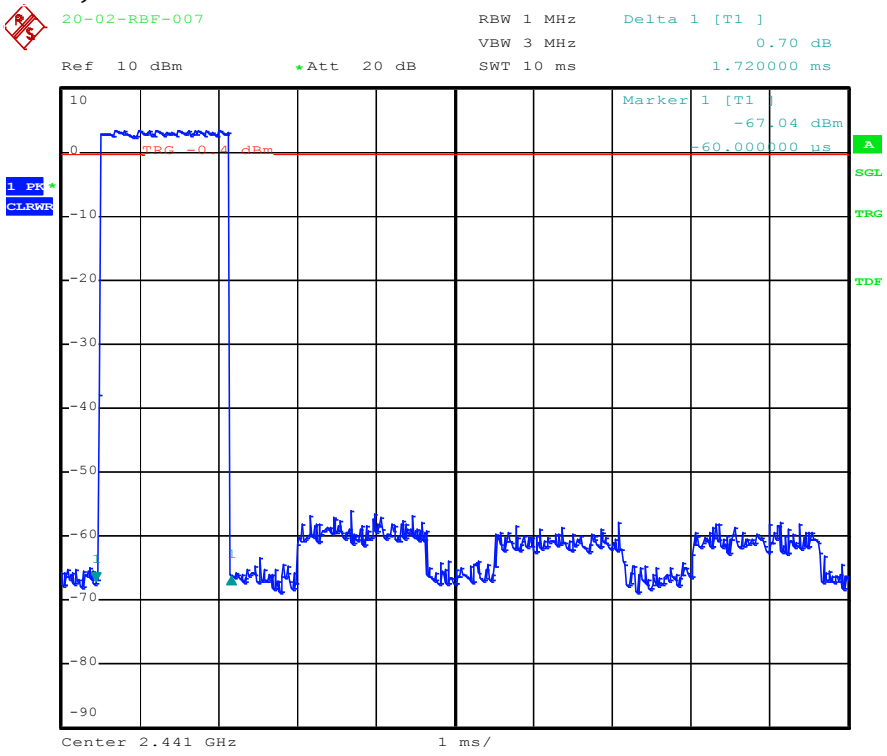
Date: 11.FEB.2020 11:56:33

Channel Low; DH3



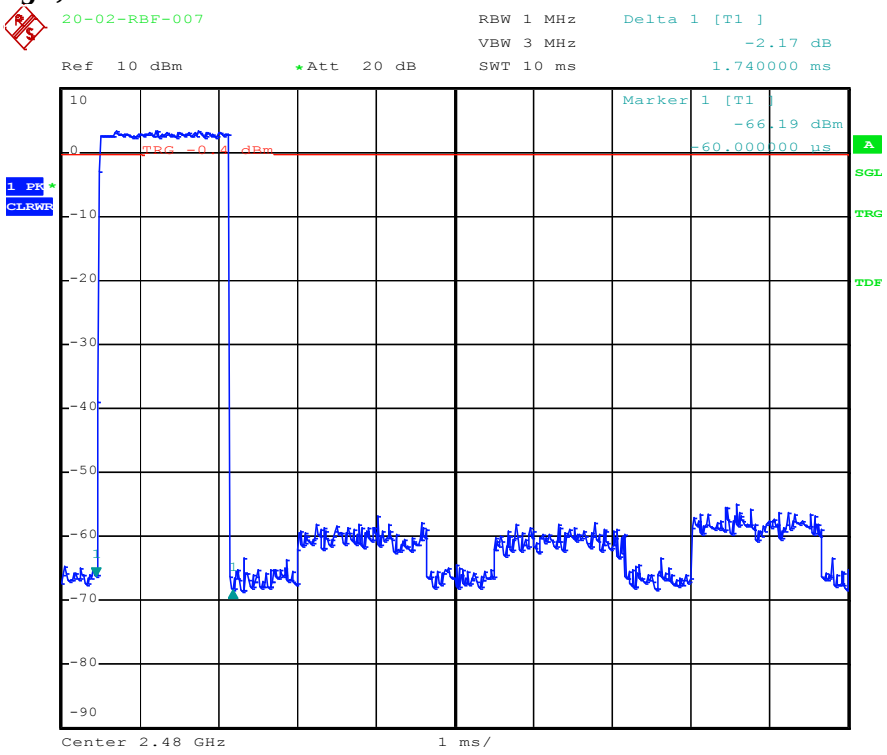
Date: 11.FEB.2020 11:55:15

Channel Middle; DH3



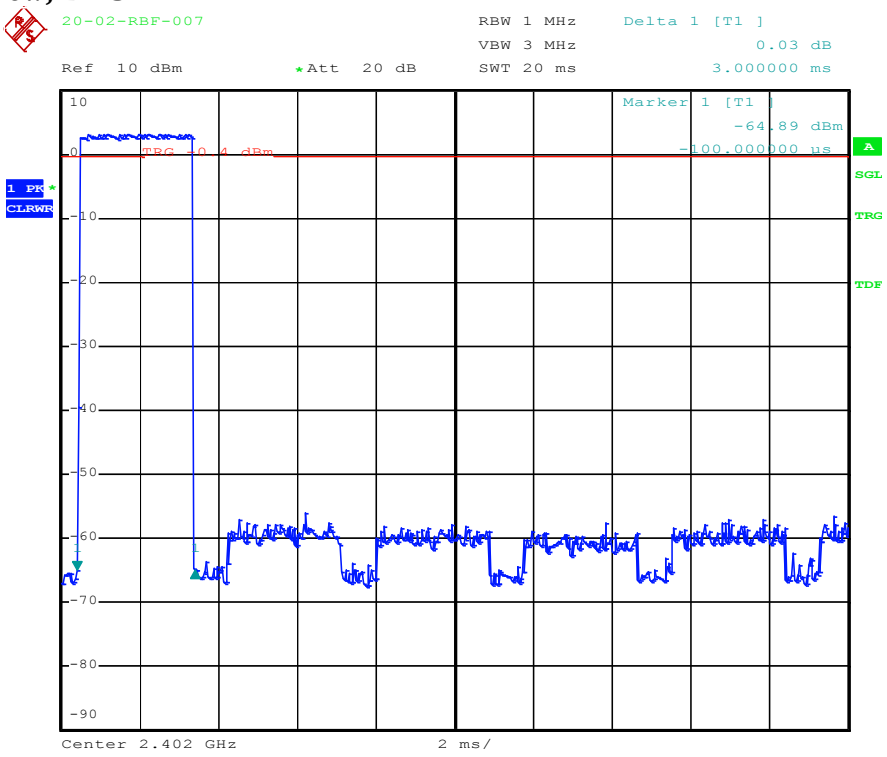
Date: 11.FEB.2020 11:54:51

Channel High; DH3



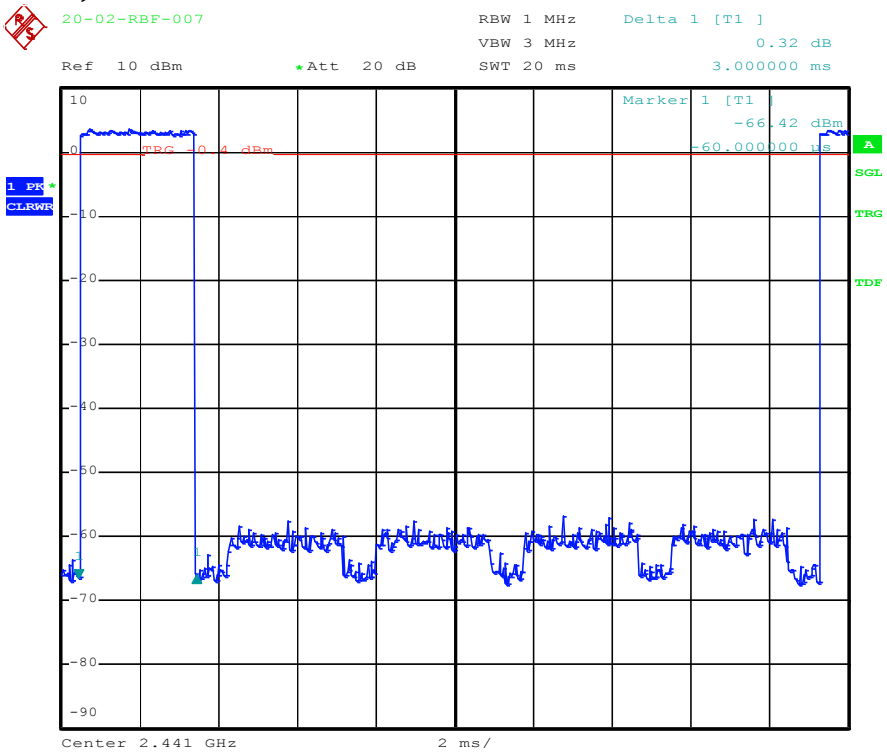
Date: 11.FEB.2020 11:54:29

Channel Low; DH5



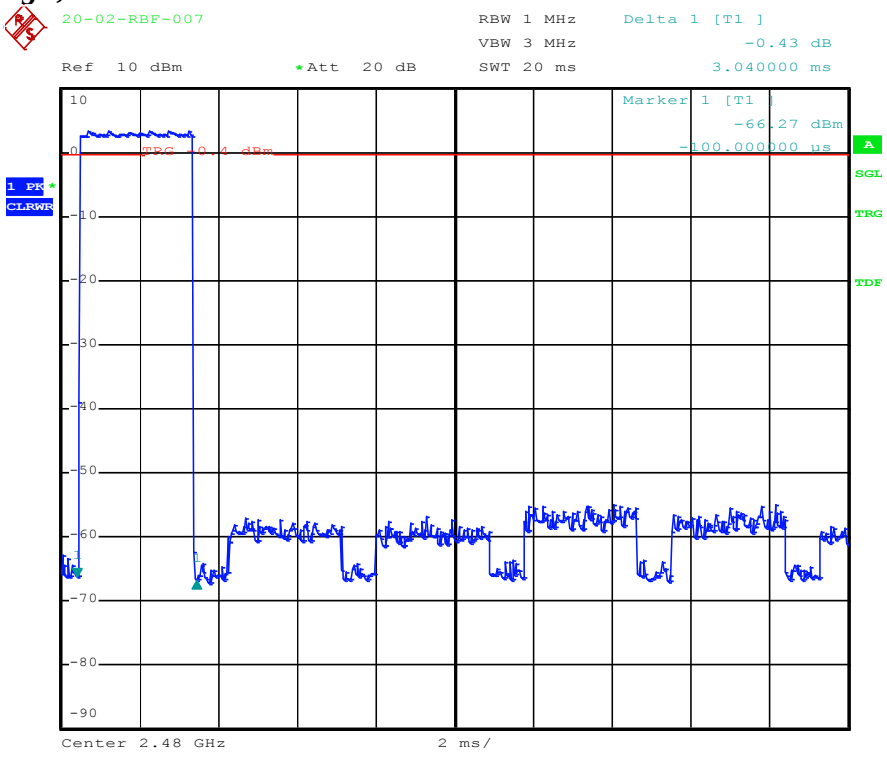
Date: 11.FEB.2020 11:53:27

Channel Middle; DH5



Date: 11.FEB.2020 11:52:34

Channel High; DH5



Date: 11.FEB.2020 11:53:49

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	FSP40	2020/01/14	2021/01/13

11.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Mode: Bluetooth BR

a)	Channel Low	:	Output Peak Power is	2.89	dBm or	1.945	mW。
b)	Channel Middle	:	Output Peak Power is	3.20	dBm or	2.089	mW。
c)	Channel High	:	Output Peak Power is	3.00	dBm or	1.995	mW。

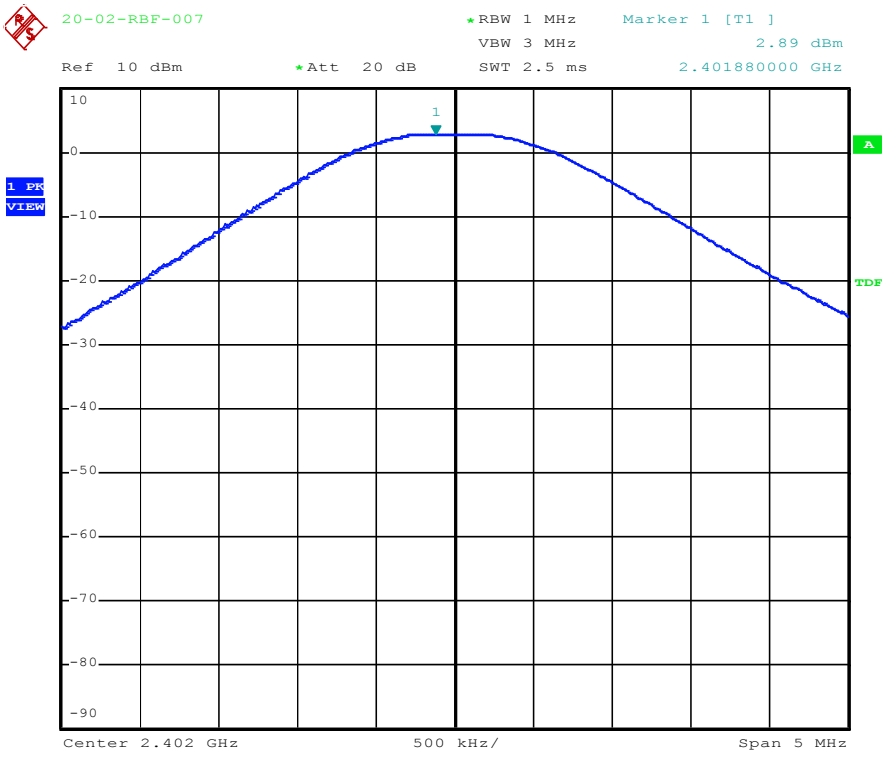
Mode: Bluetooth EDR

a)	Channel Low	:	Output Peak Power is	3.96	dBm or	2.489	mW。
b)	Channel Middle	:	Output Peak Power is	4.20	dBm or	2.630	mW。
c)	Channel High	:	Output Peak Power is	4.02	dBm or	2.523	mW。

Note : The expanded uncertainty: 2dB.

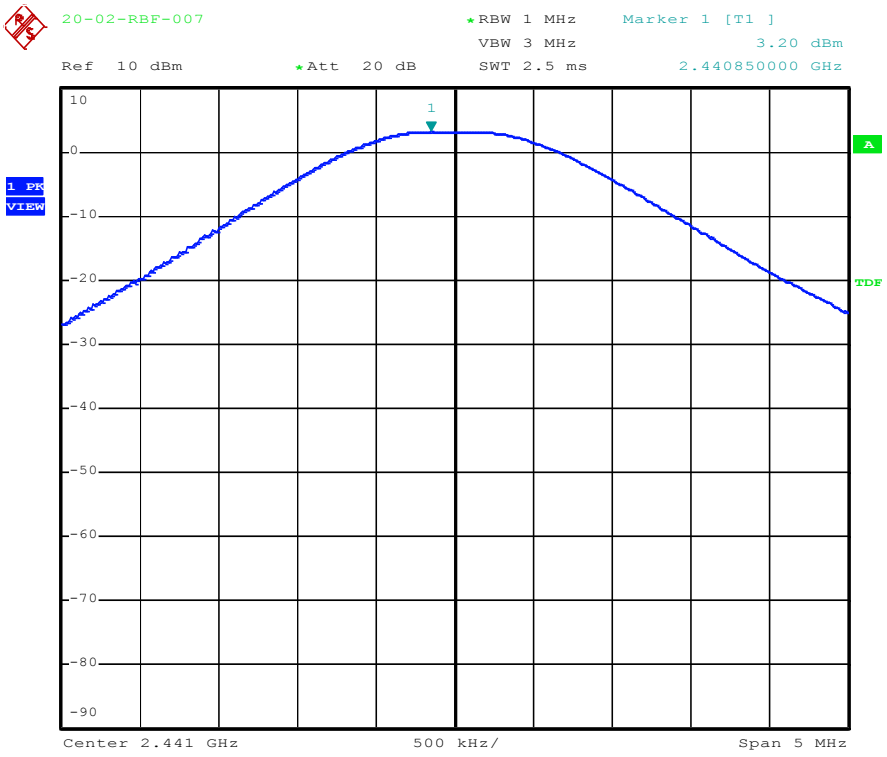
Mode: Bluetooth BR

Channel Low



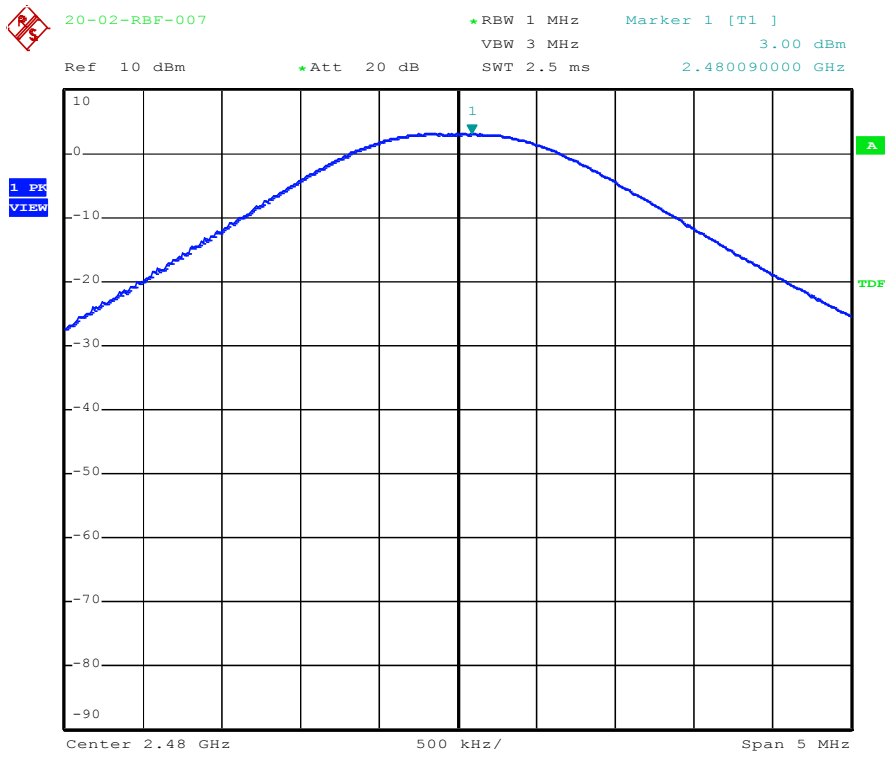
Date: 11.FEB.2020 10:51:40

Channel Middle



Date: 11.FEB.2020 10:51:01

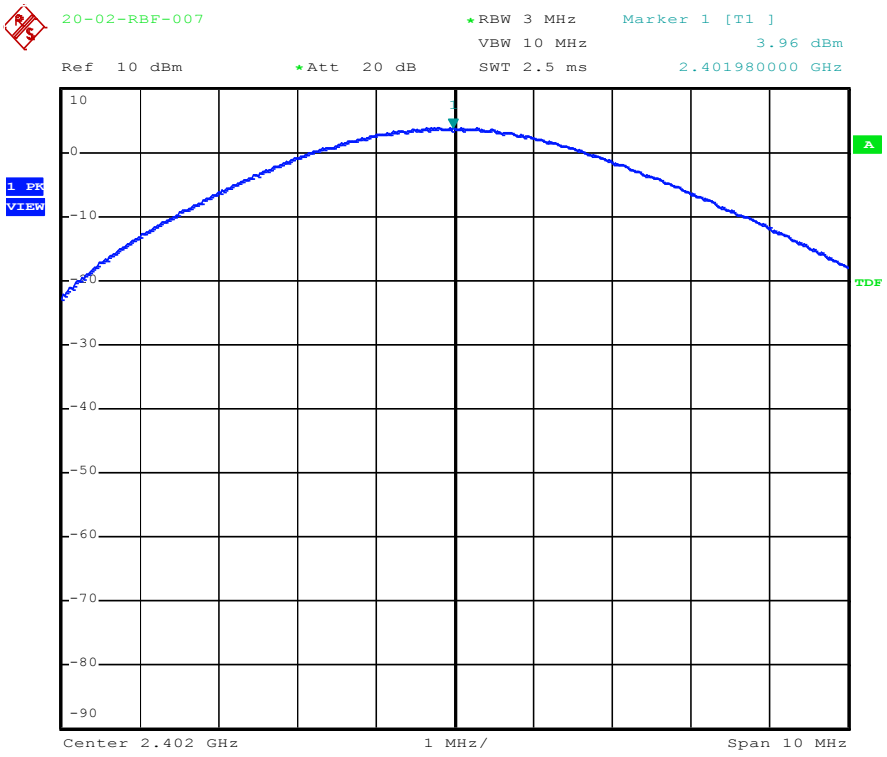
Channel High



Date: 11.FEB.2020 10:50:24

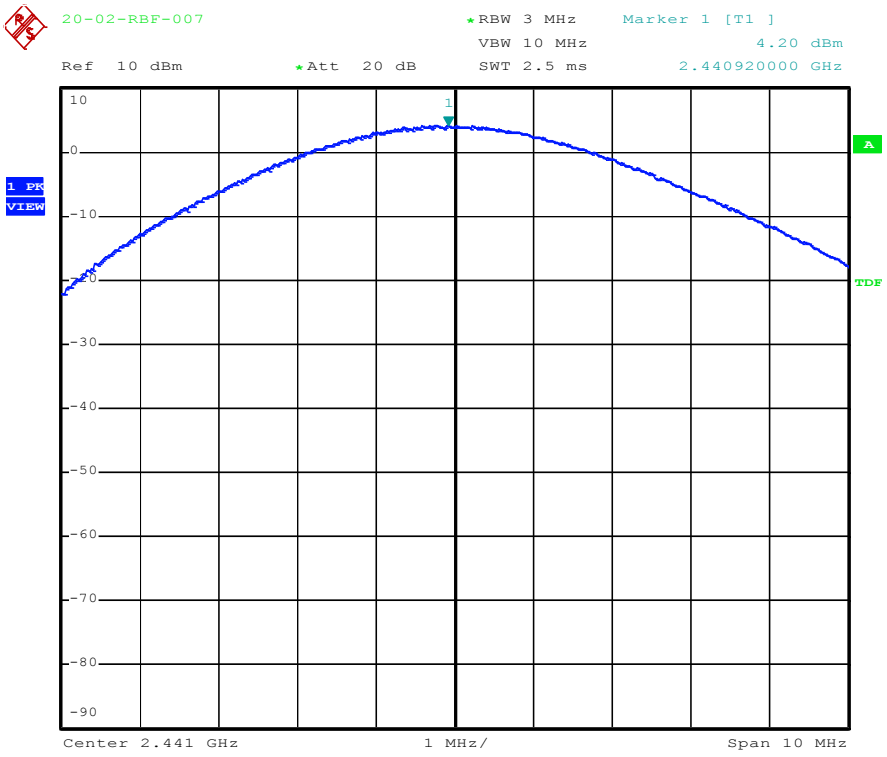
Mode: Bluetooth EDR

Channel Low



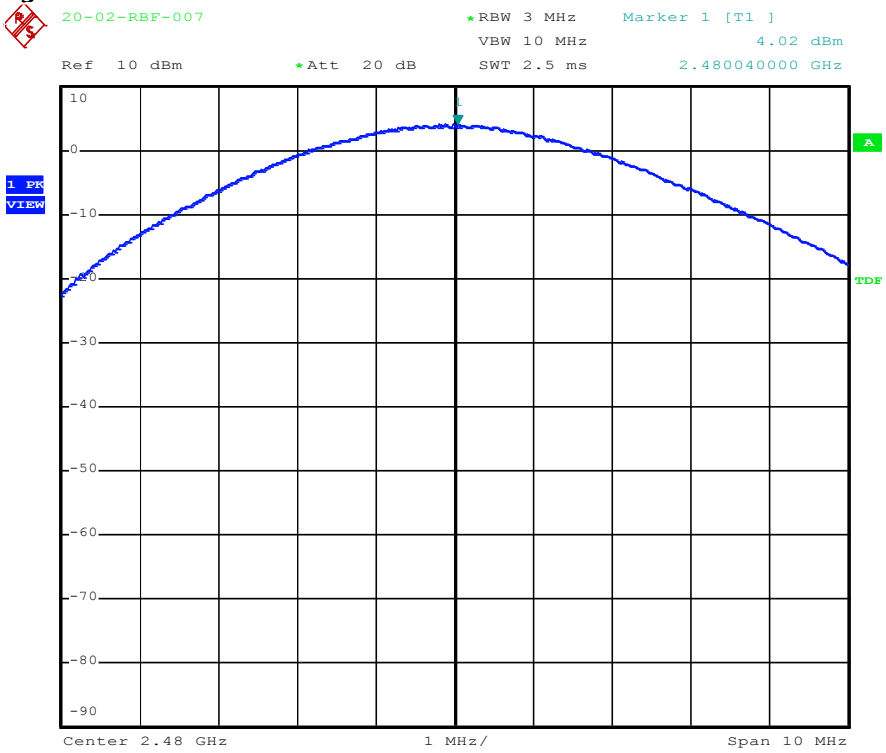
Date: 11.FEB.2020 12:03:00

Channel Middle



Date: 11.FEB.2020 12:02:34

Channel High



Date: 11.FEB.2020 12:01:55

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	FSP40	2020/01/14	2021/01/13

12.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Mode: Bluetooth BR

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

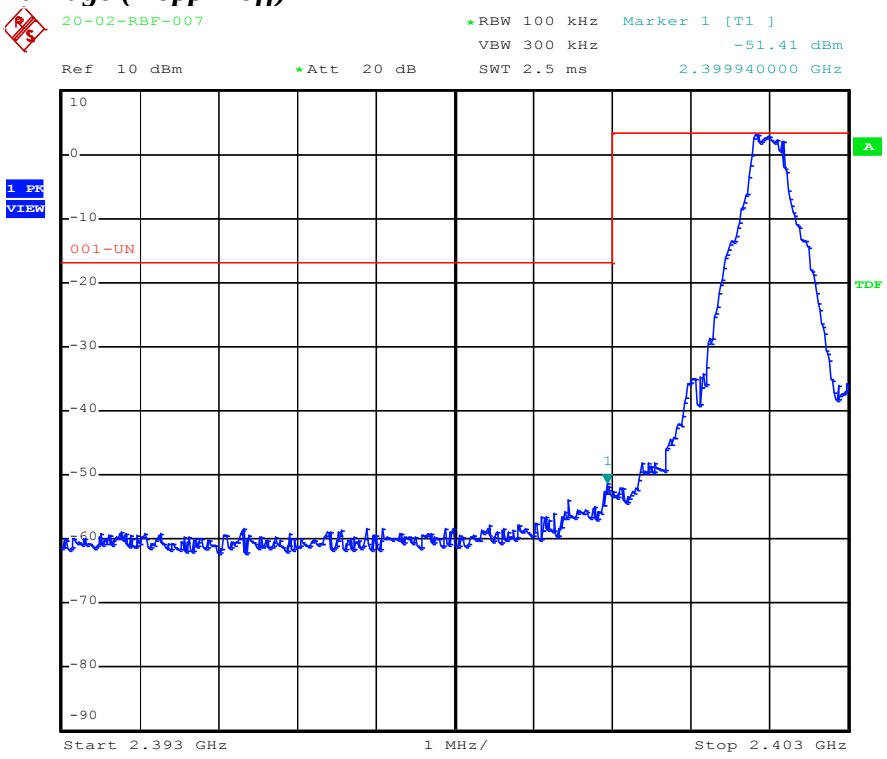
Mode: Bluetooth EDR

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

Note : The expanded uncertainty: 2dB.

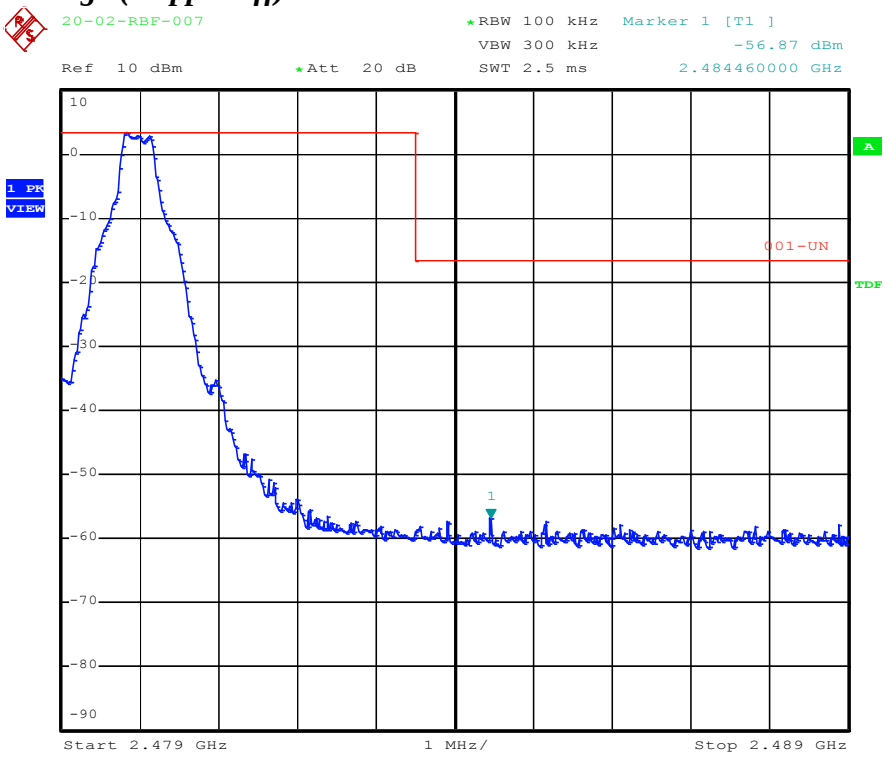
Mode: Bluetooth BR

Lower Band Edge (Hoppin off)



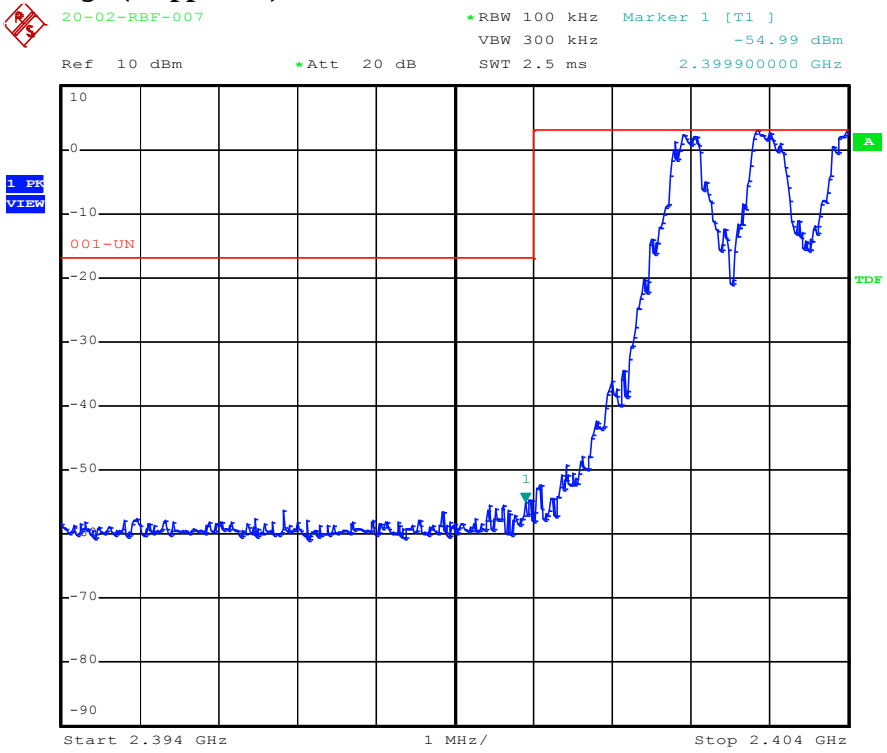
Date: 11.FEB.2020 11:35:25

Upper Band Edge (Hoppin off)



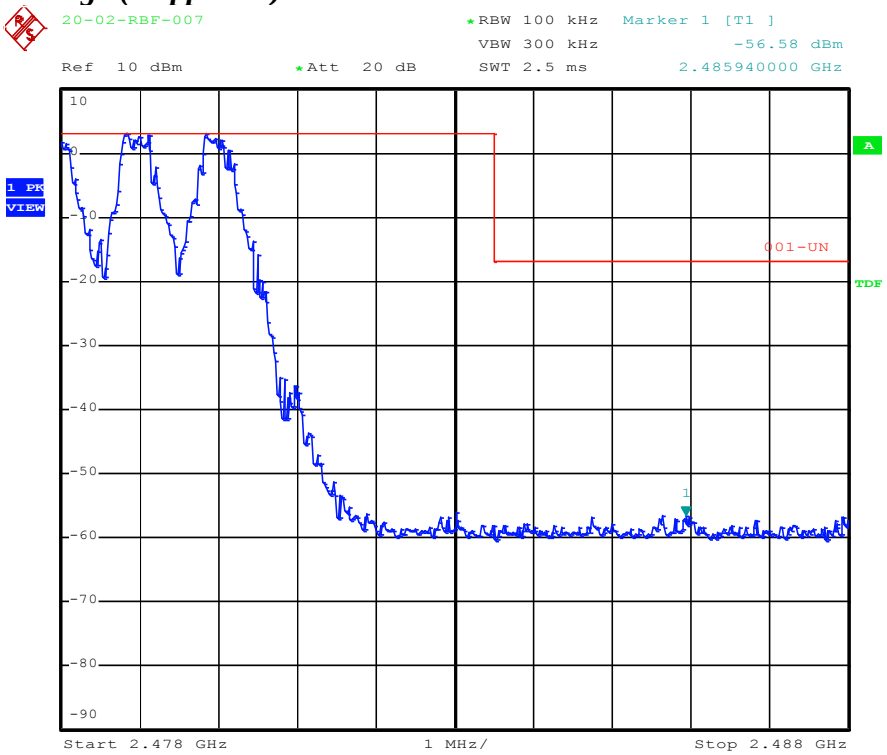
Date: 11.FEB.2020 11:34:08

Lower Band Edge (Hoppin on)



Date: 11.FEB.2020 11:30:40

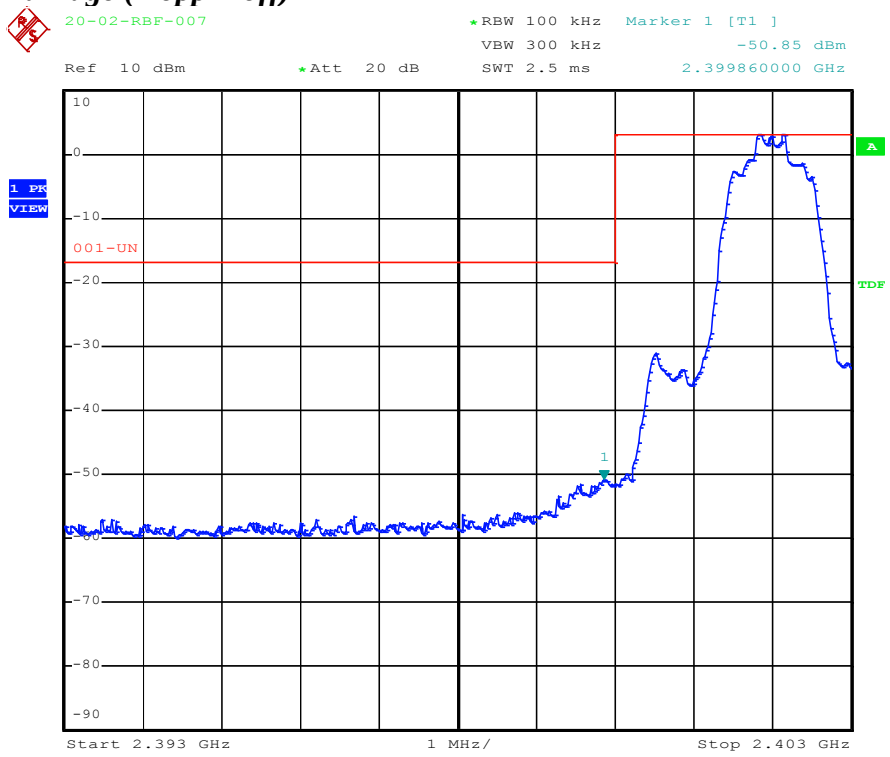
Upper Band Edge (Hoppin on)



Date: 11.FEB.2020 11:32:28

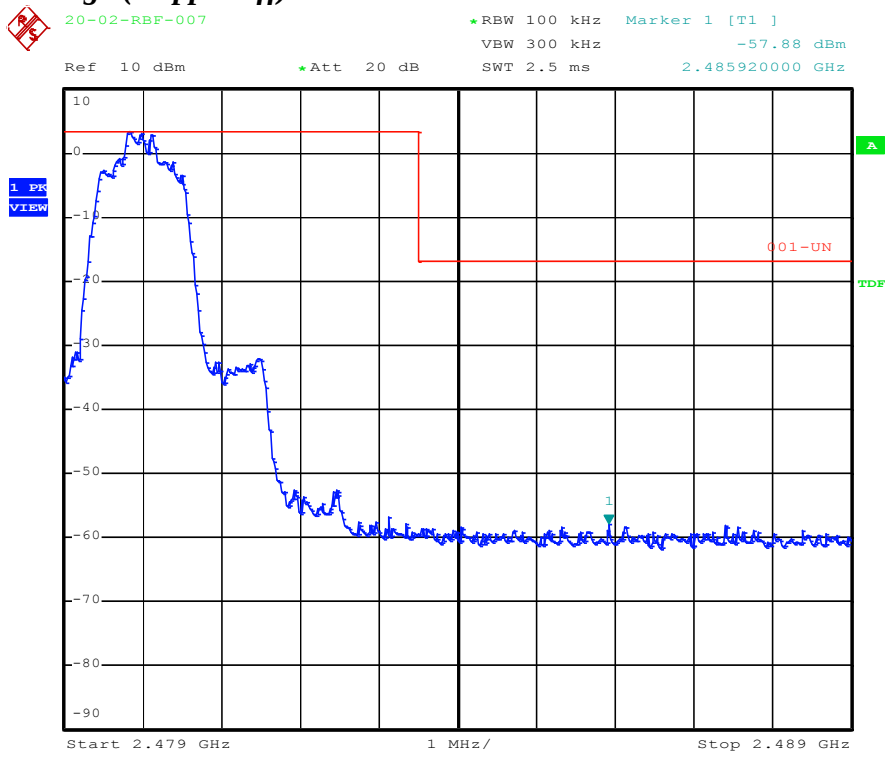
Mode: Bluetooth EDR

Lower Band Edge (Hoppin off)



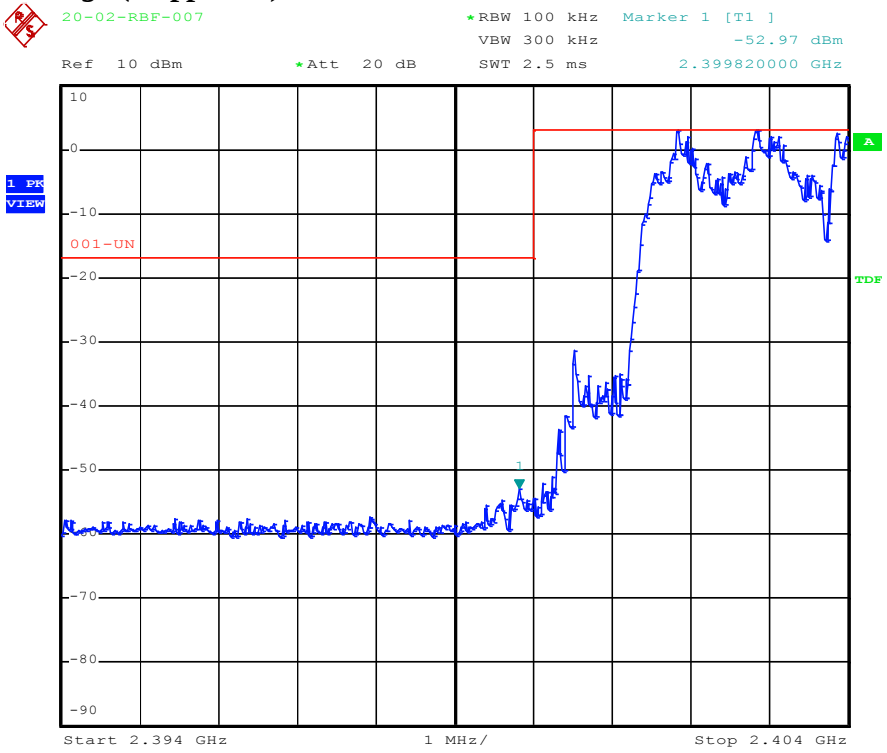
Date: 11.FEB.2020 13:26:51

Upper Band Edge (Hoppin off)



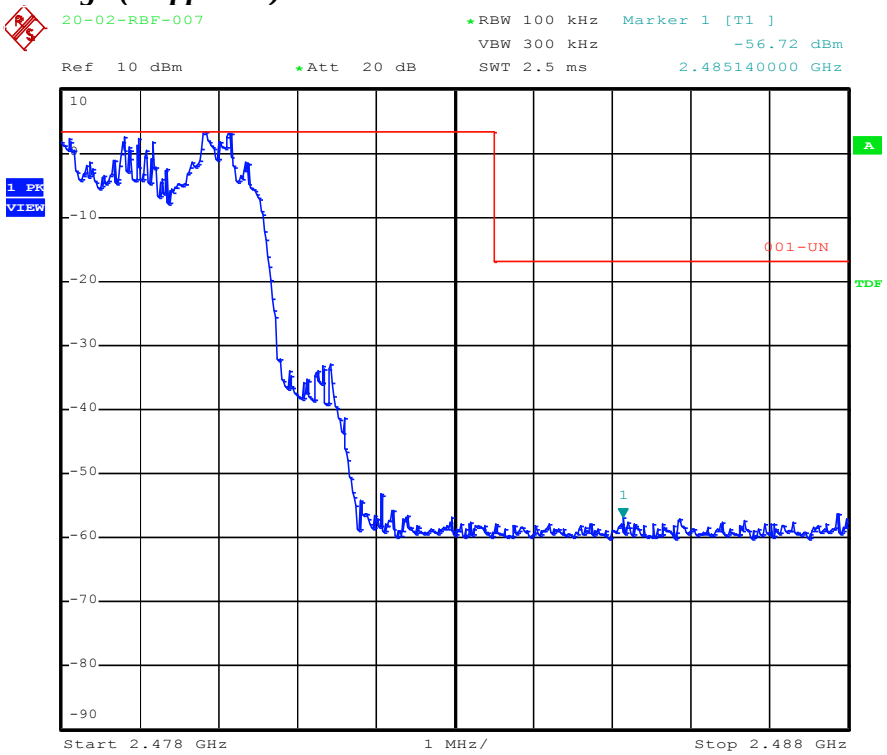
Date: 11.FEB.2020 13:22:42

Lower Band Edge (Hoppin on)



Date: 11.FEB.2020 13:19:58

Upper Band Edge (Hoppin on)



Date: 11.FEB.2020 13:21:41

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	FSP40	2020/01/14	2021/01/13

13.4 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Mode: Bluetooth BR
Mode : Low Channel/ Mid Channel/ Hi Channel

a) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

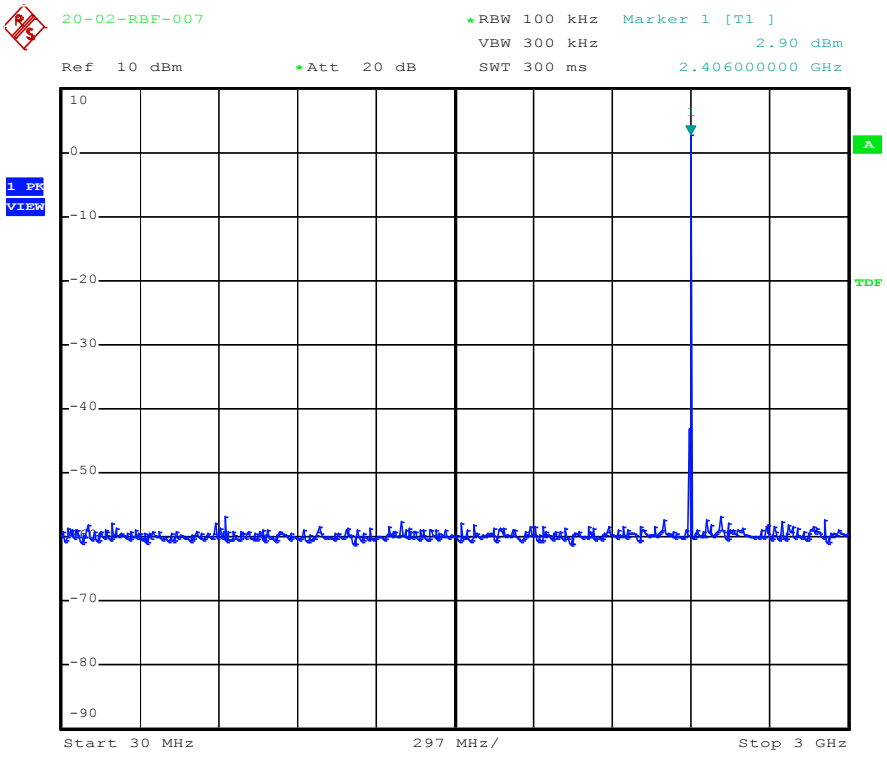
Mode: Bluetooth EDR

Mode : Low Channel/ Mid Channel/ Hi Channel

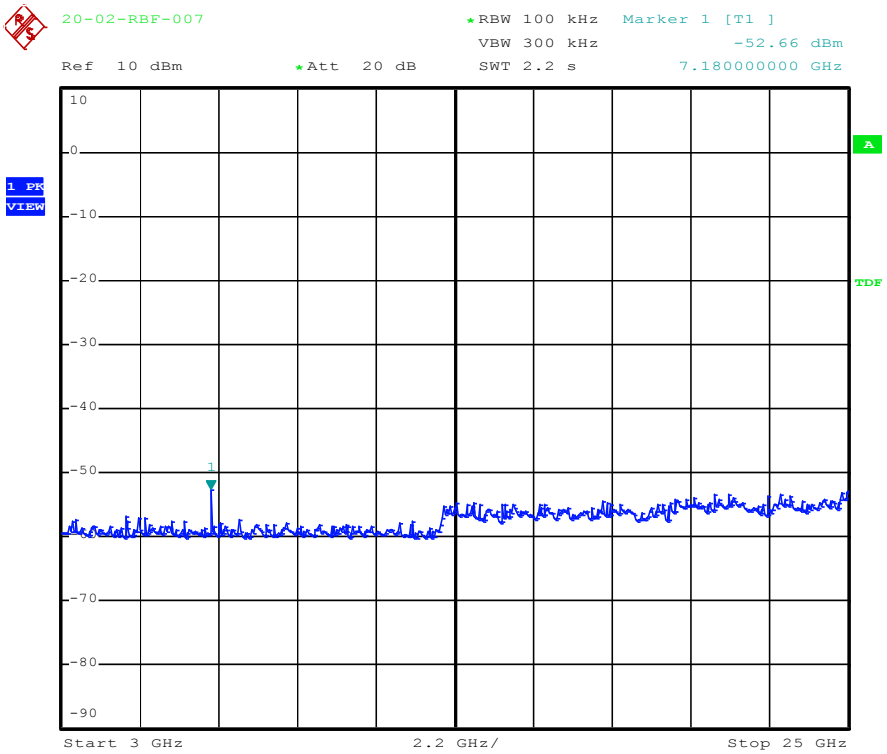
a) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Note : The expanded uncertainty: 2dB.

Mode: Bluetooth BR
Mode : Low Channel

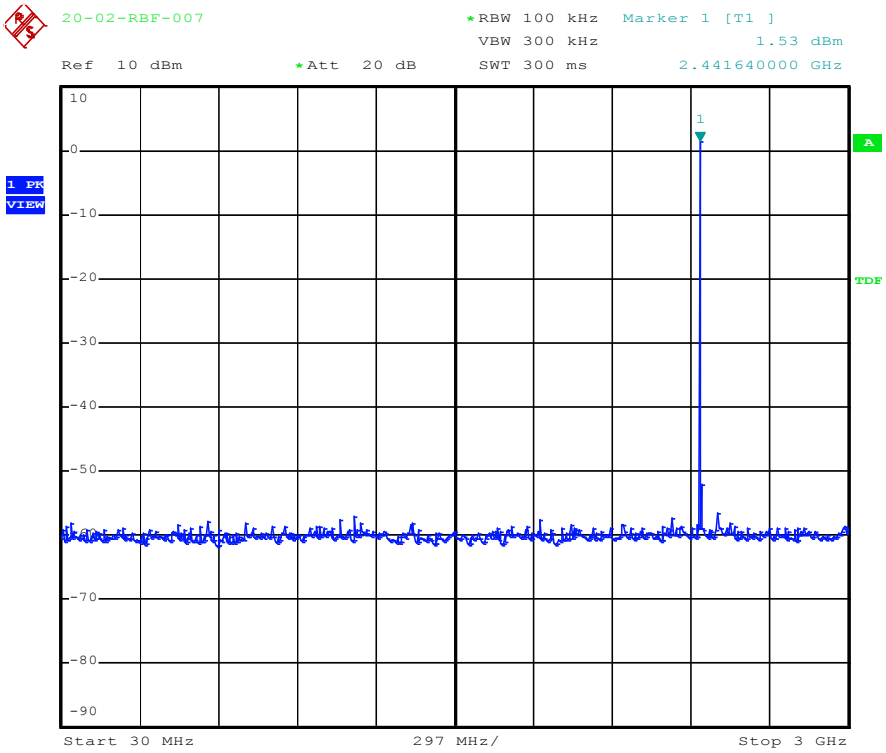


Date: 11.FEB.2020 11:36:08

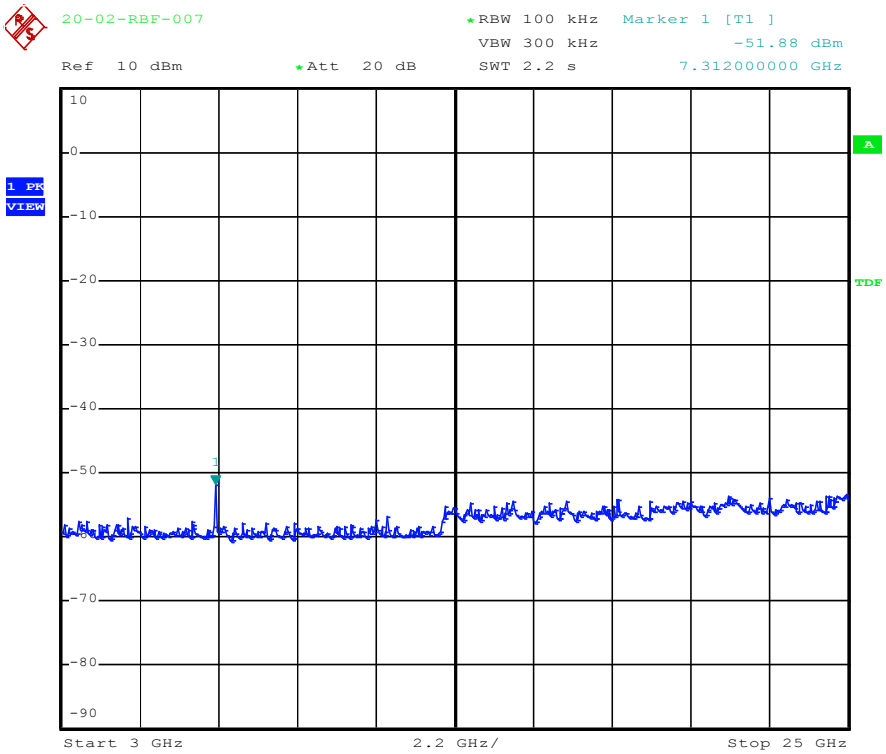


Date: 11.FEB.2020 11:36:38

Mode : Mid Channel

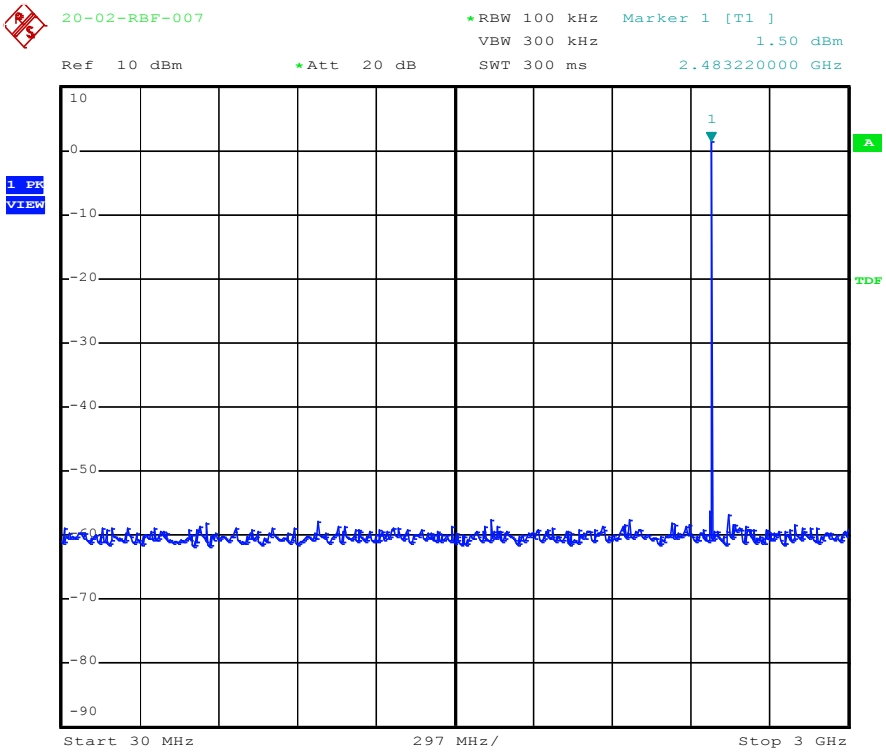


Date: 11.FEB.2020 11:38:58

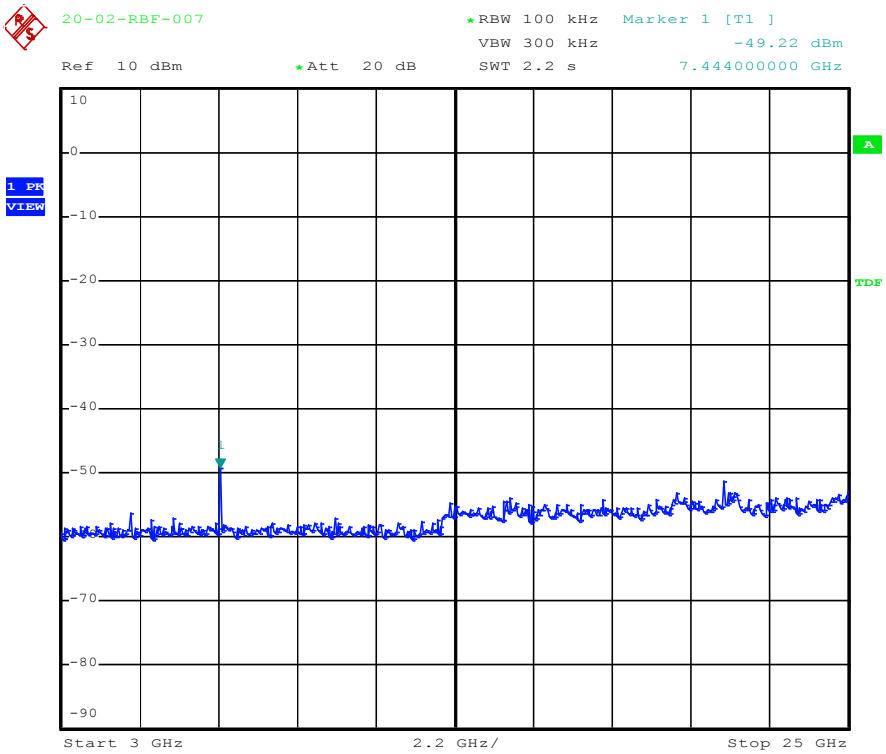


Date: 11.FEB.2020 11:38:35

Mode : Hi Channel



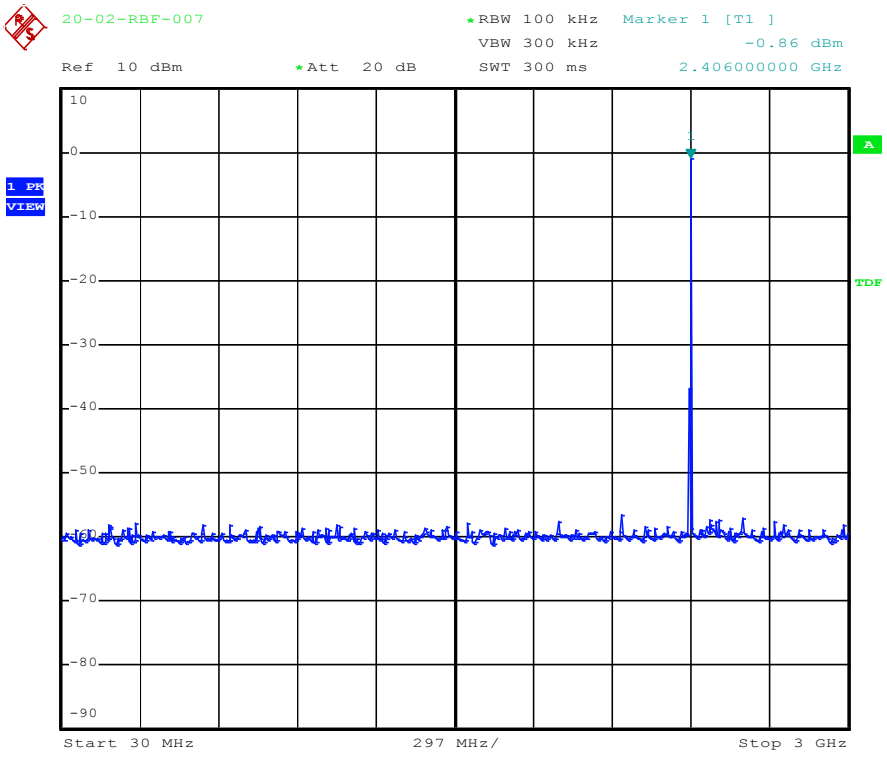
Date: 11.FEB.2020 11:39:23



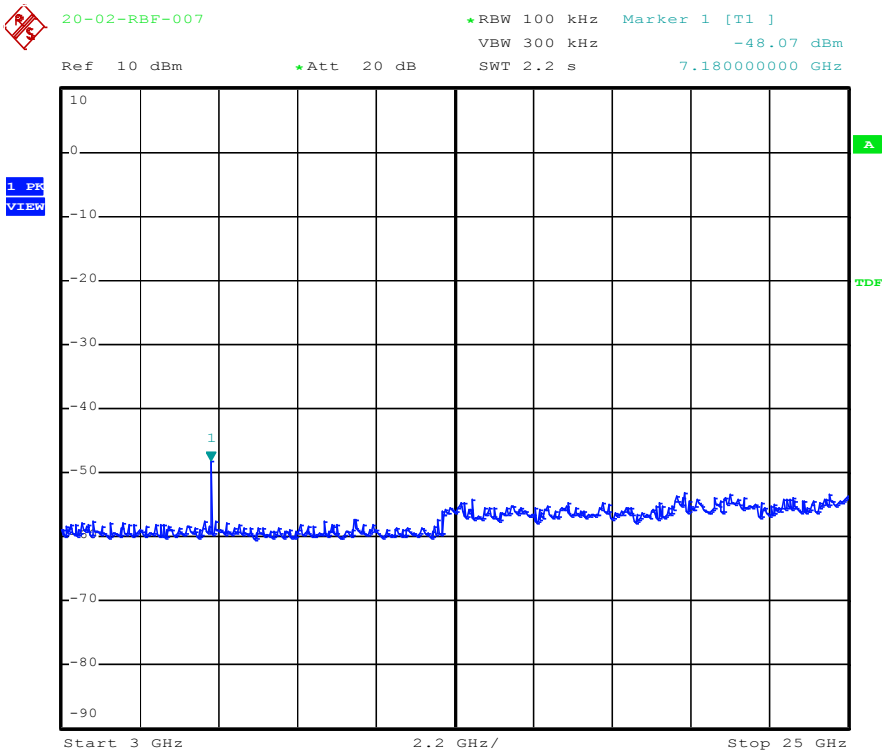
Date: 11.FEB.2020 11:39:51

Mode: Bluetooth EDR

Mode : Low Channel

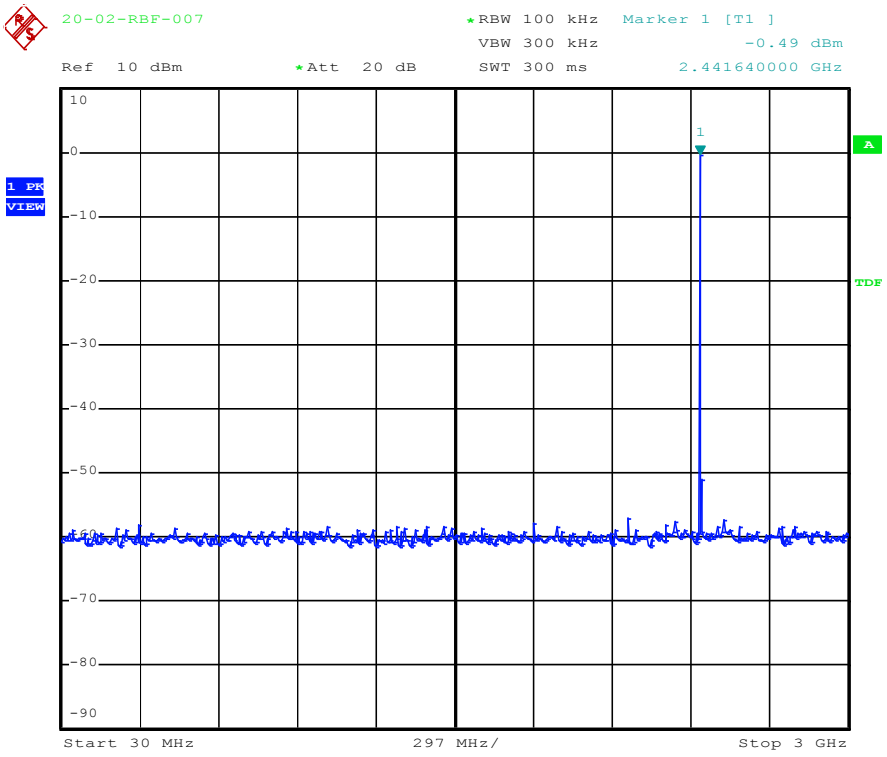


Date: 11.FEB.2020 13:27:33

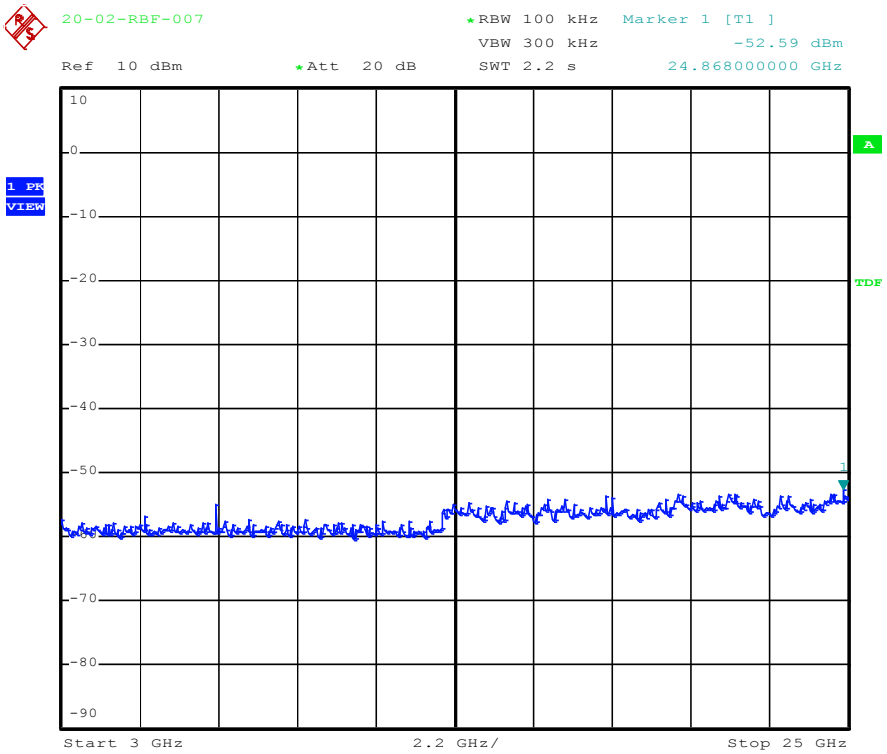


Date: 11.FEB.2020 13:27:55

Mode : Mid Channel

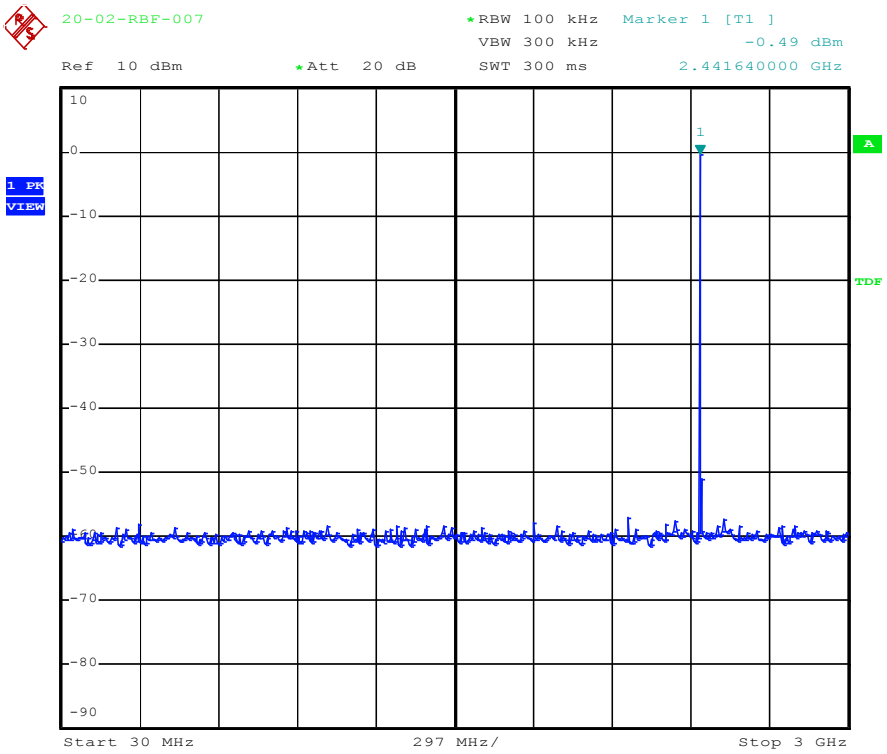


Date: 11.FEB.2020 13:28:49

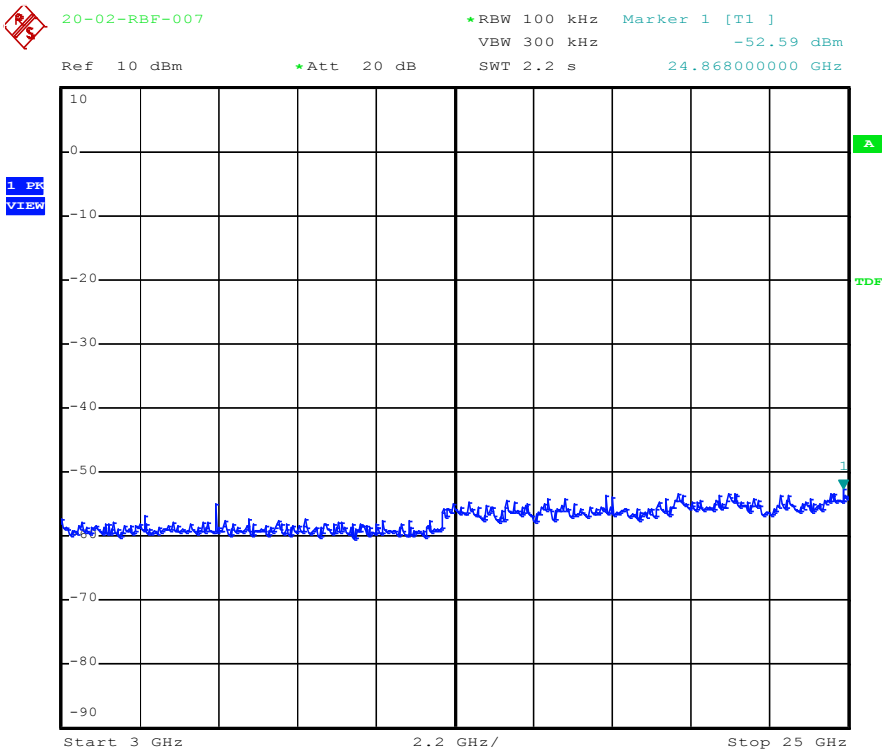


Date: 11.FEB.2020 13:28:31

Mode : Hi Channel



Date: 11.FEB.2020 13:28:49



Date: 11.FEB.2020 13:28:31

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	FSP40	2020/01/14	2021/01/13

14.3 Measurement Data

Test Date : Feb. 11, 2020 Temperature : 20 °C Humidity : 63 %

Duty Cycle Calculation

Mode	Period (ms)	Transmission duration (T) (ms)	Duty Cycle (%)	1/T (kHz)	VBW setting (kHz)
BR/DH1	1.22	0.44	36.07	2.273	3
BR/DH3	2.52	1.74	69.05	0.575	1
BR/DH5	3.74	2.98	79.68	0.336	1
EDR/DH1	1.25	0.45	36.00	2.222	3
EDR/DH3	2.52	1.74	69.05	0.575	1
EDR/DH5	3.74	3.02	80.75	0.331	1

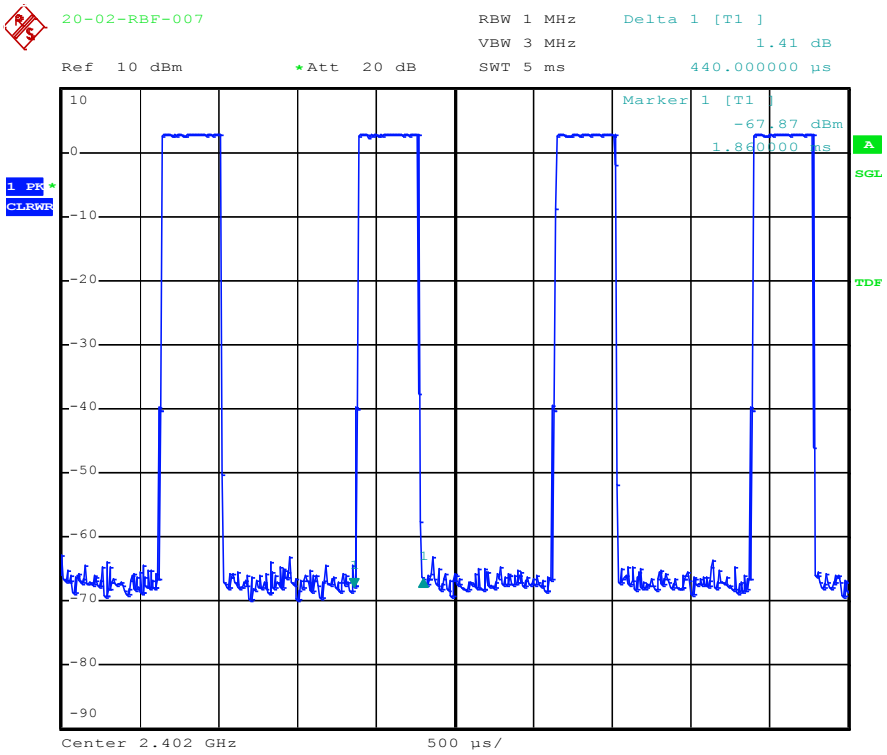
Note:

1. DH5 has the highest duty cycle worst case and is reported.
2. 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.

Refer to the following page for data plots.

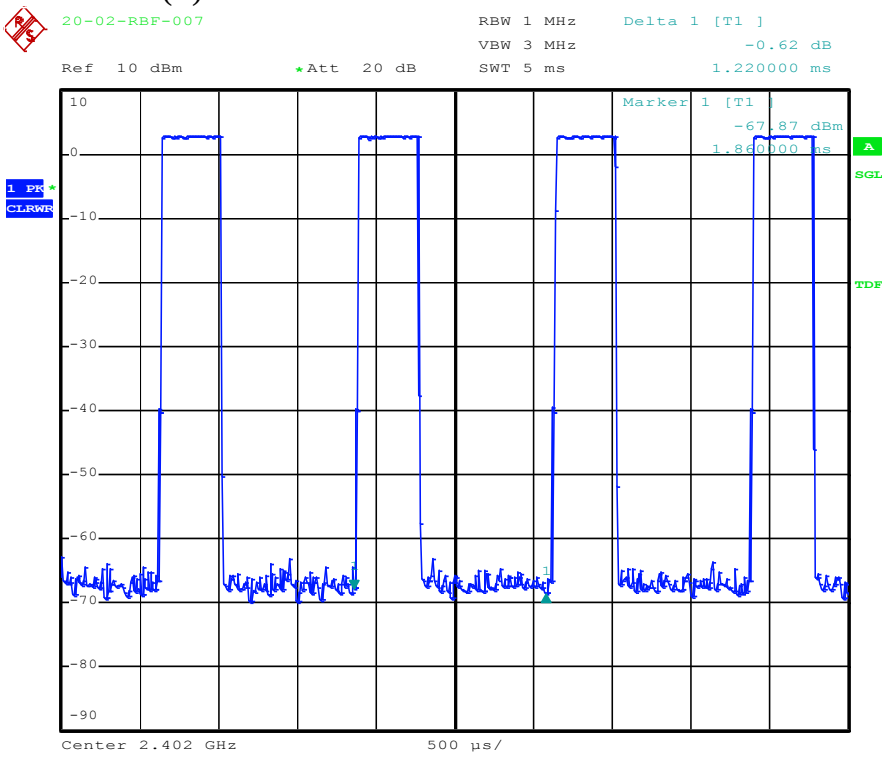
BR / DH1

Period



Date: 11.FEB.2020 10:12:45

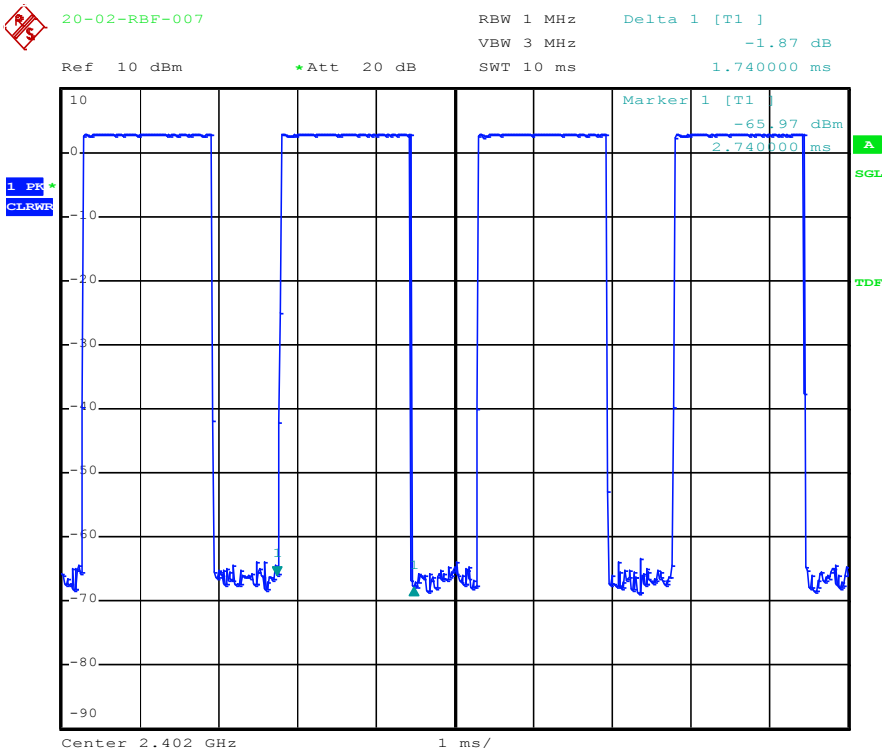
Transmission duration (T)



Date: 11.FEB.2020 10:13:02

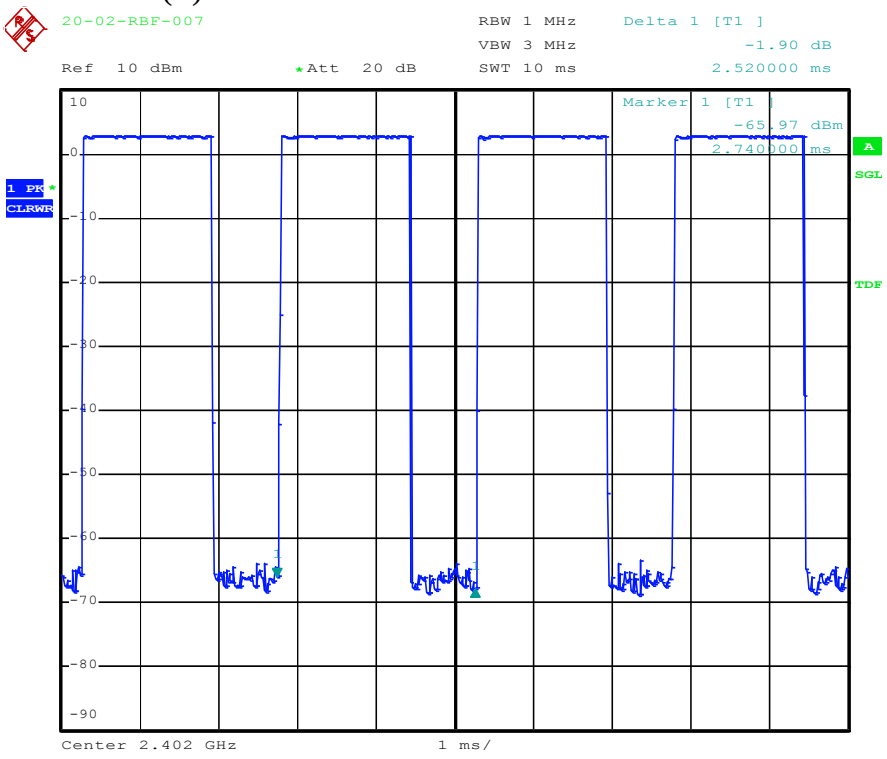
BR / DH3

Period



Date: 11.FEB.2020 10:13:42

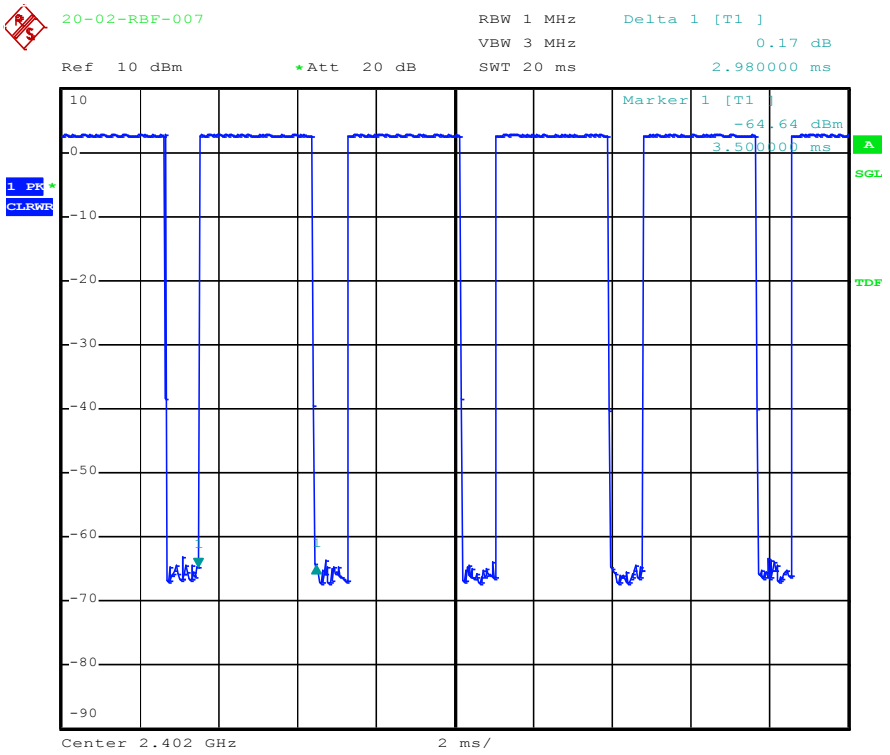
Transmission duration (T)



Date: 11.FEB.2020 10:16:54

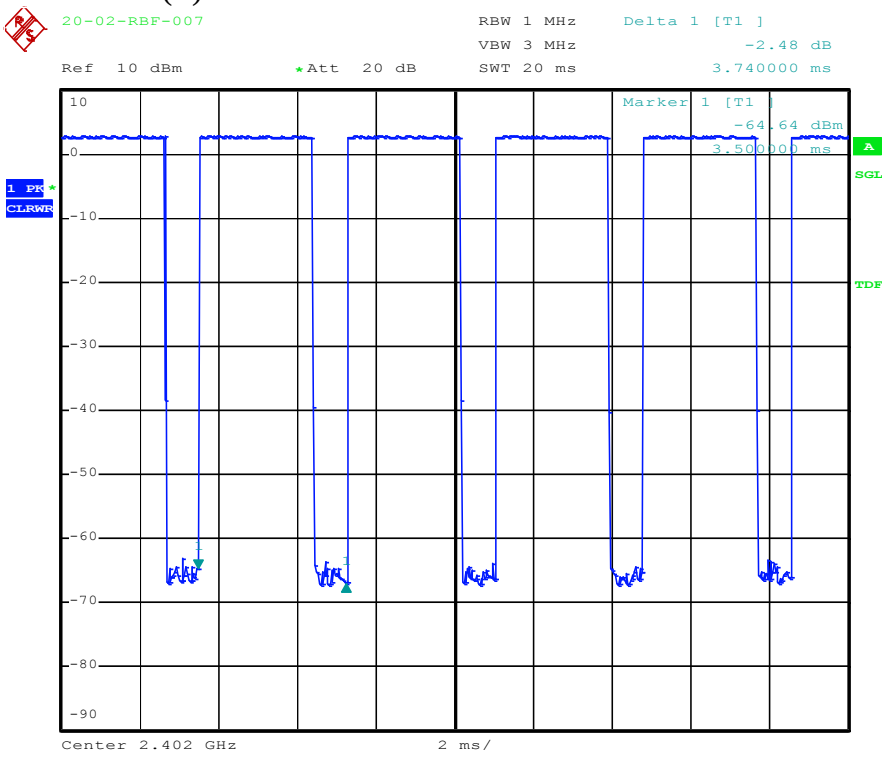
BR / DH5

Period



Date: 11.FEB.2020 10:17:21

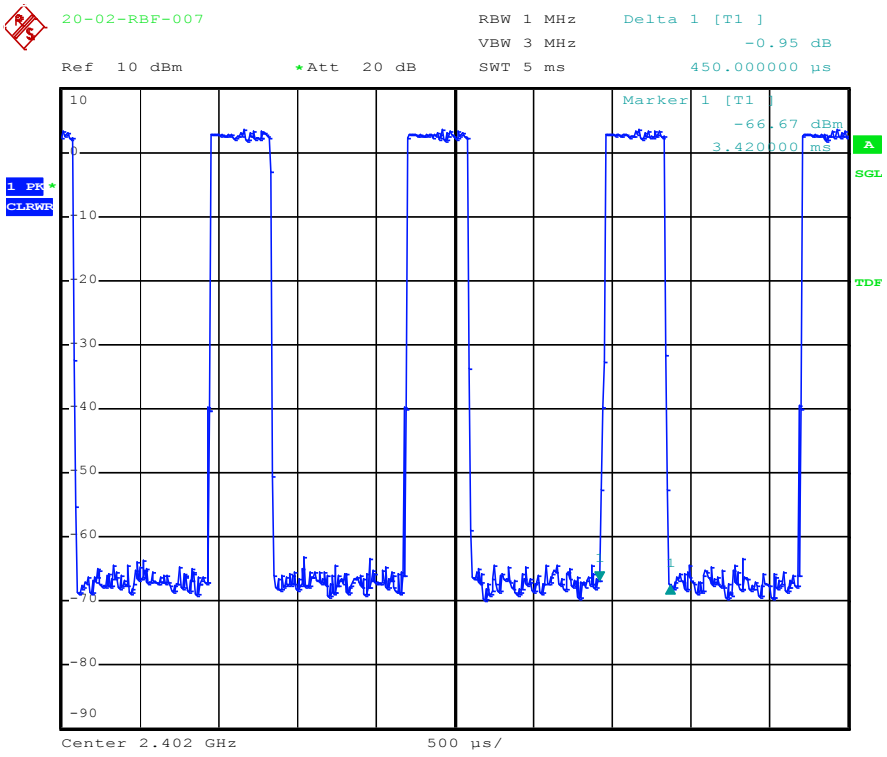
Transmission duration (T)



Date: 11.FEB.2020 10:17:48

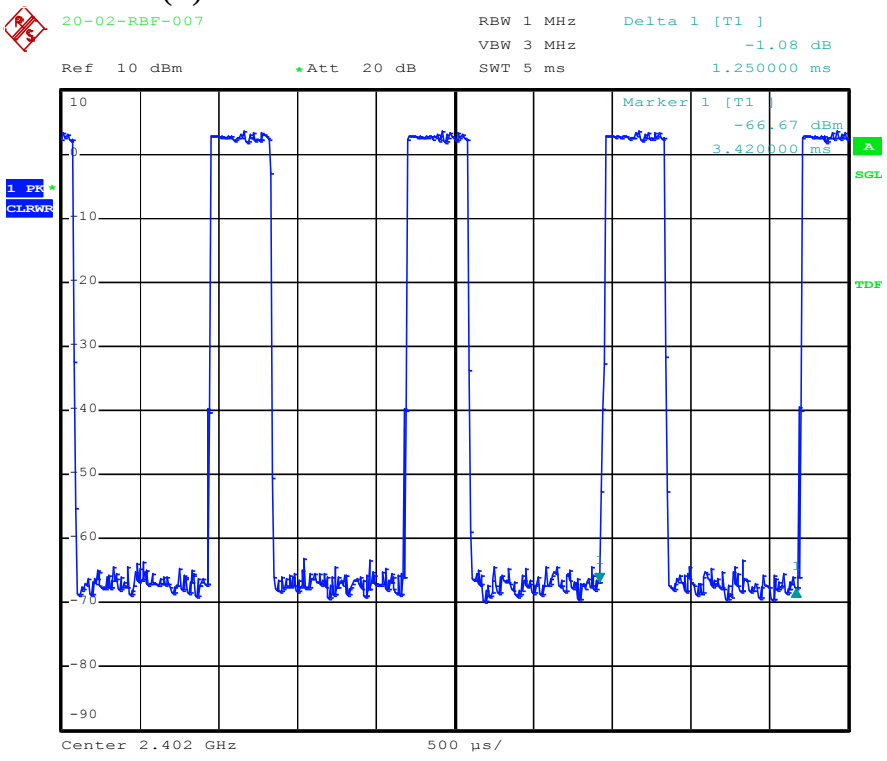
EDR / DH1

Period



Date: 11.FEB.2020 11:48:07

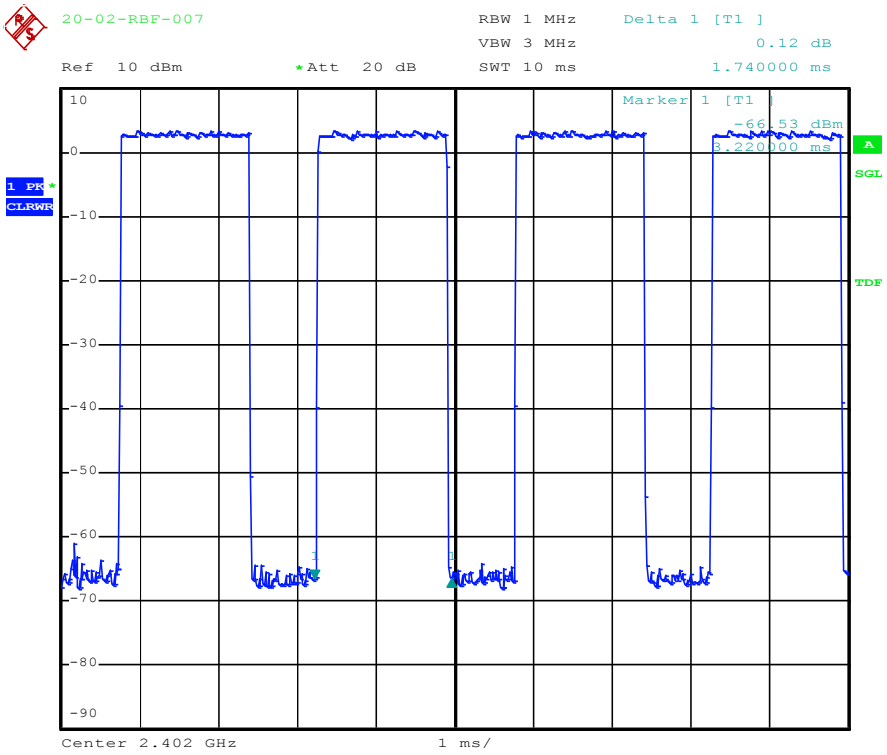
Transmission duration (T)



Date: 11.FEB.2020 11:49:47

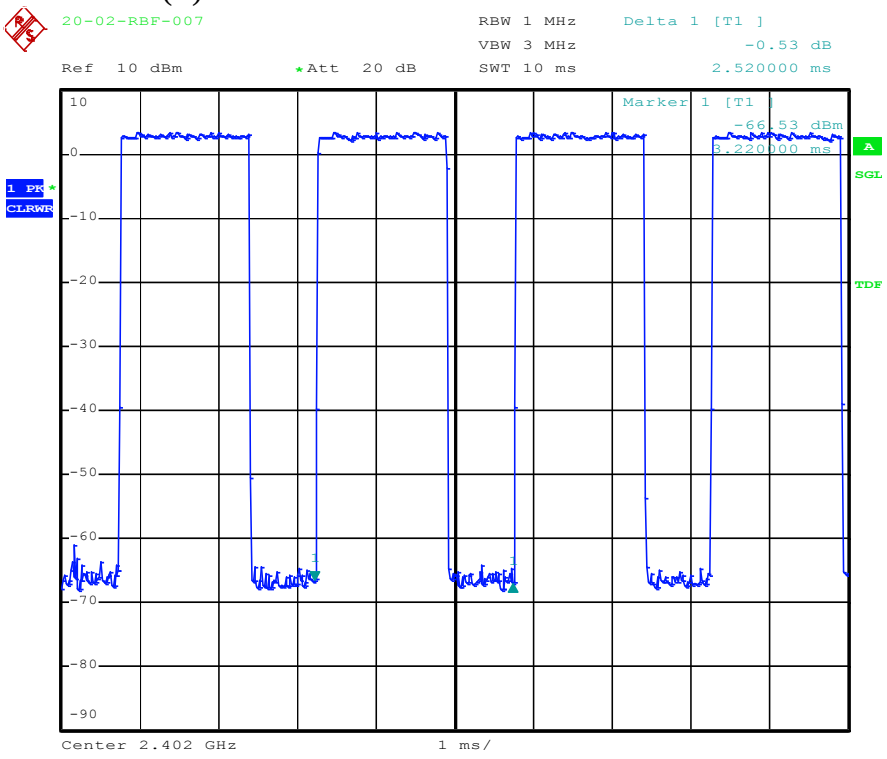
EDR / DH3

Period



Date: 11.FEB.2020 11:50:16

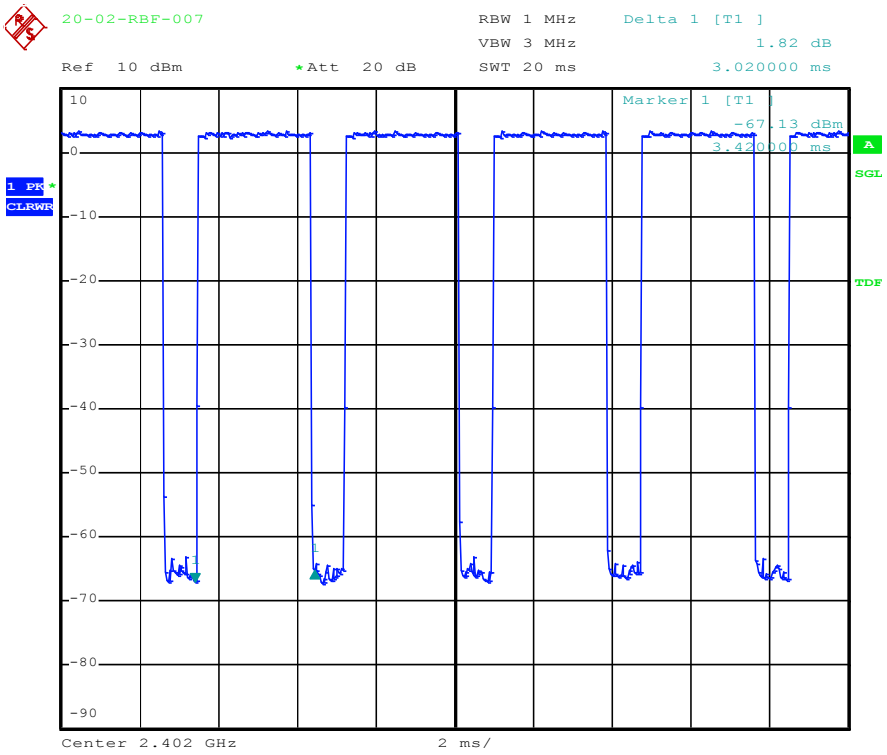
Transmission duration (T)



Date: 11.FEB.2020 11:50:36

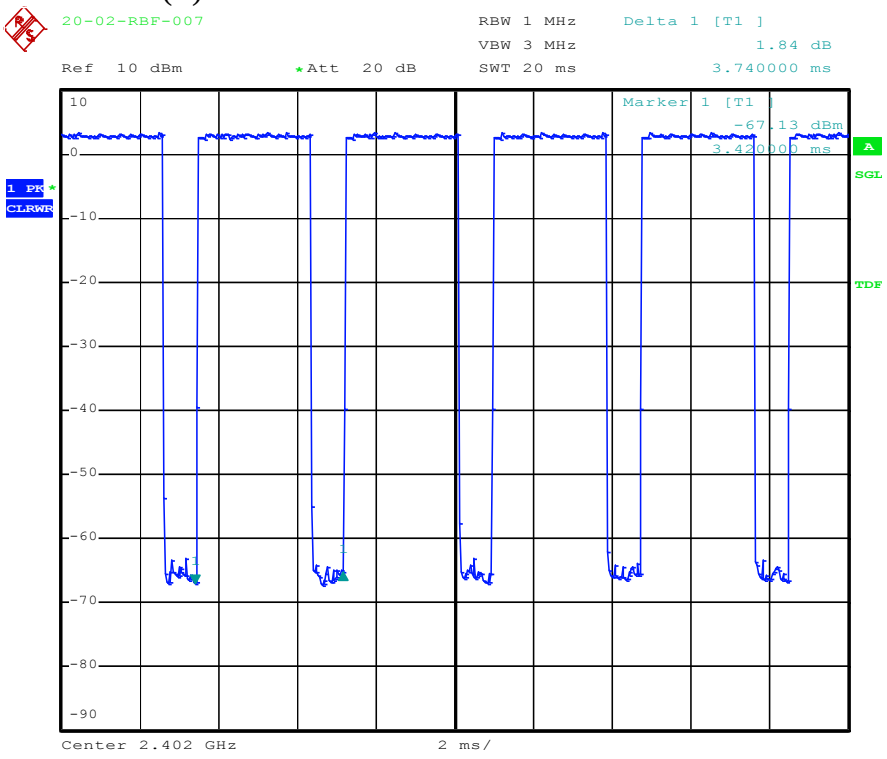
EDR / DH5

Period



Date: 11.FEB.2020 11:51:00

Transmission duration (T)



Date: 11.FEB.2020 11:51:10