

ISED CABid: ES1909

Test Report No:

Lab. Company Number: 4621A

83304RRF001A1

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Telematic control unit with wireless technologies, used in automotive industry.
(*) Trademark	VW AG
(*) Model and /or type reference	TKCMOD12N00W
(*) Derived model not tested	TKCMOD11000W
Other identification of the product	FCC ID: T8GCONMODMQB IC: 6434A-CONMODMQB
(*) Features	GSM, UMTS, LTE, 5G, Bluetooth EDR, BT Low-Energy, Wi-Fi, GNSS receiver HW version: X07 SW version: Q113
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH Becker-Goering-Str. 16 76307, Karlsbad, GERMANY
Test method requested, standard	USA FCC Part 15.247 (10-1-23 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-23 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 3 (August 2023). CANADA RSS-Gen Issue 5 amendment 2 (February 2021). Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Galván EMC Consumer & RF Lab. Manager
Date of issue	2025-07-01
Report template No	FDT08_25 (*) "Data provided by the client"

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Acronyms

Acronym ID	Acronym Description
BW	Bandwidth
Detector	Detector used
Ebw	Emission Bandwidth
Equipment	Equipment Type
Freq	Frequency
Freq Rng	Frequency Range
Inband Peak Lvl	Inband Peak Level
Lvl	Level
MP	Measurement Point
Mod	Modulation
Mode	Antenna configuration
Occ Ch BW	Occupied Channel Bandwidth
PSD	Power Spectral Density
Peak Power	Maximum Peak Conducted Output Power
Pol	Polarization
Port	Active Port
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level
EUT	Equipment Under Test

Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification S.A.U. is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification S.A.U. is an ISED-recognized accredited testing laboratory, CABid: ES1909, Company Number: 4621A, with the appropriate scope of accreditation that covers the performed tests in this report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000. The total uncertainty of the measurement system for the radiated emissions of EUT from 30 MHz to 1 GHz is: Measurement uncertainty $\leq \pm 5,35$ dB with factor ($k = 2$). The total uncertainty of the measurement system for the radiated emissions of EUT from 1 GHz to 17 GHz is: Measurement uncertainty $\leq \pm 4,32$ dB with factor ($k = 2$). The total uncertainty of the measurement system for the radiated emissions of EUT from 17 GHz to 26 GHz is: Measurement uncertainty $\leq \pm 5,51$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the conducted testing of EUT is:

- RF Peak Output Power: Measurement uncertainty $\leq \pm 0,80$ dB
- RF Average Output Power: Measurement uncertainty $\leq \pm 0,99$ dB
- Power Spectral Density: Measurement uncertainty $\leq \pm 0,99$ dB
- 6dB Bandwidth: Measurement uncertainty $\leq \pm 1,14$ %
- Occupied Channel Bandwidth: Measurement uncertainty $\leq \pm 1,40$ %
- Conducted Band-edge spurious emissions: Measurement uncertainty $\leq \pm 1,76$ dB
- Accumulated Dwell Time: Measurement uncertainty $\leq \pm 0,16$ %
- Minimum Frequency Occupation Time: Measurement uncertainty $\leq \pm 0,53$ %

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample consists of a Telematics control unit with wireless technologies, used in automotive, equipped with one modem, OEM. This unit was designed for automotive usage and contains the following features: GSM, UMTS, LTE, 5G, GNSS, WiFi (a, b, g, n, ac, ax), Bluetooth.

Antennas: the device supports several antennas for the following transmission technologies:

- LTE 1: model 3WA.035. 507.N and 3WA.035. 507.G, sub-antenna Tel 5G 1
- LTE 2: model 3WA.035. 507.N and 3WA.035. 507.G, sub-antenna Tel 5G 2
- LTE 3: model 4M0.035. 507.A
- Internal antenna
- BT_WLAN_1: model 83H.035.225.F, used for 802.11 2.4 GHz
- BT_WLAN_2: model 4N0.035.500, used for 802.11 2.4 GHz and 5GHz and Bluetooth
- BT_WLAN_3: model 3WA.035. 507.N and 83H.035.225.F used for 802.11 2.4 GHz and 5GHz
- BTLE_1: model 3WA.035. 507.N and 3WA.035. 507.G, used for BTLE

Values corresponding to antenna gain have been declared by the device manufacturer (maximum peak gain stated in antenna manufacturer's datasheet).

3. Derived model not tested. These models have been declared by the supplier of the sample as being the same as the model under test.

HARMAN Becker Automotive Systems GmbH
Becker-Goering-Str. 16
76307 Karlsbad, Germany



Date: January 28th, 2025

To whom it may concern,

We,

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
Becker-Goering-Str. 16; 76307 Karlsbad, Germany,

Hereby declare that the products listed below:

Type of equipment: Telematic control unit with wireless technologies used in automotive industry.
Brand name: VW AG
Model names: TKCMOD12N00W and TKCMOD11000W

are part of the same family and all the models are equal. The model TKCMOD12N00W is the most populated variant, and it is the one that has been tested. The model TKCMOD11000W is the same as TKCMOD12N00W but it has a different name because has the cellular module disabled (although is installed in the device).

The rest of interfaces (BT, WiFi, GNSS) are equal in all the variants.

In the table below you can find the different names based on the specific country target:

Country	Product Name	AUDI Part number	Variant	GNSS	Bluetooth	NAD (Activated)	WLAN P
NAR (online variant)	TKCMOD12N00W	57N.035.741	V160	x	x	x	-
Rest of the world (offline variant)	TKCMOD11000W	571.035.741	V333	x	x	-	-

As mentioned above, TKCMOD12N00W is the variant that has been tested and results are applicable to the rest of the variants.

Sincerely,

i.v. 

By: Iulian-George Stoica
Title: Customer Lead Certification
E-mail: iulian.stoica@harman.com
Telephone: +40799 306 699

Company: Harman Becker Automotive Systems GmbH

i.v. 

By: Alin Banica
Title: Regulatory Product Compliance Expert
E-mail: AlinLucian.Banica@harman.com

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results. The laboratory is not responsible for such information and it is not covered by accreditation.

Usage of samples

Samples undergoing test have been selected by: The client.

Id		Control Number	Description	Model	Serial N°	Date Reception	of	Application
S/01		77617B_276.1	Telematic control unit	TKCMOD12N00W	354205700032680	2024-10-16		Element Under Test
		77617B_163.1	Shark Antenna (cellular, GNSS and BTWLAN3)	3WA.035.507.N	--	2024-04-05		Auxiliary Element
		77617B_375.1	Antenna BTWLAN1	83H.035.225.F	--	2024-04-05		Auxiliary Element
		77617B_376.1	Antenna BTWLAN2	4N0.035.500	--	2024-04-05		Auxiliary Element
		77617B_377.1	Antenna LTE3	4M0.035.507.A	--	2024-04-05		Auxiliary Element
		77617B_144.1	Harness	--	--	2024-04-05		Auxiliary Element
		77617B_160.1	Module Circuit Board	--	--	2024-04-05		Auxiliary Element
		77617B_163.1	Yellow box	--	--	2024-04-05		Auxiliary Element
		77617B_164.1	USB cable	--	--	2024-04-05		Auxiliary Element
S/02		77617B_277.1	Telematic control unit	TKCMOD12N00W	354205700035618	2024-10-16		Element Under Test
		77617B_25.1	Yellow Box	--	14910	2023-11-20		Auxiliary Element
		77617B_47.1	Harness	--	--	2023-11-20		Auxiliary Element
		77617B_148.1	Module Circuit Board	--	--	2024-04-05		Auxiliary Element

Notes referenced to samples during the project:

Id		Type
S/01		Sample used for radiated tests
S/02		Sample used for conducted test

Test sample description

Ports..... :	Port name and description		Cable			
			Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾
	RF connector – code			[]	[X]	[]
	RF connector – code			[X]	[X]	[]
	RF connector – code			[X]	[]	[]
--						
Supplementary information to the ports..... :						
Rated power supply	Voltage and Frequency			Reference poles		
				L1	L2	L3
	[]	AC:	[]	[]	[]	[]
[X]		DC: 12V car battery (4.8 VDC inside of TCU)				
Rated Power	12V DC					
Clock frequencies.....	--					
Other parameters	See Technical description					
Software version	Q113					
Hardware version	X07					
Dimensions in cm (W x H x D)	--					
Mounting position	[]	Table top equipment				
	[]	Wall/Ceiling mounted equipment				
	[]	Floor standing equipment				
	[]	Hand-held equipment				
	[X]	Other: automotive telematics control unit				
Modules/parts.....	Module/parts of test item			Type		Manufacturer
	--					
Accessories (not part of the test item)	Description			Type		Manufacturer
	--					
Documents as provided by the applicant.....	Description			File name		Issue date
	--					

⁽³⁾ Only for Medical Equipment

Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH
Becker-Goering-Str. 16
76307, Karlsbad, GERMANY

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-10-02
Date (finish)	2025-01-30

Document history

Report number	Date	Description
83304RRF001	2025-06-06	First release.
83304RRF001A1	2025-07-01	Second release. Modification due to typos. This test reports cancels and replaces to 83304RRF001

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Victoria Olmedo Villalba and Valentin Andarias Diaz.

Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
08130	SEMIANECHOIC ABSORBER LINED CHAMBER	P29419	ALBATROSS	N/A
08134	SHIELDED ROOM	P29419	ALBATROSS PROJECTS GMBH	N/A
07550	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
07549	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
10304	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-02-19
09968	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2026-09-22
07763	HORN ANTENNA 1-18GHz	BBHA 9120D	SCHWARZBECK MESS-ELEKTRONIK	2026-01-16
07769	PREAMPLIFIER 30dB 500MHz-18GHz	BBV 9718 C	SCHWARZBECK	2025-03-13
06495	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2027-07-11
07862	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-3G	BONN ELEKTRONIK	2025-04-02
04848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A
06791	SEMIANECHOIC ABSORBER LINED CHAMBER IV	FACT 3 200 STP	ETS LINDGREN	N/A
06792	SHIELDED ROOM	S101	ETS LINDGREN	N/A
06609	ETHERNET TEMPERATURE AND HUMIDITY LOGGER	HWg-STE	HW GROUP	2025-04-22
06615	ETHERNET TEMPERATURE AND HUMIDITY LOGGER	HWg-STE	HW GROUP	2025-04-04
07817	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-07-01
06143	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2027-01-22
06142	PRE-AMPLIFIER G>38dB 30MHz-6GHz	BLNA 0360-01N	BONN ELEKTRONIK	2025-07-25
06496	HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2026-12-01
03783	PRE-AMPLIFIER G>30dB 1GHz-18GHz	BLMA 0118-3A	BONN ELEKTRONIK	2025-03-15
04657	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2026-06-12

Control No.	Equipment	Model	Manufacturer	Next Calibration
08856	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-4A	BONN ELEKTRONIK	2025-02-27
07445	DC POWER SUPPLY 30V/5A	U8002A	KEYSIGHT TECHNOLOGIES	N/A
07760	DIGITAL MULTIMETER	175	FLUKE	2025-11-07
08661	SHIELDED ROOM	--	SIEPEL	N/A
07552	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
08835	SIGNAL AND SPECTRUM ANALYZER 2Hz-50GHz	FSW50	ROHDE AND SCHWARZ	2025-02-08
07039	OPEN SWITCH UNIT UP TO 6 GHz	OSP-B157W8	ROHDE & SCHWARZ	2025-05-25
07040	EXTENSION FOR OPEN SWITCH UNIT UP TO 40GHz	OSP-B157Wx	ROHDE & SCHWARZ	2025-04-19
07702	DC POWER SUPPLY 30V/3A 90W	GPS-3030D	GW INSTEK	N/A
07755	DIGITAL MULTIMETER	175	FLUKE	2025-11-25
07798	WMS32	WMS32	ROHDE AND SCHWARZ	N/A

Testing verdicts

Fail	F
Inconclusive	I
Not applicable	N/A
Not measured	N/M
Pass	P

Summary

Bluetooth Low Energy (2M, 1M) (Module). Appendix A

FCC PART 15 PARAGRAPH/ RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	--
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	--
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	--
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	--
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	--
<u>Supplementary information and remarks:</u>			
None			

Bluetooth Low Energy (2M, 1M) (Chipset). Appendix B

FCC PART 15 PARAGRAPH/ RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	--
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	--
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	--
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	--
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	--
<u>Supplementary information and remarks:</u>			
None			

Bluetooth EDR. Appendix C

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
FCC 15.247 (a) (1) / RSS-247 5.1 (b)	20 dB Bandwidth	P	--
FCC 15.247 (a) (1) (iii) / RSS-247 5.1 (d)	Time of Occupancy (Dwell Time)	P	--
FCC 15.247 (b) / RSS-247 5.4. (b)	Maximum peak output power and	P	--
FCC 15.247 (a) (1) (iii) / RSS-247 5.1 (d)]	Number of hopping channels	P	--
FCC 15.247 (d) / RSS-247 5.5	Band-edge emissions compliance	P	--
FCC 15.247 (d) / RSS-247 5.5	Emission limitations radiated (Transmitter)	P	--
<u>Supplementary information and remarks:</u> None			

WLAN 2.4 GHz. Appendix D:

FCC PART 15 PARAGRAPH/ RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	--
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	--
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	--
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	--
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	--
<u>Supplementary information and remarks:</u> None.			

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	12Vdc
Type of Power Supply:	External power supply (Vehicle Battery)

ANTENNA (*):

Technology	Antenna gain	Type
BLE (module)	+0.11	External
BLE (chipset)	+4.7	External
BTEDR	+0.11	External

Technology	Port	Antenna gain (dBi)	Type
WLAN 2.4 GHz SISO	RF Output Port (Chain 0): Port 1	+2.7	External
	RF Output Port (Chain 1): Port 3	+7.45	
WLAN 2.4 GHz MIMO	RF Output Port (Chain 0): Port 1	+8.41	External
	RF Output Port (Chain 1): Port 3		

Directional Antenna Gain Calculations for CDD MIMO In-Band Measurements:

For 2Tx CDD MIMO modes, in accordance with KDB 662911 D01 v02r01 Section F)2)f)(ii) y F)2)e)ii), directional gain, directional gain was calculated as follows:

$$N_{SS} = 1, N_{ANT} = 2, G_{ANT0} = 2.7, G_{ANT1} = 7.45$$

$$\begin{aligned} Directional\ Gain &= 10 \log \left[\frac{\sum_{j=1}^{N_{SS}} (\sum_{k=1}^{N_{ANT}} g_{j,k})^2}{N_{ANT}} \right] = 10 \log \left[\frac{\sum_{j=1}^1 (\sum_{k=1}^2 g_{j,k})^2}{2} \right] \\ &= 10 \log \left[\frac{(g_{1,1} + g_{1,2})^2}{2} \right] = 10 \log \left[\frac{(10^{\frac{2.7}{20}} + 10^{\frac{7.45}{20}})^2}{2} \right] = 10 \log \left[\frac{(10^{\frac{2.7}{20}} + 10^{\frac{7.45}{20}})^2}{2} \right] = 8.41 \end{aligned}$$

TEST FREQUENCIES (*):

Modulation	Data rates	Low Channel:	Middle Channel	High Channel
BTLE GFSK	1M 1 Mbit/s	2402 MHz	2440 MHz	2480 MHz
BTLE GFSK	2M 2 Mbit/s	2402 MHz	2440 MHz	2480 MHz
BTEDR GFSK	1-DH5	2402 MHz	2441 MHz	2480 MHz
BTEDR PI/4 DQPSK	2-DH5	2402 MHz	2441 MHz	2480 MHz
BTEDR 8DPSK	3-DH5	2402 MHz	2441 MHz	2480 MHz
802.11b:	1 Mbit/s	2412 MHz	2437 MHz	2462 MHz
802.11g:	6 Mbit/s	2412 MHz	2437 MHz	2462 MHz
802.11n:	HT20 MCS0 6.5 Mbit/s	2412 MHz	2437 MHz	2462 MHz
802.11ax:	HE20 MCS0 SU	2412 MHz	2437 MHz	2462 MHz
802.11ax:	HE40 MCS0 SU	2422 MHz	2437 MHz	2452 MHz
802.11ax:	HE20 MCS0 RU 26 Worst case according to preliminary PSD testing	2412 MHz	2437 MHz	2462 MHz
802.11ax:	HE40 MCS0 RU 26 Worst case according to preliminary PSD testing	2422 MHz	2437 MHz	2452 MHz

802.11ax: HE20 MCS0 RU 26 (Worst case according to preliminary PSD testing)	
Channels	Offset
Lowest (2412 MHz):	0
Middle (2437 MHz):	4
Highest (2462 MHz):	8

802.11ax: HE40 MCS0 RU 26 (Worst case according to preliminary PSD testing)	
Channels	Offset
Lowest (2422 MHz):	0
Middle (2437 MHz):	8
Highest (2452 MHz):	17

During transmitter test the EUT was controlled by a SW tool provided by the client to operate in a continuous transmit mode on the modulation schemes and test channels as required.

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1.5 m for the frequency range 17 GHz-26 GHz (17 GHz-40 GHz horn antenna).

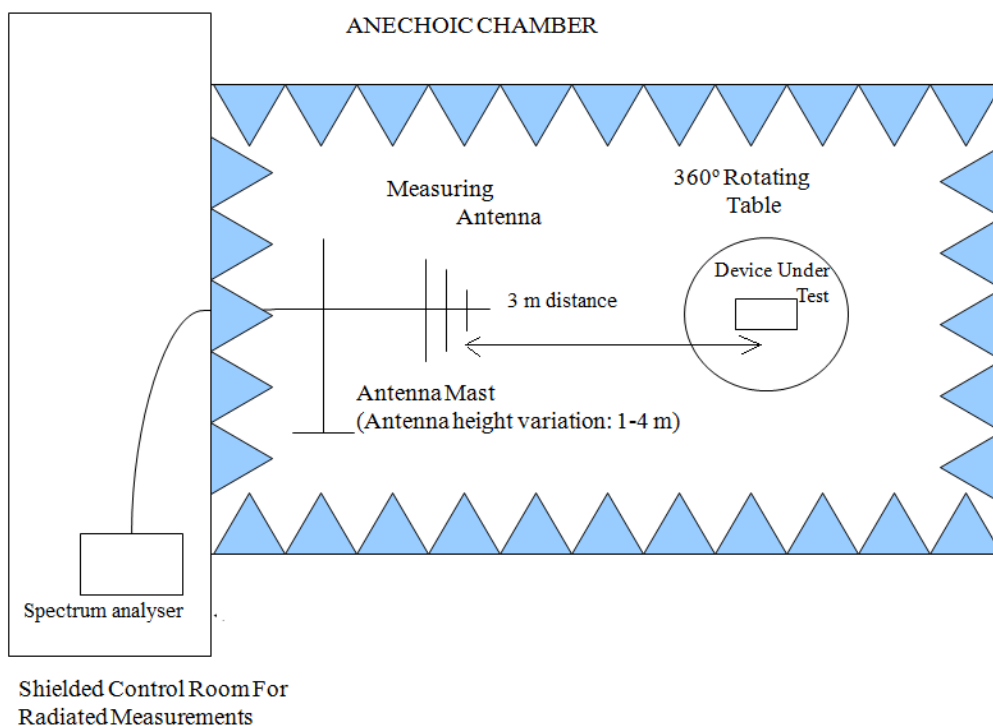
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

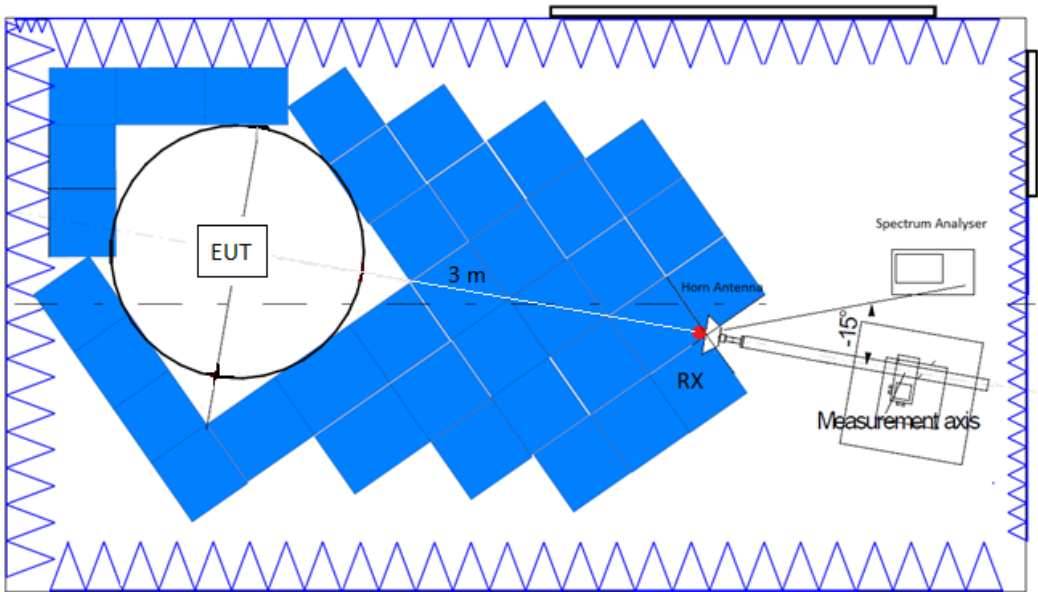
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth/video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

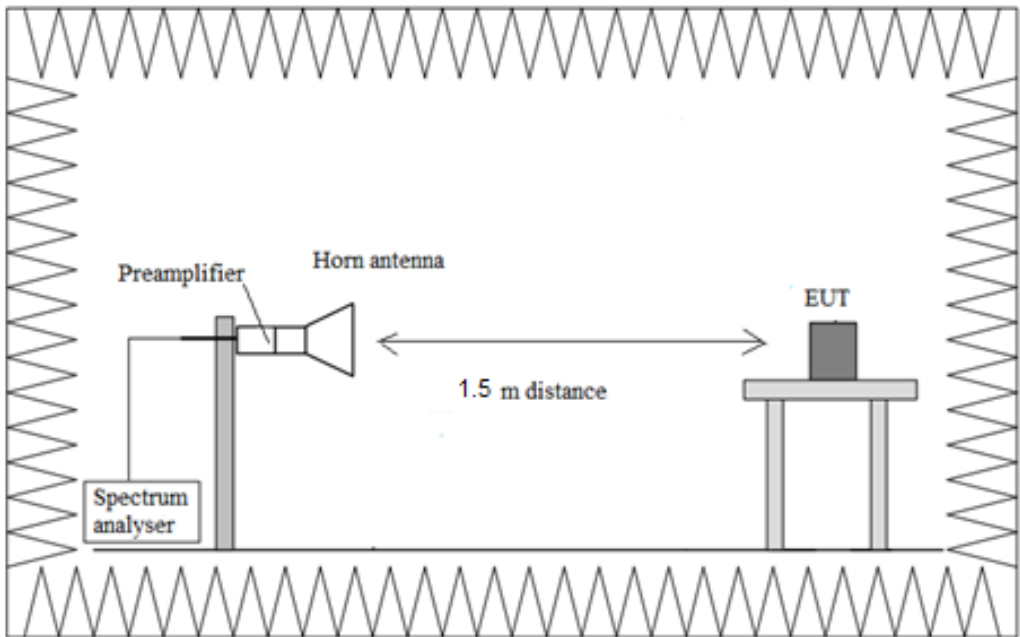
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



Appendix A: Test results. Bluetooth Low Energy (2M, 1M). Module

TEST CASES DETAILS	19
<i>Occupied Channel Bandwidth 99%</i>	<i>19</i>
<i>RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth</i>	<i>26</i>
<i>RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density</i>	<i>33</i>
<i>RSS-247 5.4 (d) / FCC 15.247 (b) (3) Maximum Peak Conducted output power</i>	<i>40</i>
<i>RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter)</i>	<i>47</i>
<i>RSS-247 5.5 / FCC 15.247 (d) Emission limitations radiated (Transmitter)</i>	<i>58</i>

TEST CASES DETAILS

Occupied Channel Bandwidth 99%

Specifications

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Occ Ch BW (MHz)
2402.00000	1.025
2440.00000	1.030
2480.00000	1.030

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

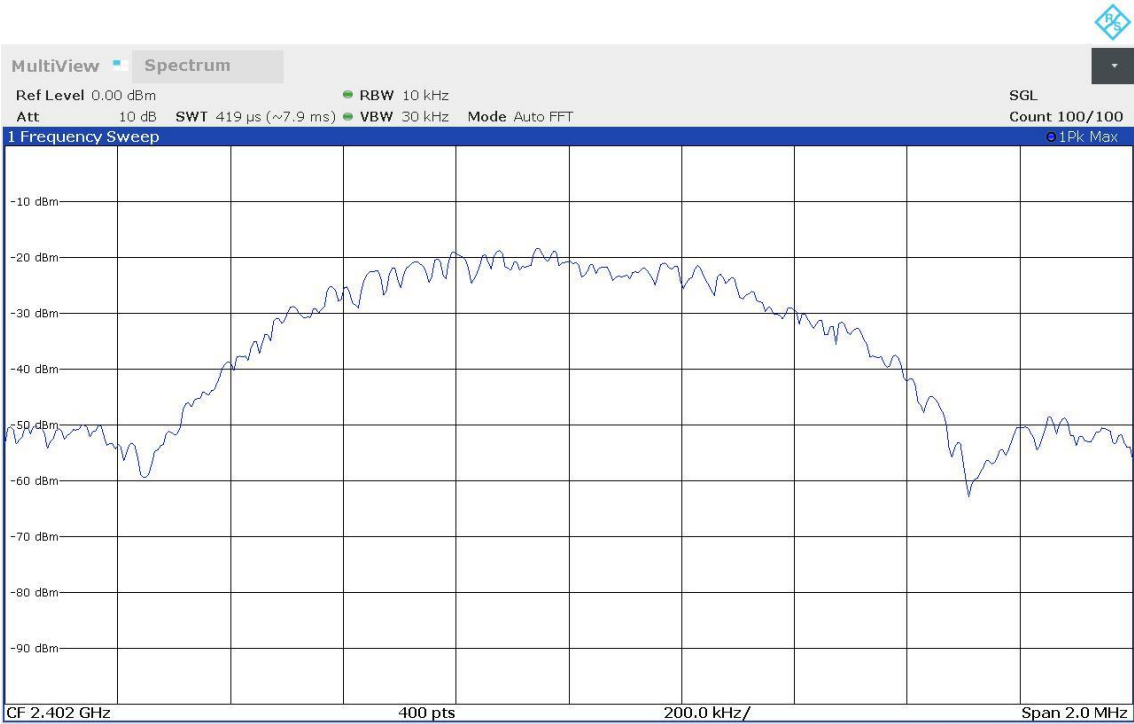
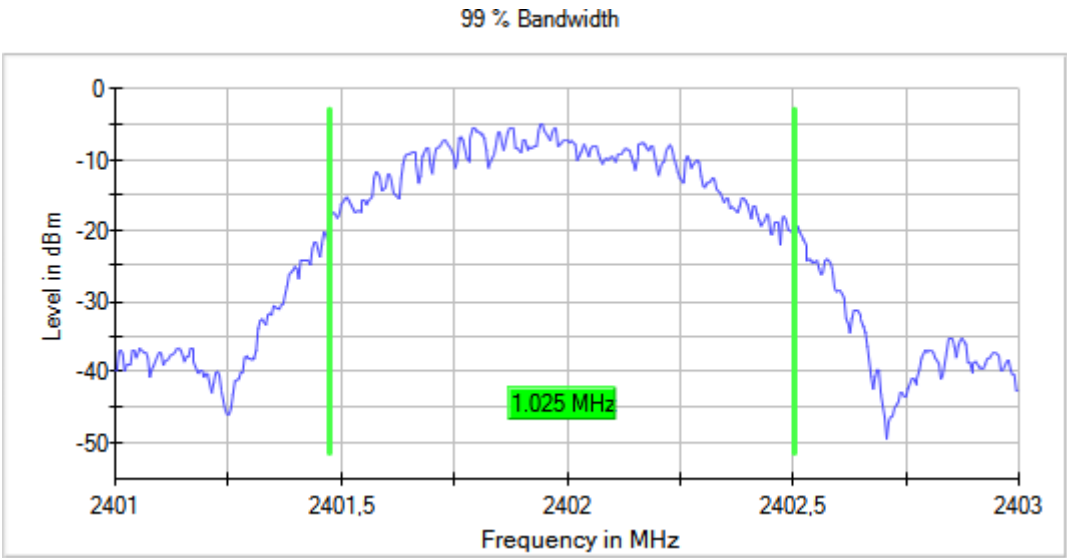
Results

Freq (MHz)	Occ Ch BW (MHz)
2402.00000	2.050
2440.00000	2.050
2480.00000	2.050

Attachments

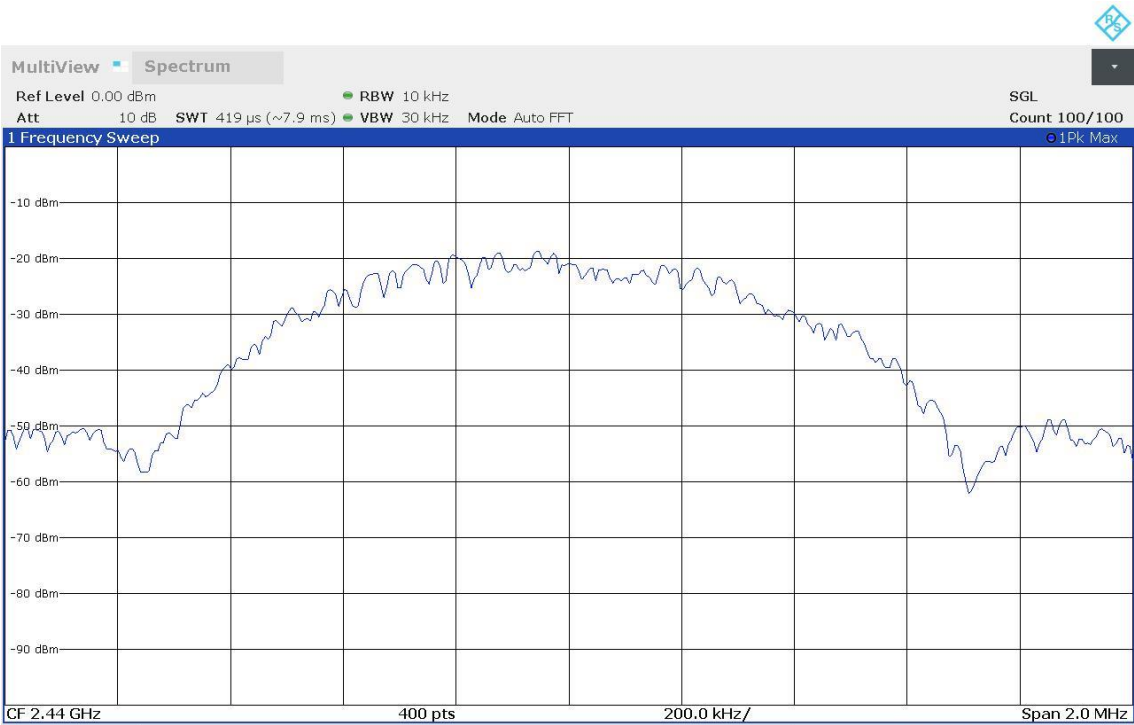
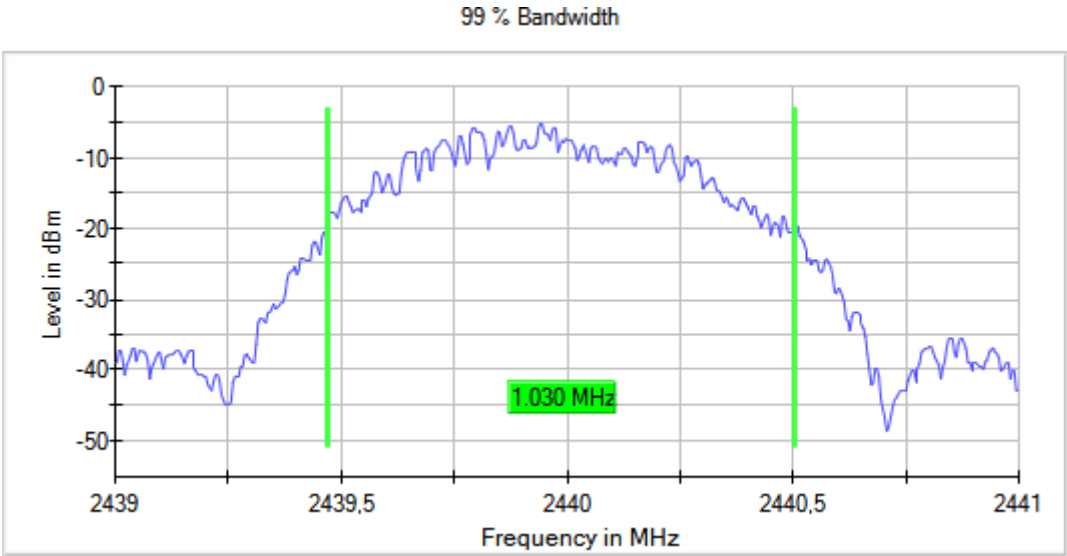
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



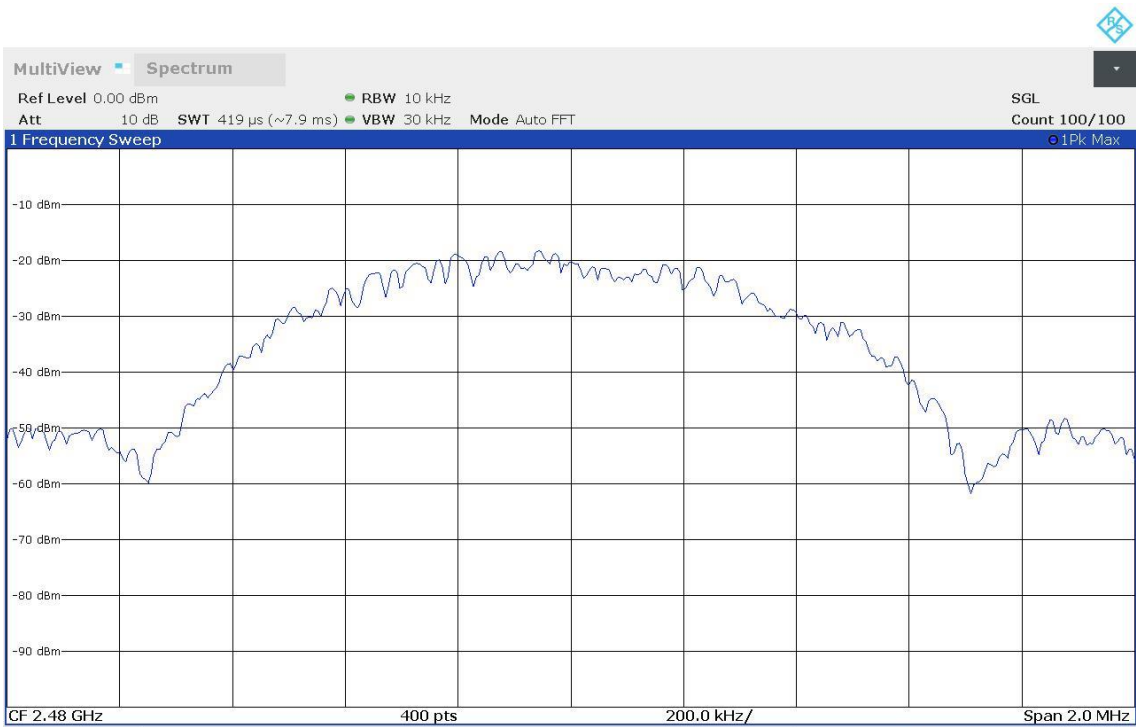
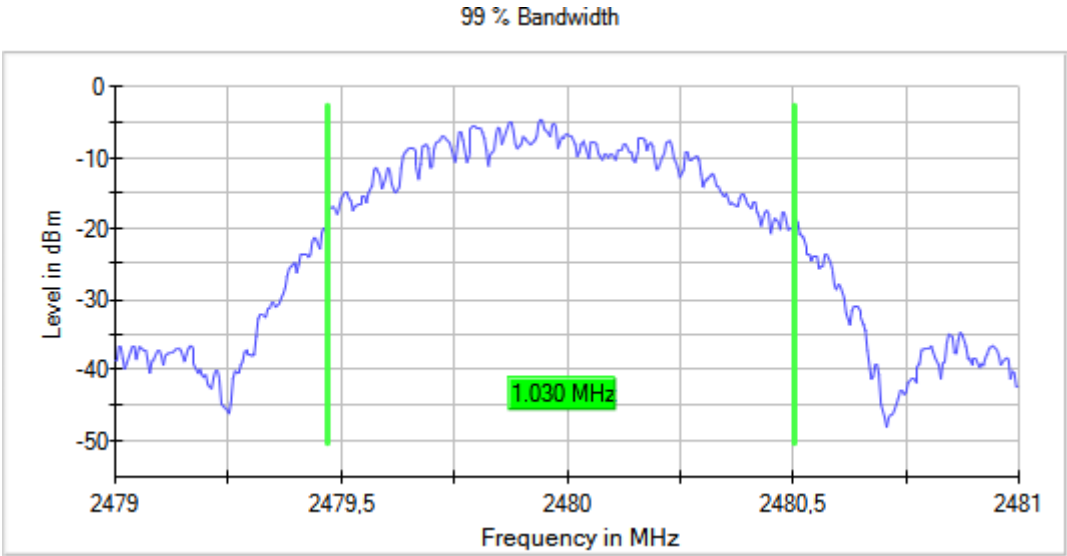
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



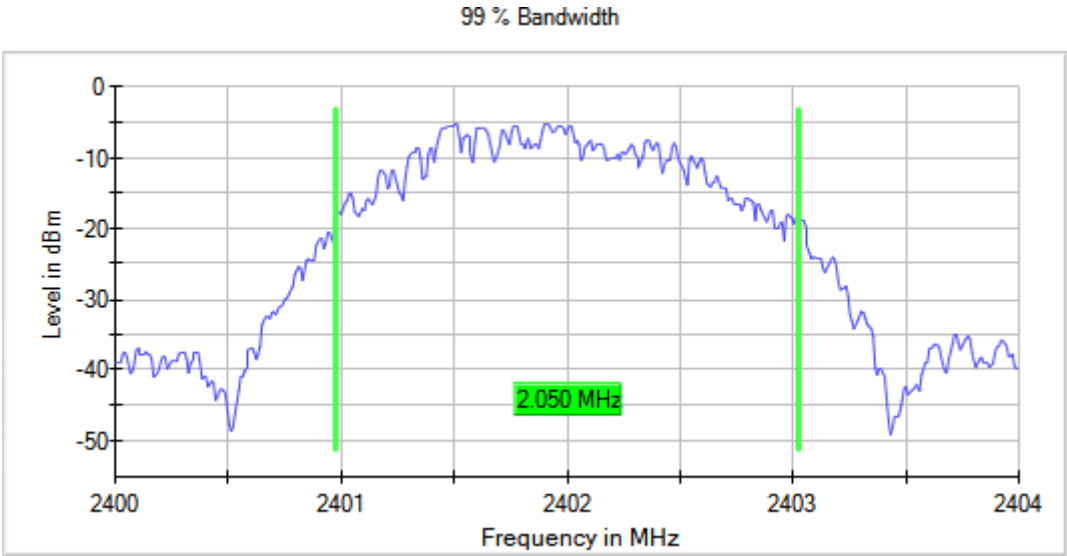
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



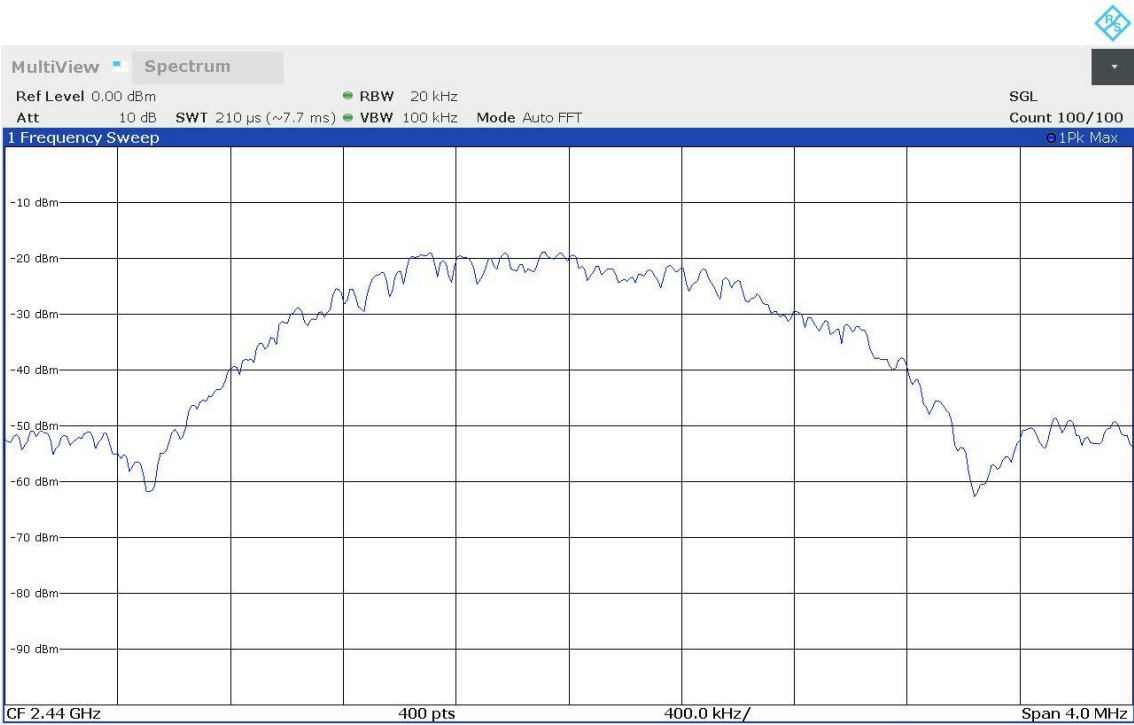
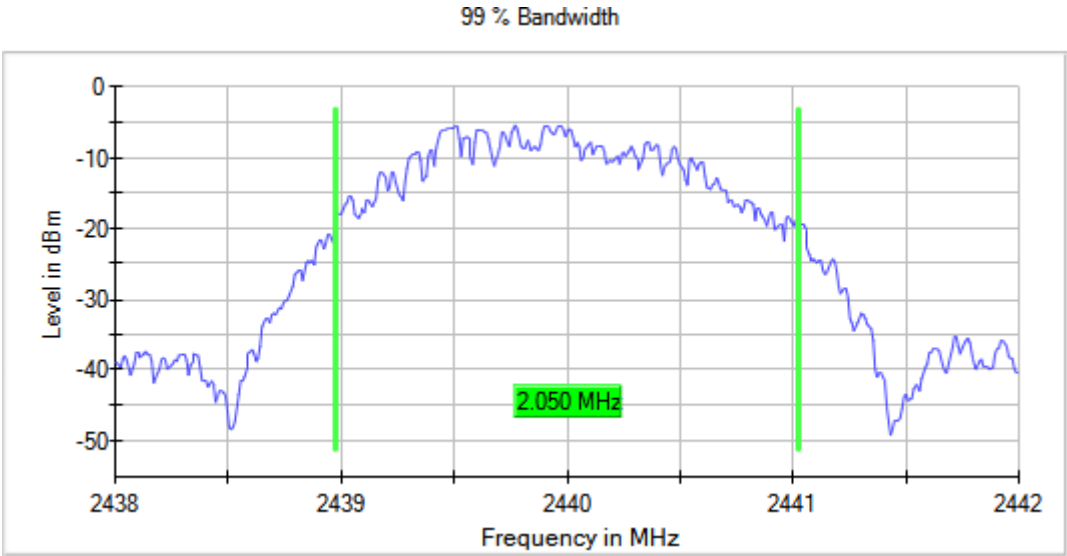
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



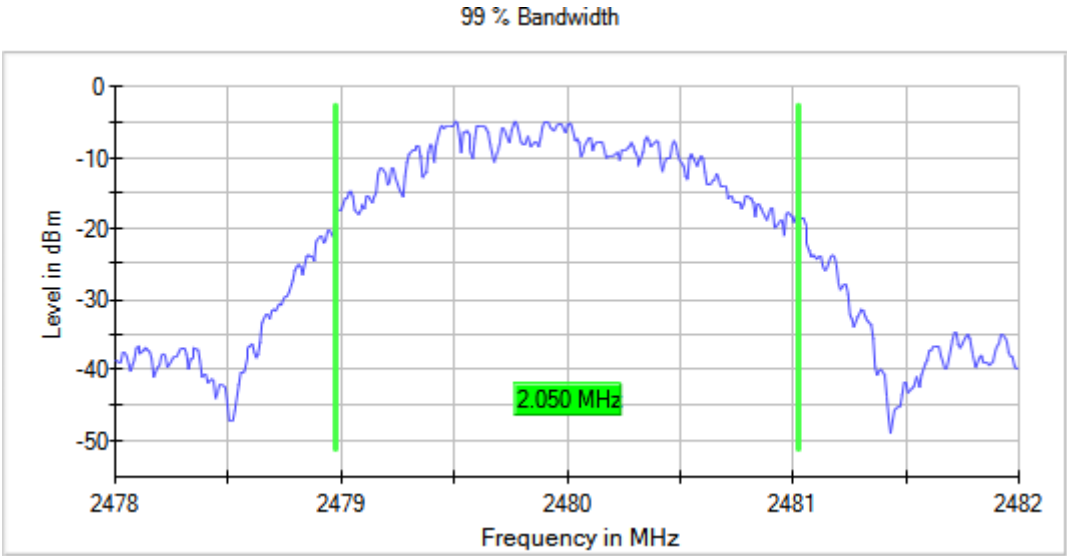
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth

Limits

The minimum 6 dB bandwidth shall be at least 500 kHz.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	6 dB Bandwidth (MHz)
2402.00000	0.772
2440.00000	0.772
2480.00000	0.772

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	6 dB Bandwidth (MHz)
2402.00000	1.465
2440.00000	1.505
2480.00000	1.505

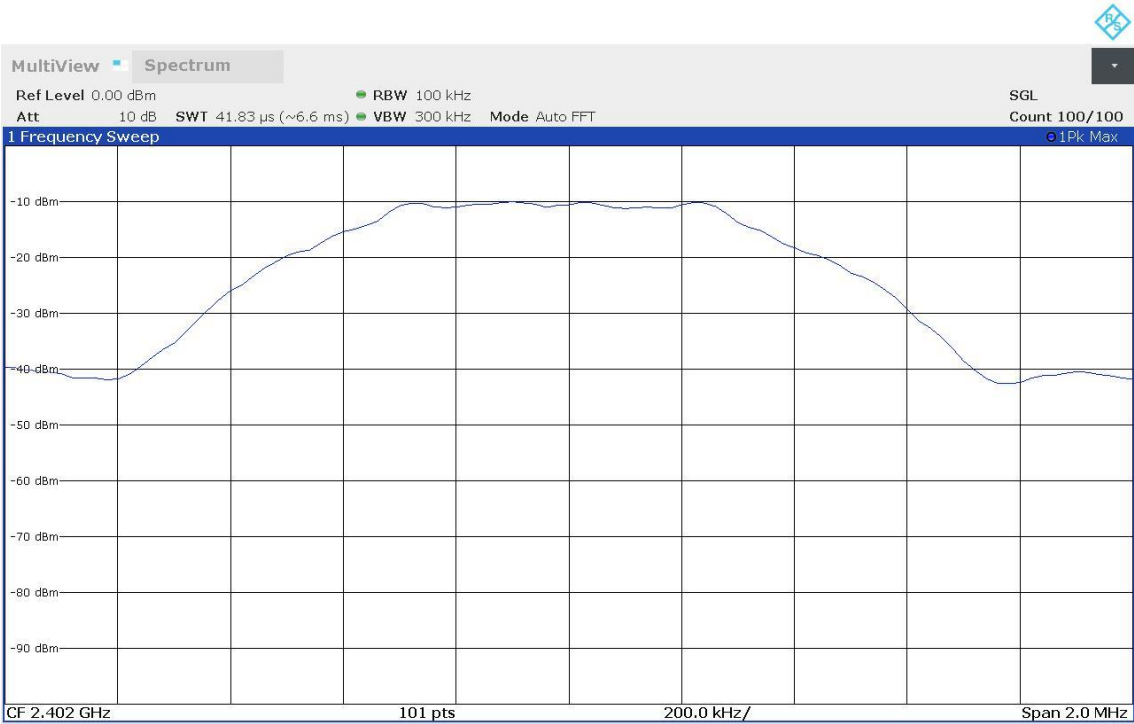
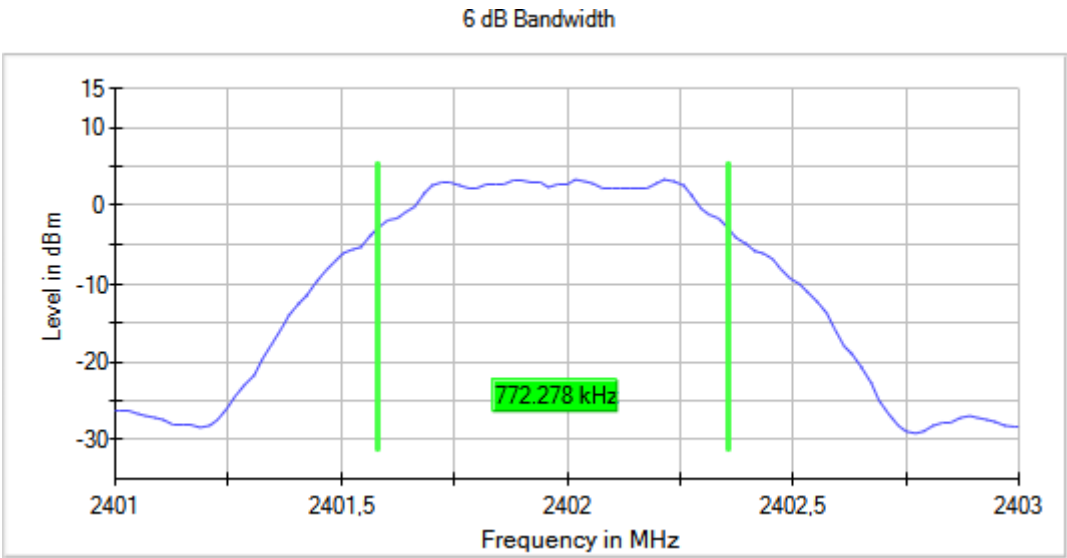
Verdict

Pass

Attachments

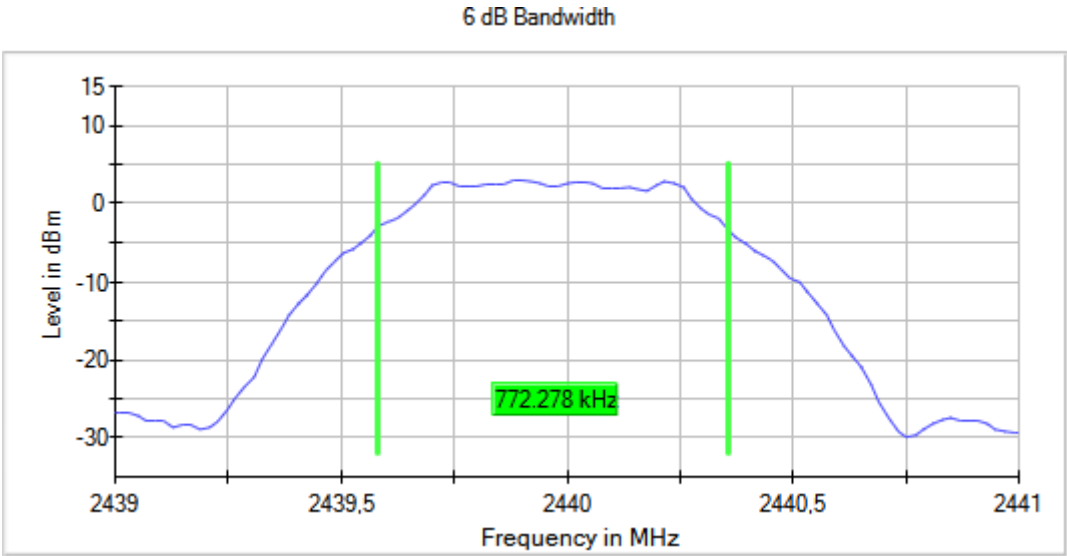
Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)
Frequency MHz = 2402.00000 Antenna configuration = SISO
Active Port = 1

Images:



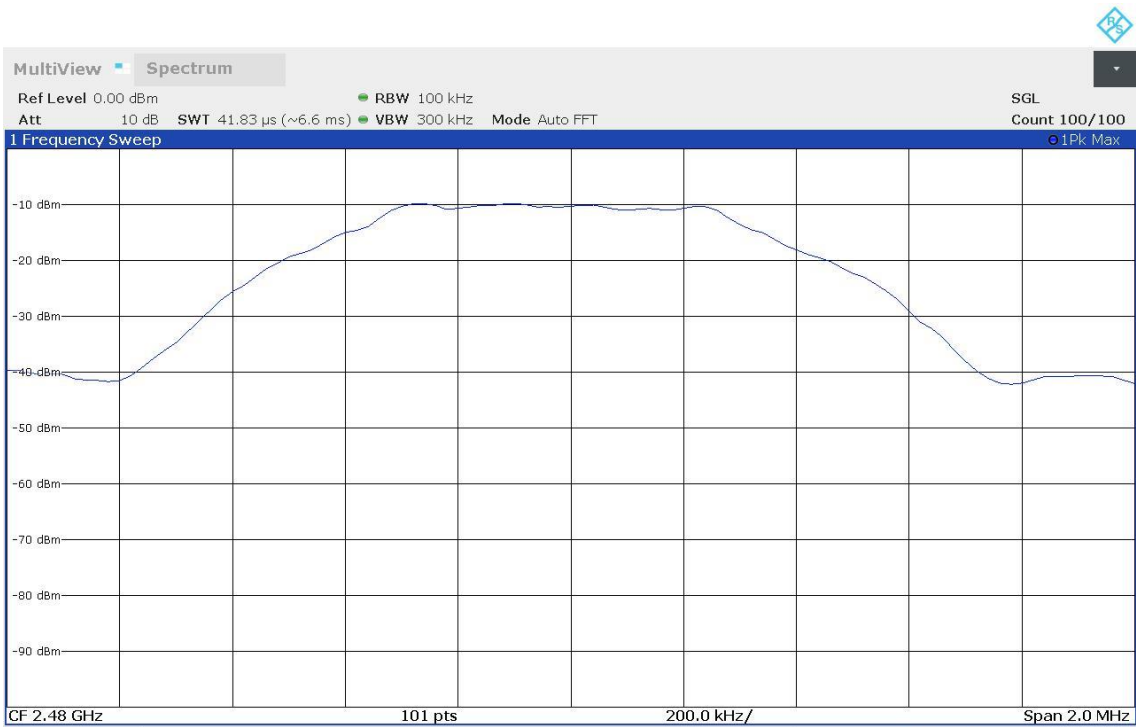
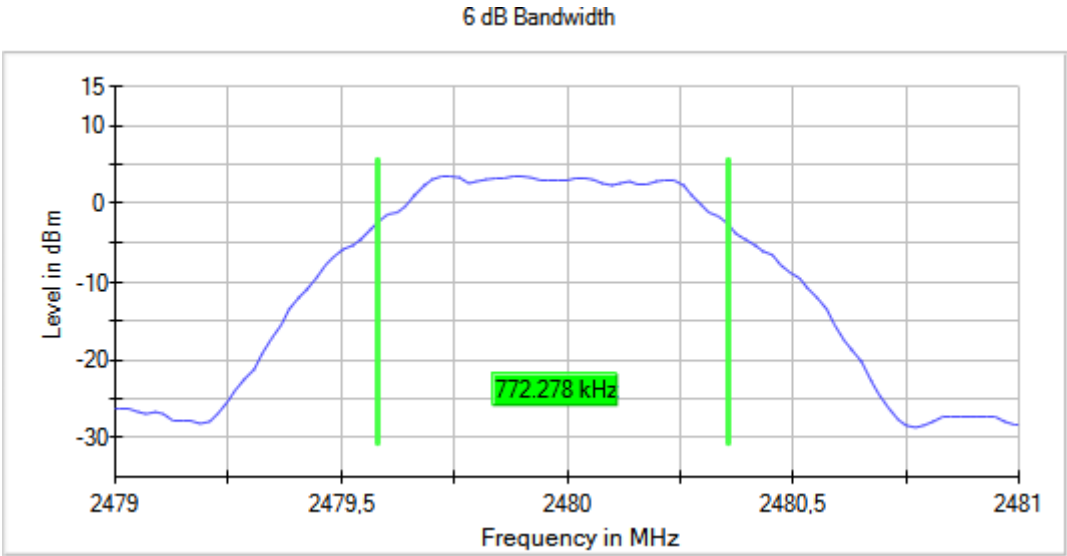
Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)
Frequency MHz = 2440.00000 Antenna configuration = SISO
Active Port = 1

Images:



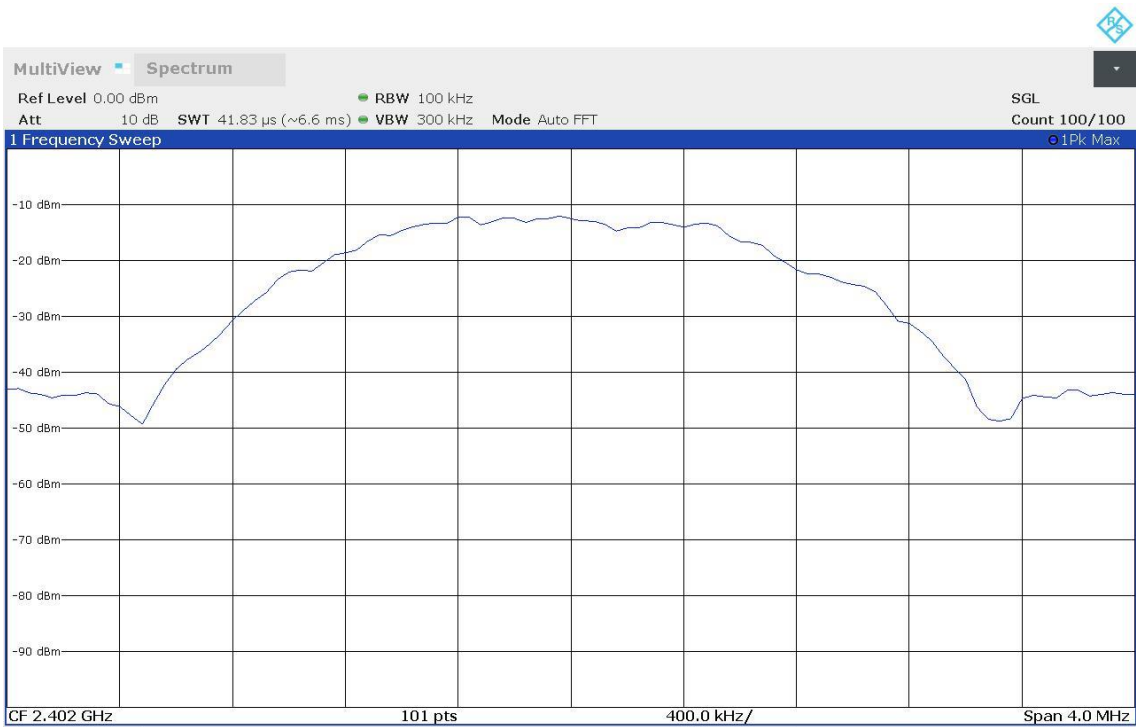
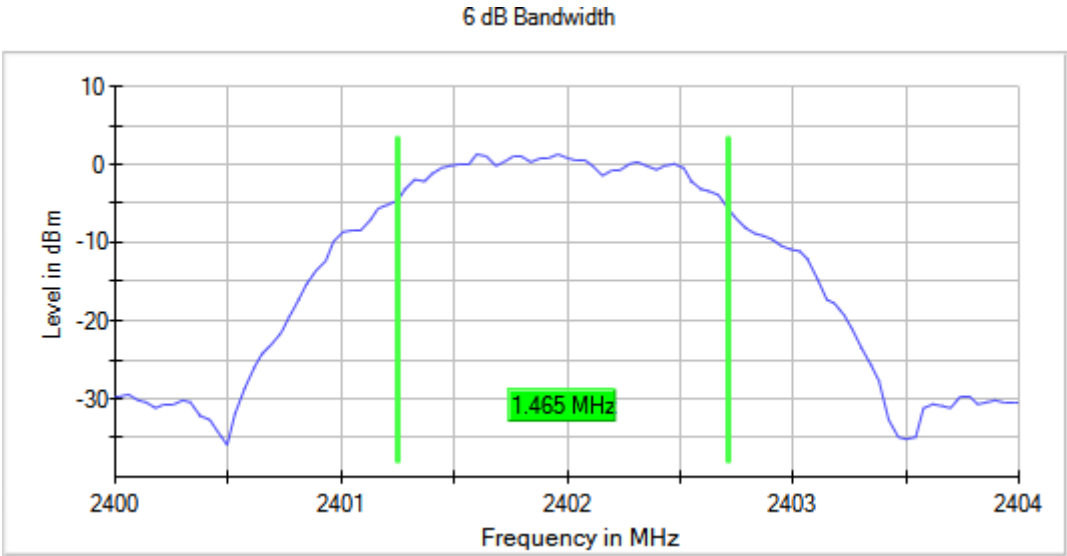
Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)
Frequency MHz = 2480.00000 Antenna configuration = SISO
Active Port = 1

Images:



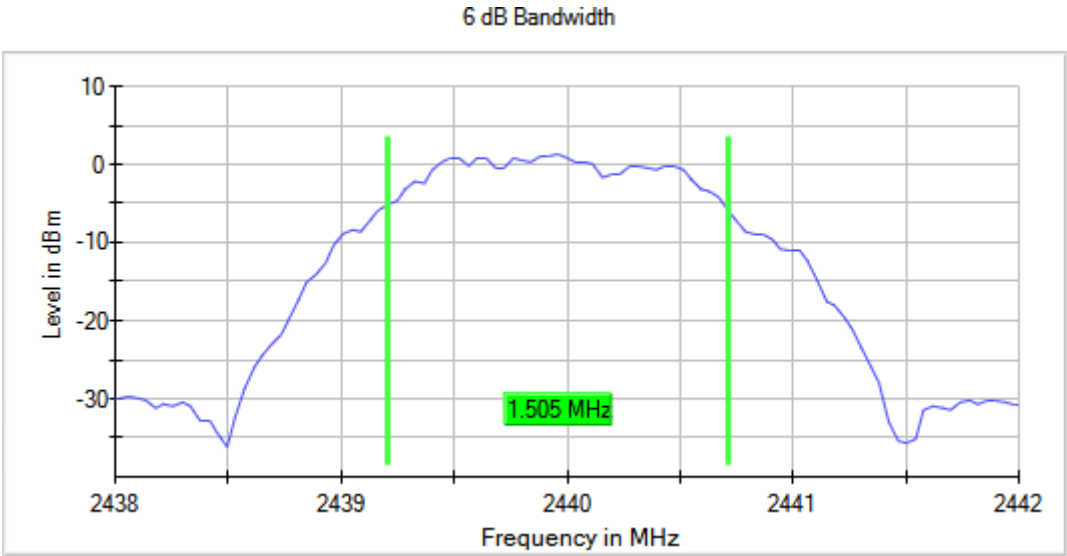
Bandwidth MHz = 2 Modulation = BTLE 5.0 (GFSK 2 Mbit/s)
Frequency MHz = 2402.00000 Antenna configuration = SISO
Active Port = 1

Images:



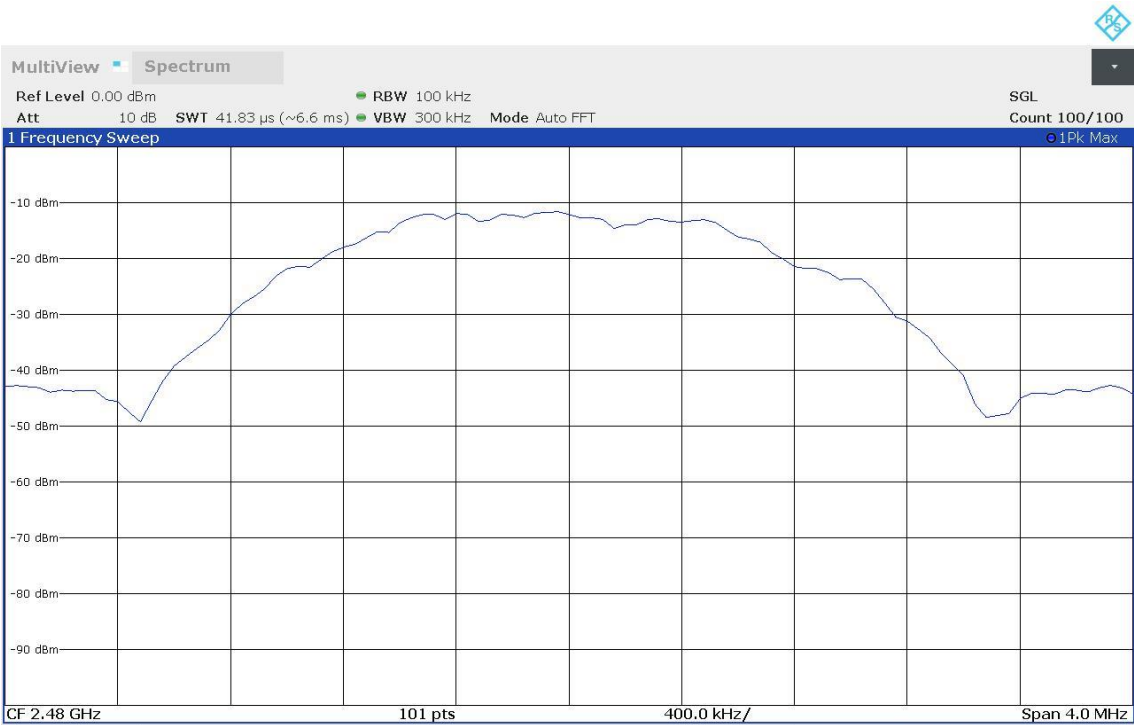
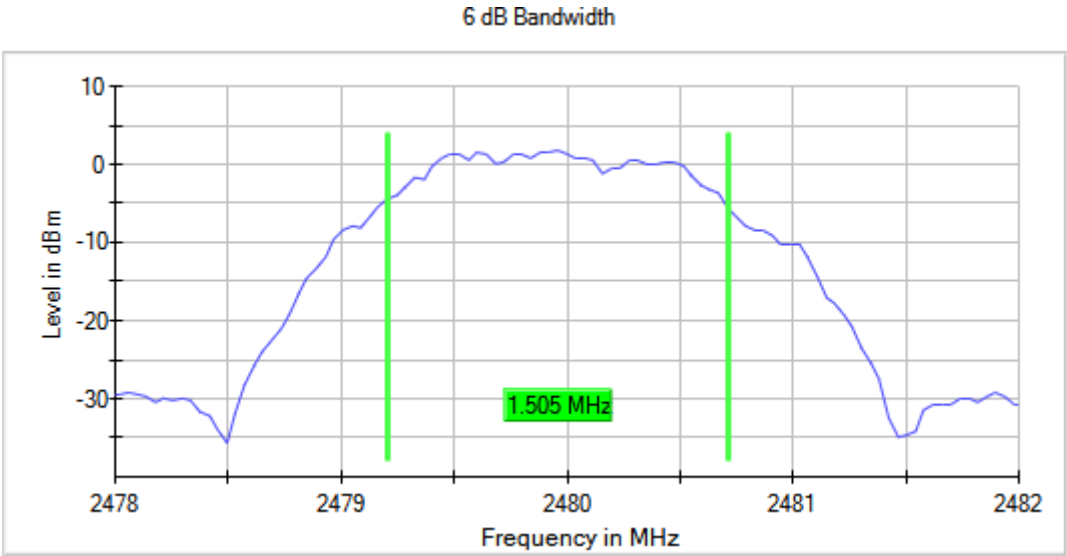
Bandwidth MHz = 2 Modulation = BTLE 5.0 (GFSK 2 Mbit/s)
Frequency MHz = 2440.00000 Antenna configuration = SISO
Active Port = 1

Images:



Bandwidth MHz = 2 Modulation = BTLE 5.0 (GFSK 2 Mbit/s)
Frequency MHz = 2480.00000 Antenna configuration = SISO
Active Port = 1

Images:



RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density

Limits

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Measured Freq (MHz)	PSD (dBm)
2402.00000	2401.94250	-4.95
2440.00000	2439.94250	-5.23
2480.00000	2479.94250	-4.70

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	Measured Freq (MHz)	PSD (dBm)
2402.00000	2401.47750	-8.34
2440.00000	2439.47250	-8.67
2480.00000	2479.47250	-8.04

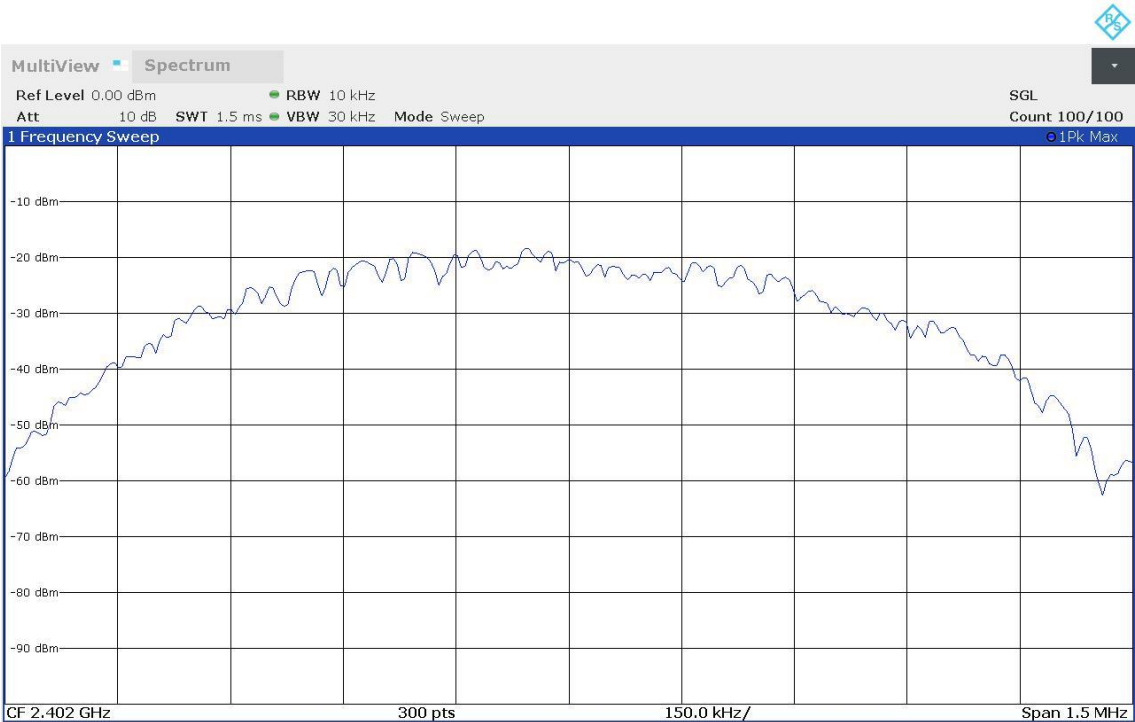
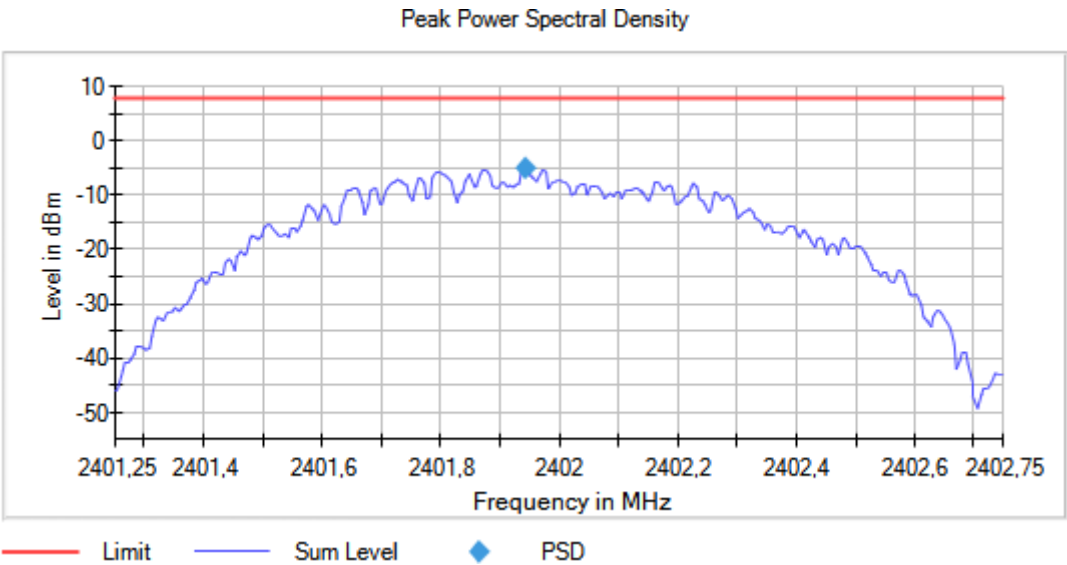
Verdict

Pass

Attachments

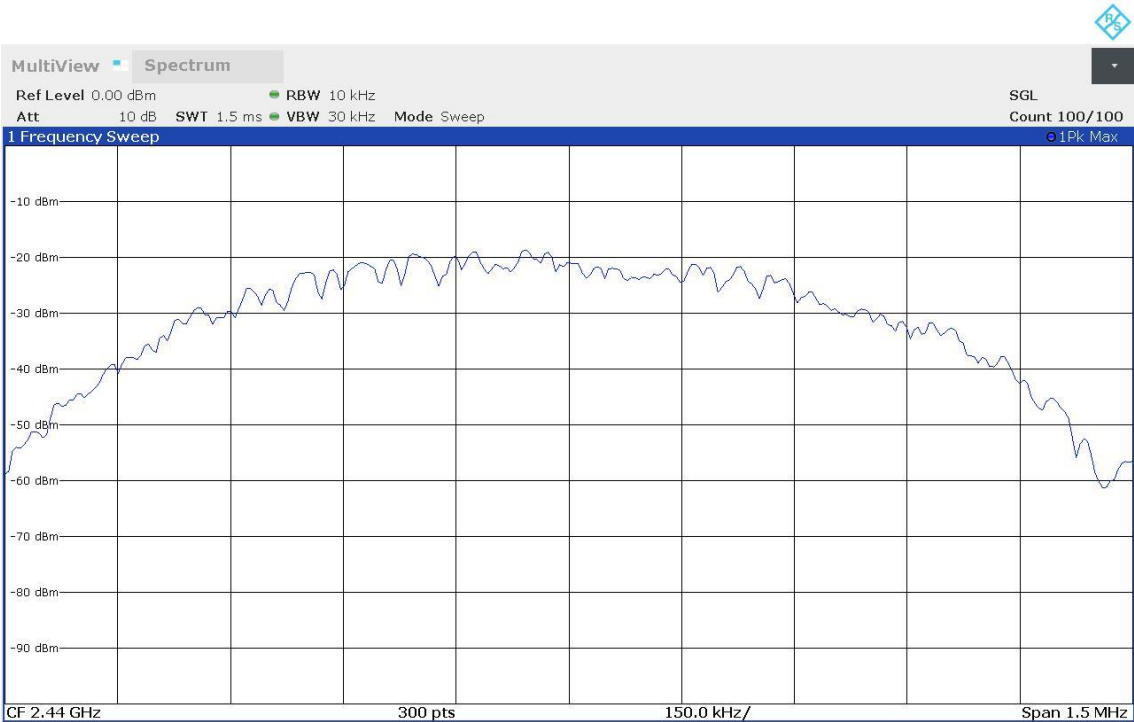
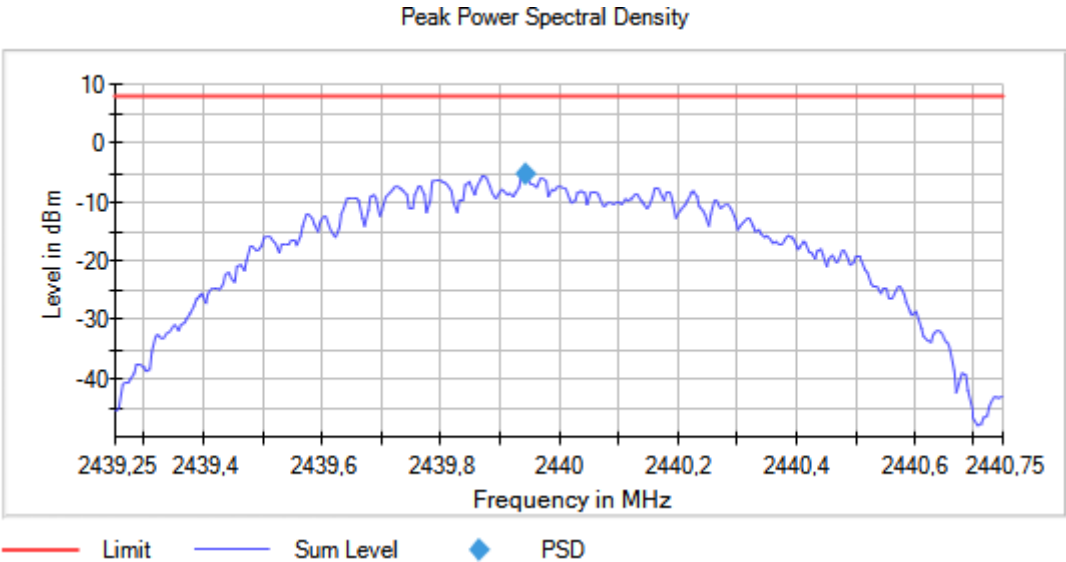
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



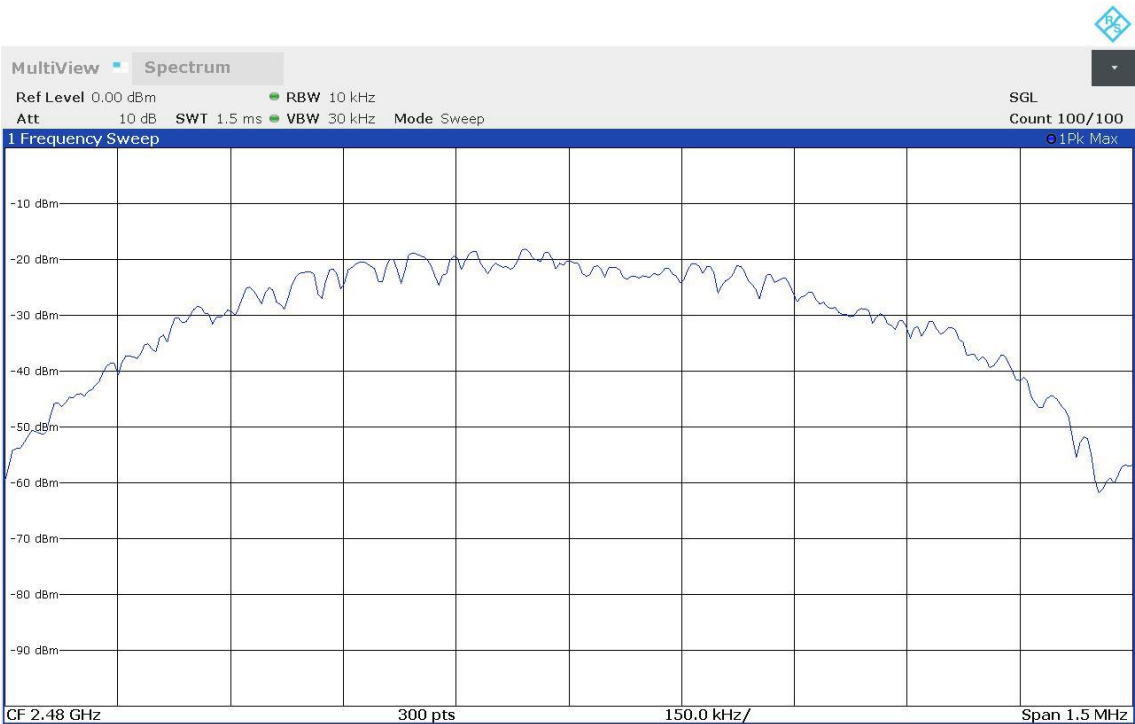
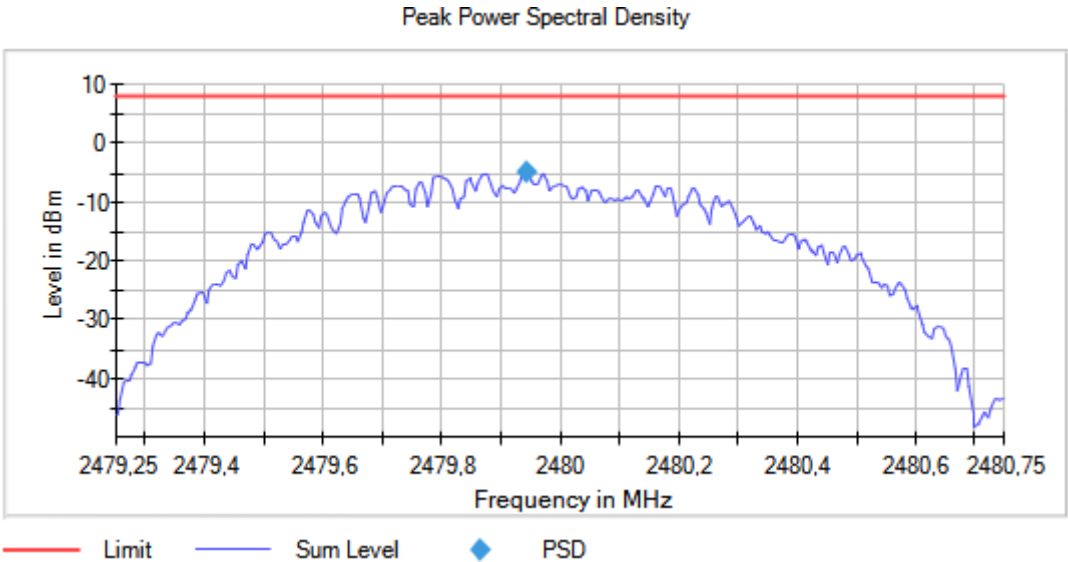
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



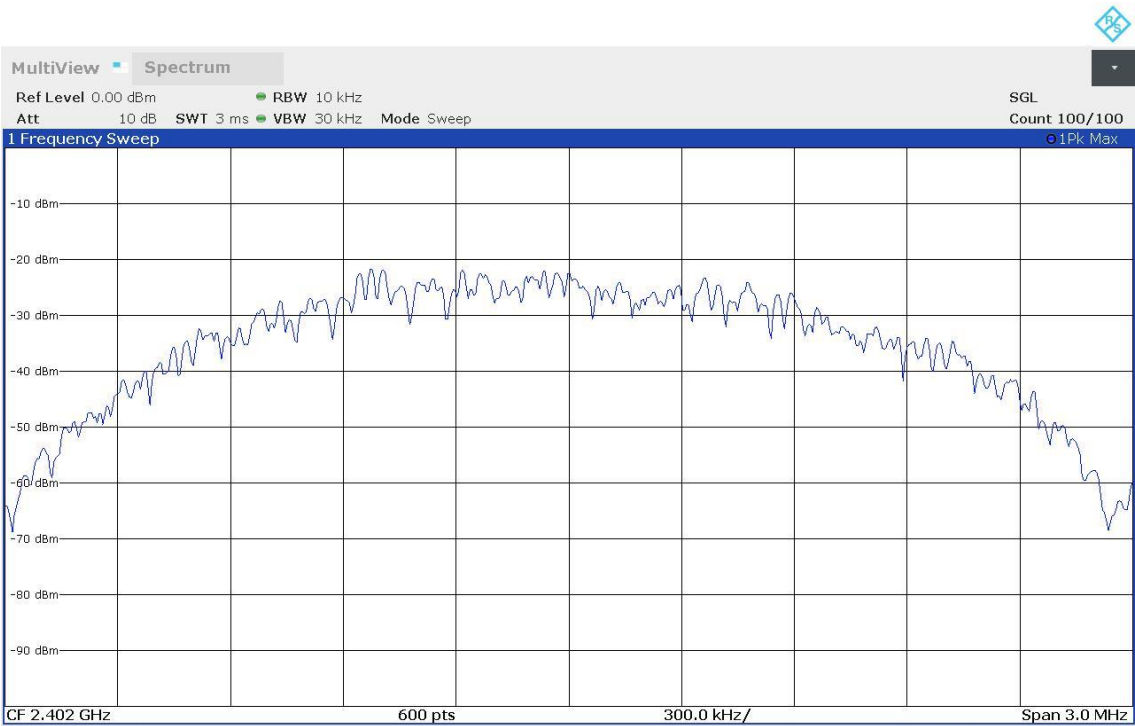
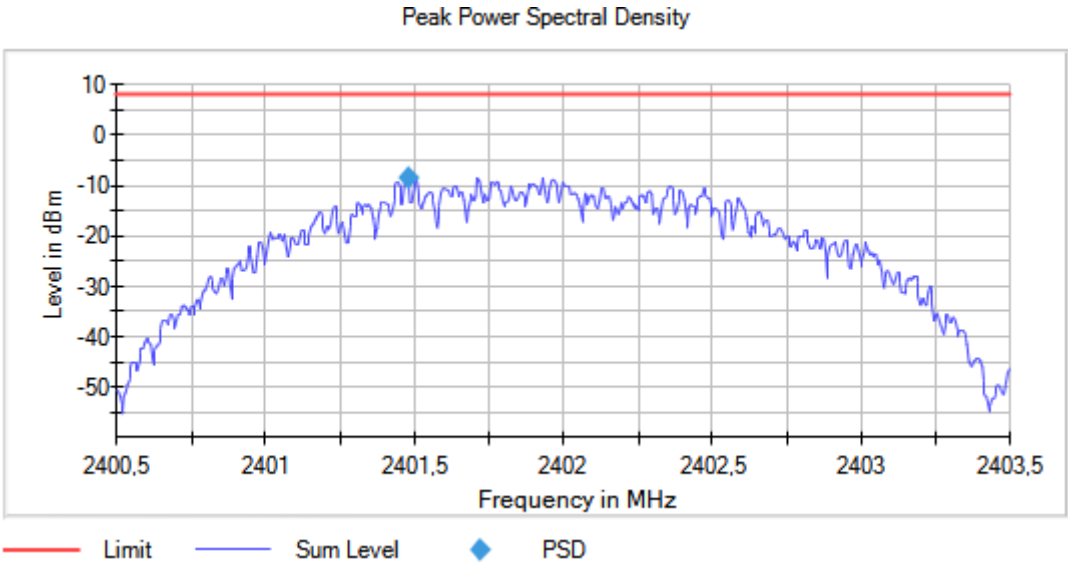
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



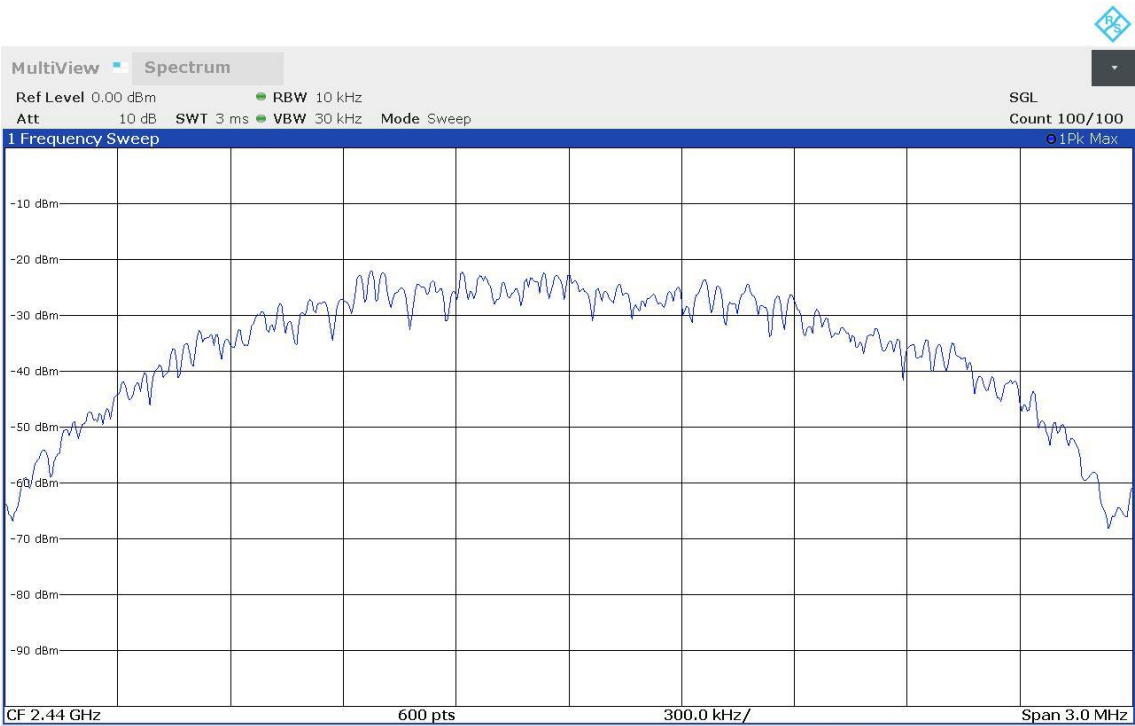
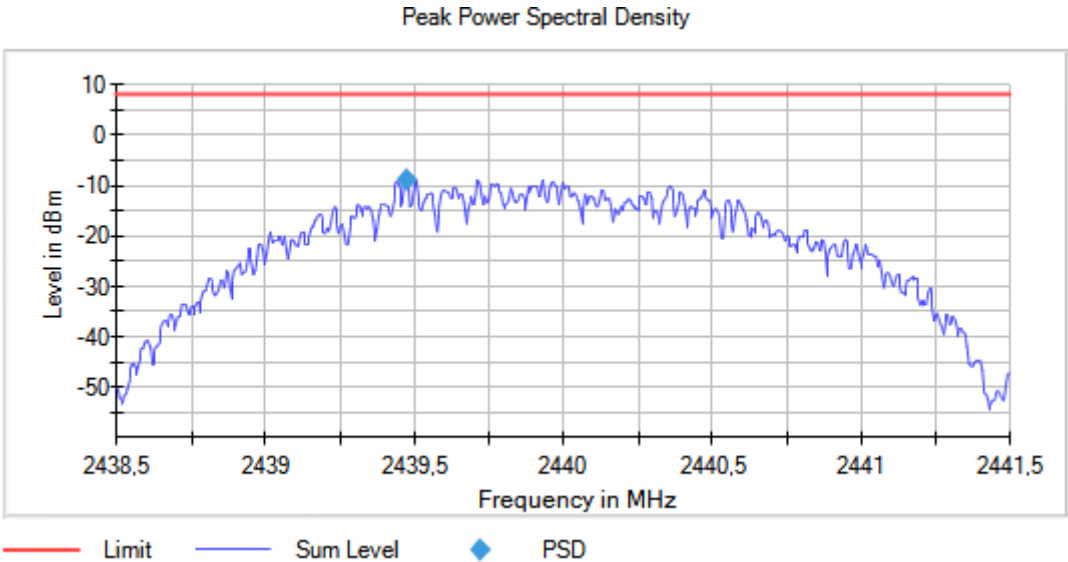
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



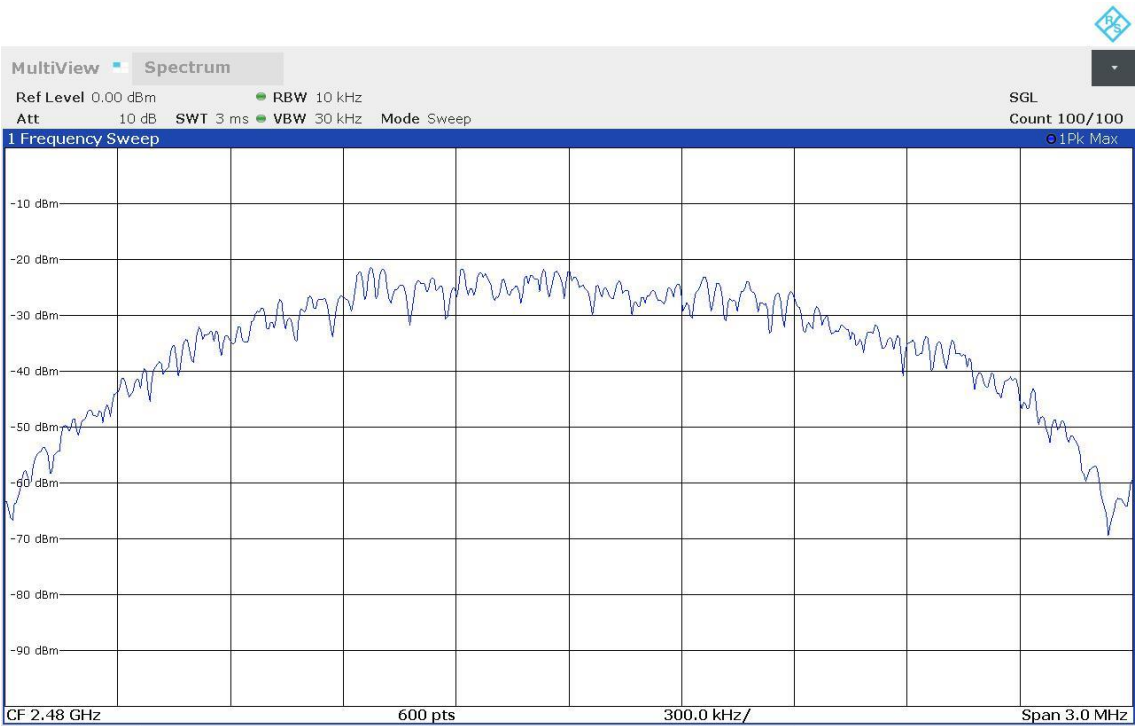
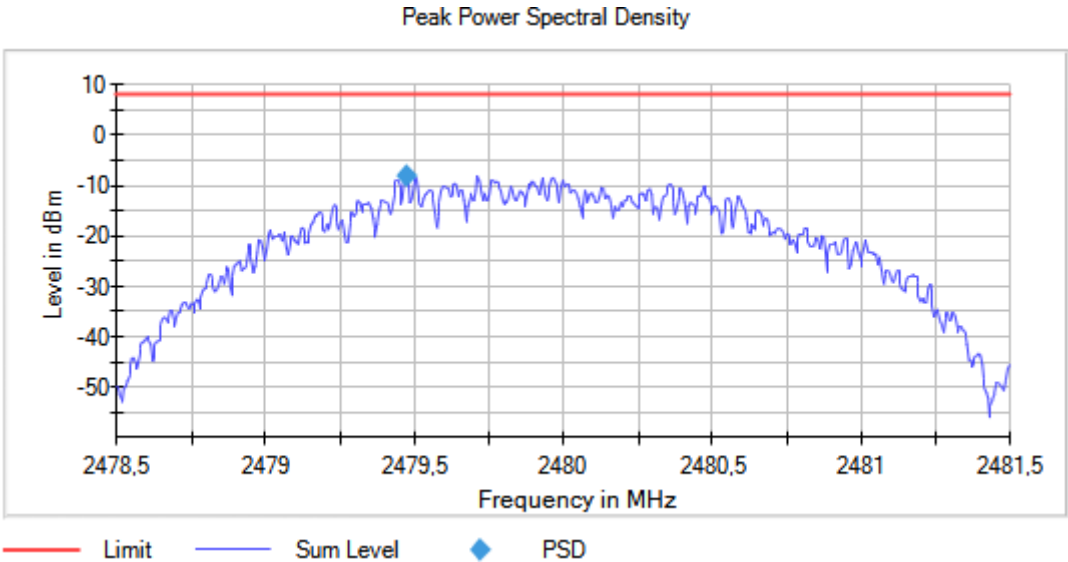
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



RSS-247 5.4 (d) / FCC 15.247 (b) (3) Maximum Peak Conducted output power

Limits

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).
The maximum peak conducted output power level in the fundamental emission was measured using the method according to point 11.9.1.1 "RBW ≥ DTS bandwidth" of ANSI C.63.10-2013.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Peak Power (dBm)	Maximum EIRP Power (dBm)
2402.00000	4.921	5.031
2440.00000	4.650	4.760
2480.00000	5.217	5.327

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	Peak Power (dBm)	Maximum EIRP Power (dBm)
2402.00000	4.962	5.072
2440.00000	4.734	4.844
2480.00000	5.268	5.378

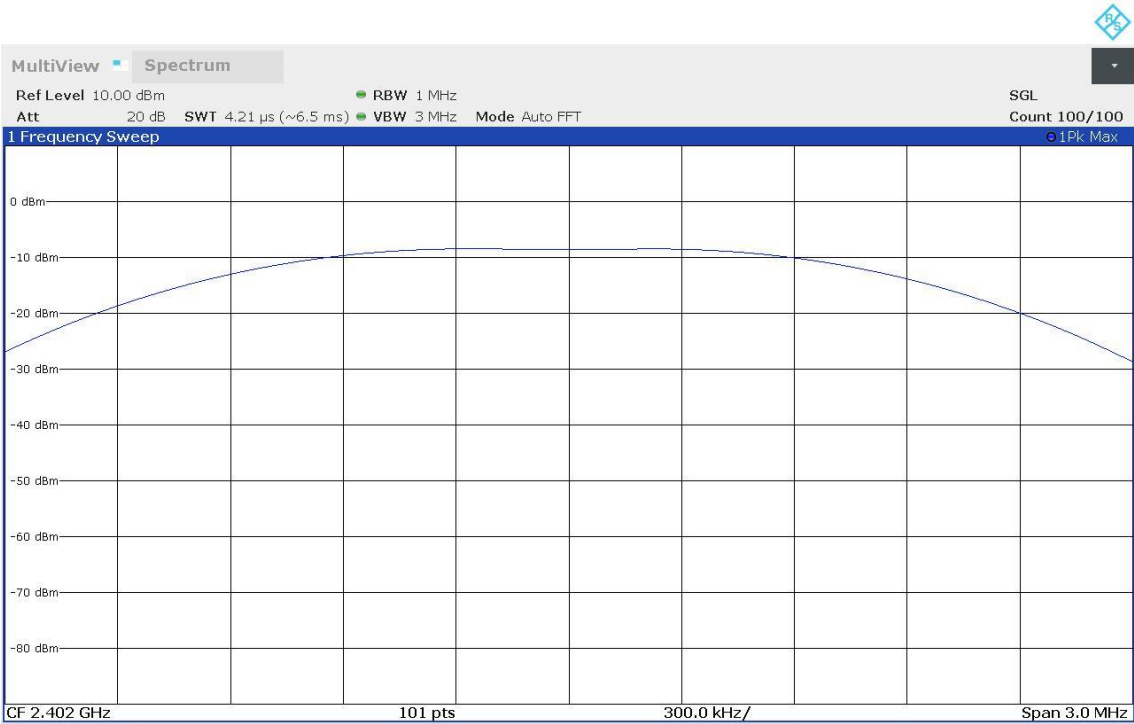
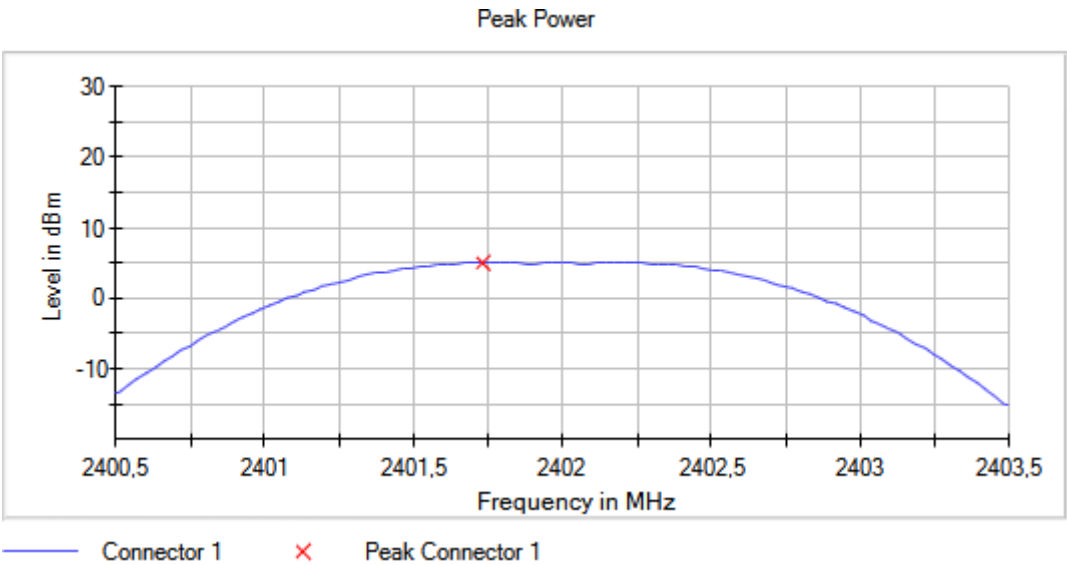
Verdict

Pass

Attachments

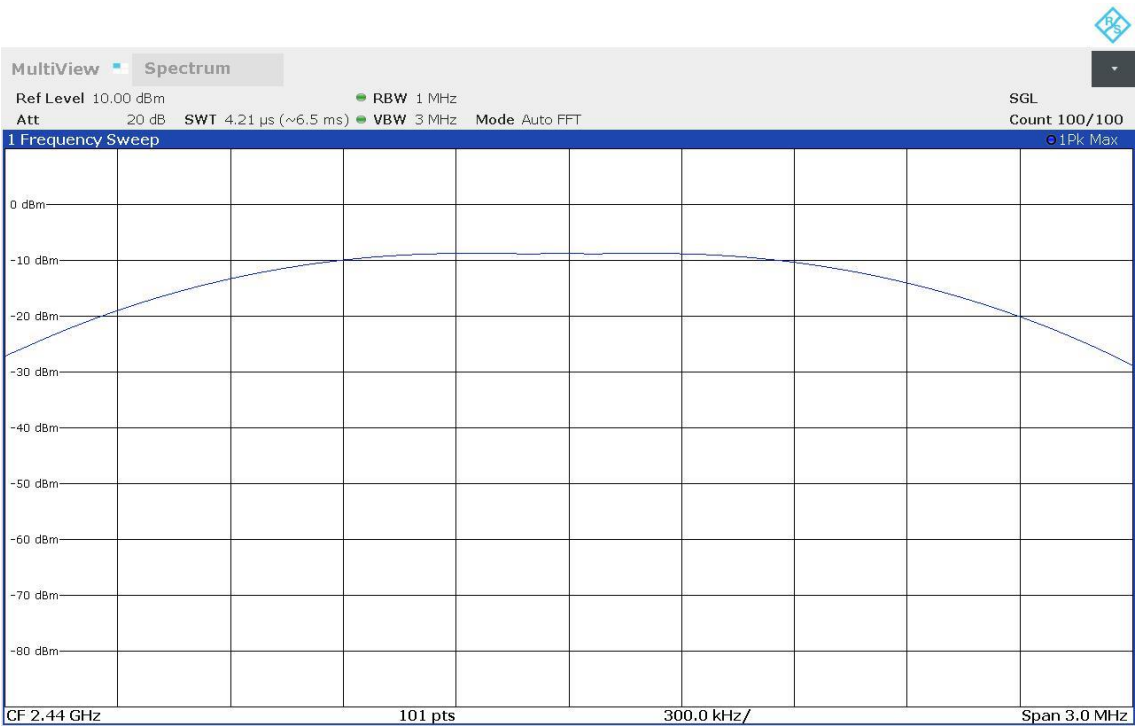
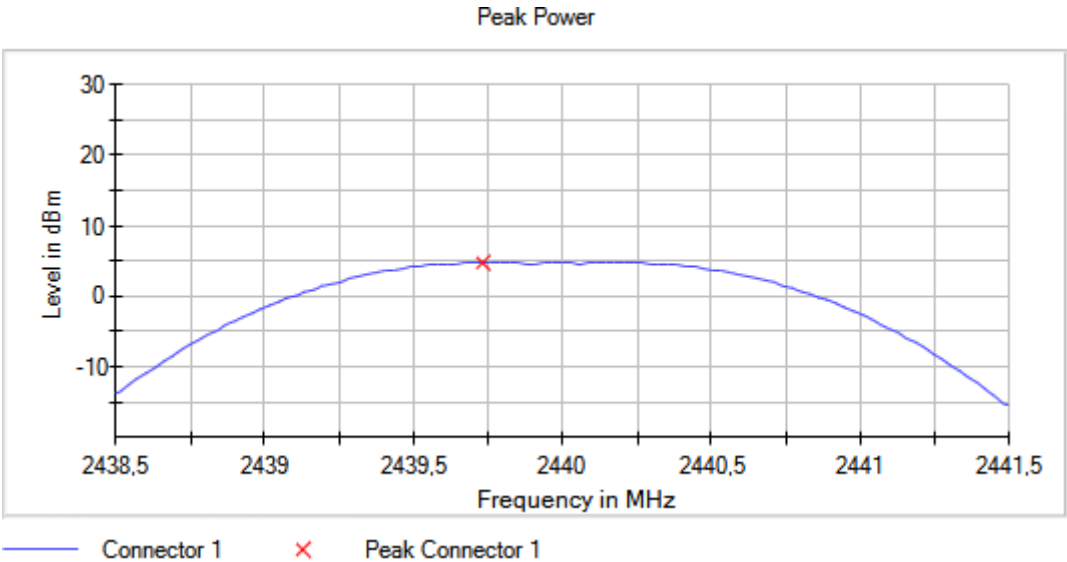
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



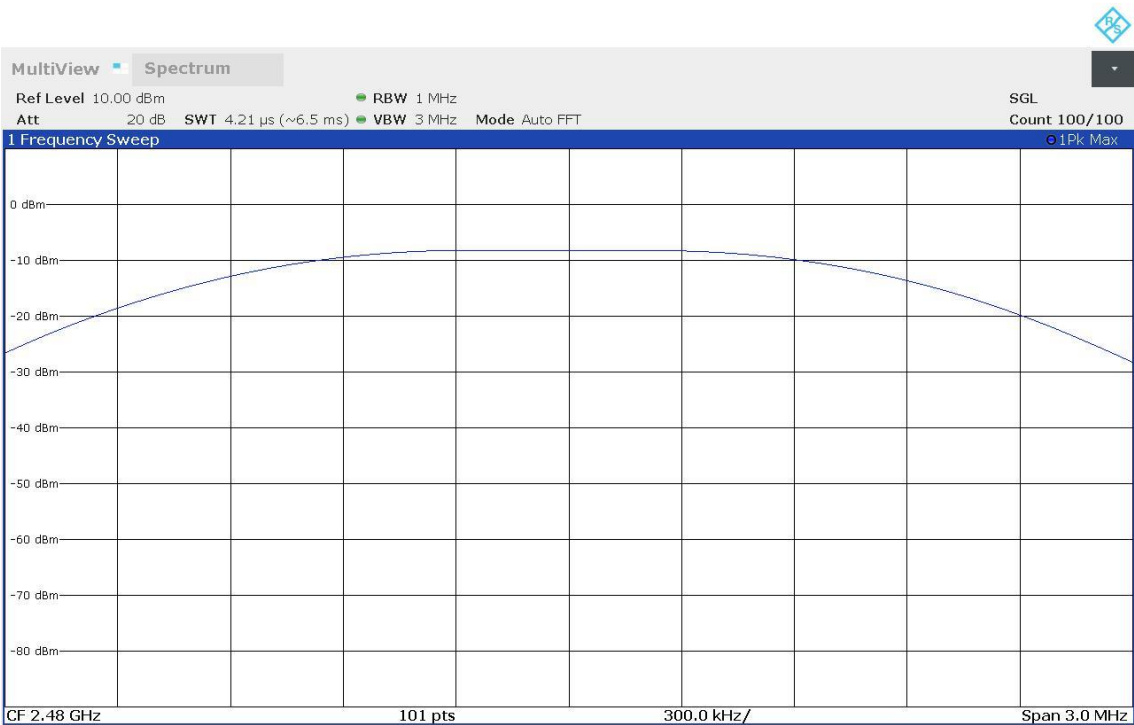
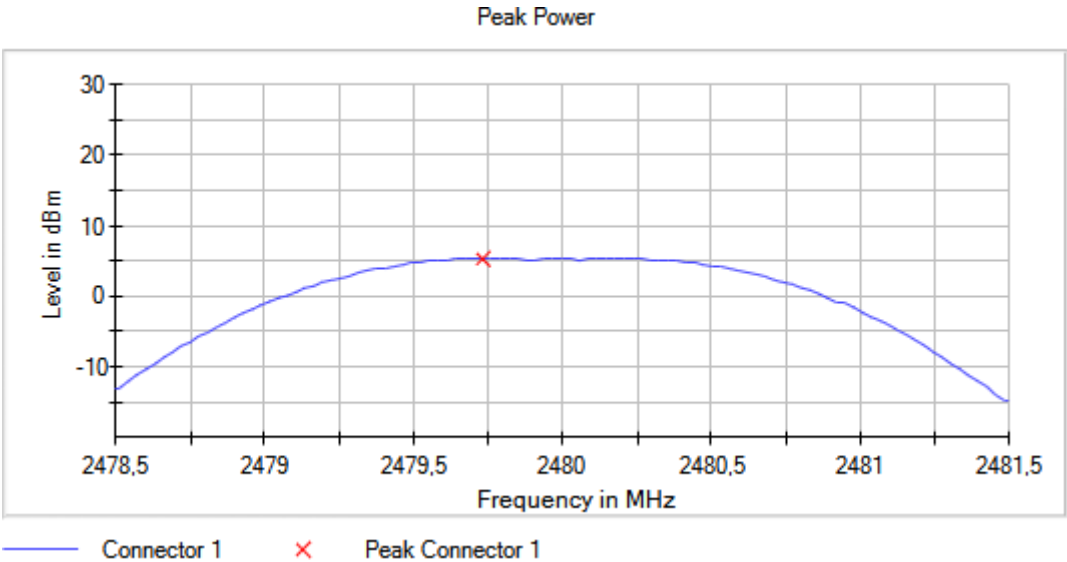
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



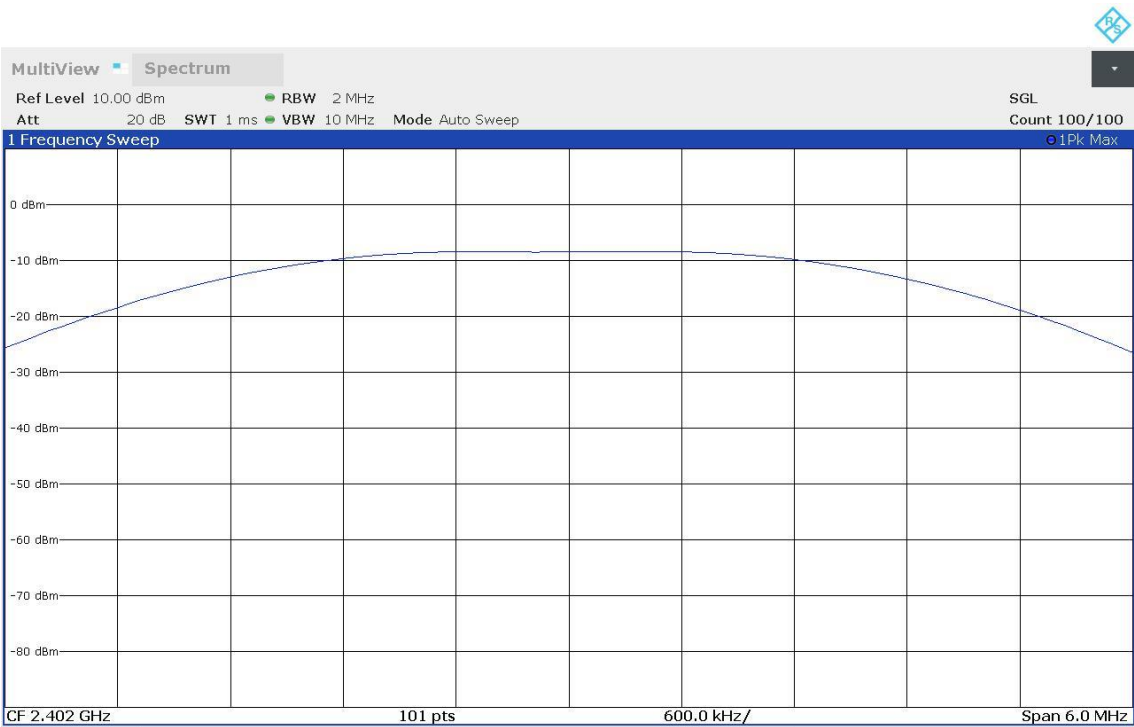
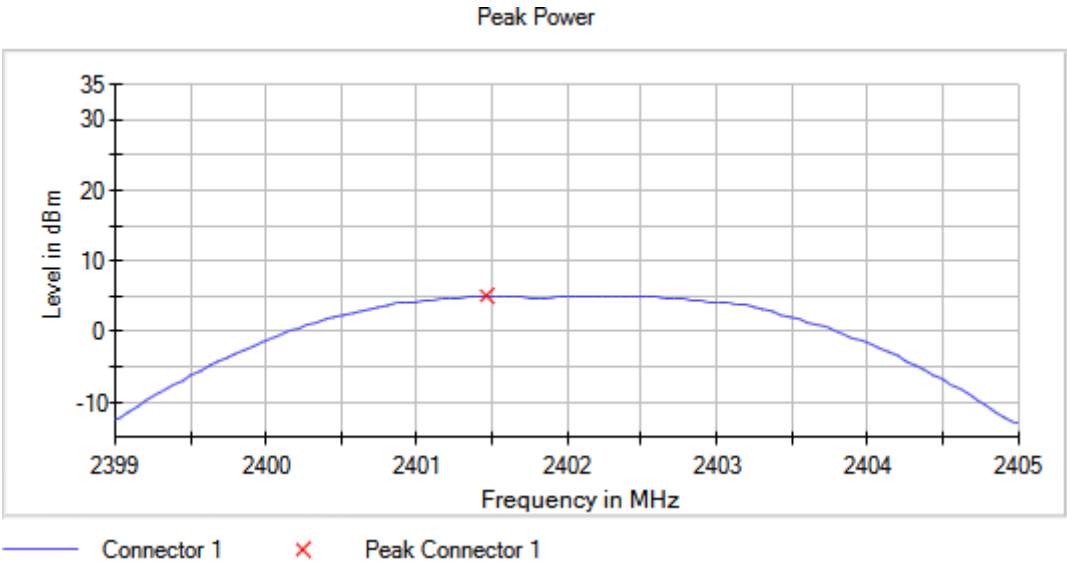
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



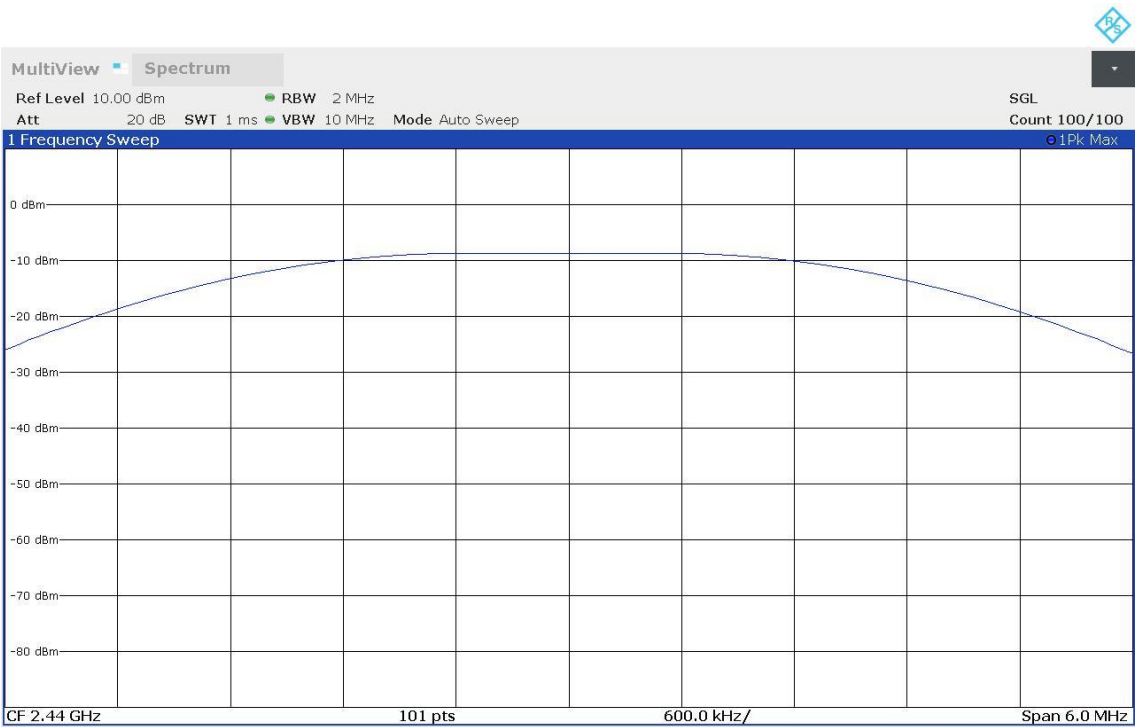
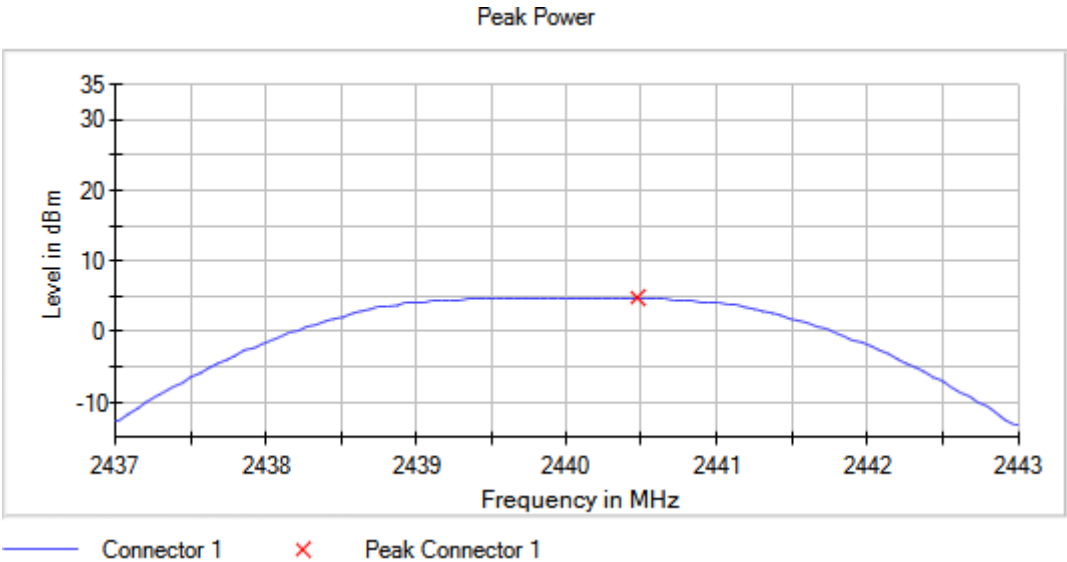
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



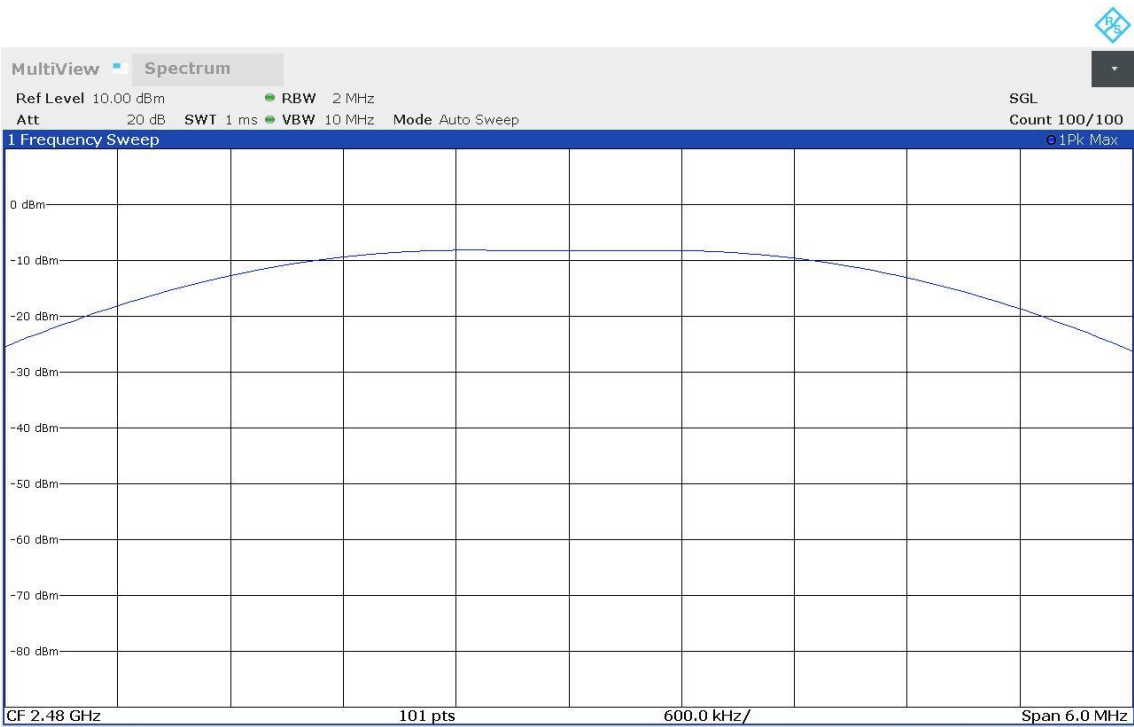
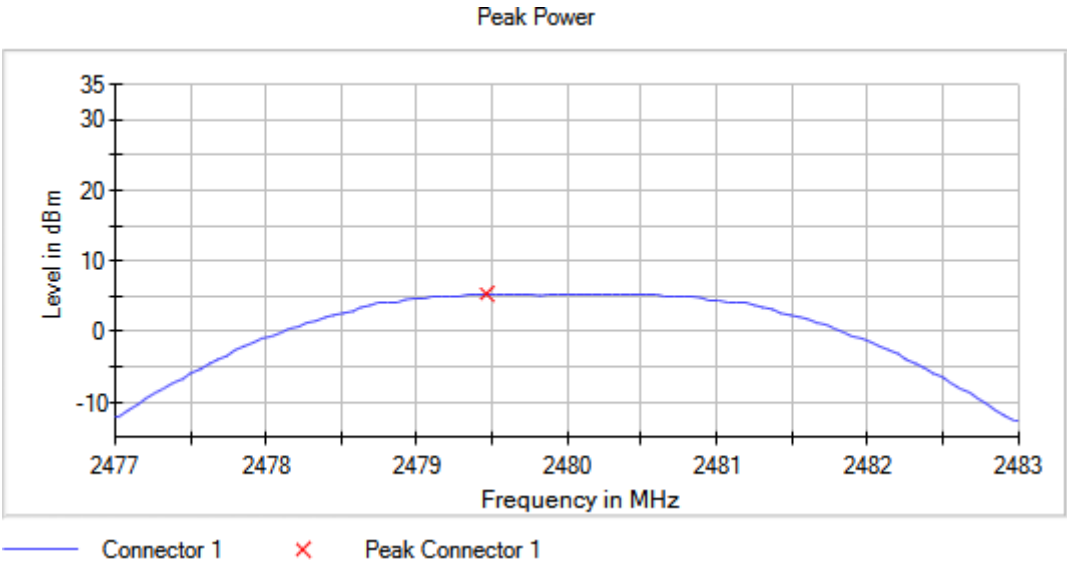
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter)

Limits

In any 100 kHz bandwidths outside the frequency band in which the 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, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Measured Freq (MHz)	Level (dBm)	Limit (dBm)
2402.00000	2399.925000	-52.809	-24.229
	2399.975000	-52.910	
	2399.875000	-53.225	
	2394.475000	-53.828	
	2394.425000	-53.985	
	2399.825000	-54.477	
	2399.775000	-54.485	
	2394.525000	-55.176	
	2399.525000	-55.308	
	2399.725000	-55.491	
	2399.375000	-55.613	
	2399.475000	-55.643	
	2399.425000	-55.690	
	2399.225000	-55.691	
	2393.475000	-55.827	

Freq (MHz)	Measured Freq (MHz)	Level (dBm)	Limit (dBm)
2480.00000	2487.475000	-53.778	-14.043
	2487.525000	-53.978	
	2487.425000	-54.647	
	2488.475000	-55.174	
	2487.575000	-55.284	
	2488.525000	-55.431	
	2487.375000	-56.098	
	2488.425000	-56.218	
	2488.375000	-56.578	
	2487.975000	-56.593	
	2487.625000	-56.718	
	2488.575000	-57.246	
	2487.925000	-57.318	
	2487.875000	-57.870	
	2487.825000	-57.873	

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	Measured Freq (MHz)	Level (dBm)	Limit (dBm)
2402.00000	2399.975000	-26.158	-14.261
	2399.925000	-26.753	
	2399.875000	-29.429	
	2399.825000	-32.232	
	2399.775000	-34.901	
	2399.725000	-35.125	
	2399.675000	-38.424	
	2399.625000	-40.843	
	2399.575000	-42.128	
	2399.475000	-45.437	
	2399.525000	-45.609	
	2399.425000	-46.108	
	2399.375000	-48.718	
	2399.325000	-50.611	
	2399.125000	-51.547	

Freq (MHz)	Measured Freq (MHz)	Level (dBm)	Limit (dBm)
2480.00000	2486.975000	-52.492	-13.917
	2487.025000	-52.620	
	2486.925000	-52.833	
	2487.075000	-54.053	
	2488.975000	-54.529	
	2486.875000	-54.894	
	2489.025000	-55.013	
	2488.925000	-55.161	
	2494.975000	-55.166	
	2495.025000	-55.169	
	2487.175000	-55.458	
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	2487.225000	-55.952	
	2483.525000	-55.994	

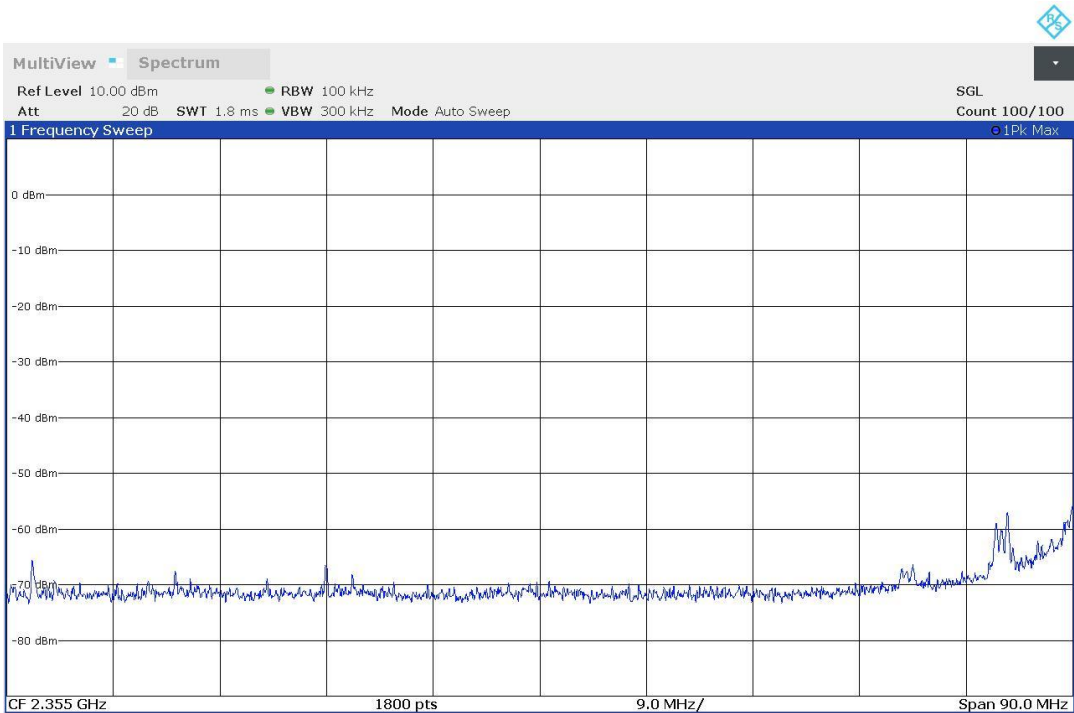
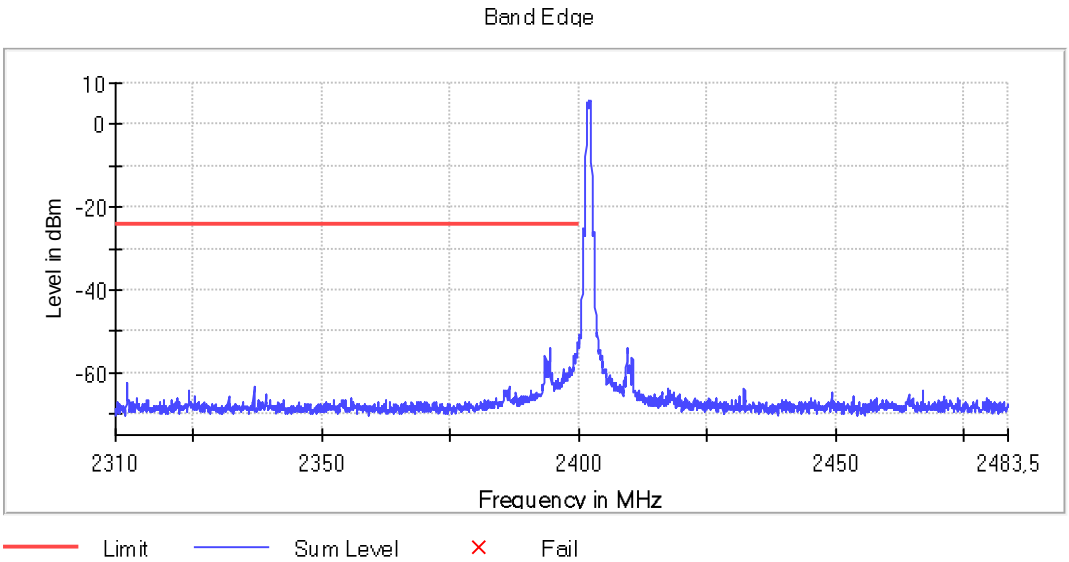
Verdict

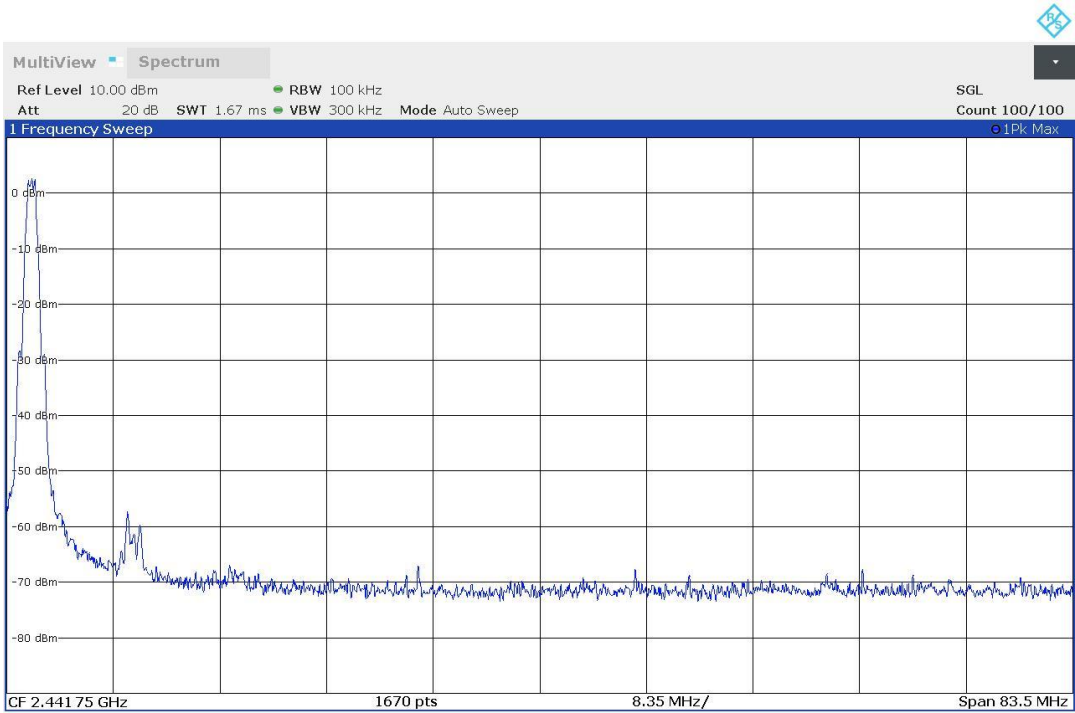
Pass

Attachments

Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

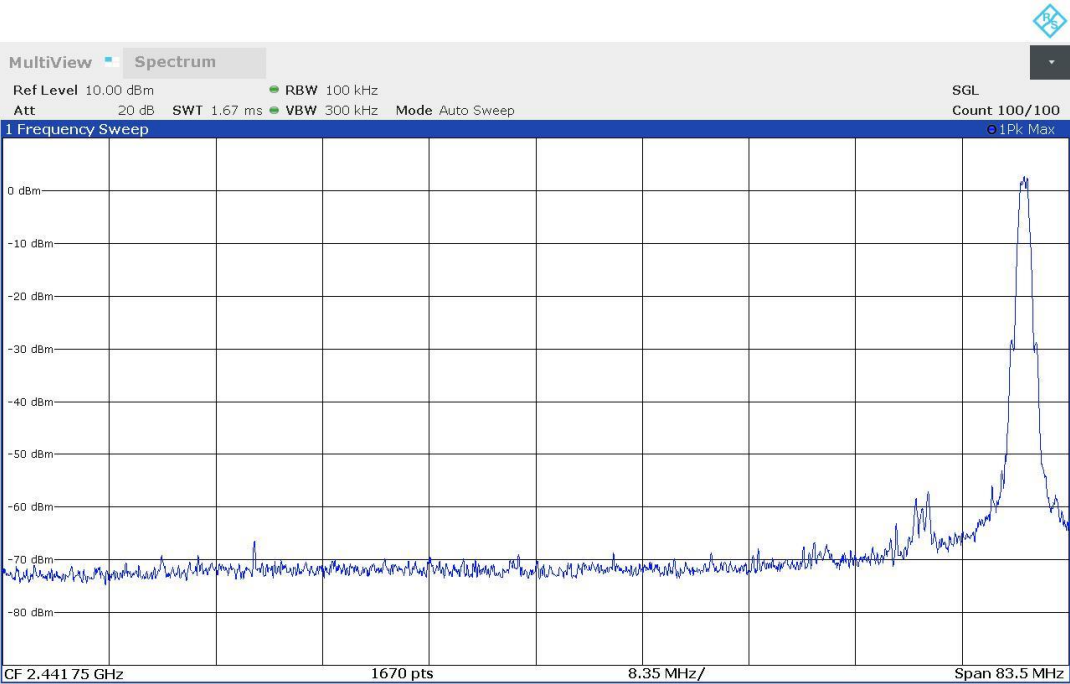
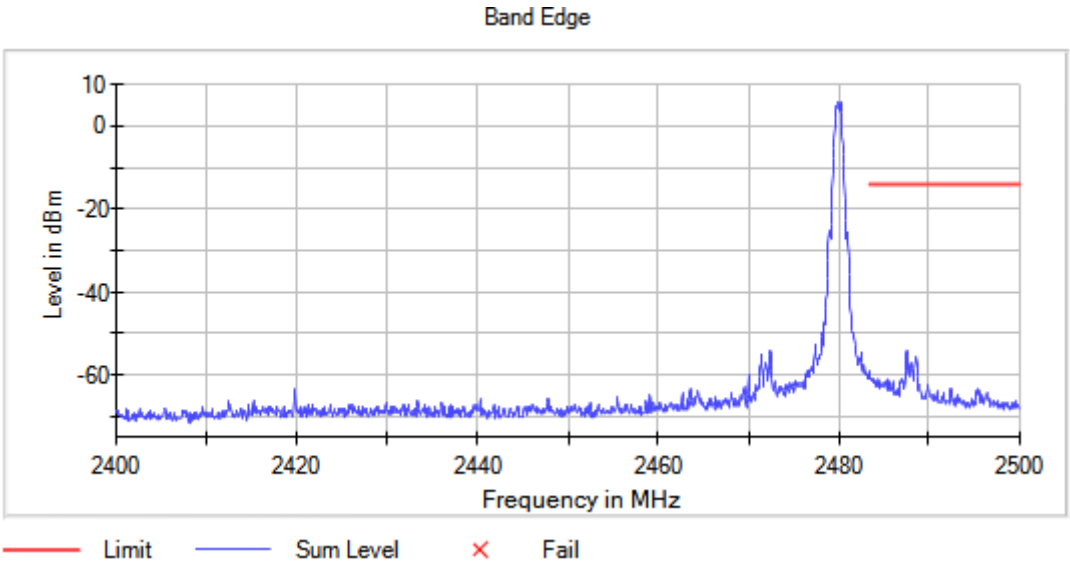
Images:

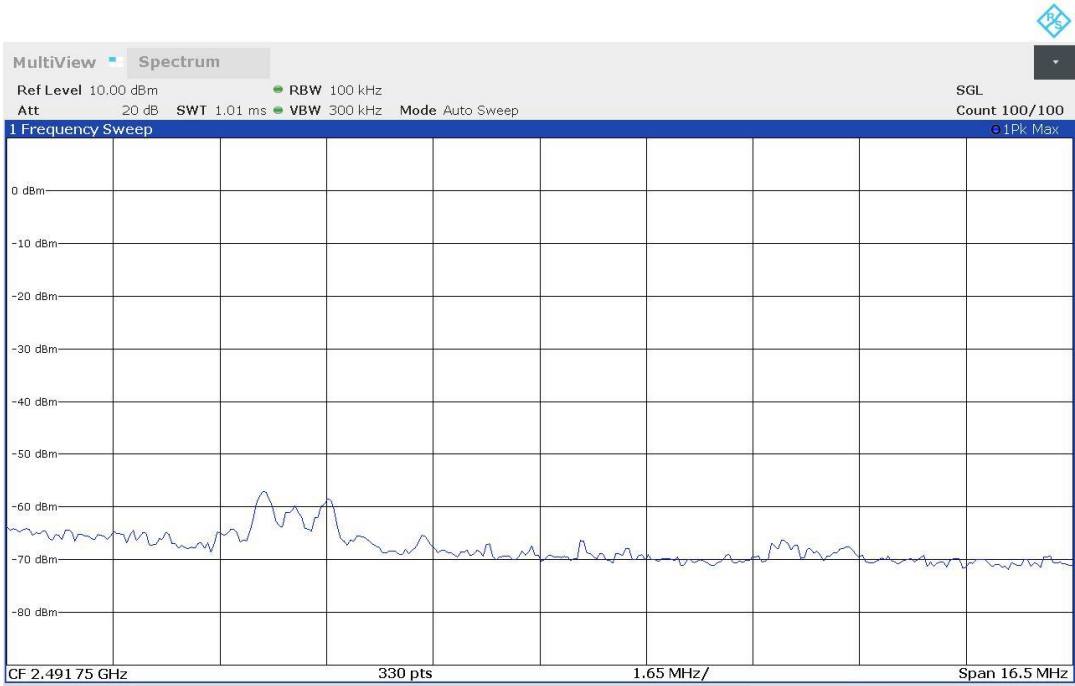




Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

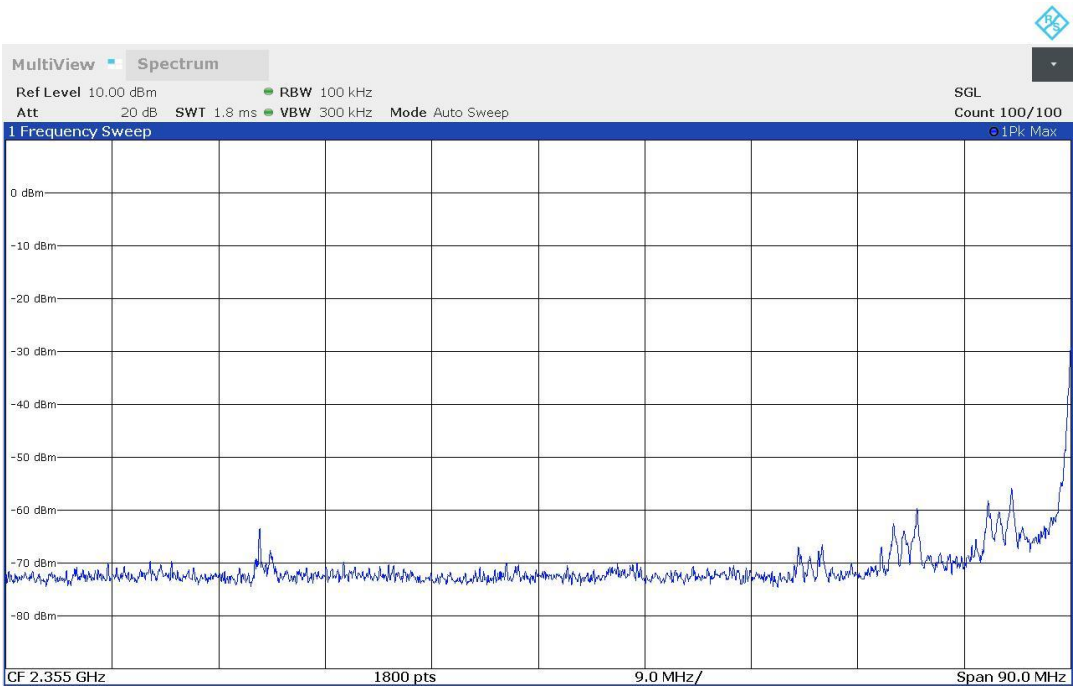
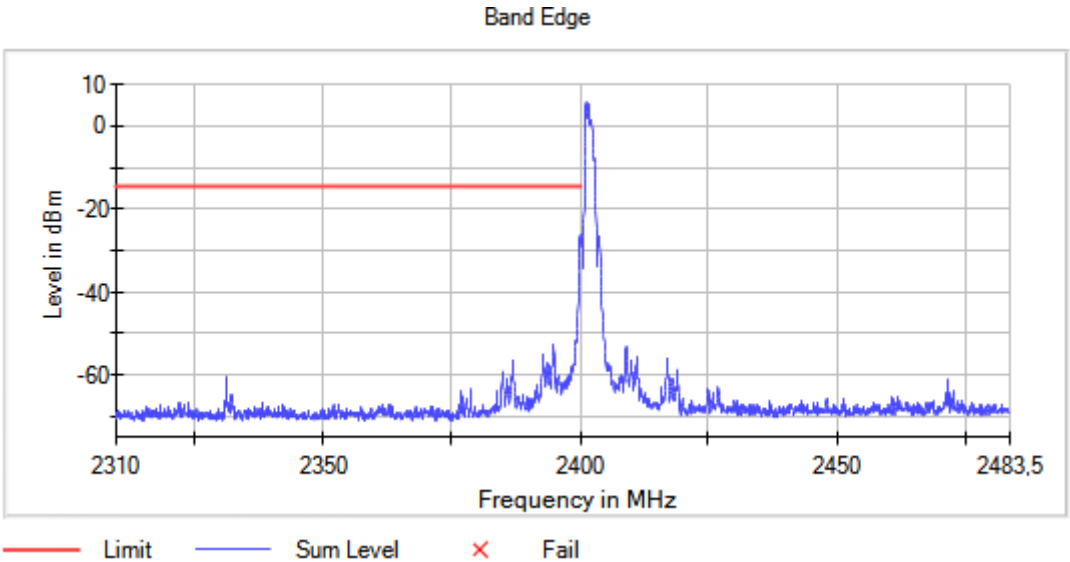
Images:

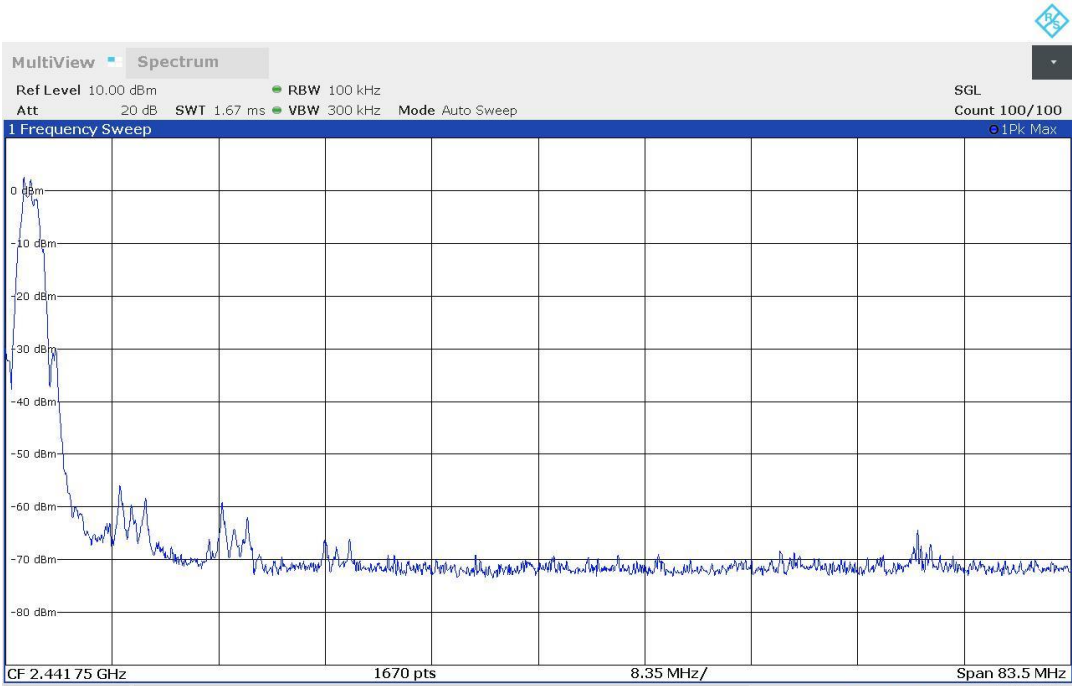




Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

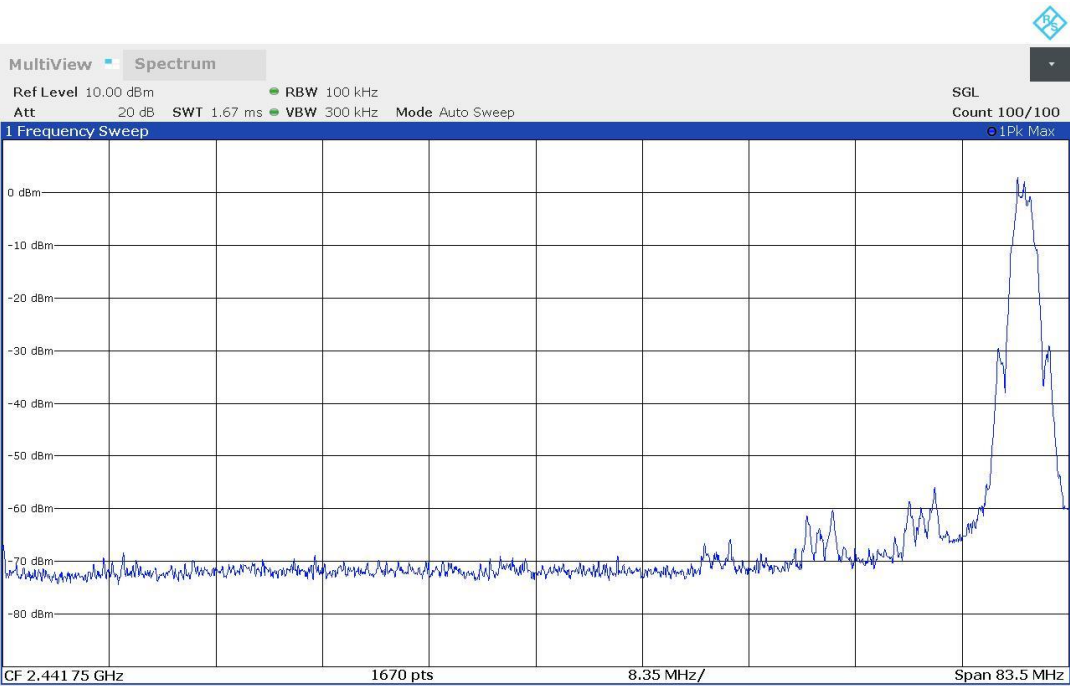
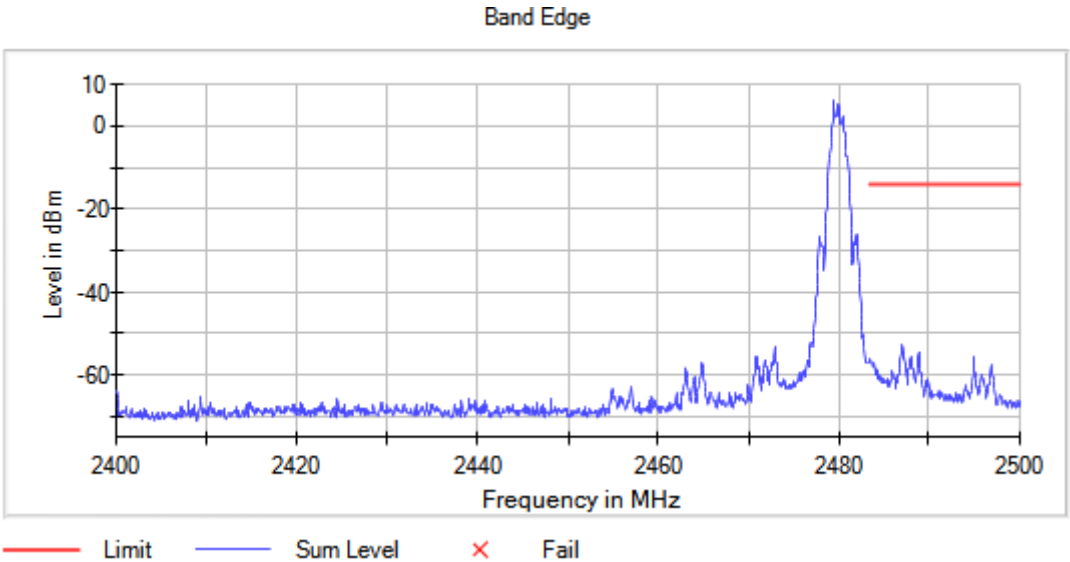
Images:

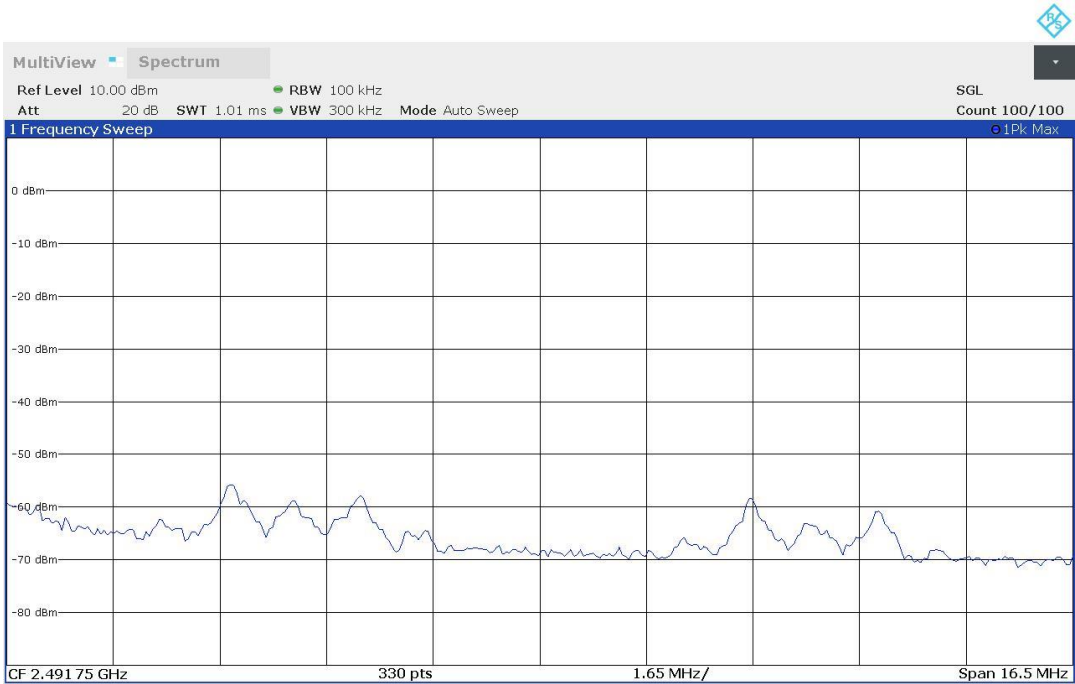




Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:





RSS-247 5.5 / FCC 15.247 (d) Emission limitations radiated (Transmitter)

Limits

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)/RSS-Gen):

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
Above 960	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RSS-247: Attenuation below the general field strength limits specified in RSS-Gen is not required.

Frequency range tested for Radiated emissions:

Start frequency: no radiofrequency signal generated in the device found below 10th sub-harmonic, no further investigation required.

Stop frequency: it has been performed the radiated spurious emissions until 10th harmonic.

Results

Modulation: The spurious frequencies detected do not depend on either the modulation or the operating channel.

Freq Rng (GHz)	Equipment	Freq (MHz)	Port	Unwanted Freq (MHz)	Unwanted Lvl (dBµV/m)	Pol	Detector
[0.03, 1]	Digital Transmission System (DTS)	2402.00000	1	213.815	31.76	H	PK
					26.14	H	QP
				374.981	38.50	H	PK
					34.27	H	QP
				399.958	34.72	H	PK
					30.38	H	QP
				424.984	35.98	V	PK
					33.33	V	QP
				875.015	37.77	V	PK
					32.50	V	QP
				941.364	35.00	H	PK
					25.99	H	QP

Verdict

Pass

Attachments

Frequency Range GHz = [0.03, 1]

Equipment Type = Frequency Hopping Spread Spectrum systems (DSS)

Modulation = The spurious frequencies detected do not depend on the modulation.

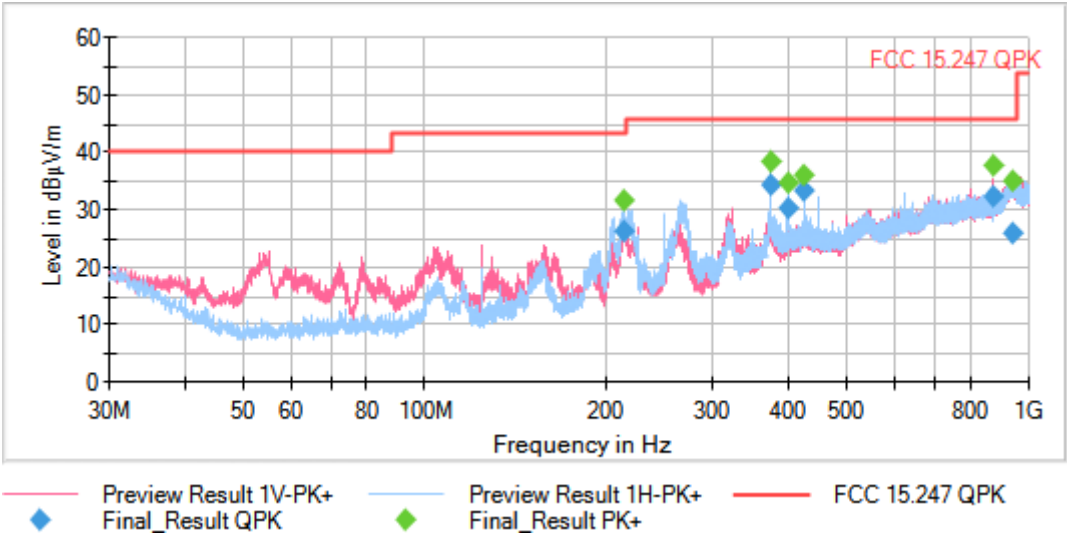
Frequency MHz = The spurious frequencies detected do not depend on the operating channel.

Antenna configuration: SISO

Active Port = 1

Images:

Test range performed in worst-case.



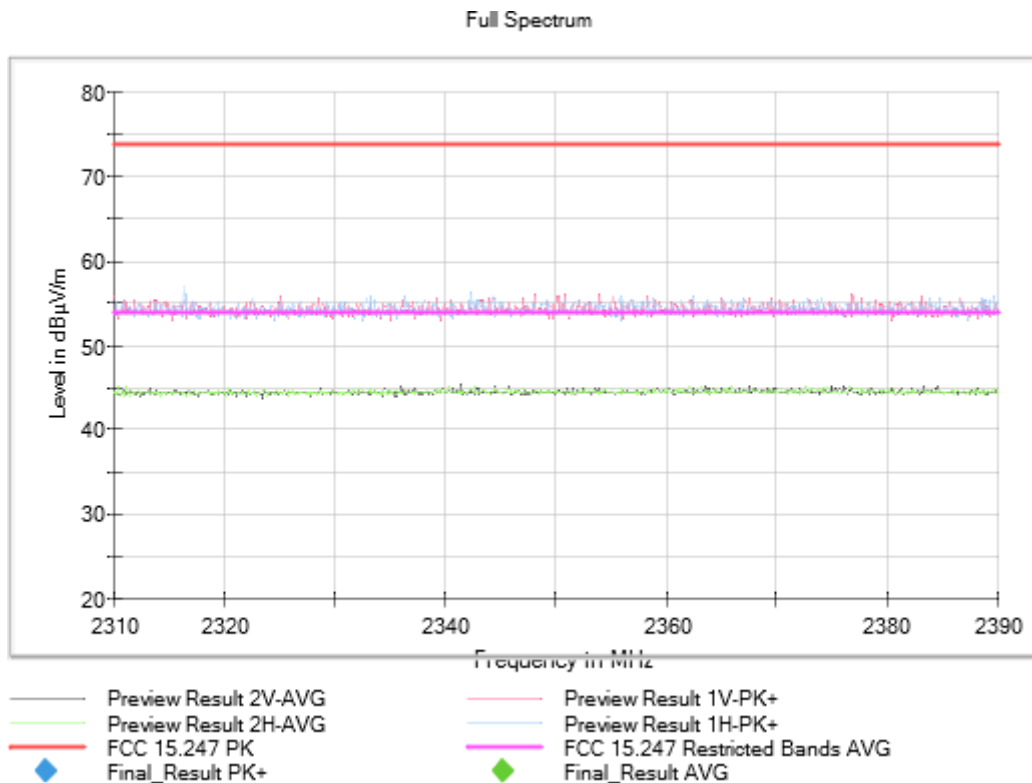
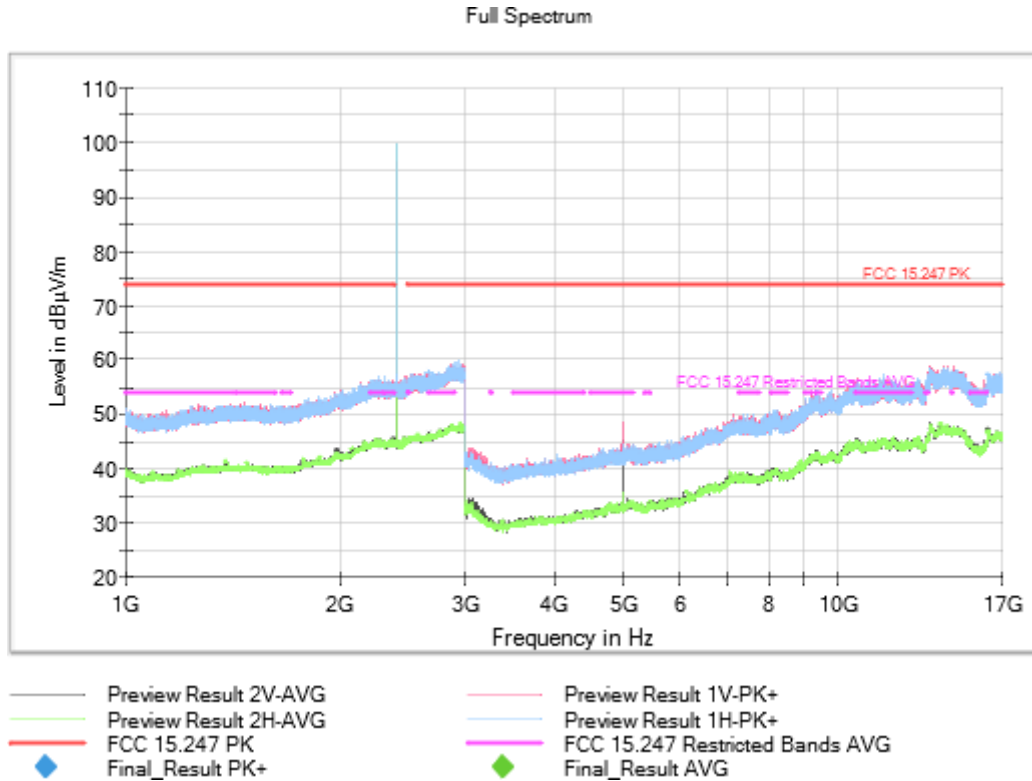
Tables:

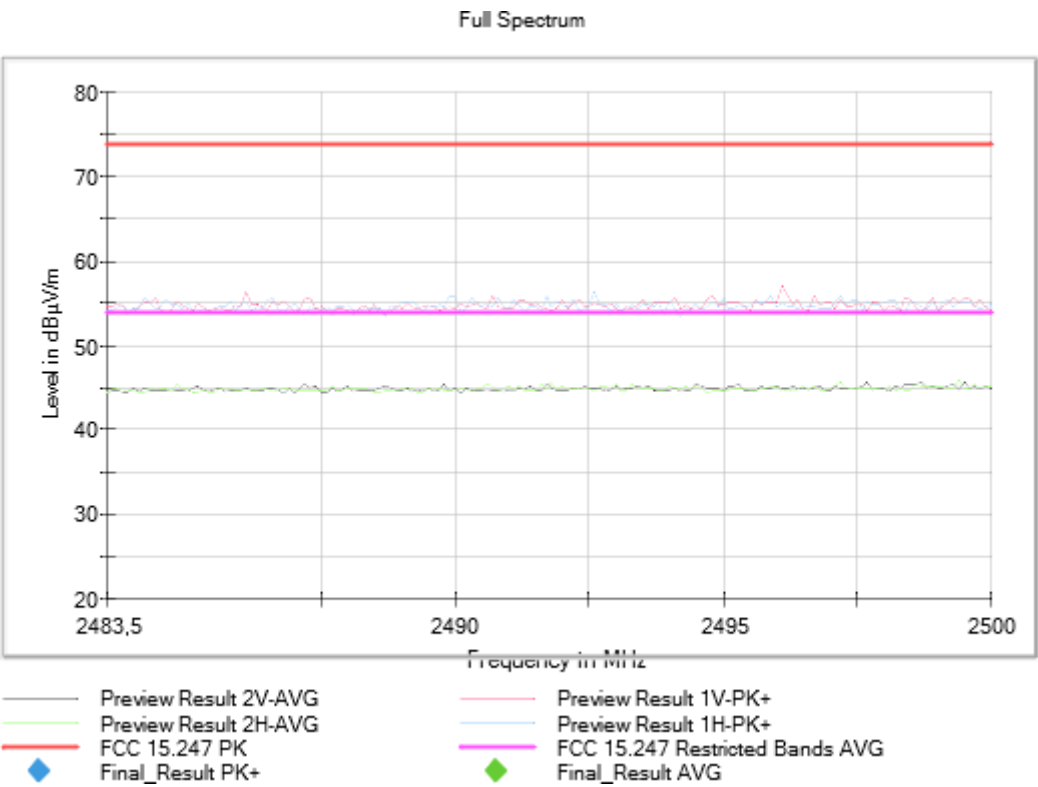
Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	20 dB

Frequency Range GHz = [1, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:





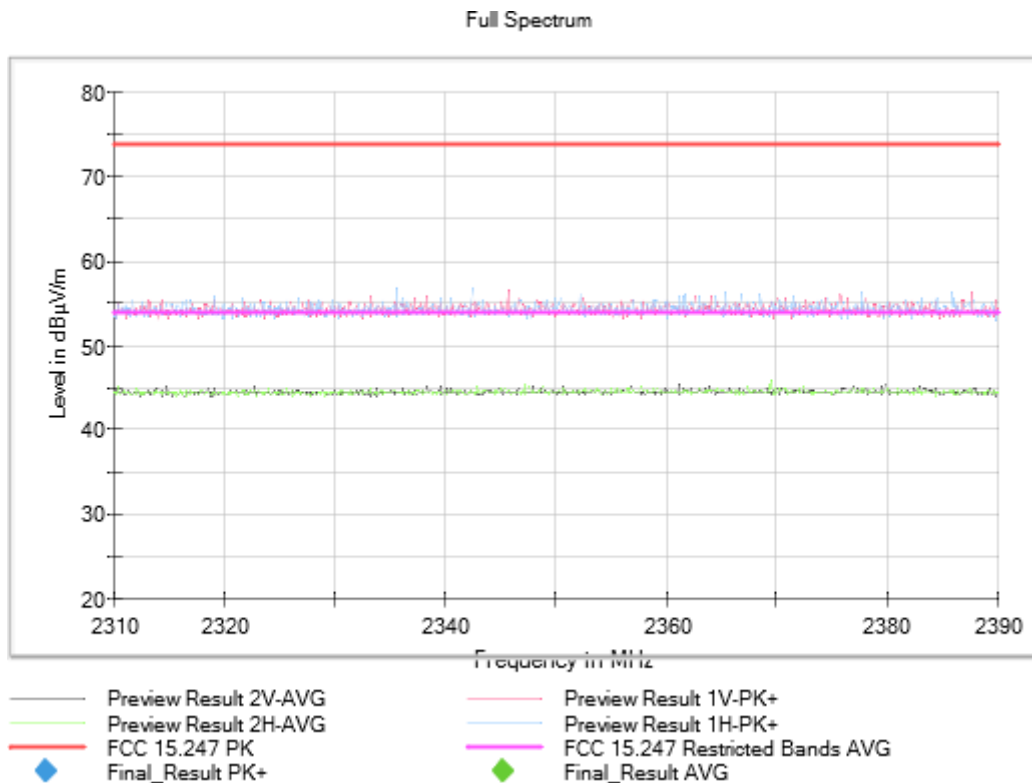
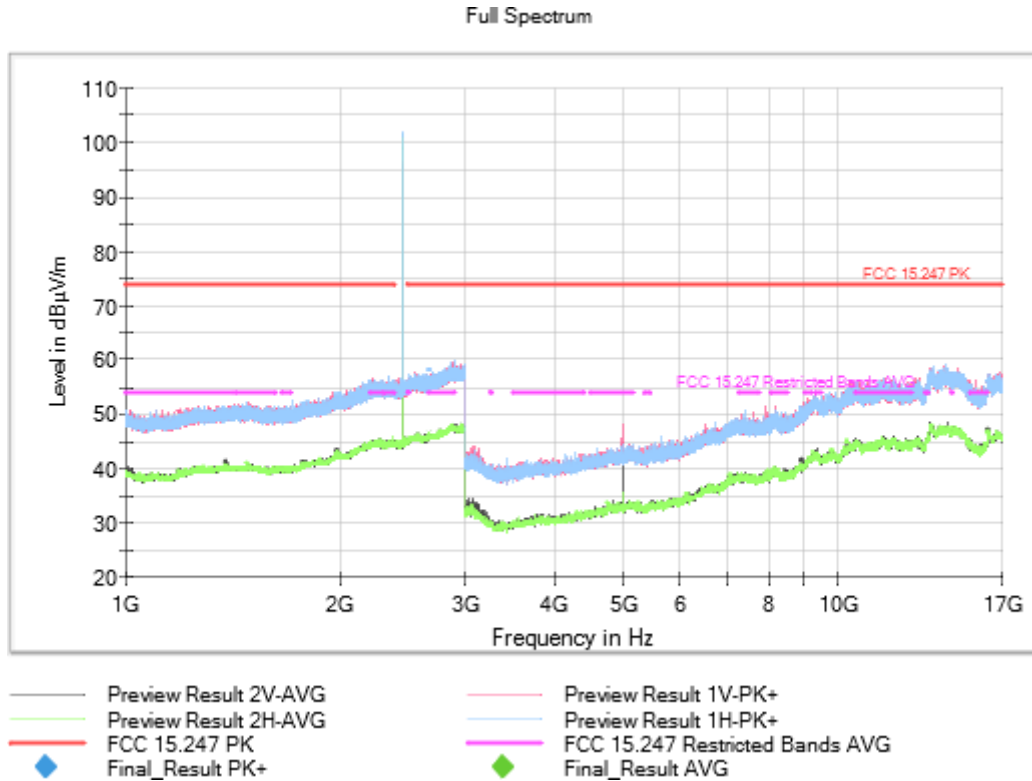
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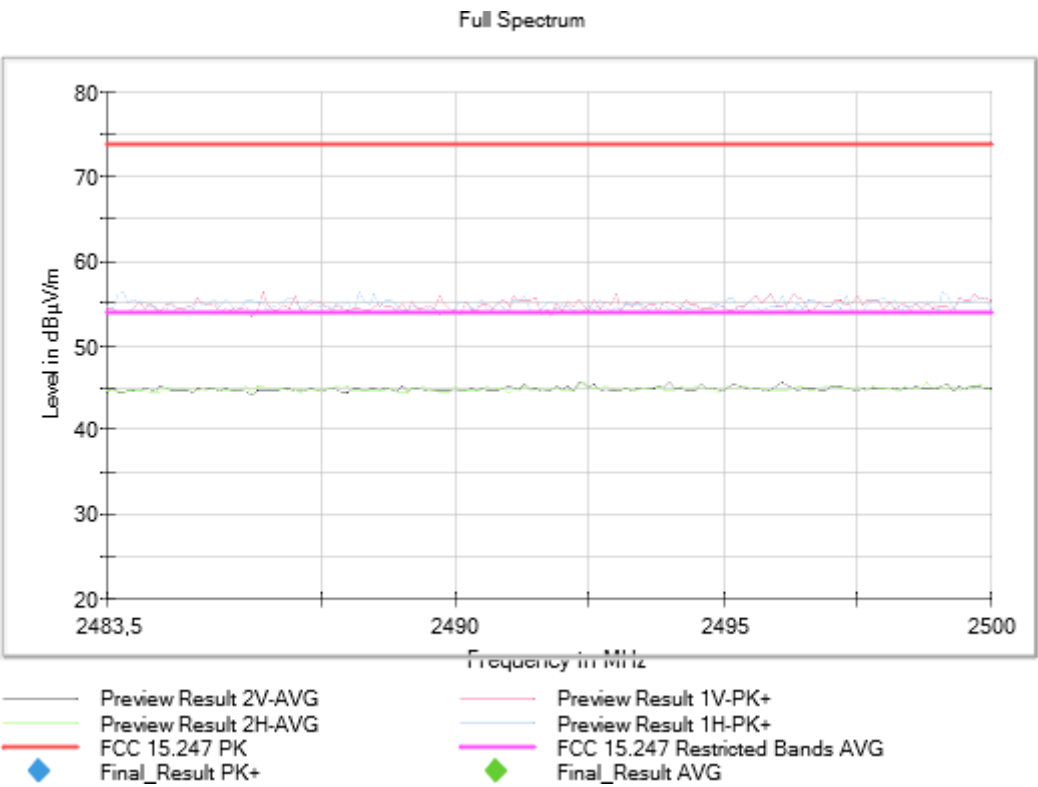
Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 2,39 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
2,39 GHz - 2,484 GHz	40 kHz	PK+	100 kHz	0,01 s	0 dB
2,484 GHz - 3 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
3 GHz - 17 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB

Frequency Range GHz = [1, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE (GFSK 1 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:





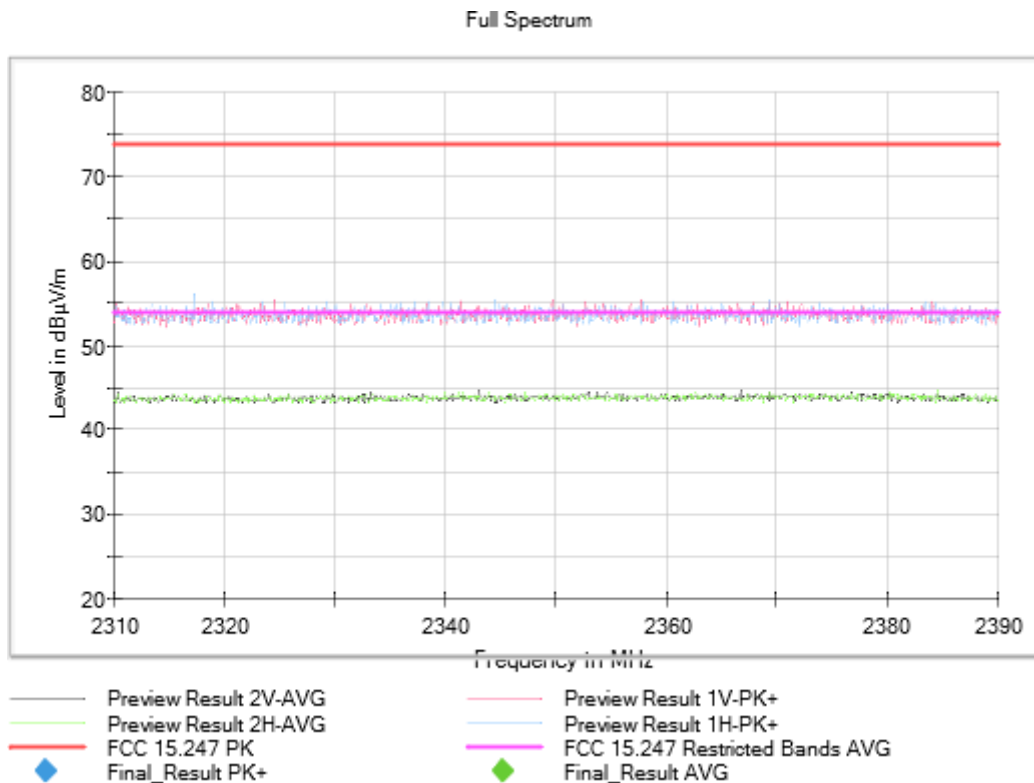
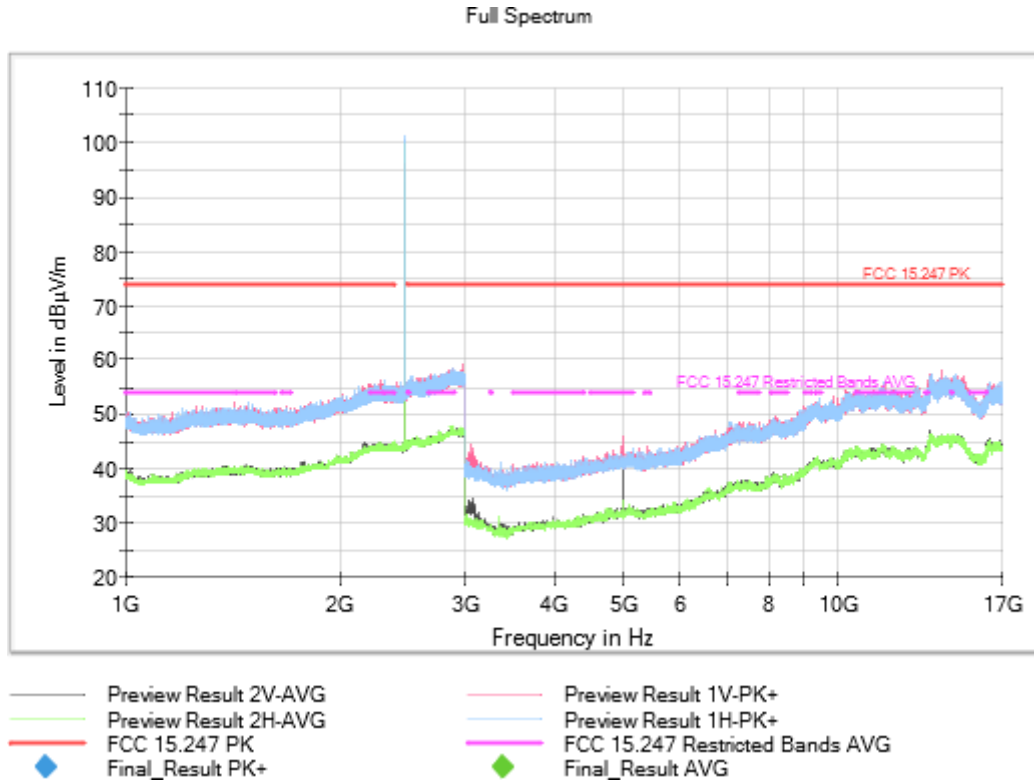
Tables:

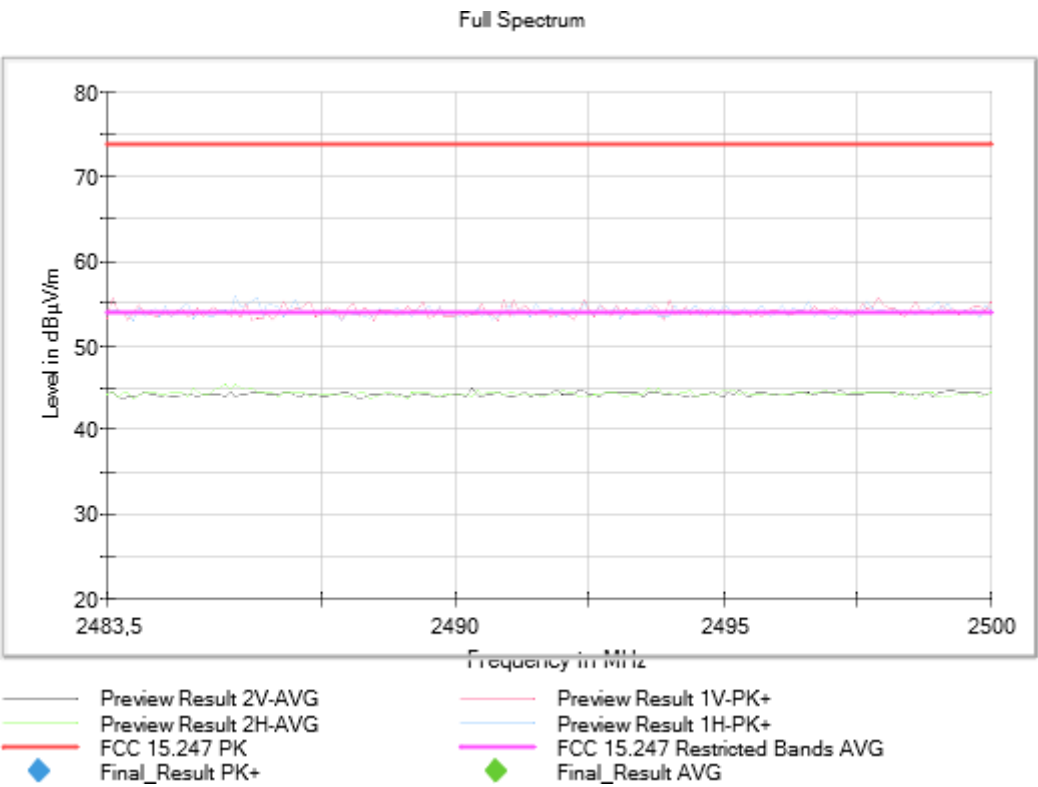
Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 2,39 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
2,39 GHz - 2,484 GHz	40 kHz	PK+	100 kHz	0,01 s	0 dB
2,484 GHz - 3 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
3 GHz - 17 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB

Frequency Range GHz = [1, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:





Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 2,39 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
2,39 GHz - 2,484 GHz	40 kHz	PK+	100 kHz	0,01 s	0 dB
2,484 GHz - 3 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB
3 GHz - 17 GHz	400 kHz	PK+	1 MHz	0,01 s	0 dB

Frequency Range GHz = [1, 3]

Equipment Type = Digital Transmission System (DTS)

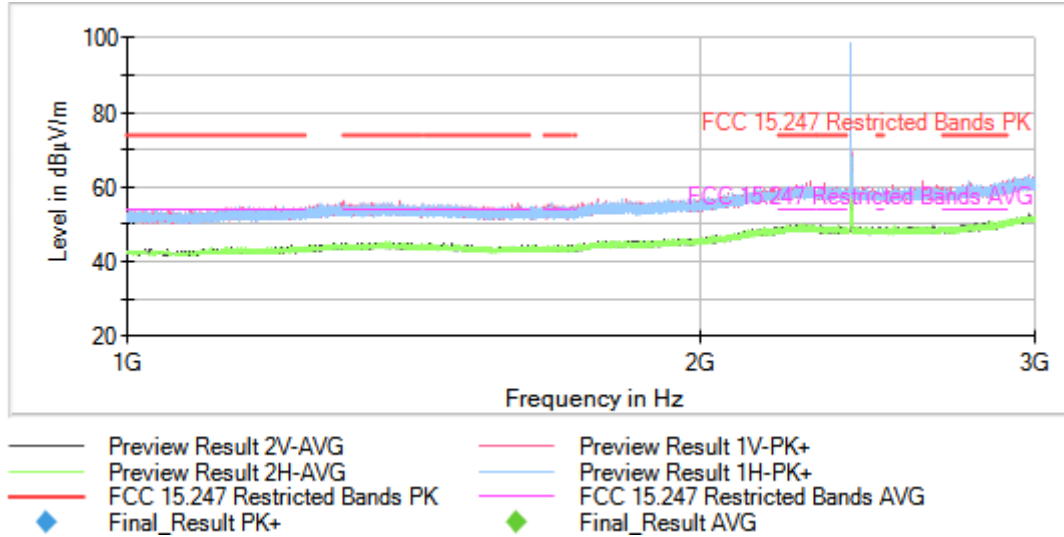
Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2402.00000

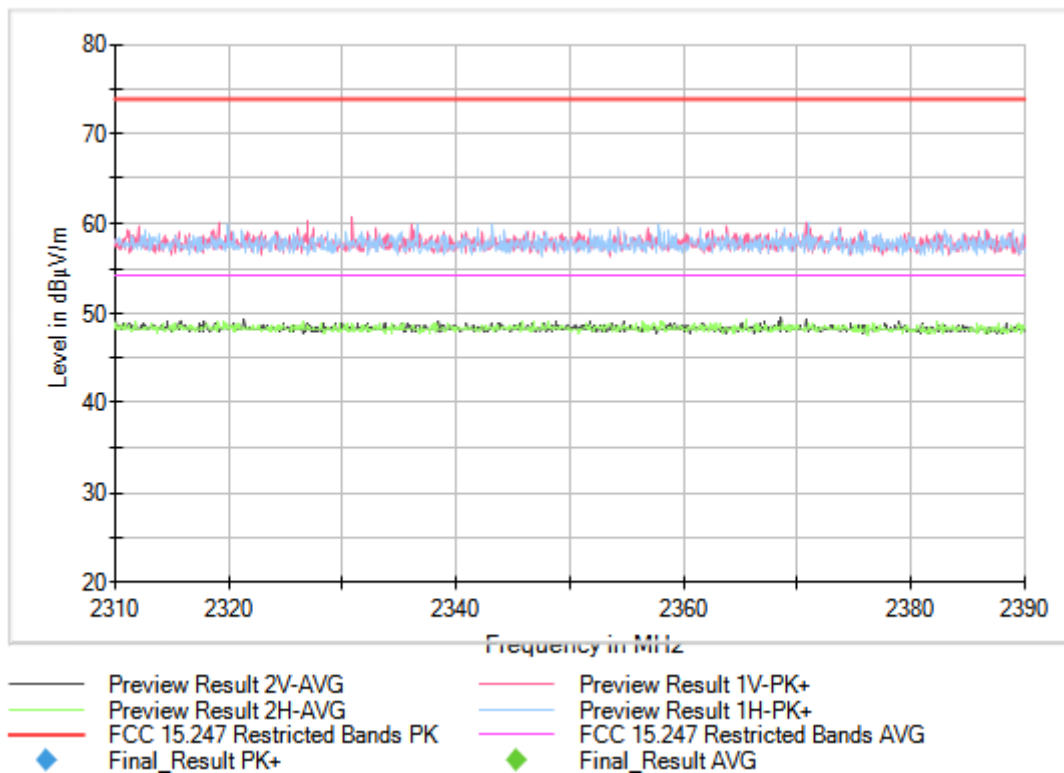
Antenna configuration = SISO

Active Port = 1

Images:



Full Spectrum





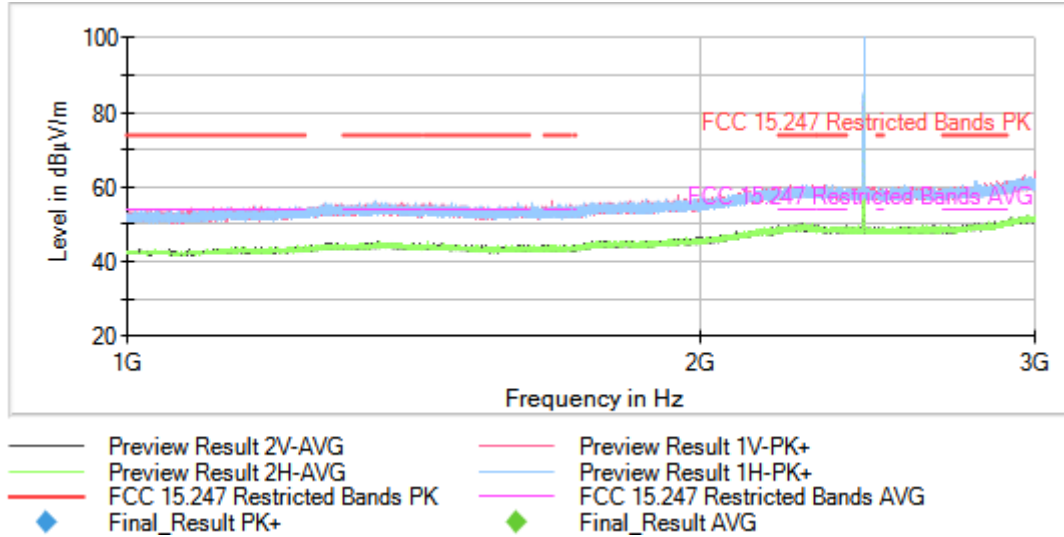
Tables:

Spectrum Analyzer Parameters

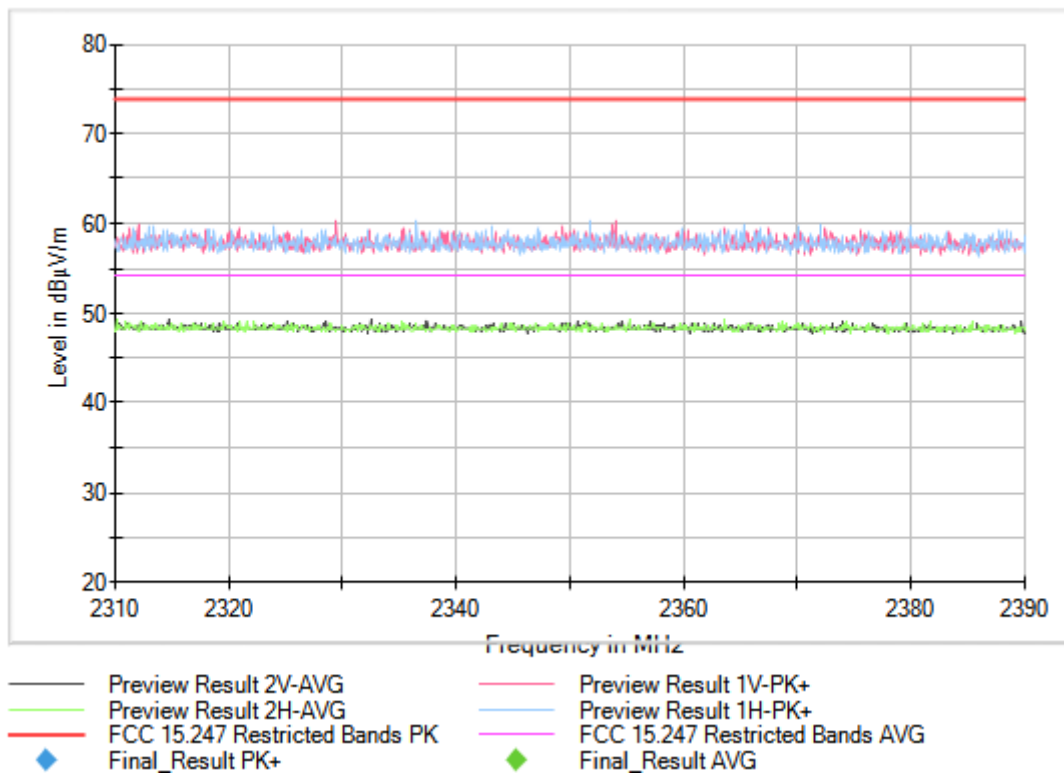
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency Range GHz = [1, 3] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



Full Spectrum





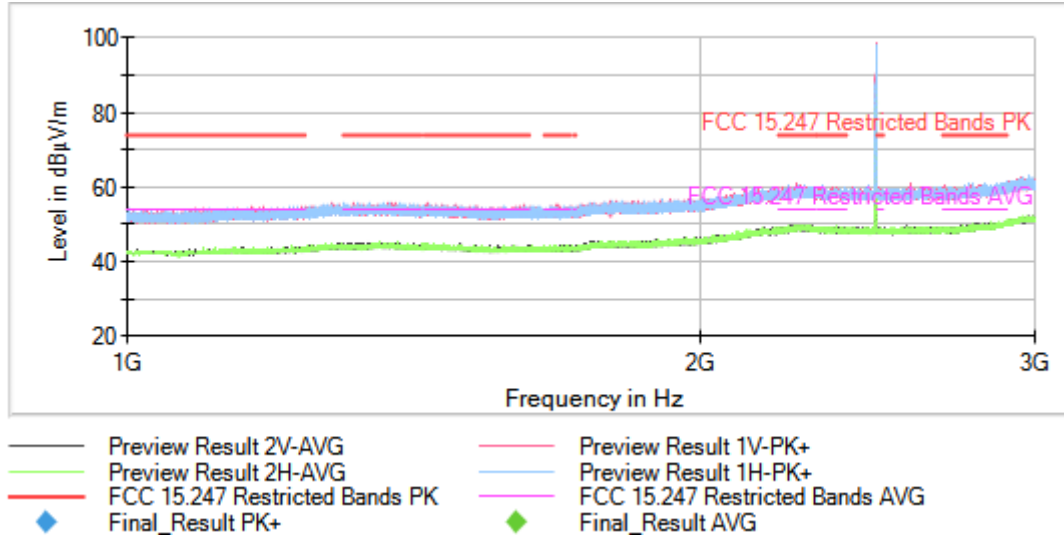
Tables:

Spectrum Analyzer Parameters

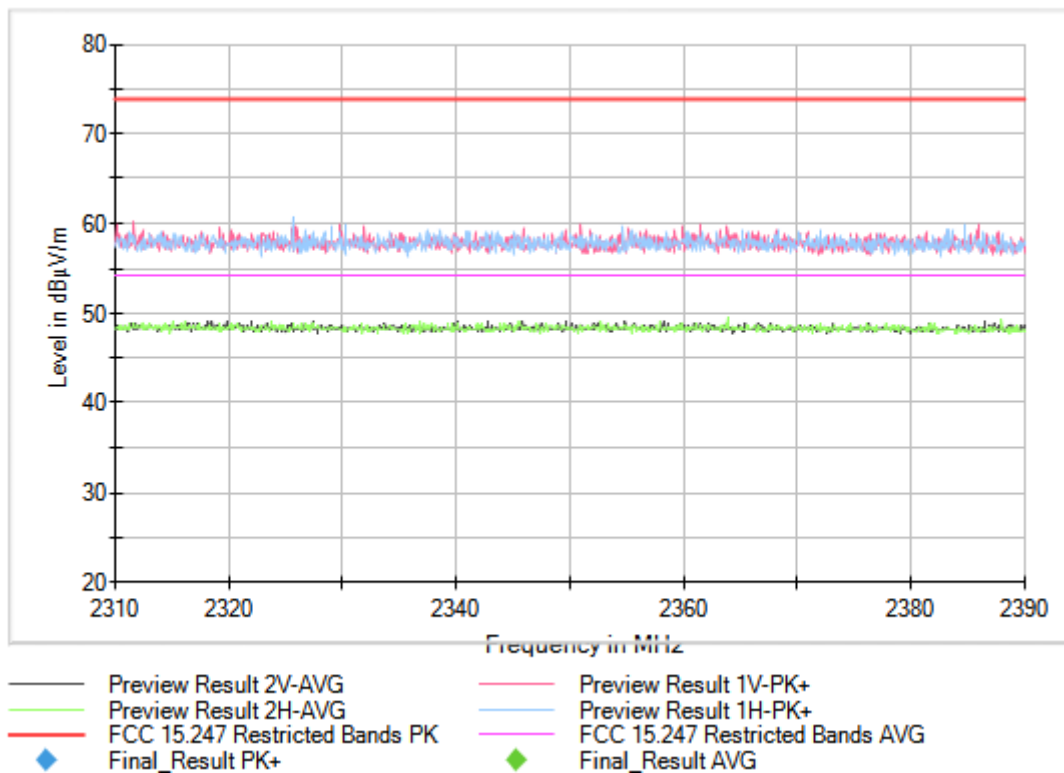
Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

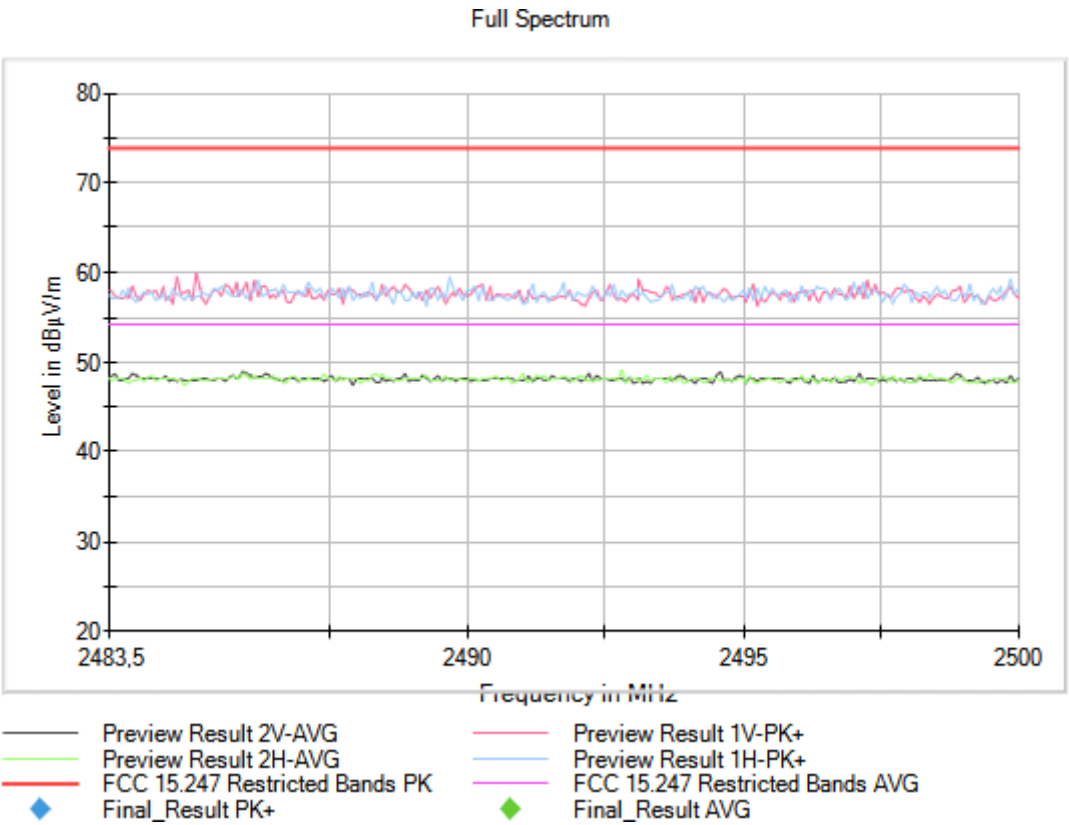
Frequency Range GHz = [1, 3] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



Full Spectrum





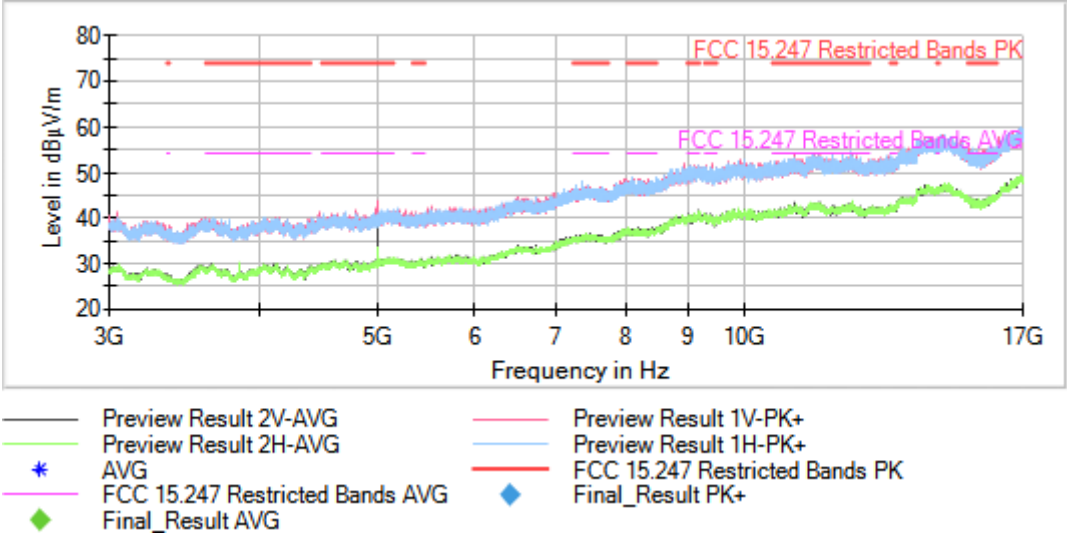
Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency Range GHz = [3, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



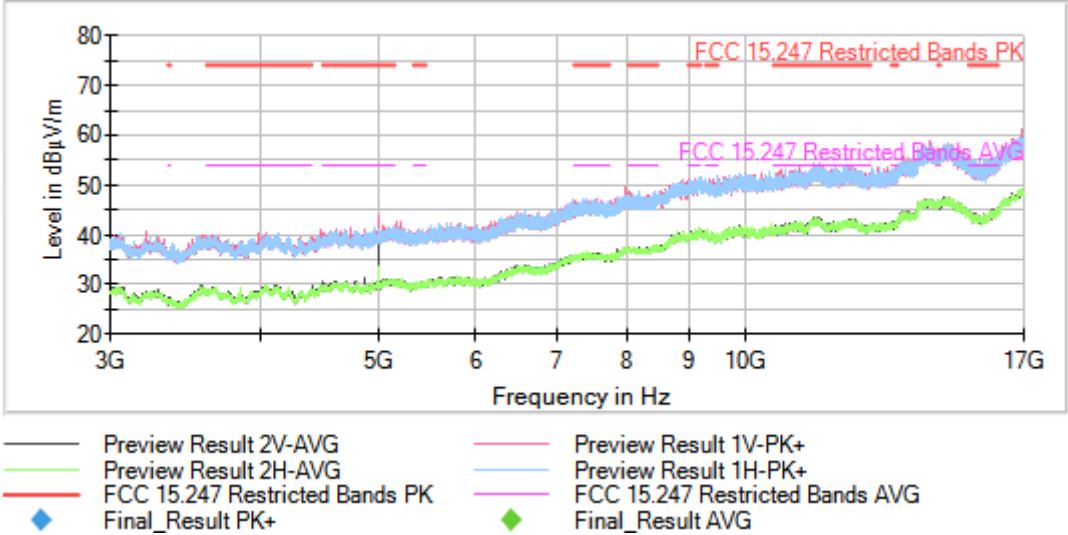
Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency Range GHz = [3, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



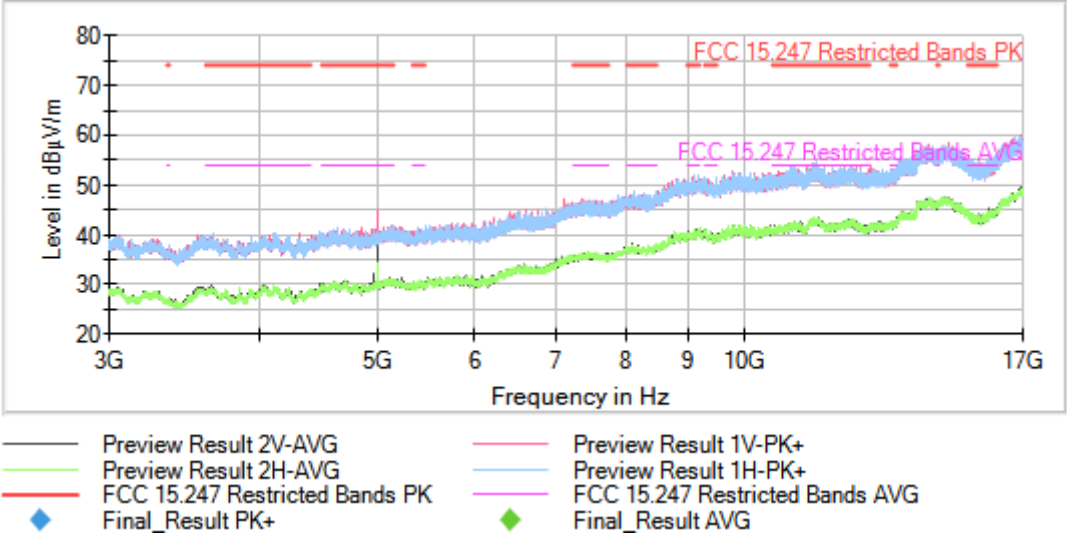
Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency Range GHz = [3, 17] Equipment Type = Digital Transmission System (DTS)
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Frequency Range GHz = [17, 26]

Modulation = The spurious frequencies detected do not depend on the modulation.

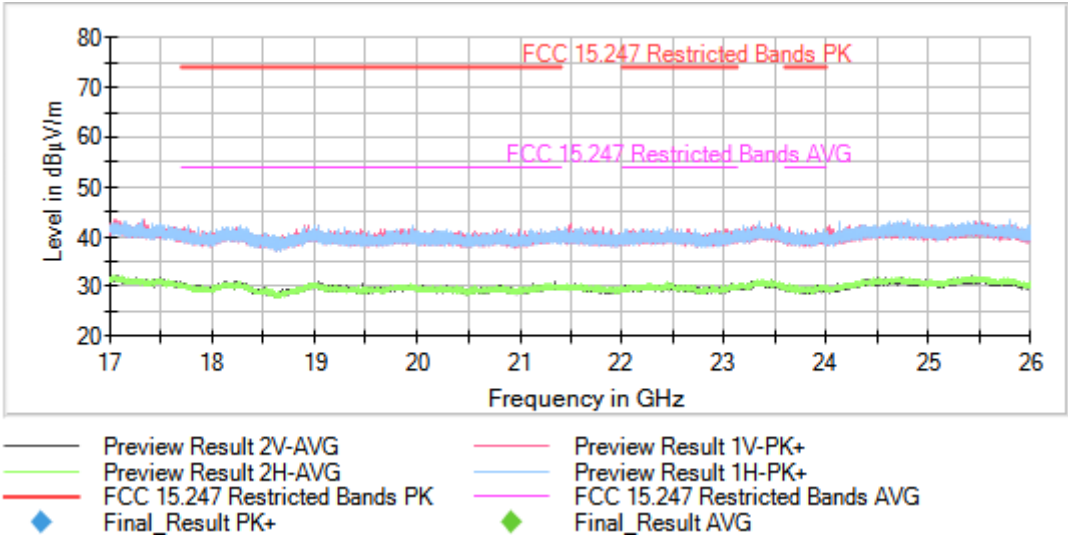
Antenna configuration = SISO

Equipment Type = Digital Transmission System (DTS)

Frequency MHz = The spurious frequencies detected do not depend on the operating channel.

Active Port = 1

Images:



Tables:

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESW 44]					
17 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Appendix B: Test results. Bluetooth Low Energy (2M, 1M). Chipset

TEST CASES DETAILS	79
<i>Occupied Channel Bandwidth 99%</i>	<i>79</i>
<i>RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth</i>	<i>86</i>
<i>RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density</i>	<i>93</i>
<i>RSS-247 5.4 (d) / FCC 15.247 (b) (3) Maximum Peak Conducted output power</i>	<i>100</i>
<i>RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter)</i>	<i>107</i>
<i>RSS-247 5.5 / FCC 15.247 (d) Emission limitations radiated (Transmitter)</i>	<i>114</i>

TEST CASES DETAILS

Occupied Channel Bandwidth 99%

Specifications

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Equipment	BW (MHz)	Freq (MHz)	Port	Occ Ch BW (MHz)
Digital Transmission System (DTS)	1	2402.00000	1	1.025
		2440.00000		1.025
		2480.00000		1.020

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

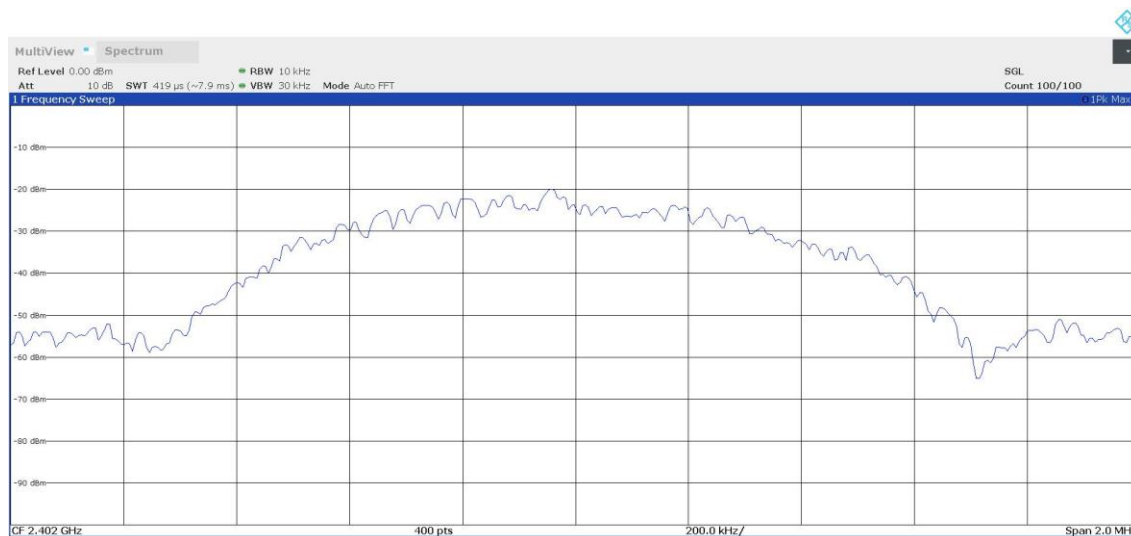
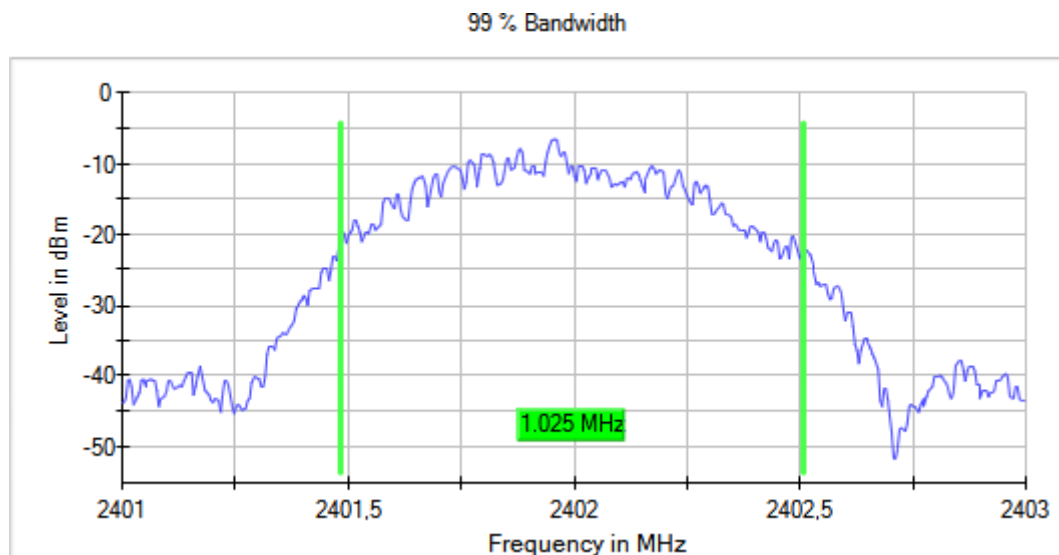
Results

Equipment	BW (MHz)	Freq (MHz)	Port	Occ Ch BW (MHz)
Digital Transmission System (DTS)	2	2402.00000	1	1.990
		2440.00000		2.000
		2480.00000		1.990

Attachments

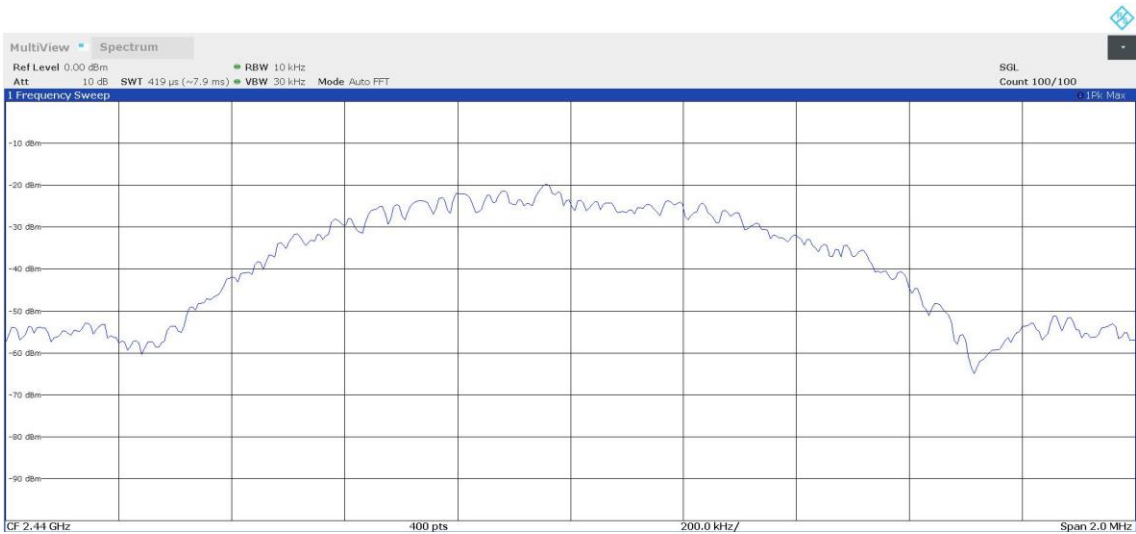
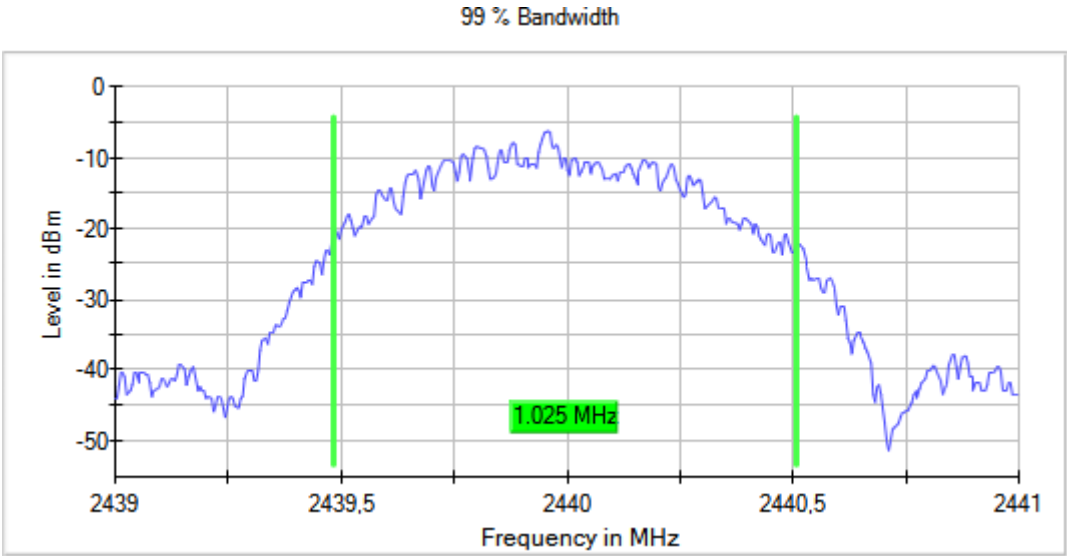
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



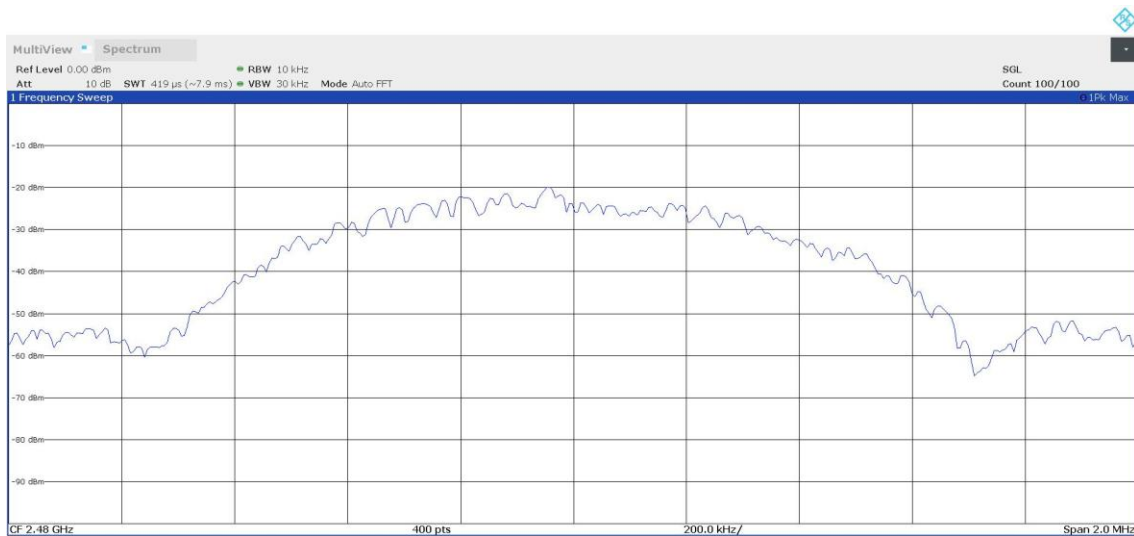
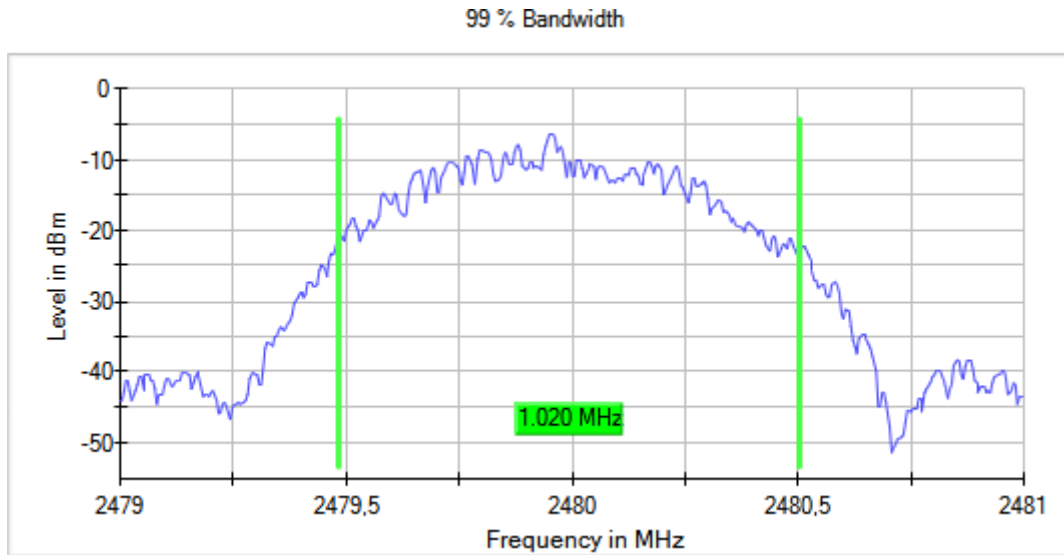
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



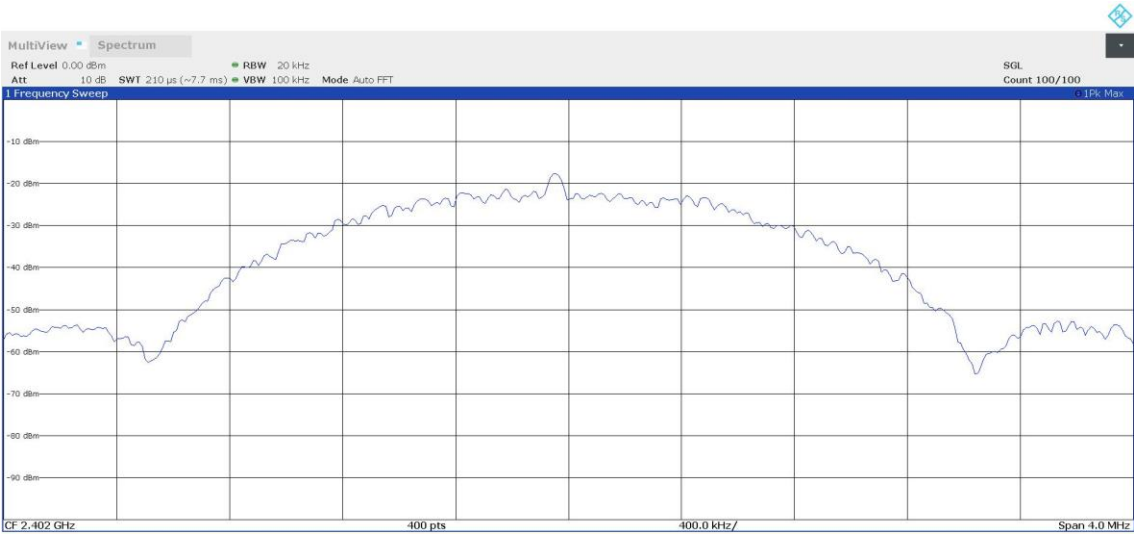
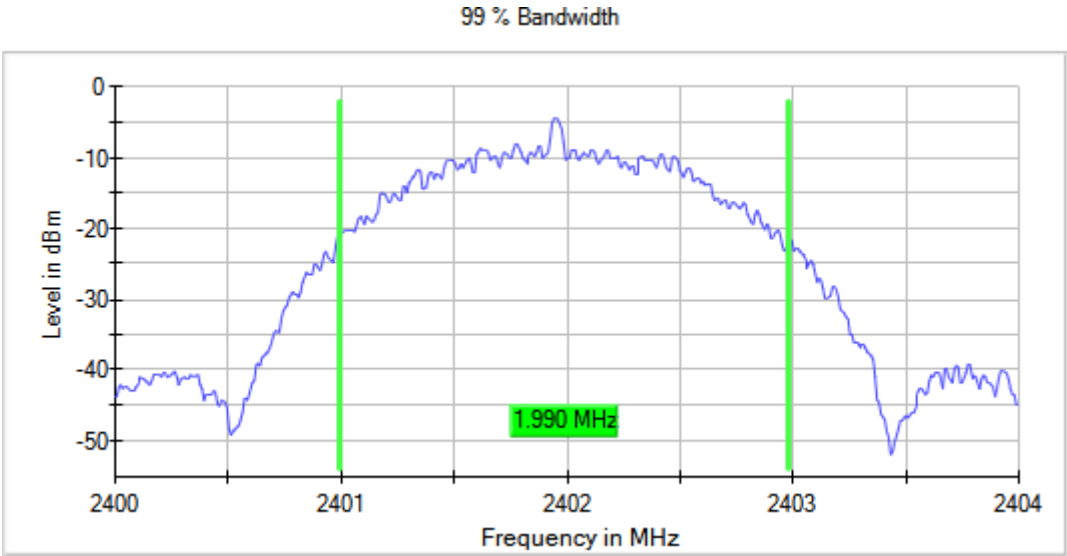
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 1
Modulation = BTLE 5.0 (GFSK 1 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



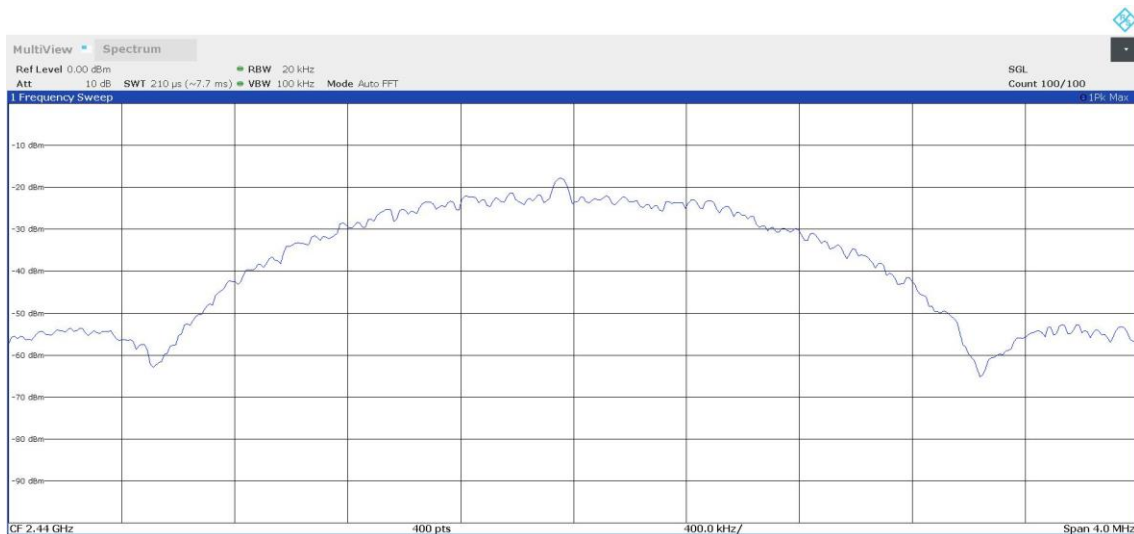
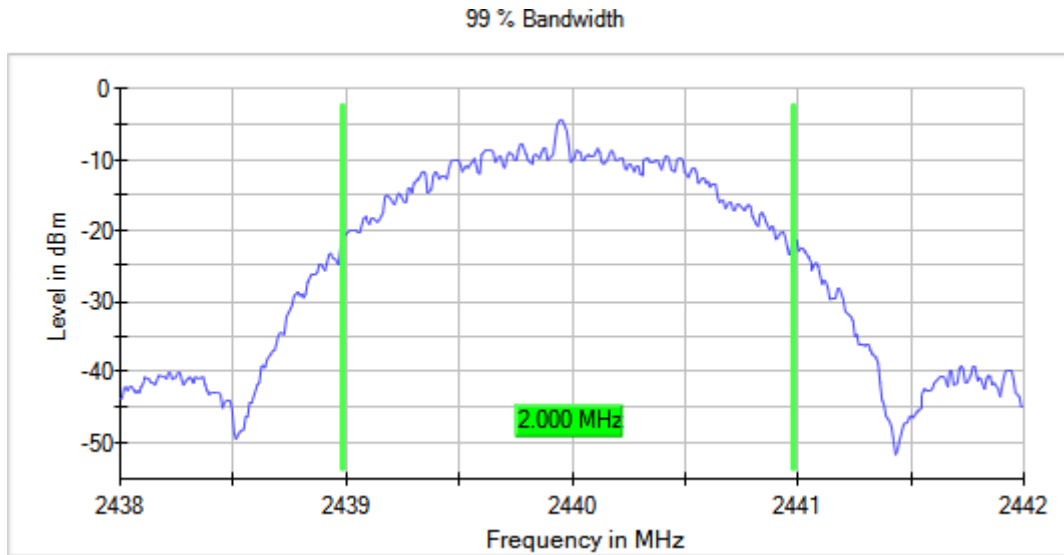
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2402.00000
Antenna configuration = SISO Active Port = 1

Images:



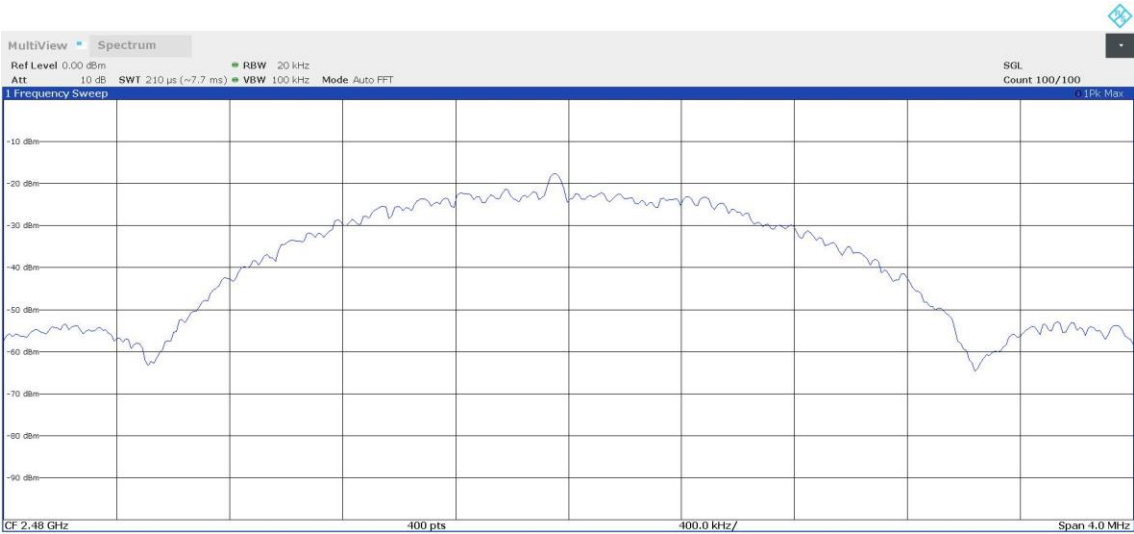
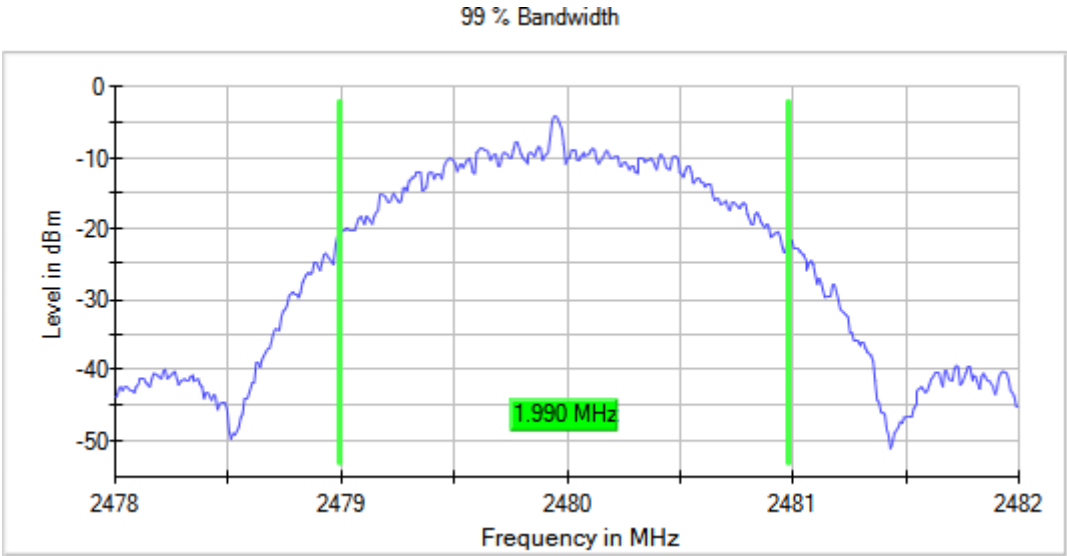
Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2440.00000
Antenna configuration = SISO Active Port = 1

Images:



Equipment Type = Digital Transmission System (DTS) Bandwidth MHz = 2
Modulation = BTLE 5.0 (GFSK 2 Mbit/s) Frequency MHz = 2480.00000
Antenna configuration = SISO Active Port = 1

Images:



RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth

Limits

The minimum 6 dB bandwidth shall be at least 500 kHz.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	6 dB Bandwidth (MHz)
2402.00000	0.792
2440.00000	0.792
2480.00000	0.792

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	6 dB Bandwidth (MHz)
2402.00000	1.465
2440.00000	1.465
2480.00000	1.465

Verdict

Pass

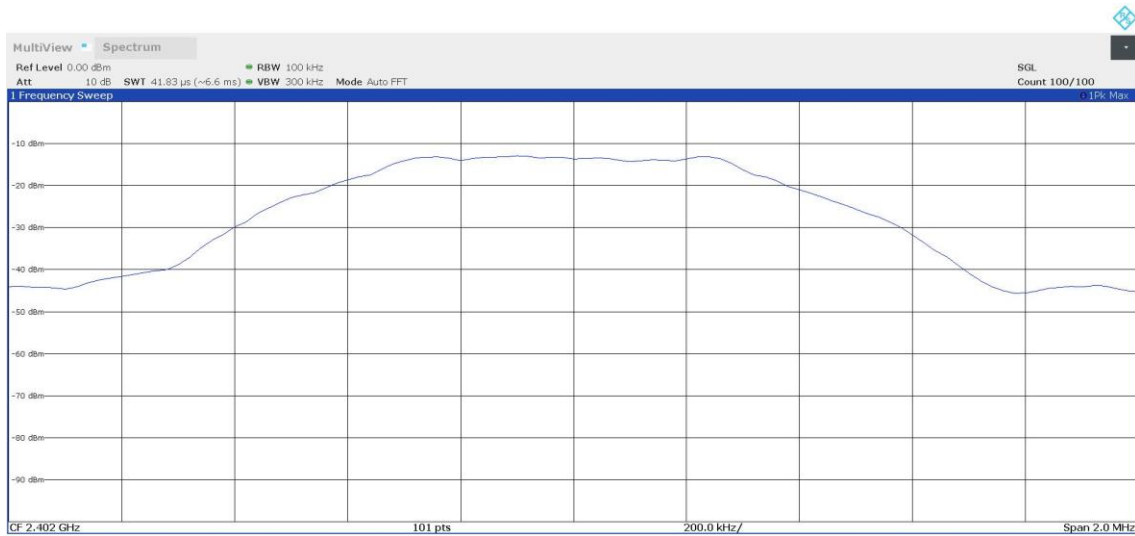
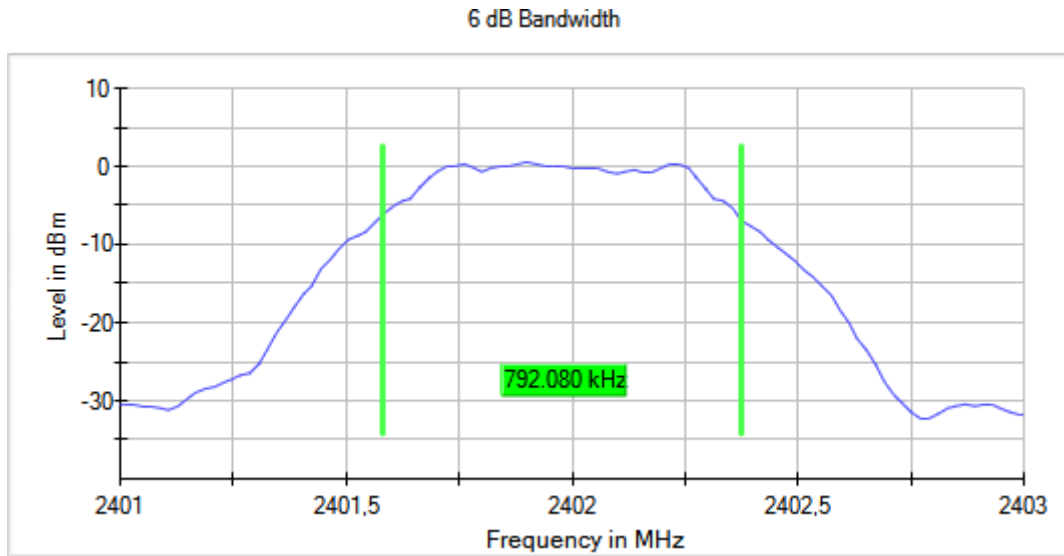
Attachments

Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2402.00000 Antenna configuration = SISO

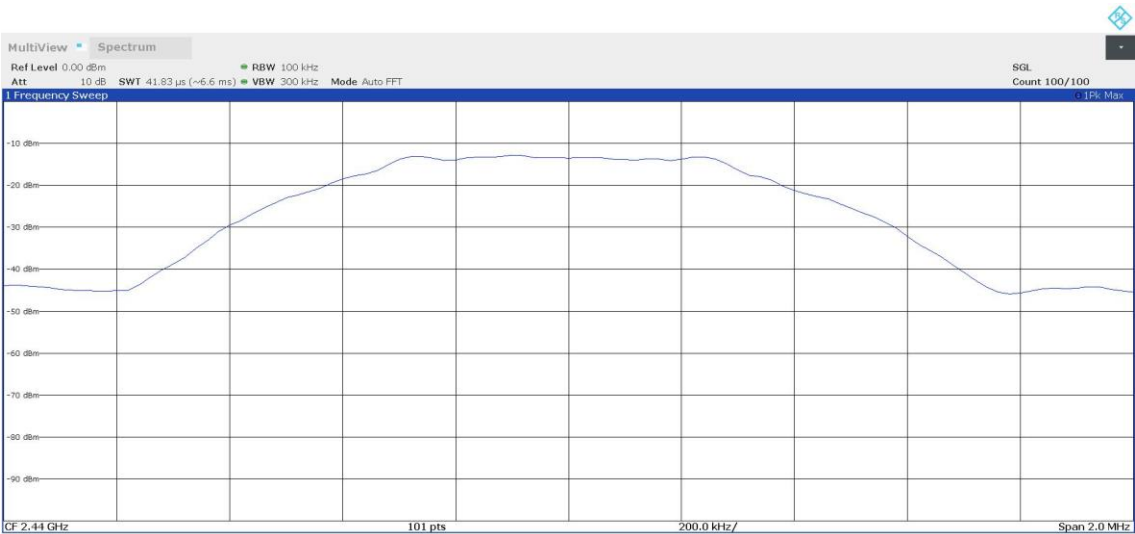
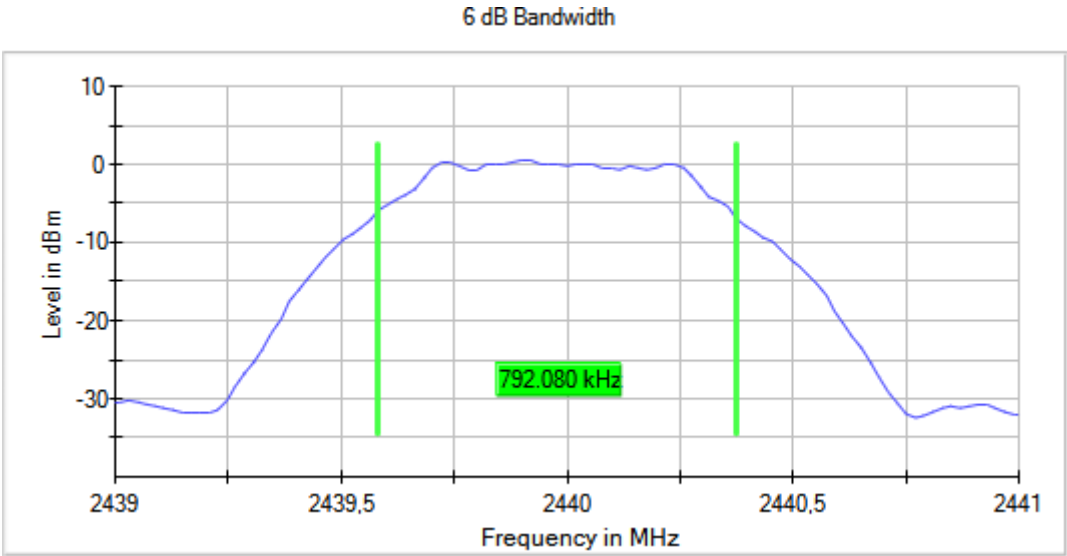
Active Port = 1

Images:



Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)
Frequency MHz = 2440.00000 Antenna configuration = SISO
Active Port = 1

Images:



Bandwidth MHz = 1 Modulation = BTLE 5.0 (GFSK 1 Mbit/s)
Frequency MHz = 2480.00000 Antenna configuration = SISO
Active Port = 1

Images:

