

ISED CABid: ES1909

Test Report No:
NIE: 65881RRF.002

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Prototyping Platform
(*) Trademark	Nordic Thingy:53
(*) Model and /or type reference	Thingy:53
Other identification of the product	HW version: v0.8.0 SW version: v1.0.0 FCC ID: 2ANPOTHINGY53 IC: Not provided
(*) Features	Bluetooth LE, 802.15.4
Manufacturer	Nordic Semiconductor ASA Otto Nielsens Veg 12 7052 Trondheim, Norway
Test method requested, standard	USA FCC Part 15.247 (10-1-20 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-20 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 amendment 1 (March 2019). 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)	Rafael López Martín EMC Consumer & RF Lab. Manager
Date of issue	2022-05-16
Report template No	FDT08_24 (*) "Data provided by the client"

Index

INDEX	2
ACRONYMS	3
COMPETENCES AND GUARANTEES	3
GENERAL CONDITIONS	4
UNCERTAINTY	4
DATA PROVIDED BY THE CLIENT	4
USAGE OF SAMPLES	5
TEST SAMPLE DESCRIPTION	6
IDENTIFICATION OF THE CLIENT	7
TESTING PERIOD AND PLACE	7
DOCUMENT HISTORY	7
ENVIRONMENTAL CONDITIONS	7
REMARKS AND COMMENTS	8
TESTING VERDICTS	9
SUMMARY	9
APPENDIX A: TEST RESULTS. BLUETOOTH LOW ENERGY 5.0 (2M, 1M). A1 ANTENNA.....	10
APPENDIX B: TEST RESULTS. BLUETOOTH LOW ENERGY 5.0 (2M, 1M). A2 ANTENNA.....	80
APPENDIX C: TEST RESULTS. IEEE 802.15.4 ZIGBEE. A1 ANTENNA	129
APPENDIX D: TEST RESULTS. IEEE 802.15.4 ZIGBEE. A2 ANTENNA	163

Acronyms

Acronym ID	Acronym Description
Ebw	Emission Bandwidth
Detector	Detector used
Equipment	Equipment Type
Freq	Frequency
Freq Rng	Frequency Range
Inband Peak Lvl	Inband Peak Level
Lvl	Level
MP	Measurement Point
Mod	Modulation
Occ Ch BW	Occupied Channel Bandwidth
Operation Band	Operation Band
PSD	Power Spectrum Density
Pol	Polarization
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level

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 is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory, CABid: ES1909, 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.

IMPORTANT: No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

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 $\leq \pm 2,84$ %
- Occupied Channel Bandwidth: Measurement uncertainty $\leq \pm 1,17$ %
- Conducted Band-edge spurious emissions: Measurement uncertainty $\leq \pm 1,76$ dB

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 battery operated prototyping platform based around the nRF5340 nRF5340 is an ultra-low power wireless System on Chip (SoC) with a multiprotocol 2.4 GHz transceiver.

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.

Usage of samples

Samples undergoing test have been selected by: The client.

Id	Control Number	Description	Model	Serial N°	Date of Reception	Application
S/01	65881B_1.1	Prototyping Platform	Thingy:53	--	2021-06-17	Element Under Test
S/02	65881B_2.1	Prototyping Platform	Thingy:53	--	2021-06-17	Element Under Test
S/03	65881B_12.1	Prototyping Platform	Thingy:53	--	2021-10-15	Element Under Test
S/04	65881B_13.1	Prototyping Platform	Thingy:53	--	2022-01-31	Element Under Test

Notes referenced to samples during the project:

Id	Type
S/01	Radiated test for A2 antenna
S/02	Conducted test for A2 antenna
S/03	Radiated test except range between 17-26 GHz for A1 antenna.
S/04	Radiated test range between 17-26 GHz for A1 antenna. Conducted test for A1 antenna

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	Current Measurement and Debug port		[]	[]	[]		
	USB port		[]	[]	[]		
	External board connector		[]	[]	[]		
	Programming connector		[]	[]	[]		
Supplementary information to the ports..... :	No cables will be attached during testing. None of the ports are RF ports.						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	[X]	DC: 1350mAh Li-po Battery, Nominal voltage 3.7V OR through USB					
Rated Power	---						
Clock frequencies.....	---						
Other parameters	---						
Software version	v1.0.0						
Hardware version	v0.8.0						
Dimensions in cm (W x H x D)	6cm x 2,4cm x 6,4cm						
Mounting position	[X]	Table top equipment					
	[]	Wall/Ceiling mounted equipment					
	[]	Floor standing equipment					
	[X]	Hand-held equipment					
	[]	Other:					
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

Nordic Semiconductor ASA
Otto Nielsens Veg 12
7052 Trondheim, Norway

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-06-25
Date (finish)	2022-03-09

Document history

Report number	Date	Description
65881RRF.003	2022-05-16	First release.

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: Javier Miguel Nadales, José Manuel Jiménez, Miguel Manuel López and Pablo Redondo.

Used instrumentation:

Equipment	Model	Manufacturer	Next Calibration
SEMIANECHOIC ABSORBER LINED CHAMBER	FACT 3 200 STP	ETS LINDGREN	N/A
SHIELDED ROOM	S101	ETS LINDGREN	N/A
EMI TEST RECEIVER 9kHz-7GHz	ESR7	ROHDE AND SCHWARZ	2022-12-12
HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK	2023-05-05
HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2023-08-24
HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2023-10-29
PRE-AMPLIFIER G>30dB 17-40GHz	BLMA 1840-4A	BONN ELEKTRONIK	2022-09-08
PRE-AMPLIFIER G>30dB 1GHz-18GHz	BLMA 0118-3A	BONN ELEKTRONIK	2022-12-01
PRE-AMPLIFIER G>40dB 10MHz-6GHz	BLNA 0160-01N	BONN ELEKTRONIK	2022-03-09
SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV40	ROHDE AND SCHWARZ	2022-03-12
SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV40	ROHDE AND SCHWARZ	2023-02-26
OPEN SWITCH UNIT UP TO 7.5 GHz	OSP-B157W8 PLUS	ROHDE & SCHWARZ	2023-08-20
SIGNAL GENERATOR 8kHz-6GHz	SMB100B	ROHDE AND SCHWARZ	2023-11-03
VECTOR SIGNAL GENERATOR 100kHz-7.5GHz	SMW200A	ROHDE AND SCHWARZ	2023-08-20
WIRELESS CONNECTIVITY TESTER BW 160 MHz	CMW270	ROHDE AND SCHWARZ	2022-11-30

Testing verdicts

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

Summary

Bluetooth Low Energy 5.0 (2M, 1M)

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.2 (a) / FCC 15.247 (a) (2) [6dBw] 6 dB Bandwidth		Pass	
RSS-247 5.2 (b) / FCC 15.247 (e) [Psd] Power spectral density		Pass	
RSS-247 5.4. (d) / FCC 15.247 (b) [Pwr]		Pass	
RSS-247 5.5 / FCC 15.247 (d) [Bndedge] Band-edge emissions compliance (Transmitter)		Pass	
RSS-247 5.5 / FCC 15.247 (d) [RSE] Emission limitations radiated (Transmitter)		Pass	
<u>Supplementary information and remarks:</u> None			

IEEE 802.15.4 ZigBee

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.2 (a) / FCC 15.247 (a) (2) [6dBw] 6 dB Bandwidth		Pass	
RSS-247 5.2 (b) / FCC 15.247 (e) [Psd] Power spectral density		Pass	
RSS-247 5.4. (d) / FCC 15.247 (b) [Pwr]		Pass	
RSS-247 5.5 / FCC 15.247 (d) [Bndedge] Band-edge emissions compliance (Transmitter)		Pass	
RSS-247 5.5 / FCC 15.247 (d) [RSE] Emission limitations radiated (Transmitter)		Pass	
<u>Supplementary information and remarks:</u> None			

Appendix A: Test results. Bluetooth Low Energy 5.0 (2M, 1M). A1 antenna

TEST CONDITIONS	12
TEST CASES DETAILS	15
FCC 47 CFR PART 15.247 / RSS-247	15
RSS-247 5.2 (a) / FCC 15.247 (a) (2) [6dBw] 6 dB Bandwidth	15
99dBw Occupied Channel Bandwidth 99%	23
FCC 15.247 (b) / RSS-247 5.4. (d) Maximum Output Power and Antenna Gain	32
RSS-247 5.2 (b) / FCC 15.247 (e) [Psdf] Power spectral density	33
RSS-247 5.5 / FCC 15.247 (d) [Bndedge] Band-edge emissions compliance (Transmitter)	42
RSS-247 5.5 / FCC 15.247 (d) [RSE] Emission limitations radiated (Transmitter)	52

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 3.7Vdc
Type of Power Supply: Battery

ANTENNA GAIN (*):

Type of Antenna: Integral
Maximum Declared Antenna Gain: 1 dBi (Ch 2402MHz, Ch 2404MHz); 1.15 dBi (Ch 2440MHz);
0.63 dBi (Ch 2476 MHz); 0.59dBi (Ch 2478MHz);
0.55dBi (Ch 2480MHz)

TEST FREQUENCIES (*):

			OUTPUT POWER
Bluetooth Low Energy 5.0 (1M):	Low Channel:	2402 MHz	Neg3dBm_20dBm
	Middle Channel:	2440 MHz	
	High Channel:	2480 MHz	
Bluetooth Low Energy 5.0 (2M):	Low Channel:	2404 MHz	Neg1dBm_20dBm
	Middle Channel:	2440 MHz	Neg1dBm_20dBm
	Channel:	2476 MHz	Neg4dBm_20dBm
	High Channel:	2478 MHz	Neg8dBm_20dBm

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).

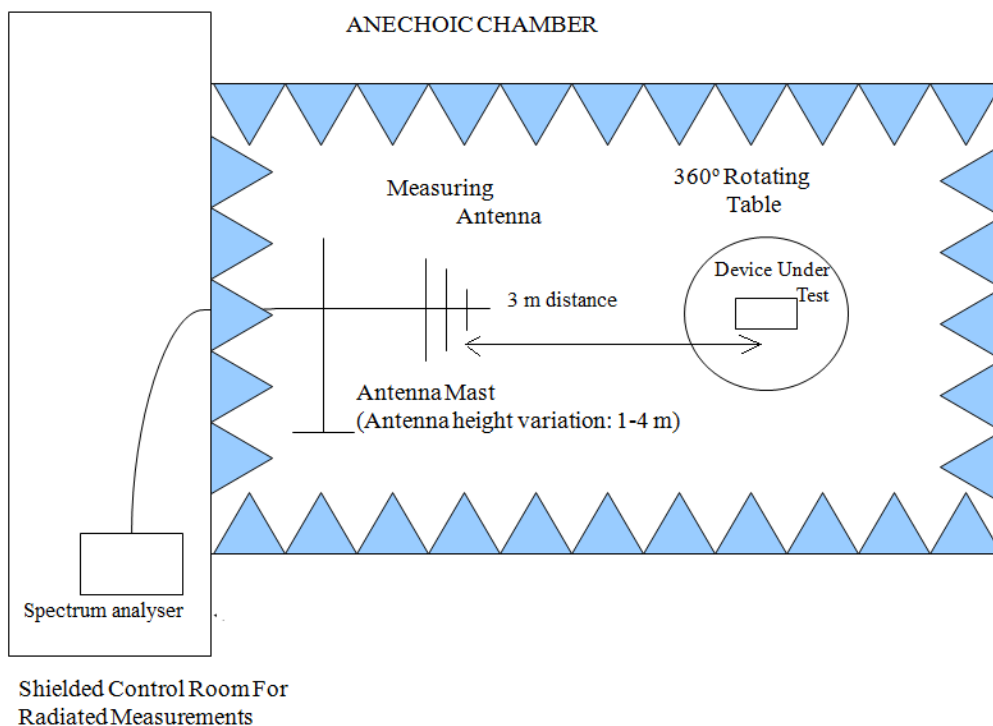
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

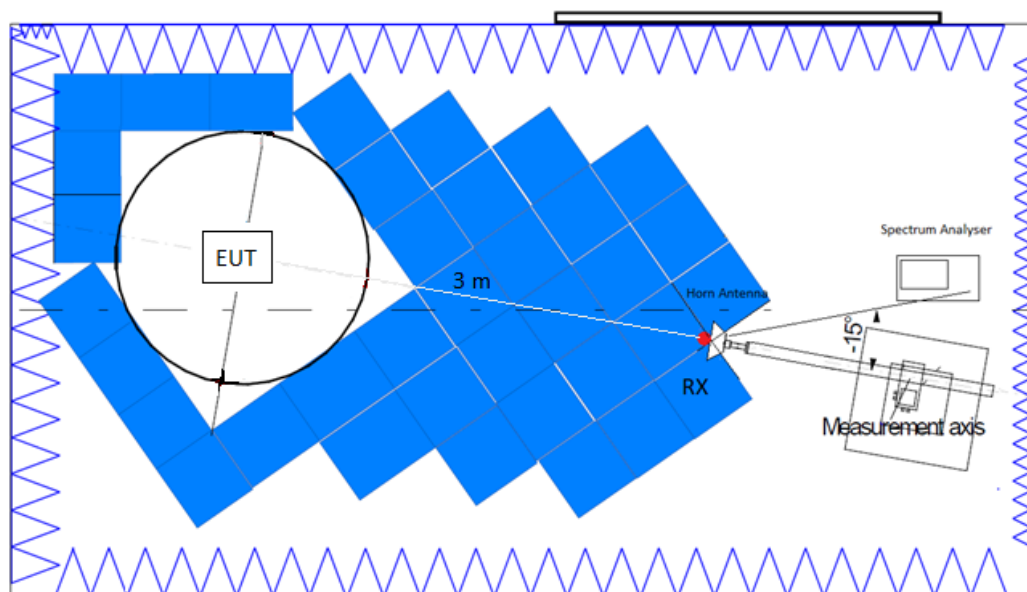
Measurements were made in both horizontal and vertical planes of polarization.

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.

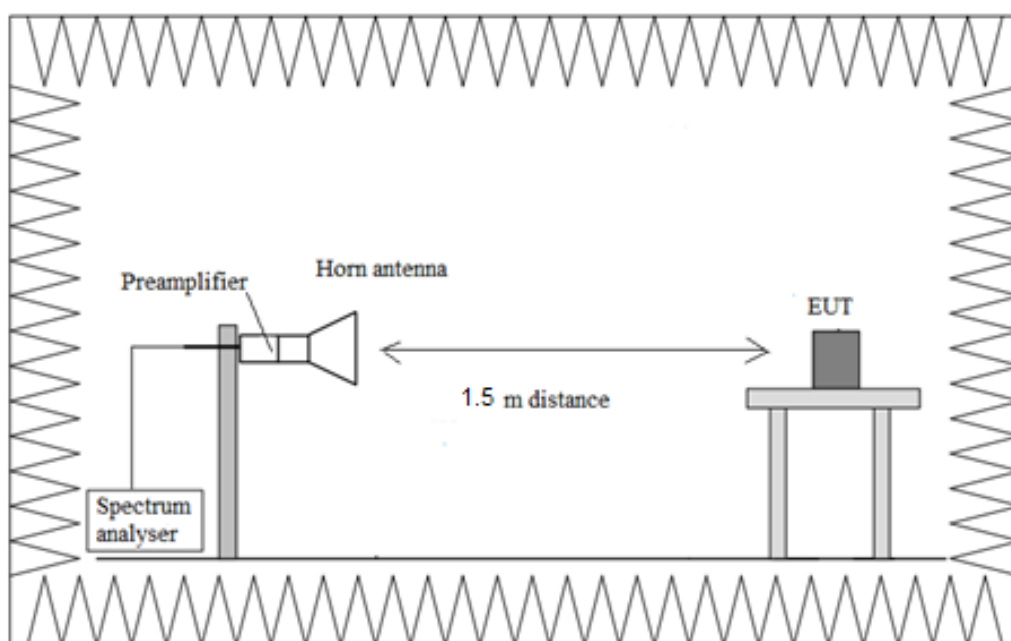
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



TEST CASES DETAILS

FCC 47 CFR Part 15.247 / RSS-247

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

Limits

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

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	Emission Bandwidth (MHz)
2404.00000	1.227722
2440.00000	1.188118
2476.00000	1.267326
2478.00000	1.227722

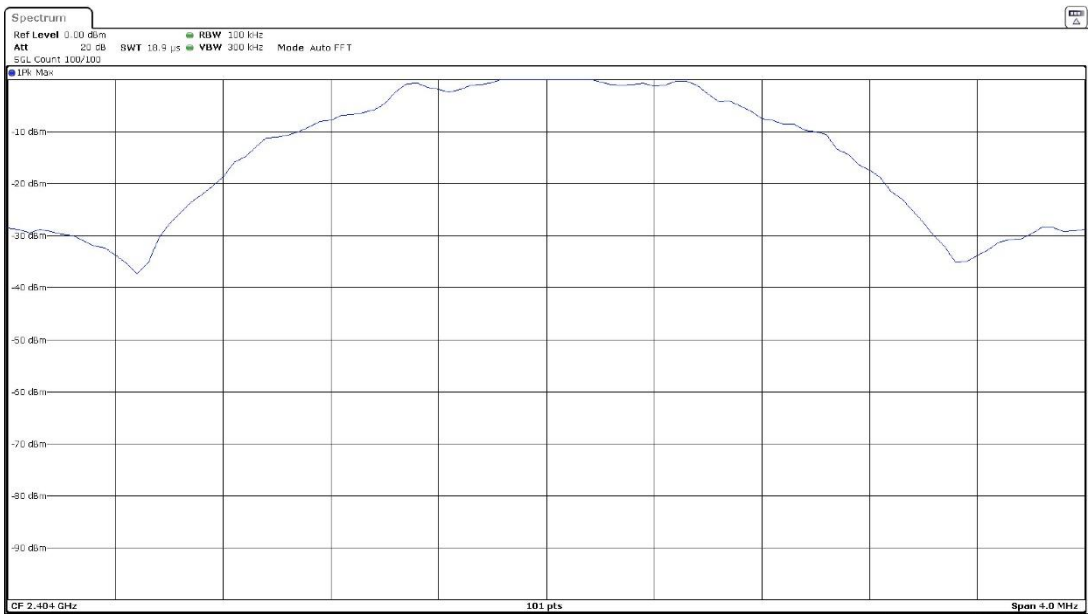
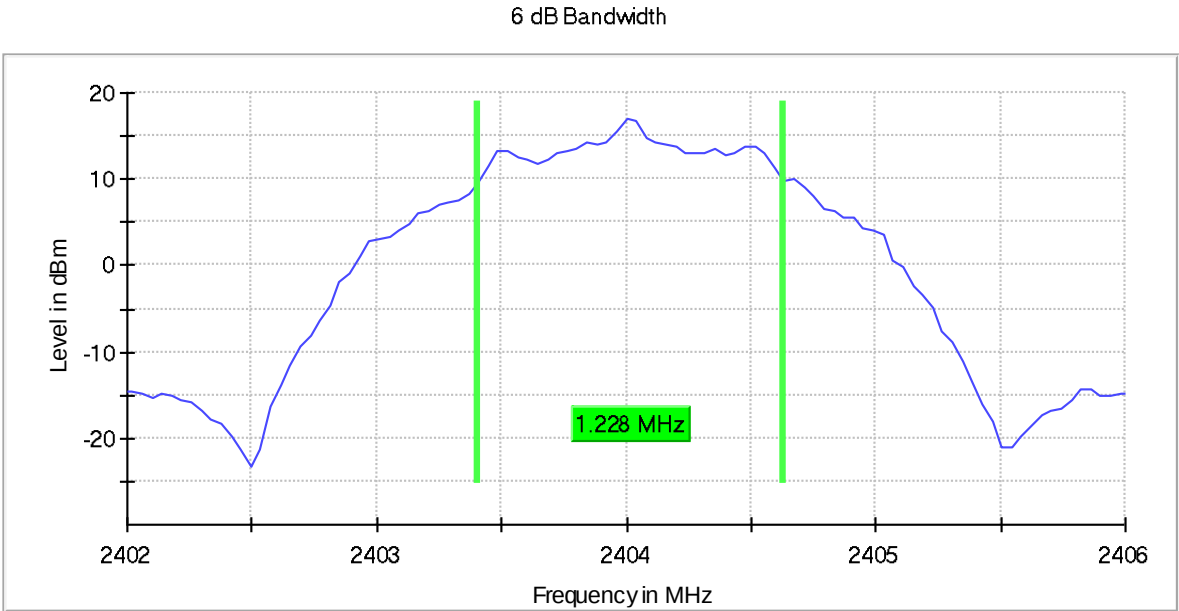
Verdict

Pass

Attachments

Frequency MHz = 2404.00000, Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

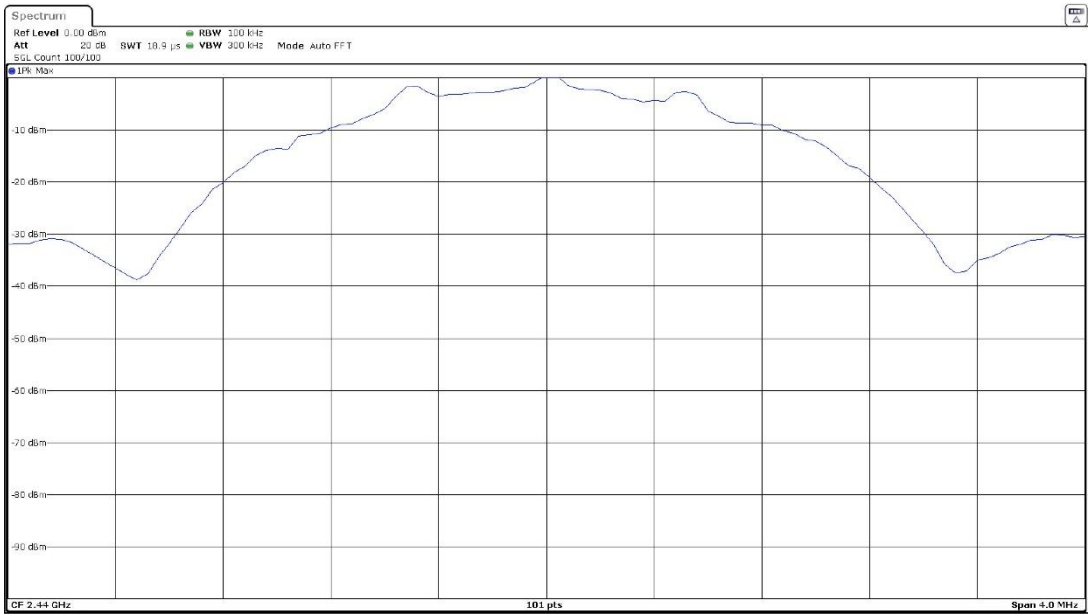
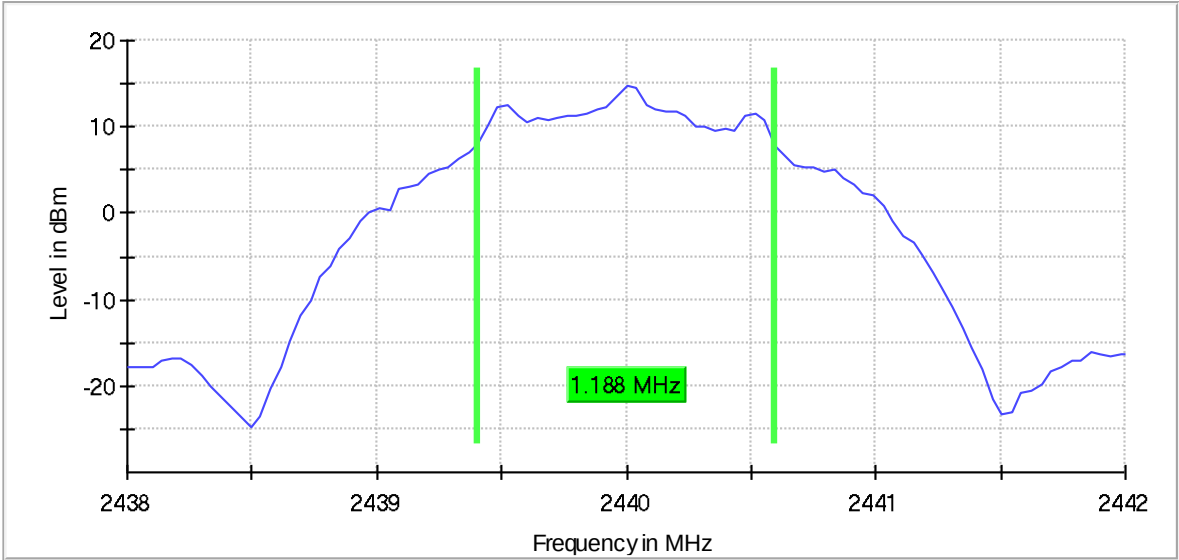
Images:



Frequency MHz = 2440.00000, Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

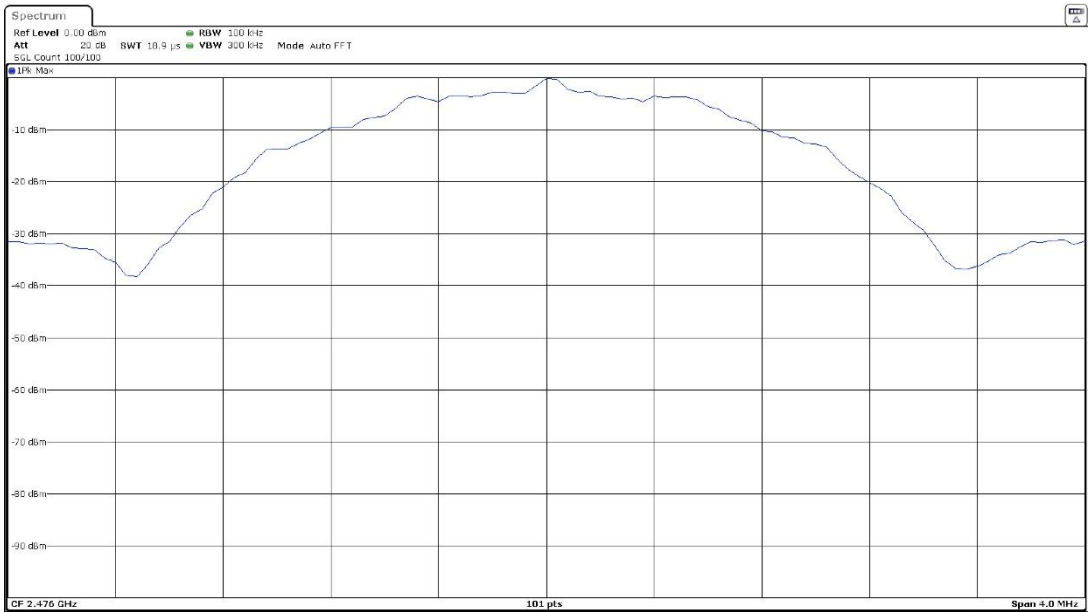
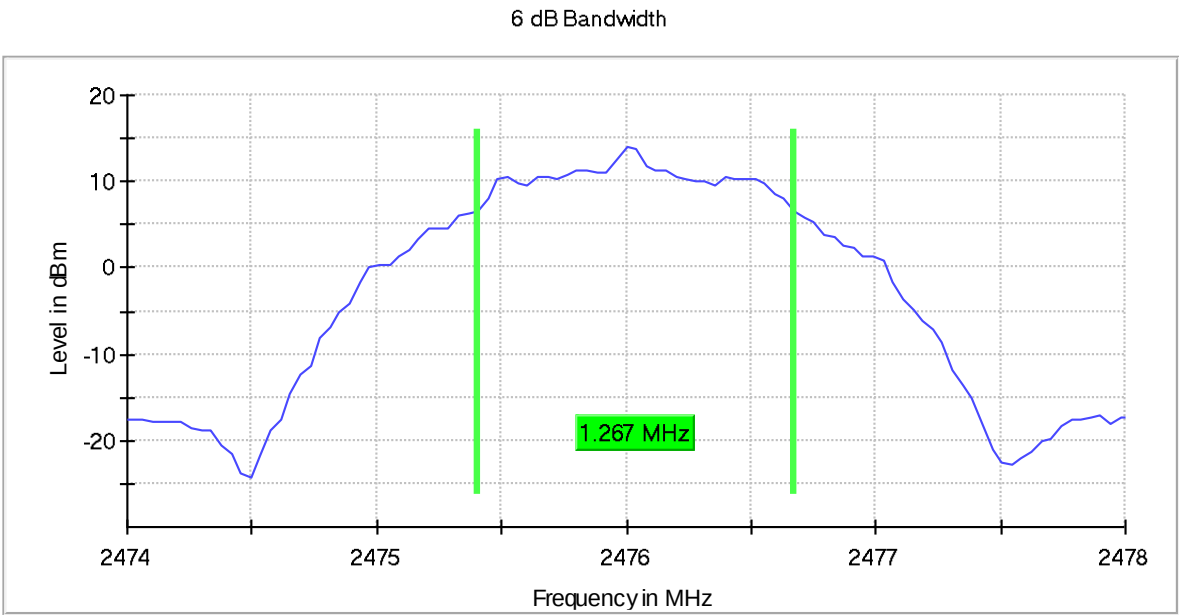
Images:

6 dB Bandwidth



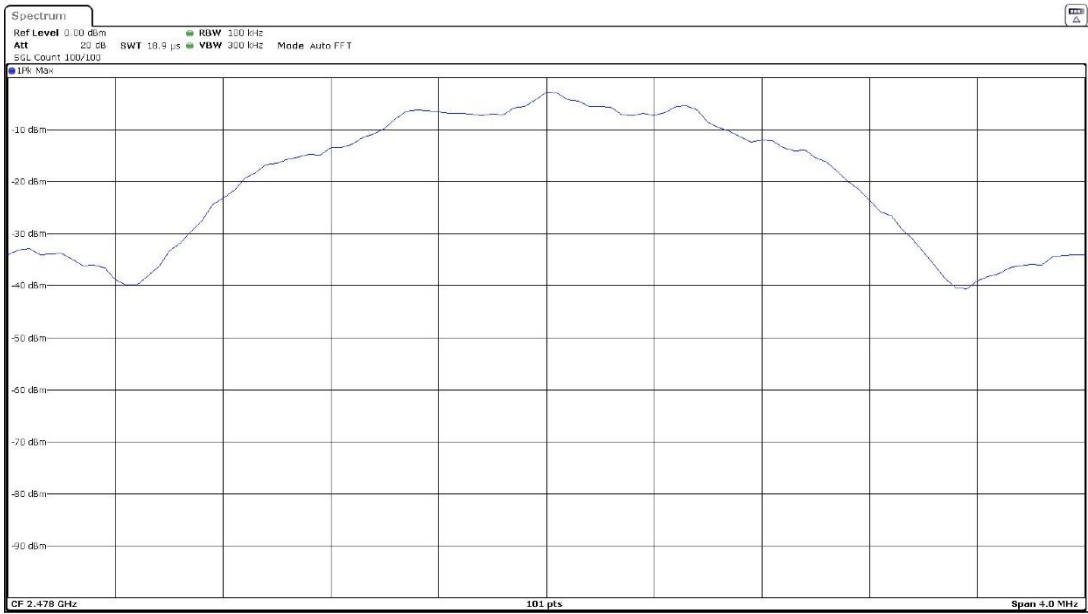
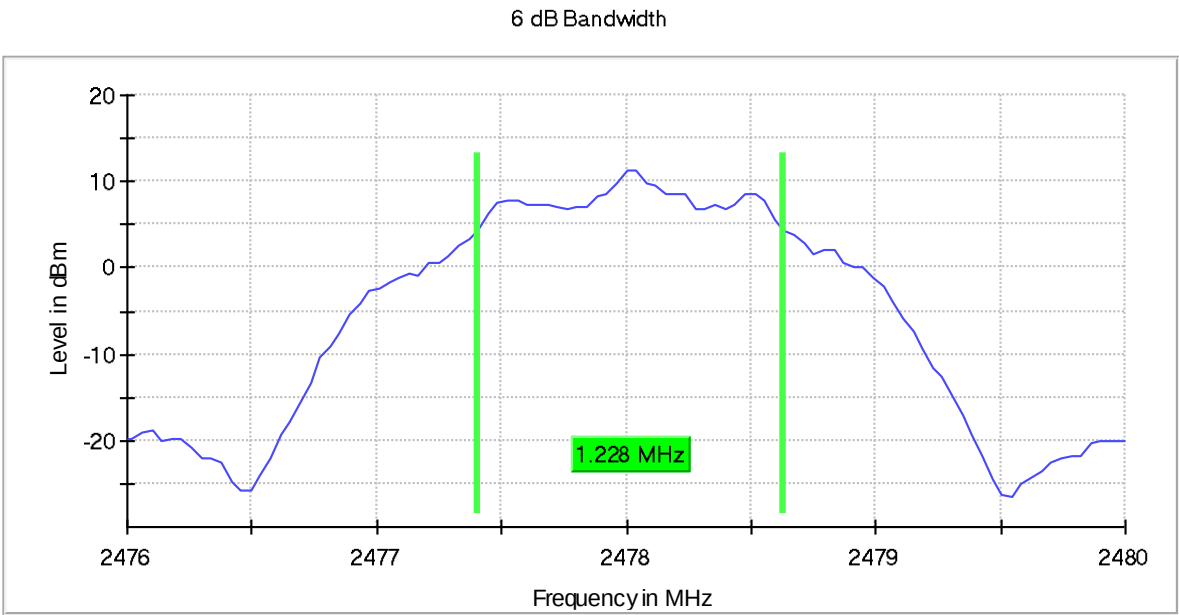
Frequency MHz = 2476.00000, Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Frequency MHz = 2478.00000, Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Emission Bandwidth (MHz)
2402.00000	0.712872
2440.00000	0.693070
2480.00000	0.693070

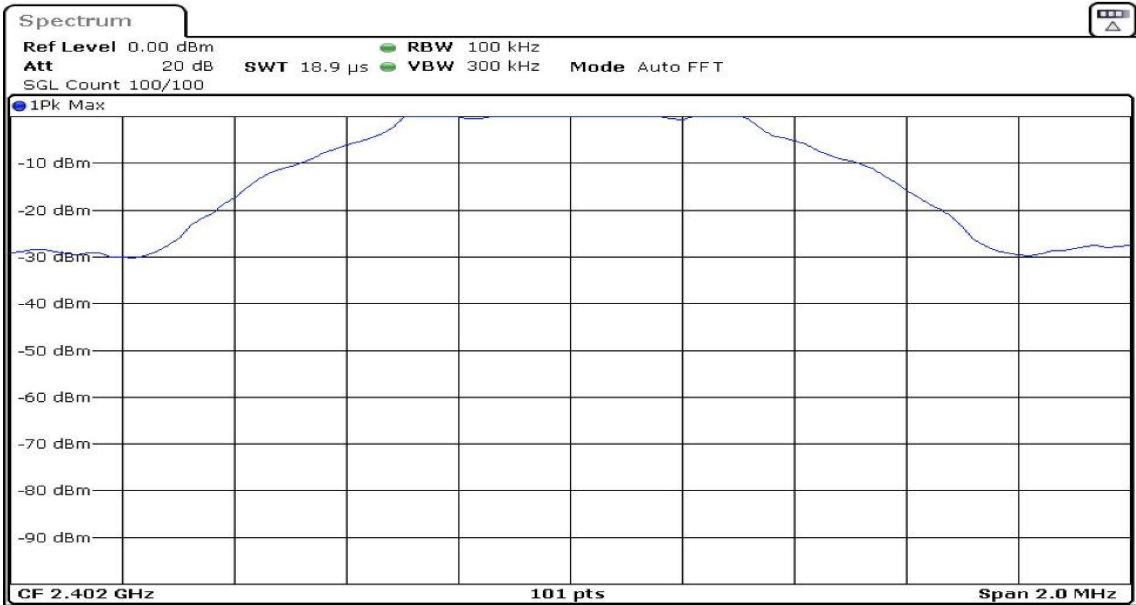
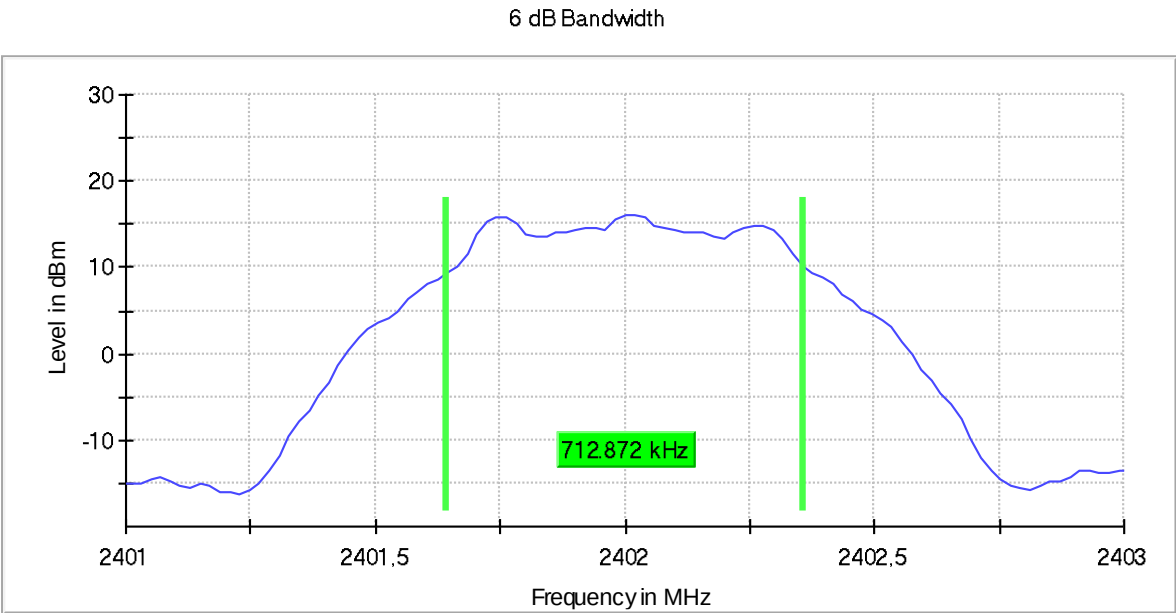
Verdict

Pass

Attachments

Frequency MHz = 2402.00000, Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

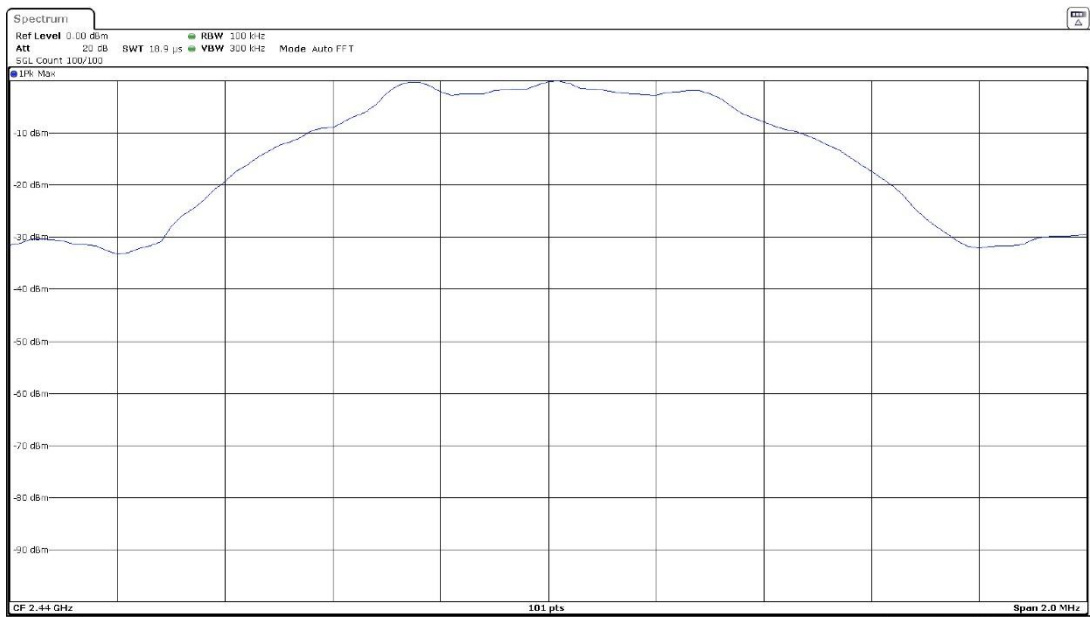
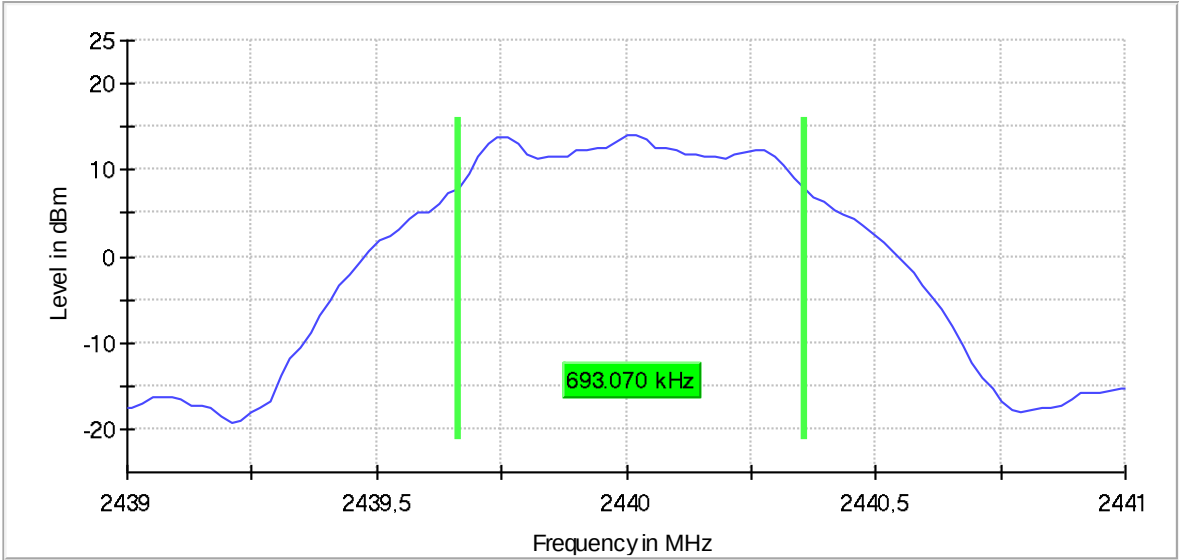
Images:



Frequency MHz = 2440.00000, Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

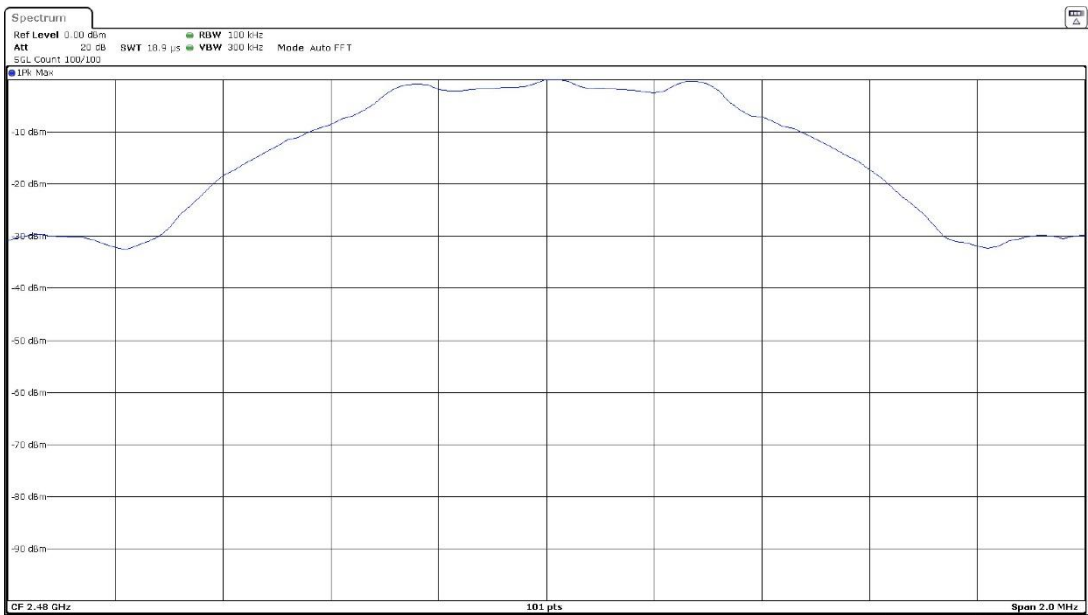
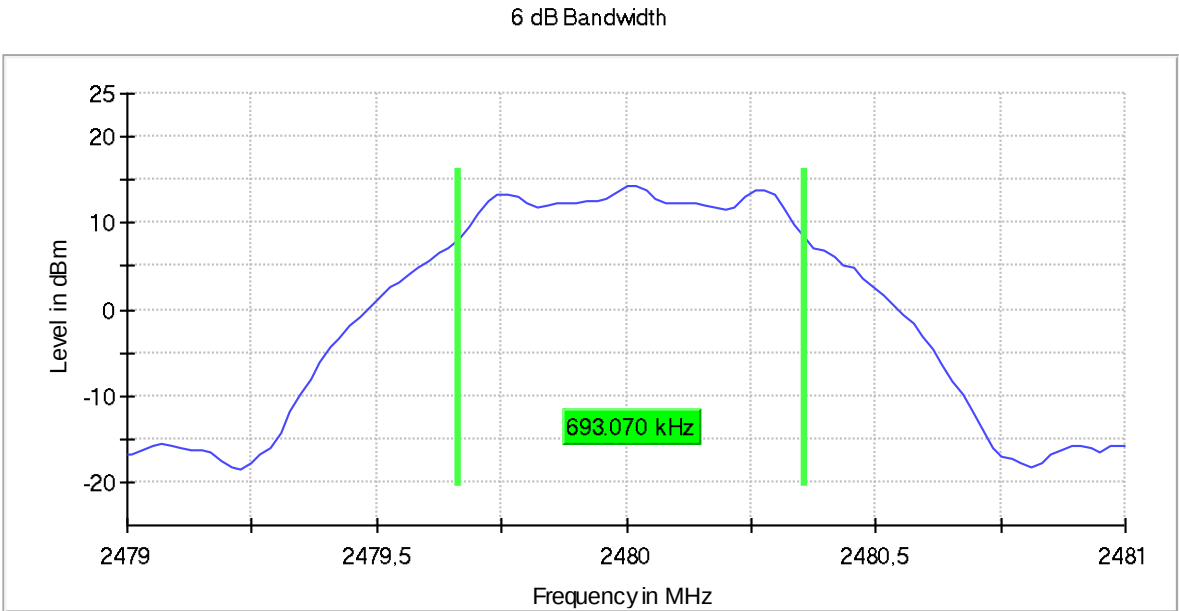
Images:

6 dB Bandwidth



Frequency MHz = 2480.00000, Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



99dBw Occupied Channel Bandwidth 99%

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

Freq (MHz)	Occ Ch BW (MHz)
2404.00000	2.070
2440.00000	2.080
2476.00000	2.100
2478.00000	2.120

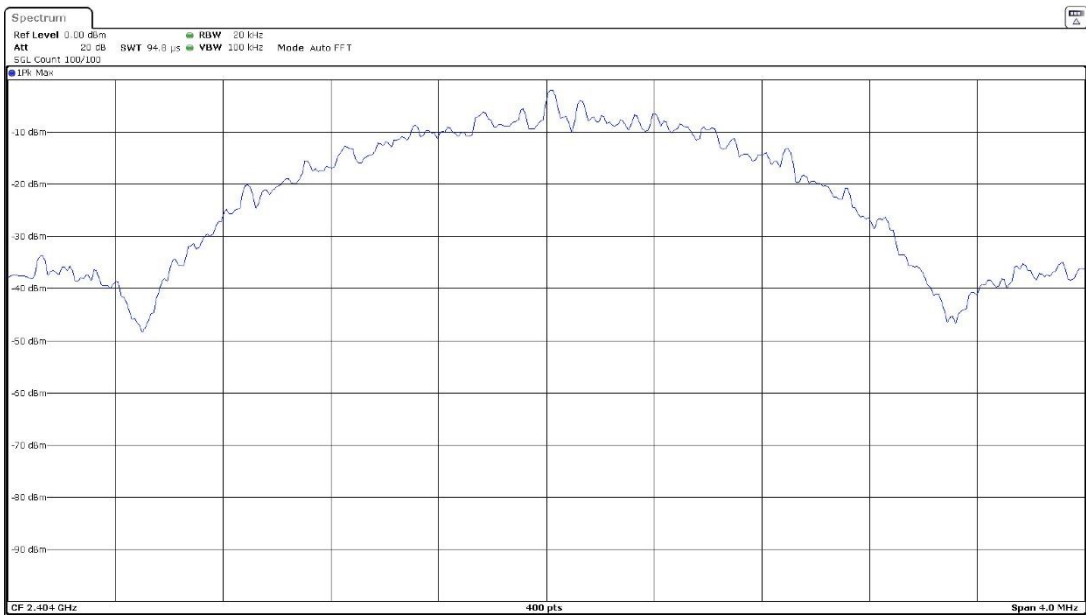
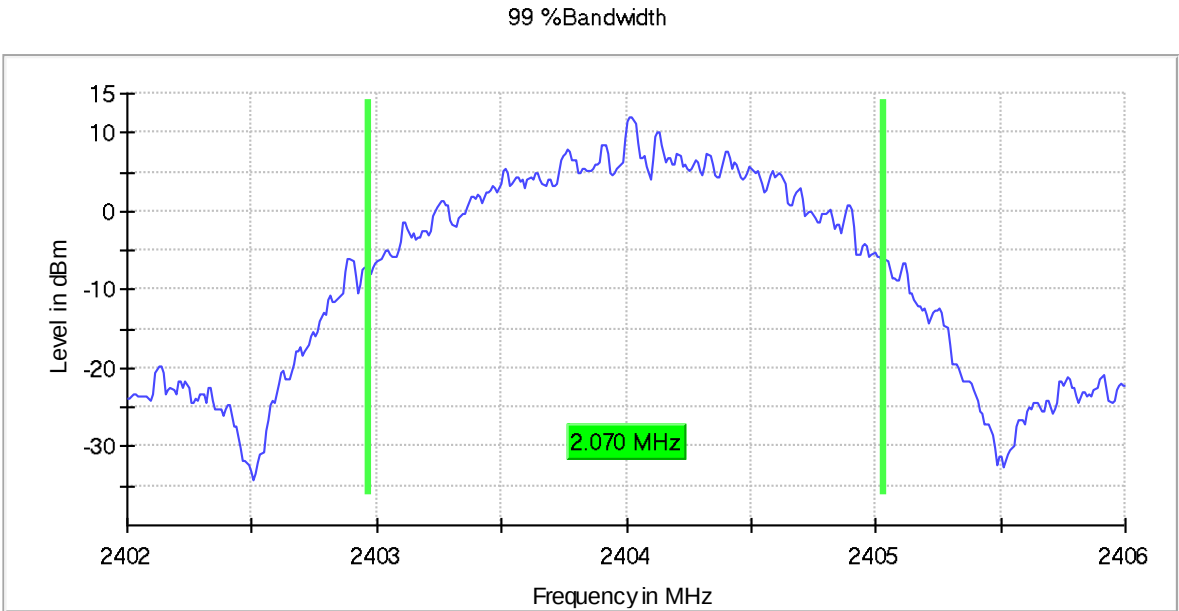
Verdict

Pass

Attachments

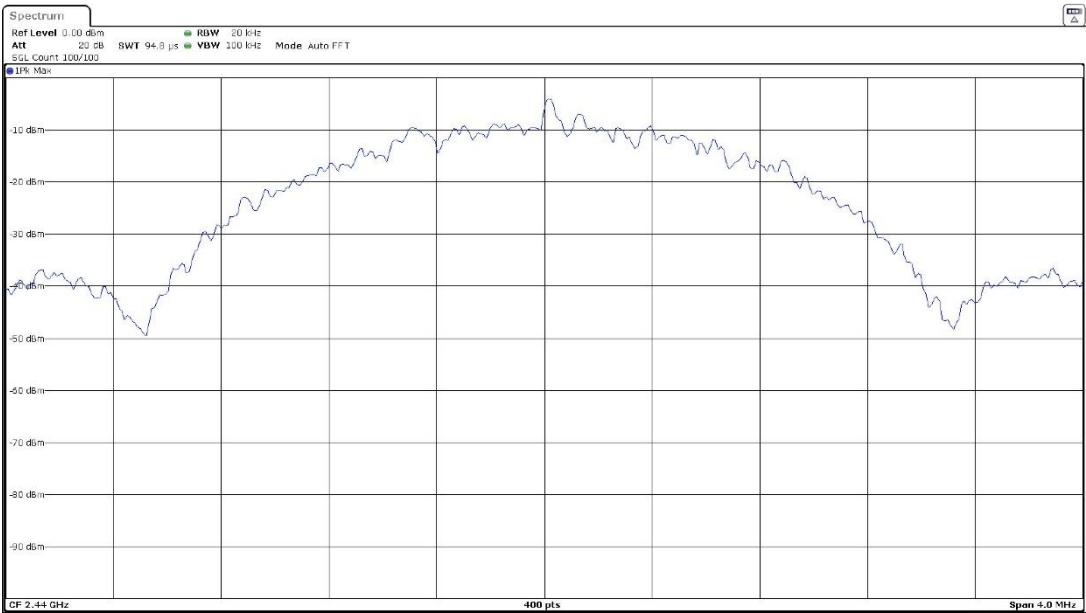
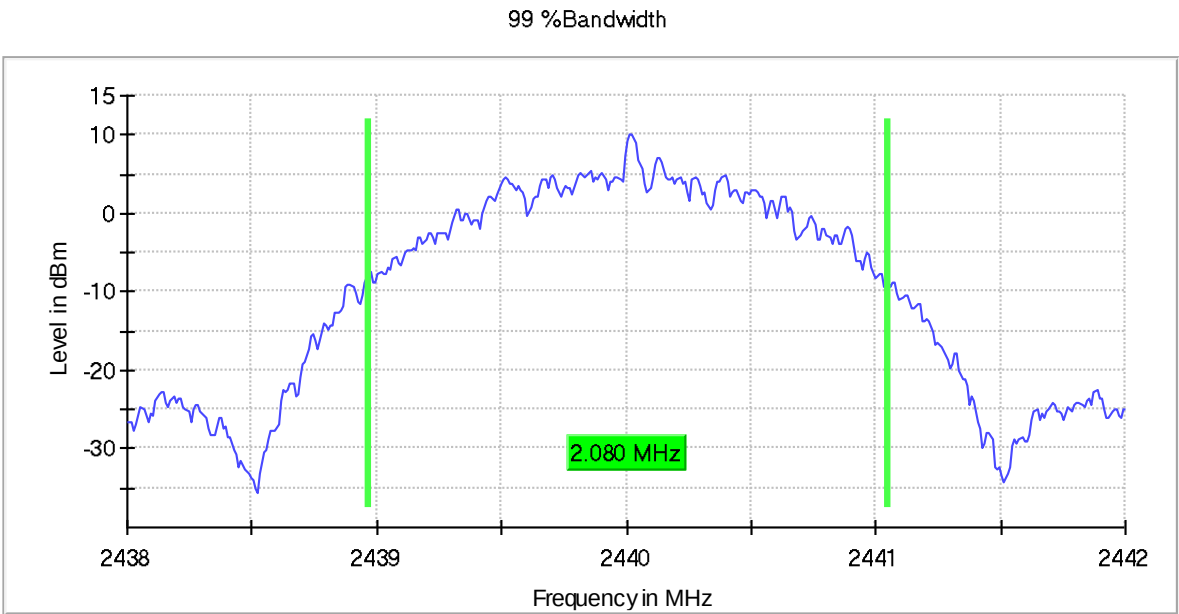
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

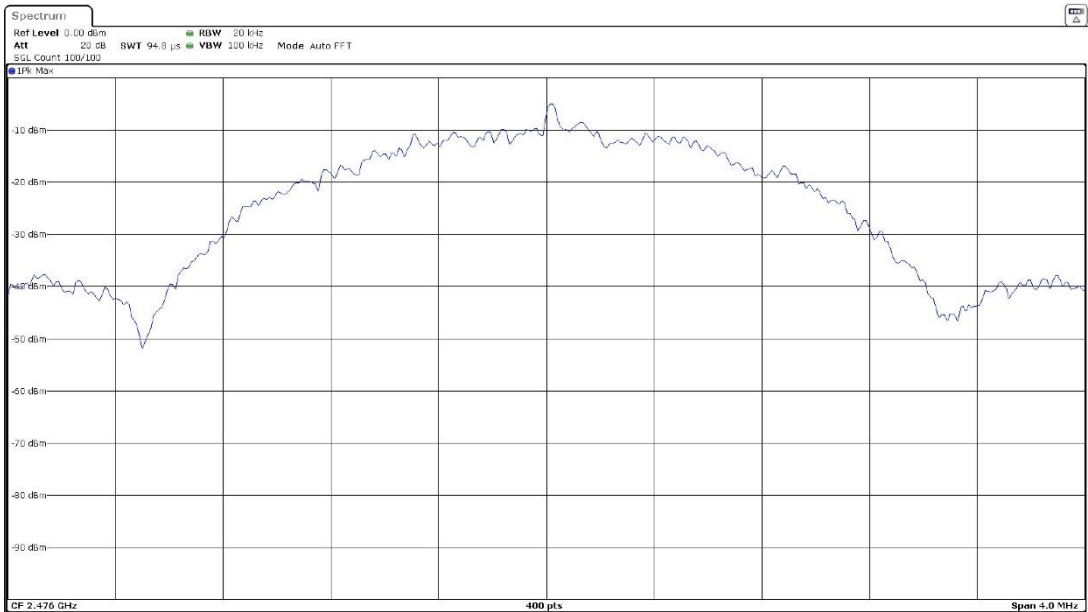
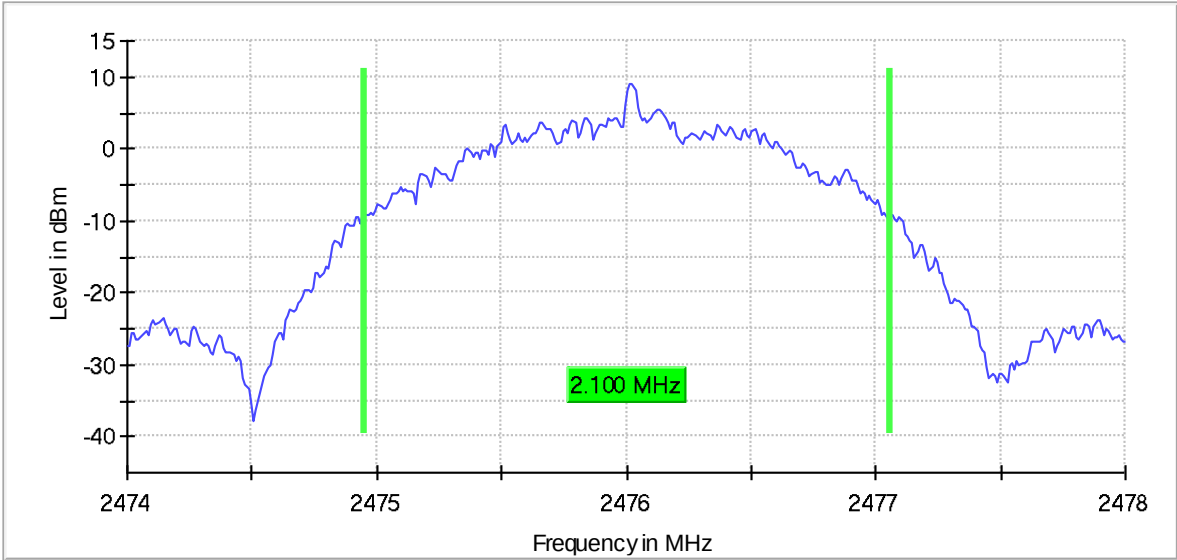
Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2476.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

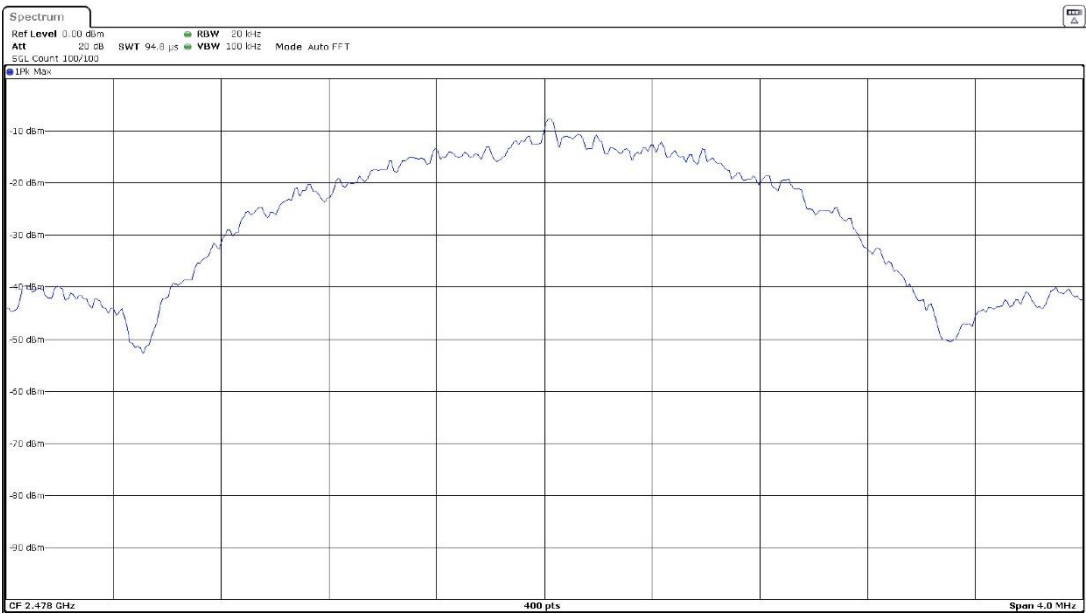
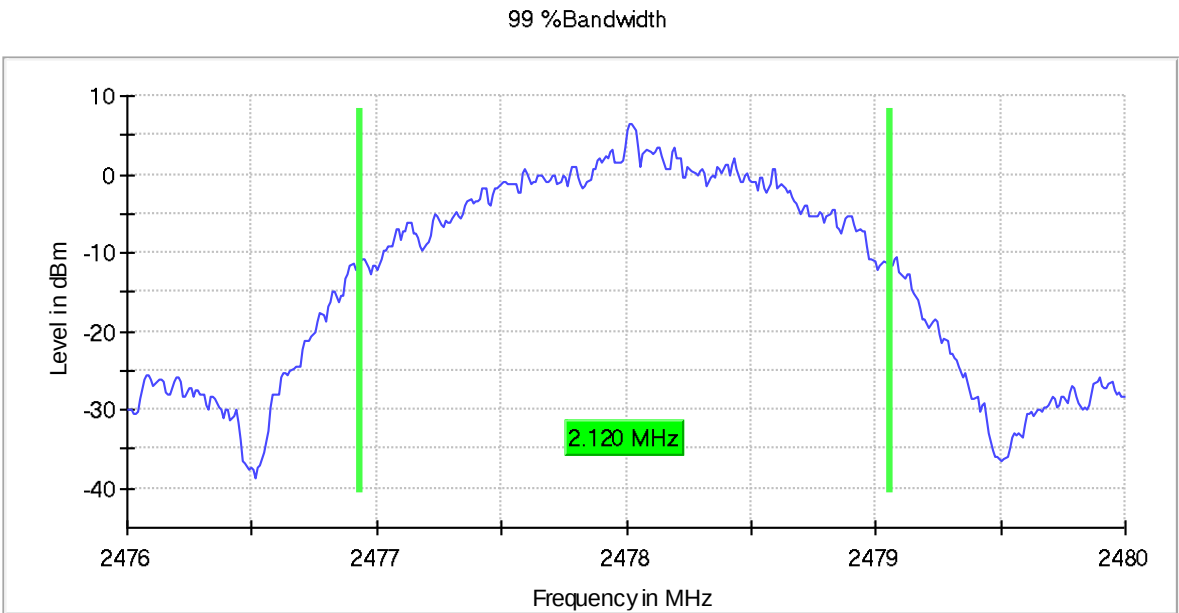
Images:

99 %Bandwidth



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	Occ Ch BW (MHz)
2402.00000	1.065
2440.00000	1.065
2480.00000	1.070

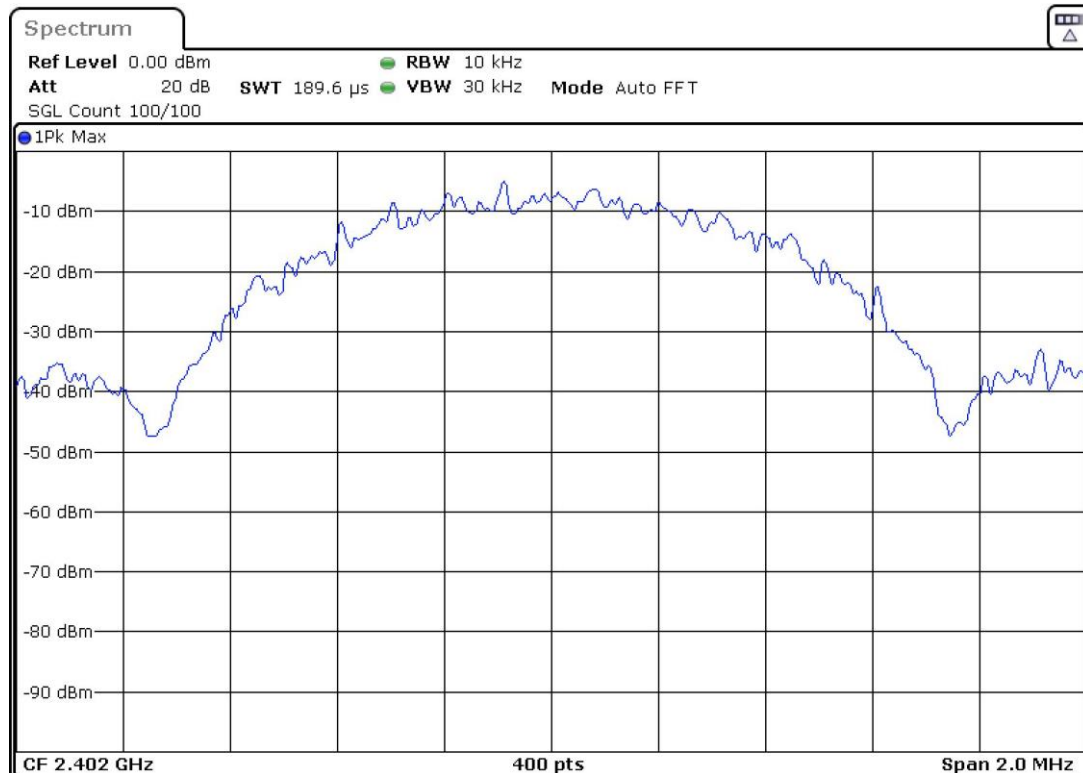
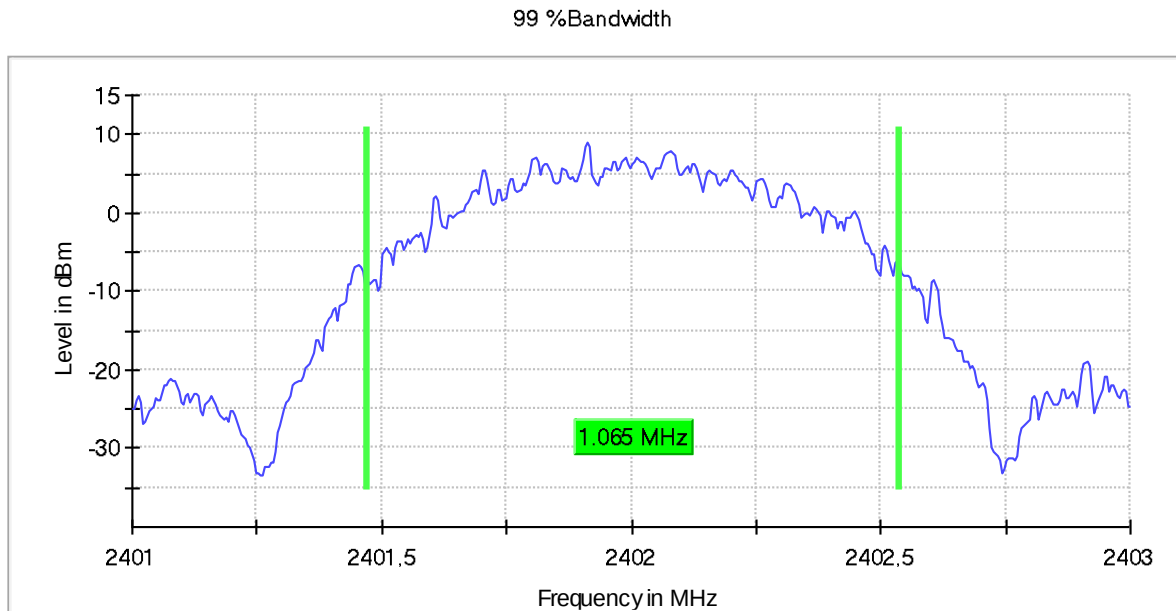
Verdict

Pass

Attachments

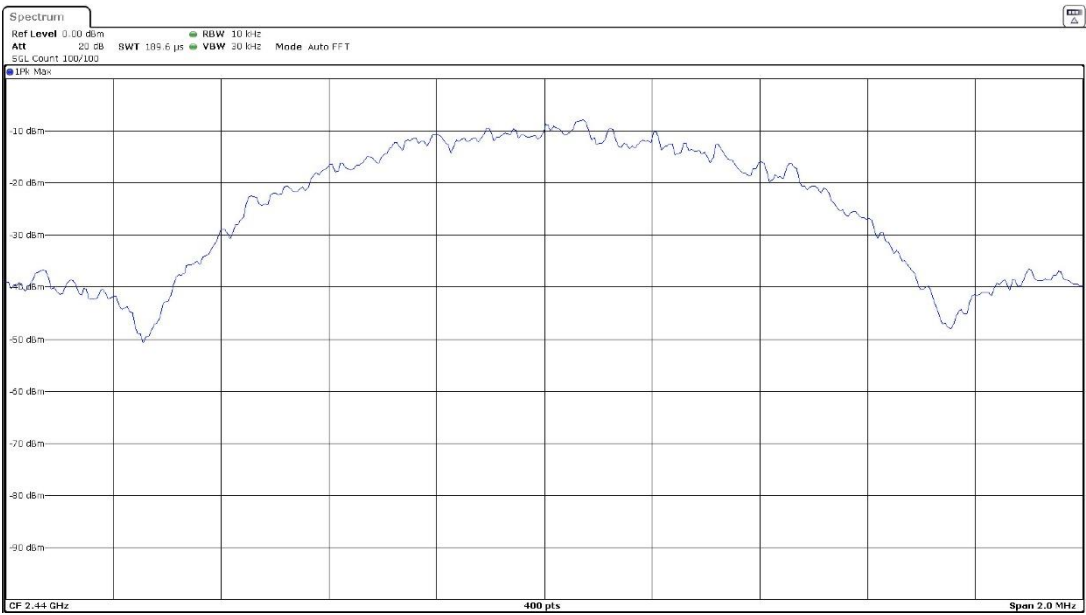
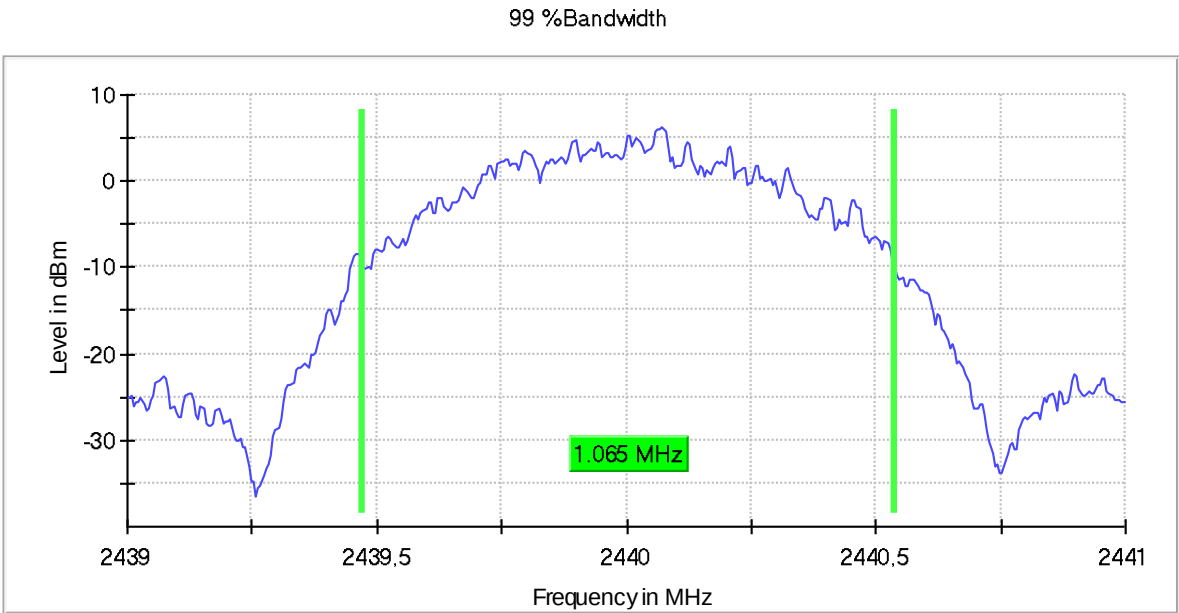
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2402.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



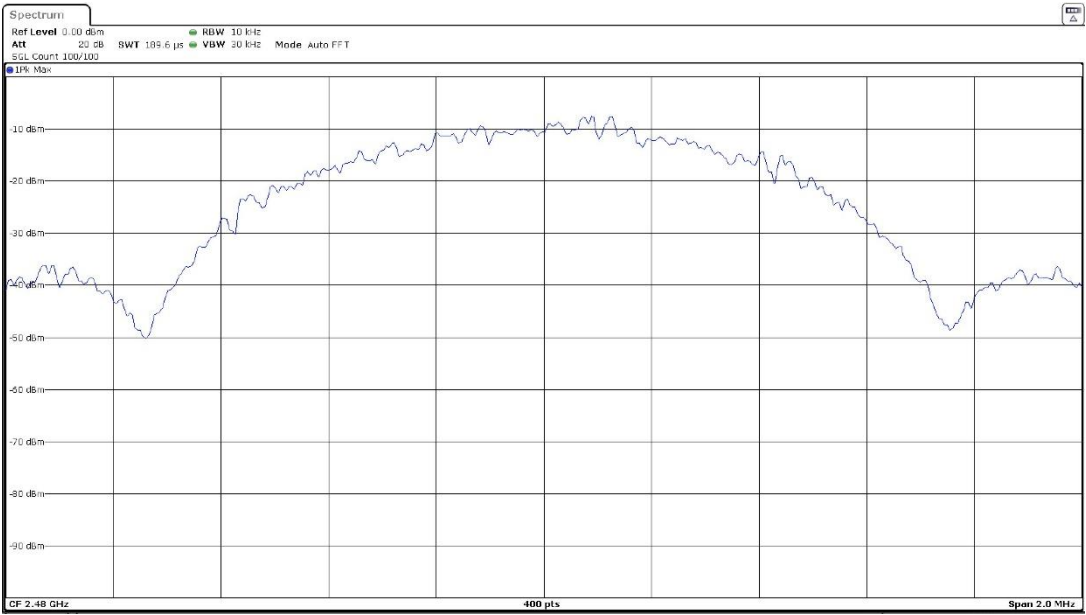
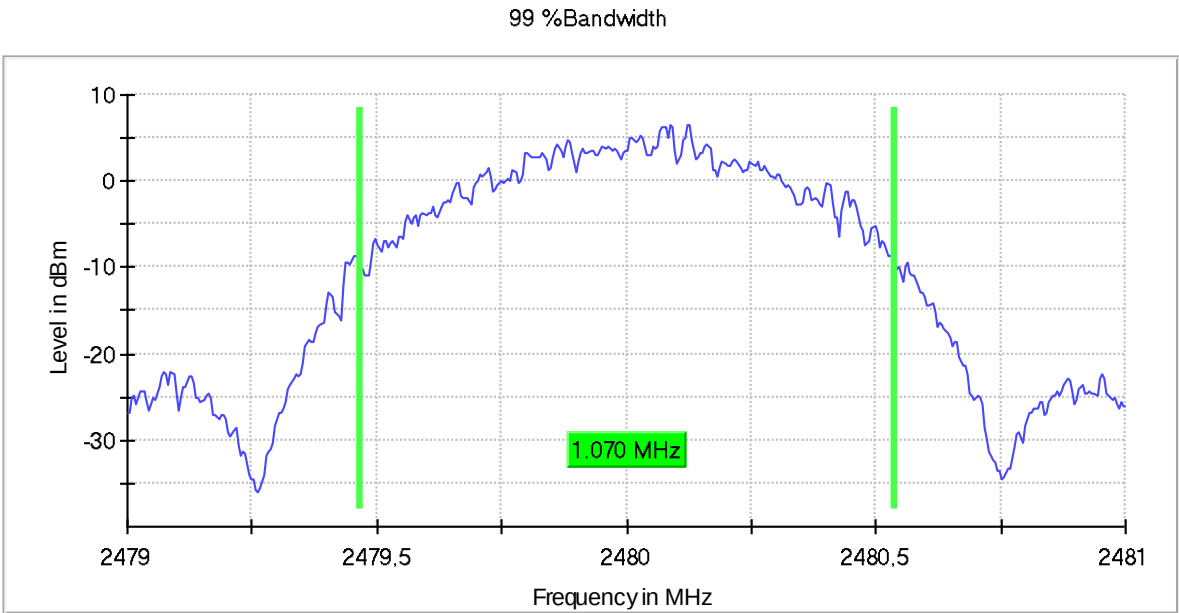
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2480.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



FCC 15.247 (b) / RSS-247 5.4. (d) Maximum Output Power and Antenna Gain

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).

Result

The maximum peak conducted output power level in the fundamental emission was measured using the method according to point 11.9.1.1 "RBW $\geq$ DTS bandwidth" of ANSI C.63.10-2013.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

Maximum Declared Antenna Gain: 1 dBi (Ch 2402MHz, Ch 2404MHz); 1.15 dBi (Ch 2440MHz);
0.63 dBi (Ch 2476 MHz); 0.59dBi (Ch 2478MHz);
0.55dBi (Ch 2480MHz)

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

	Low Channel 2404 MHz	Middle Channel 2440 MHz	High Channel 2476 MHz	High Channel 2478 MHz
Maximum Conducted Power (dBm)	16.953	14.820	14.047	11.471
Maximum EIRP Power (dBm)	17.953	15.970	15.037	12.061

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Maximum Conducted Power (dBm)	16.241	14.081	14.327
Maximum EIRP Power (dBm)	17.241	15.231	14.877

Verdict

Pass

RSS-247 5.2 (b) / FCC 15.247 (e) [Psd] 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 2 Mbit/s)

Results

Freq (MHz)	PSD (dBm)
2404.00000	7.049
2440.00000	5.302
2476.00000	4.018
2478.00000	1.688

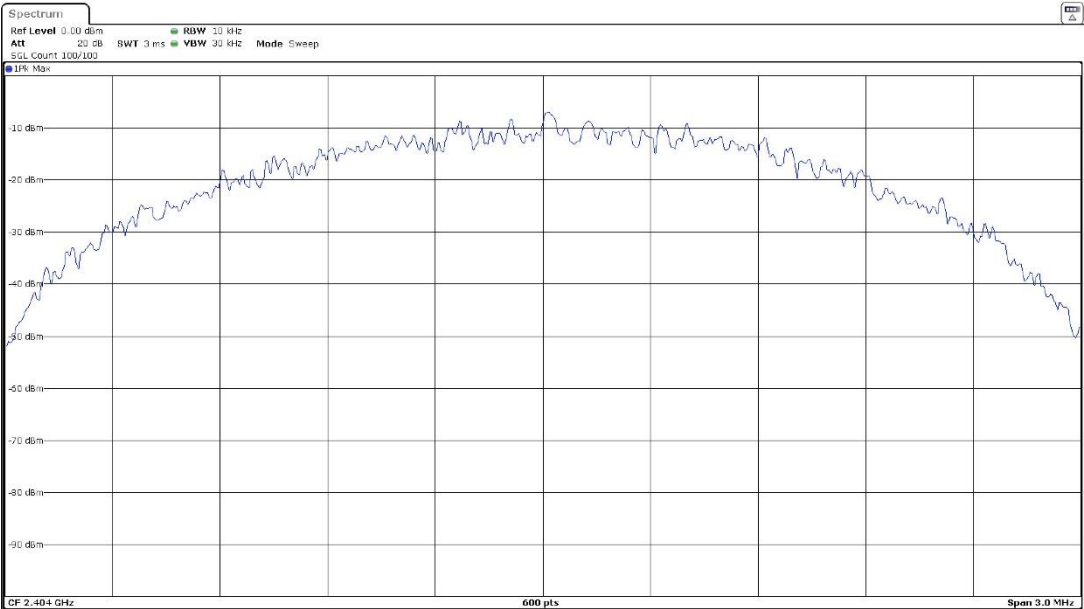
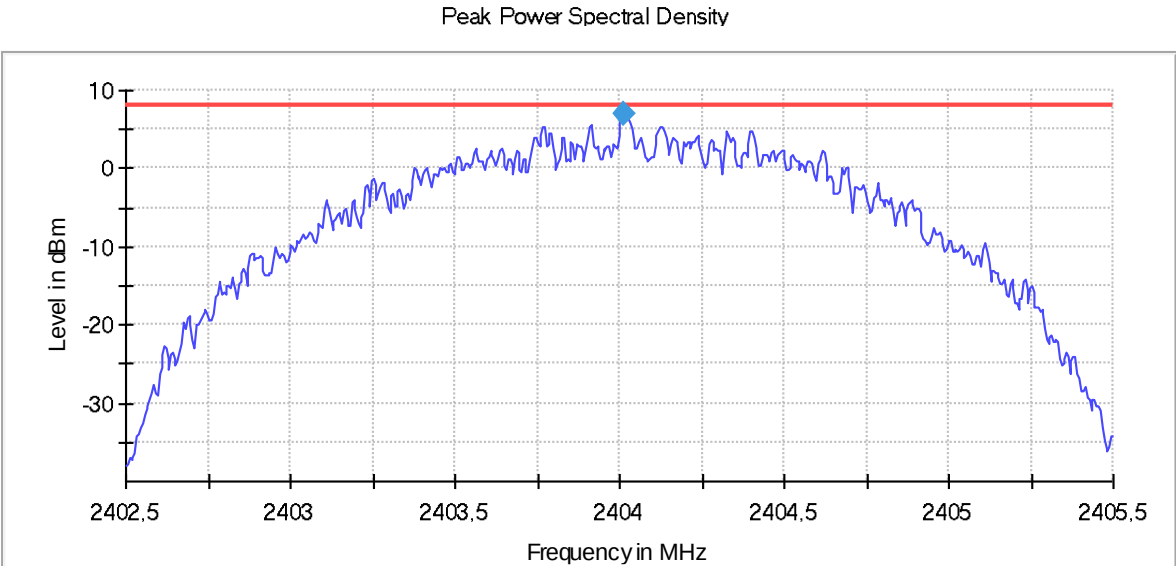
Verdict

Pass

Attachments

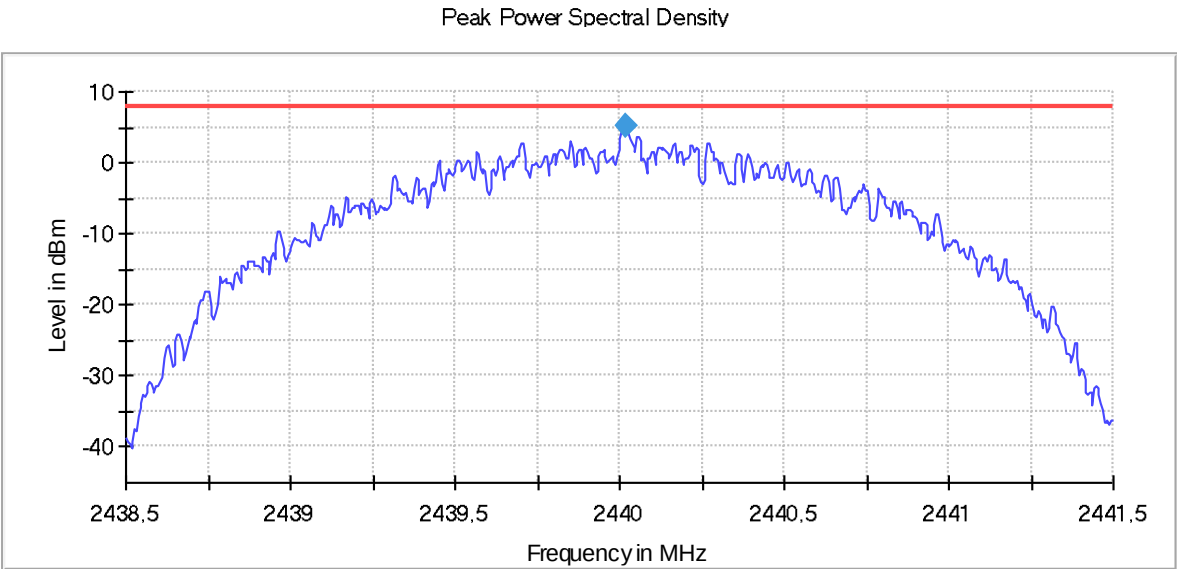
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:

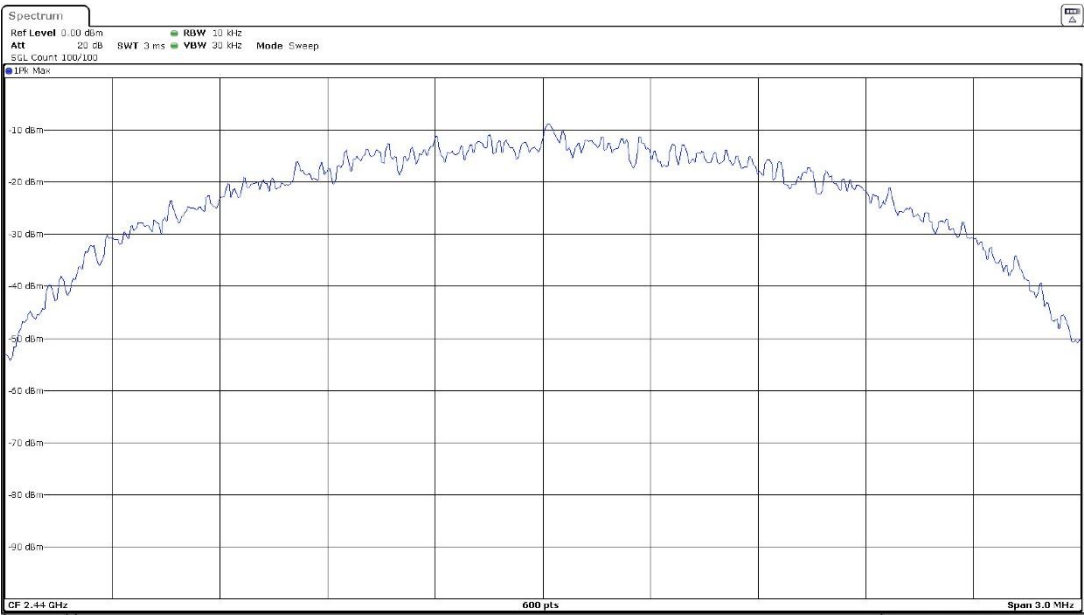


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:

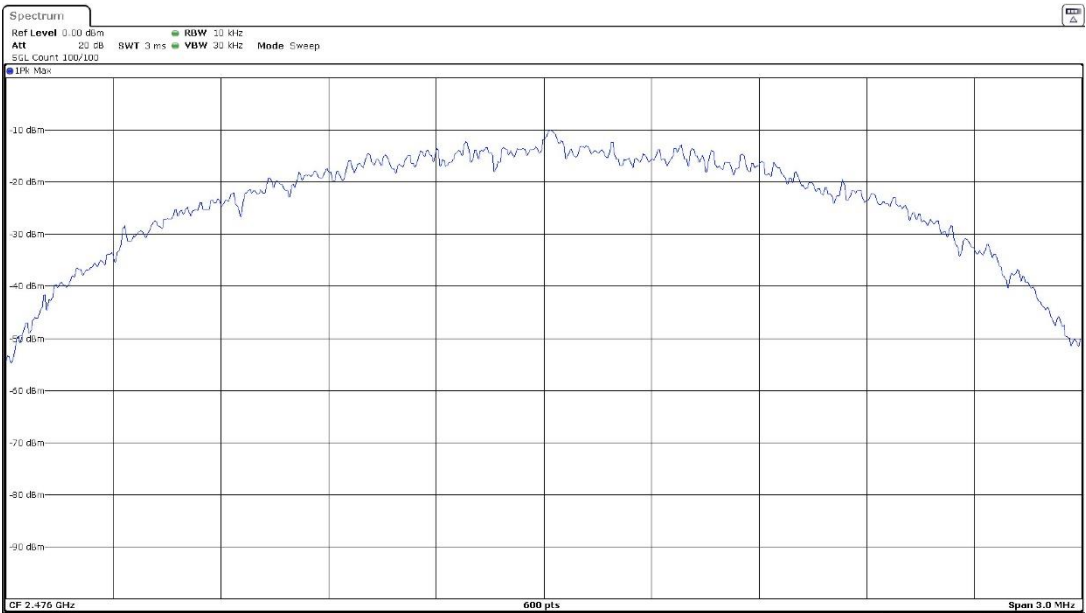
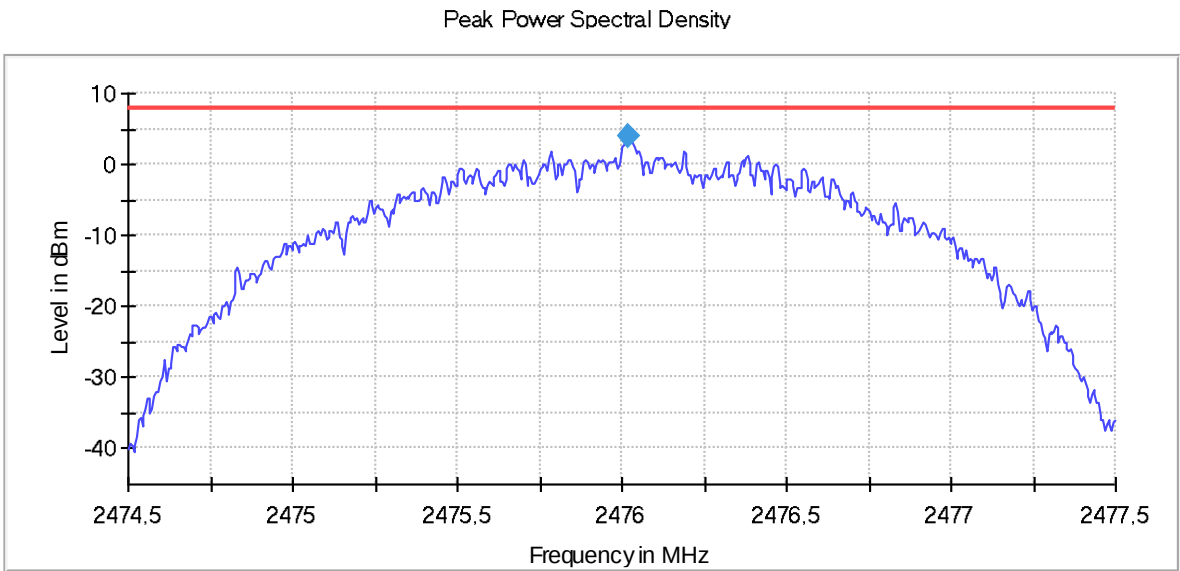


— Limit — Sum Level ◆ PSD



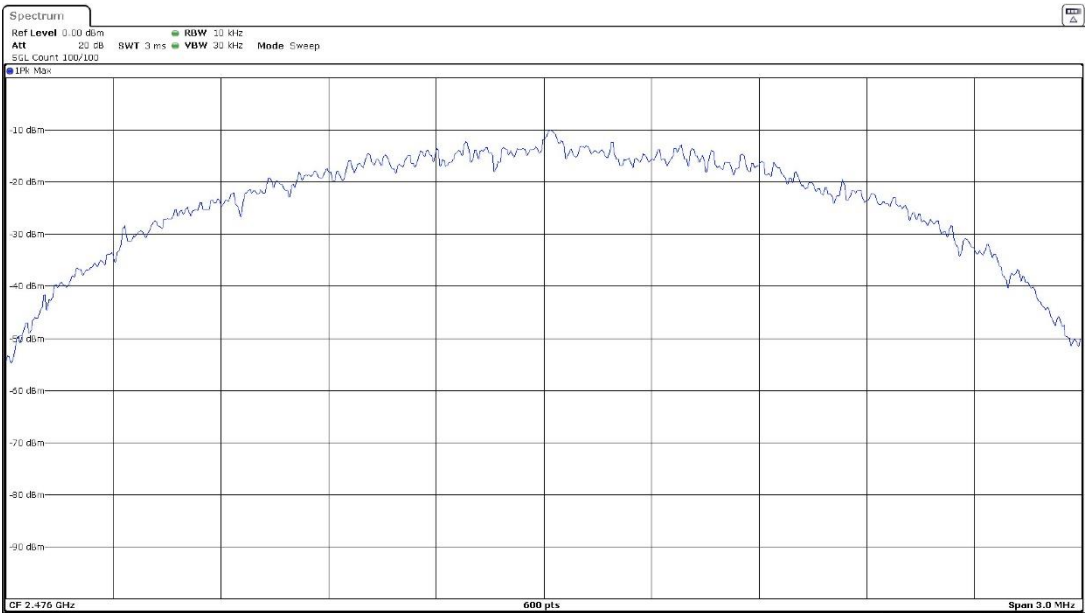
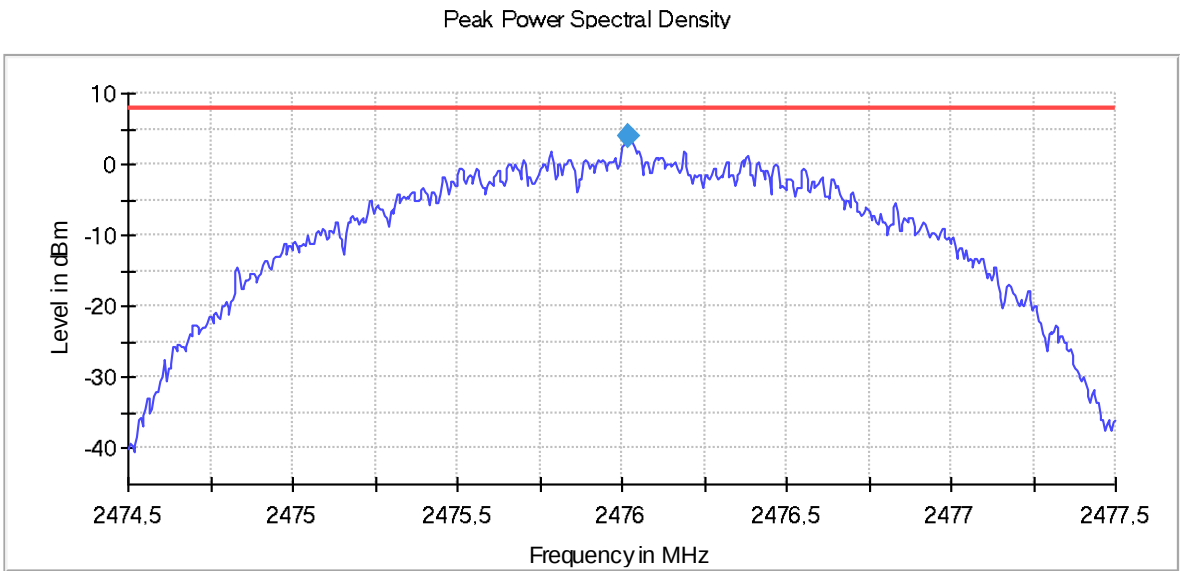
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2476.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Images:



Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Freq (MHz)	PSD (dBm)
2402.00000	2.169
2440.00000	6.474
2480.00000	6.695

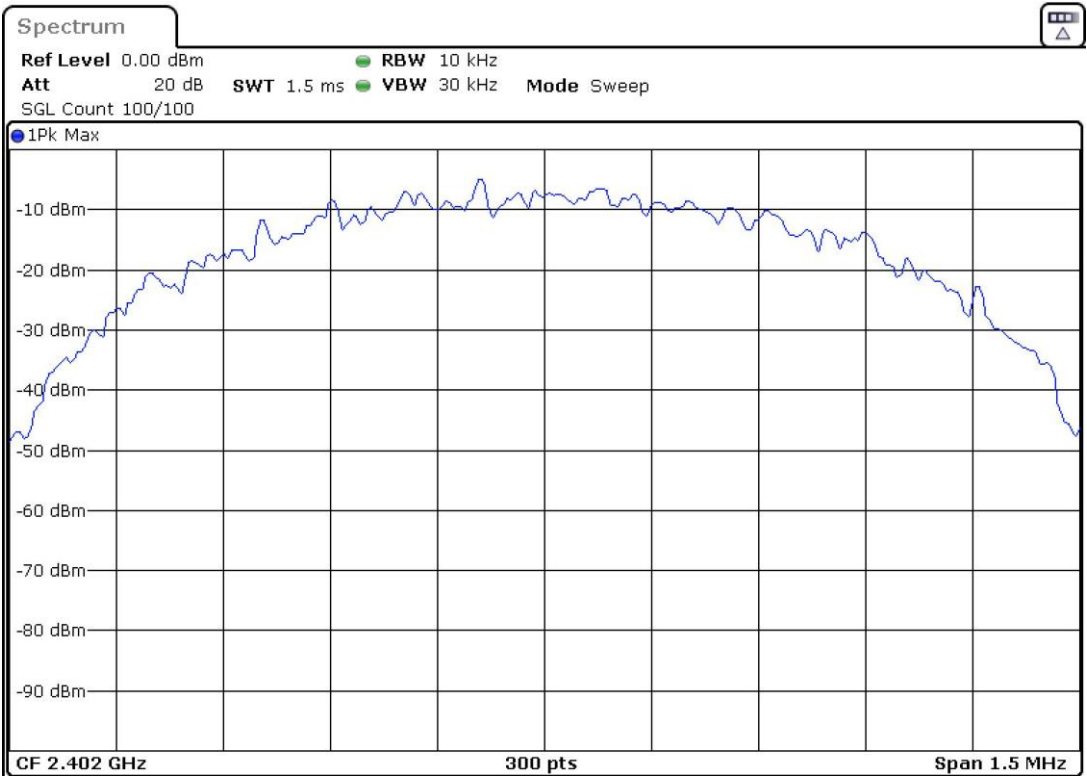
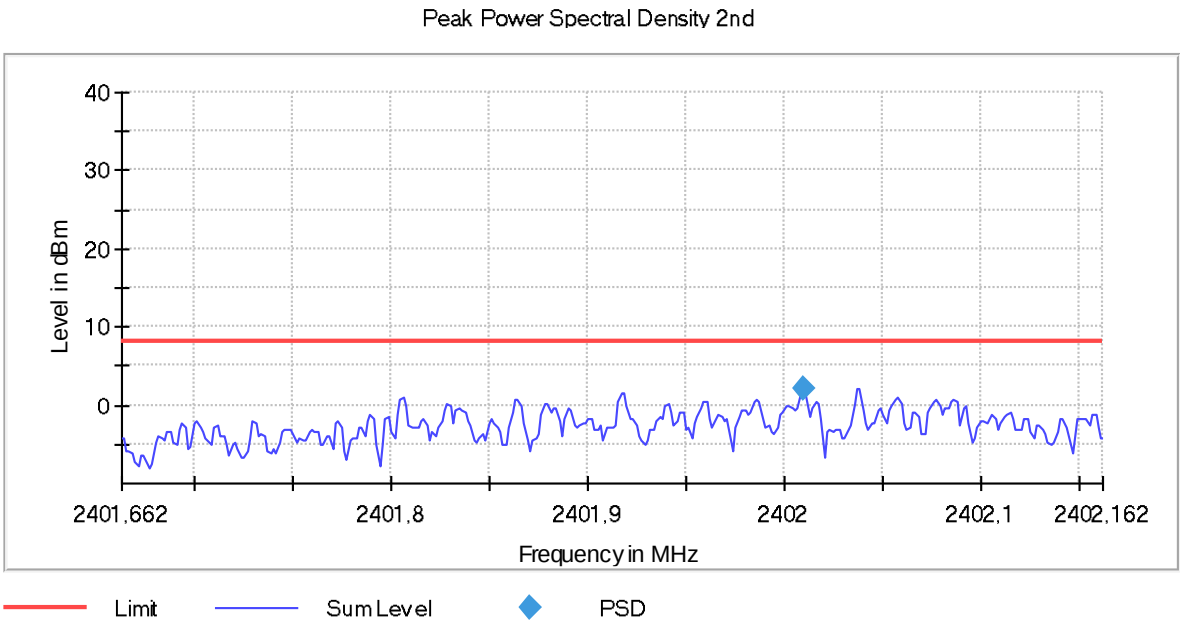
Verdict

Pass

Attachments

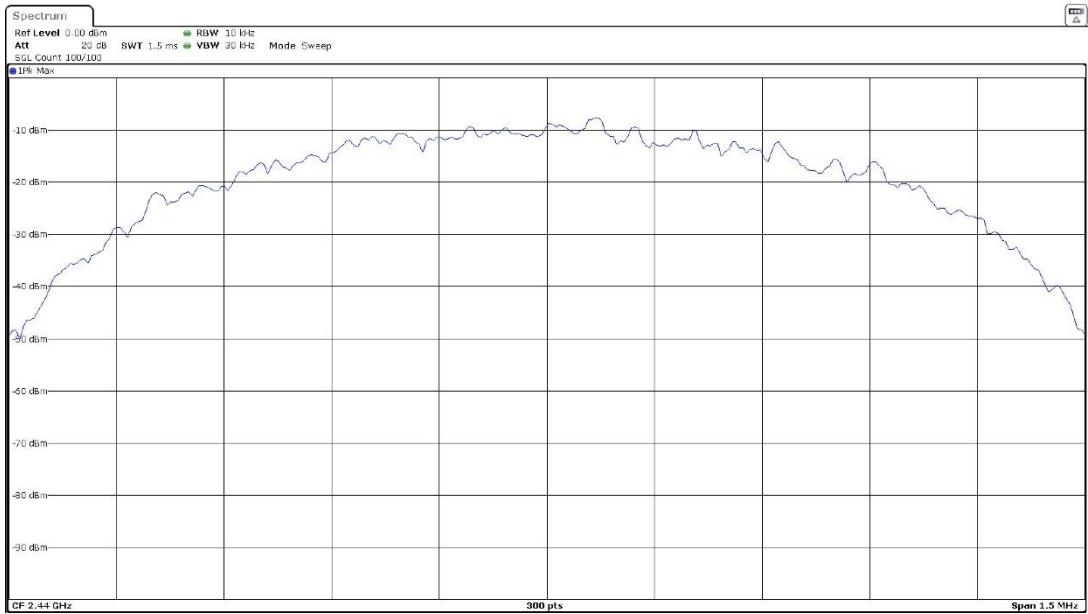
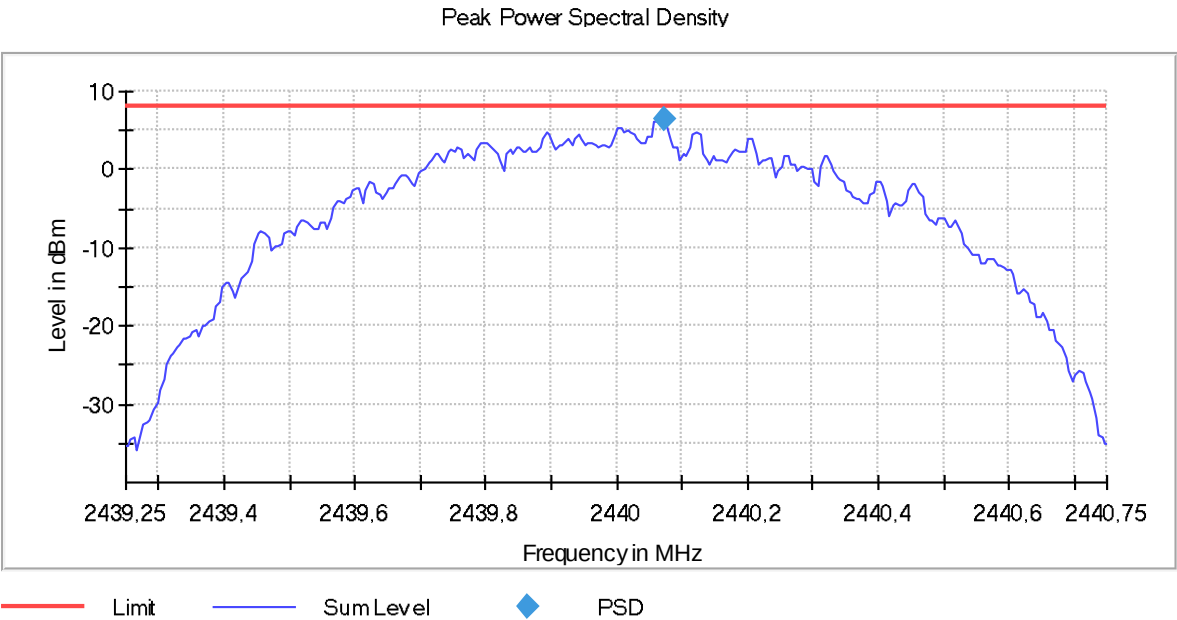
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2402.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



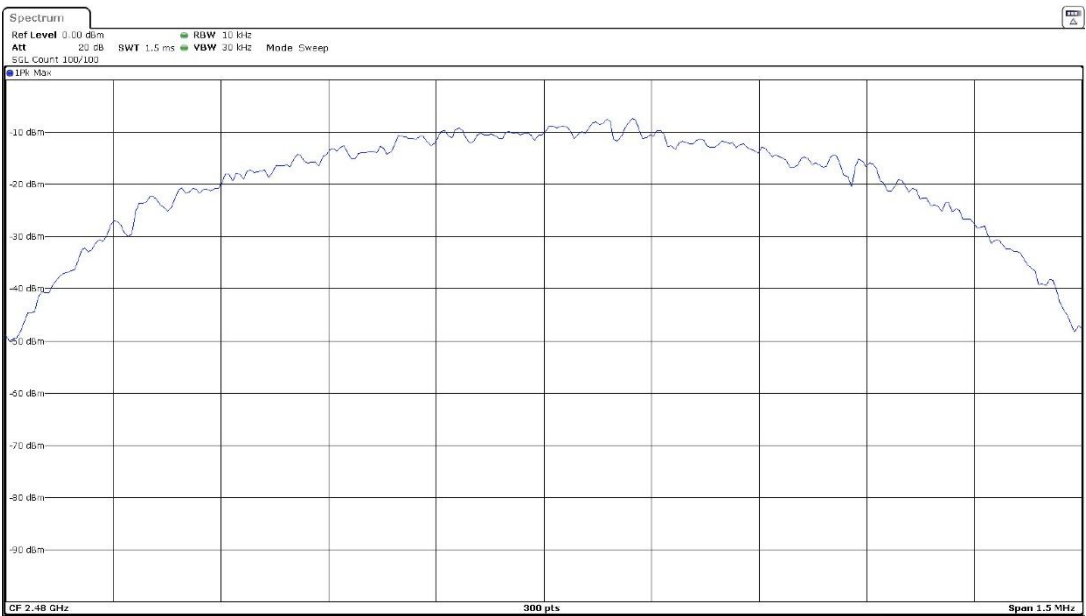
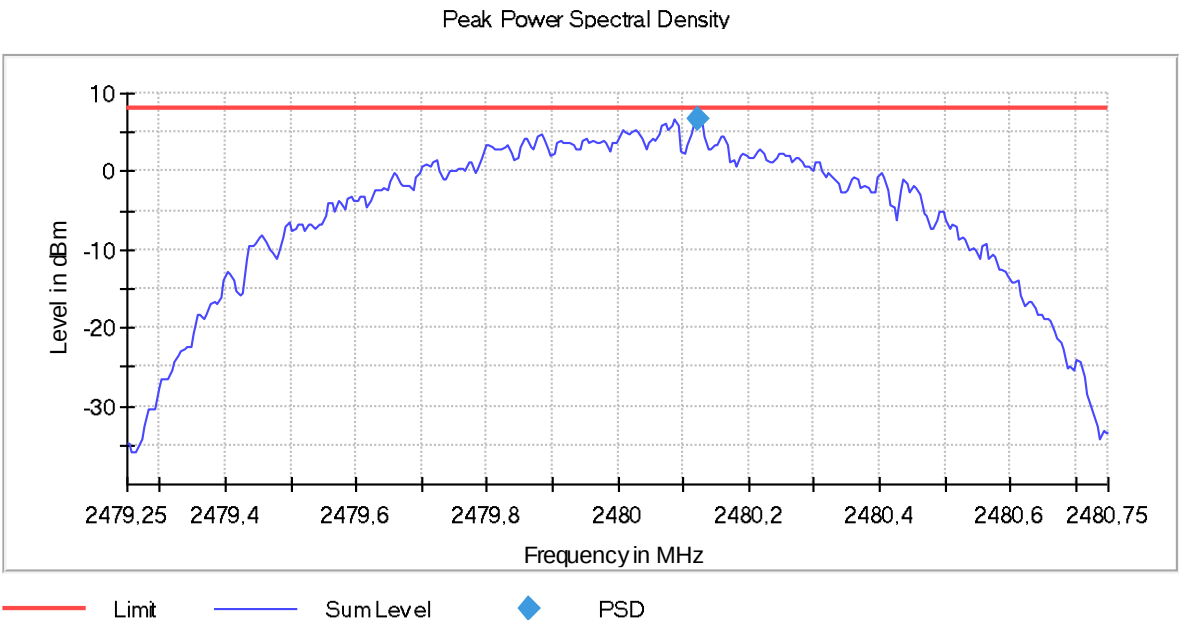
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2480.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Images:



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

Limits

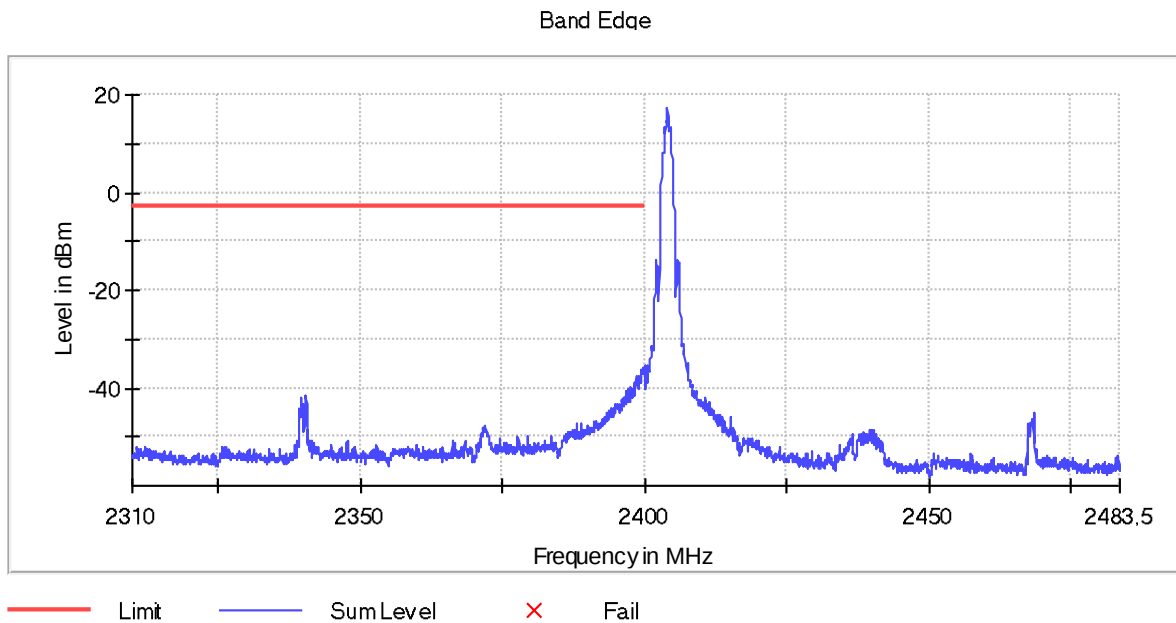
In any 100 kHz bandwidths outside the frequency band in which the intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, 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.

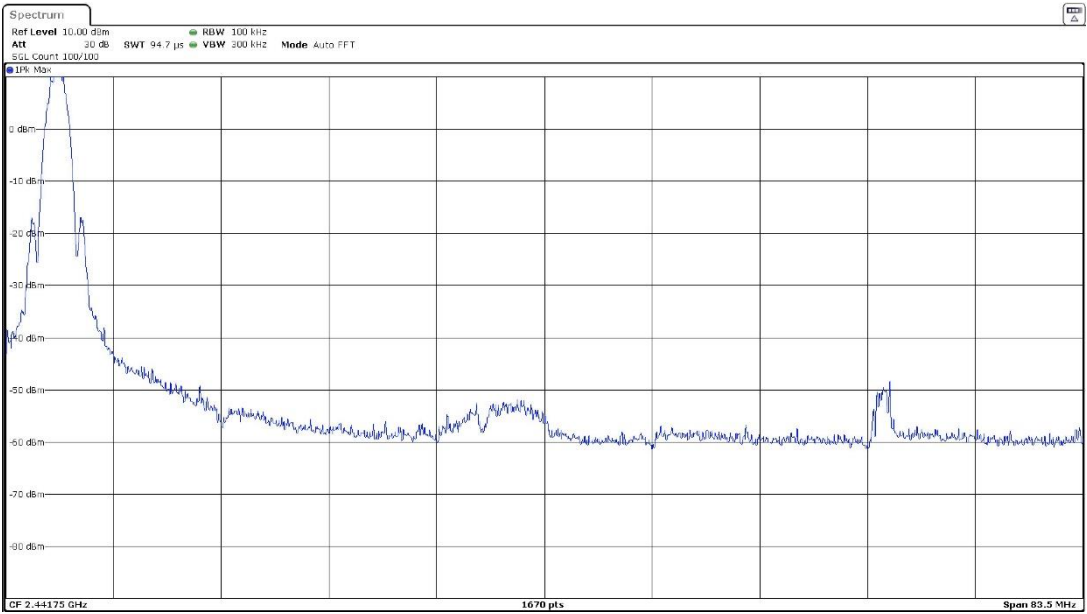
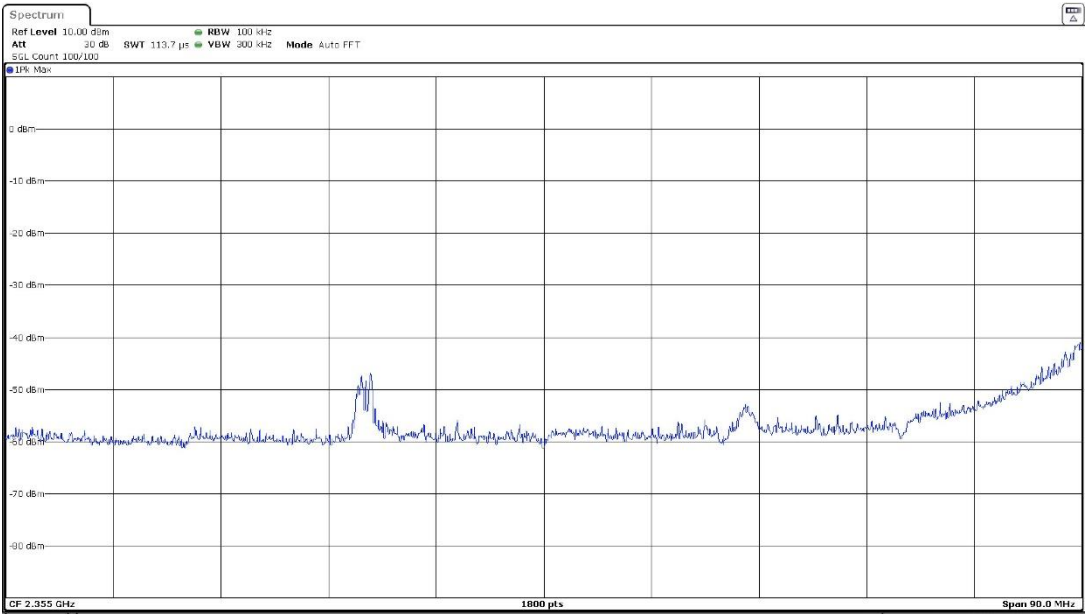
Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Attachments

Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Measurement Point = 1

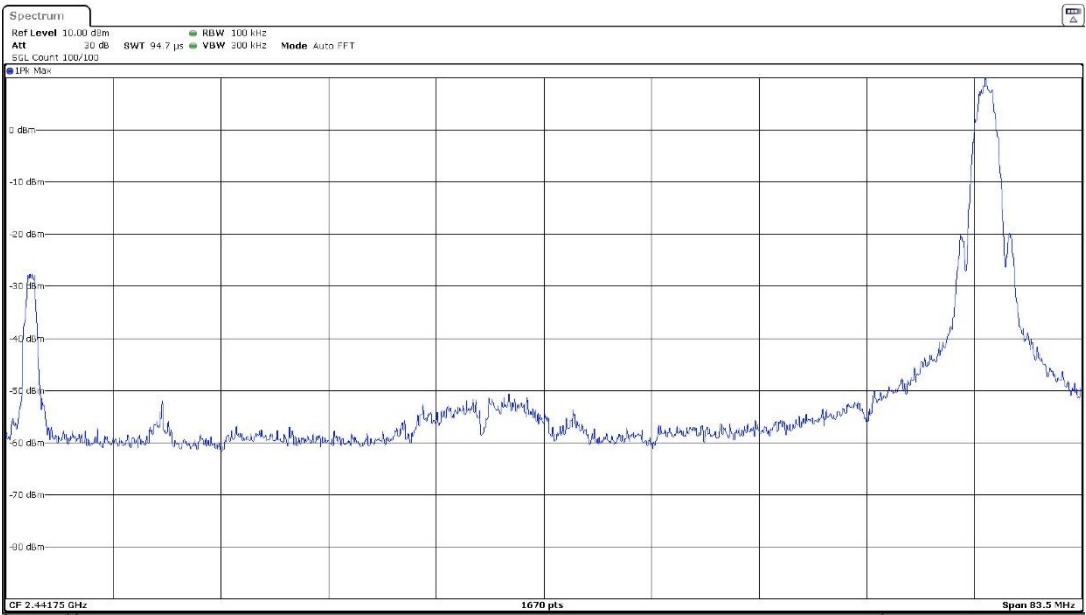
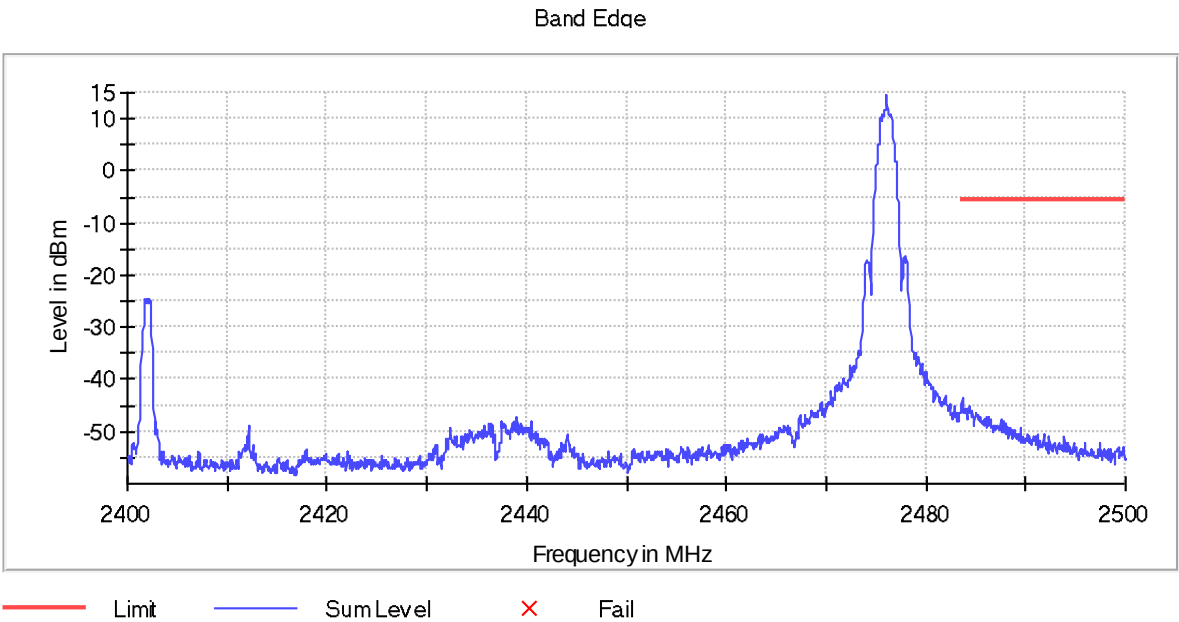
Images:

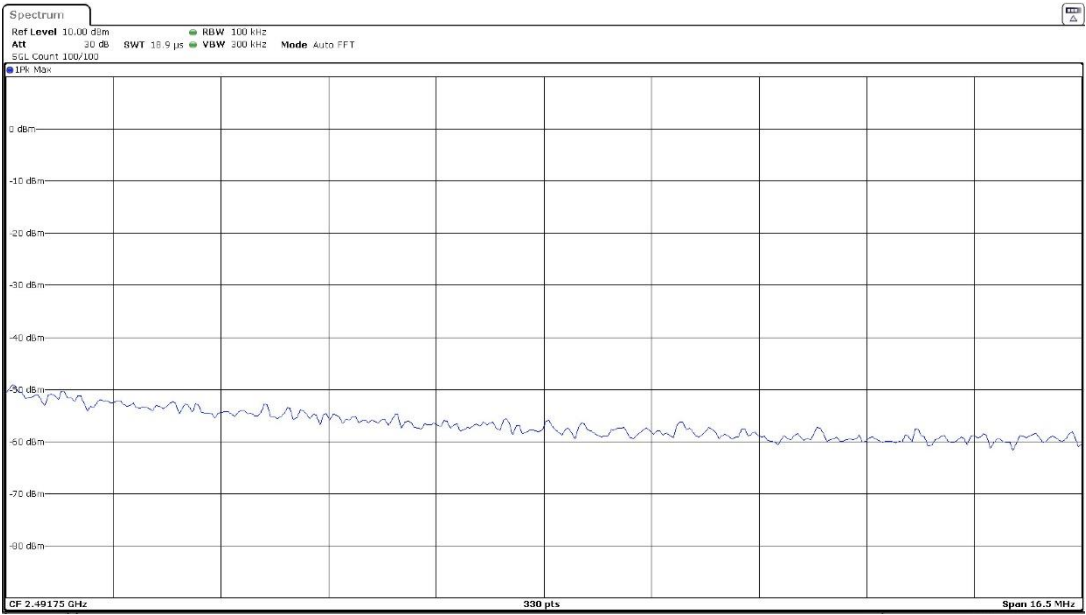




Operation Band MHz = [2400, 2483.5], Frequency MHz = 2476.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Measurement Point = 1

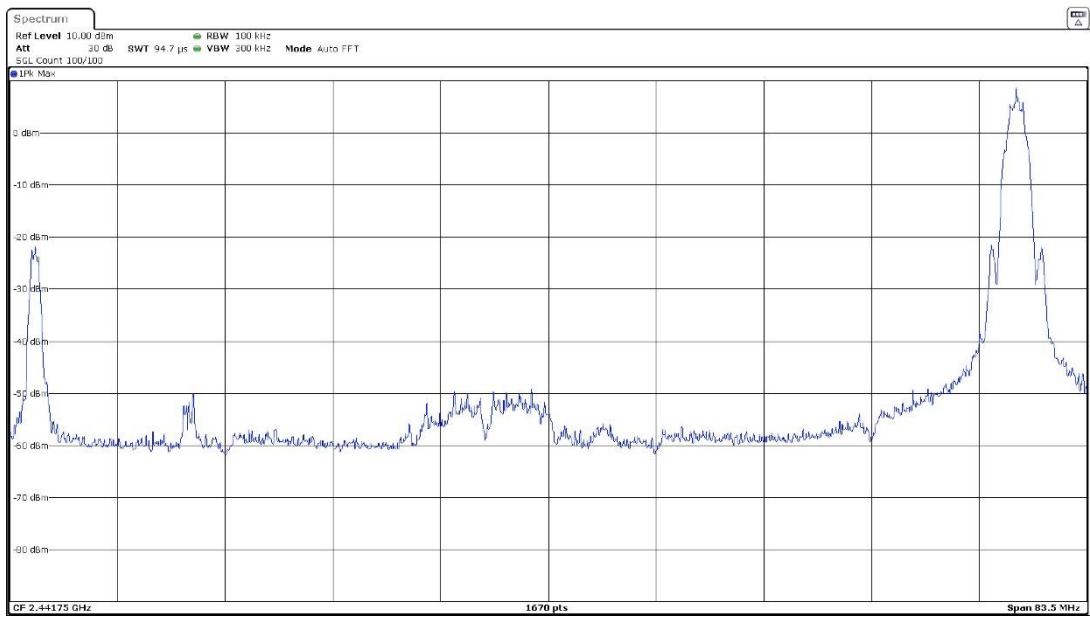
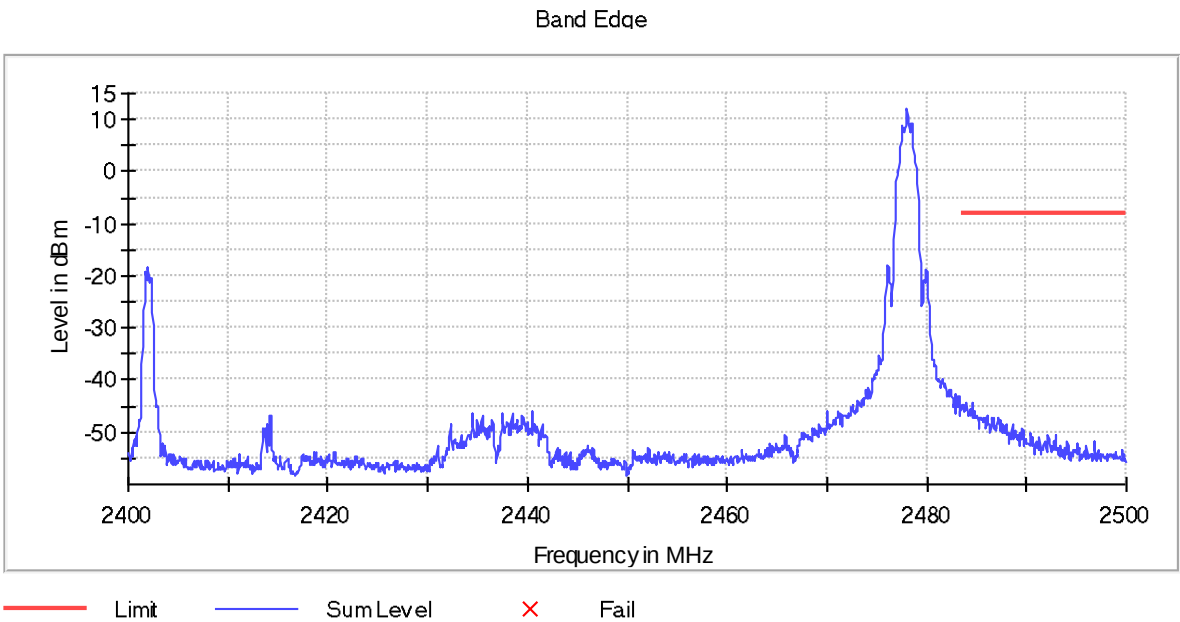
Images:

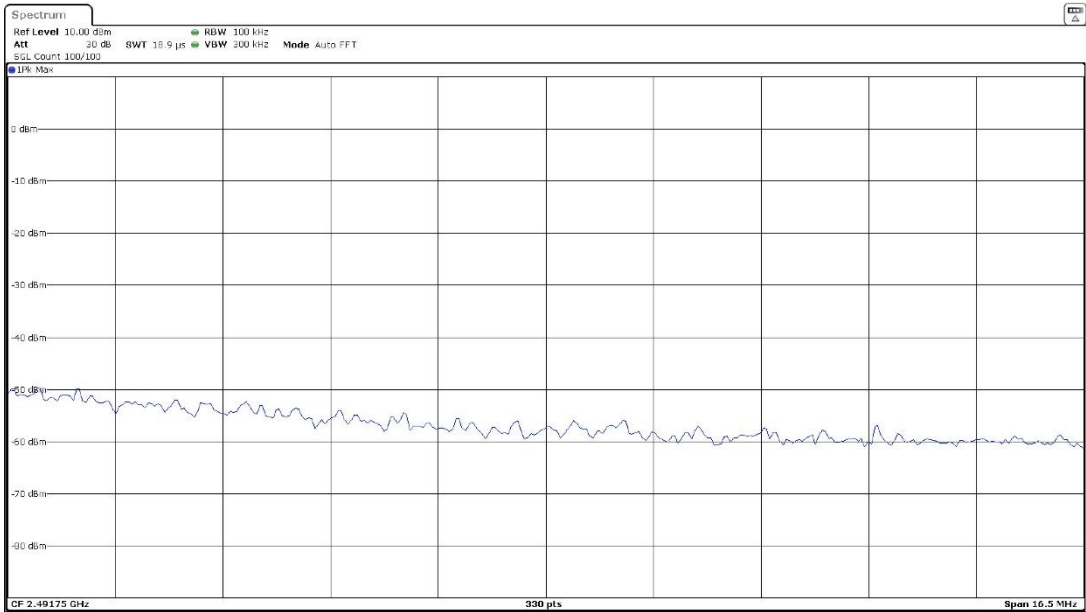




Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Measurement Point = 1

Images:





Verdict

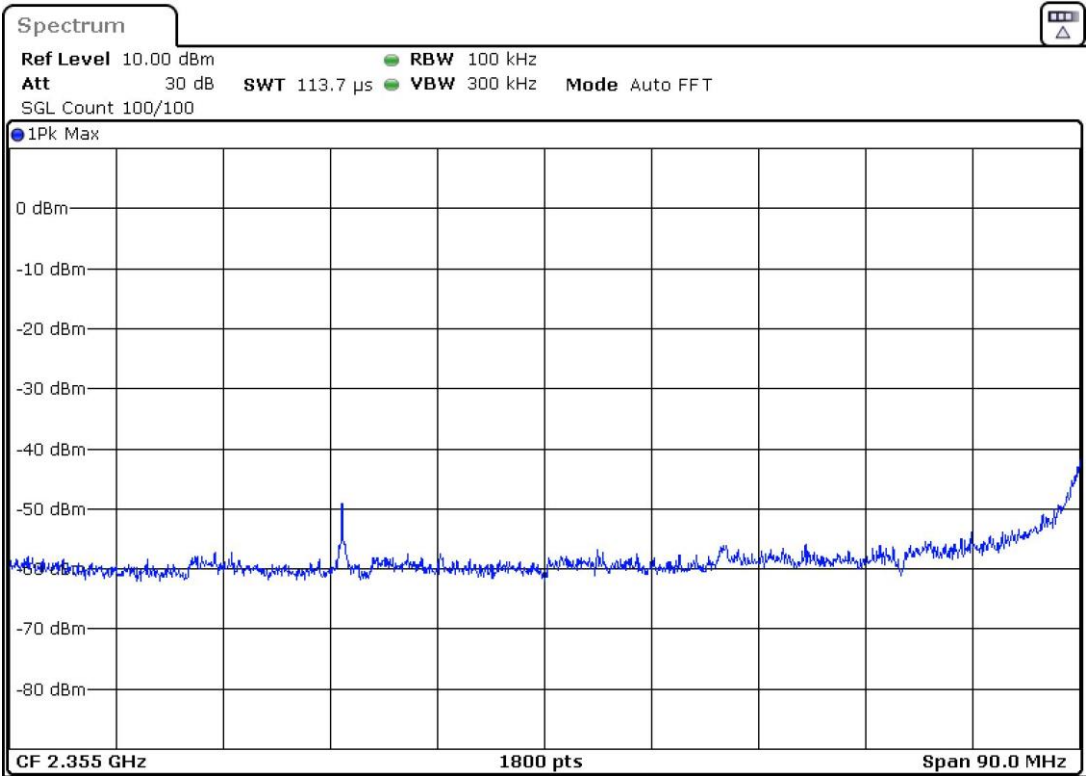
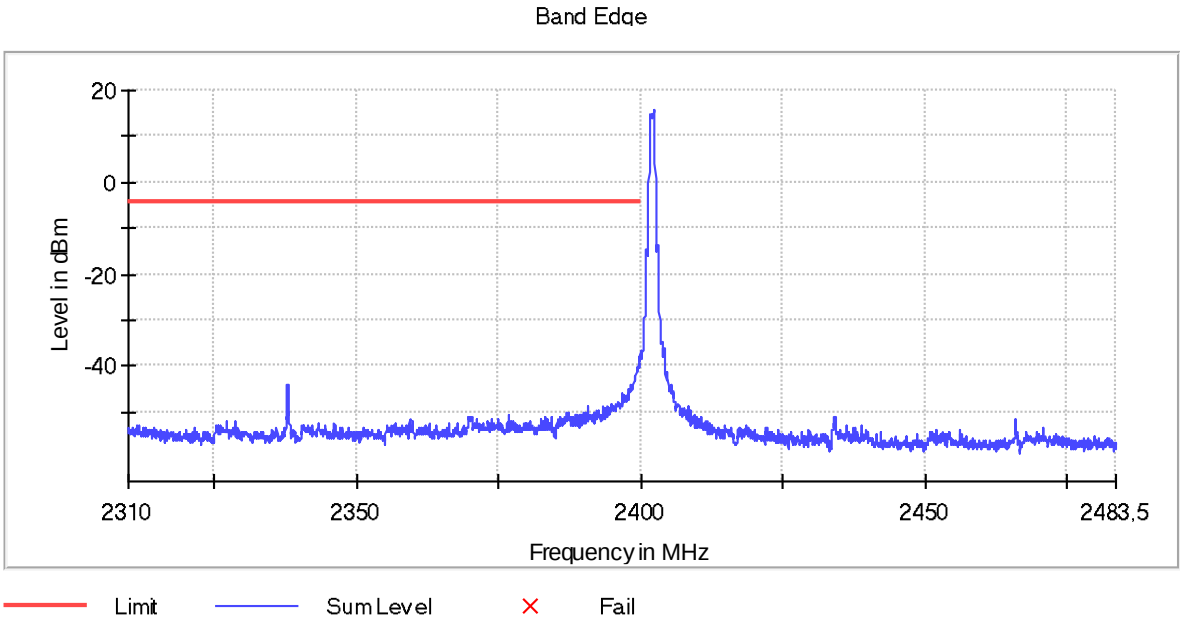
Pass

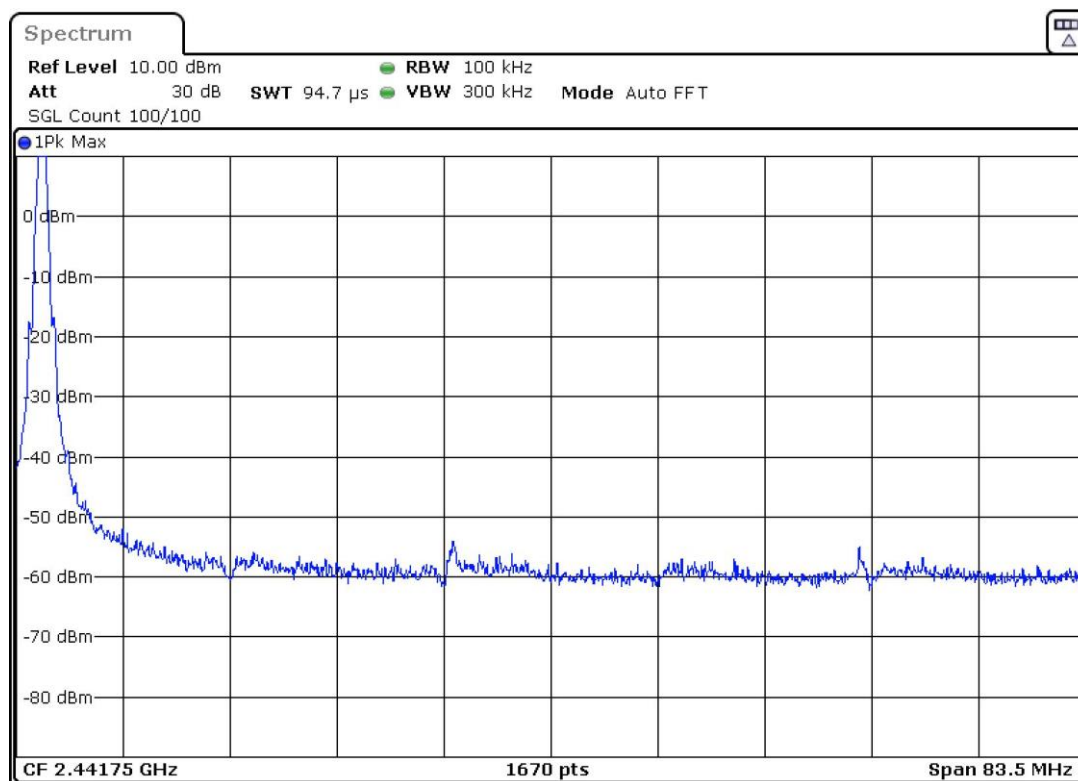
Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Attachments

Operation Band MHz = [2400, 2483.5], Frequency MHz = 2402.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s), Measurement Point = 1

Images:

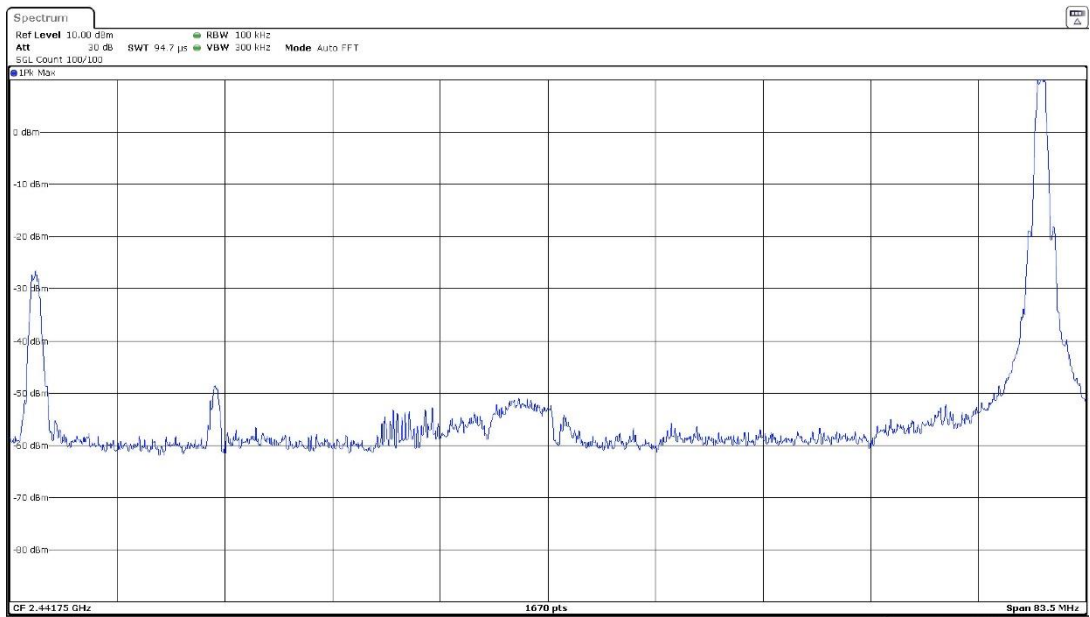
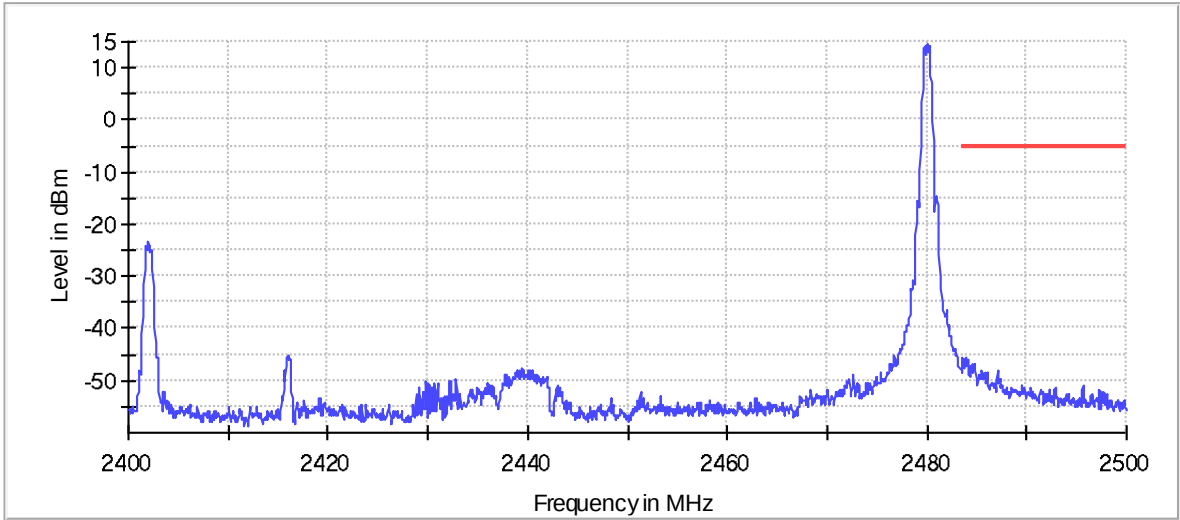


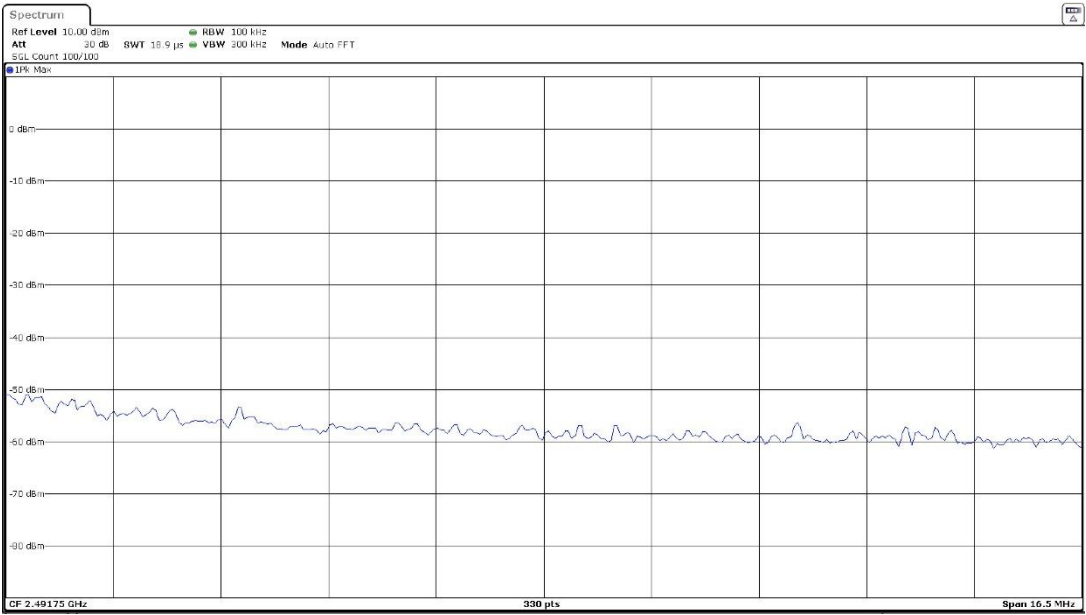


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2480.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s), Measurement Point = 1

Images:

Band Edge





Verdict

Pass

RSS-247 5.5 / FCC 15.247 (d) [RSE] 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.

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Result

Operation Band (MHz)	Freq (MHz)	Freq Rng (GHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBµV/m)	Duty cycle Correction (dB)	Corrected Unwanted Lvl (dBµV/m)	Pol	Detector
[2400, 2483.5]	2404.00000	[0.03, 1]	344.0678	32.63	--	--	H	PK
				27.92	--	--	H	QP
	2404.00000	[1, 3]	2340.2500	65.60	--	--	V	PK
				50.72	2.95	53.67	V	AVG
	2440.00000	[1, 3]	2376.5000	60.59	--	--	V	PK
				47.14	2.95	51.75	V	AVG
	2474.00000	[1, 3]	2484.0000	61.44	--	--	V	PK
				48.80	2.95	51.75	V	AVG
	2476.00000	[1, 3]	2484.0000	63.04	--	--	V	PK
				50.77	2.95	53.72	V	AVG
	2478.00000	[1, 3]	2484.0000	64.87	--	--	V	PK
				50.68 (*)	2.95	53.63	V	AVG
	2404.00000	[3, 17]	4807.7500	59.83	--	--	V	PK
				49.16	2.95	52.11	V	AVG
	2404.00000	[3, 17]	7213.1250	55.77 (**)	--	--	H	PK
	2404.00000	[3, 17]	9618.0625	64.84 (**)	--	--	H	PK
	2440.00000	[3, 17]	4879.7295	58.98	--	--	V	PK
				46.67	2.95	49.62	V	AVG
	2440.00000	[3, 17]	7318.6435	56.34	--	--	H	PK
				47.36	2.95	50.31	H	AVG
	2440.00000	[3, 17]	9760.0525	63.60 (***)	--	--	H	PK
	2478.00000	[3, 17]	4954.7500	50.78	--	--	V	PK
	2478.00000	[3, 17]	7432.7500	50.74	--	--	H	PK

(*) For emissions in restricted band, the integration method was used according to ANSI C63.10-2013 Section 11.13.3.

(**) This spurious frequency is outside restricted bands as defined in §15.209(a). The measured maximum carrier level at 3m is 115.16 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

(***) This spurious frequency is outside restricted bands as defined in §15.209(a). The measured maximum carrier level at 3m is 113.76 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

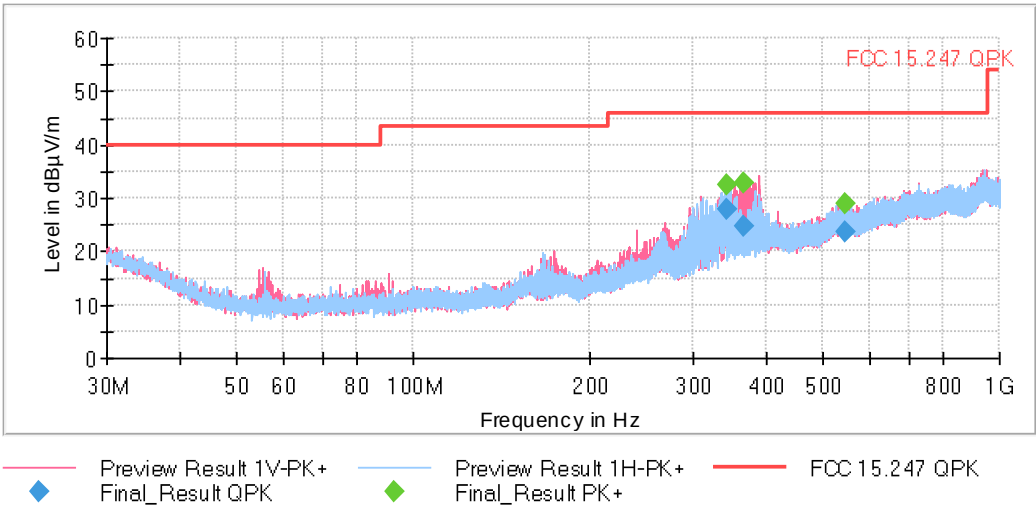
Verdict

Pass

Attachments

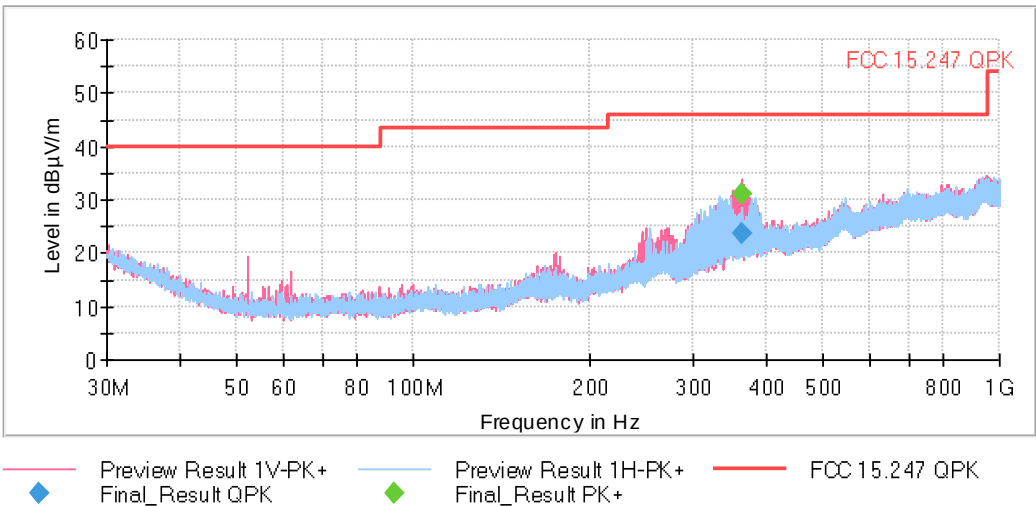
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [0.03, 1], Measurement Point = 1

Images:



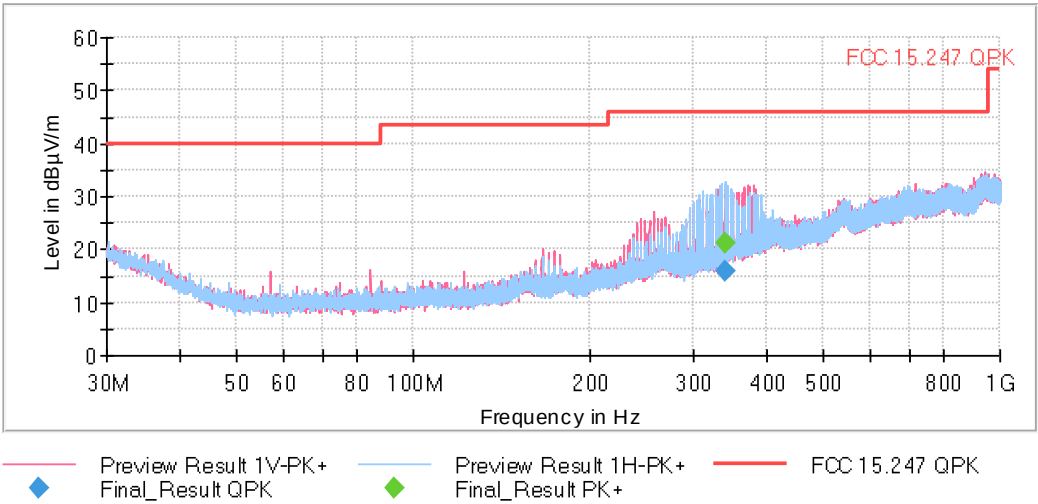
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [0.03, 1], Measurement Point = 1

Images:



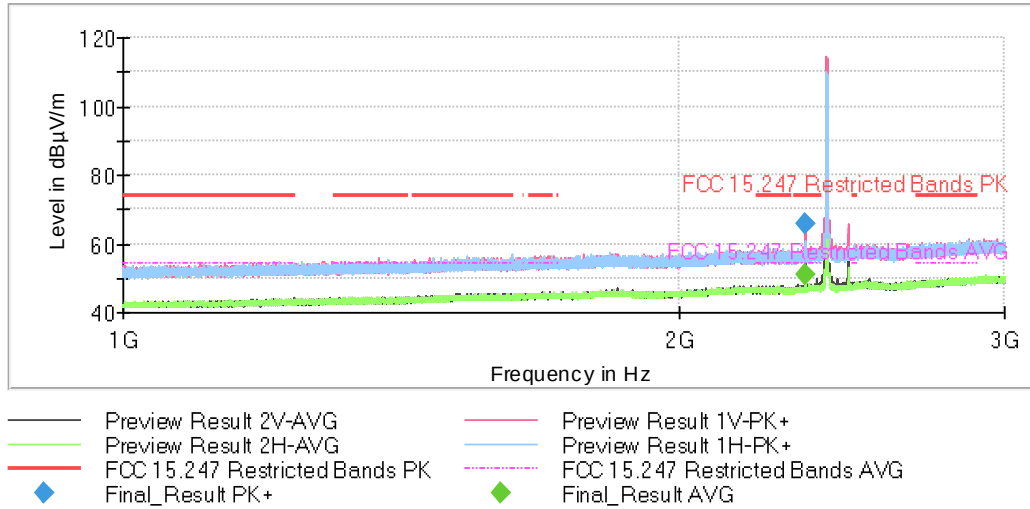
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [0.03, 1],
Measurement Point = 1

Images:

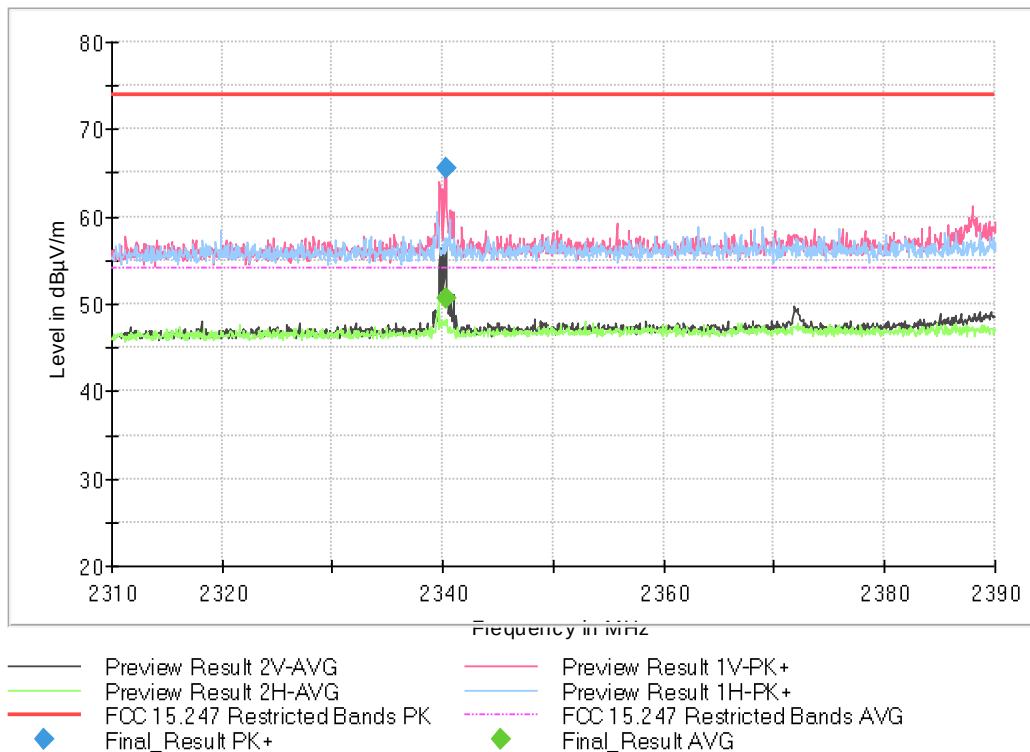


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 3], Measurement Point = 1

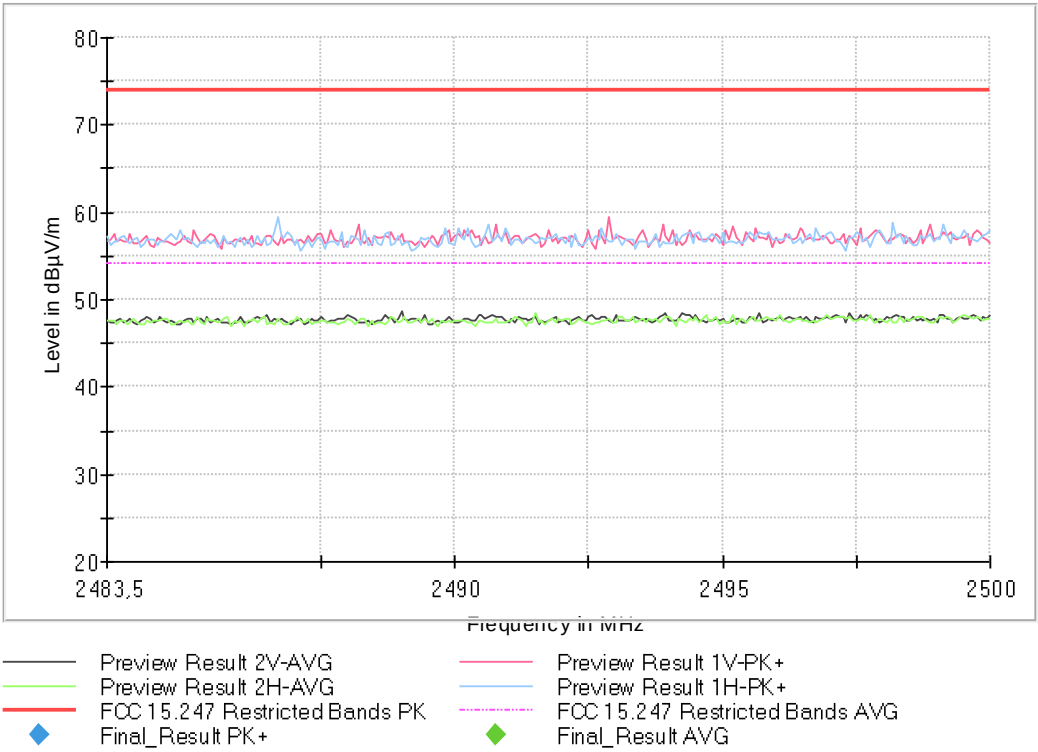
Images:



Full Spectrum

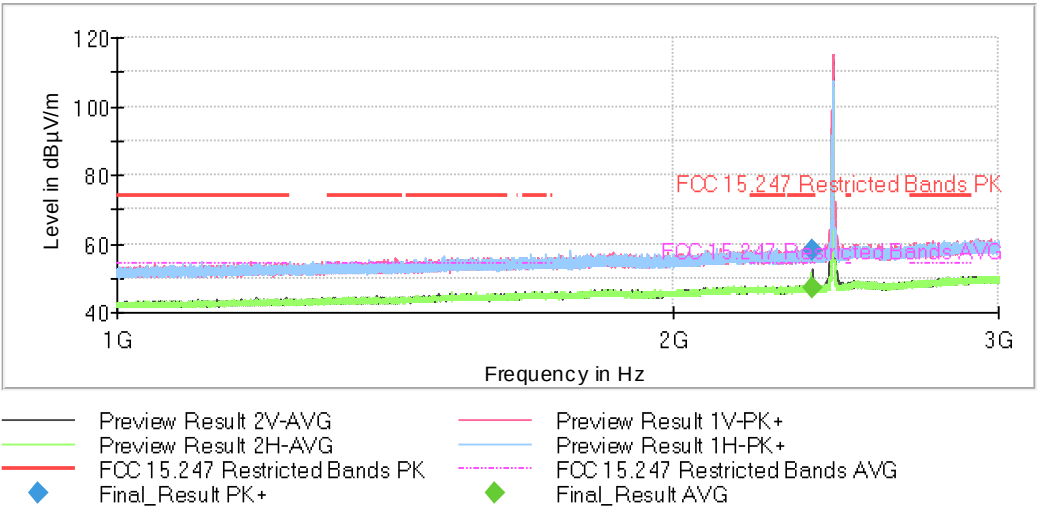


Full Spectrum

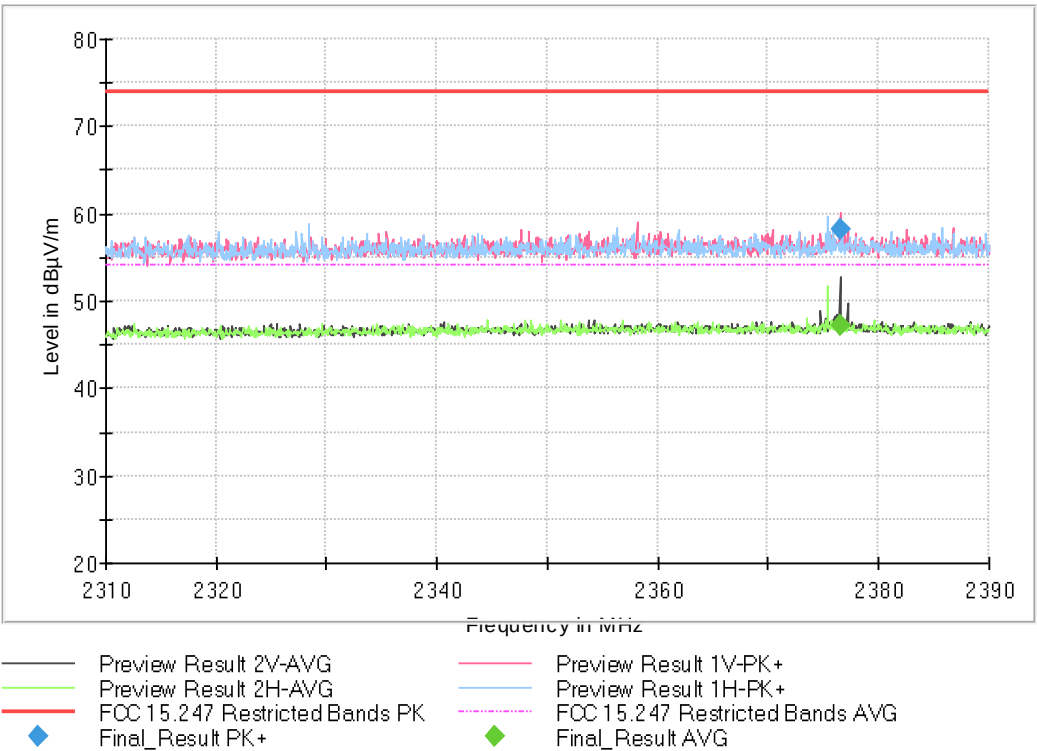


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 3],
Measurement Point = 1

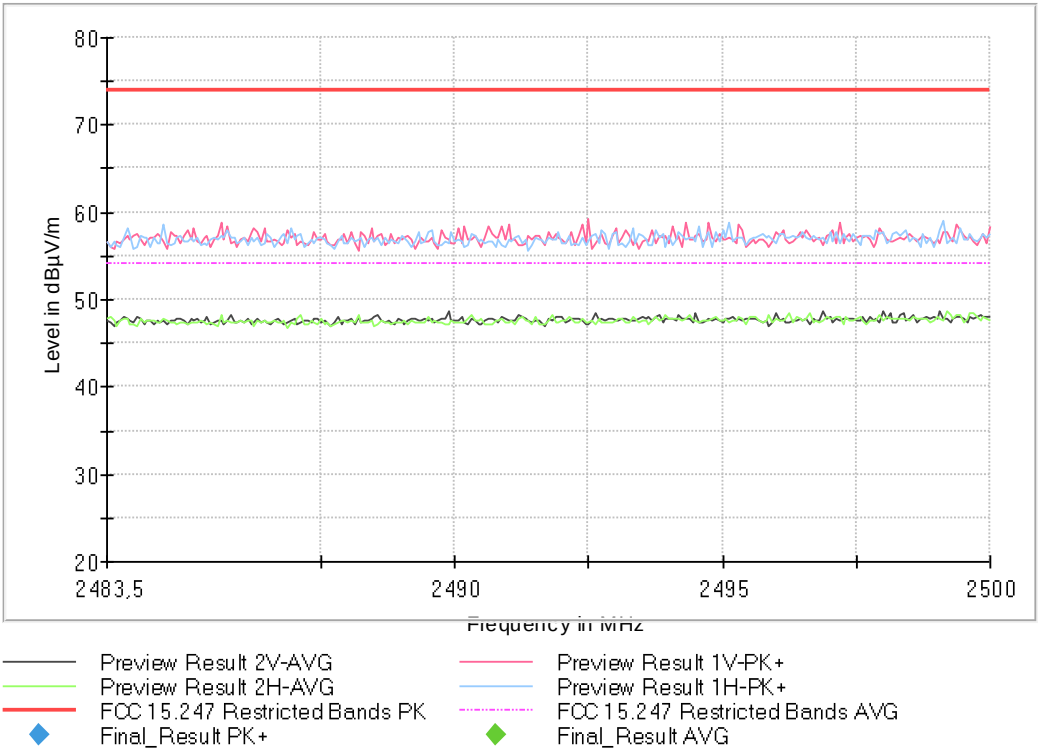
Images:



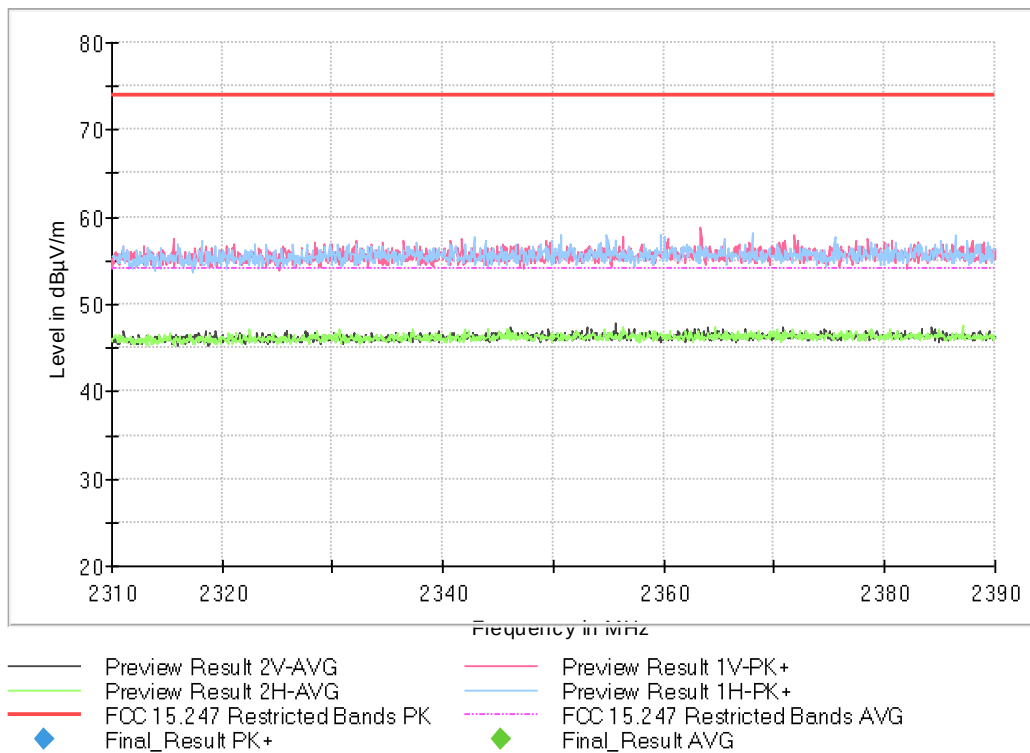
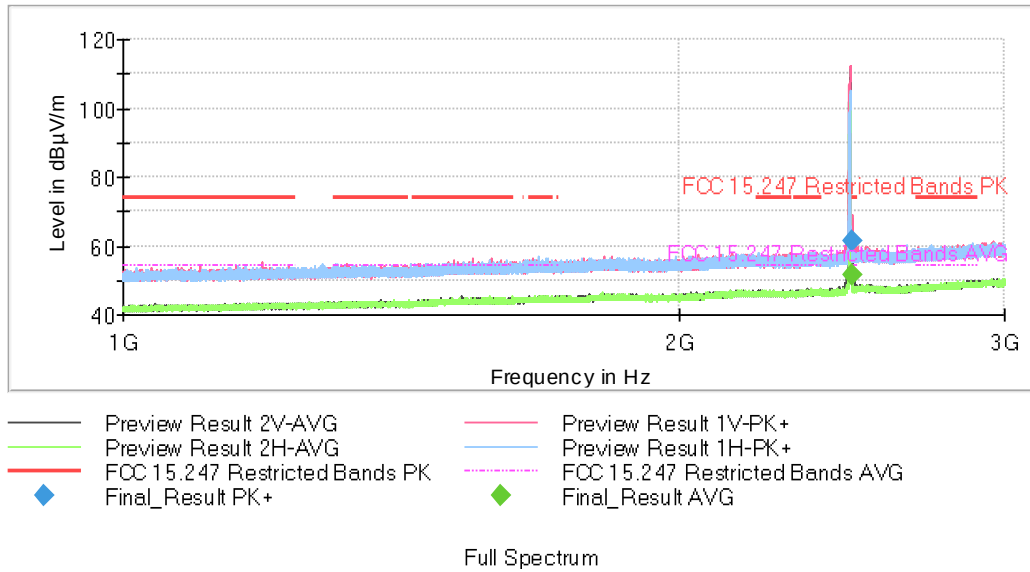
Full Spectrum



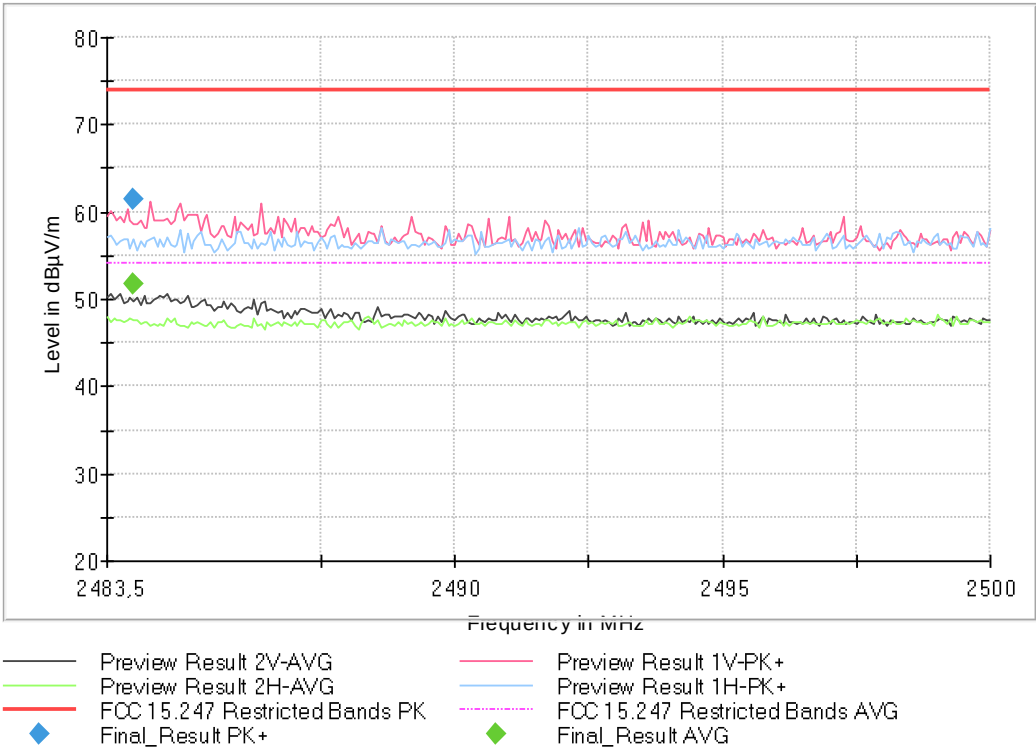
Full Spectrum



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2474.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 3], Measurement Point = 1

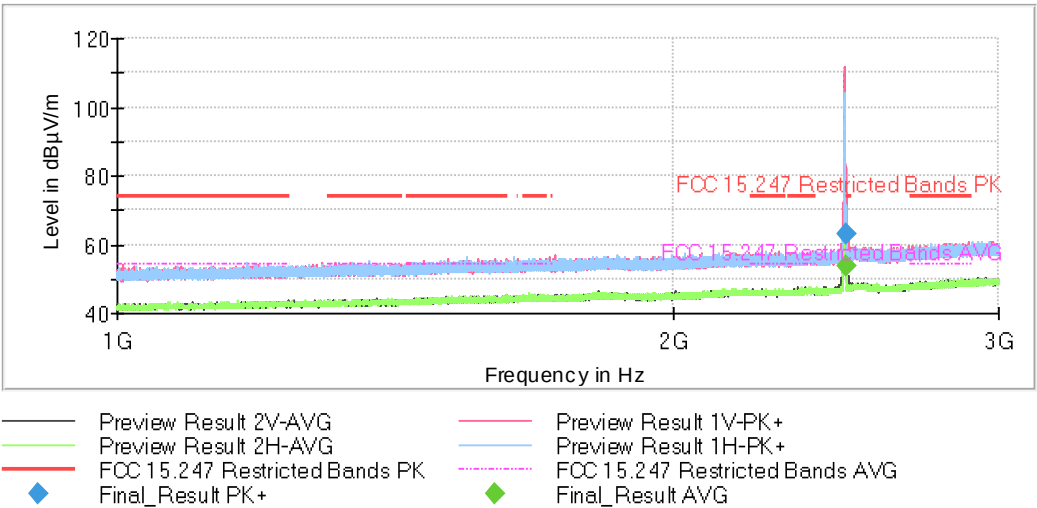


Full Spectrum

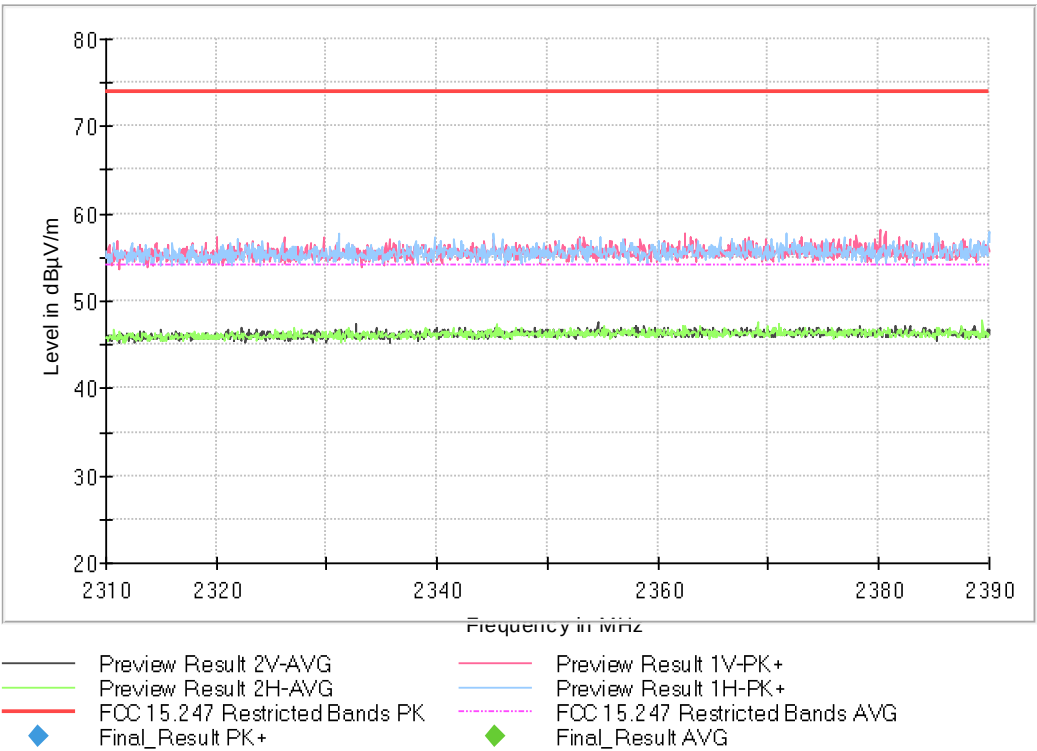


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2476.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 3],
Measurement Point = 1

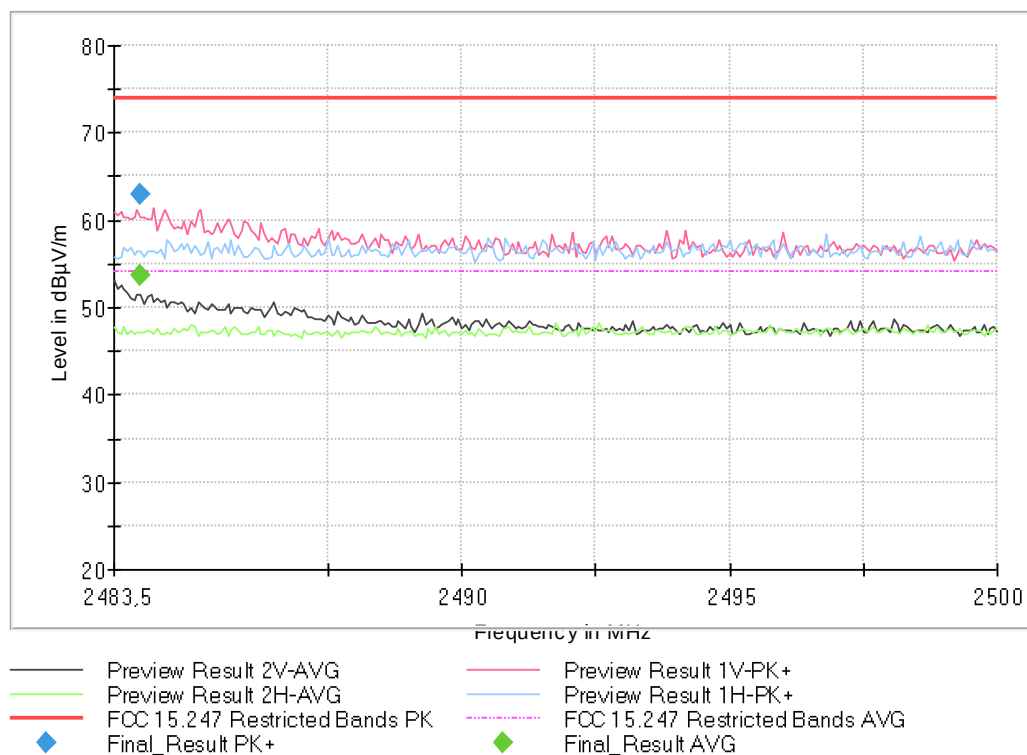
Images:



Full Spectrum

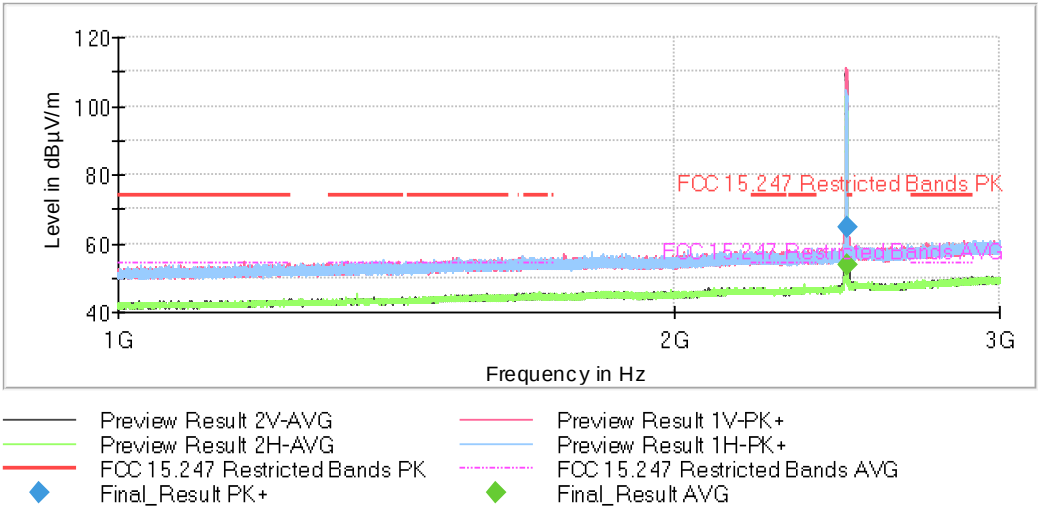


Full Spectrum

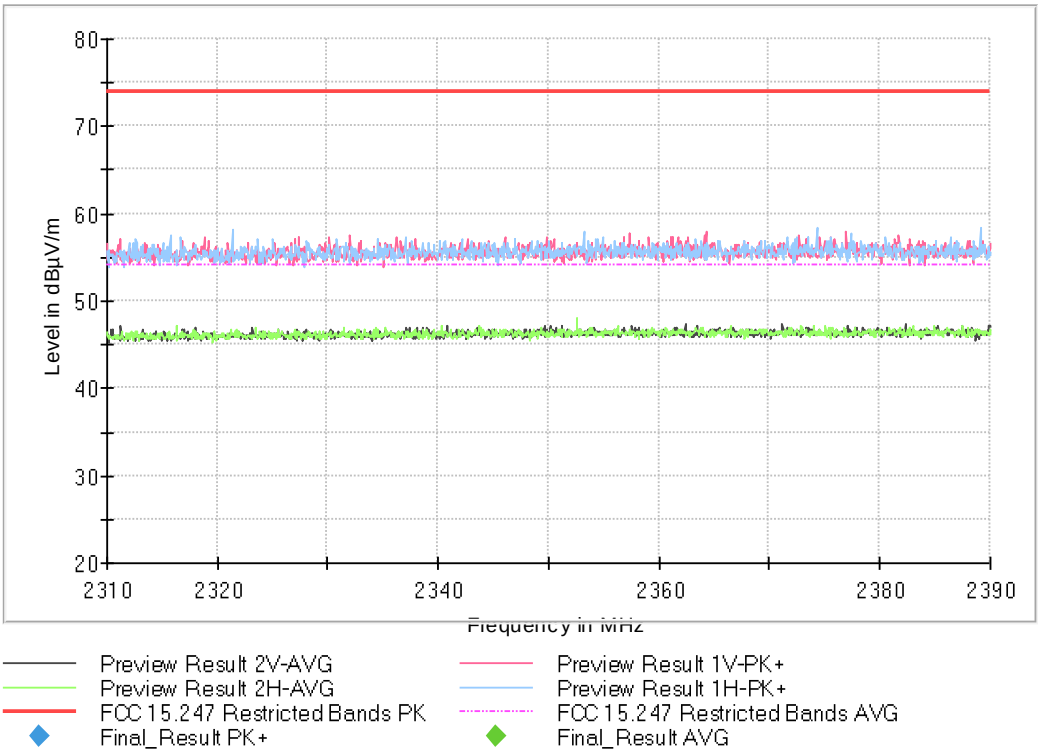


Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 3],
Measurement Point = 1

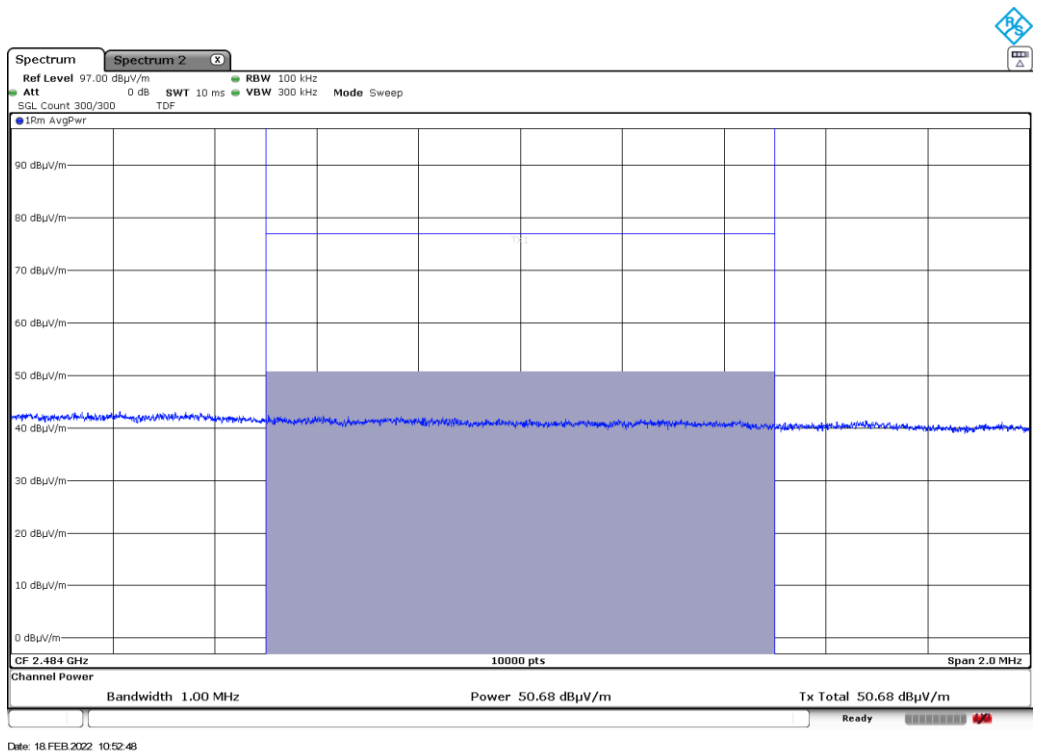
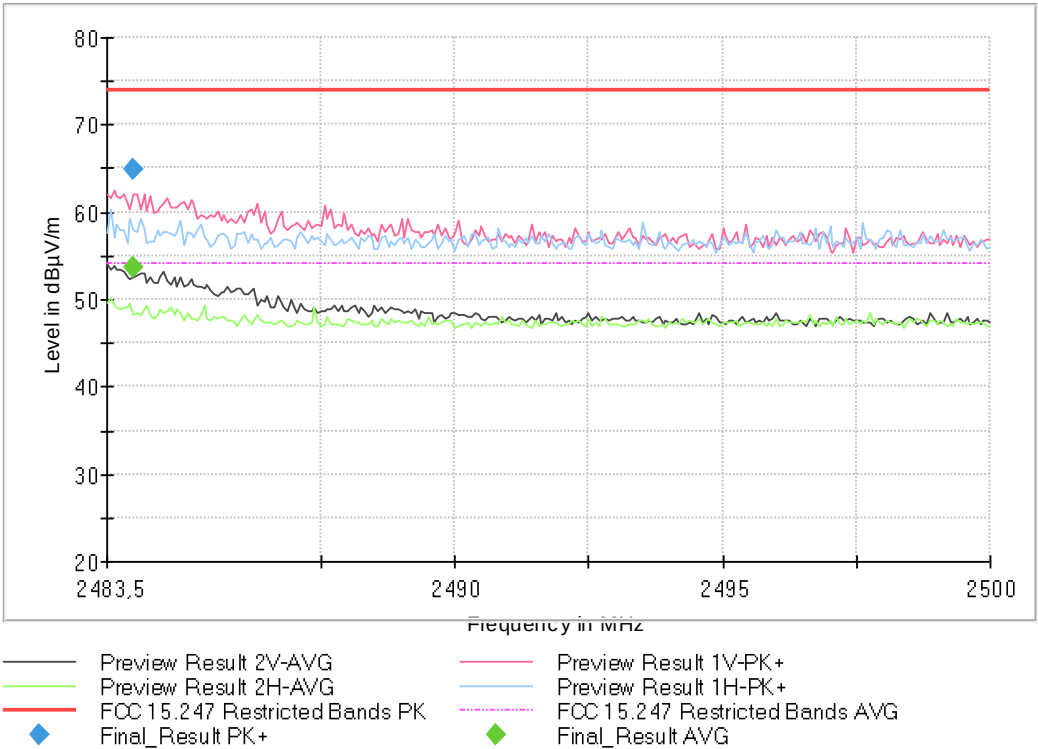
Images:



Full Spectrum

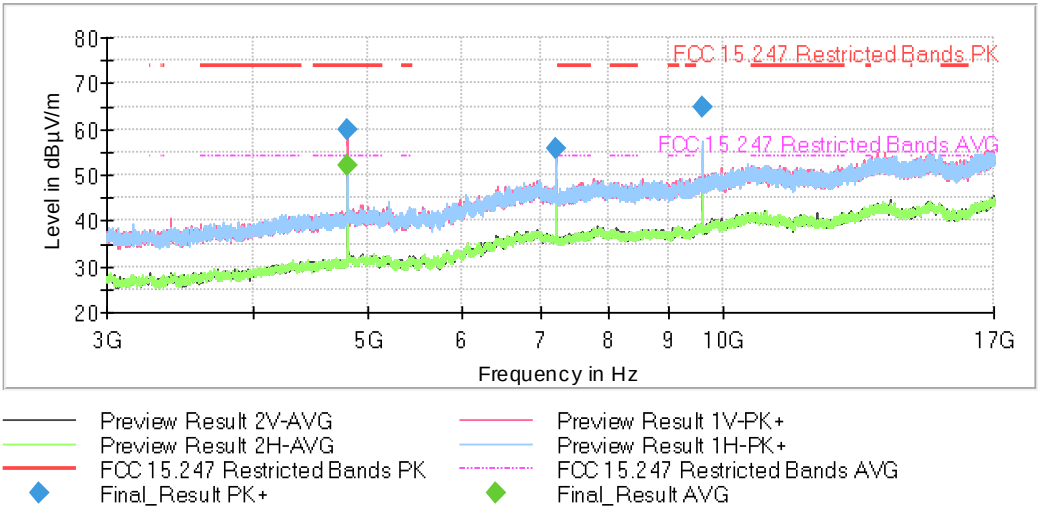


Full Spectrum



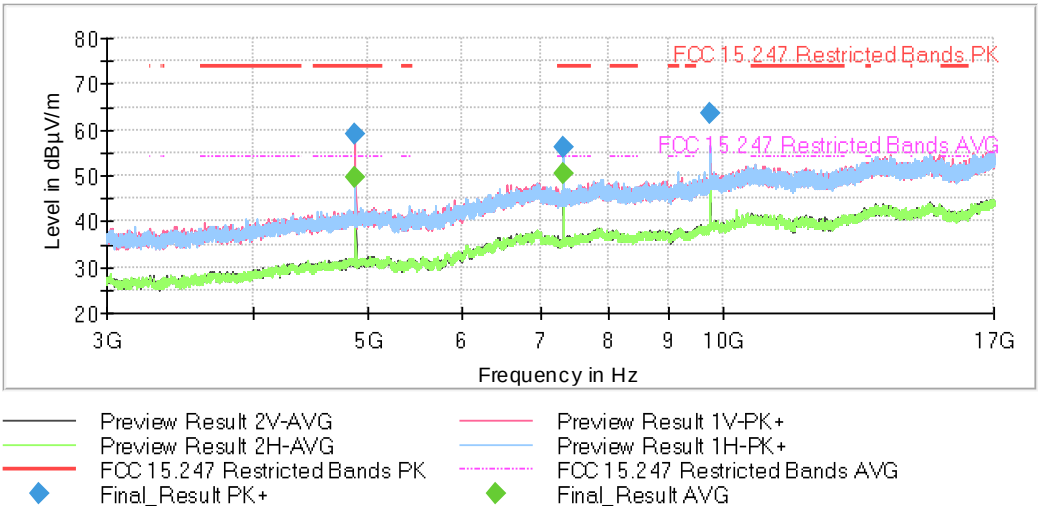
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2404.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [3, 17],
Measurement Point = 1

Images:



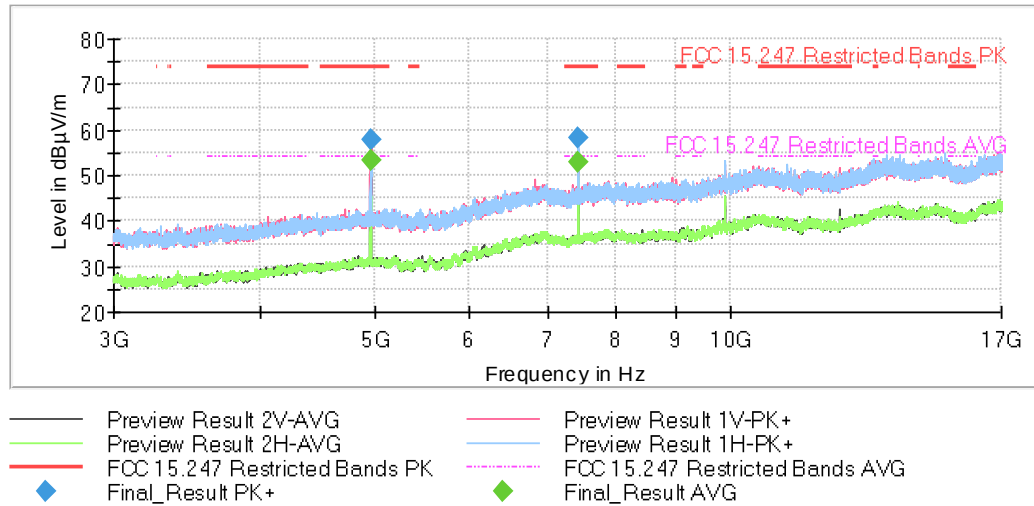
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital
Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [3, 17],
Measurement Point = 1

Images:



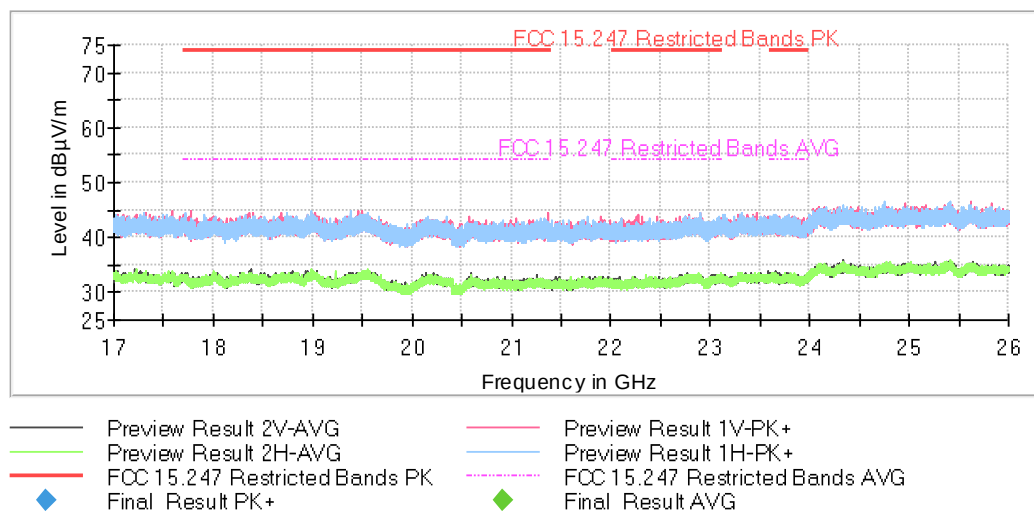
Operation Band MHz = [2400, 2483.5], Frequency MHz = 2478.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [3, 17], Measurement Point = 1

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = This plot is valid for the Low, Middle and High Channels, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [17, 26], Measurement Point = 1

Images:



Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

Operation Band (MHz)	Freq (MHz)	Freq Rng (GHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBµV/m)	Duty cycle Correction (dB)	Corrected Unwanted Lvl (dBµV/m)	Pol	Detector
[2400, 2483.5]	2402.00000	[0.03, 1]	354.7075	35.07	--	--	V	PK
				29.72	--	--	V	QP
	2402.00000	[0.03, 1]	370.9247	38.78	--	--	V	PK
				34.99	--	--	V	QP
	2402.00000	[0.03, 1]	381.0491	37.34	--	--	V	PK
				31.40	--	--	V	QP
	2440.0000	[0.03, 1]	302.7216	36.40	--	--	V	PK
				32.56	--	--	V	QP
	2480.0000	[0.03, 1]	264.8613	31.35	--	--	H	PK
				26.78	--	--	H	QP
	2480.0000	[0.03, 1]	300.0238	31.65	--	--	V	PK
				27.45	--	--	V	QP
	2402.00000	[1, 3]	2338.4680	64.28	--	--	V	PK
				48.49	2.99	51.48	V	AVG
	2440.00000	[1, 3]	2375.8600	63.60	--	--	V	PK
				48.20	2.99	51.19	V	AVG
	2480.00000	[1, 3]	2484.0000	59.47	--	--	V	PK
				49.25 (*)	2.99	52.24	V	AVG
	2402.00000	[3, 17]	4803.9788	58.76	--	--	V	PK
				50.11	2.99	53.10	V	AVG
	2402.00000	[3, 17]	7206.0368	56.45 (**)	--	--	H	PK
	2402.00000	[3, 17]	9608.0383	59.16 (**)	--	--	H	PK
	2440.00000	[3, 17]	4880.3750	50.46	--	--	V	PK
	2440.00000	[3, 17]	7320.8103	54.26	--	--	H	PK
				45.65	2.99	48.64	H	AVG
	2440.00000	[3, 17]	9759.0883	64.74 (***)	--	--	H	PK
	2440.00000	[3, 17]	12201.5000	51.61	--	--	V	PK
	2480.00000	[3, 17]	4959.5253	51.63	--	--	V	PK
	2480.00000	[3, 17]	7440.6988	57.03	--	--	H	PK
				49.36	2.99	52.35	H	AVG
	2480.00000	[3, 17]	9921.2500	62.29 (****)	--	--	H	PK

(*) For emissions in restricted band, the integration method was used according to ANSI C63.10-2013 Section 11.13.3.

(**) This spurious frequency is outside restricted bands as defined in §15.209(a). The measured maximum carrier level at 3m is 106.41 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

(***) This spurious frequency is outside restricted bands as defined in §15.209(a). The measured maximum carrier level at 3m is 110.21 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

(****) This spurious frequency is outside restricted bands as defined in §15.209(a). The measured maximum carrier level at 3m is 115.33 dBµV/m (Peak) so the spurious level is more than 20 dB below the carrier level.

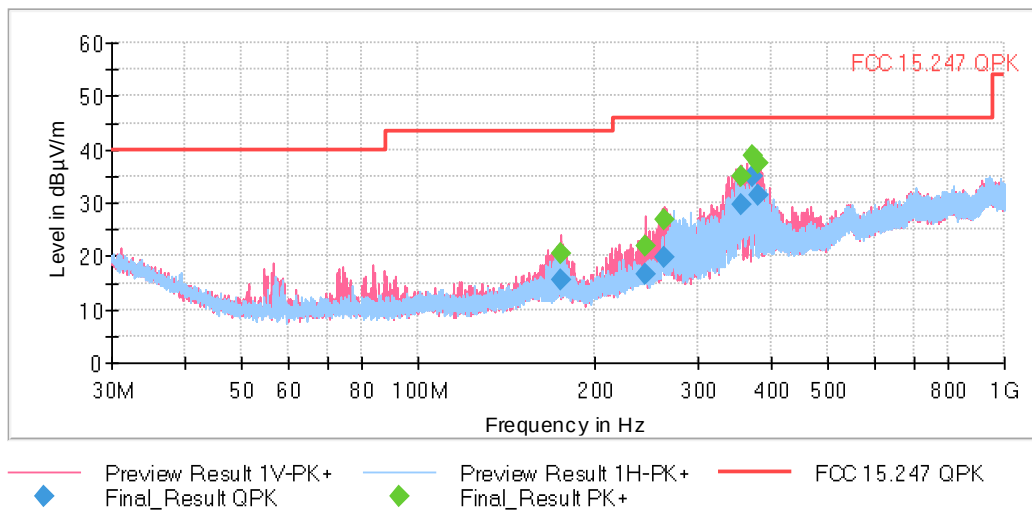
Verdict

Pass

Attachments

Operation Band MHz = [2400, 2483.5], Frequency MHz = 2402.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s), Frequency Range GHz = [0.03, 1], Measurement Point = 1

Images:



Operation Band MHz = [2400, 2483.5], Frequency MHz = 2440.00000, Equipment Type = Digital Transmission System (DTS), Modulation = BTLE 5.0 (GFSK 1 Mbit/s), Frequency Range GHz = [0.03, 1], Measurement Point = 1

Images:

