

ISED CABid: ES1909

Test Report No:
NIE: 70707RRF.006

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Machine Controller iCA202
(*) Trademark	iCON aps 202
(*) Model and /or type reference	iCA202 900MHz
Other identification of the product	HW version: 7E SW version: 0.9.104 FCC ID: RFD-ICA20X IC: 3177A-ICA20X
(*) Features	Bluetooth 3.0 EDR, 802.11@2.4GHz, LTE, 900MHz SDR, GNSS RTK
Manufacturer	LEICA GEOSYSTEMS AG Heinrich-Wild-Strasse 201 9435 Heerbrugg, Switzerland
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	2022-04-06
Report template No.	FDT08_23 (*) "Data provided by the client"

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Acronyms

Acronym ID	Acronym Description
Avg COT	Average Channel Occupancy Time
Detector	Detector used
Equipment	Equipment Type
Freq	Frequency
Freq Rng	Frequency Range
Freq Sep	Frequency Separation
Lvl	Level
Mod	Modulation
NHC	Number of Hopping Channels
NHp	Number of hops over the period
Occ Ch BW	Occupied Channel Bandwidth
Operation Band	Operation Band
Pol	Polarization
Unwanted Freq	Unwanted Emissions Frequency
Unwanted Lvl	Unwanted Emissions Level

Competences and guarantees

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

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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
- Accumulated Dwell Time: Measurement uncertainty $\leq \pm 0.16$ %
- Minimum Frequency Occupation Time: Measurement uncertainty $\leq \pm 0.53$ %
- Hopping Frequency Separation: Measurement uncertainty $\leq \pm 1.74$ %
- Occupied Channel Bandwidth: Measurement uncertainty $\leq \pm 1.24$ %
- 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 Machine Controller iCA202. Machine Controller which supplies RTK positioning data to an earthmoving machine or paver. GNSS correction data can be supplied to the unit through a variety of interfaces. The positioning data and sensor data is supplied to the machine primarily through CAN bus. The machine controller can be accessed remotely through a variety of RF or wired interfaces.

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 No.	Date Reception	of	Application
S/01	70707_9.1	Machine Controller iCON aps 202	iCA202	3730437	2022-02-17		Element Under Test
S/01	70707_6.1	Antenna	CGA100	--	2021-12-13		Element Under Test
S/01	62082B_28.1	Dual LTE antenna	BPCTHPDLTE-SF-MM	19719/010	2019-09-16		Element Under Test
S/01	62082B_101.1	Antenna	BMLPVMBLTEN GP	--	2019-09-16		Element Under Test
S/01	62082B_103.1	Antenna	BMLPVMBLTEN GP	--	2019-09-16		Element Under Test
S/01	62082B_104.1	Antenna	MLPV430	--	2019-09-16		Element Under Test
S/01	62082B_10.1	888169 Ultron Test Box	--	--	2019-09-16		Auxiliary Element
S/01	62082B_60.1	MAG Base	GMLFML195C	--	2019-09-16		Auxiliary Element
S/01	62082B_64.1	MAG Base	GMLFML195C	--	2019-09-16		Auxiliary Element
S/01	62082B_115.1	Ethernet cable	--	--	2019-09-16		Auxiliary Element
S/01	62779_150.1	Router	DSL-2750U	QXBC1H4003465	2019-09-16		Auxiliary Element
S/01	62779_153.1	AC/DC adapter	F12W8-120100SPAS	E21703271030960	2019-09-16		Auxiliary Element
S/02	70707_9.1	Machine Controller iCON aps 202	iCA202	3730437	2022-02-17		Element Under Test

Notes referenced to samples during the project:

Id	Type
S/01	Sample for Radiated tests.
S/02	Sample for Conducted tests.

Test sample description

Ports..... :	Port name and description		Cable				
			Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾	
	CAN1, 2, 3		5	[]	[]	[]	
	ETH1, 2		5	[]	[]	[]	
	USB		NA	[]	[]	[]	
	Serial S1/S2		5	[]	[]	[]	
--			[]	[]	[]		
Supplementary information to the ports..... :	--						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	[]	AC:	[]	[]	[]	[]	[]
	[X]	DC: 12V					
[X]	DC: 24V						
Rated Power	12W						
Clock frequencies..... :	--						
Other parameters	--						
Software version	1.0						
Hardware version	6E						
Dimensions in cm (W x H x D)	22.6 x 16.3 x 6.9						
Mounting position	[]	Table top equipment					
	[]	Wall/Ceiling mounted equipment					
	[]	Floor standing equipment					
	[]	Hand-held equipment					
	[X]	Other: Machine mount typically engine/cab compartment mount					
Modules/parts..... :	Module/parts of test item		Type		Manufacturer		
	EM7565		LTE Cellular		Sierra Wireless		
	TR489		SRD		Satel		
	ACM-DB-2		WLAN		Doodle labs		
	OEM719D		GNSS		Novatel		
	--						
Accessories (not part of the test item)	Description		Type		Manufacturer		
	CSR8510A10		Test Box		Leica		
	--						
Documents as provided by the applicant..... :	Description		File name		Issue date		
	Ultron Compliance Test Instructions V1.1						
	Ultron Product Description V1.1						
	--						

⁽³⁾ Only for Medical Equipment

Identification of the client

LEICA GEOSYSTEMS AG
Heinrich-Wild-Strasse, 9435 Heerbrugg, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2022-01-25
Date (finish)	2022-03-15

Document history

Report number	Date	Description
70707RRF.006	2022-04-06	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 semi-anechoic 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: José Manuel Jiménez González, Miguel Manuel López Guzmán and Pablo Redondo Reyes.

Used instrumentation:

Equipment	Model	Manufacturer	Next Calibration
SEMIANECHOIC ABSORBER LINED CHAMBER IV	FACT 3 200 STP	ETS LINDGREN	N/A
SHIELDED ROOM	S101	ETS LINDGREN	N/A
EMI TEST RECEIVER 9kHz-7GHz	ESR7	ROHDE AND SCHWARZ	2023-11-08
SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV 40	ROHDE AND SCHWARZ	2023-10-22
HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2023-10-29
HORN ANTENNA 1-18GHz	BBHA 9120 D	SCHWARZBECK	2023-08-24
HORN ANTENNA 17-40GHz	BBHA 9170	SCHWARZBECK	2023-05-05
PRE-AMPLIFIER G>40dB 10MHz-6GHz	BLMA 1006-4A	BONN ELEKTRONIK	2023-03-17
PRE-AMPLIFIER G>30dB 1GHz-18GHz	BLMA 0118-3A	BONN ELEKTRONIK	2022-12-01
PRE-AMPLIFIER G>30dB 17-40GHz	BLMA 1840-4A	BONN ELEKTRONIK	2022-09-08
SIGNAL AND SPECTRUM ANALYZER 10Hz-40GHz	FSV 40	ROHDE AND SCHWARZ	2023-02-26
WIRELESS CONNECTIVITY TESTER BW 160 MHz	CMW270	ROHDE AND SCHWARZ	2022-11-30
OPEN SWITCH UNIT UP TO 7.5 GHz	OSP-B157W8 PLUS	ROHDE AND SCHWARZ	2023-08-20
POWER SUPPLY DC 40 V / 40 A	NGPE 40/40	ROHDE AND SCHWARZ	N/A
DIGITAL MULTIMETER	179	FLUKE	2022-10-19
SOFTWARE EMC32	EMC32	ROHDE AND SCHWARZ	N/A

Testing verdicts

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

Summary

Bluetooth EDR

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

Appendix A: Test results. Bluetooth EDR.

TEST CONDITIONS	12
TEST CASES DETAILS	15
FCC 47 CFR PART 15.247 / RSS-247	15
<i>Occupied Channel Bandwidth 99%</i>	15
<i>RSS-247 5.1 (b) / FCC 15.247 (a) (1) 20 dB Bandwidth</i>	22
<i>RSS-247 5.1 (b) / FCC 15.247 (a) (1) Carrier Frequency Separation</i>	29
<i>RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Time of Occupancy (Dwell Time)</i>	32
<i>RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Number of hopping channels</i>	35
<i>RSS-247 5.4 (b) / FCC 15.247 (b) Maximum peak output power and antenna gain</i>	38
<i>RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter)</i>	46
<i>RSS-247 5.5 / FCC 15.247 (d) Emission limitations radiated (Transmitter)</i>	53

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	24 Vdc
Type of Power Supply:	DC external power supply.

ANTENNA (*):

Type of Antenna:	External
Maximum Declared Antenna Gain:	+3.0 dBi

TEST FREQUENCIES (*):

Low Channel:	2402 MHz
Middle Channel:	2441 MHz
High Channel:	2480 MHz

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 considering the cable loss.



RADIATED MEASUREMENTS:

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

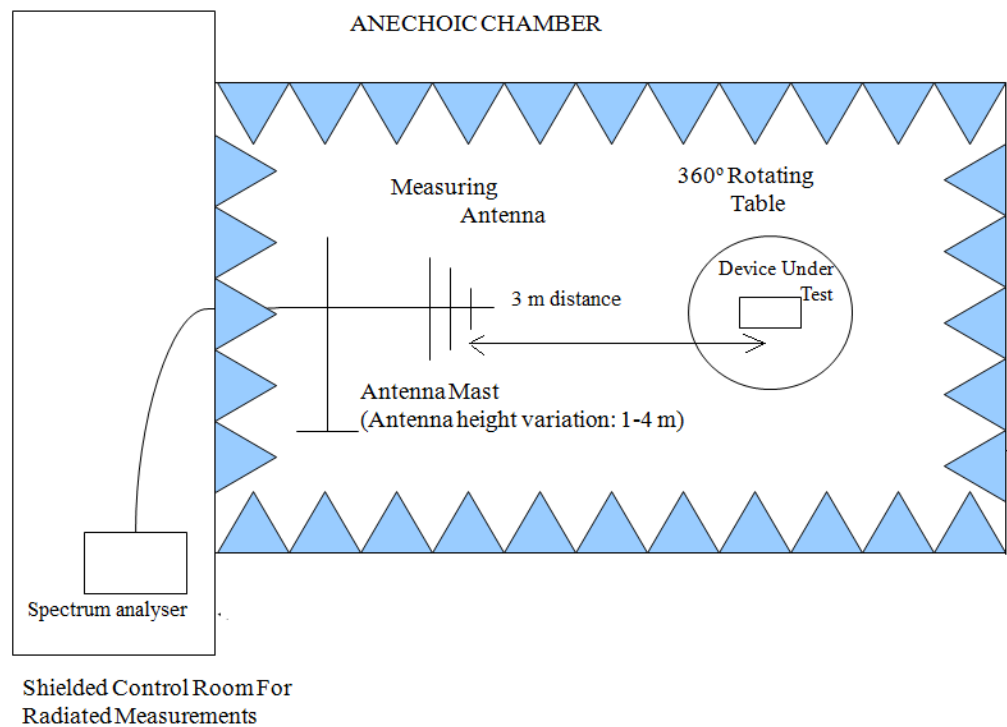
For radiated emissions in the range 17 GHz – 26 GHz performed at a distance closer than the distance specified in standard, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and its situation and orientation were varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters (up to 17GHz) to find the maximum radiated emission.

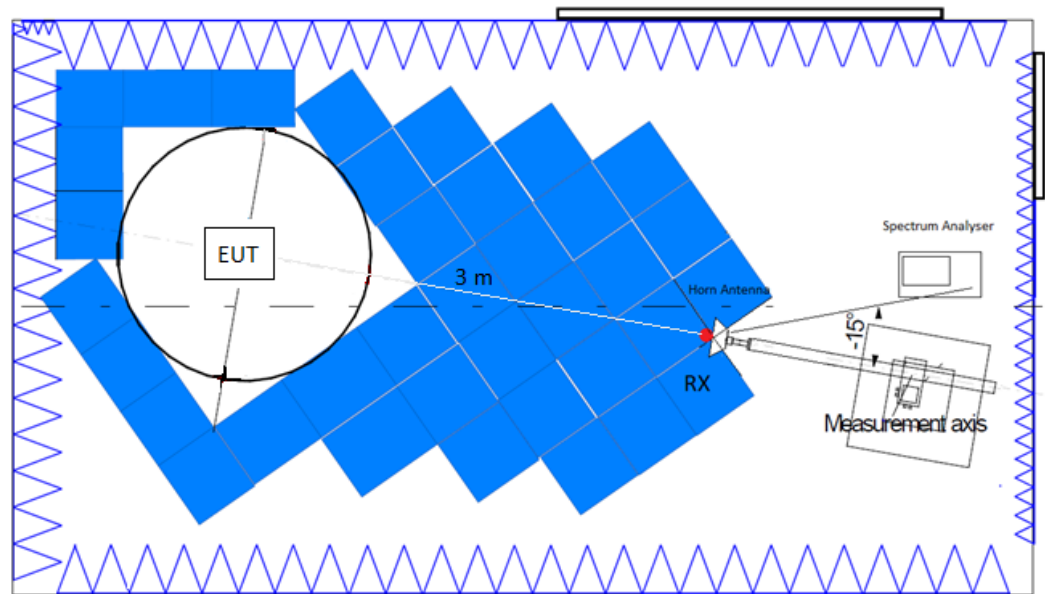
Measurements were made in both horizontal and vertical planes of polarization.

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.

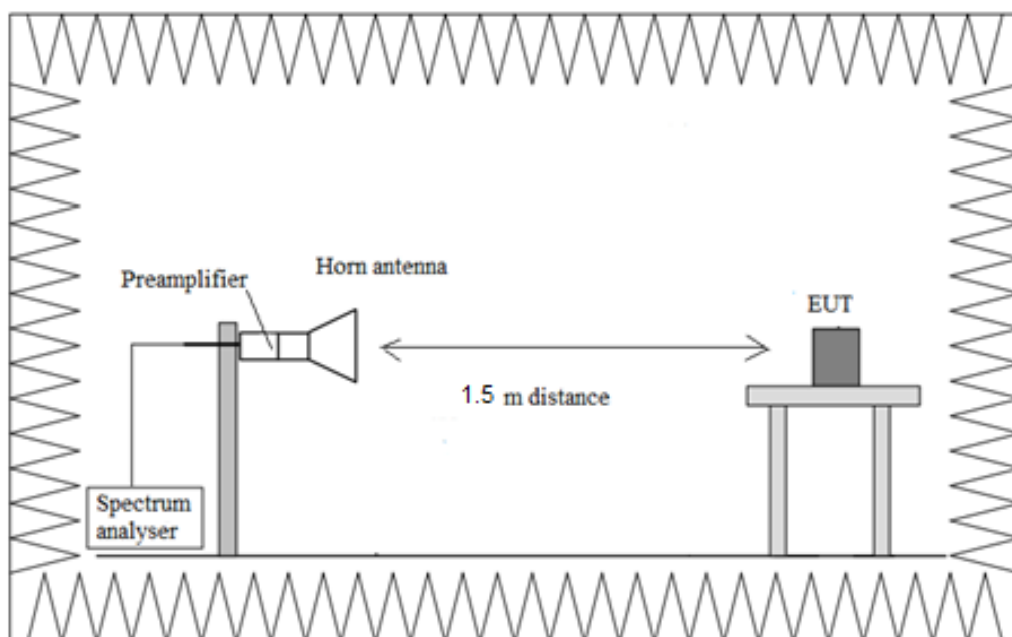
Radiated measurements setup from 30 MHz to 1 GHz:



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
Occupied Channel Bandwidth 99%

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Freq (MHz)	Equipment	Occ Ch BW (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	0.855
	2441.00000		0.860
	2480.00000		0.860

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Freq (MHz)	Equipment	Occ Ch BW (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	1.165
	2441.00000		1.165
	2480.00000		1.165

Modulation: BT (8DPSK 3-DH5)

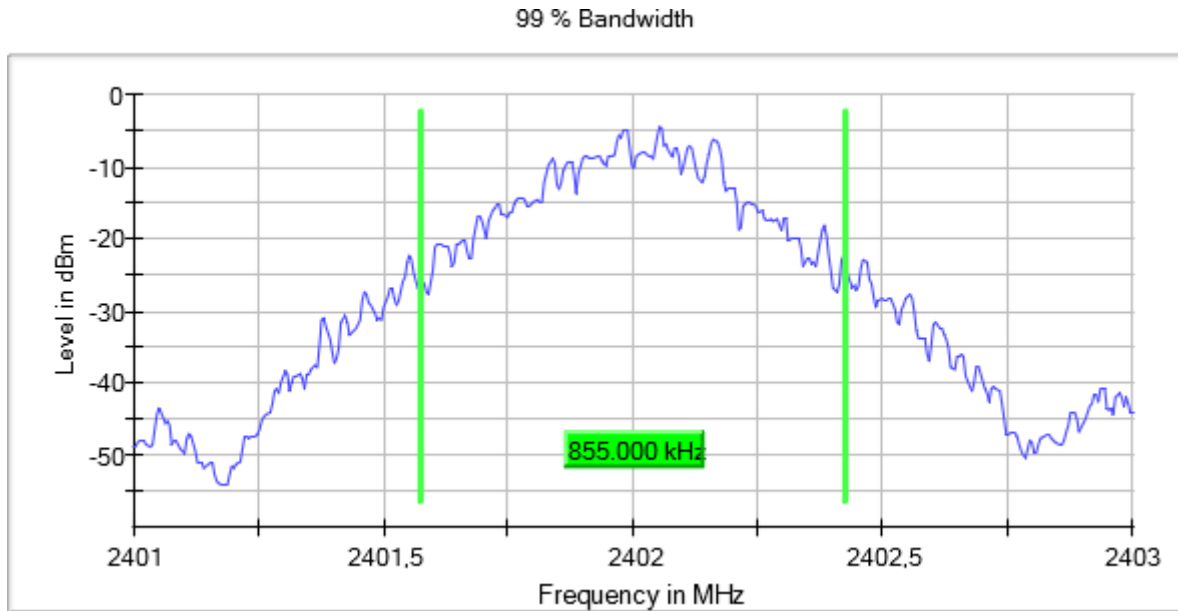
Results

Operation Band (MHz)	Freq (MHz)	Equipment	Occ Ch BW (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	1.180
	2441.00000		1.180
	2480.00000		1.175

Attachments

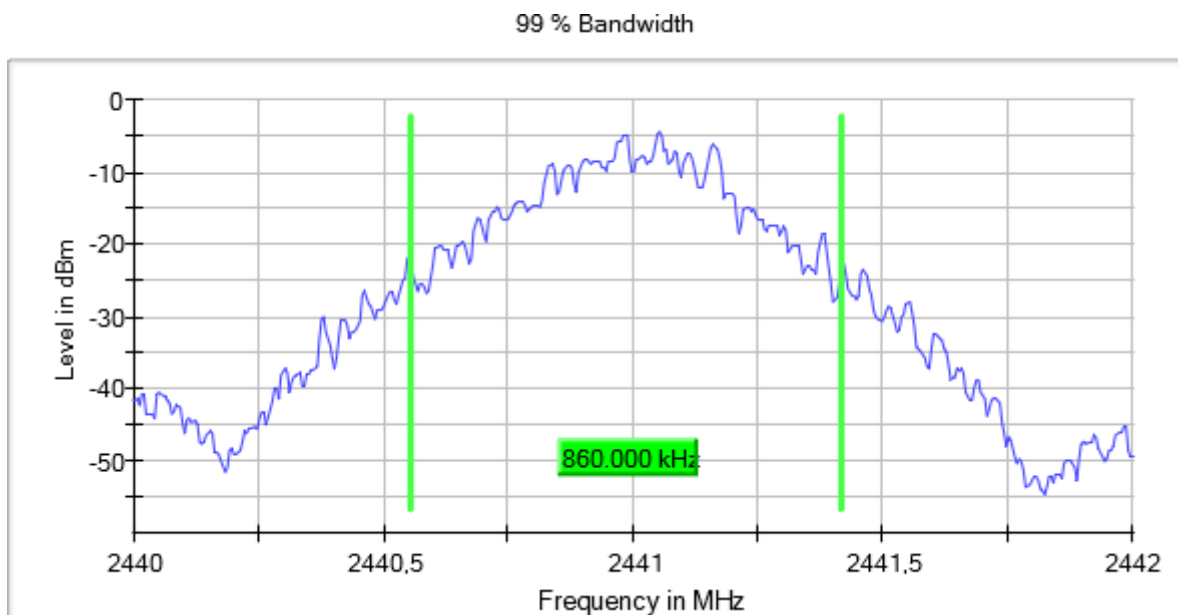
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



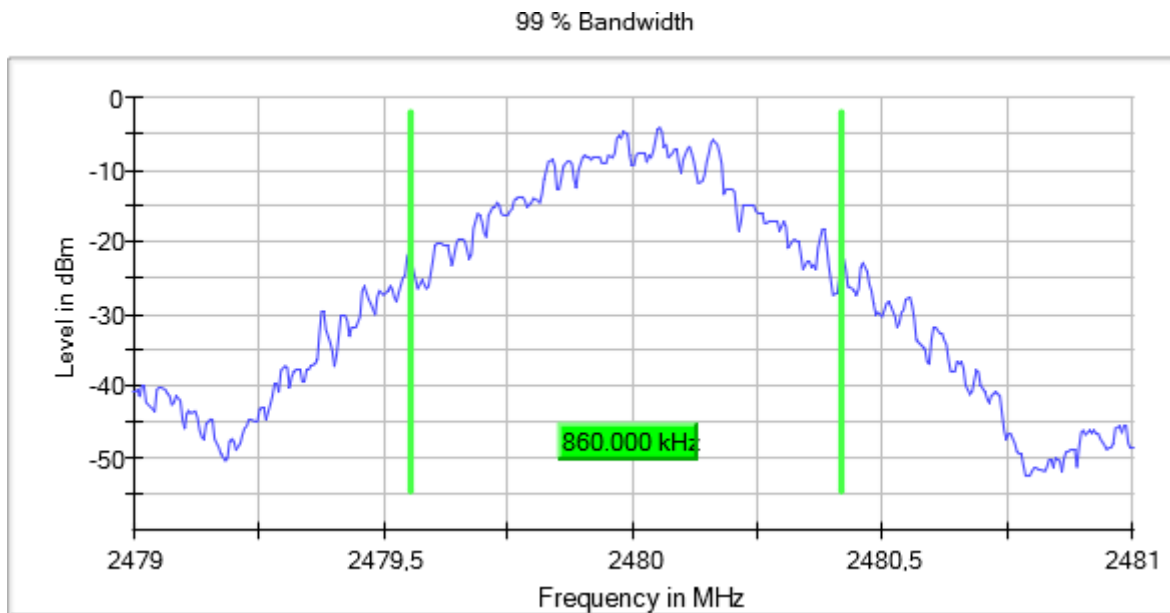
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



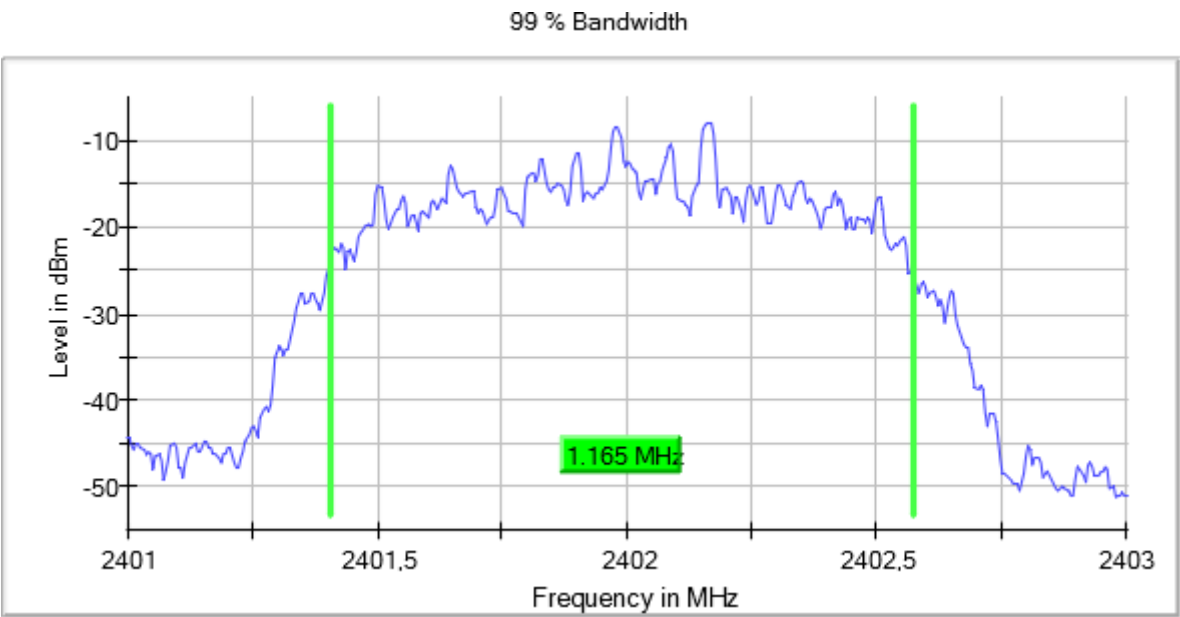
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



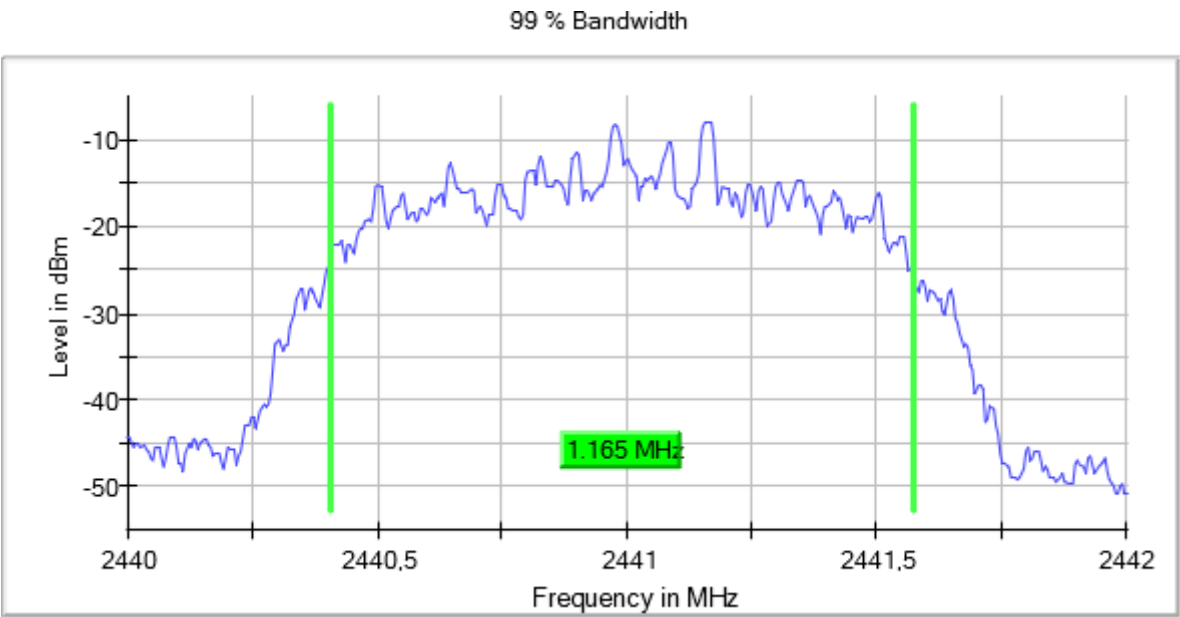
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



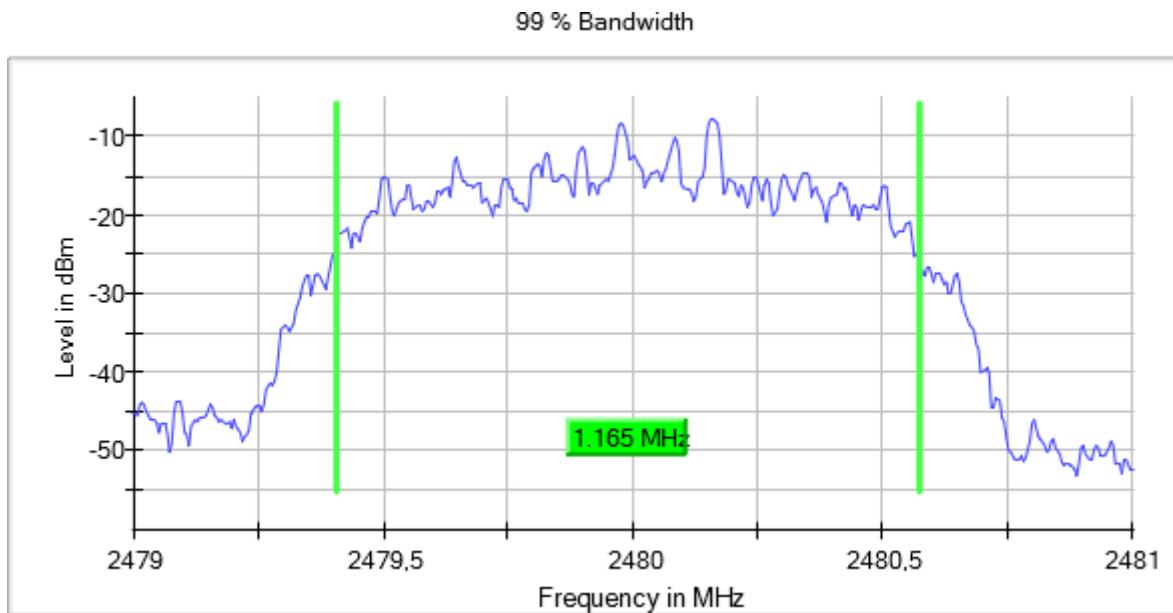
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



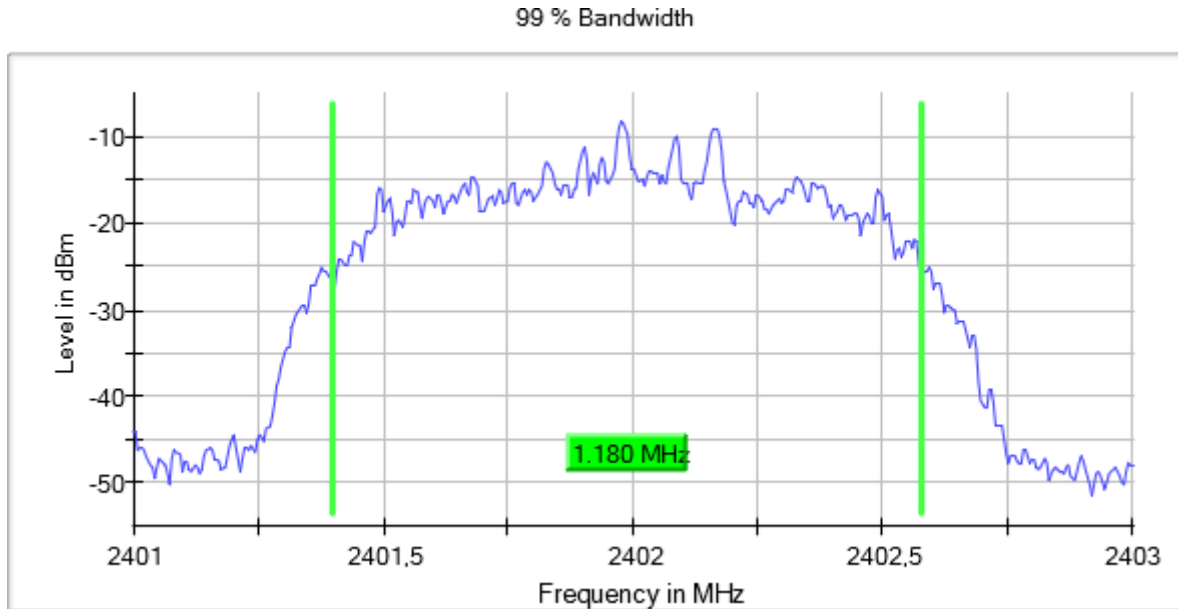
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



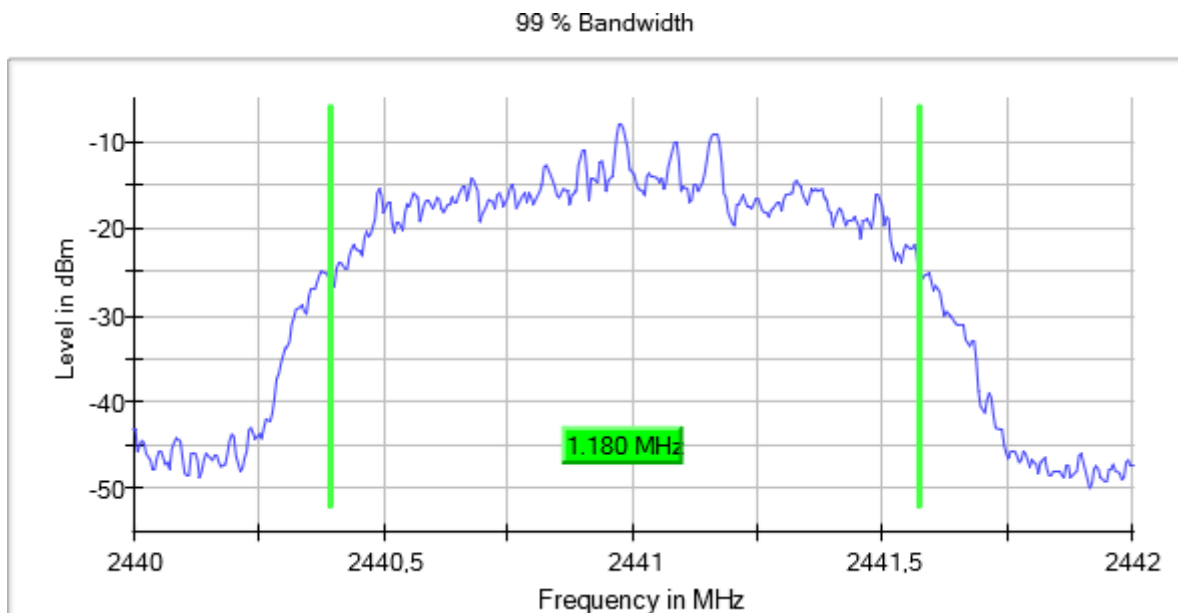
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



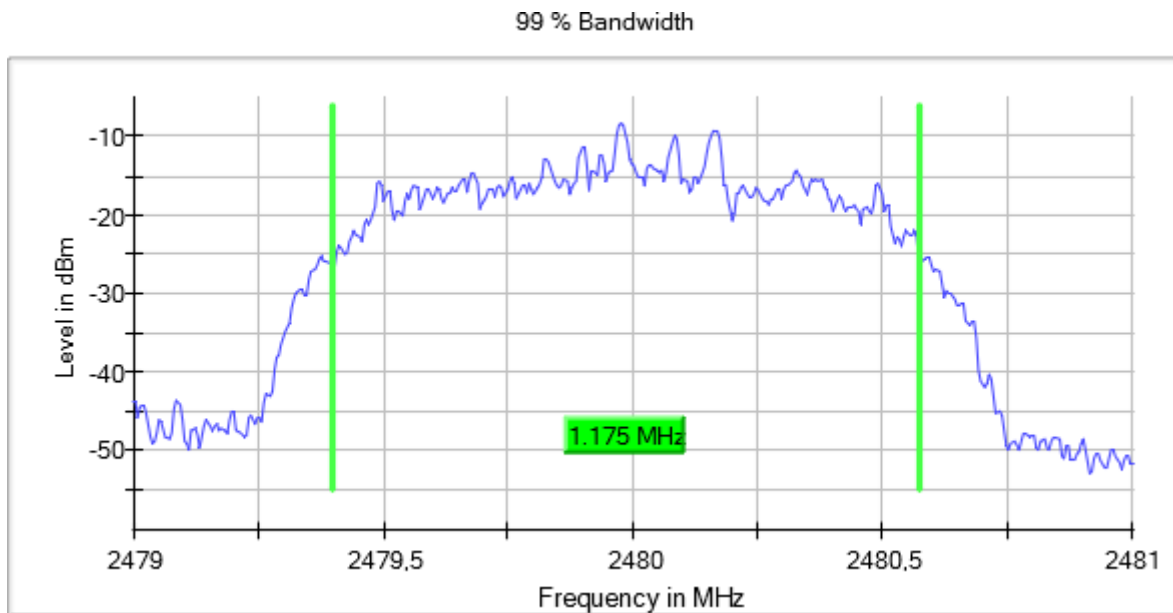
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



RSS-247 5.1 (b) / FCC 15.247 (a) (1) 20 dB Bandwidth

Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Freq (MHz)	Equipment	20 dB Bandwidth (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	0.930
	2441.00000		0.925
	2480.00000		0.925

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Freq (MHz)	Equipment	20 dB Bandwidth (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	1.315
	2441.00000		1.310
	2480.00000		1.310

Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Freq (MHz)	Equipment	20 dB Bandwidth (MHz)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	1.270
	2441.00000		1.270
	2480.00000		1.265

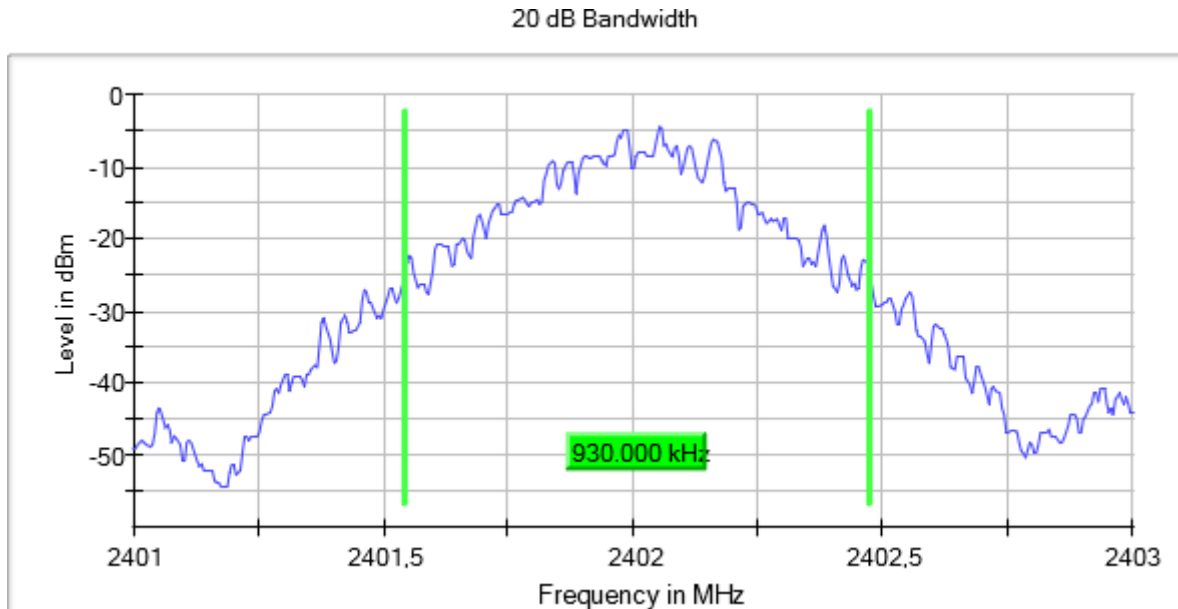
Verdict

Pass

Attachments

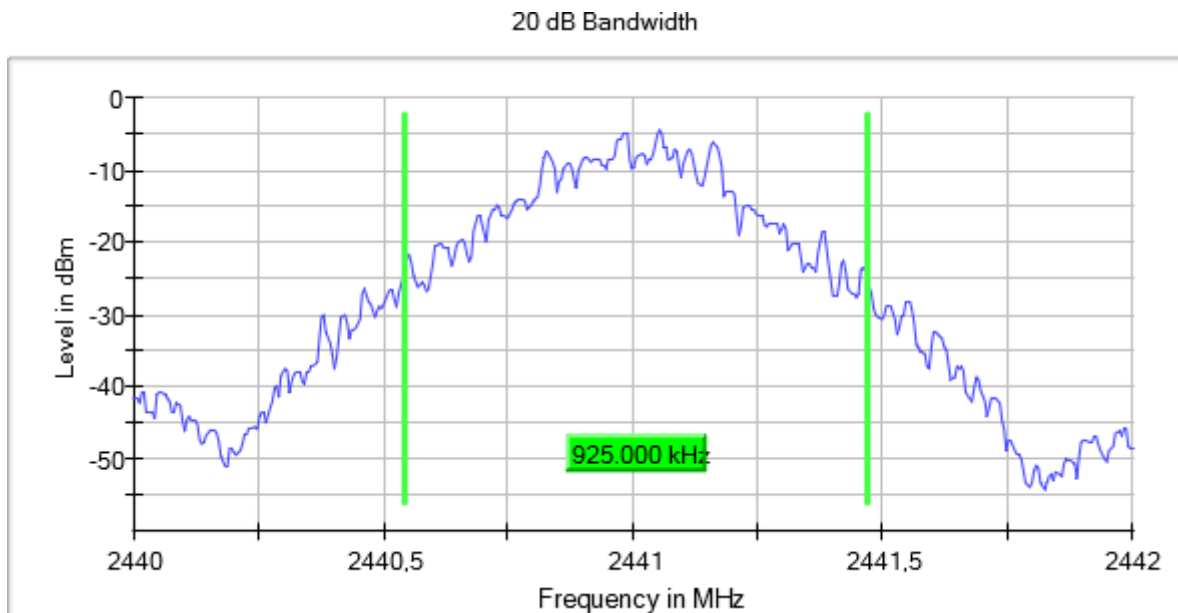
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



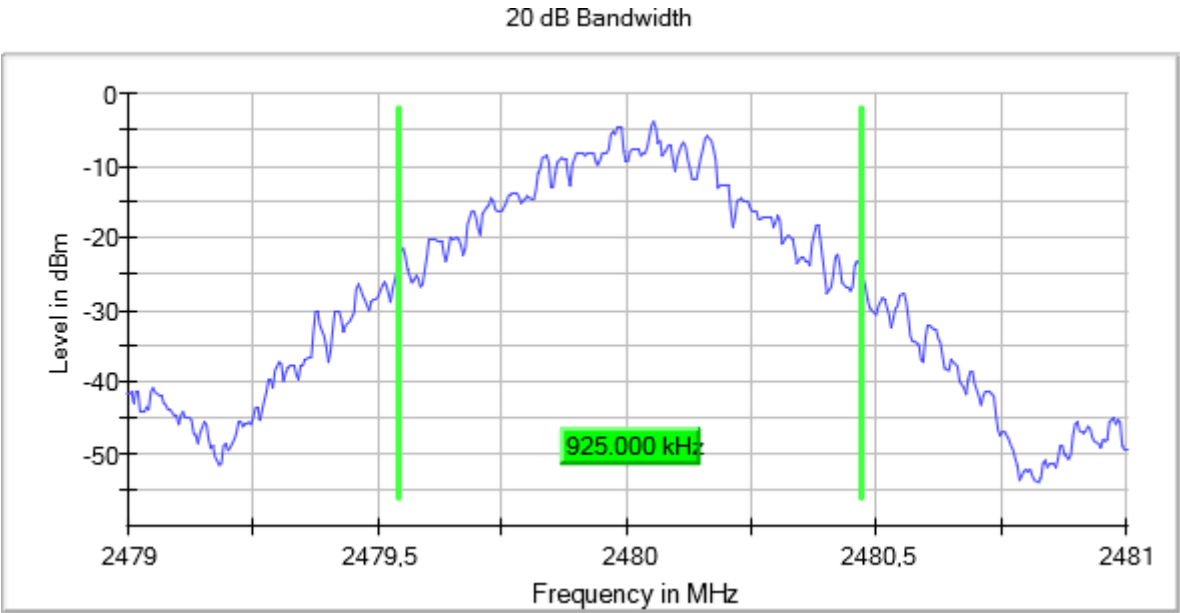
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



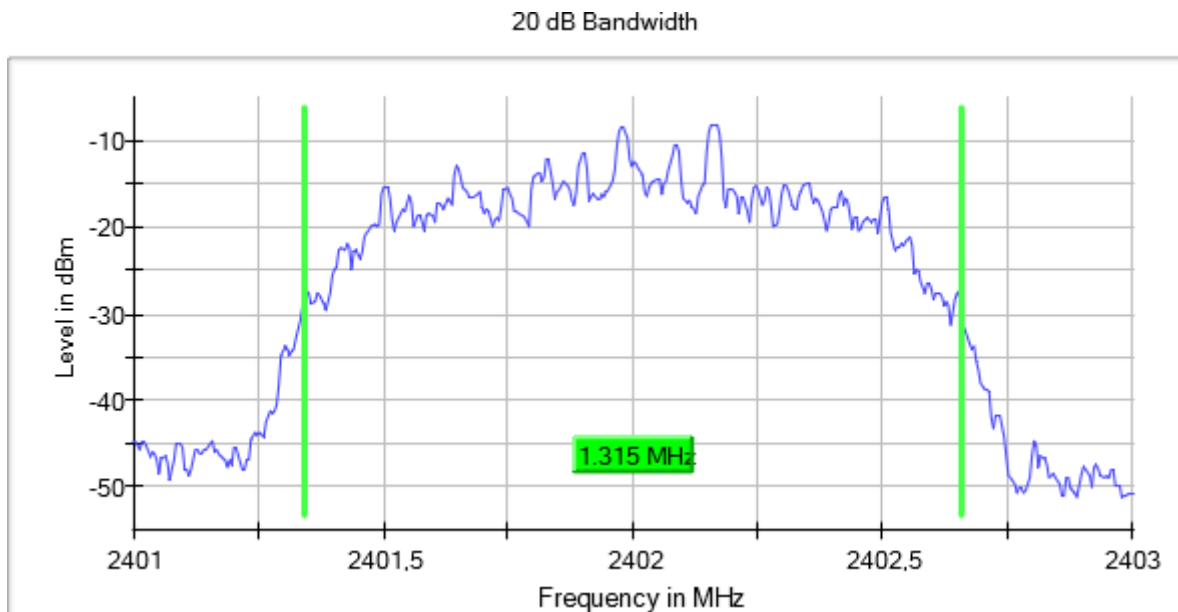
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



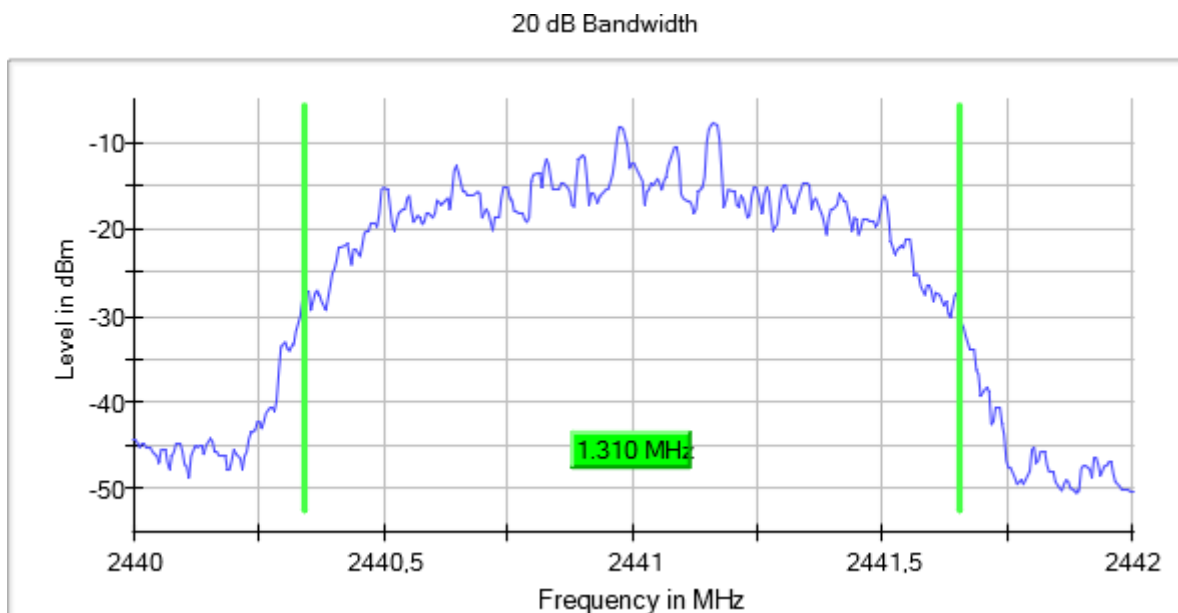
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



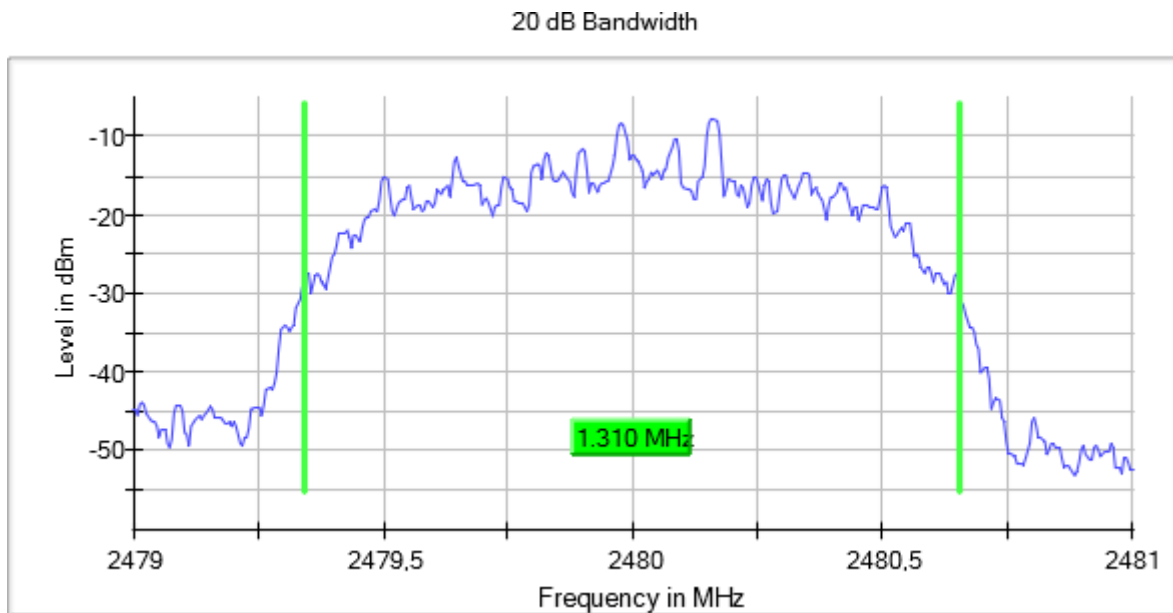
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



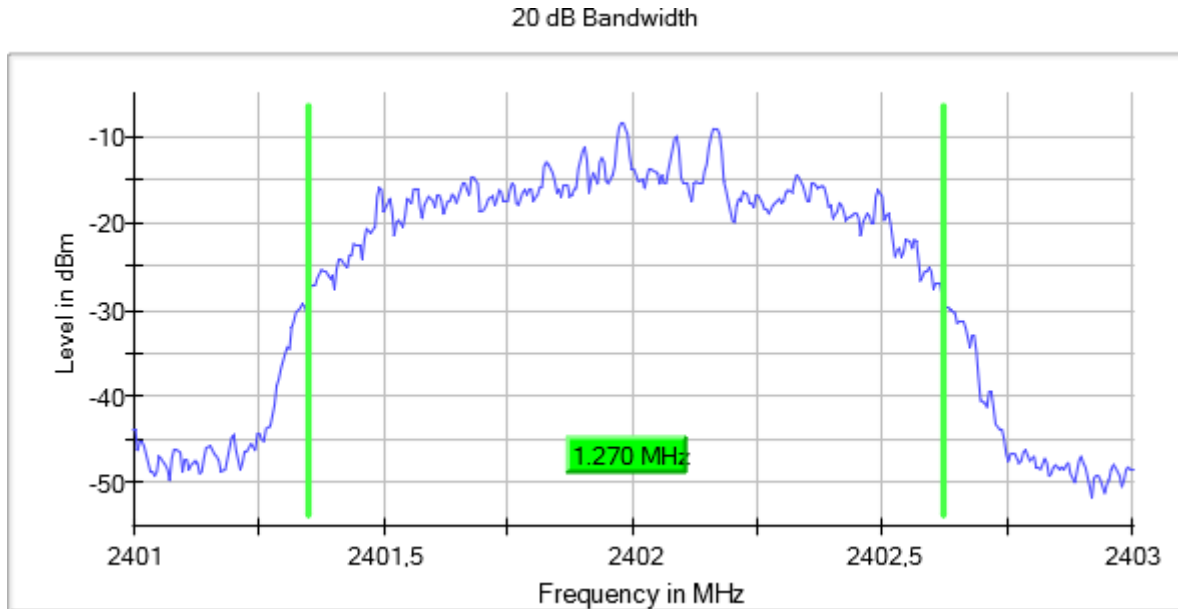
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



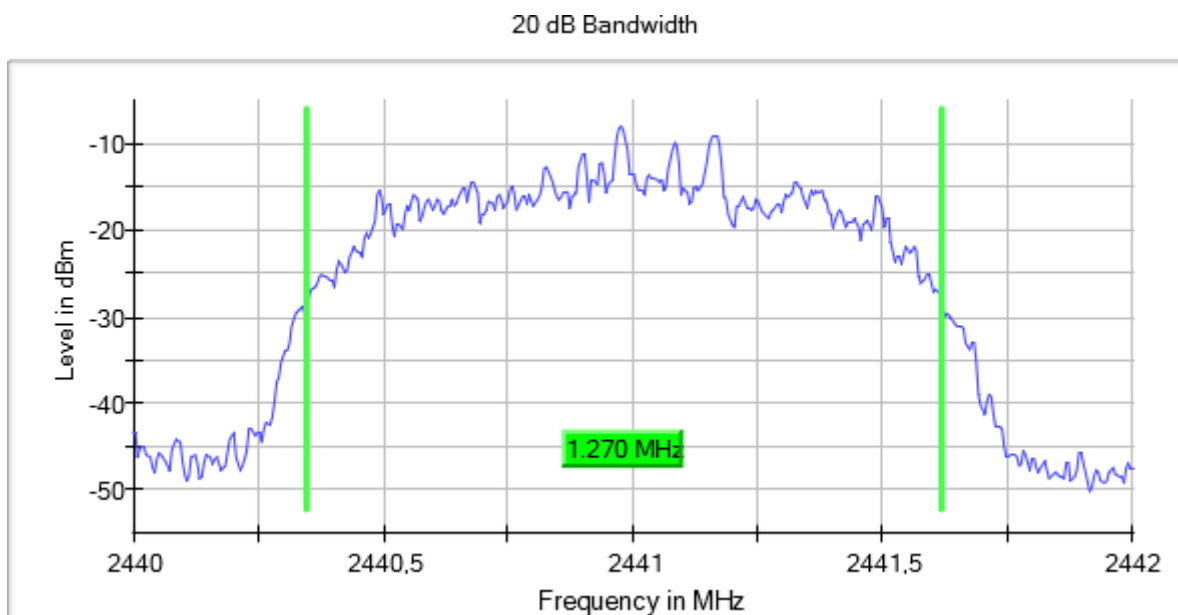
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



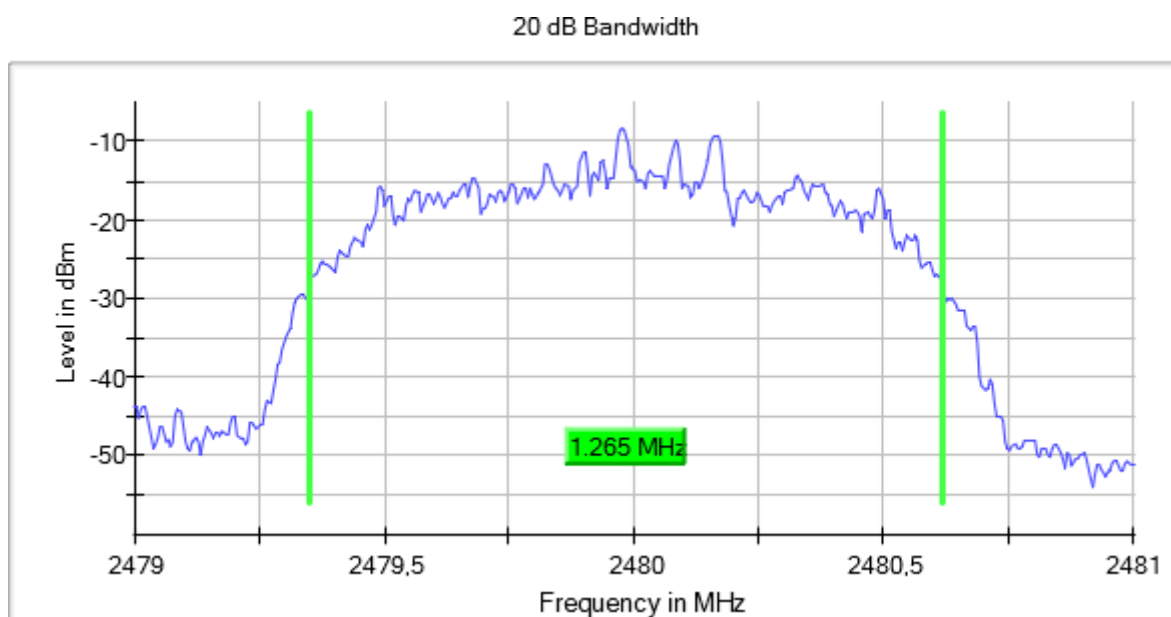
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



RSS-247 5.1 (b) / FCC 15.247 (a) (1) Carrier Frequency Separation

Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Equipment	Freq Sep (MHz)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	1.01774

The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Equipment	Freq Sep (MHz)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	1.00280

The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Equipment	Freq Sep (MHz)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	1.00280

The hopping channel carrier frequencies are separated by a minimum two-thirds of the 20 dB bandwidth of the hopping channel.

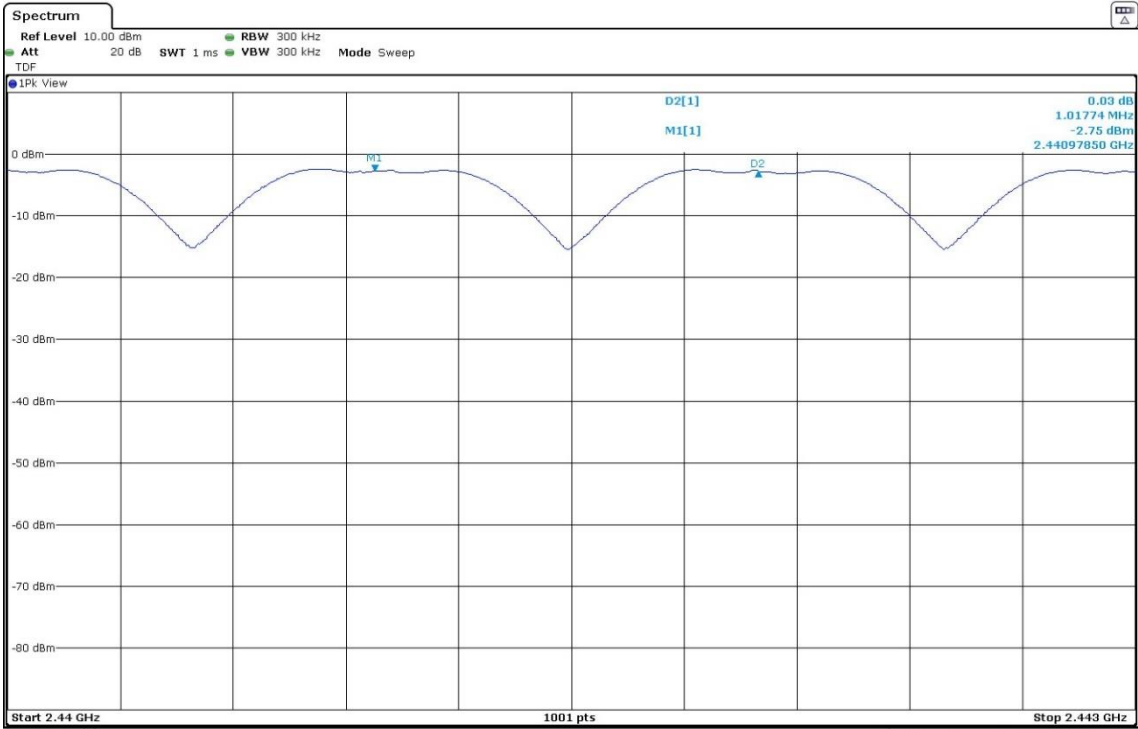
Verdict

Pass

Attachments

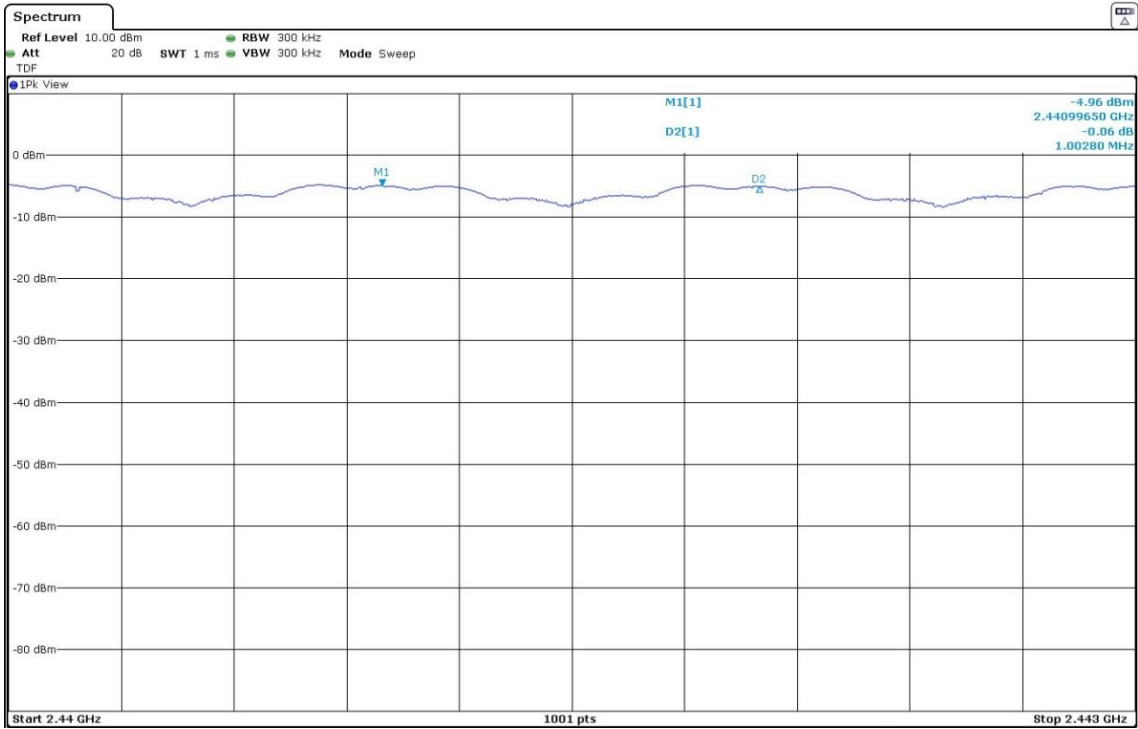
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



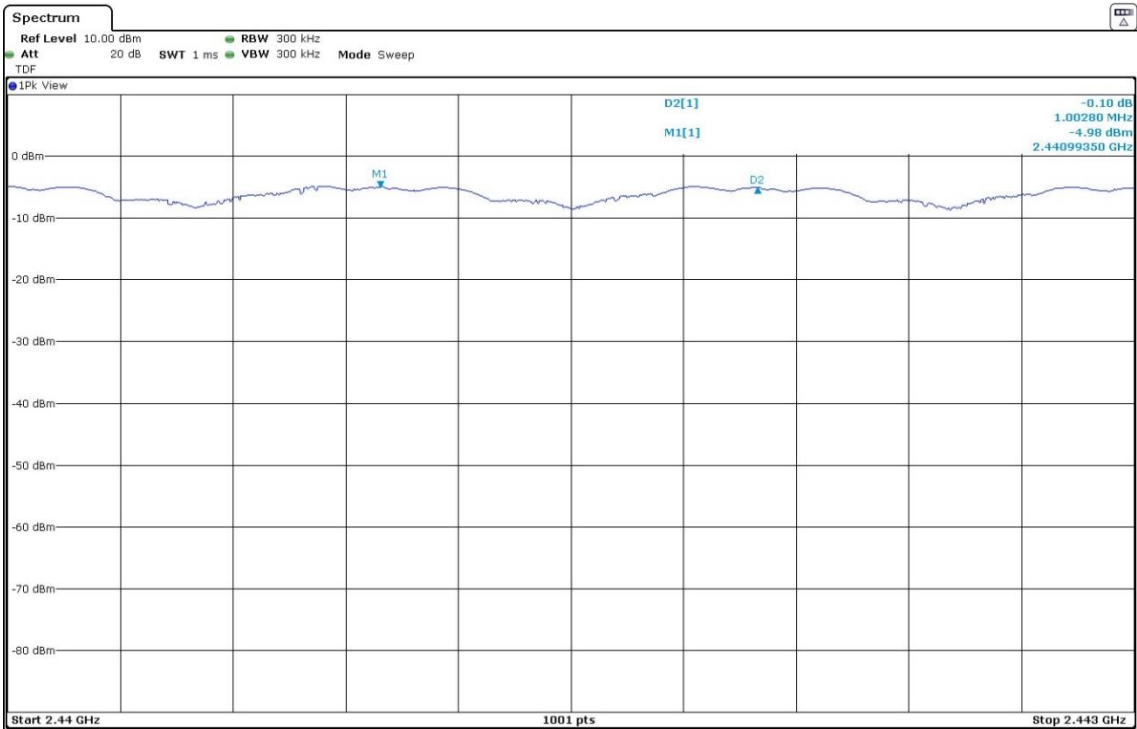
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Time of Occupancy (Dwell Time)

Limits

The average time of occupancy on any channel shall not be greater than 0.4 seconds (400 ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed = $0.4 \times 79 = 31.6$ seconds.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Equipment	NHp	Avg COT (ms)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	53	156.89

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Equipment	NHp	Avg COT (ms)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	58	164.86

Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Equipment	NHp	Avg COT (ms)
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	54	151.92

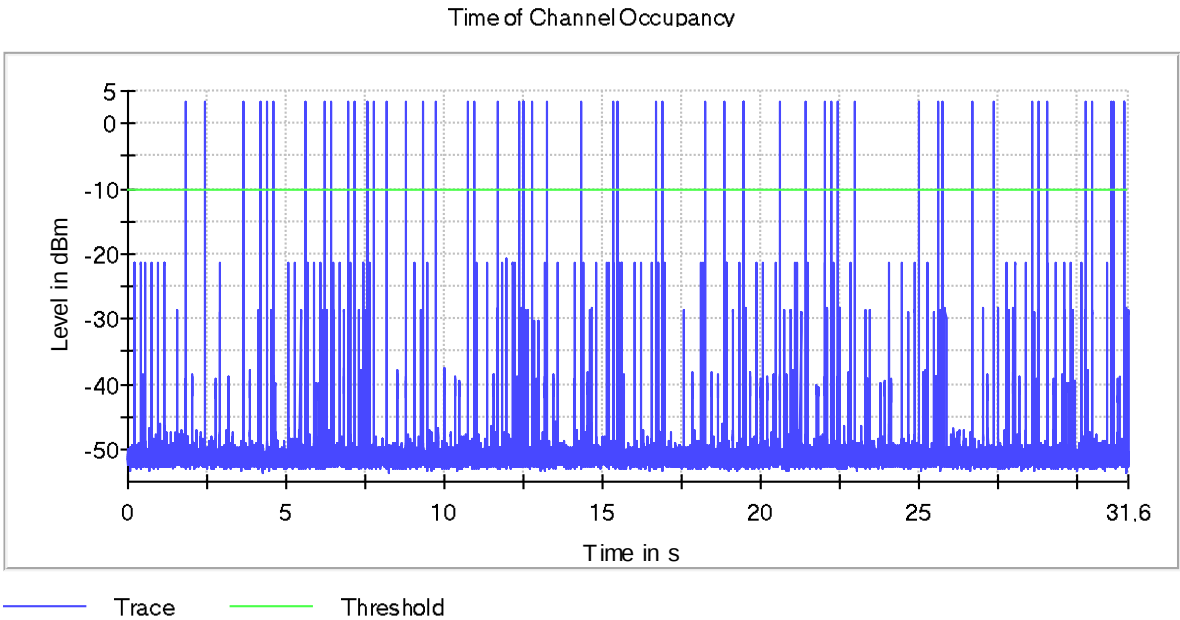
Verdict

Pass

Attachments

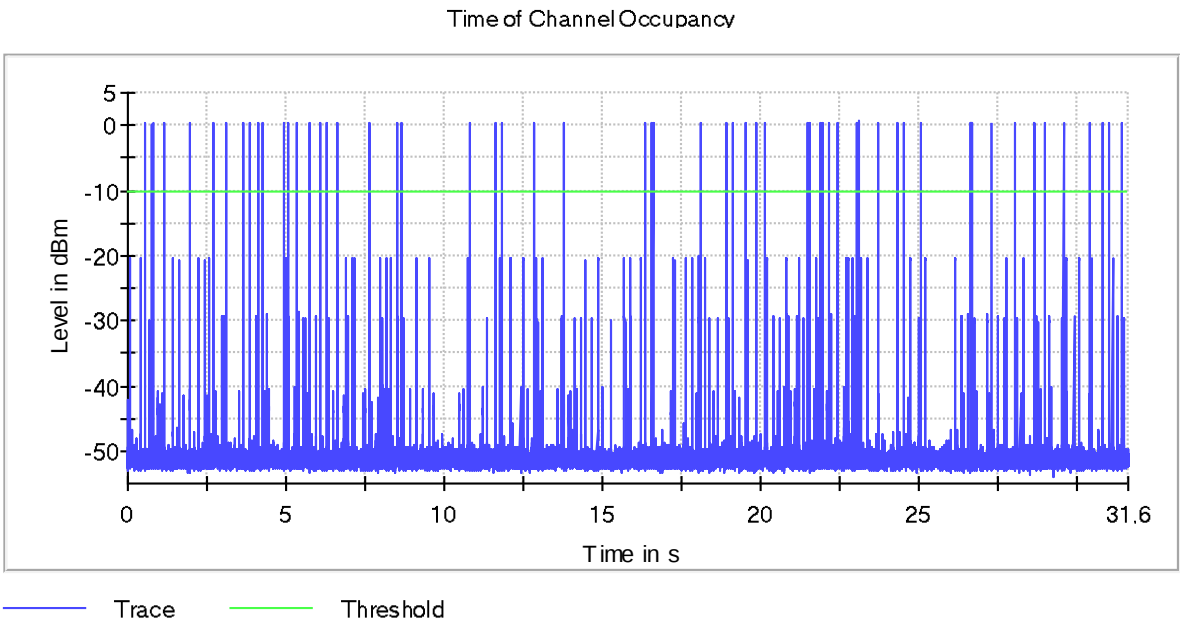
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



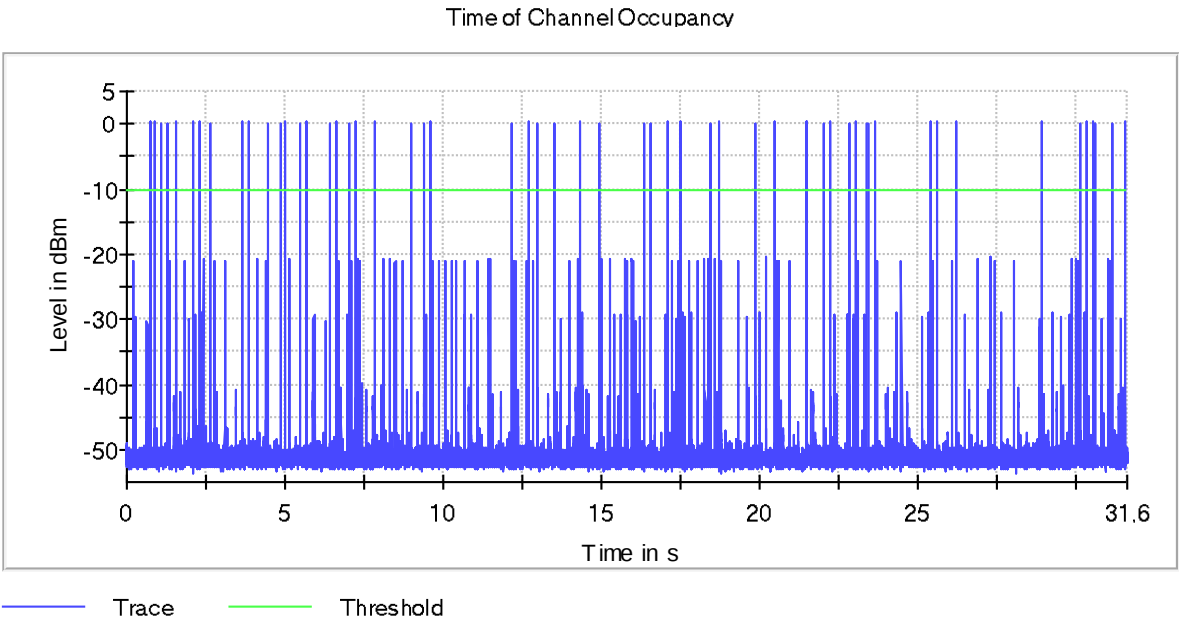
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Number of hopping channels

Limits

Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 channels.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Equipment	NHC
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	79

Modulation: BT (Pi/4 DQPSK 2-DH5)

Results

Operation Band (MHz)	Equipment	NHC
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	79

Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Equipment	NHC
[2400, 2483.5]	Frequency Hopping Spread Spectrum systems (DSS)	79

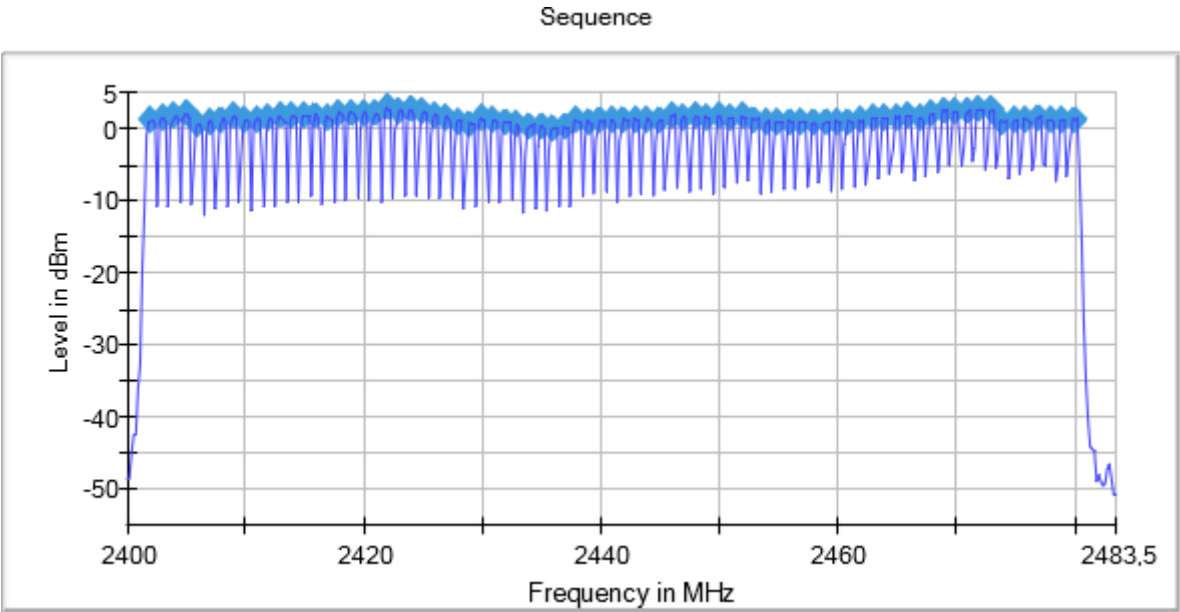
Verdict

Pass

Attachments

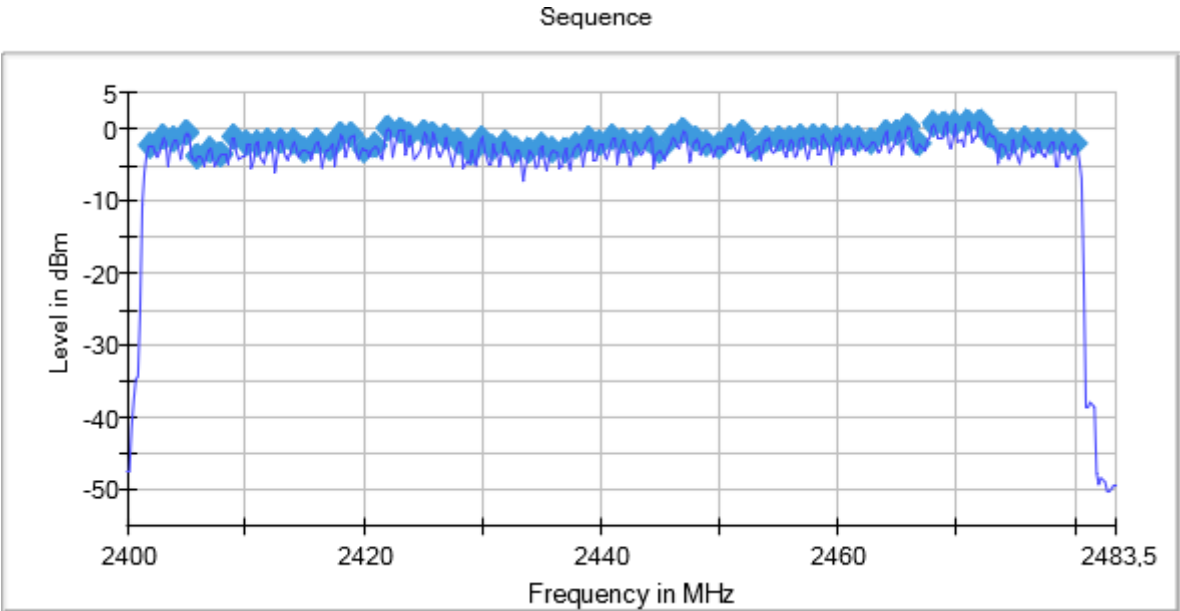
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



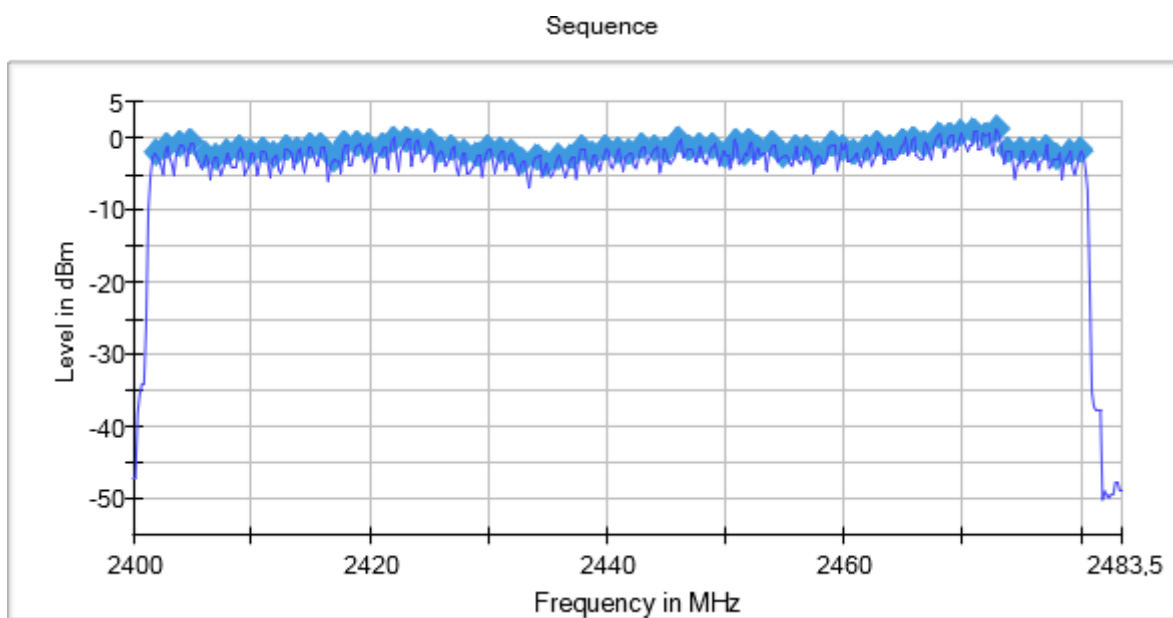
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



RSS-247 5.4 (b) / FCC 15.247 (b) Maximum peak output power and antenna gain

Limits

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm). The e.i.r.p. shall not exceed 4 W (RSS-247).

Results

The maximum peak conducted output power level of the fundamental emission was measured according to clause 7.8.5 "Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices" of ANSI C63.10-2013.

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

Maximum Declared Antenna Gain: +3.0 dBi

The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Modulation: BT (GFSK 1-DH5)

Operation Band (MHz)	Freq (MHz)	Equipment	Maximum Conducted Power (dBm)	Maximum EIRP Power (dBm)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	1.4	4.4
	2441.00000		1.4	4.4
	2480.00000		1.7	4.7

Verdict

Pass

Modulation: BT (Pi/4 DQPSK 2-DH5)

Operation Band (MHz)	Freq (MHz)	Equipment	Maximum Conducted Power (dBm)	Maximum EIRP Power (dBm)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	-0.5	2.5
	2441.00000		-0.5	2.5
	2480.00000		-0.2	2.8

Verdict

Pass

Modulation: BT (8DPSK 3-DH5)

Operation Band (MHz)	Freq (MHz)	Equipment	Maximum Conducted Power (dBm)	Maximum EIRP Power (dBm)
[2400, 2483.5]	2402.00000	Frequency Hopping Spread Spectrum systems (DSS)	-0.3	2.7
	2441.00000		0.1	3.1
	2480.00000		-0.1	2.9

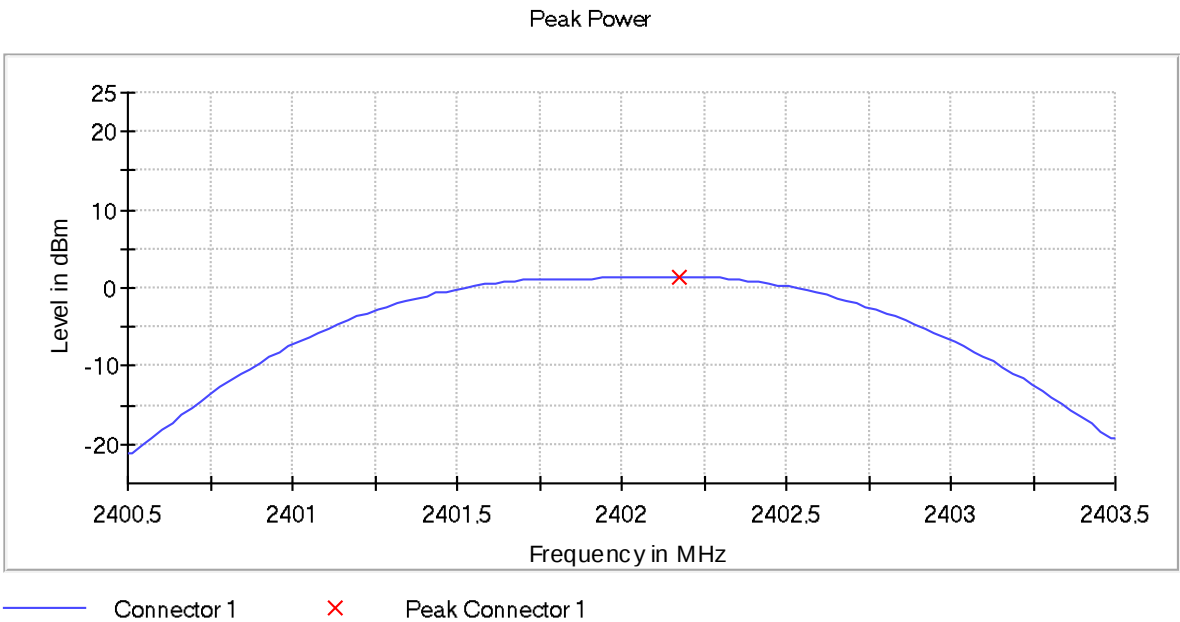
Verdict

Pass

Attachments

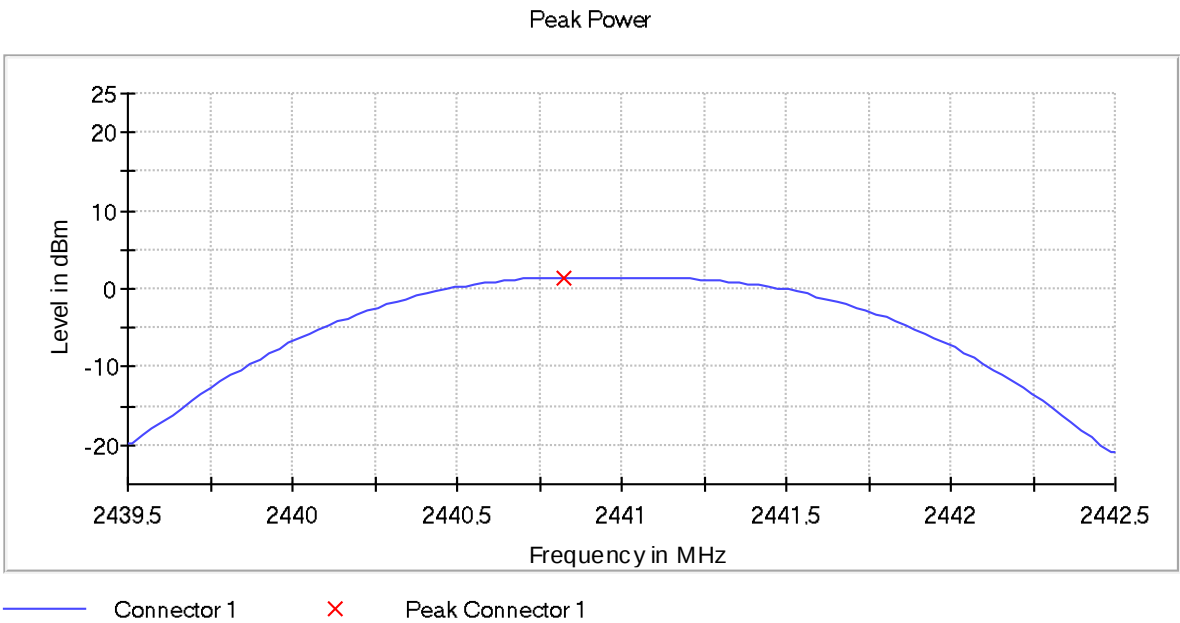
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



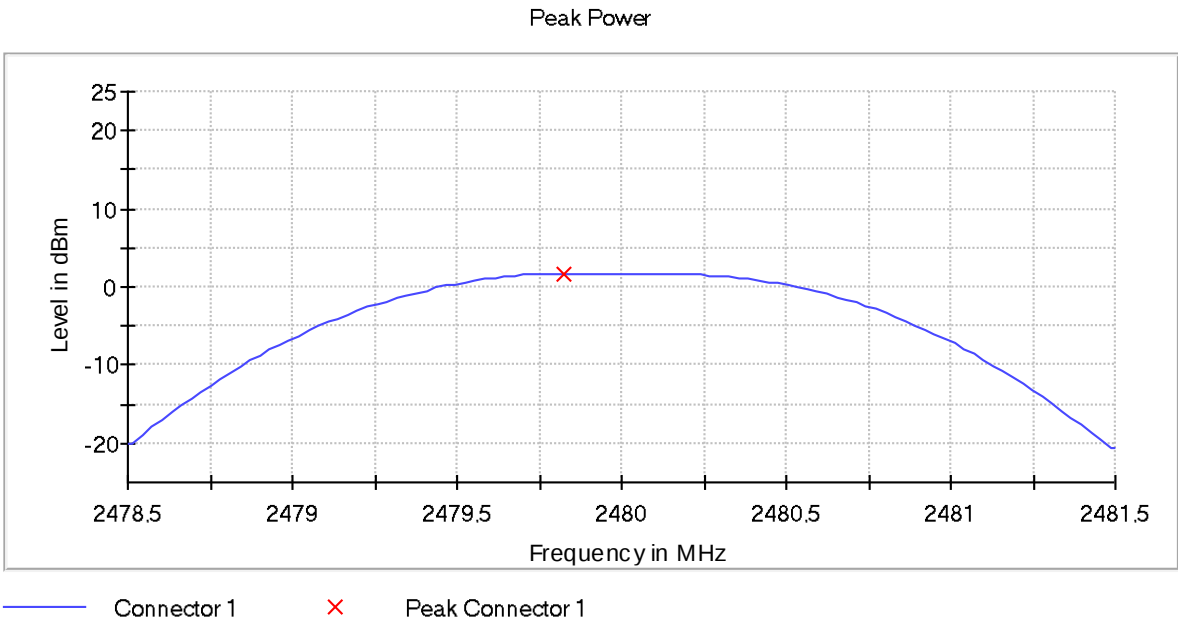
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



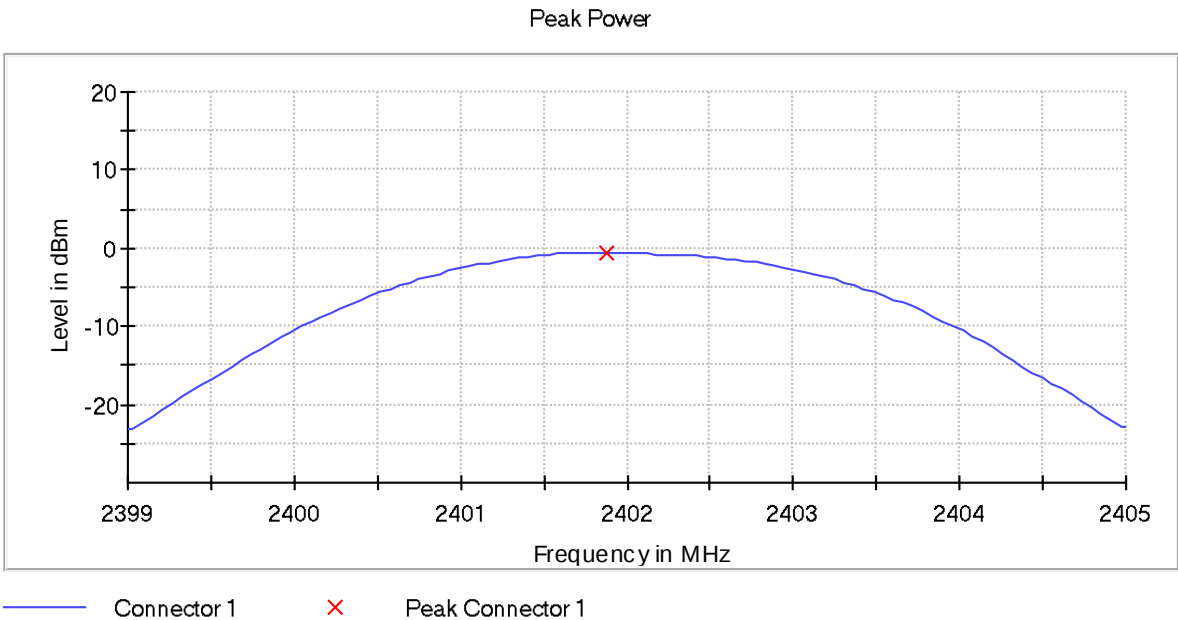
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



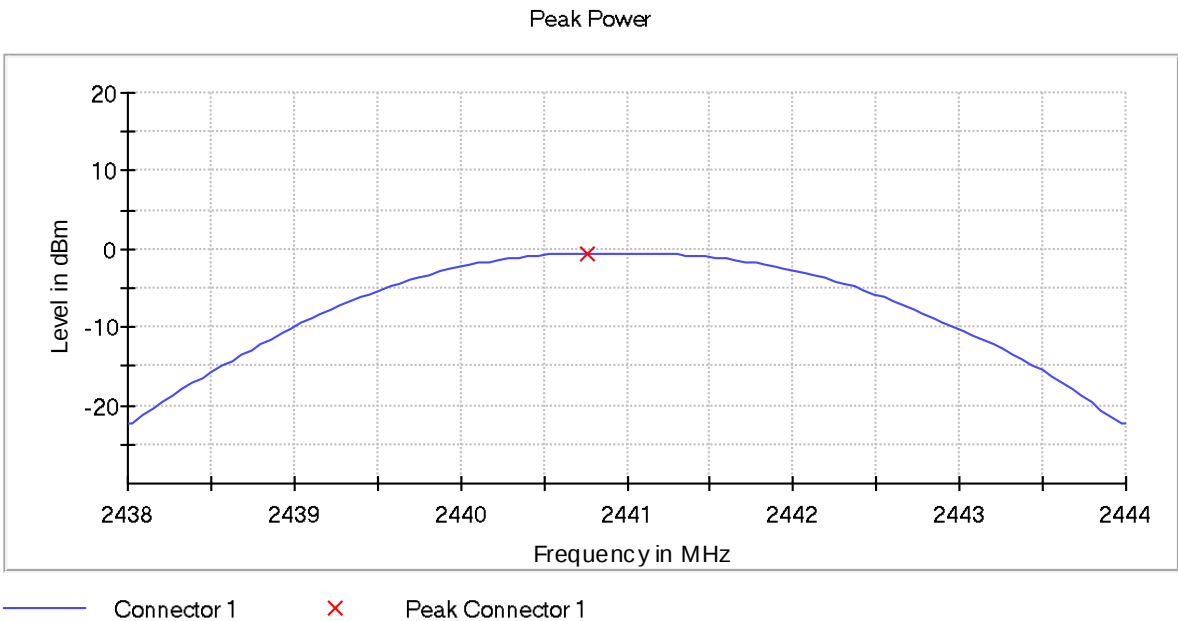
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



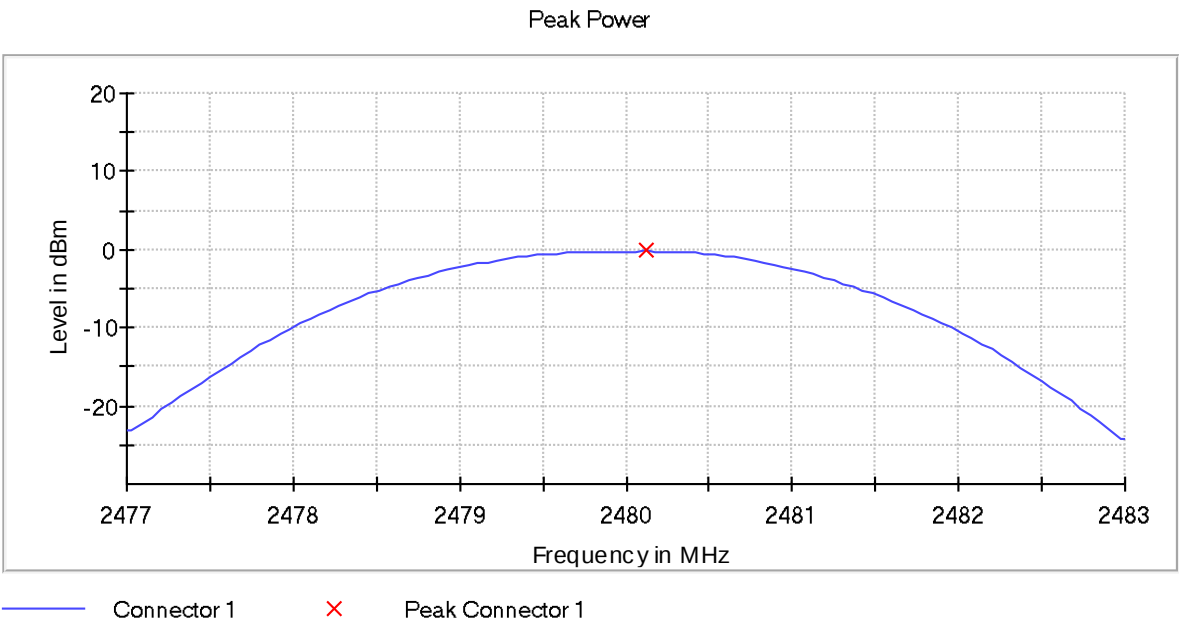
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



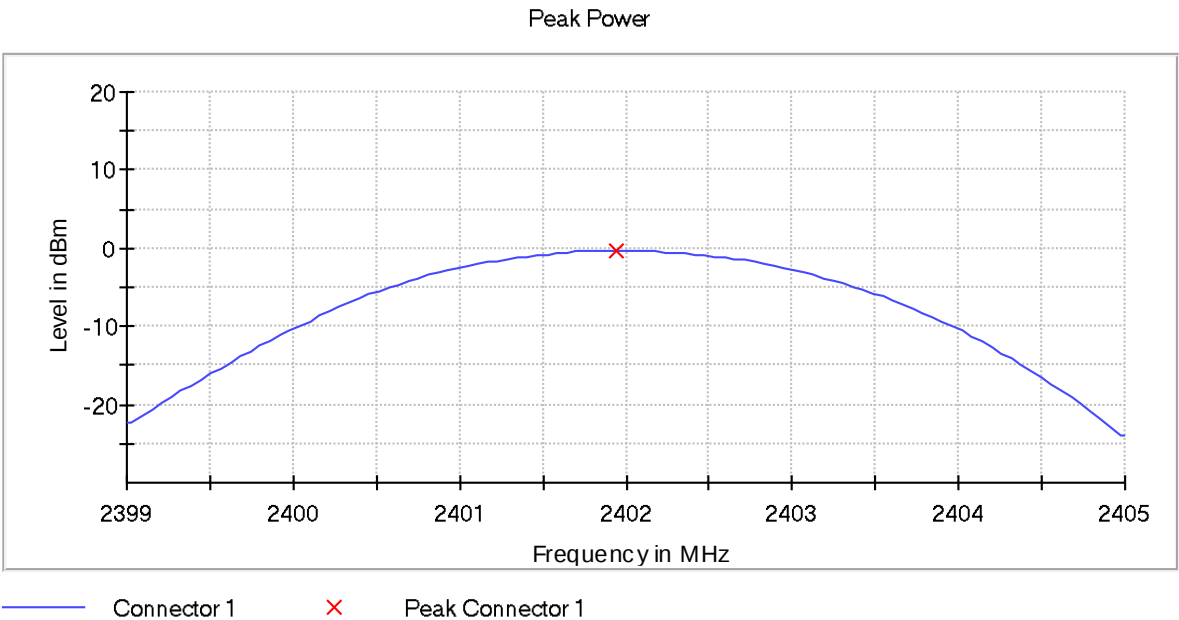
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



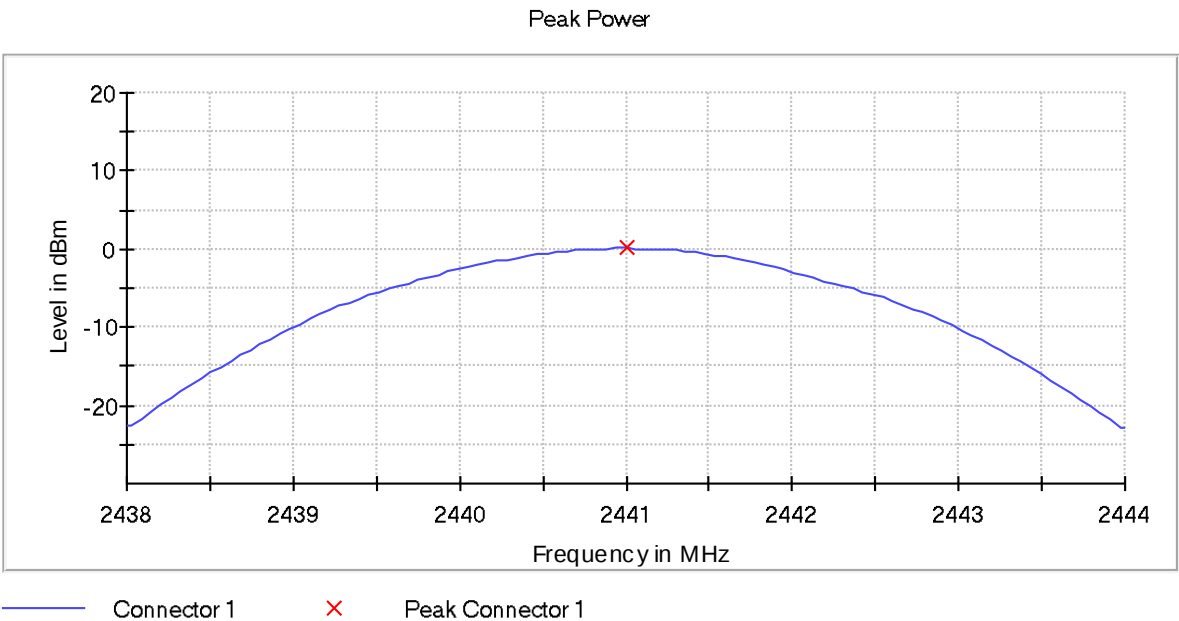
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



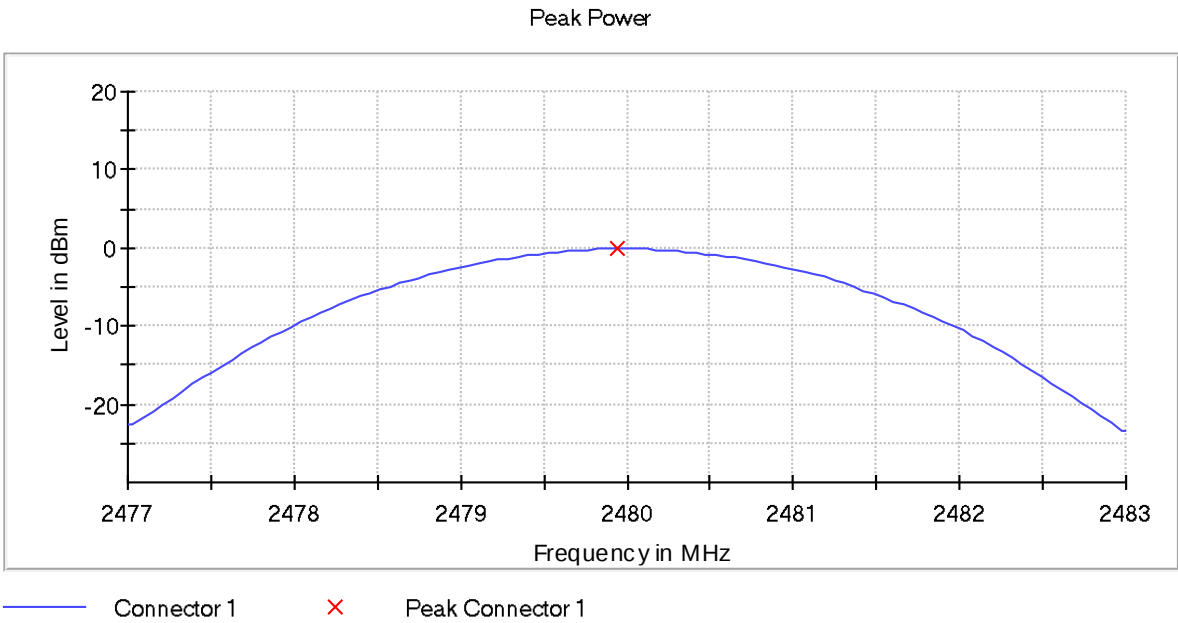
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



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.

Results

Radiated measurements were used to show compliance with the limits in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Modulation: BT (GFSK 1-DH5)

Verdict

Pass

Modulation: BT (Pi/4 DQPSK 2-DH5)

Verdict

Pass

Modulation: BT (8DPSK 3-DH5)

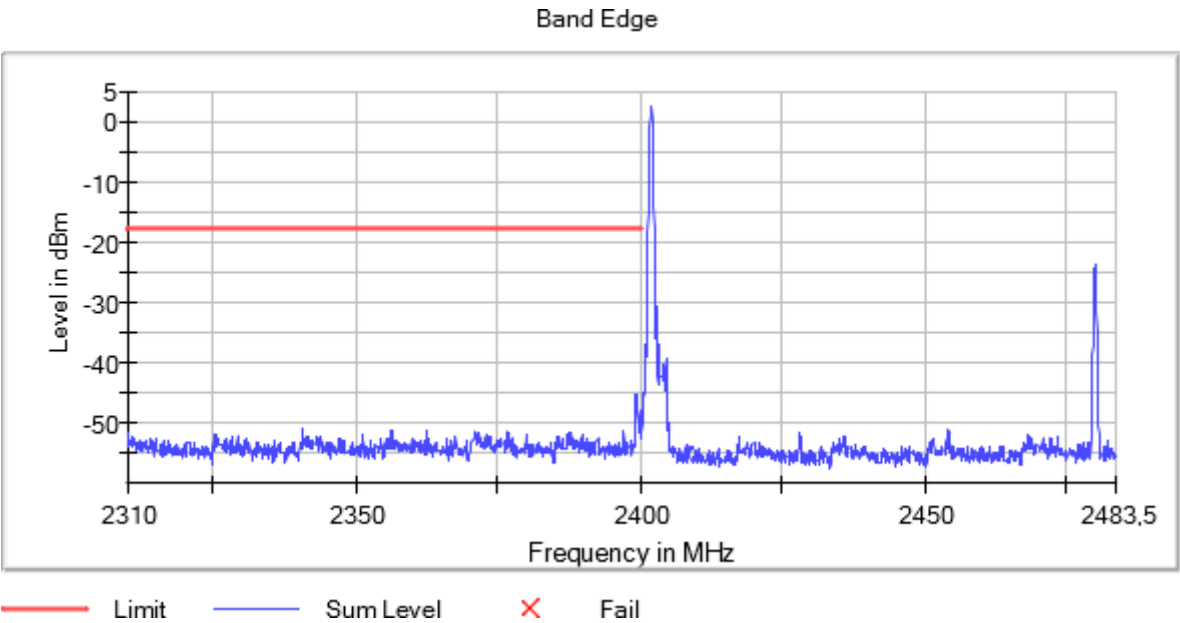
Verdict

Pass

Attachments

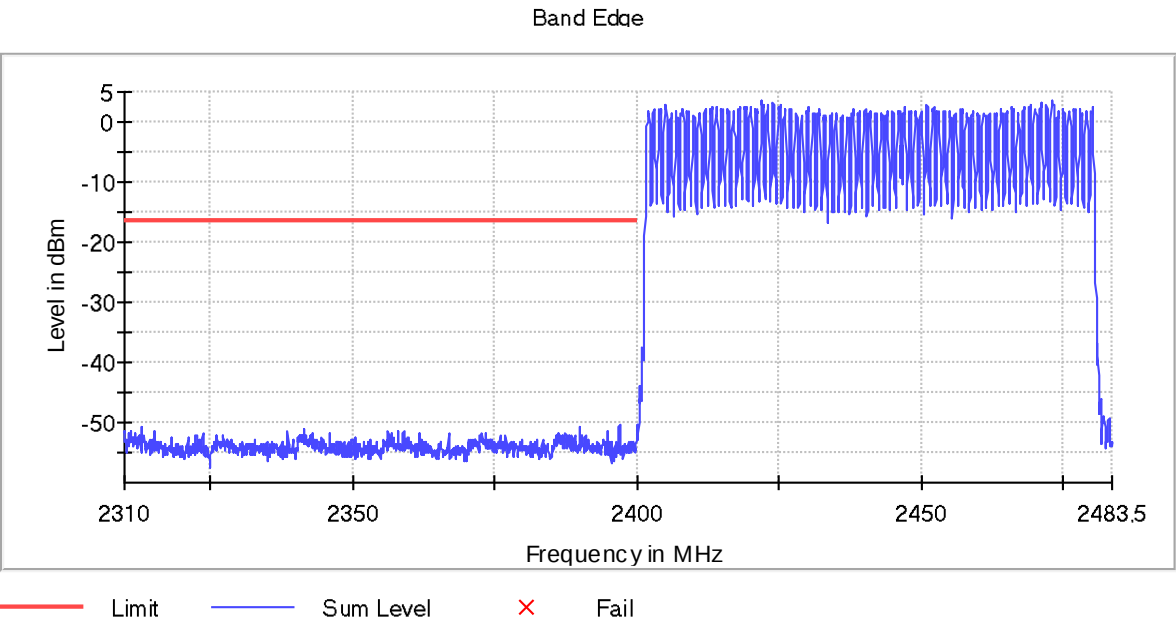
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



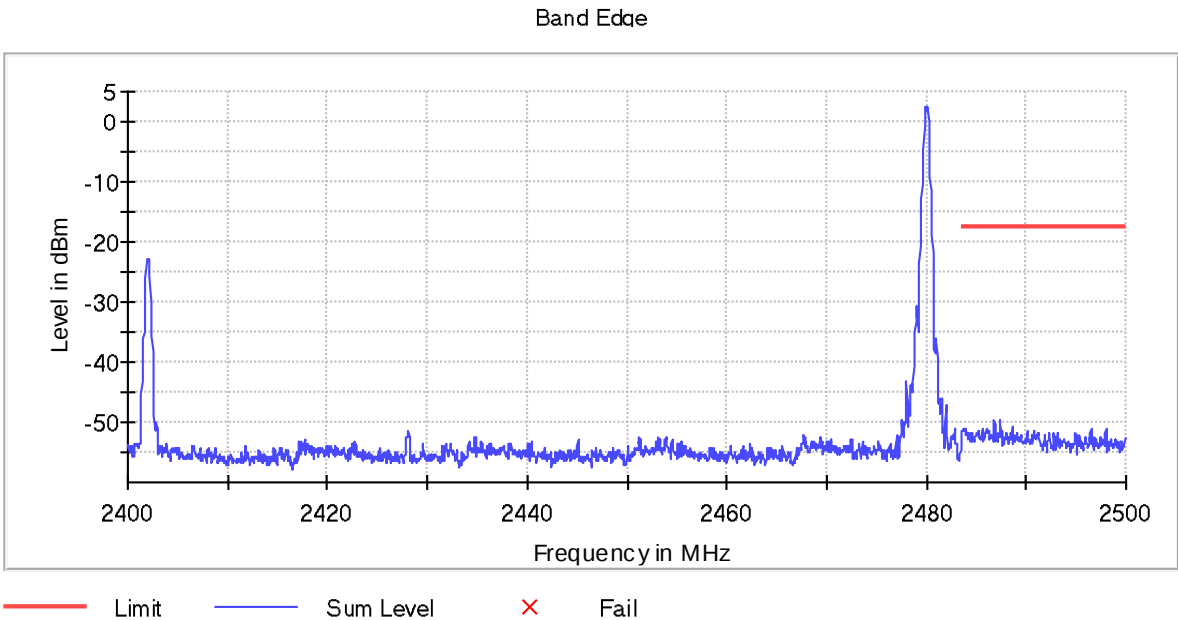
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5) – hopping

Plots:



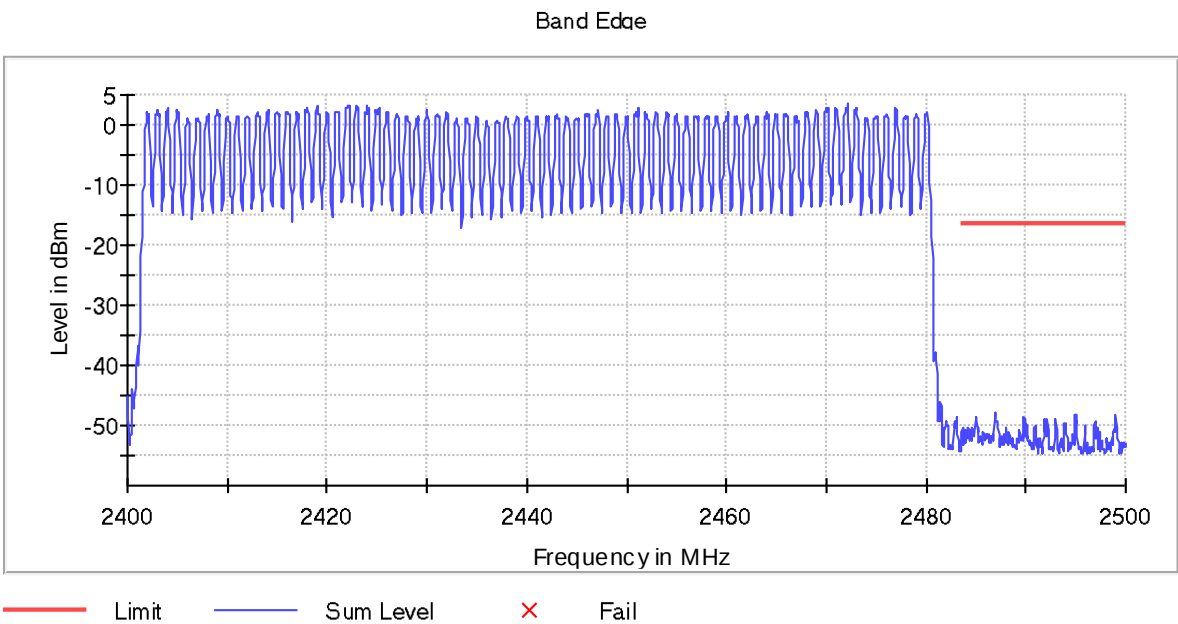
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5)

Plots:



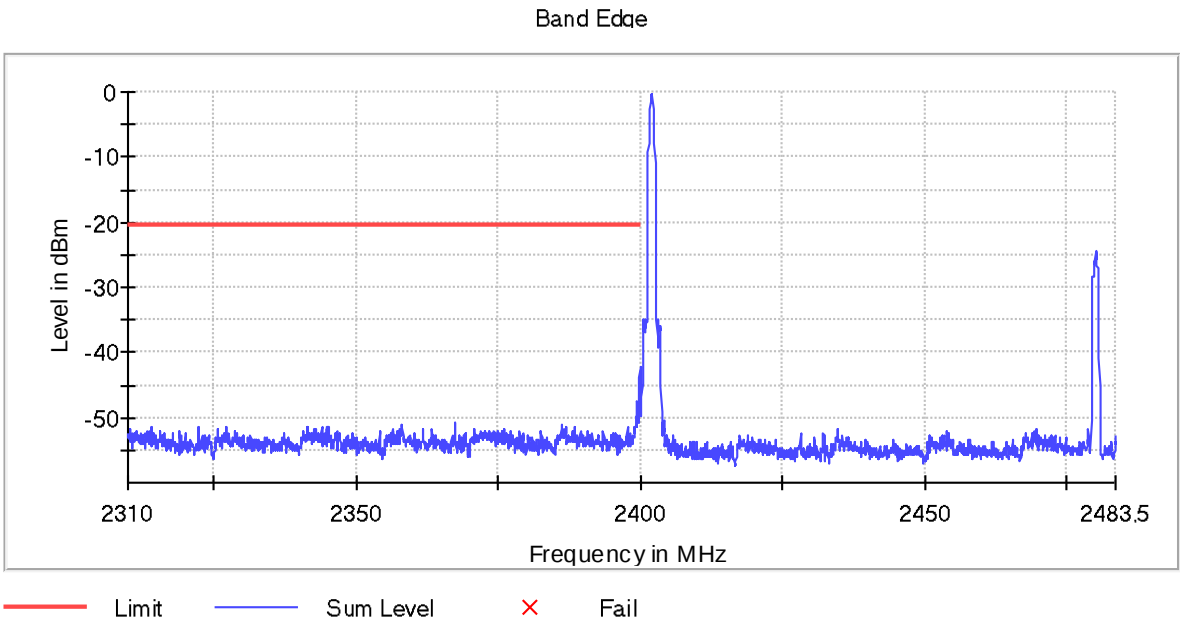
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5) – hopping

Plots:

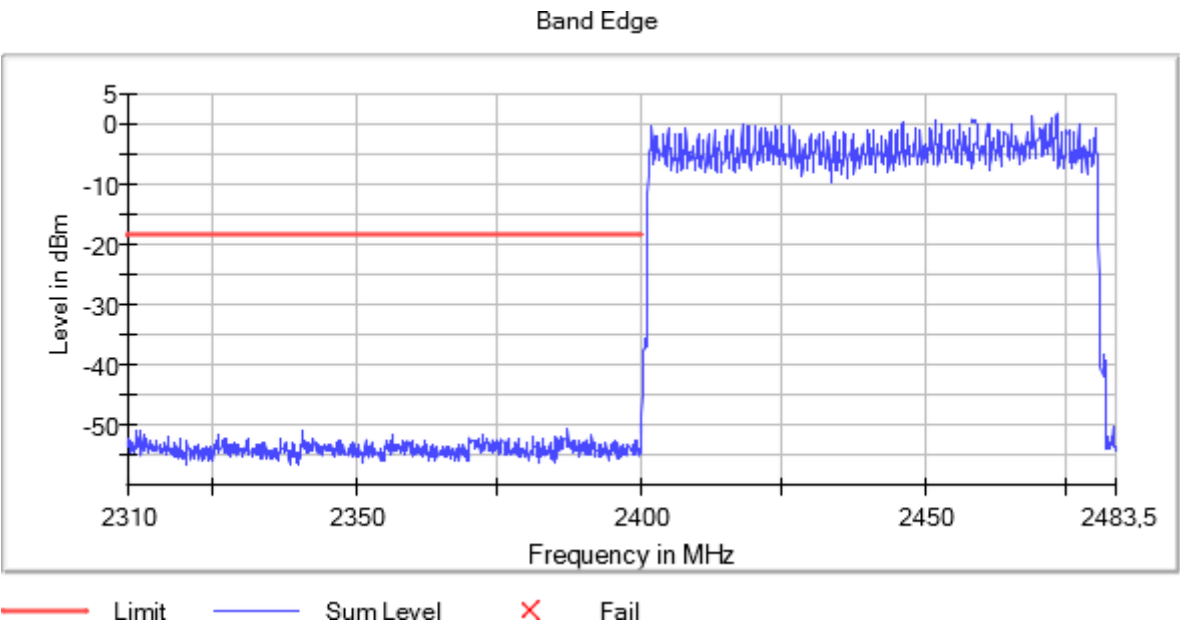


Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:

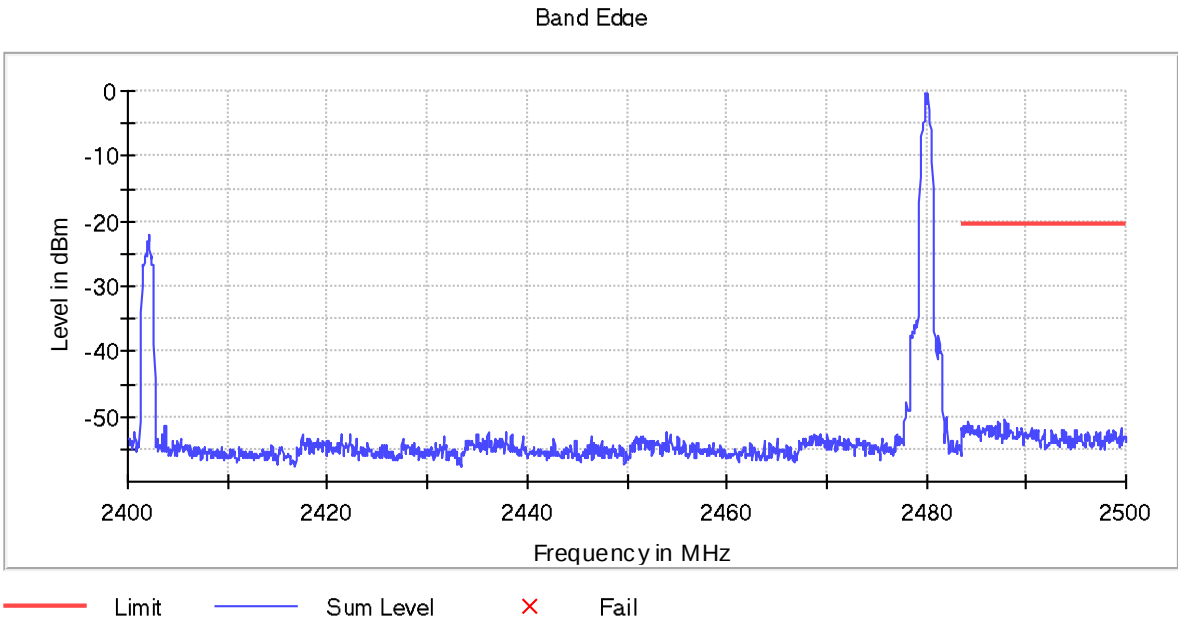


Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5) – hopping



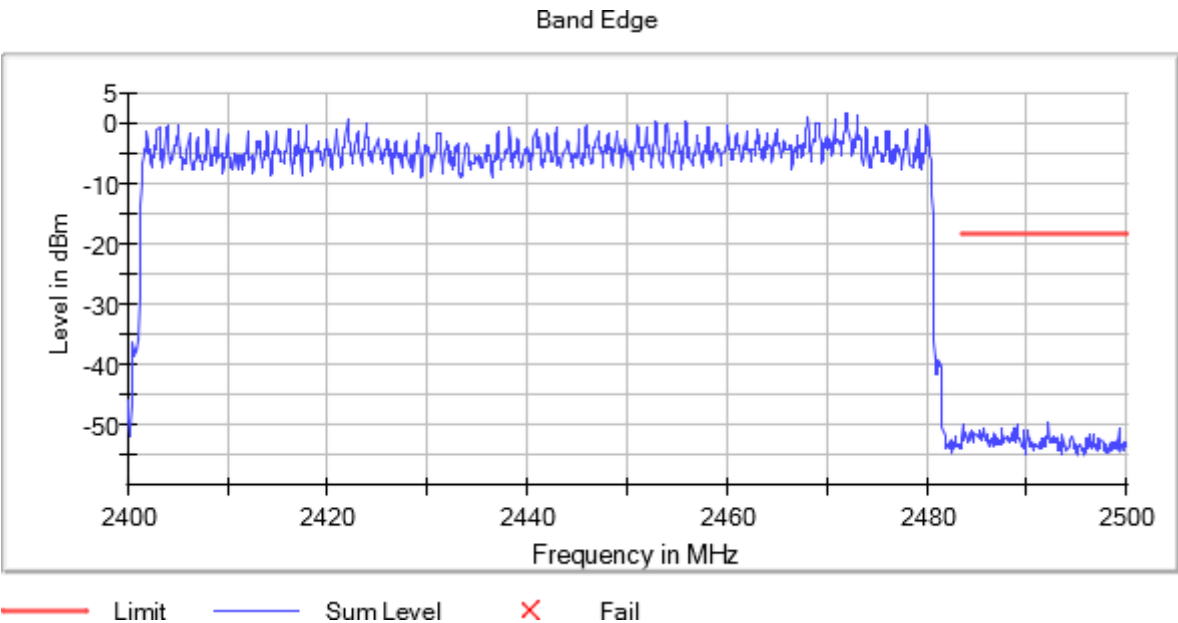
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5)

Plots:



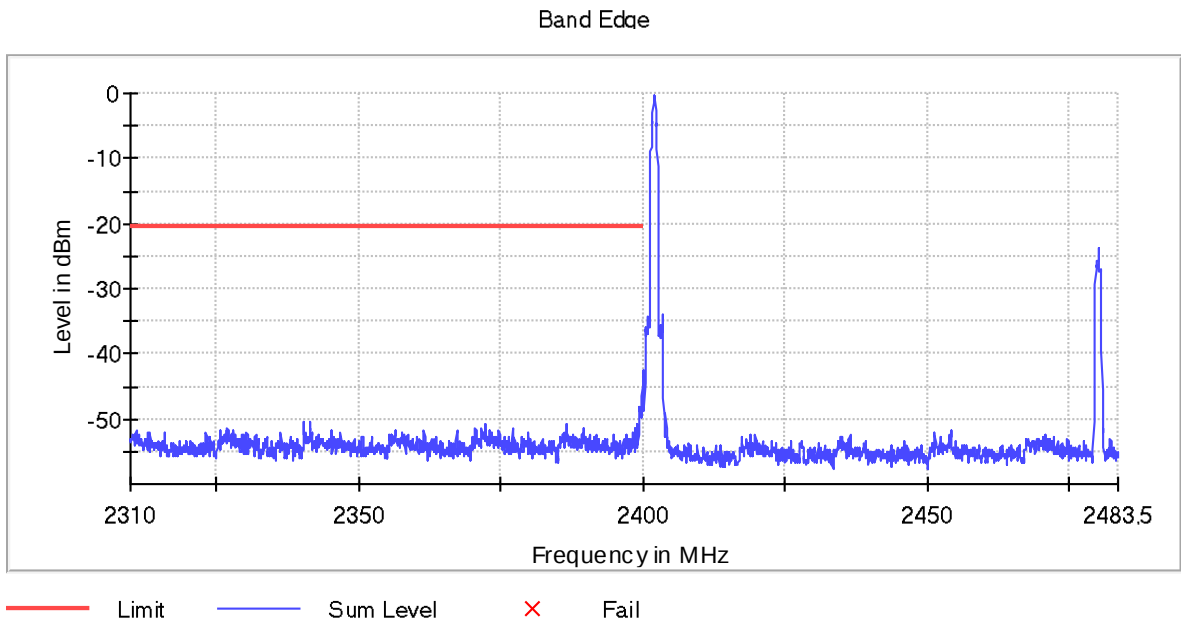
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5) – hopping

Plots:



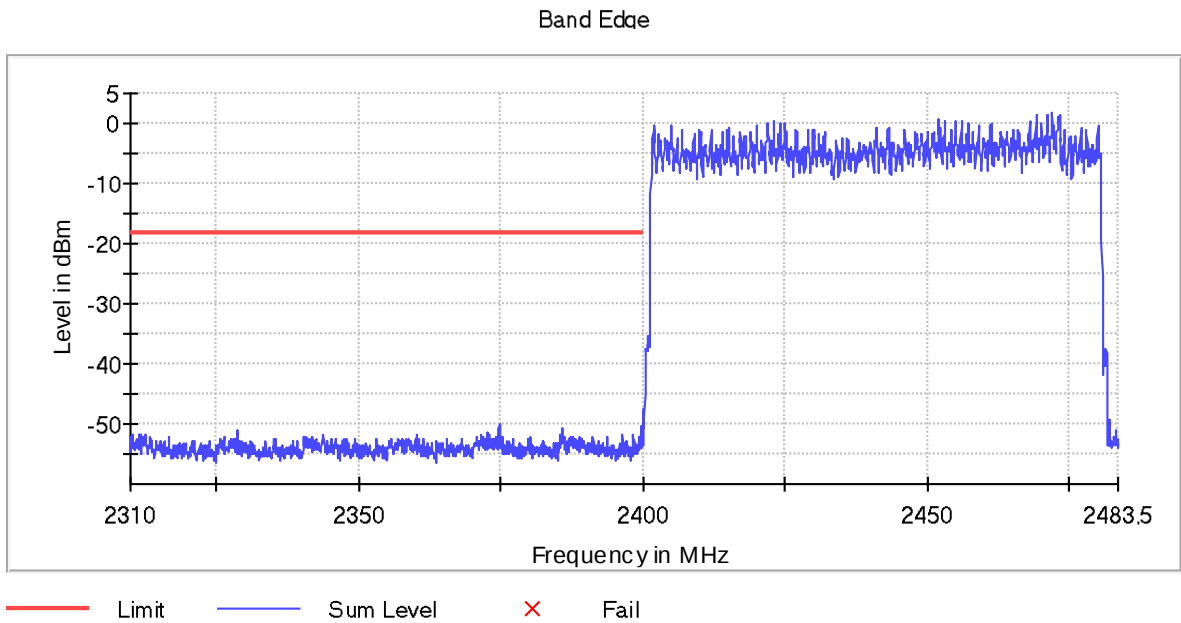
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



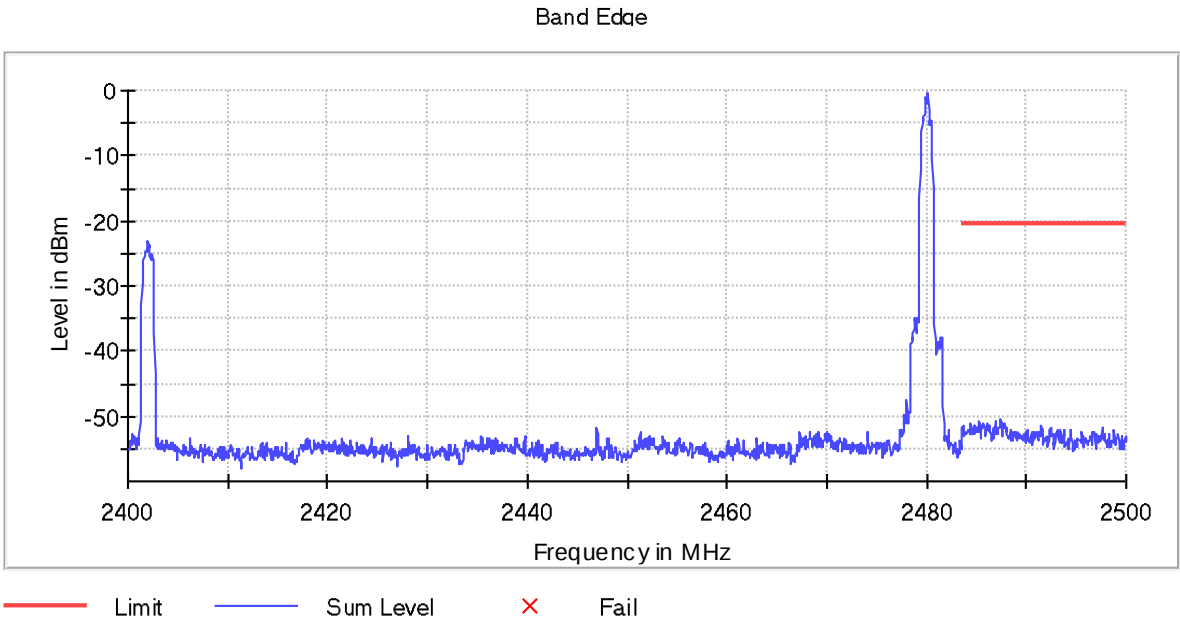
Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5) – hopping

Plots:



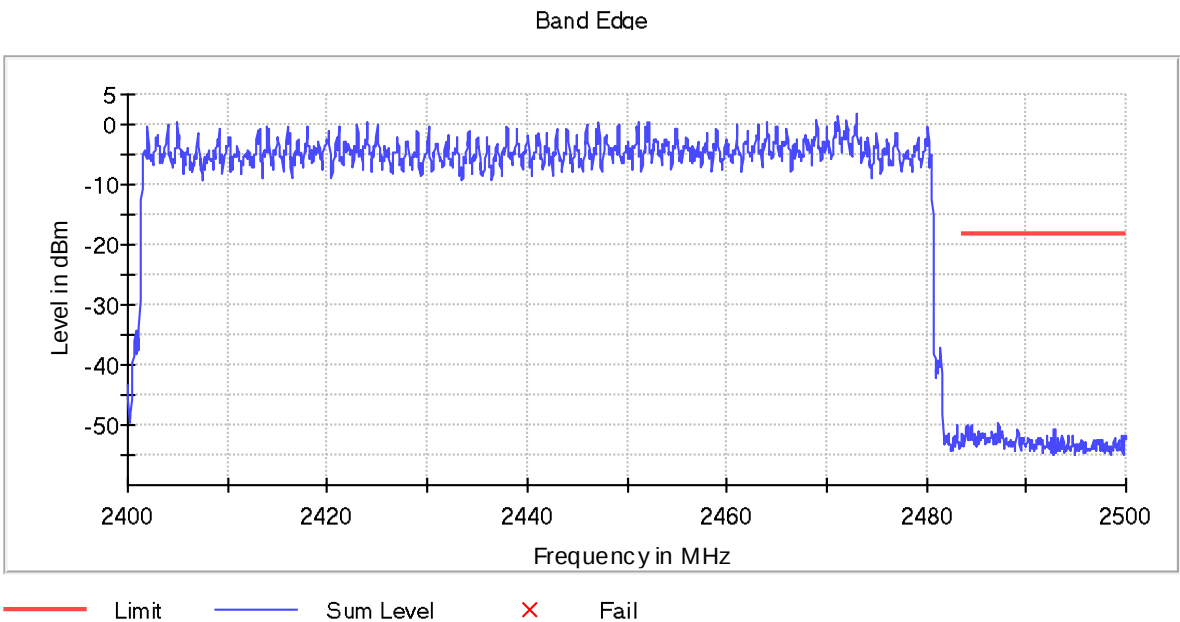
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5)

Plots:



Operation Band (MHz) = [2400, 2483.5], Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5) – hopping

Plots:



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 (μV/m)	Field strength (dBμV/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 specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.

RSS-247:

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

Results

Frequency range 30 MHz – 1 GHz

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

Freq Rng (GHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBμV/m)	PoI	Detector
[0.03, 1]	36.0322	20.63	V	QP
	37.9722	22.73	V	QP
	55.5231	20.40	V	QP
	69.7094	24.33	V	QP
	75.8931	25.01	V	QP
	79.9853	29.15	V	QP
	92.5347	26.19	V	QP
	102.2044	25.23	V	QP
	119.8463	23.70	V	QP
	151.9169	26.27	H	QP
	539.0075	27.07	H	QP
	700.7247	29.15	V	QP
	933.3428	31.86	V	QP

Modulation: BT (GFSK 1-DH5)

Frequency range 1 GHz – 26 GHz:

No spurious emissions detected at 20 dB below the limit.

Verdict

Pass

Attachments

Operation Band (MHz) = [2400, 2483.5]

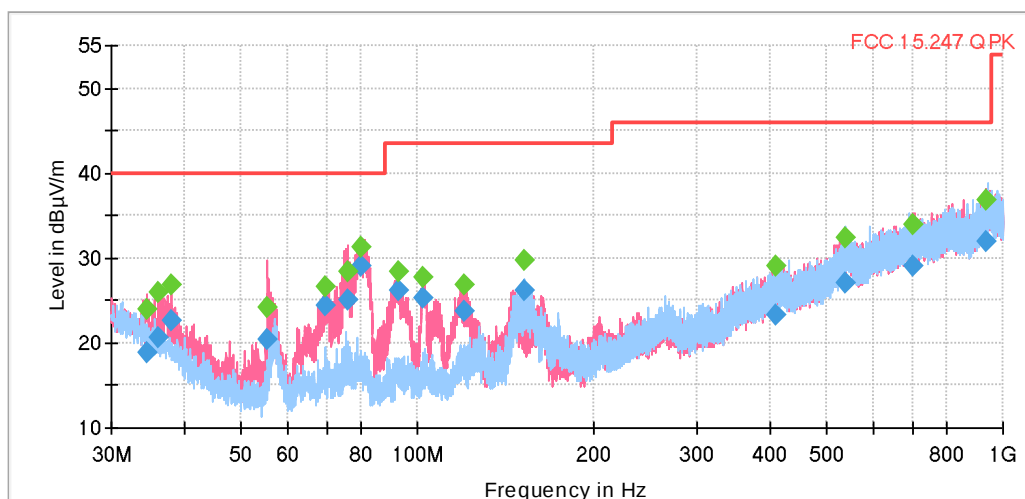
Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

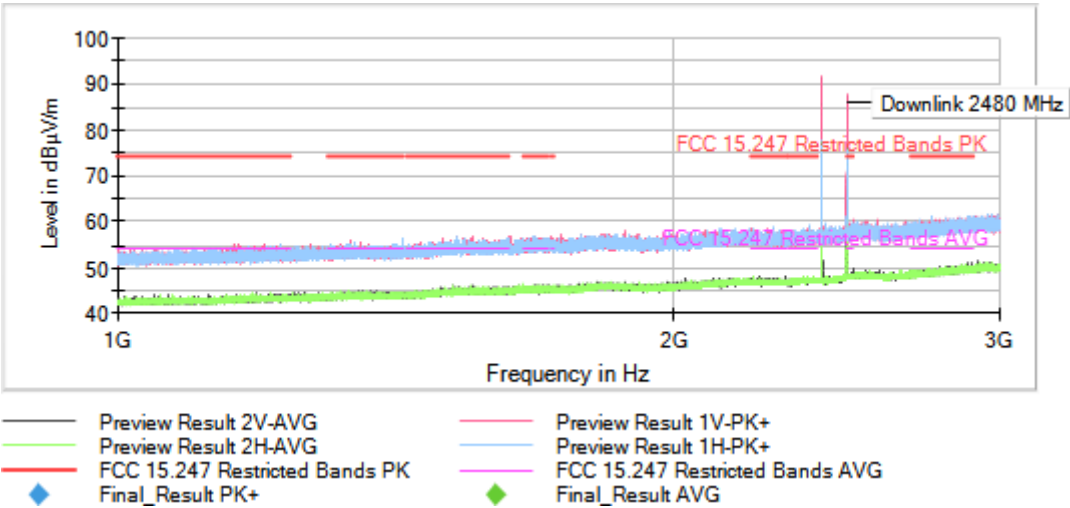
Frequency Range (GHz) = [0.03, 1]

Plots:



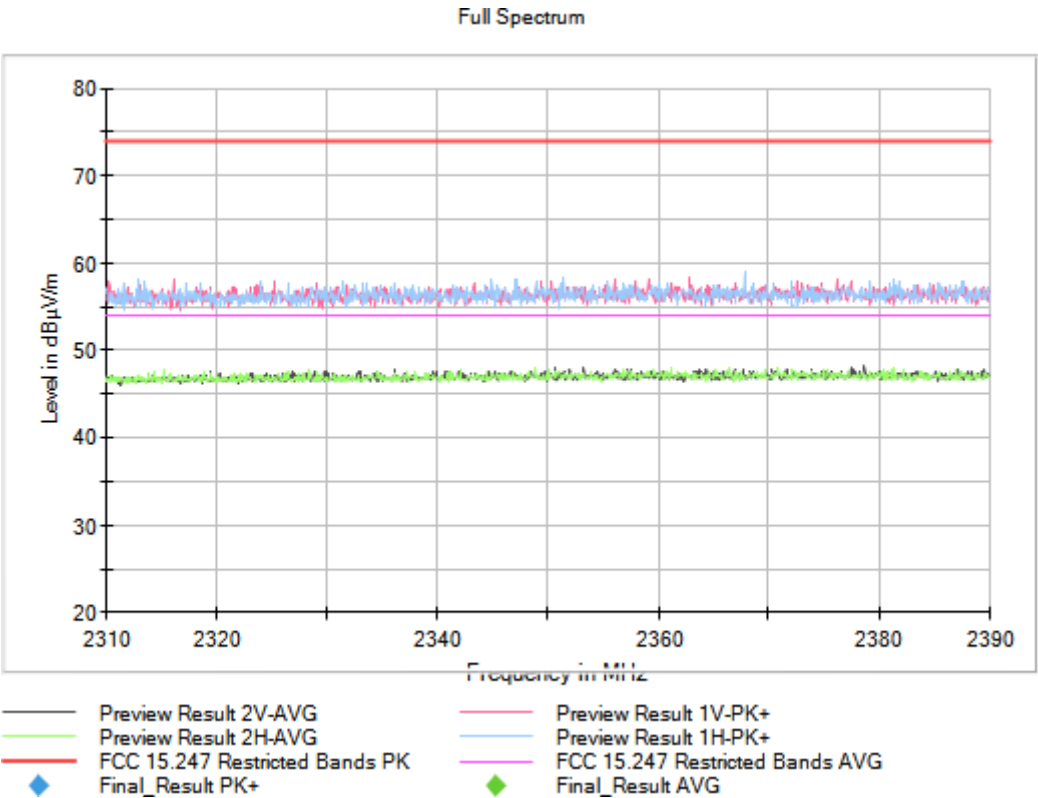
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [1, 3]

Plots:



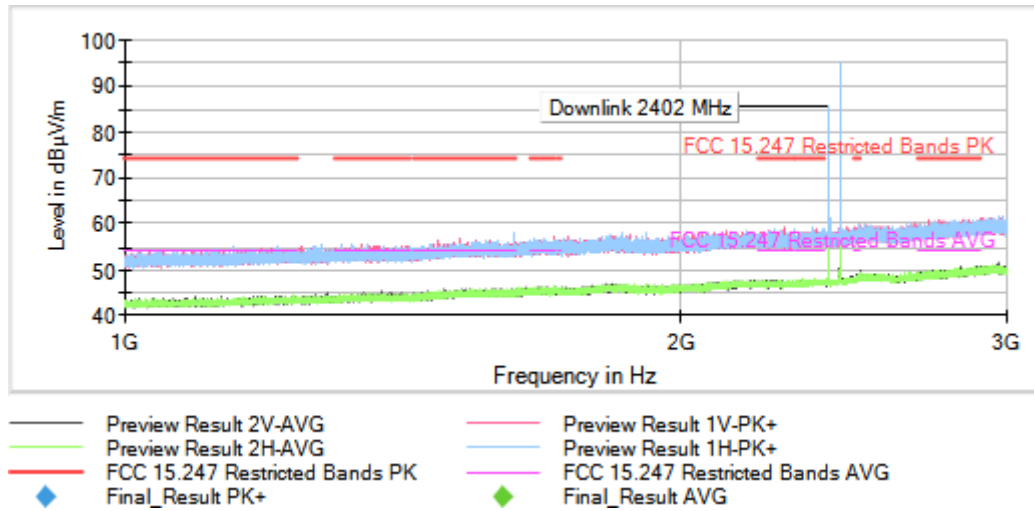
Full Spectrum





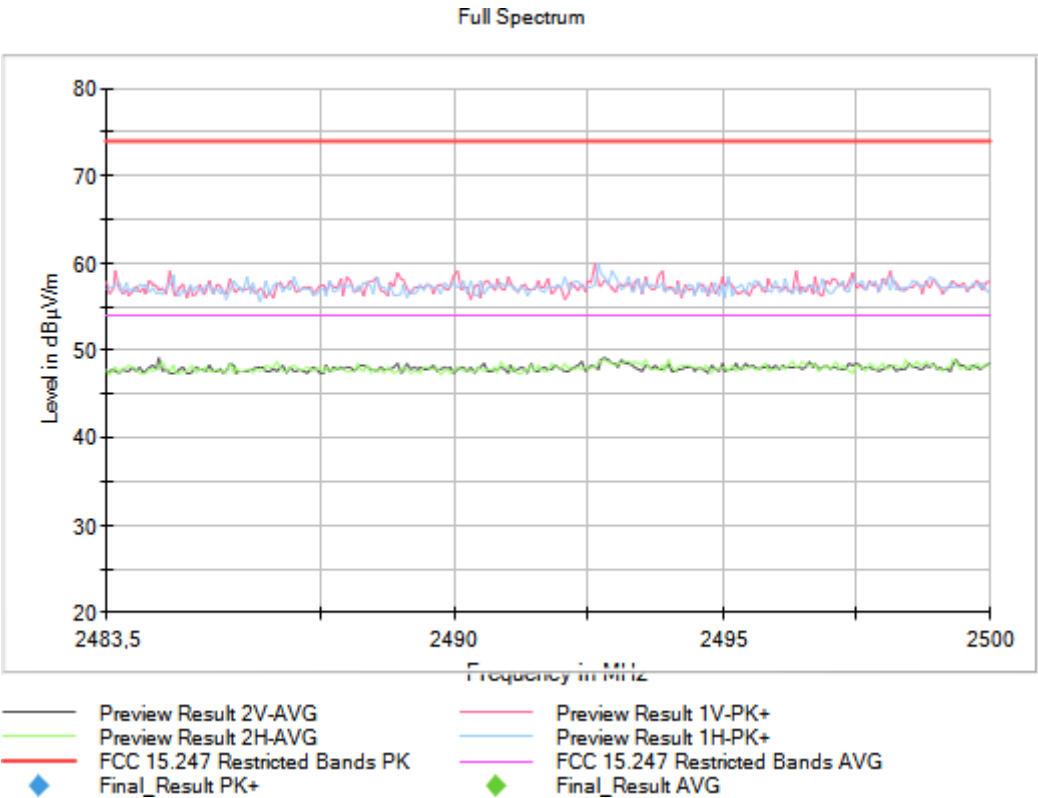
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [1, 3]

Plots:



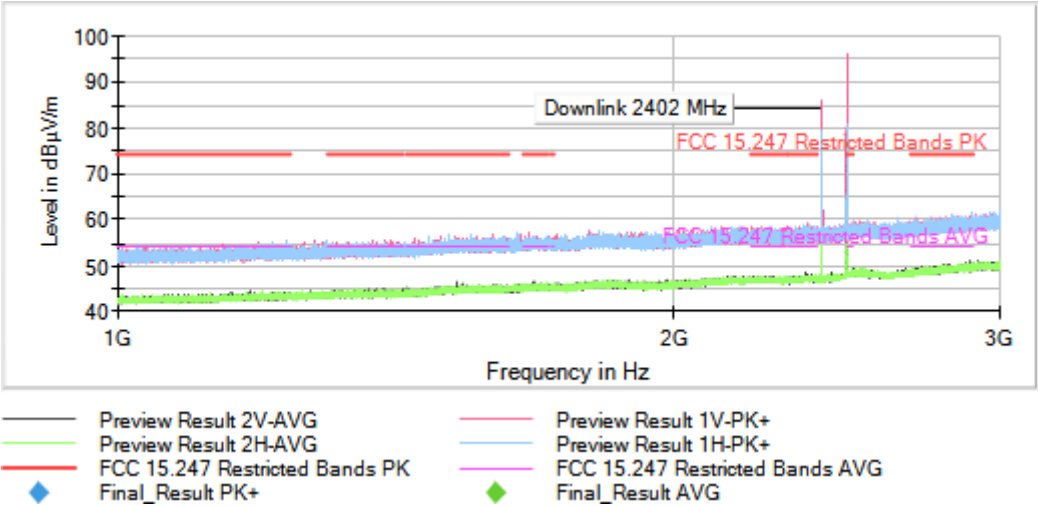
Full Spectrum





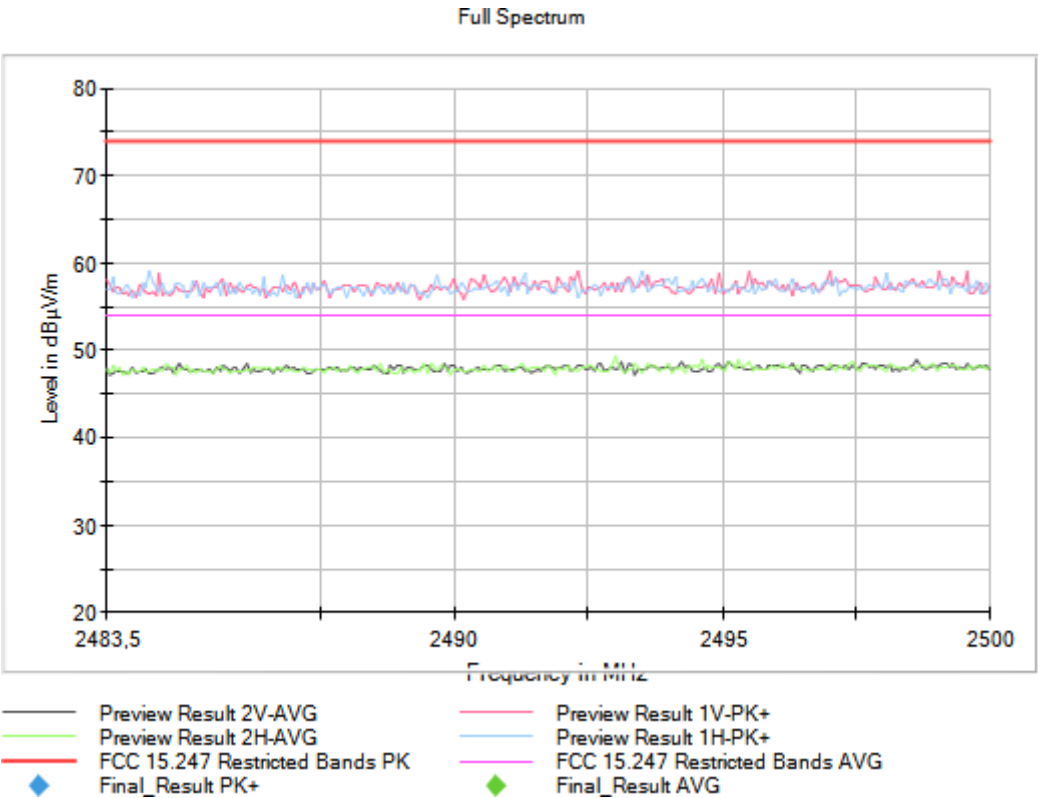
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [1, 3]

Plots:



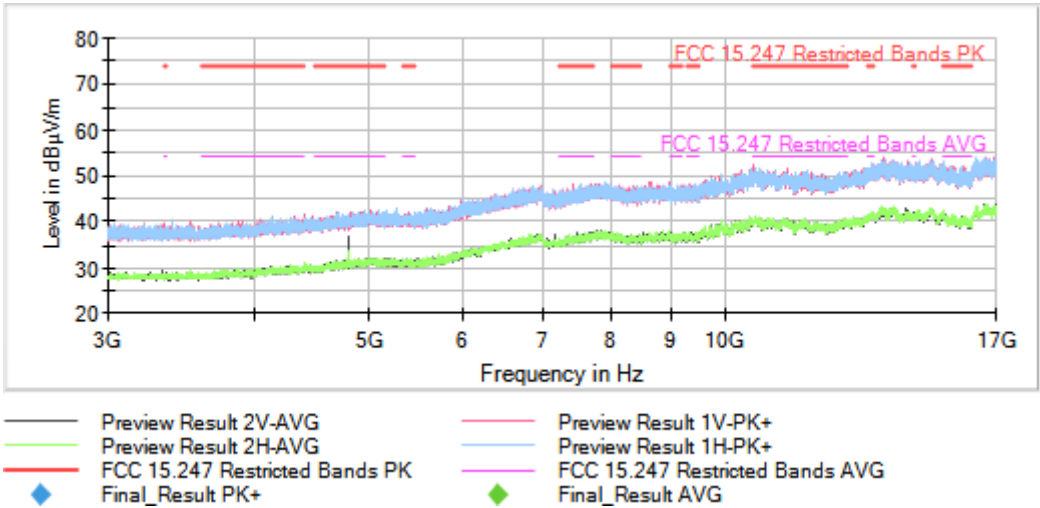
Full Spectrum





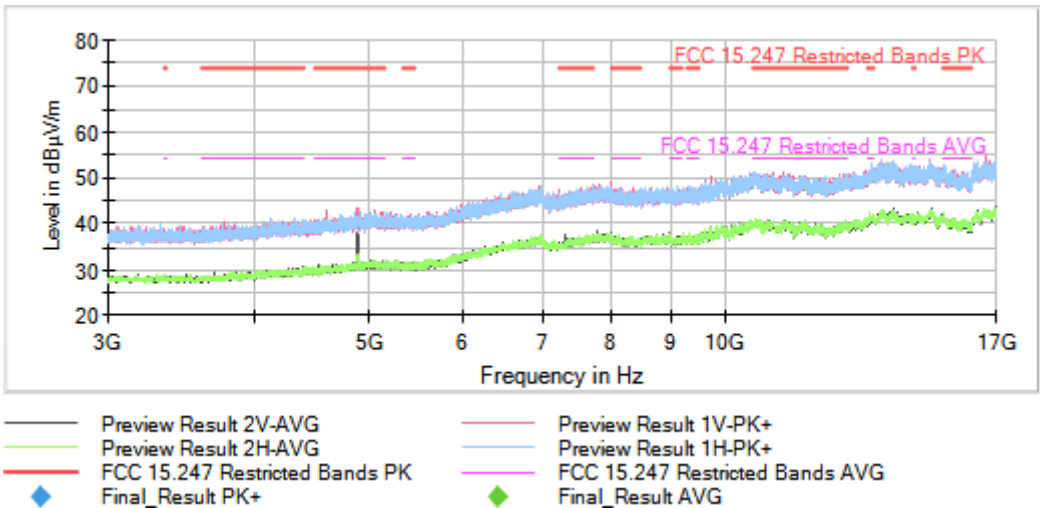
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [3, 17]

Plots:



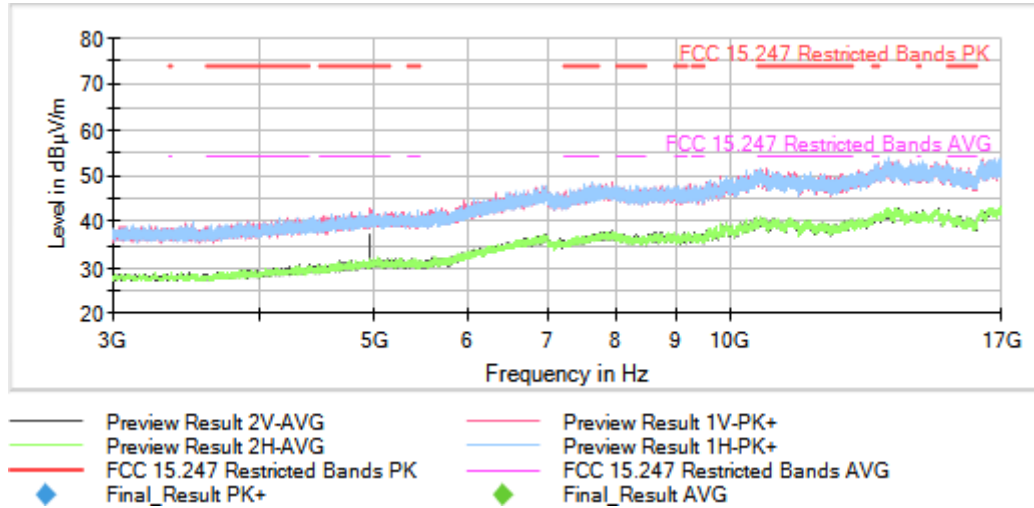
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [3, 17]

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (GFSK 1-DH5), Frequency Range (GHz) = [3, 17]

Plots:



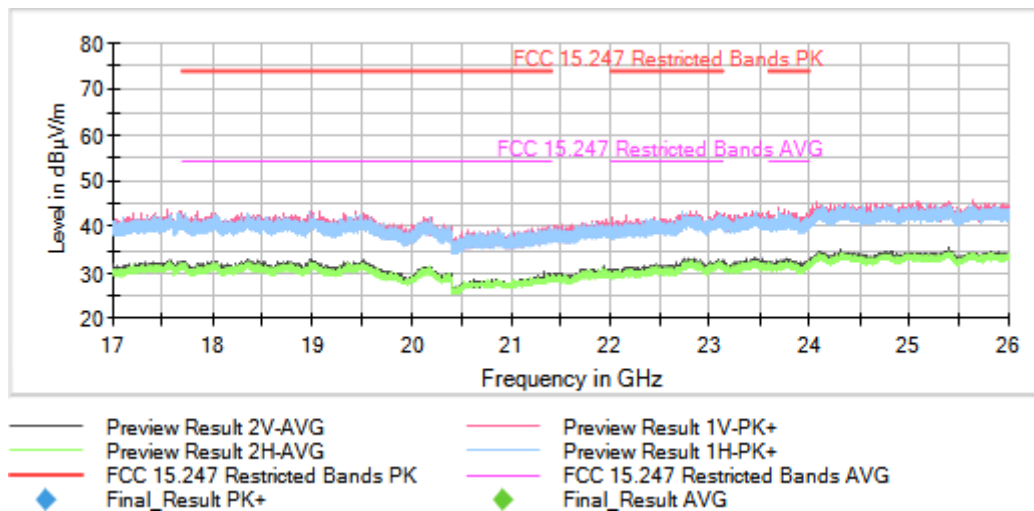
Operation Band (MHz) = [2400, 2483.5]

Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

Plots:



Modulation: BT (Pi/4 DQPSK 2-DH5)

Frequency range 1 GHz – 26 GHz:

No spurious emissions detected at 20 dB below the limit.

Verdict

Pass

Attachments

Operation Band (MHz) = [2400, 2483.5]

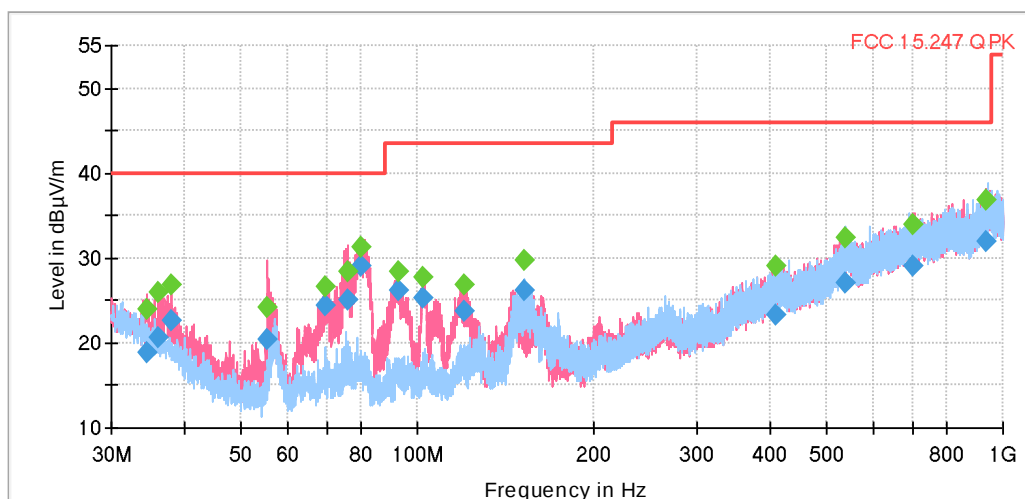
Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

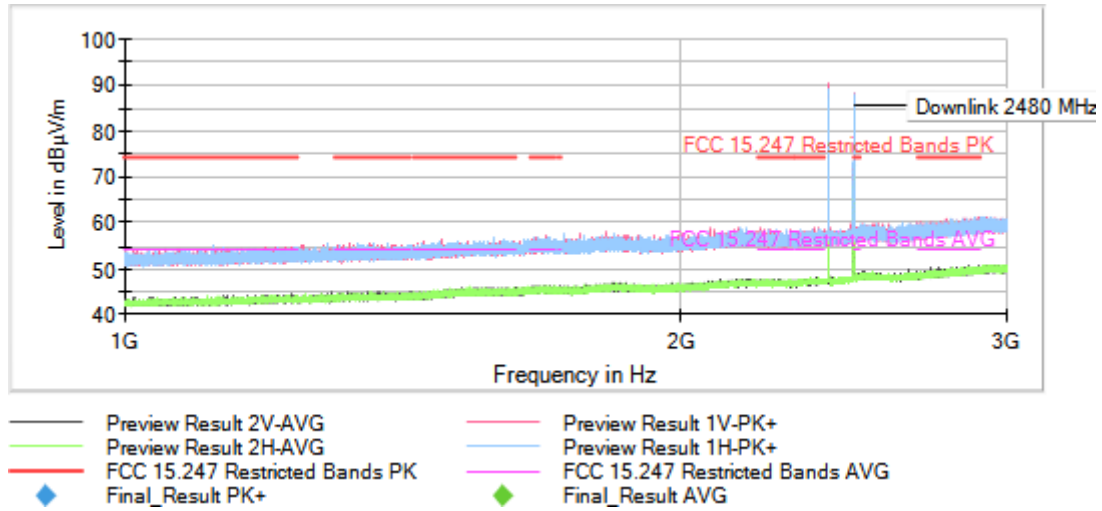
Frequency Range (GHz) = [0.03, 1]

Plots:



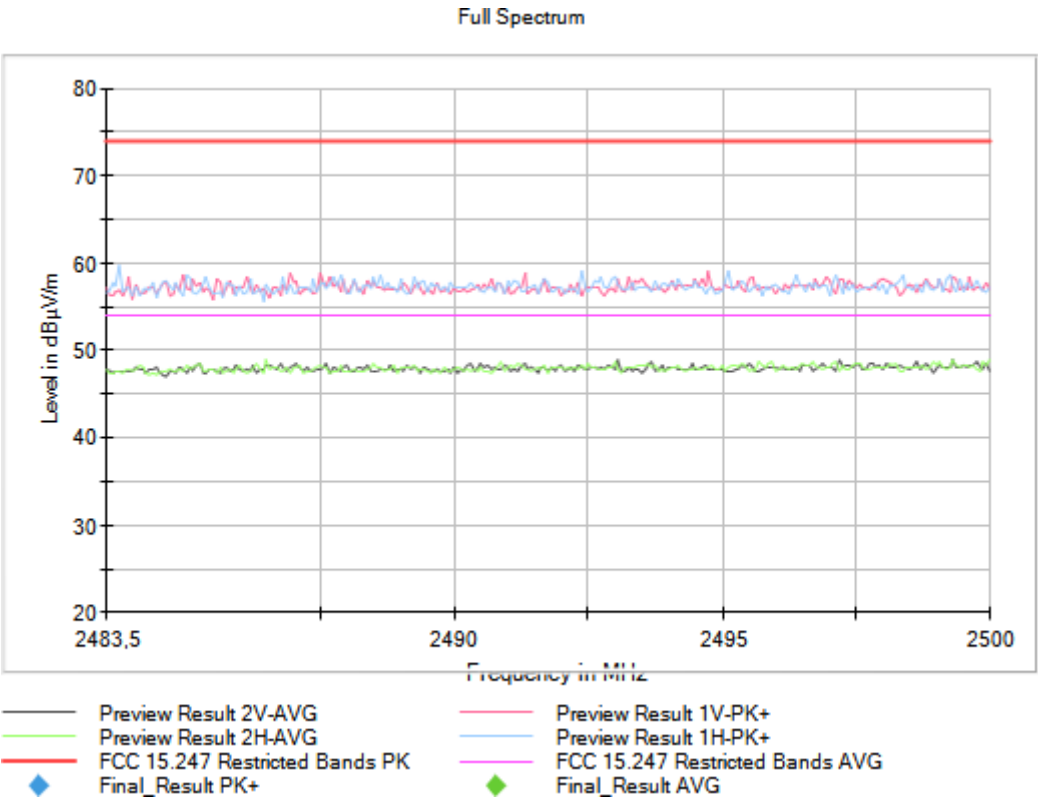
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [1, 3]

Plots:



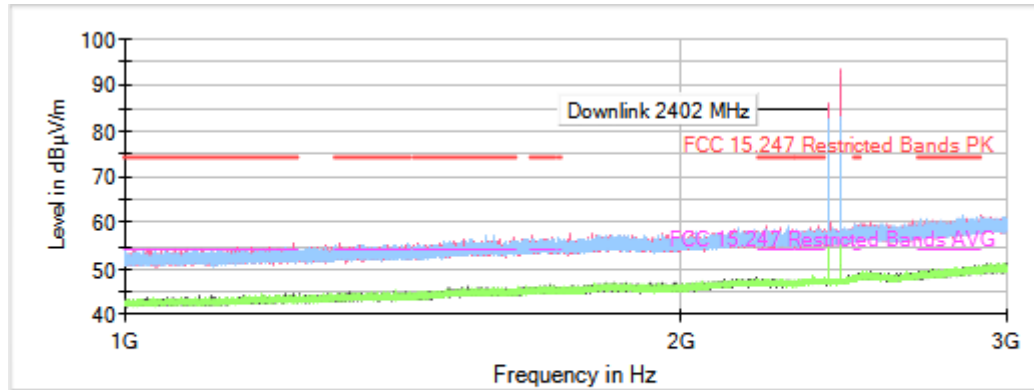
Full Spectrum



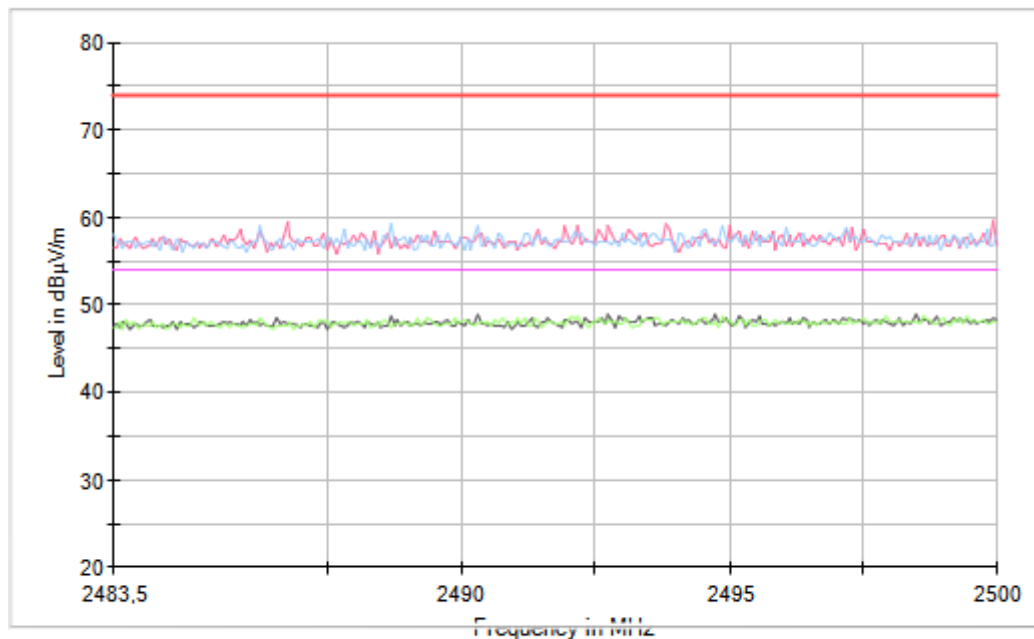


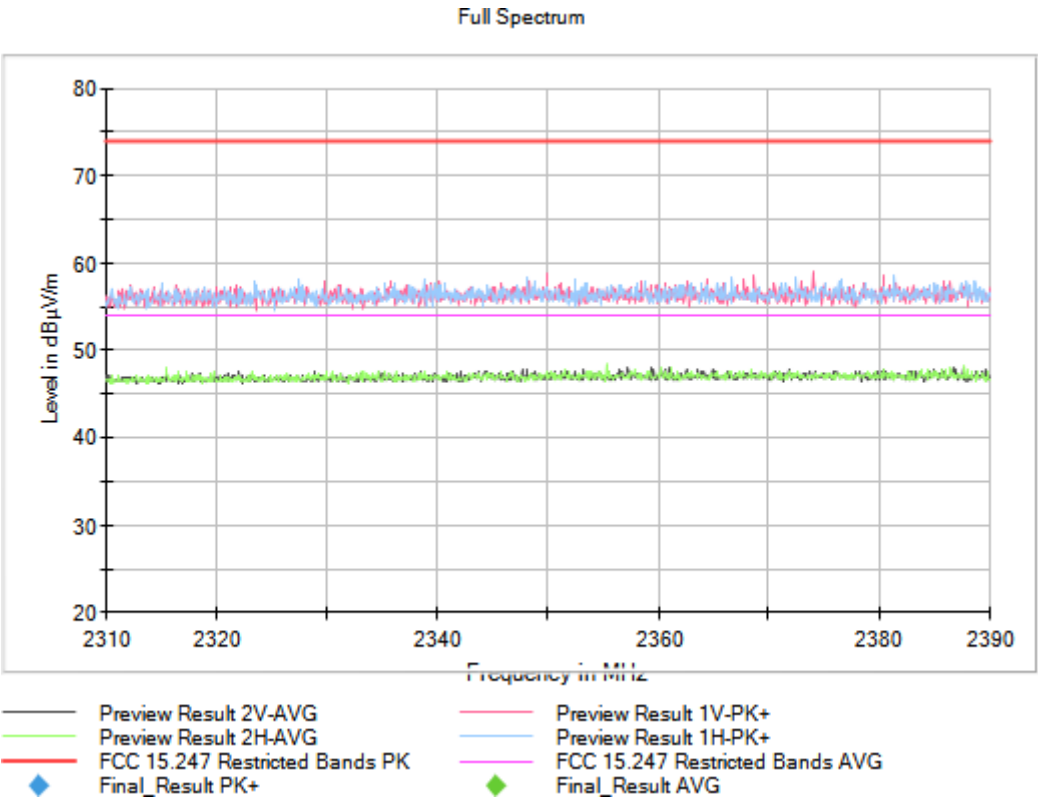
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [1, 3]

Plots:



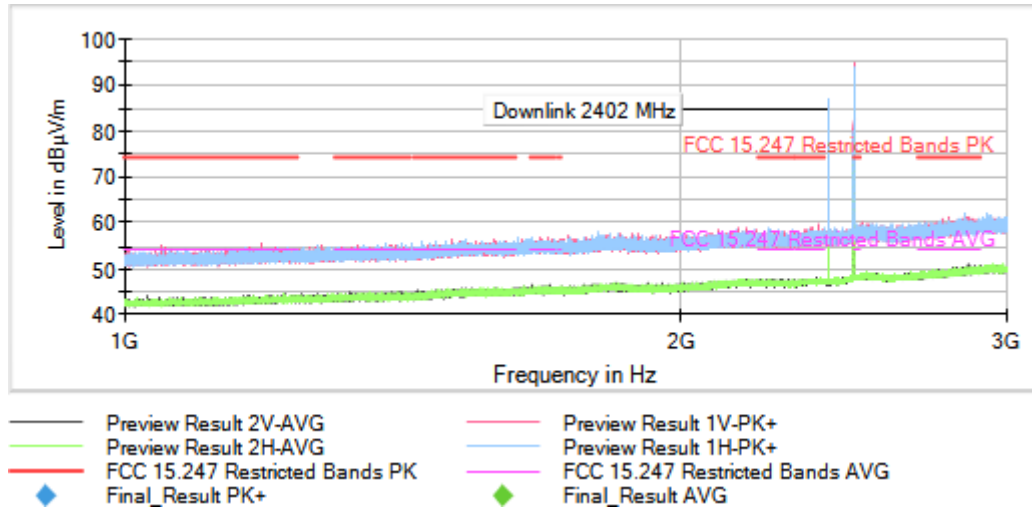
Full Spectrum





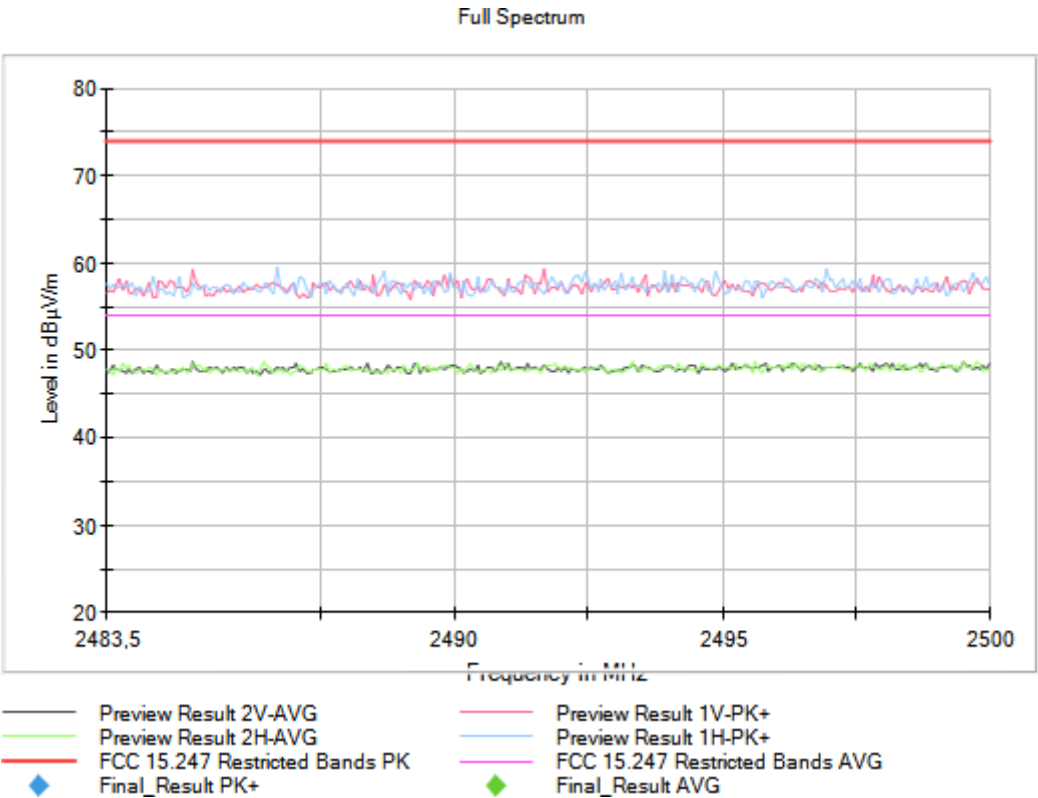
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [1, 3]

Plots:



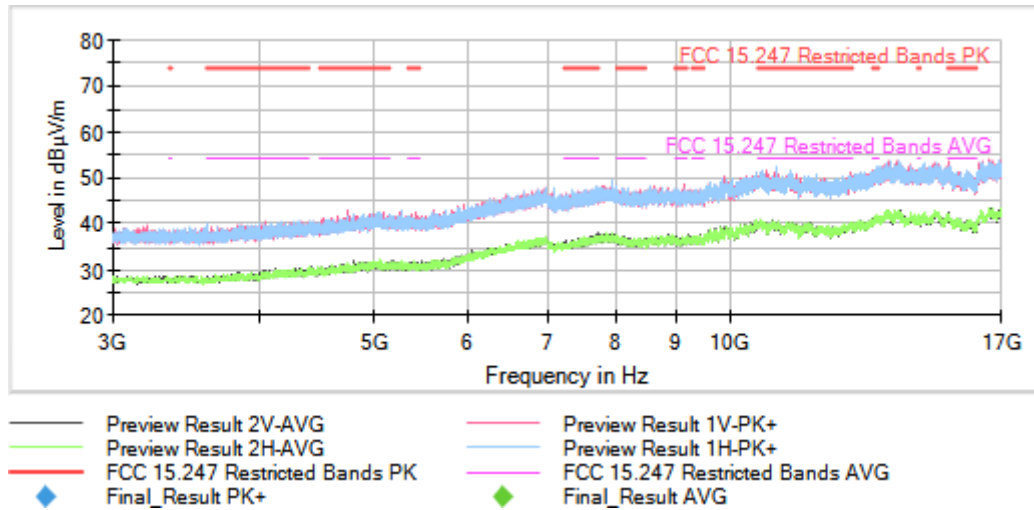
Full Spectrum





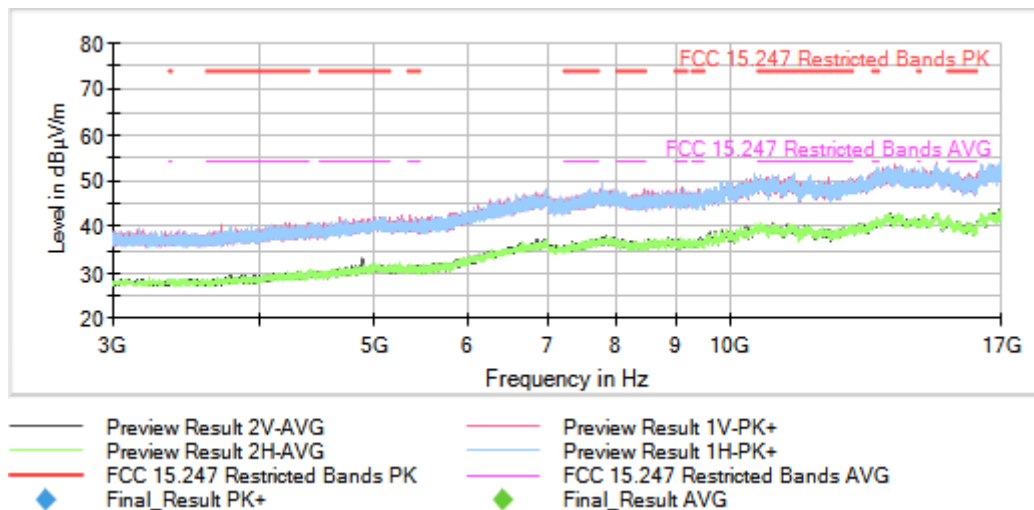
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [3, 17]

Plots:



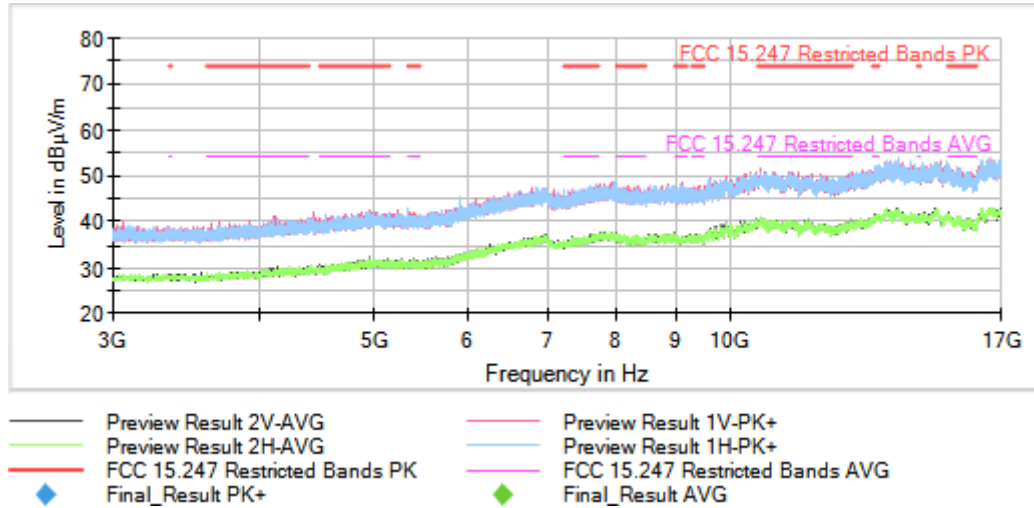
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [3, 17]

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (Pi/4 DQPSK 2-DH5), Frequency Range (GHz) = [3, 17]

Plots:



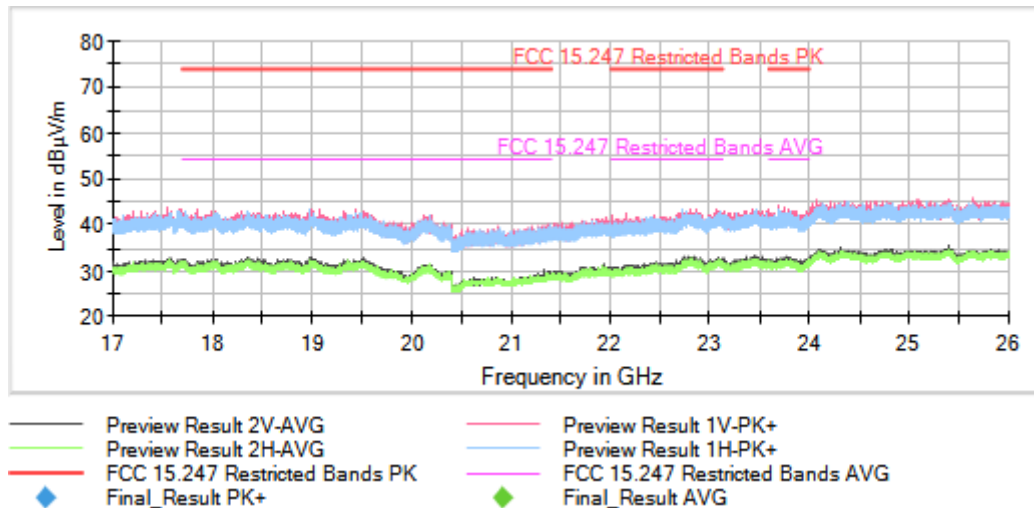
Operation Band (MHz) = [2400, 2483.5]

Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

Plots:



Modulation: BT (8DPSK 3-DH5)

Frequency range 1 GHz – 26 GHz:

No spurious emissions detected at 20 dB below the limit.

Verdict

Pass

Attachments

Operation Band (MHz) = [2400, 2483.5]

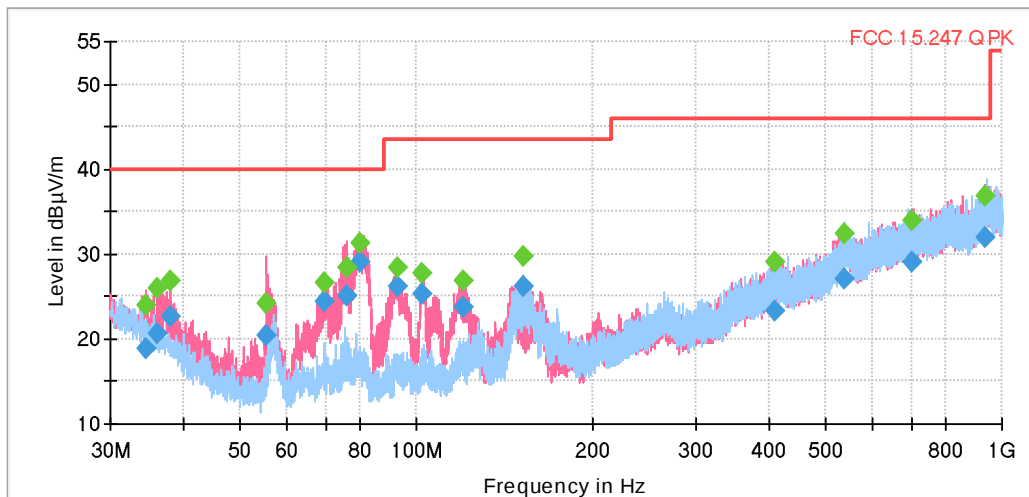
Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

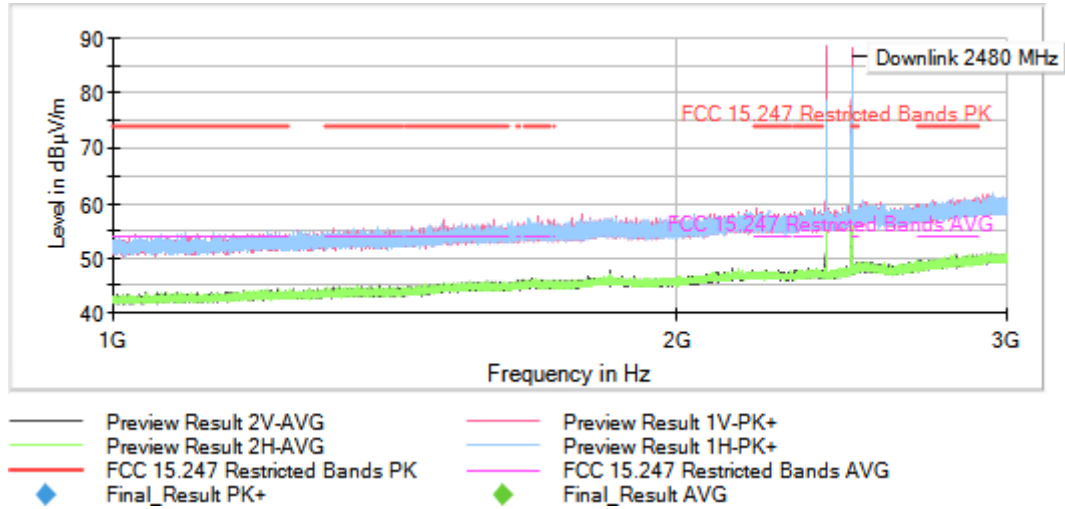
Frequency Range (GHz) = [0.03, 1]

Plots:



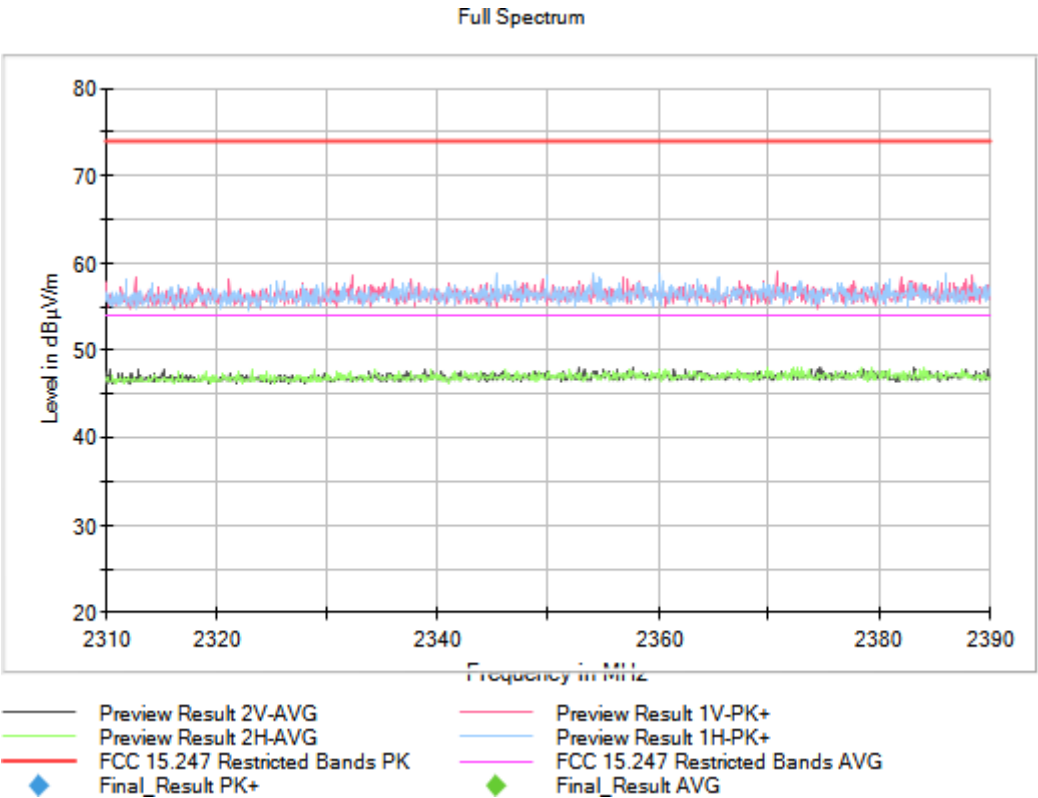
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [1, 3]

Plots:



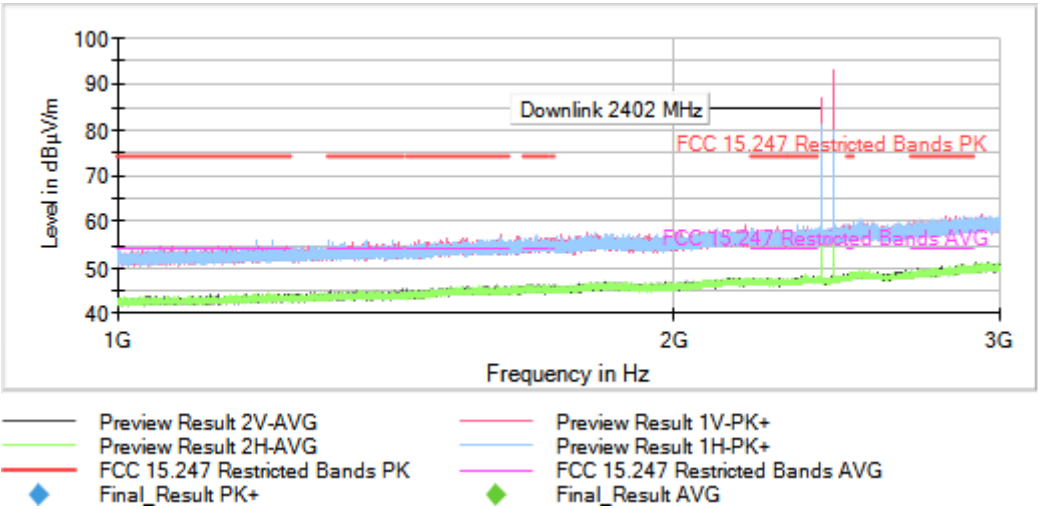
Full Spectrum



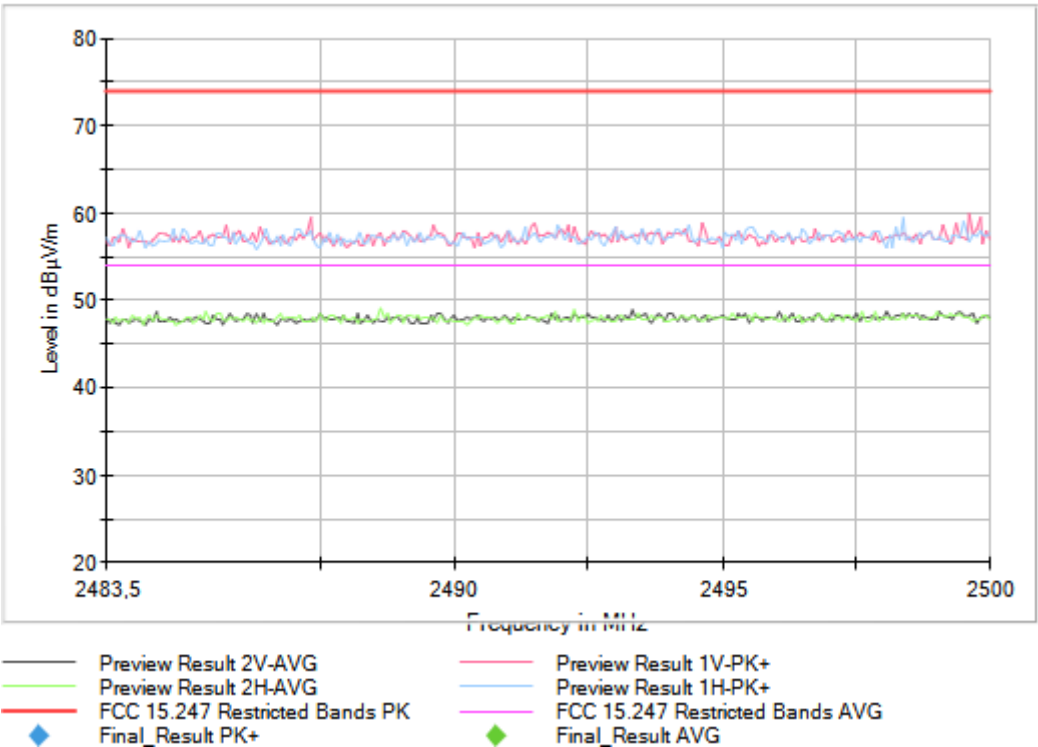


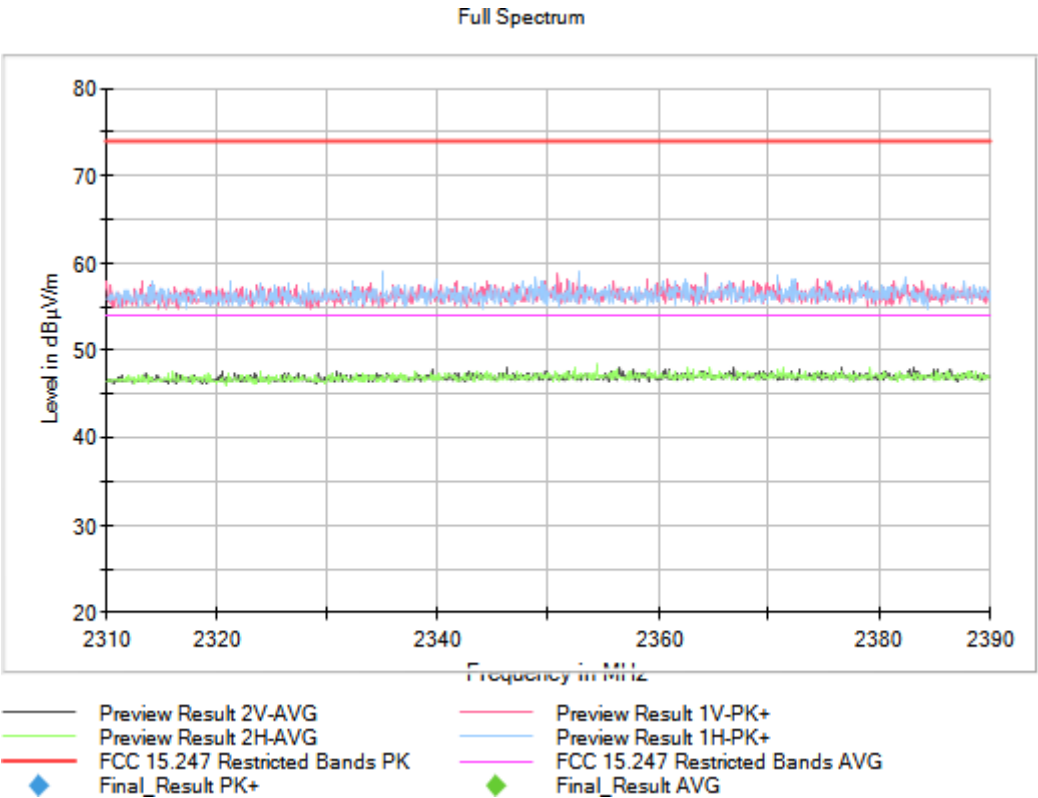
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [1, 3]

Plots:



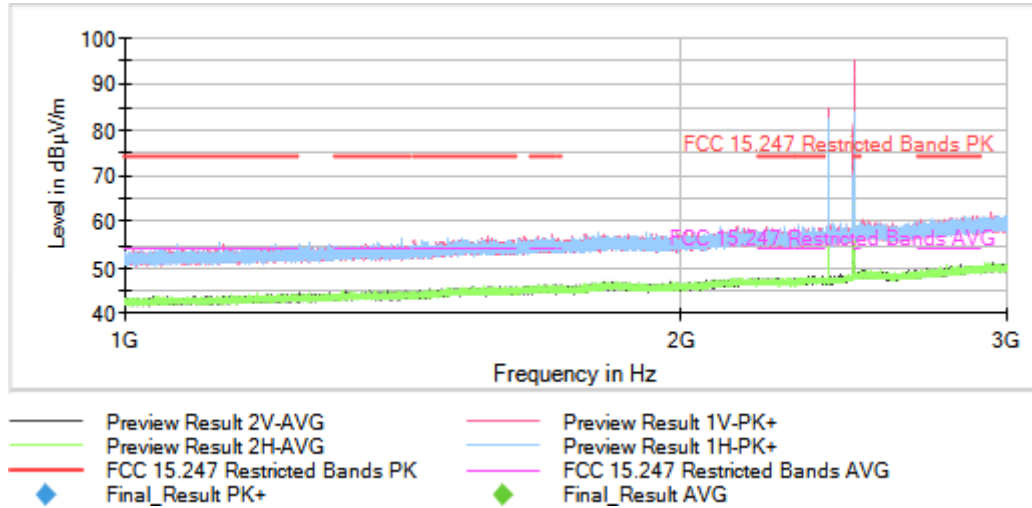
Full Spectrum





Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [1, 3]

Plots:



Note: the first peak above the limit on the plot is the signalling unit's downlink at 2402 MHz.

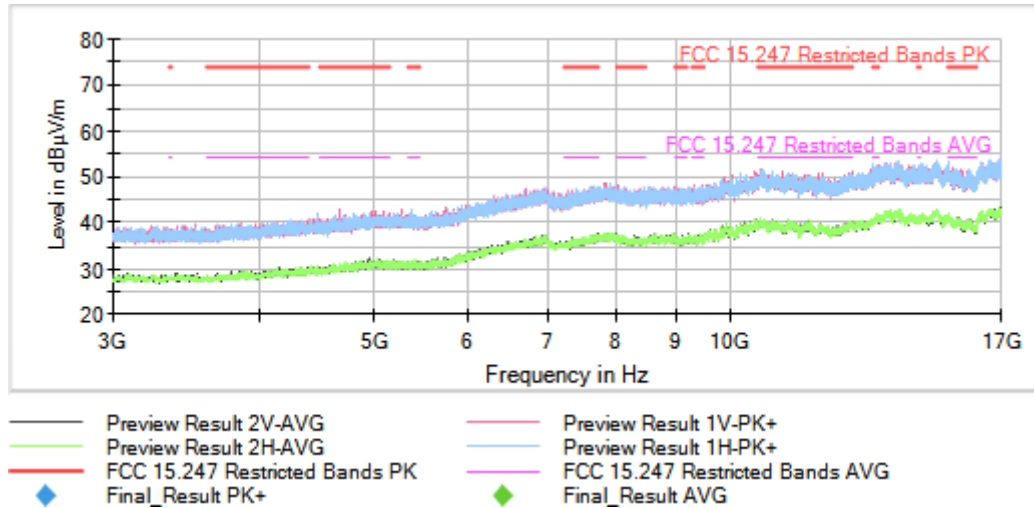
Full Spectrum





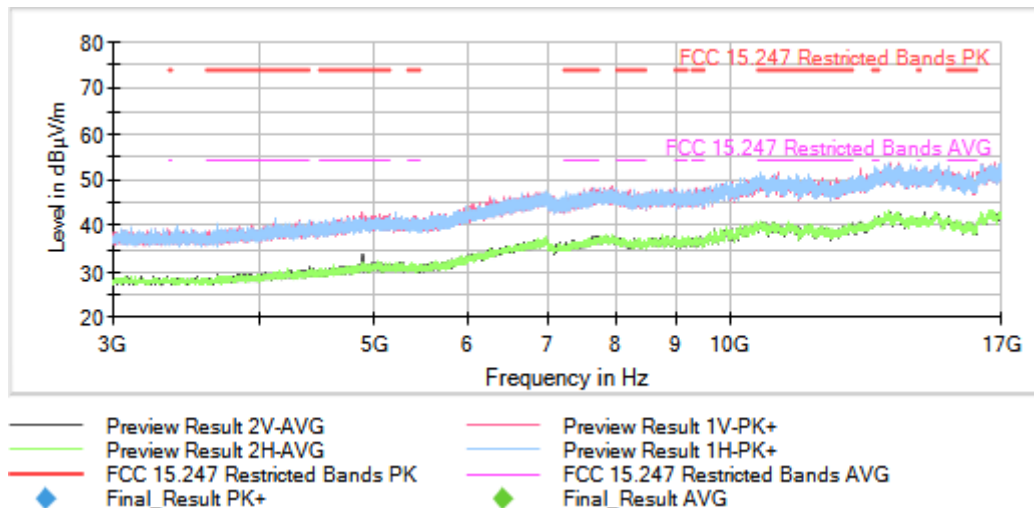
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2402.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [3, 17]

Plots:



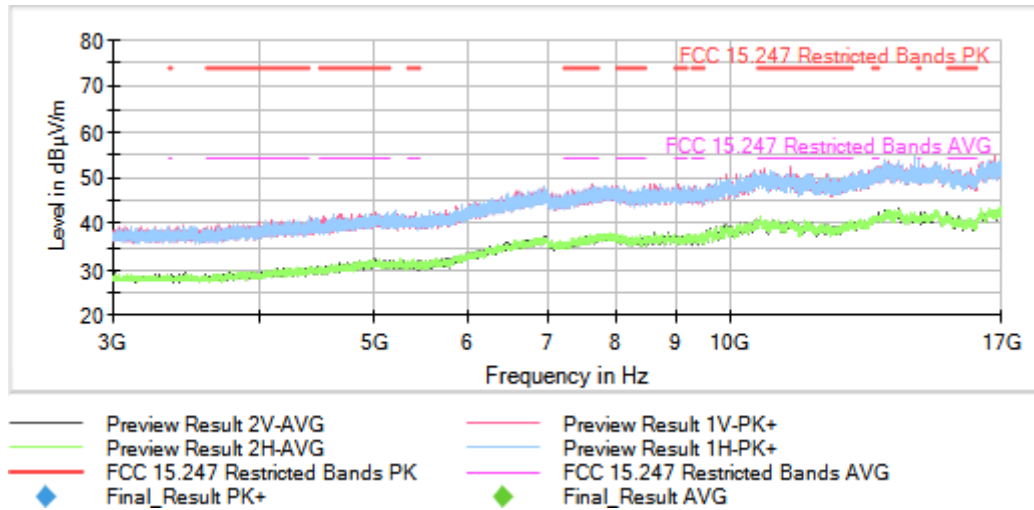
Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2441.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [3, 17],

Plots:



Operation Band (MHz) = [2400, 2483.5], Frequency (MHz) = 2480.00000, Equipment Type: Frequency Hopping Spread Spectrum systems (DSS), Modulation: BT (8DPSK 3-DH5), Frequency Range (GHz) = [3, 17]

Plots:



Operation Band (MHz) = [2400, 2483.5]

Frequency (MHz) = This plot is valid for Low, Middle and High Channels

Equipment Type: Frequency Hopping Spread Spectrum systems (DSS)

Modulation: This plot is valid for all modulations

Plots:

