

ISED CABid: ES1909
Lab. Company Number: 4621A

Test Report No:
76950RRF.002A1

Test Report

USA FCC Part 15.249, 15.209; CANADA RSS-210, RSS-Gen

(*) Identification of item tested	Receiver-In-The-Canal Hearing Aid (air-conduction, wireless)	
(*) Trademark	Phonak	
(*) Model and /or type reference	Phonak Audéo I90-R	
(*) Derived models not tested	Phonak Audéo I70-R Phonak Audéo I50-R Phonak Audéo I30-R Phonak Audéo I-R Trial ampli-energy R 5 5P R PH ampli-energy R 4 5P R PH ampli-energy R 3 5P R PH ampli-energy R 2 5P R PH ampli-energy R Trial 5P Phonak CROS I-R Phonak CROS I-R Trial See section "Data provided by the client".	
(*) Other identification of the product	FCC ID: KWC-IRF IC: 2262A-IRF HW version: 050-1050-P6, SW version: 067-1604	
(*) Features	DM (Proprietary), Flora (Proprietary), Bluetooth Classic, Bluetooth EDR (2Mbps & 3Mbps), Bluetooth Low Energy	
Applicant	Sonova USA Inc. 444 Commerce St., Aurora, Illinois, 60504, United States Phonak Canada Ltd. , 80 Courtneypark Drive West, Unit 1, Mississauga, Ontario, Canada, L5W 0B3, Leo Lau	
Test method requested, standard	USA FCC Part 15.249 (10-1-23 Edition): Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz, and 24.0 – 24.25 GHz. USA FCC Part 15.209 (10-1-23 Edition): Radiated emission limits; general requirements. CANADA RSS-210 Issue 10 (December 2019). CANADA RSS-Gen Issue 5 Amendment 2 (February 2021). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.	
Summary	IN COMPLIANCE	
Approved by (name / position & signature)	Antonio José Jurado Industrial & Automotive EMC Lab. Manager	80157242B Firmado digitalmente por 80157242B ANTONIO JOSE JURADO JURADO (CA29507456) (C:A29507456) Fecha: 2024.07.18 10:47:44 +02'00'
Date of issue	2024-07-18	
Report template No	FDT08_24 (*) "Data provided by the client"	

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Acronyms

Acronym ID	Acronym Description
Detector	Detector used
Equipment	Equipment Type
Freq	Frequency
Freq Rng	Frequency Range
MP	Measurement Point
Mod	Modulation
Operation Band	Operation Band
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 S.A.U. is an FCC-recognized accredited testing laboratory with appropriate scope of accreditation that covers the performed tests in this report.

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

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

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

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

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

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General conditions

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

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

The total uncertainty of the measurement system for the radiated emissions of EUT from 30 MHz to 1 GHz is:
Measurement uncertainty $\leq \pm 5,35$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the radiated emissions of EUT from 1 GHz to 17 GHz is:
Measurement uncertainty $\leq \pm 4,32$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the radiated emissions of EUT from 17 GHz to 26 GHz is:
Measurement uncertainty $\leq \pm 5,51$ dB with factor ($k = 2$).

The total uncertainty of the measurement system for the conducted testing of EUT is:
Occupied Channel Bandwidth: Measurement uncertainty $\leq \pm 1,17$ %.

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 Receiver-In-The-Canal Hearing Aid (air-conduction, wireless). The hearing aid is intended to amplify and transmit sound to the ear and thereby compensate for impaired hearing.
3. Derived models not tested. These models have been declared by the supplier of the sample as being in all relevant parts and hardware construction identical to the corresponding product identified. The derived models not tested document provided by the supplier is included hereby:

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.



ID: <Do not edit>
Version: <Do not edit>

<Title: Do not edit>

To whom it may concern

Stäfa (Switzerland), June 2024 / David Sooprayen, Senior Regulatory Affairs Manager

Product Equality Declaration

We, Sonova AG, hereby declare under our own responsibility that the products listed below as “Hardware Equivalent Products” are in all relevant parts and hardware construction identical to the corresponding product identified as “Products with basis Hardware”. The following standards and/or technical regulations and corresponding test reports fully apply accordingly:

Standards
Hearing aid standards: ACUSTIC: IEC (International Electroacoustic Commission) 60118-0 and NSH 7.0 (including Annex A); EMC (Electromagnetic Compatibility): IEC 60118-13; EMC immunity: ANSI (American National Standards Institute) C63.19; Degrees of protection provided by enclosures (IP Code): IEC 60529 SW: IEC/EN 62304:2006 + A1:2015; UNE EN 62304:2007 + Corr:2009 + A1:2016; Europe: HEALTH & SAFETY: IEC/EN 60601-1; IEC/EN 60601-1-6; IEC/EN 60601-1-11; IEC/EN 60601-2-66; UN 38.3 Test 7; IEC/EN 62479; EMC: IEC/EN 60601-1-2; EN ETSI 301 489-1,-17 ; SPECTRUM: EN 300 328; USA: 47 CFR Part 15 (B); Part 15 (C):15.249, 15.209; Part 2: 2.1093; 2.1091 ; Canada: RSS-Gen, ICES-003, RSS-210, RSS-102; Japan: ARIB T66, Ordinance regulating Radio Equipment (2005-08) Art.12 item 19;

Place and date

Staefa, June 10, 2024

David Sooprayen
Senior Regulatory Affairs Manager

Staefa, June 10, 2024

Lora Braun
Regulatory Affairs Manager

Products with basis Hardware (tested representative model)	Hardware Equivalent Products
Phonak Audéo I90-R (with S/M/P/UP/MAV receivers) HW version: 050-1050-xx FW version: 067-1604 SW version: Target 10	Phonak Audéo I70-R (with S/M/P/UP/MAV receivers) HW version: 050-1049-xx SW version: Target 10 FW version: 067-1605 Phonak Audéo I50-R (with S/M/P/UP/MAV receivers) HW version: 050-1048-xx SW version: Target 10 FW version: 067-1606 Phonak Audéo I30-R (with S/M/P/UP/MAV receivers) HW version: 050-1047-xx SW version: Target 10 FW version: 067-1607 Phonak Audéo I-R Trial (with S/M/P/UP/MAV receivers) HW version: 050-1044-xx SW version: Target 10 FW version: 067-1604 ampli-energy R 5 5P R PH (with S/M/P/UP/MAV receivers) HW version: 050-1050-xx67 SW version: Target 10 FW Version: 067-1604 ampli-energy R 4 5P R PH (with S/M/P/UP/MAV receivers) HW version: 050-1049-xx67 SW version: Target 10 FW Version: 067-1605 ampli-energy R 3 5P R PH (with S/M/P/UP/MAV receivers) HW version: 050-1048-xx67 SW version: Target 10 FW Version: 067-1606 ampli-energy R 2 5P R PH (with S/M/P/UP/MAV receivers) HW version: 050-1047-xx67 SW version: Target 10 FW Version: 067-1607 ampli-energy R Trial 5P (with S/M/P/UP/MAV receivers) HW version: 050-1044-xx67 SW version: Target 10 FW Version: 067-1604

where xx – means colour identification



ID: PDL-21302
Version: 1

Declaration of equivalence DOE Audeo I-R - CROS I-R

To whom it may concern

Stäfa (Switzerland), April 2024 / David Sooprayen, Interim Head of Regulatory Affairs

Product Equality Declaration

We, Sonova AG, hereby declare under our own responsibility that the products listed below as "Hardware Equivalent Products" are in all relevant parts and hardware construction identical to the corresponding product identified as "Products with basis Hardware". The following standards and/or technical regulations and corresponding test reports fully apply accordingly:

Standards
Degrees of protection provided by enclosures (IP Code): IEC 60529
SW: IEC/EN 62304:2006 + A1:2015; UNE EN 62304:2007 + Corr:2009 + A1:2016;
Europe: HEALTH & SAFETY: IEC/EN 60601-1; IEC/EN 60601-1-6; IEC/EN 60601-1-11; IEC/EN 60601-2-66; UN 38.3 Test 7; IEC/EN 62479; EMC: IEC/EN 60601-1-2; EN ETSI 301 489-1,-17 ; SPECTRUM: EN 300 328;
USA: 47 CFR Part 15 (B); Part 15 (C):15.249, 15.209; Part 2: 2.1093; 2.1091 ;
Canada: RSS-Gen, ICES-003, RSS-210, RSS-102;
Japan: ARIB T66, Ordinance regulating Radio Equipment (2005-08) Art.12 item 19;

The only difference between the listed equivalent and corresponding basis models is the model's name, a separate set of audiological features per performance level.

Products with basis Hardware (tested representative model)	Hardware Equivalent Products
Phonak Audeo I90-R (with S/M/P/UP/MAV receivers) HW version: 050-1050-xx FW version: 067-1604 SW version: Target 10	Phonak CROS I-R HW version: 050-1043-xx SW version: Target 10 FW Version: 067-1608 Phonak CROS I-R Trial HW version: 050-1046-xx SW version: Target 10 FW Version: 067-1608

where xx – means colour identification

Place and date

Staefa, April 08, 2024

David Sooprayen
Interim Head of Regulatory Affairs

Staefa, April 08, 2024

Lora Braun
Regulatory Affairs Manager

Confidential and proprietary.

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	76950B_26.1	Receiver for Varta 1	Varta 1	--	2024-04-05	Element Under Test
	76950B_5.1	Hearing aid	5271411	--	2024-03-26	Element Under Test
S/02	76950B_20.1	Setup on acrylic	WN48H38FX	--	2024-04-01	Element Under Test

Notes referenced to samples during the project:

Id	Type
S/01	Radiated
S/02	Conducted

In order to choose the worst case receiver (S/M/P/UP/MAV) and battery type (Varta/Zeni), a radiated emission pre-test is performed. No significant changes were detected.
After these previews, the receiver “S” and battery “Varta” configuration is selected as representative for the tests.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
	N/A		[]	[]	[]		
Supplementary information to the ports..... :	Not provided data						
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	[]	AC:	[]	[]	[]	[]	[]
	[X]	DC: 3.7 Lithium-ion Rechargeable Battery					
Rated Power	Not provided data						
Clock frequencies.....	Not provided data						
Other parameters	Not provided data						
Software version	067-1604						
Hardware version	050-1050-P6						
Dimensions in cm (W x H x D)	Not provided data						
Mounting position	[]	Table top equipment					
	[]	Wall/Ceiling mounted equipment					
	[]	Floor standing equipment					
	[]	Hand-held equipment					
	[X]	Other: Hearing Aid.					
Modules/parts..... :	Module/parts of test item		Type			Manufacturer	
	Not provided data						
Accessories (not part of the test item)	Description		Type			Manufacturer	
	Not provided data						

Documents as provided by the applicant	Description	File name	Issue date
	Test plan	Test plan - V.2020	2024-04-19
	Pass Fail criteria	PDL-9421 - V2.0	2023-12-04
	Declaration equipment data	FDT30	2024-04-02
	Operational and technical description	App-Notes for tests	2024-03-06

⁽³⁾ Only for Medical Equipment

Identification of the client

Sonova AG
Laubisrütistrasse, 28, 8712, Stäfa, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2024-04-09
Date (finish)	2024-04-23

Document history

Report number	Date	Description
76950RRF.002	2024-06-12	First release.
76950RRF.002A1	2024-07-18	First modification. Some typos and correction has been performed. Pag 29, 79, 137, 160: Information about the selected frequency range has been added. A note is also added indicating that limits on all the graph of 15.247 have to be considered as limits of 15.249, as both are referring to the referenced limits in 15.209. Pag 138: A typo is corrected to indicate “less than 20 dB” instead of “less than 6dB”. This report cancels and replaces the previous 76950RRF.002.

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: Jia Hao Luo, Ruben Mora and Victoria Olmedo.
Used instrumentation:

Control No.	Equipment	Model	Manufacturer	Next Calibration
10304	EMI TEST RECEIVER 2Hz-44GHz	ESW44	ROHDE AND SCHWARZ	2026-02-19
05862	EMI TEST RECEIVER 9kHz-7GHz	ESR7	ROHDE AND SCHWARZ	2025-02-15
07040	EXTENSION FOR OPEN SWITCH UNIT UP TO 40GHz	OSP-B157Wx	Rohde&Schwarz	2025-04-19
07763	HORN ANTENNA 1-18GHz	BBHA 9120D	SCHWARZBECK MESS-ELEKTRONIK	2026-01-16
04657	HORN ANTENNA 18-40GHz	BBHA 9170	SCHWARZBECK MESS-ELEKTRONIK	2026-06-12
09968	HYBRID BILOG ANTENNA 30MHz-6GHz	3142E	ETS LINDGREN	2026-09-22
07862	PRE-AMPLIFIER G>30dB 18-40GHz	BLMA 1840-3G	BONN ELEKTRONIK	2025-04-02
07769	PREAMPLIFIER 30dB 500MHz-18GHz	BBV 9718 C	SCHWARZBECK	2025-03-13
08130	SEMIANECHOIC ABSORBER LINED CHAMBER	P29419	ALBATROSS	N/A
08134	SHIELDED ROOM	P29419	ALBATROSS PROJECTS GMBH	N/A
07549	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
07550	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
07702	DC POWER SUPPLY 30V/3A 90W	GPS-3030D	GW INSTEK	N/A
08835	SIGNAL AND SPECTRUM ANALYZER 2 Hz - 50 GHz	FSW50	ROHDE AND SCHWARZ	2025-02-08
08661	SHIELDED ROOM	-	SIEPEL	N/A
07552	TEMPERATURE AND HUMIDITY PROBE	HWg-STE	HW GROUP	2025-04-24
04848	SOFTWARE FOR EMC/RF TESTING	EMC32	ROHDE AND SCHWARZ	N/A
07798	WMS32	WMS32	ROHDE AND SCHWARZ	--

Testing verdicts

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

Summary

Bluetooth Low Energy 5.0 (2M & 1M) Appendix A:

FCC PART 15 PARAGRAPH / RSS-249			
Requirement – Test case		Verdict	Remark
15.249 (b) / RSS-210 B.10 (a)	Field strength of fundamental end harmonics emissions	P	--
15.249 (d),(e) / RSS-210 B.10 (b)	Maximum output power and antenna gain	P	--
99dBw	Occupied Channel Bandwidth 99%	P	--
<u>Supplementary information and remarks:</u> None.			

Bluetooth EDR Appendix B:

FCC PART 15 PARAGRAPH / RSS-249			
Requirement – Test case		Verdict	Remark
15.249 (b) / RSS-210 B.10 (a)	Field strength of fundamental end harmonics emissions	P	--
15.249 (d),(e) / RSS-210 B.10 (b)	Maximum output power and antenna gain	P	--
99dBw	Occupied Channel Bandwidth 99%	P	--
<u>Supplementary information and remarks:</u> None.			

Flora (Proprietary) Appendix C:

FCC PART 15 PARAGRAPH / RSS-249			
Requirement – Test case		Verdict	Remark
15.249 (b) / RSS-210 B.10 (a)	Field strength of fundamental end harmonics emissions	P	--
15.249 (d),(e) / RSS-210 B.10 (b)	Maximum output power and antenna gain	P	--
99dBw	Occupied Channel Bandwidth 99%	P	--
<u>Supplementary information and remarks:</u> None.			

DM (Proprietary) Appendix D:

FCC PART 15 PARAGRAPH / RSS-249			
Requirement – Test case		Verdict	Remark
15.249 (b) / RSS-210 B.10 (a)	Field strength of fundamental end harmonics emissions	P	--
15.249 (d),(e) / RSS-210 B.10 (b)	Maximum output power and antenna gain	P	--
99dBw	Occupied Channel Bandwidth 99%	P	--
<u>Supplementary information and remarks:</u> None.			

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

TEST CONDITIONS	18
TEST CASES DETAILS	21
15.249 (b) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions	21
15.249 (d) (e) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands	29
Occupied Channel Bandwidth 99%	54

TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal:	3.7 Vdc
Type of Power Supply:	Lithium-ion Rechargeable Battery

ANTENNA (*):

Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	-11 dBi

TEST FREQUENCIES (*):

Low Channel:	2402 MHz
Middle Channel:	2440 MHz
High Channel:	2480 MHz

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

CONDUCTED MEASUREMENTS:

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



RADIATED MEASUREMENTS:

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

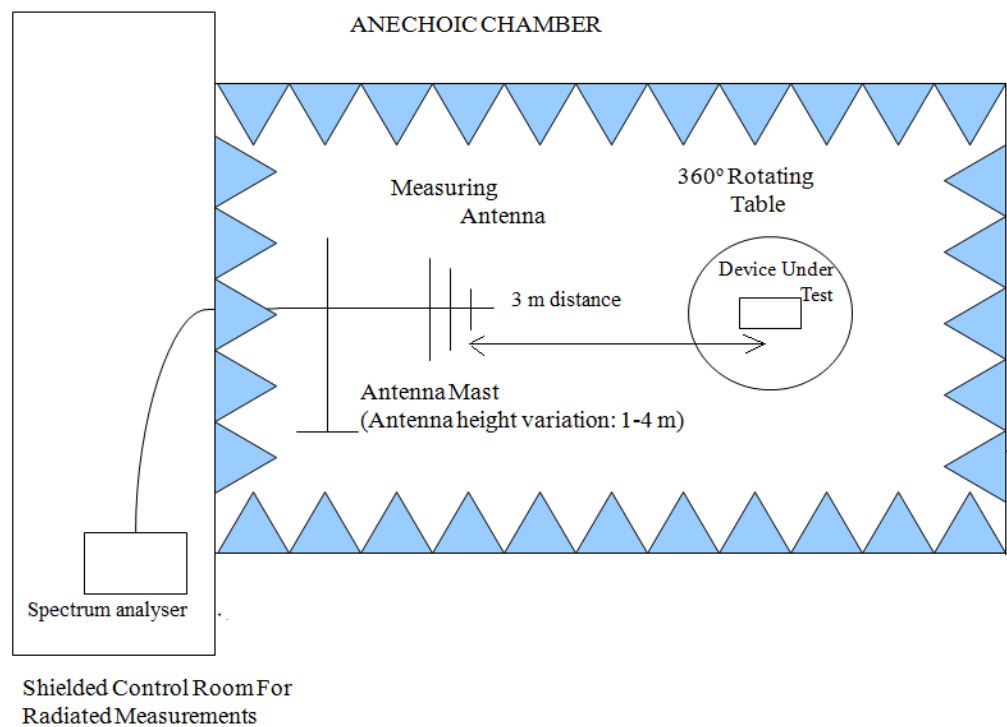
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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

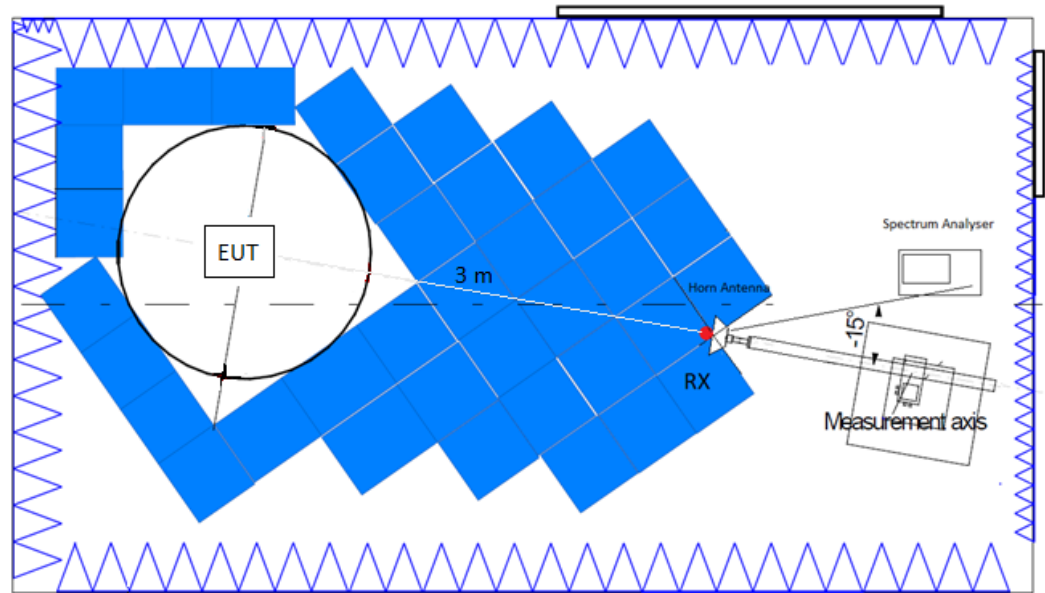
Measurements were made in both horizontal and vertical planes of polarization.

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

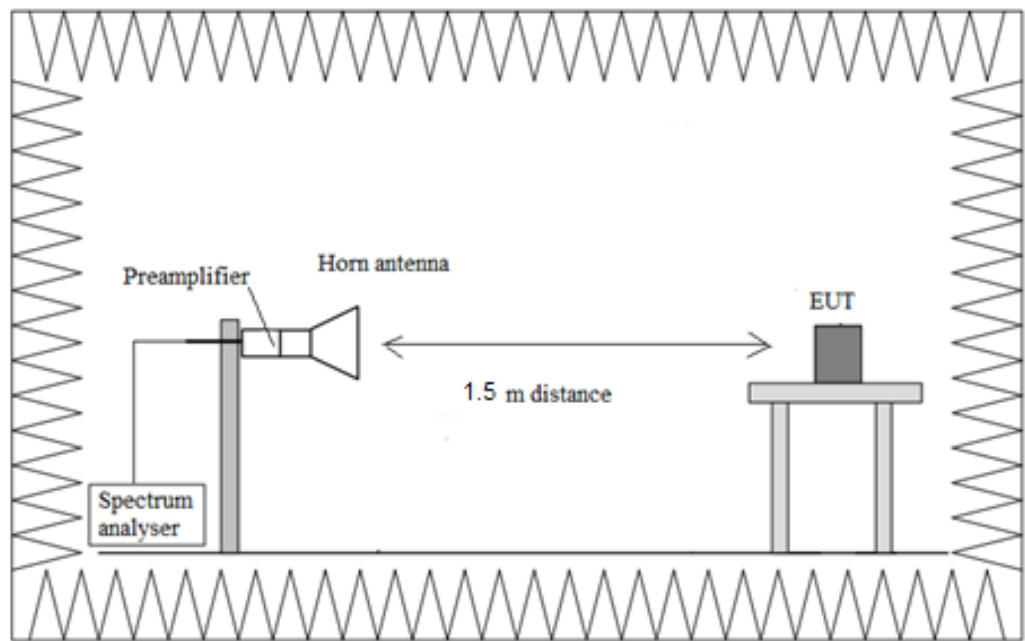
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17\text{ GHz}$:



TEST CASES DETAILS

15.249 (b) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

Limits

The field strength of emissions from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 - 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000 - 24250	250	107.96	3

For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Modulation: 1M

Results

Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	1M	2402	89.26
[2400, 2483.5]	1M	2440	91.15
[2400, 2483.5]	1M	2480	93.33

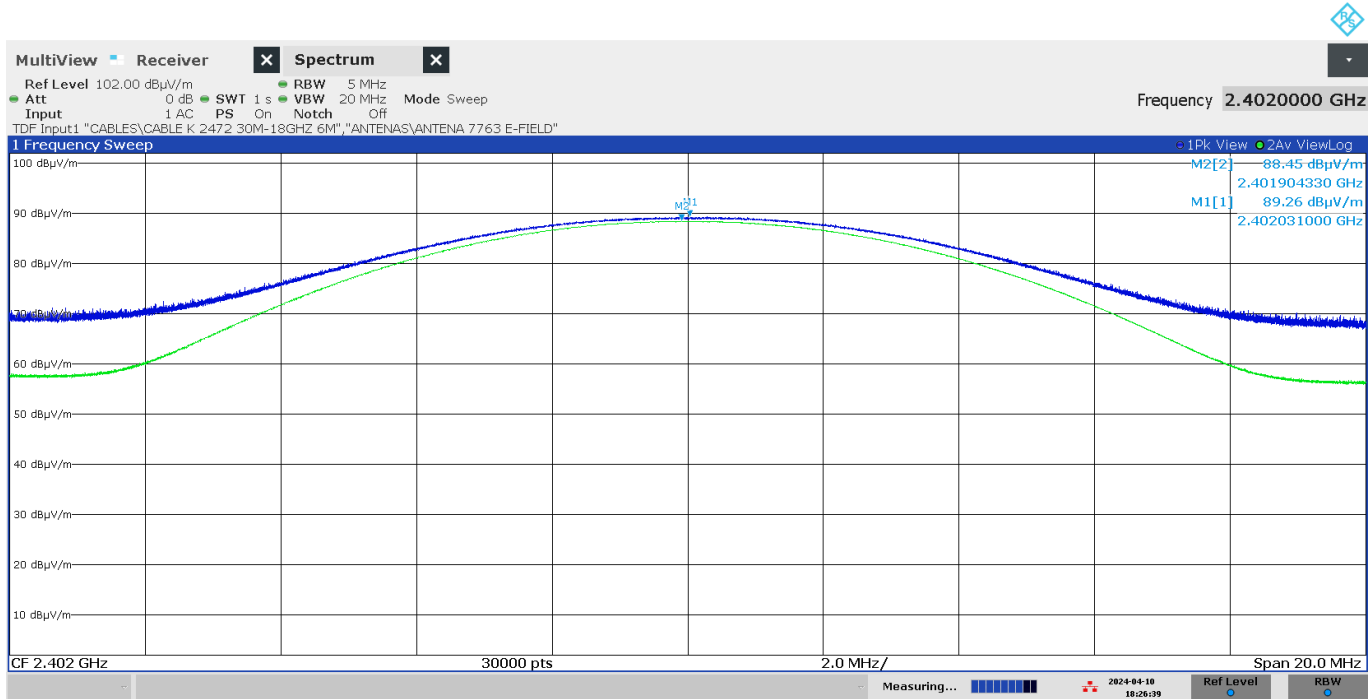
Verdict

Pass

Attachments

Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2402

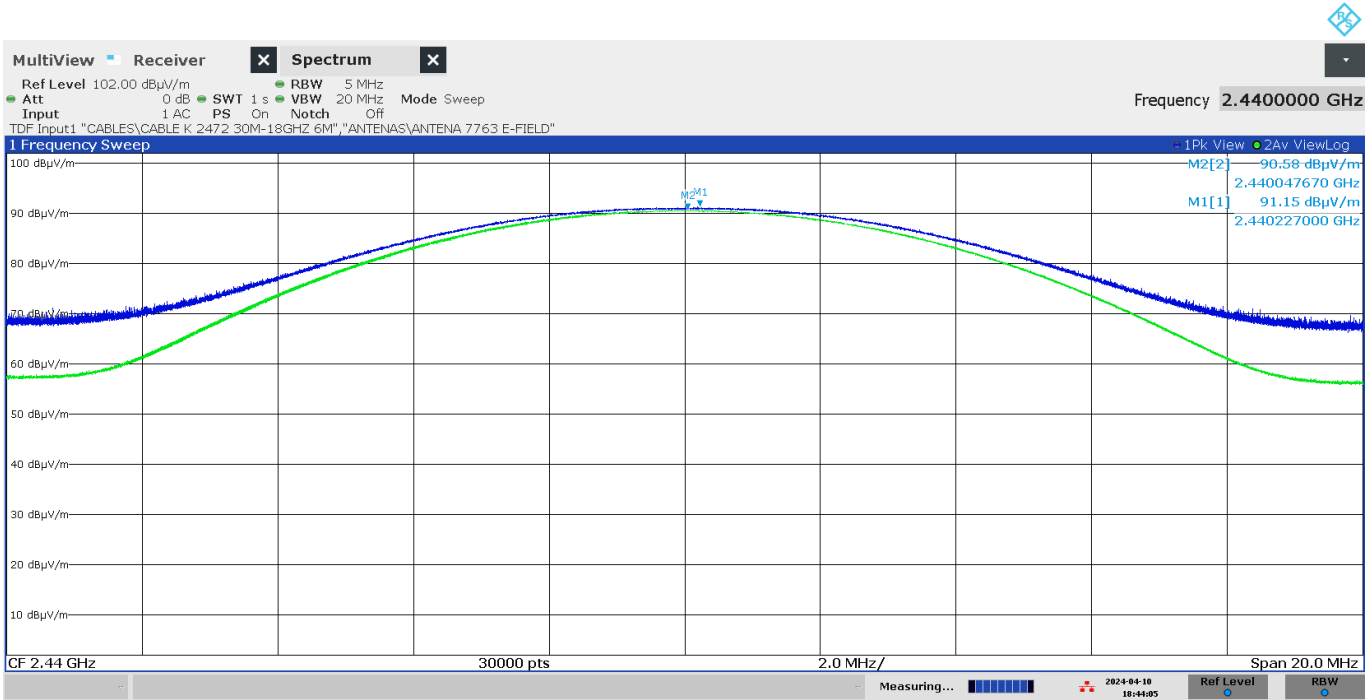
Images:



06:26:39 PM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2440

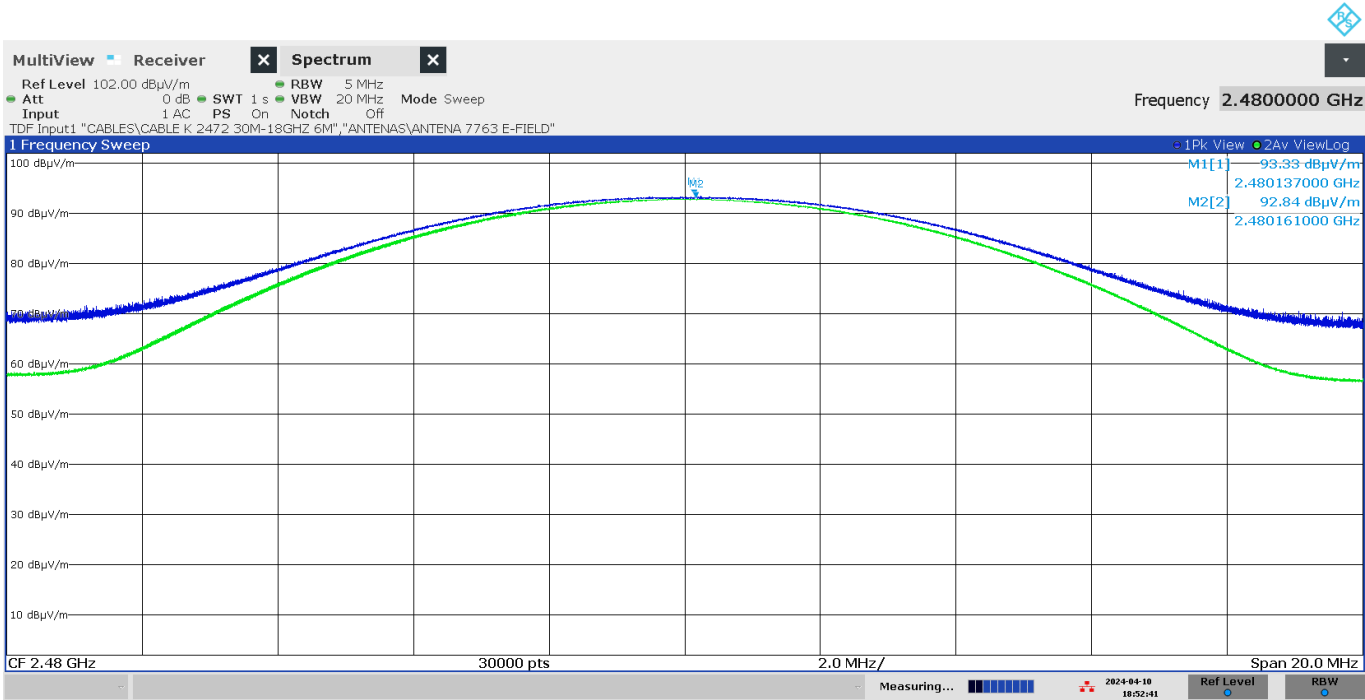
Images:



06:44:05 PM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2480

Images:



06:52:41 PM 04/10/2024

Modulation: 2M

Results

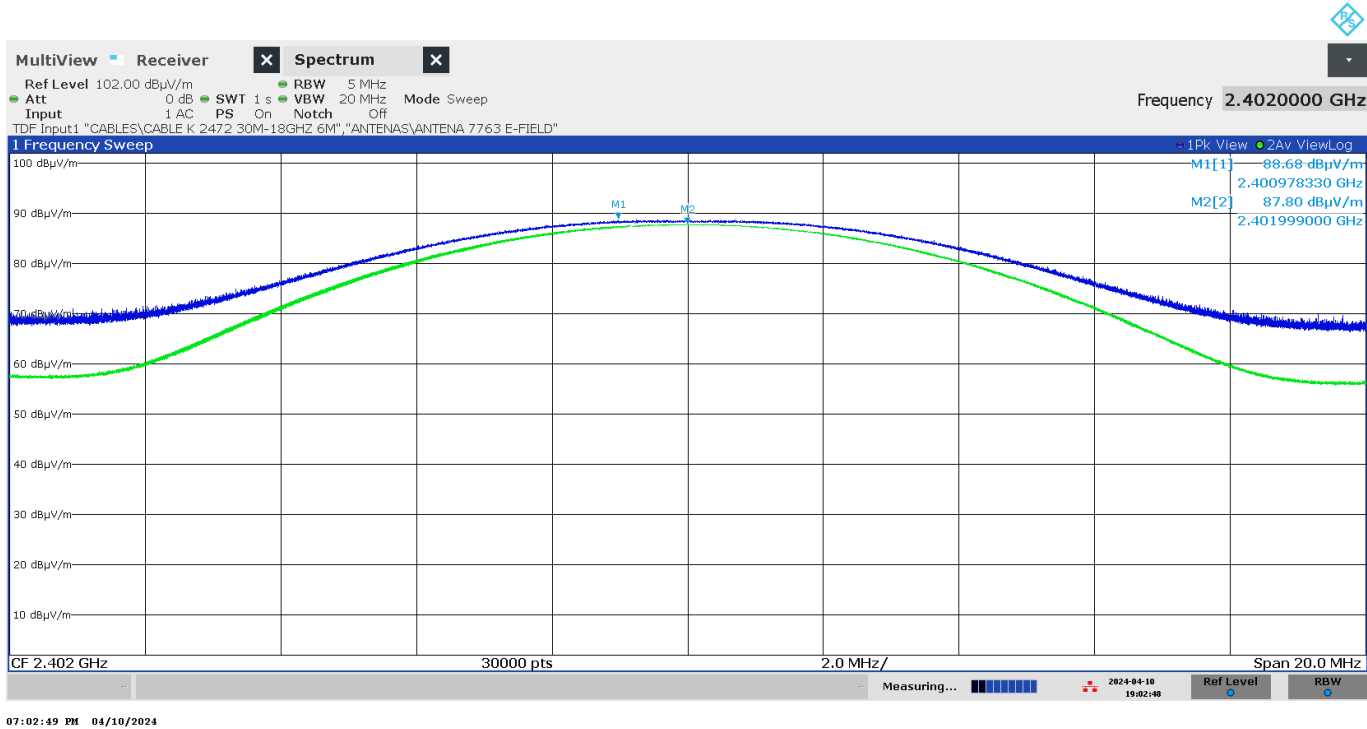
Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	2M	2402	88.68
[2400, 2483.5]	2M	2440	89.54
[2400, 2483.5]	2M	2480	92.87

Verdict

Pass

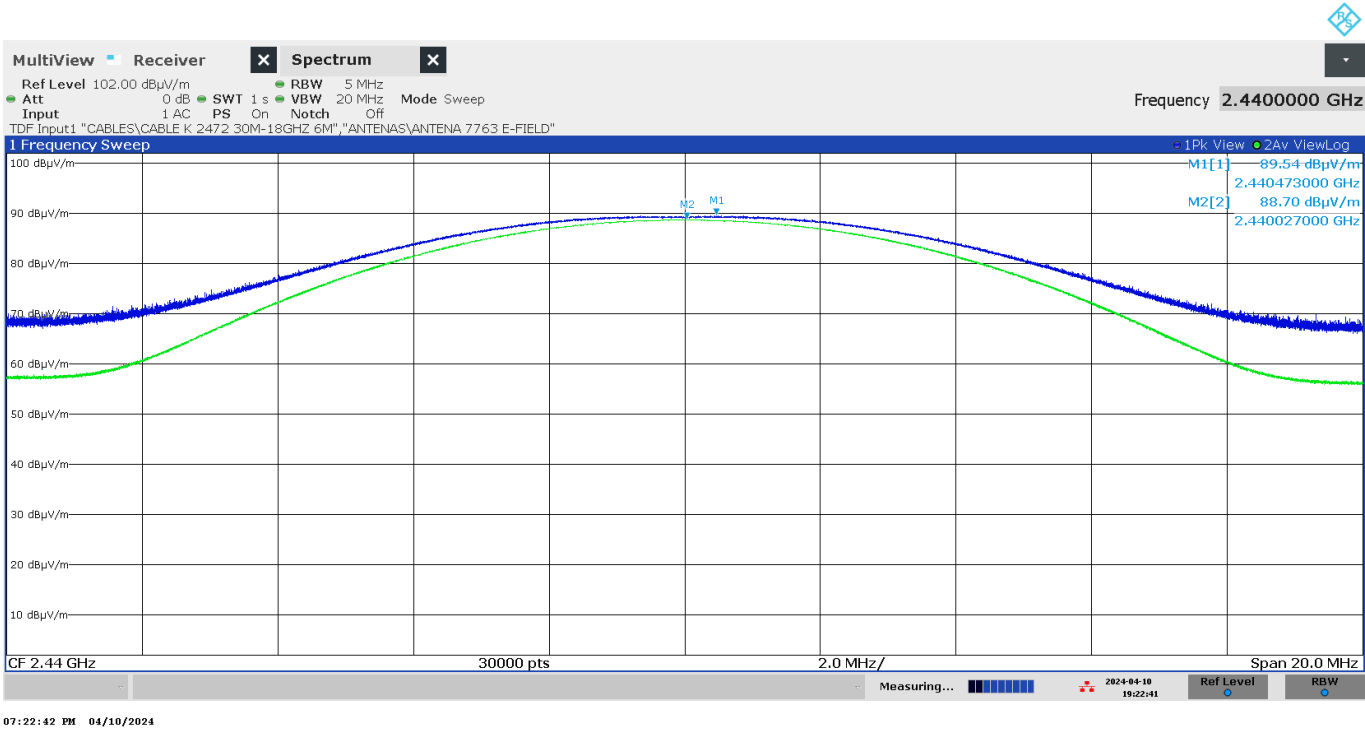
Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2402

Images:



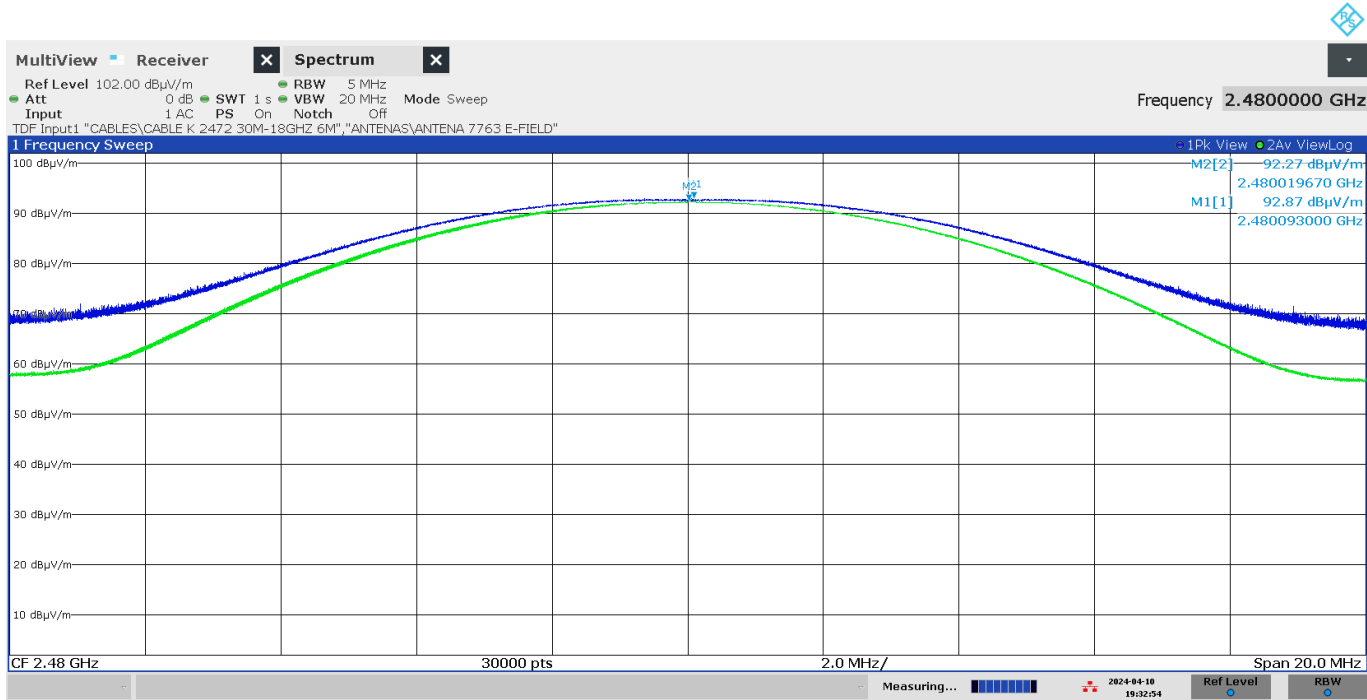
Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2440

Images:



Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2480

Images:



07:32:55 PM 04/10/2024

15.249 (d) (e) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

Limits

The field strength of harmonics from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of harmonics ($\mu\text{V/m}$)	Field strength of harmonics ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
902 - 928	500	54	3
2400 - 2483.5	500	54	3
5725 - 5875	500	54	3
24000 - 24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

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
960 - 25000	500	54	3

whichever is the lesser attenuation.

Frequency range tested for Radiated emissions according to section 15.33:

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

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

Note: Limits in the following graphs regarding 15.247 are based on 15.209 limits in the same way as 15.249. Please, consider labels 15.247 in all the below graphs also valid in this case for 15.249.

Modulation: BTLE 5.0 (GFSK 1 Mbit/s)

Results

No spurious frequencies detected at less than 20 dB below the limit.

Verdict

Pass

Spectrum Analyzer Parameters:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	20 dB
Receiver: [ESW 44] 1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 17 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

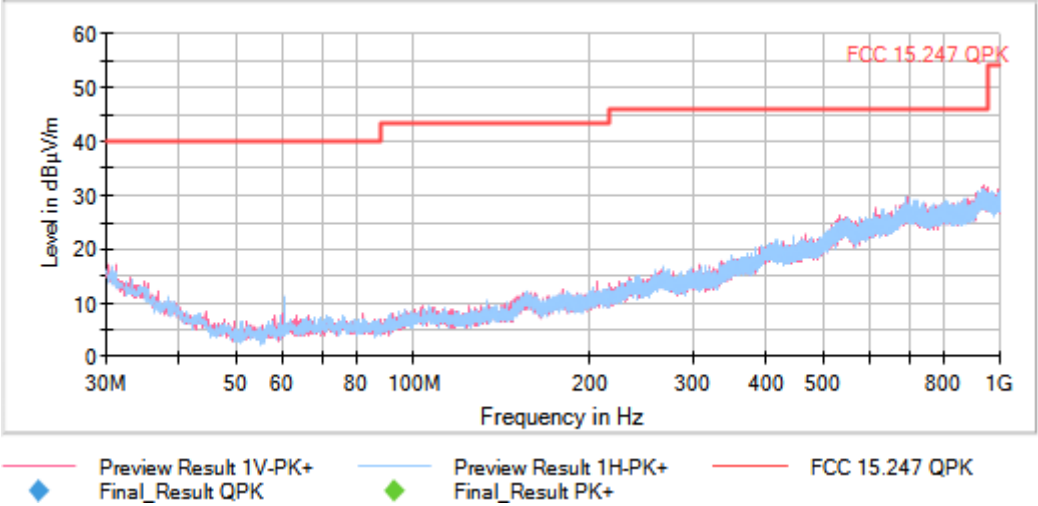
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2402.00000

Frequency Range GHz = [0.03, 1]

Images:



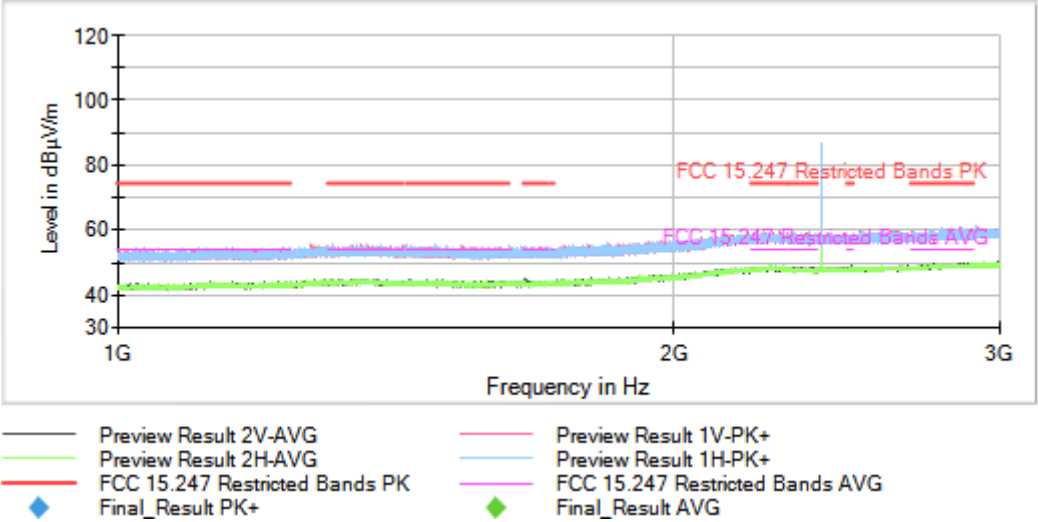
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

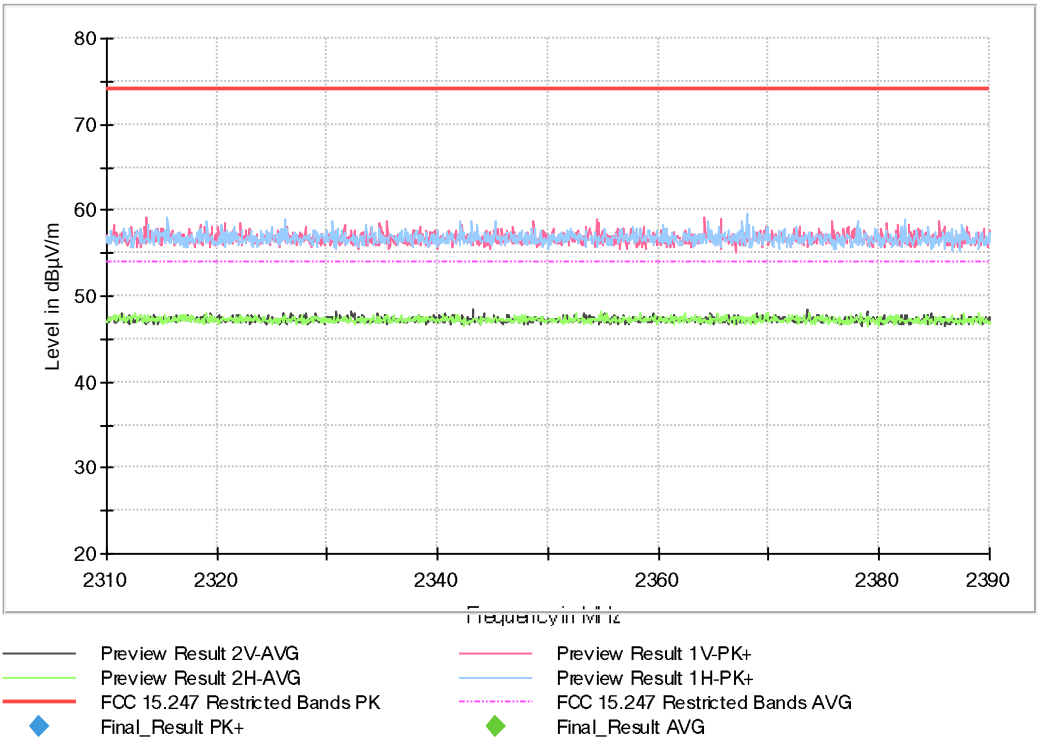
Frequency MHz = 2402.00000

Frequency Range GHz = [1, 3]

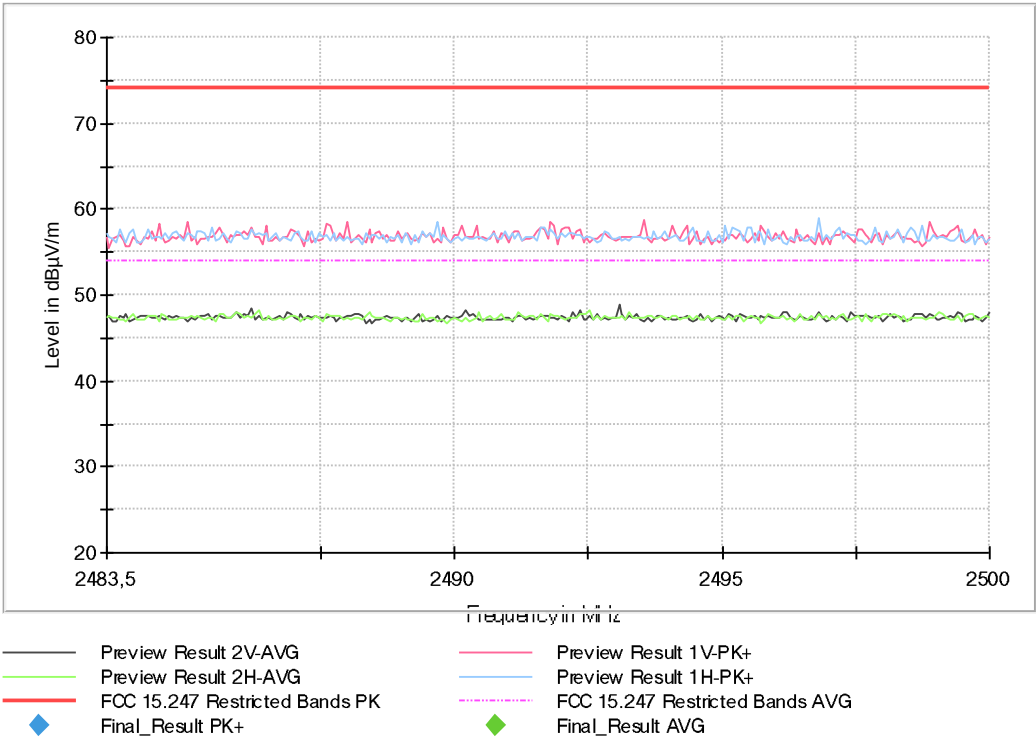
Images:



Full Spectrum



Full Spectrum

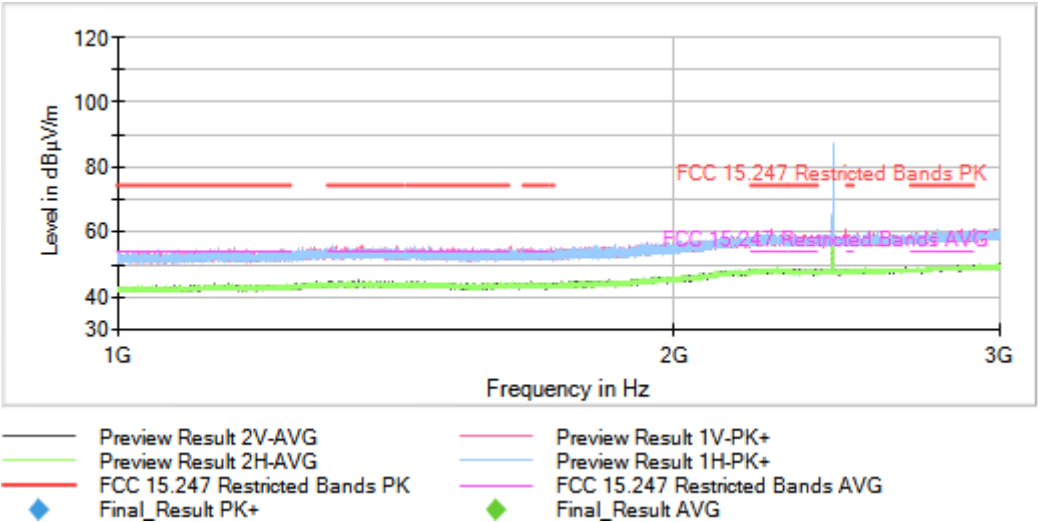


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

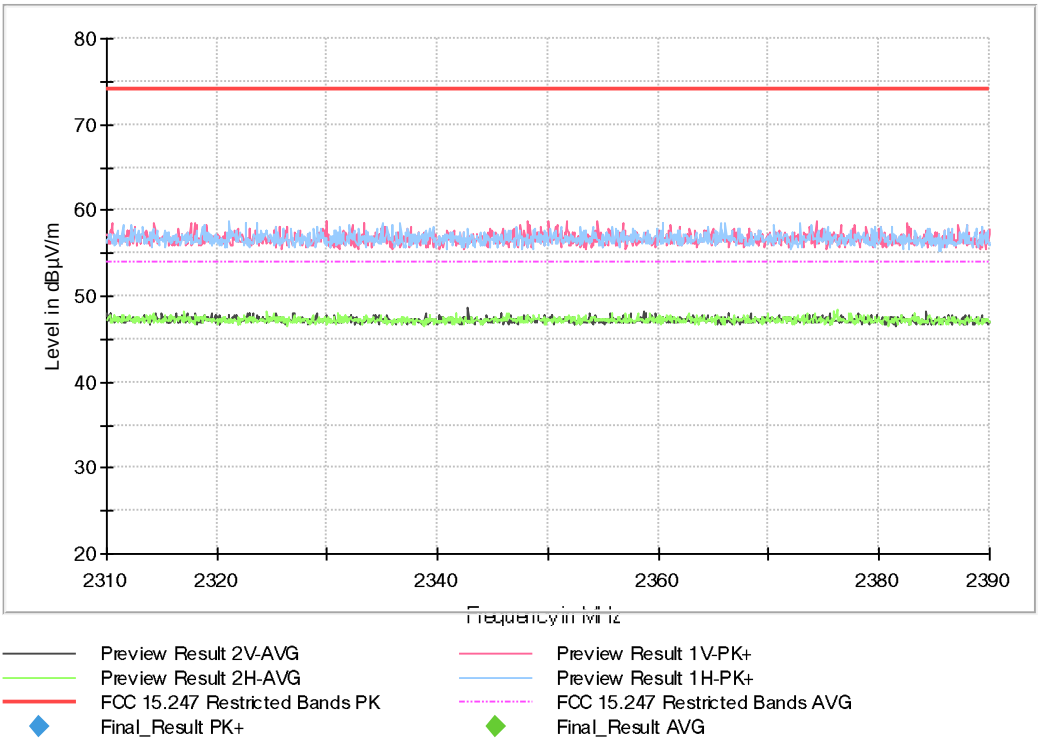
Frequency MHz = 2440.00000

Frequency Range GHz = [1, 3]

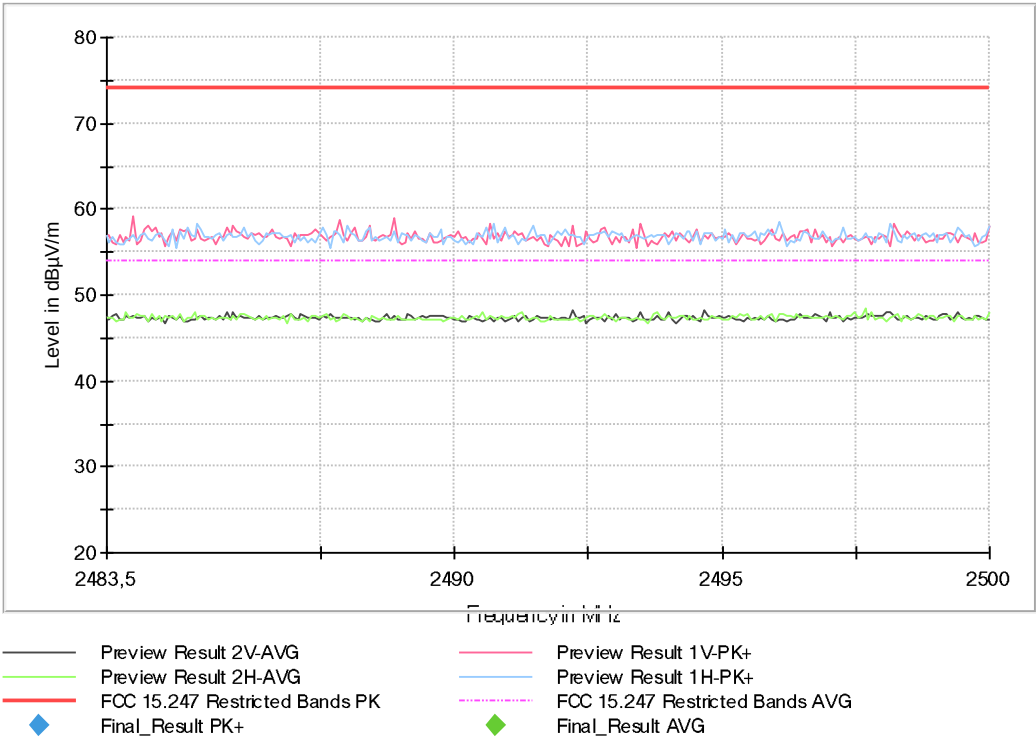
Images:



Full Spectrum



Full Spectrum

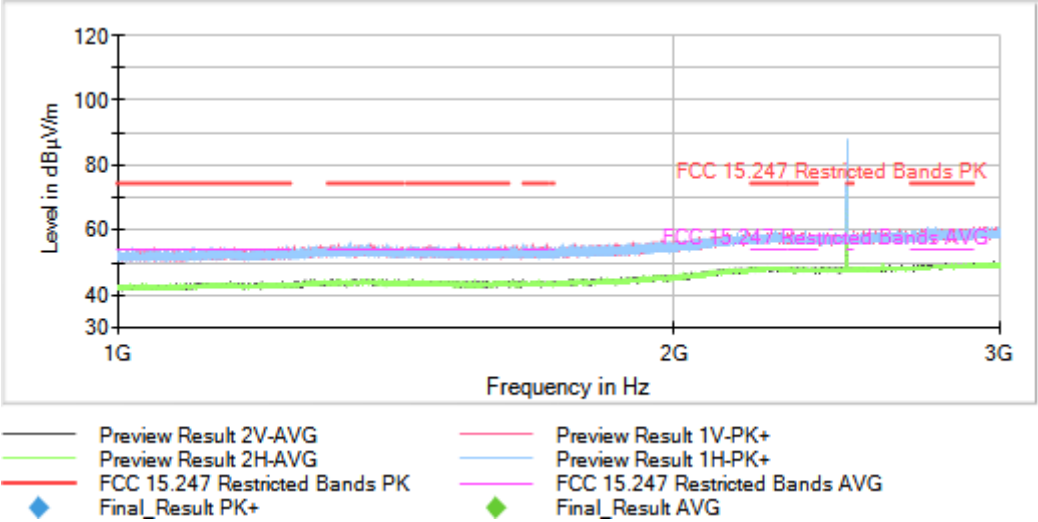


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

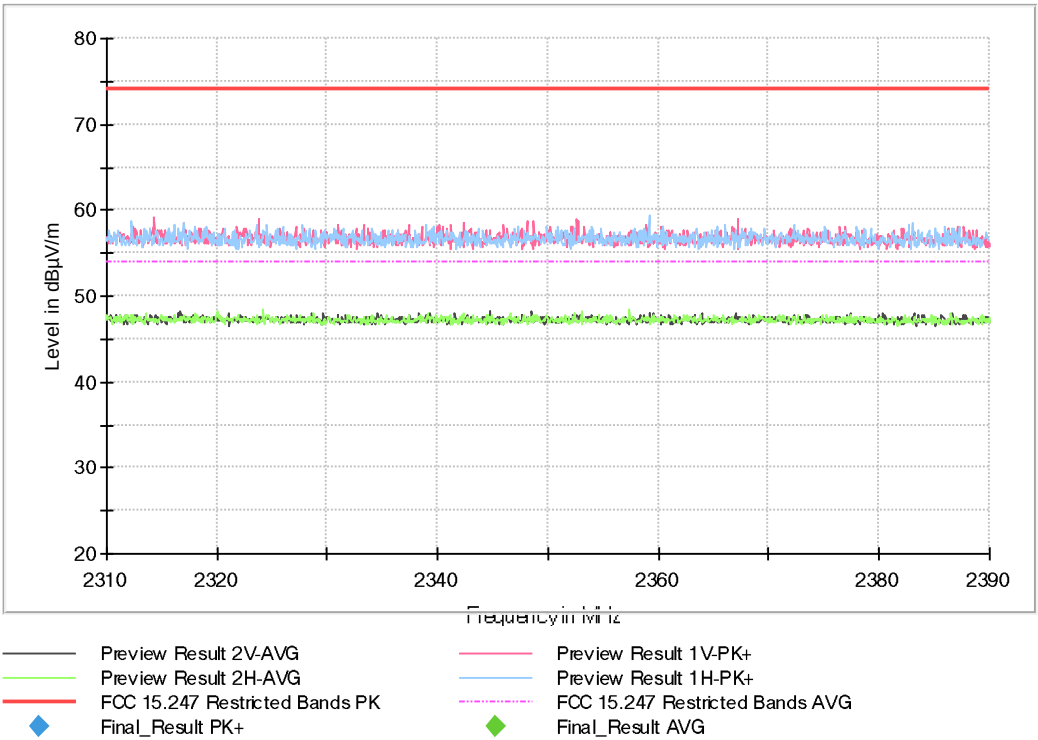
Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

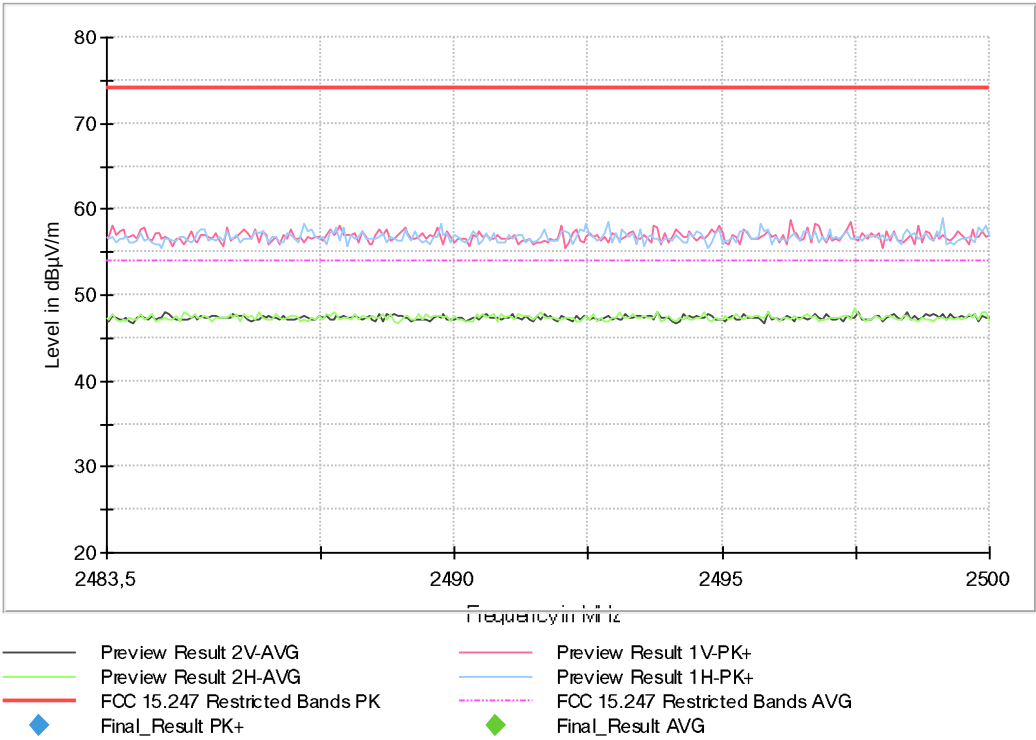
Images:



Full Spectrum



Full Spectrum

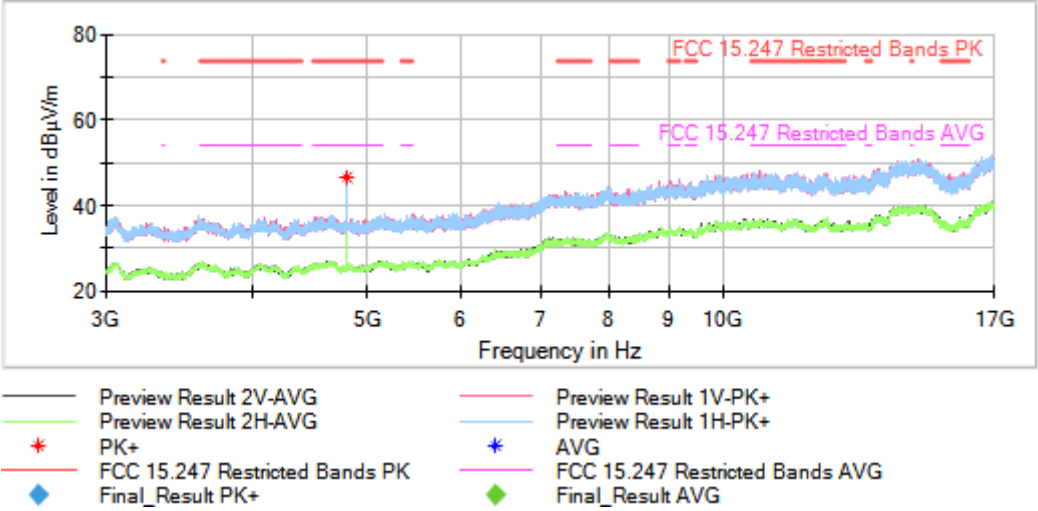


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

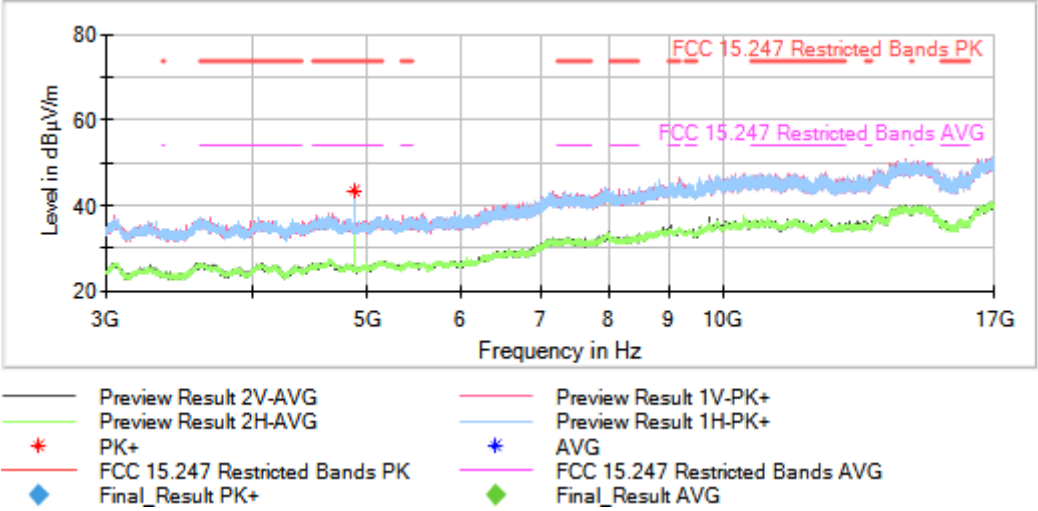


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2440.00000

Frequency Range GHz = [3, 17]

Images:

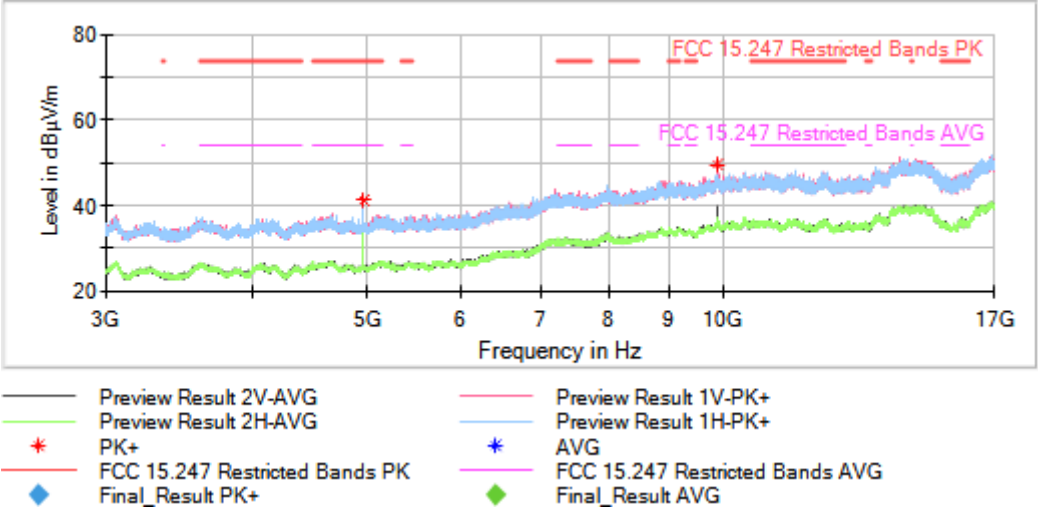


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

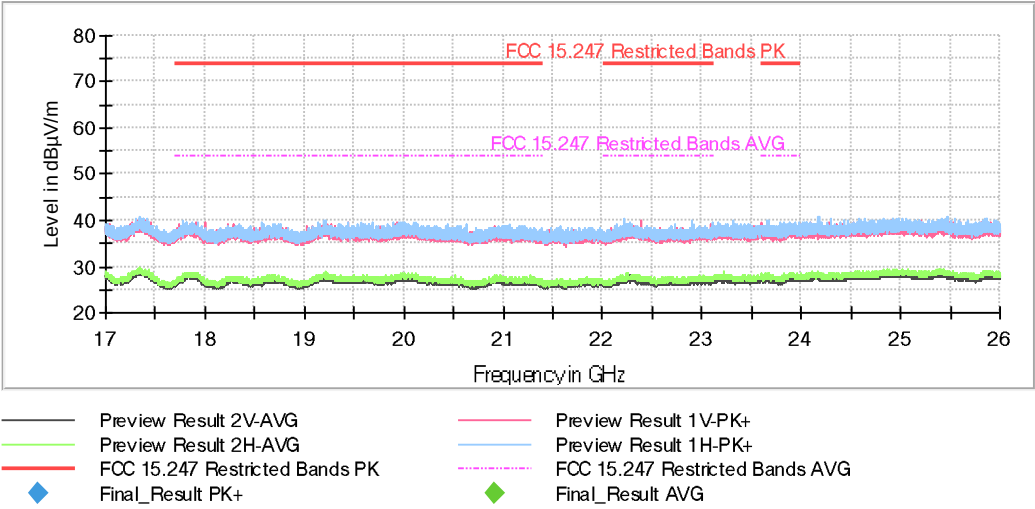


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 1 Mbit/s)

Frequency MHz = 2440.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

Results

No spurious frequencies detected at less than 20 dB below the limit.

Verdict

Pass

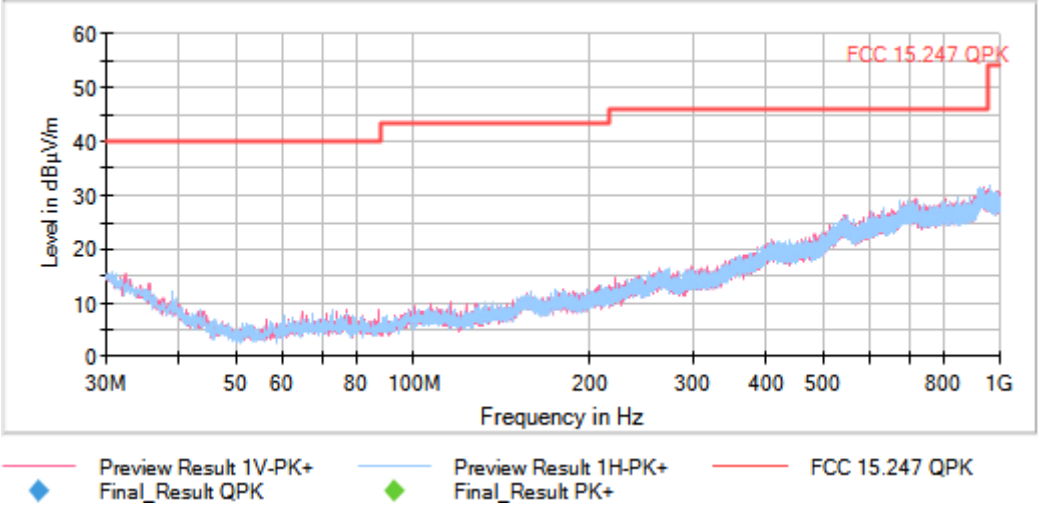
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2480.00000

Frequency Range GHz = [0.03, 1]

Images:



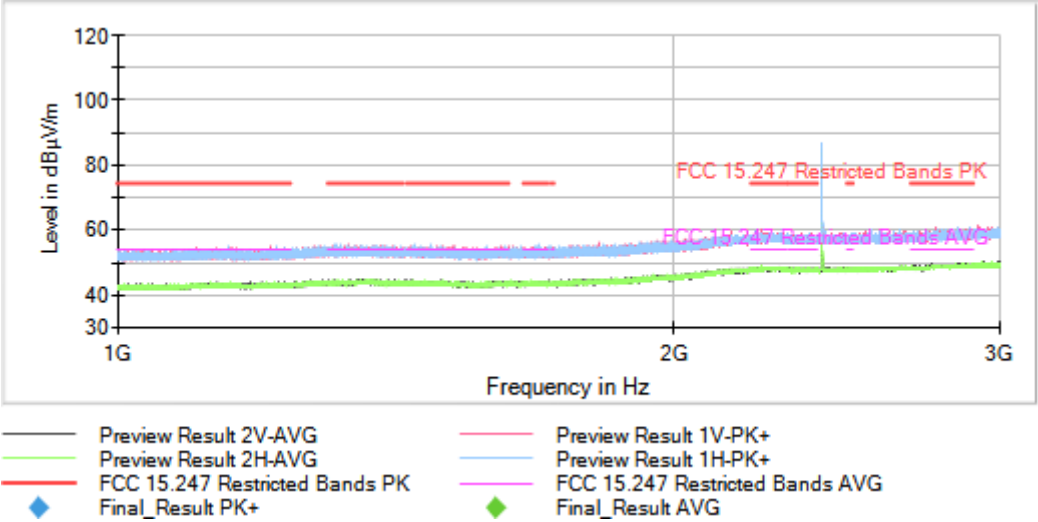
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

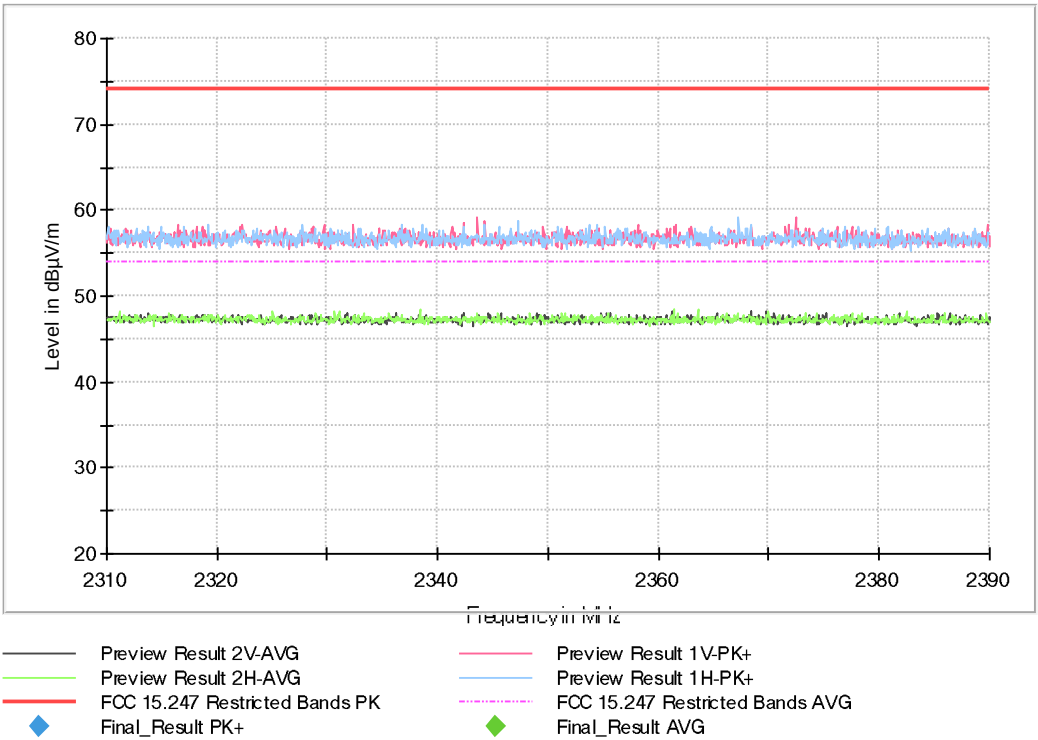
Frequency MHz = 2402.00000

Frequency Range GHz = [1, 3]

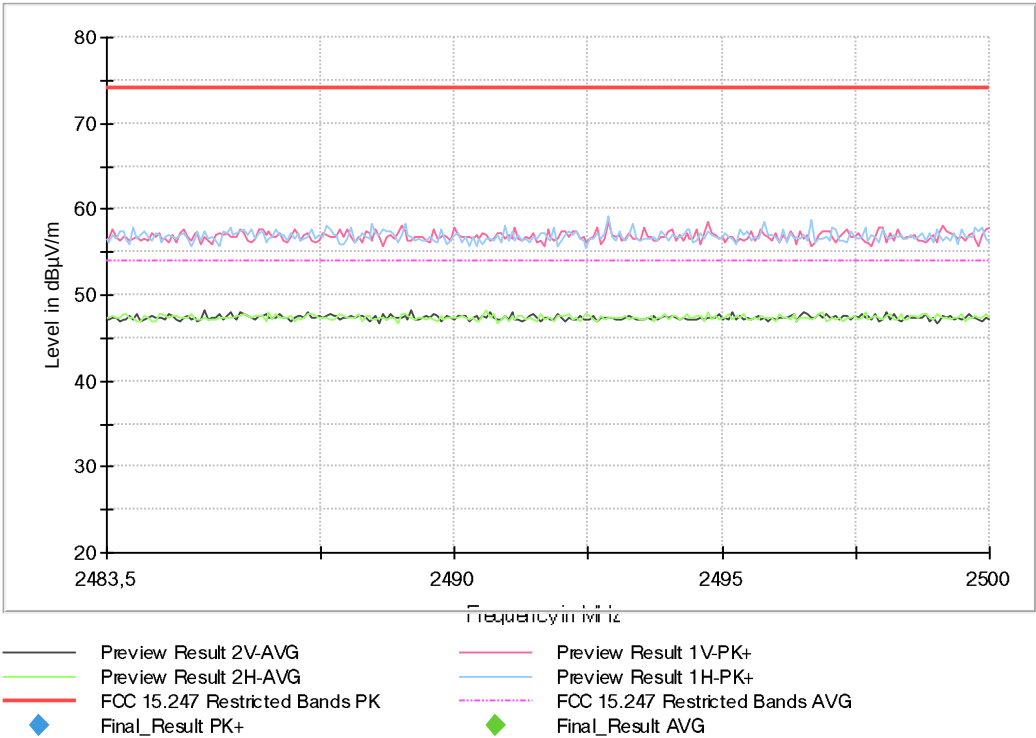
Images:



Full Spectrum

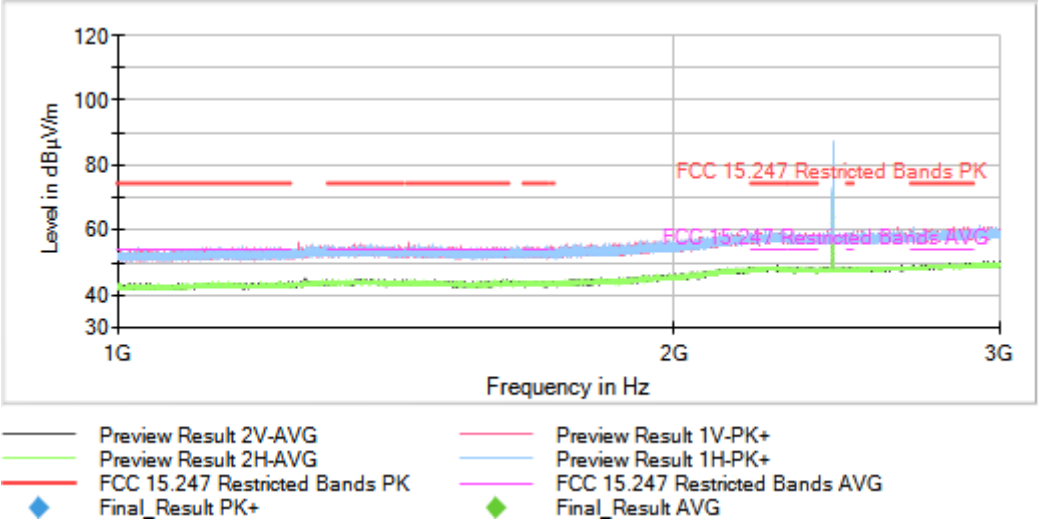


Full Spectrum

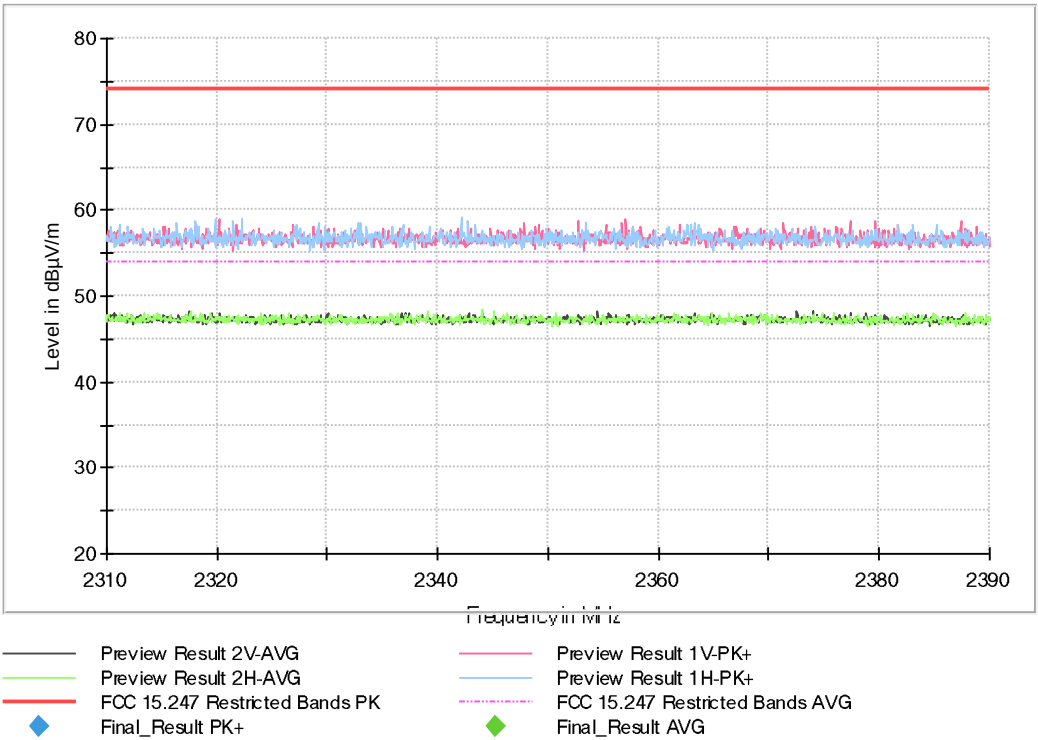


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)
Frequency MHz = 2440.00000
Frequency Range GHz = [1, 3]

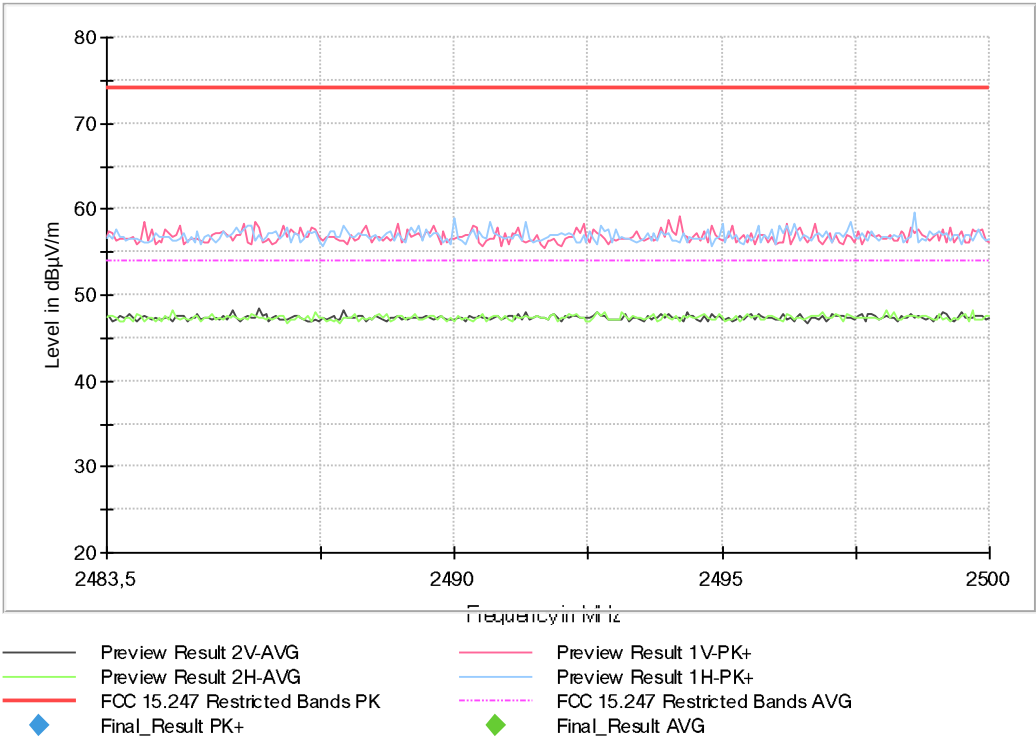
Images:



Full Spectrum



Full Spectrum

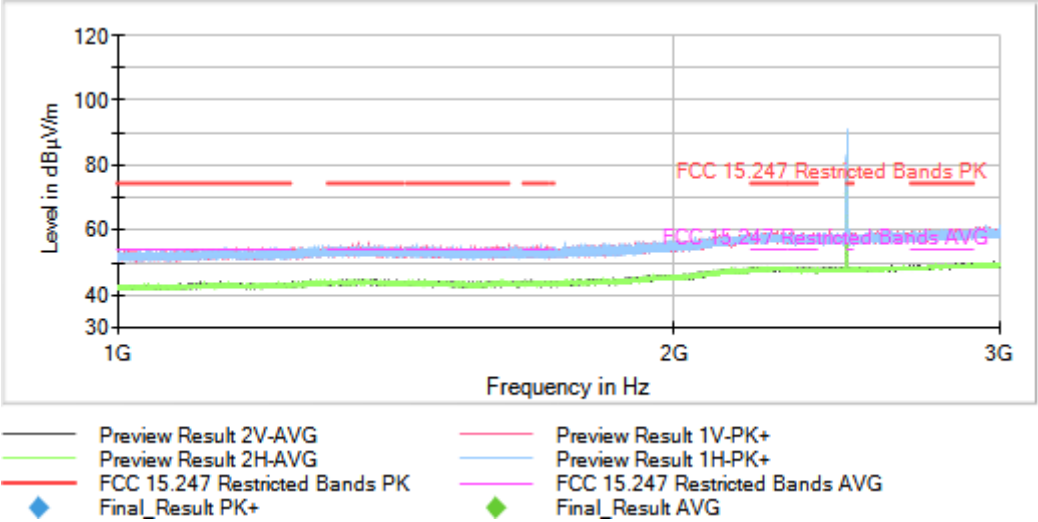


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

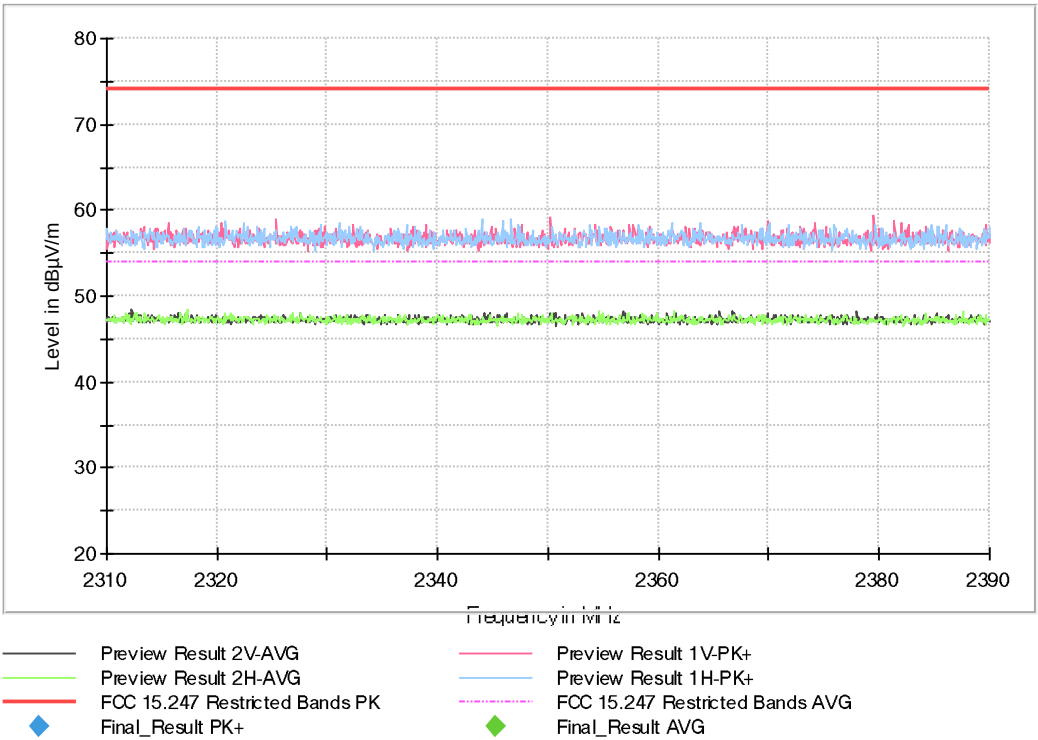
Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

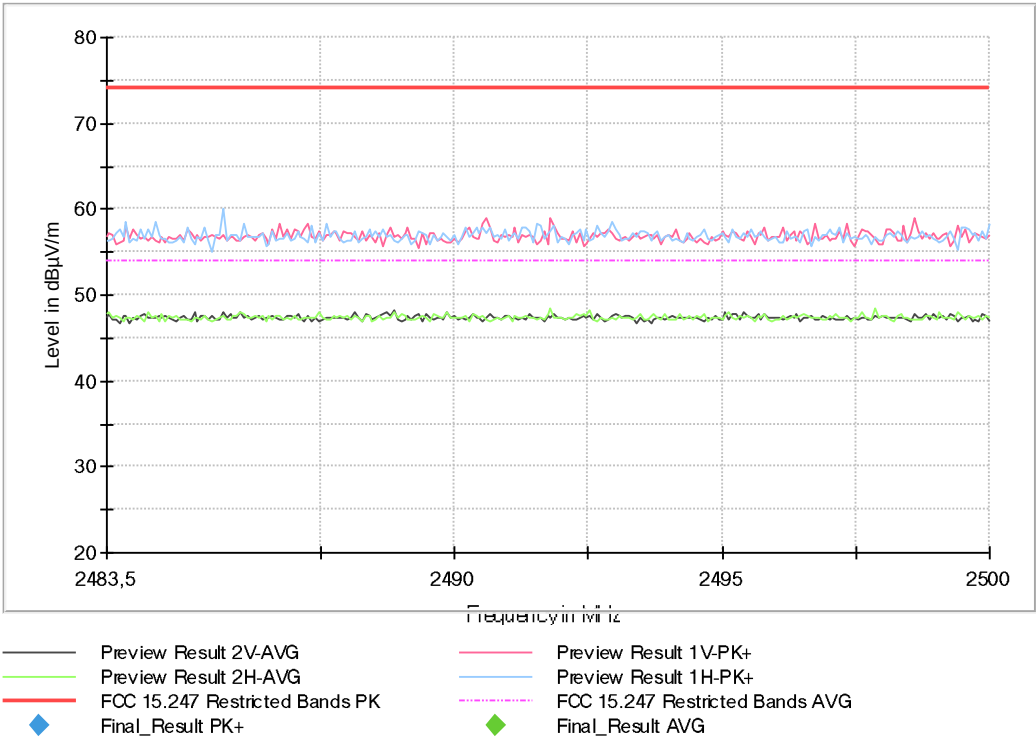
Images:



Full Spectrum



Full Spectrum

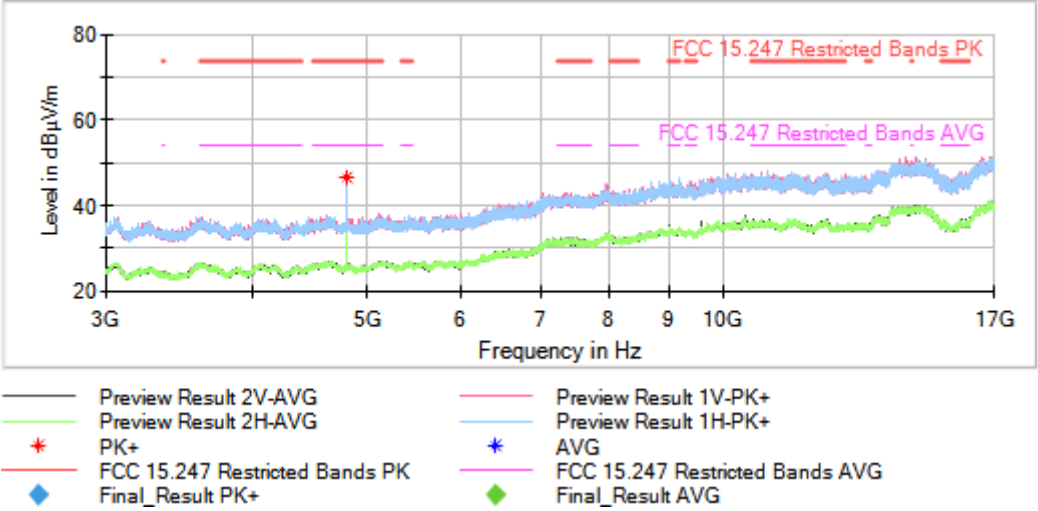


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

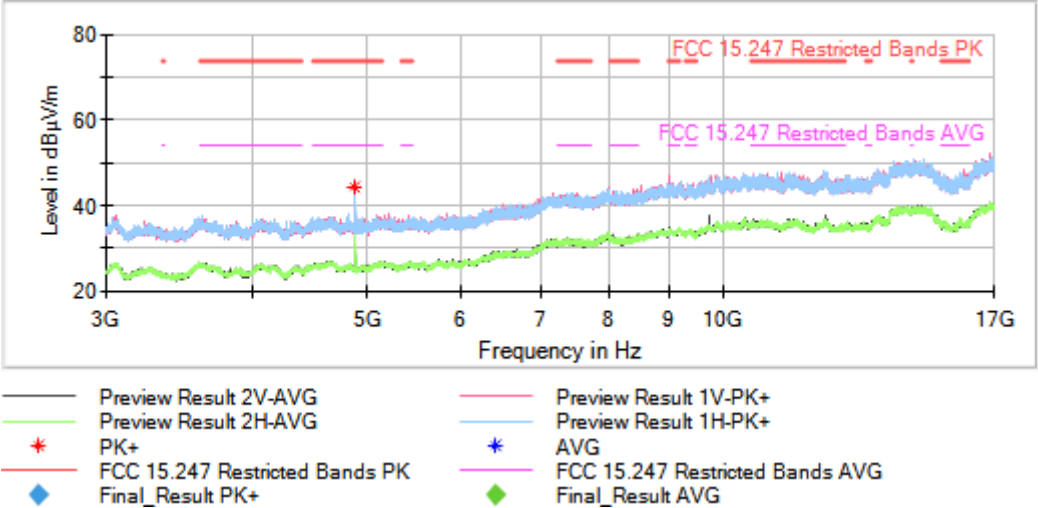


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2440.00000

Frequency Range GHz = [3, 17]

Images:

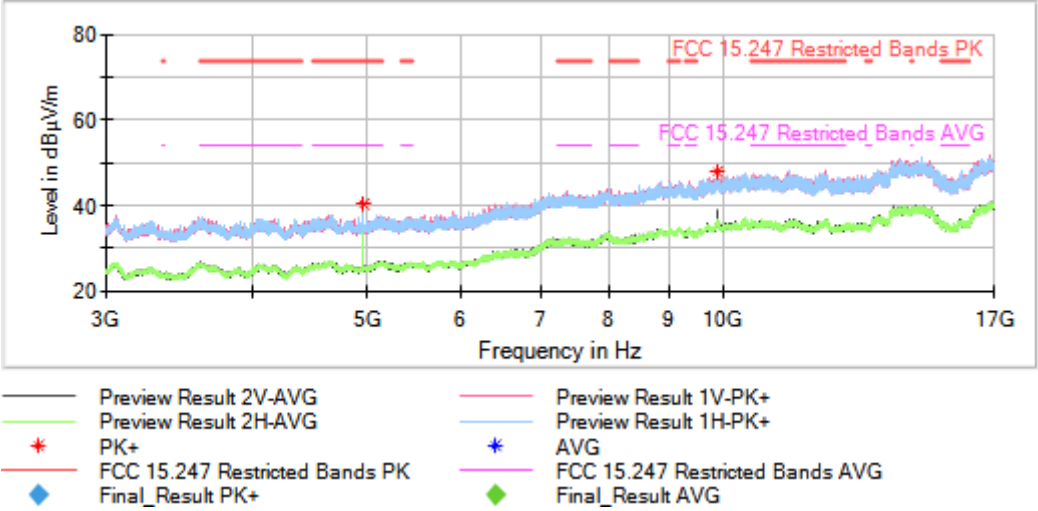


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

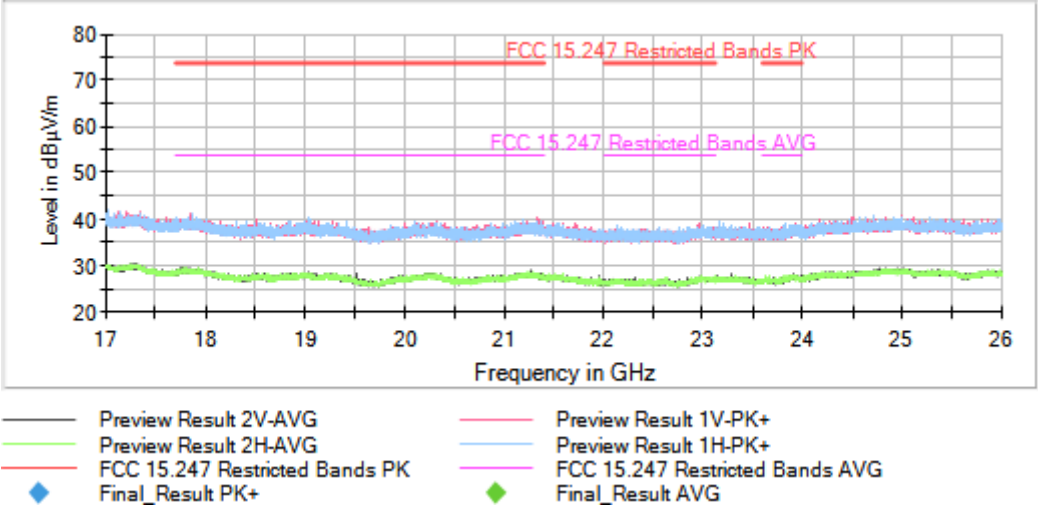


Operation Band MHz = [2400, 2483.5] Modulation = BTLE 5.0 (GFSK 2 Mbit/s)

Frequency MHz = 2440.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

Occupied Channel Bandwidth 99%

Limits

* RSS-Gen Issue 5, Clause 6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth:

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

Modulation: 1M

Results

Operation Band (MHz)	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	2402	1.031436327
[2400, 2483.5]	2440	1.031199085
[2400, 2483.5]	2480	1.030817866

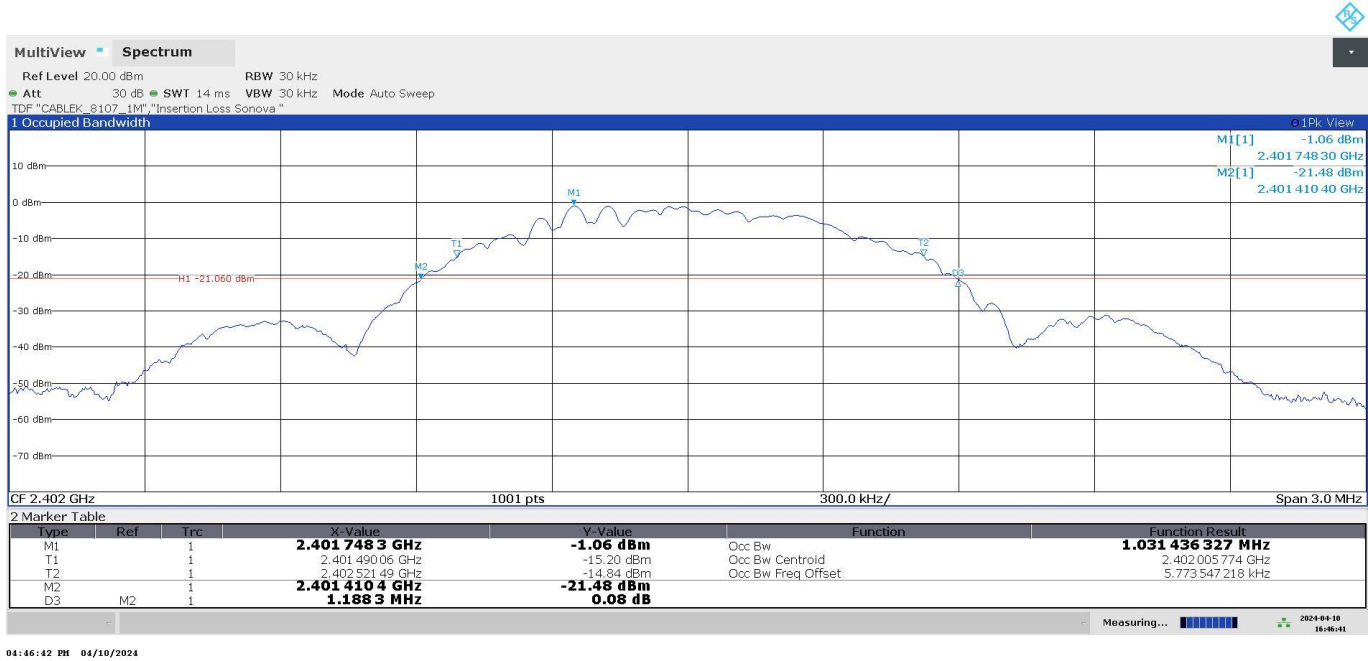
Verdict

Pass

Attachments

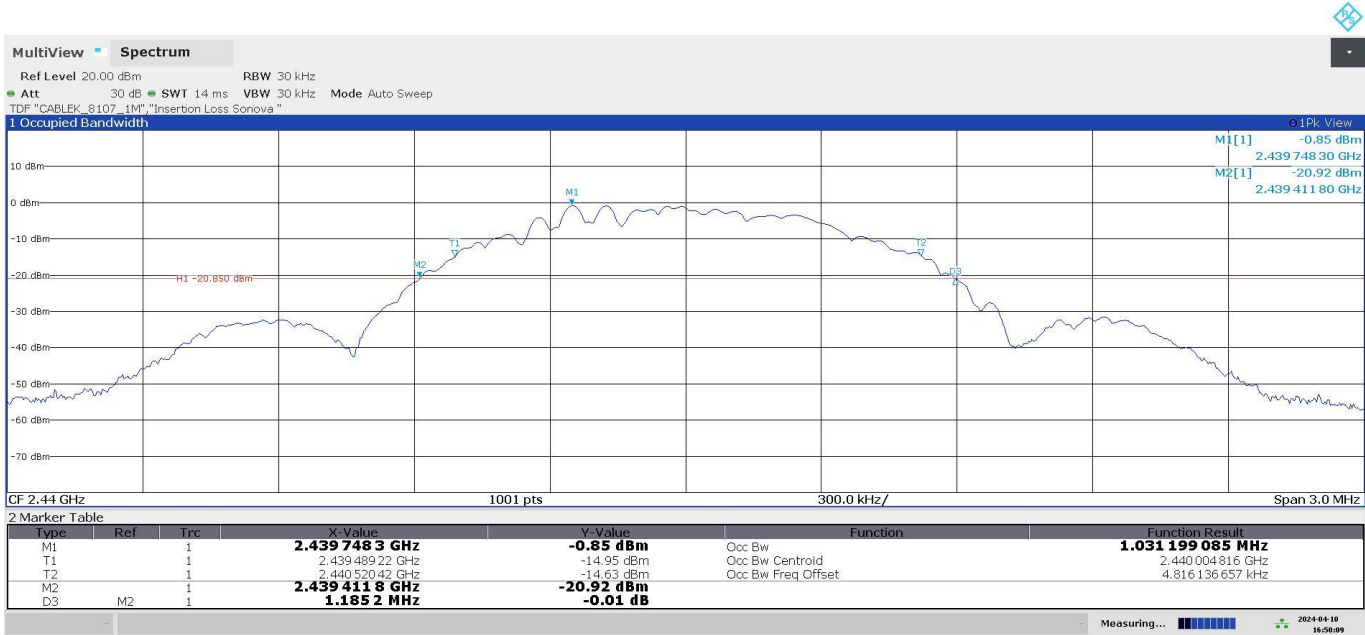
Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2402

Images:



Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2440

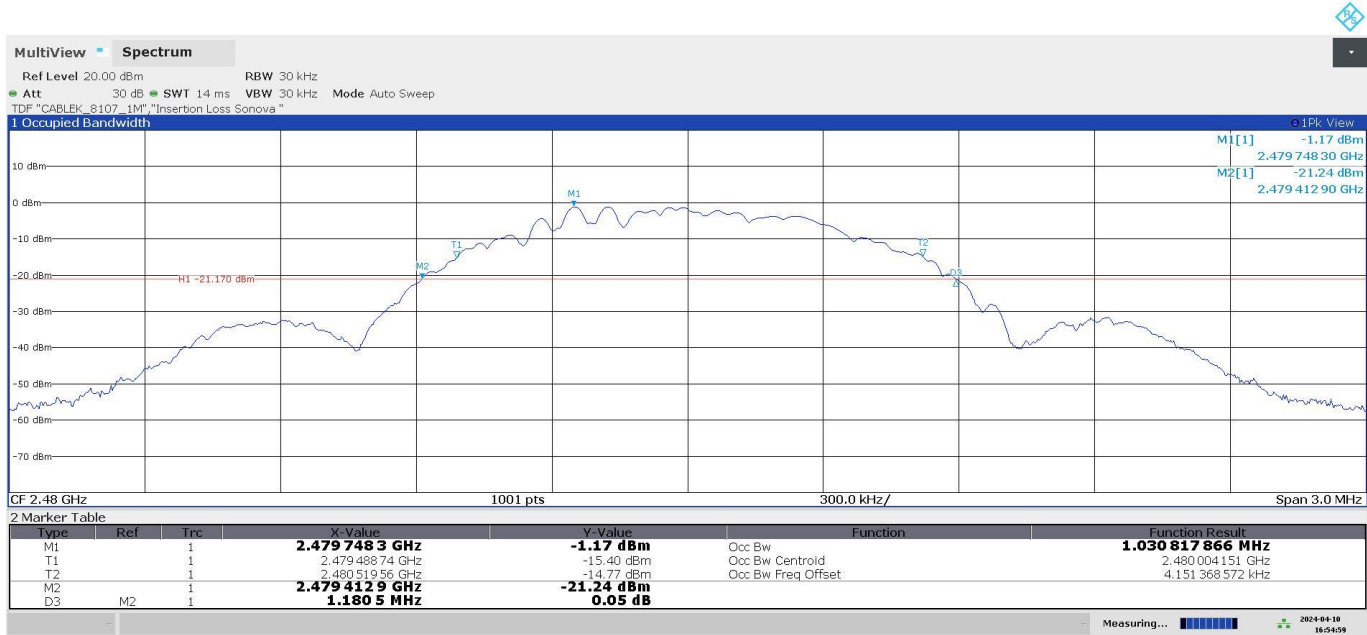
Images:



04:50:09 PM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = 1M
Frequency MHz = 2480

Images:



04:54:59 PM 04/10/2024

Modulation: 2M

Results

Operation Band (MHz)	Channel Frequency (MHz)	99% Occupied Bandwidth (MHz)
[2400, 2483.5]	2402	2.060662093
[2400, 2483.5]	2440	2.062442886
[2400, 2483.5]	2480	2.062015550

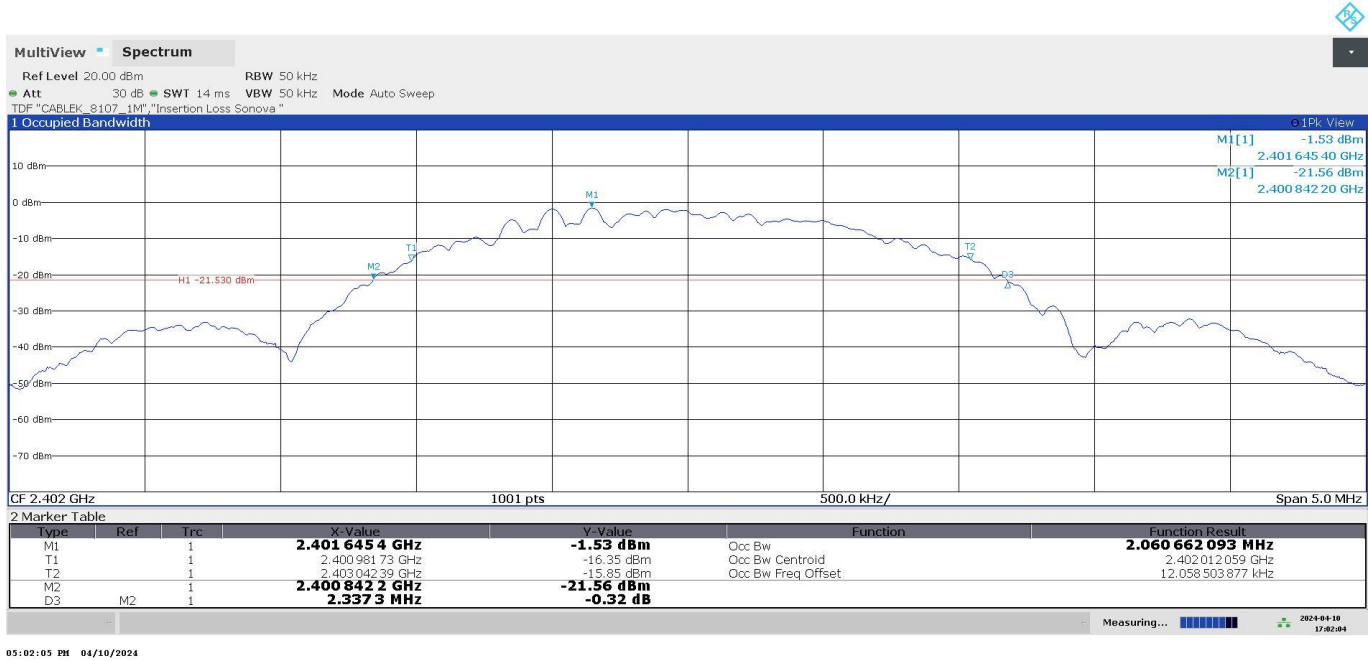
Verdict

Pass

Attachments

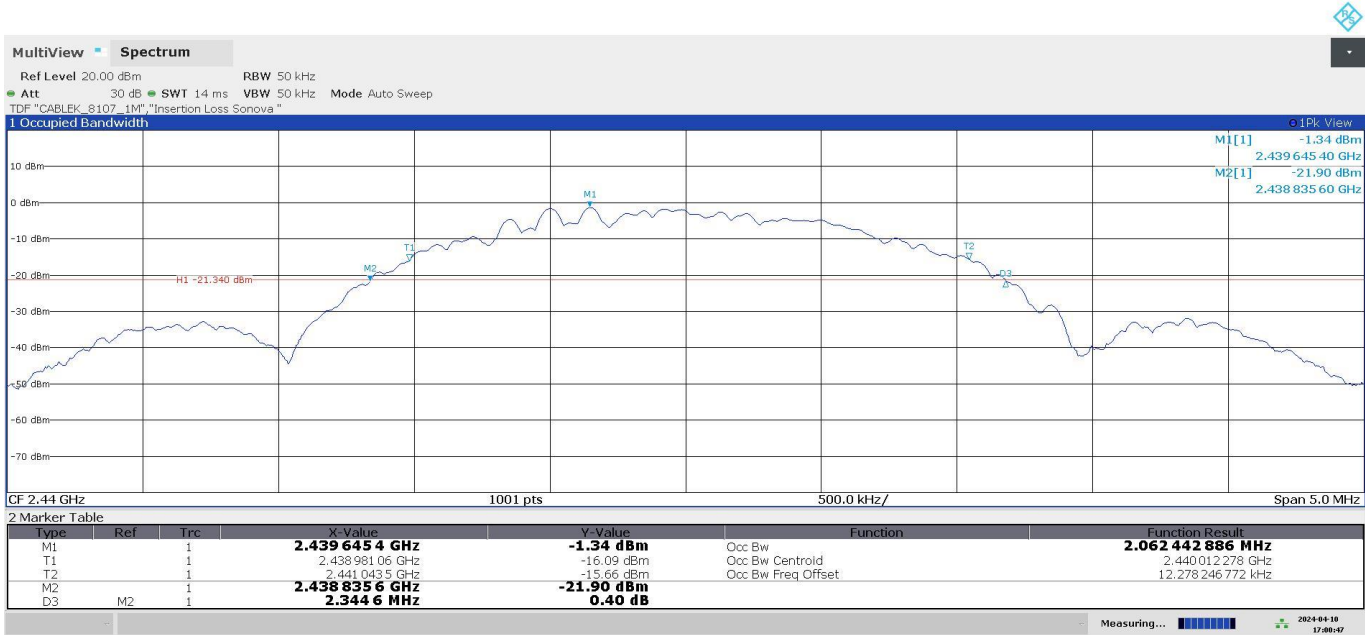
Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2402

Images:



Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2440

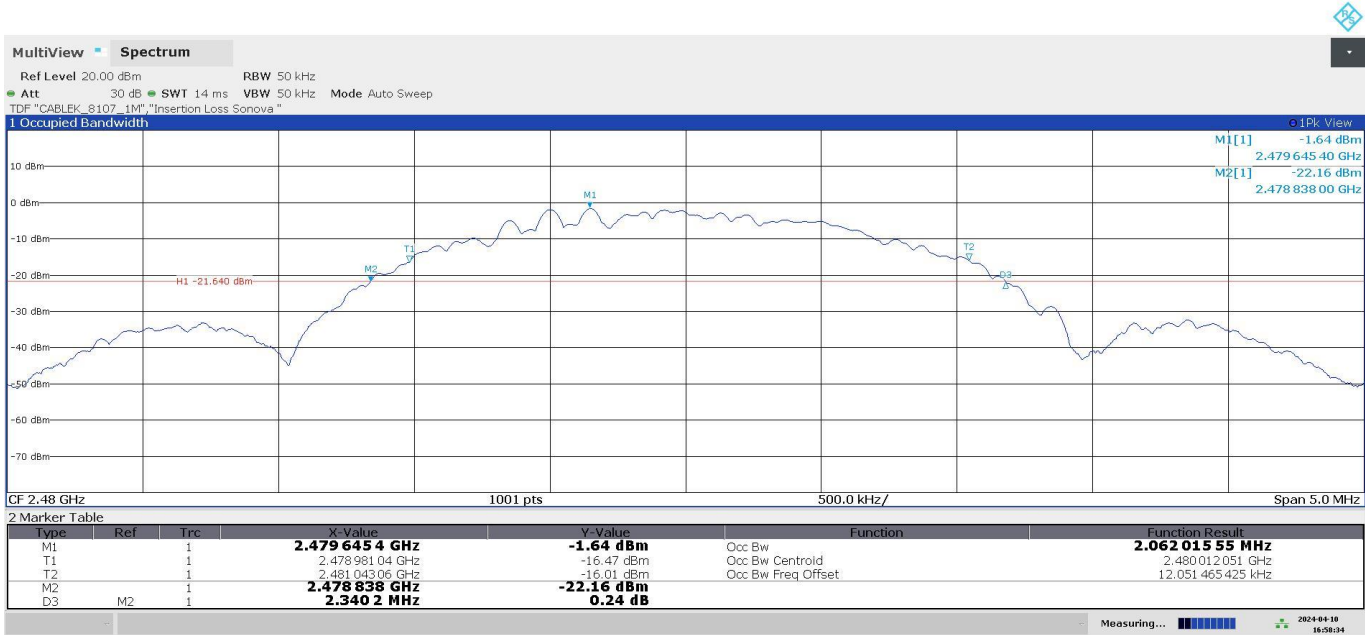
Images:



05:00:47 PM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = 2M
Frequency MHz = 2480

Images:



04:58:34 PM 04/10/2024

Appendix B: Test results. Bluetooth EDR

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TEST CONDITIONS

(*): Data provided by the client.

POWER SUPPLY (*):

Vnominal: 3.7 Vdc
Type of Power Supply: Lithium-ion Rechargeable Battery.

ANTENNA (*):

Type of Antenna: Integral.
Maximum Declared Antenna Gain: -11 dBi

TEST FREQUENCIES (*):

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

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

CONDUCTED MEASUREMENTS:

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



RADIATED MEASUREMENTS:

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

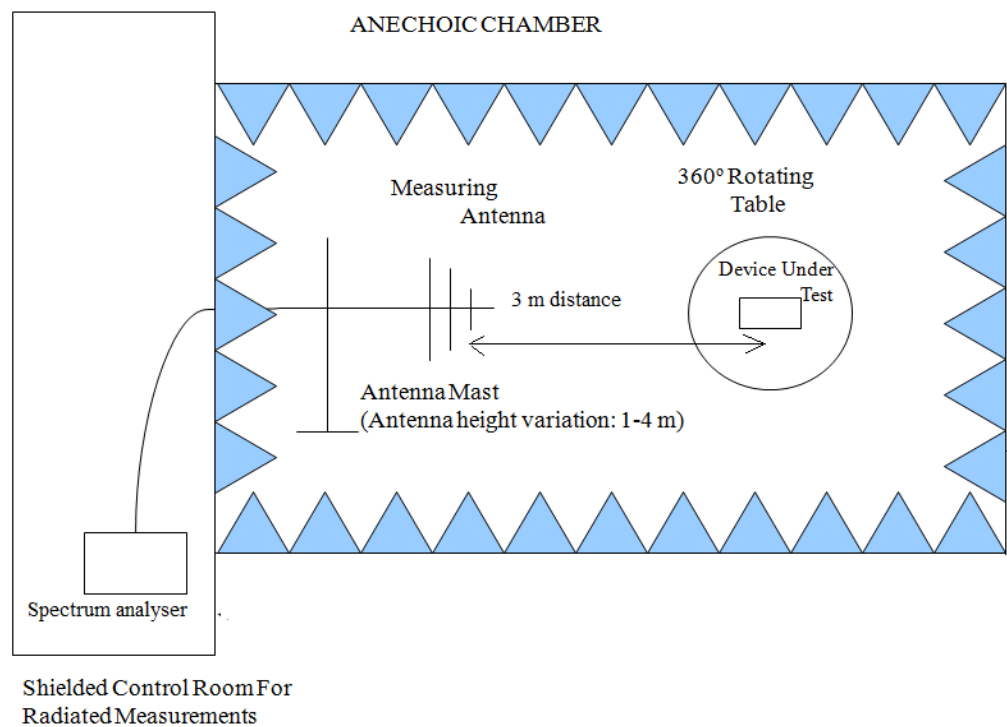
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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

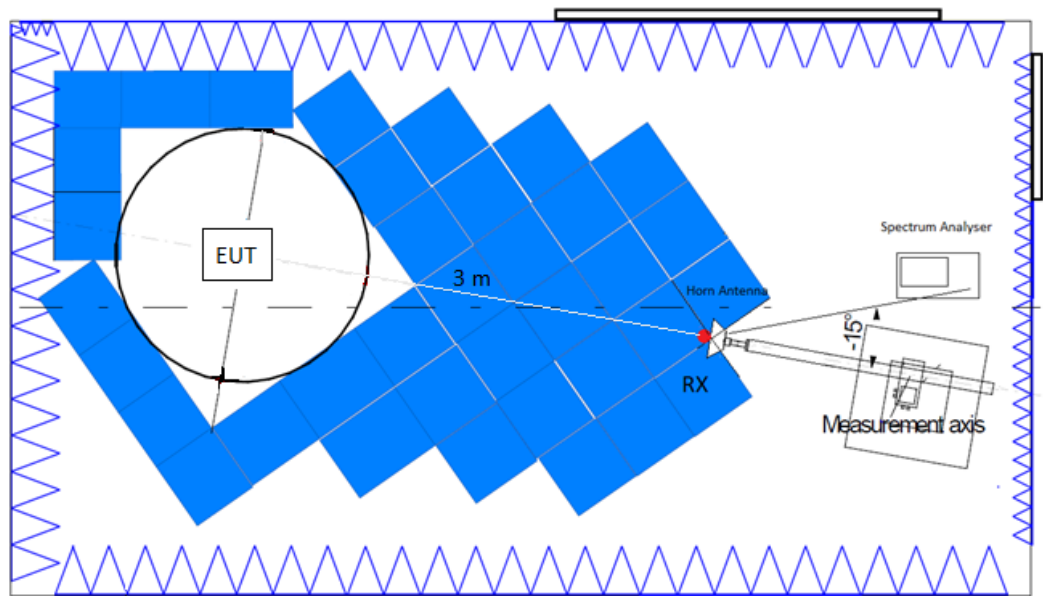
Measurements were made in both horizontal and vertical planes of polarization.

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

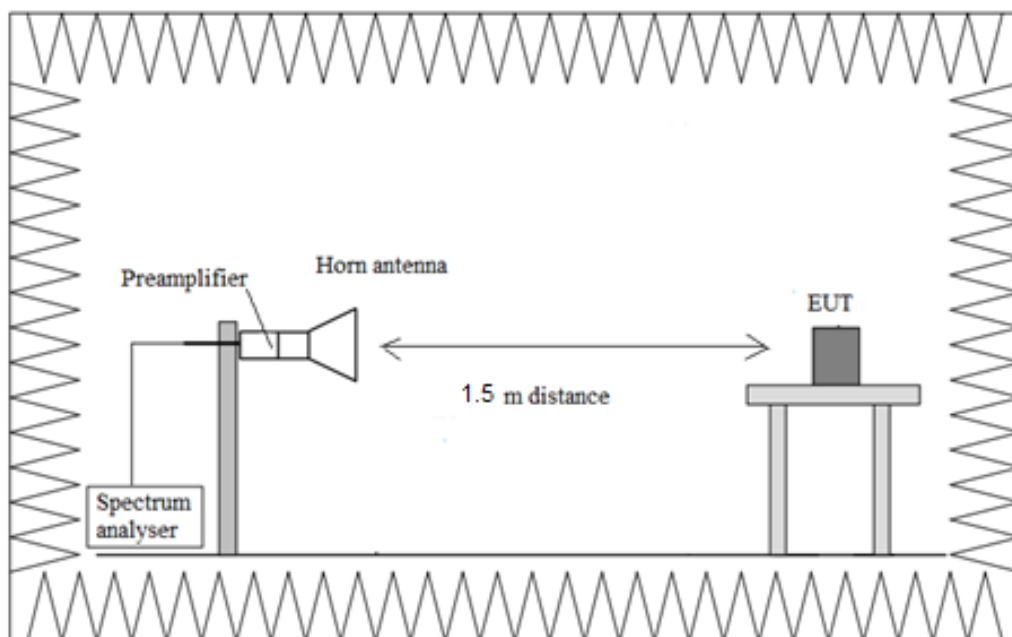
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



TEST CASES DETAILS

15.249 (b) / RSS-210 B.10 (a) Field strength of fundamental and harmonics emissions

Limits

The field strength of emissions from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (mV/m)	Field strength (dBµV/m)	Measurement distance (m)
902 - 928	50	93.98	3
2400 - 2483.5	50	93.98	3
5725 - 5875	50	93.98	3
24000 - 24250	250	107.96	3

For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

Modulation: BT (GFSK 1-DH5)

Results

Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	Modulation: BT (GFSK 1-DH5)	2402	88.75
[2400, 2483.5]	Modulation: BT (GFSK 1-DH5)	2441	90.00
[2400, 2483.5]	Modulation: BT (GFSK 1-DH5)	2480	92.46

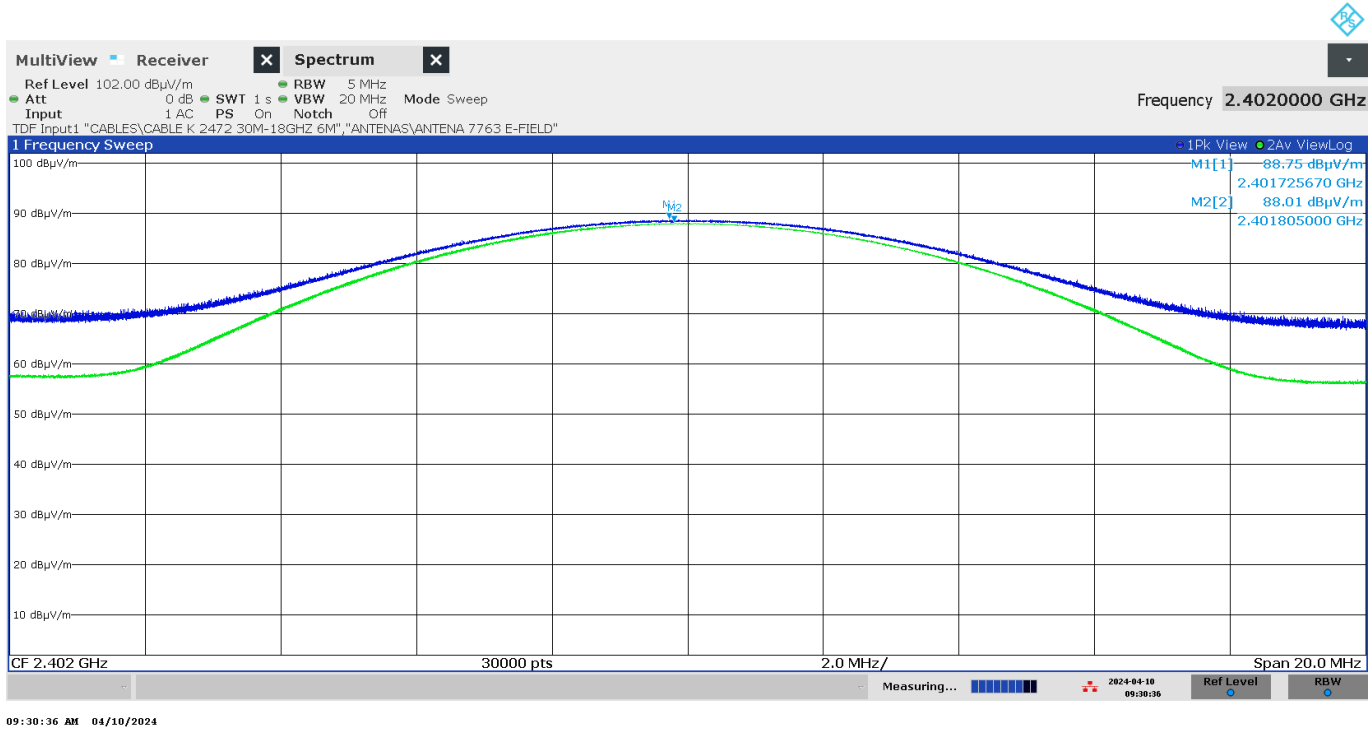
Verdict

Pass

Attachments

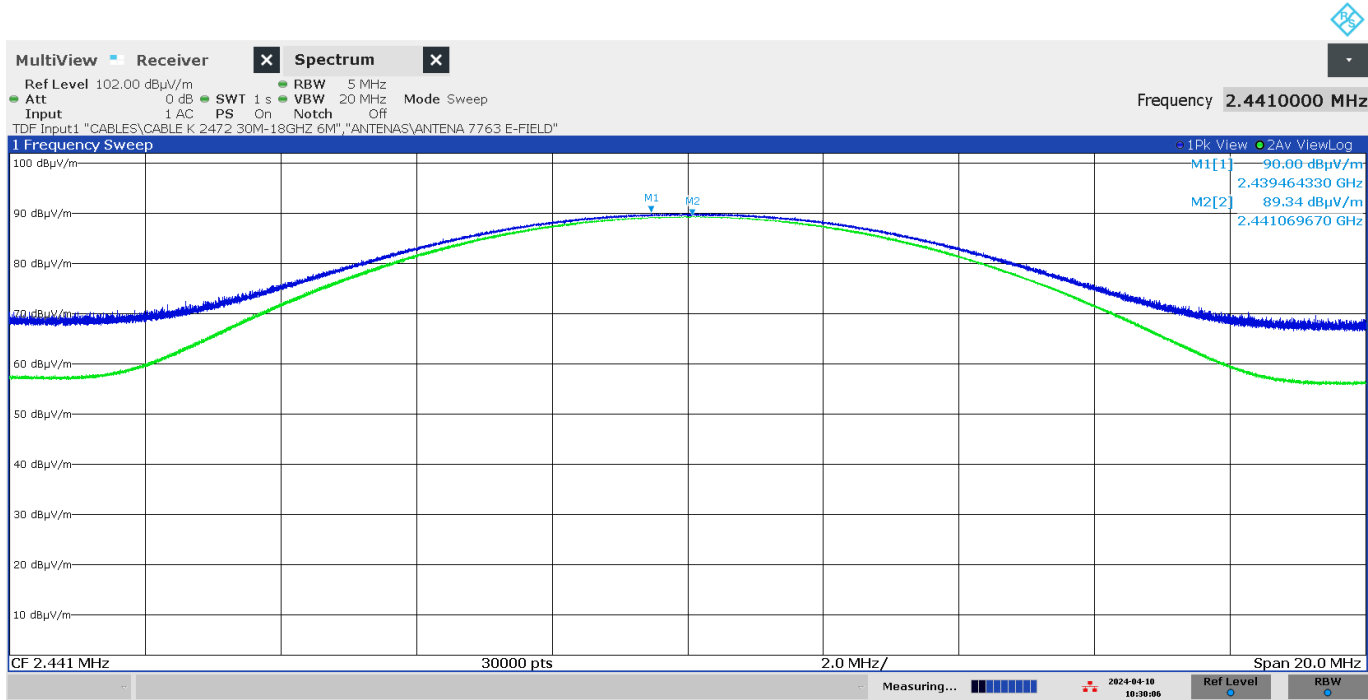
Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2441.00000

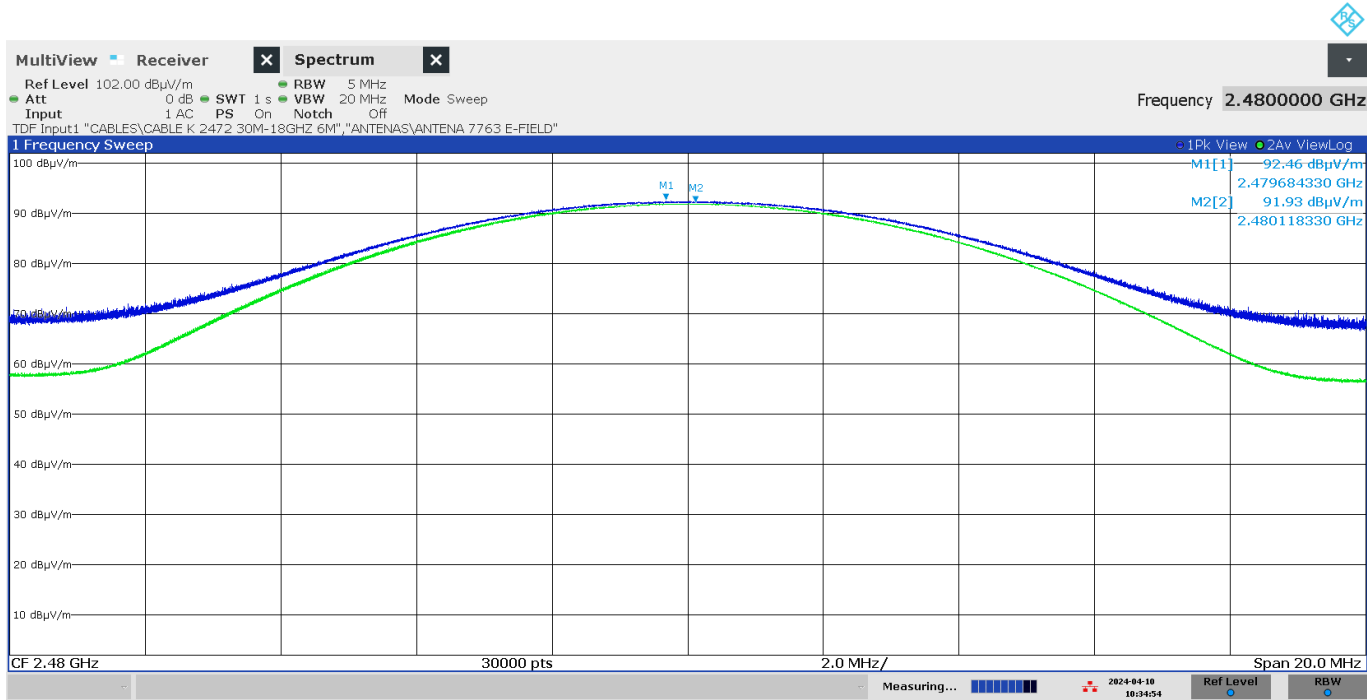
Images:



10:30:07 AM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)
Frequency MHz = 2480.00000

Images:



10:34:54 AM 04/10/2024

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

Results

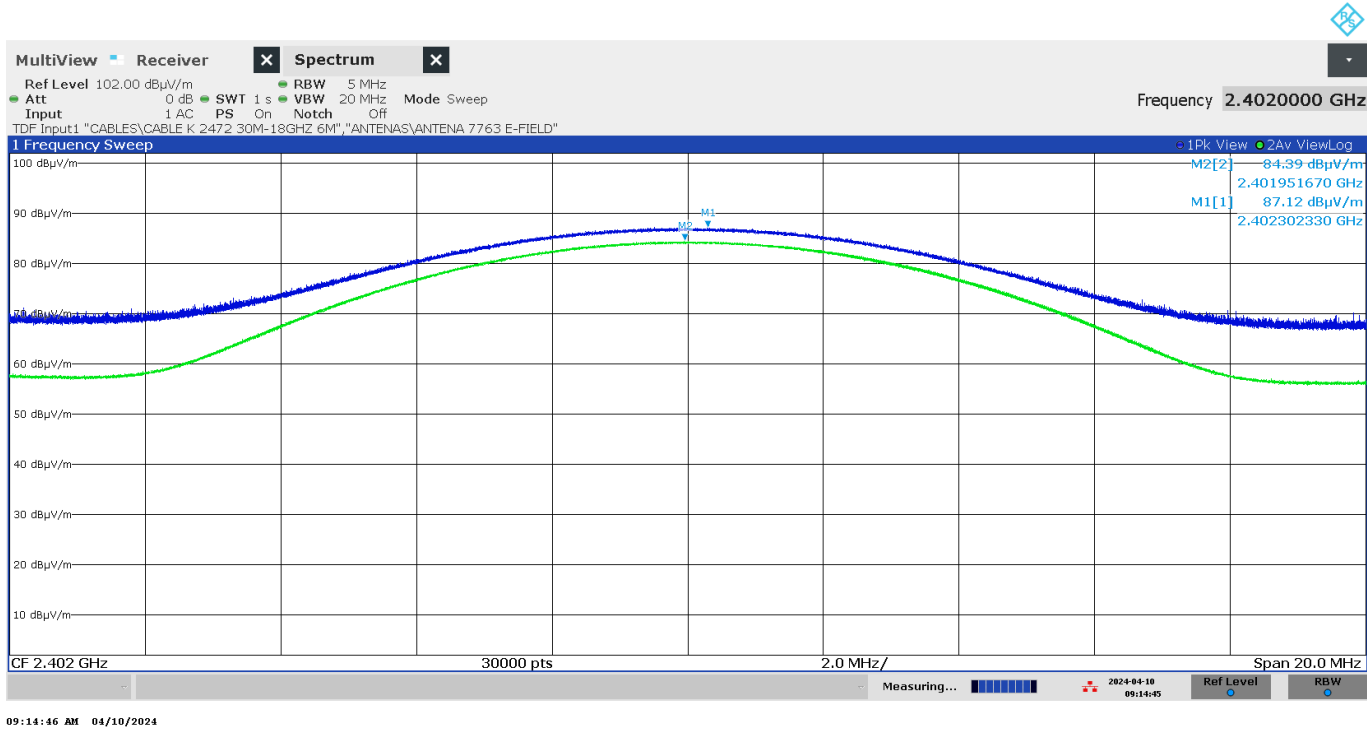
Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	Modulation: BT (Pi/4 DQPSK 2-DH5)	2402	87.12
[2400, 2483.5]	Modulation: BT (Pi/4 DQPSK 2-DH5)	2441	88.56
[2400, 2483.5]	Modulation: BT (Pi/4 DQPSK 2-DH5)	2480	91.24

Verdict

Pass

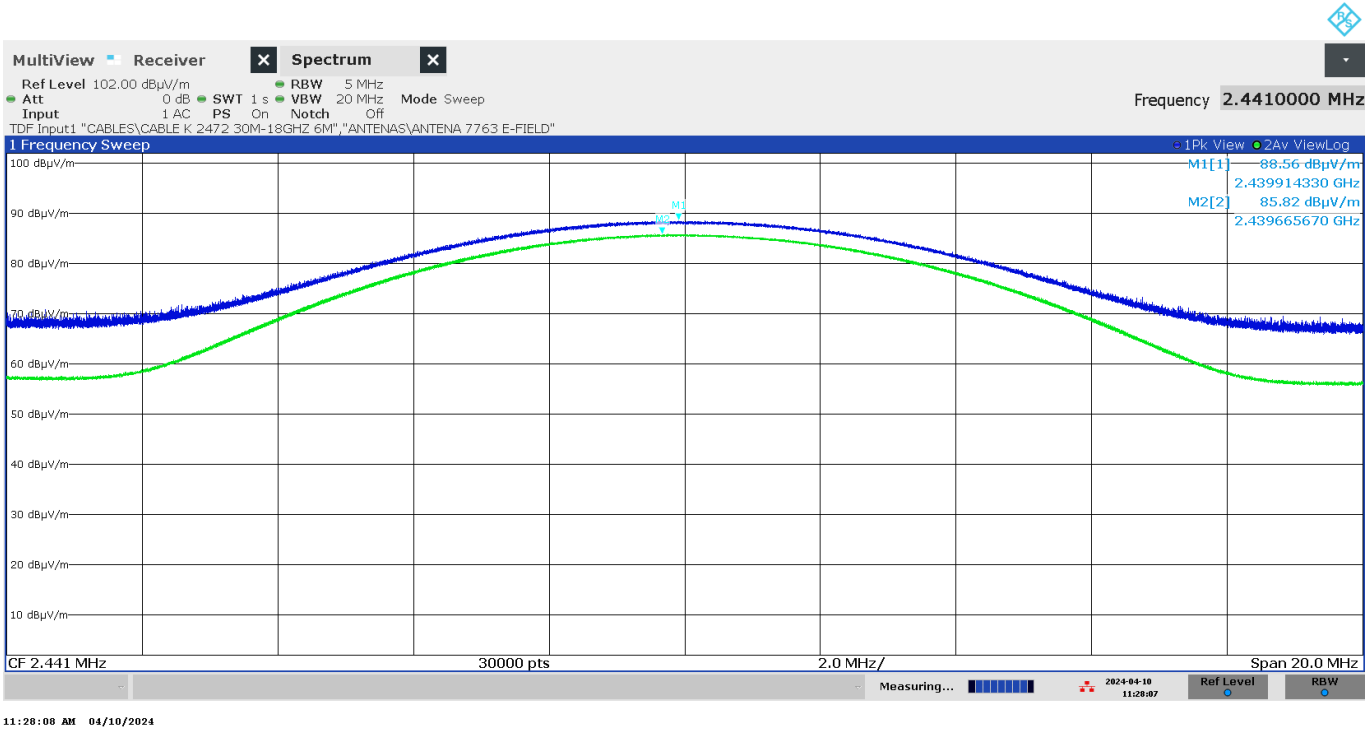
Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2402.00000

Images:



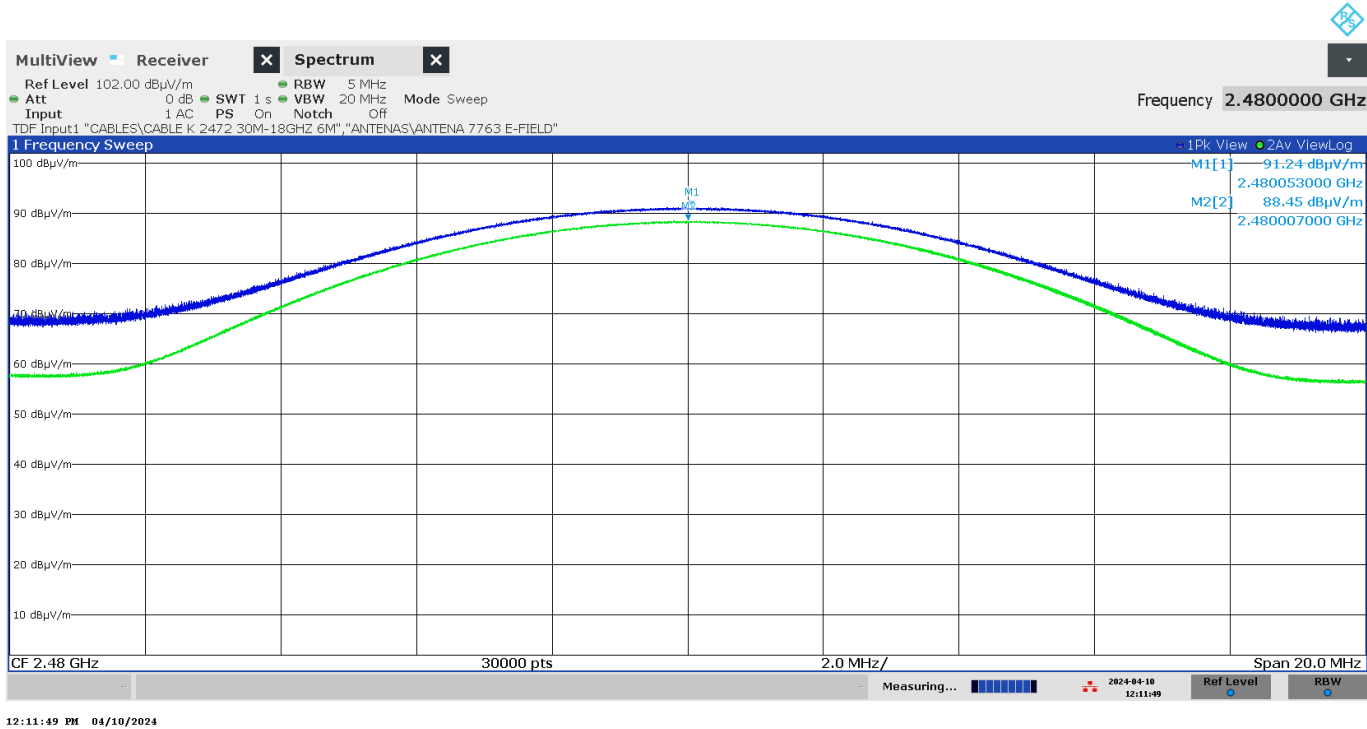
Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2441.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)
Frequency MHz = 2480.00000

Images:



Modulation: BT (8DPSK 3-DH5)

Results

Operation Band (MHz)	Modulation	Channel Frequency (MHz)	Peak Field (dBµV/m)
[2400, 2483.5]	Modulation: BT (8DPSK 3-DH5)	2402	88.63
[2400, 2483.5]	Modulation: BT (8DPSK 3-DH5)	2441	90.04
[2400, 2483.5]	Modulation: BT (8DPSK 3-DH5)	2480	92.60

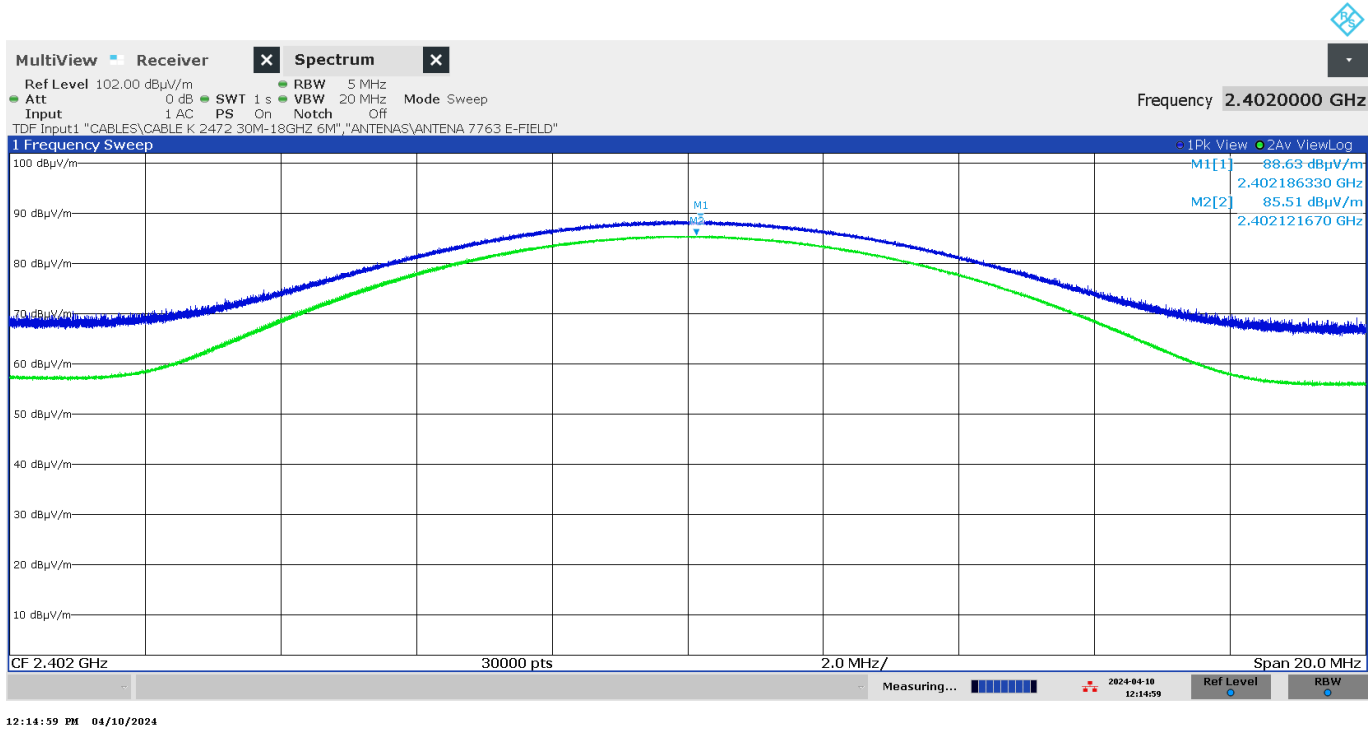
Verdict

Pass

Attachments

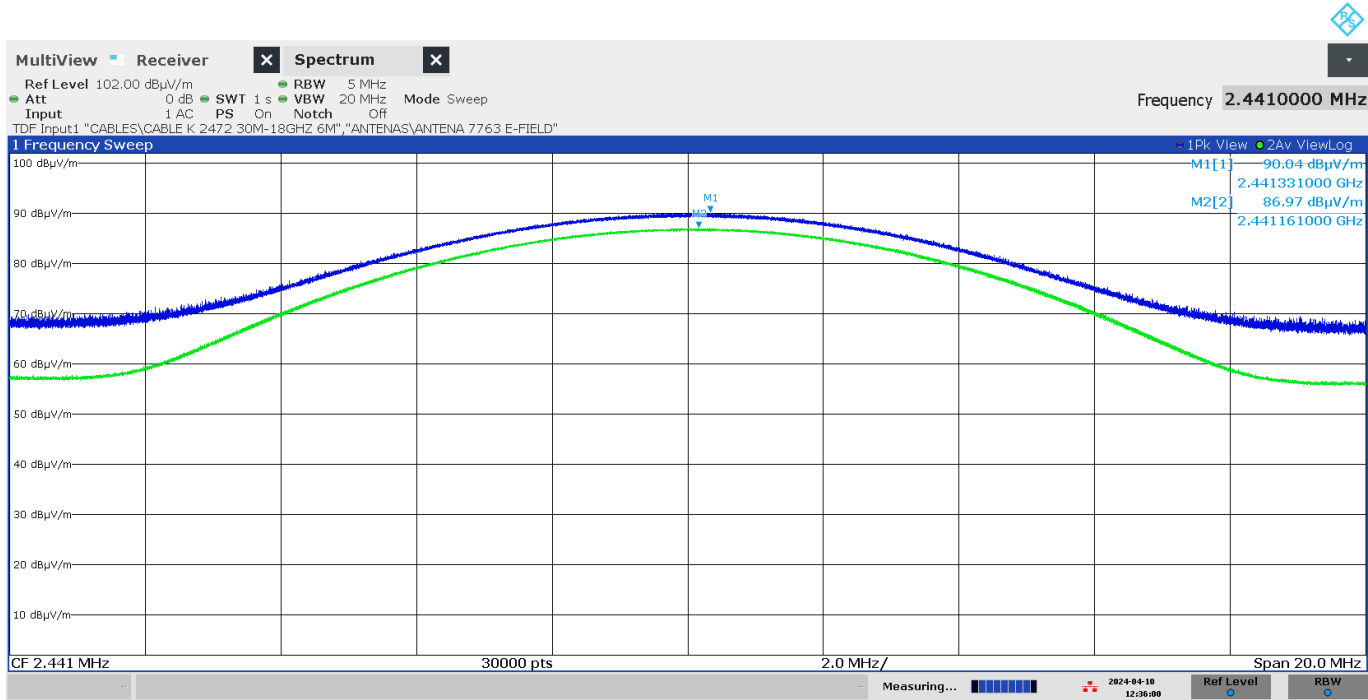
Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2402.00000

Images:



Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2441.00000

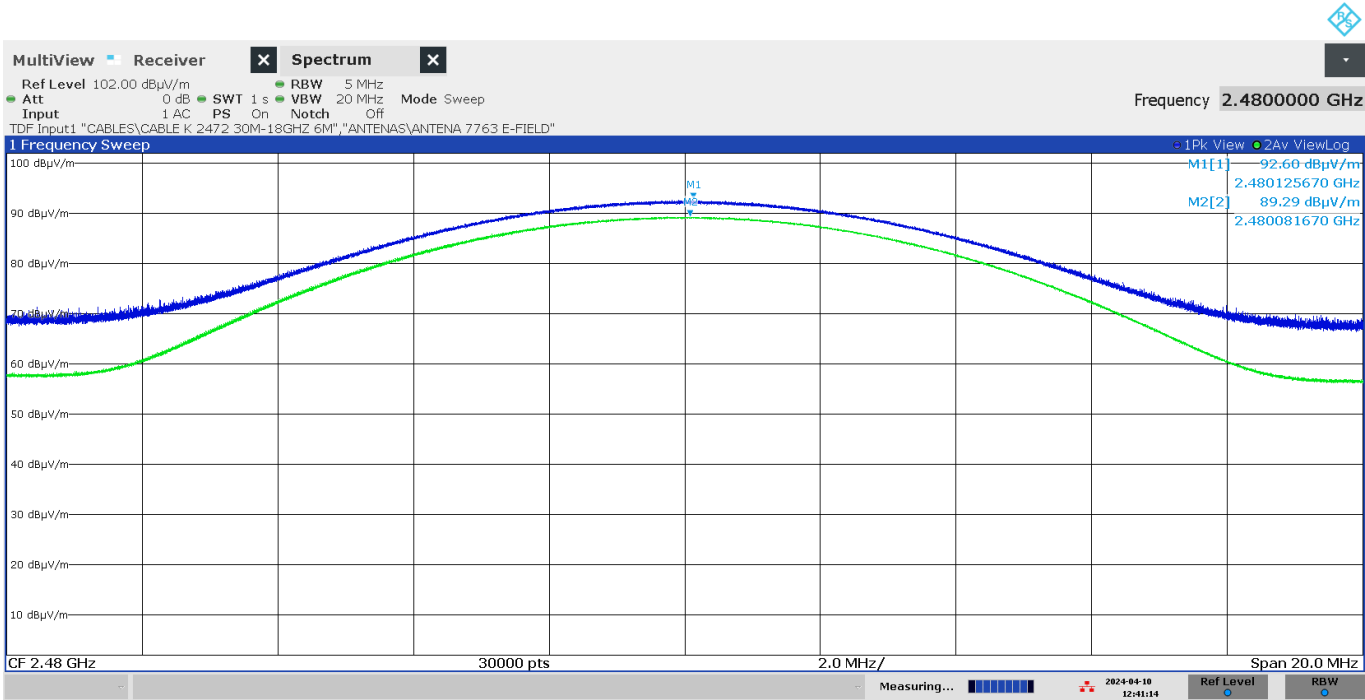
Images:



12:36:01 PM 04/10/2024

Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)
Frequency MHz = 2480.00000

Images:



12:41:15 PM 04/10/2024

15.249 (d) (e) / RSS-210 B.10 (b) Emissions radiated outside of the specific frequency bands

Limits

The field strength of harmonics from intentional radiators shall comply with the following:

Fundamental frequency (MHz)	Field strength of harmonics ($\mu\text{V/m}$)	Field strength of harmonics ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
902 - 928	500	54	3
2400 - 2483.5	500	54	3
5725 - 5875	500	54	3
24000 - 24250	2500	67.96	3

Emissions radiated outside of the specific frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of fundamental or to the general radiated emission limits specified in section 15.209:

Frequency Range (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance (m)
0.009 - 0.490	$2400/F(\text{kHz})$	-	300
0.490 - 1.705	$24000/F(\text{kHz})$	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

whichever is the lesser attenuation.

Frequency range tested for Radiated emissions according to section 15.33:

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

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

Note: Limits in the following graphs regarding 15.247 are based on 15.209 limits in the same way as 15.249. Please, consider labels 15.247 in all the below graphs also valid in this case for 15.249.

Spectrum Analyzer Parameters:

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
Receiver: [ESR 7] 30 MHz - 1 GHz	48,5 kHz	PK+	100 kHz	1 s	20 dB
Receiver: [ESW 44] 1 GHz - 3 GHz	66,667 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 3 GHz - 17 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB
Receiver: [ESW 44] 17 GHz - 26 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	0 dB

Modulation: BT (GFSK 1-DH5)

Results

The spurious frequencies detected at less than 20 dB below the limit:

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBµV/m)	Pol	Detector
[0.03, 1]	2402.00000	549.62900	14.43	V	QP

* The spurious frequencies detected does not depend of the selected channel.

Verdict

Pass

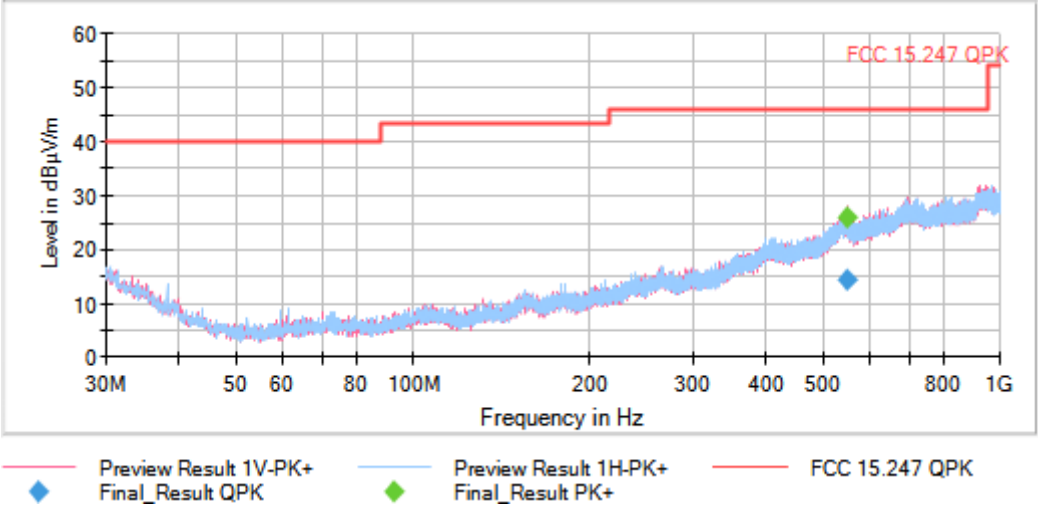
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

Frequency MHz = 2402.00000

Frequency Range GHz = [0.03, 1]

Images:



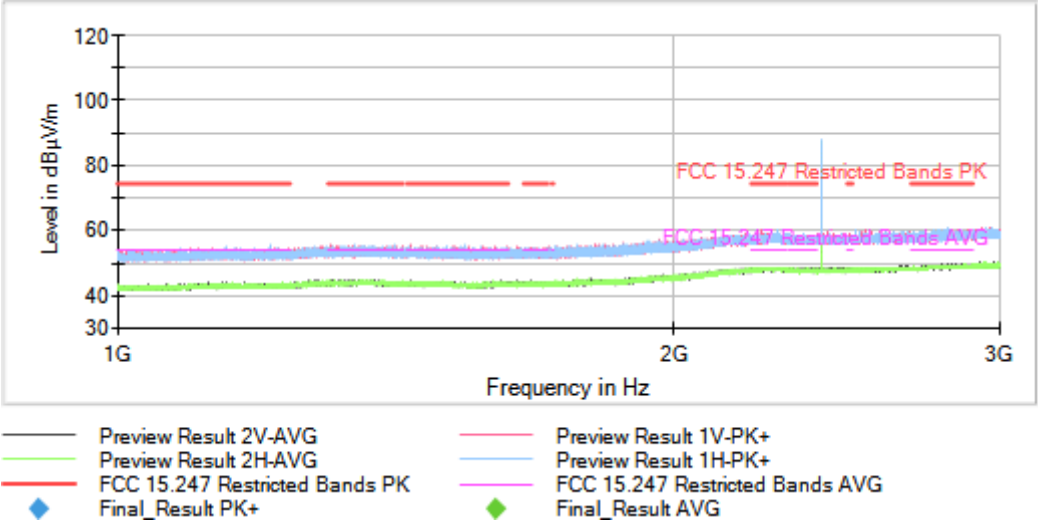
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

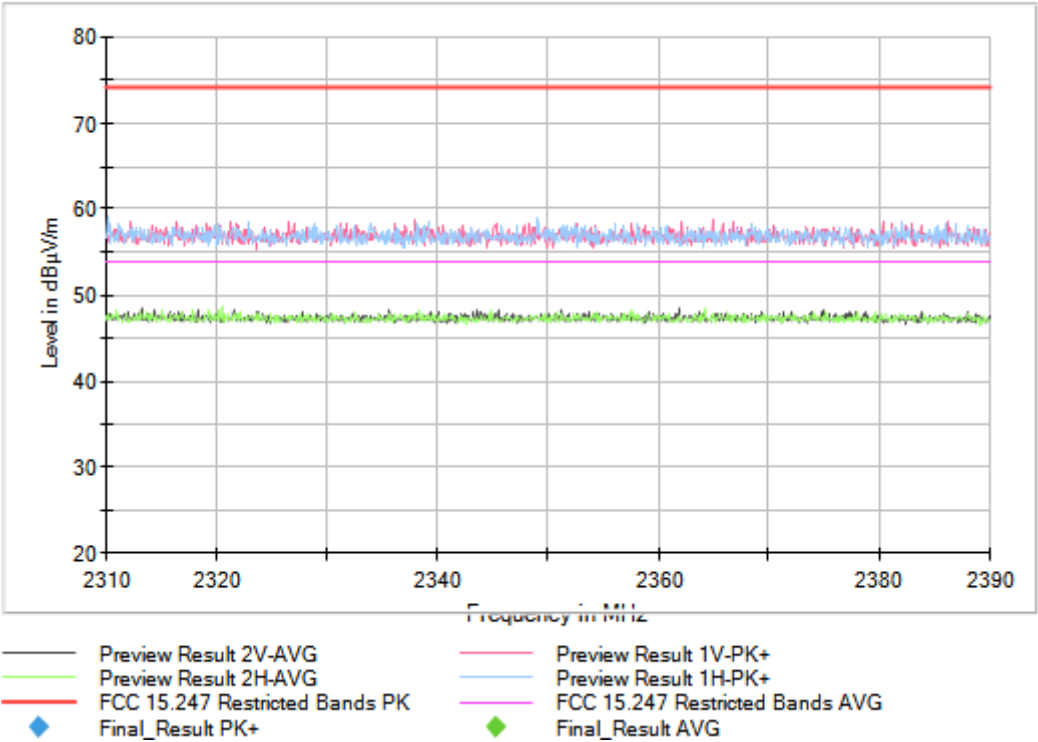
Frequency MHz = 2402.00000

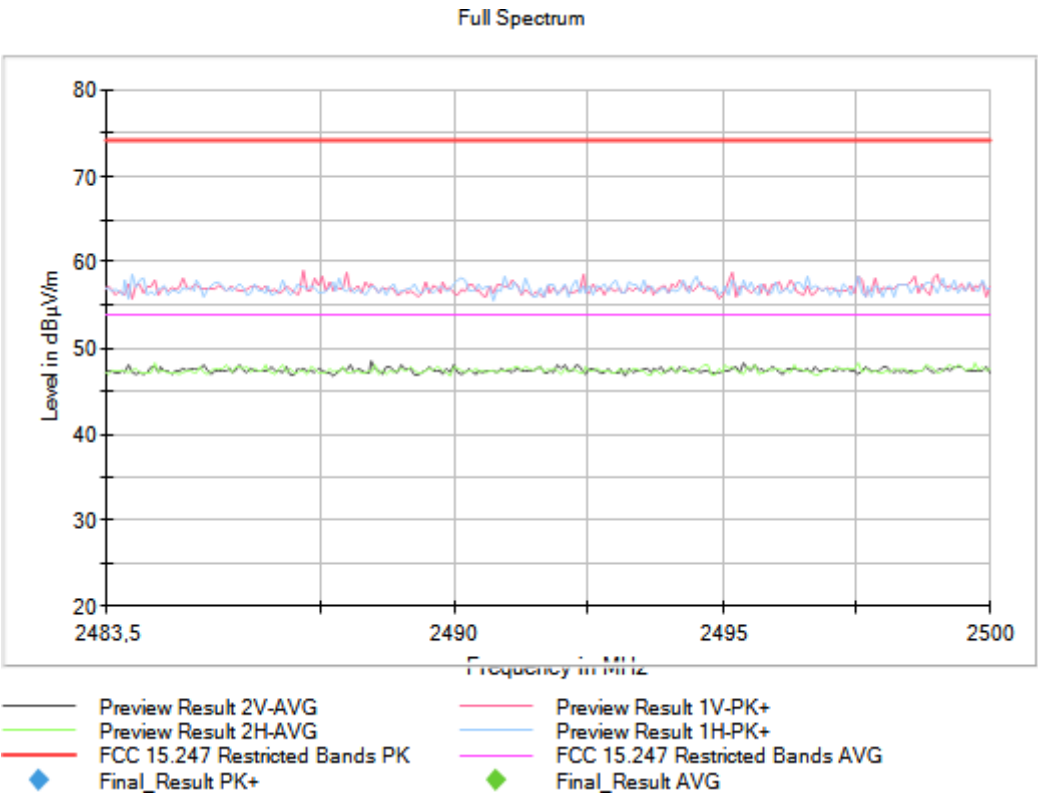
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



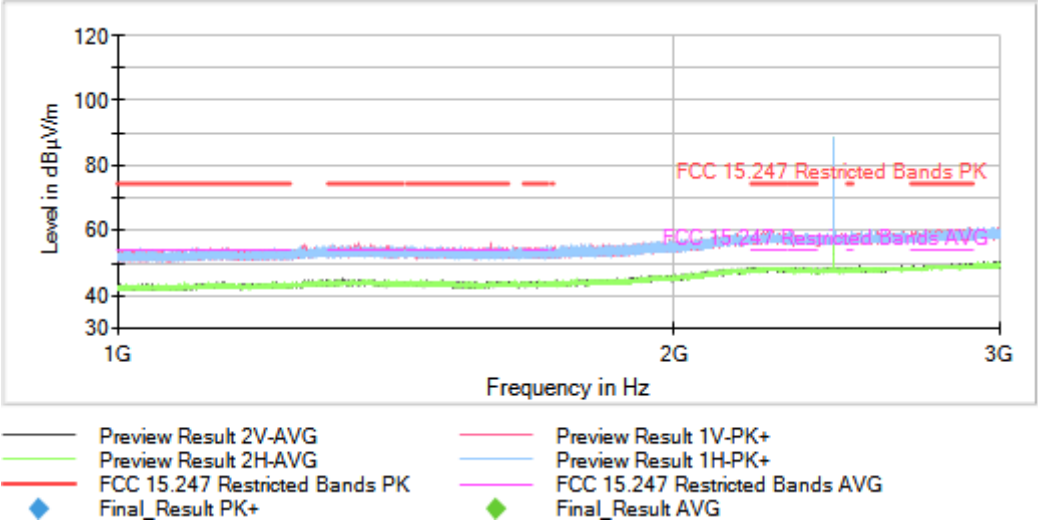


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

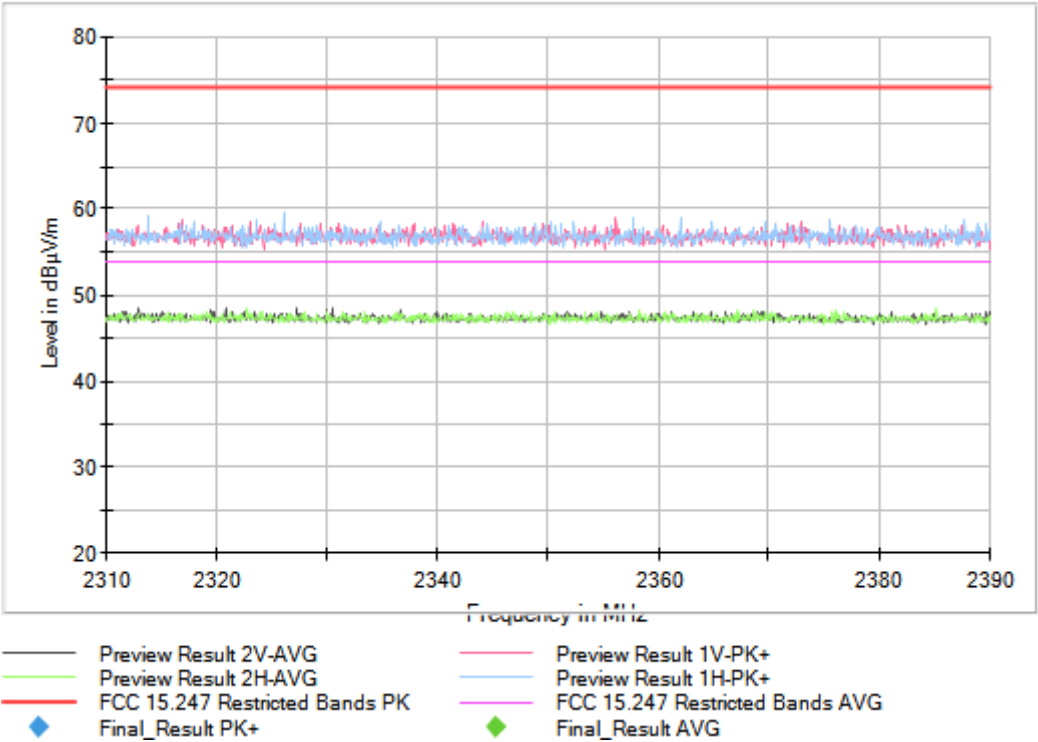
Frequency MHz = 2441.00000

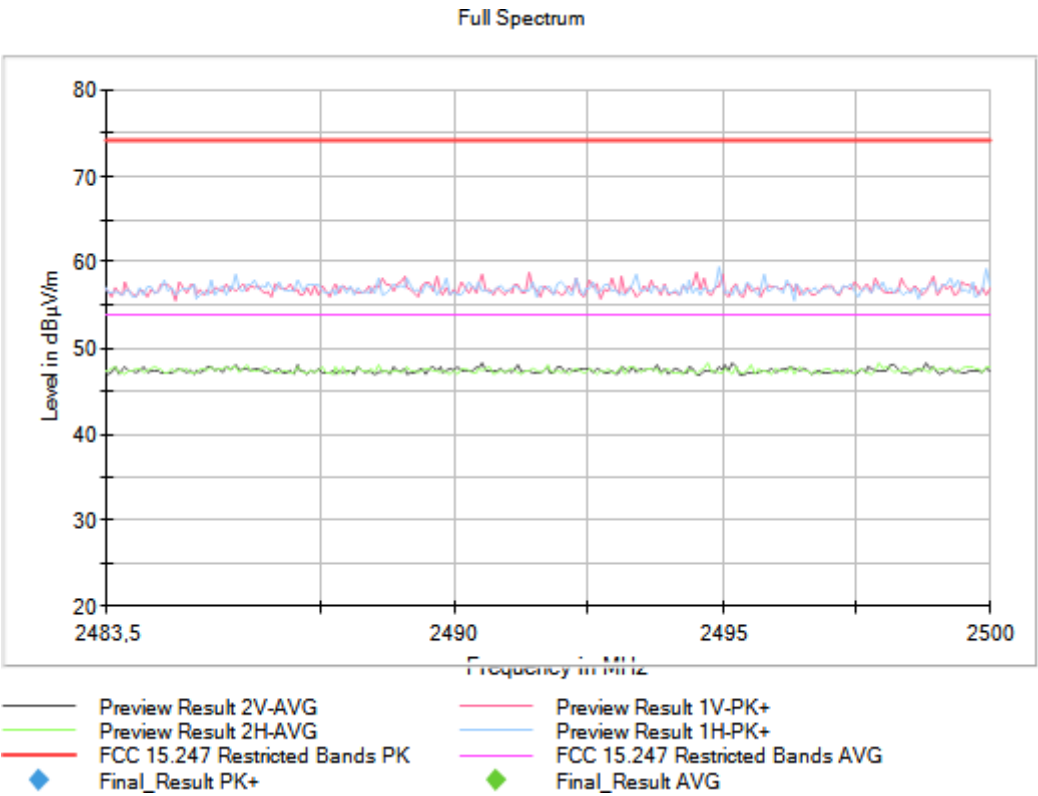
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



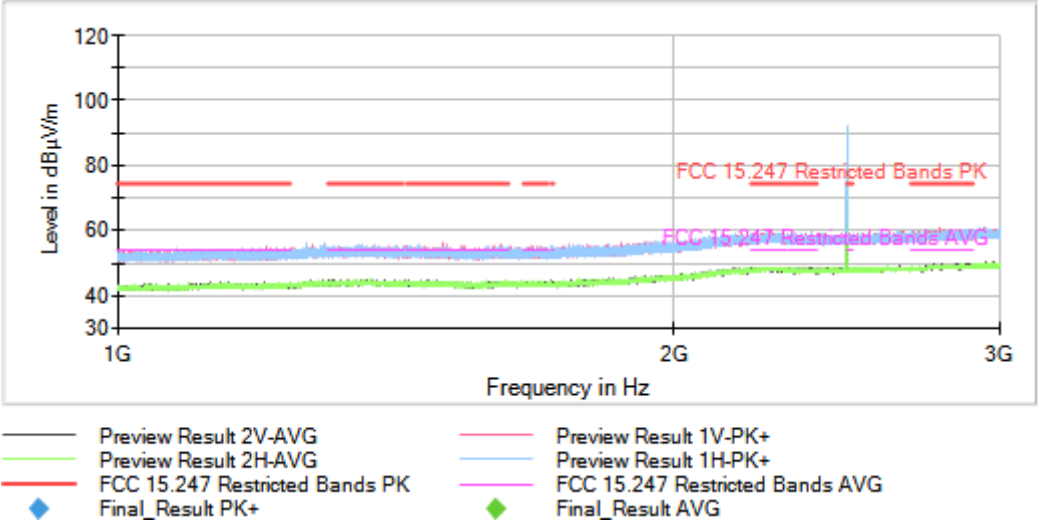


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

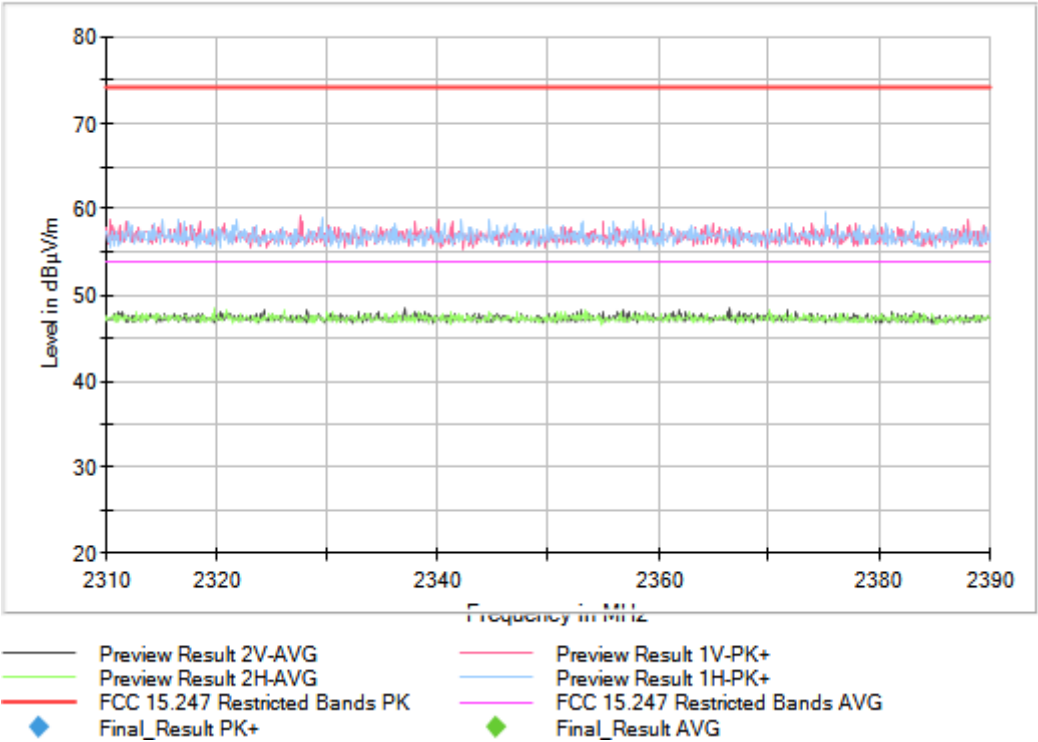
Frequency MHz = 2480.00000

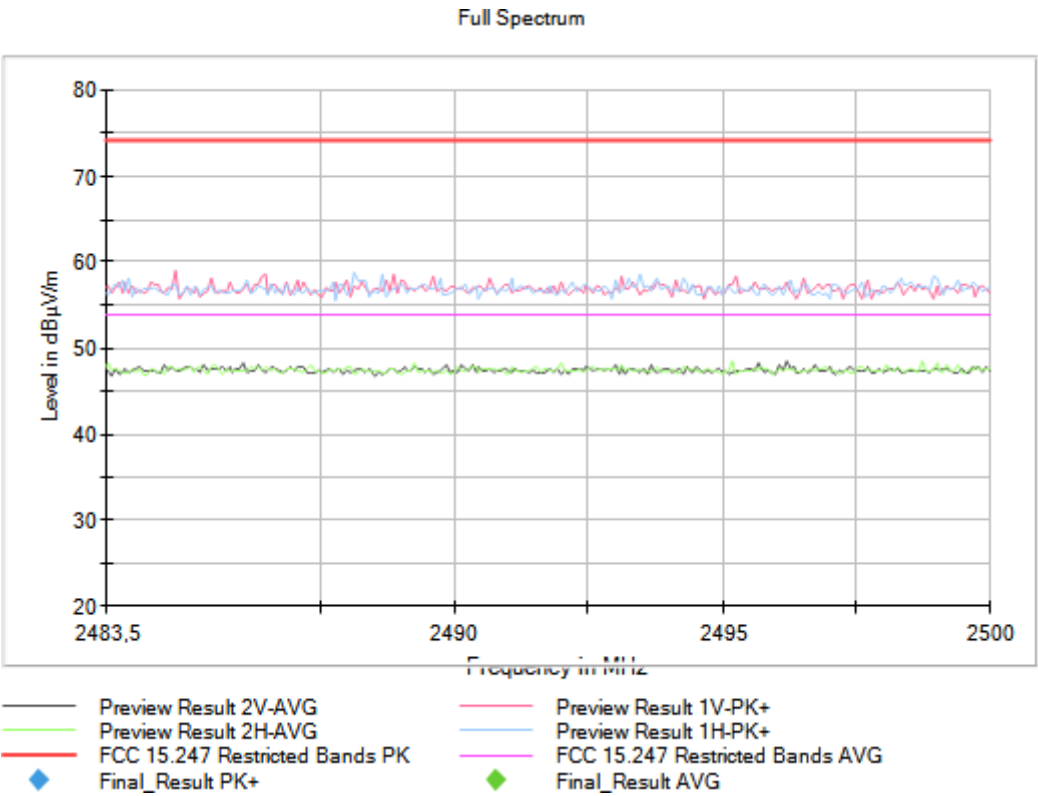
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



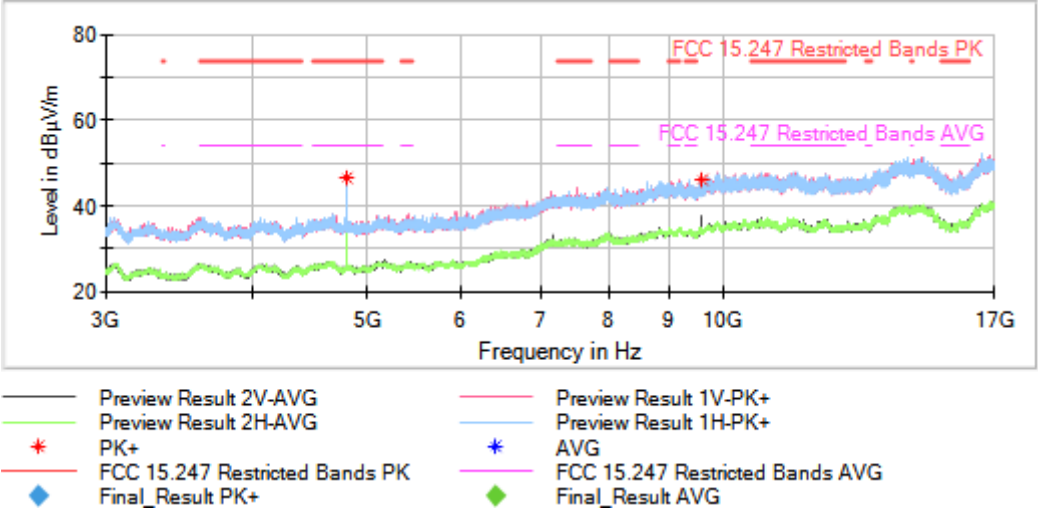


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

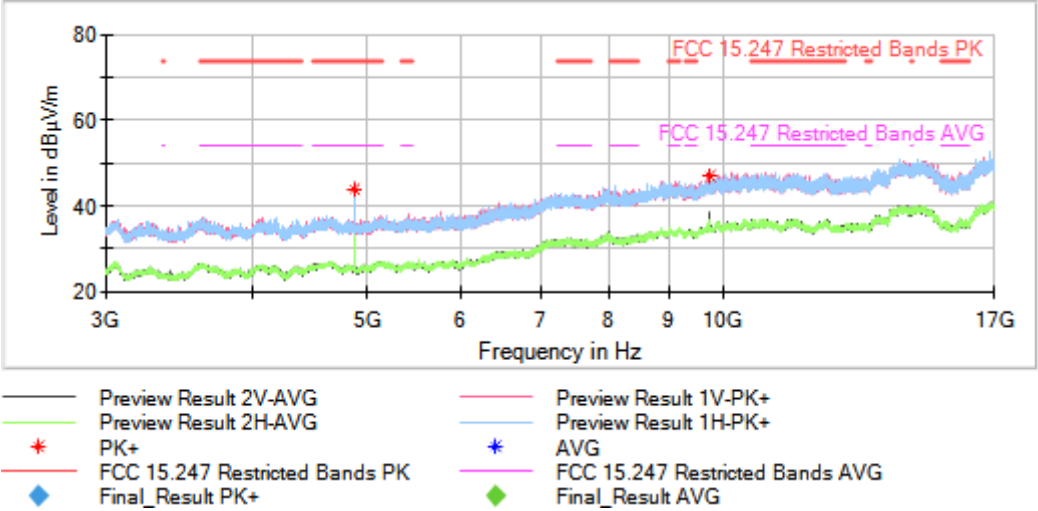


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

Frequency MHz = 2441.00000

Frequency Range GHz = [3, 17]

Images:

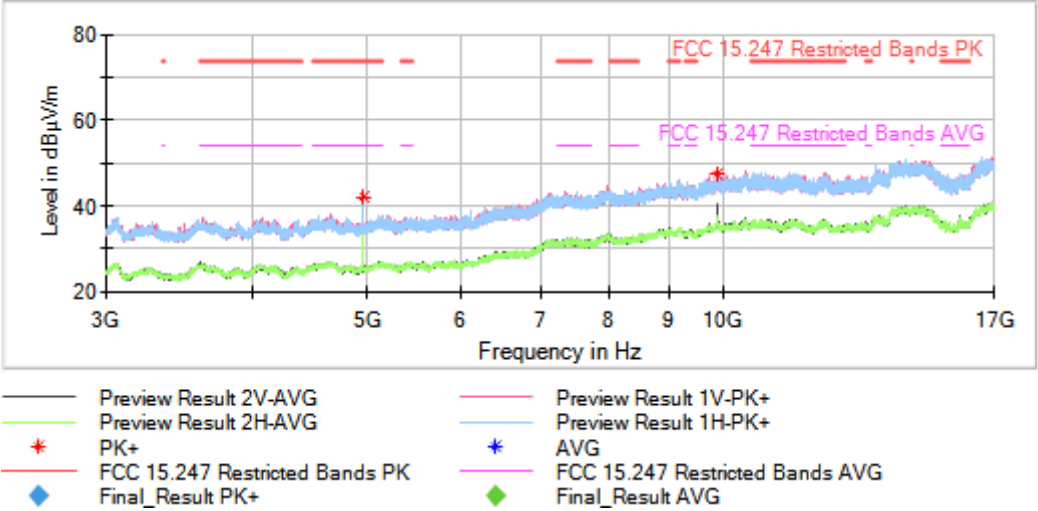


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

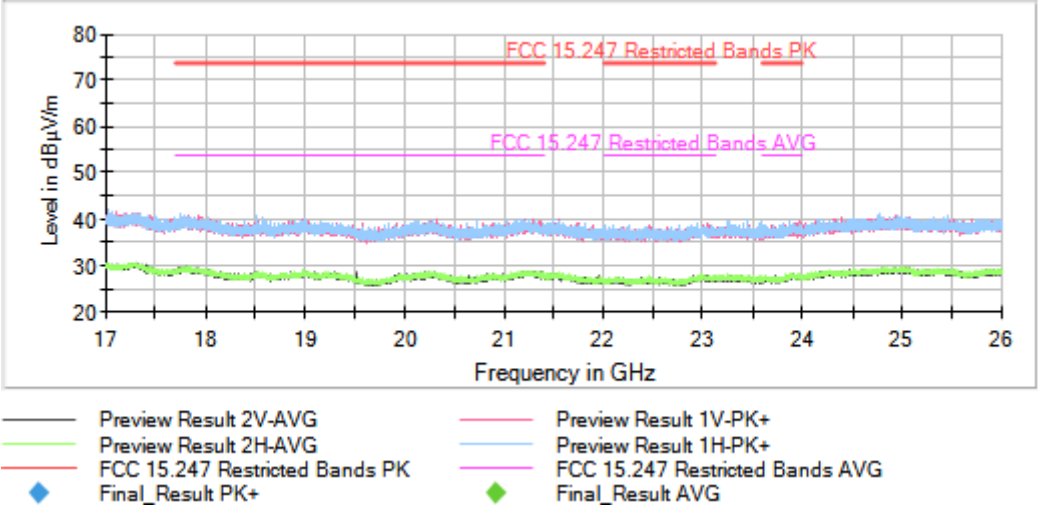


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 1-DH5)

Frequency MHz = 2480.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

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

Results

No spurious frequencies detected at less than 20 dB below the limit.

Verdict

Pass

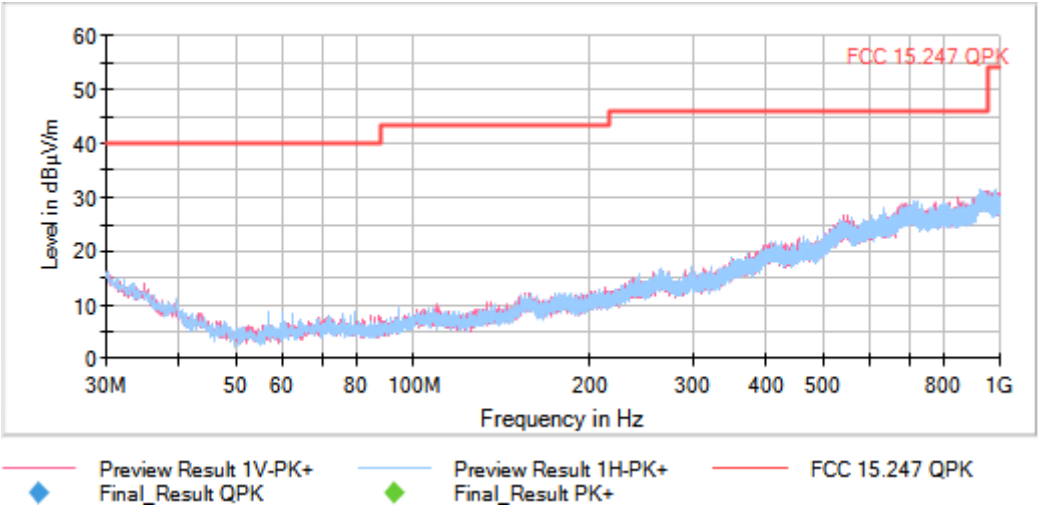
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

Frequency MHz = 2441.00000

Frequency Range GHz = [0.03, 1]

Images:



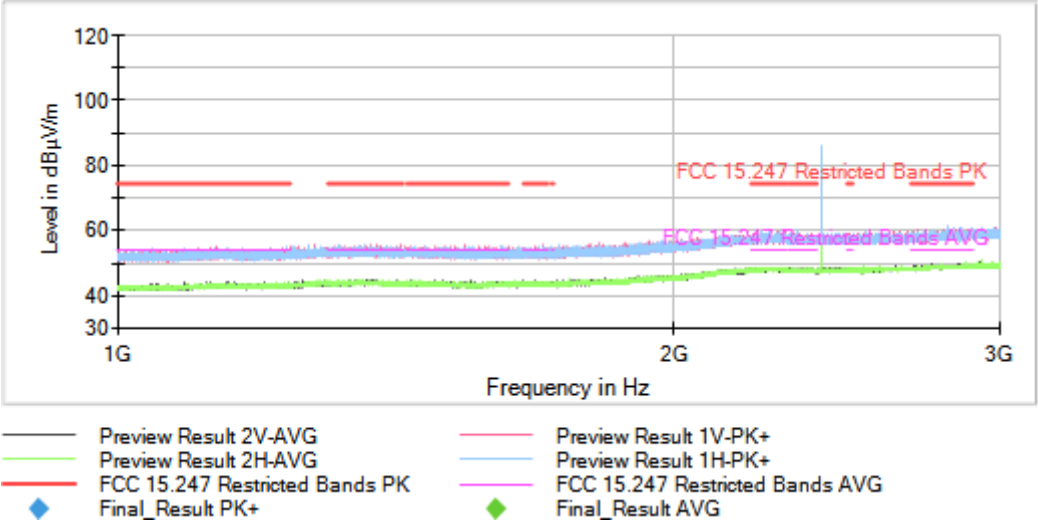
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

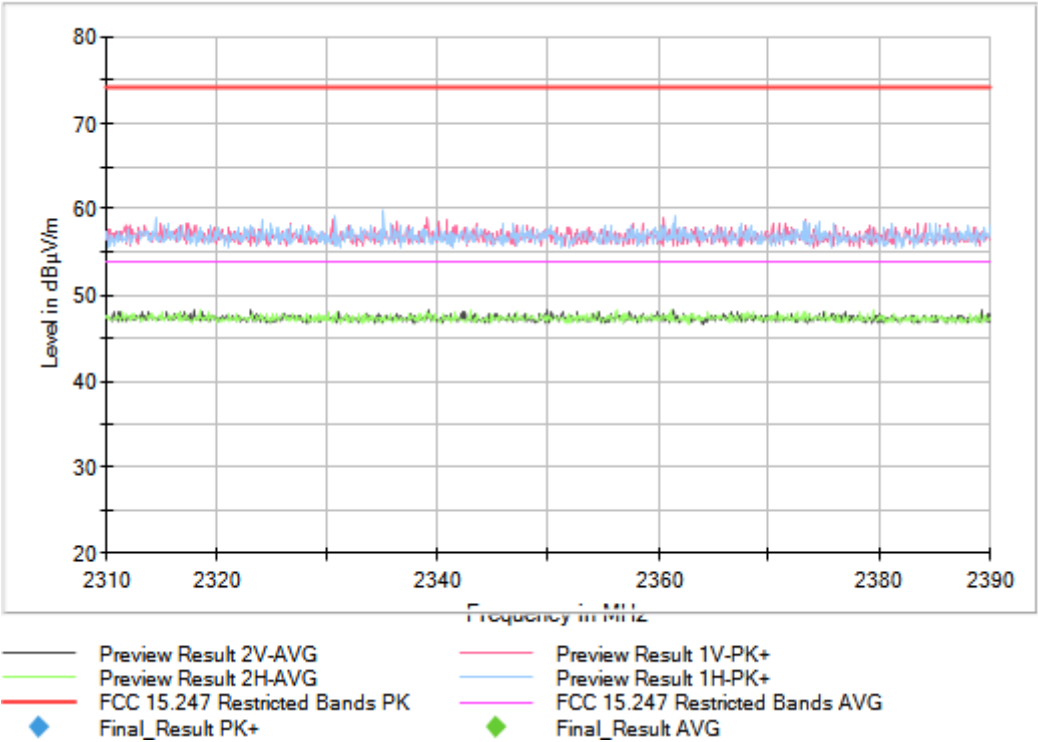
Frequency MHz = 2402.00000

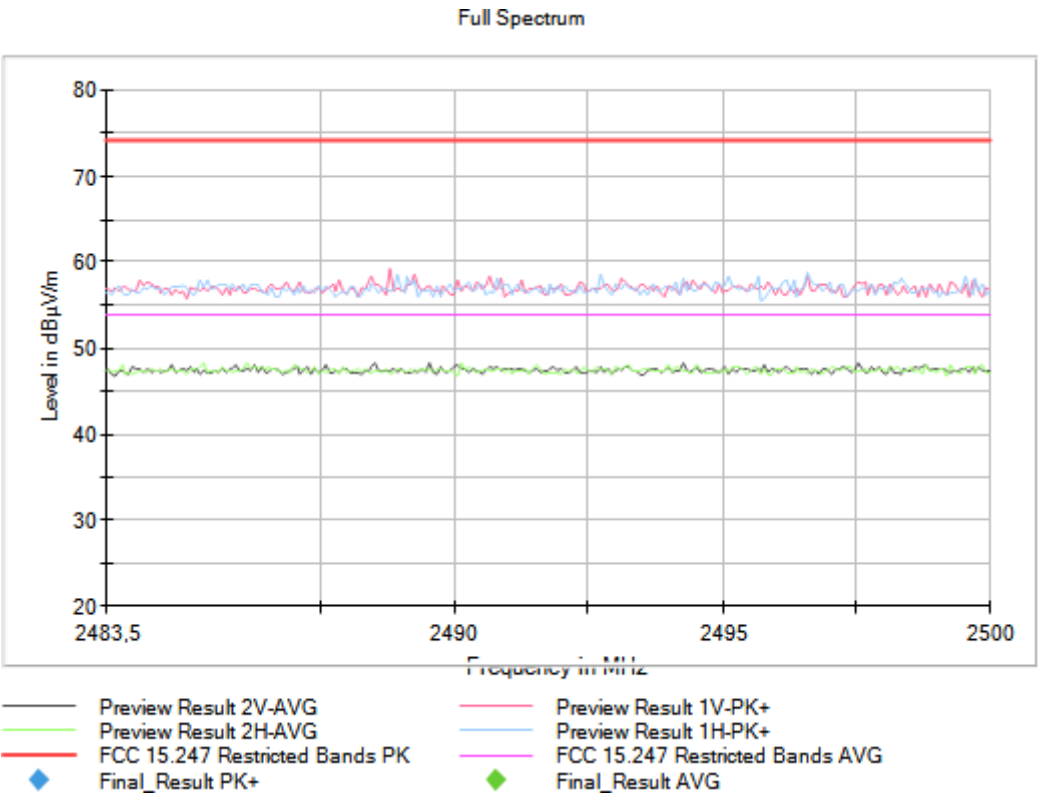
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



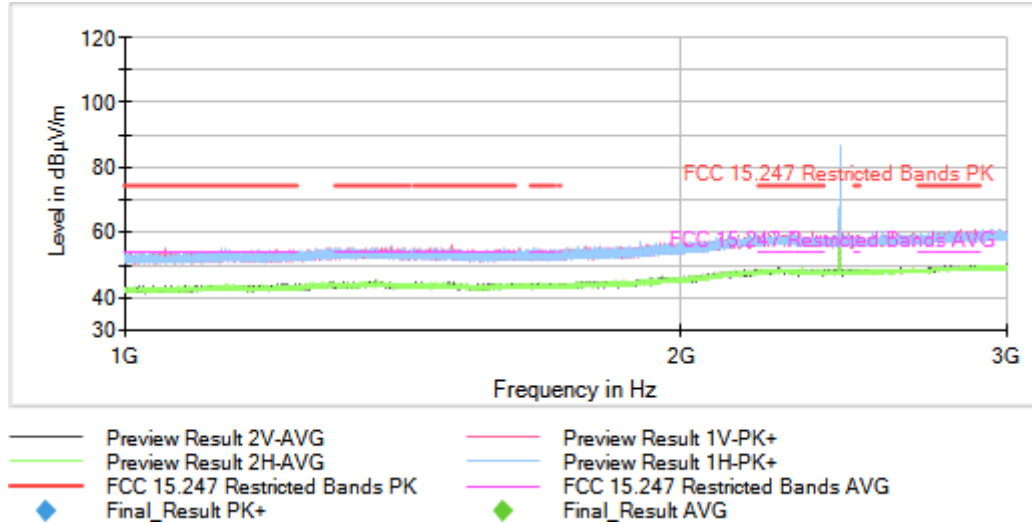


Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

Frequency MHz = 2441.00000

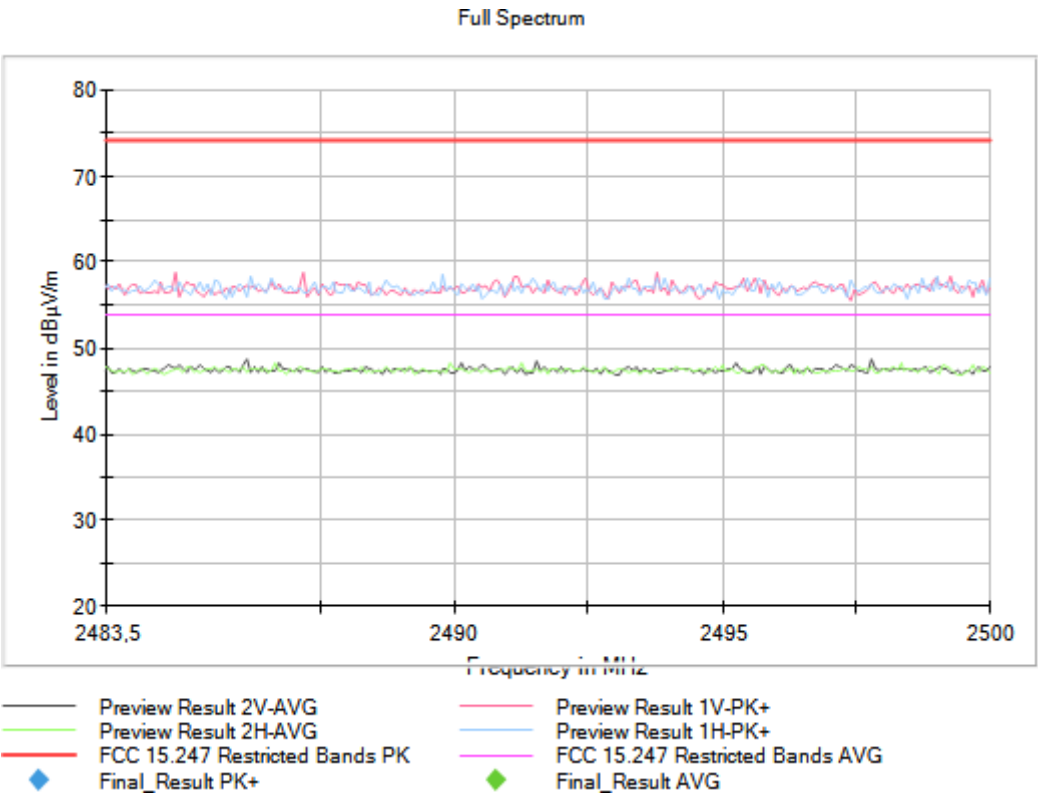
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



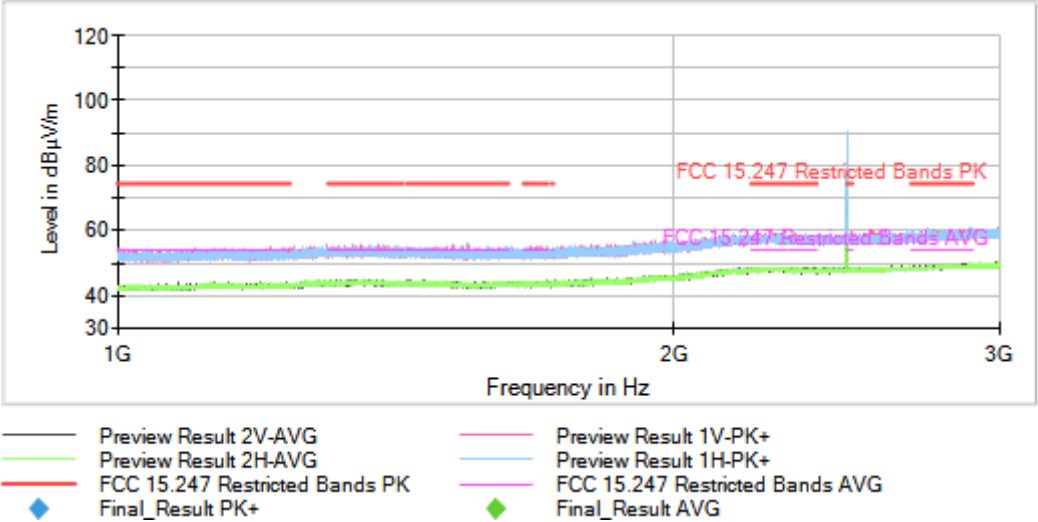


Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

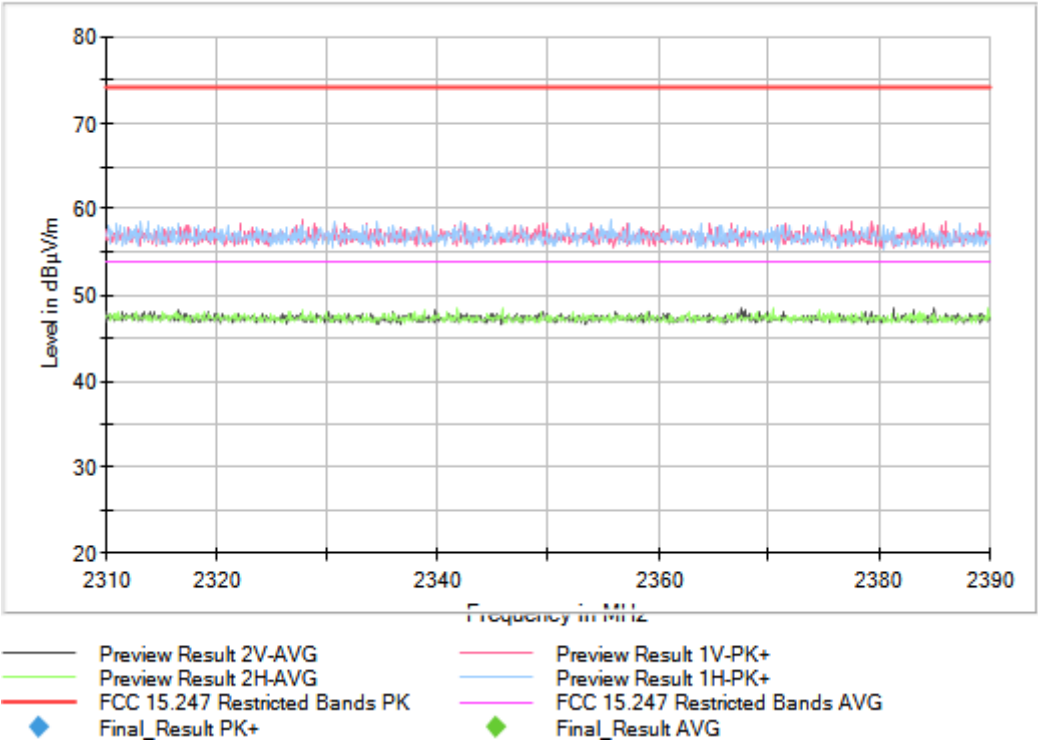
Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

Images:



Full Spectrum



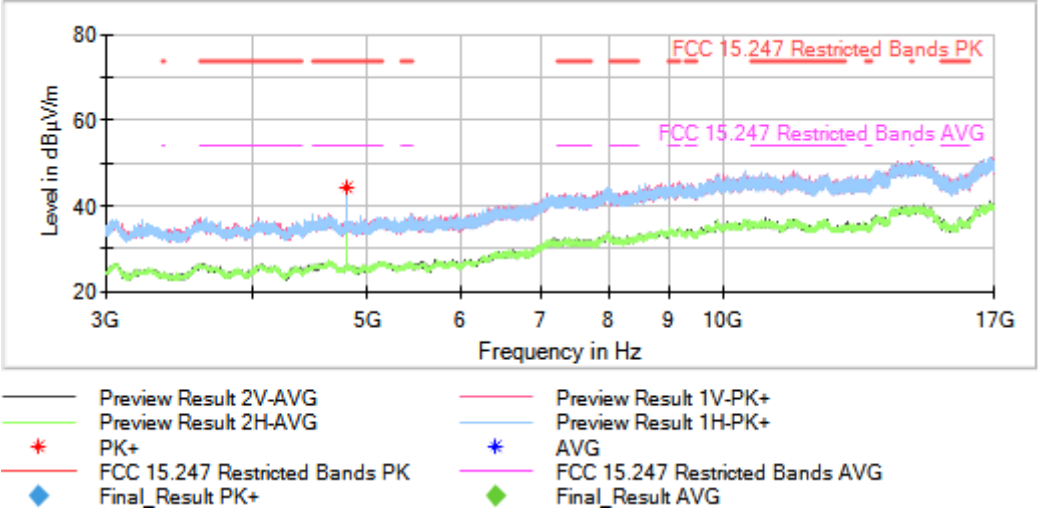


Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

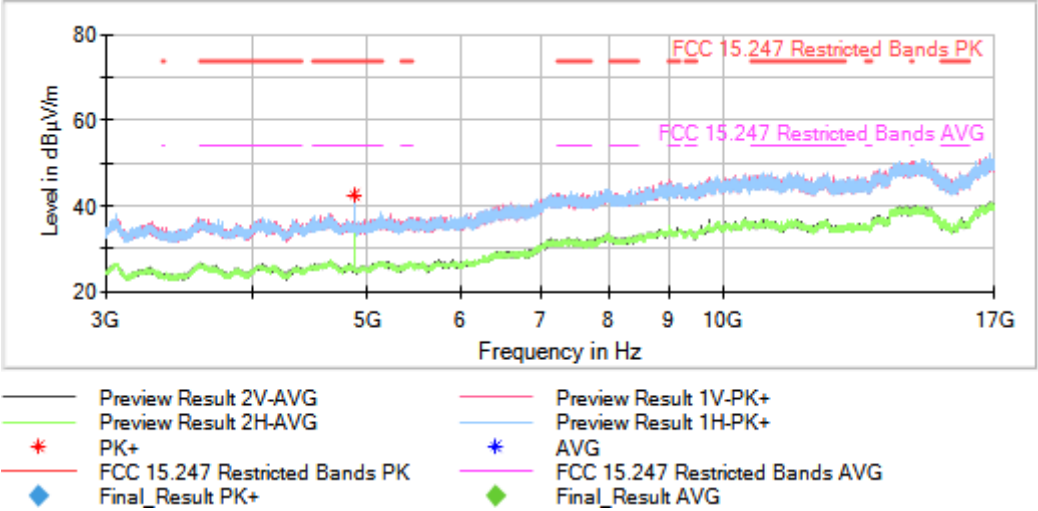


Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

Frequency MHz = 2441.00000

Frequency Range GHz = [3, 17]

Images:

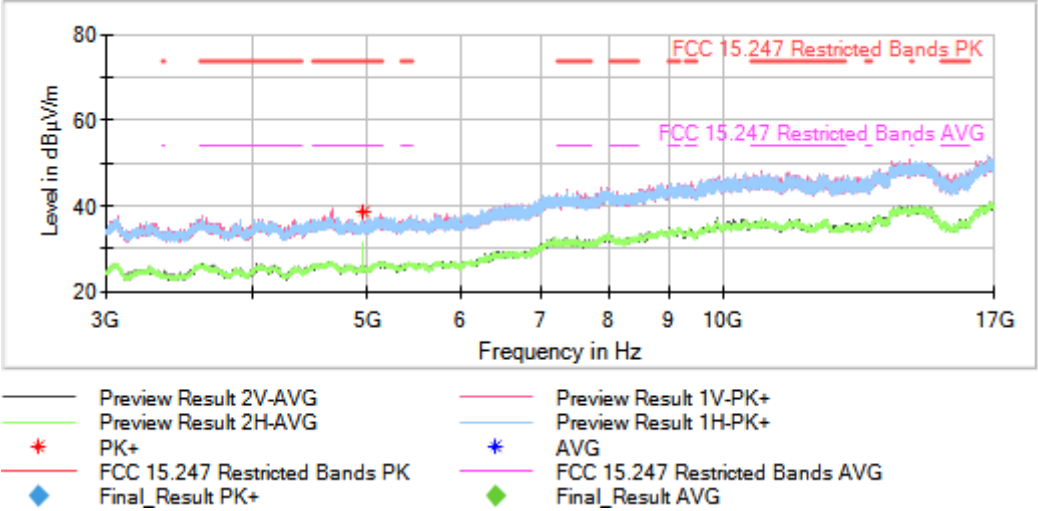


Operation Band MHz = [2400, 2483.5] Modulation = BT (Pi/4 DQPSK 2-DH5)

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

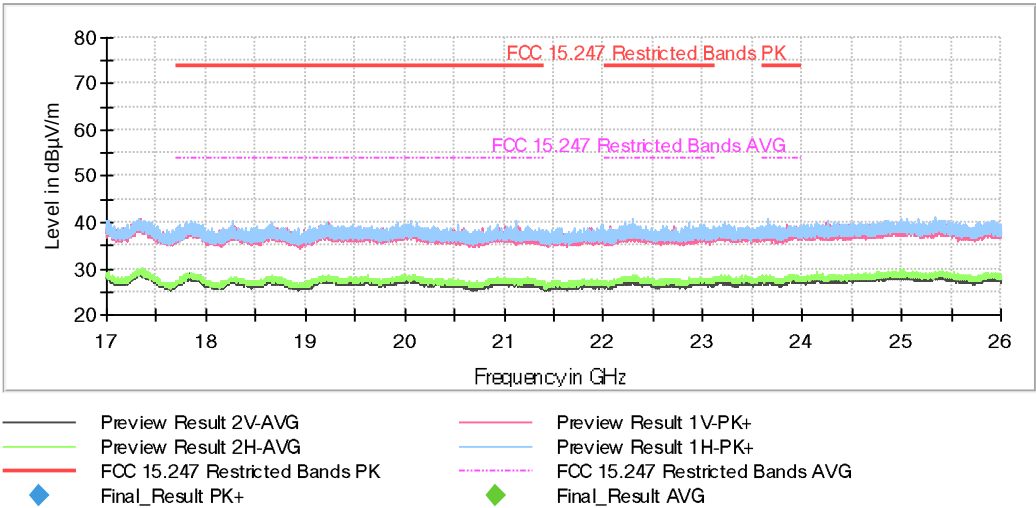


Operation Band MHz = [2400, 2483.5] Modulation = BT (GFSK 2-DH5)

Frequency MHz = 2402.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels

Modulation: BT (8DPSK 3-DH5)

Results

The spurious frequencies detected at less than 20 dB below the limit:

Freq Rng (GHz)	Freq (MHz)	Unwanted Freq (MHz)	Unwanted Lvl (dBµV/m)	Pol	Detector
[0.03, 1]	2480.00000	726.75100	17.86	V	QP

* The spurious frequencies detected does not depend of the selected channel.

Verdict

Pass

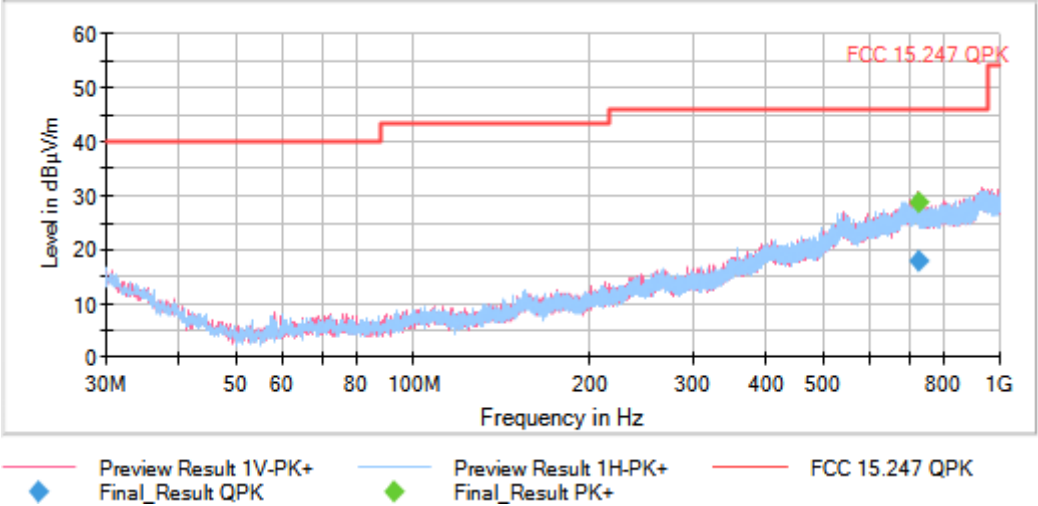
Attachments

Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

Frequency MHz = 2480.00000

Frequency Range GHz = [0.03, 1]

Images:



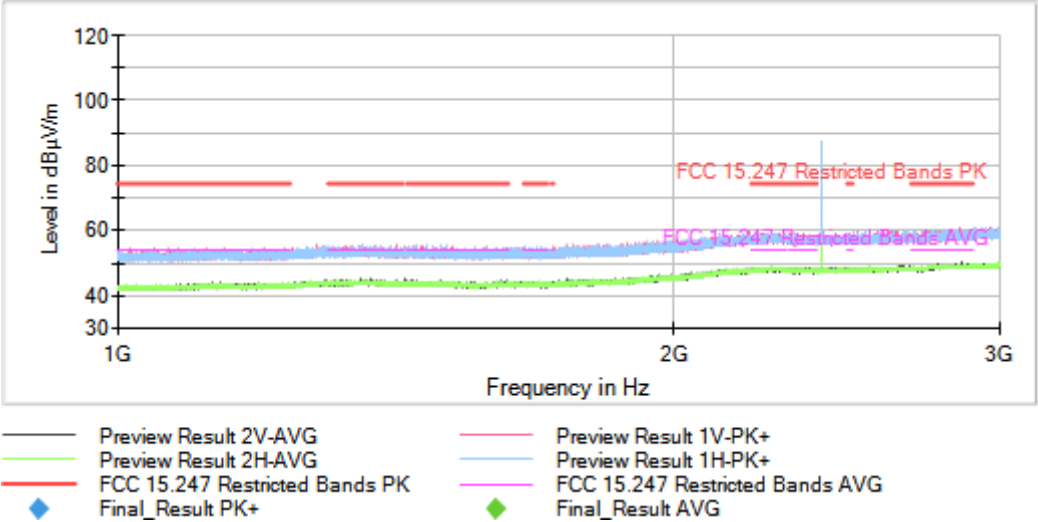
This plot is valid for all channels

Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

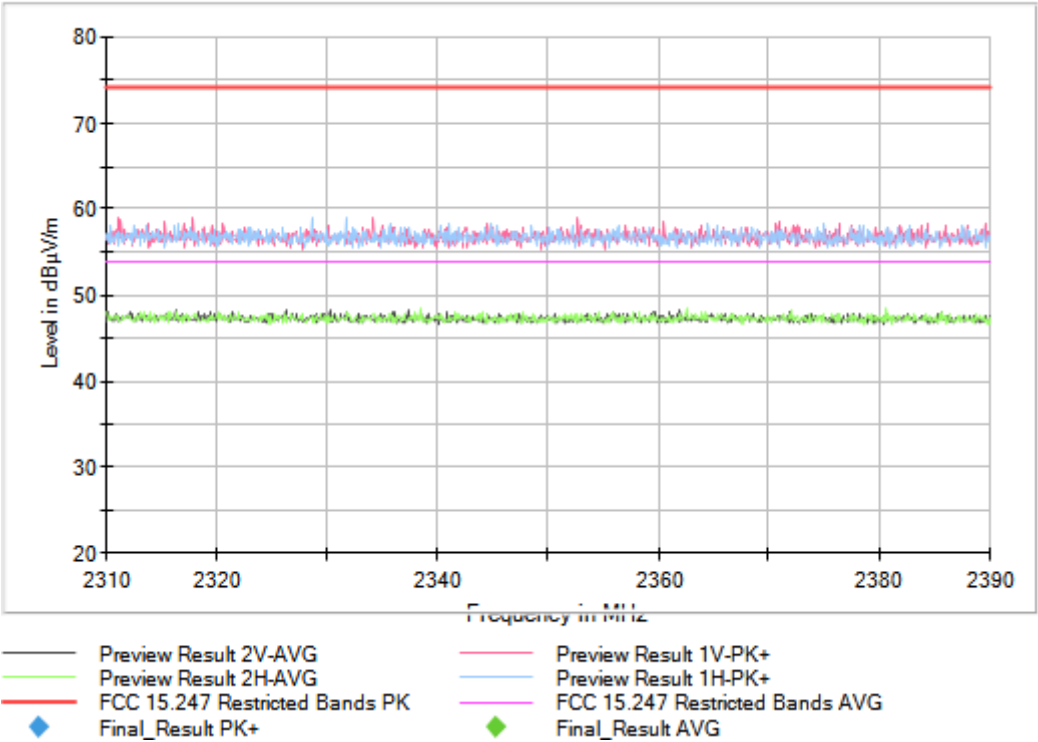
Frequency MHz = 2402.00000

Frequency Range GHz = [1, 3]

Images:



Full Spectrum



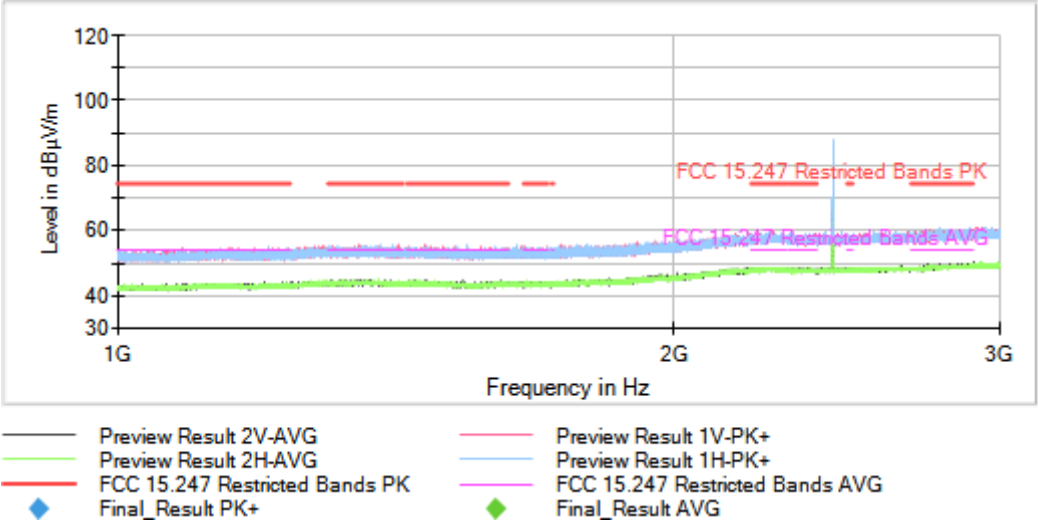


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

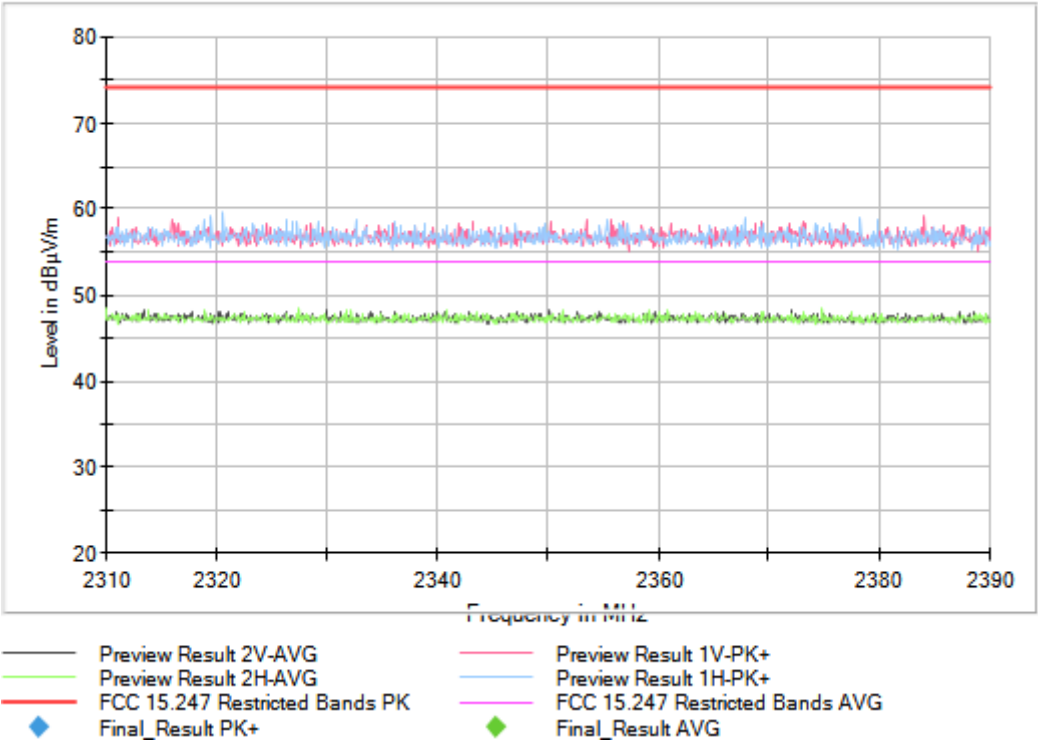
Frequency MHz = 2441.00000

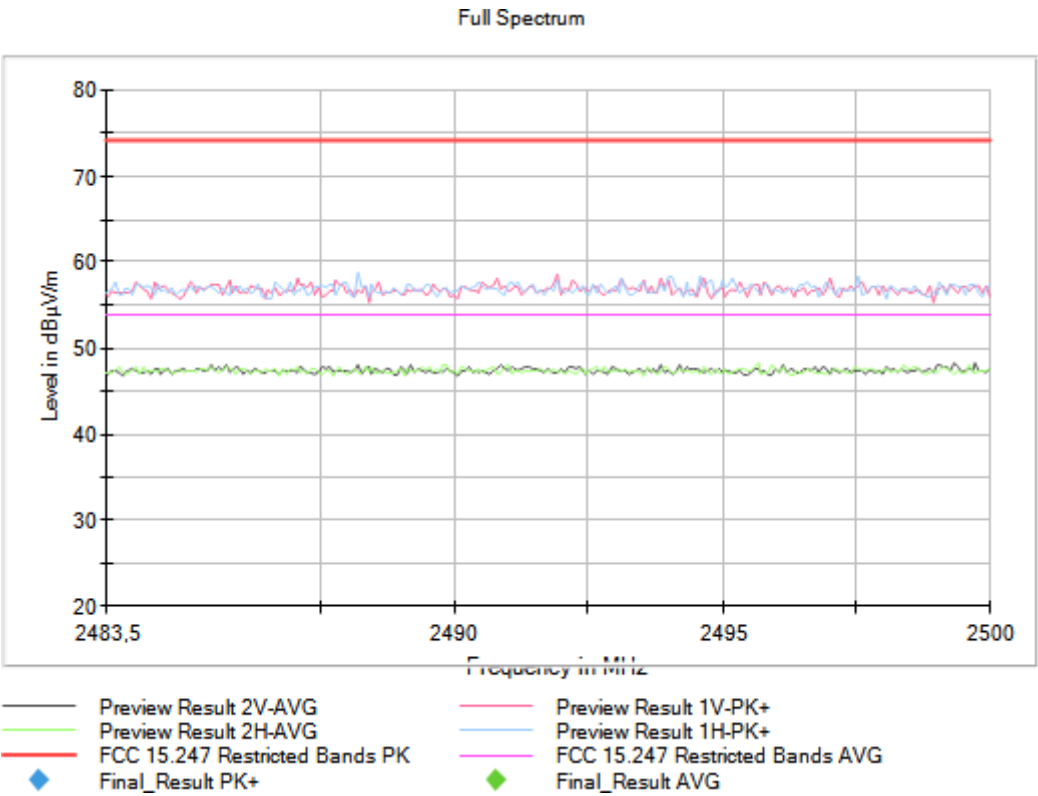
Frequency Range GHz = [1, 3]

Images:



Full Spectrum



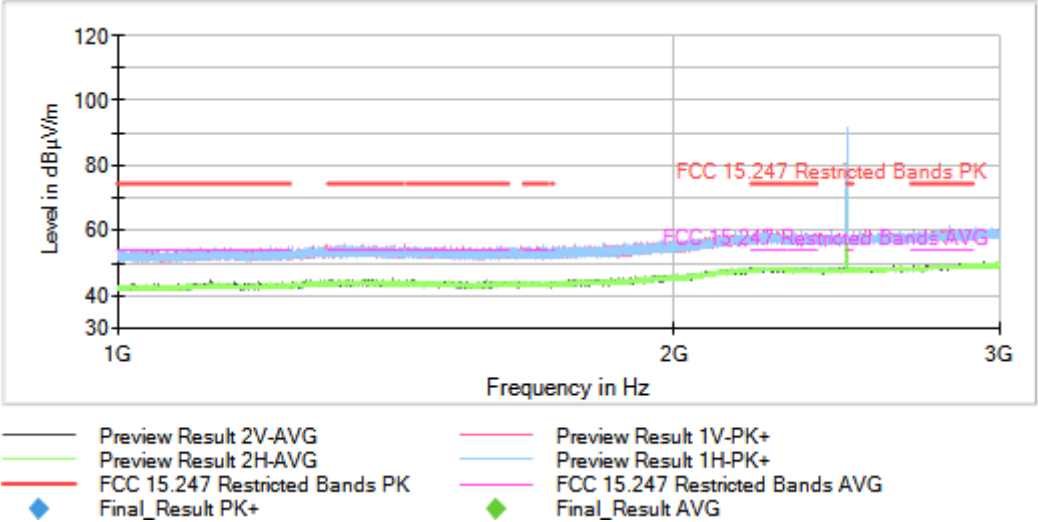


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

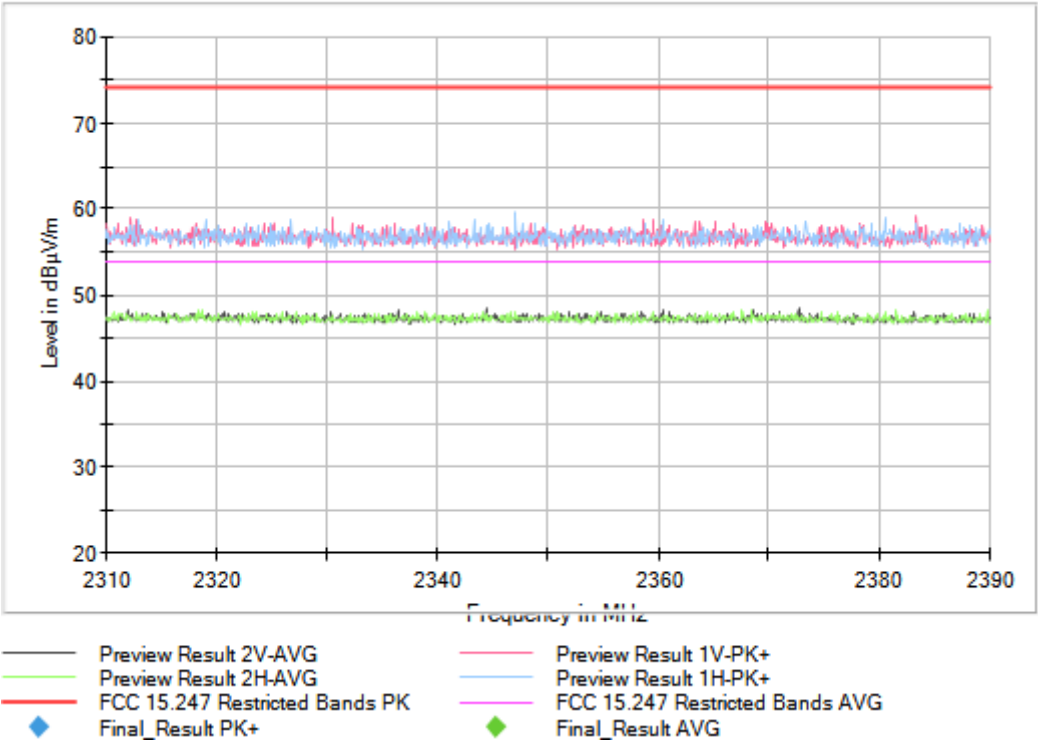
Frequency MHz = 2480.00000

Frequency Range GHz = [1, 3]

Images:



Full Spectrum



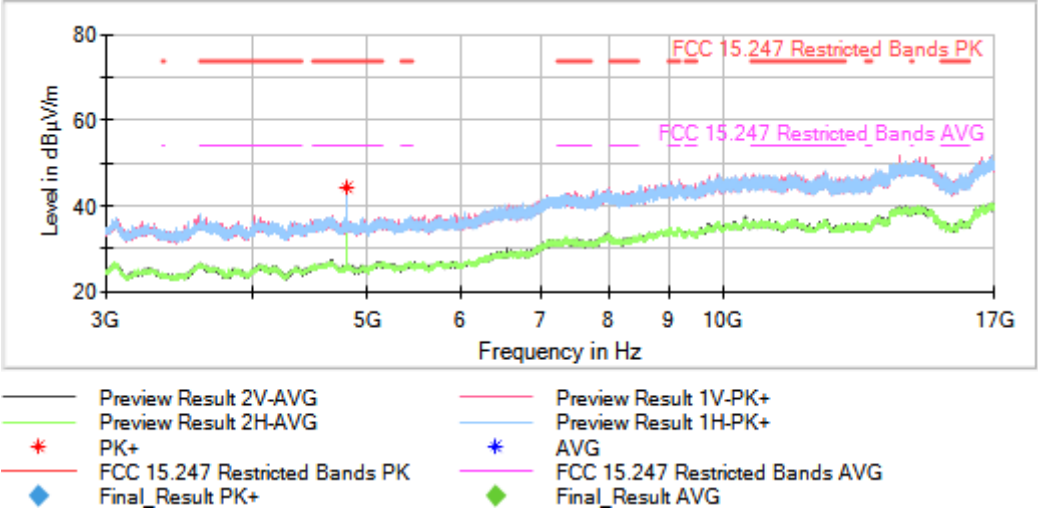


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

Frequency MHz = 2402.00000

Frequency Range GHz = [3, 17]

Images:

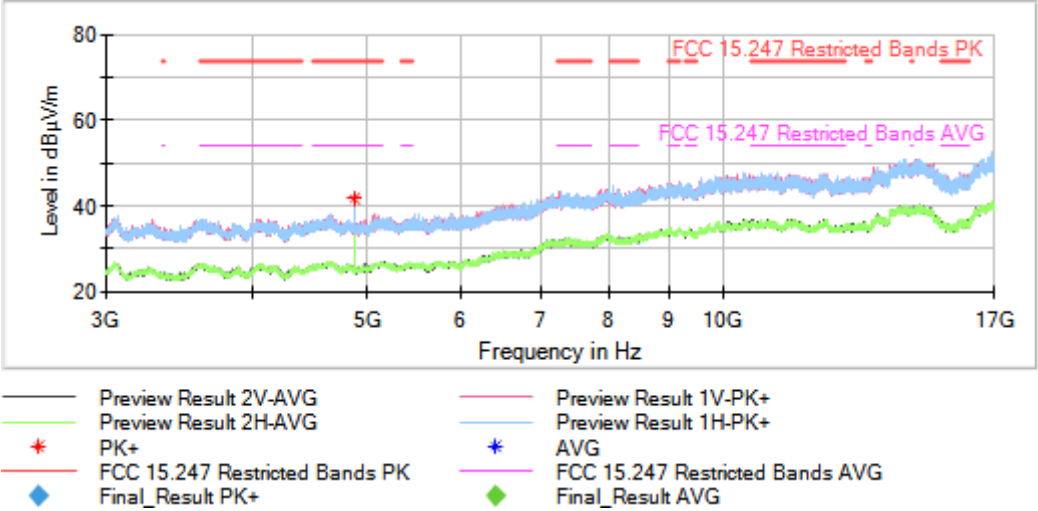


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

Frequency MHz = 2441.00000

Frequency Range GHz = [3, 17]

Images:

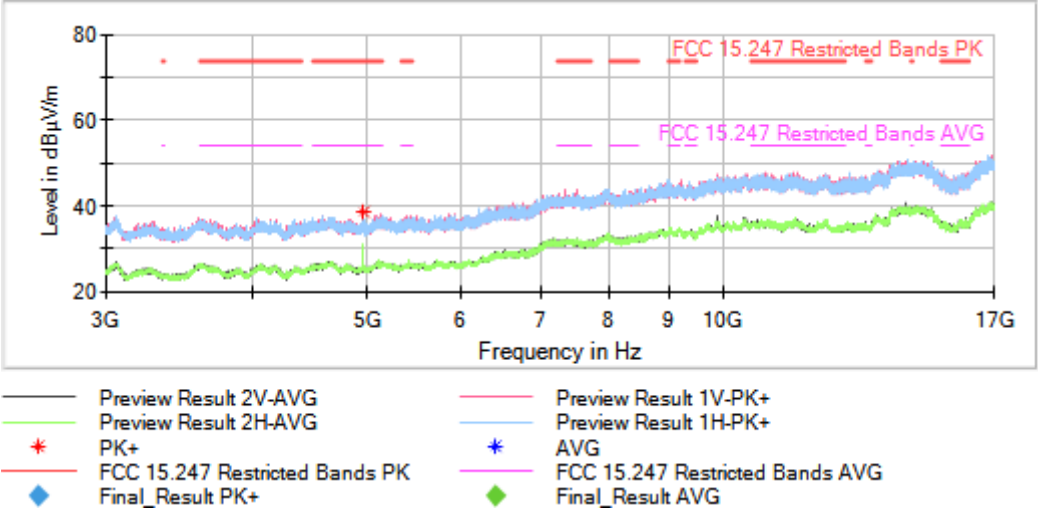


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

Frequency MHz = 2480.00000

Frequency Range GHz = [3, 17]

Images:

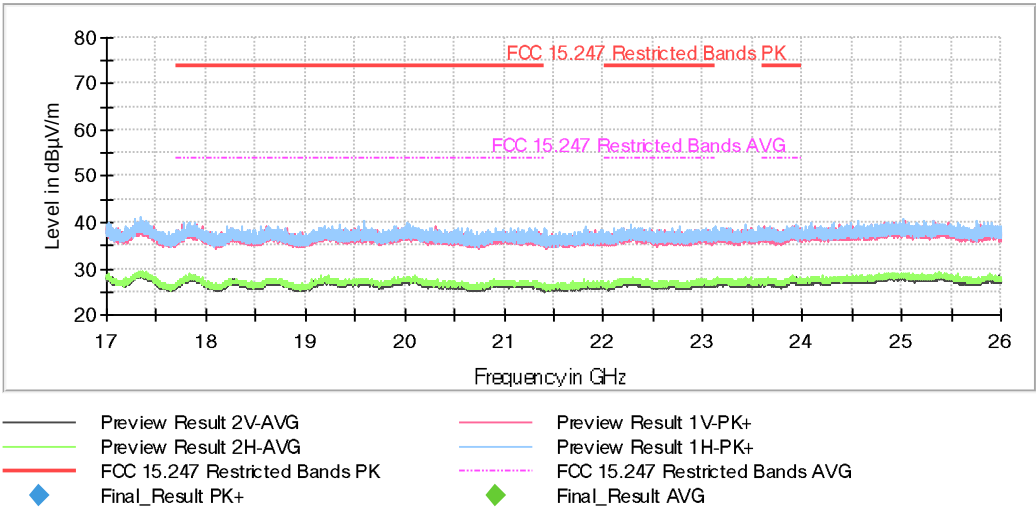


Operation Band MHz = [2400, 2483.5] Modulation = BT (8DPSK 3-DH5)

Frequency MHz = 2441.00000

Frequency Range GHz = [17, 26]

Images:



This plot is valid for all channels