



FCC LISTED, REGISTRATION
NUMBER: 2764.01

ISED LISTED REGISTRATION
NUMBER: 23595-1

Test Report No:

3853ERM.011

Partial Test Report

USA FCC Part 15.247, 15.209, 15.207; & CANADA RSS-247, RSS-Gen

Radio Frequency Devices. Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices.

(*) Identification of item tested	CIVIC (Central In-Vehicle Infotainment Computer)
(*) Trademark	BOSCH
(*) Model and /or type reference	MBCI2LS3PR1
Other identification of the product	FCC ID: 2AUXS-MBCI2LS3PR1 (ECE/RoW) IC: 25847-MBCI2LS3PR1 (ECE/RoW) HVIN: MBCI2LS3PR1
(*) Features	AM/FM/DAB/SIRIUS, GNSS, 2.4/5GHz WLAN, Bluetooth 5.1, Video/Audio etc
Manufacturer	Robert Bosch GmbH Robert-Bosch-Strasse 200, 31139 Hildesheim Germany
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	See Appendix A, B, and C
Approved by (name / position & signature)	Domingo Galvez EMC&RF Lab Manager 
Date of issue	11-23-2022
Report template No	FDT08_23 (*) "Data provided by the client"

Digitally signed by Domingo Galvez
DN: cn=Domingo Galvez,
o=DEKRA Certification Inc.,
ou=Regulatory Lab,
email=dgalvez@dekra.com, c=US

Index

INDEX	2
ACRONYMS	3
COMPETENCES AND GUARANTEES	3
GENERAL CONDITIONS	3
UNCERTAINTY	4
DATA PROVIDED BY THE CLIENT	4
USAGE OF SAMPLES	5
TEST SAMPLE DESCRIPTION	6
IDENTIFICATION OF THE CLIENT	7
TESTING PERIOD AND PLACE	8
DOCUMENT HISTORY	8
ENVIRONMENTAL CONDITIONS	8
REMARKS AND COMMENTS	8
LIST OF EQUIPMENT USED DURING THE TEST	9
TESTING VERDICTS	10
SUMMARY	10
APPENDIX A: TEST RESULTS. BLUETOOTH LOW ENERGY 5.0 (2M, 1M)	12
APPENDIX B: TEST RESULTS. BLUETOOTH BD/EDR.....	29
APPENDIX C: TEST RESULTS. WI-FI 2.4GHZ.....	62
APPENDIX C.1: MIMO	68

Acronyms

Acronym ID	Acronym Description
# of Tx Chains	Number of Transmission Chains
26Ebw	Emission Bandwidth
BW	Bandwidth
Equipment	Equipment Type
Freq	Frequency
In band Peak Lvl	In band Peak Level
Lvl	Level
MP	Measurement Point
Mod	Modulation
Occ Ch BW	Occupied Channel Bandwidth
PSD	Power Spectrum Density
Peak Power	Maximum Peak Conducted Output Power
Port	Active Port

Competences and guarantees

DEKRA Certification Inc. is a testing laboratory accredited by A2LA (The American Association for Laboratory Accreditation), to perform the tests indicated in the Certificate 2764.01

DEKRA Certification Inc. is a testing laboratory competent to carry out the tests described in this report.

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

DEKRA Certification Inc. 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 Certification at the time of performance of the test.

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

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

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

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 Certification Inc.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Certification Inc. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA Certification internal document PODT000.

Test case	Frequency (MHz)	U ($k=2$)	Units
Radiated Spurious Emission	30-180	4.27	dB
	180-1000	3.14	dB
	1000-18000	3.30	dB
	18000-40000	3.49	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 CIVIC Central In-Vehicle Infotainment Computer, including WLAN/ Bluetooth, GPS, AM/FM/DAB receiver.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples used for testing have been selected by: The client.

Sample S/01 is composed of the following elements, accessories and auxiliary equipment:

Id	Control Number	Description	Manufacturer / Model	Serial N°	Date of Reception	Application
S/01	3853/02	Central In-Vehicle Infotainment Computer	Bosch / MBCI2LS3PR1	CM0427N0006006	09/09/2022	Element Under Test
S/01	3853/16	Harness – Main connector A	-	-	09/09/2022	Accessory
S/01	3853/19	Antenna	Bosch / A1779052902/002	057577	09/09/2022	Element Under Test
S/01	3853/20	Antenna	Bosch / A1779052902/002	008686	09/09/2022	Element Under Test
S/01	3853/21	Antenna	Bosch / A1779052902/002	057584	09/09/2022	Element Under Test
S/01	3853/22	Antenna	Bosch / A1779052902/002	008733	09/09/2022	Element Under Test
S/01	3853/51	Cable – GNSS Connector	-	-	09/09/2022	Accessory
S/01	3853/55	Cable 4 in 1 – BT/Wi-Fi connector	-	-	09/09/2022	Accessory
S/01	3853/73	Cable – USB MMB Connector	-	-	09/09/2022	Accessory
S/01	3853/73.1	USB Load (dongle)	-	-	09/09/2022	Accessory
S/01	3853/75	Harness – Main connector B	-	-	09/09/2022	Accessory

1. Sample s/01 was used for the test(s): All Radiated tests Indicated in Appendix A, B, and C

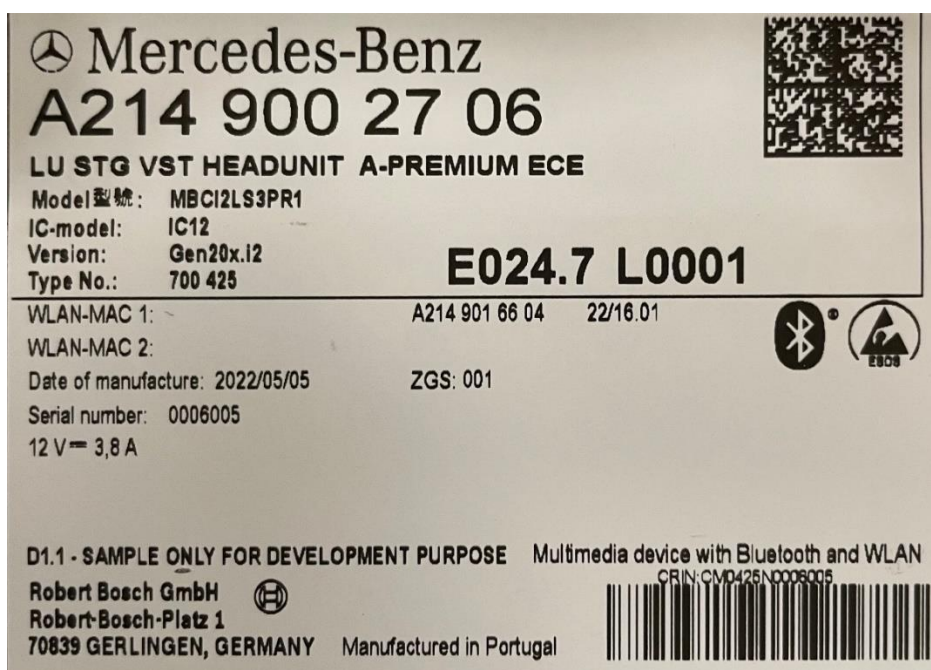
Test sample description

Test Sample description (compulsory information for EMC and RF testing services)

Ports..... :	Port name and description	Cable									
		Specified length [m]	Attached during test	Shielded	Coupled to patient						
	Main Connector A	2	☒	☐	☐						
	Main Connector B	2	☒	☐	☐						
	Fakra Quad Connector AM/FM/DAB		☒	☒	☐						
	Fakra Single Connector GPS		☒	☒	☐						
	Fakra Quad Connector WLAN/BT		☒	☐	☐						
Supplementary information to the ports..... :	No Data Provided										
Rated power supply	Voltage and Frequency	Reference poles									
		L1	L2	L3	N	PE					
	☐ AC:	☐	☐	☐	☐	☐					
	☐ AC:	☐	☐	☐	☐	☐					
	☒ DC:	9-16V nominal 12 VDC by vehicle battery									
	☐ DC:										
Rated Power	3.8 A										
Clock frequencies.....	No Data Provided										
Other parameters	No Data Provided										
Software version	E030.6										
Hardware version	D1.1										
Dimensions in cm (W x H x D)	No Data Provided										
Mounting position	☐	Table top equipment									
	☐	Wall/Ceiling mounted equipment									
	☐	Floor standing equipment									
	☐	Hand-held equipment									
	☒	Other: Cluster in the car									

Modules/parts	Module/parts of test item	Type	Manufacturer
	Antennas		
	HUD		
	SA2 Panel		
	Cameras		
Accessories (not part of the test item)	Description	Type	Manufacturer
	No Data Provided		
Documents as provided by the applicant.....	Description	File name	Issue date
	Declaration Equipment Data	LS3_Plus_FDT30_18 Declaration Equipment Data_V1_signed	11/09/2022

Copy of marking plate:



Identification of the client

Robert Bosch GmbH
Robert-Bosch-Strasse 200,
31139 Hildesheim
Germany

Testing period and place

Test Location	DEKRA Certification Inc.
Date (start)	09-29-2022
Date (finish)	11-02-2022

Document history

Report number	Date	Description
3583ERM.011	11-23-2022	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. = 30 % 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. = 30 % 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. = 30 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Qi Zhang and Koji Nishimoto.

List of equipment used during the test

Radiated Measurements

CONTROL NUMBER	DESCRIPTION	Serial No	LAST CALIBRATION	NEXT CALIBRATION
878	AMETEK DC Power Supply	1707A01783	N/A	N/A
981	Low Noise Preamplifier	1711156B	2020-11-10	2022-11-10
1012	ESR26 EMI Test Receiver	101478	2022-04-12	2024-04-12
1014	FSV40 Signal Analyzer 40GHz	101626	2021-05-19	2023-05-19
1056	3116C Double-Ridged Waveguide Horn Antenna 19-40 GHz	213179	2020-01-10	2023-01-10
1057	3115 Double-Ridged Waveguide Horn Antenna 1-18 GHz	211373	2020-06-03	2023-06-03
1065	Ethernet SNMP Thermometer-CR Room	208587	2020-08-13	2023-08-13
1108	Ethernet SNMP Thermometer-SAC	60038026954	2022-10-18	2024-10-18
1111	Semi anechoic Absorber Lined Chamber	60038026577	2022-10-18	2024-10-18
1179	Wireless Measurement Software R&S EMC32	F169021	N/A	N/A
1314	Low Noise Preamplifier	1040-OT102236	N/A	N/A

Testing verdicts

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

Summary

Bluetooth Low Energy

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth		N/M	Refer 1
FCC 2.1049 / 99dBw Occupied Channel Bandwidth 99%		N/M	Refer 1
RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density		N/M	Refer 1
RSS-247 5.4 (d) / FCC 15.247 (b) (3) Maximum Peak Conducted output power		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter)		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Conducted		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Radiated		Pass	Refer 2
<u>Supplementary information and remarks:</u> (1) Test is not requested			

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		N/M	Refer 1
FCC 2.1049 / 99dBw Occupied Channel Bandwidth 99%		N/M	Refer 1
RSS-247 5.1 (b) / FCC 15.247 (a) (1) Carrier Frequency Separation		N/M	Refer 1
RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Time of Occupancy (Dwell Time)		N/M	Refer 1
RSS-247 5.1 (d) / FCC 15.247 (a) (1) (iii) Number of hopping channels		N/M	Refer 1
RSS-247 5.4 (b) / FCC 15.247 (b) (1) Maximum Peak Conducted output power & Antenna gain		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter) - Conducted		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Conducted		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Radiated		Pass	Refer 2
<u>Supplementary information and remarks:</u> (1) Test is not requested			

Wi-Fi 2.4GHz

Requirement – Test case	FCC PART 15 PARAGRAPH / RSS-247	Verdict	Remark
RSS-247 5.2 (a) / FCC 15.247 (a) (2) 6 dB Bandwidth		N/M	Refer 1
FCC 2.1049 / 99dBw Occupied Channel Bandwidth 99%		N/M	Refer 1
RSS-247 5.2 (b) / FCC 15.247 (e) Power spectral density		N/M	Refer 1
RSS-247 5.4 (d) / FCC 15.247 (b) (1) Maximum Average Conducted Output Power		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter) - Conducted		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Conducted		N/M	Refer 1
RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) - Radiated		Pass	Refer 2
<u>Supplementary information and remarks:</u> (1) Test is not requested (2) Appendix C1: MIMO			

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

Appendix A

PRODUCT INFORMATION14

TEST CONDITIONS15

TEST CASES DETAILS18

RSS-247 5.5 / FCC 15.247 (d) Band-edge emissions compliance (Transmitter) - Radiated.....18

PRODUCT INFORMATION

Information	Description
Modulation	GFSK
Operation mode 1: Single Antenna Equipment	
Operating Frequency Range	2402 – 2480 MHz
Nominal Channel Bandwidth	1 MHz, 2 MHz
RF Output Power	10 dBm
Antenna type	External
Antenna gain	2 dBi
Nominal Voltage	
Supply Voltage	12 Vdc
Type of power source	DC voltage
Equipment type	Bluetooth Low Energy

TEST CONDITIONS

(*): Data provided by the client.

TEST CONDITIONS	DESCRIPTION
TC#01 (1 Mbps)	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ V dc}$ Data Rate: 1 Mbps Bandwidth: 1 MHz <u>Test Frequencies for Conducted/ Radiated tests:</u> Lowest channel: 2402 MHz Middle channel: 2440 MHz Highest channel: 2480 MHz
TC#02 (2 Mbps)	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ V dc}$ Data Rate: 2 Mbps Bandwidth: 2 MHz <u>Test Frequencies for Conducted/ Radiated tests:</u> Lowest channel: 2402 MHz Middle channel: 2440 MHz Highest channel: 2480 MHz

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at 3 m for the frequency range 30-1000 MHz (Bilog antenna) and 1-18 GHz (Double ridge horn antenna), and 1m for the frequency range 18 GHz- 26 GHz (Double ridge horn antenna).

For radiated emissions in the range 18 - 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 was varied from 1 to 4 meters to find the maximum radiated emission.

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

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

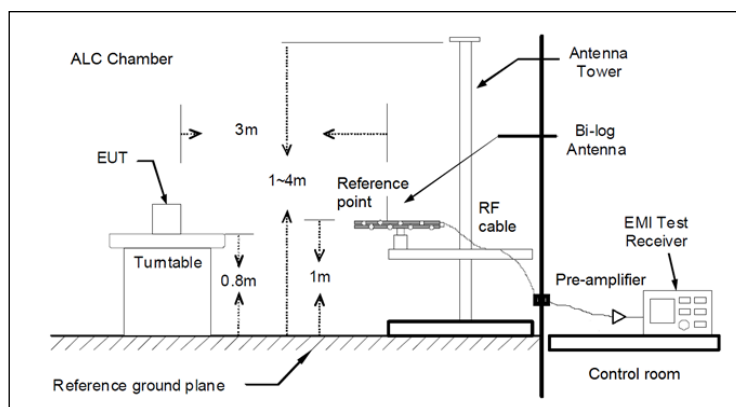


Fig A1: Radiated measurements Setup $f < 1$ GHz

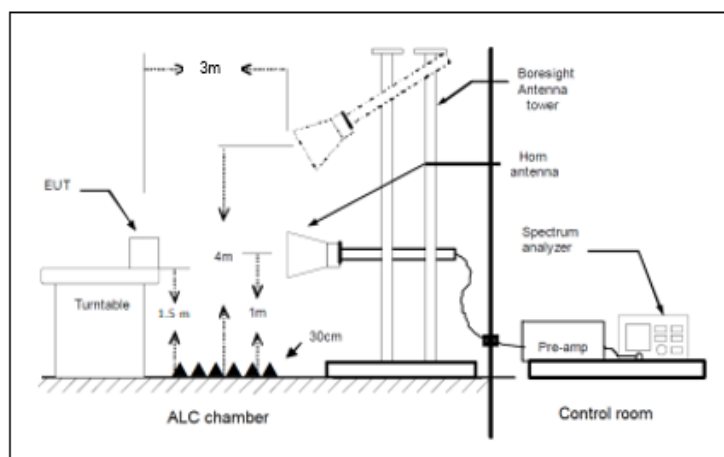


Fig A2: Radiated measurements setup $f > 1-18$ GHz

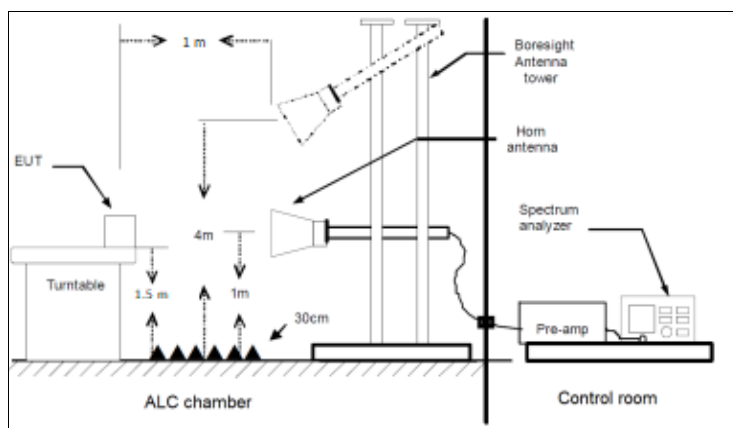


Fig A3: Radiated measurements setup $f > 18$ GHz

TEST CASES DETAILS

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

Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §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
s30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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

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

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

Verdict

Pass

Modulation: BTLE 5.0 (GFSK 2 Mbit/s)

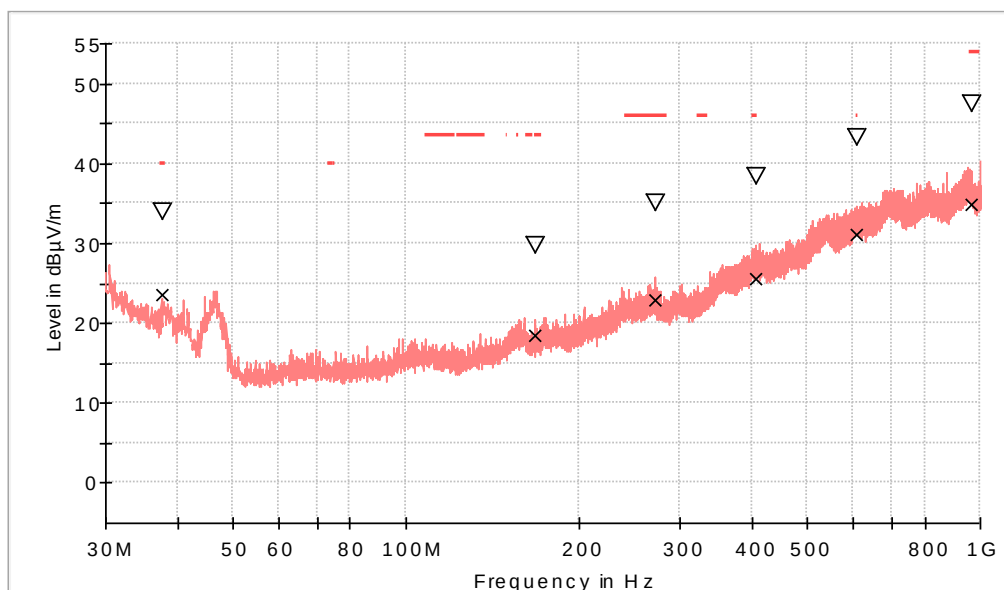
Results

Frequency range 0.03 - 1 GHz

The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Middle Channel

Frequency MHz = 2440.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [0.03, 1]



— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
▽ MaxPeak-PK+ (Single)
x QuasiPeak-QPK (Single)

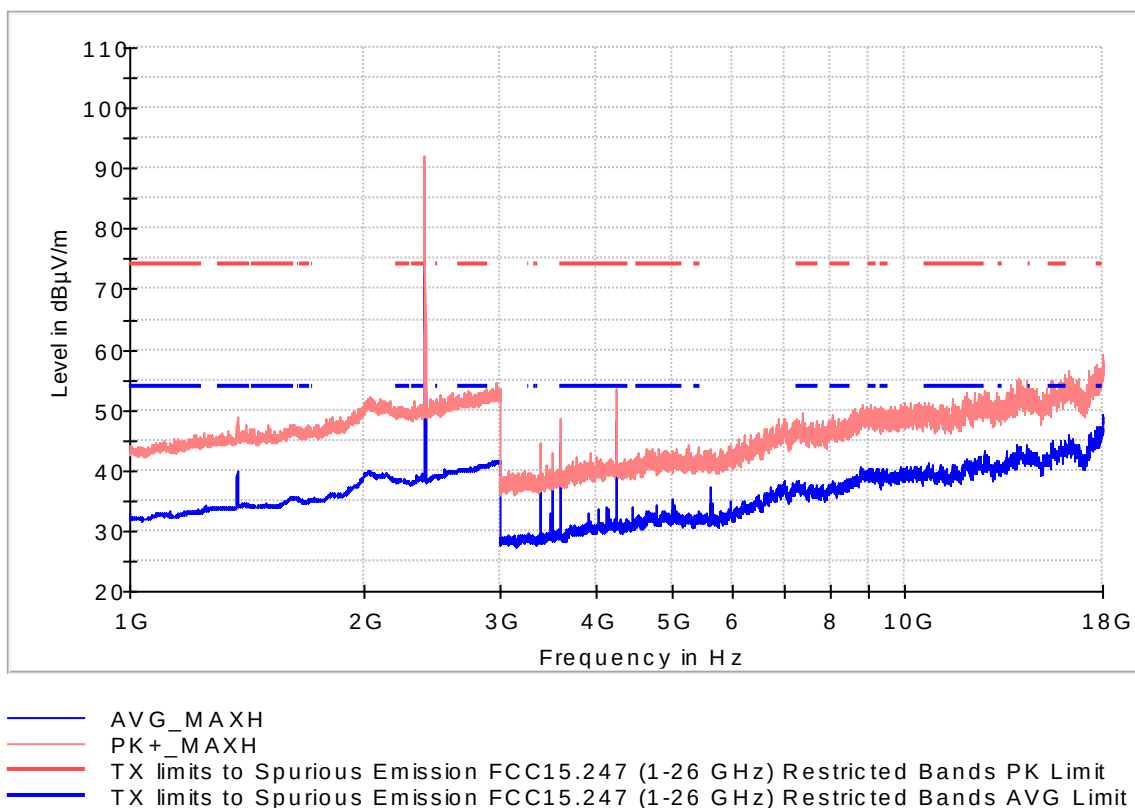
Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBμV/m)
37.517500	33.9	23.5	V	16.5	40.0
168.225000	29.7	18.4	V	25.1	43.5
272.354500	35.0	22.9	V	23.1	46.0
407.233000	38.4	25.7	V	20.3	46.0
610.884500	43.2	31.2	V	14.8	46.0

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),

Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]



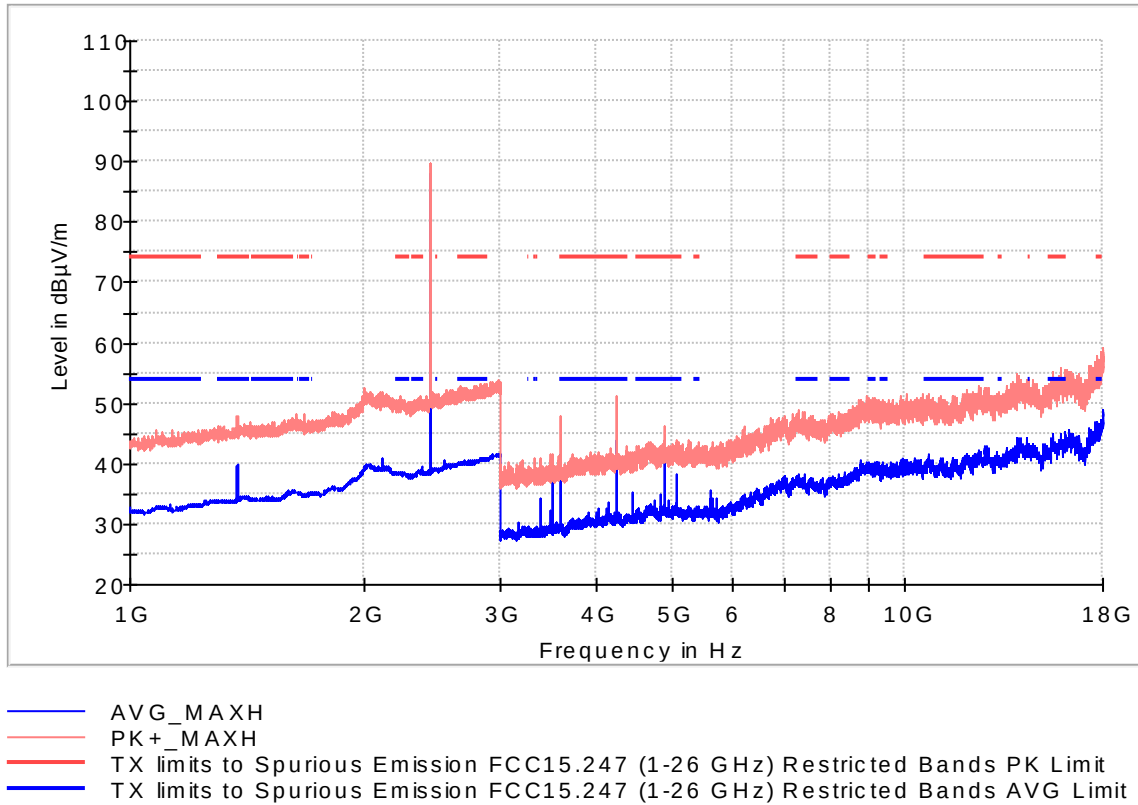
Frequency (MHz)	PK+ _MAXH (dB μ V/m)	AVG _MAXH (dB μ V/m)	Pol	Margin - AVG (dB)	Limit - AVG (dB μ V/m)	Comment
2401.500000	92.0	85.9	H	---	---	Fundamental
4233.000000	53.5	48.3	V	5.7	54.0	
17968.500000	58.9	47.8	H	6.2	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2440.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),

Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]

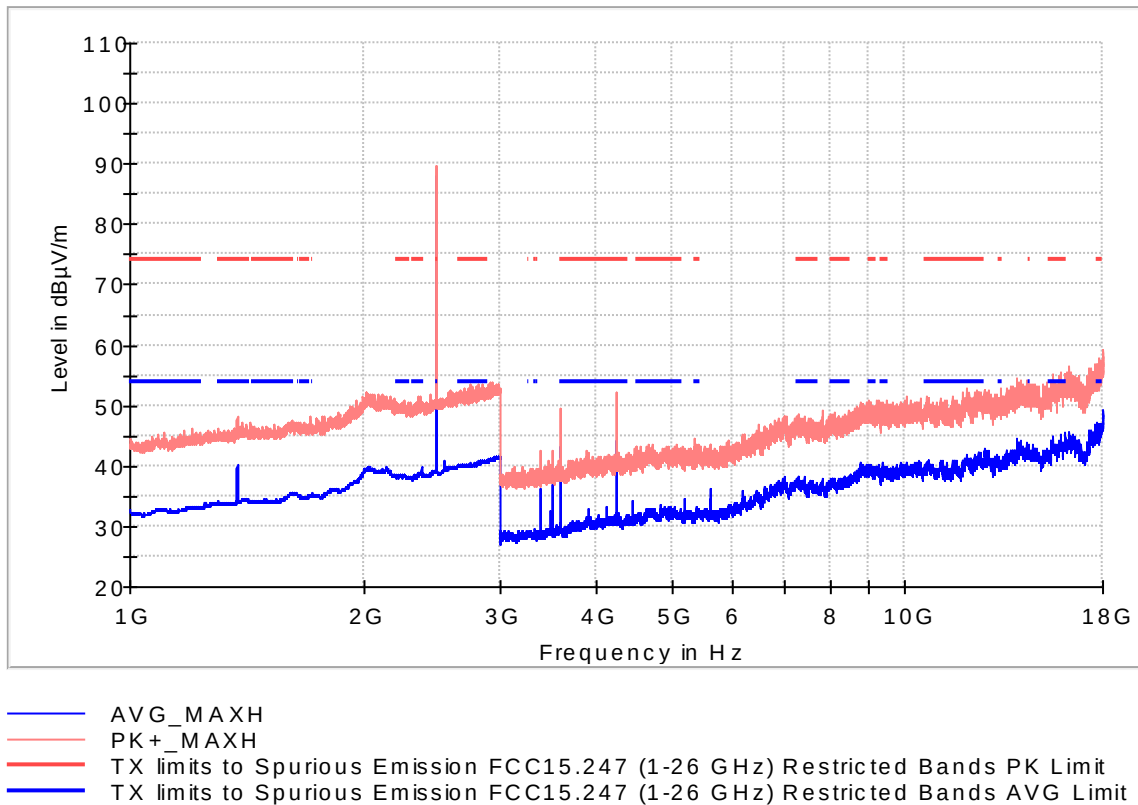


Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2440.500000	89.9	86.1	V	---	---	Fundamental
4233.000000	51.3	43.8	V	10.2	54.0	
17929.500000	58.6	45.9	H	8.1	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]

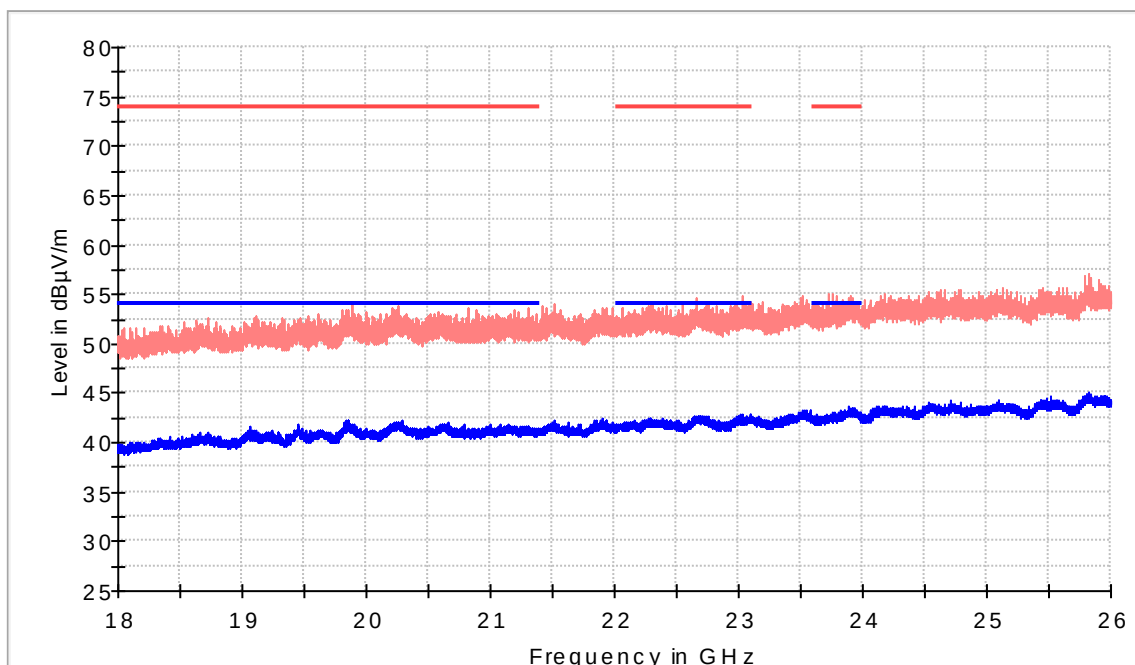


Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2479.500000	89.8	85.1	V	---	---	Fundamental
4233.000000	52.2	44.4	V	9.6	54.0	
17986.000000	59.2	49.1	V	4.9	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [18, 26]



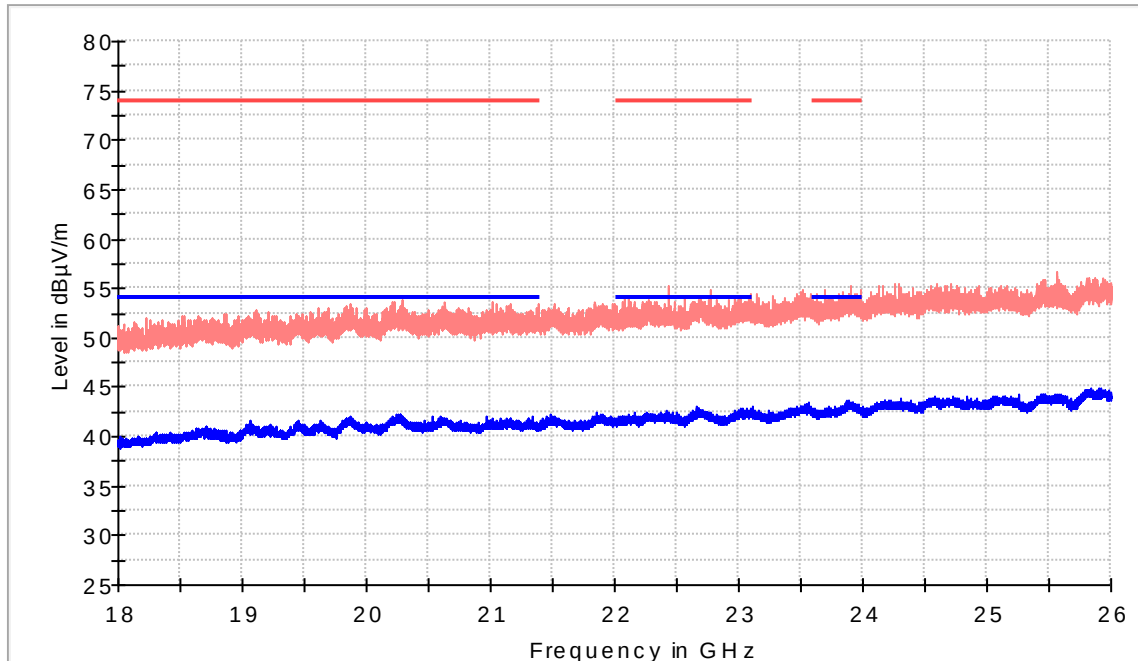
— AVG _MAXH
— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
19853.500000	52.2	42.3	H	11.7	54.0
23025.000000	54.8	42.1	H	11.9	54.0
23765.500000	55.1	42.4	V	11.6	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2440.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [18, 26]



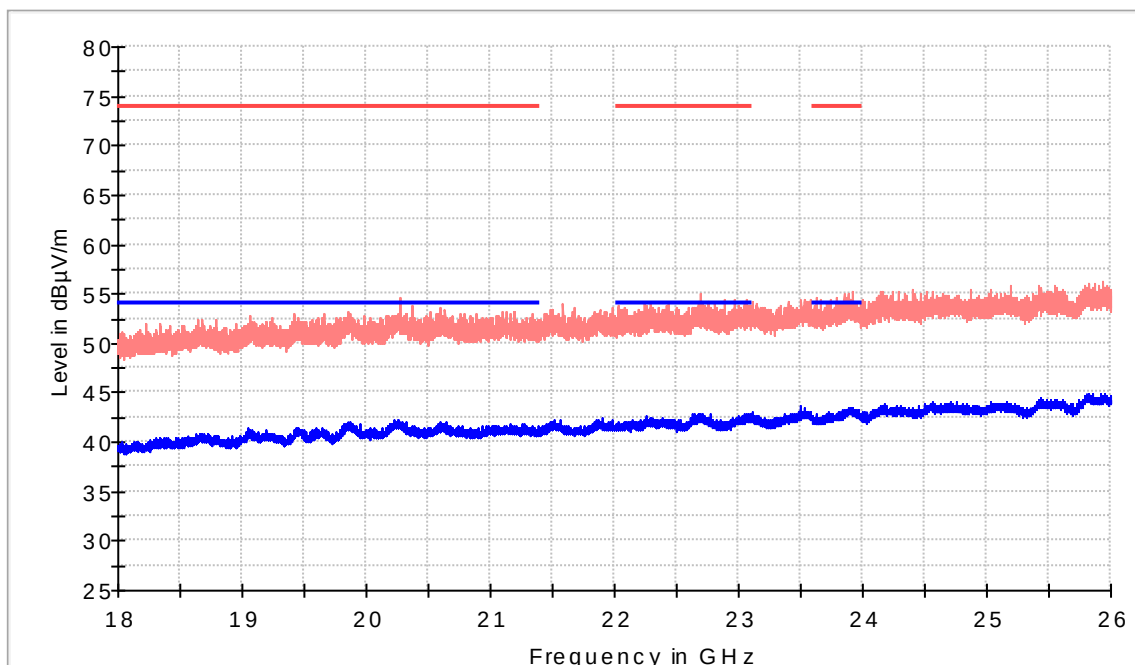
— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
22431.000000	55.1	41.7	H	12.3	54.0
22662.500000	52.4	43.1	V	10.9	54.0
23899.000000	55.2	43.0	H	11.0	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [18, 26]



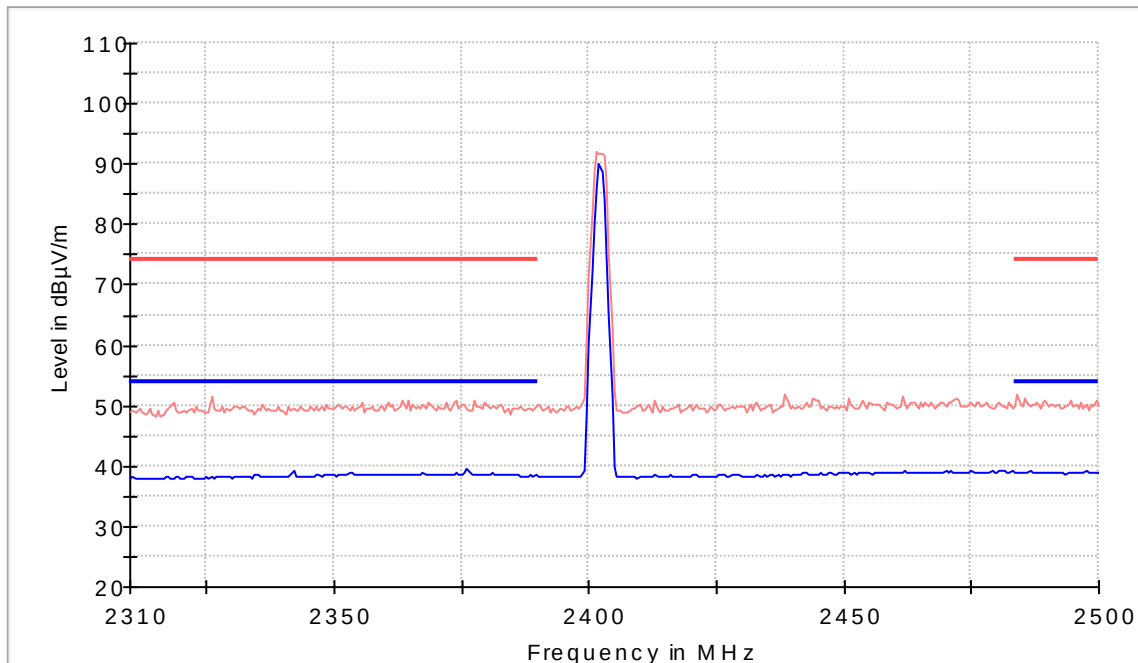
— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20271.000000	54.6	41.4	V	12.6	54.0
22689.000000	55.0	42.3	H	11.7	54.0
23919.500000	55.3	43.0	V	11.0	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

Lowest Channel

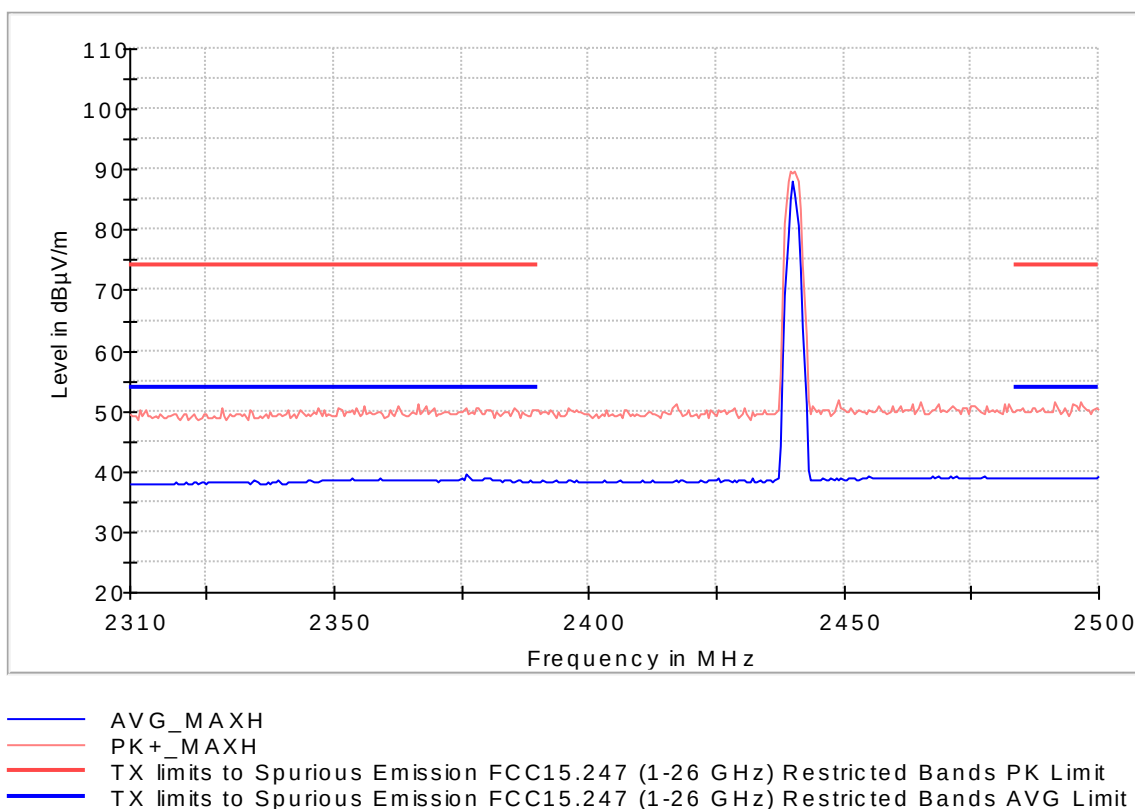
Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

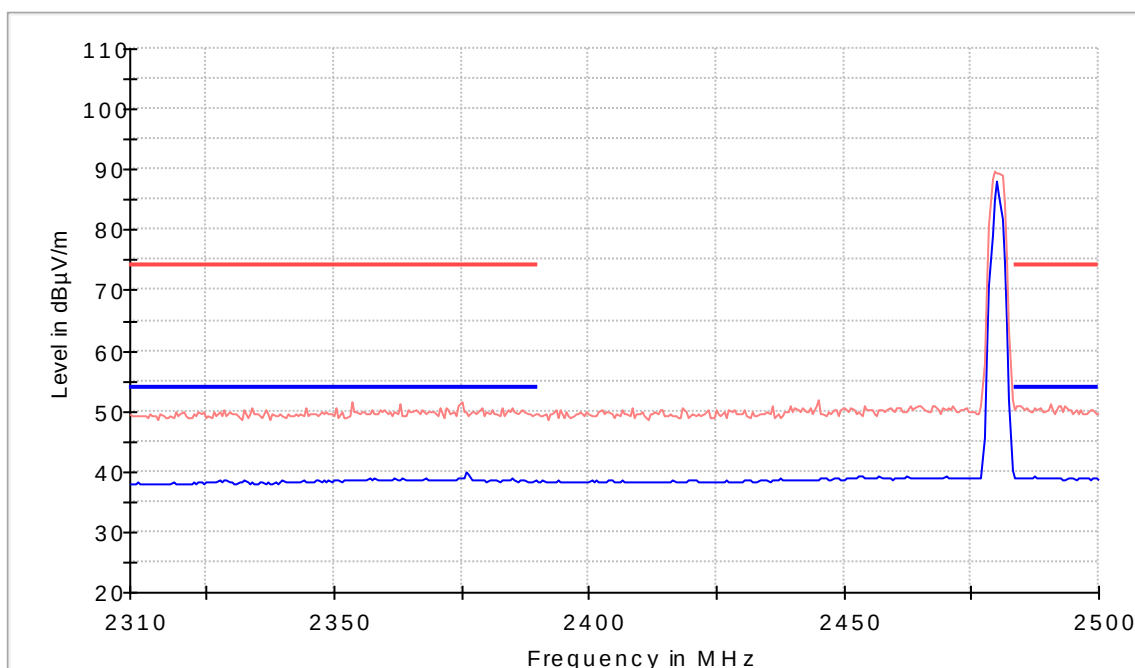
Middle Channel

Frequency MHz = 2440.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]



Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BTLE 5.0 (GFSK 2 Mbit/s), Frequency Range GHz = [1, 18]



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamplifier
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB

Appendix B: Test results. Bluetooth BD/EDR

Appendix B

PRODUCT INFORMATION31

TEST CONDITIONS32

TEST CASES DETAILS33

RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) – Radiated33

PRODUCT INFORMATION

Information	Description
Modulation	GFSK, $\pi/4$ -DQPSK, 8-DPSK
Operation mode 1: Single Antenna Equipment	
Operating Frequency Range	2402 – 2480 MHz
Nominal Channel Bandwidth	1 MHz
RF Output Power	10 dBm
Antenna type	External
Antenna gain	2 dBi
Nominal Voltage	
Supply Voltage	12 Vdc
Type of power source	DC voltage
Equipment type	Bluetooth Classic

TEST CONDITIONS

(*): Data provided by the client.

TEST CONDITIONS	DESCRIPTION
TC#01	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ Vdc}$ <u>Modulation:</u> GFSK <u>Test Frequencies for conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz
TC#02	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ Vdc}$ <u>Modulation:</u> $\pi/4$ -DQPSK <u>Test Frequencies for Conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz
TC#03	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ Vdc}$ <u>Modulation:</u> 8-DPSK <u>Test Frequencies for Conducted/Radiated tests:</u> Lowest range: 2402 MHz Middle channel: 2441 MHz Highest range: 2480 MHz

TEST CASES DETAILS

RSS-247 5.5 / FCC 15.247 (d) Emissions compliance (Transmitter) – Radiated

Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §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
960 - 25000	500	54	3

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

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

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

Verdict

Pass

Modulation: BT (GFSK 1-DH5)

Results

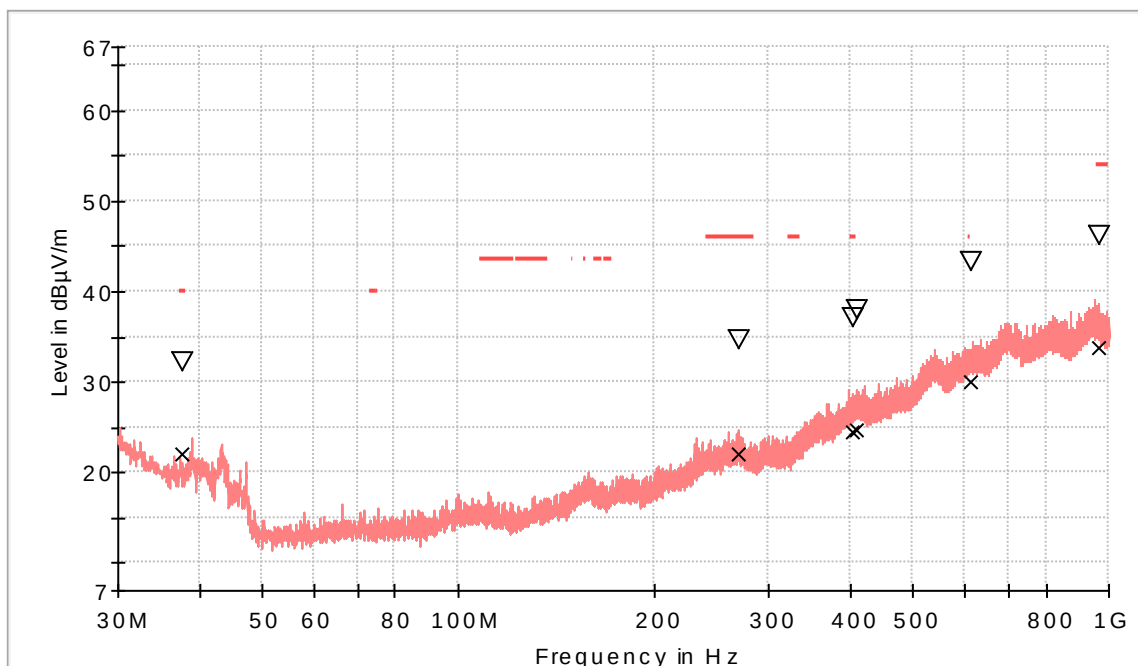
Frequency range 0.03 - 1 GHz

The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [0.03, 1]

Images:



— PK+ MAXH
— TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limit
▽ MaxPeak-PK+ (Single)
x QuasiPeak-QPK (Single)

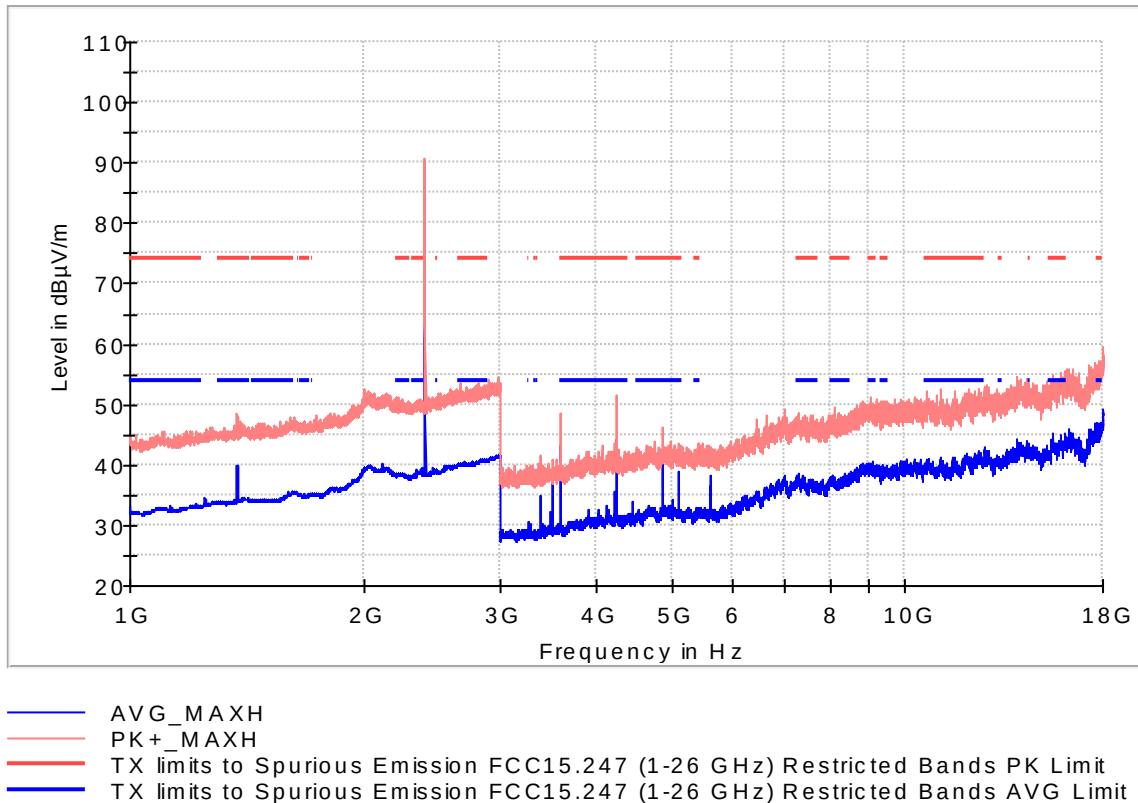
Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBμV/m)
37.760000	32.3	22.1	H	69.0	17.9
269.590000	34.7	22.0	V	-180.0	24.0
405.099000	37.2	24.5	V	-180.0	21.5
409.706500	37.9	24.7	H	180.0	21.3
611.418000	43.4	30.1	H	-152.0	15.9
965.953000	46.3	33.7	V	-180.0	20.3

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

Images:



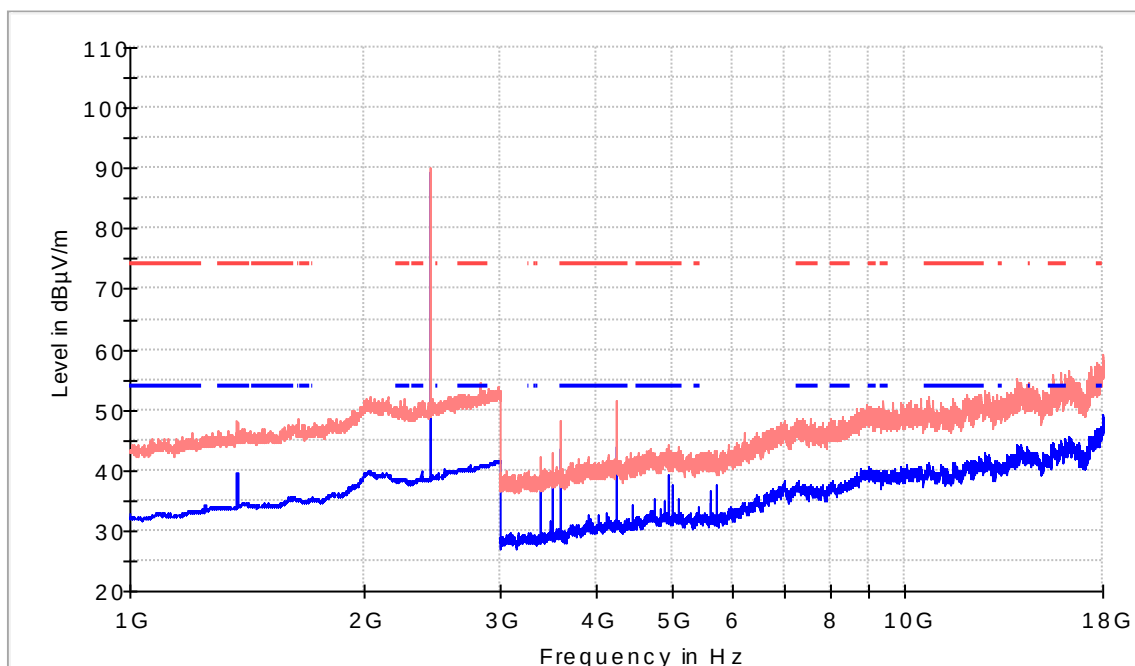
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2402.000000	90.8	90.2	H	---	---	Fundamental
4872.500000	46.2	40.2	H	13.8	54.0	
15925.000000	52.7	44.6	H	9.4	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

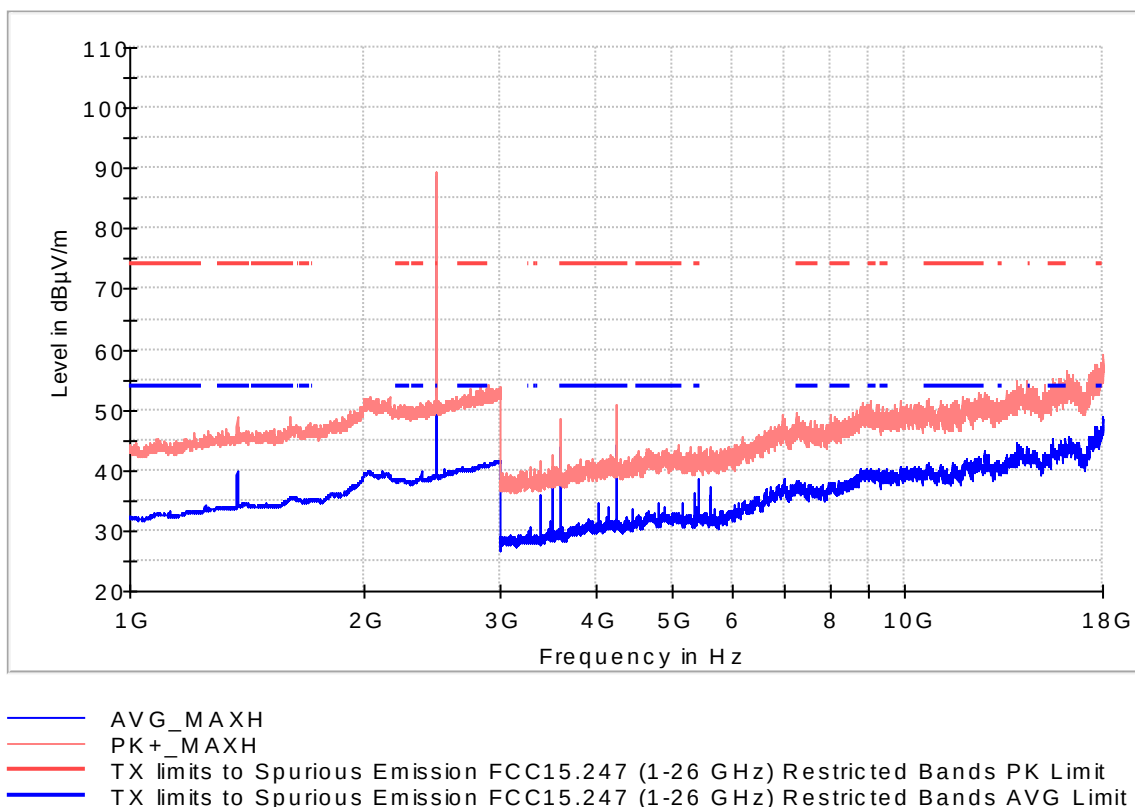
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2441.000000	90.0	89.3	H	---	---	Fundamental
4233.000000	51.5	43.9	V	10.1	54.0	
17994.000000	57.8	49.2	V	4.8	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

Images:



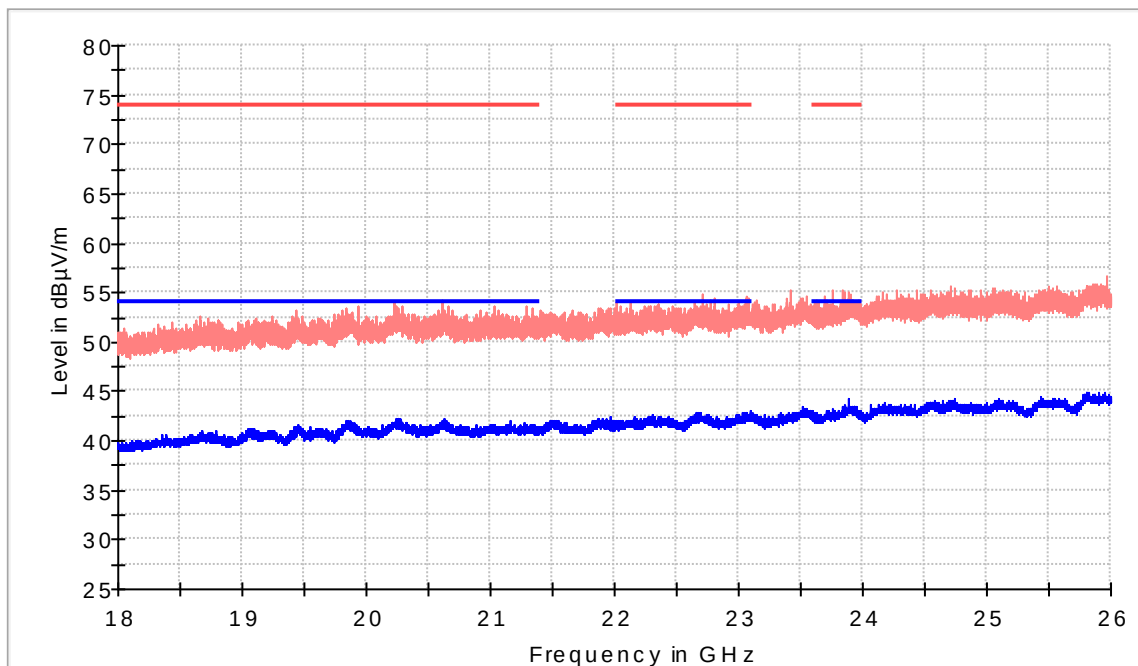
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2480.000000	89.3	88.6	V	---	---	Fundamental
4233.000000	50.7	44.2	V	9.8	54.0	
15481.500000	54.1	45.2	H	8.8	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

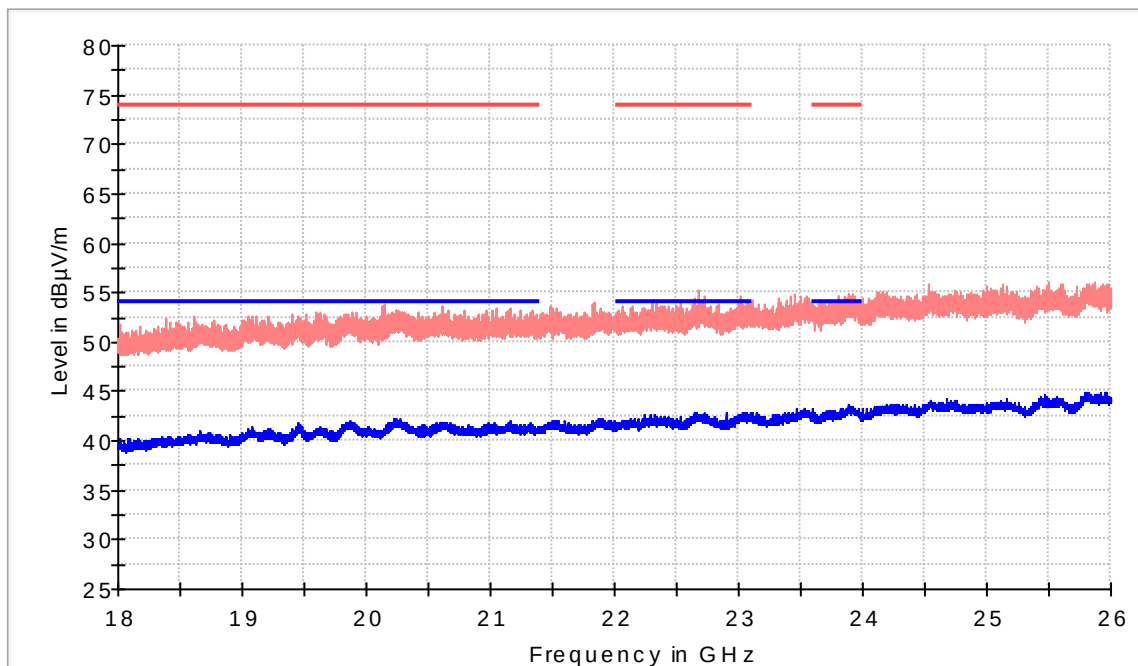
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20611.500000	54.2	41.3	V	12.8	54.0
22715.000000	54.9	42.3	V	11.7	54.0
23764.500000	55.1	42.4	H	11.6	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

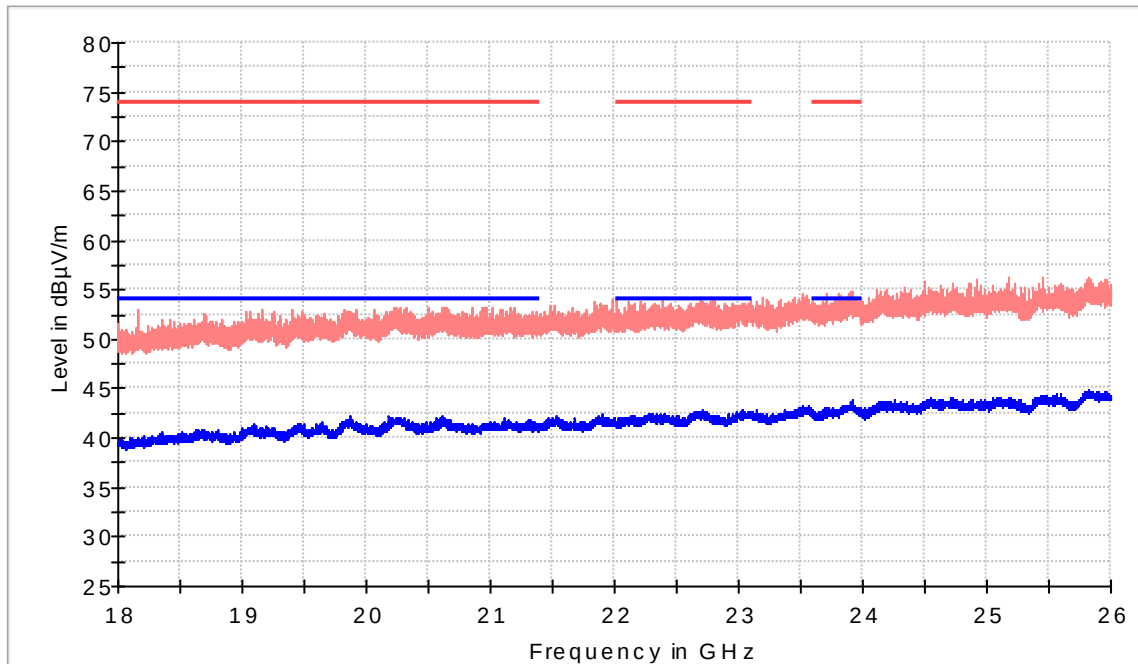
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20266.500000	52.9	42.3	H	11.7	54.0
22675.500000	55.2	42.4	V	11.6	54.0
23881.500000	53.2	43.8	H	10.2	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
— PK+ MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

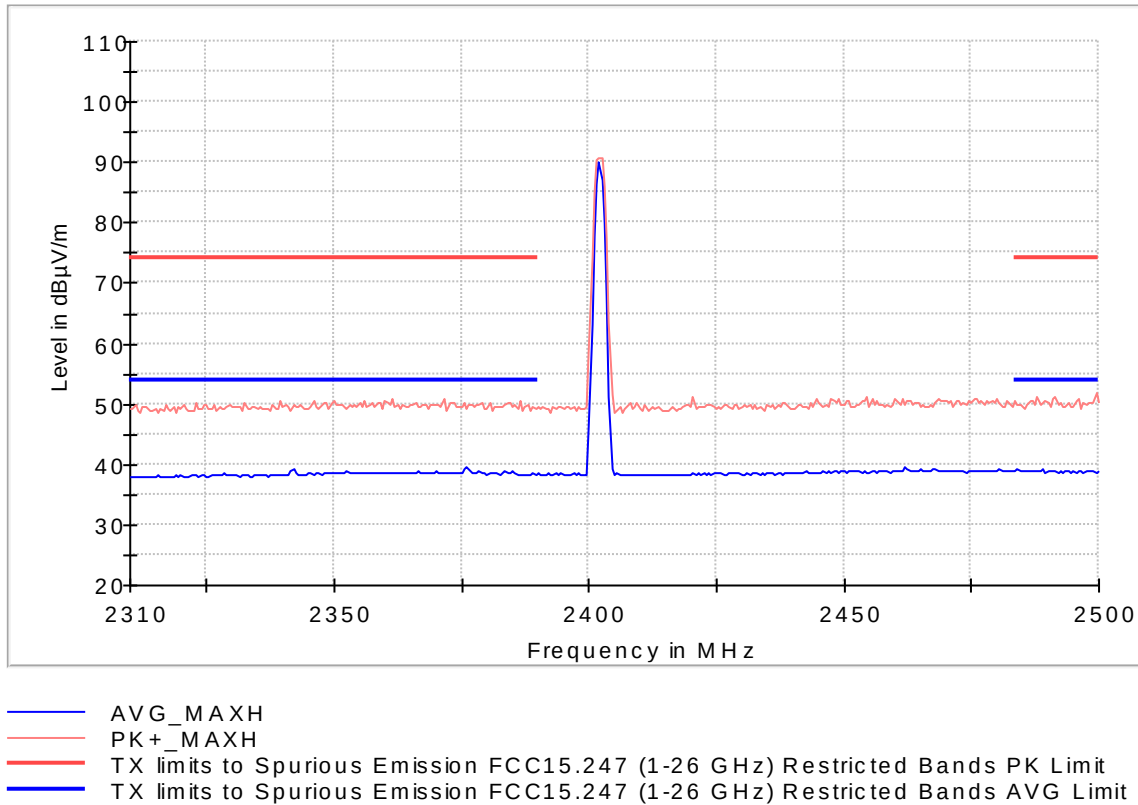
Frequency (MHz)	PK+ MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20617.000000	51.6	42.3	V	11.7	54.0
23030.000000	52.4	42.9	V	11.1	54.0
23922.000000	53.1	43.9	V	10.1	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

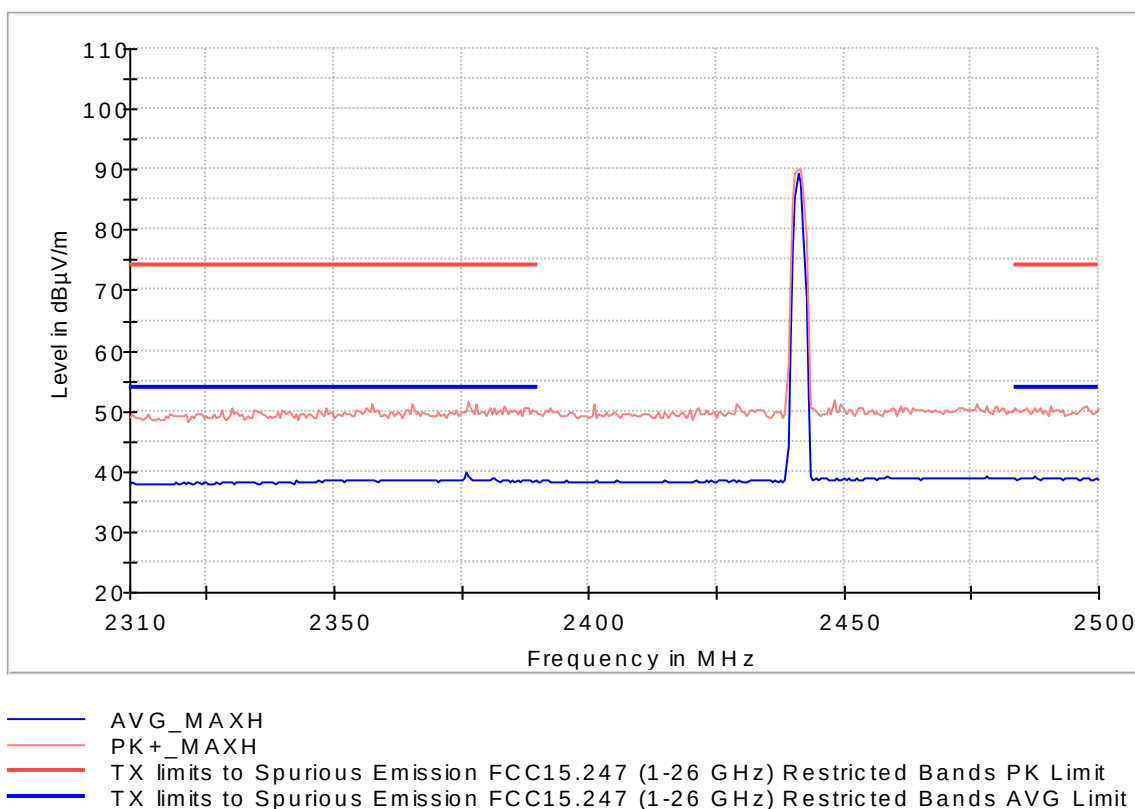
Images:



Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

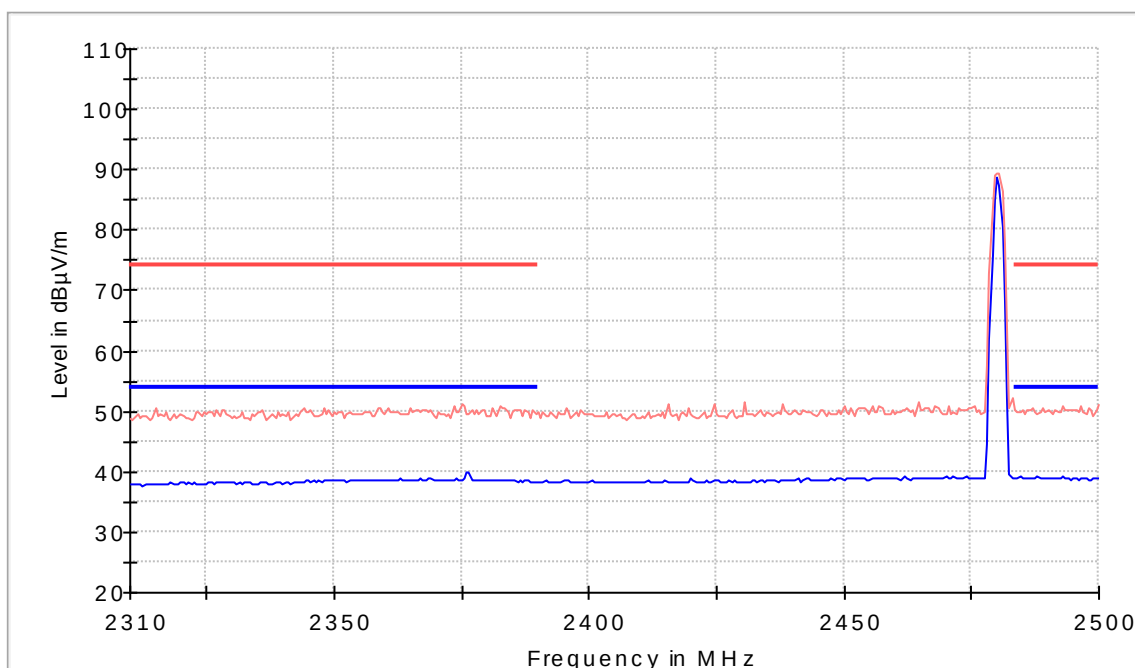
Images:



Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (GFSK 1-DH5), Frequency Range GHz = [1, 18]

Images:



- AVG_MAXH
- PK+_MAXH
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

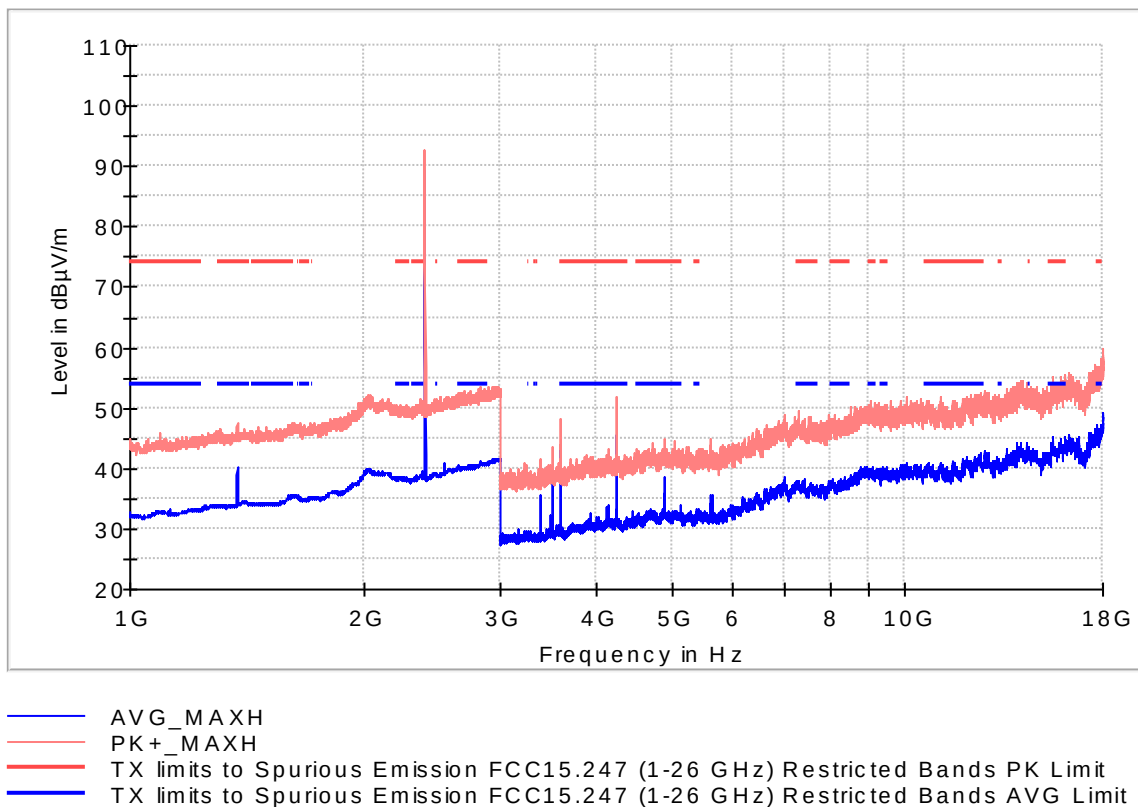
Modulation: BT ($\pi/4$ DQPSK 2-DH5)
Results

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [1, 18]

Images:



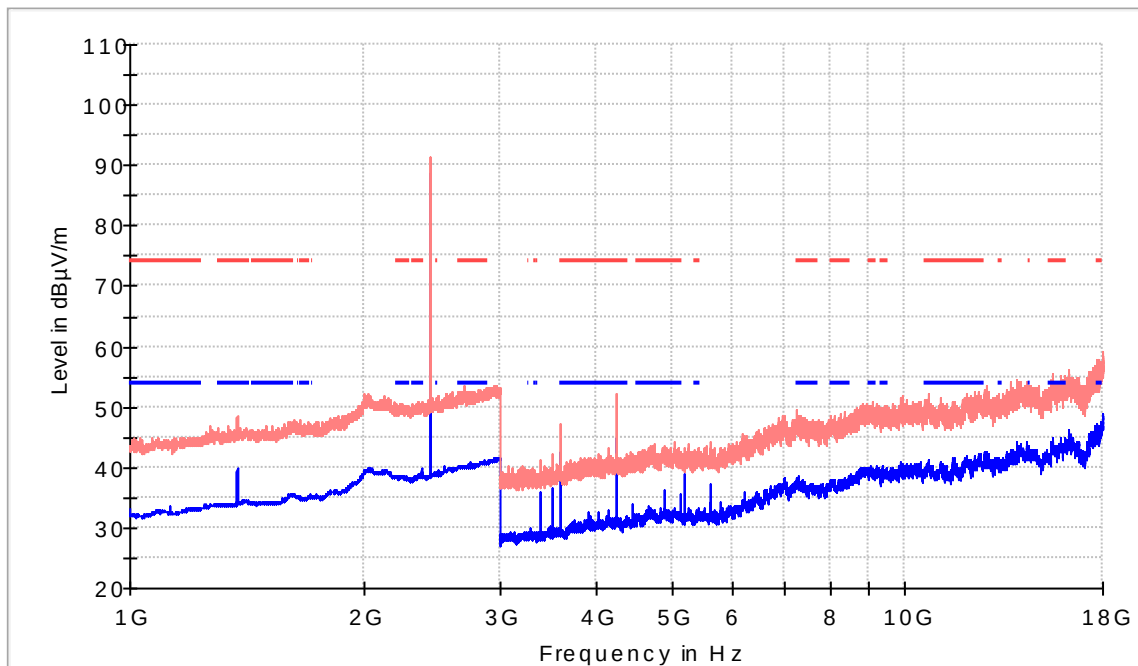
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2402.000000	92.6	46.1	H	---	---	Fundamental
4233.000000	51.8	45.7	V	8.3	54.0	
17823.500000	54.7	46.1	H	7.9	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

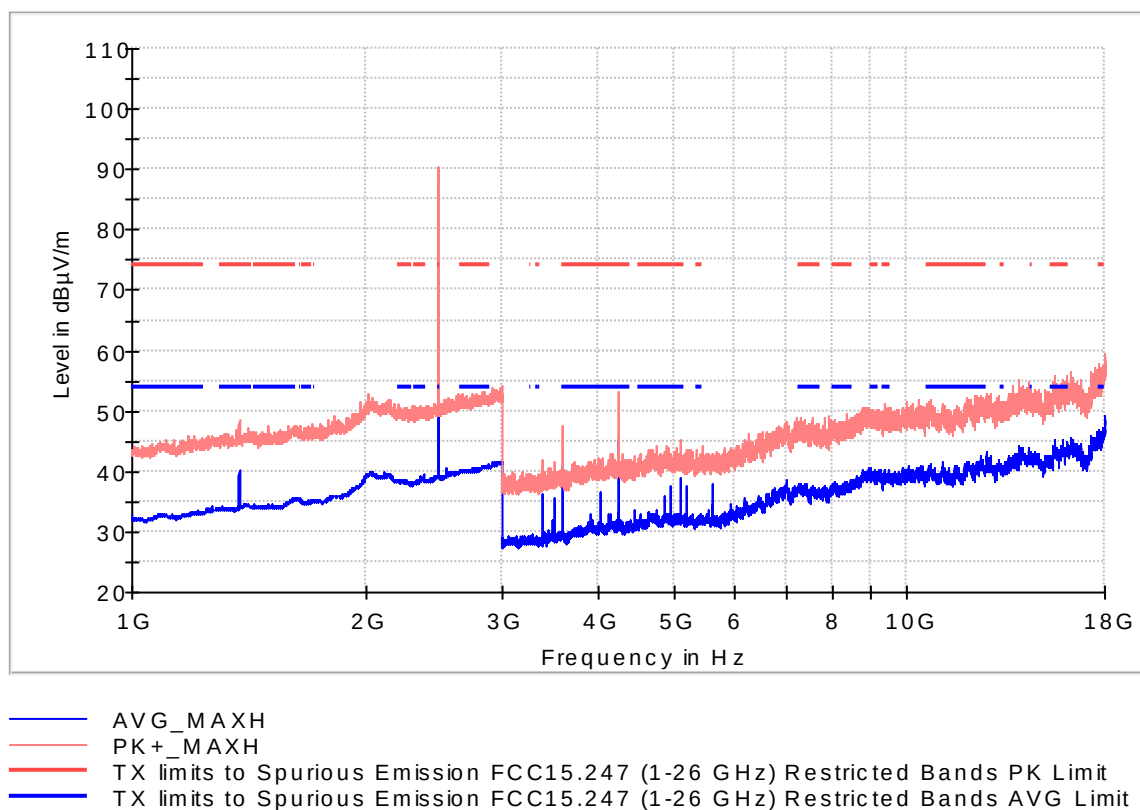
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2441.000000	91.2	88.8	V	---	---	Fundamental
4233.000000	52.3	45.1	V	8.9	54.0	
15867.000000	53.8	44.7	H	9.3	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [1, 18]

Images:



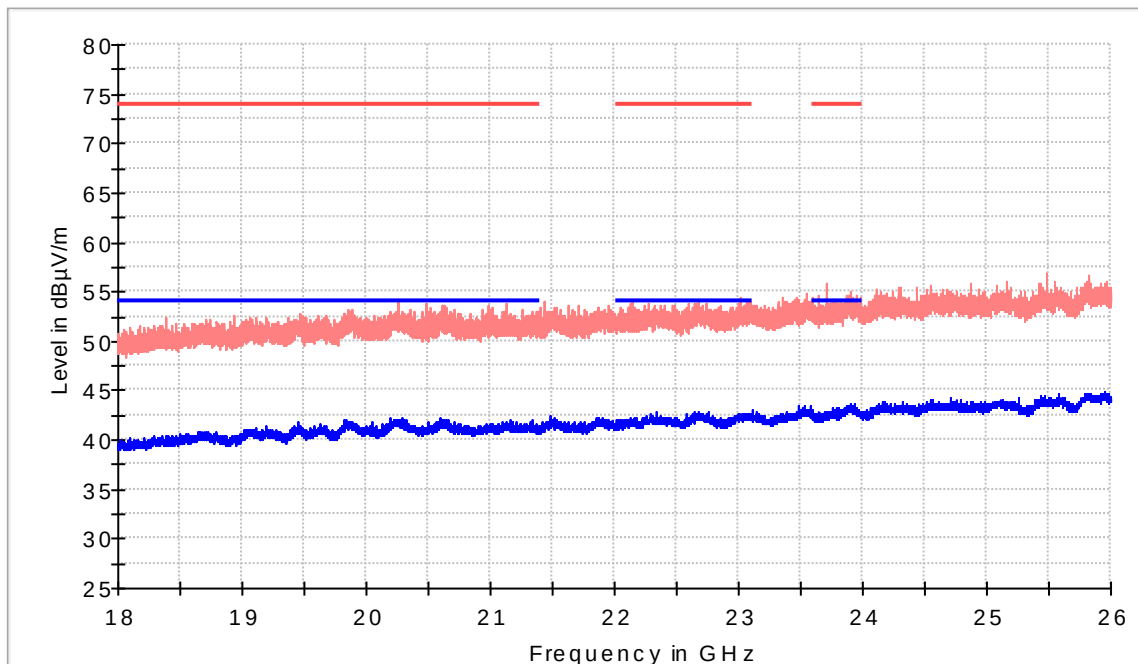
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2480.500000	90.6	86.4	V	---	---	Fundamental
4233.000000	53.1	45.3	V	8.7	54.0	
15481.500000	55.8	44.5	H	9.5	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG _MAXH
— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

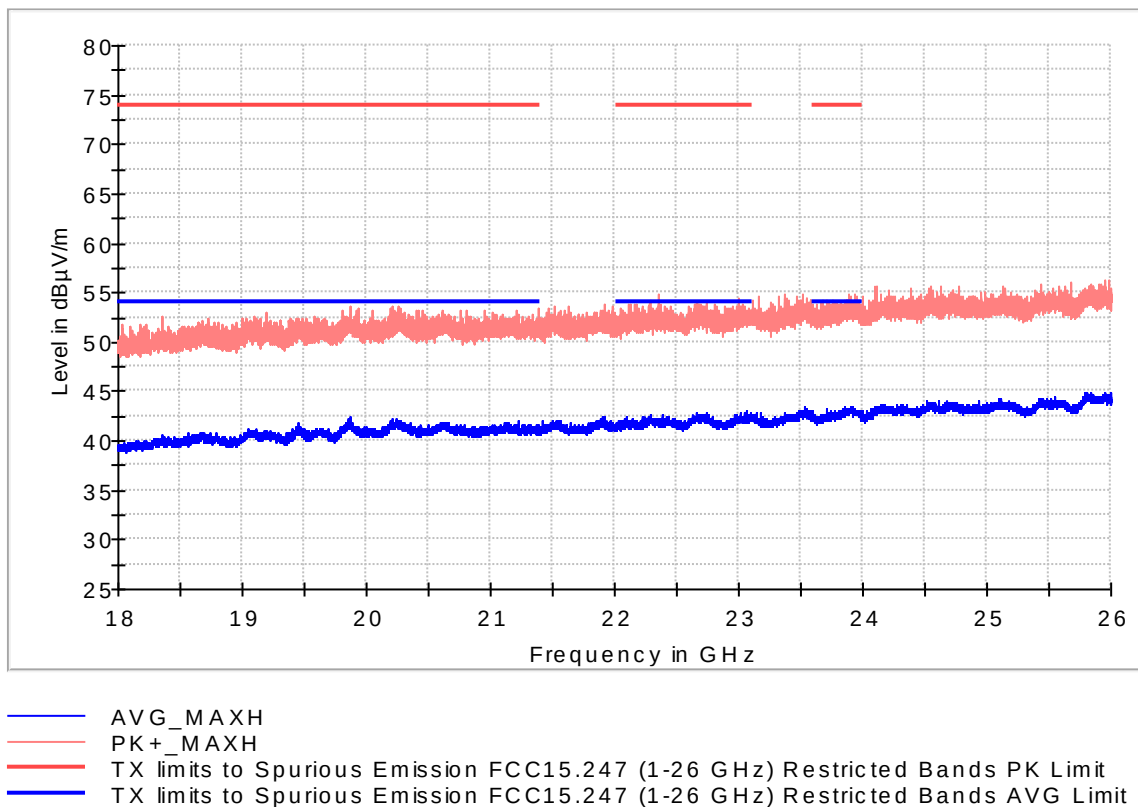
Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20259.500000	54.2	41.6	H	12.4	54.0
23014.500000	54.4	42.2	H	11.8	54.0
23708.000000	55.8	42.4	H	11.6	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [18, 26]

Images:



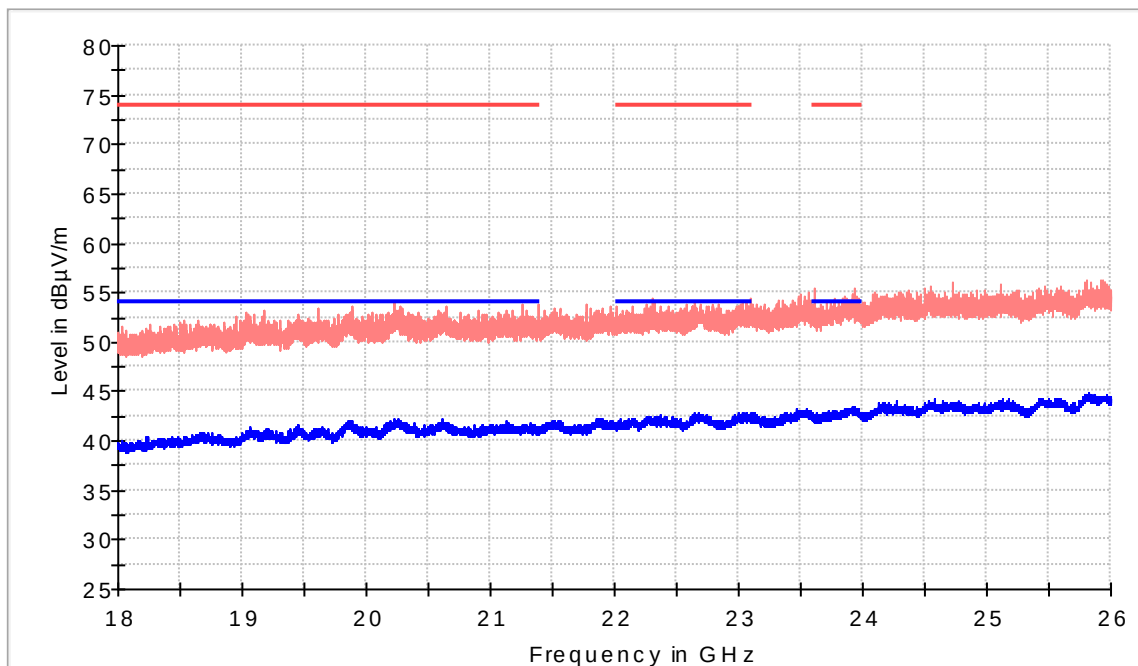
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
19866.000000	52.2	42.4	V	11.6	54.0
23061.000000	51.9	43.0	H	11.0	54.0
23859.000000	53.3	43.4	H	10.6	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

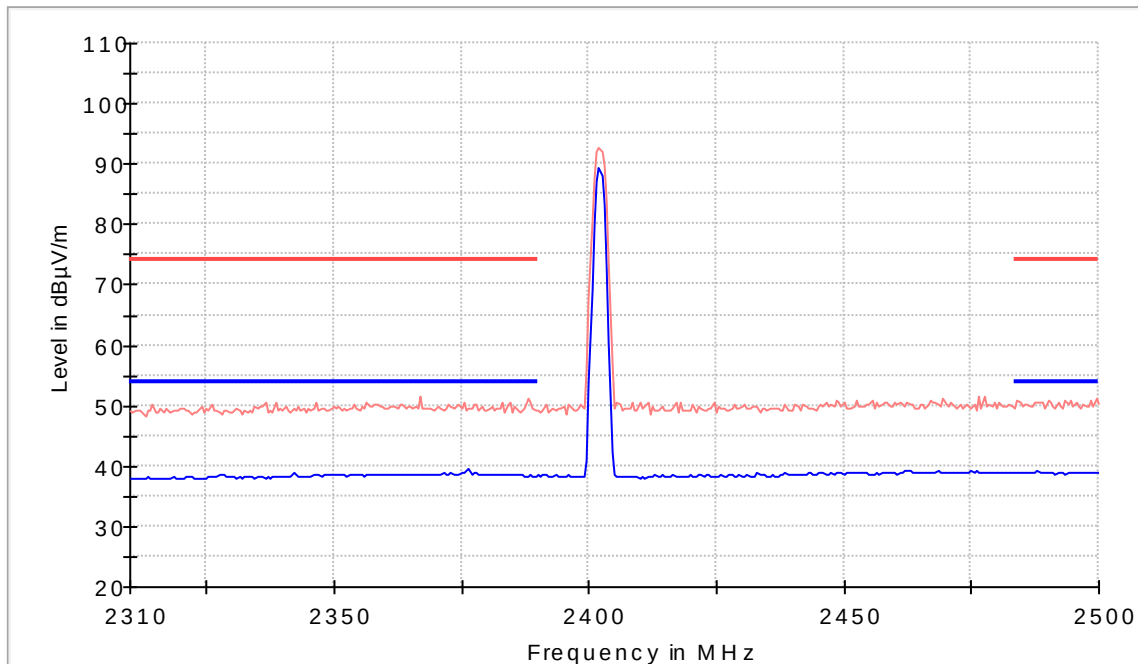
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20221.000000	51.9	42.2	H	11.8	54.0
20607.500000	51.6	42.0	V	12.0	54.0
23607.500000	55.5	42.2	H	11.8	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH1), Frequency Range GHz = [1, 18]

Images:

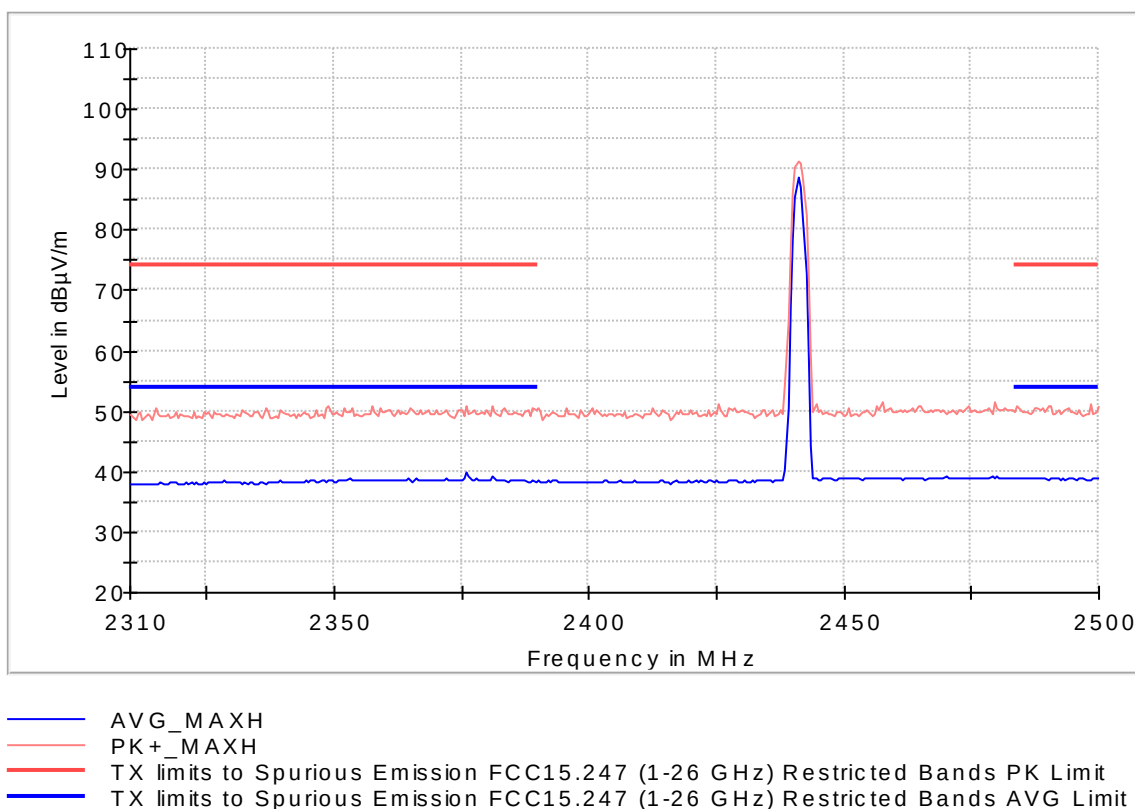


- AVG_MAXH
- PK+_MAXH
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH1), Frequency Range GHz = [1, 18]

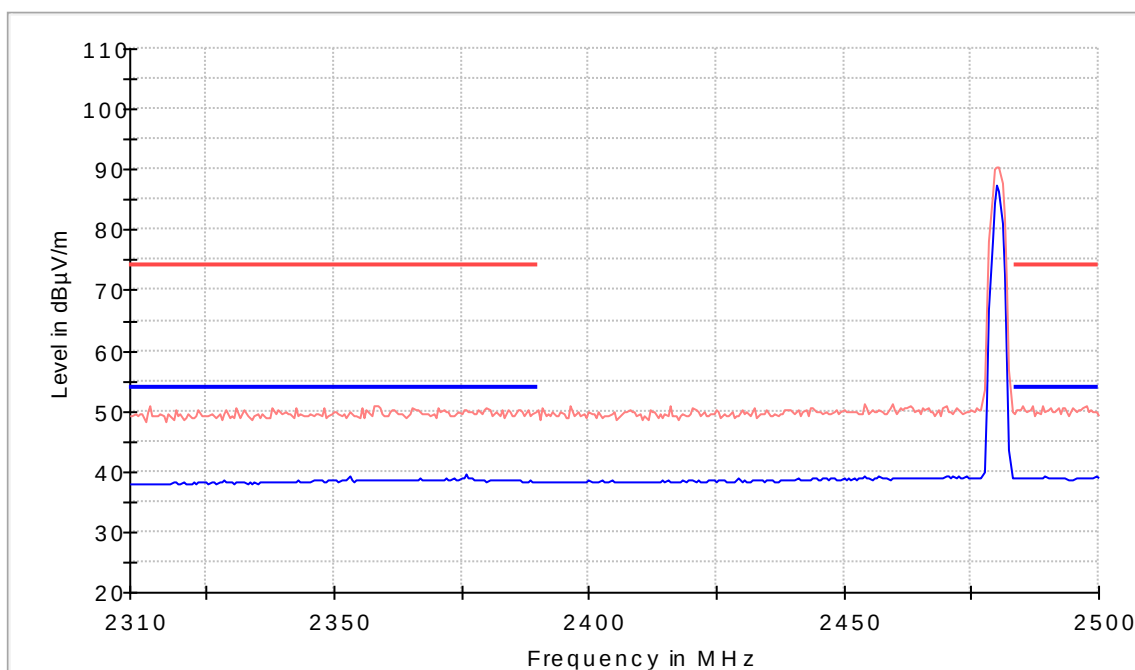
Images:



Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT ($\pi/4$ DQPSK 2-DH1), Frequency Range GHz = [1, 18]

Images:



- AVG_MAXH
- PK+_MAXH
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

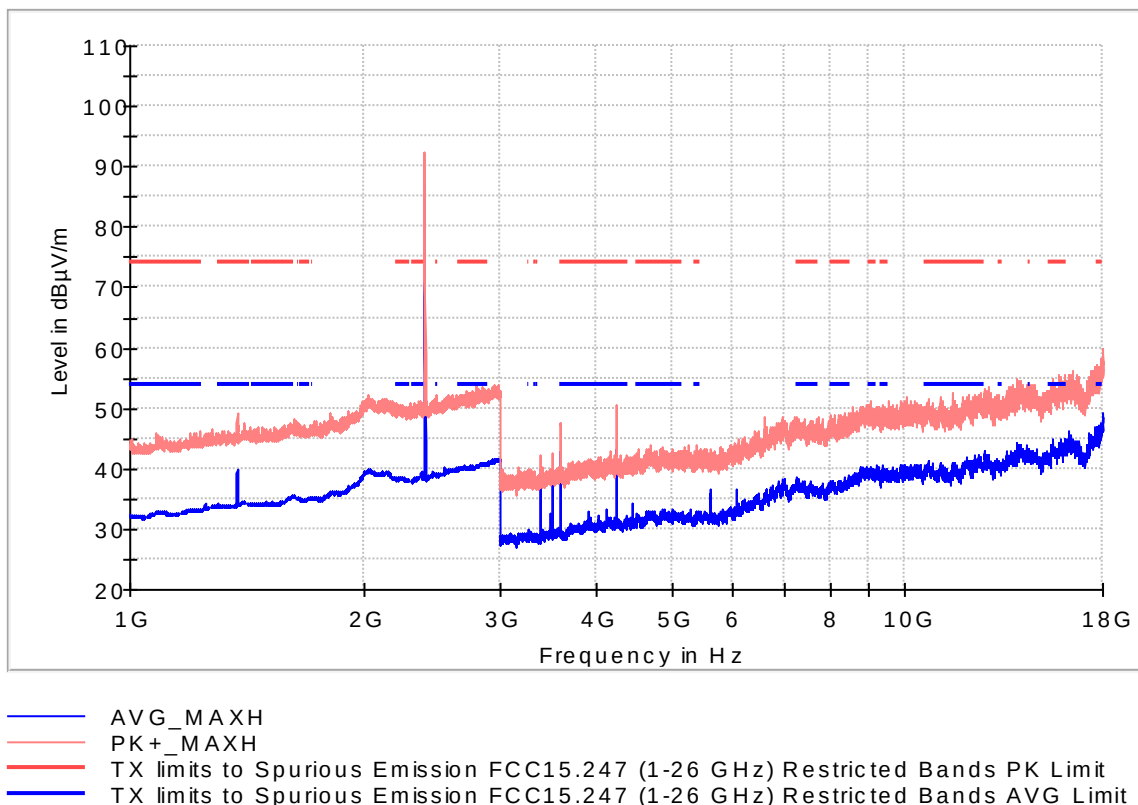
Modulation: BT (8DPSK 3-DH5)
Results

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

Images:



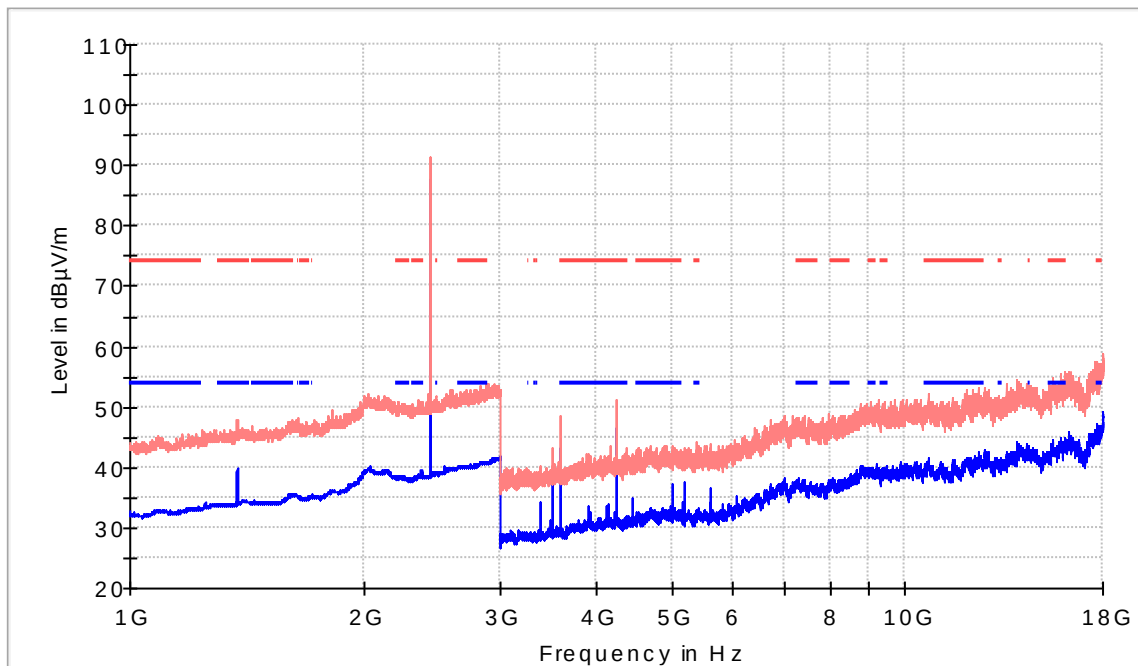
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2402.000000	92.4	87.2	H	---	---	Fundamental
4233.000000	50.5	43.3	V	10.7	54.0	
17865.000000	58.3	46.7	H	7.3	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

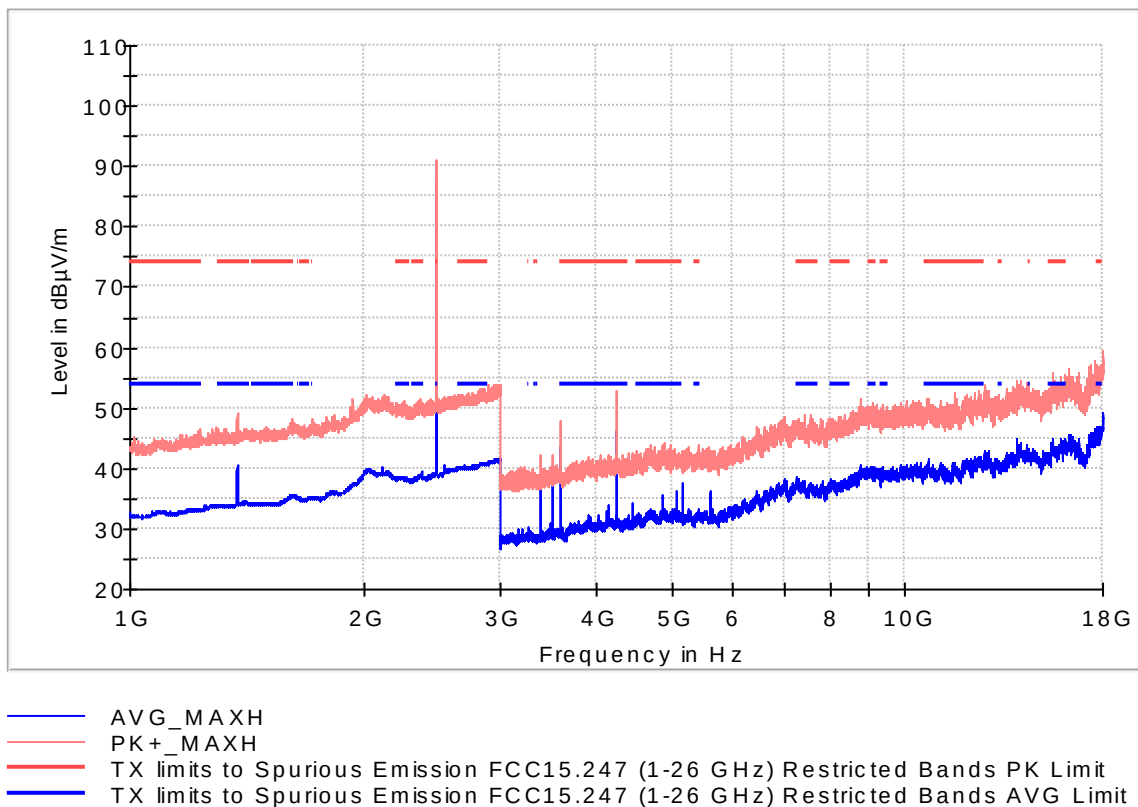
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2441.000000	91.3	87.9	V	---	---	Fundamental
4233.000000	51.2	46.5	V	7.5	54.0	
17995.000000	58.9	48.7	V	5.3	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

Images:



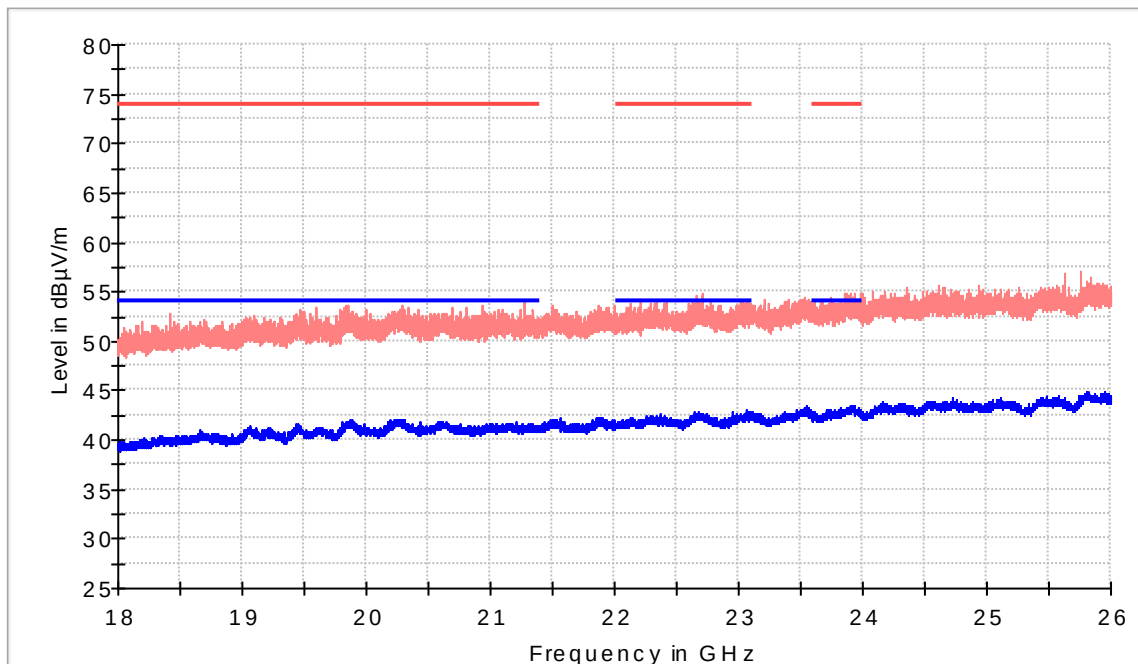
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2480.000000	91.1	87.7	V	---	---	Fundamental
4233.000000	53.0	46.2	V	7.8	54.0	
17995.500000	59.5	49.3	H	4.7	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG _MAXH
— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

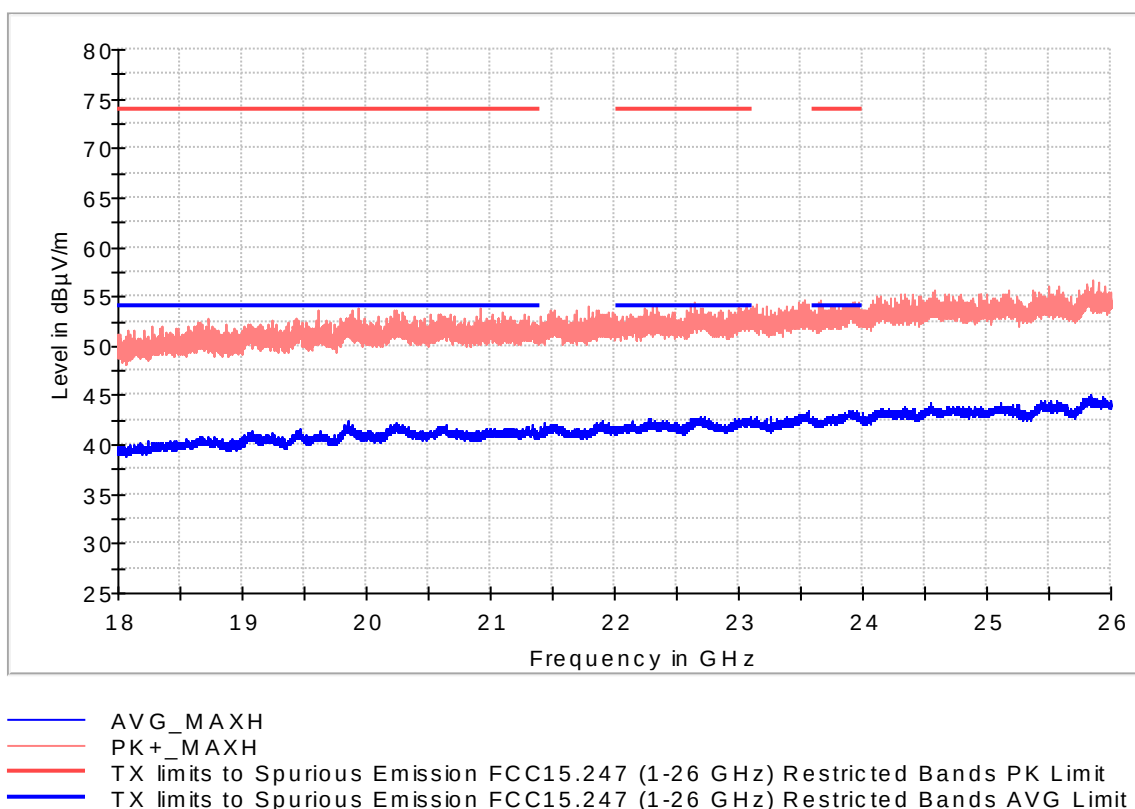
Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
21268.000000	54.1	41.1	H	12.9	54.0
22707.500000	54.9	42.4	V	11.6	54.0
23903.000000	54.9	43.1	V	10.9	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [18, 26]

Images:



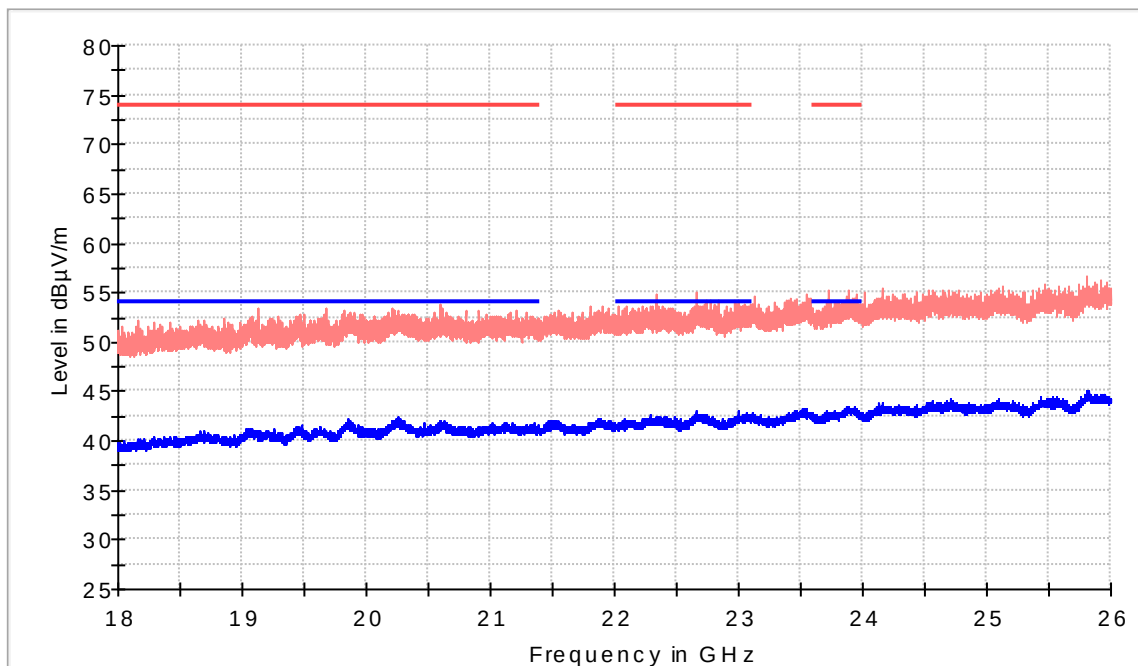
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
19861.000000	51.0	42.4	H	11.6	54.0
22639.000000	54.4	42.0	V	12.0	54.0
23658.500000	54.6	42.2	V	11.8	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

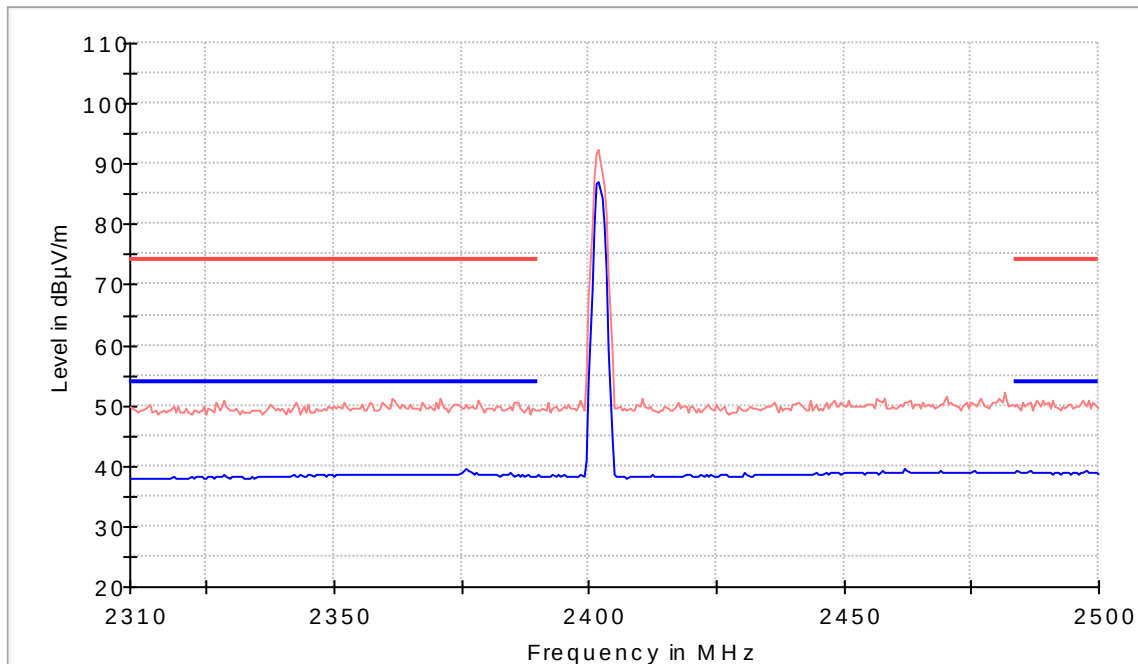
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20255.500000	51.8	42.4	V	11.6	54.0
22661.000000	55.0	42.3	H	11.7	54.0
23729.500000	55.3	42.6	V	11.4	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

Lowest Channel

Frequency MHz = 2402.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

Images:

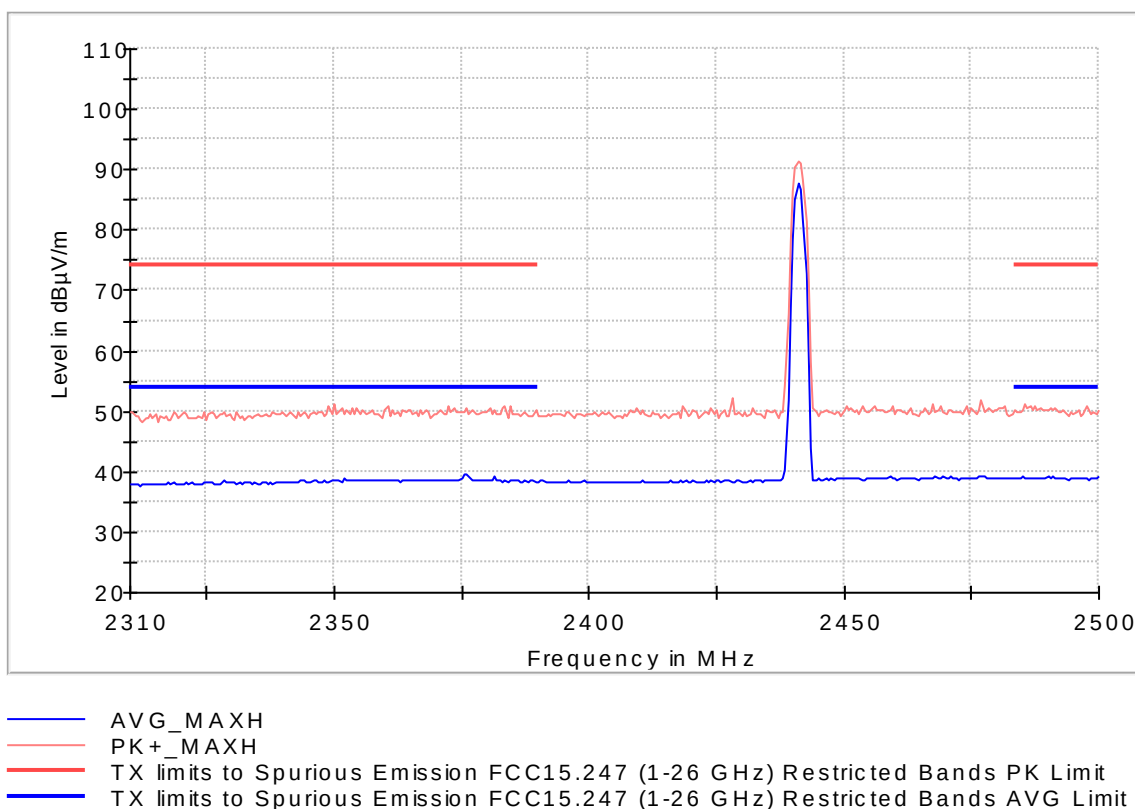


- AVG_MAXH
- PK+_MAXH
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
- TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Middle Channel

Frequency MHz = 2441.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

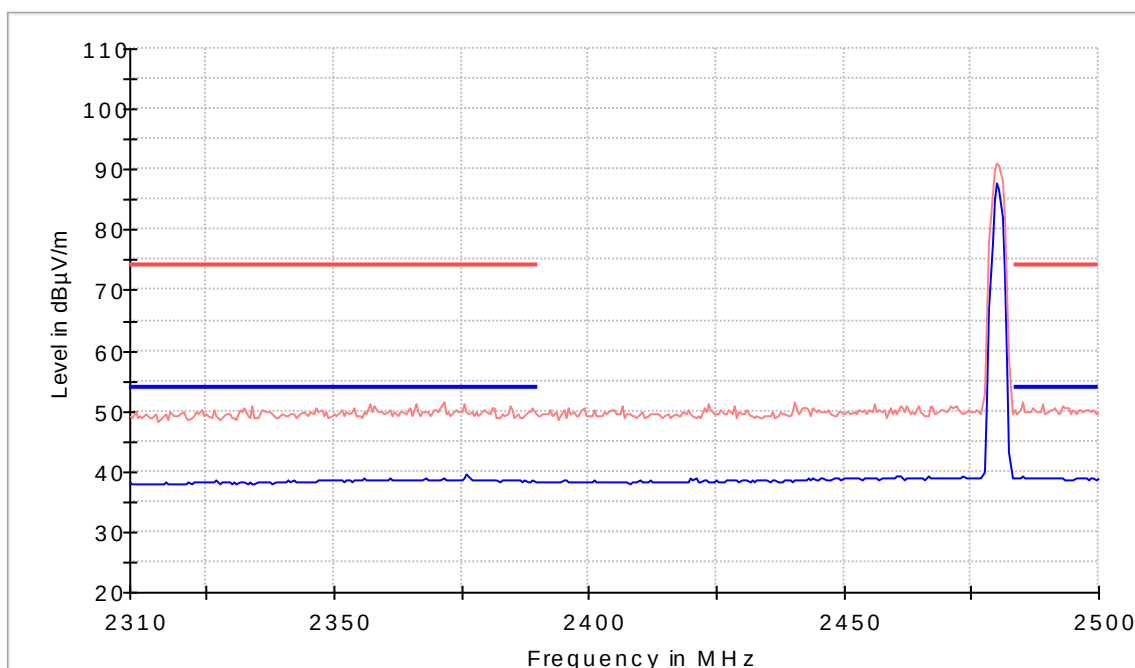
Images:



Highest Channel

Frequency MHz = 2480.00000, Equipment Type = Frequency Hopping Spread Spectrum systems (DSS),
Modulation = BT (8DPSK 3-DH5), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB

Appendix C: Test results. Wi-Fi 2.4GHz

Appendix C

PRODUCT INFORMATION64

TEST CONDITIONS65

APPENDIX C.1: MIMO68

TEST CASES DETAILS69

RSS-247 5.5 / FCC 15.247 (d) Emission Limitations Radiated (Transmitter)69

PRODUCT INFORMATION

Information	Description
Modulation	CCK, DSSS, OFDM, (BPSK, QPSK, 16/64QAM)
Operation mode:	
Operating Frequency Range	2400 – 2483.5 MHz
Nominal Channel Bandwidth	20 MHz,
Maximum RF Output Power	9 dBm
Antenna type	External
Antenna gain	2 dBi
Nominal Voltage	
Supply Voltage	12 Vdc
Type of power source	DC voltage
Equipment type	Wi-Fi 2.4 GHz b/g/n20/ax20

TEST CONDITIONS

(*): Data provided by the client.

TEST CONDITIONS	DESCRIPTION
TC#01 ⁽¹⁾ (b mode)	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ Vdc}$ <u>Channel Bandwidth:</u> 20 MHz <u>Test Frequencies for Radiated tests (Radio A + B MIMO):</u> Lowest channel: 2412 MHz Middle channel: 2437 MHz Highest channel: 2462 MHz
TC#02 ⁽¹⁾ (n mode)	<u>Power supply (V):</u> $V_{\text{nominal}} = 12 \text{ Vdc}$ <u>Channel Bandwidth:</u> 20 MHz <u>Test Frequencies for Radiated tests (Radio A + B MIMO):</u> Lowest channel: 2412 MHz Middle channel: 2437 MHz Highest channel: 2462 MHz

Note (1): The following tables and plots show the results for the worst case in OFDM for modulation (802.11b) and modulation (802.11n). The data rates of 11Mb/s for 802.11b, and HT20 (OFDM MCS7) for 802.11n, were selected based on preliminary testing that identified those rates corresponding to the worst cases.

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at 3 m for the frequency range 30-1000 MHz (Bilog antenna) and 1-18 GHz (Double ridge horn antenna), and 1m for the frequency range 18 GHz- 26 GHz (Double ridge horn antenna).

For radiated emissions in the range 18 - 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 was varied from 1 to 4 meters to find the maximum radiated emission.

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

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

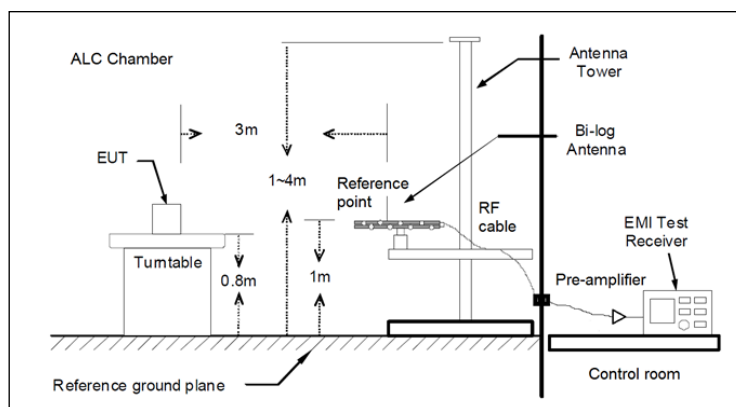


Fig A1: Radiated measurements Setup $f < 1$ GHz

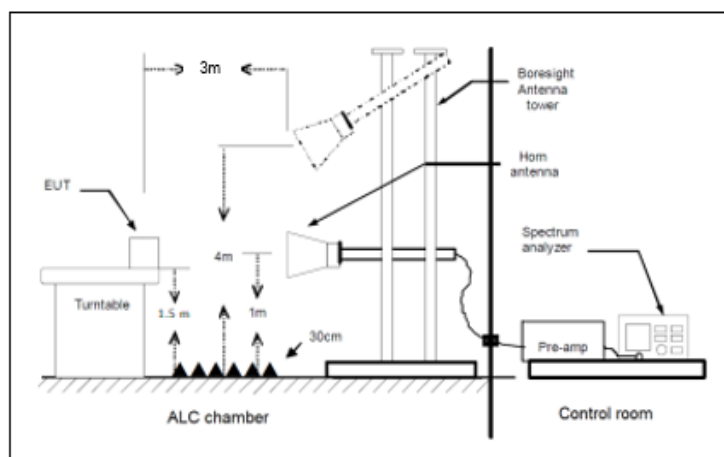


Fig A2: Radiated measurements setup $f > 1-18$ GHz

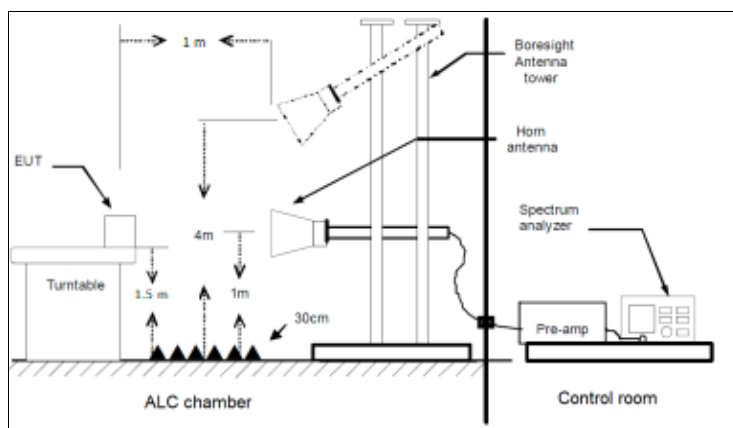


Fig A3: Radiated measurements setup $f > 18$ GHz

Appendix C.1: MIMO

TEST CASES DETAILS

RSS-247 5.5 / FCC 15.247 (d) Emission Limitations Radiated (Transmitter)

Limits

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §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
960 - 25000	500	54	3

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

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

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

Verdict

Pass

Modulation: 802.11b (DSSS 1 Mbit/s)

Results

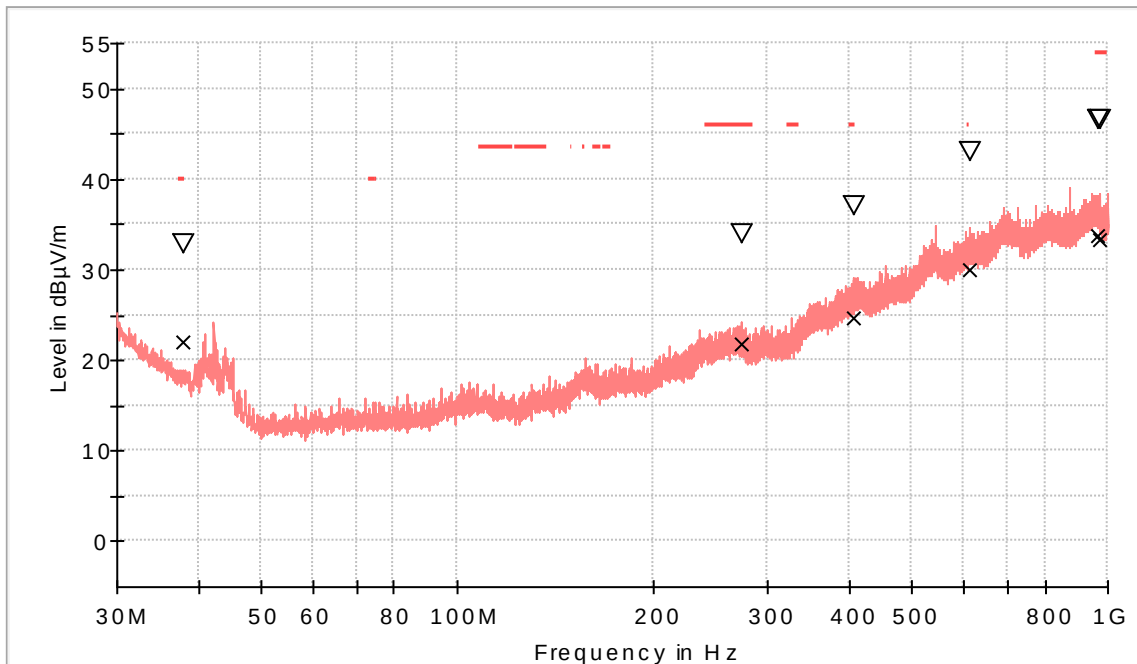
Frequency range 0.03 - 1 GHz

The spurious emissions below 1 GHz do not depend on the operating channel selected in the EUT.

Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [0.03, 1]

Images:



—	PK+_MAXH
- - -	TX limits to Spurious Emission FCC15.247 (30MHz to 1GHz) Restricted Bands QPK Limi
▽	MaxPeak-PK+ (Single)
x	QuasiPeak-QPK (Single)

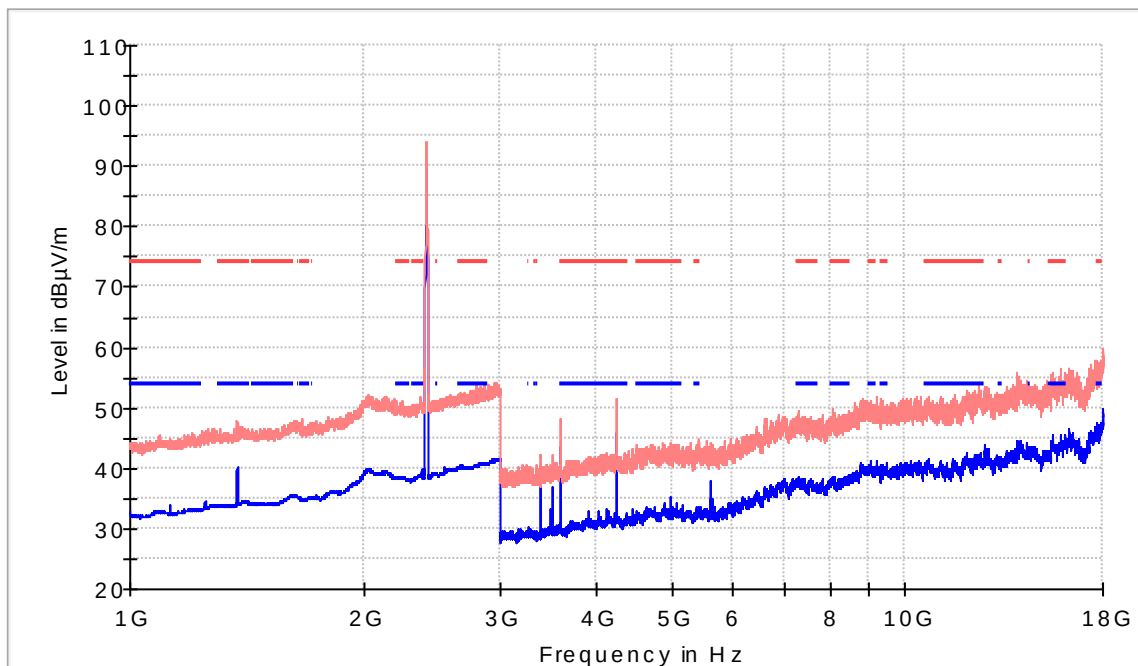
Frequency (MHz)	MaxPeak (dBμV/m)	QuasiPeak (dBμV/m)	Pol	Margin - QPK (dB)	Limit - QPK (dBμV/m)
37.857000	33.0	22.1	V	144.0	18.0
273.567000	33.9	21.7	V	-132.0	24.3
406.748000	37.1	24.6	H	-35.0	21.4
611.515000	43.2	30.1	H	164.0	15.9
963.237000	46.5	33.8	H	118.0	20.2

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

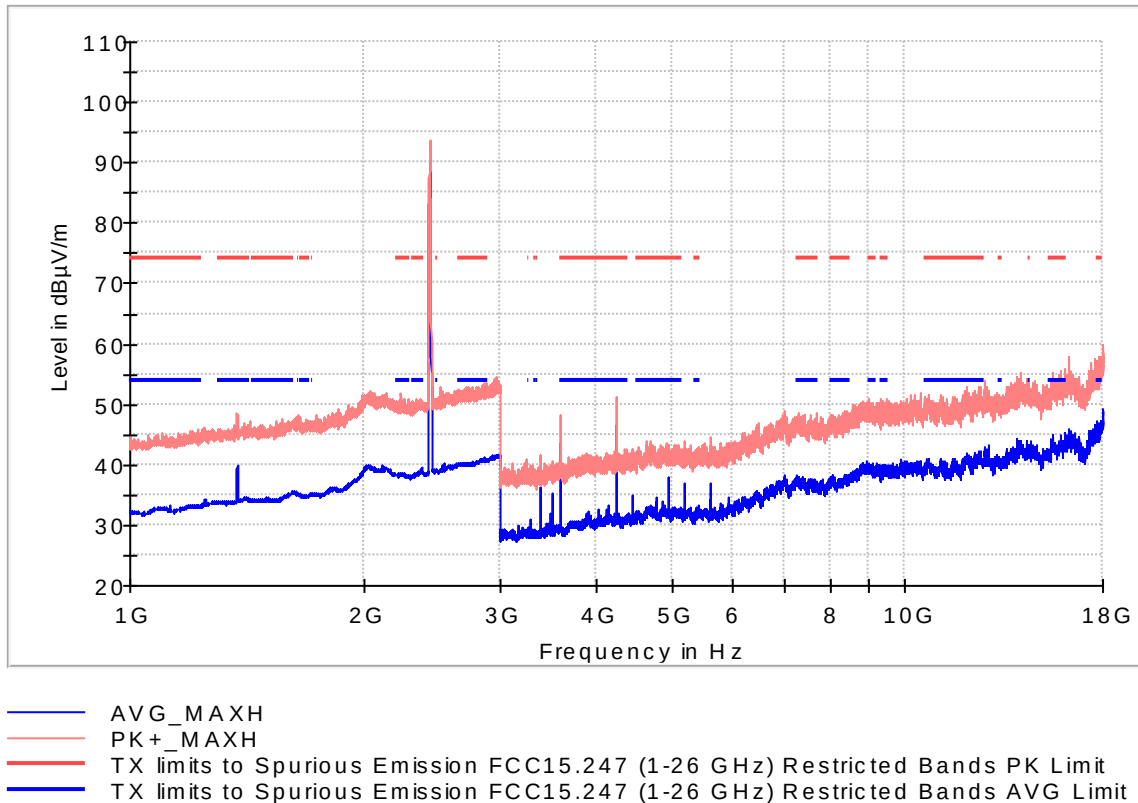
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2412.000000	93.8	88.0	H	---	---	Fundamental
4233.000000	51.7	46.0	V	8.0	54.0	
17866.00000	58.0	47.0	V	7.0	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]

Images:



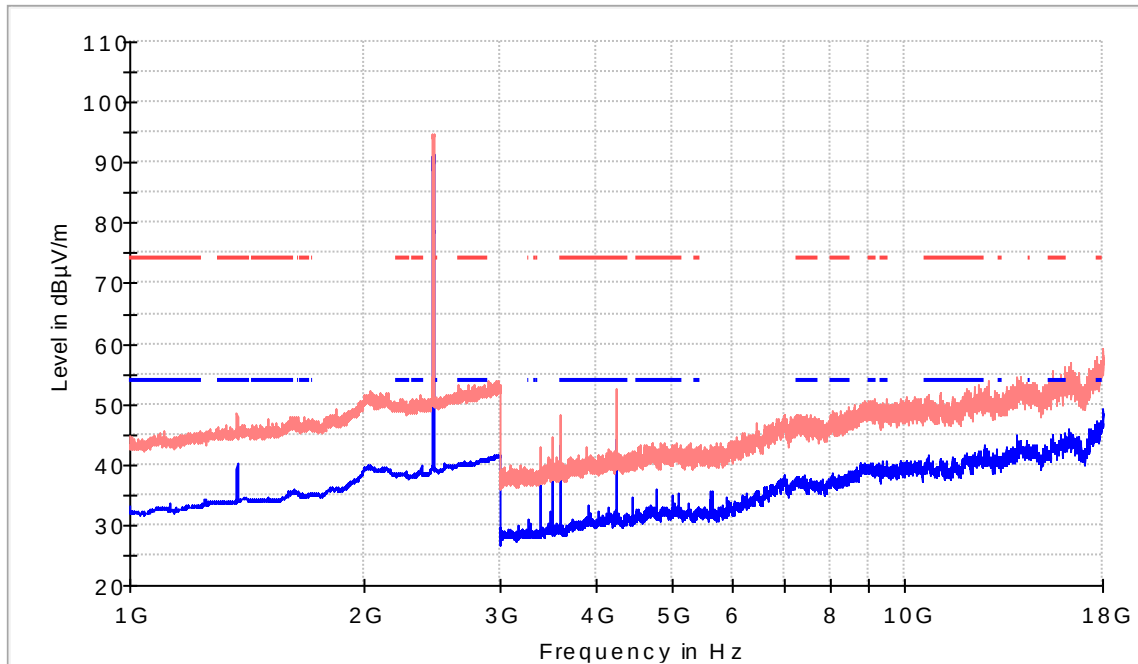
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2437.0000	93.2	87.3	V	---	---	Fundamental
4233.0000	51.1	46.6	V	7.4	54.0	
17993.000	57.9	49.3	H	4.7	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

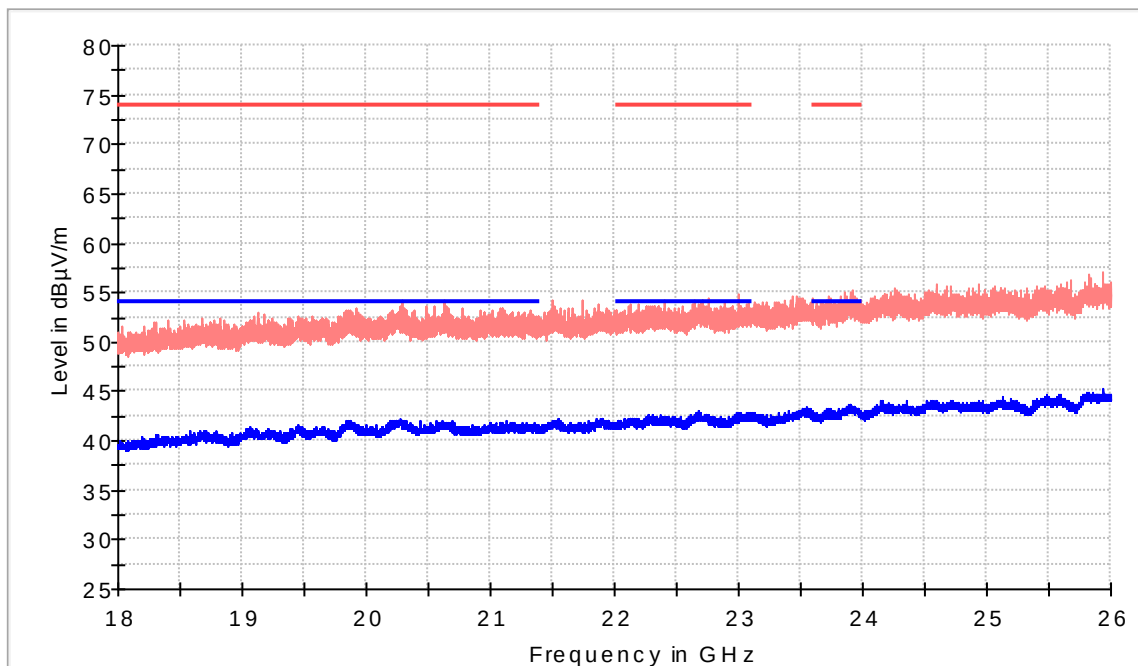
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2463.500000	94.7	90.9	V	---	---	Fundamental
4233.000000	52.7	44.4	V	9.6	54.0	
16057.50000	56.3	44.5	V	9.5	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

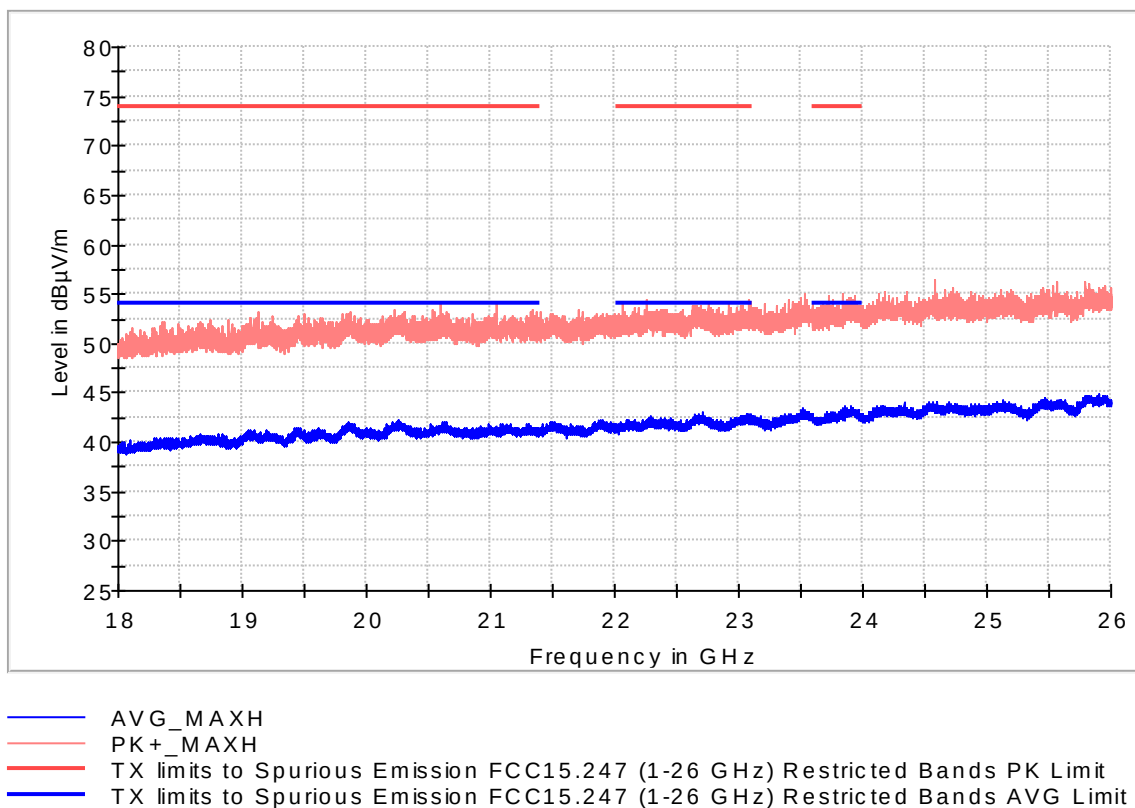
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
23887.500000	54.1	43.8	H	10.2	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [18, 26]

Images:



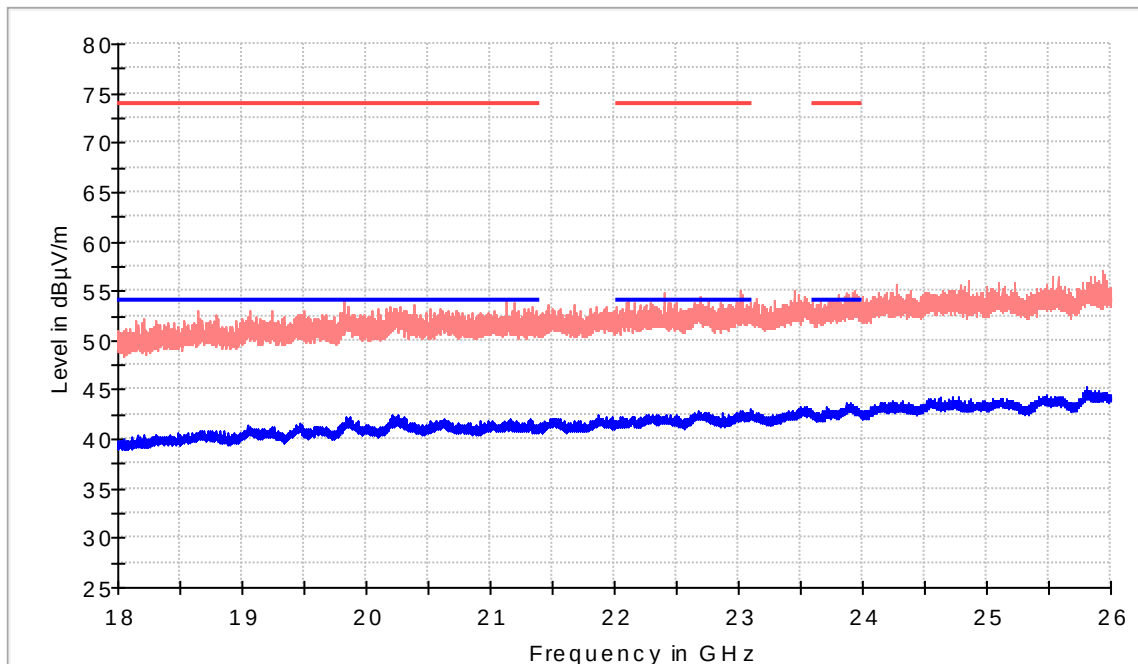
Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
23862.000000	52.2	43.6	H	10.4	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [18, 26]

Images:



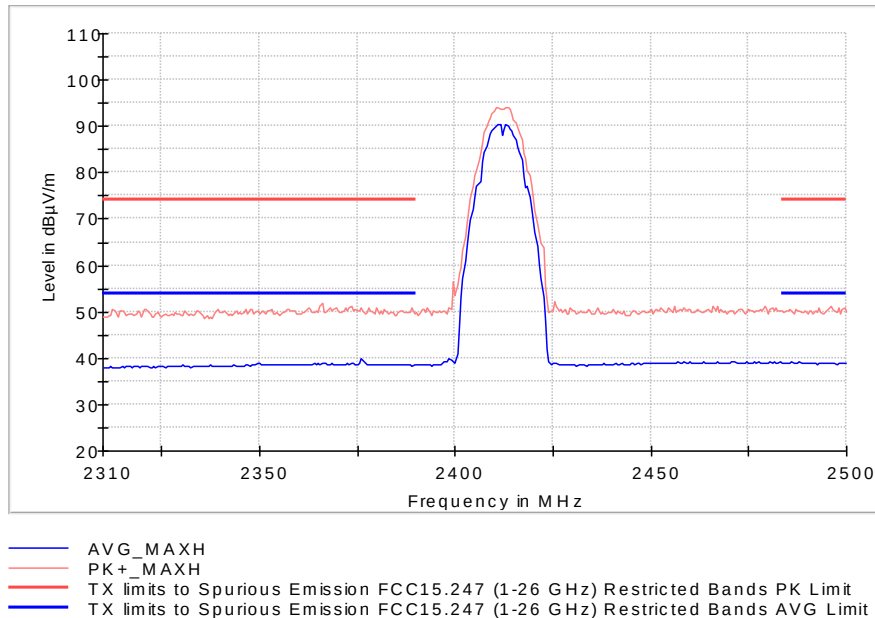
— AVG_MAXH
— PK+ MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+ MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
23910.000000	53.6	43.6	H	10.4	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

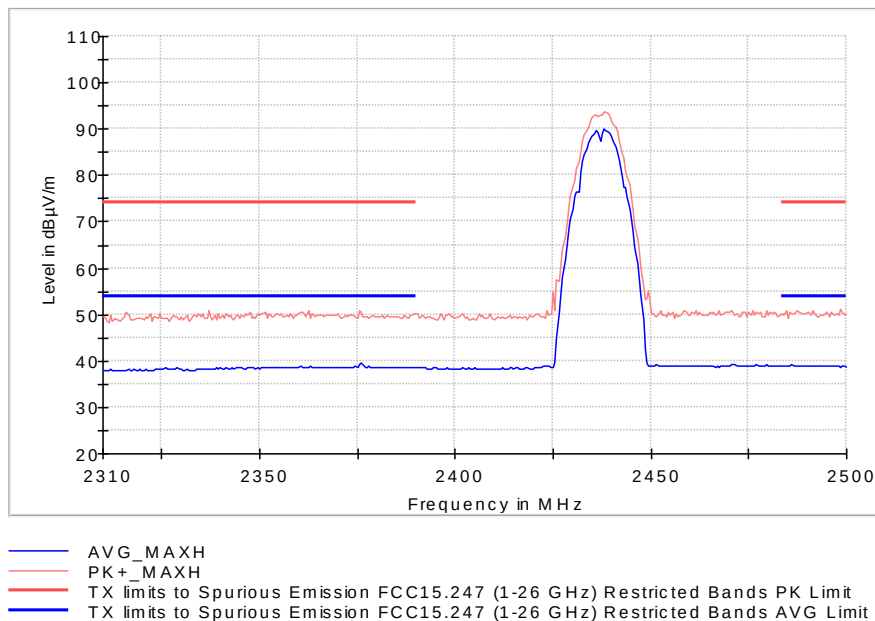
Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]

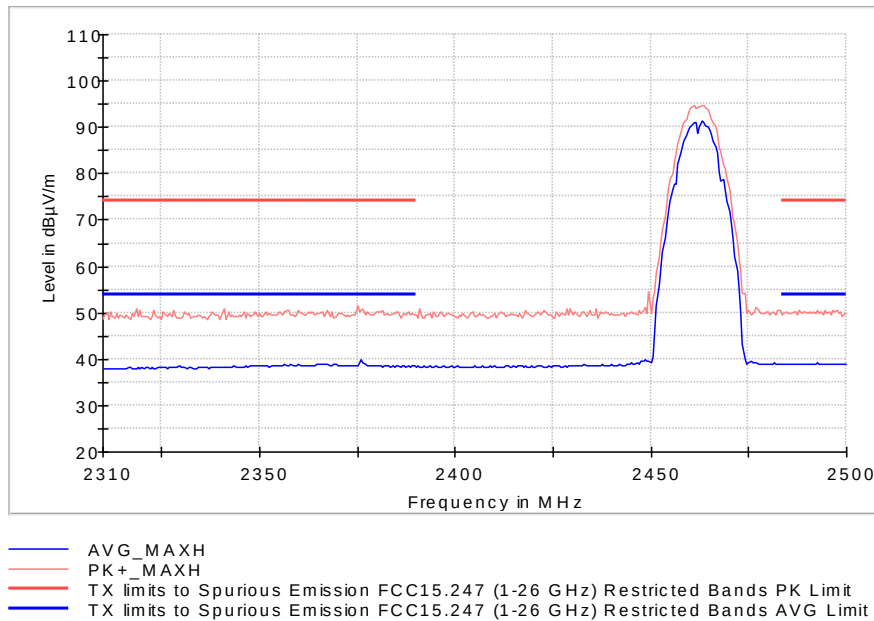


Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]



**Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11b (DSSS 1 Mbit/s), Frequency Range GHz = [1, 18]**



Modulation: 802.11n HT20 (OFDM MCS0 6.5 Mbit/s)

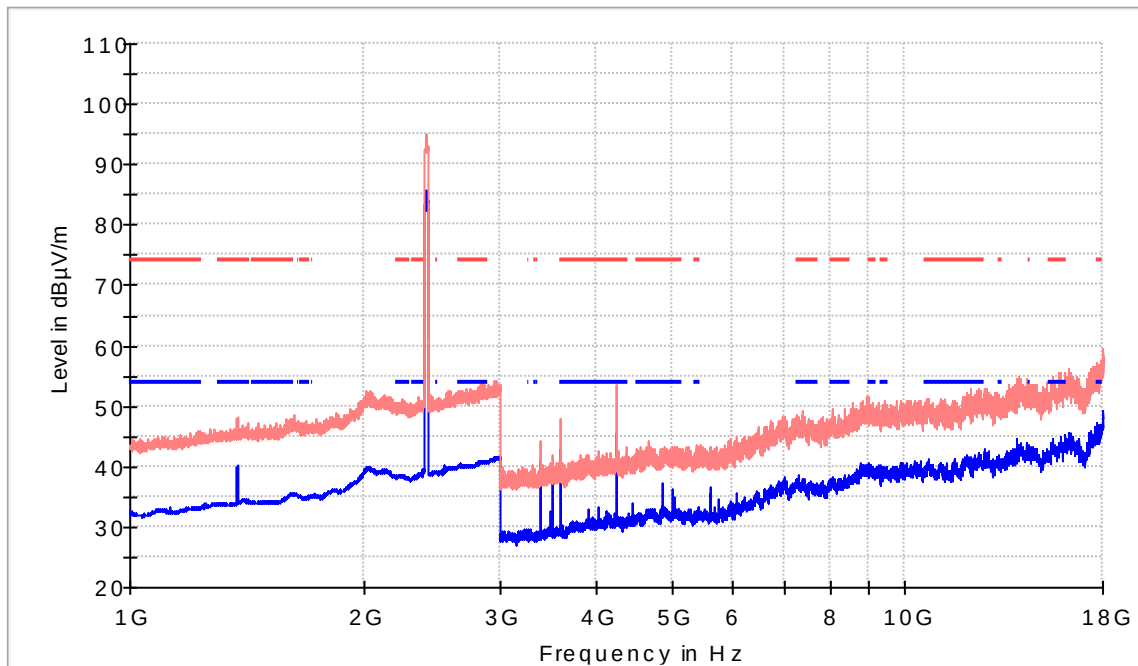
Results

Frequency range 1 - 18 GHz

Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

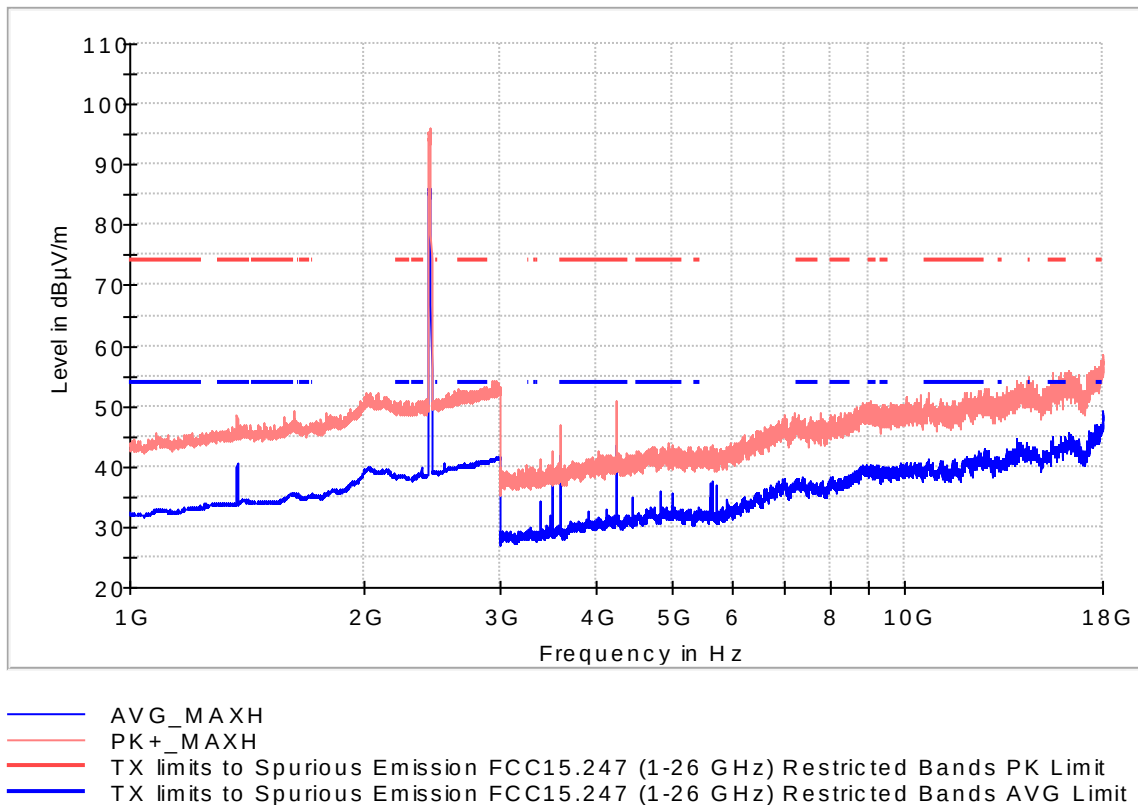
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2415.500000	95.1	85.2	H	---	---	fundamental
4233.000000	53.4	45.6	V	8.4	54.0	
17722.50000	56.0	47.2	V	6.8	54.0	

Frequency range 1 - 18 GHz

Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]

Images:



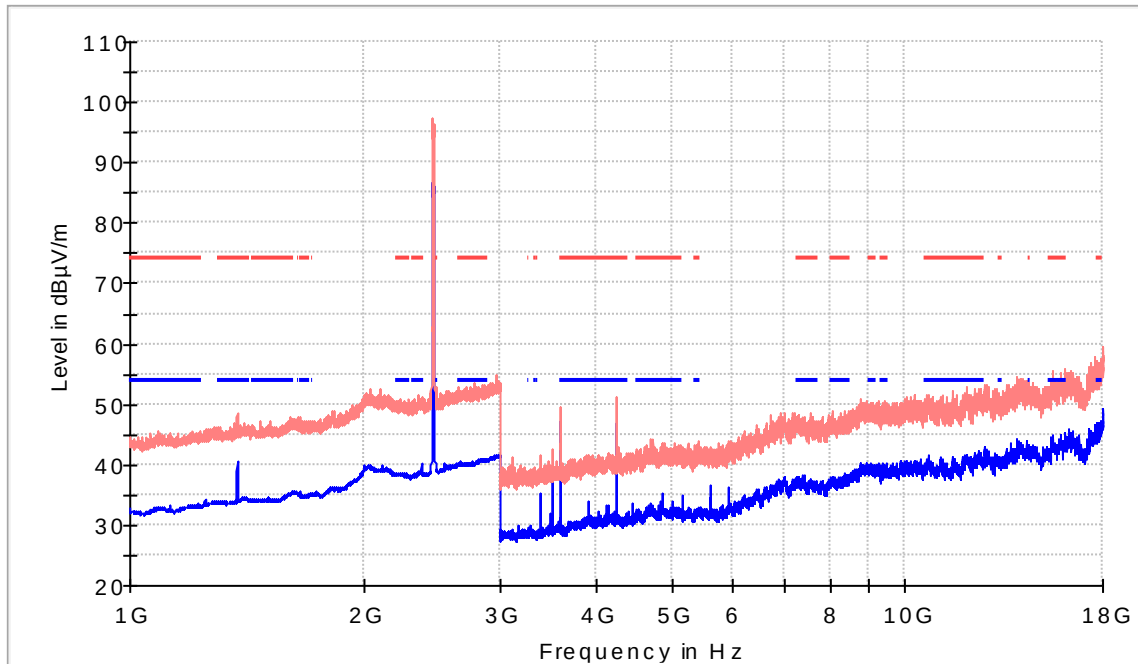
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2440.000000	96.0	85.9	V	---	---	Fundamental
4233.000000	51.0	43.6	V	10.4	54.0	
15900.00000	54.0	45.0	H	9.0	54.0	

Frequency range 1 - 18 GHz

Highest Channel

Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

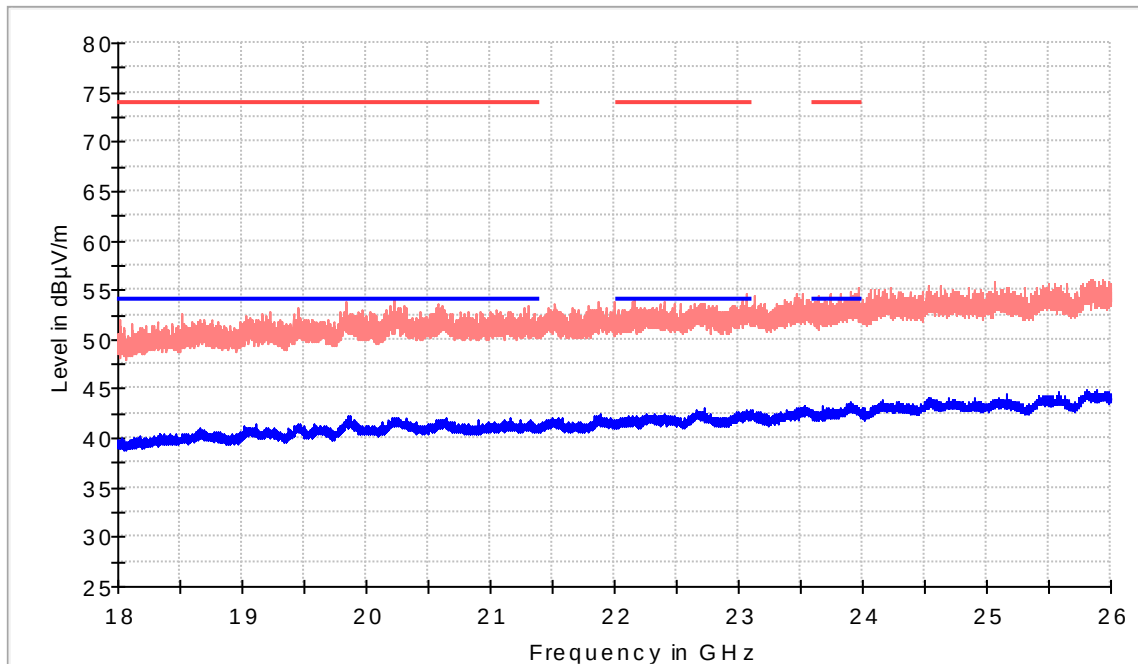
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)	Comment
2458.500000	97.3	86.6	V	---	---	Fundamental
4233.000000	51.3	46.8	V	7.2	54.0	
16052.50000	53.4	45.1	H	8.9	54.0	

Frequency range 18 - 26 GHz

Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

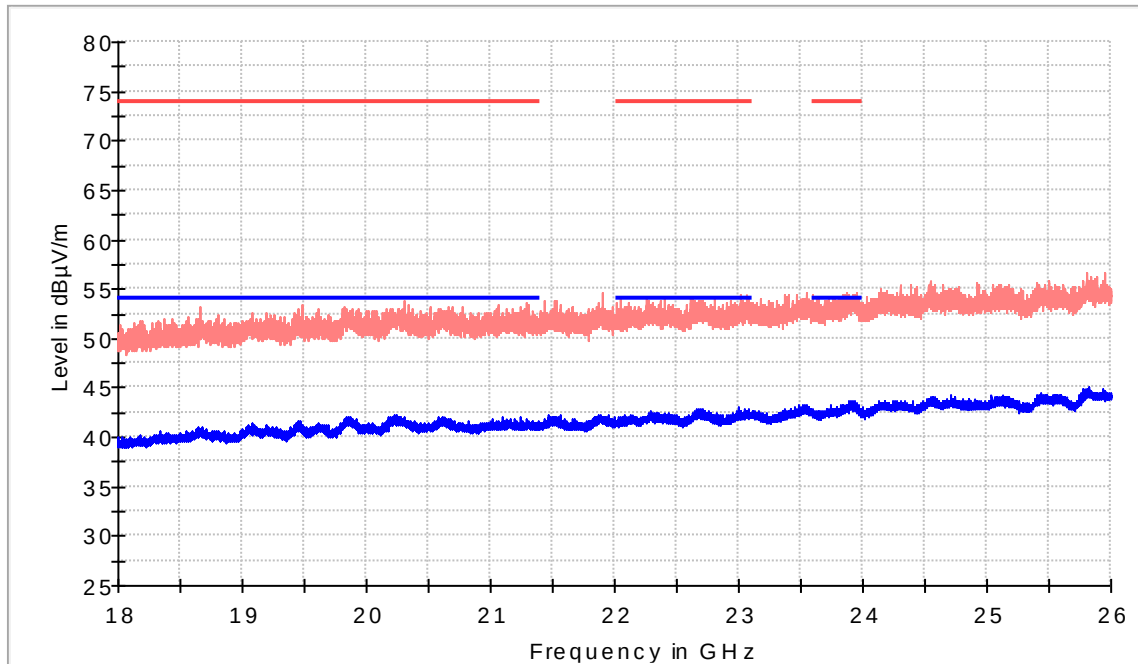
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20233.000000	54.0	41.9	V	12.1	54.0
23071.000000	54.5	42.5	V	11.5	54.0
23962.500000	55.2	43.1	V	10.9	54.0

Frequency range 18 - 26 GHz

Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [18, 26]

Images:



— AVG_MAXH
 — PK+_MAXH
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
 — TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

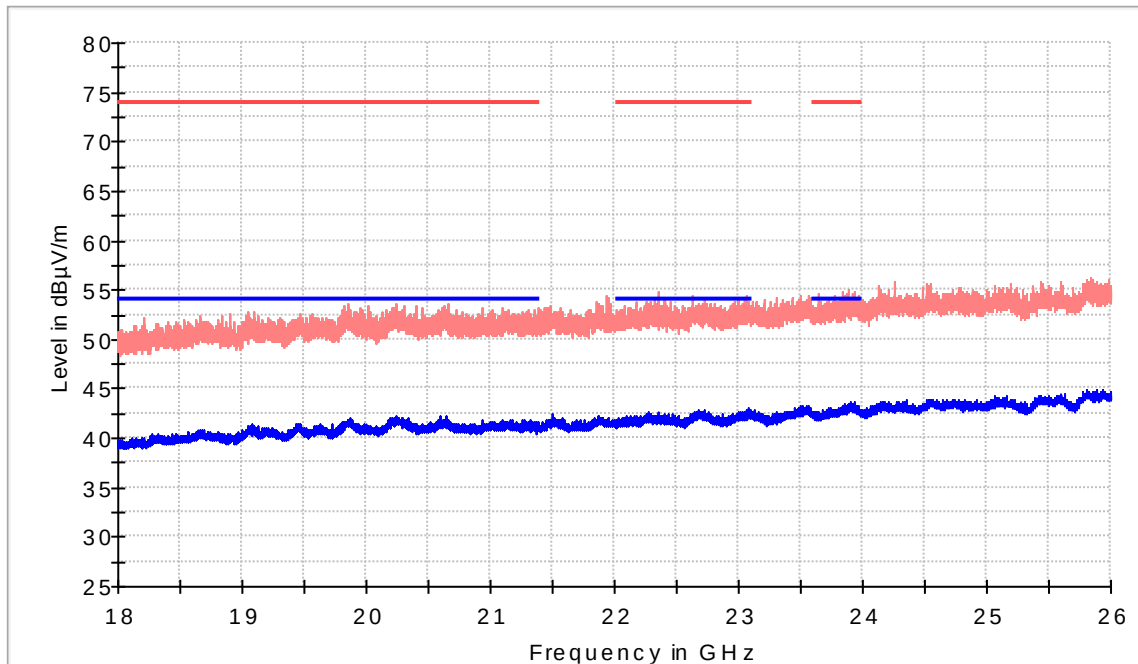
Frequency (MHz)	PK+_MAXH (dBμV/m)	AVG_MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
20246.500000	52.2	42.3	H	11.7	54.0
22997.000000	52.9	43.0	V	11.0	54.0
23913.000000	53.0	43.7	H	10.3	54.0

Frequency range 18 - 26 GHz

Highest Channel

Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [18, 26]

Images:



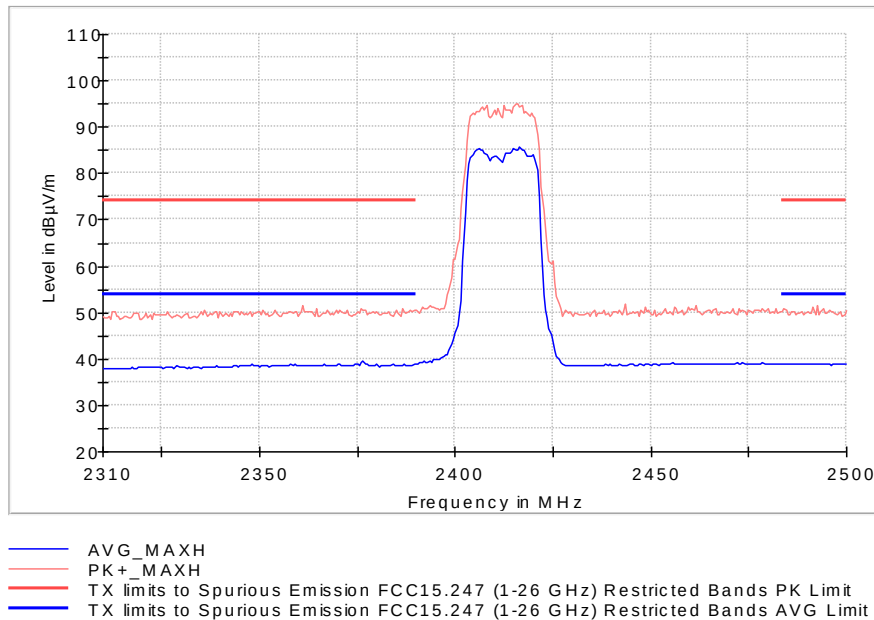
— AVG _MAXH
— PK+ _MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Frequency (MHz)	PK+ _MAXH (dBμV/m)	AVG _MAXH (dBμV/m)	Pol	Margin - AVG (dB)	Limit - AVG (dBμV/m)
22356.500000	54.9	42.1	V	11.9	54.0
23645.000000	54.6	42.2	V	11.8	54.0
23892.500000	55.0	43.2	V	10.8	54.0

Restricted Bands (2.31 GHz - 2.5 GHz)

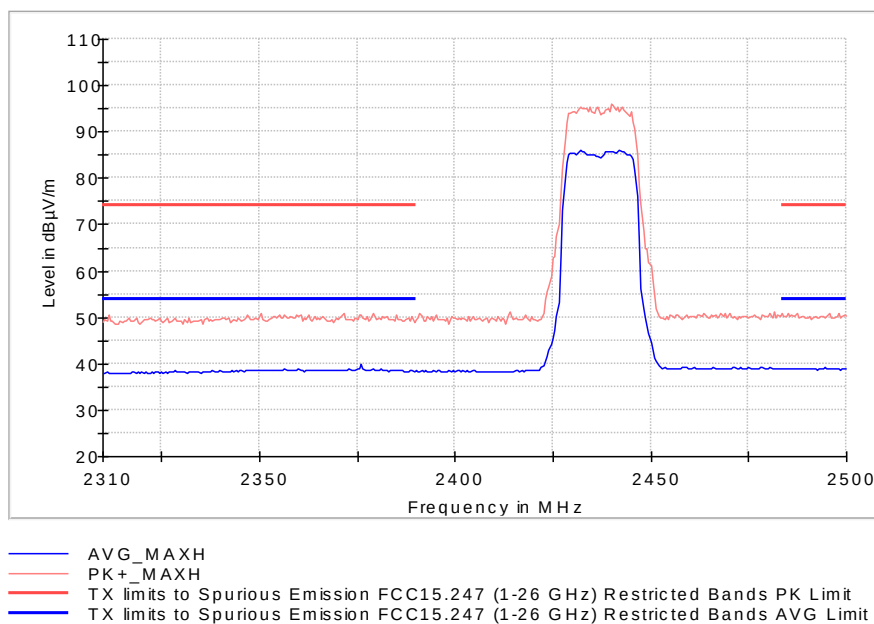
Lowest Channel

Frequency MHz = 2412.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]



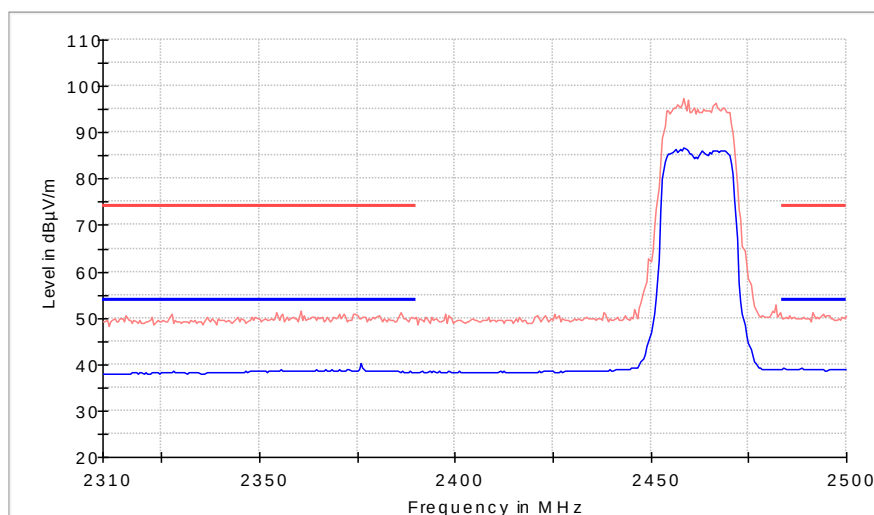
Middle Channel

Frequency MHz = 2437.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]



Highest Channel

Frequency MHz = 2462.00000, Equipment Type = Digital Transmission System (DTS), Bandwidth MHz = 20,
Modulation = 802.11n HT20 (OFDM MCS0 6.5 Mbit/s), Frequency Range GHz = [1, 18]



— AVG_MAXH
— PK+_MAXH
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands PK Limit
— TX limits to Spurious Emission FCC15.247 (1-26 GHz) Restricted Bands AVG Limit

Spectrum Analyzer Parameters

Subrange	Step Size	Detectors	Bandwidth	Sweep Time	Preamp
1 GHz - 3 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB
3 GHz - 18 GHz	500 kHz	PK+ ; AVG	1 MHz	1 s	20 dB