

FCC LISTED, REGISTRATION
NUMBER: 720267

Informe de ensayo nº:
Test report No:

IC LISTED REGISTRATION
NUMBER IC 4621A-1

NIE: 47427RRF.002

Test report

USA FCC Part 15.247, 15.209

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 Licence-Exempt
Local Area Network (LE-LAN) Devices.

General Requirements and Information for the Certification of Radio Apparatus.

Identificación del objeto ensayado.....: Identification of item tested	Wireless accessory to hearing instrument
Marca Trademark	Resound
Modelo y/o referencia tipo Model and /or type reference	SM-2P
Other identification of the product	FCC ID: X26SM-2P IC: 6941C-SM2P
Final HW version	PCBA, SM-2P MAIN BOARD, Rev A
Final SW version	Farlander 3.2.0
Características Features	Microphone audio input, Mini-jack audio input, 3pin Euro input, telecoil receiver, 2.4 GHz proprietary wireless data protocol (Proximity)
Fabricante Manufacturer	GN Hearing A/S Lautrupbjerg 7, 2750 Ballerup, Denmark
Método de ensayo solicitado, norma.....: Test method requested, standard	USA FCC Part 15.247 10-1-14 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 10-1-14 Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 1 (May 2015). CANADA RSS-Gen Issue 4 (November 2014). FCC part 15.247 and Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum System DA 00-705 Released March 30, 2000. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Resultado.....: Summary	IN COMPLIANCE

Aprobado por (nombre / cargo y firma) Approved by (name / position & signature)	A. Llamas RF Lab. Manager
Fecha de realización Date of issue	2015-12-22
Formato de informe No. Report template No	FDT08_17

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Competences and guarantees

AT4 wireless is a laboratory with a measurement facility in compliance with the requirements of Section 2.948 of the FCC rules and has been added to the list of facilities whose measurements data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Registration Number: 720267.

AT4 wireless is a laboratory with a measurement site in compliance with the requirements of RSS 212, Issue 1 (Provisional) and has been added to the list of filed sites of the Canadian Certification and Engineering Bureau. Reference File Number: IC 4621A-1.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance program for its measurement equipment.

AT4 wireless 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 AT4 wireless at the time of performance of the test.

AT4 wireless 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 AT4 wireless.

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 AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

Uncertainty

Uncertainty (factor $k=2$) was calculated according to the AT4 wireless internal document PODT000.

Usage of samples

Samples undergoing test have been selected by: **the client**

Sample S/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
47427/010	Wireless accessory to hearing instrument with integral antenna	SM-2P	---	2015-11-27

1. Sample S/01 has undergone following test(s).
All radiated tests indicated in appendix A.

Sample S/02 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
47427/009	Wireless accessory to hearing instrument with temporary antenna connector	SM-2P	---	2015-11-27

1. Sample S/02 has undergone following test(s).

All conducted tests indicated in appendix A.

Test sample description

The test sample consists of a Wireless accessory to hearing instrument.

The purpose of the device es to pick up audio signals from one of 4 audio sources and transmit audio signal to a compatible hearing instrument through proprietary 2,4 GHz protocol (Proximity).

The 4 audio sources are:

- Built-in microphone
- Mini-jack line in
- 3pin Euro line in
- Built-in telecoil receiver

Identification of the client

GN Hearing A/S

Lautrupbjerg 7, 2750 Ballerup, Denmark

Testing period

The performed test started on 2015-11-27 and finished on 2015-12-22.

The tests have been performed at AT4 wireless.

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 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 1 Ω

Remarks and comments

1: Used instrumentation:

Conducted Measurements

		Last Cal. date	Cal. due date
1.	Spectrum analyser Agilent E4440A	2015/10	2017/10
2.	DC power supply R&S NGPE 40/40	2014/11	2017/11

Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2013/11	2016/11
5.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 40	2014/02	2016/02
7.	EMI Test Receiver R&S ESU 26	2015/11	2017/11
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2015/03	2016/03
9.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-3A	2015/05	2016/05
10.	RF pre-amplifier 12-26 GHz Miteq JS4-12002600-30-5A	2015/10	2017/10

Testing verdicts

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

FCC PART 15 PARAGRAPH / RSS-247		VERDICT			
		NA	P	F	NM
FCC 15.247 Subclause (a) (1) / RSS-247 Clause 5.1 (2)	20 dB Bandwidth and Carrier frequency separation		P		
FCC 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (4)	Number of hopping channels		P		
FCC 15.247 Subclause (a)(1)(iii) / RSS-247 Clause 5.1 (4)	Time of occupancy (Dwell Time)		P		
FCC 15.247 Subclause (b) / RSS-247 Clause 5.4 (2)	Maximum peak output power and antenna gain		P		
FCC 15.247 Subclause (d) / RSS-247 Clause 5.5	Emission limitations conducted (Transmitter)		P		
FCC 15.247 Subclause (d) / RSS-247 Clause 5.5	Emission limitations radiated (Transmitter)		P		

Appendix A – Test result

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TEST CONDITIONS

Power supply (V):

$V_{\text{nominal}} = 3.7 \text{ Vdc}$

Type of power supply = DC voltage from internal battery.

Type of antenna = Integral antenna.

Declared Gain for antenna (maximum) = 3.1 dBi

TEST FREQUENCIES:

Lowest channel: 2404 MHz

Middle channel: 2440 MHz

Highest channel: 2478 MHz

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using a low loss RF cable provided by the client. The measurements are corrected taking into account the cable loss.



RADIATED MEASUREMENTS

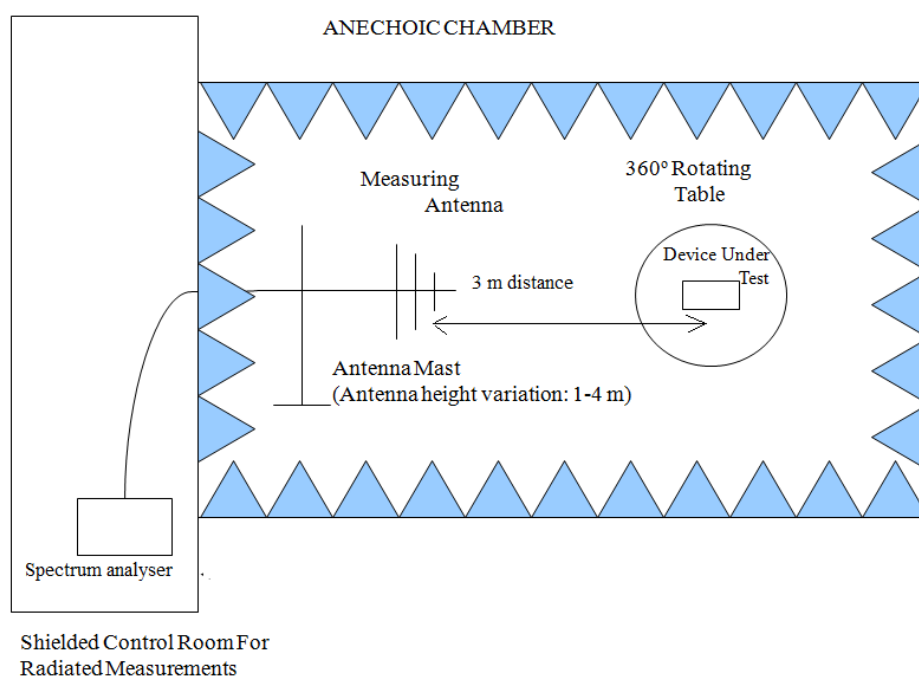
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-25 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 GHz-25 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.

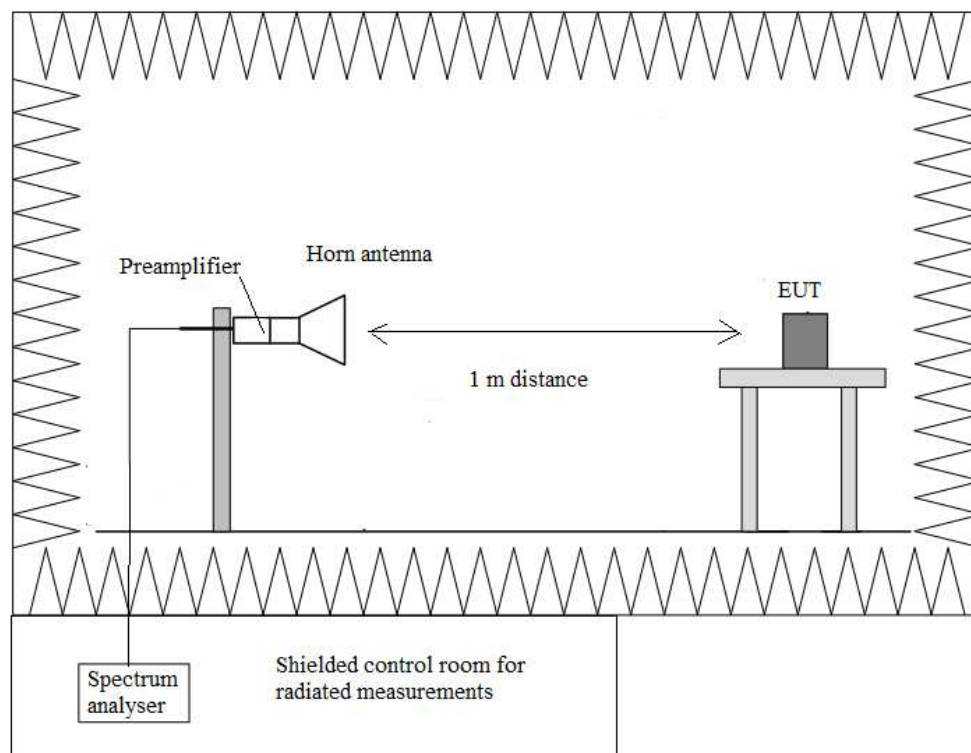
The equipment under test was set up on a non-conductive (wooden) platform 1.5 meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup $f < 1$ GHz



Radiated measurements setup $f > 1$ GHz



FCC Section 15.247 Subclause (a) (1) / RSS-247 Clause 5.1 (2). 20 dB Bandwidth and Carrier frequency separation

SPECIFICATION

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

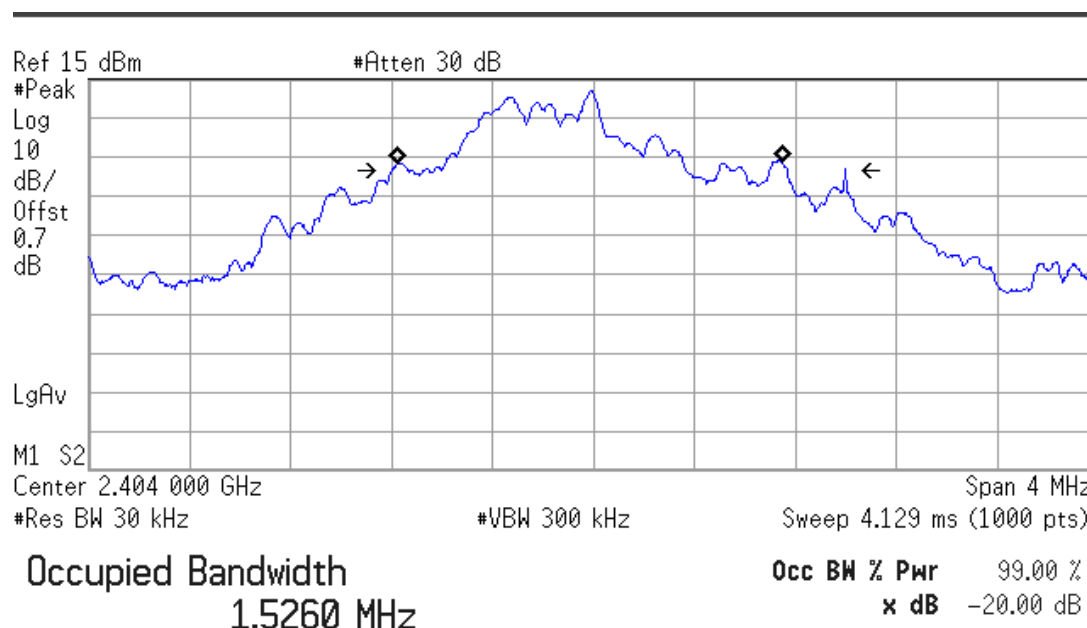
RESULTS

(See next plots)

	Lowest frequency 2404 MHz	Middle frequency 2440 MHz	Highest frequency 2478 MHz
20 dB Spectrum bandwidth (kHz)	1796	1557	1540
Measurement uncertainty (kHz)	<±13.5		

20 dB BANDWIDTH.

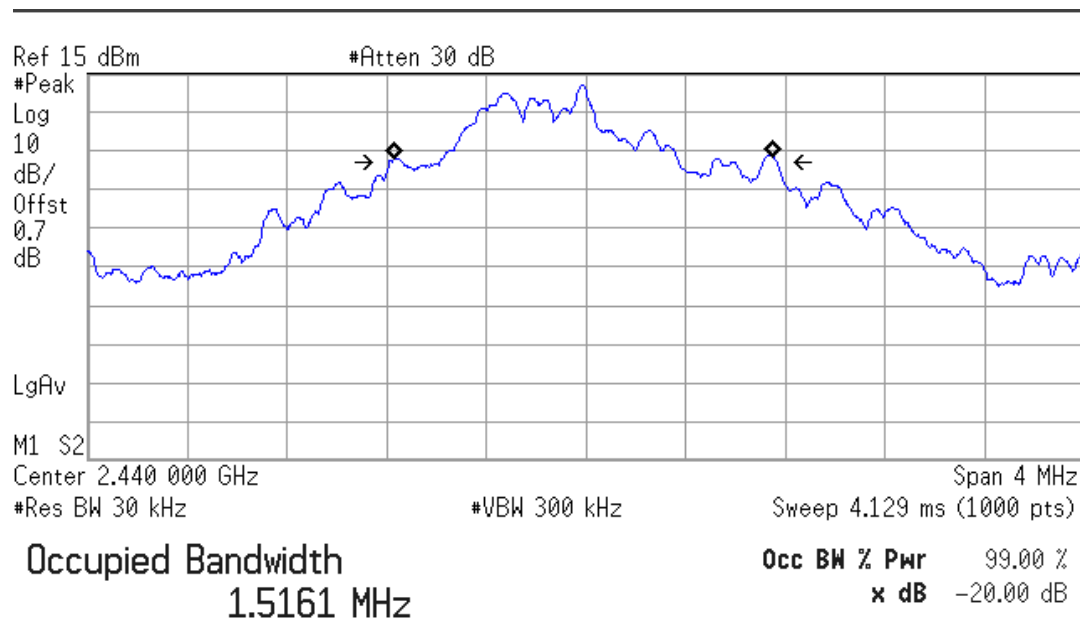
Lowest Channel: 2404 MHz.



Transmit Freq Error -16.199 kHz
x dB Bandwidth 1.796 MHz

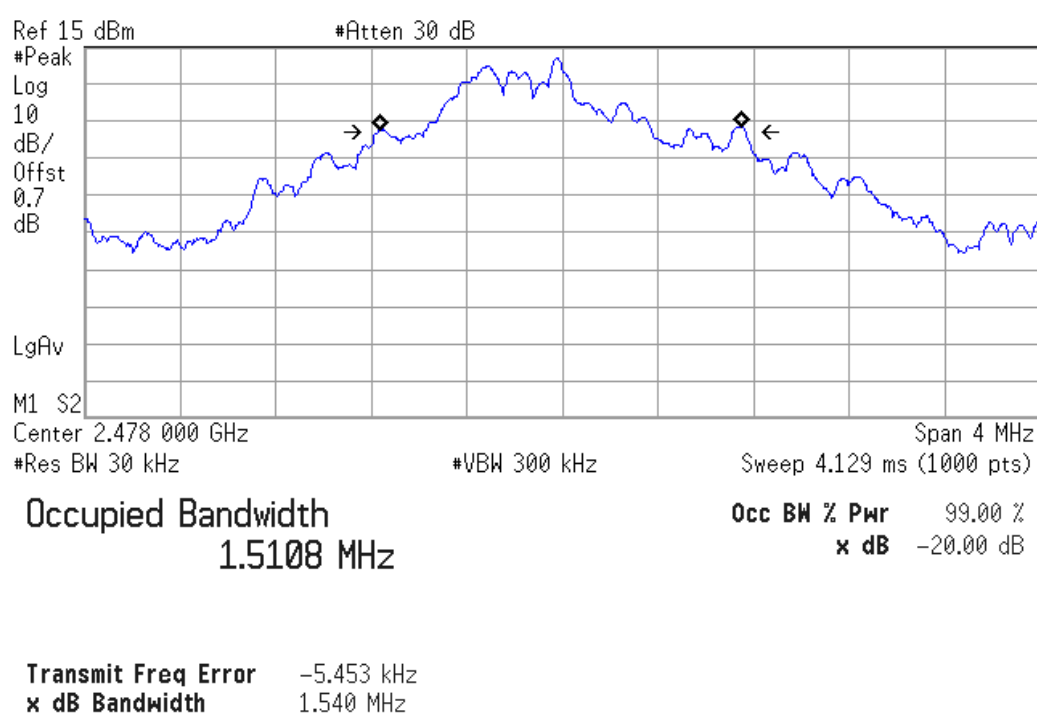
20 dB BANDWIDTH

Middle Channel: 2440 MHz.

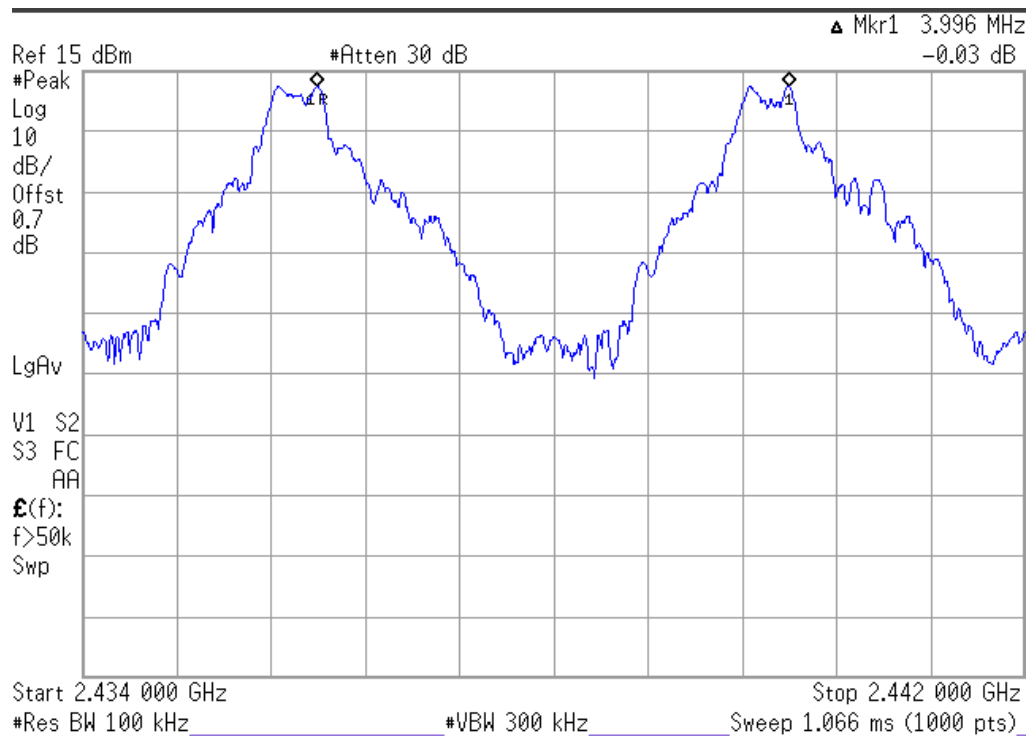


Transmit Freq Error -9.321 kHz
x dB Bandwidth 1.557 MHz

Highest Channel: 2478 MHz.



Carrier frequency separation



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

Verdict: PASS

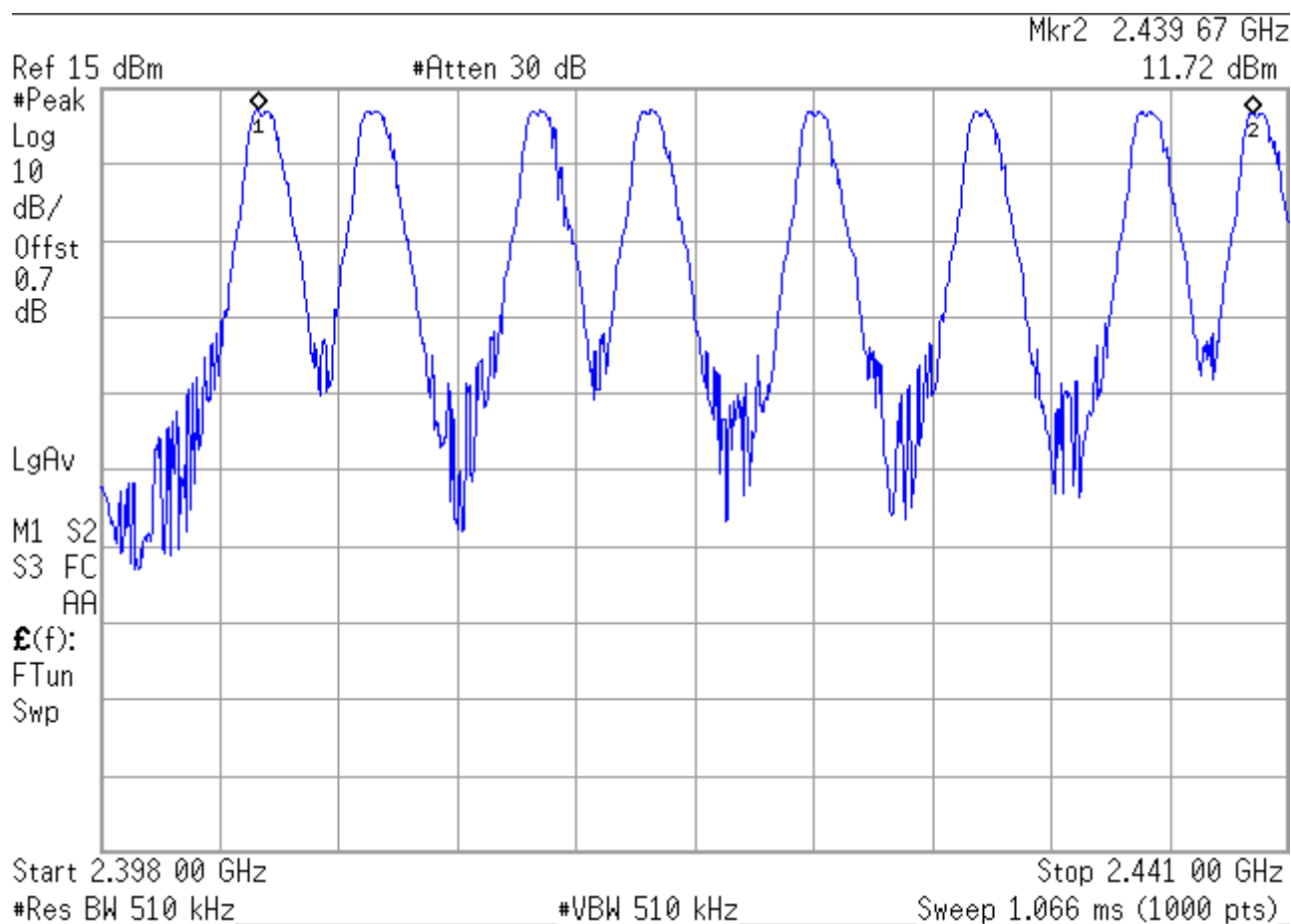
FCC Section 15.247 Subclause (a) (1) (iii) / RSS-247 Clause 5.1 (4). Number of hopping channels

SPECIFICATION

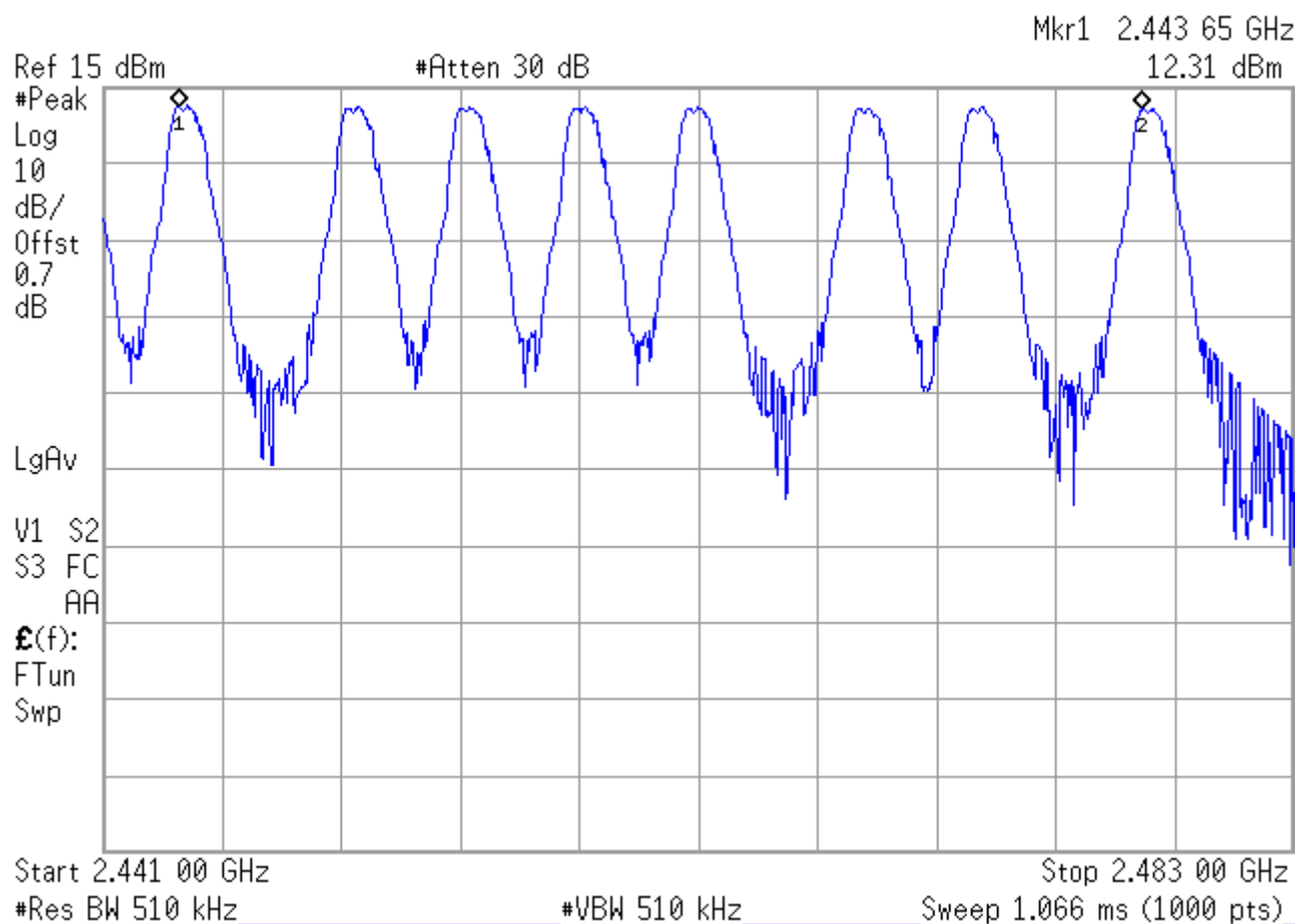
Frequency hopping system in the 2400-2483.5 MHz band shall use at least 15 channels.

RESULTS

The number of hopping channels is 16 (see next plots).



Number of hopping frequencies: 8



Number of hopping frequencies: 8

Total number of hopping frequencies: 16

Verdict: PASS

FCC Section 15.247 Subclause (a) (1) (iii) / RSS-247 Clause 5.1 (4). Time of occupancy (Dwell Time)

SPECIFICATION

The average time of occupancy on any channel shall not be greater than 0.4 seconds (400 ms) within a period of 0.4 seconds multiplied by the number of hopping channels employed = $0.4 \times 16 = 6.4$ seconds.

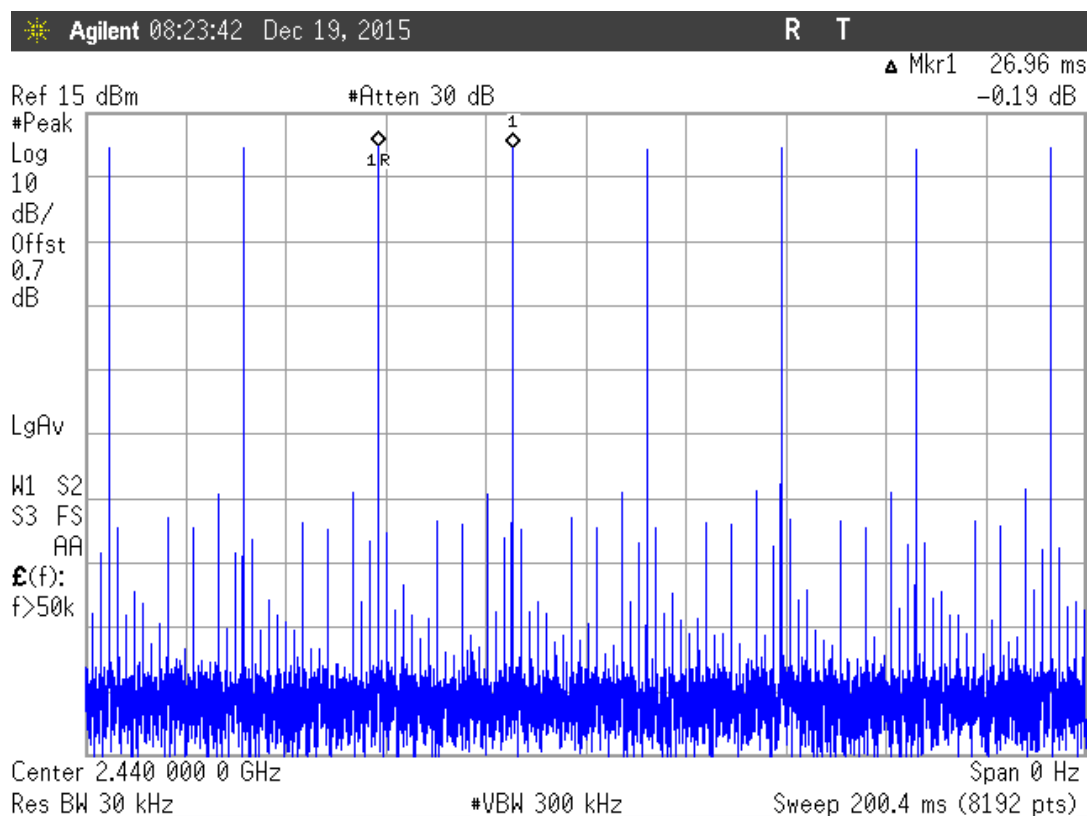
RESULTS

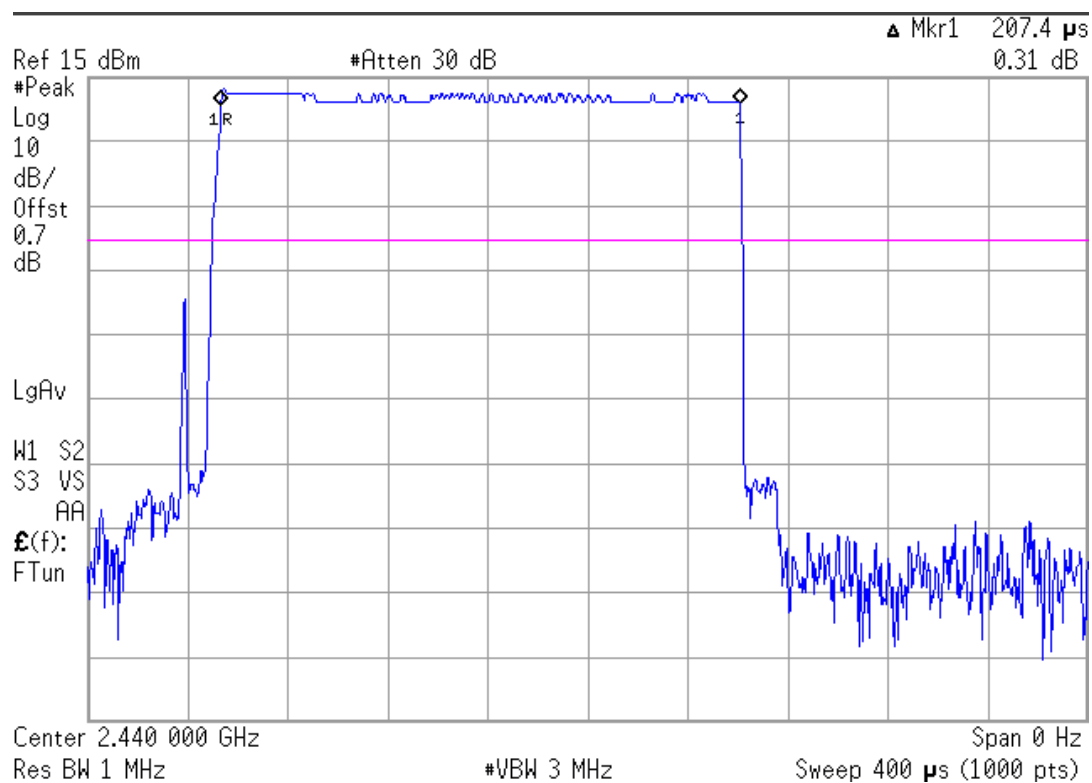
1. TIME OF OCCUPANCY (DWEELL TIME).

The system makes worst case 1 hop in each channel every 26.96 ms (see next plots), so you have each channel 37.09 times per second and so for a period of $0.4 \times 16 = 6.4$ seconds you have $37.09 \times 6.4 = 237.38$ times of appearance.

Each Tx-time per appearance is 207.4 μ s (see next plots).

So we have $237.38 \times 207.4 \mu\text{s} = 49.23$ ms per 6.4 seconds.





Verdict: PASS

FCC Section 15.247 Subclause (b) / RSS-247 Clause 5.4 (2). Maximum peak output power and antenna gain

SPECIFICATION

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt (30 dBm). For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts (20.97 dBm).

The e.i.r.p. shall not exceed 0.5 W (26.99 dBm) (RSS-247).

MAXIMUM OUTPUT POWER. See next plots.

Declared maximum antenna gain: 3.1 dBi.

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

	Lowest frequency 2404 MHz	Middle frequency 2440 MHz	Highest frequency 2478 MHz
Maximum peak power (dBm)	13.22	13.12	12.90
Maximum EIRP power (dBm)	16.32	16.22	16.00
Measurement uncertainty (dB)	<± 0.78		

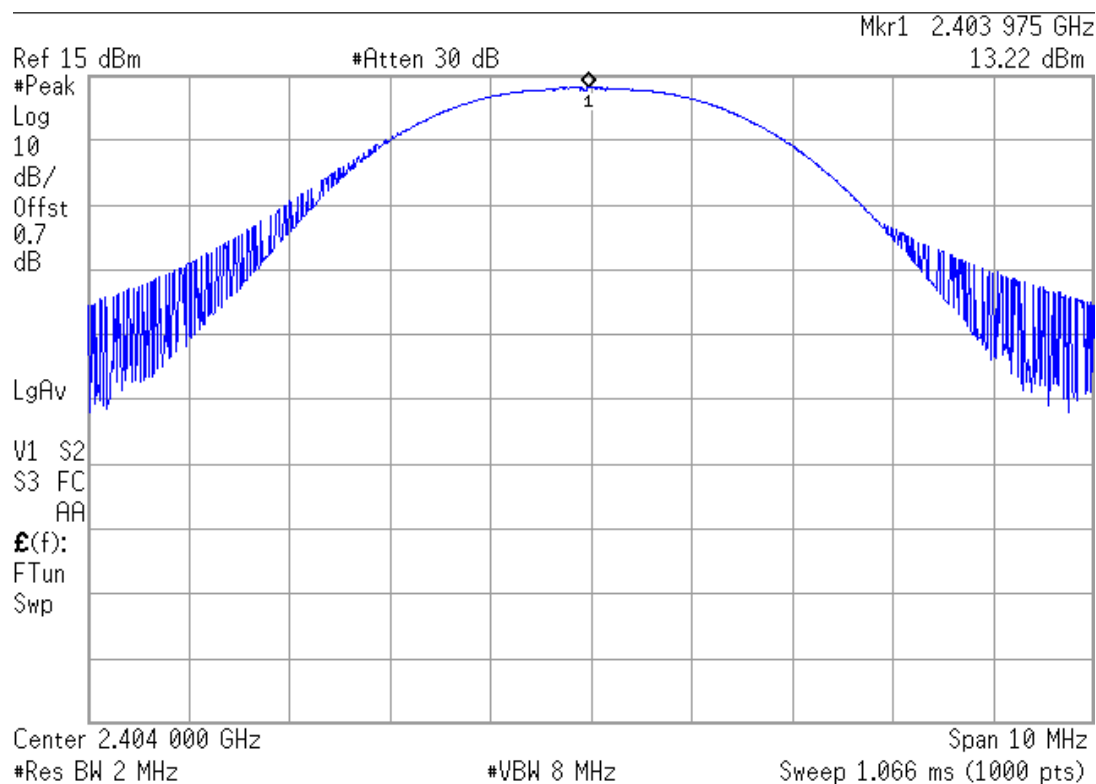
The maximum directional gain of the antenna is less than 6 dBi and therefore the maximum output power is not required to be reduced from the stated values.

Verdict: PASS

PEAK OUTPUT POWER (CONDUCTED).

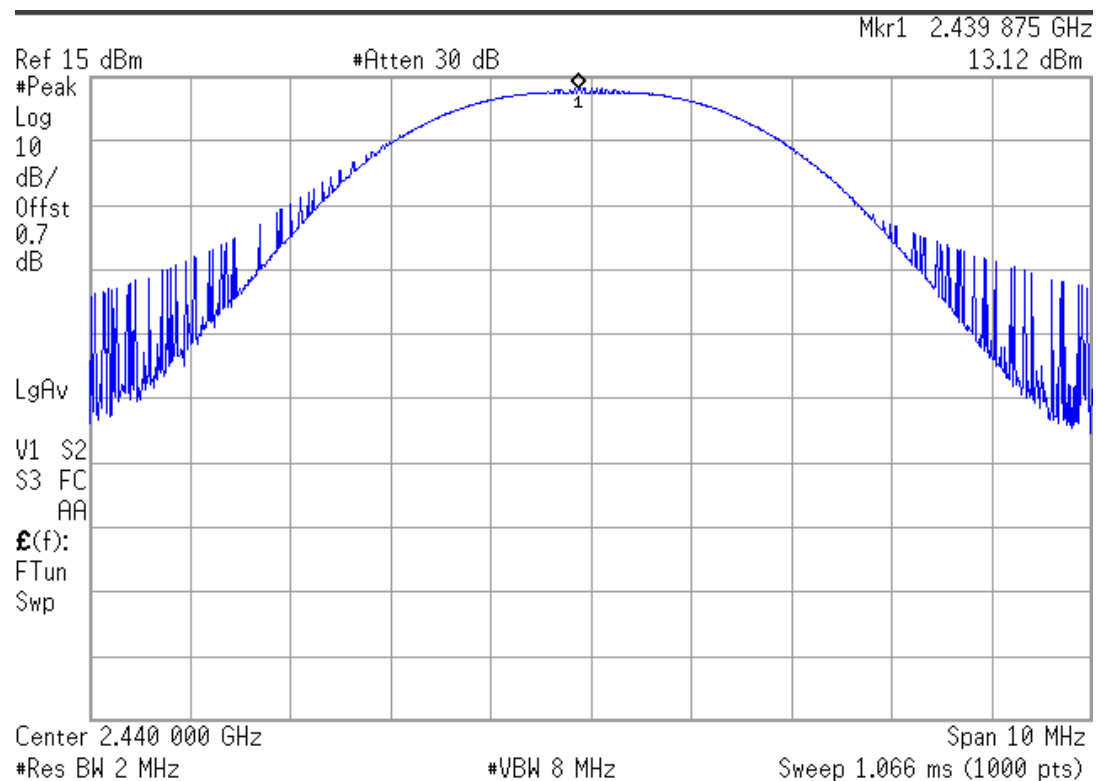
Modulation: GFSK

Lowest Channel: 2404 MHz.



Modulation: GFSK

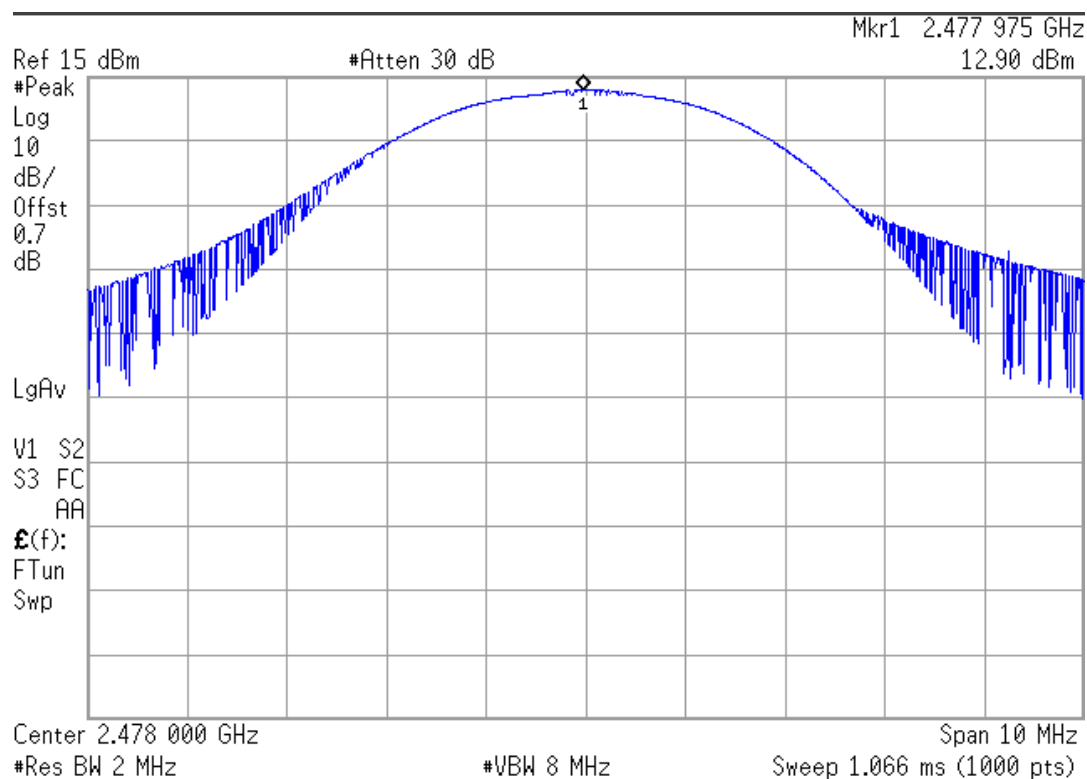
Middle Channel: 2440 MHz.



PEAK OUTPUT POWER (CONDUCTED).

Modulation: GFSK

Highest Channel: 2478 MHz.



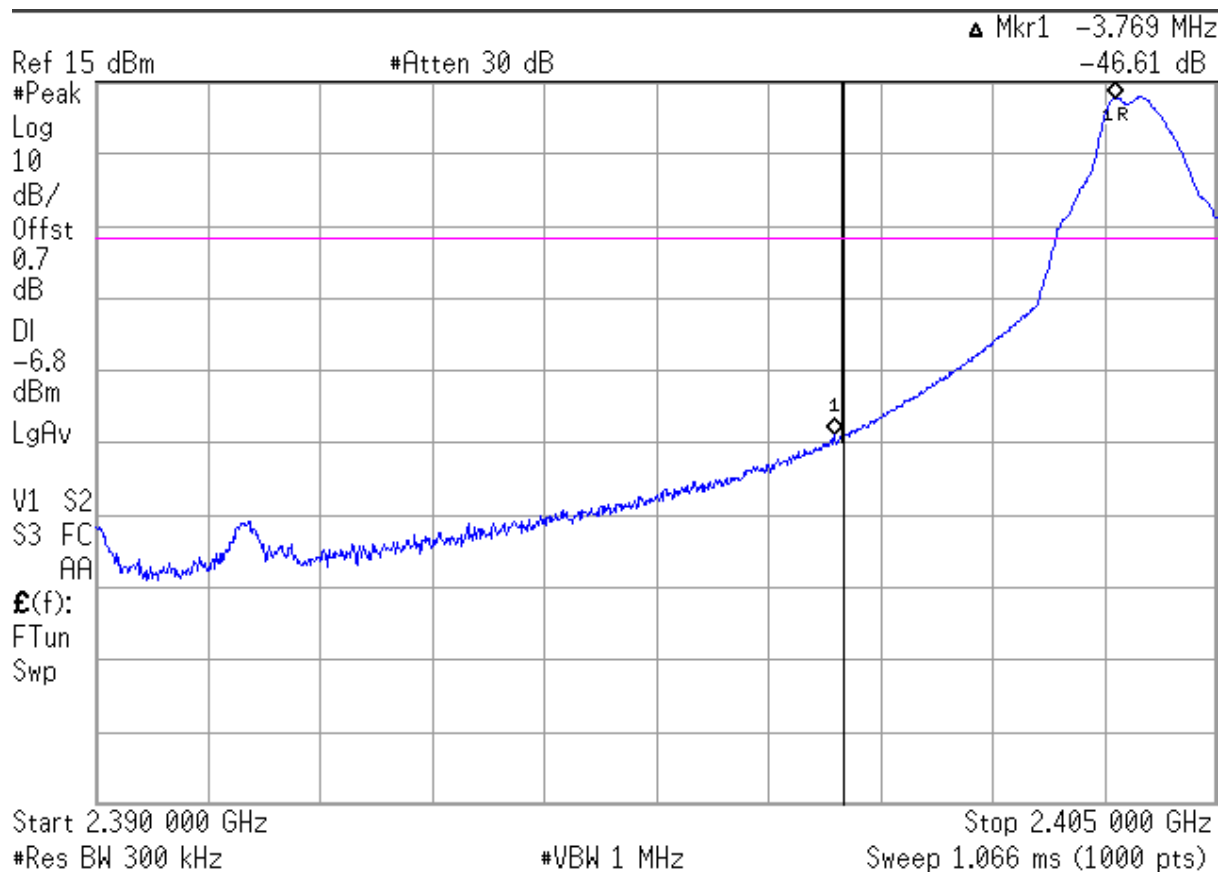
FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Band-edge compliance of conducted emissions (Transmitter)

SPECIFICATION

Emissions outside the frequency band in which the intentional radiator is operating shall be at least 20 dB below the highest level of the desired power.

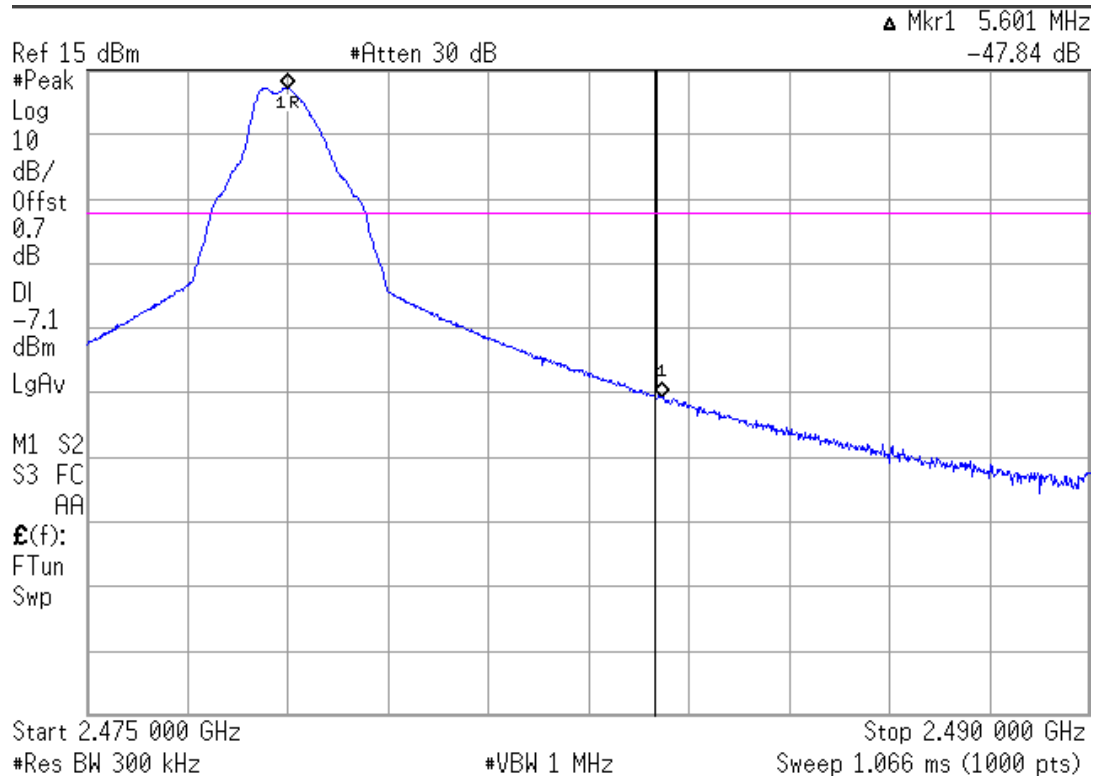
RESULTS:

1. LOW FREQUENCY SECTION 2404 MHz (HOPPING OFF). See next plot.



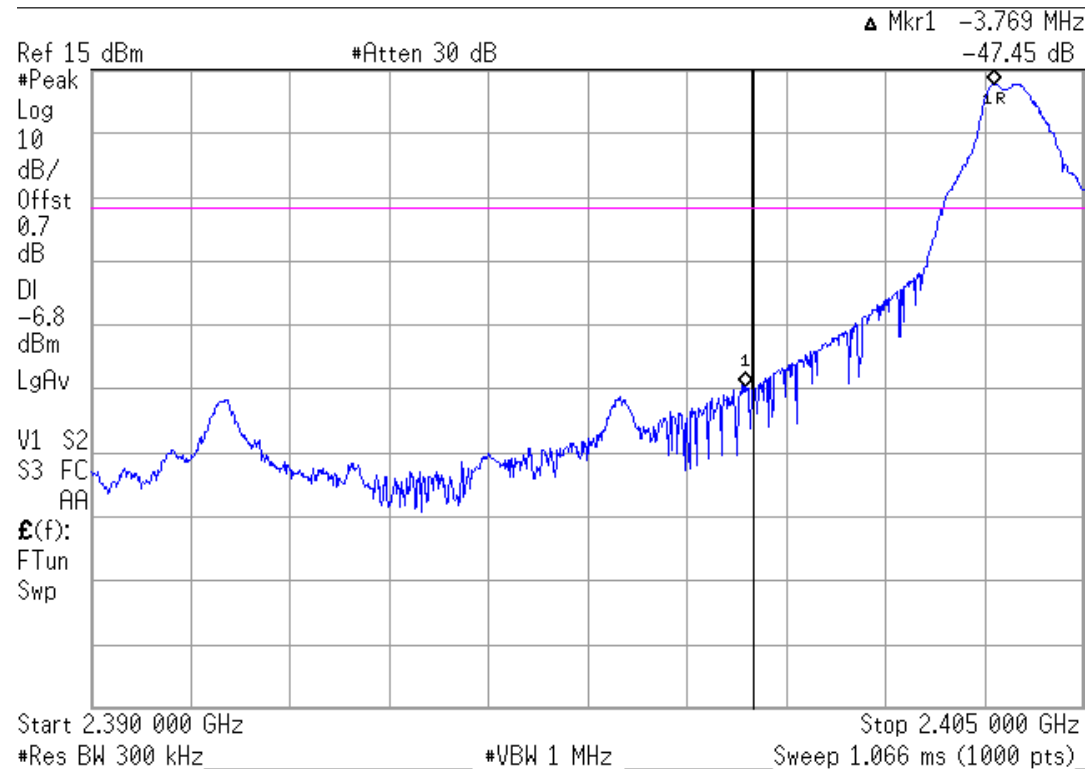
Verdict: PASS

2. HIGH FREQUENCY SECTION 2478 MHz (HOPPING OFF). See next plot.



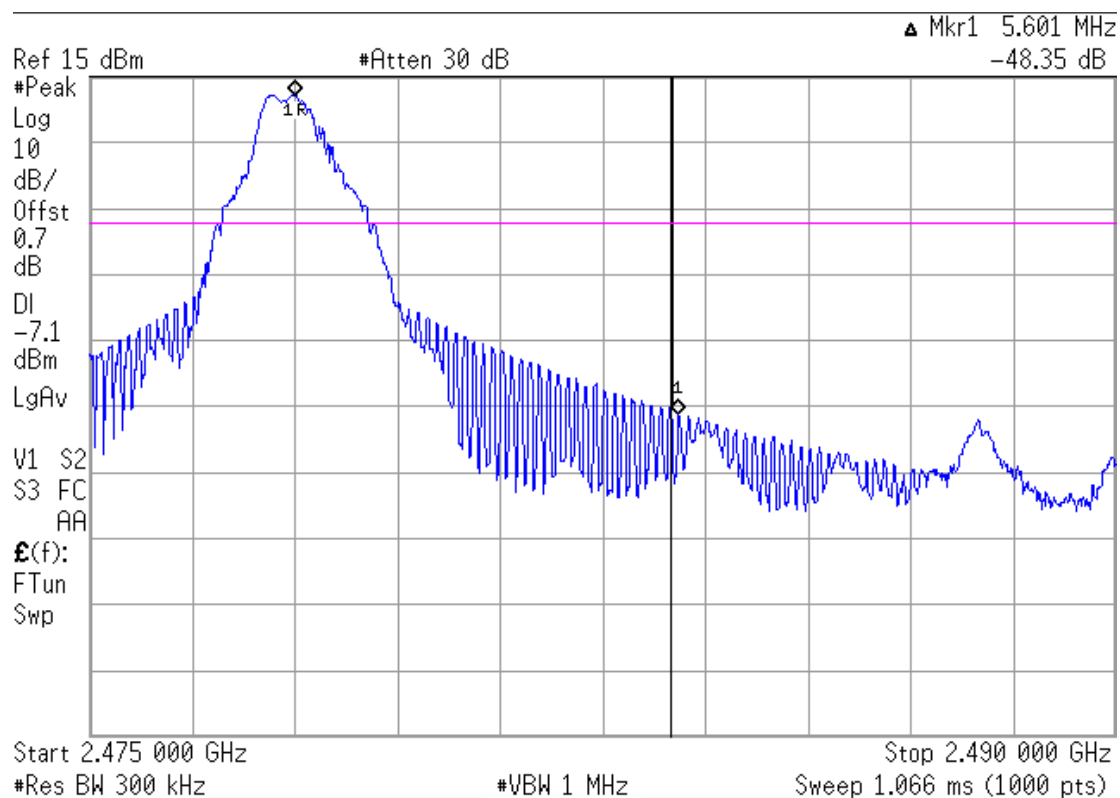
Verdict: PASS

3. LOW FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

4. HIGH FREQUENCY SECTION (HOPPING ON). See next plot.



Verdict: PASS

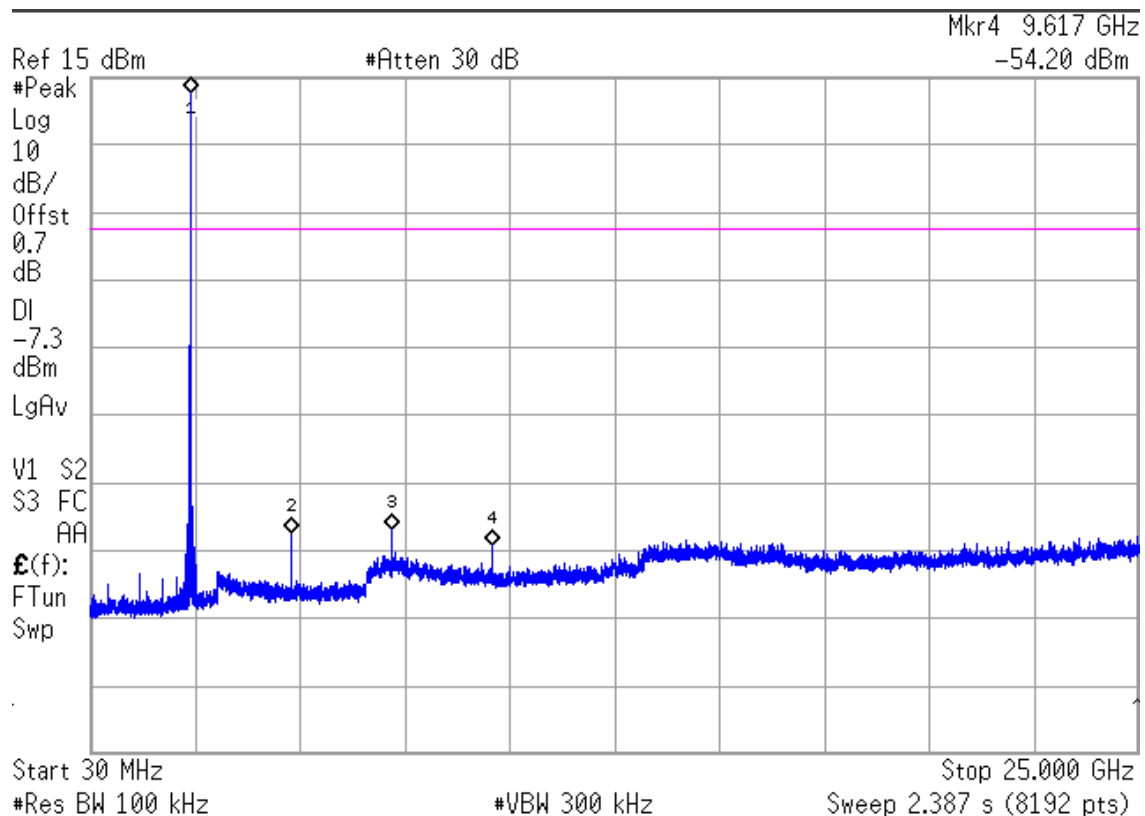
FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations conducted (Transmitter)

SPECIFICATION

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

RESULTS:

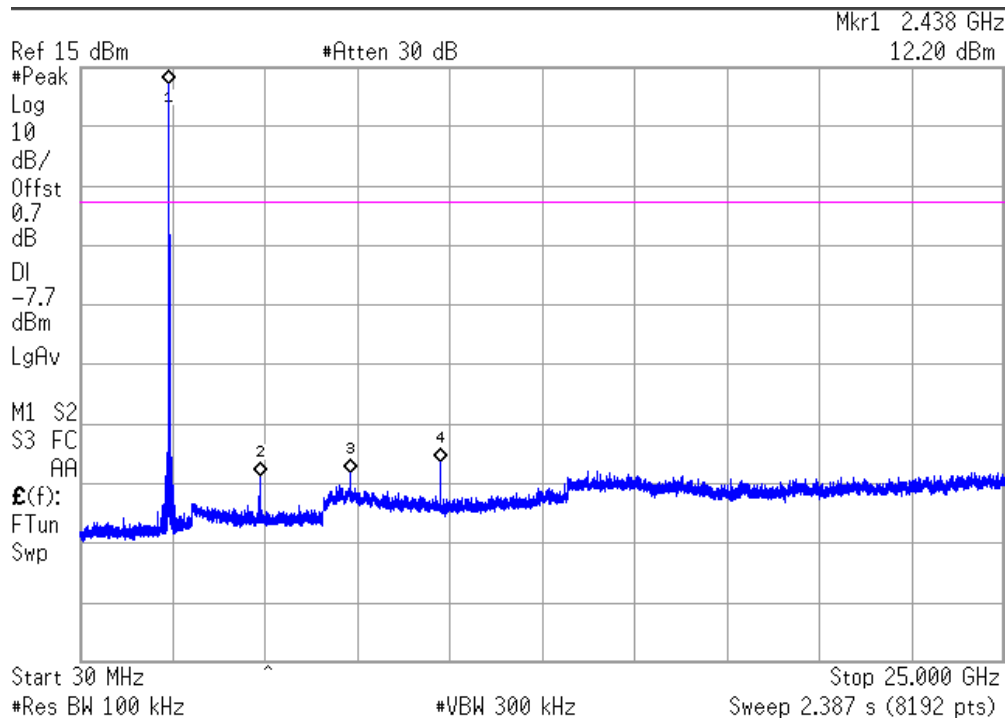
1. LOWEST CHANNEL (2404 MHz): 30 MHz-25 GHz (see next plot).



Note: The peak above the limit is the carrier frequency.

Verdict: PASS

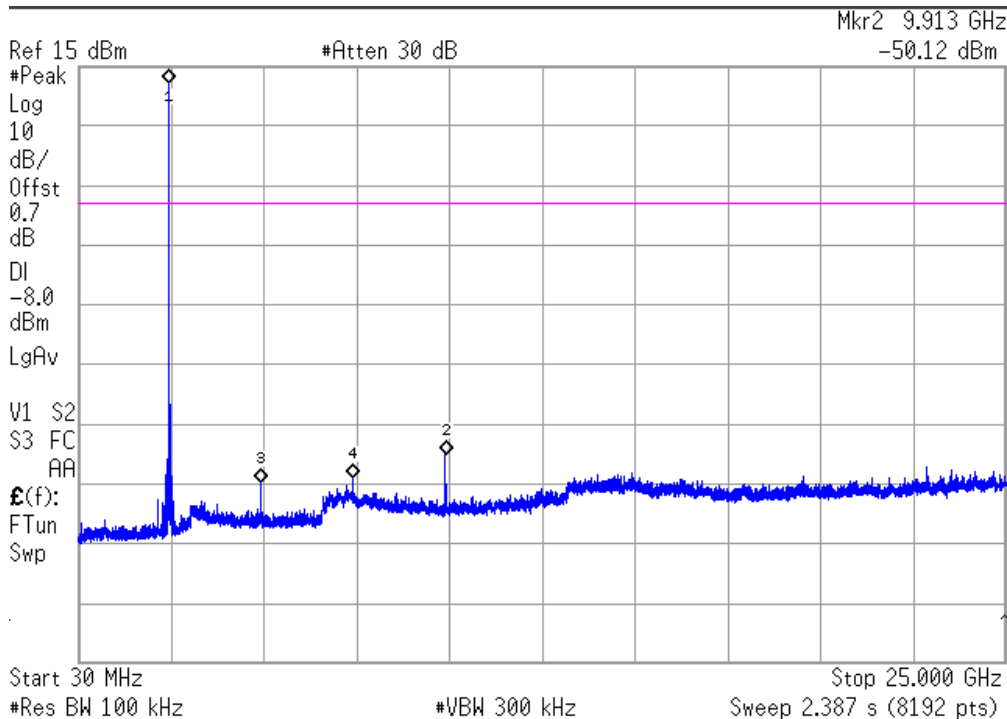
2. MIDDLE CHANNEL (2440 MHz): 30 MHz-25 GHz (see next plot).



Note: The peak above the limits is the carrier frequency.

Verdict: PASS

3. HIGH CHANNEL (2478 MHz): 30 MHz-25 GHz (see next plot).



Note: The peak above the limits is the carrier frequency.

Verdict: PASS

FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated (Transmitter)

SPECIFICATION

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)):

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

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.

RESULTS:

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.

All tests were performed in a semi-anechoic chamber at a distance of 3 m for the frequency range 30 MHz-1000 MHz and at distance of 1m for the frequency range 1 GHz-25 GHz.

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.

Frequency range 30 MHz-1000 MHz.

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

Highest spurious levels

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
59.973	V	Quasi-Peak	24.94	± 3.88
165.994	V	Quasi-Peak	24.99	± 3.88

Frequency range 1 GHz-25 GHz

1. CHANNEL: LOWEST (2404 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.387712	V	Peak	49.12	± 4.69
		AVG	36.77	± 4.69
9.615000	V	Peak	45.80	± 4.69
		AVG	35.80	± 4.69

2. CHANNEL: MIDDLE (2440 MHz).

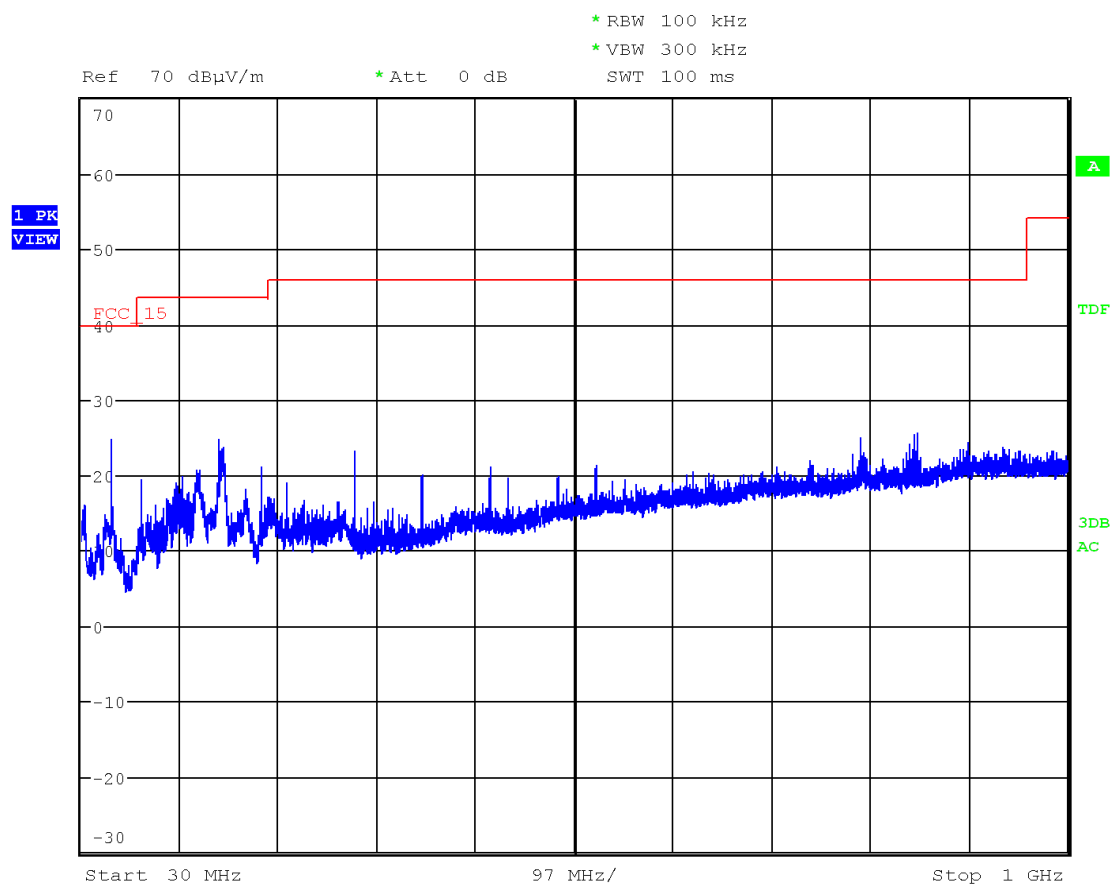
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.486077	V	Peak	49.90	± 4.69
		AVG	37.40	± 4.69
7.319000	V	Peak	45.02	± 4.69
		AVG	40.31	± 4.69
9.759000	V	Peak	44.27	± 4.69
		AVG	38.77	± 4.69

3. CHANNEL: HIGHEST (2480 MHz).

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.484007	V	Peak	49.85	± 4.69
		AVG	36.95	± 4.69
7.434000	V	Peak	42.78	± 4.69
		AVG	36.49	± 4.69

Verdict: PASS

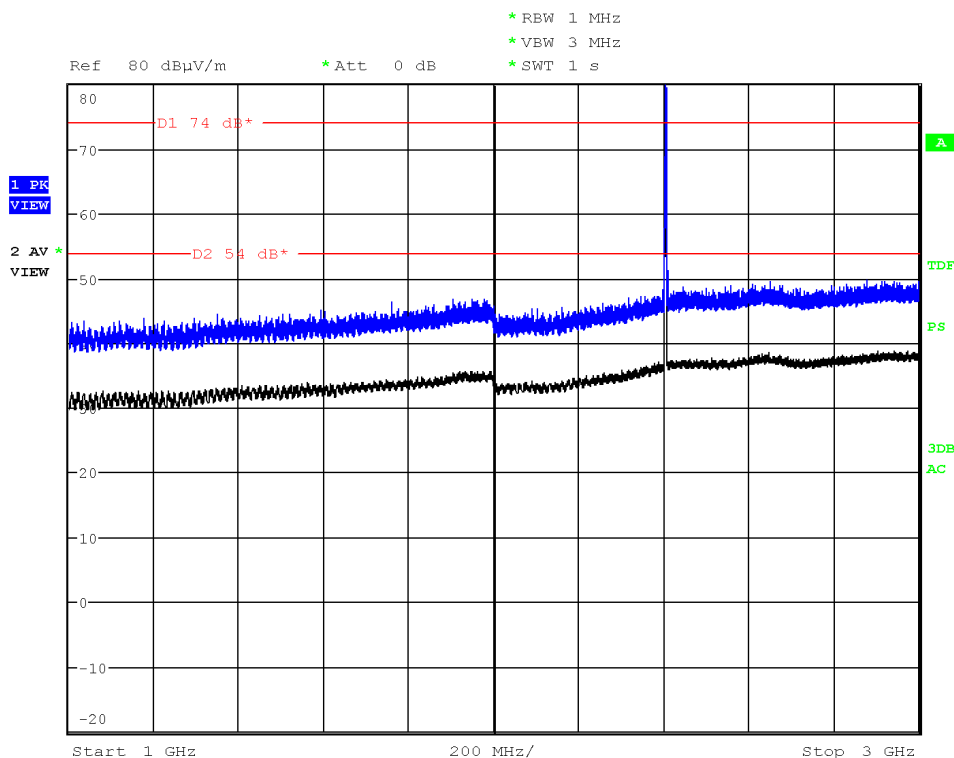
FREQUENCY RANGE 30 MHz-1000 MHz.



(This plot is valid for all three channels).

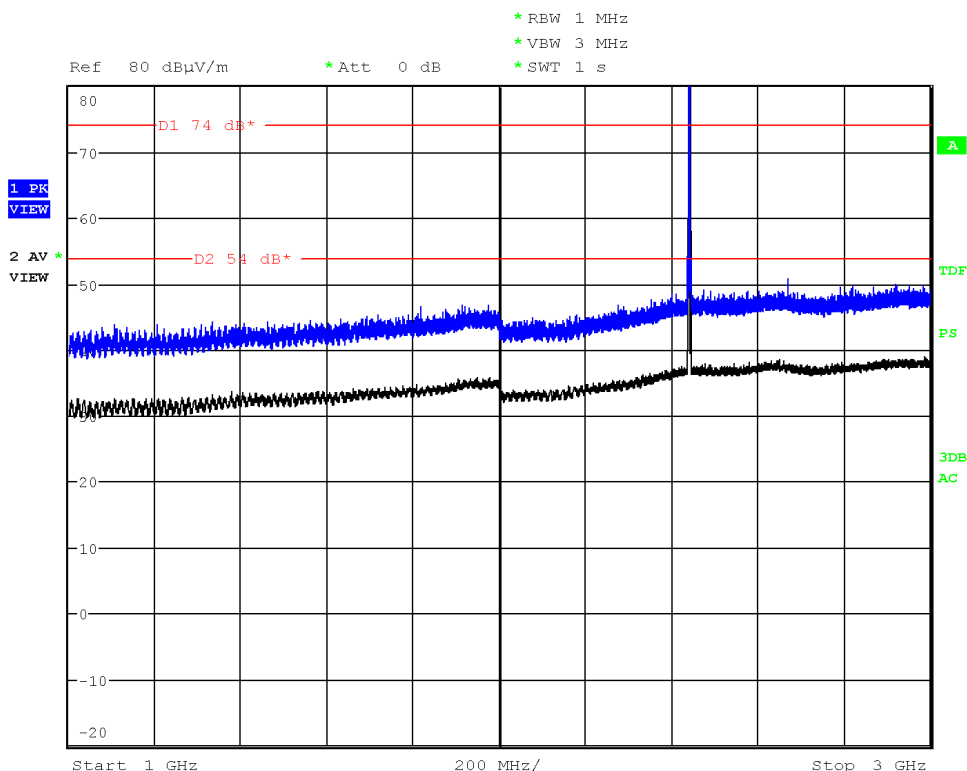
FREQUENCY RANGE 1 GHz to 3 GHz.

CHANNEL: Lowest (2404 MHz).



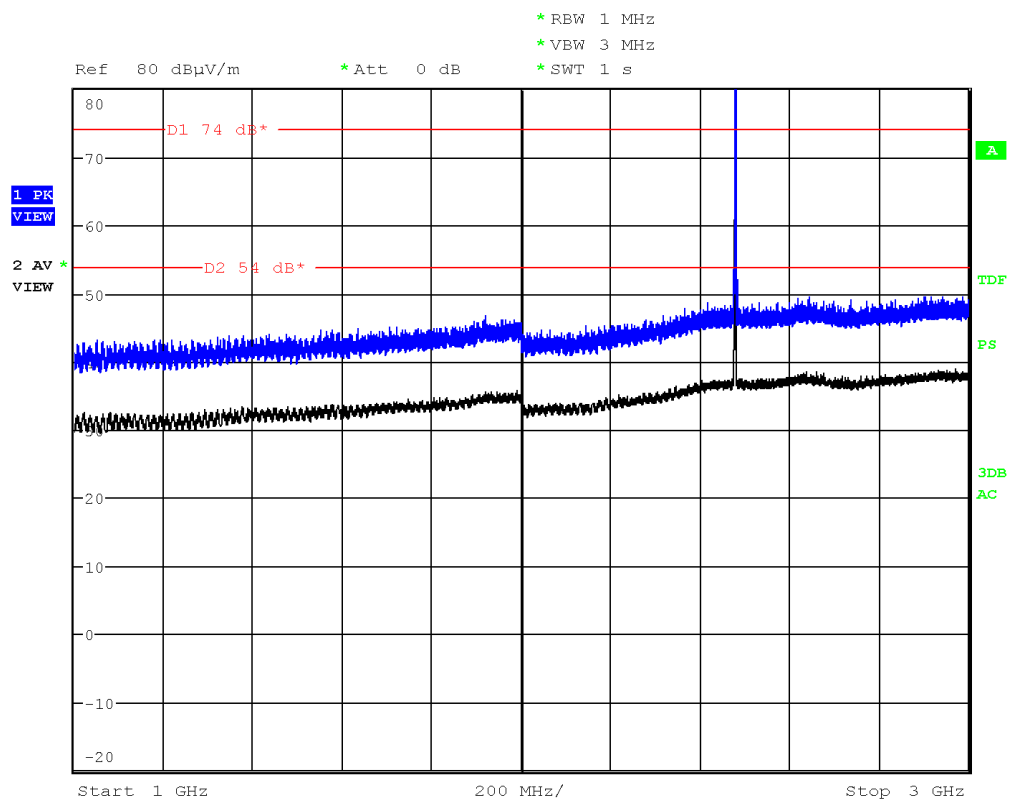
Note: The peak shown in the plot is the carrier frequency.

CHANNEL: Middle (2440 MHz).



Note: The peak shown in the plot is the carrier frequency.

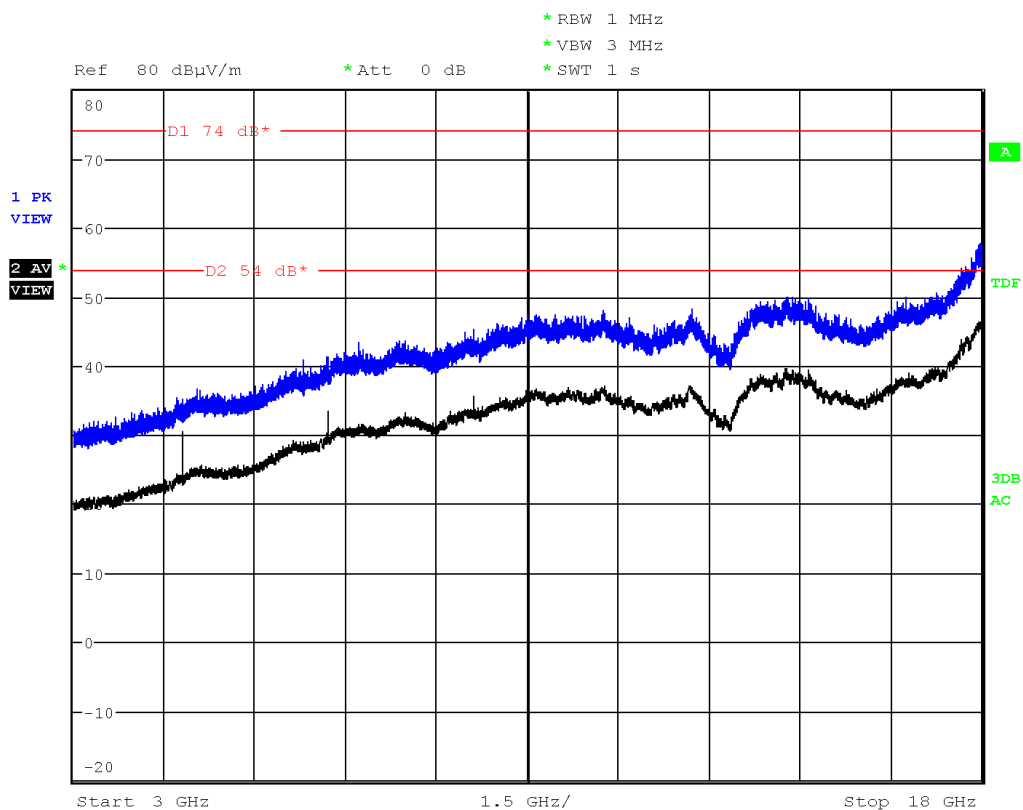
CHANNEL: Highest (2478 MHz).



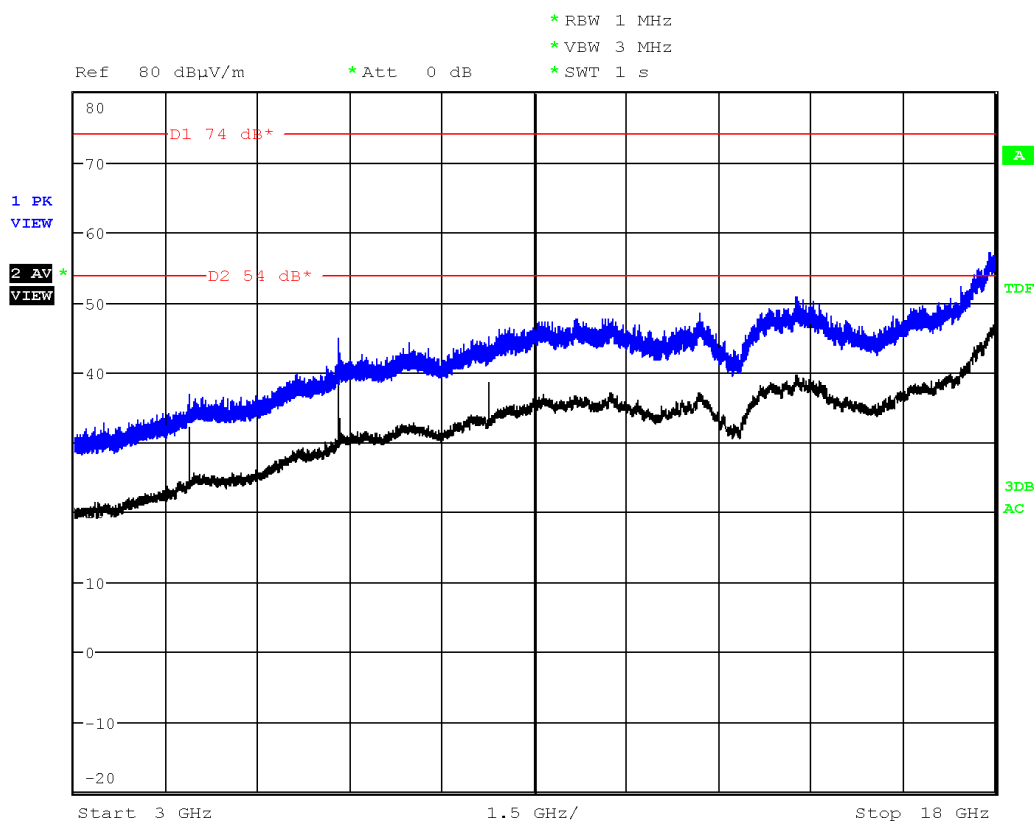
Note: The peak shown in the plot is the carrier frequency.

FREQUENCY RANGE 3 GHz to 18 GHz.

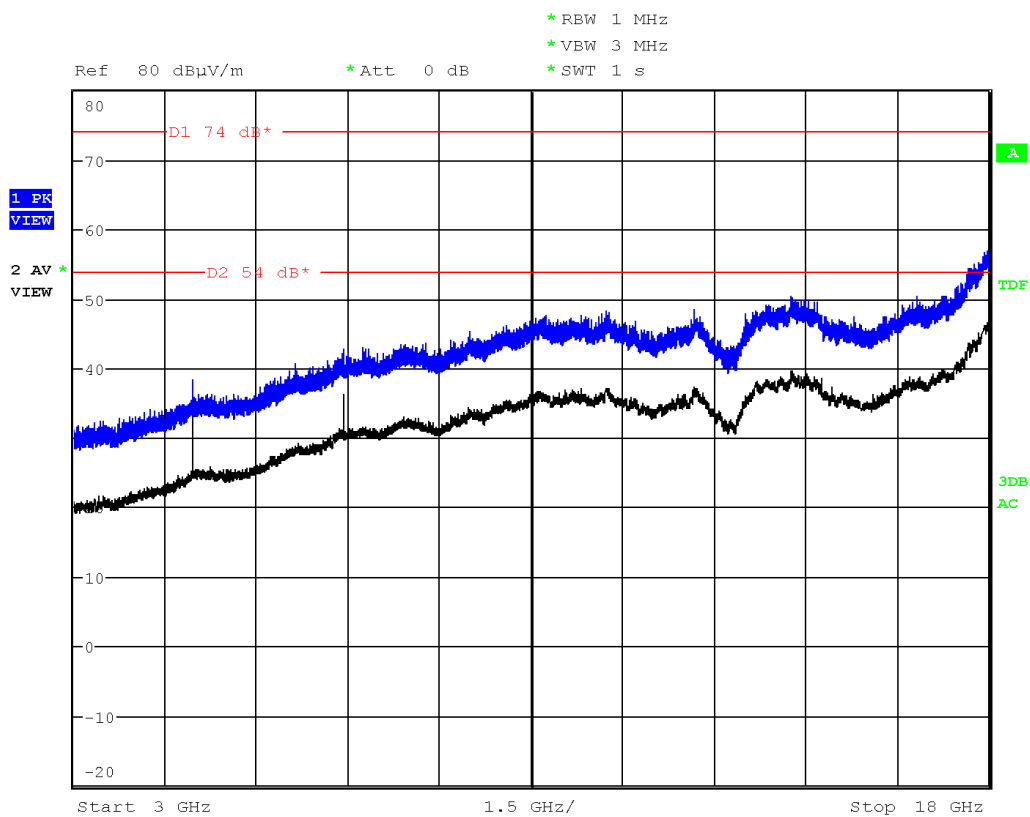
CHANNEL: Lowest (2404 MHz).



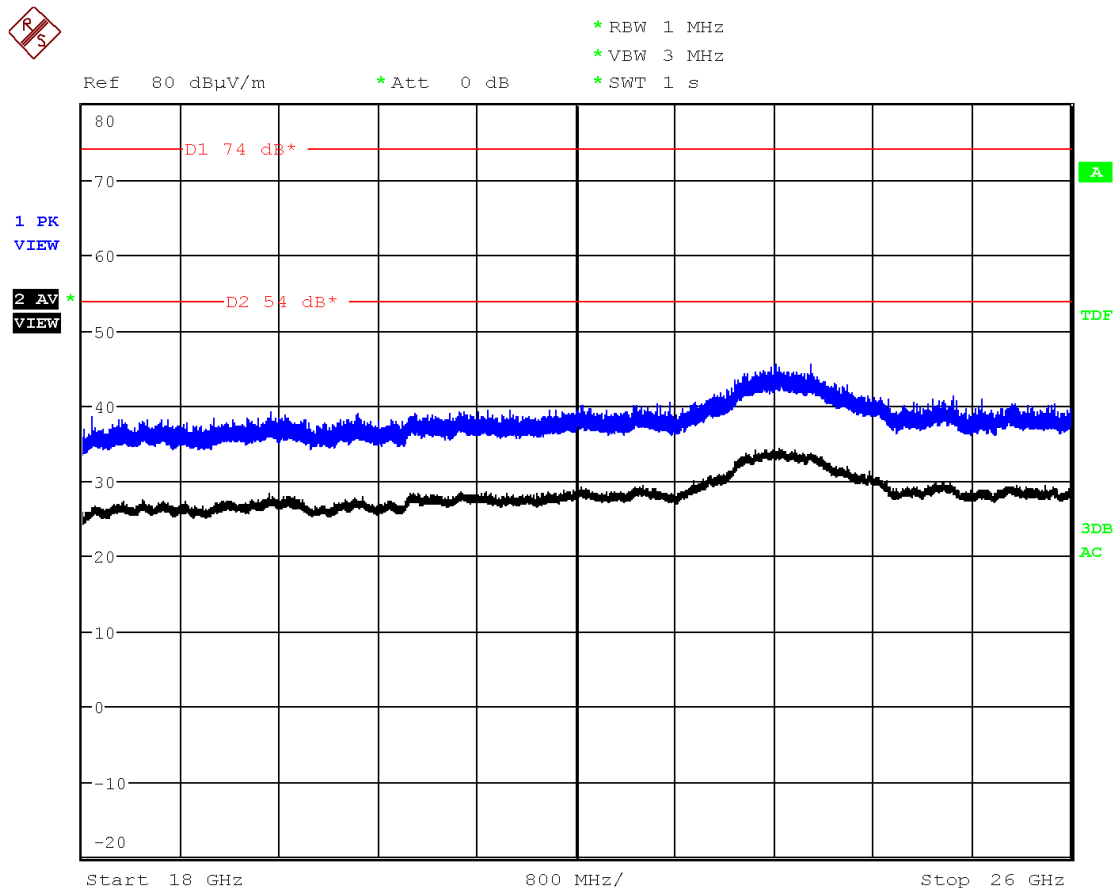
CHANNEL: Middle (2440 MHz).



CHANNEL: Highest (2478 MHz).



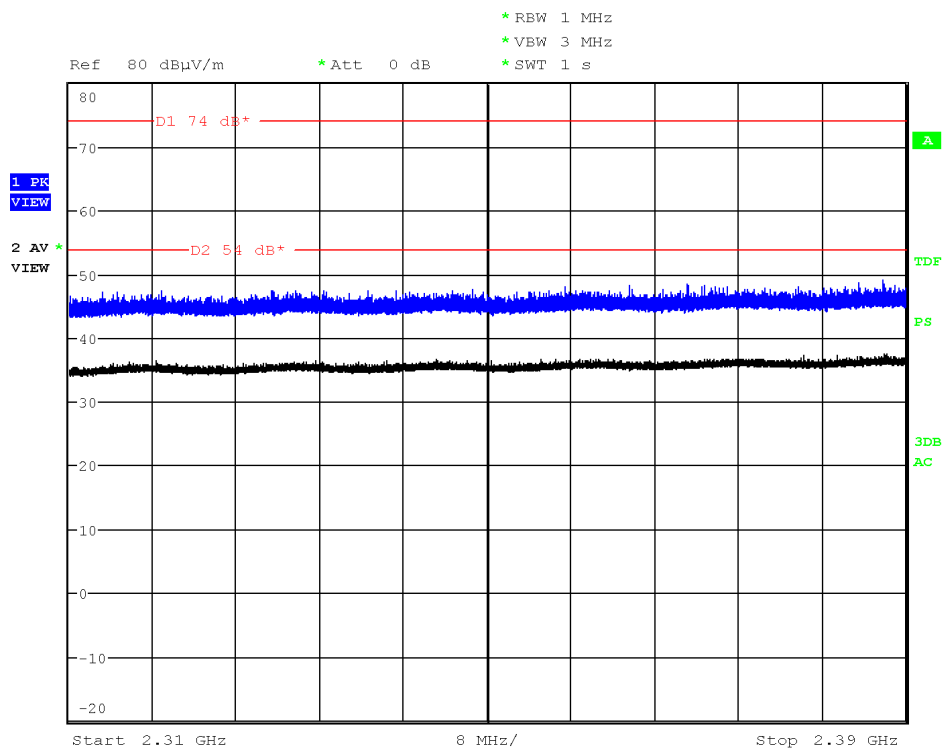
FREQUENCY RANGE 18 GHz to 26 GHz.



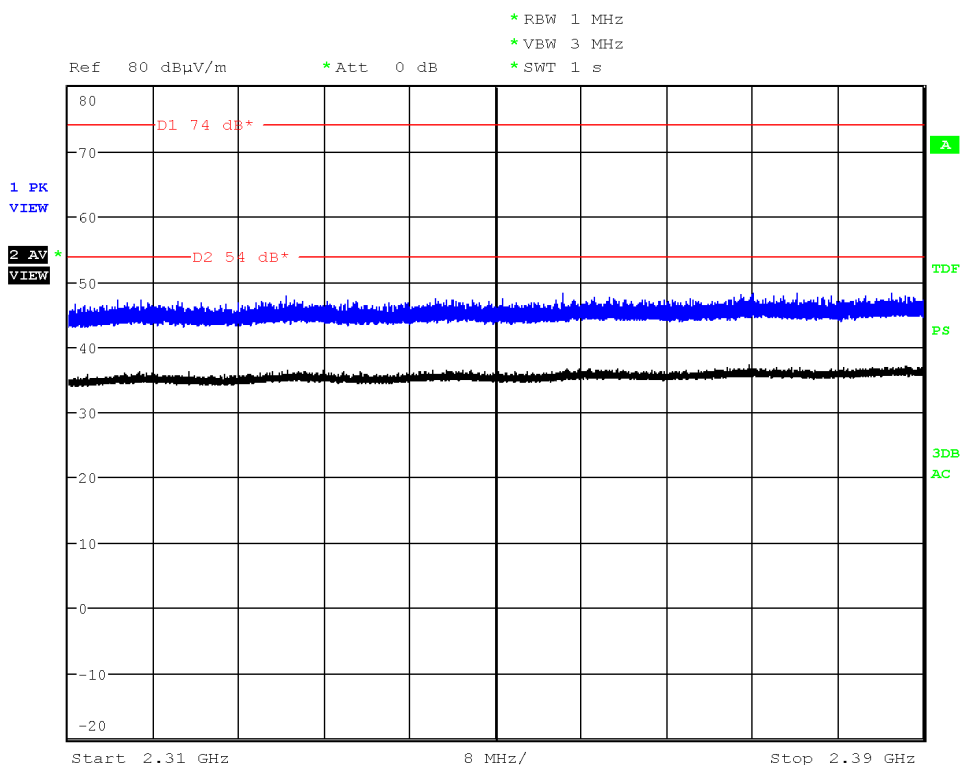
(This plot is valid for all three channels).

FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

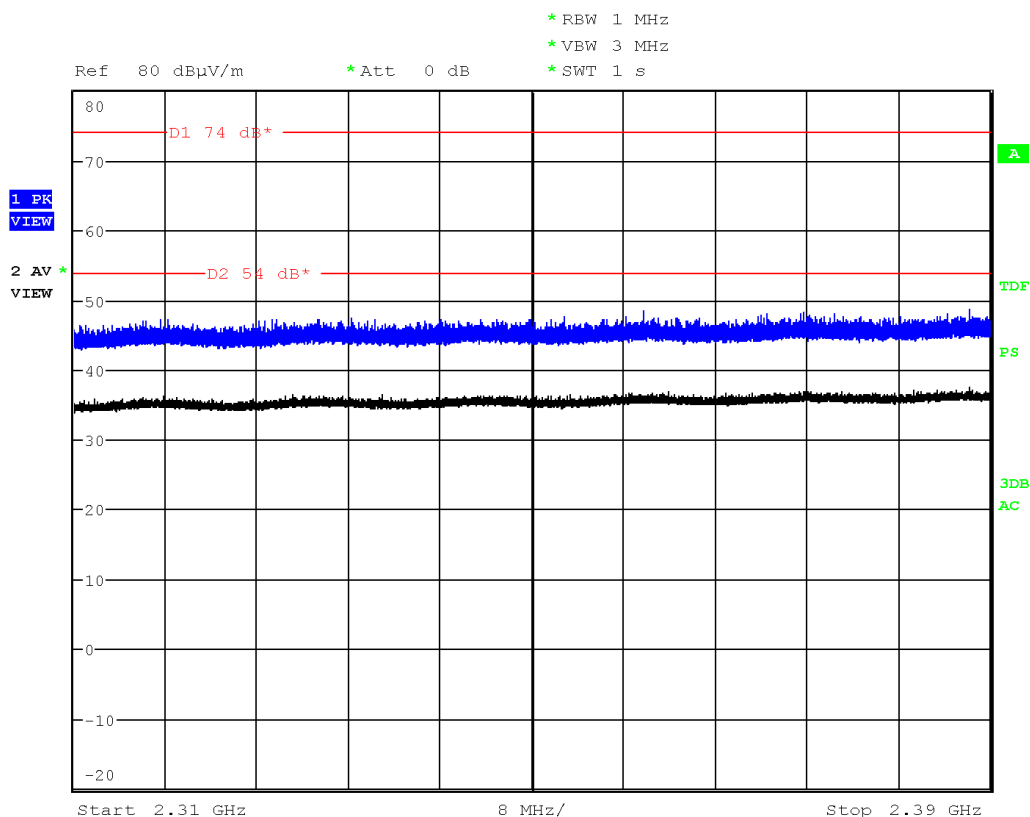
CHANNEL: Lowest (2404 MHz).



CHANNEL: Middle (2440 MHz).

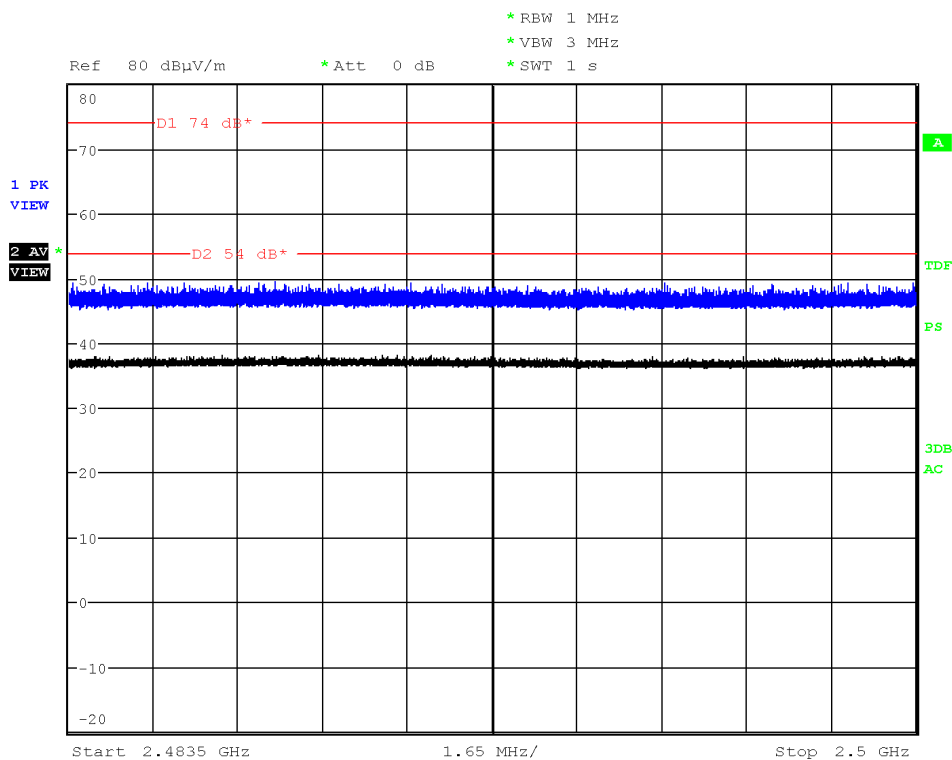


CHANNEL: Highest (2478 MHz).

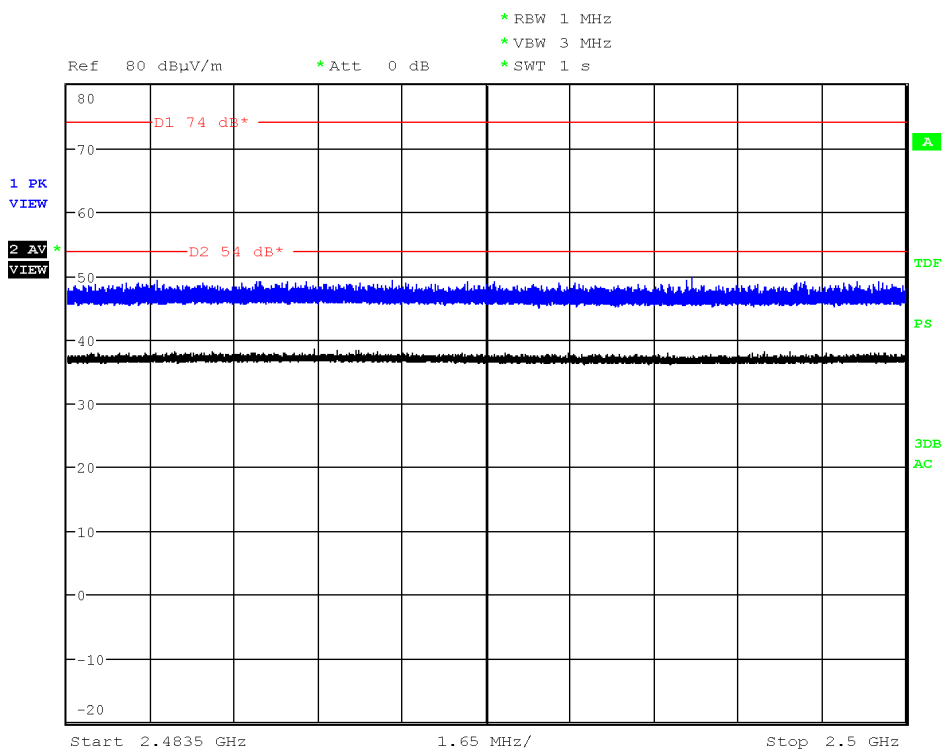


FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

CHANNEL: Lowest (2404 MHz).



CHANNEL: Middle (2440 MHz).



CHANNEL: Highest (2478 MHz).

