DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

Nº 51/LE147

Test report No:
NIE: 59212RRF.002

Test report

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

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

Identification of item tested	Hearing Aid
Trademark	Phonak
Model and /or type reference	Bolero M90-PR
Other identification of the product	HW version: 050-0677 SW version: 067-1332 FCC ID: KWC-BSR IC: 2262A-BSR
Features	BT Classic, BLE, DM and Flora proprietary.
Applicant	SONOVA USA INC. 4520 Weaver Parkway, 60555 Warrenville, IL, USA
Test method requested, standard	USA FCC Part 15.249 10-1-18 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 10-1-18 Edition: Radiated emission limits; general requirements. CANADA RSS-210 Issue 9 (August 2016). CANADA RSS-Gen Issue 5 (April 2018). ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Approved by (name / position & signature)	A. Llamas RF Lab. Manager Firmado digitalmente por ALEJANDRO LLAMAS RODRIGUEZ Fecha: 2019.07.03 14:22:50 +02'00'
Date of issue	2019-07-03
Report template No	FDT08_21

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Competences and guarantees

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DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

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

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.

Data provided by the client

The sample consists of a Hearing aid with wireless connectivity and rechargeable battery.

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

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample M/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Reception
59212D/001	Hearing Aid (PCB)	Bolero M90-PR	--	2019/03/04
59212D/005	Battery Pack	--	--	2019/03/04

Sample M/01 has undergone the following test(s): All CONDUCTED tests indicated in Appendixes A, B, C and D.

- Sample M/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Reception
59212D/010	Hearing Aid	Bolero M90-PR	W148H219V	2019/03/05
59212D/011	Hearing Aid	Bolero M90-PR	W148H2N2E	2019/03/05
59212D/036	Charger	--	1913NYFAP	2019/04/29
59212D/019	AC/DC Adaptor	--	--	2019/03/05

Sample M/02 has undergone the following test(s): All RADIATED tests indicated in Appendixes A, B, C and D.

Test sample description

<table>
<tr><td rowspan="4">Ports…… :</td><td rowspan="2">Port name and description</td><td colspan="4">Cable</td></tr>
<tr><td>Specified max length [m]</td><td>Attached during test</td><td>Shielded</td><td>Coupled to patient(3)</td></tr>
<tr><td>N/A</td><td></td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td></td><td></td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>Supplementary information to the ports…… :</td><td colspan="5"></td></tr>
<tr><td rowspan="4">Rated power supply ..... :</td><td colspan="2" rowspan="2">Voltage and Frequency</td><td colspan="3">Reference poles</td></tr>
<tr><td>L1</td><td>L2</td><td>L3</td><td>N</td><td>PE</td></tr>
<tr><td>☐</td><td>AC:</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td>☒</td><td colspan="5">DC:
Bolero M90-PR
Vnom=3.7 V rechargeable battery; battery charging case supplied by a power supply 5 Vdc 1A</td></tr>
</table>

Rated Power .....:			
Clock frequencies .....:			
Other parameters.....:			
Software version .....:	067-1332		
Hardware version.....:	050-0677		
Dimensions in cm (W x H x D)....:			
Mounting position.....:	☐	Table top equipment	
	☐	Wall/Ceiling mounted equipment	
	☐	Floor standing equipment	
	☐	Hand-held equipment	
	☒	Other: Hearing Aid	
Modules/parts .....:	Module/parts of test item	Type	Manufacturer
Accessories (not part of the test item) .....:	Description	Type	Manufacturer
Documents as provided by the applicant.....:	Description	File name	Issue date

Identification of the client

SONOVA AG
Laubisruetistrasse 28, 8712 Staefa, Switzerland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-03-07
Date (finish)	2019-04-29

Document history

Report number	Date	Description
59212RRF.002	2019-07-03	First release

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 35 %

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, José Gabriel Pendón, Ignacio Cabra, Francisco José Alcaide.

Used instrumentation:

Conducted Measurements:

		Last Calibration	Due Calibration
1.	Spectrum Analyzer PSA 3Hz-26.5 GHz AGILENT TECHNOLOGIES E4440A	2017/10	2019/10

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
3.	RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/02	2020/08
4.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2017/09	2020/09
5.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
6.	RF Pre-amplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04
7.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
8.	Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
9.	RF Pre-amplifier, G>48dB, 18-40GHz NARDA JS44-18004000-33-8P	2018/02	2020/02

Testing verdicts

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

Summary

1. Bluetooth Low Energy

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		**Verdict**	**Remark**
Section 15.249 Subclause (a) / RSS-210 B.10. (a)	Field strength of fundamental and harmonic emissions	P	
Section 15.249 Subclause (d) / RSS-210 B.10. (b)	Emissions radiated outside of the specific frequency bands	P	(1)
Supplementary information and remarks: Emissions radiated outside of the specific frequency bands performed without charger and while charging.			

2. Bluetooth Basic Rate

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		**Verdict**	**Remark**
Section 15.249 Subclause (a) / RSS-210 B.10. (a)	Field strength of fundamental and harmonic emissions	P	
Section 15.249 Subclause (d) / RSS-210 B.10. (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

3. Proprietary protocol DM 2.4 GHz

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		**Verdict**	**Remark**
Section 15.249 Subclause (a) / RSS-210 B.10. (a)	Field strength of fundamental and harmonic emissions	P	
Section 15.249 Subclause (d) / RSS-210 B.10. (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

4. Proprietary protocol Flora 2.4 GHz

FCC PART 15 PARAGRAPH / RSS-210			
Requirement – Test case		**Verdict**	**Remark**
Section 15.249 Subclause (a) / RSS-210 B.10. (a)	Field strength of fundamental and harmonic emissions	P	
Section 15.249 Subclause (d) / RSS-210 B.10. (b)	Emissions radiated outside of the specific frequency bands	P	
Supplementary information and remarks: None.			

Appendix A: Test results. Bluetooth Low Energy

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.7 Vdc
Type of power supply:	DC rechargeable battery; battery charging case supplied by a power supply 5 Vdc.
Type of antenna:	Small magnetic loop antenna.
Declared antenna gain:	- 12 dBi

TEST FREQUENCIES:

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

CONDUCTED MEASUREMENTS

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

RADIATED MEASUREMENTS

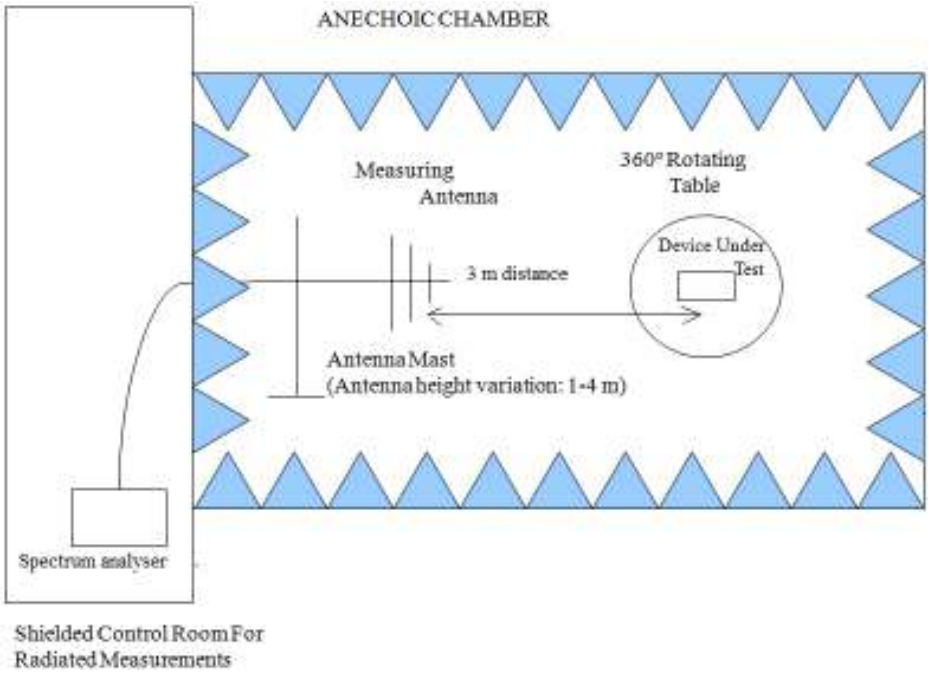
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 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.

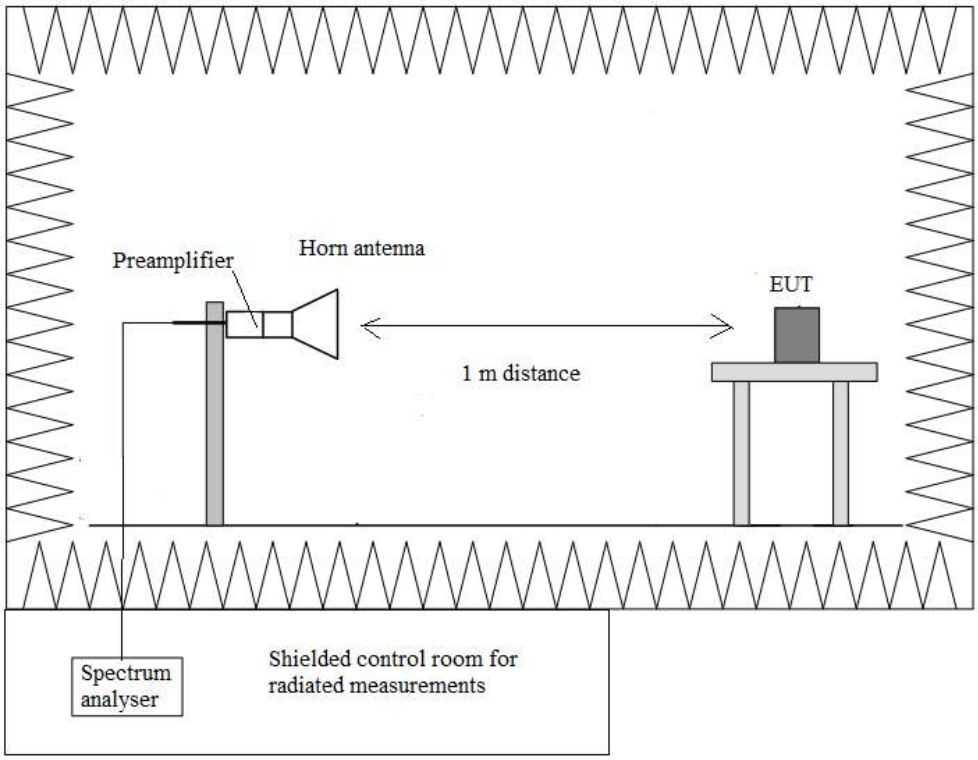
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz:

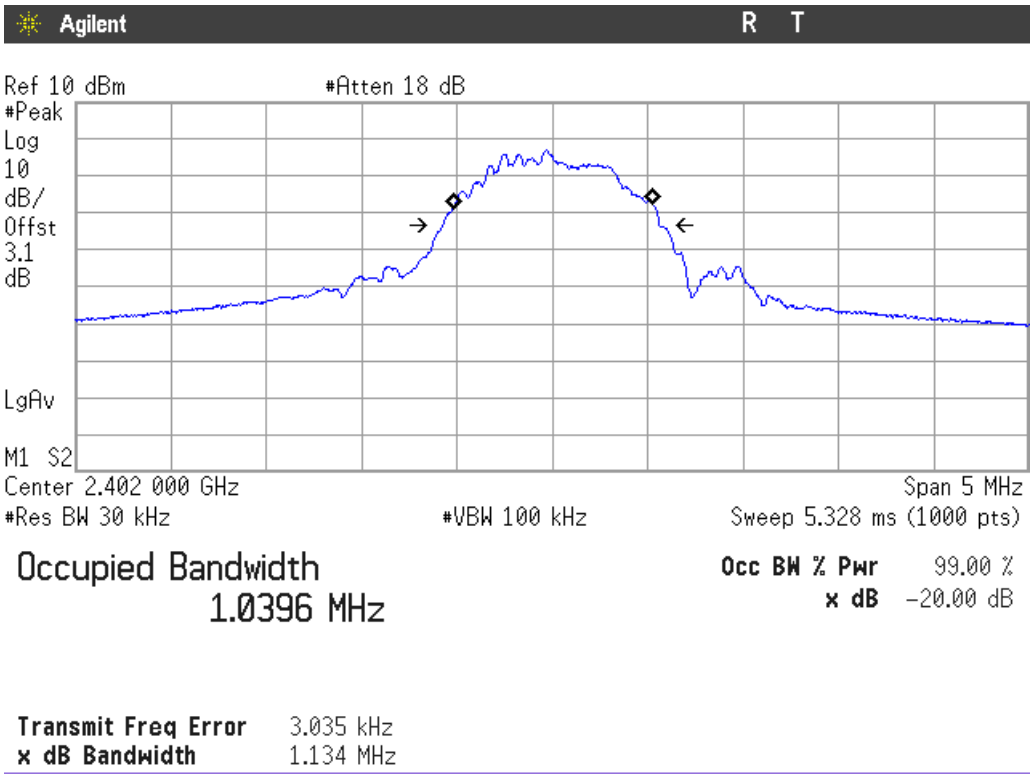


Occupied Bandwidth

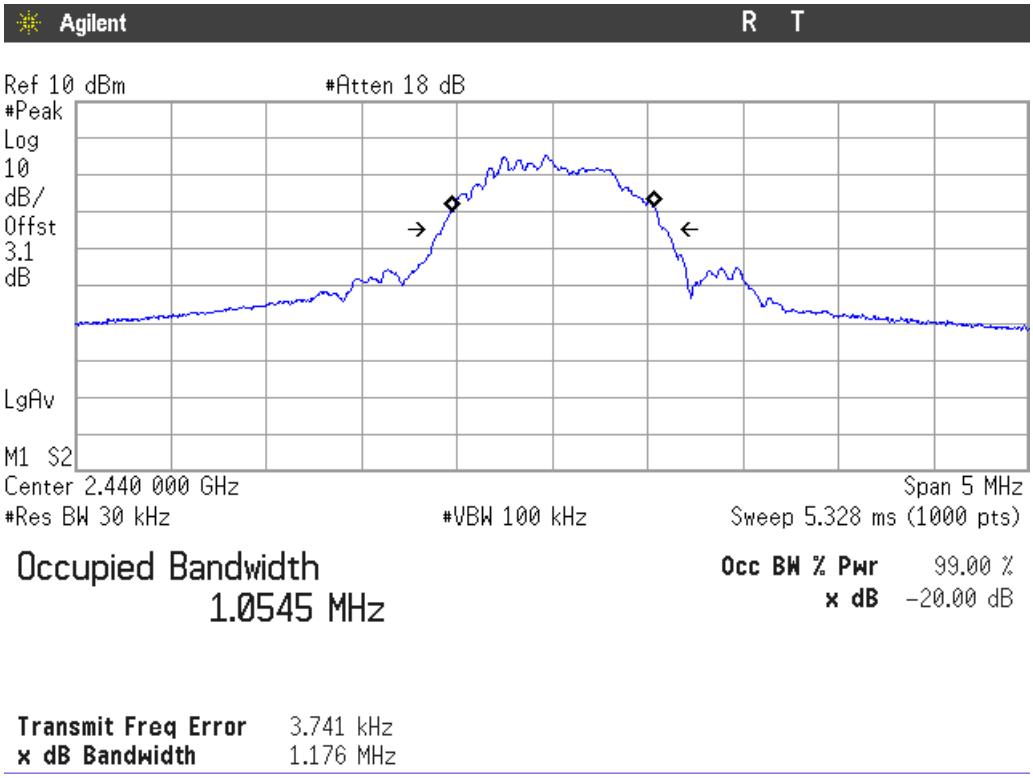
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	1.0396	1.0545	1.0712
Measurement Uncertainty (kHz)	<±5.00		

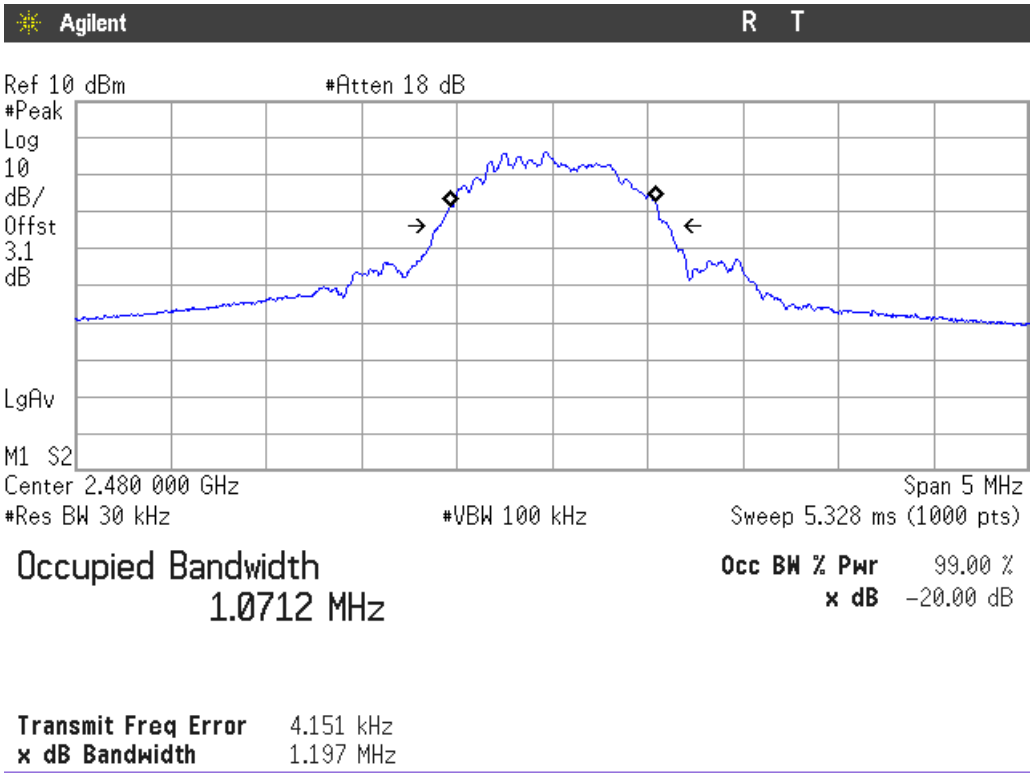
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

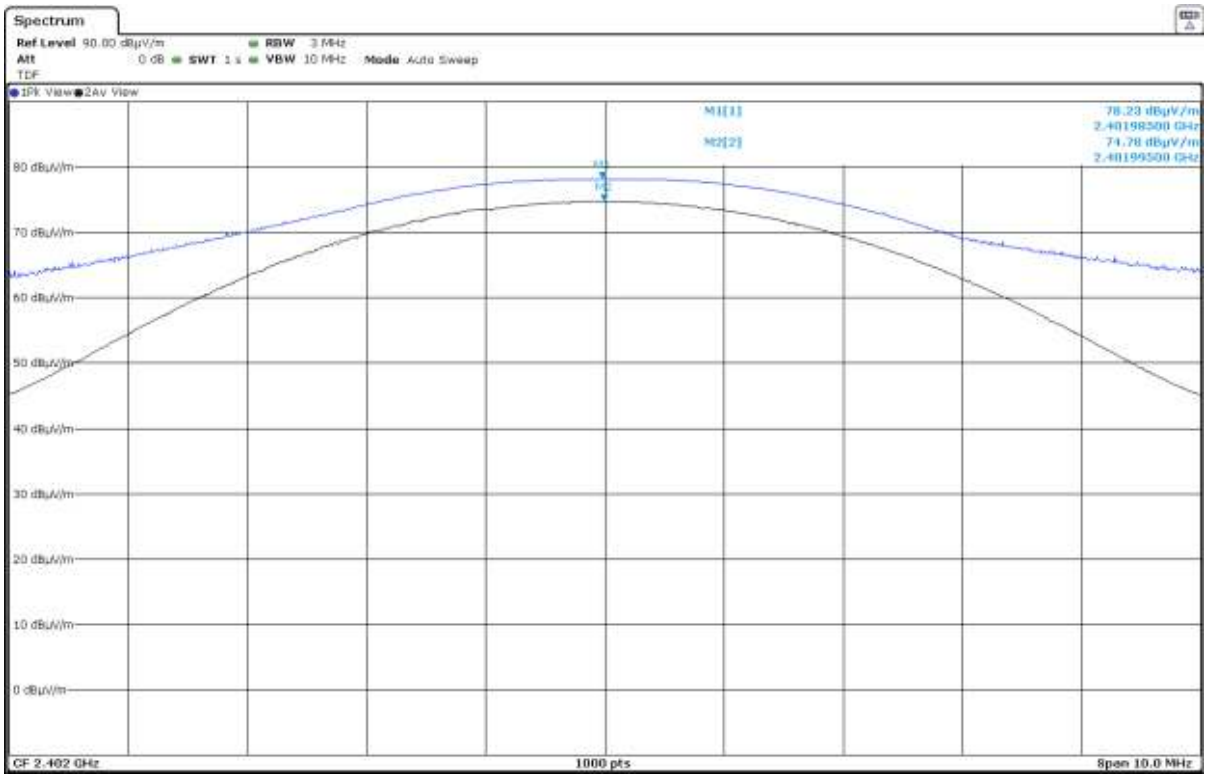
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

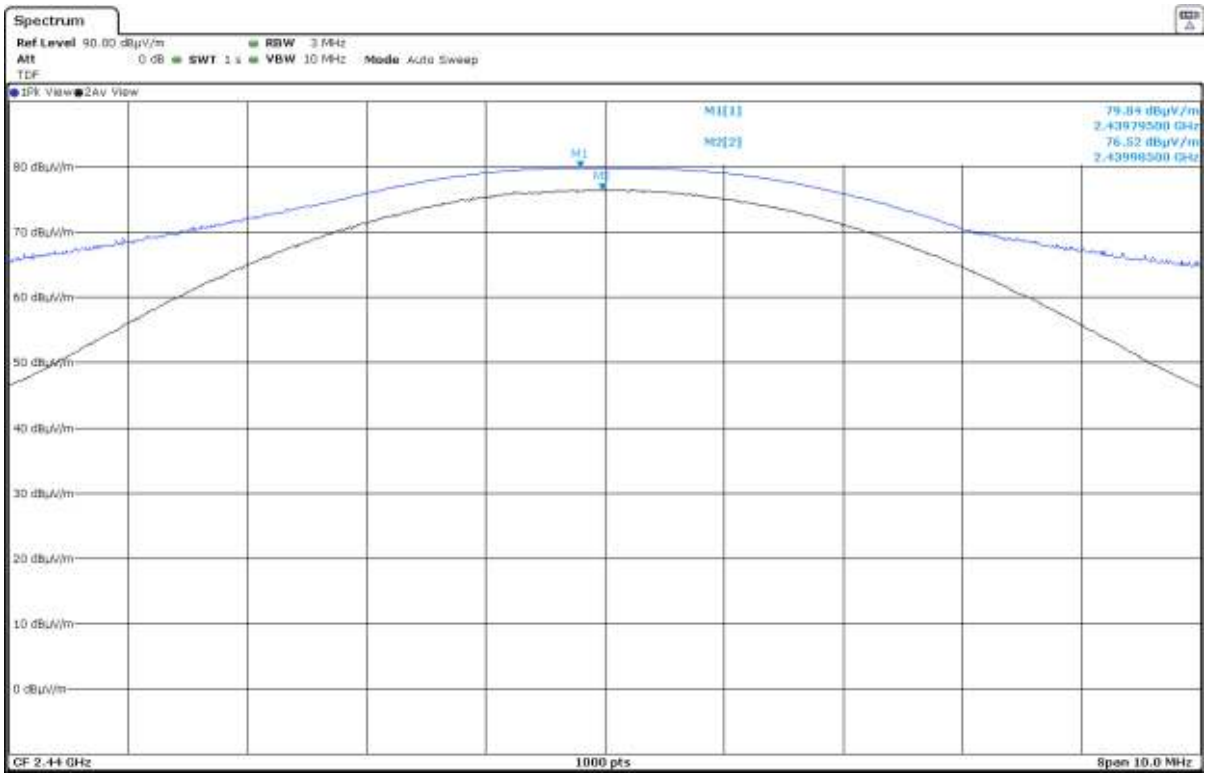
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	74.78	76.52	76.72
Peak Field Strength (dBµV/m)	78.23	79.84	80.00
Measurement Uncertainty (dB)	<±3.05		

Verdict: PASS

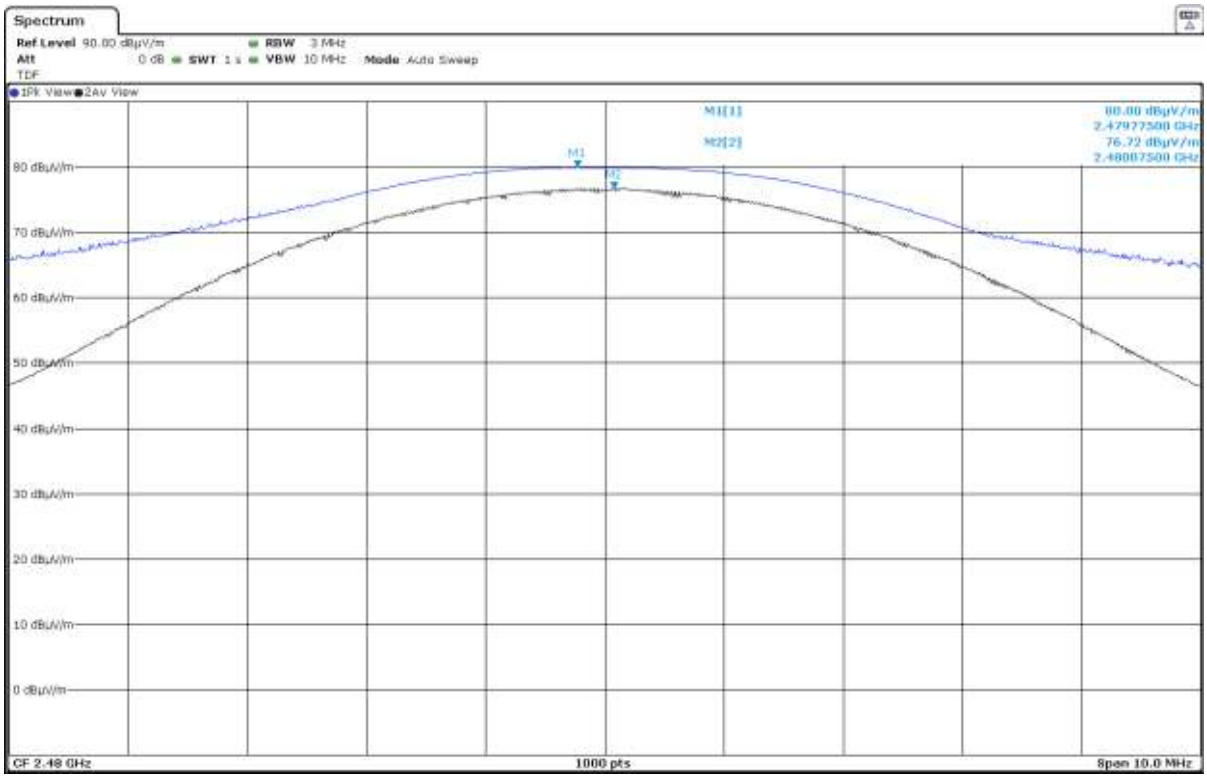
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/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 (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

Whichever is the lesser attenuation.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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-26 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.

RADIATED WITHOUT CHARGER:

Frequency range 30 MHz - 1 GHz.

The spurious signals detected do not depend on the operating channel.

No spurious emissions were found at less than 20 dB below the limit.

Frequency range 1 - 26 GHz.

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (2402 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.80343	Peak	42.48	V	<±3.70
21.61600	Peak	40.75	H	<±3.70

- Middle Channel (2440 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.34392	Peak	52.03	H	<±3.70
2.49428	Peak	53.15	V	<±3.70
2.87997	Peak	39.97	V	<±3.70
21.96215	Peak	42.27	H	<±3.70

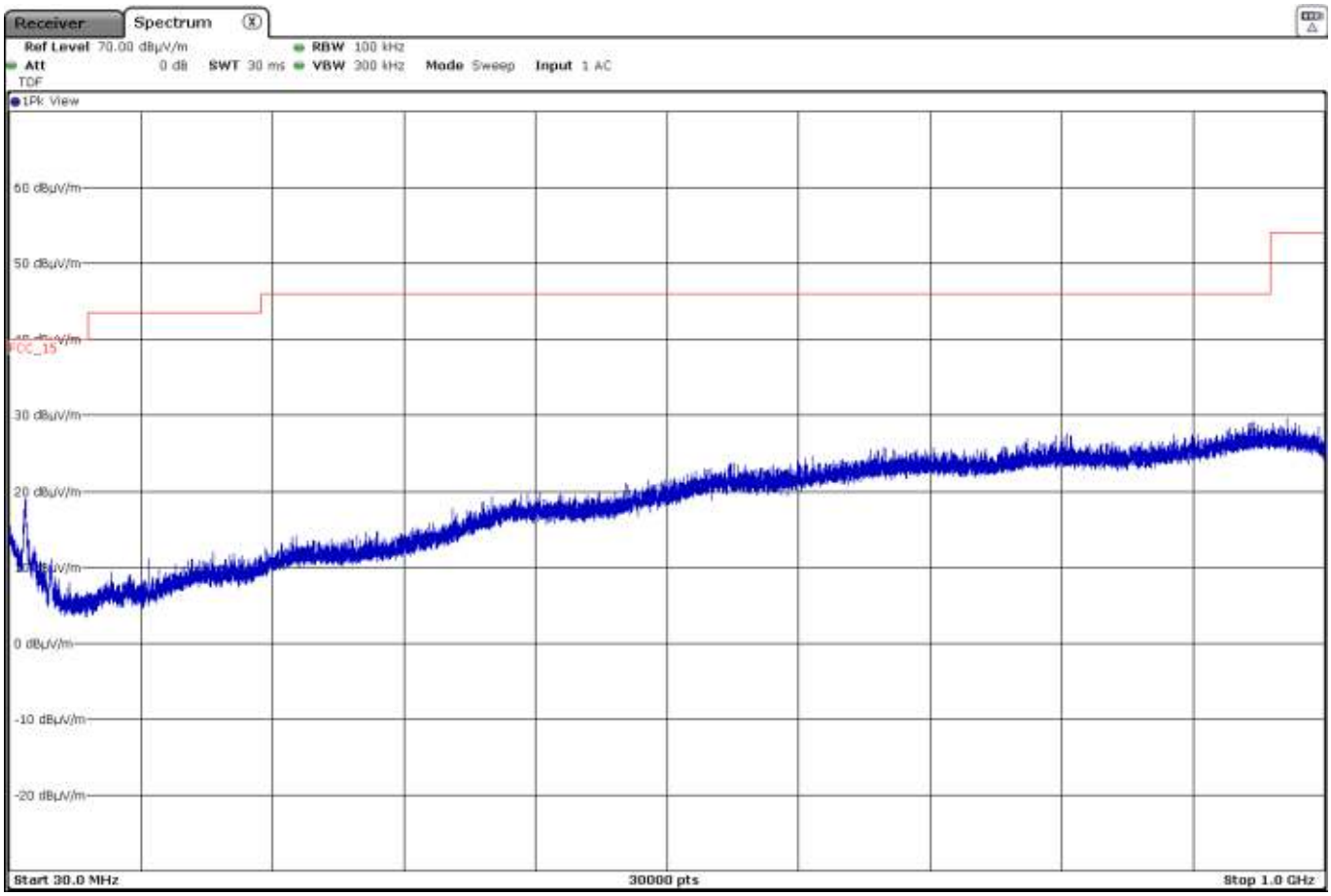
- High Channel (2480 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48357	Peak	57.07	H	<±3.70
	Average	41.25		<±3.70
4.95977	Peak	43.44	V	<±3.70
22.31765	Peak	44.74	V	<±3.70

Verdict: PASS

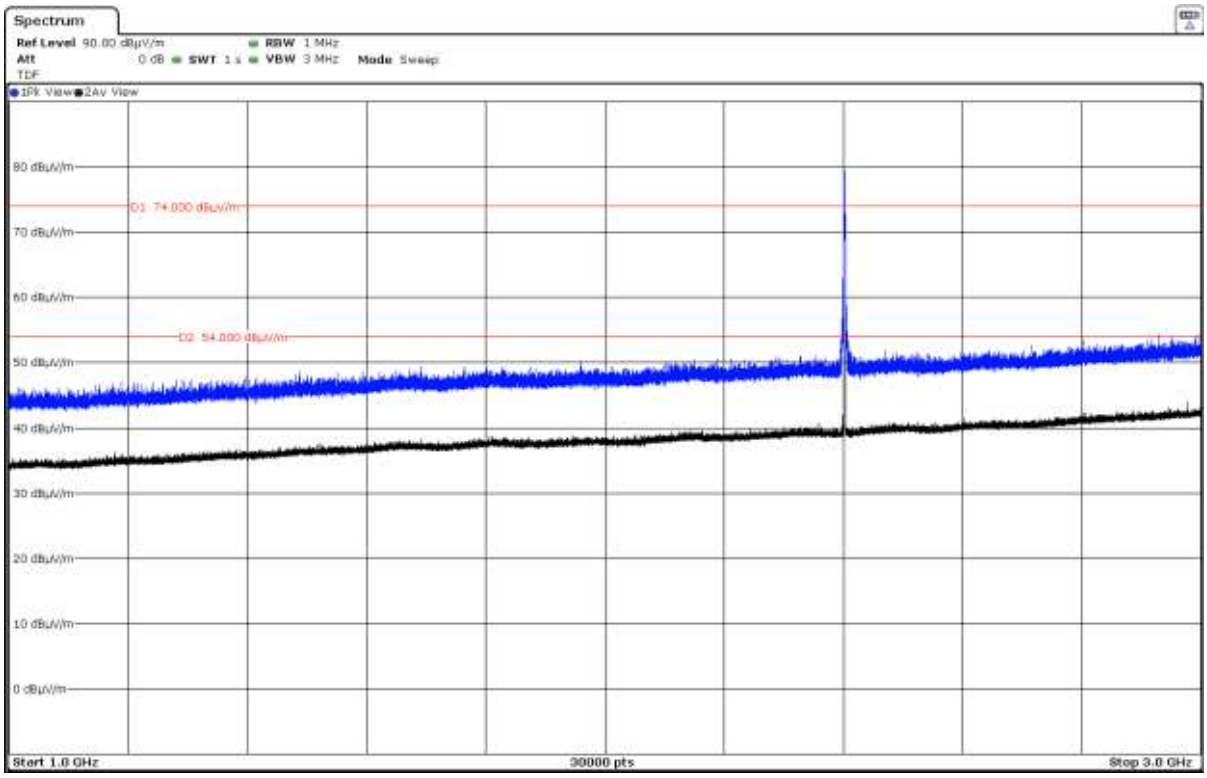
FREQUENCY RANGE 30 MHz - 1 GHz

The spurious signals detected do not depend on the operating channel, so valid for Low, Middle and High Channels.



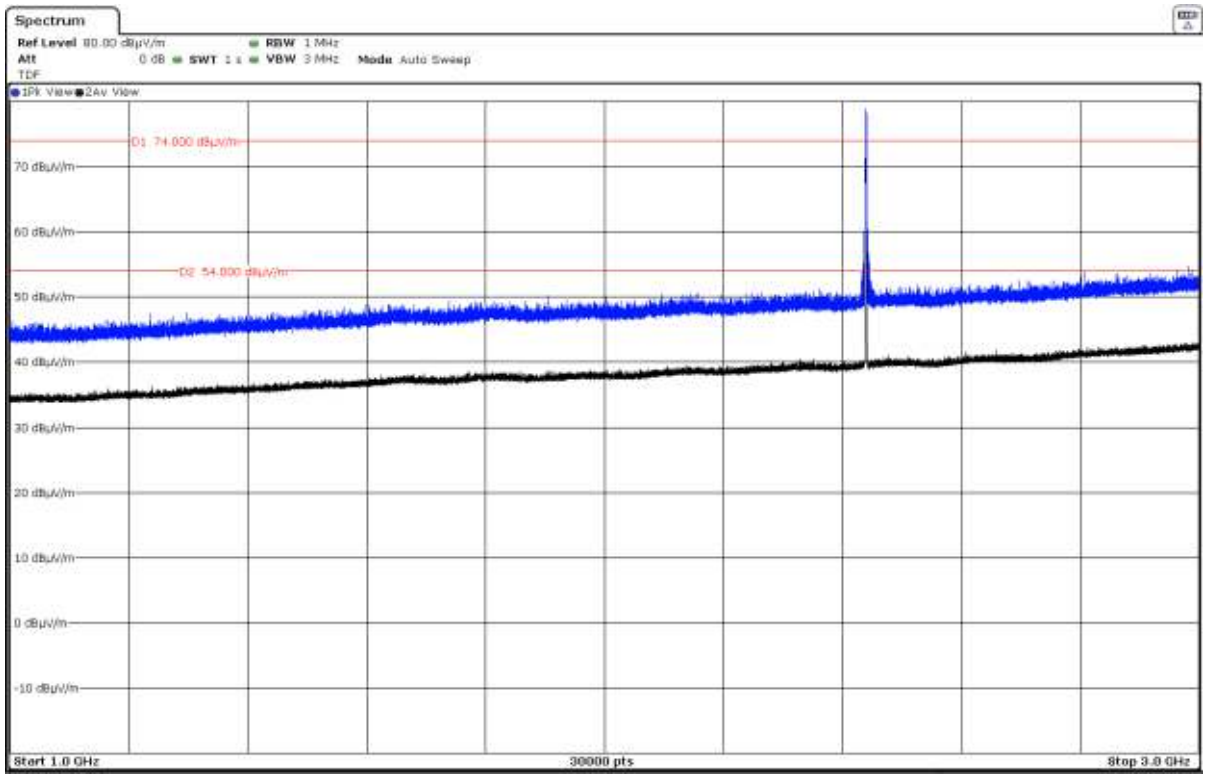
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



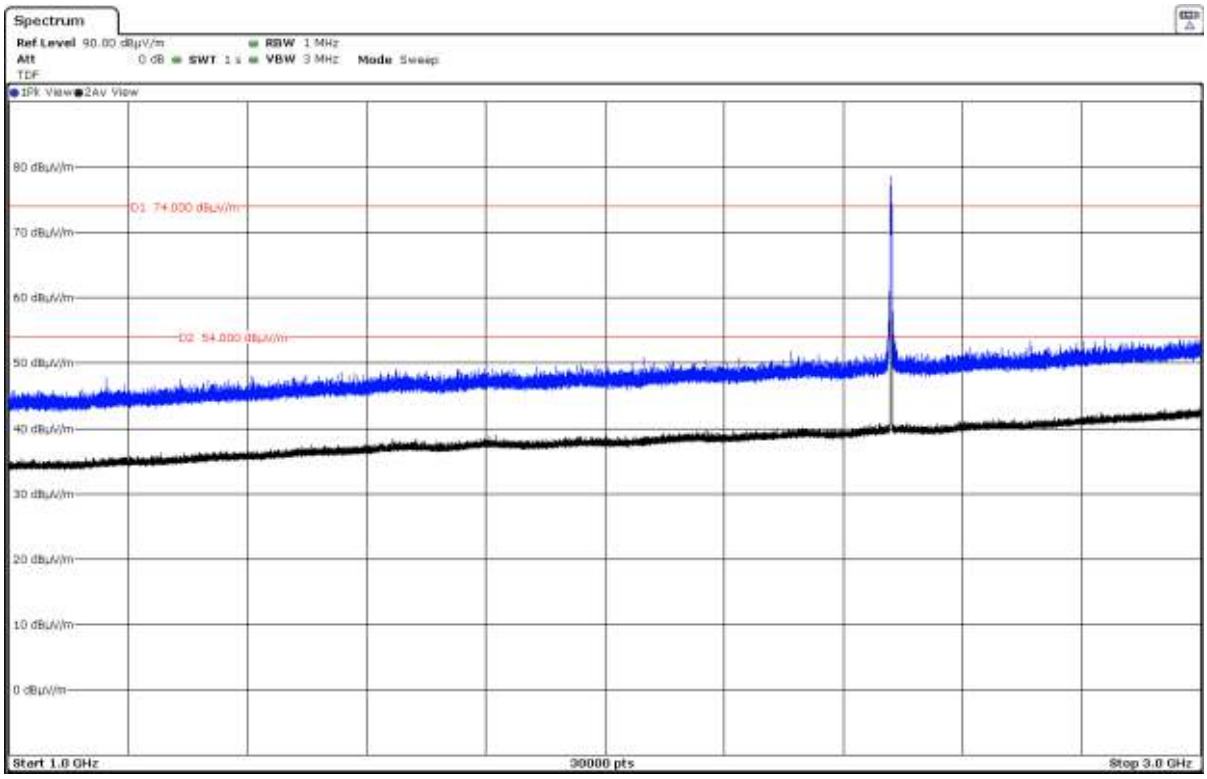
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

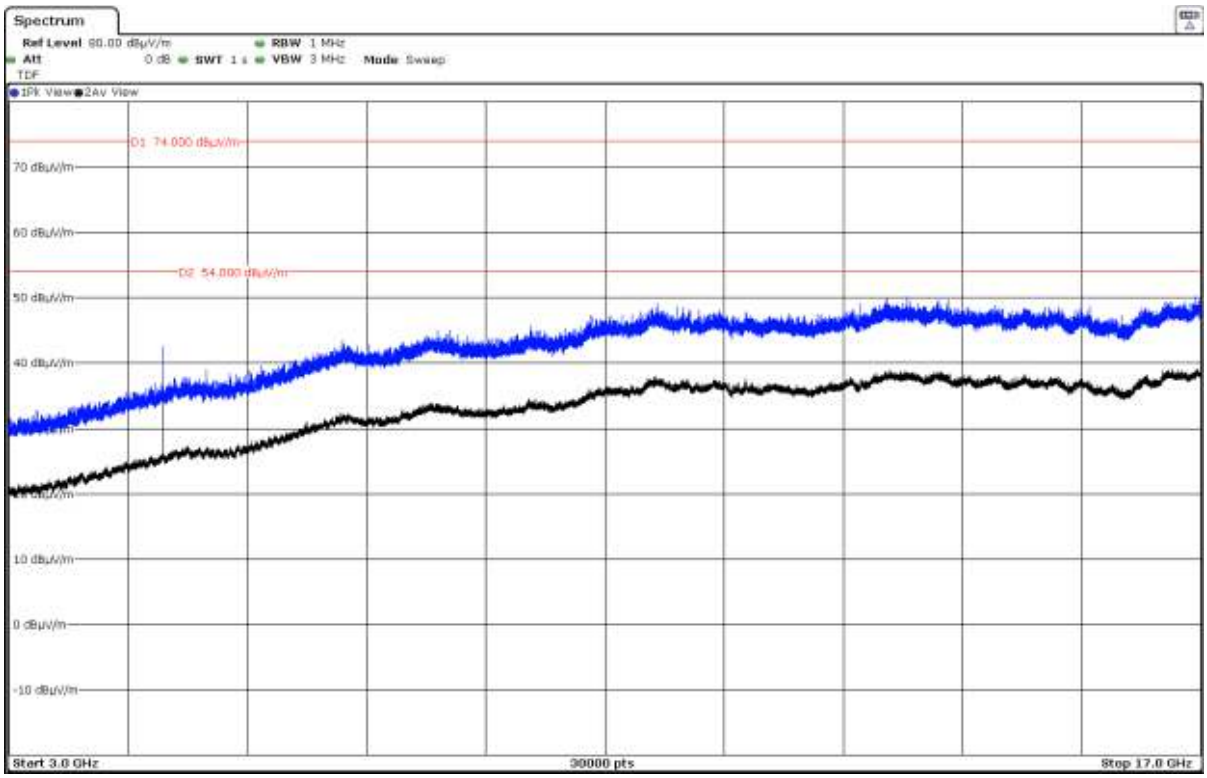
- High Channel:



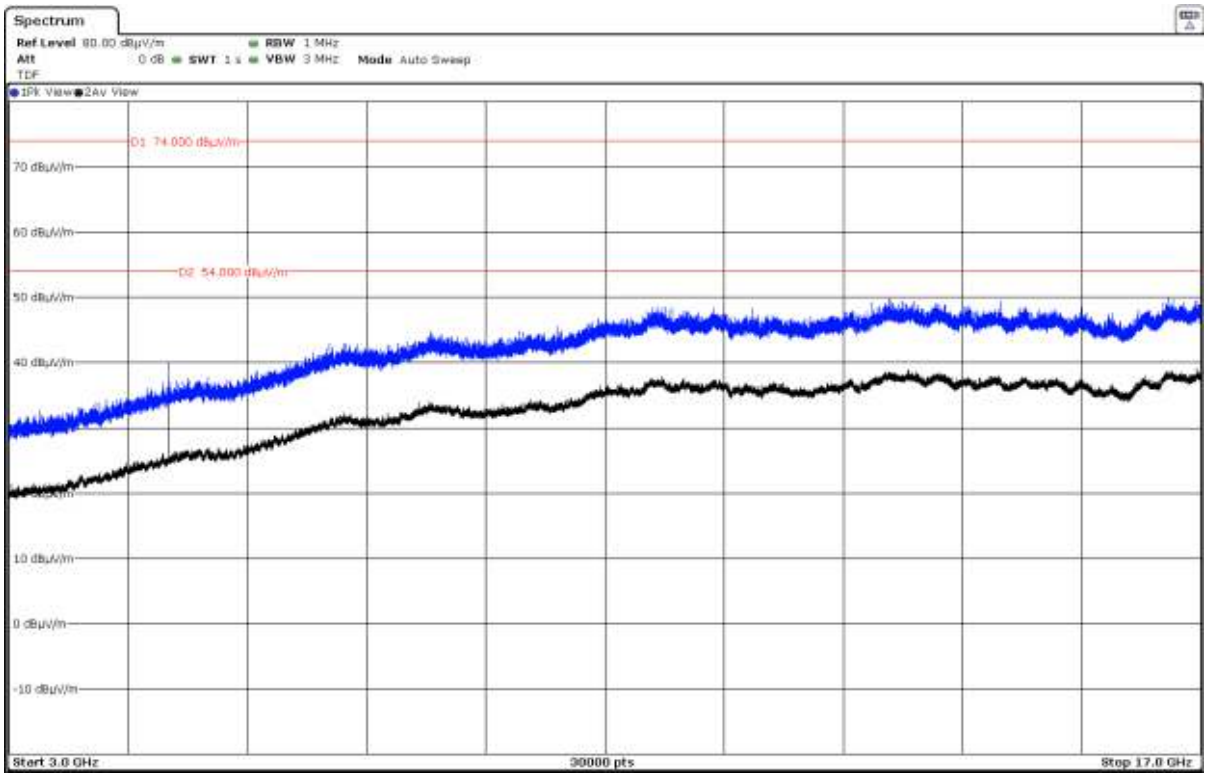
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

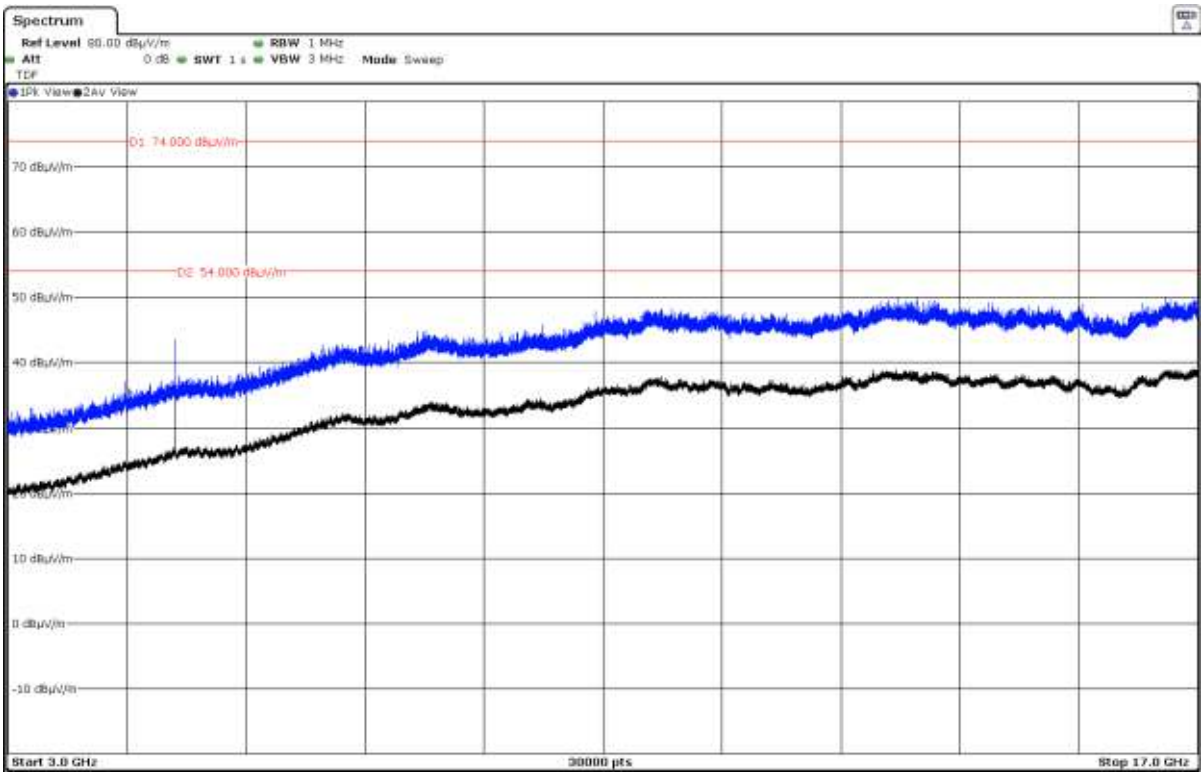
- Low Channel:



- Middle Channel:

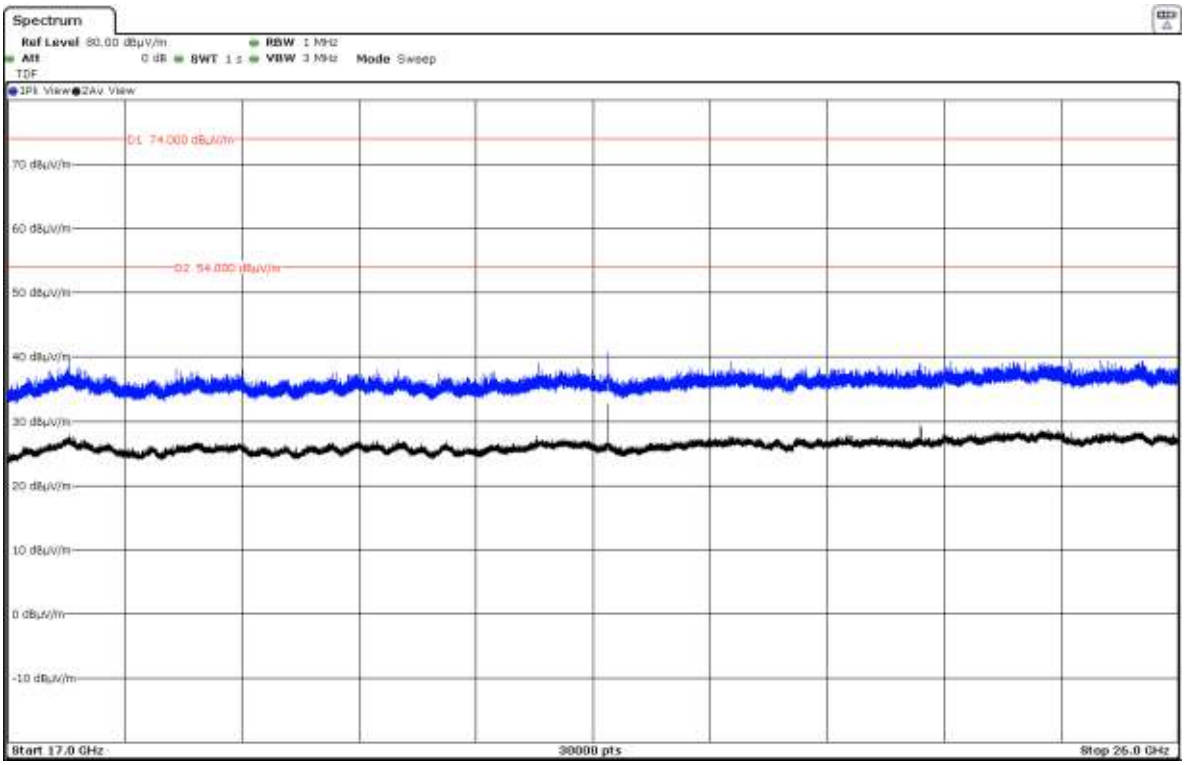


- High Channel:

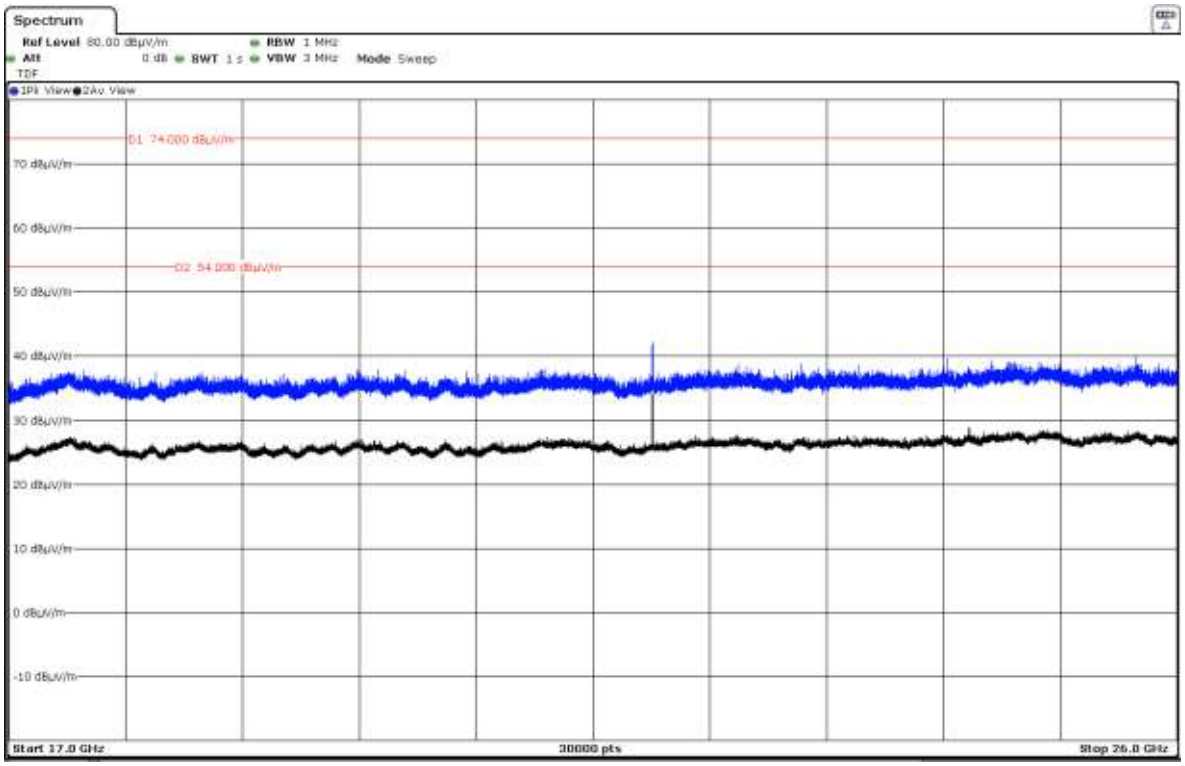


FREQUENCY RANGE 17 - 26 GHz

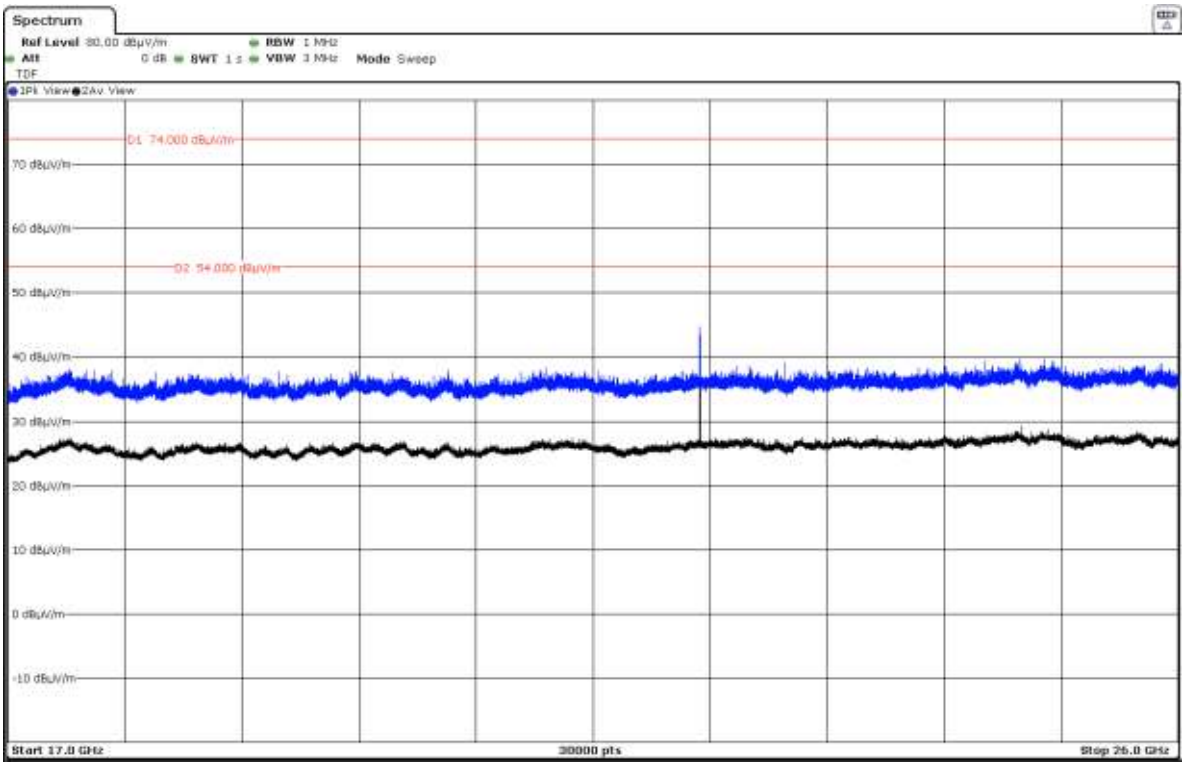
- Low Channel:



- Middle Channel:

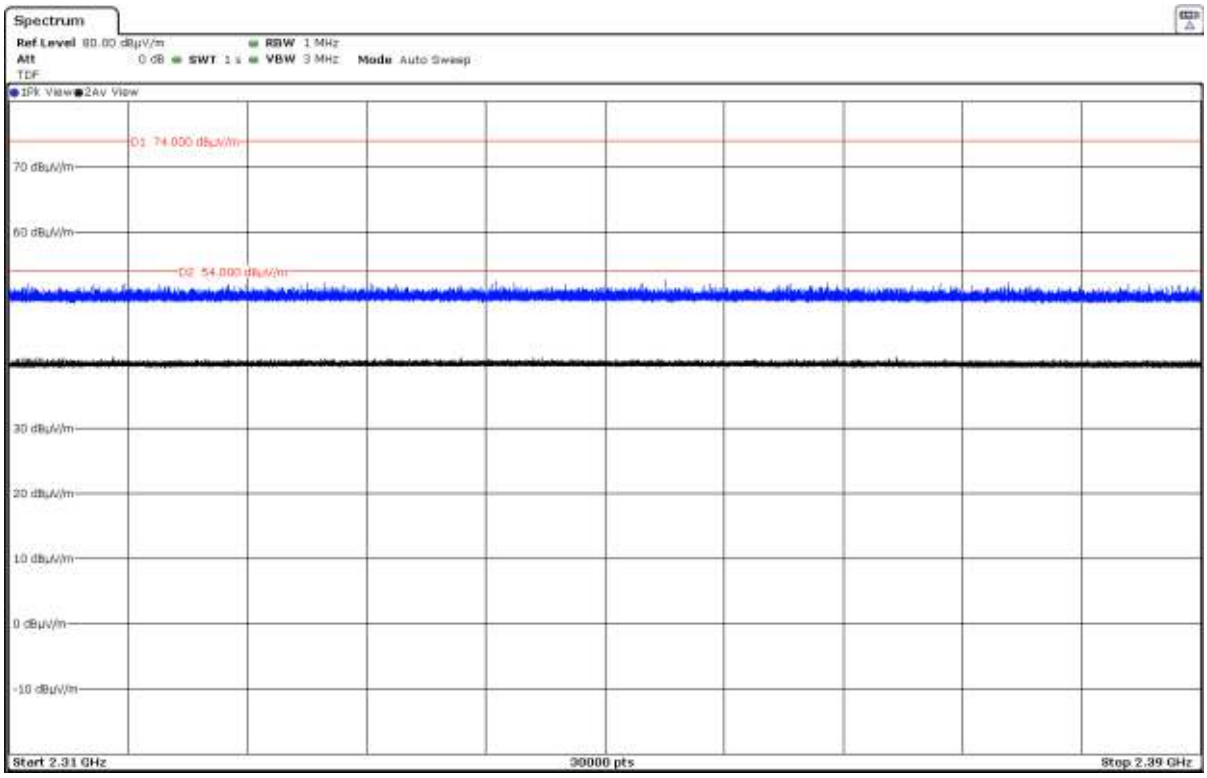


- High Channel:

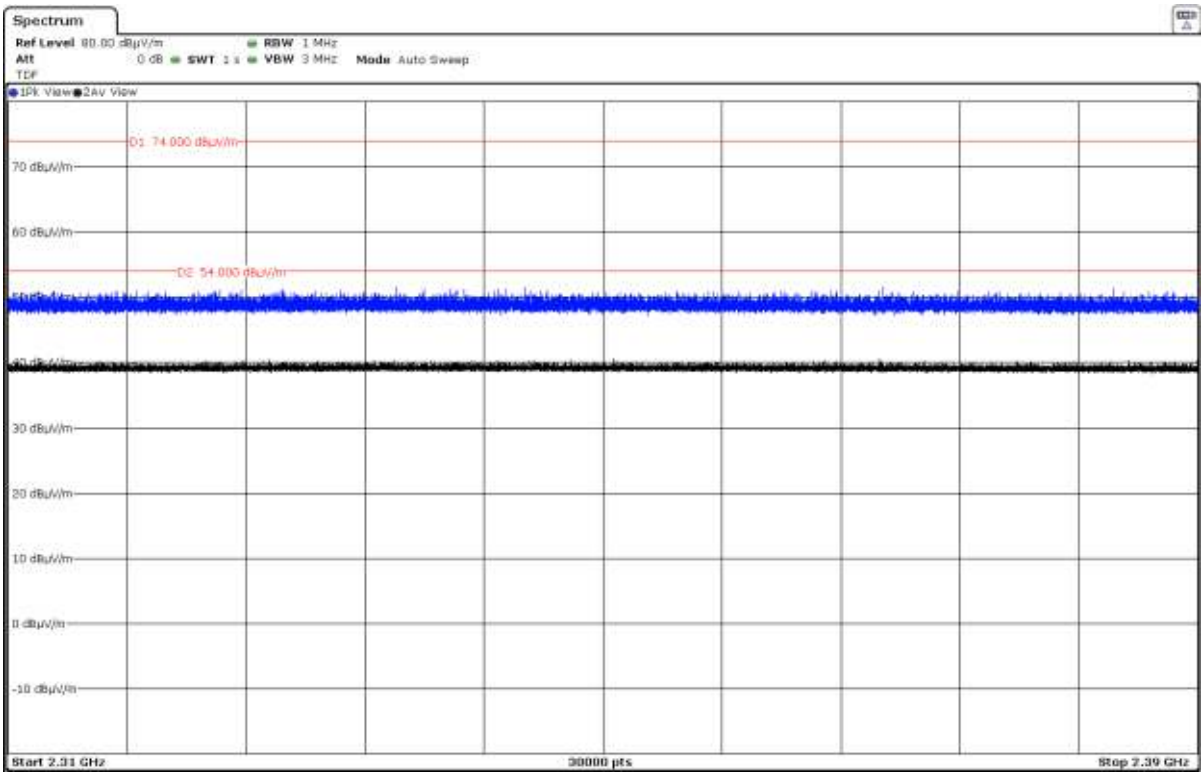


FREQUENCY RANGE 2.31 - 2.39 GHz (Restricted Band 1)

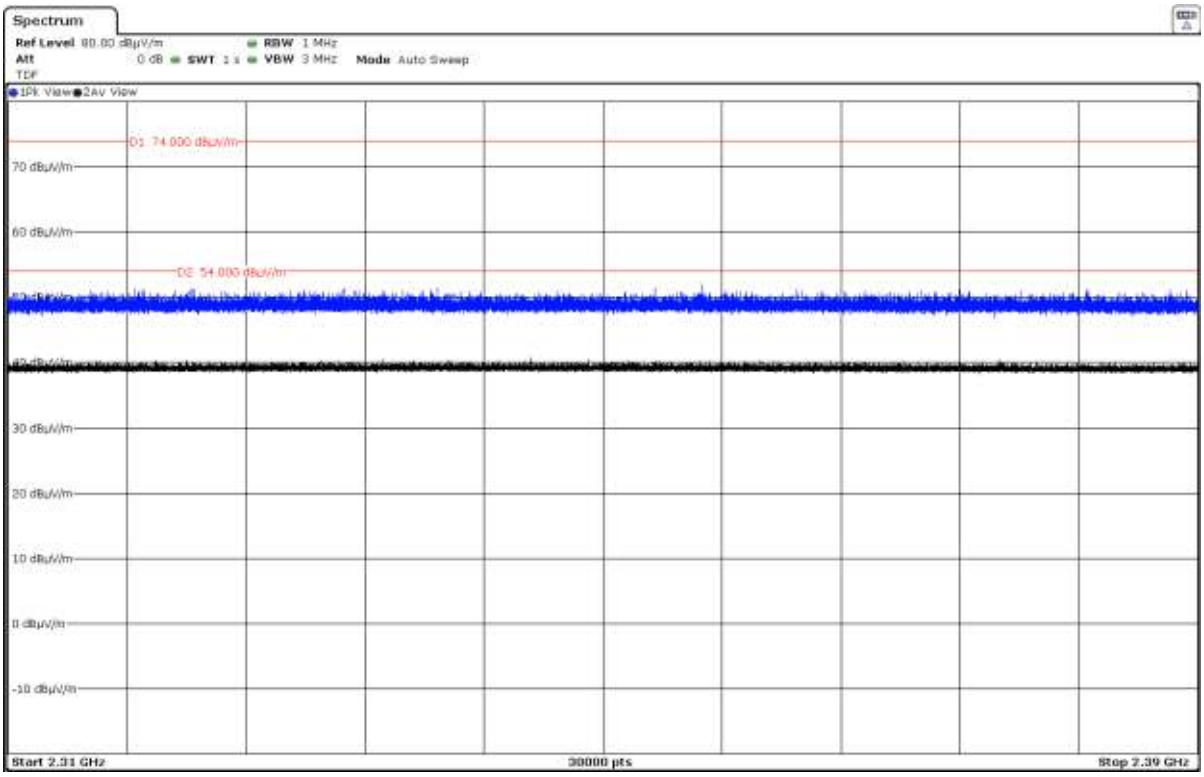
- Low Channel:



- Middle Channel:

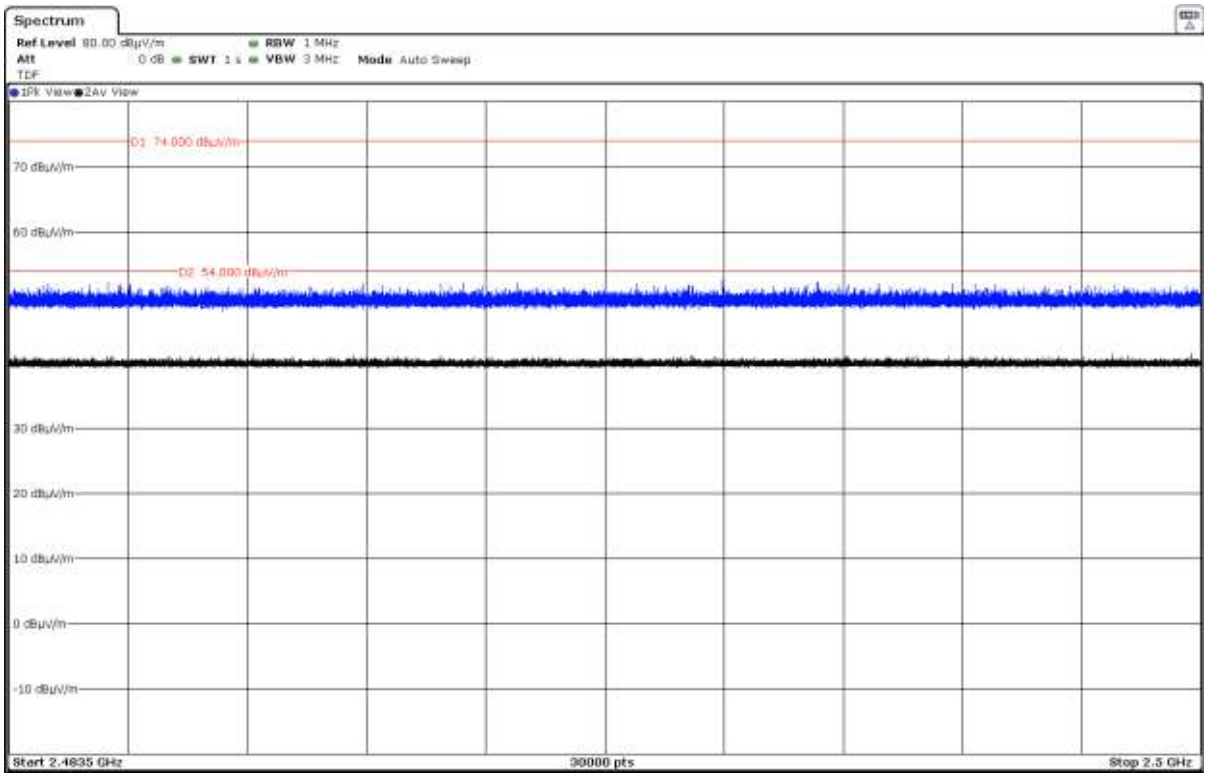


- High Channel:

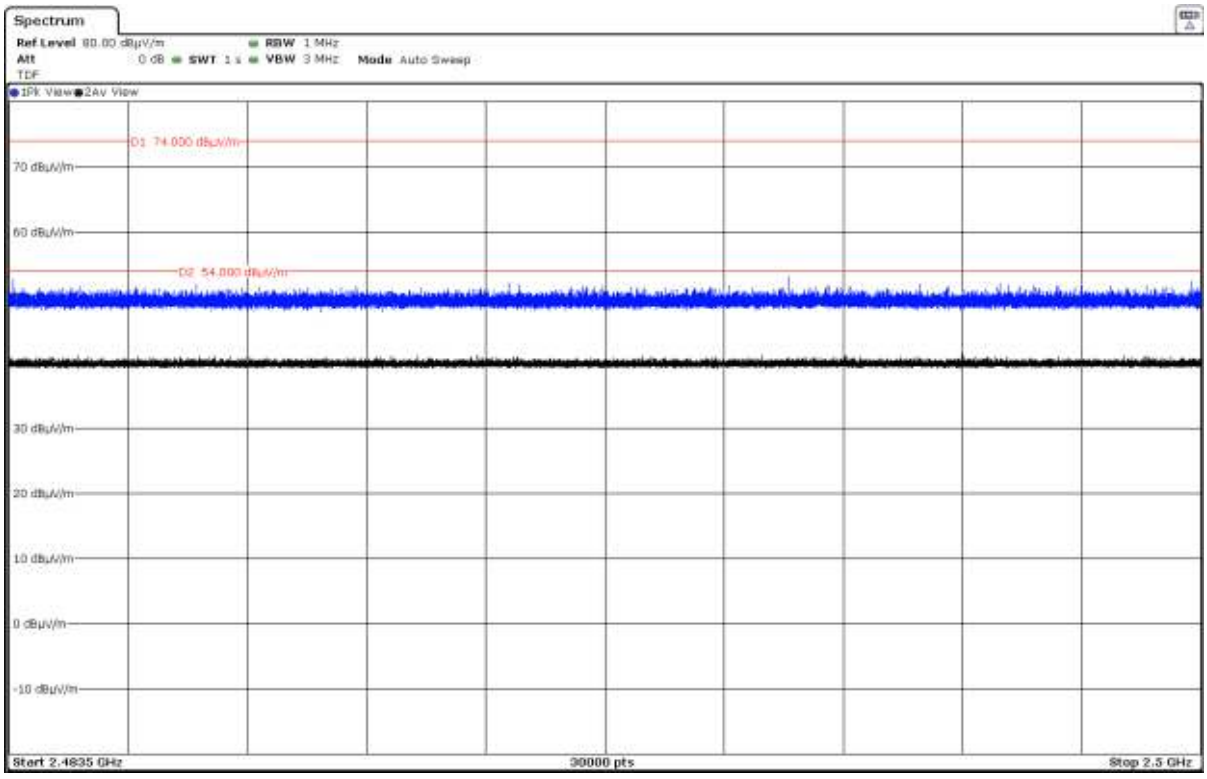


FREQUENCY RANGE 2.4835 - 2.5 GHz (Restricted Band 2)

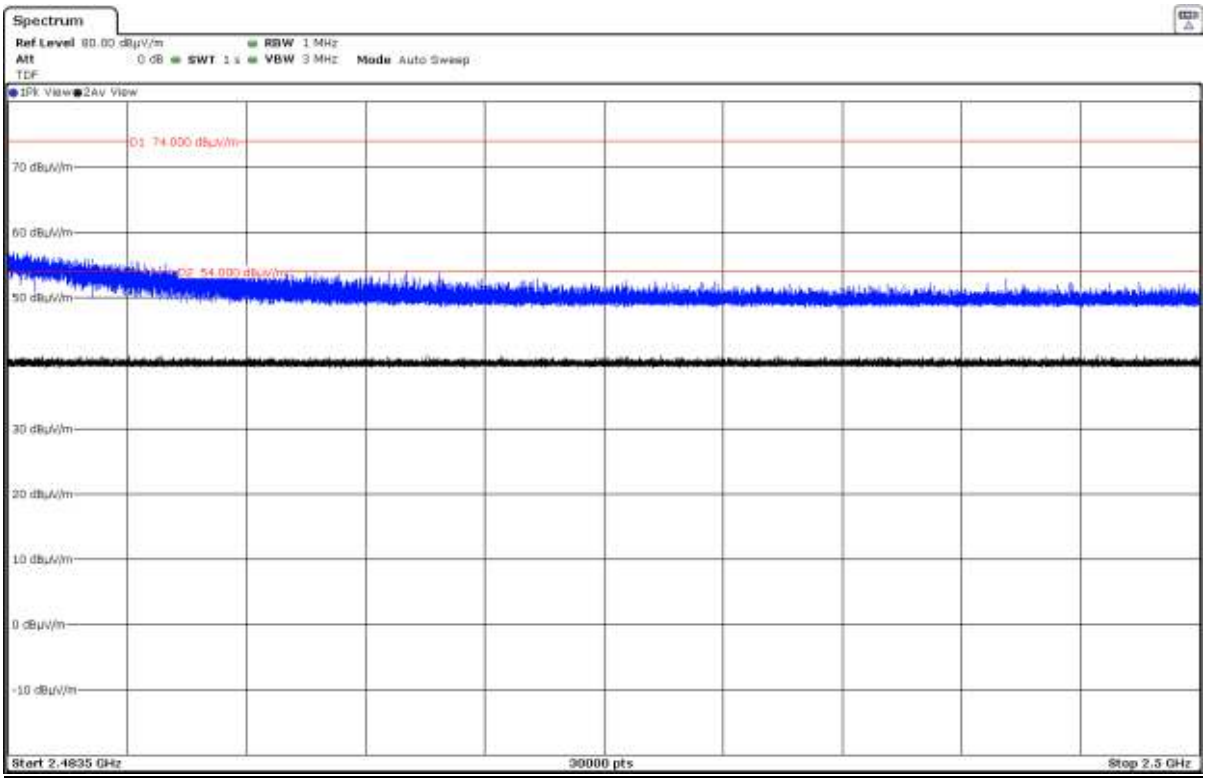
- Low Channel:



- Middle Channel:



- High Channel:



RADIATED WHILE CHARGING:

Frequency range 30 MHz - 1 GHz.

The spurious signals detected do not depend on the operating channel.

Spurious emissions at less than 20 dB of the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
56.174	Quasi peak	26.5	V	<± 3.88
190.325	Quasi peak	23.7	H	<± 3.88

Frequency range 1 - 26 GHz.

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (2402 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.33303	Peak	52.42	H	<±3.70
2.49886	Peak	53.18	H	<±3.70
4.80354	Peak	39.12	V	<±3.70
21.62015	Peak	42.24	H	<±3.70

- Middle Channel (2440 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.32663	Peak	52.60	H	<±3.70
2.48968	Peak	53.95	V	<±3.70
4.87944	Peak	39.83	V	<±3.70
21.95785	Peak	42.58	V	<±3.70

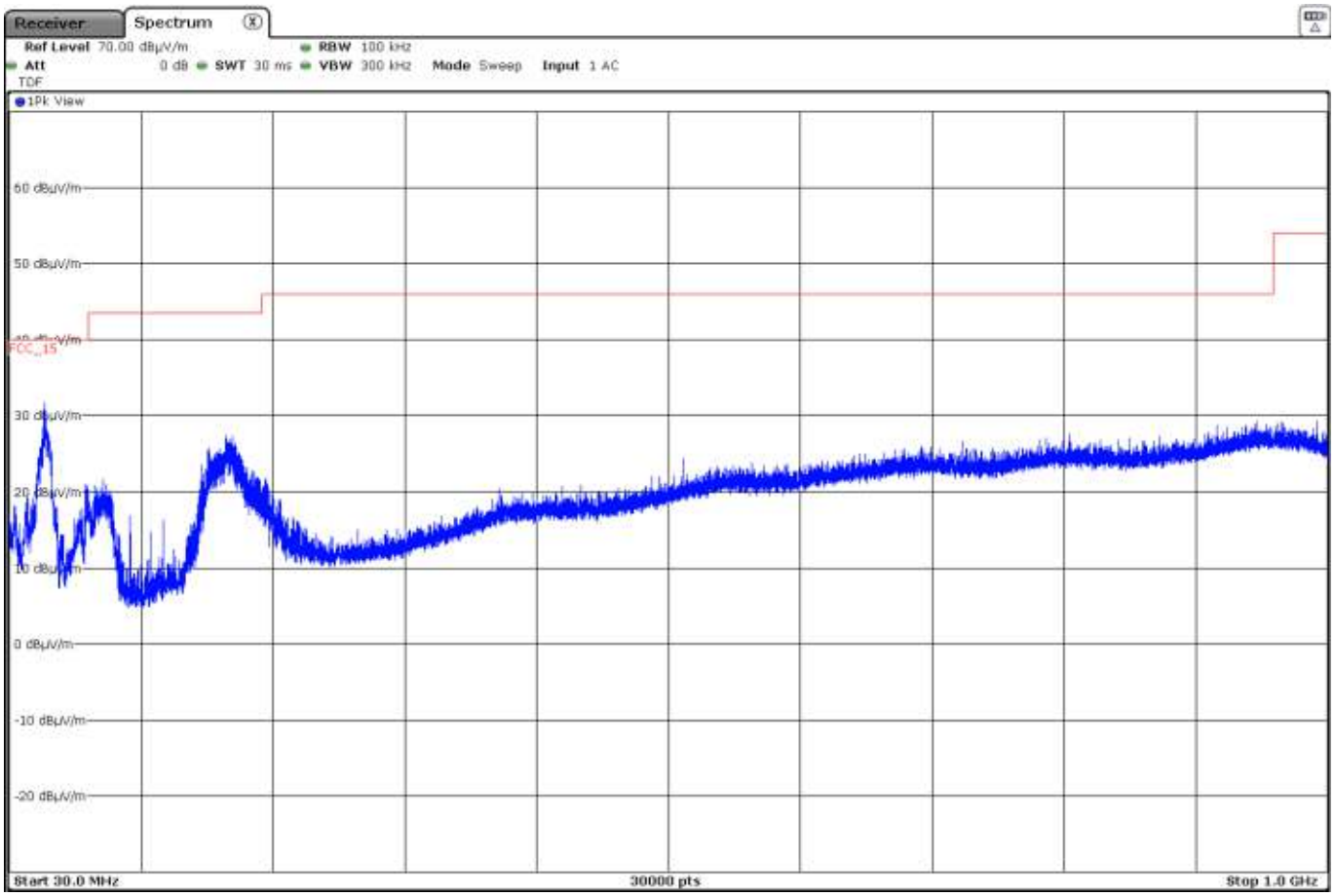
- High Channel (2480 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.31239	Peak	52.61	H	<±3.70
2.48389	Peak	58.01	H	<±3.70
	Average	40.79		<±3.70
4.95977	Peak	40.36	V	<±3.70
22.31735	Peak	45.18	V	<±3.70

Verdict: PASS

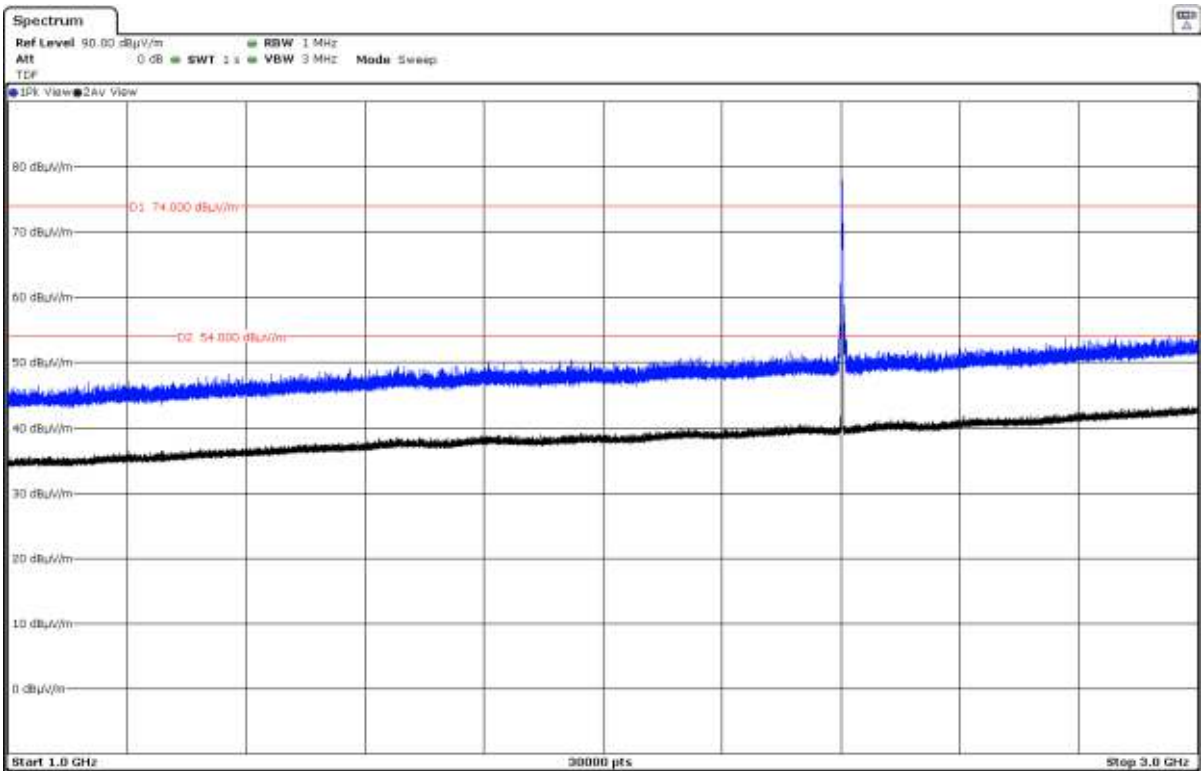
FREQUENCY RANGE 30 MHz - 1 GHz

The spurious signals detected do not depend on the operating channel, so valid for Low, Middle and High Channels.



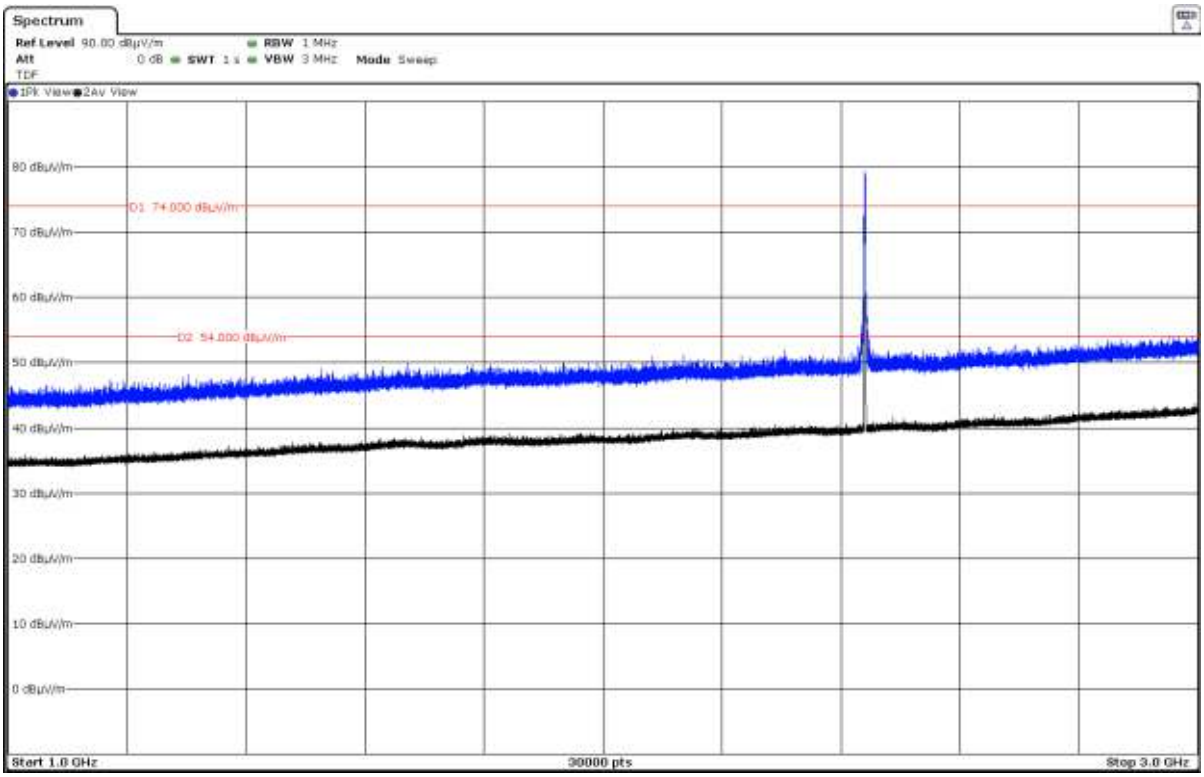
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



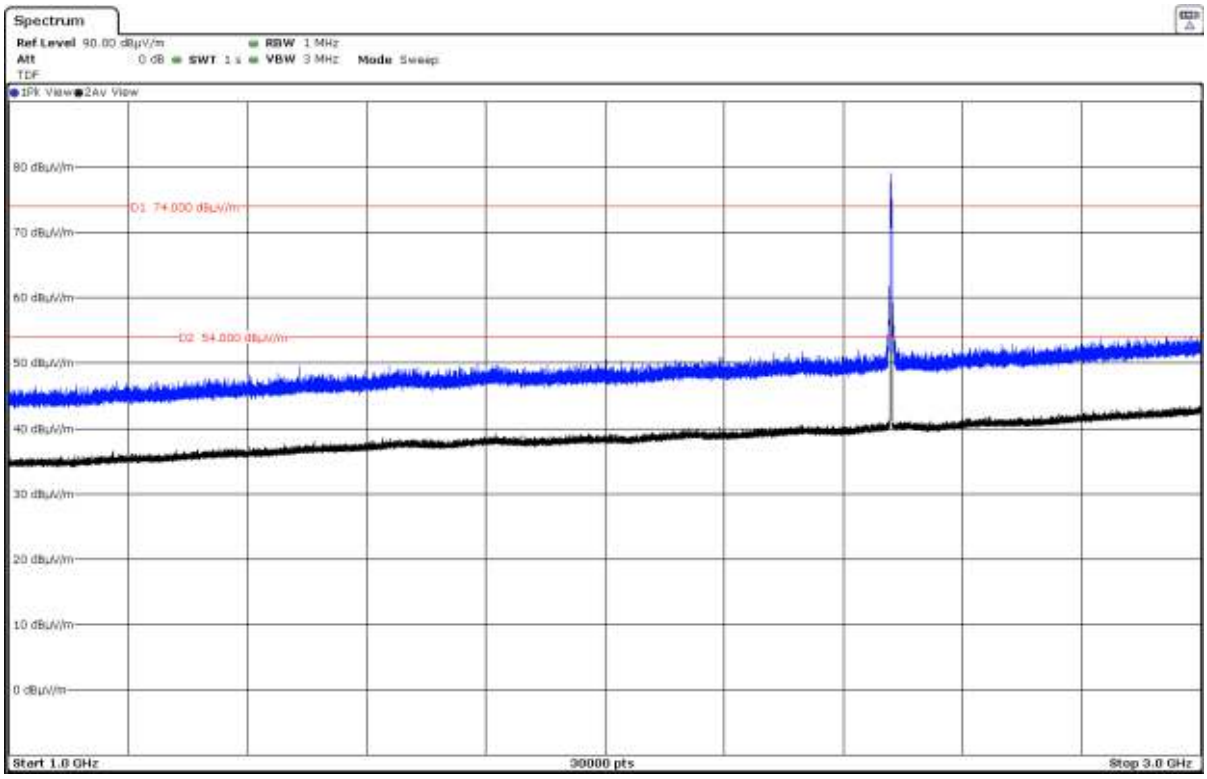
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

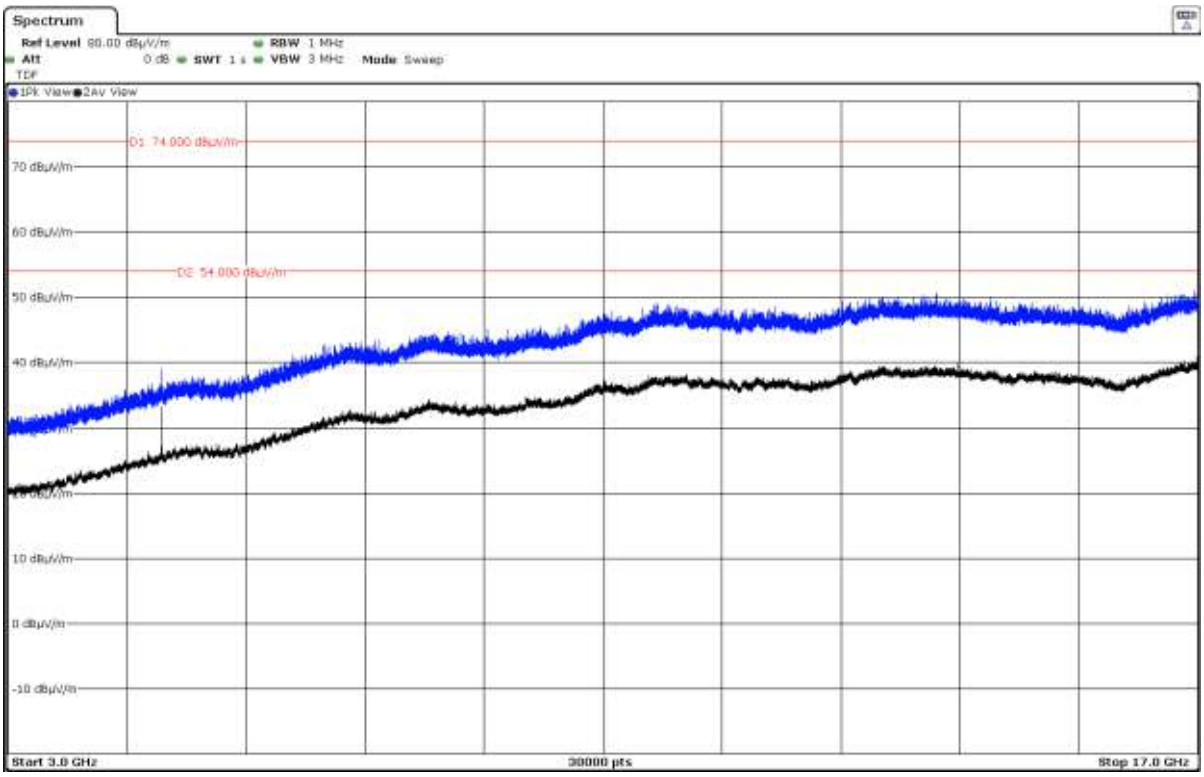
- High Channel:



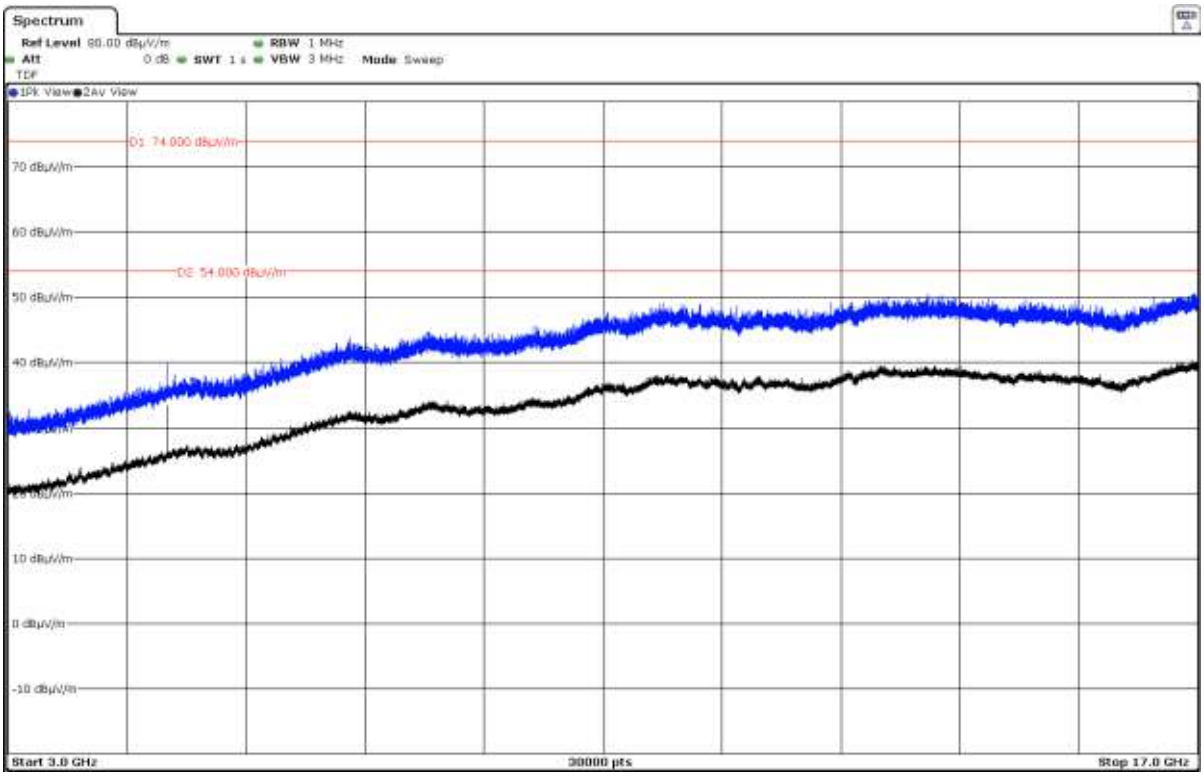
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

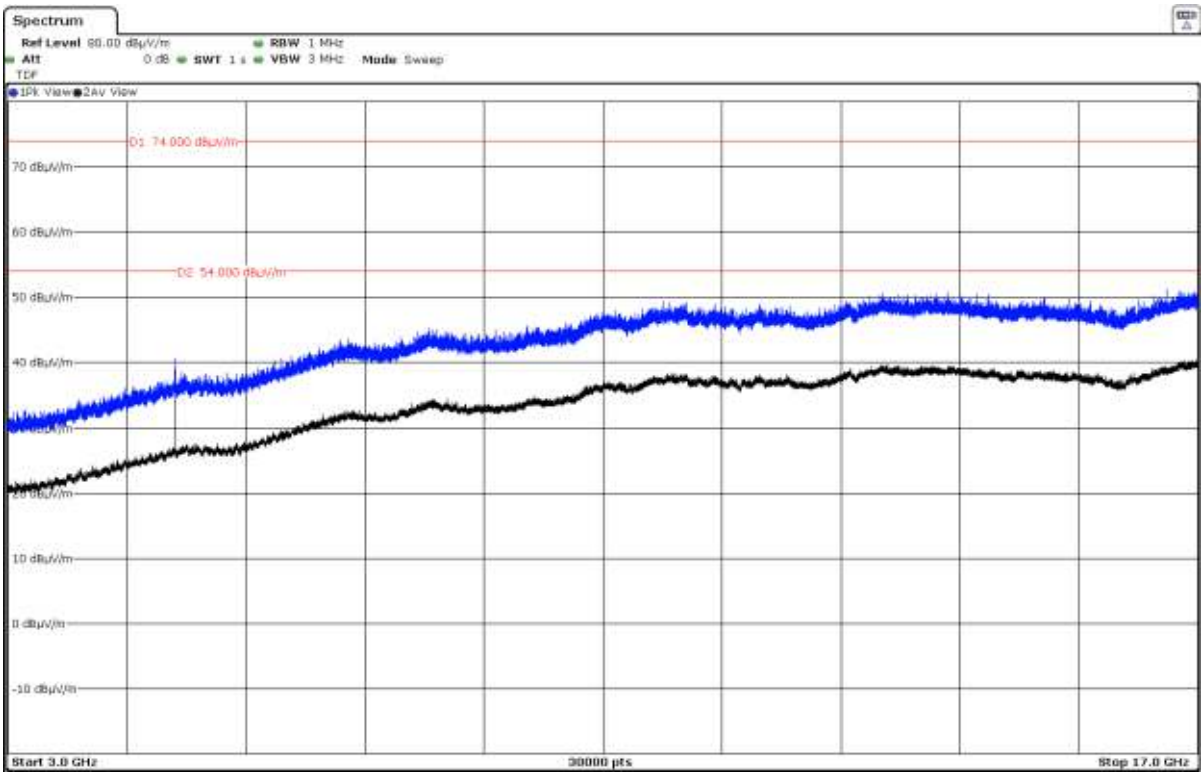
- Low Channel:



- Middle Channel:

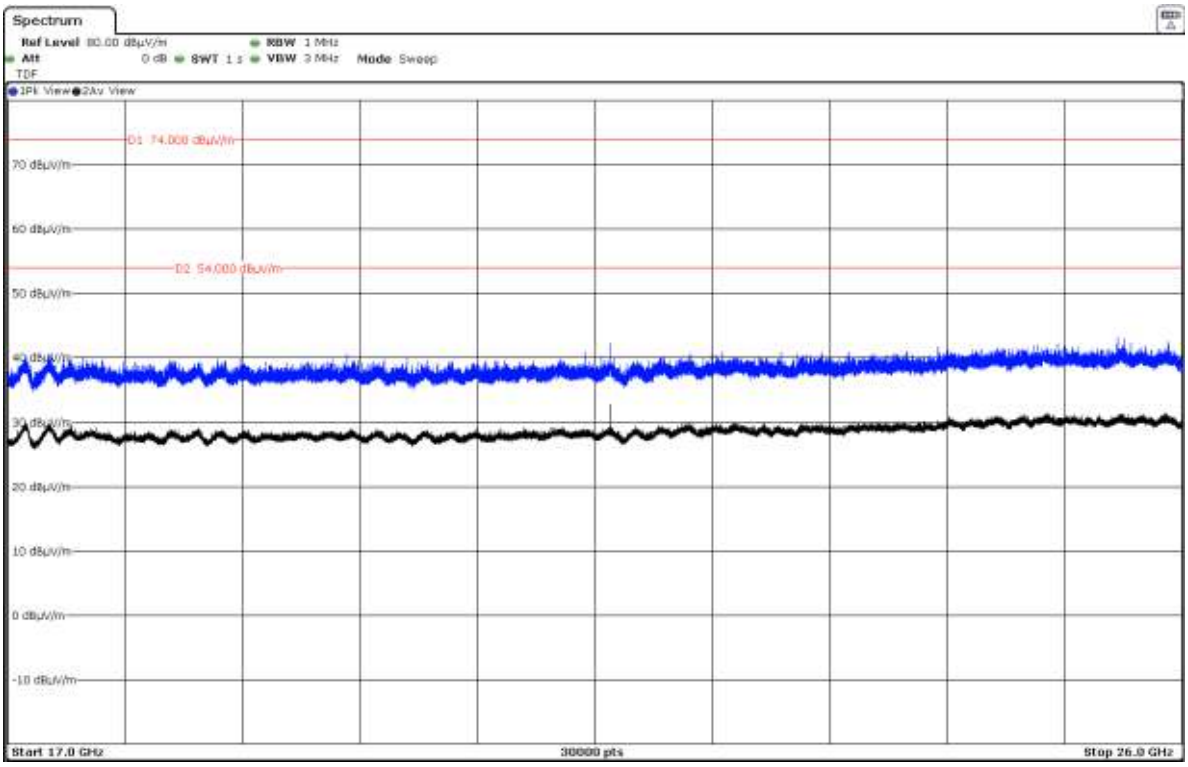


- High Channel:

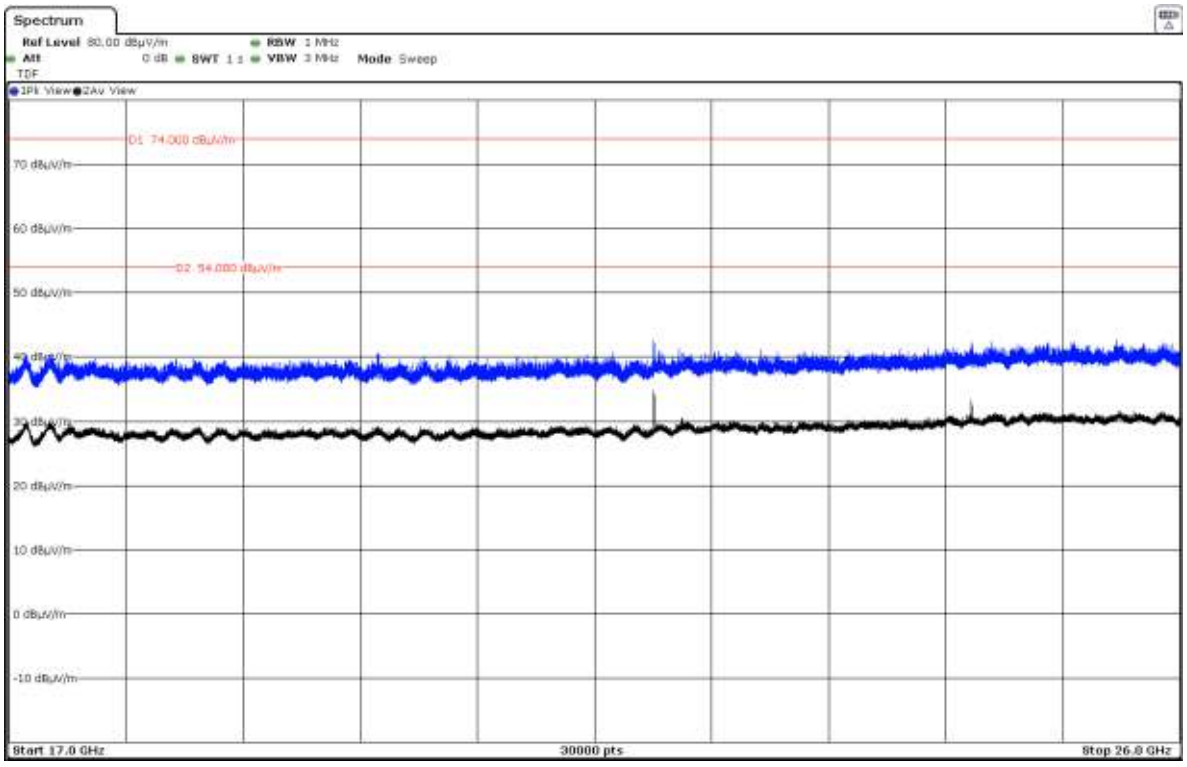


FREQUENCY RANGE 17 - 26 GHz

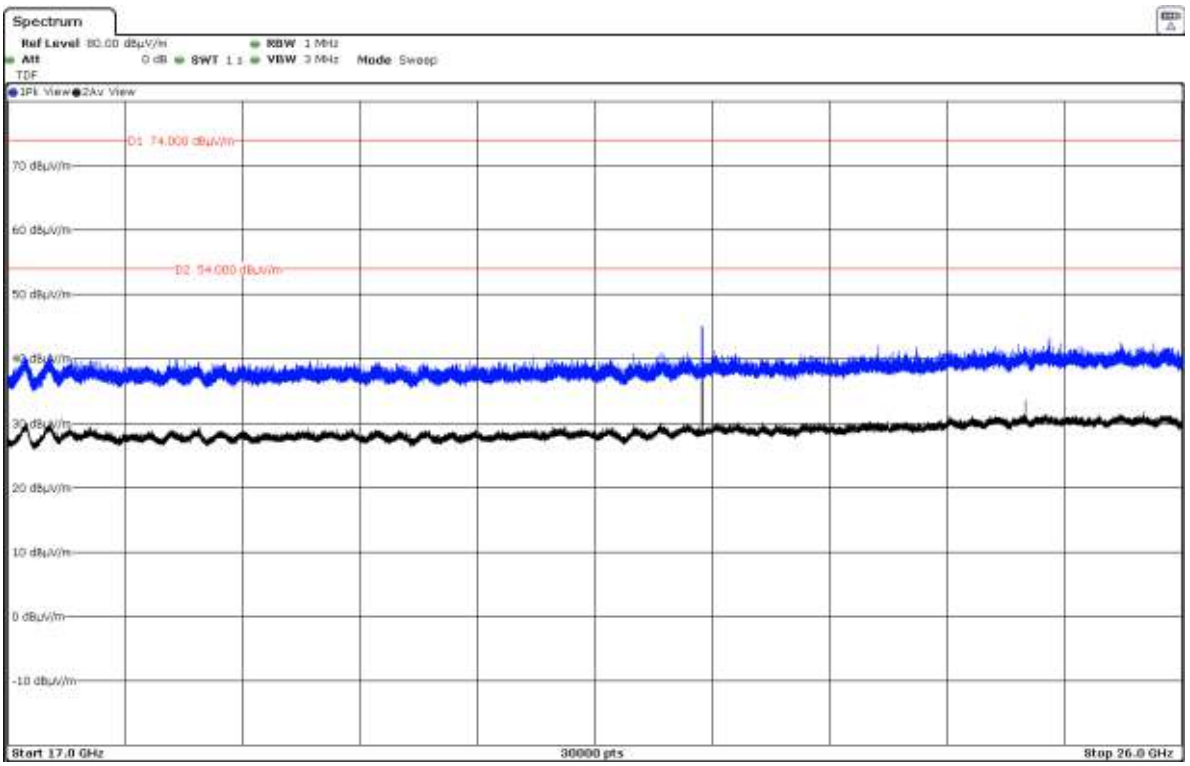
- Low Channel:



- Midle Channel:

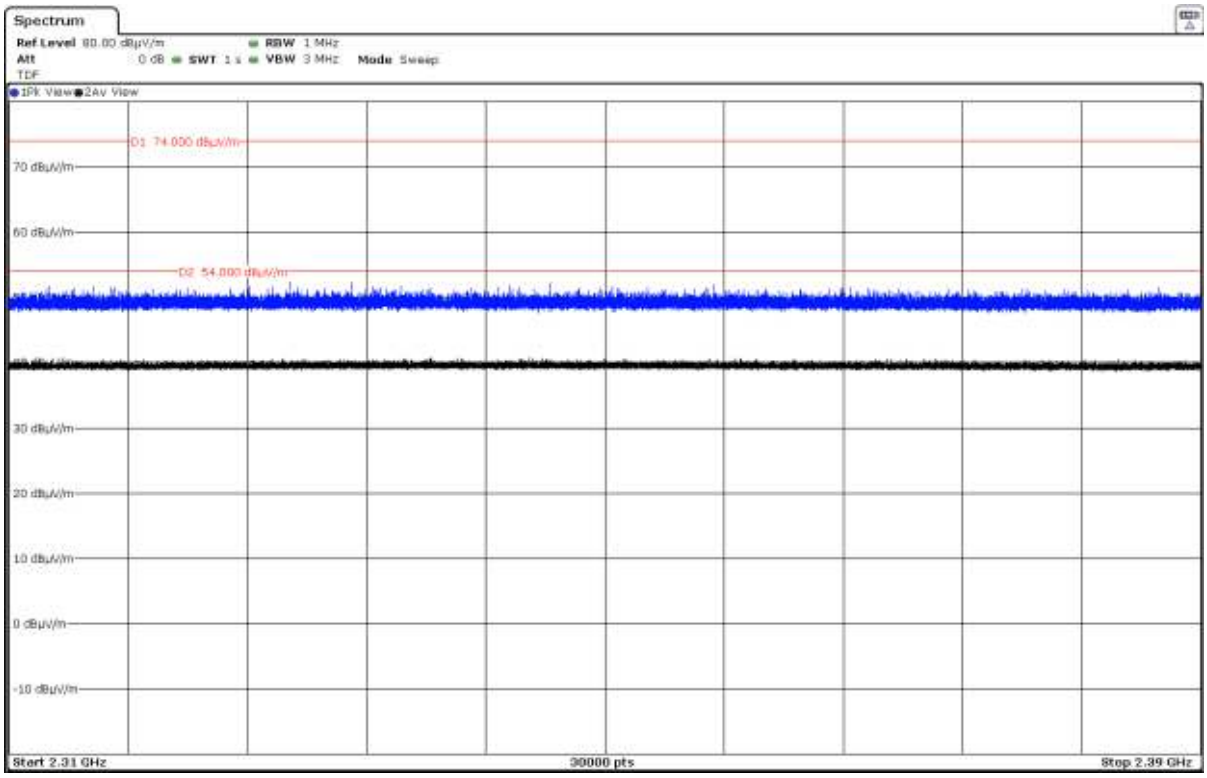


- High Channel:

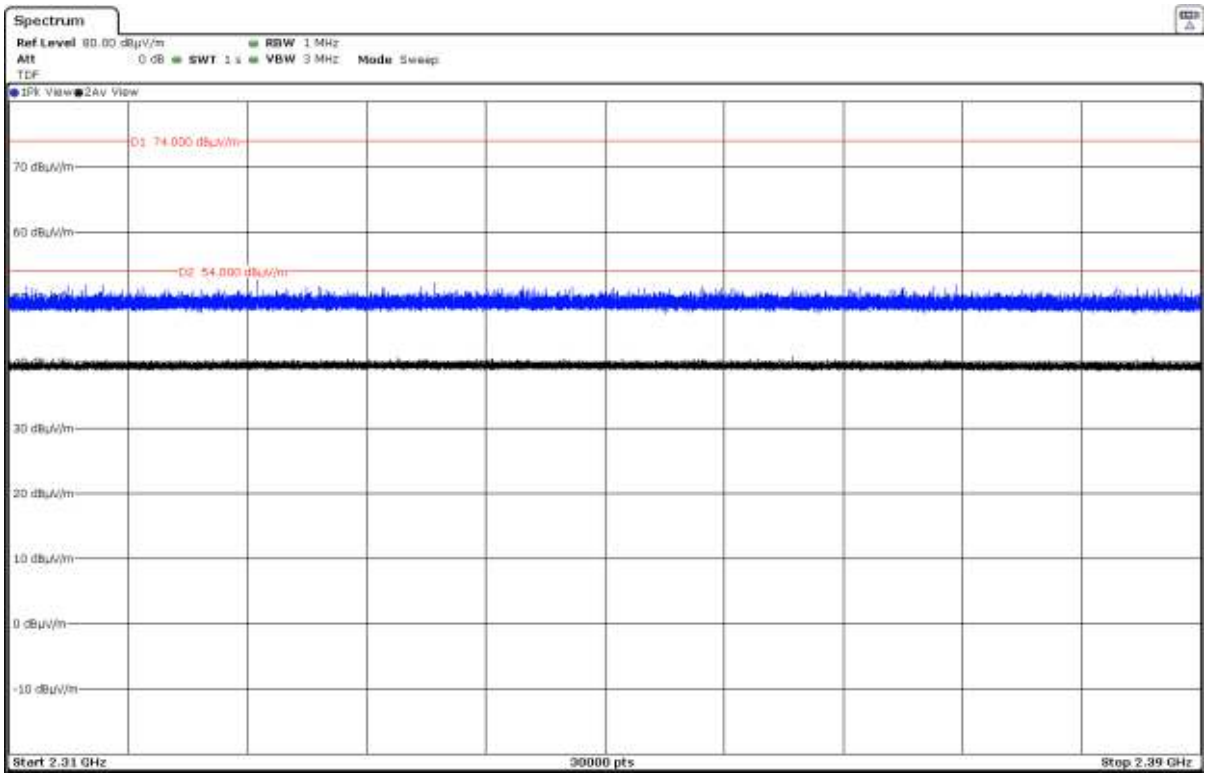


FREQUENCY RANGE 2.31 - 2.39 GHz (Restricted Band 1)

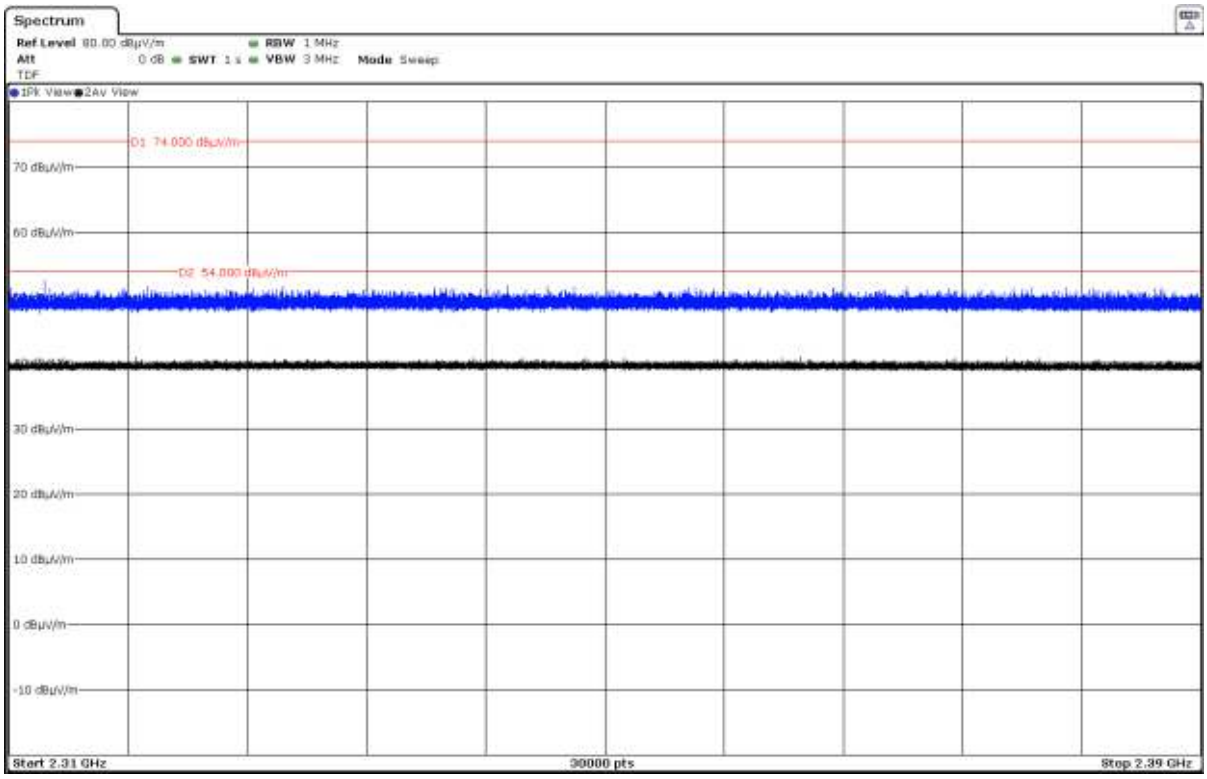
- Low Channel:



- Middle Channel:

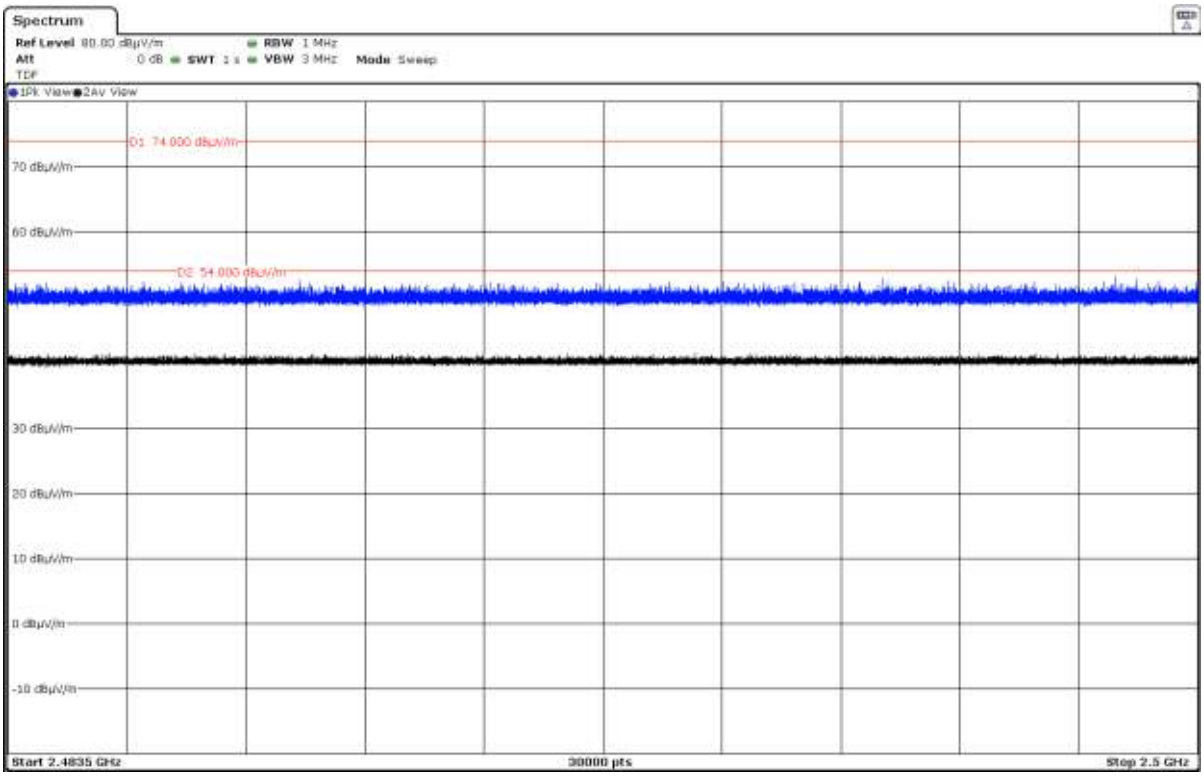


- High Channel:

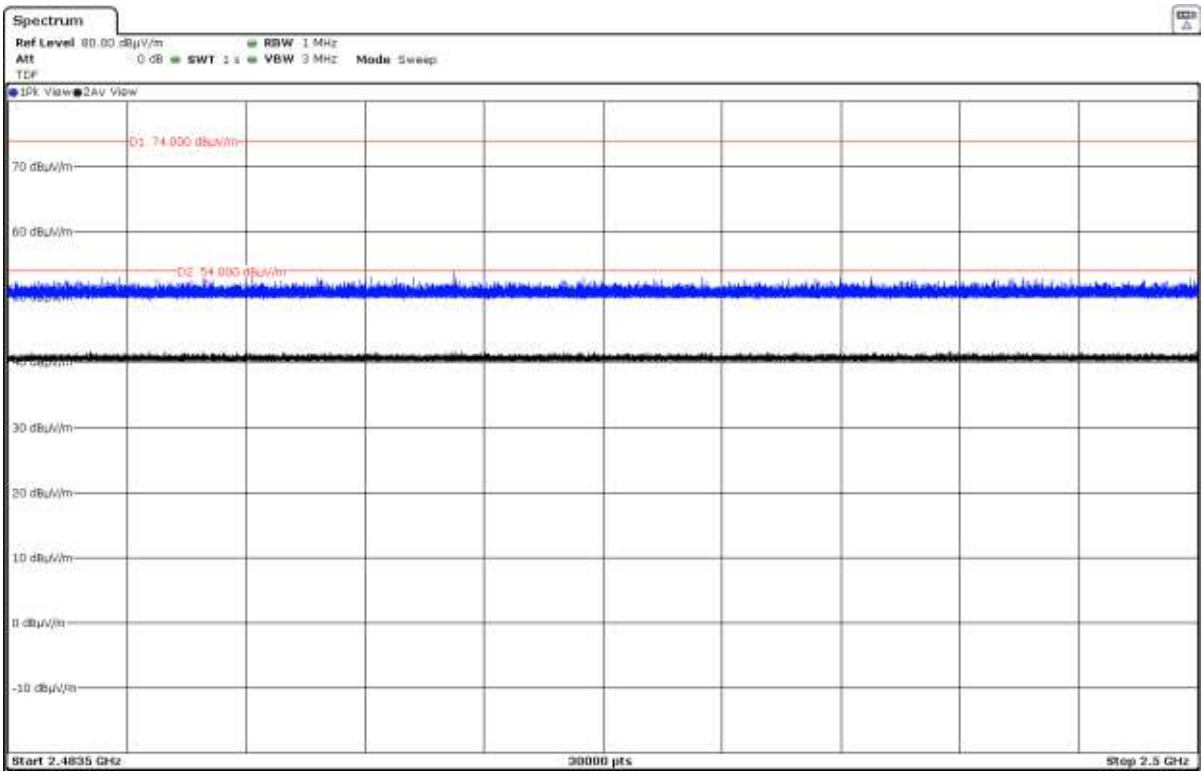


FREQUENCY RANGE 2.4835 - 2.5 GHz (Restricted Band 2)

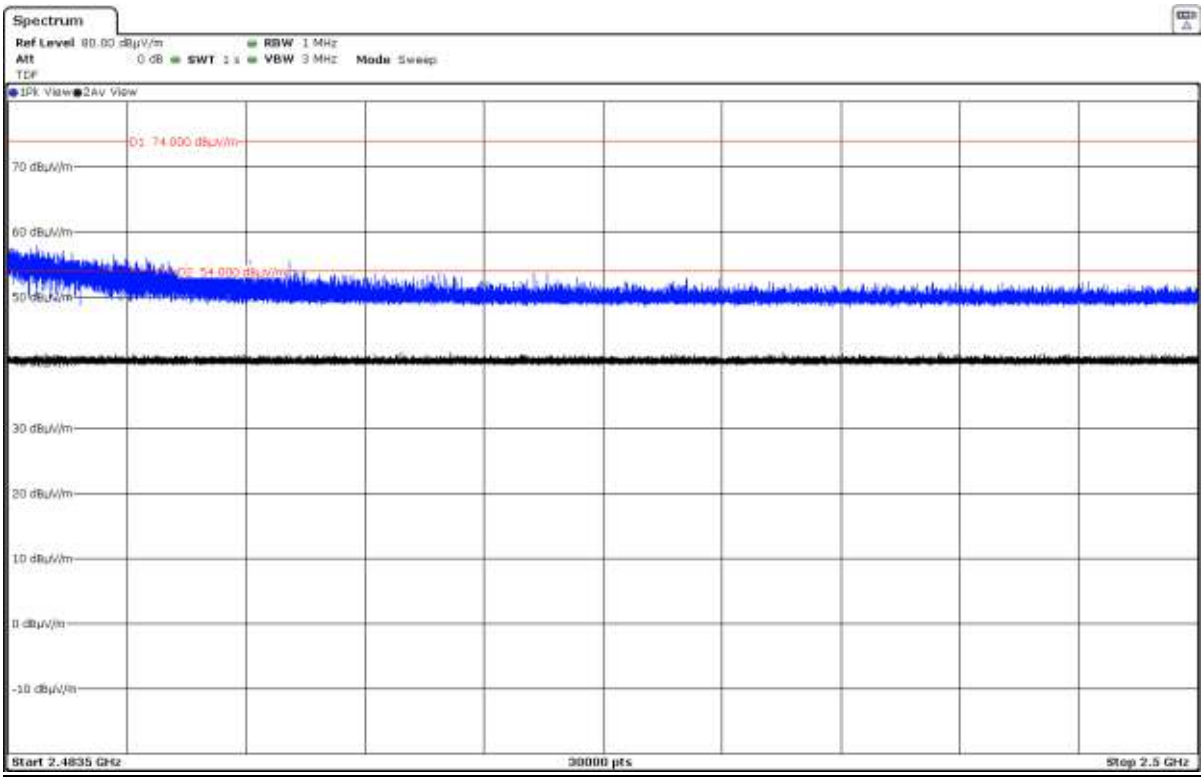
- Low Channel:



- Middle Channel:



- High Channel:



Appendix B: Test results. Bluetooth Basic Rate

INDEX

TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.7 Vdc
Type of power supply:	DC rechargeable battery; battery charging case supplied by a power supply 5 Vdc.
Type of antenna:	Small magnetic loop antenna.
Declared antenna gain:	- 12 dBi

TEST FREQUENCIES:

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

CONDUCTED MEASUREMENTS

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

RADIATED MEASUREMENTS

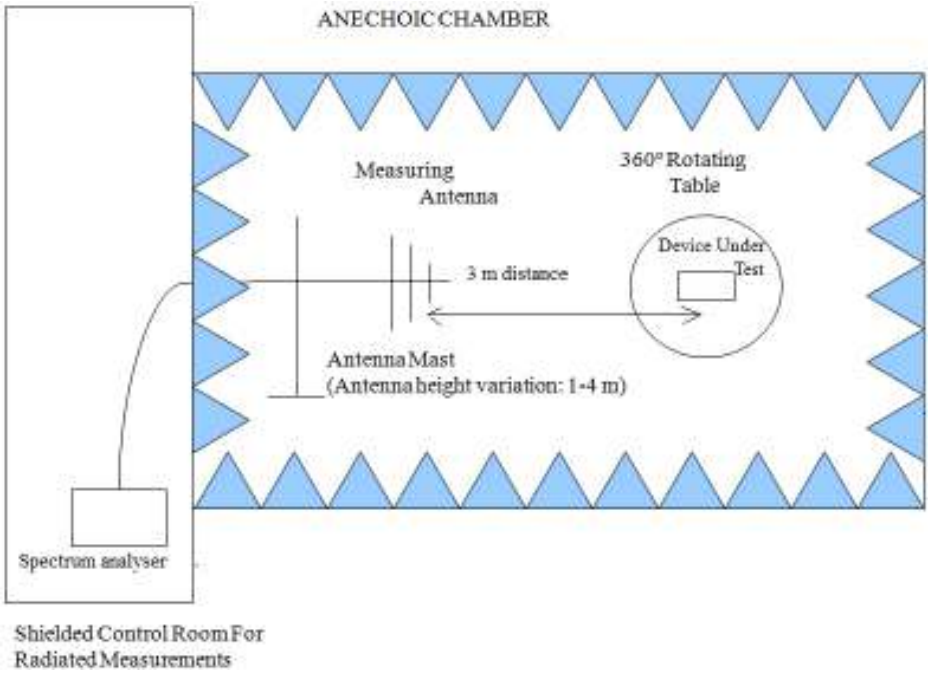
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 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.

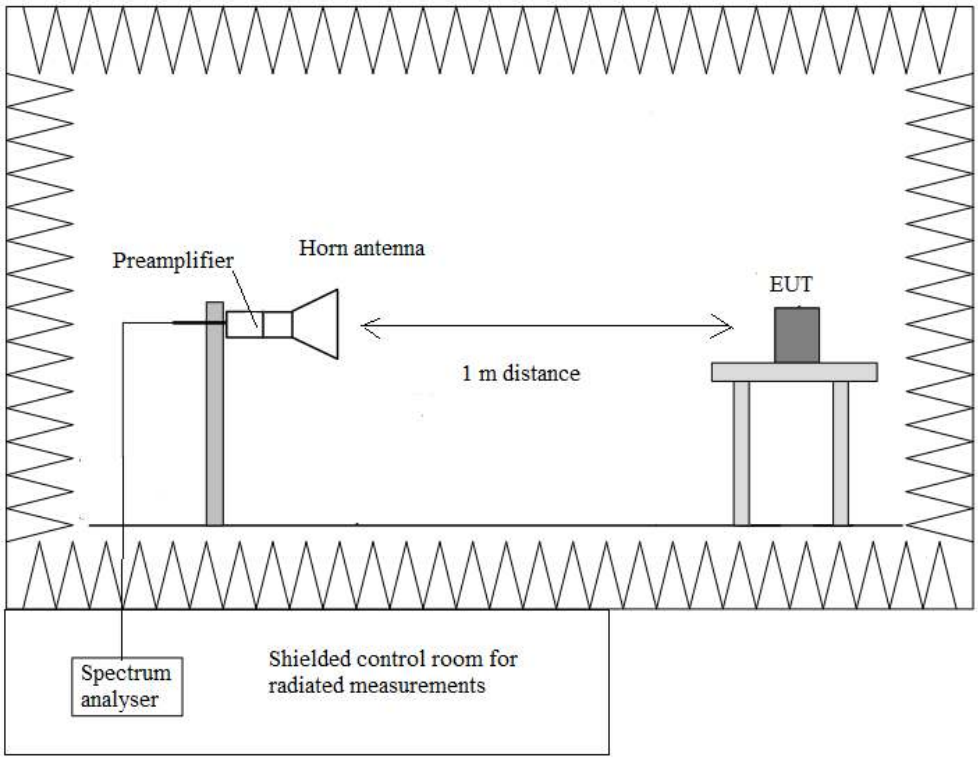
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz:

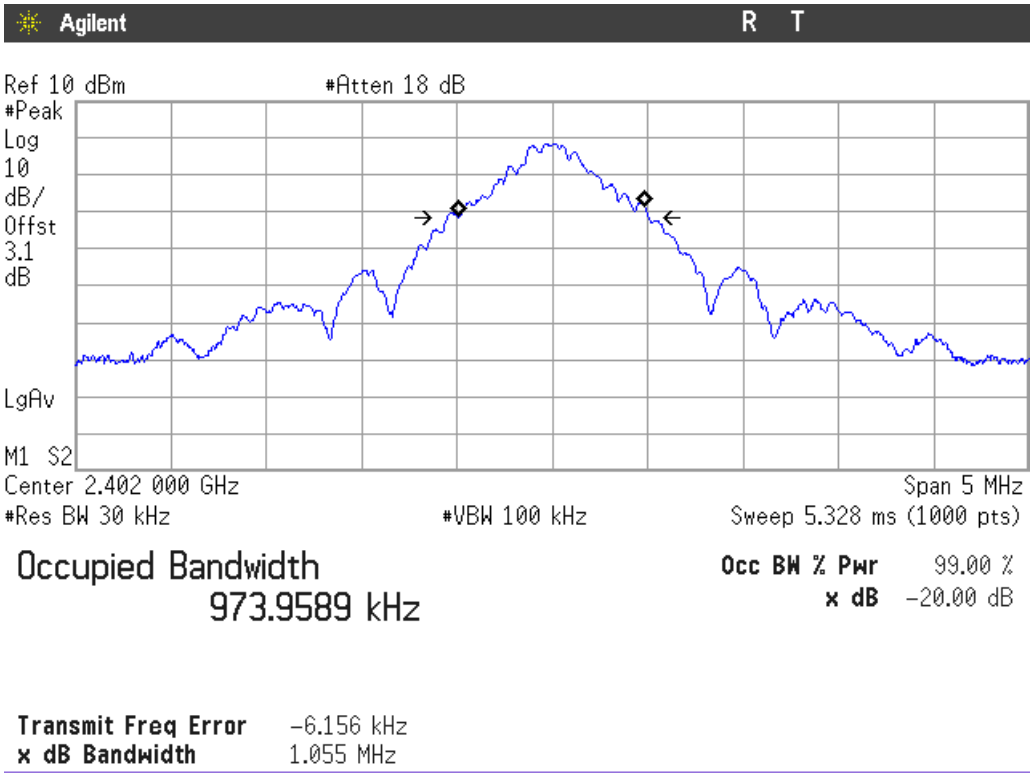


Occupied Bandwidth

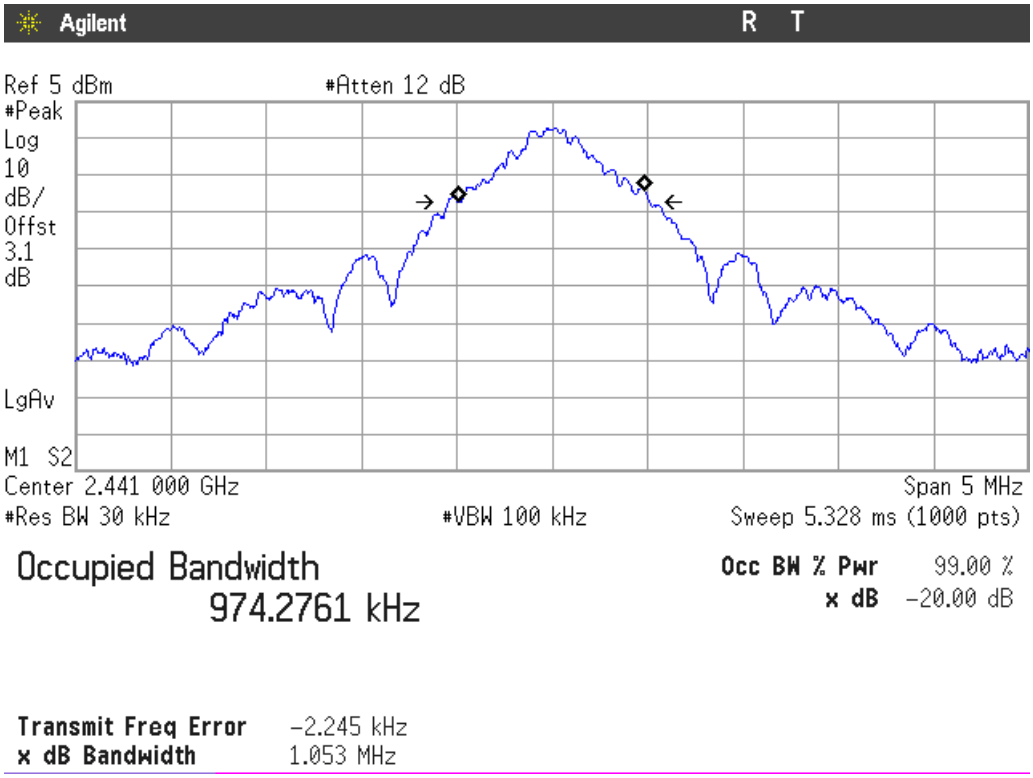
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2441 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	0.9739589	0.9742761	0.9746551
Measurement Uncertainty (kHz)	<±5.00		

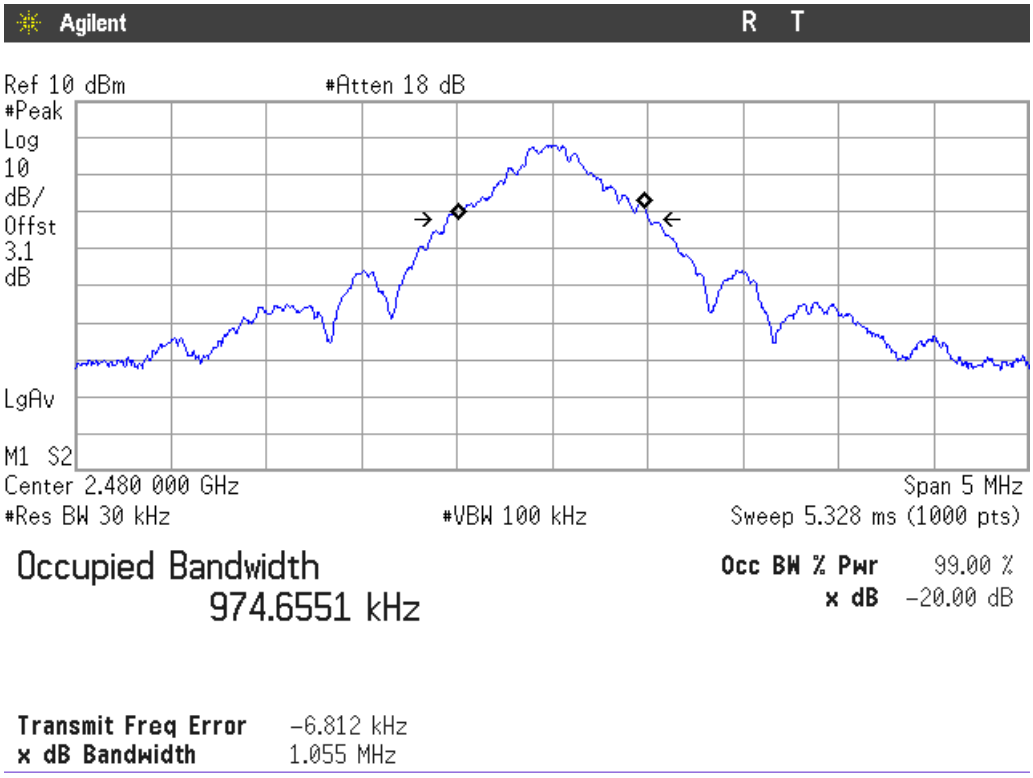
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

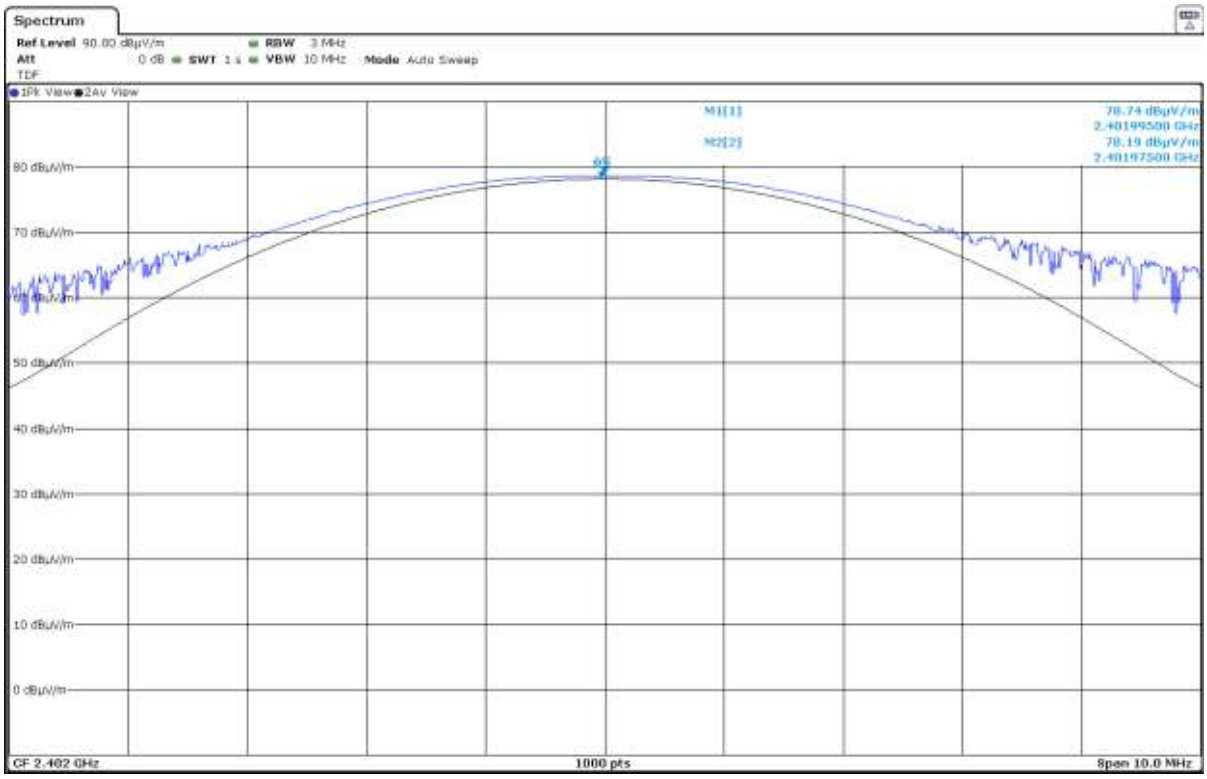
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

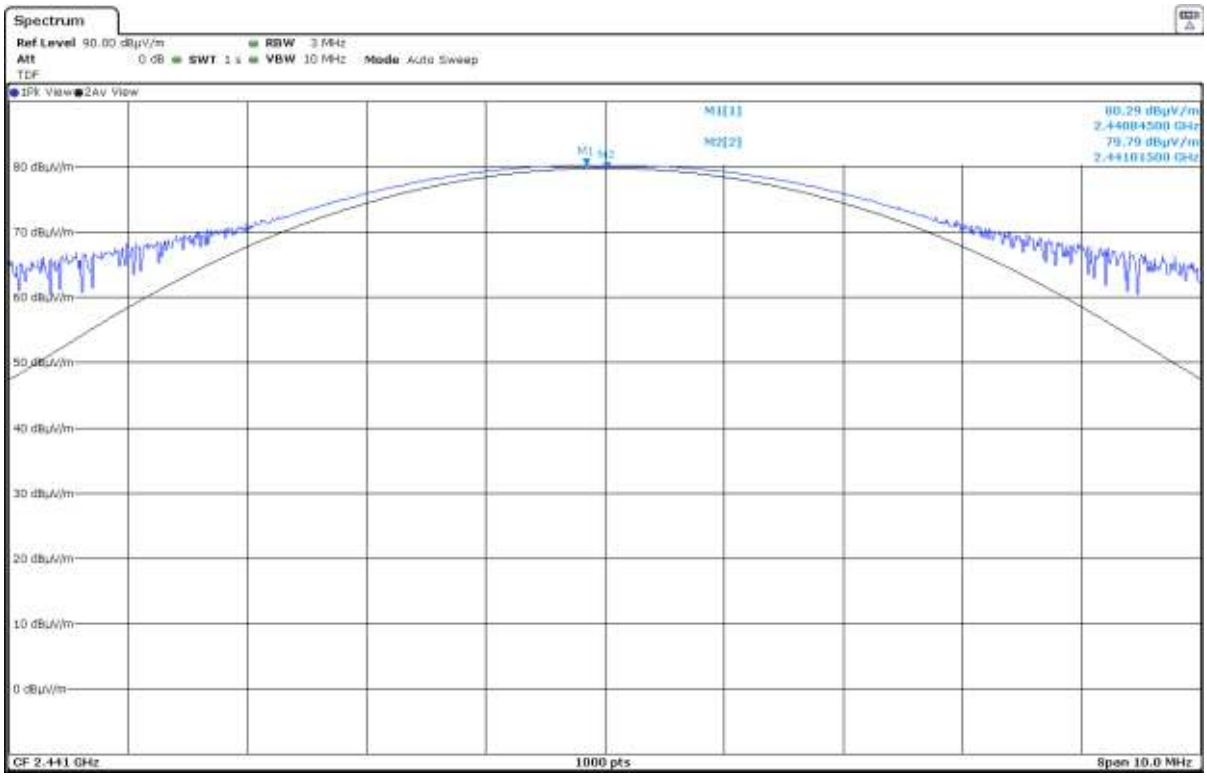
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	78.19	79.79	79.81
Peak Field Strength (dBµV/m)	78.74	80.29	80.30
Measurement Uncertainty (dB)	<±3.05		

Verdict: PASS

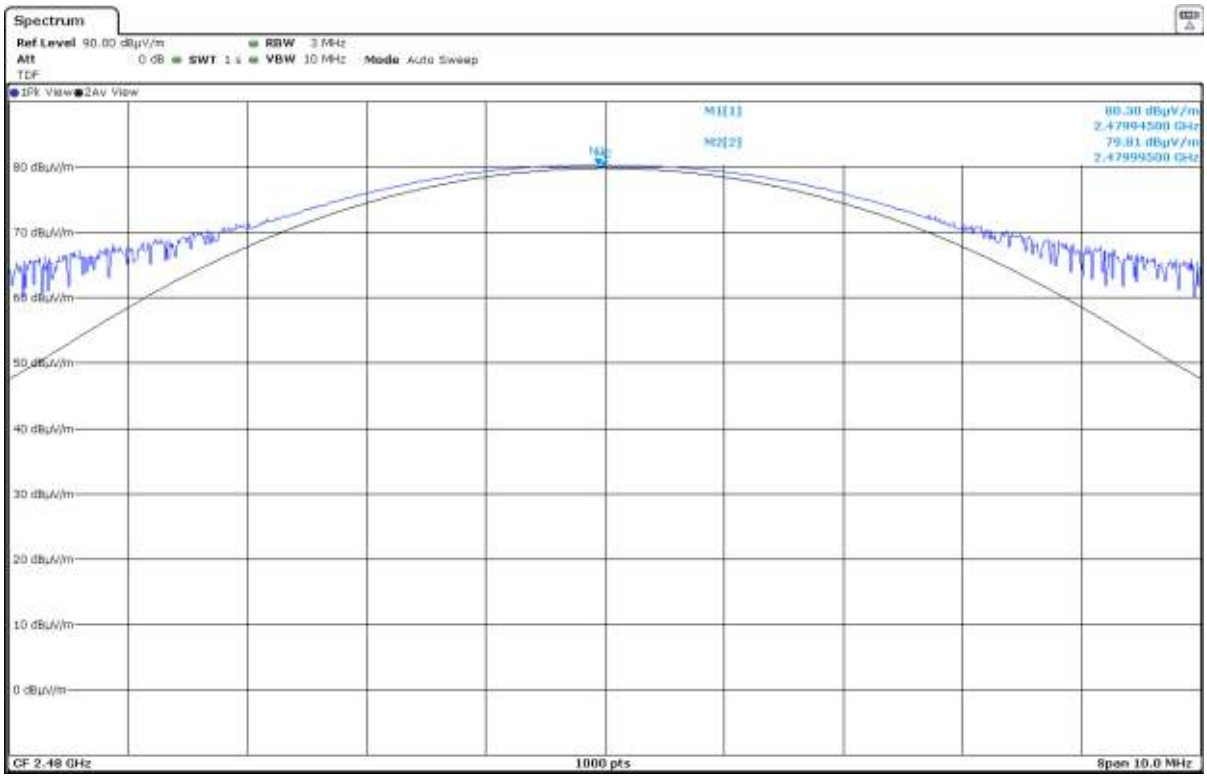
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/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 (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

Whichever is the lesser attenuation.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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-26 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 - 1 GHz.

The spurious signals detected do not depend on the operating channel.

No spurious emissions were found at less than 20 dB of the limit.

Frequency range 1 - 26 GHz.

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (2402 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.37395	Peak	51.84	V	<±3.70
2.48360	Peak	52.98	H	<±3.70
4.80390	Peak	40.98	V	<±3.70

- Middle Channel (2440 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.88183	Peak	44.86	V	<±3.70
21.96785	Peak	43.27	V	<±3.70

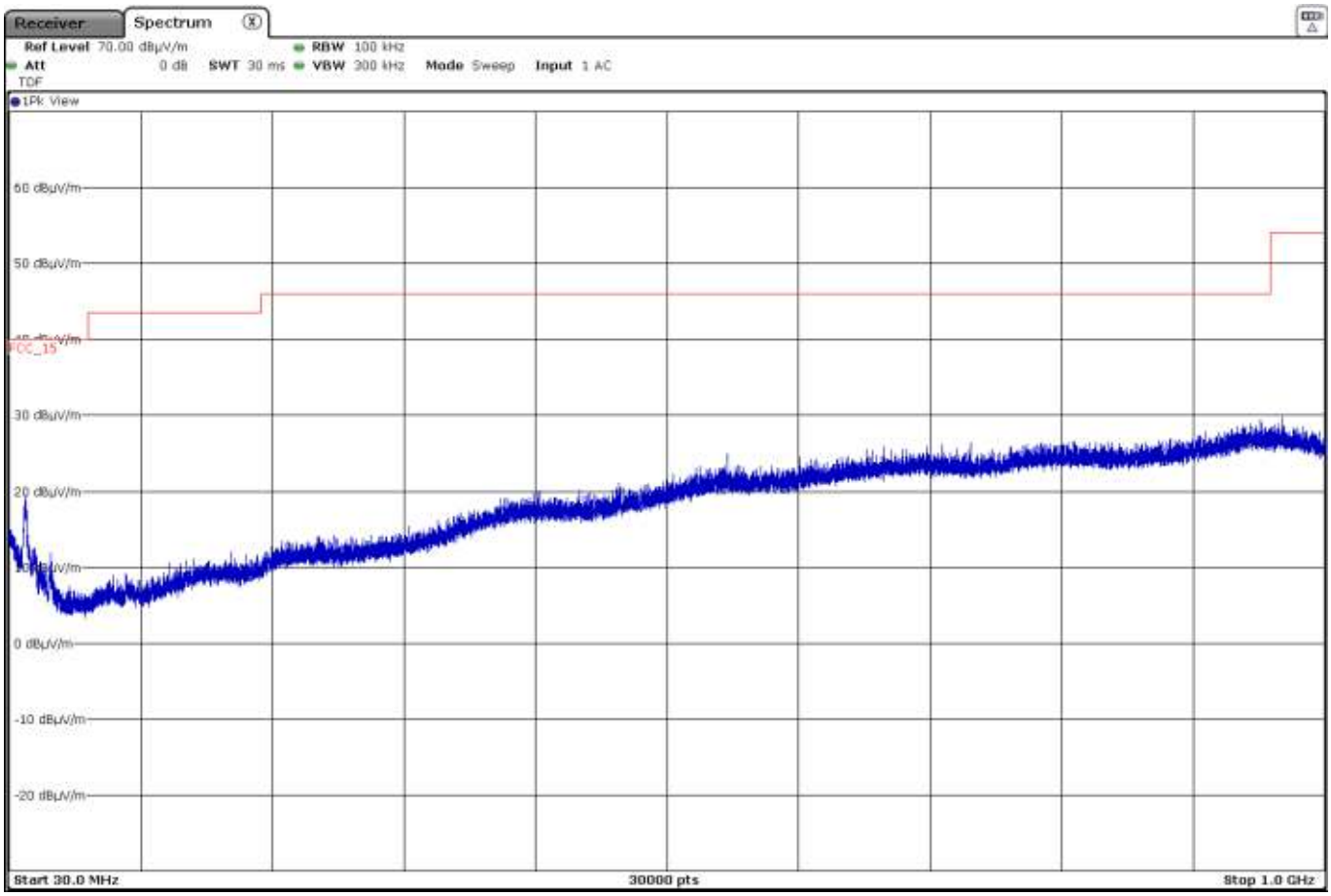
- High Channel (2480 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.34510	Peak	51.75	H	<±3.70
2.48415	Peak	56.04	H	<±3.70
	Average	41.10		<±3.70
4.96023	Peak	41.24	V	<±3.70
22.32125	Peak	44.17	H	<±3.70

Verdict: PASS

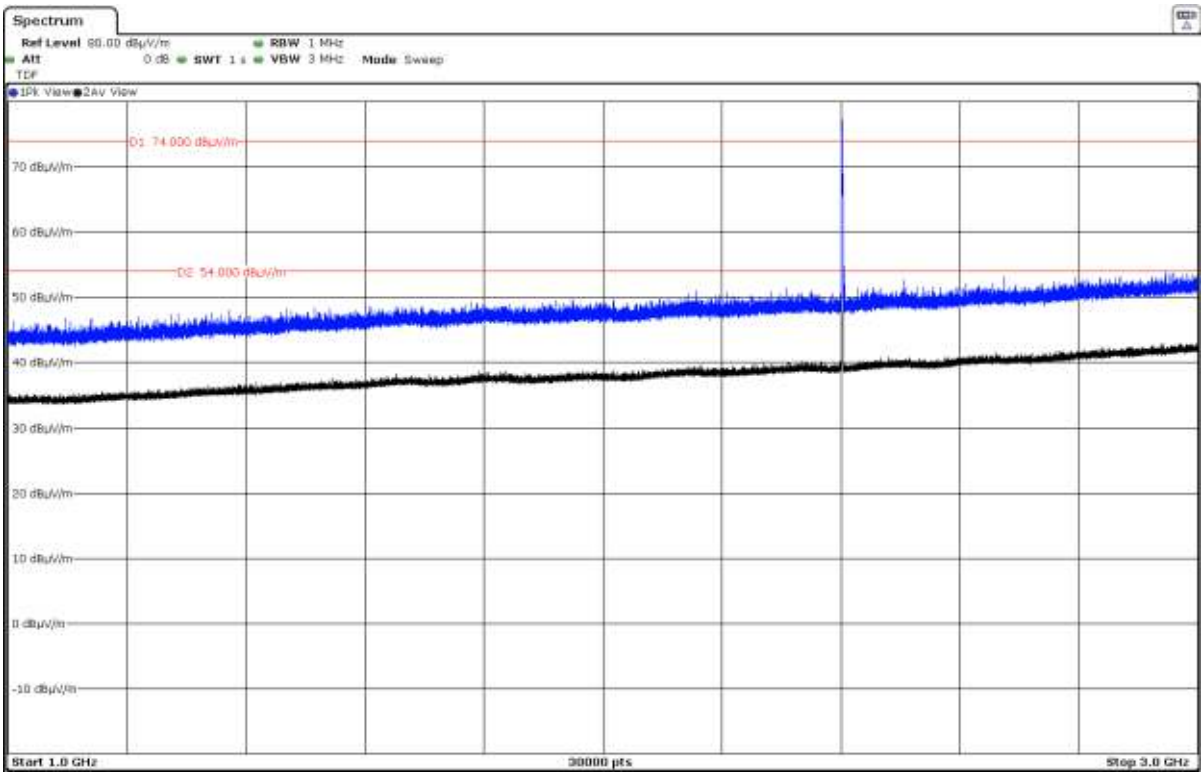
FREQUENCY RANGE 30 MHz - 1 GHz

The spurious signals detected do not depend on the operating channel, so valid for Low, Middle and High Channels.



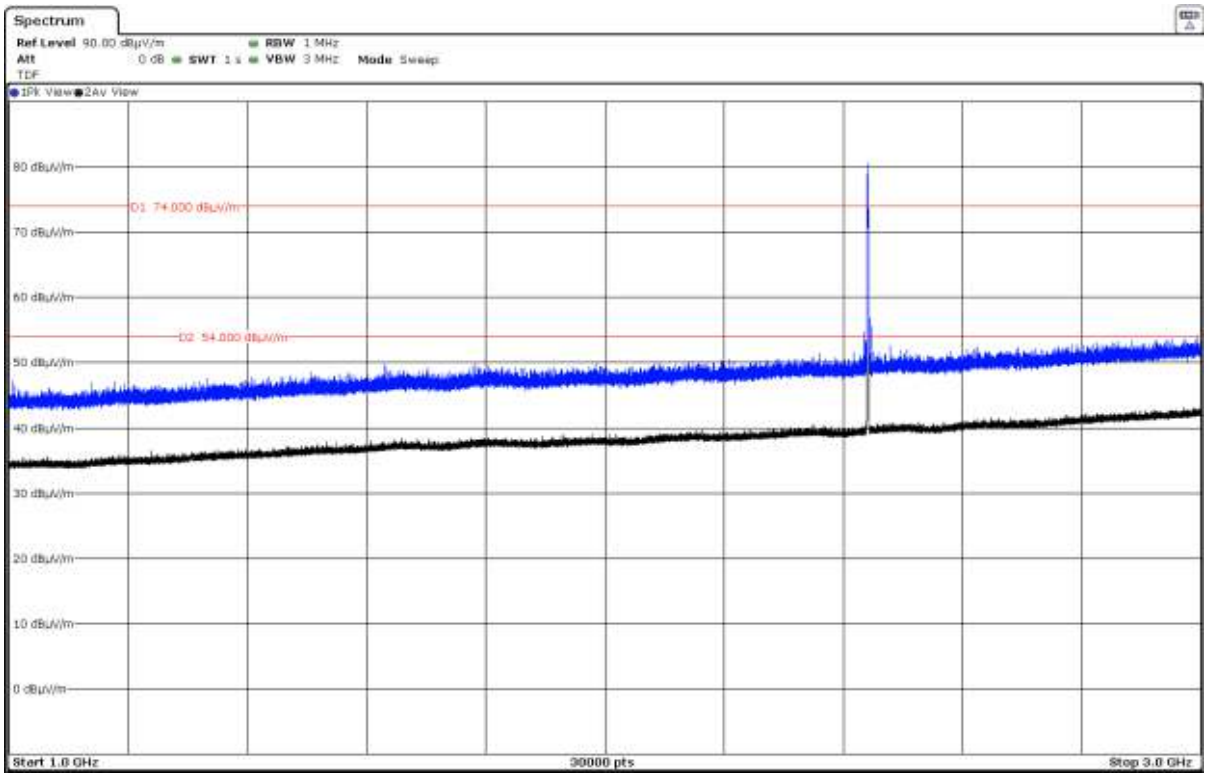
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



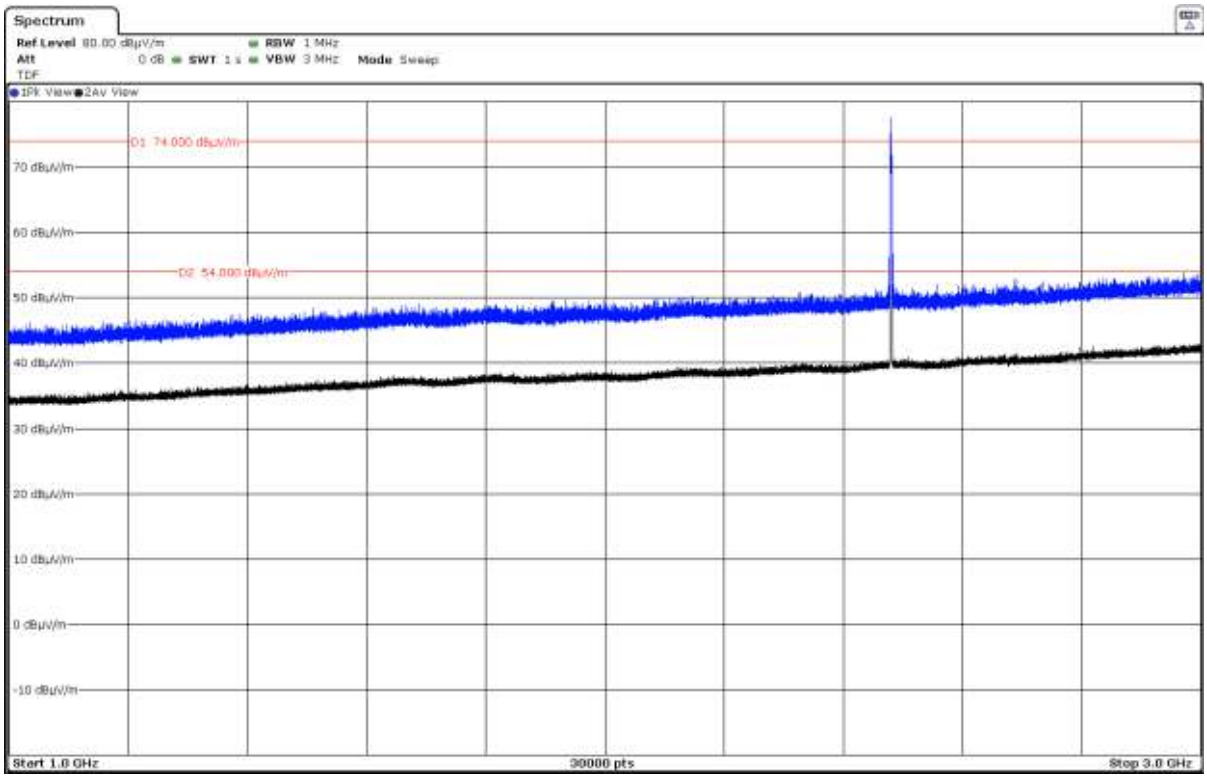
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

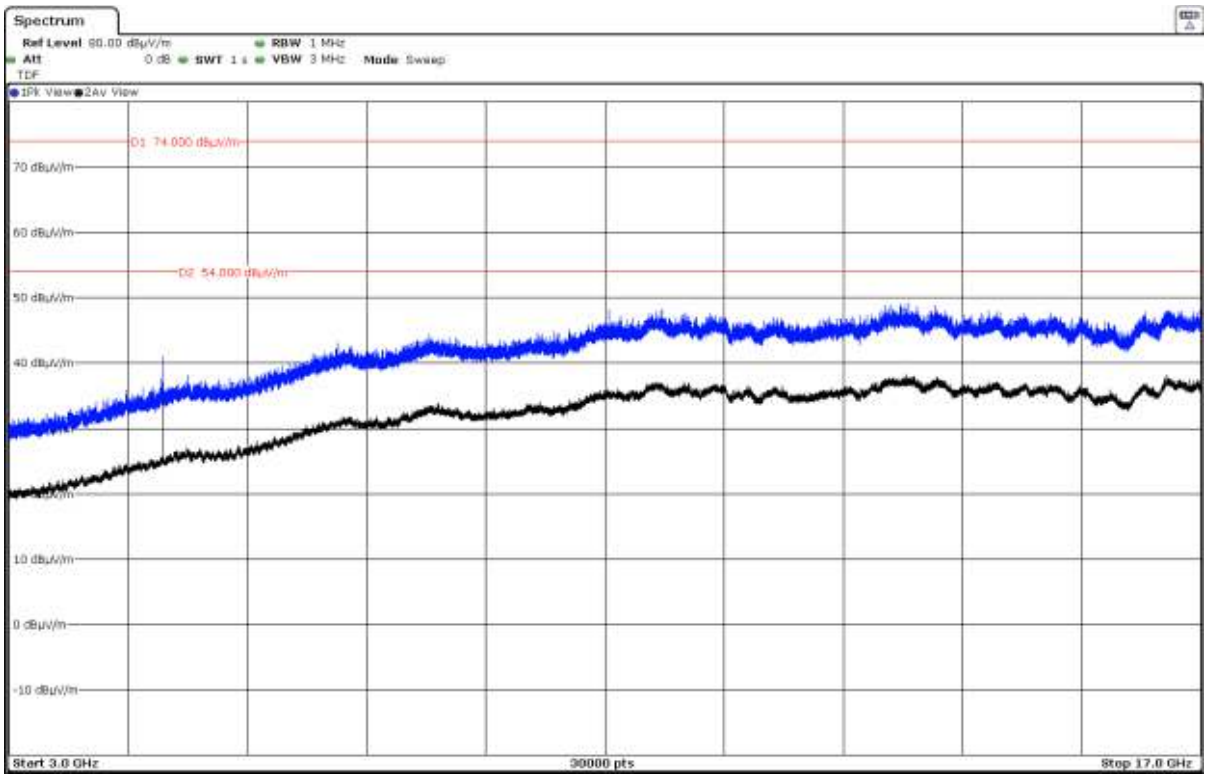
- High Channel:



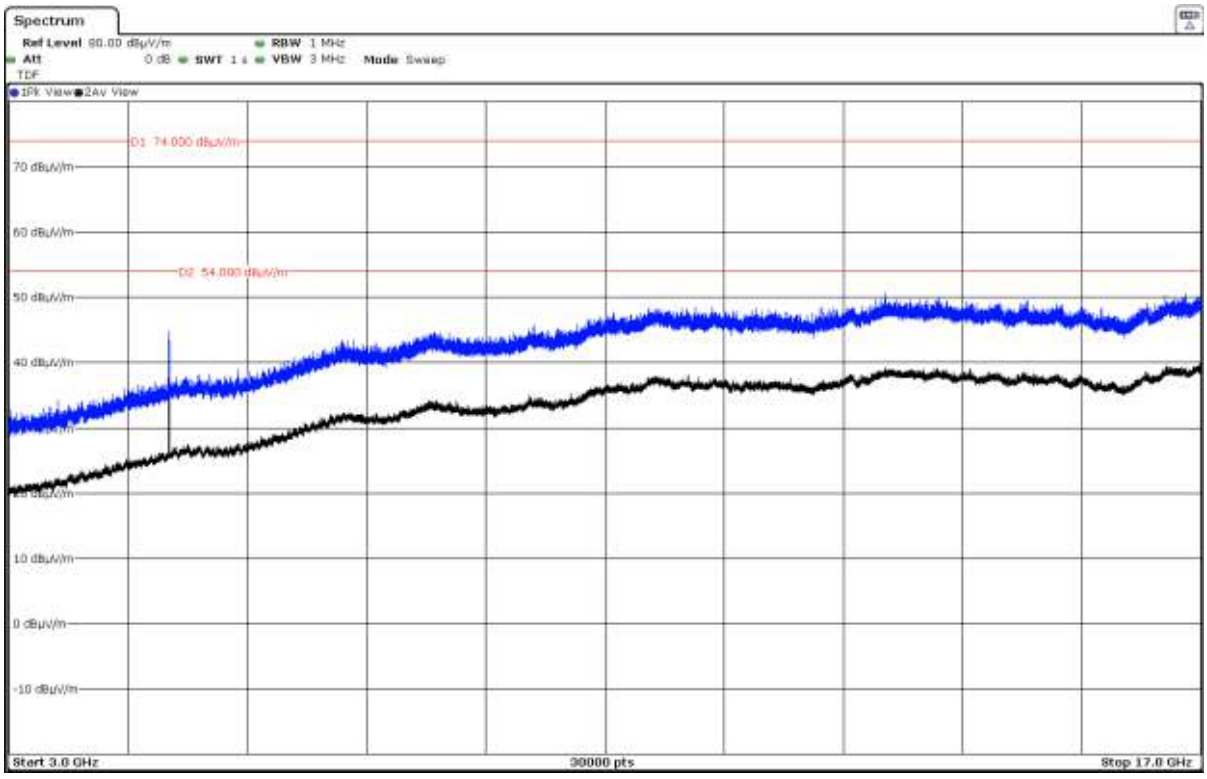
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

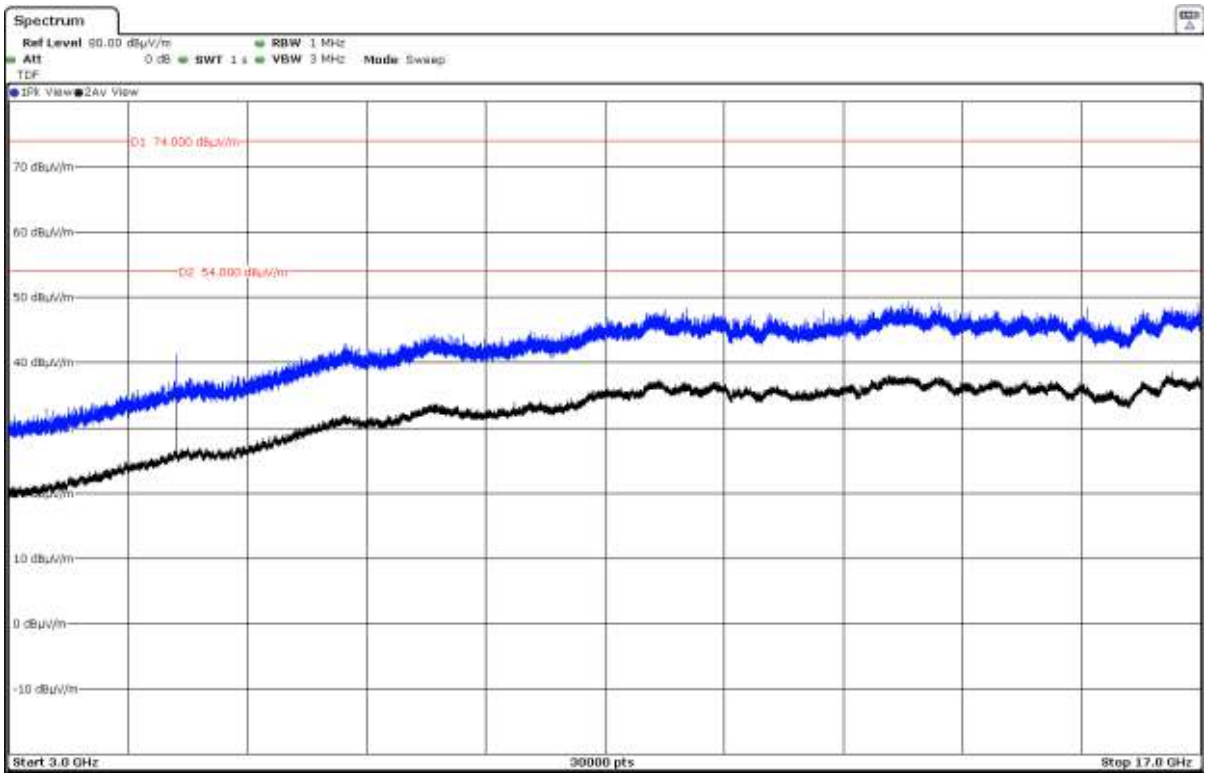
- Low Channel:



- Middle Channel:

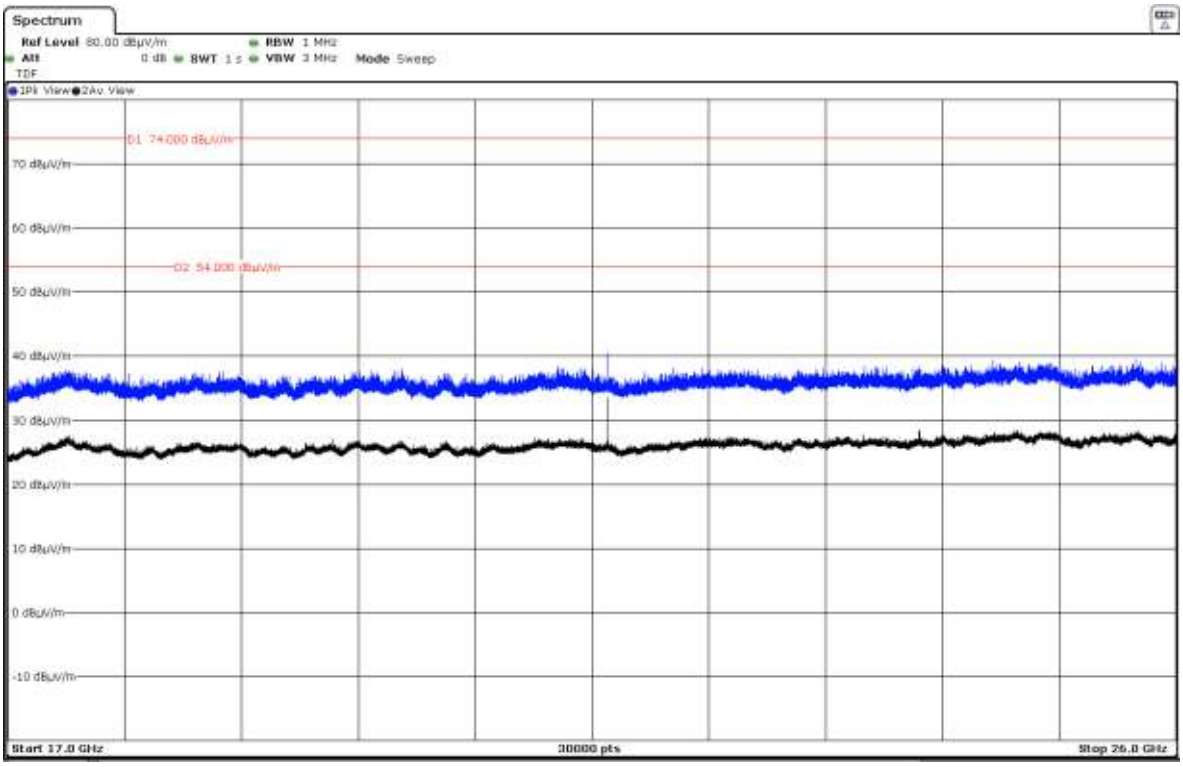


- High Channel:

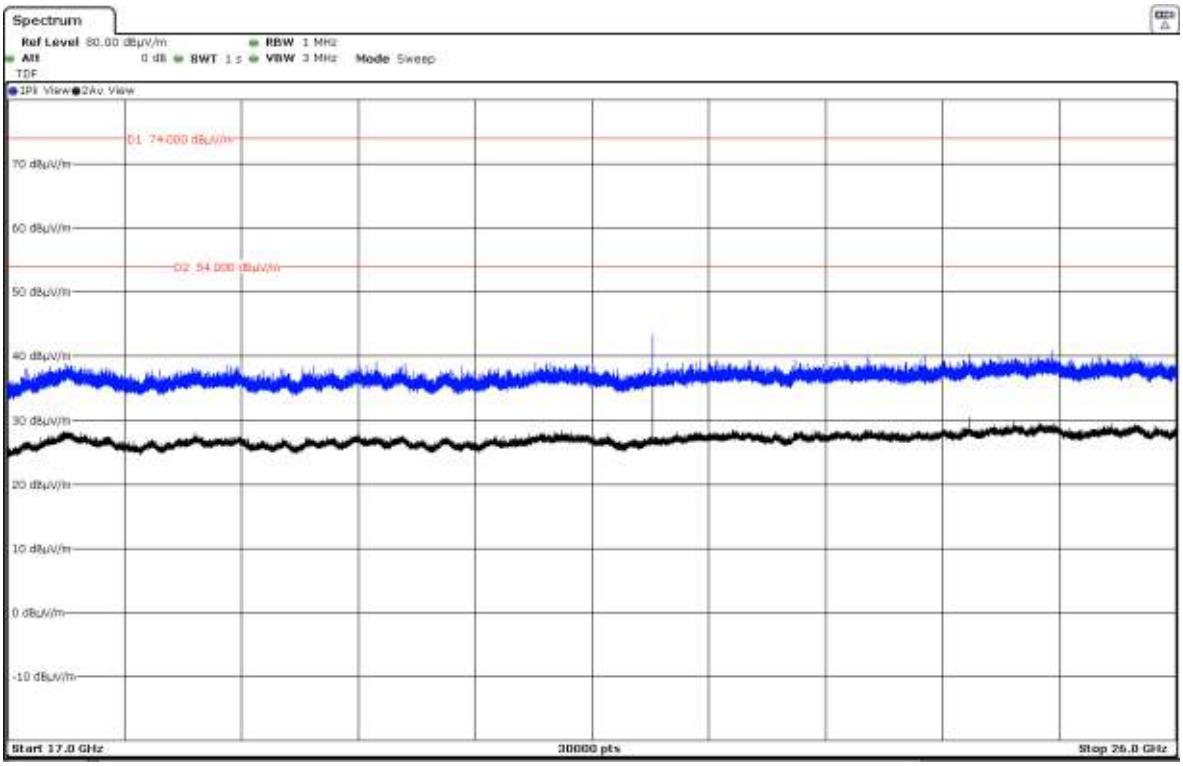


FREQUENCY RANGE 17 - 26 GHz

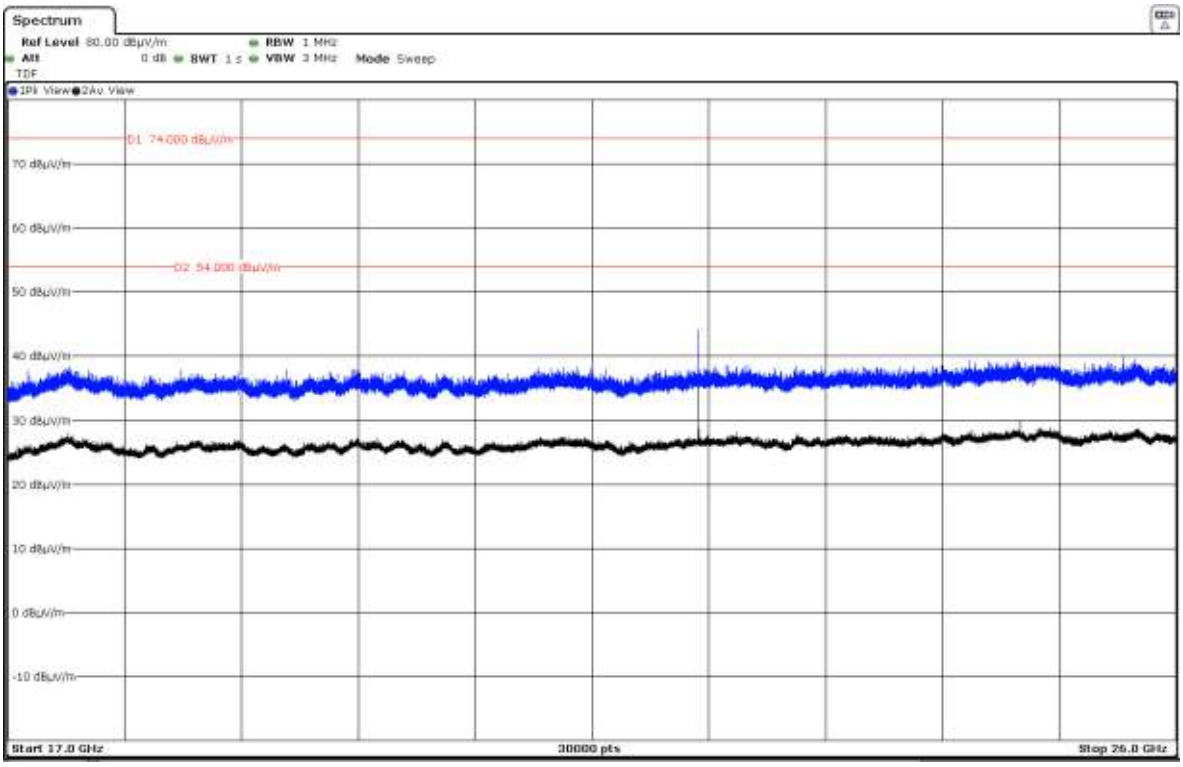
- Low Channel:



- Middle Channel:

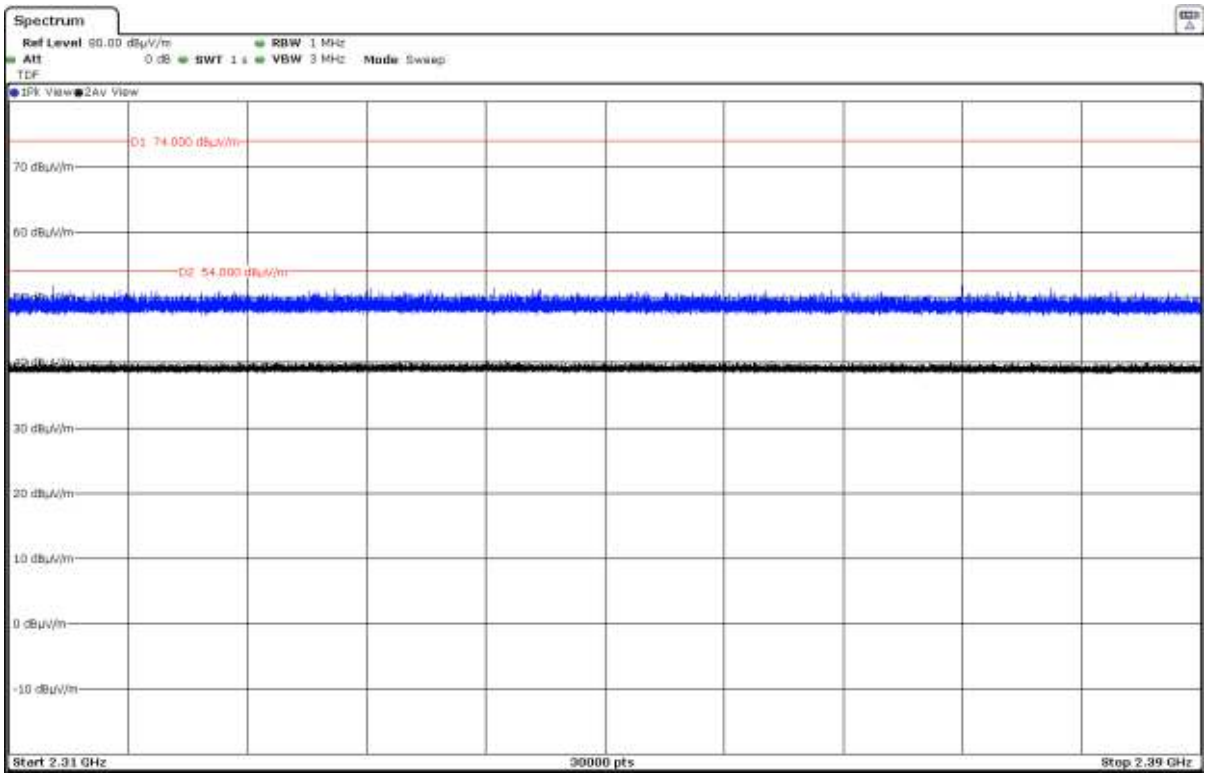


- High Channel:

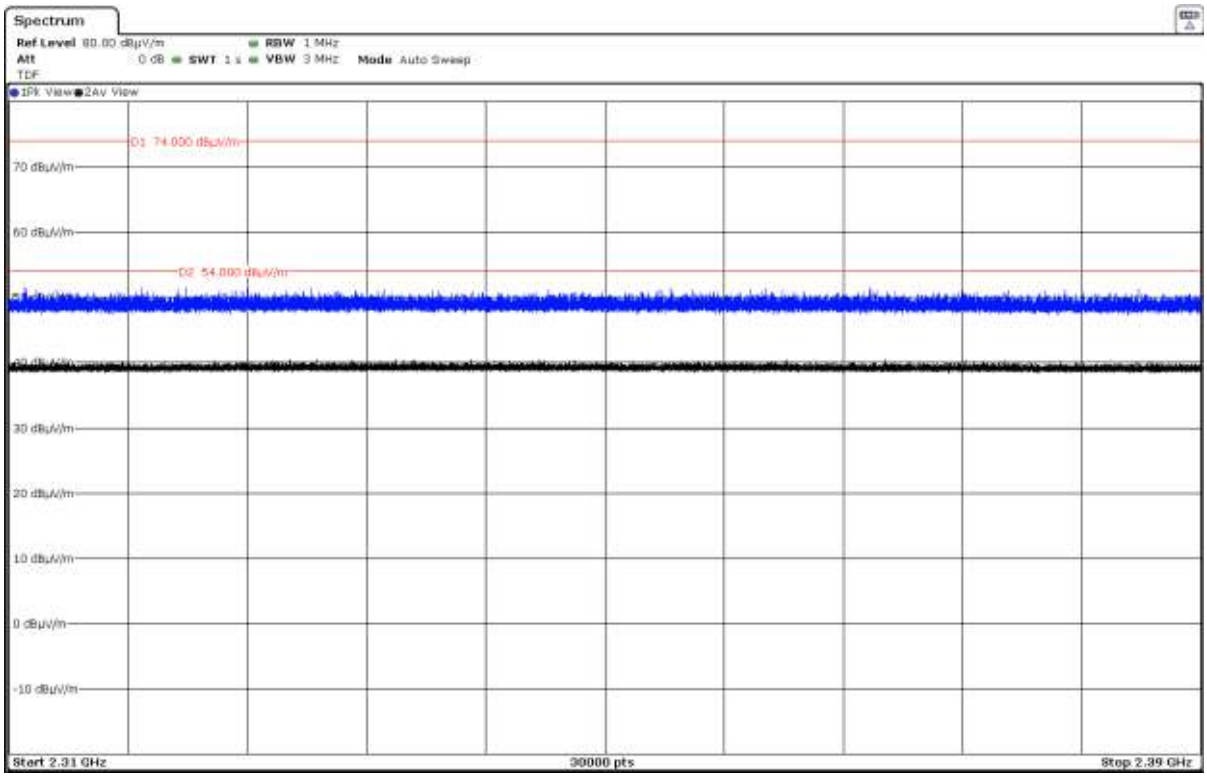


FREQUENCY RANGE 2.31 - 2.39 GHz (Restricted Band 1)

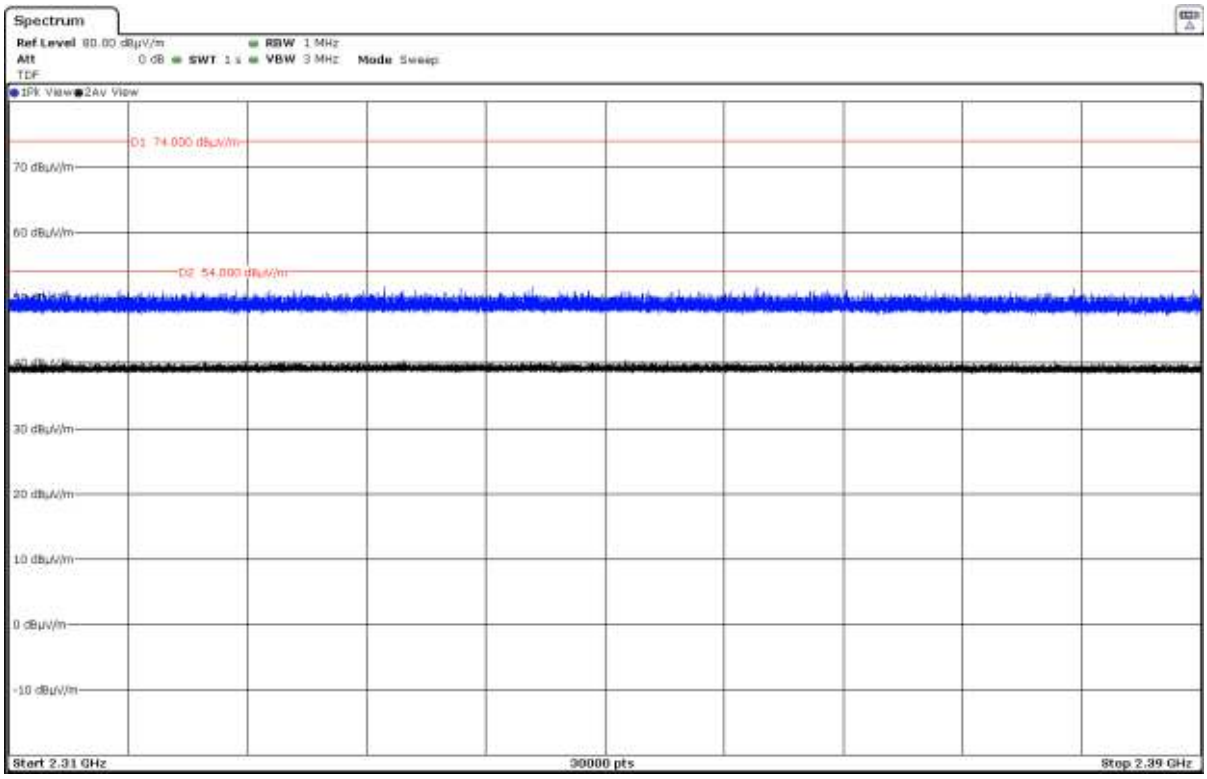
- Low Channel:



- Middle Channel:

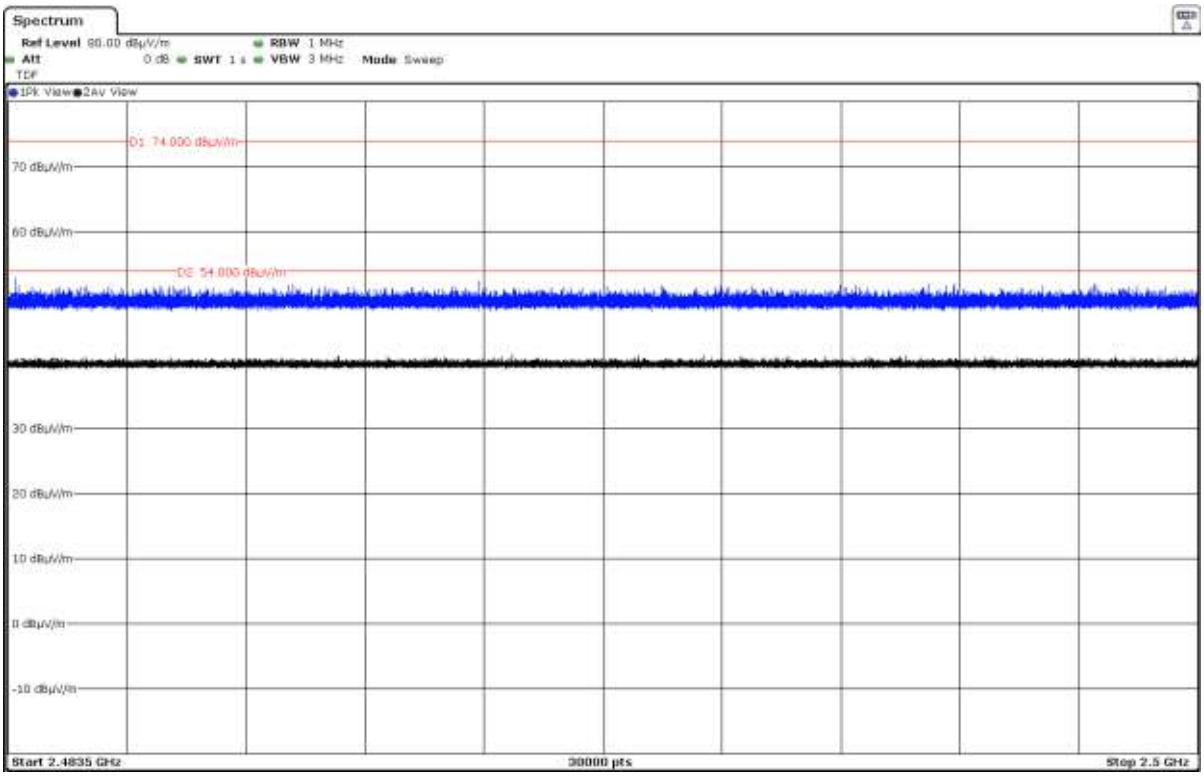


- High Channel:

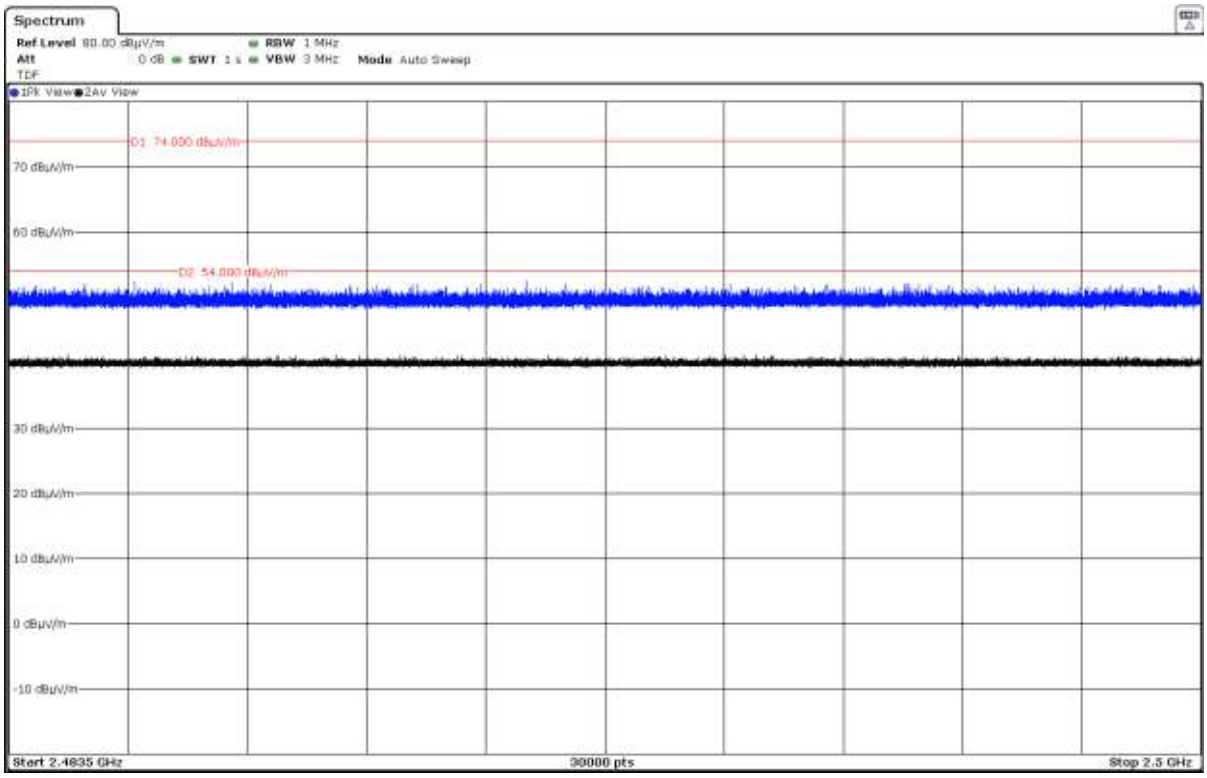


FREQUENCY RANGE 2.4835 - 2.5 GHz (Restricted Band 2)

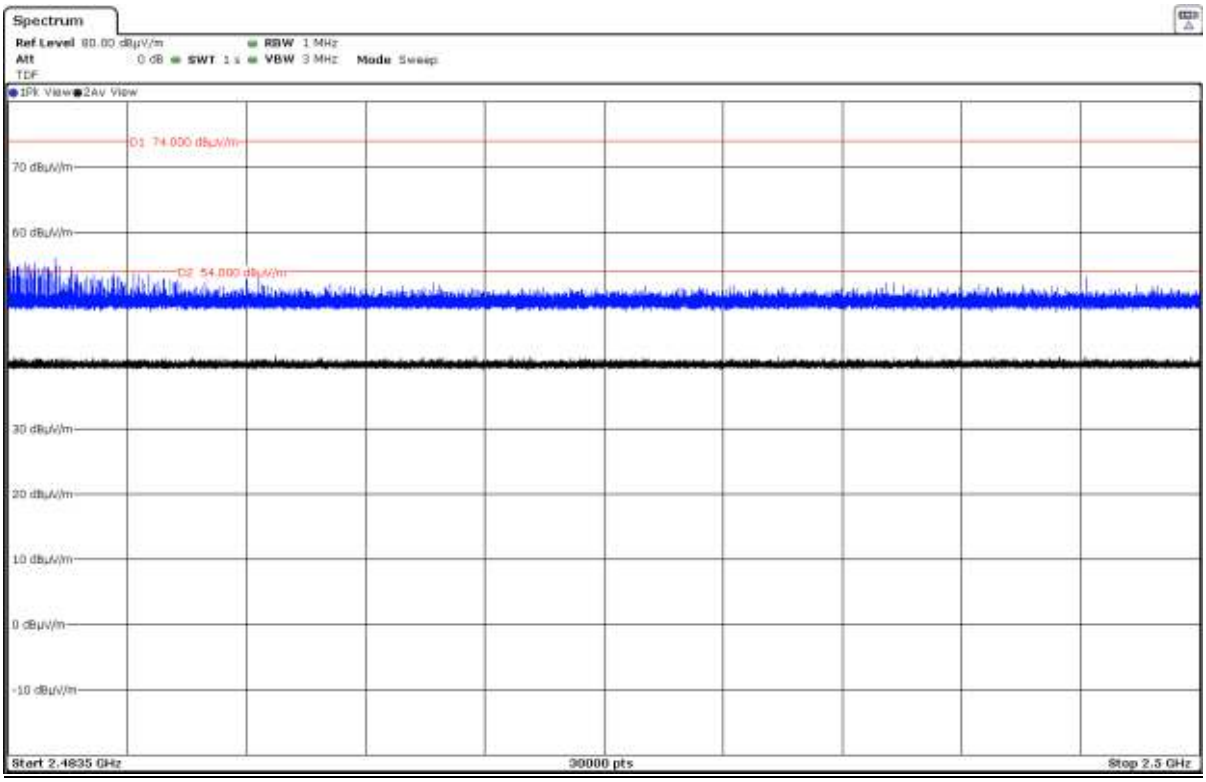
- Low Channel:



- Middle Channel:



- High Channel:



Appendix C: Test results. Proprietary protocol DM

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.7 Vdc
Type of power supply:	DC rechargeable battery; battery charging case supplied by a power supply 5 Vdc.
Type of antenna:	Small magnetic loop antenna.
Declared antenna gain:	- 12 dBi

TEST FREQUENCIES:

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

CONDUCTED MEASUREMENTS

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

RADIATED MEASUREMENTS

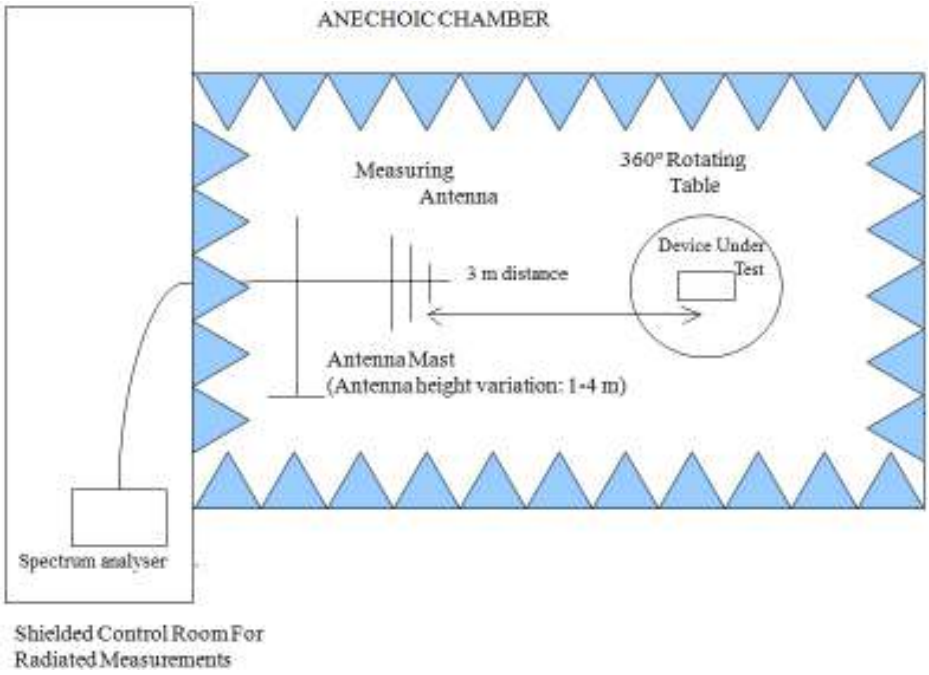
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 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.

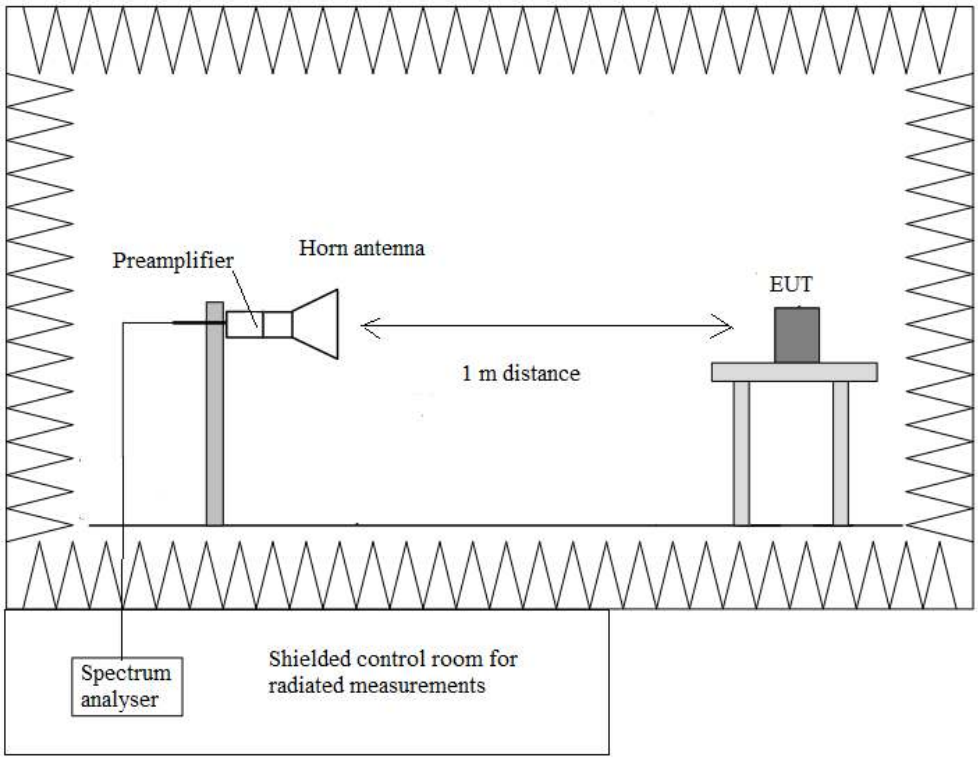
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz:

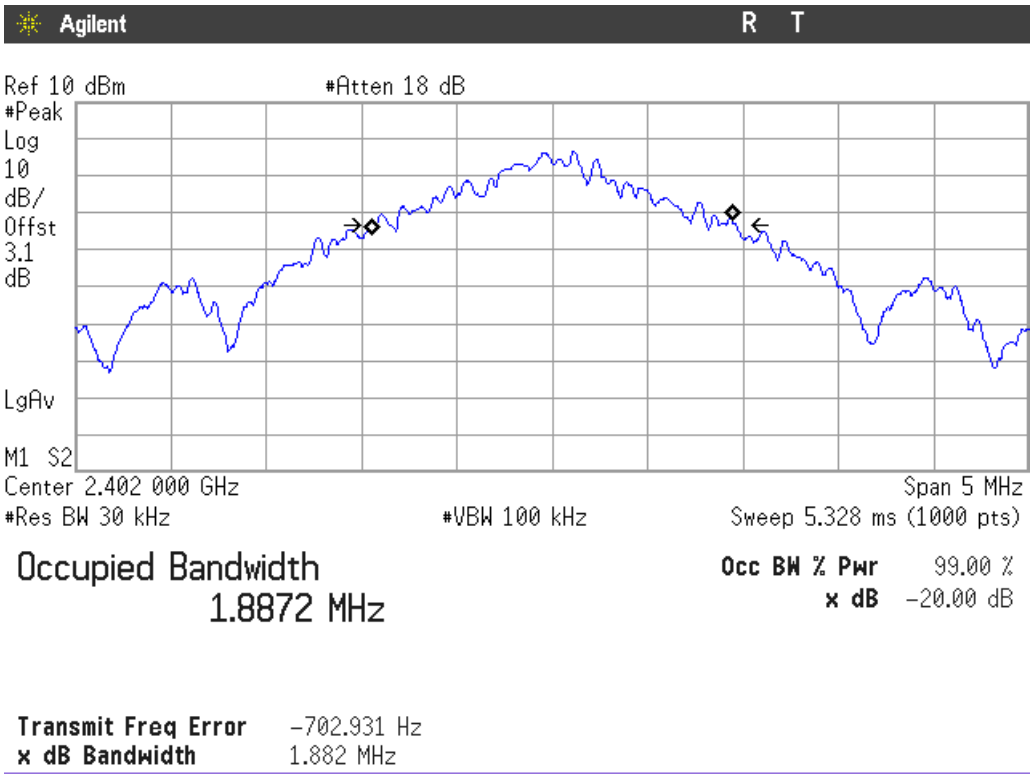


Occupied Bandwidth

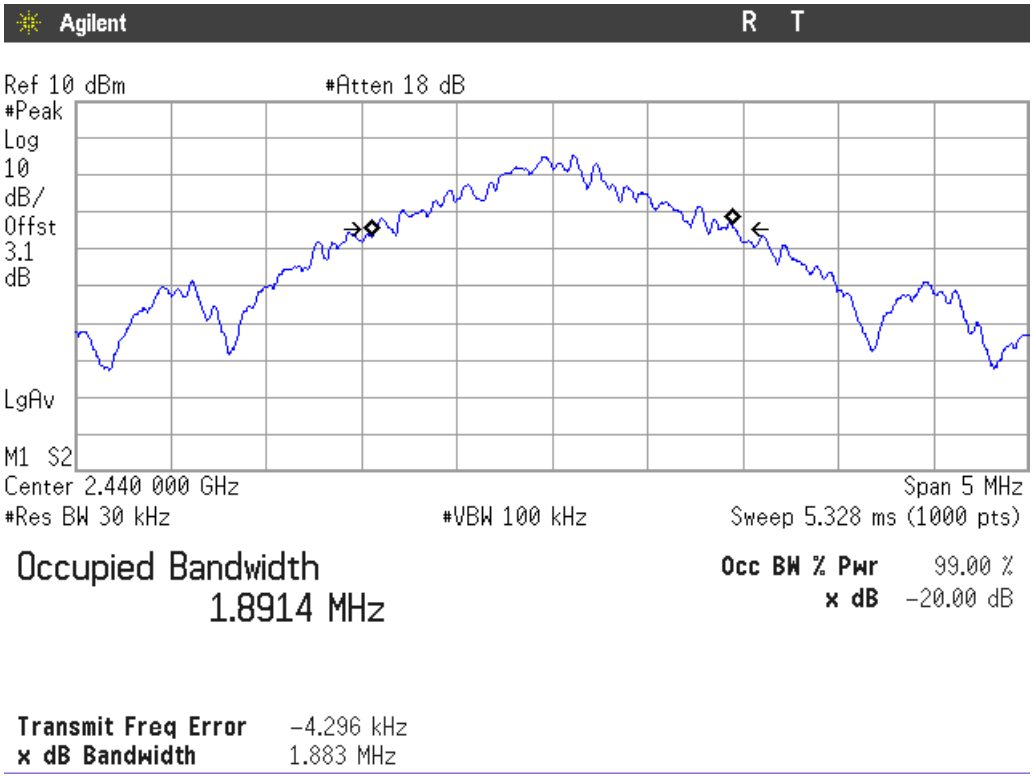
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	1.8872	1.8914	1.8890
Measurement Uncertainty (kHz)	<±5.00		

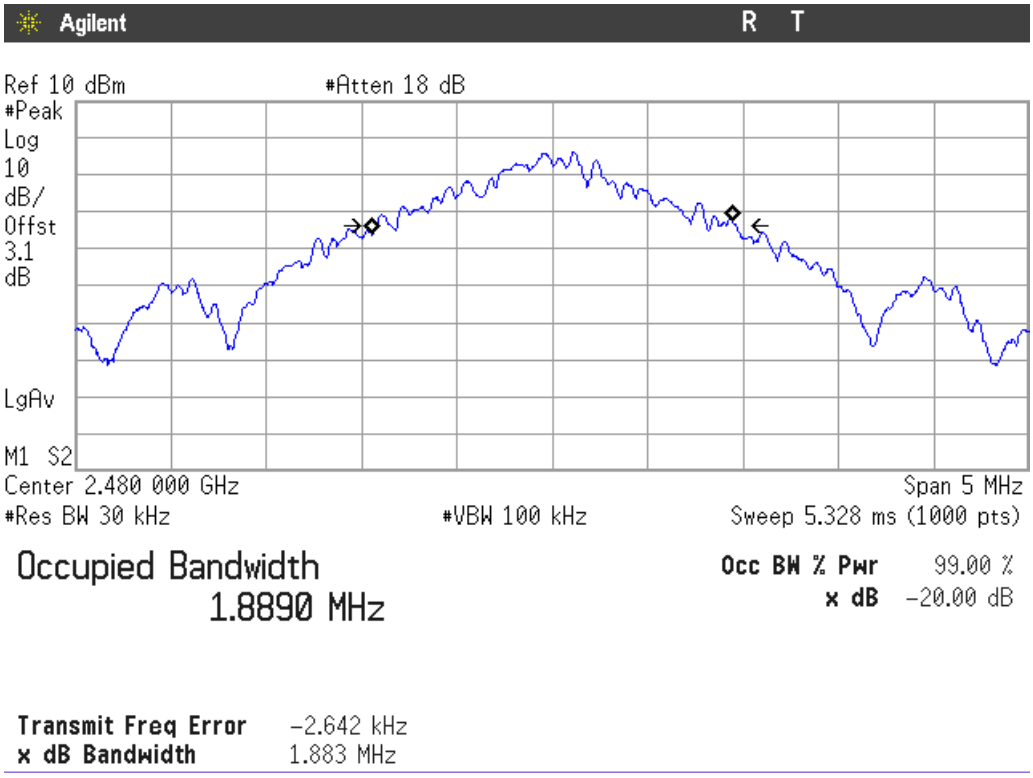
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

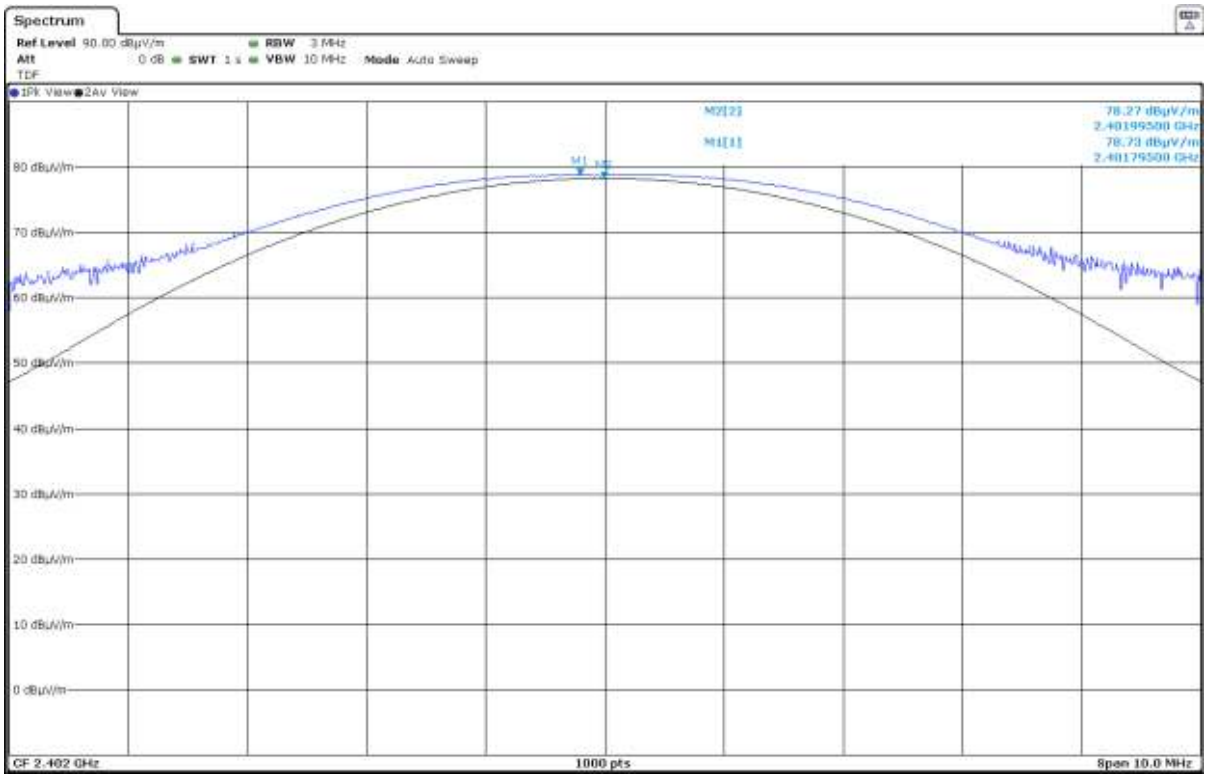
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

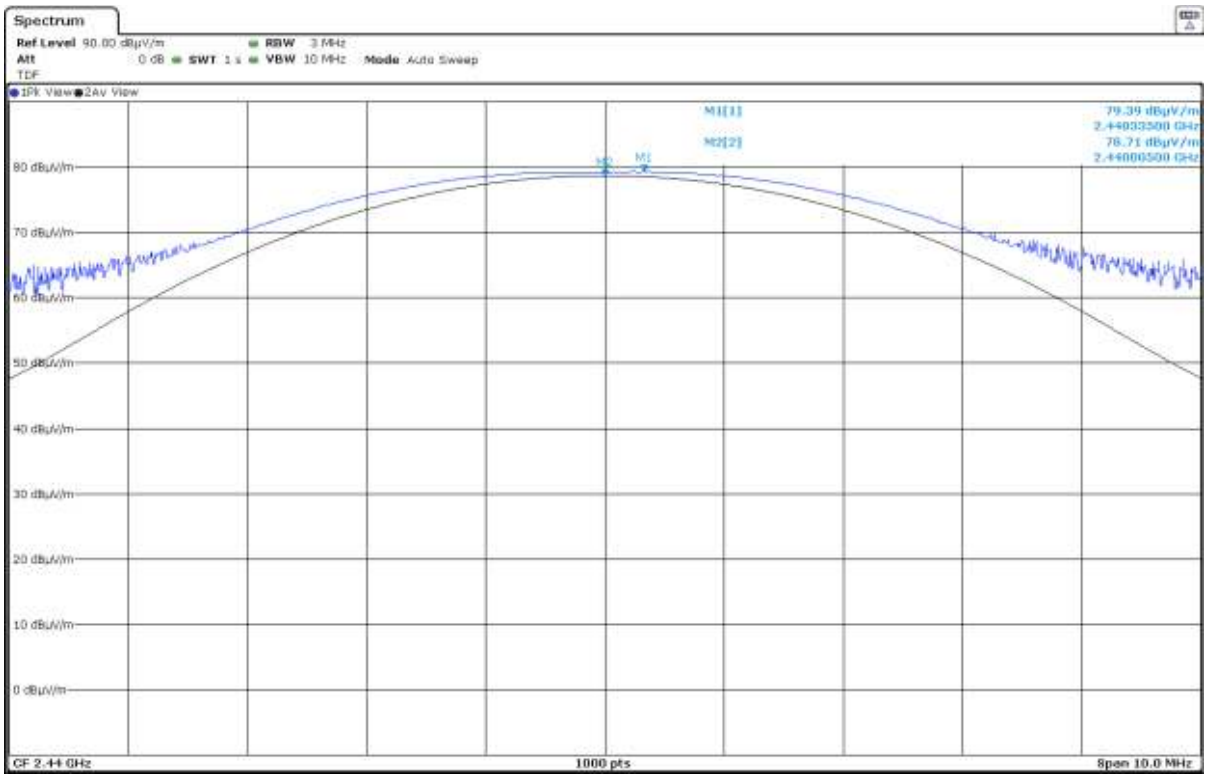
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	78.27	78.71	78.94
Peak Field Strength (dBµV/m)	78.73	79.39	79.53
Measurement Uncertainty (dB)	<±3.05		

Verdict: PASS

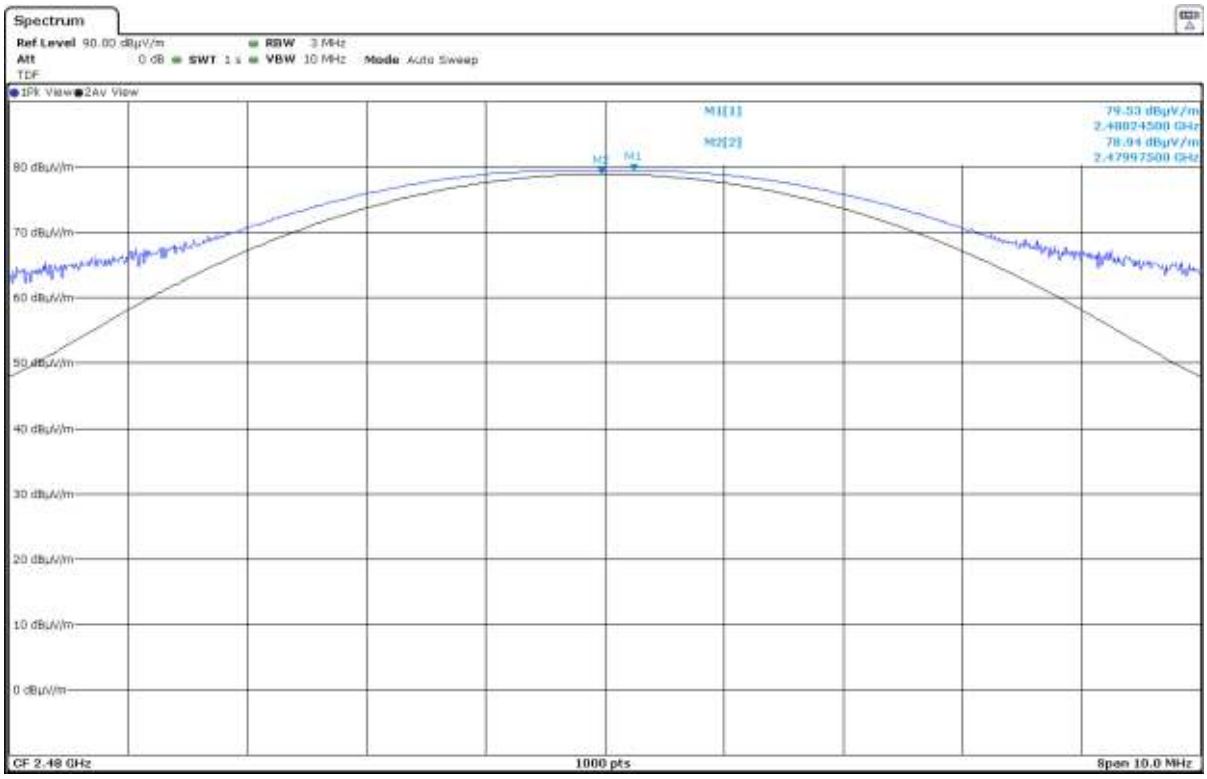
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/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 (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

Whichever is the lesser attenuation.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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-26 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 - 1 GHz.

The spurious signals detected do not depend on the operating channel.

No spurious emissions were found at less than 20 dB from the limit.

Frequency range 1 - 26 GHz.

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (2402 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.80437	Peak	42.45	V	<±3.70
21.62045	Peak	40.66	V	<±3.70

- Middle Channel (2440 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.87950	Peak	44.00	V	<±3.70
21.95735	Peak	41.57	V	<±3.70

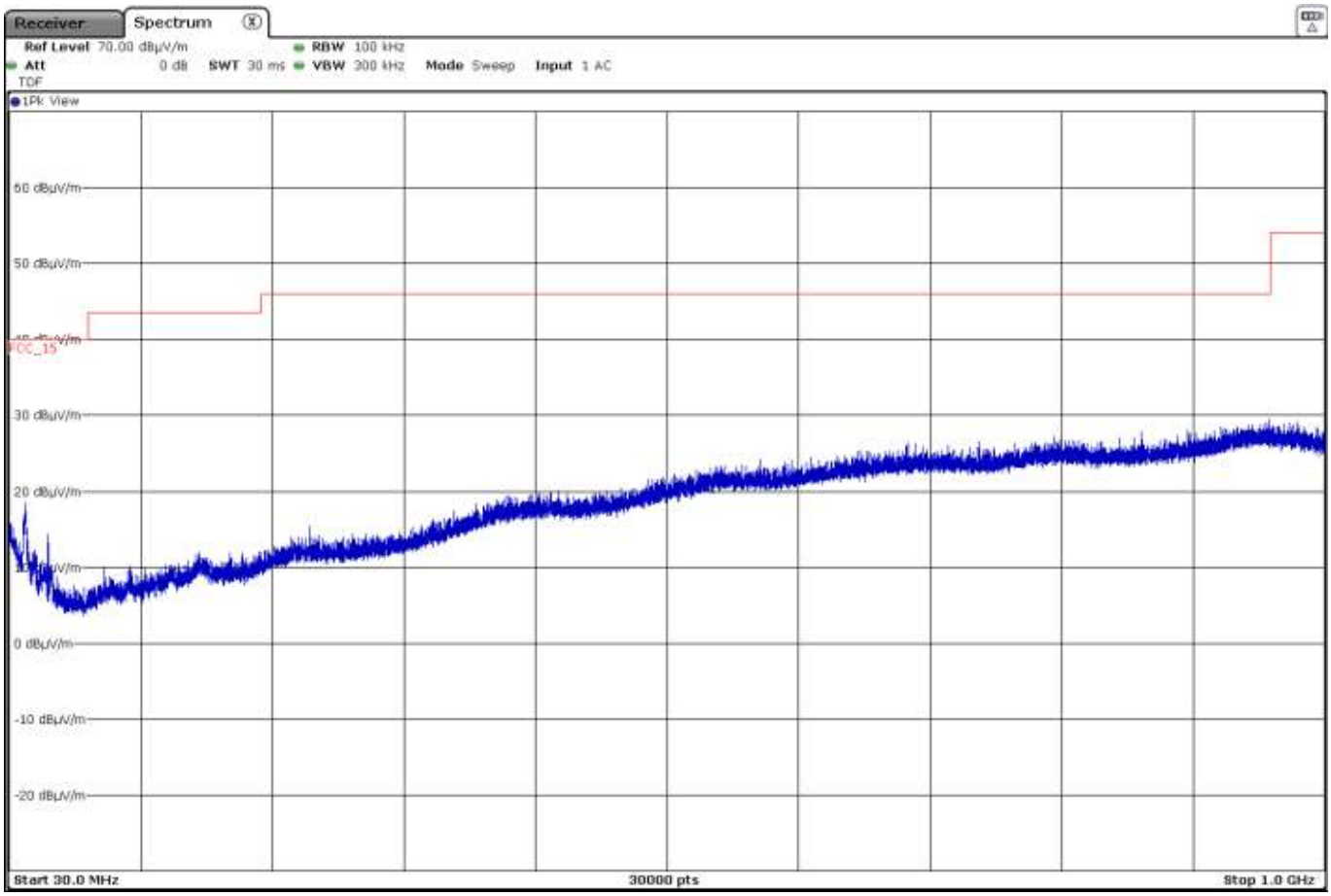
- High Channel (2480 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48359	Peak	57.13	H	<±3.70
	Average	41.24		<±3.70
4.95998	Peak	43.39	V	<±3.70
22.32275	Peak	43.33	H	<±3.70

Verdict: PASS

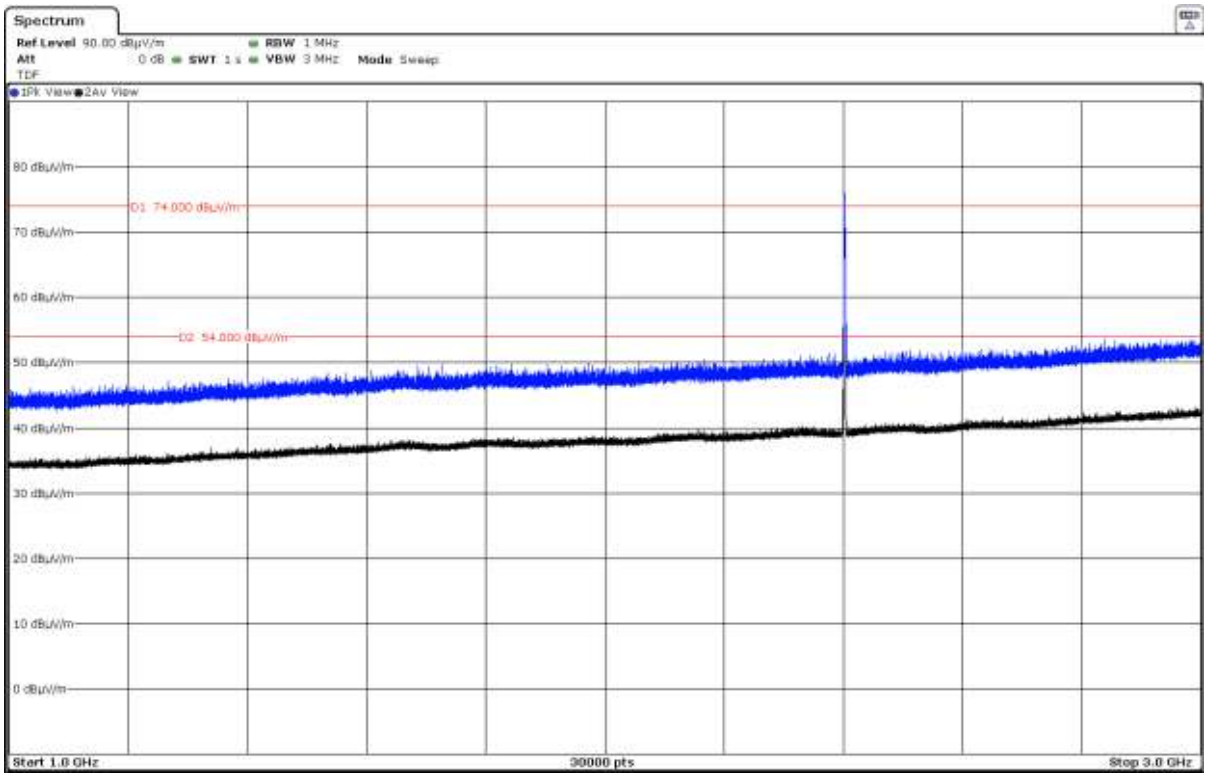
FREQUENCY RANGE 30 MHz - 1 GHz

The spurious signals detected do not depend on the operating channel, so valid for Low, Middle and High Channels.



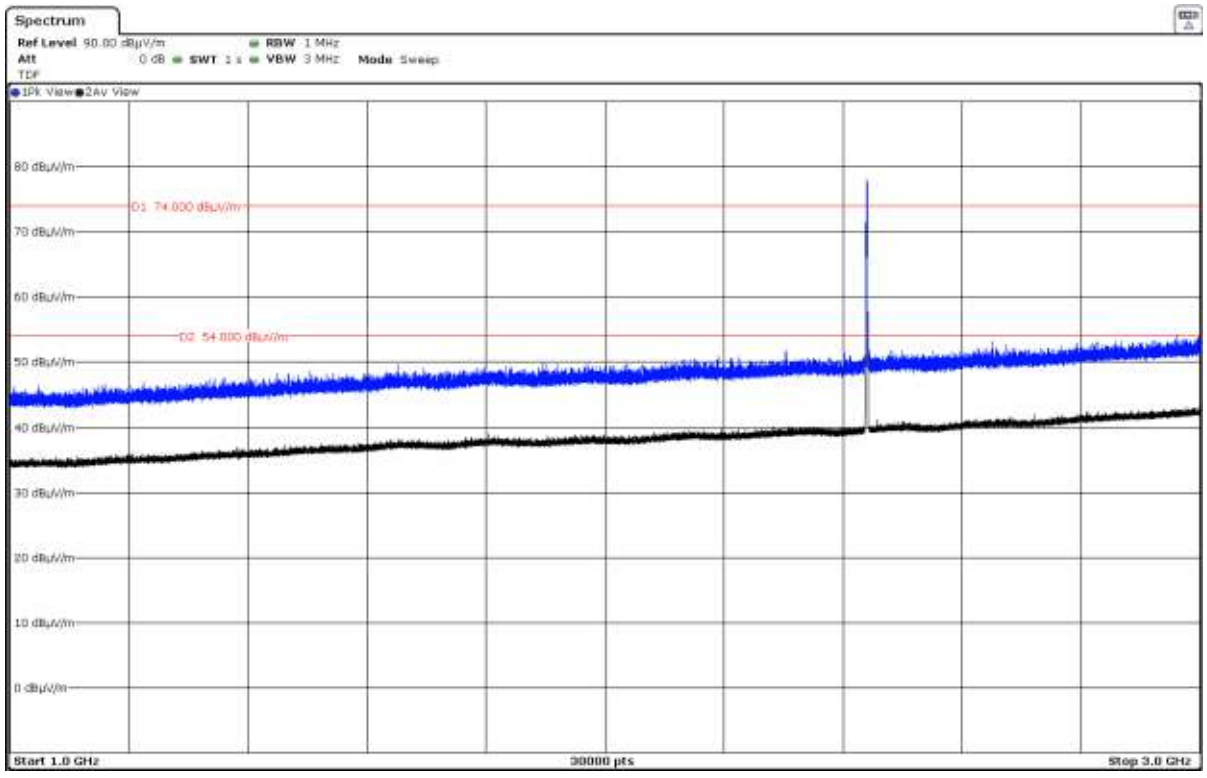
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



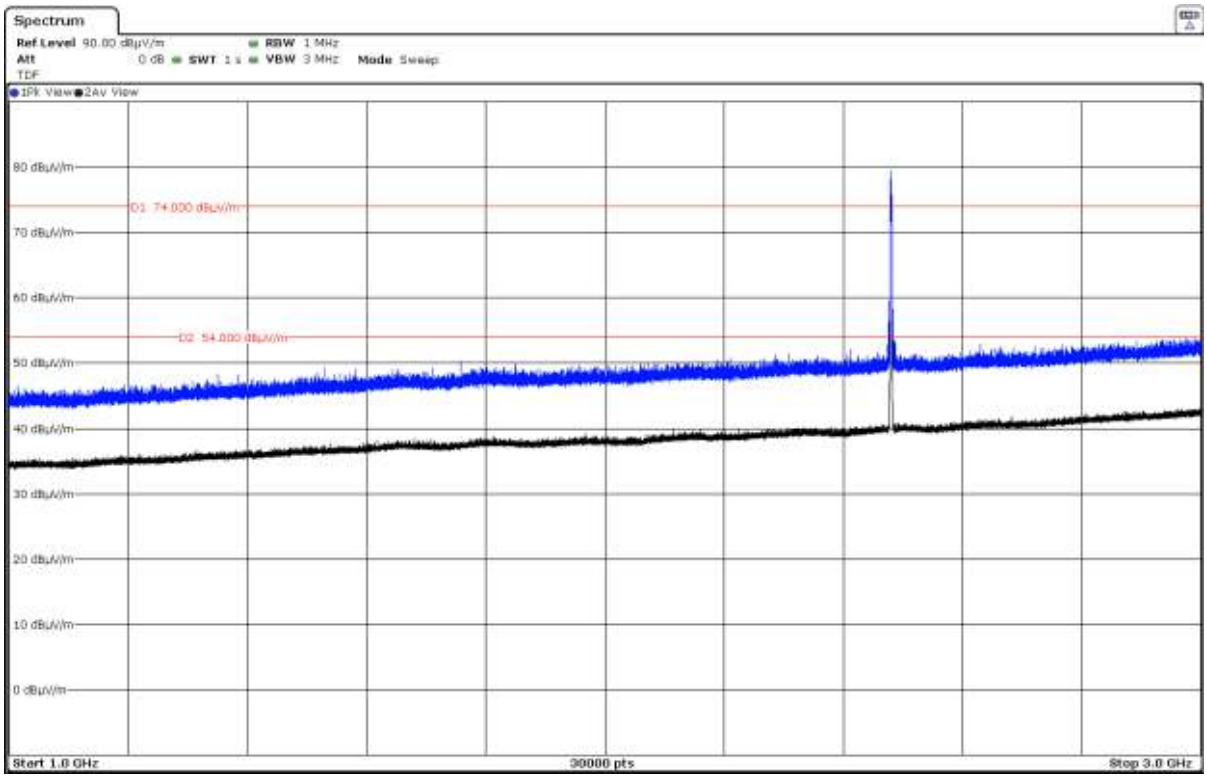
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

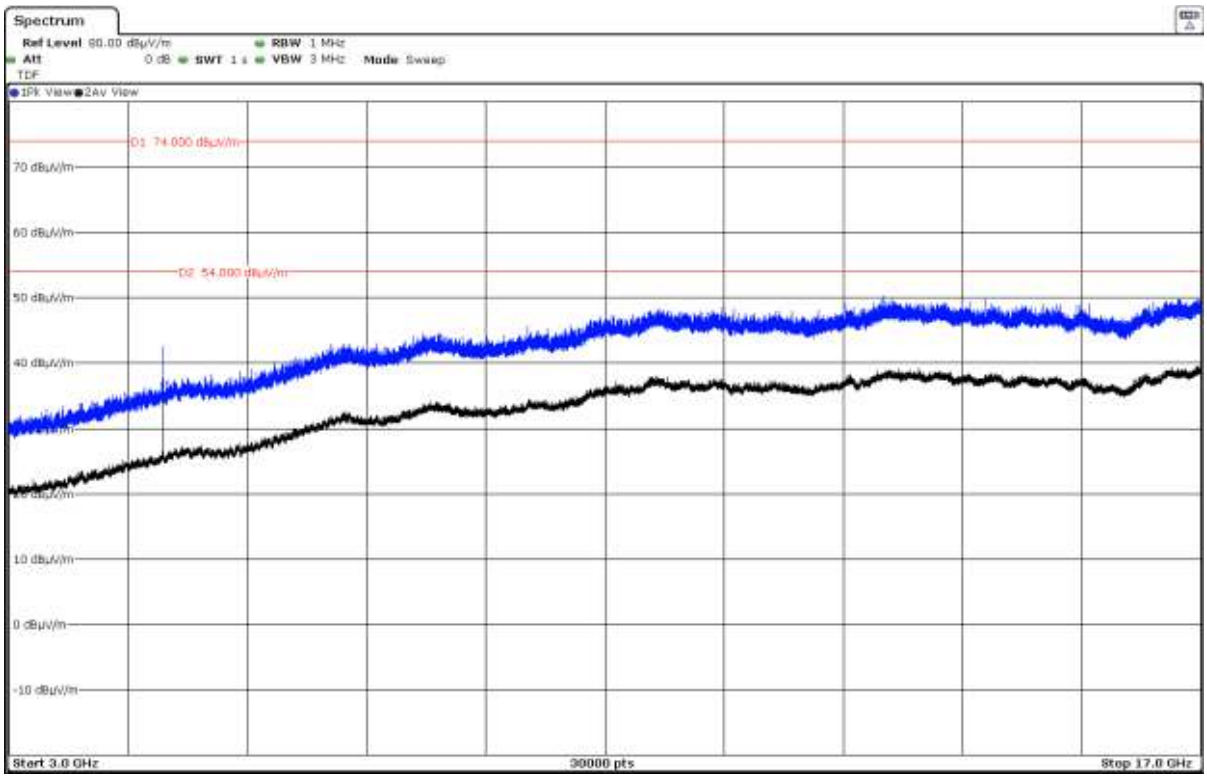
- High Channel:



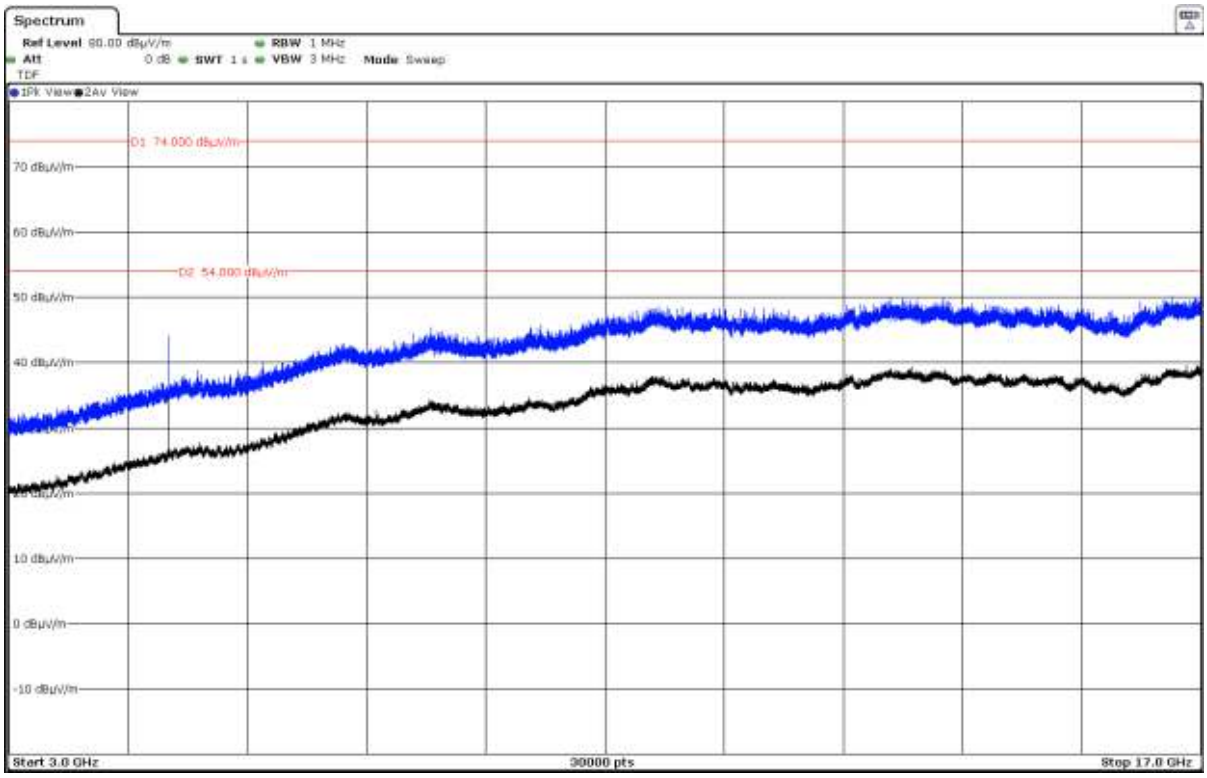
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

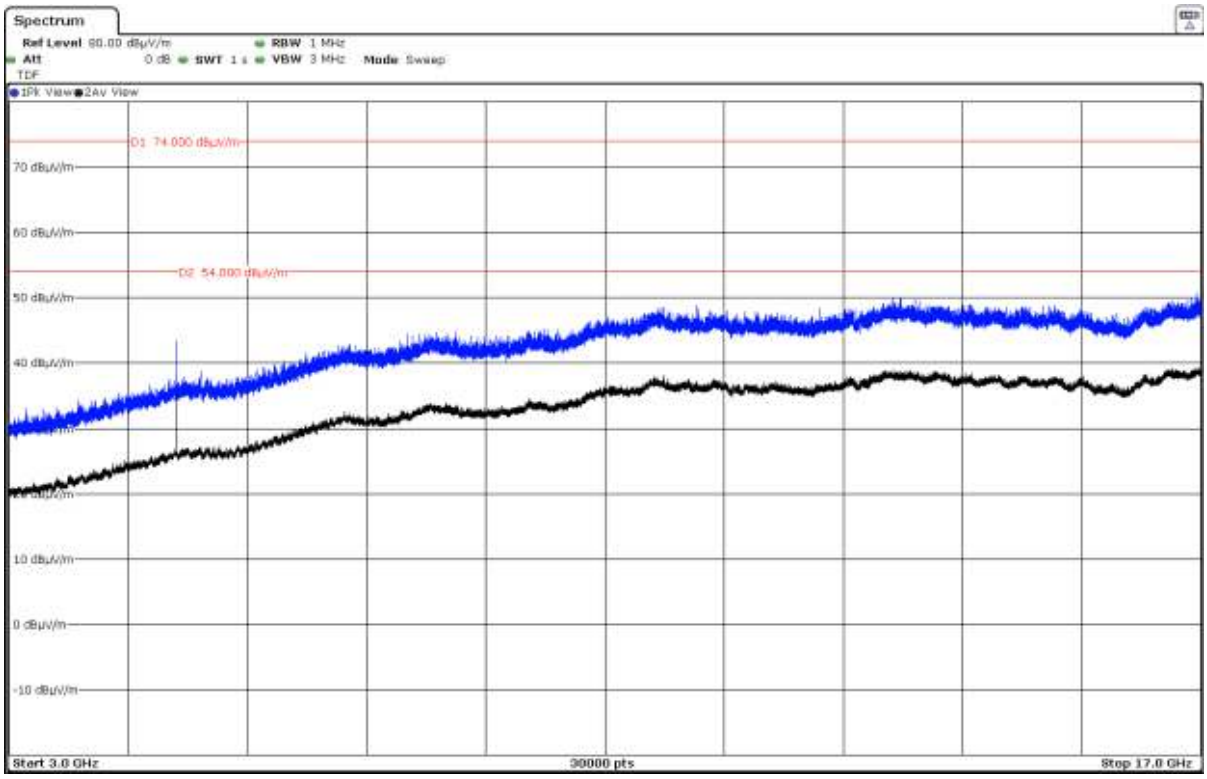
- Low Channel:



- Middle Channel:

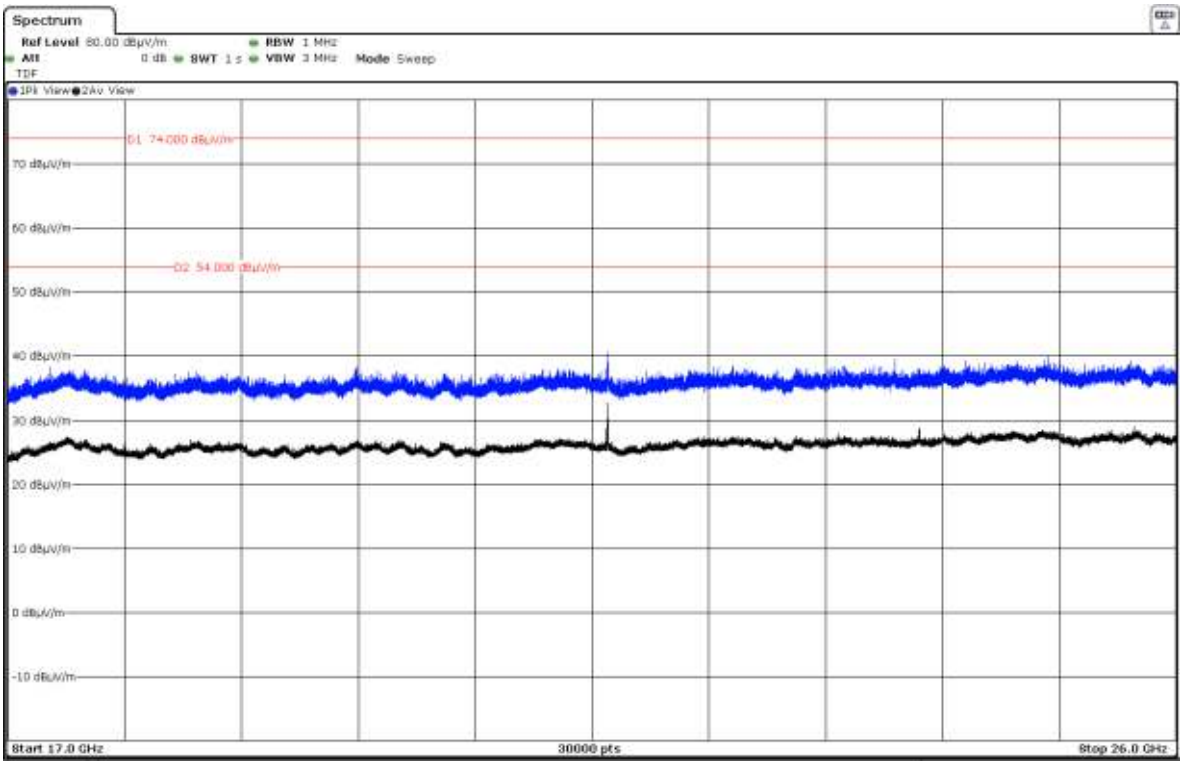


- High Channel:

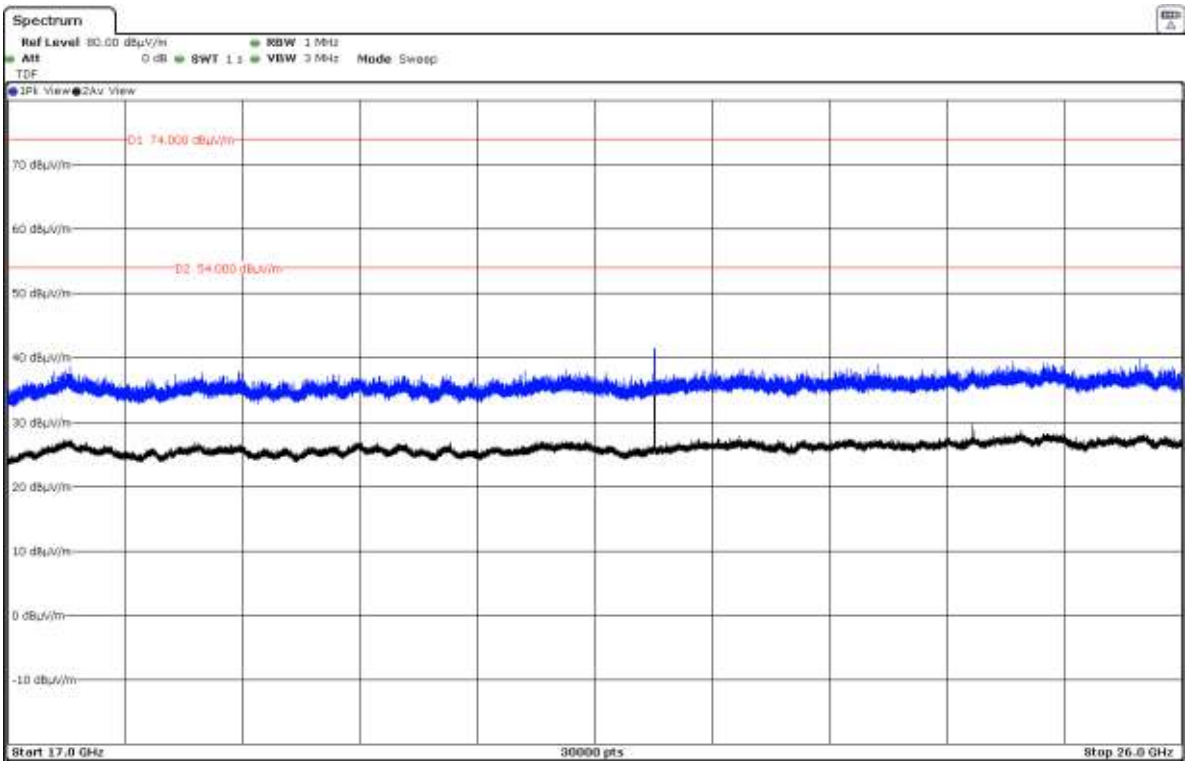


FREQUENCY RANGE 17 - 26 GHz

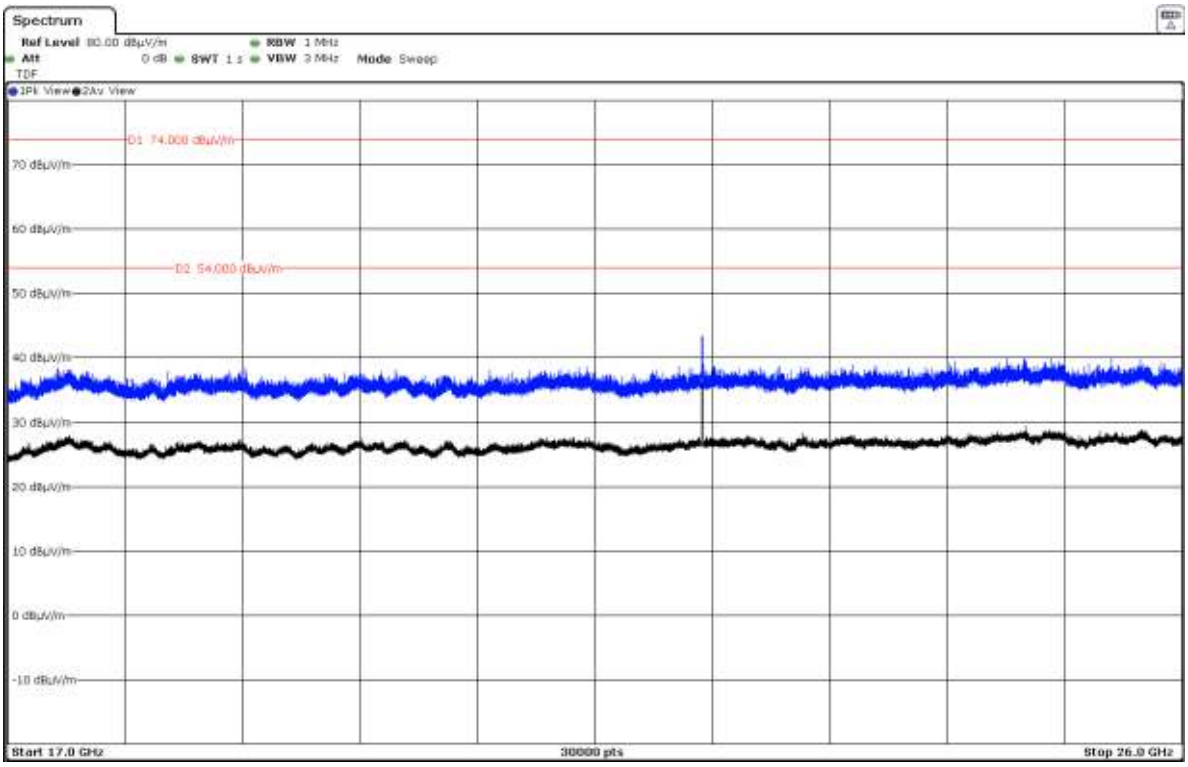
- Low Channel:



- Middle Channel:

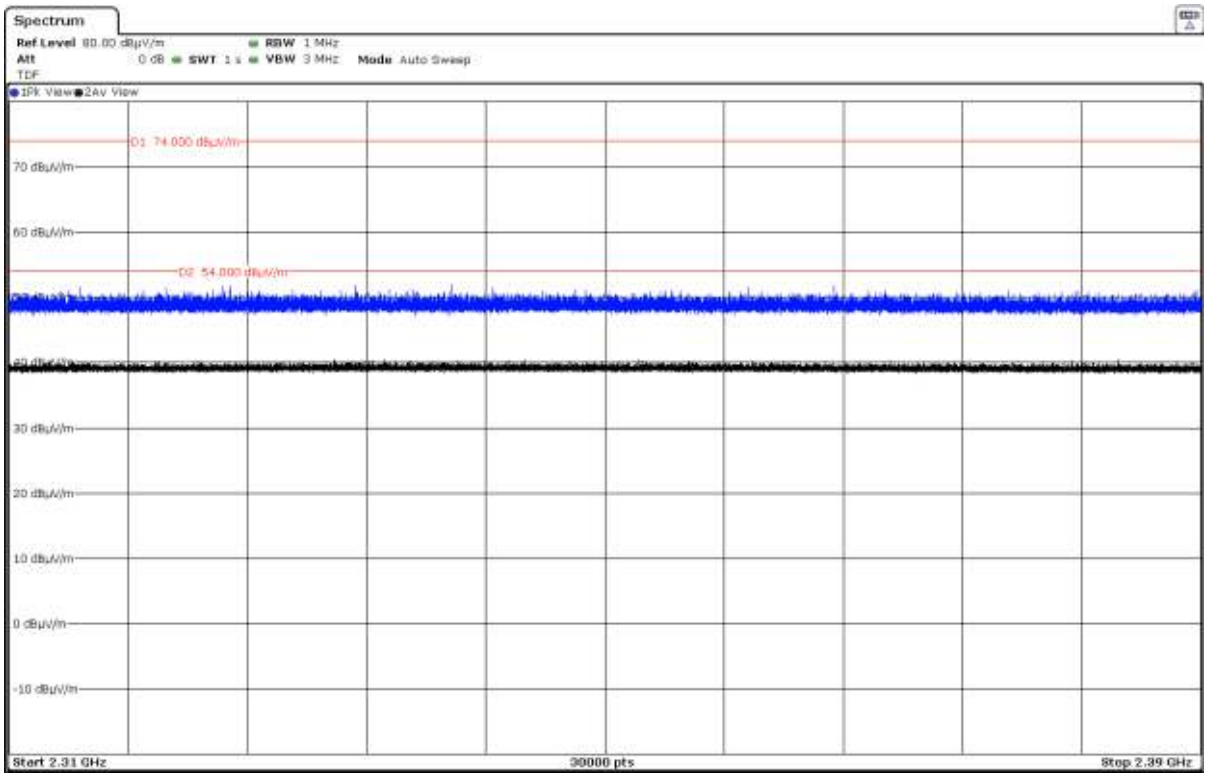


- High Channel:

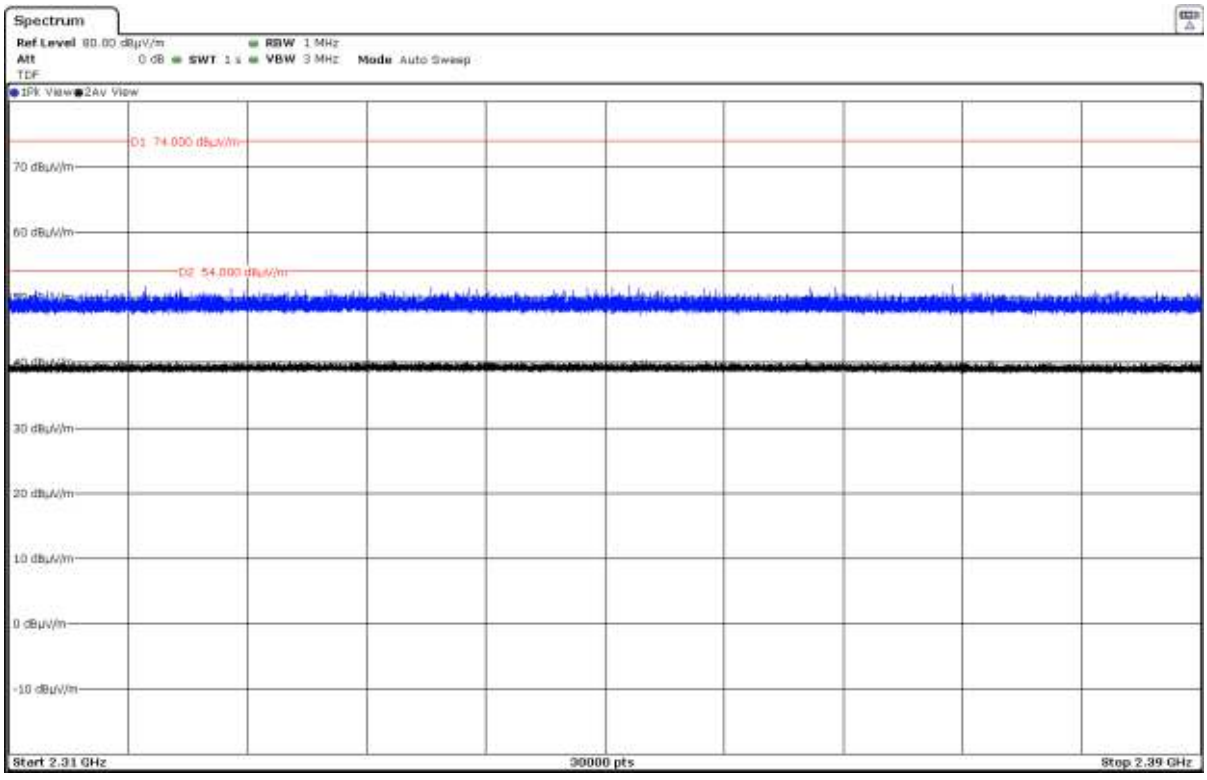


FREQUENCY RANGE 2.31 - 2.39 GHz (Restricted Band 1)

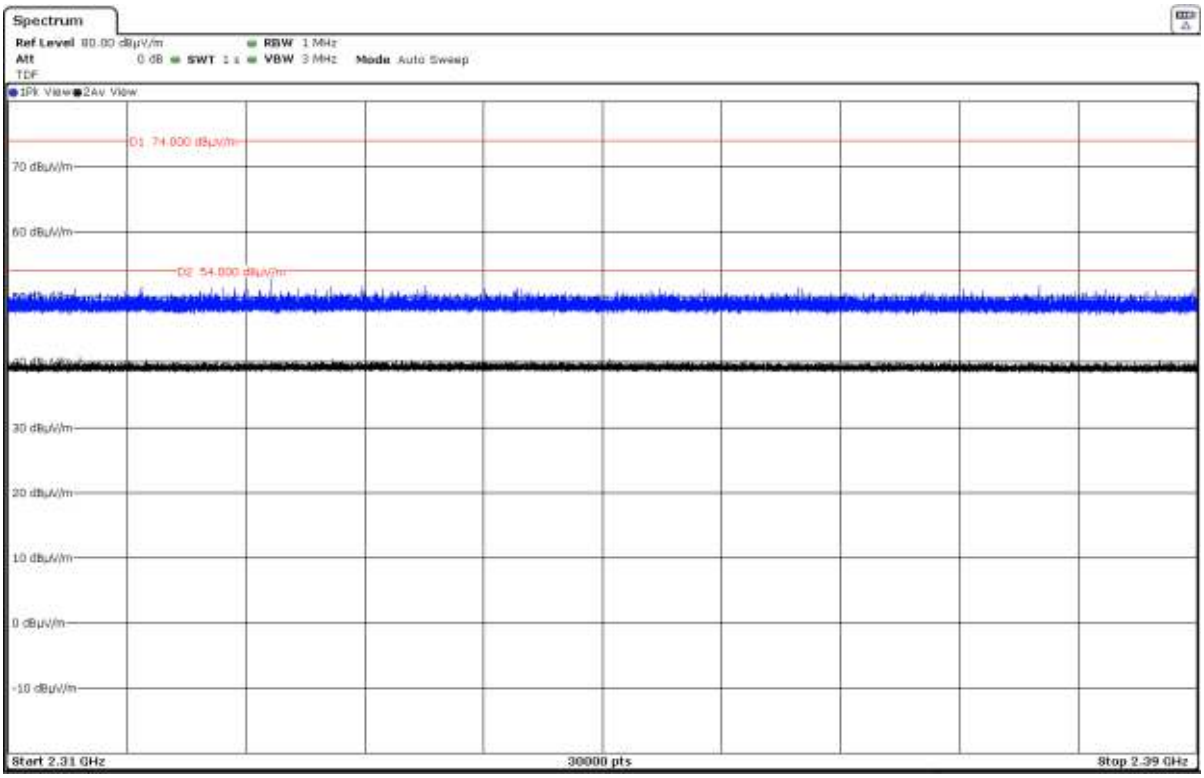
- Low Channel:



- Middle Channel:

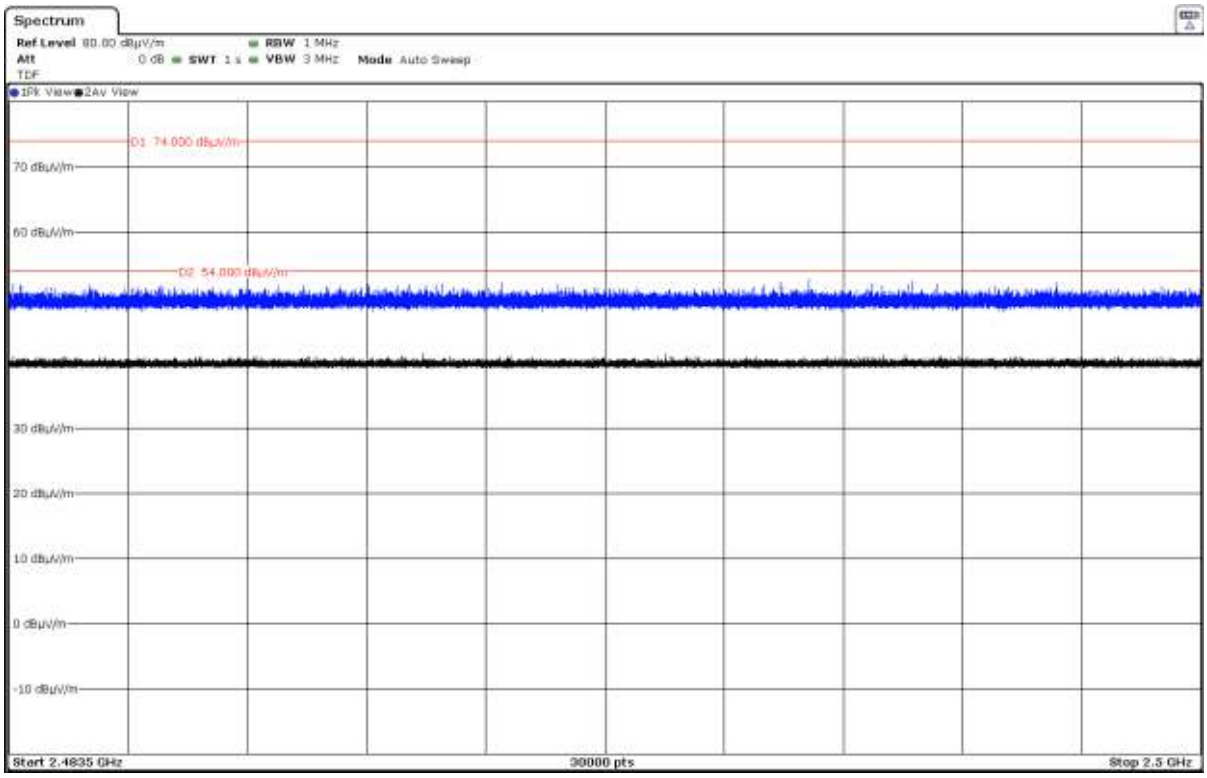


- High Channel:

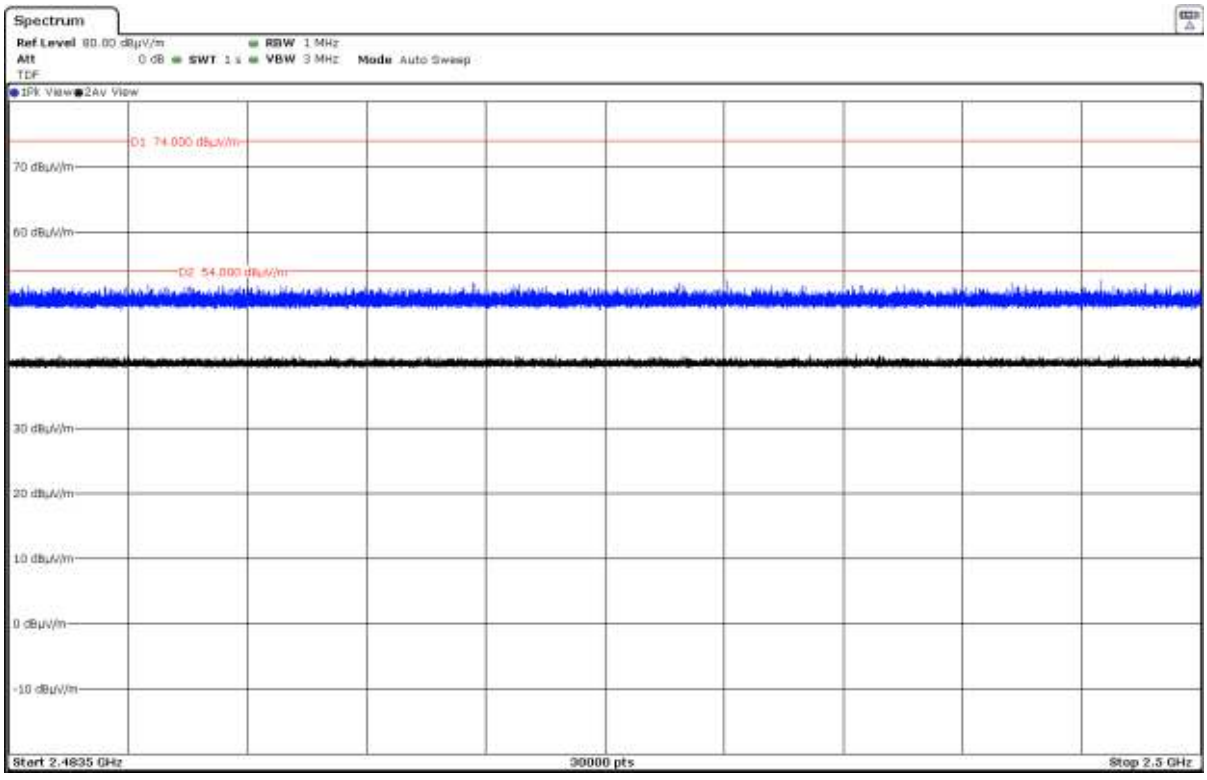


FREQUENCY RANGE 2.4835 - 2.5 GHz (Restricted Band 2)

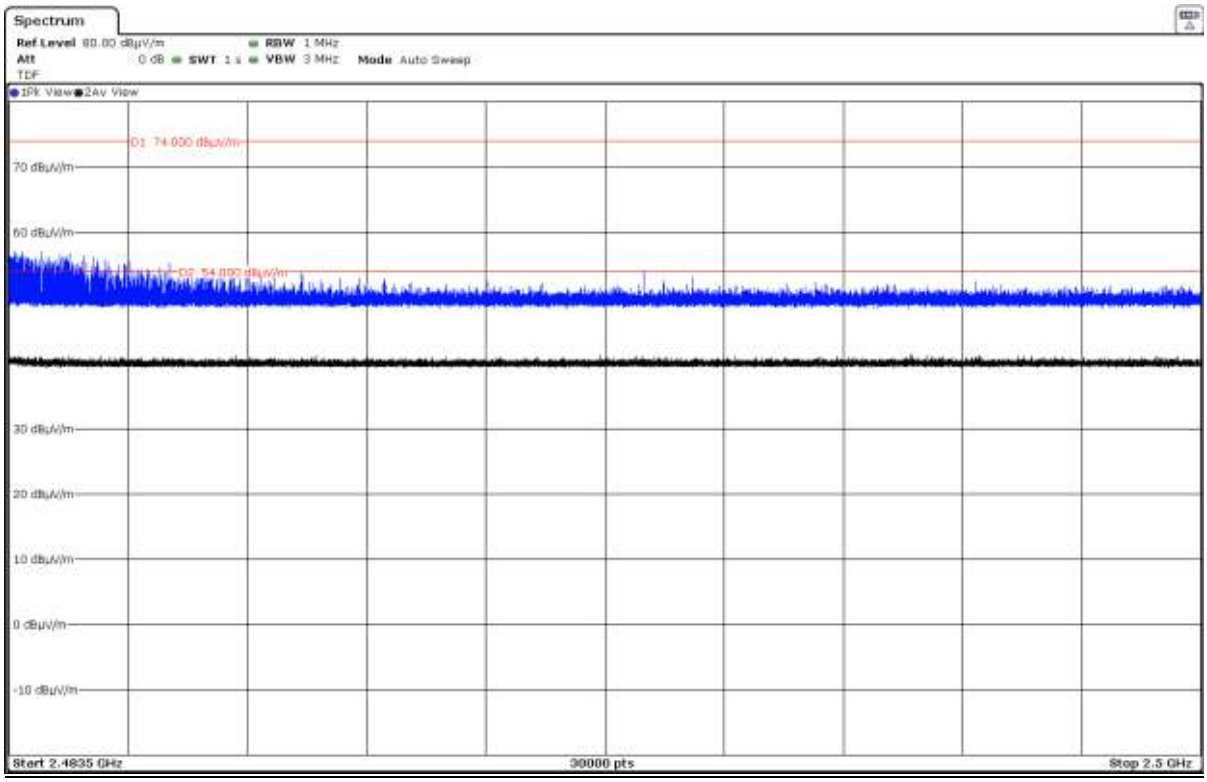
- Low Channel:



- Middle Channel:



- High Channel:



Appendix D: Test results. Proprietary protocol Flora

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TEST CONDITIONS

POWER SUPPLY (V):

V nominal:	3.7 Vdc
Type of power supply:	DC rechargeable battery; battery charging case supplied by a power supply 5 Vdc.
Type of antenna:	Small magnetic loop antenna.
Declared antenna gain:	- 12 dBi

TEST FREQUENCIES:

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

CONDUCTED MEASUREMENTS

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

RADIATED MEASUREMENTS

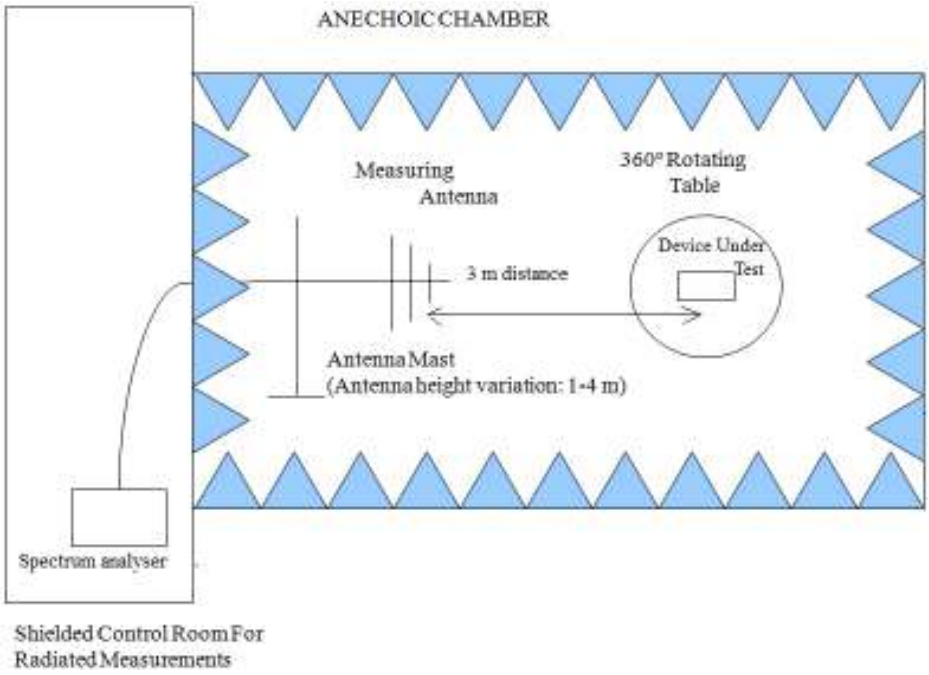
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

For radiated emissions in the range 1 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.

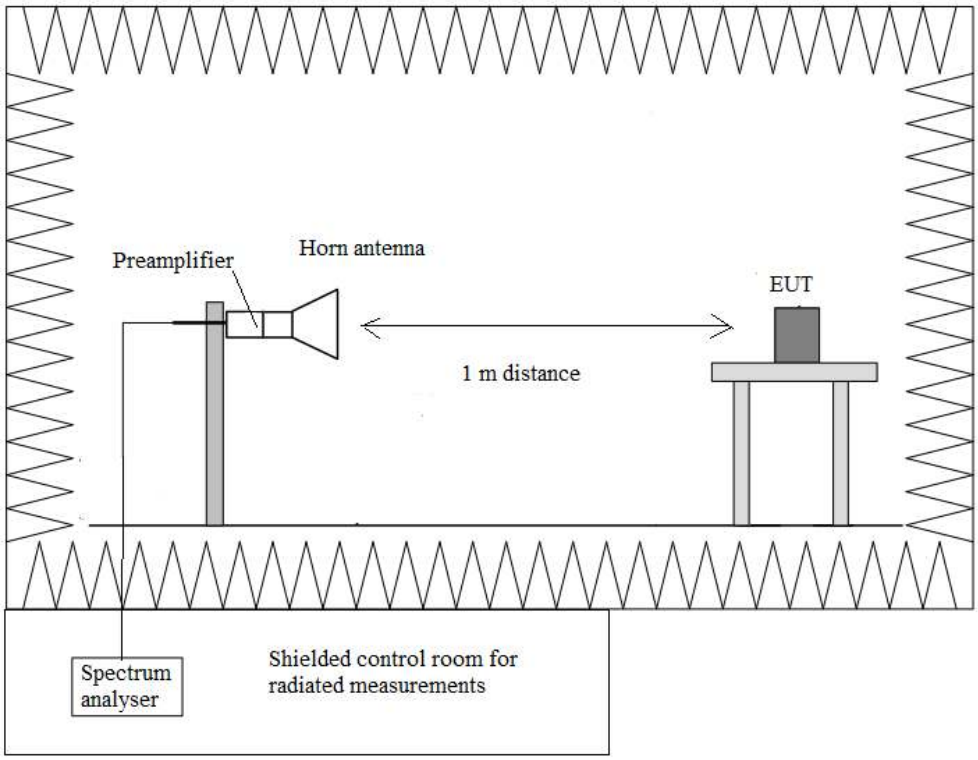
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

Radiated measurements setup f < 1 GHz:



Radiated measurements setup f > 1 GHz:

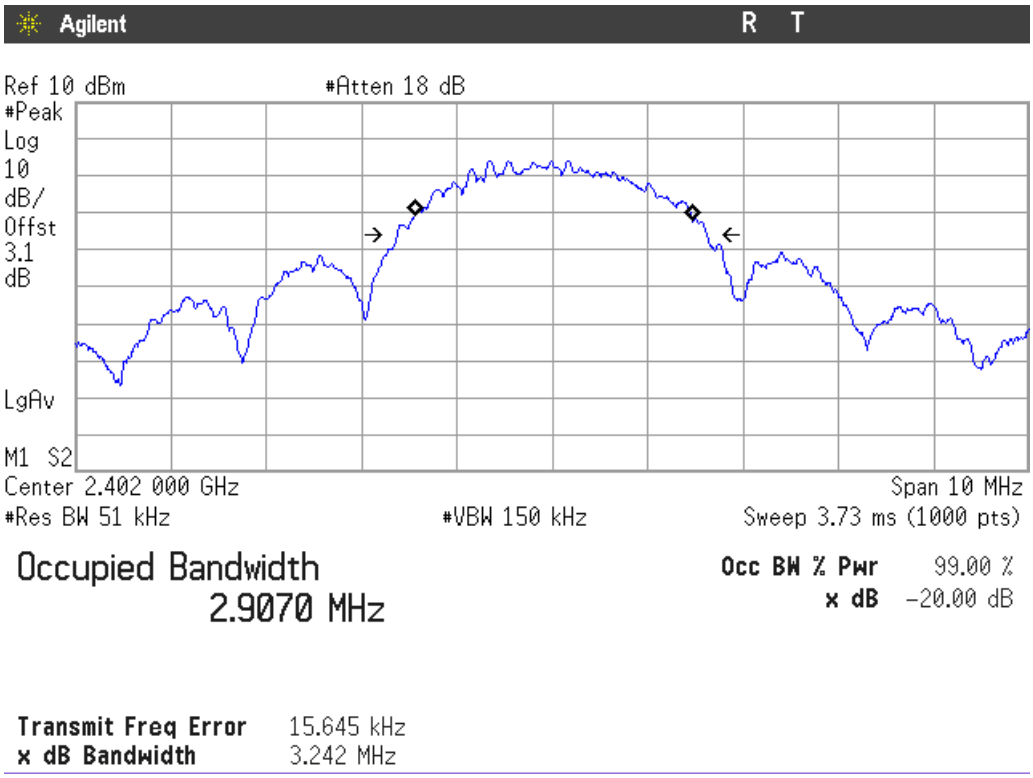


Occupied Bandwidth

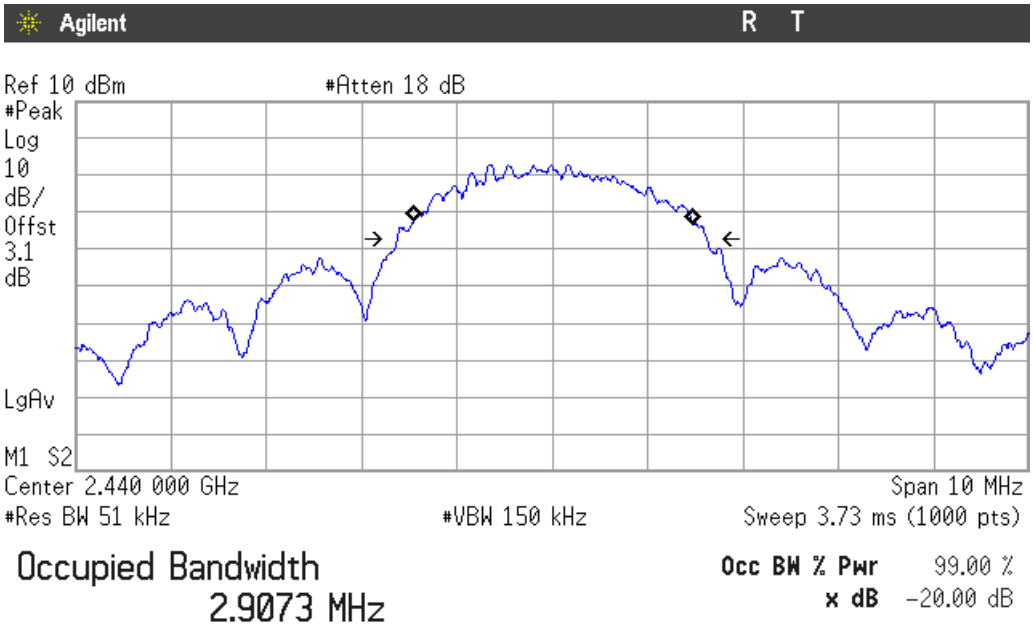
RESULTS:

	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
99% Bandwidth (MHz)	2.9070	2.9073	2.9064
Measurement Uncertainty (kHz)	<±5.00		

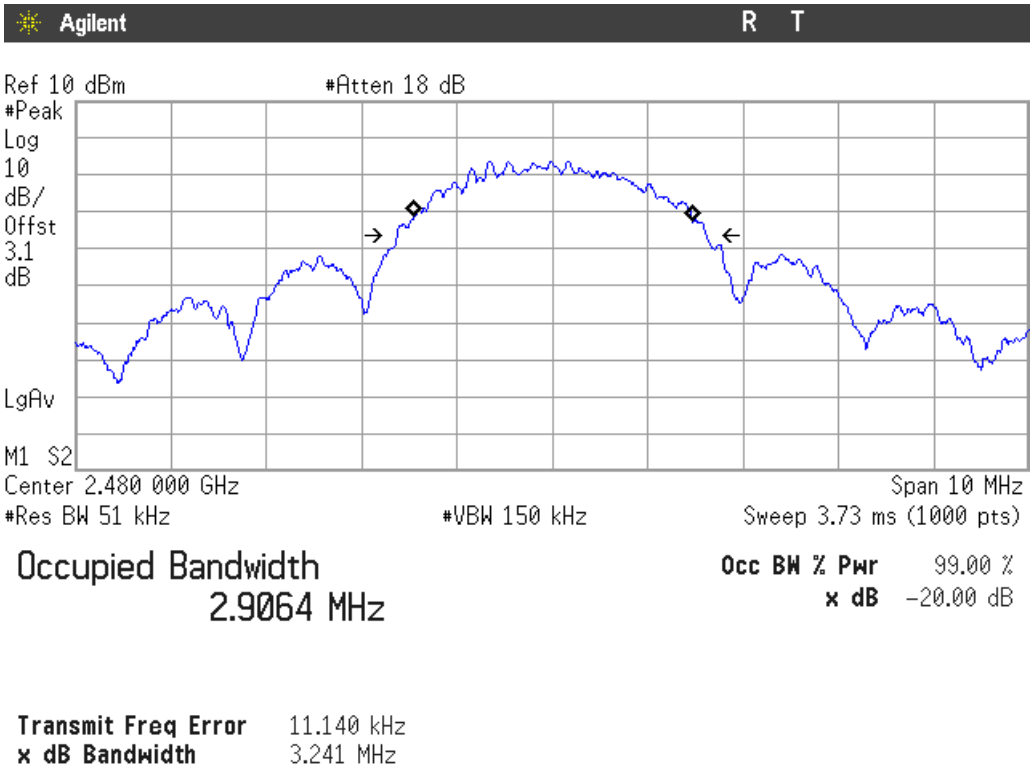
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

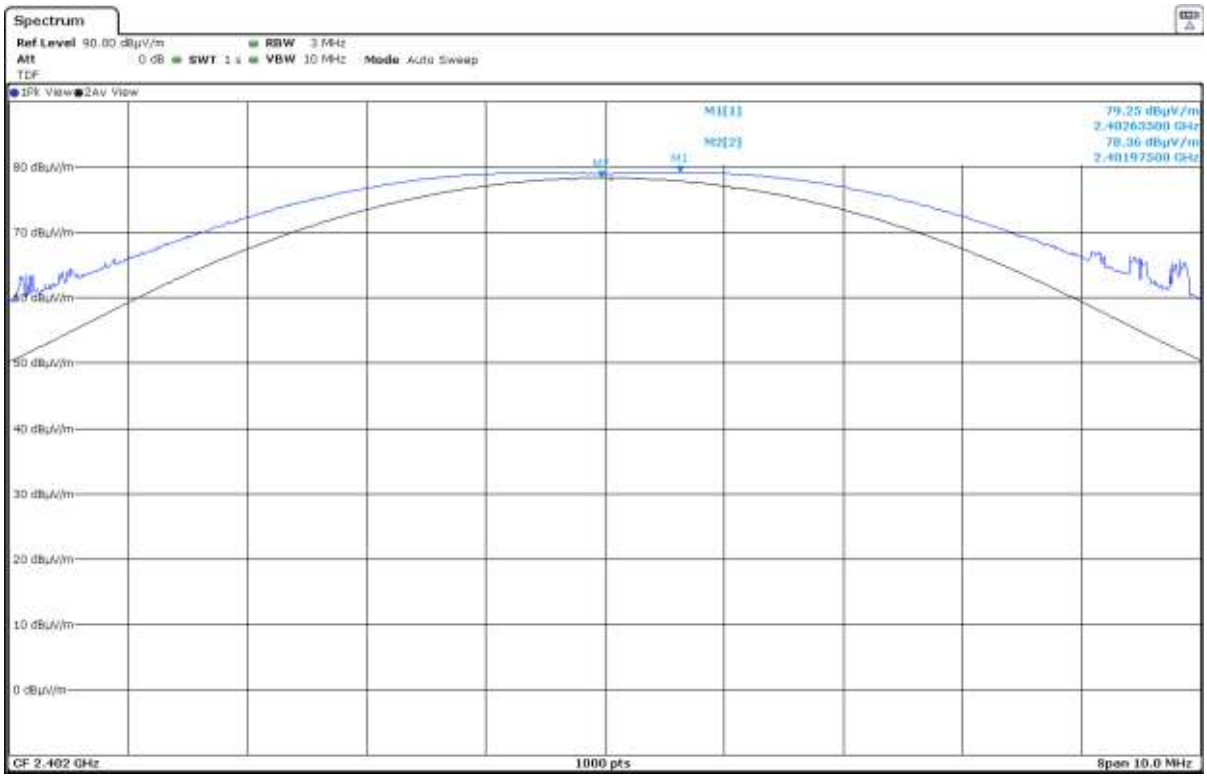
For frequencies above 1000 MHz, the above field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

RESULTS:

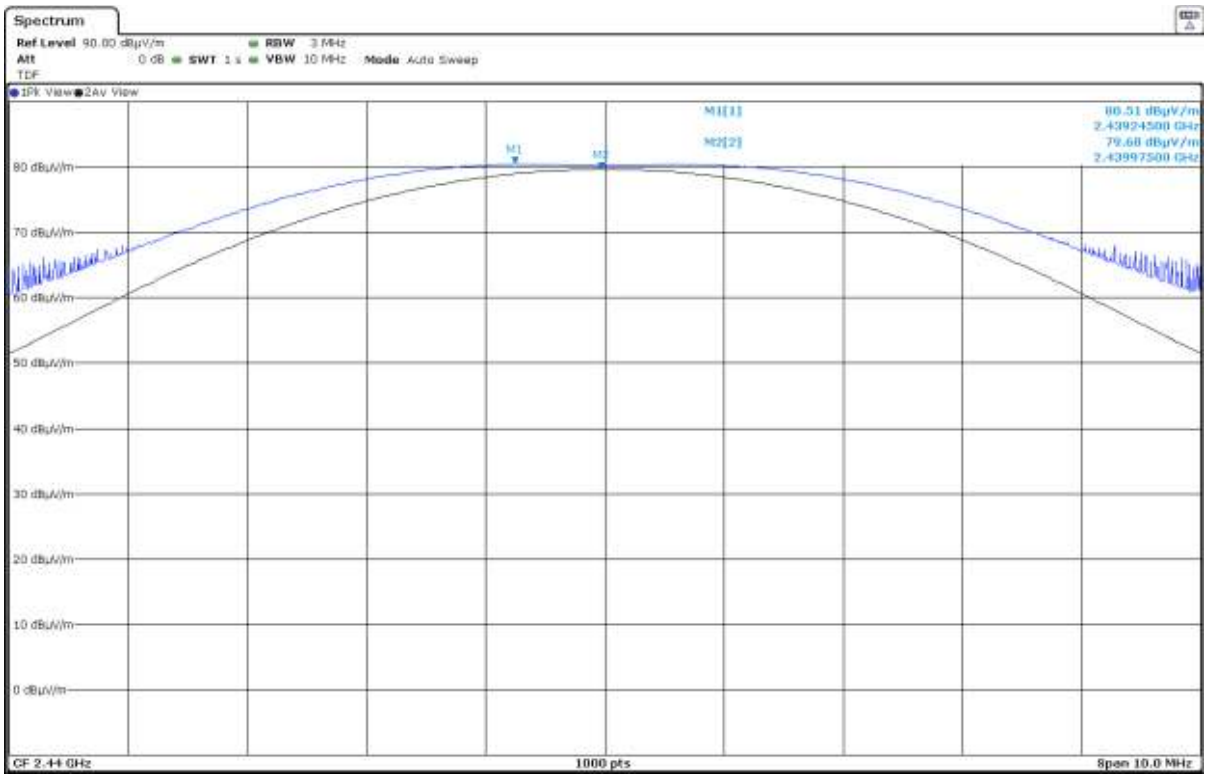
	Low Channel 2402 MHz	Middle Channel 2440 MHz	High Channel 2480 MHz
Average Field Strength (dBµV/m)	78.36	79.68	77.95
Peak Field Strength (dBµV/m)	79.25	80.51	78.94
Measurement Uncertainty (dB)	<±3.05		

Verdict: PASS

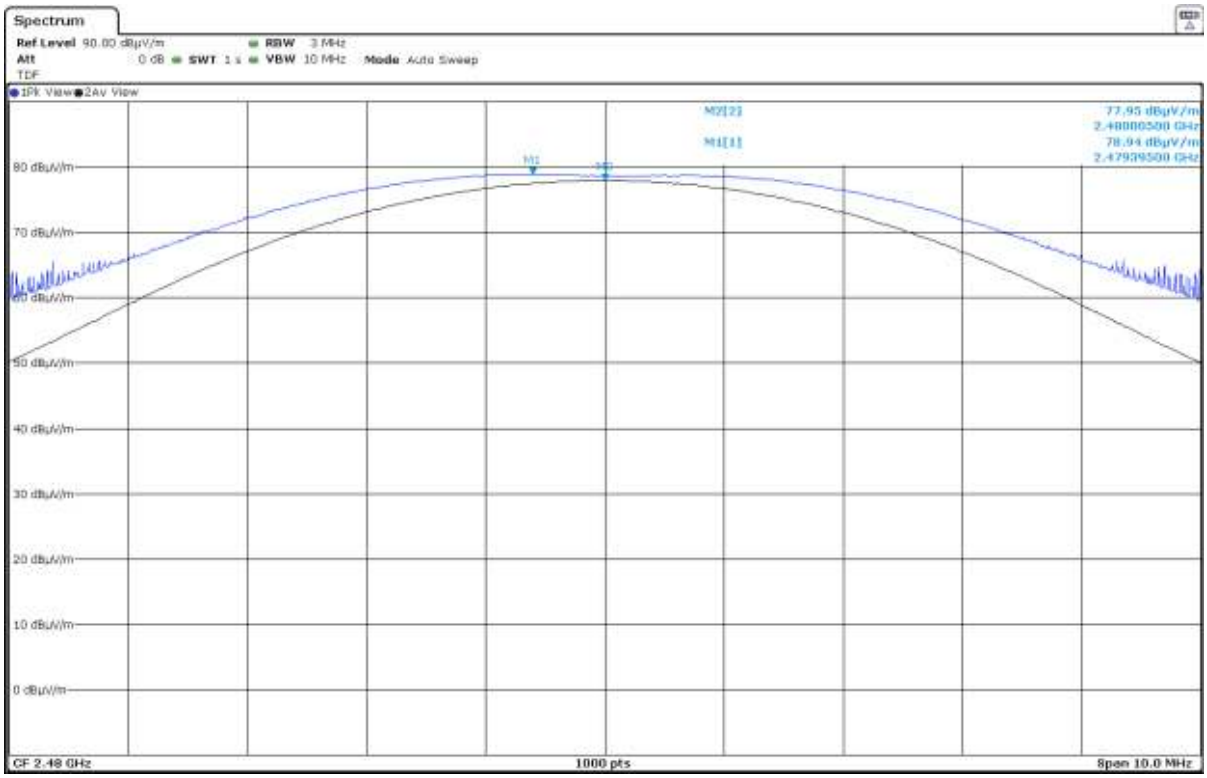
- Low Channel:



- Middle Channel:



- High Channel:



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

SPECIFICATION:

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

Fundamental frequency (MHz)	Field strength of harmonics (µV/m)	Field strength of harmonics (dBµV/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 (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

Whichever is the lesser attenuation.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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-26 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 - 1 GHz.

The spurious signals detected do not depend on the operating channel.

No spurious emissions were found at less than 20 dB of the limit.

Frequency range 1 - 26 GHz.

The results in the next tables show the maximum measured levels in the 1-26 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz (see next plots).

Spurious signals with peak levels above the average limit (54 dBµV/m at 3 m) are measured with average detector for checking compliance with the average limit.

- Low Channel (2402 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.80250	Peak	42.95	V	<±3.70
21.61205	Peak	41.54	V	<±3.70

- Middle Channel (2440 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
4.87903	Peak	44.09	V	<±3.70
21.95435	Peak	43.61	V	<±3.70

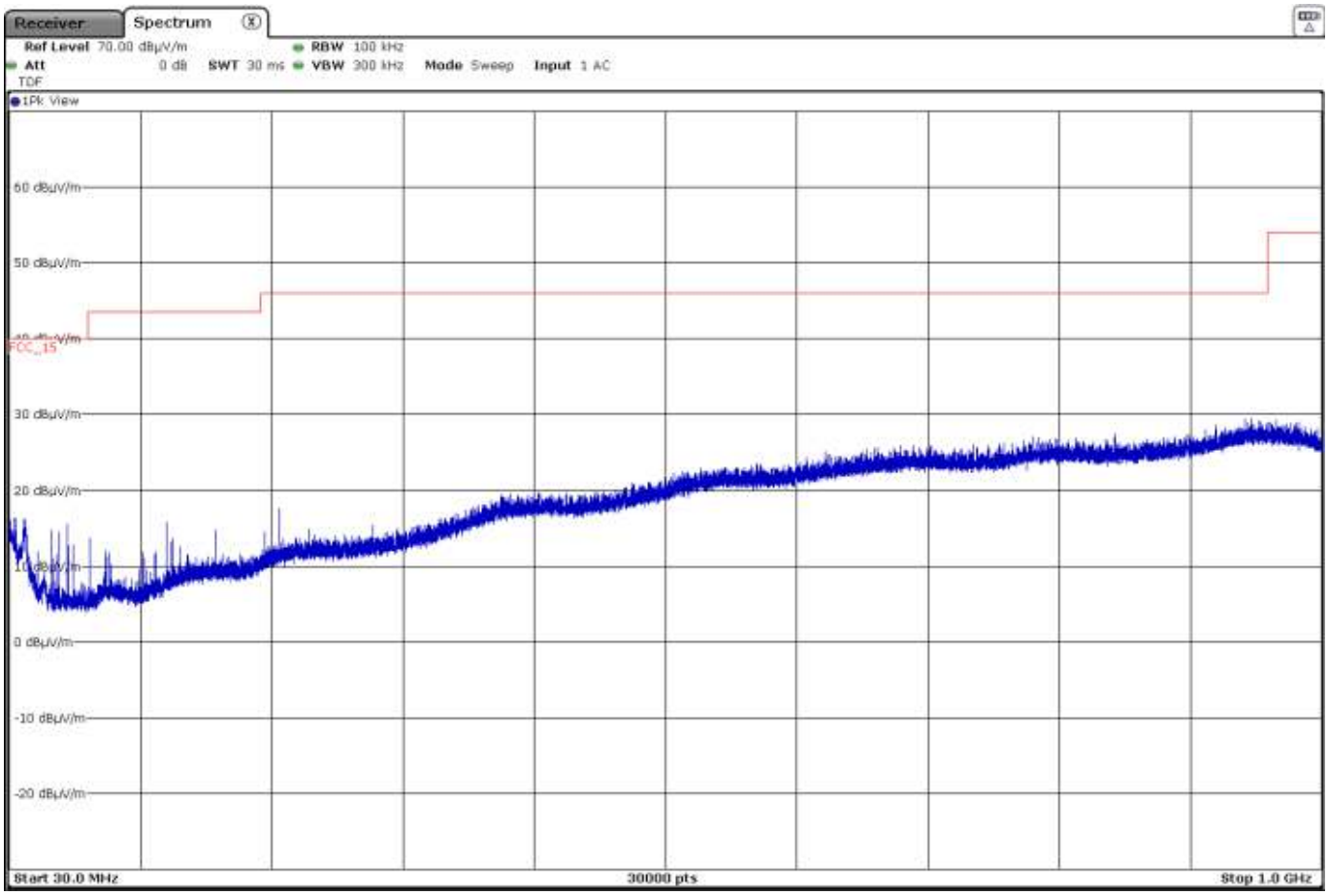
- High Channel (2480 MHz):

Spurious frequency (GHz)	Detector	Emission Level (dBµV/m)	Polarization	Measurement Uncertainty (dB)
2.48361	Peak	55.78	H	<±3.70
	Average	43.24		<±3.70
4.96163	Peak	43.71	V	<±3.70
22.32570	Peak	43.82	V	<±3.70

Verdict: PASS

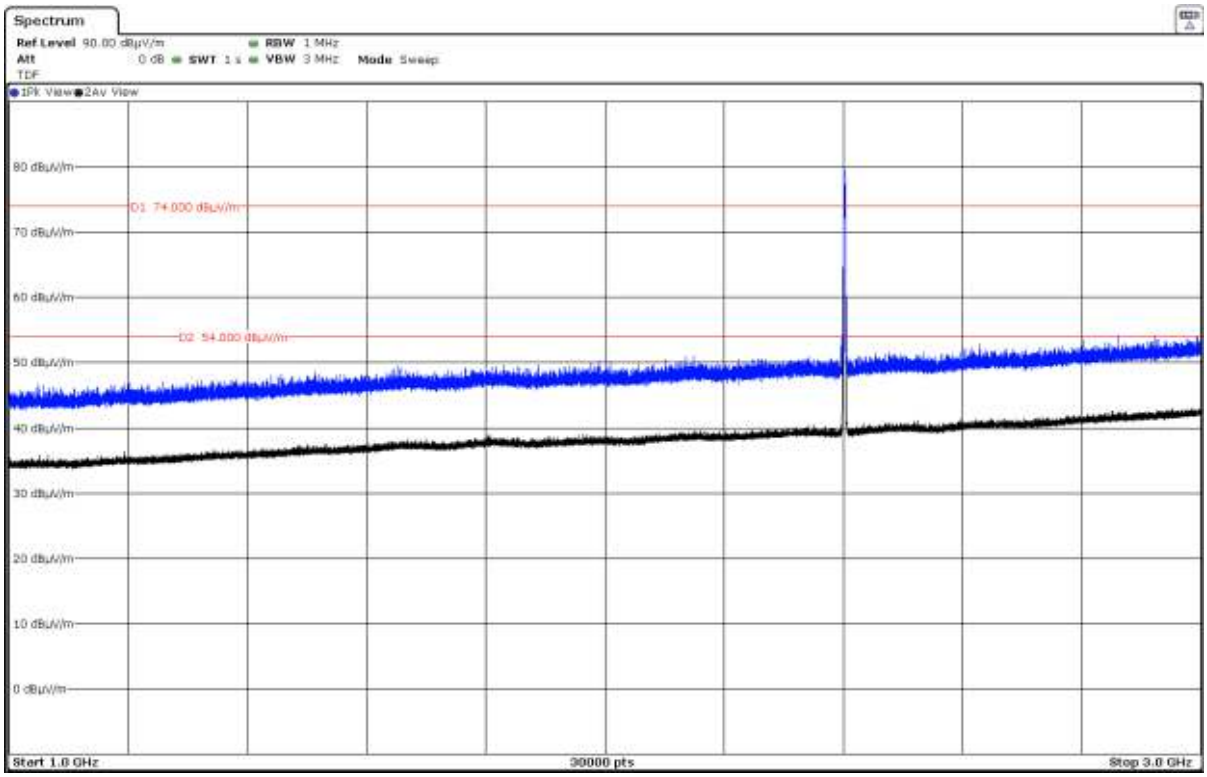
FREQUENCY RANGE 30 MHz - 1 GHz

The spurious signals detected do not depend on the operating channel, so valid for Low, Middle and High Channels.



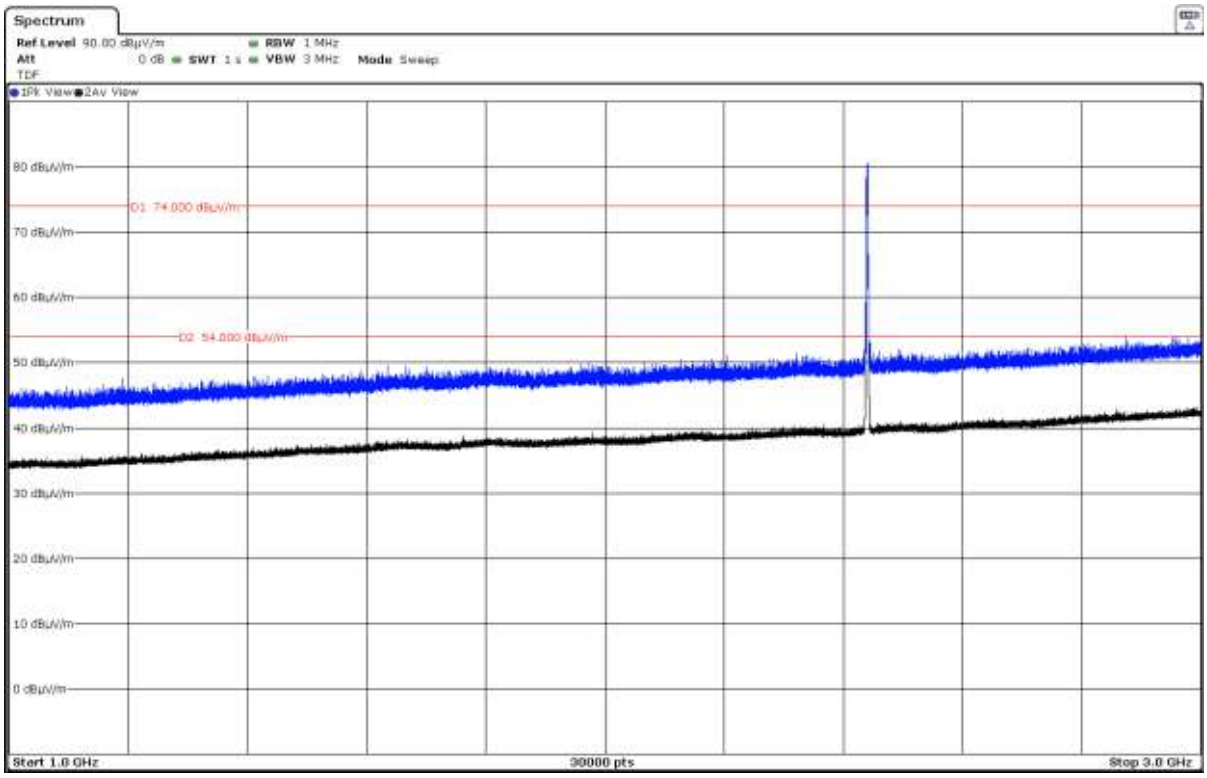
FREQUENCY RANGE 1 - 3 GHz

- Low Channel:



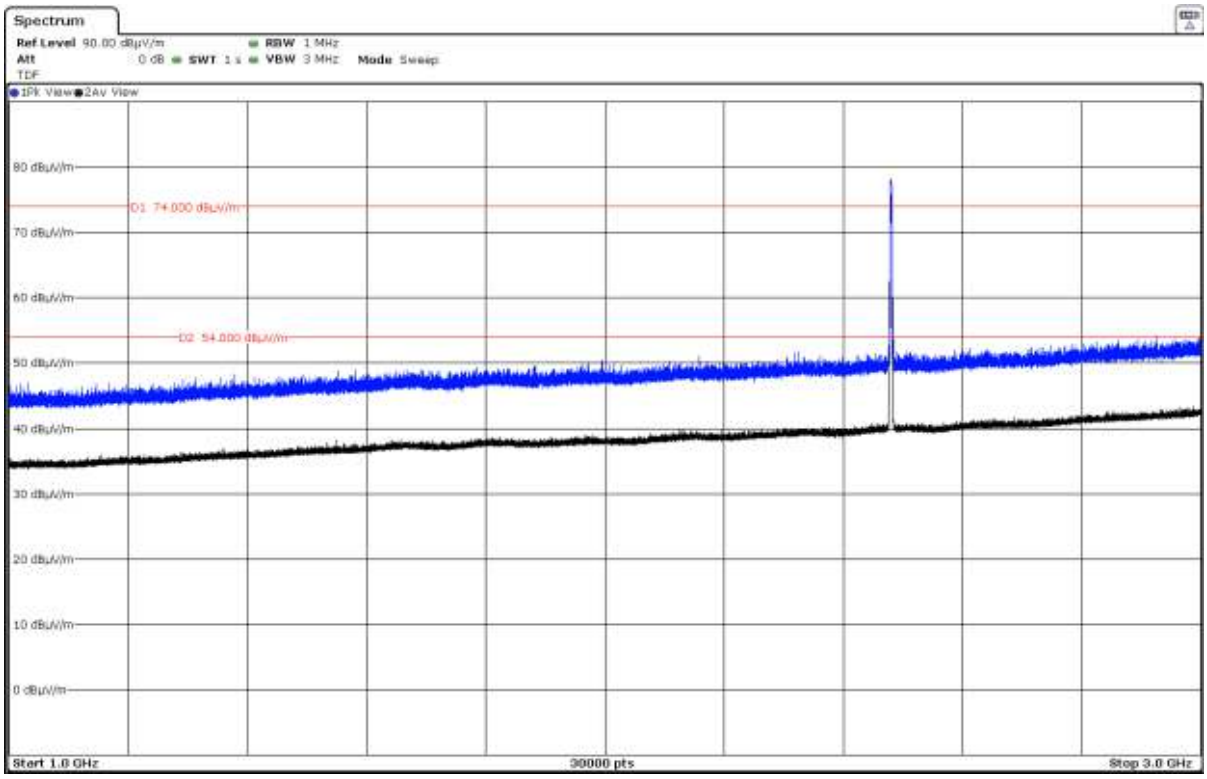
The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



The peak shown in the plot above the limit is the carrier frequency.

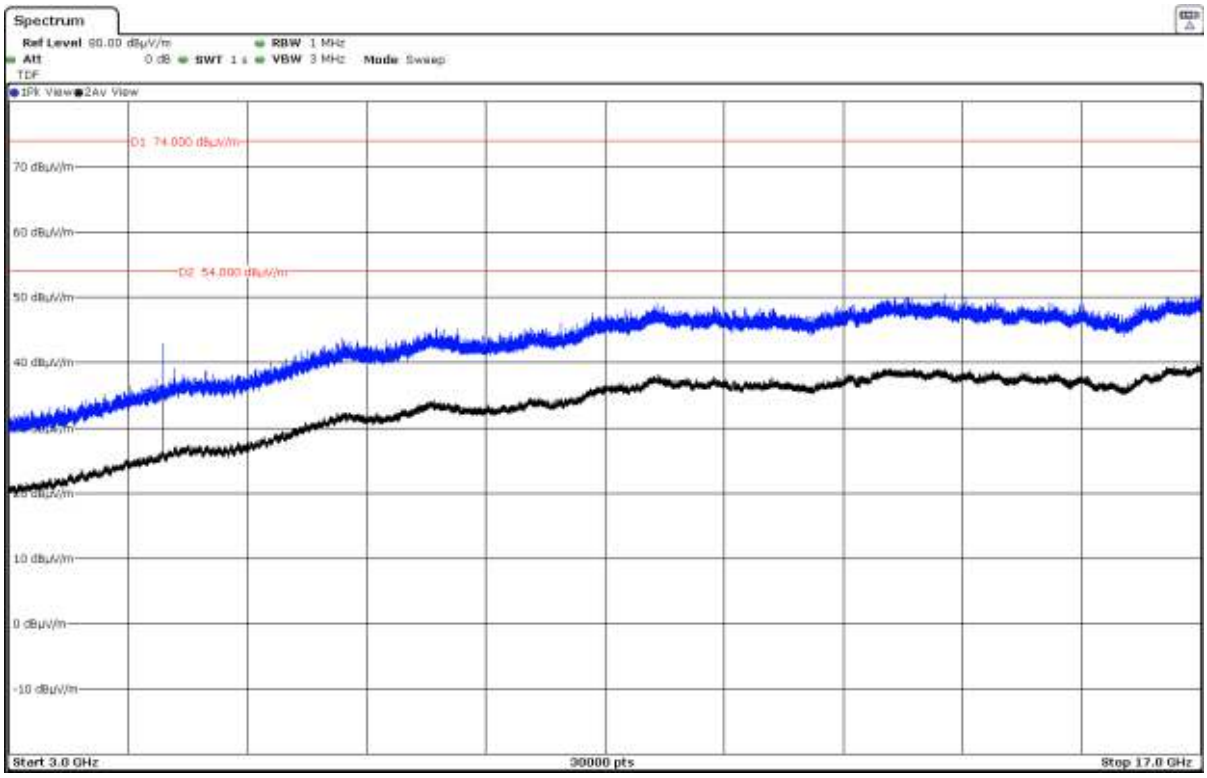
- High Channel:



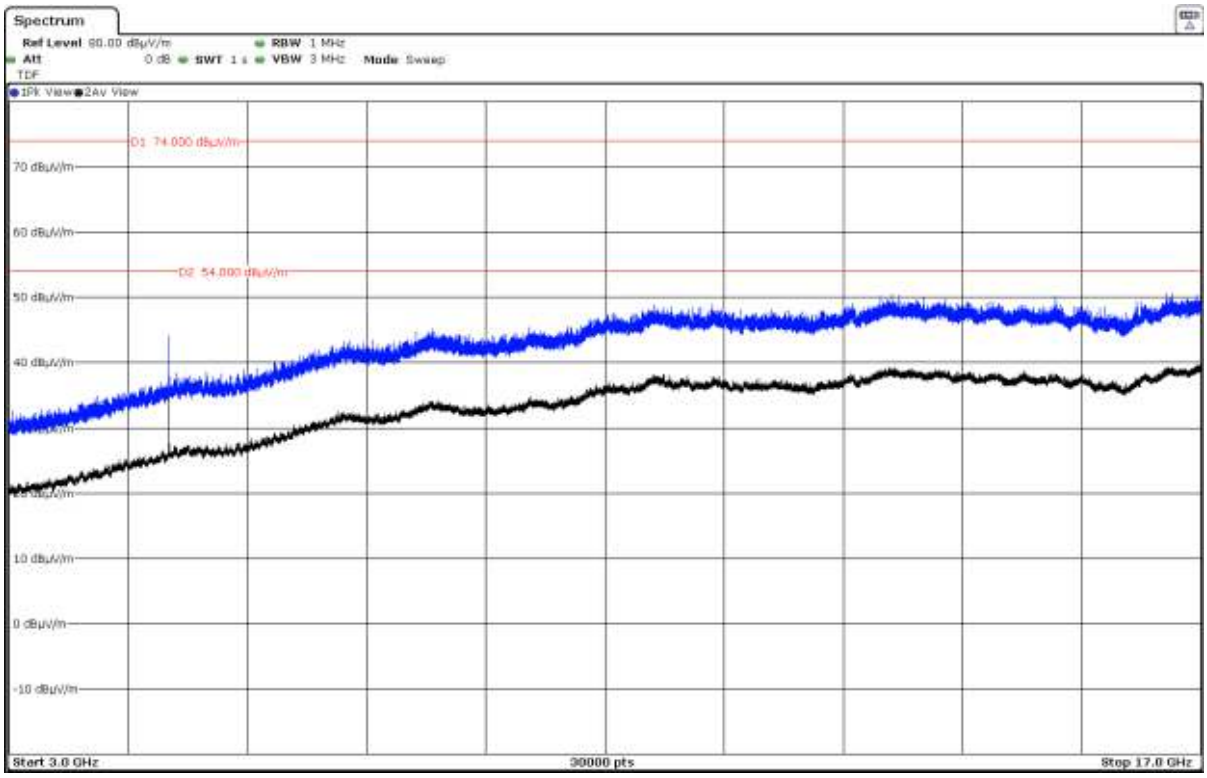
The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz

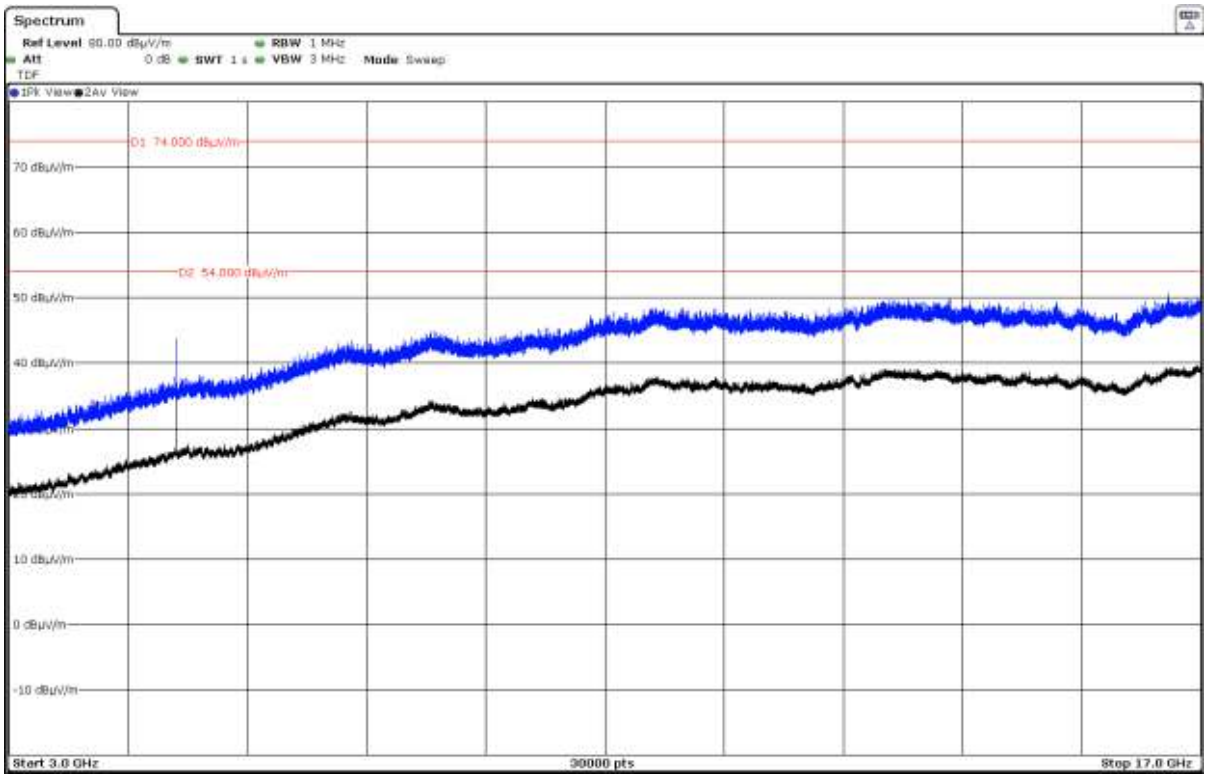
- Low Channel:



- Middle Channel:

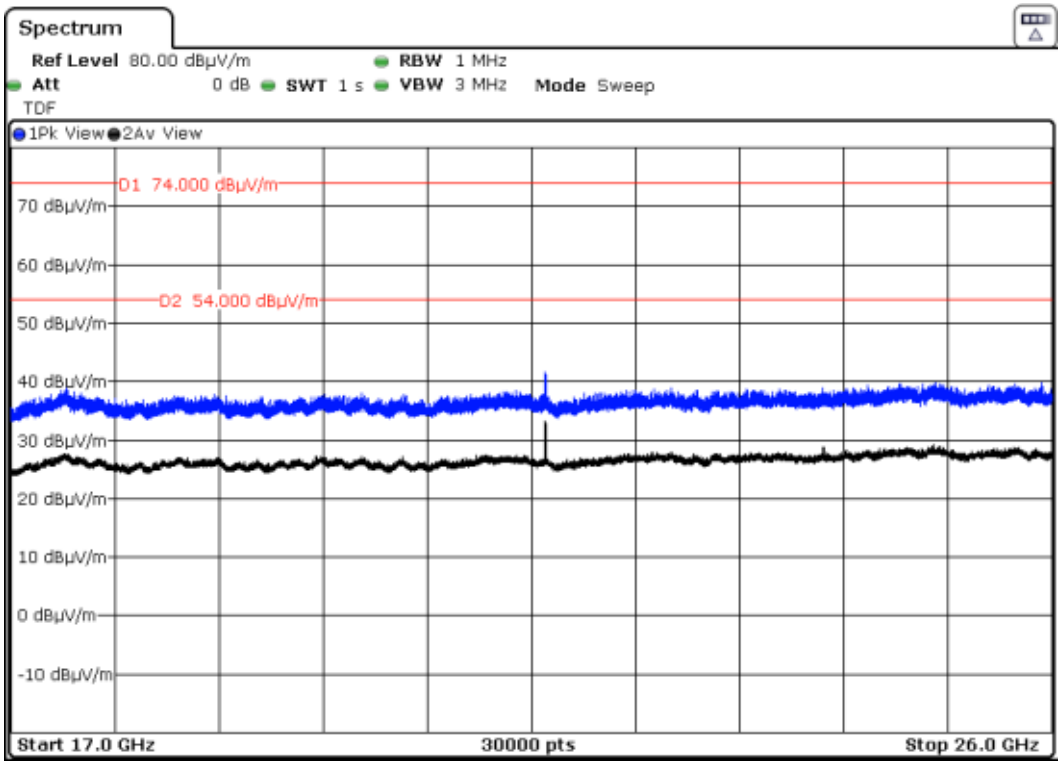


- High Channel:

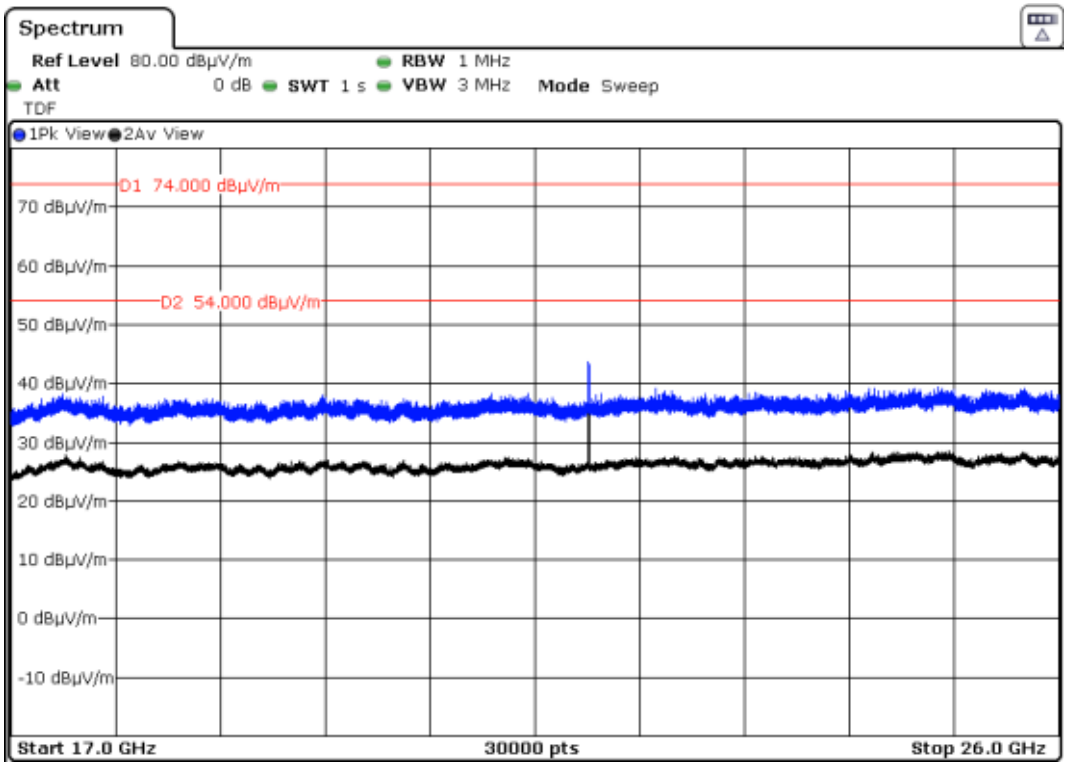


FREQUENCY RANGE 17 - 26 GHz

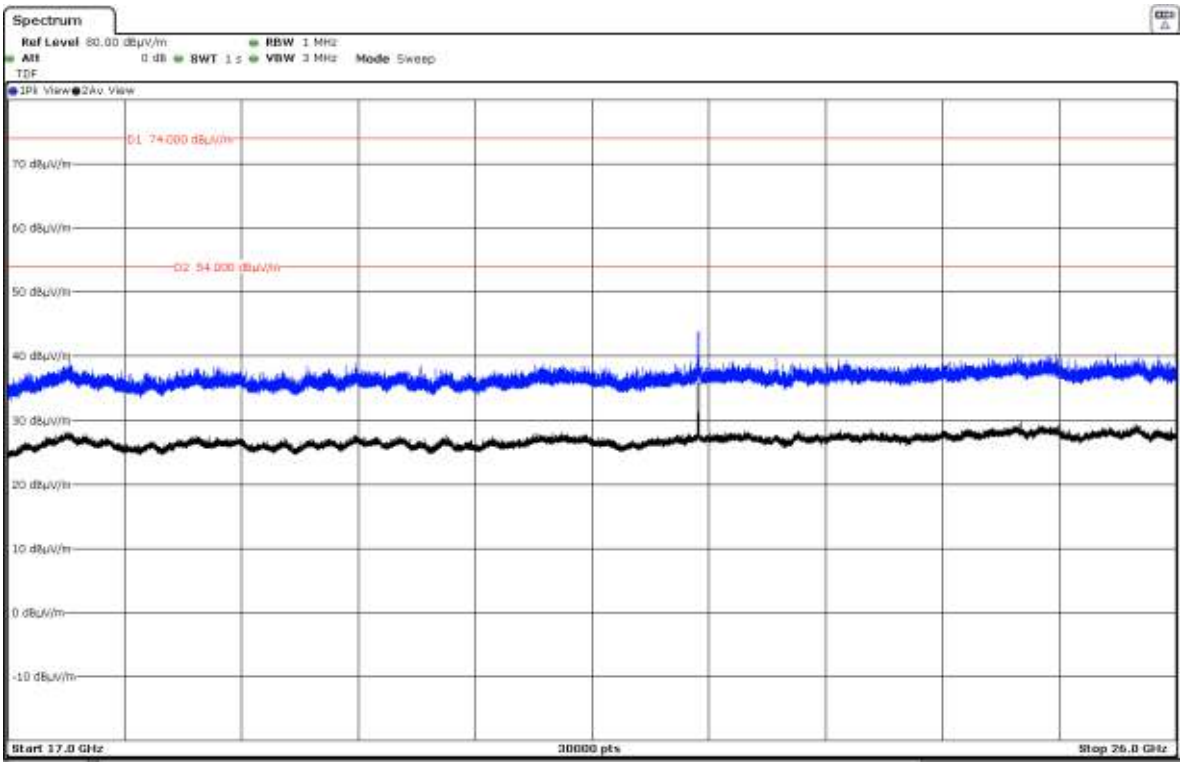
- Low Channel:



- Middle Channel:

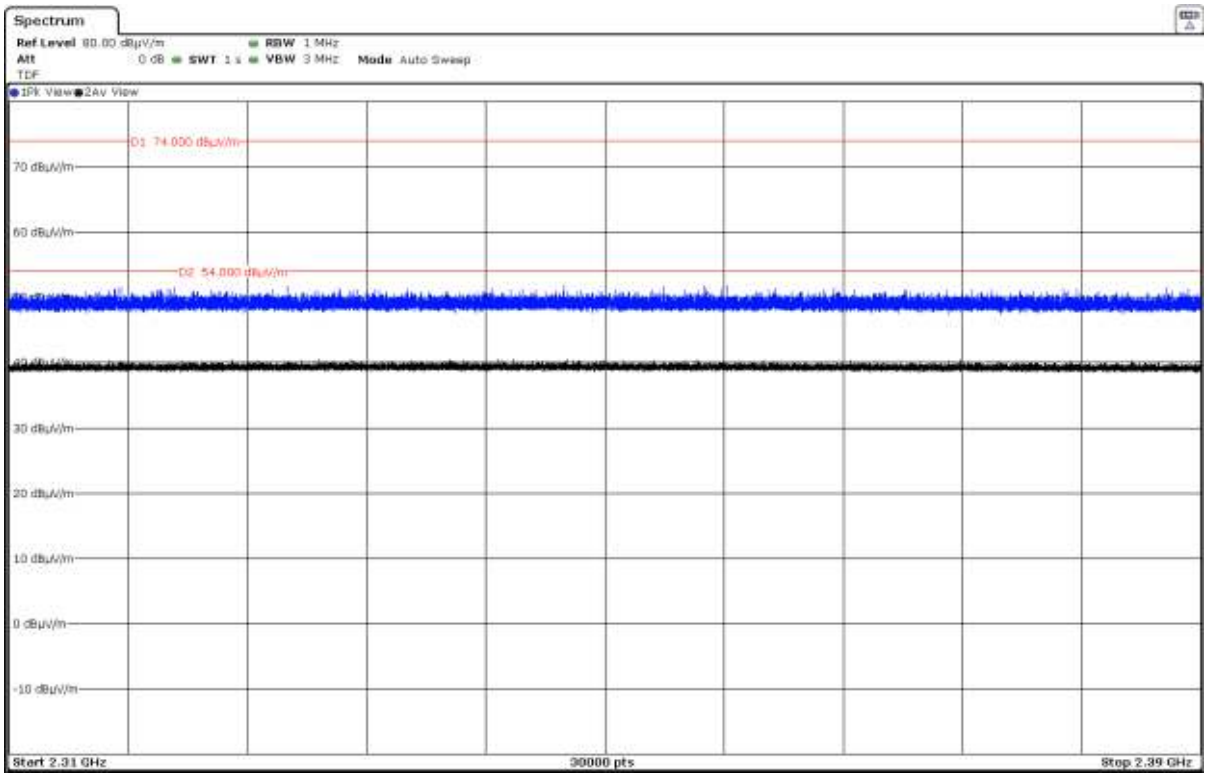


- High Channel:

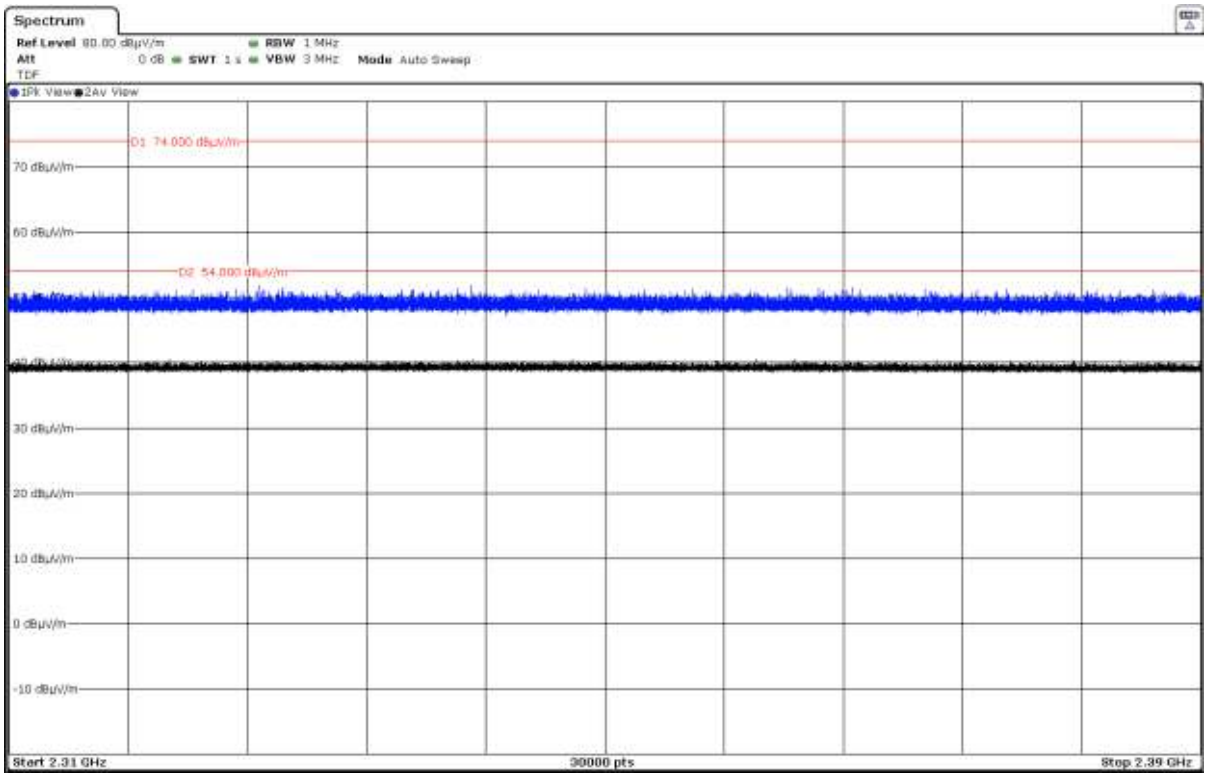


FREQUENCY RANGE 2.31 - 2.39 GHz (Restricted Band 1)

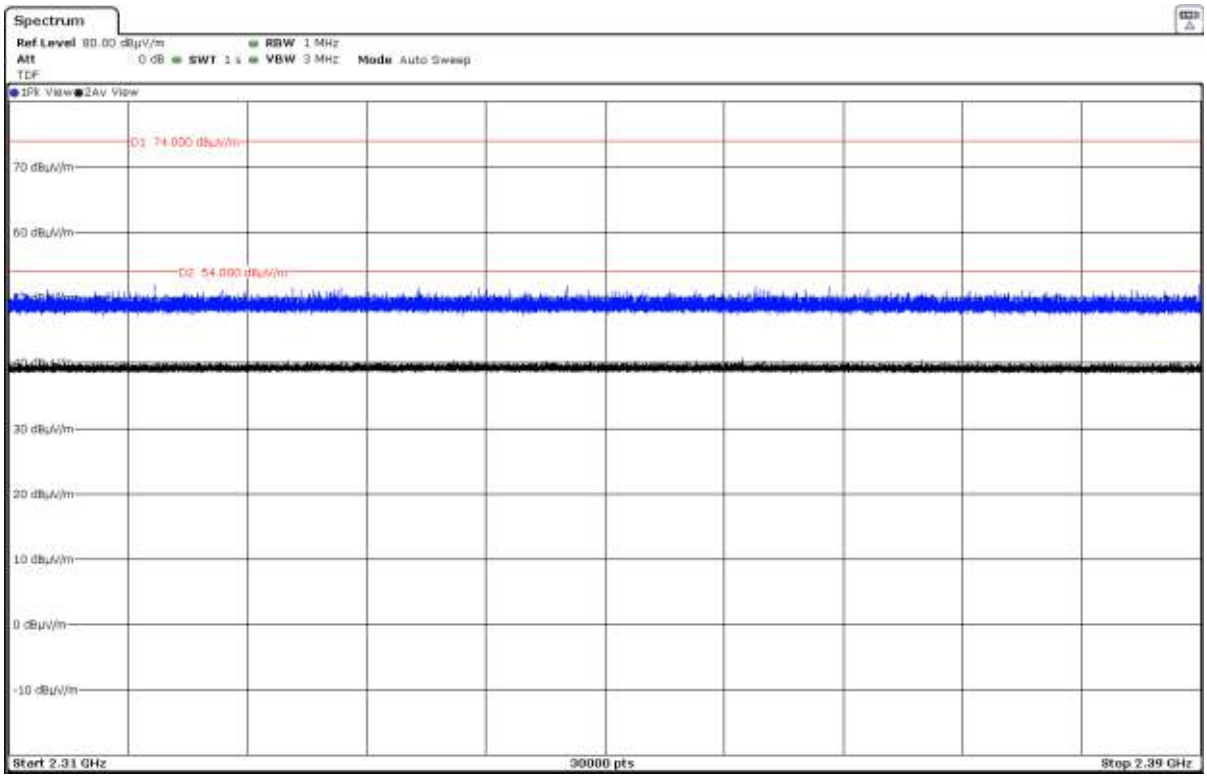
- Low Channel:



- Middle Channel:

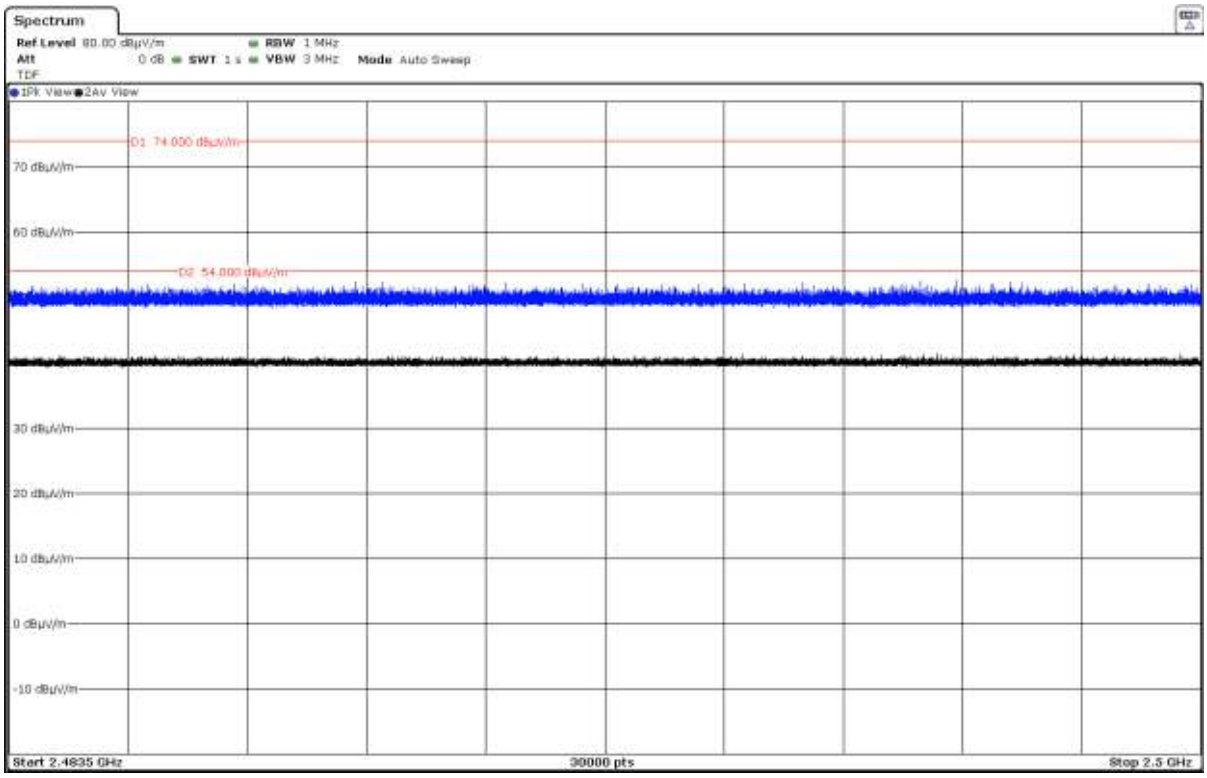


- High Channel:

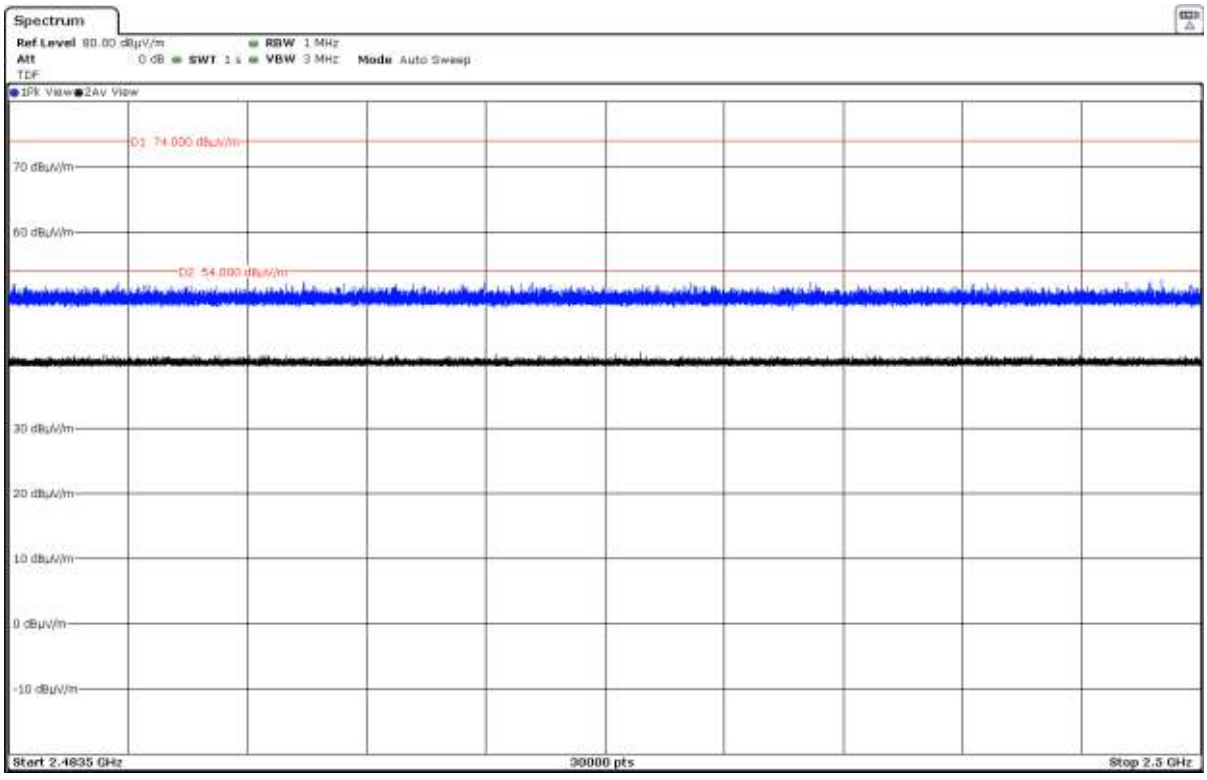


FREQUENCY RANGE 2.4835 - 2.5 GHz (Restricted Band 2)

- Low Channel:



- Middle Channel:



- High Channel: