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

Test report No:
NIE: 51929RRF.034

Partial 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.

(*) Identification of item tested	Headunit with radio and Bluetooth
(*) Trademark	Panasonic
(*) Model and /or type reference	MIB3E_MQB_BTWIFI
Other identification of the product	HW version: X40 SW version: X820 Part number: 575.035.869 FCC ID: WUQ-MIB3HBTWIFI IC: 216R-MIB3HBTWIFI
(*) Features	Bluetooth, WLAN, FM, AM, DAB, USB
Applicant	PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH Robert Bosch Str. 27-29, 63225, Langen, Germany
Test method requested, standard	USA FCC Part 15.247 (10-1-18) Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-18) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). 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.
Approved by (name / position & signature)	Rafael López Martín EMC Consumer & RF Lab. Manager RAFAEL LÓPEZ MARTÍN 2020.05.07 13:52:44 +02'00'
Date of issue	2020-05-07
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

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

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

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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.
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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 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 of the model MIB3E_MQB_BTWIFI is an Automotive Head Unit to be installed in cars with the following features: Bluetooth, WLAN, FM, AM, DAB, USB.

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 result.

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control Nº	Description	Model	Serial Nº	Date of reception
51929B/634	Automotive Head Unit Var 5_Ateca BTWIFI	MIB3E_MQB_BT WIFI	PM6-00124.10.19413F0447	2019/12/27

Auxiliary elements used with the sample S/01:

Control Nº	Description	Model	Serial Nº	Date of reception
51929B/228	Harness	--	--	2019/01/24

Sample S/01 has undergone the following test(s): All tests indicated in Appendixes A, B.

Test sample description

Ports…… :	Port name and description	Cable			
		Specified max length [m]	Attached during test	Shielded	Coupled to patient(3)
	-		☐	☐	☐
	-		☐	☐	☐
Supplementary information to the ports…… :	-				
Rated power supply .....:	Voltage and Frequency				
	☒	DC: 12 Vdc			
Rated Power .....:	-				
Clock frequencies.....:	-				
Other parameters .....:	-				
Software version .....:	X820				
Hardware version .....:	X40				
Dimensions in cm (W x H x D) ....:	-				
Mounting position .....:	☒	Other: Vehicle.			
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

PANASONIC AUTOMOTIVE SYSTEMS EUROPE GMBH
Robert Bosch Str. 27-29, 63225, Langen, Germany

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-01-10
Date (finish)	2020-01-17

Document history

Report number	Date	Description
51929RRF.034	2020-05-07	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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Miguel Ángel Torres, Nicolás Salguero and José Manuel Jiménez.

Used instrumentation:

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.	Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2018/02	2020/02
8.	Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
9.	Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
10.	DC Power Supply 30V/5A KEYSIGHT TECHNOLOGIES, U8002A	N.A.	N.A.
11.	Digital Multimeter, FLUKE 175	2019/06	2020/06

Testing verdicts

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

Summary

1. Bluetooth EDR

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
FCC 15.247 (a)(1) / RSS-247 5.1. (b)	20 dB Bandwidth and Carrier frequency separation	N/M	
FCC 15.247 (a)(1)(iii) / RSS-247 5.1. (d)	Number of hopping channels	N/M	
FCC 15.247 (a)(1)(iii) / RSS-247 5.1. (d)	Time of occupancy (Dwell Time)	N/M	
FCC 15.247 (b) / RSS-247 5.4. (b)	Maximum peak output power and antenna gain	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	(1)
Supplementary information and remarks: (1) Only test requested.			

2. WLAN 2.4 GHz (802.11 b/g/n20 1x1).

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		**Verdict**	**Remark**
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	N/M	
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	N/M	
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	N/M	
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	(1)
Supplementary information and remarks: (1) Only test requested.			

Appendix A: Test results. Bluetooth EDR (GFSK, Pi/4 DQPSK, 8DPSK)

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TEST CONDITIONS

POWER SUPPLY (V):

V nonimal:	12 Vdc.
Type of Power Supply:	DC External (vehicle battery).
Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	+1.3 dBi

TEST FREQUENCIES:

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

RADIATED MEASUREMENTS:

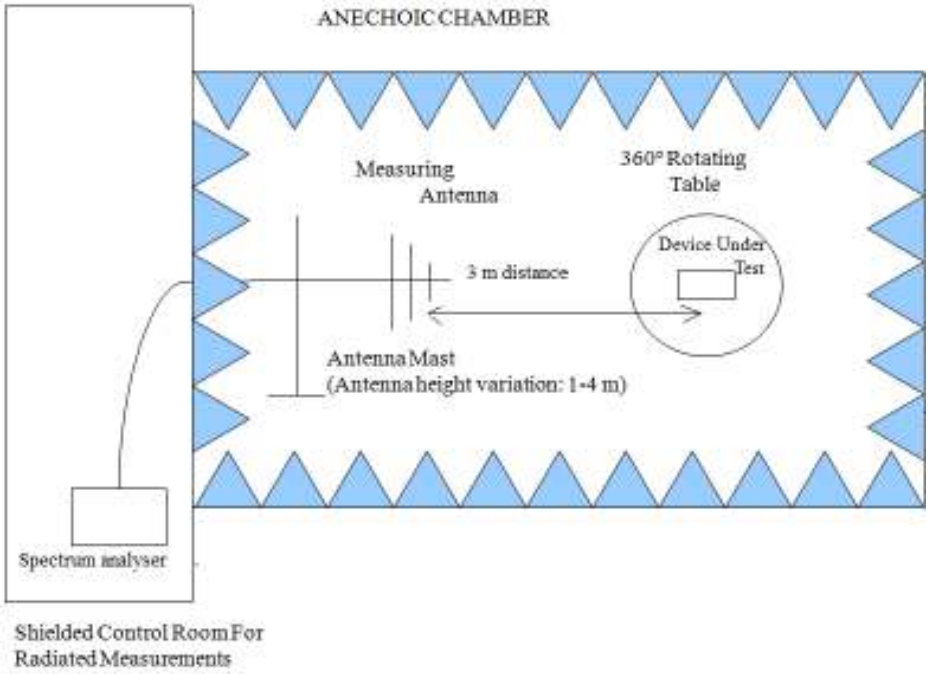
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

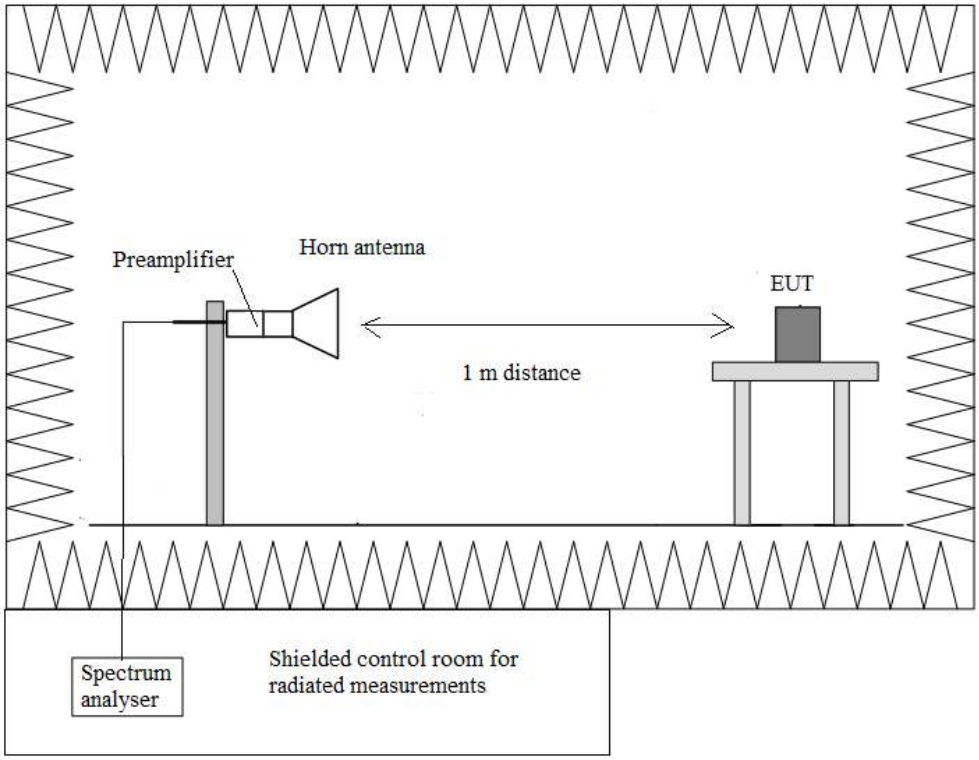
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup f > 1 GHz:



FCC 15.247 (d) / RSS-247 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)/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.

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-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 - 1 GHz:

The spurious frequencies detected below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious frequencies operating detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
425.13	30.5	46	V	Quasi peak	<± 2.07
575.027	30.3	46	V	Quasi peak	<± 2.07
771.84	37	46	V	Quasi peak	<± 2.07
815.005	28.6	46	V	Quasi peak	<± 2.07
274.036	29.2	46	H	Quasi peak	<± 2.07
550.001	29.8	46	H	Quasi peak	<± 2.07
779.794	31.2	46	H	Quasi peak	<± 2.07
812.58	28.1	46	H	Quasi peak	<± 2.07

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.

Spurious frequencies 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.

- **GFSK (DH5):**

  - LOW CHANNEL (2402 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.315789	47.92	74	V	Peak	<± 3.04
1.3737678	51.39	74	V	Peak	<± 3.04
1.791609	51.66	74	V	Peak	<± 3.04
1.873825	50.46	74	V	Peak	<± 3.04
2.369683	58.47	74	V	Peak	<± 3.04
	41.2	54		Average	<± 3.04
2.3948772	59.08	74	V	Peak	<± 3.04
	40.8	54		Average	<± 3.04
1.510769	47.83	74	H	Peak	<± 3.04
2.3575187	60.03	74	V	Peak	<± 3.04
	39	54		Average	<± 3.04
2.3755827	59.33	74	V	Peak	<± 3.04
	40.93	54		Average	<± 3.04
2.388116	58.27	74	V	Peak	<± 3.04
	42.38	54		Average	<± 3.04
3.97697	55.97	74	V	Peak	<± 4.88
	34.96	54		Average	<± 4.88
4.40957	41.44	74	V	Peak	<± 4.88
4.5659	47.05	74	V	Peak	<± 4.88
4.78617	49.97	74	V	Peak	<± 4.88
6.8493	42.02	74	V	Peak	<± 4.88
7.9371	45.72	74	V	Peak	<± 4.88
5.57063	46.2	74	H	Peak	<± 4.88
17.63825	38.59	74	V	Peak	<± 4.88

- MIDDLE CHANNEL (2441 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.358367	49.82	74	V	Peak	<± 3.04
1.8015	49.61	74	V	Peak	<± 3.04
1.989633	46.09	74	V	Peak	<± 3.04
2.355433	58.45	74	V	Peak	<± 3.04
	41.13	54		Average	<± 3.04
2.387367	60.22	74	V	Peak	<± 3.04
	38.8	54		Average	<± 3.04
2.3574867	62.49	74	V	Peak	<± 3.04
	39.11	54		Average	<± 3.04
2.3692387	62.02	74	V	Peak	<± 3.04
	41.21	54		Average	<± 3.04
2.3806947	61.63	74	V	Peak	<± 3.04
	39.25	54		Average	<± 3.04
3.97137	56.64	74	V	Peak	<± 4.88
	33.03	54		Average	<± 4.88
4.3713	46.65	74	V	Peak	<± 4.88
4.79783	50.25	74	V	Peak	<± 4.88
5.5669	48.63	74	V	Peak	<± 4.88

- HIGH CHANNEL (2480 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.355167	49.58	74	V	Peak	<± 3.04
1.7995	49.13	74	V	Peak	<± 3.04
1.9979	51.32	74	V	Peak	<± 3.04
2.355767	59.16	74	V	Peak	<± 3.04
	40.2	54		Average	<± 3.04
2.3869	59.81	74	V	Peak	<± 3.04
	39.81	54		Average	<± 3.04
2.377967	61.58	74	H	Peak	<± 3.04
	40.59	54		Average	<± 3.04
2.3991	60.03	74	H	Peak	<± 3.04
	41.17	54		Average	<± 3.04
2.409967	54.48	74	H	Peak	<± 3.04
	37.49	54		Average	<± 3.04
2.354828	62.56	74	V	Peak	<± 3.04
	39.95	54		Average	<± 3.04
2.3756787	62.91	74	V	Peak	<± 3.04
	40.46	54		Average	<± 3.04
2.3845747	62.58	74	V	Peak	<± 3.04
	40.79	54		Average	<± 3.04
3.9611	55.75	74	V	Peak	<± 4.88
	33.23	54		Average	<± 4.88
4.38857	46.2	74	V	Peak	<± 4.88
4.79597	49.37	74	V	Peak	<± 4.88
5.57157	49.68	74	V	Peak	<± 4.88

Verdict: PASS

- **Pi/4-DQPSK (2-DH5):**

  - LOW CHANNEL (2402 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.3963	45.55	74	V	Peak	<± 3.04
1.7909	46.58	74	V	Peak	<± 3.04
1.9957	52.37	74	V	Peak	<± 3.04
2.369633	57.39	74	V	Peak	<± 3.04
	37.39	54		Average	<± 3.04
1.353367	49.31	74	H	Peak	<± 3.04
2.3138973	48.96	74	V	Peak	<± 3.04
2.383484	60.29	74	V	Peak	<± 3.04
	40.34	54		Average	<± 3.04
2.3763907	57.23	74	H	Peak	<± 3.04
	38.68	54		Average	<± 3.04
2.3892627	56.8	74	H	Peak	<± 3.04
	38.77	54		Average	<± 3.04
3.97277	57.04	74	V	Peak	<± 4.88
	35	54		Average	<± 4.88
4.4091	41.72	74	V	Peak	<± 4.88
4.64757	45.81	74	V	Peak	<± 4.88
4.8011	50.98	74	V	Peak	<± 4.88
5.58883	49.95	74	V	Peak	<± 4.88
4.7549	47.38	74	H	Peak	<± 4.88

  - MIDDLE CHANNEL (2441 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.351567	46.72	74	V	Peak	<± 3.04
1.7947	45.86	74	V	Peak	<± 3.04
1.938167	47.2	74	V	Peak	<± 3.04
2.400357	58.48	74	V	Peak	<± 3.04
	42.88	54		Average	<± 3.04
2.359033	58.22	74	H	Peak	<± 3.04
	38.13	54		Average	<± 3.04
2.379567	57.66	74	H	Peak	<± 3.04
	38.74	54		Average	<± 3.04
2.3585853	60.87	74	V	Peak	<± 3.04
	38.69	54		Average	<± 3.04
2.3757613	60.56	74	V	Peak	<± 3.04
	39.97	54		Average	<± 3.04
2.3888813	61.28	74	H	Peak	<± 3.04
	40.29	54		Average	<± 3.04
3.9781	55.88	74	V	Peak	<± 4.88
	29.48	54		Average	<± 4.88
4.27377	43.73	74	V	Peak	<± 4.88
4.40957	41.32	74	V	Peak	<± 4.88
4.78383	49.95	74	V	Peak	<± 4.88
5.57903	50.39	74	V	Peak	<± 4.88
7.0551	43.08	74	H	Peak	<± 4.88

- HIGH CHANNEL (2480 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.769033	52.14	74	V	Peak	<± 3.04
1.999367	52.18	74	V	Peak	<± 3.04
2.323767	48.81	74	V	Peak	<± 3.04
2.3943	59.88	74	V	Peak	<± 3.04
	39.28	54		Average	<± 3.04
2.3565	57.75	74	H	Peak	<± 3.04
	37.87	54		Average	<± 3.04
2.388433	61.74	74	H	Peak	<± 3.04
	39.6	54		Average	<± 3.04
2.3558093	61.18	74	V	Peak	<± 3.04
	40.95	54		Average	<± 3.04
2.362964	62.89	74	V	Peak	<± 3.04
	40.29	54		Average	<± 3.04
2.3780227	63.03	74	V	Peak	<± 3.04
	40.38	54		Average	<± 3.04
2.3880253	62.76	74	H	Peak	<± 3.04
	40.67	54		Average	<± 3.04
3.99143	55.5	74	V	Peak	<± 4.88
	29.48	54		Average	<± 4.88
4.5995	46.13	74	V	Peak	<± 4.88
4.7871	50.15	74	V	Peak	<± 4.88
5.58697	50.23	74	V	Peak	<± 4.88
6.8997	43.02	74	V	Peak	<± 4.88
4.40957	39.64	74	H	Peak	<± 4.88

Verdict: PASS

- **8-DPSK (3DH5):**

  - LOW CHANNEL (2402 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.3629	50.35	74	V	Peak	<± 3.04
1.788571	49.2	74	V	Peak	<± 3.04
2.012167	50.55	74	V	Peak	<± 3.04
2.3795	59.79	74	V	Peak	<± 3.04
	38.08	54		Average	<± 3.04
2.375233	56.32	74	H	Peak	<± 3.04
	37.96	54		Average	<± 3.04
2.3581267	57.05	74	V	Peak	<± 3.04
	37.59	54		Average	<± 3.04
2.3668562	57.74	74	V	Peak	<± 3.04
	39.18	54		Average	<± 3.04
2.3813053	58.97	74	V	Peak	<± 3.04
	40.6	54		Average	<± 3.04
2.387684	60.07	74	V	Peak	<± 3.04
	41.05	54		Average	<± 3.04
3.98303	55.95	74	V	Peak	<± 4.88
	29.55	54		Average	<± 4.88
4.40957	42.12	74	V	Peak	<± 4.88
4.72177	46.91	74	V	Peak	<± 4.88
5.5823	49.75	74	V	Peak	<± 4.88
3.96717	54.23	74	H	Peak	<± 4.88
	28.35	54		Average	<± 4.88

- MIDDLE CHANNEL (2441 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.3549	55.29	74	V	Peak	<± 3.04
	37.76	54		Average	<± 3.04
2.367167	60.06	74	V	Peak	<± 3.04
	39.11	54		Average	<± 3.04
2.3927	59.57	74	V	Peak	<± 3.04
	40.42	54		Average	<± 3.04
2.401433	60.97	74	V	Peak	<± 3.04
	38.13	54		Average	<± 3.04
2.376967	56.3	74	H	Peak	<± 3.04
	38.12	54		Average	<± 3.04
2.388767	59.79	74	H	Peak	<± 3.04
	38.12	54		Average	<± 3.04
2.356108	59.97	74	V	Peak	<± 3.04
	39.03	54		Average	<± 3.04
2.357252	60.17	74	V	Peak	<± 3.04
	38.41	54		Average	<± 3.04
2.362644	60.33	74	V	Peak	<± 3.04
	39	54		Average	<± 3.04
2.3791667	61.53	74	V	Peak	<± 3.04
	41.4	54		Average	<± 3.04
2.3867427	61.08	74	H	Peak	<± 3.04
	38.5	54		Average	<± 3.04
3.96857	54.62	74	V	Peak	<± 4.88
	30.32	54		Average	<± 4.88
4.2957	45.8	74	V	Peak	<± 4.88
4.40957	41.11	74	V	Peak	<± 4.88
5.60088	45.73	74	V	Peak	<± 4.88
4.78266	45.65	74	H	Peak	<± 4.88
7.05492	42.37	74	H	Peak	<± 4.88
7.93698	42.99	74	H	Peak	<± 4.88

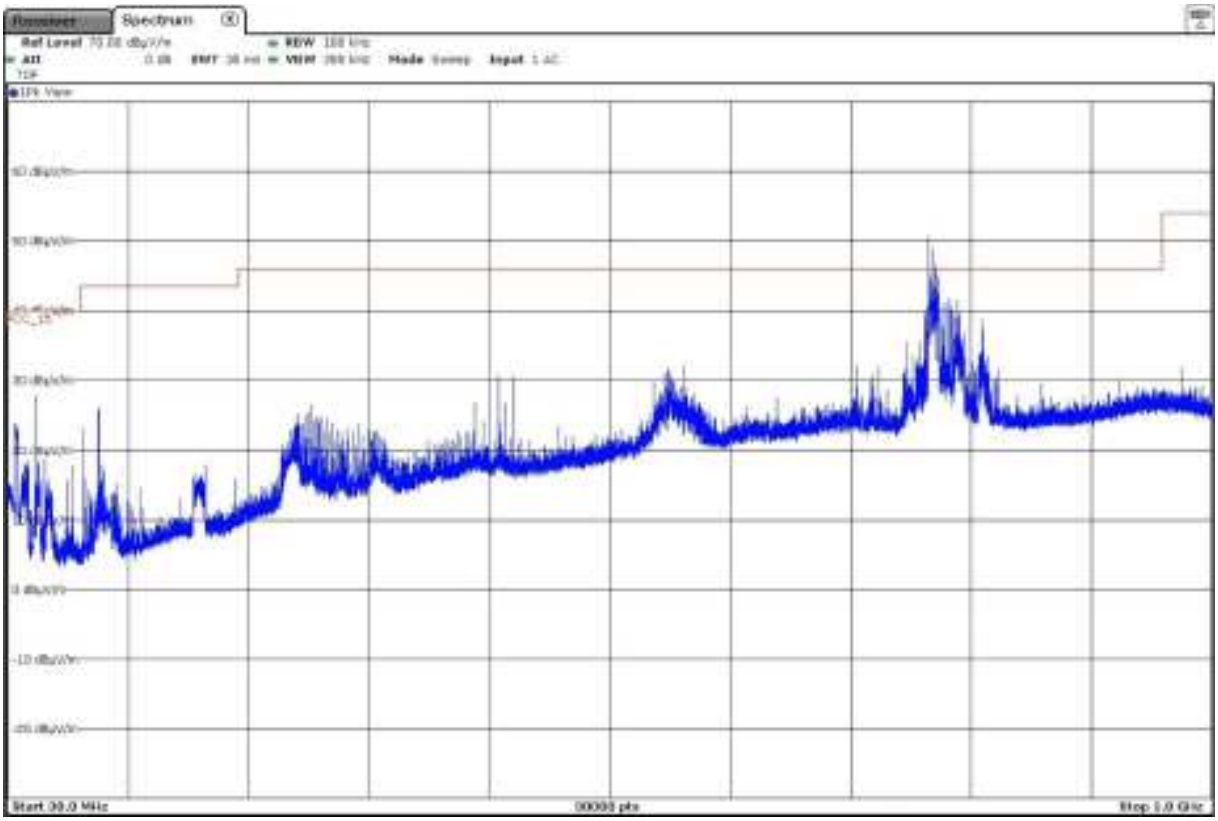
- HIGH CHANNEL (2480 MHz). Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
2.389033	59.94	74	V	Peak	<± 3.04
	41.36	54		Average	<± 3.04
1.785632	50.19	74	V	Peak	<± 3.04
2.3847	62.12	74	H	Peak	<± 3.04
	38.98	54		Average	<± 3.04
1.3623	50.66	74	H	Peak	<± 3.04
2.3754013	63.59	74	V	Peak	<± 3.04
	39.63	54		Average	<± 3.04
2.3691613	61.7	74	V	Peak	<± 3.04
	39.57	54		Average	<± 3.04
2.389636	62.69	74	H	Peak	<± 3.04
	39.7	54		Average	<± 3.04
2.3808067	61.84	74	H	Peak	<± 3.04
	40.04	54		Average	<± 3.04
2.3607213	59.63	74	H	Peak	<± 3.04
	39.97	54		Average	<± 3.04
3.9849	56.31	74	V	Peak	<± 4.88
	32.61	54		Average	<± 4.88
4.7955	49.39	74	V	Peak	<± 4.88
5.59117	54.08	74	V	Peak	<± 4.88
	29.16	54		Average	<± 4.88
4.15477	43.2	74	V	Peak	<± 4.88
3.99703	54.65	74	H	Peak	<± 4.88
	30.47	54		Average	<± 4.88
4.26677	41.34	74	H	Peak	<± 4.88
5.55742	46.45	74	H	Peak	<± 4.88
7.0551	43.16	74	H	Peak	<± 4.88
7.93698	44.22	74	H	Peak	<± 4.88
8.81896	42.25	74	H	Peak	<± 4.88

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

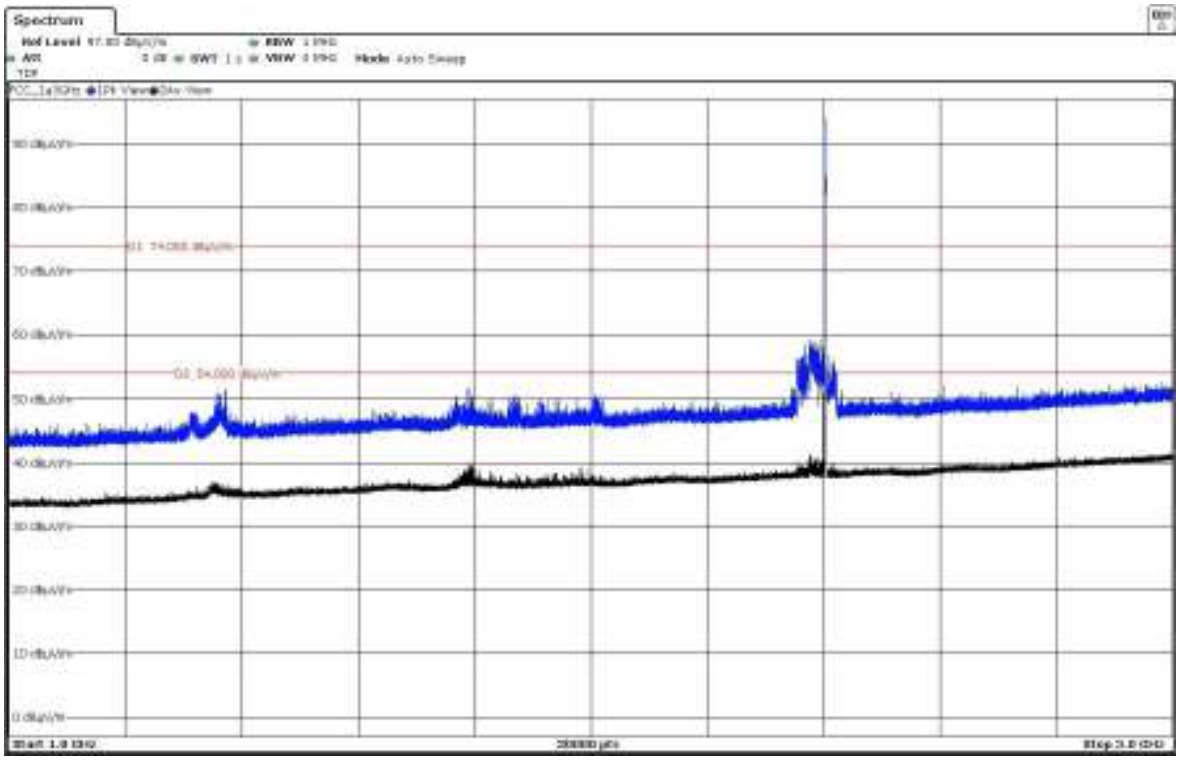
This plot is valid for all the modulation modes and the Low, Middle and High Channels.



- **GFSK (DH5):**

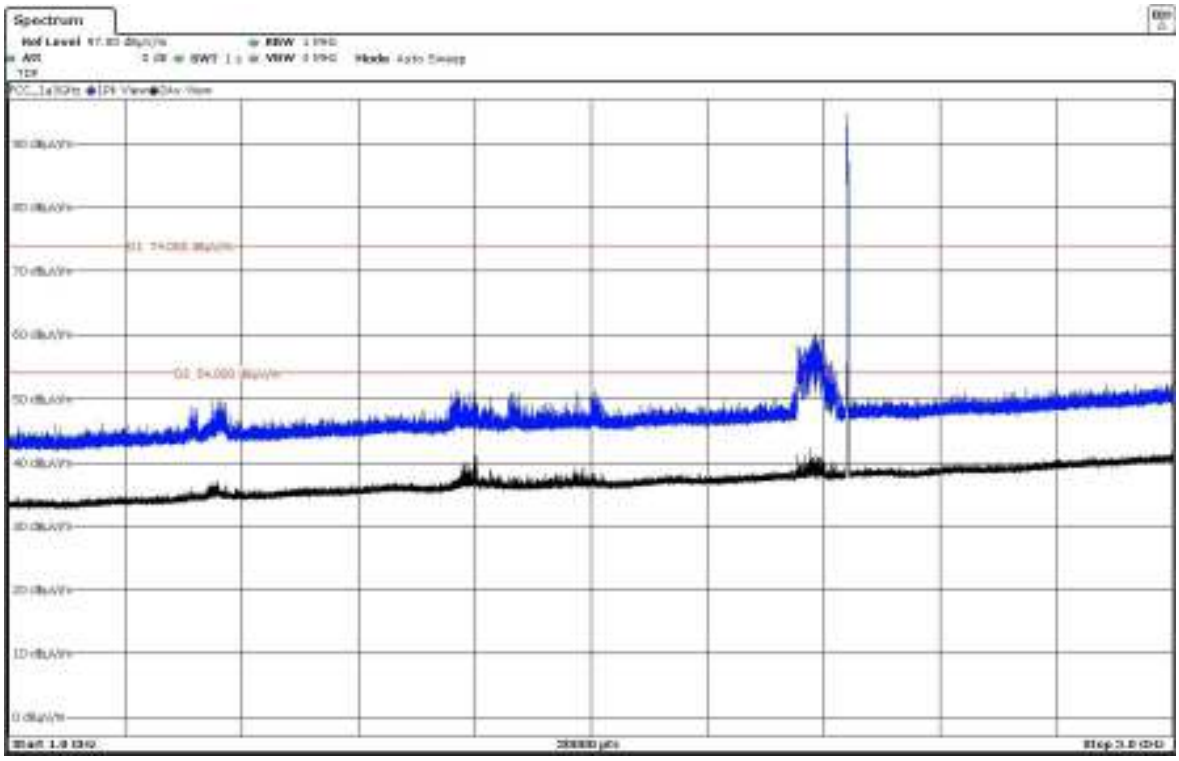
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel (2402 MHz):



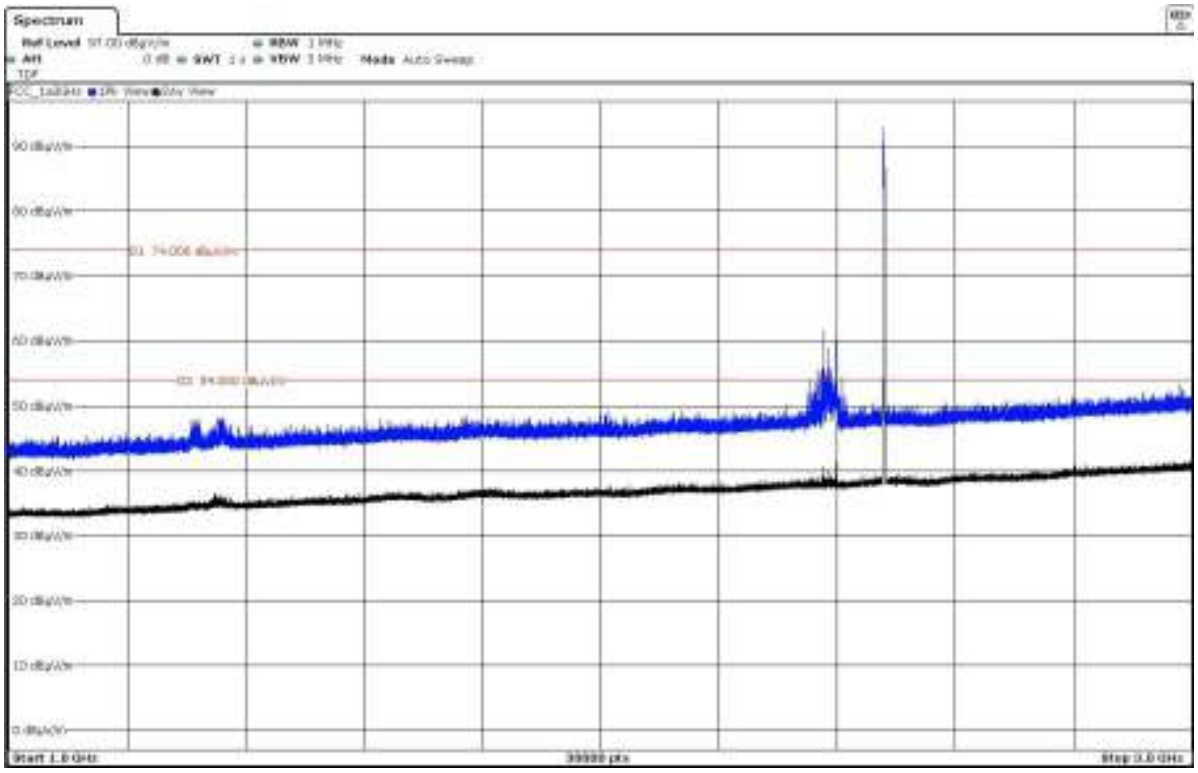
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

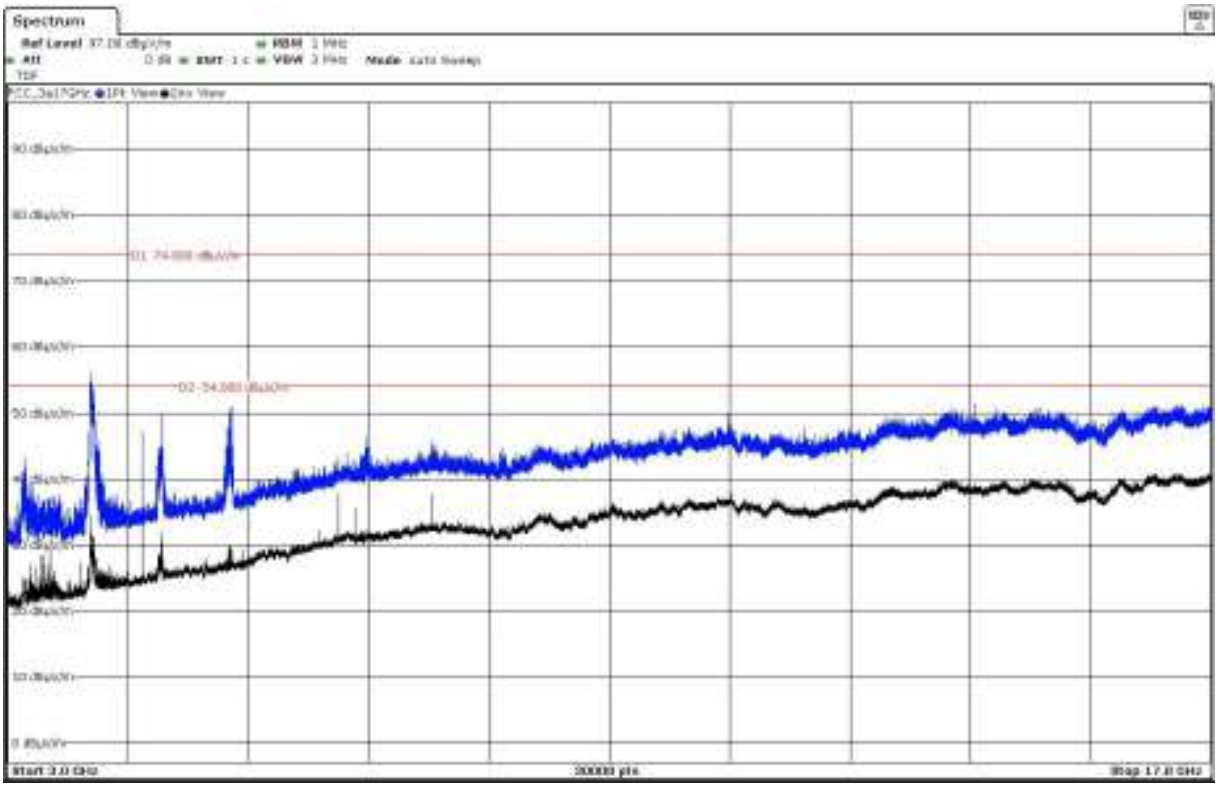
- High Channel (2480 MHz):



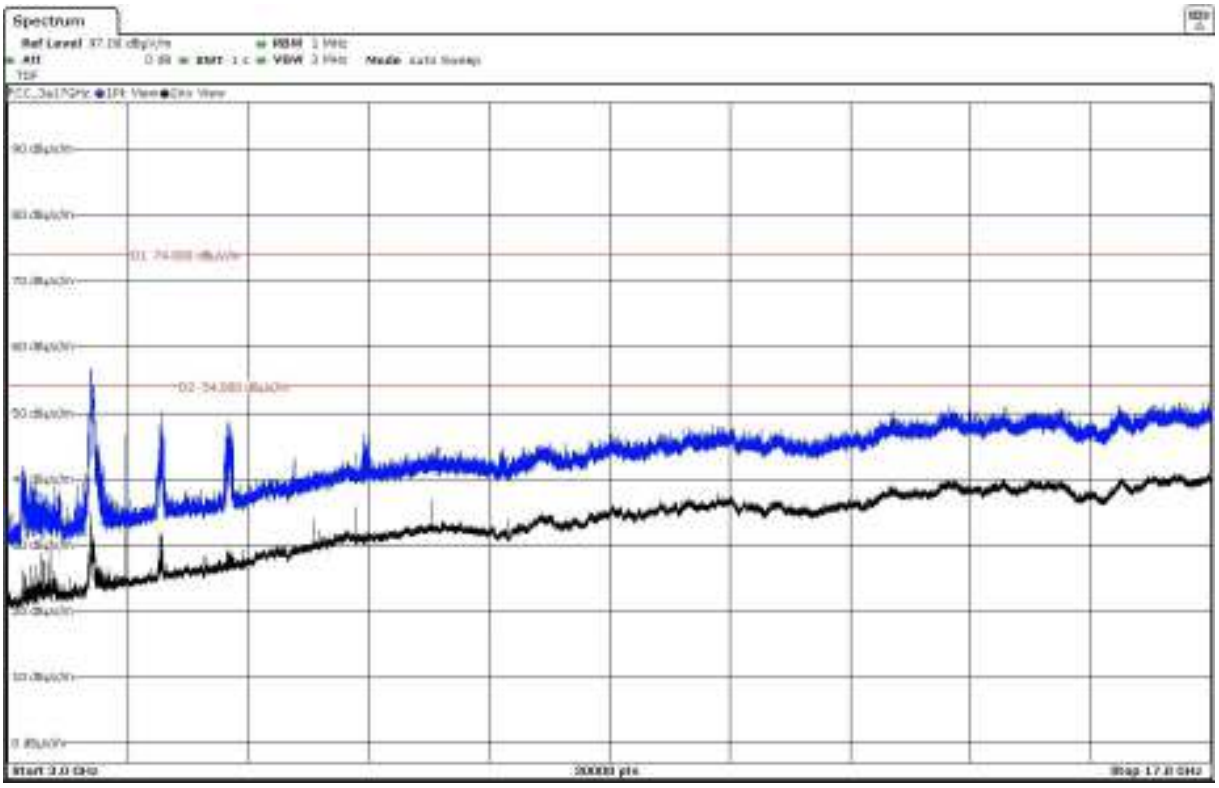
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

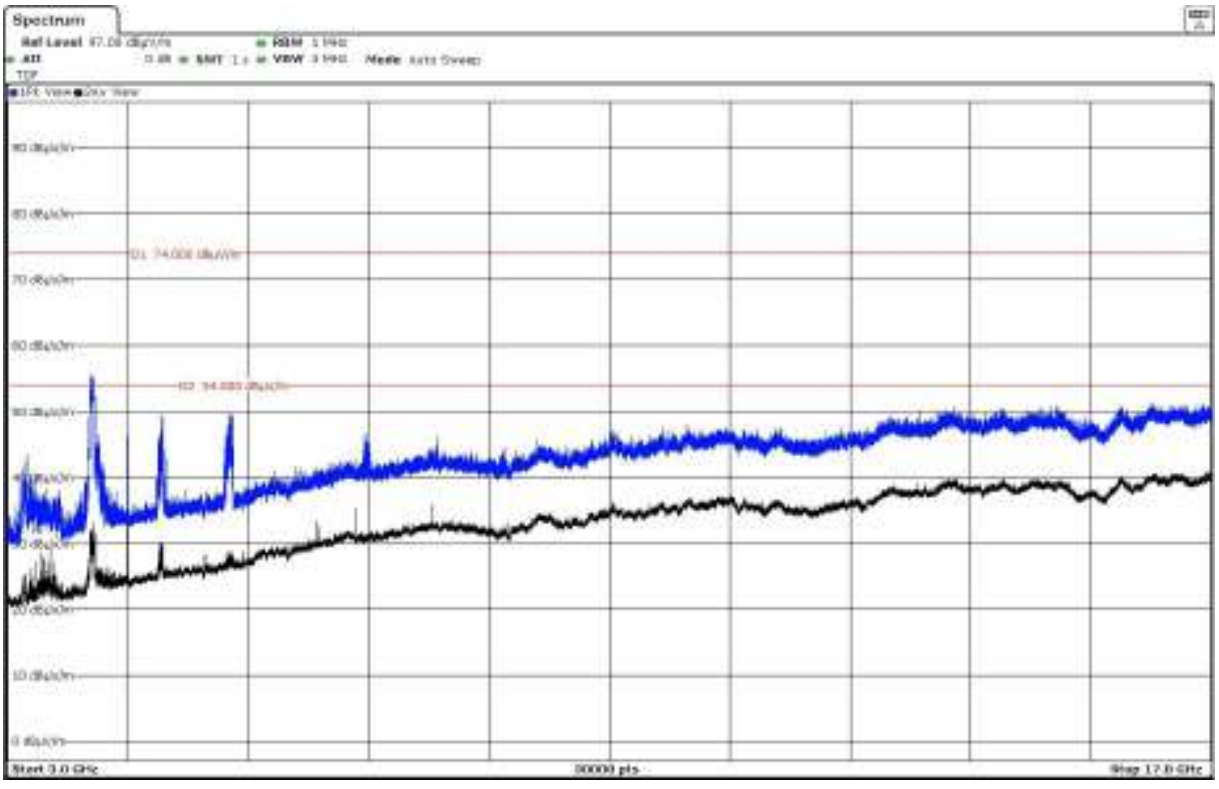
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

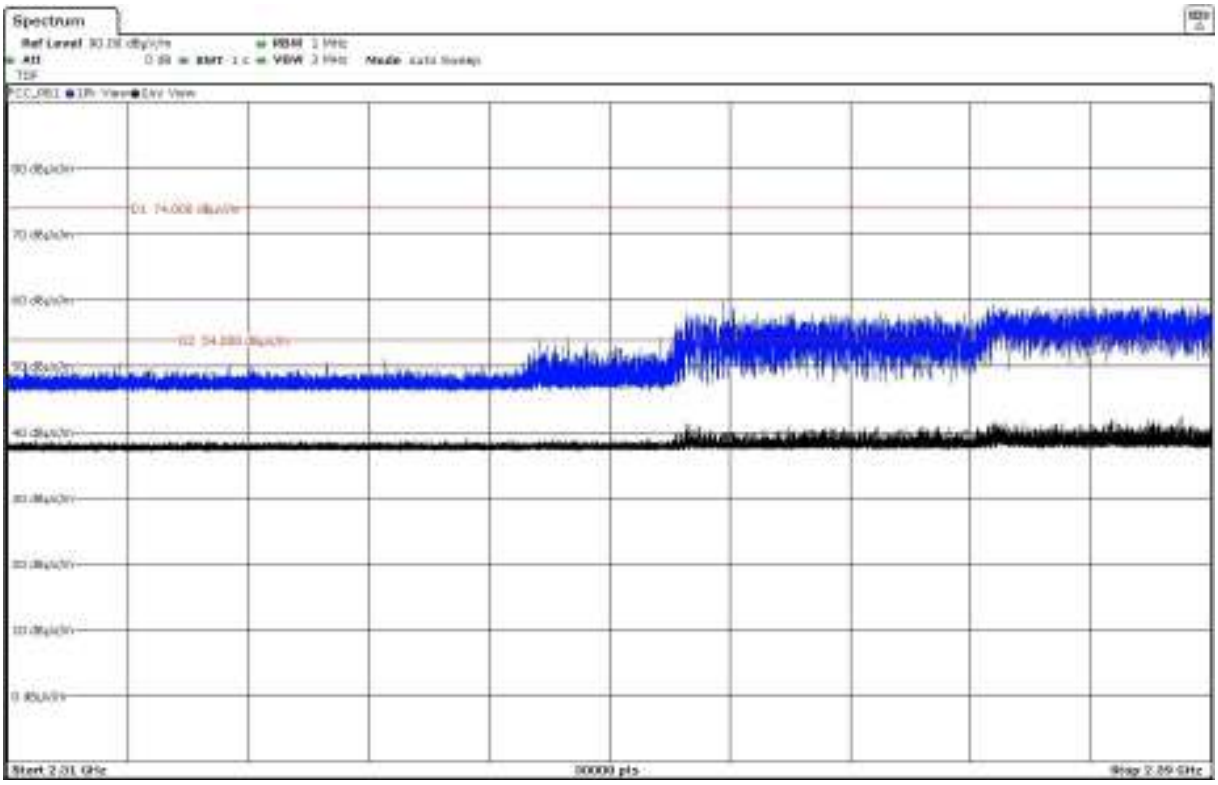


- High Channel (2480 MHz):

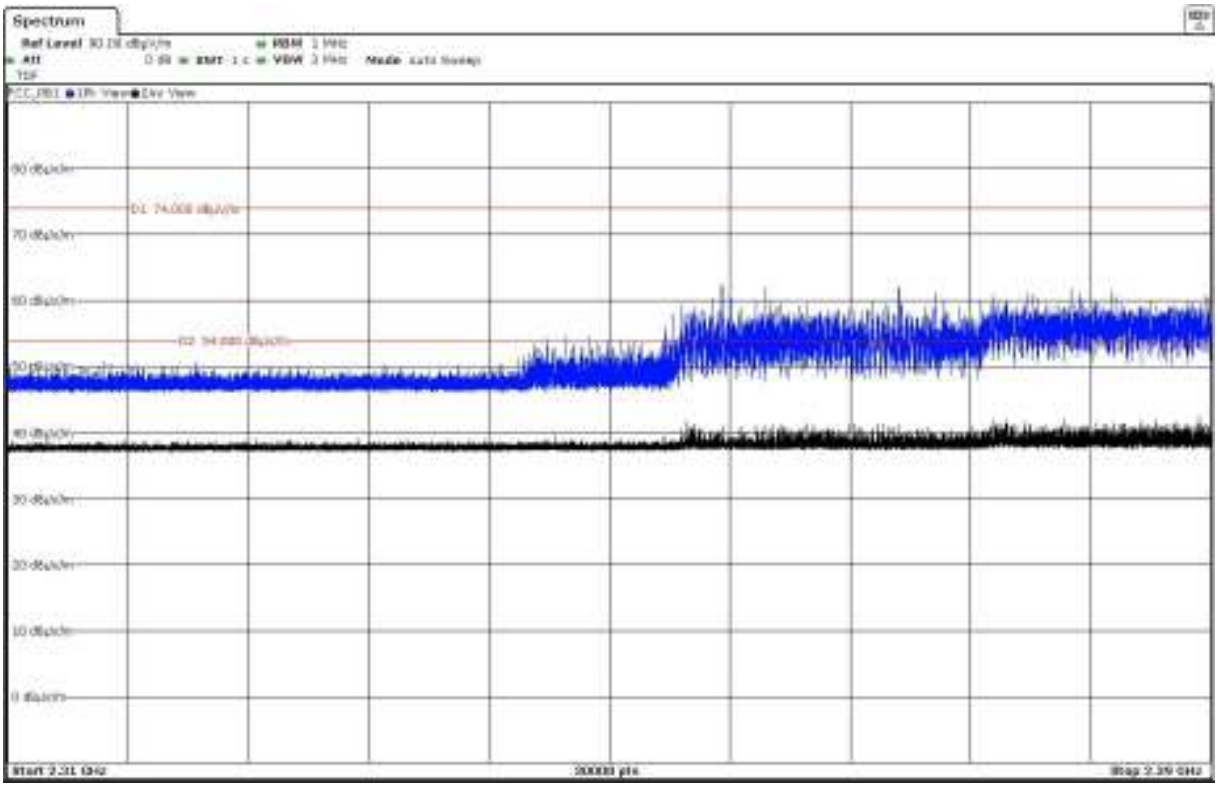


FREQUENCY RANGE 2.31-2.39 GHz

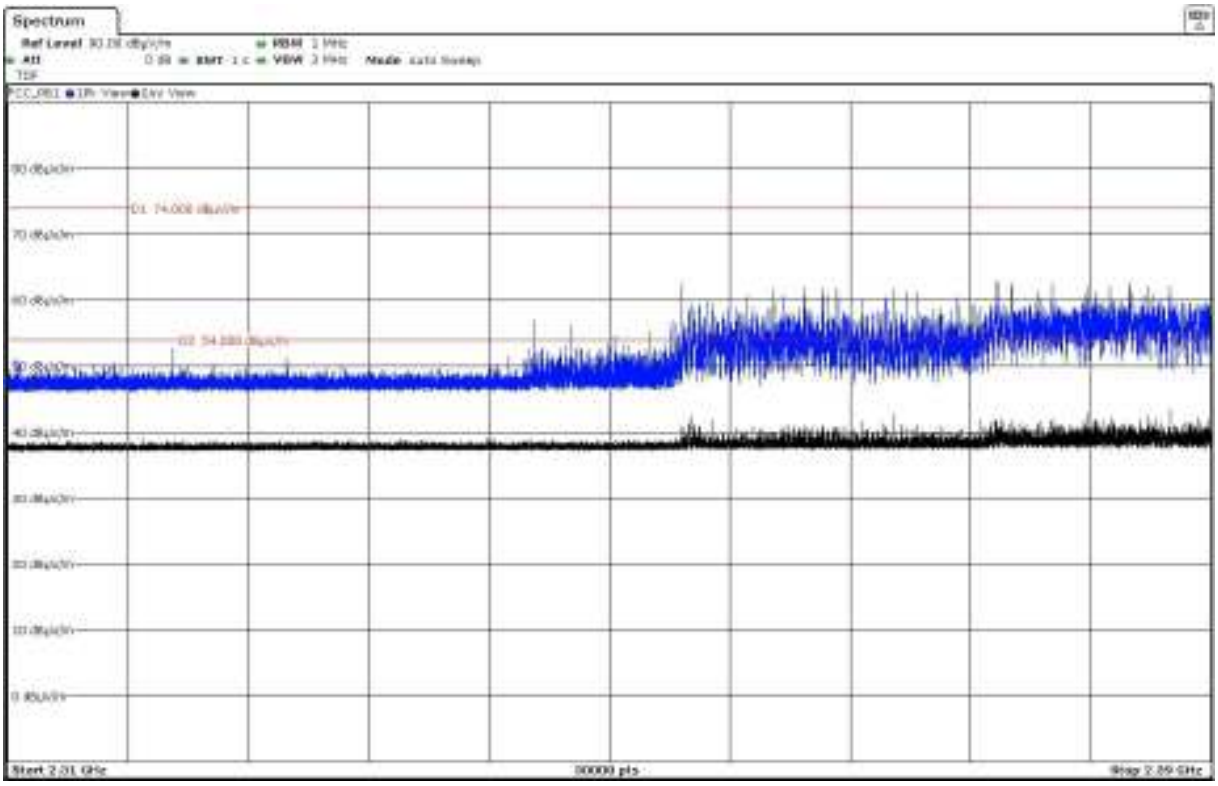
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

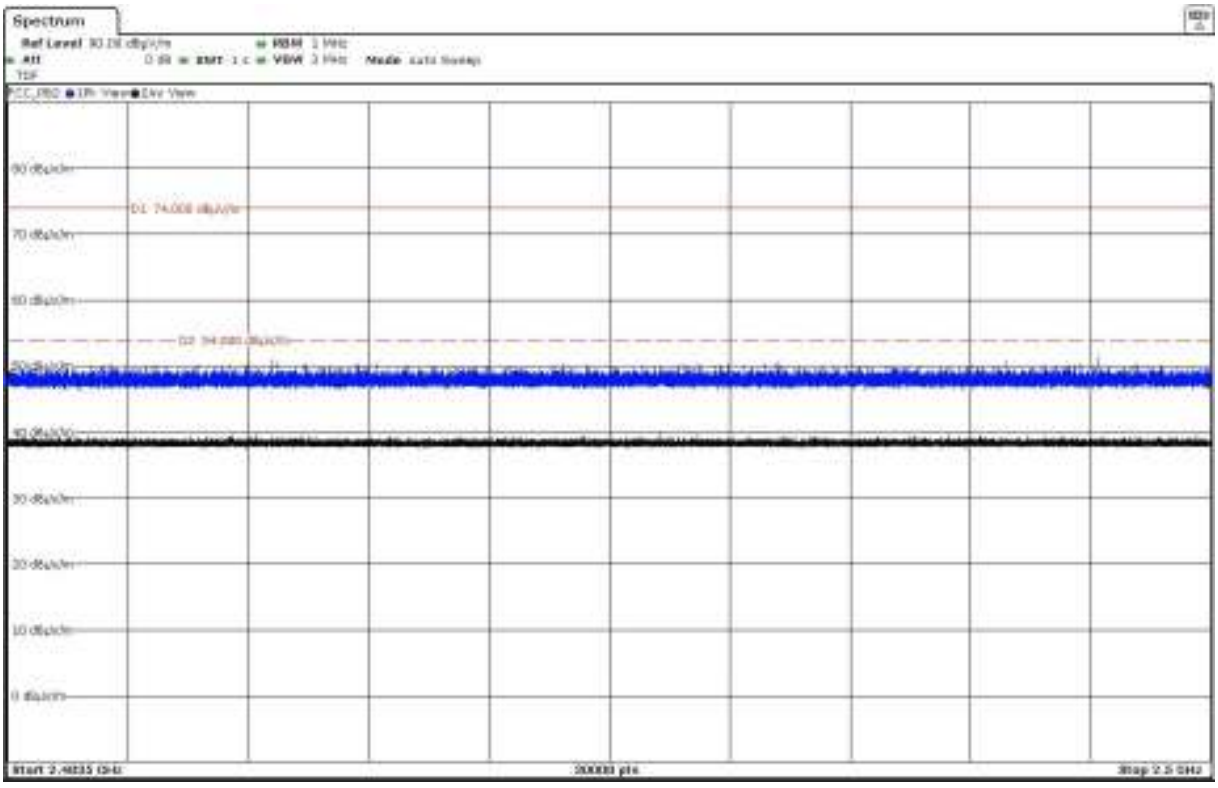


- High Channel (2480 MHz):

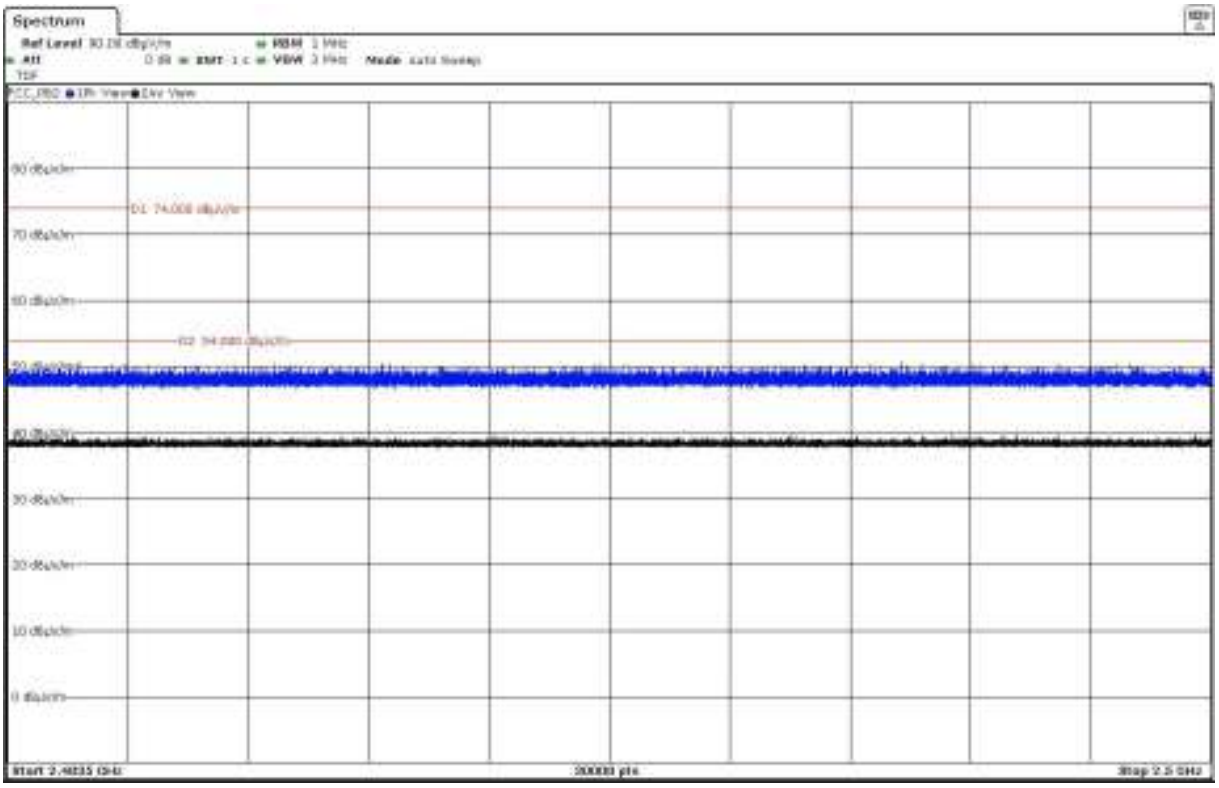


FREQUENCY RANGE 2.4835-2.5 GHz:

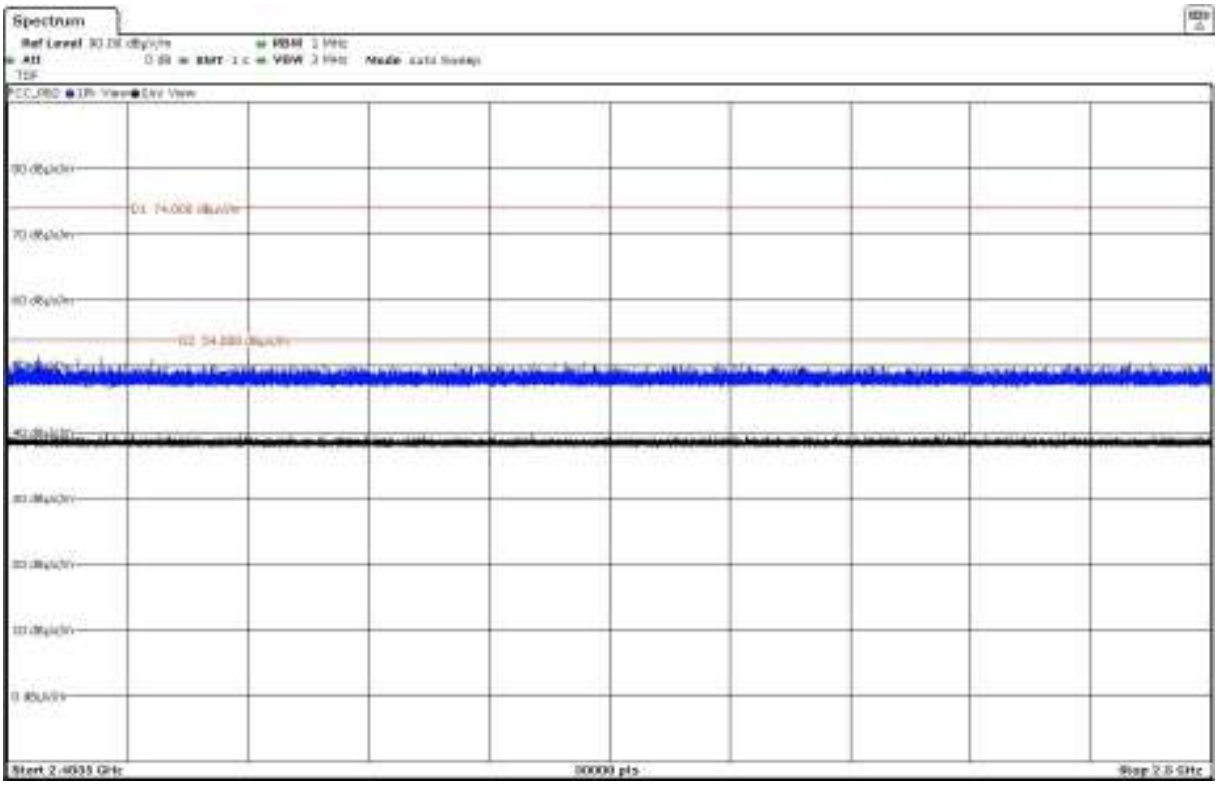
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):



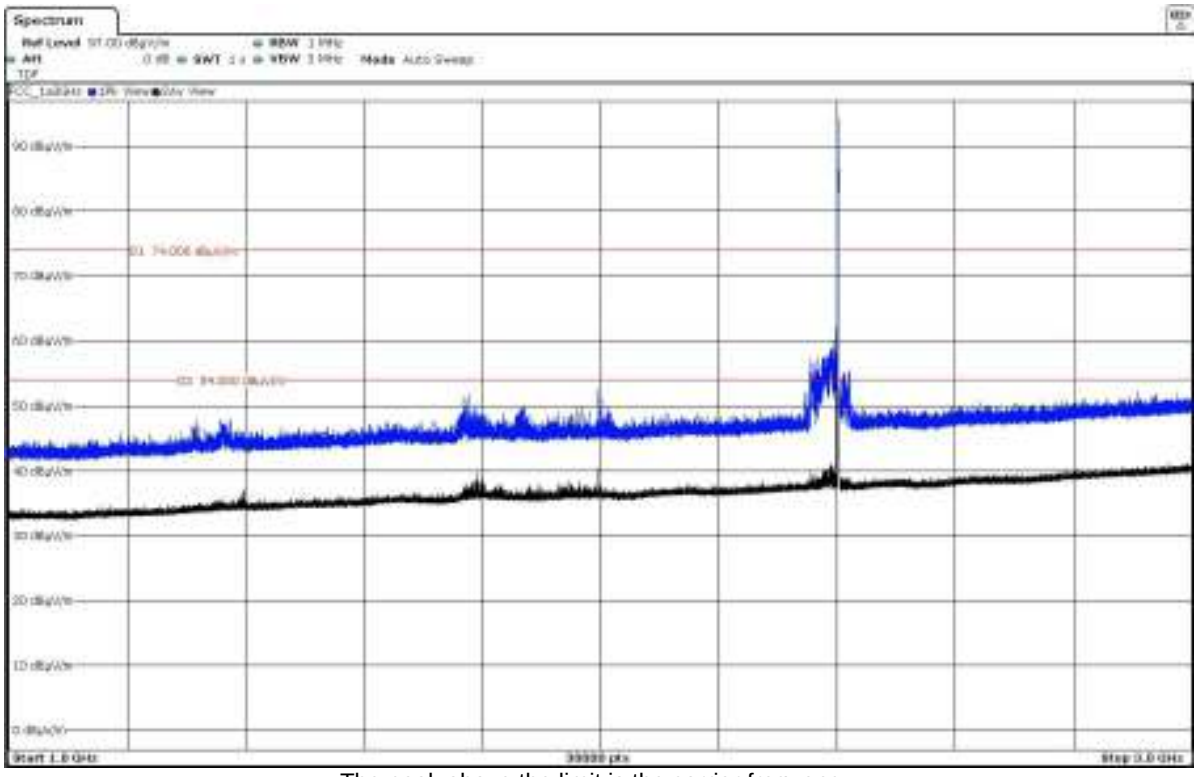
- High Channel (2480 MHz):



- **Pi/4-DQPSK (2DH5):**

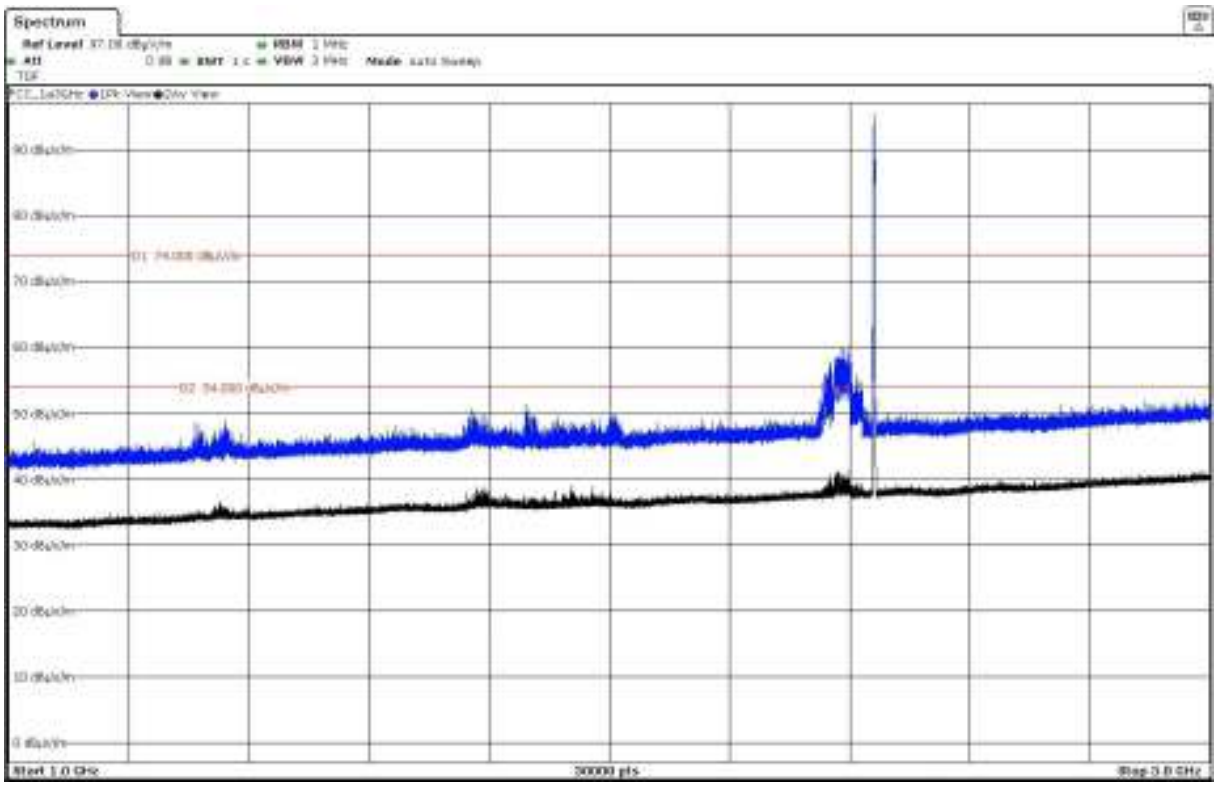
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel (2402 MHz):



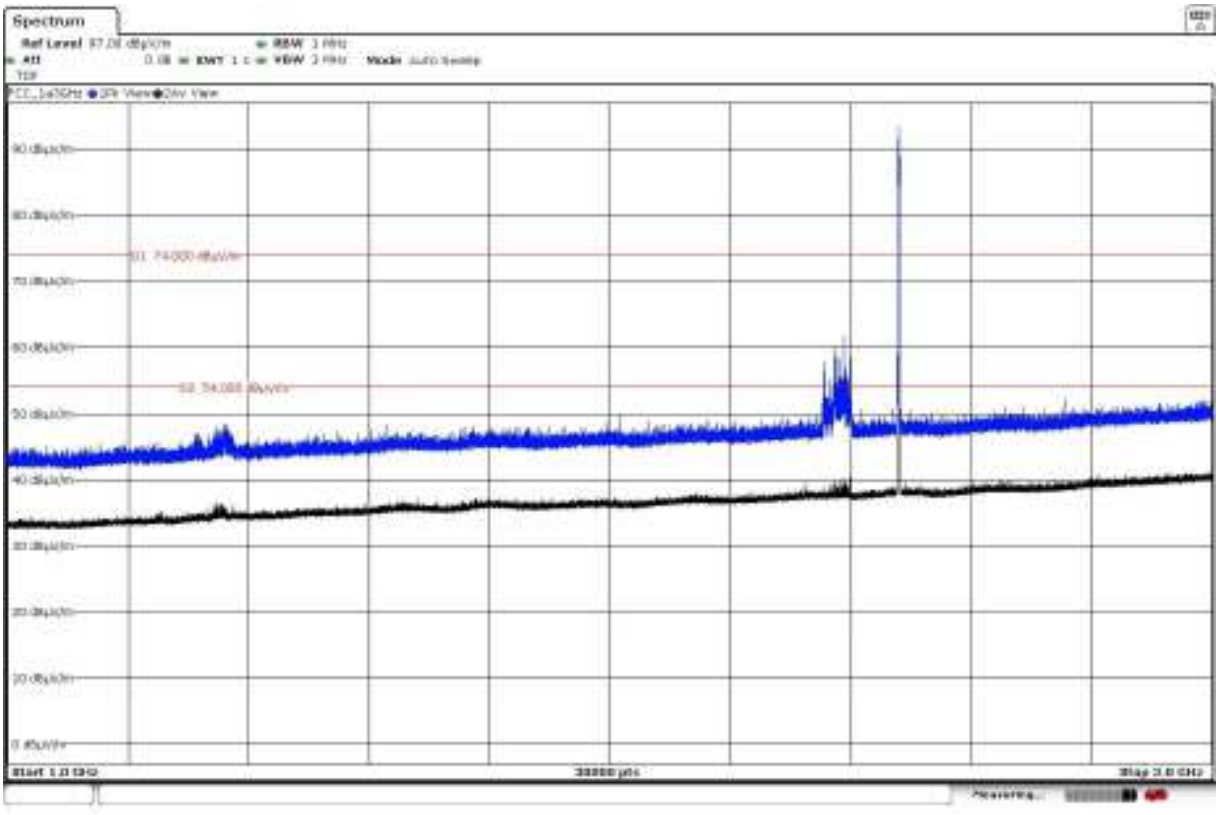
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

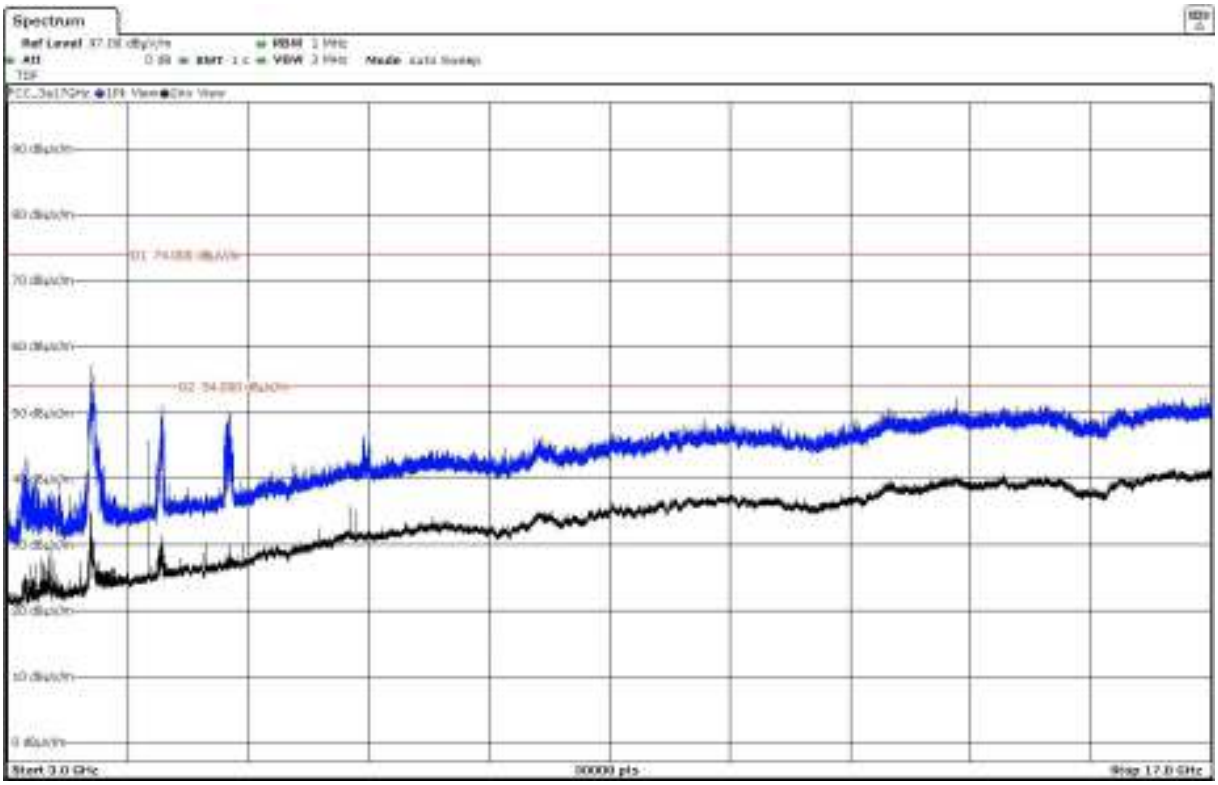
- High Channel (2480 MHz):



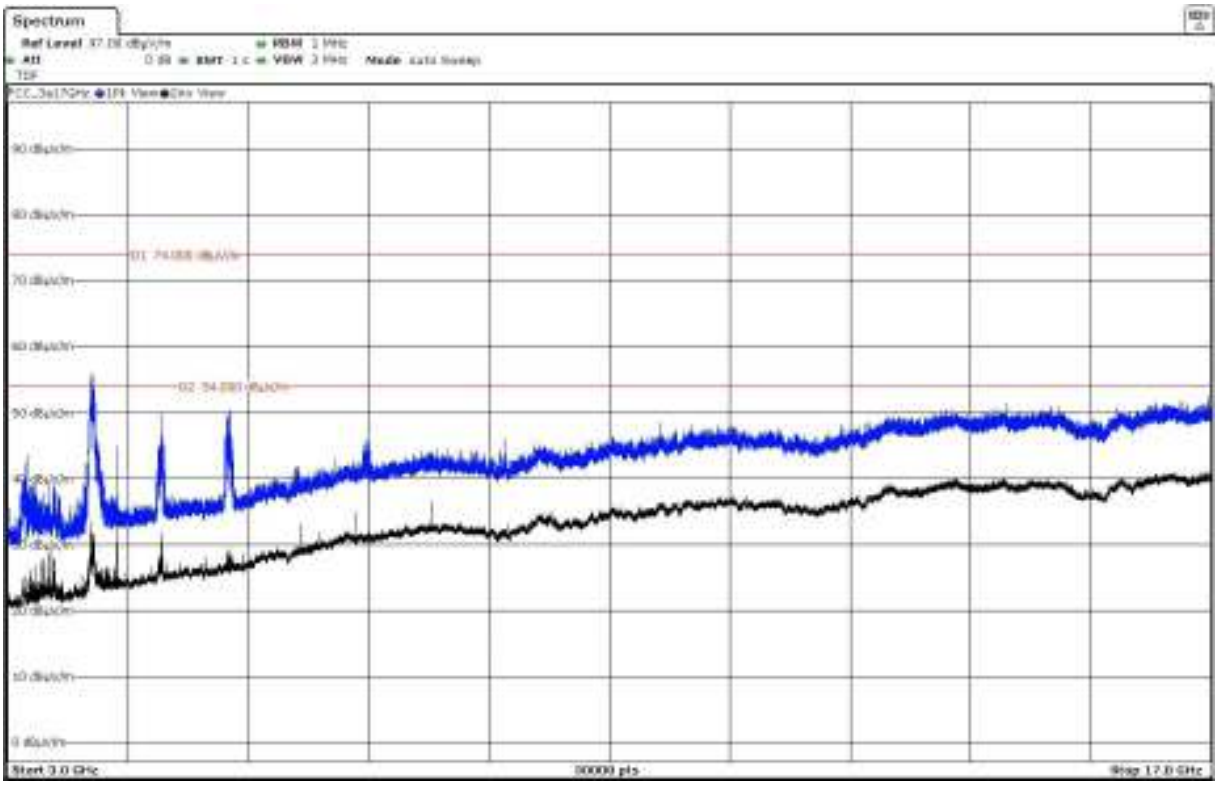
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

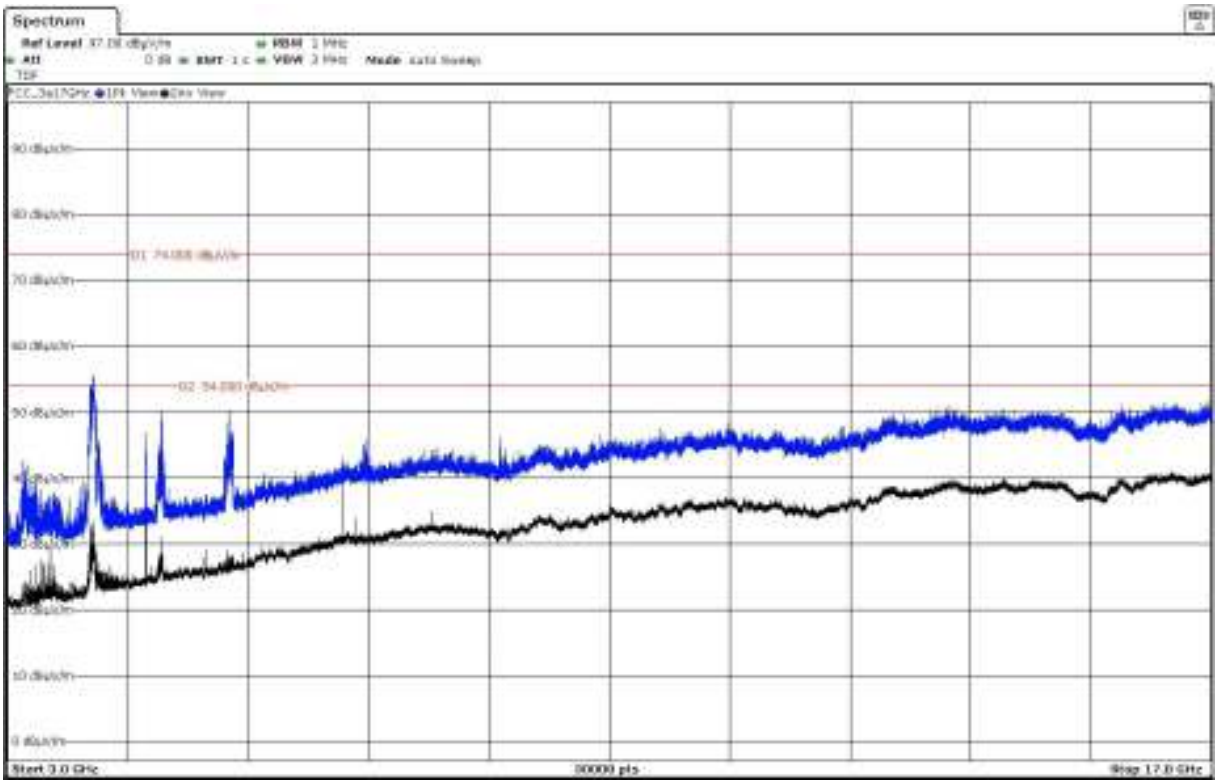
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

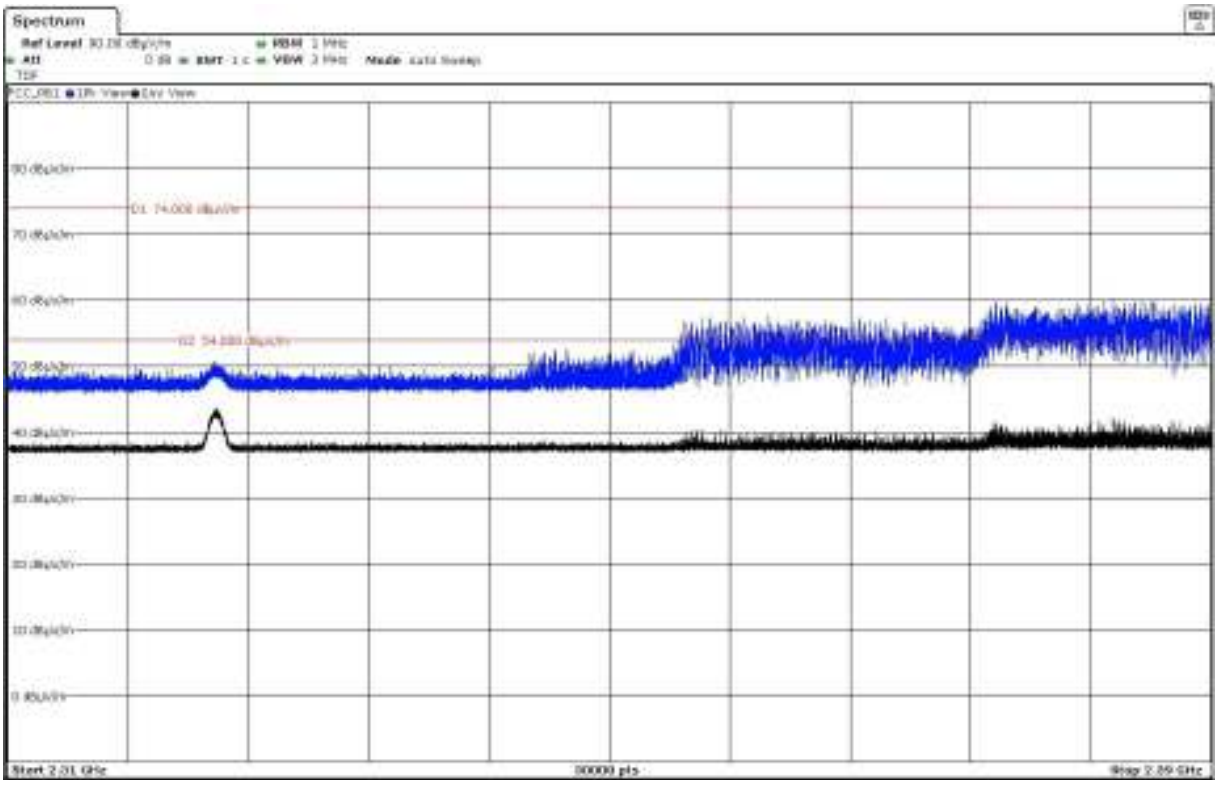


- High Channel (2480 MHz):

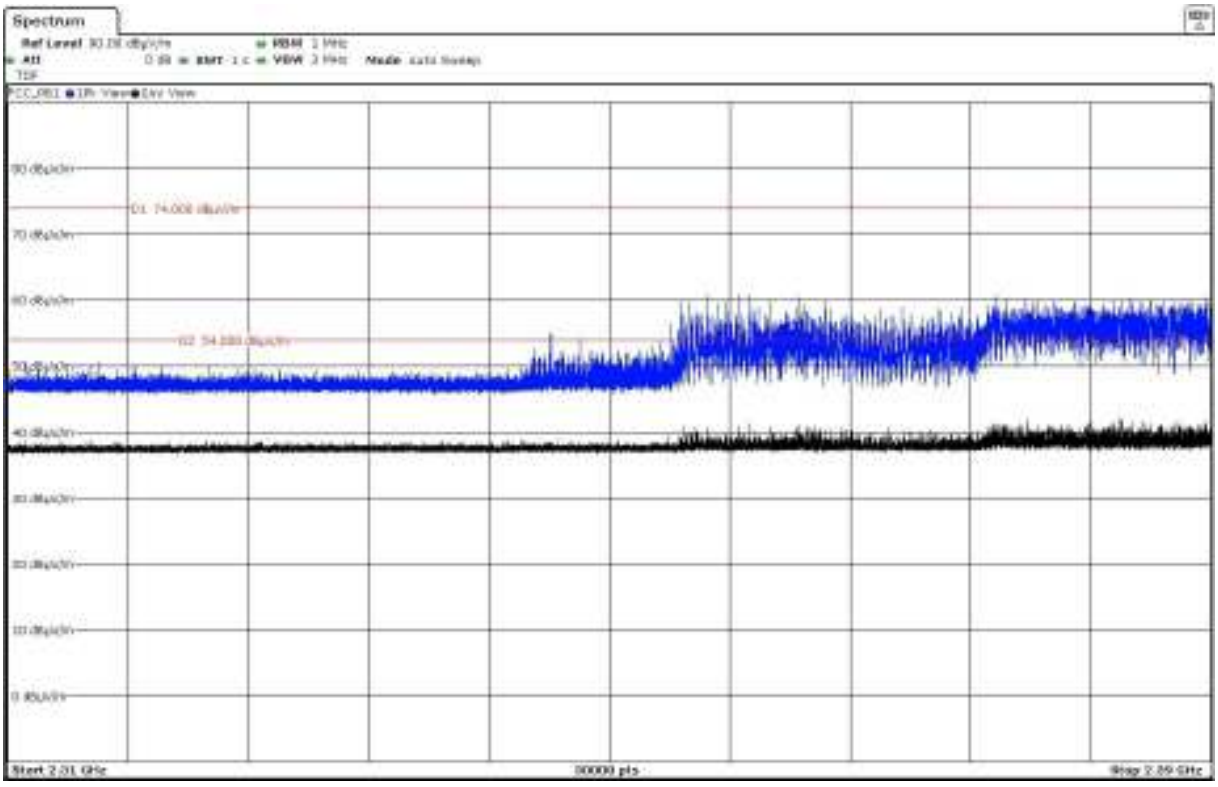


FREQUENCY RANGE 2.31-2.39 GHz

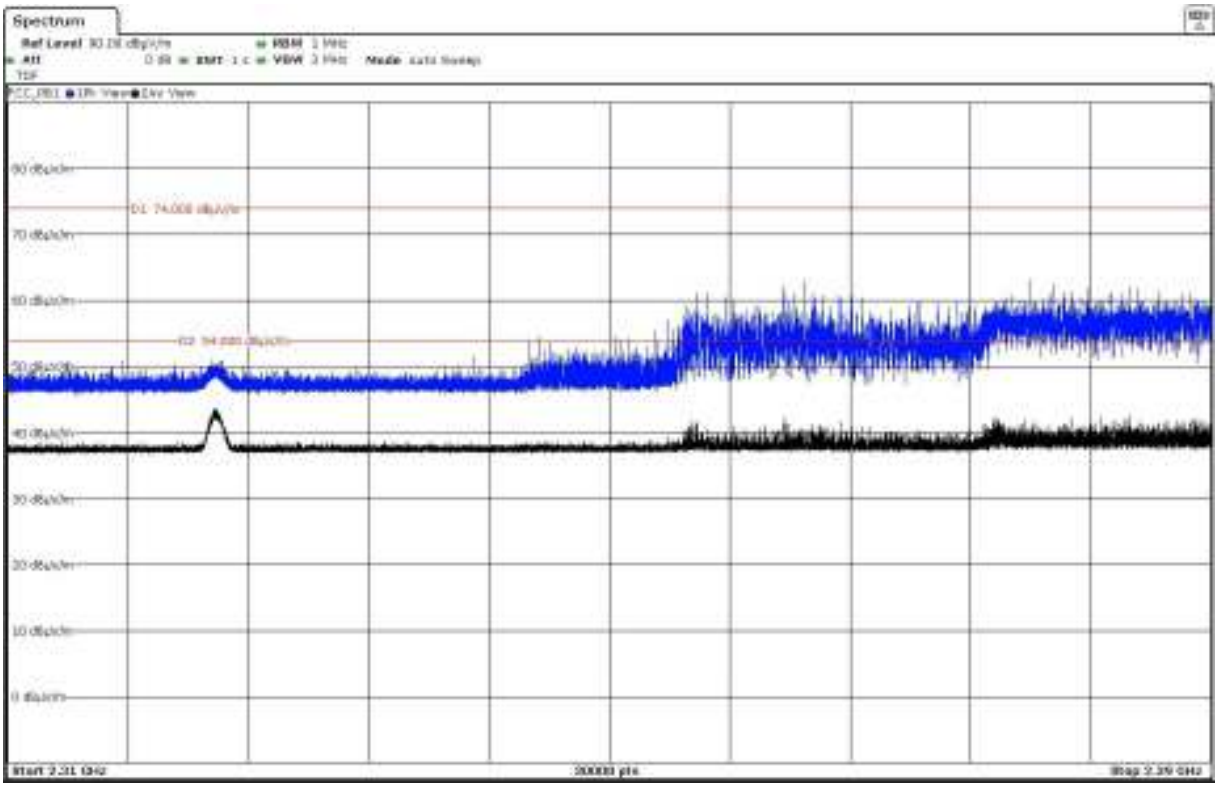
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

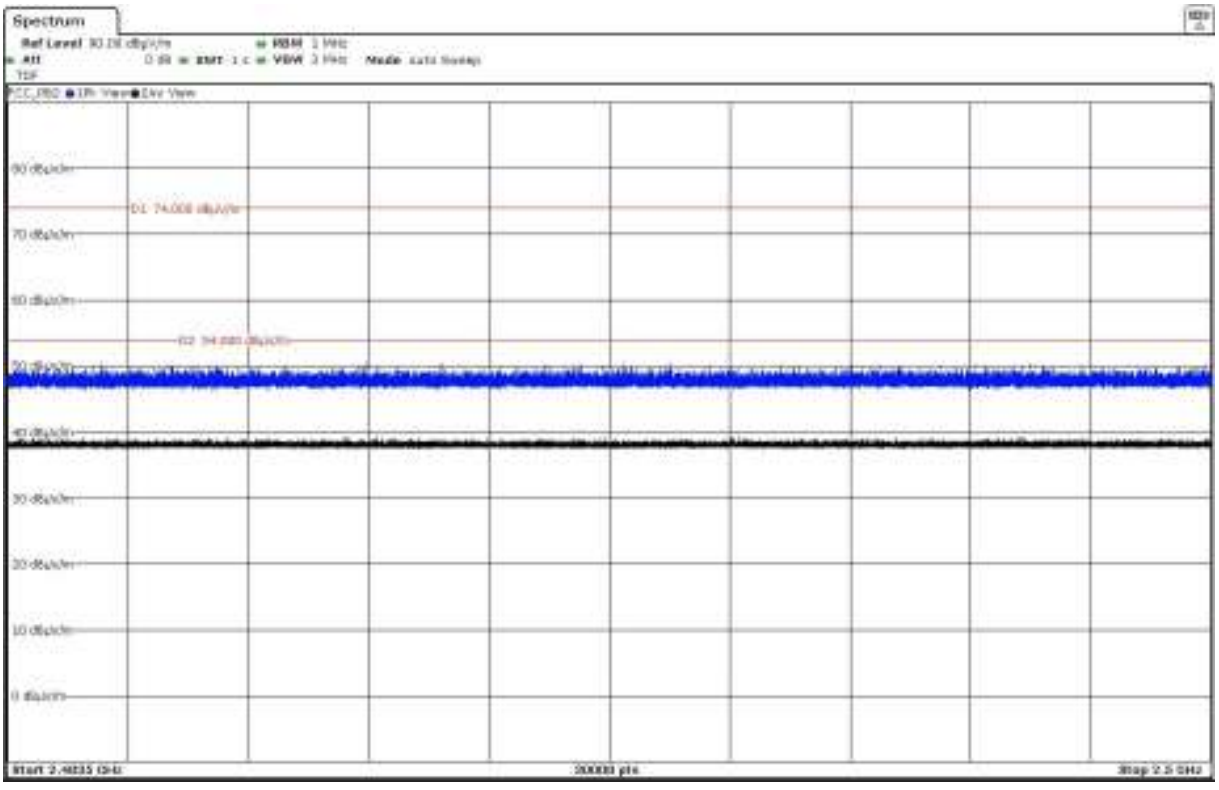


- High Channel (2480 MHz):

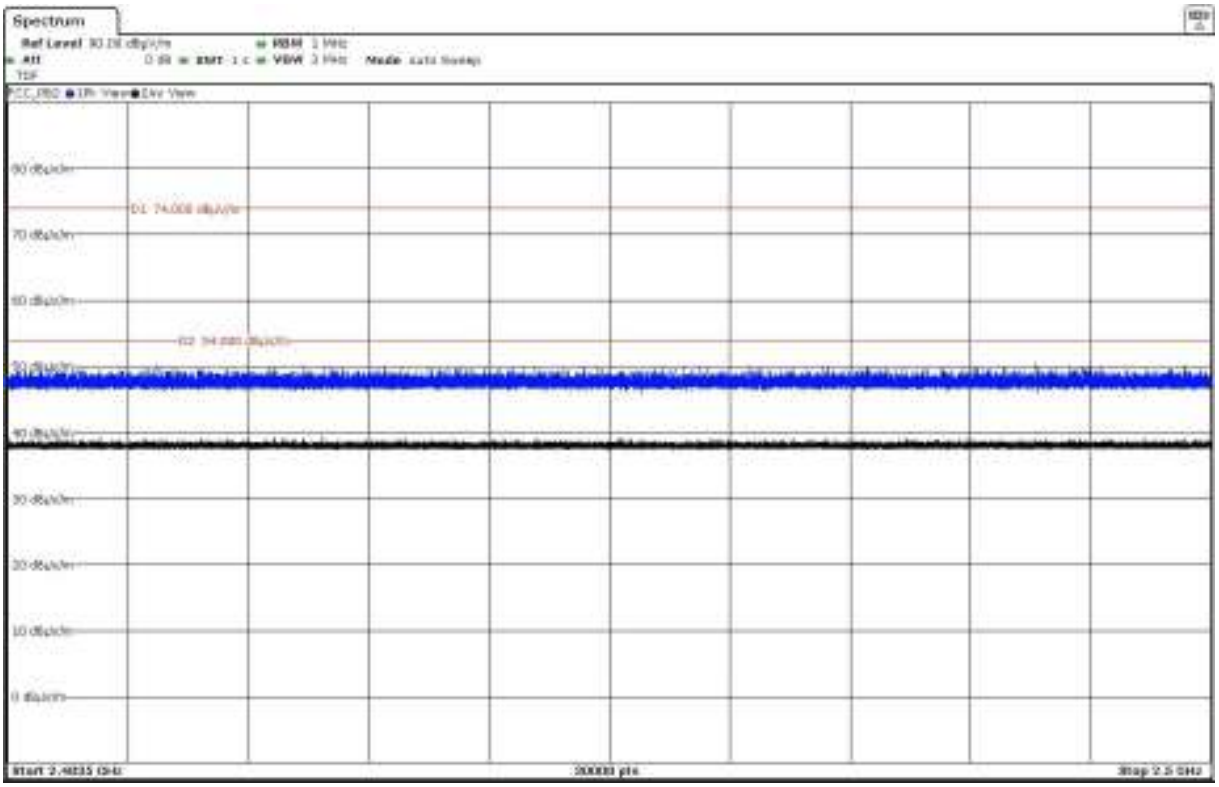


FREQUENCY RANGE 2.4835-2.5 GHz:

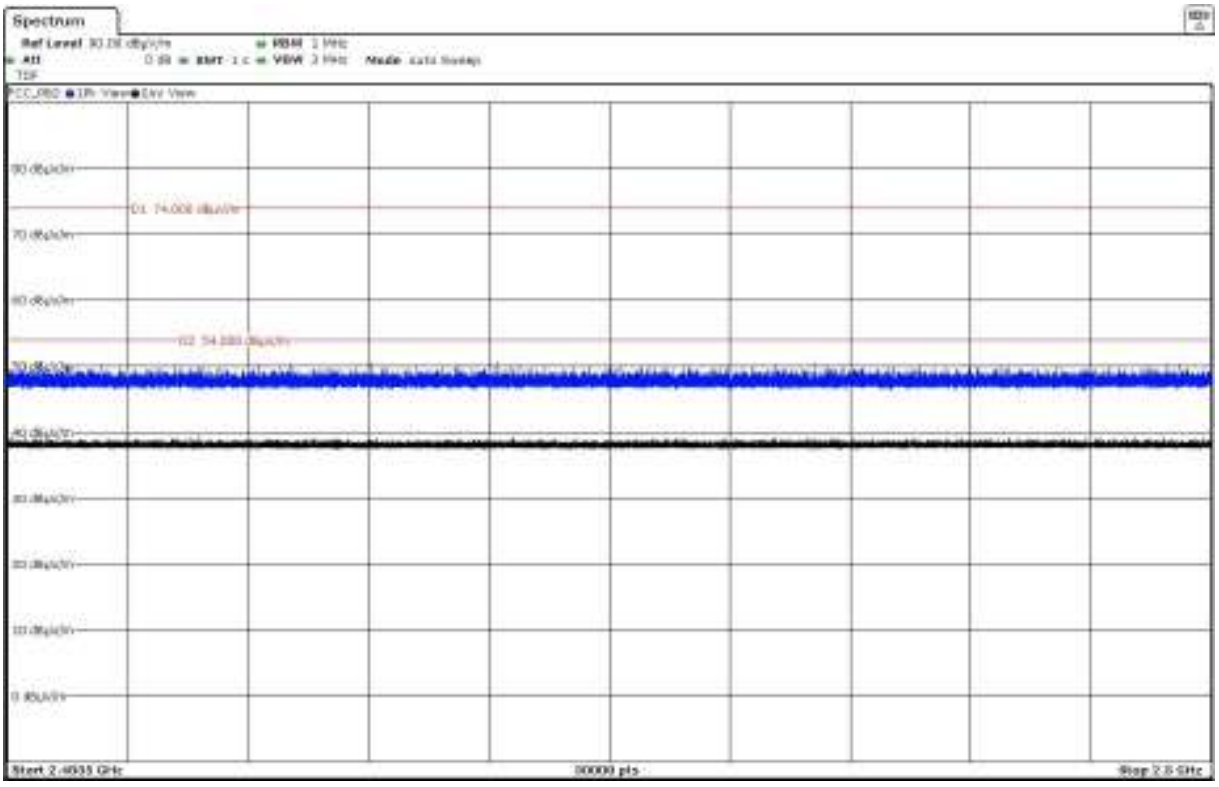
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):



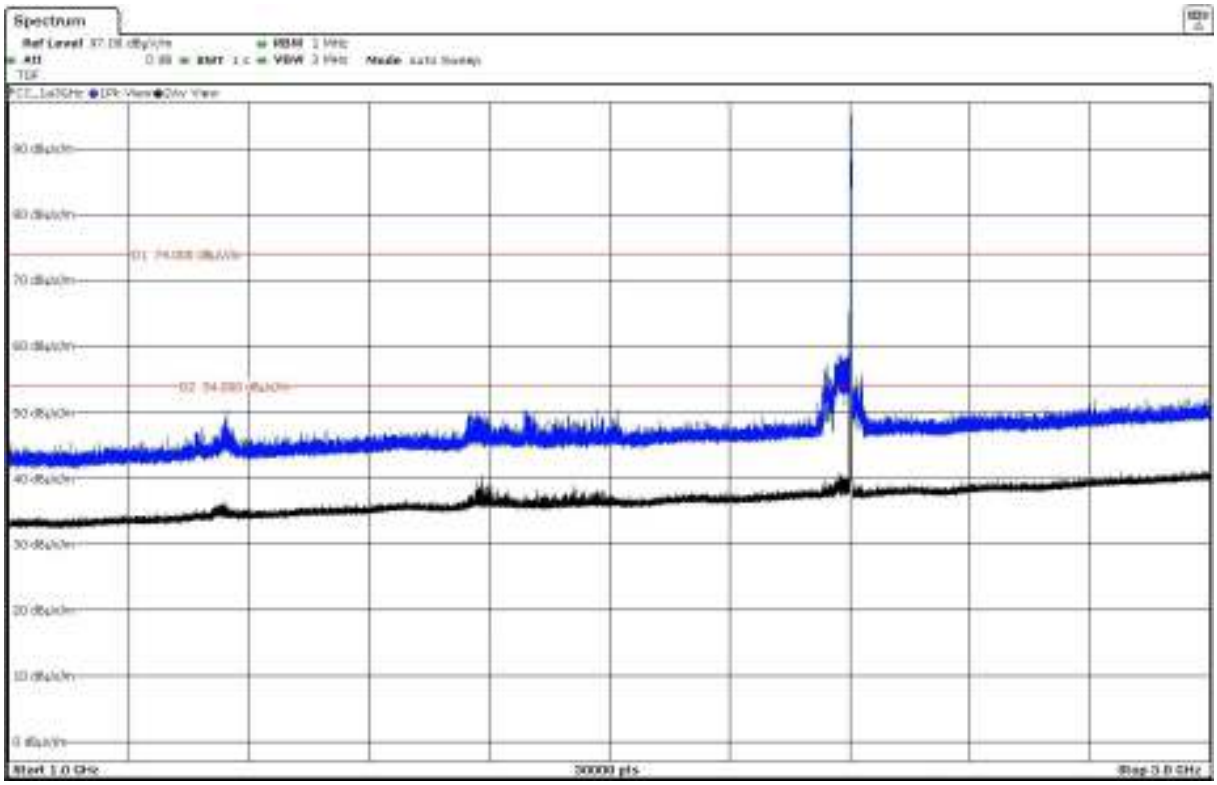
- High Channel (2480 MHz):



- **8-DPSK (3DH5):**

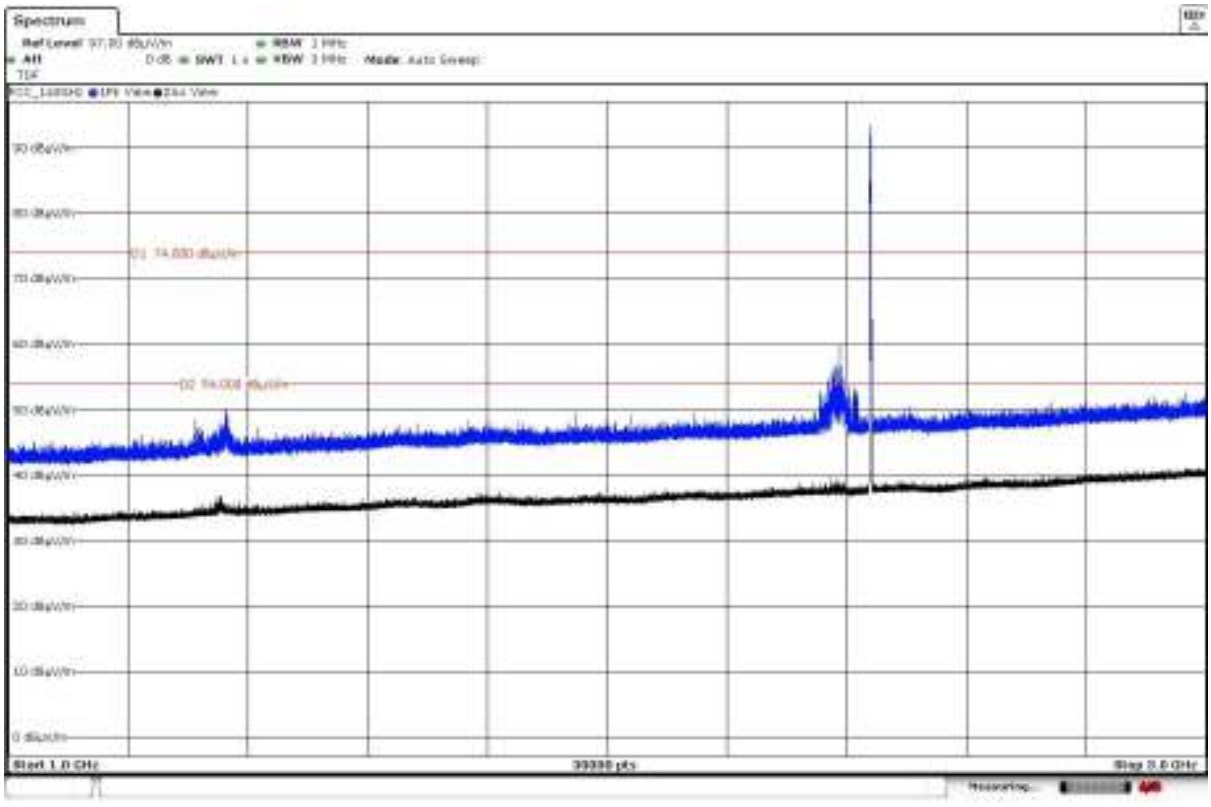
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel (2402 MHz):



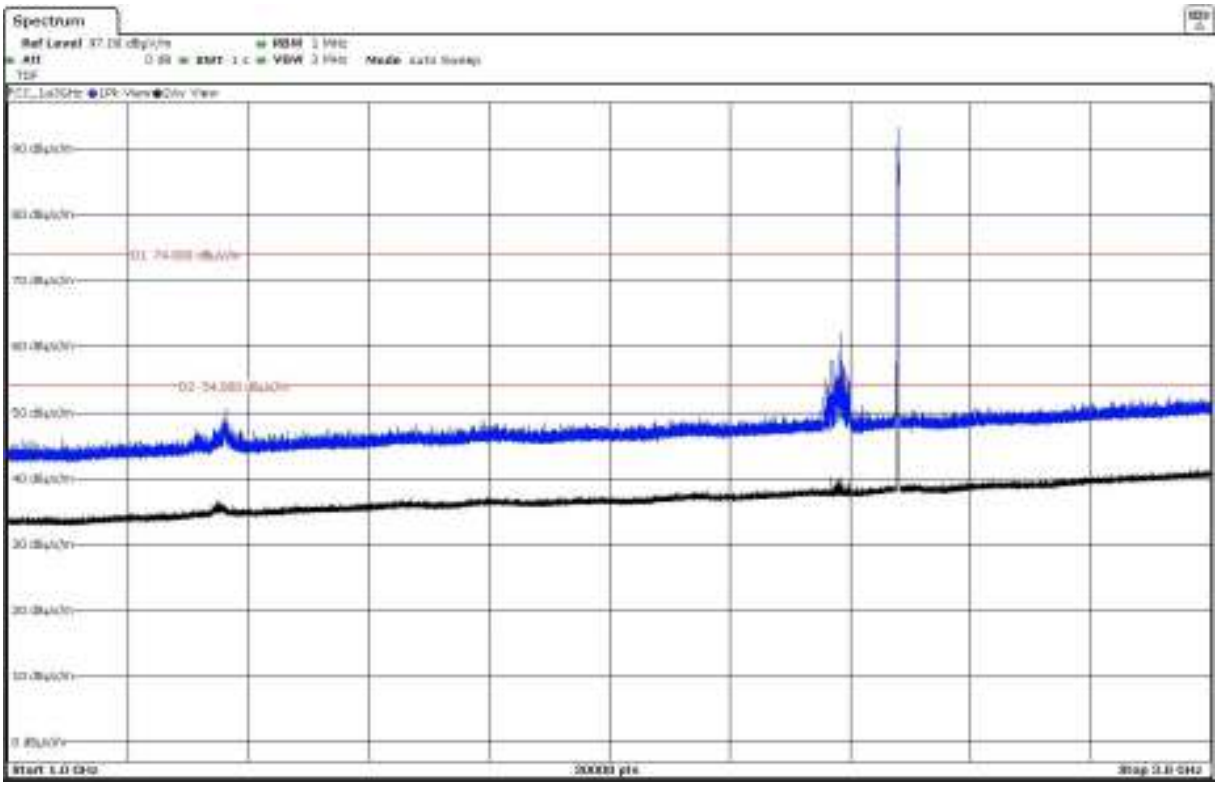
The peak above the limit is the carrier frequency.

- Middle Channel (2441 MHz):



The peak above the limit is the carrier frequency.

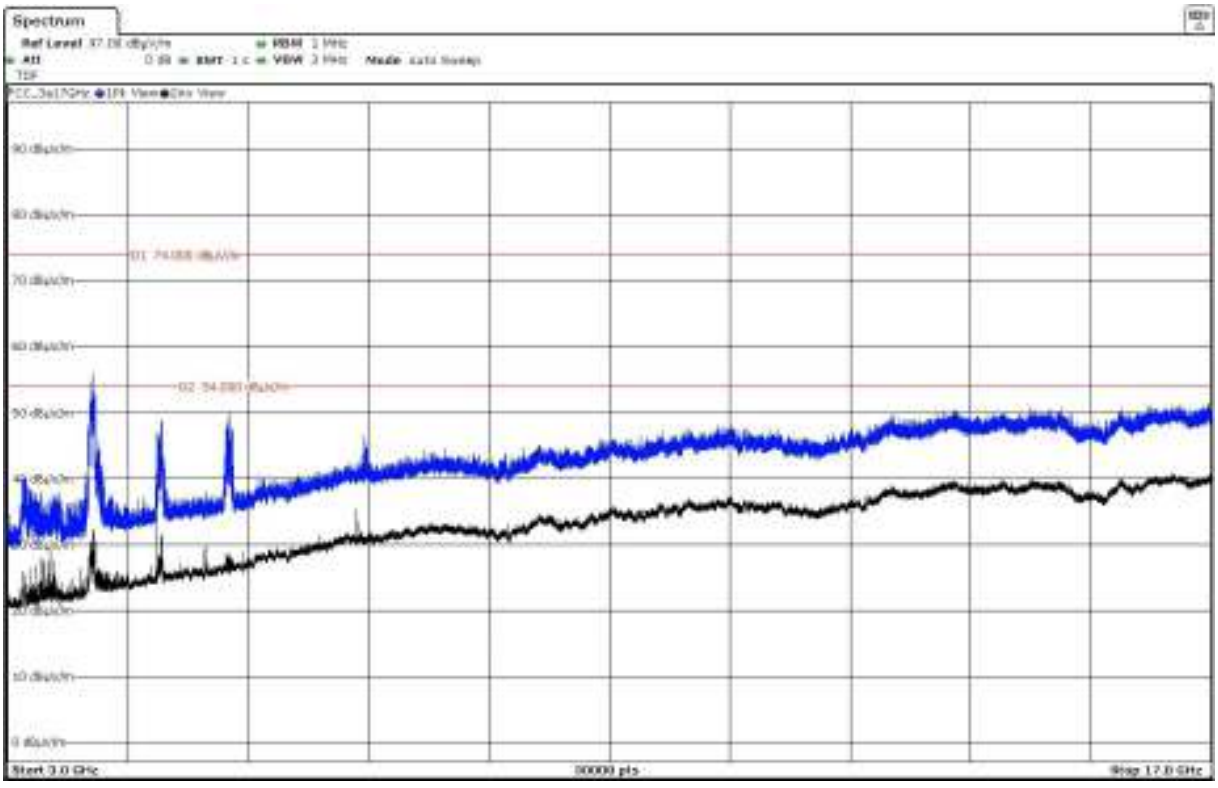
- High Channel (2480 MHz):



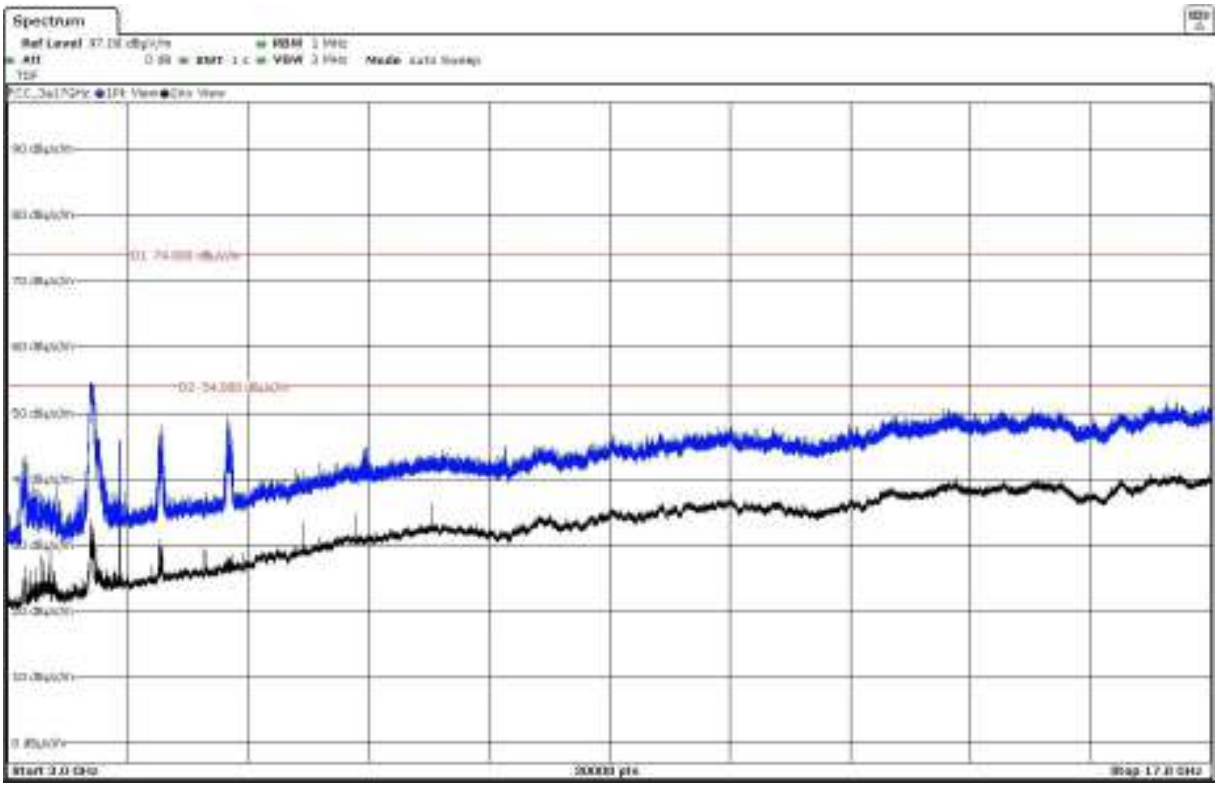
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

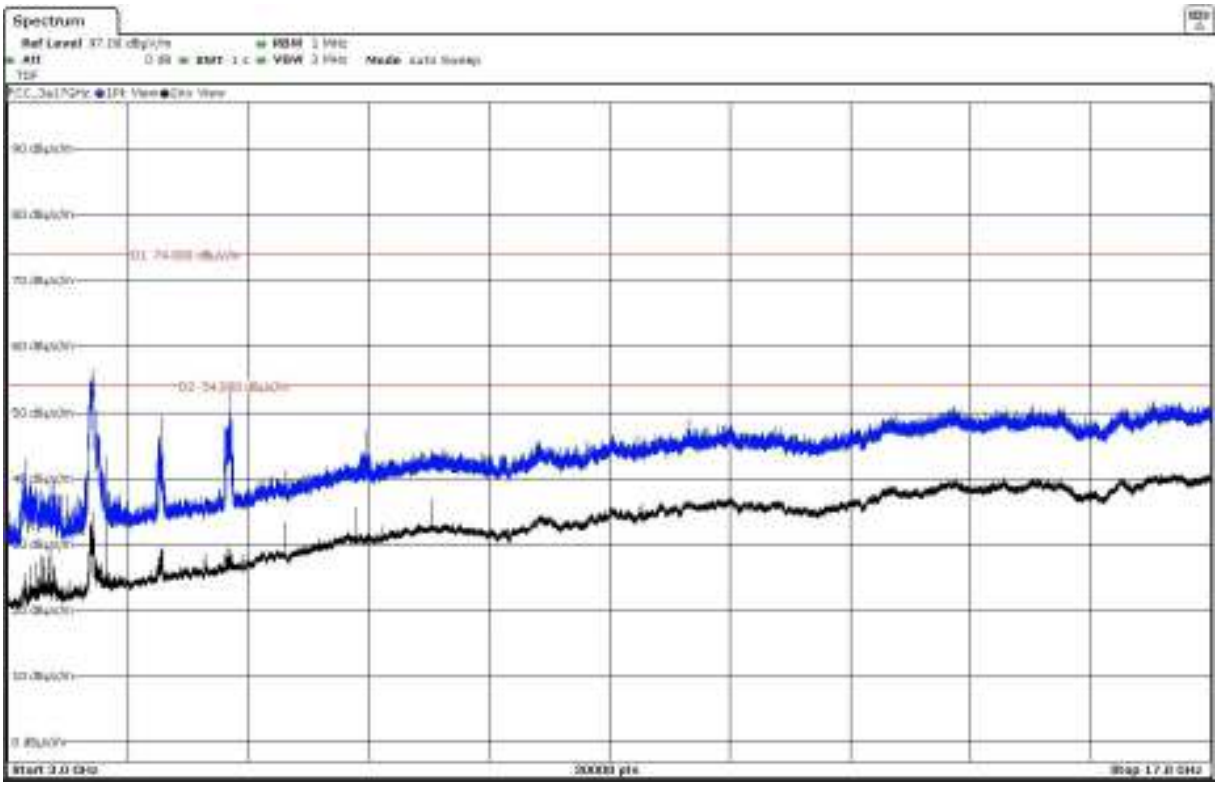
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

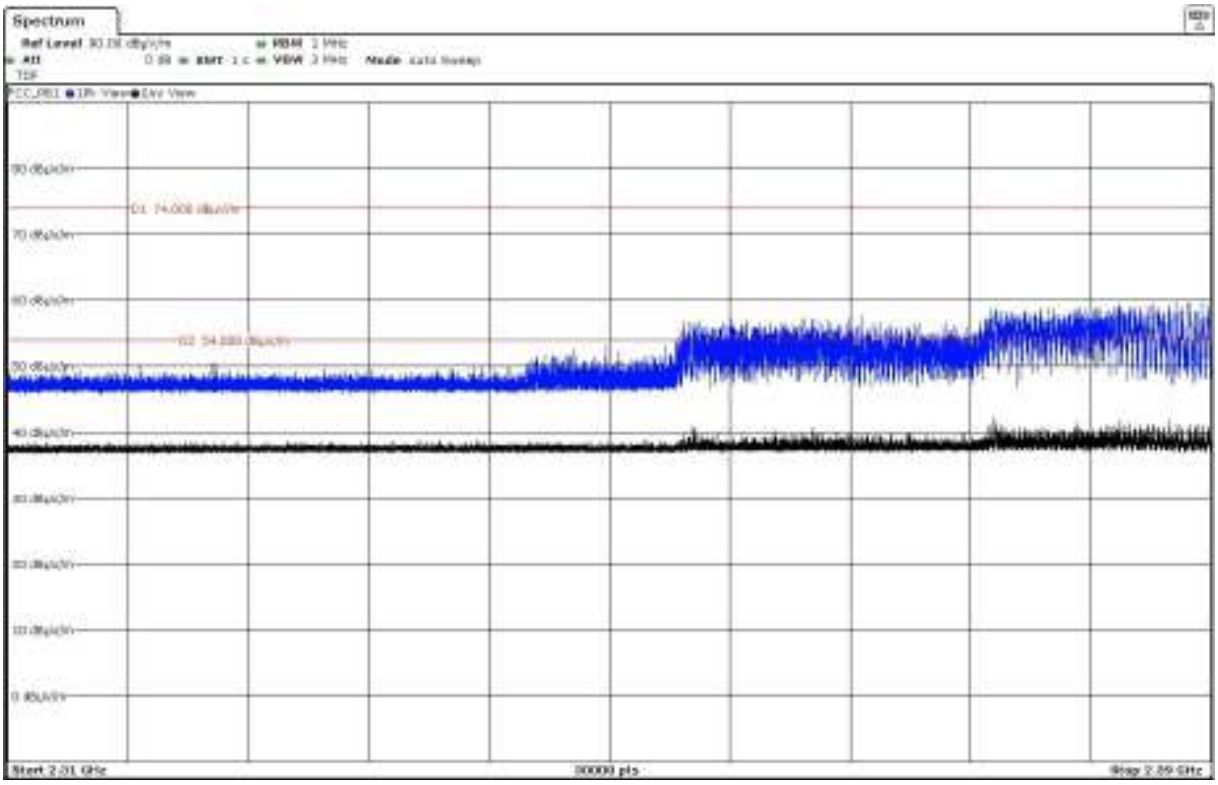


- High Channel (2480 MHz):

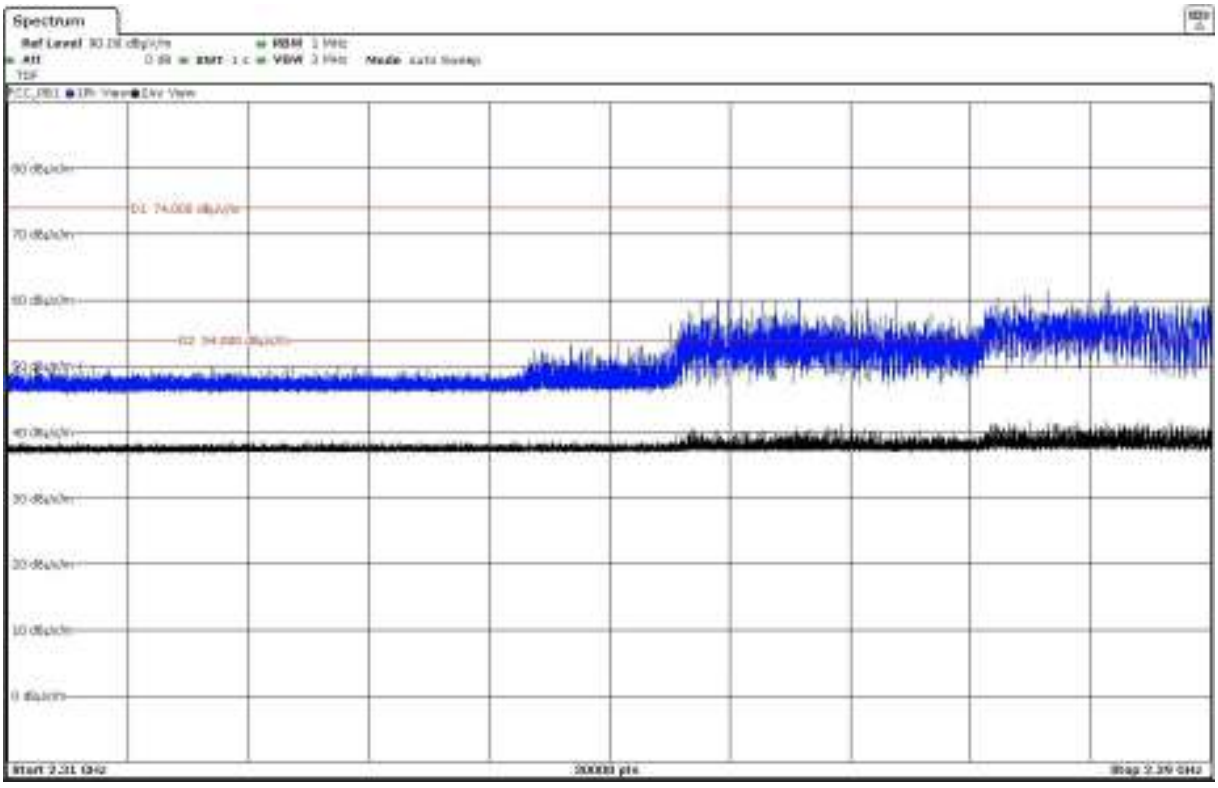


FREQUENCY RANGE 2.31-2.39 GHz

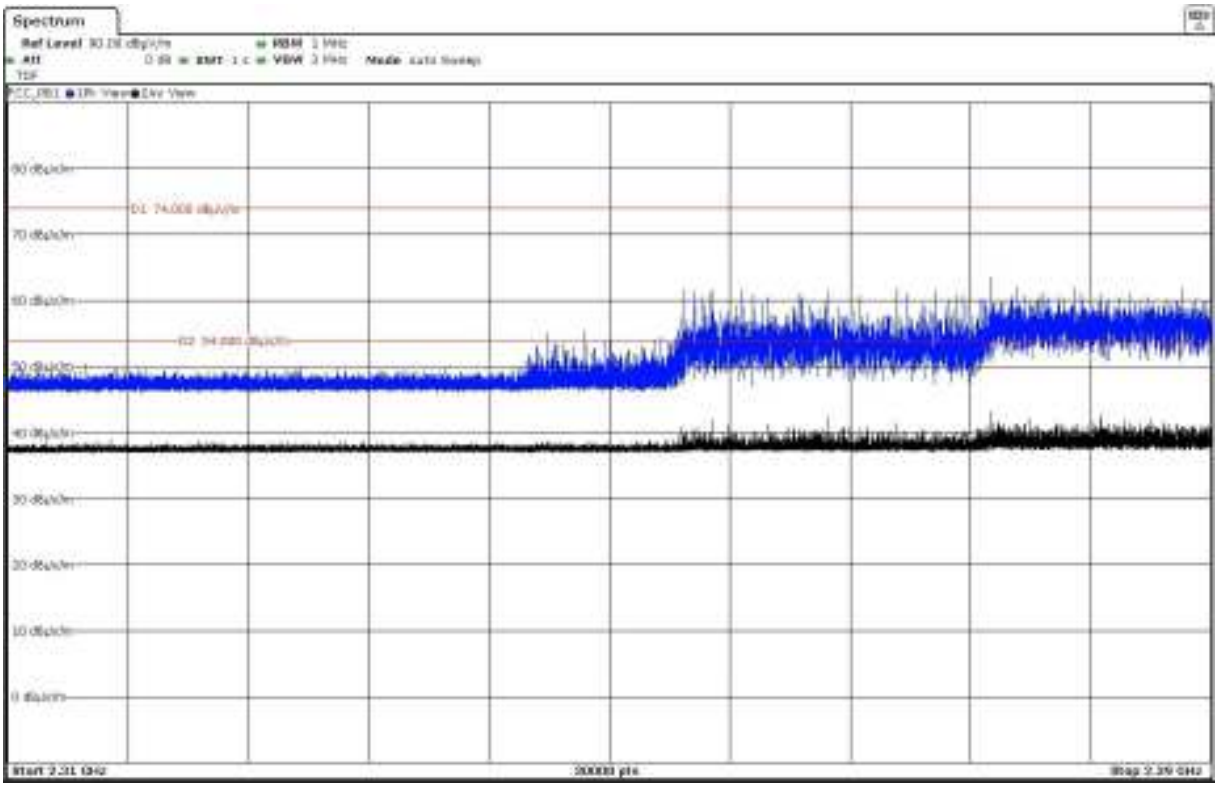
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

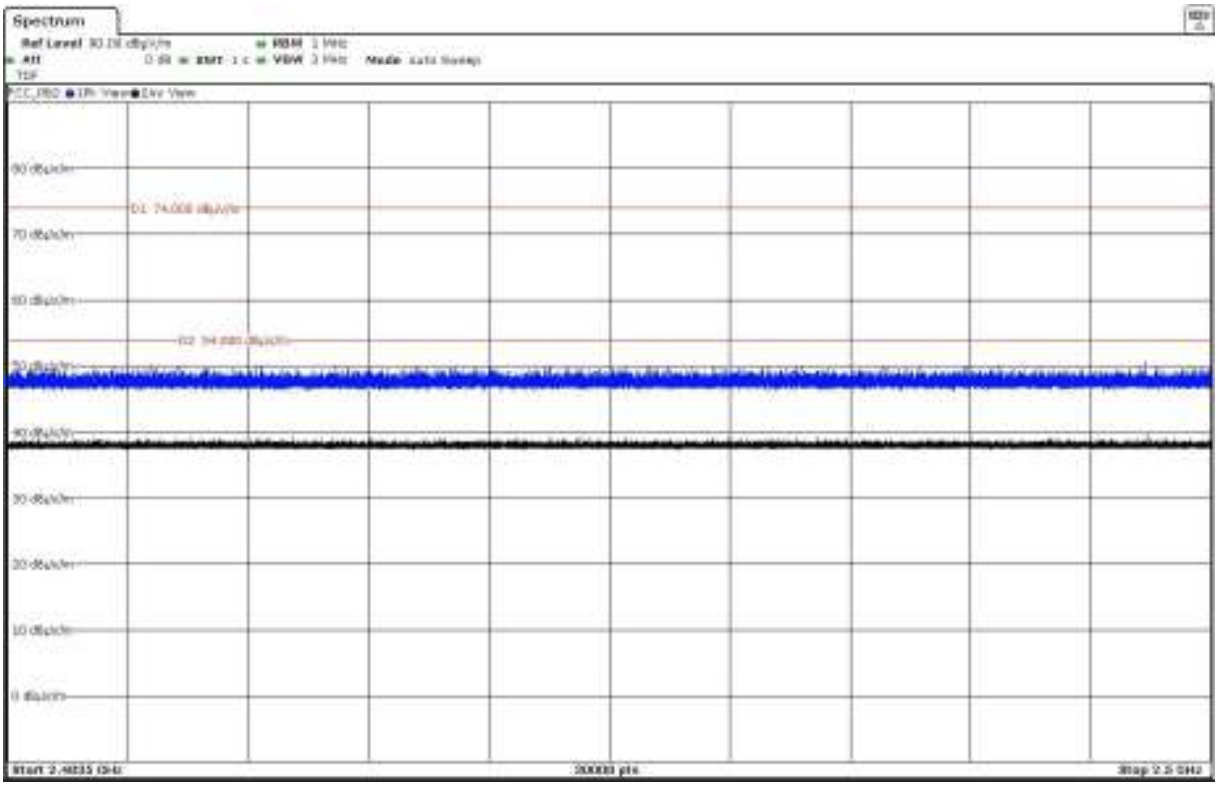


- High Channel (2480 MHz):

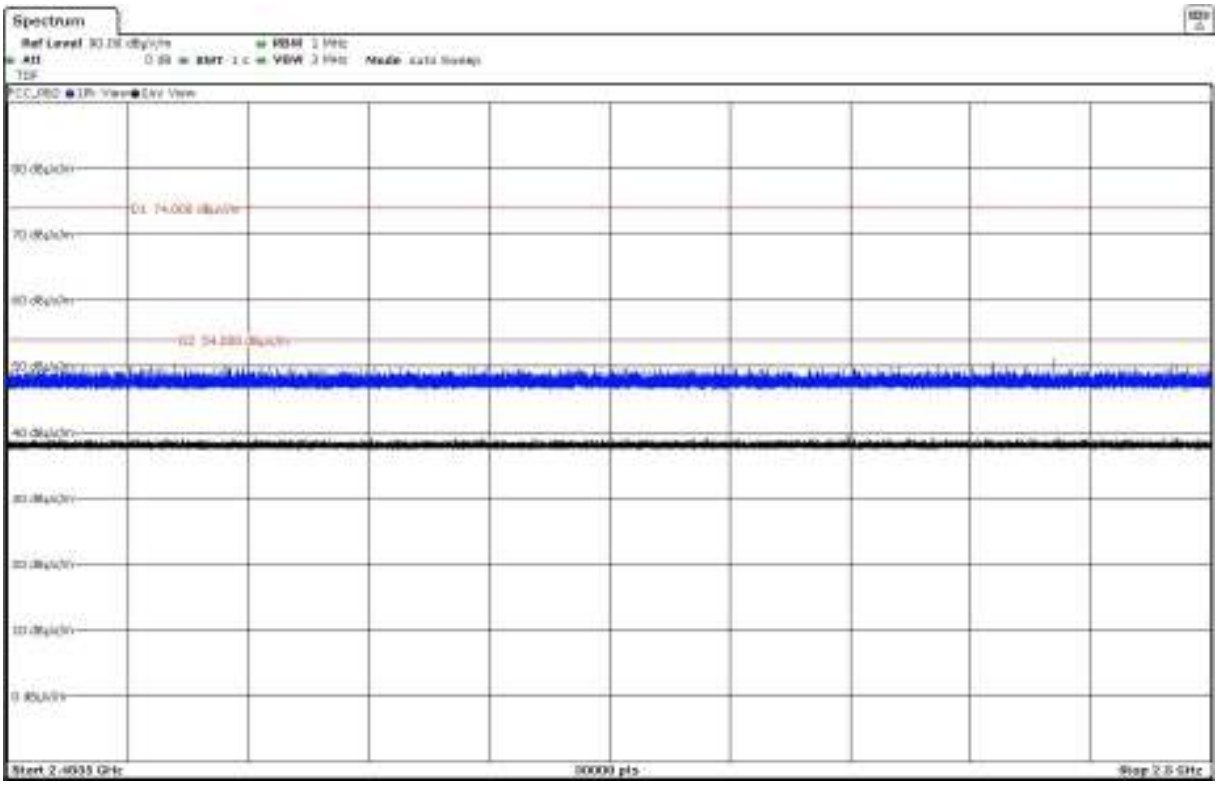


FREQUENCY RANGE 2.4835-2.5 GHz:

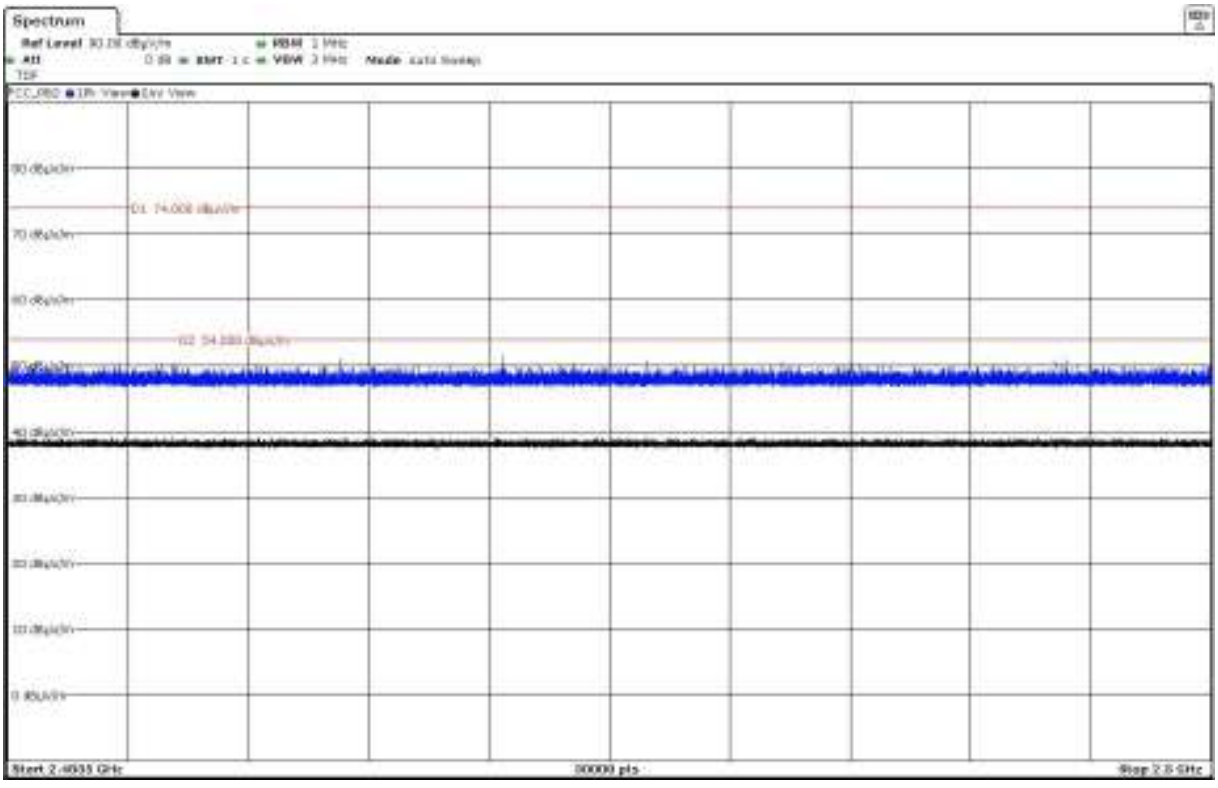
- Low Channel (2402 MHz):



- Middle Channel (2441 MHz):

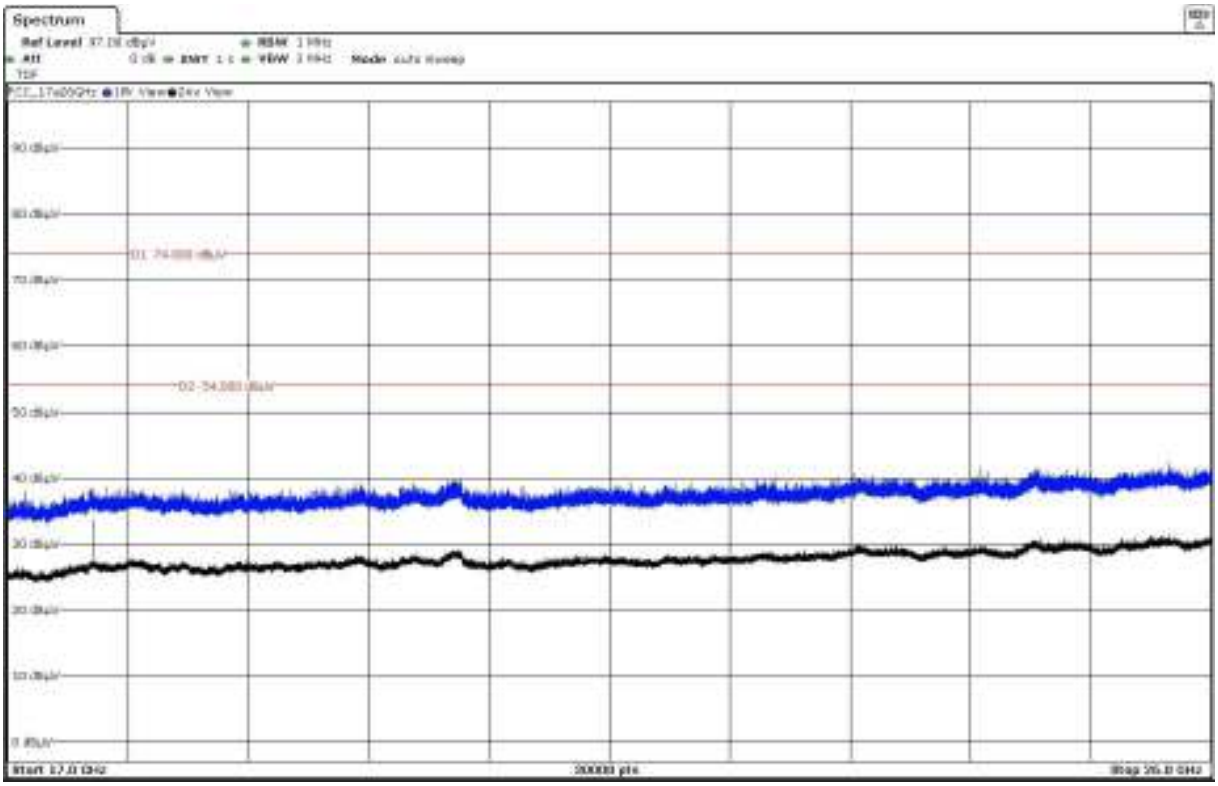


- High Channel (2480 MHz):



FREQUENCY RANGE 17 - 26 GHz:

This plot is valid for all the modulation modes and the Low, Middle and High Channels.



Appendix B: Test results. 802.11 bgn20 1x1

INDEX

TEST CONDITIONS

POWER SUPPLY (V):

V nonimal:	12 Vdc.
Type of Power Supply:	DC External (vehicle battery).
Type of Antenna:	Integral.
Maximum Declared Antenna Gain:	+0.4 dBi

TEST FREQUENCIES:

802.11 bgn20:

Low Channel:	2412 MHz
Middle Channel:	2437 MHz
High Channel:	2462 MHz

RADIATED MEASUREMENTS:

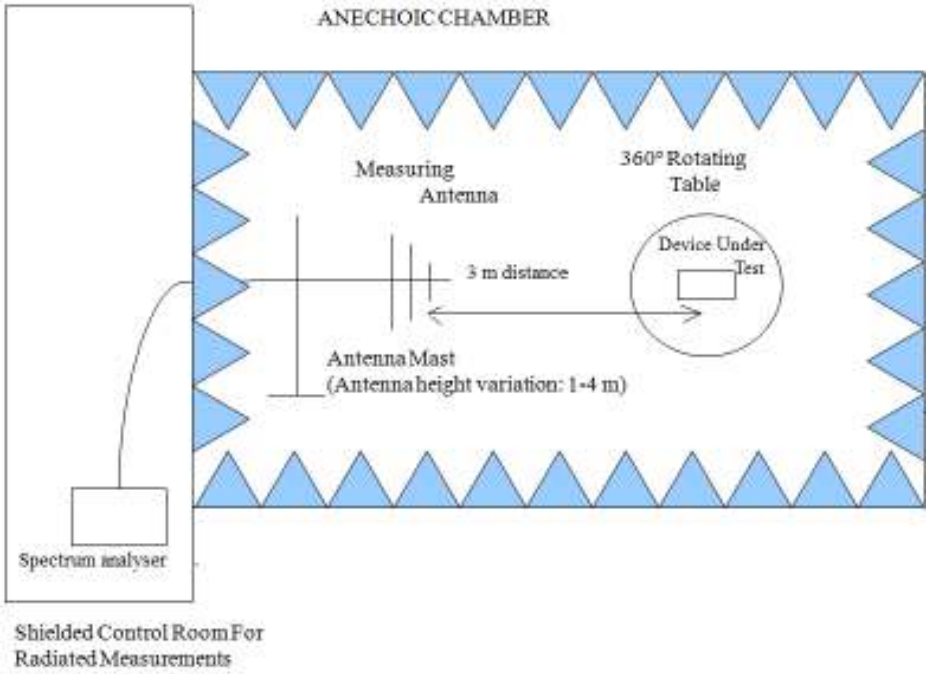
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

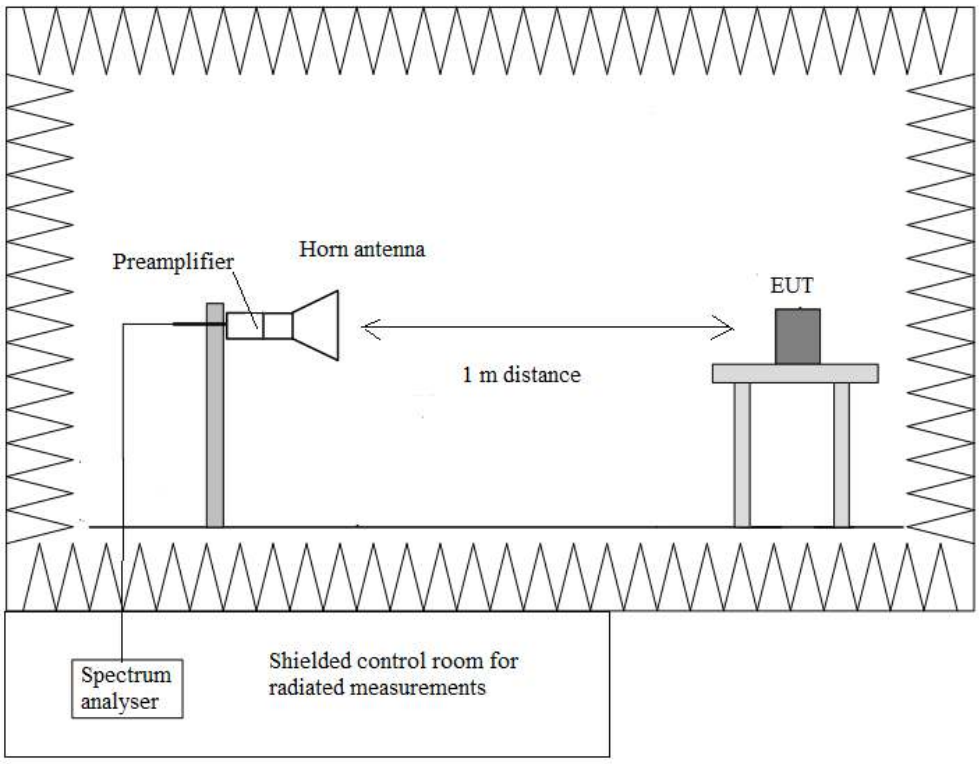
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup f > 1 GHz:



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

SPECIFICATION:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)/RSS-Gen):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	30
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 10000	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 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 frequencies do not depend on the operating channel.

Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
282.443	27.8	46	V	Quasi peak	<± 2.07
425.13	29.8	46	V	Quasi peak	<± 2.07
550.033	32.7	46	V	Quasi peak	<± 2.07
795.637	27.4	46	V	Quasi peak	<± 2.07
274.101	34.5	46	H	Quasi peak	<± 2.07
799.065	28.5	46	H	Quasi peak	<± 2.07

- **802.11 b:**

Frequency range 1 - 26 GHz:

The results in the next tables show the maximum measured levels in the 1-25 GHz range including the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

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 (2412 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.774796	50.89	74	V	Peak	<±3.04
2.3631	58.26	74	V	Peak	<±3.04
	40.7	54		Average	<±3.04
2.386167	56.92	74	H	Peak	<±3.04
	40.24	54		Average	<±3.04
3.97183	57.41	74	V	Peak	<±4.88
	32.85	54		Average	<±4.88
4.2425	44.76	74	V	Peak	<±4.88
4.40957	41.85	74	V	Peak	<±4.88
6.36443	42.29	74	V	Peak	<±4.88
7.23523	46.85	74	V	Peak	<±4.88
7.0551	47.82	74	H	Peak	<±4.88
17.63795	39.5	74	H	Peak	<±4.88

- MIDDLE CHANNEL (2437 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.7937	51.45	74	V	Peak	<±3.04
	41.59	54		Average	<±3.04
2.384767	58.96	74	V	Peak	<±3.04
	41.7	54		Average	<±3.04
3.99143	55.94	74	V	Peak	<±4.88
	34.75	54		Average	<±4.88
4.2003	43.89	74	V	Peak	<±4.88
4.40957	41.04	74	V	Peak	<±4.88
6.30517	43.17	74	V	Peak	<±4.88
7.3141	43.69	74	V	Peak	<±4.88
3.41603	47.25	74	H	Peak	<±4.88
7.0551	43.44	74	H	Peak	<±4.88
8.8191	46.52	74	H	Peak	<±4.88

- HIGH CHANNEL (2462 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.786766	49.89	74	V	Peak	<±3.04
2.390833	58.95	74	V	Peak	<±3.04
	41.16	54		Average	<±3.04
3.97837	56.67	74	V	Peak	<±4.88
	35.07	54		Average	<±4.88
4.40957	41.26	74	V	Peak	<±4.88
7.3869	46.93	74	V	Peak	<±4.88
3.96017	54.66	74	H	Peak	<±4.88
	32.15	54		Average	<±4.88
7.9371	43.13	74	H	Peak	<±4.88
8.8191	47.22	74	H	Peak	<±4.88

- RESTRICTED BAND 2.31 - 2.39 GHz. Spurious frequencies operating at less than 20 dB below the limit:

Channel	Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
CH 1	2.3815	59.79	74	V	Peak	<±3.04
		42.16	54		Average	<±3.04
	2.3772013	58.24	74	H	Peak	<±3.04
		41.54	54		Average	<±3.04

- RESTRICTED BAND 2.4835 - 2.5 GHz. Spurious frequencies operating at less than 20 dB below the limit:

Channel	Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
CH 11	2.48616228	50.97	74	V	Peak	<±3.04

Verdict: PASS

OFDM mode:

- **802.11 n20:**

The results in the next tables show the maximum measured levels in the restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

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 (2412 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1,7981	52,3	74	V	Peak	<±3.04
1,998367	56.08	74	V	Peak	<±3.04
	39.67	54		Average	<±3.04
3.96857	54.8	74	H	Peak	<±4.88
	30.14	54		Average	<±4.88
3.98023	54.58	74	V	Peak	<±4.88
	32.44	54		Average	<±4.88
4.3069	45.99	74	V	Peak	<±4.88
4.40957	41.64	74	V	Peak	<±4.88
7.9371	43.34	74	V	Peak	<±4.88
8.8191	36.39	74	H	Peak	<±4.88

MIDDLE CHANNEL (2437 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1,7951	52,8	74	V	Peak	<±3.04
3.96017	57.17	74	V	Peak	<±4.88
	32.59	54		Average	<±4.88
3.98023	54.86	74	V	Peak	<±4.88
	32.02	54		Average	<±4.88
4.29243	46.8	74	V	Peak	<±4.88
4.40957	41.23	74	V	Peak	<±4.88
7.0551	47.35	74	V	Peak	<±4.88
8.8191	47.03	74	H	Peak	<±4.88

HIGH CHANNEL (2462 MHz). Spurious frequencies operating at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1,792367	52,07	74	V	Peak	<±3.04
3.97883	56.23	74	V	Peak	<±4.88
	33.09	54		Average	<±4.88
4.40957	41.25	74	V	Peak	<±4.88
7.0551	46.46	74	V	Peak	<±4.88

- RESTRICTED BAND 2.31 - 2.39 GHz. Spurious frequencies operating at less than 20 dB below the limit:

Channel	Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
CH 1	2.3867747	59.82	74	V	Peak	<±3.04
		44.7	54		Average	<±3.04

	2.3841533	58.63	74	H	Peak	<±3.04
		42.54	54		Average	<±3.04

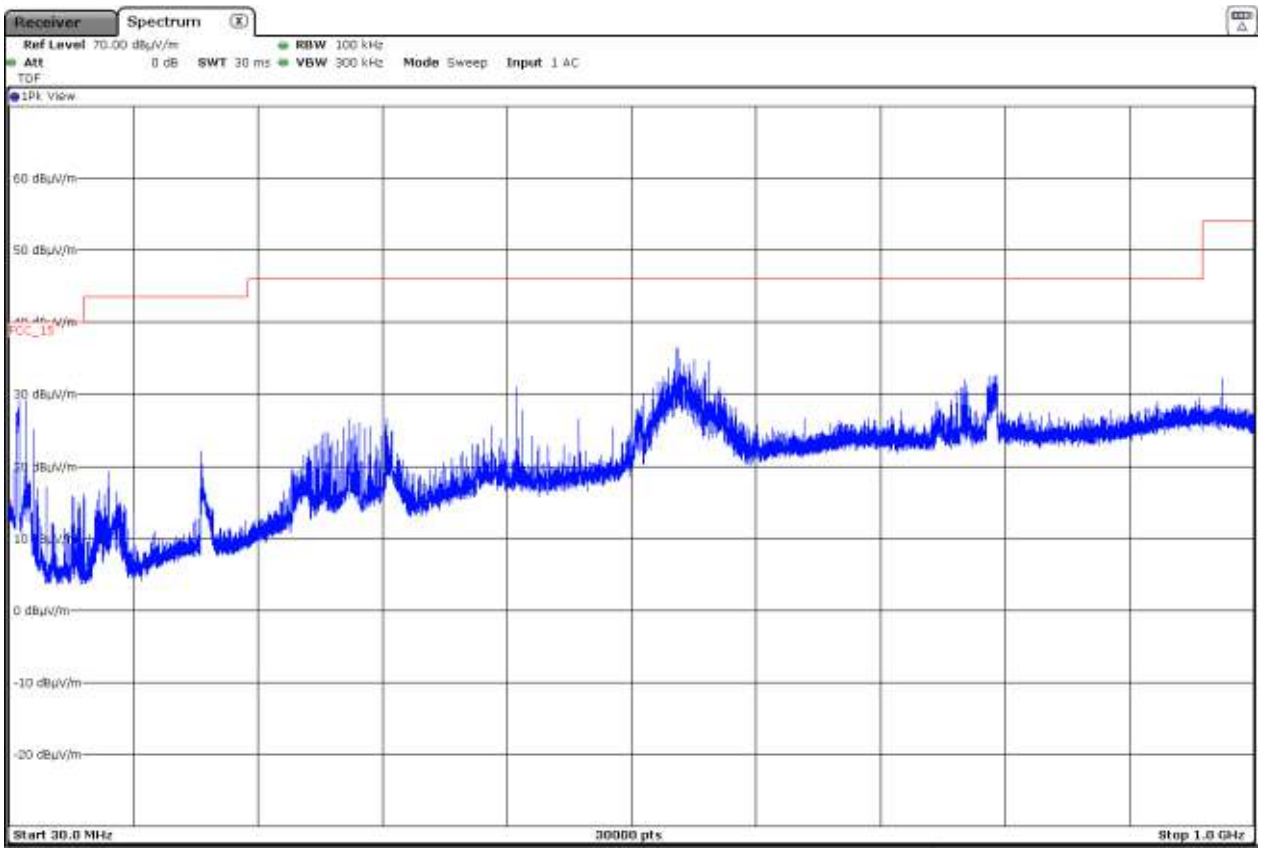
- RESTRICTED BAND 2.4835 - 2.5 GHz. Spurious frequencies operating at less than 20 dB below the limit:

Channel	Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
CH 11	2.48399198	57.77	74	V	Peak	<±3.04
		44.4	54		Average	<±3.04

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz:

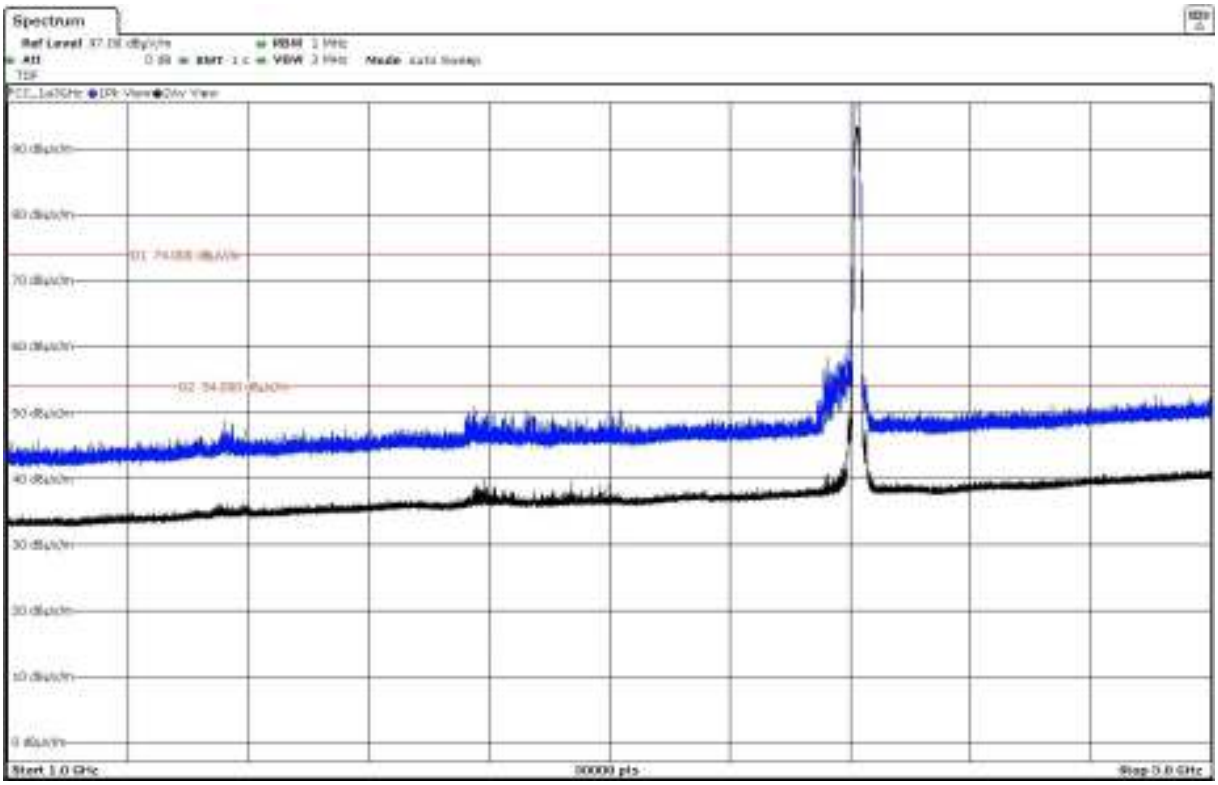
This plot is valid for all the modulation modes and the Low, Middle and High Channels.



- **802.11 b:**

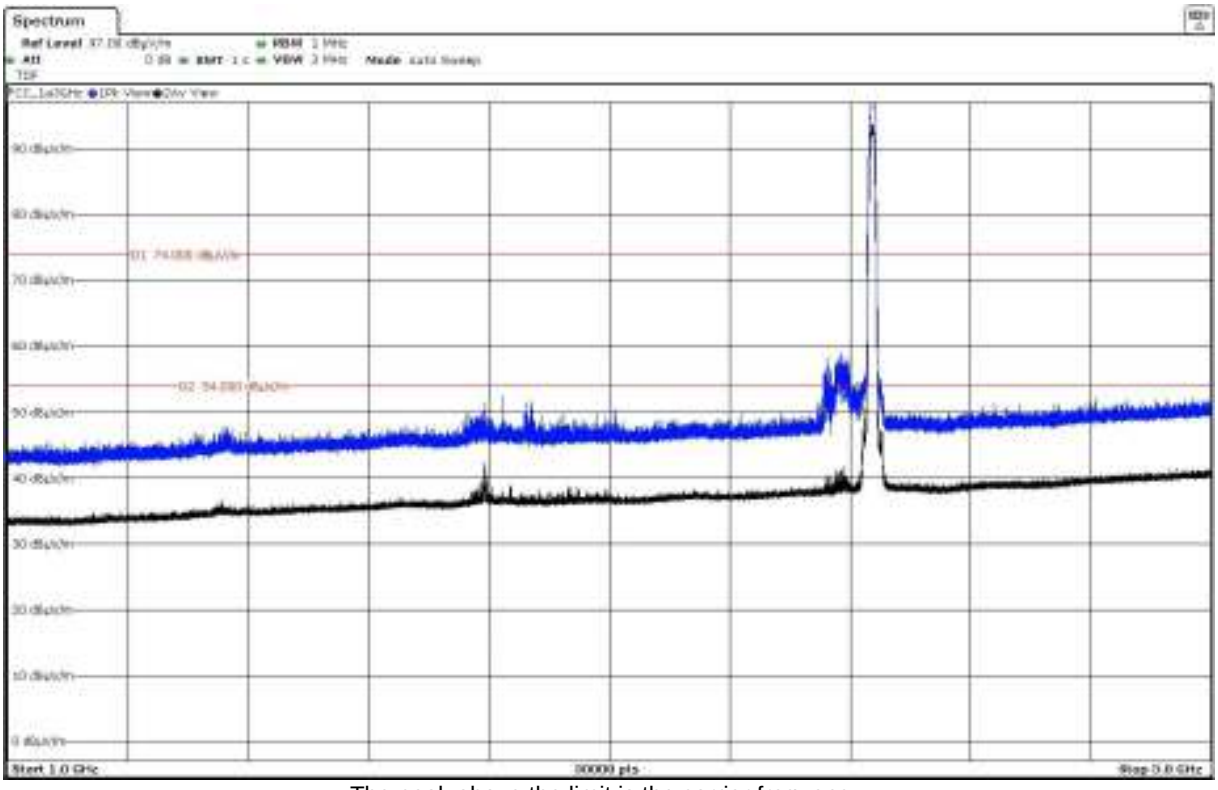
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



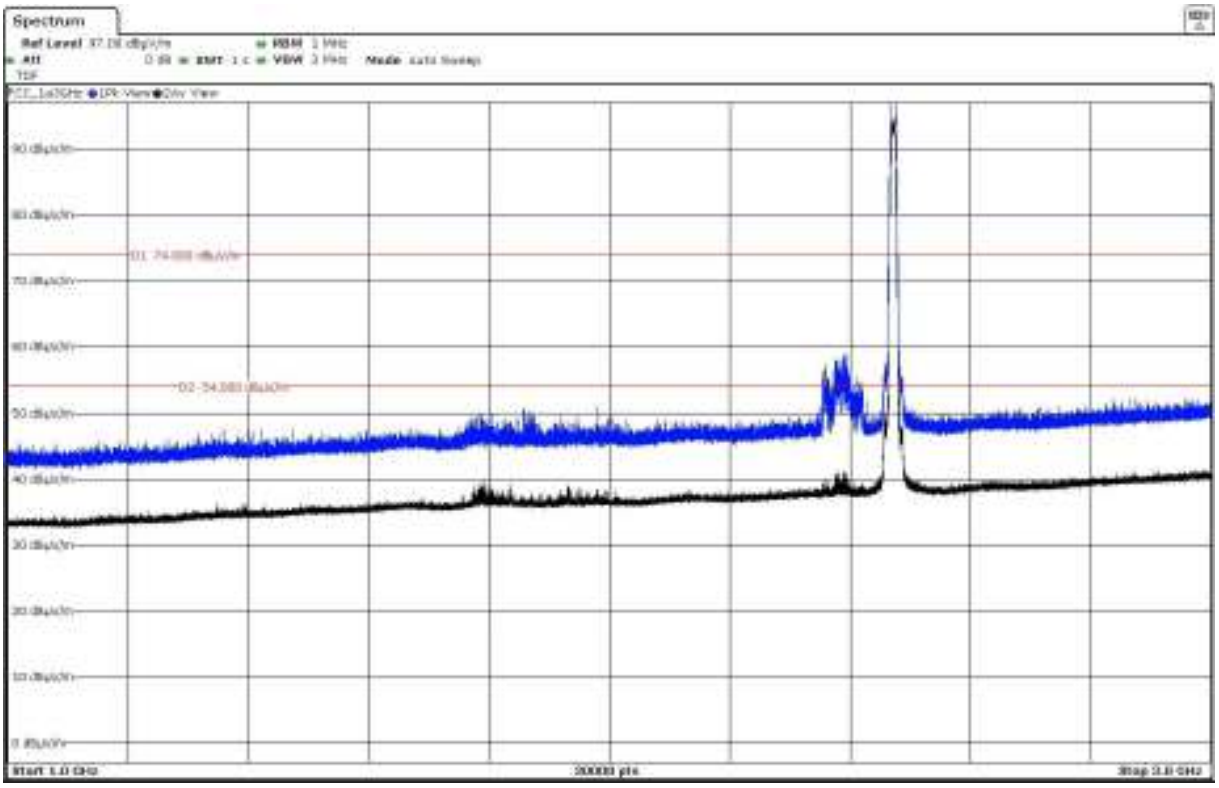
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

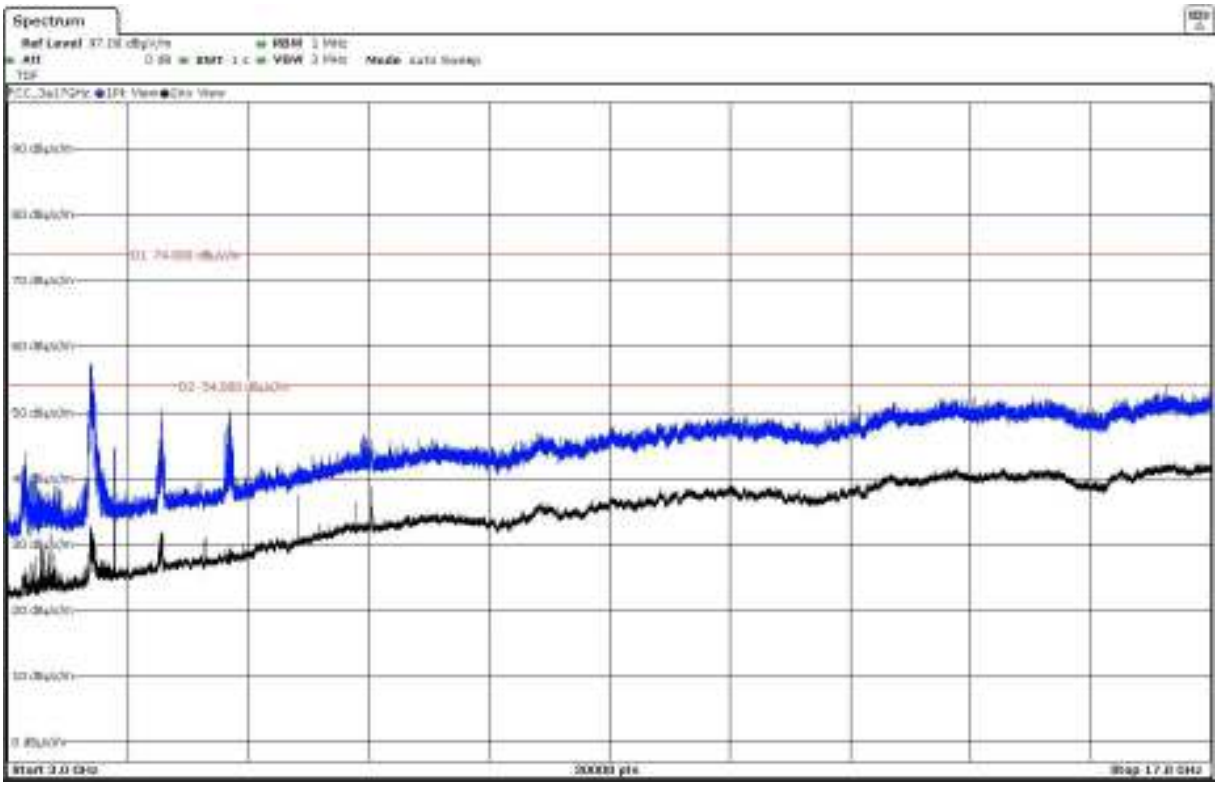
- High Channel:



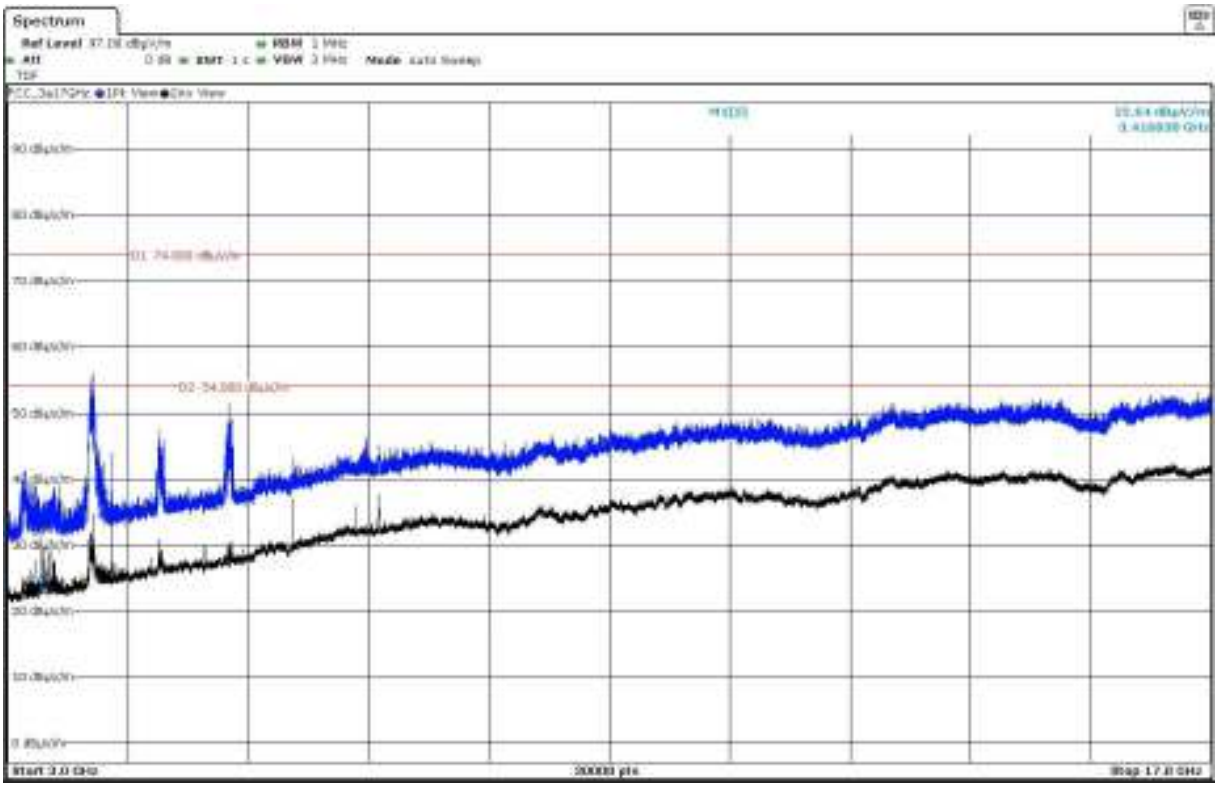
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

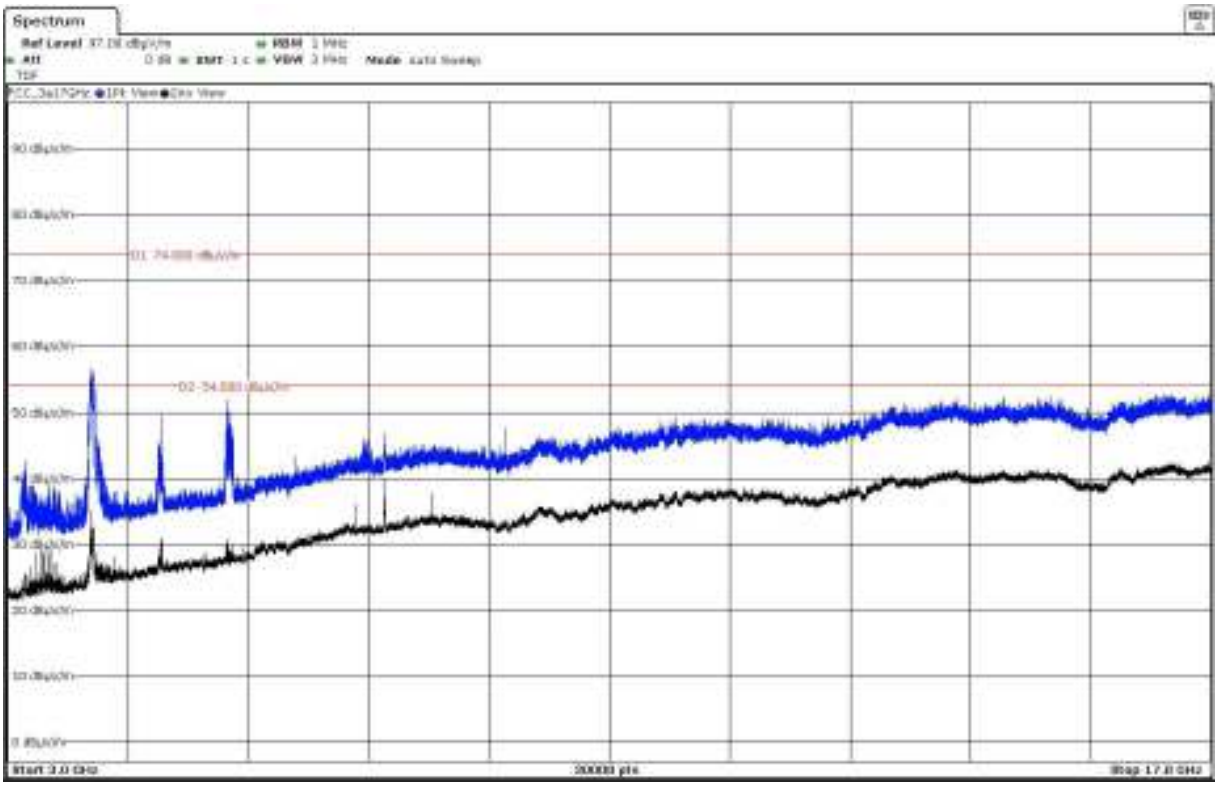
- Low Channel:



- Middle Channel:

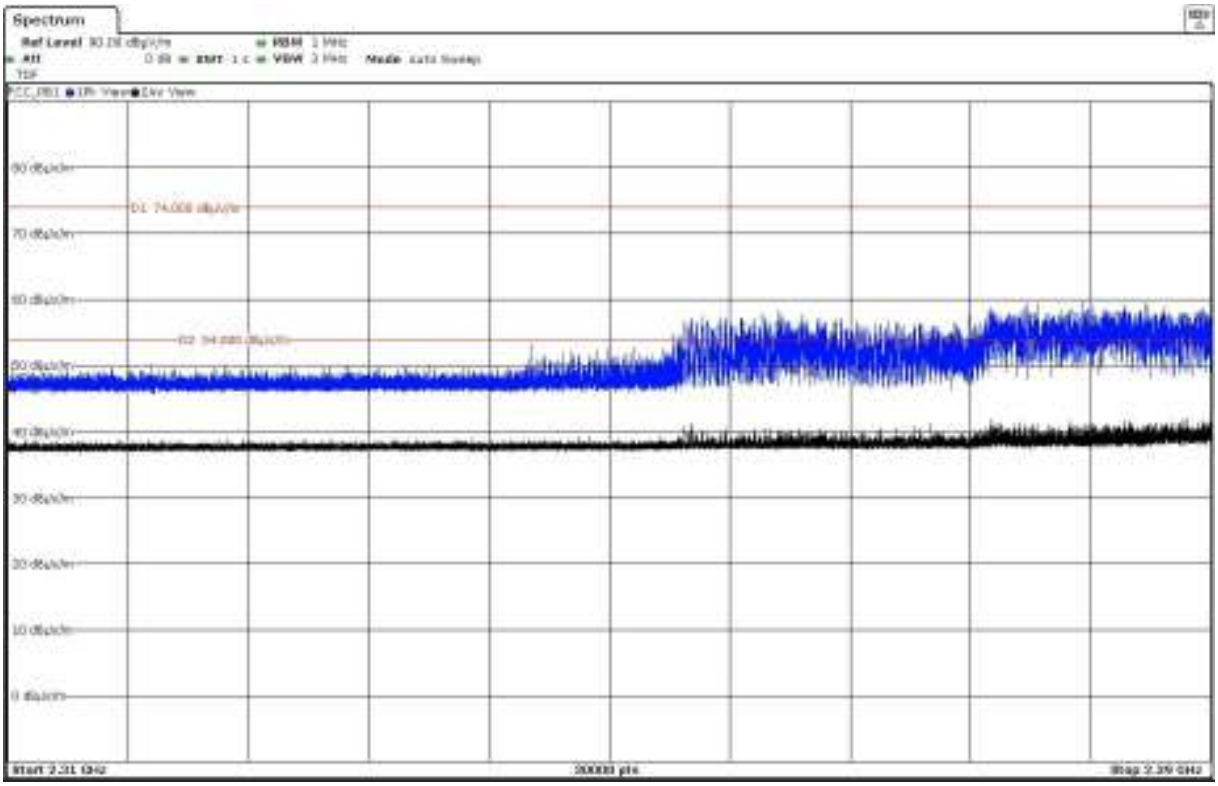


- High Channel:



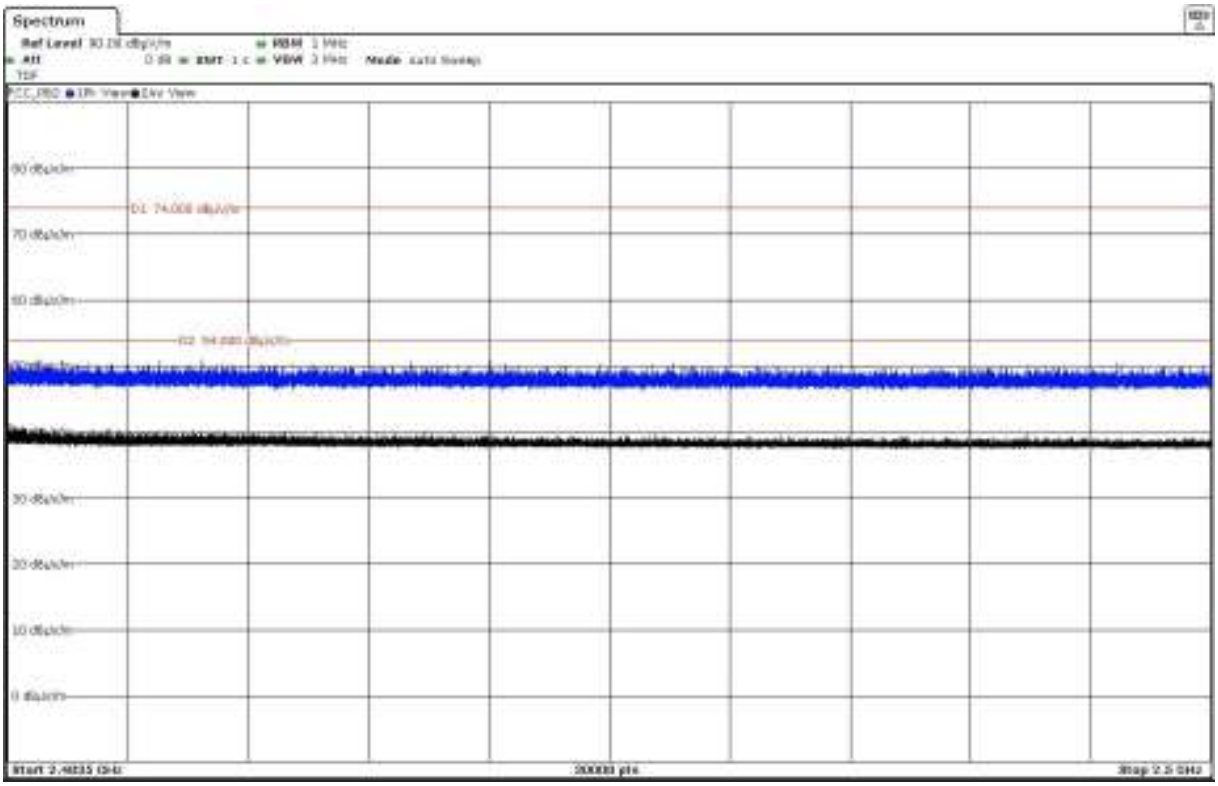
FREQUENCY RANGE 2.31-2.39 GHz:

- Low Channel:



FREQUENCY RANGE 2.4835-2.5 GHz:

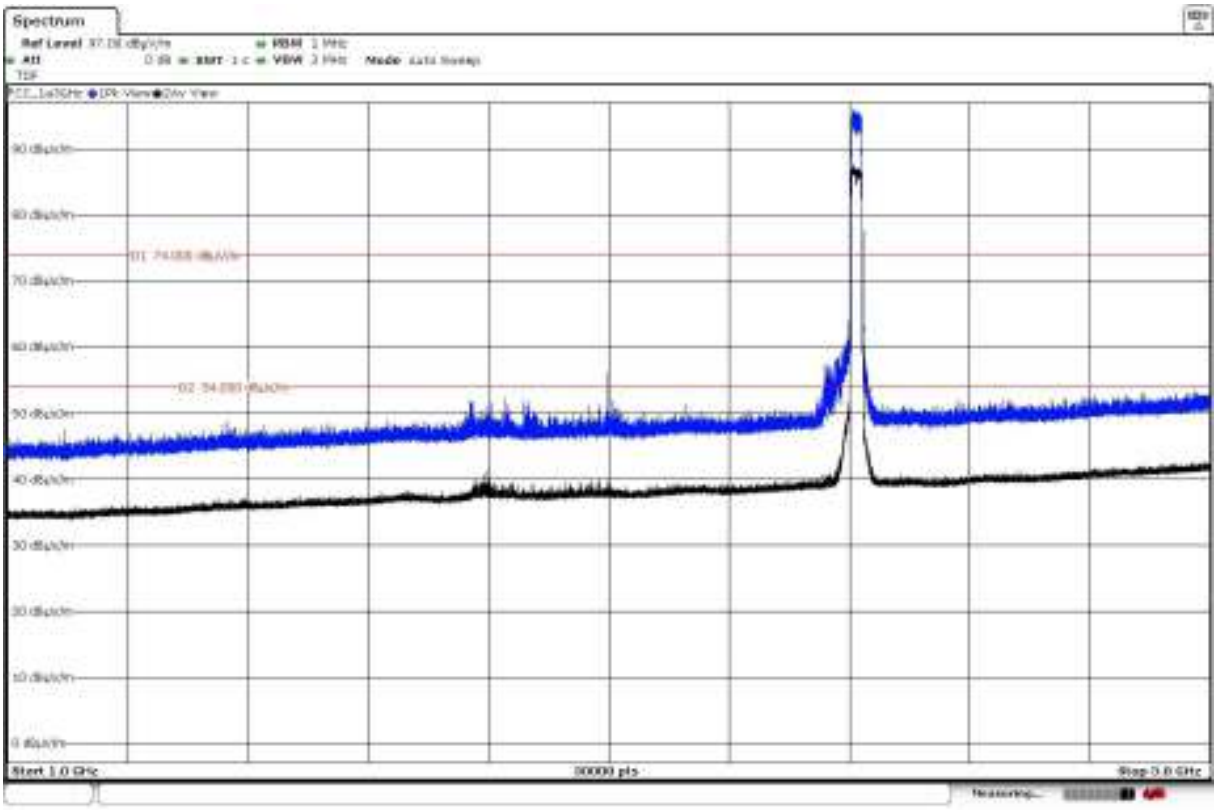
- High Channel:



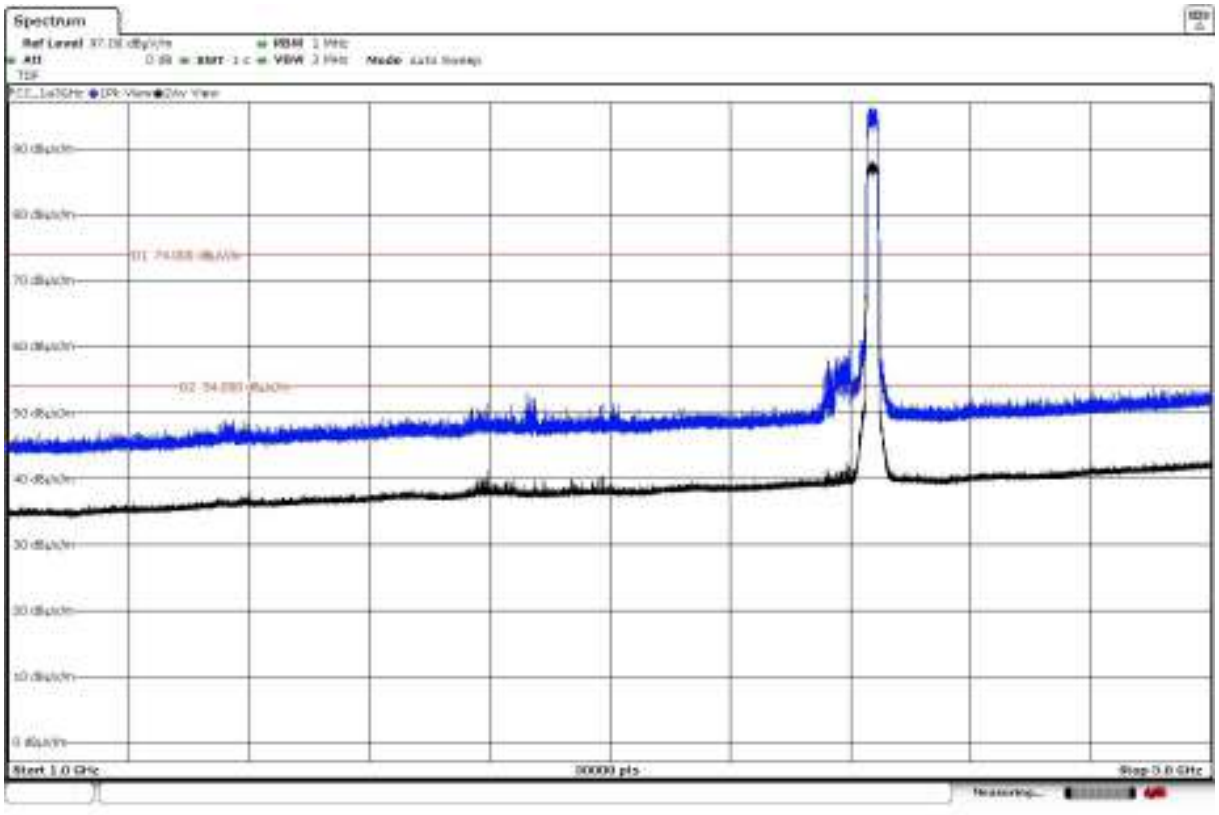
- **802.11 n20:**

FREQUENCY RANGE 1 - 3 GHz:

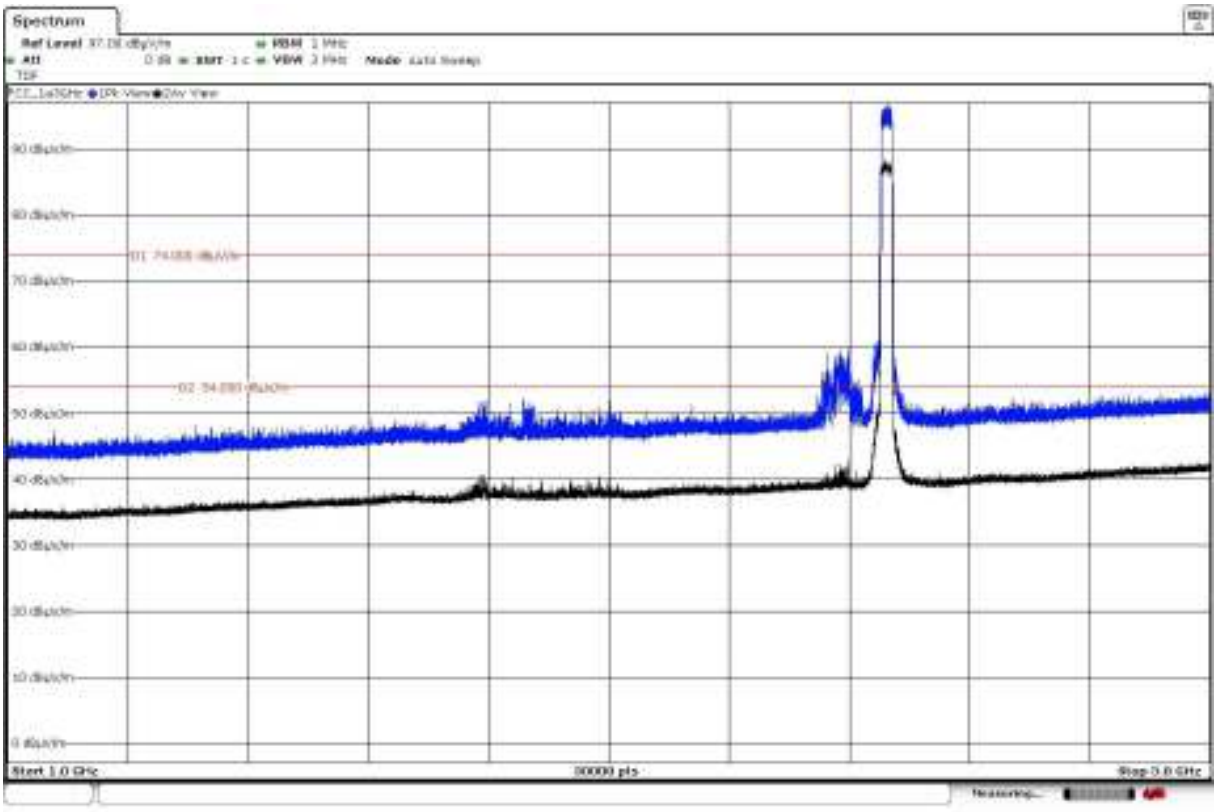
Low Channel:



Middle channel:

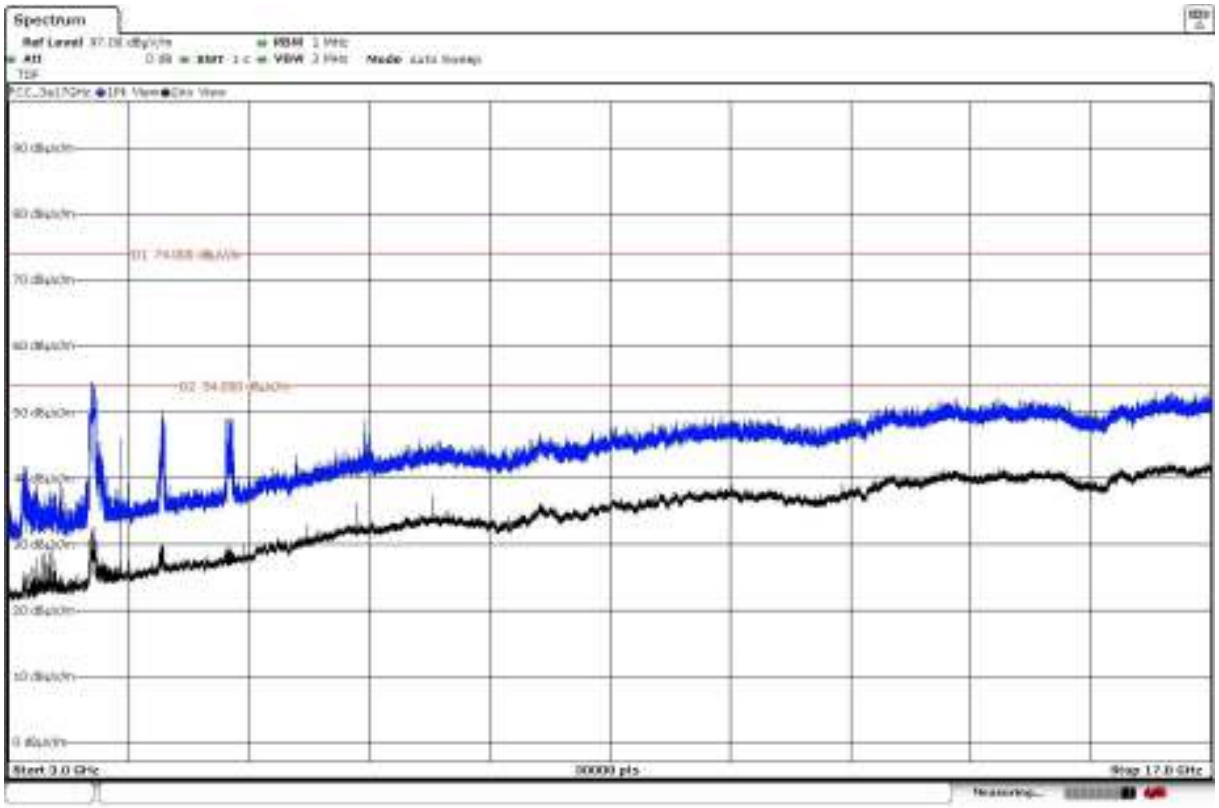


High channel:

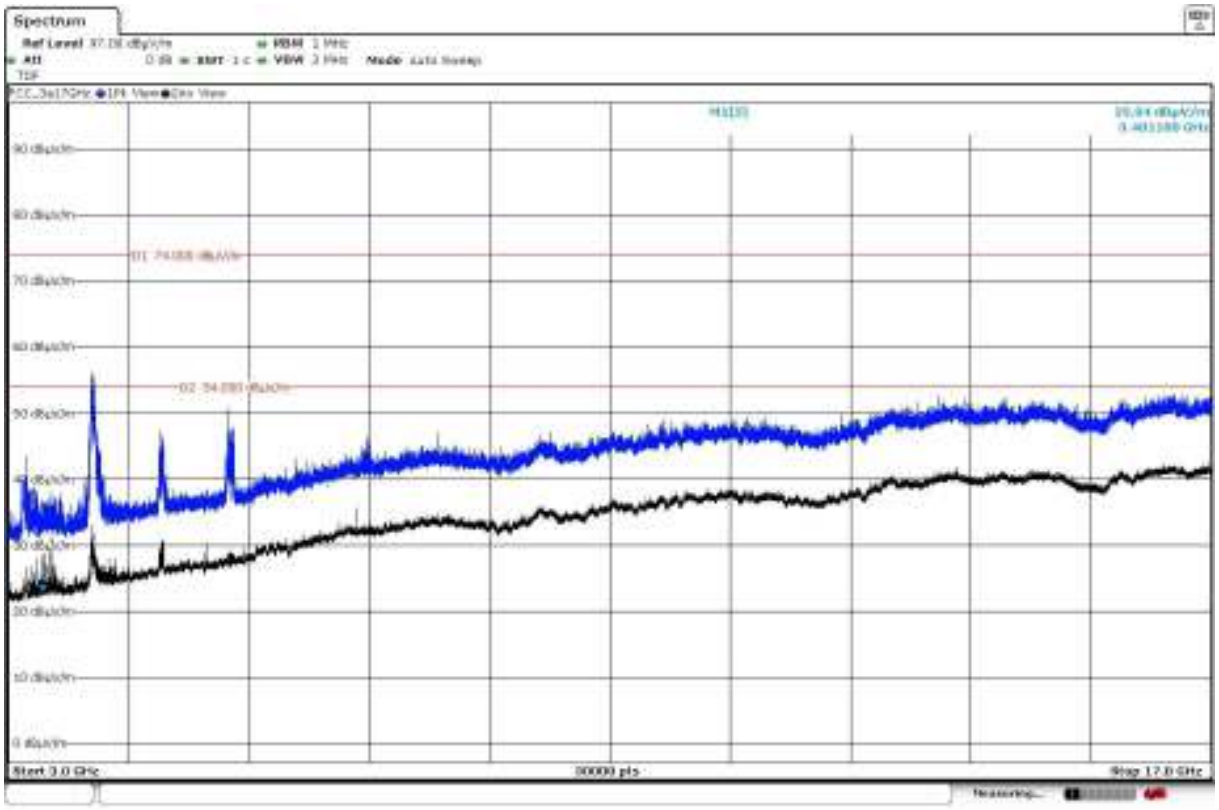


FREQUENCY RANGE 3 - 17 GHz:

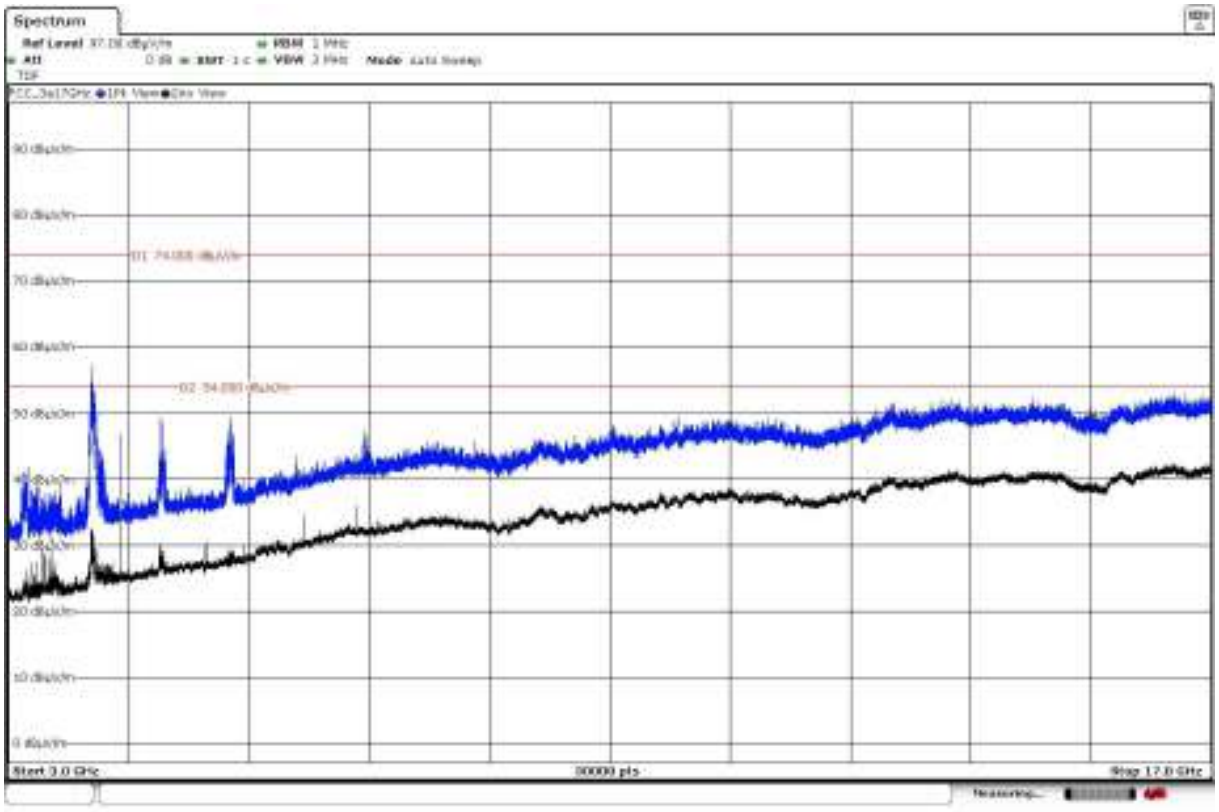
Low channel:



Middle channel:

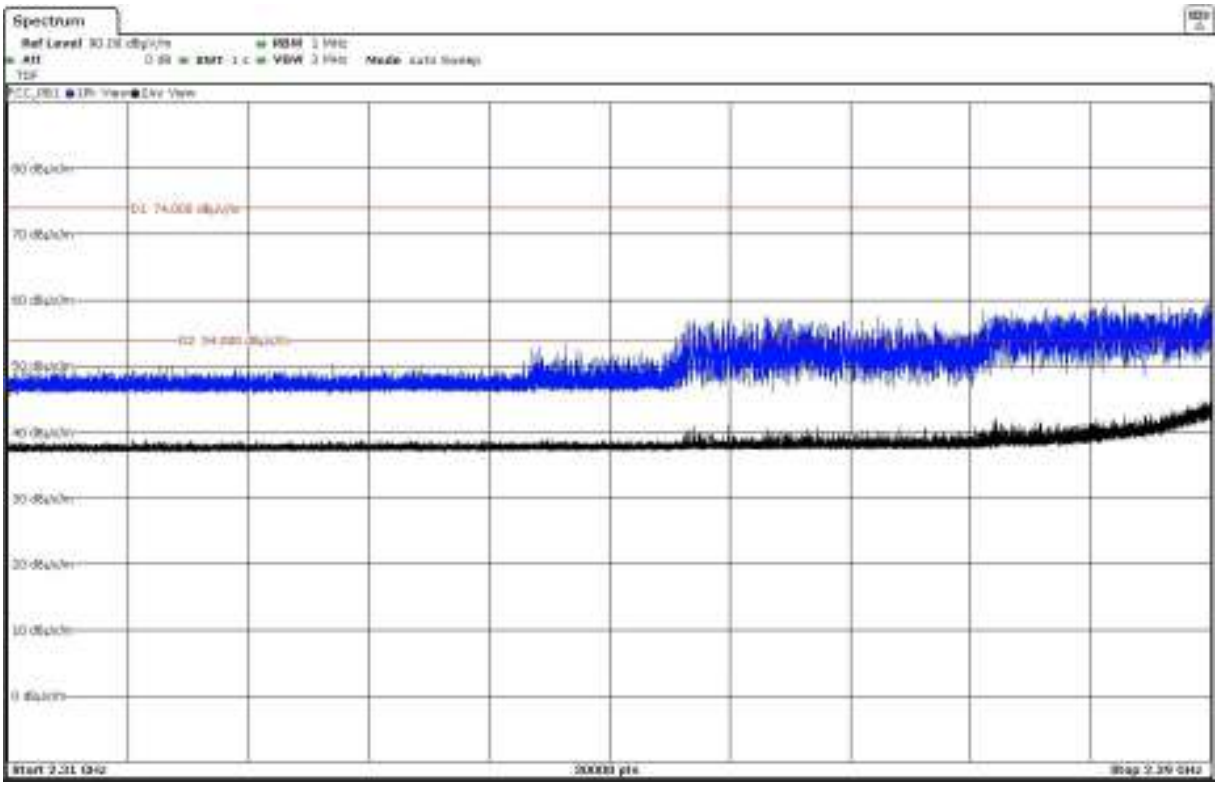


High channel:



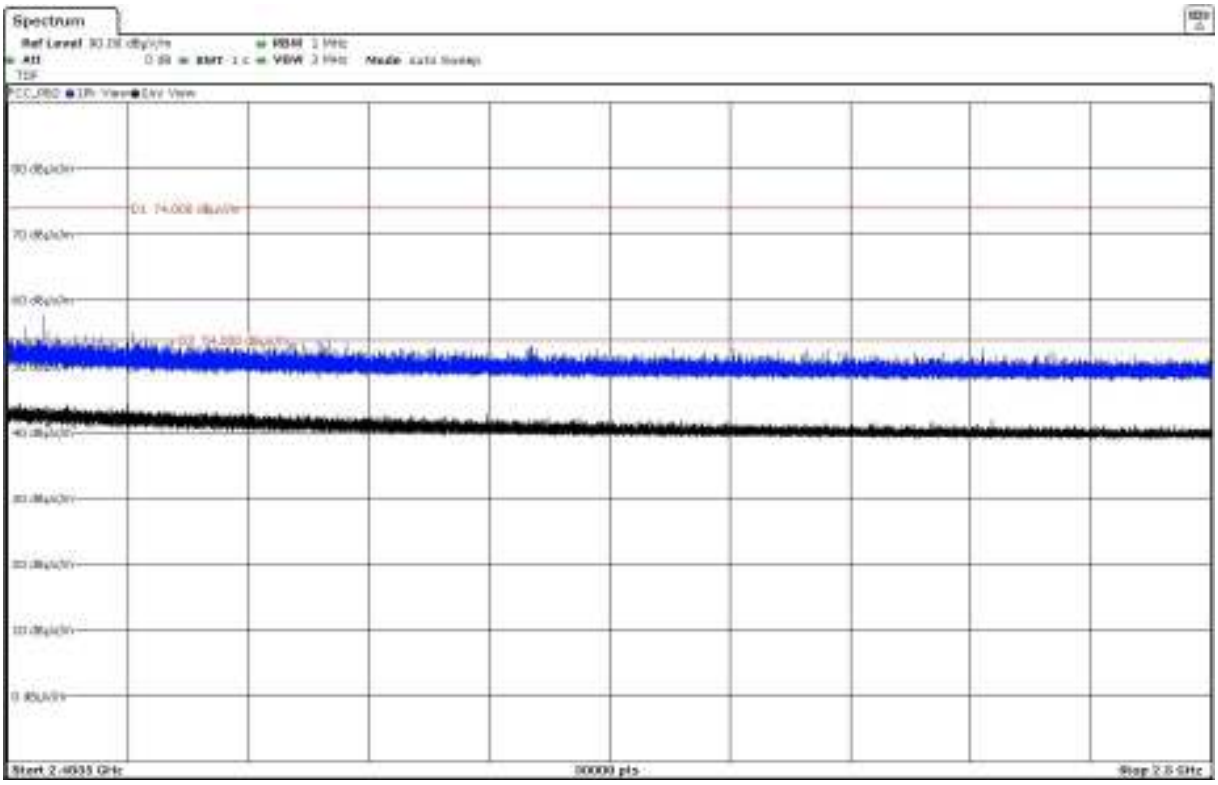
FREQUENCY RANGE 2.31-2.39 GHz:

- Low Channel:



FREQUENCY RANGE 2.4835-2.5 GHz:

- High Channel:



FREQUENCY RANGE 17 - 26 GHz:

This plot is valid for all the modulation modes and the Low, Middle and High Channels.