

Appendix B: Test results. 802.11 bgn20 2x2

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TEST CONDITIONS45

FCC Section 15.247 Subclause (d) / RSS-247 Clause 5.5. Emission limitations radiated (Transmitter)48

TEST CONDITIONS

POWER SUPPLY (V):

V nominal: 12 Vdc
Type of Power Supply: DC voltage from external power supply (car battery).

ANTENNAS:

Type of Antenna: External.
Antennas Gain:

- SISO – CORE1_Port4 Antenna – Declared Maximum Antenna Gain: +2.4 dBi
- MIMO – Port4 & Port2 Antennas – Declared Maximum Antenna Gain:
 - Antenna Port4 Gain: +2.4 dBi
 - Antenna Port2 Gain: -0.3 dBi

TEST FREQUENCIES:

For Wi-Fi 802.11b/g/n20:

Low Channel (1): 2412 MHz
Middle Channel (6): 2437 MHz
High Channel (11): 2462 MHz

The sample was used to configure the EUT to continuously transmit at a specified output power in all channels with different modes and modulation schemes.

During transmitter test the EUT was being controlled by the SW tool to operate in a continuous transmit mode on the test channel as required and in each of the different modulation modes.

The EUT has four separate antennas which correspond to one port of the equipment.

The data rates of 1Mb/s for 802.11b, 6.5Mb/s for 802.11g, MSC0 for 802.11n20 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

RADIATED MEASUREMENTS

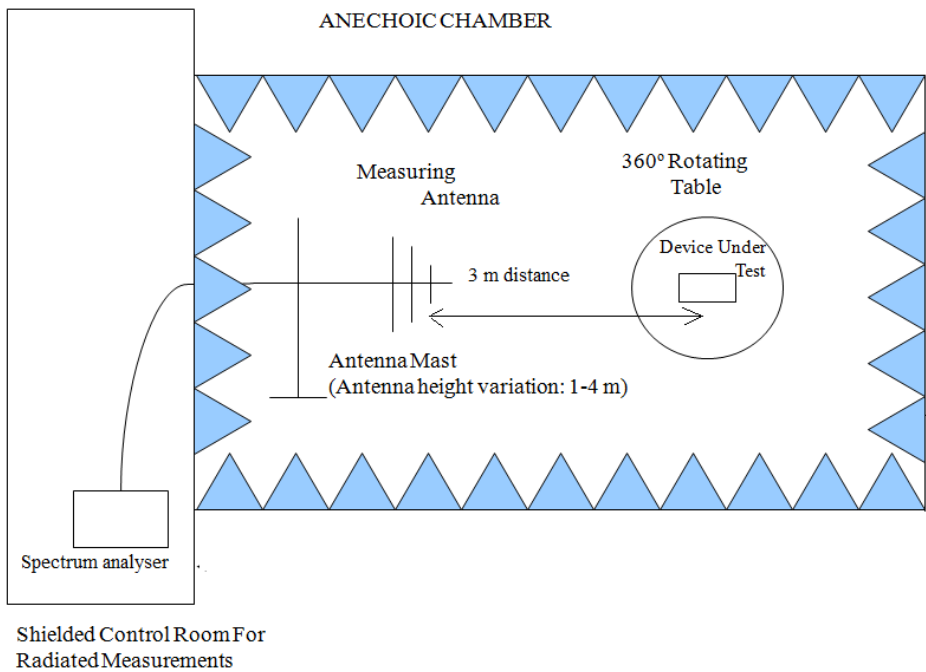
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) is situated at a distance of 3 m and at a distance of 1m for the frequency range 1 GHz-26 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

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.

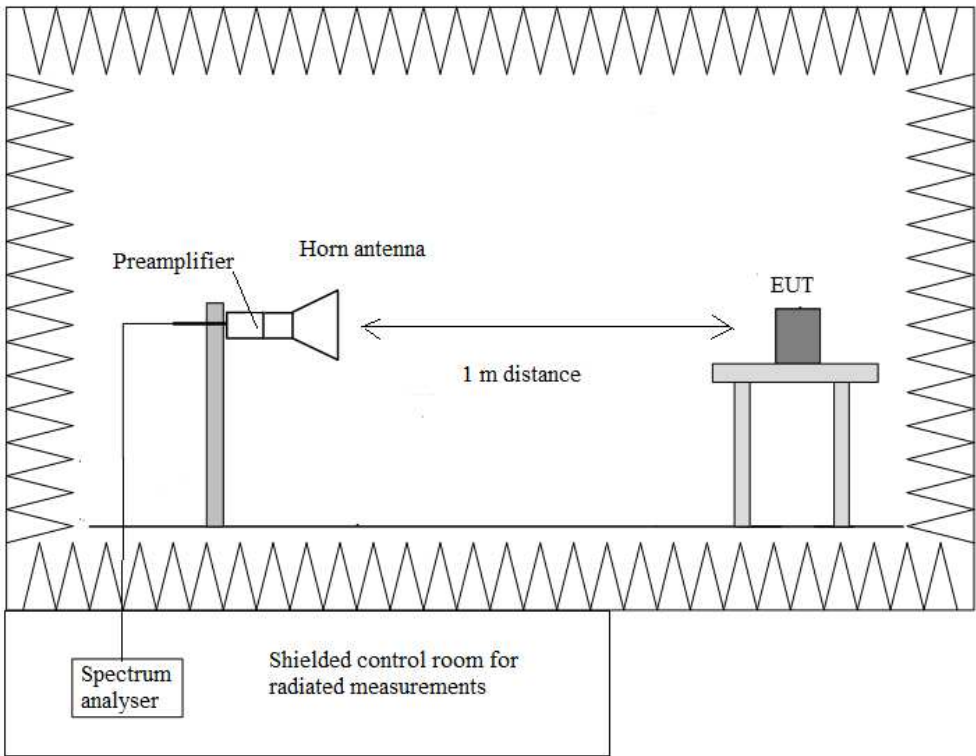
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup $f > 1$ GHz:



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

SPECIFICATION:

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

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

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

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

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

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

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

SISO CORE1_Port4 Antenna:

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend neither on the operating channel nor the modulation mode.

Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (MHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
46.991	Quasi peak	38.4	V	<± 3.81
84.466	Quasi peak	30.4	V	<± 3.81
250.012	Quasi peak	31.2	V	<± 3.81
375.013	Quasi peak	36.3	H	<± 3.81
499.981	Quasi peak	33.9	V	<± 3.81
958.856	Quasi peak	30.0	V	<± 3.81

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 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

- **Mode 802.11 b**

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.4455	Peak	49.69	H	<±2.78
4.8239	Peak	36.89	H	<±4.72
5.9999	Peak	39.50	V	<±4.72
7.0000	Peak	38.56	V	<±4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
4.8739	Peak	36.79	H	<±4.72
7.0000	Peak	39.61	V	<±4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
4.9238	Peak	36.30	H	<±4.72
7.0000	Peak	39.01	V	<±4.72

Verdict: PASS

- **Mode 802.11 g**

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
7.0000	Peak	39.35	V	<±4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
6.9995	Peak	39.83	V	<±4.72
5.9999	Peak	39.11	V	<±4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.48376868	Peak	58.35	H	<± 2.78
	Quasi peak	44.01		
6.9995	Peak	38.97	V	<±4.72

Verdict: PASS

- **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 frequencies with peak levels above the average limit (54 dB μ V/m at 3 m) are measured with average detector for checking compliance with the average limit.

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.388572	Peak	54.73	H	< $\pm$ 2.78
	Quasi Peak	43.53		
2.389372	Peak	57.39	V	< $\pm$ 2.78
	Quasi Peak	43.35		
7.0000	Peak	40.47	V	< $\pm$ 4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
7.0000	Peak	39.75	V	< $\pm$ 4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
2.48368948	Peak	55.67	V	< $\pm$ 2.78
	Quasi Peak	39.84		
2.48370543	Peak	62.72	H	< $\pm$ 2.78
	Quasi Peak	46.23		
7.0000	Peak	39.27	V	< $\pm$ 4.72

Verdict: PASS

MIMO – CORE1_Port4 Antenna & CORE1_Port2 Antenna:

Frequency range 30 MHz - 1 GHz:

The spurious frequencies do not depend neither on the operating channel nor the modulation.

Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (MHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
33.411	Quasi peak	28.4	V	< $\pm$ 3.88
46.506	Quasi peak	29.7	V	< $\pm$ 3.88
107.567	Quasi peak	28.8	V	< $\pm$ 3.88
145.673	Quasi peak	26.9	V	< $\pm$ 3.88
238.341	Quasi peak	30.8	V	< $\pm$ 3.88
375.013	Quasi peak	33.6	V	< $\pm$ 3.88
500.000	Quasi peak	27.5	H	< $\pm$ 3.88
659.449	Quasi peak	26.8	V	< $\pm$ 3.88
959.988	Quasi peak	30.7	H	< $\pm$ 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.

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

- **Mode 802.11 b**

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
5.9999	Peak	40.01	V	< $\pm$ 4.72
7.0000	Peak	42.21	V	< $\pm$ 4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
4.8739	Peak	44.55	V	< $\pm$ 4.72
5.9999	Peak	41.50	V	< $\pm$ 4.72
6.9995	Peak	43.11	V	< $\pm$ 4.72
7.3099	Peak	43.13	V	< $\pm$ 4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dB μ V/m)	Polarization	Measurement Uncertainty (dB)
5.9999	Peak	42.46	V	< $\pm$ 4.72

Verdict: PASS

- **Mode 802.11 g**

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.3895000	Peak	54.38	V	<±2.78
	Quasi Peak	41.84		
2.3896973	Peak	56.85	H	<±2.78
	Quasi Peak	44.58		
5.9999	Peak	41.12	V	<±4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
5.9999	Peak	40.80	V	<±4.72
7.3117	Peak	44.17	H	<±4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.48626018	Peak	53.01	V	<±2.78
5.9999	Peak	41.01	V	<±4.72

Verdict: PASS

- **Mode 802.11 n20**

- LOW CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.388396	Peak	56.13	V	<±2.78
	Quasi Peak	42.86		
2.389748	Peak	60.64	H	<±2.78
	Quasi Peak	46.14		
5.9999	Peak	42.47	V	<±4.72

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB of the limit:

Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
5.9999	Peak	41.01	V	<±4.72
7.3007	Peak	44.78	H	<±4.72

- HIGH CHANNEL. Spurious frequencies at less than 20 dB of the limit:

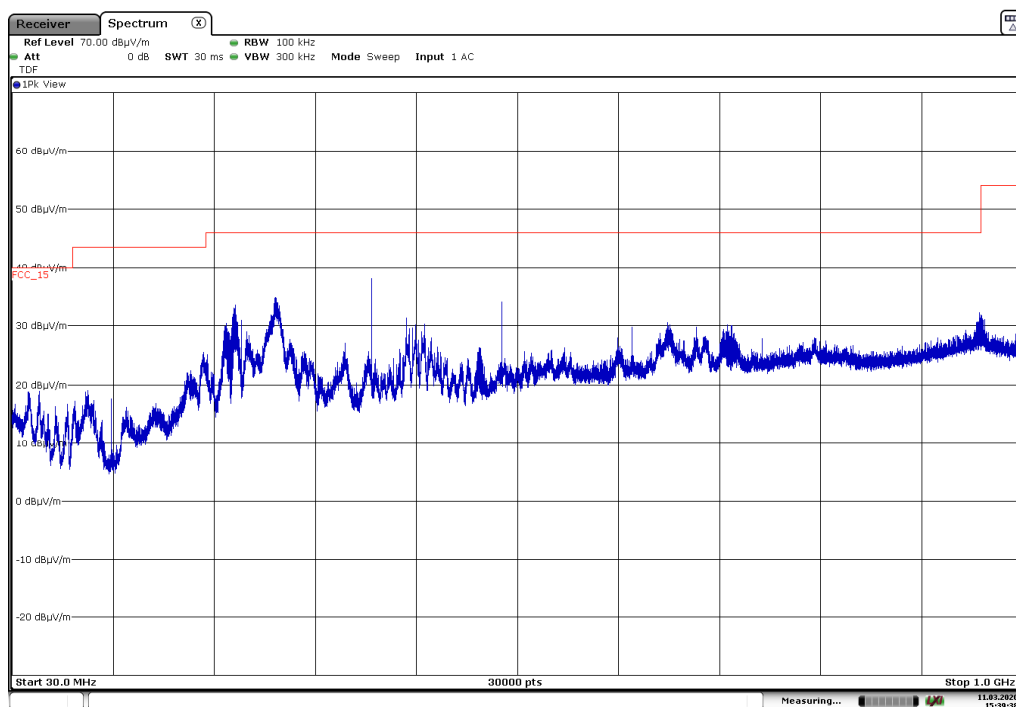
Spurious frequency (GHz)	Detector	Emission Level (dBμV/m)	Polarization	Measurement Uncertainty (dB)
2.48417843	Peak	54.97	H	<±2.78
	Quasi Peak	42.08		
2.48496658	Peak	54.40	V	<±2.78
	Quasi Peak	40.40		
5.9999	Peak	41.79	V	<±4.72

Verdict: PASS

SISO CORE1_Port4 Antenna:

FREQUENCY RANGE 30 MHz - 1 GHz:

The spurious signals detected do not depend neither on the operating channel nor the modulation mode.

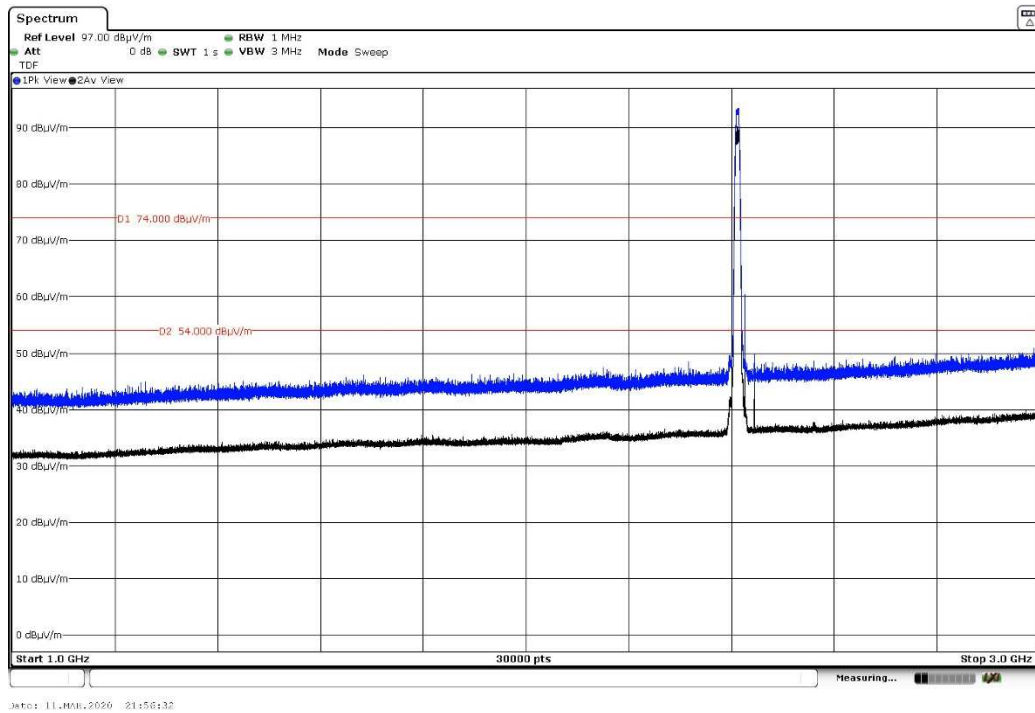


SISO CORE1_Port4 Antenna:

- Mode 802.11 b

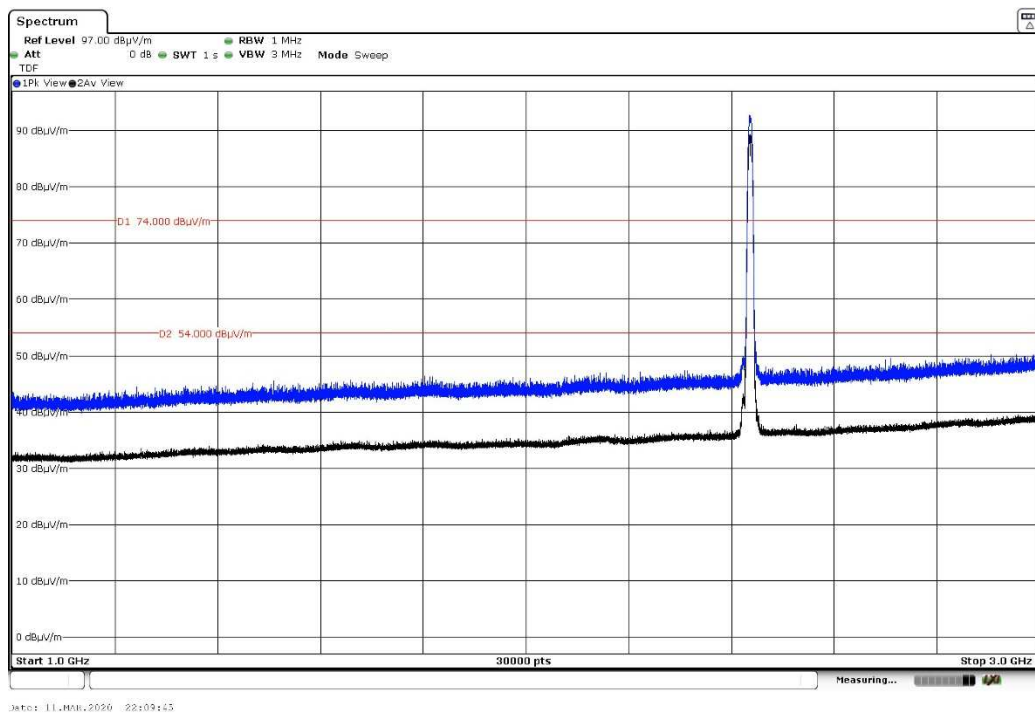
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



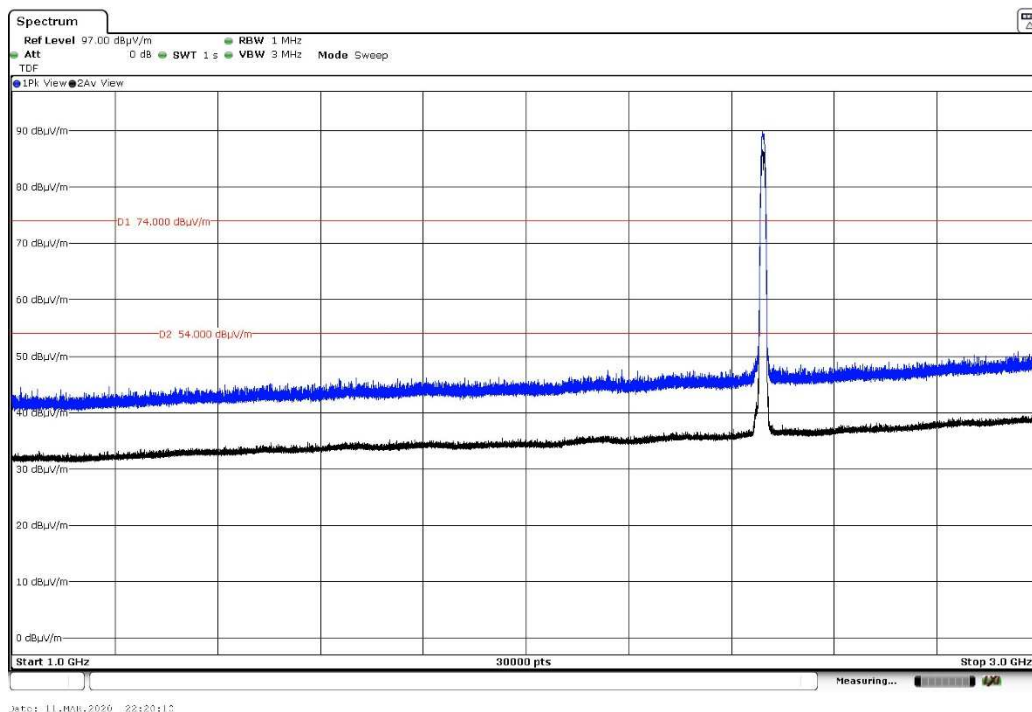
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

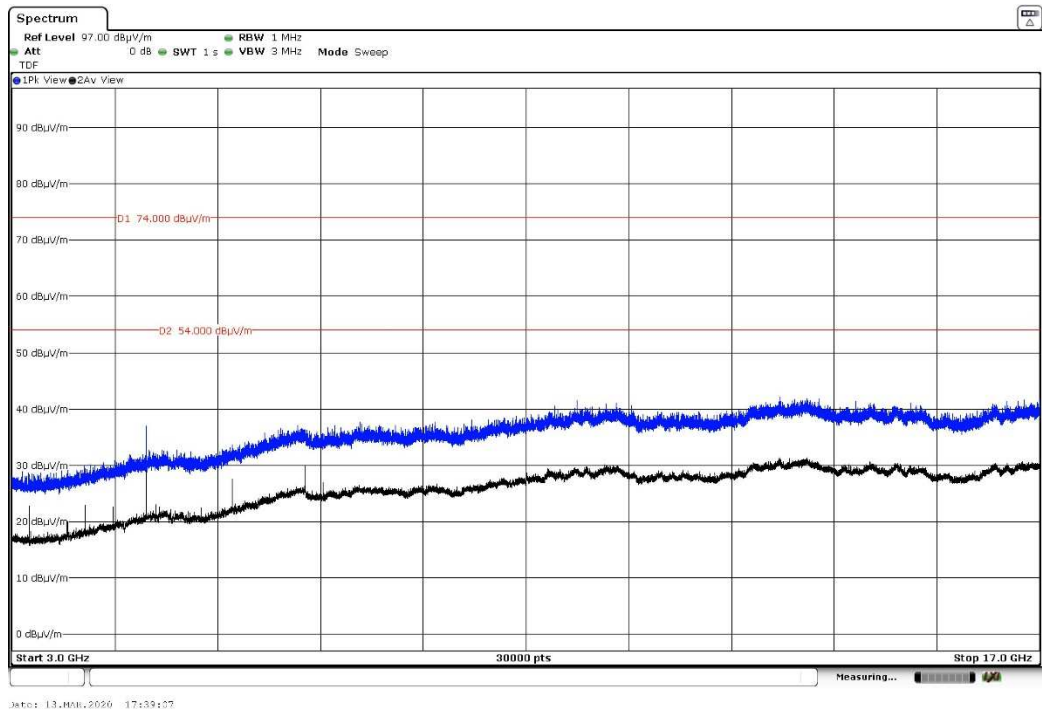
- High Channel:



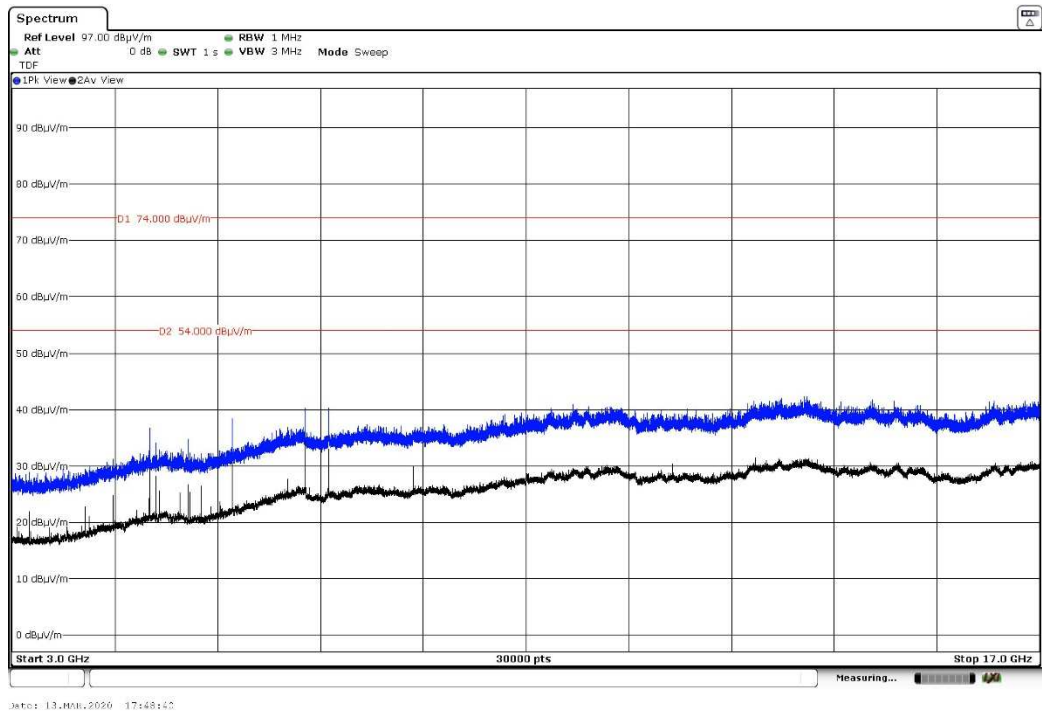
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

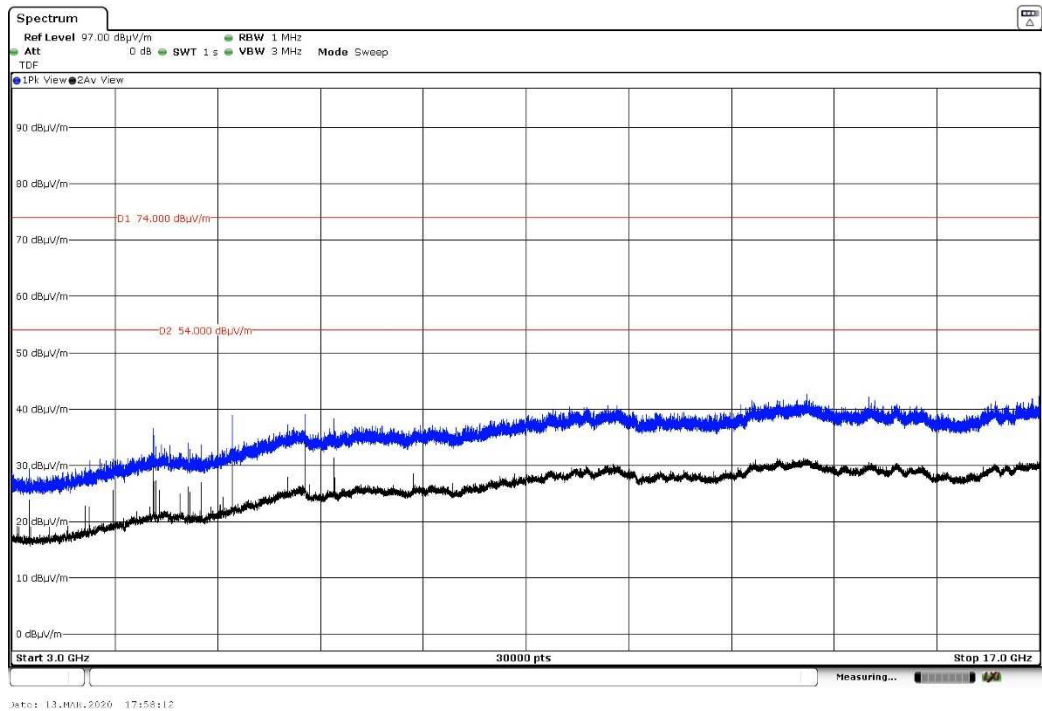
- Low Channel:



- Middle Channel:

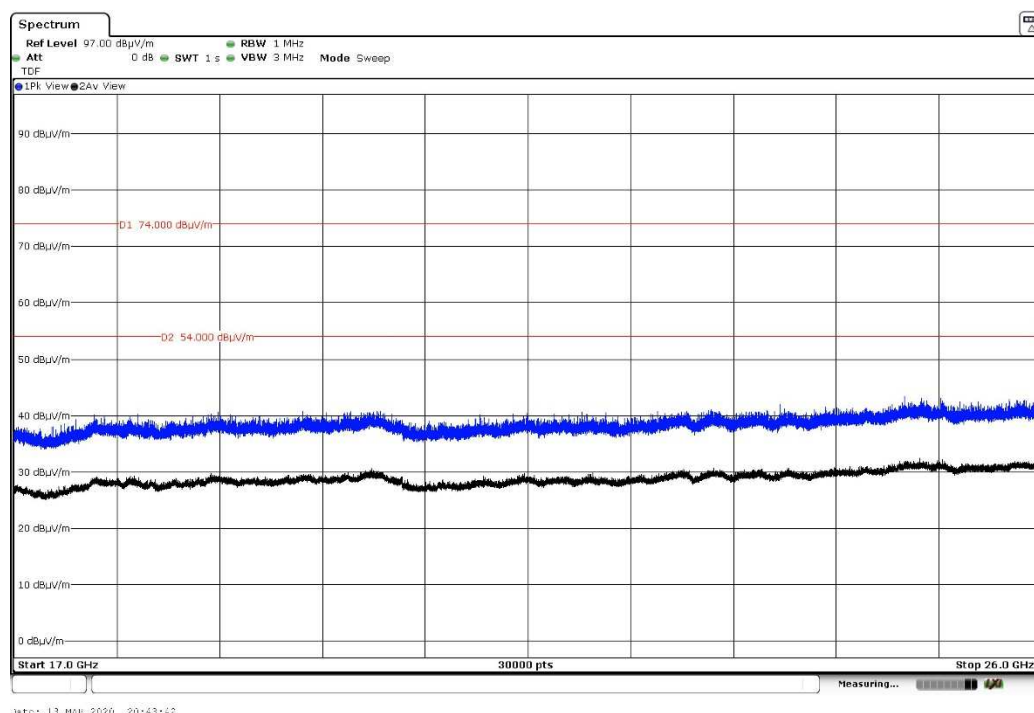


- High Channel:



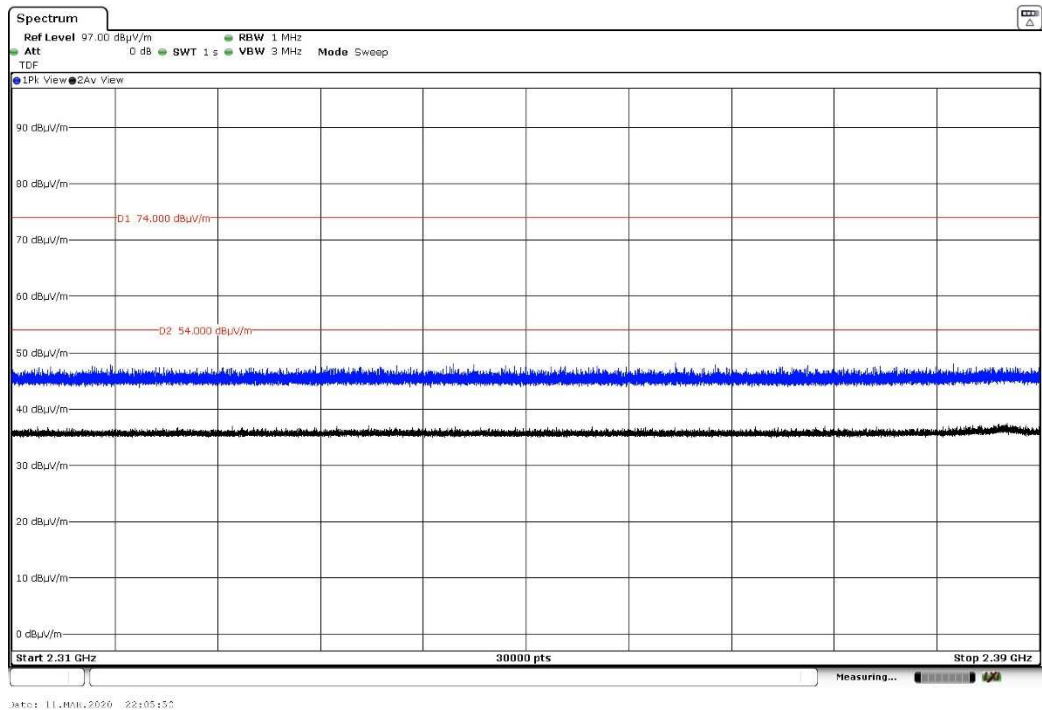
FREQUENCY RANGE 17 - 26 GHz:

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



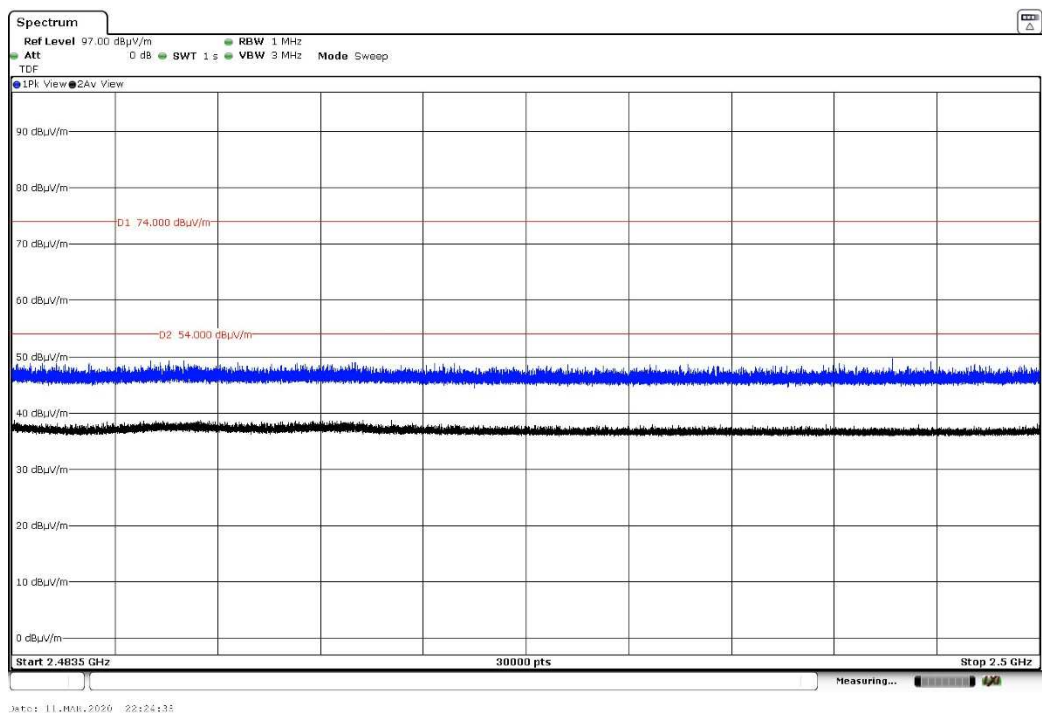
Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

- High Channel:

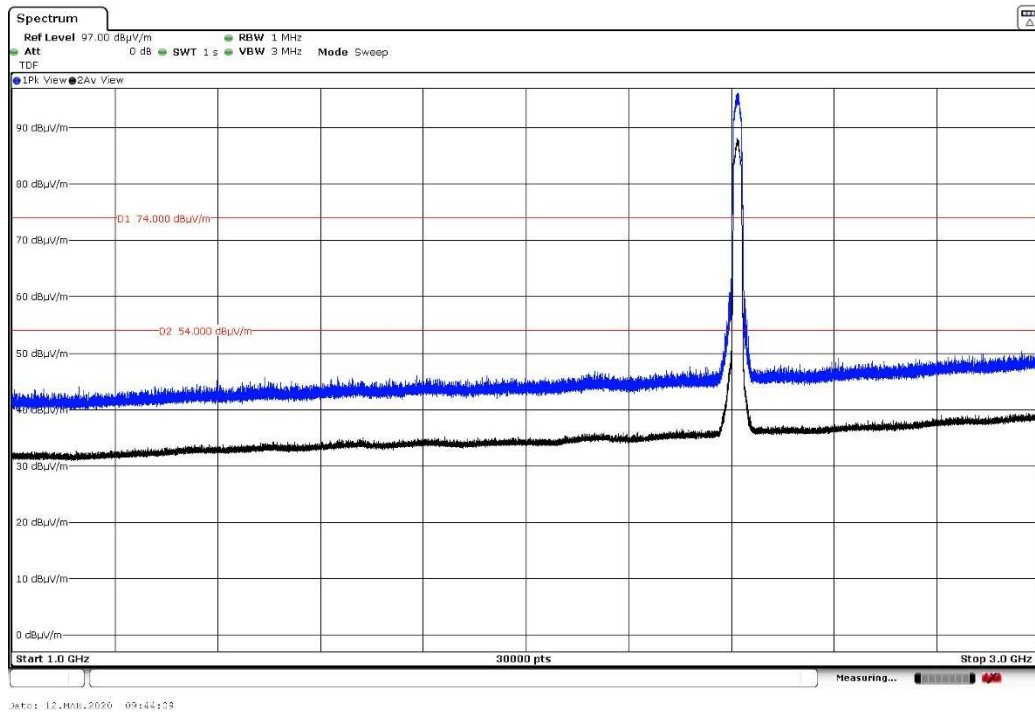


SISO CORE1_Port4 Antenna:

- Mode 802.11 g

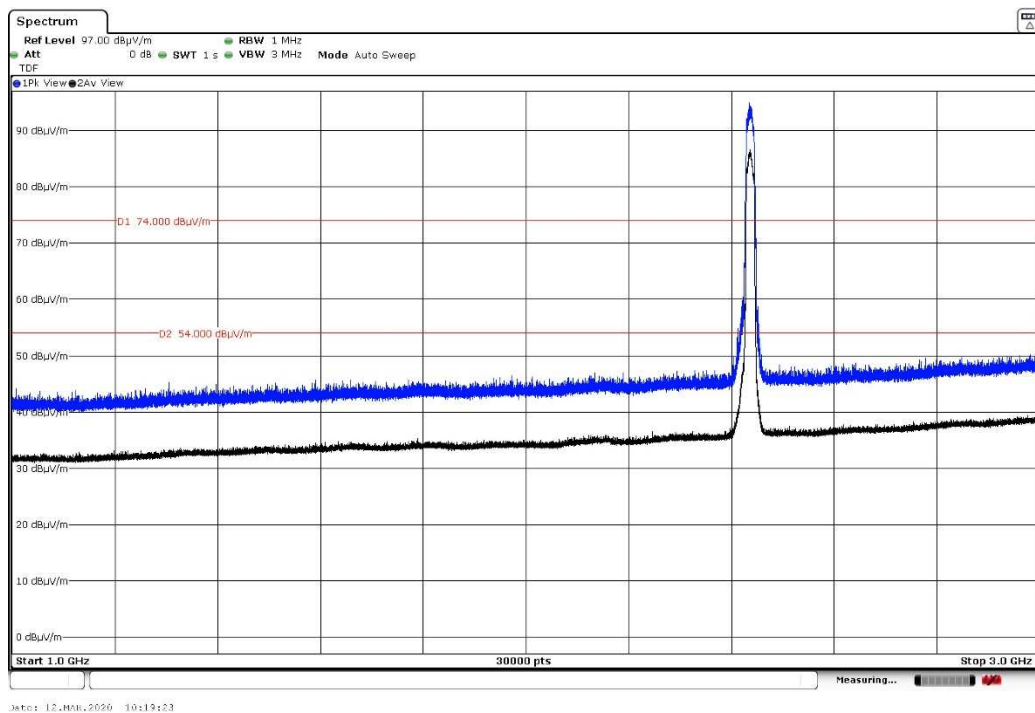
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



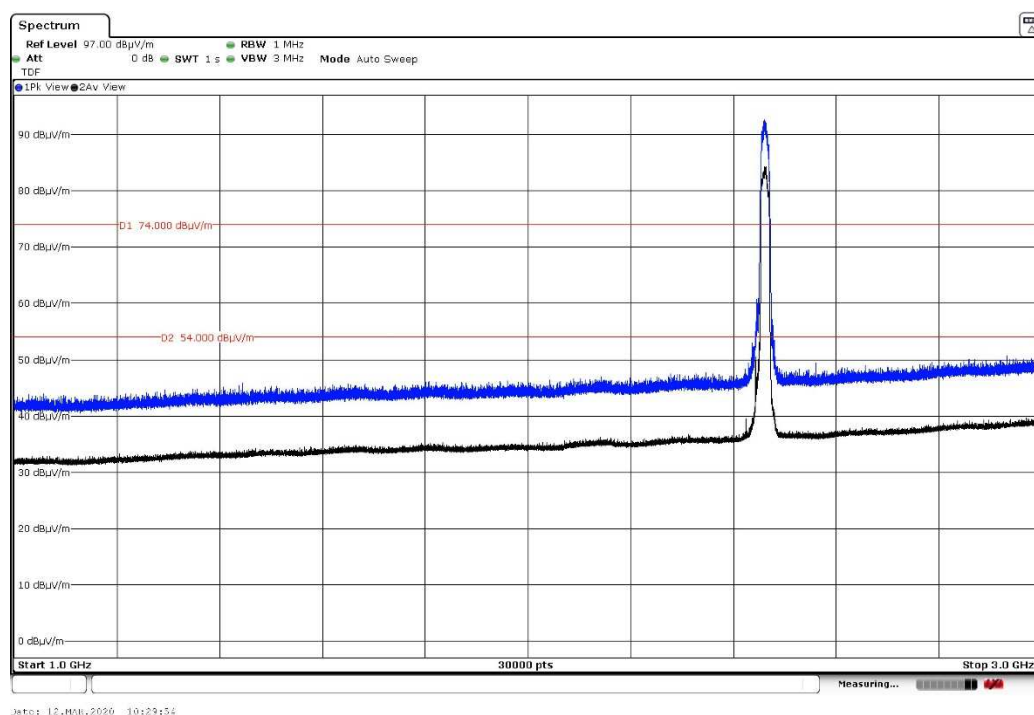
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

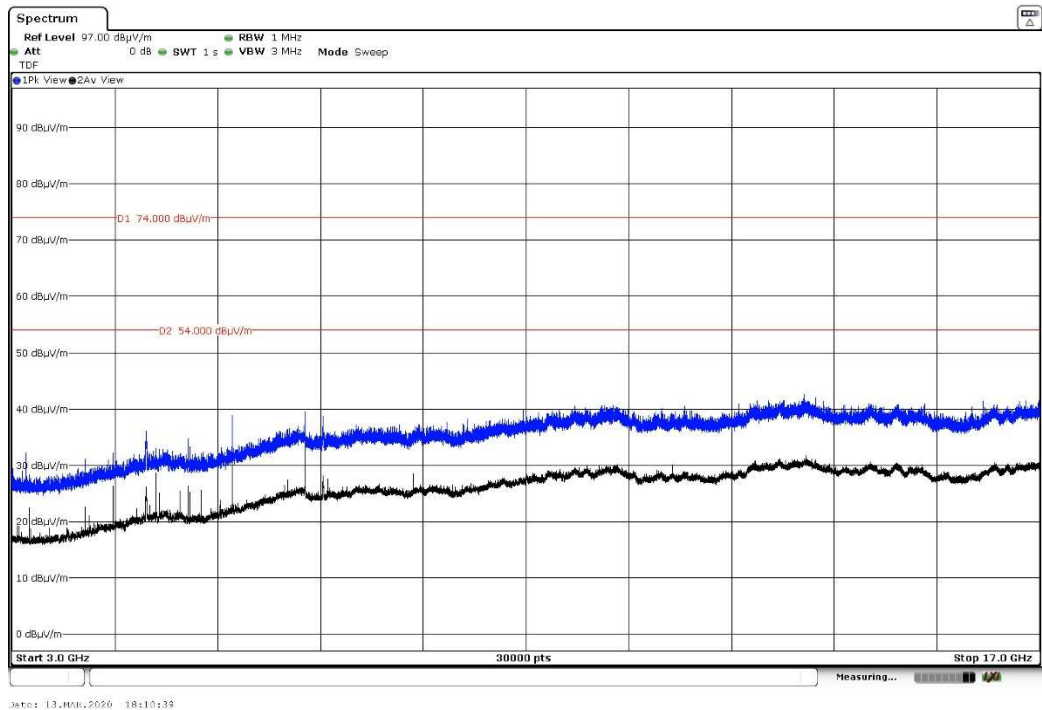
- High Channel:



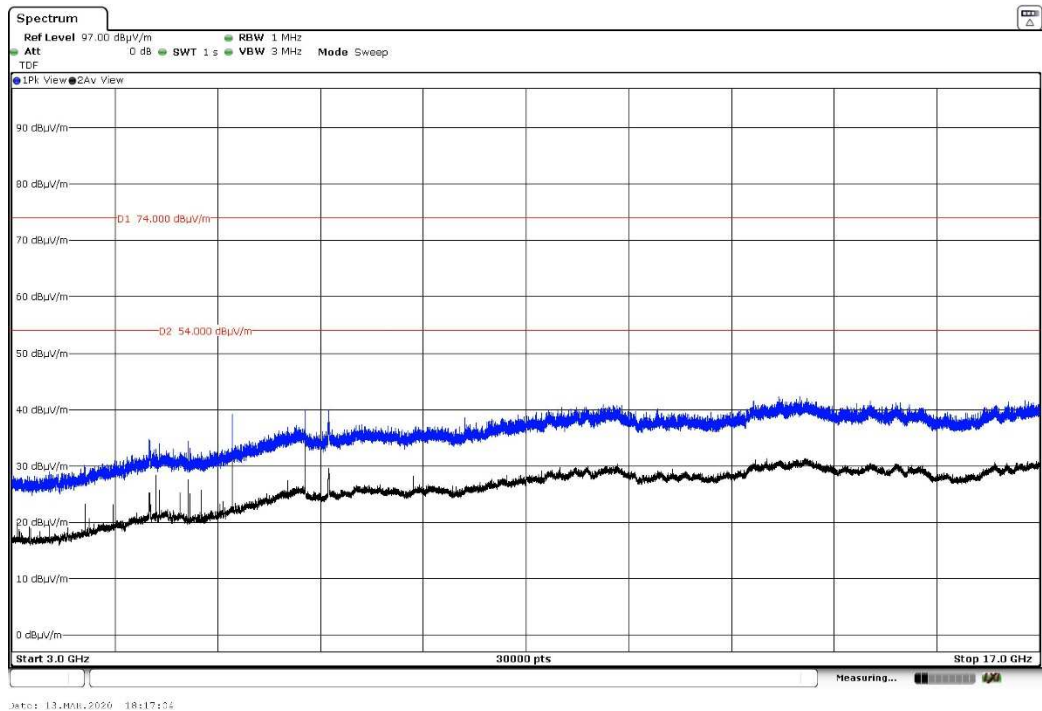
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

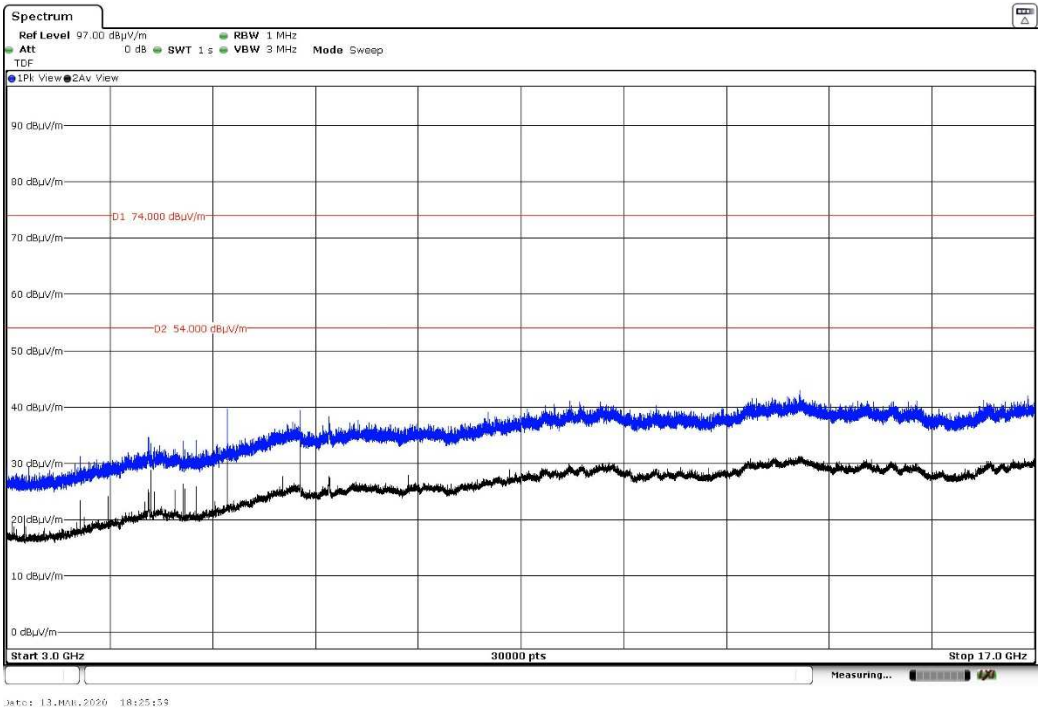
- Low Channel:



- Middle Channel:

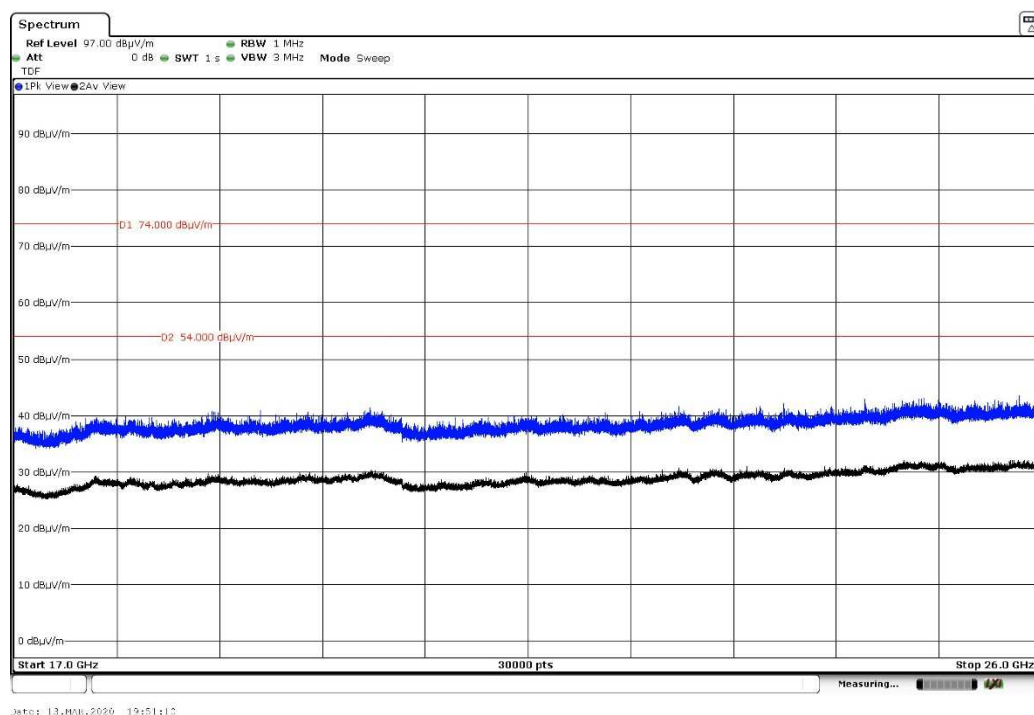


- High Channel:



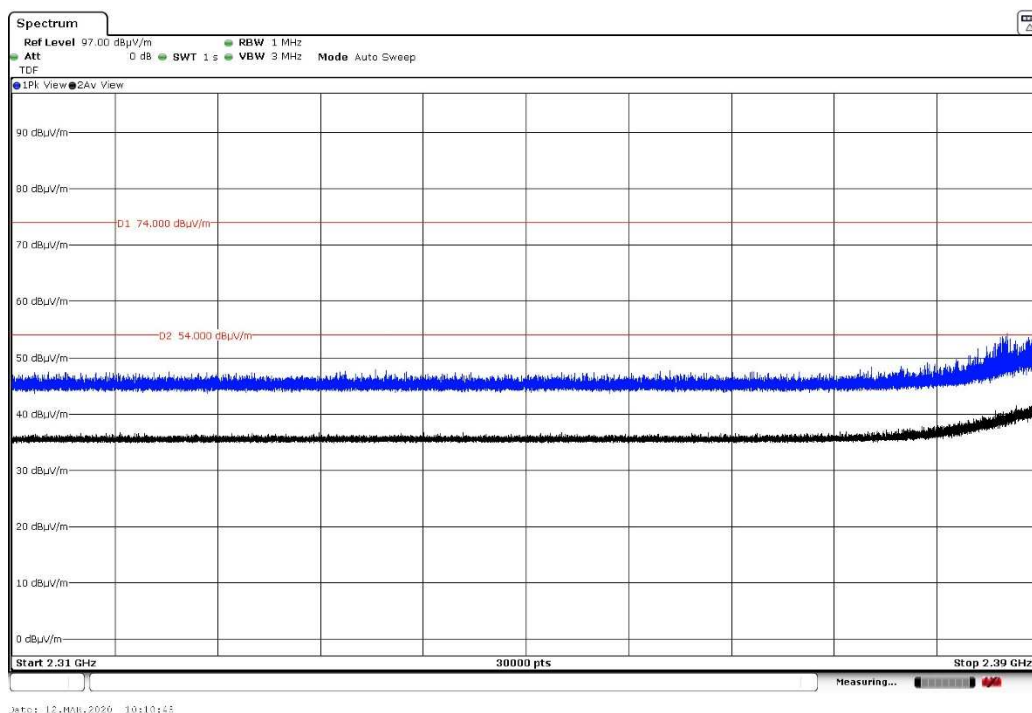
FREQUENCY RANGE 17 - 26 GHz:

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



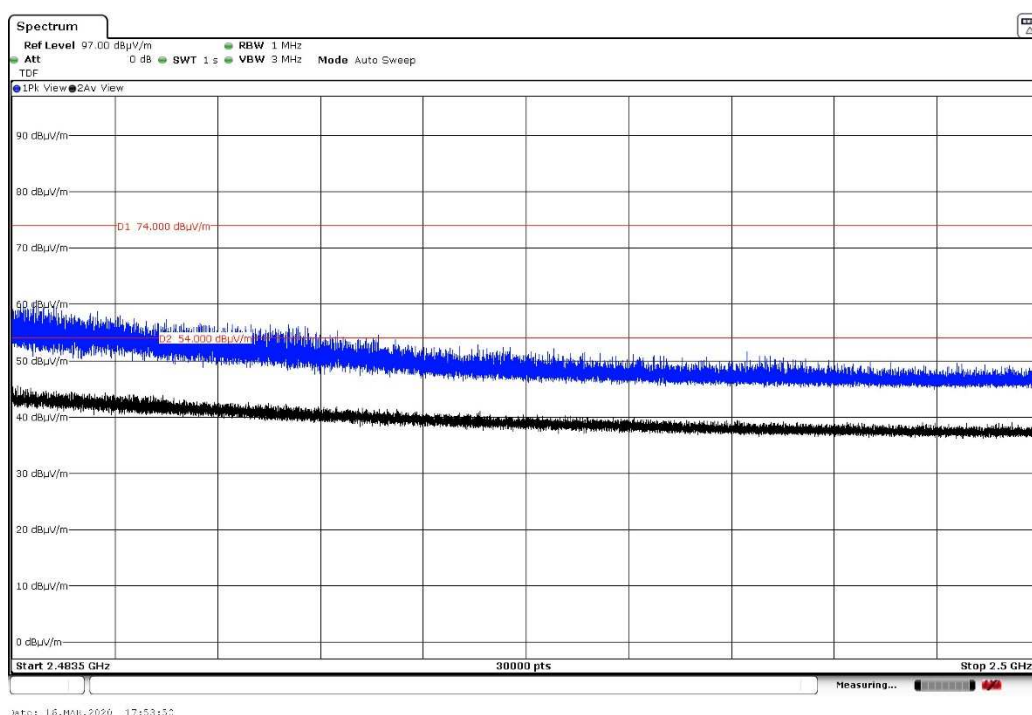
Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

- High Channel:

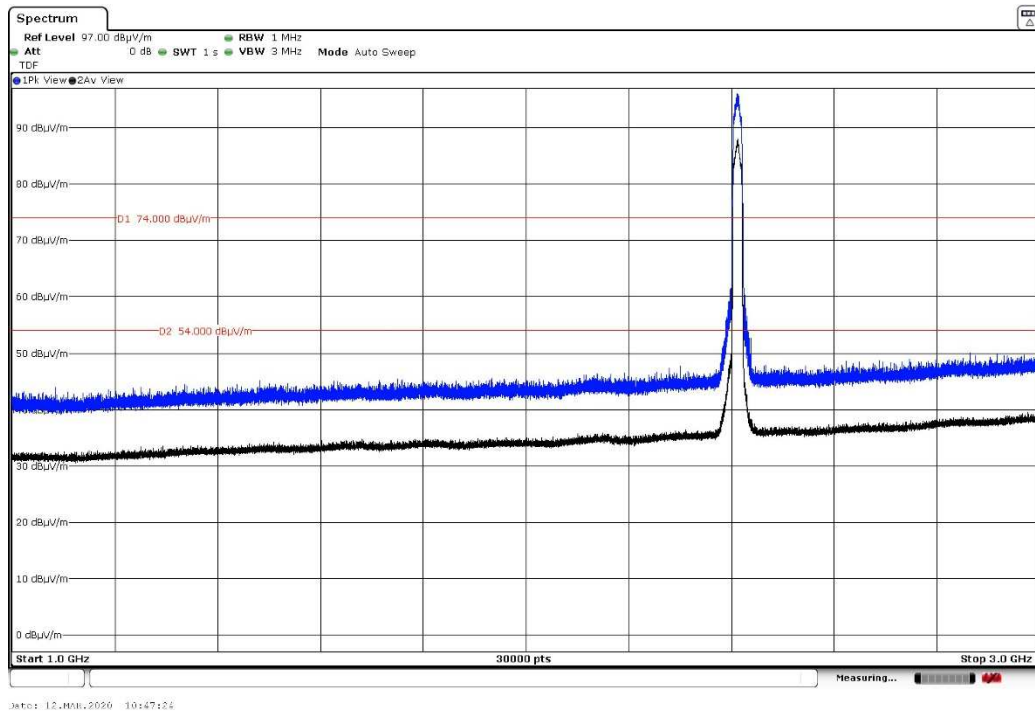


SISO CORE1_Port4 Antenna:

- Mode 802.11 n20

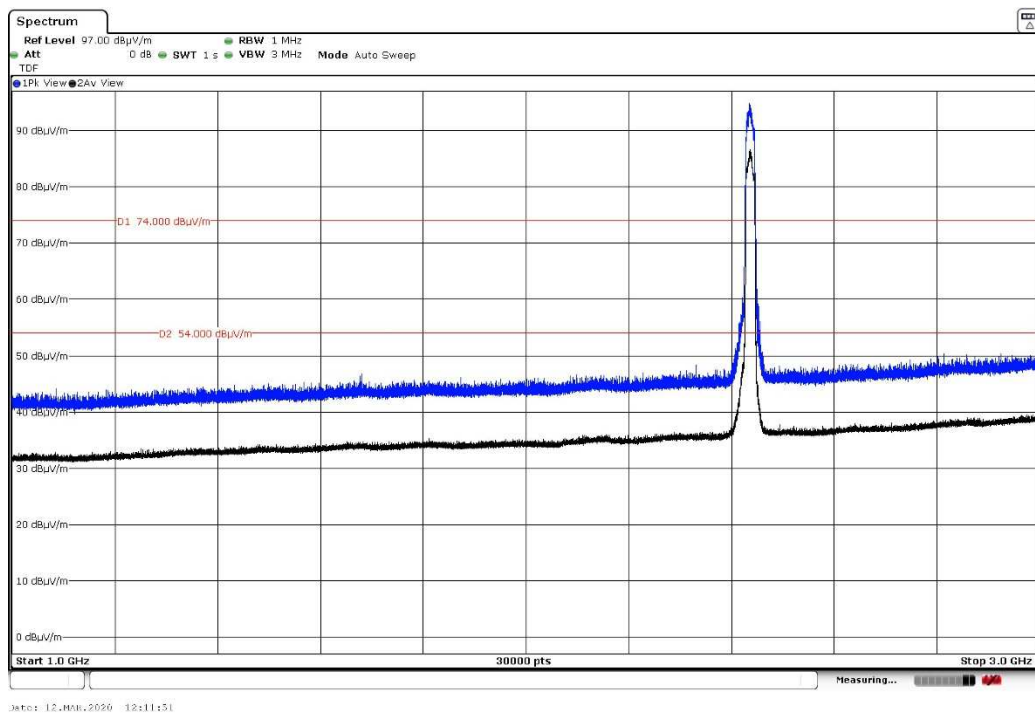
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



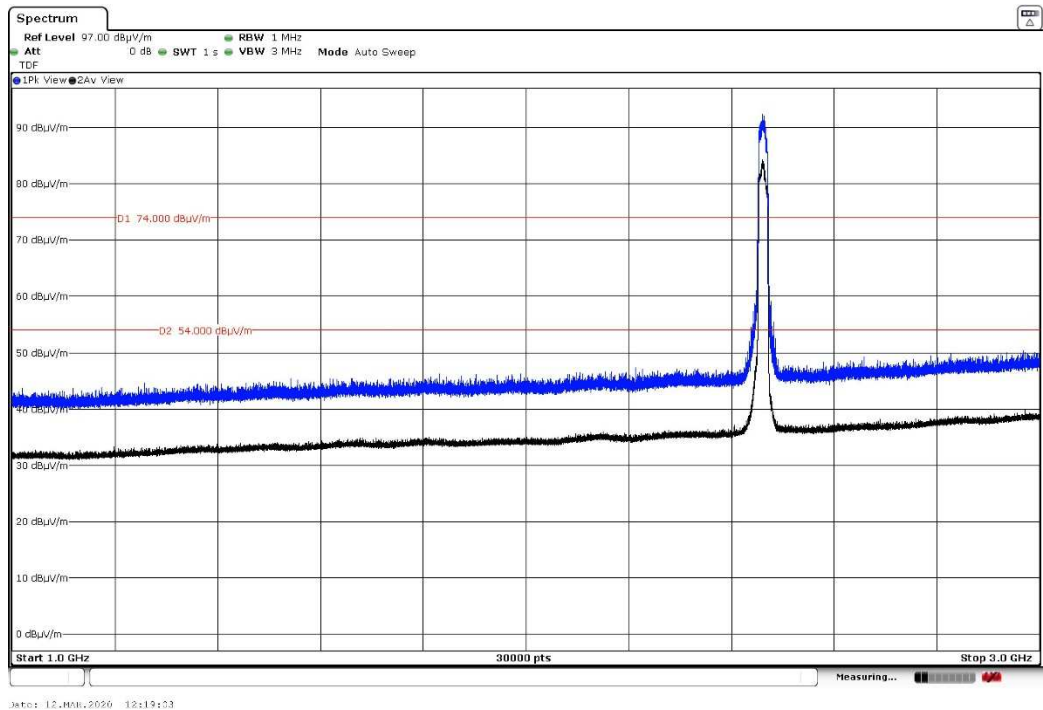
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

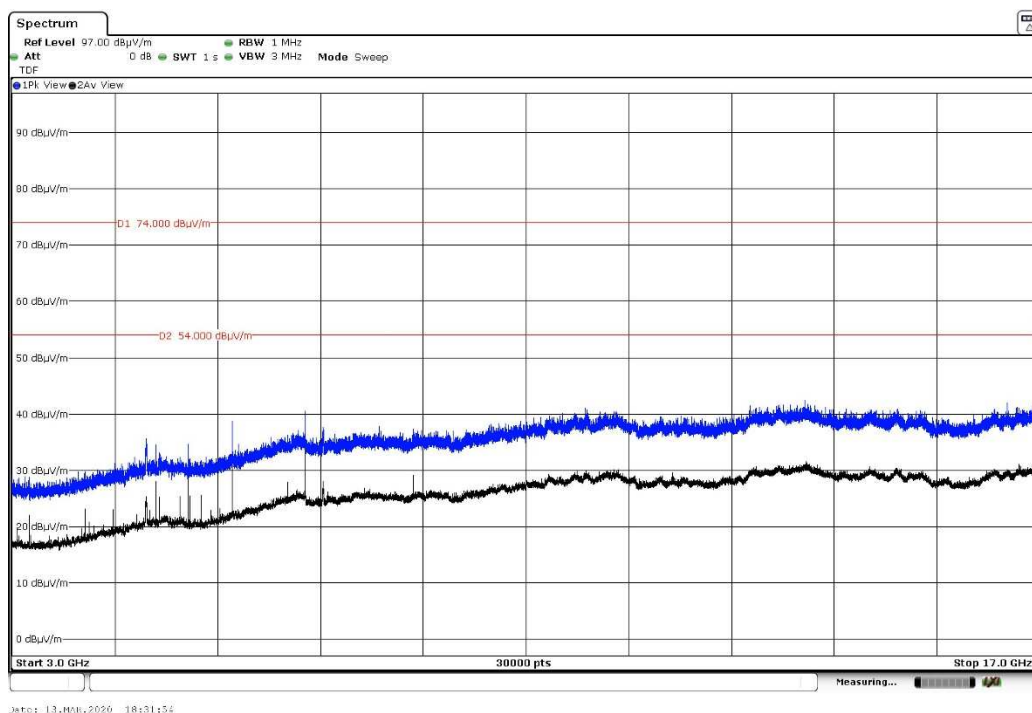
- High Channel:



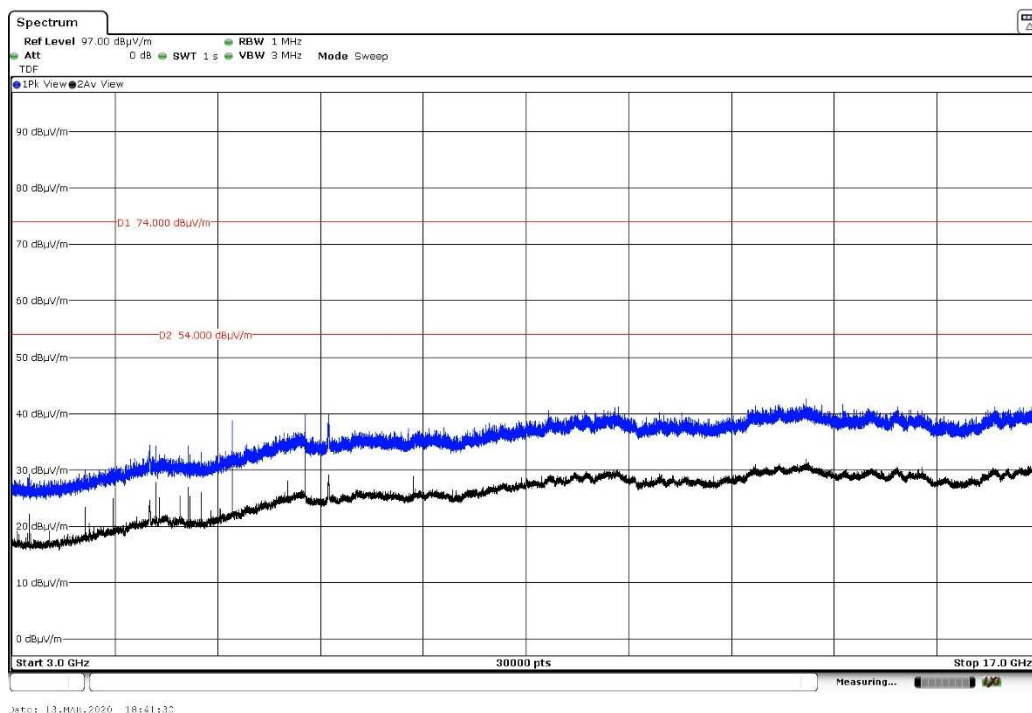
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

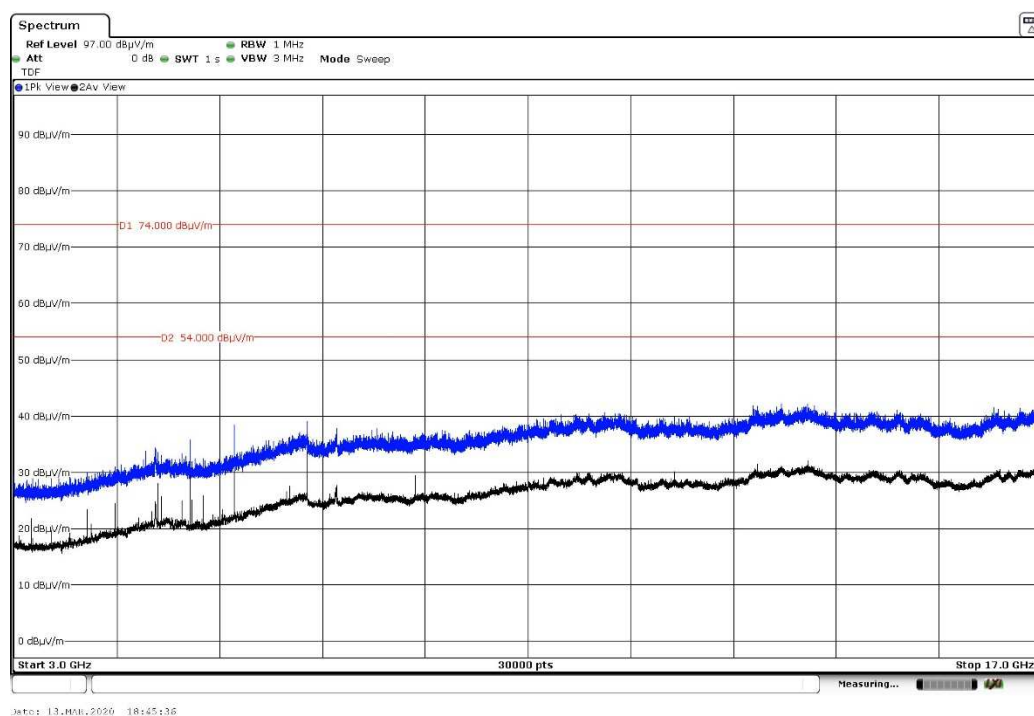
- Low Channel:



- Middle Channel:

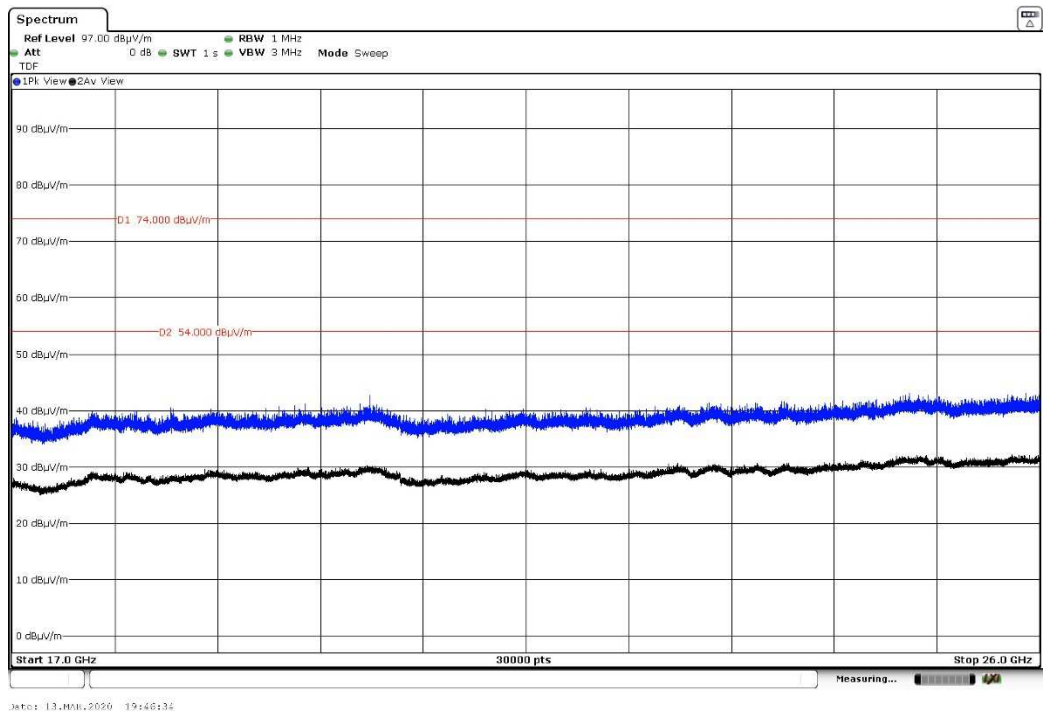


- High Channel:



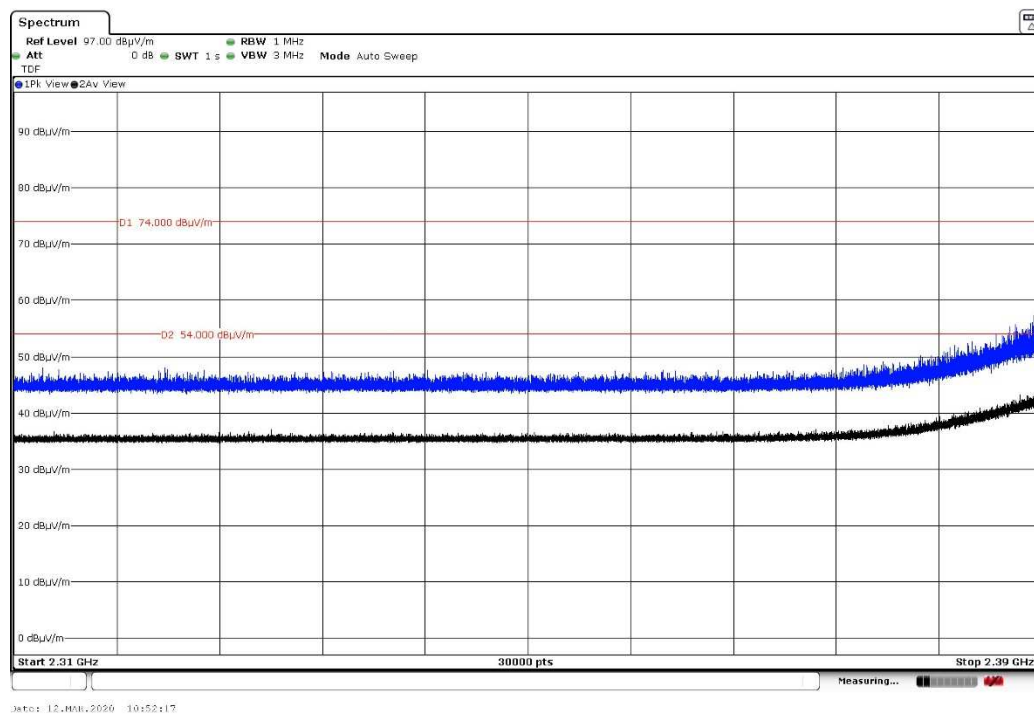
FREQUENCY RANGE 17 - 26 GHz:

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



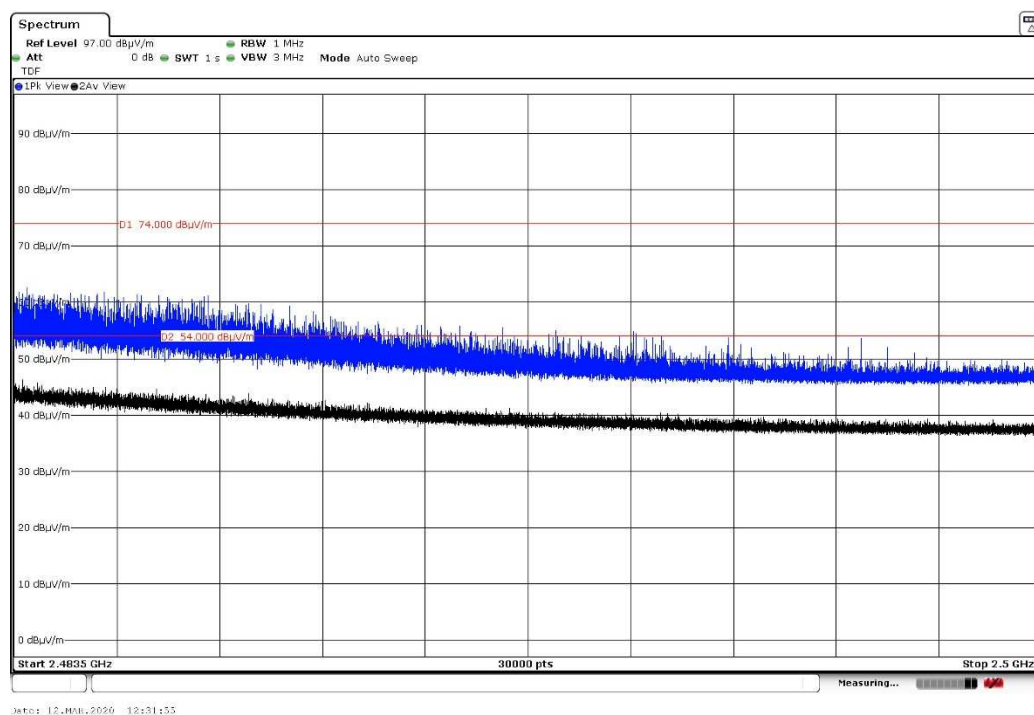
Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

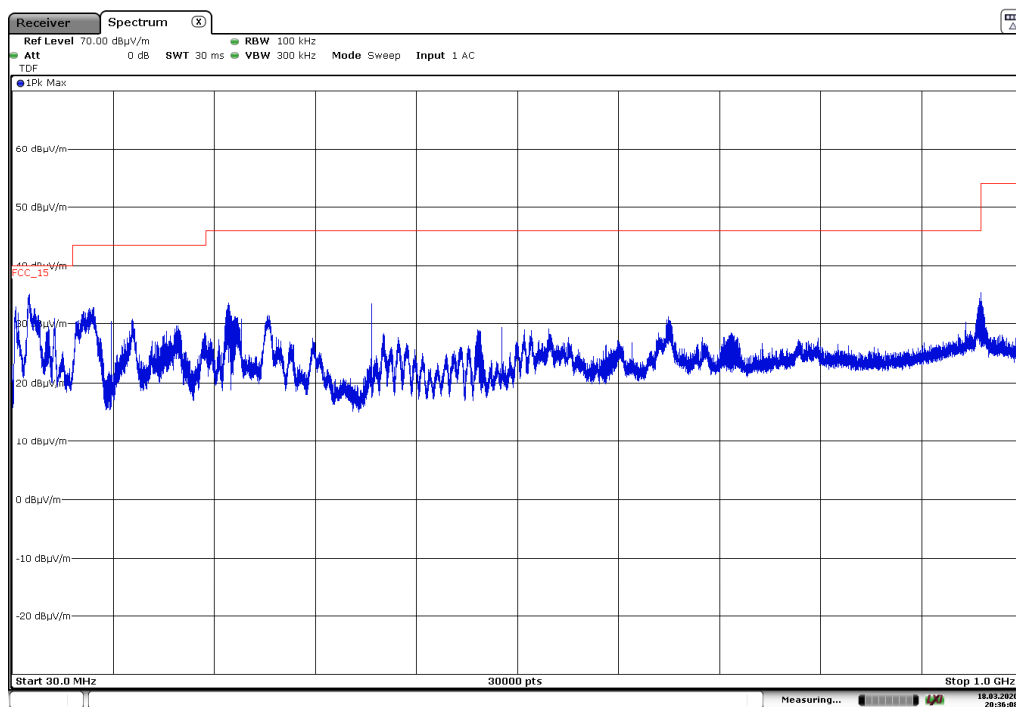
- High Channel:



MIMO – CORE1_Port4 Antenna & CORE1_Port2 Antenna:

FREQUENCY RANGE 30 MHz - 1 GHz:

The spurious signals detected do not depend neither on the operating channel nor the modulation mode.

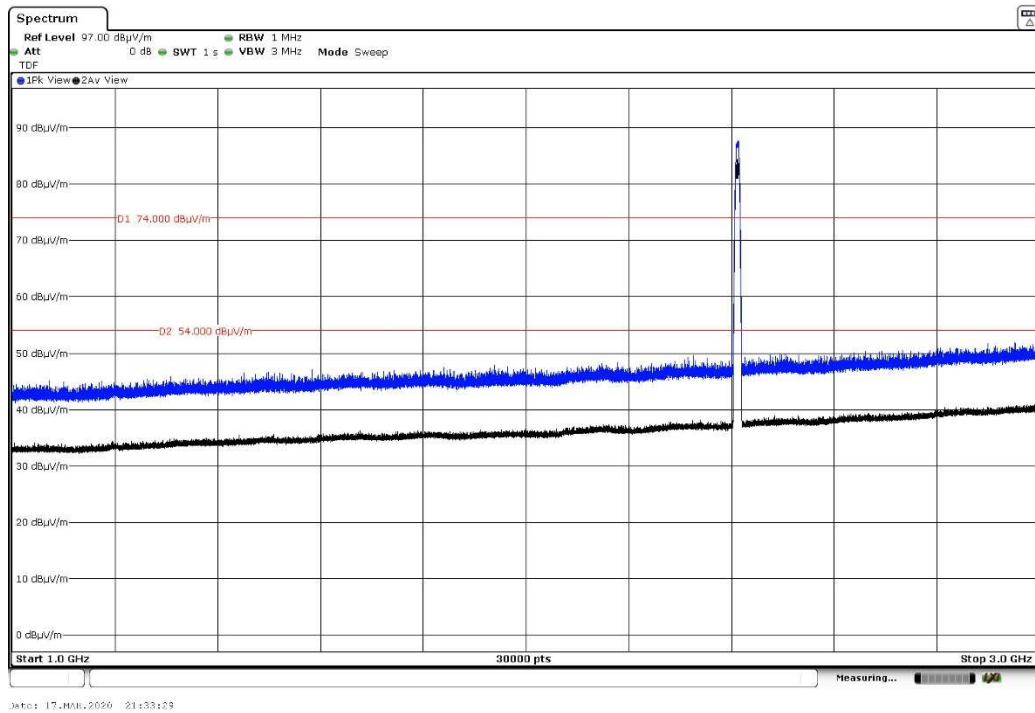


MIMO – CORE1_Port4 Antenna & CORE1_Port2 Antenna:

- Mode 802.11 b

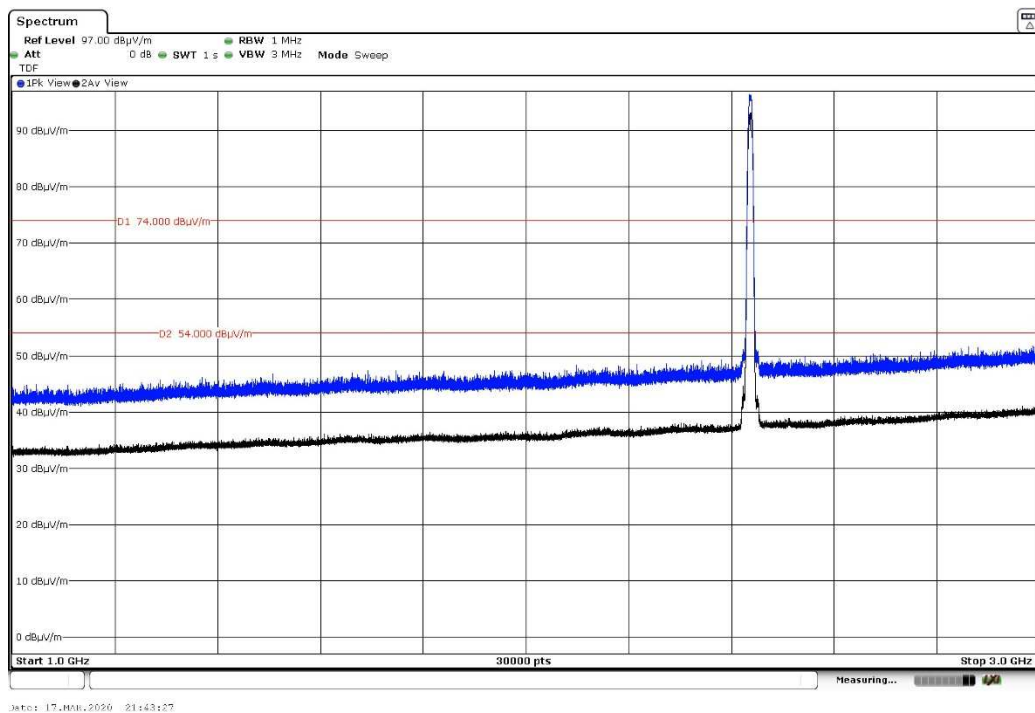
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



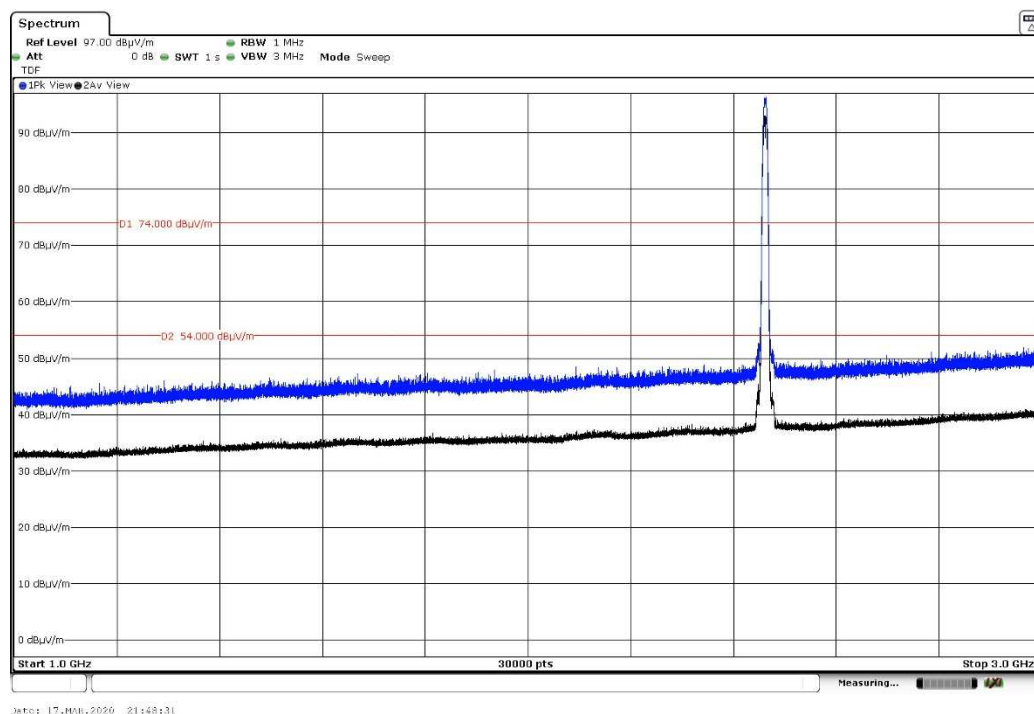
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

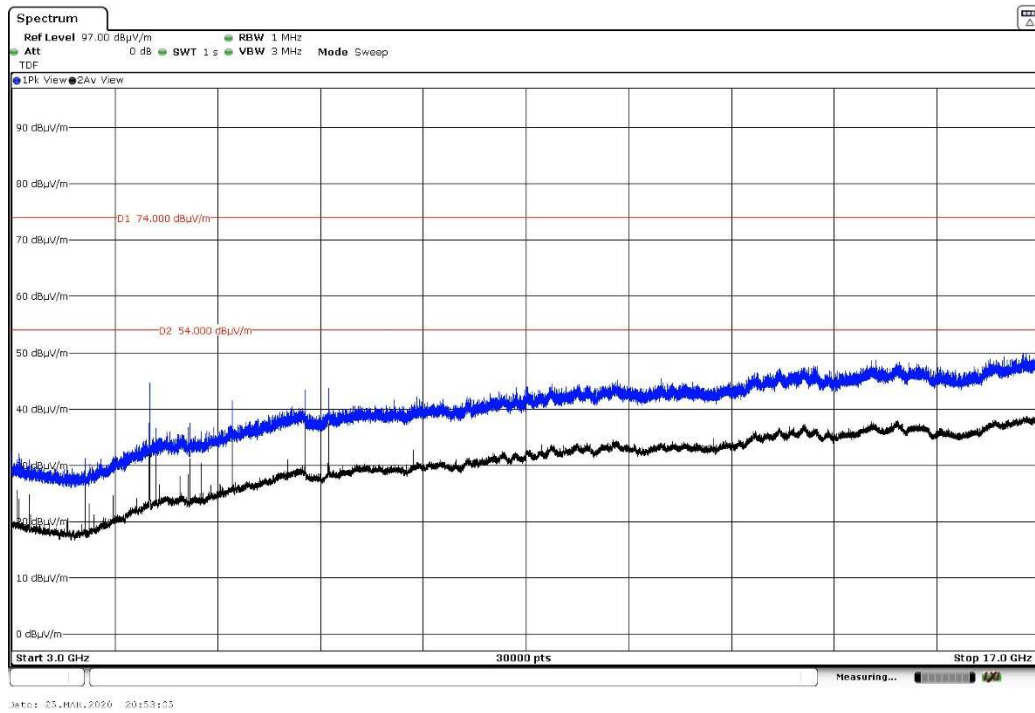
- High Channel:



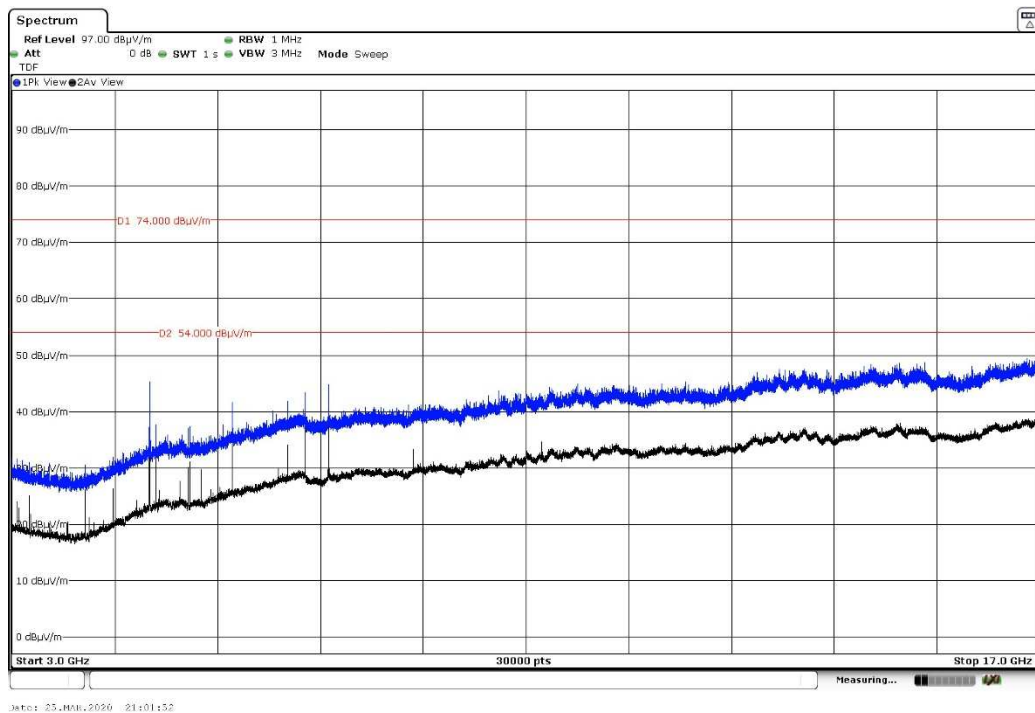
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

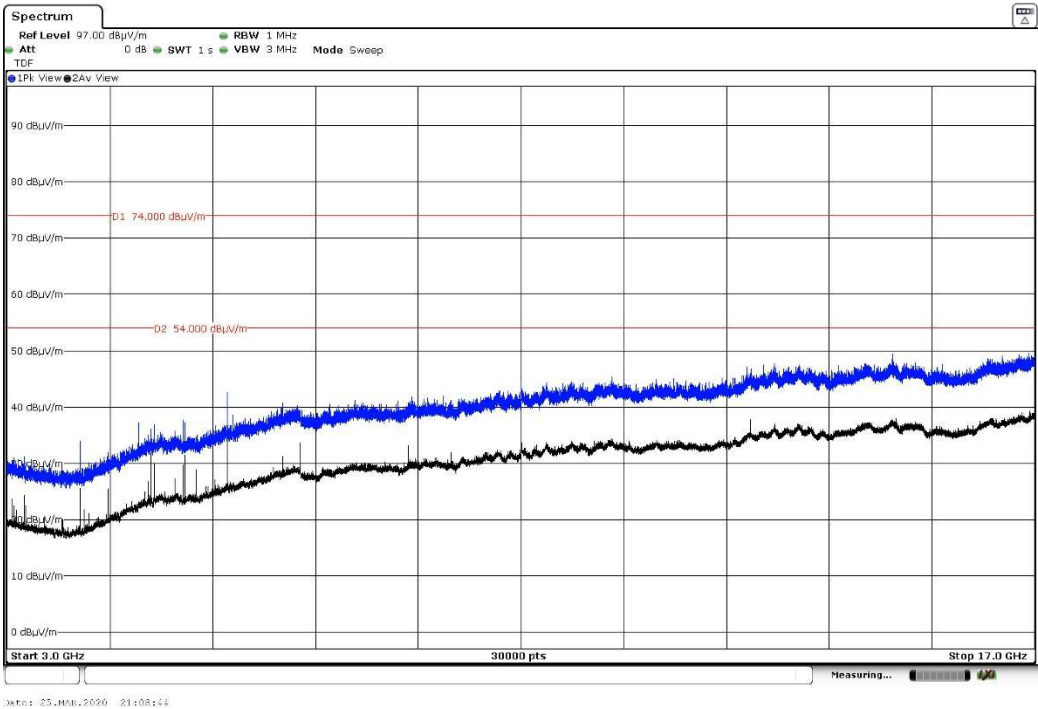
- Low Channel:



- Middle Channel:

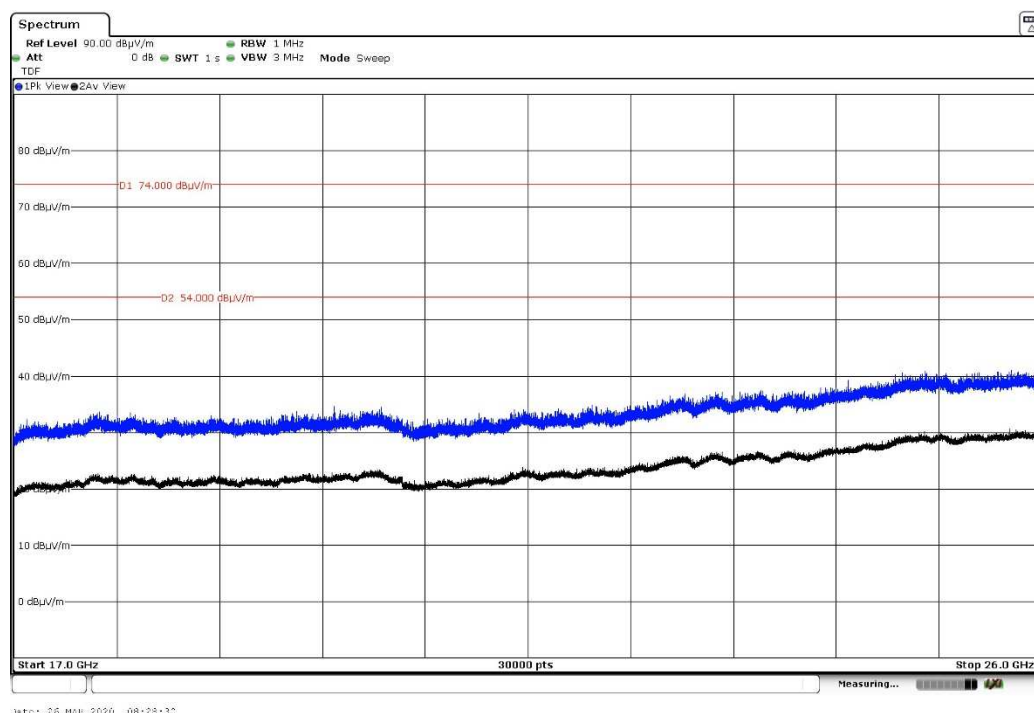


- High Channel:



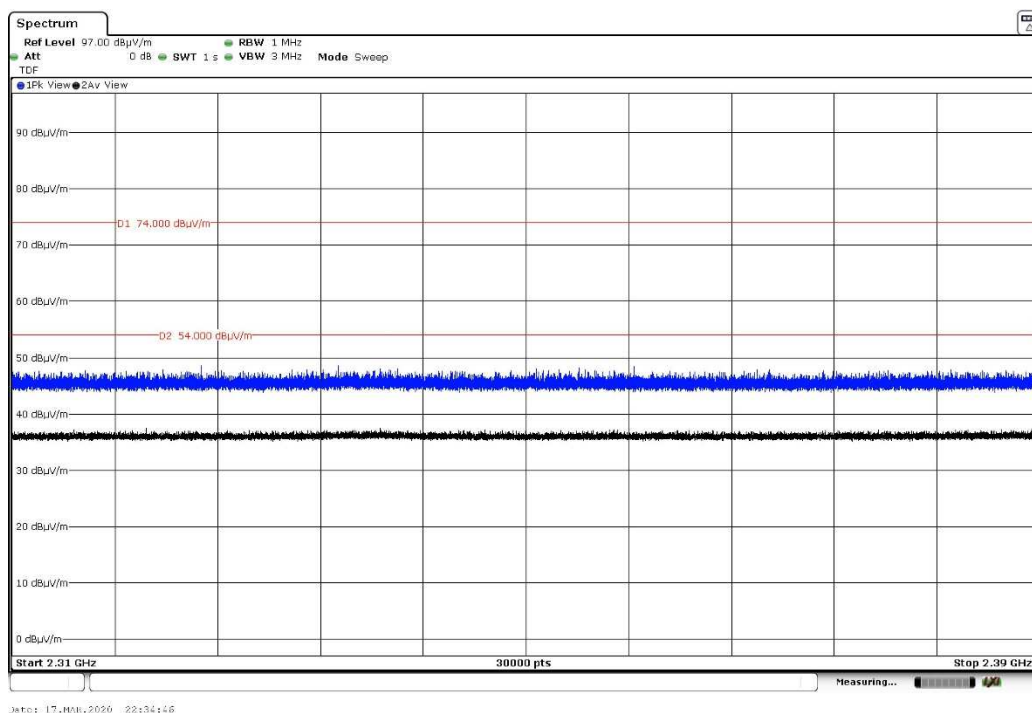
FREQUENCY RANGE 17 - 26 GHz:

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



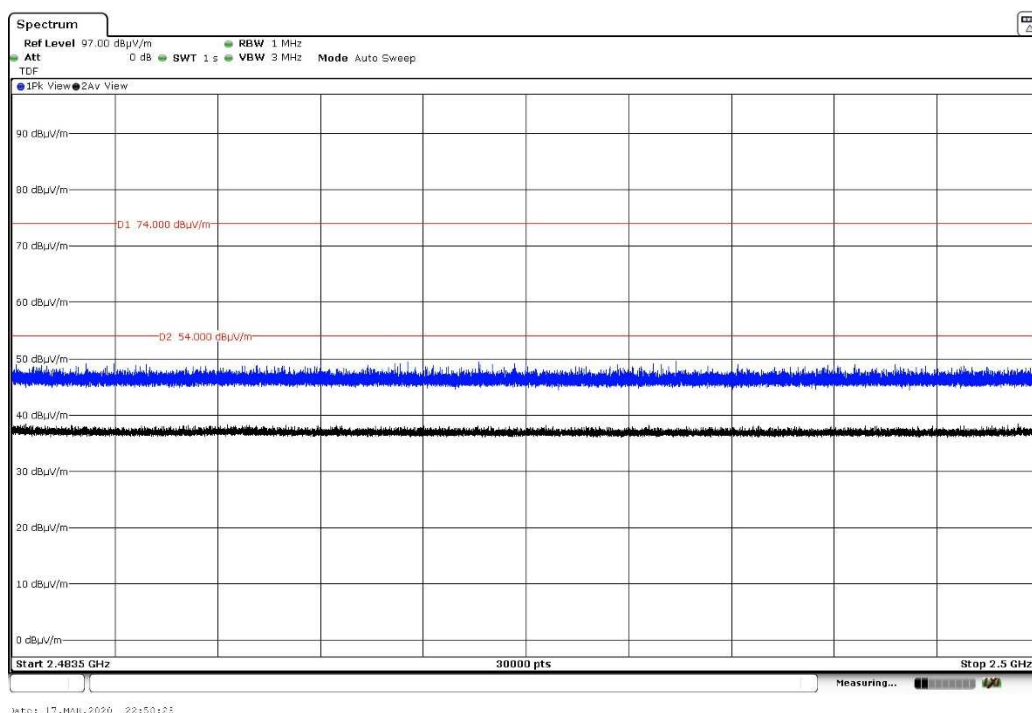
Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

- High Channel:

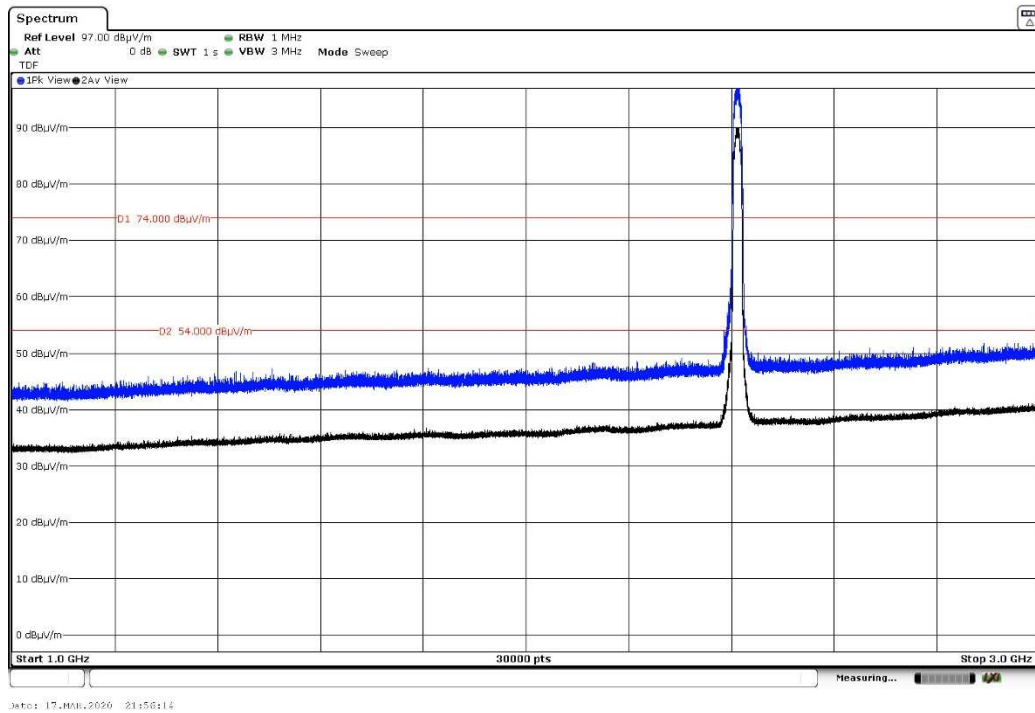


MIMO – CORE1_Port4 Antenna & CORE1_Port2 Antenna:

- Mode 802.11 g

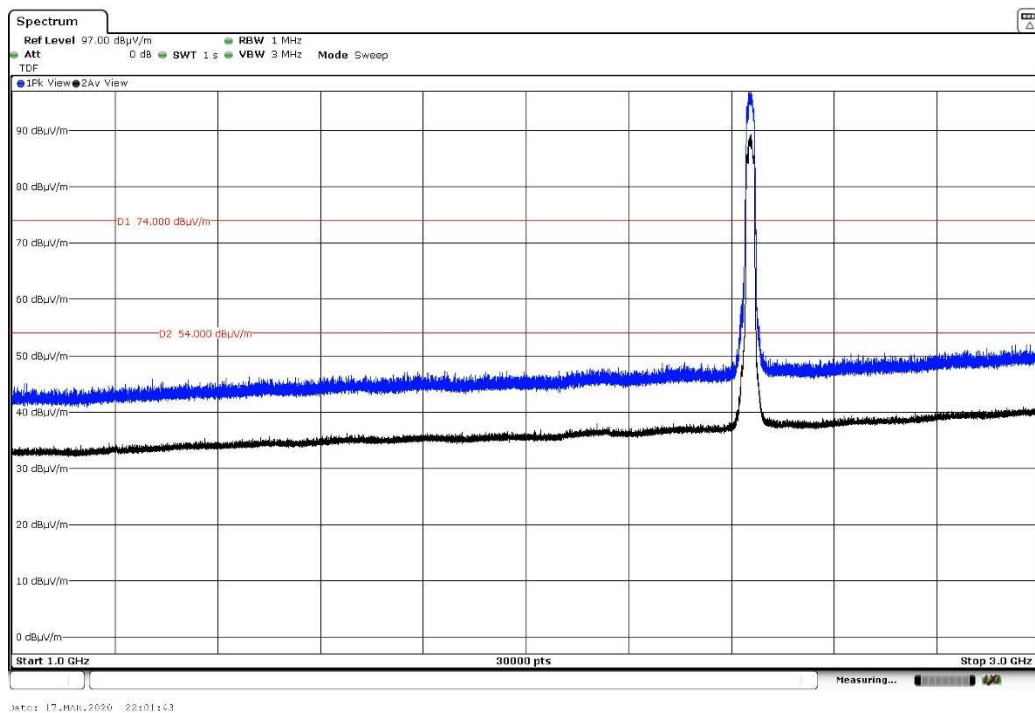
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



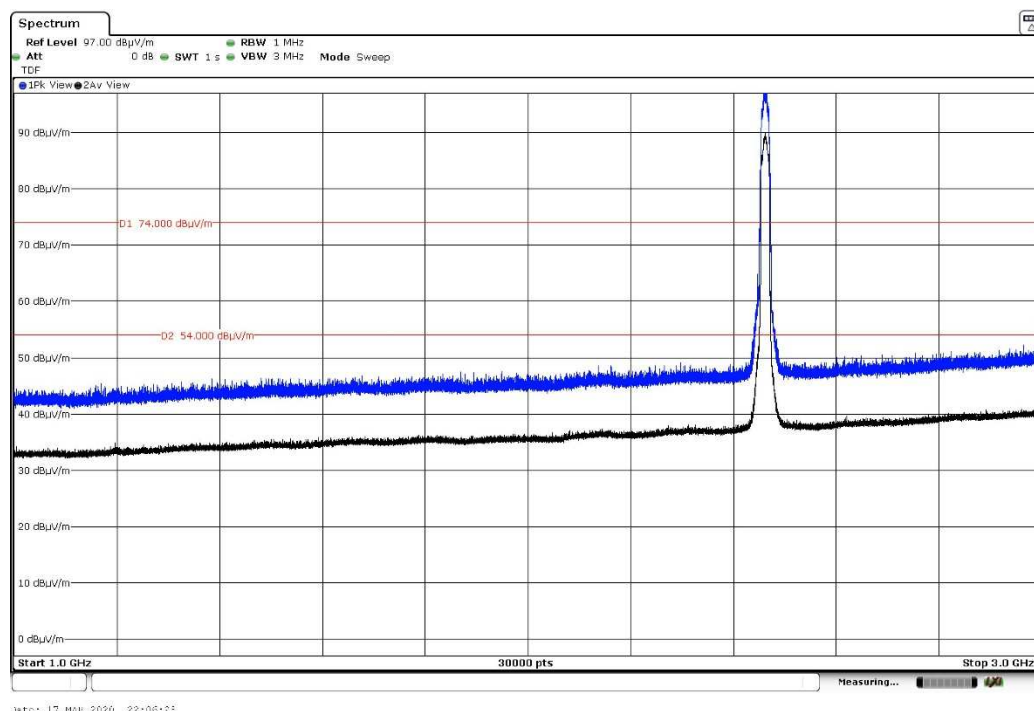
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

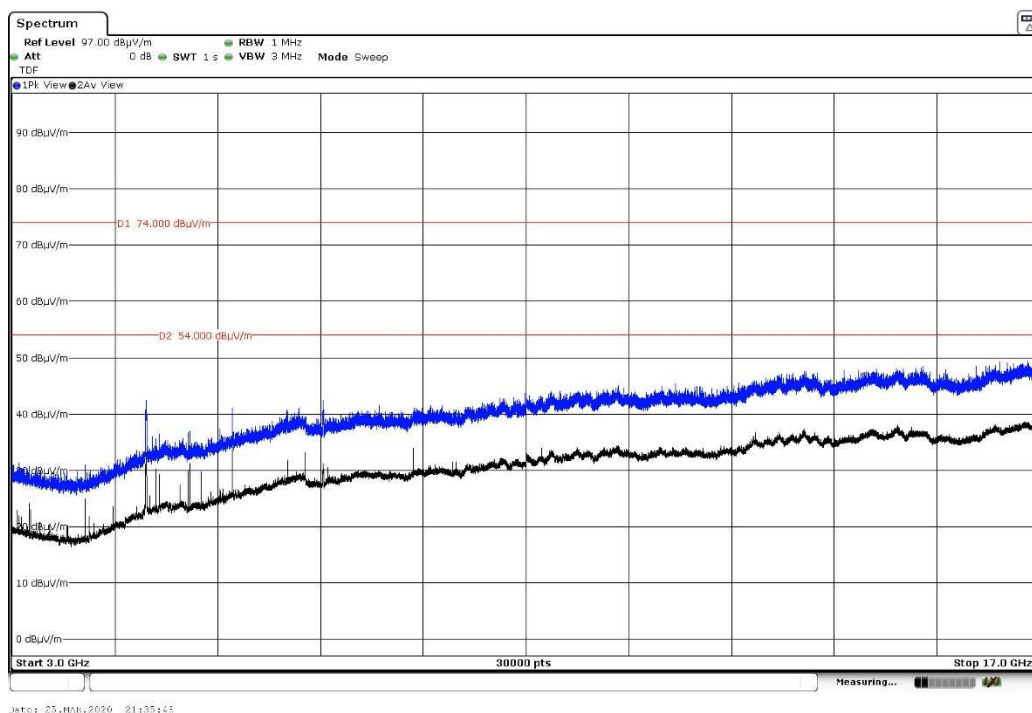
- High Channel:



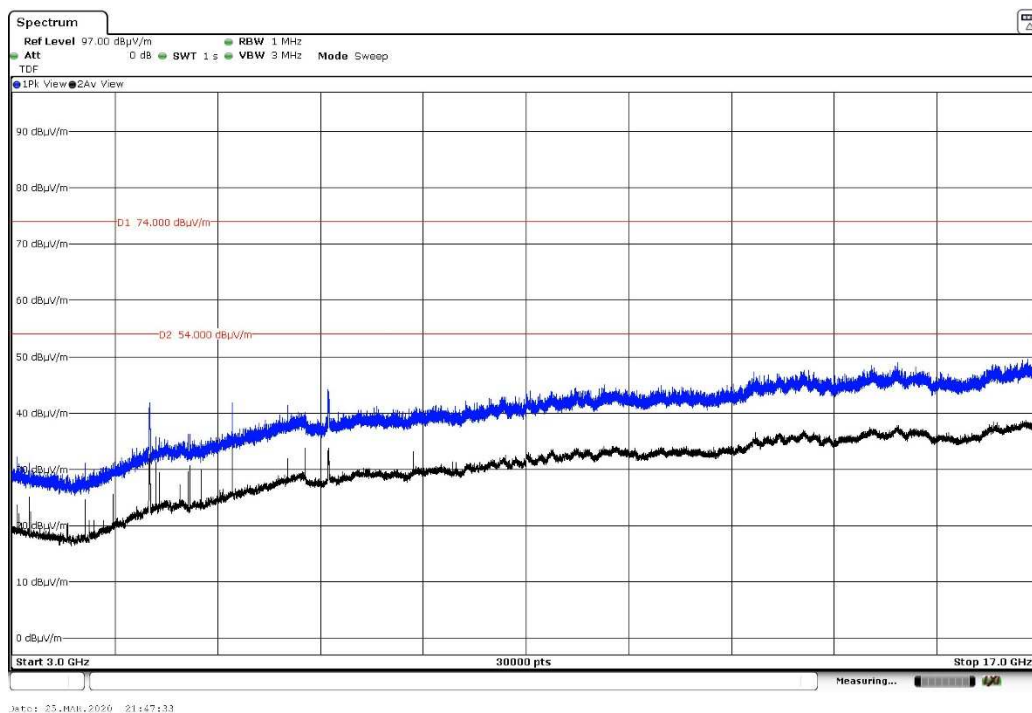
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

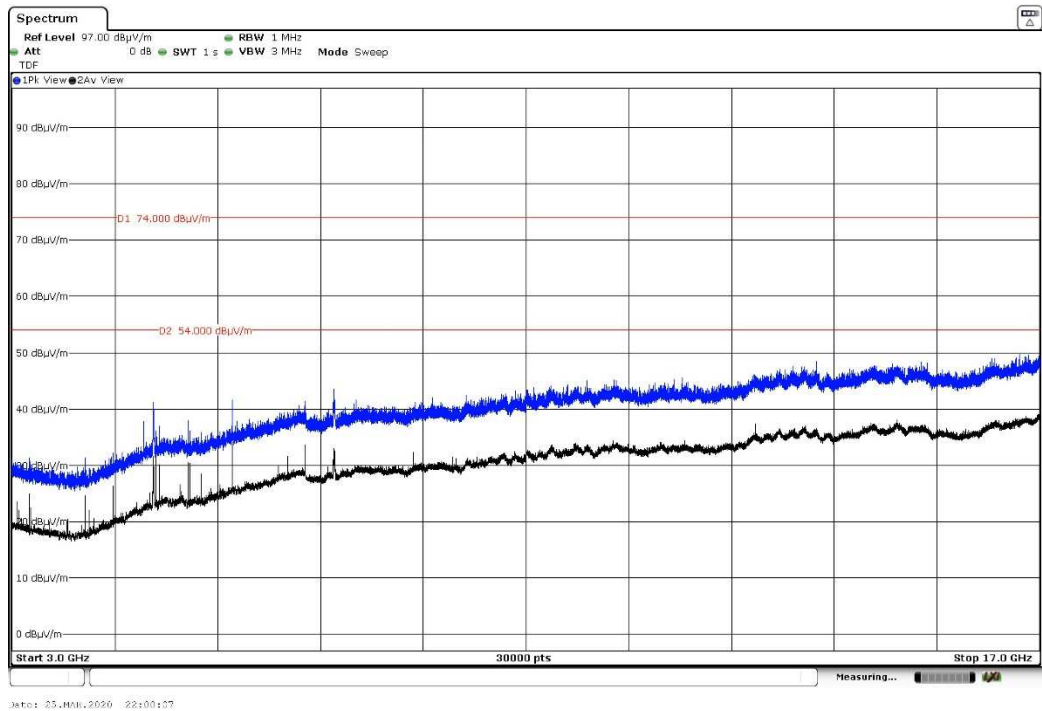
- Low Channel:



- Middle Channel:

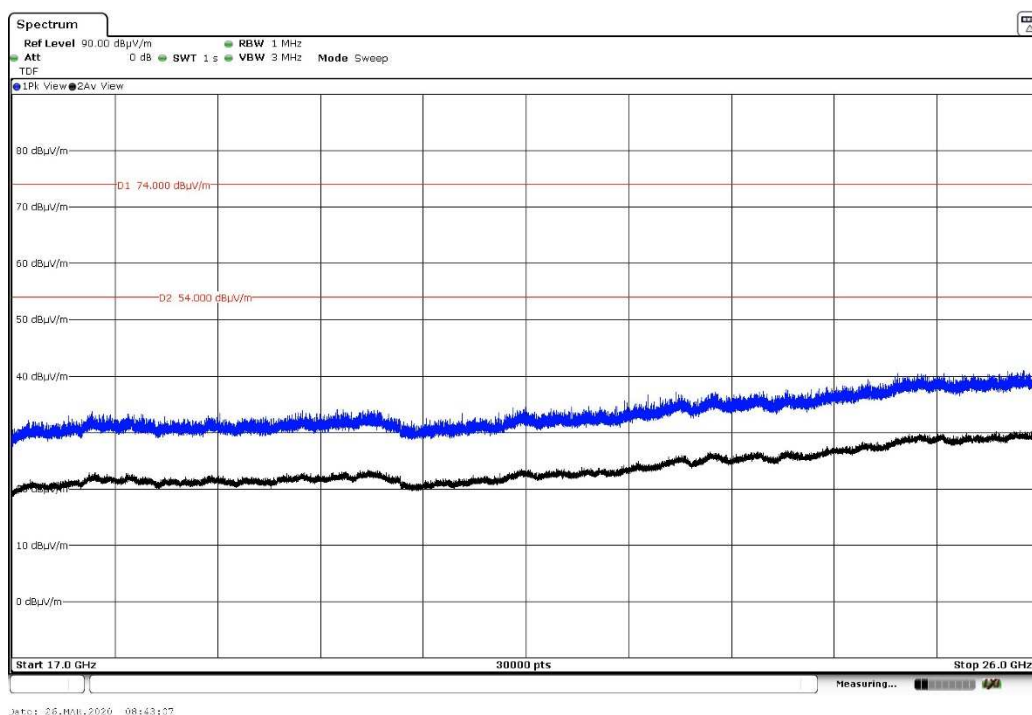


- High Channel:



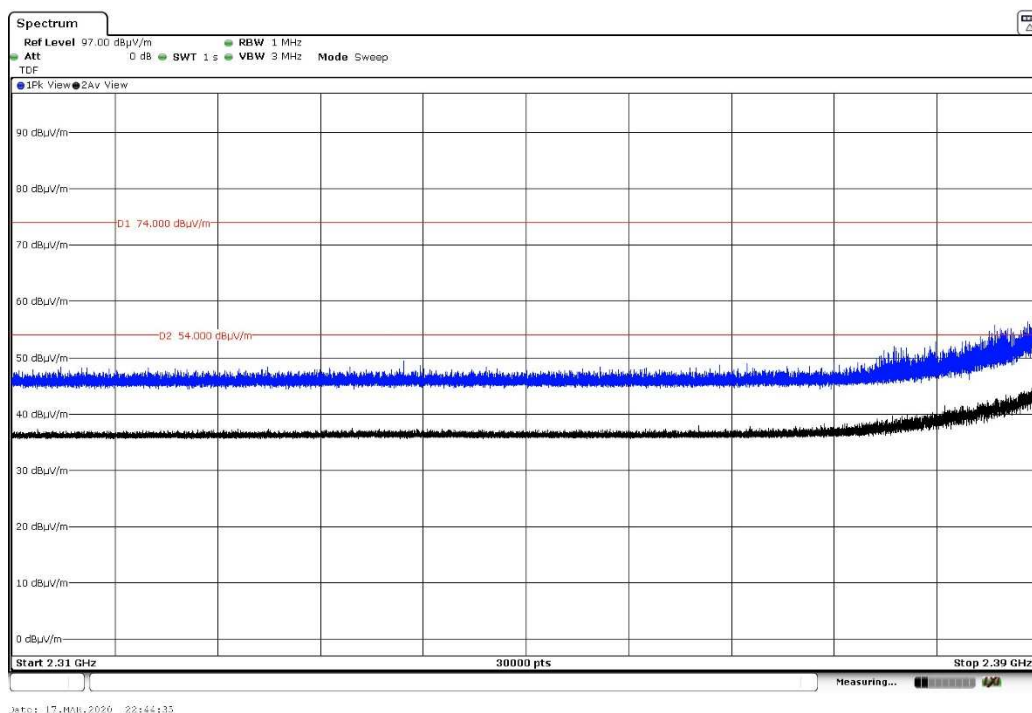
FREQUENCY RANGE 17 - 26 GHz:

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



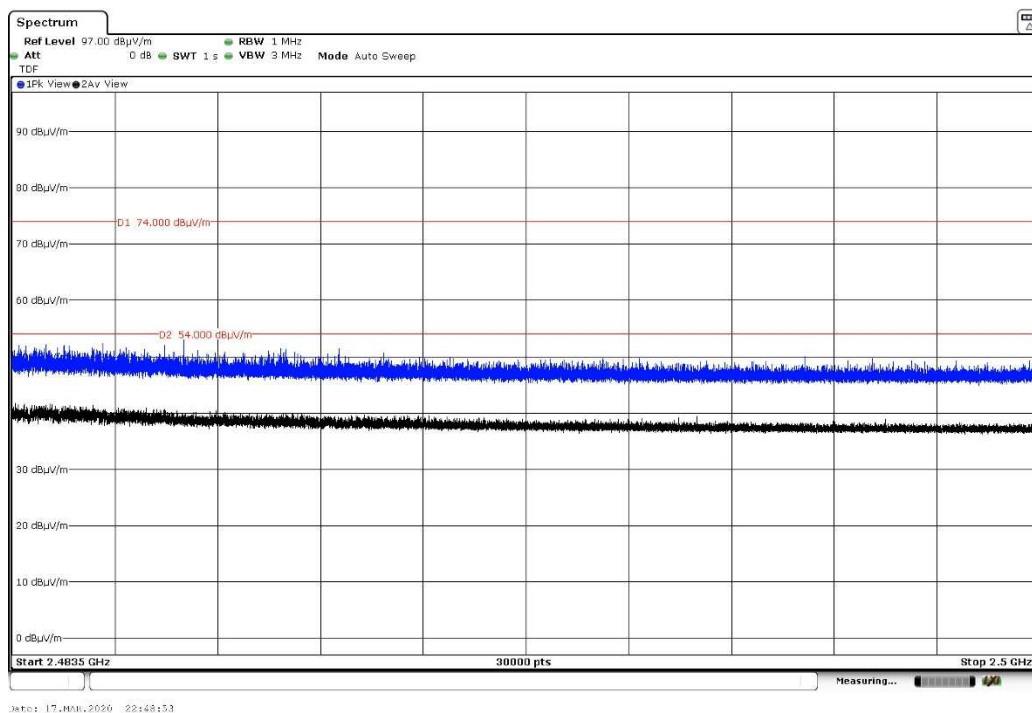
Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

- High Channel:

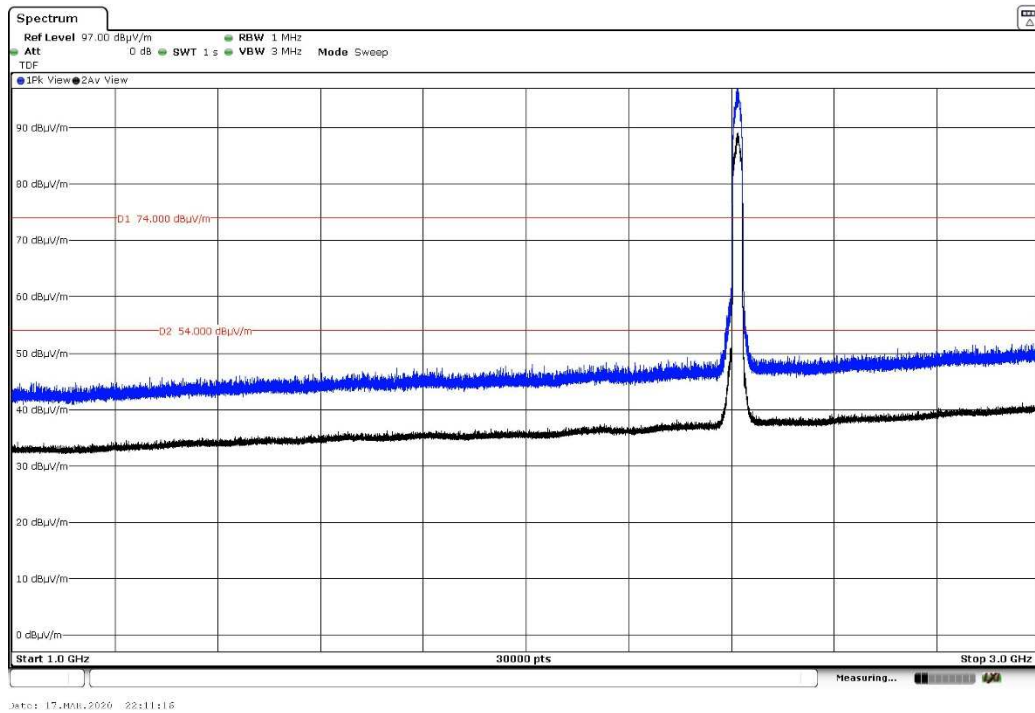


MIMO – CORE1_Port4 Antenna & CORE1_Port2 Antenna:

- Mode 802.11 n20

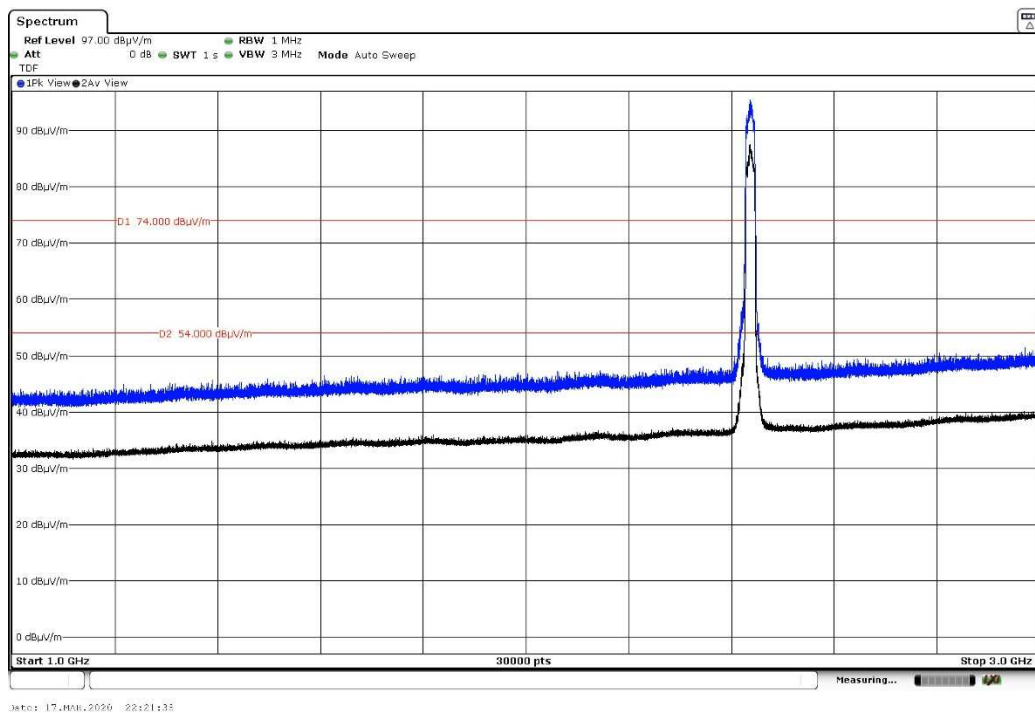
FREQUENCY RANGE 1 - 3 GHz:

- Low Channel:



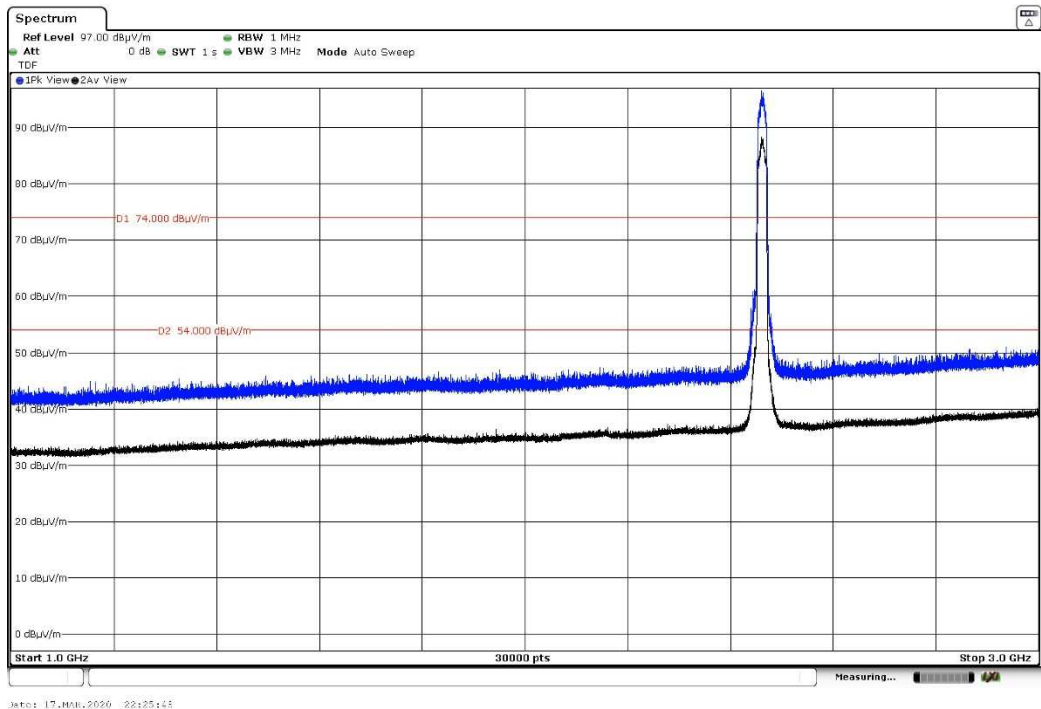
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

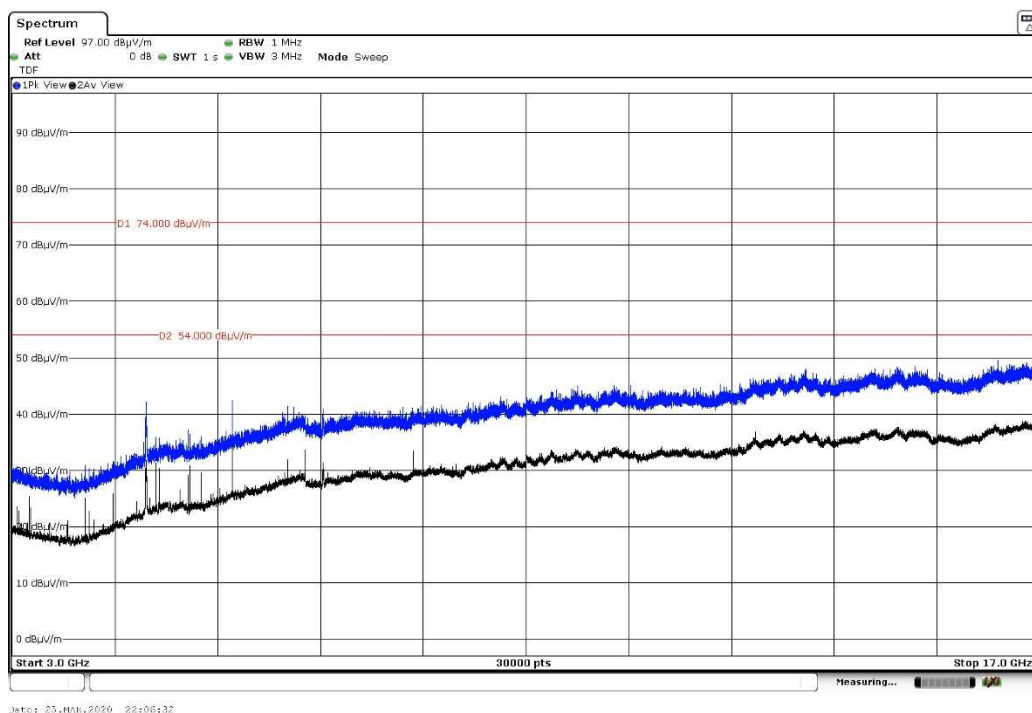
- High Channel:



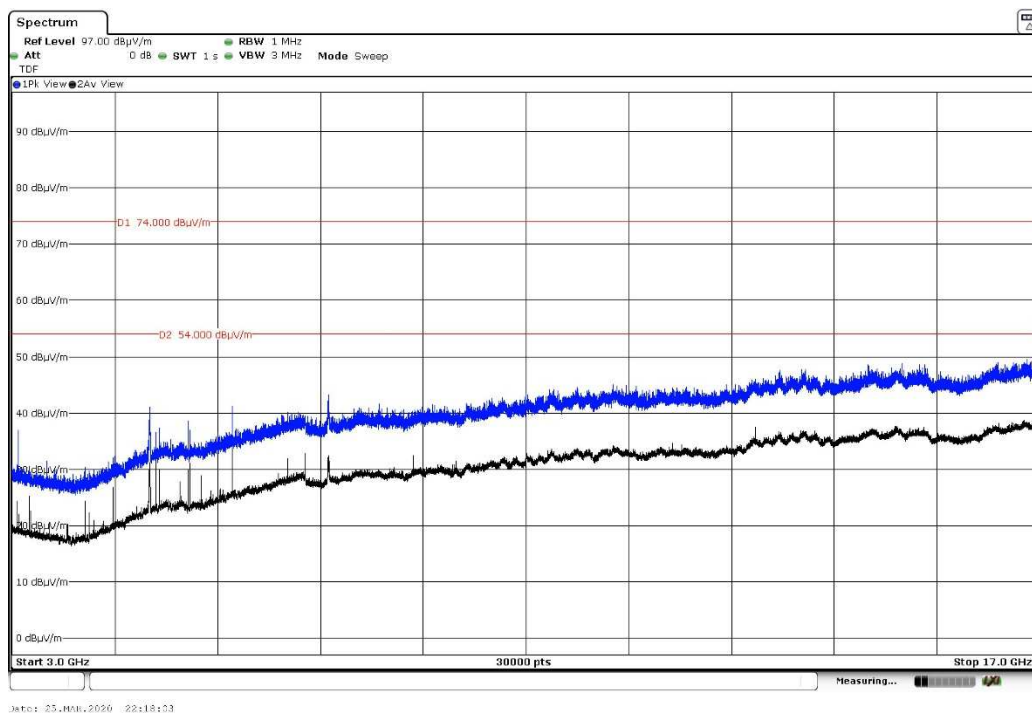
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 - 17 GHz:

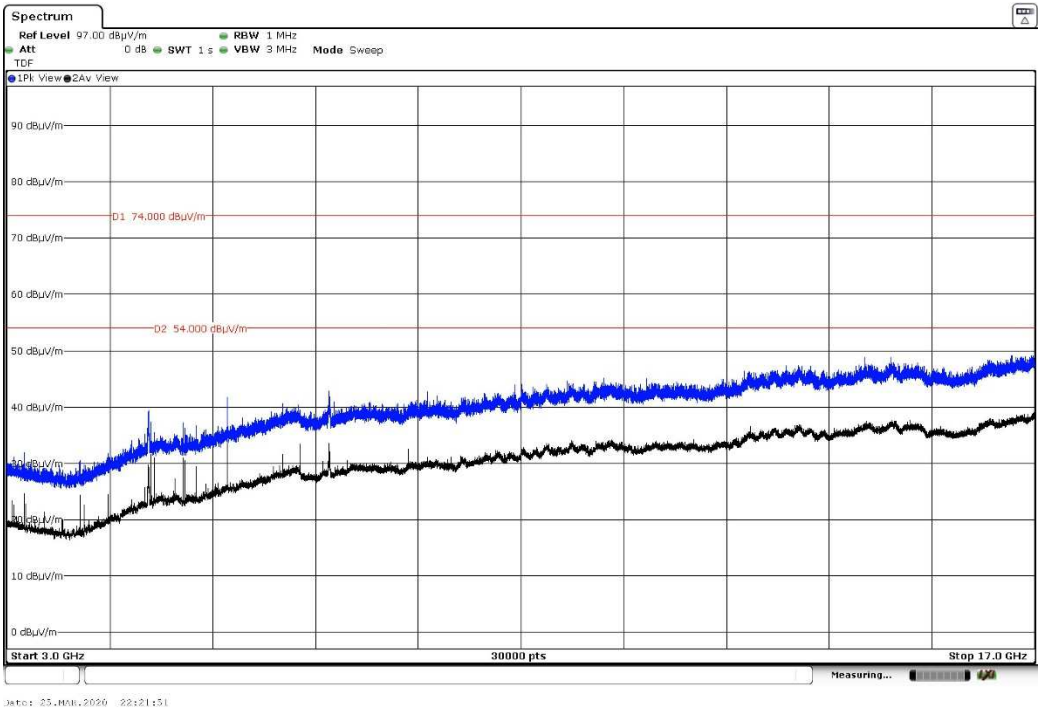
- Low Channel:



- Middle Channel:

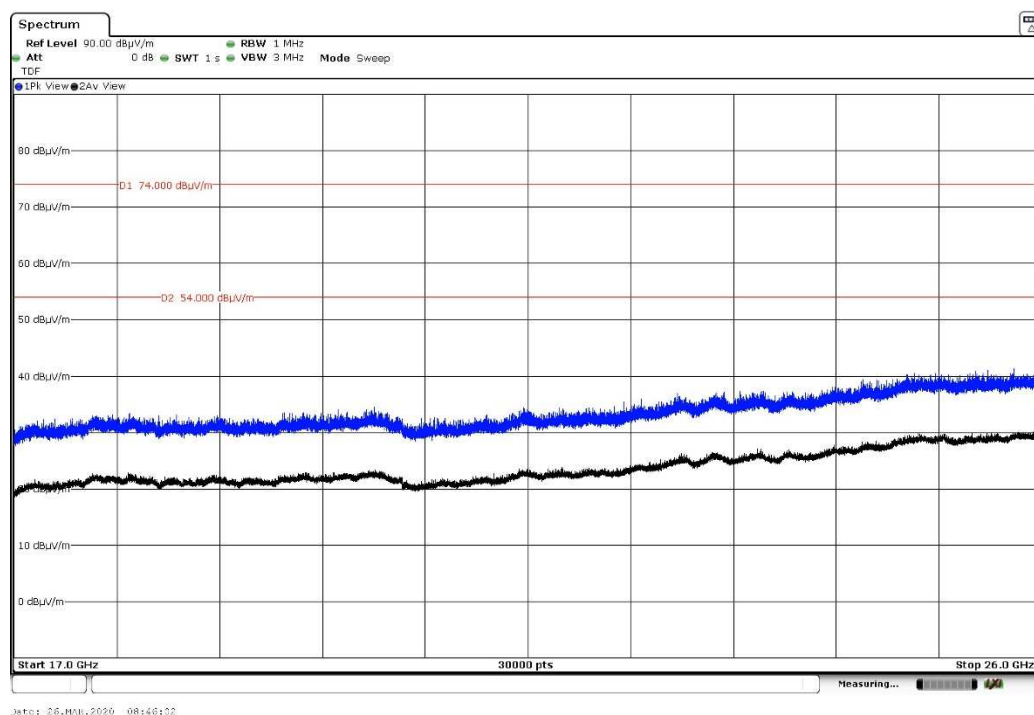


- High Channel:



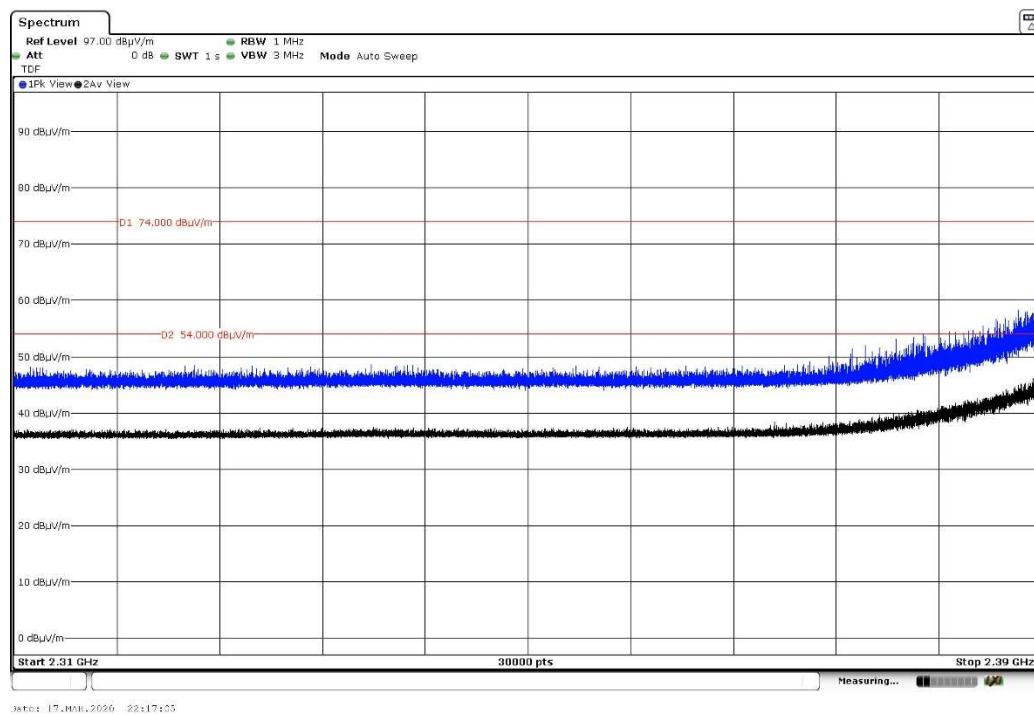
FREQUENCY RANGE 17 - 26 GHz:

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



Restricted Band 2.31-2.39 GHz:

- Low Channel:



Restricted Band 2.4835-2.5 GHz:

- High Channel:

