

FCC LISTED, REGISTRATION  
 NUMBER: 720267

Informe de ensayo n°:  
 Test report No:

IC LISTED REGISTRATION  
 NUMBER IC 4621A-1

**NIE: 46706RRF.001**

### 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.

<b>Identificación del objeto ensayado.....:</b> Identification of item tested	THINGSEE ONE developer device with 2G, Wi-Fi, Bluetooth LE 4.1 and sensors
<b>Marca .....</b> Trademark	Thingsee
<b>Modelo y/o referencia tipo .....</b> Model and /or type reference	TSONE
<b>Other identification of the product .....</b>	Commercial name: THINGSEE ONE FCC ID: 2AEU3TSONE IC: 20236-TSONE
<b>Final HW version .....</b>	0404
<b>Final SW version .....</b>	2015.06.01.1
<b>IMEI TAC .....</b>	35381605 (SARA 2G modem IMEI TAC)
<b>Características .....</b> Features	2G/GPRS,WLAN, Bluetooth, set of sensors
<b>Fabricante .....</b> Manufacturer	THINGSEE OY Yrttpellontie 1D, 90230 Oulu, Finland
<b>Método de ensayo solicitado, norma.....:</b> Test method requested, standard	USA FCC Part 15.247 10-1-14 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 10-1-14 Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 1 (May 2015). CANADA RSS-Gen Issue 4 (November 2014). Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 558074 D01 DTS Meas Guidance v03r02 dated 05/06/2014. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
<b>Resultado.....:</b> Summary	IN COMPLIANCE

<b>Aprobado por (nombre / cargo y firma) .....</b> Approved by (name / position & signature)	A. Llamas RF Lab. Manager
<b>Fecha de realización .....</b> Date of issue	2015-07-09
<b>Formato de informe No.....</b> Report template No	FDT08_16

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## Competences and guarantees

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

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

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

AT4 wireless guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at AT4 wireless at the time of performance of the test.

AT4 wireless is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

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

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## General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of AT4 wireless.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of AT4 wireless and the Accreditation Bodies.

## Uncertainty

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

## Usage of samples

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

Sample M/01 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
45639C/009	ThingseeONE device	TSONE	XNG51760171	2015-06-02

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

## Test sample description

THINGSEE ONE is an Internet of Things developer device that enables the fast and efficient development of new Io apps and solutions. The device has wireless connectivity (2G, Wi-Fi, Bluetooth LE 4.1) and a wide set of built-in sensors to track location, speed, movement, orientation, direction, light, temperature and humidity. The sensor set can also be augmented via the device’s free serial interfaces. The battery can last up to a year with a single charge.

## Identification of the client

THINGSEE OY

Yrttpellontie 1D, 90230 Oulu, Finland

## Testing period

The performed test started on 2015-06-19 and finished on 2015-06-22.

The tests have been performed at AT4 wireless.

## Environmental conditions

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

<b>Temperature</b>	Min. = 15 °C Max. = 35 °C
<b>Relative humidity</b>	Min. = 20 % Max. = 75 %
<b>Shielding effectiveness</b>	> 100 dB
<b>Electric insulation</b>	> 10 kΩ
<b>Reference resistance to earth</b>	< 1 Ω

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

<b>Temperature</b>	Min. = 15 °C Max. = 35 °C
<b>Relative humidity</b>	Min. = 20 % Max. = 75 %
<b>Air pressure</b>	Min. = 860 mbar Max. = 1060 mbar
<b>Shielding effectiveness</b>	> 100 dB
<b>Electric insulation</b>	> 10 kΩ
<b>Reference resistance to earth</b>	< 1 Ω
<b>Normal site attenuation (NSA)</b>	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
<b>Field homogeneity</b>	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

## Remarks and comments

- 1: Only radiated spurious emission test was requested.
- 2: Used instrumentation:

### Radiated Measurements

		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	BiconicalLog antenna ETS LINDGREN 3142E	2014/03	2017/03
3.	Multi Device Controller EMCO 2090	N.A.	N.A.
4.	Double-ridge Guide Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2013/11	2016/11
5.	Double-ridge Guide Horn antenna 14- 40 GHz SCHWARZBECK BBHA 9170	2014/03	2017/03
6.	EMI Test Receiver R&S ESU 26	2013/08	2015/08
7.	Spectrum analyser Rohde & Schwarz FSW50	2013/10	2015/10
8.	RF pre-amplifier 10 MHz-6 GHz SCHWARZBECK BBV9743	2015/03	2016/03
9.	RF pre-amplifier Miteq AFS5- 04001300-15-10P-6.	2014/05	2016/05
10.	RF pre-amplifier Miteq JS4-12002600- 30-5A.	2014/05	2016/05

## Testing verdicts

<b>Not applicable</b> .....	N/A
<b>Pass</b> .....	P
<b>Fail</b> .....	F
<b>Not measured</b> .....	N/M

FCC PART 15 PARAGRAPH / RSS-247		VERDICT			
		NA	P	F	NM
Section 15.247 Subclause (a) (2) / RSS-247 5.2. (1)	6 dB Bandwidth				NM <sup>1</sup>
Section 15.247 Subclause (b) / RSS-247 5.4. (4)	Maximum output power and antenna gain				NM <sup>1</sup>
Section 15.247 Subclause (d) / RSS-247 5.5.....	Emission limitations conducted (Transmitter)				NM <sup>1</sup>
Section 15.247 Subclause (d) / RSS-247 5.5. ...	Band-edge conducted emissions compliance (Transmitter)				NM <sup>1</sup>
Section 15.247 Subclause (e) / RSS-247 5.2. (2)	Power spectral density				NM <sup>1</sup>
Section 15.247 Subclause (d) / RSS-247 5.5.....	Emission limitations radiated (Transmitter)		P		

1: See point “Remarks and Comments”.

## Appendix A – Test result

## INDEX

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## TEST CONDITIONS

Power supply (V):

$V_{\text{nominal}} = 3.8 \text{ Vdc}$

Type of power supply = DC voltage from battery.

Type of antenna = Integral antenna.

Declared Gain for antenna (maximum) = 0.6 dBi

### TEST FREQUENCIES:

WiFi 802.11 b/g

Lowest channel (1): 2412 MHz

Middle channel (6): 2437 MHz

Highest channel (11): 2462 MHz

### RADIATED MEASUREMENTS

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

For radiated emissions in the range 1 GHz-25 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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

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

**Section 15.247 Subclause (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 8.9.:

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)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 25000	500	54	3

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

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

**RESULTS:**

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

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

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

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

**Frequency range 30 MHz-1000 MHz.**

The spurious signals detected do not depend on either the operating channel or the modulation mode.

Spurious levels closest to the limit:

Spurious frequency (MHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
109.830	PV	Quasi-Peak	19.28	± 4.12
118.270	PV	Quasi-Peak	21.11	± 4.12
127.388	PV	Quasi-Peak	29.76	± 4.12
307.226	PH	Quasi-Peak	21.14	± 4.12

**Frequency range 1 GHz-25 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 (see next plots).

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

1. WiFi 2.4GHz 802.11 b mode.

1.1. CHANNEL 1: LOWEST (2412 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.31-2.39 GHz.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.38577	PV	Peak	52.01	± 4.00
2.49317	PV	Peak	60.65	± 4.00
		RMS	51.34	± 4.00
2.53070	PV	Peak	60.74	± 4.00
		RMS	51.41	± 4.00
2.57377	PV	Peak	66.08	± 4.00
		RMS	50.57	± 4.00
4.82374	PH	Peak	37.53	± 4.00
7.23589	PV	Peak	44.36	± 4.00
9.64804	PV	Peak	46.26	± 4.00
14.47209	PV	Peak	46.48	± 4.00
19.29587	PH	Peak	44.00	± 4.00
24.11960	PH	Peak	40.68	± 4.00

1.2. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.31179	PV	Peak	47.41	± 4.00
2.49464	PV	Peak	49.06	± 4.00
2.51663	PV	Peak	58.42	± 4.00
		RMS	45.67	± 4.00
2.55837	PV	Peak	59.74	± 4.00
		RMS	50.18	± 4.00
2.59857	PV	Peak	64.87	± 4.00
		RMS	49.15	± 4.00
4.87411	PH	Peak	37.56	± 4.00
7.31096	PV	Peak	44.14	± 4.00
9.74814	PV	Peak	46.93	± 4.00
14.62206	PH	Peak	44.22	± 4.00
19.49613	PH	Peak	45.76	± 4.00
24.37000	PH	Peak	42.04	± 4.00

1.3. CHANNEL 11: HIGHEST (2462 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.4835-2.5 GHz.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.49845	PV	Peak	53.44	± 4.00
2.54343	PV	Peak	60.92	± 4.00
		RMS	51.38	± 4.00
2.58357	PV	Peak	58.42	± 4.00
		RMS	49.07	± 4.00
2.62390	PV	Peak	62.26	± 4.00
		RMS	46.83	± 4.00
4.92416	PH	Peak	37.03	± 4.00
7.38669	PV	Peak	43.12	± 4.00
9.84791	PV	Peak	45.63	± 4.00
19.69613	PH	Peak	44.09	± 4.00
24.62013	PH	Peak	41.15	± 4.00

Verdict: PASS

2. WiFi 2.4GHz 802.11 g mode

2.1. CHANNEL 1: LOWEST (2412 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.31-2.39 GHz.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.38979	PV	Peak	68.14	± 4.00
		RMS	52.53	± 4.00
2.49430	PV	Peak	60.92	± 4.00
		RMS	50.95	± 4.00
2.53443	PV	Peak	60.87	± 4.00
		RMS	51.05	± 4.00
2.56703	PV	Peak	55.42	± 4.00
		RMS	46.08	± 4.00
7.23493	PV	Peak	44.82	± 4.00
9.64804	PV	Peak	46.80	± 4.00
19.2956	PH	Peak	45.16	± 4.00
24.12013	PH	Peak	42.45	± 4.00

2.2. CHANNEL 6: MIDDLE (2437 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted bands 2.31-2.39 GHz and 2.4835-2.5 GHz.

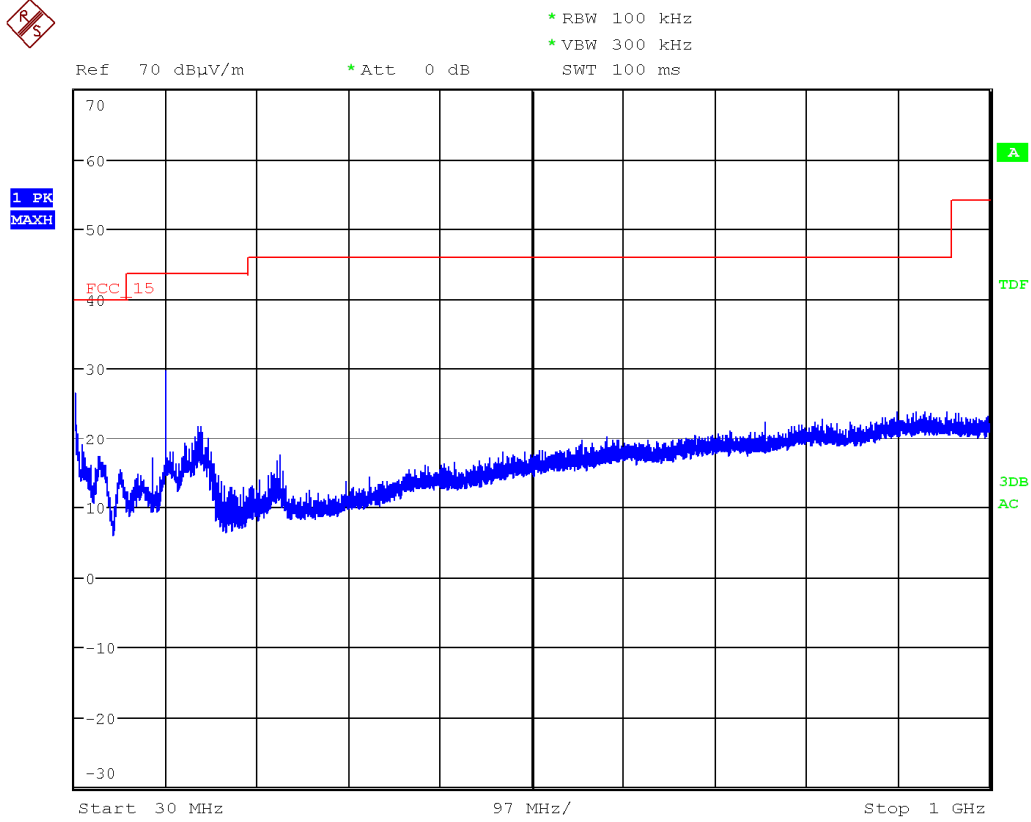
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBμV/m)	Measurement Uncertainty (dB)
2.35628	PV	Peak	47.32	± 4.00
2.38821	PV	Peak	48.42	± 4.00
2.48354	PV	Peak	53.11	± 4.00
2.51943	PV	Peak	57.72	± 4.00
		RMS	47.62	± 4.00
2.55943	PV	Peak	58.41	± 4.00
		RMS	48.24	± 4.00
2.59897	PV	Peak	53.97	± 4.00
7.31486	PV	Peak	44.30	± 4.00
9.74781	PV	Peak	45.93	± 4.00
19.49587	PH	Peak	45.50	± 4.00
24.37000	PH	Peak	41.51	± 4.00

2.3. CHANNEL 11: HIGHEST (2462 MHz). Out-of-band spurious emissions in the 1-25 GHz range and inside restricted band 2.4835-2.5 GHz.

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
2.48432	PV	Peak	69.81	± 4.00
		RMS	48.31	± 4.00
2.54377	PV	Peak	59.79	± 4.00
		RMS	50.03	± 4.00
2.58463	PV	Peak	58.43	± 4.00
		RMS	49.05	± 4.00
2.61830	PV	Peak	54.80	± 4.00
		RMS	44.06	± 4.00
7.38600	PV	Peak	42.48	± 4.00
9.84824	PV	Peak	45.29	± 4.00
19.69587	PH	Peak	43.12	± 4.00
24.62013	PH	Peak	40.20	± 4.00

Verdict: PASS

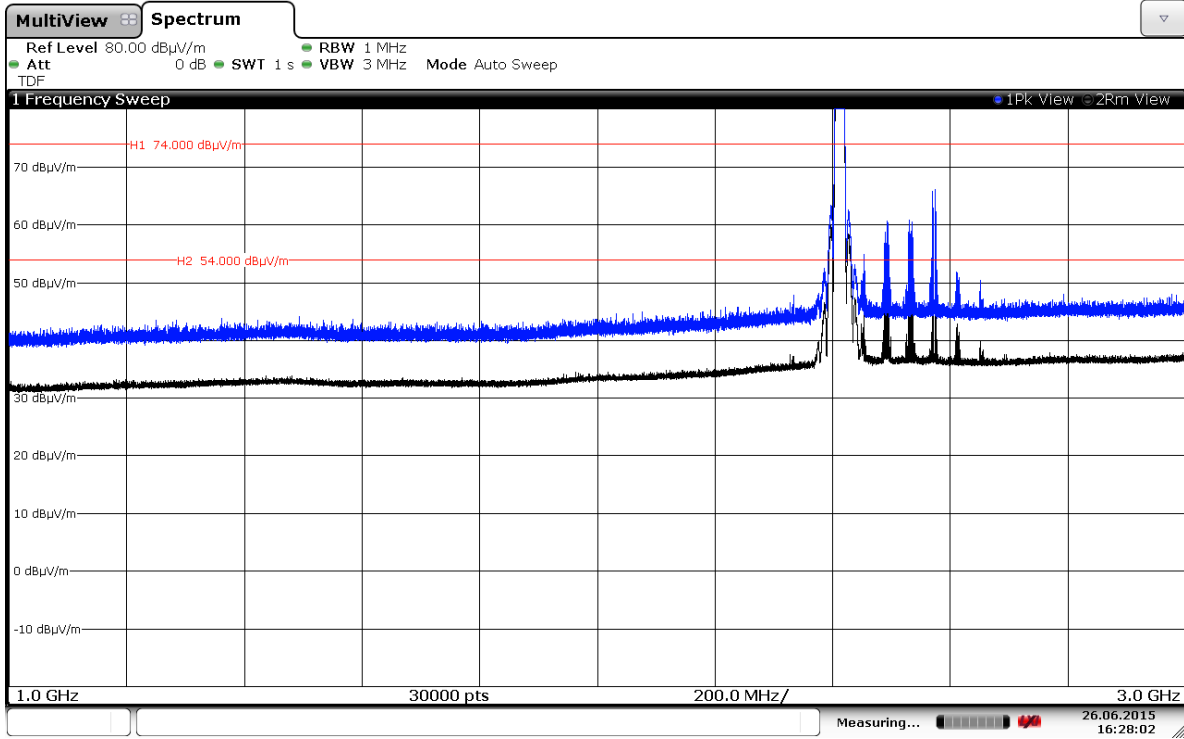
**FREQUENCY RANGE 30 MHz-1000 MHz.**



(This plot is valid for all three channels and all modes).

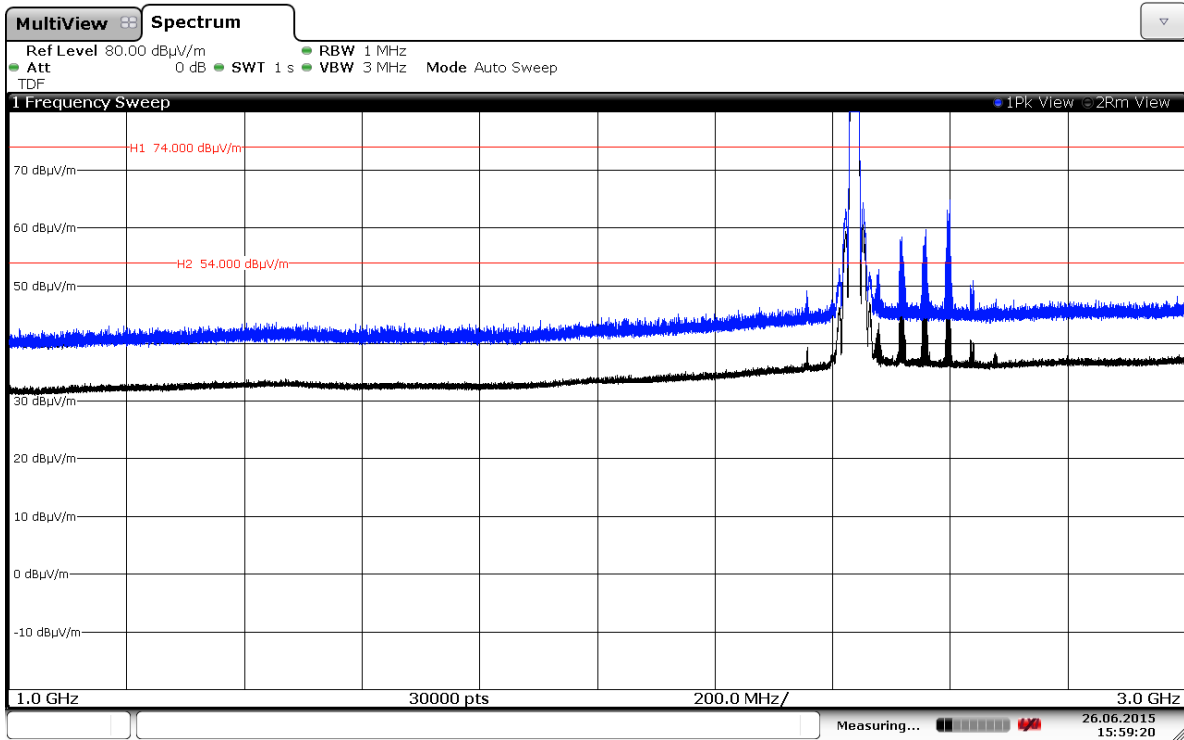
**FREQUENCY RANGE 1 GHz to 3 GHz.**  
**1. WiFi 2.4GHz 802.11 b mode**

CHANNEL 1 (2412 MHz).



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

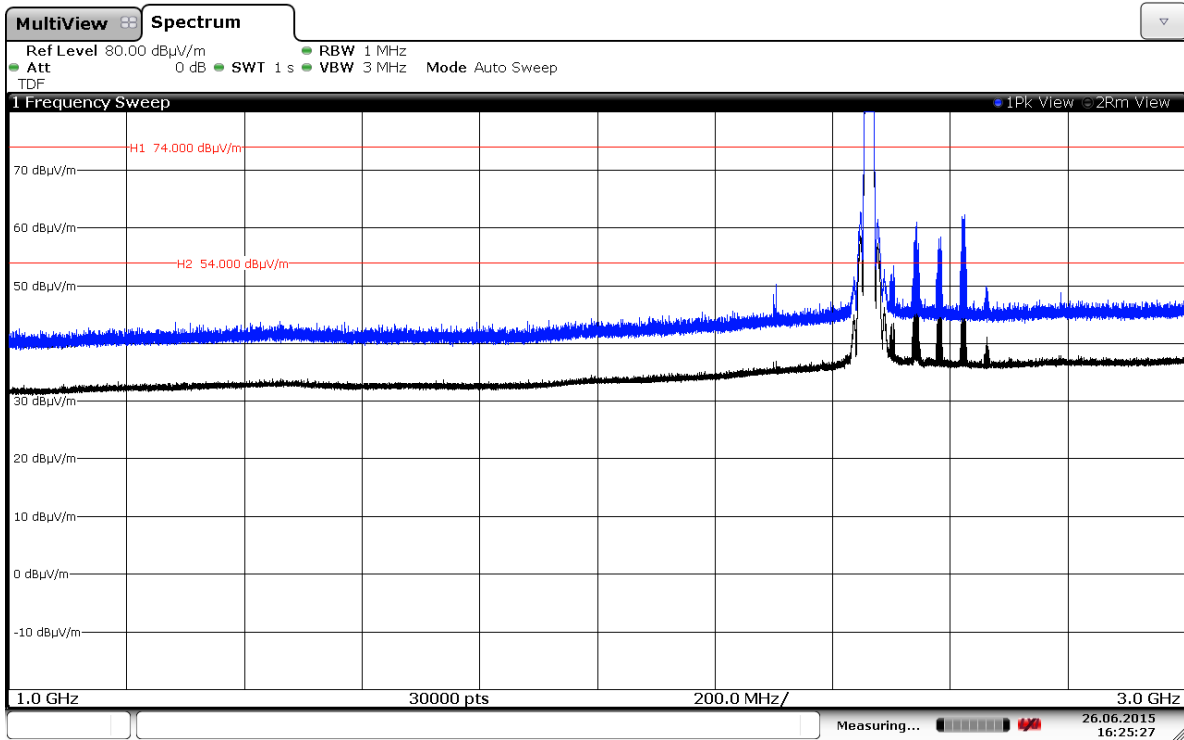
CHANNEL 6 (2437 MHz).



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



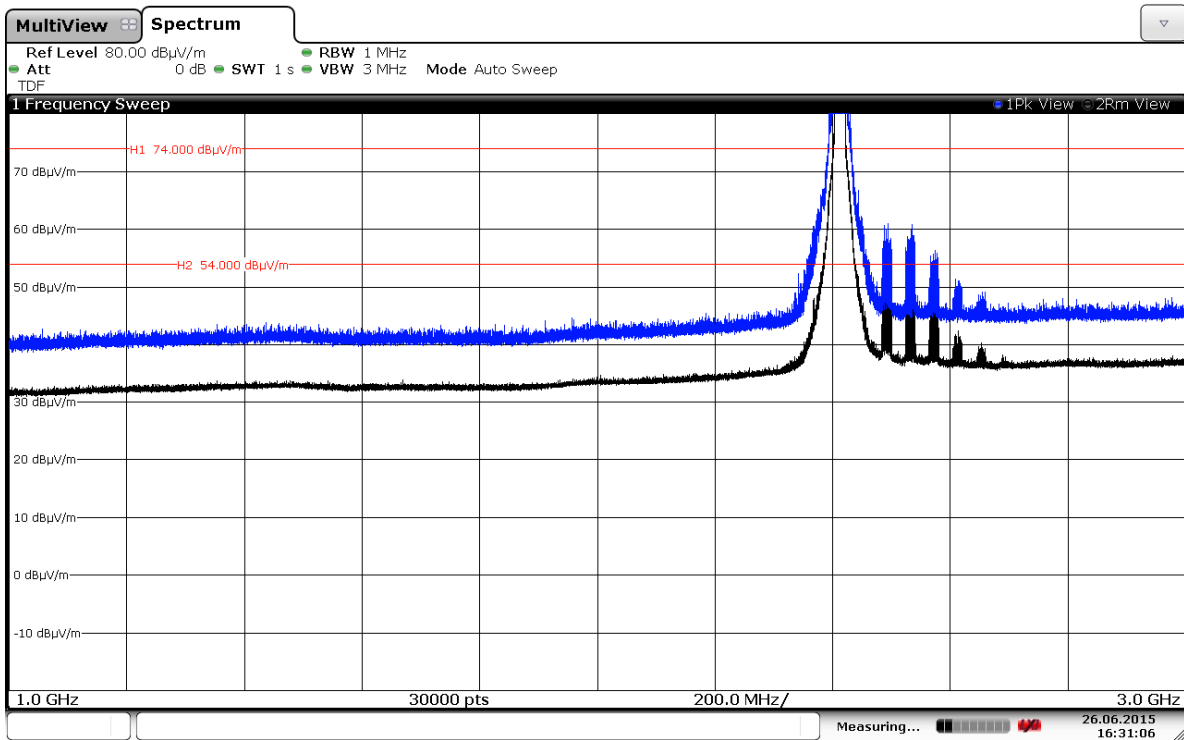
CHANNEL 11 (2462 MHz).



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

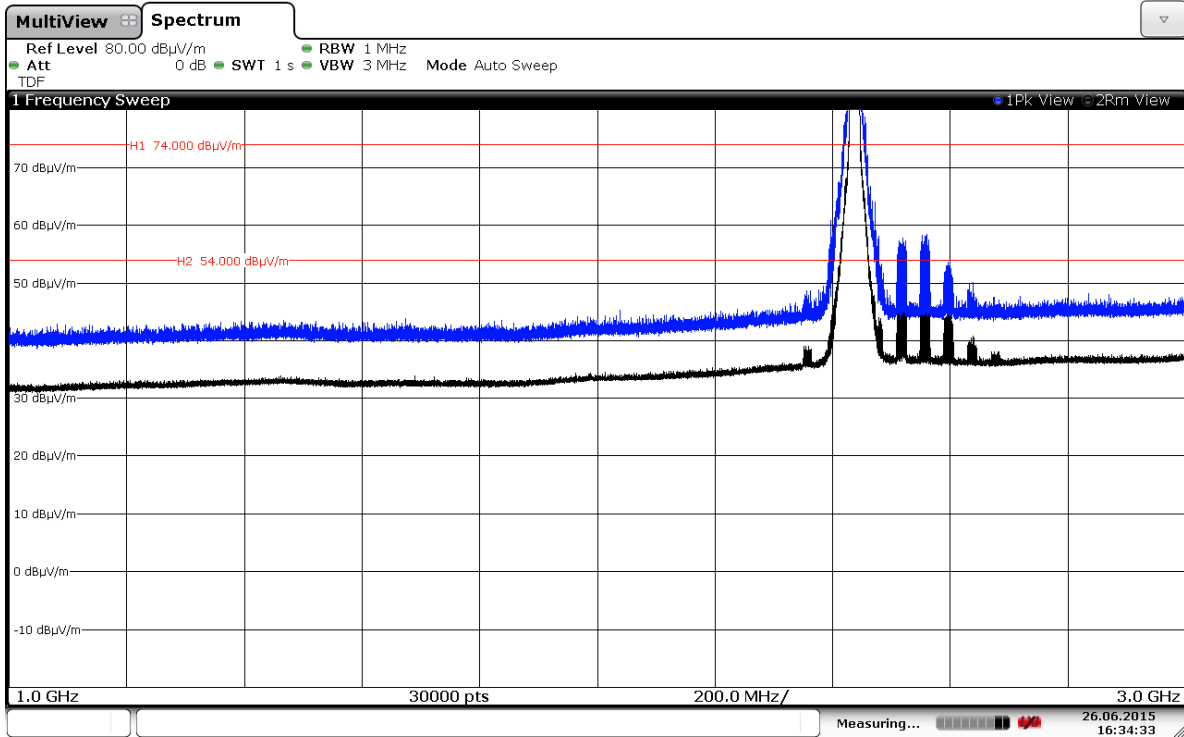
2. WiFi 2.4GHz 802.11 g mode

CHANNEL 1 (2412 MHz).



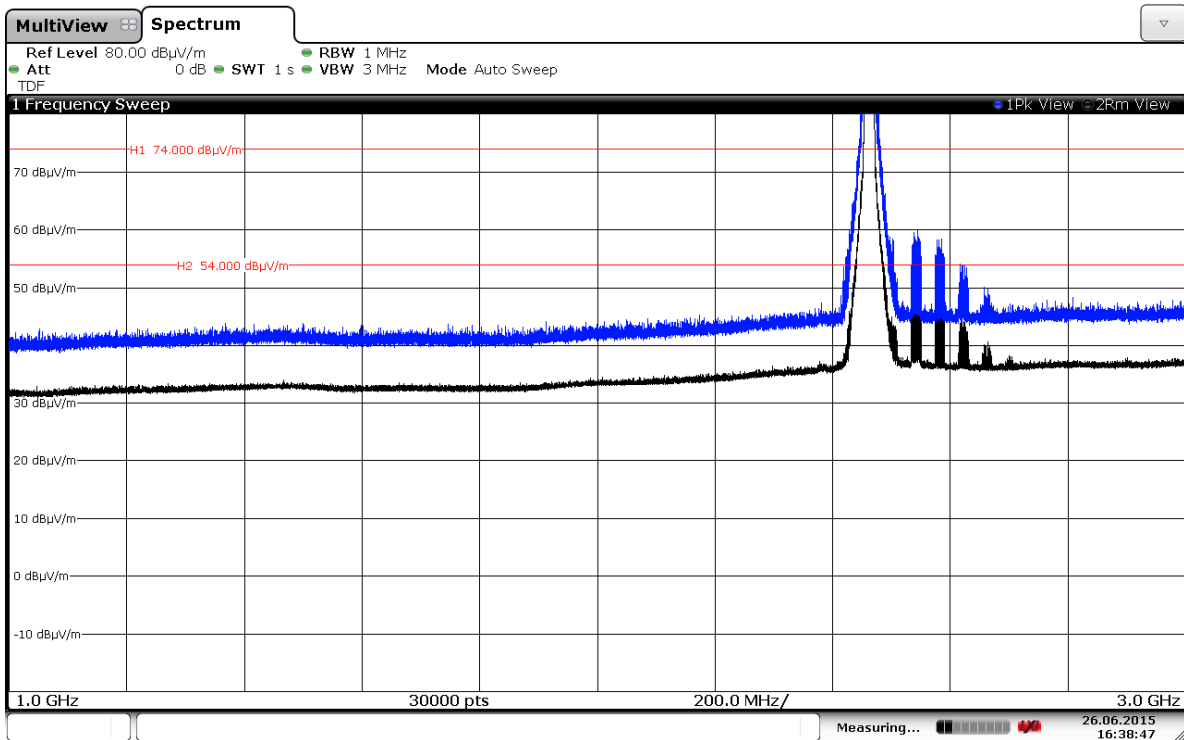
Note: The peak shown in the plot above the limit is the carrier frequency.

CHANNEL 6 (2437 MHz).



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

CHANNEL 11 (2462 MHz).

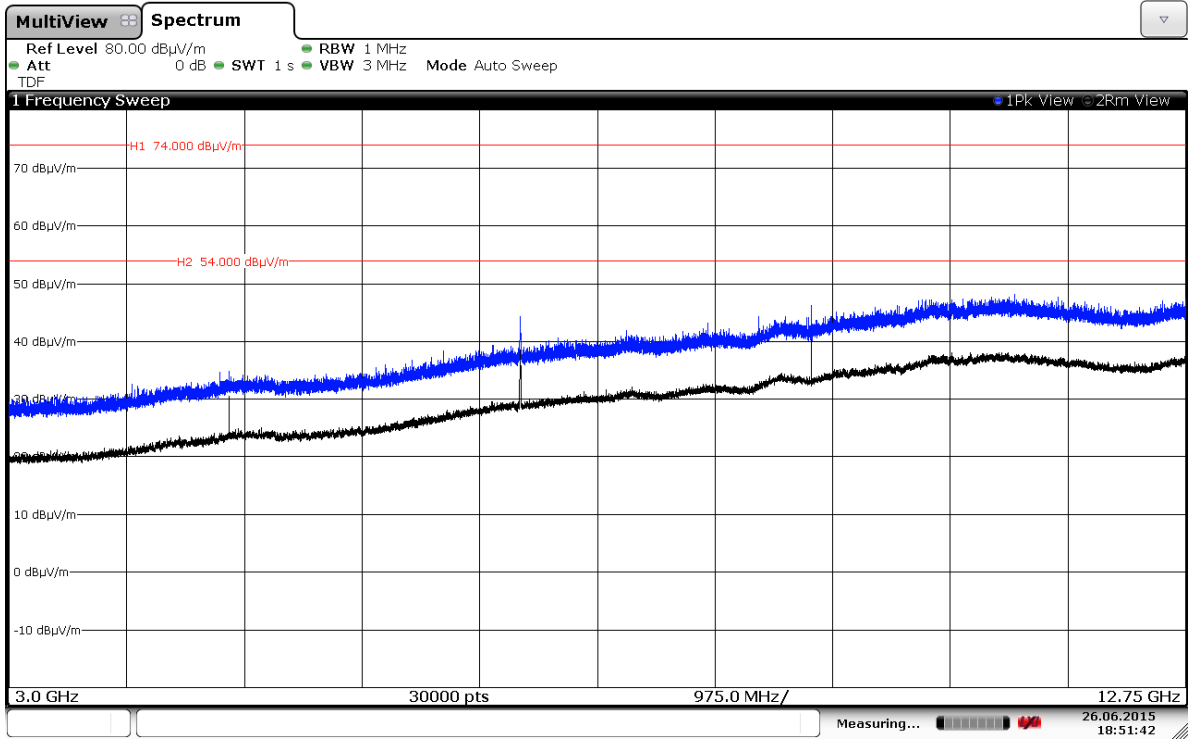


Note: The peak shown in the plot above the limit is the carrier frequency.

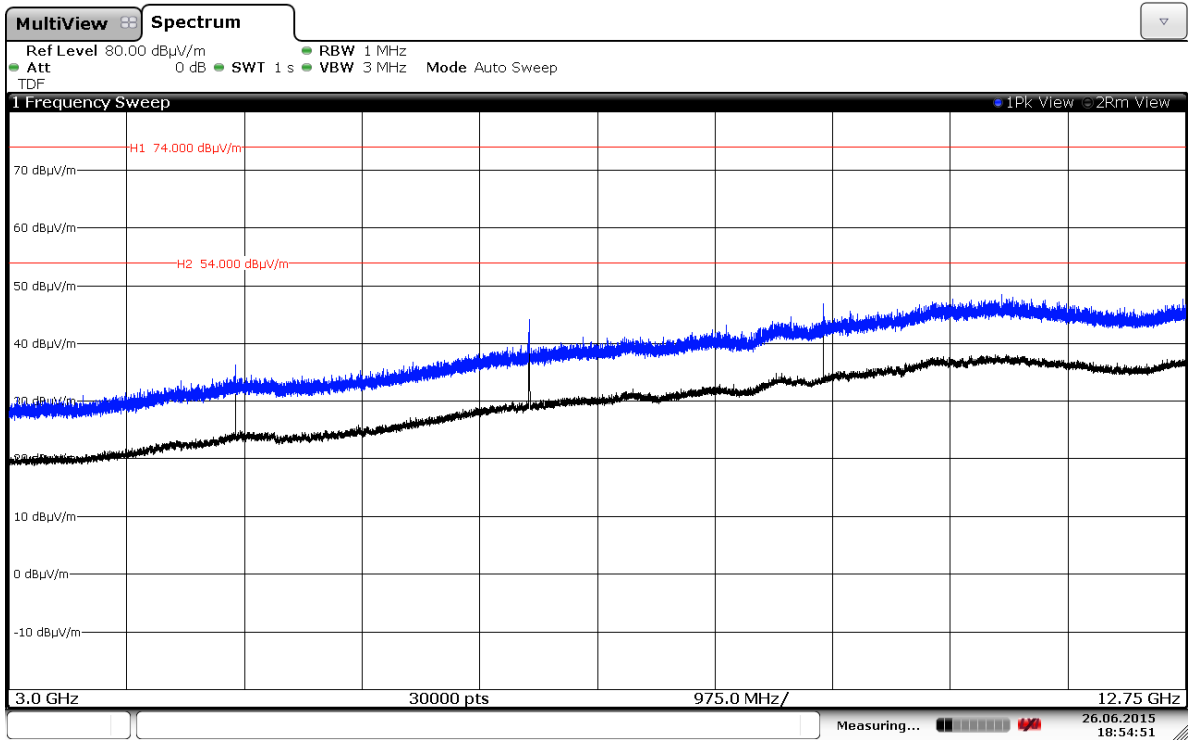
### FREQUENCY RANGE 3 GHz to 12 GHz.

#### 1. WiFi 2.4GHz 802.11 b mode

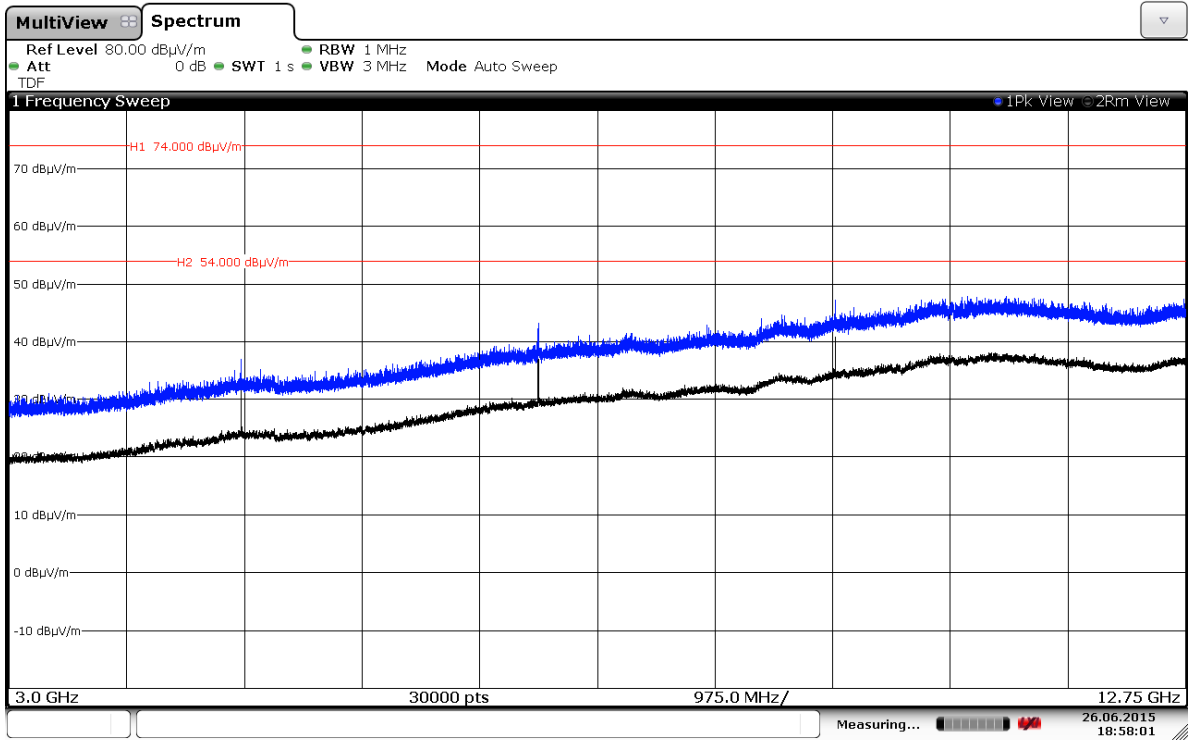
##### CHANNEL 1 (2412 MHz).



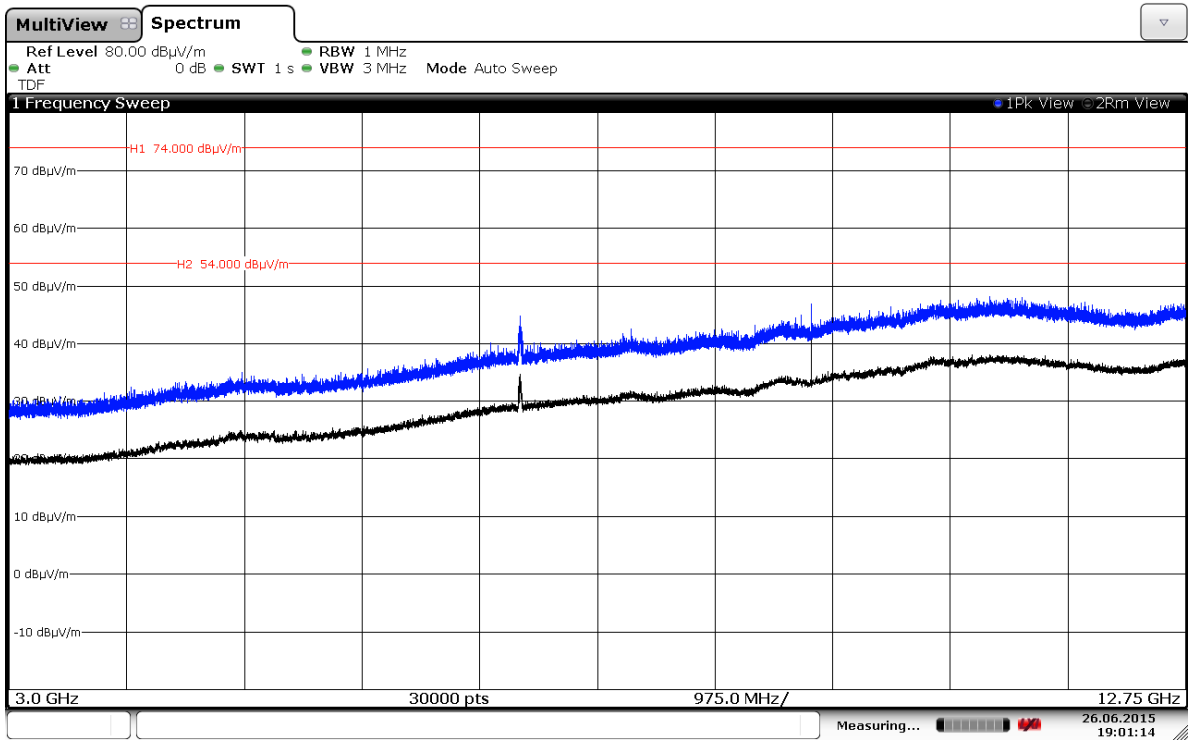
##### CHANNEL 6 (2437 MHz).



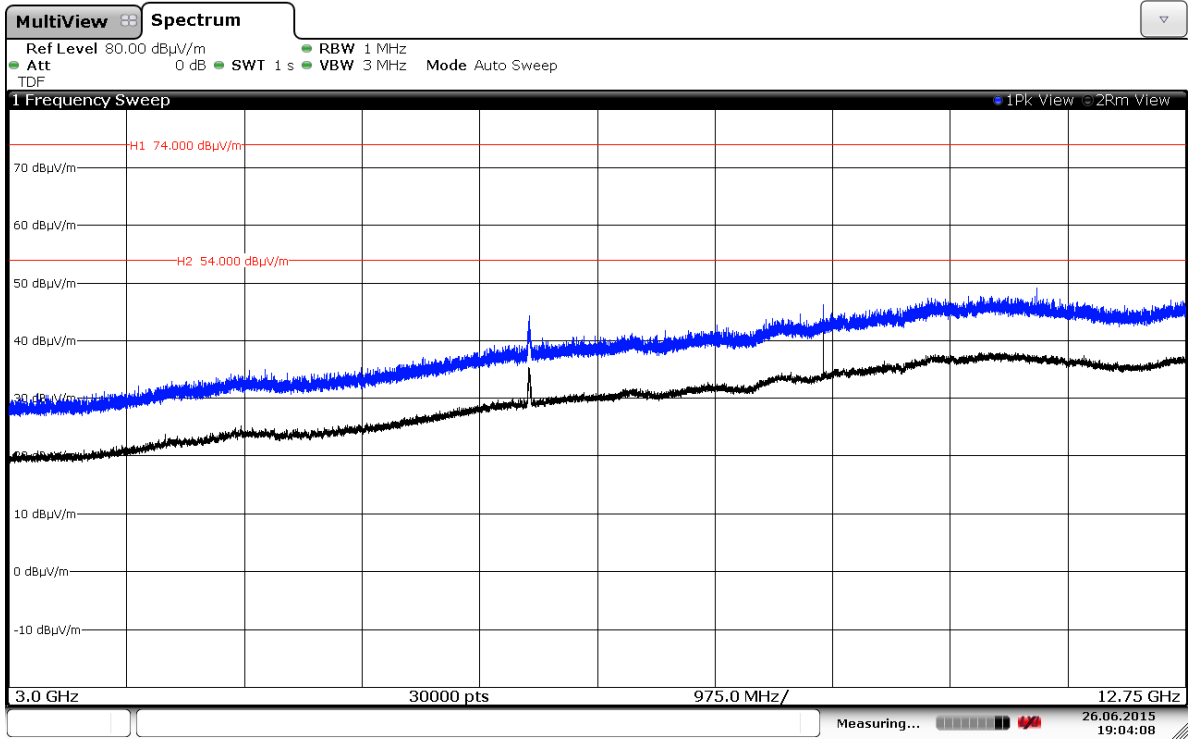
CHANNEL 11 (2462 MHz).



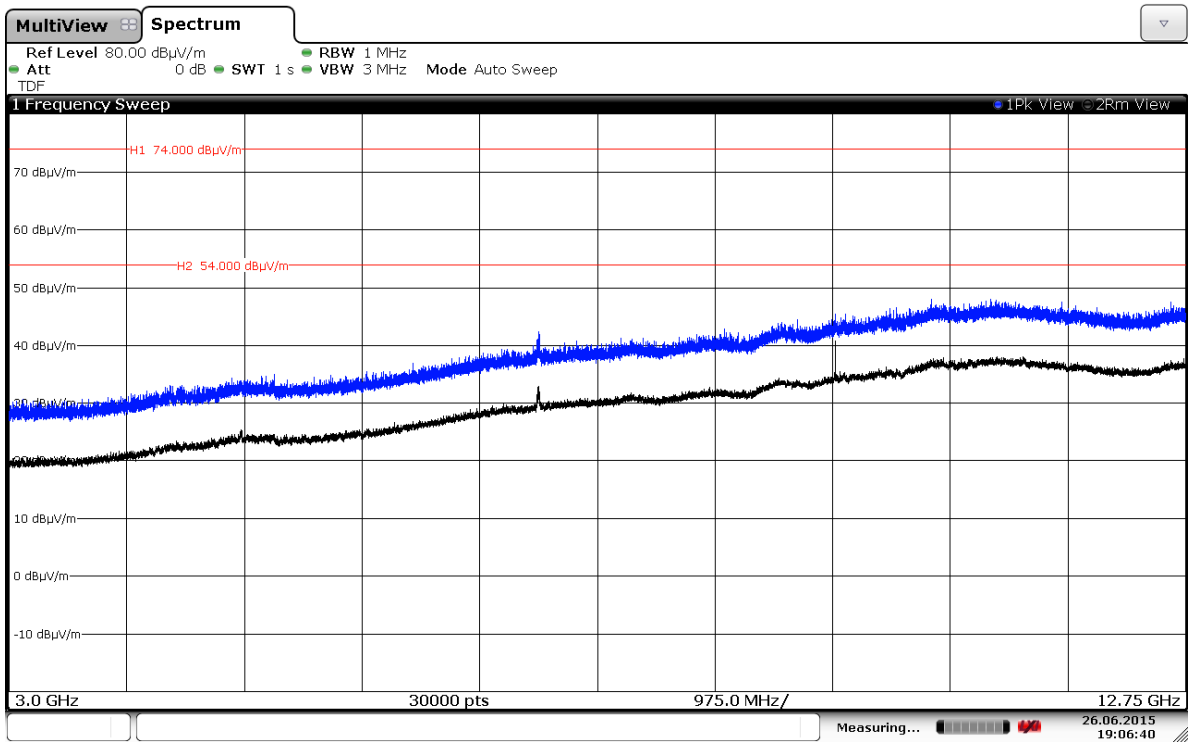
2. WiFi 2.4GHz 802.11 g mode  
CHANNEL 1 (2412 MHz).



CHANNEL 6 (2437 MHz).



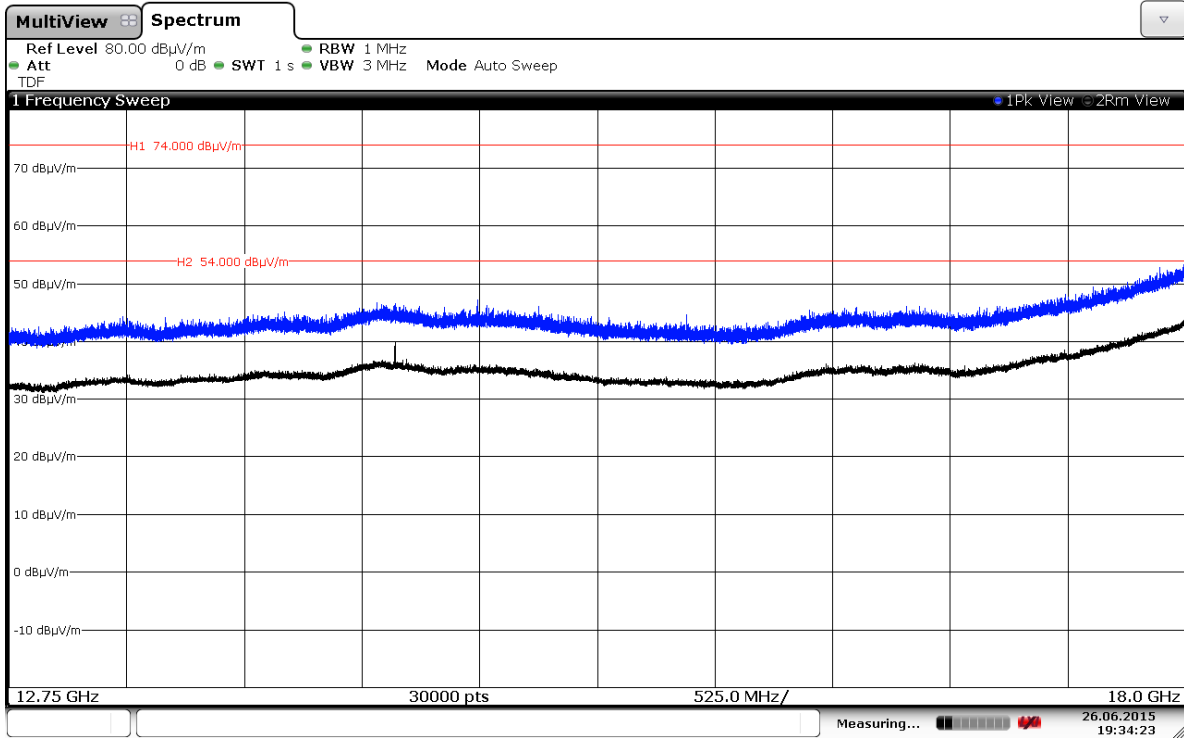
CHANNEL 11 (2462 MHz).



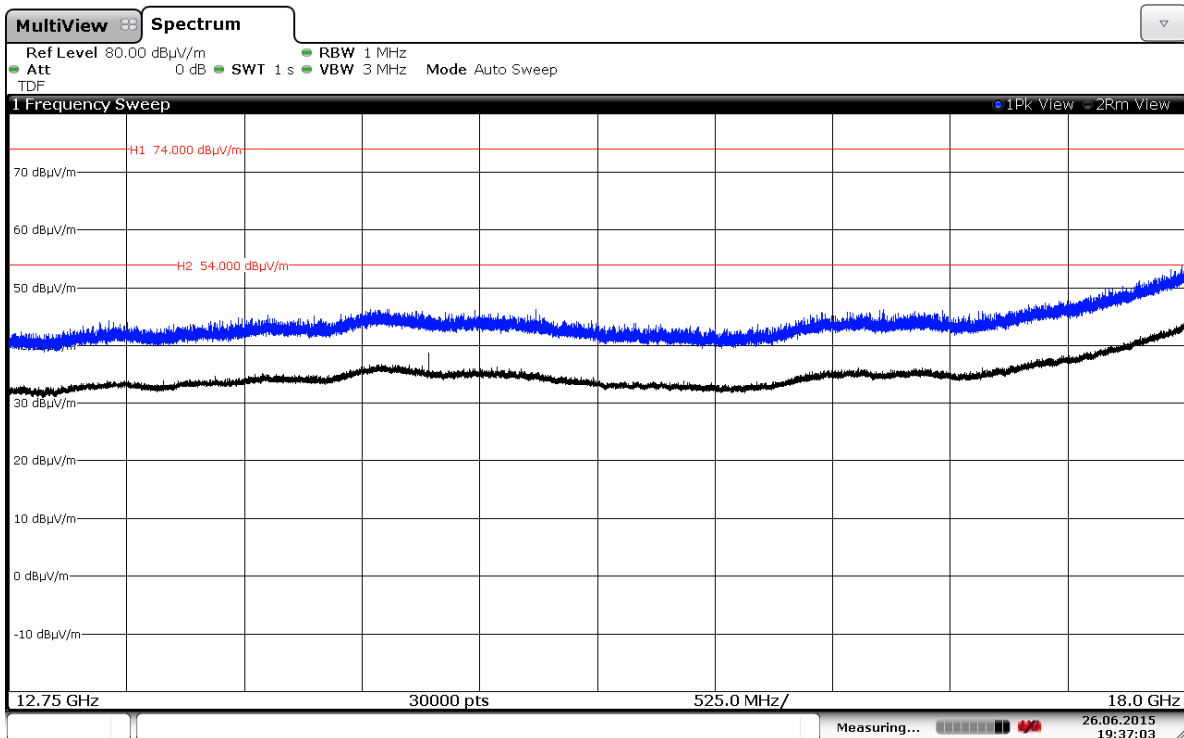
## FREQUENCY RANGE 12.75 GHz to 18 GHz

### 1. WiFi 2.4GHz 802.11 b mode

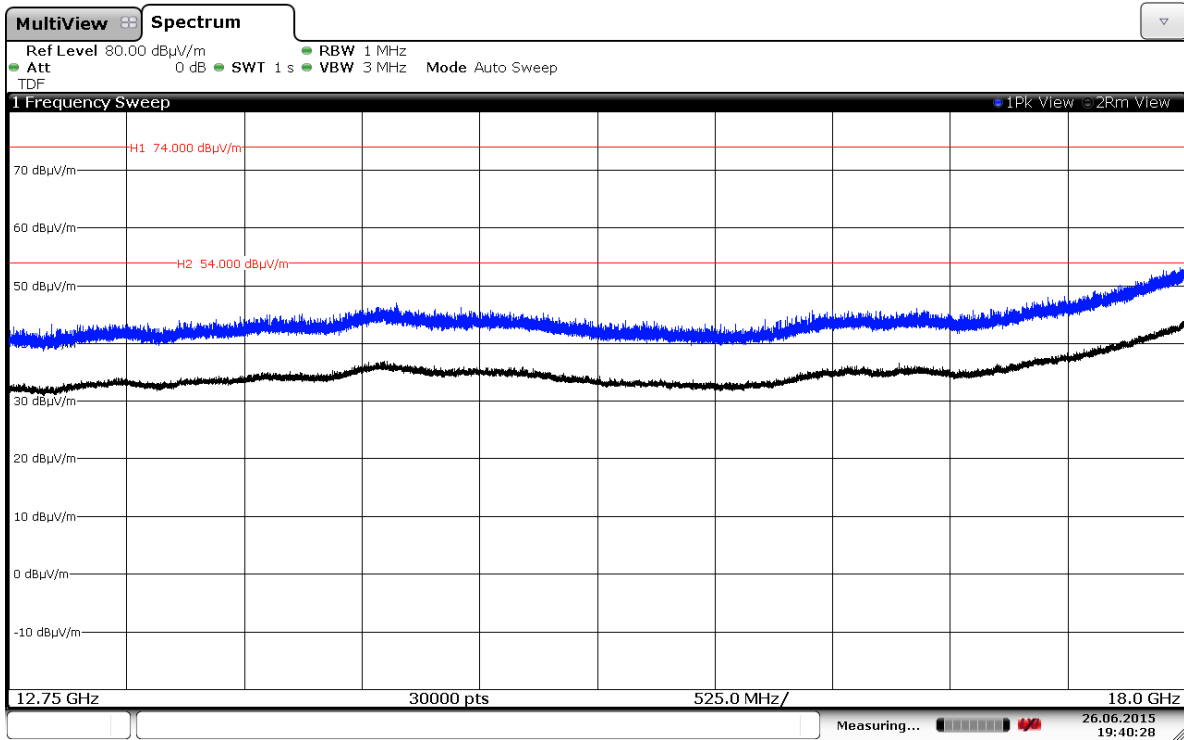
#### CHANNEL 1 (2412 MHz).



#### CHANNEL 6 (2437 MHz).

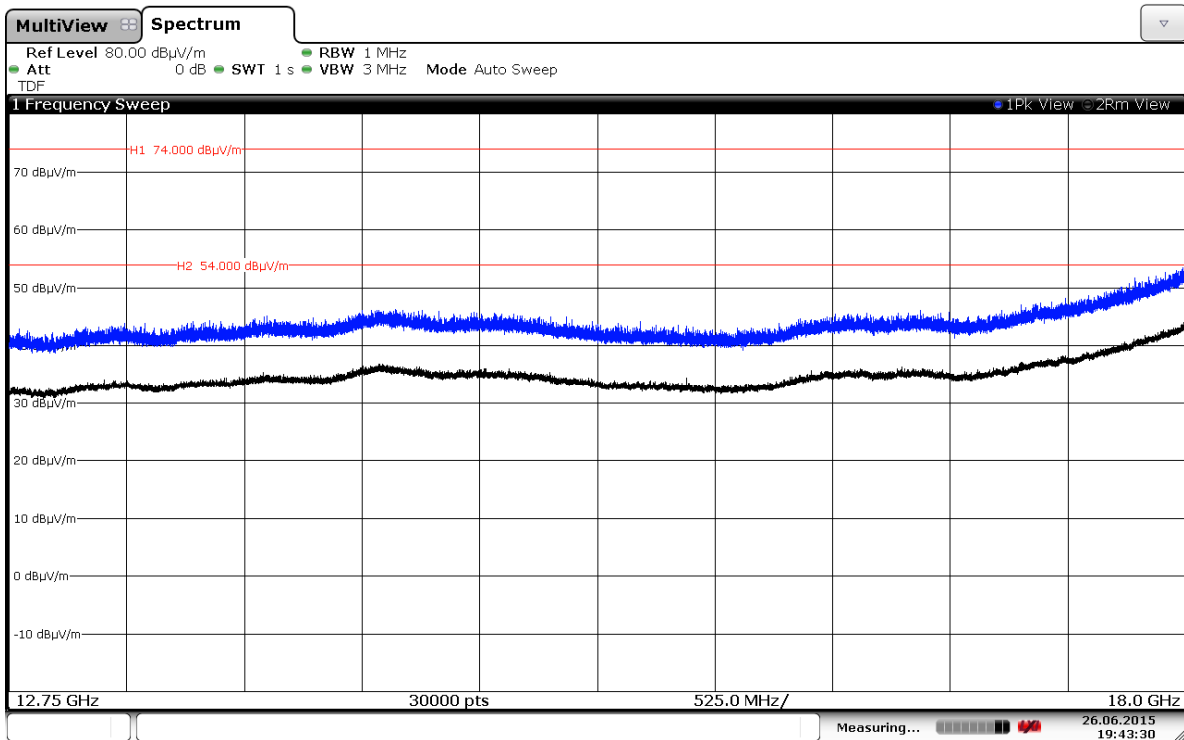


CHANNEL 11 (2462 MHz).

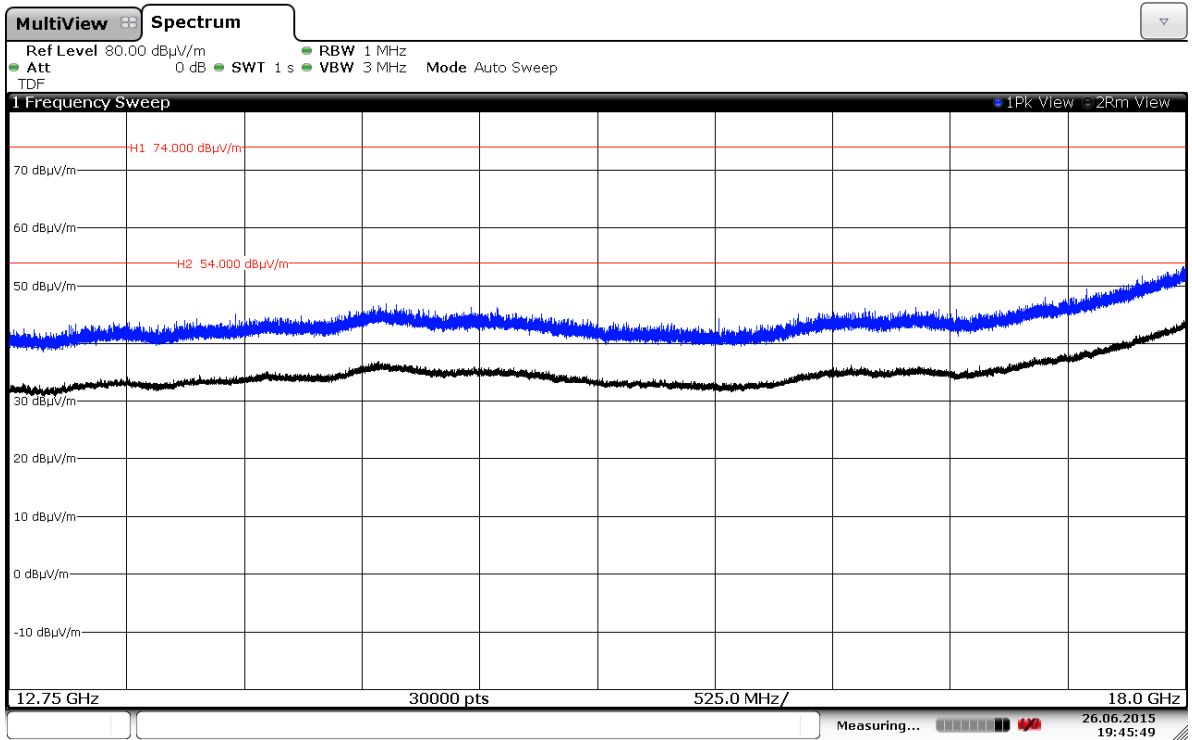


2. WiFi 2.4GHz 802.11 g mode

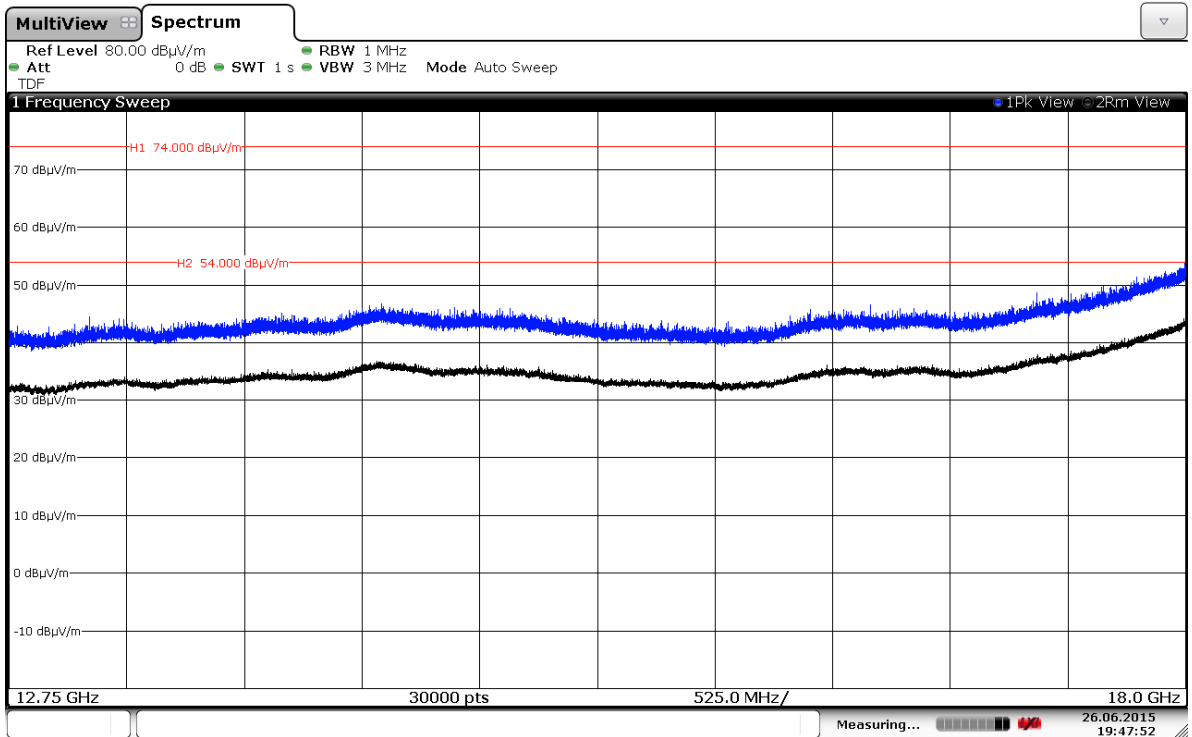
CHANNEL 1 (2412 MHz).



CHANNEL 6 (2437 MHz).



CHANNEL 11 (2462 MHz).

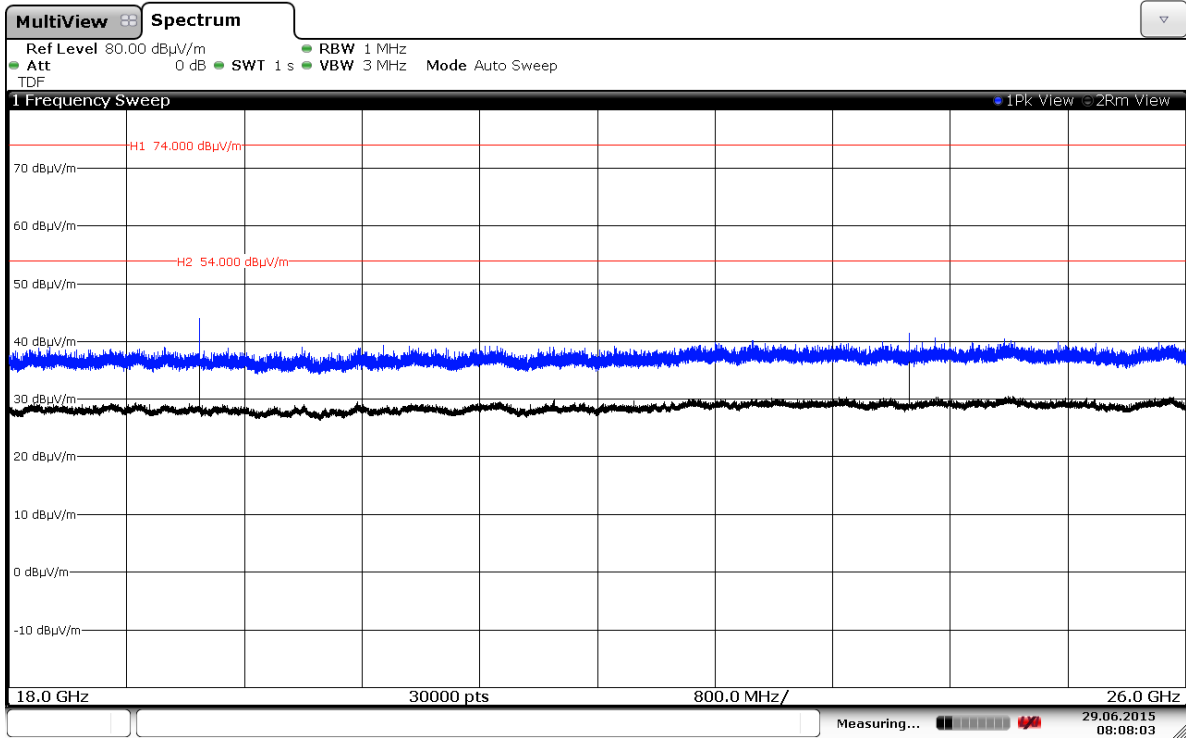




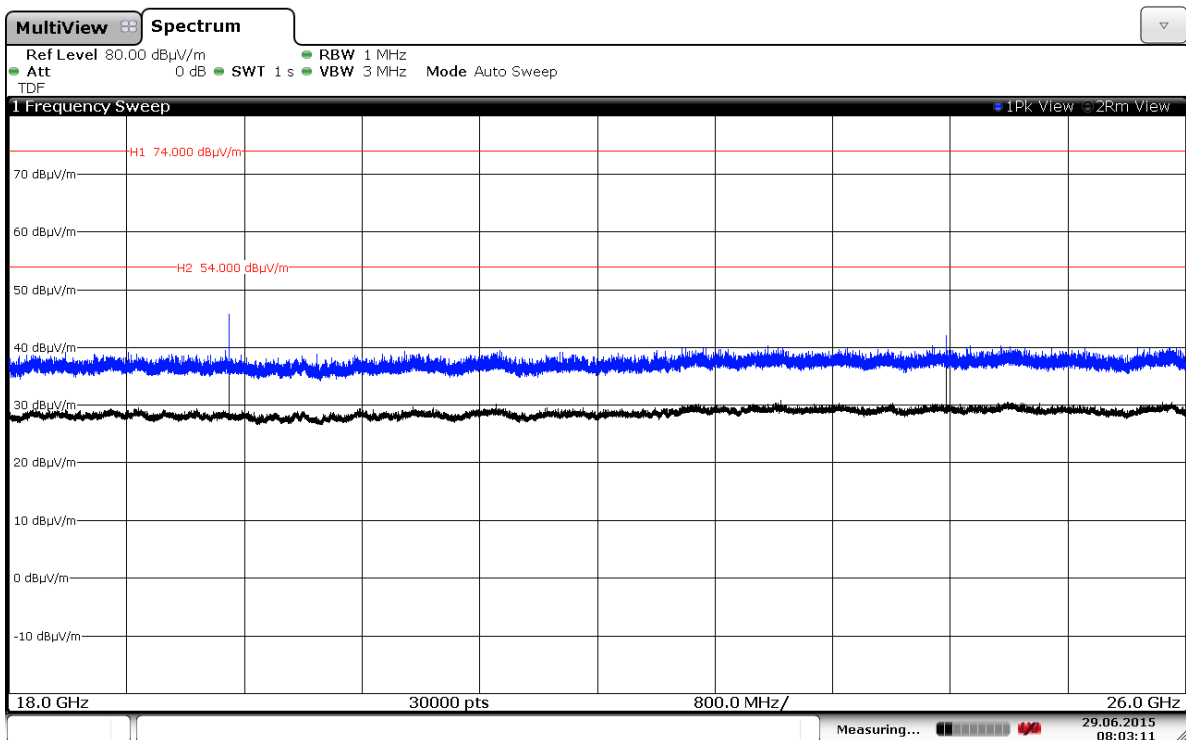
## FREQUENCY RANGE 18 GHz to 26 GHz

### 1. WiFi 2.4GHz 802.11 b mode

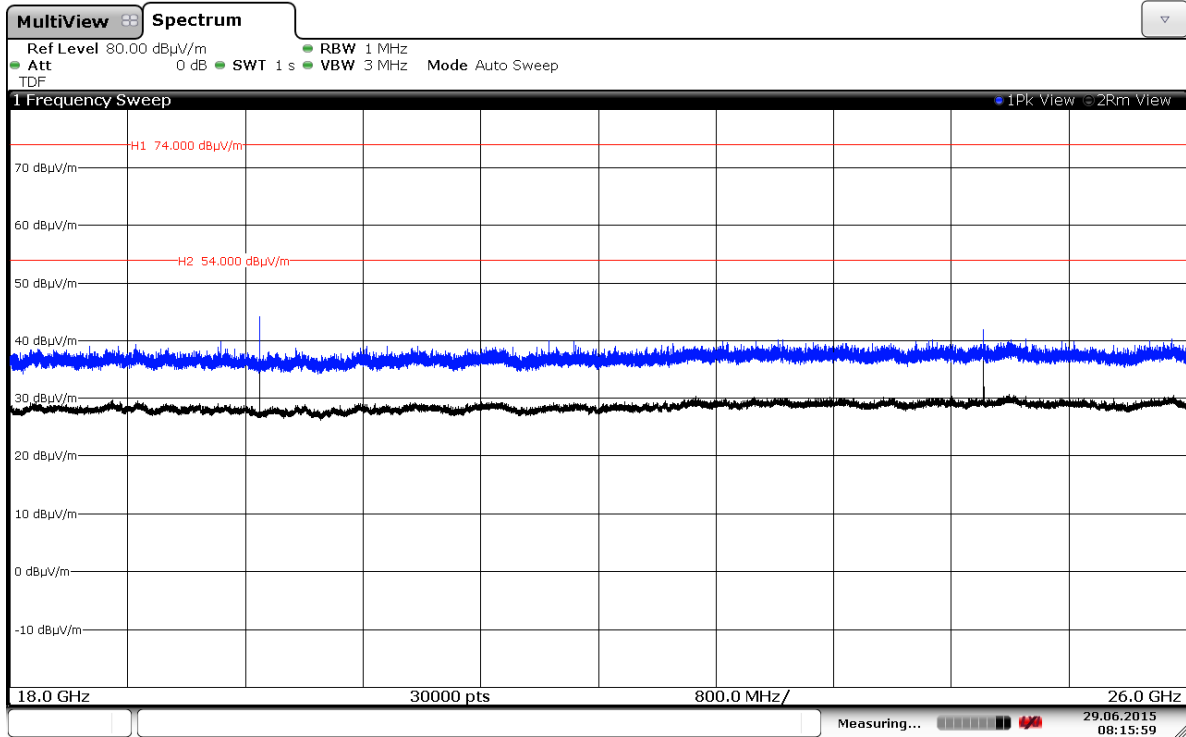
#### CHANNEL 1 (2412 MHz).



#### CHANNEL 6 (2437 MHz).

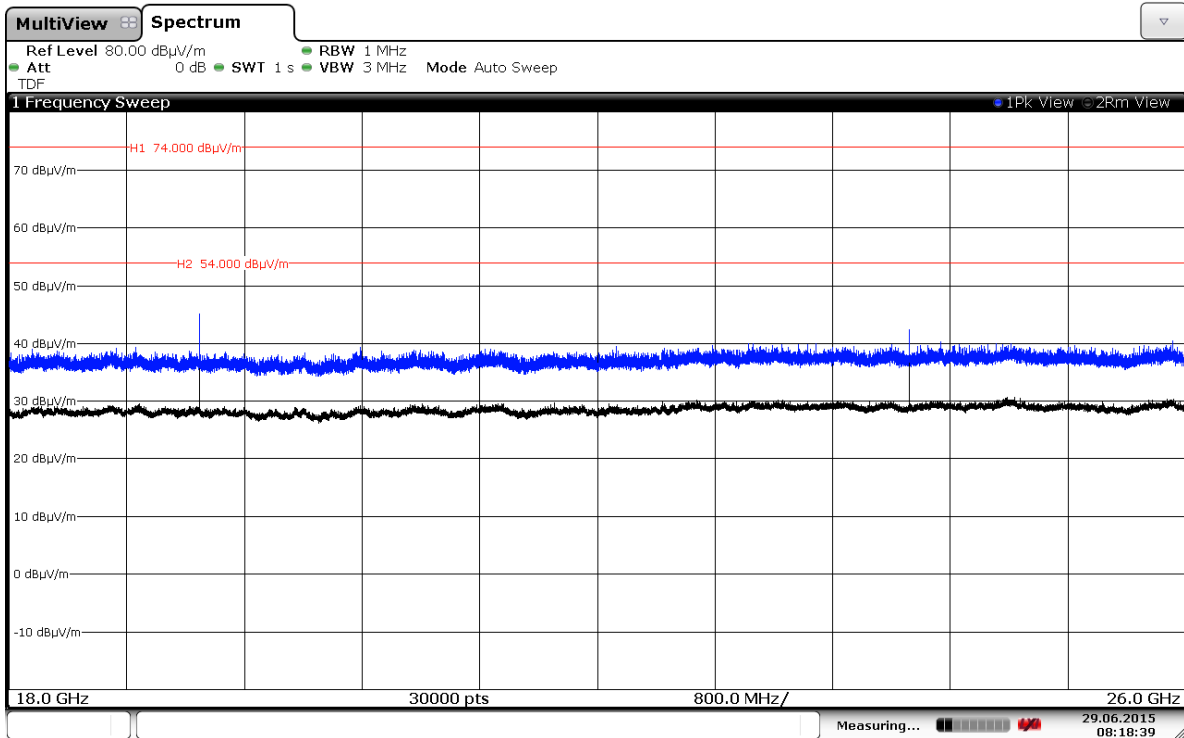


CHANNEL 11 (2462 MHz).

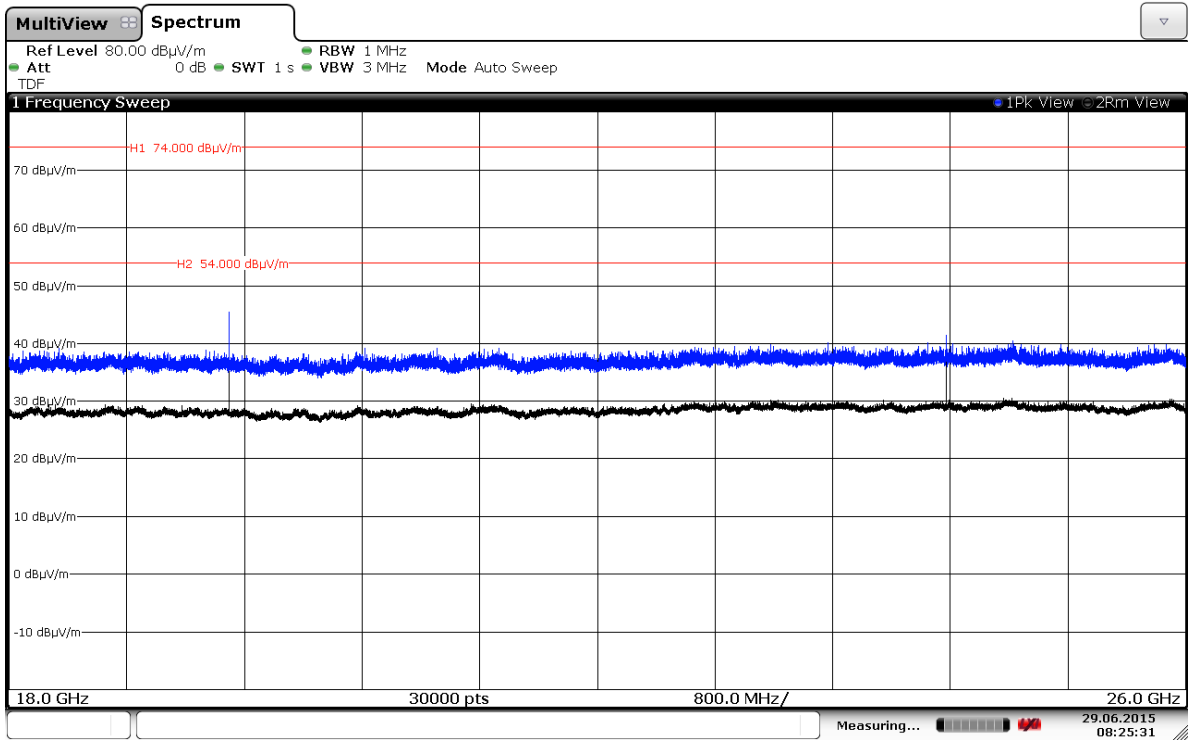


2. WiFi 2.4GHz 802.11 g mode

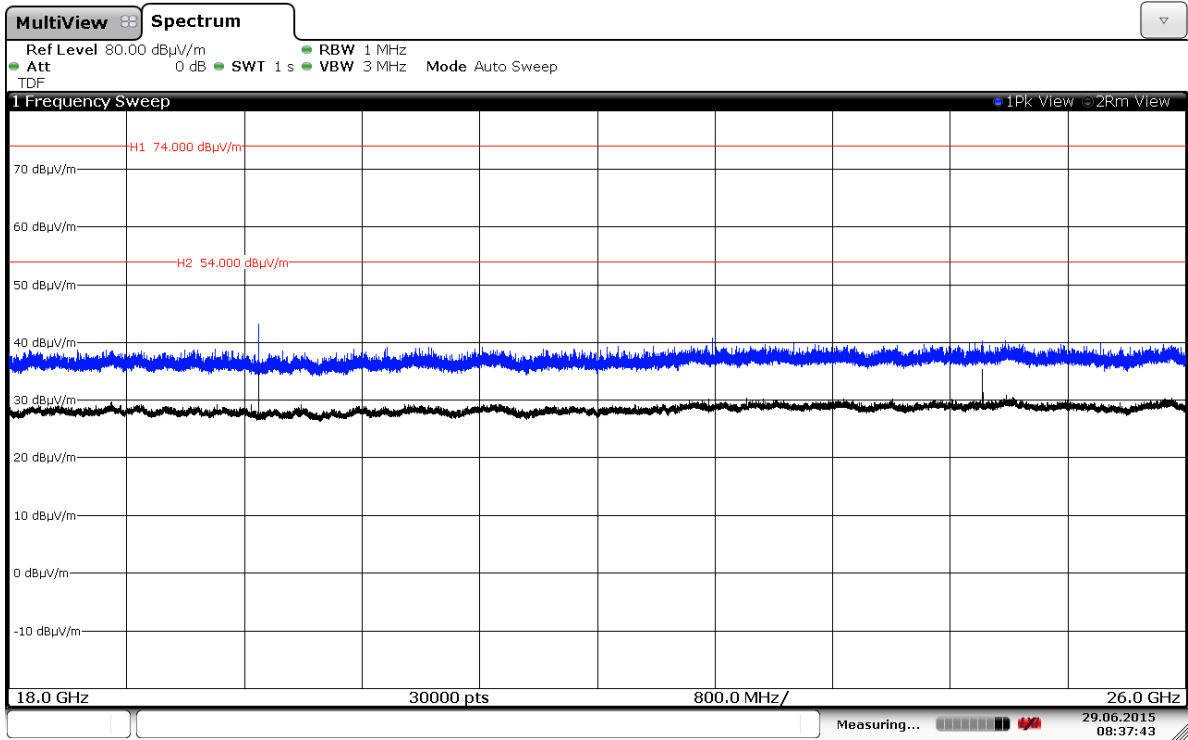
CHANNEL 1 (2412 MHz).



CHANNEL 6 (2437 MHz).



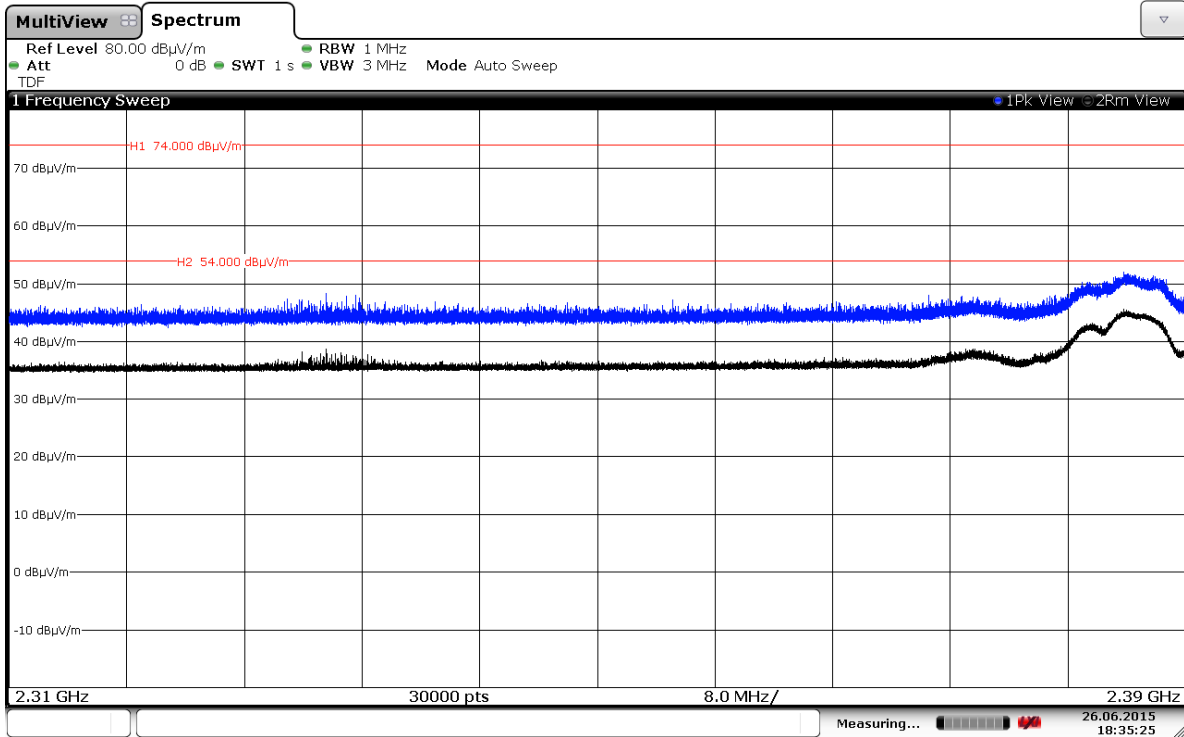
CHANNEL 11 (2462 MHz).



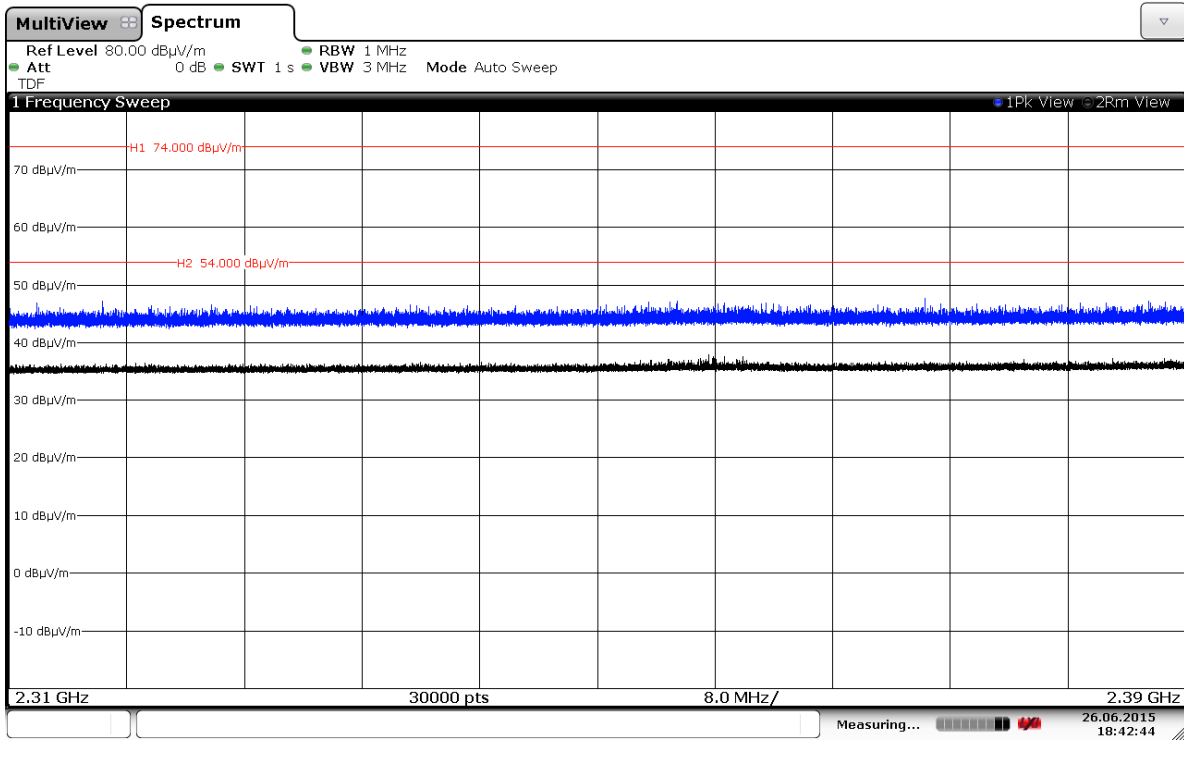
### FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

#### 1. WiFi 2.4GHz 802.11 b mode

CHANNEL 1 (2412 MHz).

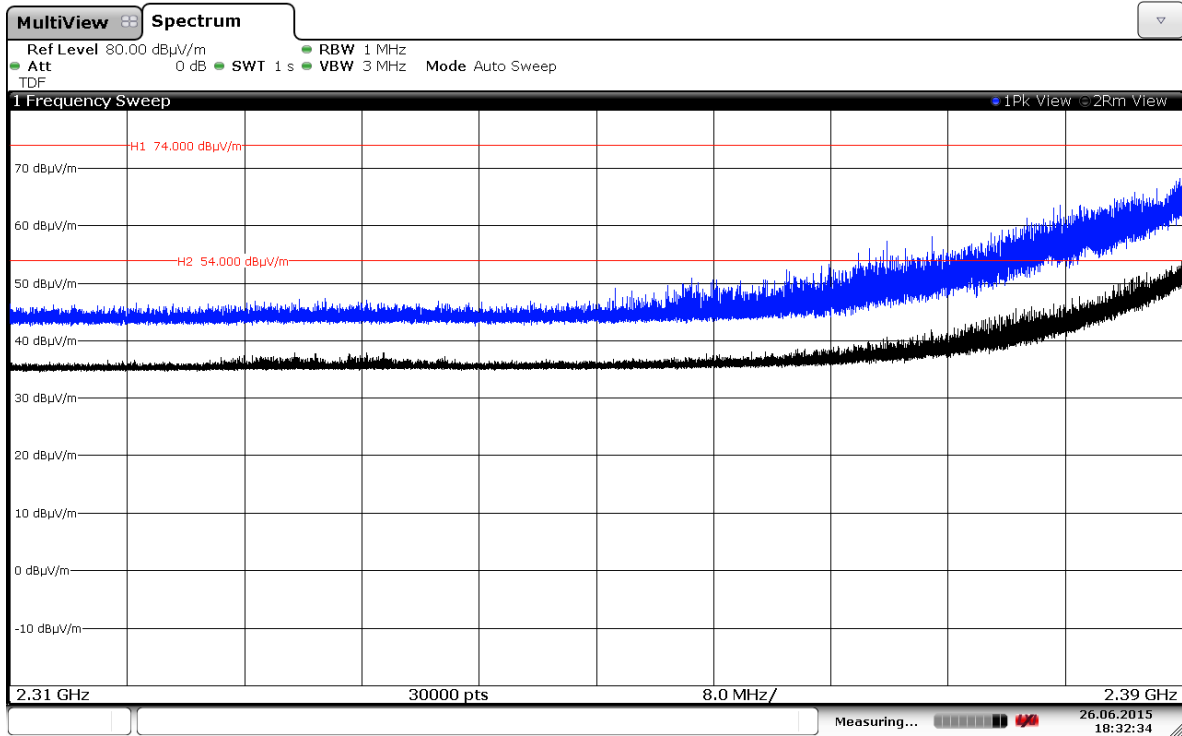


CHANNEL 6 (2437 MHz).

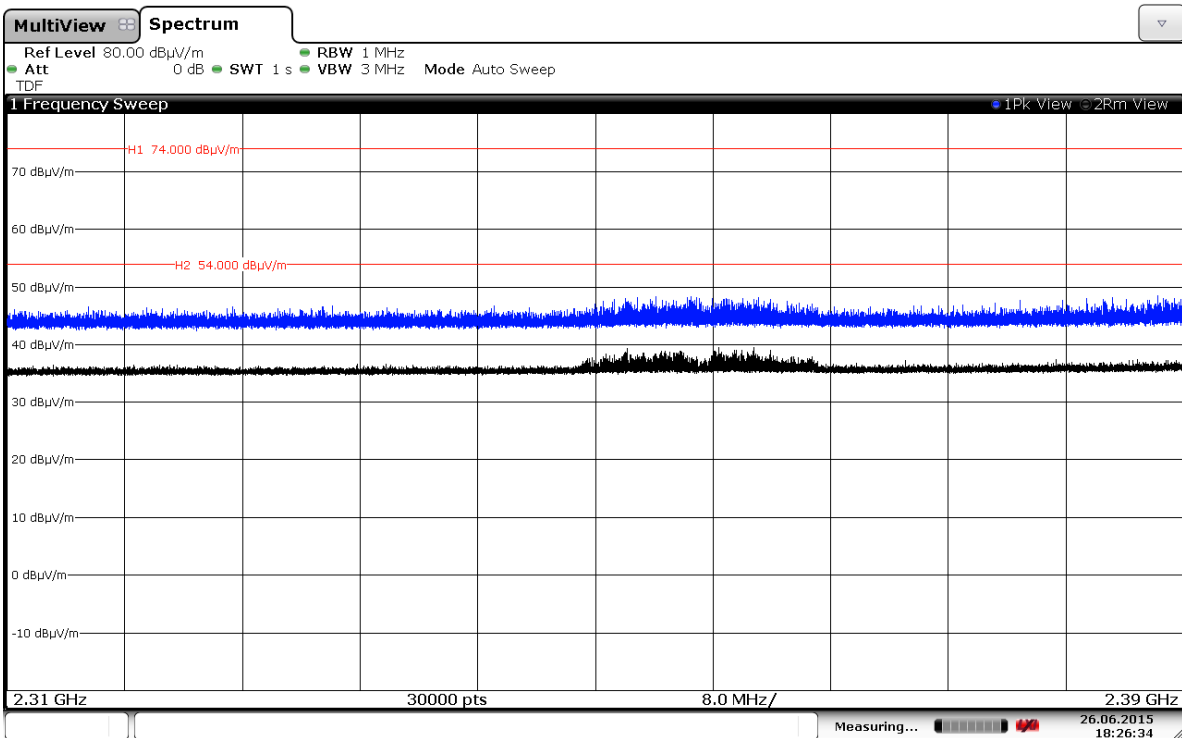


## 2. WiFi 2.4GHz 802.11 g mode

### CHANNEL 1 (2412 MHz)



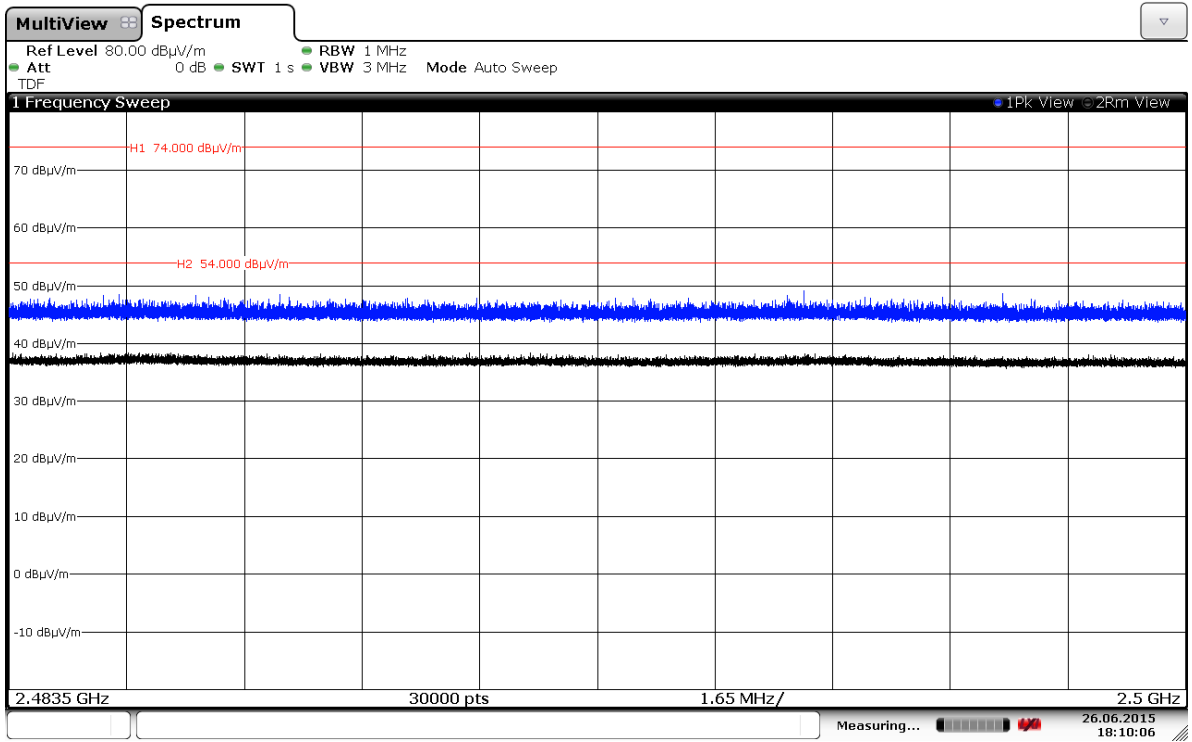
### CHANNEL 6 (2437 MHz).



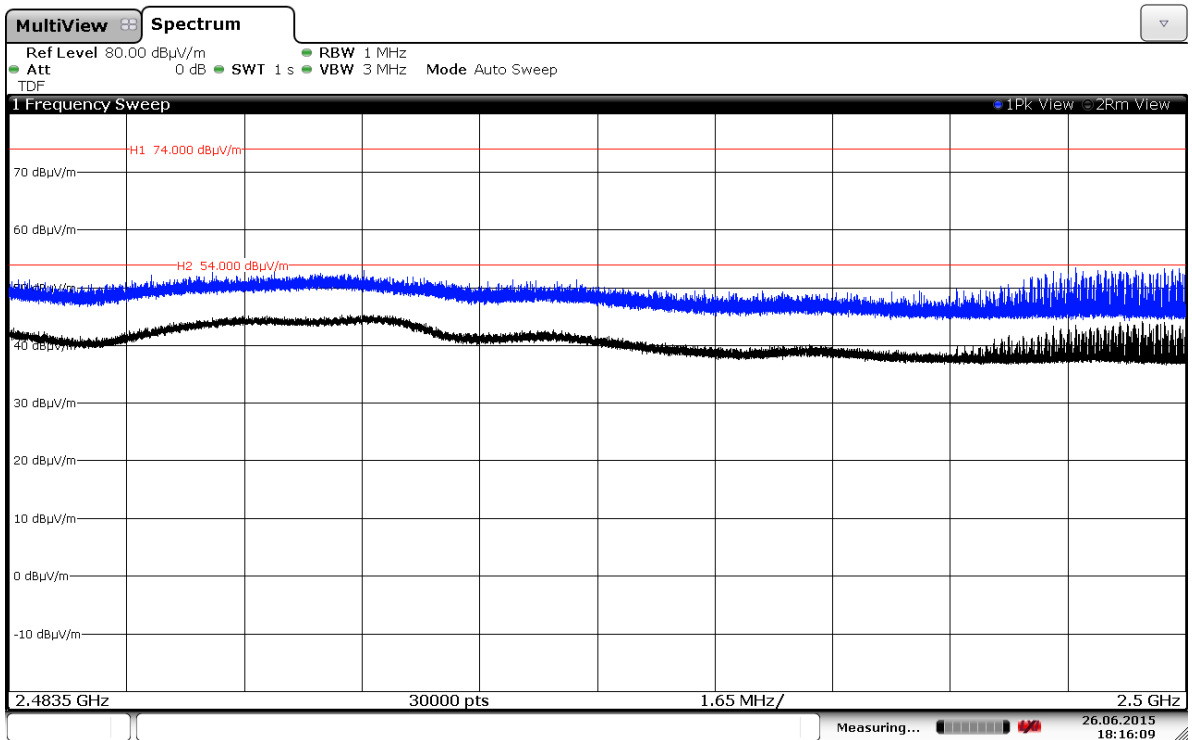
### FREQUENCY RANGE 2.4835 GHz to 2.5 GHz. (RESTRICTED BAND)

#### 1. WiFi 2.4GHz 802.11 b mode

#### CHANNEL 6 (2437 MHz). .

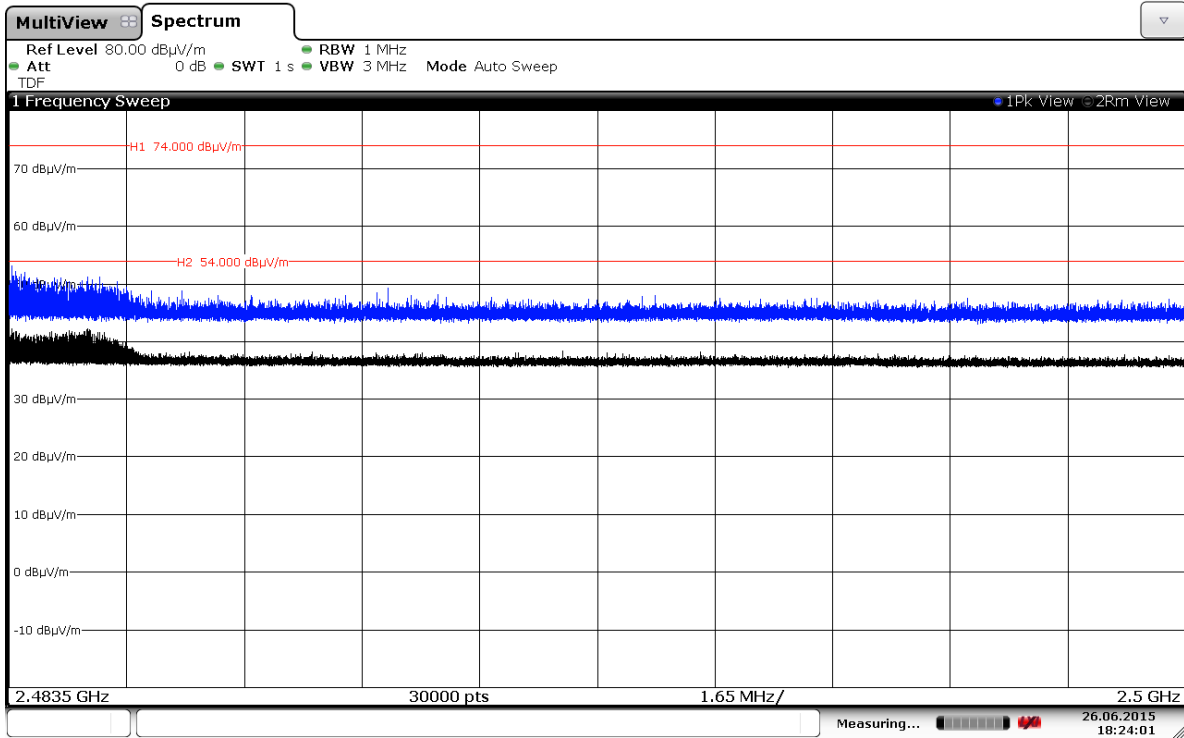


#### CHANNEL 11 (2462 MHz).



## 2. WiFi 2.4GHz 802.11 g mode

CHANNEL 6 (2437 MHz).



CHANNEL 11 (2462 MHz).

