

**FCC LISTED, REGISTRATION  
NUMBER: 905266**

**IC LISTED REGISTRATION NUMBER  
IC 4621**

**AT4 wireless, S.A.**

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Registro Mercantil de Málaga, Tomo 1169,  
Libro 82, Folio 133, Hoja MA3729

## TEST REPORT

### REFERENCE STANDARD:

**USA FCC Part 15.247, 15.109 and 15.207**

**NIE** ..... : 29742RET.003

Approved by  
(name / position & signature) ..... : A. Llamas / RF Lab. Manager

Elaboration date ..... : 16/11/2009

**Identification of item tested** ..... : PDA

Trademark ..... : Genus

Model and/or type reference ..... : TSN-1

Serial number ..... : Serial number (PSN): EBL 0001277, EBL 0002015

Other identification of the product ..... : Commercial name: TERRESTAR GENUS  
FCC ID: OBW120897  
IC: 3282A-120897

Features ..... : GSM850/GSM900/GSM1800/GSM1900/WCDMA FDD V/ WCDMA FDD  
II / GMR-1 3G / BT / WiFi / A-GPS

Description ..... : PDA

**Applicant** ..... : ELEKTROBIT INC.

Address ..... : 22745 29TH DRIVE SE, SUITE 200 BOTHELL, WASHINGTON 98021  
USA

CIF/NIF/Passport ..... : 91-1746142

Contact person: ..... : Tuomo Väinämö

Telephone / Fax ..... : +358 40 3442000 / : +358 8 343 032

e-mail: ..... : tuomo.vainamo@elektrobit.com

**Test samples supplier** ..... : Same as applicant

**Manufacturer** ..... : Same as applicant

Test method requested .....	See Standard		
Standard .....	USA FCC Part 15.247 07-10-08 Edition: Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. Guidelines for measurement of Digital Transmission Systems operating under section 15.247 dated March 23, 2005. USA FCC part 15.207 07-10-08 Edition: Conducted limits. USA FCC Part 15.109 07-10-08 Edition: Receiver radiated emission.		
Test procedure .....	PEET034: Medidas radioeléctricas a equipos de radio de espectro ensanchado en la banda de 2,4 GHz. PEEM001: Medida de la tensión perturbadora en bornes de alimentación según EN 55022.		
Non-standardized test method .....	N/A		
Used instrumentation .....	<u>Conducted Measurements</u>		
		Last Cal. date	Cal. due date
1.	Spectrum analyser Agilent PSA E4440A	2008/01	2010/01
2.	Spectrum analyser R&S ESU 40	2007/11	2009/11
3.	Bluetooth test set Anritsu MT8852A	N.A.	N.A.
4.	DC power supply R&S NGPE 40/40	2008/11	2011/11
5.	EMI Test Receiver R&S ESIB26	2009/09	2011/09
6.	Spectrum analyser R&S FSU8	2009/08	2011/08
7.	Transient limiter. HP 11947A	2007/01	2010/01
8.	Line Impedance Stabilization Network (L.I.S.N.) R&S. ESH2-Z5	2008/01	2010/01
<u>Radiated Measurements</u>			
		Last Cal. date	Cal. due date
1.	Semianechoic Absorber Lined Chamber IR 11. BS	N.A.	N.A.
2.	Control Chamber IR 12.BC	N.A.	N.A.
3.	Hybrid Bilog antenna Sunol Sciences Corporation JB6	2008/10	2011/10
4.	Antenna mast EM 1072 NMT	N.A.	N.A.
5.	Rotating table EM 1084-4. ON	N.A.	N.A.
6.	Double-ridge Guide Horn antenna 1-18 GHz HP 11966E	2008/03	2011/03
7.	Double-ridge Guide Horn antenna 18-40 GHz Agilent 119665J	2008/09	2011/09
8.	EMI Test Receiver R&S ESIB26	2009/09	2011/09
9.	RF pre-amplifier Miteq JS4-12002600-30-5A.	2008/07	2010/07
10.	Multi Device Controller EMCO 2090	N.A.	N.A.
11.	Spectrum Analyzer R&S ESU40	2007/11	2009/11
12.	Spectrum Analyzer Agilent E4440A	2008/01	2010/01
13.	RF pre-amplifier Miteq AFS5-04001300-15-10P-6.	2008/07	2010/07
14.	RF pre-amplifier Schaffner CPA 9231.	2009/03	2011/03
15.	Bluetooth test set Anritsu MT8852A.	N.A.	N.A.
16.	Antenna tripod EMCO 11968C.	N.A.	N.A.
17.	Spectrum analyser R&S FSU8	2009/08	2011/08
Report template No. ....	FDT08_11		
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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: 905266.

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 4621.

In order to assure the traceability to other national and international laboratories, AT4 wireless has a calibration and maintenance programme 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.

## 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 documents:

PODT000: : Procedimiento para el cálculo de incertidumbres de medida

FEM12\_07: Formato de cálculo de incertidumbre a aplicar en la medida de la tensión perturbadora en bornes de alimentación según EN 55022.

## Usage of samples

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

**Sample M/01 is formed by the following elements:**

<u>Control No.</u>	<u>Description</u>	<u>Model</u>	<u>Serial No.</u>	<u>Date of reception</u>
29742/69	Mobile phone with integral antenna	TSN-1	EBL 0002015	05/11/09

**Sample M/02 is formed by the following elements:**

<u>Control No.</u>	<u>Description</u>	<u>Model</u>	<u>Serial No.</u>	<u>Date of reception</u>
29742/51	Mobile phone with antenna connector	TSN-1	EBL0001502	22/09/09
29742/19	Dummy battery	---	---	28/09/09

**Sample S/03 is composed of the following elements:**

<u>Control N°</u>	<u>Description</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
29609/73	PDA	TSN-1	EBL0001821	2009-11-05
29609/74	AC/DC adapter	FN10-UB	---	2009-11-09
29609/79	Battery	---	---	2009-11-09

**Sample S/04 is composed of the following elements:**

<u>Control N°</u>	<u>Description</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
29609/73	PDA	TSN-1	EBL0001821	2009-11-05
29609/79	Battery	---	---	2009-11-09
29609/64	USB Cable	---	---	2009-11-02

**With the sample S/04 it was used the next auxiliary element:**

<u>Control N°</u>	<u>Description</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Serial N°</u>	<u>Date of reception</u>
2914	Laptop PC	DELL	N5543C	MY4728E801	Property of AT4 wireless.

1. Sample M/01 has undergone following test(s).  
Radiated tests indicated in appendix A.
2. Sample M/02 has undergone following test(s).  
Conducted tests indicated in appendix A.
3. Samples S/03 & S/04 have undergone the next test(s):  
Continuous conducted emission, power leads, in appendix B

## Testing period

The performed test started on 2009-10-23 and finished on 2009-11-11.

The tests have been performed at AT4 wireless.

## Environmental conditions

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

Temperature	Min. = 23.6 °C Max. = 24.6 °C
Relative humidity	Min. = 48.4 % Max. = 53.2 %
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

In the semianechoic chamber (21 meters x 11 meters x 8 meters), the following limits were not exceeded during the test.

Temperature	Min. = 23.6 °C Max. = 24.6 °C
Relative humidity	Min. = 48.4 % Max. = 53.2 %
Air pressure	Min. = 1015 mbar Max. = 1015 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω
Normal site attenuation (NSA)	< ±4 dB at 10 m distance between item under test and receiver antenna, (30 MHz to 1000 MHz)
Field homogeneity	More than 75% of illuminated surface is between 0 and 6 dB (26 MHz to 1000 MHz).

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

Temperature	Min. = 24.6 °C Max. = 25.2 °C
Relative humidity	Min. = 48.5 % Max. = 49.3 %
Air pressure	Min. = 1019 mbar Max. = 1020 mbar
Shielding effectiveness	> 100 dB
Electric insulation	> 10 kΩ
Reference resistance to earth	< 0,5 Ω

## Summary

Considering the results of the performed test according to standard USA FCC Parts 15.247, 15.207 and 15.109, the item under test is **IN COMPLIANCE** with the requested specifications specified in the standard.

NOTE: The results presented in this Test Report apply only to the particular item under test established in page 1 of this document, as presented for test on the date(s) shown in section, "USAGE OF SAMPLES, TESTING PERIOD AND ENVIRONMENTAL CONDITIONS".

### Remarks and comments

None.

### Testing verdicts

Not applicable .....: NA

Pass.....: P

Fail .....: F

Not measured.....: NM

FCC PART 15 PARAGRAPH	VERDICT			
	NA	P	F	NM
Section 15.247 Subclause (a) (2). 6 dB Bandwidth		P		
Section 15.247 Subclause (b). Maximum output power and antenna gain		P		
Section 15.247 Subclause (d). Emission limitations conducted (Transmitter)		P		
Section 15.247 Subclause (d). Band-edge emissions compliance (Transmitter)		P		
Section 15.247 Subclause (e). Power spectral density		P		
Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)		P		
Section 15.109. Radiated emission limits for receiver		P		
Section 15.207. Conducted limits		P		

## **APPENDIX A: Test result**



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## TEST CONDITIONS

Power supply (V):

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

Type of power supply = DC voltage from rechargeable Li-Ion polymer battery.

Type of antenna = Integral antenna.

Maximum Gain for antenna = 3.95 dBi

Operating Temperature Range (°C):

$$T_n = -20^{\circ}\text{C to } +55^{\circ}\text{C}$$

TEST FREQUENCIES:

Lowest channel: 2412 MHz

Middle channel: 2437 MHz

Highest channel: 2462 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.4: 2003.

## CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using low loss RF cables with sma type connectors. The reading in the spectrum analyzer is corrected taking into account the cable loss.

## RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 3 m for the frequency range 30 MHz-1000 MHz (30 MHz-1000 MHz Bilog antenna) and at a distance of 1m for the frequency range 1 GHz-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 (a) (2). 6 dB Bandwidth

### SPECIFICATION

The minimum 6 dB bandwidth shall be at least 500 kHz.

### RESULTS

#### 1. DSSS modulation

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 11 Mbps bit rate. Results shown below correspond to 11 Mbps.

6 dB Bandwidth (see next plots).

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
6 dB Spectrum bandwidth (MHz)	11.58	11.58	11.62
Measurement uncertainty (kHz)	±89		

#### 2. OFDM modulation

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps and the worst case was for 24 Mbps bit rate. Results shown below correspond to 24 Mbps.

6 dB Bandwidth (see next plots).

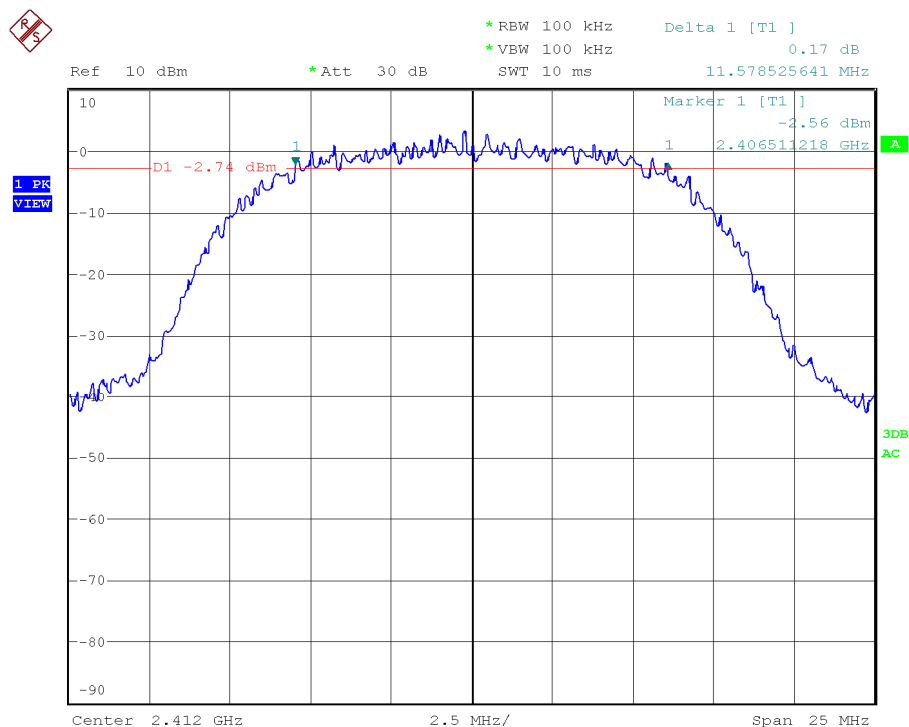
	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
6 dB Spectrum bandwidth (MHz)	16.47	16.47	16.51
Measurement uncertainty (kHz)	±89		

Verdict: PASS

# 1. DSSS modulation

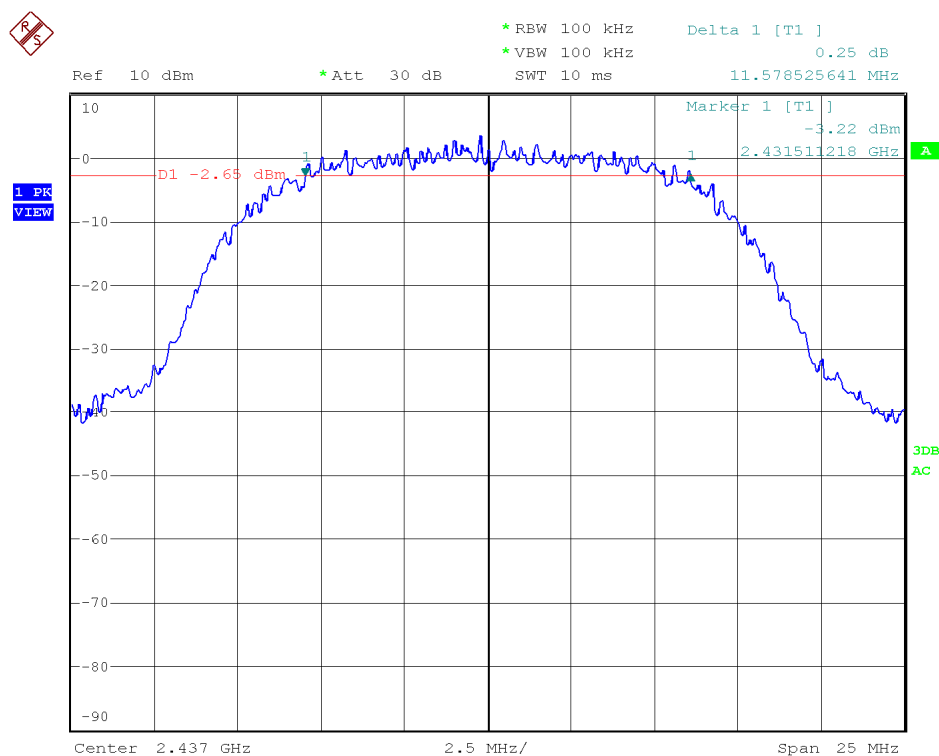
6 dB BANDWIDTH.

Lowest Channel: 2412 MHz.



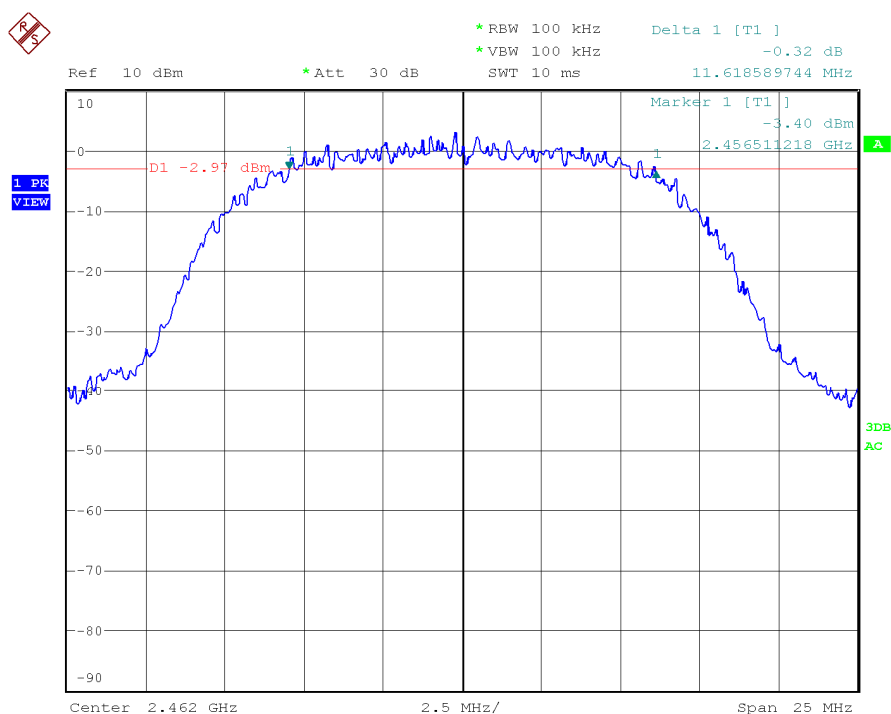
6 dB BANDWIDTH.

Middle Channel: 2437 MHz.



6 dB BANDWIDTH.

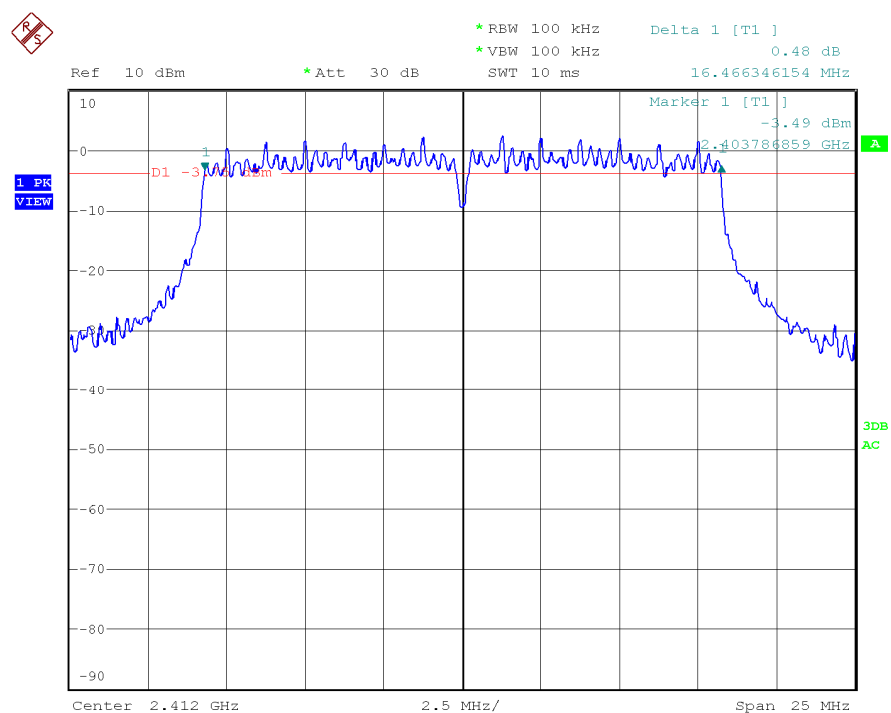
Highest Channel: 2462 MHz.



## 2. OFDM modulation

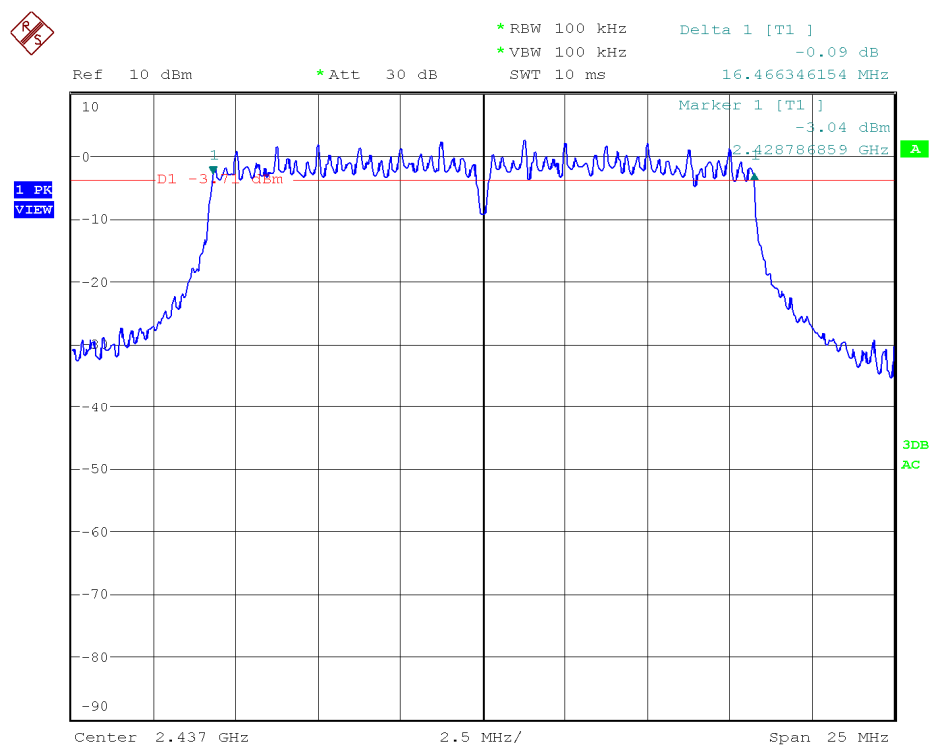
6 dB BANDWIDTH.

Lowest Channel: 2412 MHz.



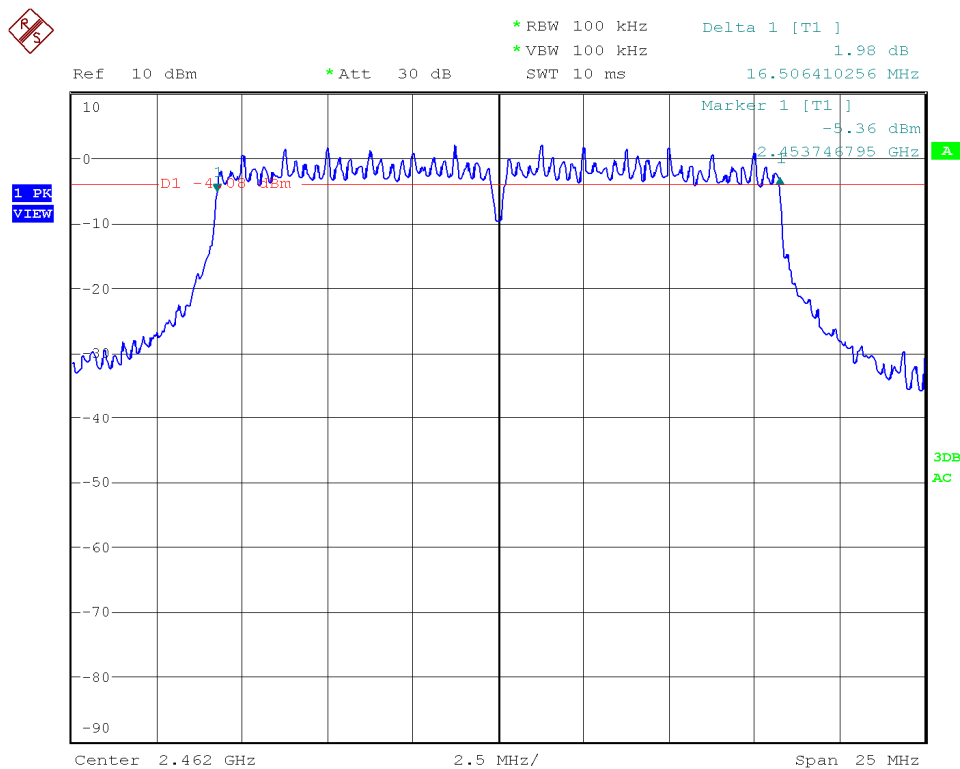
6 dB BANDWIDTH.

Middle Channel: 2437 MHz.



6 dB BANDWIDTH.

Highest Channel: 2462 MHz.



## Section 15.247 Subclause (b). Maximum output power and antenna gain

### SPECIFICATION

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).

### RESULTS

#### 1. DSSS modulation

MAXIMUM OUTPUT POWER (CONDUCTED). See next plots.

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 5.5 Mbps bit rate. Results shown below correspond to 5.5 Mbps.

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Maximum power (dBm)	16.43	16.62	16.36
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 3.95 dBi, therefore the maximum theoretical radiated power (EIRP) in the three measurement channels for this device is 20.57 dBm or 114.02 mW.

The actual maximum radiated power (EIRP) was measured for the lowest, middle and highest frequency.

MAXIMUM OUTPUT POWER (RADIATED). See next plots.

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 5.5 Mbps bit rate. Results shown below correspond to 5.5 Mbps.

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Maximum EIRP power (dBm)	14.13	14.49	15.00
Measurement uncertainty (dB)	±4.0		

Maximum declared antenna gain: 3.95 dBi

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

## 2. OFDM modulation

MAXIMUM OUTPUT POWER (CONDUCTED). See next plots.

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps, and the worst case was for 18 Mbps bit rate. Results shown below correspond to 18 Mbps.

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Maximum power (dBm)	23.22	23.38	23.36
Measurement uncertainty (dB)	±1.5		

The maximum declared antenna gain for this device is 3.95 dBi, therefore the maximum theoretical radiated power (EIRP) in the three measurement channels for this device is 27.33 dBm or 540.75 mW.

The actual maximum radiated power (EIRP) was measured for the lowest, middle and highest frequency.

MAXIMUM OUTPUT POWER (RADIATED). See next plots.

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps, and the worst case was for 18 Mbps bit rate. Results shown below correspond to 18 Mbps.

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Maximum EIRP power (dBm)	17.37	18.84	20.07
Measurement uncertainty (dB)	±4.0		

Maximum declared antenna gain: 3.95 dBi

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

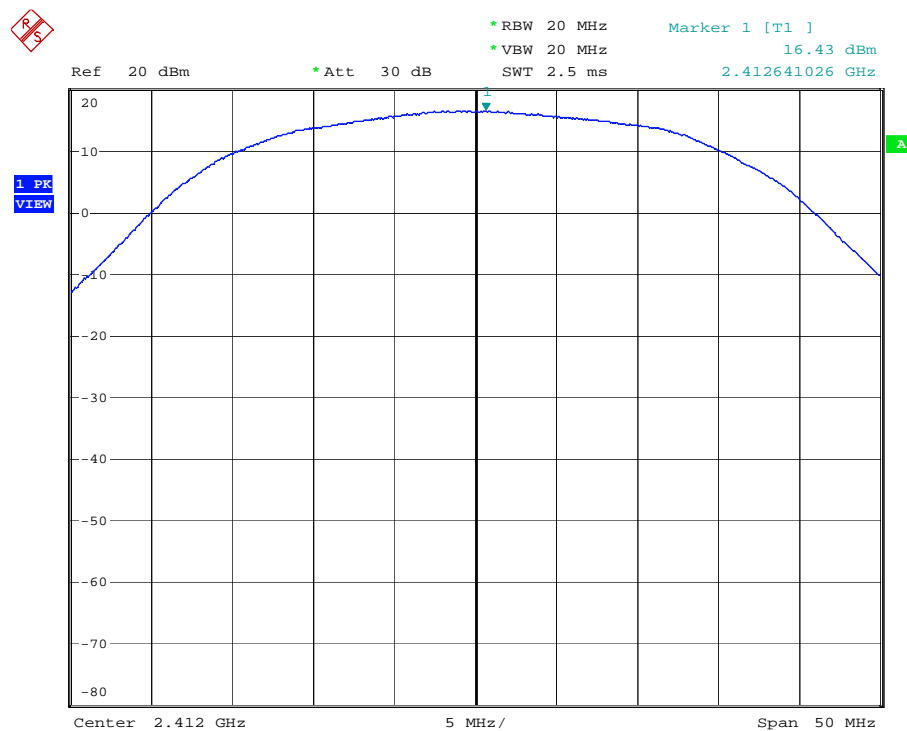
Verdict: PASS



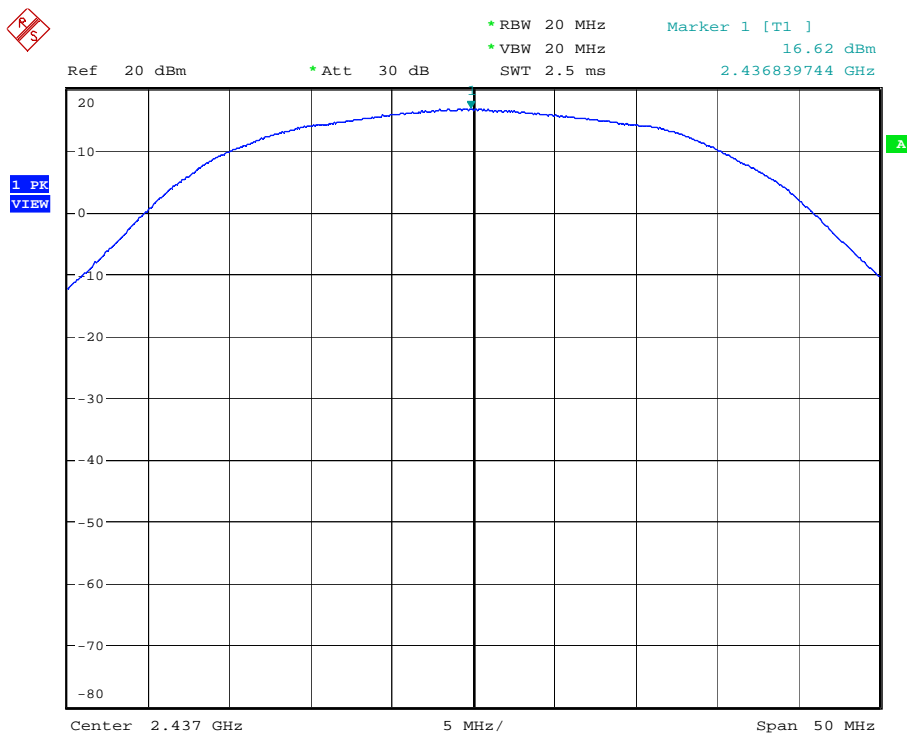
# 1. CONDUCTED PEAK POWER.

## DSSS modulation

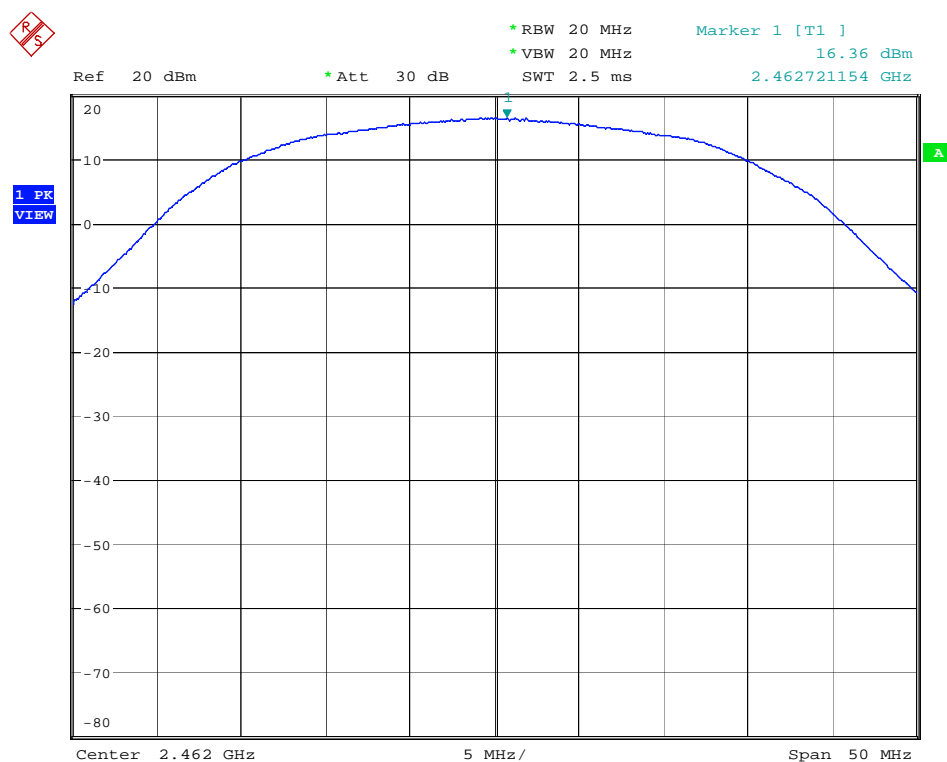
Lowest frequency 2412 MHz



Middle frequency 2437 MHz

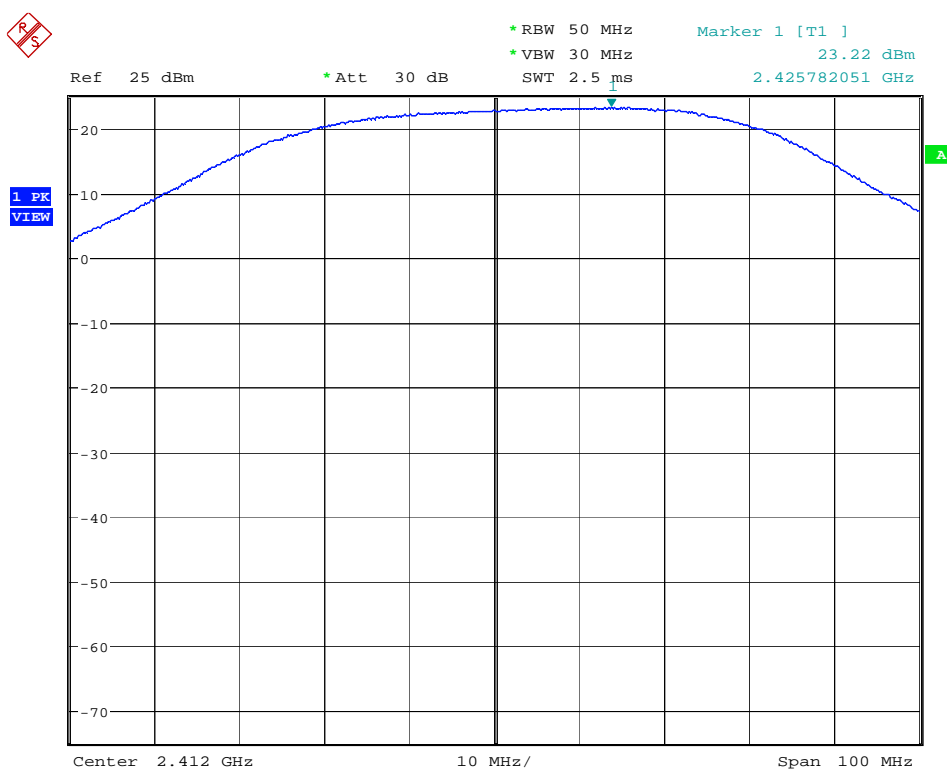


Highest frequency 2462 MHz

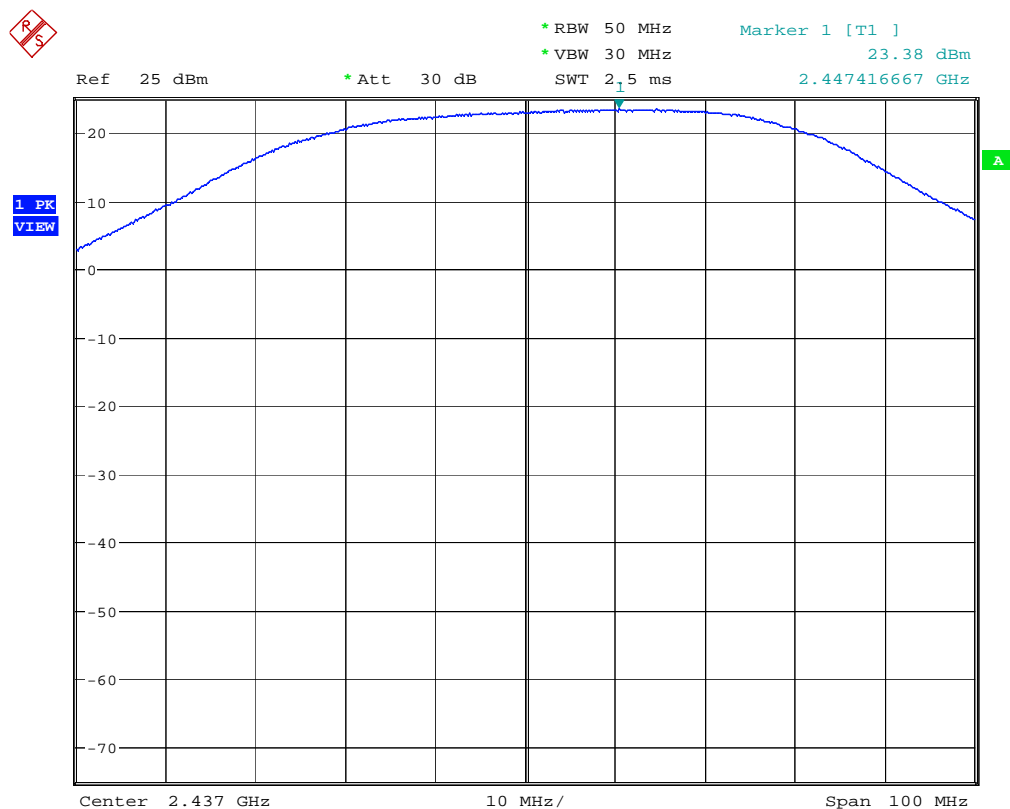


OFDM modulation

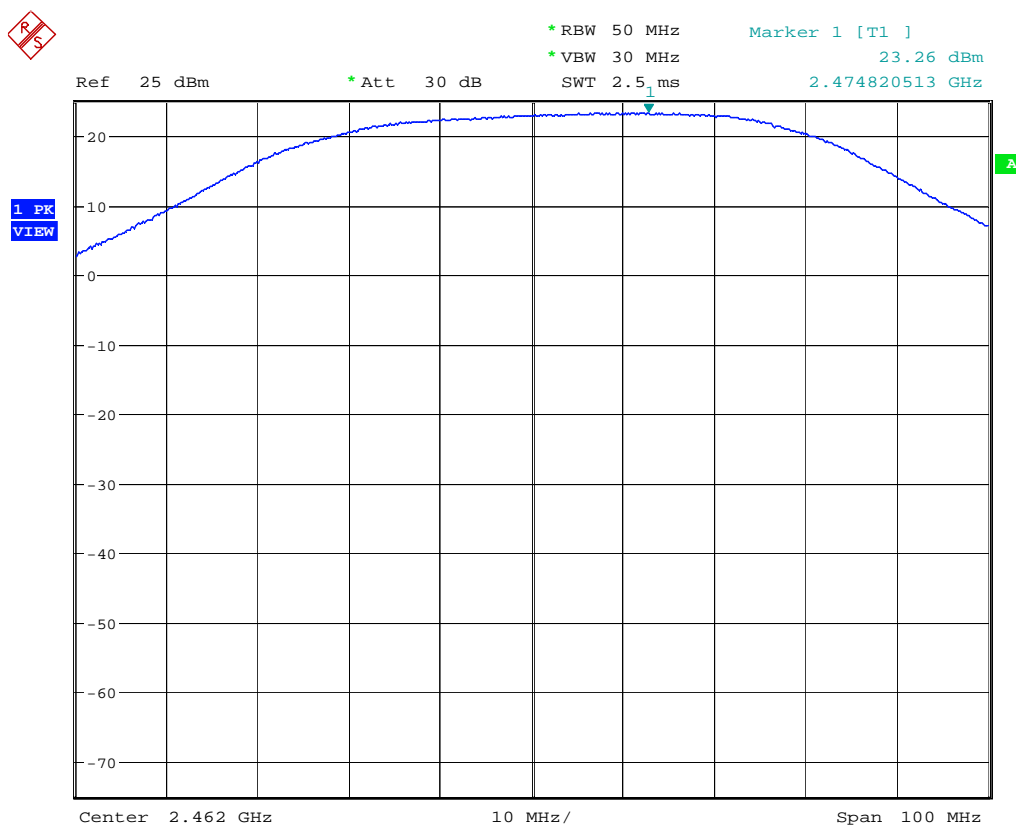
Lowest frequency 2412 MHz



## Middle frequency 2437 MHz



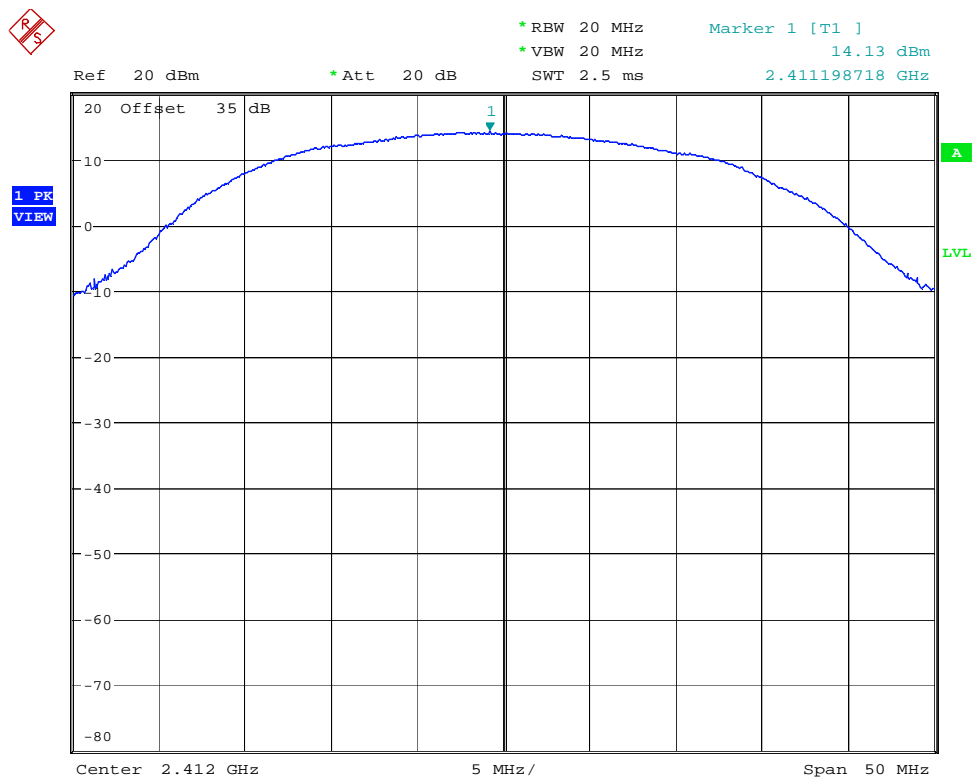
## Highest frequency 2462 MHz



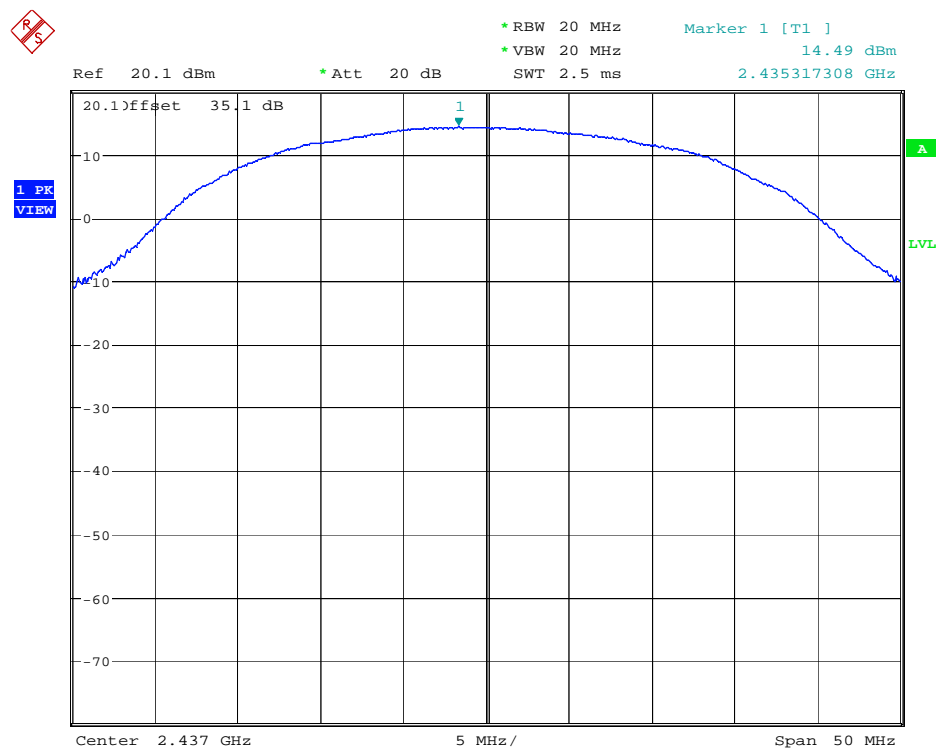
## 2. RADIATED PEAK POWER.

### DSSS modulation

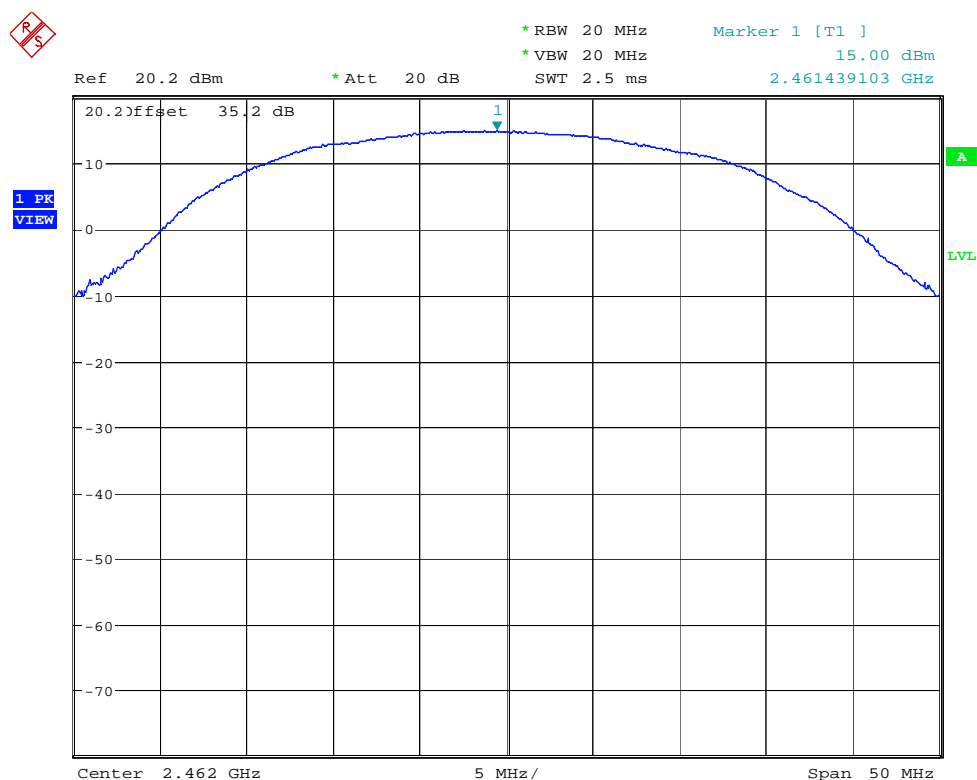
Lowest frequency 2412 MHz



Middle frequency 2437 MHz

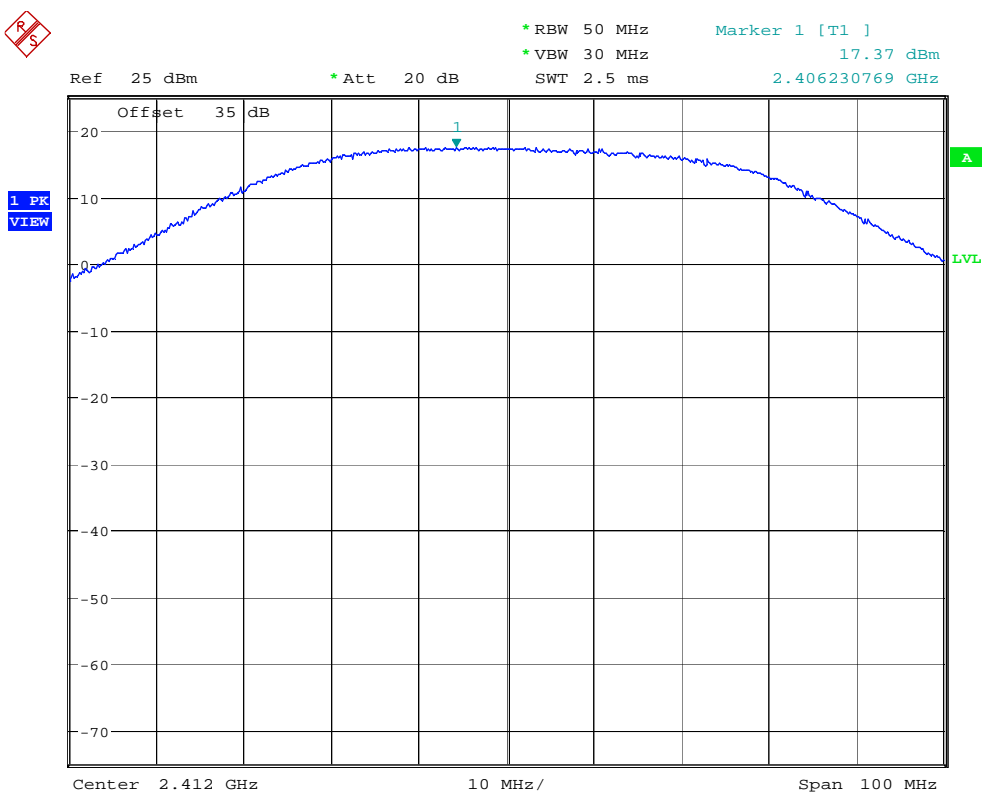


Highest frequency 2462 MHz

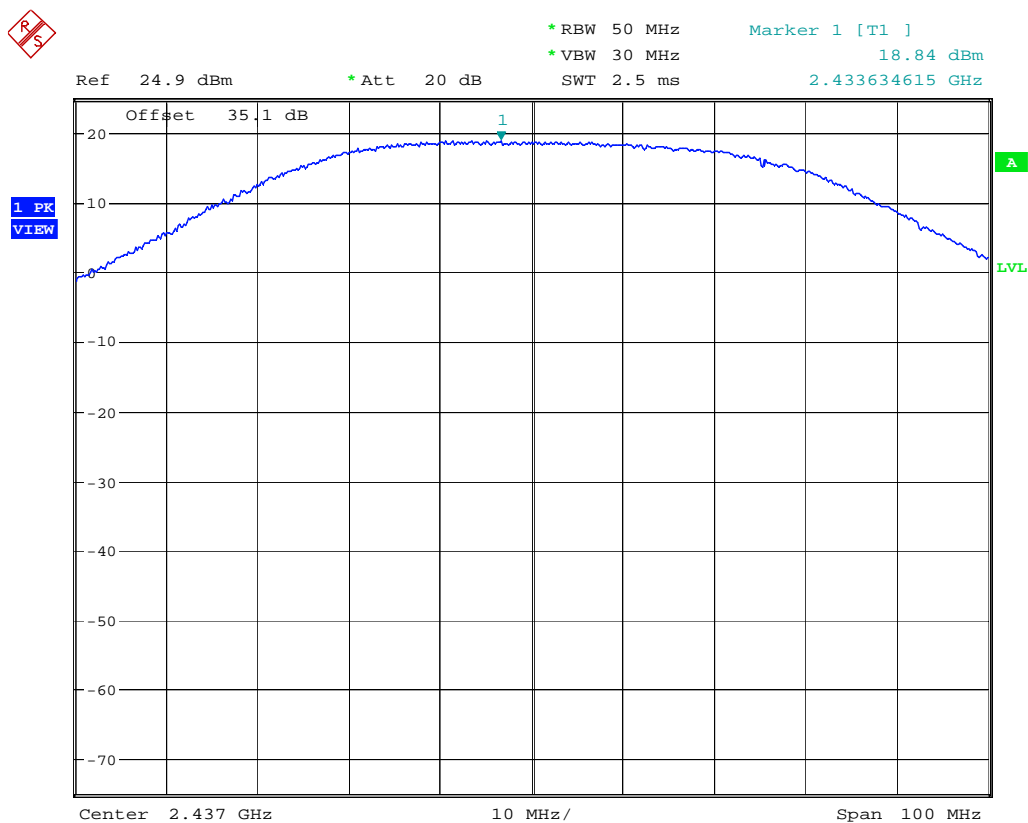


OFDM modulation

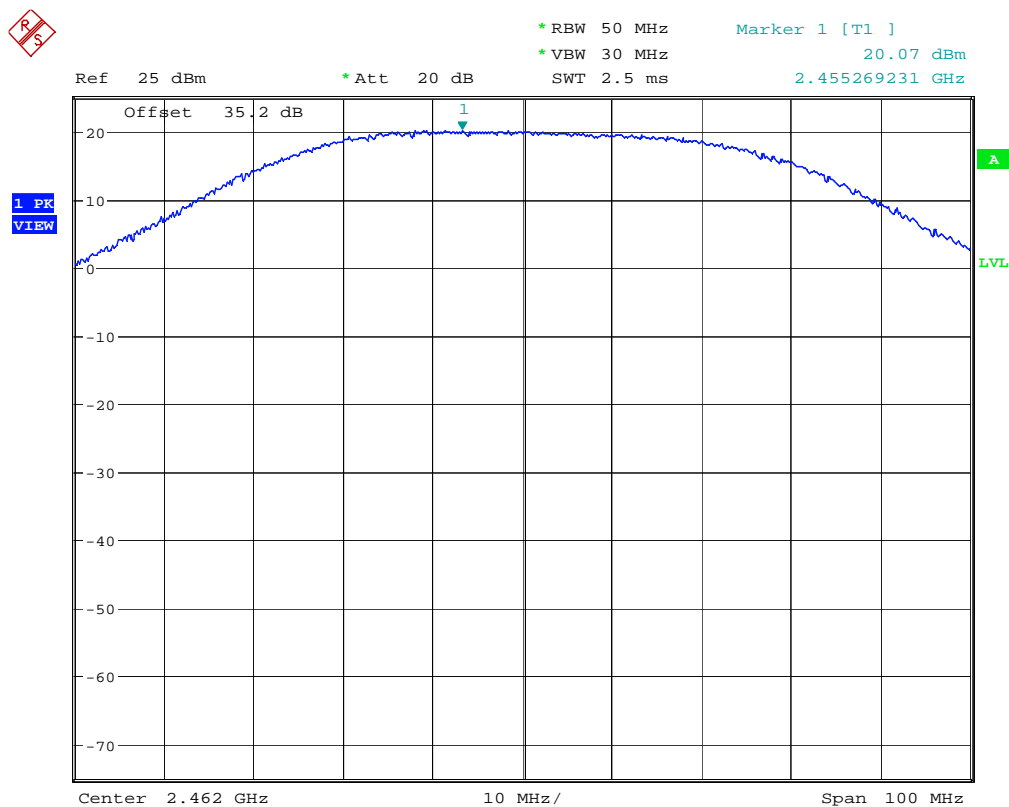
Lowest frequency 2412 MHz



## Middle frequency 2437 MHz



## Highest frequency 2462 MHz



## Section 15.247 Subclause (d). Emission limitations conducted (Transmitter)

### SPECIFICATION

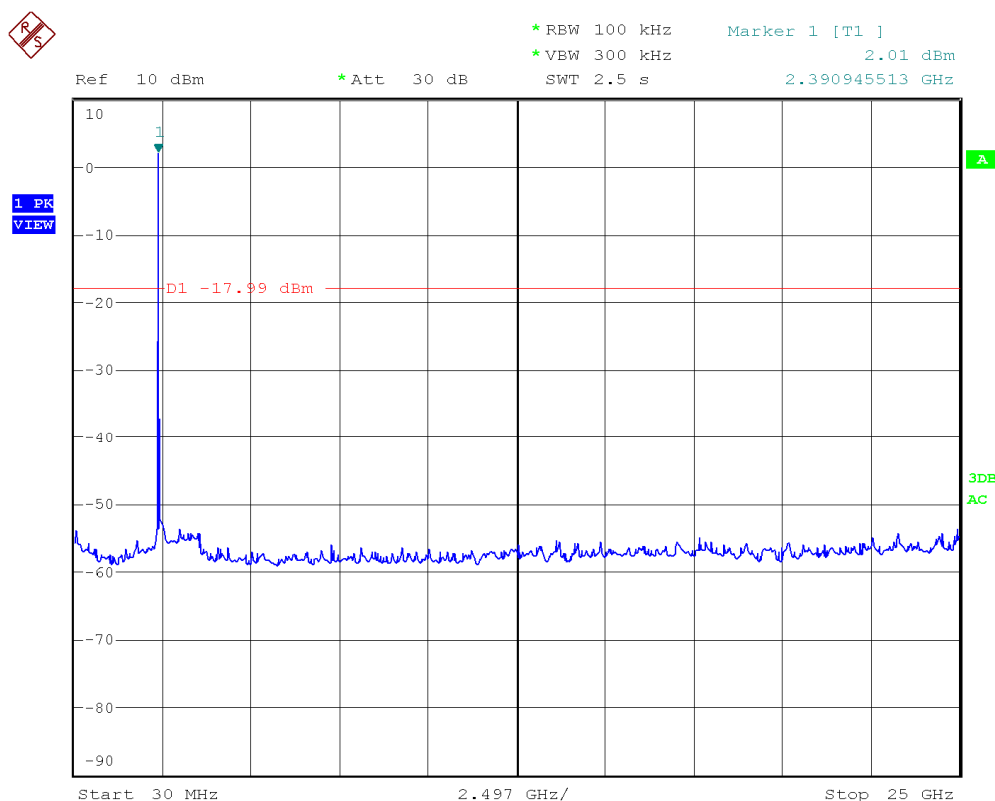
In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

### RESULTS:

#### 1. DSSS modulation

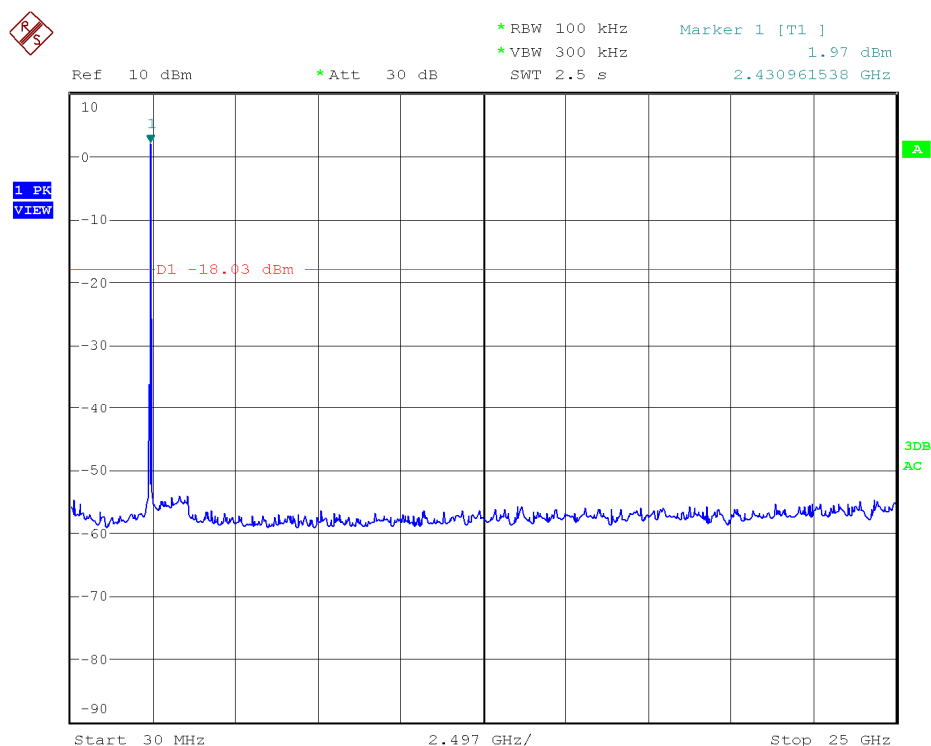
No spurious signals were detected in all the range for all modulation modes selected.

Lowest Channel: 2412 MHz.



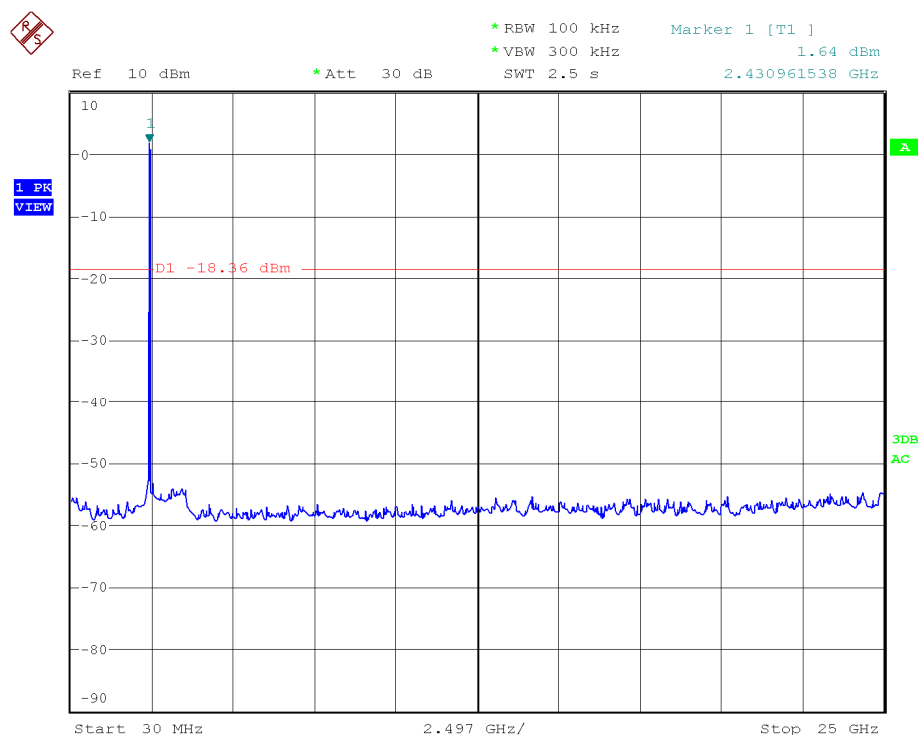
Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz.



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

Highest Channel: 2462 MHz.



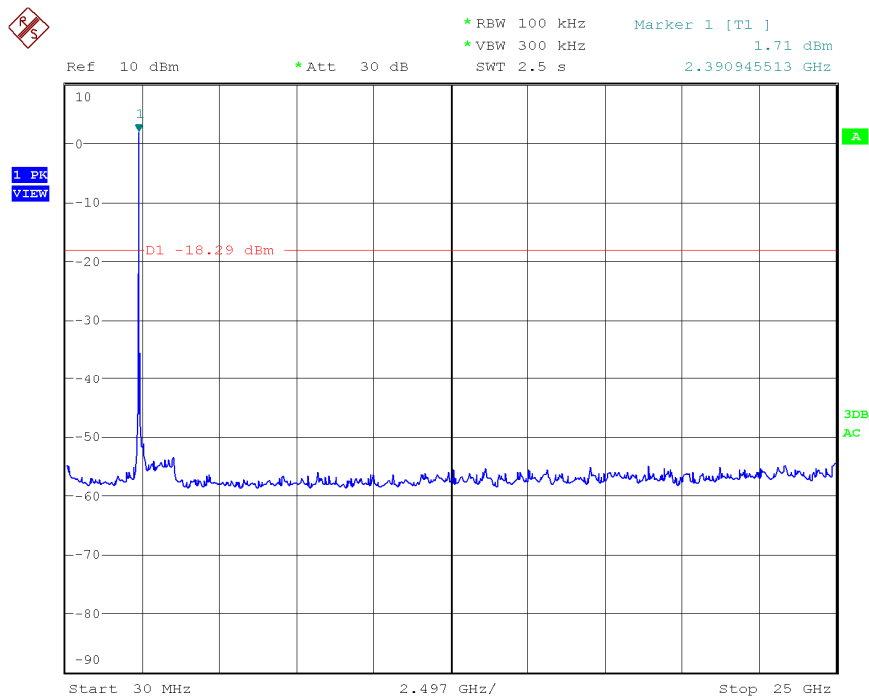
Note: The peak above the limit is the carrier frequency.



## 2. OFDM Modulation

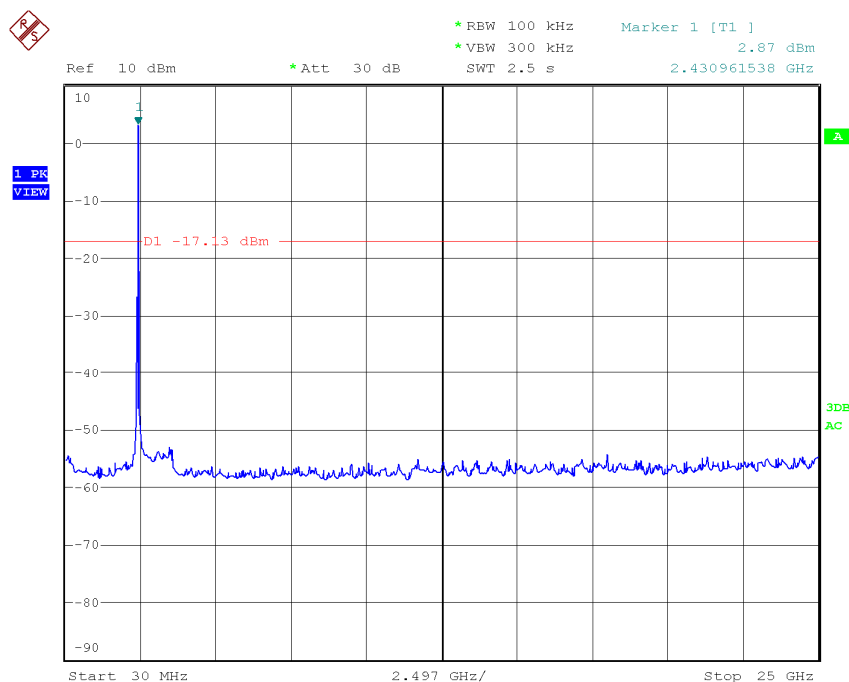
No spurious signals were detected in all the range for all modulation modes selected.

Lowest Channel: 2412 MHz.



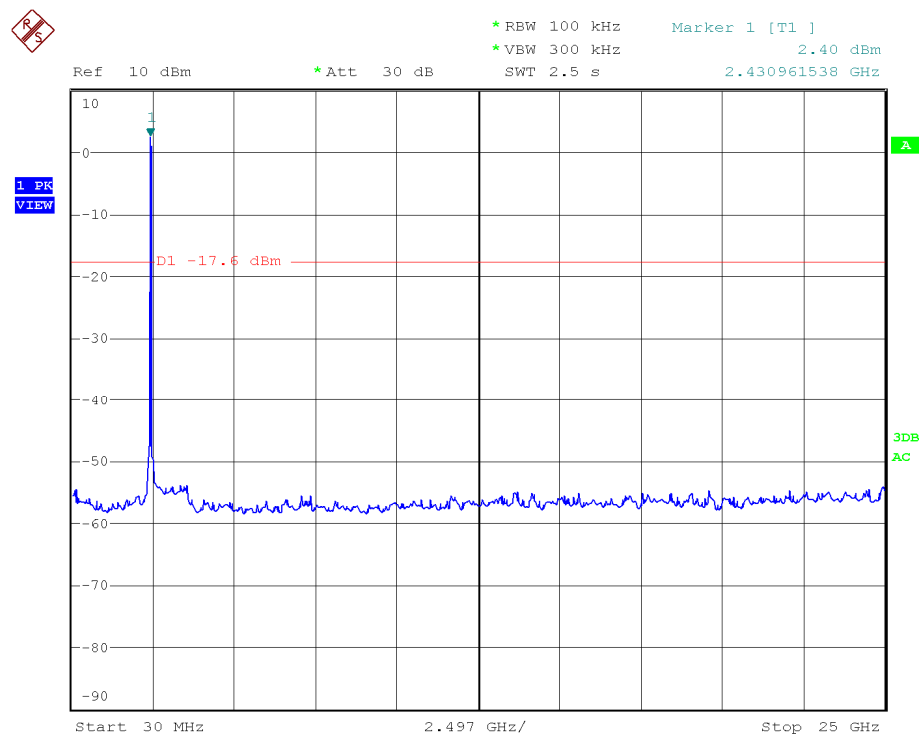
Note: The peak above the limit is the carrier frequency.

Middle Channel: 2437 MHz.



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

Highest Channel: 2462 MHz.



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

Verdict: PASS

## Section 15.247 Subclause (d). Band-edge emissions compliance (Transmitter)

### SPECIFICATION

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

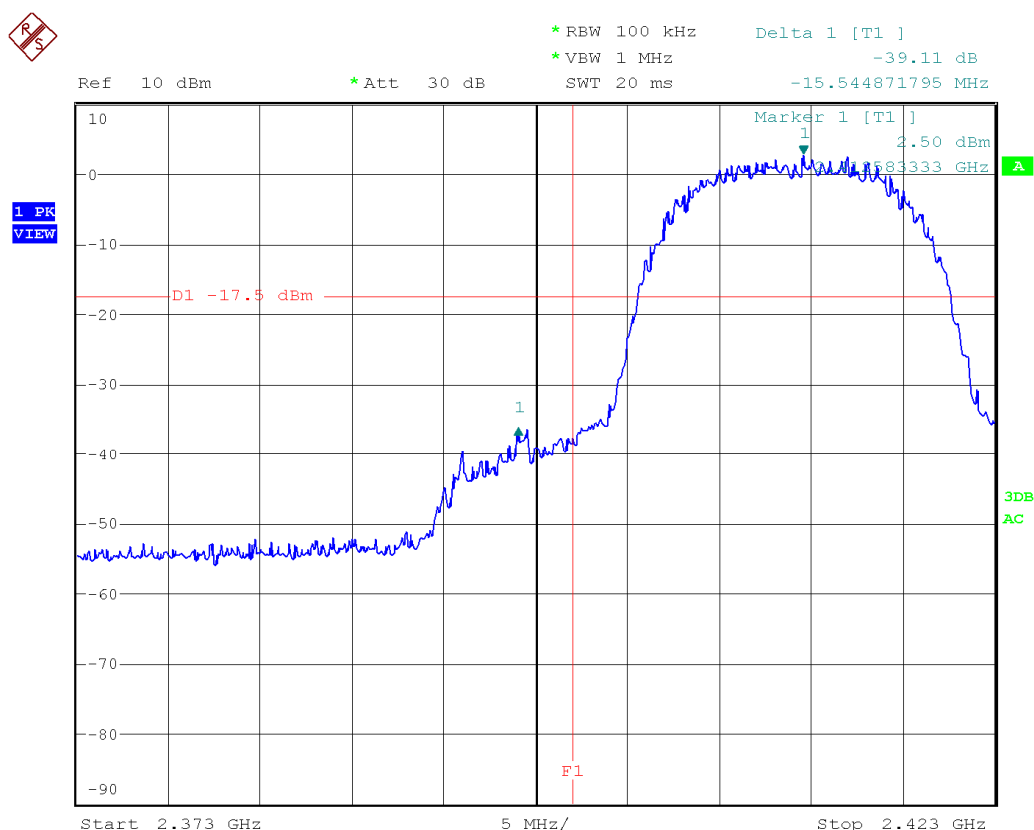
### RESULTS:

#### 1. DSSS Modulation

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 5.5 Mbps bit rate. Results shown below correspond to 5.5 Mbps.

#### 1. LOW FREQUENCY SECTION 2412 MHz. CONDUCTED.

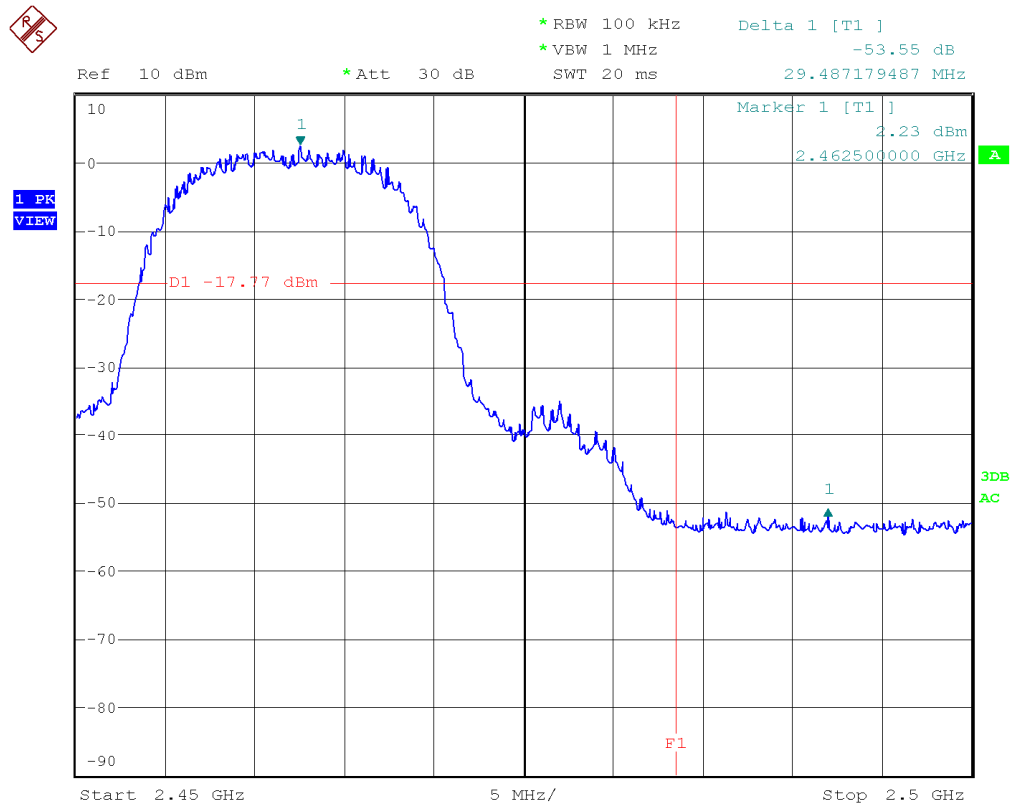
See next plot.



Verdict: PASS

## 2. HIGH FREQUENCY SECTION 2462 MHz. CONDUCTED.

See next plot.



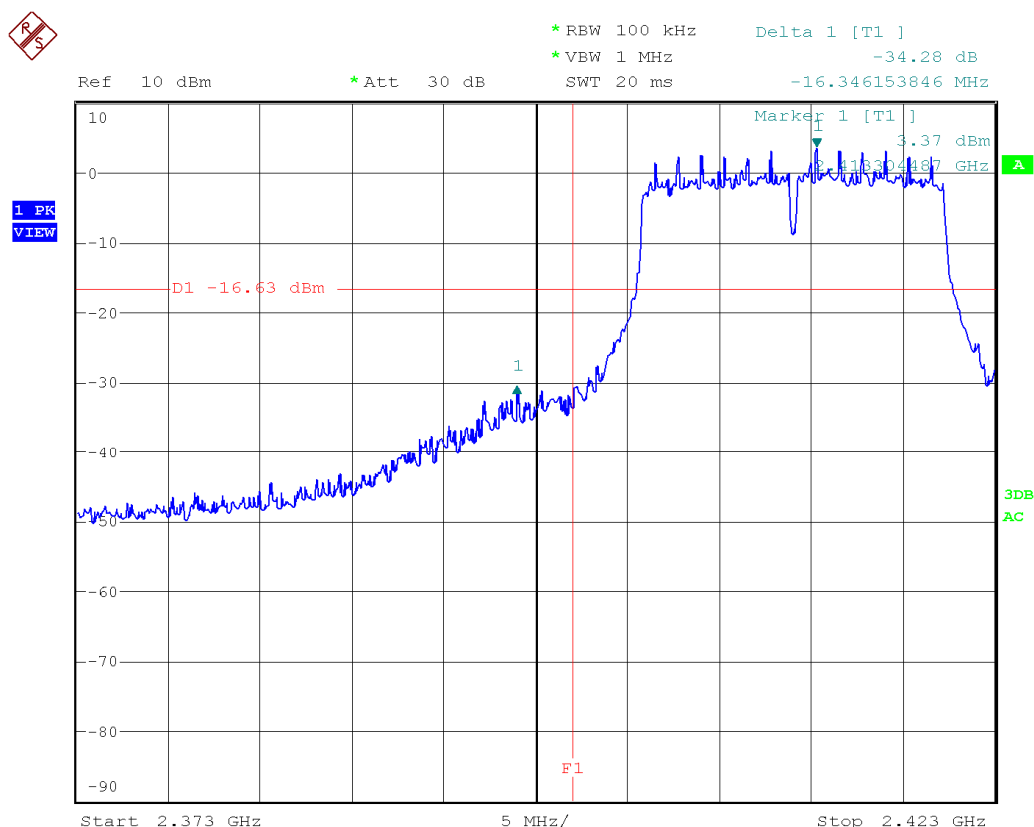
Verdict: PASS

## 2. OFDM Modulation

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps, and the worst case was for 18 Mbps bit rate. Results shown below correspond to 18 Mbps.

### 1. LOW FREQUENCY SECTION 2412 MHz. CONDUCTED.

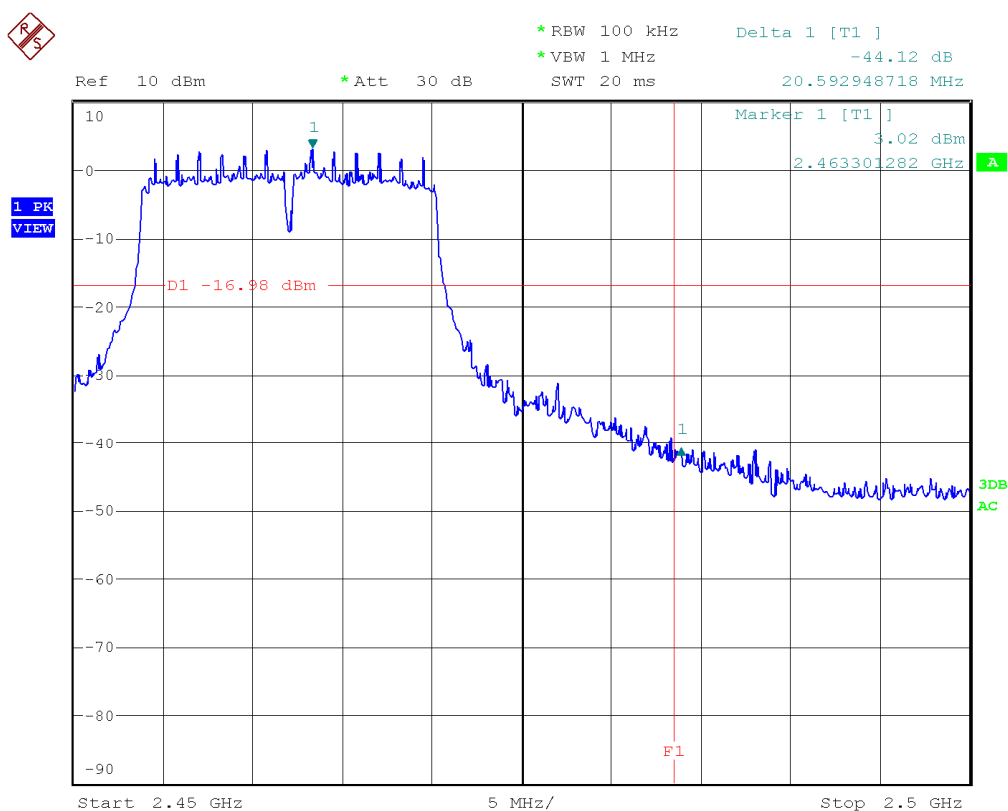
See next plot.



Verdict: PASS

## 2. HIGH FREQUENCY SECTION 2462 MHz. CONDUCTED.

See next plot.



Verdict: PASS

## Band-edge compliance of radiated emissions

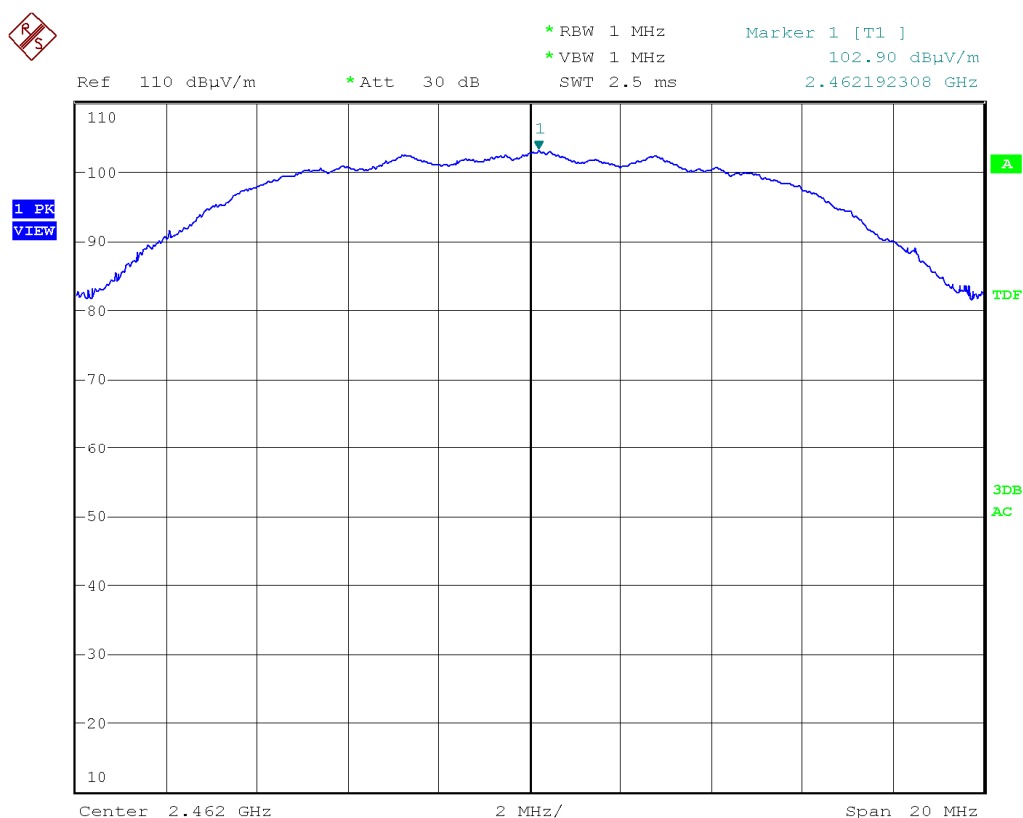
### 1. DSSS Modulation

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 5.5 Mbps bit rate. Results shown below correspond to 5.5 Mbps

Maximum peak and average field strength of fundamental emission at 3 m distance

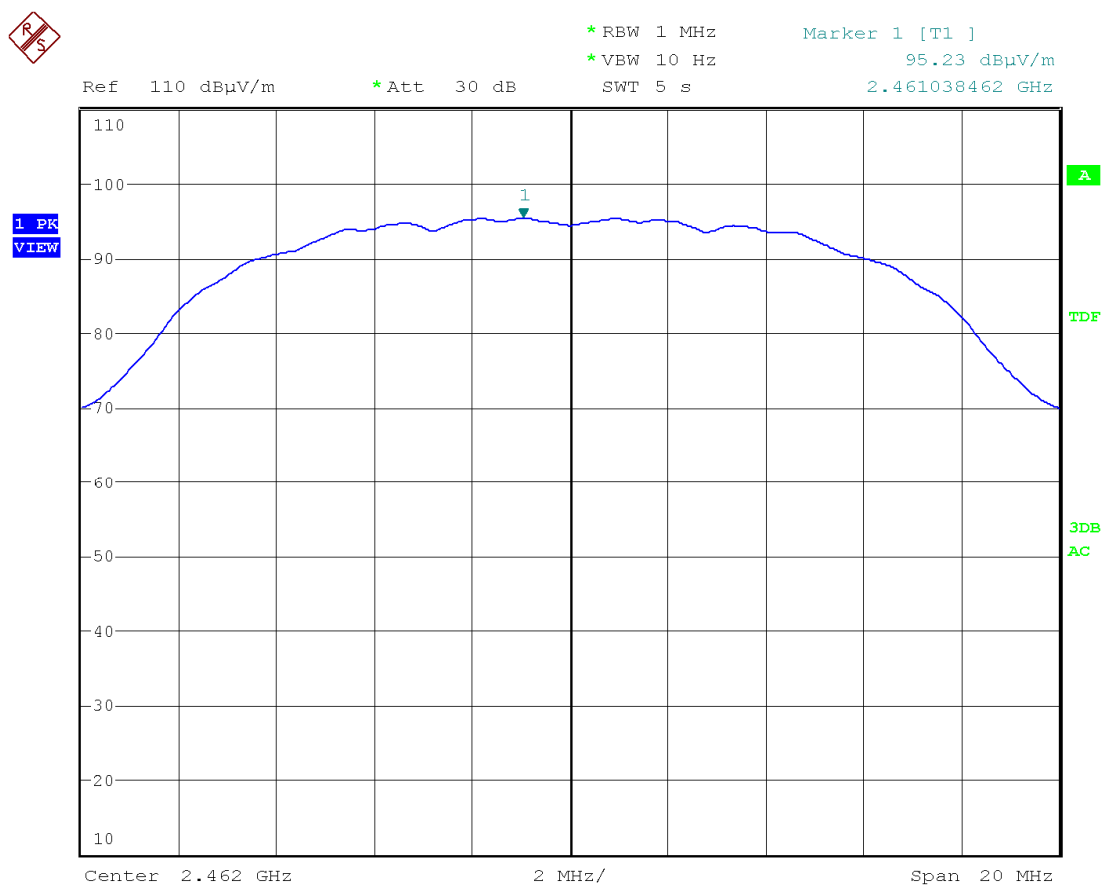
HIGHEST CHANNEL (2462 MHz):

Maximum field strength at 3 m. Peak value.



Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

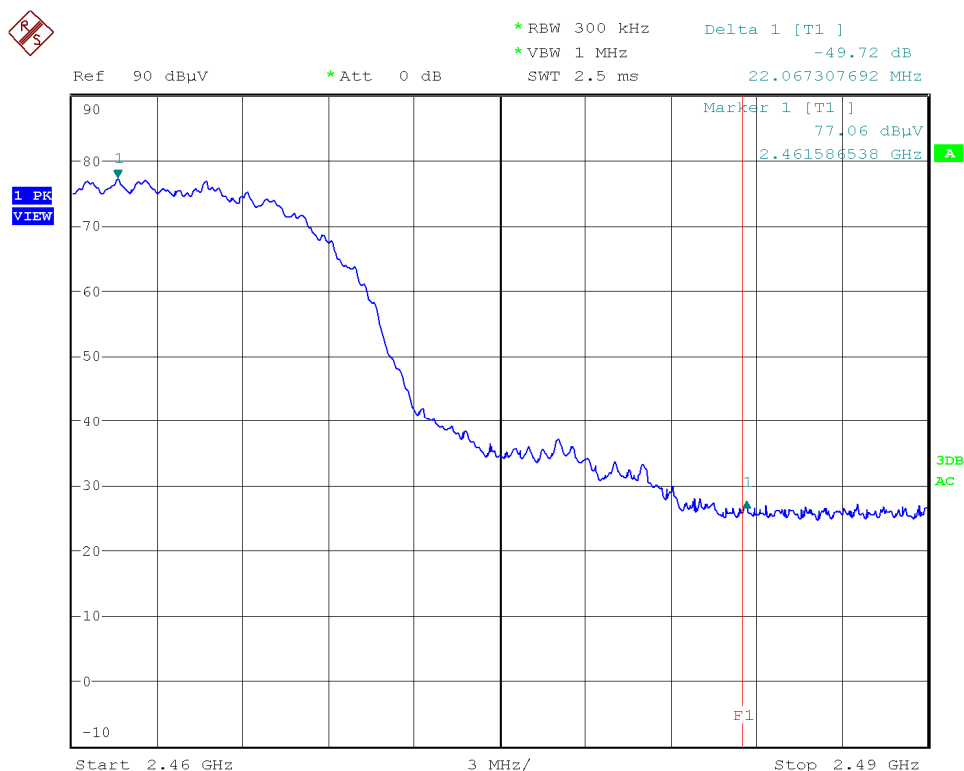
Maximum field strength at 3 m. Average value.



Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.



# BAND-EDGE COMPLIANCE. RADIATED. Marker-Delta Method.



Note: No correction is applied for this relative measurement.

## Band edge compliance of radiated emissions

Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
95.23 dBμV/m	49.72 dB	45.51 dBμV/m	54 dBμV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
102.90 dBμV/m	49.72 dB	53.18 dBμV/m	74 dBμV/m

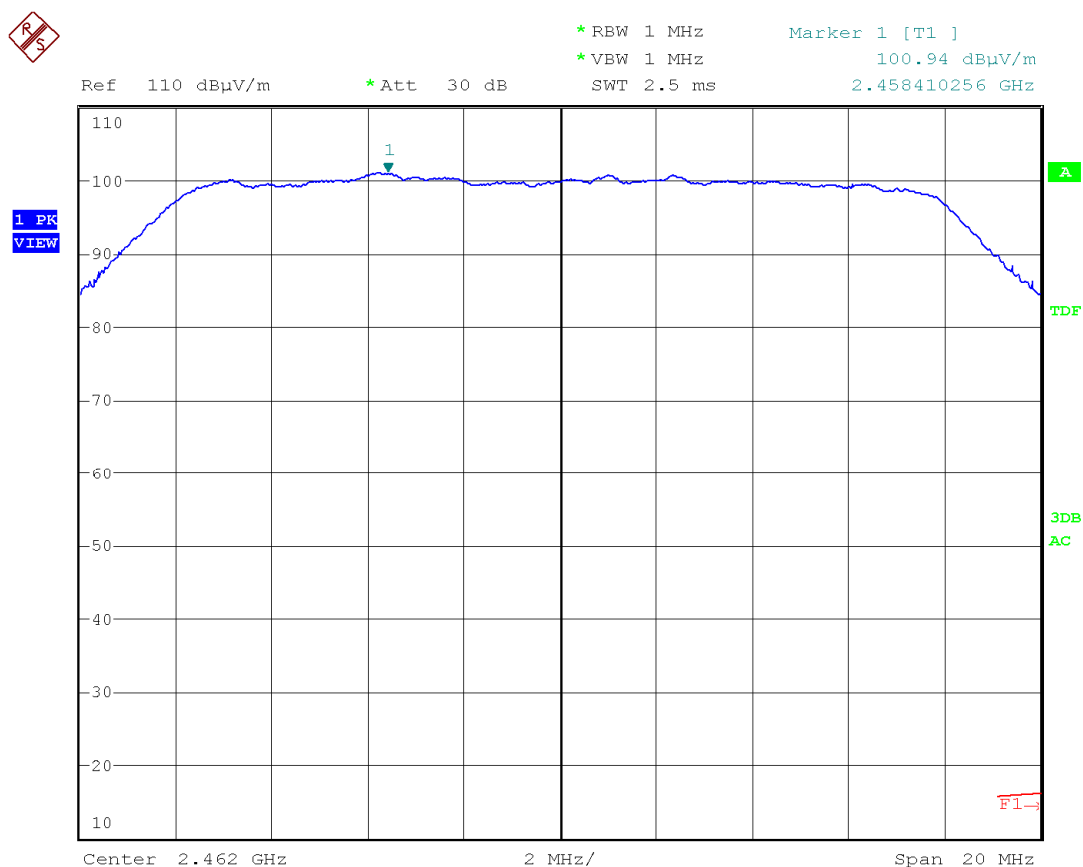
Verdict: PASS

## 2. OFDM Modulation

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps, and the worst case was for 18 Mbps bit rate. Results shown below correspond to 18 Mbps.

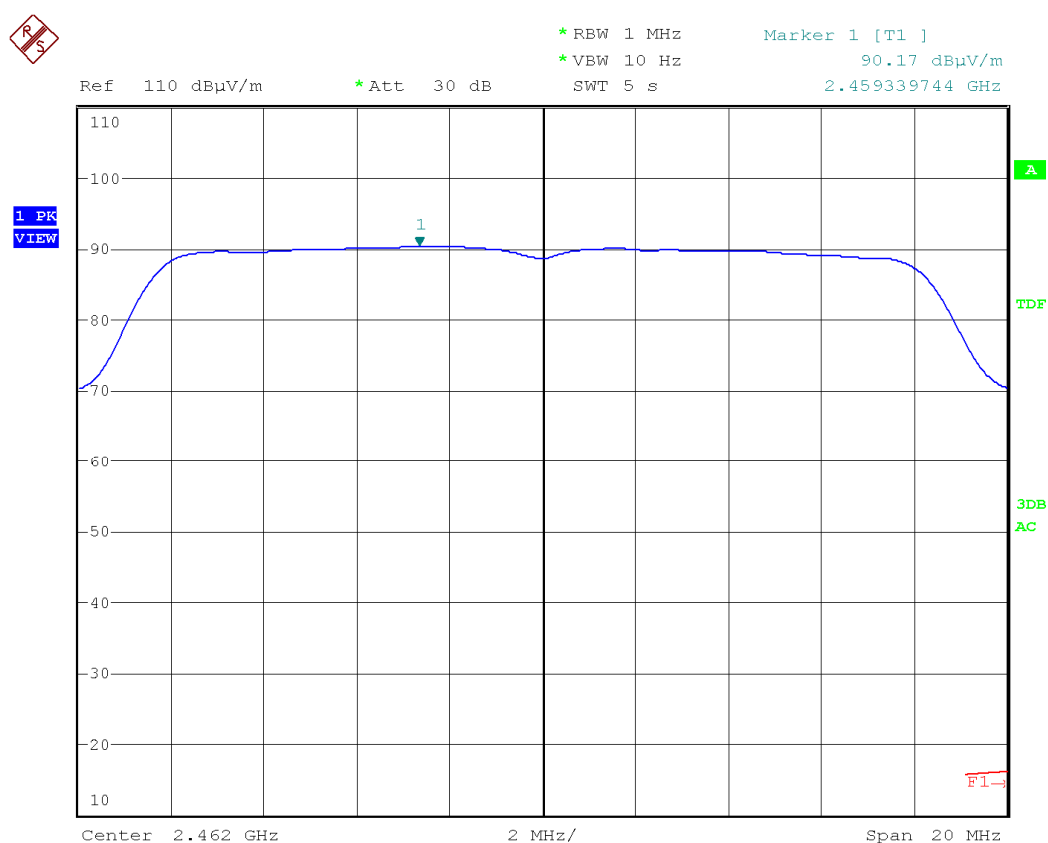
HIGHEST CHANNEL (2462 MHz):

Maximum field strength at 3 m. Peak value.



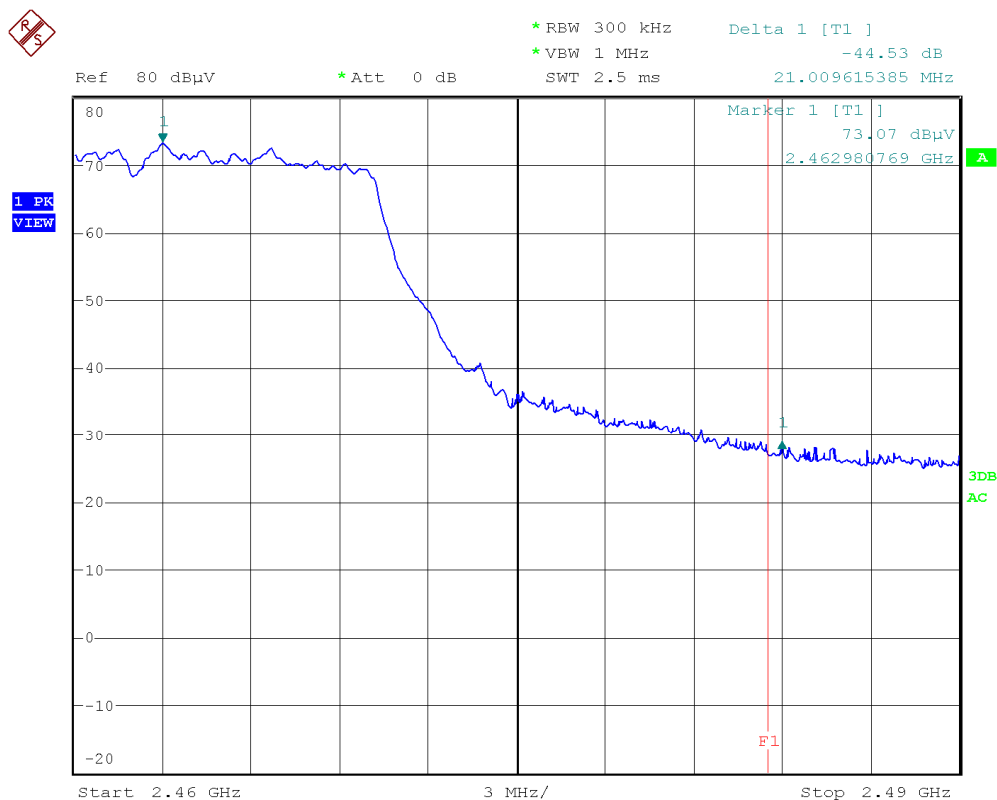
Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

Maximum field strength at 3 m. Average value.



Note: The correction factor is already included in the spectrum analyzer as a transducer factor so that the marker shows directly the field strength level.

# BAND-EDGE COMPLIANCE. RADIATED. Marker-Delta Method.



Note: No correction is applied for this relative measurement.

## Band edge compliance of radiated emissions

Fundamental max. average value 3 m	Delta value	Calculated value 3 m	Limit
90.17 dBμV/m	44.53 dB	45.64 dBμV/m	54 dBμV/m

Fundamental max. Peak value 3 m	Delta value	Calculated value 3 m	Limit
100.94 dBμV/m	44.53 dB	56.41 dBμV/m	74 dBμV/m

Verdict: PASS

## Section 15.247 Subclause (e). Power spectral density

### SPECIFICATION

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

### RESULTS

#### 1. DSSS modulation

Preliminary tests were done with the equipment operating with DSSS modulation mode at 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps and the worst case was for 5.5 Mbps bit rate. Results shown below correspond to 5.5 Mbps.

Power spectral density (see next plots).

	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Power spectral density (dBm) in 3 kHz bandwidth	-10.88	-10.88	-11.12
Measurement uncertainty (dB)	$\pm 1.5$		

#### 2. OFDM modulation

Preliminary tests were done with the equipment operating with OFDM modulation mode at 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps and 54 Mbps, and the worst case was for 18 Mbps bit rate. Results shown below correspond to 18 Mbps.

Power spectral density (see next plots).

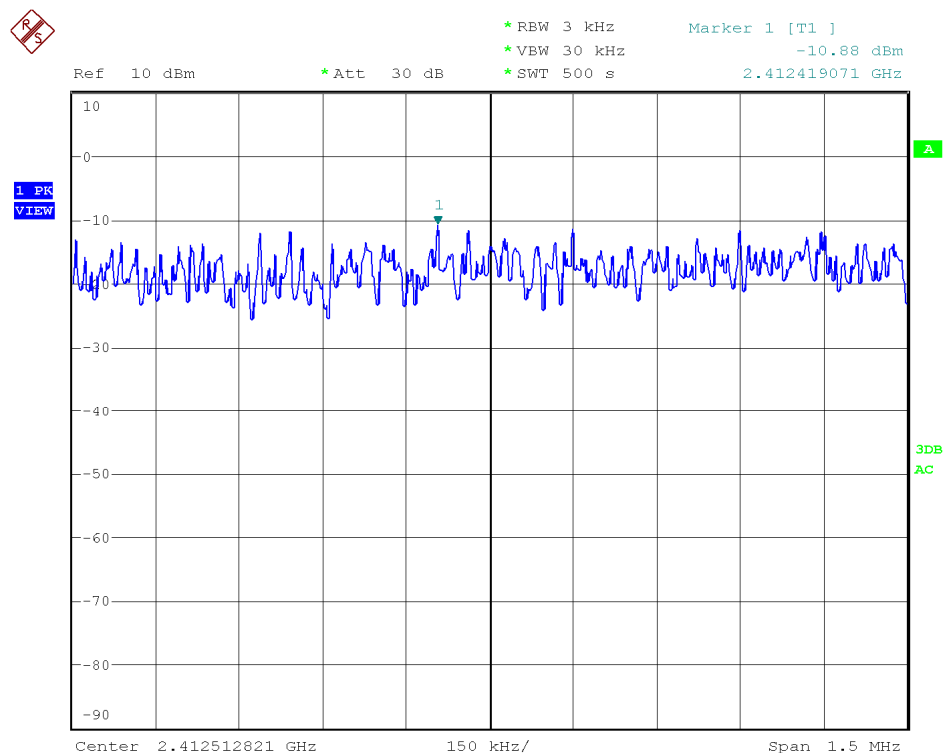
	Lowest frequency 2412 MHz	Middle frequency 2437 MHz	Highest frequency 2462 MHz
Power spectral density (dBm) in 3 kHz bandwidth	-12.01	-12.02	-12.31
Measurement uncertainty (dB)	$\pm 1.5$		

Verdict: PASS

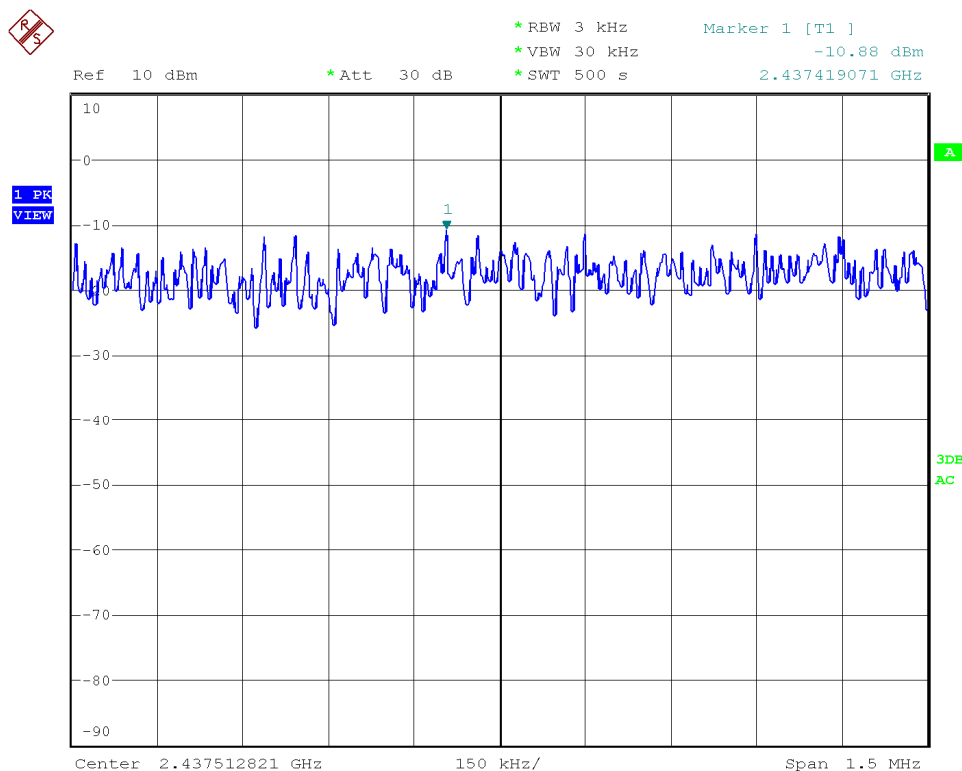
# 1. DSSS modulation

Power spectral density.

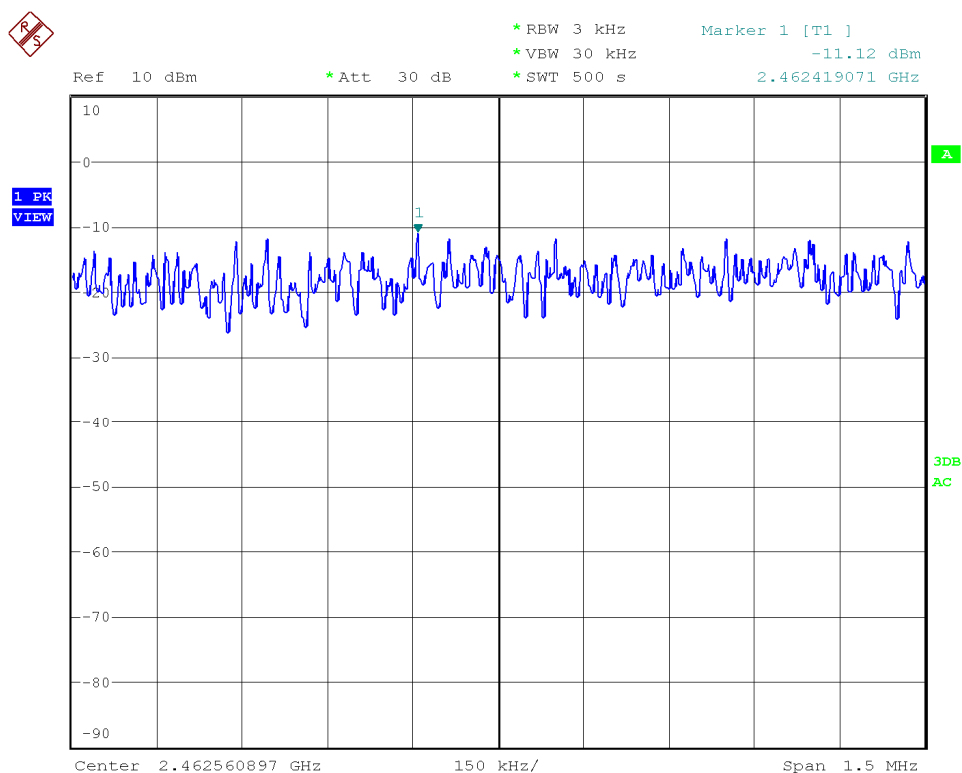
Lowest Channel: 2412 MHz.



Middle Channel: 2437 MHz.



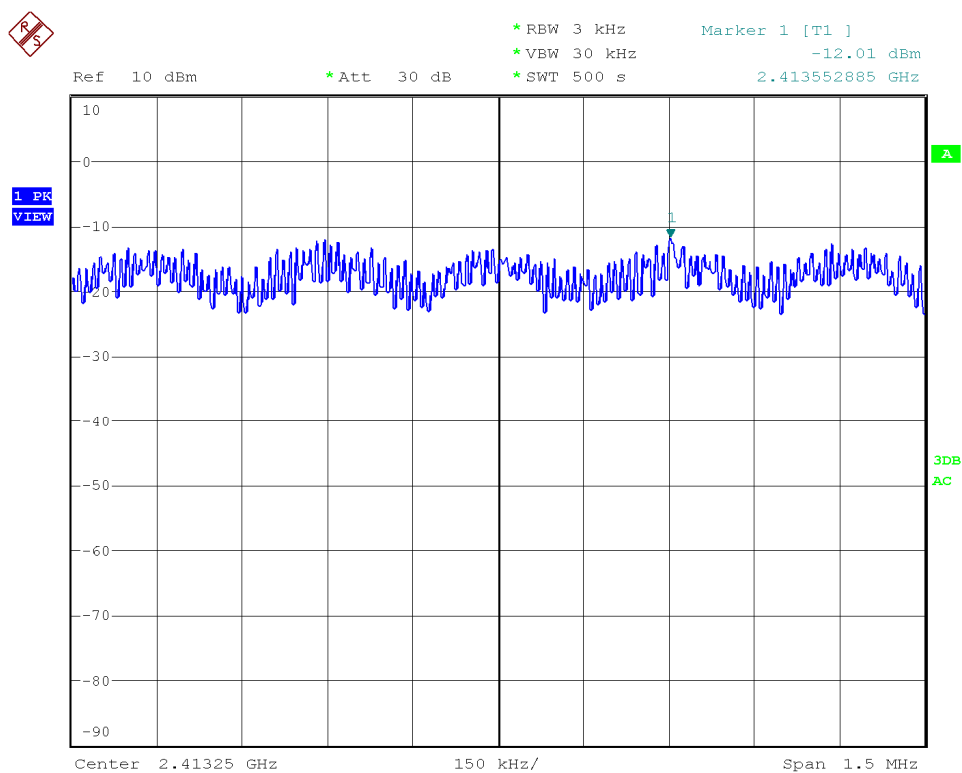
Highest Channel: 2462 MHz.



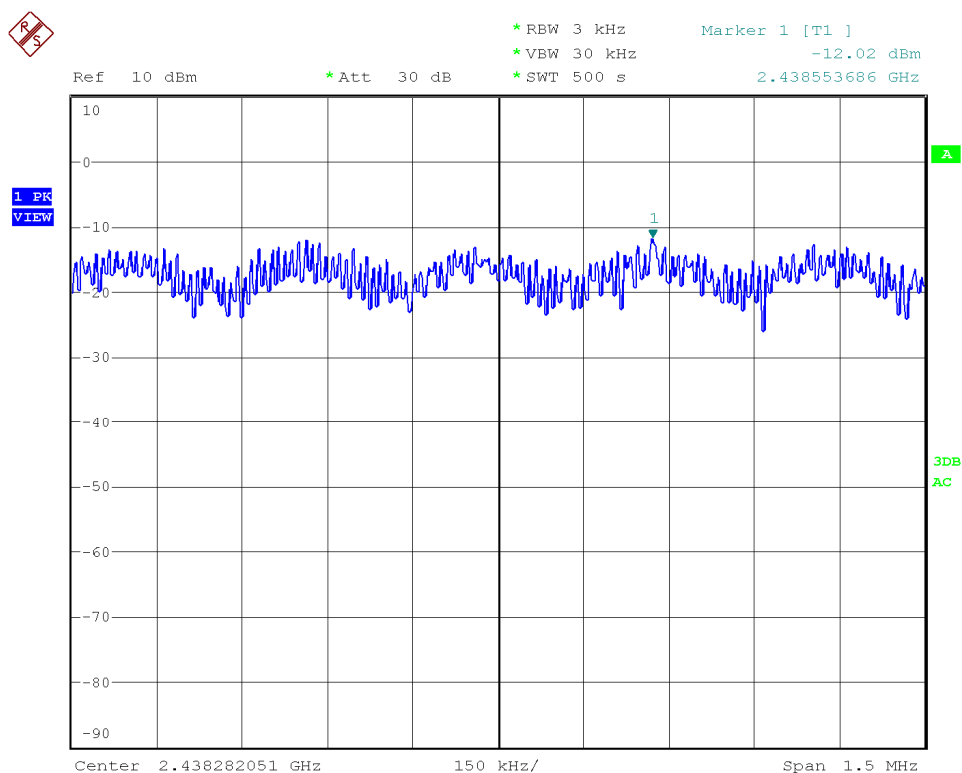
## 2. OFDM modulation

Power spectral density.

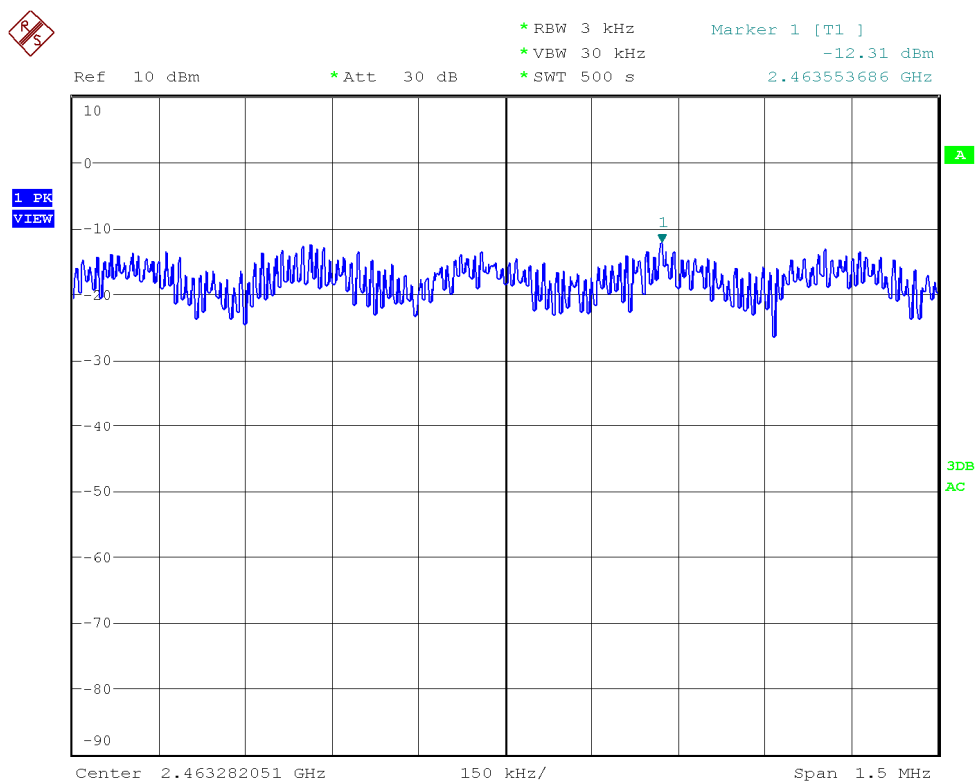
Lowest Channel: 2412 MHz.



Middle Channel: 2437 MHz.



Highest Channel: 2462 MHz.





## Section 15.247 Subclause (d). Emission limitations radiated (Transmitter)

### SPECIFICATION

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

Frequency Range (MHz)	Field strength ( $\mu\text{V/m}$ )	Field strength ( $\text{dB}\mu\text{V/m}$ )	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	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.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

## 1. DSSS Modulation

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

No spurious signals found in all the range for all modulation modes.

### **Frequency range 1 GHz-25 GHz**

No spurious signals found in all the range for all modulation modes.

Additionally, no spurious signals were found inside the restricted bands 2310-2390 MHz and 2483.5-2500 MHz and at the harmonic frequencies for the three operating channels and modulation modes.

Verdict: PASS

## 2. OFDM Modulation

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

No spurious signals found in all the range for all modulation modes.

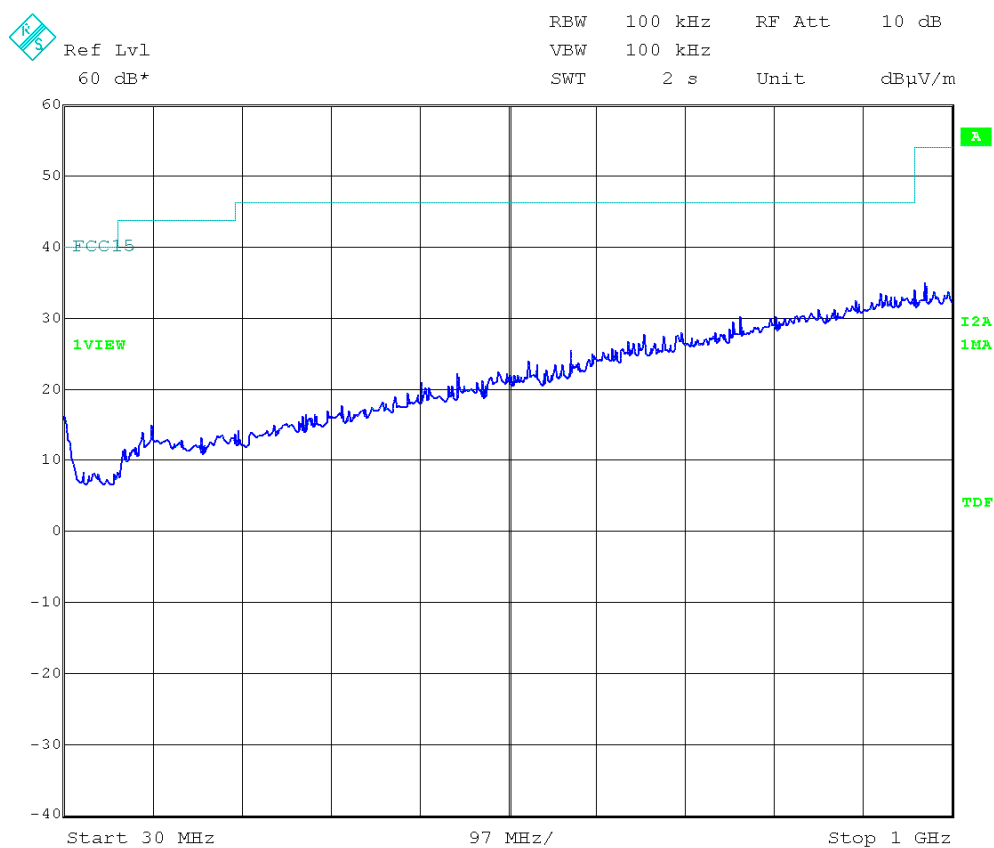
### **Frequency range 1 GHz-25 GHz**

No spurious signals found in all the range for all modulation modes.

Additionally, no spurious signals were found inside the restricted bands 2310-2390 MHz and 2483.5-2500 MHz and at the harmonic frequencies for the three operating channels and modulation modes.

Verdict: PASS

FREQUENCY RANGE 30 MHz-1000 MHz.

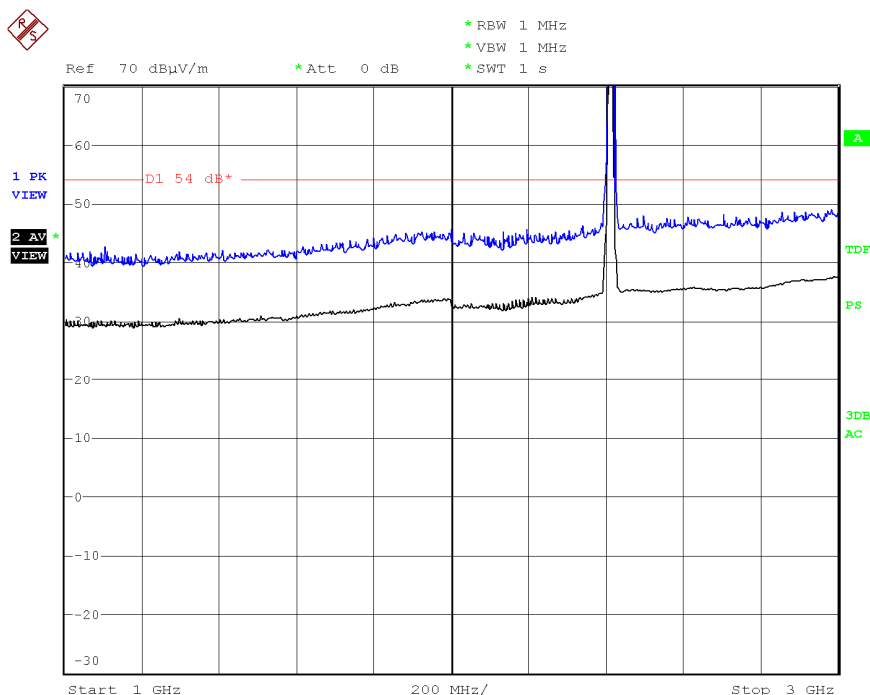


(This plot is valid for all three channels and all modulation modes).

FREQUENCY RANGE 1 GHz to 3 GHz.

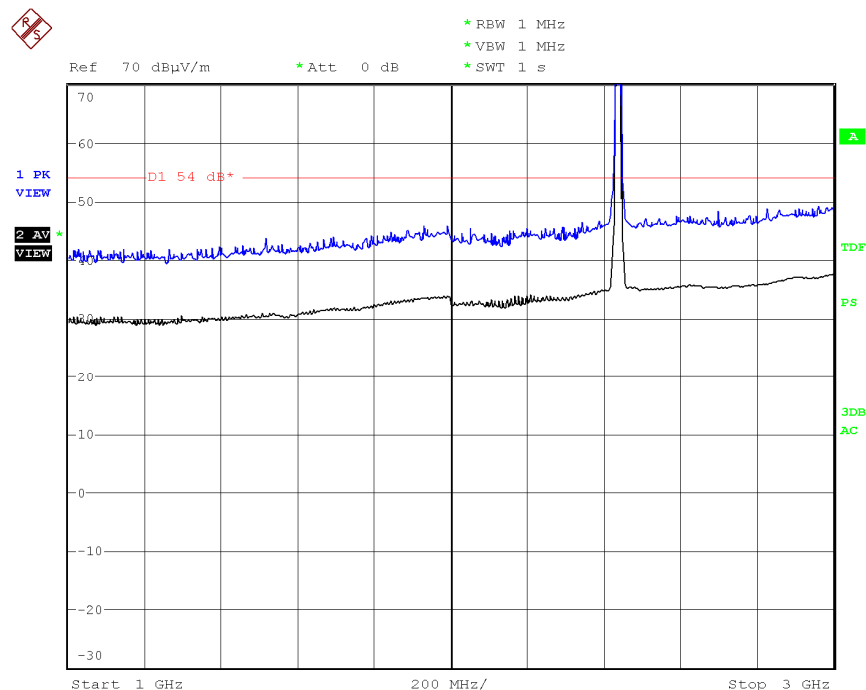
# 1. DSSS modulation

**CHANNEL: Lowest (2412 MHz).**



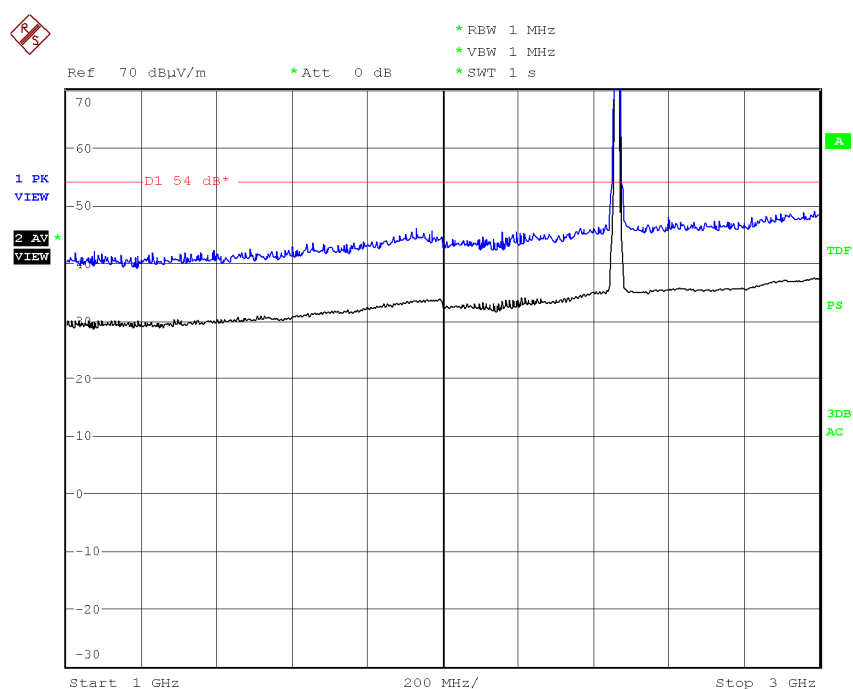
Note: The peak above the limit is the carrier frequency.

**CHANNEL: Middle (2437 MHz).**



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

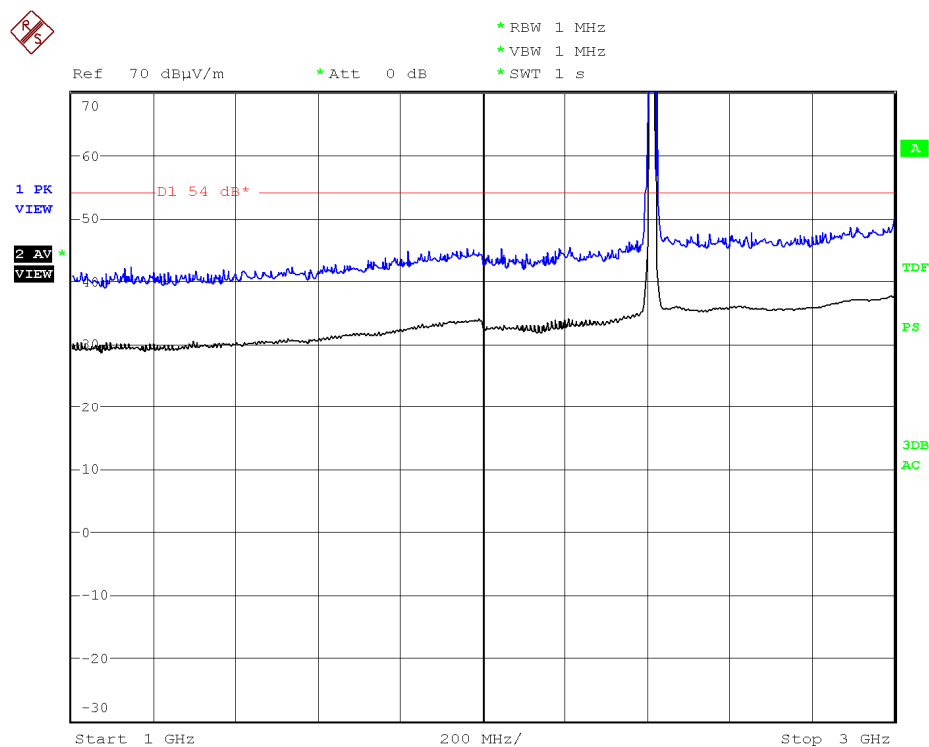
**CHANNEL: Highest (2462 MHz).**



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

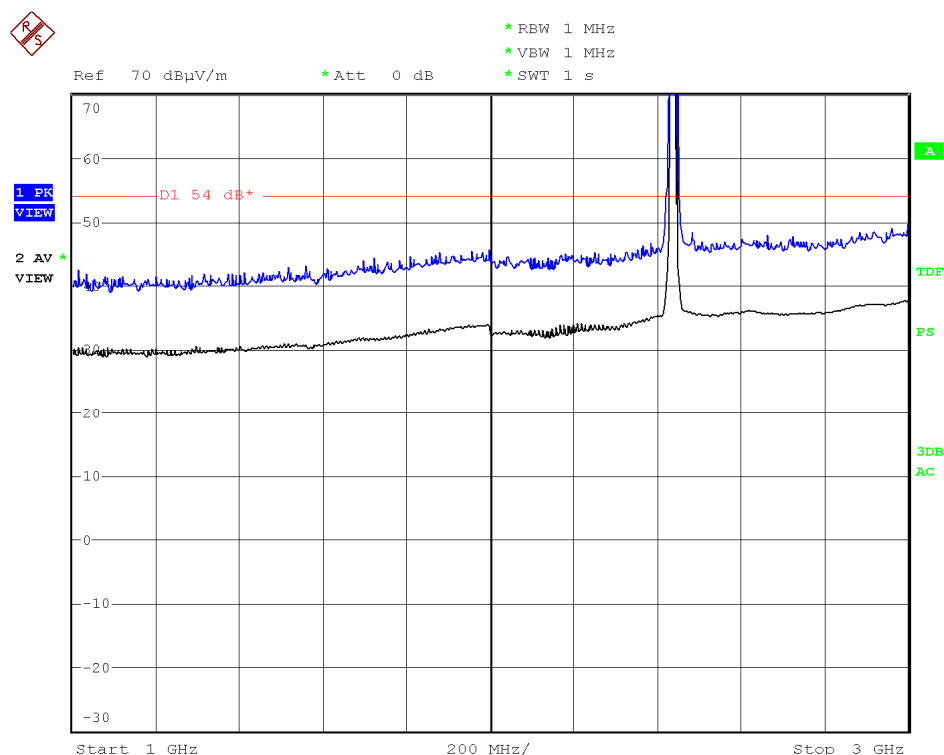
## 2. OFDM modulation

**CHANNEL: Lowest (2412 MHz).**



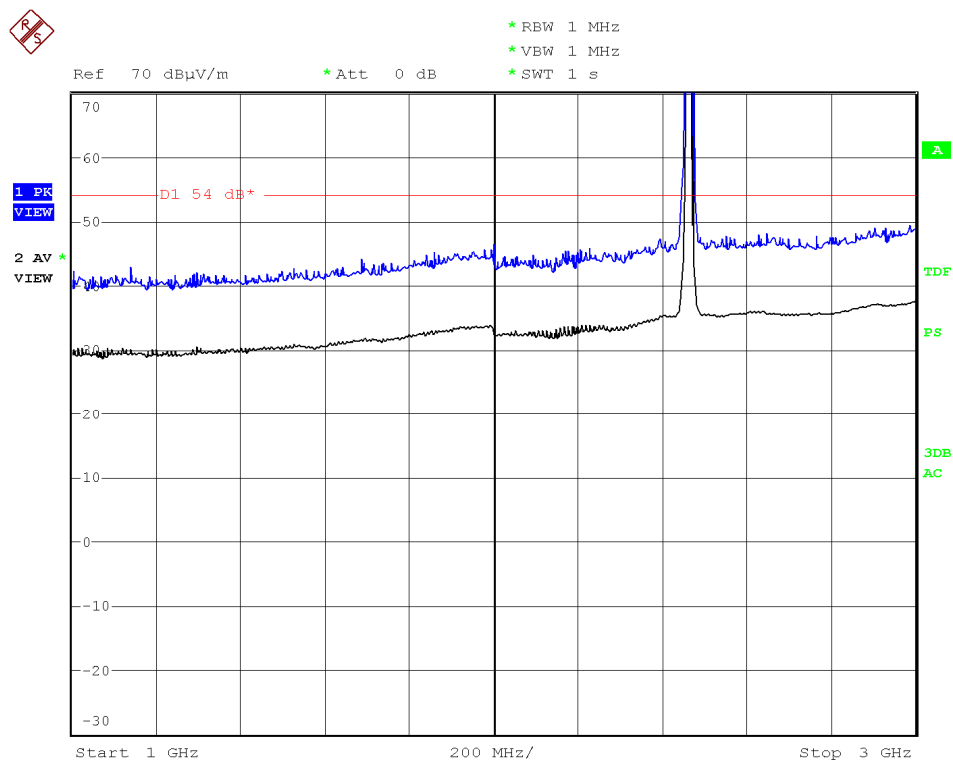
Note: The peak above the limit is the carrier frequency.

# CHANNEL: Middle (2437 MHz).



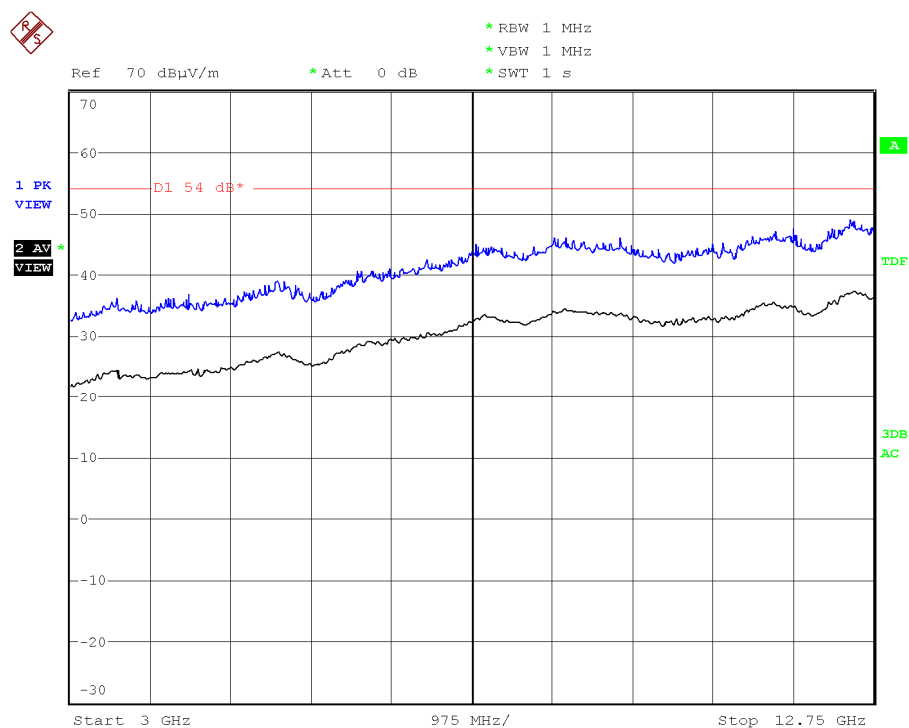
Note: The peak above the limit is the carrier frequency.

# CHANNEL: Highest (2462 MHz).



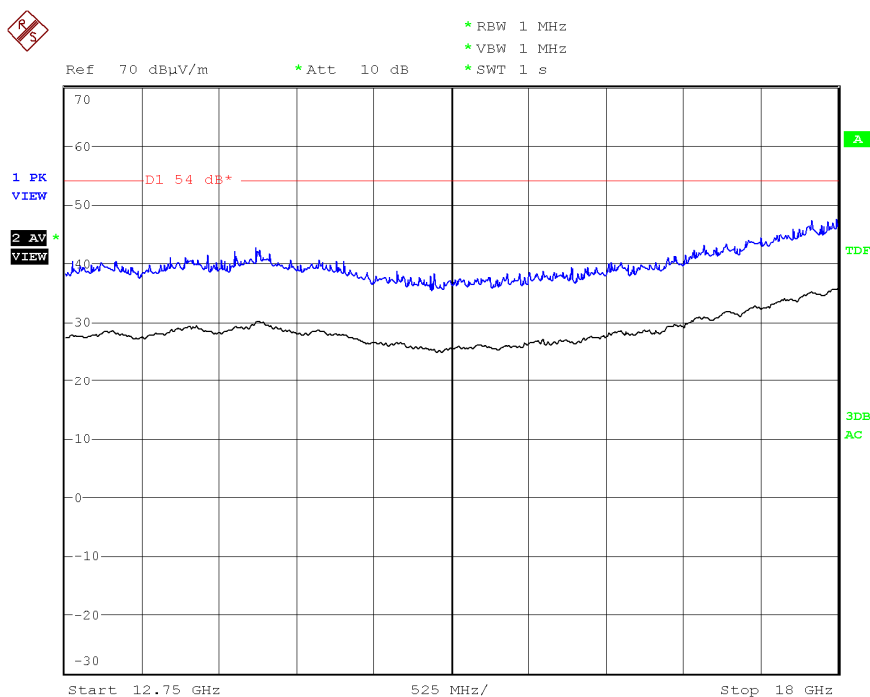
Note: The peak above the limit is the carrier frequency.

FREQUENCY RANGE 3 GHz to 12.75 GHz.



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

FREQUENCY RANGE 12.75 GHz to 18 GHz.



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

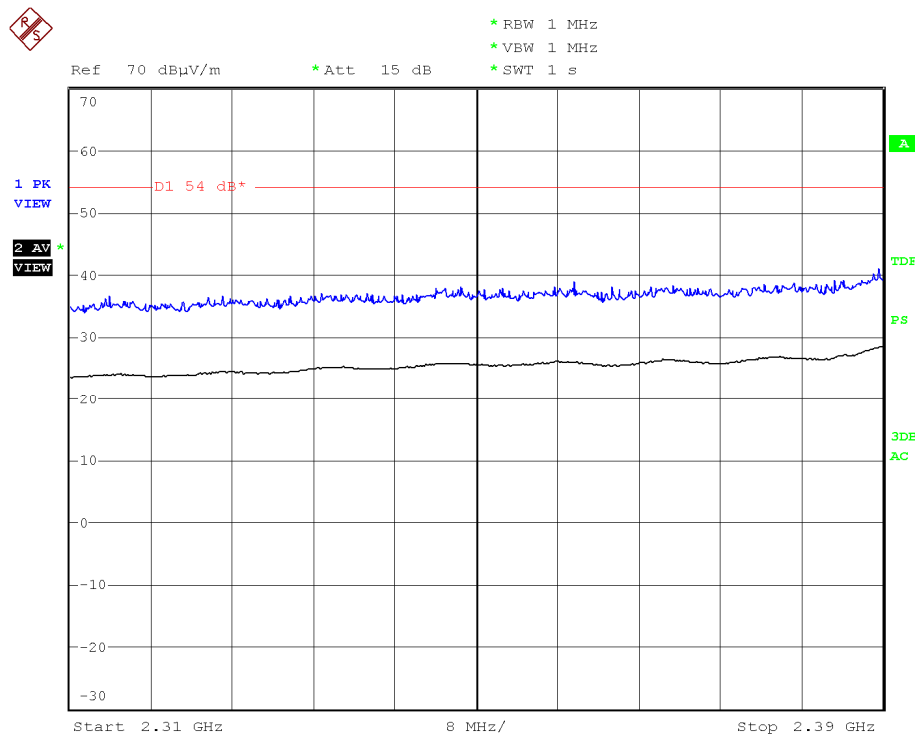




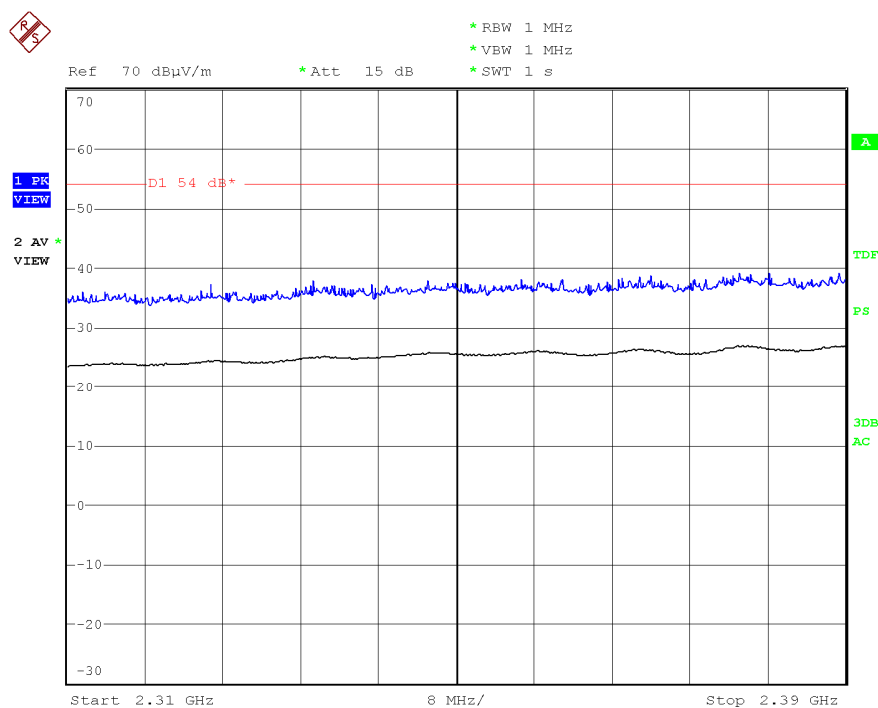
FREQUENCY RANGE 2.31 GHz to 2.39 GHz. (RESTRICTED BAND)

## 1. DSSS Modulation

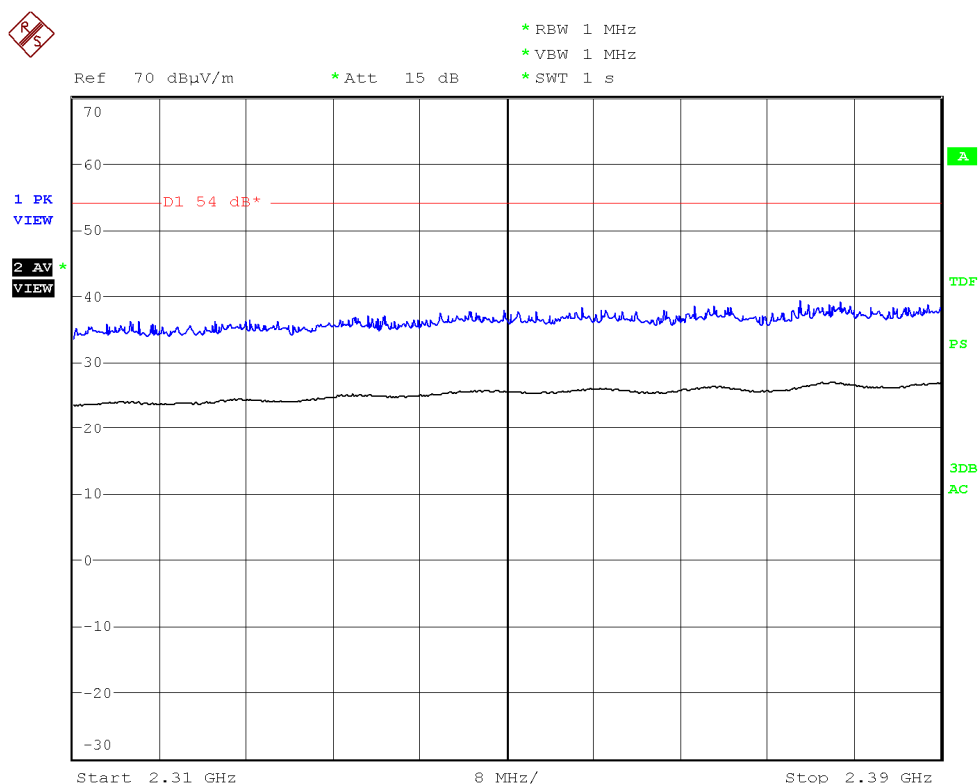
**CHANNEL: Lowest (2412 MHz).**



**CHANNEL: Middle (2437 MHz).**

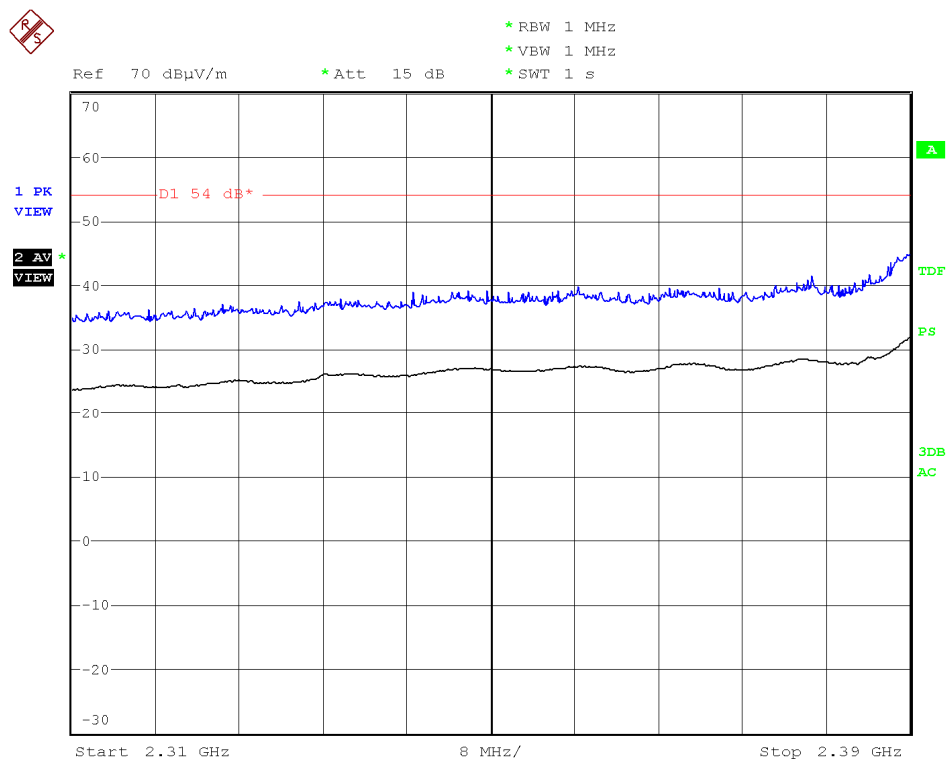


## CHANNEL: Highest (2462 MHz).

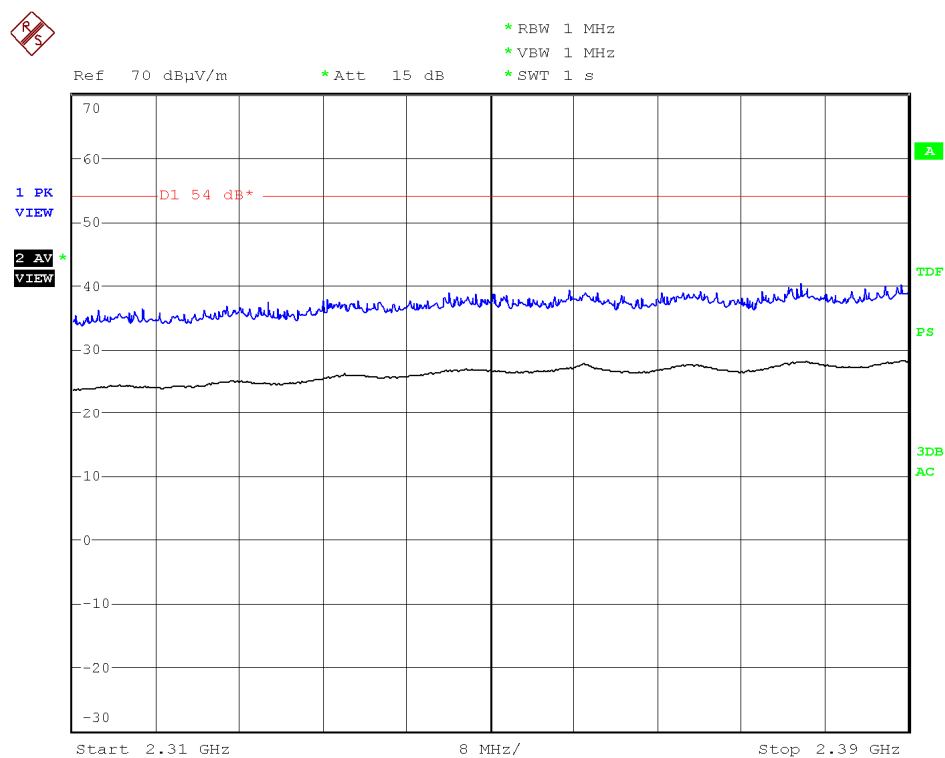


## 2. OFDM Modulation

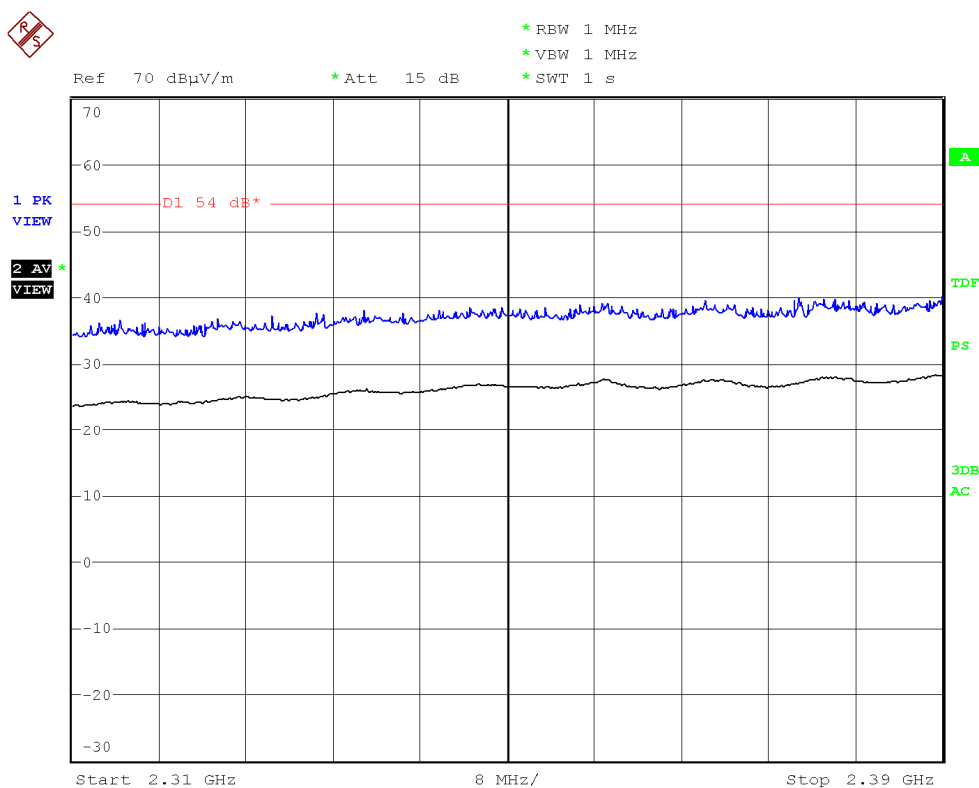
### CHANNEL: Lowest (2412 MHz).



# CHANNEL: Middle (2437 MHz).

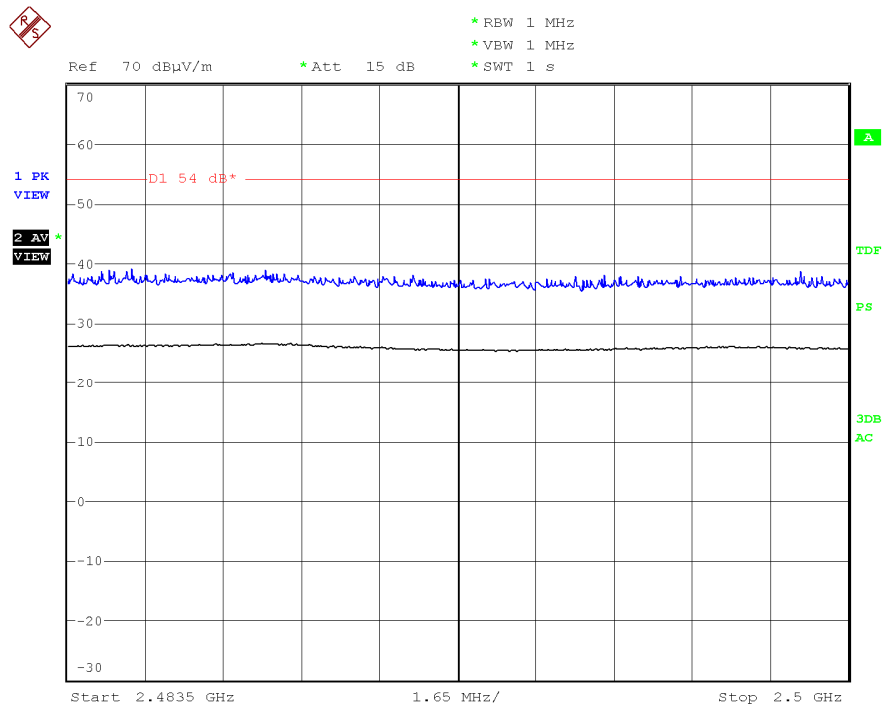


# CHANNEL: Highest (2462 MHz).



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

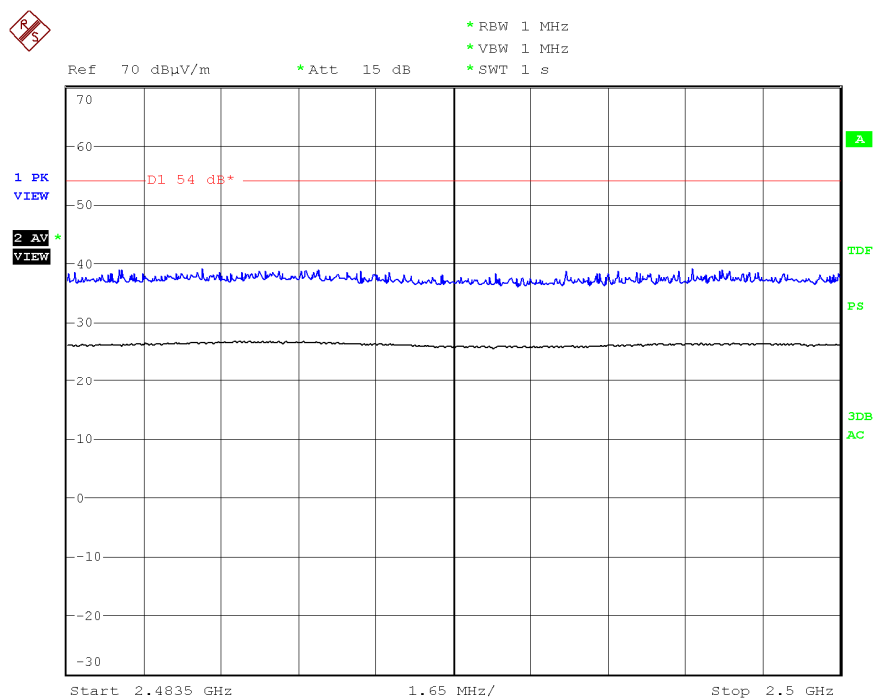
## 1. DSSS Modulation



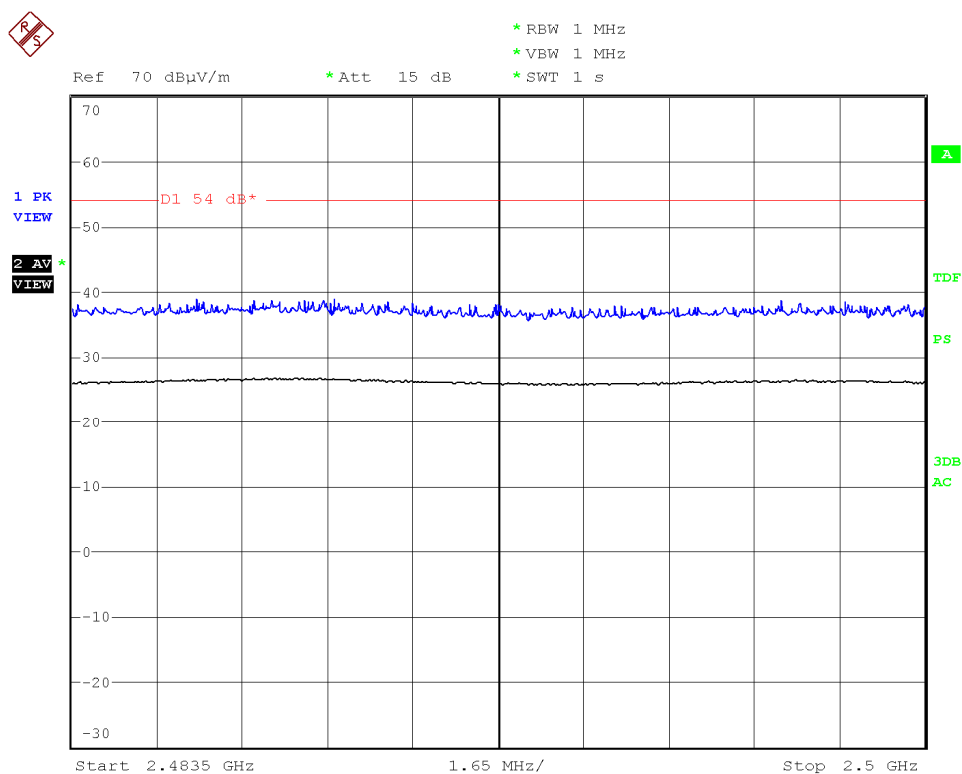
(This plot is valid for all three channels).

## 2. OFDM Modulation

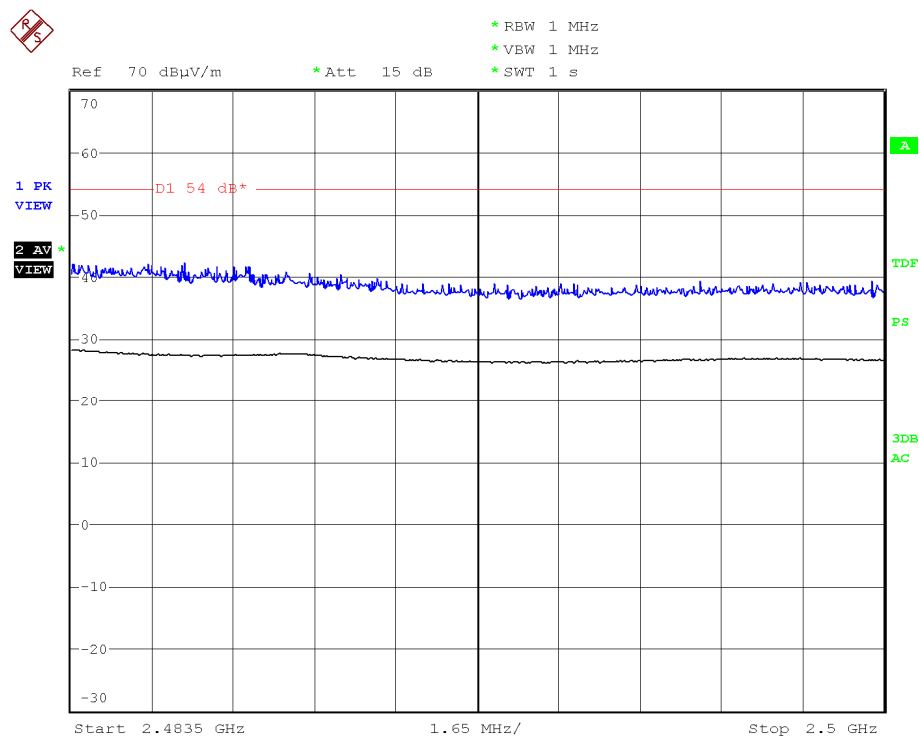
**CHANNEL: Lowest (2412 MHz).**



# CHANNEL: Middle (2437 MHz).



# CHANNEL: Highest (2462 MHz).



## Section 15.109. Receiver spurious radiation

### SPECIFICATION

The field strength shall not exceed the following values:

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)	-	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 analyser. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Note: It is not possible to select individual receiving channels in the equipment under test. The equipment under test is powered on with the receiver open and scanning through receiving channels.

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

No spurious signals were detected in all the range.

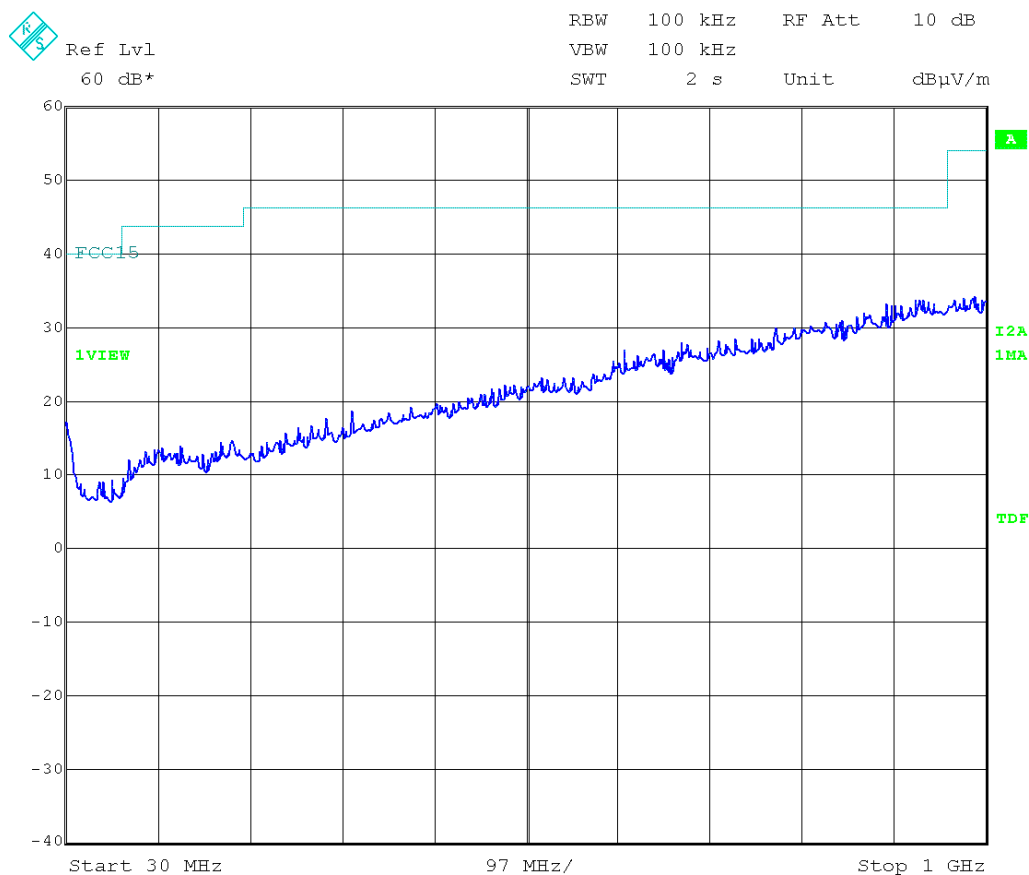
**Frequency range 1 GHz-25 GHz.**

No spurious signals were detected in all the range.

Additionally, no spurious signals were found inside the restricted bands 2310-2390 MHz and 2483.5-2500 MHz.

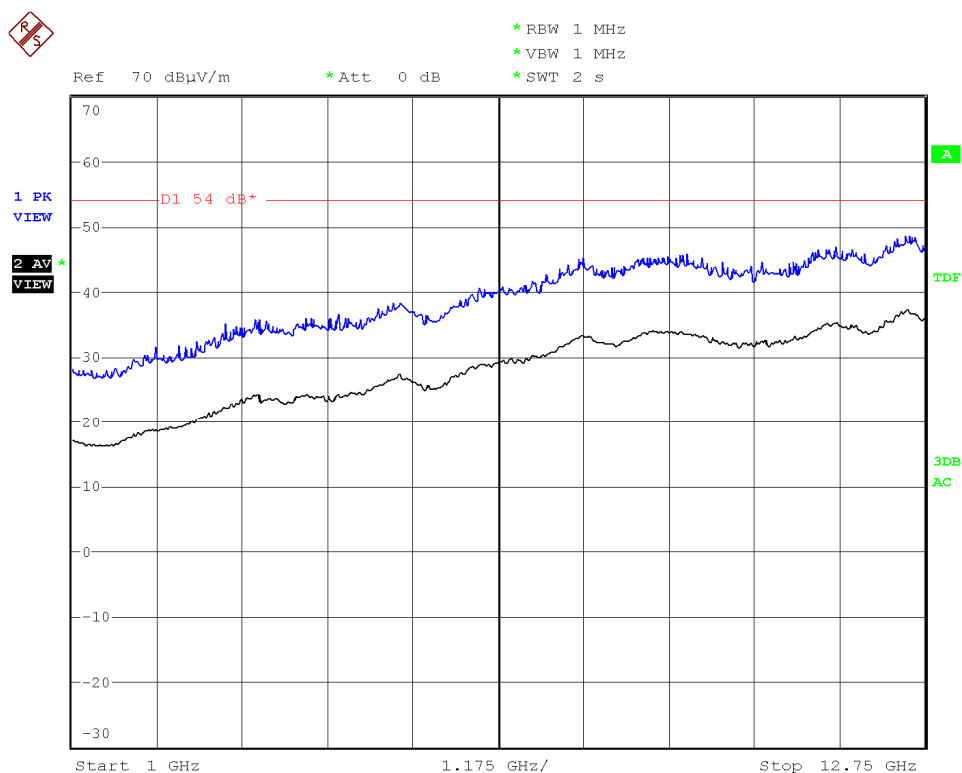
Verdict: PASS.

FREQUENCY RANGE 30 MHz-1000 MHz.

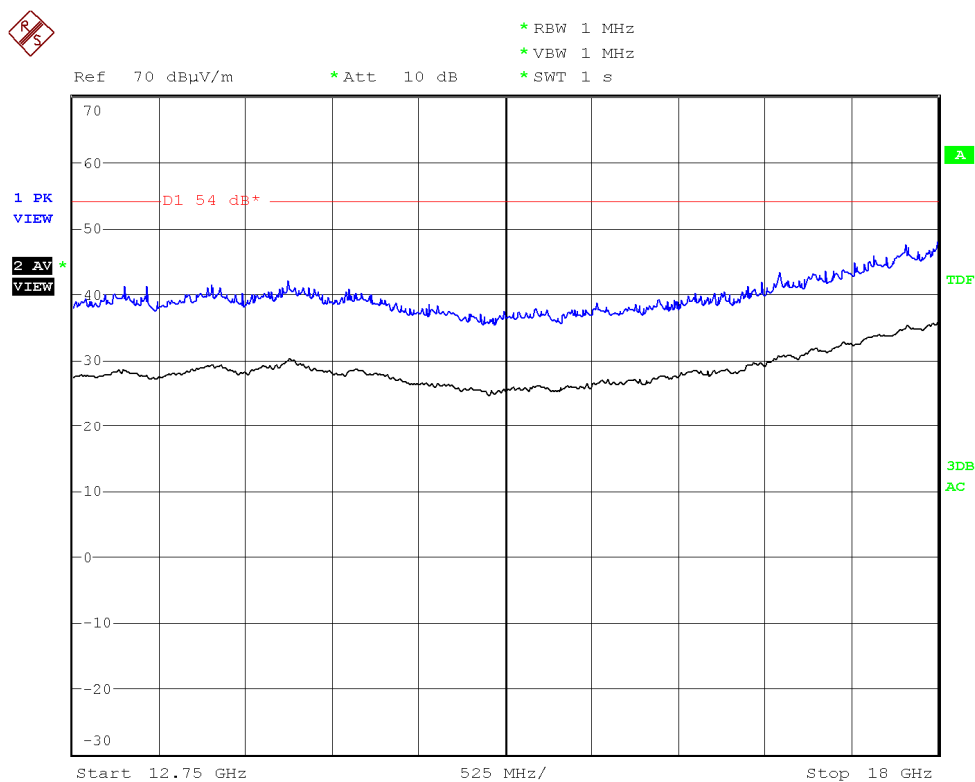




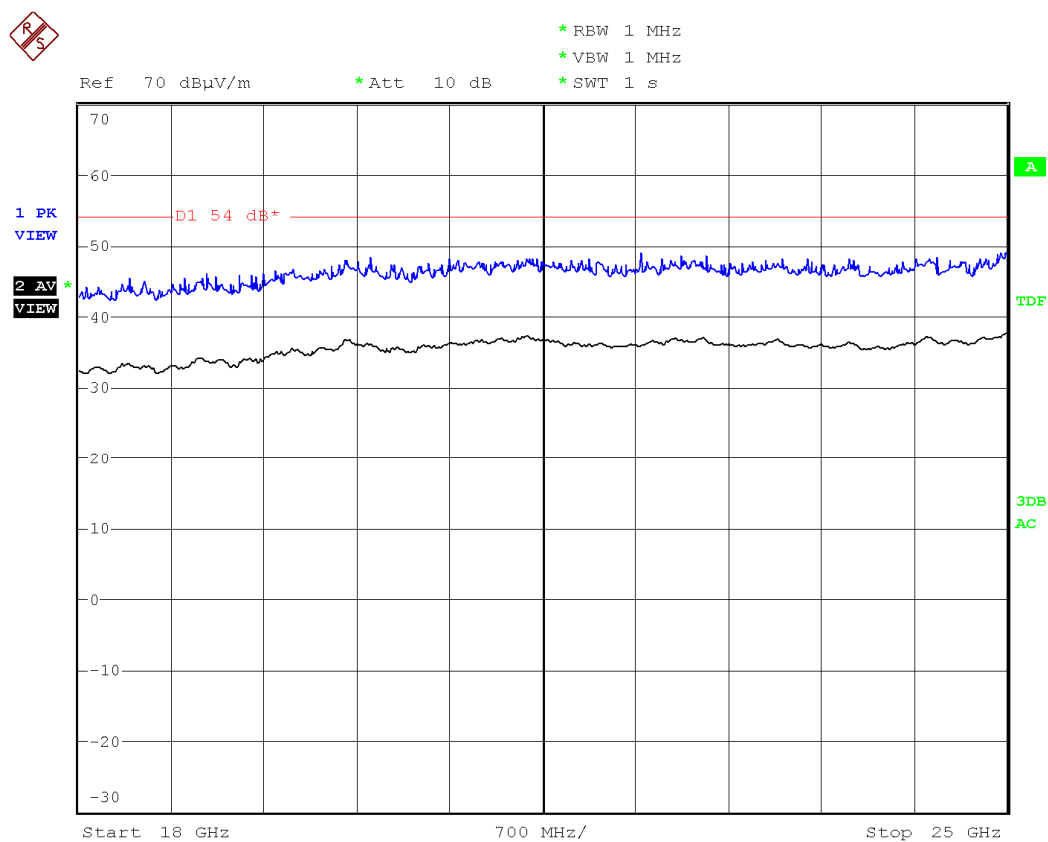
# FREQUENCY RANGE 1 GHz-12.75 GHz.



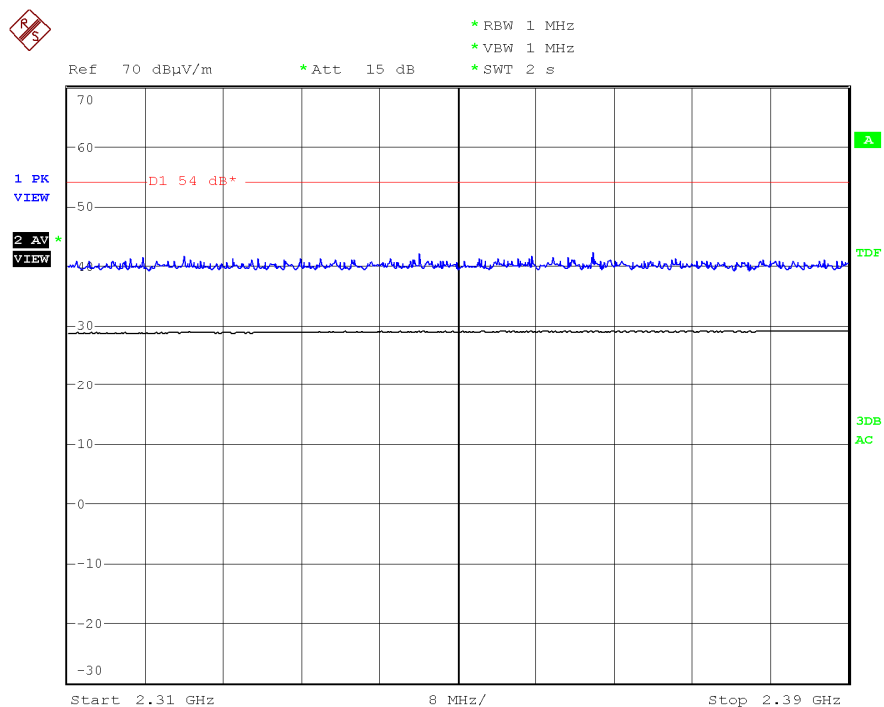
# FREQUENCY RANGE 12.75 GHz-18 GHz.



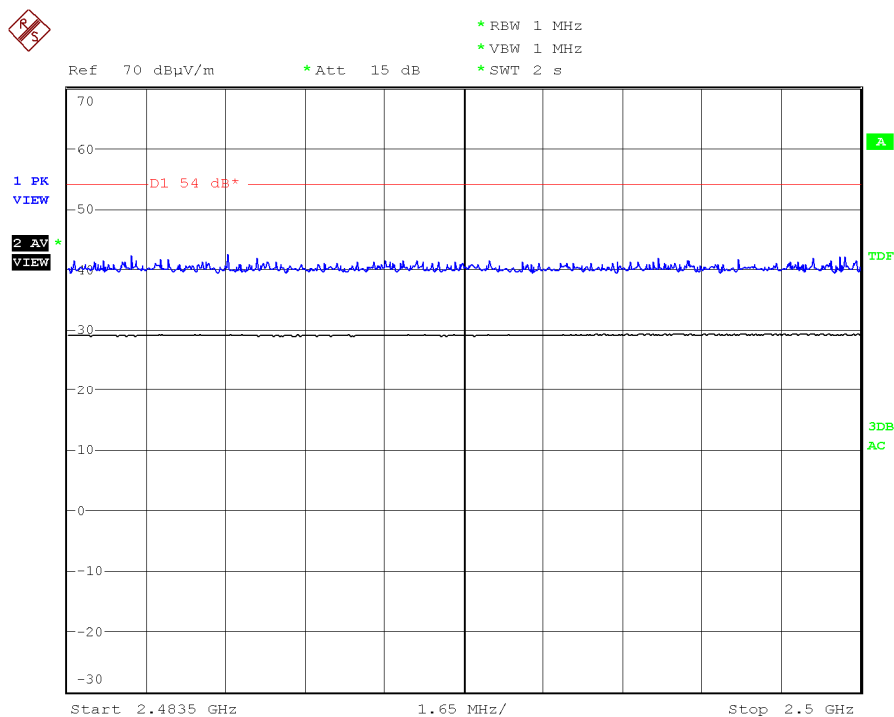
FREQUENCY RANGE 18 GHz-25 GHz.



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



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



## **APPENDIX B: Measuring results for electromagnetic conducted emission**

**CONTENT:**

DESCRIPTION OF THE OPERATION MODES.....	62
CONTINUOUS CONDUCTED EMISSION ON POWER LEADS .....	63

## DESCRIPTION OF THE OPERATION MODES

The operation modes described in this paragraph constitute a functionality of the sample under test for itself. Every operation mode takes a failure criteria for the immunity test that they were applying to it and a monitoring to guarantee performance of the same ones.

In the following table appears the operation modes used by the samples tested to that it refers the present test report.

OPERATION MODE	DESCRIPTION
OM#011	EUT ON. TCH WiFi. Bluetooth Tx. Charging batteries.

\*Power supply: 115Vac / 60 Hz or by means of the laptop PC USB port, depending of the used sample.

## CONTINUOUS CONDUCTED EMISSION ON POWER LEADS

<b>LIMITS:</b>	Product standard :	FCC RULES AND REGULATIONS 47 CFR PART 15, SUBPART C.
	Test standard :	FCC RULES AND REGULATIONS 47 CFR PART 15, SUBPART C.

### CLASS B

The applied limit for continuous conducted emissions in power leads, according with the requirements of FCC Rules and Regulations 47 CFR Part 15, Subpart B in the frequency range 0,15 to 30 MHz, for Class B equipment was:

Frequency range (MHz)	Limit (dBμV)	
	Quasi-peak	Average
0,15 to 0,5	66-56	56-46
0,5 to 5	56	46
5 to 30	60	50

<b>TESTED SAMPLES:</b>	S/03 & 04
<b>TESTED OPERATION MODES:</b>	OM#11
<b>TEST RESULTS :</b>	CCmmnnhh: CC, Conducted Condition; mm: Sample number; nn: Operation mode; hh: wire

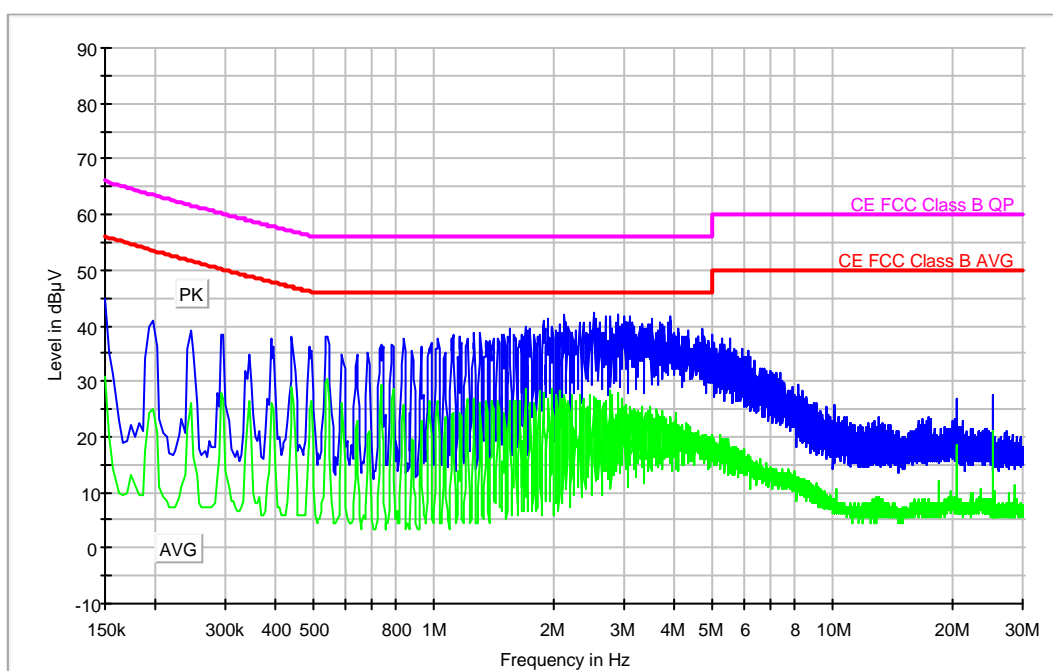
CCmmnnhh	Description	Result
CC03110N	Neutral wire noise.	P
CC0311L1	Phase wire noise.	P
CC04110N	Neutral wire noise.	P
CC0411L1	Phase wire noise.	P

Continuous Conducted emission : CC03110N

Detector : Peak / Average / Cuasi-peak

Project: 29742REM.002  
 Company: ELEKTROBIT  
 Sample: S/03  
 Operation mode: OM#11  
 Date: 2009-11-10 21:37  
 Setup: EMI conducted  
 Mode: EUT ON. TCH mode WIFI+ BT on. Neutral noise.

## EC FCC Class B ESIB26 CC



## Subrange Maximum

Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)
0.150000	44.9	30.7
0.294000	38.4	28.1
0.538000	38.1	29.6
0.842000	37.7	25.2
1.310000	38.6	25.0
1.934000	41.3	26.7
2.510000	42.4	24.5
3.914000	41.5	23.6
5.518000	37.5	17.9
8.222000	29.4	12.5
17.378000	23.6	8.7
25.254000	27.5	21.2

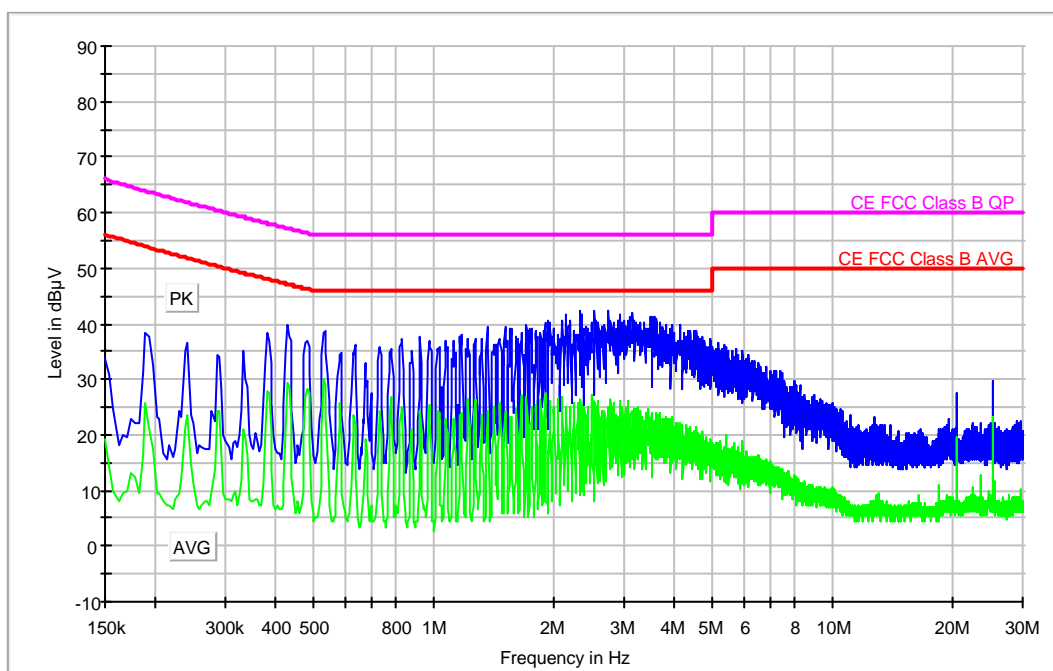


Continuous Conducted emission : CC0311L1

Detector : Peak / Average / Cuasi-peak

Project: 29742REM.002  
 Company: ELEKTROBIT  
 Sample: S/03  
 Operation mode: OM#11  
 Date: 2009-11-10 21:40  
 Setup: EMI conducted  
 Mode: EUT ON. TCH mode WIFI+ BT Tx. Phase noise.

## EC FCC Class B ESIB26 CC



## Subrange Maximum

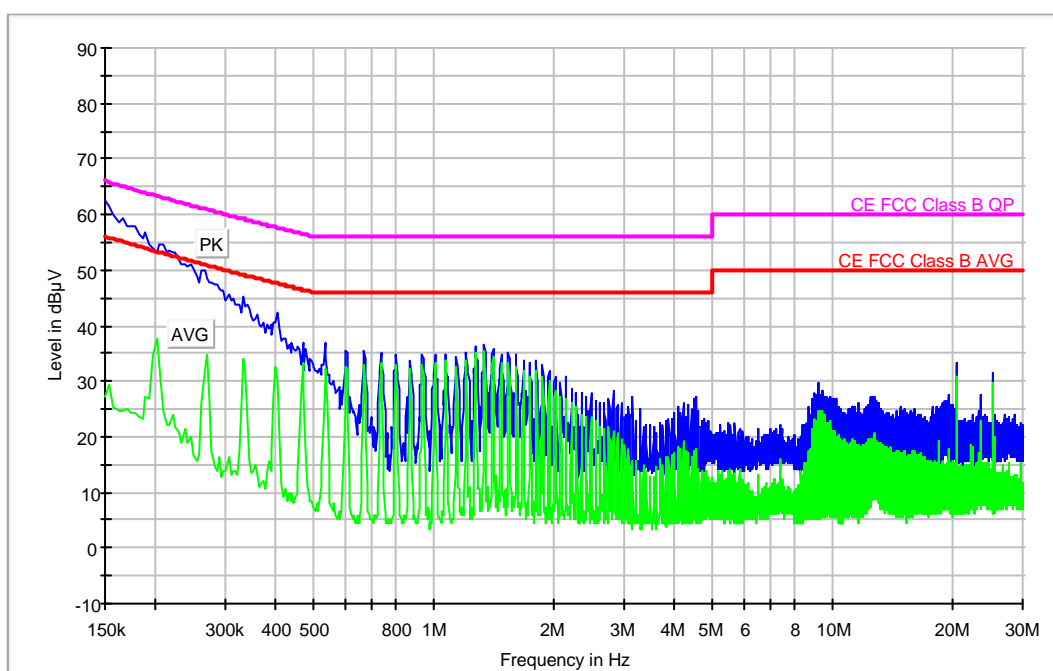
Frequency (MHz)	MaxPeak-ClearWrite (dBμV)	Average-ClearWrite (dBμV)
0.190000	38.5	25.6
0.334000	35.0	21.2
0.430000	39.9	29.5
0.834000	37.2	24.8
1.362000	39.4	22.9
2.094000	40.7	27.0
2.534000	42.5	26.1
3.562000	41.4	22.0
5.182000	36.4	15.6
8.054000	29.7	11.7
12.814000	23.2	6.8
25.254000	29.6	23.3

Continuous Conducted emission : CC04110N

Detector : Peak / Average / Cuasi-peak

Project: 29742REM.002  
 Company: ELEKTROBIT  
 Sample: S/04  
 Operation mode: OM#11  
 Date: 2009-11-10 23:36  
 Setup: EMI conducted  
 Mode: EUT ON. TCH mode WIFI + BT ON. Neutral noise.

## EC FCC Class B ESIB26 CC



## Subrange Maximum

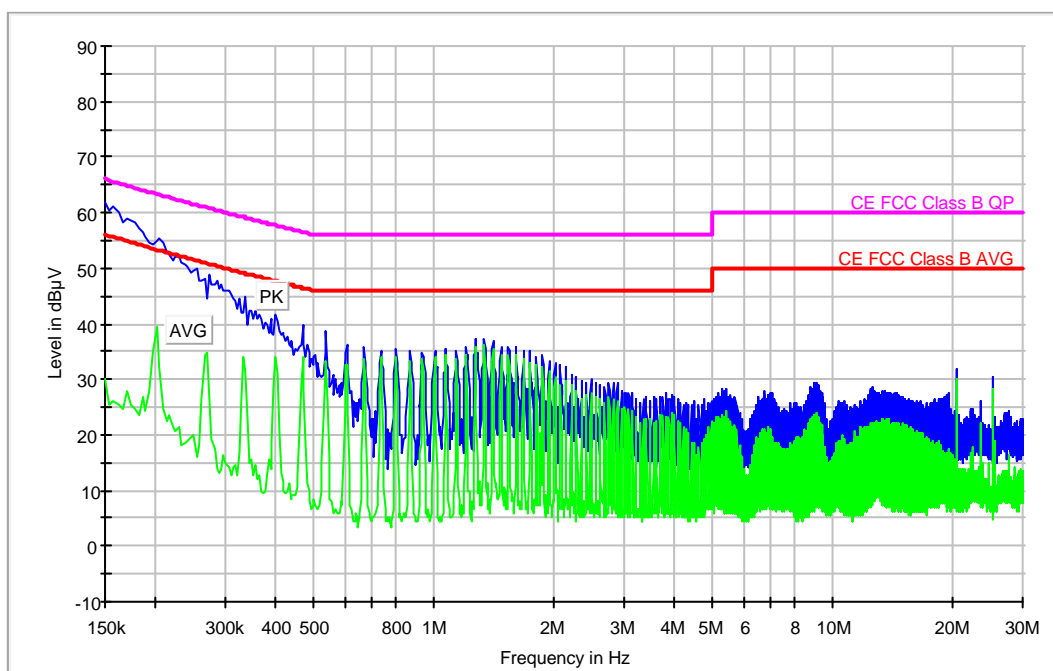
Frequency (MHz)	MaxPeak-ClearWrite (dBµV)	Average-ClearWrite (dBµV)	Comment
0.150000	62.6	27.3	
0.670000	35.4	33.1	
1.342000	36.5	35.4	
1.410000	35.8	34.3	
2.146000	30.6	27.0	
4.562000	27.2	17.7	
5.502000	22.4	13.7	
9.258000	29.6	24.6	
12.814000	27.4	20.5	
20.482000	33.3	30.7	

Continuous Conducted emission : CC0411L1

Detector : Peak / Average / Cuasi-peak

Project: 29742REM.002  
 Company: ELEKTROBIT  
 Sample: S/04  
 Operation mode: OM#11  
 Date: 2009-11-10 23:35  
 Setup: EMI conducted  
 Mode: EUT ON. TCH mode WIFI + BT ON. Phase noise.

## EC FCC Class B ESIB26 CC



## Subrange Maximum

Frequency (MHz)	MaxPeak-ClearWrite (dBμV)	Average-ClearWrite (dBμV)	Comment
0.150000	61.9	30.1	
0.538000	38.6	33.4	
0.606000	36.2	32.4	
1.342000	37.5	36.3	
1.410000	36.9	35.5	
2.146000	32.2	29.6	
3.826000	27.4	23.3	
5.434000	28.2	24.1	
8.990000	29.5	23.5	
12.546000	28.5	21.3	
20.478000	31.9	29.8	

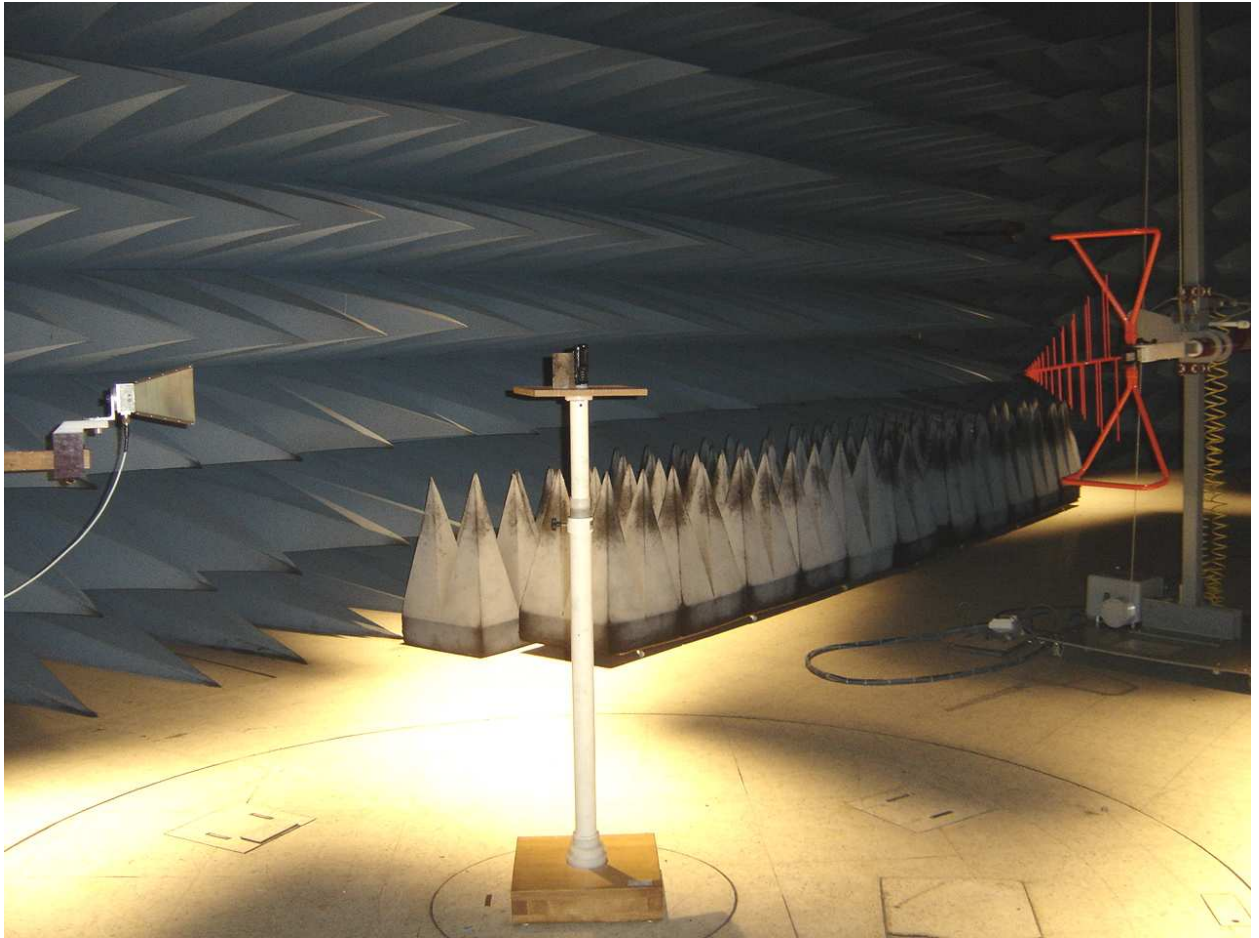
## **APPENDIX C: Photographs**

**EQUIPMENT FOR RADIATED MEASUREMENTS**



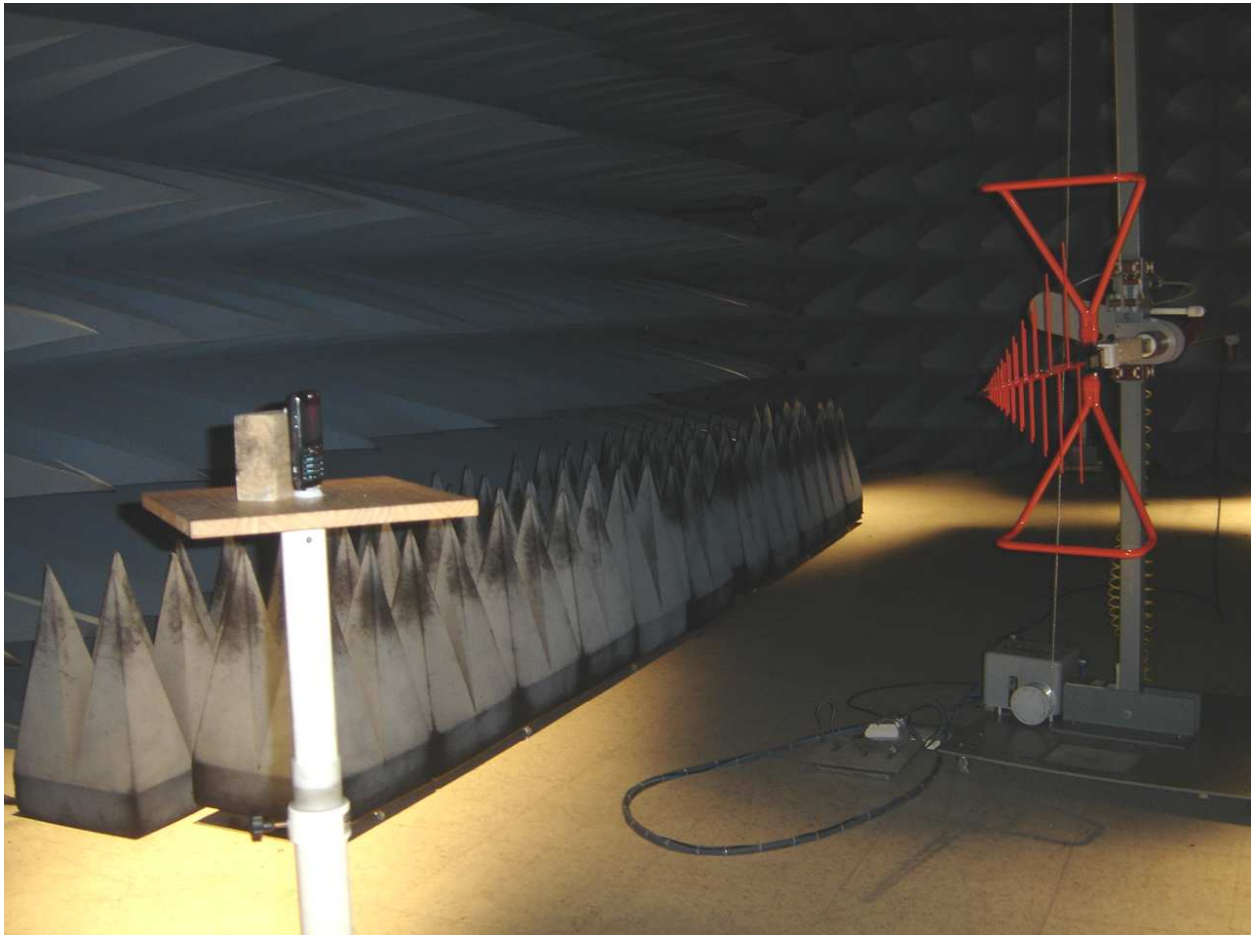
**EQUIPMENT FOR CONDUCTED MEASUREMENTS**



**GENERAL SET-UP FOR RADIATED MEASUREMENTS**

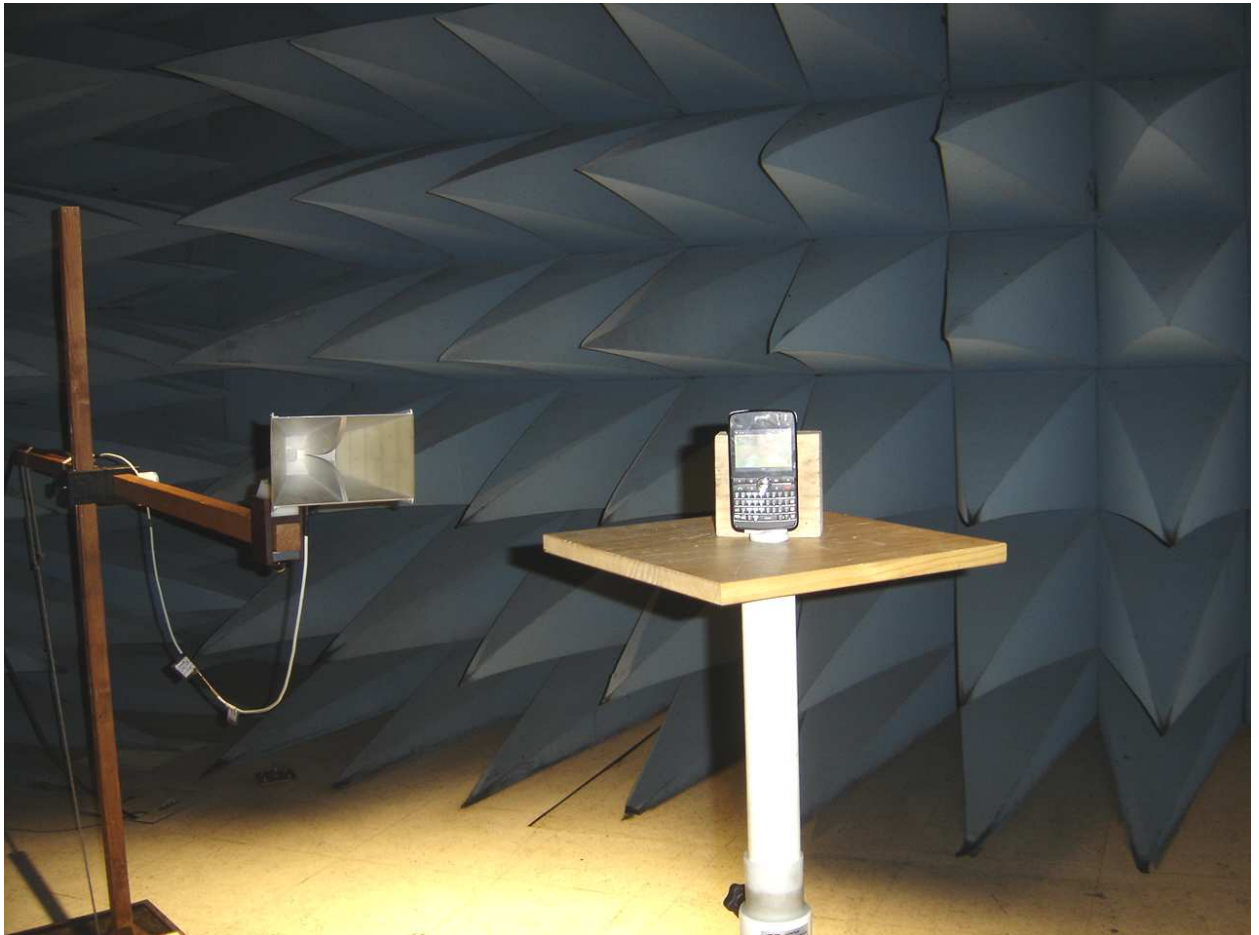


**TEST SET-UP FOR RADIATED MEASUREMENTS BELOW 1 GHz**





**TEST SET-UP FOR RADIATED MEASUREMENTS ABOVE 1GHz**



## GENERAL SET-UP FOR CONDUCTED MEASUREMENTS

