

**CETECOM™**

**CETECOM ICT Services**  
consulting - testing - certification >>>

## TEST REPORT

Test report no.: 1-9611/15-01-09-A



Deutsche  
Akkreditierungsstelle  
D-PL-12076-01-00

### Testing laboratory

**CETECOM ICT Services GmbH**

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**Accredited Testing Laboratory:**

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)

The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-00

### Applicant

**Bowers & Wilkins**

Dale Rd, Worthing,

West Sussex BN11 2BH / UNITED KINGDOM

Phone: -/-

Fax: -/-

Contact: -/- -/-

e-mail: -/-

Phone: -/-

### Manufacturer

**Bowers & Wilkins**

Dale Rd, Worthing,

West Sussex BN11 2BH / UNITED KINGDOM

### Test standard/s

47 CFR Part 15

Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 247 Issue 1

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:** Wireless music system

**Model name:** Zeppelin Wireless

**FCC ID:** 2ACIX-ZW

**IC:** 11946B-ZW

**Frequency:** DTS band 2400 MHz to 2483.5 MHz

**Technology tested:** WLAN (DSSS/b-mode; OFDM/g-; n/HT20-mode)

**Antenna:** Integrated antenna

**Power supply:** 110 V AC by internal power supply unit

**Temperature range:** +5°C to +35°C



This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Test report authorised:

Marco Bertolino  
Lab Manager  
Radio Communications & EMC

### Test performed:

Christoph Schneider  
Testing Manager  
Radio Communications & EMC

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.

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**This test report replaces the test report with the number 1-9611/15-01-09 and dated 2015-06-30.**

### 2.2 Application details

Date of receipt of order:	2015-04-22
Date of receipt of test item:	2015-05-28
Start of test:	2015-05-28
End of test:	2015-06-10
Person(s) present during the test:	-/-

## 3 Test standard/s

Test standard	Date	Test standard description
47 CFR Part 15	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 1	01.05.2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

### 3.1 Measurement guidance

DTS : KDB 558074	2014-06	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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#### 4 Test environment

Temperature:	$T_{nom}$	+22 °C during room temperature tests
	$T_{max}$	No tests under extreme conditions
	$T_{min}$	No tests under extreme conditions
Relative humidity content:		44 %
Barometric pressure:		not relevant for this kind of testing
Power supply:	$V_{nom}$	110 V AC by internal power supply unit
	$V_{max}$	No tests under extreme conditions
	$V_{min}$	No tests under extreme conditions

#### 5 Test item

Kind of test item	:	Wireless music system
Type identification	:	Zeppelin Wireless
HMN	:	-/-
PMN	:	Zeppelin Wireless
HVIN	:	1.0
FVIN	:	MCU 1.00, WiFi CP15, BT 1.1
S/N serial number	:	1503-TR110095
HW hardware status	:	TR1
SW software status	:	Wifi ir-ser.tst.ven6.5-f32s16_V2.7.3.58736-1
Frequency band	:	DTS band 2400 MHz to 2483.5 MHz (lowest channel 2412 MHz; highest channel 2462 MHz)
Type of radio transmission	:	DSSS, OFDM
Use of frequency spectrum	:	
Type of modulation	:	BPSK, QPSK, 16 – QAM, 64 – QAM
Number of channels	:	11
Antenna	:	Integrated antenna
Power supply	:	110 V AC by internal power supply unit
Temperature range	:	+5°C to +35°C

#### 5.1 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup- and EUT-photos are included in test report:

- 1-9611/15-01-01\_AnnexA
- 1-9611/15-01-01\_AnnexB
- 1-9611/15-01-01\_AnnexD

#### 6 Test laboratories sub-contracted

None

## 7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

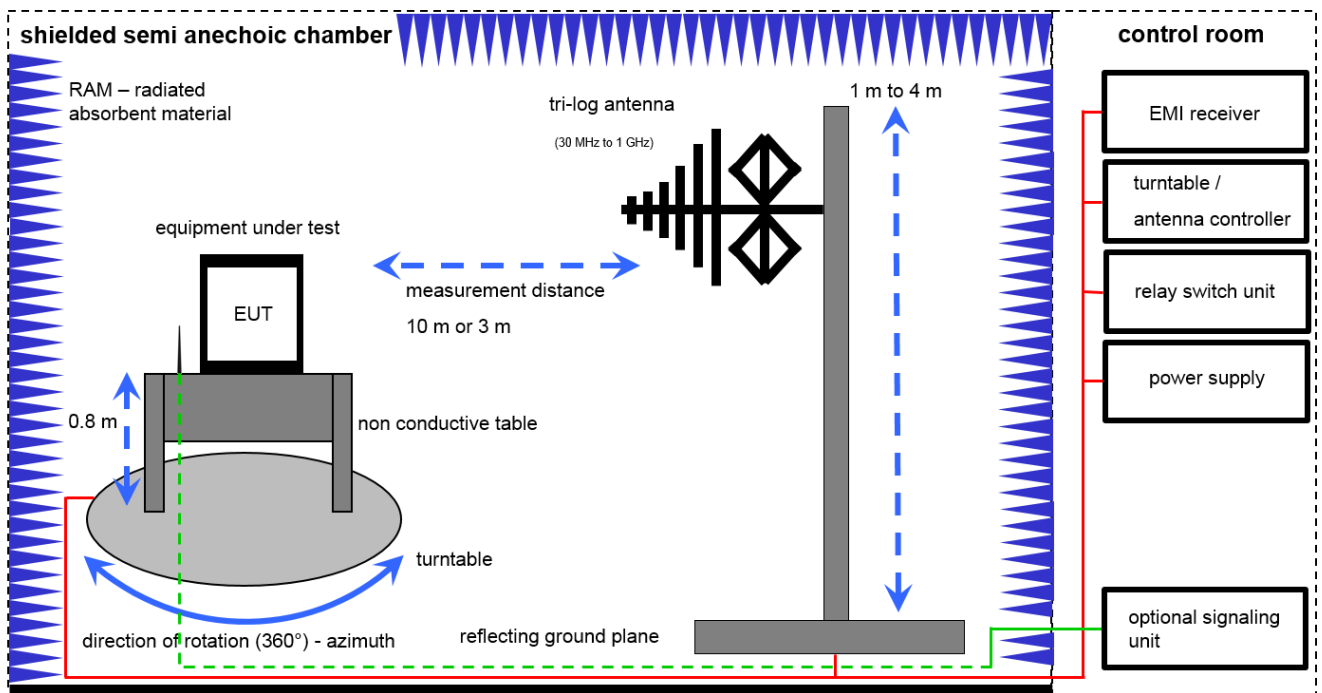
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**Agenda:** Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
v/k!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

## 7.1 Shielded semi anechoic chamber

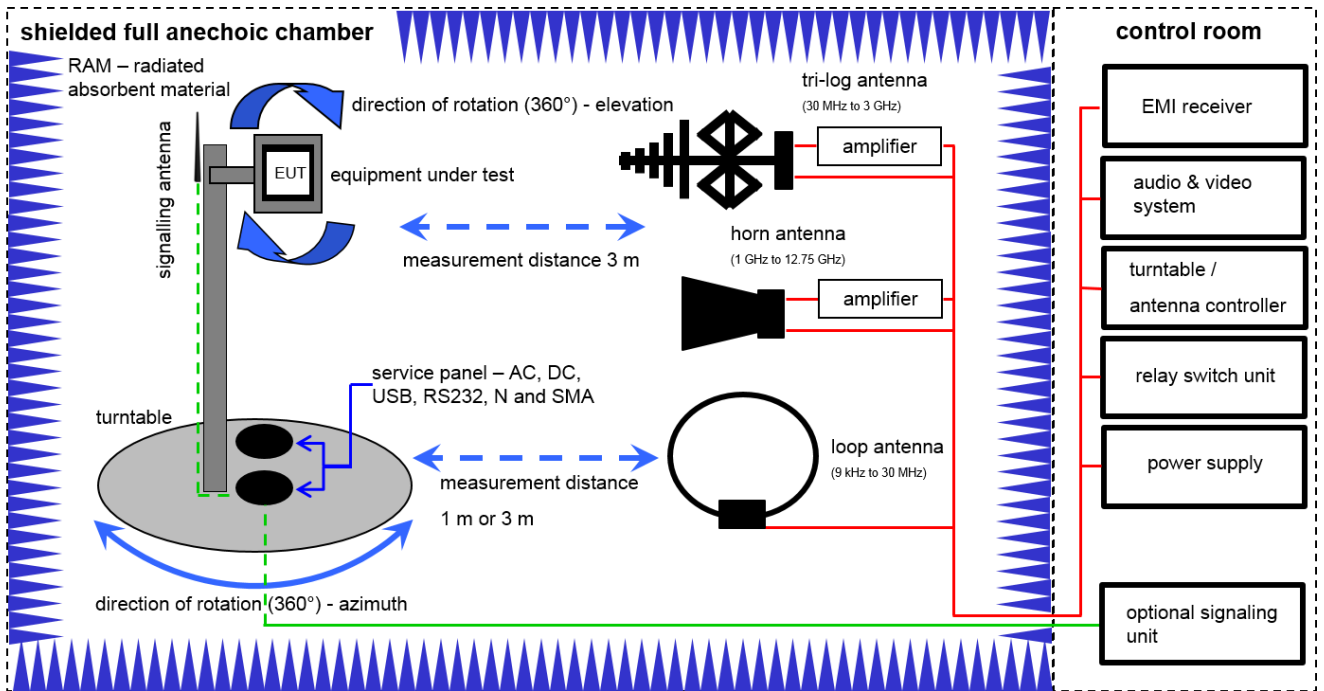
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



### Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	45	Switch-Unit	3488A	HP	2719A14505	300000368	ev		
2	45	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2015	26.01.2016
3	45	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw		
4	45	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw		
5	45	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw		
6	45	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	22.04.2014	22.04.2016

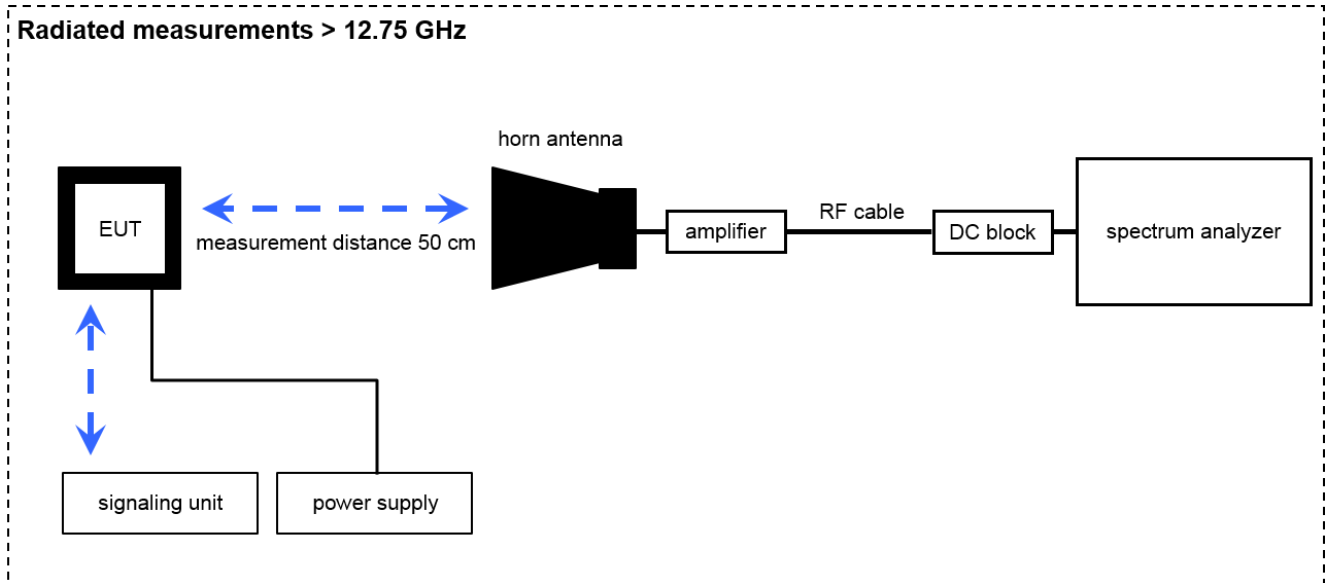
## 7.2 Shielded fully anechoic chamber



### Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vIKI!	20.05.2015	20.05.2017
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev		
3	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne		
4	90	Active Loop Antenna 10 kHz to 30 MHz	6502	Kontron Psychotech	8905-2342	300000256	k	13.06.2013	13.06.2015
5	90	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne		
6	90	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev		
7	90	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vIKI!	29.10.2014	29.10.2017
8	90	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	06.03.2015	06.03.2016

### 7.3 Radiated measurements > 12.75 GHz

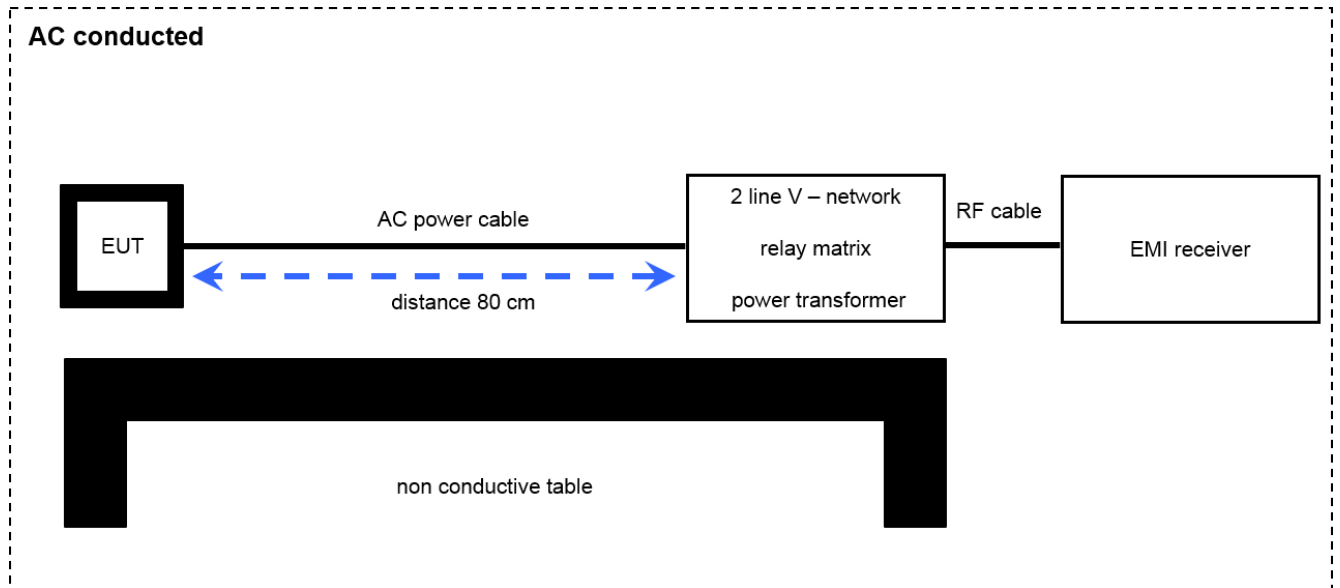


**Equipment table:**

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A026	Std. Gain Horn Antenna 12.4 to 18.0 GHz	639	Narda	8402	300000787	k	22.07.2013	22.07.2015
2	A029	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	k	19.07.2013	19.07.2015
3	A029	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
4	A029	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev		



## 7.4 AC conducted



### Equipment table:

No.	Lab / Item	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Netznachbildung	ESH3-Z5	R&S	892475/017	300002209	k	17.06.2014	17.06.2016
2	85	Koppelnetzwerk	CDN 801 M2/M3	EM-Test	9350105	300000534	k		
3	68	EMI-Receiver	8542E	HP	3617A00170	300000568	k	28.01.2015	28.01.2016

## 8 Summary of measurement results

<input type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input checked="" type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15 RSS - 247, Issue 1	See table!	2015-07-21	-/-

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	Pass	Fail	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (4)	System gain	-/-	Nominal	Nominal	DSSS	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(e) RSS - 247 / 5.2 (2)	Power spectral density	KDB 558074 DTS clause: 10.6	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(a)(2) RSS - 247 / 5.2 (1)	DTS bandwidth – 6 dB bandwidth	KDB 558074 DTS clause: 8.1	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 9.2.2.5	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	-/-	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated	KDB 558074 DTS clause: 13.3.2	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d) RSS - 247 / 5.5	TX spurious emissions conducted	KDB 558074 DTS clause: 11.1 & 11.2 11.3	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-/-
§15.209(a) RSS-Gen	TX spurious emissions radiated below 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.109 RSS-Gen	RX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	RX / idle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.109 RSS-Gen	RX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	RX / idle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies

**Note:** NA = Not Applicable; NP = Not Performed

**9 Additional comments**

Reference documents: Document 75917143 Report 05 Issue 3 (TÜV Süd)

Special test descriptions: None

Configuration descriptions: None

Test mode:  No test mode available.  
Iperf was used to ping another device with the largest support packet size

Special software is used.  
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

Operating mode 1 (single antenna)

- Equipment with 1 antenna,
- Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,
- Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)

Operating mode 2 (multiple antennas, no beamforming)

- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.

Operating mode 3 (multiple antennas, with beamforming)

- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.  
In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

## 10 Measurement results

### 10.1 System gain

#### Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal WLAN devices, the DSSS mode is used.

#### Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max hold

#### Limits:

FCC	IC
Antenna Gain	
6 dBi	

#### Results:

T <sub>nom</sub>	V <sub>nom</sub>	lowest channel 2412 MHz	middle channel 2437 MHz	highest channel 2462 MHz
Conducted power [dBm] Measured with DSSS modulation		15.18	15.93	15.36
Radiated power [dBm] Measured with DSSS modulation		14.9	15.0	15.0
Gain [dBi] Calculated		-0.28	-0.93	-0.36
Measurement uncertainty			± 1.5 dB (cond.) / ± 3 dB (rad.)	

Verdict: **complies**

## 10.2 Identify worst case data rate

### Measurement:

All modes of the module will be measured with an average power meter or spectrum analyzer to identify the maximum transmission power.

In further tests only the identified worst case modulation scheme or bandwidth will be measured and this mode is used as representative mode for all other modulation schemes.

Additional the band edge compliance test will be performed in the lowest and highest modulation scheme.

### Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	3 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max hold

### Results:

Modulation	Modulation scheme / bandwidth
DSSS / b – mode	1 Mbit/s
OFDM / g – mode	36 Mbit/s
OFDM / n HT20 – mode	MCS2

### 10.3 Occupied bandwidth – 99% emission bandwidth

**Description:**

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

**Measurement:**

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	1 MHz
Span:	30 MHz
Measurement procedure:	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace-Mode:	Max hold (allow trace to stabilize)

**Usage:**

-/-	IC
Occupied Bandwidth – 99% emission bandwidth	
OBW is necessary for Emission Designator	

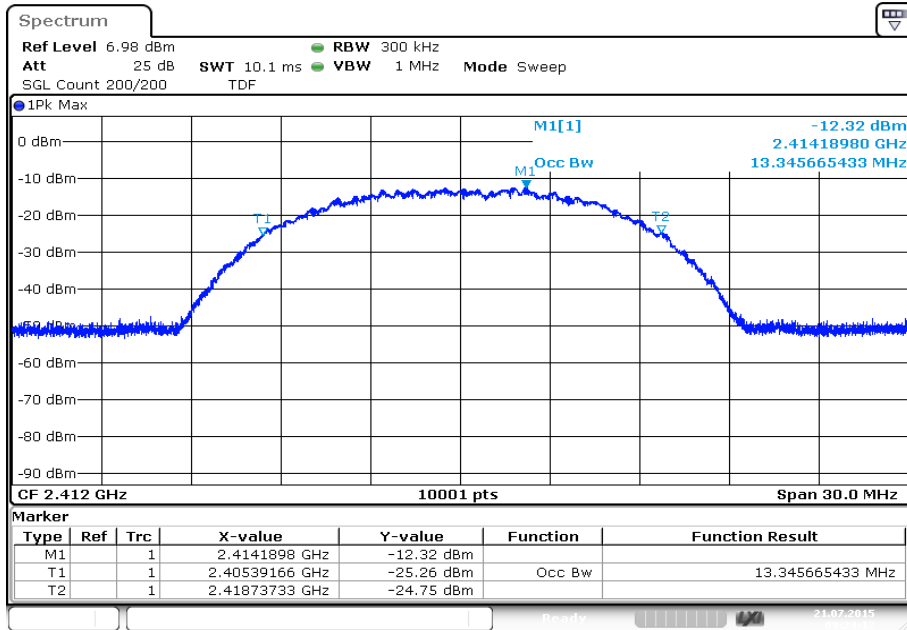
**Results:**

Modulation Frequency	99% bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	13.35	13.46	13.50
OFDM / g – mode	16.76	16.80	16.87
OFDM / n HT20 – mode	18.00	17.93	17.98
Measurement uncertainty	± RBW		

**Verdict:** [complies](#)

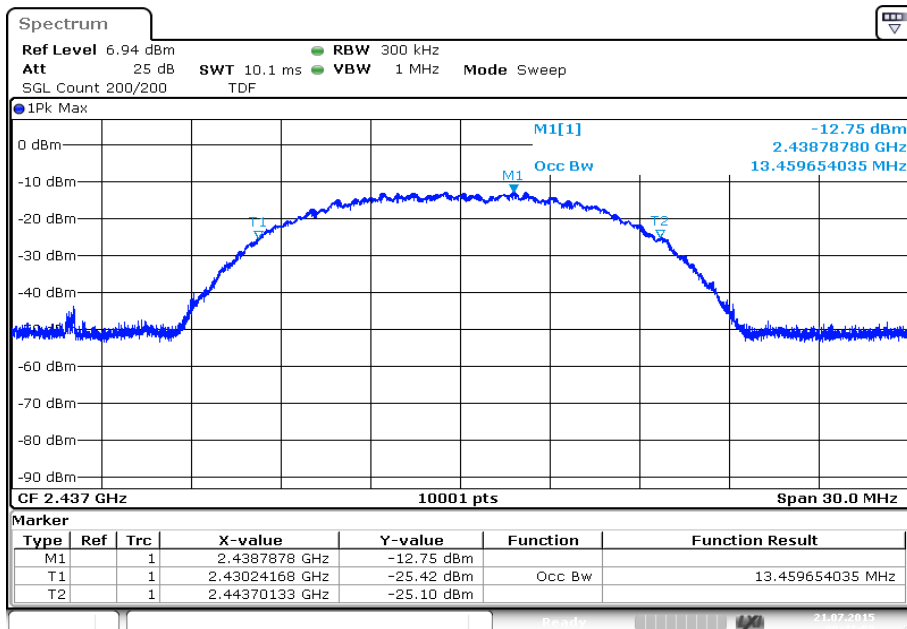
**Plots:** DSSS / b – mode

**Plot 1:** TX mode, lowest channel



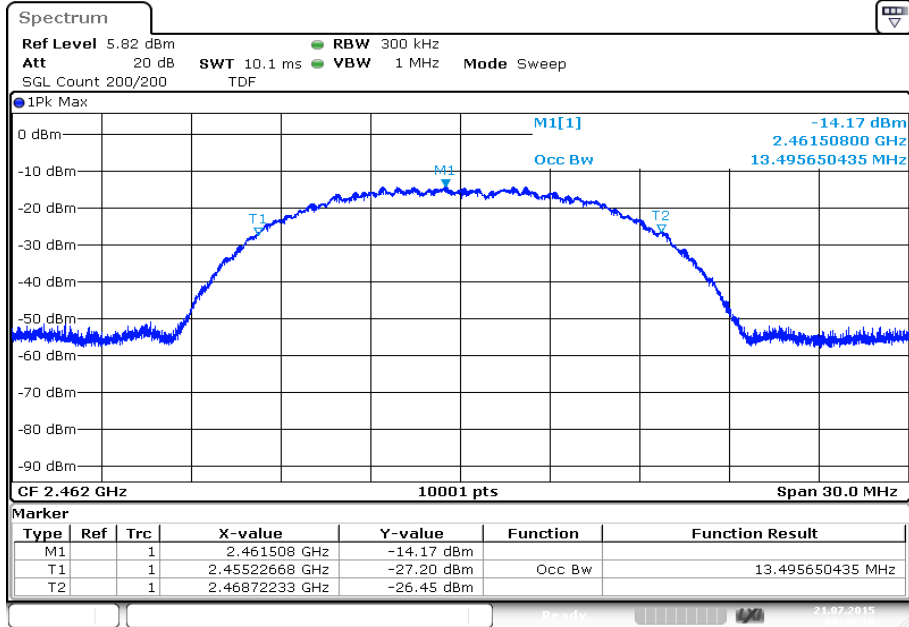
Date: 21.JUL.2015 09:24:12

**Plot 2:** TX mode, middle channel



Date: 21.JUL.2015 09:41:58

Plot 3: TX mode, highest channel

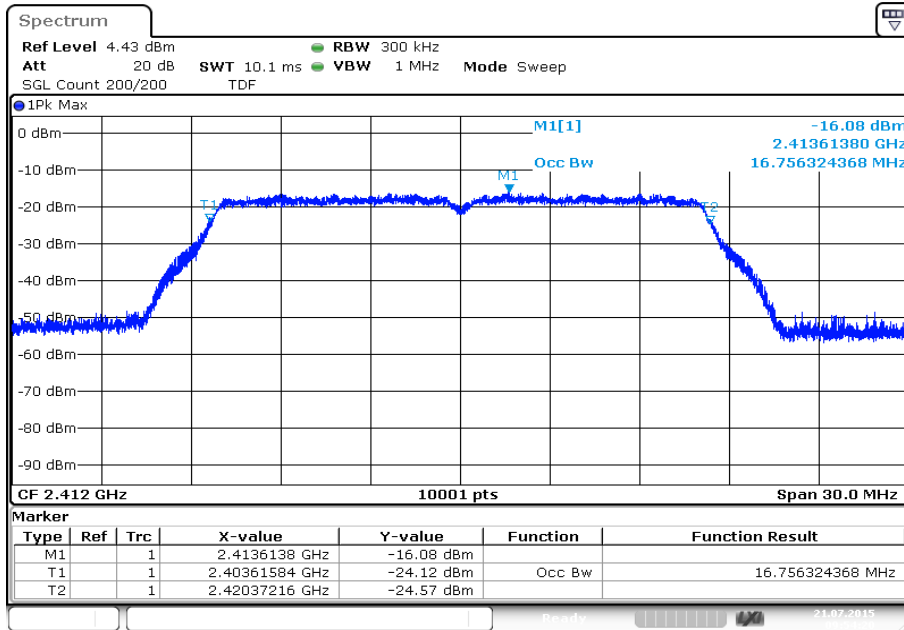


Date: 21.JUL.2015 09:48:10



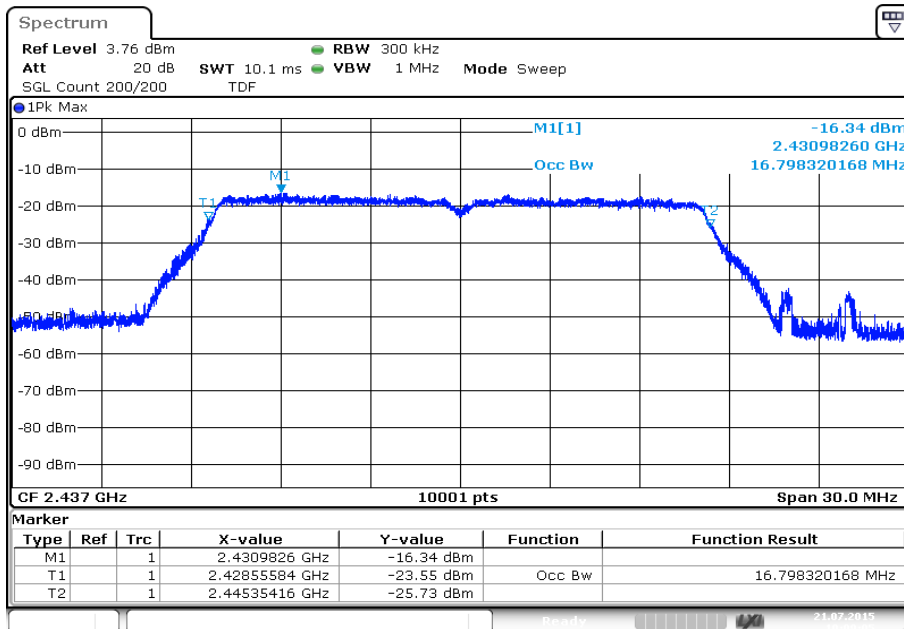
**Plots:** OFDM / g – mode

**Plot 1:** TX mode, lowest channel



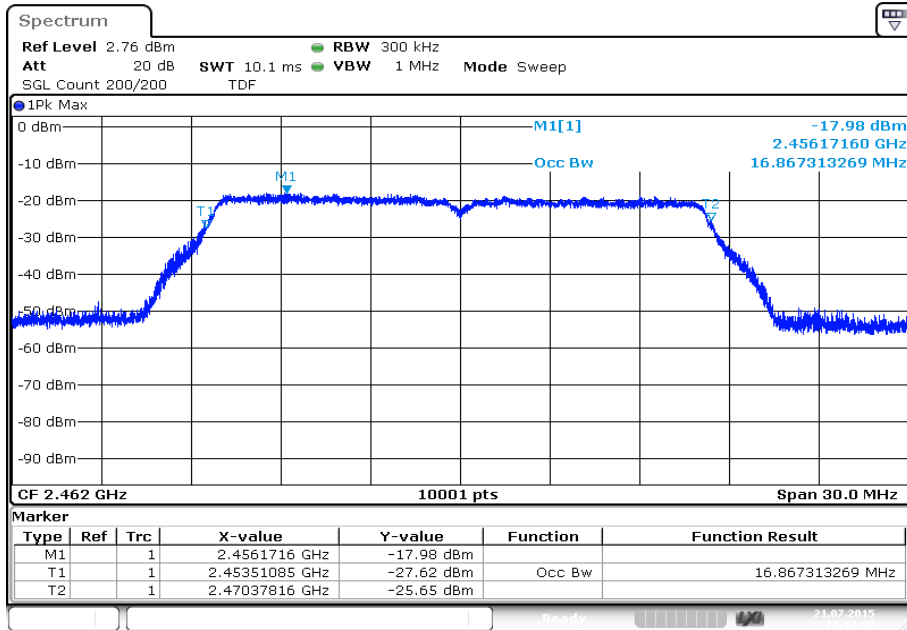
Date: 21.JUL.2015 09:54:20

**Plot 2:** TX mode, middle channel



Date: 21.JUL.2015 10:09:05

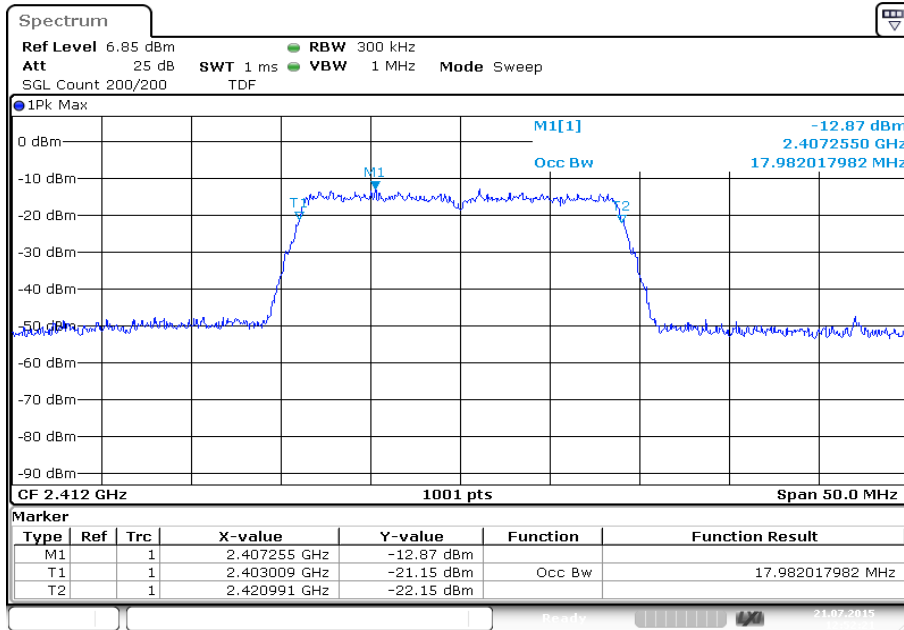
Plot 3: TX mode, highest channel



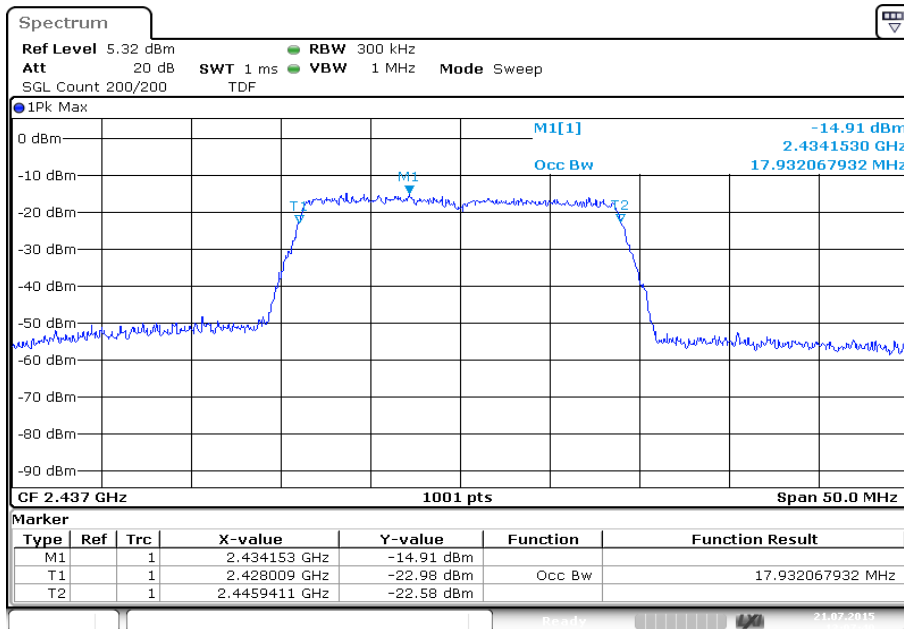
Date: 21.JUL.2015 10:14:45

**Plots:** OFDM / n HT20 – mode

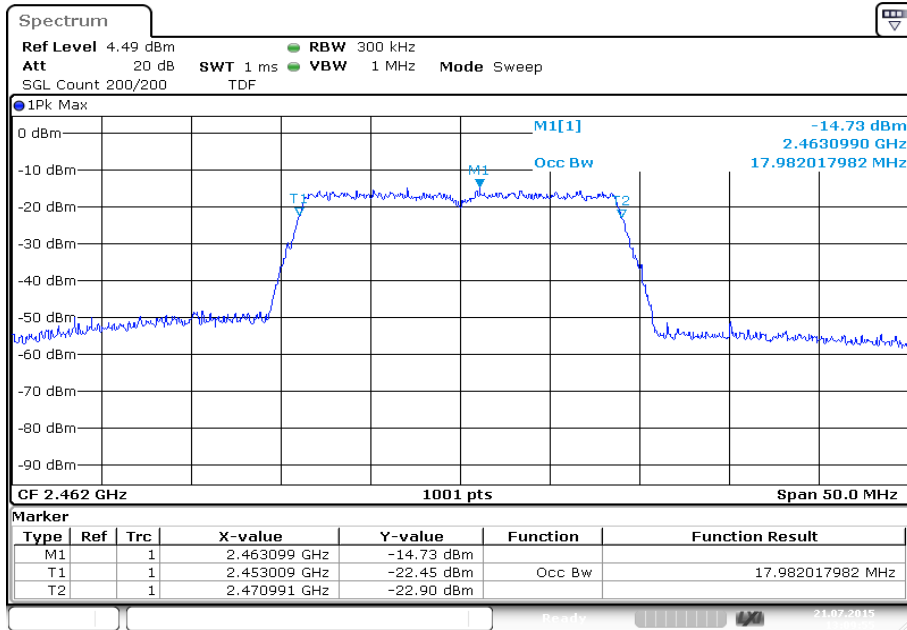
**Plot 1:** TX mode, lowest channel



**Plot 2:** TX mode, middle channel



Plot 3: TX mode, highest channel



Date: 21.JUL.2015 13:09:55

## 10.4 Band edge compliance radiated

### Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to channel 1 for the lower restricted band and to channel 11 for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3m.

### Measurement:

Measurement parameter for peak measurements	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 MHz
Video bandwidth:	1 MHz
Span:	See plot!
Trace-Mode:	Max Hold

Measurement parameter for average measurements	
According to DTS clause: 13.3.2	
Detector:	RMS
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	2 MHz
Trace-Mode:	RMS Average over 101 sweeps

### Limits:

FCC	IC
Band Edge Compliance Radiated	
<p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).</p>	
74 dBµV/m Peak 54 dBµV/m AVG	

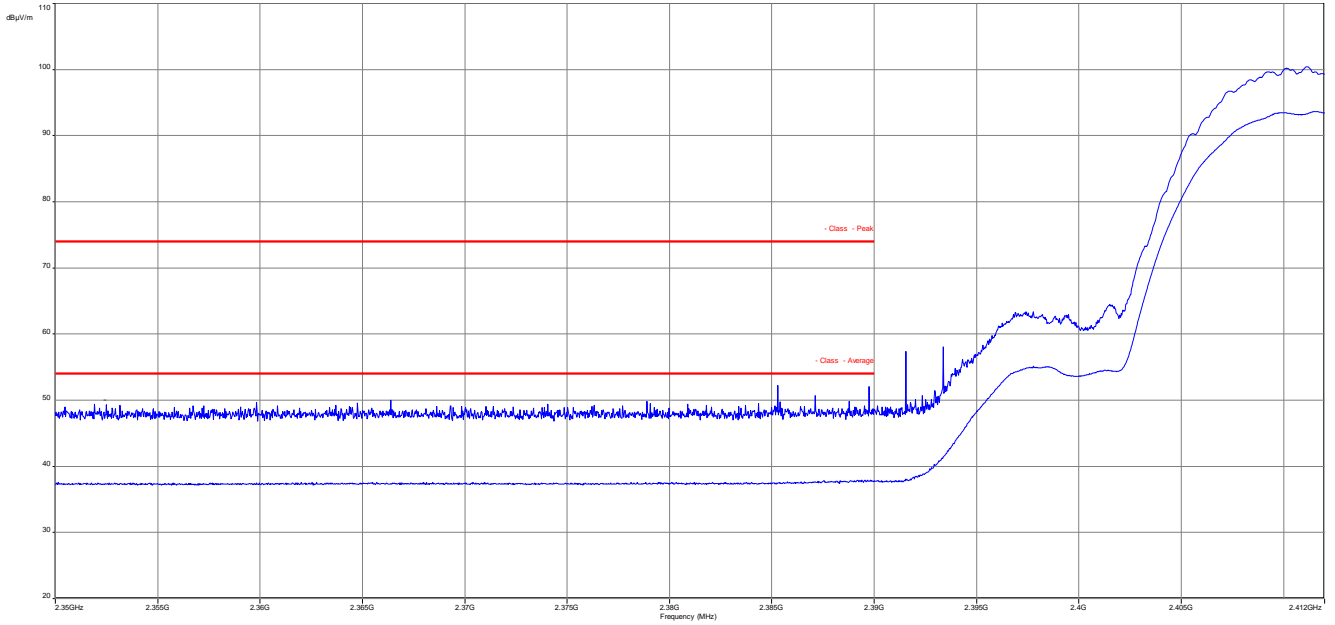
**Results:**

Scenario Modulation	Band Edge Compliance Conducted [dB]	
	DSSS	OFDM
Lower band edge	> 20 dB (Peak) > 20 dB (AVG)	> 20 dB (Peak) > 20 dB (AVG)
Upper band edge	> 20 dB (Peak) > 20 dB (AVG)	> 20 dB (Peak) > 20 dB (AVG)
Measurement uncertainty	± 3 dB	

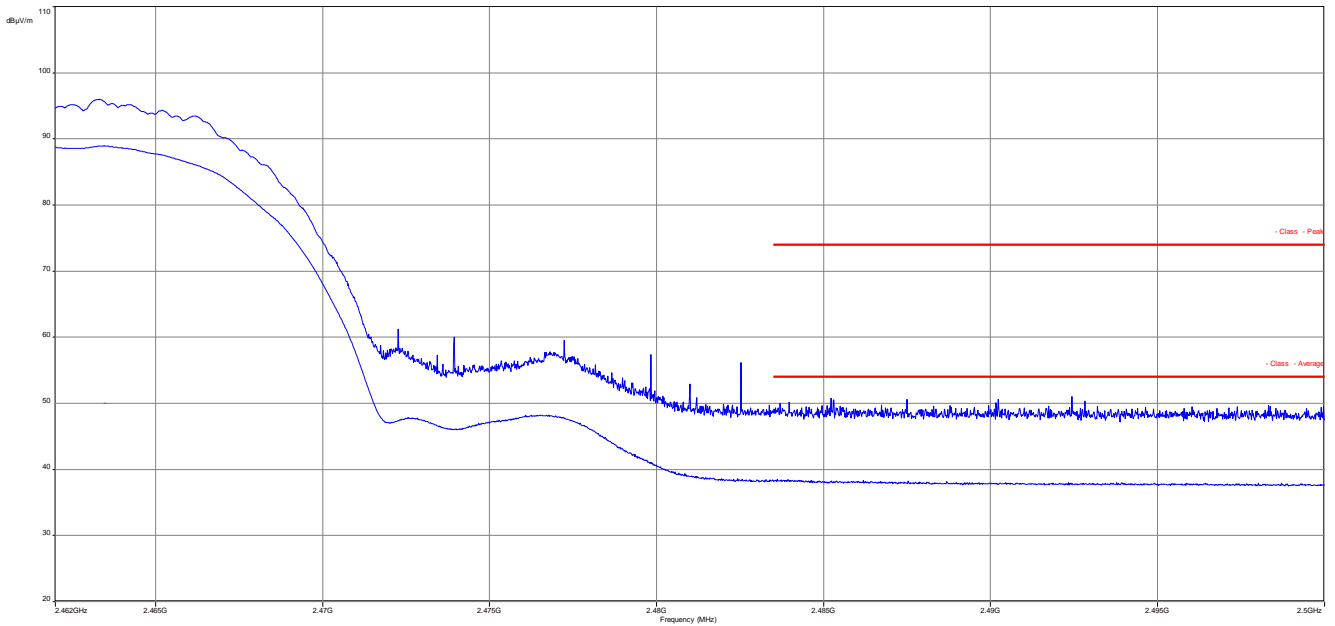
**Verdict:** [complies](#)

**Plots:** DSSS peak / average

**Plot 1:** TX mode, lower band edge, vertical & horizontal polarization

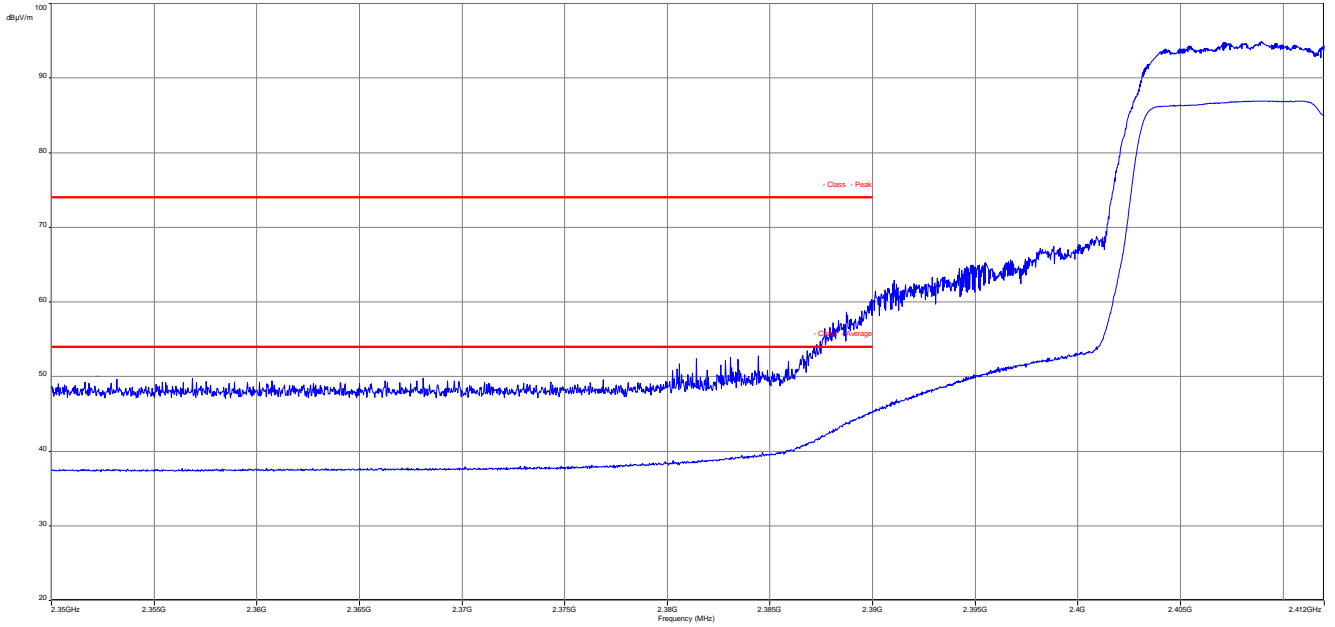


**Plot 2:** TX mode, upper band edge, vertical & horizontal polarization

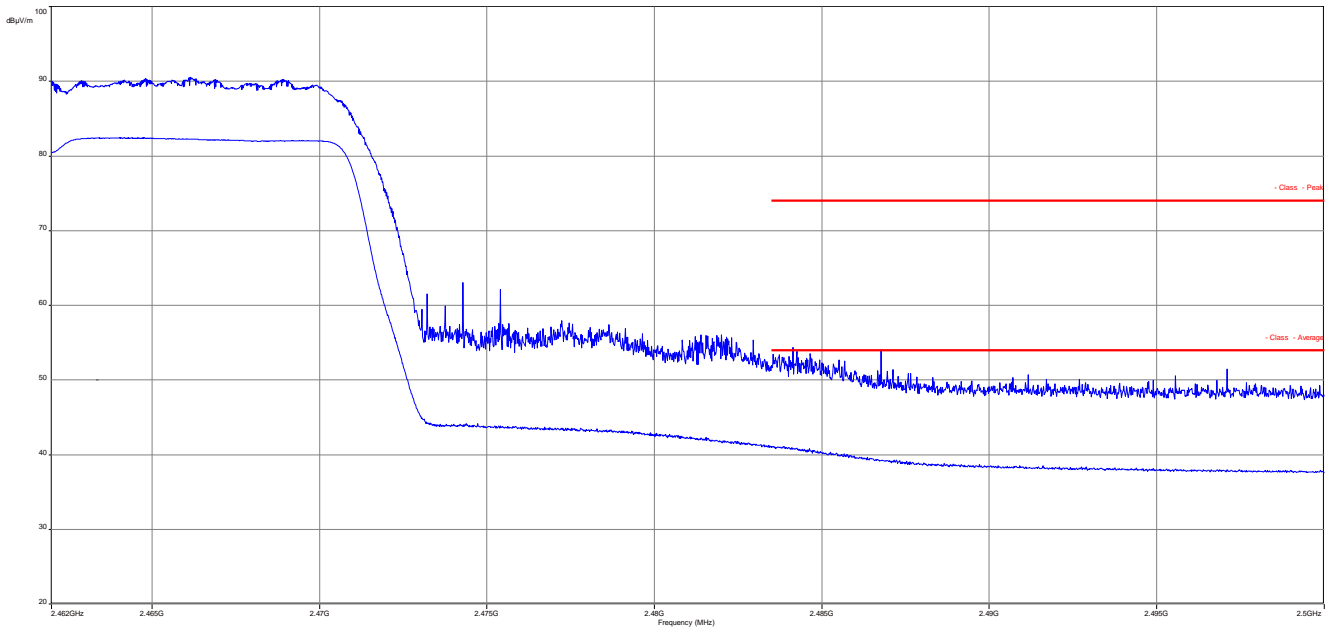


**Plots:** OFDM peak / average

**Plot 1:** TX mode, lower band edge, vertical & horizontal polarization



**Plot 2:** TX mode, upper band edge, vertical & horizontal polarization





## 10.5 Spurious emissions radiated below 30 MHz

### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The measurement is performed with the data rate producing the highest output power. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

### Limits:

FCC		IC
TX Spurious Emissions Radiated < 30 MHz		
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

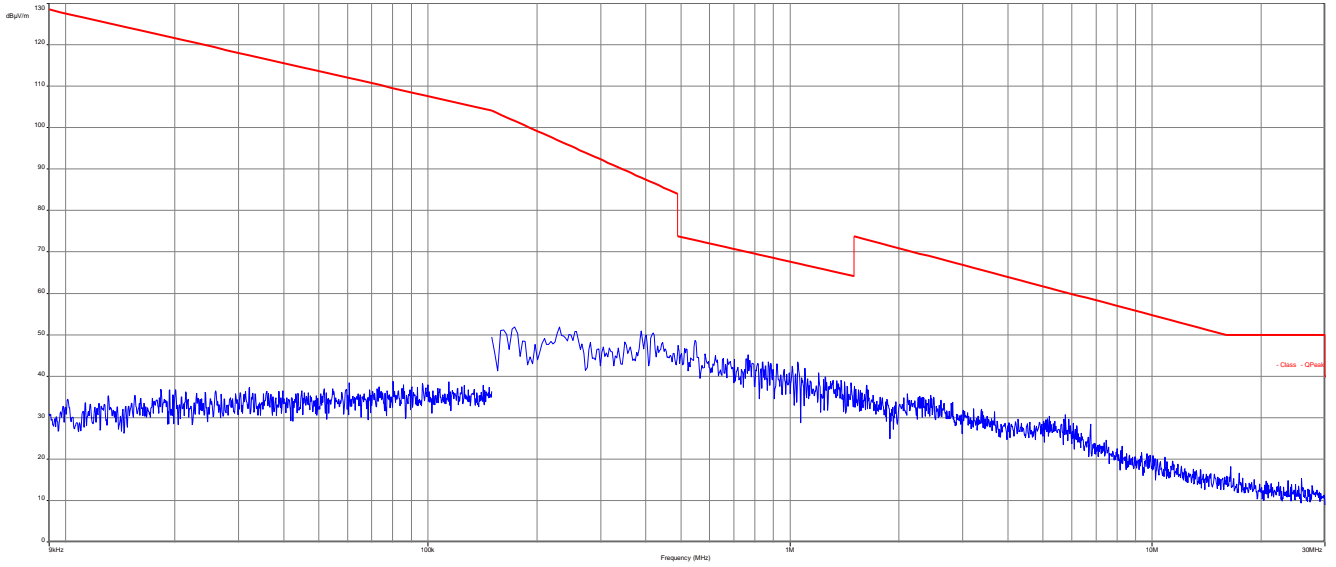
### Results:

TX Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		
Measurement uncertainty	± 3 dB	

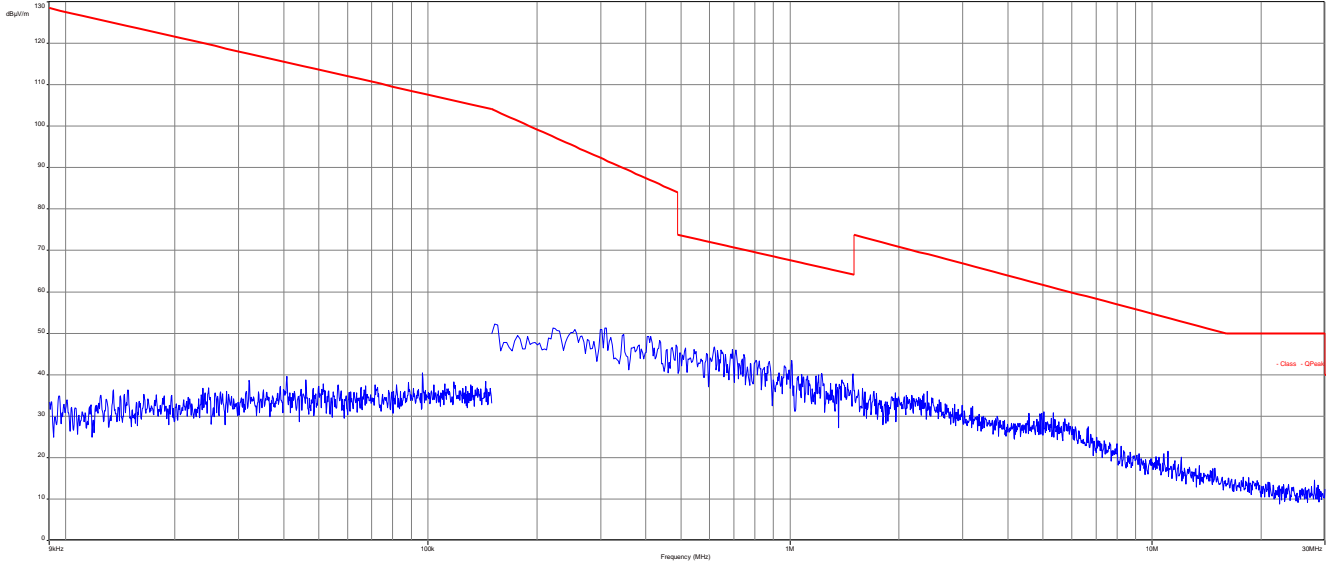
**Verdict:** [complies](#)

**Plots:** DSSS

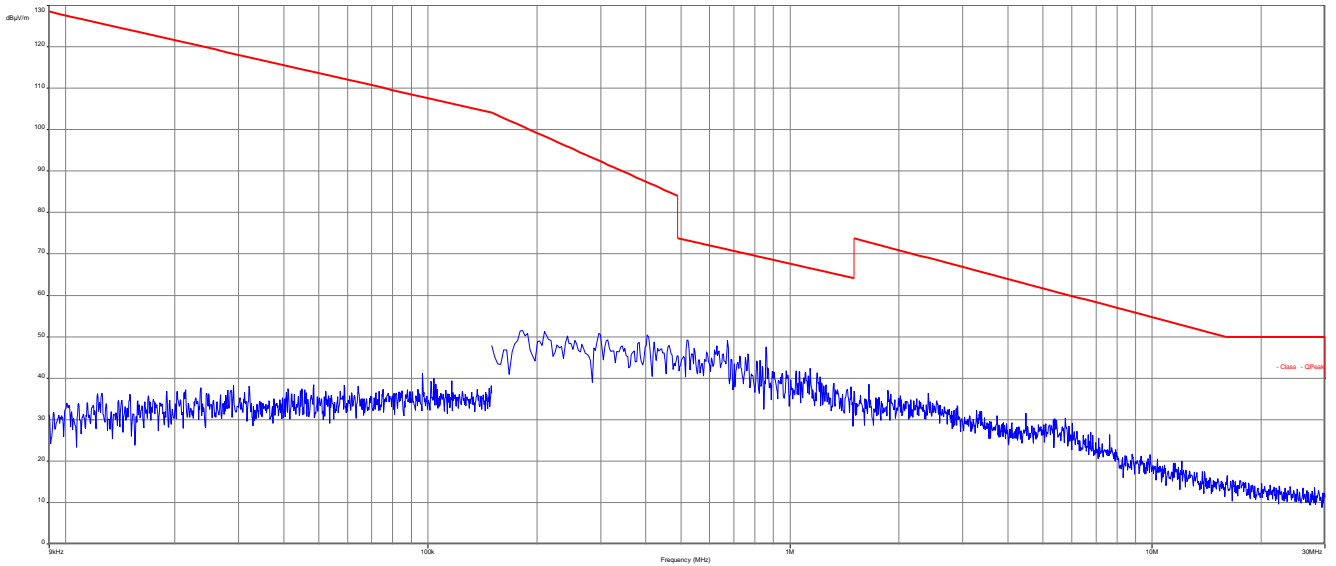
**Plot 1:** 9 kHz to 30 MHz, low channel



**Plot 2:** 9 kHz to 30 MHz, mid channel

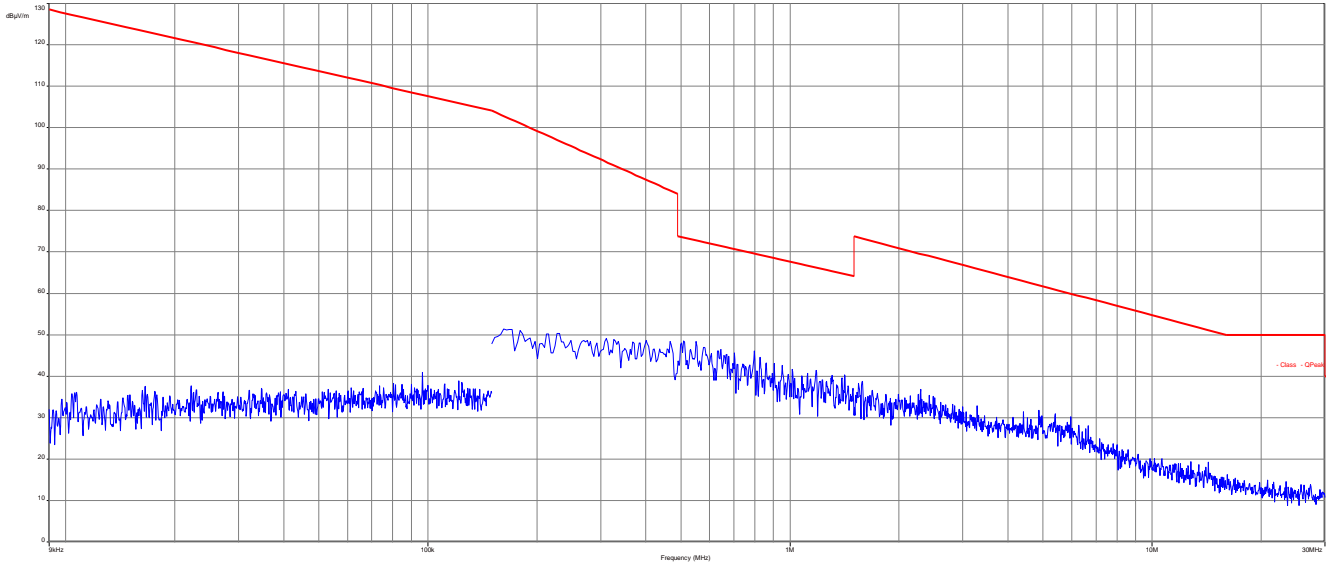


**Plot 3: 9 kHz to 30 MHz, high channel**

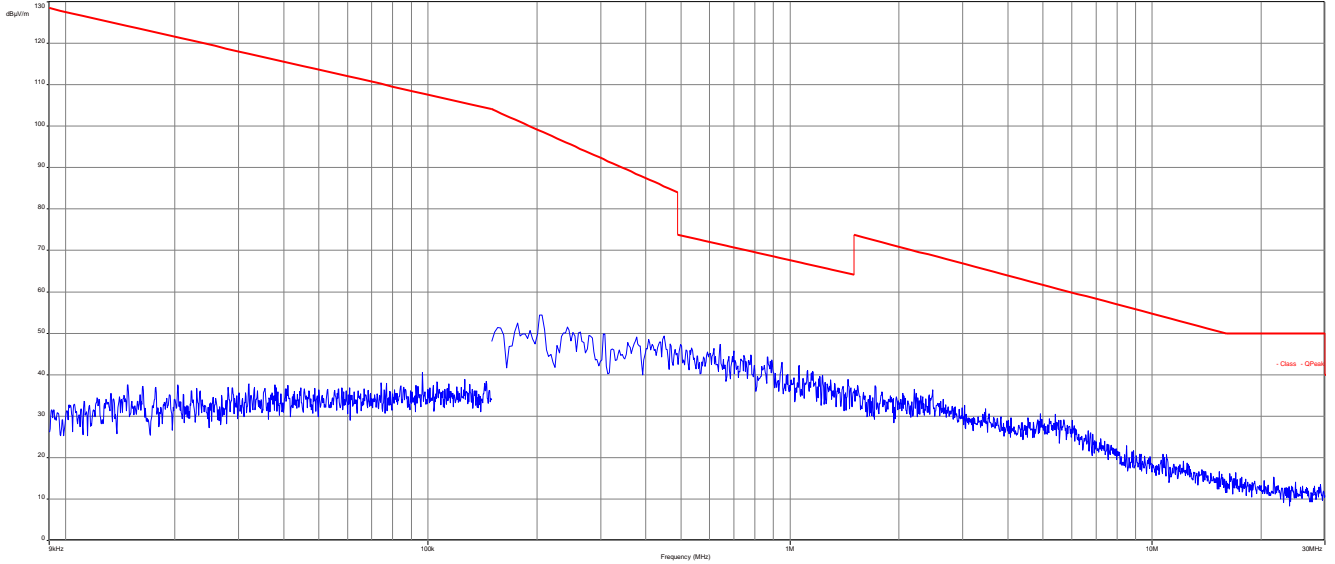


**Plots: OFDM**

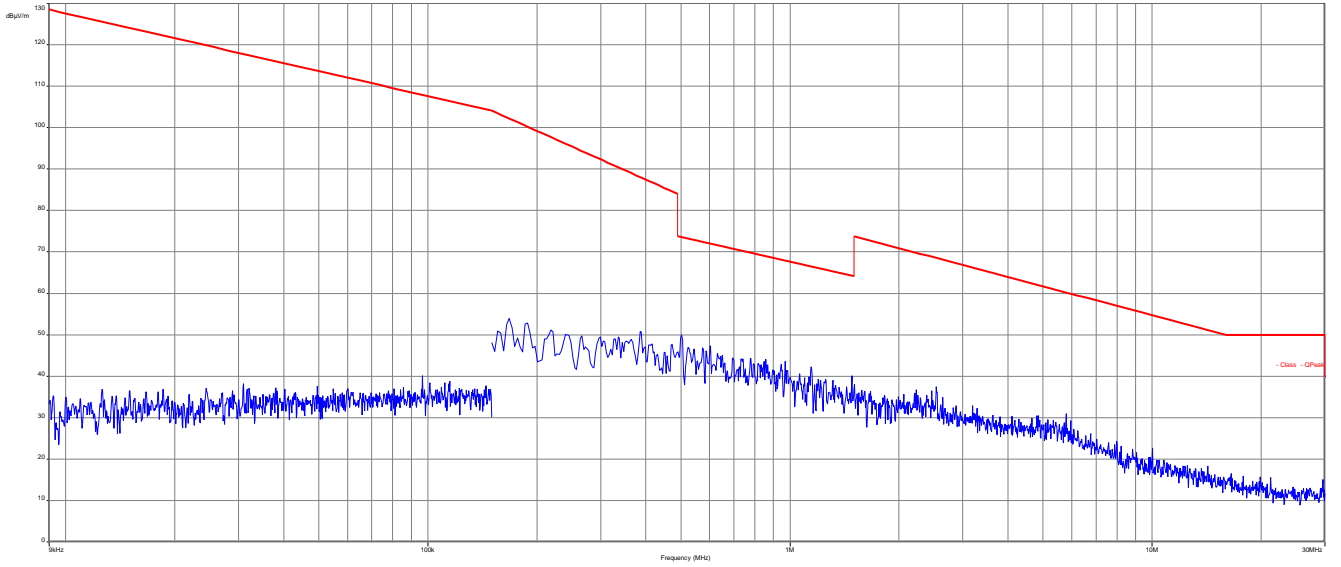
**Plot 1: 9 kHz to 30 MHz, low channel**



**Plot 2: 9 kHz to 30 MHz, mid channel**



**Plot 3: 9 kHz to 30 MHz, high channel**



**10.6 Spurious emissions radiated 30 MHz to 1 GHz**

**Description:**

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

**Measurement:**

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	F < 1 GHz: 120 kHz
Video bandwidth:	3 x RBW
Span:	30 MHz to 1 GHz
Trace-Mode:	Max Hold
Measured Modulation	<input checked="" type="checkbox"/> DSSS b – mode <input type="checkbox"/> OFDM g – mode <input checked="" type="checkbox"/> OFDM n HT20 – mode <input type="checkbox"/> OFDM n HT40 – mode <input checked="" type="checkbox"/> RX / Idle – mode

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

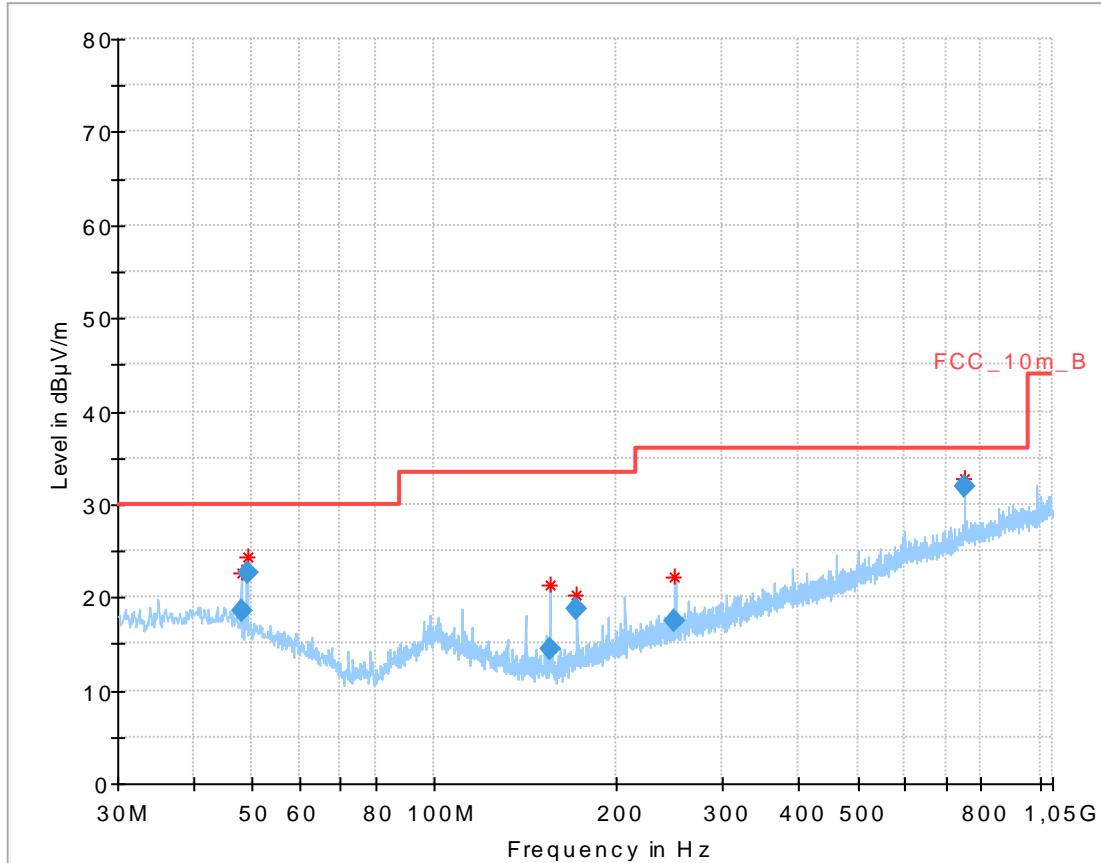
**Limits:**

FCC	IC	
TX Spurious Emissions Radiated		
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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 (MHz)	Field Strength (dBµV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10

**Verdict:** [complies](#)

**Plot:** DSSS

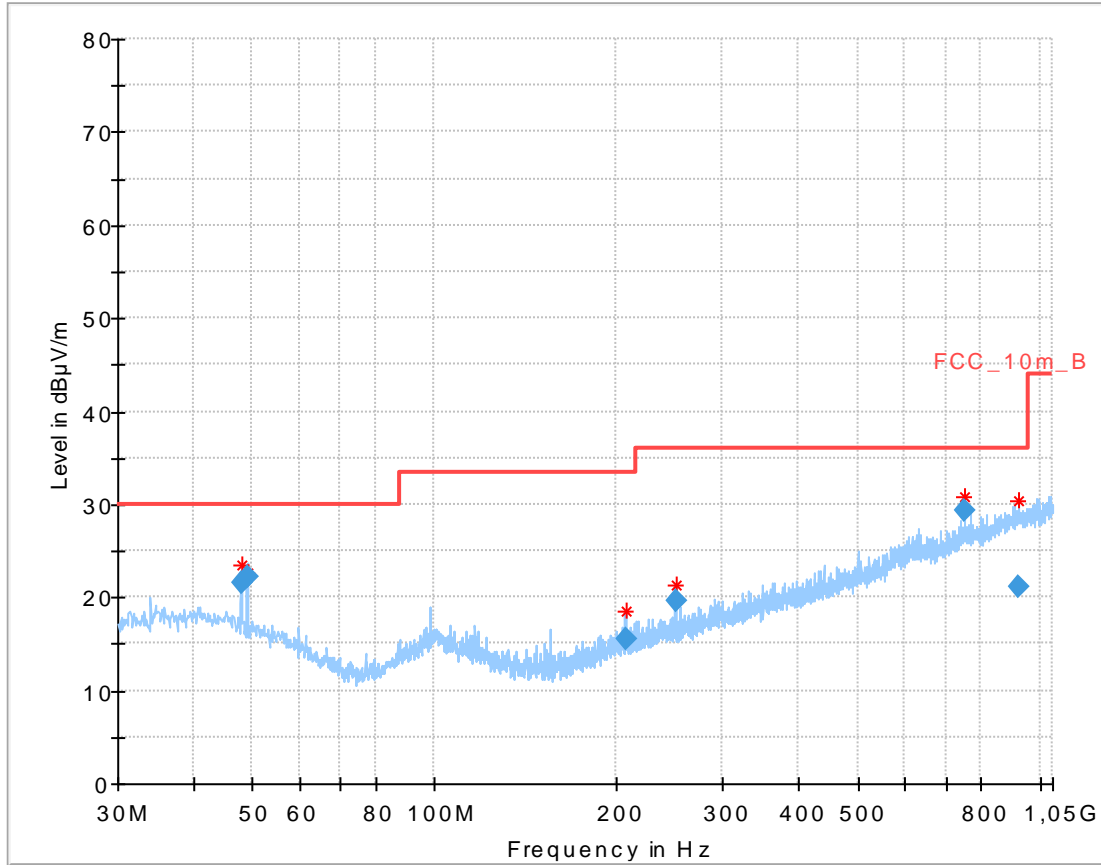
**Plot 1:** 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
47.979000	18.59	30.00	11.41	1000.0	120.000	98.0	V	55	13.1
49.164150	22.64	30.00	7.36	1000.0	120.000	98.0	V	55	12.8
154.982700	14.42	33.50	19.08	1000.0	120.000	98.0	V	81	9.0
172.032150	18.78	33.50	14.72	1000.0	120.000	98.0	V	322	9.9
249.965550	17.54	36.00	18.46	1000.0	120.000	98.0	V	164	13.3
750.046350	32.02	36.00	3.98	1000.0	120.000	101.0	H	277	22.7

Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel

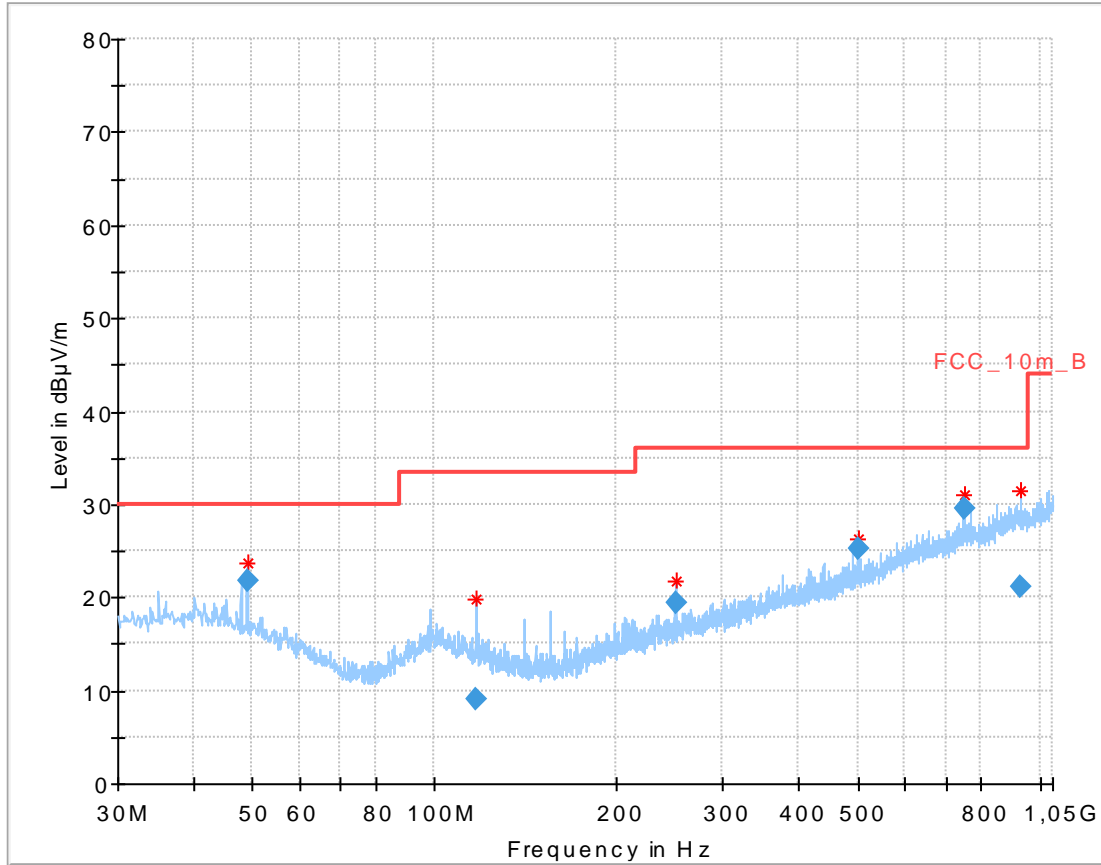


**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
48.010500	21.60	30.00	8.40	1000.0	120.000	98.0	V	86	13.1
49.141800	22.30	30.00	7.70	1000.0	120.000	98.0	V	55	12.8
206.675100	15.59	33.50	17.91	1000.0	120.000	98.0	V	152	11.9
250.017750	19.53	36.00	16.47	1000.0	120.000	98.0	V	164	13.4
750.046050	29.39	36.00	6.61	1000.0	120.000	98.0	H	8	22.7
923.149200	21.14	36.00	14.86	1000.0	120.000	170.0	V	358	24.2



Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, high channel

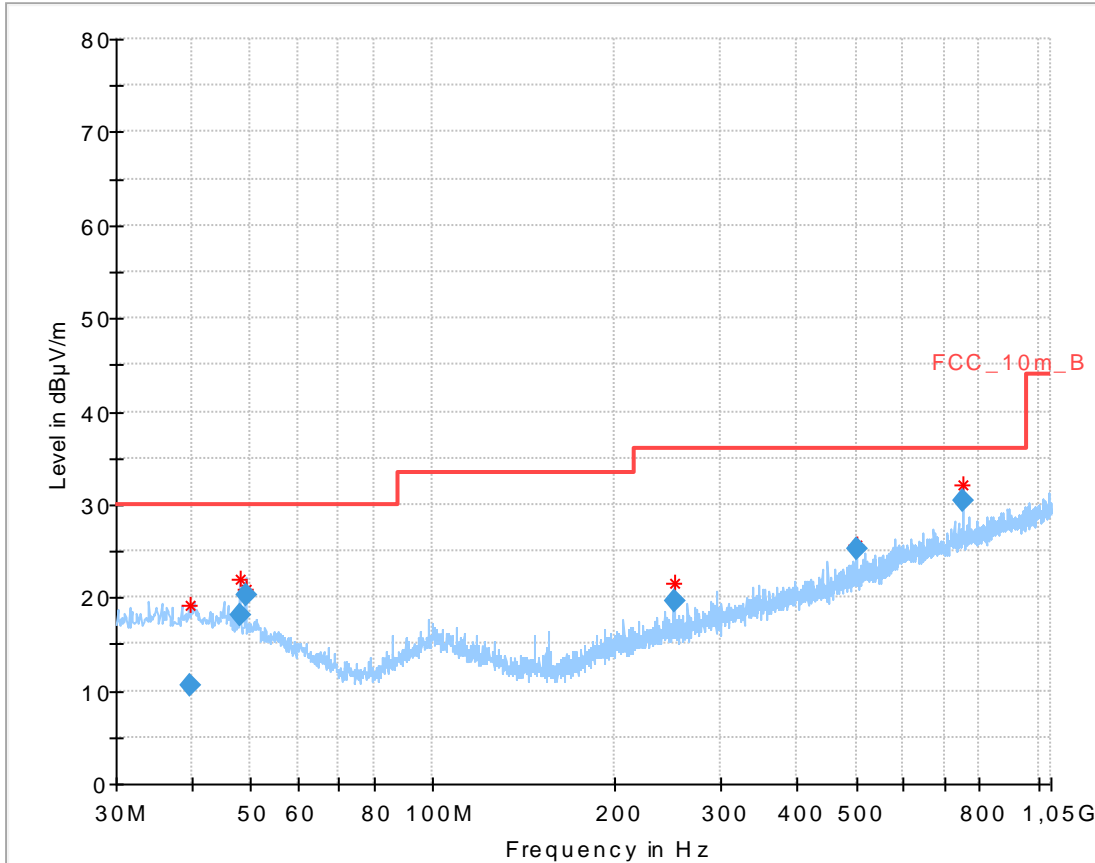


**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
49.150800	21.88	30.00	8.12	1000.0	120.000	101.0	V	97	12.8
117.001350	9.16	33.50	24.34	1000.0	120.000	101.0	V	254	10.4
250.010850	19.38	36.00	16.62	1000.0	120.000	98.0	V	215	13.4
500.014800	25.16	36.00	10.84	1000.0	120.000	170.0	H	55	18.7
750.050700	29.61	36.00	6.39	1000.0	120.000	101.0	H	254	22.7
927.801300	21.08	36.00	14.92	1000.0	120.000	101.0	V	186	24.2

**Plot:** OFDM

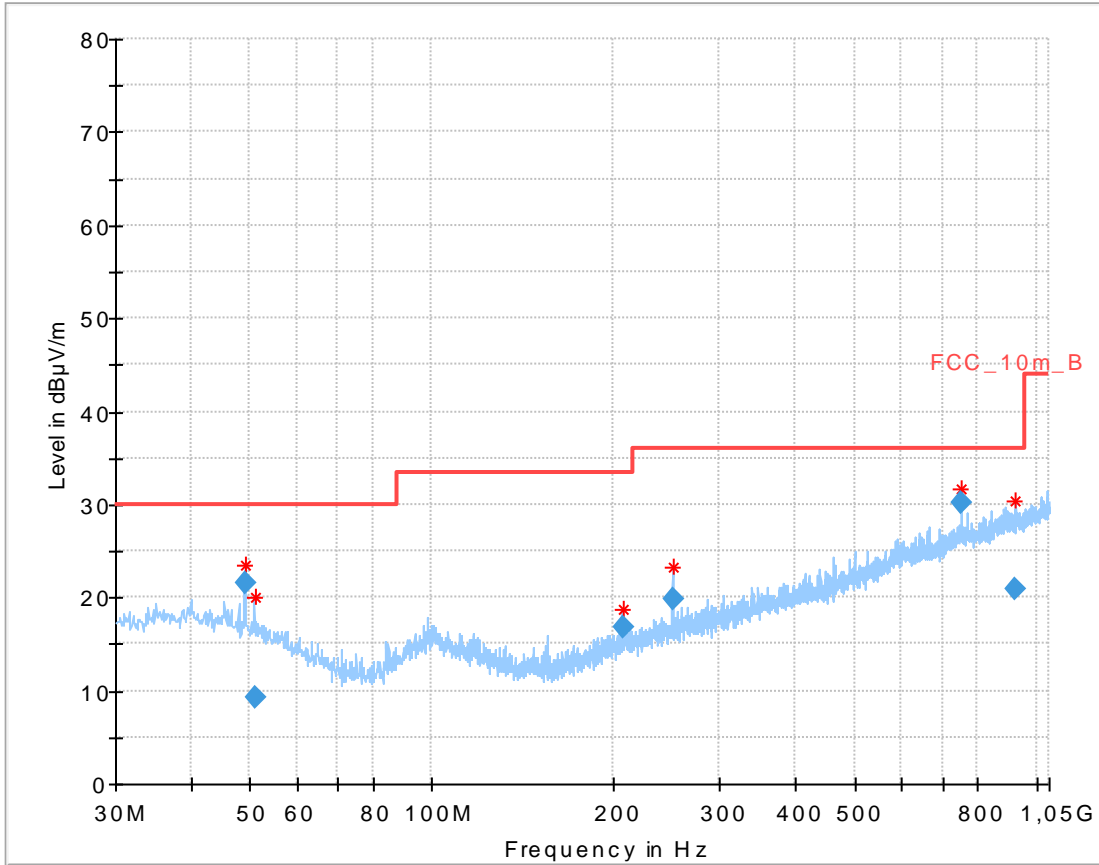
**Plot 1:** 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



**Final Result**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.831150	10.58	30.00	19.42	1000.0	120.000	101.0	H	301	14.0
48.016350	18.16	30.00	11.84	1000.0	120.000	98.0	V	42	13.1
49.159500	20.37	30.00	9.63	1000.0	120.000	98.0	V	105	12.8
250.002600	19.61	36.00	16.39	1000.0	120.000	98.0	V	172	13.4
500.033100	25.13	36.00	10.87	1000.0	120.000	170.0	H	42	18.7
750.026700	30.48	36.00	5.52	1000.0	120.000	98.0	H	266	22.7

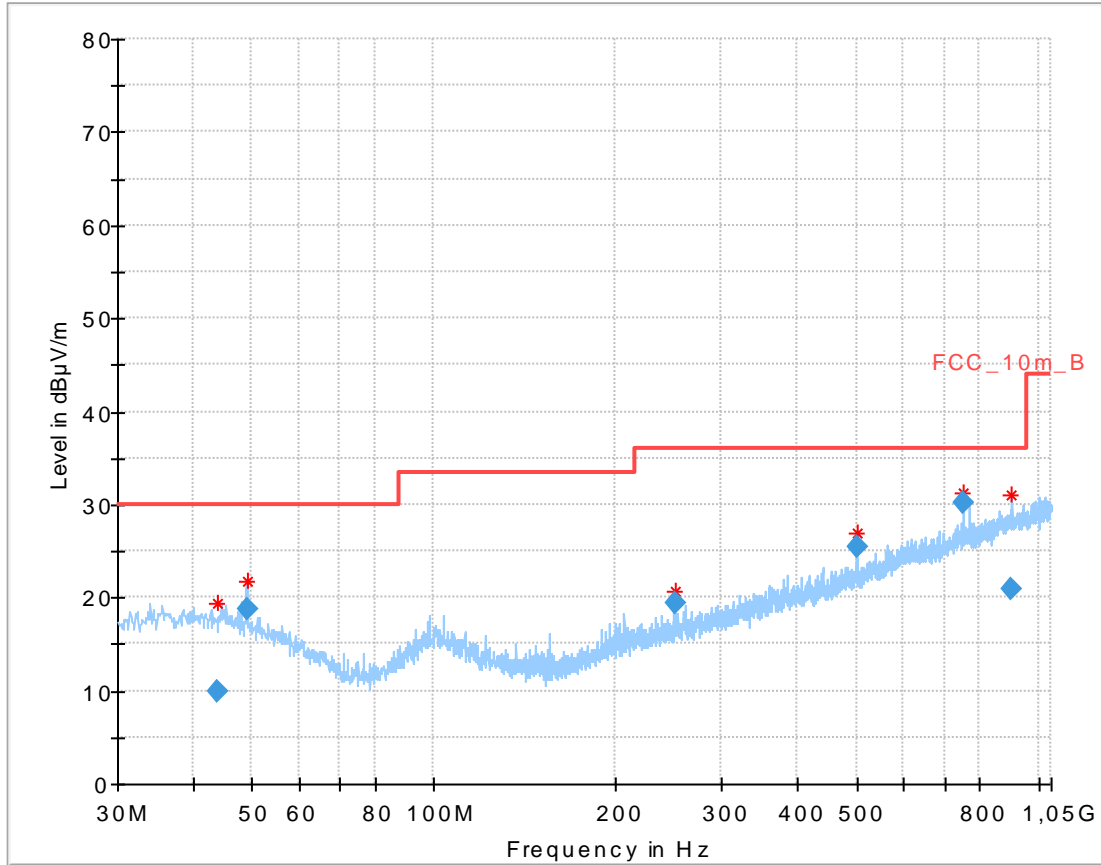
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
49.145100	21.65	30.00	8.35	1000.0	120.000	98.0	V	97	12.8
50.930400	9.30	30.00	20.70	1000.0	120.000	170.0	V	44	12.5
206.673900	16.85	33.50	16.65	1000.0	120.000	170.0	H	174	11.9
250.021200	19.74	36.00	16.26	1000.0	120.000	98.0	V	193	13.4
750.030300	30.17	36.00	5.83	1000.0	120.000	98.0	H	22	22.7
925.081050	20.95	36.00	15.05	1000.0	120.000	170.0	V	0	24.2

Plot 3: 30 MHz to 1 GHz, vertical & horizontal polarization, high channel

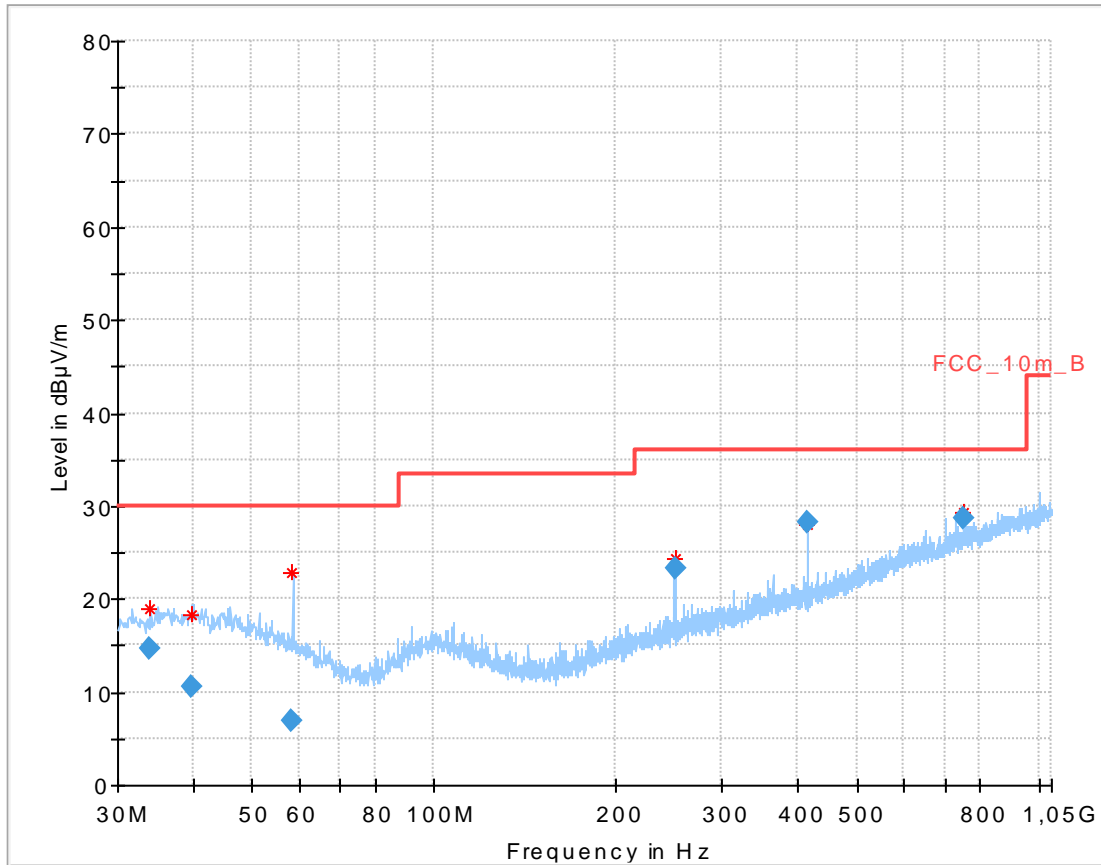


**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
44.019300	9.91	30.00	20.09	1000.0	120.000	101.0	V	131	13.9
49.126650	18.76	30.00	11.24	1000.0	120.000	101.0	V	131	12.8
250.019700	19.48	36.00	16.52	1000.0	120.000	98.0	V	202	13.4
500.021550	25.55	36.00	10.45	1000.0	120.000	170.0	H	33	18.7
750.024300	30.27	36.00	5.73	1000.0	120.000	98.0	H	272	22.7
904.957200	20.99	36.00	15.01	1000.0	120.000	98.0	V	104	24.1

**Plot:** RX / Idle mode

**Plot 1:** 30 MHz to 1 GHz, vertical & horizontal polarization



**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	PoI	Azimuth (deg)	Corr. (dB)
34.006950	14.59	30.00	15.41	1000.0	120.000	101.0	V	7	13.7
39.648750	10.61	30.00	19.39	1000.0	120.000	101.0	V	25	14.0
58.230900	6.89	30.00	23.11	1000.0	120.000	101.0	V	56	11.0
250.007700	23.22	36.00	12.78	1000.0	120.000	98.0	V	164	13.4
415.008600	28.19	36.00	7.81	1000.0	120.000	170.0	H	49	17.1
750.042900	28.68	36.00	7.32	1000.0	120.000	98.0	H	270	22.7

**10.7 Spurious emissions radiated above 1 GHz**

**Description:**

Measurement of the radiated spurious emissions above 1 GHz in transmit mode and receiver / idle mode.

**Measurement:**

Measurement parameter	
Detector:	Peak / RMS
Sweep time:	Auto
Resolution bandwidth:	F > 1 GHz: 1 MHz
Video bandwidth:	3 x RBW
Span:	1 GHz to 26 GHz
Trace-Mode:	Max Hold
Measured Modulation	<input checked="" type="checkbox"/> DSSS b – mode <input type="checkbox"/> OFDM g – mode <input checked="" type="checkbox"/> OFDM n HT20 – mode <input type="checkbox"/> OFDM n HT40 – mode <input checked="" type="checkbox"/> RX / Idle – mode

**Limits:**

FCC	IC	
TX Spurious Emissions Radiated		
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, 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 (MHz)	Field Strength (dBµV/m)	Measurement distance
Above 960	54.0	3

**Results:** DSSS

TX Spurious Emissions Radiated [dB $\mu$ V/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	Peak			Peak			Peak	
	AVG			AVG			AVG	
	Peak			Peak			Peak	
	AVG			AVG			AVG	
Measurement uncertainty			± 3 dB					

**Verdict:** [complies](#)

**Results:** OFDM

TX Spurious Emissions Radiated [dB $\mu$ V/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	Peak			Peak			Peak	
	AVG			AVG			AVG	
	Peak			Peak			Peak	
	AVG			AVG			AVG	
Measurement uncertainty			± 3 dB					

**Verdict:** [complies](#)

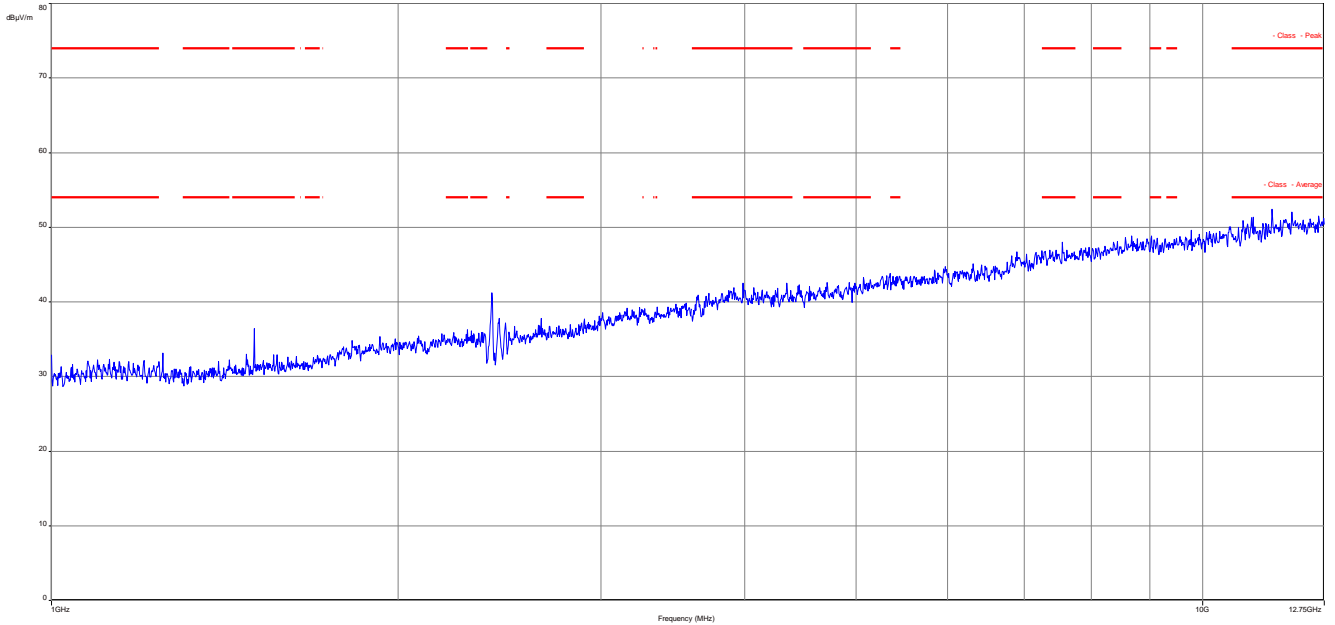
**Results:** RX / idle – mode

TX Spurious Emissions Radiated [dB $\mu$ V/m]		
F [MHz]	Detector	Level [dB $\mu$ V/m]
All detected emissions are more than 20 dB below the limit.		
	Peak	
	AVG	
	Peak	
	AVG	
Measurement uncertainty ± 3 dB		

**Verdict:** [complies](#)

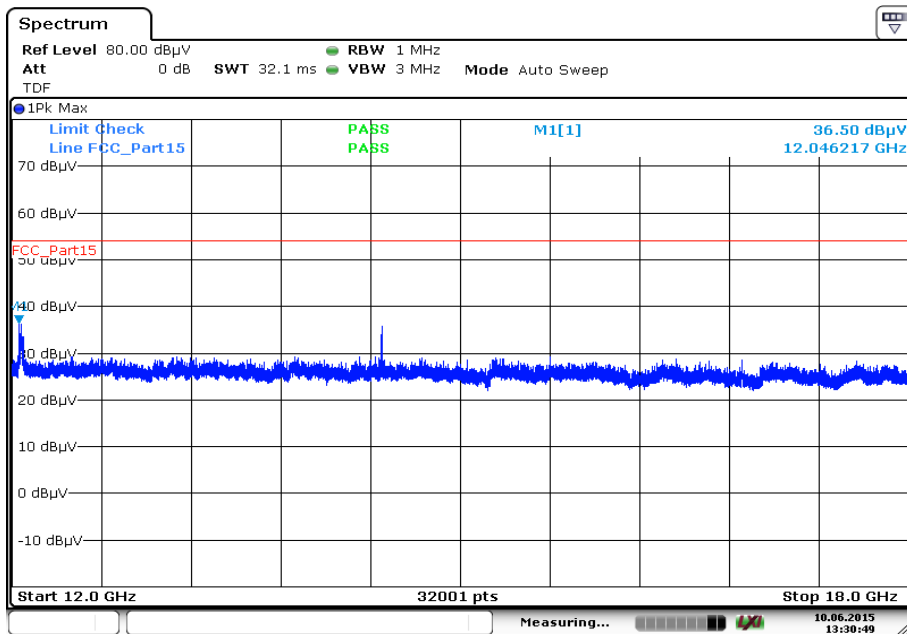
**Plots:** DSSS

**Plot 1:** Lowest channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

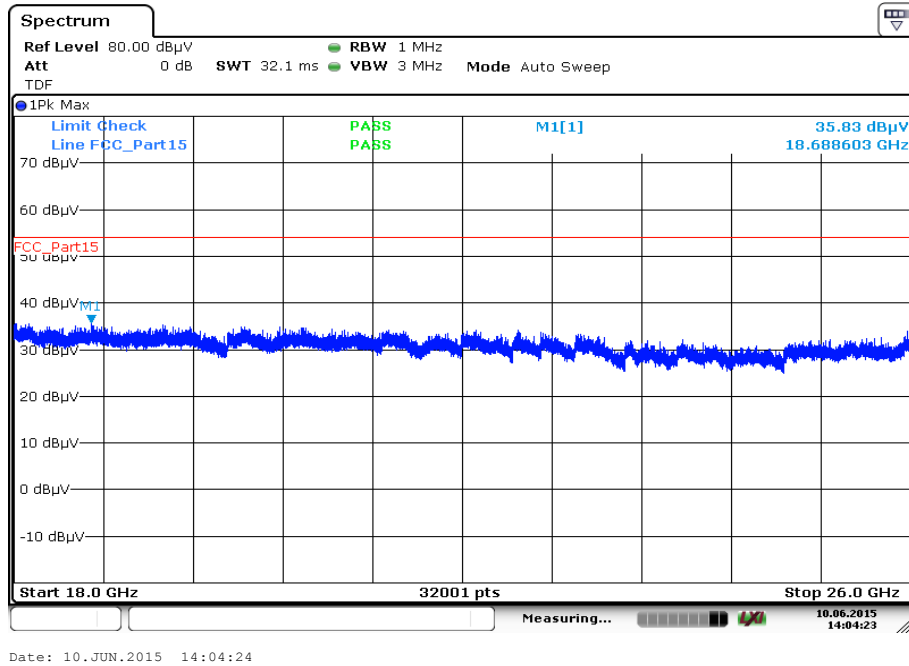
**Plot 2:** Lowest channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



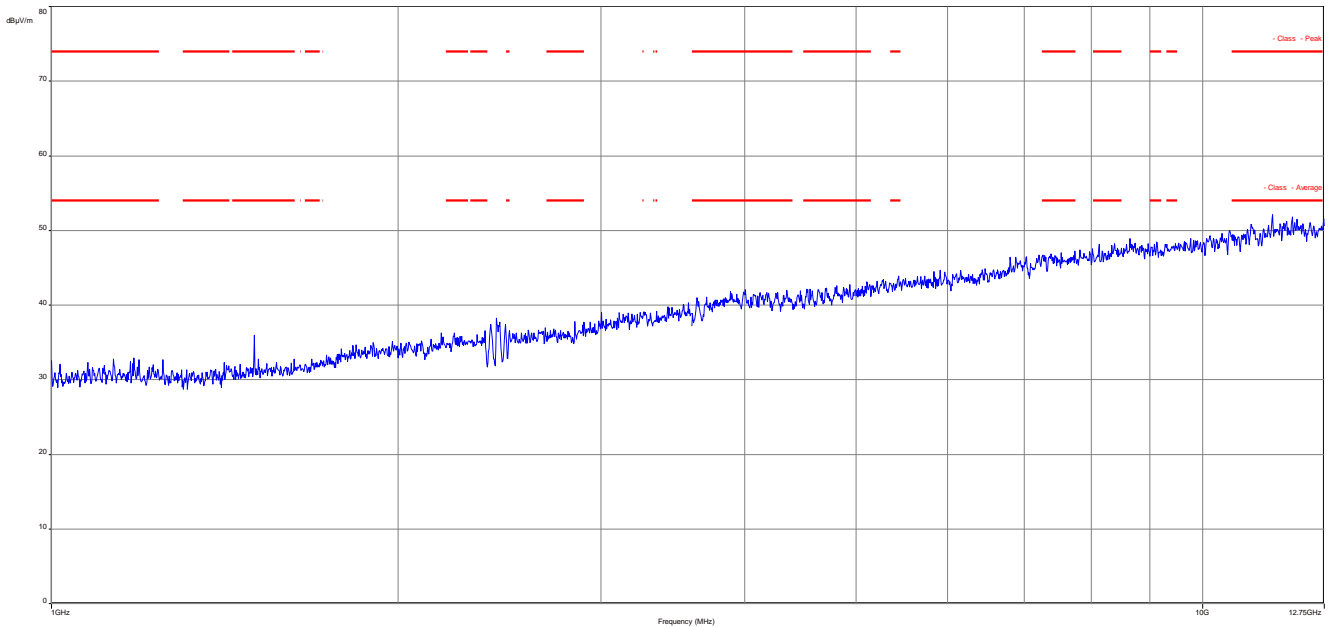
Date: 10. JUN. 2015 13:30:49



Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

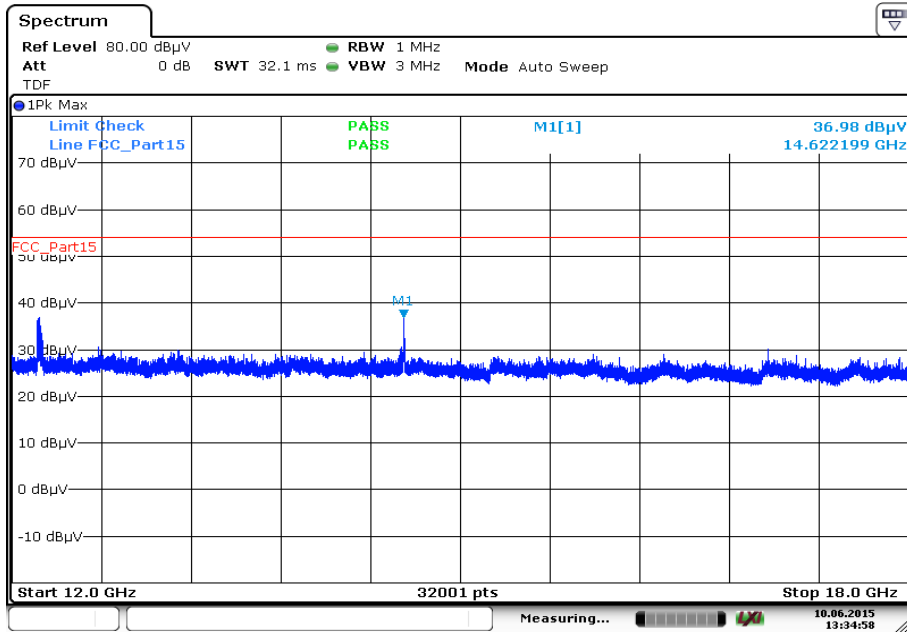


Plot 4: Middle channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



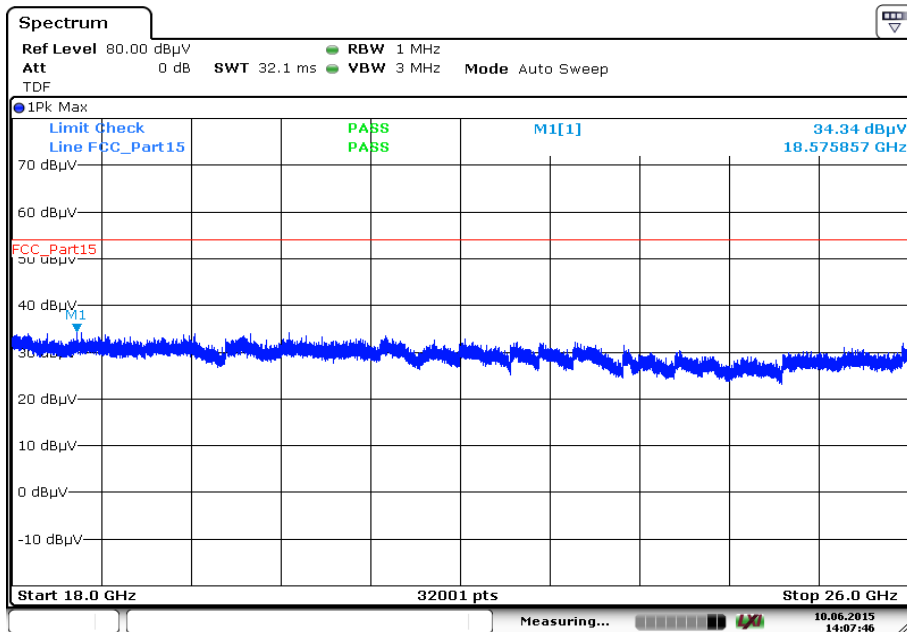
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



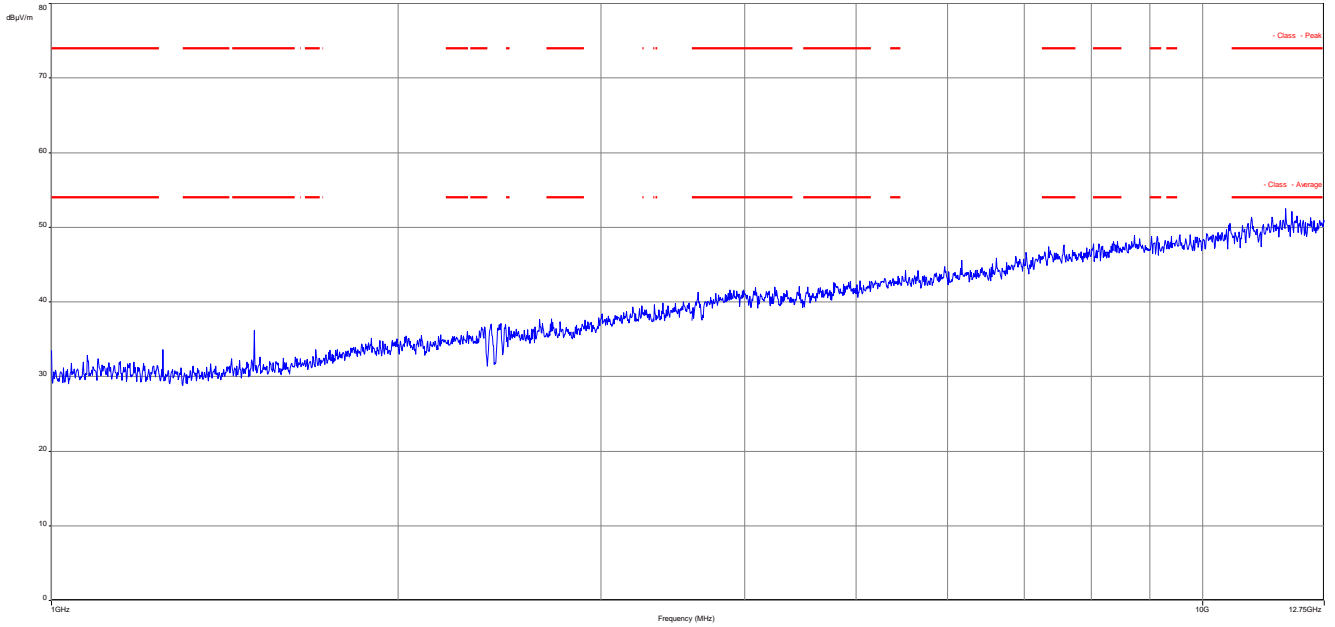
Date: 10.JUN.2015 13:34:59

Plot 6: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization



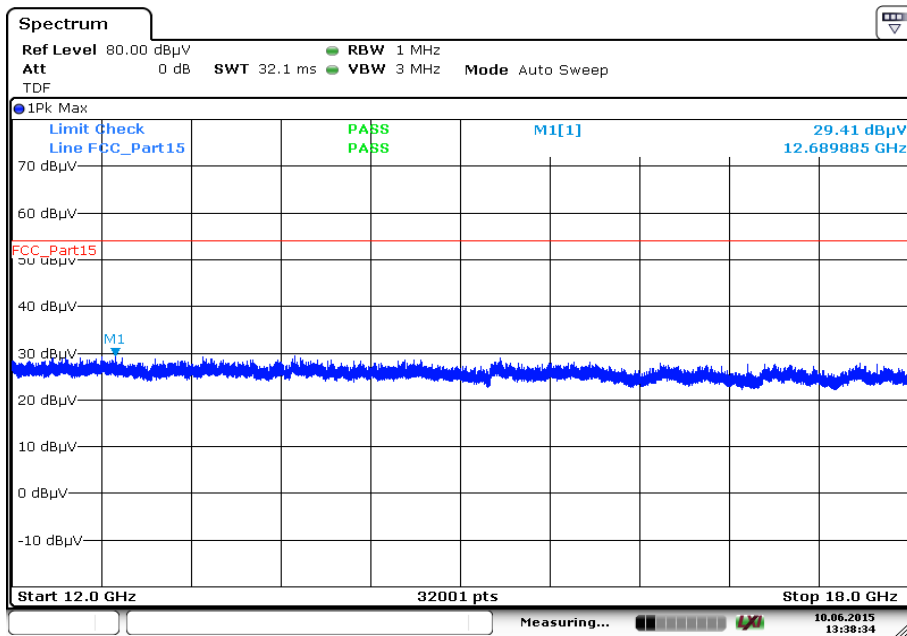
Date: 10.JUN.2015 14:07:46

**Plot 7:** Highest channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



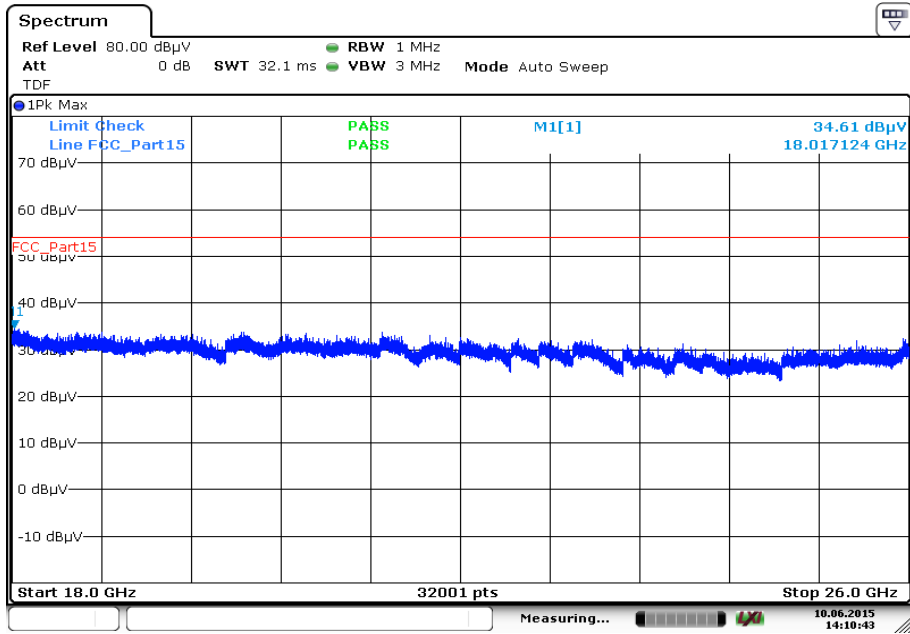
The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 8:** Highest channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



Date: 10. JUN. 2015 13:38:34

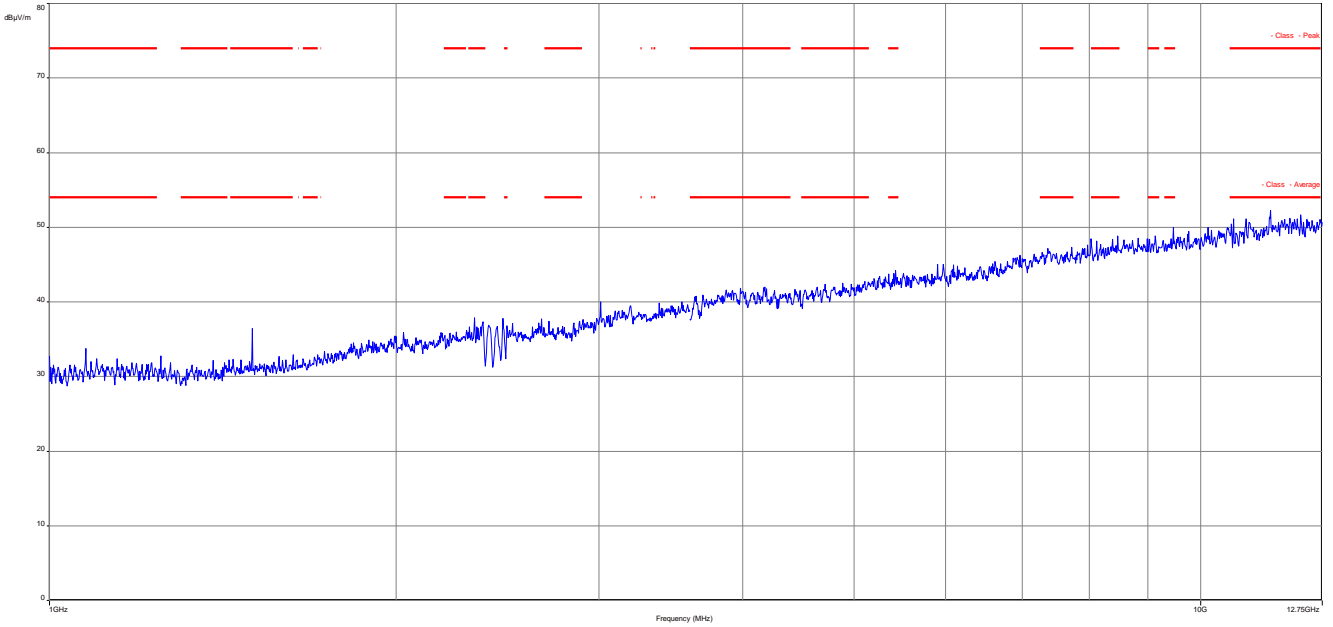
Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 10.JUN.2015 14:10:43

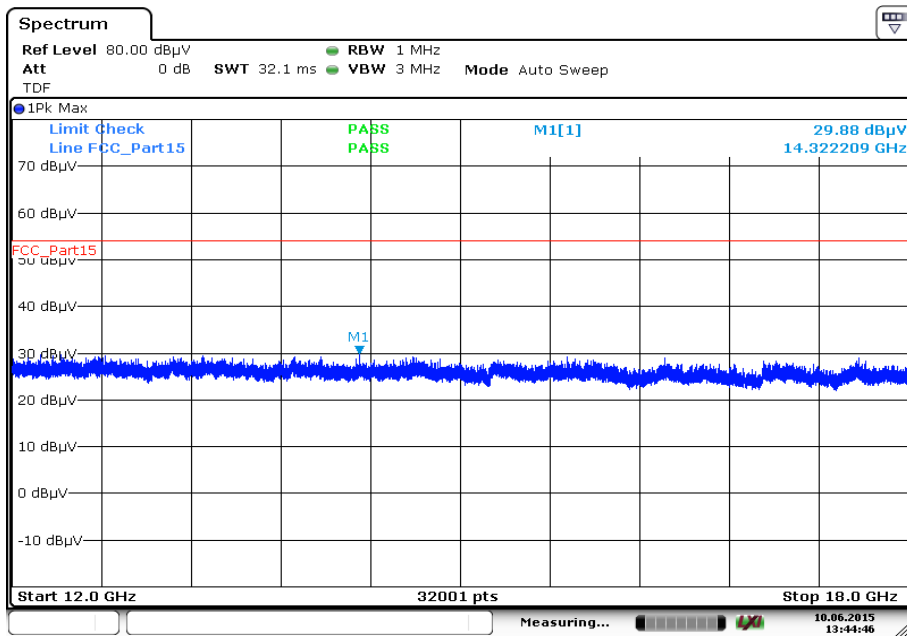
**Plots:** OFDM

**Plot 1:** Lowest channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



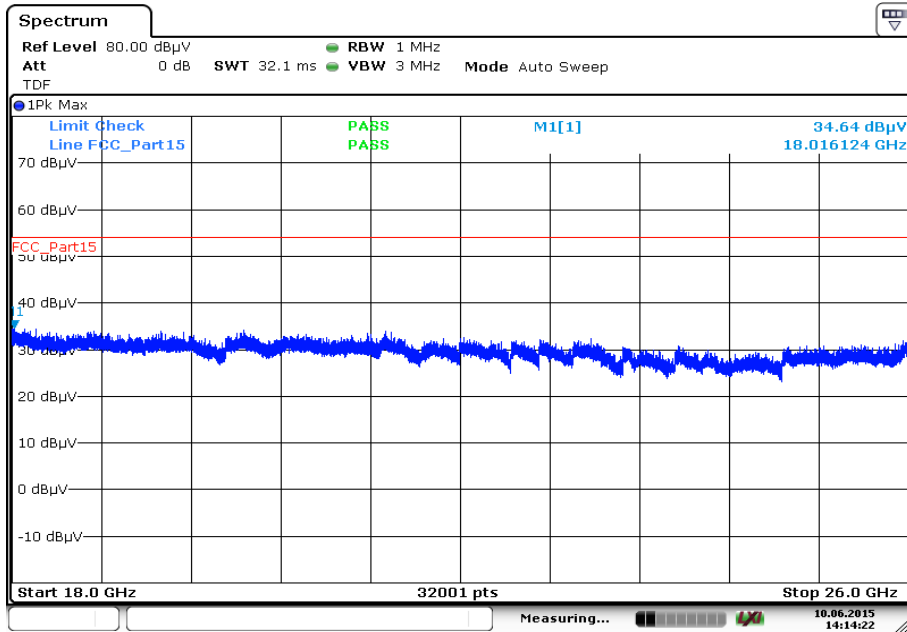
The carrier signal is notched with a 2.4 GHz band rejection filter.

**Plot 2:** Lowest channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



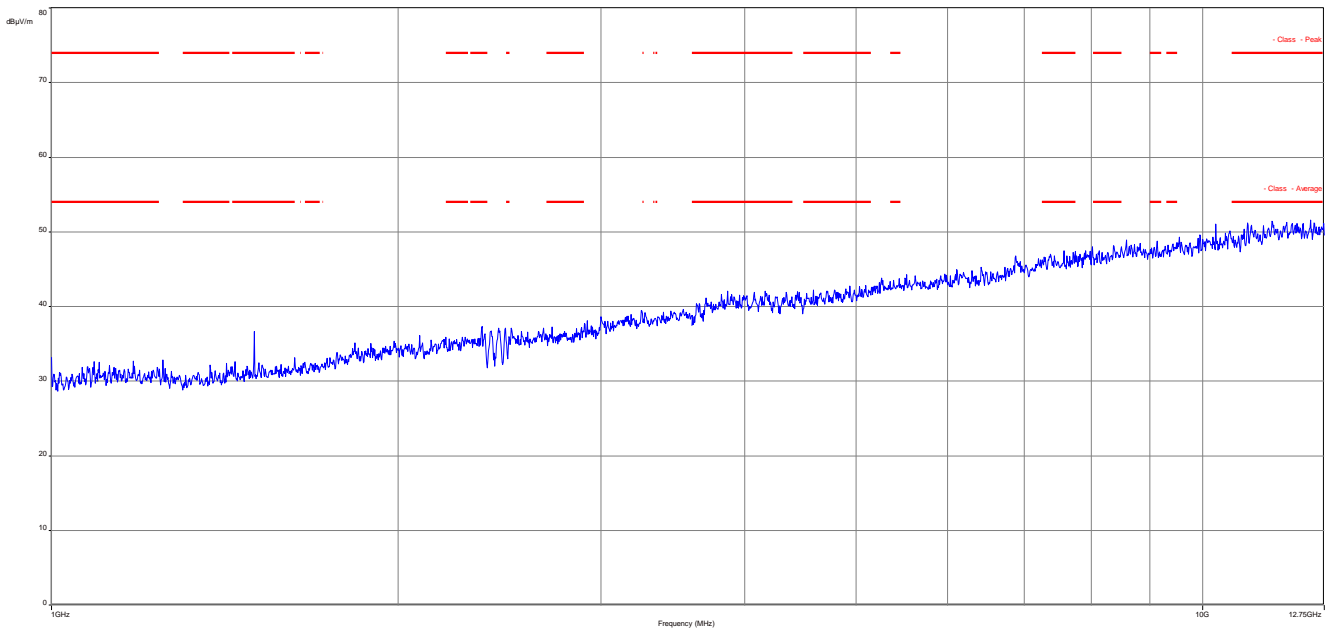
Date: 10.JUN.2015 13:44:46

**Plot 3:** Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



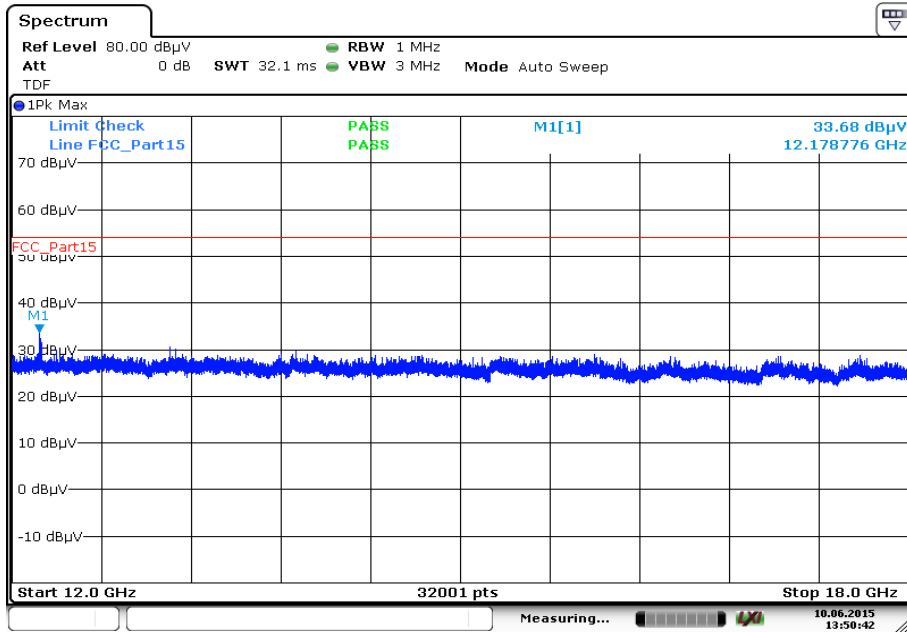
Date: 10.JUN.2015 14:14:22

**Plot 4:** Middle channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



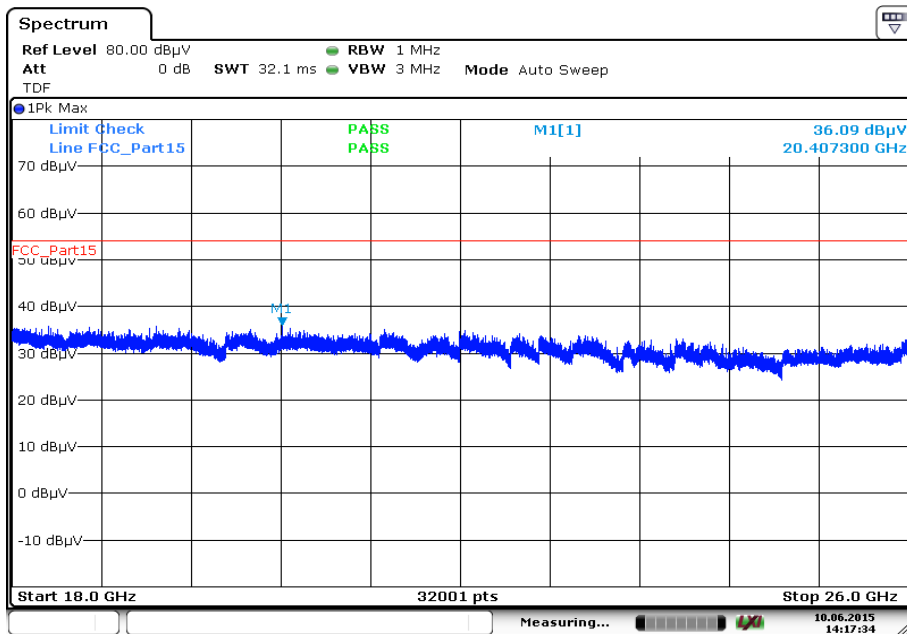
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



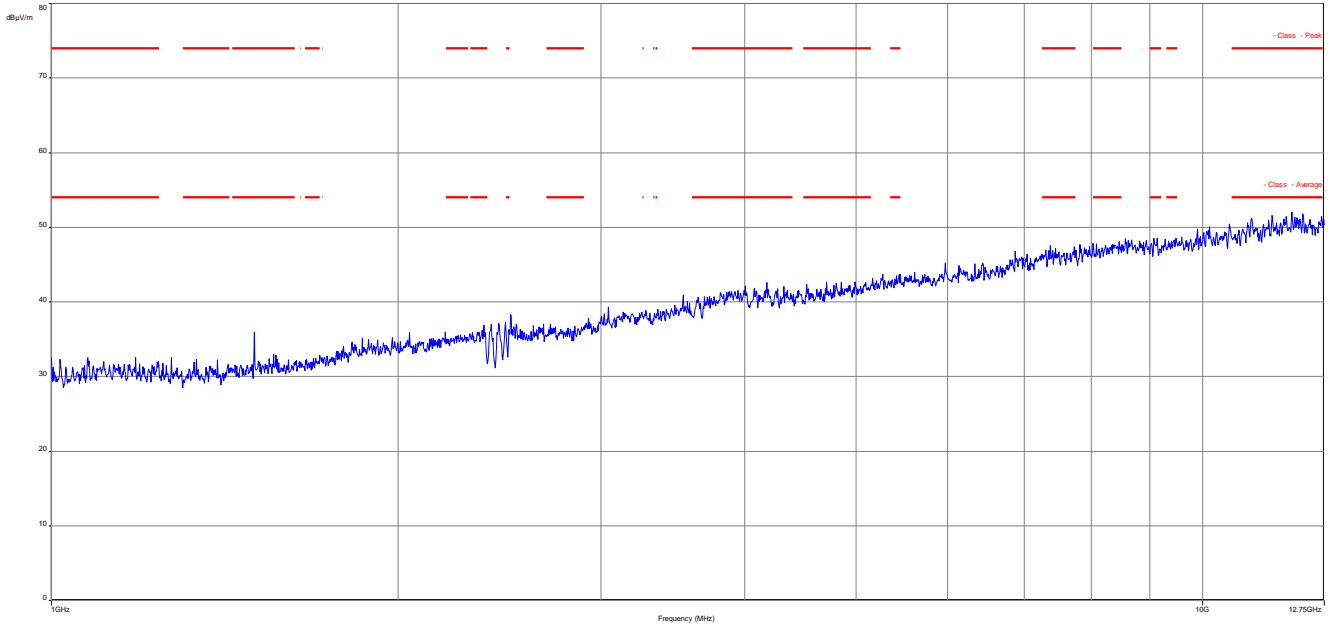
Date: 10.JUN.2015 13:50:42

Plot 6: Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization



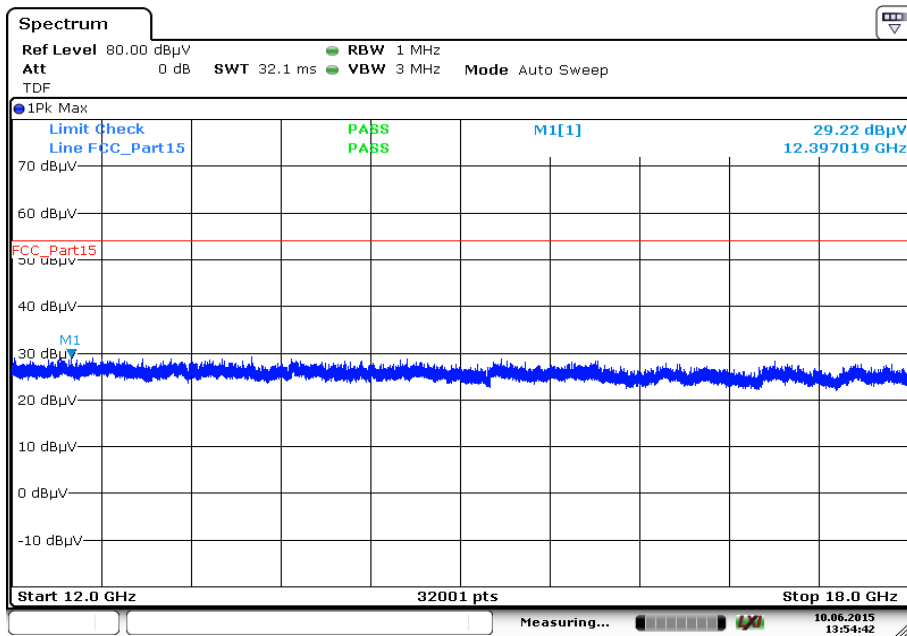
Date: 10.JUN.2015 14:17:35

**Plot 7:** Highest channel, 1 GHz to 12.75 GHz, vertical & horizontal polarization



The carrier signal is notched with a 2.4 GHz band rejection filter.

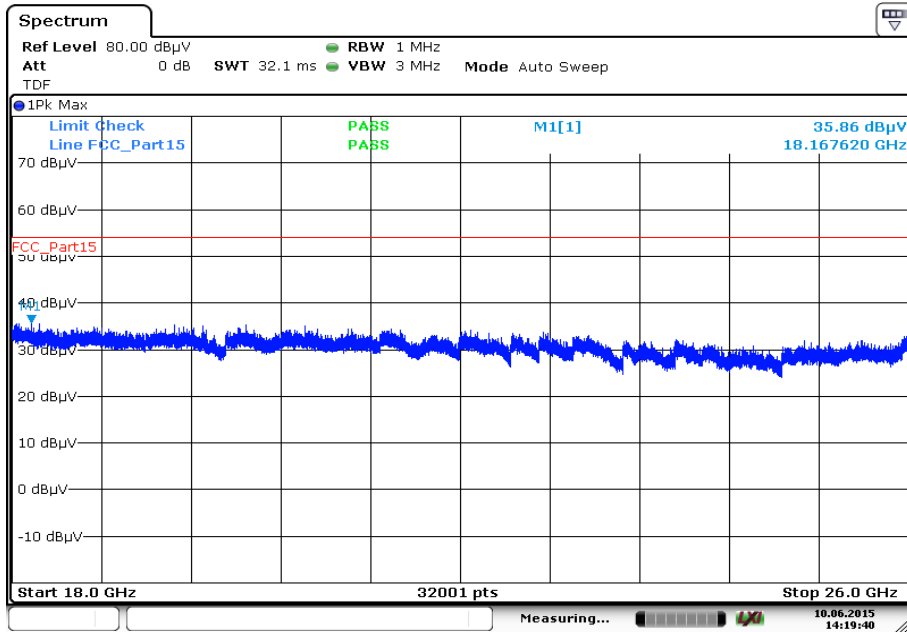
**Plot 8:** Highest channel, 12.75 GHz to 18 GHz, vertical & horizontal polarization



Date: 10.JUN.2015 13:54:43



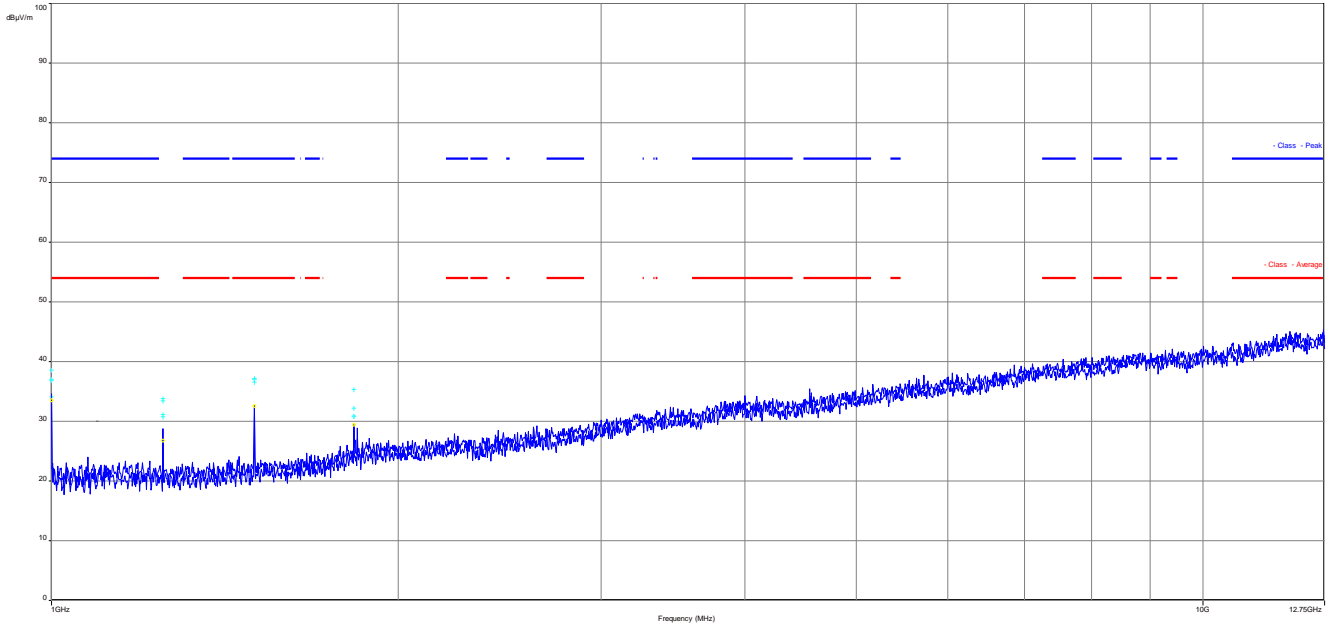
Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



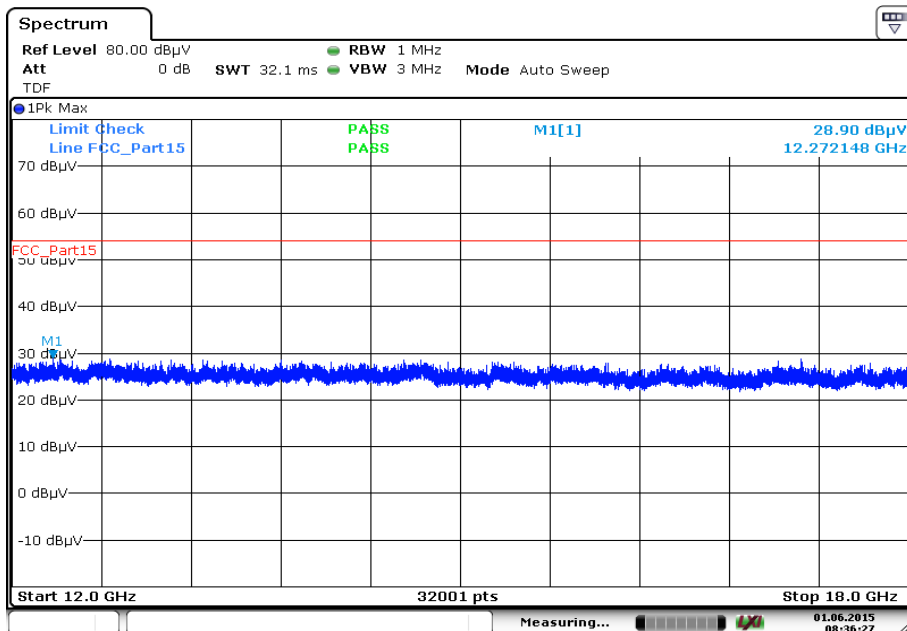
Date: 10.JUN.2015 14:19:41

**Plots:** RS / idle – mode

**Plot 1:** 1 GHz to 12.75 GHz, vertical & horizontal polarization

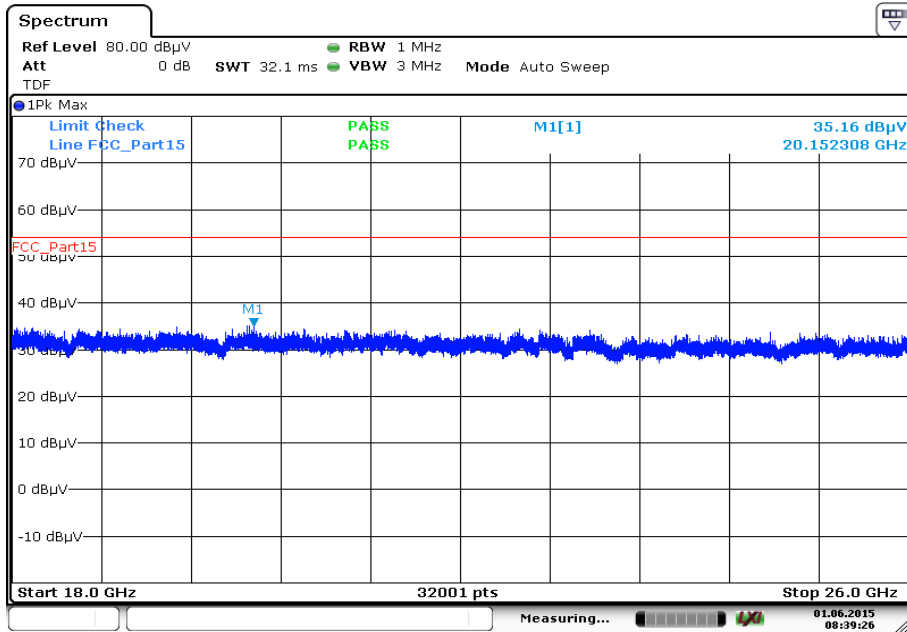


**Plot 2:** 12.75 GHz to 18 GHz, vertical & horizontal polarization



Date: 1.JUN.2015 08:36:28

Plot 3: 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 1.JUN.2015 08:39:26

**10.8 Spurious emissions conducted below 30 MHz (AC conducted)**

**Description:**

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to channel 6. This measurement is repeated for DSSS and OFDM modulation. If peaks are found channel 1 and channel 11 will be measured too. The measurement is performed with the data rate producing the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

**Measurement:**

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

**Limits:**

FCC		IC
TX Spurious Emissions Conducted < 30 MHz		
Frequency (MHz)	Quasi-Peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

\*Decreases with the logarithm of the frequency

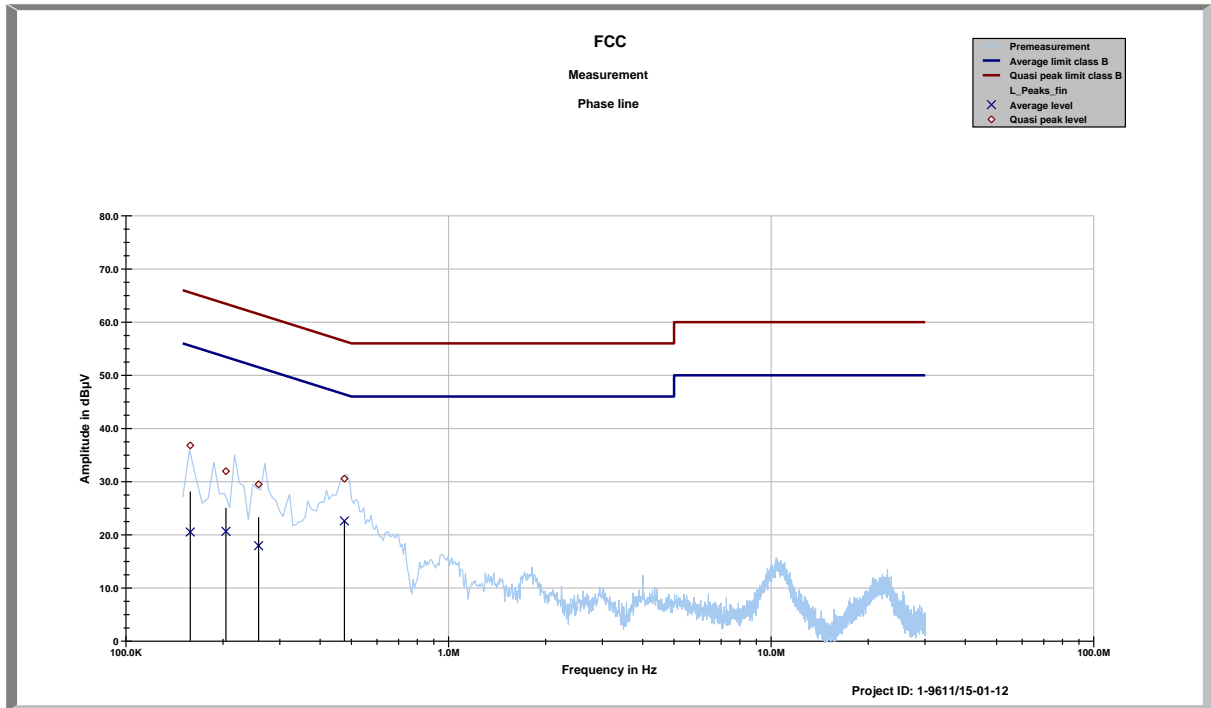
**Results:**

TX Spurious Emissions Conducted < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		
Measurement uncertainty	± 3 dB	

**Verdict:** complies

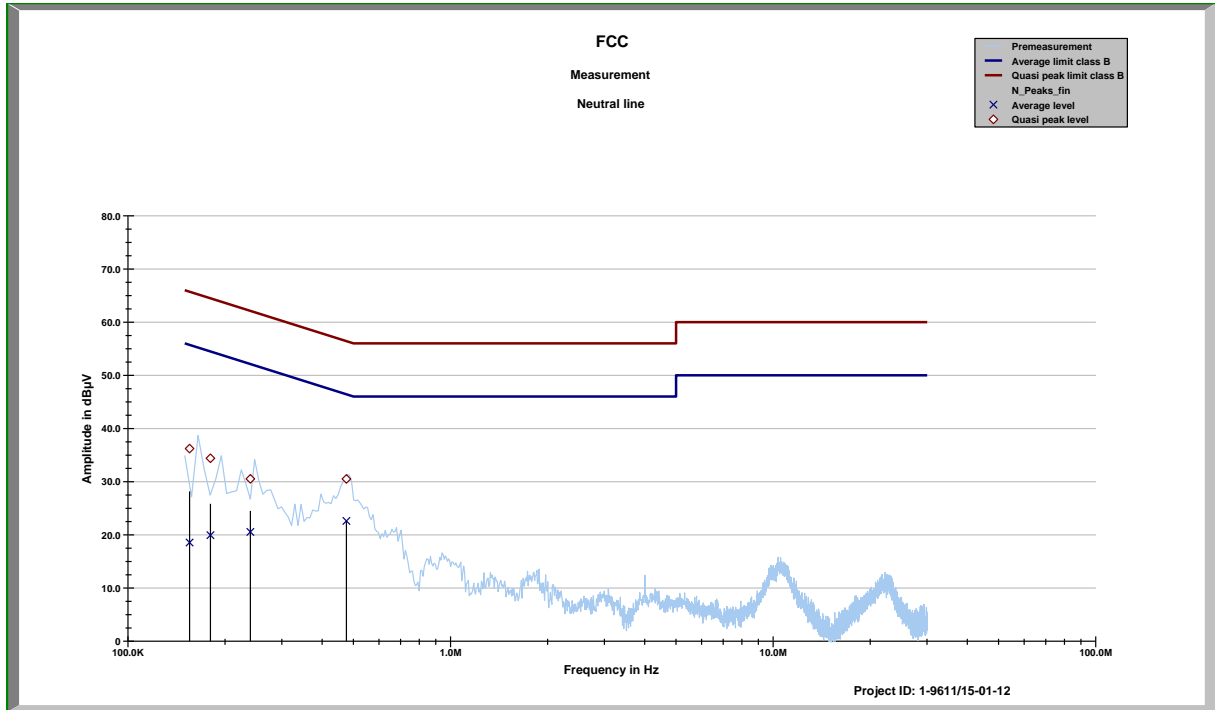
**Plots:**

**Plot 1:** 150 kHz to 30 MHz, phase line



Frequency MHz	Quasi peak level dBµV	Margin quasi peak dBµV	Average level dBµV	Margin average dBµV
0.15834	36.81	28.74	20.53	35.23
0.20414	31.97	31.47	20.66	33.80
0.25777	29.50	32.00	17.95	34.97
0.47553	30.56	25.85	22.62	24.08

Plot 2: 150 kHz to 30 MHz, neutral line



Frequency MHz	Quasi peak level dBµV	Margin quasi peak dBµV	Average level dBµV	Margin average dBµV
0.15532	36.22	29.49	18.55	37.30
0.18018	34.39	30.09	19.93	35.21
0.23959	30.52	31.59	20.54	32.90
0.47546	30.51	25.90	22.61	24.09

## 11 Observations

No observations except those reported with the single test cases have been made.

## Annex A Document history

Version	Applied changes	Date of release
	Initial release	2015-06-30
A	OBW measurements added	2015-07-21

## Annex B Further information

### Glossary

AVG	-	Average
DUT	-	Device under test
EMC	-	Electromagnetic Compatibility
EN	-	European Standard
EUT	-	Equipment under test
ETSI	-	European Telecommunications Standard Institute
FCC	-	Federal Communication Commission
FCC ID	-	Company Identifier at FCC
HW	-	Hardware
IC	-	Industry Canada
Inv. No.	-	Inventory number
N/A	-	Not applicable
PP	-	Positive peak
QP	-	Quasi peak
S/N	-	Serial number
SW	-	Software
PMN		Product marketing name
HMN		Host marketing name
HVIN		Hardware version identification number
FVIN		Firmware version identification number

## Annex C Accreditation Certificate

Front side of certificate

Back side of certificate



Deutsche Akkreditierungsstelle GmbH

Befehlener gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV  
 Unterzeichnerin der Multilateralen Abkommen  
 von EA, ILAC und IAF zur gegenseitigen Anerkennung

**Akkreditierung**



Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

**CETECOM ICT Services GmbH**  
 Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

- Drahtgebundene Kommunikation einschließlich xDSL
- VofP und DECT
- Akustik
- Funk einschließlich WLAN
- Short Range Devices (SRD)
- RFID
- WiMax und Richtfunk
- Mobilfunk (GSM / DCS, Over the Air (OTA) Performance)
- Elektromagnetische Verträglichkeit (EMV) einschließlich Automotive
- Produktsicherheit
- SAR und Hearing Aid Compatibility (HAC)
- Umweltsimulation
- Smart Card Terminals
- Bluetooth
- Wi-Fi-Services

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 07.03.2014 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 77 Seiten.

Registrierungsnummer der Urkunde: D-PL-12076-01-00

Frankfurt am Main, 07.03.2014  
 Datum des Bescheides

Dr. Ingrid Dill - B. V. M. H. Wagner  
 stellv. Präsidentin

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**Note:**

The current certificate including annex is published on our website (see link below) or may be received from CETECOM ICT Services on request.

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