

## TEST REPORT

Test report no.: 1-1889/16-01-09



Deutsche  
Akkreditierungsstelle  
D-PL-12076-01-01

### Testing laboratory

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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-12076-01-01

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### Manufacturer

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### Test standard/s

47 CFR Part 15

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

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

### Test Item

Kind of test item: Digital Back

Model name: S 30i45

FCC ID: 2AJ8SS3045

Frequency: DTS band 2400 MHz to 2483.5 MHz

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

Antenna: Integrated PCB antenna

Power supply: 7.3 V DC by Li-Ion battery

Temperature range: 0°C to +45°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 authorized:



Marco Bertolino  
Lab Manager  
Radio Communications & EMC

### Test performed:



p.o.  
Andreas Luckenbill  
Lab Manager  
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## 1 Table of contents

1	Table of contents .....	2
2	General information .....	3
2.1	Notes and disclaimer .....	3
2.2	Application details .....	3
3	Test standard/s and references .....	3
4	Test environment .....	4
5	Test item .....	4
5.1	General description .....	4
5.2	Additional information .....	4
6	Test laboratories sub-contracted .....	4
7	Description of the test setup .....	5
7.1	Shielded semi anechoic chamber .....	6
7.2	Shielded fully anechoic chamber .....	7
7.3	Radiated measurements > 18 GHz .....	8
7.4	Conducted measurements .....	9
8	Sequence of testing .....	10
8.1	Sequence of testing radiated spurious 9 kHz to 30 MHz .....	10
8.2	Sequence of testing radiated spurious 30 MHz to 1 GHz .....	11
8.3	Sequence of testing radiated spurious 1 GHz to 18 GHz .....	12
8.4	Sequence of testing radiated spurious above 18 GHz .....	13
9	Measurement uncertainty .....	14
10	Summary of measurement results .....	15
11	Additional comments .....	16
12	Measurement results .....	18
12.1	Antenna gain .....	18
12.2	Identify worst case data rate .....	20
12.3	Maximum output power .....	21
12.4	Duty cycle .....	22
12.5	Peak power spectral density .....	29
12.6	6 dB DTS bandwidth .....	36
12.7	Occupied bandwidth – 99% emission bandwidth .....	43
12.8	Occupied bandwidth – 20 dB bandwidth .....	50
12.9	Band edge compliance conducted .....	57
12.10	Spurious emissions conducted .....	61
12.11	Spurious emissions radiated below 30 MHz .....	73
12.12	Spurious emissions radiated 30 MHz to 1 GHz .....	78
12.13	Spurious emissions radiated above 1 GHz .....	86
13	Observations .....	102
Annex A	Document history .....	102
Annex B	Further information .....	102
Annex C	Accreditation Certificate .....	103

## 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.

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

### 2.2 Application details

Date of receipt of order:	2016-06-01
Date of receipt of test item:	2016-11-07
Start of test:	2016-11-07
End of test:	2016-11-10
Person(s) present during the test:	-/-

## 3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 15	-/-	Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

Guidance	Version	Description
DTS: KDB 558074 D01	v03r05	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.4-2014	-/-	American national standard for methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American national standard of procedures for compliance testing of unlicensed wireless devices

## 4 Test environment

Temperature	:	$T_{nom}$ $T_{max}$ $T_{min}$	+22 °C during room temperature tests No tests under extreme conditions required. No tests under extreme conditions required.
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	$V_{nom}$ $V_{max}$ $V_{min}$	7.3 V DC by Li-Ion battery No tests under extreme conditions required. No tests under extreme conditions required.

## 5 Test item

### 5.1 General description

Kind of test item	:	Digital Back
Type identification	:	S 30i45
S/N serial number	:	Radiated unit: 380101 Conducted unit: Unit 3
HW hardware status	:	None
SW software status	:	None
FW firmware status	:	Frederiksberg-0.0.0.43-13dbm.FWS
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	:	(D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM
Number of channels	:	11
Antenna	:	Integrated PCB antenna
Power supply	:	7.3 V DC by Li-Ion battery
Temperature range	:	0°C to +45°C

### 5.2 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:

1-1889/16-01-01\_AnnexA  
 1-1889/16-01-01\_AnnexB  
 1-1889/16-01-01\_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 signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

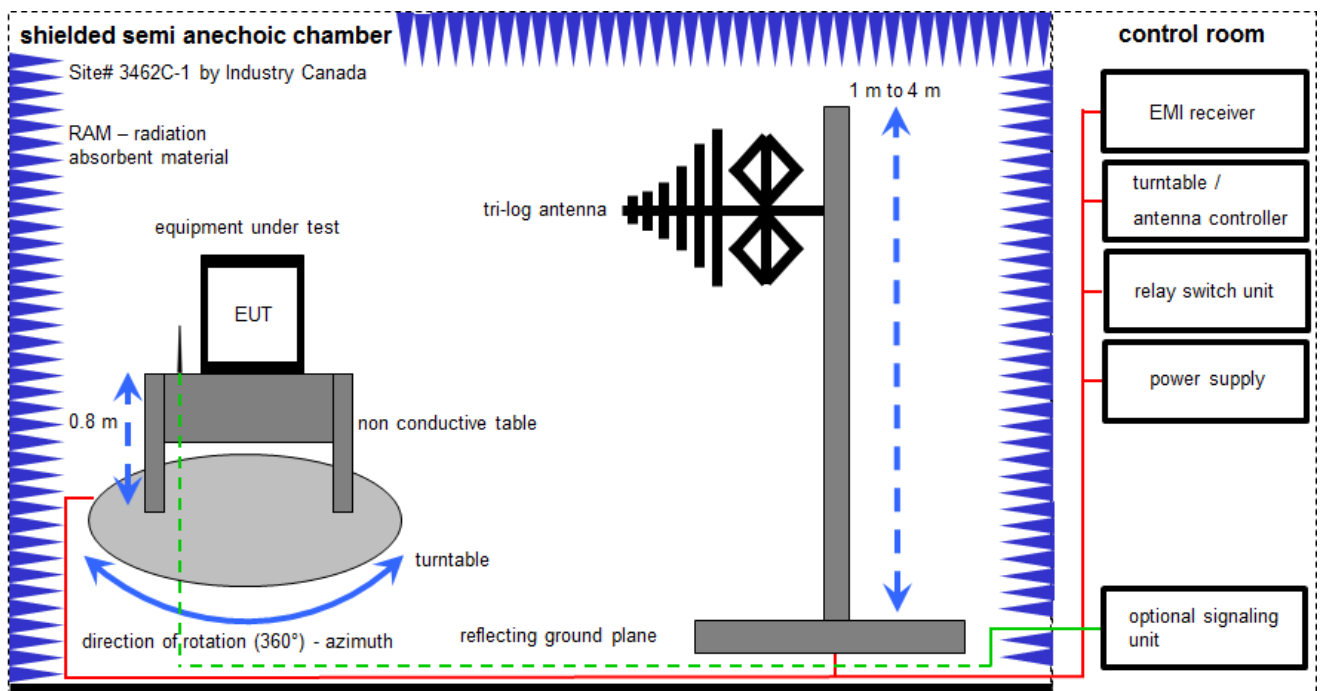
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**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
vlk!	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 analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

$$FS = UR + CL + AF$$

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

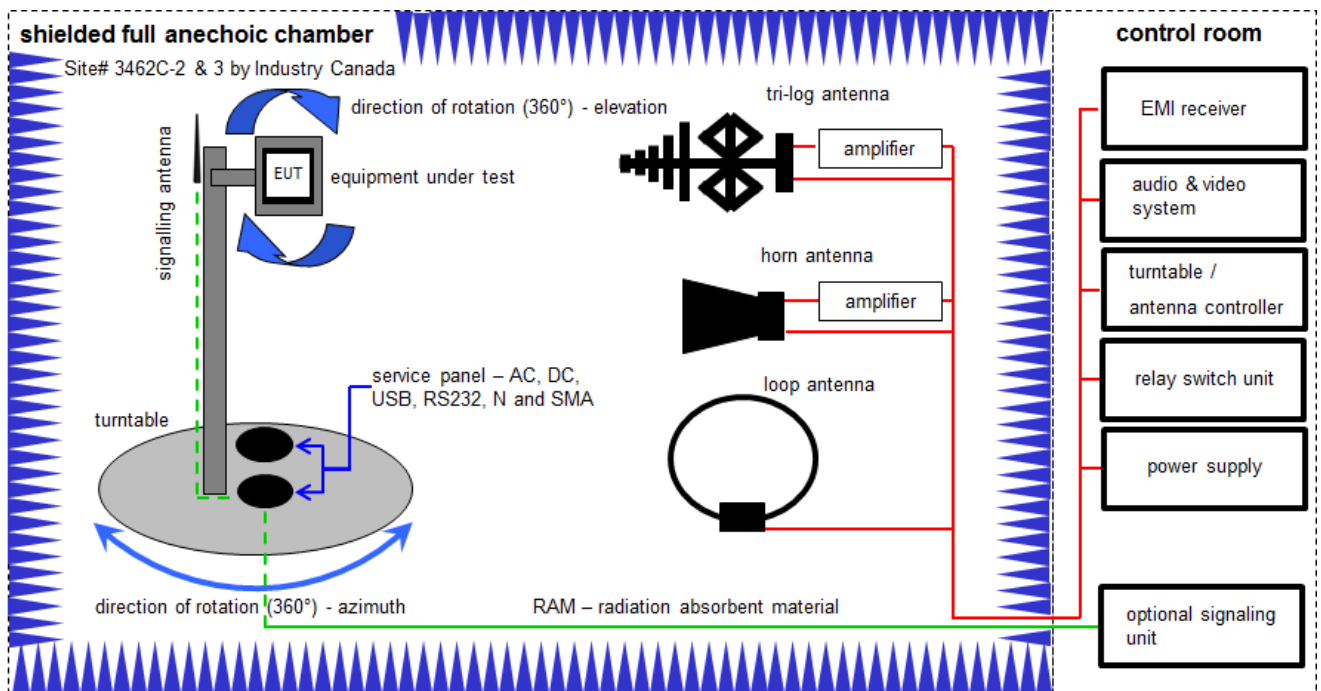
Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	08.03.2016	08.03.2017
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	25.04.2016	25.04.2018

## 7.2 Shielded fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter / 1 meter

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

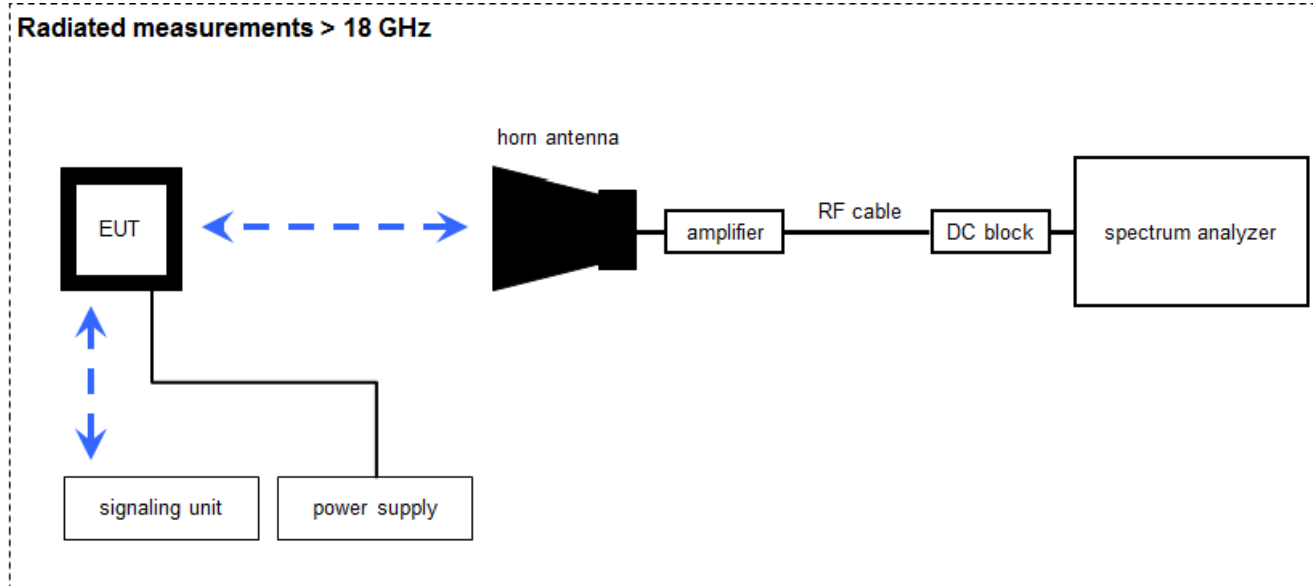
Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A, B, C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	A, B, C	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
3	A	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
4	B	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne	-/-	-/-
5	B	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
6	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
7	B	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vKI!	29.10.2014	29.10.2017
8	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
9	A, B, C	EMI Test Receiver 9kHz-26.5GHz	ESR26	R&S	101376	300005063	k	13.09.2016	13.09.2018
10	B, C	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vKI!	20.05.2015	20.05.2017

### 7.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

$$FS = U_R + CA + AF$$

(FS-field strength;  $U_R$ -voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:

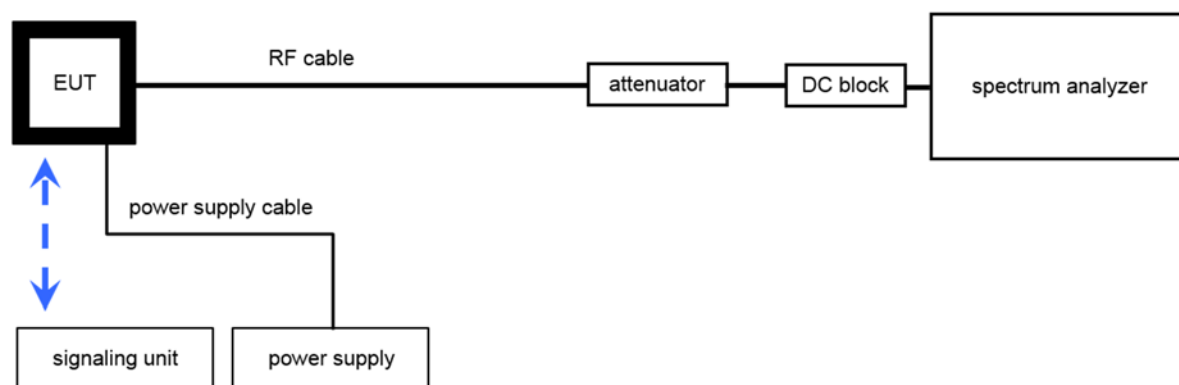
$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-60.1) \text{ [dB]} + 36.74 \text{ [dB/m]} = 16.64 \text{ [dB}\mu\text{V/m]} \text{ (6.79 } \mu\text{V/m)}$$

#### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8402	300000486	k	10.09.2015	10.09.2017
2	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
3	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
4	A	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
5	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-

## 7.4 Conducted measurements

### Conducted measurements normal conditions



$$OP = AV + CA$$

(OP-output power; AV-analyzer value; CA-loss signal path)

#### Example calculation:

$$OP \text{ [dBm]} = 6.0 \text{ [dBm]} + 11.7 \text{ [dB]} = 17.7 \text{ [dBm]} \text{ (58.88 mW)}$$

#### Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
2	A	Switch / Control Unit	3488A	HP	2719A15013	300000151	ne	-/-	-/-
3	A	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	R&S	2V2403033A4523	300004589	ne	-/-	-/-
4	A	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A4523	300004590	ne	-/-	-/-
5	A	RF-Cable	ST18/SMAM/SMAM/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
6	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-
7	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	Batch no. 606844	400001186	ev	-/-	-/-
8	A	Power Sensor	NRP-Z81	R&S	100010	300003780	k	25.01.2016	25.01.2017

## 8 Sequence of testing

### 8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

## 8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position  $\pm 45^\circ$  and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

### 8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

#### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8.4 Sequence of testing radiated spurious above 18 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

### Premeasurement

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

### Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

**9 Measurement uncertainty**

Measurement uncertainty	
Test case	Uncertainty
Antenna gain	± 3 dB
Power spectral density	± 1.5 dB
DTS bandwidth	± 100 kHz (depends on the used RBW)
Occupied bandwidth	± 100 kHz (depends on the used RBW)
Maximum output power	± 1.5 dB
Detailed spurious emissions @ the band edge - conducted	± 1.5 dB
Band edge compliance radiated	± 3 dB
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

## 10 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input 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!	2016-11-22	-/-

Test specification clause	Test case	Guideline	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS - 247 / 5.4 (4)	Antenna gain	-/-	Nominal	Nominal	-/-	-/-				Declared
RSS - 247 / 6.0	Duty cycle	-/-	Nominal	Nominal	DSSS OFDM	-/-				-/-
§15.247(e) RSS - 247 / 5.2 (2)	Power spectral density	KDB 558074 DTS clause: 10.2	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(a)(2) RSS - 247 / 5.2 (1)	DTS bandwidth	KDB 558074 DTS clause: 8.1	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input 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"/>	-/-
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 9.1.2	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance conducted and radiated	KDB 558074 DTS clause: 13.3.2 and clause 12.2.2	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§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 checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input 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"/>	-/-
§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"/>	-/-
§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"/>	-/-
§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"/>	-/-
§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"/>	-/-
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Battery powered only!

**Note:** C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

## 11 Additional comments

Reference documents: Customer Questionnaire, Sinar Photography\_020516

Hollywood antenna datasheet

WLAN\_Debug\_Cases\_Frederiksberg\_2016-10\_27

Special test descriptions: Output power setting 13 dBm used for all modes

Configuration descriptions:

Additional EUT cable correction:

Photo: EUT cable with two UFL/SMA adapter



Plot: EUT cable attenuation measured with network analyzer



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:

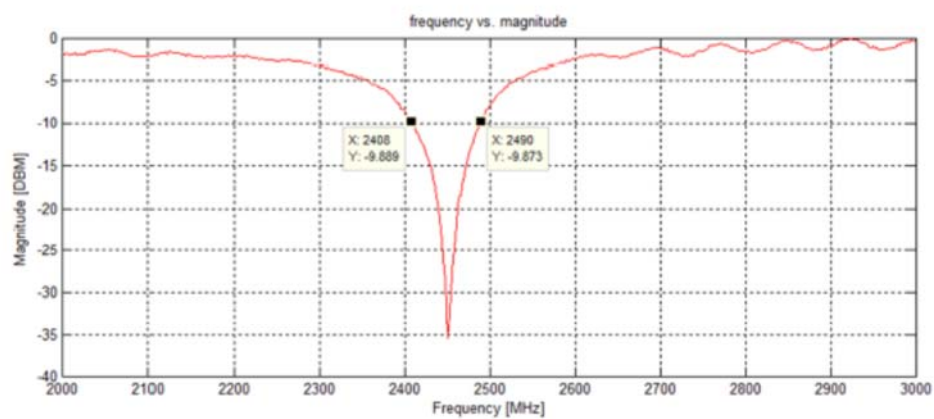
- ☒ Operating mode 1 (single antenna)
- Equipment with 1 antenna,
  - Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,
  - Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive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

## 12 Measurement results

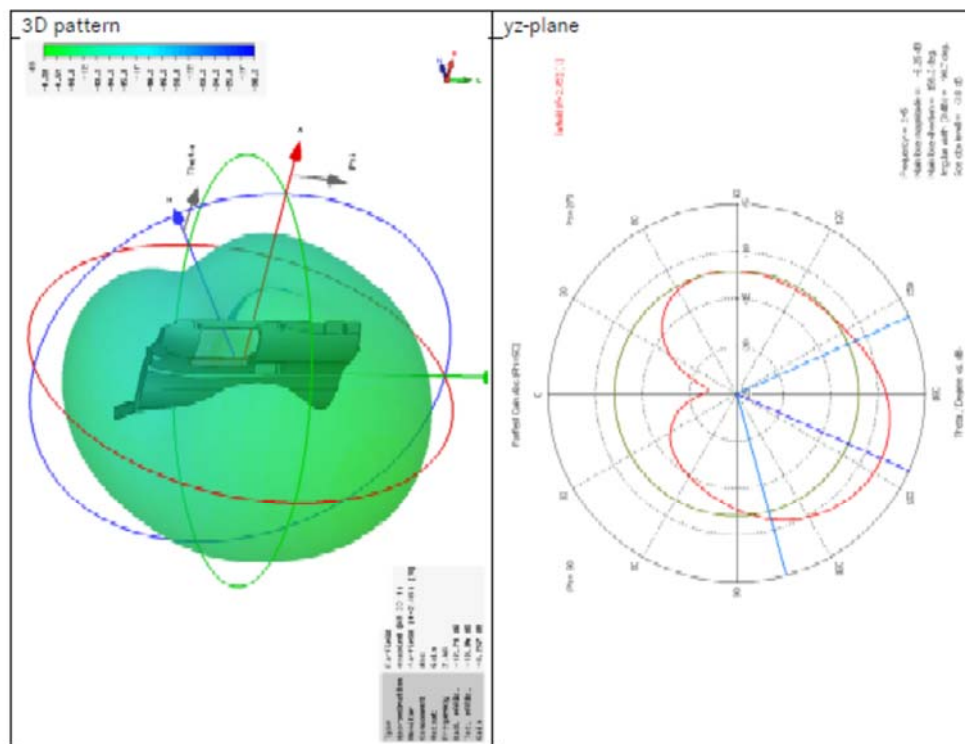
### 12.1 Antenna gain

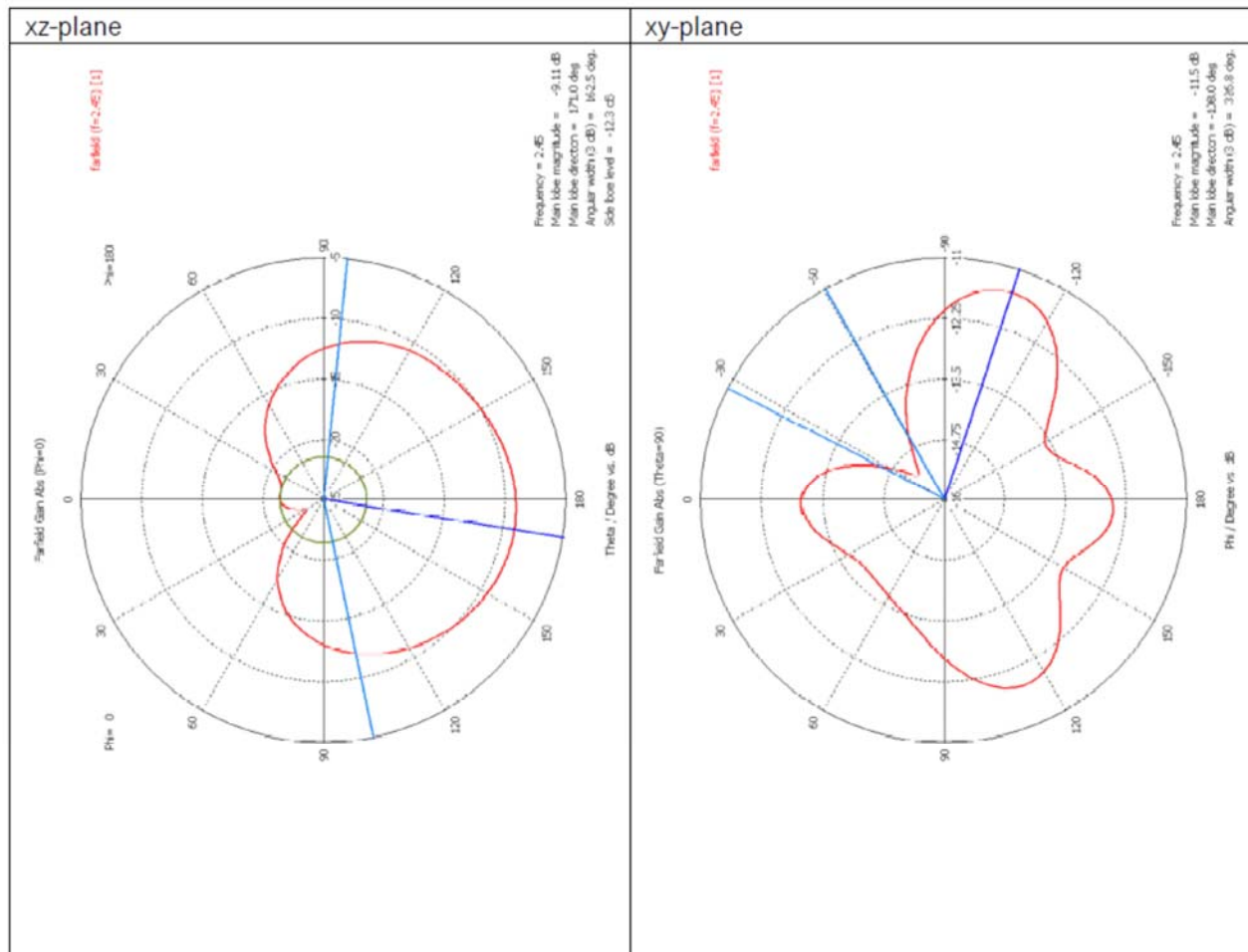
#### Limits:

FCC	IC
6 dBi / > 6 dBi output power and power density reduction required	



### Radiations patterns





Customer declared antenna gain according to the reference document Hollywood antenna datasheet: -8.26 dBi

## 12.2 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
Test setup:	See sub clause 7.4 – A
Measurement uncertainty:	-/-

### Results:

Modulation	Modulation scheme / bandwidth
DSSS / b – mode	1 Mbit/s
OFDM / g – mode	6 Mbit/s
OFDM / n HT20 – mode	MCS0

## 12.3 Maximum output power

### Description:

Measurement of the maximum output power conducted and radiated. The measurements are performed using the data rate producing the highest conducted output power.

### Measurement:

Measurement parameter	
According to DTS clause: 9.1.2	
Peak power meter	
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	IC
Conducted: 1.0 W – Antenna gain with max. 6 dBi	

### Results:

Frequency	Maximum Output Power [dBm]		
	2412 MHz	2437 MHz	2462 MHz
Output power conducted DSSS / b – mode	16.3	15.7	15.3
Output power conducted OFDM / g – mode	19.5	19.7	19.6
Output power conducted OFDM / n HT20 – mode	19.7	19.8	19.7

## 12.4 Duty cycle

### Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Depends on the signal see plot
Resolution bandwidth:	10 MHz
Video bandwidth:	10 MHz
Trace mode:	Max hold
Test setup:	See sub clause 7.5 - A
Measurement uncertainty:	See sub clause 9

### Limits:

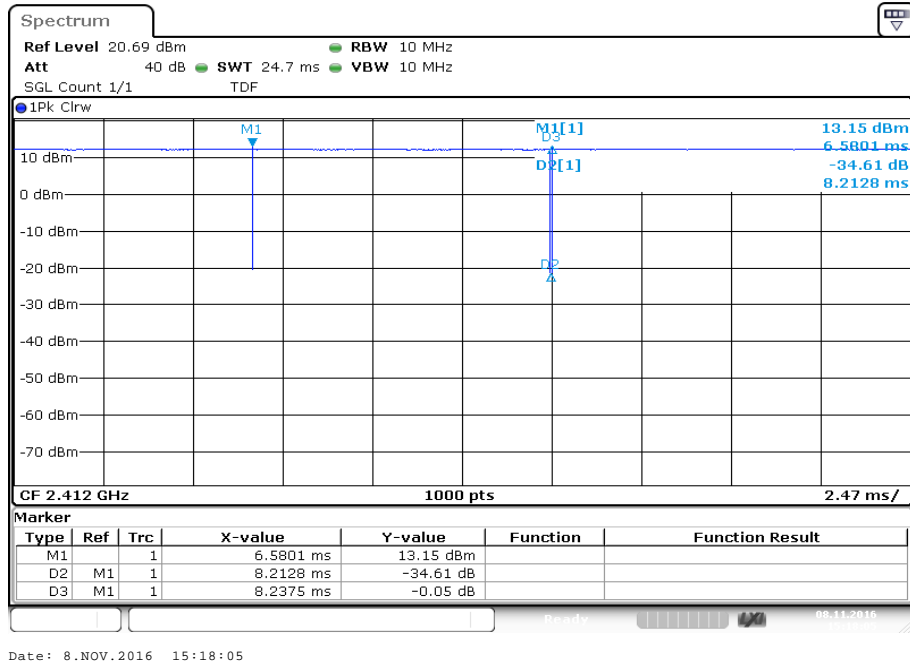
FCC	IC
-/-	

### Results:

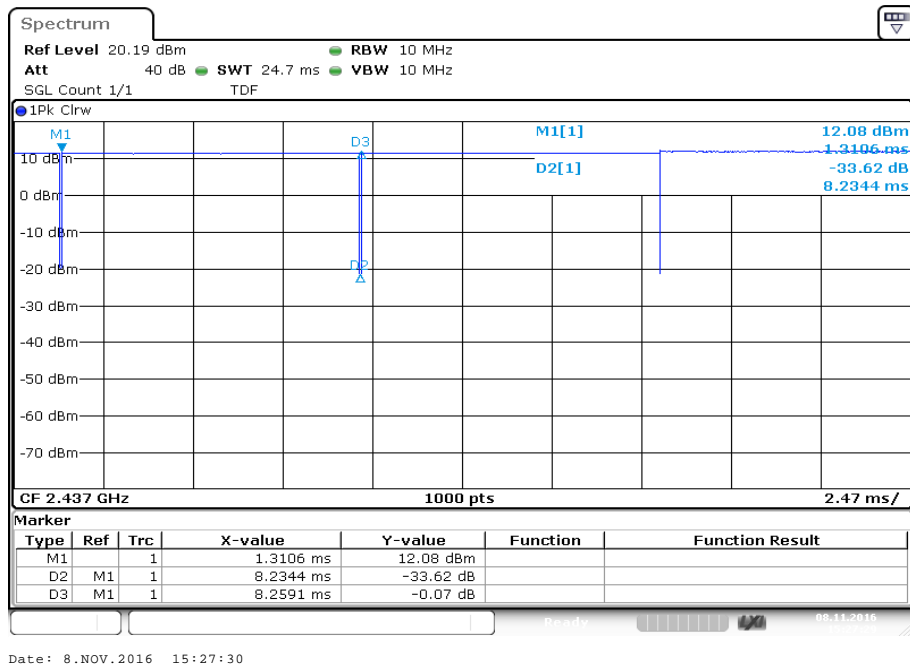
T <sub>nom</sub>	V <sub>nom</sub>	lowest channel 2412 MHz	middle channel 2437 MHz	highest channel 2462 MHz
DSSS / b – mode		99.7 % / 0.01 dB	99.7 % / 0.01 dB	99.9 % / 0.01 dB
OFDM / g – mode		97.0 % / 0.13 dB	96.7 % / 0.15 dB	96.7 % / 0.15 dB
OFDM / n HT20 – mode		96.4 % / 0.16 dB	96.7 % / 0.15 dB	96.7 % / 0.15 dB

**Plots:** DSSS / b – mode

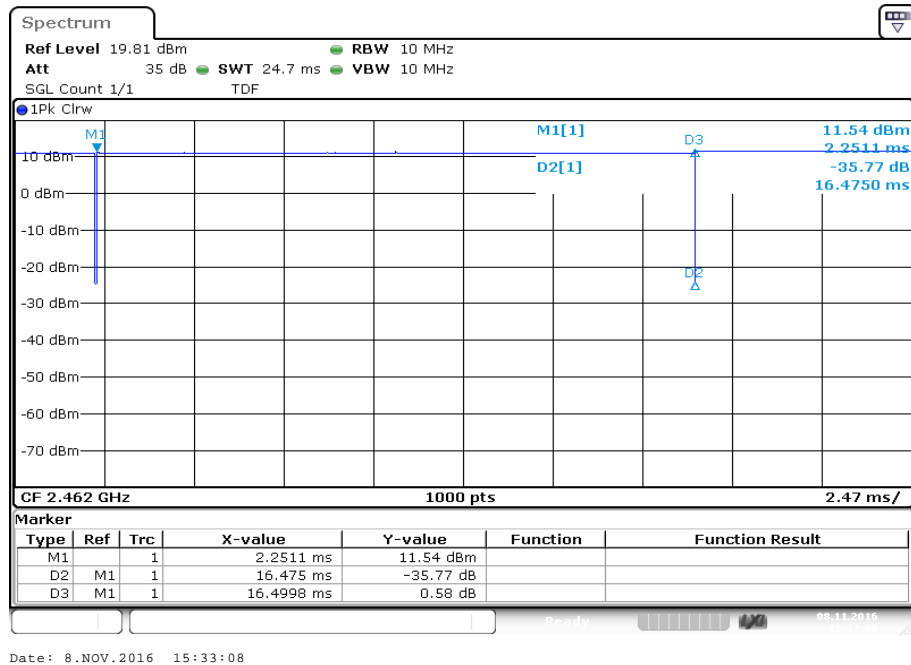
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz

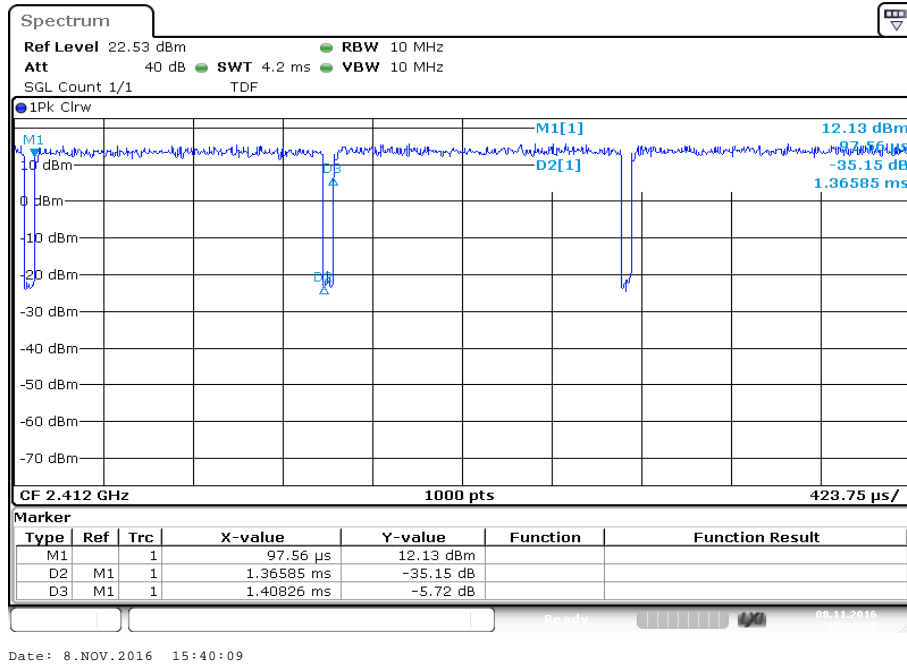


**Plot 3:** Channel 11, 2462 MHz

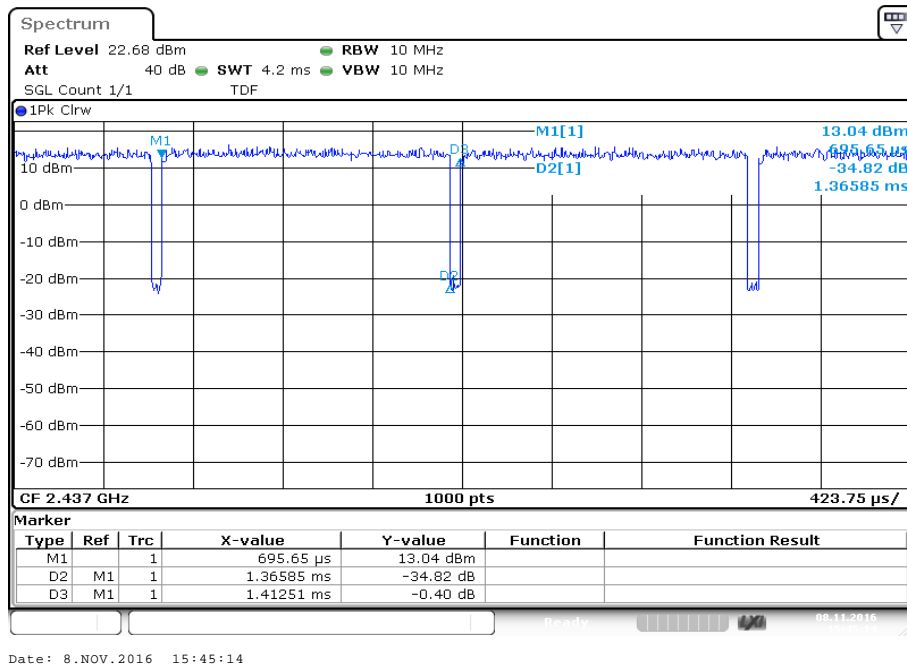


**Plots:** OFDM / g – mode

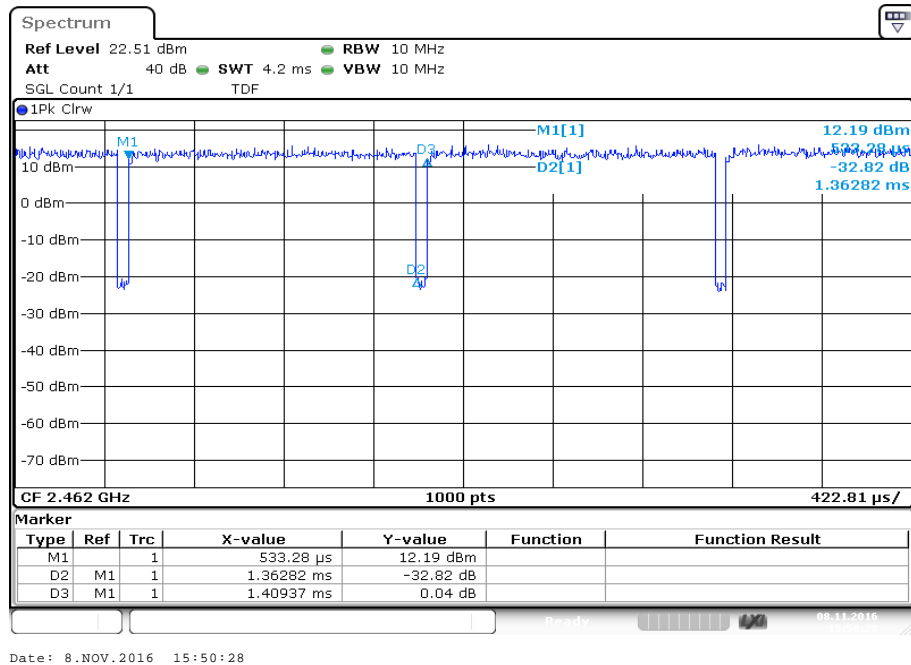
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz

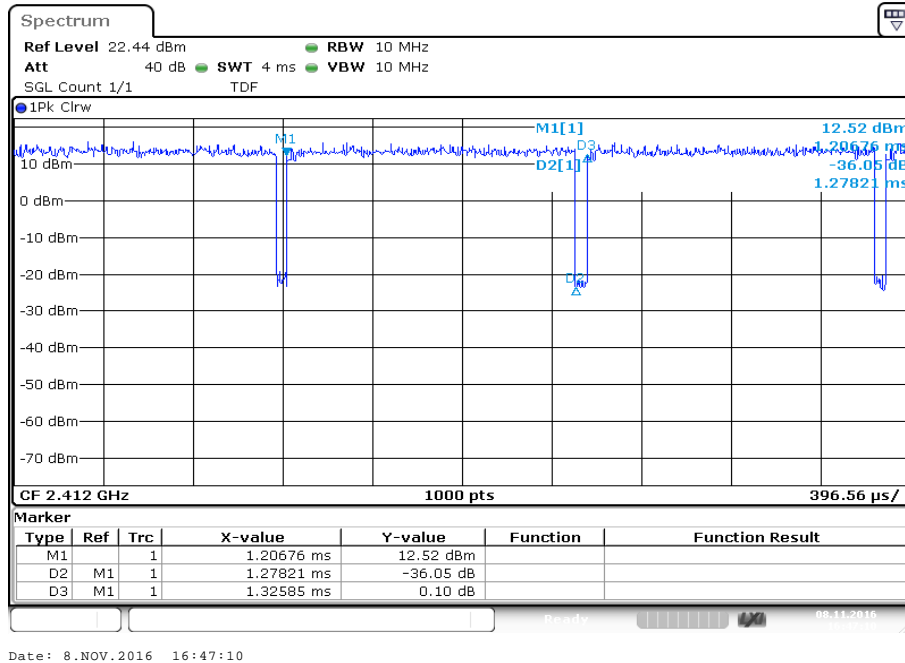


**Plot 3: Channel 11, 2462 MHz**

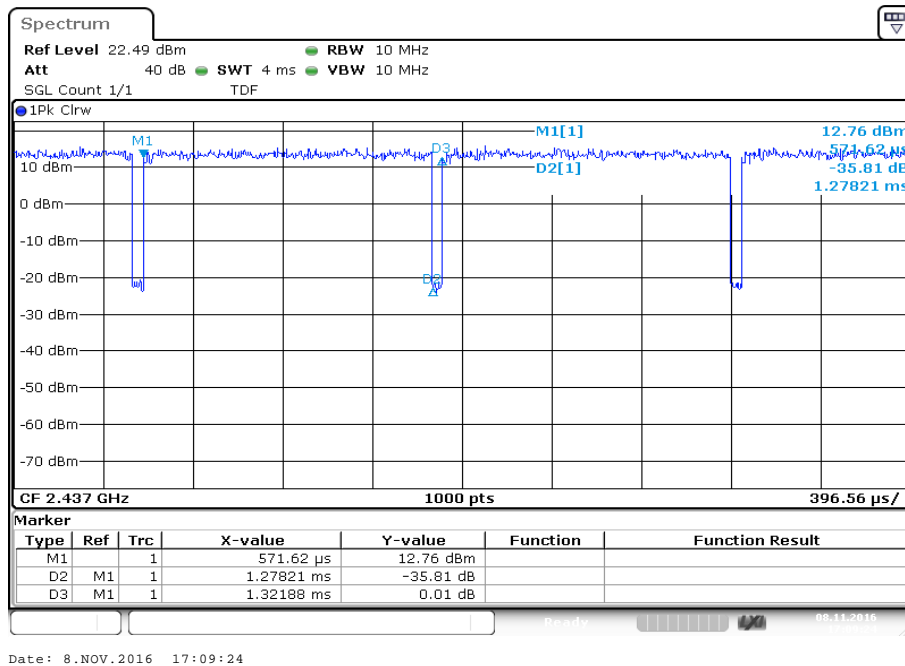


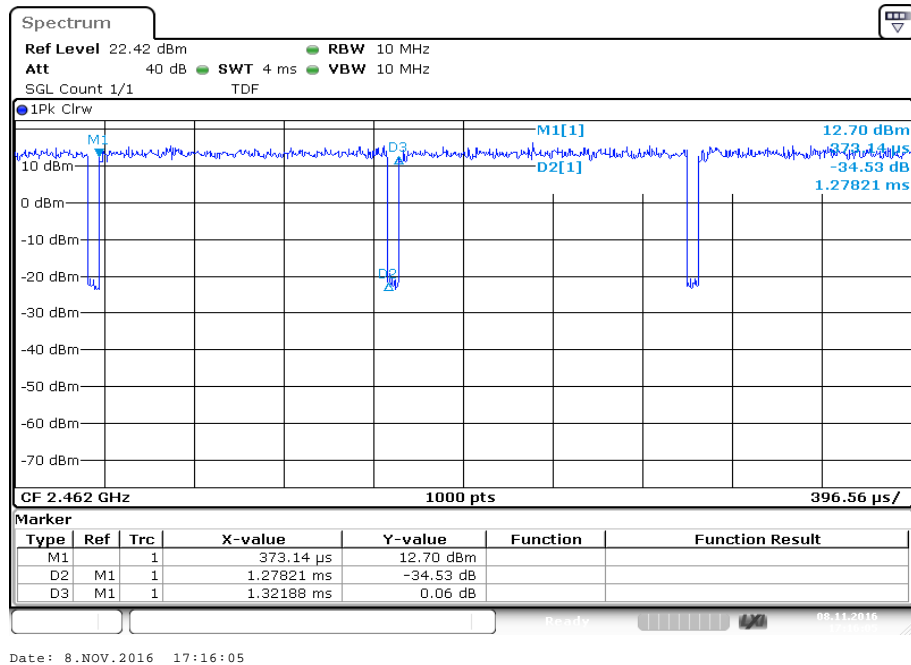
**Plots:** OFDM / n HT20 – mode

**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz



**Plot 3:** Channel 11, 2462 MHz

## 12.5 Peak power spectral density

### Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated for both modulations at the lowest, middle and highest channel.

### Measurement:

Measurement parameter	
According to DTS clause: 10.2	
Detector:	Positive Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	30 MHz
Trace mode:	Max hold (allow trace to fully stabilize)
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Limits:

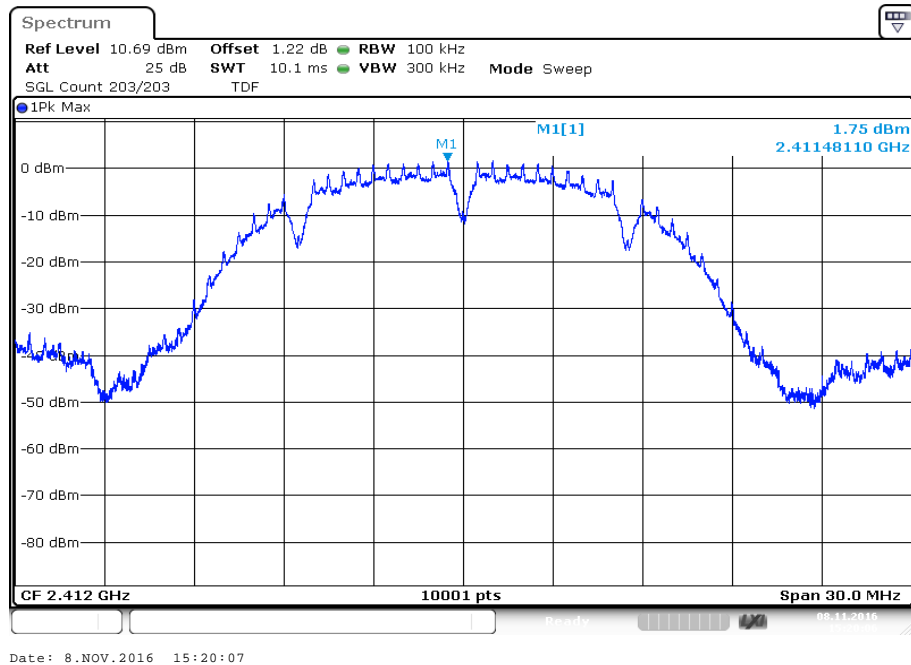
FCC	IC
8 dBm / 3 kHz (conducted)	

### Results:

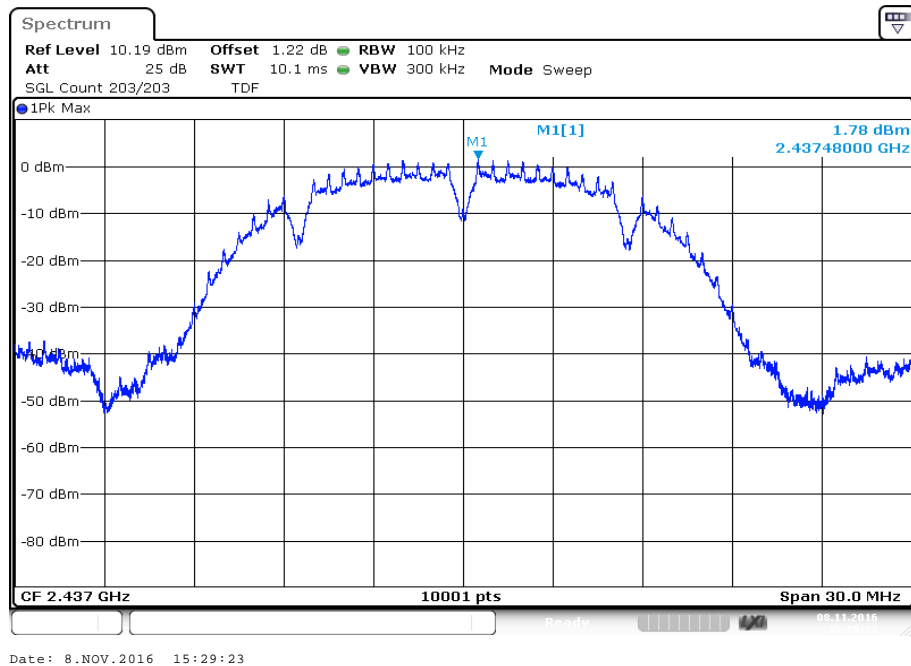
Modulation Frequency	Peak power spectral density [dBm/100kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	1.8	1.8	1.6
OFDM / g – mode	0.7	0.7	0.4
OFDM / n HT20 – mode	0.7	0.9	0.4

**Plots:** DSSS / b – mode

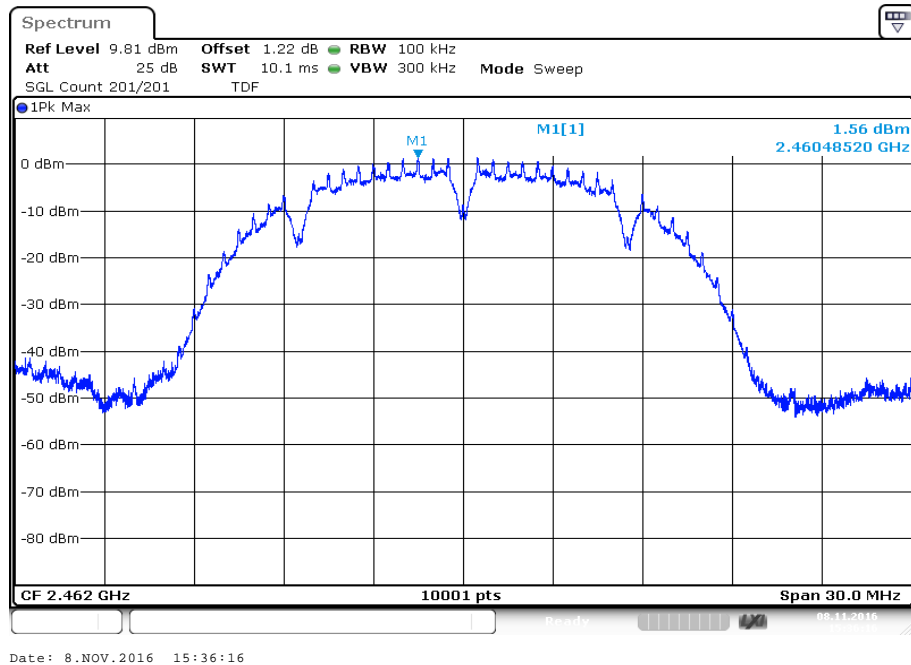
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz

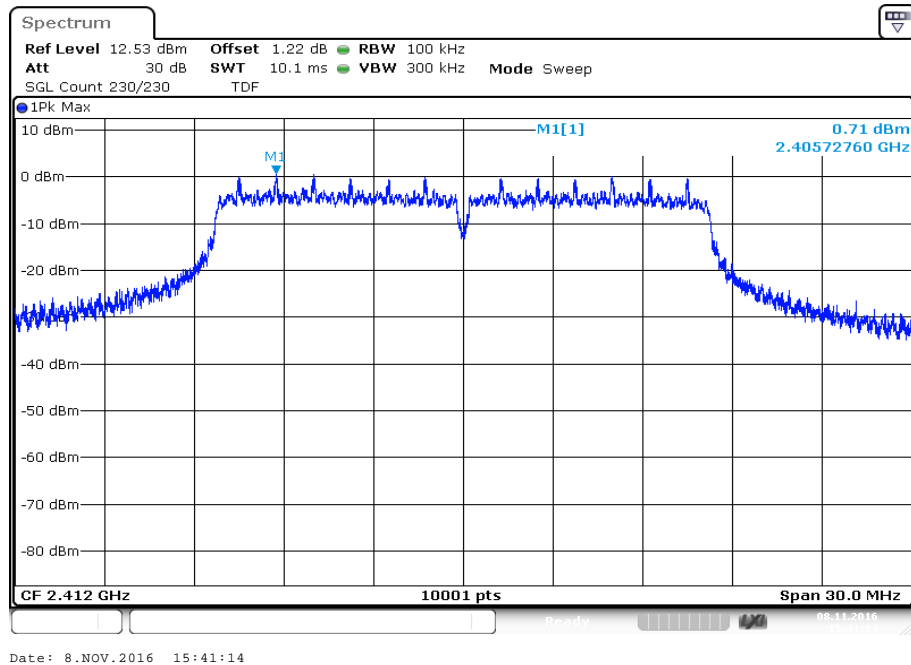


**Plot 3:** Channel 11, 2462 MHz

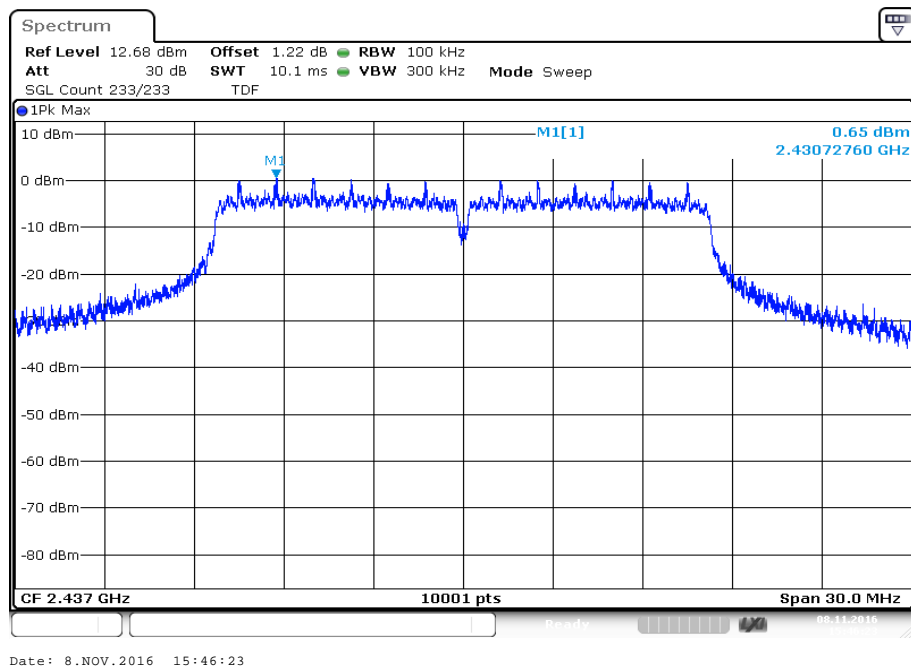


**Plots:** OFDM / g – mode

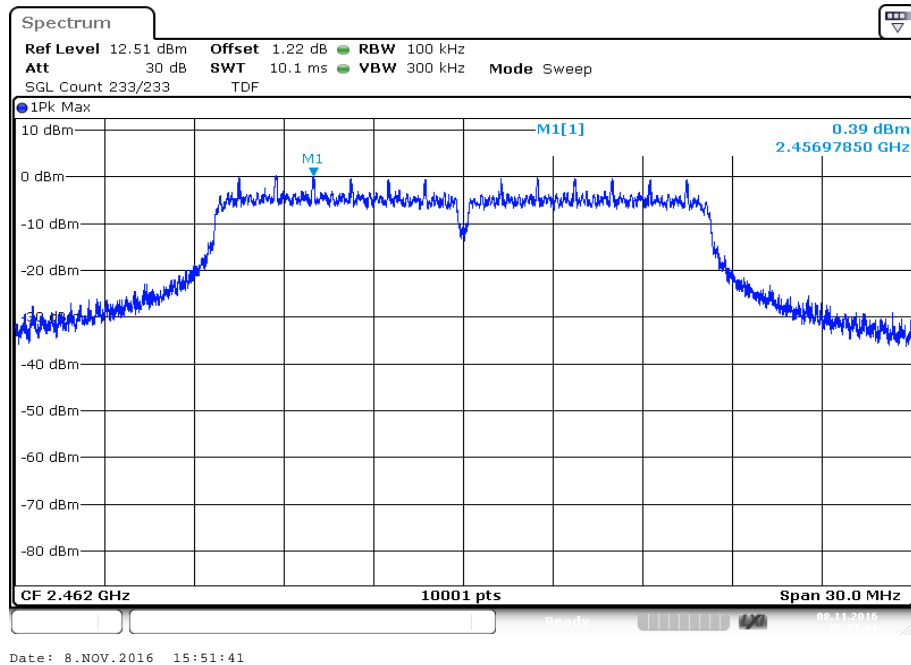
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz

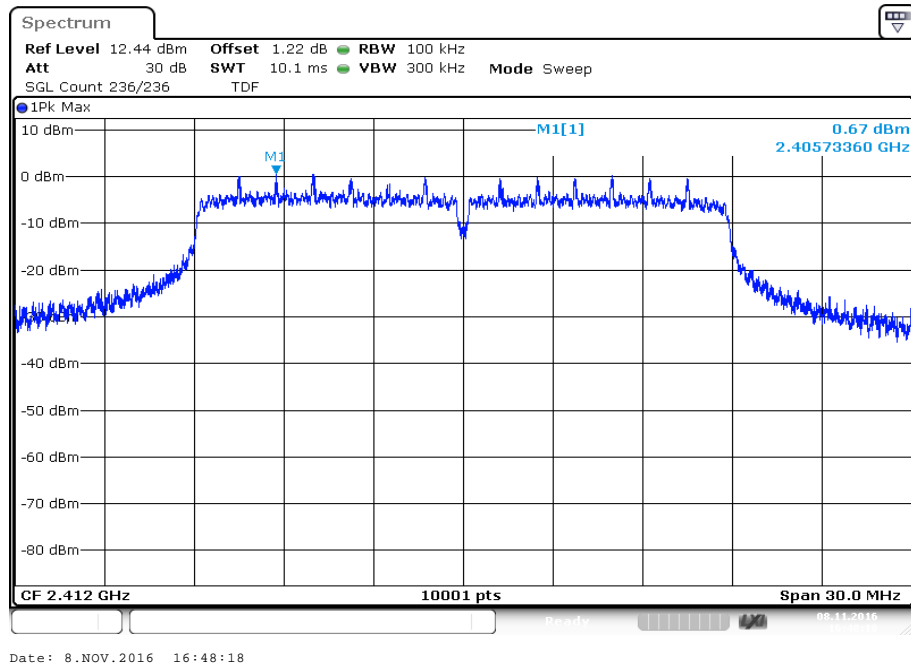


**Plot 3:** Channel 11, 2462 MHz

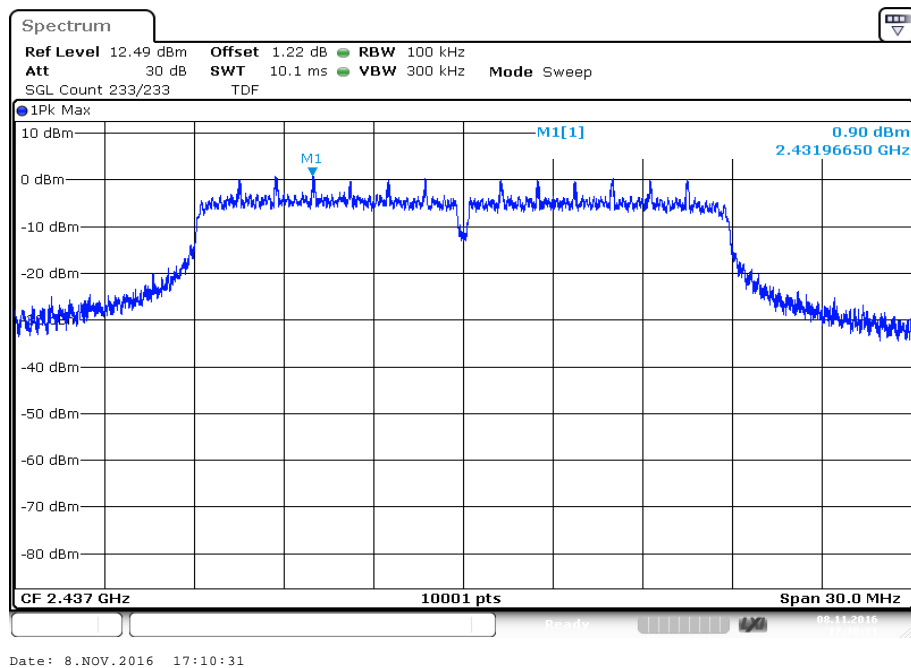


**Plots:** OFDM / n HT20 – mode

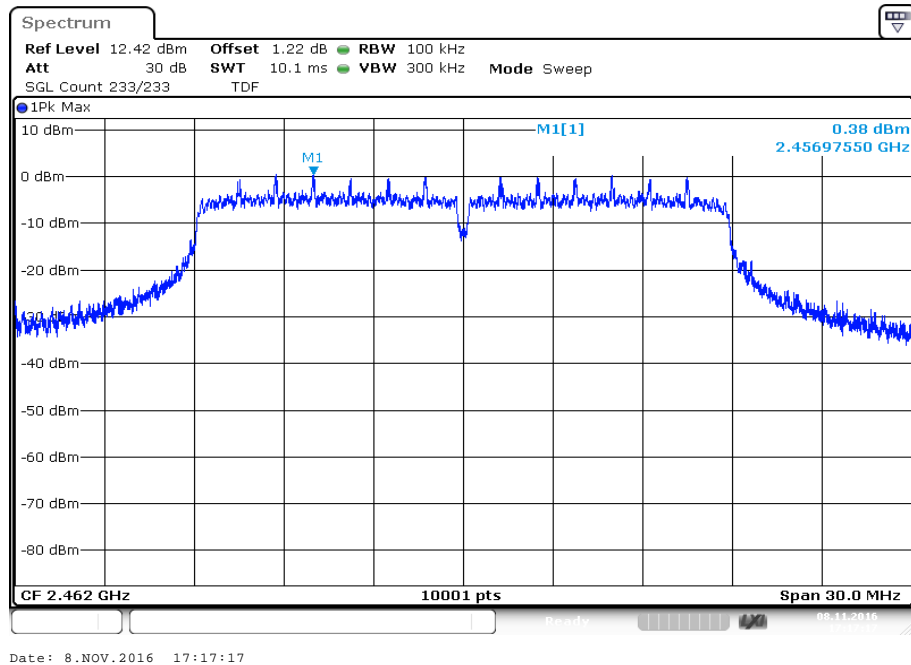
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz



**Plot 3:** Channel 11, 2462 MHz



## 12.6 6 dB DTS bandwidth

### Description:

Measurement of the 6 dB bandwidth of the modulated signal.

### Measurement:

Measurement parameter	
According to DTS clause: 8.1	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	500 kHz
Span:	30 MHz / 50 MHz
Measurement procedure:	Measurement of the 75% bandwidth using the integration function of the analyzer
Trace mode:	Single count with 200 counts
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Limits:

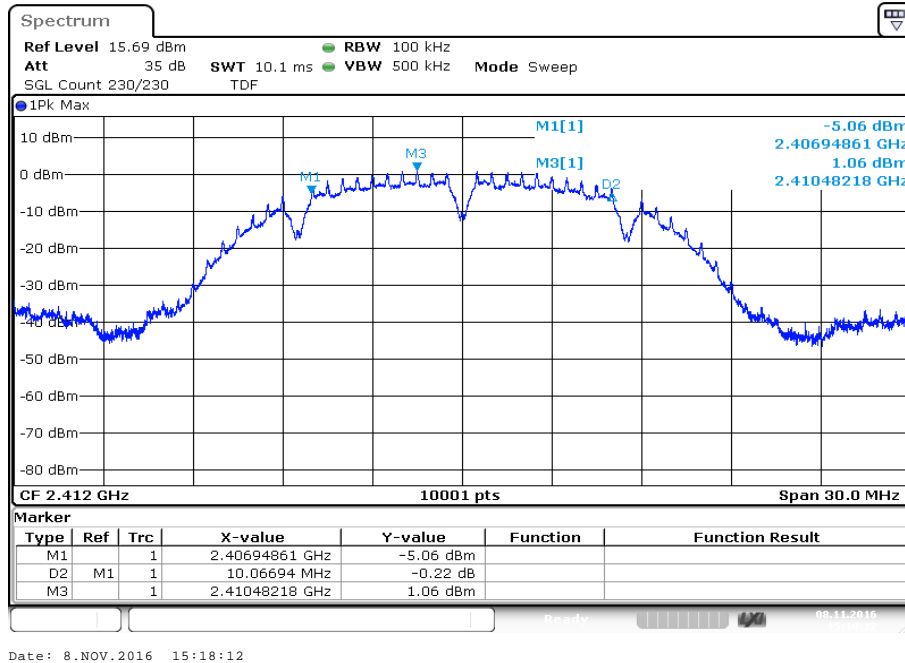
FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

### Results:

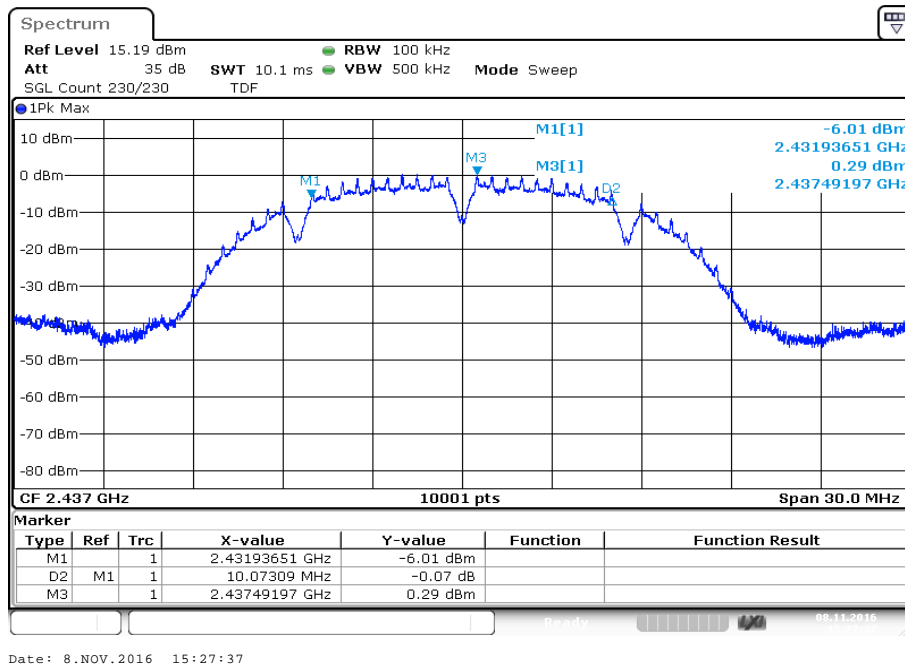
Frequency	6 dB DTS bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	10067	10073	10067
OFDM / g – mode	16303	16321	16324
OFDM / n HT20 – mode	17296	17536	17533

**Plots:** DSSS / b – mode

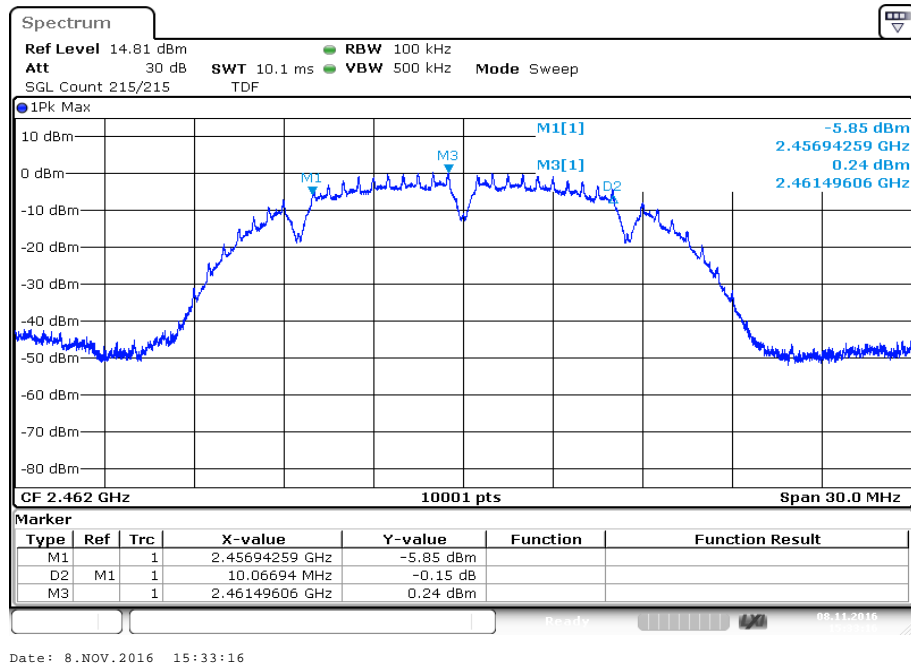
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz

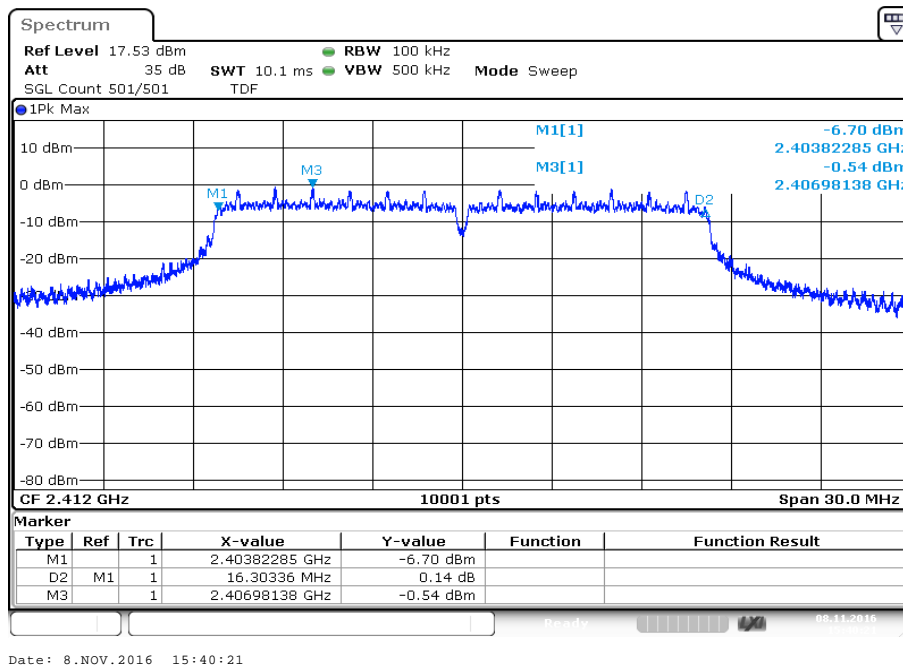


**Plot 3:** Channel 11, 2462 MHz

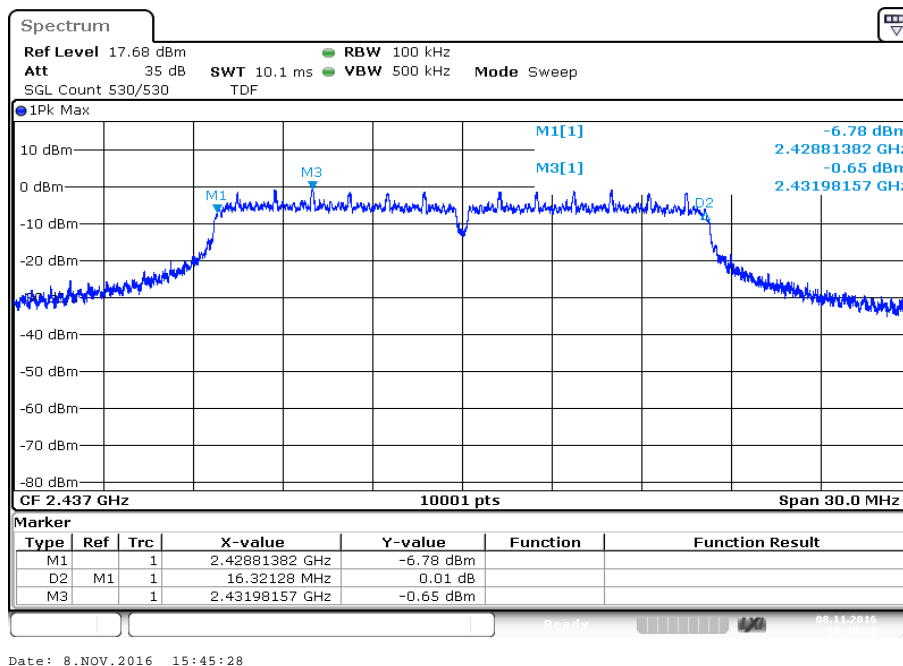


**Plots:** OFDM / g – mode

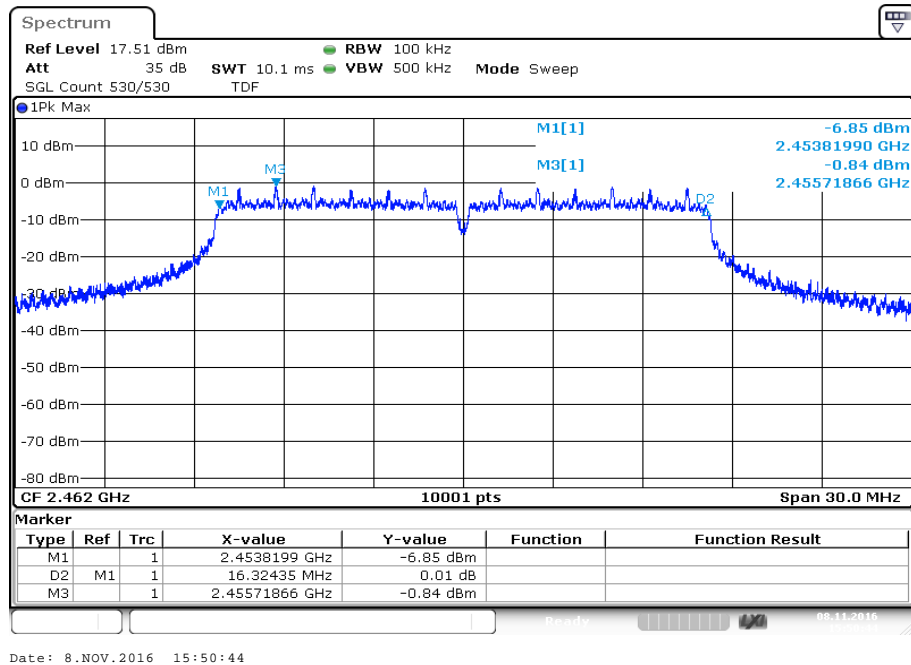
**Plot 1:** Channel 1, 2412 MHz

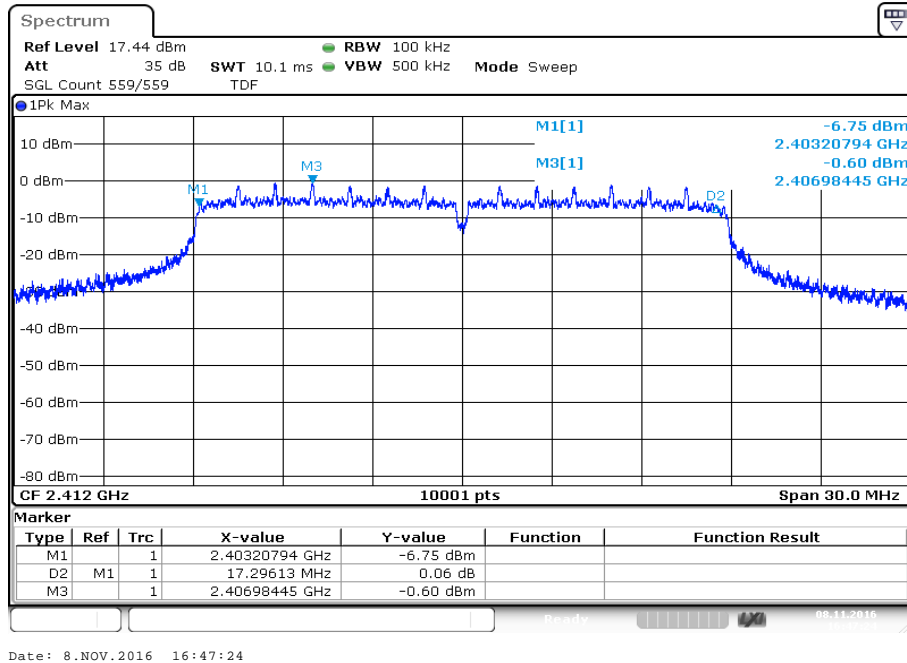
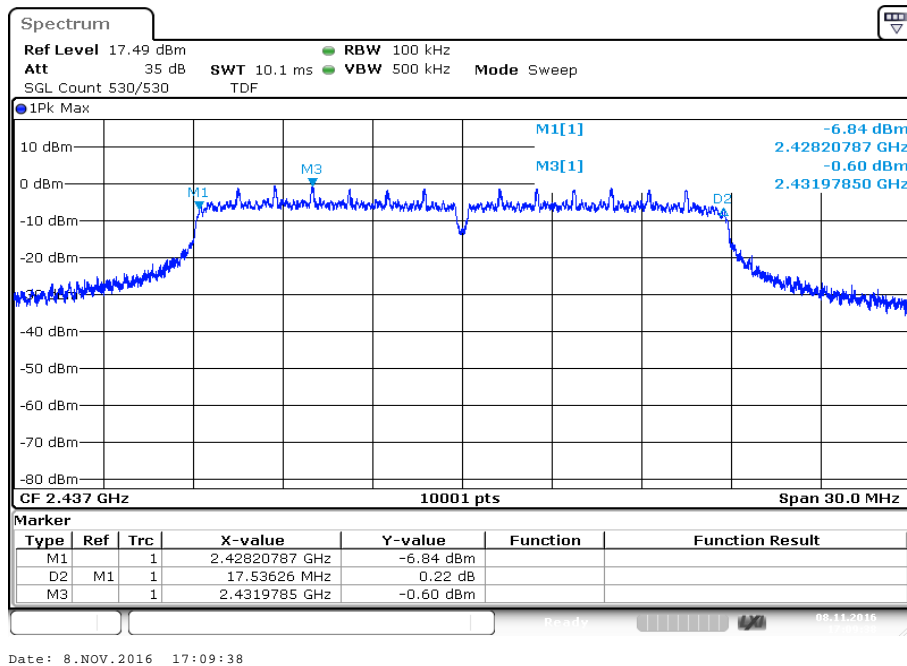


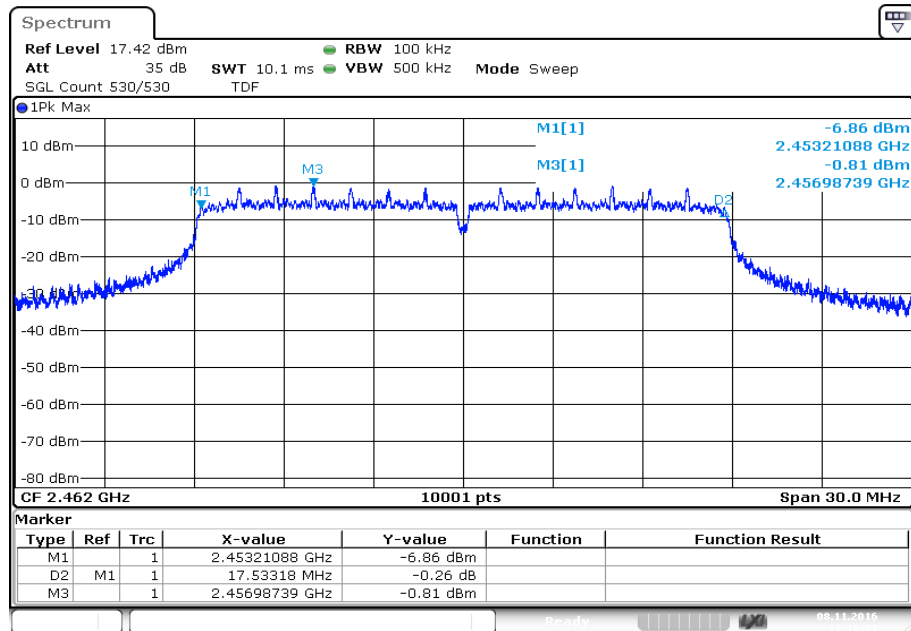
**Plot 2:** Channel 6, 2437 MHz



**Plot 3:** Channel 11, 2462 MHz



**Plots:** OFDM / n HT20 – mode**Plot 1:** Channel 1, 2412 MHz**Plot 2:** Channel 6, 2437 MHz

**Plot 3:** Channel 11, 2462 MHz

## 12.7 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:	300 kHz
Video bandwidth:	1 MHz
Span:	30 MHz / 50 MHz
Measurement procedure:	Measurement of the 99% bandwidth using the integration function of the analyzer
Trace mode:	Single count with 200 counts
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Usage:

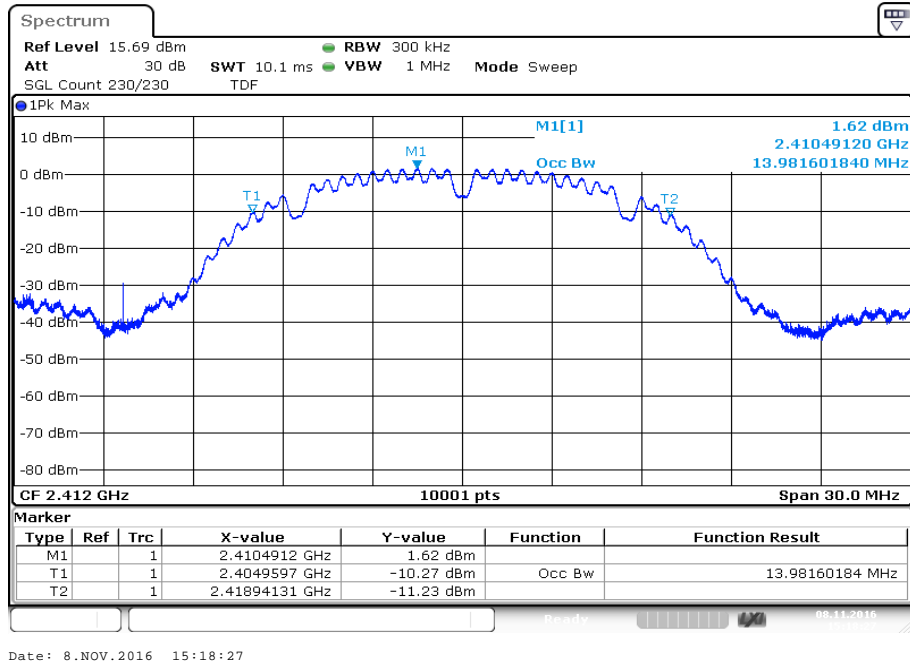
-/-	IC
OBW is necessary for Emission Designator	

### Results:

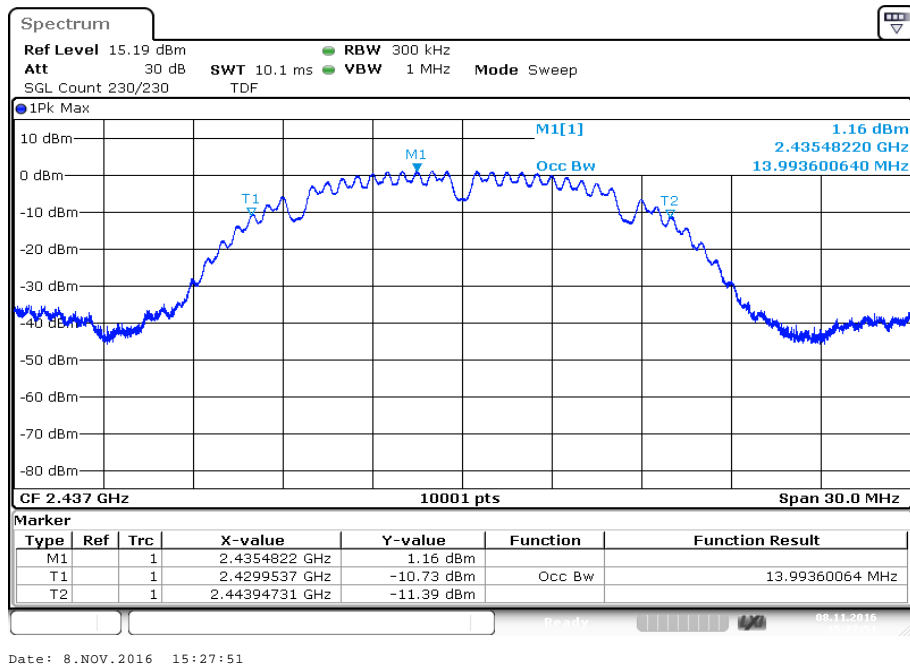
Modulation Frequency	99% bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	13982	13994	13931
OFDM / g – mode	17296	17284	17203
OFDM / n HT20 – mode	18301	18277	18232

**Plots:** DSSS / b – mode

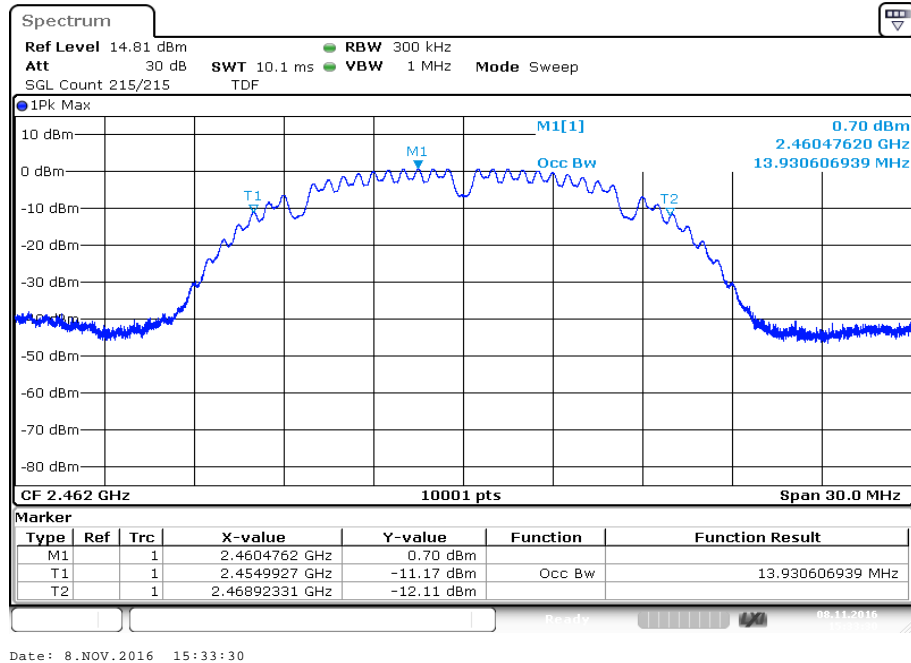
**Plot 1:** Channel 1, 2412 MHz

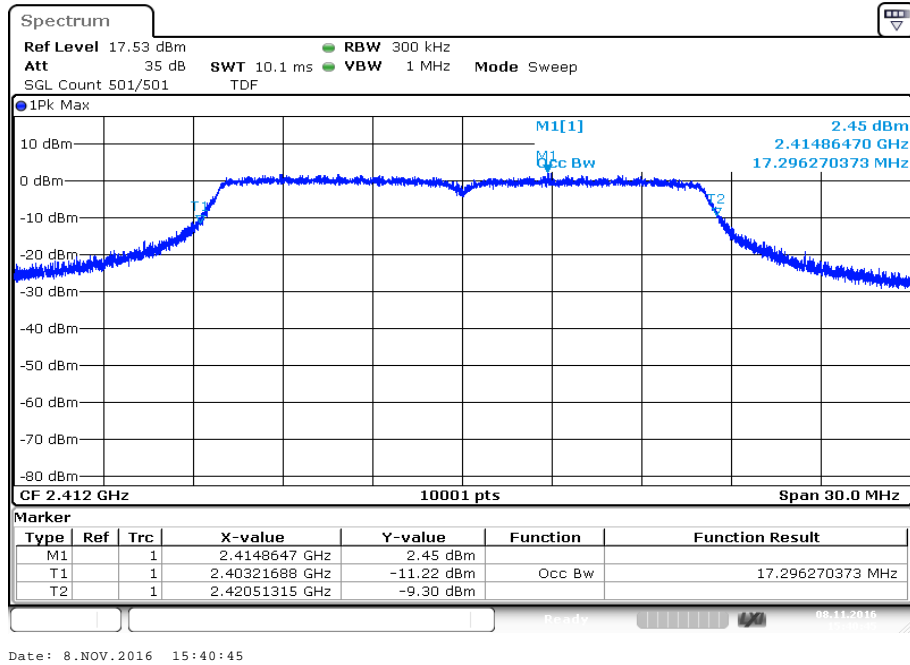
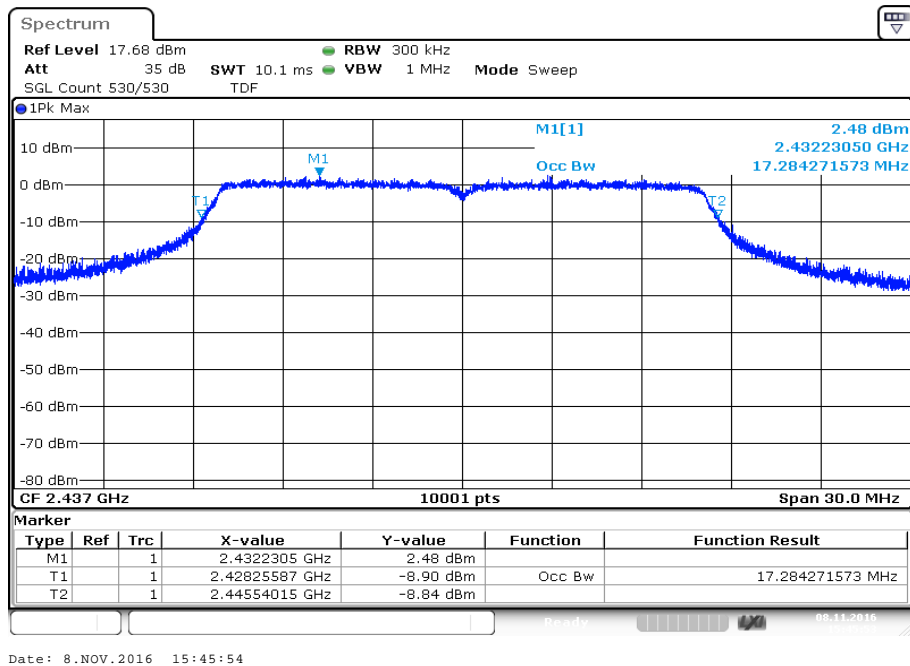


**Plot 2:** Channel 6, 2437 MHz

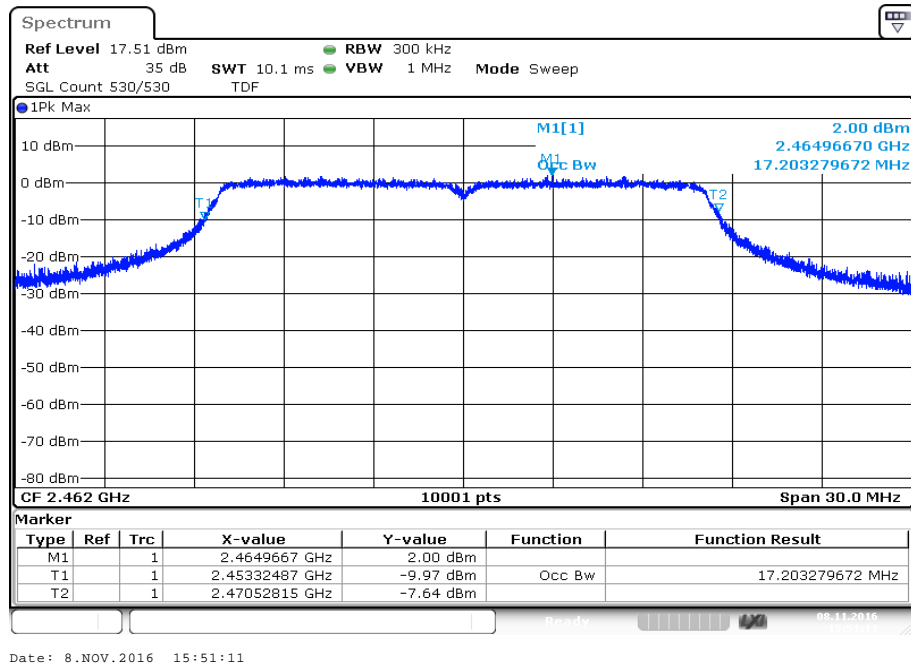


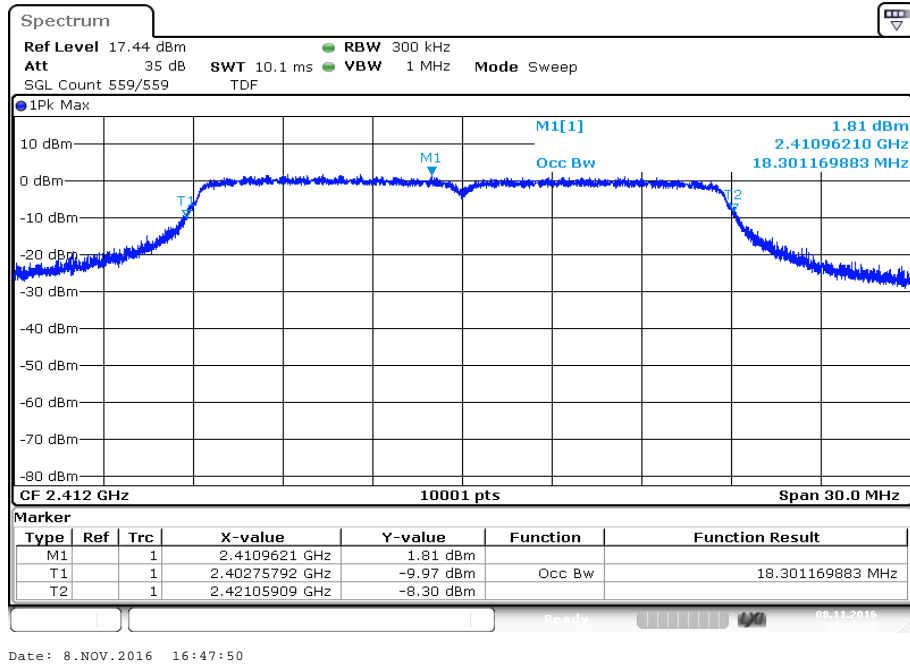
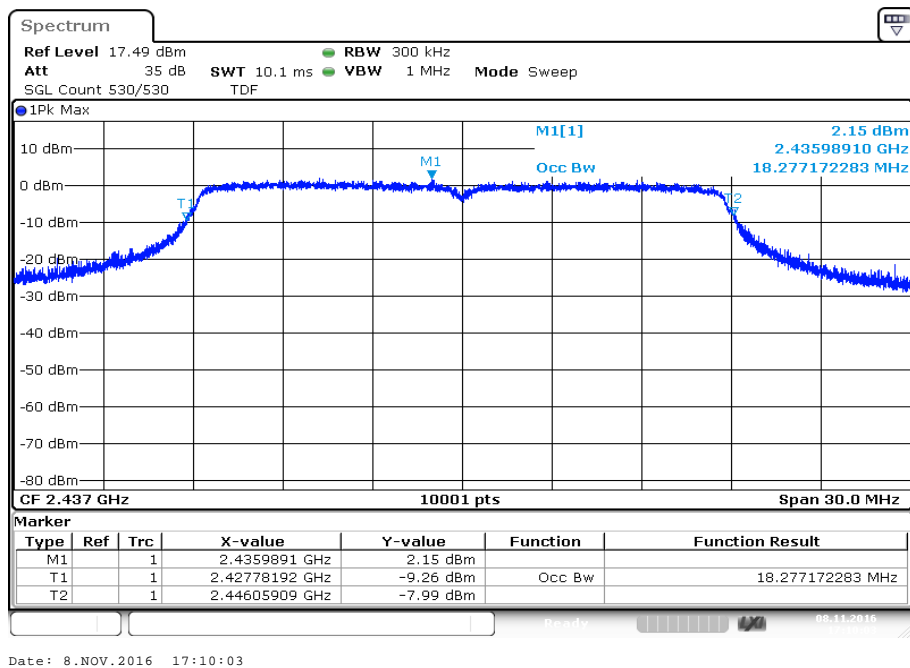
**Plot 3: Channel 11, 2462 MHz**



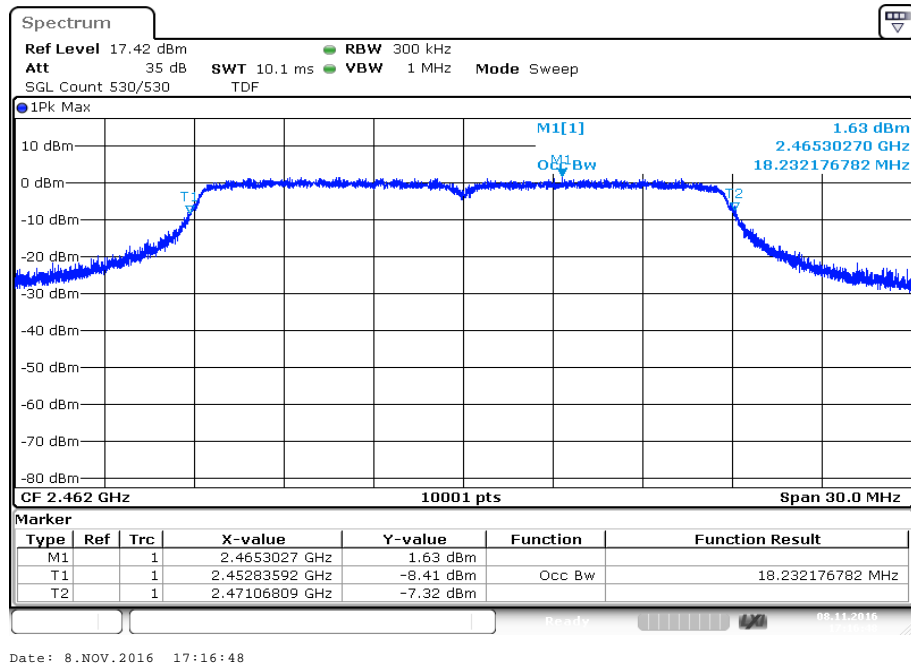
**Plots:** OFDM / g – mode**Plot 1:** Channel 1, 2412 MHz**Plot 2:** Channel 6, 2437 MHz

**Plot 3:** Channel 11, 2462 MHz



**Plots:** OFDM / n HT20 – mode**Plot 1:** Channel 1, 2412 MHz**Plot 2:** Channel 6, 2437 MHz

**Plot 3:** Channel 11, 2462 MHz



## 12.8 Occupied bandwidth – 20 dB bandwidth

### Description:

Measurement of the 20 dB bandwidth of the modulated carrier.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	500 kHz
Span:	30 MHz / 50 MHz
Trace mode:	Single count with min. 200 counts
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Usage:

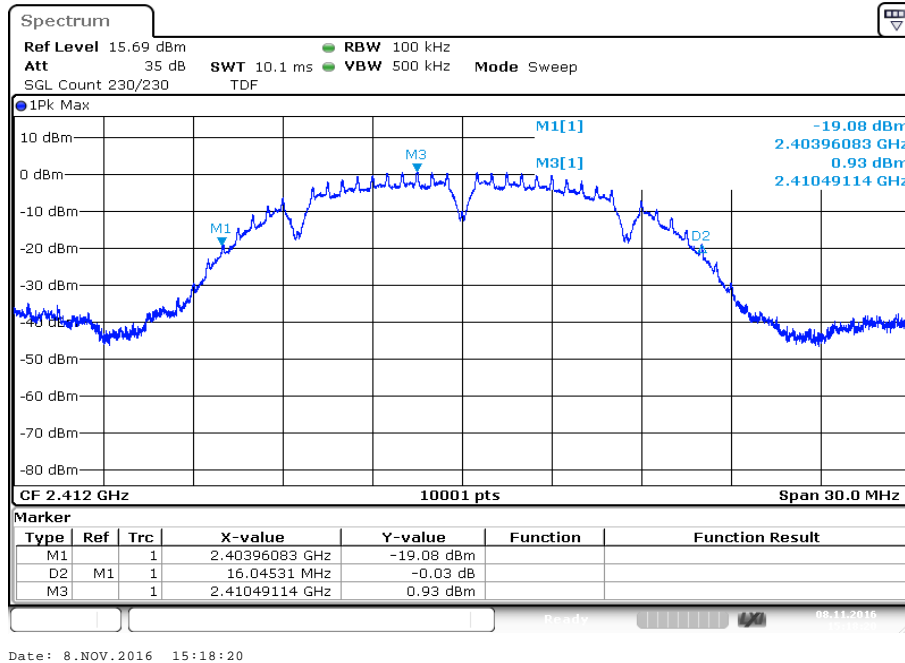
-/-	IC
Within the used band!	

### Results:

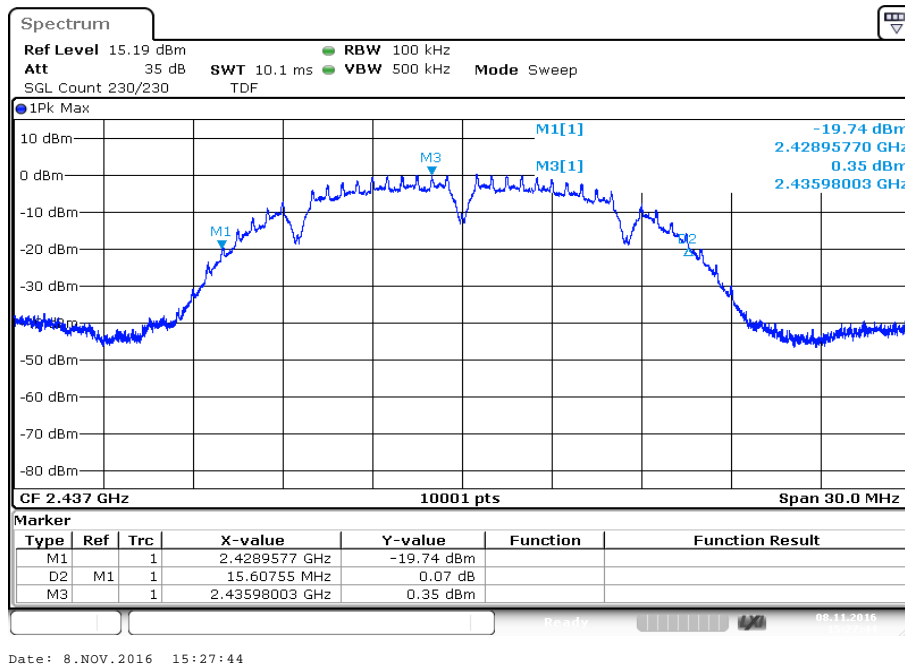
Modulation Frequency	20 dB bandwidth [MHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	16.0	15.6	15.6
OFDM / g – mode	18.4	18.4	18.1
OFDM / n HT20 – mode	19.4	19.2	19.2

**Plots:** DSSS / b – mode

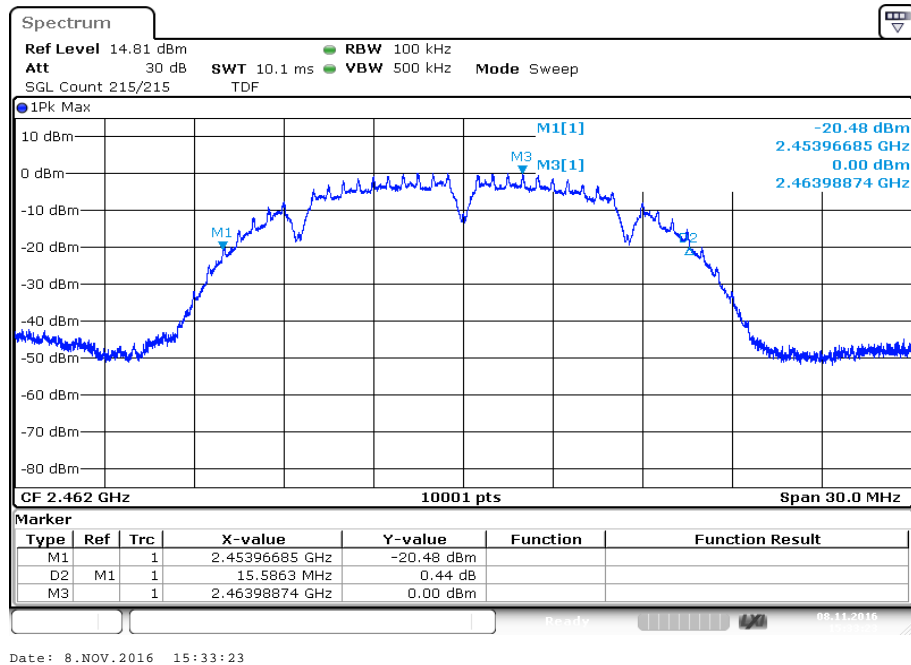
**Plot 1:** Channel 1, 2412 MHz

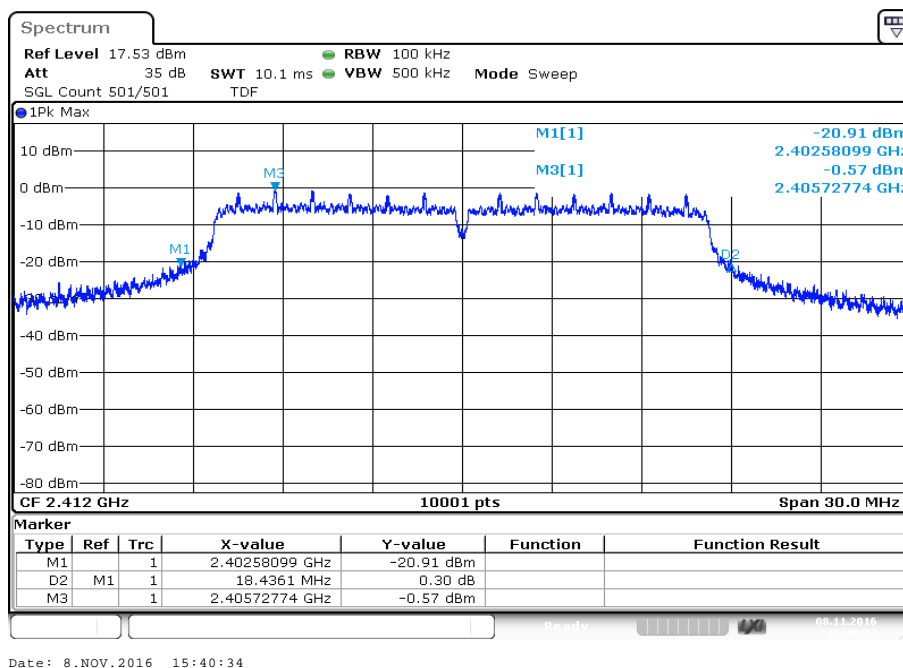
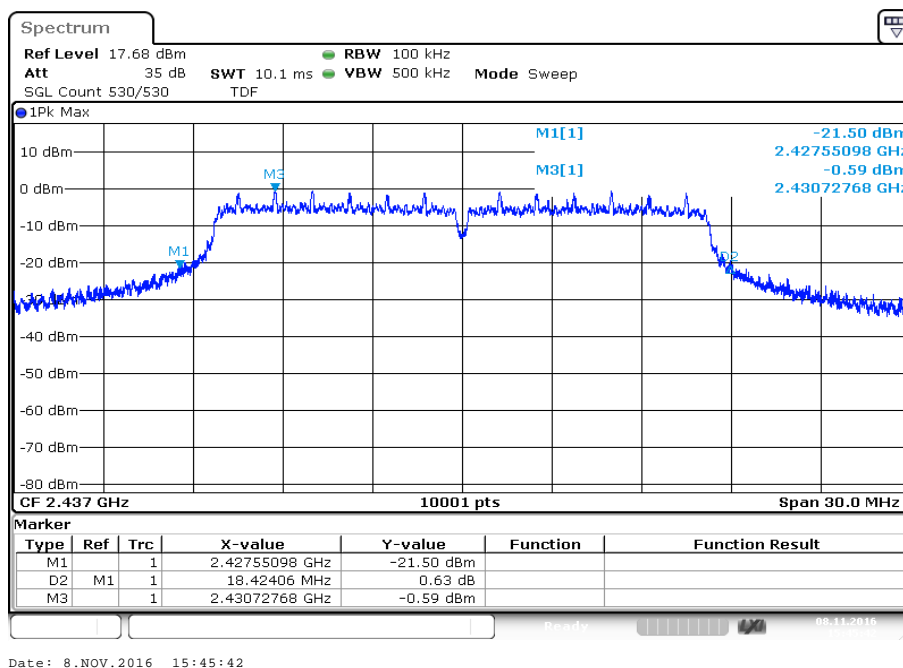


**Plot 2:** Channel 6, 2437 MHz

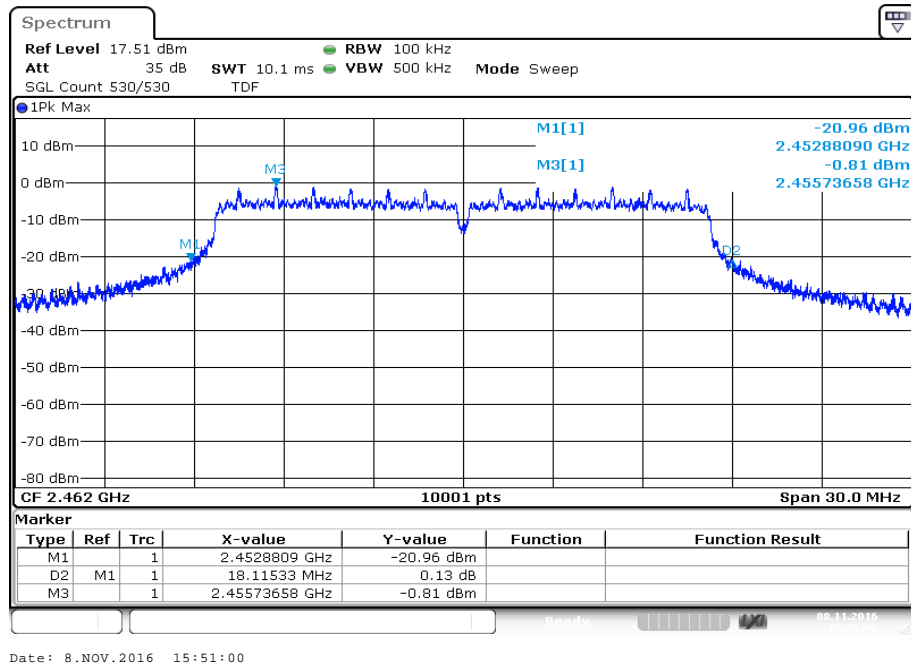


**Plot 3:** Channel 11, 2462 MHz



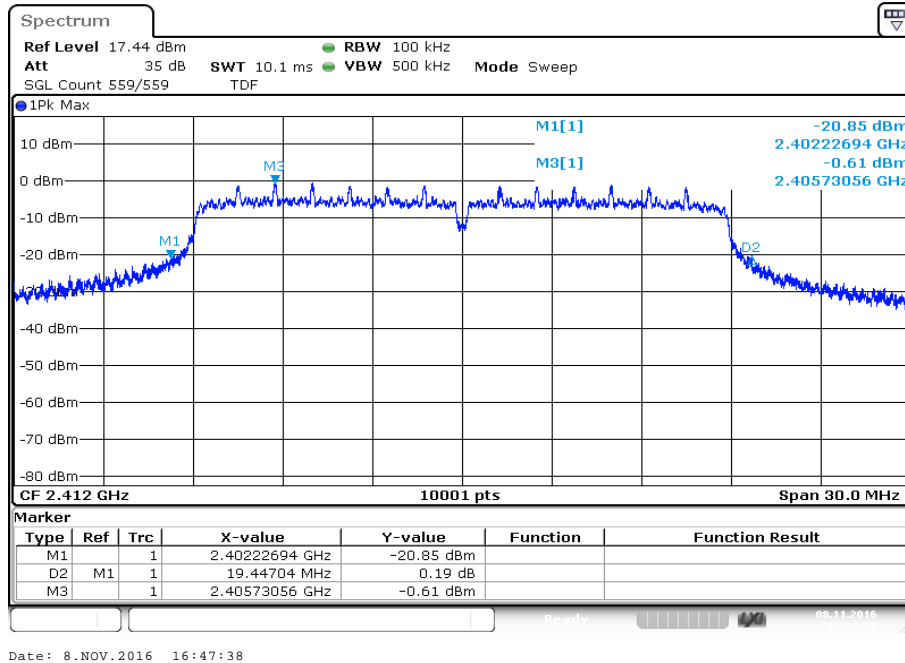
**Plots:** OFDM / g – mode**Plot 1:** Channel 1, 2412 MHz**Plot 2:** Channel 6, 2437 MHz

**Plot 3:** Channel 11, 2462 MHz

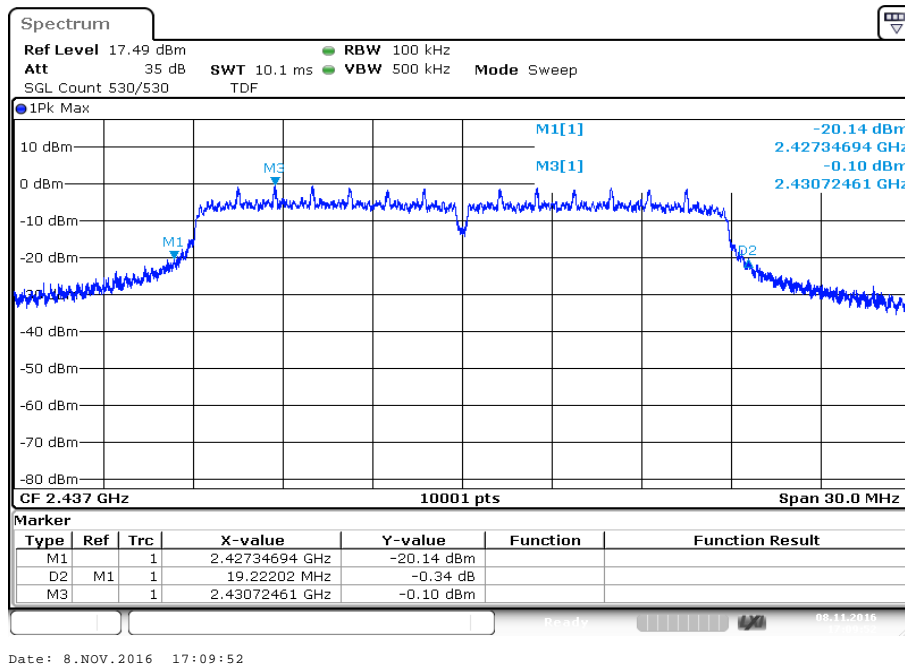


**Plots:** OFDM / n HT20 – mode

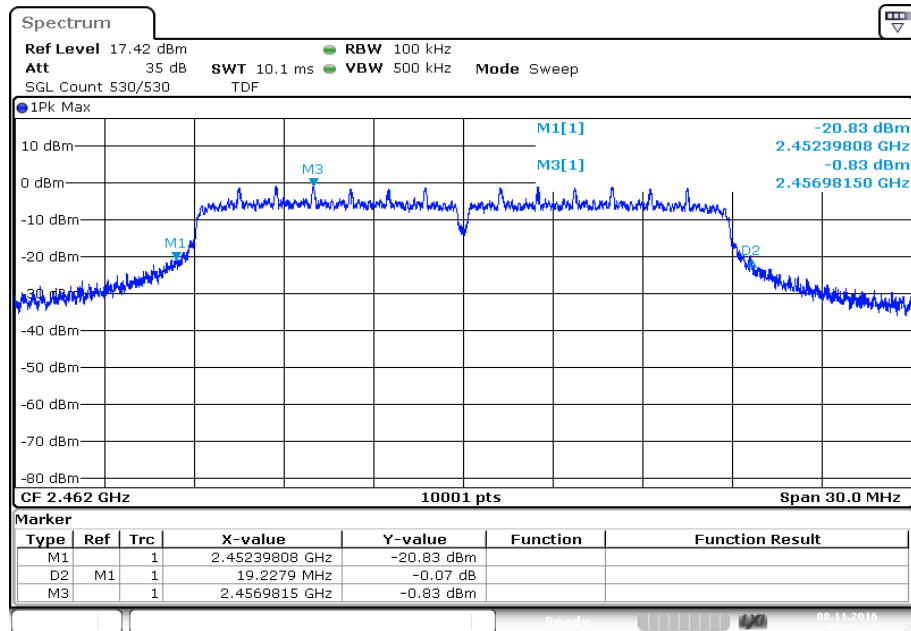
**Plot 1:** Channel 1, 2412 MHz



**Plot 2:** Channel 6, 2437 MHz



**Plot 3:** Channel 11, 2462 MHz



Date: 8.NOV.2016 17:16:37

## 12.9 Band edge compliance conducted

### Description:

Measurement of the radiated band edge compliance with a conducted test setup.

### Measurement:

Measurement parameter for measurements	
According to DTS clause: 13.3.2 and clause 12.2.2	
Detector:	RMS
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Span:	Lower band edge: 2388 MHz to 2390 MHz (2 MHz) Upper band edge: 2483.5 MHz to 2485.5 MHz (2 MHz)
Trace mode:	Trace average with 200 counts
See sub clause 7.4 – A	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Limits:

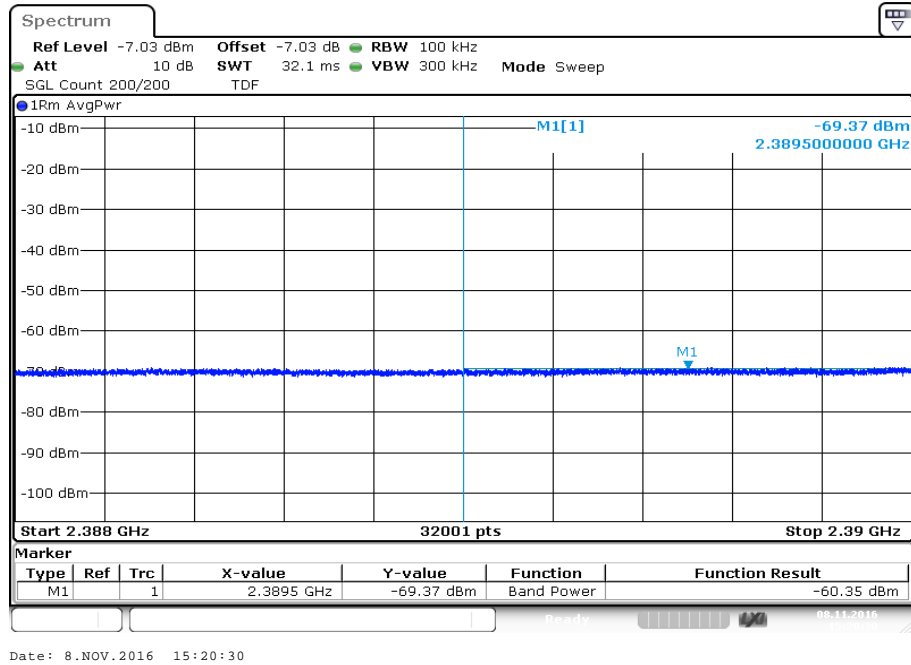
FCC	IC
-41.26 dBm	

### Results:

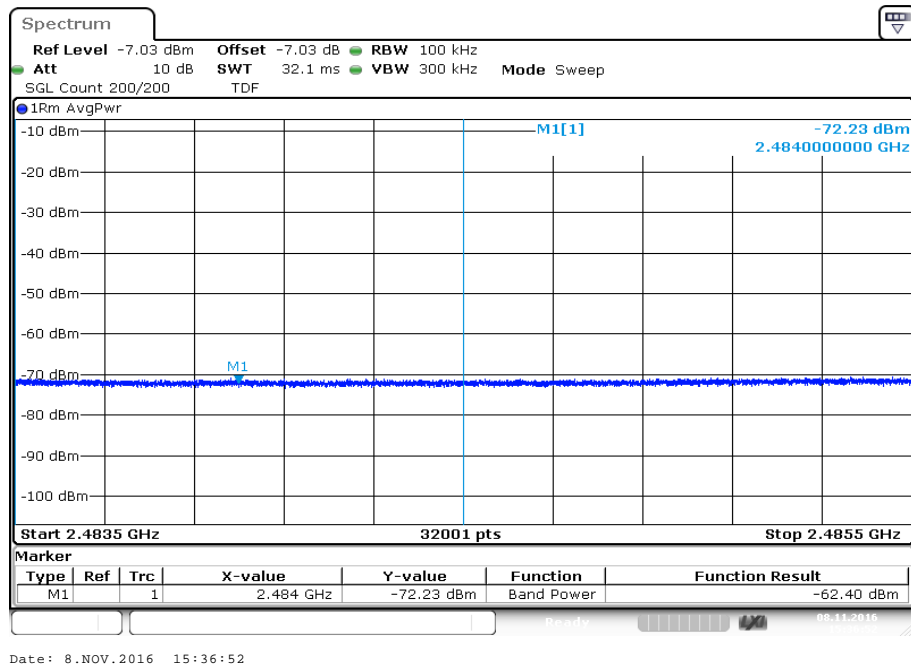
Scenario Modulation	Band edge compliance [dBm]			
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode	-/-
Max. lower band edge power radiated	-60.4	-49.0	-46.1	-/-
Max. upper band edge power radiated	-62.4	-51.1	-49.0	-/-

**Plots:** DSSS / b – mode

**Plot 1:** Lower band edge, channel 1

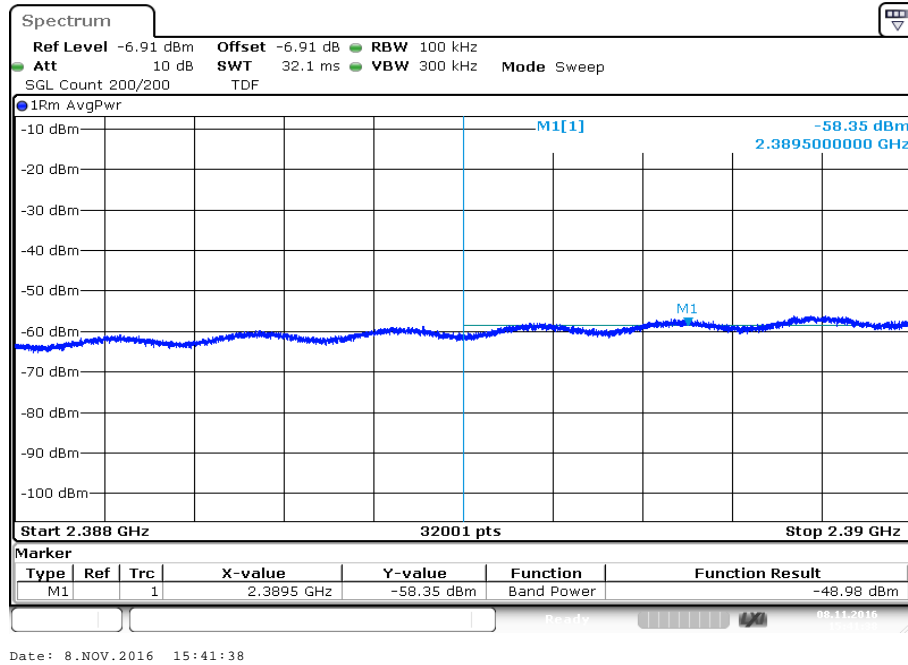


**Plot 2:** Upper band edge, channel 11

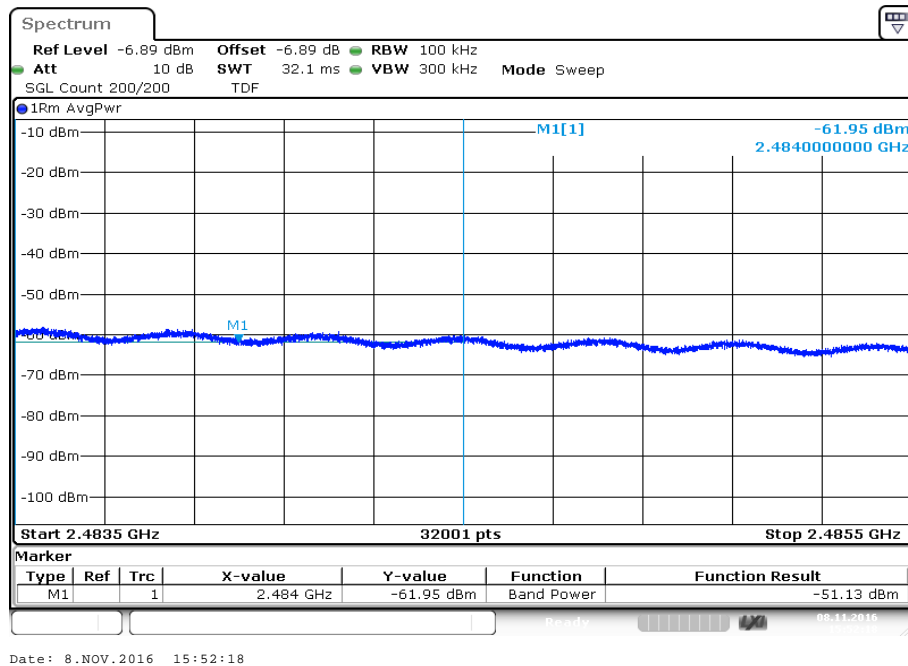


**Plots:** OFDM / g – mode

**Plot 1:** Lower band edge, channel 1

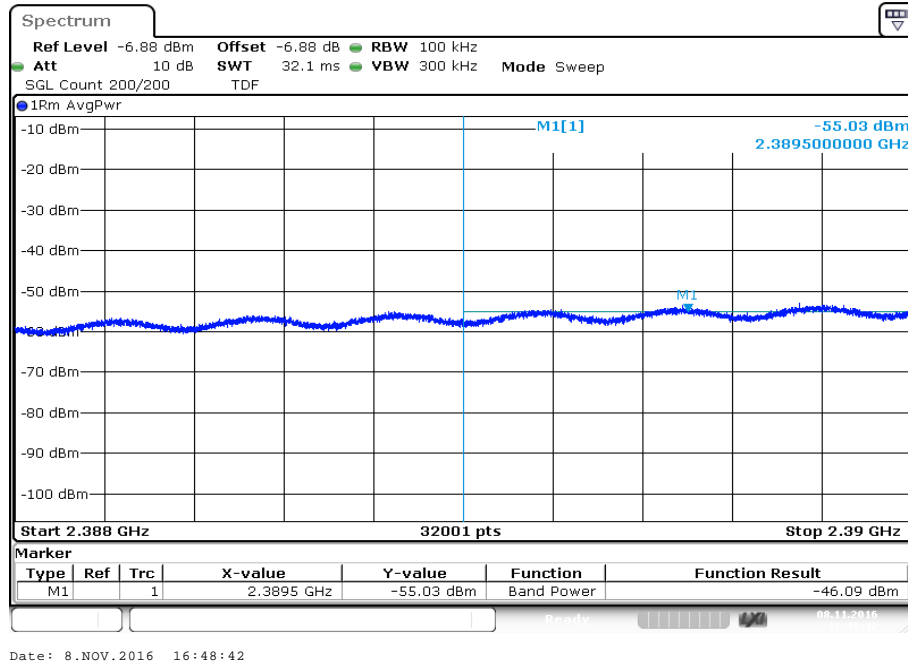


**Plot 2:** Upper band edge, channel 11

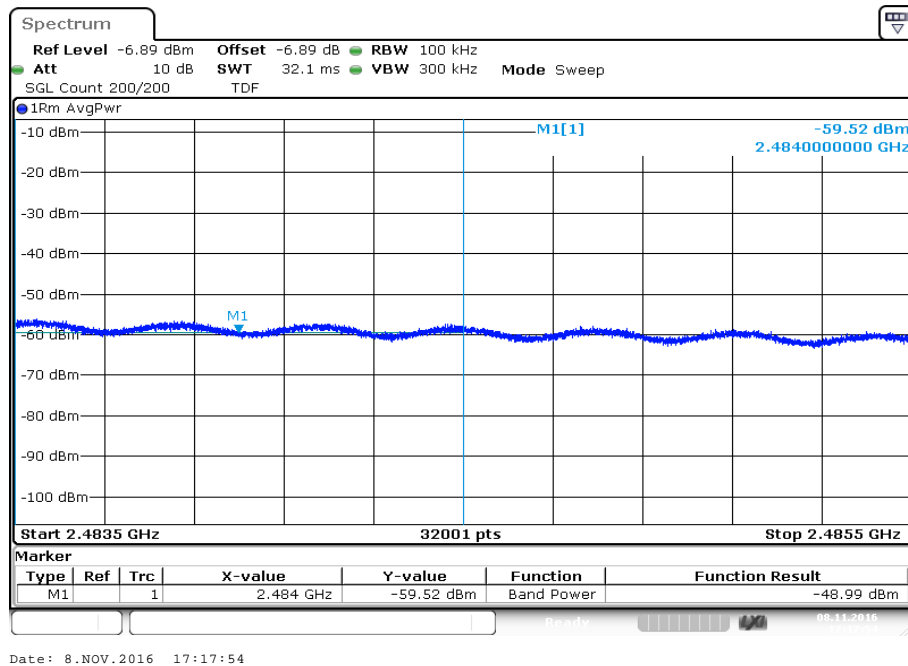


**Plots:** OFDM / n HT20 – mode

**Plot 1:** Lower band edge, channel 1



**Plot 2:** Upper band edge, channel 11



## 12.10 Spurious emissions conducted

### Description:

Measurement of the conducted spurious emissions in transmit mode. The measurement is performed at channel 1, 6 and 11. The measurement is repeated for all modulations.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	100 kHz
Video bandwidth:	500 kHz
Span:	9 kHz to 25 GHz
Trace mode:	Max Hold
Test setup:	See sub clause 7.4 – A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	IC
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	

**Results:** DSSS / b – mode

TX Spurious Emissions Conducted					
DSSS / b – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		1.6	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		1.0	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		1.0	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

**Results:** OFDM / g – mode

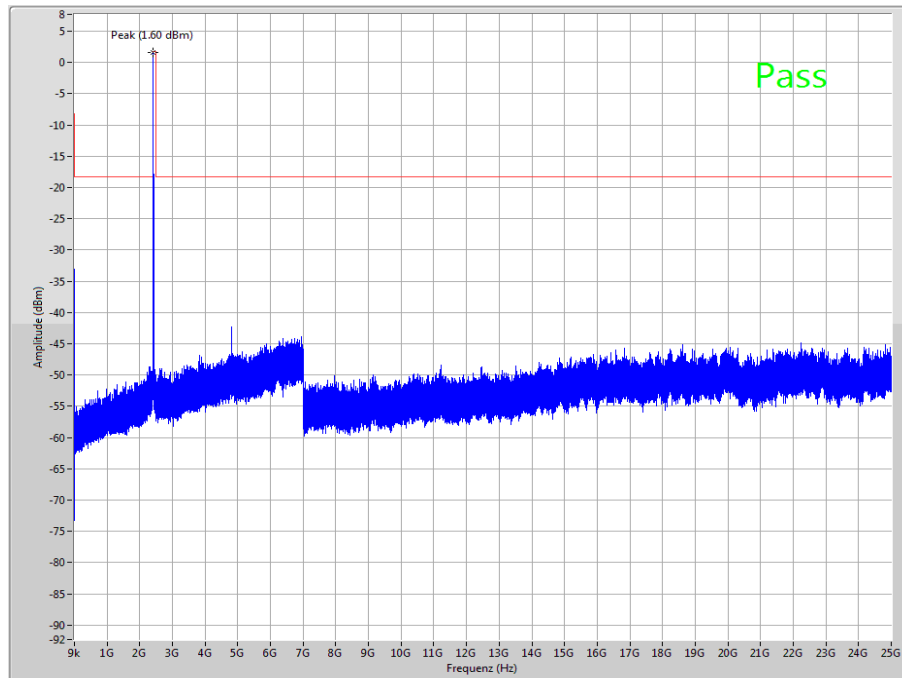
TX Spurious Emissions Conducted					
OFDM / g – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-0.7	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		0.1	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		0.4	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

**Results:** OFDM / n HT20 – mode

TX Spurious Emissions Conducted					
OFDM / n HT20 – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		0.4	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		0.0	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-1.2	30 dBm		Operating frequency
All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

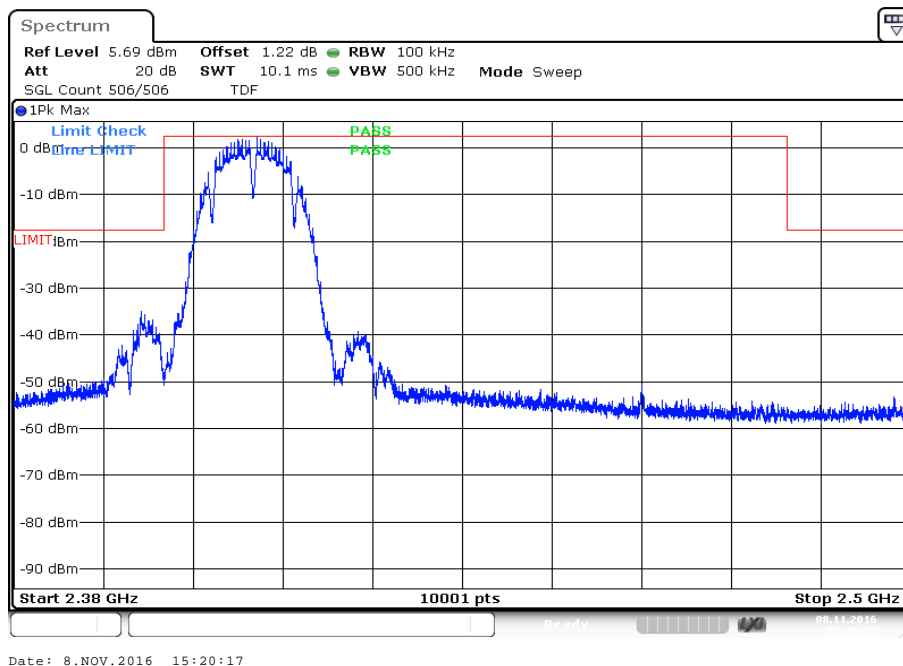
**Plots:** DSSS / b – mode

**Plot 1:** Channel 1, 2412 MHz, up to 25 GHz



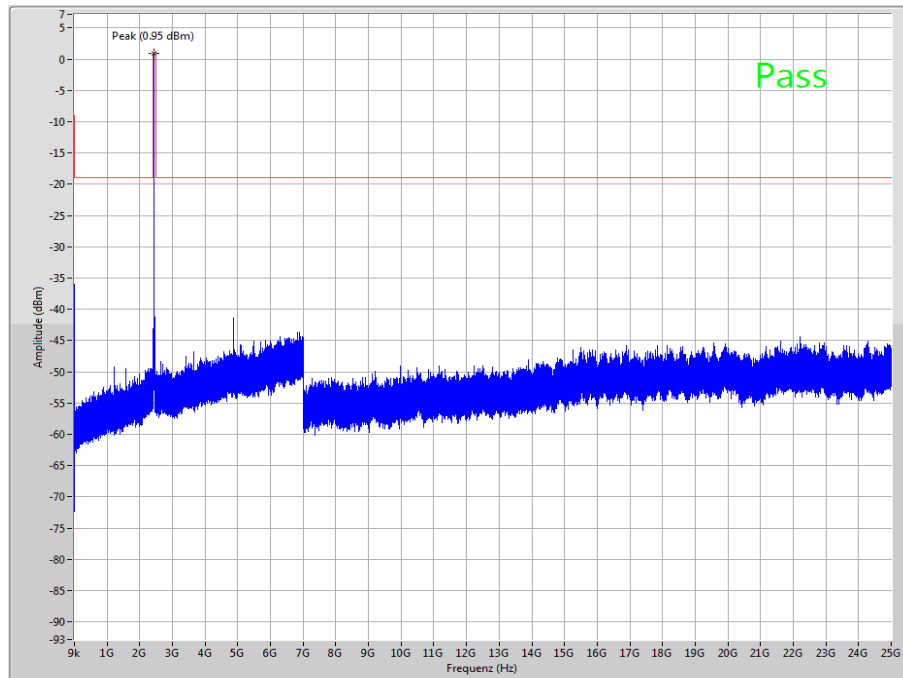
The peak at the beginning of the plot is the LO from the SA.

**Plot 2:** Channel 1, 2412 MHz, zoomed carrier



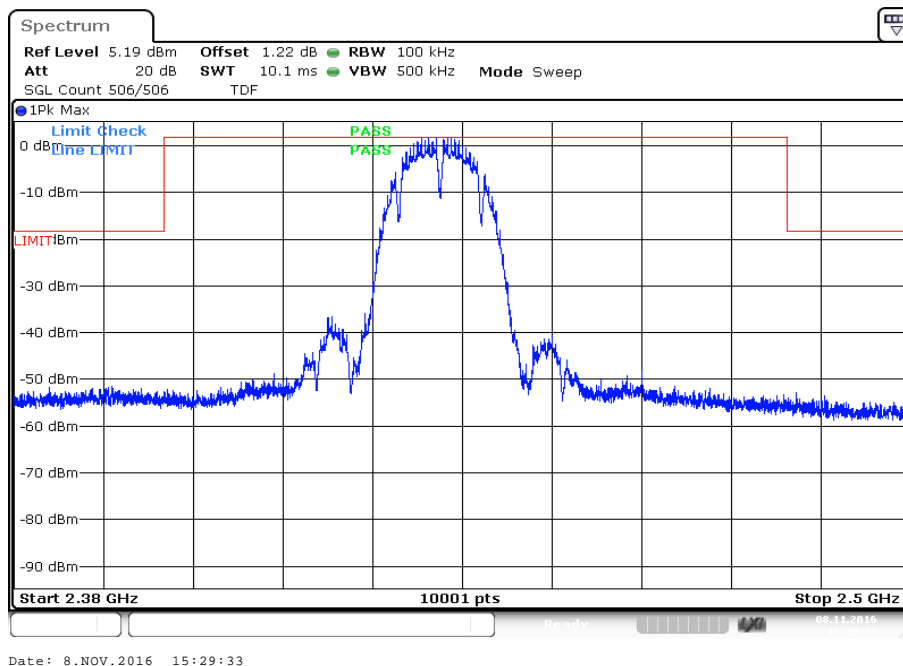
Date: 8. NOV. 2016 15:20:17

**Plot 3:** Channel 6, 2437 MHz, up to 25 GHz



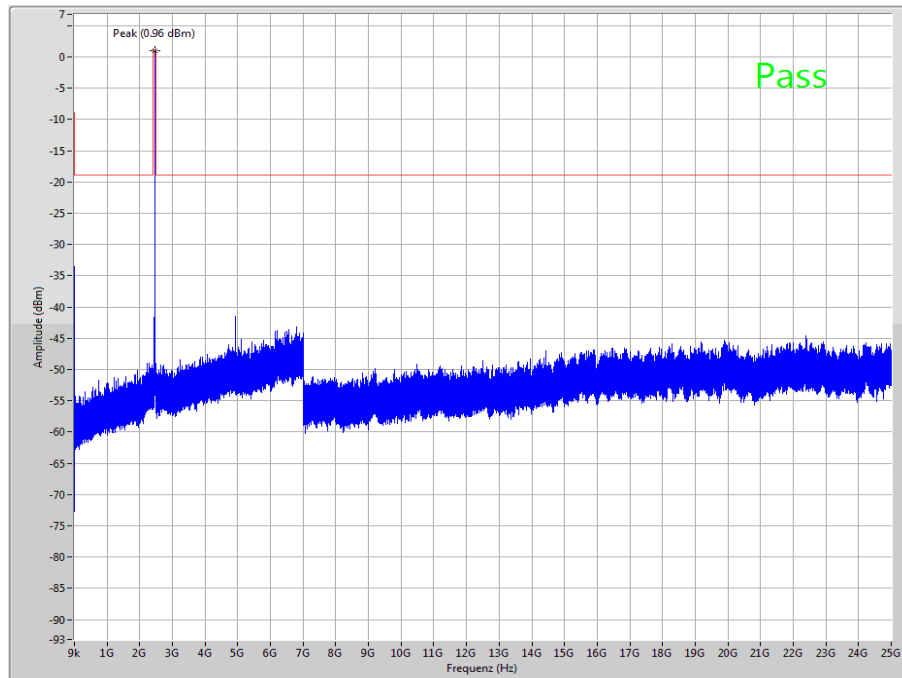
The peak at the beginning of the plot is the LO from the SA.

**Plot 4:** Channel 6, 2437 MHz, zoomed carrier



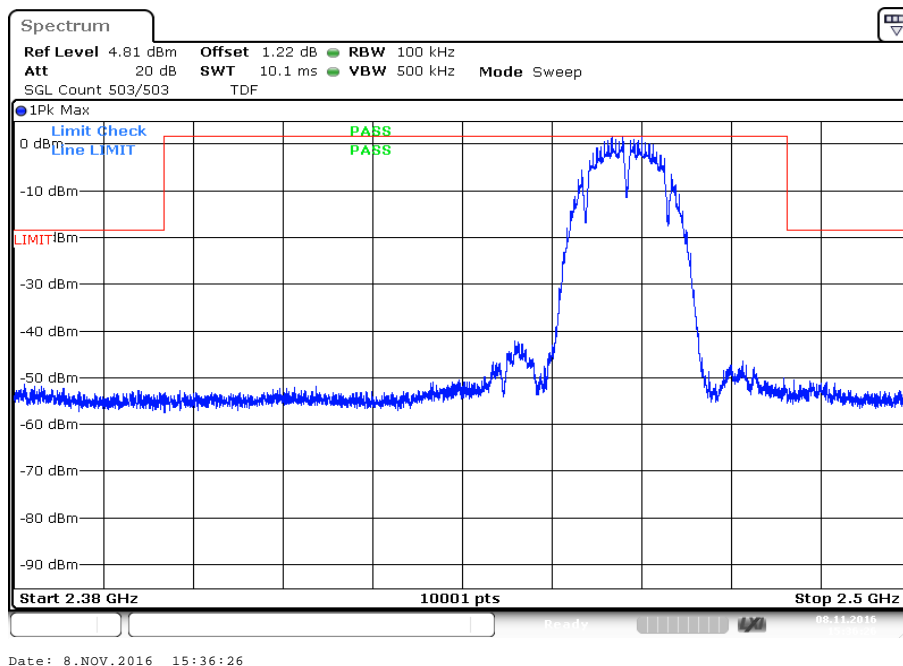
Date: 8.NOV.2016 15:29:33

**Plot 5:** Channel 11, 2462 MHz, up to 25 GHz



The peak at the beginning of the plot is the LO from the SA.

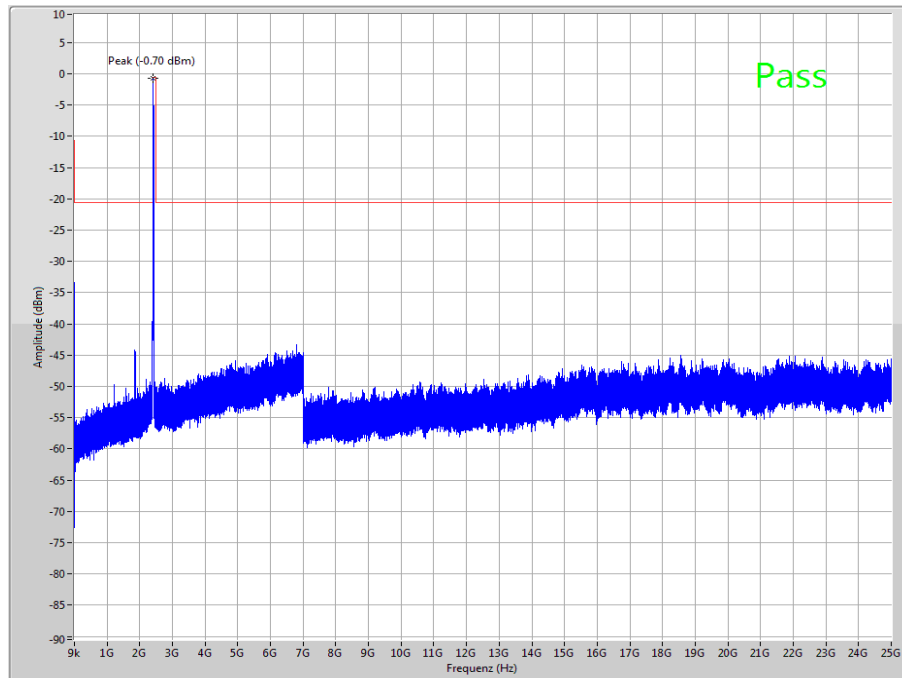
**Plot 6:** Channel 11, 2462 MHz, zoomed carrier



Date: 8.NOV.2016 15:36:26

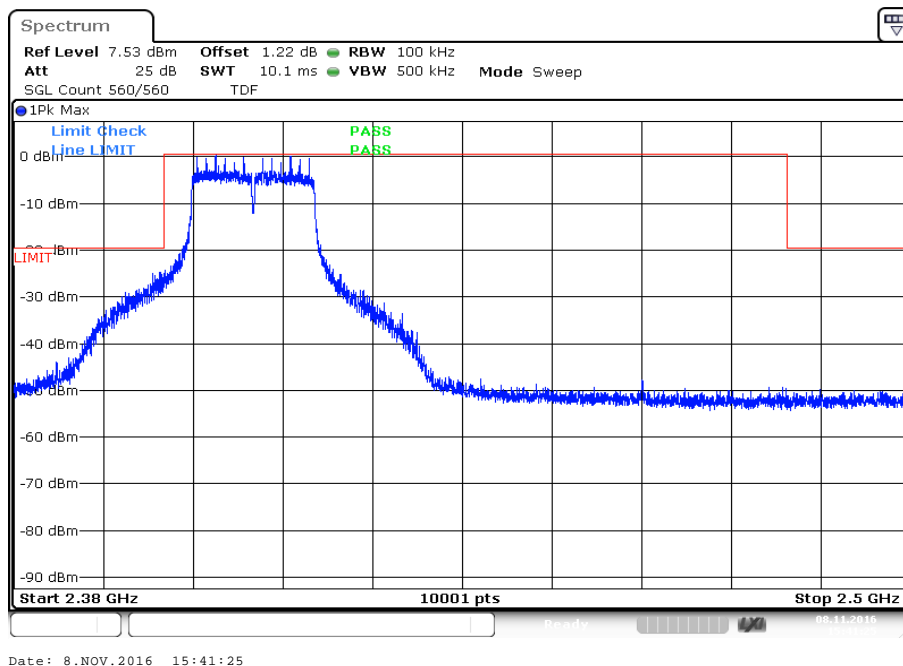
**Plots:** OFDM / g – mode

**Plot 1:** Channel 1, 2412 MHz, up to 25 GHz

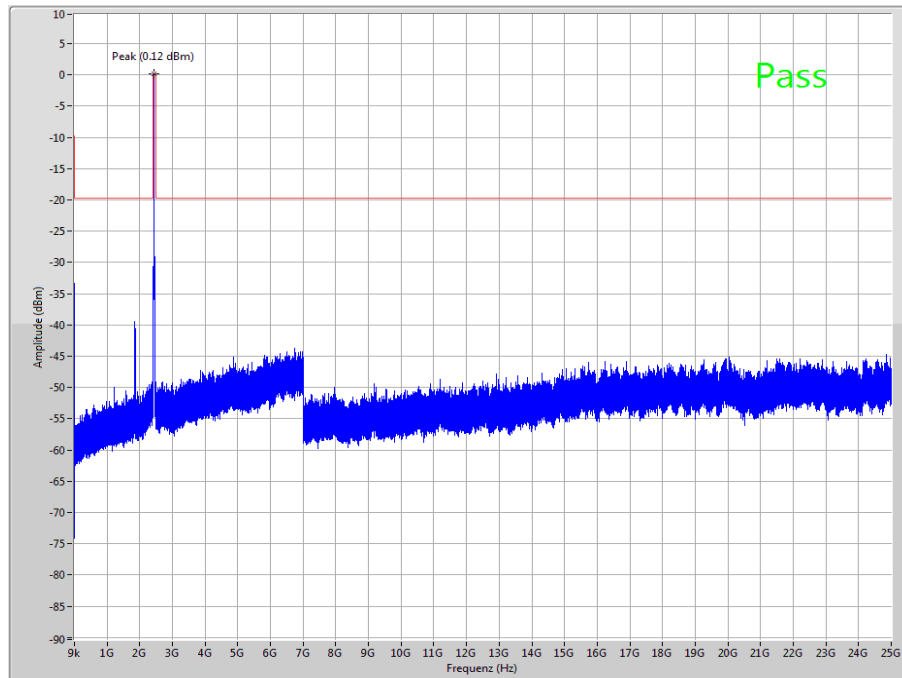


The peak at the beginning of the plot is the LO from the SA.

**Plot 2:** Channel 1, 2412 MHz, zoomed carrier

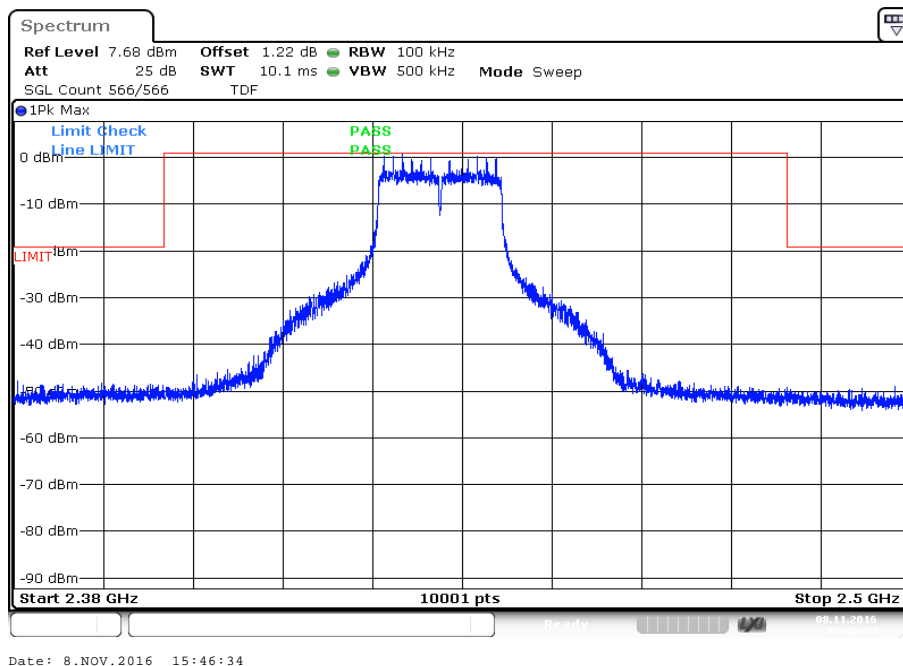


**Plot 3:** Channel 6, 2437 MHz, up to 25 GHz

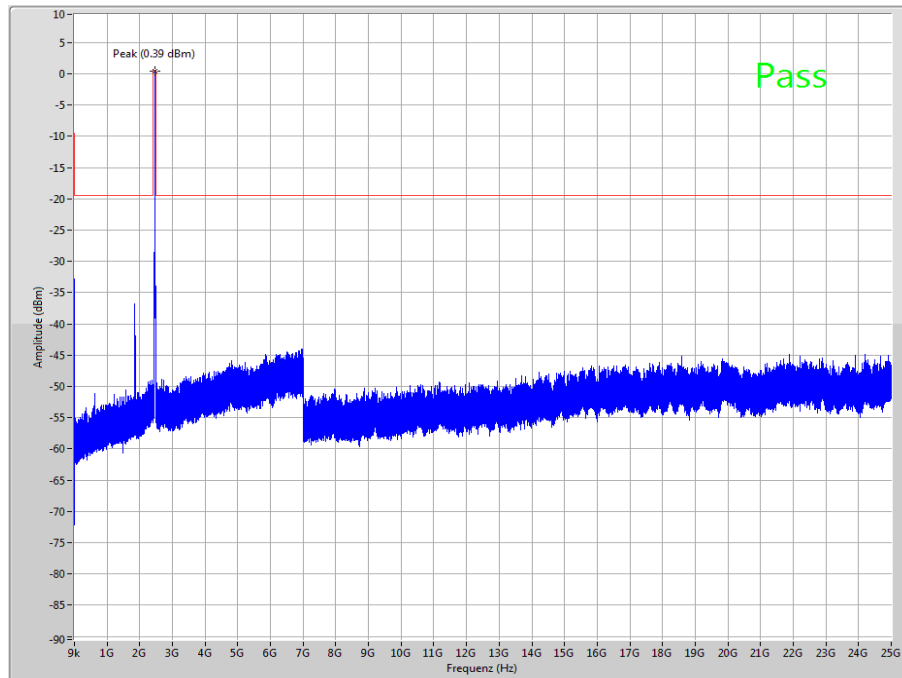


The peak at the beginning of the plot is the LO from the SA.

**Plot 4:** Channel 6, 2437 MHz, zoomed carrier

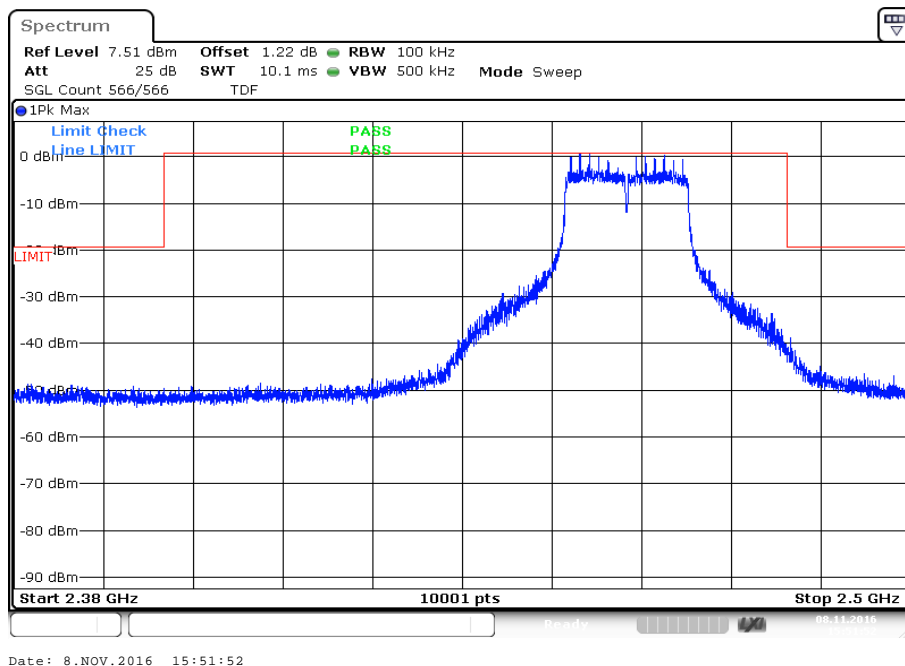


**Plot 5:** Channel 11, 2462 MHz, up to 25 GHz



The peak at the beginning of the plot is the LO from the SA.

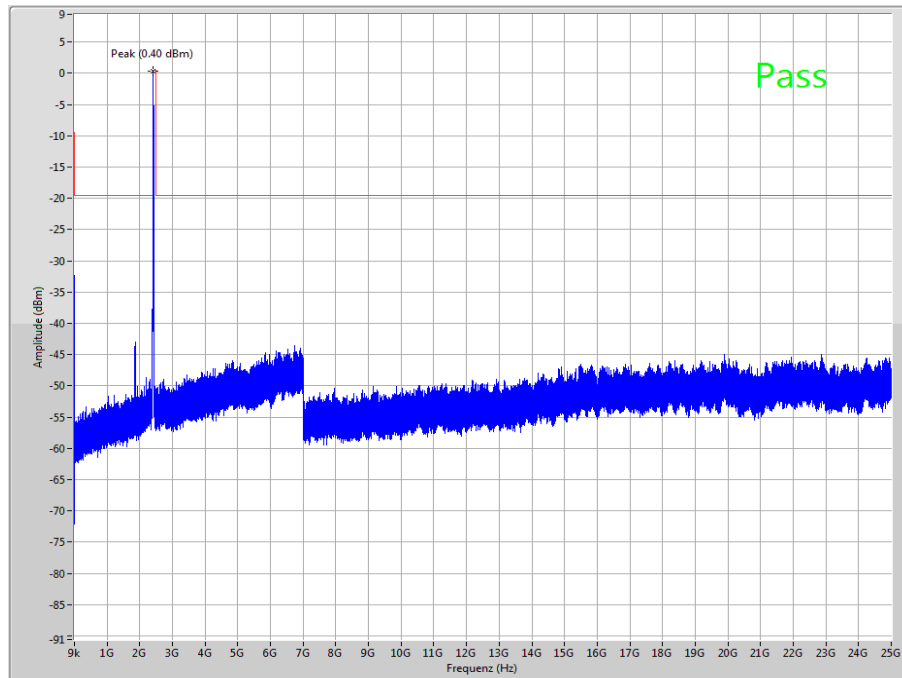
**Plot 6:** Channel 11, 2462 MHz, zoomed carrier



Date: 8. NOV. 2016 15:51:52

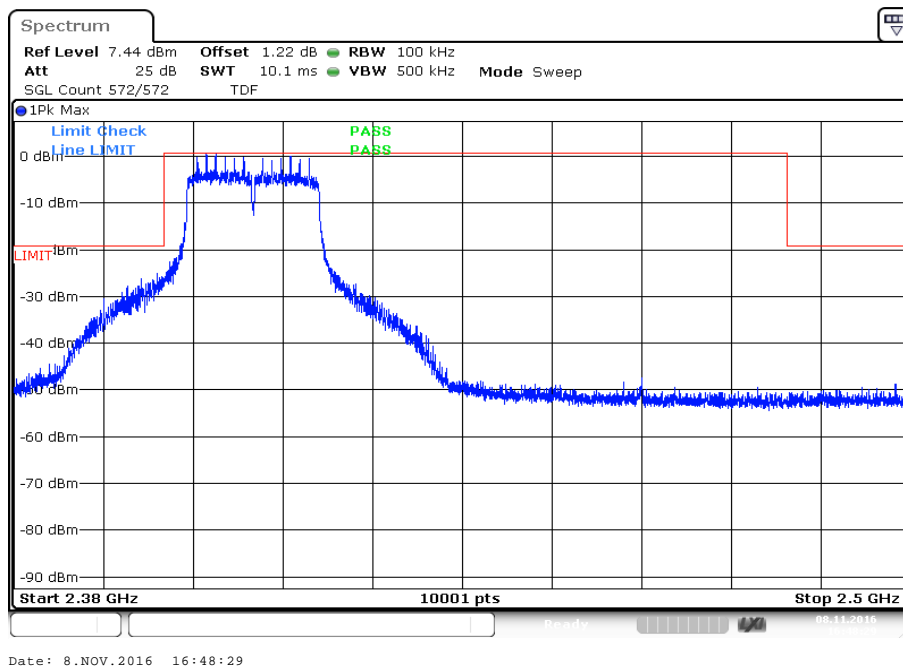
**Plots:** OFDM / n HT 20 – mode

**Plot 1:** Channel 1, 2412 MHz, up to 25 GHz

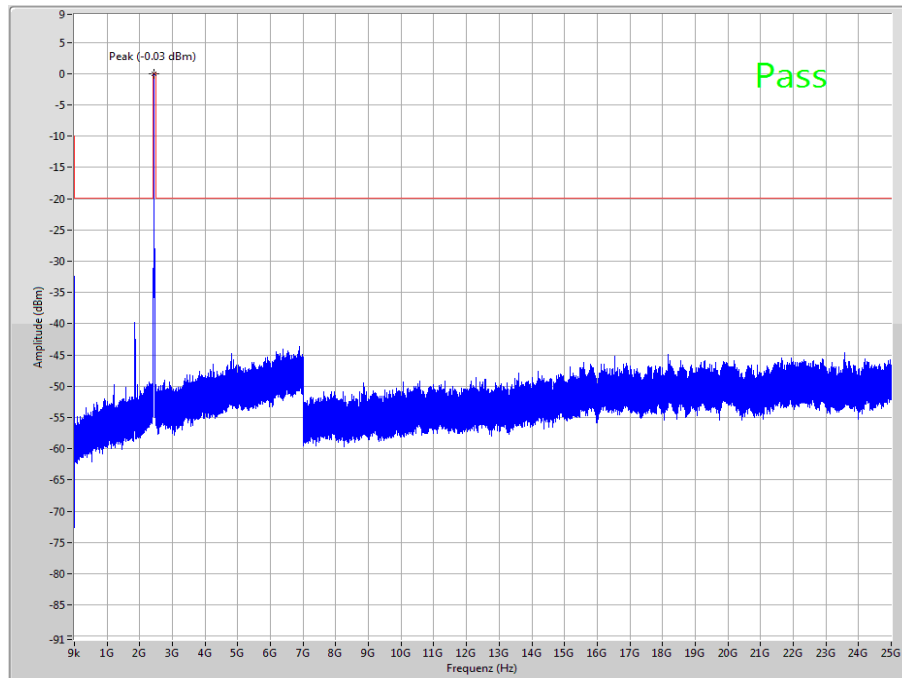


The peak at the beginning of the plot is the LO from the SA.

**Plot 2:** Channel 1, 2412 MHz, zoomed carrier

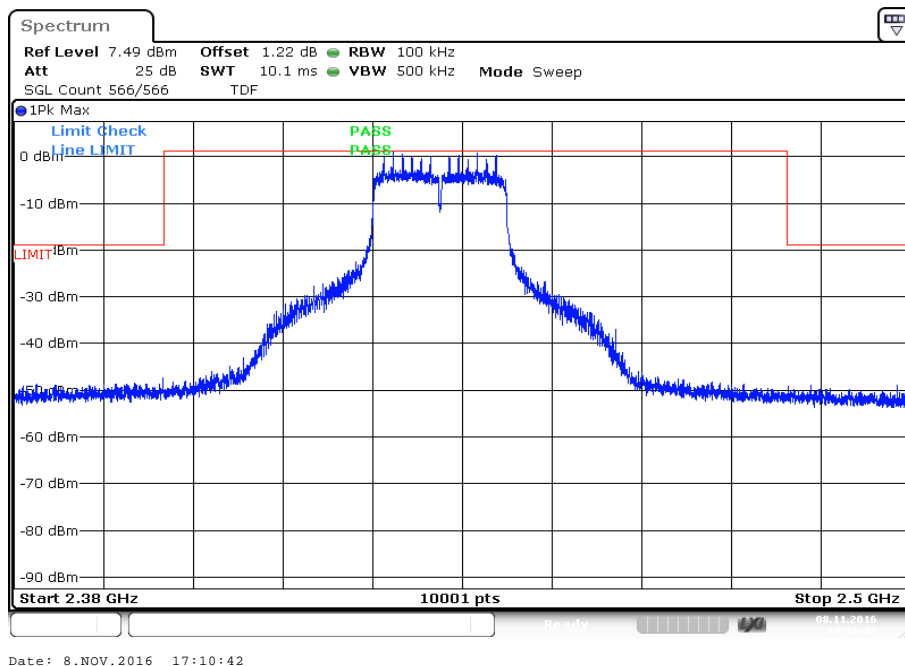


### Plot 3: Channel 6, 2437 MHz, up to 25 GHz

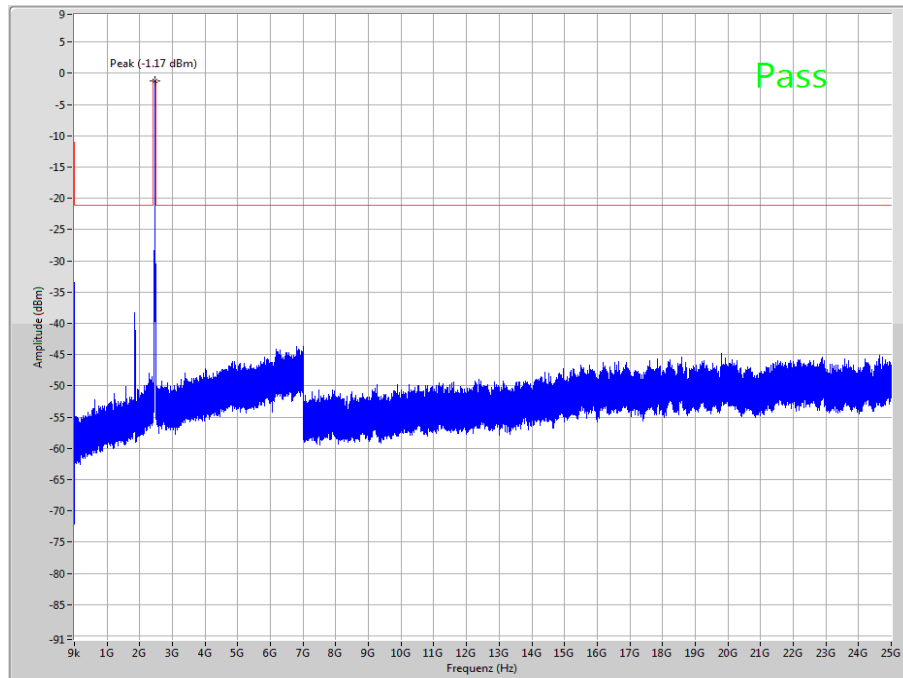


The peak at the beginning of the plot is the LO from the SA.

#### Plot 4: Channel 6, 2437 MHz, zoomed carrier

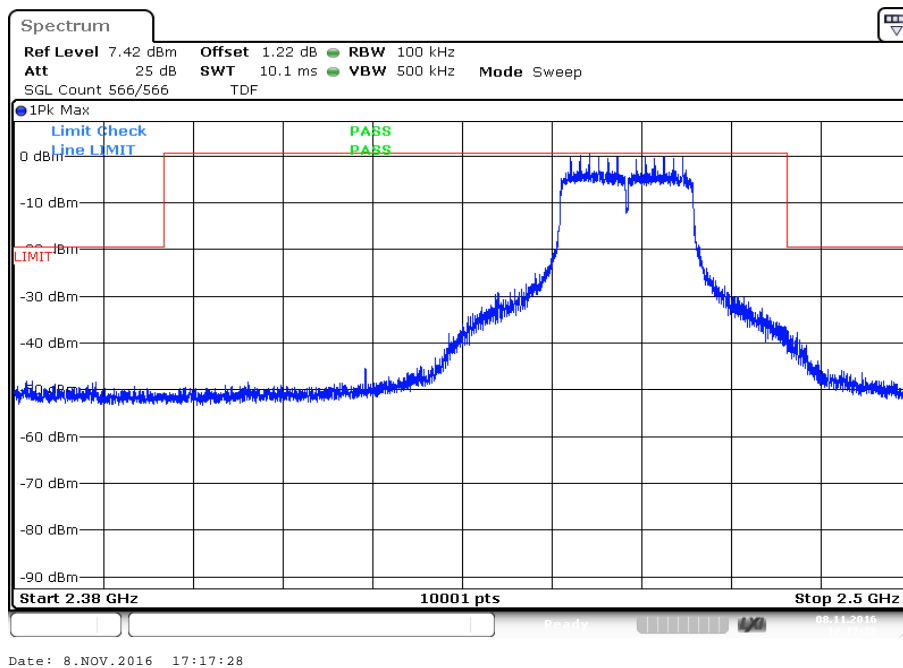


**Plot 5:** Channel 11, 2462 MHz, up to 25 GHz



The peak at the beginning of the plot is the LO from the SA.

**Plot 6:** Channel 11, 2462 MHz, zoomed carrier



Date: 8.NOV.2016 17:17:28

## 12.11 Spurious emissions radiated below 30 MHz

### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to channel 6. This measurement is representative for all channels and modes. 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. 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
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
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
Test setup:	See sub clause 7.2 - A
Measurement uncertainty	See sub clause 9

### Limits:

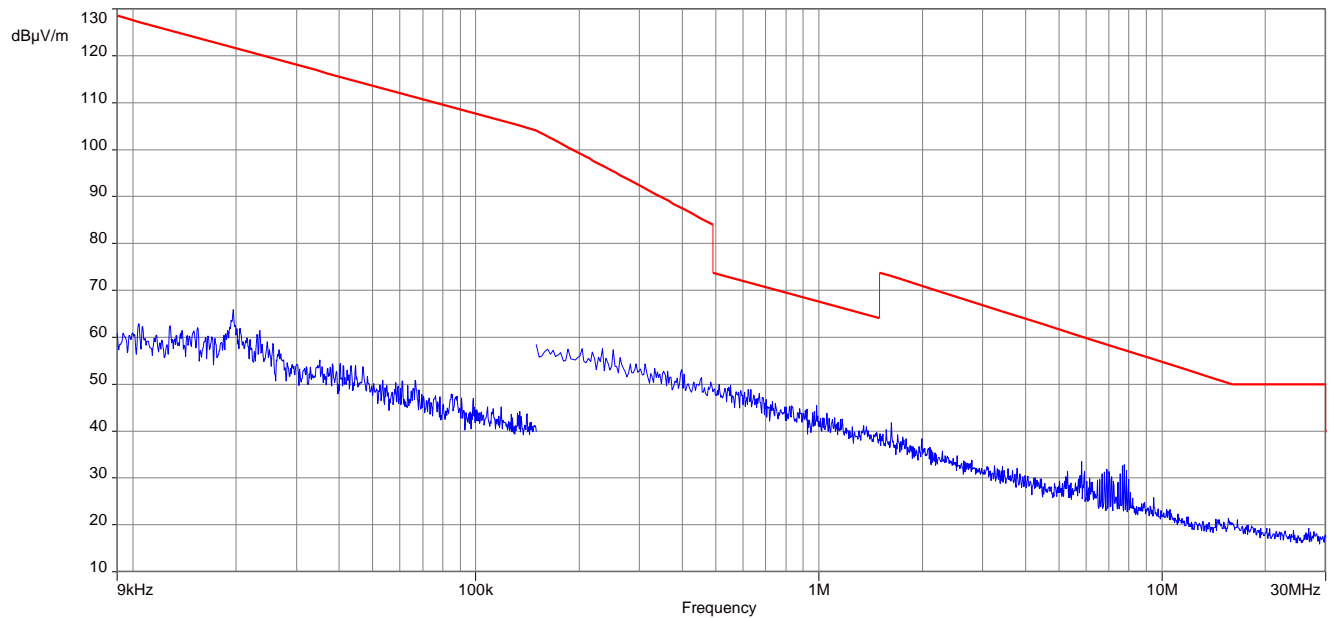
FCC		IC
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

### Results:

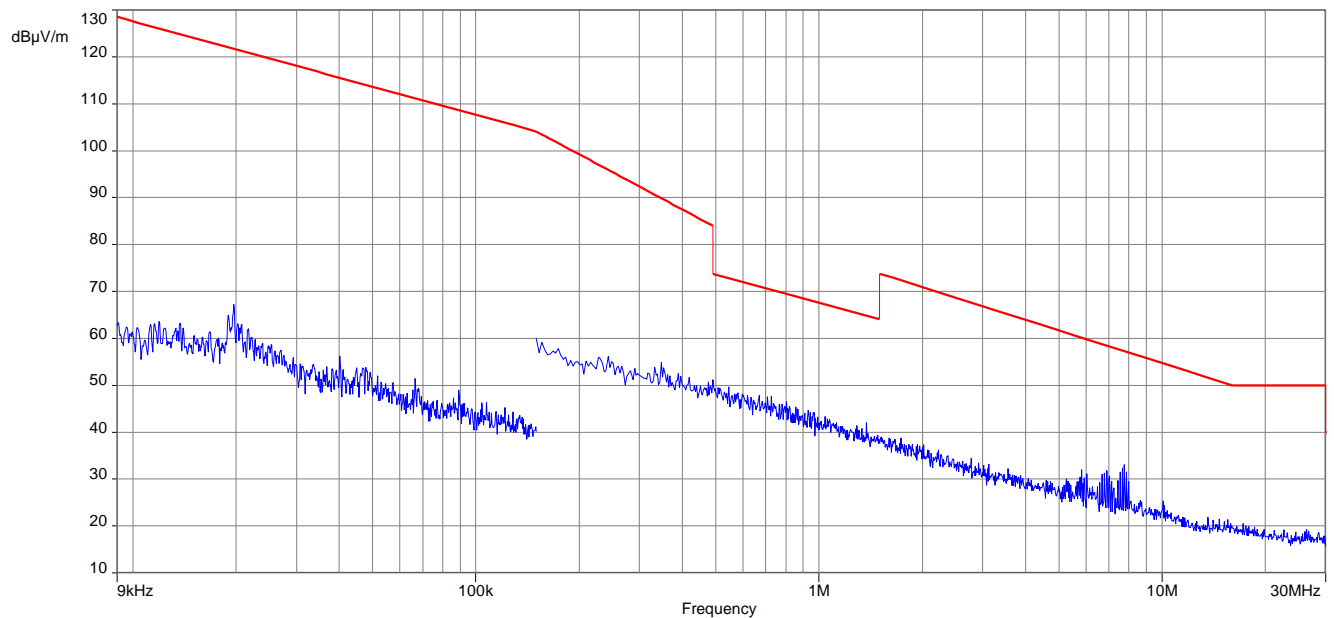
TX Spurious Emissions Radiated < 30 MHz [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
All detected peaks are more than 20 dB below the limit.		

**Plots:** DSSS

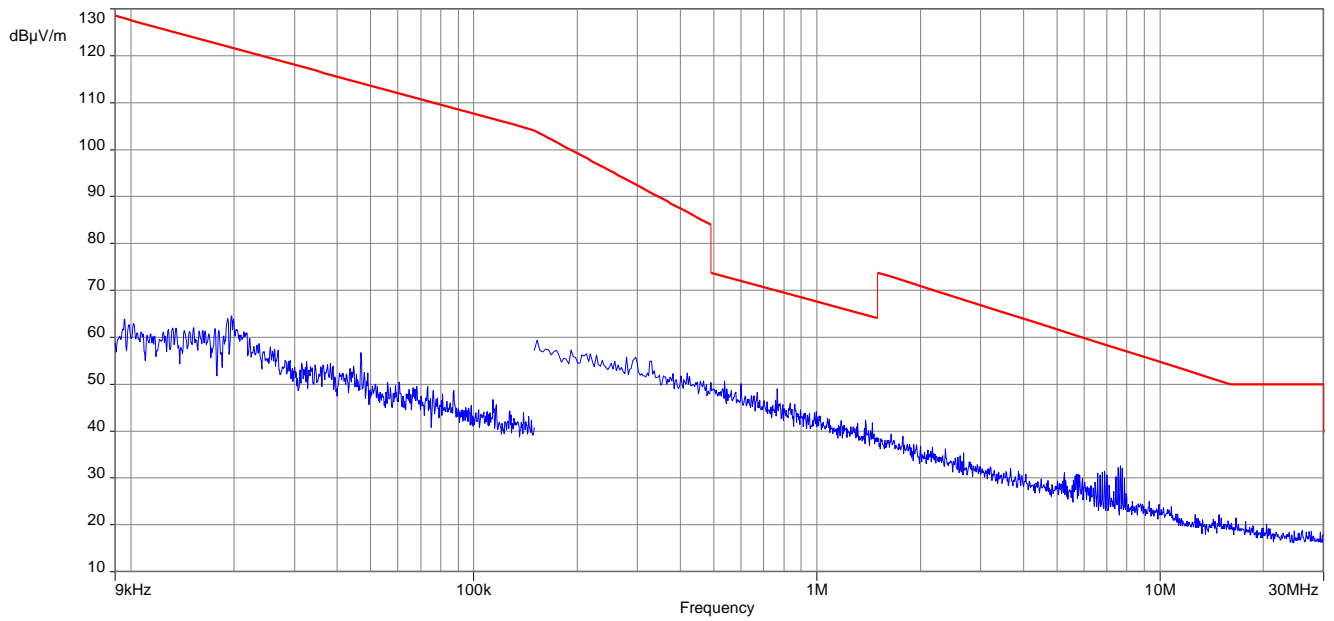
**Plot 1:** 9 kHz to 30 MHz, low channel



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

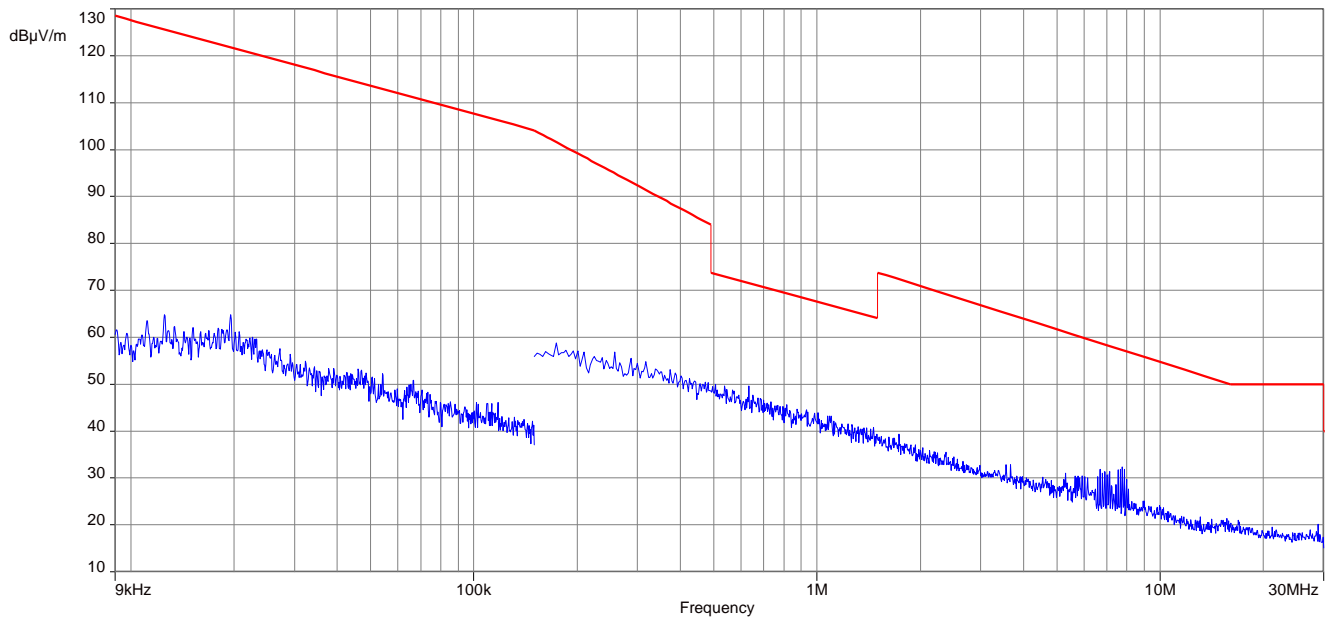


**Plot 3:** 9 kHz to 30 MHz, high channel

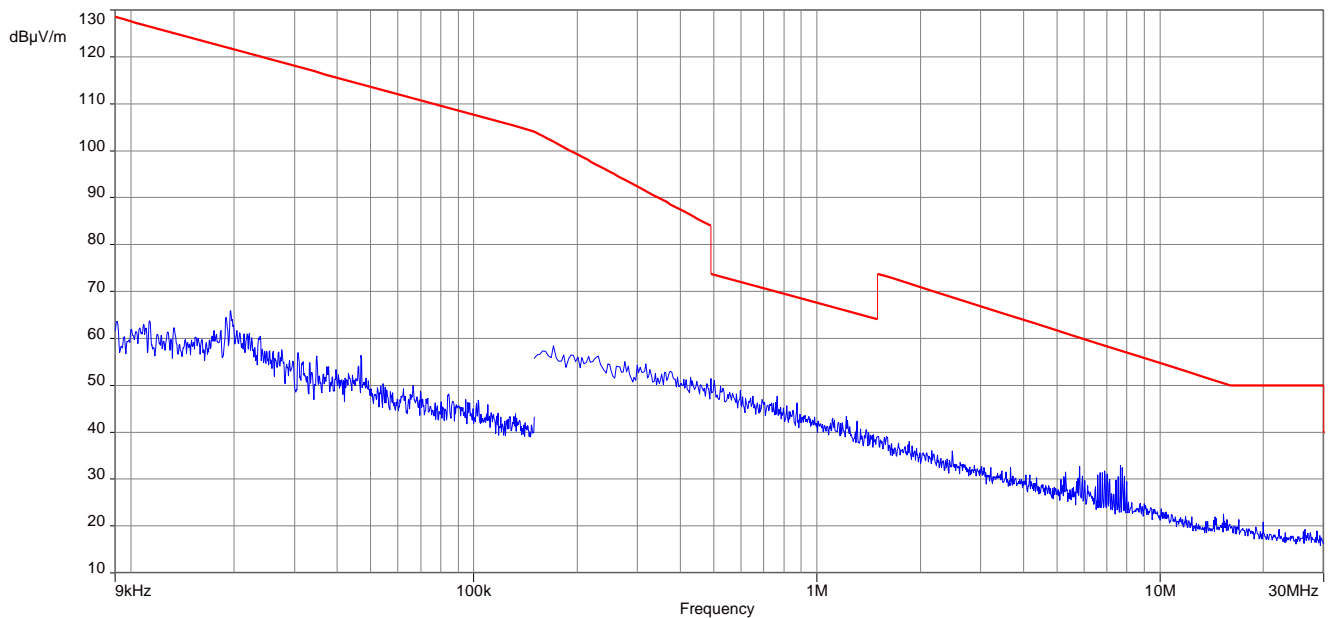


**Plots:** OFDM (20 MHz bandwidth)

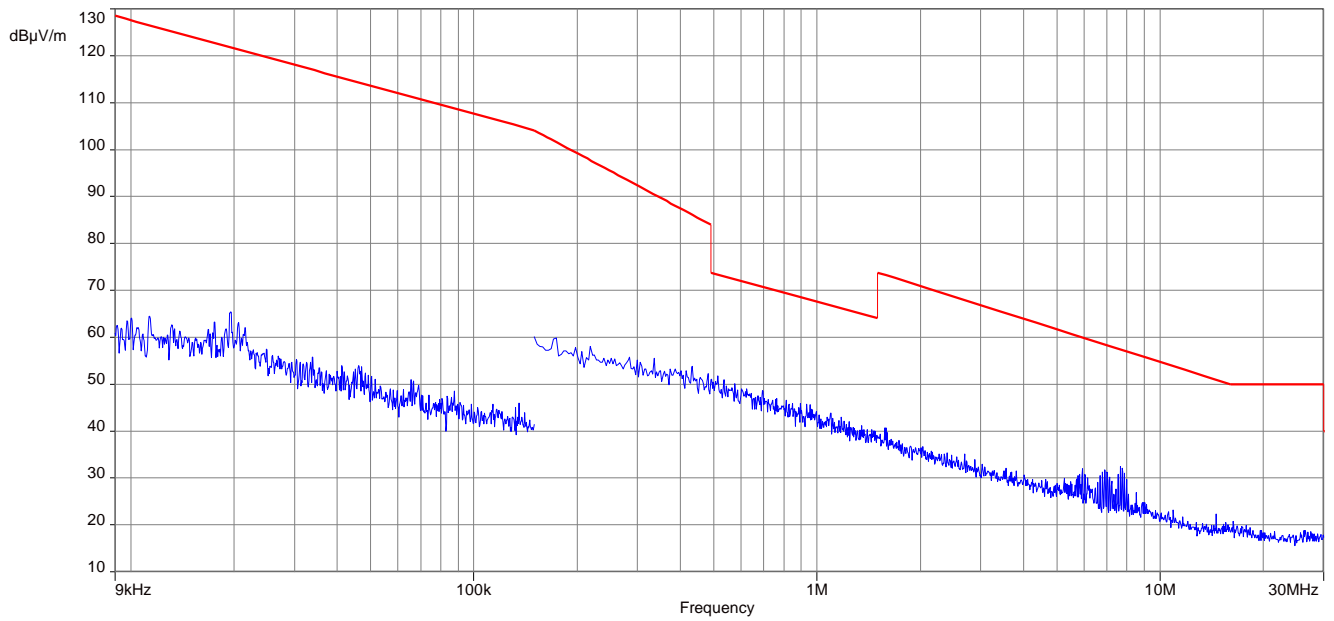
**Plot 1:** 9 kHz to 30 MHz, low channel



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



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



## 12.12 Spurious emissions radiated 30 MHz to 1 GHz

### Description:

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

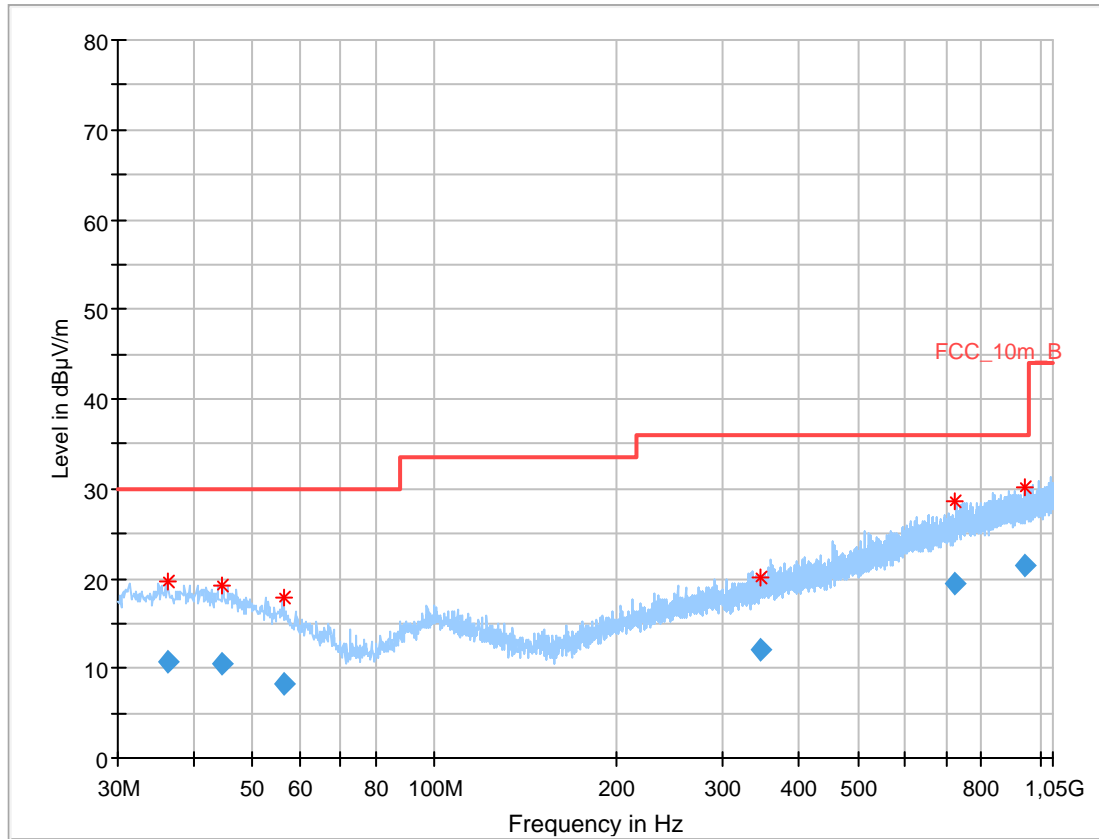
### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	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
Test setup:	See sub clause 7.1 – A
Measurement uncertainty	See sub clause 9

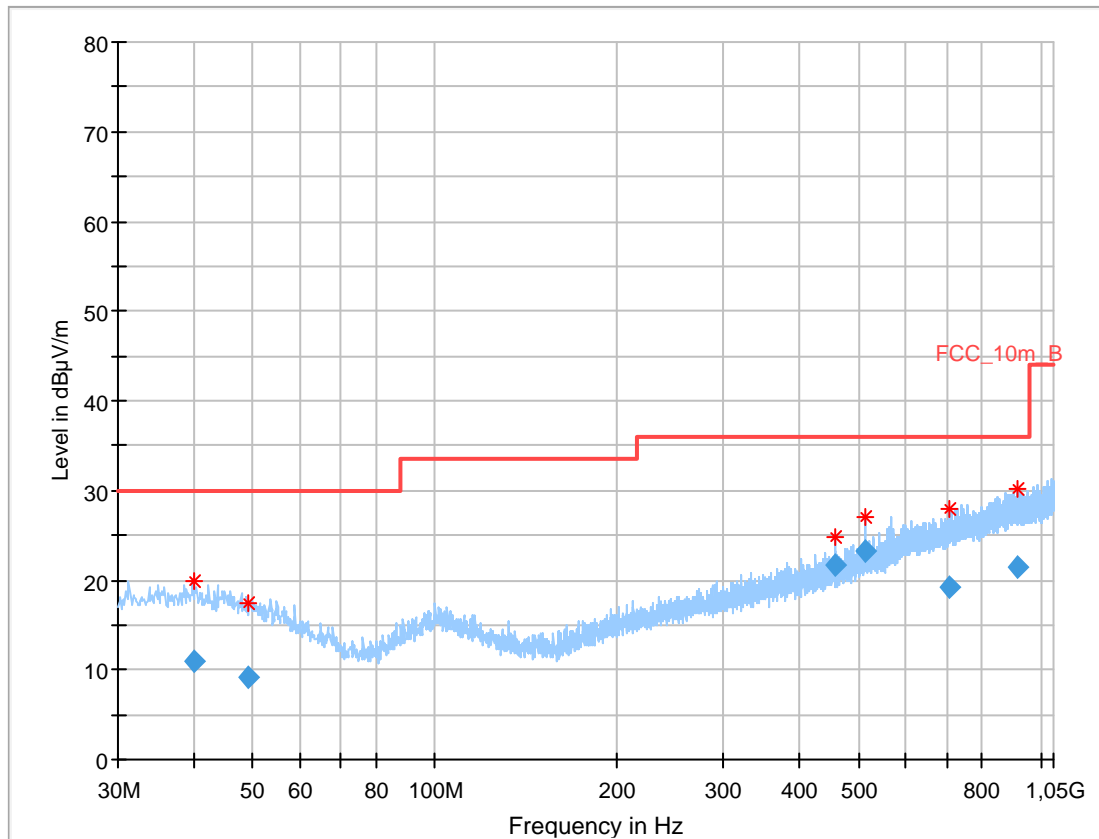
The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

### Limits:

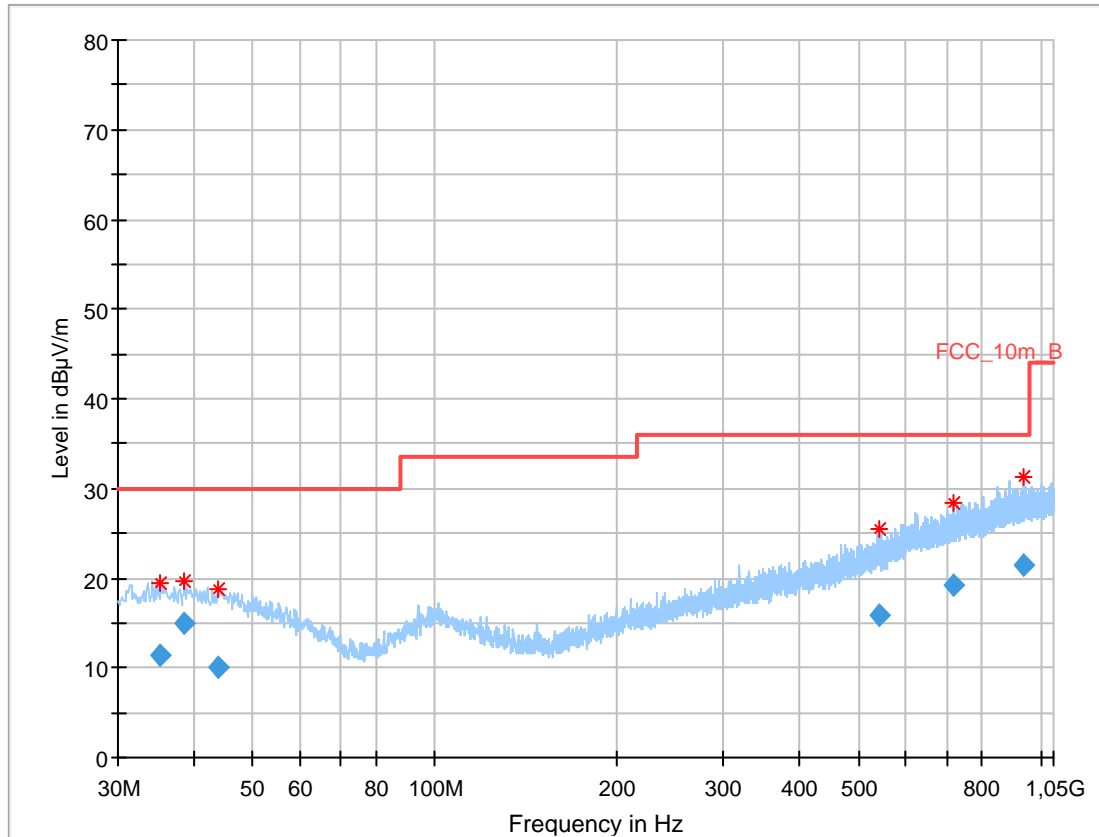
FCC		IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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

**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)	Pol	Azimuth (deg)	Corr. (dB)
36.160950	10.80	30.00	19.20	1000.0	120.000	101.0	H	156.0	13.9
44.531550	10.47	30.00	19.53	1000.0	120.000	101.0	H	317.0	13.9
56.458200	8.22	30.00	21.78	1000.0	120.000	98.0	H	48.0	11.5
346.067250	12.06	36.00	23.94	1000.0	120.000	185.0	H	56.0	15.9
725.563650	19.51	36.00	16.49	1000.0	120.000	185.0	H	238.0	22.1
947.016150	21.48	36.00	14.52	1000.0	120.000	98.0	V	225.0	24.3

**Plot 2:** 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel**Final\_Result:**

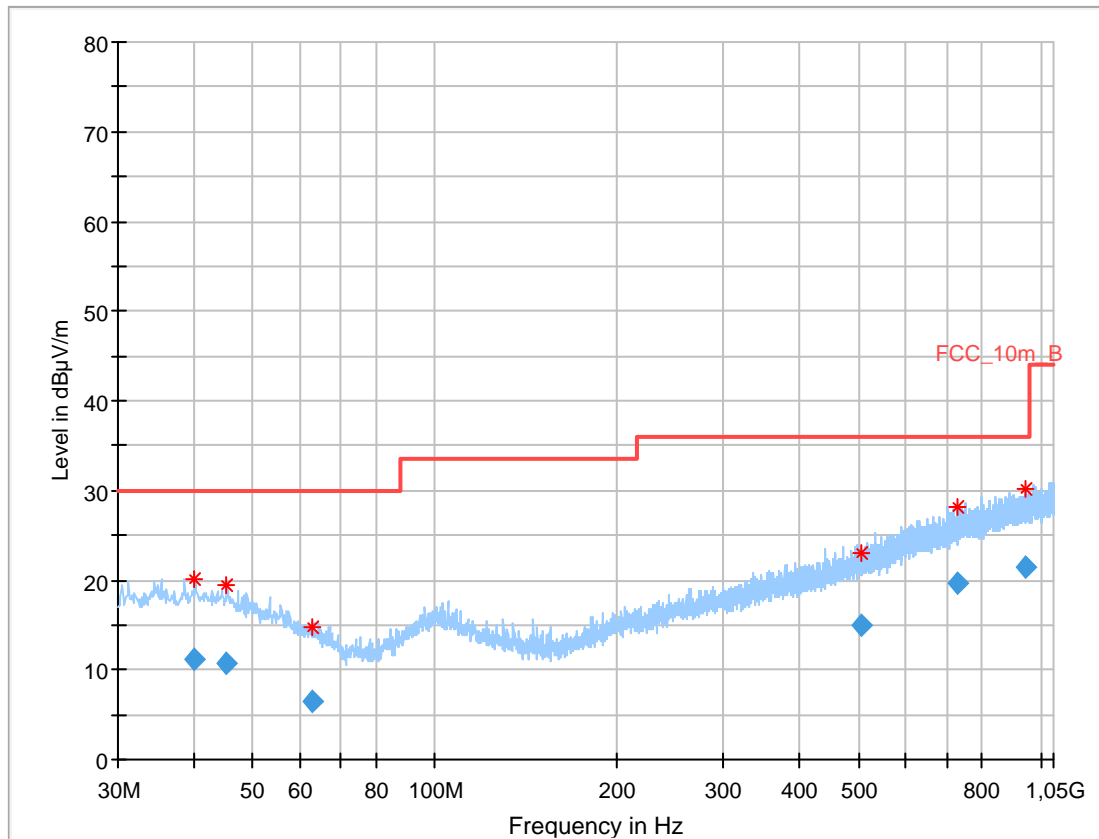
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.187850	10.99	30.00	19.01	1000.0	120.000	101.0	H	9.0	14.0
49.376100	9.15	30.00	20.85	1000.0	120.000	185.0	H	24.0	12.8
459.009300	21.64	36.00	14.36	1000.0	120.000	185.0	H	201.0	17.8
512.988000	23.14	36.00	12.86	1000.0	120.000	185.0	H	162.0	18.9
708.600600	19.16	36.00	16.84	1000.0	120.000	100.0	V	179.0	21.7
914.383200	21.45	36.00	14.55	1000.0	120.000	98.0	V	236.0	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)	Pol	Azimuth (deg)	Corr. (dB)
35.070750	11.38	30.00	18.62	1000.0	120.000	185.0	V	215.0	13.8
38.693400	15.00	30.00	15.00	1000.0	120.000	101.0	V	275.0	14.0
43.732050	10.00	30.00	20.00	1000.0	120.000	98.0	H	215.0	13.9
541.375500	15.77	36.00	20.23	1000.0	120.000	185.0	H	121.0	19.2
715.562250	19.25	36.00	16.75	1000.0	120.000	101.0	V	111.0	21.9
933.341700	21.42	36.00	14.58	1000.0	120.000	101.0	V	166.0	24.2

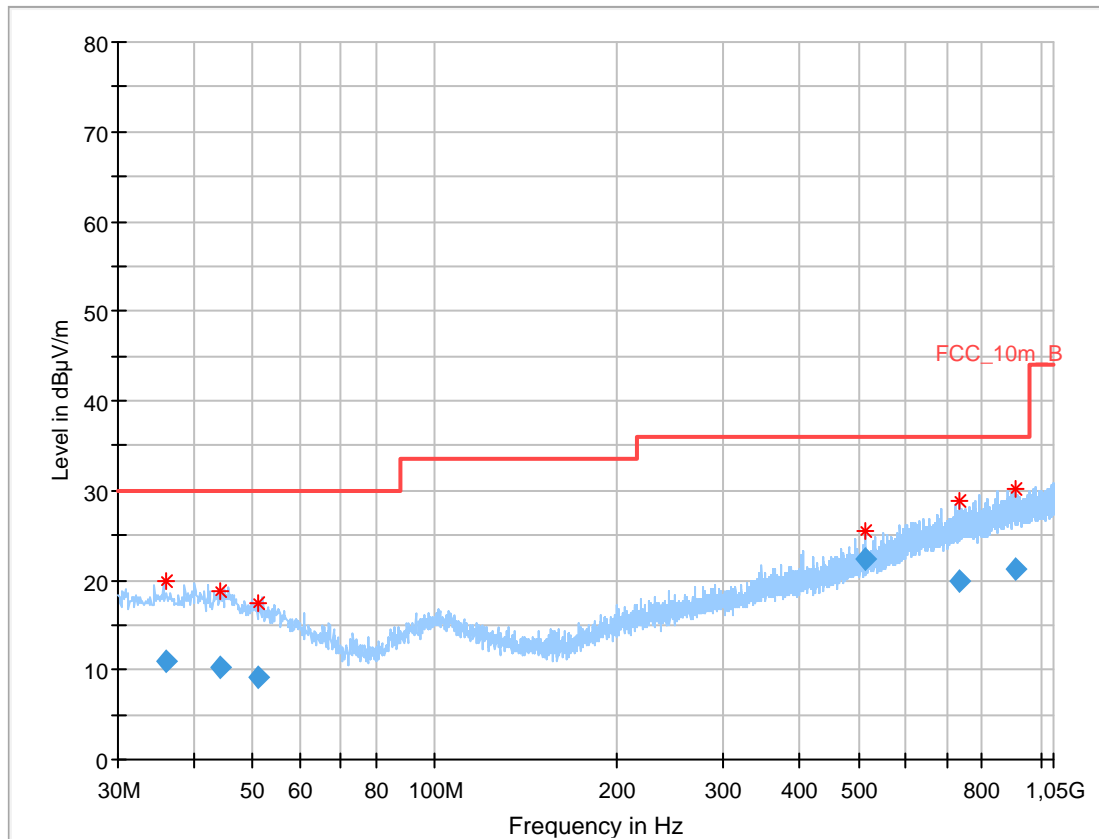
**Plot:** OFDM (20 MHz bandwidth)

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

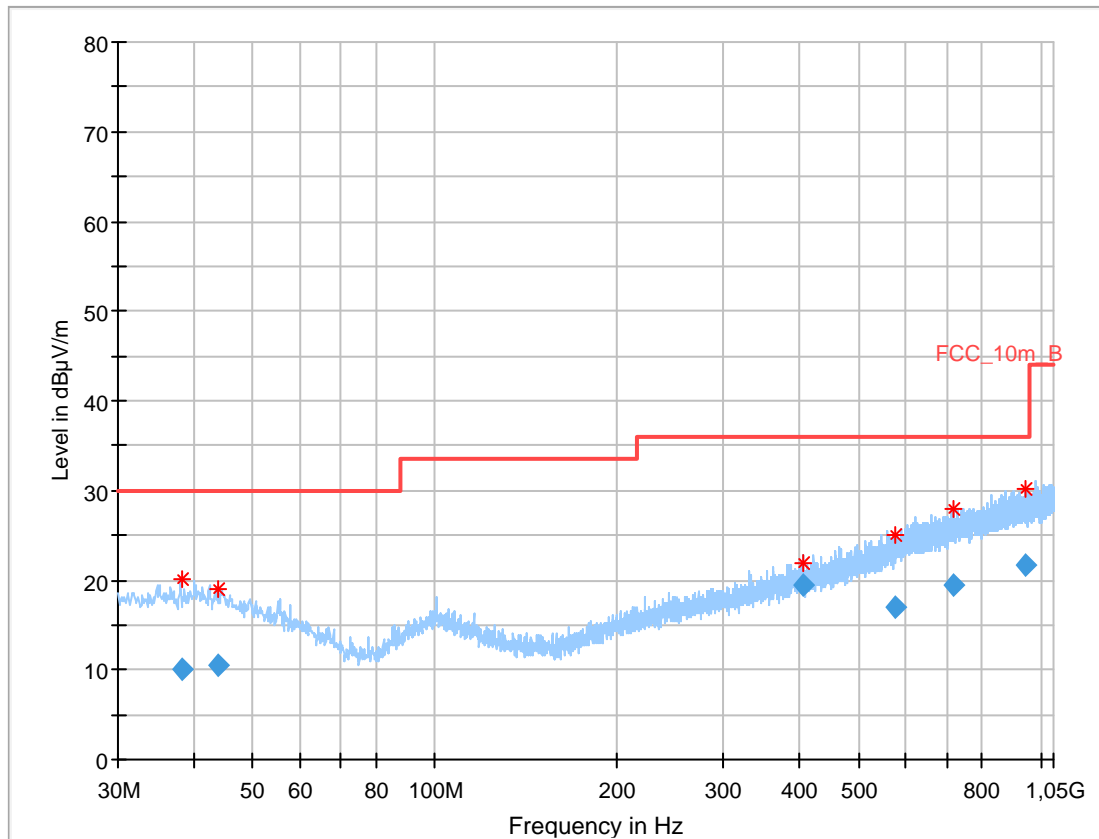


**Final\_Result:**

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.956250	11.13	30.00	18.87	1000.0	120.000	101.0	V	257.0	14.0
45.101700	10.70	30.00	19.30	1000.0	120.000	101.0	H	100.0	13.8
62.892900	6.54	30.00	23.46	1000.0	120.000	101.0	V	353.0	9.9
504.139650	14.90	36.00	21.10	1000.0	120.000	185.0	H	54.0	18.8
728.055000	19.61	36.00	16.39	1000.0	120.000	179.0	V	299.0	22.2
944.040450	21.53	36.00	14.47	1000.0	120.000	185.0	V	207.0	24.2

**Plot 2:** 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel**Final\_Result:**

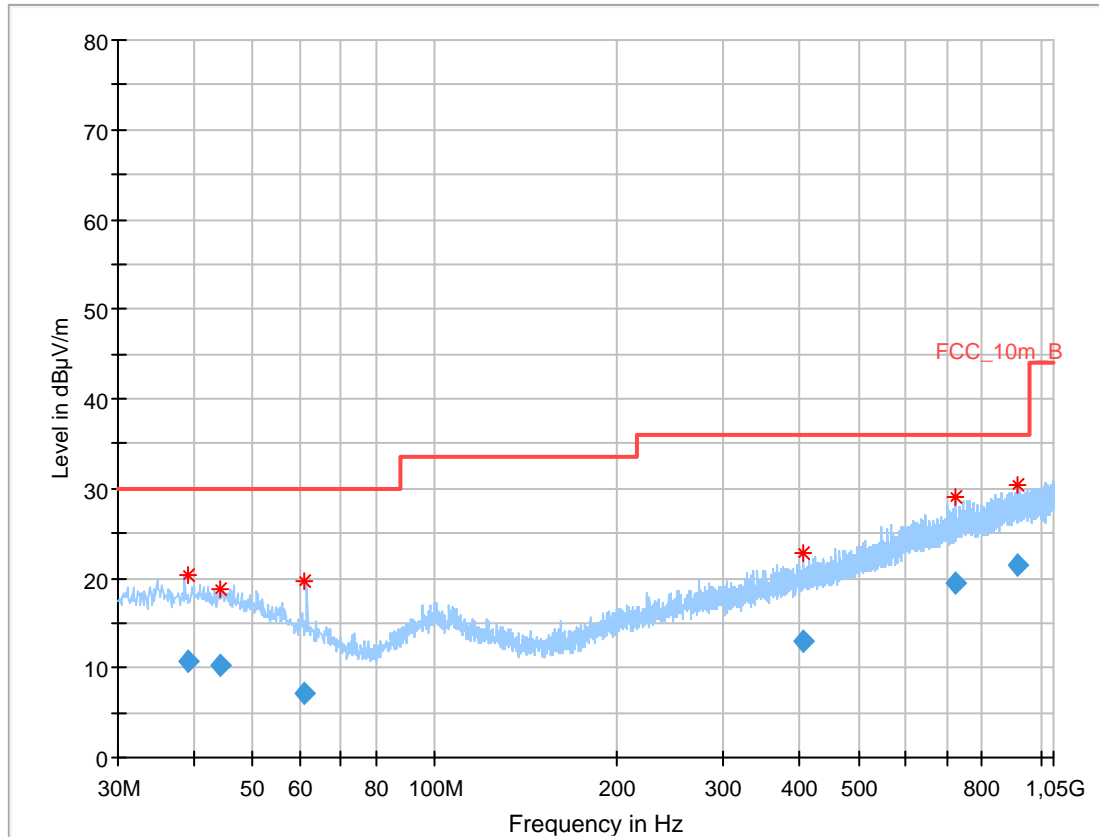
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.056250	10.85	30.00	19.15	1000.0	120.000	101.0	H	223.0	13.8
44.325900	10.39	30.00	19.61	1000.0	120.000	185.0	V	130.0	13.9
51.155550	9.19	30.00	20.81	1000.0	120.000	98.0	H	333.0	12.5
512.981400	22.40	36.00	13.60	1000.0	120.000	185.0	H	196.0	18.9
735.850050	19.82	36.00	16.18	1000.0	120.000	101.0	V	169.0	22.4
910.726500	21.32	36.00	14.68	1000.0	120.000	98.0	H	207.0	24.1

**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)	Pol	Azimuth (deg)	Corr. (dB)
38.285700	10.00	30.00	20.00	1000.0	120.000	179.0	V	237.0	14.0
43.999350	10.57	30.00	19.43	1000.0	120.000	101.0	V	50.0	13.9
404.968650	19.49	36.00	16.51	1000.0	120.000	185.0	H	205.0	16.9
577.328100	16.88	36.00	19.12	1000.0	120.000	185.0	V	350.0	20.1
719.776050	19.48	36.00	16.52	1000.0	120.000	185.0	H	114.0	22.0
942.170250	21.57	36.00	14.43	1000.0	120.000	101.0	V	152.0	24.2

**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)	Pol	Azimuth (deg)	Corr. (dB)
39.245550	10.66	30.00	19.34	1000.0	120.000	101.0	V	159.0	14.0
44.186100	10.26	30.00	19.74	1000.0	120.000	100.0	H	298.0	13.9
60.917400	7.24	30.00	22.76	1000.0	120.000	98.0	H	278.0	10.4
404.996250	13.07	36.00	22.93	1000.0	120.000	185.0	H	168.0	16.9
721.145700	19.46	36.00	16.54	1000.0	120.000	185.0	V	298.0	22.0
914.637750	21.41	36.00	14.59	1000.0	120.000	179.0	V	253.0	24.2

### 12.13 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:	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
Test setup:	See sub clause 7.2 – B See sub clause 7.3 – A
Measurement uncertainty	See sub clause 9

#### Limits:

FCC		IC
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]
4824.0	Peak	56.0	1810.3	Peak	No RB	1812	Peak	48.6
	AVG	50.6		AVG			AVG	43.3
-/-	Peak	-/-	3063.7	Peak	No RB	3112	Peak	52.0
	AVG	-/-		AVG			AVG	45.7
-/-	Peak	-/-	4874.0	Peak	57.0	4924	Peak	57.0
	AVG	-/-		AVG	52.3		AVG	52.4

**Results:** OFDM (20 MHz bandwidth)

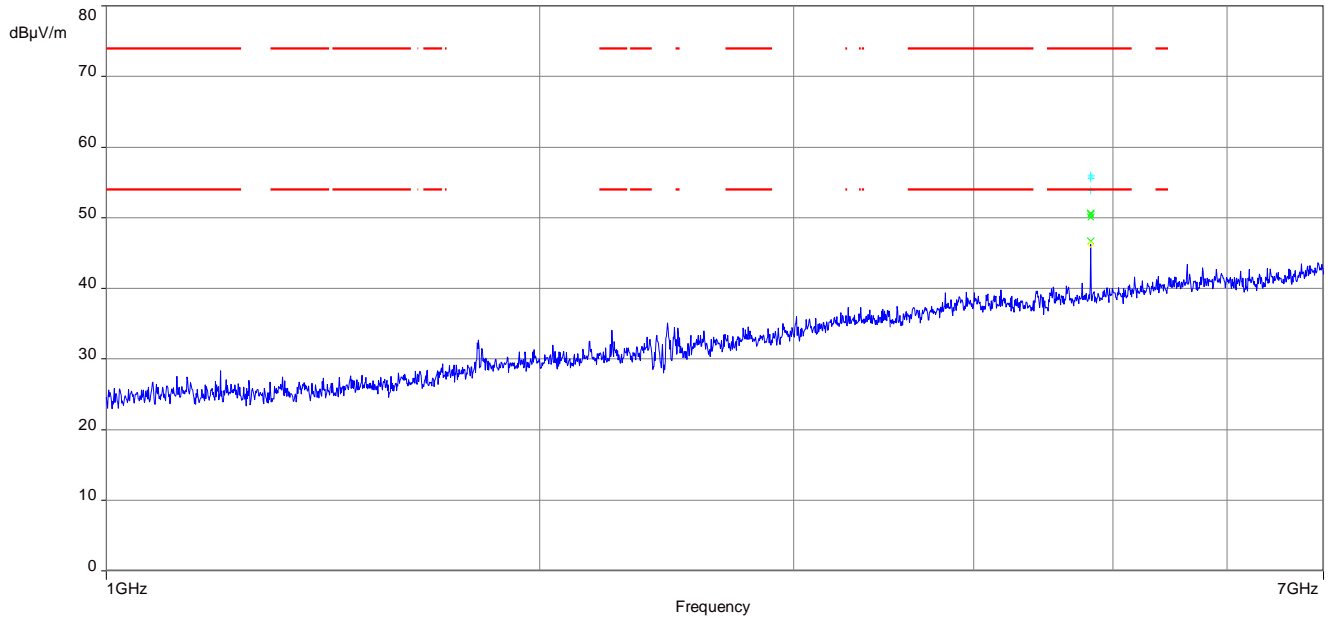
TX Spurious Emissions Radiated [dB $\mu$ V/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]
4824.0	Peak	58.9	4874.0	Peak	60.4	1821.6	Peak	No RB
	AVG	46.3		AVG	48.4		AVG	
7236.0	Peak	No RB	7311.0	Peak	>20 dB	-/-	Peak	-/-
	AVG			AVG			AVG	-/-

**Results:** RX / idle – mode

RX 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.		

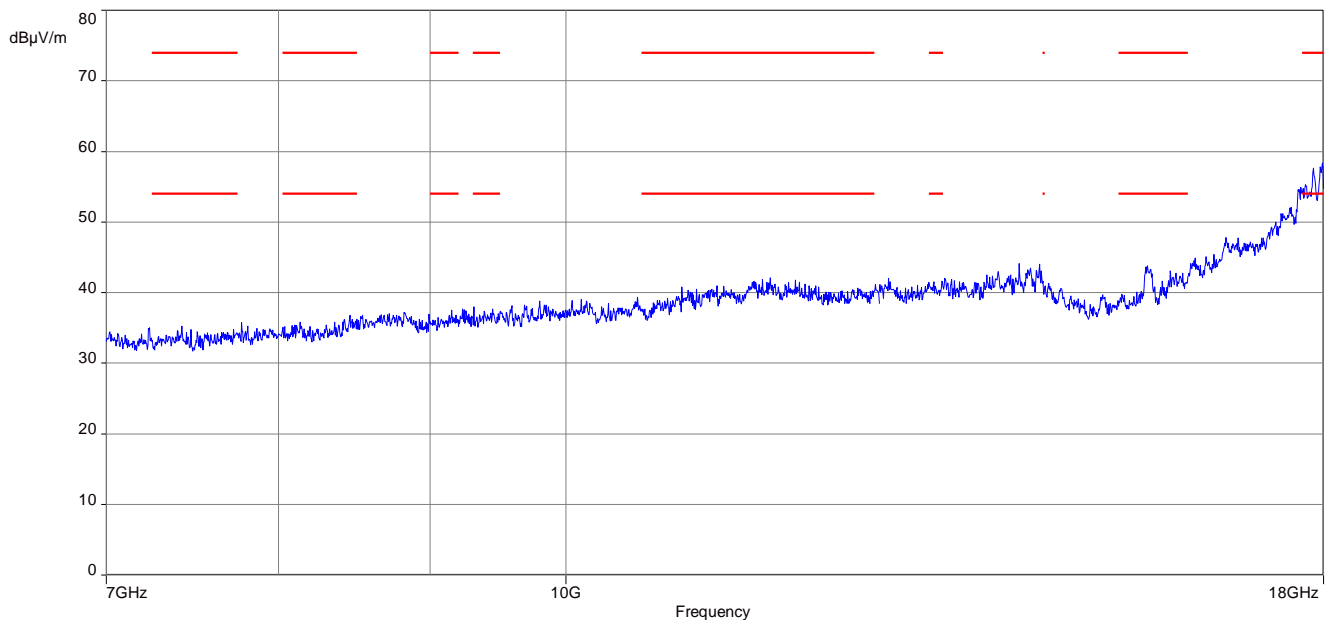
**Plots:** DSSS

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

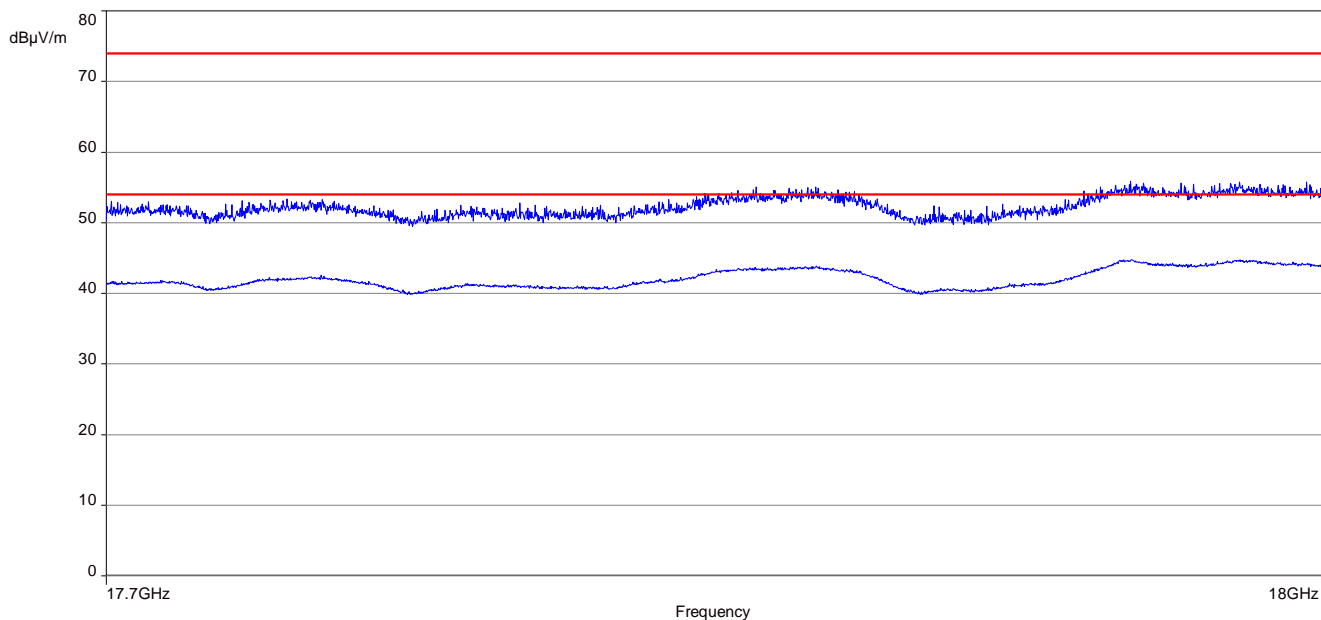


The carrier signal is notched with a 2.4 GHz band rejection filter.

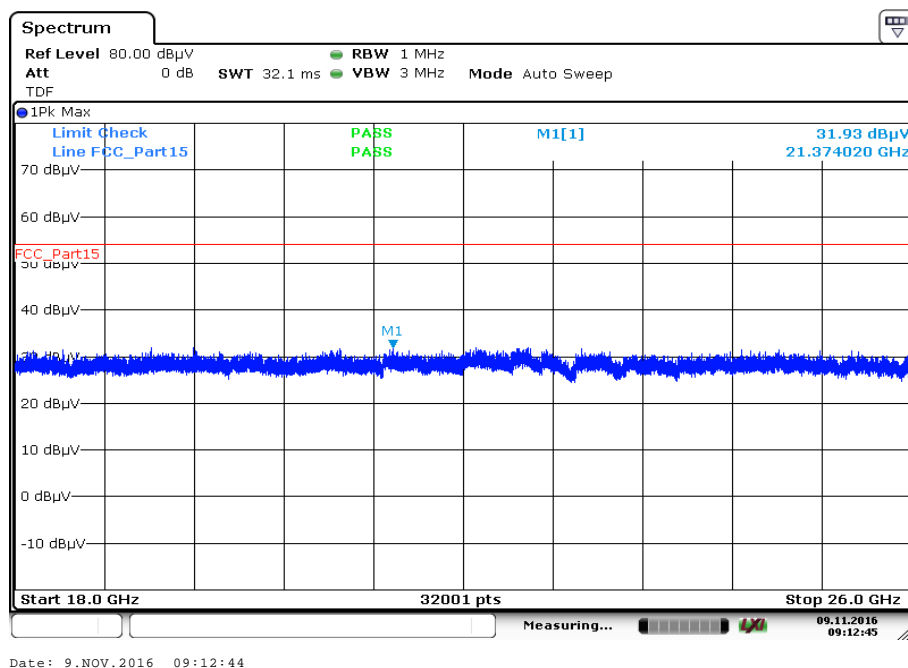
**Plot 2:** Lowest channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



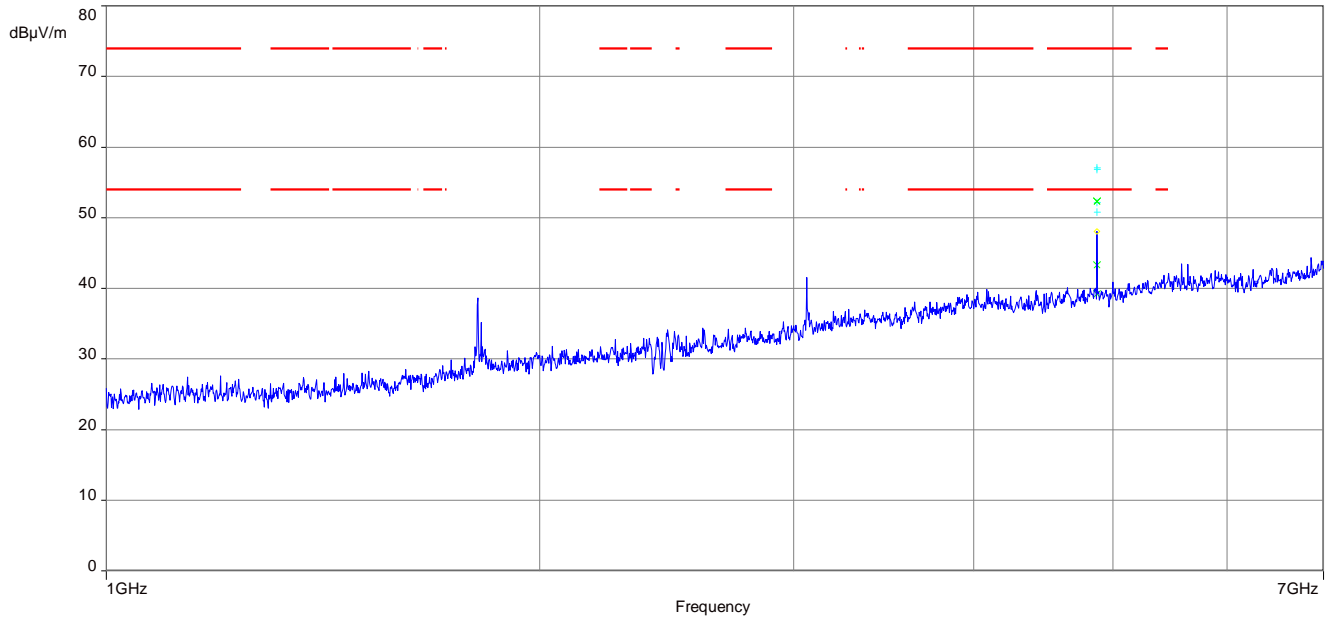
**Plot 3:** Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



**Plot 4:** Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

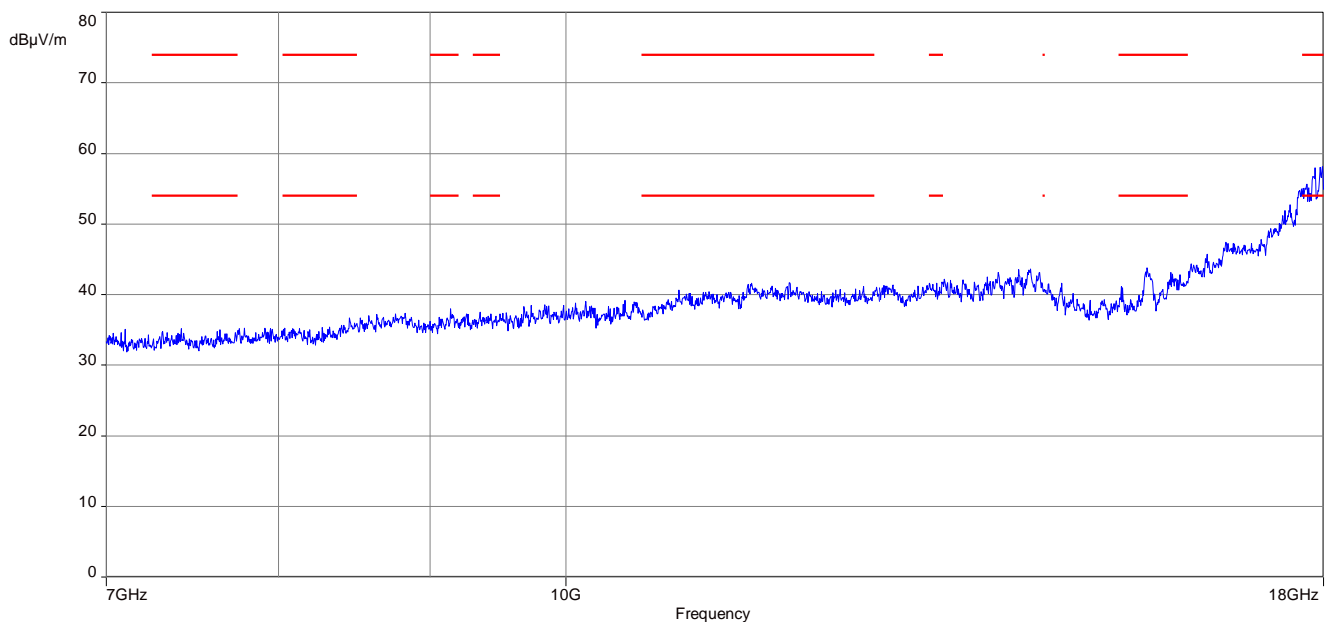


**Plot 5:** Middle channel, 1 GHz to 7 GHz, vertical & horizontal polarization

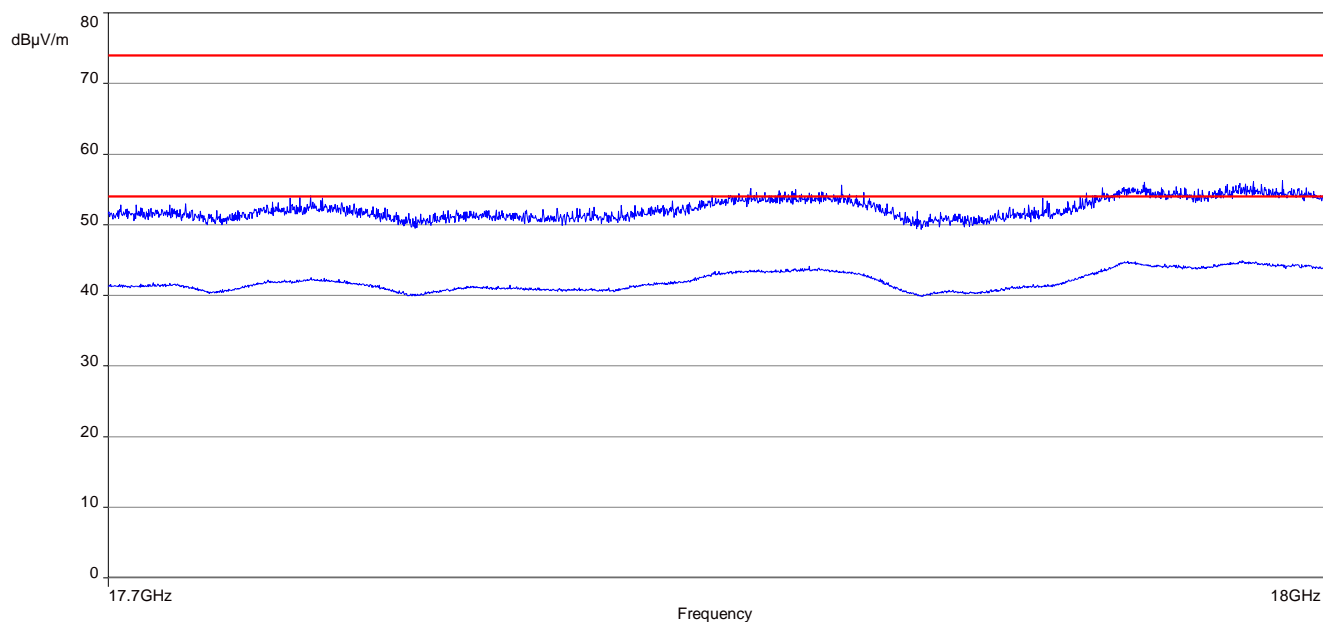


The carrier signal is notched with a 2.4 GHz band rejection filter.

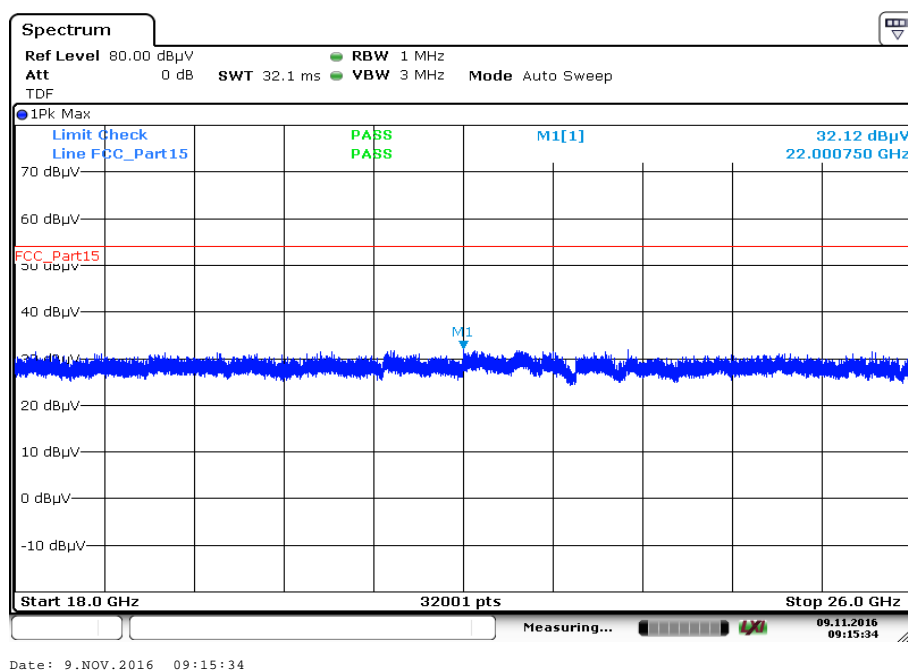
**Plot 6:** Middle channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



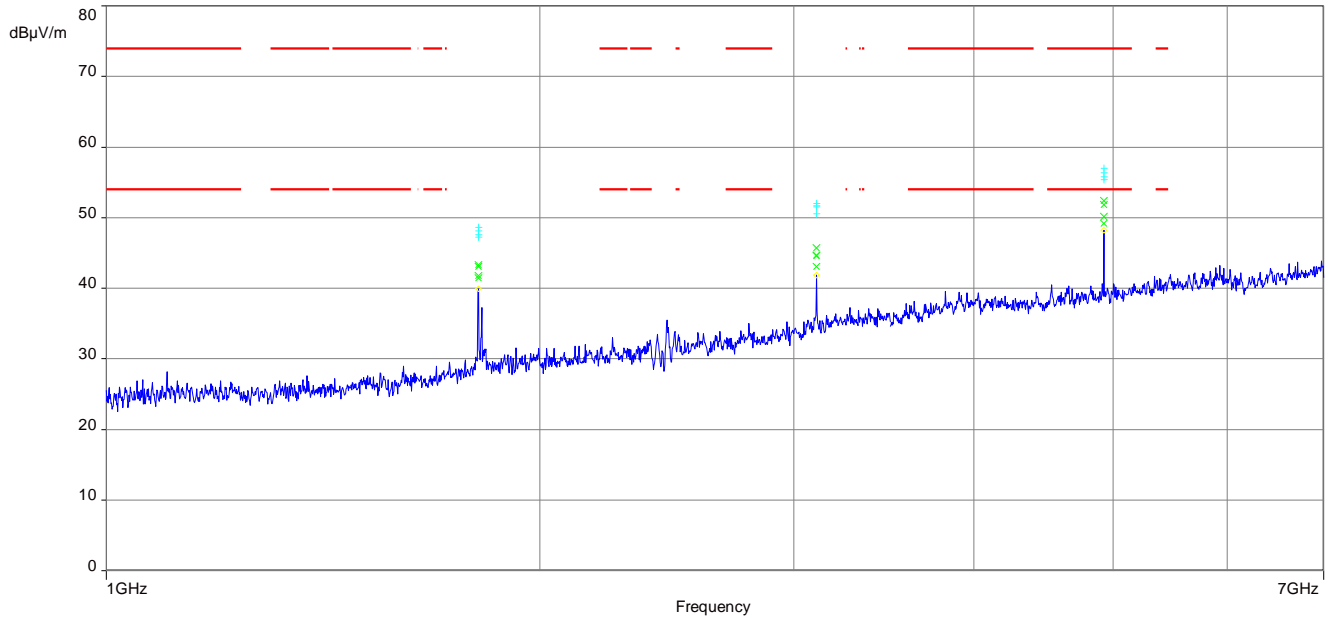
**Plot 7:** Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



**Plot 8:** Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

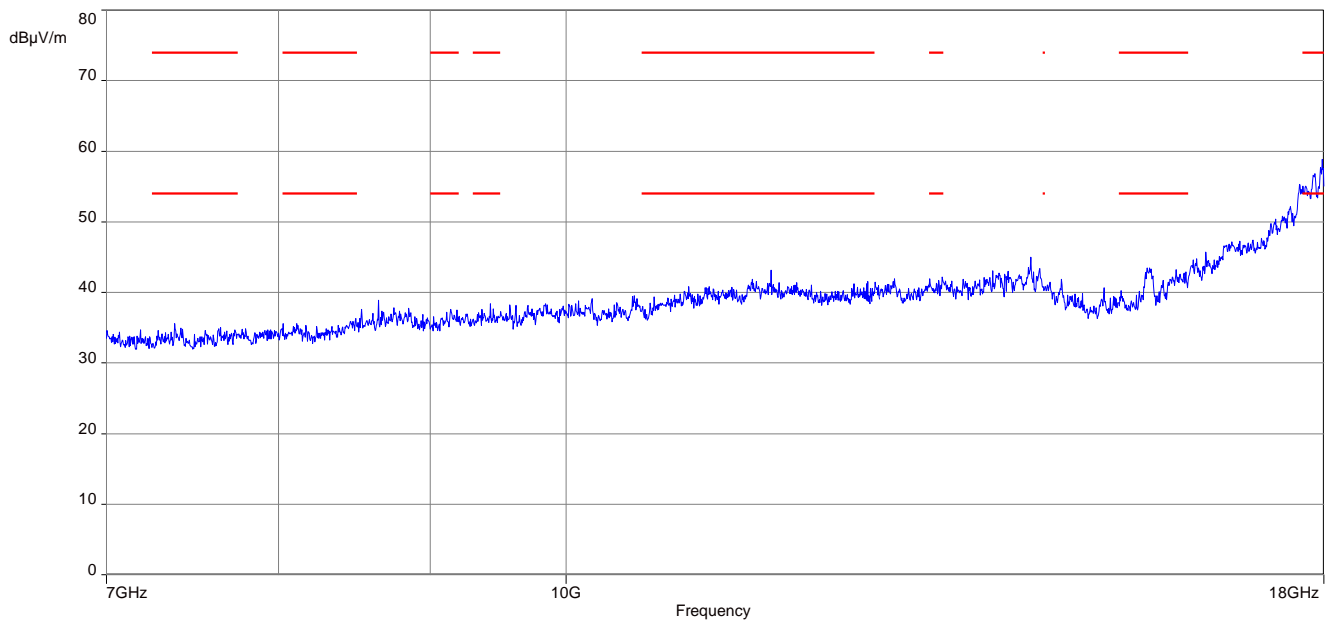


**Plot 9:** Highest channel, 1 GHz to 7 GHz, vertical & horizontal polarization

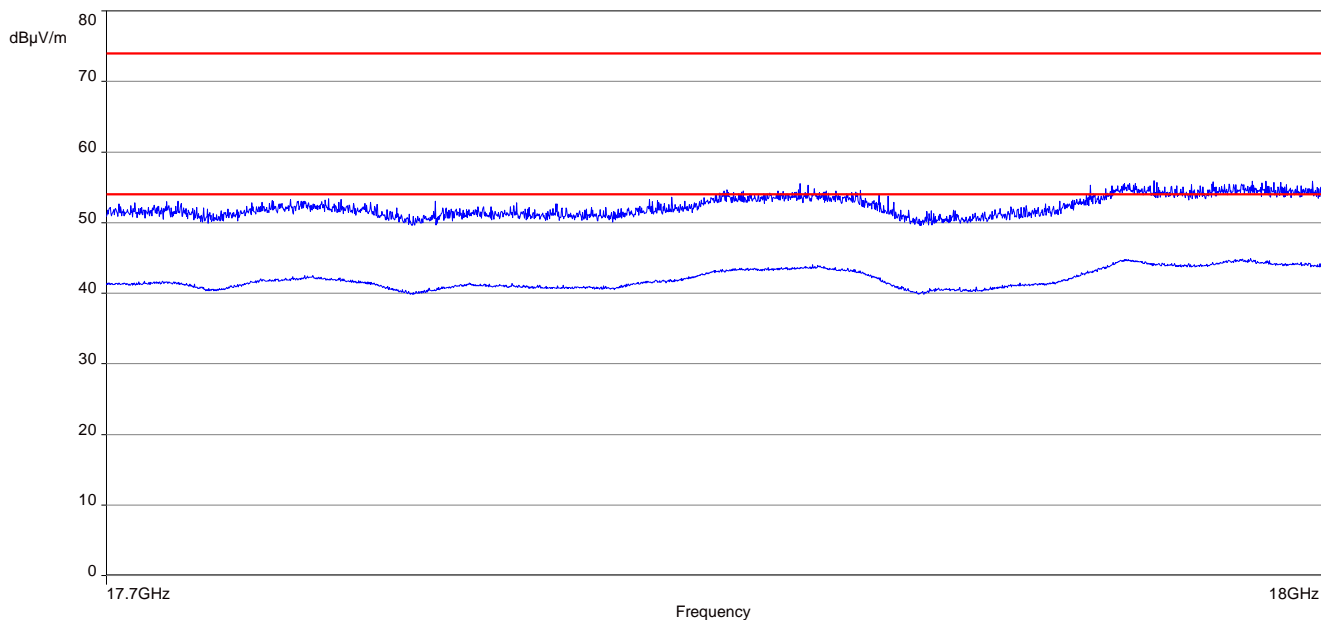


The carrier signal is notched with a 2.4 GHz band rejection filter.

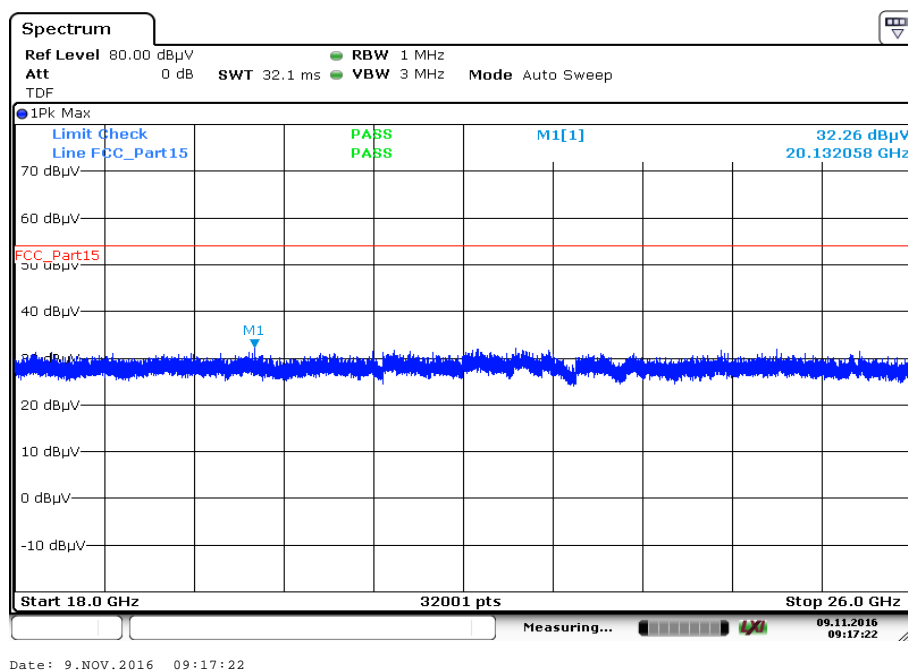
**Plot 10:** Highest channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



**Plot 11:** Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average

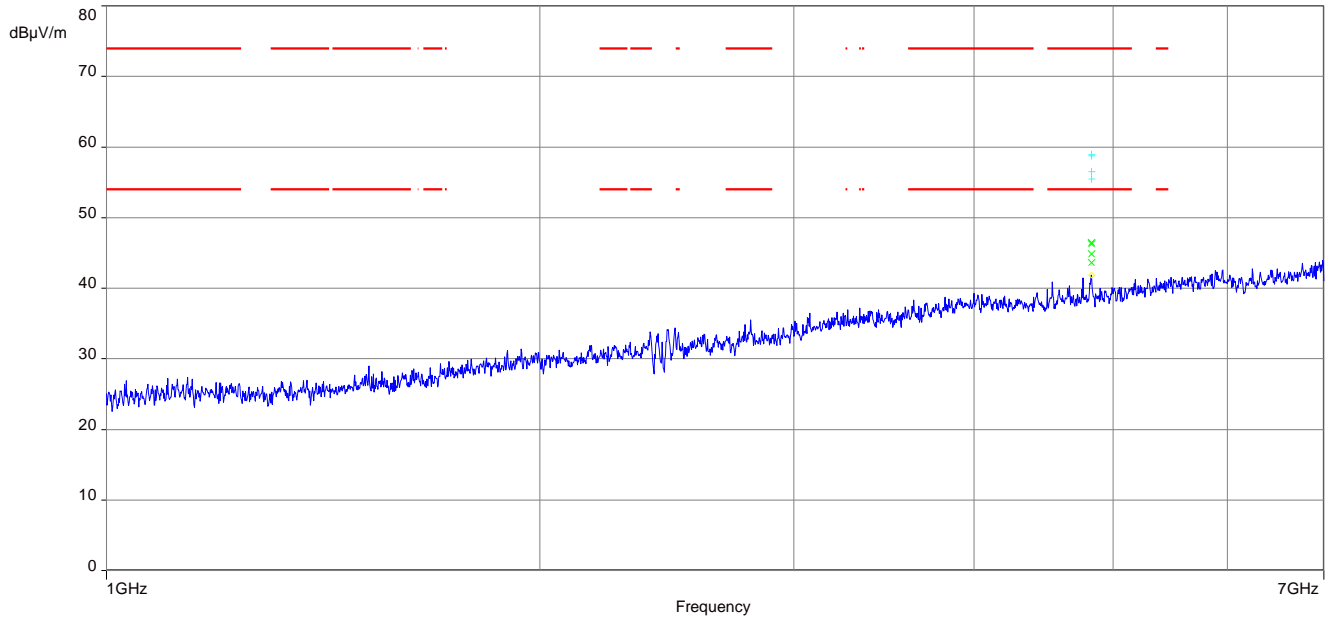


**Plot 12:** Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



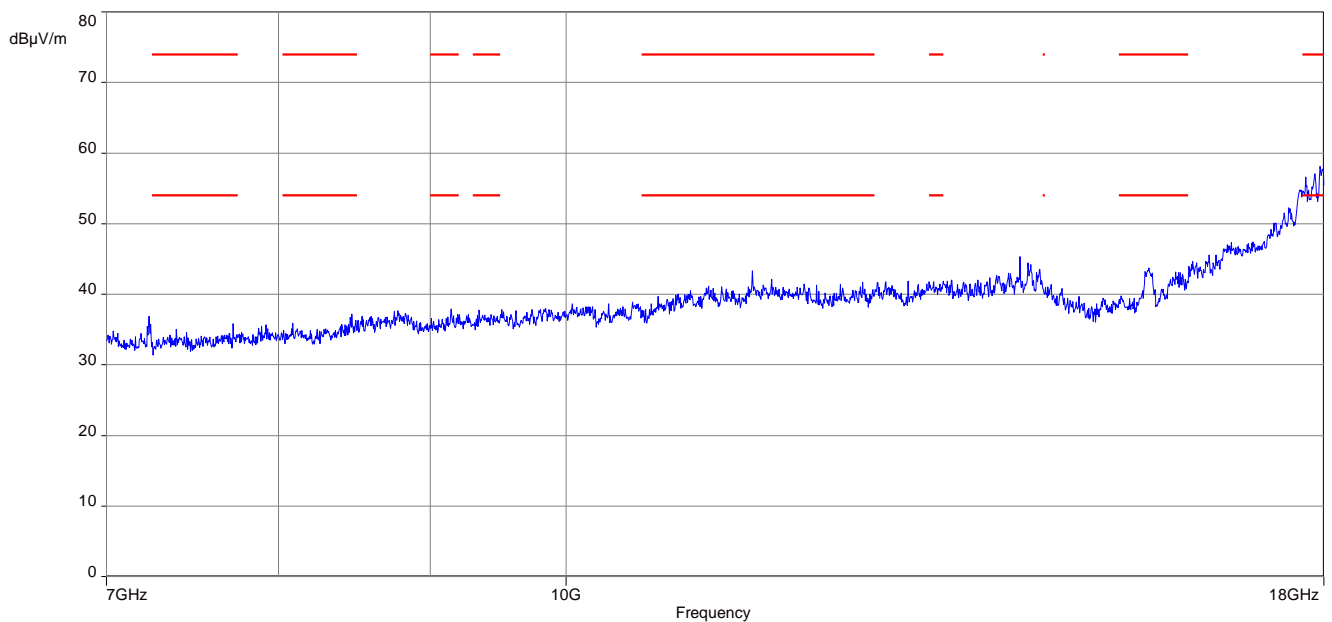
**Plots:** OFDM (20 MHz bandwidth)

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

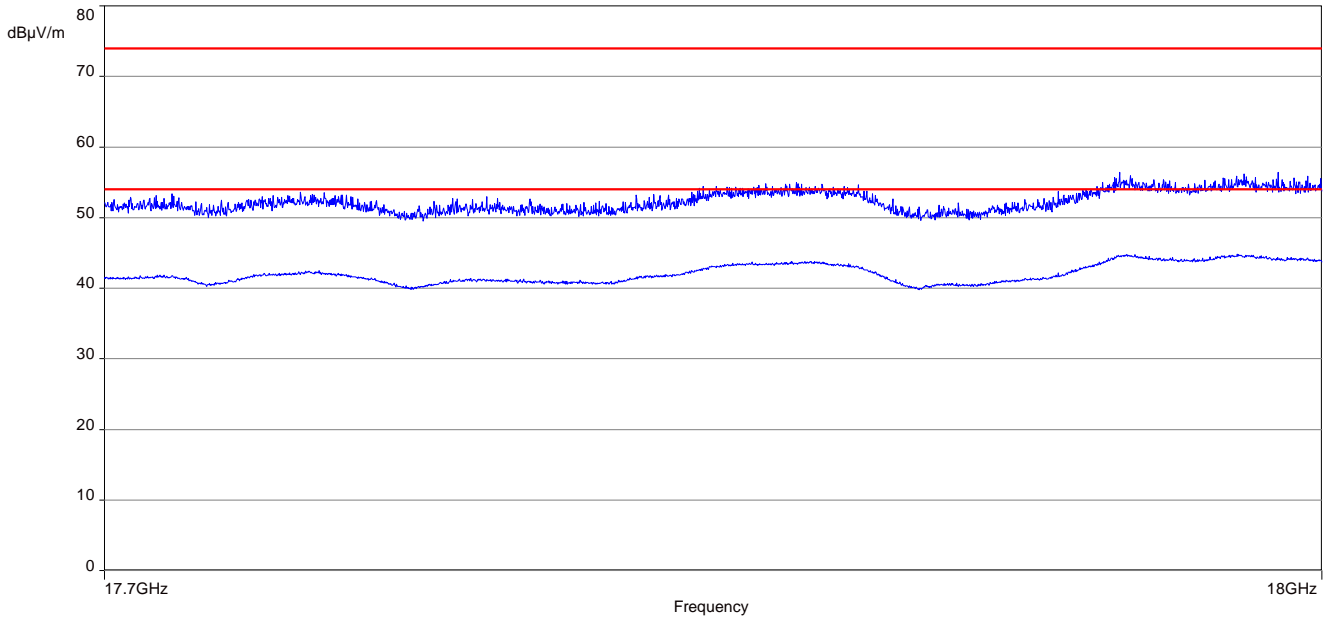


The carrier signal is notched with a 2.4 GHz band rejection filter.

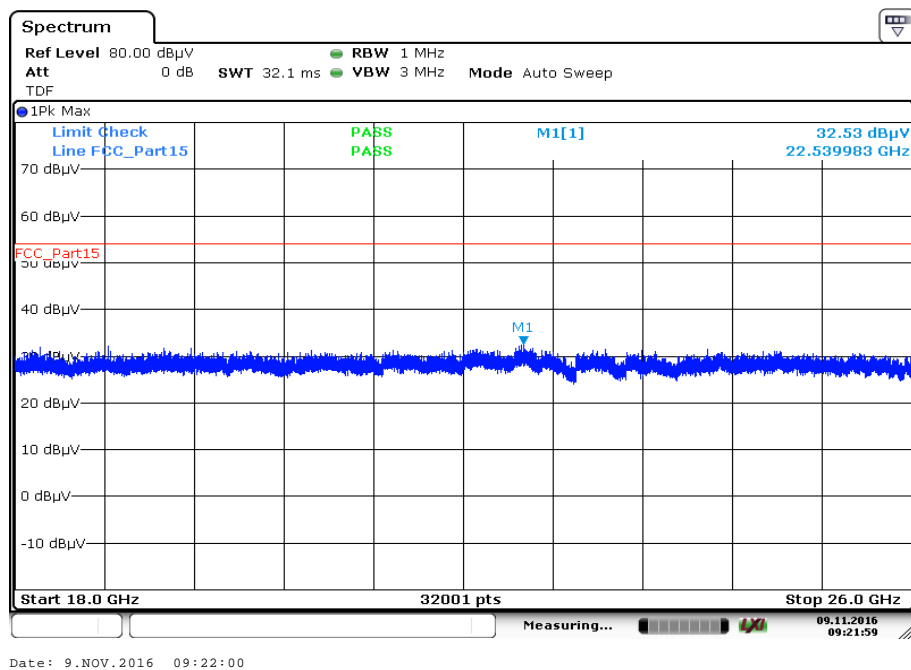
**Plot 2:** Lowest channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



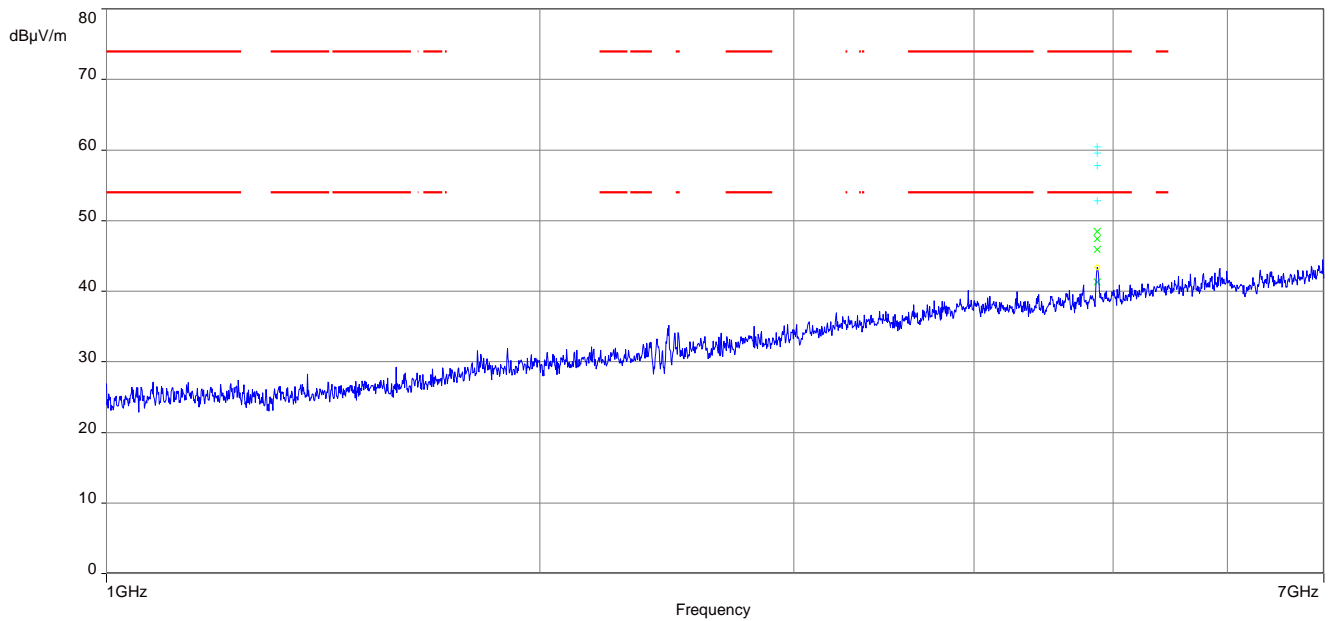
**Plot 3:** Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



**Plot 4:** Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

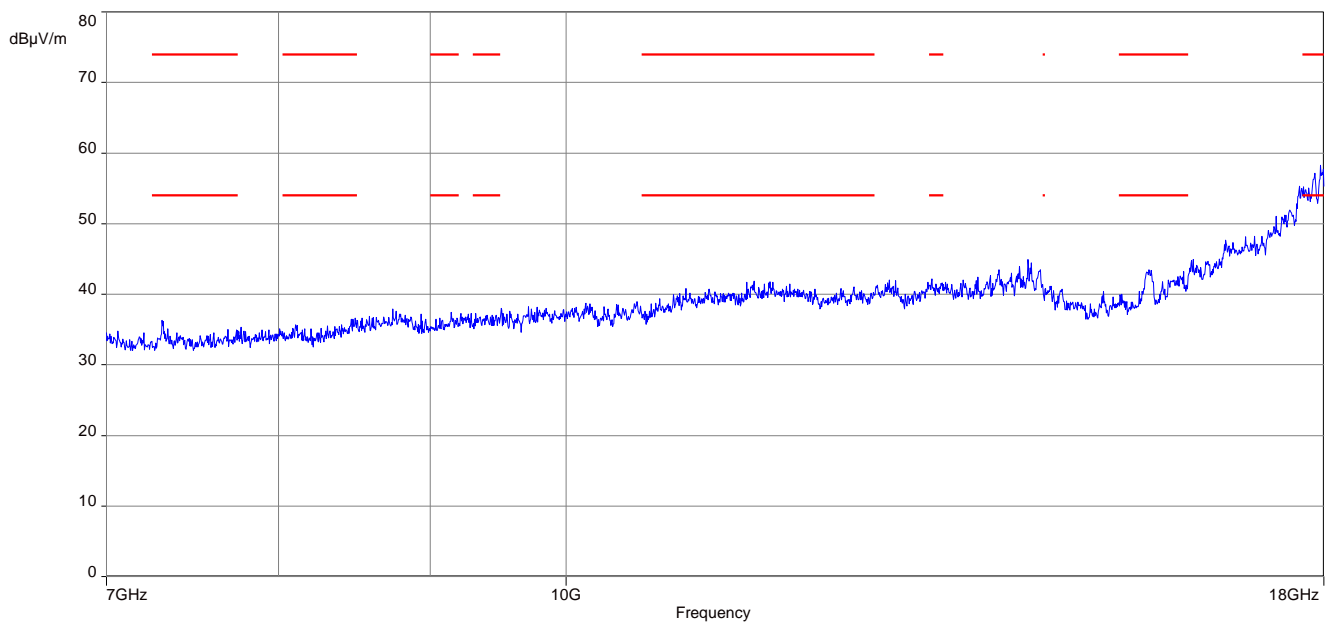


**Plot 5:** Middle channel, 1 GHz to 7 GHz, vertical & horizontal polarization

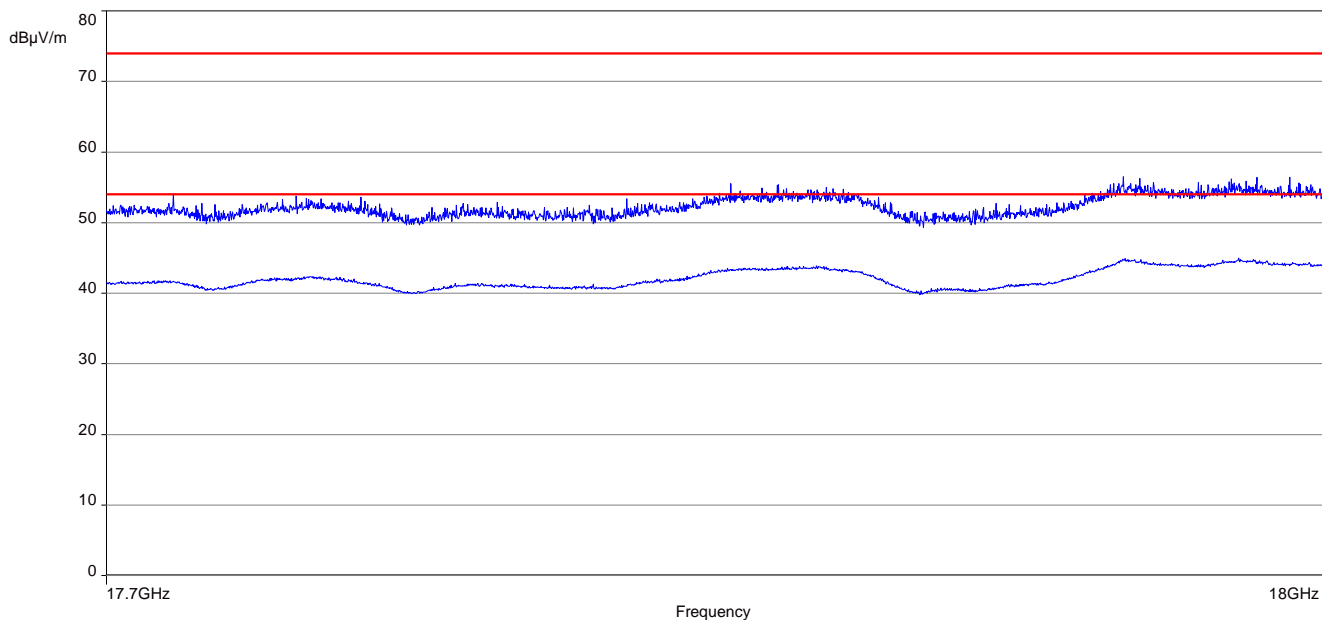


The carrier signal is notched with a 2.4 GHz band rejection filter.

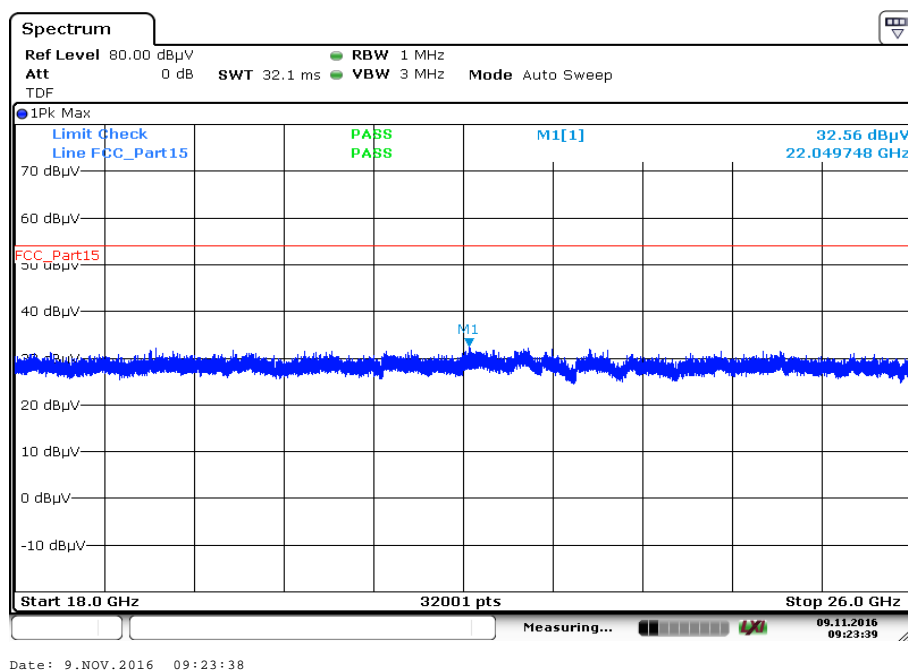
**Plot 6:** Middle channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



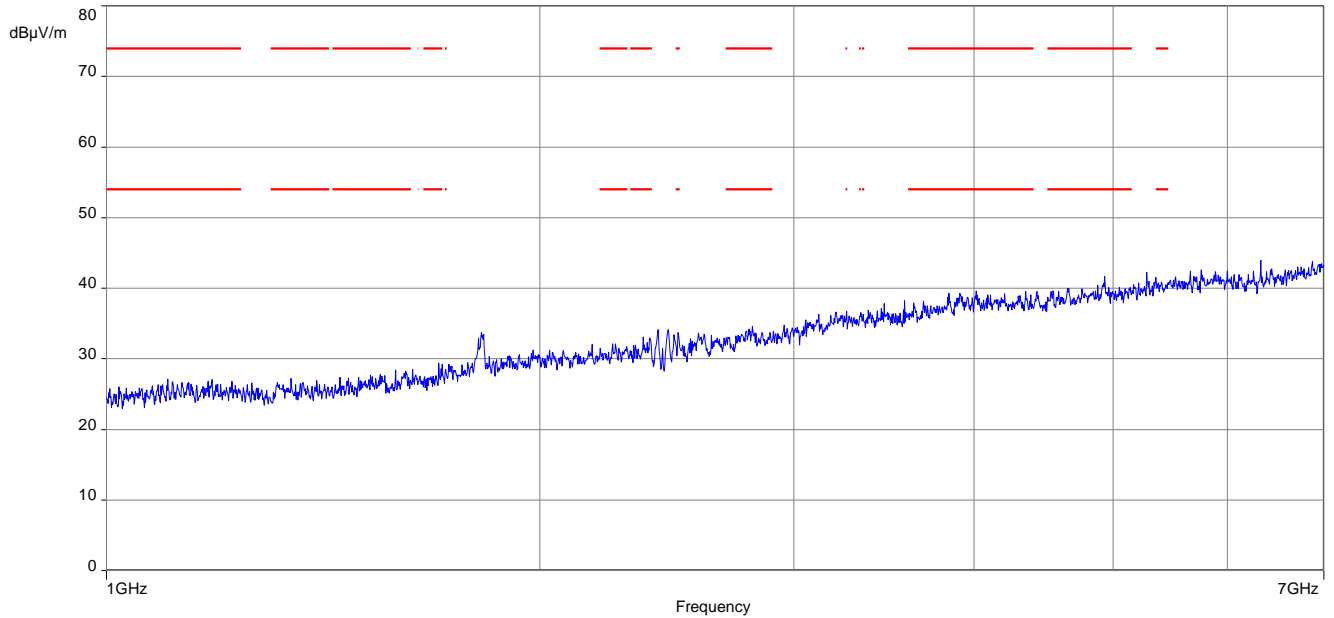
**Plot 7:** Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



**Plot 8:** Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

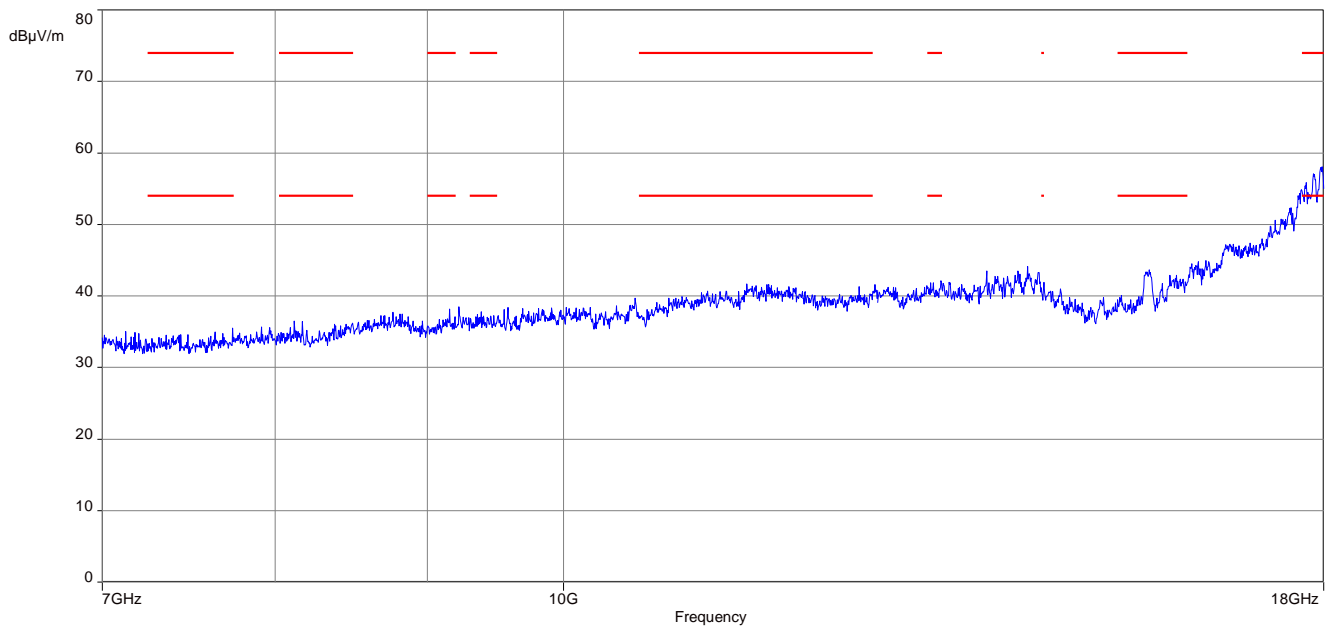


**Plot 9:** Highest channel, 1 GHz to 7 GHz, vertical & horizontal polarization

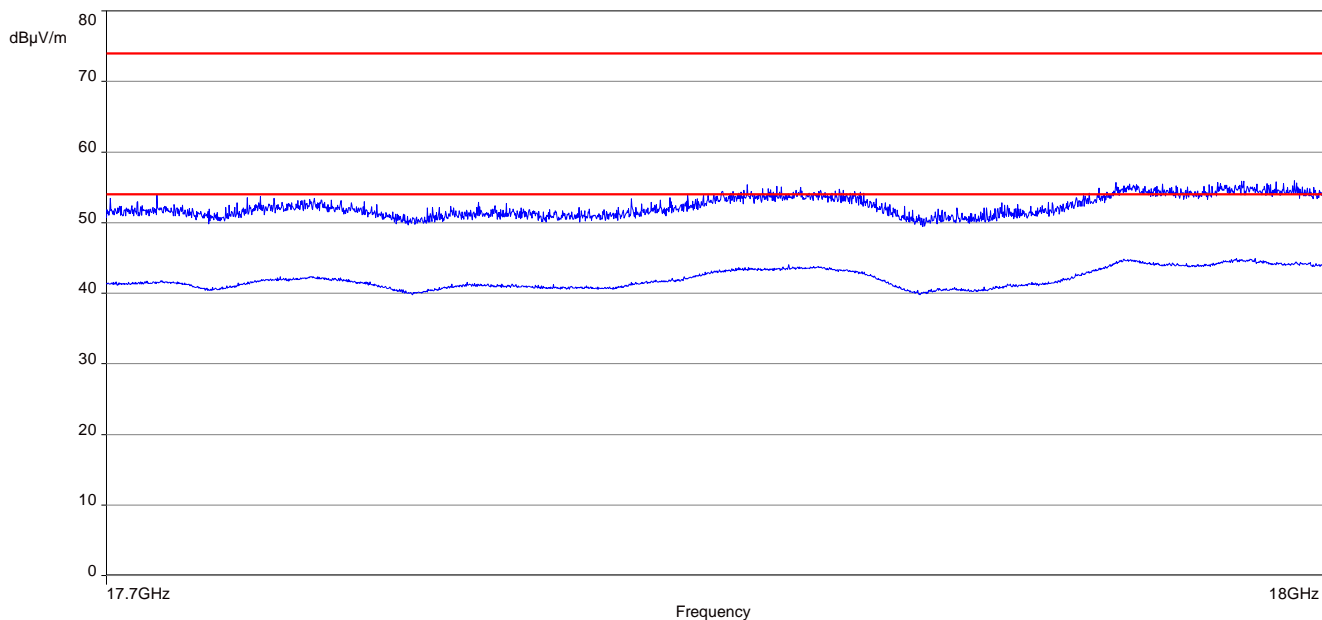


The carrier signal is notched with a 2.4 GHz band rejection filter.

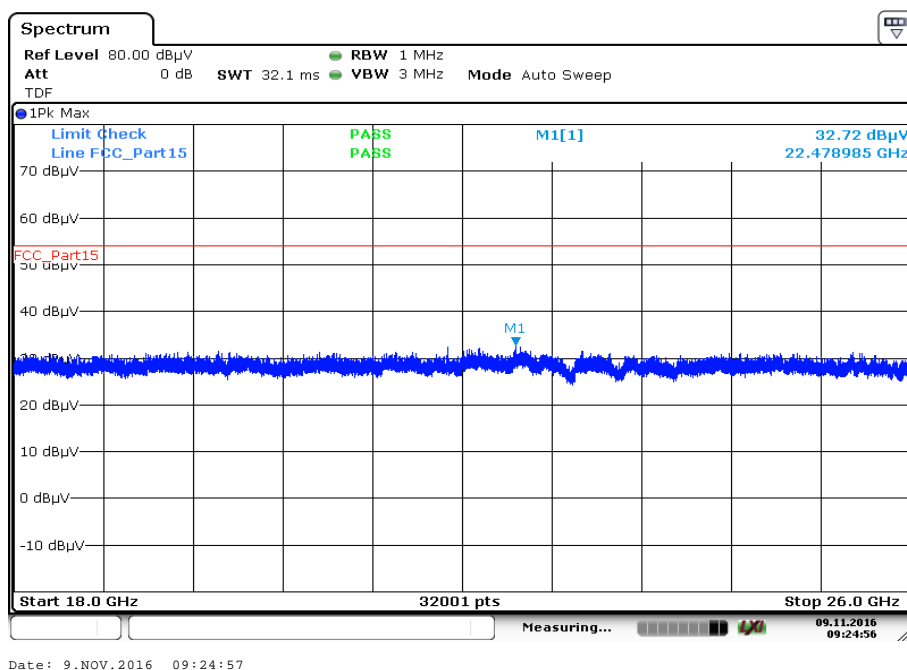
**Plot 10:** Highest channel, 7 GHz to 18 GHz, vertical & horizontal polarization, peak



**Plot 11:** Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average

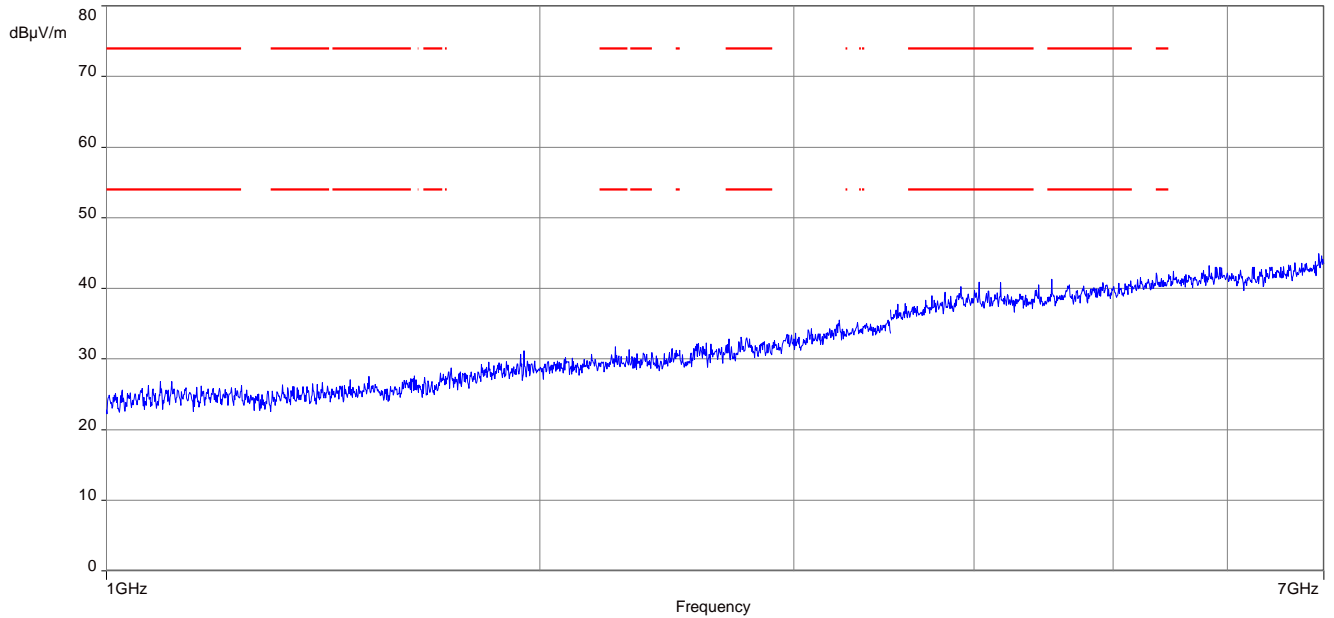


**Plot 12:** Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

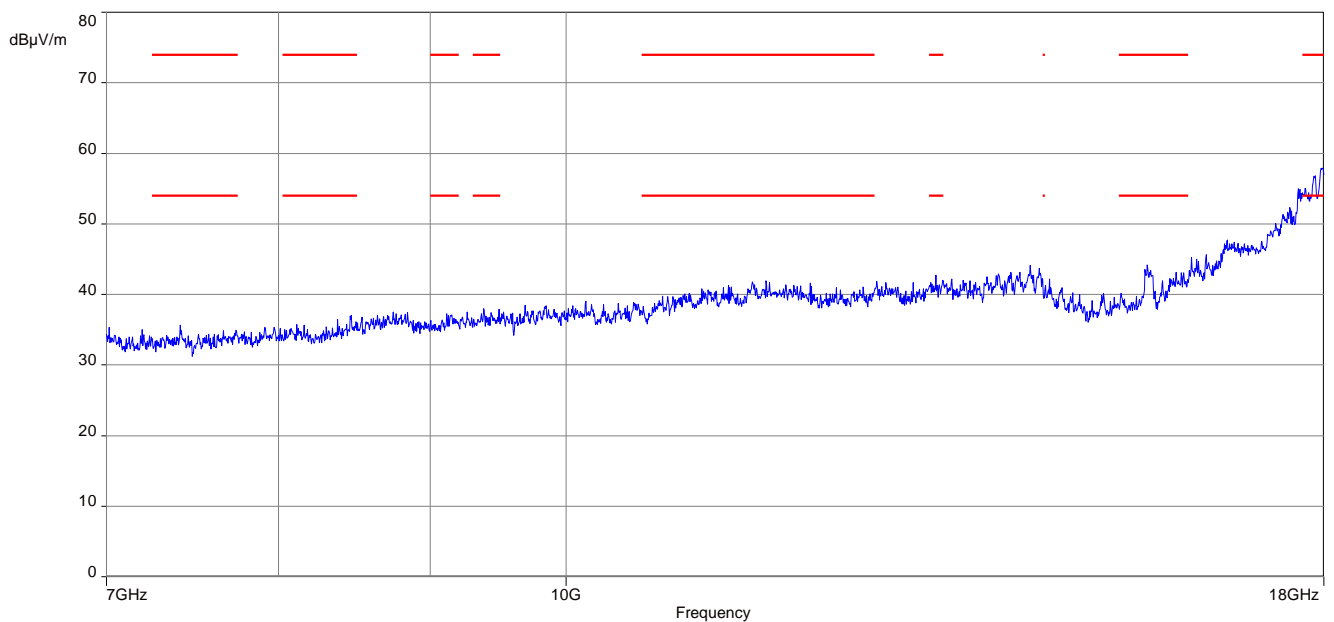


**Plots:** RX / idle mode

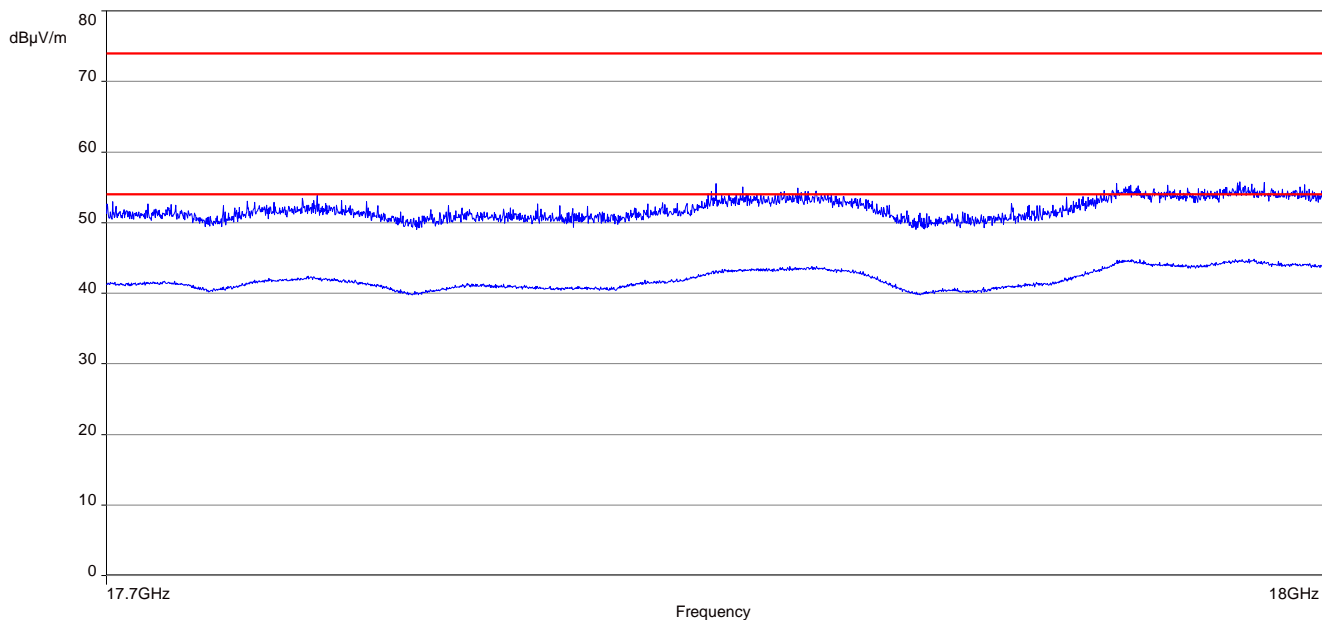
**Plot 1:** 1 GHz to 7 GHz, vertical & horizontal polarization



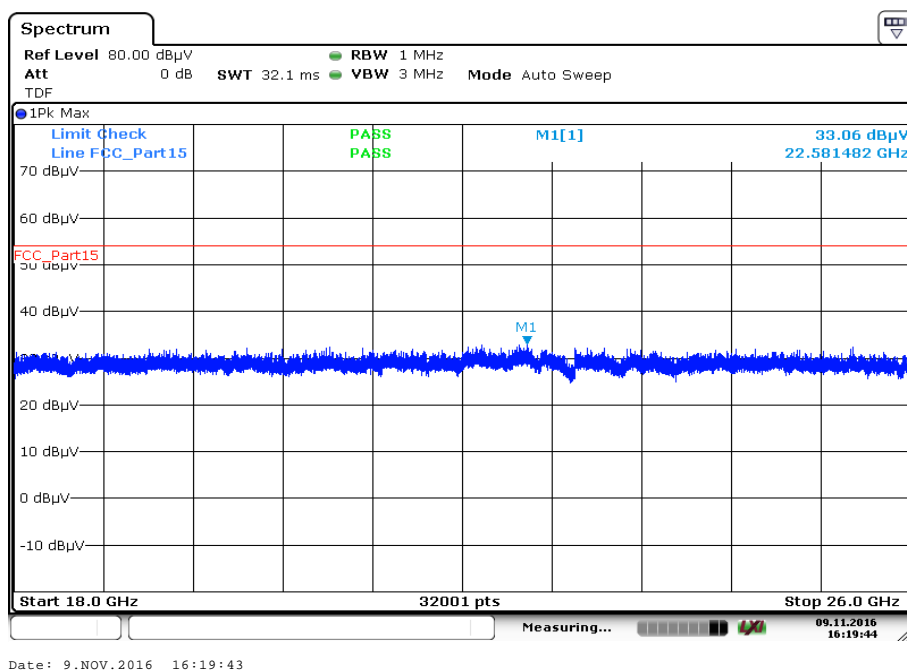
**Plot 2:** 7 GHz to 18 GHz, vertical & horizontal polarization



**Plot 3:** 17.7 GHz to 18 GHz, vertical & horizontal polarization



**Plot 4:** 18 GHz to 26 GHz, vertical & horizontal polarization



### 13 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	2016-11-22

### 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

Befähigung 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:

**Funk**  
Mobilfunk (GSM / DCS) + OTA  
Elektromagnetische Verträglichkeit (EMV)  
Produktsicherheit  
SAR / EMF  
Umwelt  
Smart Card Technology  
Bluetooth®  
Automotive  
Wi-Fi Services  
Kanadische Anforderungen  
US-Anforderungen  
Akustik  
Near Field Communication (NFC)

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 04.05.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

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

Frankfurt, 04.05.2016

Siehe Hinweise auf der Rückseite

Im Auftrag Dipl.-Ing. (FH) Ralf Eigner  
Abteilungsleiter

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10117 Berlin

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Europa-Allee 52  
60327 Frankfurt am Main

Standort Braunschweig  
Bundesallee 100  
38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAKKS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAKKS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abi. L 218 vom 9. Juli 2008, S. 30). Die DAKKS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:  
EA: [www.european-accreditation.org](http://www.european-accreditation.org)  
ILAC: [www.ilac.org](http://www.ilac.org)  
IAF: [www.iaf.nu](http://www.iaf.nu)

### Note:

The current certificate including annex can be received from CETECOM ICT Services GmbH on request.