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Bundesnetzagentur

TEST REPORT

Test report no.: 1-9841/15-01-06-C



DAkkS
Deutsche
Akreditierungsstelle
D-PL-12076-01-03

BNetzA-CAB-02/21-102

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-12076-01-03

Applicant

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Manufacturer

Sontheim Industrie Elektronik GmbH
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87437 Kempten / GERMANY

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 2

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: **Diagnostics Interface**
Model name: **ComFalcon**
FCC ID: **2AGFACOMFALCON01**
IC: **20746-COMFALCON01**
Frequency: DTS band 2400 MHz to 2483.5 MHz
Technology tested: WLAN (DSSS/b-mode; OFDM/g- & n HT20-mode)
Antenna: External antenna
Power supply: 5 V to 32 V DC by external power supply
Temperature range: -20°C to +55°C



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.

Test report authorized:

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

Andreas Luckenbill
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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. CTC advanced 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 replaces the test report with the number 1-9841/15-01-06-B and dated 2018-03-12.

2.2 Application details

Date of receipt of order:	2015-05-11
Date of receipt of test item:	2015-09-22
Start of test:	2015-09-22
End of test:	2016-01-15
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 2	February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence – Exempt Local Area Network (LE-LAN) Devices

3.1 Measurement guidance

Guidance	Version	Description
DTS: KDB 558074 D01	v03r04	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 +55 °C during high temperature tests -20 °C during low temperature tests
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	12.0 V DC by external power supply 32.0 V 5.0 V

5 Test item

5.1 General description

Kind of test item	:	Diagnostics Interface
Type identification	:	ComFalcon
PMN	:	ComFalcon
HVIN	:	V930232000
FVIN	:	-/-
HMN	:	-/-
S/N serial number	:	C0100132
HW hardware status	:	Rev 3.1
SW software status	:	-/-
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, 16 – QAM, 64 – QAM
Number of channels	:	11
Antenna	:	External antenna
Power supply	:	5 V to 32 V DC external power supply
Temperature range	:	-20°C to +55°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:
 1-9841/15-01-01_AnnexA
 1-9841/15-01-01_AnnexB
 1-9841/15-01-01_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 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).

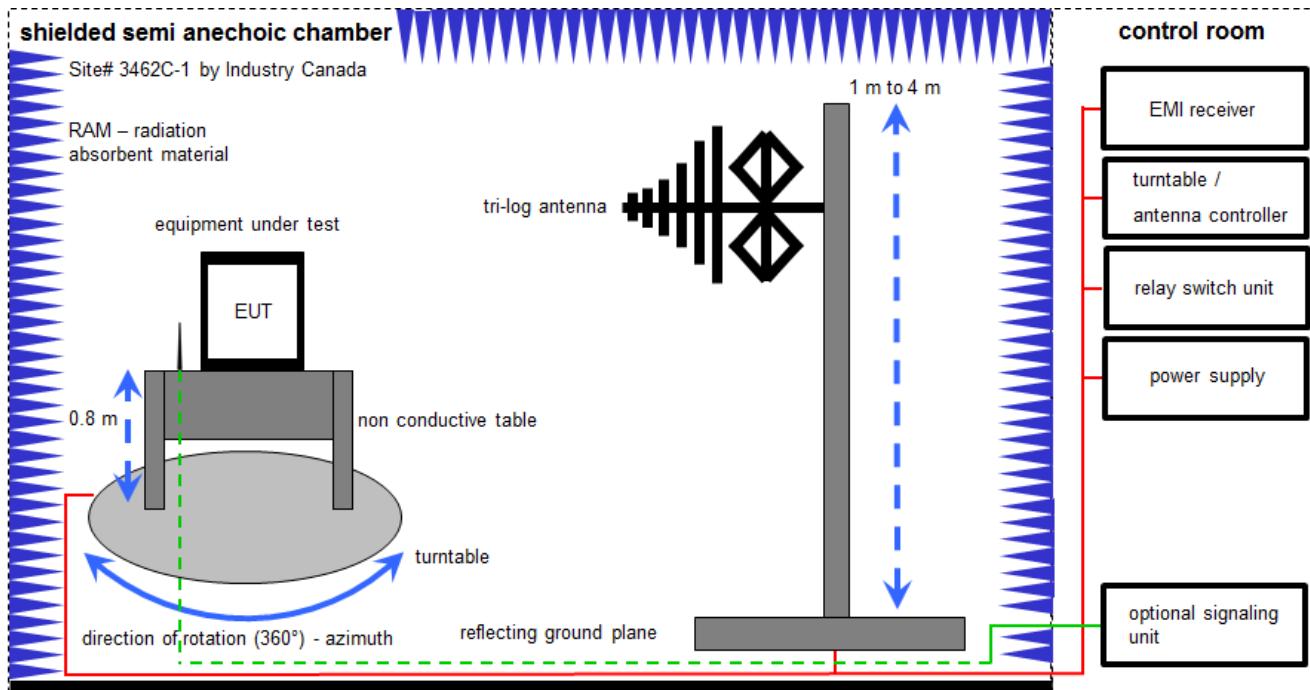
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vlkl!	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 30 MHz 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 conform to 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)

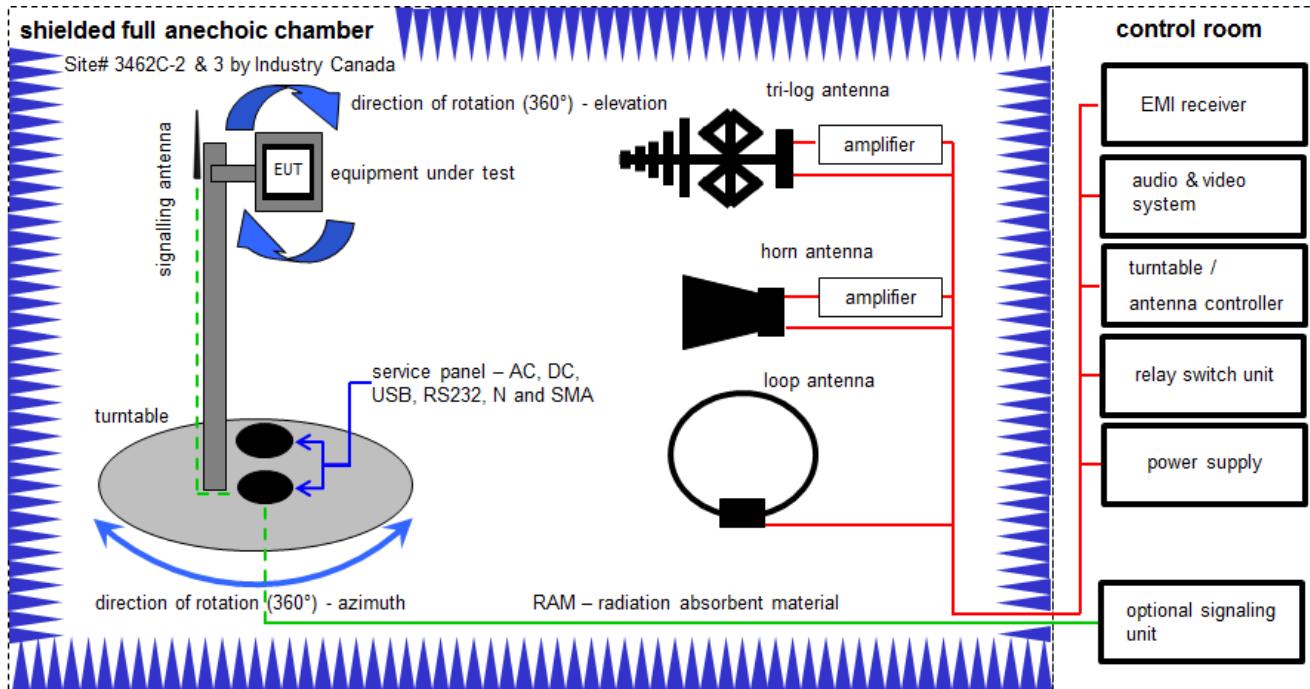
Example calculation:

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecon	Kind of Calibration	Last Calibration	Next Calibration
1	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	-/-	-/-
2	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	26.01.2015	26.01.2016
3	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	11.02.2014	11.02.2016
4	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	A	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



Measurement distance: tri-log antenna and horn antenna 3 meter; loop antenna 3 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 μ V/m] = 40.0 [dB μ V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB μ V/m] (71.61 μ V/m)

OP = AV + D - G + CA

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

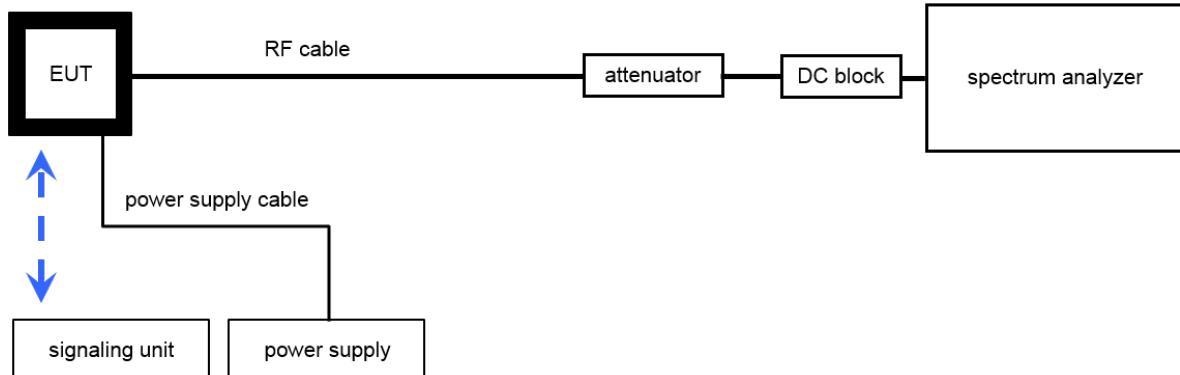
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 μ W)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A, B, C	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	Ve	20.01.2015	20.01.2018
2	A, C	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vlKI!	20.05.2015	20.05.2017
3	A, B, C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	A, B, C	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
5	A, B	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
6	A, C	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne	-/-	-/-
7	A, C	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
8	A, C	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
9	A, C	TRILOG Broadband Test-Antenna 30 MHz – 3 GHz	VULB9163	Schwarzbeck	371	300003854	vlKI!	29.10.2014	29.10.2017

7.3 Conducted measurements

Conducted measurements normal conditions



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

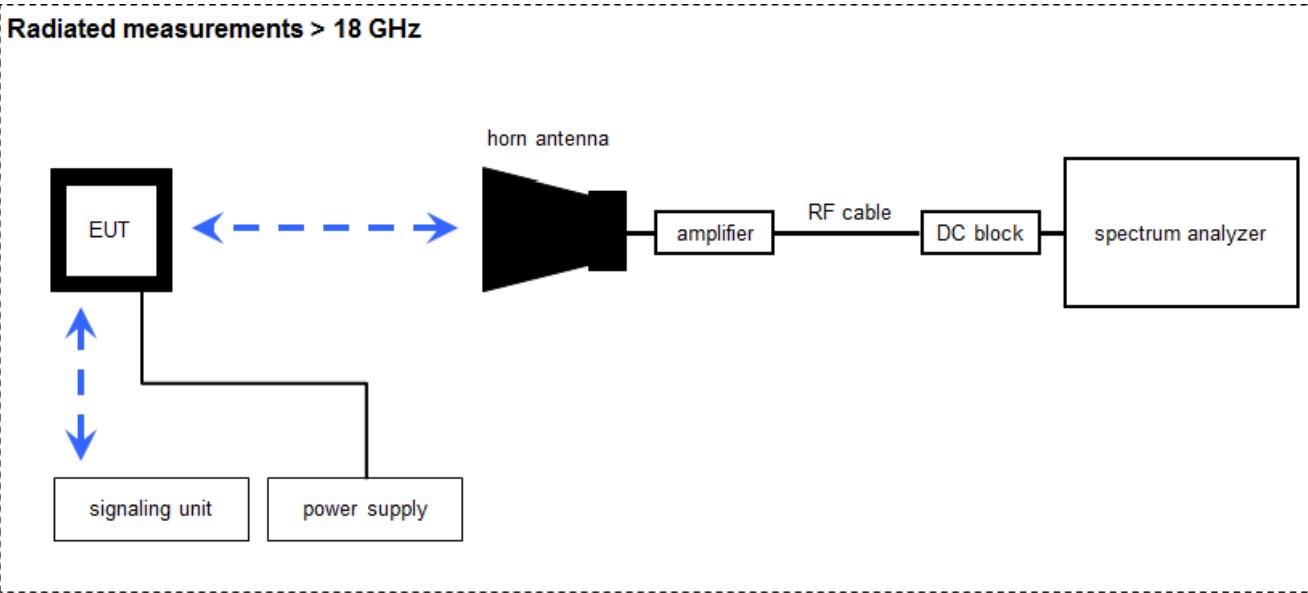
Example calculation:

OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (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	DC Power Supply, 60V, 10A	6038A	HP	3122A11097	300001204	Ve	21.01.2015	21.01.2018
2	A	Signal Analyzer 40 GHz	FSV40	R&S	101353	300004819	k	24.08.2015	24.08.2016
3	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 127377	400001185	ev	-/-	-/-
4	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	Batch no. 127377	400001186	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-

7.4 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:

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda	8205	300002442	NK!	14.08.2015	14.08.2017
2	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	22.01.2015	22.01.2016
3	A	RF-Cable	ST18/SMAm/SMAm/72	Huber & Suhner	Batch no. 699714	400001184	RF-Cable	-/-	-/-
4	A	Microwave System Amplifier, 0.5-26.5 GHz	83017A	HP	00419	300002268	ev	-/-	-/-
5	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 127377	400001185	ev	-/-	-/-
6	A	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	Batch no. 127377	400001186	ev	-/-	-/-

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, it is placed on a table with 0.8 m height.
- 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 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 pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- 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.

*)Note: The sequence will be repeated three times with different EUT orientations.

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.

Premereasurement

- 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.

Premereasurement

- 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 2	See table!	2019-03-25	-/-

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 (f)(ii)	Antenna gain	-/-	Nominal	Nominal	DSSS	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
	Duty cycle	-/-	Nominal	Nominal	DSSS OFDM	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(e) RSS - 247 / 5.2 (b)	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 (a)	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 (d)	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 – restricted bands	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"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated – restricted bands	-/-	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"/>	-/-

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

11 Additional comments

Reference documents: None

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.*

12 Measurement results

12.1 Antenna gain

Limits:

FCC	IC
6 dBi	

Results:

T _{nom}	V _{nom}	lowest channel 2412 MHz	middle channel 2437 MHz	highest channel 2462 MHz
Gain [dBi] declared by manufacturer		0 dBi	0 dBi	0 dBi

12.2 Identify worst case data rate

Worst case taken from module test report.

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 7.3 – 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	18.06	17.44	17.78
Output power conducted DSSS / g – mode	21.15	20.85	20.31
Output power conducted DSSS / n HT20 – mode	21.37	21.07	20.57

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 _{nom}	V _{nom}	lowest channel 2412 MHz	middle channel 2437 MHz	highest channel 2462 MHz
DSSS / b – mode		100 %		
OFDM / g – mode		100 %		
OFDM / n HT20 – mode		100 %		

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 7.3 – A
Measurement uncertainty	See sub clause 9

Limits:

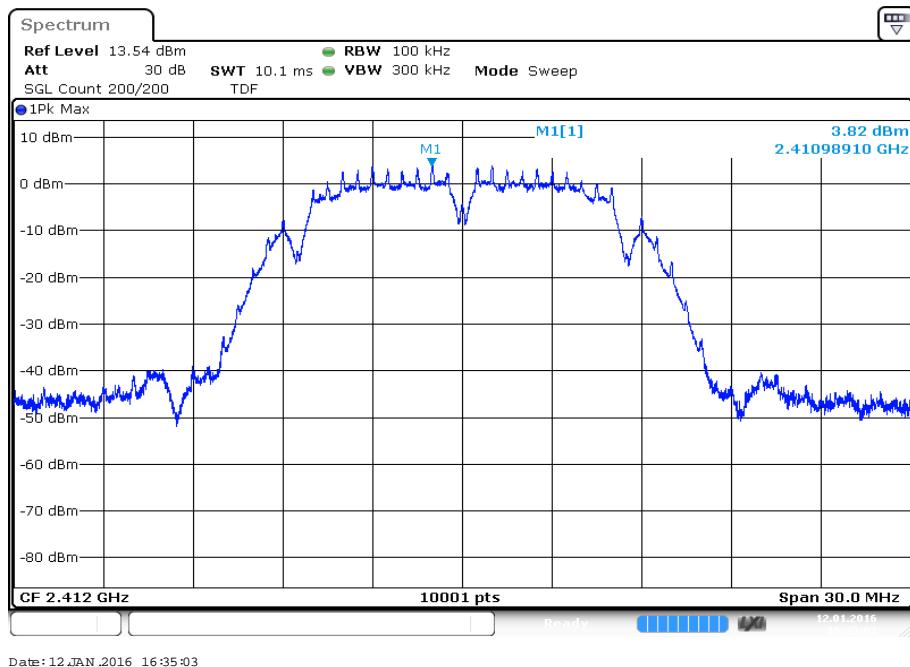
FCC	IC
8 dBm / 3kHz (conducted)	

Results:

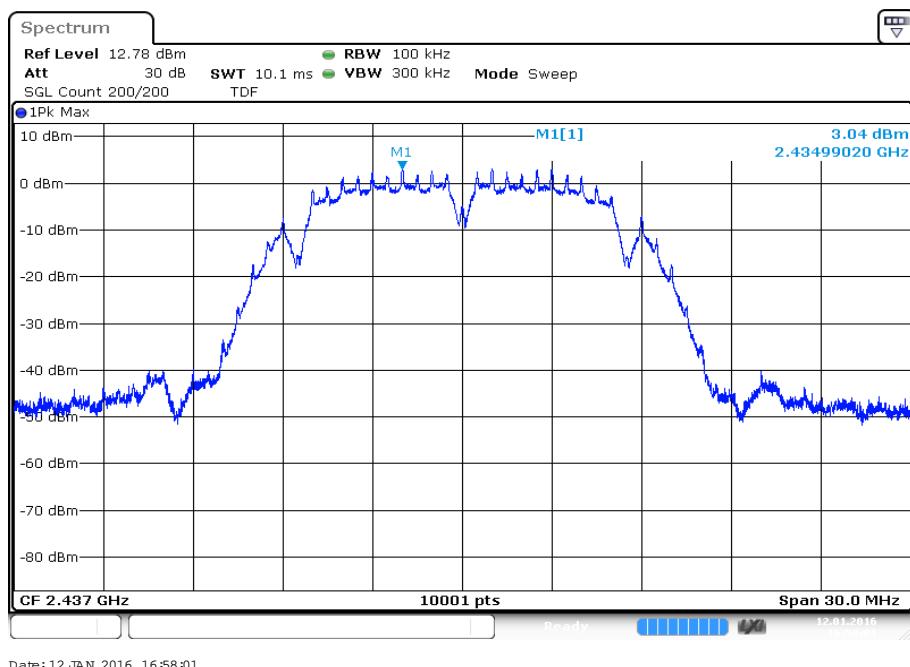
Modulation	Power Spectral density [dBm/100kHz]		
	2412 MHz	2437 MHz	2462 MHz
Frequency			
DSSS / b – mode	3.8	3.0	3.4
OFDM / g – mode	-2.7	-3.1	-3.8
OFDM / n HT20 – mode	-2.8	-3.5	-3.7

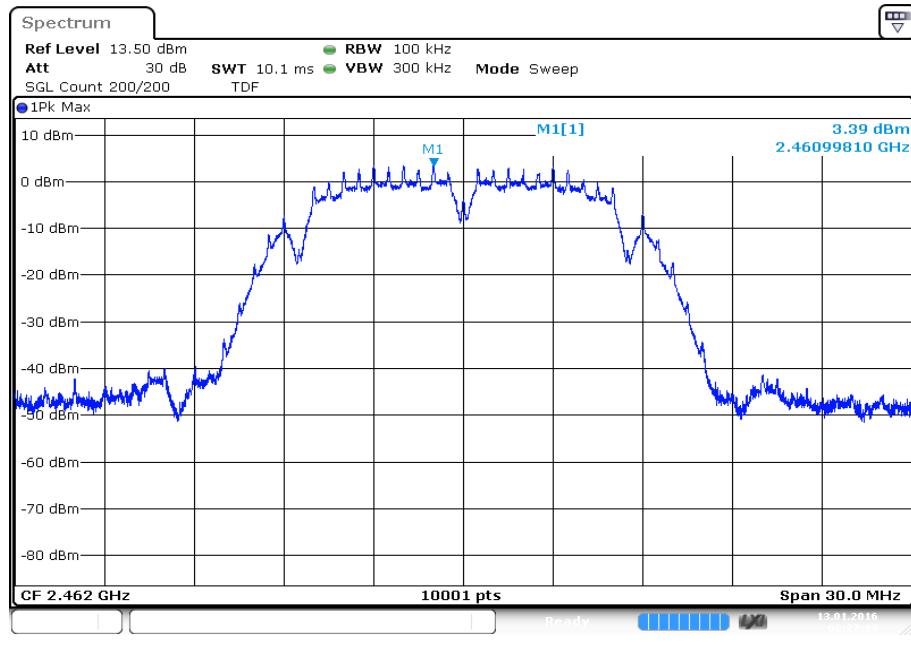
Plots: DSSS / b – mode

Plot 1: TX mode, lowest channel

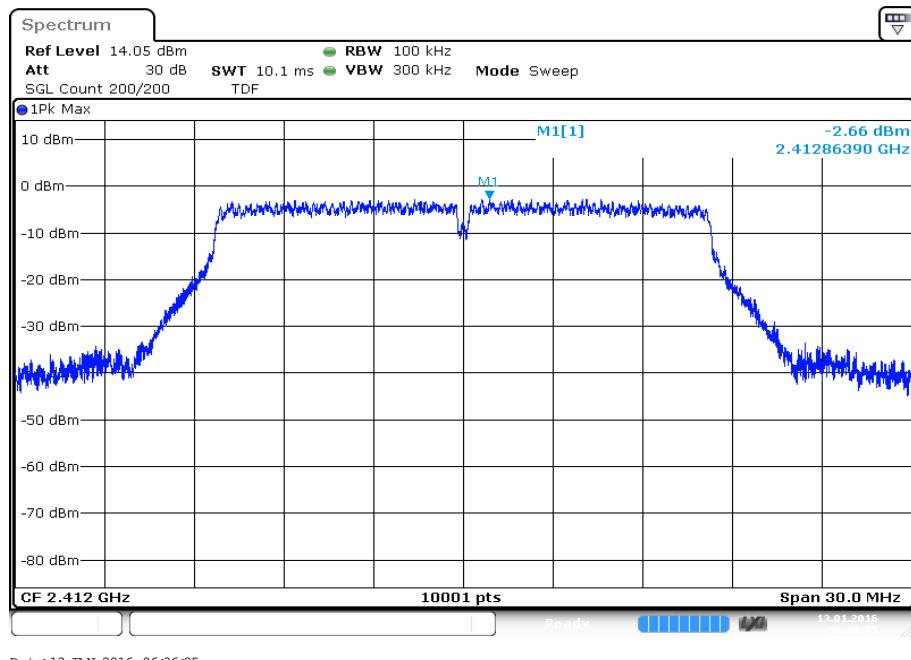
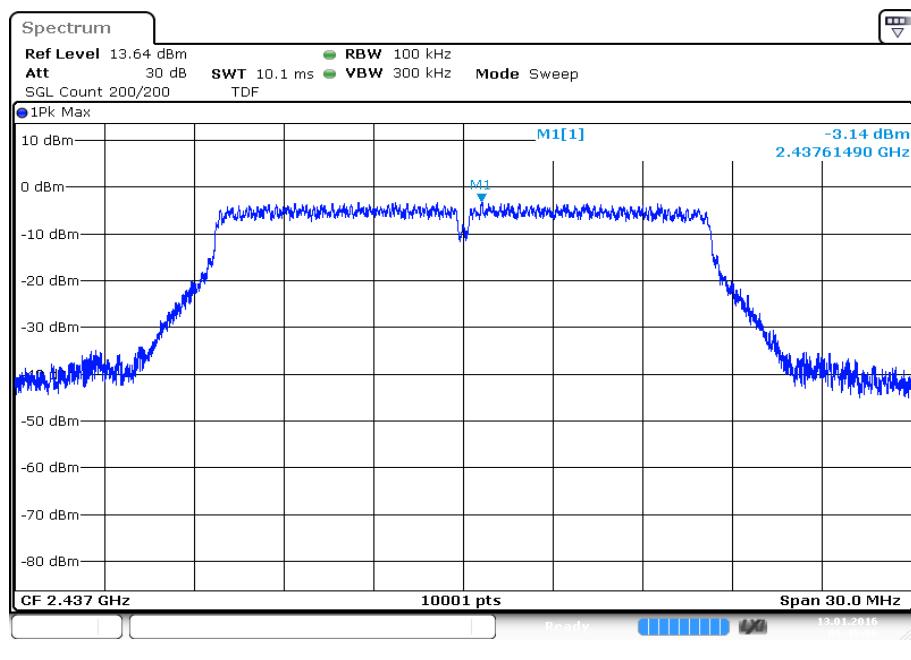


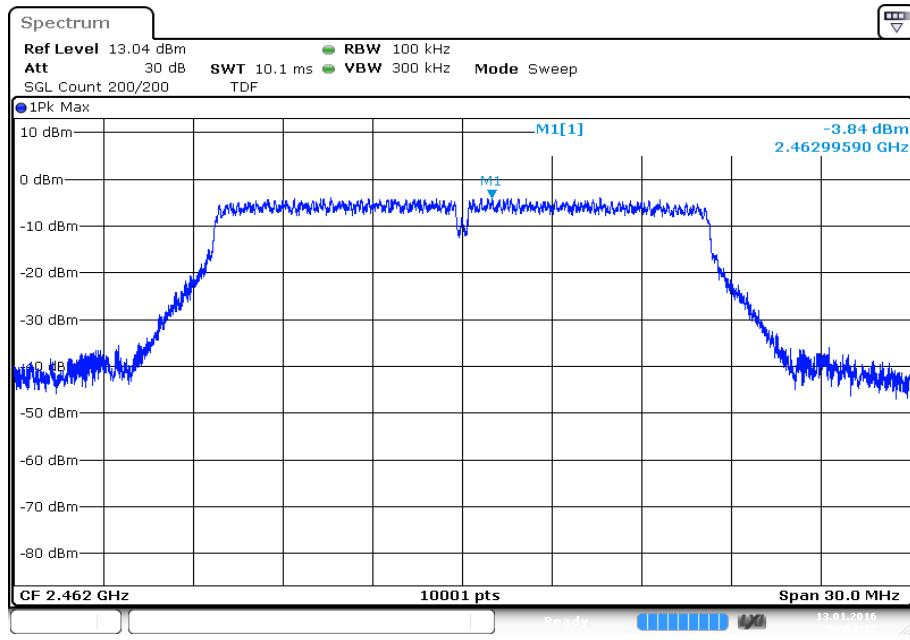
Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel

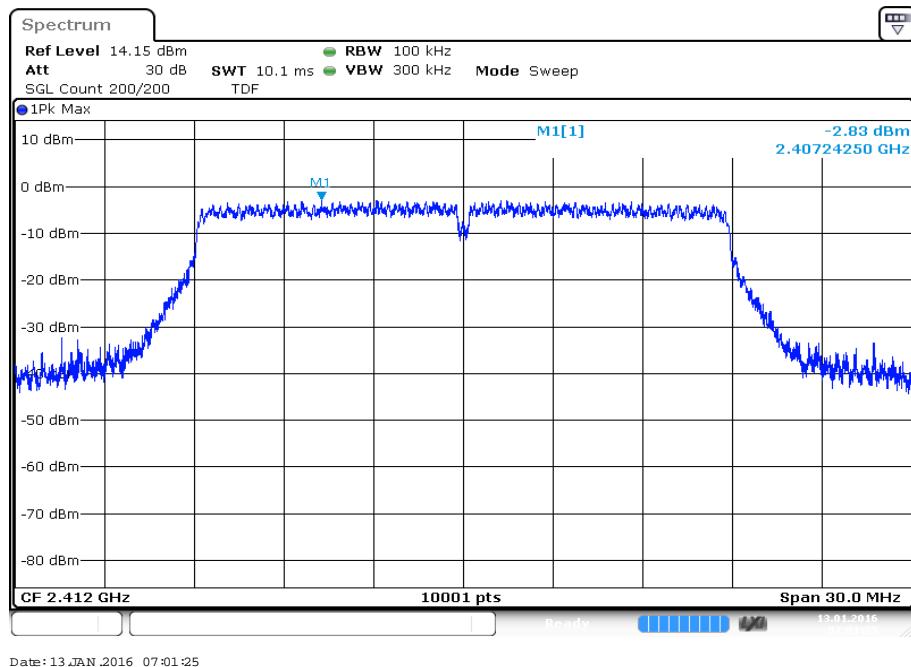
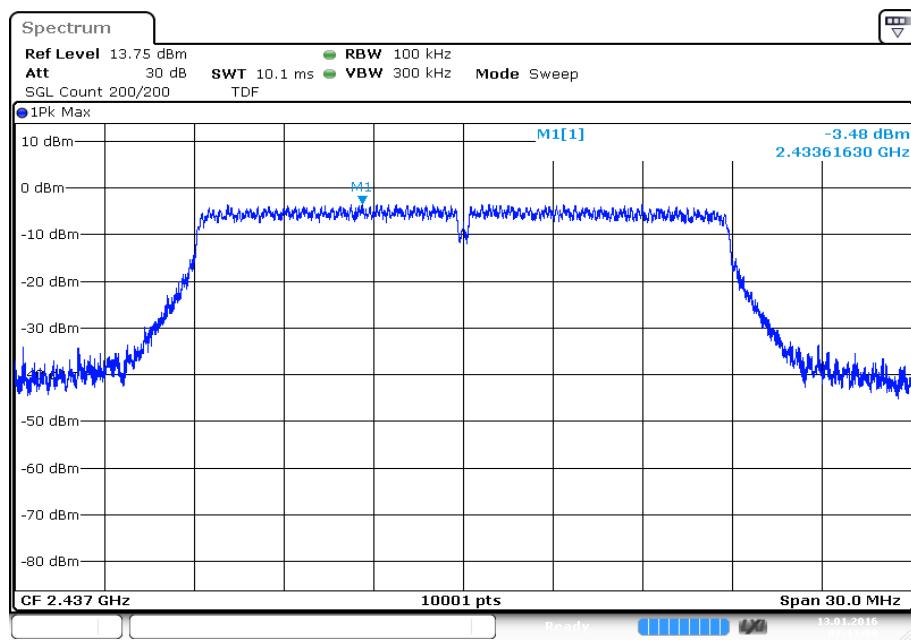
Plots: OFDM / g – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


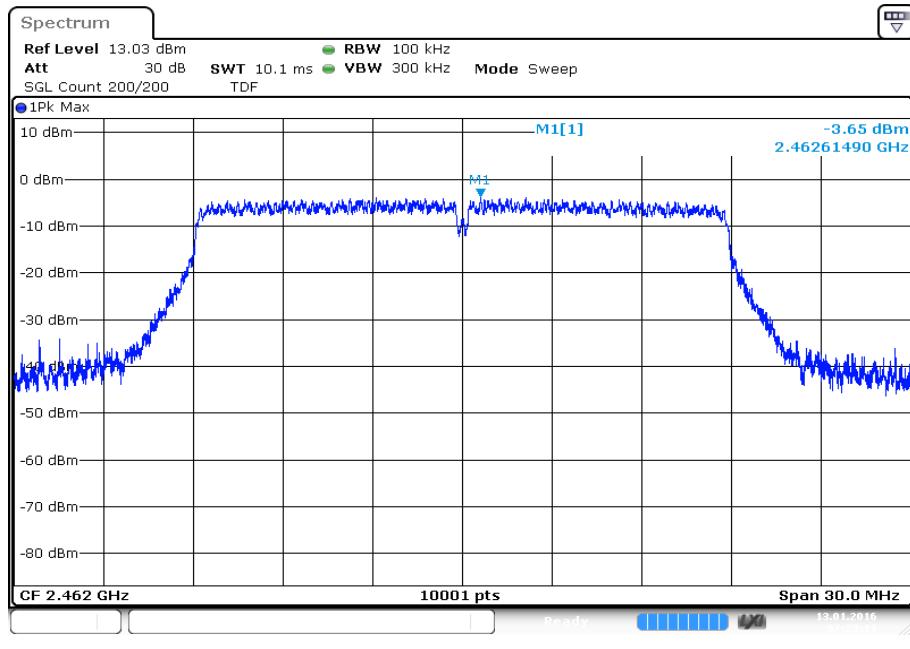
Plot 3: TX mode, highest channel

Date: 13 JAN 2016 06:53:12

Plots: OFDM / n HT20 – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


Plot 3: TX mode, highest channel



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
Trace mode:	Single count with 200 counts
Test setup:	See sub clause 7.3 – A
Measurement uncertainty	See sub clause 9

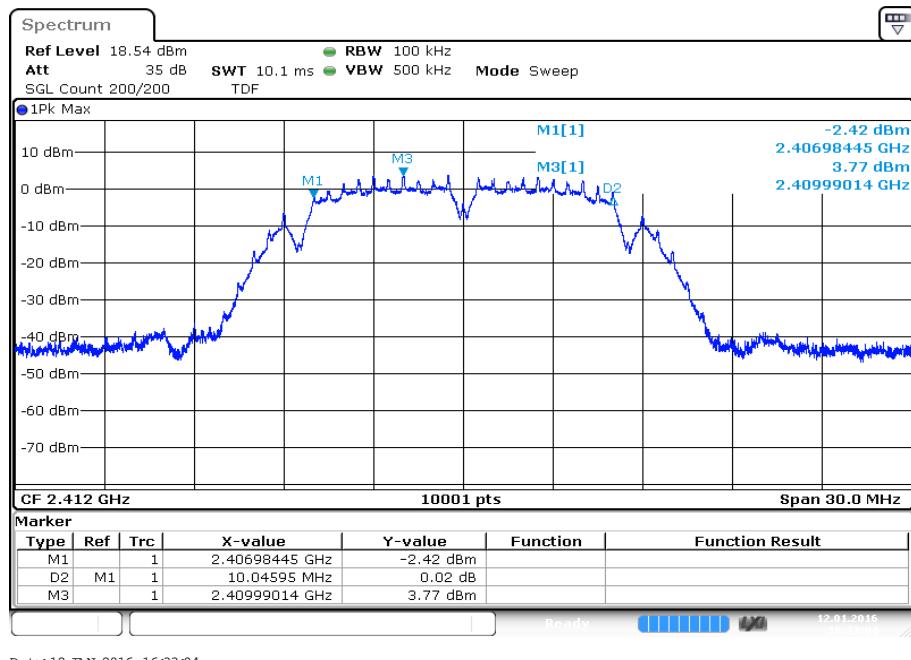
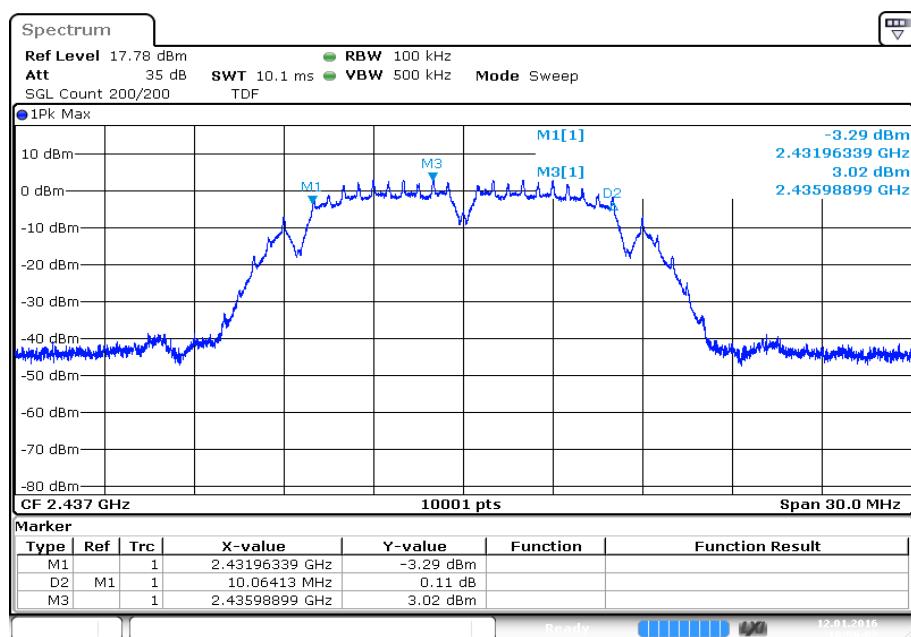
Limits:

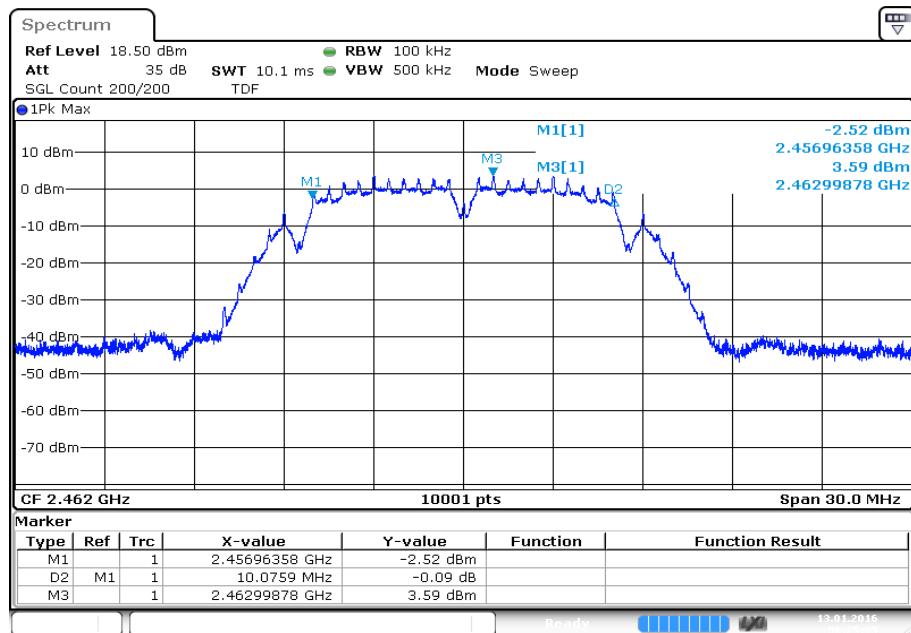
FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

Frequency	6 dB bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	10.05	10.06	10.08
OFDM / g – mode	16.56	16.56	16.54
OFDM / n HT20 – mode	17.81	17.79	17.77

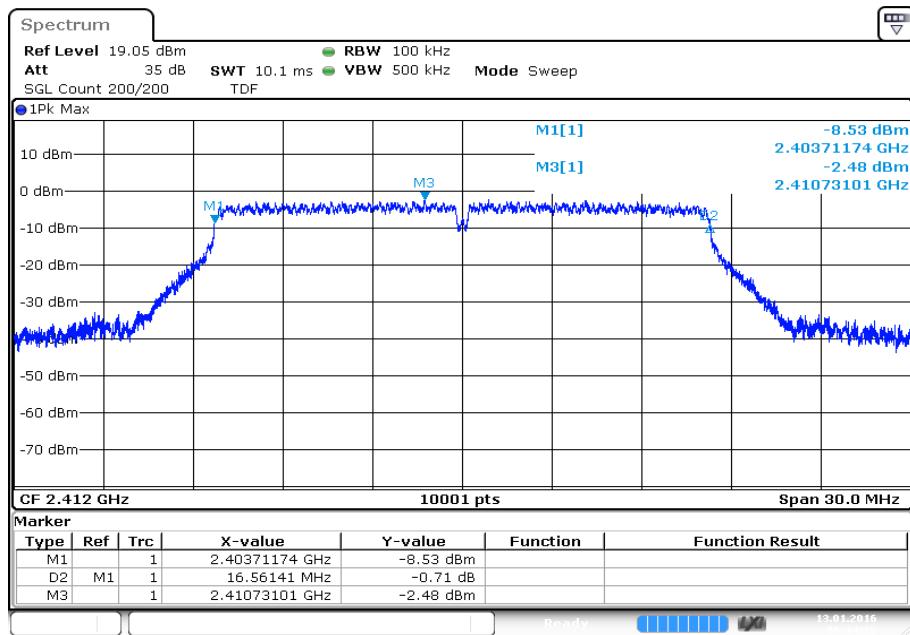
Plots: DSSS / b – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


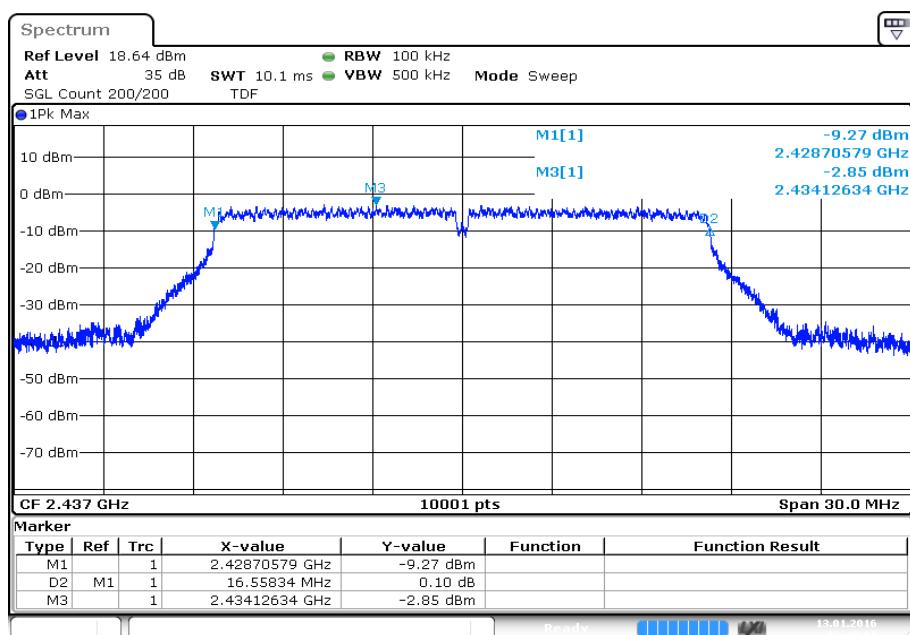
Plot 3: TX mode, highest channel


Plots: OFDM / g – mode

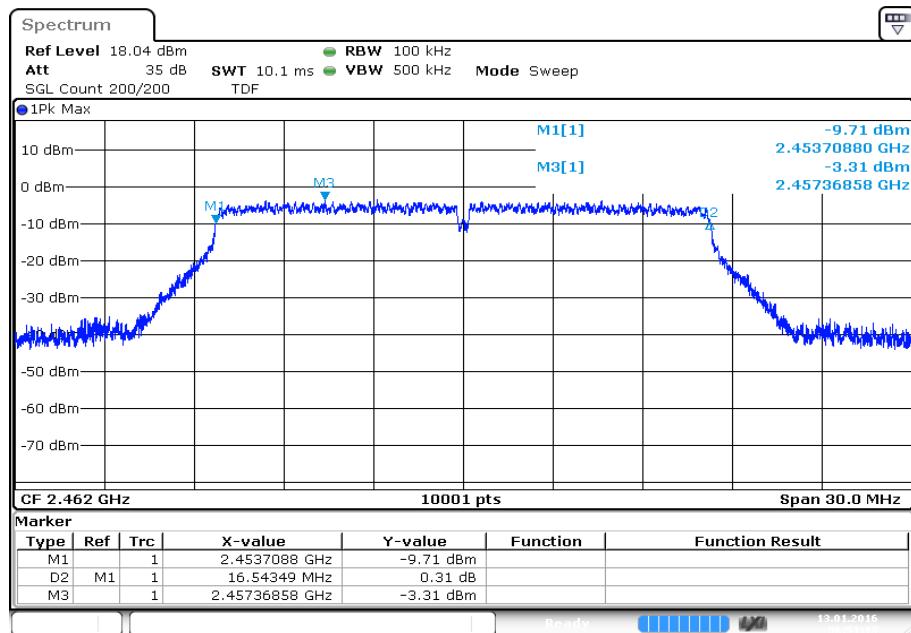
Plot 1: TX mode, lowest channel



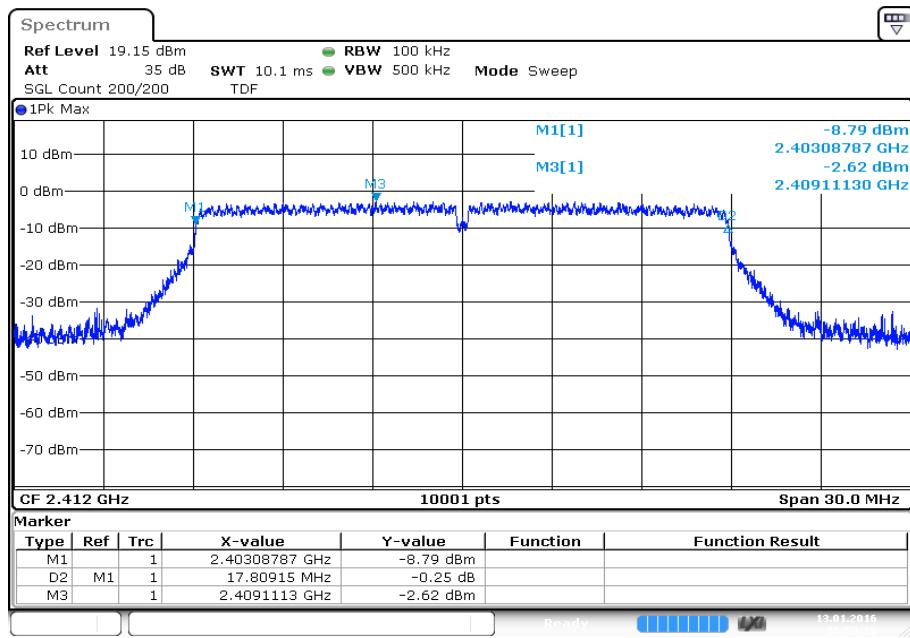
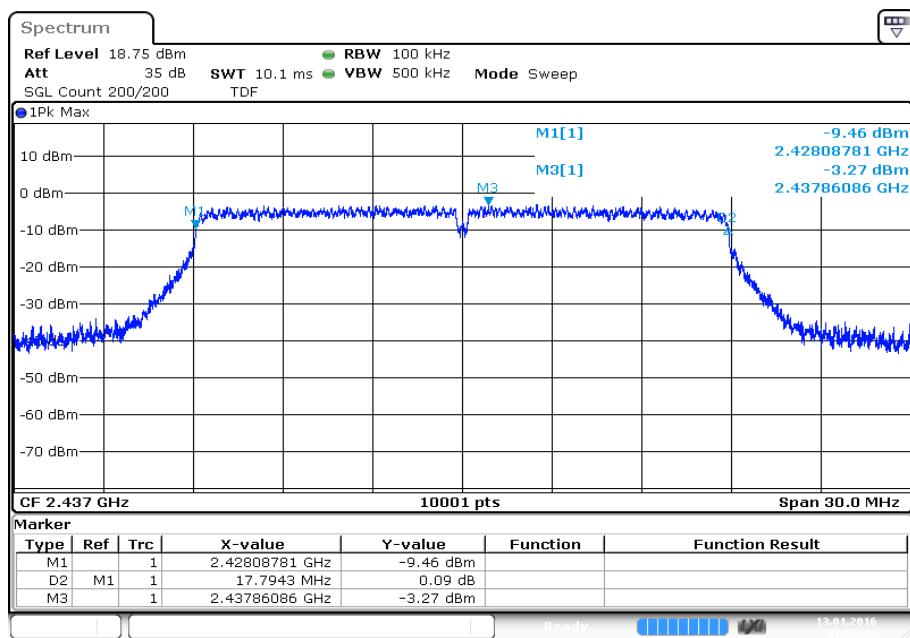
Plot 2: TX mode, middle channel



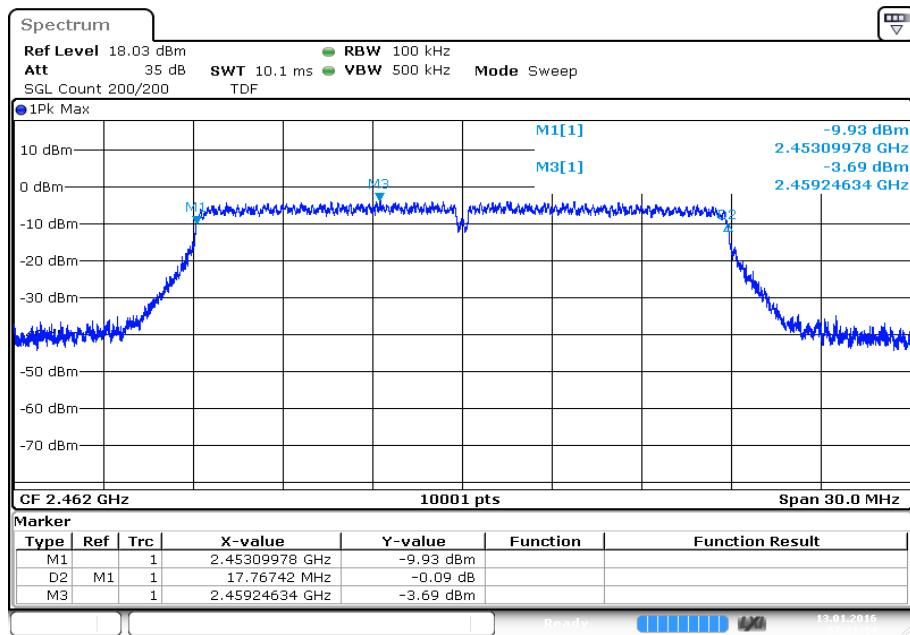
Plot 3: TX mode, highest channel



Plots: OFDM / n HT20 – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


Plot 3: TX mode, highest channel



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 7.3 – A
Measurement uncertainty	See sub clause 9

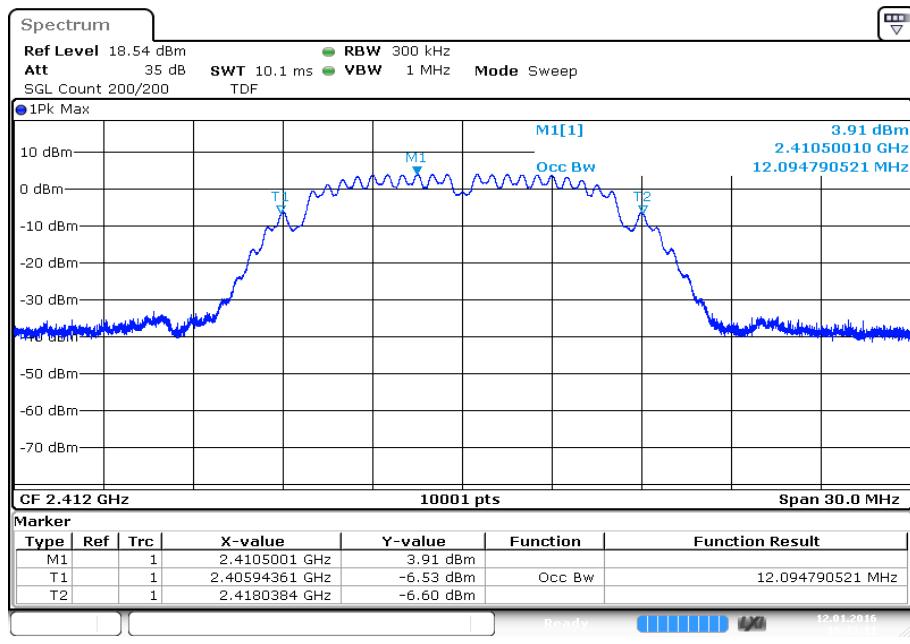
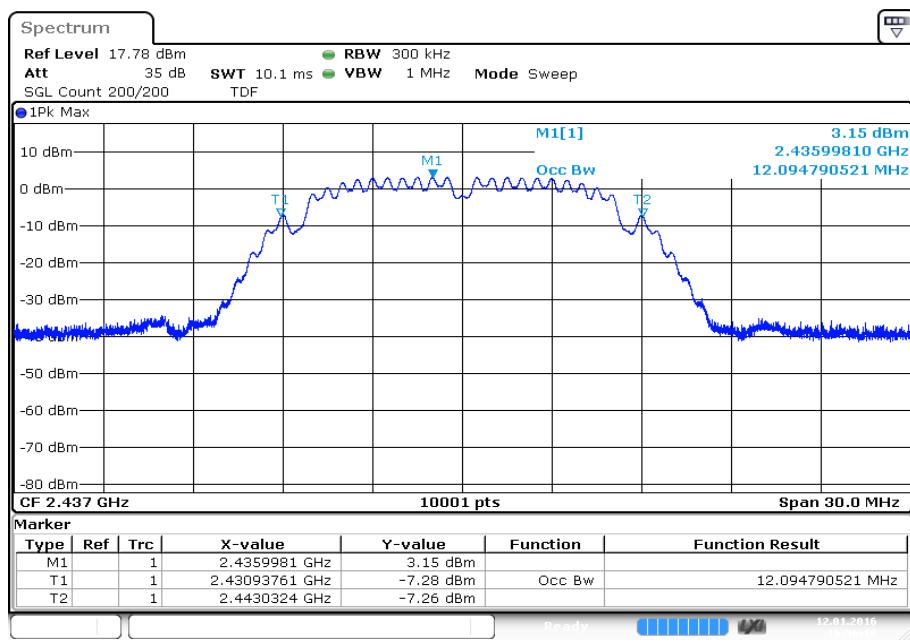
Usage:

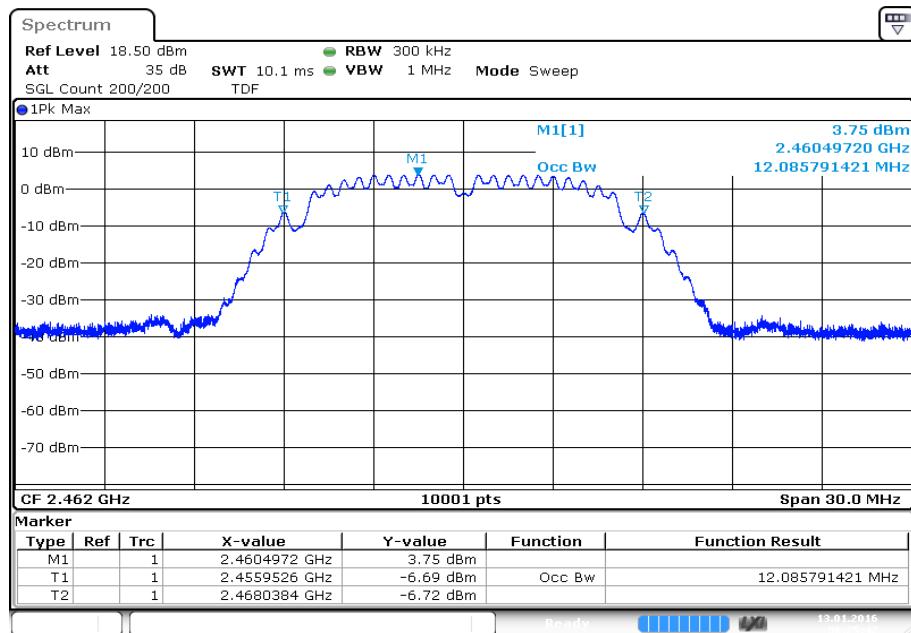
-/-	IC
OBW is necessary for Emission Designator	

Results:

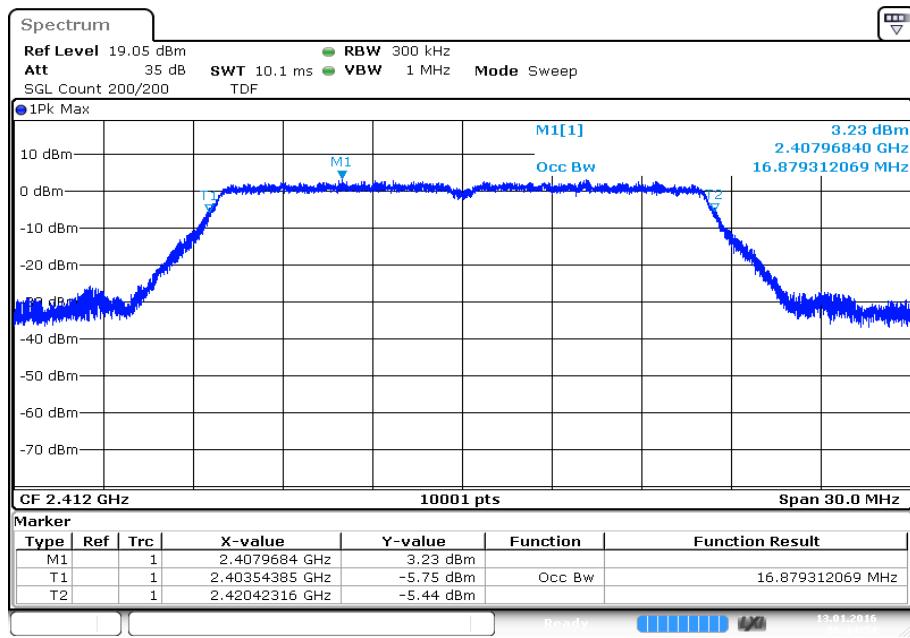
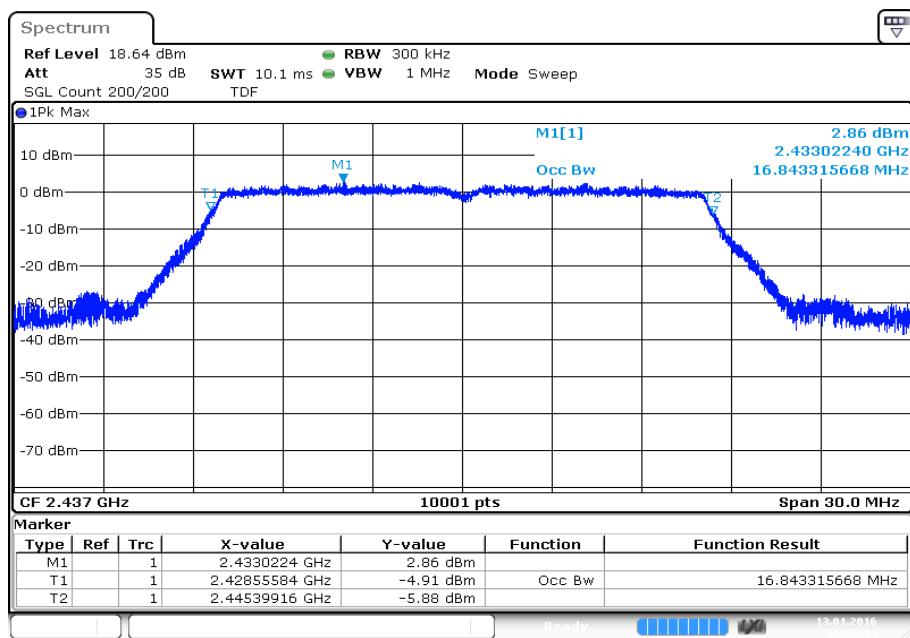
Modulation	99% bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	12.09	12.09	12.09
OFDM / g – mode	16.88	16.84	16.84
OFDM / n HT20 – mode	17.85	17.85	17.82

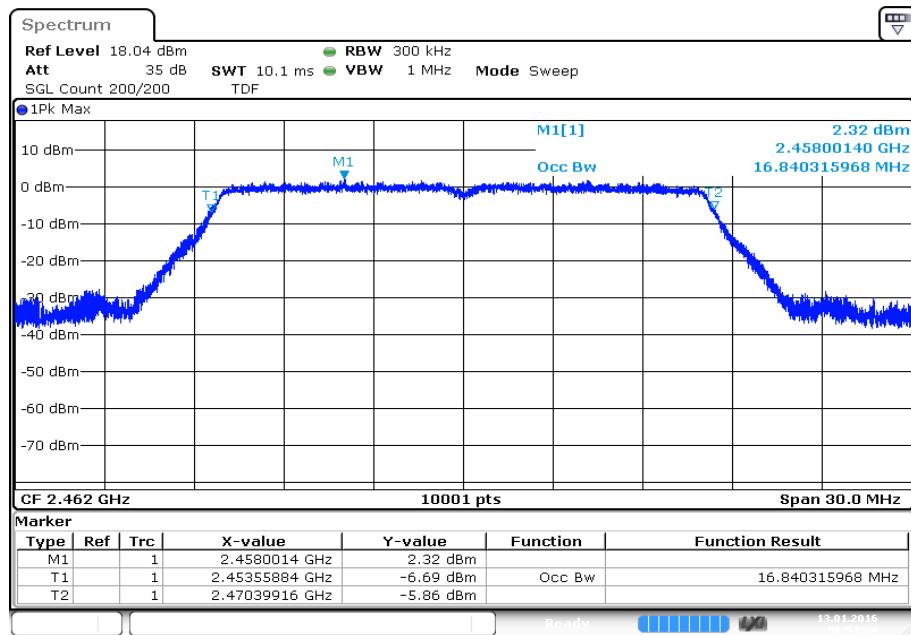
Plots: DSSS / b – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


Plot 3: TX mode, highest channel


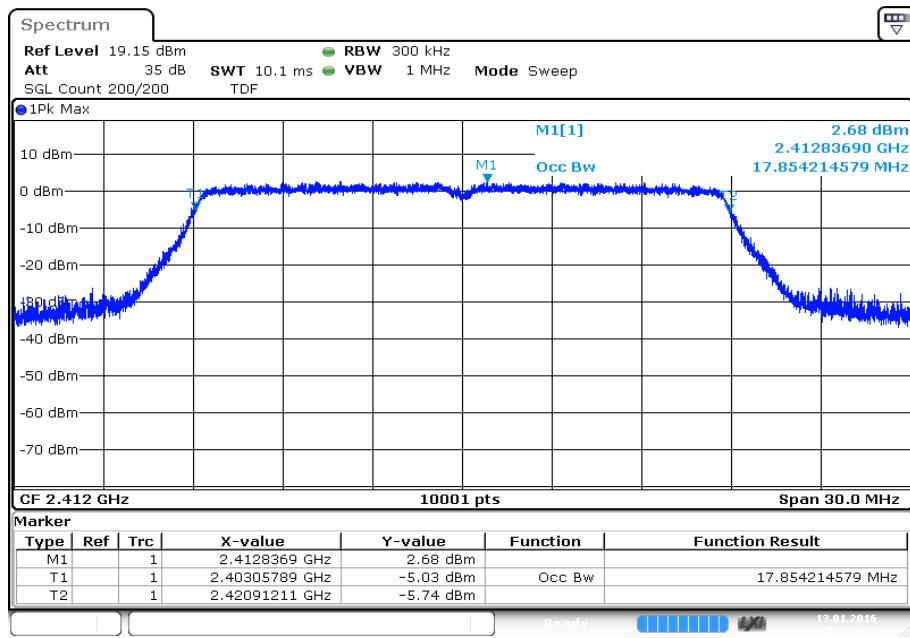
Plots: OFDM / g – mode

Plot 1: TX mode, lowest channel

Plot 2: TX mode, middle channel


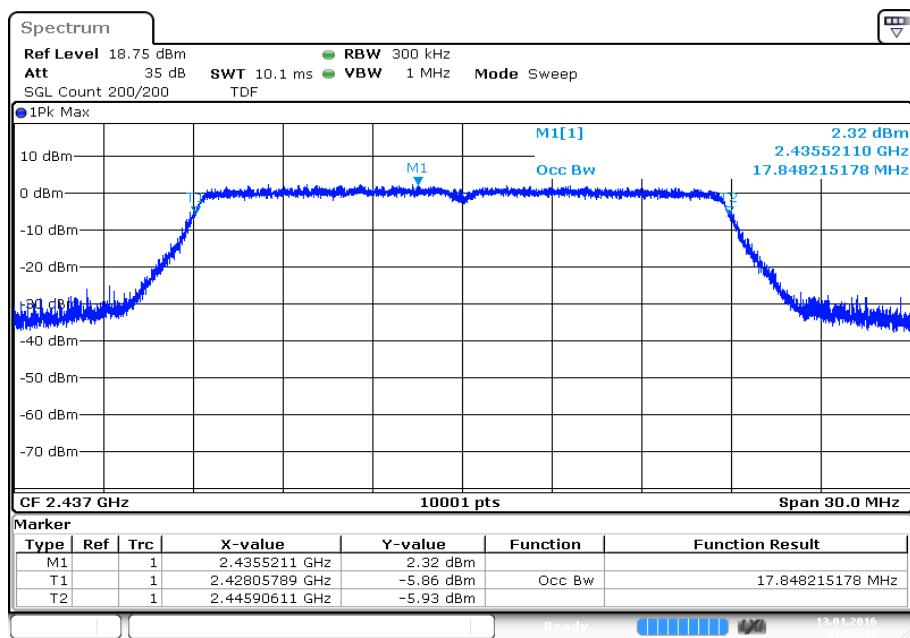
Plot 3: TX mode, highest channel


Plots: OFDM / n HT20 – mode

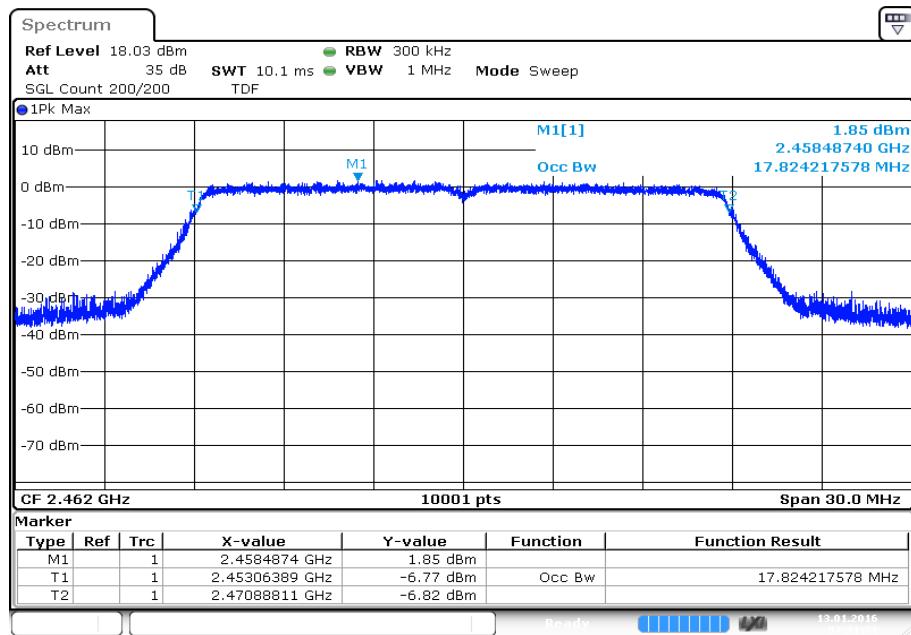
Plot 1: TX mode, lowest channel



Plot 2: TX mode, middle channel



Plot 3: TX mode, highest channel



12.8 Band edge compliance radiated – restricted bands

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 3 m.

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
Test setup:	See sub clause 7.2
Measurement uncertainty	See sub clause 9

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
Test setup:	See sub clause 7.2
Measurement uncertainty	See sub clause 9

Limits:

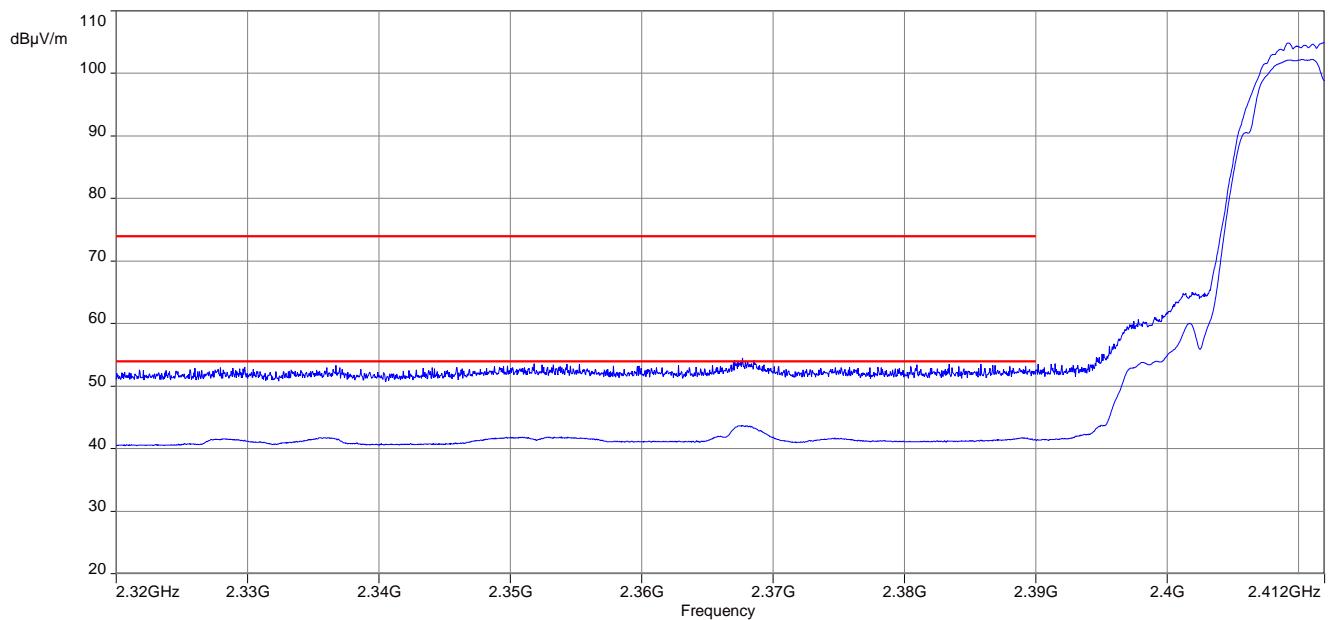
FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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)).	
74 dB μ V/m Peak	54 dB μ V/m AVG

Results:

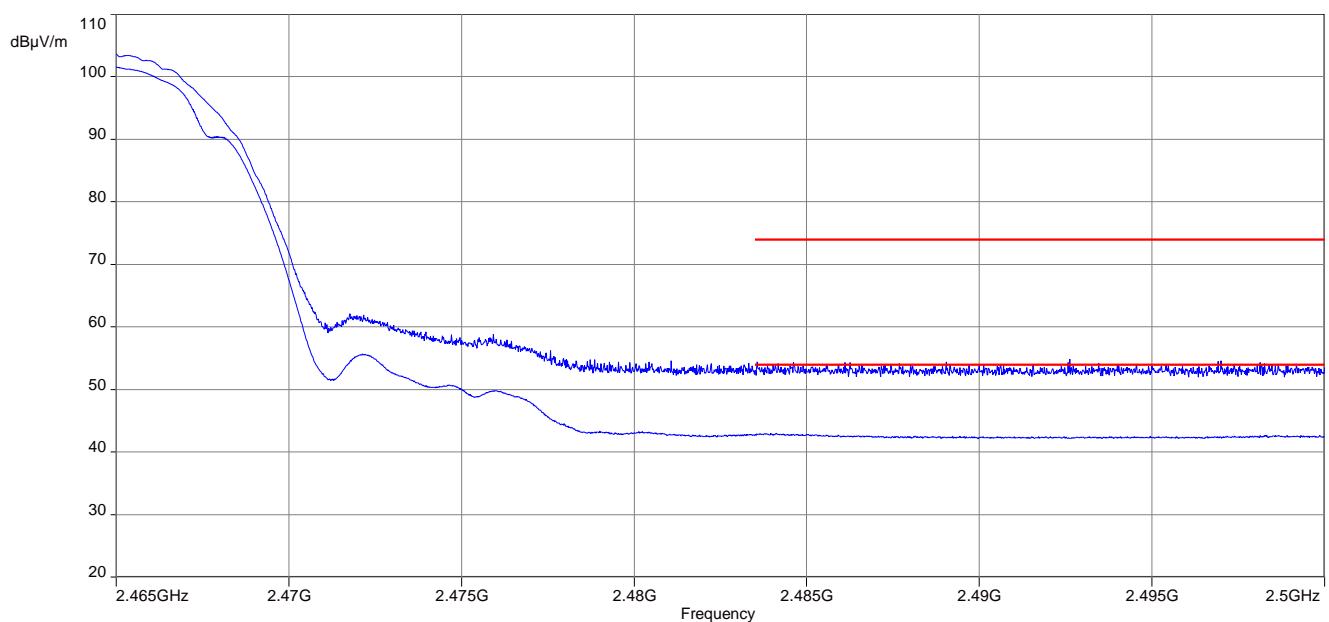
Scenario Modulation	Band edge compliance radiated [dB]	
	DSSS	OFDM
Lower band edge	> 10 dB (Peak) > 10 dB (AVG)	> 70.9 dB (Peak) > 50.7 dB (AVG)
Upper band edge	> 10 dB (Peak) > 10 dB (AVG)	> 71.4 dB (Peak) > 50.1 dB (AVG)

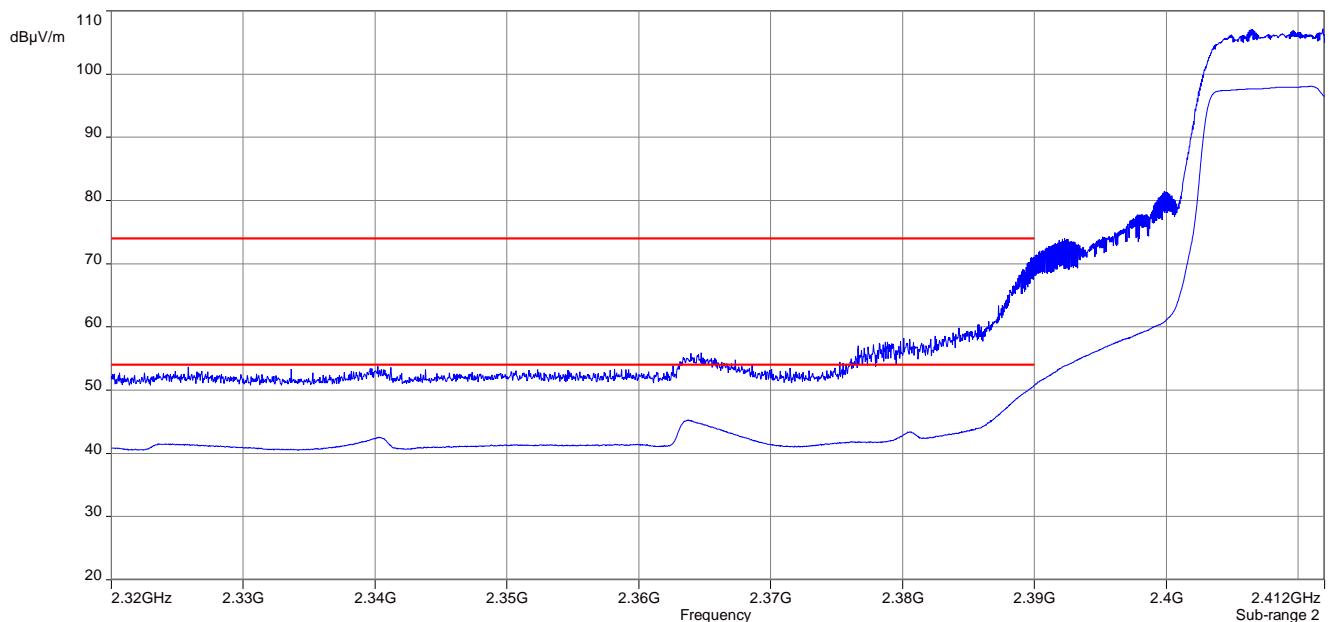
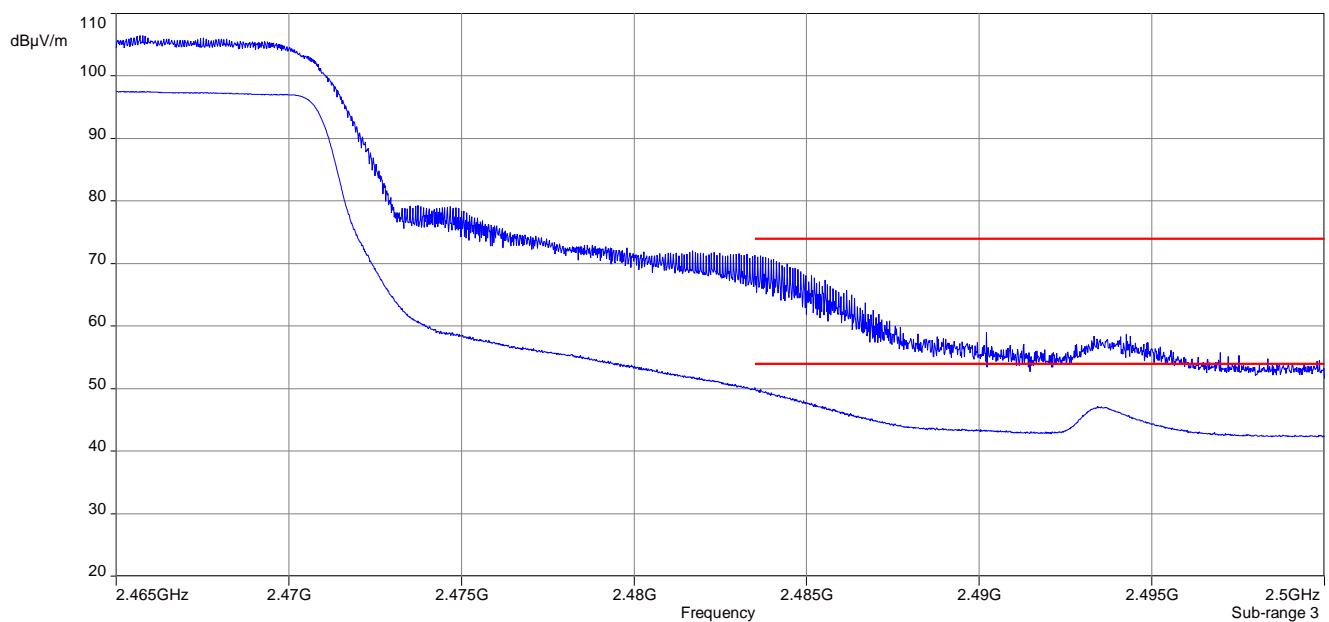
Plots: DSSS (peak & average)

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

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
Test setup:	See sub clause 7.3 – A
Measurement uncertainty	See sub clause 9

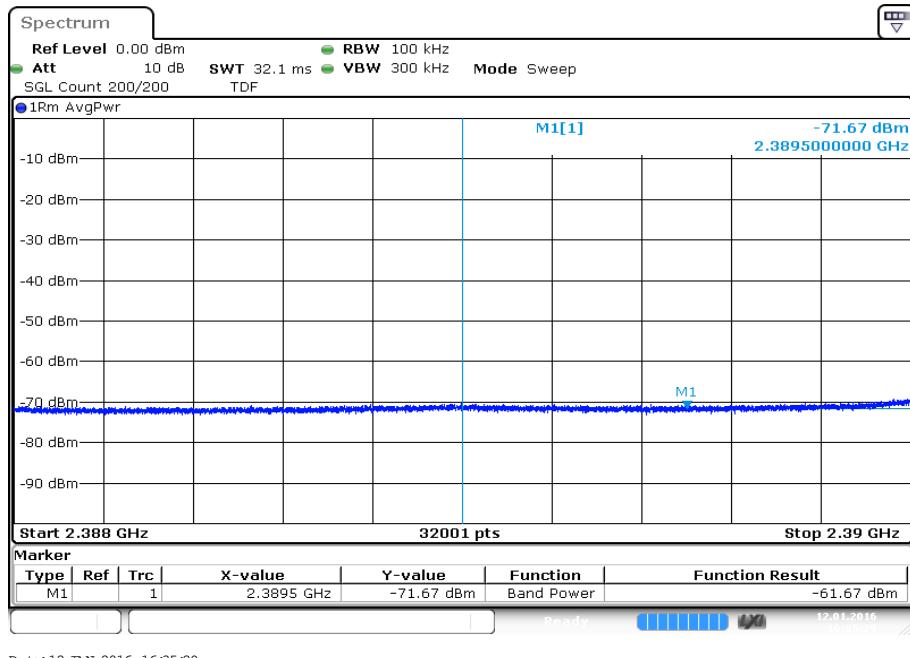
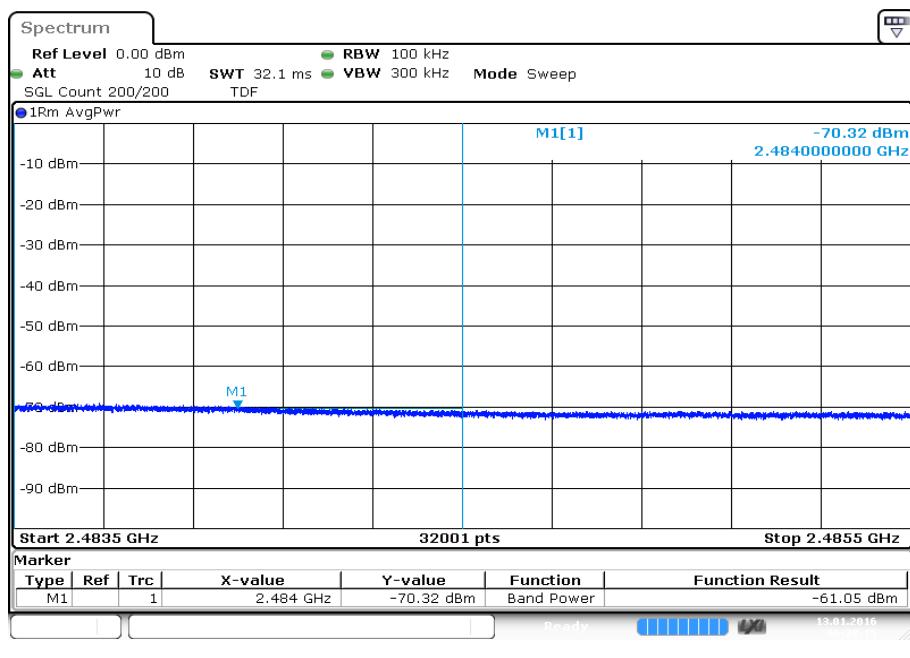
Limits:

FCC	IC
-41.26 dBm	

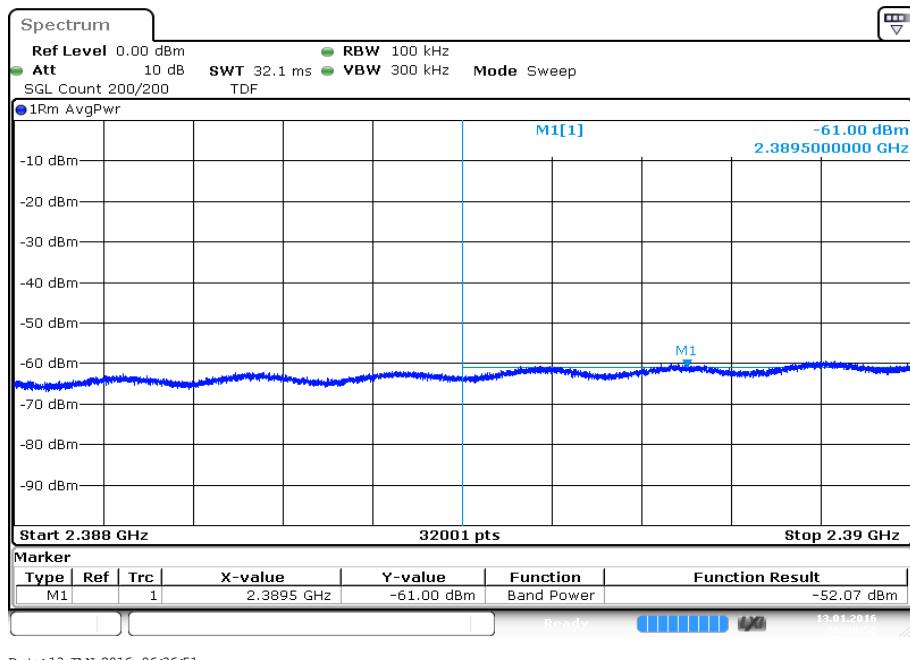
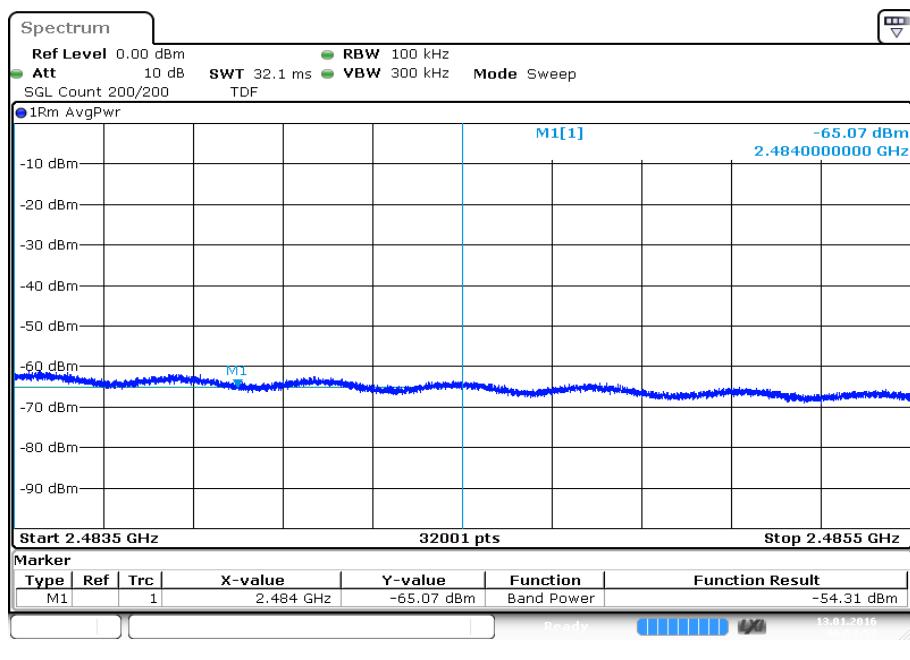
Results:

Scenario	Band edge compliance radiated [dB]		
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode
Max. lower band edge power	-61.67	-52.07	-49.14
Max. upper band edge power	-61.05	-54.31	-51.09

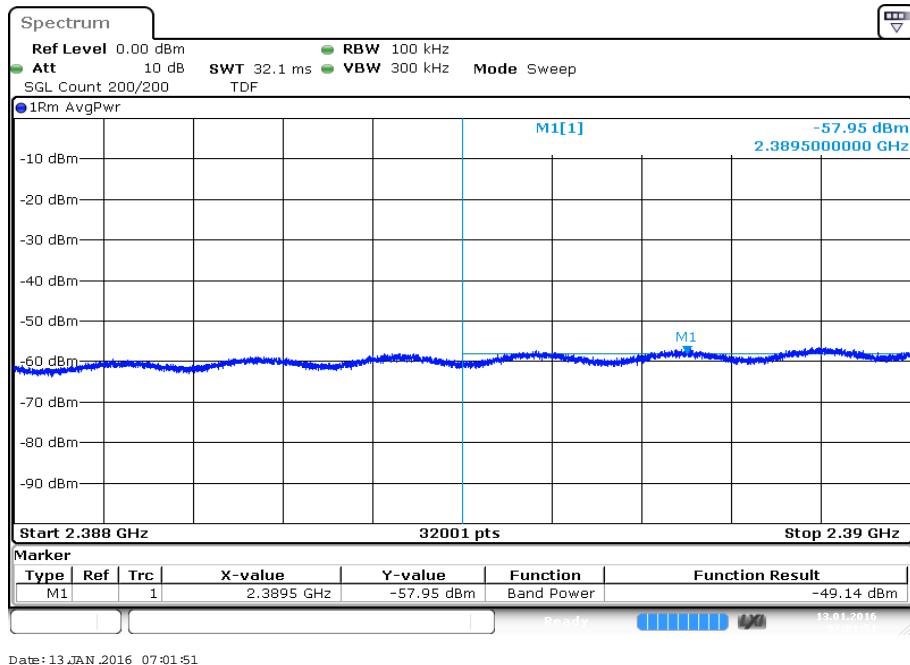
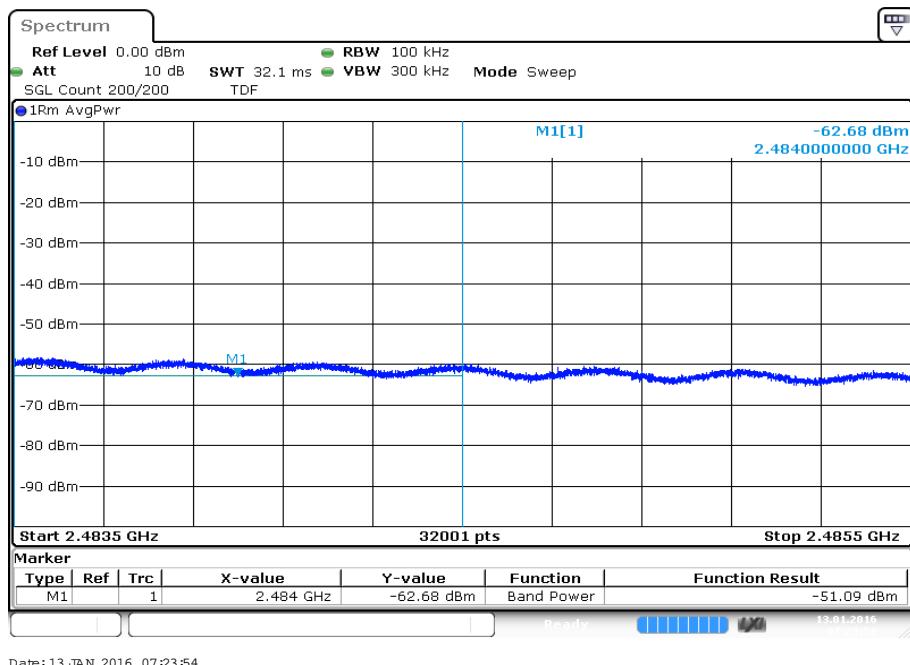
Plots: DSSS / b – mode

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

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


Plots: OFDM / g – mode

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

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


Plots: OFDM / n HT20 – mode

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

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


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 7.3 – 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	

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		3.72	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		2.08	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		2.95	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Measurement uncertainty		± 3 dB			

Results: OFDM / g – mode

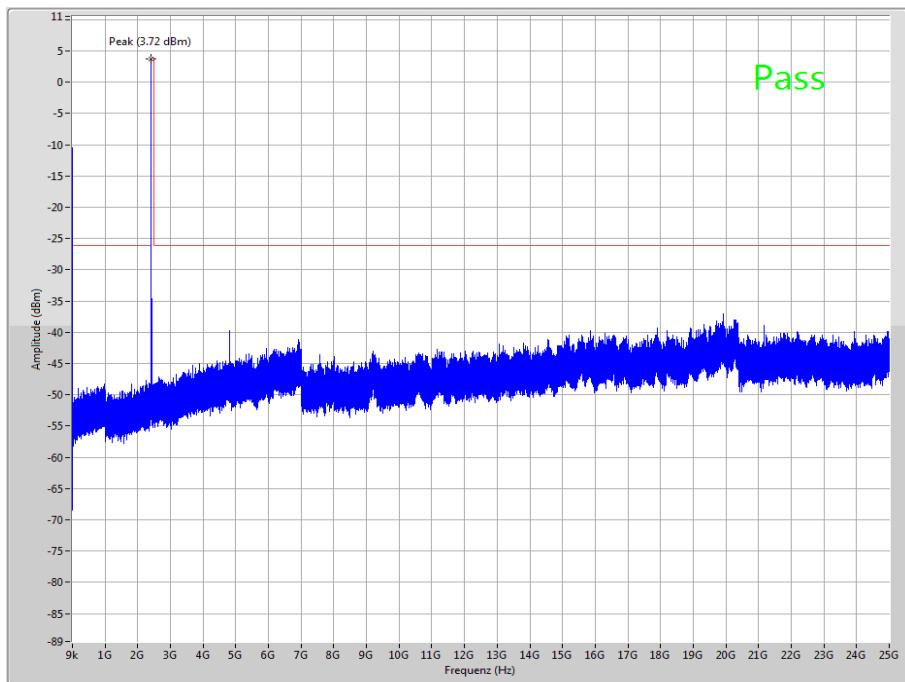
TX Spurious Emissions Conducted					
OFDM / g – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-2.80	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		-3.49	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-4.30	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Measurement uncertainty		± 3 dB			

Results: OFDM / n HT20 – mode

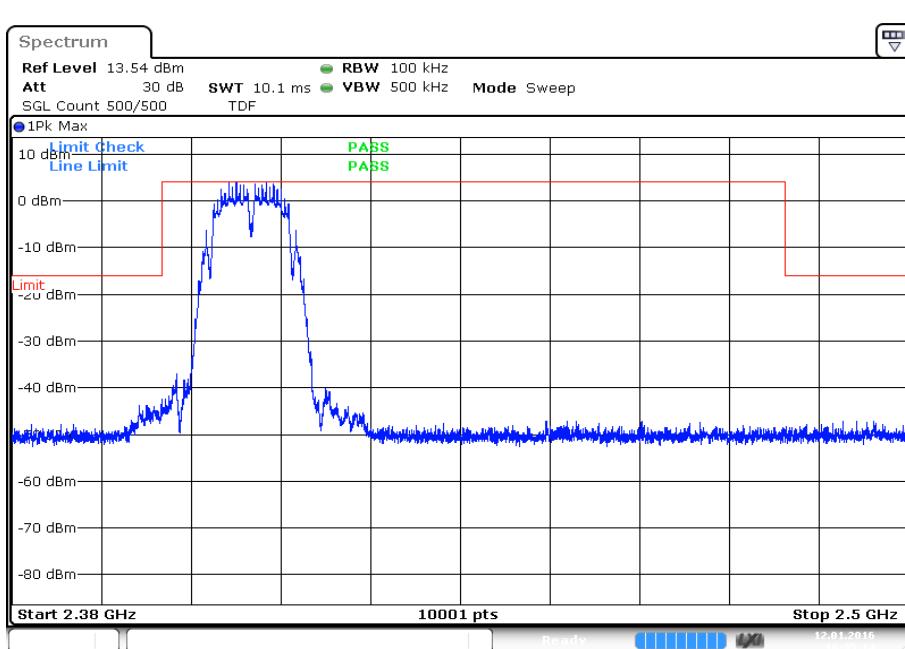
TX Spurious Emissions Conducted					
OFDM / n HT20 – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-3.37	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		-3.36	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-3.92	30 dBm		Operating frequency
No peaks detected. All detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
Measurement uncertainty		± 3 dB			

Plots: DSSS / b – mode

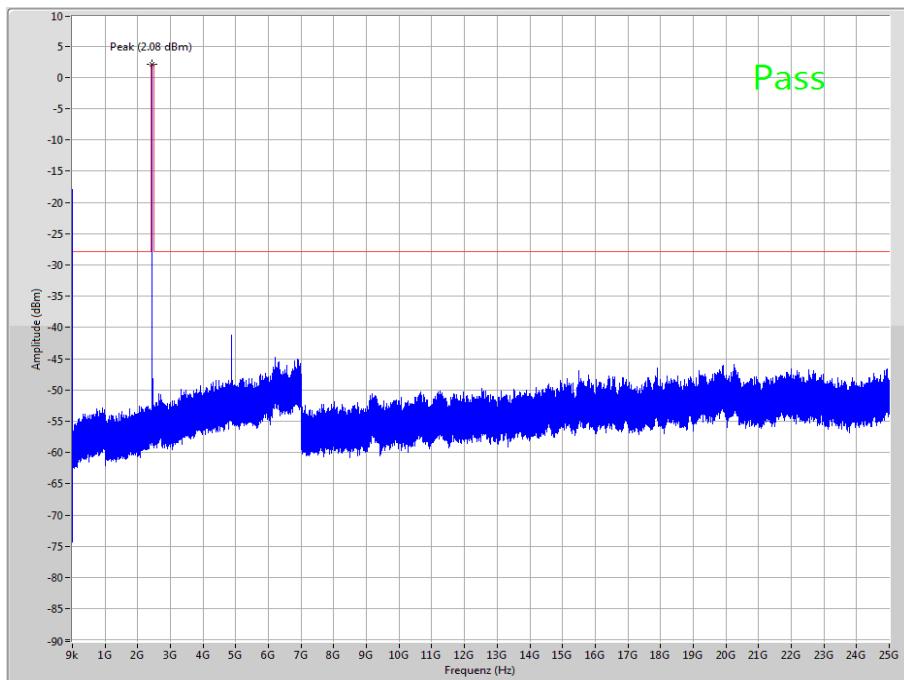
Plot 1: TX mode, lowest channel, up to 25 GHz



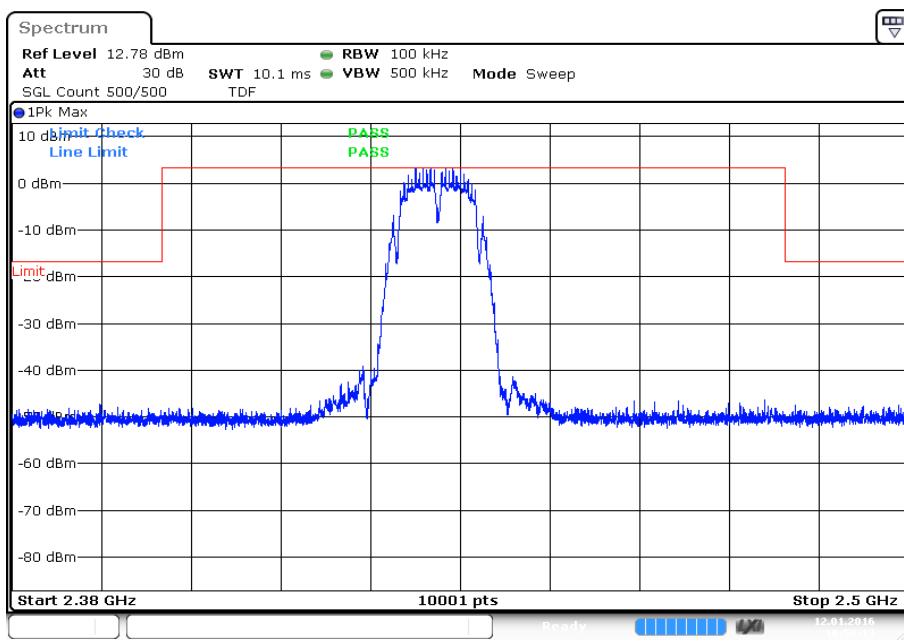
Plot 2: TX mode, lowest channel, zoomed carrier



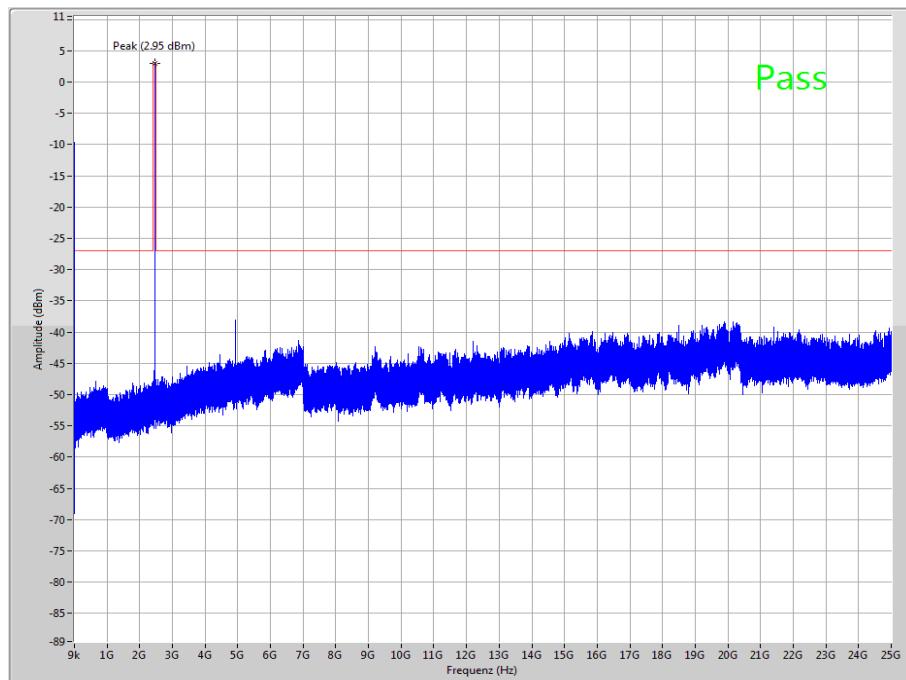
Date: 12 JAN 2016 16:35:15

Plot 3: TX mode, middle channel, up to 25 GHz

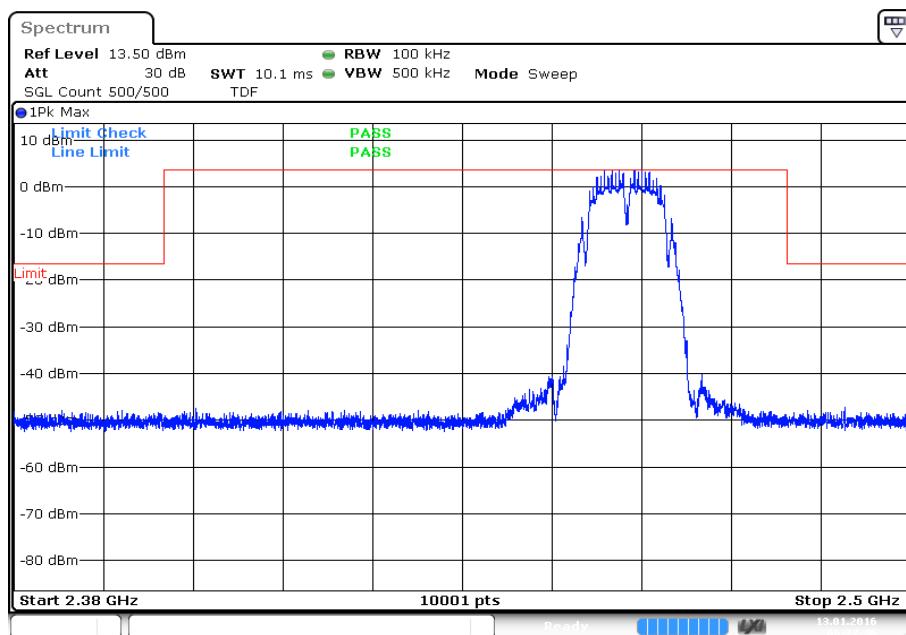
The peak at the beginning of the plot is the LO from the SA.

Plot 4: TX mode, middle channel, zoomed carrier

Date: 12 JAN 2016 16:58:13

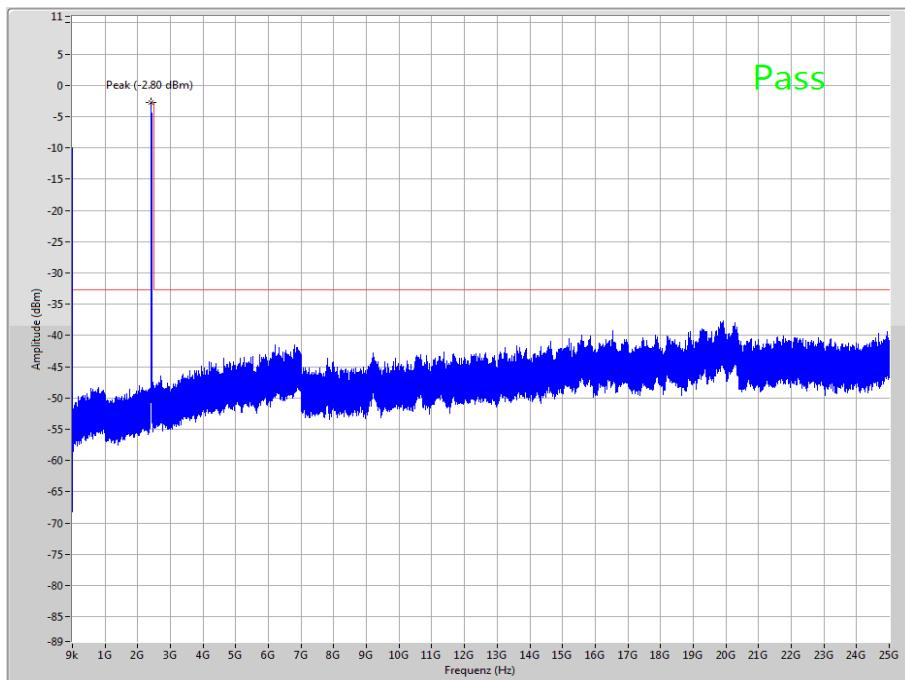
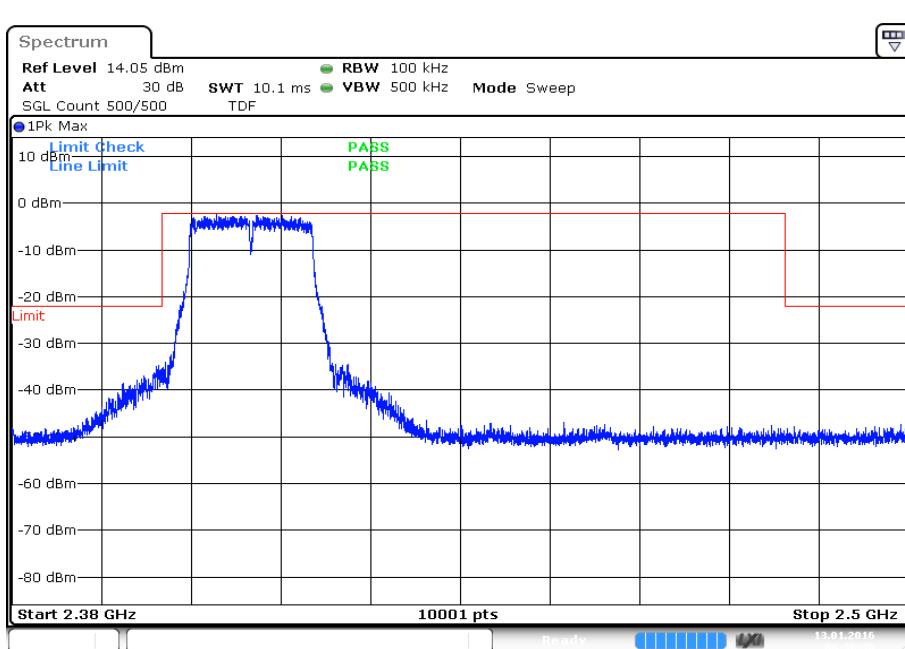
Plot 5: TX mode, highest channel, up to 25 GHz

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

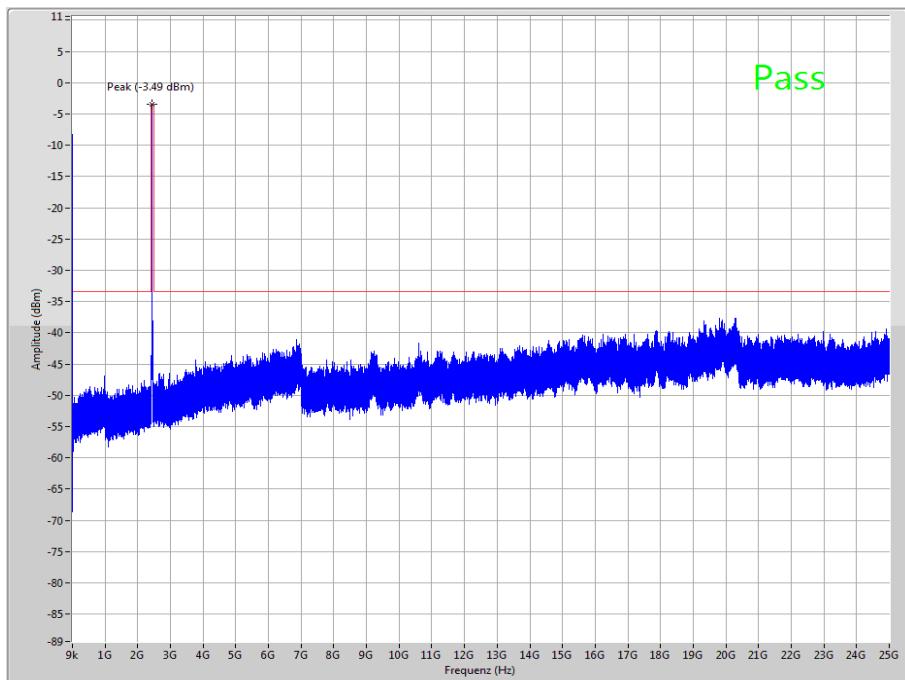
Plot 6: TX mode, highest channel, zoomed carrier

Date: 13 JAN 2016 06:27:46

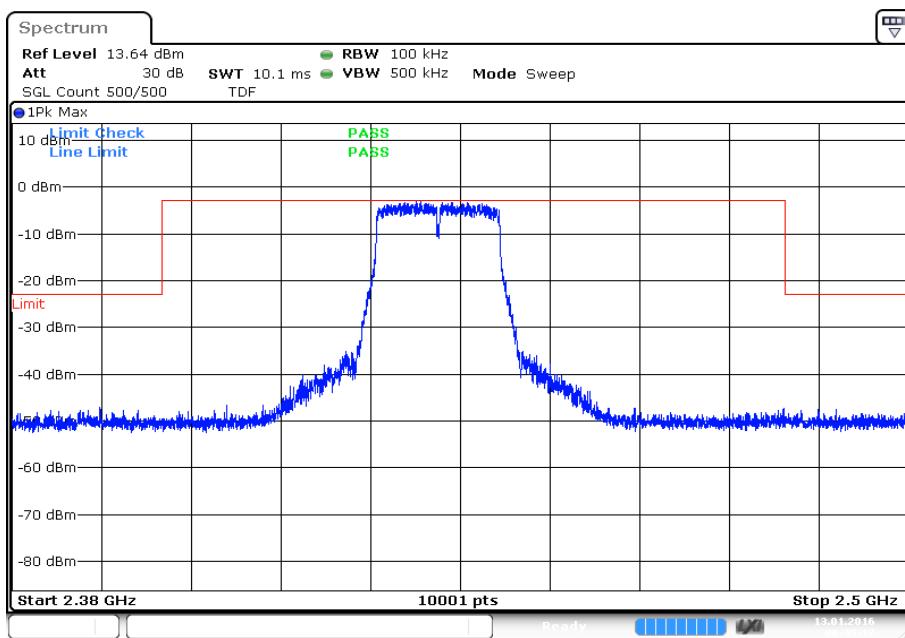
Plots: OFDM / g – mode

Plot 1: TX mode, lowest channel, up to 25 GHz

Plot 2: TX mode, lowest channel, zoomed carrier


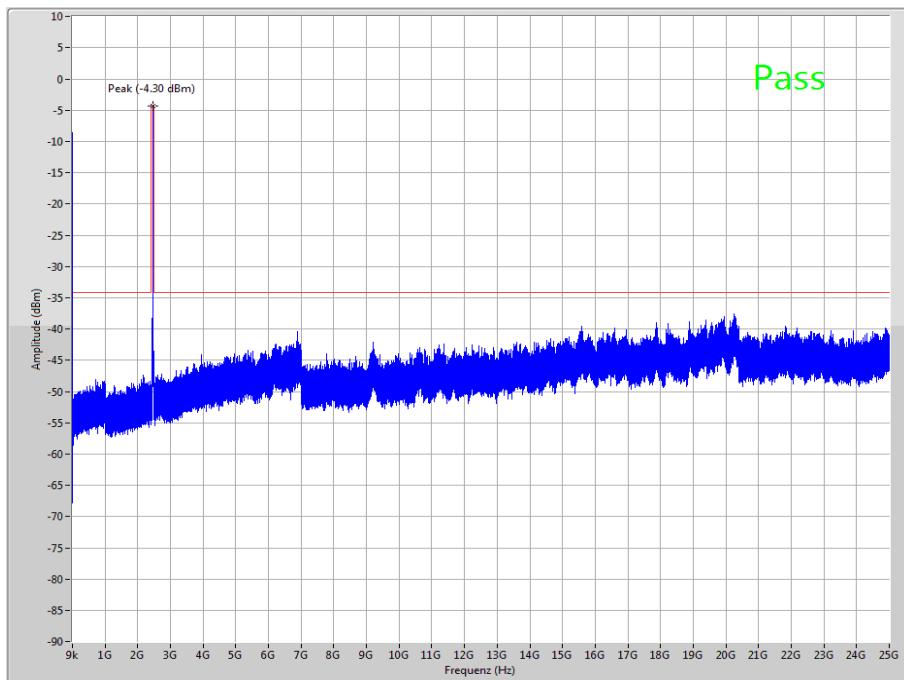
Date: 13 JAN 2016 06:36:36

Plot 3: TX mode, middle channel, up to 25 GHz

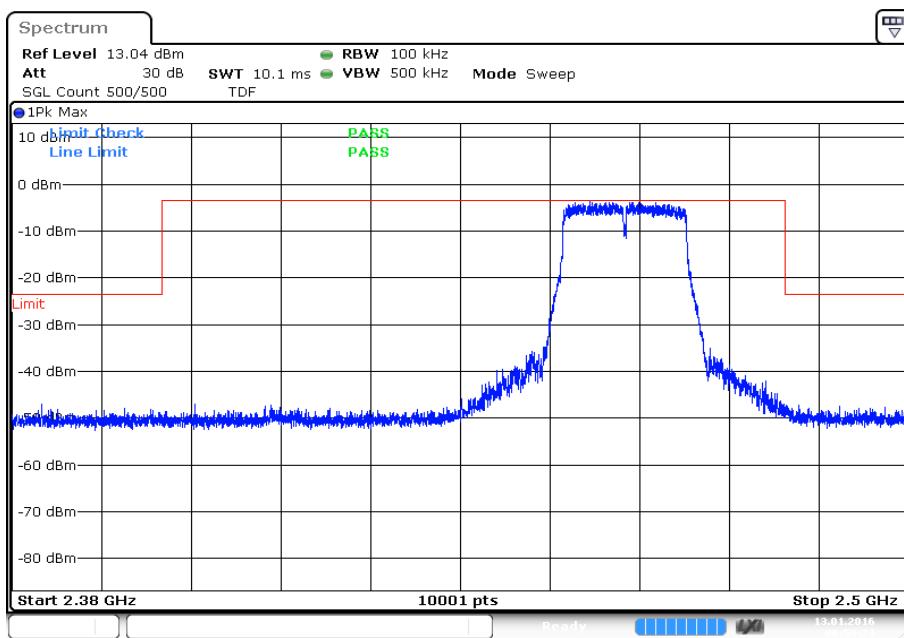
The peak at the beginning of the plot is the LO from the SA.

Plot 4: TX mode, middle channel, zoomed carrier

Date: 13 JAN 2016 06:45:18

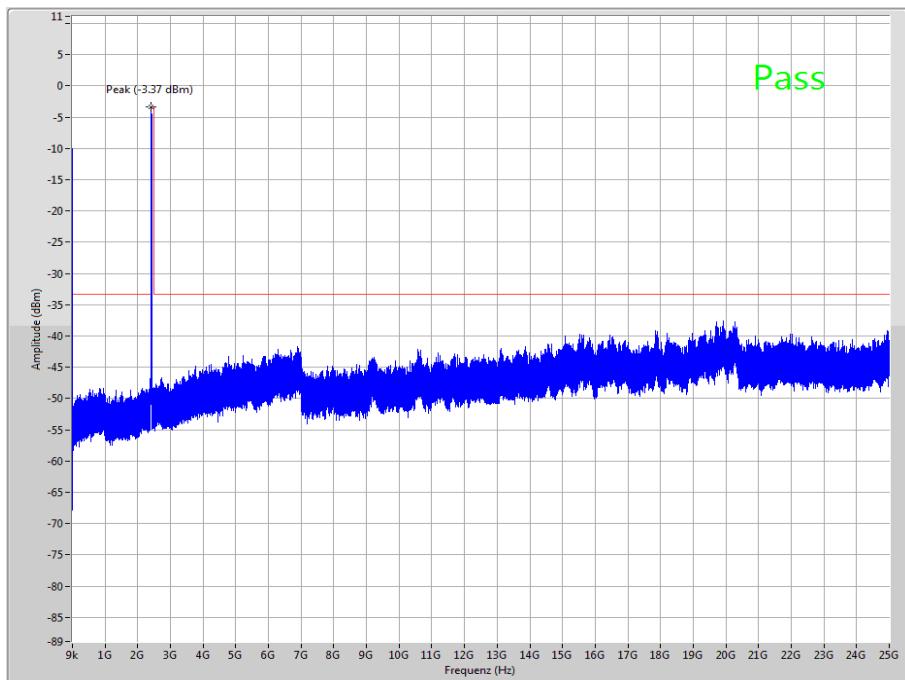
Plot 5: TX mode, highest channel, up to 25 GHz

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

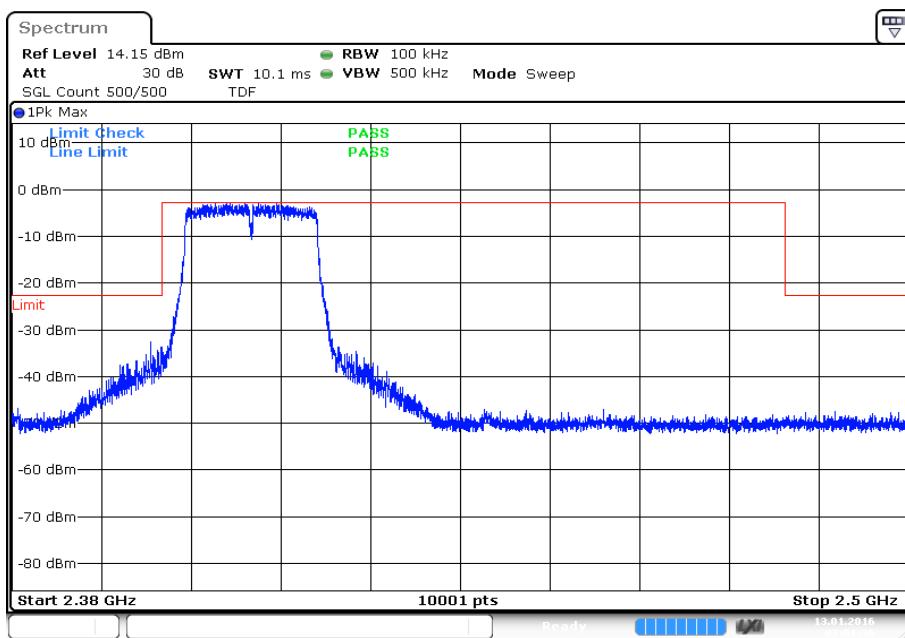
Plot 6: TX mode, highest channel, zoomed carrier

Date: 13 JAN 2016 06:53:24

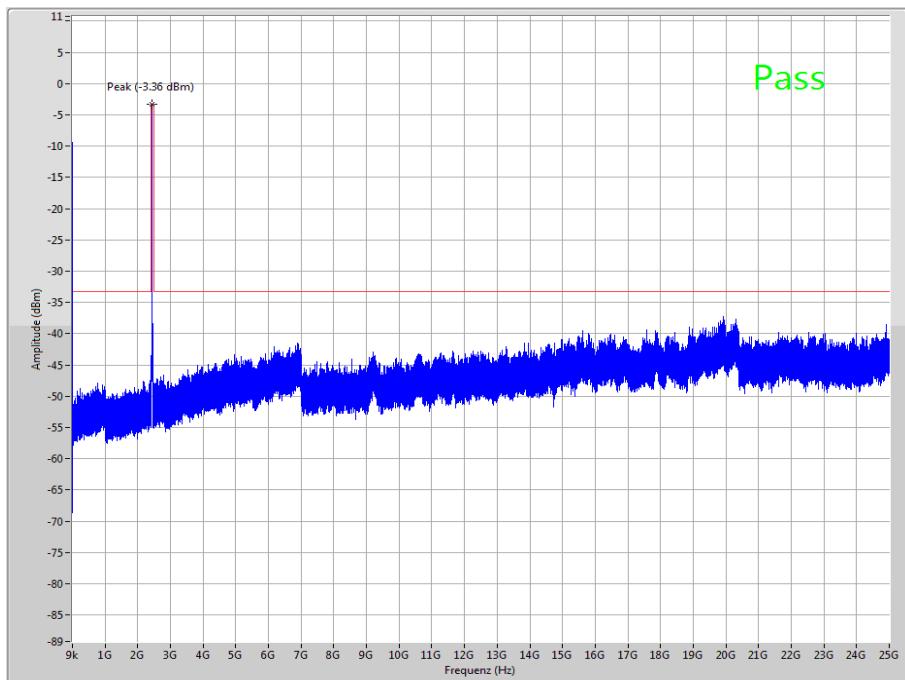
Plots: OFDM / n HT 20 – mode

Plot 1: TX mode, lowest channel, up to 25 GHz


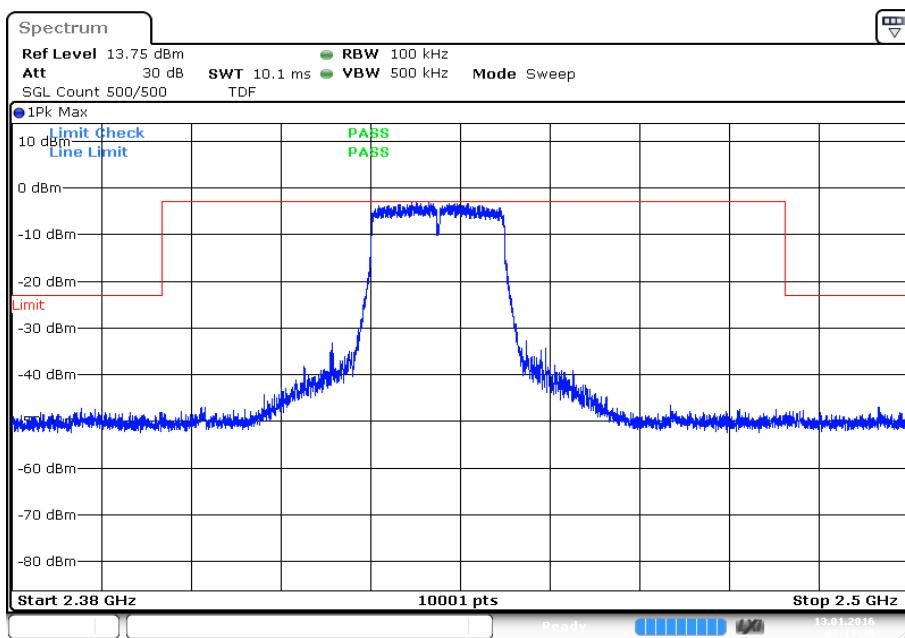
The peak at the beginning of the plot is the LO from the SA.

Plot 2: TX mode, lowest channel, zoomed carrier


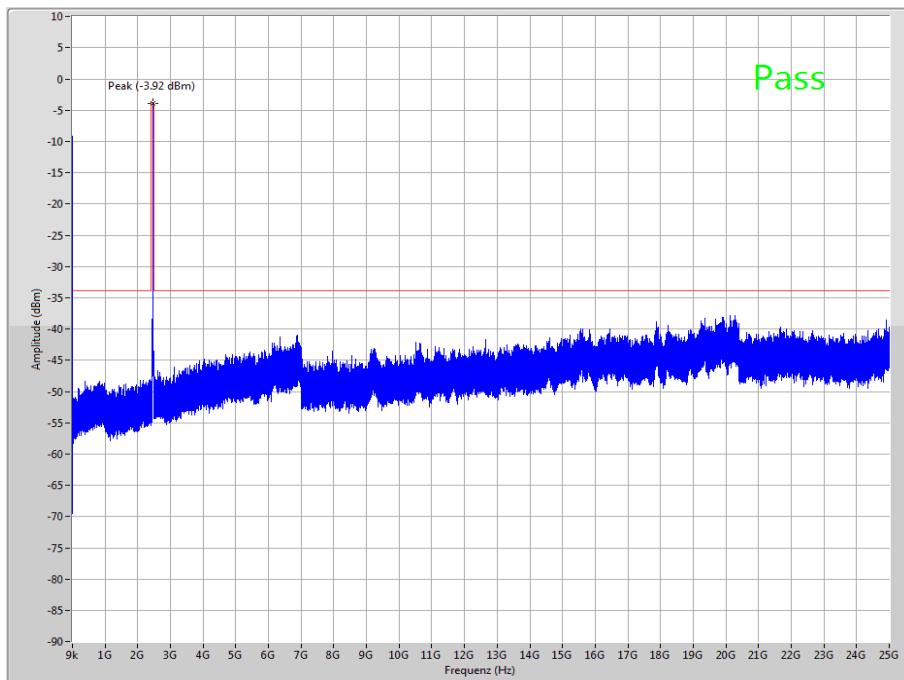
Date: 13 JAN 2016 07:01:36

Plot 3: TX mode, middle channel, up to 25 GHz

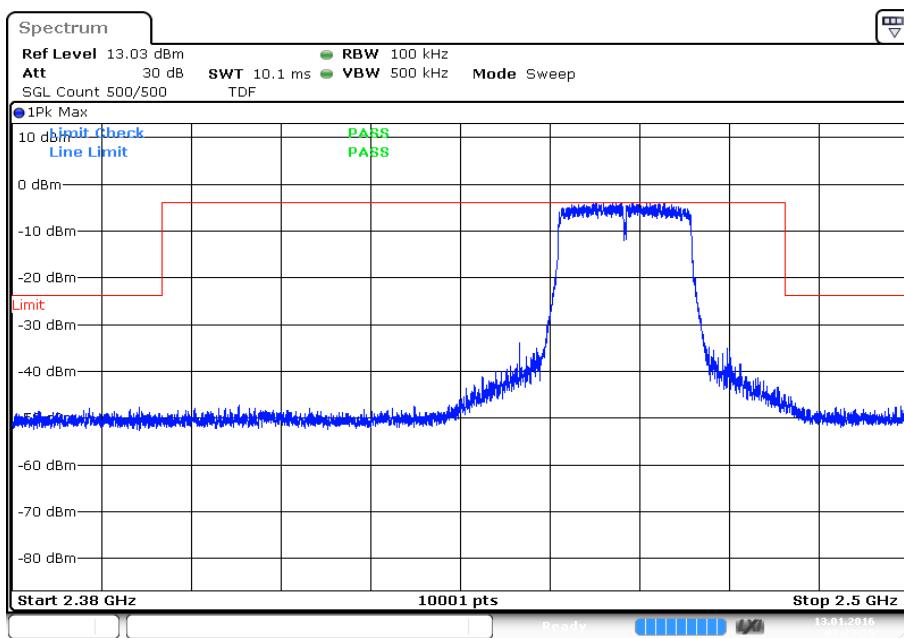
The peak at the beginning of the plot is the LO from the SA.

Plot 4: TX mode, middle channel, zoomed carrier

Date: 13 JAN 2016 07:11:20

Plot 5: TX mode, highest channel, up to 25 GHz

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

Plot 6: TX mode, highest channel, zoomed carrier

Date: 13 JAN 2016 07:23:25

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
Measurement uncertainty	See sub clause 9

Limits:

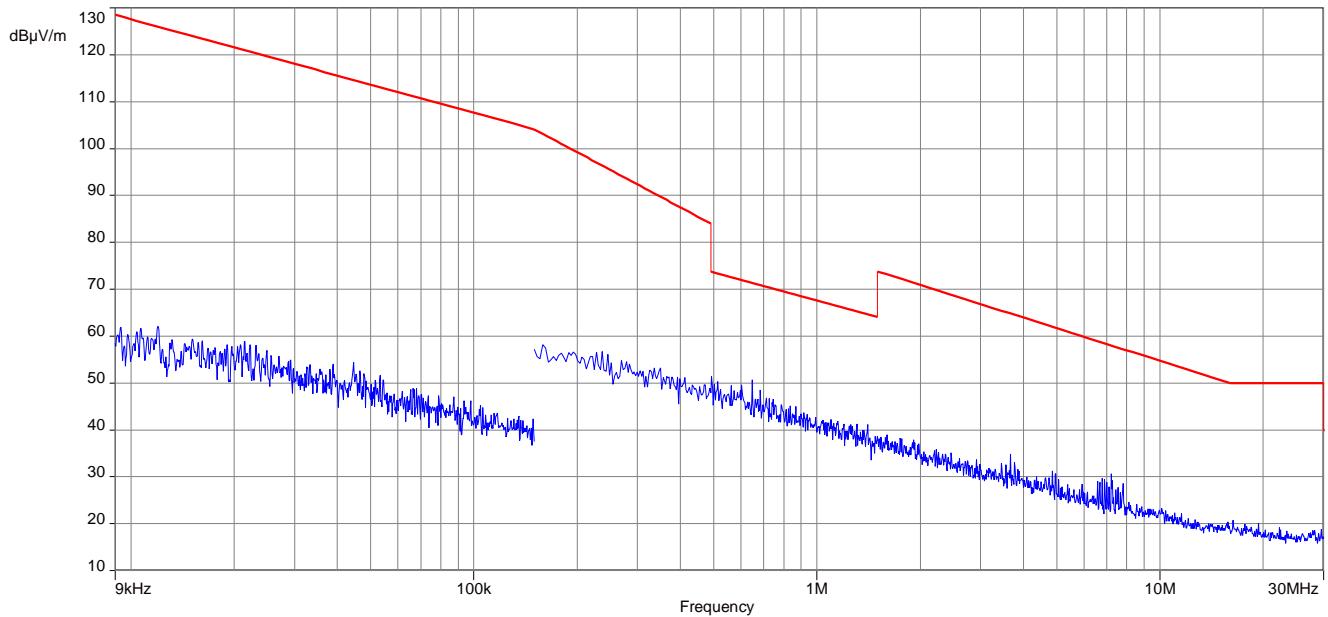
FCC		IC
Frequency (MHz)	Field Strength (dB μ V/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

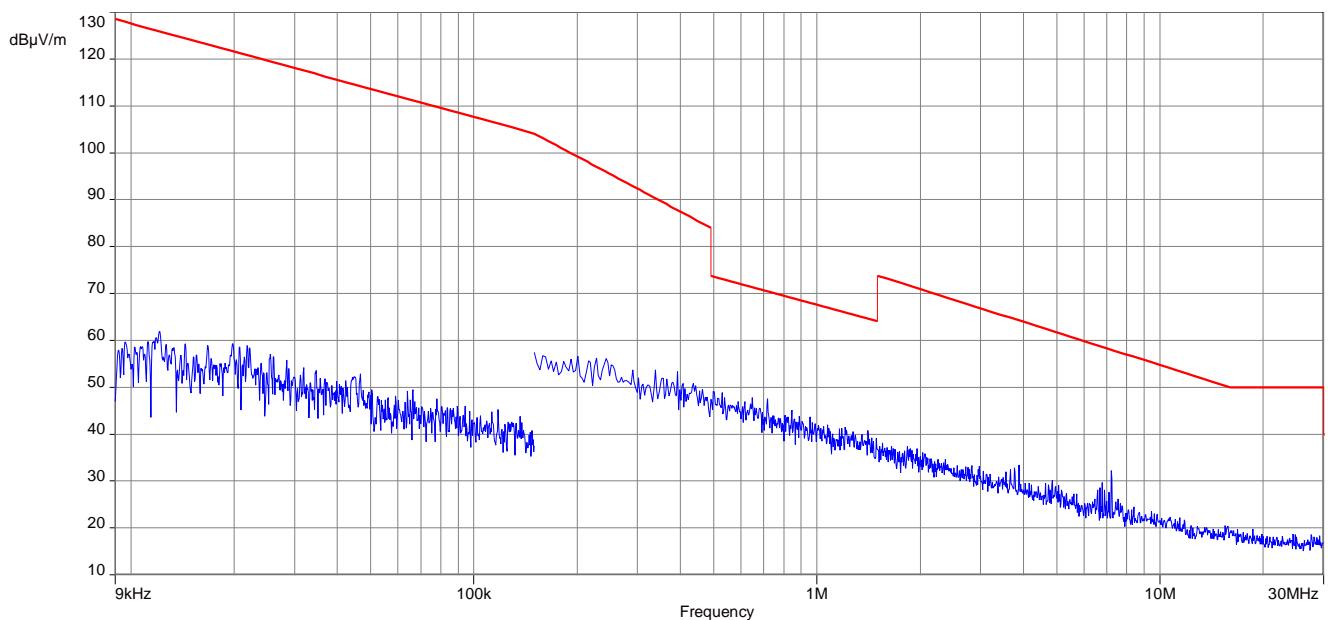
TX Spurious Emissions Radiated < 30 MHz [dB μ V/m]		
F [MHz]	Detector	Level [dB μ V/m]
All detected peaks are more than 20 dB below the limit.		

Plots: DSSS

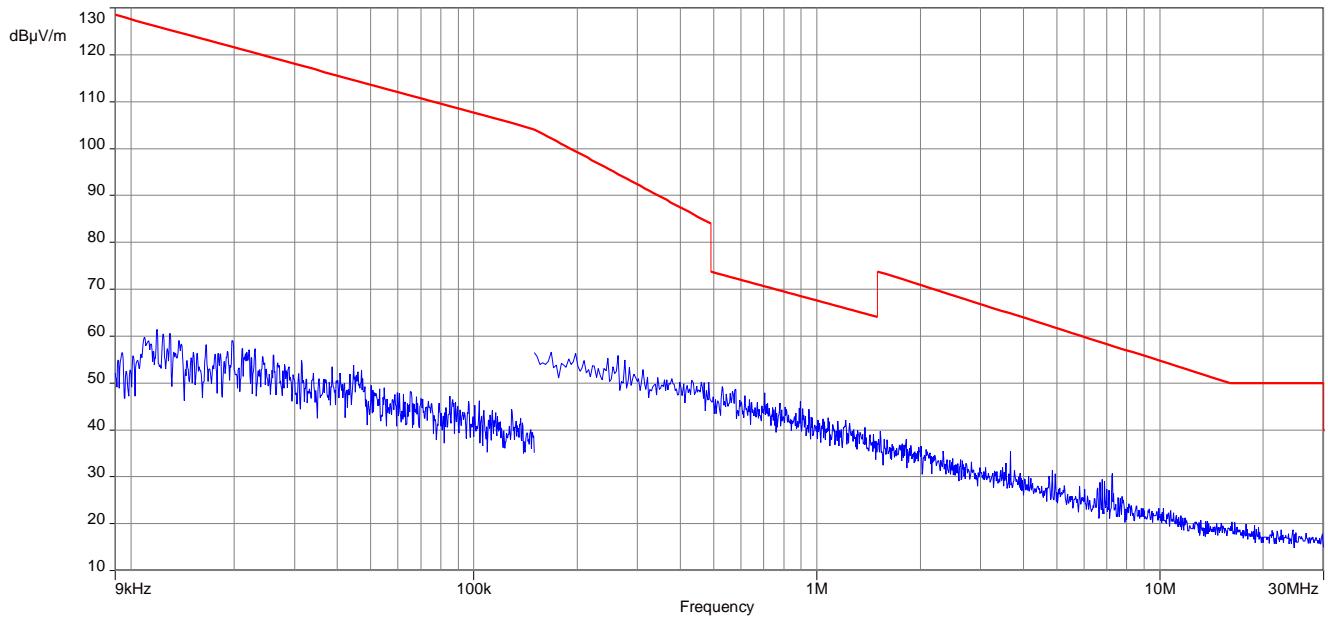
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel

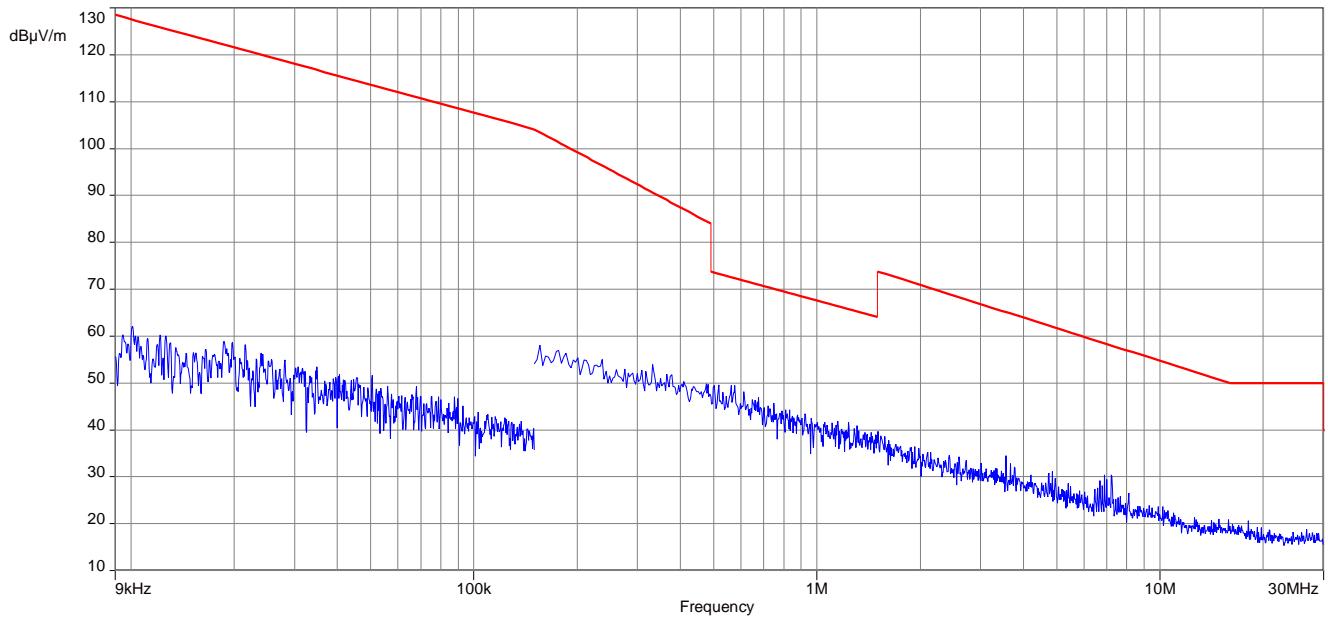


Plot 3: 9 kHz to 30 MHz, high channel

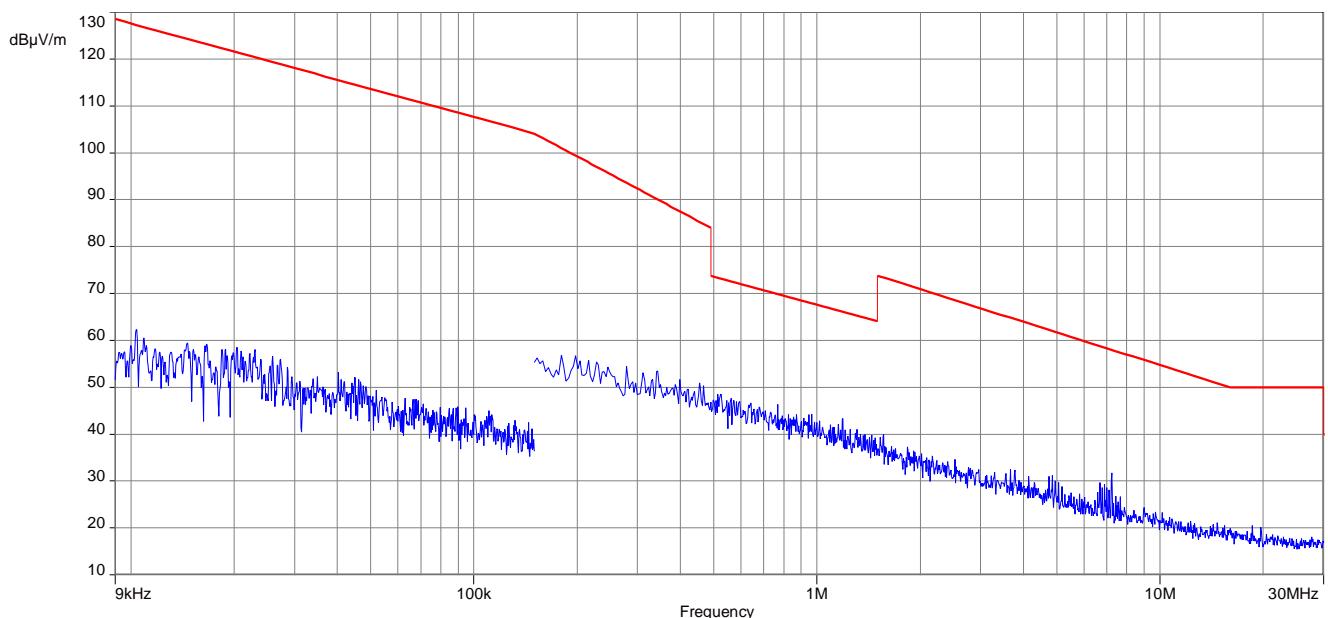


Plots: OFDM

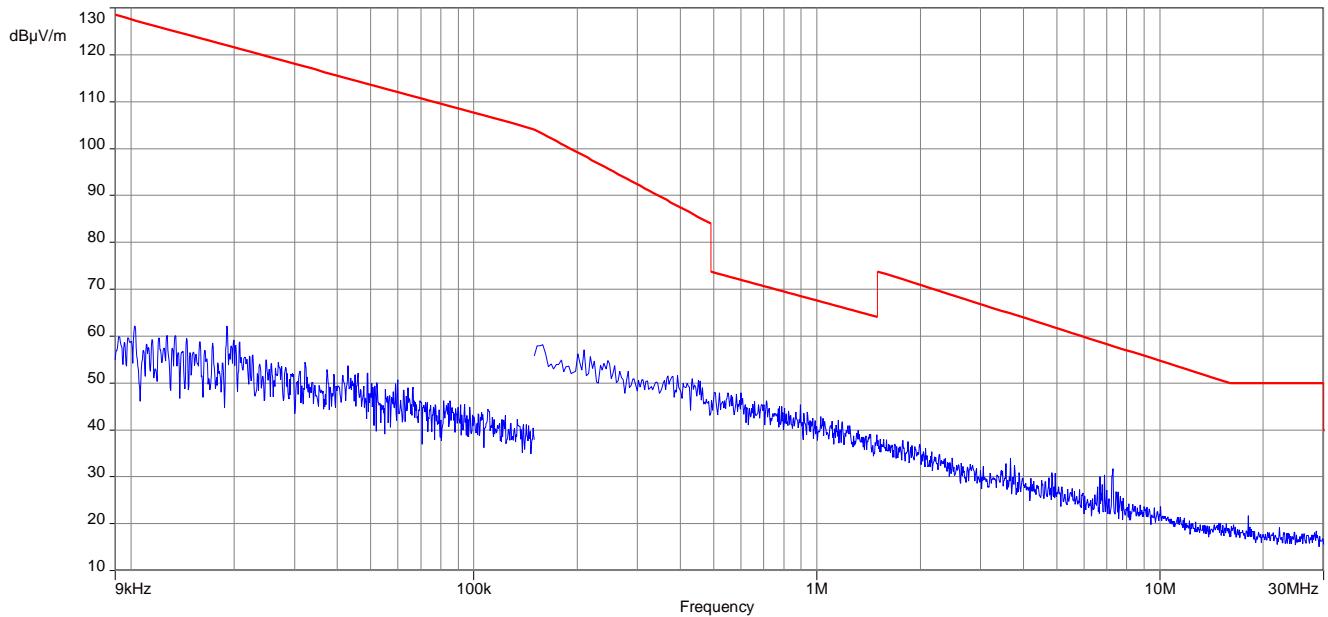
Plot 1: 9 kHz to 30 MHz, low channel



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.

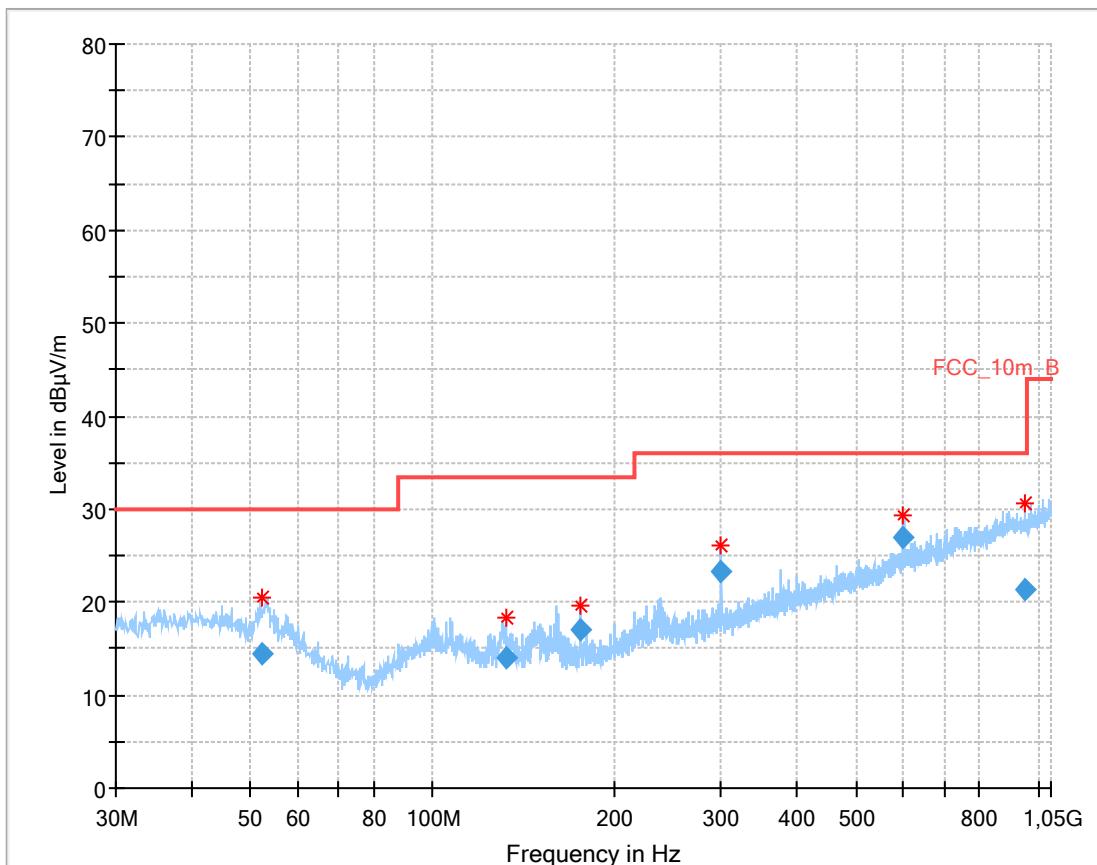
Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Resolution bandwidth:	$F < 1 \text{ GHz}$: 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
Test setup:	See sub clause 7.1
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.

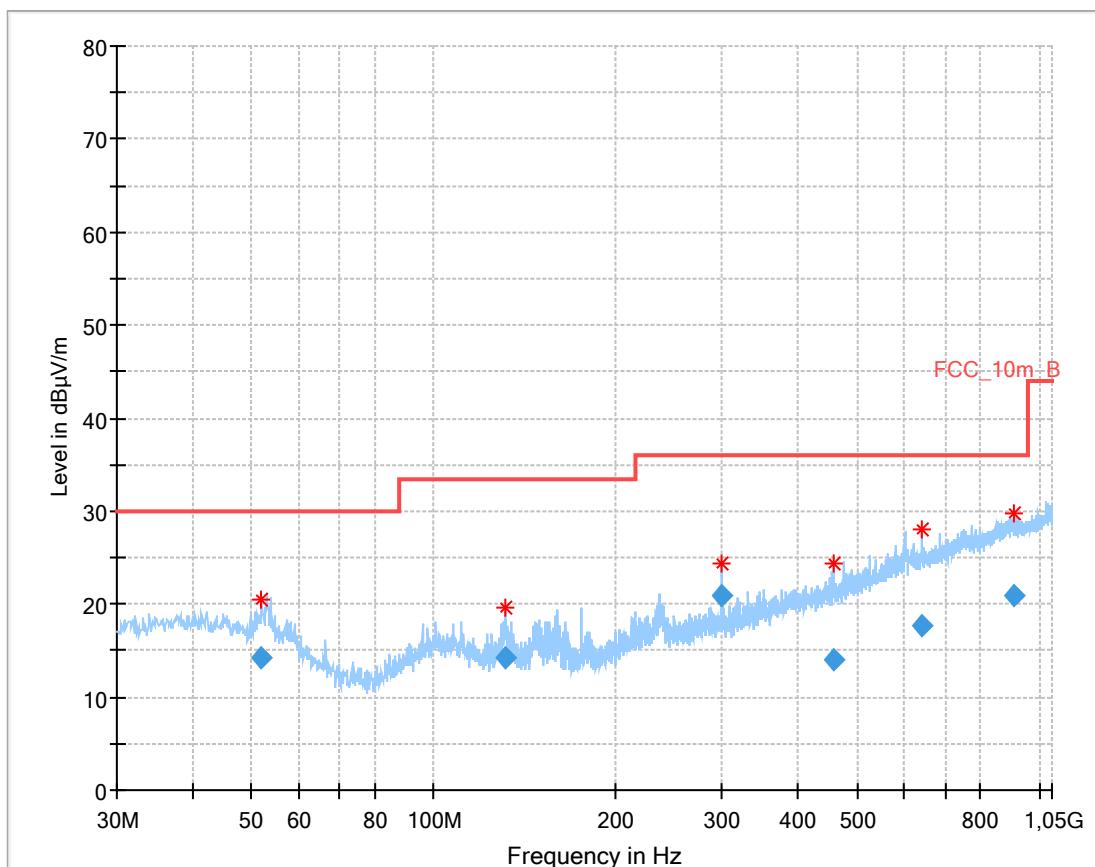
Limits:

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)).													
<table border="1"> <thead> <tr> <th>Frequency (MHz)</th> <th>Field Strength (dBμV/m)</th> <th>Measurement distance</th> </tr> </thead> <tbody> <tr> <td>30 – 88</td> <td>30.0</td> <td>10</td> </tr> <tr> <td>88 – 216</td> <td>33.5</td> <td>10</td> </tr> <tr> <td>216 – 960</td> <td>36.0</td> <td>10</td> </tr> </tbody> </table>		Frequency (MHz)	Field Strength (dB μ V/m)	Measurement distance	30 – 88	30.0	10	88 – 216	33.5	10	216 – 960	36.0	10
Frequency (MHz)	Field Strength (dB μ V/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:**

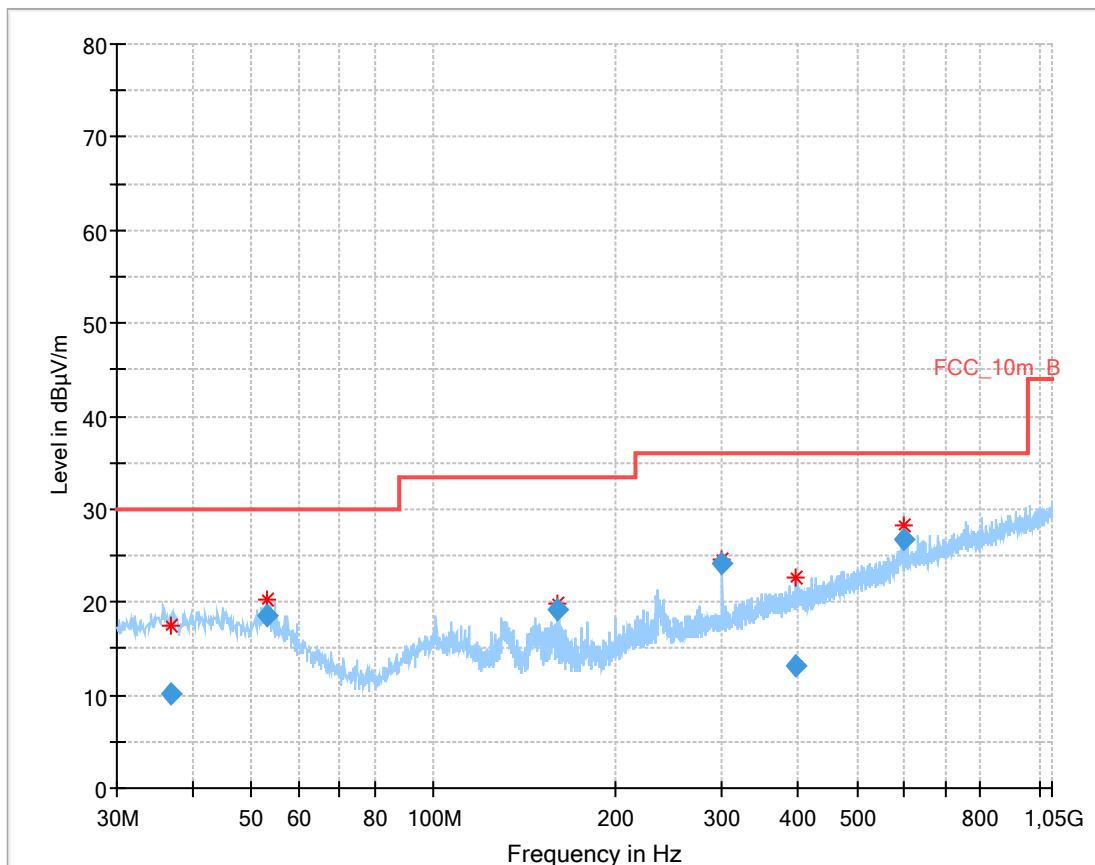
Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
52.411800	14.52	30.00	15.48	1000.0	120.000	170.0	V	4	12.3
131.956500	13.98	33.50	19.52	1000.0	120.000	170.0	V	72	9.3
174.975450	17.14	33.50	16.36	1000.0	120.000	98.0	V	356	10.1
299.989800	23.21	36.00	12.79	1000.0	120.000	98.0	V	107	14.4
599.984400	26.90	36.00	9.10	1000.0	120.000	170.0	H	152	20.7
949.997250	21.34	36.00	14.66	1000.0	120.000	170.0	V	87	24.3

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

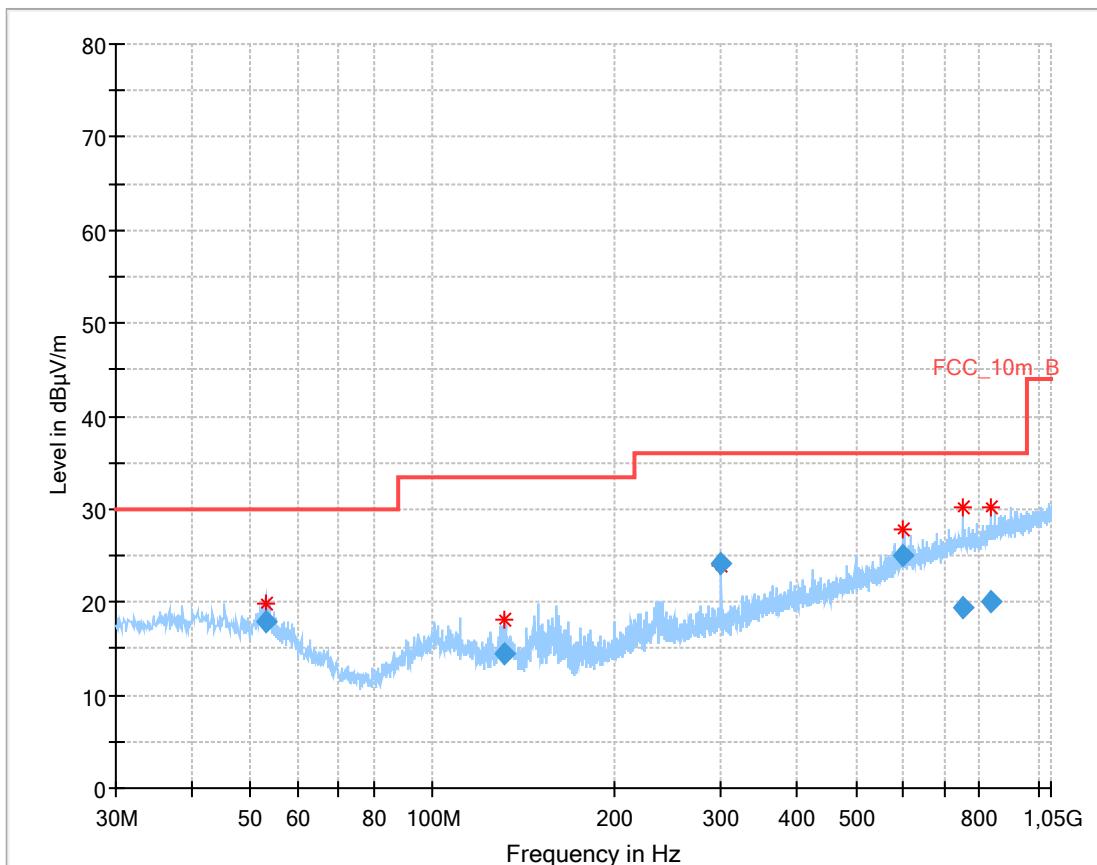
**Final_Result:**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
51.881850	14.14	30.00	15.86	1000.0	120.000	170.0	V	101	12.3
131.001900	14.33	33.50	19.17	1000.0	120.000	101.0	V	32	9.3
300.027750	20.99	36.00	15.01	1000.0	120.000	98.0	V	152	14.4
457.264800	14.11	36.00	21.89	1000.0	120.000	98.0	H	171	17.8
640.911000	17.78	36.00	18.22	1000.0	120.000	170.0	H	101	21.0
905.958900	20.84	36.00	15.16	1000.0	120.000	98.0	H	255	24.1

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

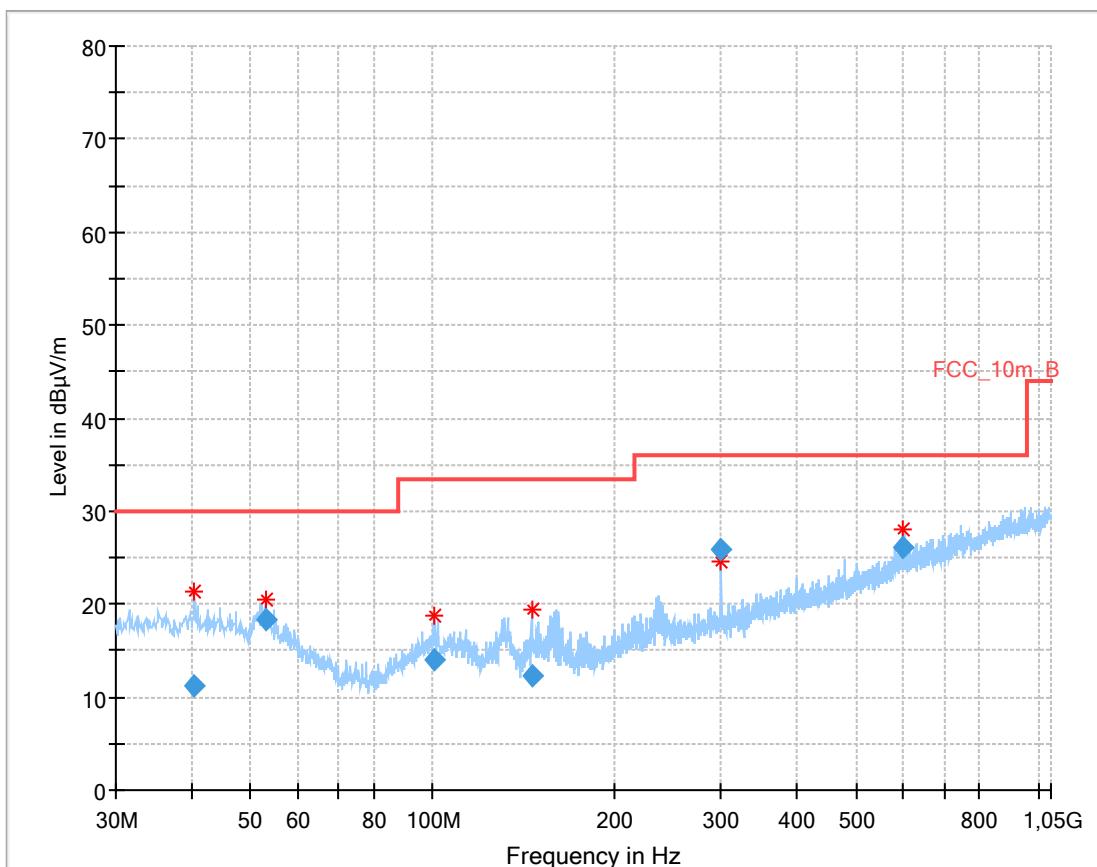
**Final_Result:**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.916200	10.03	30.00	19.97	1000.0	120.000	101.0	H	0	13.9
53.035200	18.64	30.00	11.36	1000.0	120.000	98.0	V	113	12.2
159.975150	19.21	33.50	14.29	1000.0	120.000	98.0	V	354	9.1
299.982600	24.08	36.00	11.92	1000.0	120.000	170.0	H	242	14.4
396.968700	13.11	36.00	22.89	1000.0	120.000	170.0	V	354	16.8
600.004950	26.78	36.00	9.22	1000.0	120.000	170.0	H	147	20.7

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

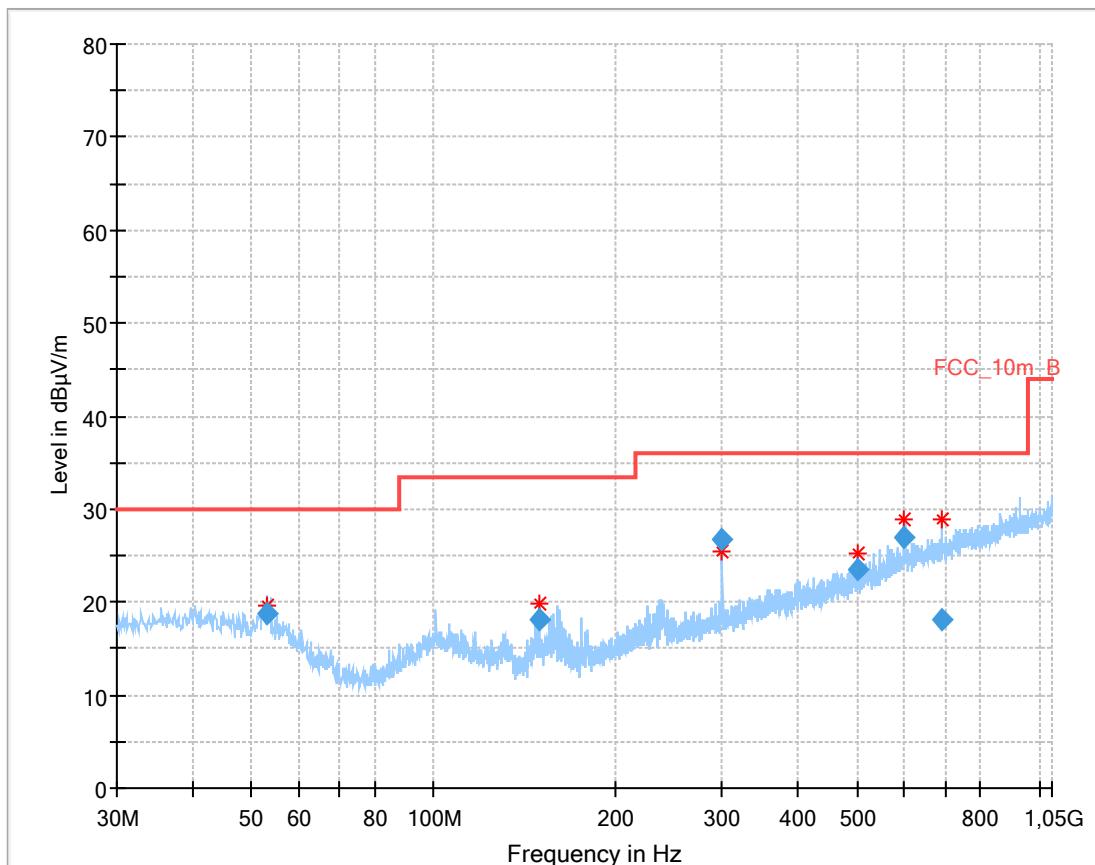
Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
53.019600	18.00	30.00	12.00	1000.0	120.000	98.0	V	172	12.2
131.730150	14.34	33.50	19.16	1000.0	120.000	101.0	V	83	9.3
300.001500	24.23	36.00	11.77	1000.0	120.000	170.0	V	52	14.4
600.006000	24.98	36.00	11.02	1000.0	120.000	101.0	H	262	20.7
750.205800	19.49	36.00	16.51	1000.0	120.000	170.0	H	206	22.7
836.770650	20.04	36.00	15.96	1000.0	120.000	98.0	H	331	23.3

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

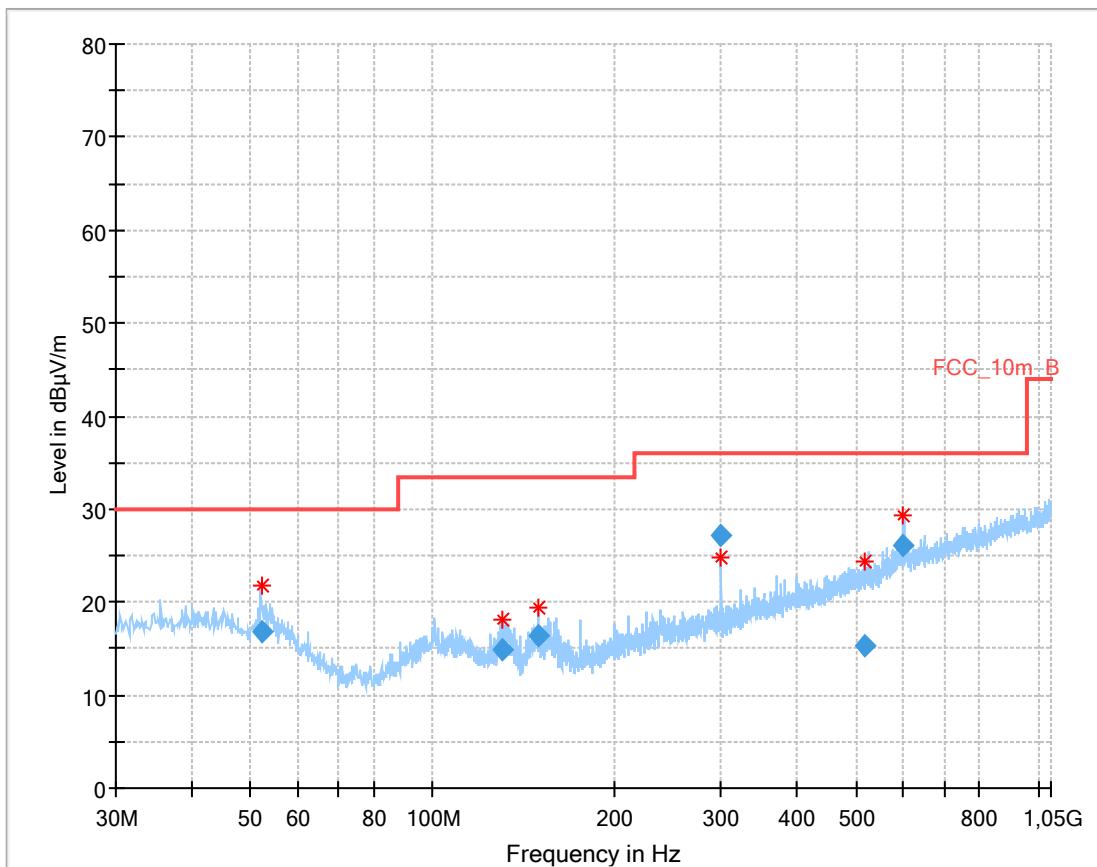
**Final_Result:**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.417500	11.23	30.00	18.77	1000.0	120.000	170.0	V	262	14.0
53.013750	18.36	30.00	11.64	1000.0	120.000	98.0	V	117	12.2
100.975200	13.97	33.50	19.53	1000.0	120.000	98.0	V	273	12.1
146.142600	12.21	33.50	21.29	1000.0	120.000	98.0	V	42	8.8
299.987250	25.93	36.00	10.07	1000.0	120.000	98.0	V	356	14.4
599.985600	26.01	36.00	9.99	1000.0	120.000	101.0	H	149	20.7

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

**Final_Result:**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
53.037300	18.71	30.00	11.29	1000.0	120.000	101.0	V	63	12.2
150.009300	18.02	33.50	15.48	1000.0	120.000	98.0	V	55	8.9
300.002850	26.74	36.00	9.26	1000.0	120.000	98.0	V	351	14.4
499.987050	23.57	36.00	12.43	1000.0	120.000	98.0	V	164	18.7
599.984850	26.93	36.00	9.07	1000.0	120.000	170.0	H	134	20.7
692.017950	18.22	36.00	17.78	1000.0	120.000	170.0	V	79	21.5

Plot: RX / Idle mode**Plot 1:** 30 MHz to 1 GHz, vertical & horizontal polarization**Final_Result:**

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
52.176600	16.84	30.00	13.16	1000.0	120.000	98.0	V	347	12.3
130.398150	14.82	33.50	18.68	1000.0	120.000	170.0	V	79	9.4
150.021600	16.40	33.50	17.10	1000.0	120.000	98.0	V	32	8.9
299.996550	27.22	36.00	8.78	1000.0	120.000	170.0	H	110	14.4
517.523550	15.32	36.00	20.68	1000.0	120.000	170.0	V	79	18.9
599.982750	26.17	36.00	9.83	1000.0	120.000	101.0	H	137	20.7

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:	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
Test setup:	See sub clause 7.2 & 7.4
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 (dB μ V/m)	Measurement distance
Above 960	54.0	3

Results: DSSS

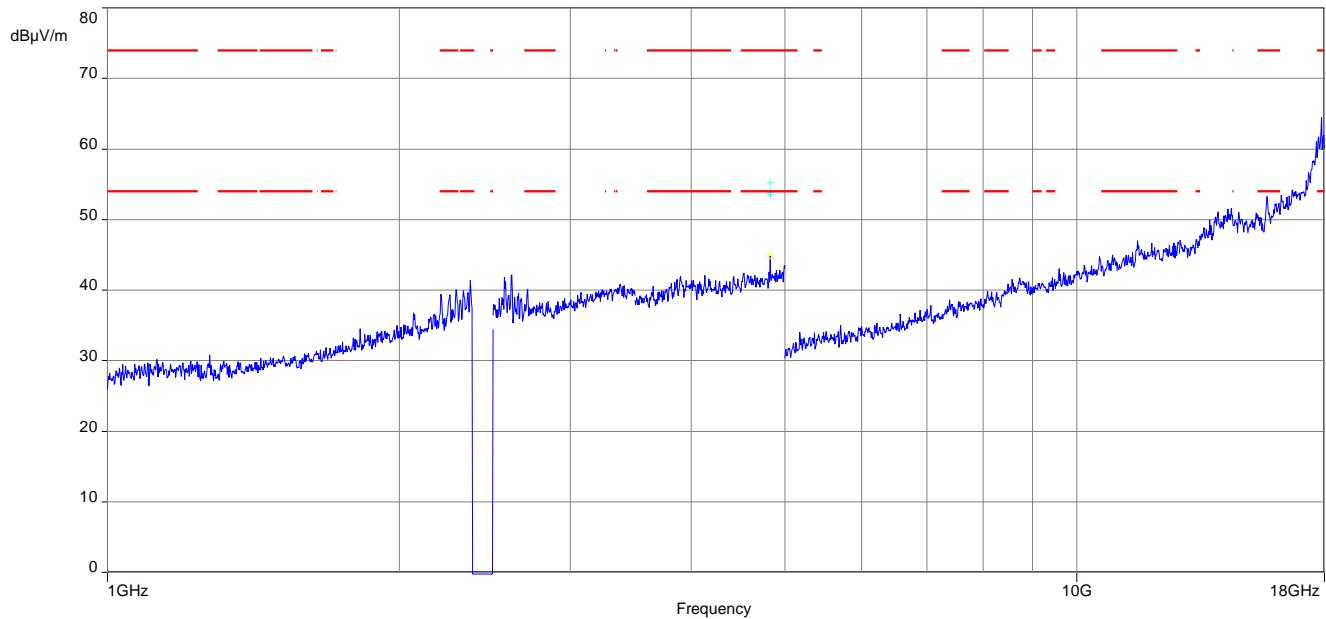
TX Spurious Emissions Radiated [dB μ V/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dB μ V/m]	F [MHz]	Detector	Level [dB μ V/m]	F [MHz]	Detector	Level [dB μ V/m]
4824	Peak	46.7	4884	Peak	47.1	4924	Peak	46.4
	AVG	-/-		AVG	-/-		AVG	-/-
	Peak			Peak			Peak	
	AVG			AVG			AVG	

Results: OFDM

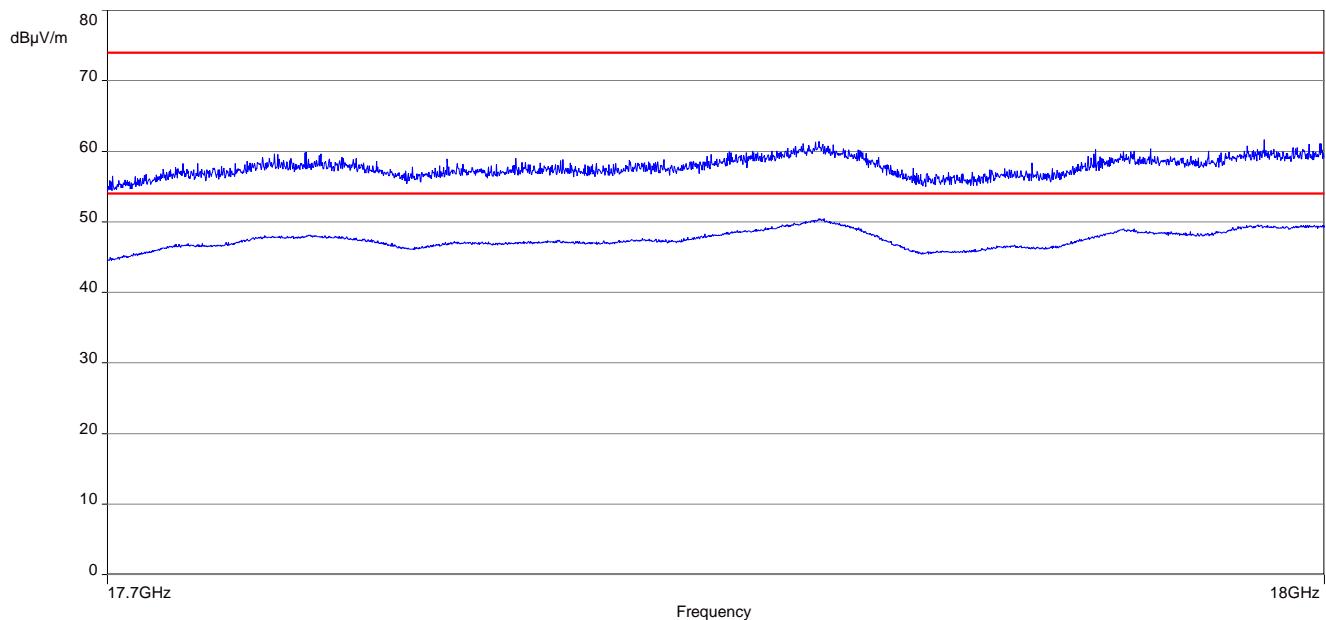
TX Spurious Emissions Radiated [dB μ V/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dB μ V/m]	F [MHz]	Detector	Level [dB μ V/m]	F [MHz]	Detector	Level [dB μ V/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	Peak			Peak			Peak	
	AVG			AVG			AVG	
	Peak			Peak			Peak	
	AVG			AVG			AVG	

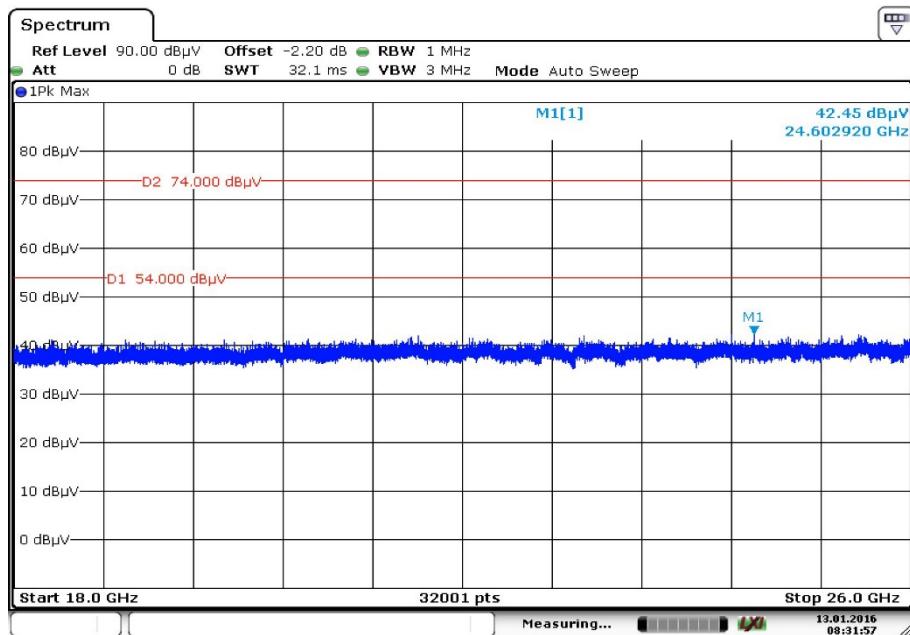
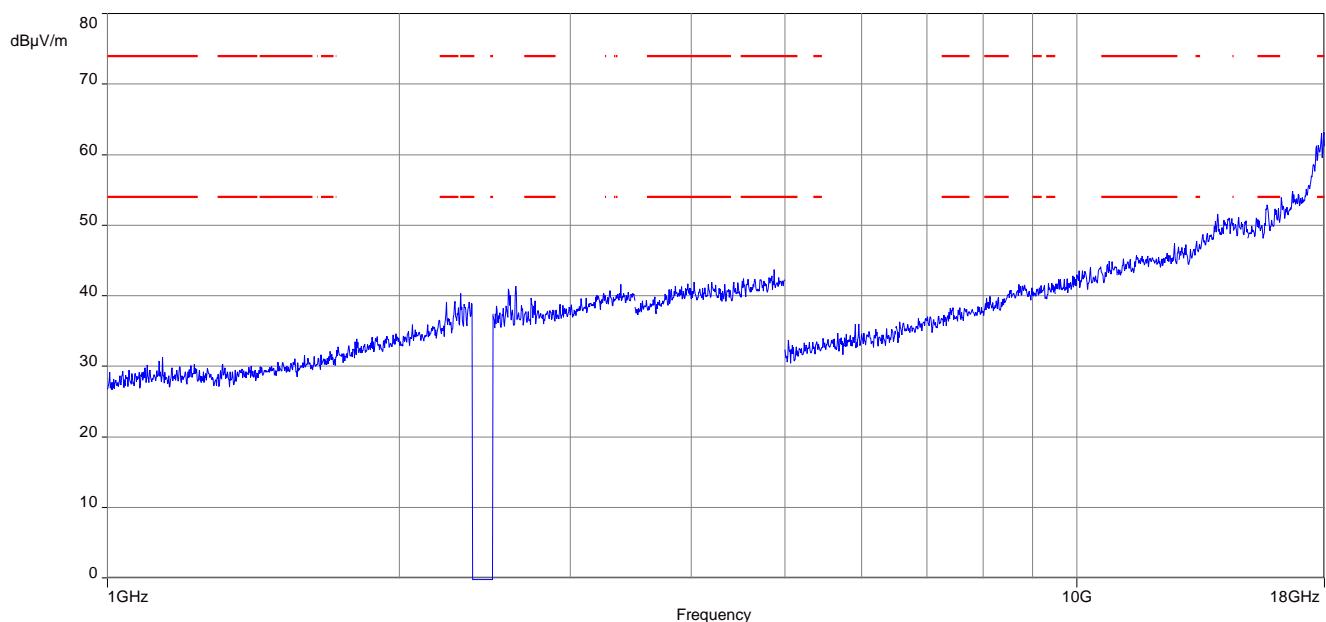
Results: RX / idle – mode

TX Spurious Emissions Radiated [dB μ V/m]		
F [MHz]	Detector	Level [dB μ V/m]
All detected emissions are more than 20 dB below the limit.		
	Peak	
	AVG	
	Peak	
	AVG	

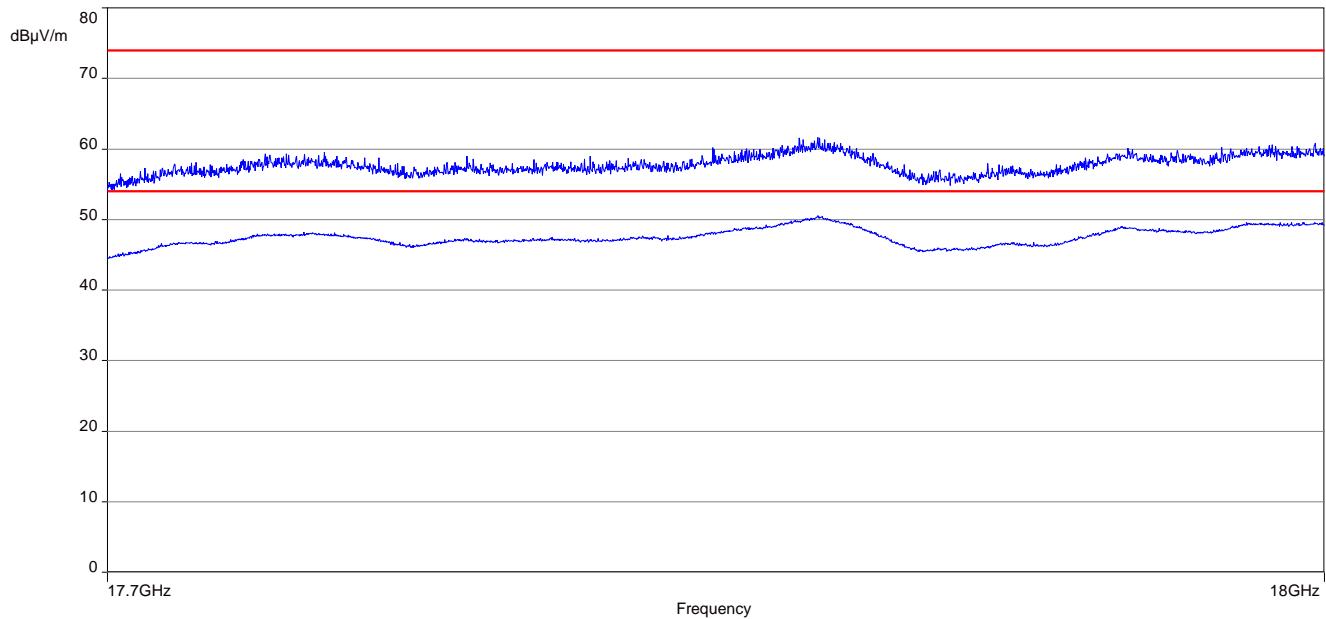
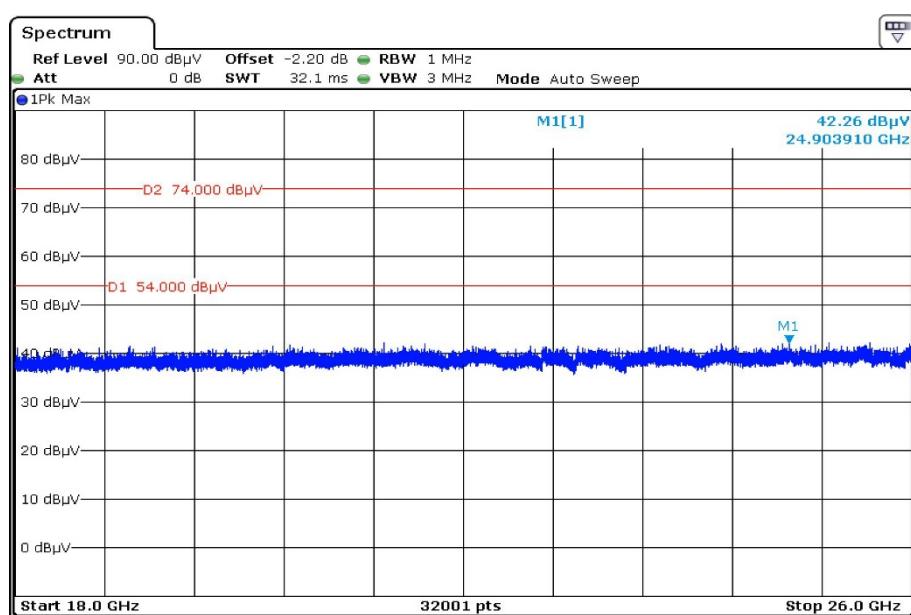
Plots: DSSS**Plot 1:** Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

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

Plot 2: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average

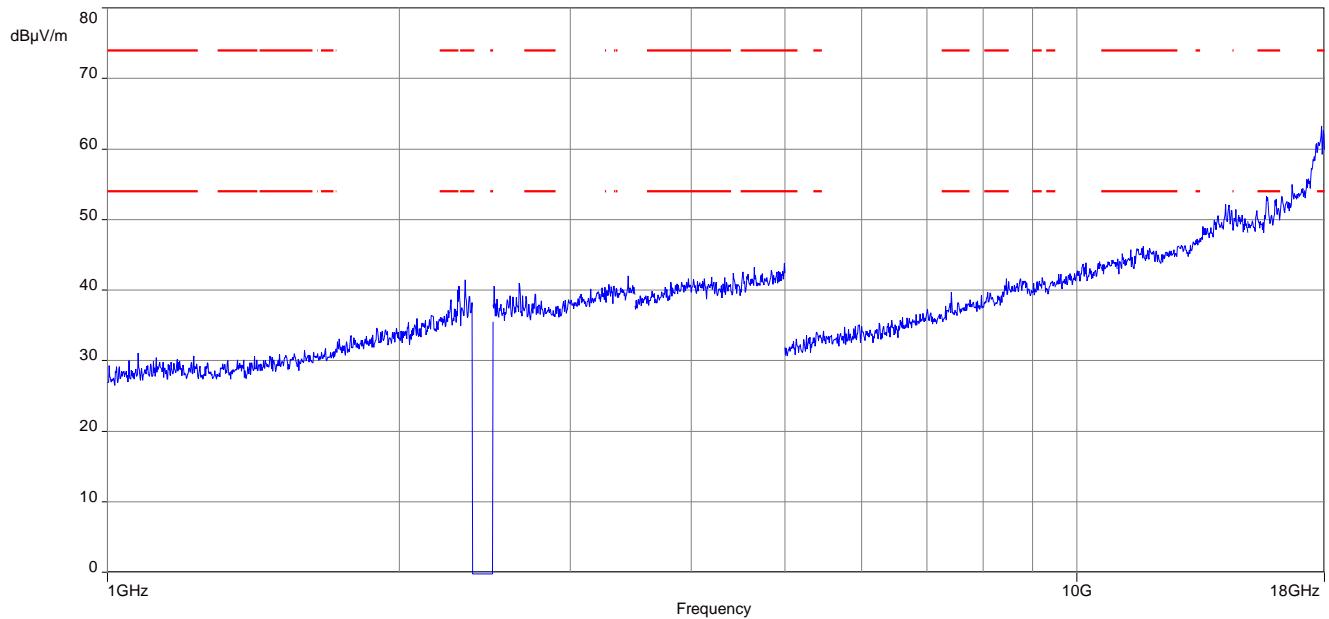
Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization**Plot 4:** Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

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

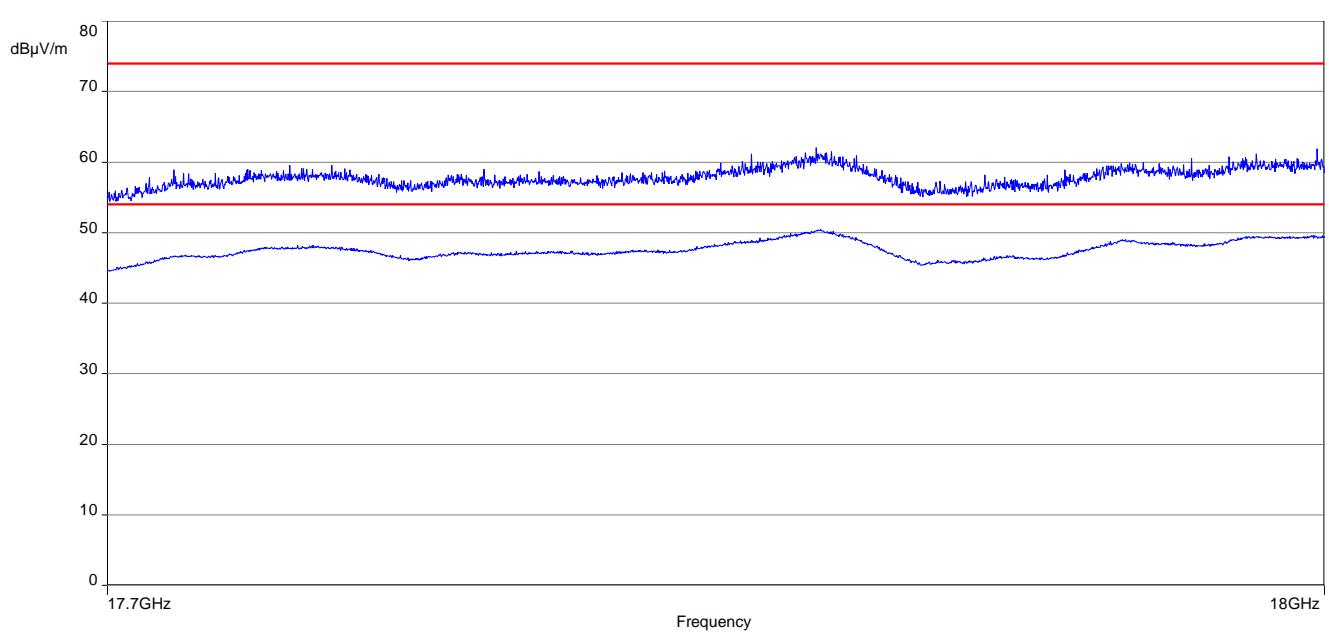
Plot 5: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization**Plot 6:** Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

Date: 13.JAN.2016 08:33:10

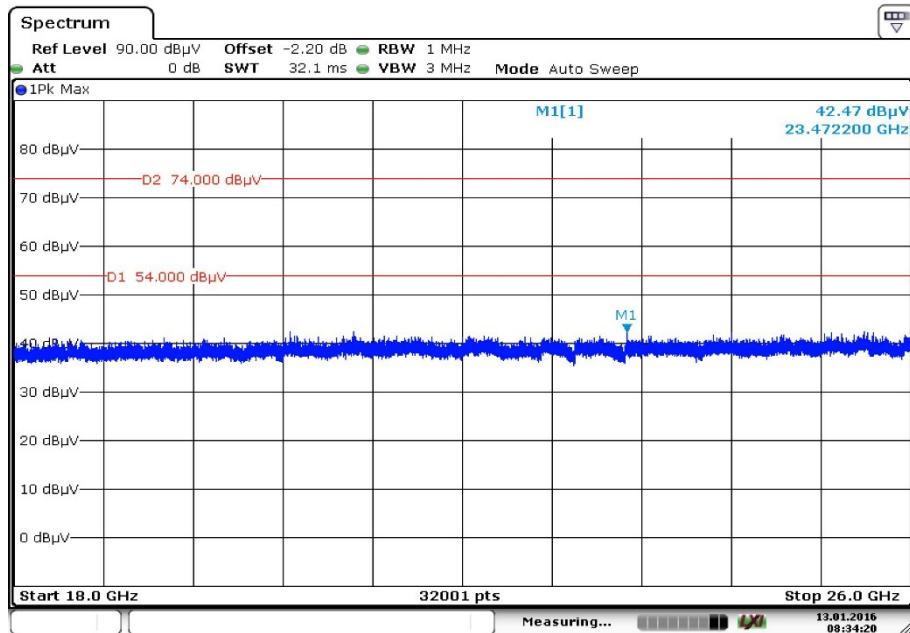
Plot 7: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



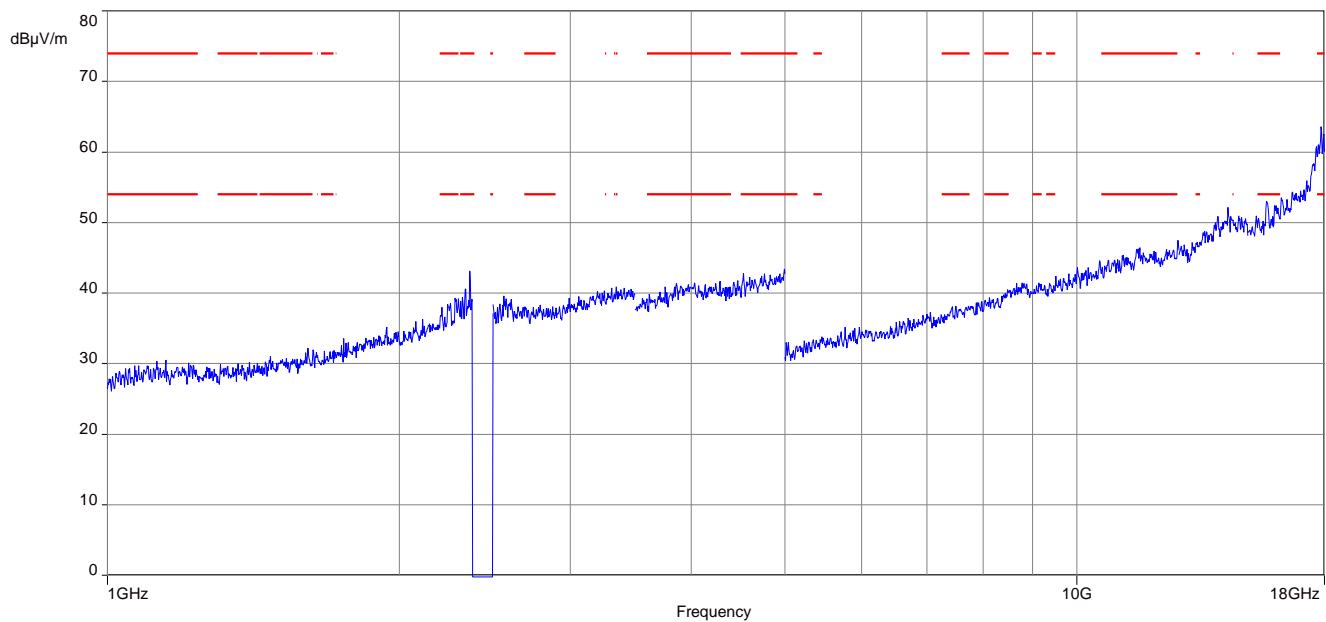
Plot 8: Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization



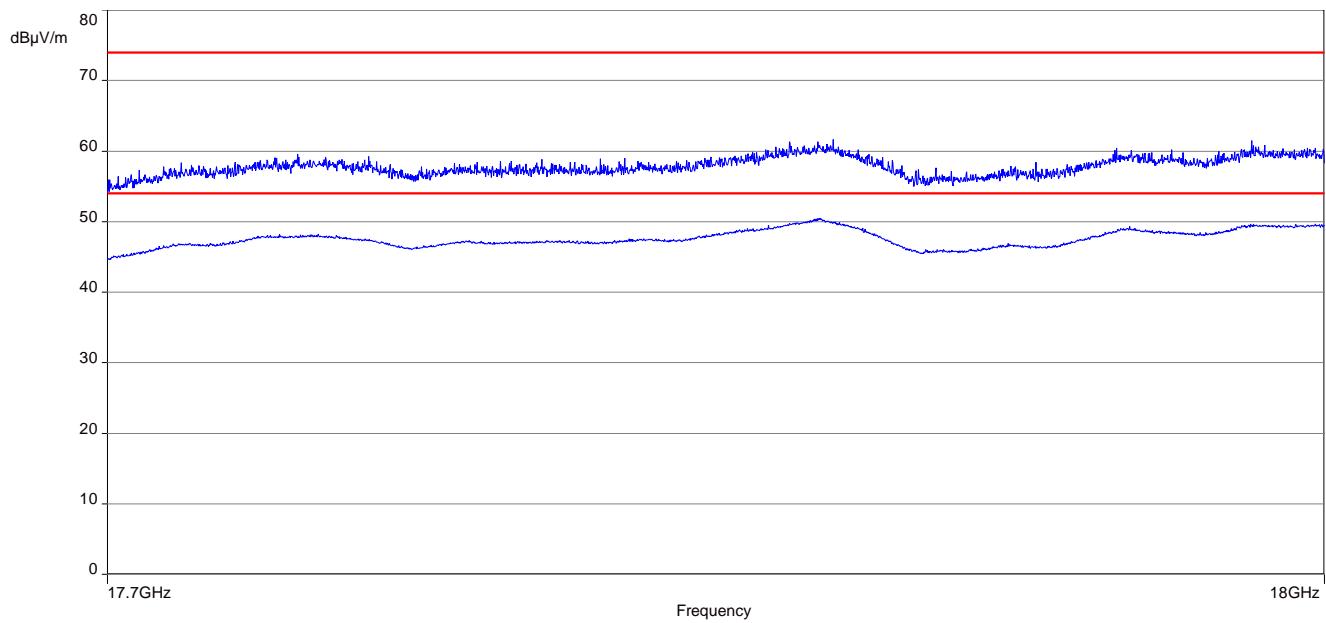
Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

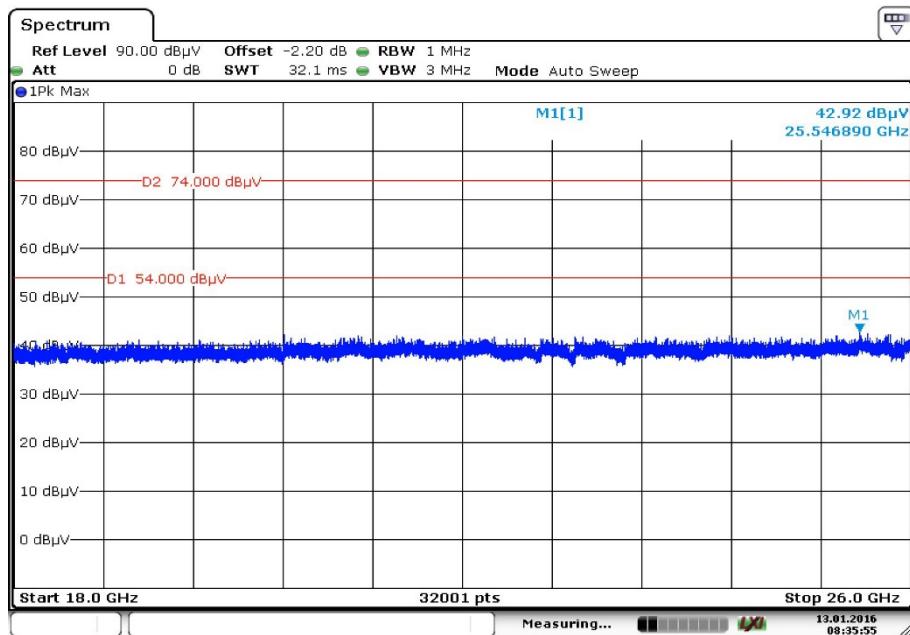
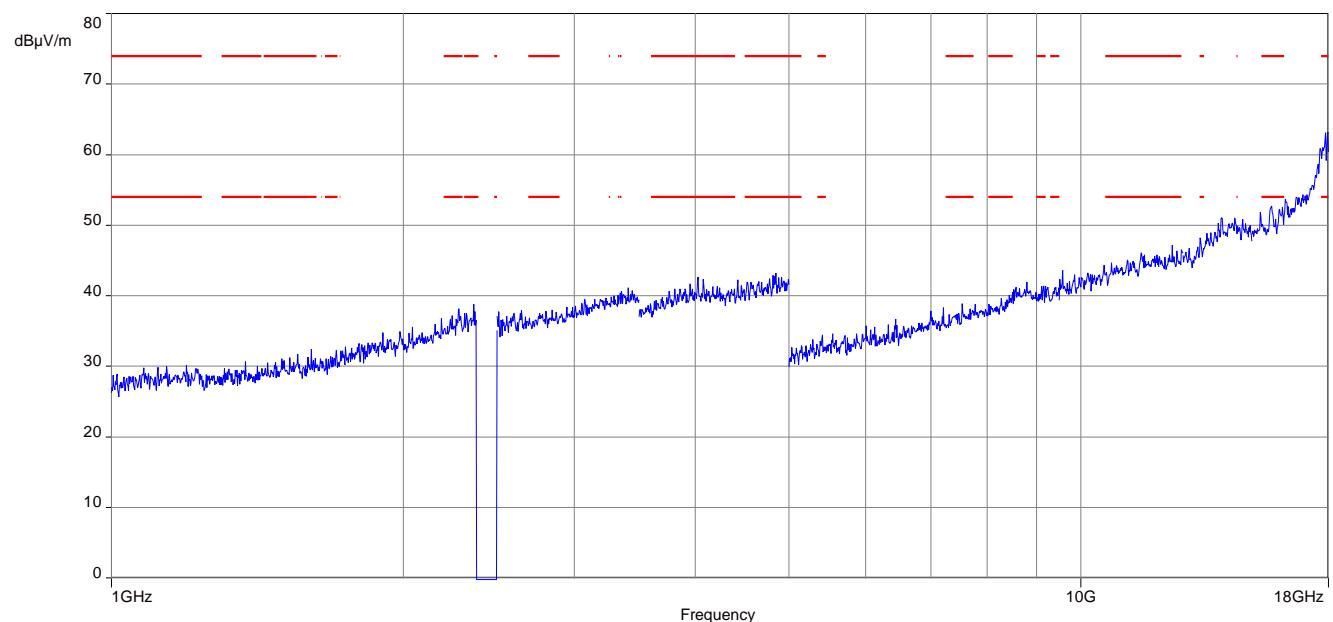


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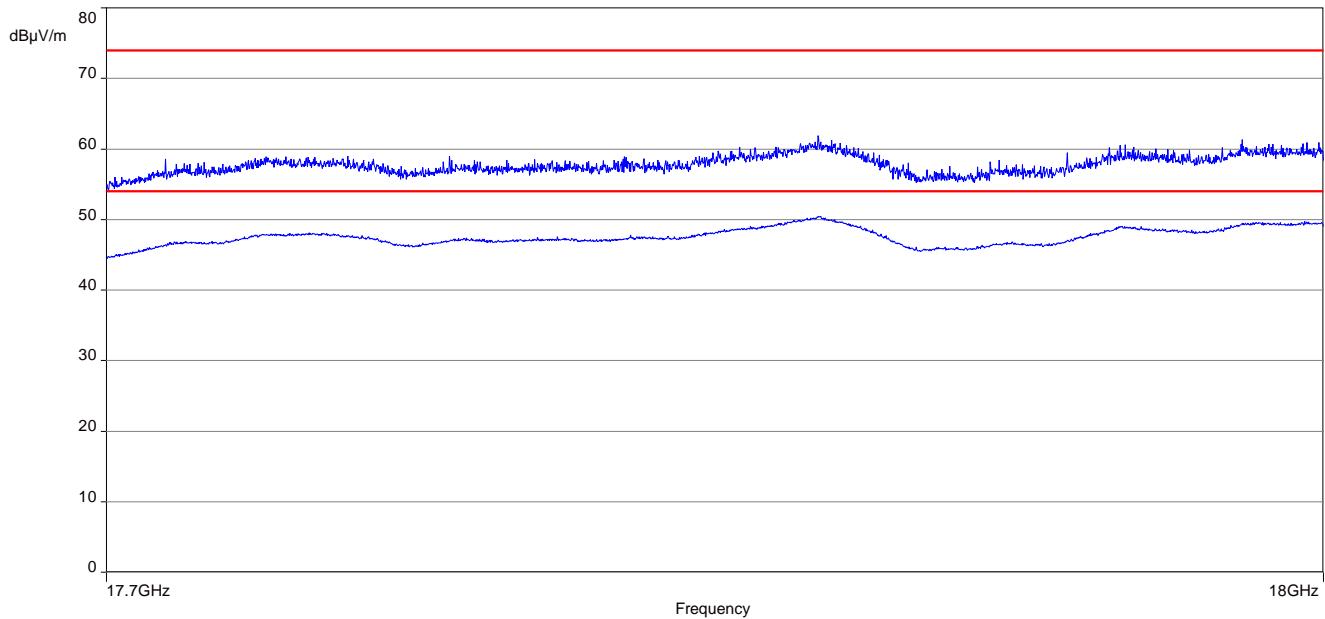
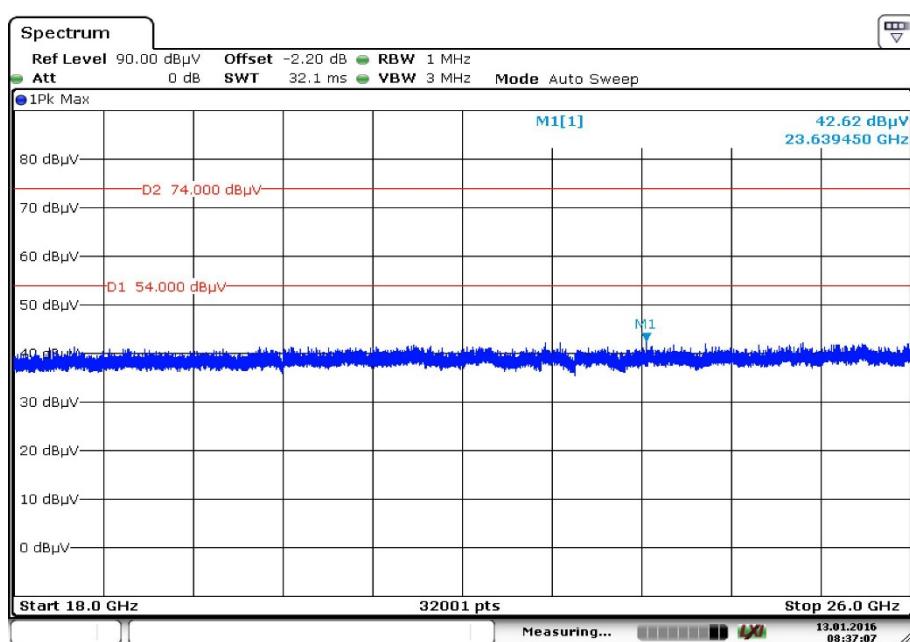
Plots: OFDM**Plot 1:** Lowest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

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

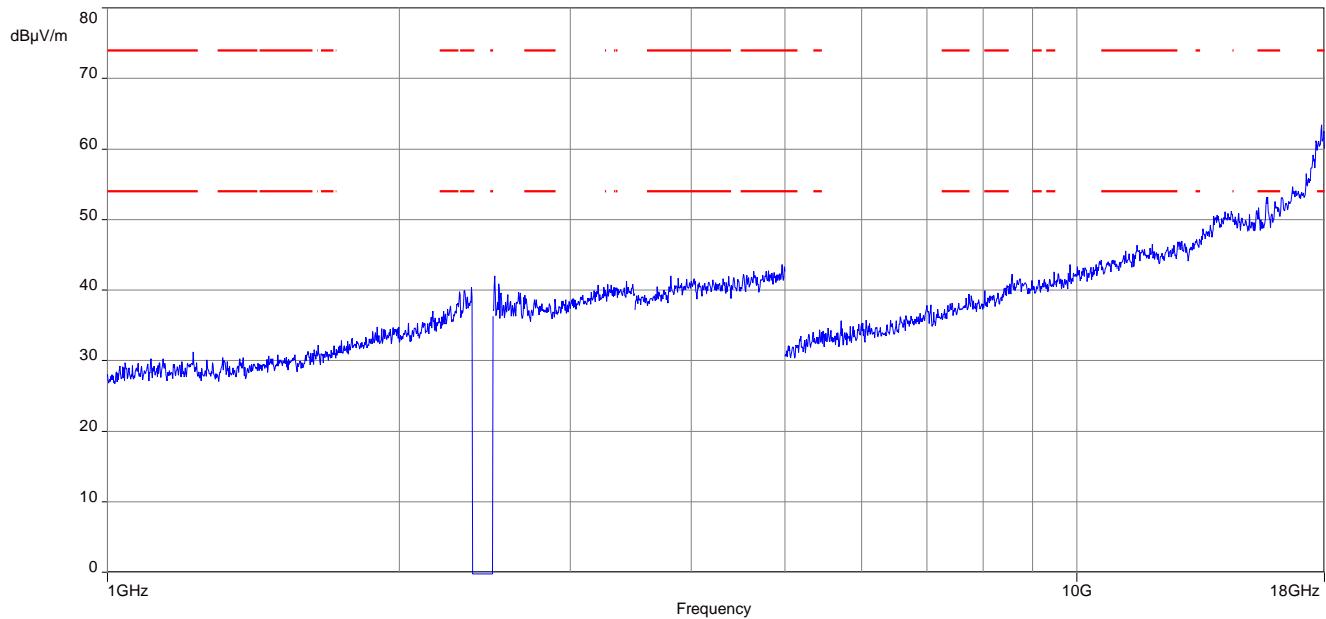
Plot 2: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

Plot 3: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization**Plot 4:** Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

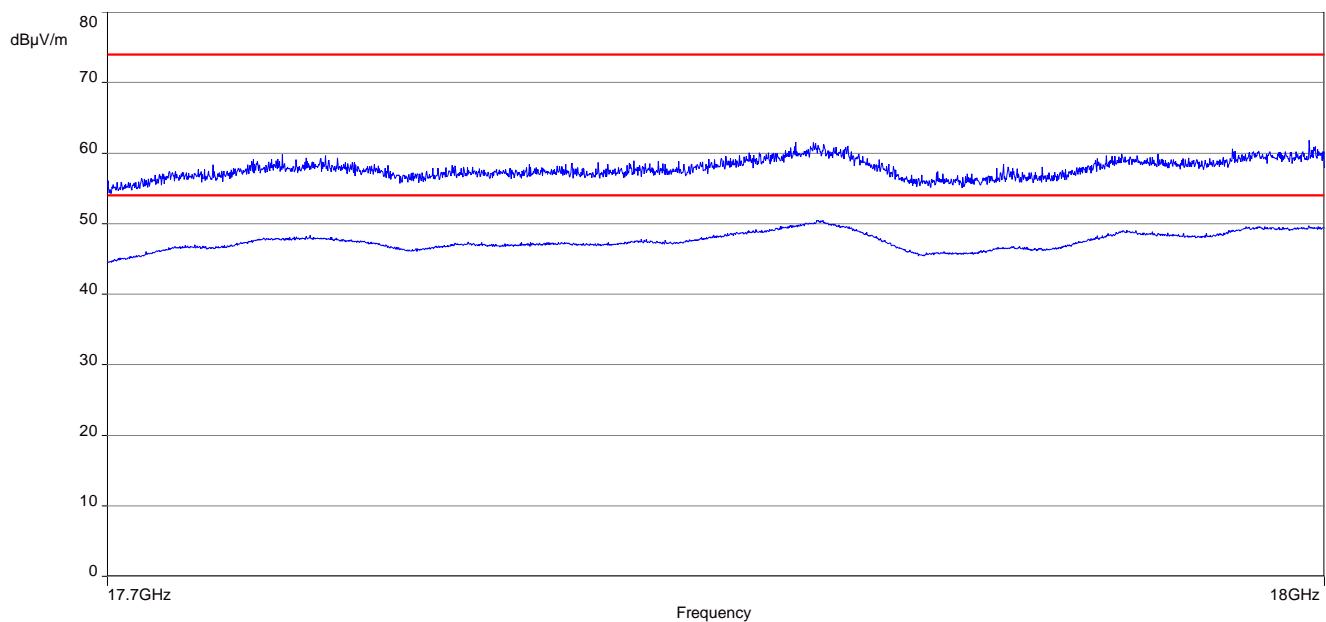
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 5: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization**Plot 6:** Middle channel, 18 GHz to 26 GHz, vertical & horizontal polarization

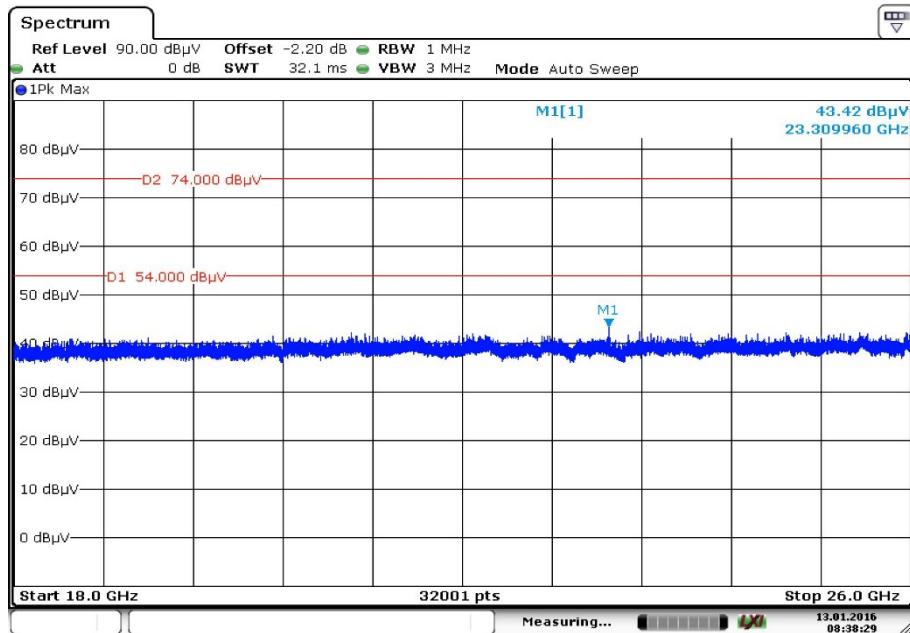
Date: 13.JAN.2016 08:37:07

Plot 7: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization

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

Plot 8: Highest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization

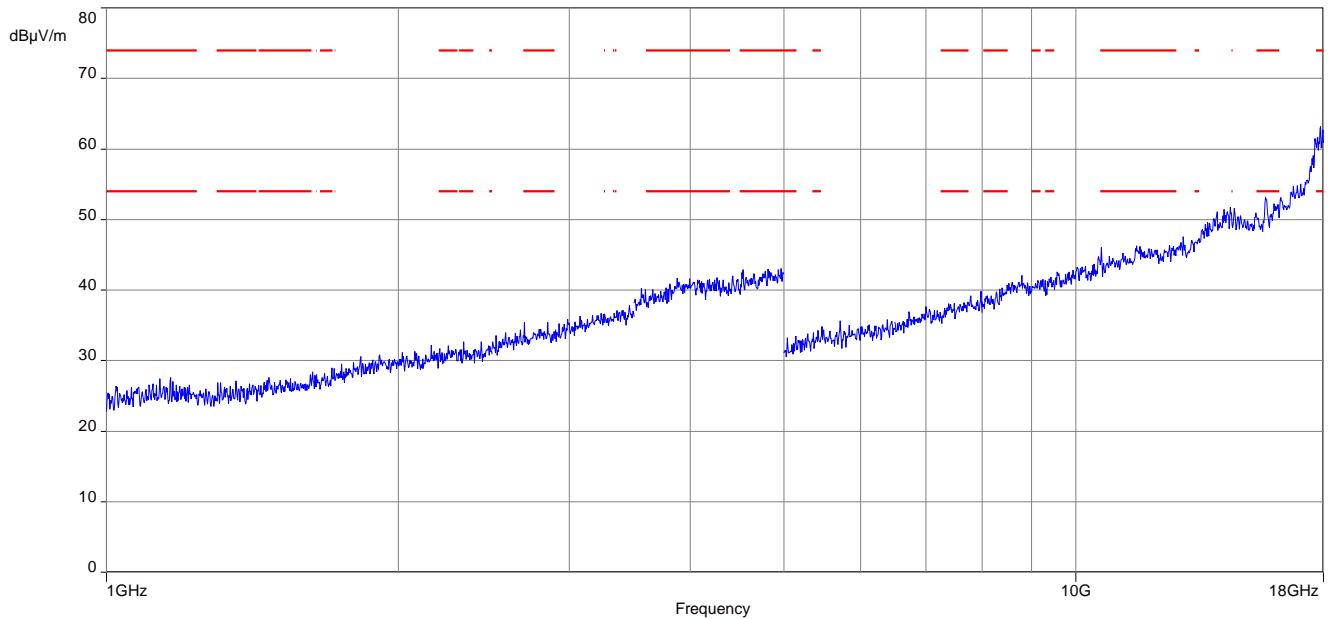
Plot 9: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



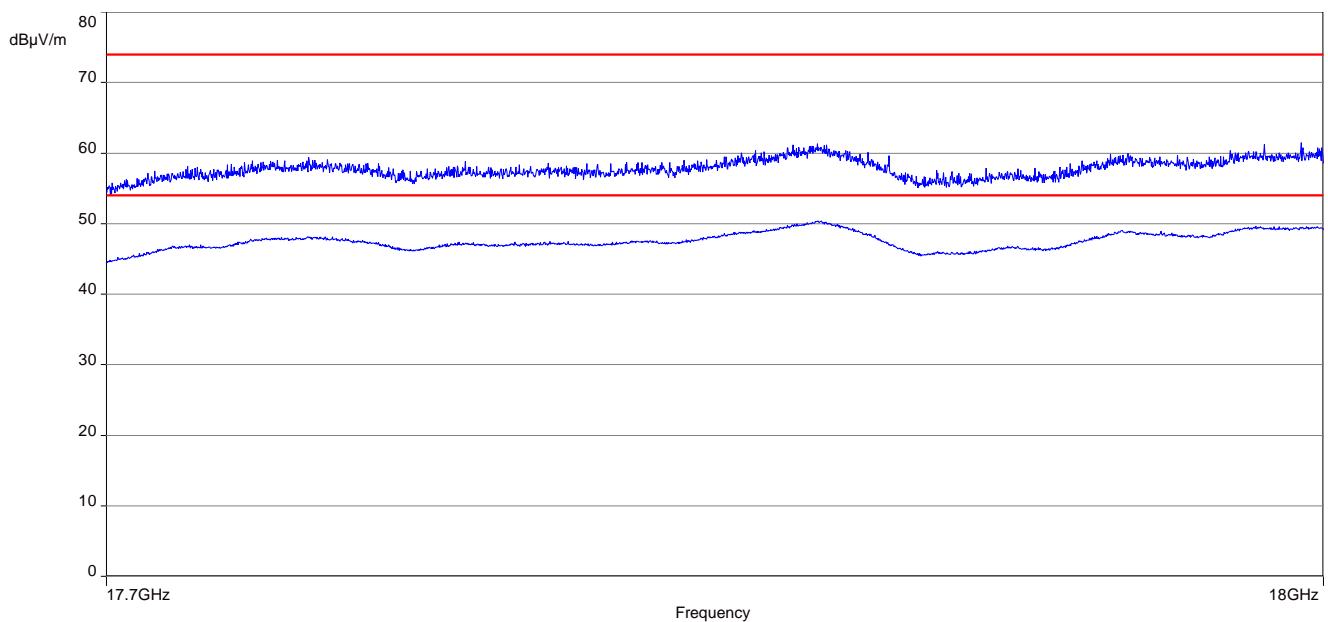
Date: 13.JAN.2016 08:38:29

Plots: RX / idle mode

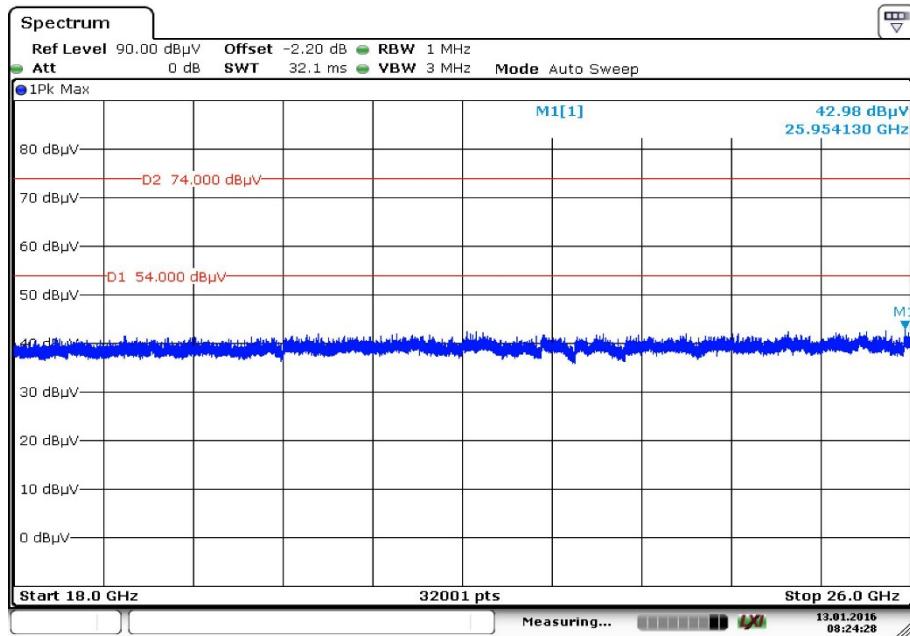
Plot 1: 1 GHz to 18 GHz, vertical & horizontal polarization



Plot 2: 17.7 GHz to 18 GHz, vertical & horizontal polarization



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



Date: 13.JAN.2016 08:24:29

Annex A Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N₀	Carrier to noise-density ratio, expressed in dB-Hz

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	
A	Re-measured with a new sample	2016-01-18
B	Change of PMN, HVIN, IC Certification No.	2016-04-26
C	Minor changes, redesign of the test report	2019-03-25

Annex C Accreditation Certificate

first page	last page
 <p>Deutsche Akkreditierungsstelle GmbH</p> <p>Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition</p> <p>Accreditation</p>  <p>The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken</p> <p>is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields: Telecommunication</p> <p>The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-PL-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages.</p> <p>Registration number of the certificate: D-PL-12076-01-03</p> <p>Frankfurt, 02.06.2017 Dipl.-Ing. (FH) Ralf Peter Head of Division</p> <p>See notes overleaf.</p>	<p>Deutsche Akkreditierungsstelle GmbH</p> <p>Office Berlin Spittelmarkt 10 10117 Berlin</p> <p>Office Frankfurt am Main Spittelmarkt 10 60327 Frankfurt am Main</p> <p>Office Braunschweig Bundesallee 100 38116 Braunschweig</p> <p>The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.</p> <p>No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.</p> <p>The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I, p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 15 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.</p> <p>The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu</p>

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

<http://www.dakks.de/as/ast/d/D-PL-12076-01-03.pdf>