

TEST REPORT

Test report no.: 1-1390/16-01-11



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

Applicant

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Manufacturer

FLIR Systems AB

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18715 Täby / SWEDEN

Test standard/s

47 CFR Part 15

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

RSS - 247 Issue 1

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

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

Test Item

Kind of test item: Infrared Camera

Model name: FLIR-E7850

FCC ID: ZLV-FLIRE7850

IC: 5306A-FLIRE7850

Frequency: DTS band 2400 MHz to 2483.5 MHz

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

Antenna: Integrated PIFA antenna

Power supply: 3.7 V DC by VARTA 2P/LIC18650-29EC Li-ION battery



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:



Andreas Luckenbill
Lab Manager
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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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2.2 Application details

Date of receipt of order:	2016-11-02
Date of receipt of test item:	2016-11-14
Start of test:	2016-11-14
End of test:	2016-11-17
Person(s) present during the test:	Mr. Göran Skedung & Mr. Erik Zarmen

2.3 Test laboratories sub-contracted

None

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
RSS - 247 Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) 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 test under extreme conditions required. No test under extreme conditions required.
Relative humidity content :		55 %
Barometric pressure :		1021 hpa
Power supply :	V _{nom} V _{max} V _{min}	3.7 V DC by VARTA 2P/LIC18650-29EC Li-ION battery No test under extreme conditions required. No test under extreme conditions required.

5 Test item

5.1 General description

Kind of test item :	Infrared Camera
Type identification :	FLIR-E7850
HMN :	-/-
PMN :	FLIR-E7850
HVIN :	E75, E85, E95
FVIN :	-/-
S/N serial number :	Rad. 78100214, 78100407, 78100411 Cond. 78100204
HW hardware status :	1
SW software status :	0.6.2
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 PIFA antenna
Power supply :	3.7 V DC by VARTA 2P/LIC18650-29EC Li-ION battery

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: 1-1390/16-01-01_AnnexA
 1-1390/16-01-01_AnnexB
 1-1390/16-01-01_AnnexD

6 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).

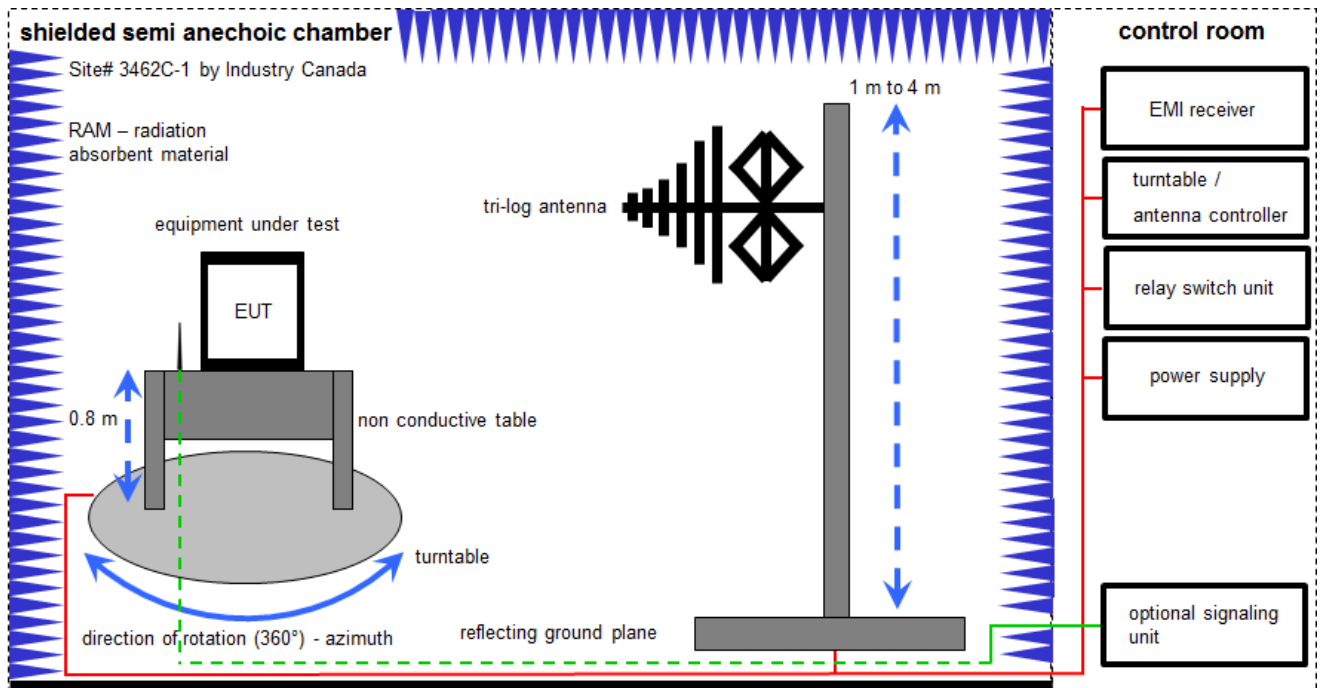
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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

6.1 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)

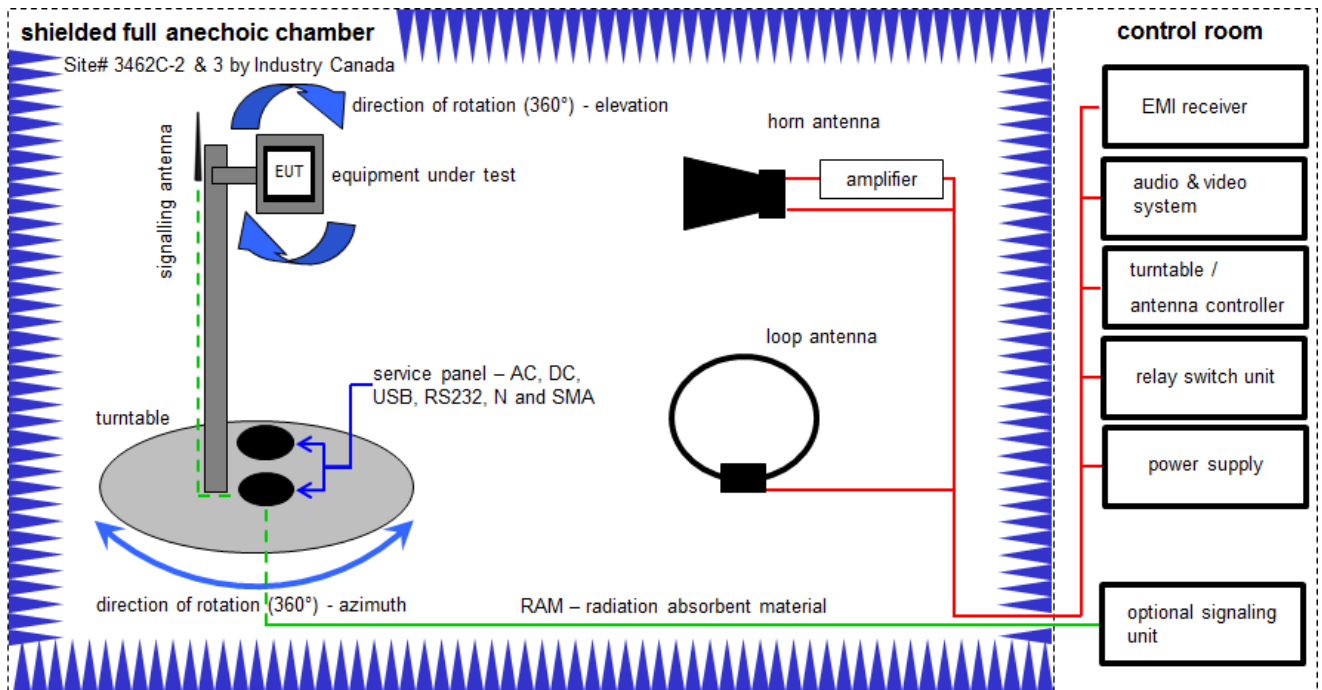
Example calculation:

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	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	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2016	02.02.2018
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	25.04.2016	25.04.2018

6.2 Shielded fully anechoic chamber



Measurement distance: 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)

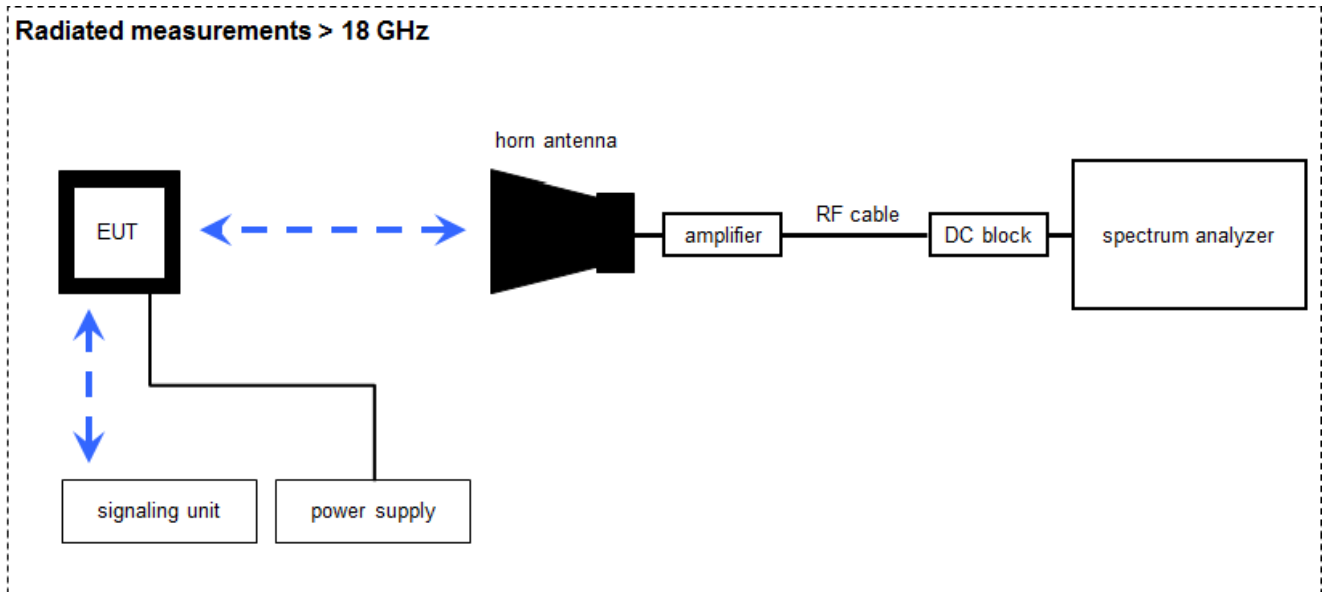
Example calculation:

FS [dBμV/m] = 40.0 [dBμV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBμV/m] (71.61 μV/m)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vKI!	20.05.2015	20.05.2017
2	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A, B	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
4	A	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	k	24.06.2015	24.06.2017
5	B	Amplifier	js42-00502650-28-5a	Parzich GMBH	928979	300003143	ne	-/-	-/-
6	B	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351	ev	-/-	-/-
7	B	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	vKI!	29.10.2014	29.10.2017
8	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
9	B	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
10	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
11	A, B	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	vKI!	13.09.2016	13.03.2018

6.3 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:

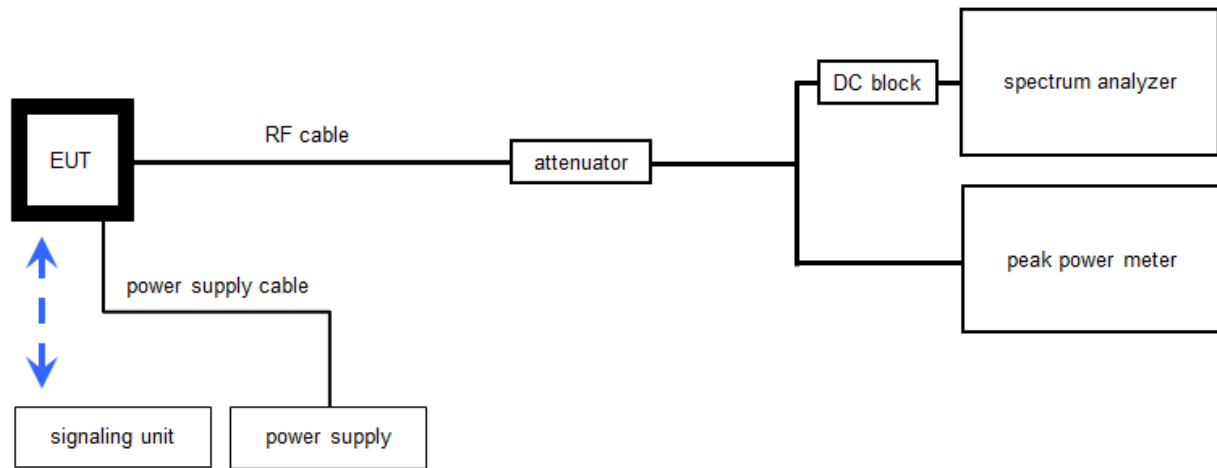
$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-60.1) \text{ [dB]} + 36.74 \text{ [dB/m]} = 16.64 \text{ [dB}\mu\text{V/m]} \text{ (6.79 } \mu\text{V/m)}$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Std. Gain Horn Antenna 18.0 to 26.5 GHz	638	Narda		300000486	k	10.09.2015	10.09.2017
2	A	Broadband Low Noise Amplifier 18-50 GHz	CBL18503070-XX	CERNEX	19338	300004273	ev	-/-	-/-
3	A	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
4	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
6	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 127377	400001185	ev	-/-	-/-

6.4 Conducted measurements

Conducted measurements normal conditions



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

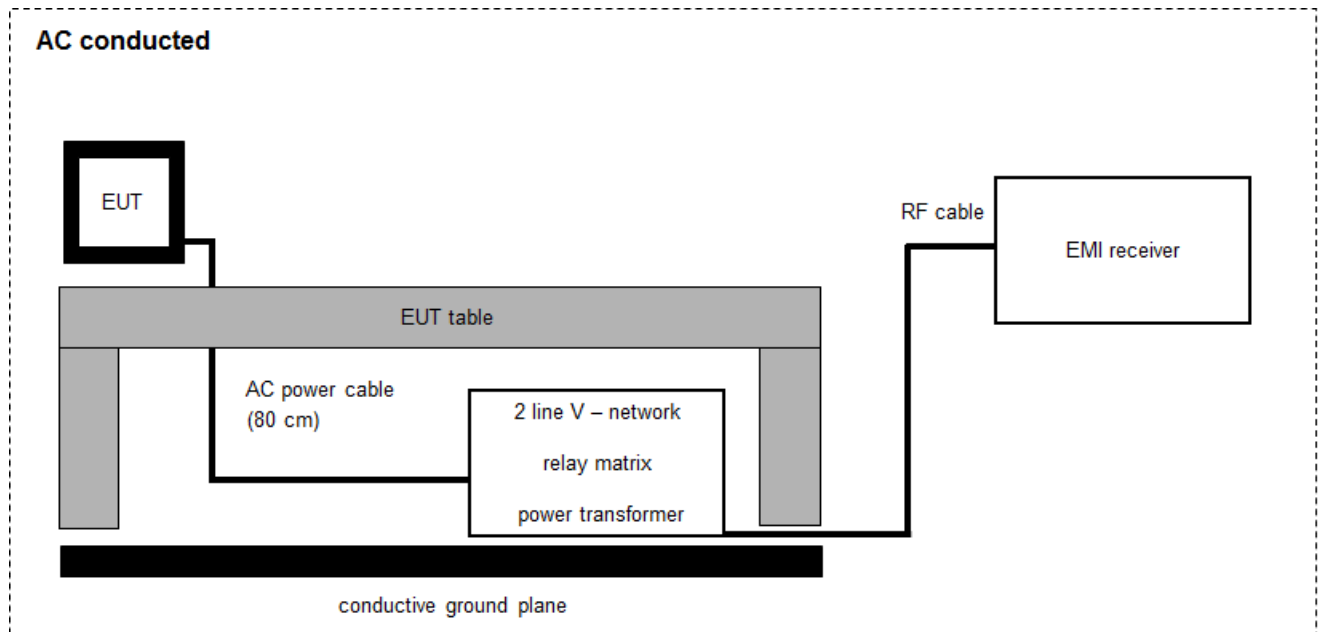
Example calculation:

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.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Switch / Control Unit	3488A	HP	2719A15013	300000151	ne	-/-	-/-
2	A, B	Hygro-Thermometer	-/-, 5-45C, 20-100rF	HP	-/-	400000108	ev	07.09.2015	07.09.2017
3	B	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	R&S	2V2403033A4523	300004589	ne	-/-	-/-
4	B	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A4523	300004590	ne	-/-	-/-
5	A	Power Sensor	NRP-Z81	R&S	100010	300003780	k	25.01.2016	25.01.2017
6	A, B	RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
7	A, B	Coax Attenuator 10 dB 2W 0-40 GHz	MCL BW-K10-2W44+	Mini Circuits	Batch no. 606844	400001186	ev	-/-	-/-
8	B	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017

6.5 AC conducted



$$FS = UR + CF + VC$$

(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:

$$FS [dB\mu V/m] = 37.62 [dB\mu V/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dB\mu V/m] (244.06 \mu V/m)$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	R&S	892475/017	300002209	k	17.06.2016	17.06.2018
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	27.11.2006	-/-
3	A	AC-Spannungsquelle variabel	MV2616-V	EM-Test	0397-12	300003259	k	11.12.2015	11.12.2017
4	A	Power Supply	NGSM 32/10	R&S	3939	400000192	vIKI!	22.01.2015	22.01.2017
5	A	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	04.02.2016	04.02.2017

7 Sequence of testing

7.1 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.

7.2 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.

7.3 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.

7.4 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.

8 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

9 Summary of measurement results

☒	No deviations from the technical specifications were ascertained
☐	There were deviations from the technical specifications ascertained
☐	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!	2016-12-15	-/-

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	DSSS	-/-				-/-
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	☒	☐	☐	☐	-/-
§15.247(a)(2) RSS - 247 / 5.2 (1)	DTS bandwidth	KDB 558074 DTS clause: 8.1	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
RSS Gen clause 4.6.1	Occupied bandwidth	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.247(b)(3) RSS - 247 / 5.4 (4)	Maximum output power	KDB 558074 DTS clause: 9.1.2	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5	Detailed spurious emissions @ the band edge - conducted	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§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	☒	☐	☐	☐	-/-
§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	☒	☐	☐	☐	-/-
§15.209(a) RSS-Gen	TX spurious emissions radiated below 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.247(d) RSS - 247 / 5.5 RSS-Gen	TX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated 30 MHz to 1 GHz	-/-	Nominal	Nominal	RX / idle	☒	☐	☐	☐	-/-
§15.109 RSS-Gen	RX spurious emissions radiated above 1 GHz	-/-	Nominal	Nominal	RX / idle	☒	☐	☐	☐	-/-
§15.107(a) §15.207	Conducted emissions < 30 MHz	-/-	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-

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

10 Additional comments

Reference documents: 3-3-TECH-587 920-02 Flir Evander antenna characterization B.pdf
 FR4O0971C_R01_Part15C_Texas_WG7837-T0B.pdf

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.

11 Measurement results

11.1 Antenna gain

Measurement:

The antenna gain of the complete system is stated by the customer.

Limits:

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

Results:

T _{nom}	V _{nom}	DTS band 2400 MHz to 2483.5 MHz
Gain [dBi]		1.4 dBi

11.2 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 6.4 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

11.3 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 6.4 A
Measurement uncertainty	See sub clause 8

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	15.8	15.8	15.6
Output power conducted OFDM / g – mode	19.3	19.1	18.6
Output power conducted OFDM / n HT20 – mode	19.1	19.1	18.5

11.4 Duty cycle

Measurement:

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 6.4 B
Measurement uncertainty:	See sub clause 8

Limits:

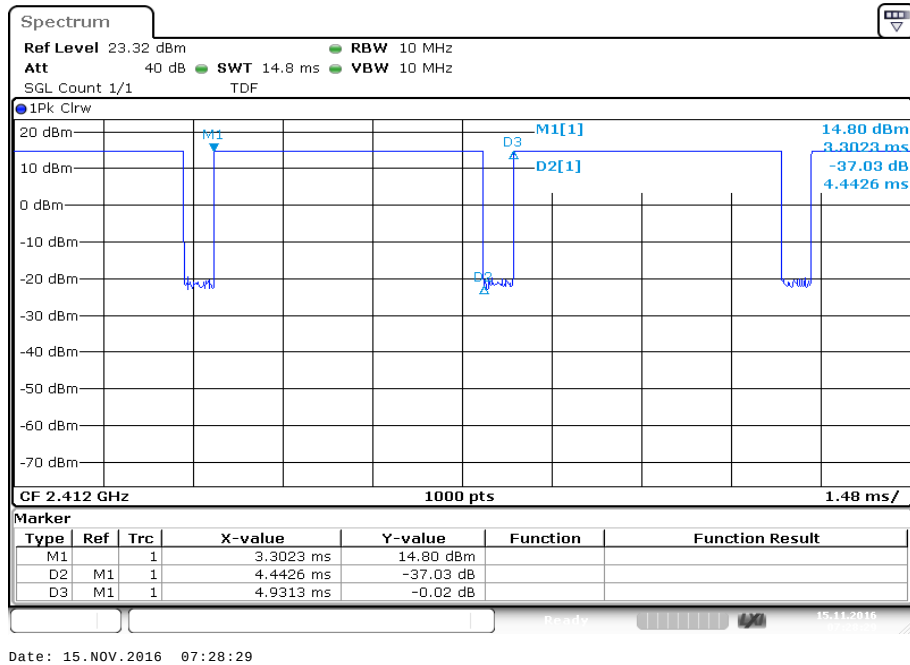
FCC	IC
-/-	

Results:

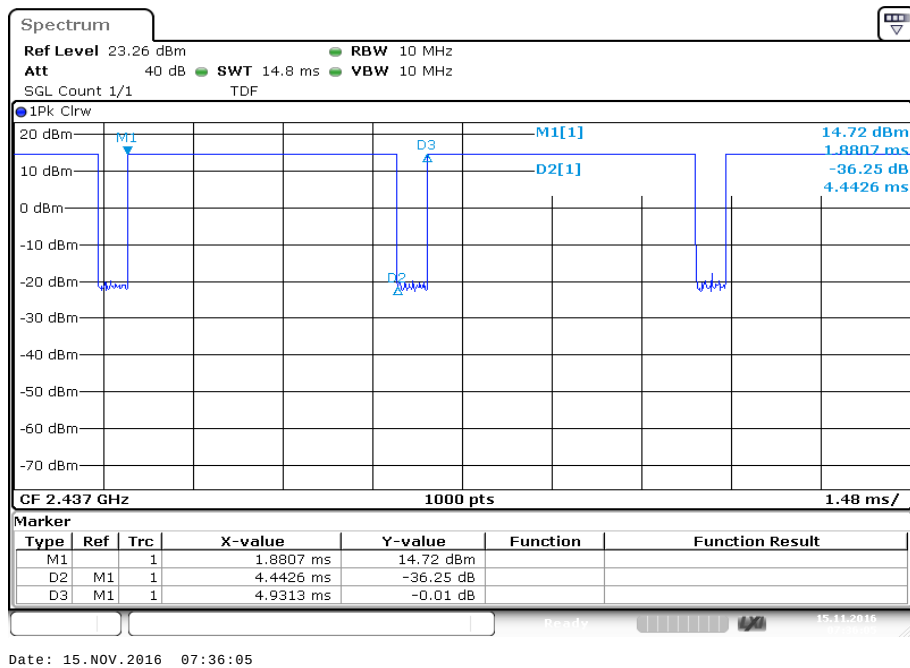
T _{nom}	V _{nom}	lowest channel 2412 MHz	middle channel 2437 MHz	highest channel 2462 MHz
DSSS / b – mode		90.09 % / 0.45 dB	90.09 % / 0.45 dB	90.12 % / 0.45 dB
OFDM / g – mode		59.52 % / 2.25 dB	59.58 % / 2.25 dB	59.82 % / 2.23 dB
OFDM / n HT20 – mode		56.06 % / 2.51 dB	56.06 % / 2.51 dB	55.65 % / 2.55 dB

Plots: DSSS / b – mode

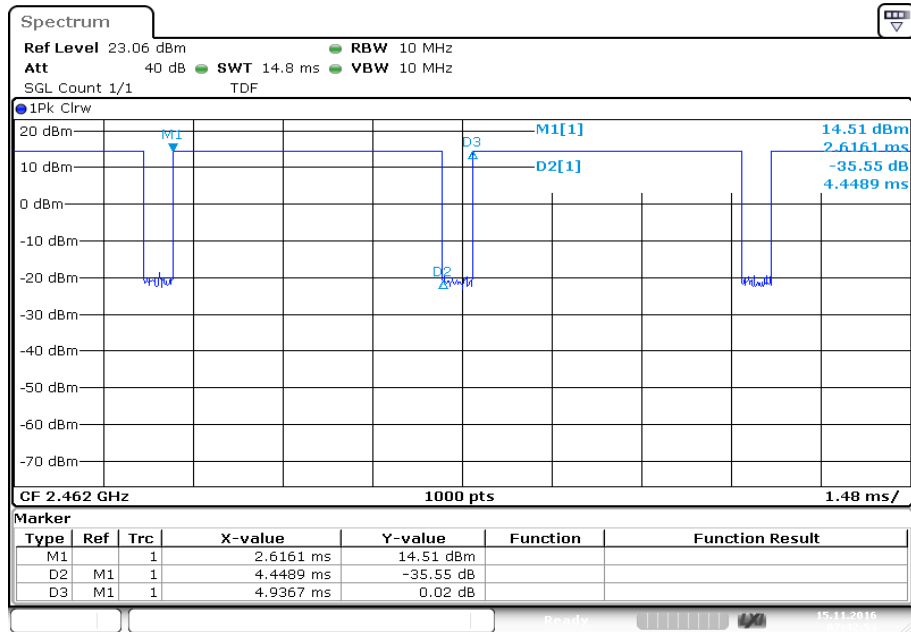
Plot 1: Lowest channel



Plot 2: Middle channel



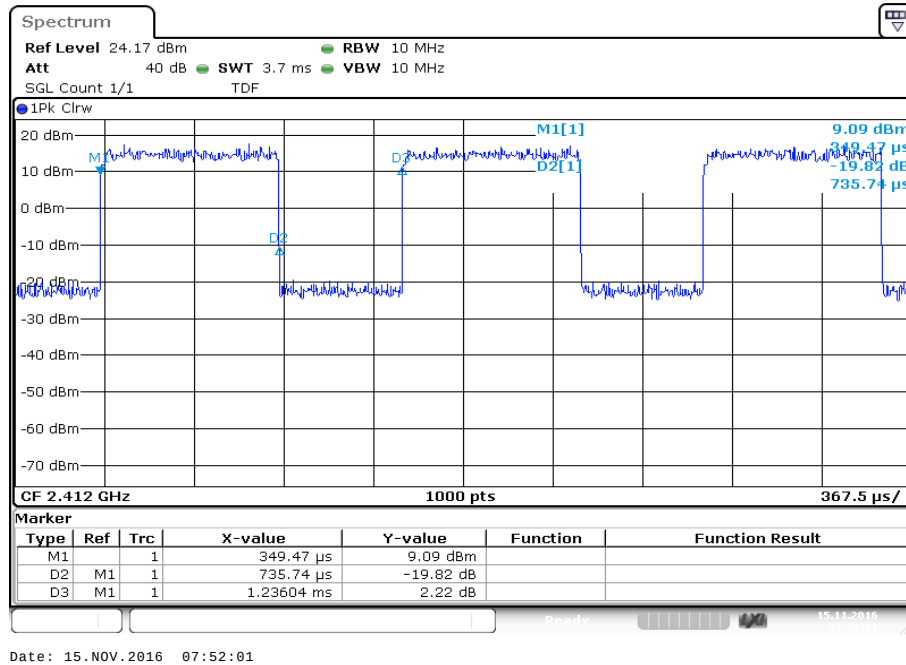
Plot 3: Highest channel



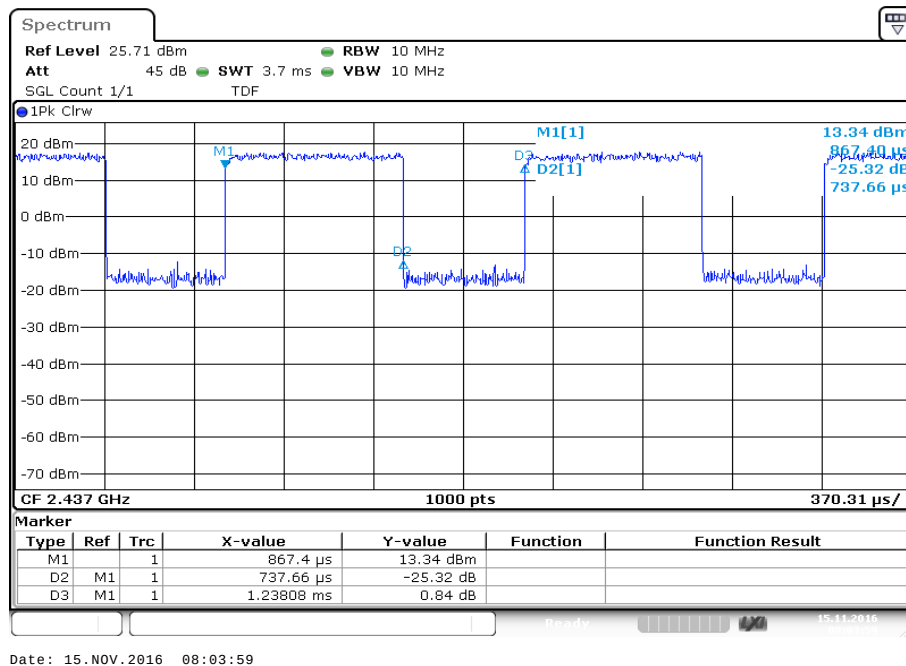
Date: 15.NOV.2016 07:42:53

Plots: OFDM / g – mode

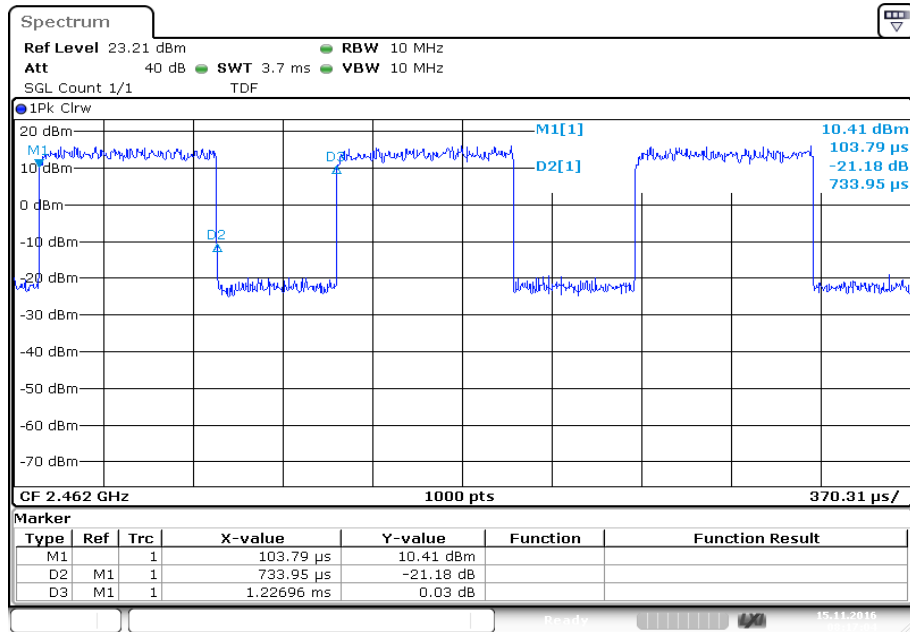
Plot 1: Lowest channel



Plot 2: Middle channel



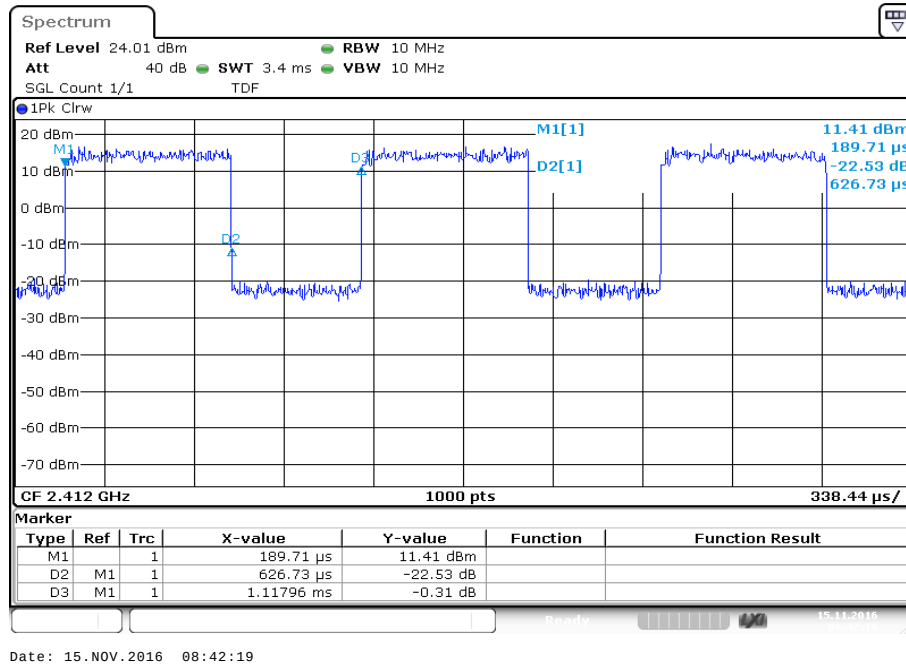
Plot 3: Highest channel



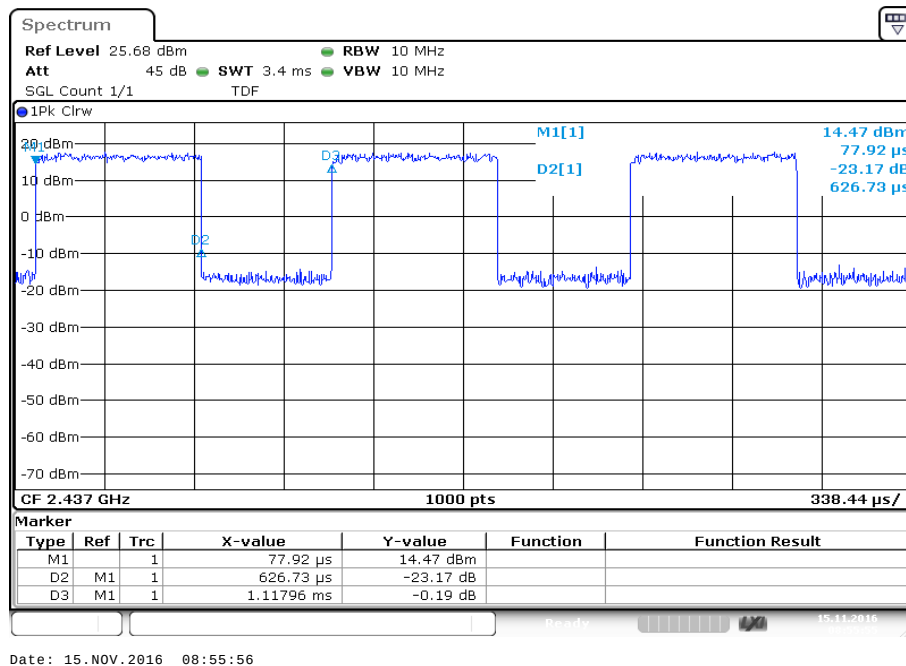
Date: 15.NOV.2016 08:17:04

Plots: OFDM / n HT20 – mode

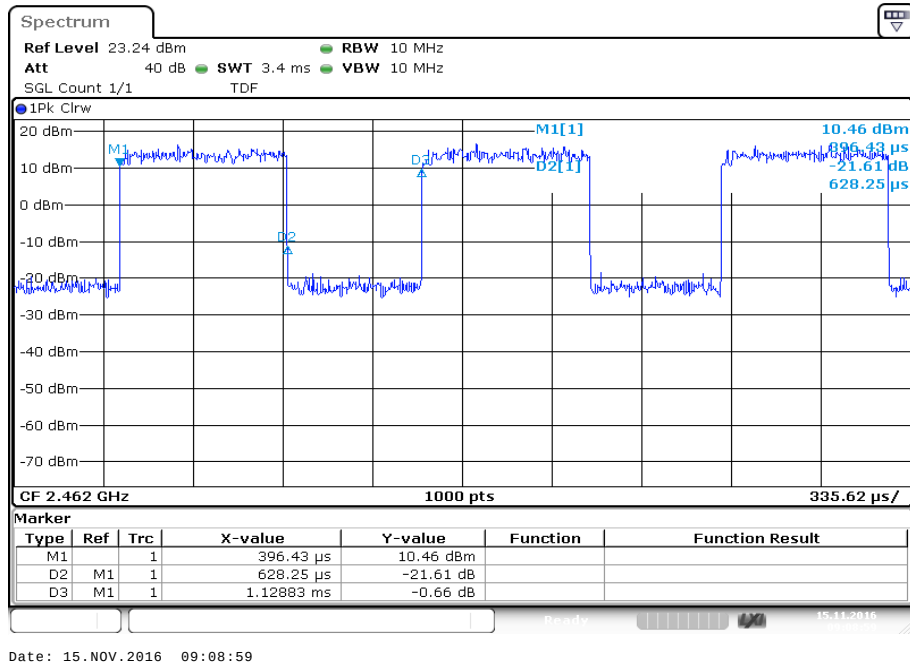
Plot 1: Lowest channel



Plot 2: Middle channel



Plot 3: Highest channel



11.5 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 6.4 B
Measurement uncertainty	See sub clause 8

Limits:

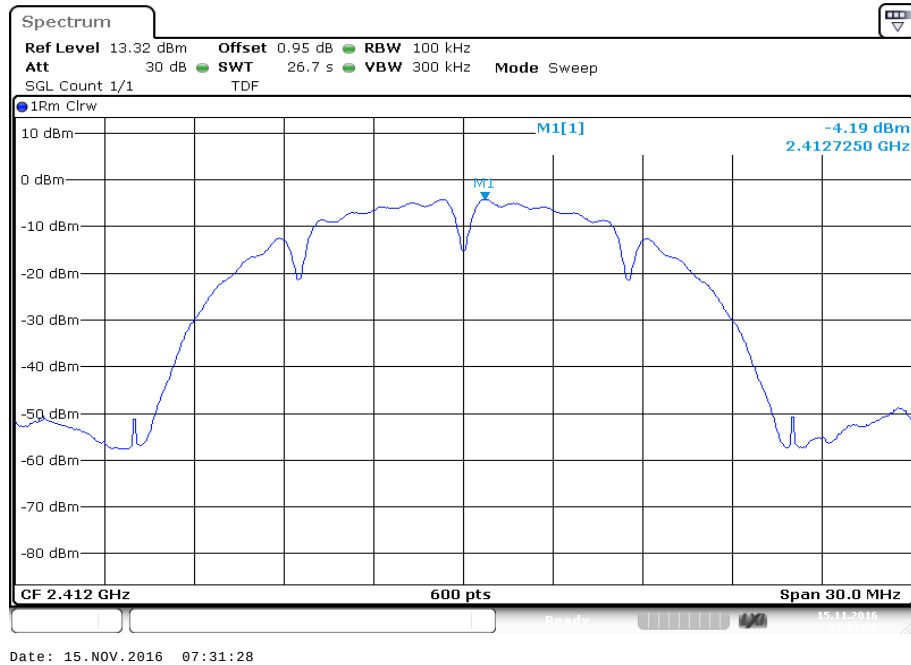
FCC	IC
8 dBm / 3kHz (conducted)	

Results:

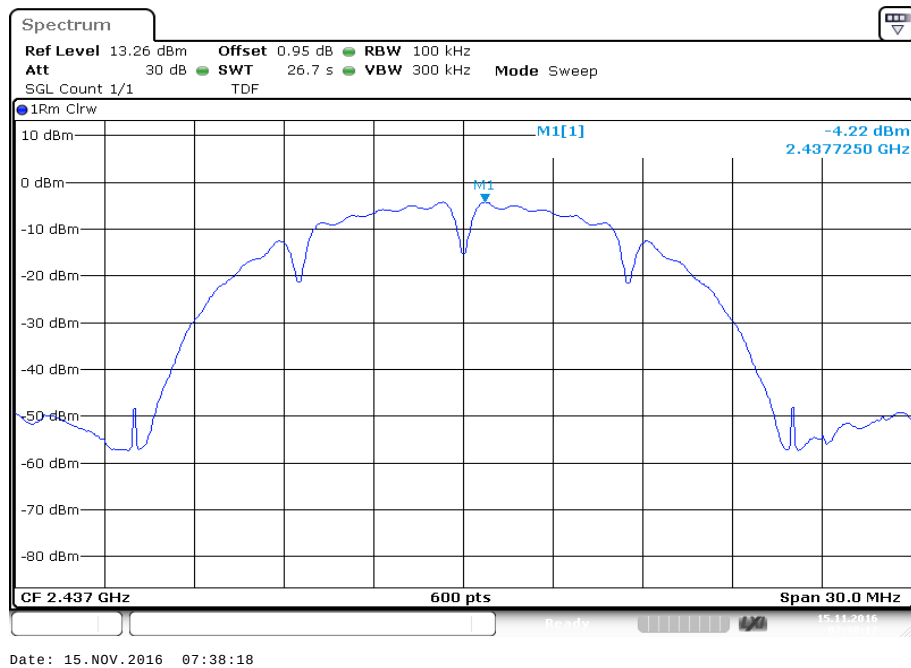
Modulation Frequency	Peak power spectral density [dBm]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	-4.2	-4.2	-4.4
OFDM / g – mode	-8.5	-6.0	-9.7
OFDM / n HT20 – mode	-8.9	-6.3	-9.6

Plots: DSSS / b – mode

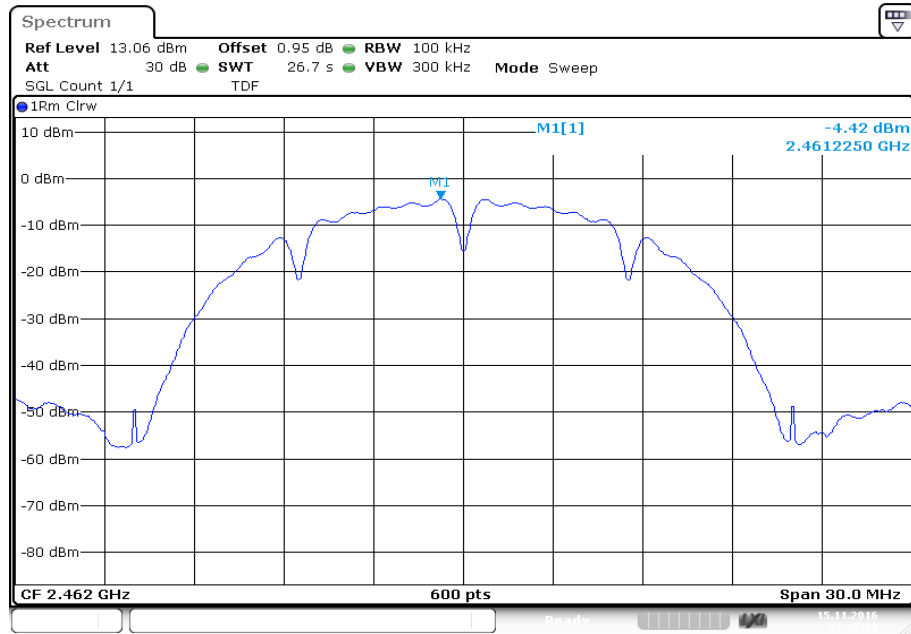
Plot 1: Lowest channel



Plot 2: Middle channel



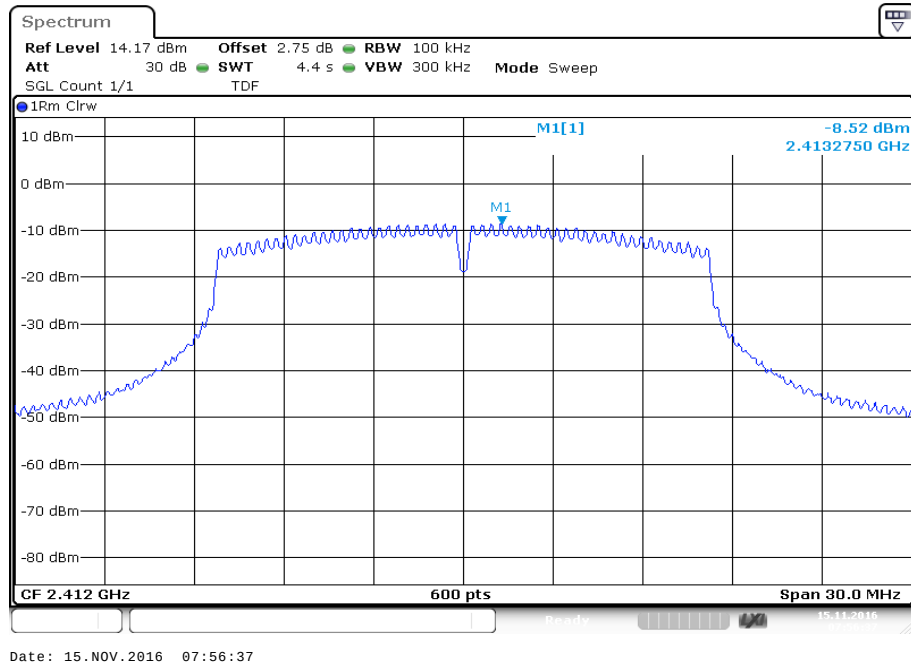
Plot 3: Highest channel



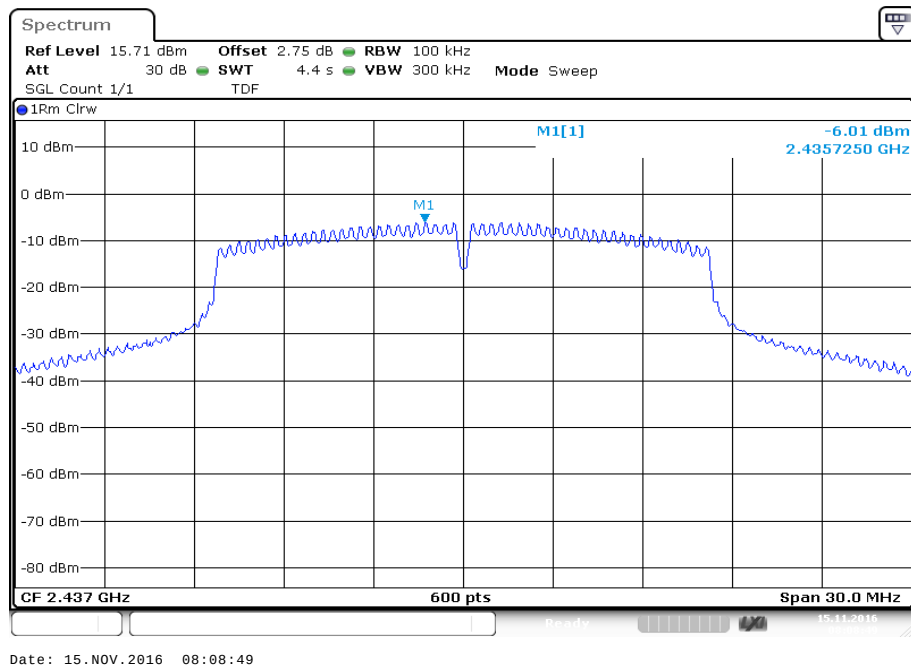
Date: 15.NOV.2016 07:45:13

Plots: OFDM / g – mode

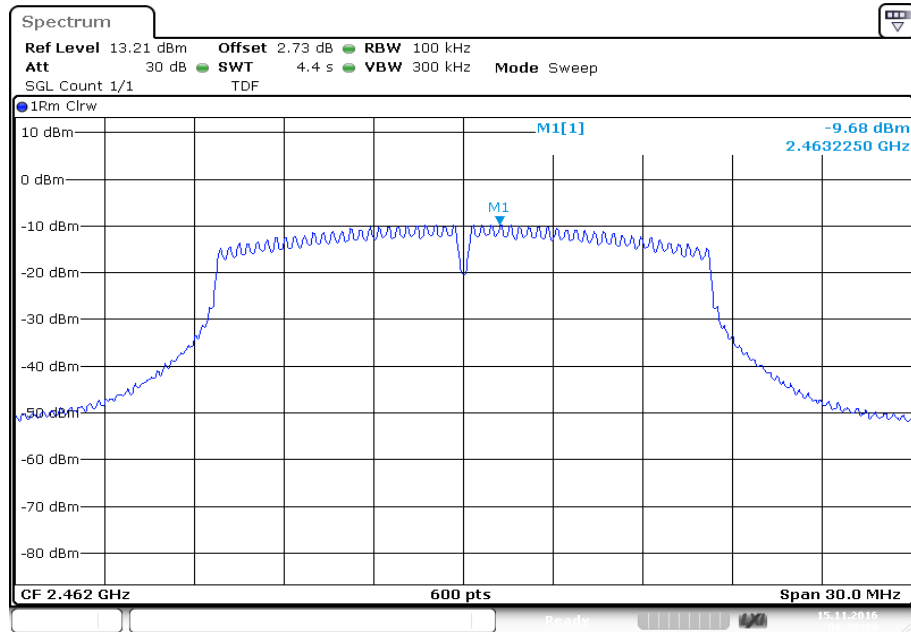
Plot 1: Lowest channel



Plot 2: Middle channel



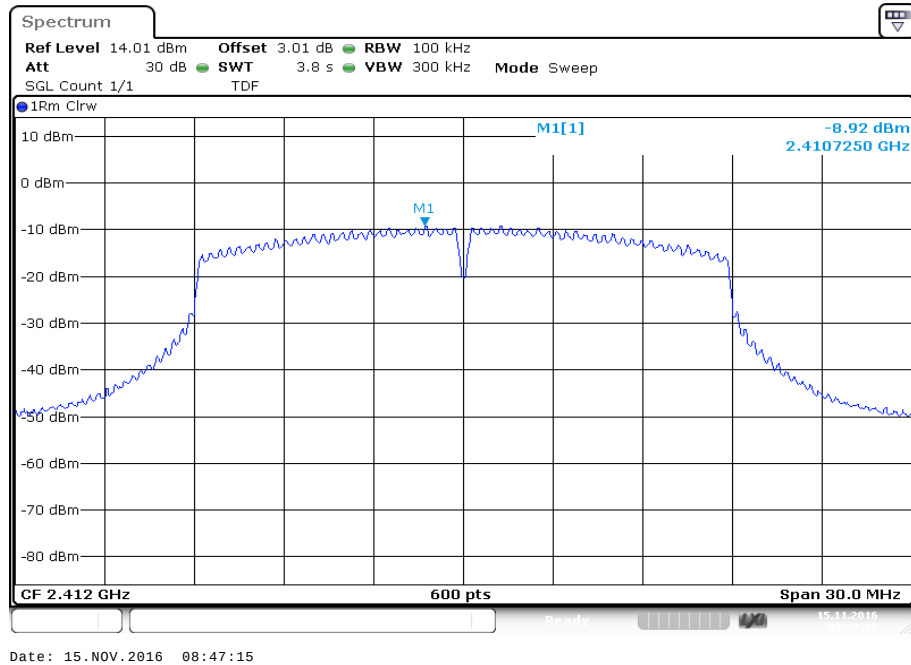
Plot 3: Highest channel



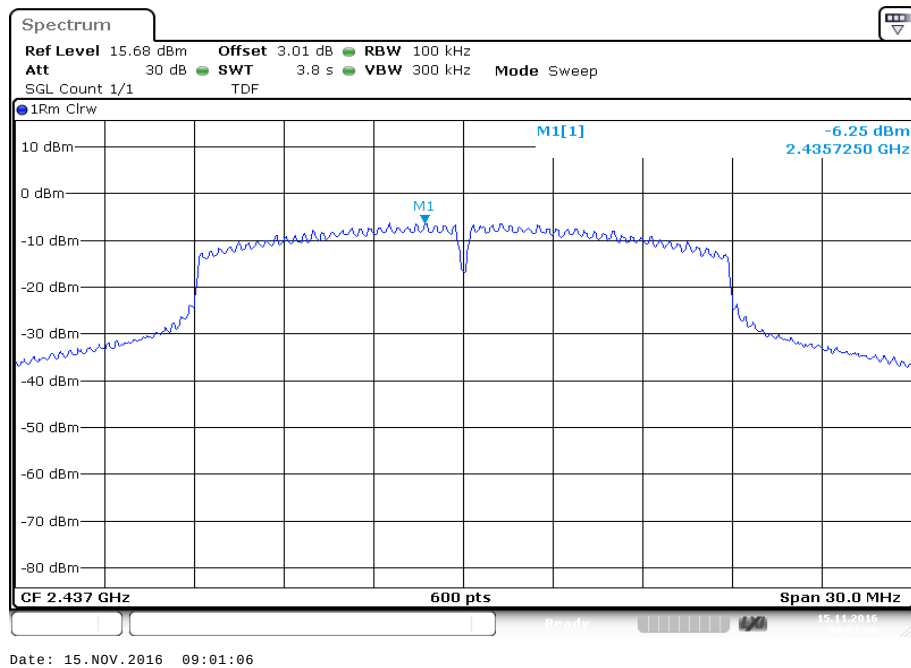
Date: 15.NOV.2016 08:22:20

Plots: OFDM / n HT20 – mode

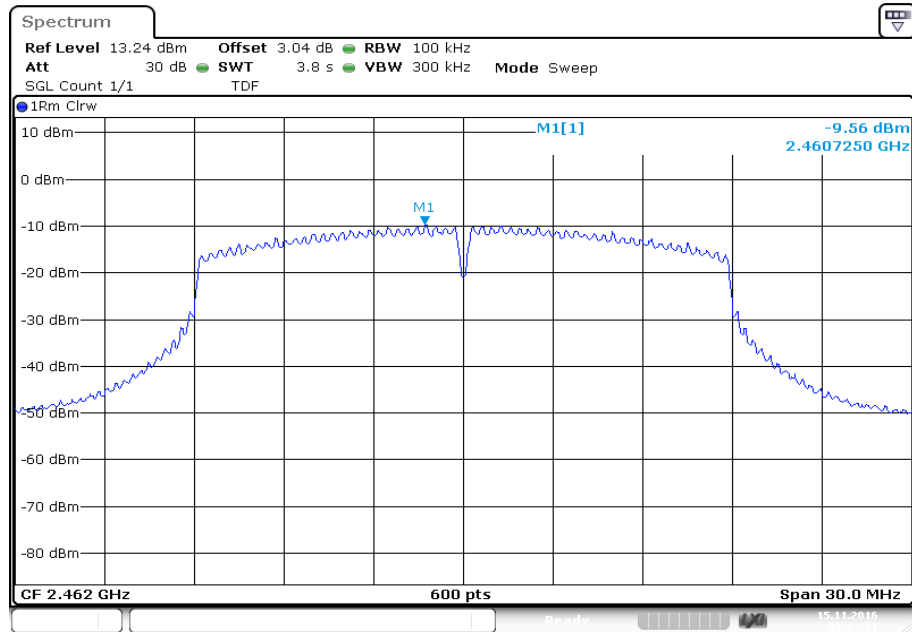
Plot 1: Lowest channel



Plot 2: Middle channel



Plot 3: Highest channel



Date: 15.NOV.2016 09:14:41

11.6 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 6.4 B
Measurement uncertainty	See sub clause 8

Limits:

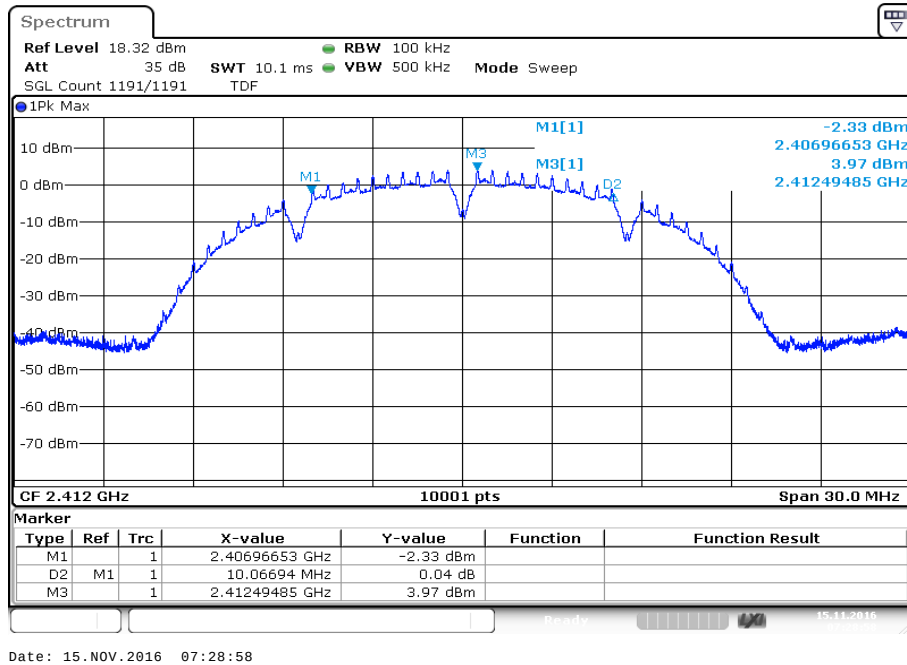
FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

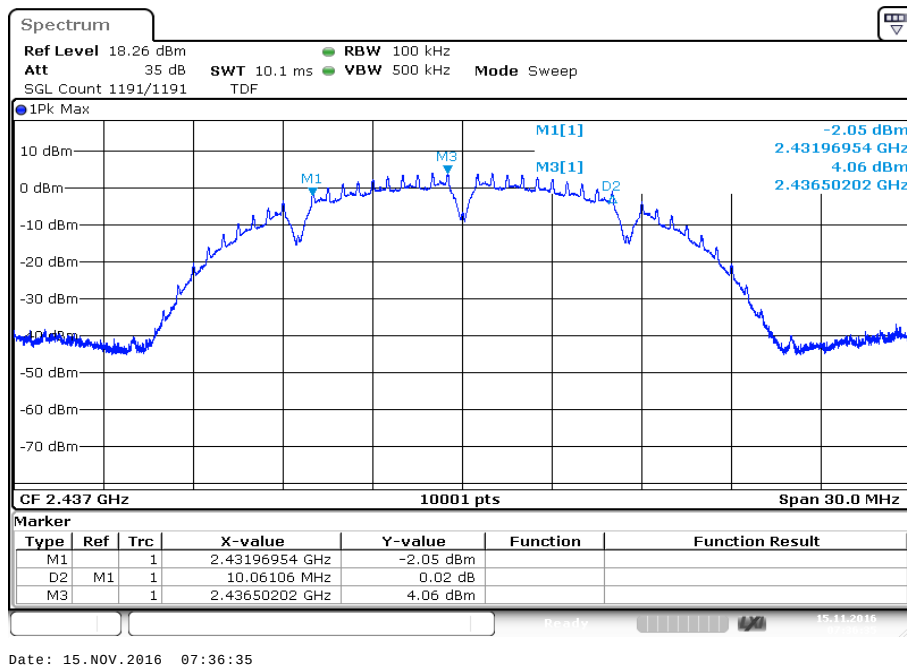
Frequency	6 dB DTS bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	10,067	10,061	10,055
OFDM / g – mode	15,103	15,097	15,103
OFDM / n HT20 – mode	15,103	15,097	15,100

Plots: DSSS / b – mode

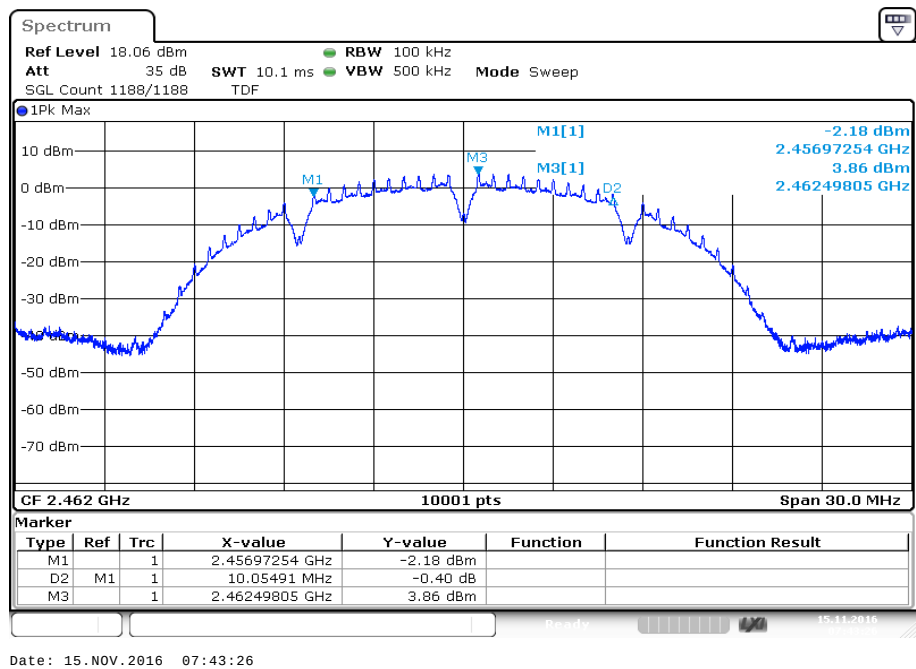
Plot 1: Lowest channel



Plot 2: Middle channel

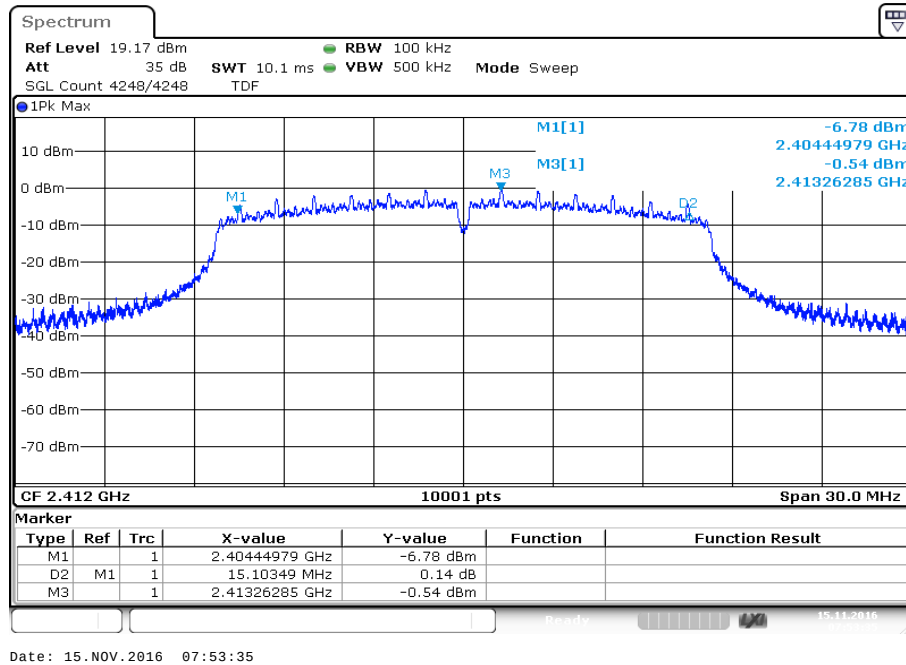


Plot 3: Highest channel

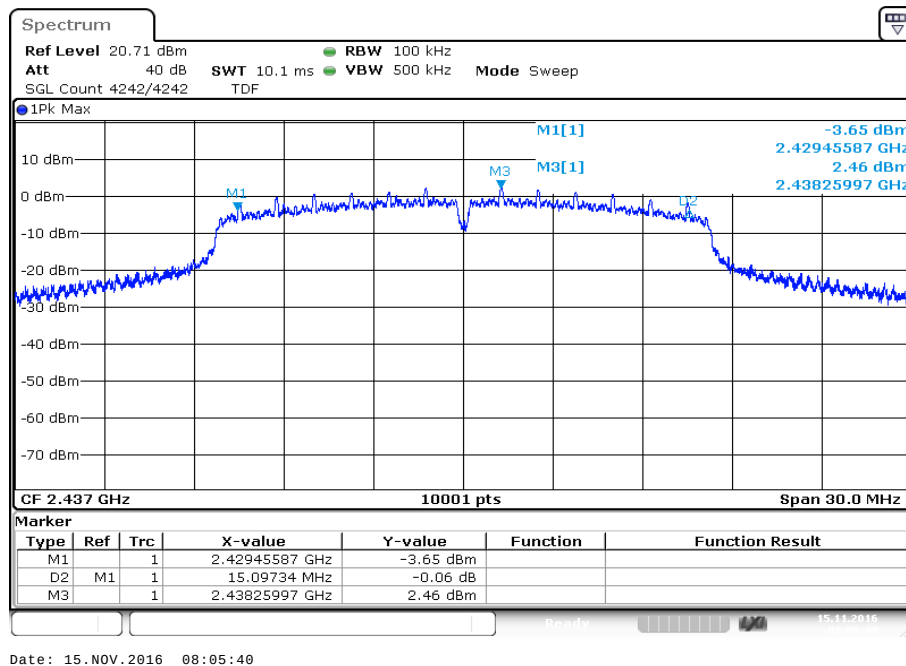


Plots: OFDM / g – mode

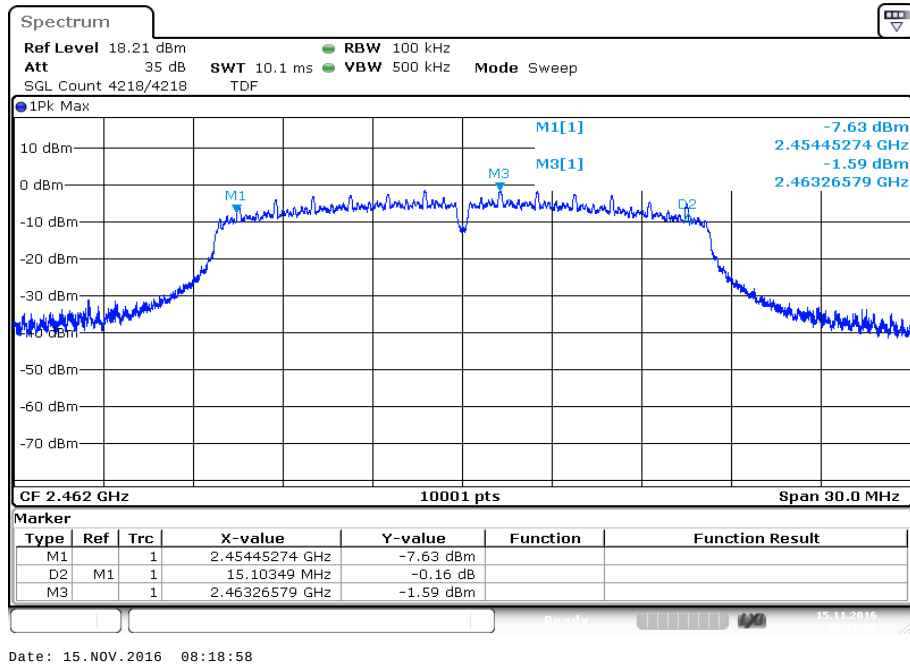
Plot 1: Lowest channel



Plot 2: Middle channel

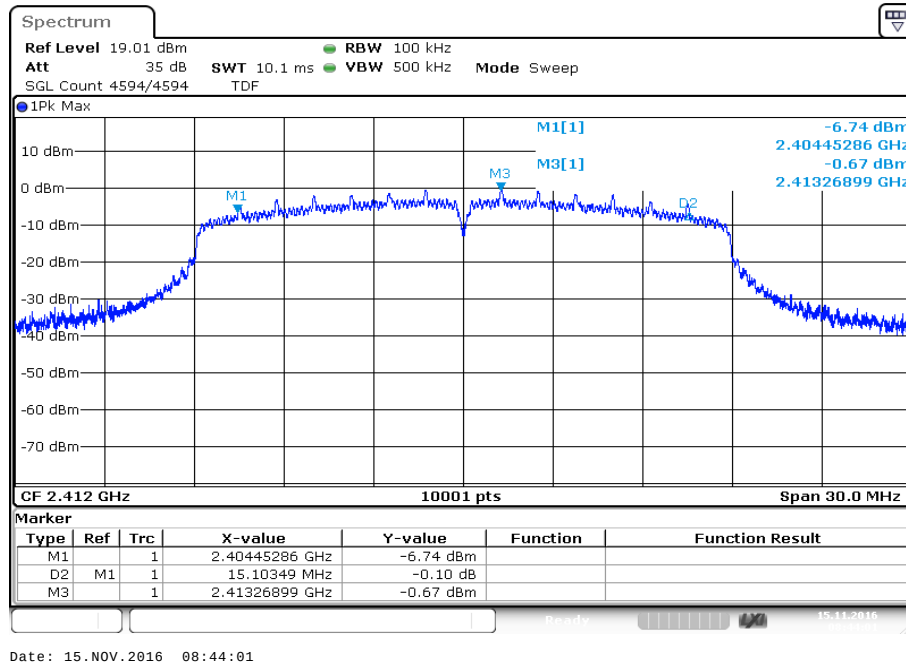


Plot 3: Highest channel

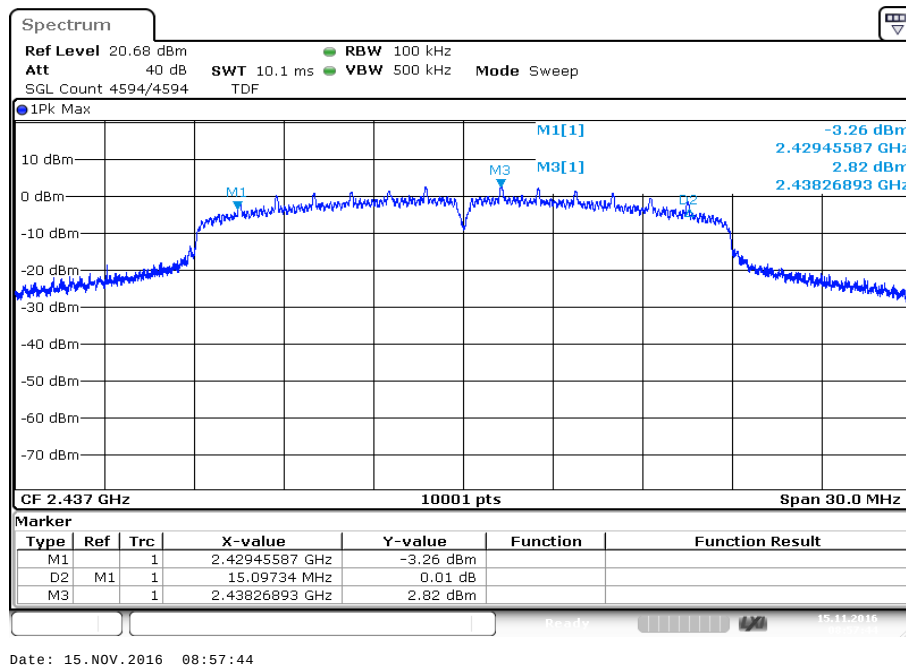


Plots: OFDM / n HT20 – mode

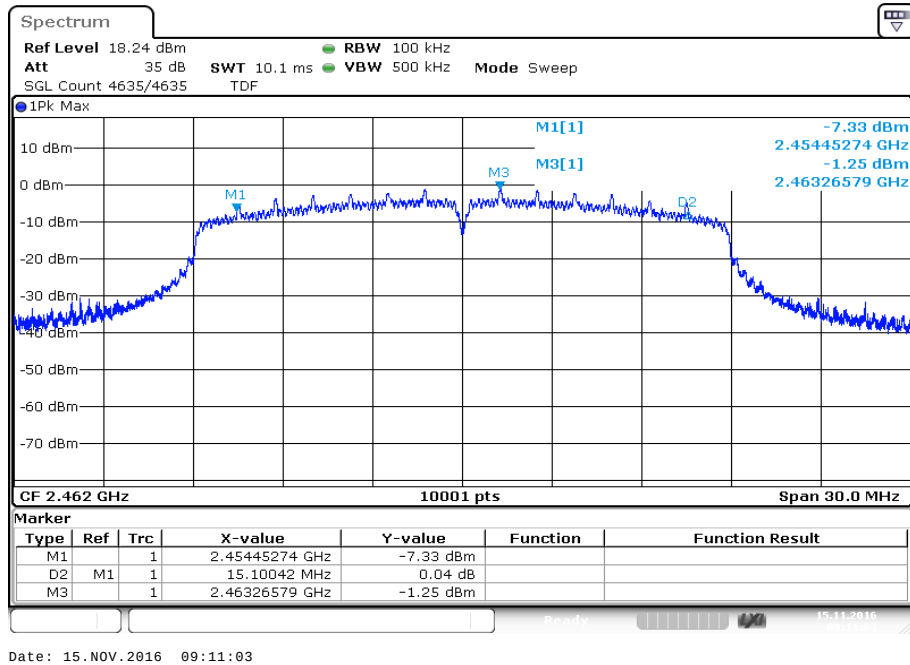
Plot 1: Lowest channel



Plot 2: Middle channel



Plot 3: Highest channel



11.7 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 6.4 B
Measurement uncertainty	See sub clause 8

Usage:

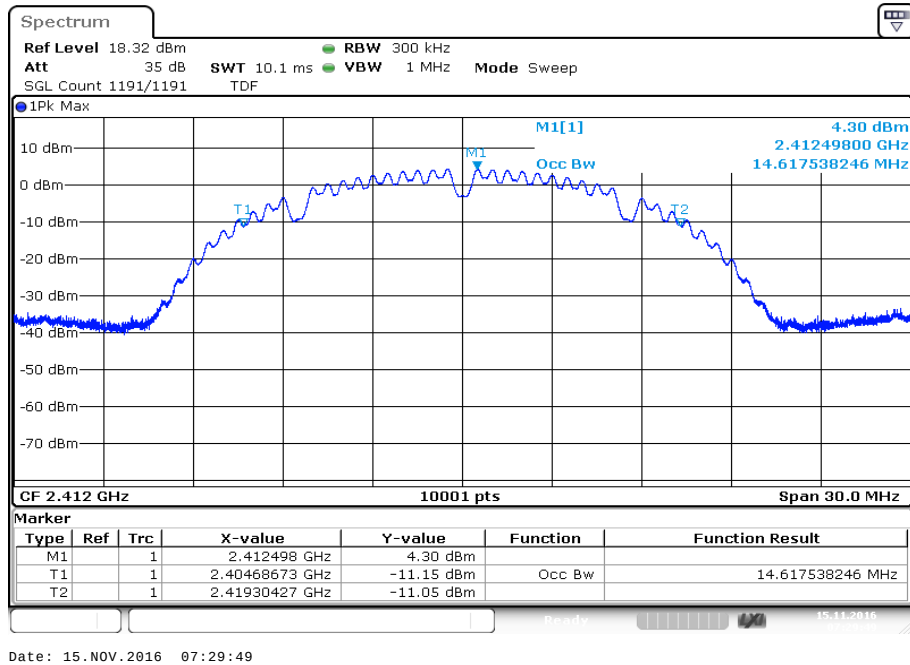
-/-	IC
OBW is necessary for Emission Designator	

Results:

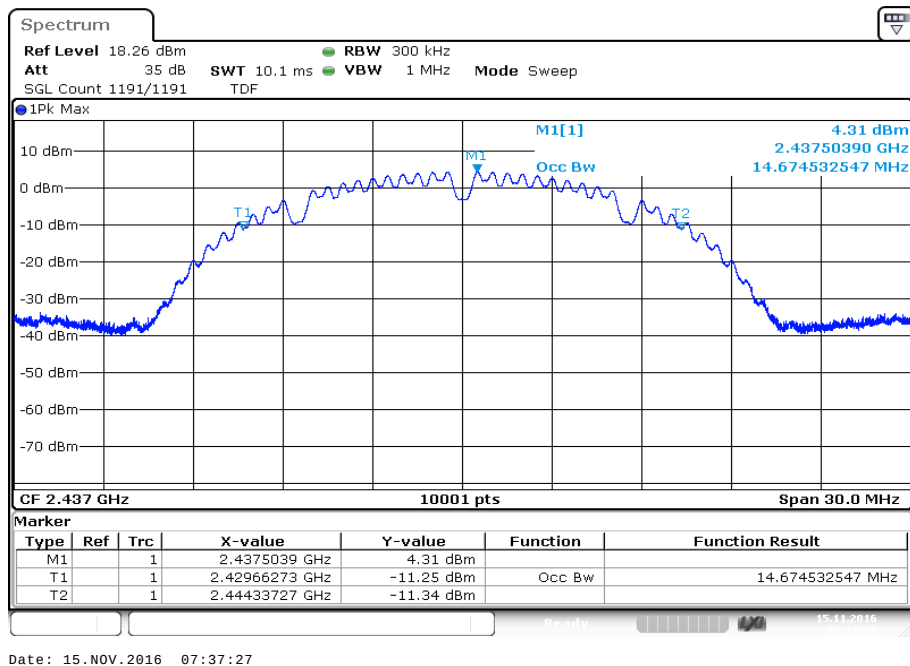
Modulation Frequency	99% bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	14,618	14,675	14,690
OFDM / g – mode	16,402	17,290	16,384
OFDM / n HT20 – mode	17,542	18,406	17,542

Plots: DSSS / b – mode

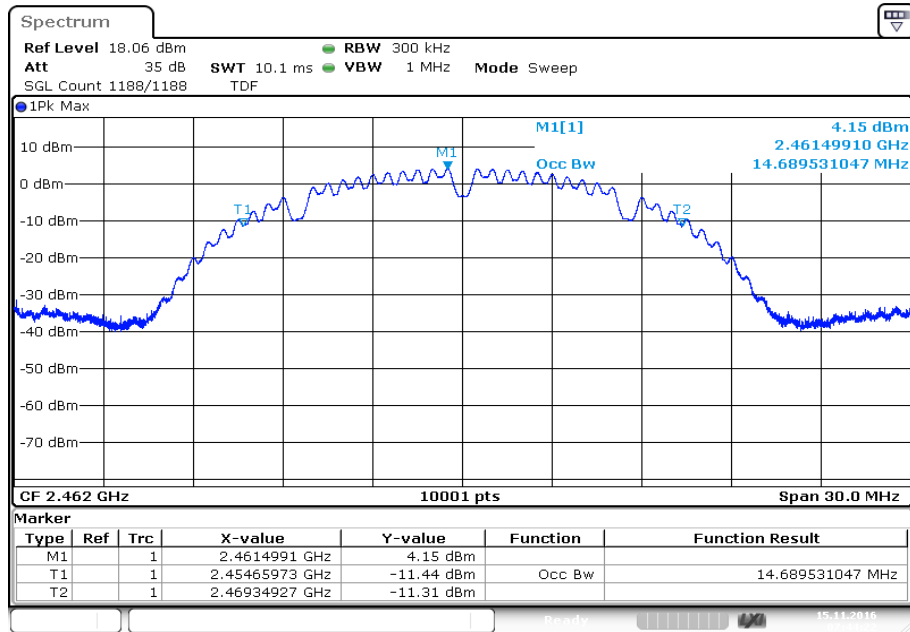
Plot 1: Lowest channel



Plot 2: Middle channel



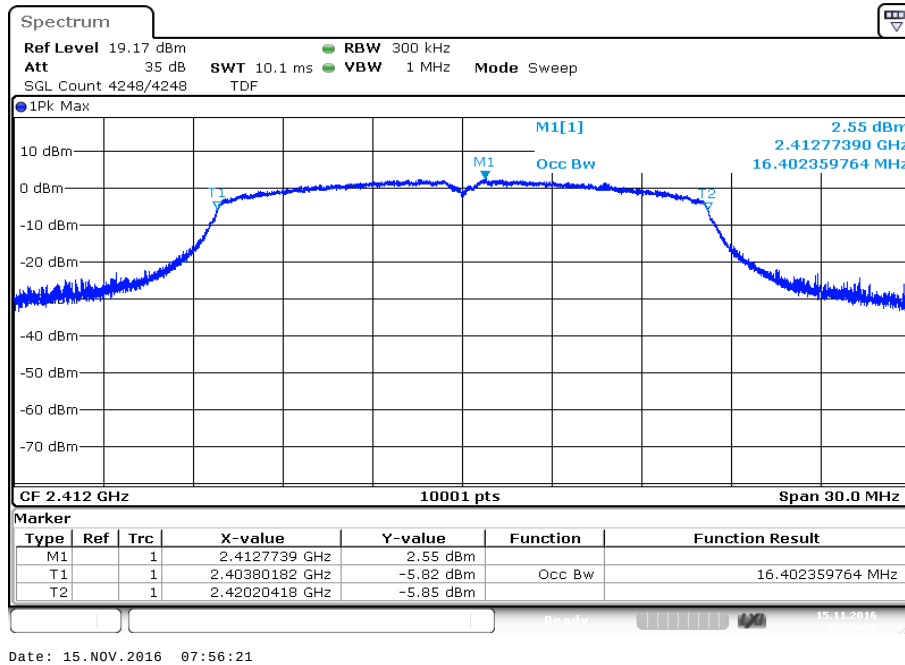
Plot 3: Highest channel



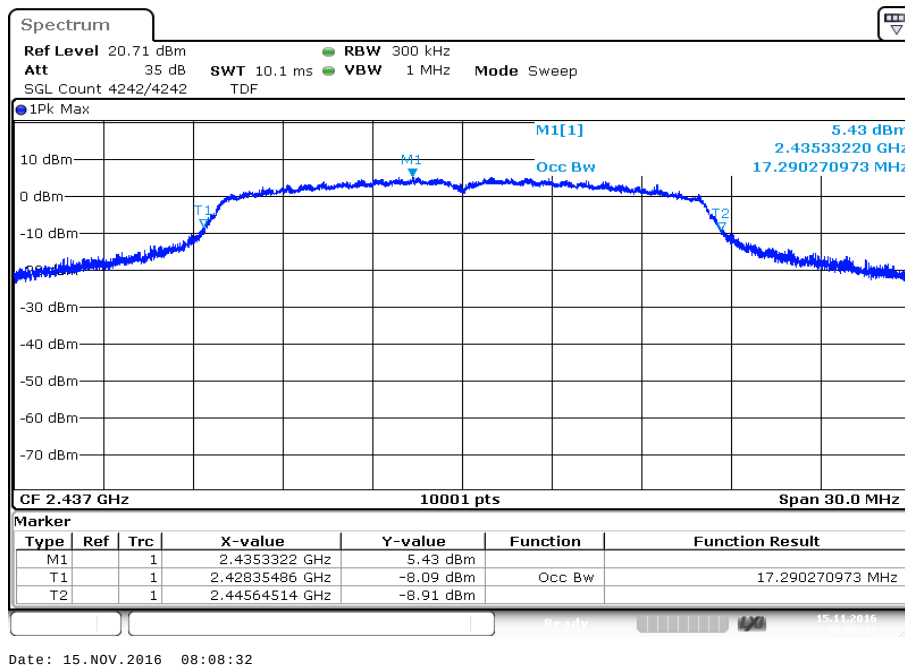
Date: 15.NOV.2016 07:44:22

Plots: OFDM / g – mode

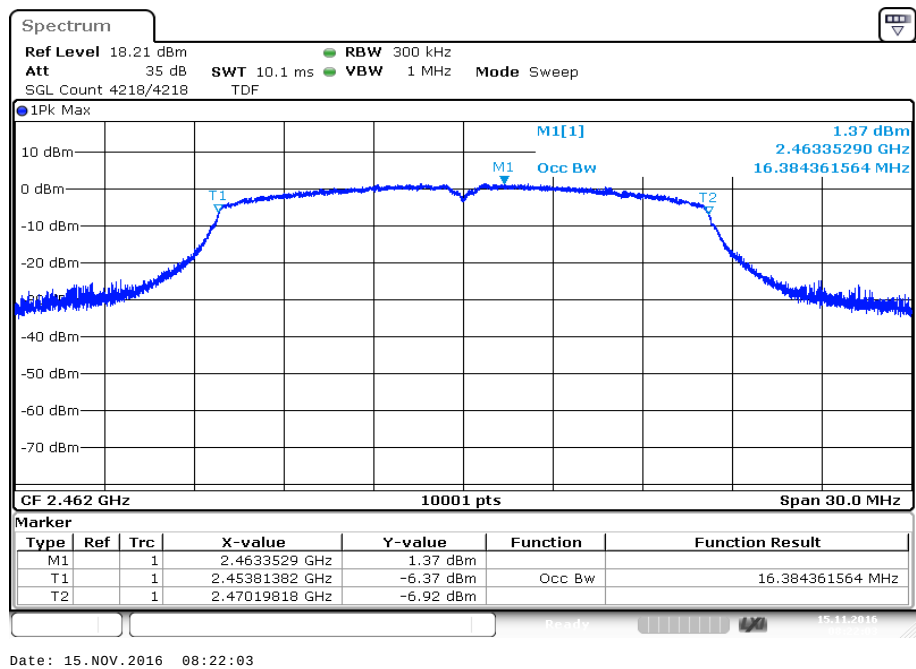
Plot 1: Lowest channel



Plot 2: Middle channel

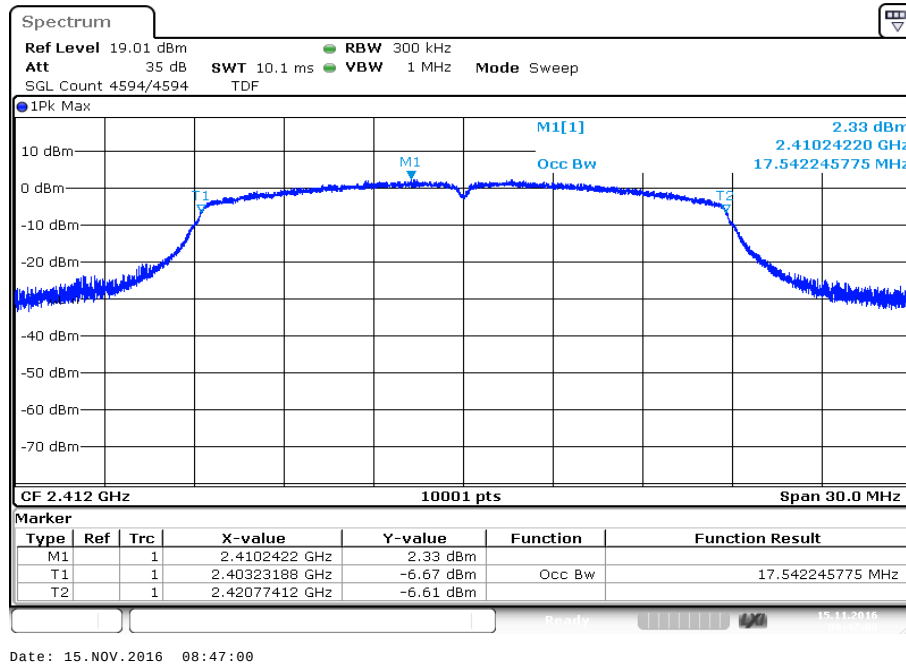


Plot 3: Highest channel

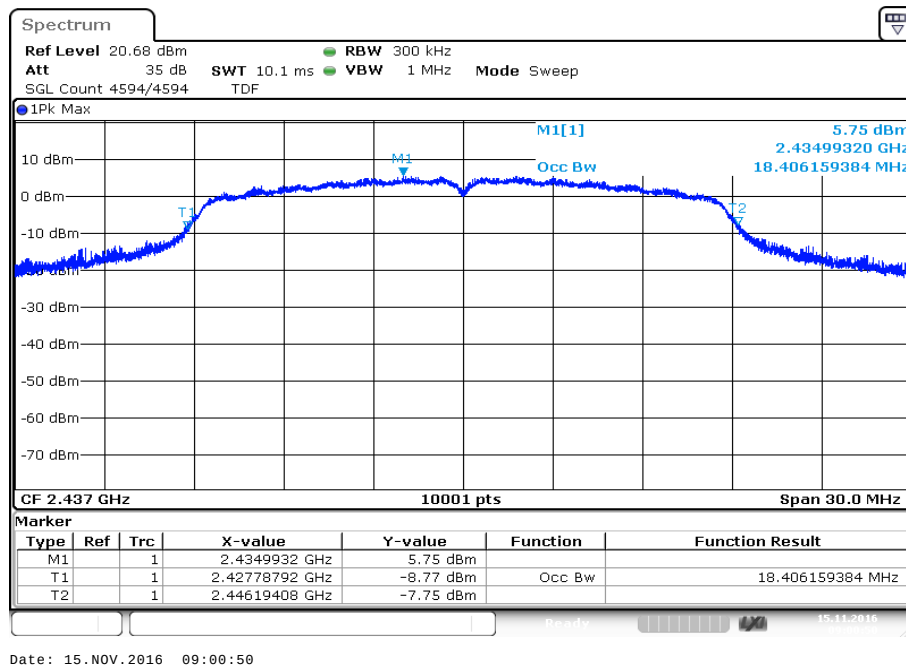


Plots: OFDM / n HT20 – mode

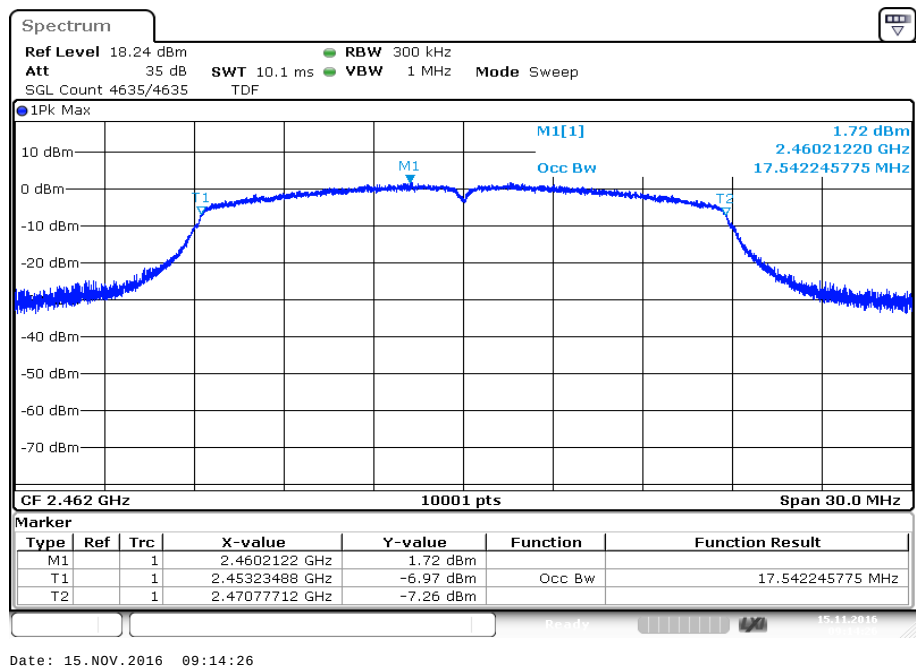
Plot 1: Lowest channel



Plot 2: Middle channel



Plot 3: Highest channel



11.8 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 6.4 B
Measurement uncertainty	See sub clause 8

Usage:

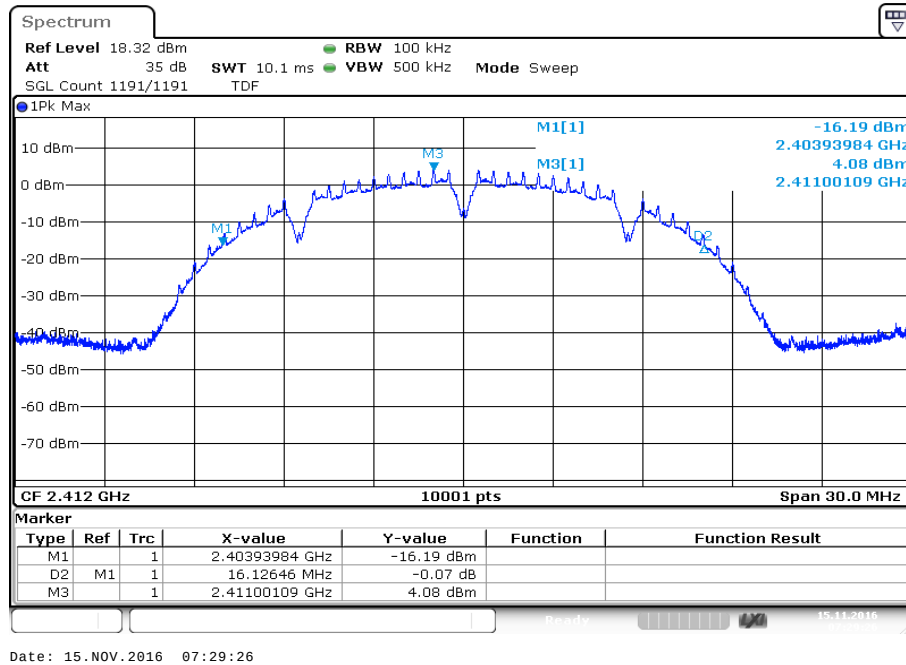
-/-	IC
Within the used band!	

Results:

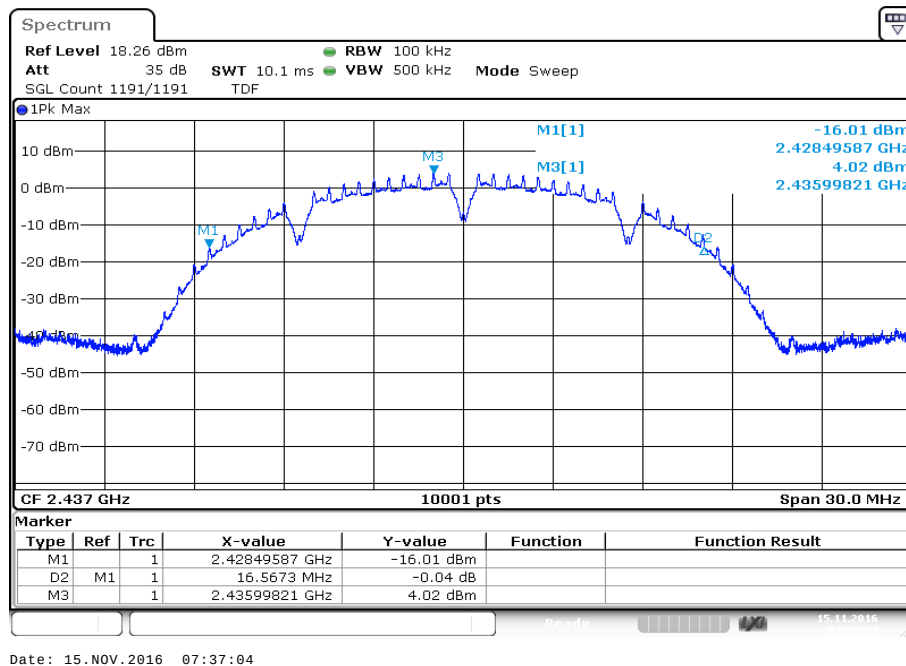
Modulation Frequency	20 dB bandwidth [MHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	16.13	16.57	16.13
OFDM / g – mode	17.11	17.89	17.10
OFDM / n HT20 – mode	18.39	18.92	18.41

Plots: DSSS / b – mode

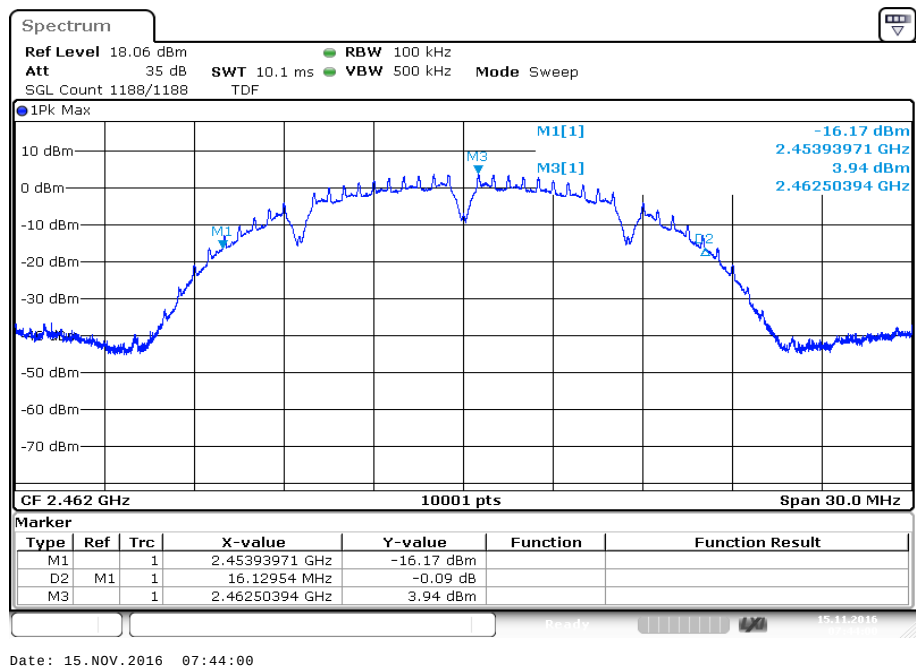
Plot 1: Lowest channel



Plot 2: Middle channel

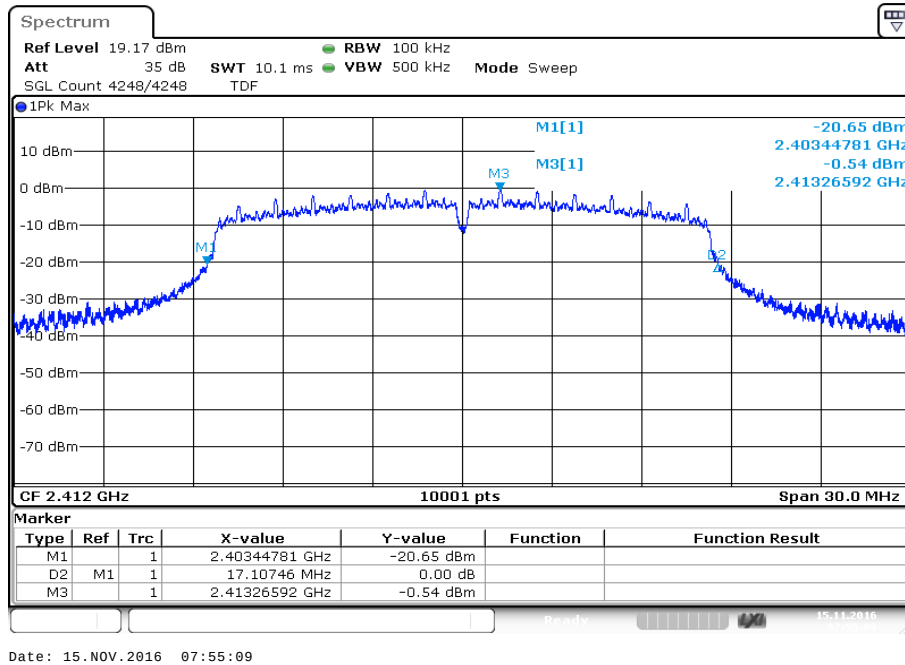


Plot 3: Highest channel

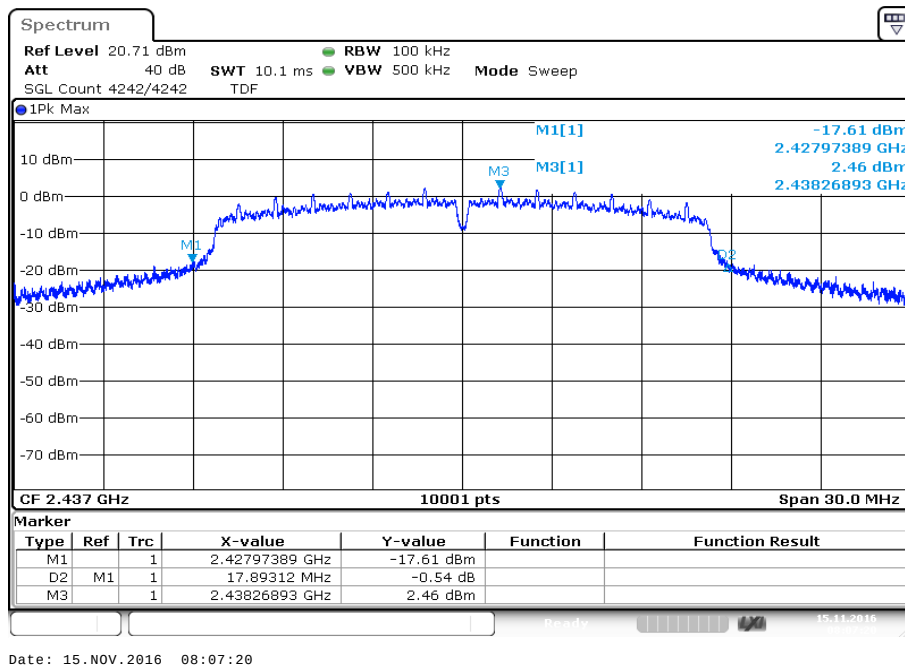


Plots: OFDM / g – mode

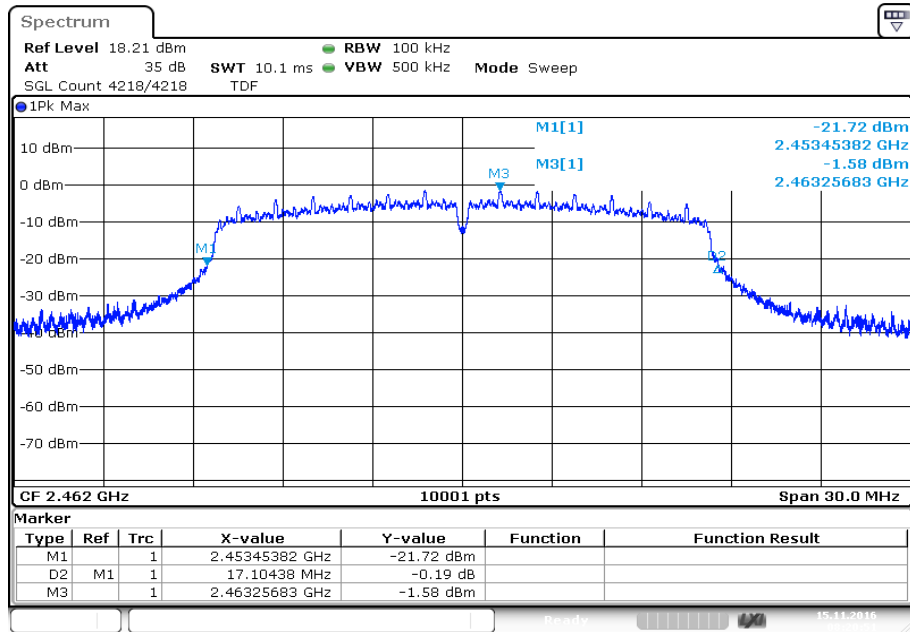
Plot 1: Lowest channel



Plot 2: Middle channel



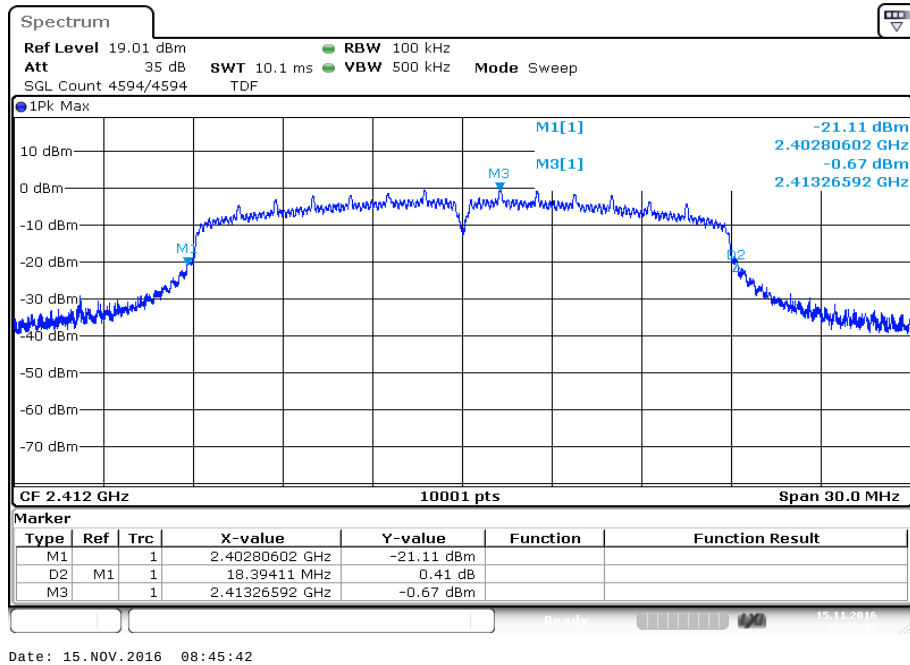
Plot 3: Highest channel



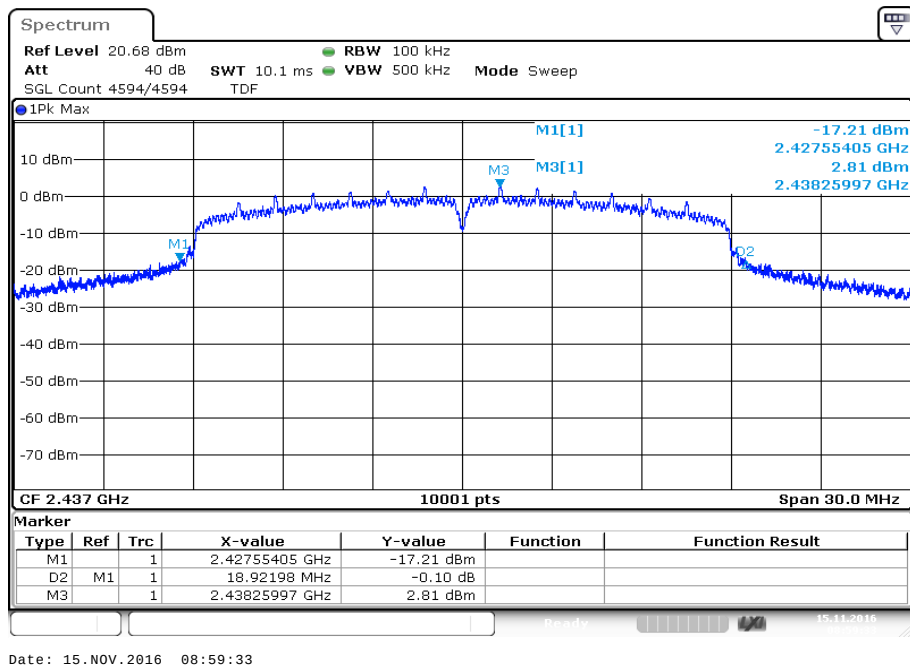
Date: 15.NOV.2016 08:20:51

Plots: OFDM / n HT20 – mode

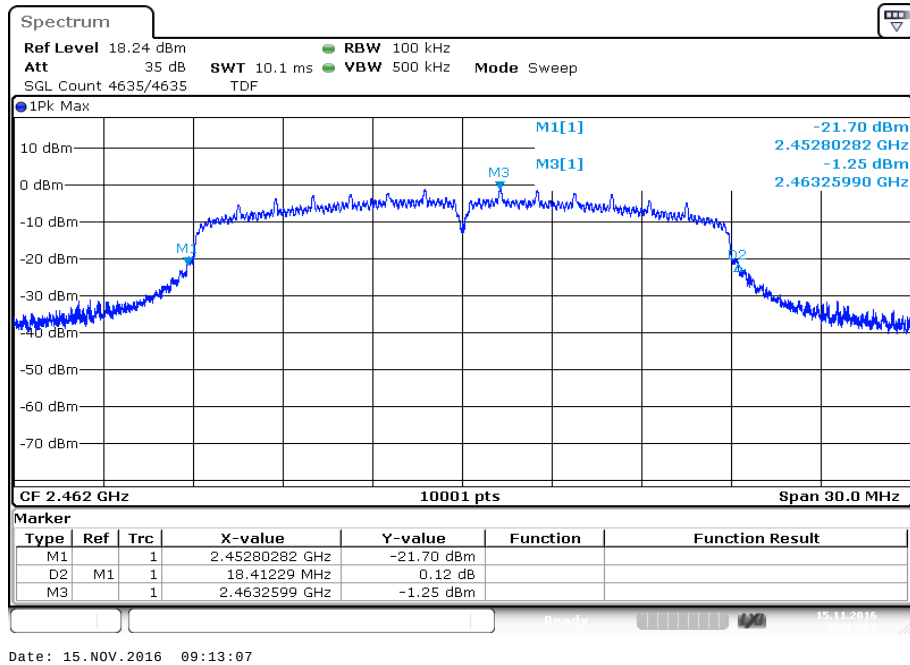
Plot 1: Lowest channel



Plot 2: Middle channel



Plot 3: Highest channel



11.9 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 6.4 B
Measurement uncertainty	See sub clause 8

Limits:

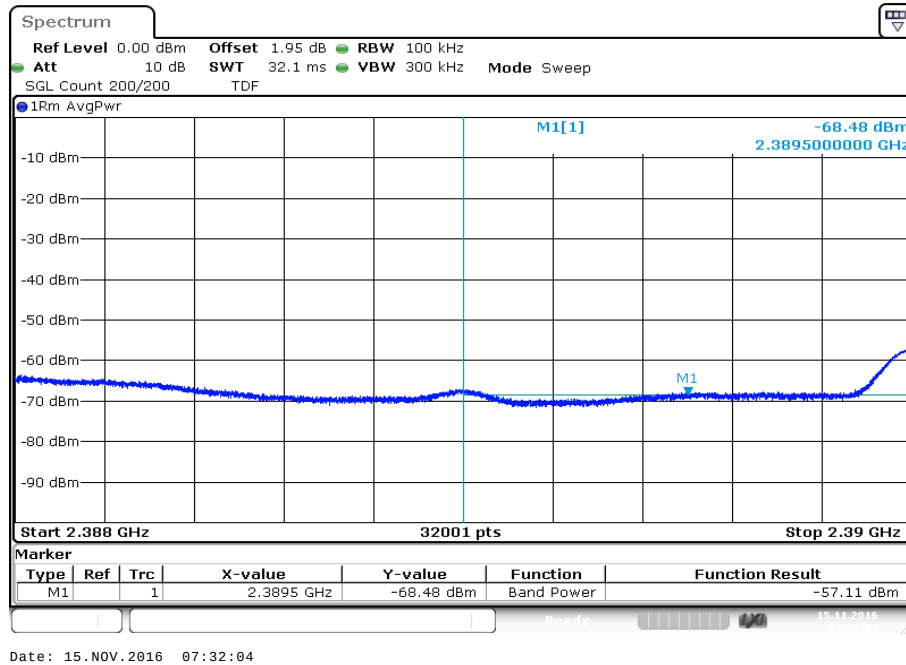
FCC	IC
-41.26 dBm	

Results:

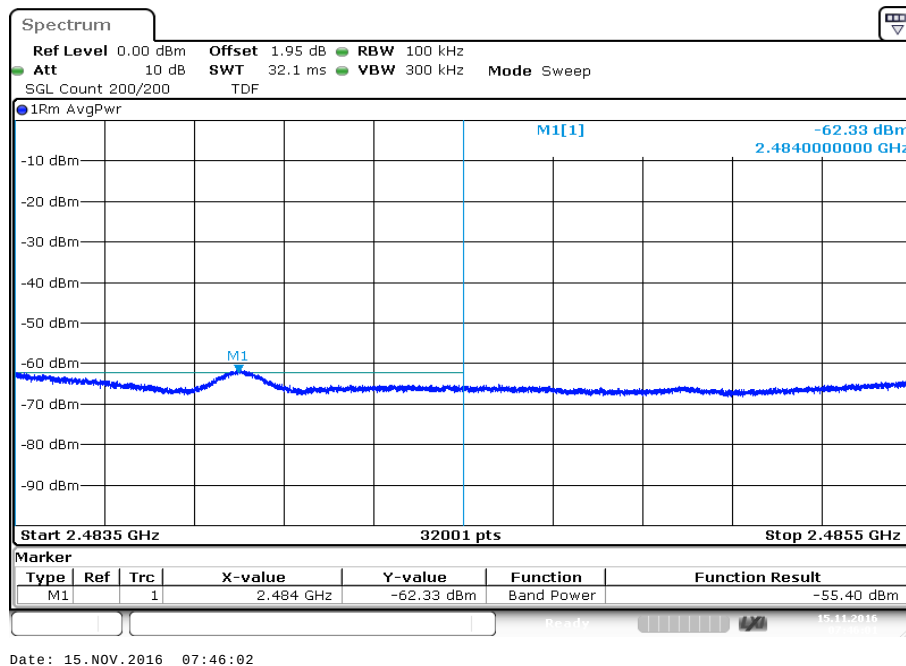
Scenario Modulation	Band edge compliance [dBm] (included antenna gain)			
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode	-/-
Max. lower band edge power	-57.11	-50.86	-49.14	-/-
Max. upper band edge power	-55.40	-51.52	-49.62	-/-

Plots: DSSS / b – mode

Plot 1: Lower band edge

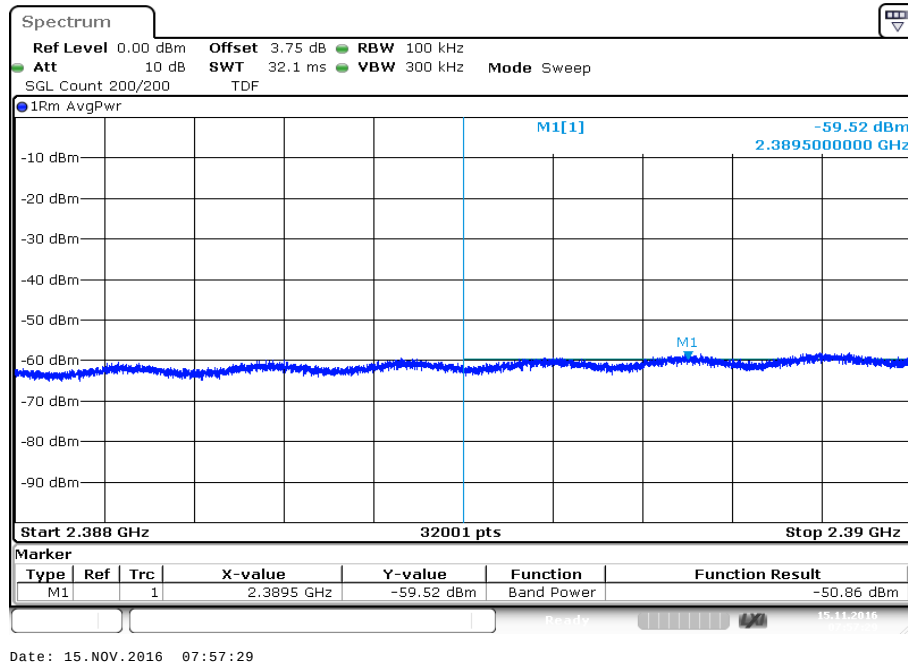


Plot 2: Upper band edge

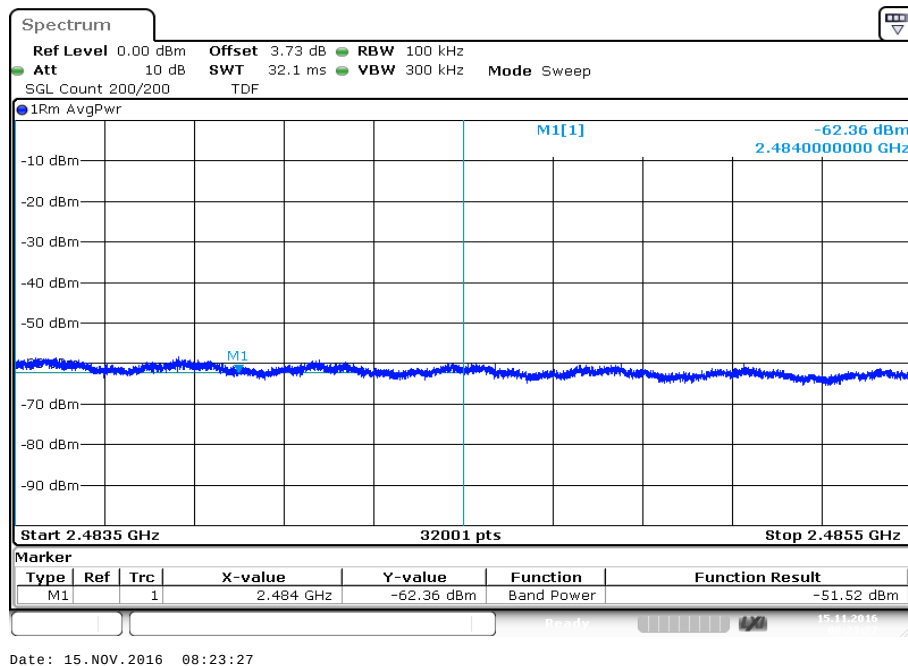


Plots: OFDM / g – mode

Plot 1: Lower band edge

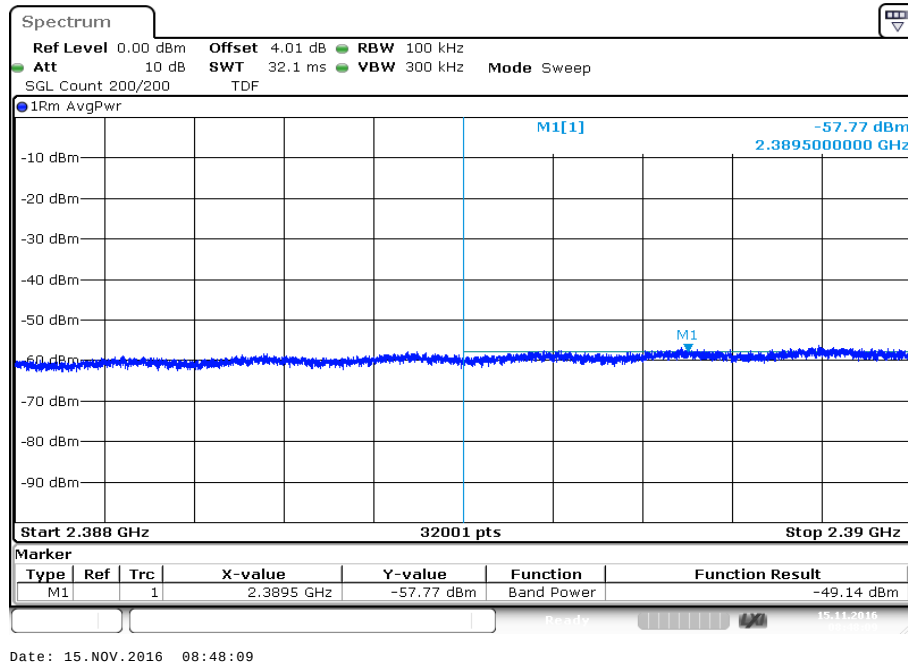


Plot 2: Upper band edge

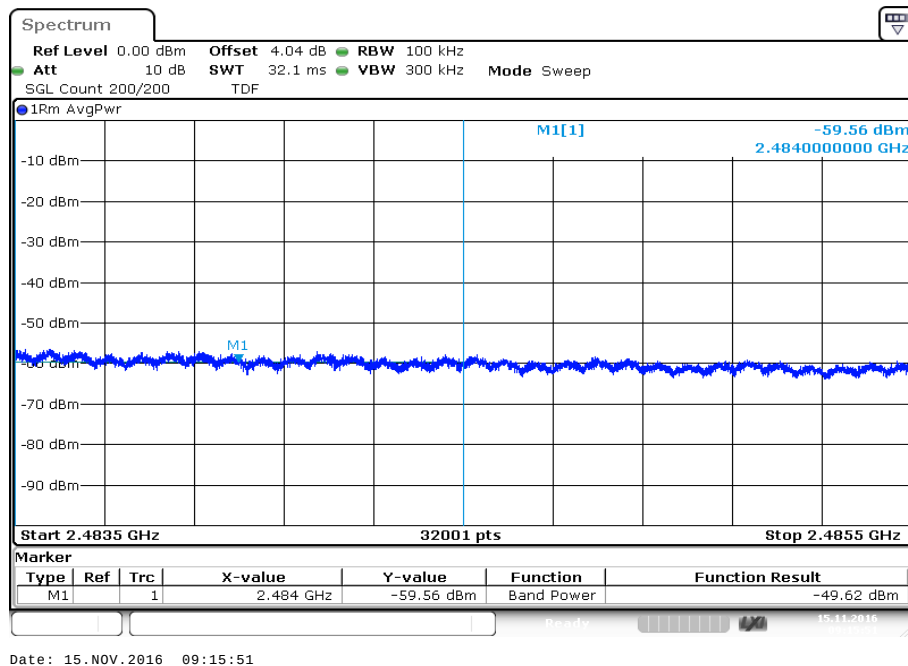


Plots: OFDM / n HT20 – mode

Plot 1: Lower band edge



Plot 2: Upper band edge



11.10 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 6.4 B
Measurement uncertainty	See sub clause 8

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		4.1	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2437		3.9	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2462		3.5	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / g – mode

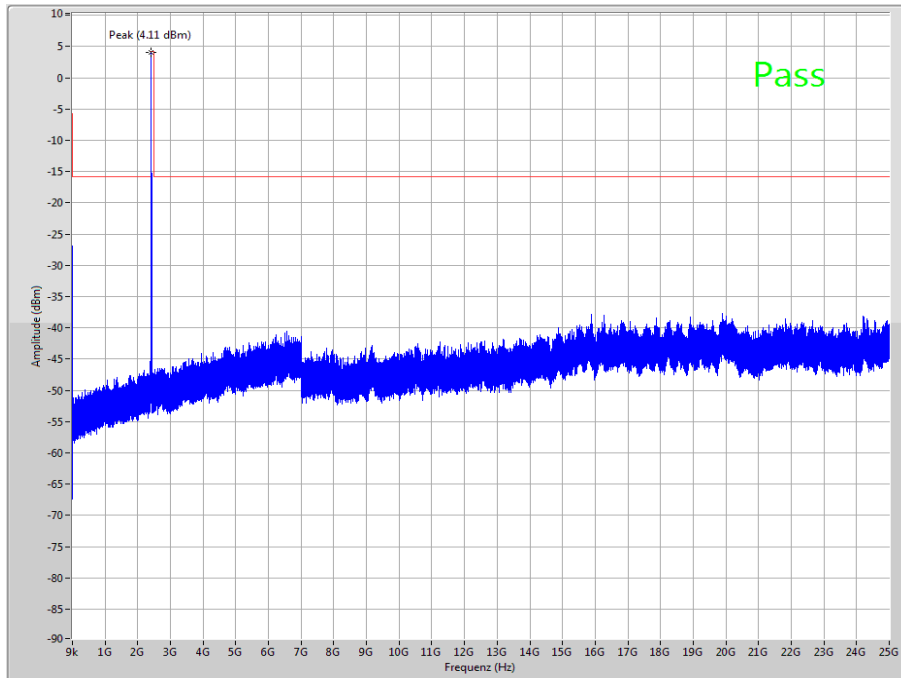
TX Spurious Emissions Conducted					
OFDM / g – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-0.1	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2437		2.5	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-2.4	30 dBm		Operating frequency
No peaks detected.			-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
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2437		2.2	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-05	30 dBm		Operating frequency
No peaks detected.			-20 dBc (peak) -30 dBc (average)		compliant

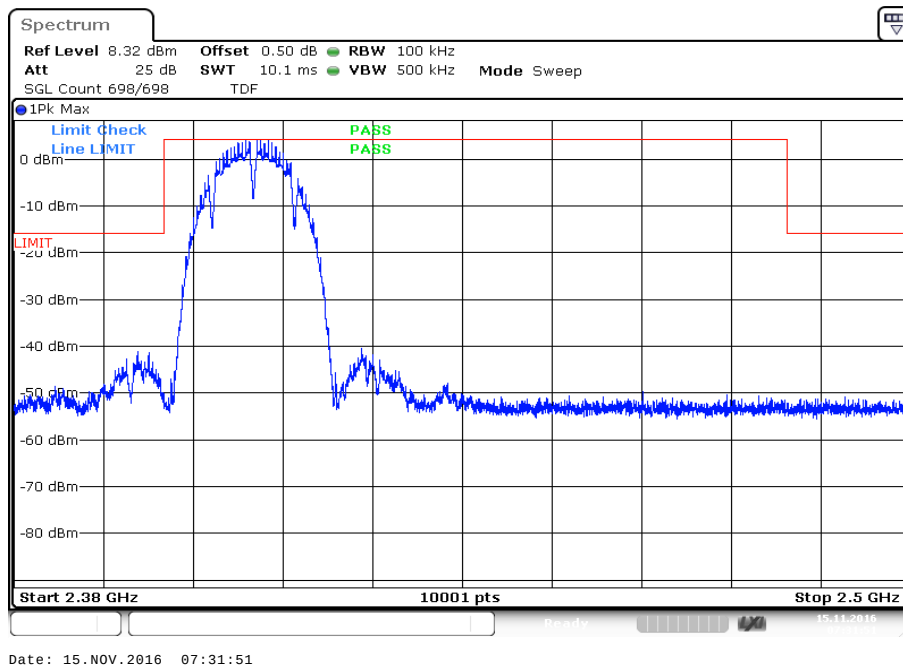
Plots: DSSS / b – mode

Plot 1: Lowest channel, up to 25 GHz

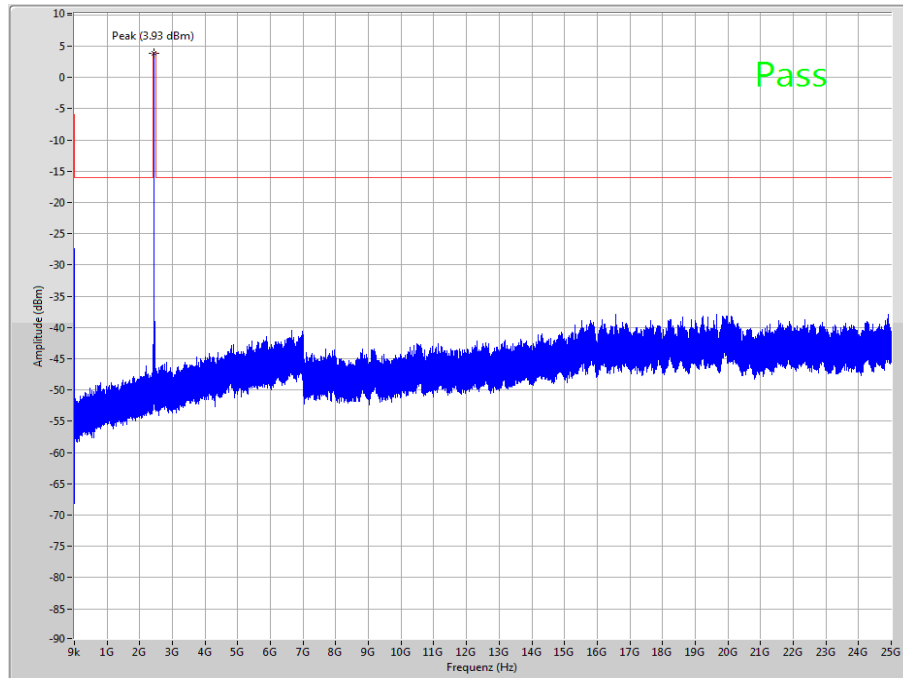


The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier

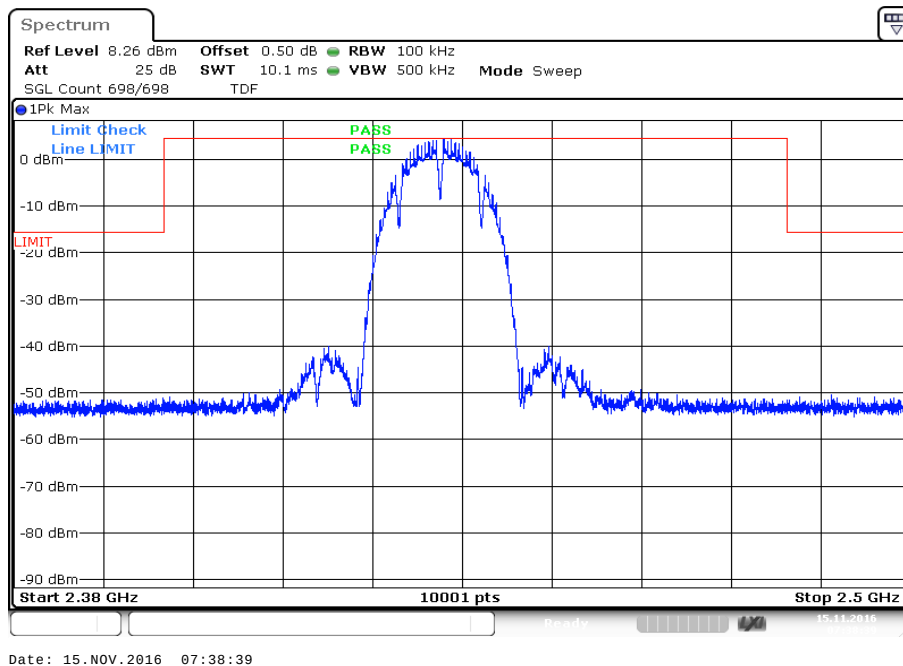


Plot 3: Middle channel, up to 25 GHz

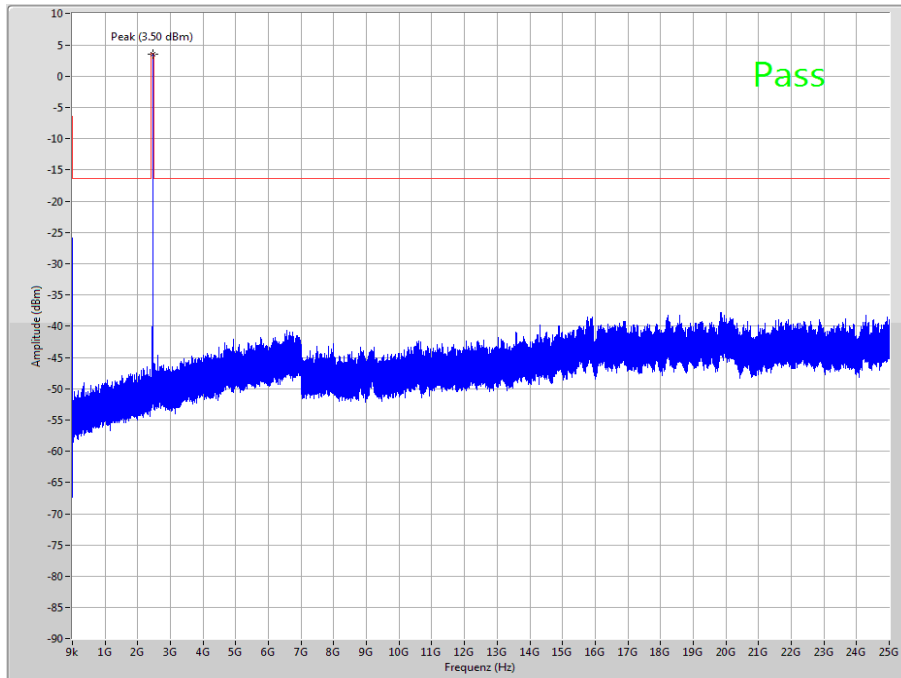


The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier

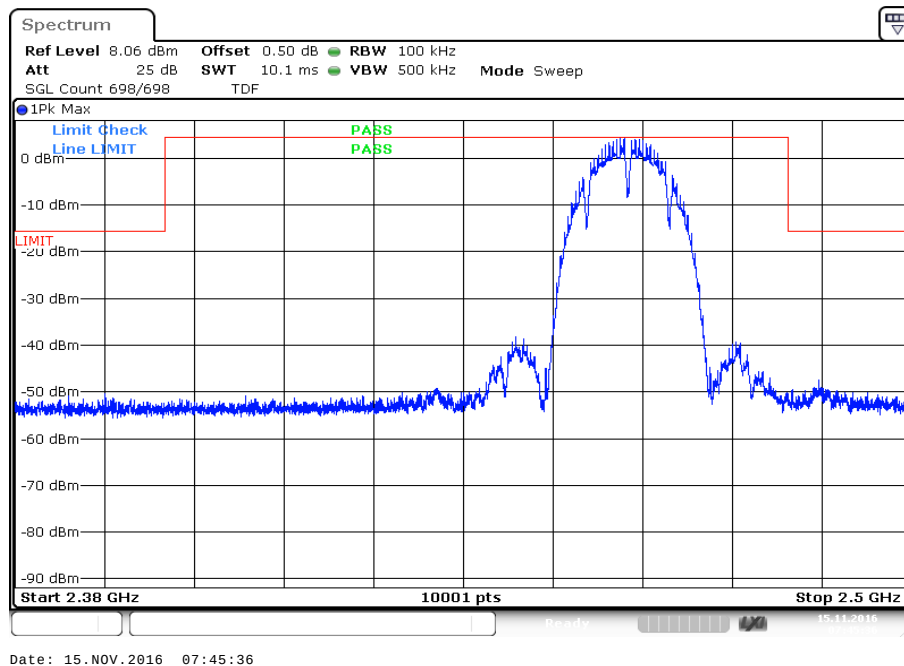


Plot 5: Highest channel, up to 25 GHz



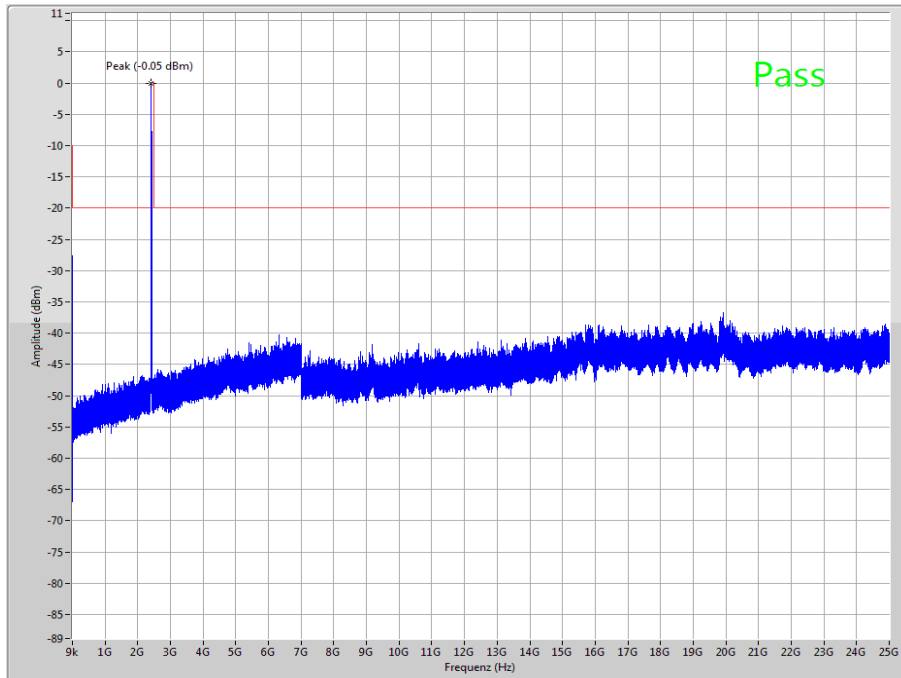
The peak at the beginning of the plot is the LO from the SA.

Plot 6: Highest channel, zoomed carrier



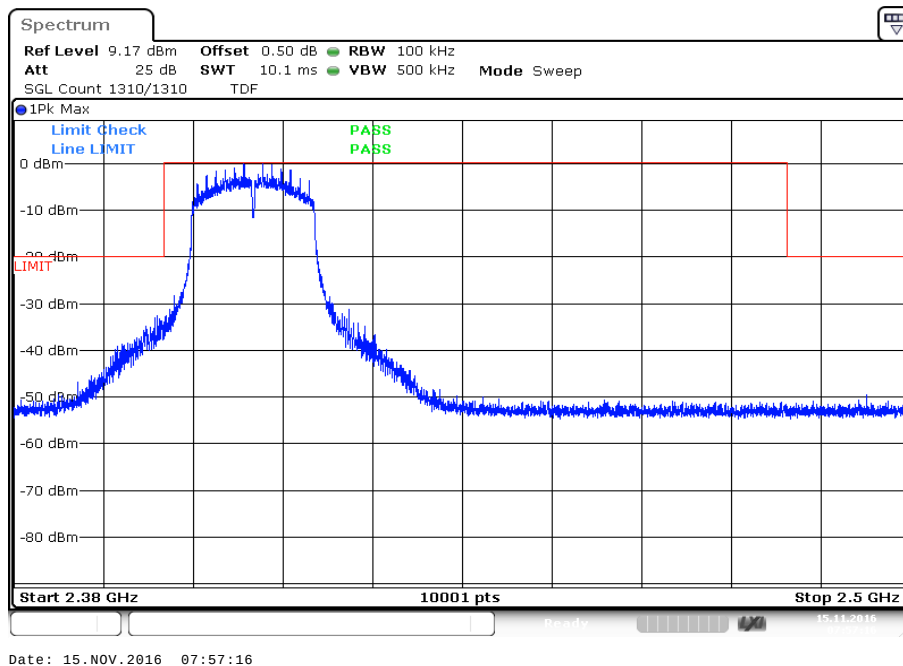
Plots: OFDM / g – mode

Plot 1: Lowest channel, up to 25 GHz

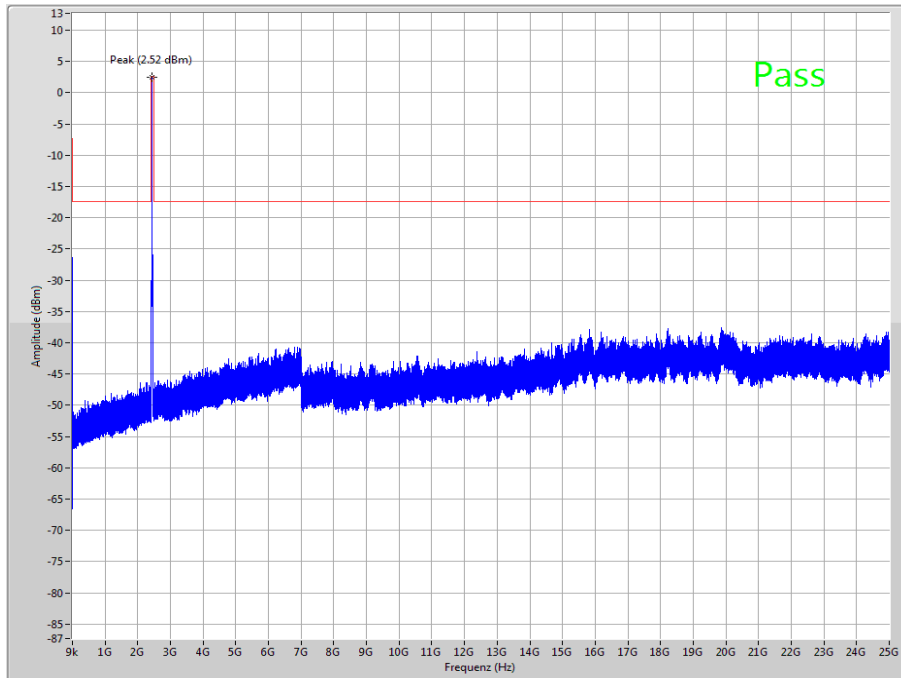


The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier

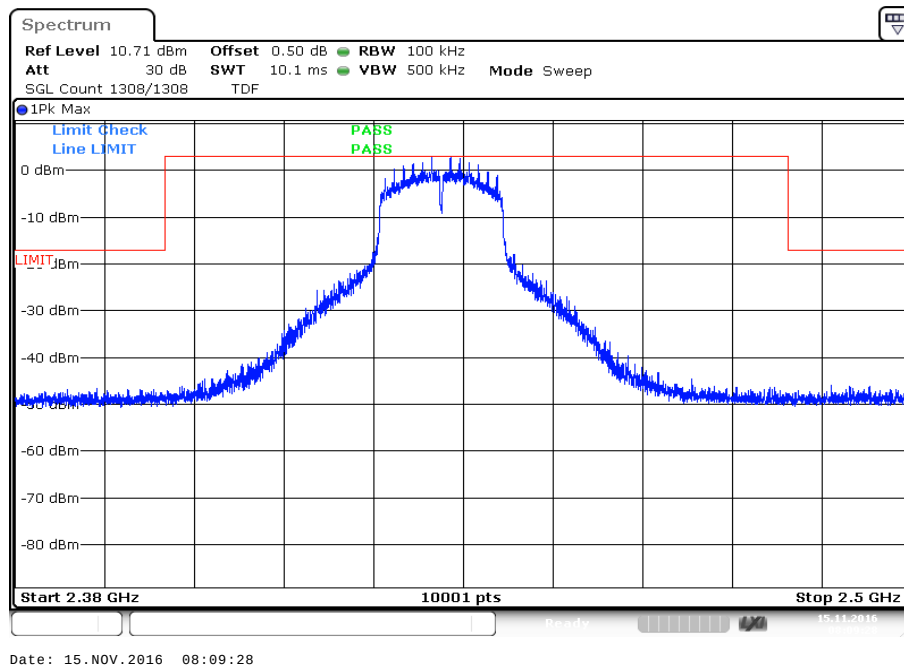


Plot 3: Middle channel, up to 25 GHz



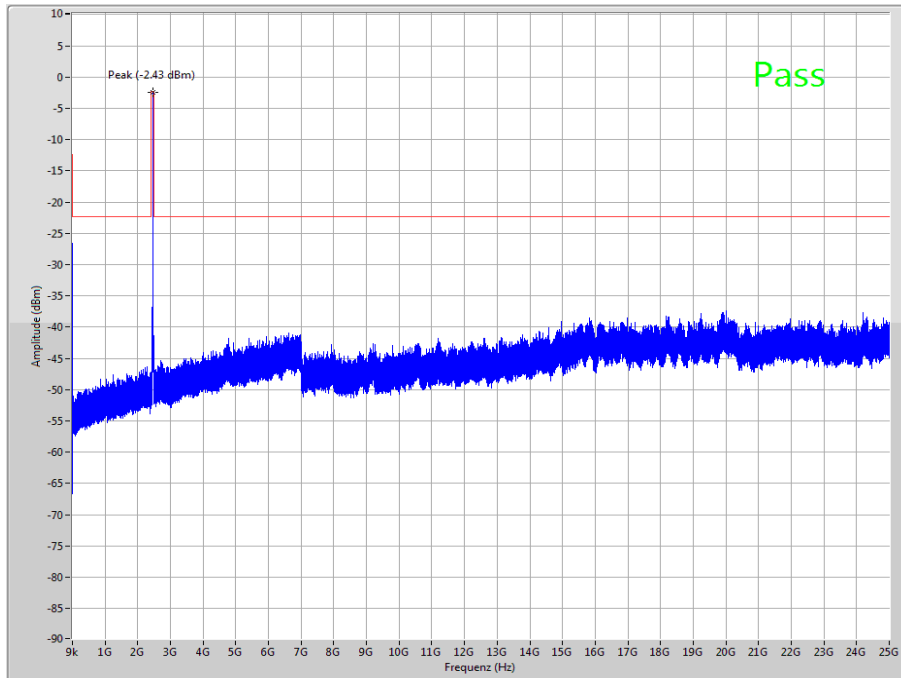
The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier



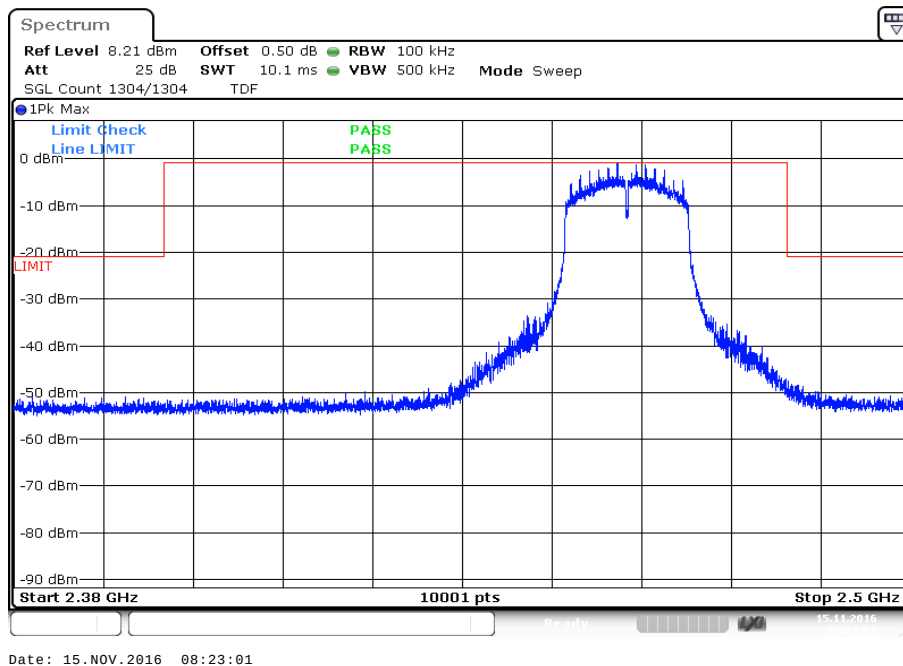
Date: 15.NOV.2016 08:09:28

Plot 5: Highest channel, up to 25 GHz



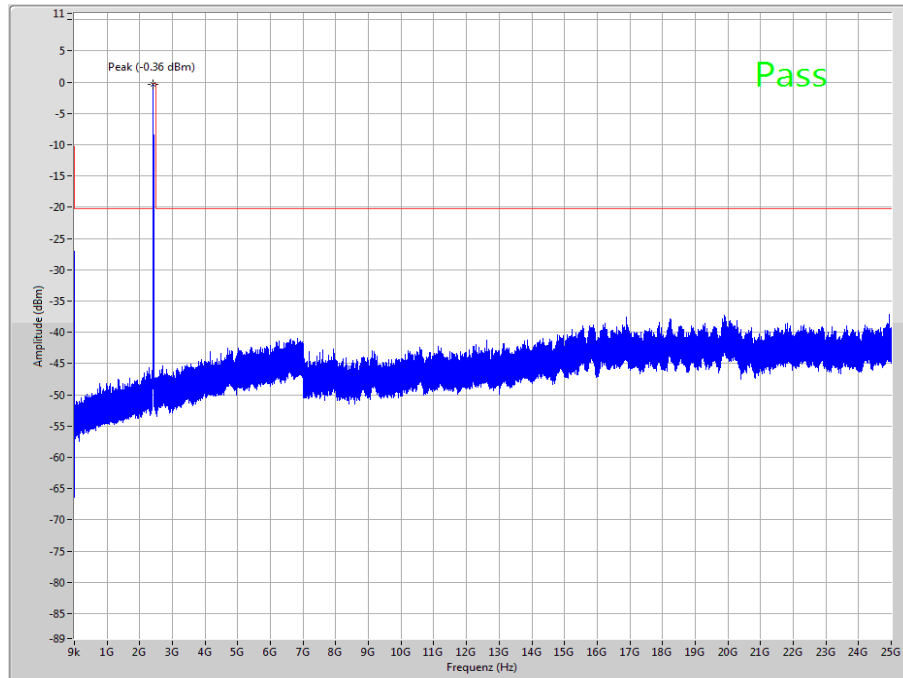
The peak at the beginning of the plot is the LO from the SA.

Plot 6: Highest channel, zoomed carrier



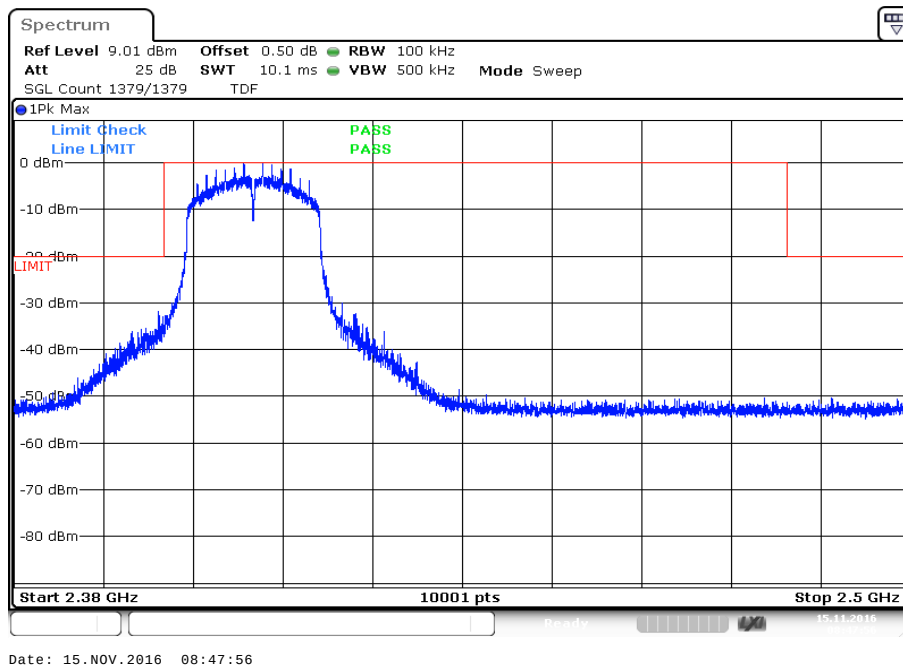
Plots: OFDM / n HT 20 – mode

Plot 1: Lowest channel, up to 25 GHz



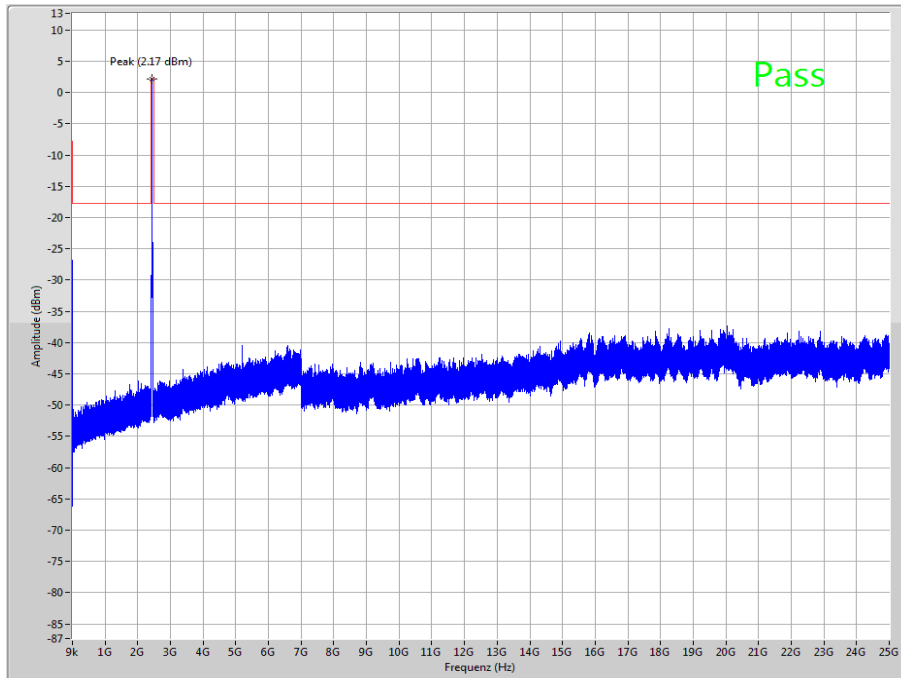
The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier



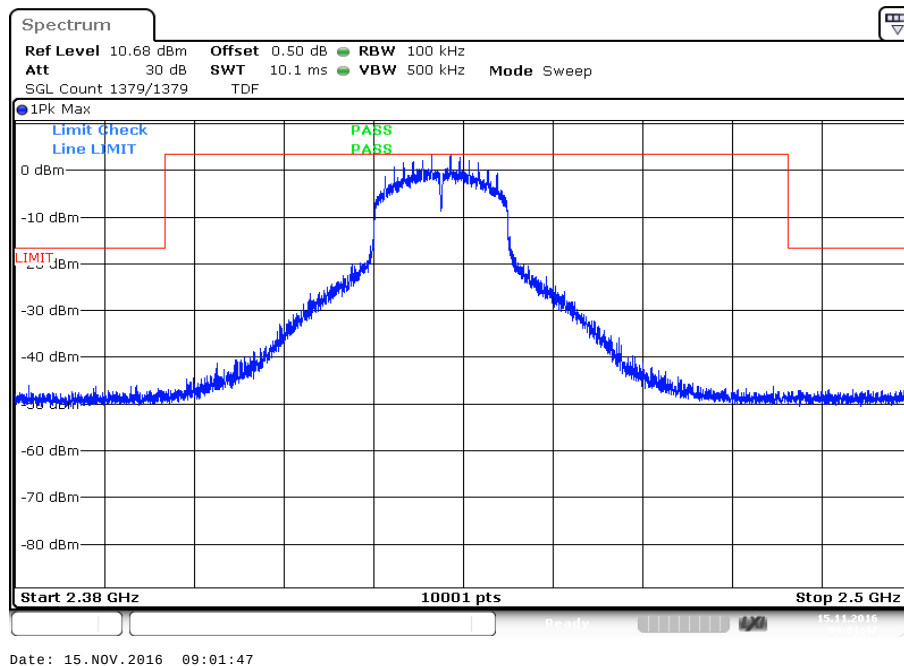
Date: 15.NOV.2016 08:47:56

Plot 3: Middle channel, up to 25 GHz



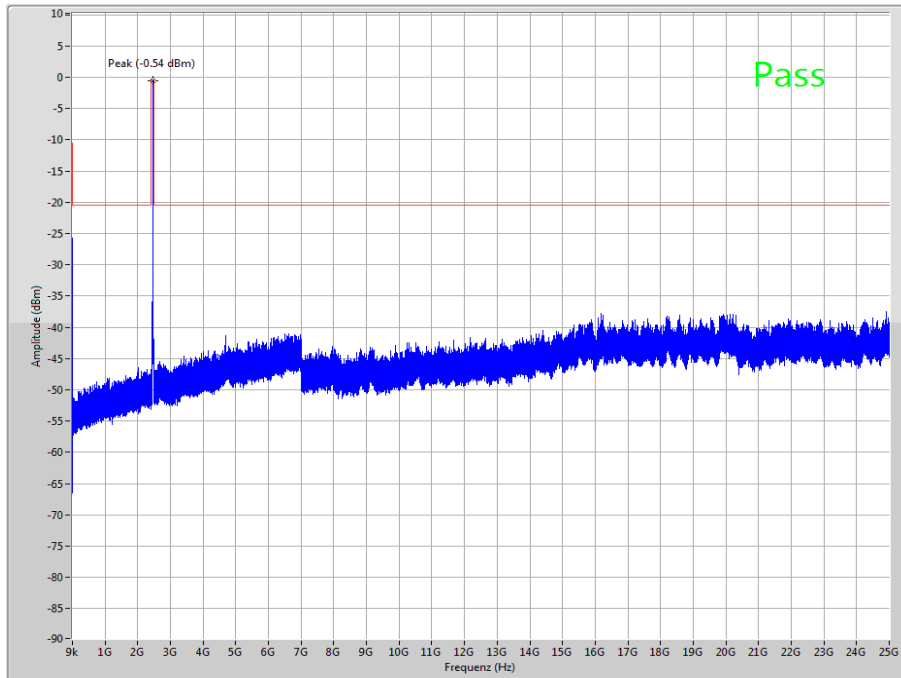
The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier



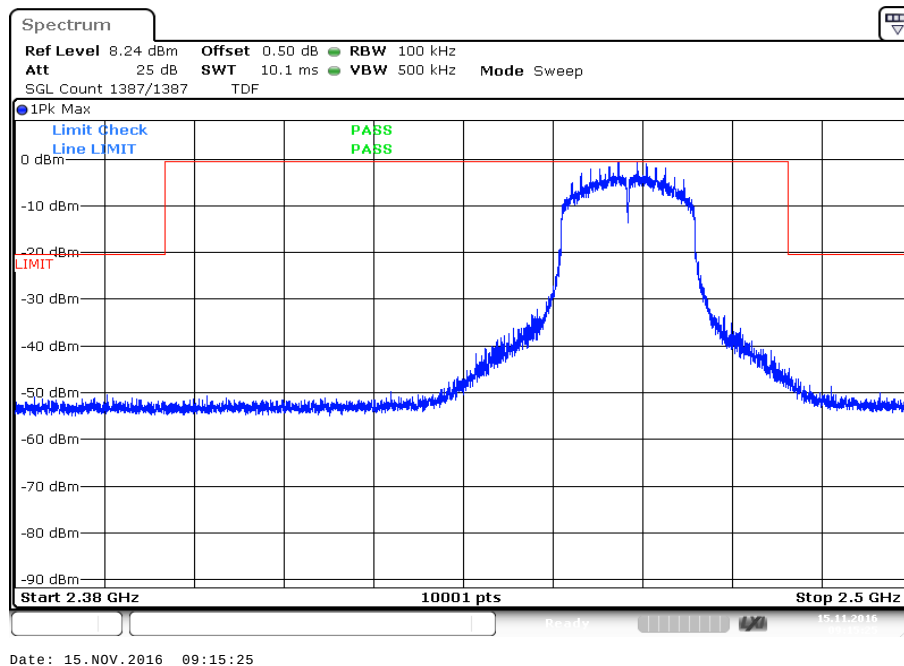
Date: 15.NOV.2016 09:01:47

Plot 5: Highest channel, up to 25 GHz



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

Plot 6: Highest channel, zoomed carrier



Date: 15.NOV.2016 09:15:25

11.11 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	☒ DSSS b – mode ☐ OFDM g – mode ☒ OFDM n HT20 – mode ☐ OFDM n HT40 – mode
Test setup:	See sub clause 6.2 A
Measurement uncertainty	See sub clause 8

Limits:

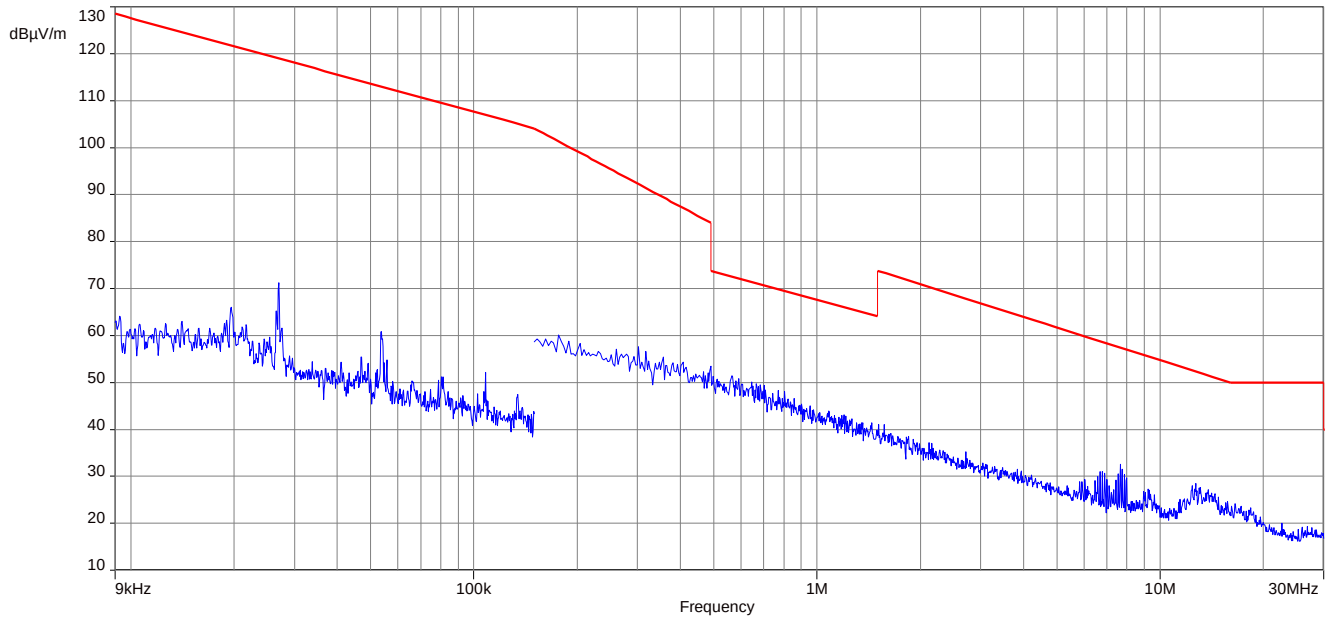
FCC		IC
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

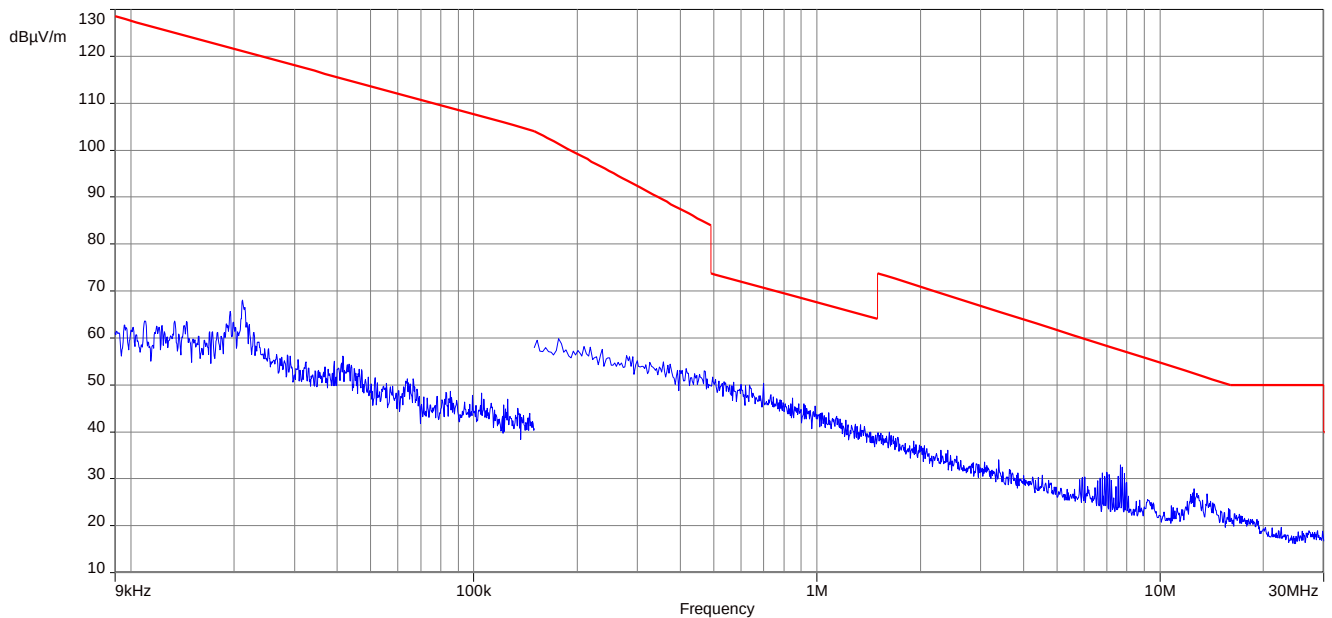
TX Spurious Emissions Radiated < 30 MHz [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
All detected peaks are more than 20 dB below the limit.		

Plots: DSSS

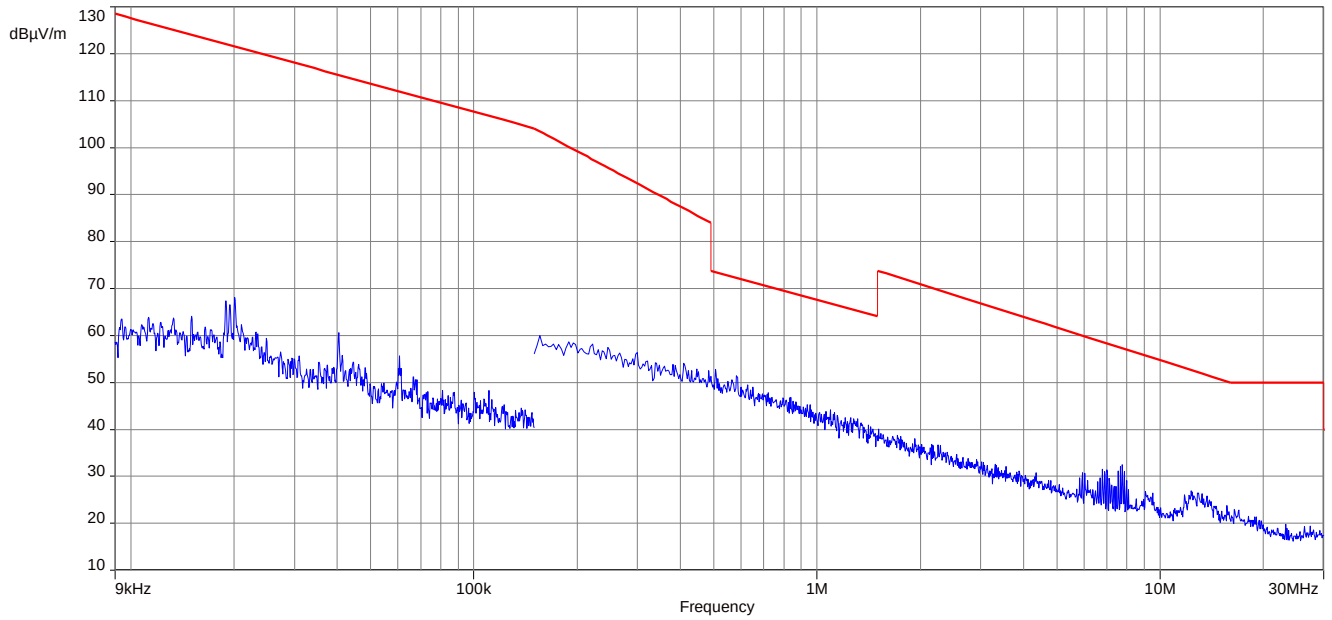
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel

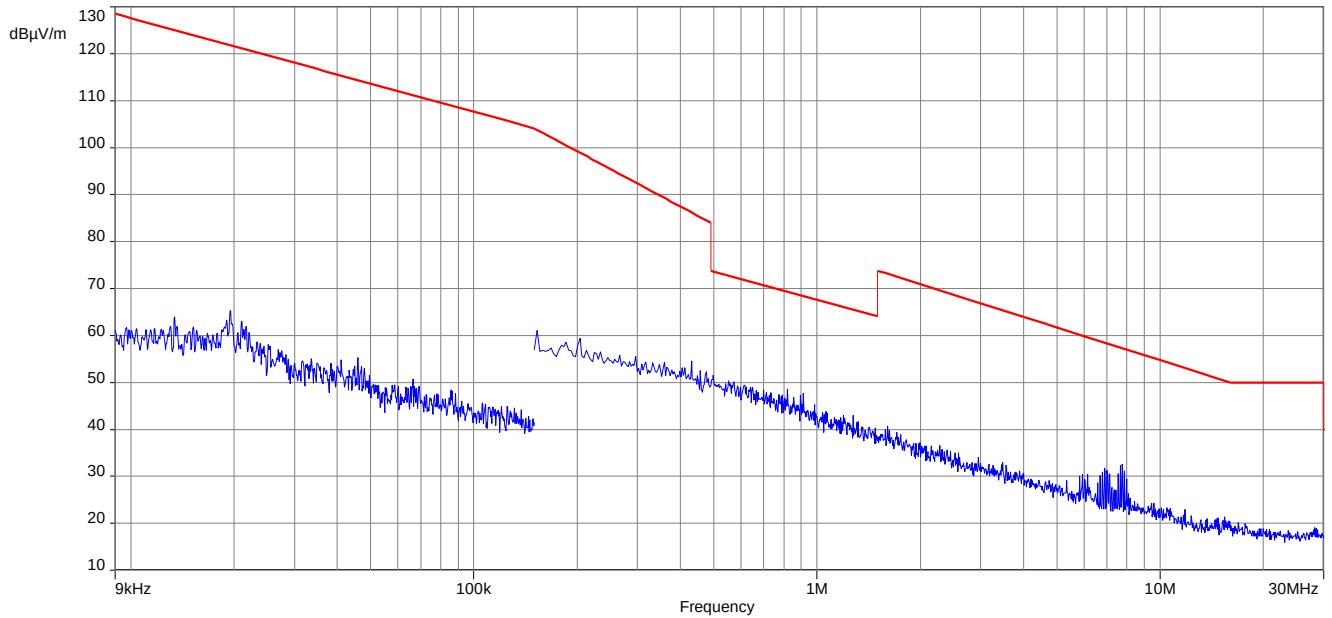


Plot 3: 9 kHz to 30 MHz, high channel

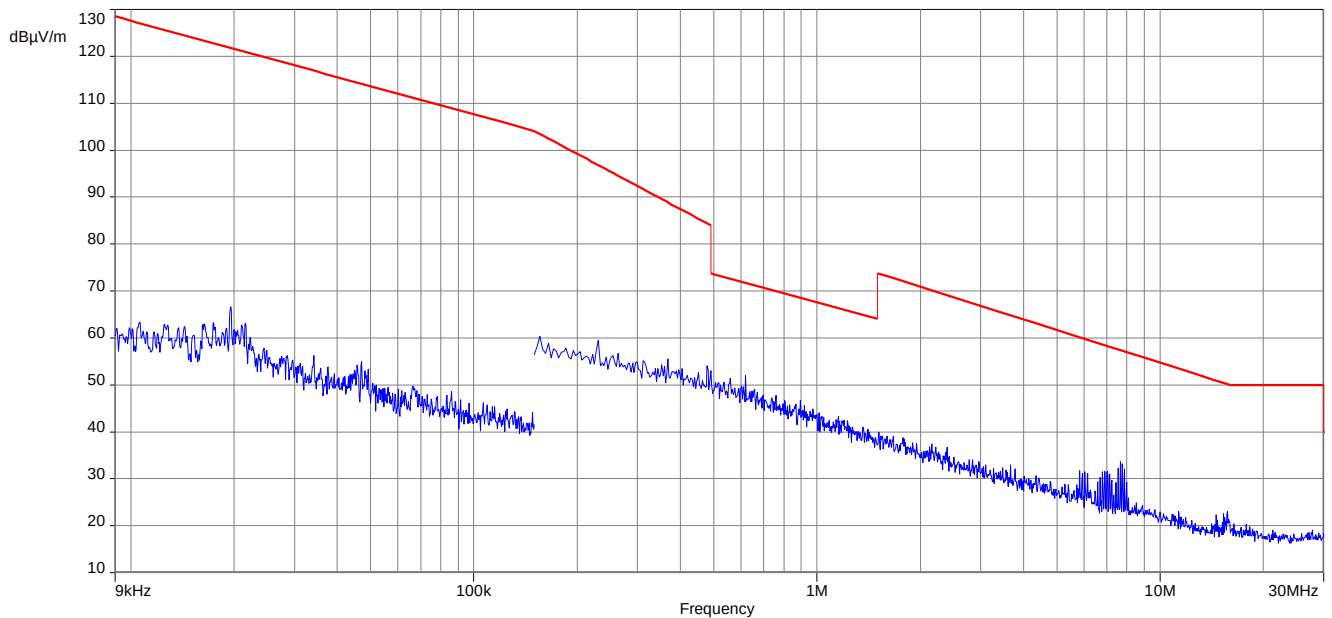


Plots: OFDM (20 MHz bandwidth)

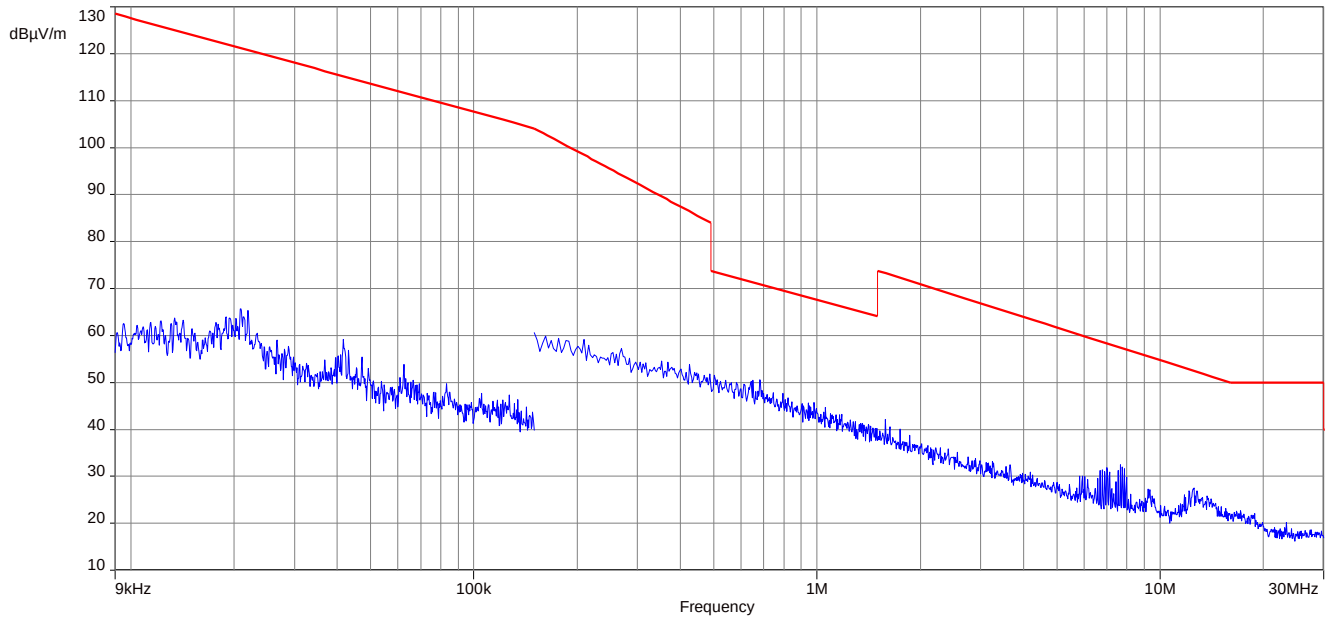
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel



Plot 3: 9 kHz to 30 MHz, high channel



11.12 Spurious emissions radiated 30 MHz to 1 GHz

Description:

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

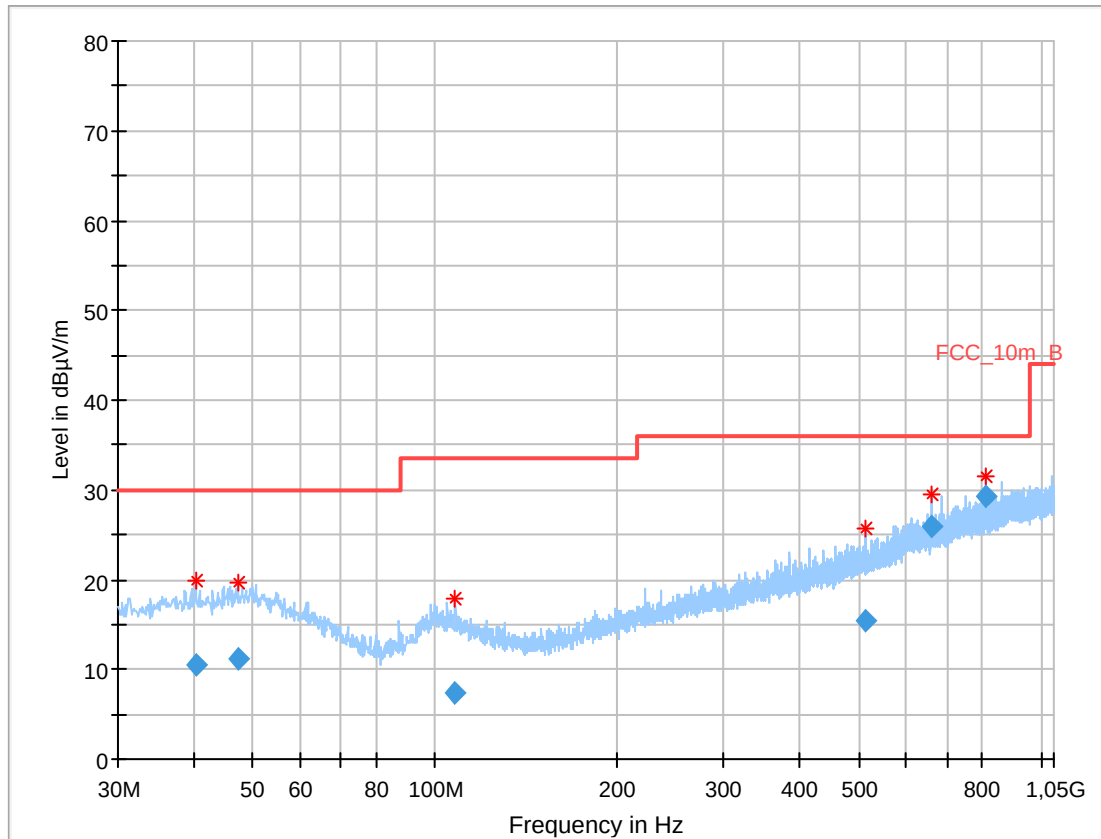
Measurement:

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	☒ DSSS b – mode ☒ OFDM g – mode ☐ OFDM n HT20 – mode ☐ OFDM n HT40 – mode ☒ RX / Idle – mode
Test setup:	See sub clause 6.1
Measurement uncertainty	See sub clause 8

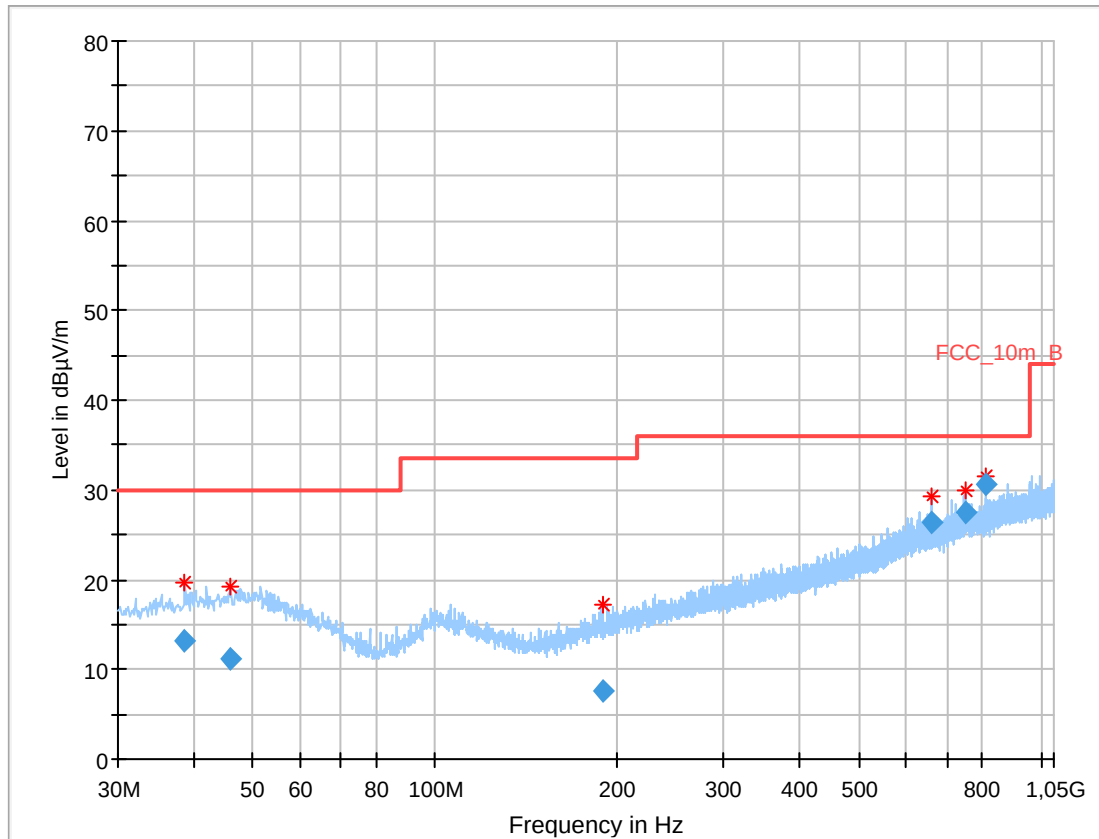
The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

Limits:

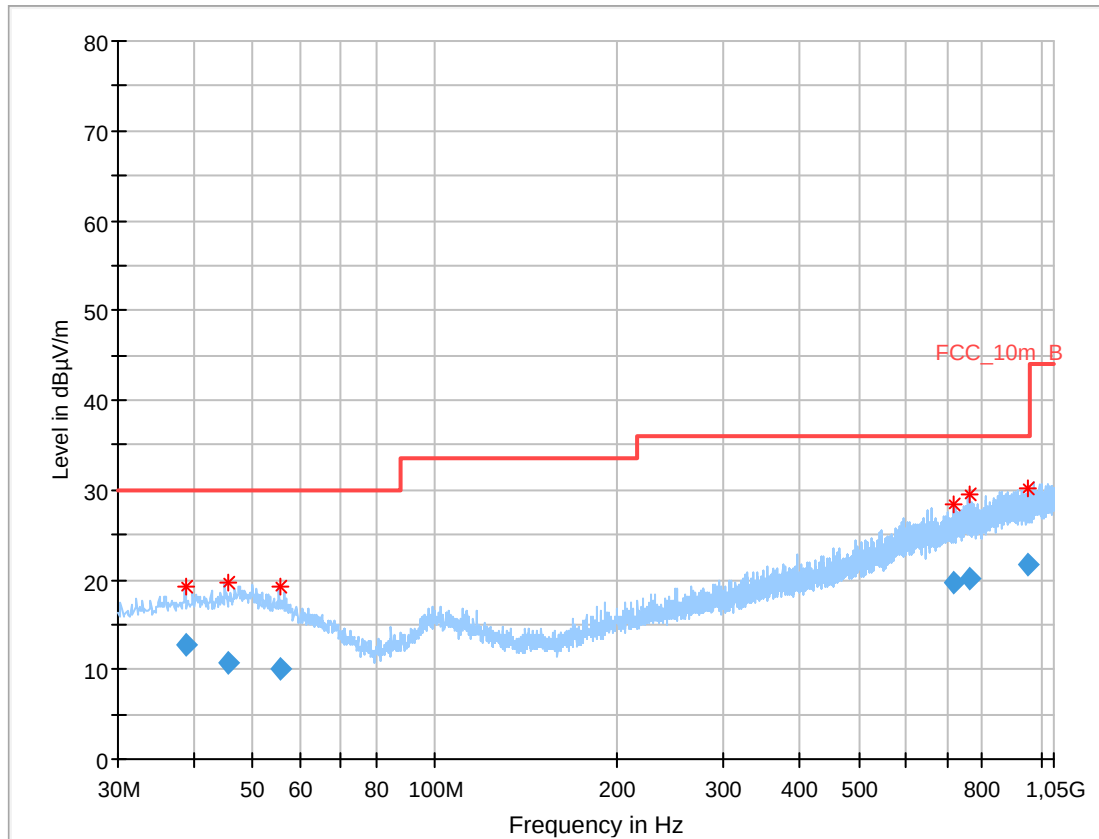
FCC		IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains 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)
40.272000	10.42	30.00	19.58	1000.0	120.000	101.0	V	167.0	13.2
47.478750	11.21	30.00	18.79	1000.0	120.000	98.0	V	350.0	13.7
108.126150	7.46	33.50	26.04	1000.0	120.000	185.0	V	231.0	11.3
515.088300	15.37	36.00	20.63	1000.0	120.000	179.0	H	139.0	18.9
661.722750	26.01	36.00	9.99	1000.0	120.000	101.0	H	344.0	21.2
808.773150	29.38	36.00	6.62	1000.0	120.000	98.0	H	116.0	22.9

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

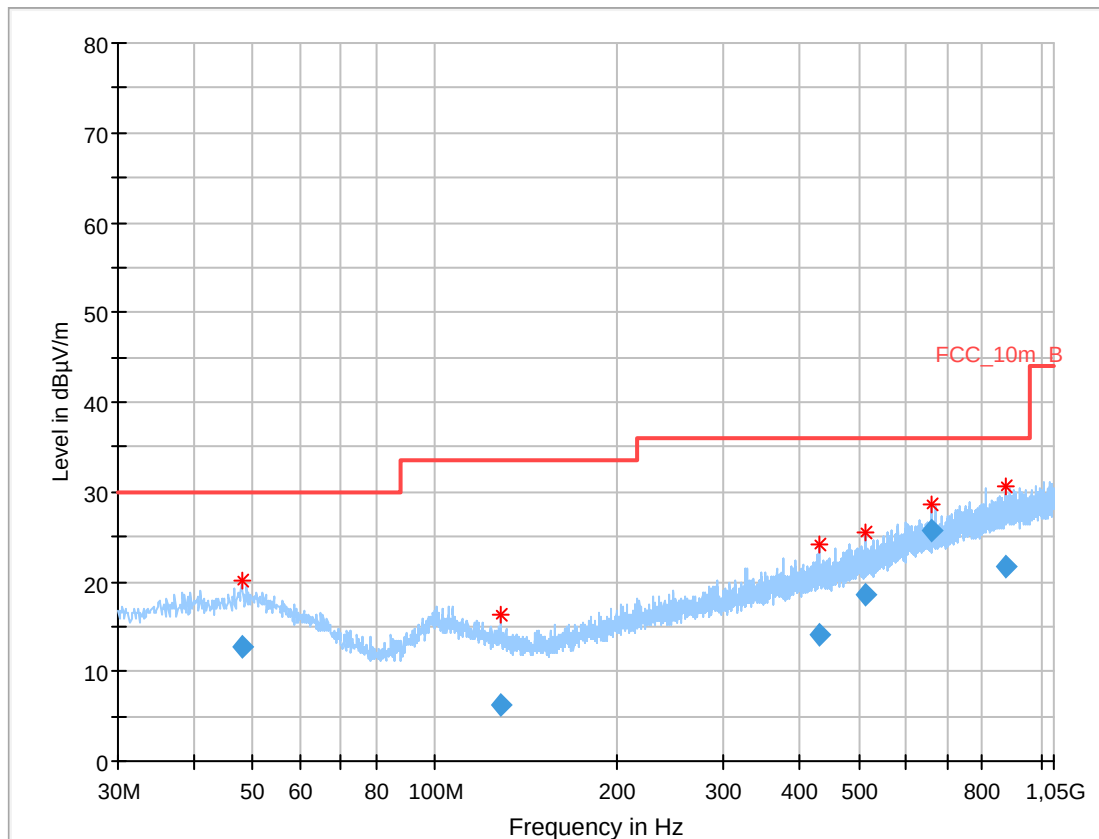
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.689050	13.12	30.00	16.88	1000.0	120.000	101.0	V	142.0	13.1
46.042950	11.15	30.00	18.85	1000.0	120.000	101.0	V	135.0	13.7
188.839050	7.65	33.50	25.85	1000.0	120.000	101.0	H	74.0	11.3
661.719900	26.45	36.00	9.55	1000.0	120.000	98.0	H	124.0	21.2
749.992350	27.50	36.00	8.50	1000.0	120.000	101.0	H	196.0	22.7
808.759800	30.58	36.00	5.42	1000.0	120.000	98.0	H	105.0	22.9

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)
38.715750	12.78	30.00	17.22	1000.0	120.000	178.0	V	172.0	13.1
45.440250	10.76	30.00	19.24	1000.0	120.000	98.0	H	195.0	13.6
55.547400	9.98	30.00	20.02	1000.0	120.000	178.0	V	97.0	13.0
717.393750	19.69	36.00	16.31	1000.0	120.000	98.0	V	309.0	22.0
760.464300	20.22	36.00	15.78	1000.0	120.000	101.0	H	309.0	22.7
950.619450	21.77	36.00	14.23	1000.0	120.000	185.0	H	252.0	24.3

Plot: OFDM (20 MHz bandwidth)

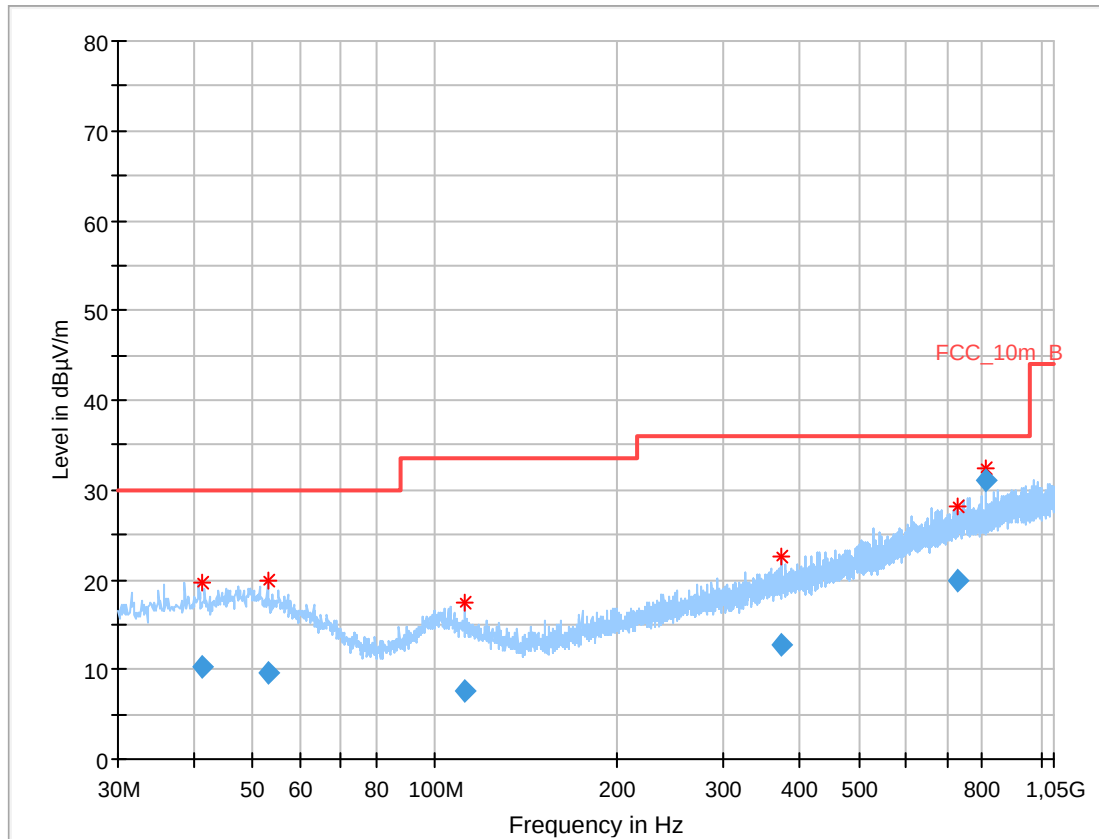
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result:

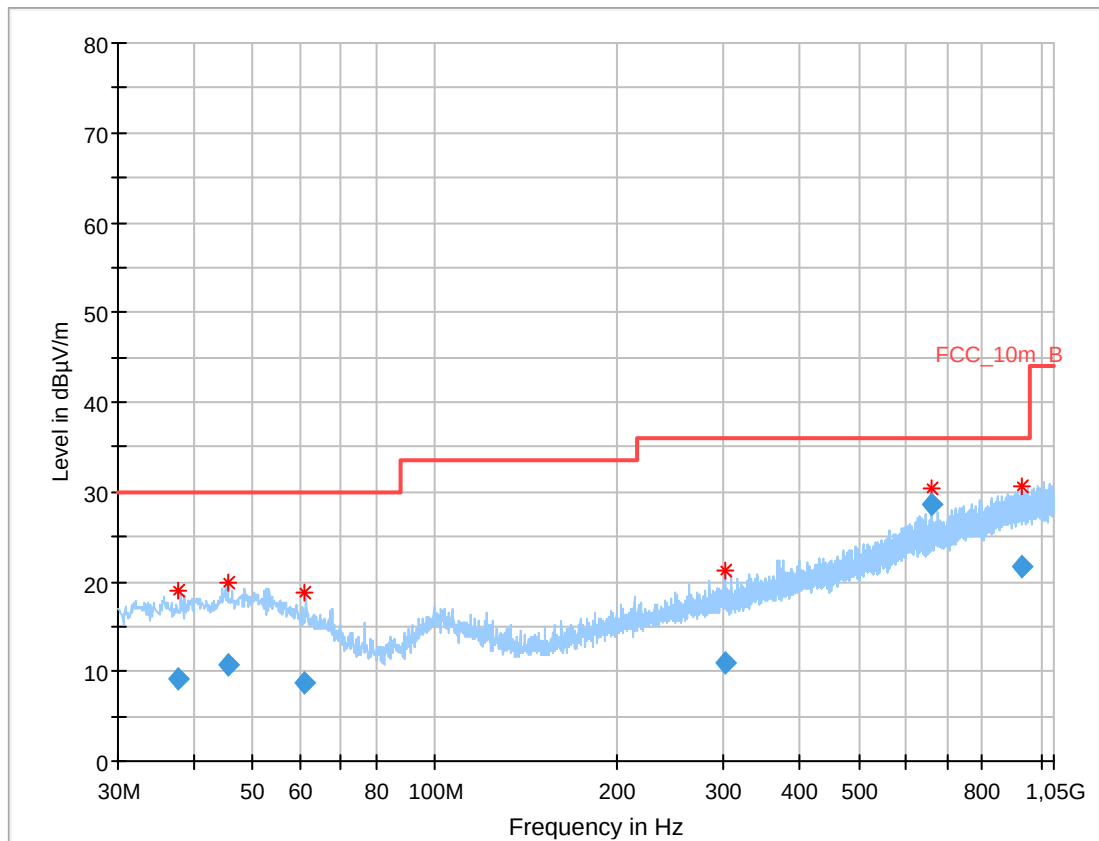
Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
47.965650	12.84	30.00	17.16	1000.0	120.000	98.0	V	332.0	13.7
128.009100	6.22	33.50	27.28	1000.0	120.000	101.0	H	21.0	9.7
432.063000	14.17	36.00	21.83	1000.0	120.000	185.0	V	39.0	17.4
514.630050	18.65	36.00	17.35	1000.0	120.000	185.0	H	233.0	18.9
661.720200	25.78	36.00	10.22	1000.0	120.000	98.0	H	306.0	21.2
874.670850	21.73	36.00	14.27	1000.0	120.000	185.0	V	89.0	23.9

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



Final_Result:

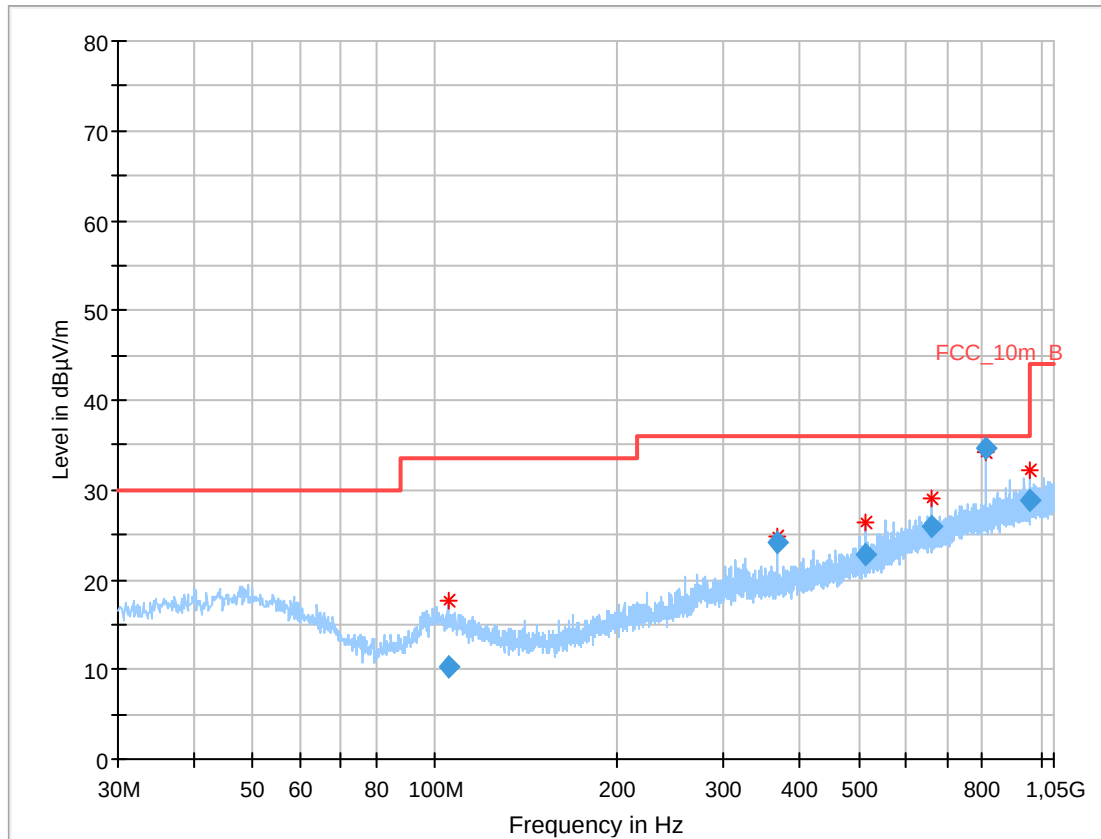
Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.203650	10.22	30.00	19.78	1000.0	120.000	101.0	H	0.0	13.3
53.210400	9.54	30.00	20.46	1000.0	120.000	185.0	H	268.0	13.3
112.005000	7.64	33.50	25.86	1000.0	120.000	101.0	H	210.0	11.0
372.517800	12.67	36.00	23.33	1000.0	120.000	98.0	V	326.0	16.4
729.479850	19.95	36.00	16.05	1000.0	120.000	98.0	H	298.0	22.2
808.778400	30.95	36.00	5.05	1000.0	120.000	98.0	H	104.0	22.9

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)
37.750050	9.14	30.00	20.86	1000.0	120.000	101.0	H	0.0	13.0
45.541950	10.72	30.00	19.28	1000.0	120.000	101.0	H	138.0	13.6
61.056750	8.69	30.00	21.31	1000.0	120.000	101.0	H	237.0	11.6
300.591450	10.94	36.00	25.06	1000.0	120.000	101.0	H	27.0	14.4
661.717800	28.55	36.00	7.45	1000.0	120.000	101.0	H	127.0	21.2
929.442150	21.63	36.00	14.37	1000.0	120.000	101.0	H	353.0	24.3

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)
104.961150	10.25	33.50	23.25	1000.0	120.000	101.0	V	30.0	11.6
367.637400	24.03	36.00	11.97	1000.0	120.000	185.0	H	134.0	16.3
514.672500	22.87	36.00	13.13	1000.0	120.000	179.0	H	116.0	18.9
661.704450	25.88	36.00	10.12	1000.0	120.000	100.0	H	349.0	21.2
808.761600	34.53	36.00	1.47	1000.0	120.000	98.0	H	157.0	22.9
955.817850	28.83	36.00	7.17	1000.0	120.000	98.0	H	123.0	24.4

11.13 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	☒ DSSS b – mode ☒ OFDM g – mode ☐ OFDM n HT20 – mode ☐ OFDM n HT40 – mode ☒ RX / Idle – mode
Test setup:	See sub clause 6.2 B
Measurement uncertainty	See sub clause 8

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 [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
4824	Peak	54.4	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	47.5		AVG	-/-		AVG	-/-
-/-	Peak	-/-	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	-/-		AVG	-/-		AVG	-/-

Results: OFDM (20 MHz bandwidth)

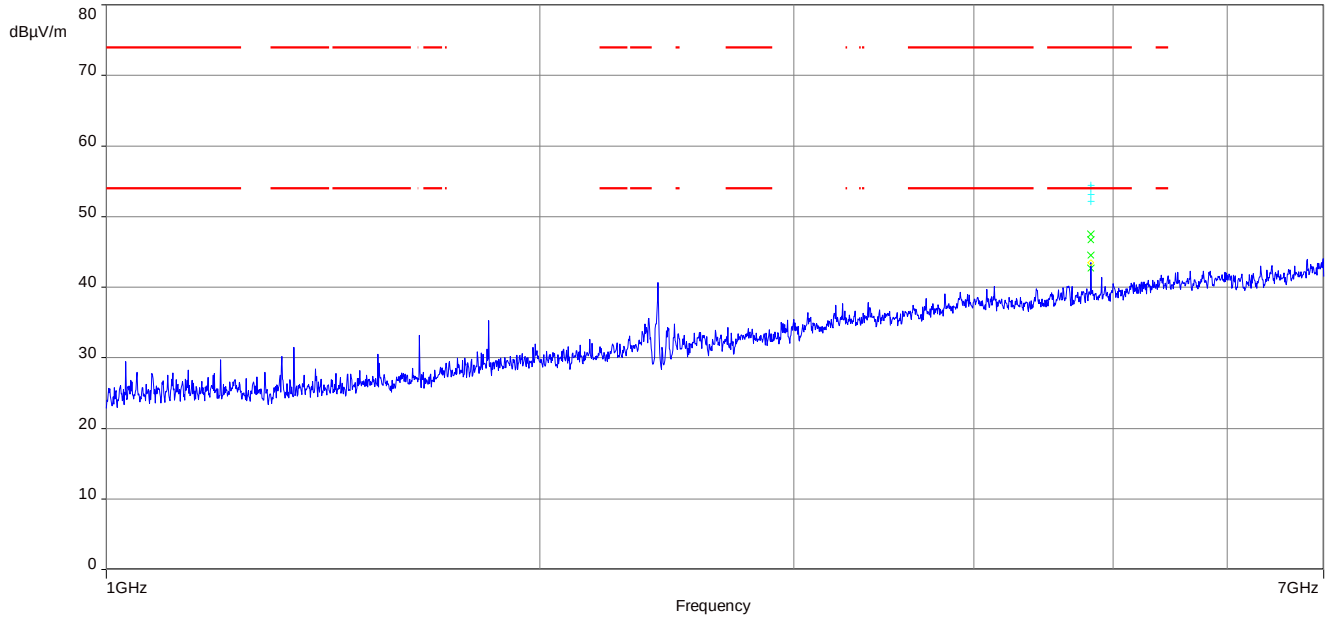
TX Spurious Emissions Radiated [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
1650	Peak	43.2	4874	Peak	56.3	-/-	Peak	-/-
	AVG	-/-		AVG	50.1		AVG	-/-
4824	Peak	55.4	-/-	Peak	-/-	-/-	Peak	-/-
	AVG	49.5		AVG	-/-		AVG	-/-

Results: RX / idle – mode

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

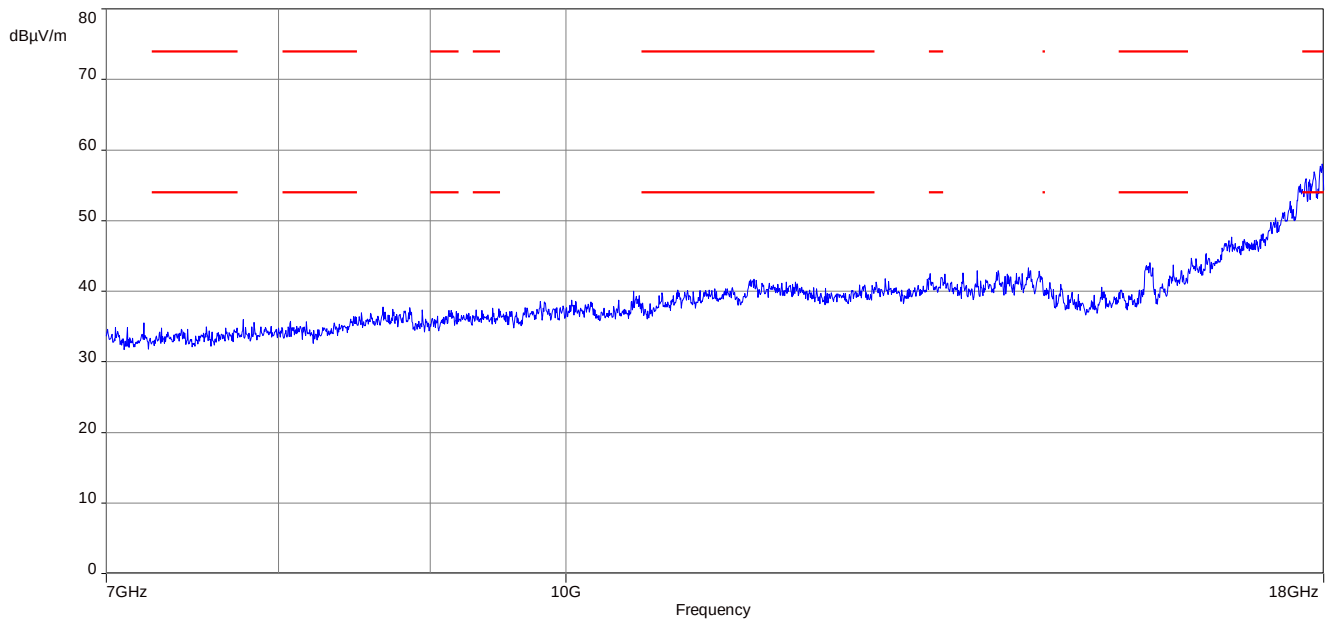
Plots: DSSS

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

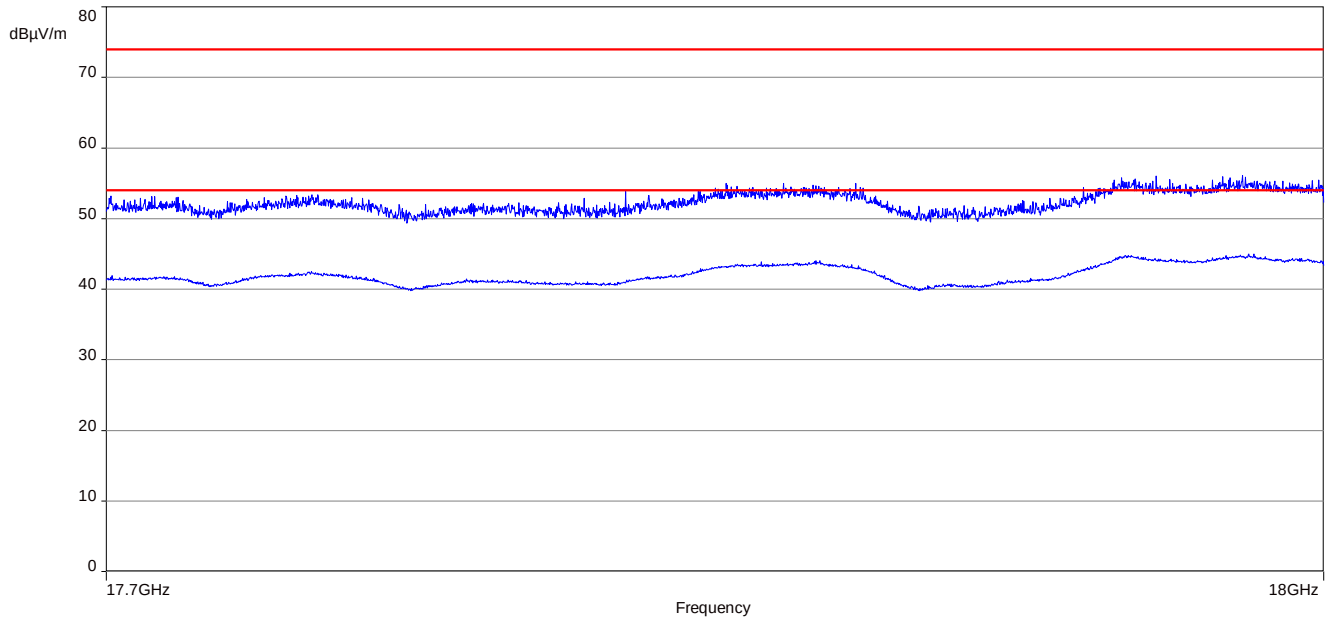


The carrier signal is notched with a 2.4 GHz band rejection filter.

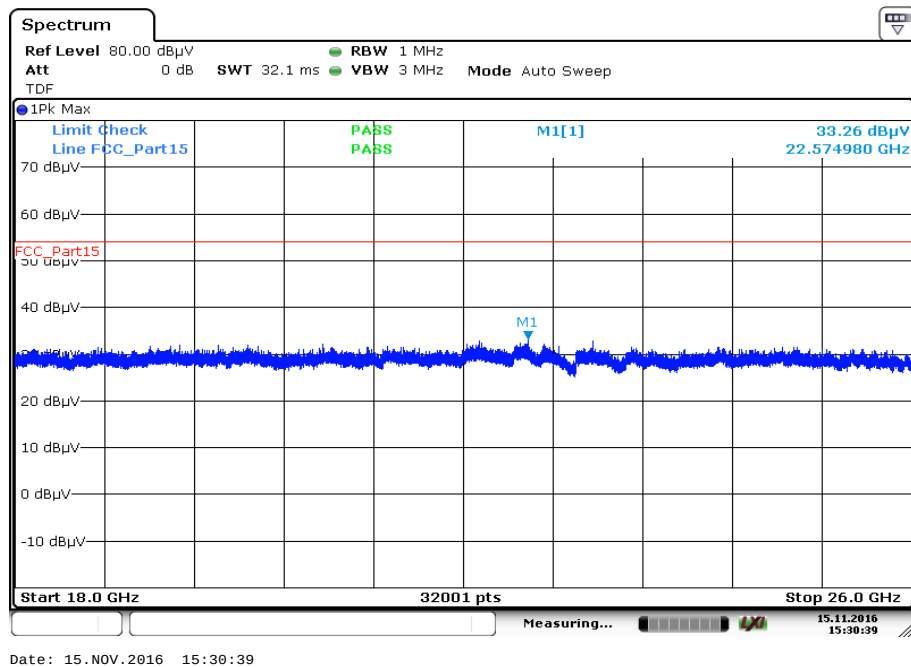
Plot 2: Lowest channel, 7 GHz to 18 GHz, vertical & horizontal polarization



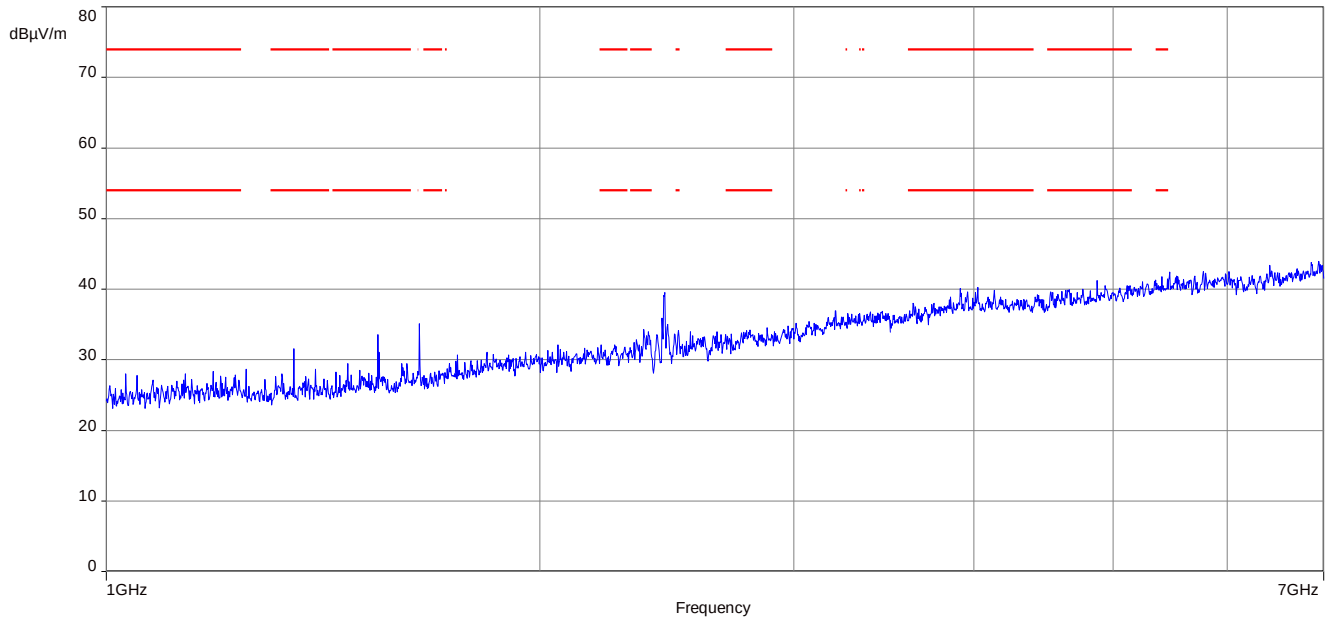
Plot 3: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



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

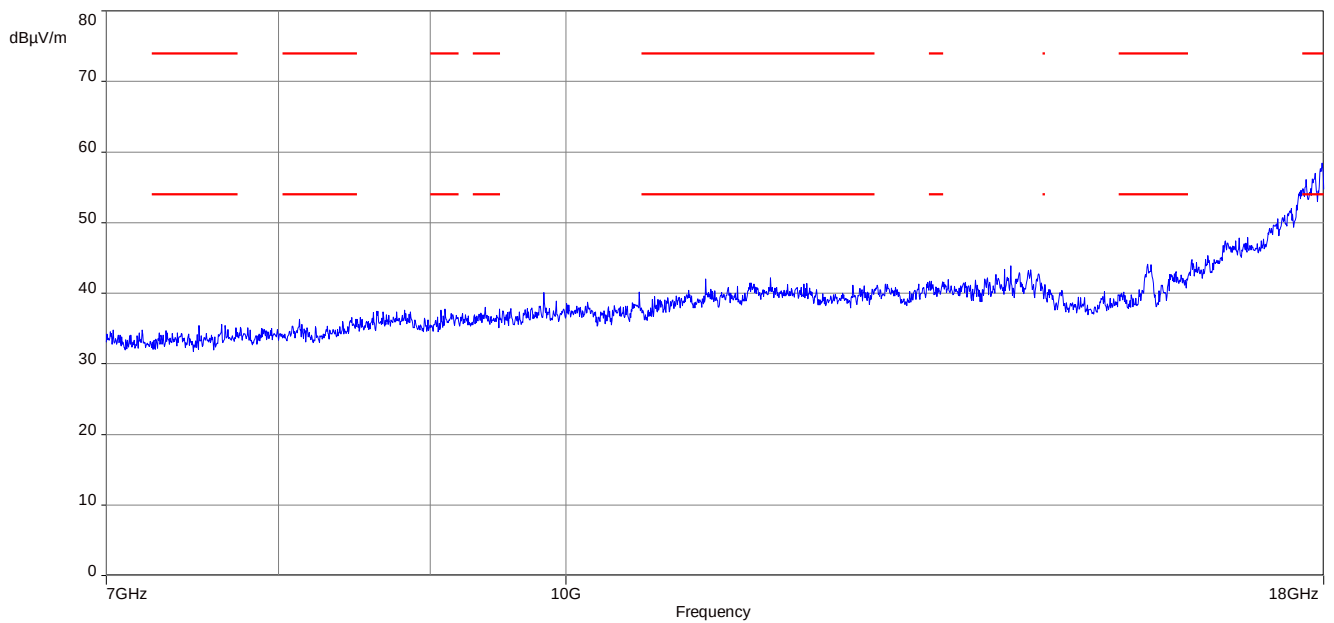


Plot 5: Middle channel, 1 GHz to 7 GHz, vertical & horizontal polarization

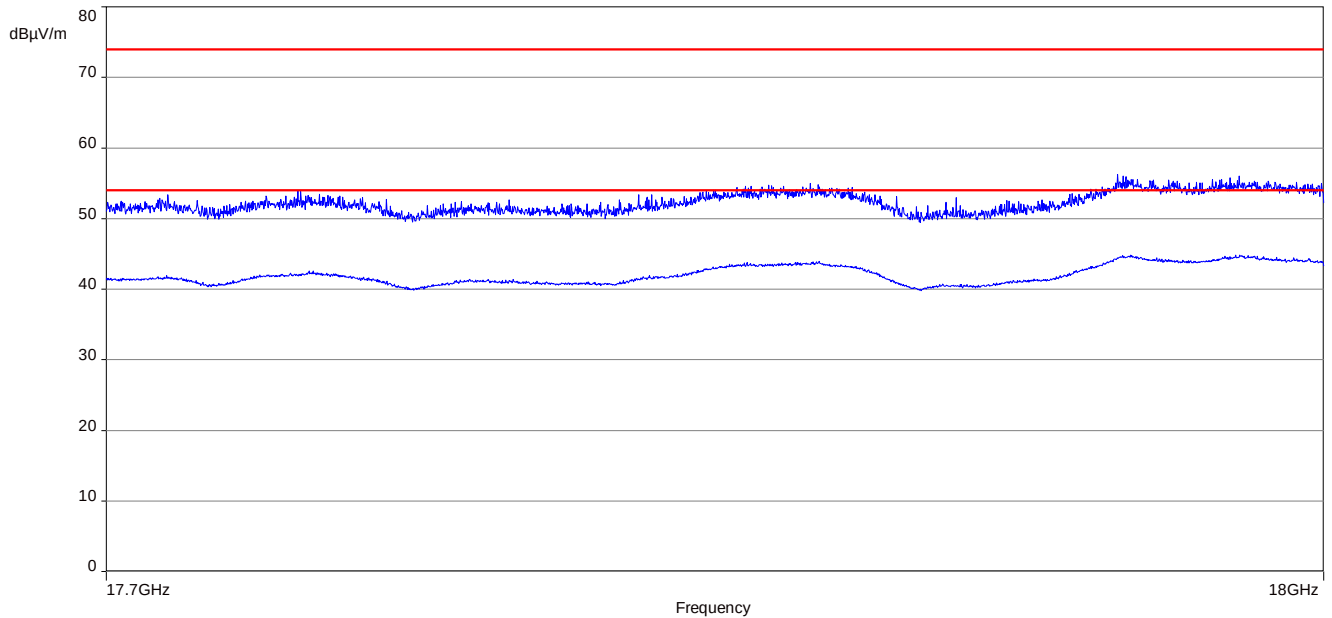


The carrier signal is notched with a 2.4 GHz band rejection filter.

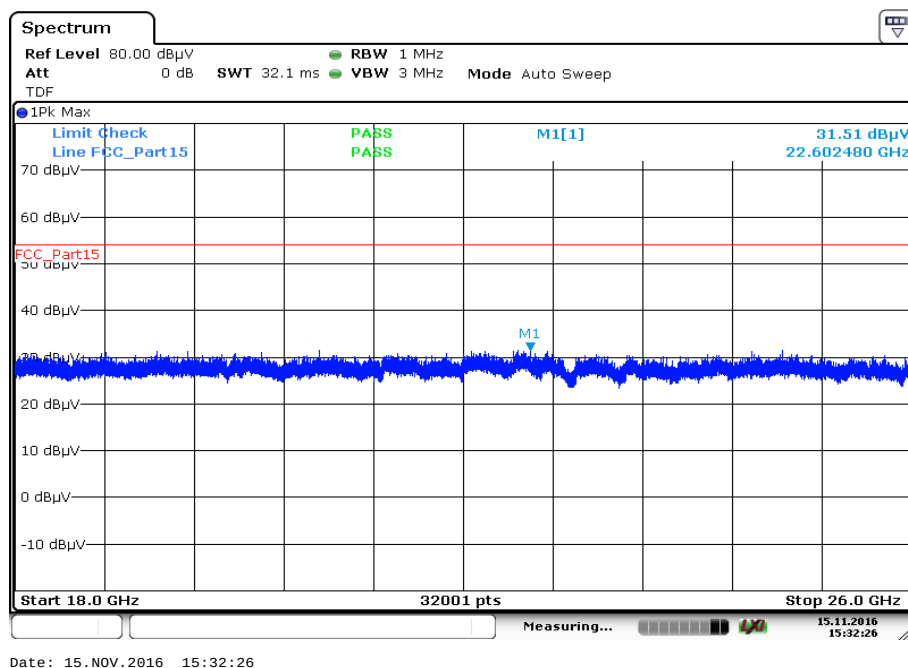
Plot 6: Middle channel, 7 GHz to 18 GHz, vertical & horizontal polarization



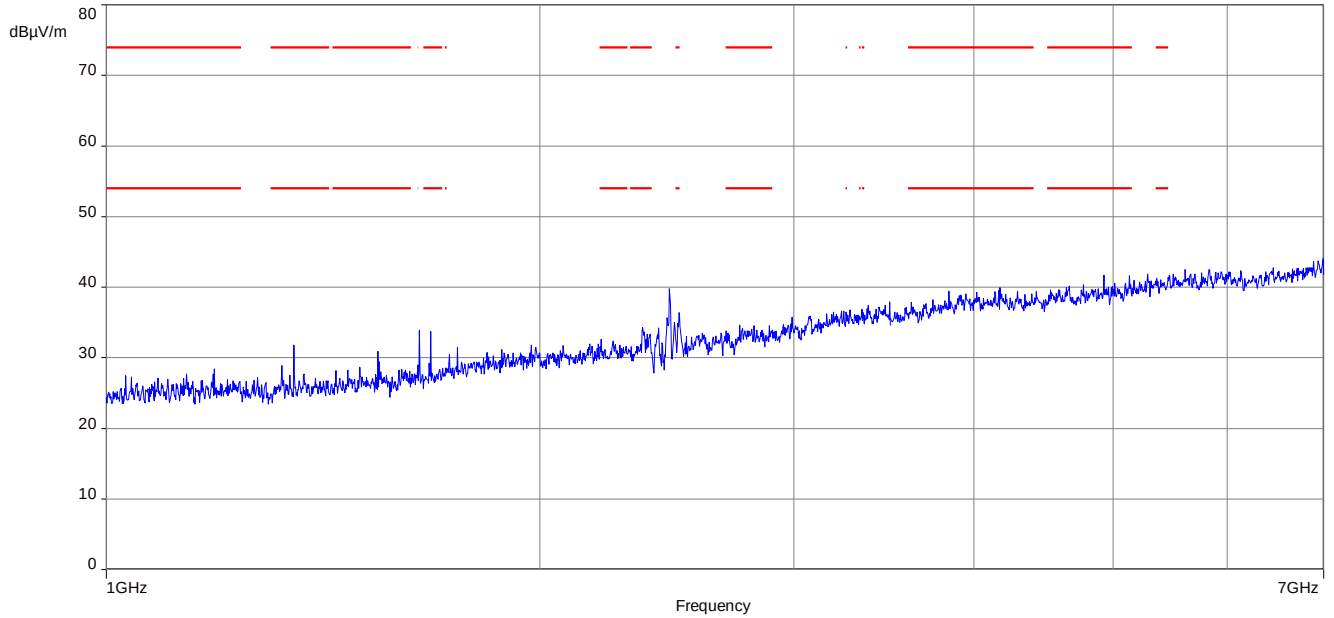
Plot 7: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



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

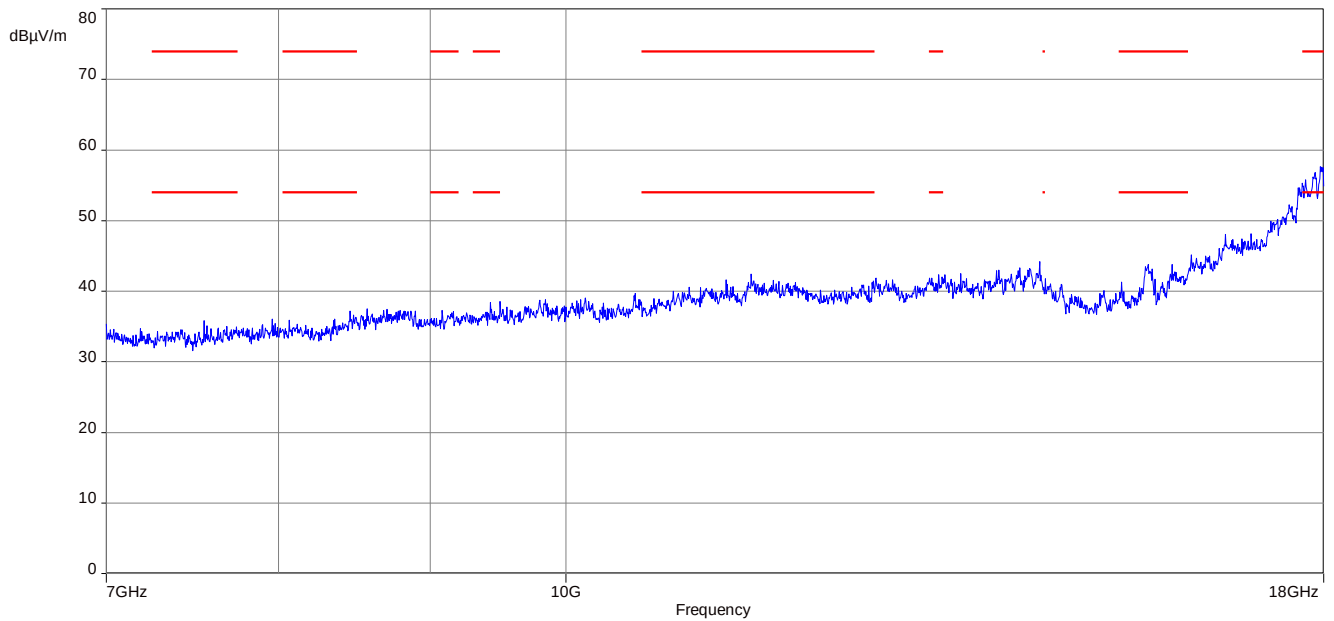


Plot 9: Highest channel, 1 GHz to 7 GHz, vertical & horizontal polarization

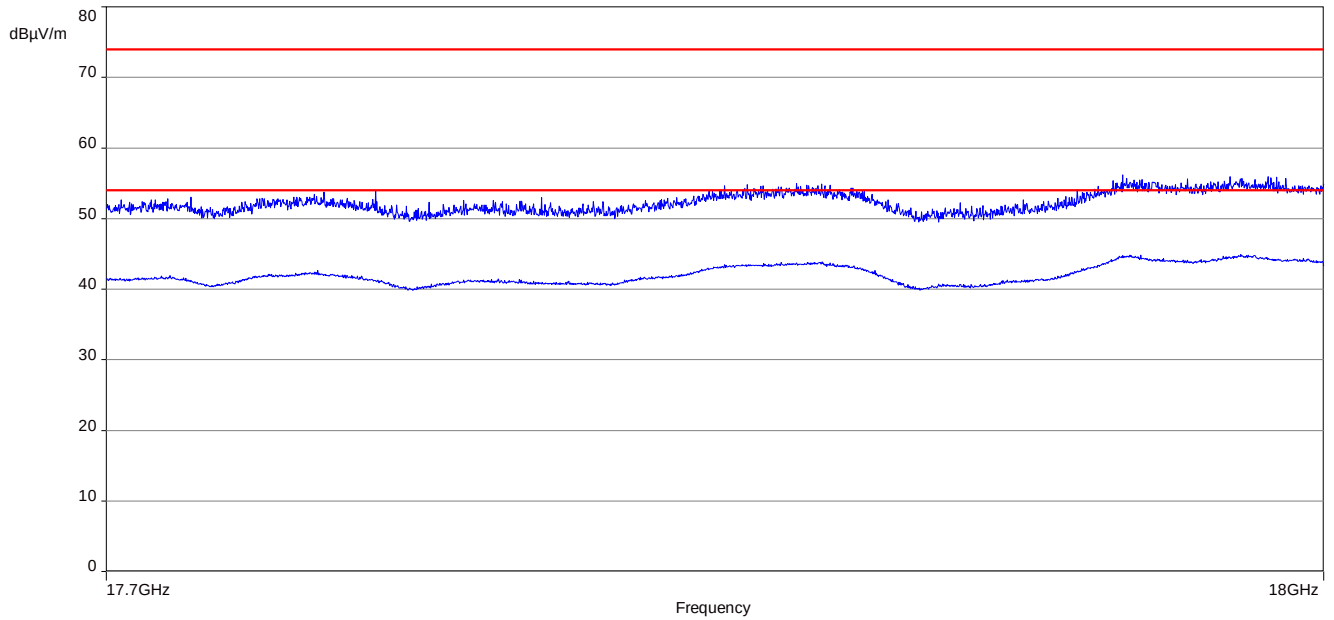


The carrier signal is notched with a 2.4 GHz band rejection filter.

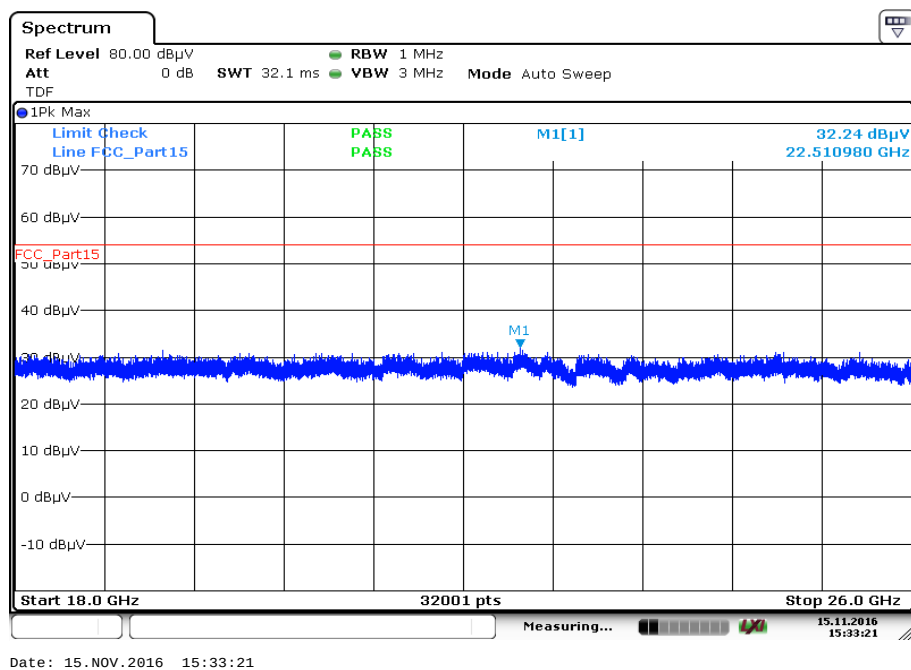
Plot 10: Highest channel, 7 GHz to 18 GHz, vertical & horizontal polarization



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

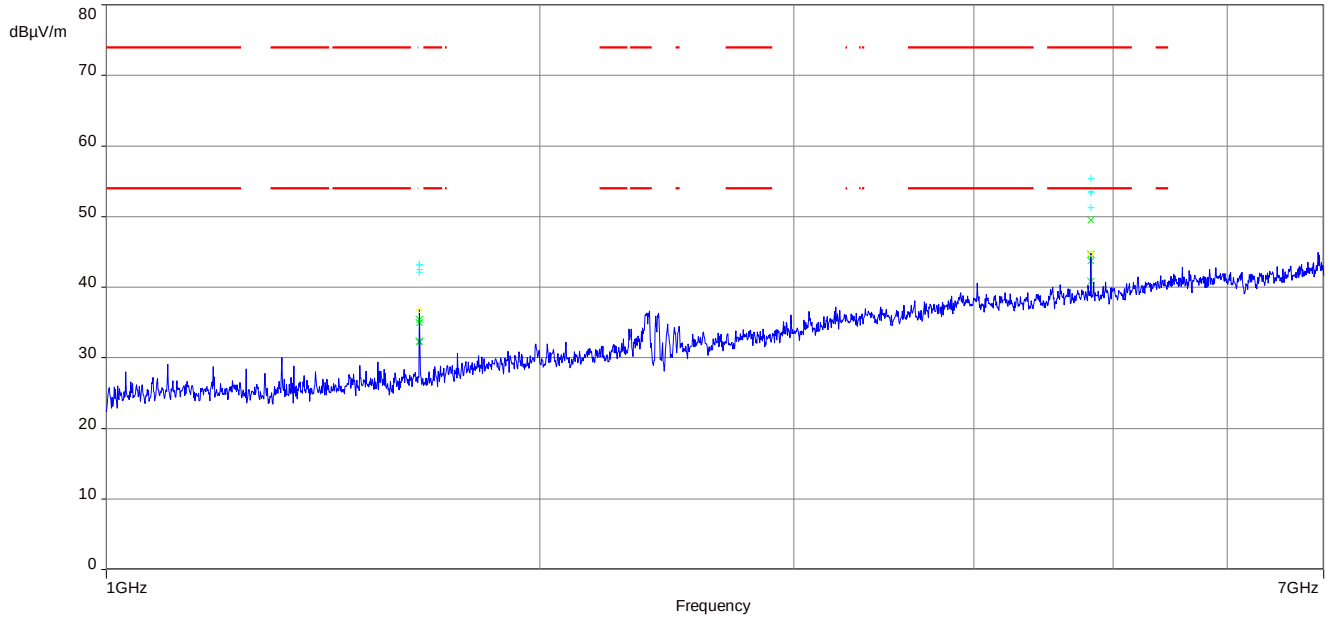


Plot 12: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



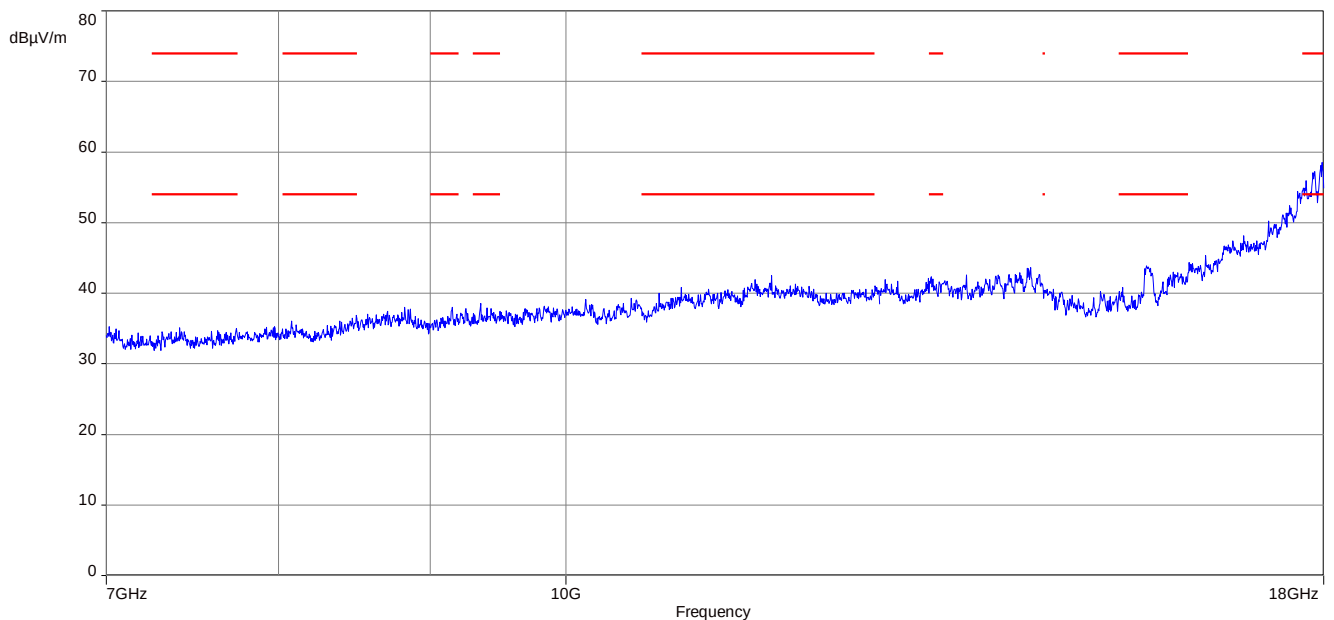
Plots: OFDM (20 MHz bandwidth)

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

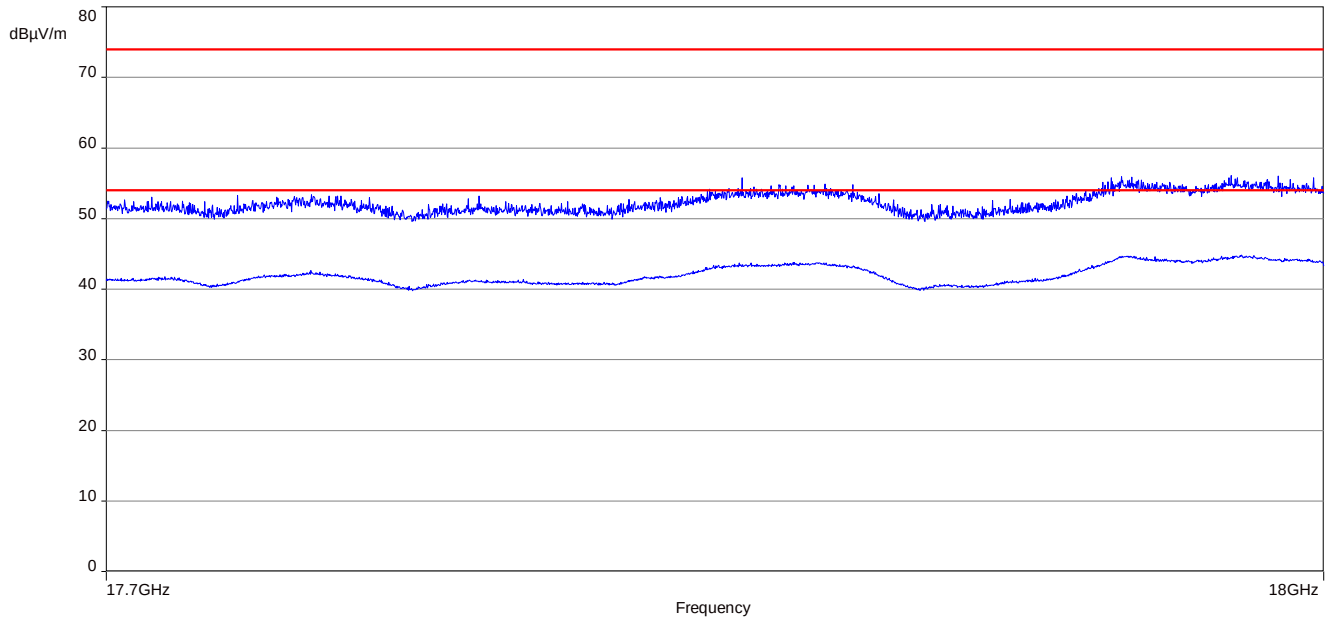


The carrier signal is notched with a 2.4 GHz band rejection filter.

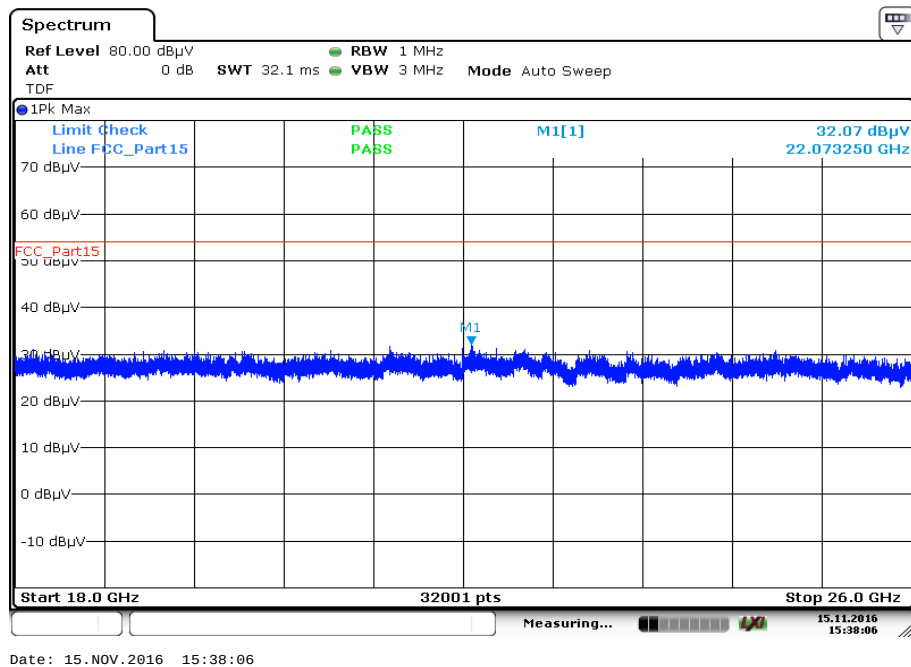
Plot 2: Lowest channel, 7 GHz to 18 GHz, vertical & horizontal polarization



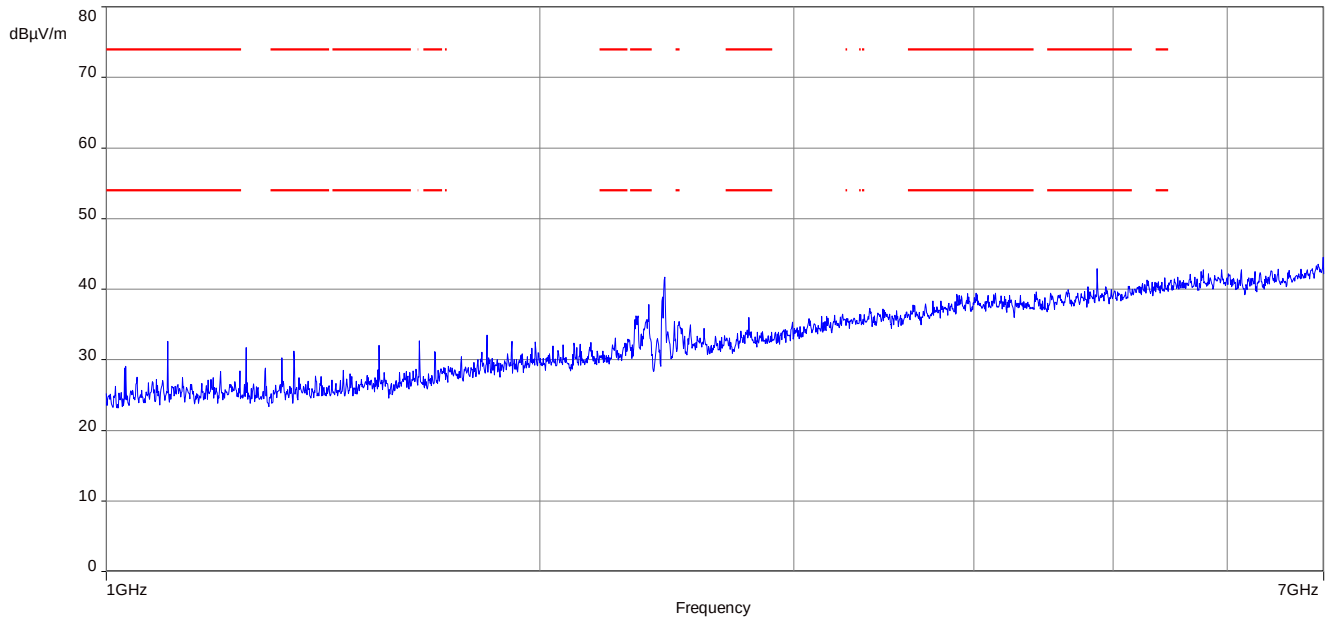
Plot 3: Lowest channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



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

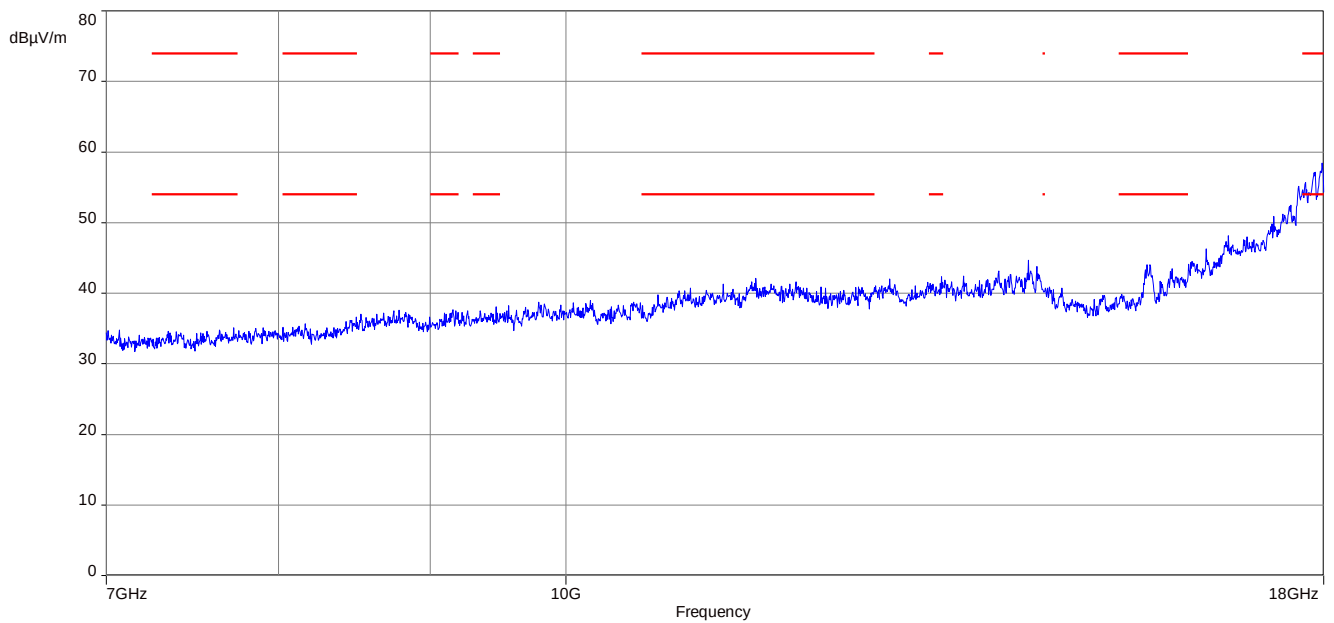


Plot 5: Middle channel, 1 GHz to 7 GHz, vertical & horizontal polarization

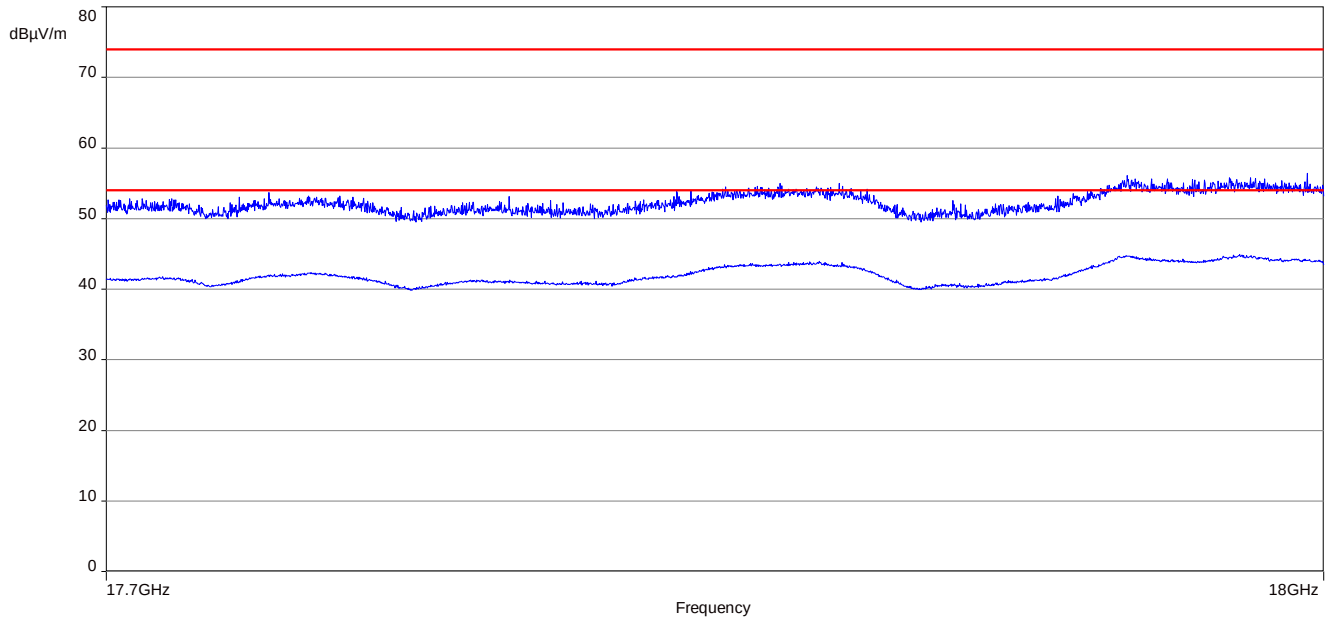


The carrier signal is notched with a 2.4 GHz band rejection filter.

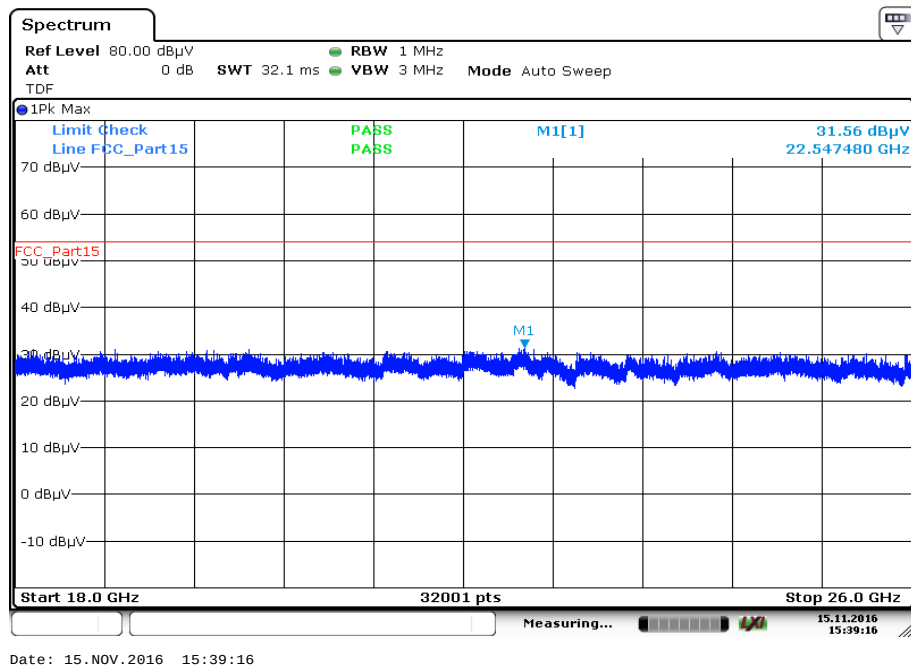
Plot 6: Middle channel, 7 GHz to 18 GHz, vertical & horizontal polarization



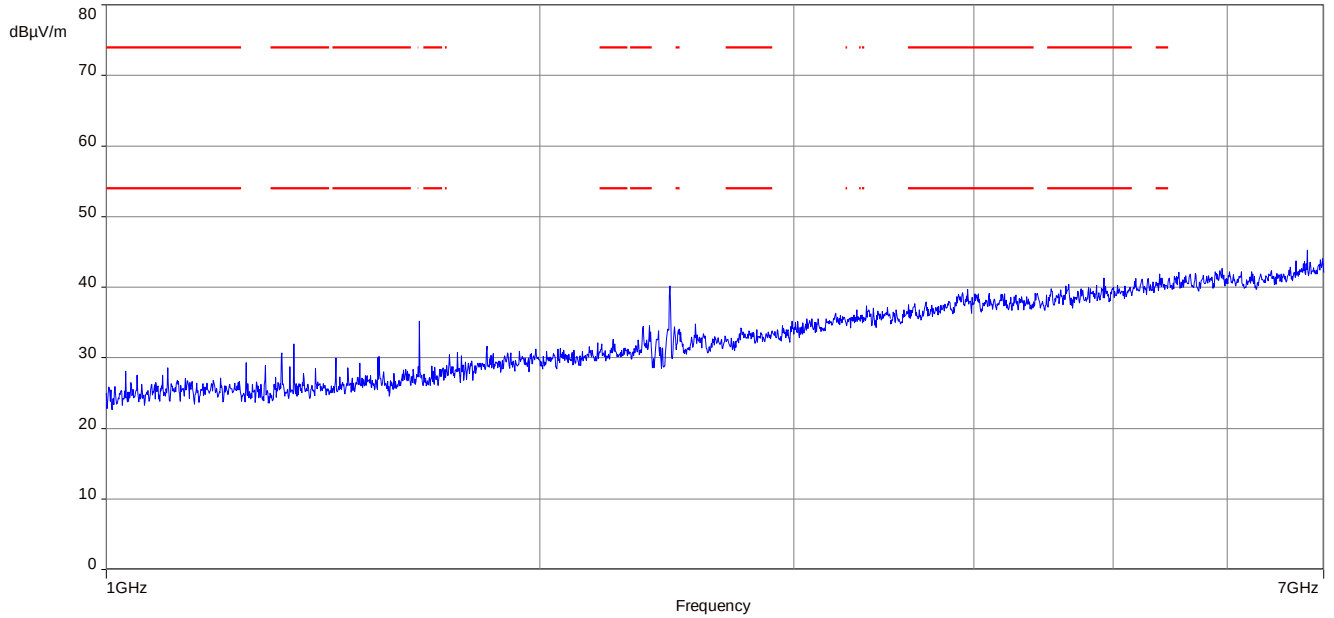
Plot 7: Middle channel, 17.7 GHz to 18 GHz, vertical & horizontal polarization, peak & average



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

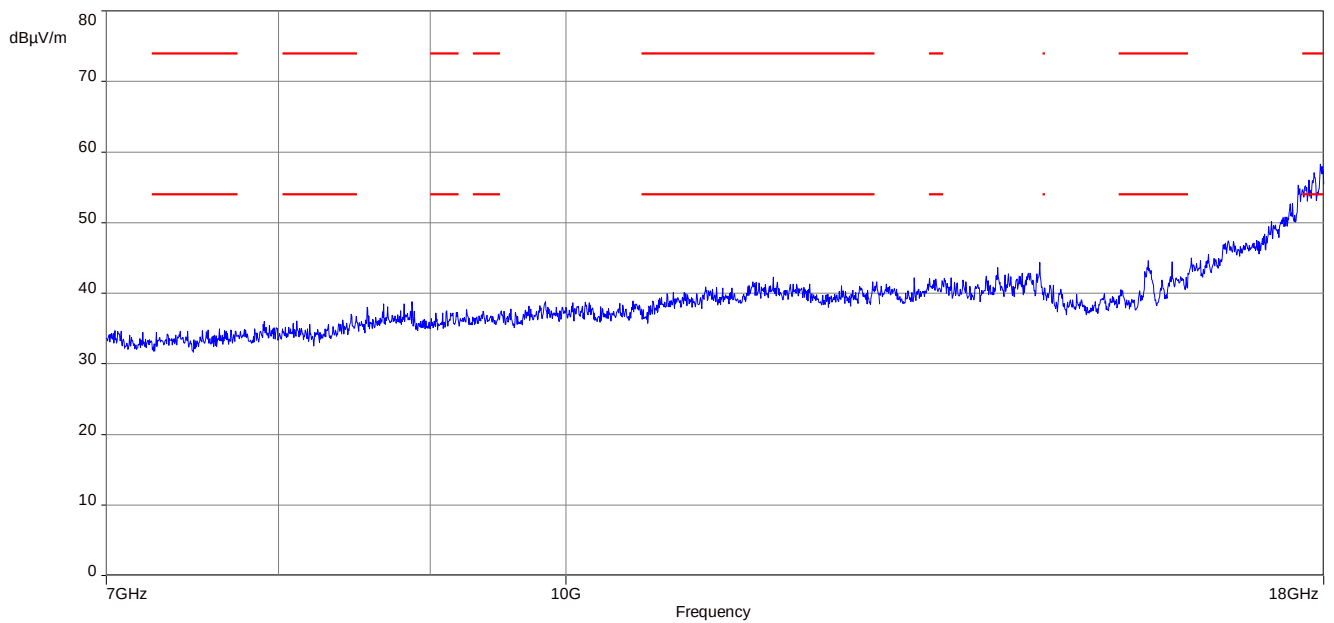


Plot 9: Highest channel, 1 GHz to 7 GHz, vertical & horizontal polarization

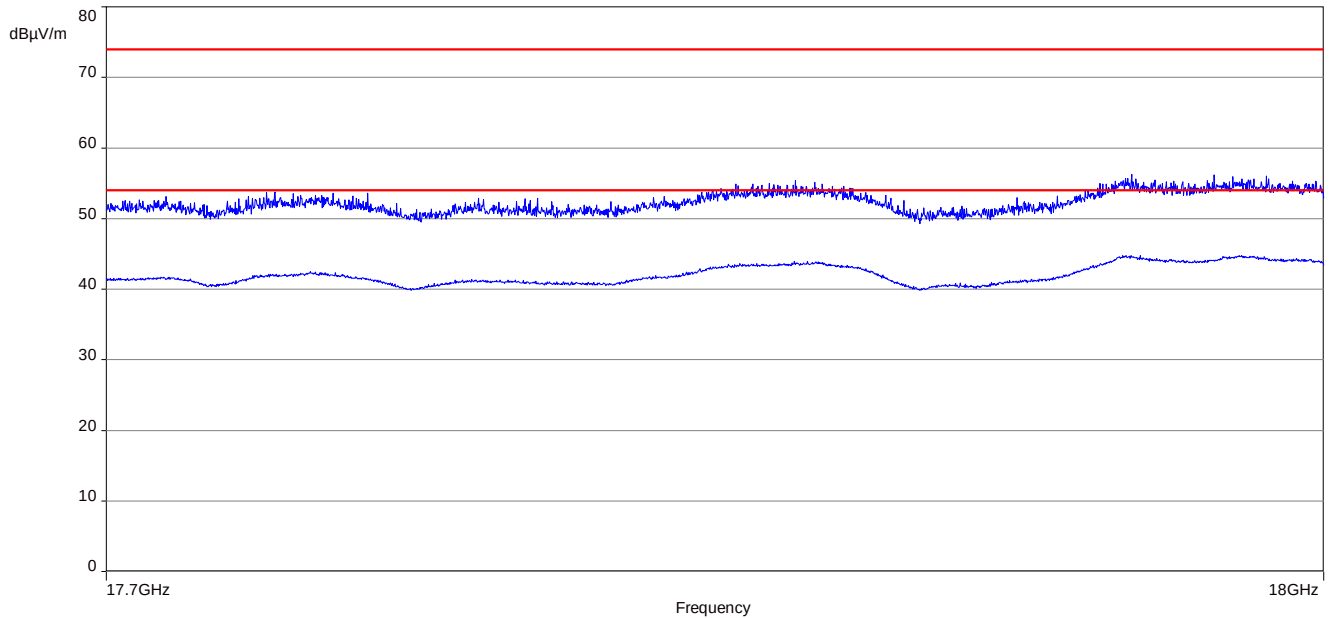


The carrier signal is notched with a 2.4 GHz band rejection filter.

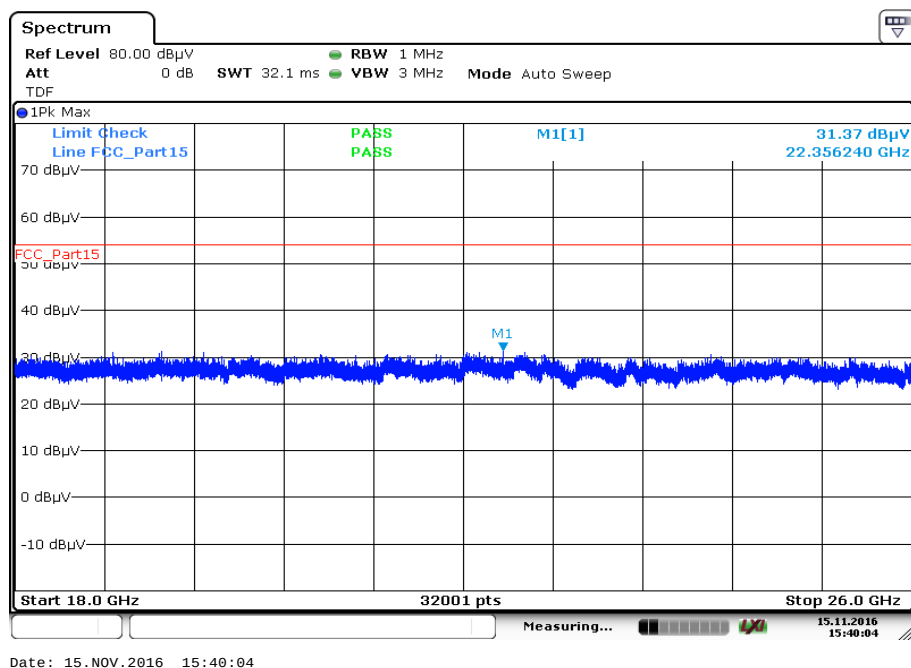
Plot 10: Highest channel, 7 GHz to 18 GHz, vertical & horizontal polarization



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

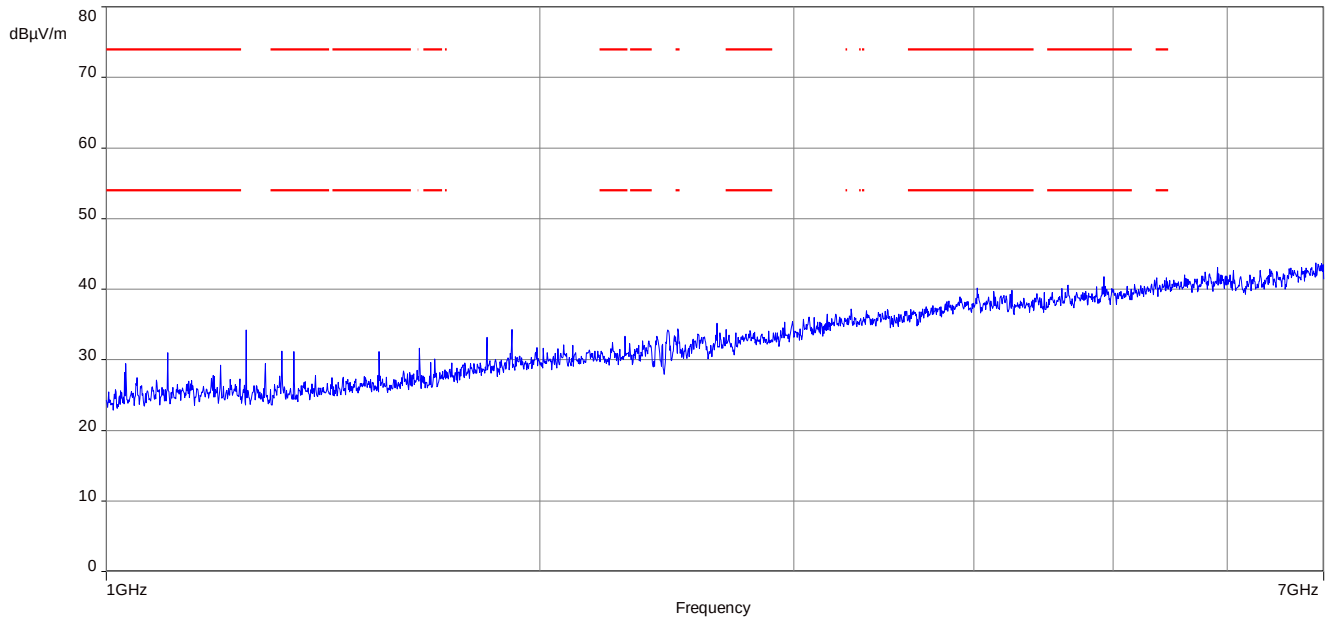


Plot 12: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization

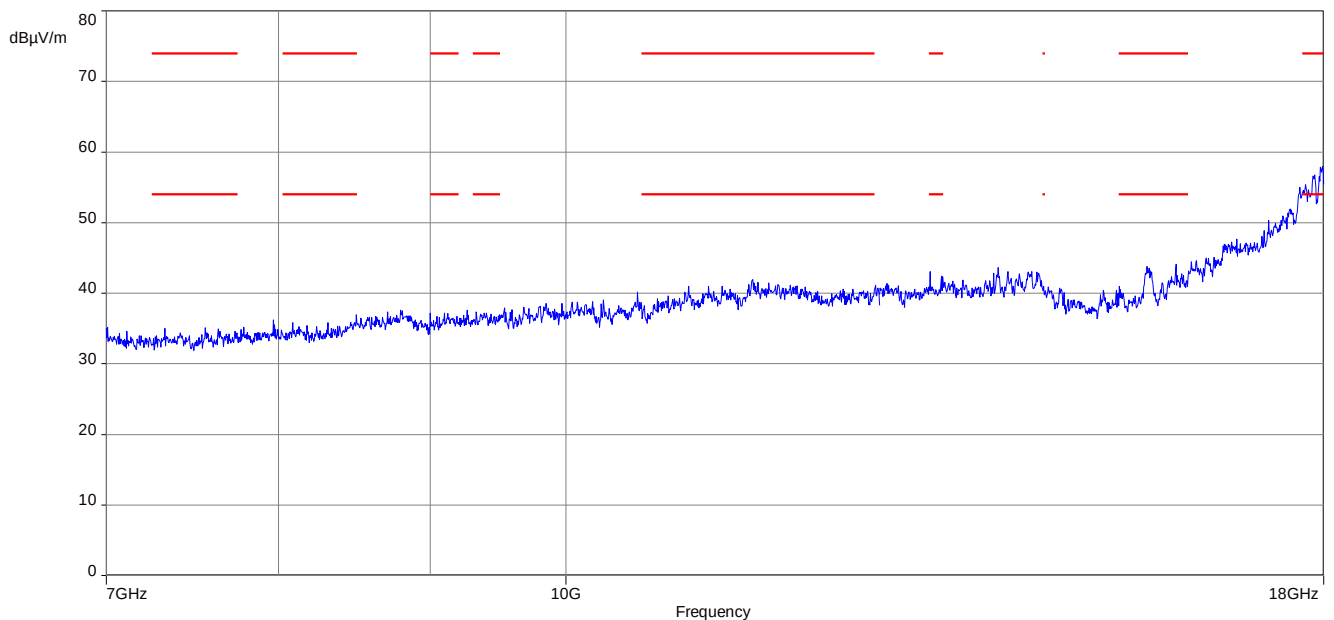


Plots: RX / idle mode

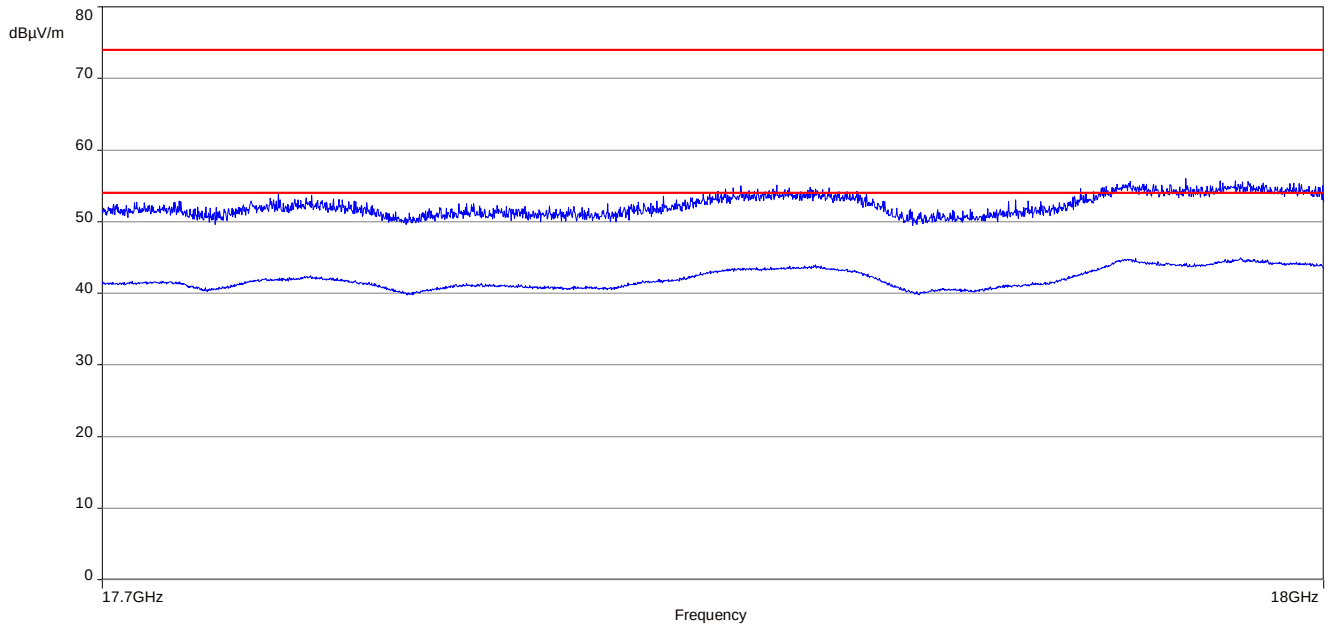
Plot 1: 1 GHz to 7 GHz, vertical & horizontal polarization



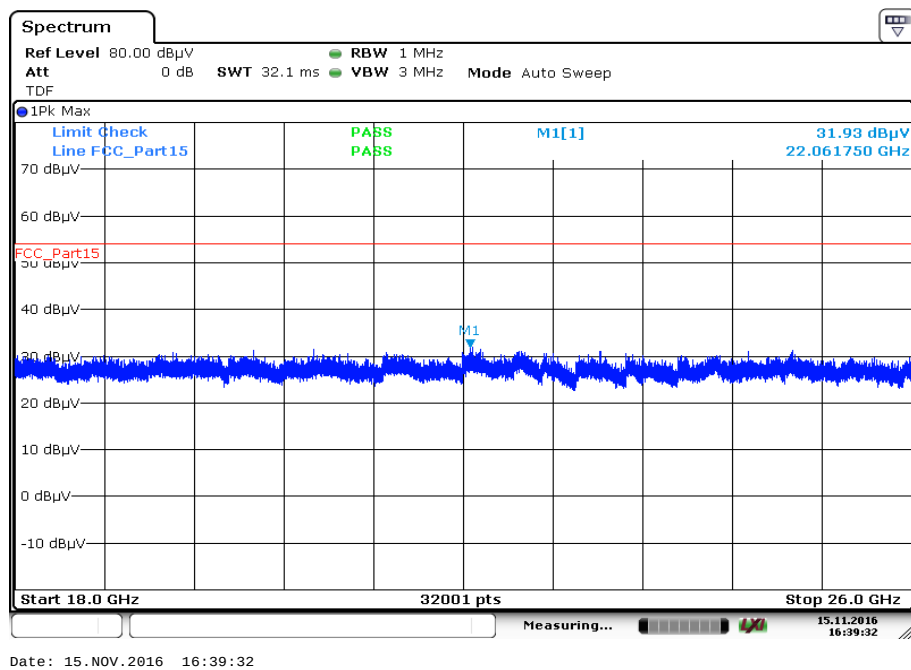
Plot 2: 7 GHz to 18 GHz, vertical & horizontal polarization



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



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



11.14 Spurious emissions conducted below 30 MHz (AC conducted)

Description:

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

Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
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
Test setup:	See sub clause 6.5 A
Measurement uncertainty:	See sub clause 8

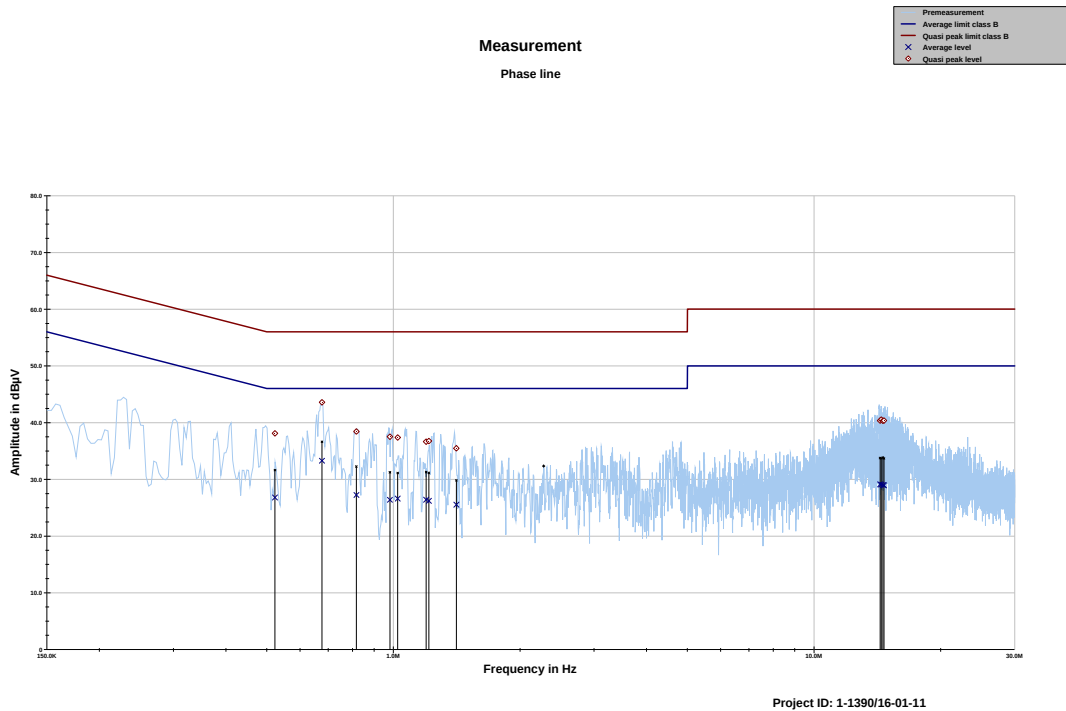
Limits:

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

*Decreases with the logarithm of the frequency

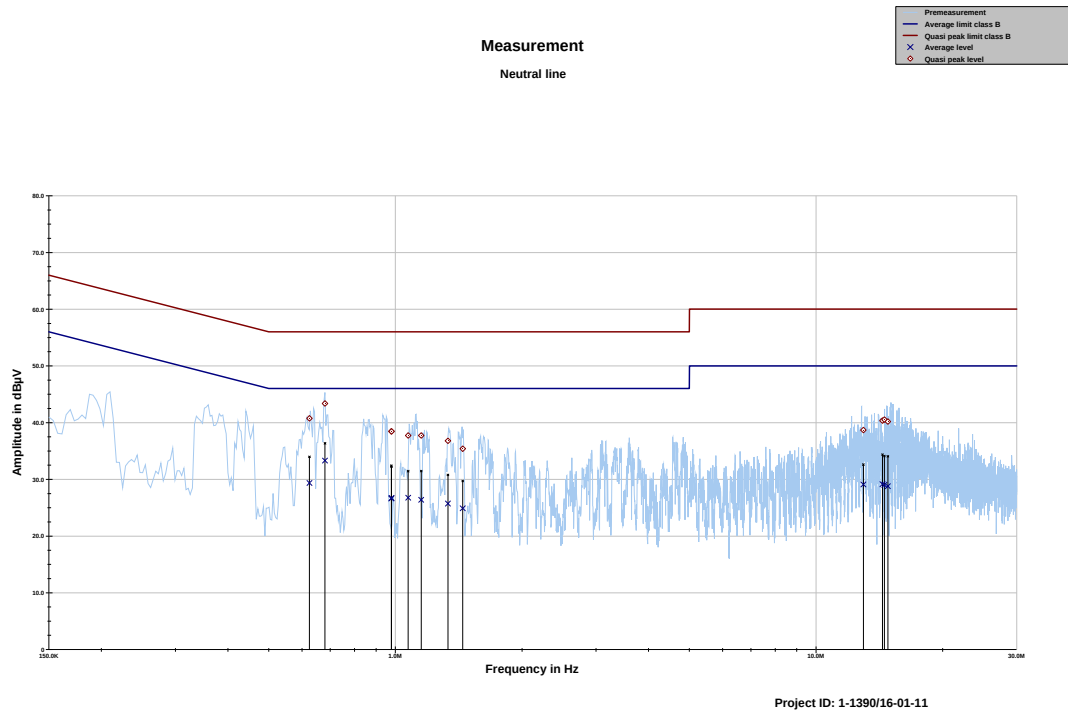
Results:

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

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

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.522919	38.10	17.90	56.000	26.79	19.21	46.000
0.676320	43.58	12.42	56.000	33.27	12.73	46.000
0.816828	38.43	17.57	56.000	27.23	18.77	46.000
0.981097	37.50	18.50	56.000	26.38	19.62	46.000
1.024143	37.38	18.62	56.000	26.59	19.41	46.000
1.195907	36.63	19.37	56.000	26.40	19.60	46.000
1.214471	36.75	19.25	56.000	26.19	19.81	46.000
1.411336	35.46	20.54	56.000	25.53	20.47	46.000
14.359560	40.35	19.65	60.000	29.10	20.90	50.000
14.454061	40.53	19.47	60.000	29.08	20.92	50.000
14.580180	40.32	19.68	60.000	29.00	21.00	50.000
14.665834	40.37	19.63	60.000	28.93	21.07	50.000

Plot 2: 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.624863	40.74	15.26	56.000	29.36	16.64	46.000
0.680382	43.36	12.64	56.000	33.30	12.70	46.000
0.978189	38.46	17.54	56.000	26.61	19.39	46.000
0.979038	38.43	17.57	56.000	26.71	19.29	46.000
1.072460	37.72	18.28	56.000	26.76	19.24	46.000
1.151821	37.71	18.29	56.000	26.37	19.63	46.000
1.333267	36.78	19.22	56.000	25.72	20.28	46.000
1.445692	35.38	20.62	56.000	24.88	21.12	46.000
12.961744	38.68	21.32	60.000	29.10	20.90	50.000
14.385329	40.34	19.66	60.000	29.14	20.86	50.000
14.539006	40.52	19.48	60.000	29.02	20.98	50.000
14.815537	40.18	19.82	60.000	28.79	21.21	50.000

12 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	2016-12-15

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
OBW		Occupied Bandwidth
OC		Operating Channel
OCW		Operating Channel Bandwidth
OOB		Out Of Band

Annex C Accreditation Certificate

Front 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

CTC advanced 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 25.11.2016 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, 25.11.2016

Befähigung auf der Rückseite

Im Auftrag: Dipl.-Ing. Ralf Eigner
 Abteilungsleiter

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
 Spittelmarkt 10
 10117 Berlin

Standort Frankfurt am Main
 Europa-Allee 52
 60327 Frankfurt am Main

Standort Braunschweig
 Bundesallee 100
 38116 Braunschweig

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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 (Abl. 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.

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 ILAC: www.ilac.org
 IAF: www.iaf.nu

Note:

The current certificate including annex can be received from CTC advanced GmbH on request.