
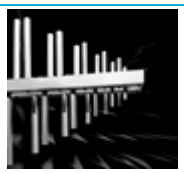


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TEST REPORT

Test report no.: 1-2970/16-01-06

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

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

FLIR Systems AB
Antennvägen 6
187 66 Täby / SWEDEN
Phone: +46 87 53 25 00
Fax: +46 87 53 23 64
Contact: Göran Skedung
e-mail: goran.skedung@flir.se
Phone: +46 87 53 27 59

Manufacturer

FLIR Systems AB
Antennvägen 6
187 66 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 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

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

Test Item

Kind of test item:	**Thermal imaging camera**
Model name:	**FLIR-T8210**
FCC ID:	**ZLV-FLIRT8210**
IC:	**5306A-FLIRT8210**
Frequency:	DTS band 2400 MHz to 2483.5 MHz
Technology tested:	WLAN
Antenna:	Integrated PIFA antenna
Power supply:	3.65 V DC by LiOn battery
Temperature range:	-20°C to +55°C

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

Test report authorized:

cn=Stefan Boes, o=CTC advanced GmbH, ou=BOE-161129, email=Stefan.Boes@ctcadvanced.com, c=DE
2017.04.20 14:17:23 +02'00'

Stefan Bös
Lab Manager
Radio Communications & EMC

Test performed:

cn=Mihail Dorongovskij, o=CTC advanced GmbH, ou=DOR-281116, email=Mihail.Dorongovskij@ctcadvanced.com, c=DE
2017.04.20 14:07:39 +02'00'

Mihail Dorongovskij
Lab Manager
Radio Communications & EMC

1 Table of contents

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:	2017-01-20
Date of receipt of test item:	2017-03-13
Start of test:	2017-03-13
End of test:	2017-03-17
Person(s) present during the test:	Mr. Göran Skedung

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 2	February 2017	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 4	November 2014	Spectrum Management and Telecommunications Radio Standards Specifications - General Requirements and Information for the Certification of Radio Apparatus

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}	+23 °C during room temperature tests No tests under extreme temperature conditions required! No tests under extreme temperature conditions required!
Relative humidity content	:		35 %
Barometric pressure	:		1021 hpa
Power supply	:	V_{nom} V_{max} V_{min}	3.65 V DC by LiOn battery No tests under extreme voltage conditions required! No tests under extreme voltage conditions required!

5 Test item

5.1 General description

Kind of test item	:	Thermal imaging camera
Type identification	:	FLIR-T8210
HMN	:	-/-
PMN	:	T530, T540, T850 and T860
HVIN	:	FLIR-T8210
FVIN	:	-/-
S/N serial number	:	Radiated unit: 79100425 Conducted unit: 79100421
HW hardware status	:	1
SW software status	:	RF test mode
Frequency band	:	DTS band 2400 MHz to 2483.5 MHz (lowest channel 2412 MHz; highest channel 2462 MHz)
Type of radio transmission Use of frequency spectrum	: :	DSSS, OFDM
Type of modulation	:	(D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM
Number of channels	:	11
Antenna	:	Integrated PIFA antenna
Power supply	:	3.65 V DC by LiOn battery
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: 1-2970/16-01-10_AnnexA
1-2970/16-01-10_AnnexB
1-2970/16-01-10_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).

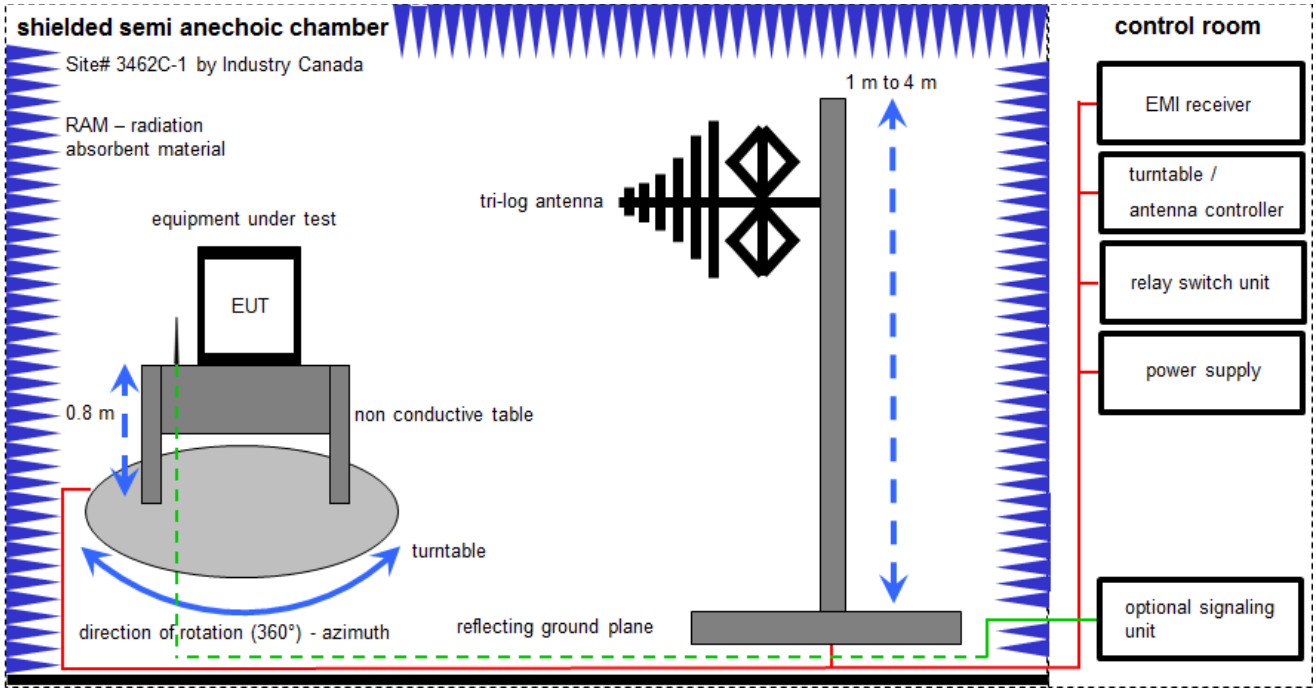
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vlkl!	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 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

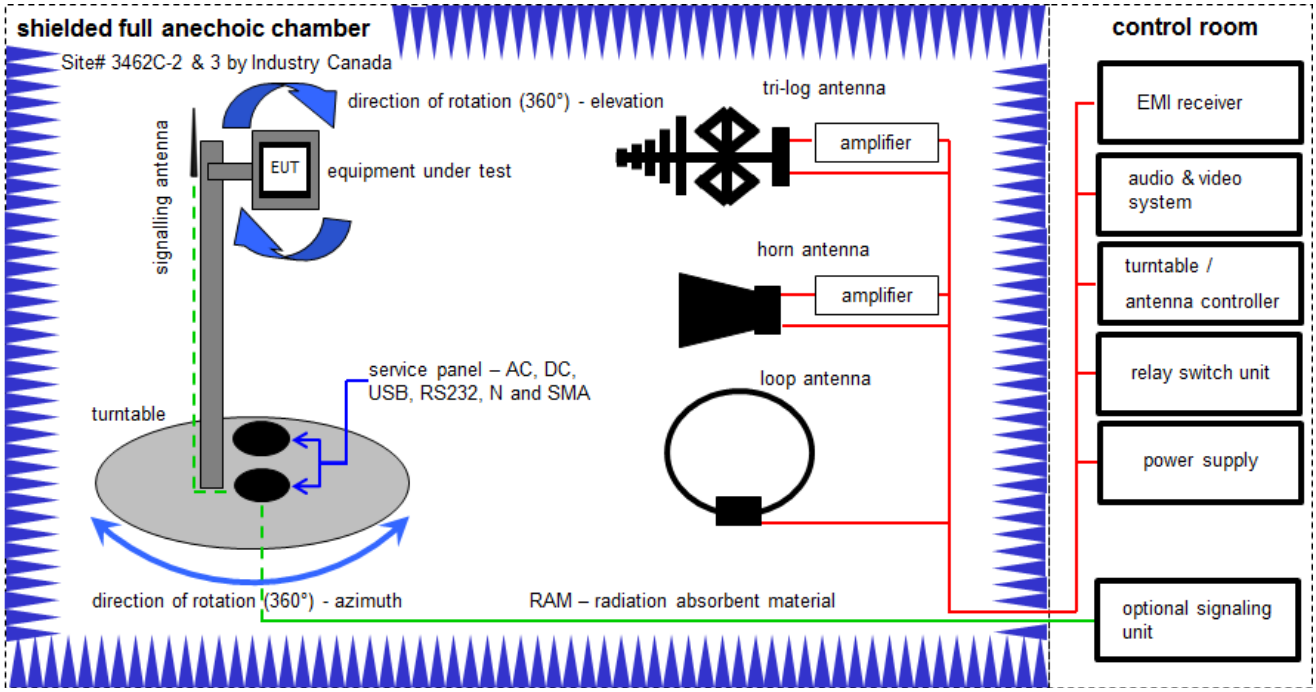
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/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	Meßkabine 1	HF-Absorberhalle	MWB AG 300023	101042	300000551	ne	-/-	-/-
3	A	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	01.02.2017	31.01.2018
4	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2018	02.02.2020
5	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
6	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
7	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
8	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: tri-log antenna and horn antenna 3 meter; loop antenna 3 meter

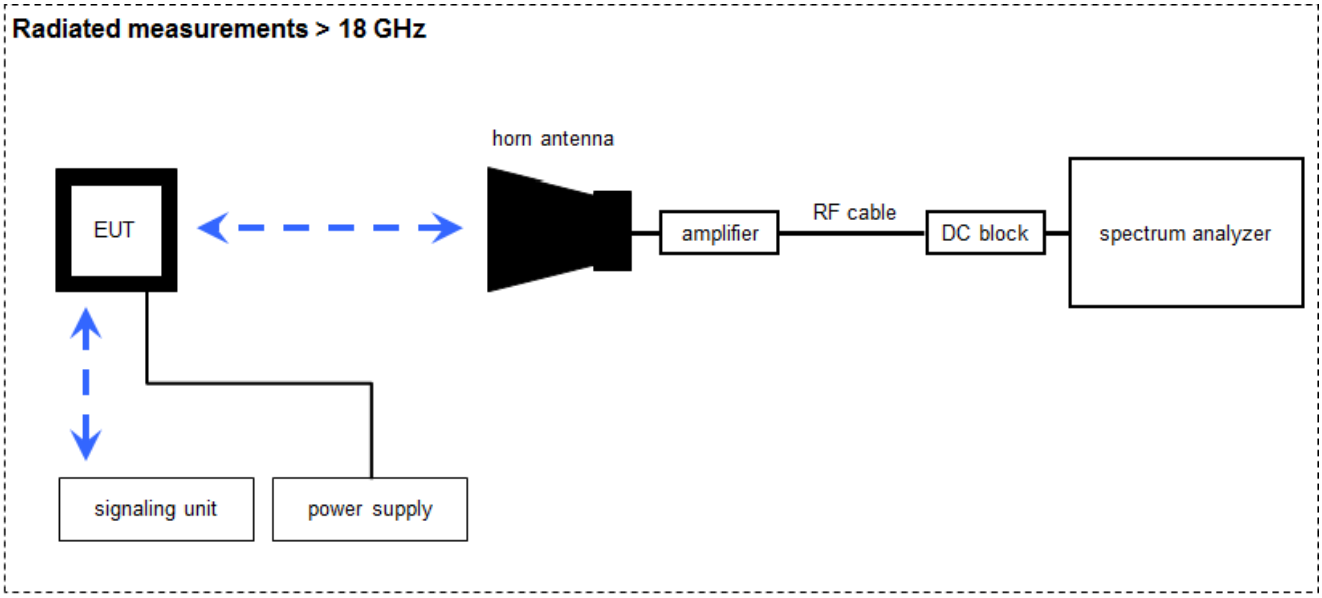
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [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	C	Active Loop Antenna 10 kHz to 30 MHz	6502	EMCO	2210	300001015	k	20.05.2015	20.05.2017
2	A	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017
3	A	Highpass Filter	WHK1.1/15G-10SS	Wainwright	37	400000148	ne	-/-	-/-
4	A	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
5	A	Band Reject Filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	26	300003792	ne	-/-	-/-
6	B	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	318	300003696	k	22.04.2014	22.04.2017
7	A, B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
8	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
9	A, B, C	Messrechner und Monitor	Intel Core i3 3220/3,3 GHz, Prozessor	Huber & Suhner	2V2403033A5421	300004591	ne	-/-	-/-
10	A, B, C	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO	Batch no. 14844	300004682	ne	-/-	-/-
11	A, B, C	Anechoic chamber	ESH3-Z5	TDK	893045/004	300003726	ne	-/-	-/-
12	A, B, C	EMI Test Receiver 9kHz-26,5GHz	ESR26	R&S	101376	300005063	vIKI!	13.09.2016	13.03.2018

6.3 Radiated measurements > 18 GHz



Measurement distance: horn antenna 50 cm

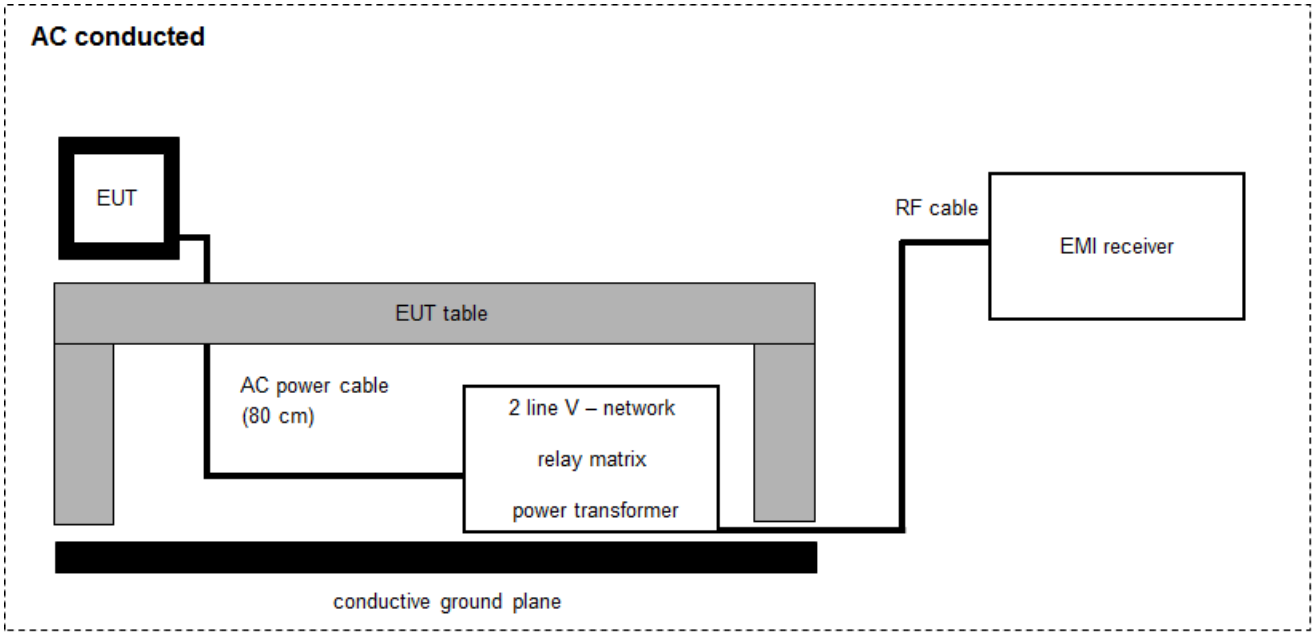
FS = U_R + CA + AF
(FS-field strength; U_R-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/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	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	27.01.2017	26.01.2018
3	A	Amplifier 2-40 GHz	JS32-02004000-57-5P	MITEQ	1777200	300004541	ev	-/-	-/-
4	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 600918	400001182	ev	-/-	-/-
5	A	RF-Cable	ST18/SMAm/SMAm/48	Huber & Suhner	Batch no. 127377	400001183	ev	-/-	-/-
6	A	DC-Blocker 0.1-40 GHz	8141A	Inmet	-/-	400001185	ev	-/-	-/-

6.4 AC conducted



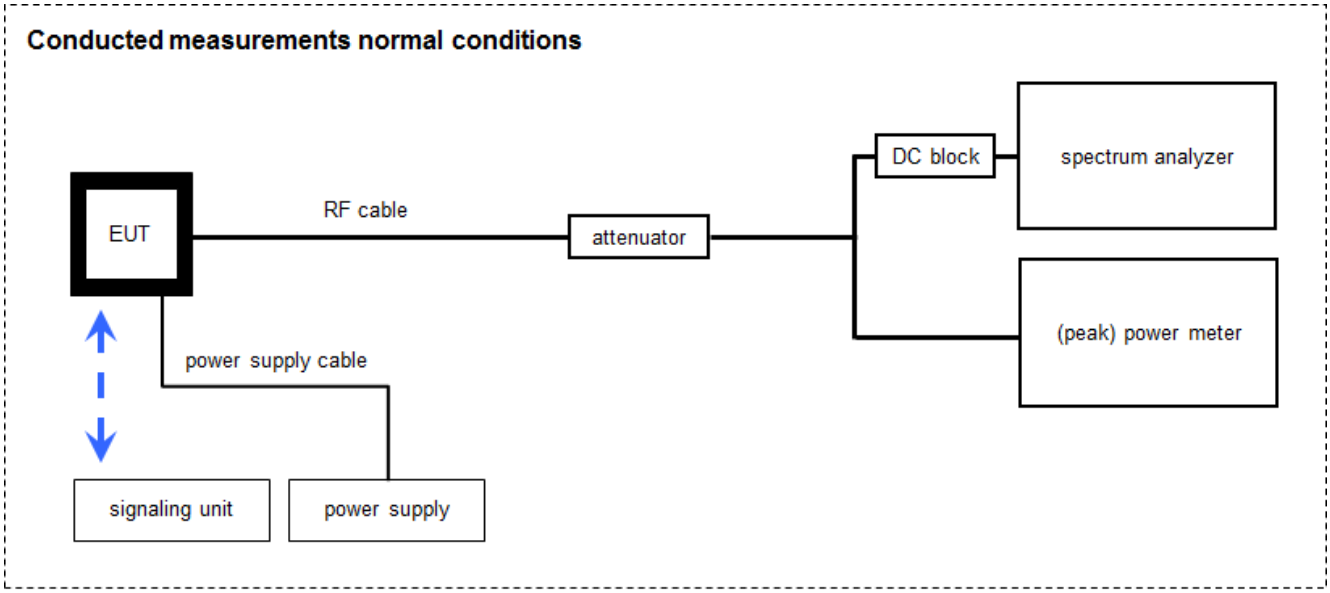
FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

Example calculation:
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/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	893045/004	300000584	k	31.01.2017	30.01.2018
2	A	RF-Filter-section	85420E	HP	3427A00162	300002214	k	-/-	-/-
3	A	EM-Injection Clamp	FCC-203i	emv	232	300000626	ev	-/-	-/-
4	A	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2018	02.02.2020
5	A	AC-Spannungsquelle variabel	MV2616-V	EM-Test	0397-12	300003259	k	11.12.2015	11.12.2017
6	A	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-
7	A	MXE EMI Receiver 20 Hz to 26,5 GHz	N9038A	Agilent Technologies	MY51210197	300004405	k	16.08.2016	16.08.2017

6.5 Conducted measurements with peak power meter & spectrum analyzer



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	PC-WLAN Tester	Intel Core i3 3220/3,3 GHz, Prozessor	R&S	2V2403033A4523	300004589	ne	-/-	-/-
3	A, B	Teststand	Teststand Custom Sequence Editor	National Instruments GmbH	2V2403033A4523	300004590	ne	-/-	-/-
4	A	Power Sensor	NRP-Z81	R&S	100010	300003780	k	27.01.2017	26.01.2019
5	A, B	PowerSplitter/Combiner 150-6000MHz N-Type	ZB3PD-63-N+	Mini-Circuits	100010	400000451	ev	-/-	-/-
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	DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 127377	400001185	ev	-/-	-/-
9	B	Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	27.01.2017	26.01.2018

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 ± 45° 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 2	See table!	2017-04-11	-/-

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 (d)	Antenna gain	-/-	Nominal	Nominal	DSSS	-/-				Declared
RSS – 247 / 6.0	Duty cycle	-/-	Nominal	Nominal	DSSS OFDM	-/-				-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	KDB 558074 DTS clause: 10.2	Nominal	Nominal	DSSS OFDM	☒	☐	☐	☐	-/-
§15.247(a)(2) RSS - 247 / 5.2 (a)	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 (d)	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: Customer Questionnaire

3-3-TECH-587 920-04 Flir Lennox antenna characterization A

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

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] Declared by the customer		-1.5

Plots: antenna characterization and gain (provided by the customer)

Plot 1: plane definitions

Figure 3 Measurement plane definitions

Figure 4 XY-plane

Figure 5 XZ-plane

Figure 6 YZ-plane

Plot 2: XY-plane

2.3.2 XY-plane

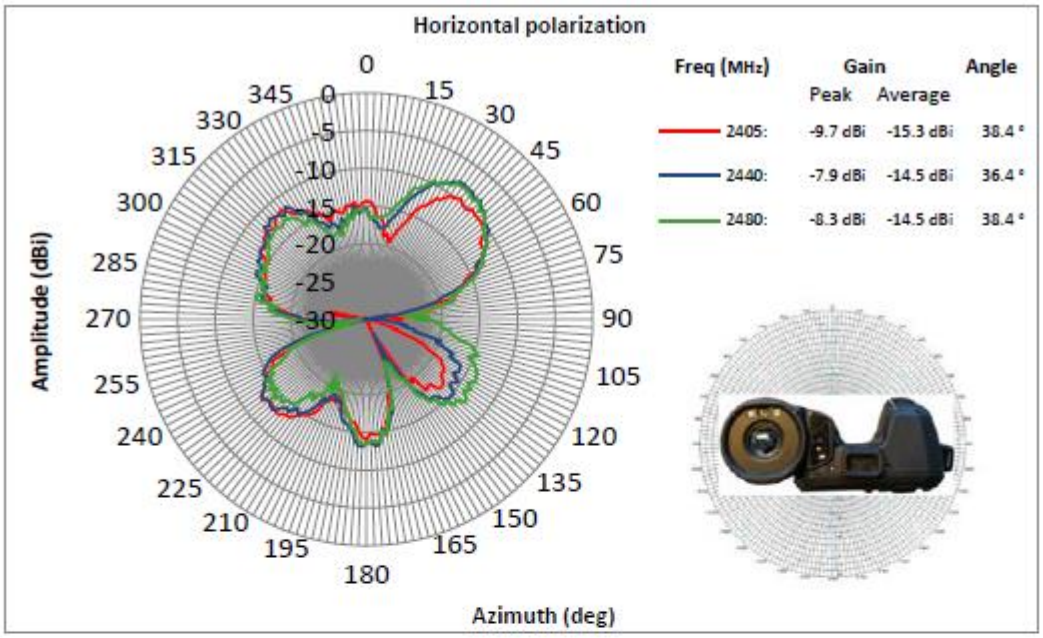


Figure 8 2,5GHz XY-plane, horizontal polarization

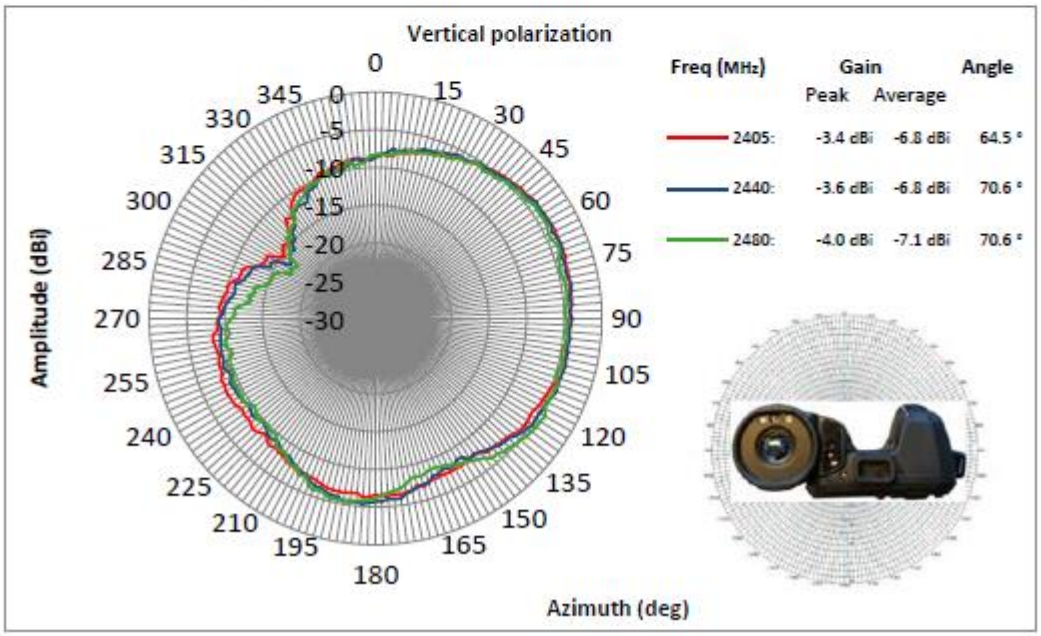


Figure 9 2,5GHz XY-plane, vertical polarization

Plot 3: XZ-plane

2.3.3 XZ-plane

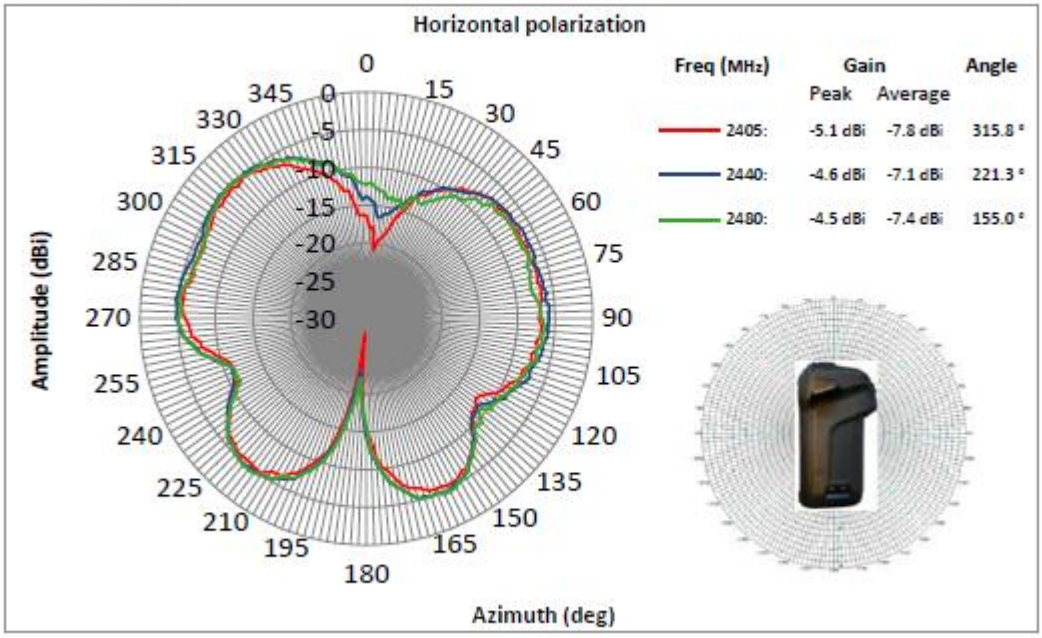


Figure 12 2,5GHz XZ-plane, horizontal polarization

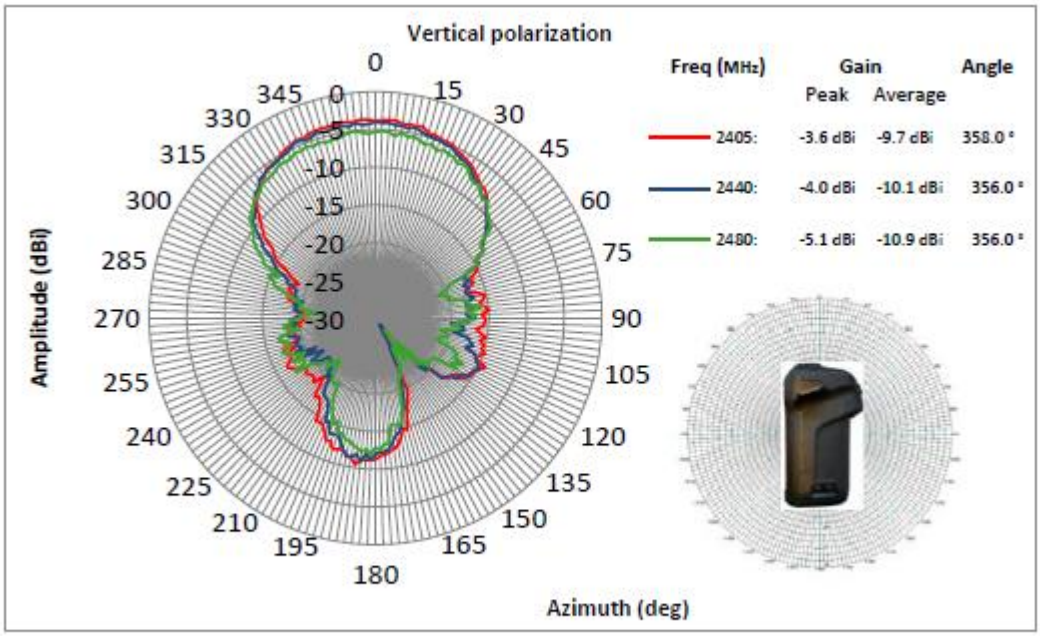


Figure 13 2,5GHz XZ-plane, vertical polarization

Plot 4: YZ-plane

2.3.4 YZ-plane

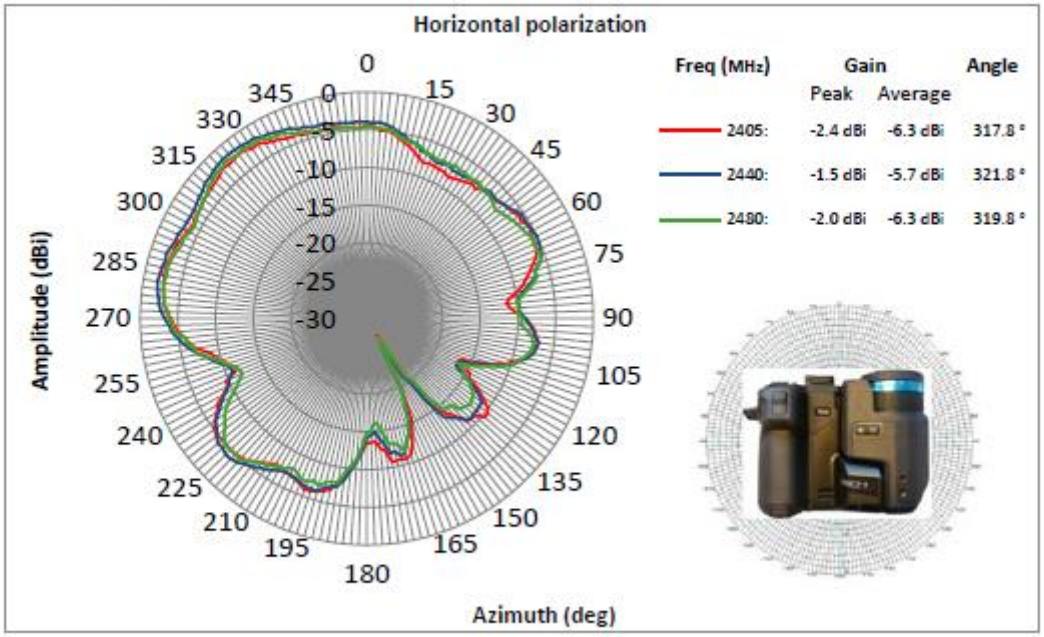


Figure 16 2,5GHz YZ-plane, horizontal polarization

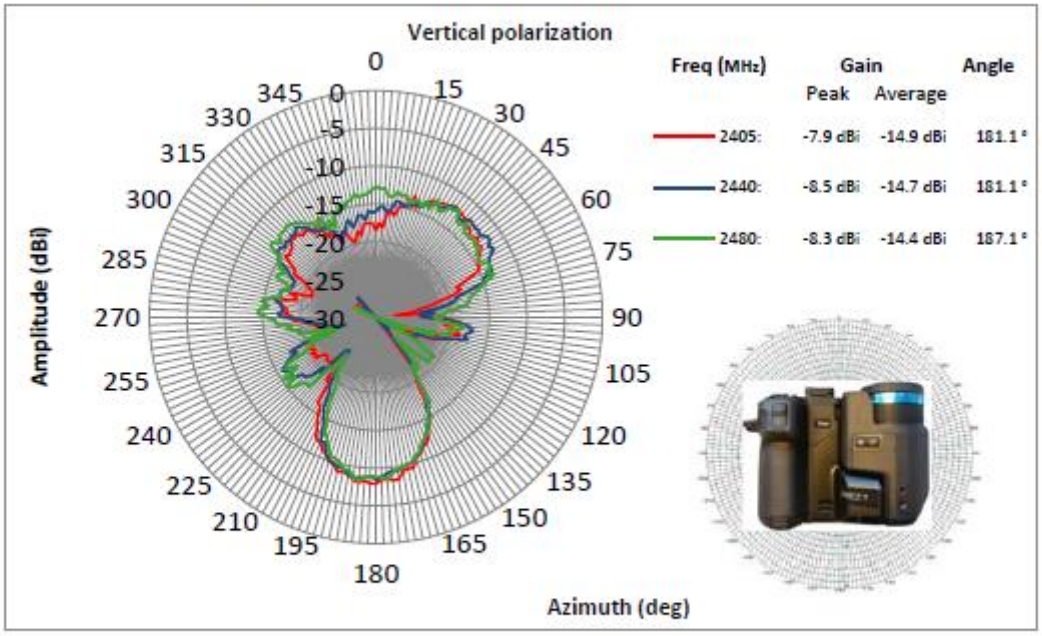


Figure 17 2,5GHz YZ-plane, vertical polarization

Plot 5: summary

3 Summary

The WiFi antenna within the *Flir Lennox* thermal camera has been characterized. The maximum antenna gain has been measured to be -1,5dBi for the 2.4GHz band and 2,0dBi for the 5GHz band.

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 6.5 – 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 6.5 – 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	16.7	17.1	17.0
Output power conducted OFDM / g – mode	19.7	19.9	19.3
Output power conducted OFDM / n HT20 – mode	19.7	20.0	19.4

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 6.5 - A
Measurement uncertainty:	See sub clause 8

Limits:

FCC	IC
-/-	

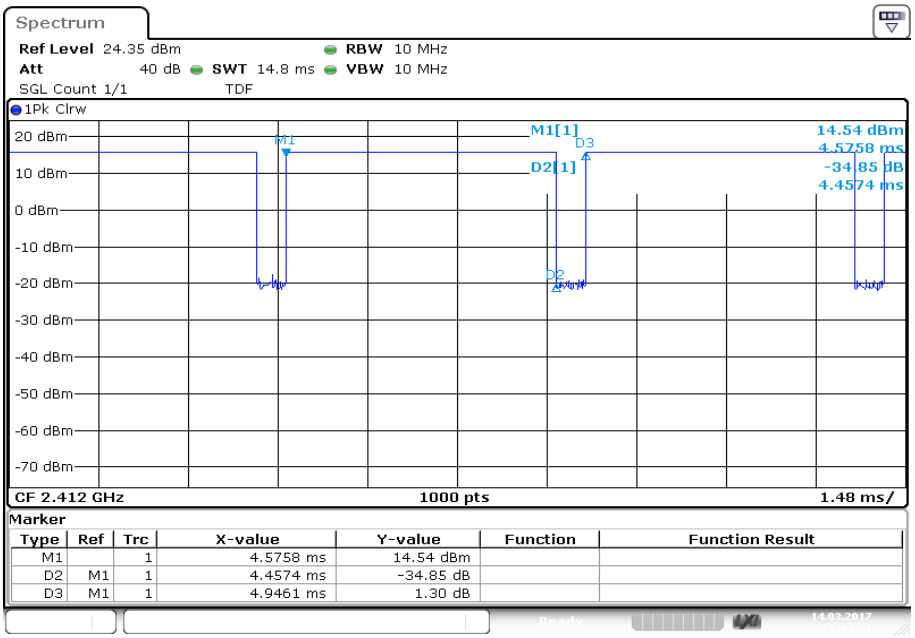
Results:

T_{nom}	V_{nom}	lowest channel 2412 MHz (Duty Cycle / DCCF)*	middle channel 2437 MHz (Duty Cycle / DCCF)*	highest channel 2462 MHz (Duty Cycle / DCCF)*
DSSS / b – mode		90.11 % / 0.45 dB	90.39 % / 0.44 dB	90.39 % / 0.44 dB
OFDM / g – mode		59.52 % / 2.25 dB	59.76 % / 2.24 dB	60.12 % / 2.21 dB
OFDM / n HT20 – mode		55.65 % / 2.55 dB	56.19 % / 2.50 dB	56.36 % / 2.49 dB

*DCCF: Duty Cycle Correction Factor

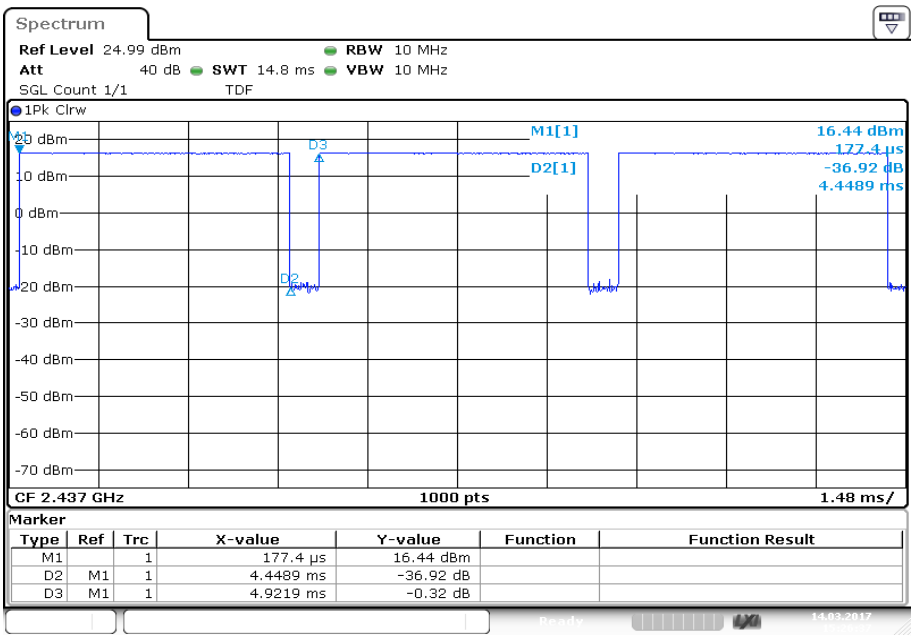
Plots: DSSS / b – mode

Plot 1: Lowest channel



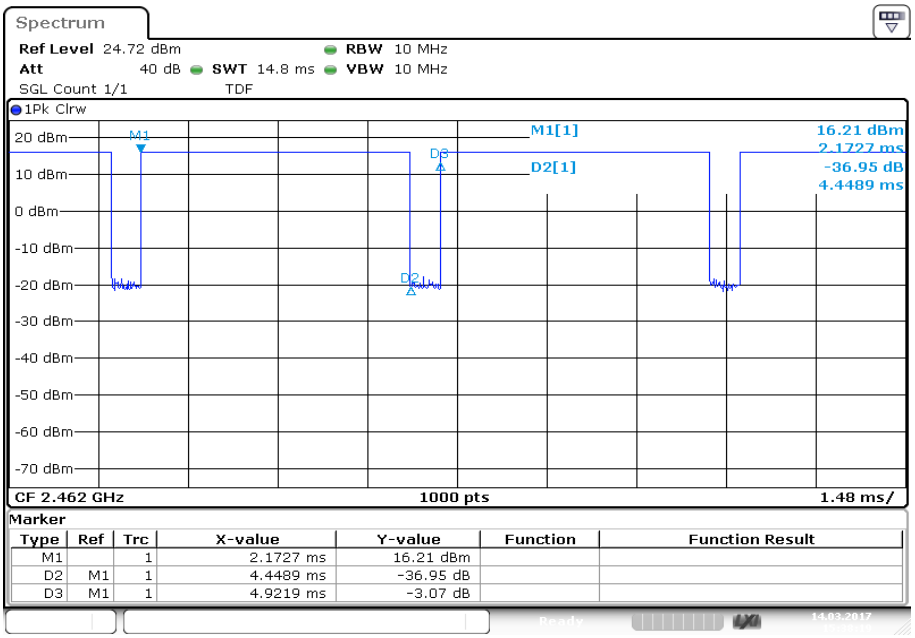
Date: 14.MAR.2017 15:03:51

Plot 2: Middle channel



Date: 14.MAR.2017 15:26:38

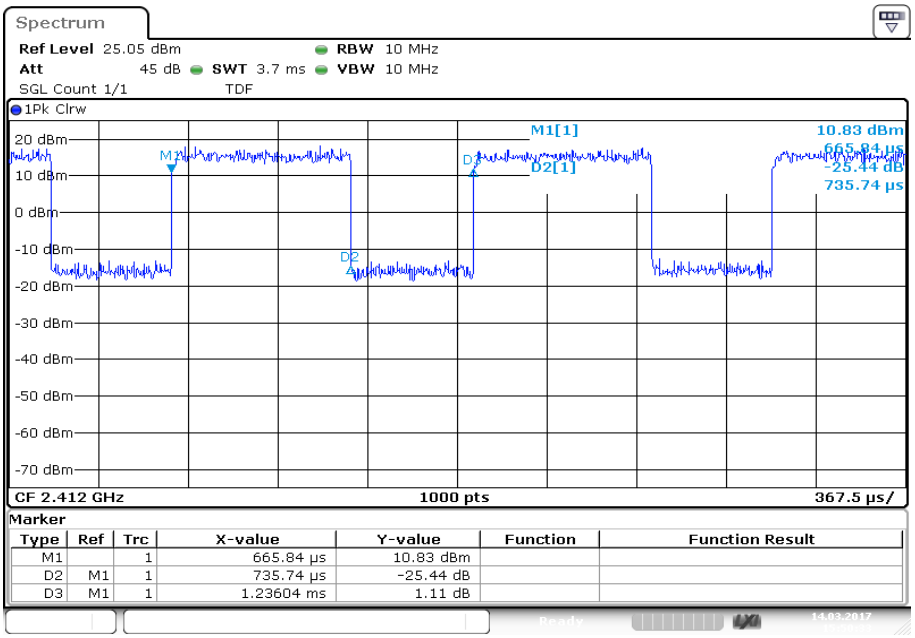
Plot 3: Highest channel



Date: 14.MAR.2017 15:38:20

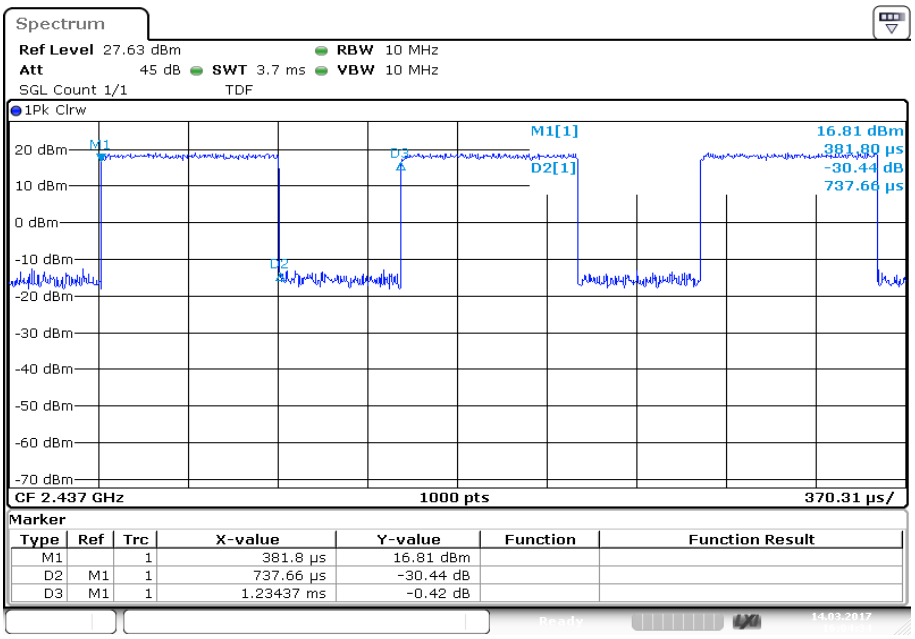
Plots: OFDM / g – mode

Plot 1: Lowest channel



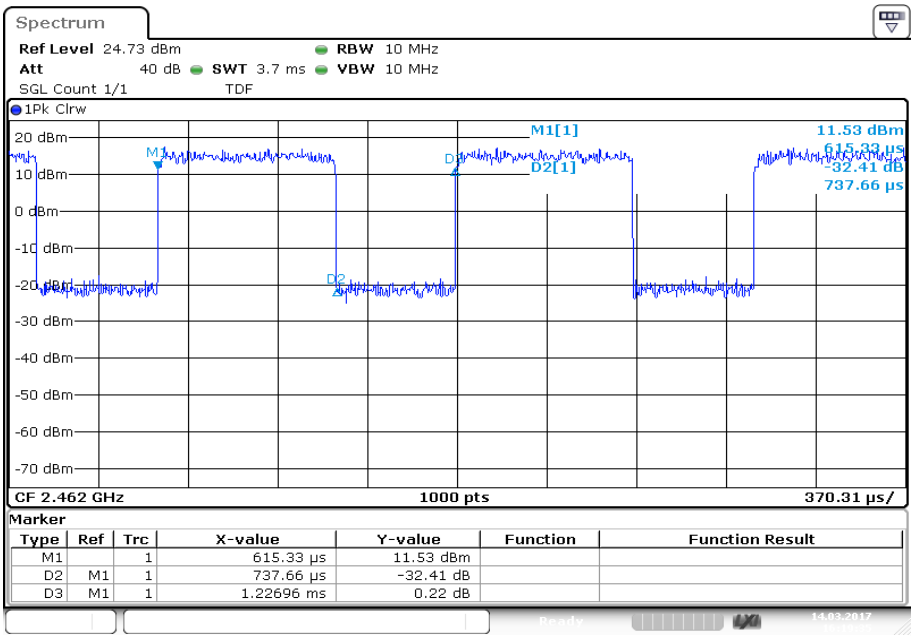
Date: 14.MAR.2017 15:50:33

Plot 2: Middle channel



Date: 14.MAR.2017 16:04:35

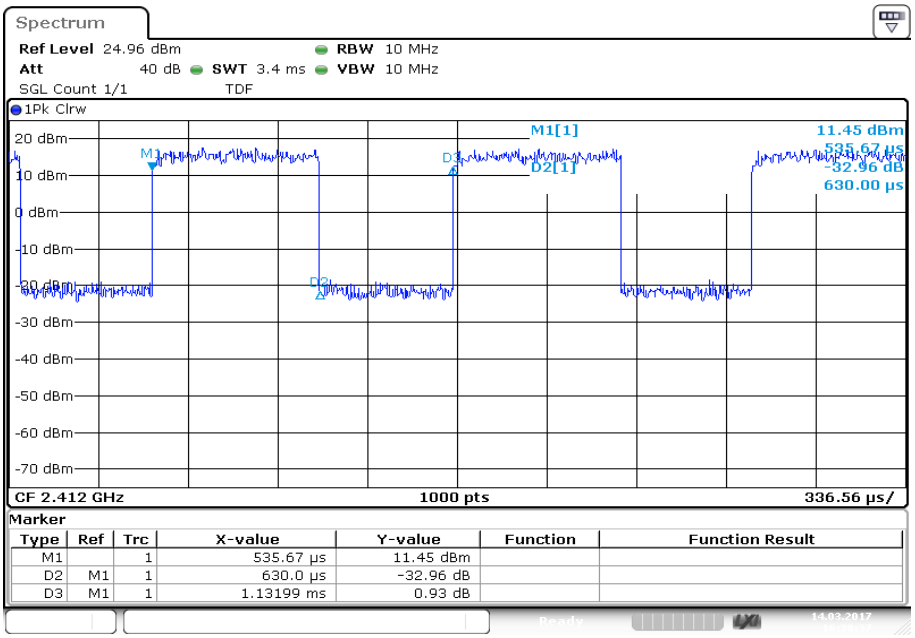
Plot 3: Highest channel



Date: 14.MAR.2017 16:19:35

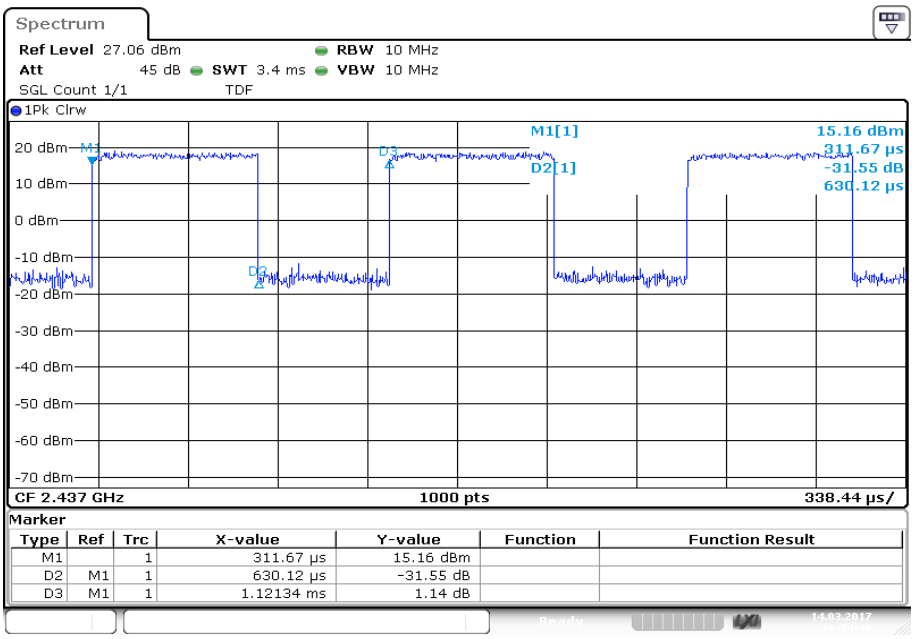
Plots: OFDM / n HT20 – mode

Plot 1: Lowest channel



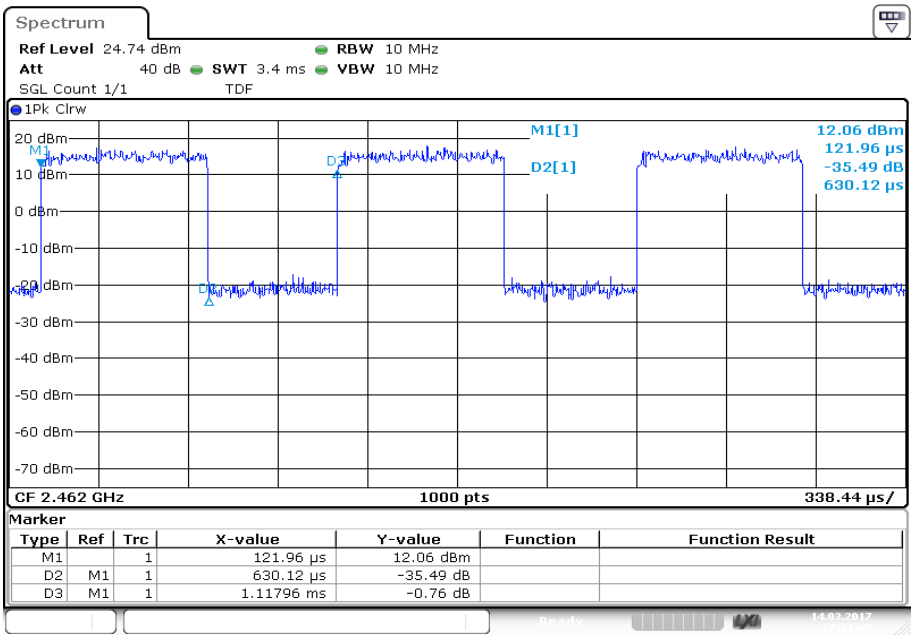
Date: 14.MAR.2017 16:38:38

Plot 2: Middle channel



Date: 14.MAR.2017 16:54:50

Plot 3: Highest channel



Date: 14.MAR.2017 17:11:06

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 6.3 – A
Measurement uncertainty	See sub clause 8

Limits:

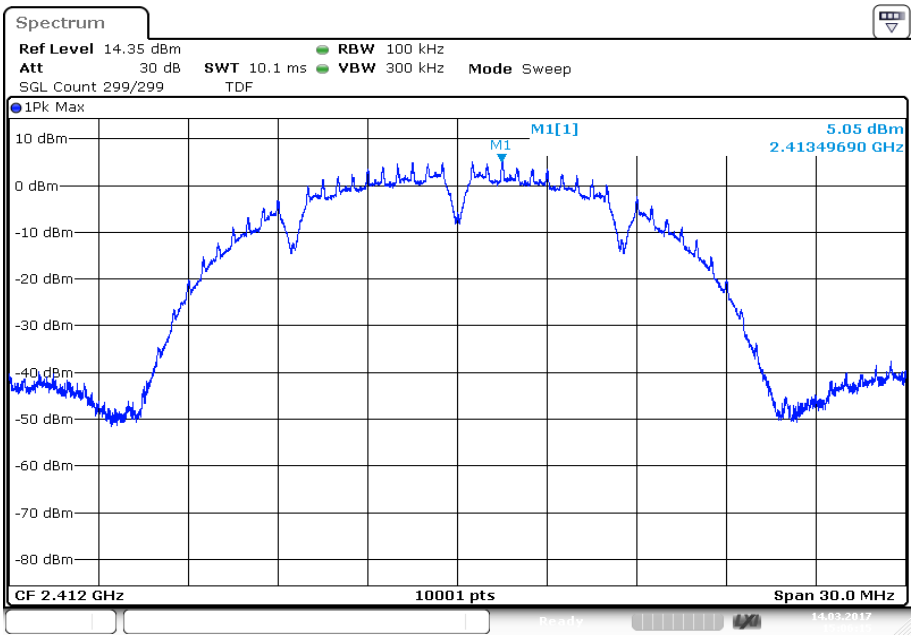
FCC	IC
8 dBm / 3kHz (conducted)	

Results:

Modulation	Peak power spectral density [dBm]		
Frequency	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	5.05	5.58	5.53
OFDM / g – mode	0.18	5.17	-0.24
OFDM / n HT20 – mode	0.30	4.43	0.18

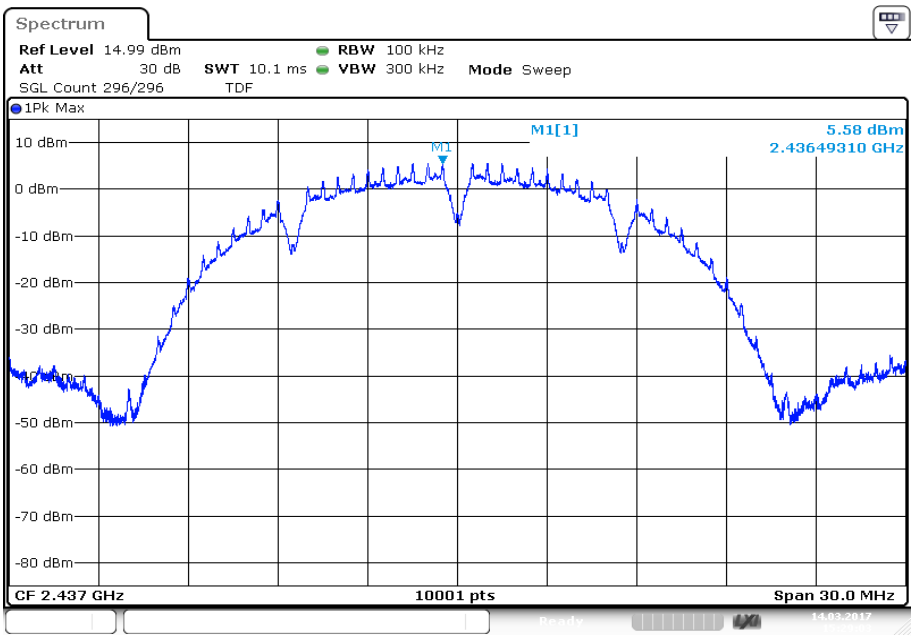
Plots: DSSS / b – mode

Plot 1: Lowest channel



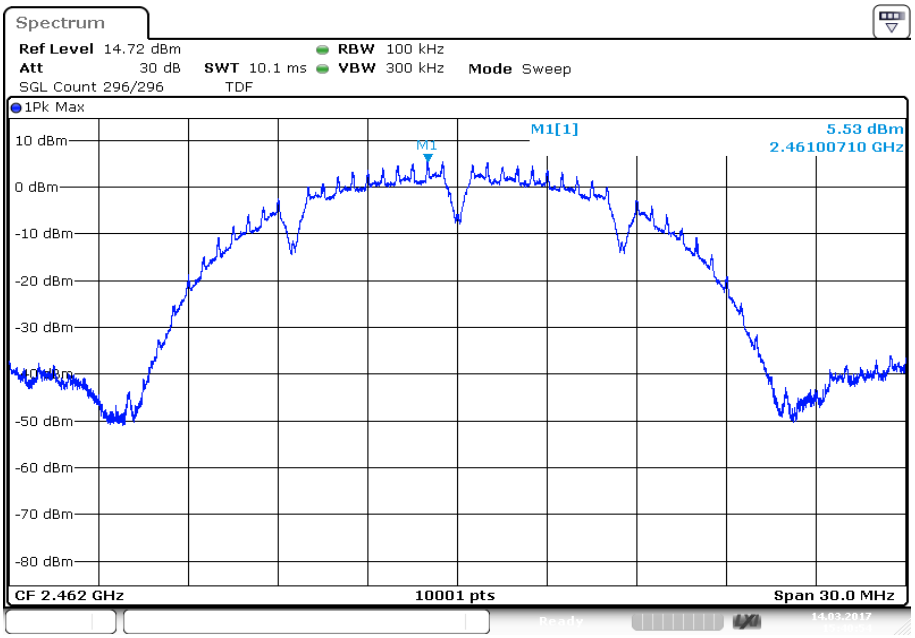
Date: 14.MAR.2017 15:06:15

Plot 2: Middle channel



Date: 14.MAR.2017 15:29:04

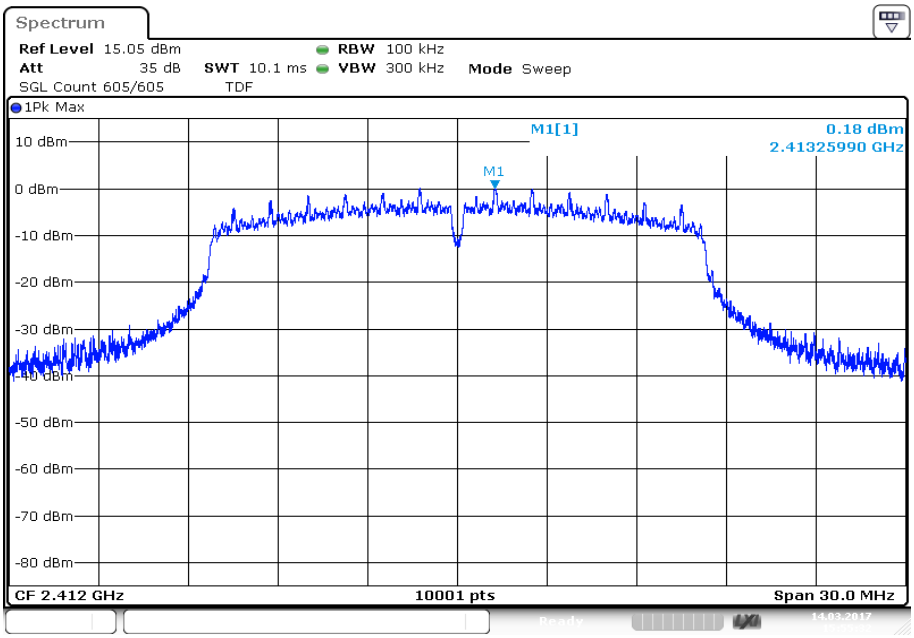
Plot 3: Highest channel



Date: 14.MAR.2017 15:40:55

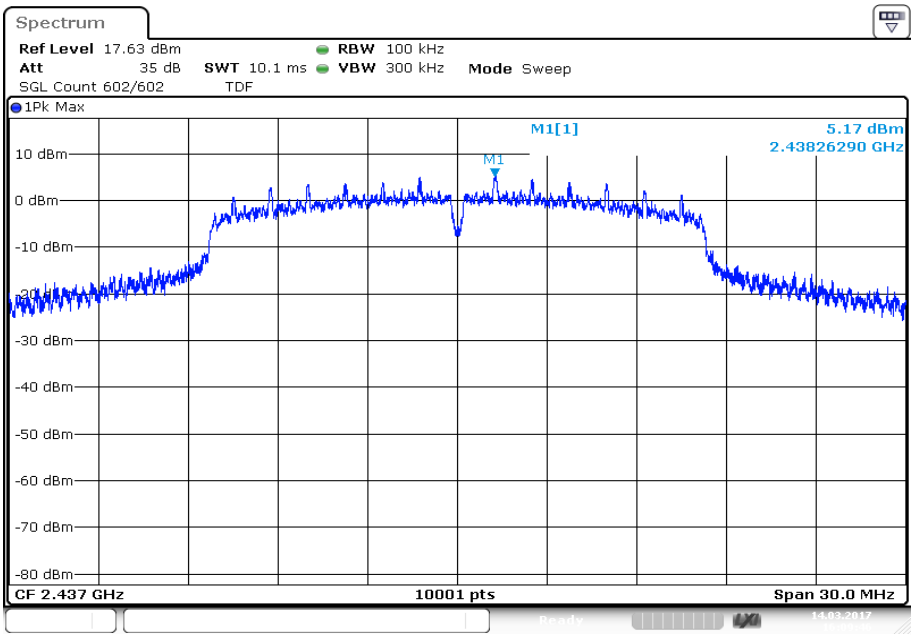
Plots: OFDM / g – mode

Plot 1: Lowest channel



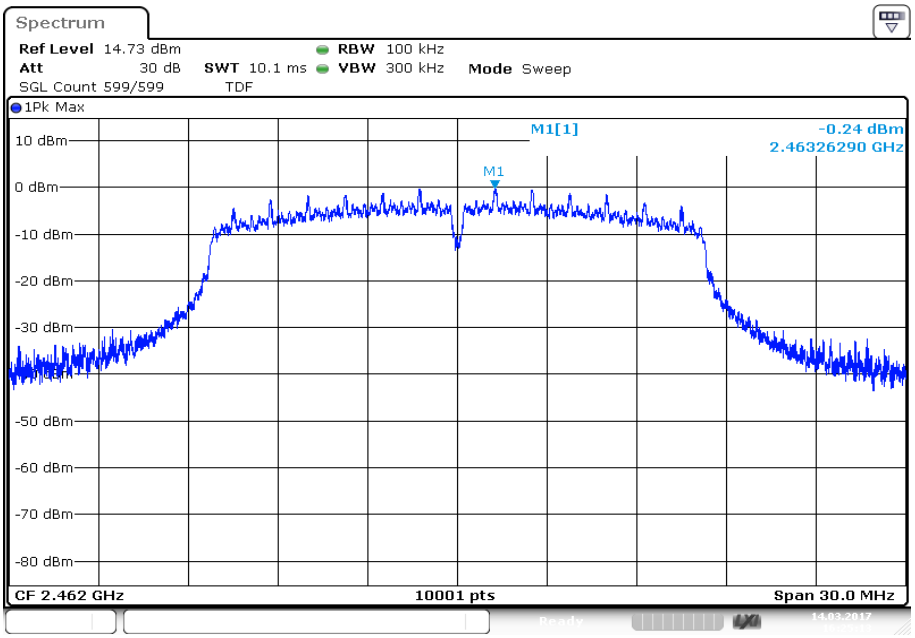
Date: 14.MAR.2017 15:55:33

Plot 2: Middle channel



Date: 14.MAR.2017 16:09:47

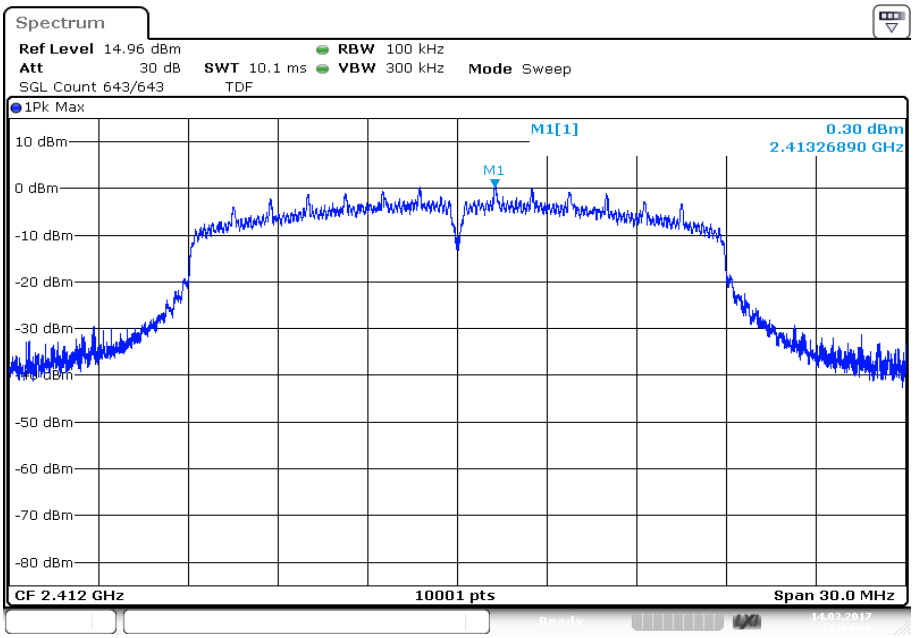
Plot 3: Highest channel



Date: 14.MAR.2017 16:25:13

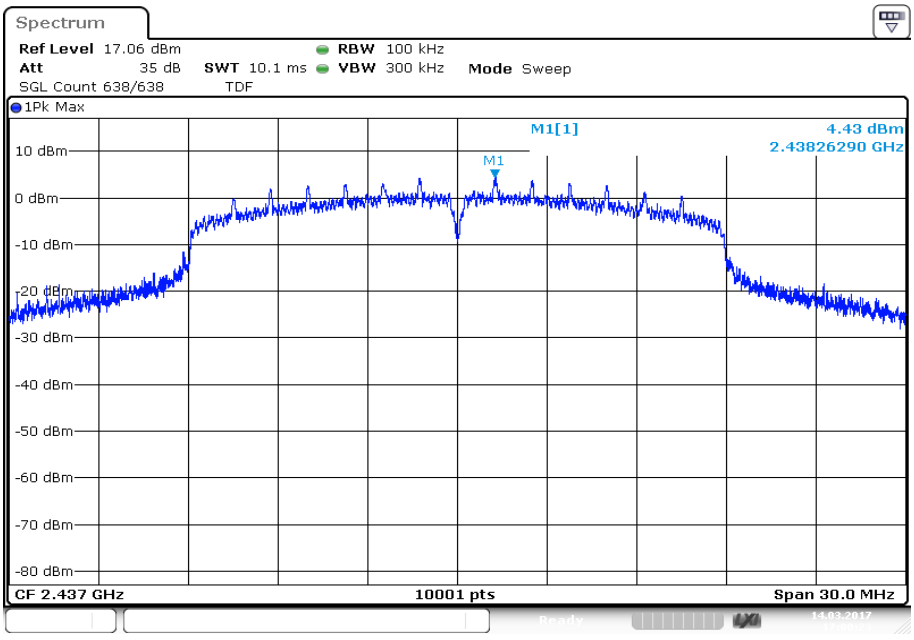
Plots: OFDM / n HT20 – mode

Plot 1: Lowest channel



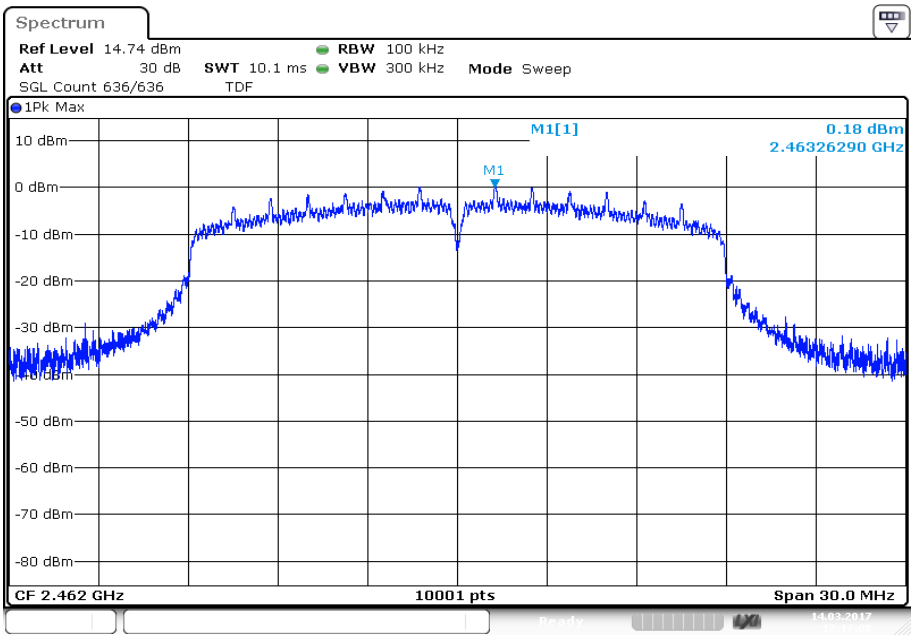
Date: 14.MAR.2017 16:44:00

Plot 2: Middle channel



Date: 14.MAR.2017 17:00:24

Plot 3: Highest channel



Date: 14.MAR.2017 17:17:09

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 6.3 – A
Measurement uncertainty	See sub clause 8

Limits:

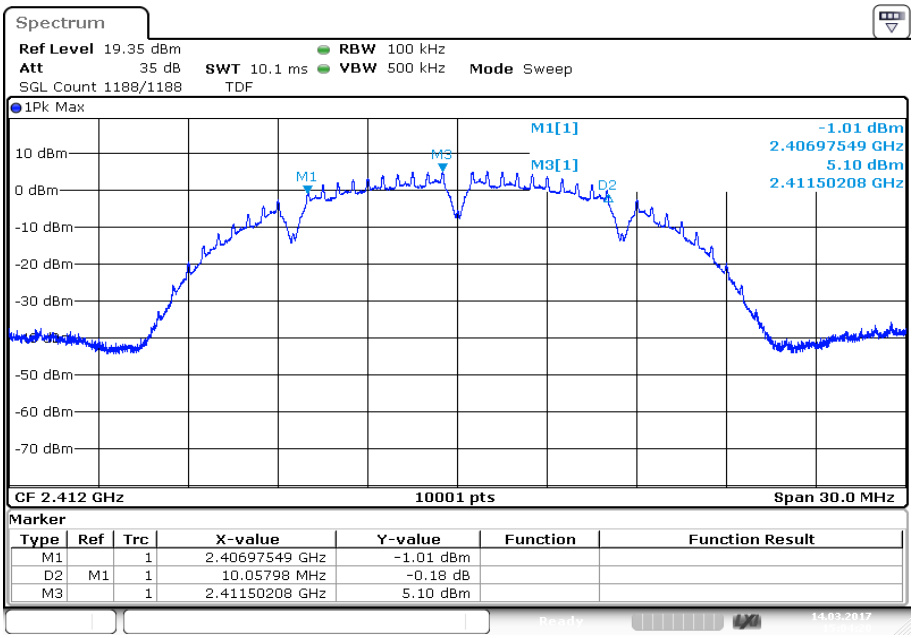
FCC	IC
Systems using digital modulation techniques may operate in the 2400–2483.5 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.	

Results:

Frequency	6 dB DTS bandwidth [kHz]		
	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	10058	10061	10055
OFDM / g – mode	15100	15097	15100
OFDM / n HT20 – mode	15100	15097	15100

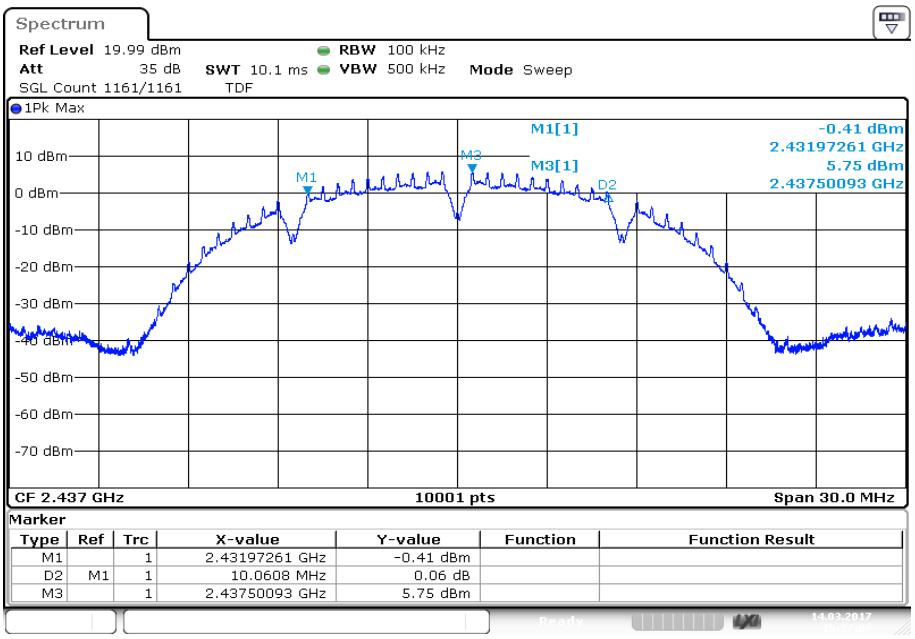
Plots: DSSS / b – mode

Plot 1: Lowest channel



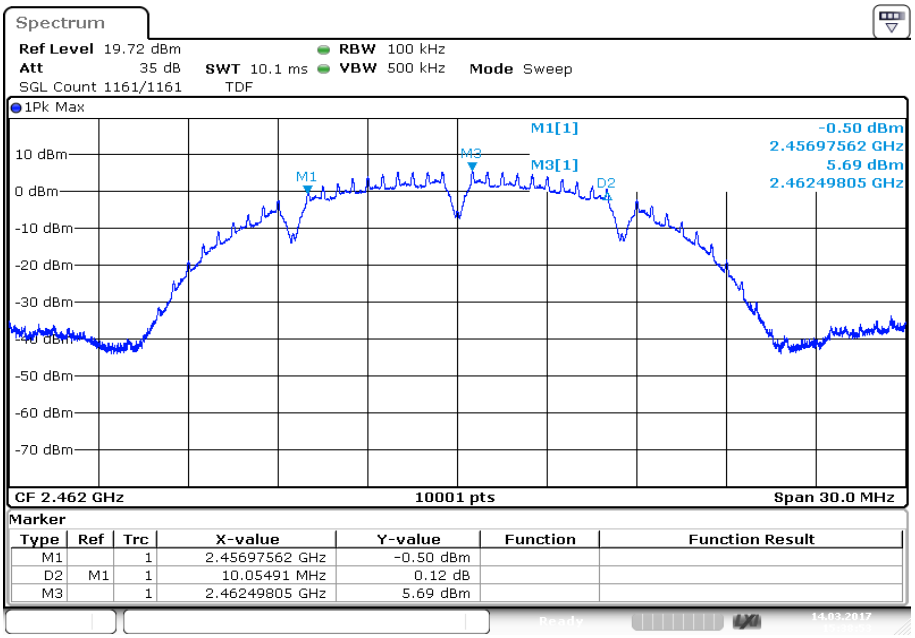
Date: 14.MAR.2017 15:04:21

Plot 2: Middle channel



Date: 14.MAR.2017 15:27:08

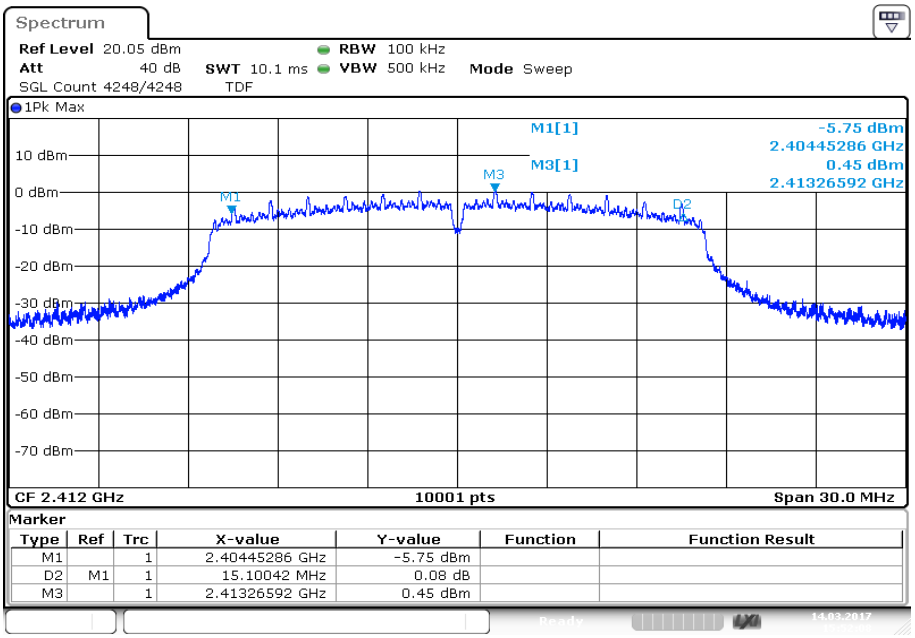
Plot 3: Highest channel



Date: 14.MAR.2017 15:38:54

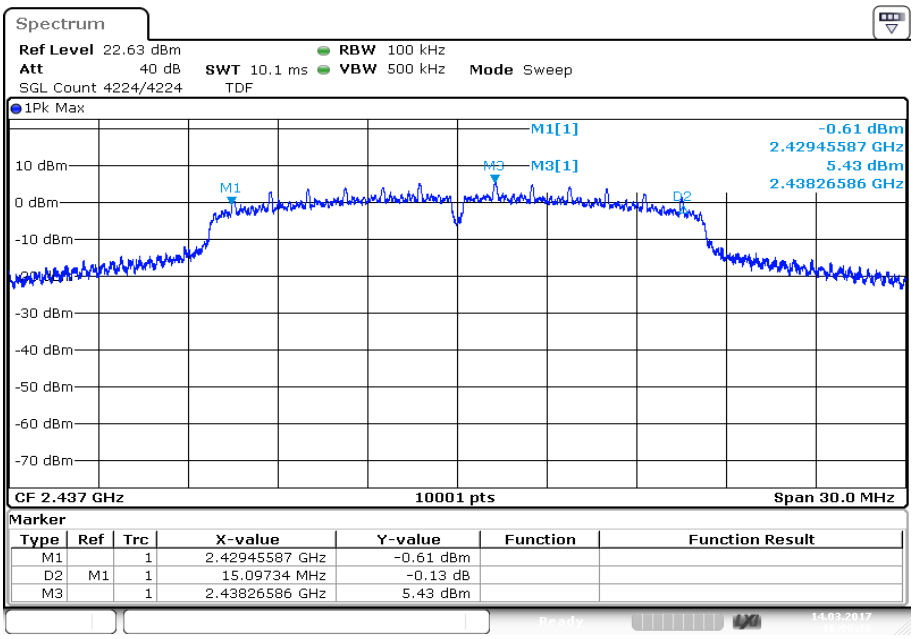
Plots: OFDM / g – mode

Plot 1: Lowest channel



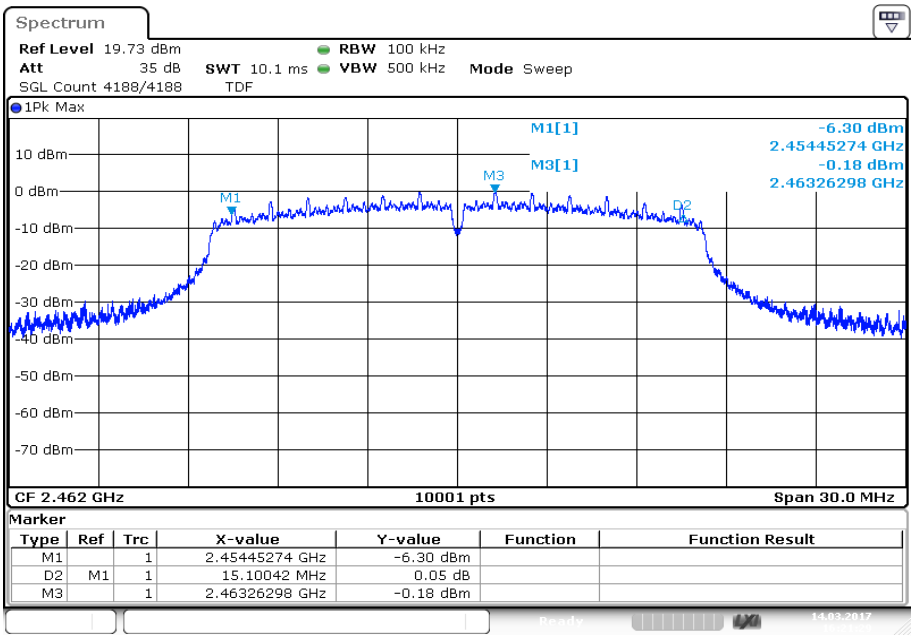
Date: 14.MAR.2017 15:52:09

Plot 2: Middle channel



Date: 14.MAR.2017 16:06:16

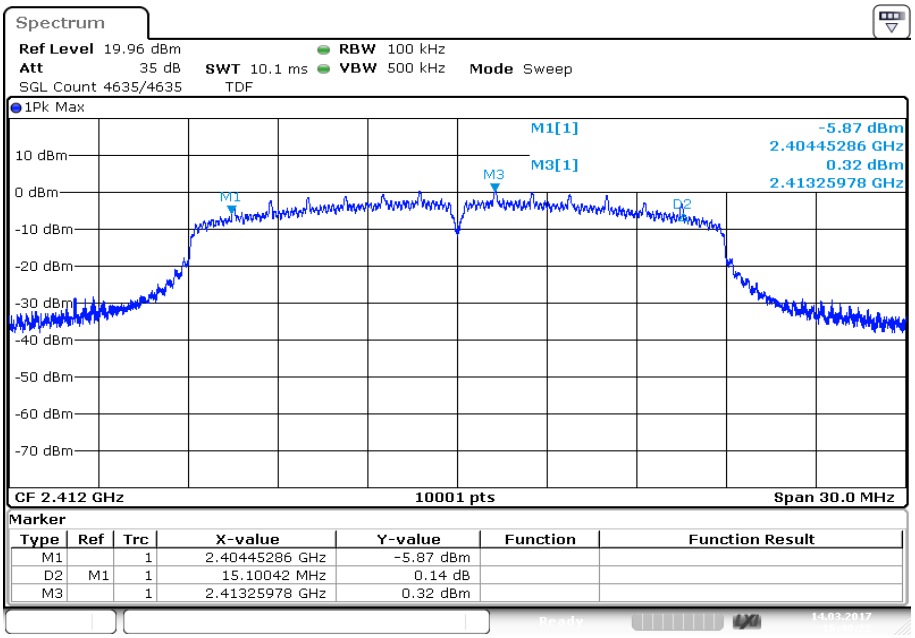
Plot 3: Highest channel



Date: 14.MAR.2017 16:21:29

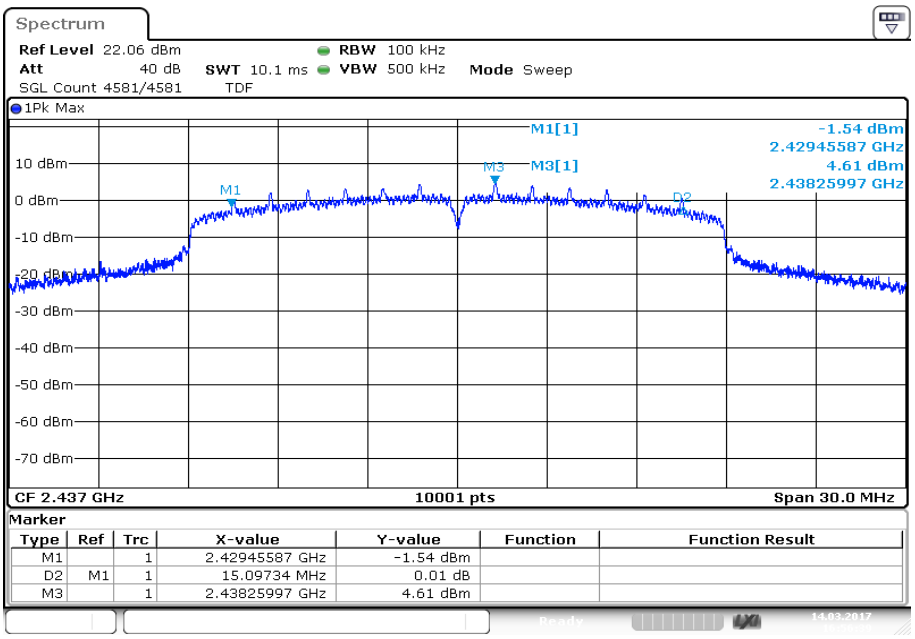
Plots: OFDM / n HT20 – mode

Plot 1: Lowest channel



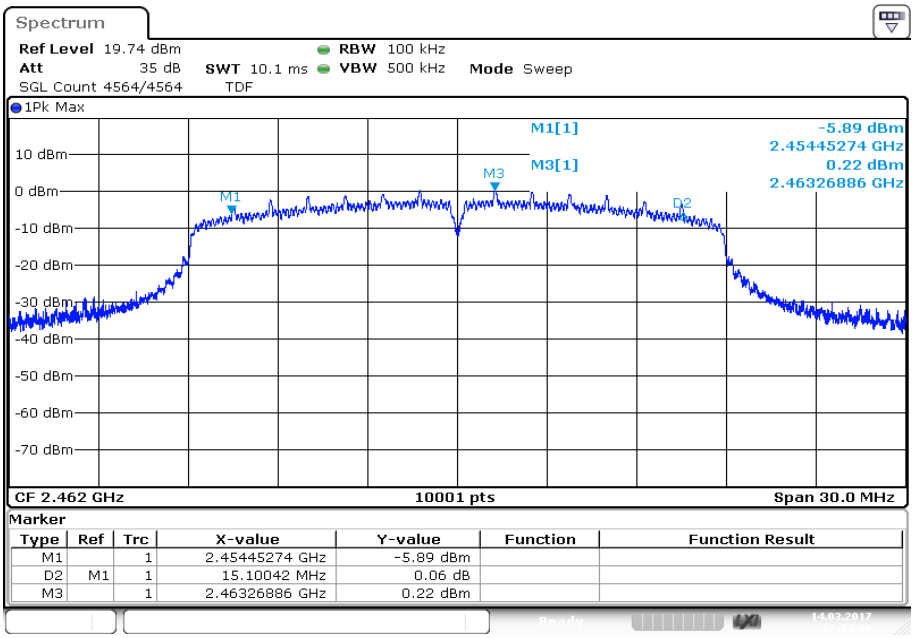
Date: 14.MAR.2017 16:40:22

Plot 2: Middle channel



Date: 14.MAR.2017 16:56:40

Plot 3: Highest channel



Date: 14.MAR.2017 17:13:09

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 6.5 – A
Measurement uncertainty	See sub clause 8

Usage:

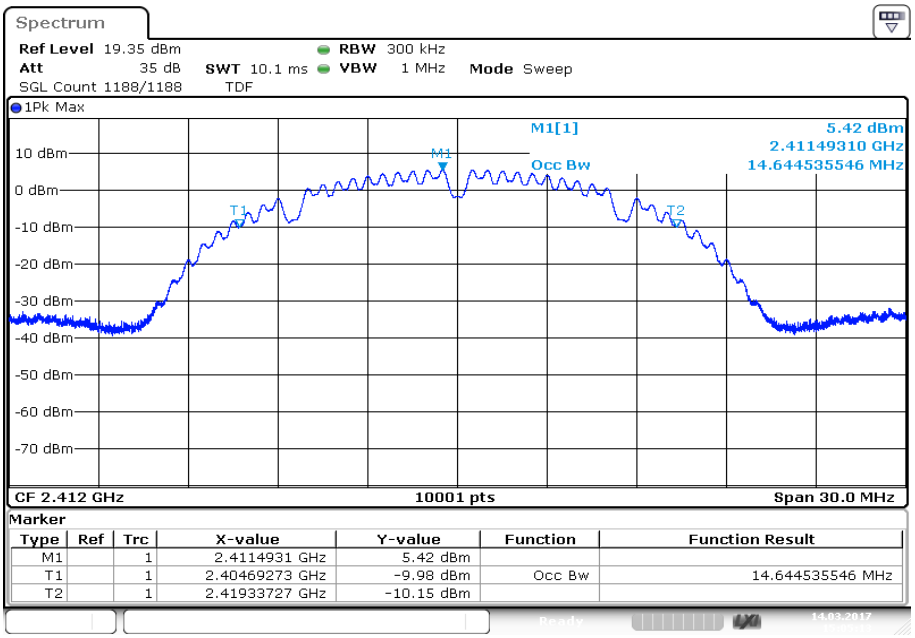
-/-	IC
OBW is necessary for Emission Designator	

Results:

Modulation	99% bandwidth [kHz]		
Frequency	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	14645	14732	14744
OFDM / g – mode	16405	19468	16405
OFDM / n HT20 – mode	17548	18766	17554

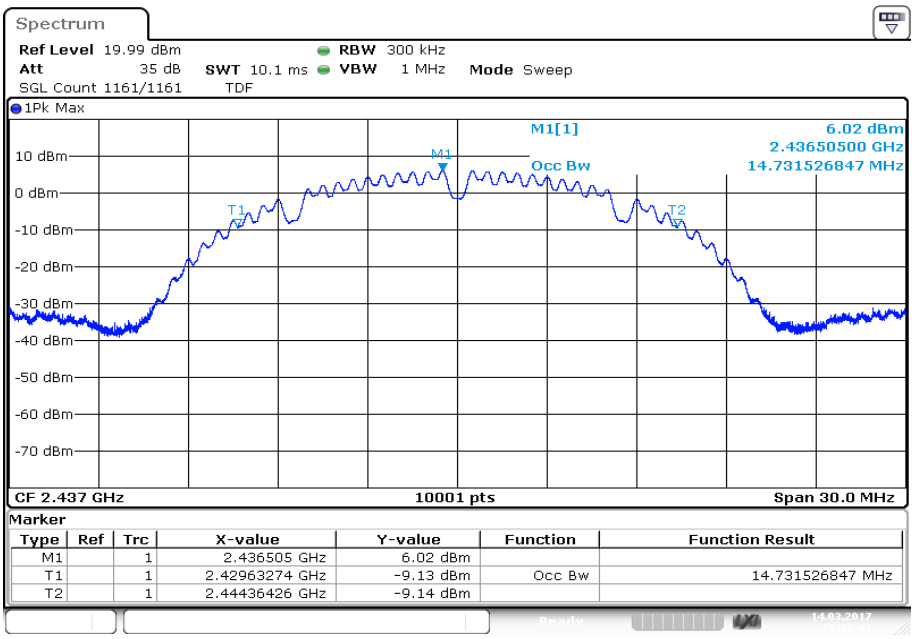
Plots: DSSS / b – mode

Plot 1: Lowest channel



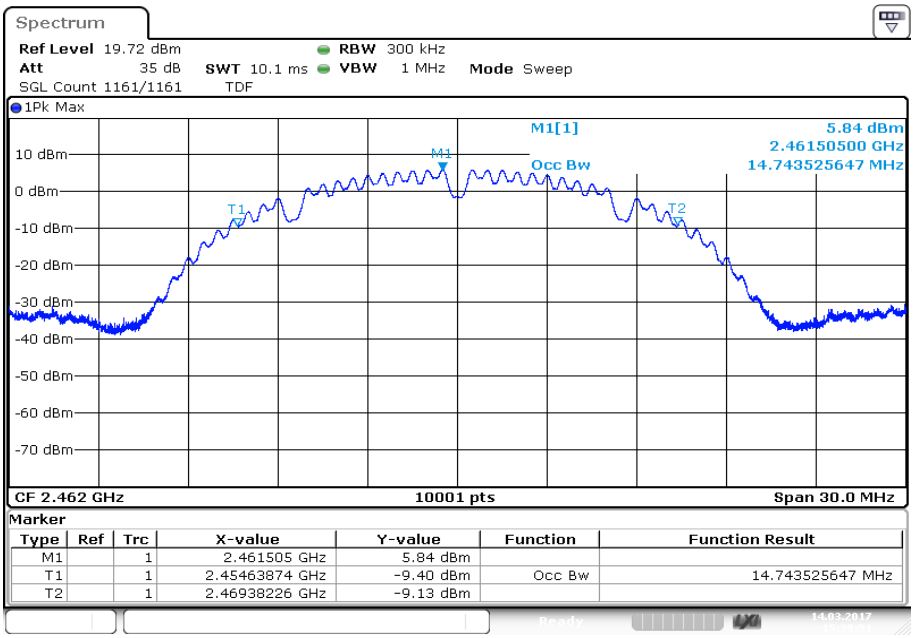
Date: 14.MAR.2017 15:05:14

Plot 2: Middle channel



Date: 14.MAR.2017 15:28:02

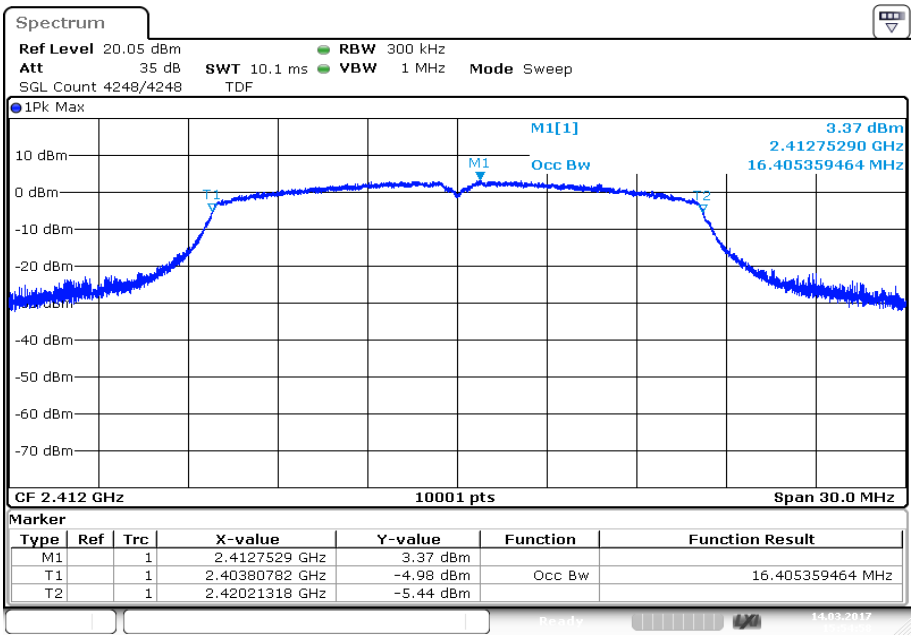
Plot 3: Highest channel



Date: 14.MAR.2017 15:39:52

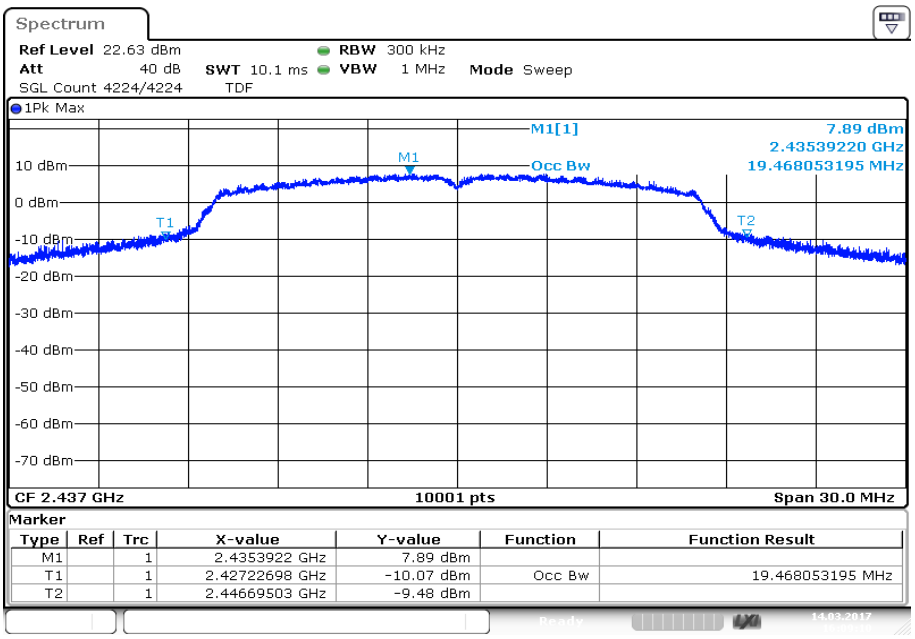
Plots: OFDM / g – mode

Plot 1: Lowest channel



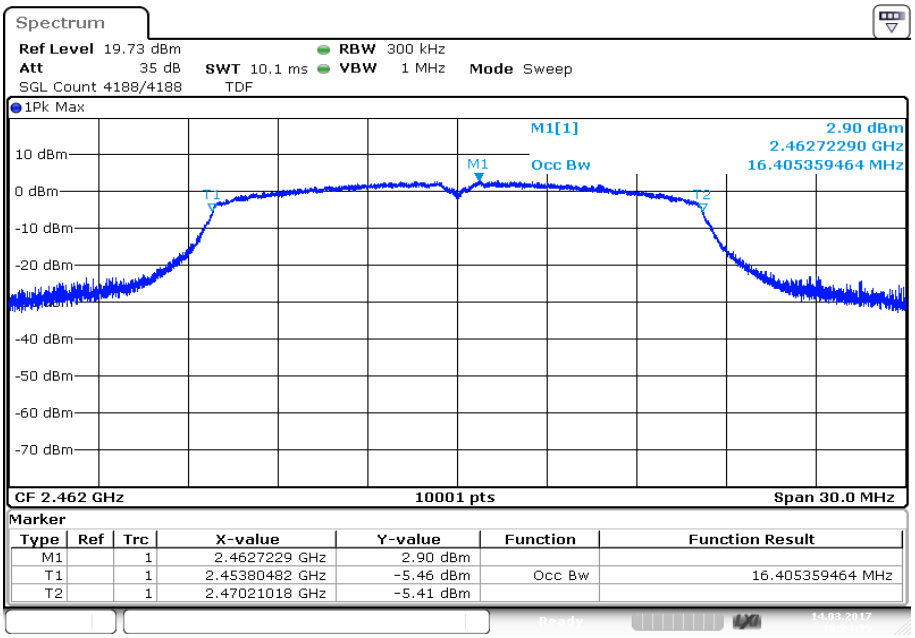
Date: 14.MAR.2017 15:54:59

Plot 2: Middle channel



Date: 14.MAR.2017 16:09:11

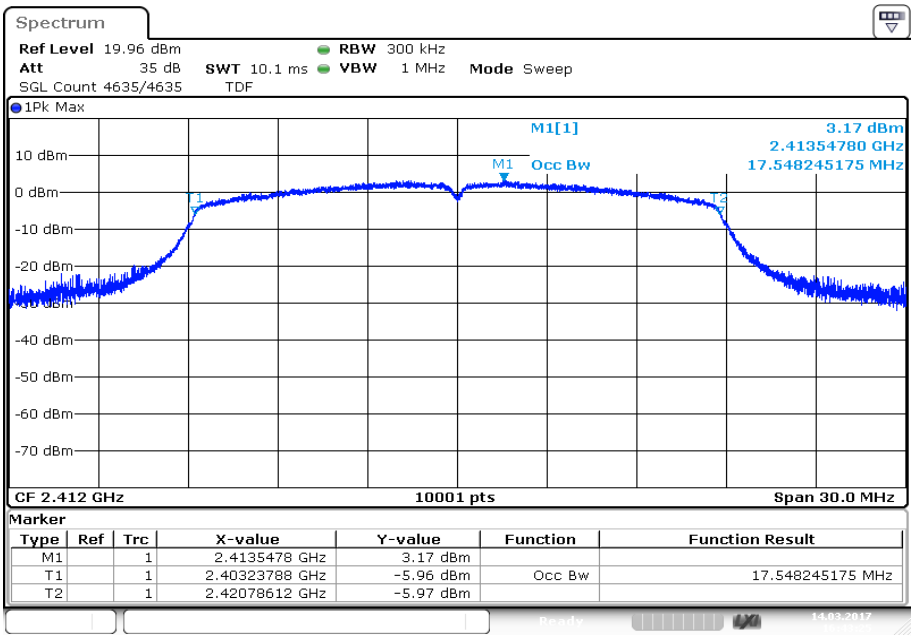
Plot 3: Highest channel



Date: 14.MAR.2017 16:24:36

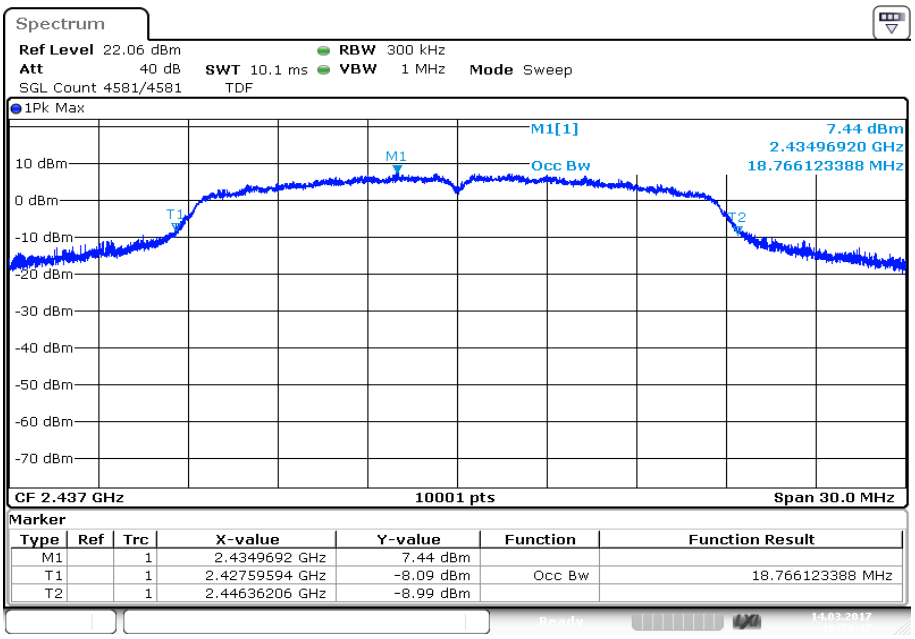
Plots: OFDM / n HT20 – mode

Plot 1: Lowest channel



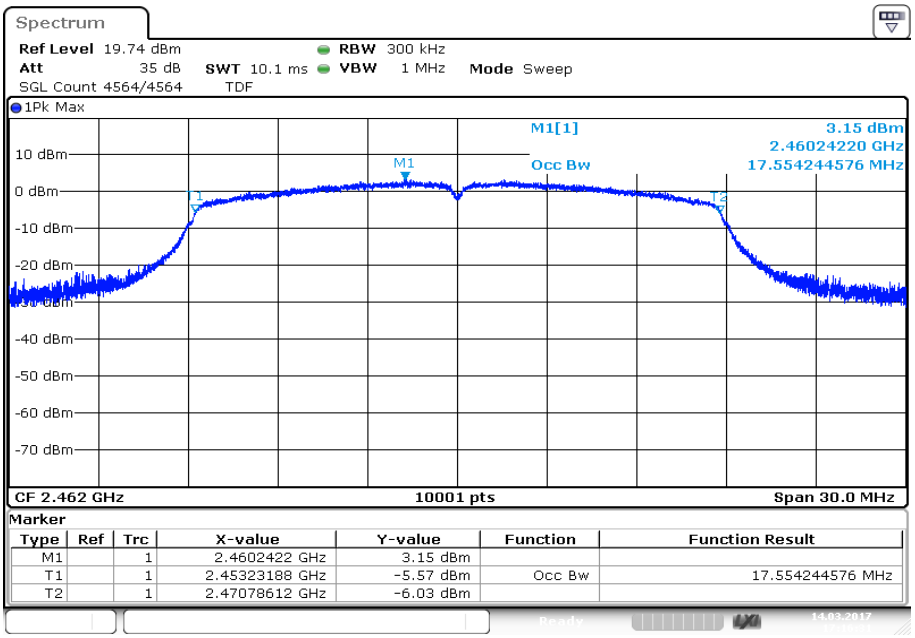
Date: 14.MAR.2017 16:43:26

Plot 2: Middle channel



Date: 14.MAR.2017 16:59:48

Plot 3: Highest channel



Date: 14.MAR.2017 17:16:32

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 6.5 – A
Measurement uncertainty	See sub clause 8

Usage:

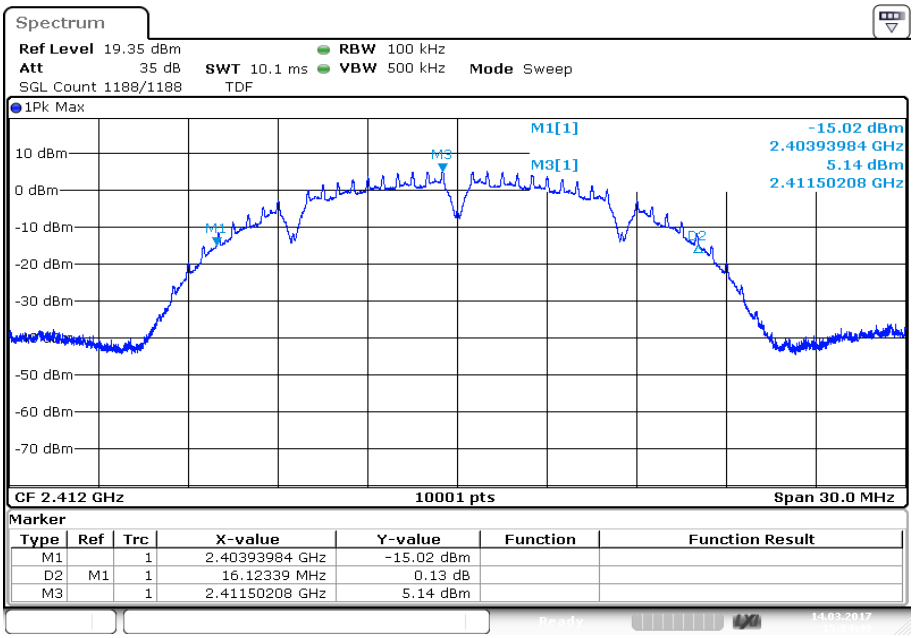
-/-	IC
Within the used band!	

Results:

Modulation	20 dB bandwidth [MHz]		
Frequency	2412 MHz	2437 MHz	2462 MHz
DSSS / b – mode	16.12	17.03	17.02
OFDM / g – mode	17.30	20.30	17.10
OFDM / n HT20 – mode	18.42	18.91	18.42

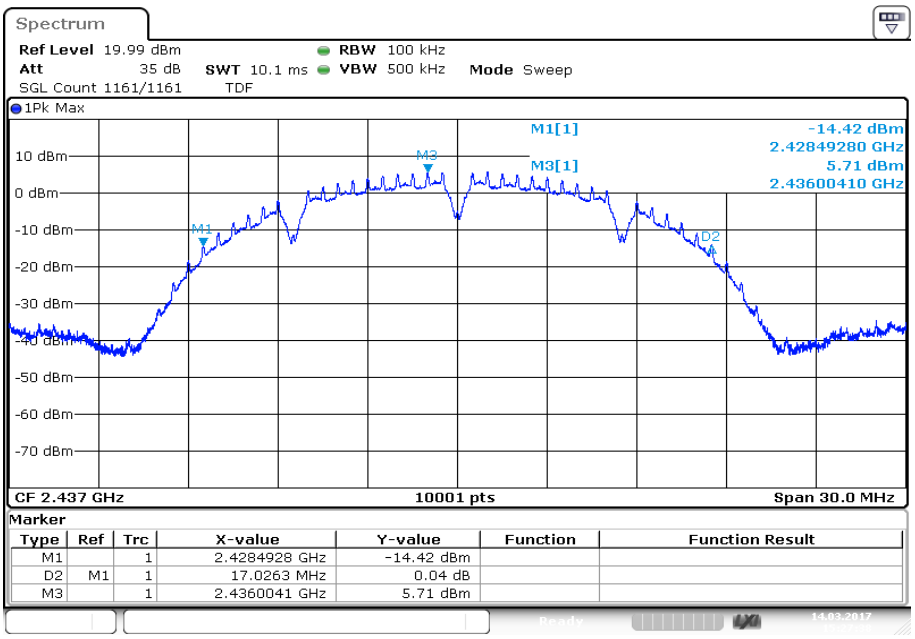
Plots: DSSS / b – mode

Plot 1: Lowest channel



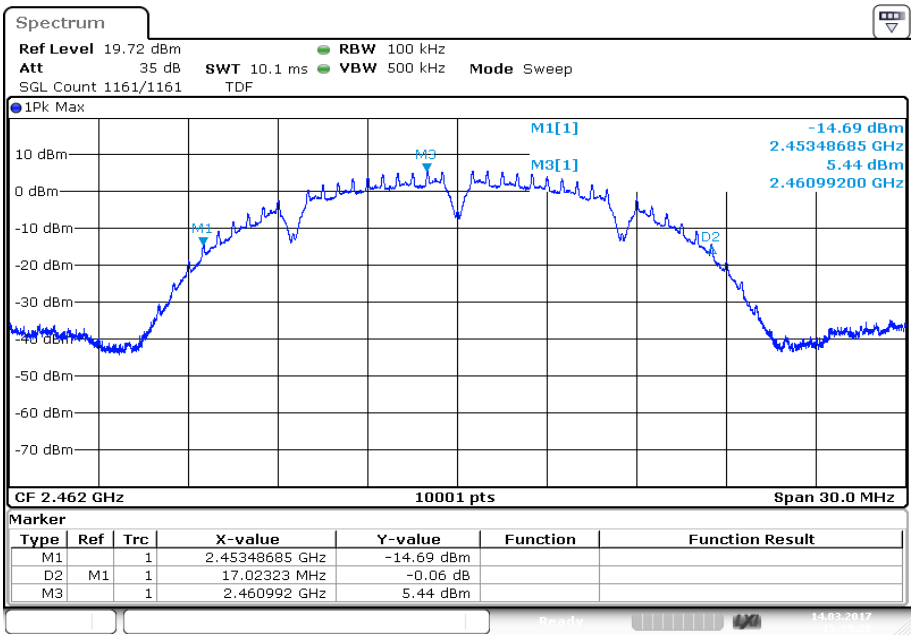
Date: 14.MAR.2017 15:04:50

Plot 2: Middle channel



Date: 14.MAR.2017 15:27:39

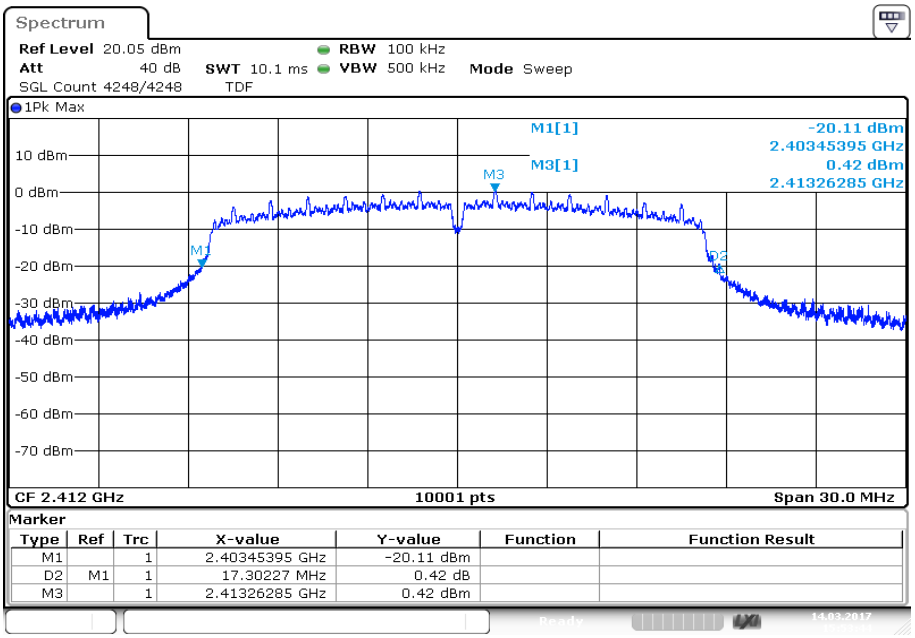
Plot 3: Highest channel



Date: 14.MAR.2017 15:39:28

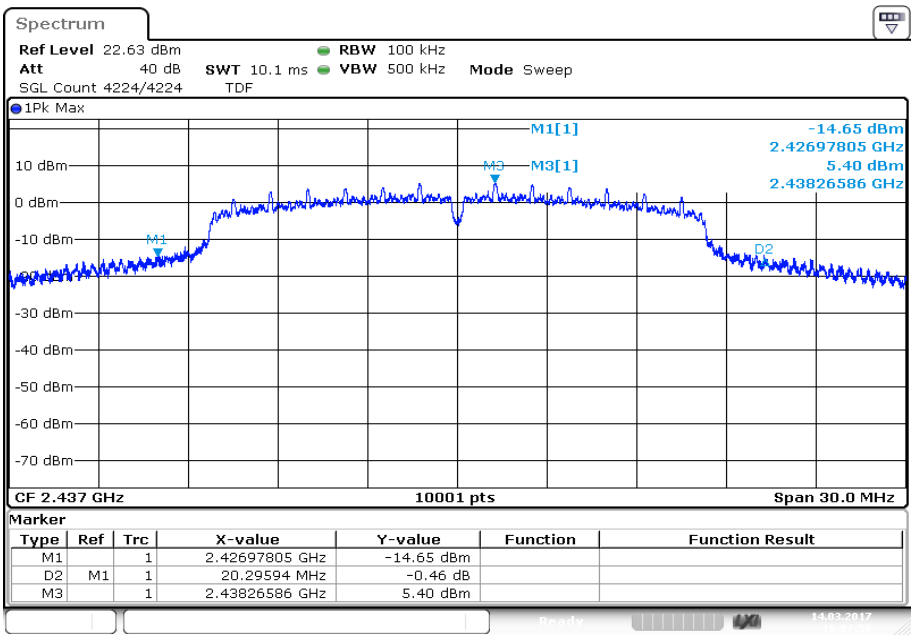
Plots: OFDM / g – mode

Plot 1: Lowest channel



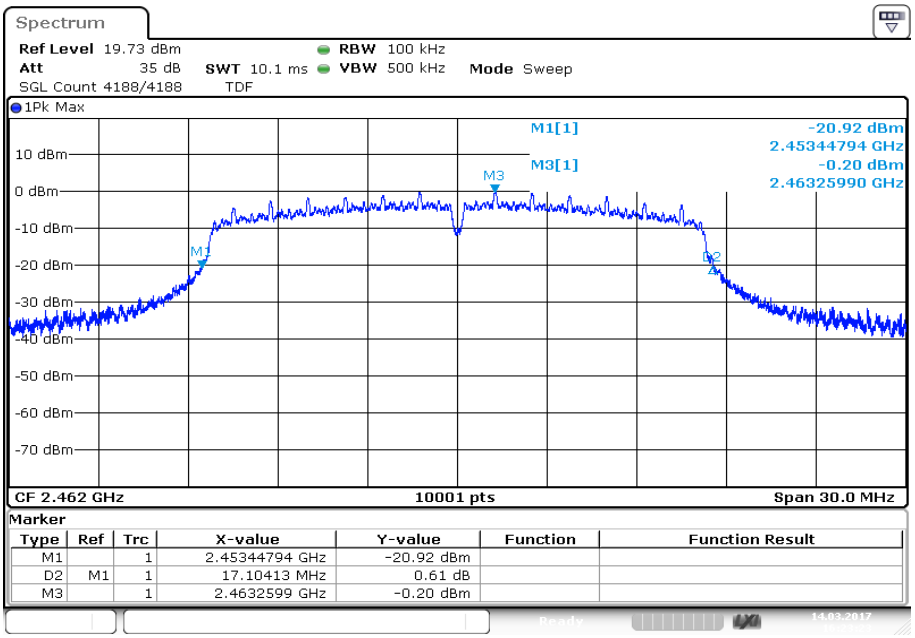
Date: 14.MAR.2017 15:53:45

Plot 2: Middle channel



Date: 14.MAR.2017 16:07:58

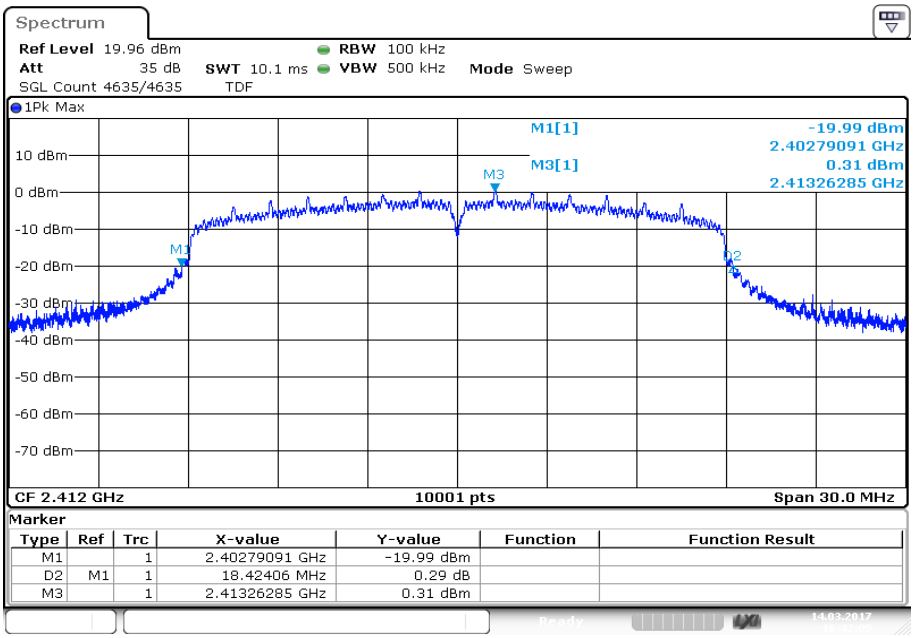
Plot 3: Highest channel



Date: 14.MAR.2017 16:23:23

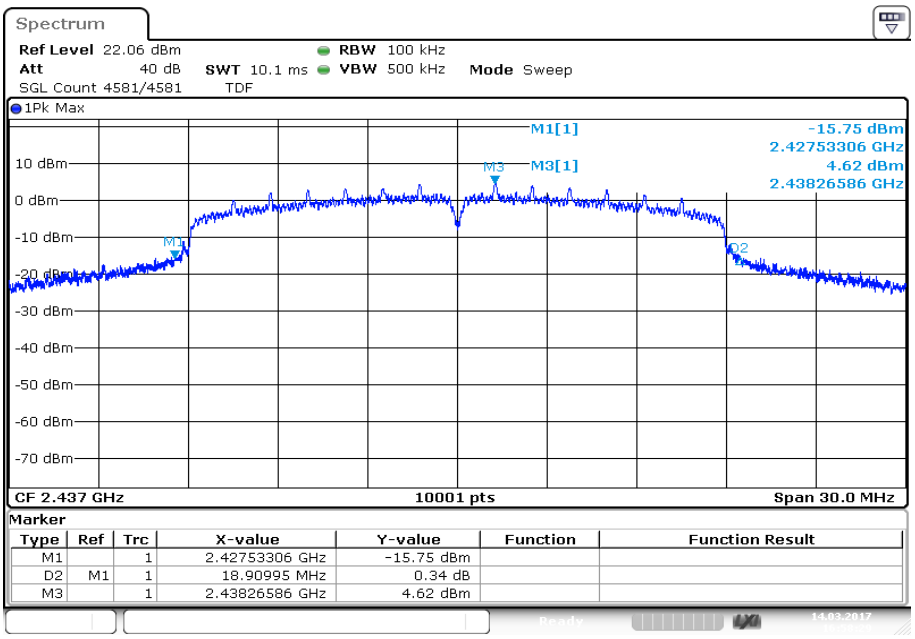
Plots: OFDM / n HT20 – mode

Plot 1: Lowest channel



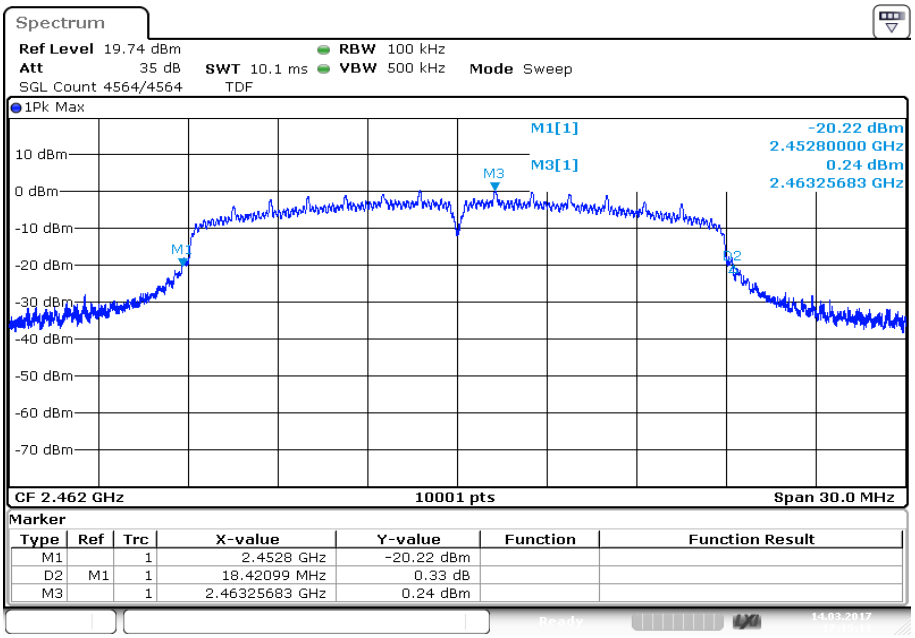
Date: 14.MAR.2017 16:42:06

Plot 2: Middle channel



Date: 14.MAR.2017 16:58:29

Plot 3: Highest channel



Date: 14.MAR.2017 17:15:13

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 6.5 – A
Measurement uncertainty	See sub clause 8

Limits:

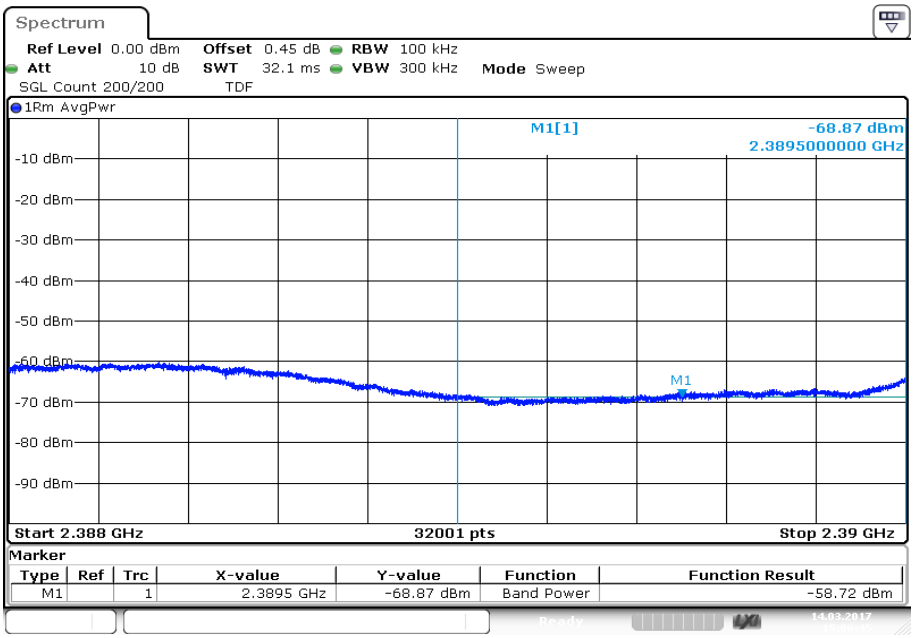
FCC	IC
-41.26 dBm	

Results:

Scenario Modulation	Band edge compliance [dBm] (gain calculation)			
	DSSS / b – mode	OFDM / g – mode	OFDM / n HT20 – mode	OFDM / n HT40 – mode
Max. lower band edge power conducted	-58.72	-51.71	-49.71	-/-
Antenna gain	-1.5			
Max. lower band edge power radiated	-60.22	-53.21	-51.21	-/-
Max. upper band edge power conducted	-56.04	-50.60	-48.38	-/-
Antenna gain	-1.5			
Max. upper band edge power radiated	-57.54	-52.10	-49.88	-/-

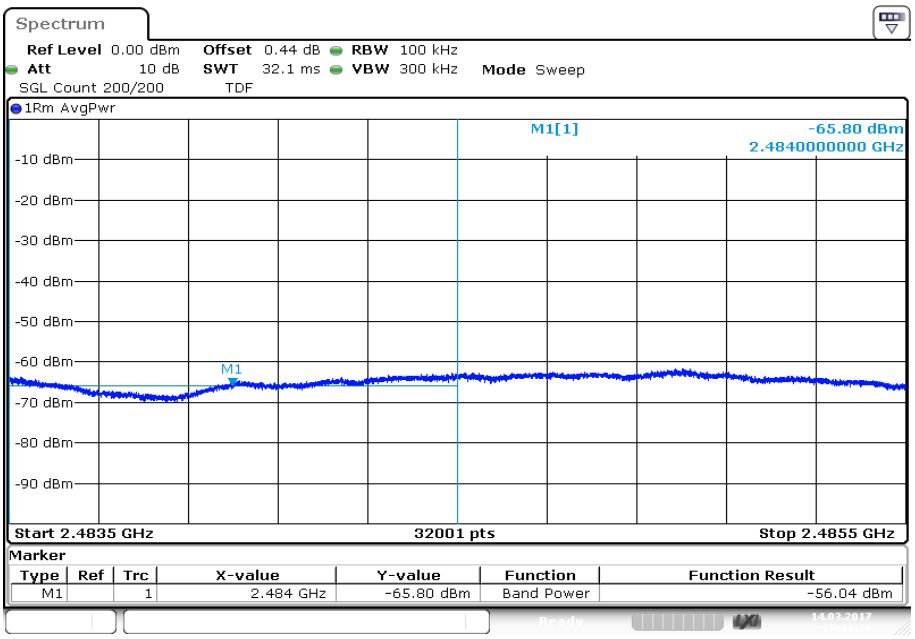
Plots: DSSS / b – mode

Plot 1: Lower band edge



Date: 14.MAR.2017 15:06:45

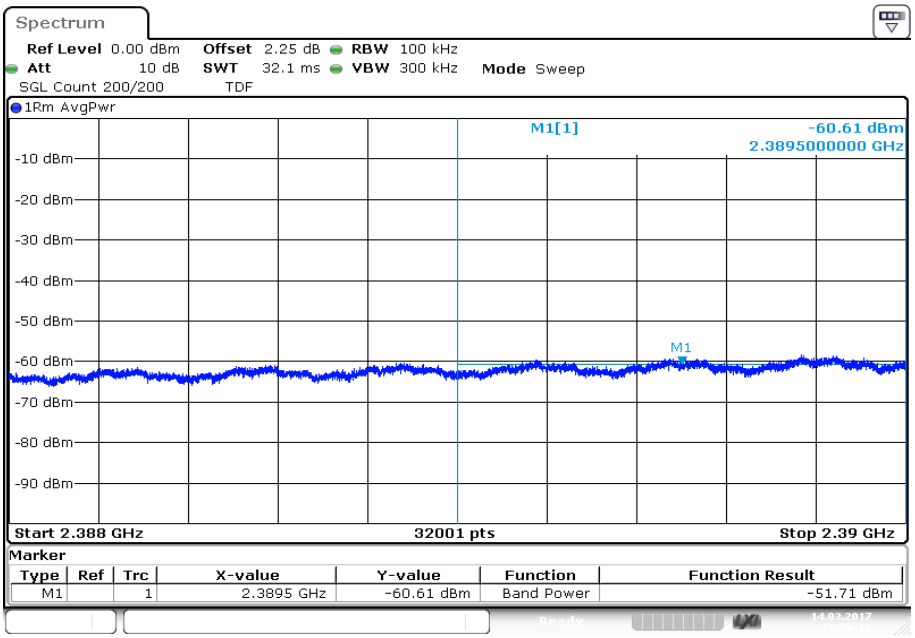
Plot 2: Upper band edge



Date: 14.MAR.2017 15:41:39

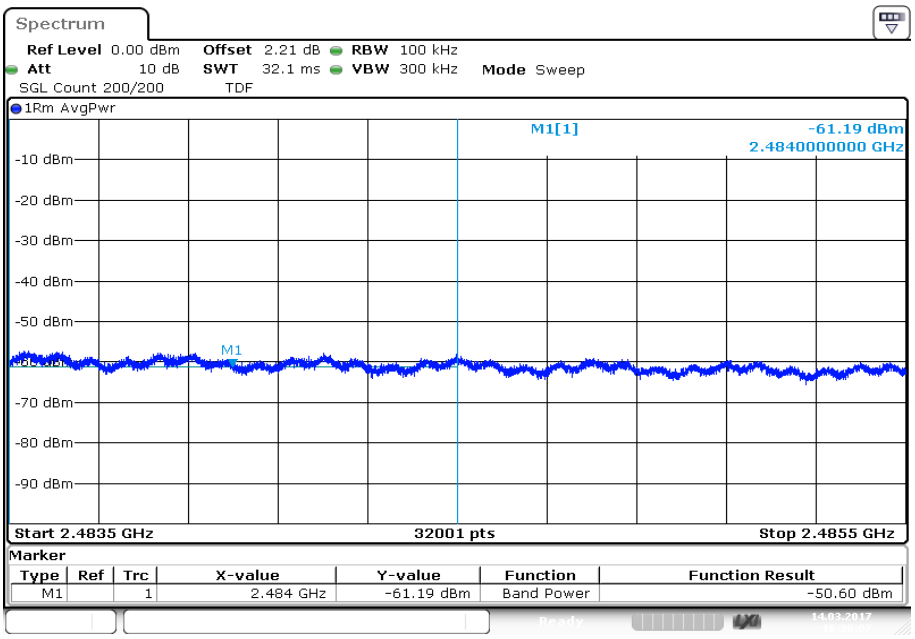
Plots: OFDM / g – mode

Plot 1: Lower band edge



Date: 14.MAR.2017 15:56:13

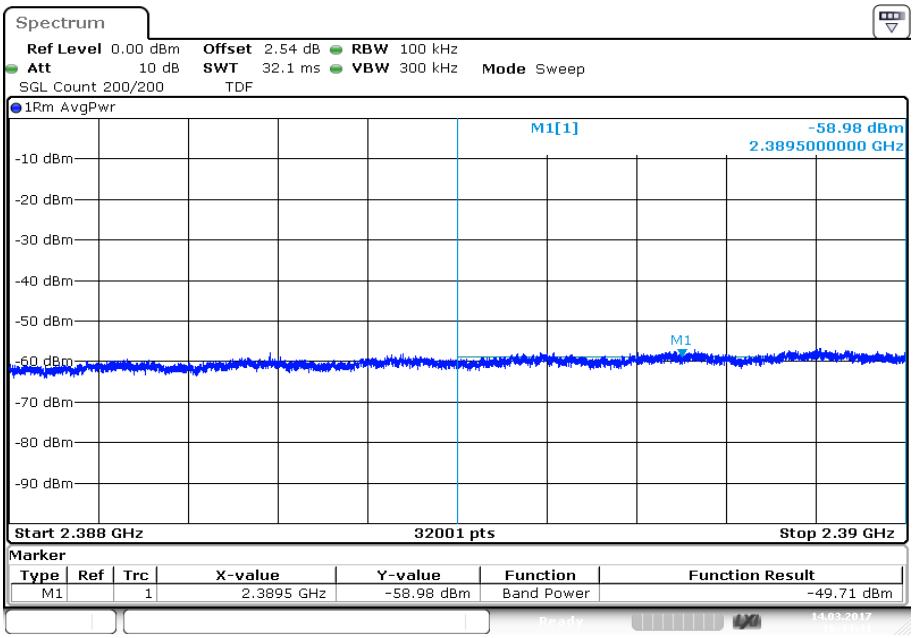
Plot 2: Upper band edge



Date: 14.MAR.2017 16:26:08

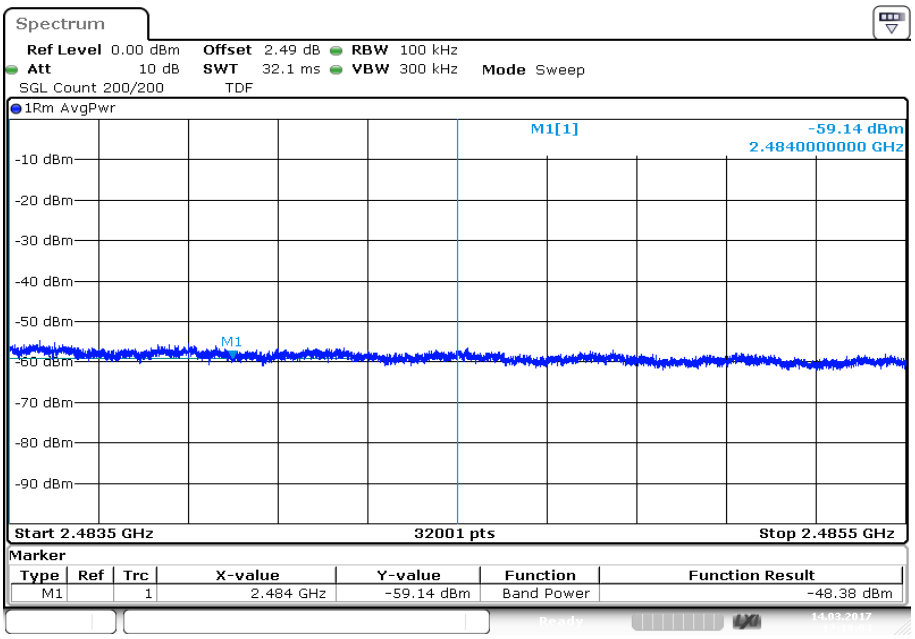
Plots: OFDM / n HT20 – mode

Plot 1: Lower band edge



Date: 14.MAR.2017 16:44:42

Plot 2: Upper band edge



Date: 14.MAR.2017 17:18:05

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 6.5 – A
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		4.36	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		5.20	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		4.97	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / g – mode

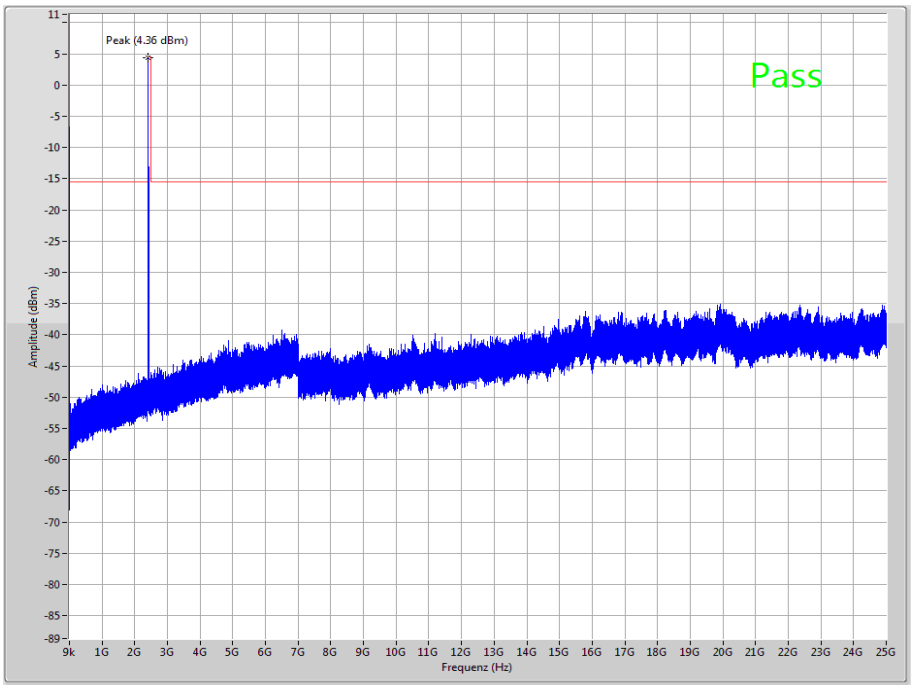
TX Spurious Emissions Conducted					
OFDM / g – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-0.70	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		4.03	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		-1.29	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

Results: OFDM / n HT20 – mode

TX Spurious Emissions Conducted					
OFDM / n HT20 – mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2412		-0.78	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2437		2.86	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant
2462		0.04	30 dBm		Operating frequency
No peaks detected or all detected emissions are below the -20 dBc & -30 dBc criteria.			-20 dBc (peak) -30 dBc (average)		compliant

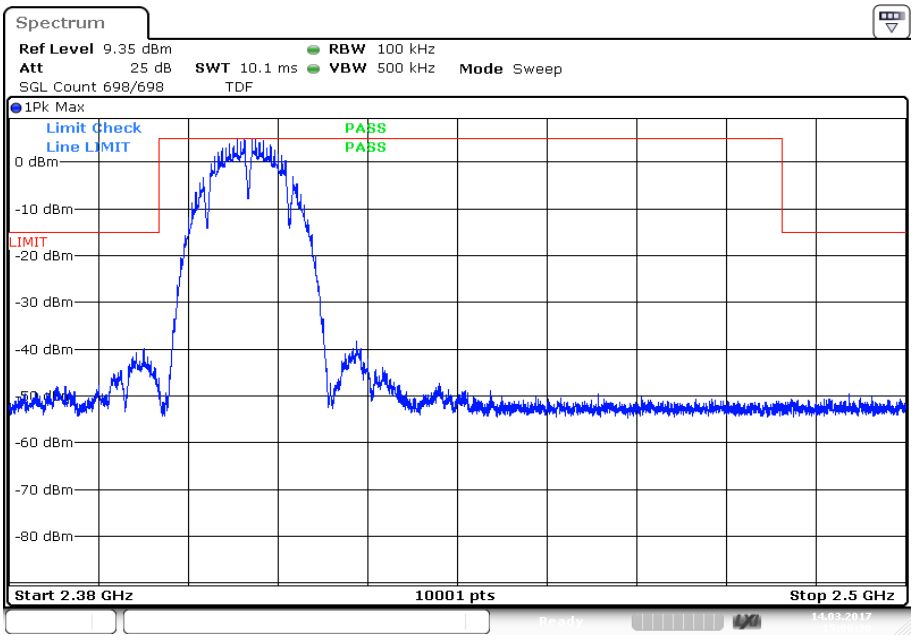
Plots: DSSS / b – mode

Plot 1: Lowest channel, up to 25 GHz



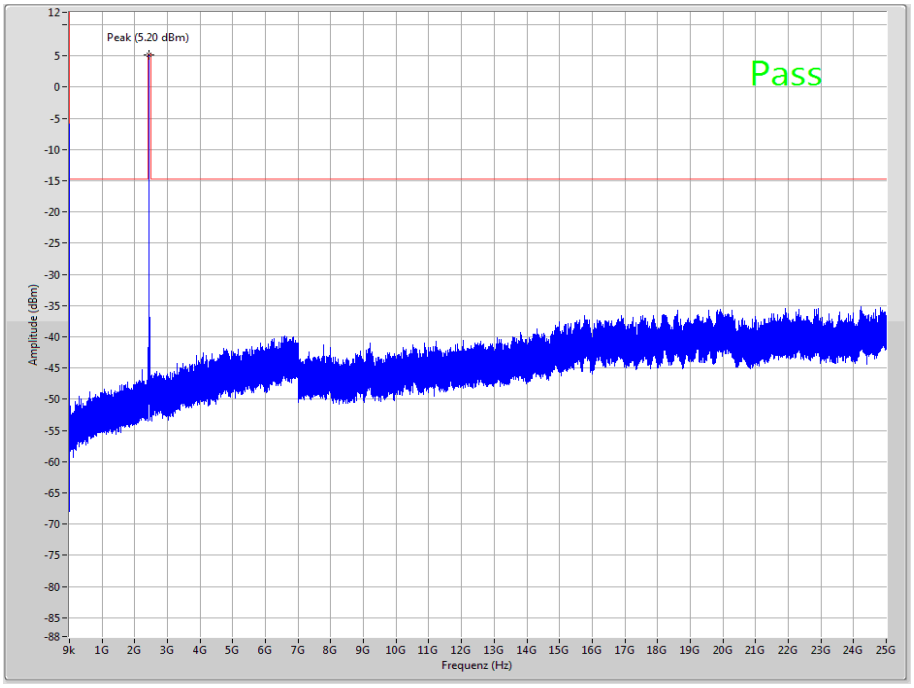
The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier



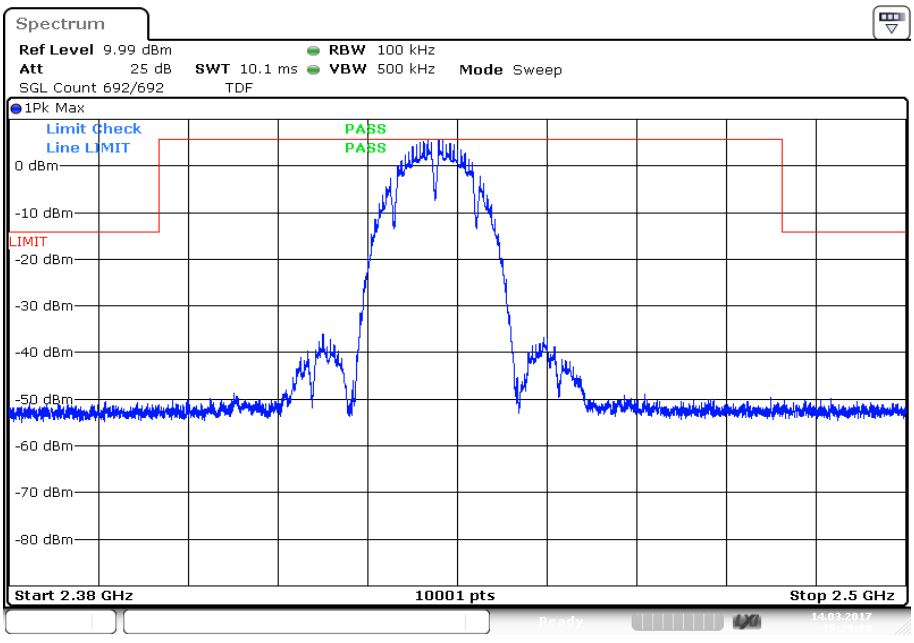
Date: 14.MAR.2017 15:06:31

Plot 3: Middle channel, up to 25 GHz



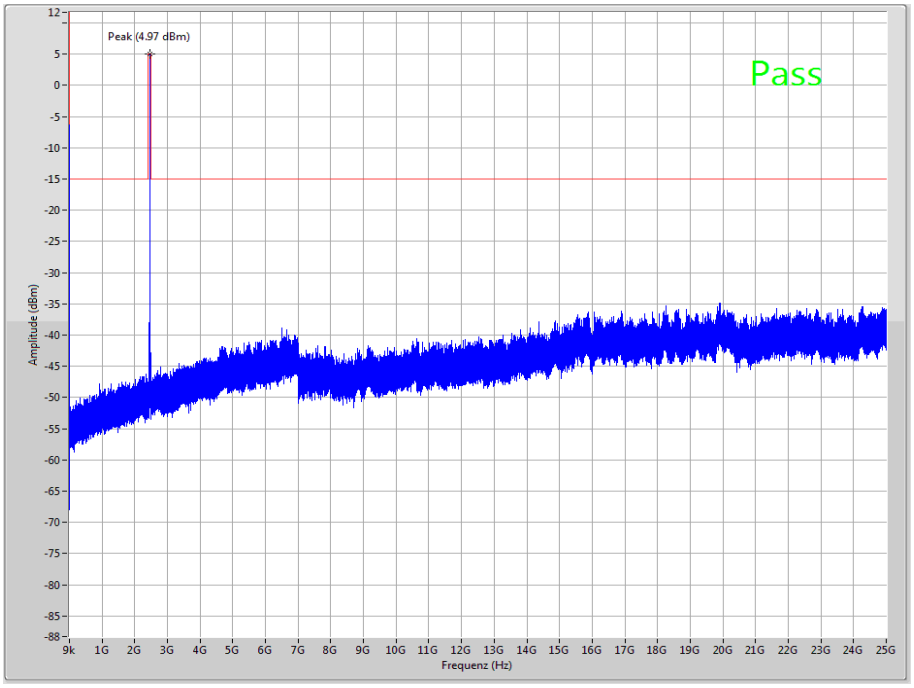
The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier



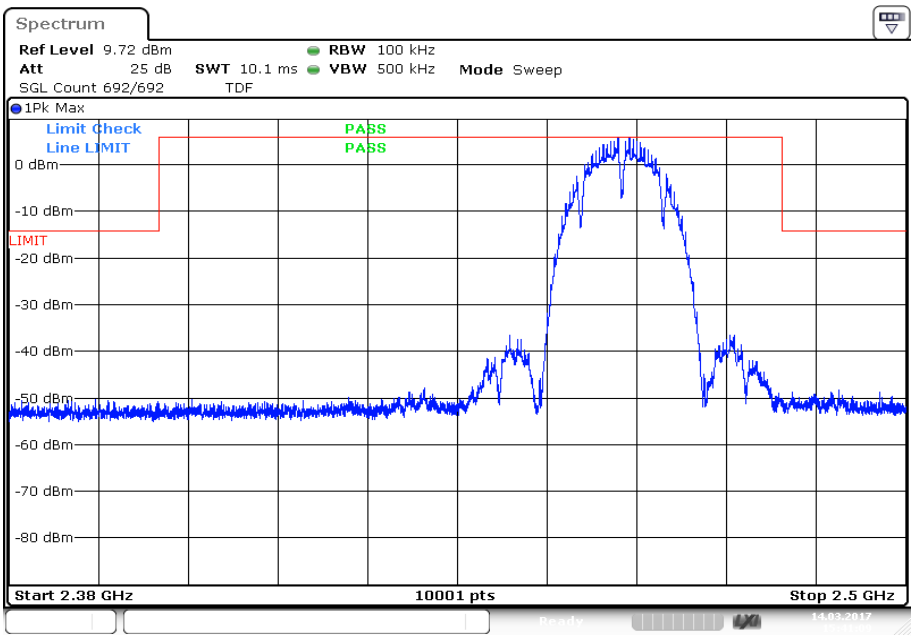
Date: 14.MAR.2017 15:29:19

Plot 5: Highest channel, up to 25 GHz



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

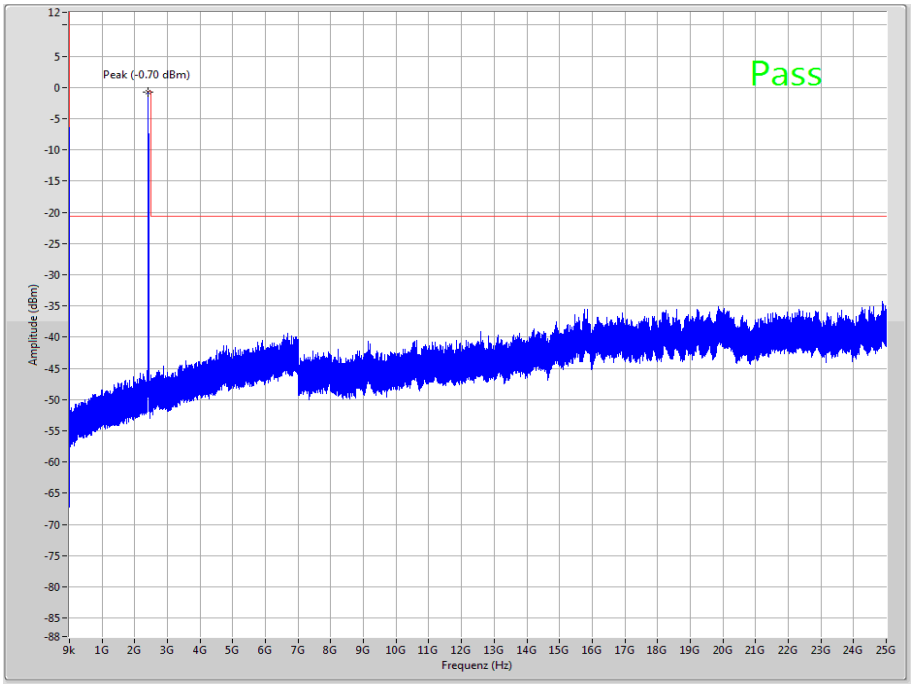
Plot 6: Highest channel, zoomed carrier



Date: 14.MAR.2017 15:41:10

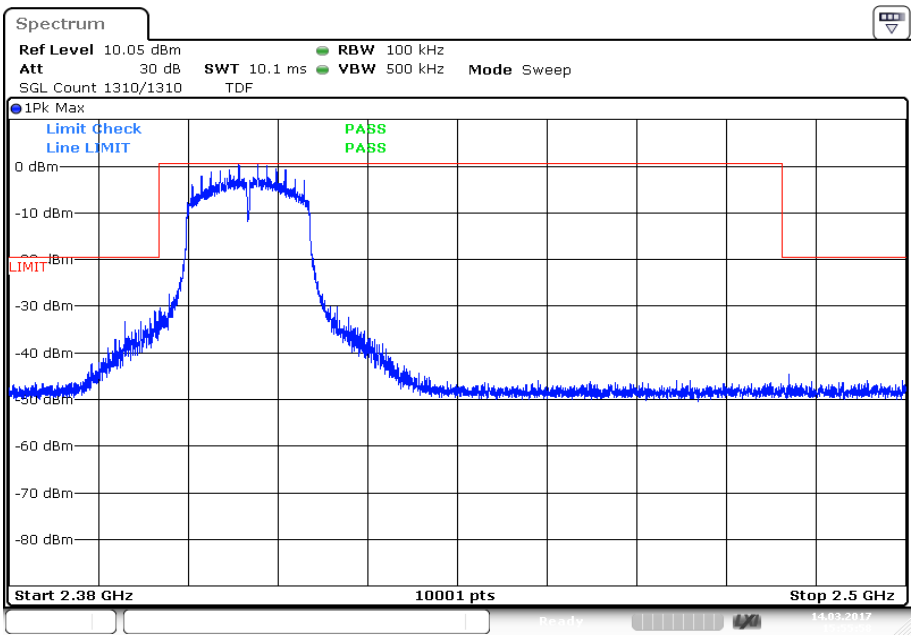
Plots: OFDM / g – mode

Plot 1: Lowest channel, up to 25 GHz



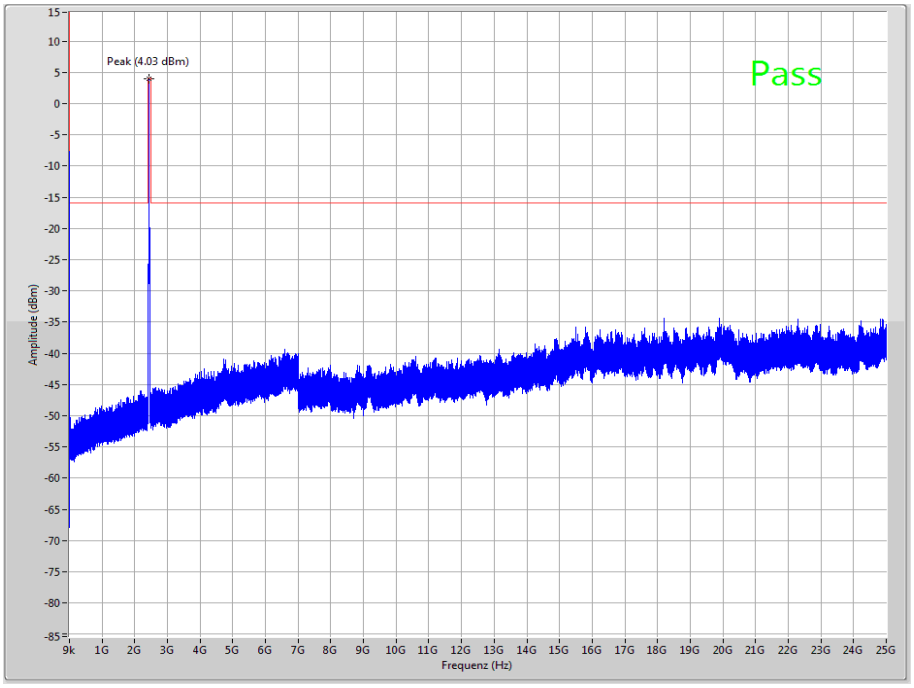
The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier



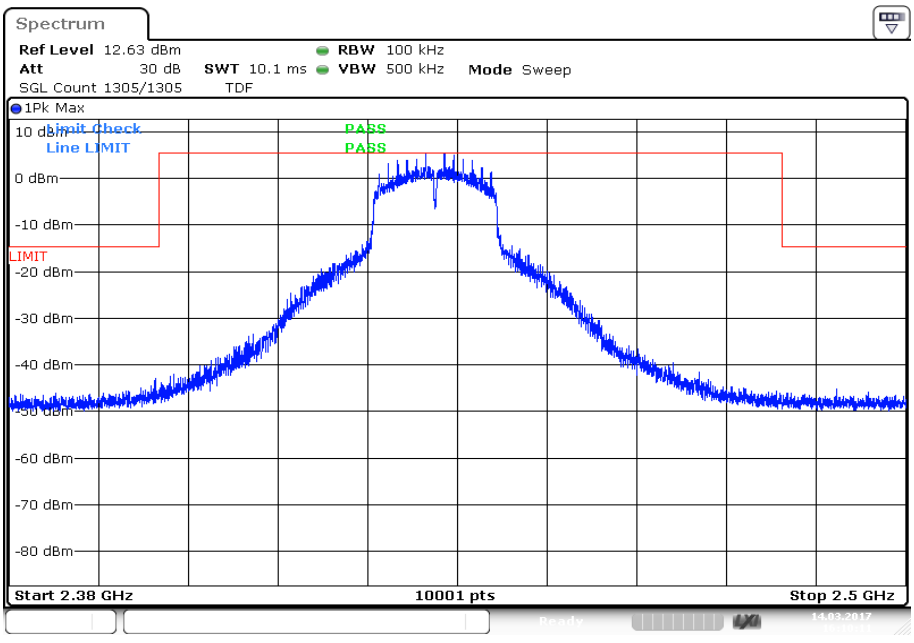
Date: 14.MAR.2017 15:55:58

Plot 3: Middle channel, up to 25 GHz



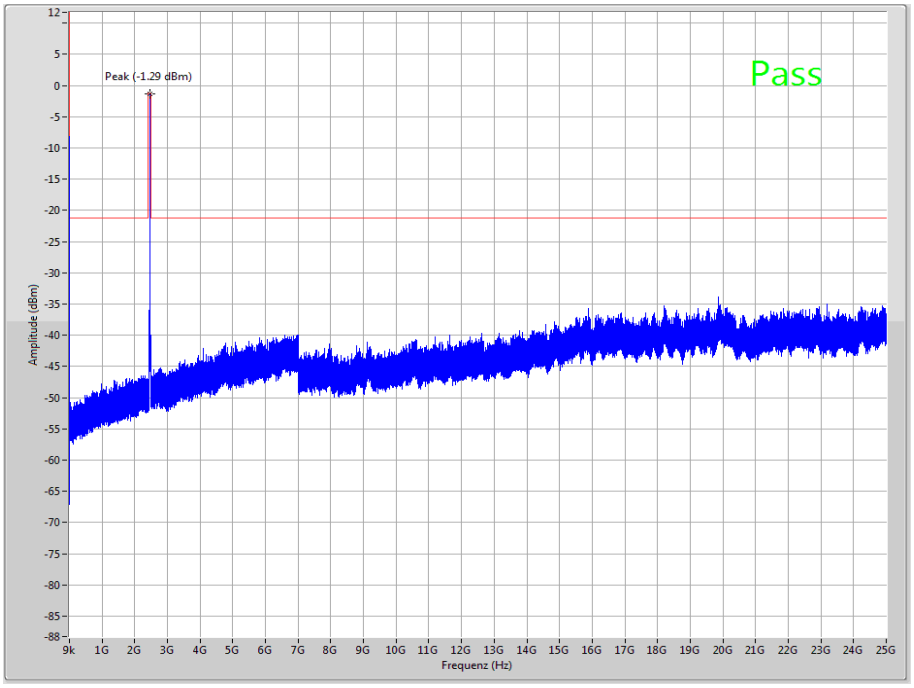
The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier



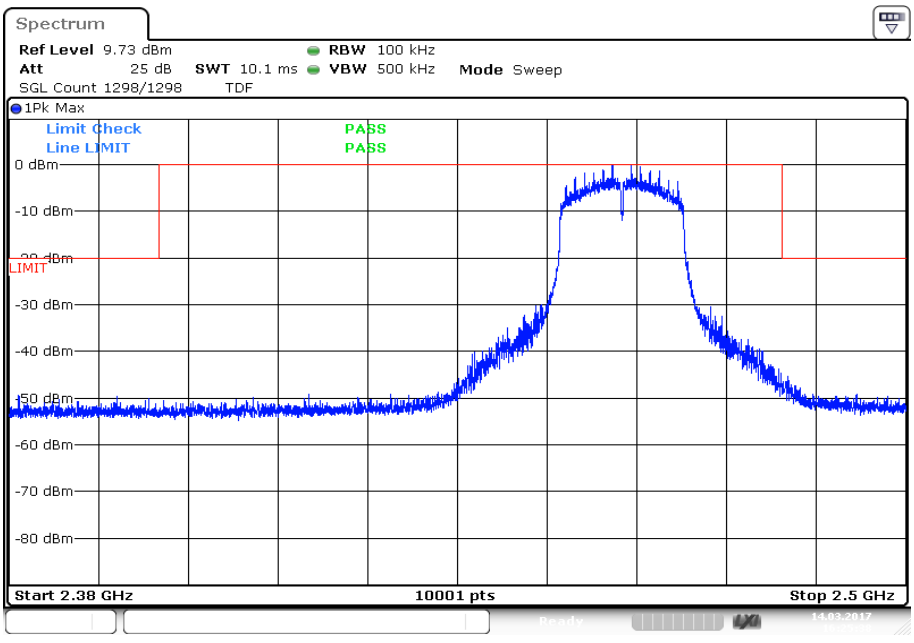
Date: 14.MAR.2017 16:10:12

Plot 5: Highest channel, up to 25 GHz



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

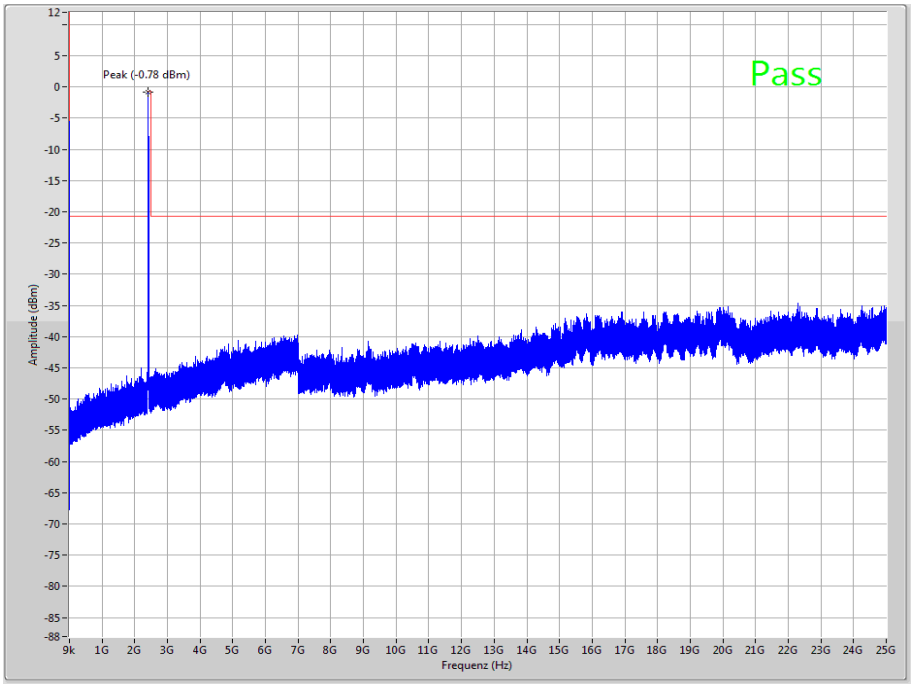
Plot 6: Highest channel, zoomed carrier



Date: 14.MAR.2017 16:25:39

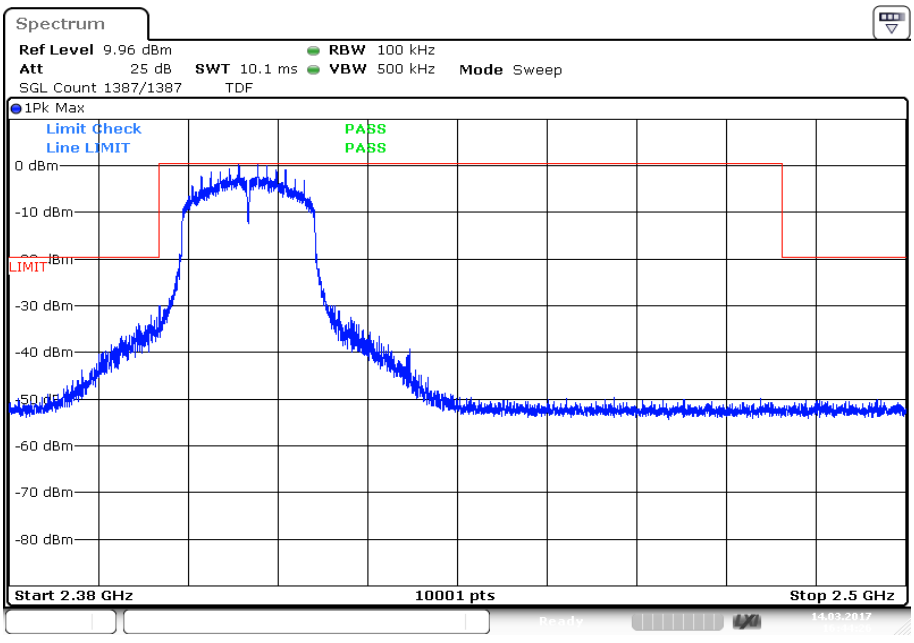
Plots: OFDM / n HT 20 – mode

Plot 1: Lowest channel, up to 25 GHz



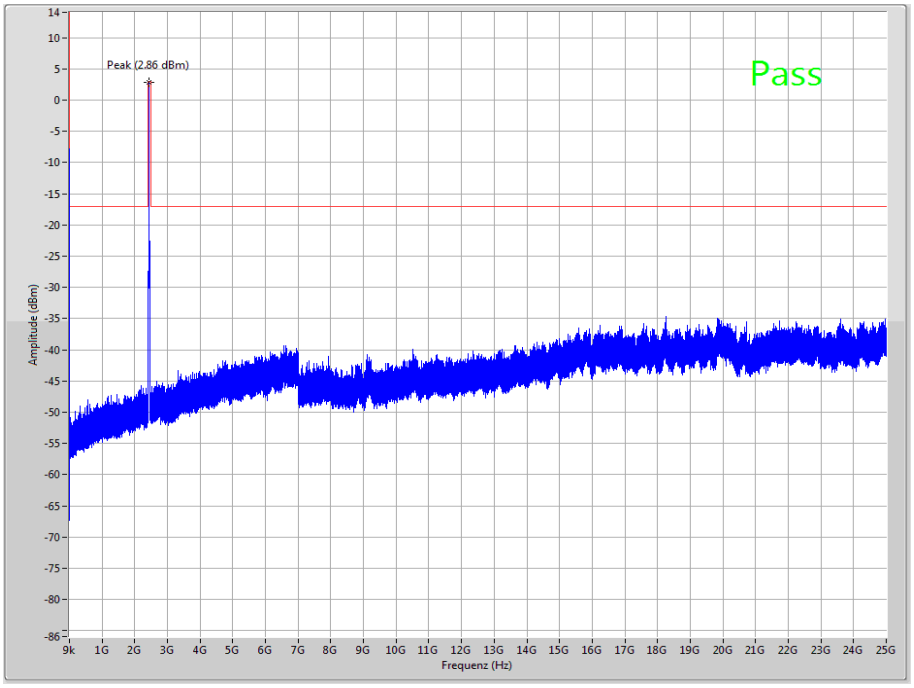
The peak at the beginning of the plot is the LO from the SA.

Plot 2: Lowest channel, zoomed carrier



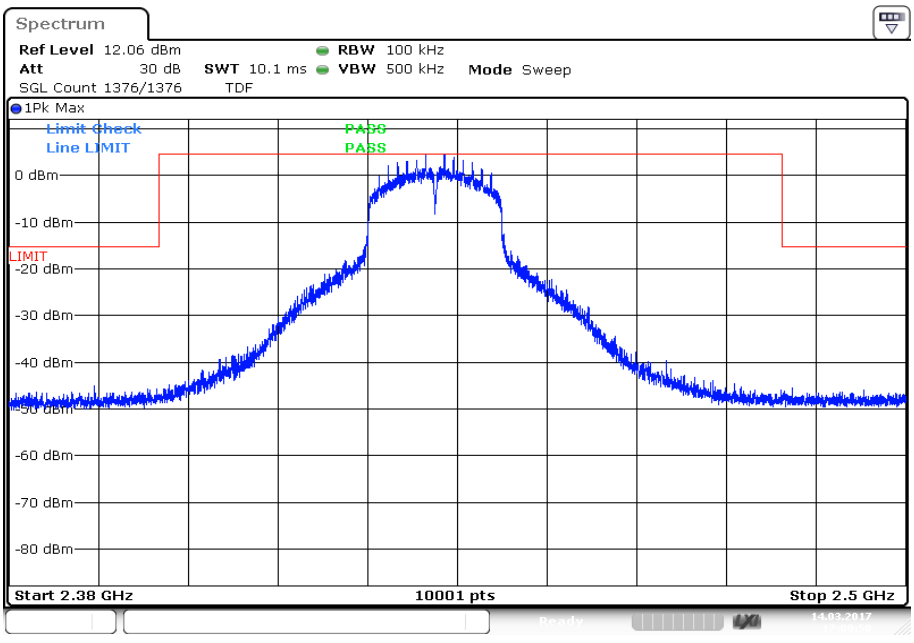
Date: 14.MAR.2017 16:44:27

Plot 3: Middle channel, up to 25 GHz



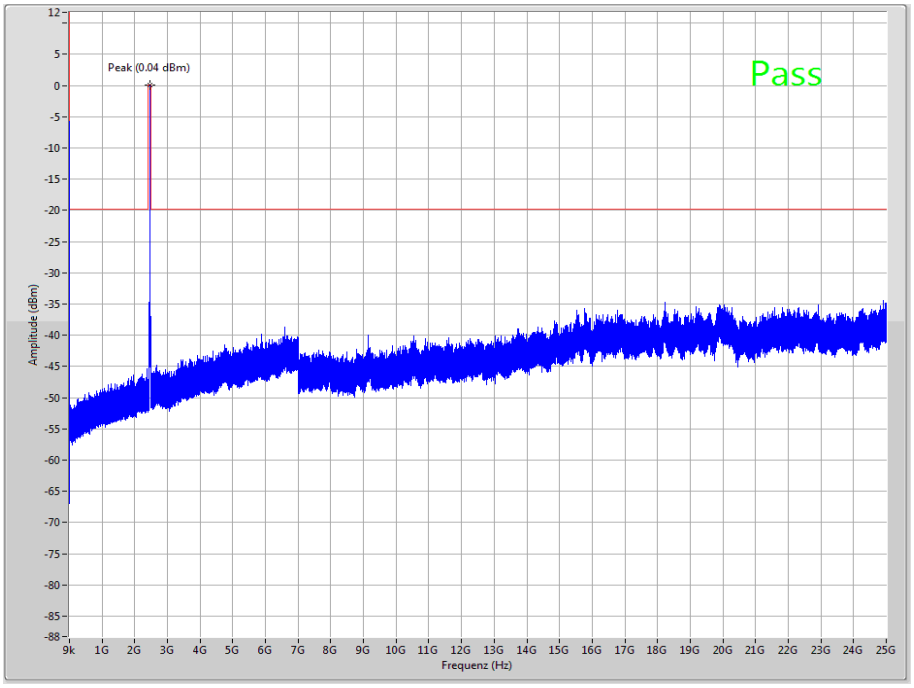
The peak at the beginning of the plot is the LO from the SA.

Plot 4: Middle channel, zoomed carrier



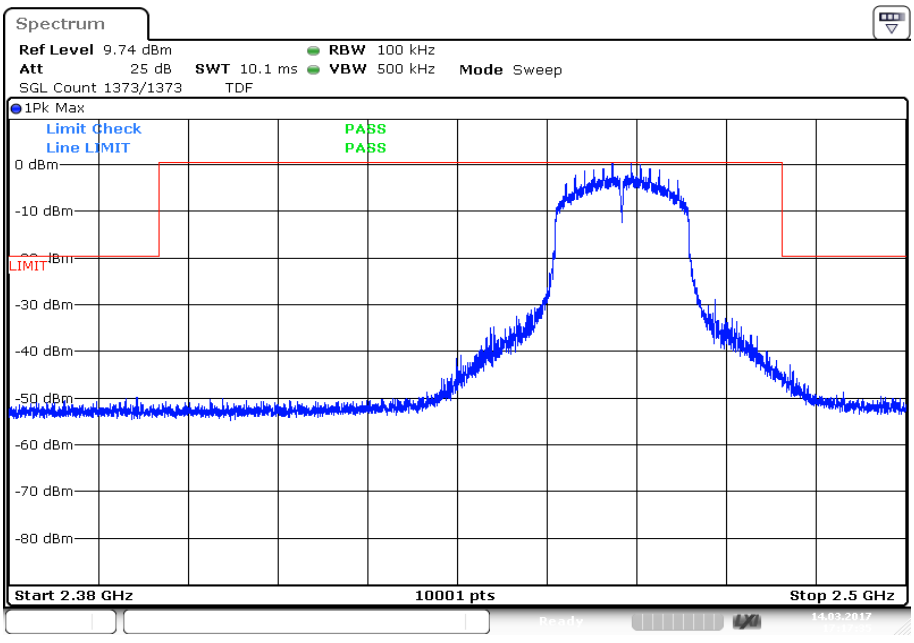
Date: 14.MAR.2017 17:00:50

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: 14.MAR.2017 17:17:35

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:

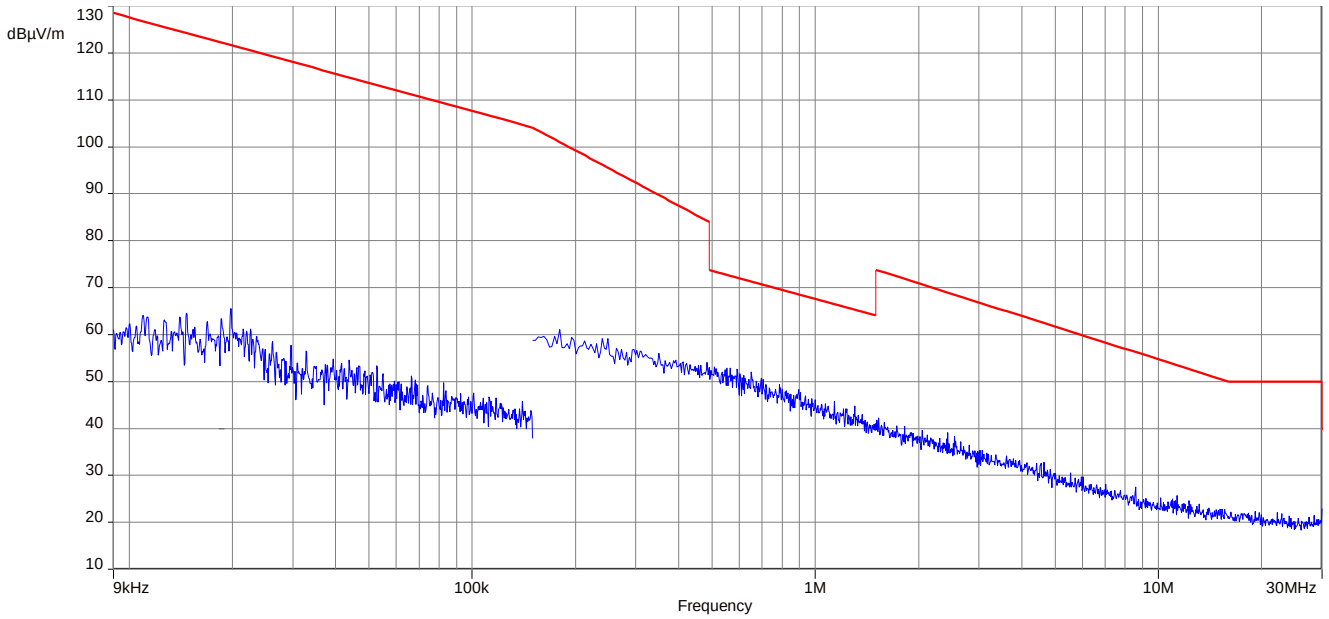
FCC		IC
Frequency (MHz)	Field Strength (dBµV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

Results:

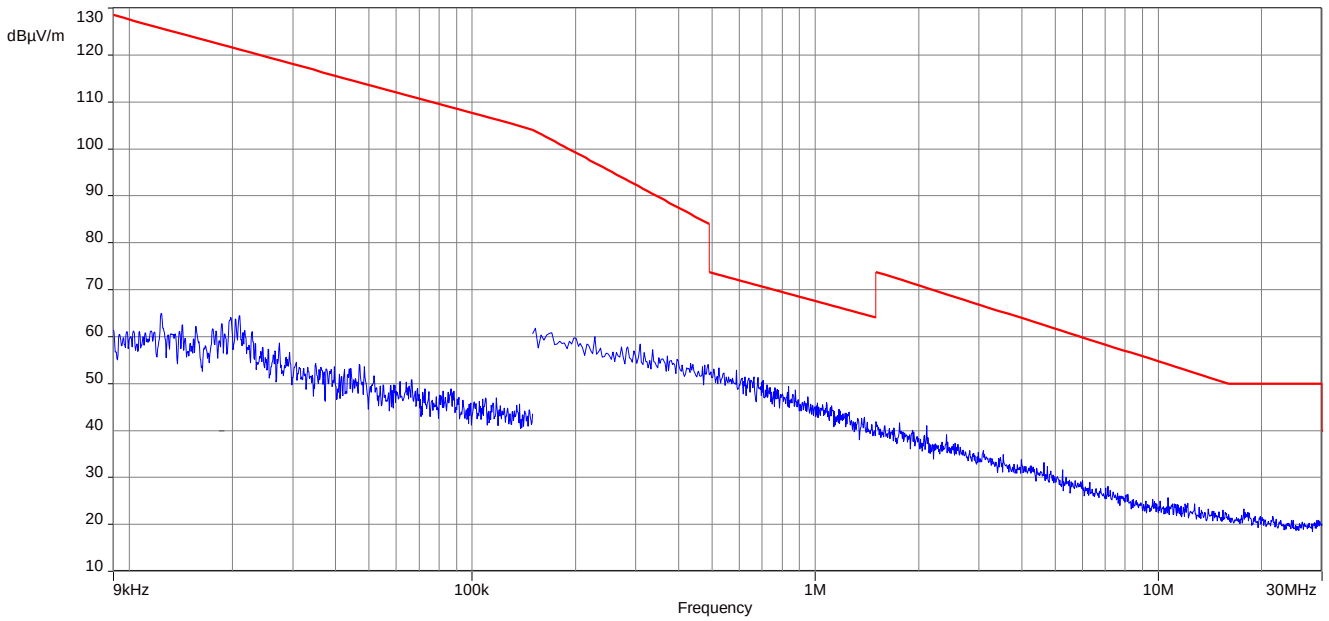
TX Spurious Emissions Radiated < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
All detected peaks are more than 20 dB below the limit.		

Plots: DSSS

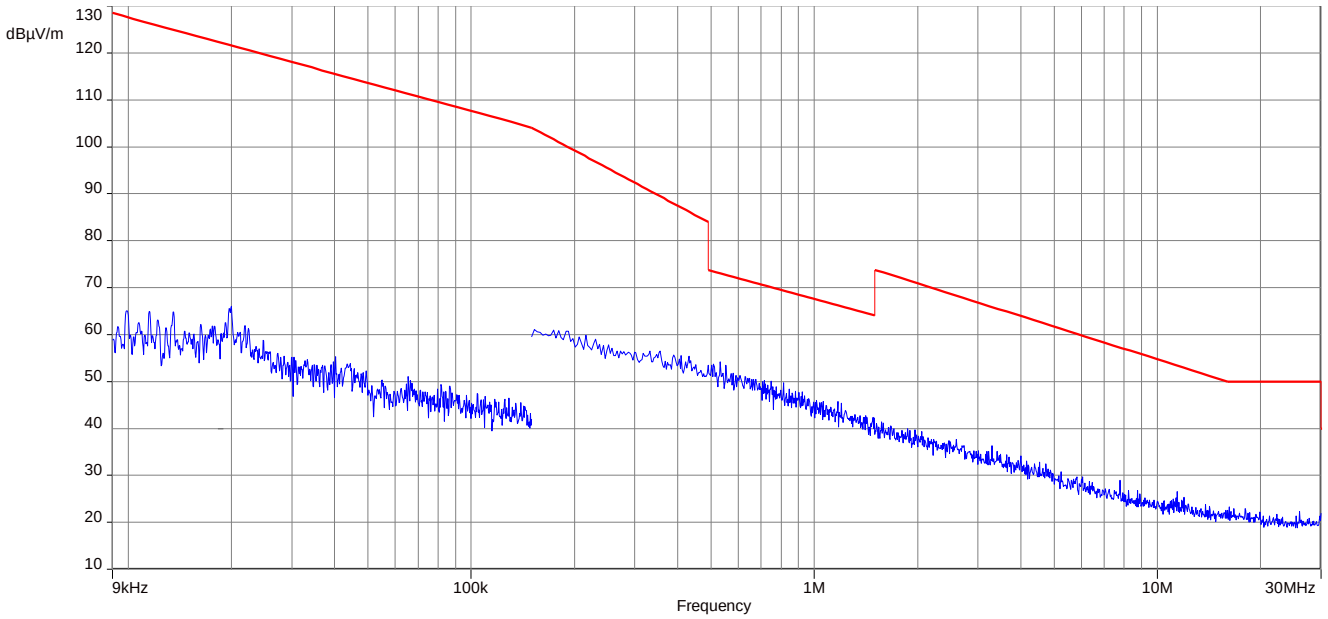
Plot 1: 9 kHz to 30 MHz, low channel



Plot 2: 9 kHz to 30 MHz, mid channel

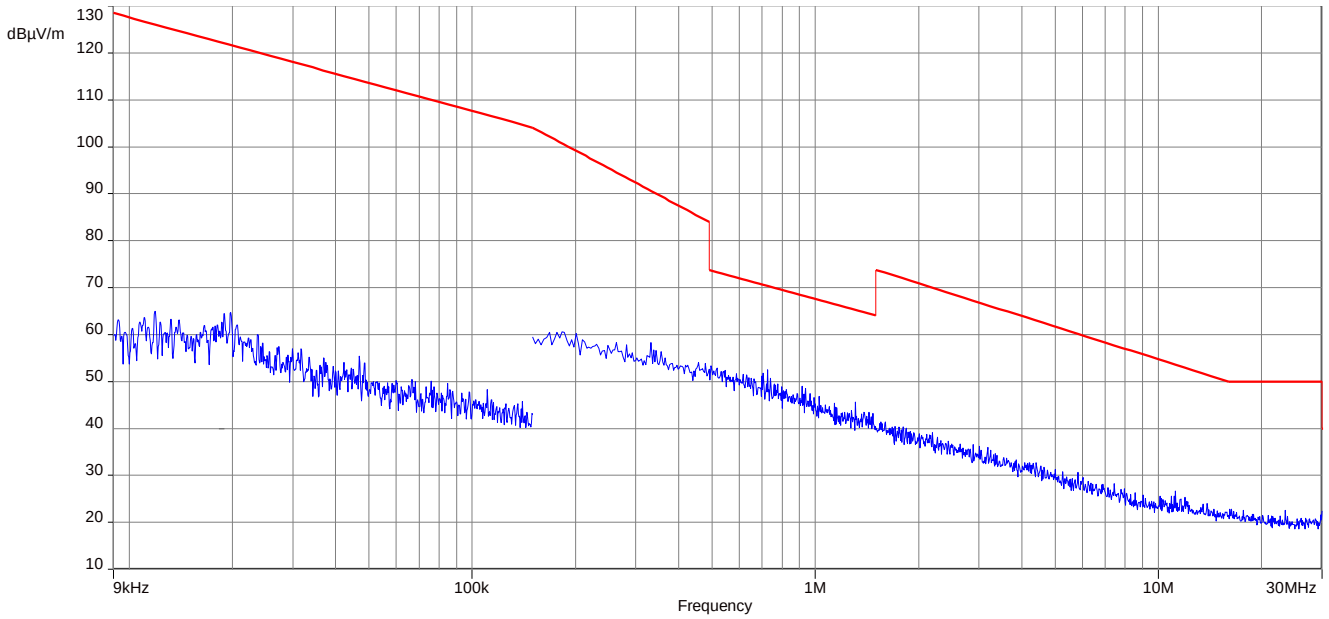


Plot 3: 9 kHz to 30 MHz, high channel

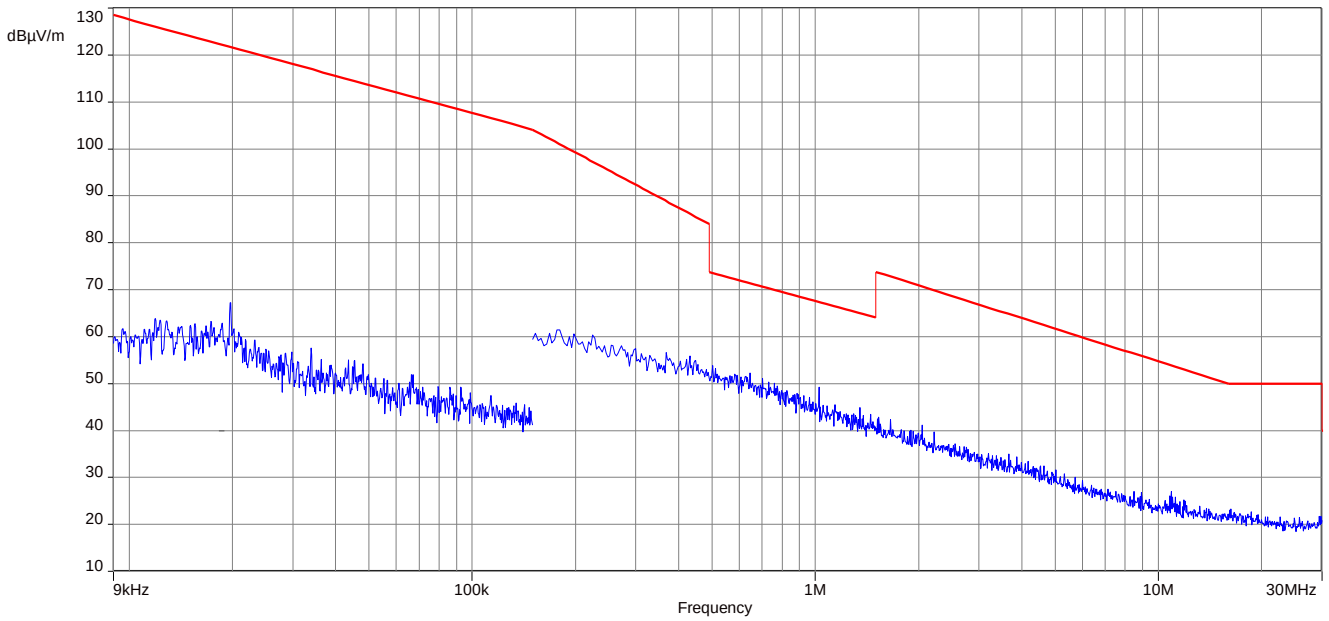


Plots: OFDM (20 MHz bandwidth)

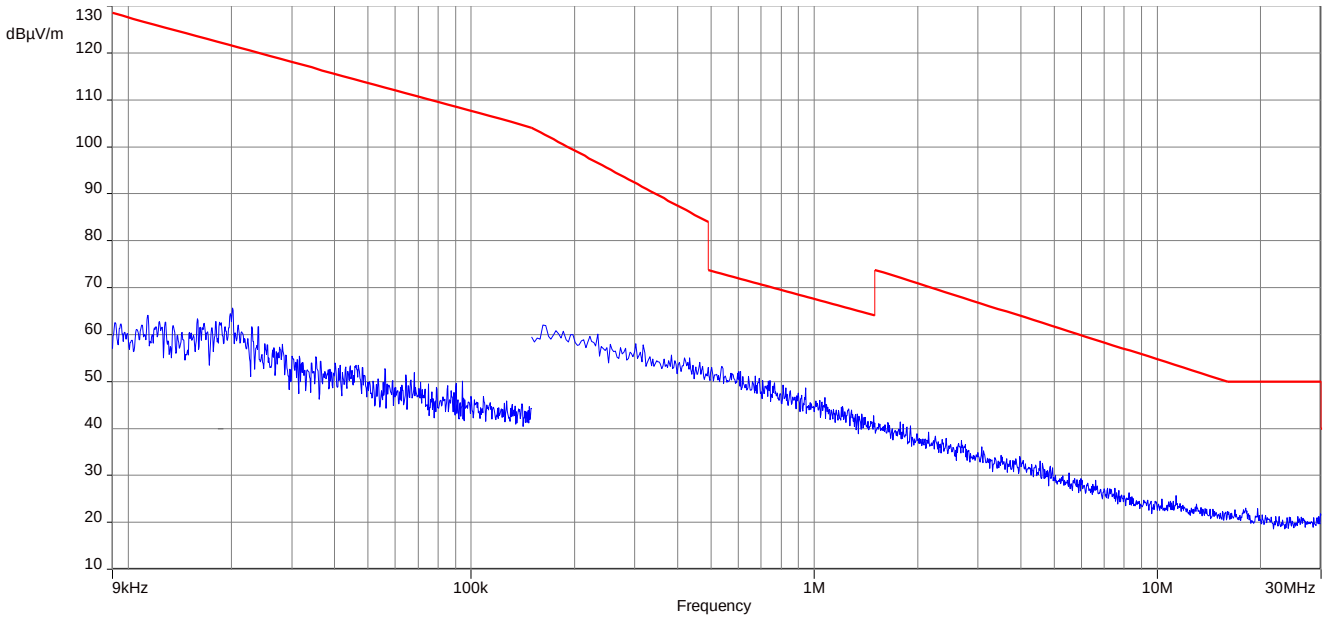
Plot 1: 9 kHz to 30 MHz, low channel



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

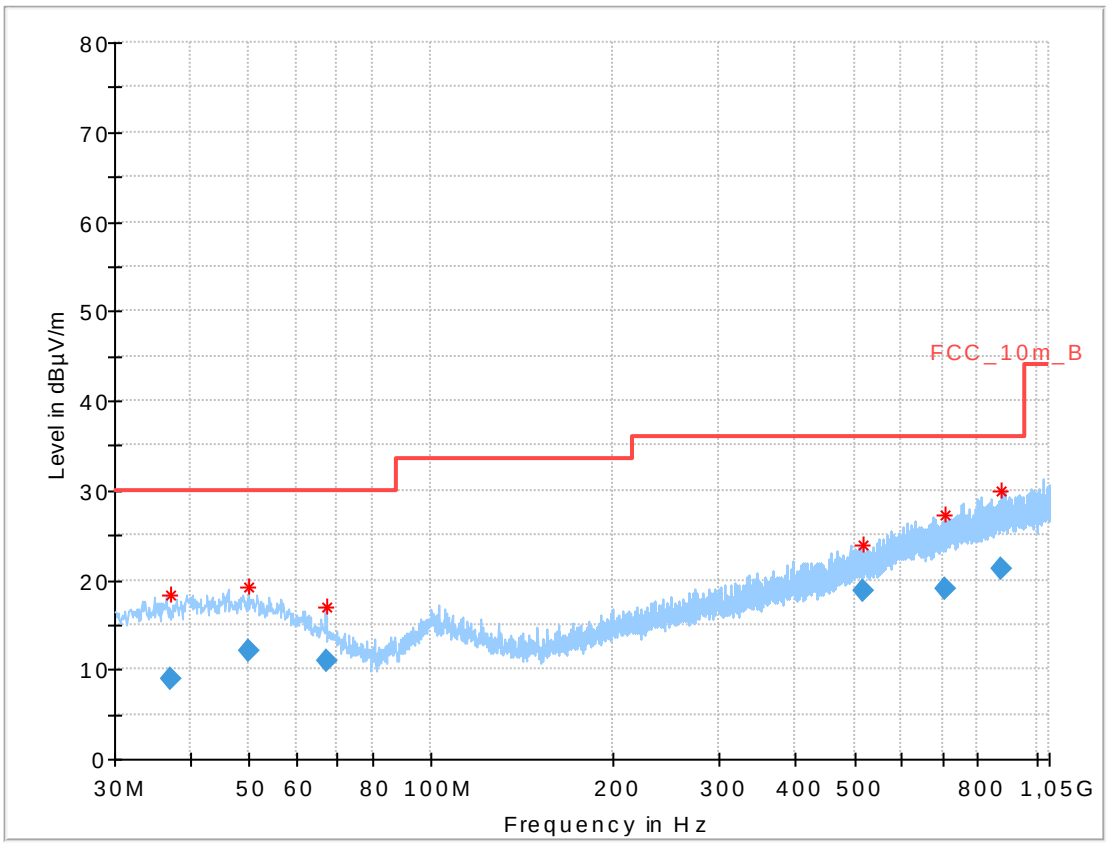
The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

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

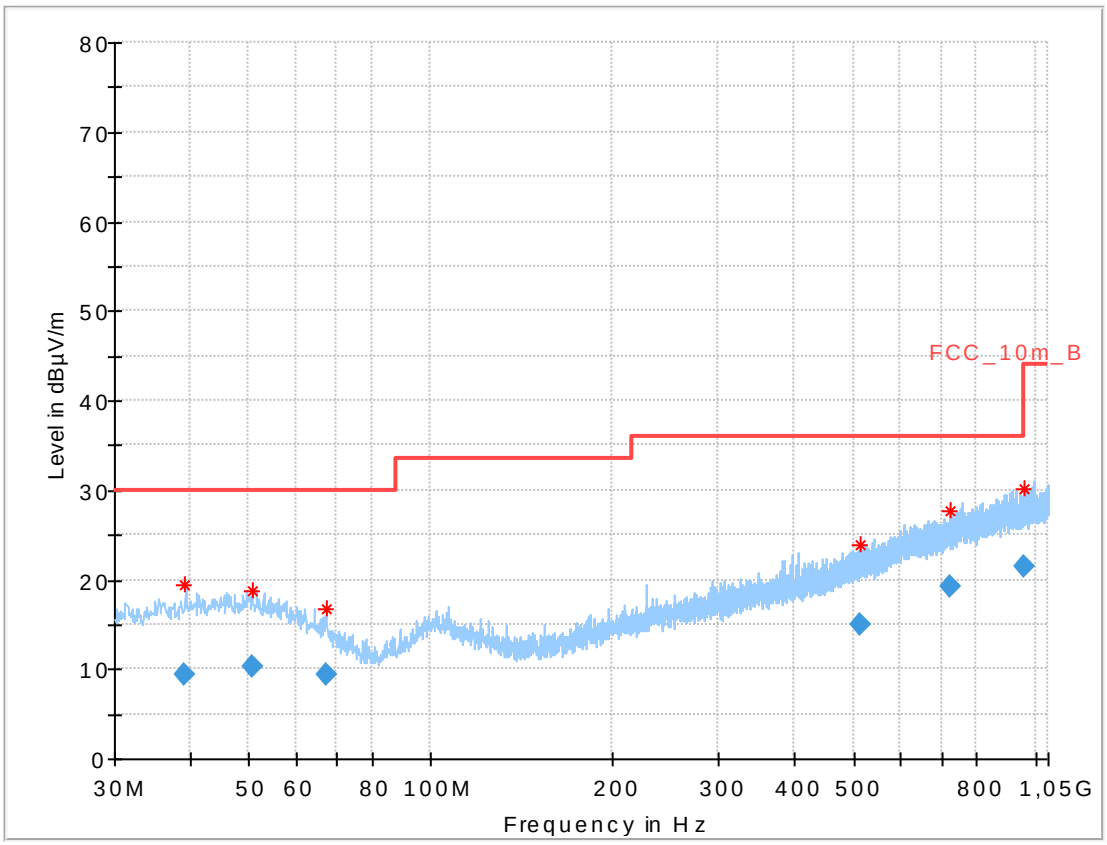
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.090800	8.99	30.00	21.01	1000.0	120.000	179.0	H	241.0	12.9
49.964850	12.00	30.00	18.00	1000.0	120.000	178.0	V	80.0	13.7
67.009200	10.86	30.00	19.14	1000.0	120.000	185.0	V	52.0	10.3
515.426100	18.81	36.00	17.19	1000.0	120.000	100.0	H	63.0	18.9
708.906900	19.04	36.00	16.96	1000.0	120.000	185.0	V	265.0	21.8
876.689550	21.17	36.00	14.83	1000.0	120.000	179.0	V	80.0	23.9

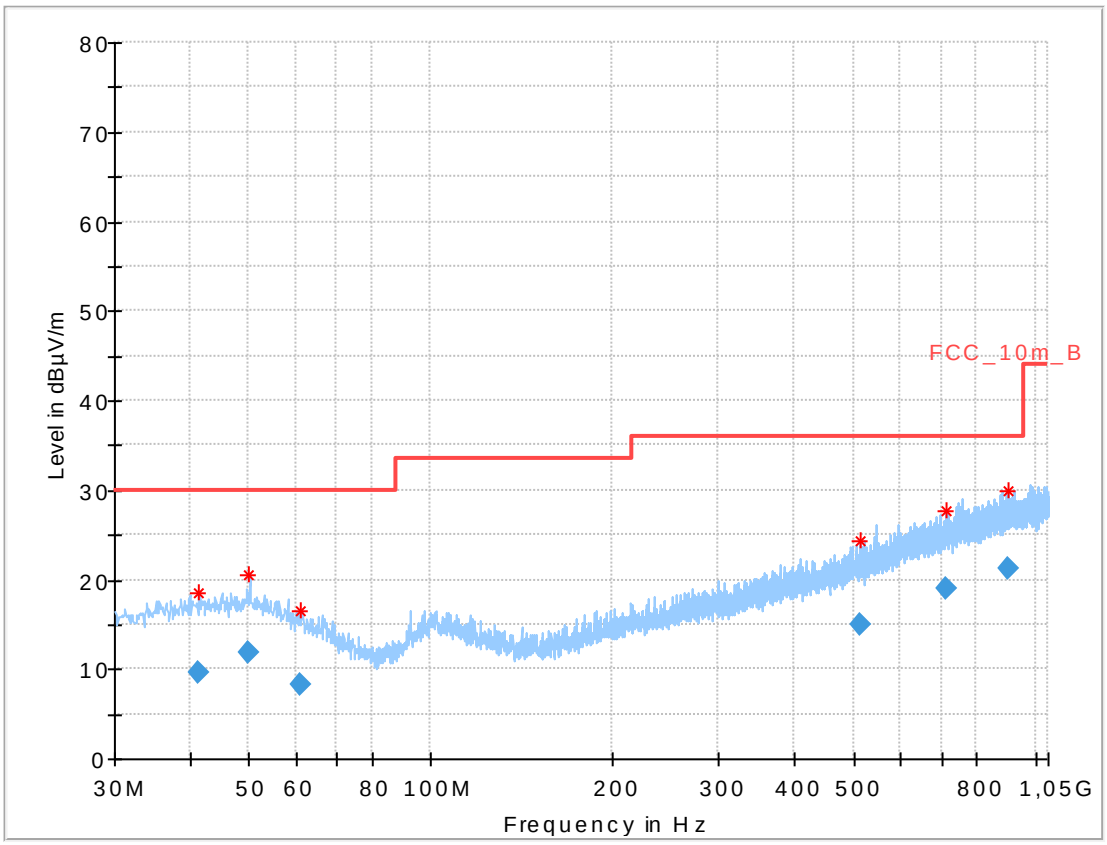
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.168300	9.28	30.00	20.72	1000.0	120.000	101.0	H	0.0	13.1
50.783550	10.25	30.00	19.75	1000.0	120.000	101.0	H	12.0	13.6
67.116900	9.38	30.00	20.62	1000.0	120.000	185.0	V	198.0	10.3
511.867350	15.05	36.00	20.95	1000.0	120.000	185.0	H	198.0	18.9
722.514450	19.30	36.00	16.70	1000.0	120.000	179.0	H	208.0	22.1
955.258500	21.41	36.00	14.59	1000.0	120.000	185.0	H	340.0	24.4

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

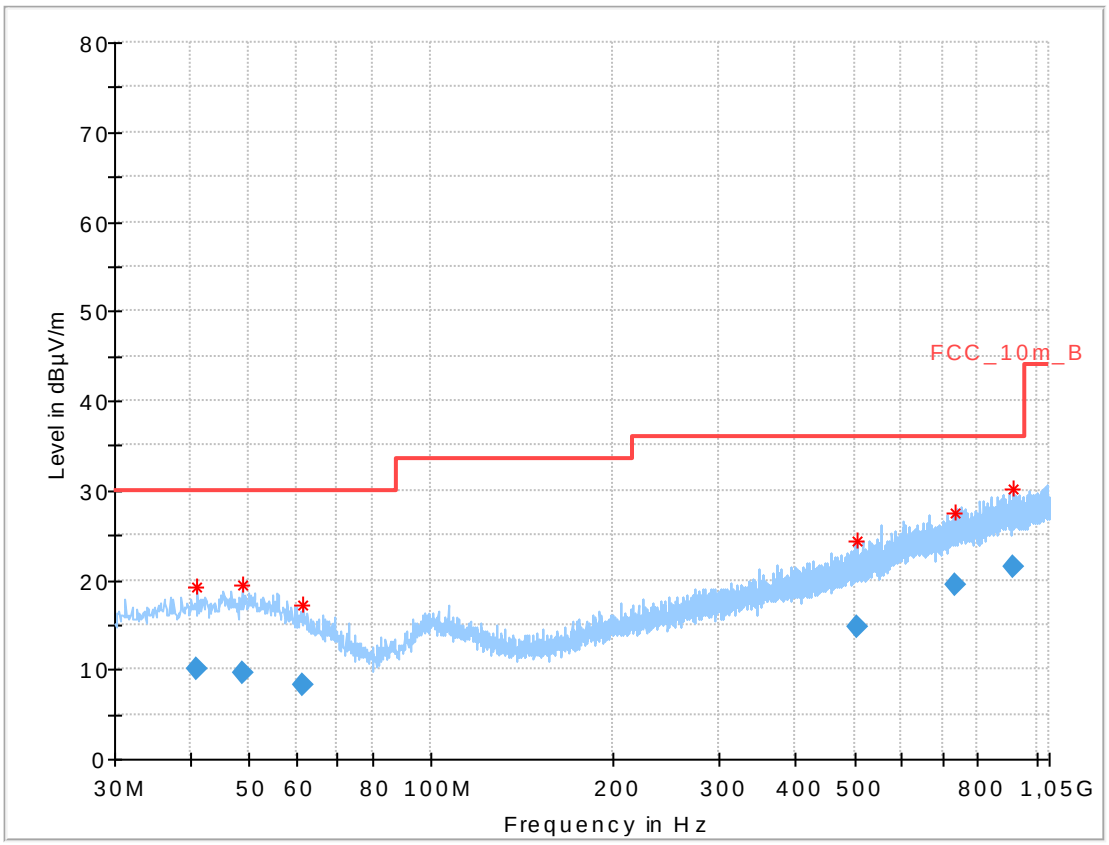


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.396850	9.70	30.00	20.30	1000.0	120.000	98.0	H	9.0	13.3
49.995900	11.88	30.00	18.12	1000.0	120.000	179.0	V	249.0	13.7
60.743250	8.24	30.00	21.76	1000.0	120.000	101.0	H	0.0	11.7
511.438500	15.00	36.00	21.00	1000.0	120.000	185.0	H	225.0	18.9
710.824200	19.02	36.00	16.98	1000.0	120.000	178.0	H	104.0	21.8
904.359450	21.18	36.00	14.82	1000.0	120.000	179.0	H	65.0	24.2

Plot: OFDM (20 MHz bandwidth)

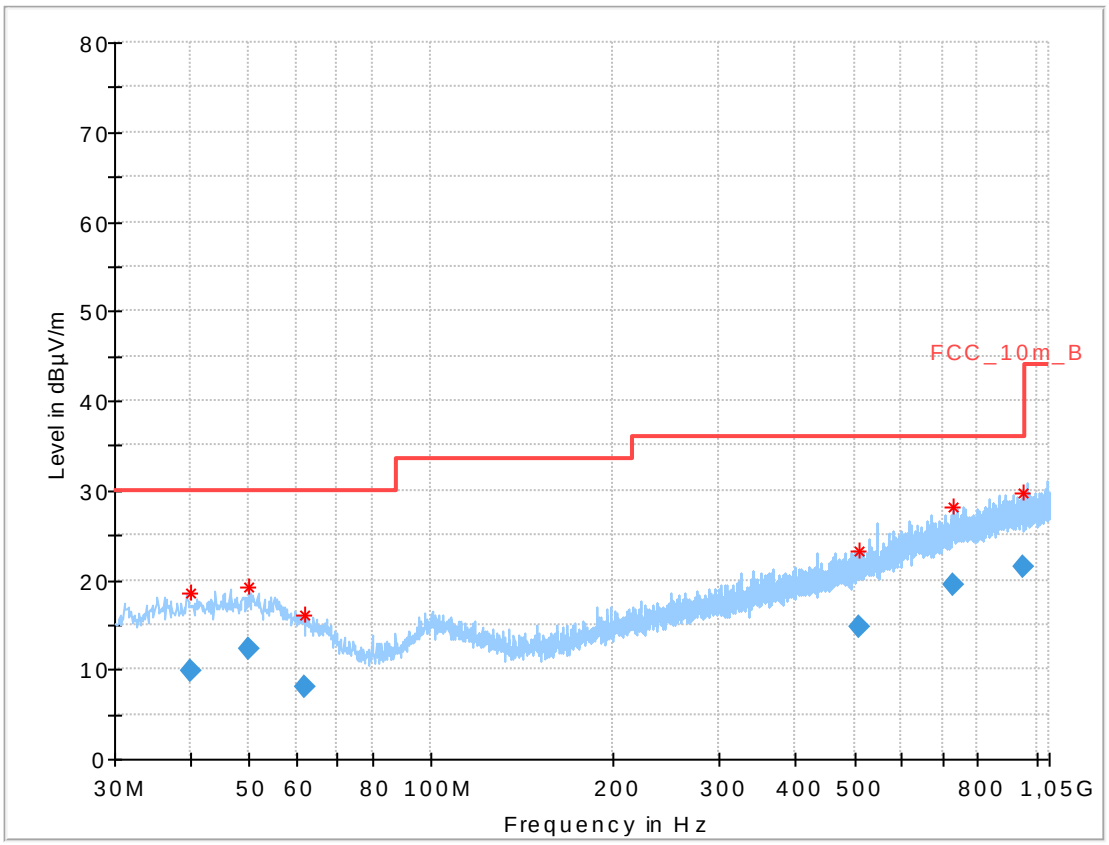
Plot 1: 30 MHz to 1 GHz, vertical & horizontal polarization, low channel



Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.034300	9.96	30.00	20.04	1000.0	120.000	178.0	V	298.0	13.3
48.922800	9.68	30.00	20.32	1000.0	120.000	101.0	H	63.0	13.7
61.494300	8.19	30.00	21.81	1000.0	120.000	185.0	V	241.0	11.5
504.427050	14.71	36.00	21.29	1000.0	120.000	185.0	V	298.0	18.8
731.508750	19.50	36.00	16.50	1000.0	120.000	101.0	H	202.0	22.3
915.042900	21.35	36.00	14.65	1000.0	120.000	101.0	V	0.0	24.2

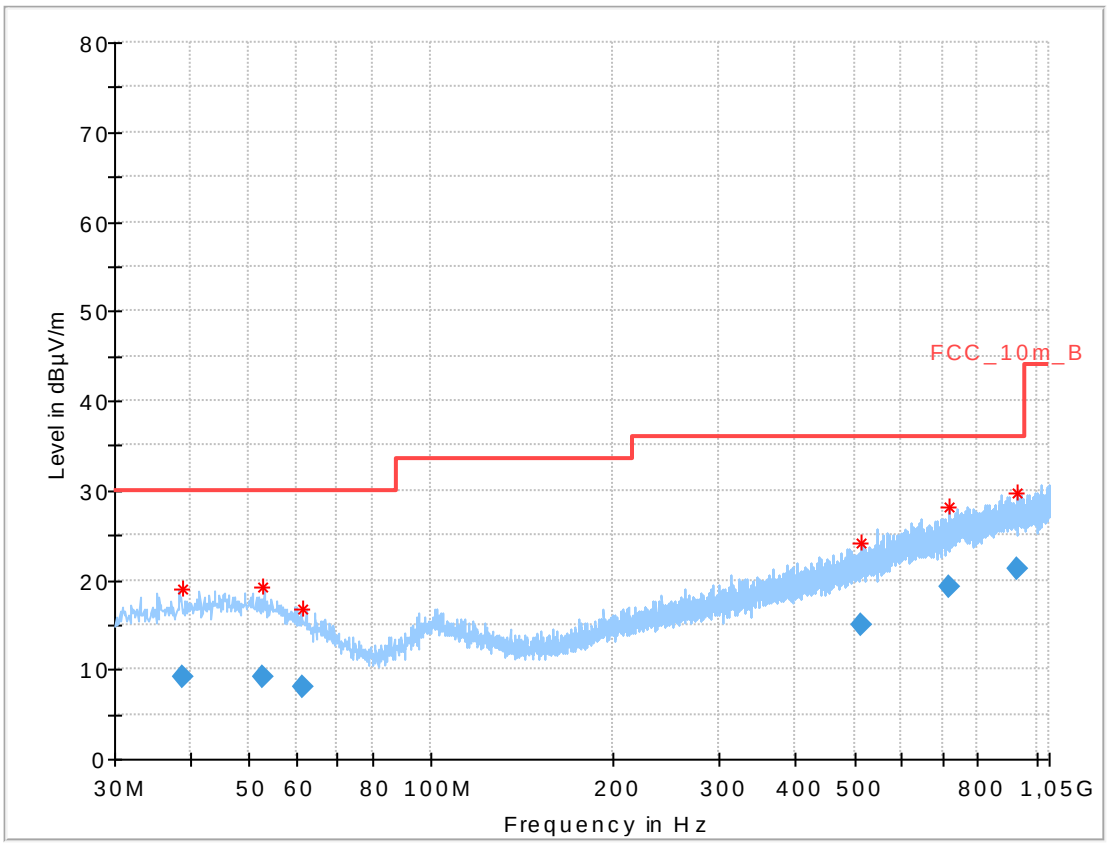
Plot 2: 30 MHz to 1 GHz, vertical & horizontal polarization, mid channel



Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
39.964650	9.88	30.00	20.12	1000.0	120.000	101.0	H	260.0	13.2
49.971600	12.33	30.00	17.67	1000.0	120.000	98.0	V	38.0	13.7
61.907550	8.01	30.00	21.99	1000.0	120.000	98.0	H	233.0	11.4
510.379350	14.86	36.00	21.14	1000.0	120.000	101.0	V	53.0	18.8
728.471250	19.42	36.00	16.58	1000.0	120.000	101.0	H	203.0	22.2
952.784850	21.37	36.00	14.63	1000.0	120.000	185.0	H	30.0	24.4

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

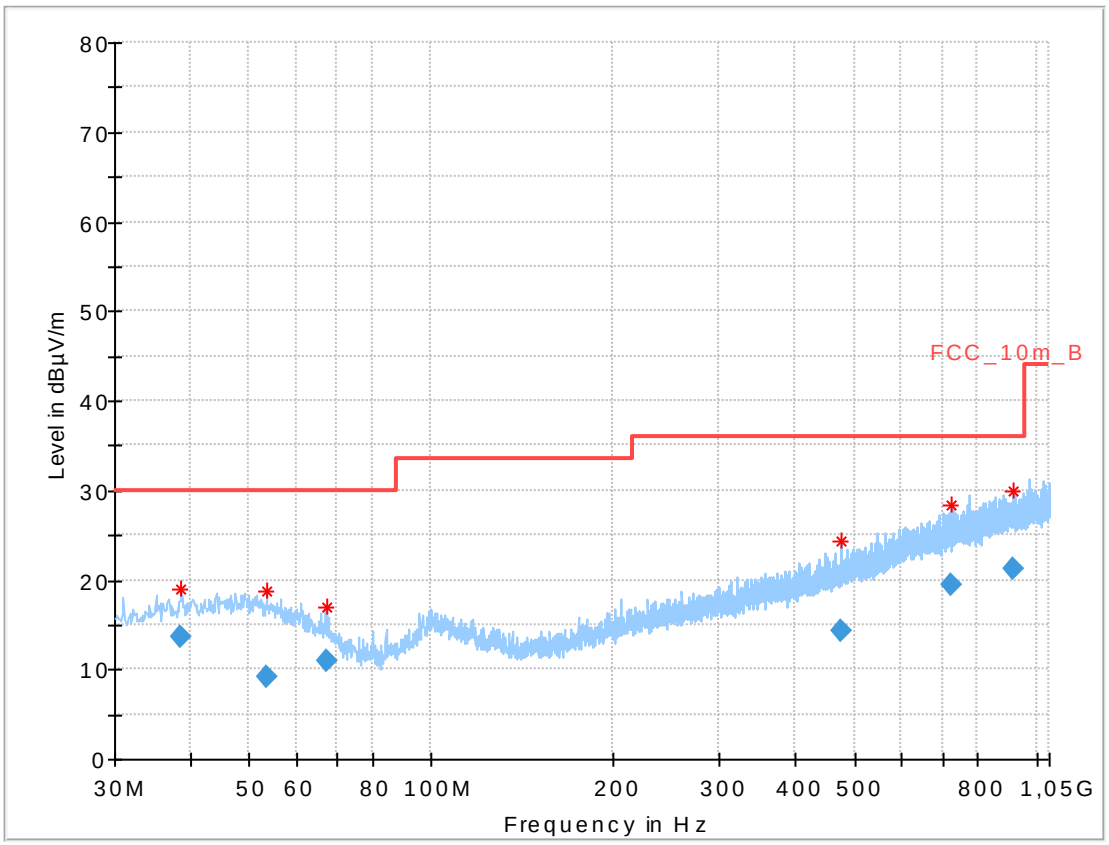


Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.911650	9.11	30.00	20.89	1000.0	120.000	101.0	H	112.0	13.1
52.648650	9.23	30.00	20.77	1000.0	120.000	185.0	H	192.0	13.4
61.540650	8.15	30.00	21.85	1000.0	120.000	101.0	H	198.0	11.5
515.207850	14.98	36.00	21.02	1000.0	120.000	178.0	H	100.0	18.9
717.415350	19.18	36.00	16.82	1000.0	120.000	185.0	V	315.0	22.0
930.467550	21.23	36.00	14.77	1000.0	120.000	185.0	V	62.0	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)
38.713800	13.65	30.00	16.35	1000.0	120.000	101.0	V	318.0	13.1
53.668650	9.10	30.00	20.90	1000.0	120.000	101.0	H	335.0	13.3
67.095450	10.90	30.00	19.10	1000.0	120.000	101.0	V	59.0	10.3
477.243300	14.28	36.00	21.72	1000.0	120.000	185.0	H	191.0	18.2
723.951000	19.40	36.00	16.60	1000.0	120.000	178.0	H	108.0	22.1
913.528050	21.27	36.00	14.73	1000.0	120.000	98.0	V	38.0	24.2

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 A (1 GHz - 18 GHz) See sub clause 6.3 A (18 GHz - 26 GHz)
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 (dBµV/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	53.6	All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		
	AVG	49.0						
	Peak			Peak			Peak	
	AVG			AVG			AVG	

Results: OFDM (20 MHz bandwidth)

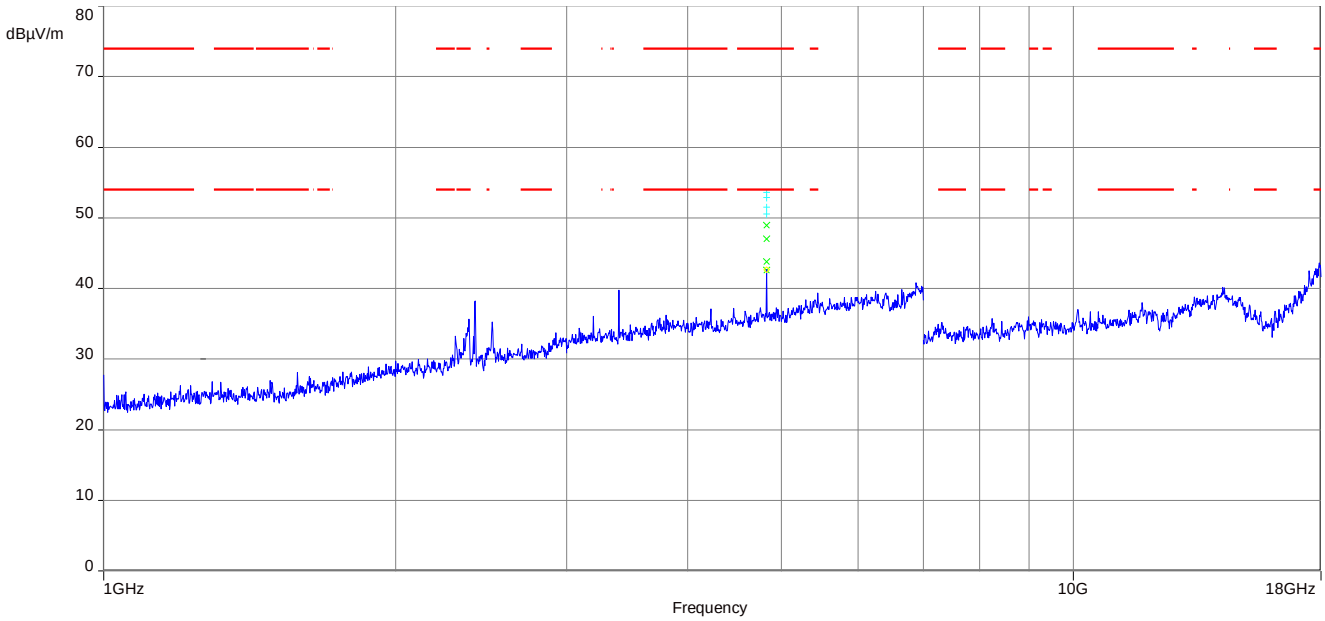
TX Spurious Emissions Radiated [dBµV/m]								
2412 MHz			2437 MHz			2462 MHz		
F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]	F [MHz]	Detector	Level [dBµV/m]
All detected emissions are more than 20 dB below the limit.			All detected emissions are more than 20 dB below the limit.		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

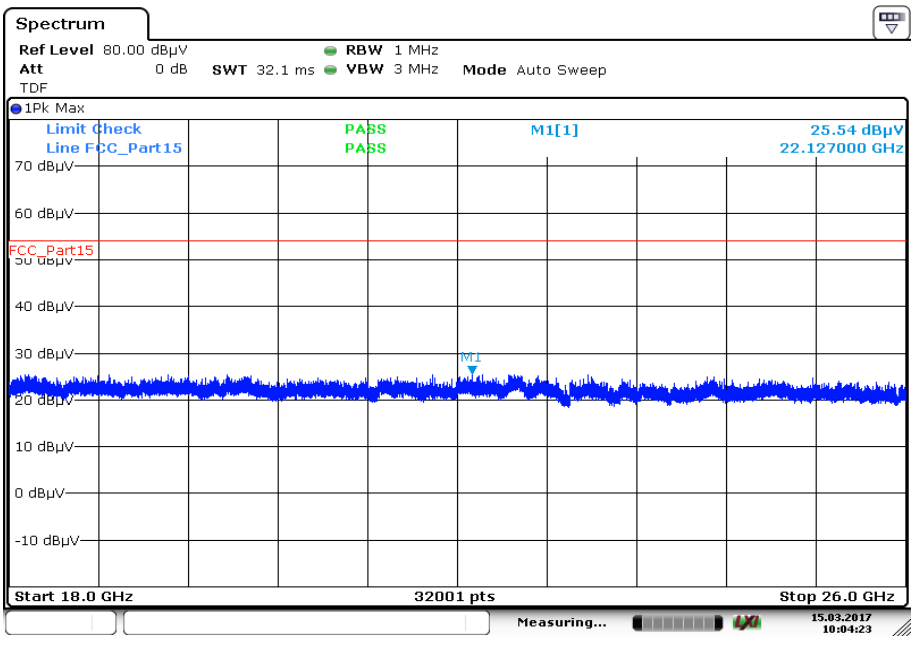
Plots: DSSS

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



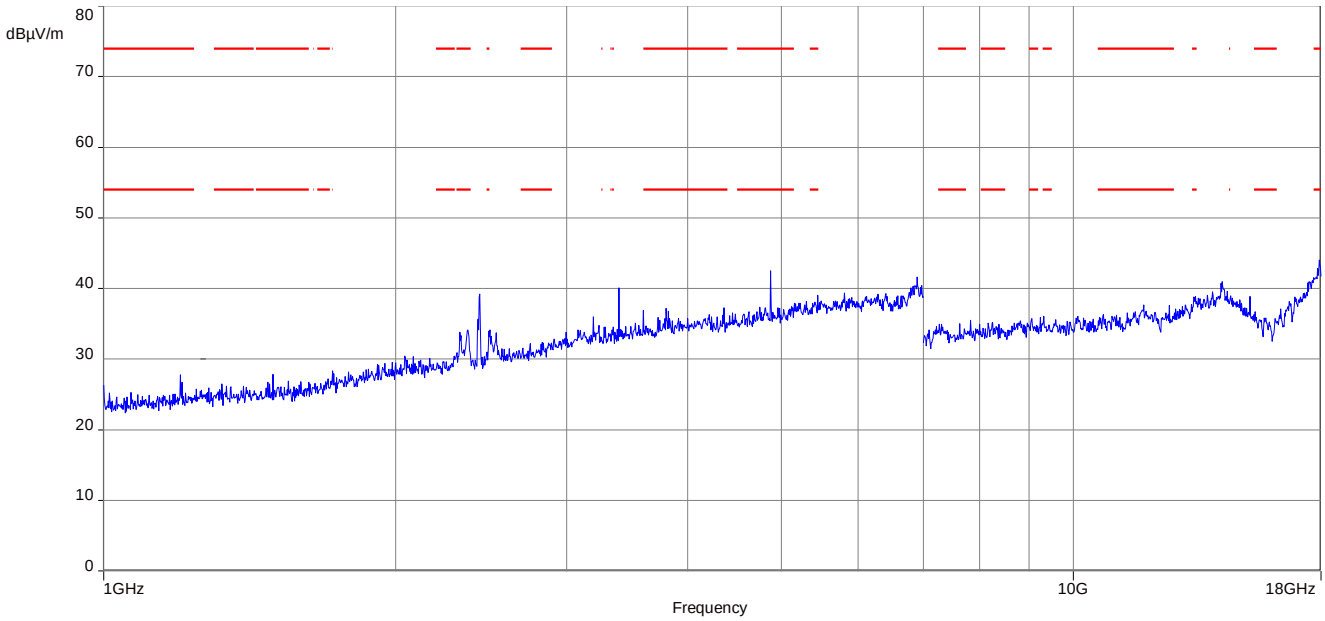
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



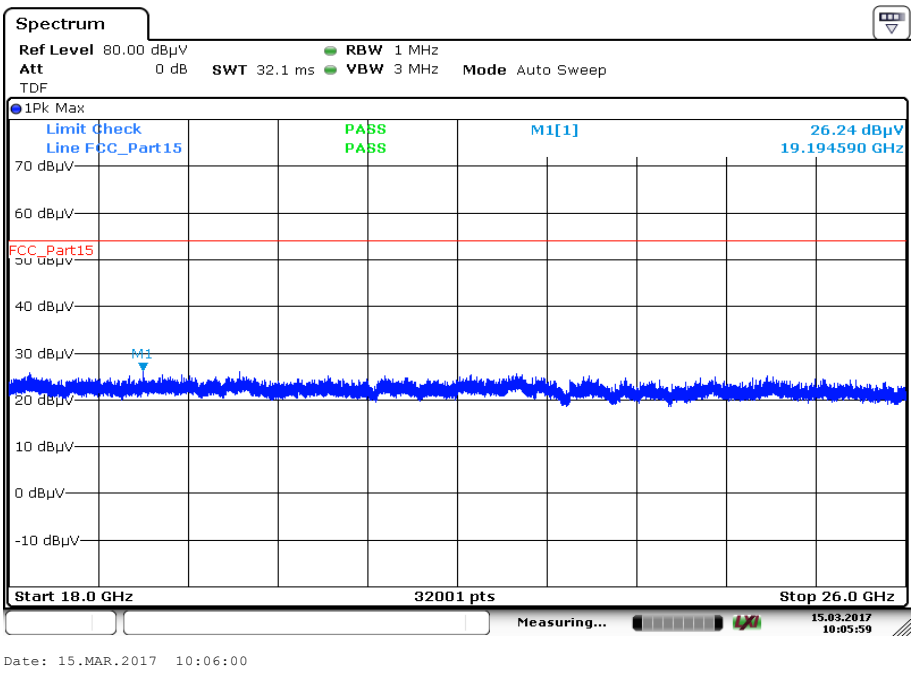
Date: 15.MAR.2017 10:04:24

Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization



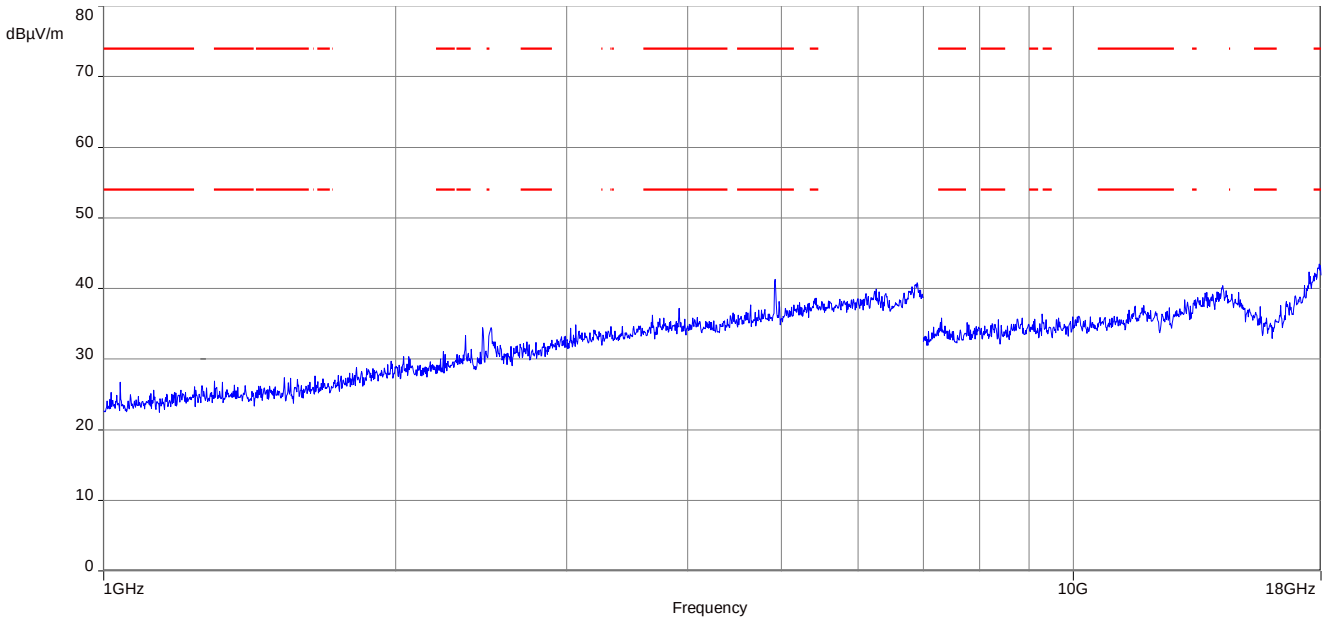
The carrier signal is notched with a 2.4 GHz band rejection filter.

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



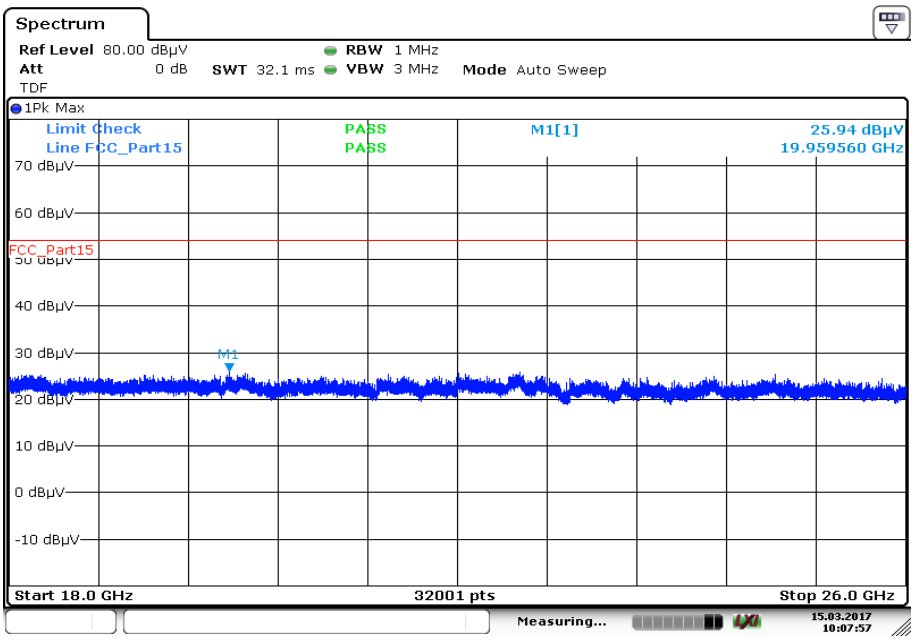
Date: 15.MAR.2017 10:06:00

Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



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

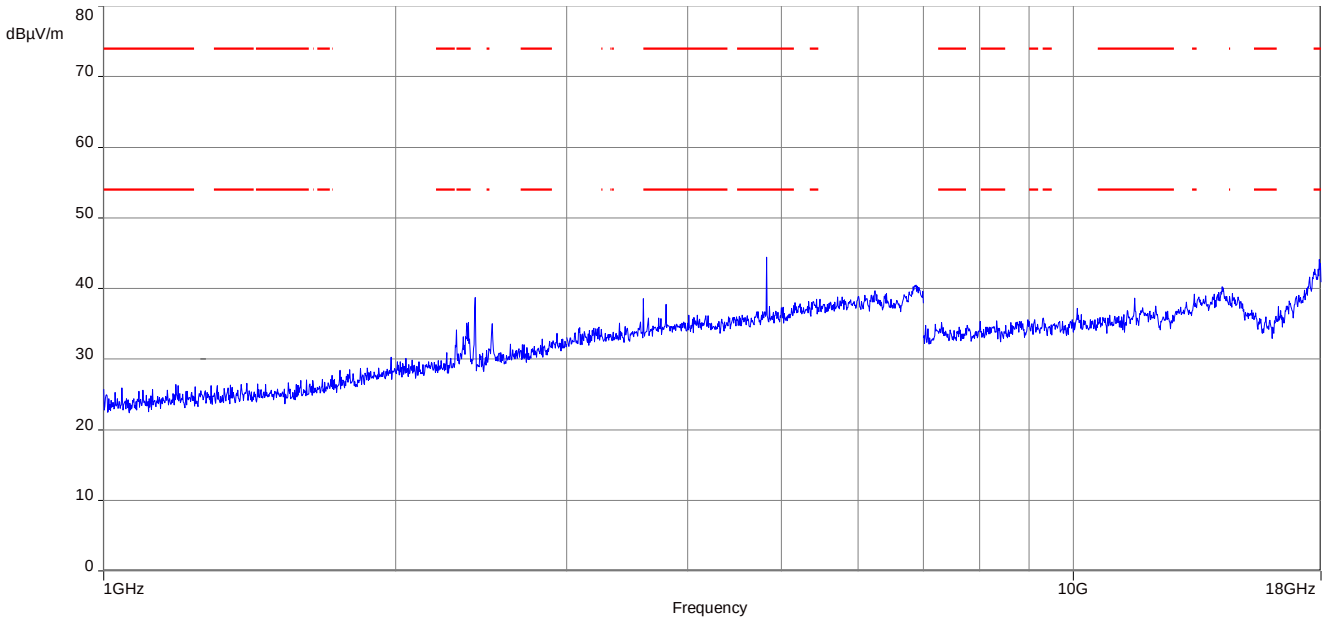
Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 15.MAR.2017 10:07:57

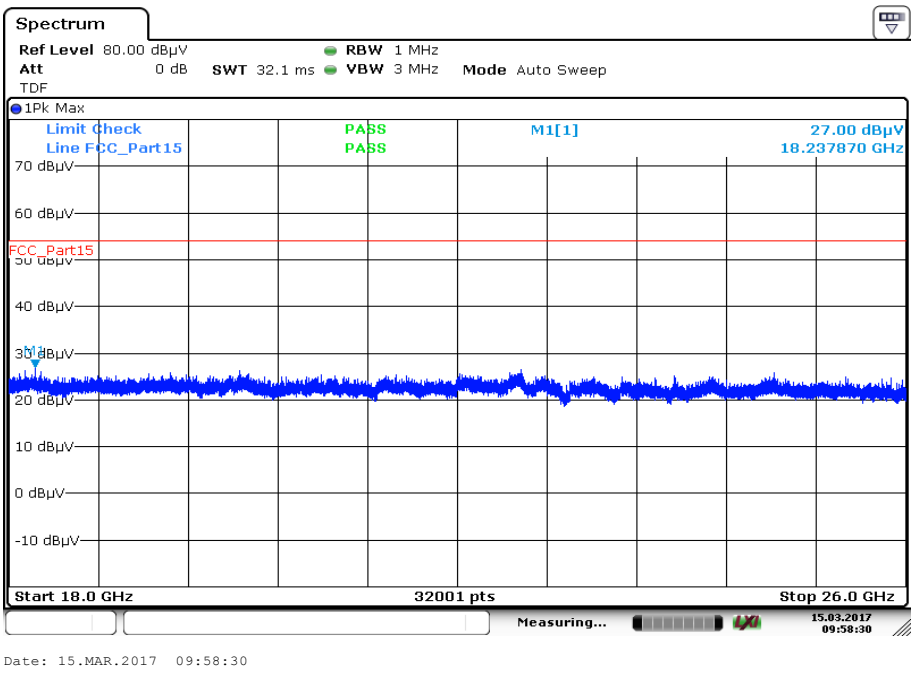
Plots: OFDM (20 MHz bandwidth)

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



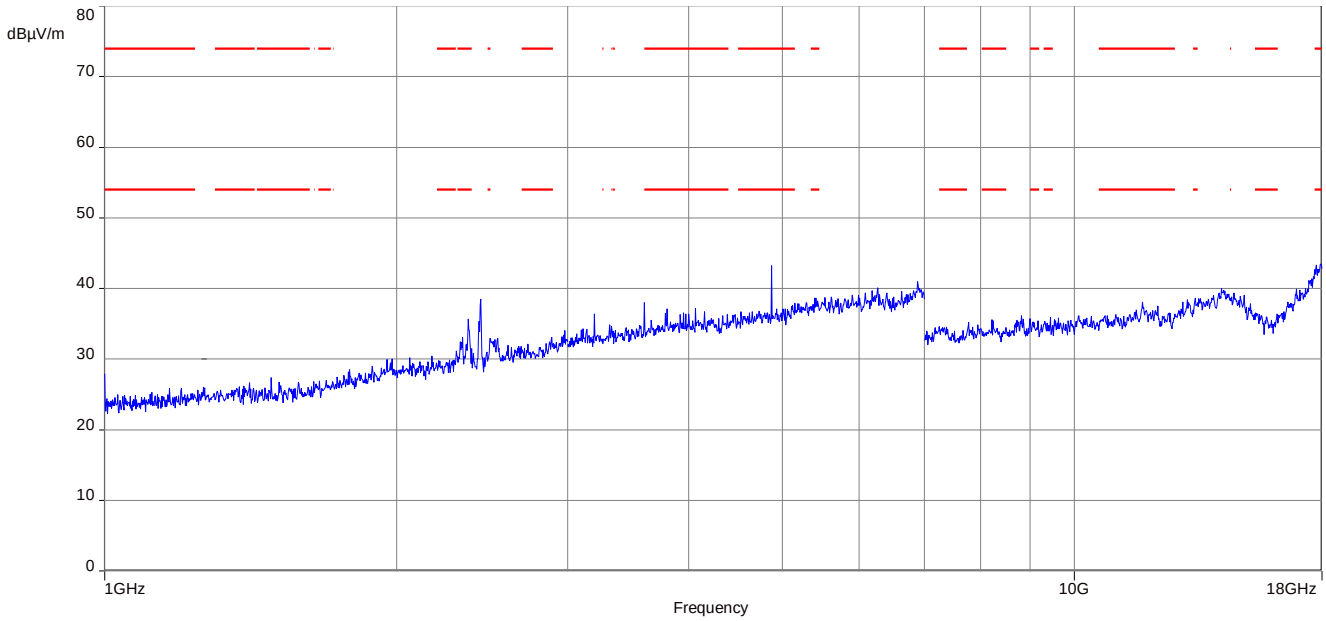
The carrier signal is notched with a 2.4 GHz band rejection filter.

Plot 2: Lowest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



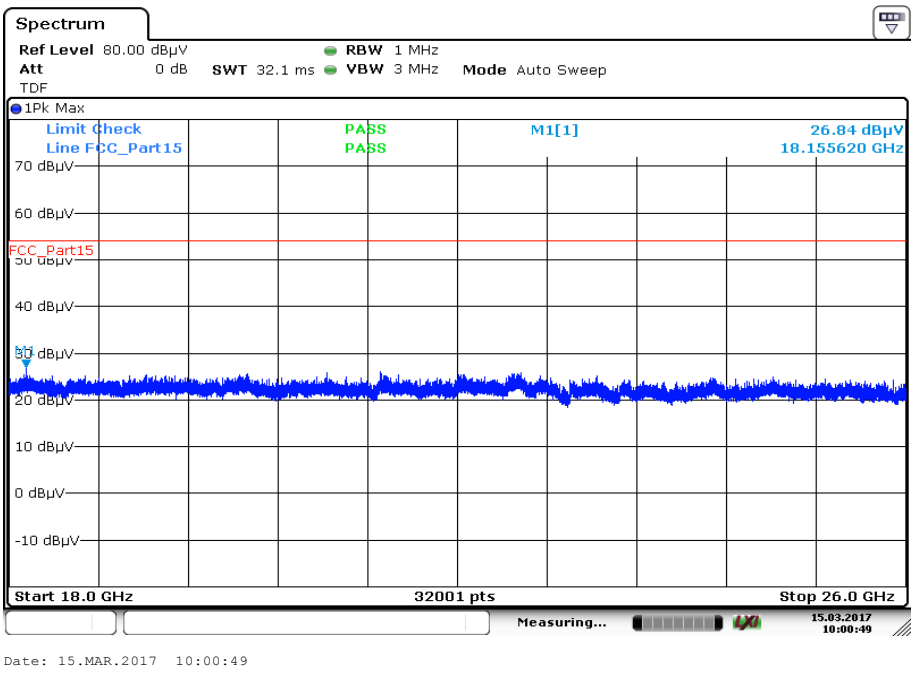
Date: 15.MAR.2017 09:58:30

Plot 3: Middle channel, 1 GHz to 18 GHz, vertical & horizontal polarization

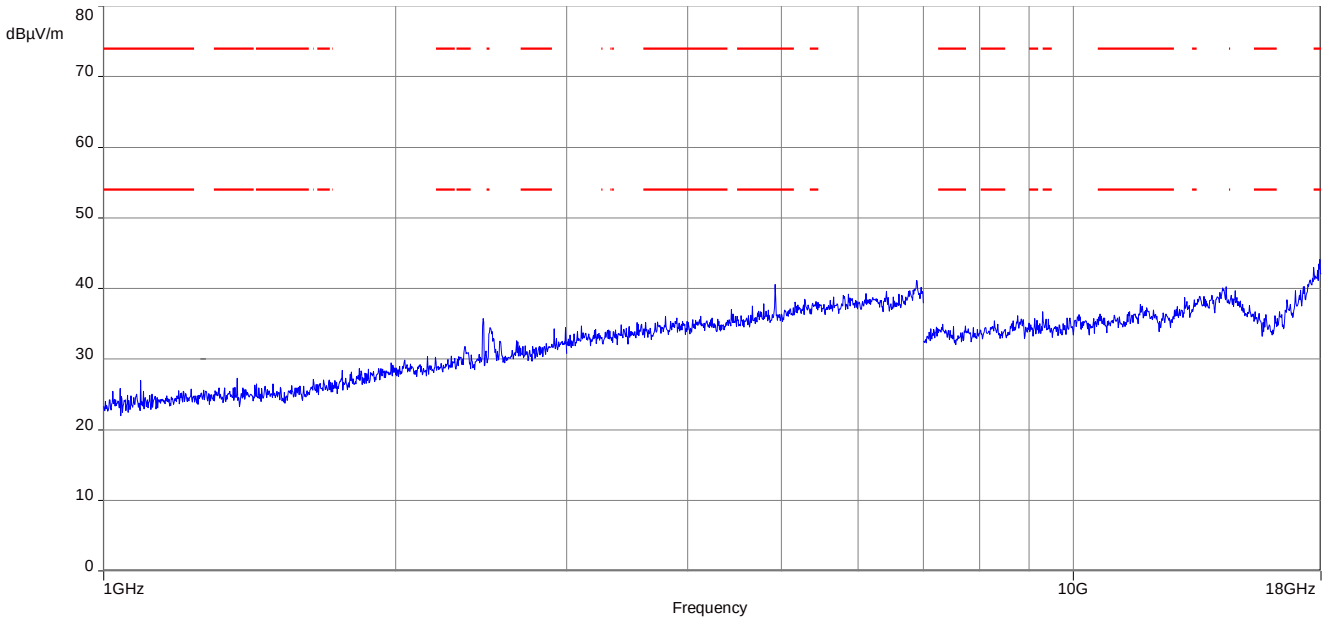


The carrier signal is notched with a 2.4 GHz band rejection filter.

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

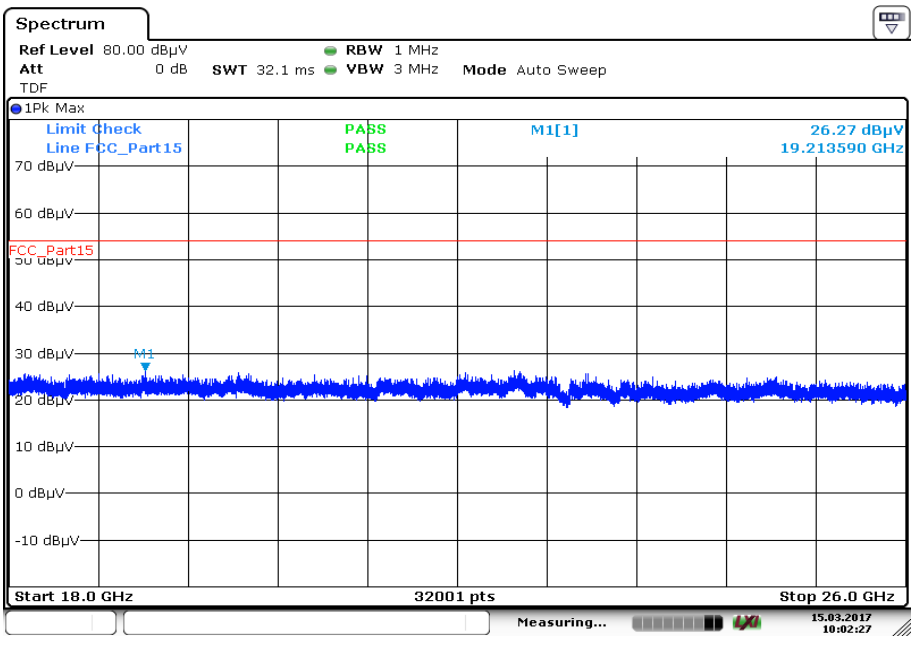


Plot 5: Highest channel, 1 GHz to 18 GHz, vertical & horizontal polarization



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

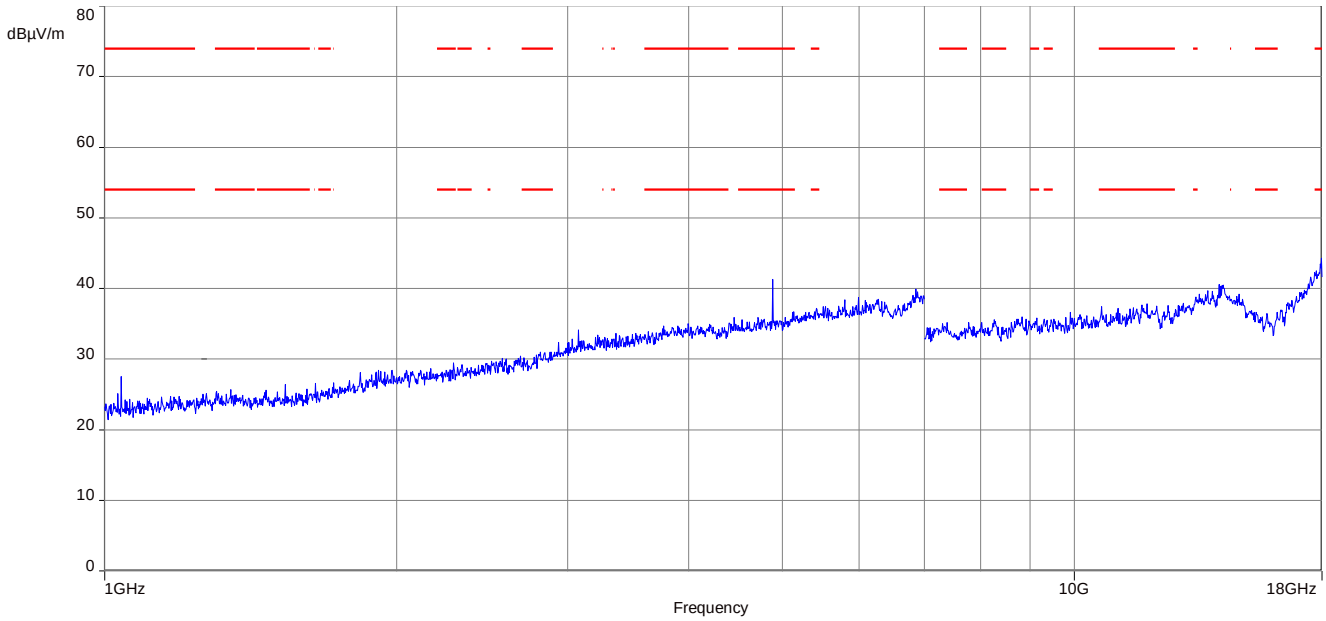
Plot 6: Highest channel, 18 GHz to 26 GHz, vertical & horizontal polarization



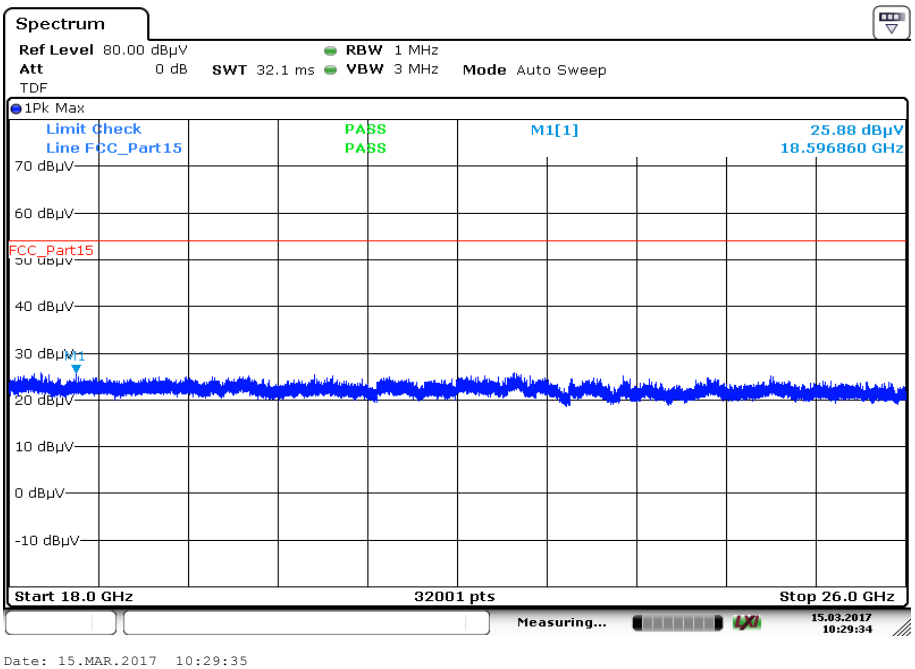
Date: 15.MAR.2017 10:02:27

Plots: RX / idle mode

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



Plot 2: 18 GHz to 26 GHz, vertical & horizontal polarization



Date: 15.MAR.2017 10:29:35

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 6.4 - 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

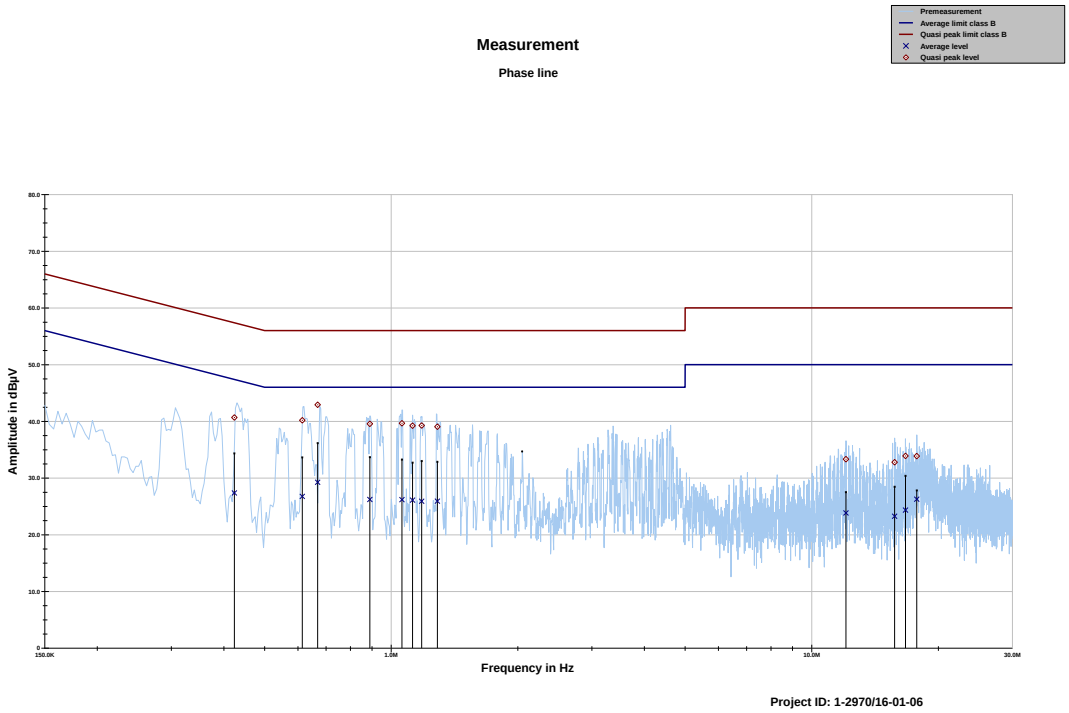
*Decreases with the logarithm of the frequency

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.		

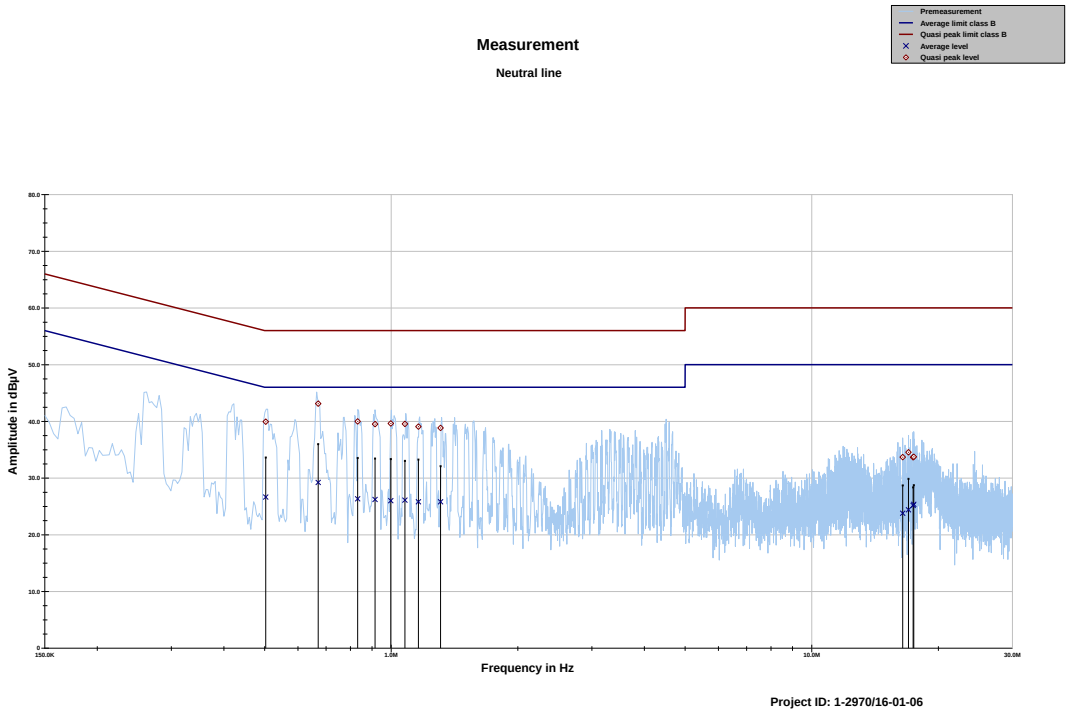
Plots:

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
0.423791	40.68	16.70	57.374	27.37	20.81	48.177
0.614796	40.18	15.82	56.000	26.76	19.24	46.000
0.668620	42.93	13.07	56.000	29.26	16.74	46.000
0.889856	39.56	16.44	56.000	26.22	19.78	46.000
1.060464	39.65	16.35	56.000	26.18	19.82	46.000
1.124105	39.23	16.77	56.000	26.10	19.90	46.000
1.181388	39.26	16.74	56.000	25.90	20.10	46.000
1.287751	39.05	16.95	56.000	25.92	20.08	46.000
12.058760	33.32	26.68	60.000	23.83	26.17	50.000
15.740456	32.78	27.22	60.000	23.27	26.73	50.000
16.708687	33.90	26.10	60.000	24.35	25.65	50.000
17.777760	33.87	26.13	60.000	26.27	23.73	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
0.503073	39.93	16.07	56.000	26.64	19.36	46.000
0.670647	43.11	12.89	56.000	29.22	16.78	46.000
0.832161	39.98	16.02	56.000	26.33	19.67	46.000
0.915400	39.50	16.50	56.000	26.22	19.78	46.000
0.997903	39.62	16.38	56.000	26.00	20.00	46.000
1.078146	39.54	16.46	56.000	26.10	19.90	46.000
1.160683	39.06	16.94	56.000	25.80	20.20	46.000
1.310169	38.84	17.16	56.000	25.80	20.20	46.000
16.454069	33.68	26.32	60.000	23.79	26.21	50.000
16.983016	34.54	25.46	60.000	24.40	25.60	50.000
17.421034	33.65	26.35	60.000	25.16	24.84	50.000
17.488563	33.74	26.26	60.000	25.35	24.65	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	2017-04-11

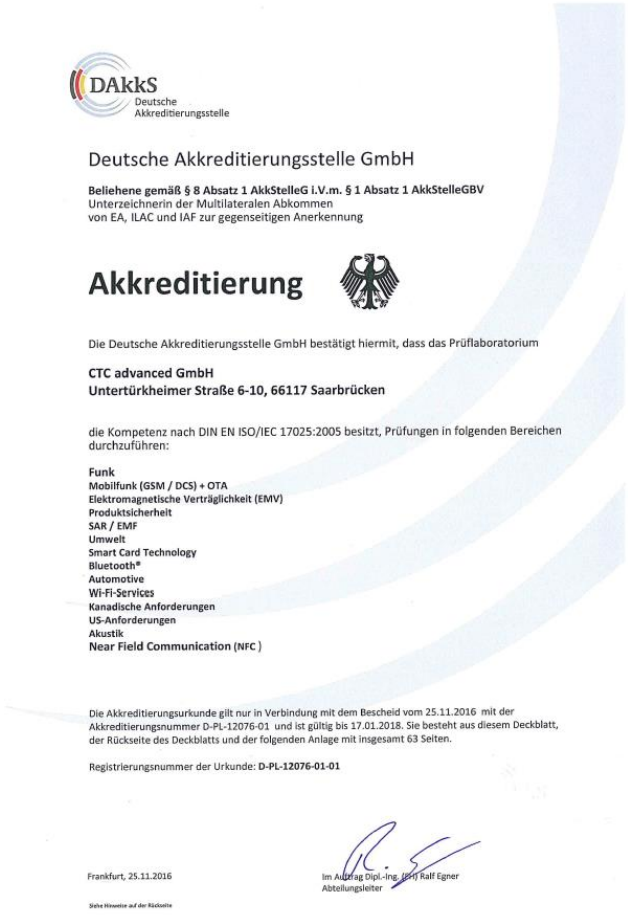
Annex B Further information

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

first page



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Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

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Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

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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:

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SAR / EMF
Umwelt
Smart Card Technology
Bluetooth®
Automotive
Wi-Fi-Services
Kanadische Anforderungen
US-Anforderungen
Akustik
Near Field Communication (NFC)

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Frankfurt, 25.11.2016

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

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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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