

TEST REPORT

Test report no.: 1-7202/18-01-03



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-12076-01-03

Applicant

Sennheiser electronic GmbH & Co. KG

Am Labor 1

30900 Wedemark / GERMANY

Phone: +49 5130 600-0

Contact: Nils Knauer

e-mail: Nils.Knauer@sennheiser.com

Phone: +49 5130/600-9524

Manufacturer

Sennheiser electronic GmbH & Co. KG

Am Labor 1

30900 Wedemark / GERMANY

Test standard/s

FCC - Title 47 CFR
Part 74

FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services

RSS - 210 Issue 9

Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

RSS - Gen Issue 5

Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

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

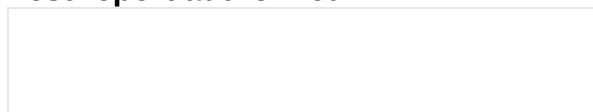
Test Item

Kind of test item: Pocket Transmitter
Model name: SK 9000 / SK 6000
FCC ID: DMOSK9000
IC: 2099A-SK9000
Frequency: 470.200 MHz – 607.800 MHz
Technology tested: Digital audio transmission
Antenna: Integrated antenna
Power supply: 4.5 V DC by 3*AA battery
Temperature range: -30°C to 50°C



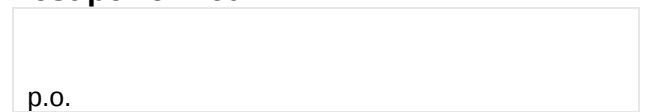
This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

Test report authorized:



Christoph Schneider
Lab Manager
Radio Communications & EMC

Test performed:



p.o.
Sumit Kumar
Testing Manager
Radio Communications & EMC

1 Table of contents

1	Table of contents	2
2	General information	3
2.1	Notes and disclaimer	3
2.2	Application details	3
2.3	Test laboratories sub-contracted	3
3	Test standard/s	4
4	Test environment	5
5	Test item	5
5.1	General description	5
5.2	Additional information	5
6	Description of the test setup	6
6.1	Shielded fully anechoic chamber	7
6.2	Conducted measurements normal and extreme conditions	8
7	Measurement uncertainty	9
8	Summary of measurement results	10
9	Additional comments	11
10	Measurement results	12
10.1	Transmitter unwanted emissions (radiated)	12
10.2	Necessary bandwidth (BN)	16
11	Observations	20
Annex A	Glossary	21
Annex B	Document history	22
Annex C	Accreditation Certificate	22

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.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CTC advanced GmbH.

The testing service provided by CTC advanced GmbH has been rendered under the current "General Terms and Conditions for CTC advanced GmbH".

CTC advanced GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.

Under no circumstances does the CTC advanced GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.

Under no circumstances does the CTC advanced GmbH test report include or imply any product or service warranties from CTC advanced GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CTC advanced GmbH.

All rights and remedies regarding vendor's products and services for which CTC advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by CTC advanced GmbH. In no case this test report can be considered as a Letter of Approval.

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

2.2 Application details

Date of receipt of order:	2018-10-30
Date of receipt of test item:	2018-10-29
Start of test:	2018-11-10
End of test:	2018-12-12
Person(s) present during the test:	-/-

2.3 Test laboratories sub-contracted

None

3 Test standard/s

Test standard	Date	Description
FCC - Title 47 CFR Part 74		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 74 - Experimental radio, auxiliary, special broadcast and other program distributional services
RSS - 210 Issue 9	August 2016	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - Gen Issue 5	April 2018	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus
ETSI EN 300 422-1 V1.4.2	2011-08	Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement

Guidance	Version	Description
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

4 Test environment

Temperature :	T _{nom} T _{max} T _{min}	+22 °C during room temperature tests 50 °C during high temperature tests -30 °C during low temperature tests
Relative humidity content :		45 %
Barometric pressure :		not relevant for this kind of testing
Power supply :	V _{nom} V _{max} V _{min}	4.5 V DC by 3*AA battery 4.6 V 3.8 V

5 Test item

5.1 General description

Kind of test item :	Pocket Transmitter
Type identification :	SK 9000 / SK 6000
S/N serial number :	A1-A4: 1257103676 A5-A8 US: 1257103154
HVIN :	SK 6000; SK 9000
PMN :	SK 6000; SK 9000
FVIN :	SK 6000: 1.1.29 SK 9000: 1.0.146
Hardware status :	572011
Software status :	001.000.136
Firmware status :	-/-
Frequency band :	470.200 MHz – 607.800 MHz Frequency range: A1 - A4: 470.2 MHz, 514.0 MHz, 558.0 MHz A5 - A8 US: 550.0 MHz, 579.0 MHz, 607.8 MHz
Type of radio transmission : Use of frequency spectrum :	Modulated carrier
Type of modulation :	Pi/4 QPSK, 64 DAPSK
Channel bandwidth (B) :	200 kHz
Antenna :	Integrated antenna
Power supply :	4.5 V DC by 3*AA battery
Temperature range :	-30°C to 50°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:

1-7202/18-01-01_AnnexA
1-7202/18-01-01_AnnexB
1-7202/18-01-01_AnnexC

6 Description of the test setup

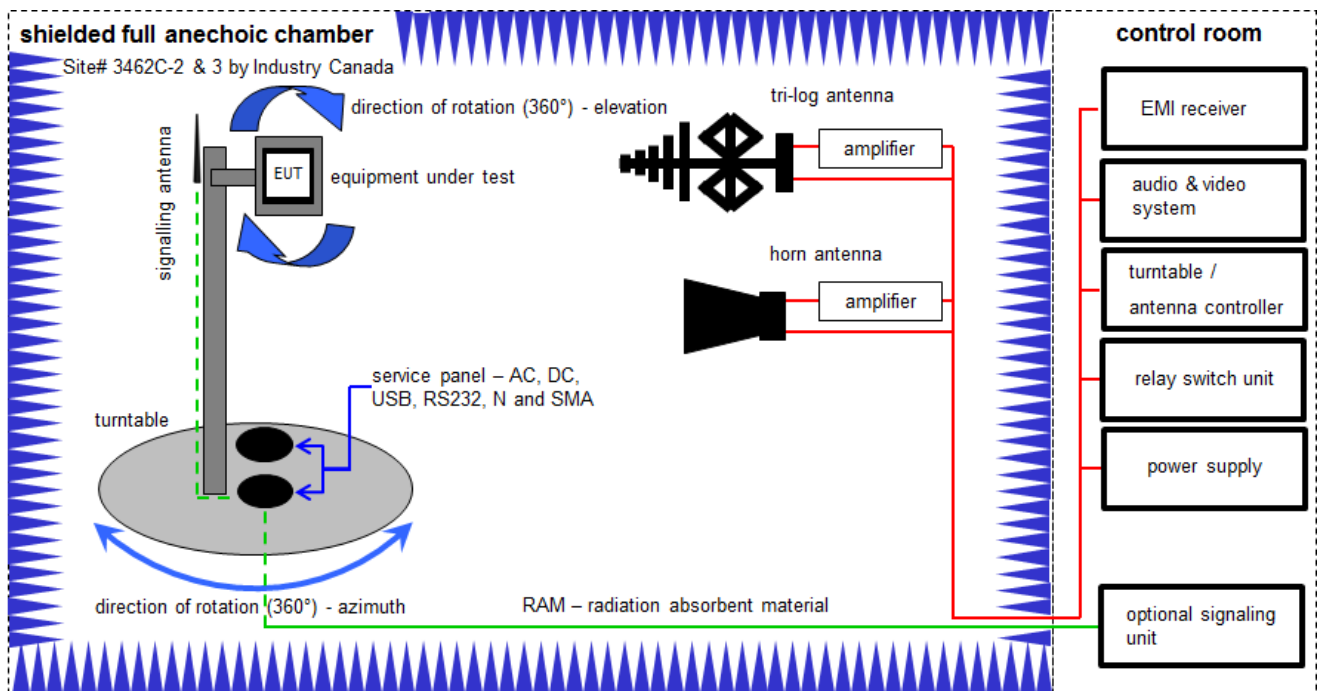
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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 fully anechoic chamber



Measurement distance: tri-log antenna and horn antenna 3 meter

$$OP = AV + D - G + CA$$

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

Example calculation:

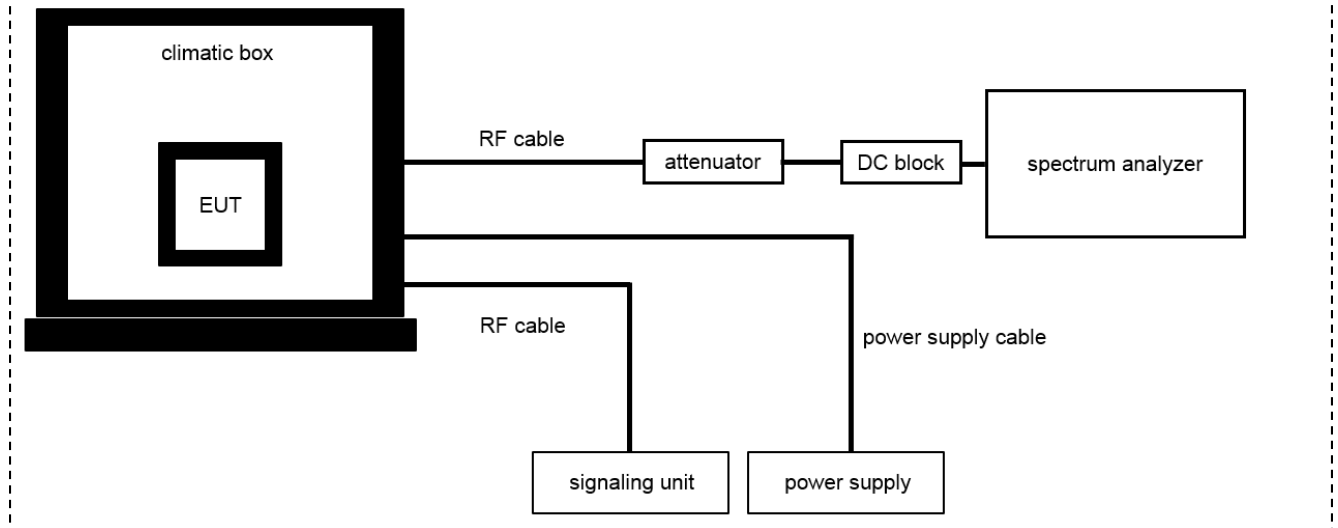
$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50 \text{ [dB]} - 20 \text{ [dBi]} + 5 \text{ [dB]} = -30 \text{ [dBm]} \text{ (1 } \mu\text{W)}$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
2	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vIKII	14.02.2017	13.02.2019
3	A, B	Switch / Control Unit	3488A	HP	-/-	300000199	ne	-/-	-/-
4	B	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255	ev	-/-	-/-
5	A	TRILOG Broadband Test-Antenna	VULB9163	Schwarzbeck Mess Elektronik	01029	300005379	k	07.04.2017	06.04.2020
6	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
7	A, B	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
8	A, B	NEXIO EMV-Software	BAT EMC V3.16.0.49	EMCO	-/-	300004682	ne	-/-	-/-
9	A, B	PC	ExOne	F+W	-/-	300004703	ne	-/-	-/-
10	A,B	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	20.12.2017	19.12.2018

6.2 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme 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	Power Supply 0-20V; 0-5A	6632B	HP	US37478366	400000117	vKI!	25.01.2017	24.01.2019
2	A, B	Signal- and Spectrum Analyzer	FSW26	R&S	101455	300004528	k	20.12.2017	19.12.2018

7 Measurement uncertainty

Measurement uncertainty	
Test case	Uncertainty
Transmitter output power	± 3 dB
Occupied bandwidth	± 3 kHz to 10 kHz (depends on the used RBW)
Transmitter frequency stability	± 1 Hz to 1 kHz (depends on the used RBW)
Transmitter unwanted emissions (radiated or conducted)	Radiated: ± 3 dB Conducted: ± 0.5 dB
Modulation characteristics	-/-
Necessary bandwidth (BN) for analogue systems	± 1 kHz (depends on the used RBW)
Frequency modulation	± 3 kHz (depends on the used RBW)
Spurious emissions conducted below 30 MHz (AC conducted)	± 2.6 dB

8 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	FCC Part 74 RSS - 210, Issue 9 RSS-Gen Issue 4	See table!	2018-12-12	-/-

Test specification clause	Test case	Temperature conditions	Voltage conditions	C	NC	NA	NP	Remark
FCC Part 74.861 (e)(1)(ii) FCC Part 2.1046) RSS-210 – G.3.1 RSS-Gen – 6.12	Transmitter output power	Nominal	Nominal	☐	☐	☐	☒	-/-
FCC Part 74.861 (e)(5) FCC Part 2.1049 RSS-210 – G.3.2 RSS-Gen – 6.6	Occupied bandwidth	Nominal	Nominal	☐	☐	☐	☒	-/-
FCC Part 74.861 (e)(4) FCC Part 2.1055 RSS-210 – G.3.3 RSS-Gen – 6.11	Transmitter frequency stability	Nominal	Nominal	☐	☐	☐	☒	-/-
		Extreme	Extreme	☐	☐	☐	☒	
FCC Part 74.861 (e)(6) FCC Part 74.861 (e)(7) RSS-210 – G.3.4 ETSI EN 300 422-1 v1.4.2 (2011-08)	Transmitter unwanted emissions (radiated or conducted)	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 2.1047	Modulation characteristics	Nominal	Nominal	-/-				-/-
FCC Part 74.861 (e)(7) ETSI EN 300 422-1 v1.4.2 (2011-08)	Necessary bandwidth (BN) for digital systems	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(3) RSS-210 – G.3.5.2	Frequency modulation	Nominal	Nominal	☐	☐	☒	☐	-/-
FCC Part 74.861 (e)(7) RSS-210 – G.3.4	Receiver spurious emissions	Nominal	Nominal	☐	☐	☒	☐	-/-
FCC Part 15.107(a) FCC Part 15.207	Conducted emissions < 30 MHz	Nominal	Nominal	☐	☐	☒	☐	-/-

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

9 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: EUT tested with a sensitivity setting of -30 dB – pre-setting from manufacturer.

Test mode:

☒ No test mode available.
Test signal is applied to the transmitter.

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

Antennas and transmit operating modes:

☒ **Operating mode 1 (single antenna)**

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

☐ **Operating mode 2 (multiple antennas, no beamforming)**

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

☐ **Operating mode 3 (multiple antennas, with beamforming)**

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

10 Measurement results

10.1 Transmitter unwanted emissions (radiated)

Measurement:

Measurement parameter	
Detector:	Peak (prescan) / RMS
Sweep time:	Auto
Resolution bandwidth:	See table below!
Video bandwidth:	See table below!
Span:	100 MHz steps!
Trace-Mode:	Max. hold
EUT:	MC with max frequency deviation
Used equipment:	See chapter 6.1- A / B
Measurement uncertainty:	See chapter 7

Frequency being measured	Measuring receiver bandwidth
25 MHz to 30 MHz	9 kHz to 10 kHz
30 MHz to 1 000 MHz	100 kHz
> 1 000 MHz	1 MHz

Limits:

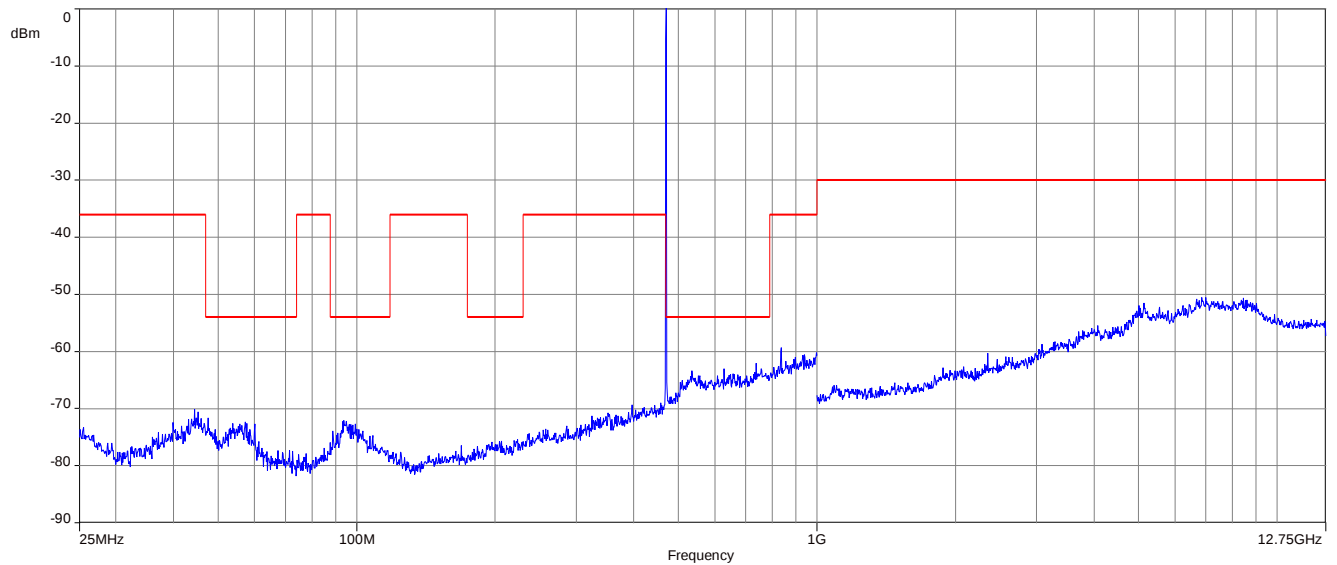
FCC & IC (according to ETSI EN 300 422-1 v1.4.2 (2011-08))			
State	Max. spurious level		
	47 MHz to 74 MHz 87.5 MHz to 118 MHz 174 MHz to 230 MHz 470 MHz to 862 MHz	Other frequencies ≤ 1000 MHz	All frequencies > 1000 MHz
Operating	4.0 nW	250 nW	1.00 µW
Standby	2.0 nW	2.0 nW	20.0 nW

Results:

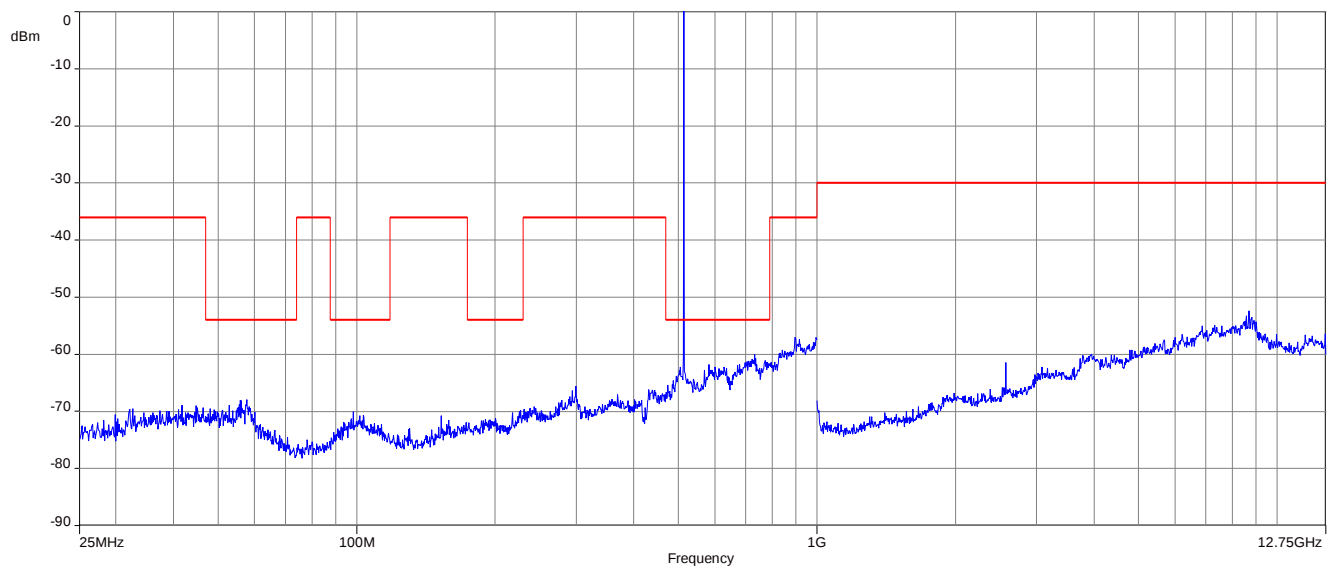
carrier frequency	unwanted emission frequency (MHz)	Limit (dBm)	level (dB) / (dBm) or remark
470.2 MHz	All peaks are more than 20 dB from the limit line.		
514.0 MHz			
558.0 MHz			
550.0 MHz			
579.0 MHz			
607.8 MHz			

Plots: radiated

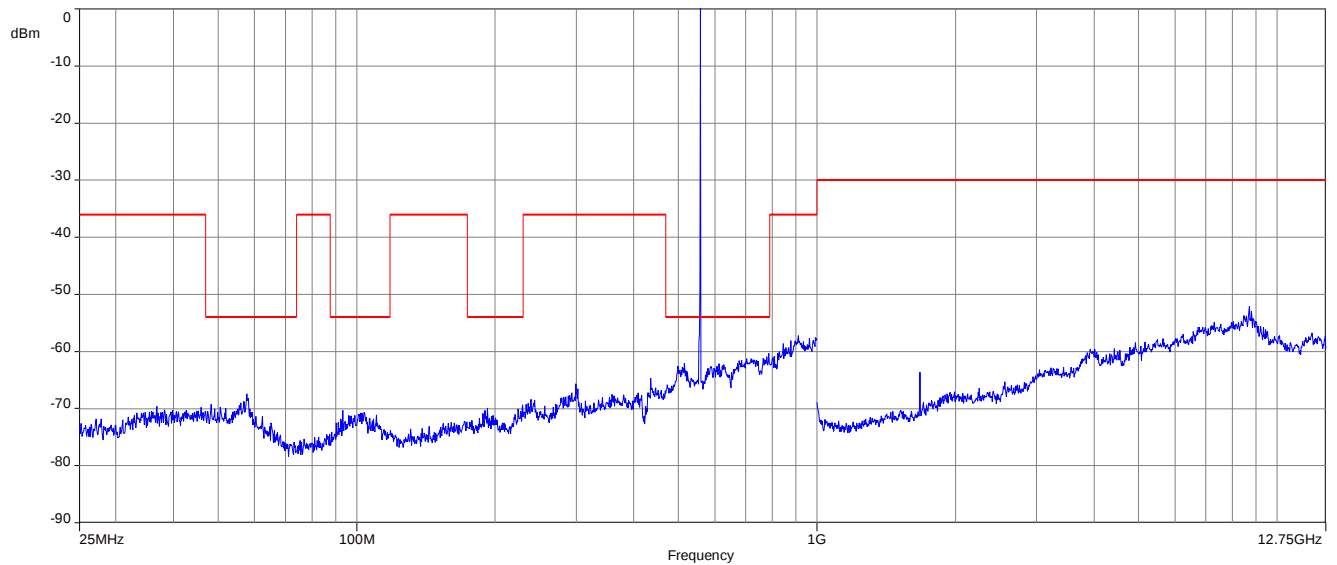
Plot 1: 470.2 MHz, spurious emissions, 25 MHz – 12.75 GHz



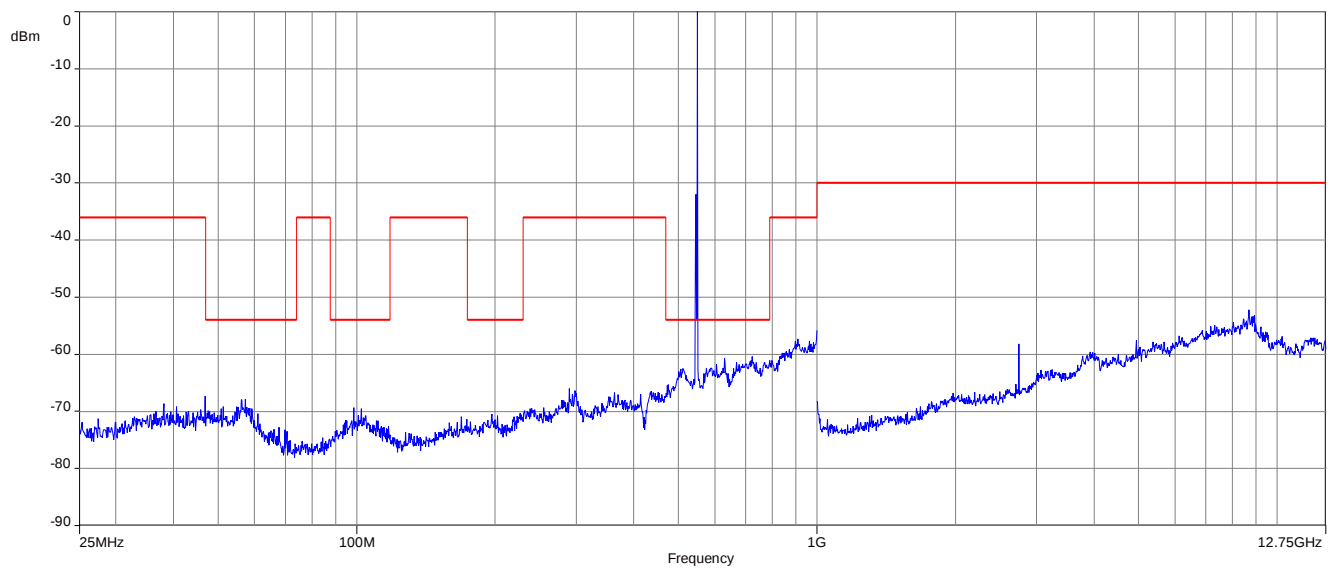
Plot 2: 514.0 MHz, spurious emissions, 25 MHz – 12.75 GHz



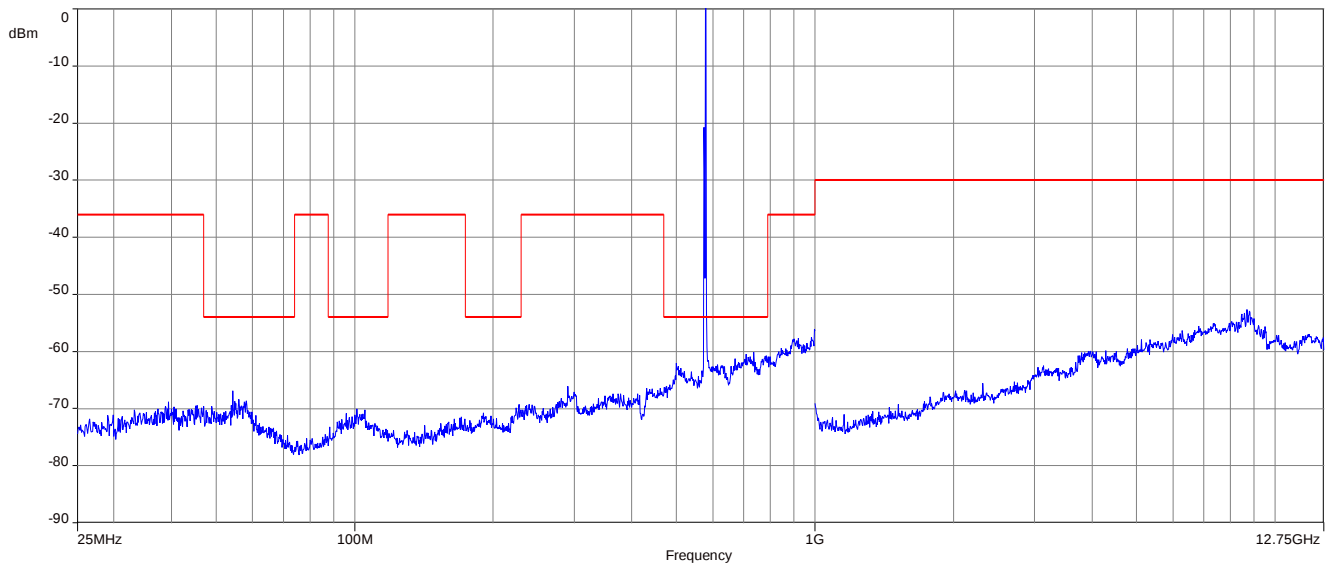
Plot 3: 558.0 MHz, spurious emissions, 25 MHz – 12.75 GHz



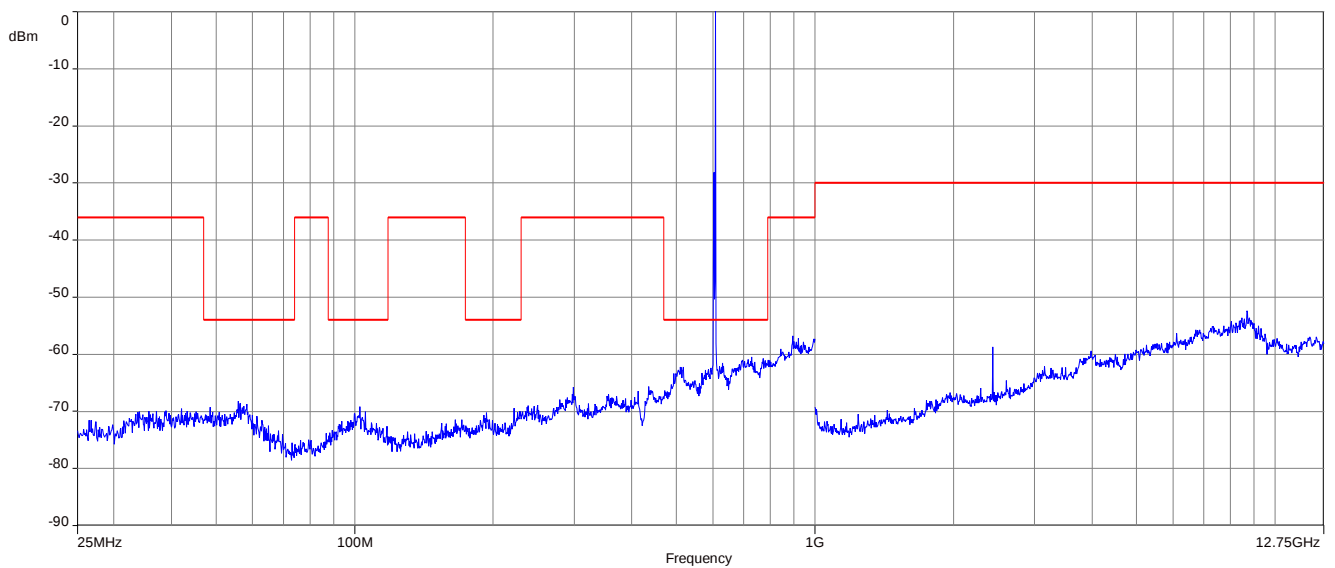
Plot 4: 550.0 MHz, spurious emissions, 25 MHz – 12.75 GHz



Plot 5: 579.0 MHz, spurious emissions, 25 MHz – 12.75 GHz



Plot 6: 607.8 MHz, spurious emissions, 25 MHz – 12.75 GHz



10.2 Necessary bandwidth (BN)

Digital systems:

Measurement:

Measurement parameters	Carrier Power	Maximum relative level (dBc)	Transmitter wide band noise floor
Detector:	RMS	RMS	RMS
Centre frequency:	f_c	f_c	
Sweep time:	$\geq 2s$	$\geq 2s$	$\geq 2s$
Video bandwidth:			
Resolution bandwidth:			
Span:	Zero span	$\geq 5 \times B$	
Trace-Mode:	Average	Peak Hold	Average
RBW&VBW	$5 \times B$	1 kHz	1 kHz

Frequency	below 1GHz	above 1 GHz
Start:	$f_c + 1.75B$ and $f_c - 1 \text{ MHz}$	$f_c + B$ and $f_c - 1 \text{ MHz}$
Stop:	$f_c + 1 \text{ MHz}$ and $f_c - 1.75 B$	$f_c + 1 \text{ MHz}$ and $f_c - B$

Limits:

Subclause 8.3.2.2

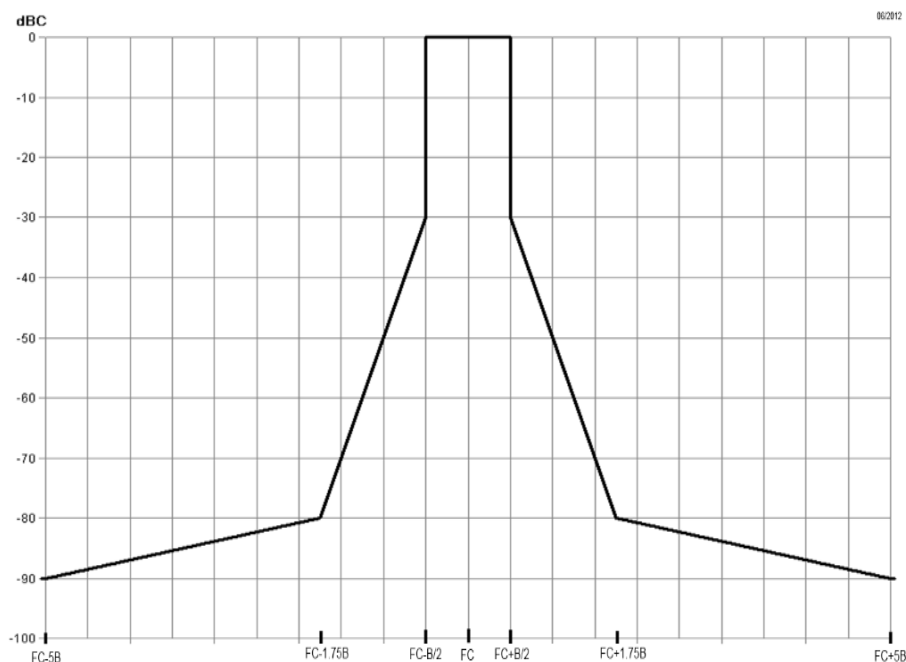
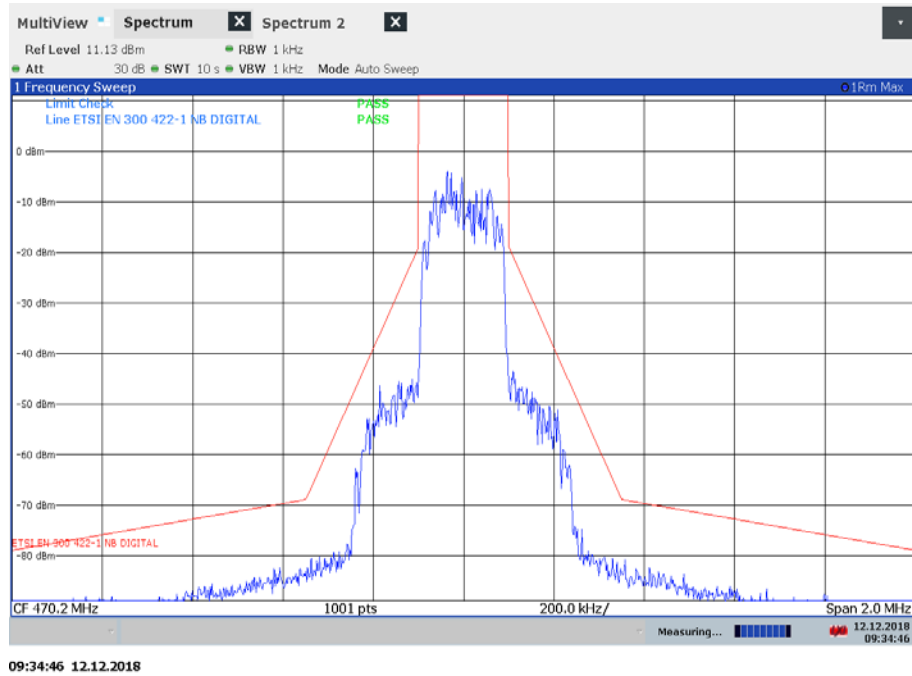
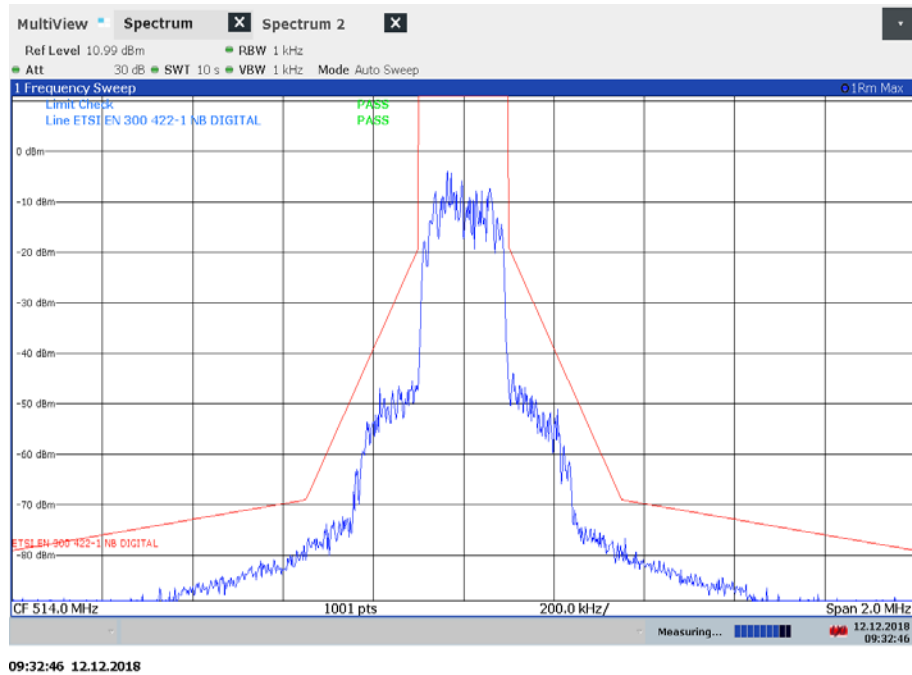
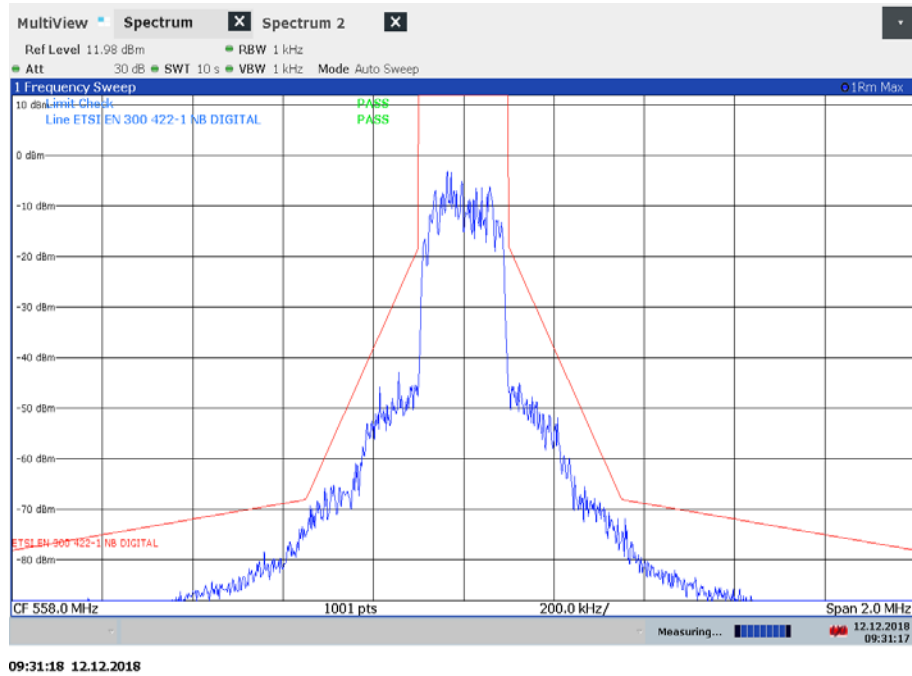
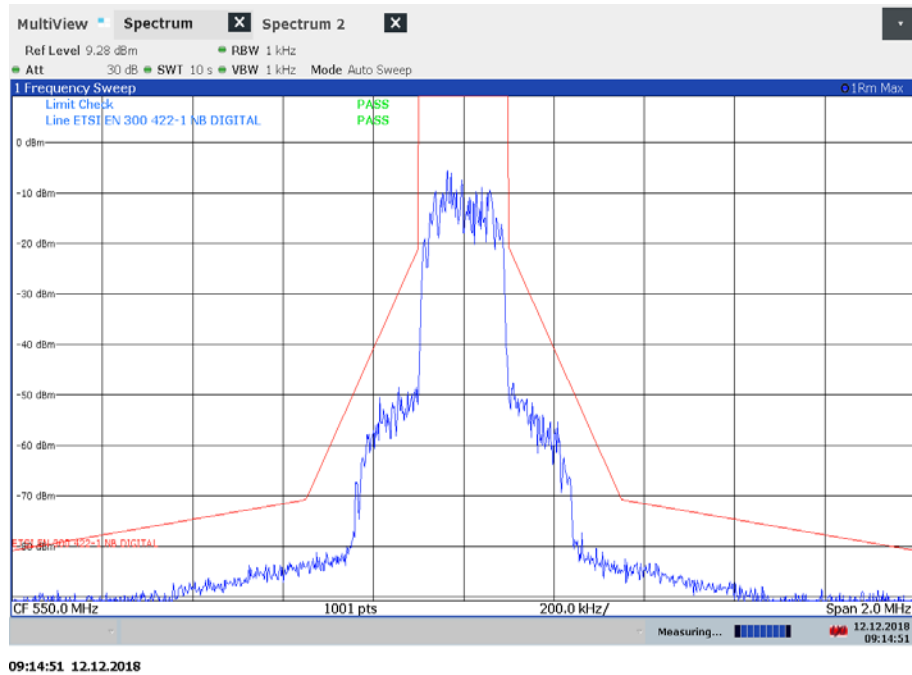
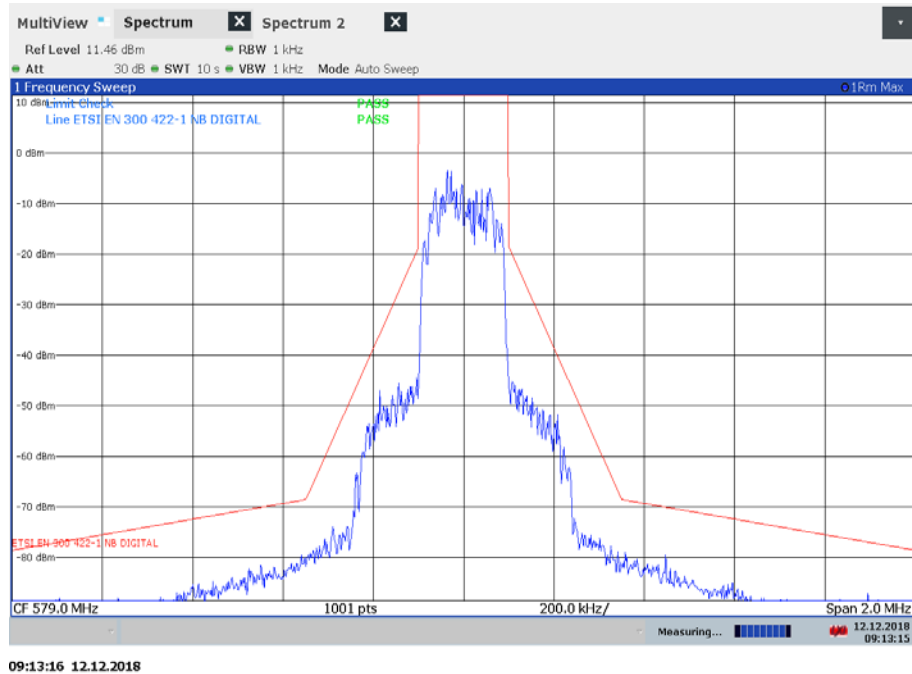
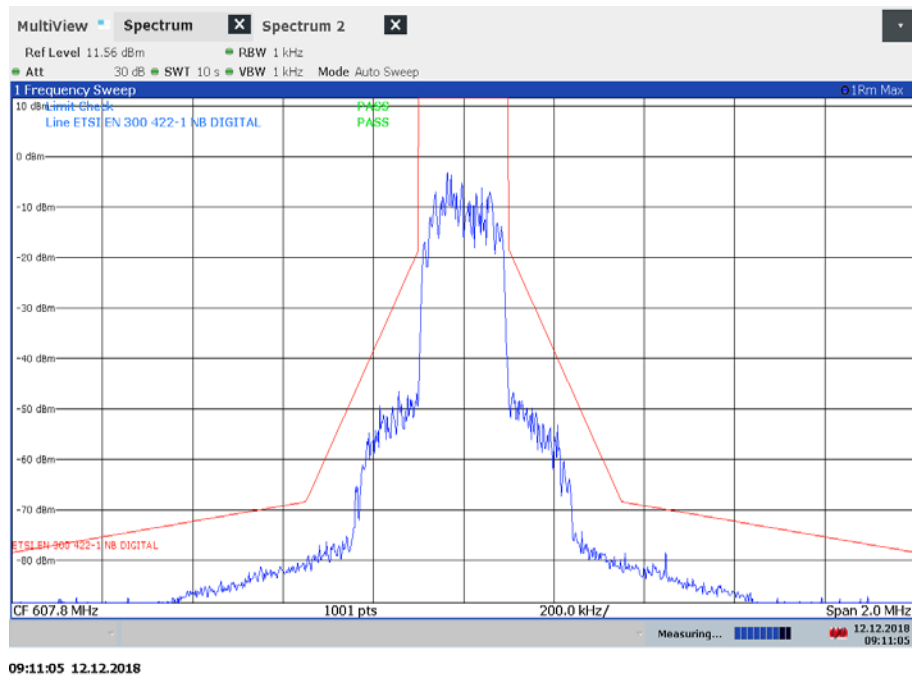


Figure 1: Spectrum mask for digital systems below 2 GHz

Plots:**Plot 1:** Modulated carrier with the weighted noise source, 470.2 MHz**Plot 2:** Modulated carrier with the weighted noise source, 514.0 MHz

Plot 3: Modulated carrier with the weighted noise source, 558.0 MHz**Plot 4:** Modulated carrier with the weighted noise source, 550.0 MHz

Plot 5: Modulated carrier with the weighted noise source, 579.0 MHz**Plot 6:** Modulated carrier with the weighted noise source, 607.8 MHz

11 Observations

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

Annex A Glossary

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

Annex B Document history

Version	Applied changes	Date of release
-/-	Initial release	2018-12-12

Annex C Accreditation Certificate

first page	last page
 Deutsche Akkreditierungsstelle GmbH Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Accreditation  The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields: Telecommunication The accreditation certificate shall only apply in connection with the notice of accreditation of 02.06.2017 with the accreditation number D-PL-12076-01 and is valid until 21.04.2021. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 43 pages. Registration number of the certificate: D-PL-12076-01-03 Frankfurt, 02.06.2017  Dep. Dir. (FH) Ralf Böker Head of Division	Deutsche Akkreditierungsstelle GmbH Office Berlin Spittelmarkt 10 10117 Berlin Office Frankfurt am Main Europa-Allee 52 60327 Frankfurt am Main Office Braunschweig Bundesallee 100 38116 Braunschweig The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAKKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAKKS. The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAKKS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org IAF: www.iaf.nu

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

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

END OF TEST REPORT