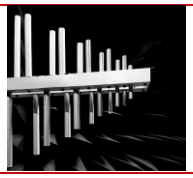
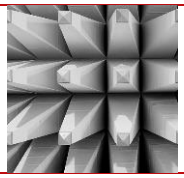




CETECOM™

CETECOM ICT Services

consulting - testing - certification ➤➤➤

TEST REPORT

Test report no.: 1-1410/16-02-02

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

Testing laboratory

CETECOM ICT Services GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.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

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY
Phone: +49 5130 600-0
Fax: +49 5130 600-574
Contact: Volker Bartsch
e-mail: volker.bartsch@sennheiser.com
Phone: +49 5130 600 1465

Manufacturer

Sennheiser electronic GmbH & Co. KG
Am Labor 1
30900 Wedemark / GERMANY

Test standard/s

47 CFR Part 74	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 8	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

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

Test Item

Kind of test item:	**Active Antenna Combiner**
Model name:	**AC 3**
FCC ID:	**DMOAC3**
IC:	**2099A-AC3**
Frequency:	470 MHz to 516 MHz
Technology tested:	Analog FM
Antenna:	External dedicated dipole antenna
Power supply:	115 V AC
Temperature range:	-30°C to +50°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=Marco Bertolino, o=CETECOM ICT Services GmbH, ou=BTL-150828, email=marco.bertolino@cetecom.com, c=DE
2016.10.06 15:14:16 +02'00'

Marco Bertolino
Lab Manager
Radio Communications & EMC

Test performed:

p.o.

cn=Stefan Boes, o=CETECOM ICT Services GmbH, ou=BOE-111011, email=Stefan.Boes@cetecom.com, c=DE
2016.10.06 15:09:25 +02'00'

Andreas Luckenbill
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. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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 CETECOM ICT Services GmbH.
The testing service provided by CETECOM ICT Services GmbH has been rendered under the current "General Terms and Conditions for CETECOM ICT Services GmbH".
CETECOM ICT Services 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 CETECOM ICT Services 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 CETECOM ICT Services GmbH test report include or imply any product or service warranties from CETECOM ICT Services GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM ICT Services GmbH.
All rights and remedies regarding vendor's products and services for which CETECOM ICT Services GmbH has prepared this test report shall be provided by the party offering such products or services and not by CETECOM ICT Services 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:	2016-07-25
Date of receipt of test item:	2016-07-22
Start of test:	2016-09-26
End of test:	2016-09-09
Person(s) present during the test:	-/-

3 Test standard/s and references

Test standard	Date	Description
47 CFR Part 74		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 8	December 2010	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment
RSS - 210 Issue 8 Amendment 1	February 2015	RSS-210, Amendment 1 — Licence-Exempt, Low-Power Radio Apparatus Operating in the Television Bands (February 2015)
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
KDB 935210 D05	v01r01	KDB Publication 935210 D05 Measurements guidance for industrial and non-consumer signal booster, repeater, and amplifier devices

4 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+22 °C during room temperature tests No tests under extreme conditions required. No tests under extreme conditions required.
Relative humidity content	:		55 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	115 V AC No tests under extreme conditions required. No tests under extreme conditions required.

5 Test item

5.1 General description

Kind of test item	:	Active Antenna Combiner
Type identification	:	AC 3
HMN	:	-/-
PMN	:	AC 3
HVIN	:	AC 3-US
FVIN	:	-/-
S/N serial number	:	Rad. -/- Cond. -/-
HW hardware status	:	-/-
SW software status	:	-/-
Frequency band	:	470 MHz to 516 MHz
Type of radio transmission Use of frequency spectrum	: :	Analog FM
Type of modulation	:	Modulated carrier
Antenna	:	External dedicated dipole antenna
Power supply	:	100 V to 240 V AC
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: 1-1410/16-02-01_AnnexA
1-1410/16-02-01_AnnexB
1-1410/16-02-01_AnnexC

6 Test laboratories sub-contracted

None

7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

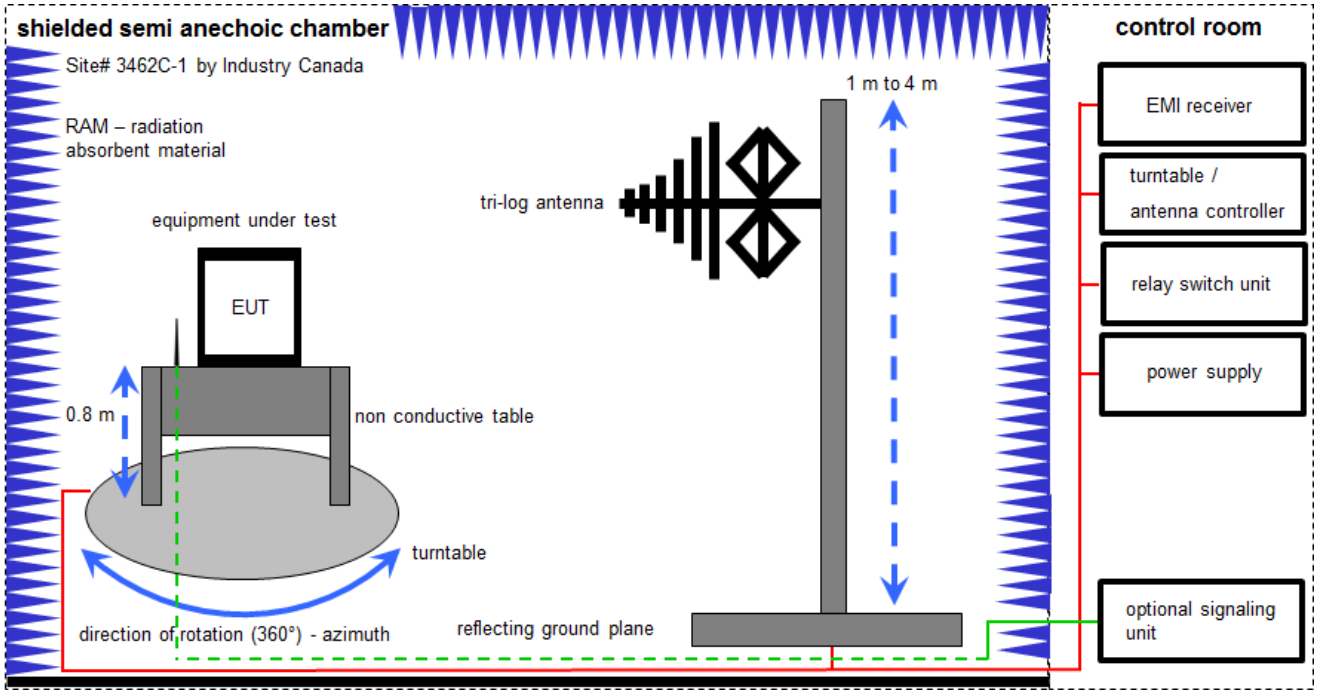
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

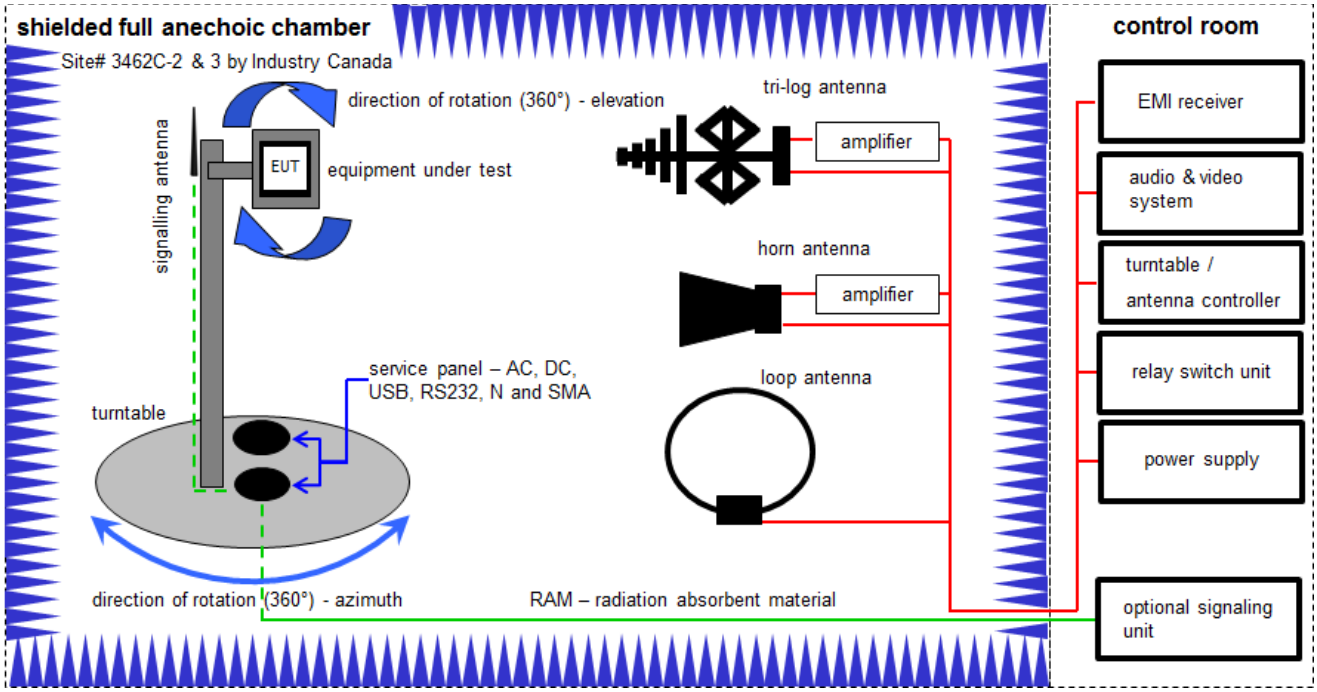
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [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 Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1		Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2		EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	08.03.2016	08.03.2017
3		Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	02.02.2016	02.02.2018
4		Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5		Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6		Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7		TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	k	25.04.2016	25.04.2018

7.2 Shielded fully anechoic chamber



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

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

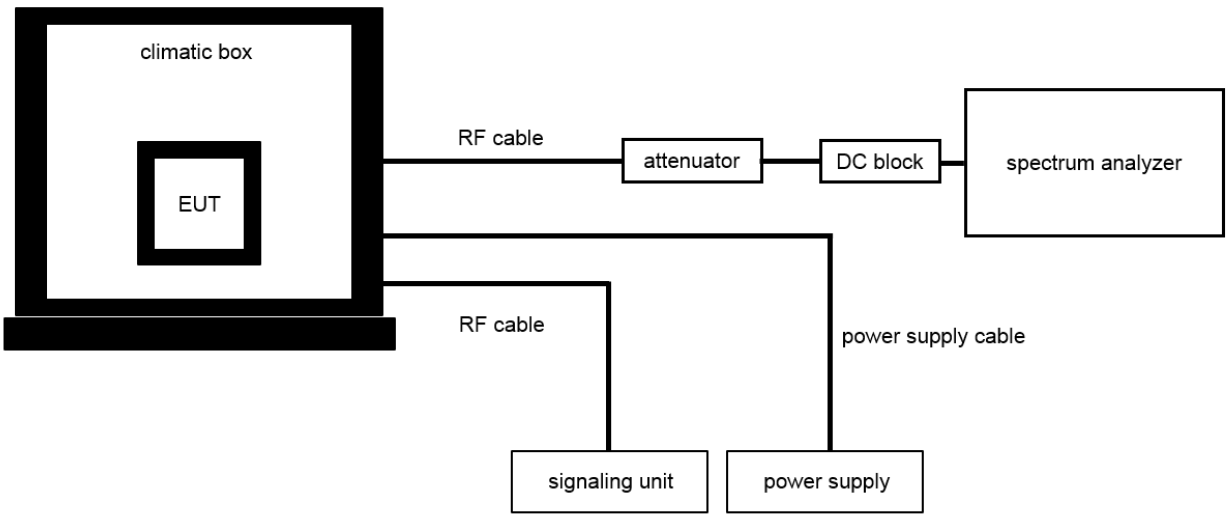
Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1		Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5290	300000212	k	13.08.2015	13.08.2017
2		EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	02.02.2016	02.02.2017
3		TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	318	300003696	k	22.04.2014	22.04.2017
4		Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22050	300004482	ev	-/-	-/-
5		Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22011	300004492	ev	-/-	-/-
6		4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
7		Messrechner und Monitor	Intel Core i3 3220/3,3 GHz, Prozessor	Agilent Technologies	2V2403033A5421	300004591	ne	-/-	-/-
8		NEXIO EMV-Software	BAT EMC	EMCO	2V2403033A5421	300004682	ne	-/-	-/-

7.3 Conducted measurements normal and extreme conditions

Conducted measurements normal & extreme conditions



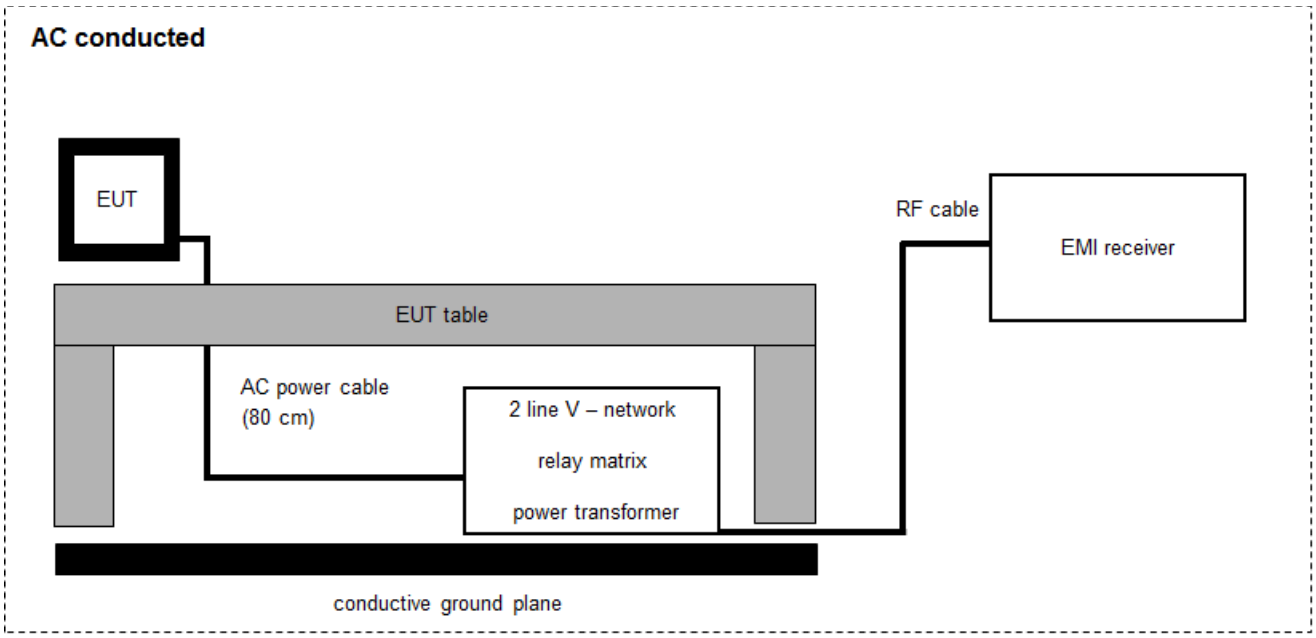
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

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 Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1		Isolating Transformer	RT5A	Grundig	12780	300001166	ev	-/-	-/-
2		Signal Generator 0.1-4200 MHz	8665A	HP	2833A00109	300001177	vIKI!	29.01.2014	29.01.2017
3		Temperature Test Chamber	VT 4002	Heraeus Voetsch	521/83761	300002326	ev	03.09.2015	03.09.2017
4		Hygro-Thermometer	-/-, 5-45C, 20-100rF	Heraeus Voetsch	-/-	400000108	ev	07.09.2015	07.09.2017
5		Signal Analyzer 40 GHz	FSV40	R&S	101042	300004517	k	21.01.2016	21.01.2017
6		RF-Cable	ST18/SMAm/SMAm/60	Huber & Suhner	Batch no. 606844	400001181	ev	-/-	-/-
7		DC-Blocker 0.1-40 GHz	8141A	Inmet	Batch no. 606844	400001185	ev	-/-	-/-
8		Radiocom. Analyzer	CMTA 84	R&S	894199/012	300001176	vIKI!	07.03.2016	07.03.2018
9		Multifunction synthesizer DC-600 kHz	8904A	HP	2822A01203	300001367	Ve	30.01.2014	30.01.2017
10		Audio Analyzer	UPA	R&S	841074/009	300001236	k	02.02.2016	02.02.2018

7.4 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 Cetecom	Kind of Calibration	Last Calibration	Next Calibration
1	A	Netznachbildung	ESH3-Z5	R&S	892475/017	300002209	k	17.06.2014	17.06.2016
2	A	EMI-Receiver	8542E	HP	3617A00170	300000568	k	28.01.2016	28.01.2017
3	A.	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	Ve	28.01.2016	28.01.2017

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup

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

Premeasurement

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

Final measurement

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

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup

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

Premeasurement

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

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 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.

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

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

Premeasurement

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

Final measurement

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

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

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

Premeasurement

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

Final measurement

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

8.5 Sequence of testing radiated spurious above 50 GHz with external mixers

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 for far field (e.g. 0.25 m).
- The EUT is set into operation.

Premeasurement

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

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).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

9 Measurement uncertainty

Measurement uncertainty	
Test case	**Uncertainty**
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

10 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!	2016-10-06	-/-

Test specification clause	Test case	Temperature conditions	Voltage conditions	C	NC	NA	NP	Remark
FCC Part 74.861 (e)(1)(ii) RSS-210 A1 – 5.1 & 5.3.2 RSS-Gen – 6.12	Transmitter output power	Nominal	Nominal	☒	☐	☐	☐	comparison between input and output signal
FCC Part 74.861 (e)(5) FCC Part 2.1049 RSS-210 A1 – 6.2 RSS-Gen – 6.6	Occupied bandwidth	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 74.861 (e)(4) FCC Part 2.1055 RSS-210 A1 – 6.3 RSS-Gen – 6.11	Transmitter frequency stability	Nominal	Nominal	☐	☐	☒	☐	No signal generation inside the EUT.
		Extreme	Extreme	☐	☐	☒	☐	
FCC Part 74.861 (e)(6) RSS-210 A1 – 6.4.1	Transmitter unwanted emissions (radiated or conducted)	Nominal	Nominal	☒	☐	☐	☐	-/-
FCC Part 2.1049	Modulation characteristics	Nominal	Nominal	-/-				-/-
FCC Part 74.861 (e)(7) ETSI EN 300 422-1 8.3.1	Necessary bandwidth (BN) for analogue systems	Nominal	Nominal	☐	☐	☒	☐	No signal generation inside the EUT.
FCC Part 74.861 (e)(3) RSS-210 A1 – 6.6.2	Frequency modulation	Nominal	Nominal	☐	☐	☒	☐	No signal generation inside the EUT.
RSS-210 A1 – 6.5 RSS-Gen	Receiver spurious emissions	Nominal	Nominal	☐	☐	☒	☐	No receiver integrated!
§15.107(a) §15.207	Conducted emissions < 30 MHz	Nominal	Nominal	☒	☐	☐	☐	-/-

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

11 Additional comments

Reference documents:	Cetecom test report of the signaling input, SR300-IEMG3: 1-1410/16-01-05 Main testreport of the EUT: Cetecom test report 1-1126-01-14/09_B
Special test descriptions:	Output power and spurious emissions conducted are made on the EUT output port and at the output port of the SR300-IEMG3, which is used as signal input for the EUT.
Configuration descriptions:	EUT tested with a sensitivity setting of -18 dB.

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.

12 Measurement results

12.1 Transmitter output power

Measurement description:

Two traces are captured to show the difference between input- and output signals and to measure the effective output power of the device. Trace 1 shows the measurement results of the output signal and trace 2 shows the measurement results of the input signal. Marker D2 in the plots shows the difference between the input and the output signal.

Measurement:

Measurement parameter	
Detector:	Peak (worst case) / Average (RMS)
Sweep time:	Auto / 20s
Resolution bandwidth:	> emission bandwidth
Video bandwidth:	> resolution bandwidth
Span:	> 2 times emissions bandwidth
Trace mode:	Max. hold
EUT configuration:	Peak: Unmodulated carrier RMS: Modulate the transmitter with a 2.5 kHz tone at a level 16 dB higher than that required to produce a frequency deviation of ± 75 kHz, or to produce 50% of the manufacturer's rated deviation, whichever is less.
Test setup:	See sub clause 7.3 – A
Measurement uncertainty:	See sub clause 9

Limits:

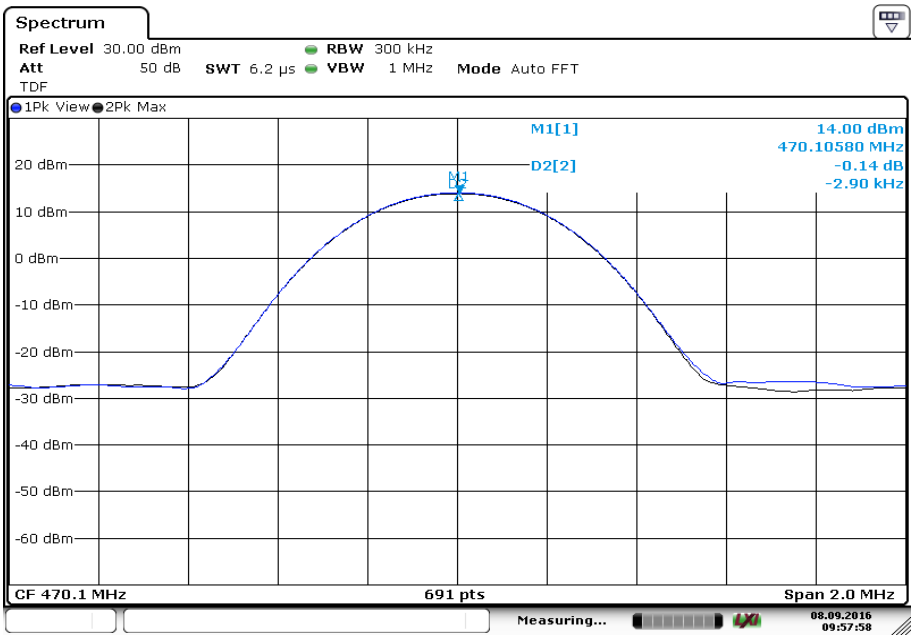
FCC & IC	
470 MHz to 608 MHz	250 mW (average) / 24 dBm (average)

Result:

Frequency (MHz)	transmitter output power (dBm)	
	Peak	Average
470.100	14.0	13.9
493.000	14.2	14.2
516.000	14.6	14.4

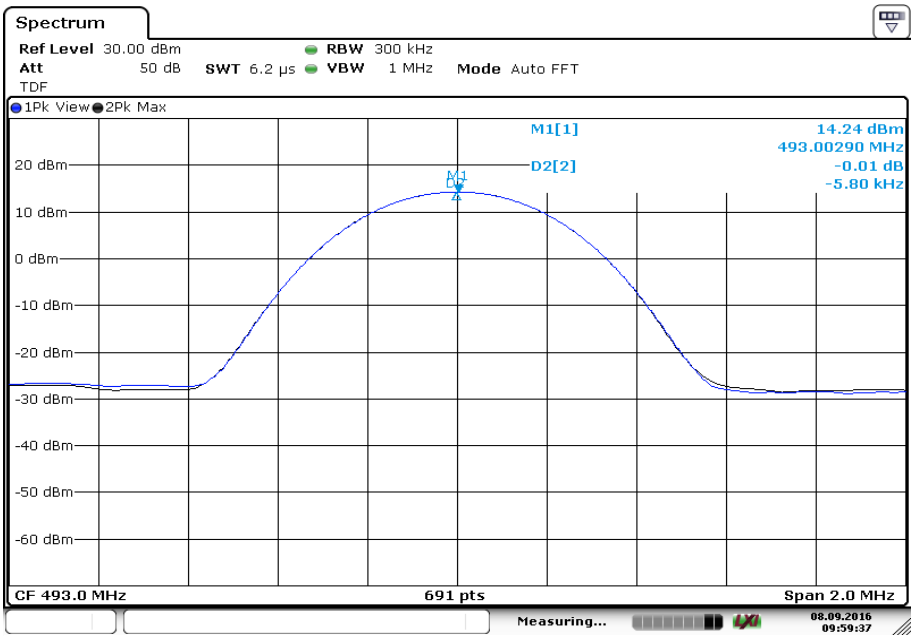
Plots:

Plot 1: lowest channel, conducted peak power



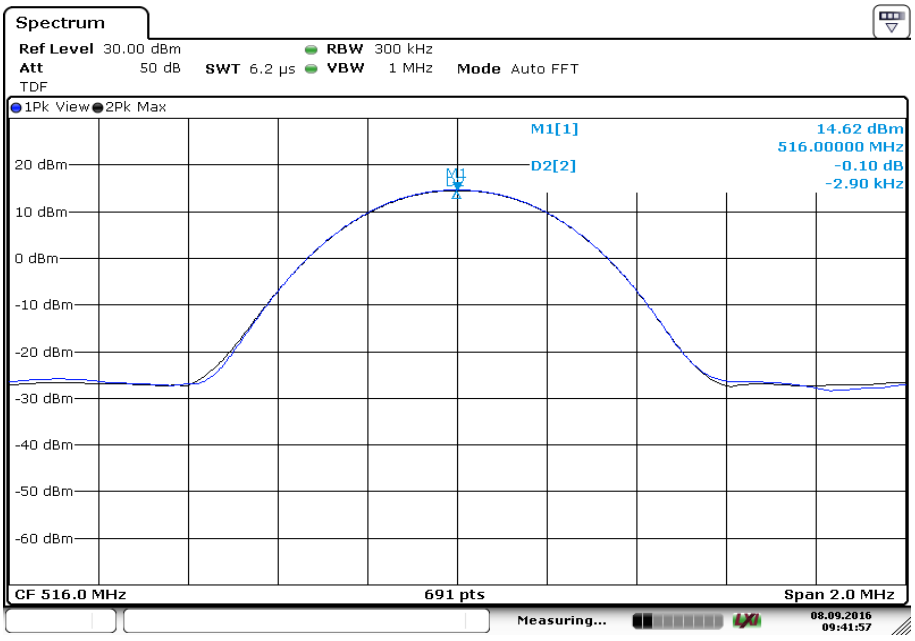
Date: 8.SEP.2016 09:57:58

Plot 2: middle channel, conducted peak power



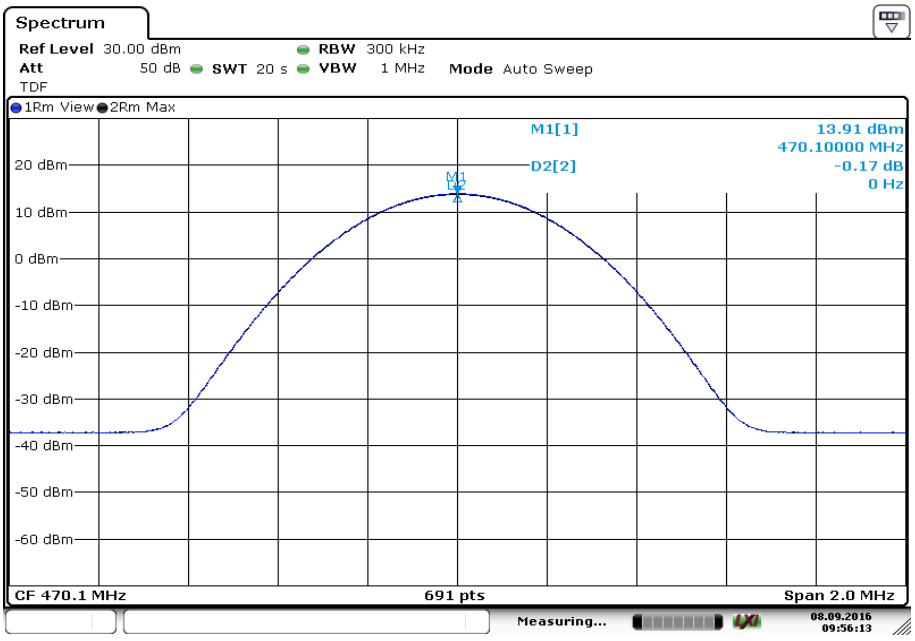
Date: 8.SEP.2016 09:59:37

Plot 3: highest channel, conducted peak power



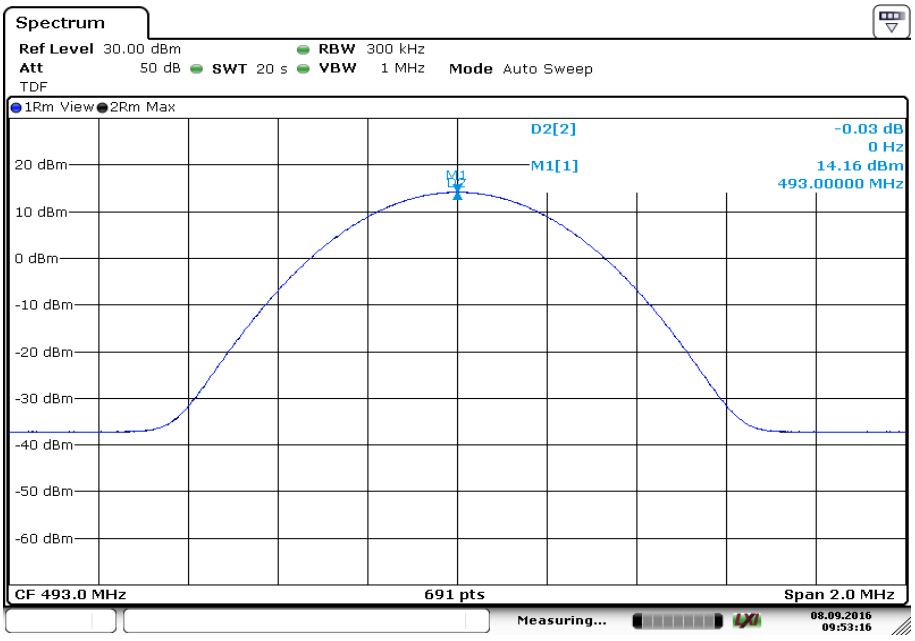
Date: 8.SEP.2016 09:41:57

Plot 4: lowest channel, conducted average power



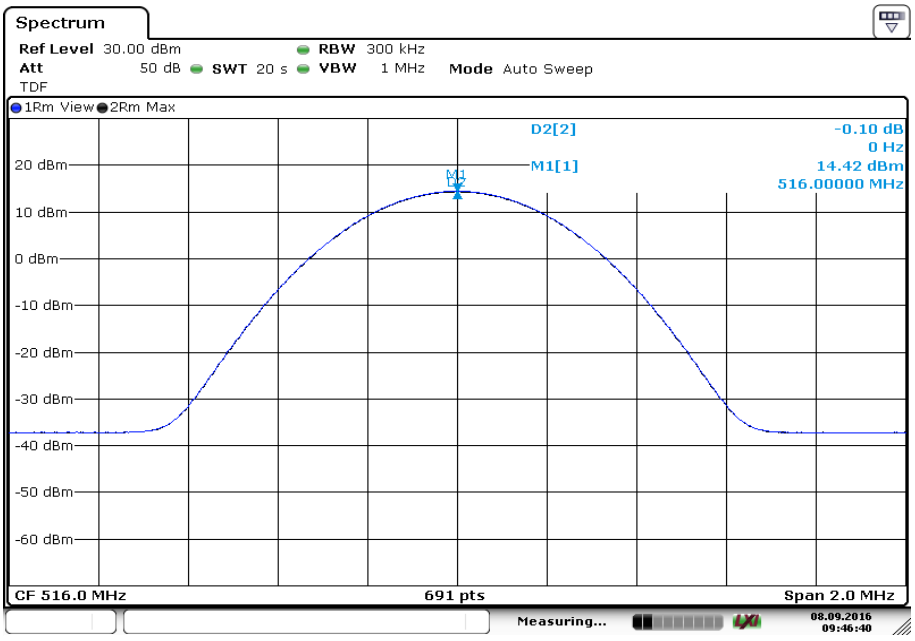
Date: 8.SEP.2016 09:56:13

Plot 5: middle channel, conducted average power



Date: 8.SEP.2016 09:53:16

Plot 6: highest channel, conducted average power



Date: 8.SEP.2016 09:46:40

12.2 Occupied bandwidth

Measurement description:

Two traces are captured to show the difference between input- and output signals and to measure the effective bandwidth of the output signal. Trace 1 shows the measurement results of the output signal and trace 2 shows the measurement results of the input signal.

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	1 % to 5 % of the occupied bandwidth
Video bandwidth:	3 x resolution bandwidth
Span:	2 x emission bandwidth
Trace mode:	Max. hold
Analyzer function:	99% power occupied bandwidth function
EUT:	Modulated signal with max. frequency deviation
Test setup:	See sub clause 7.3 - A
Measurement uncertainty:	See sub clause 9

Limits:

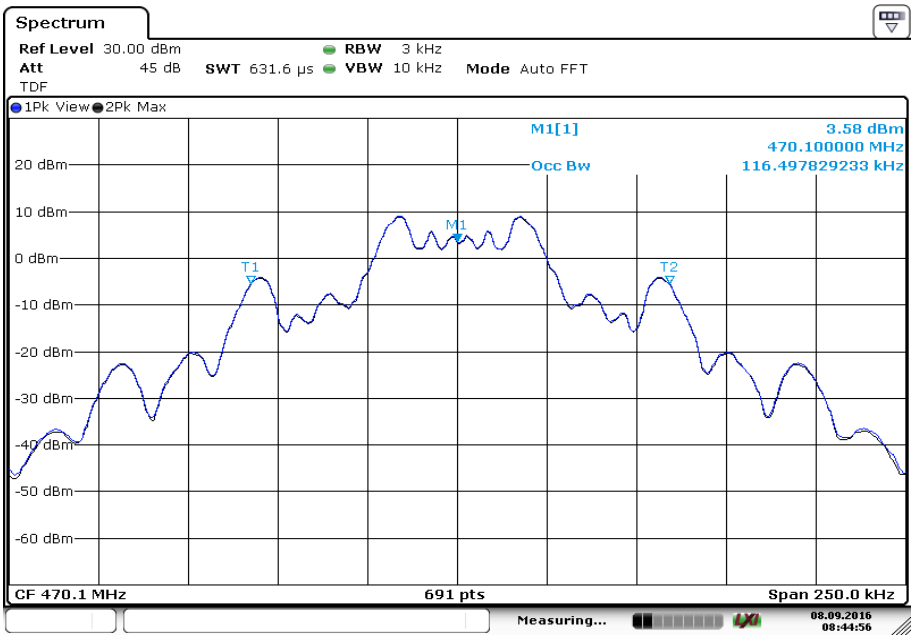
FCC & IC
470 MHz to 608 MHz 200 kHz
Occupied bandwidth 99%. Other than single sideband or independent sideband transmitters - when modulated by a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50 percent modulation. The input level shall be established at the frequency of maximum response of the audio modulating circuit.

Result:

Frequency (MHz)	occupied bandwidth (kHz)
	2.5 kHz tone
470.100	116
493.000	115
516.000	115

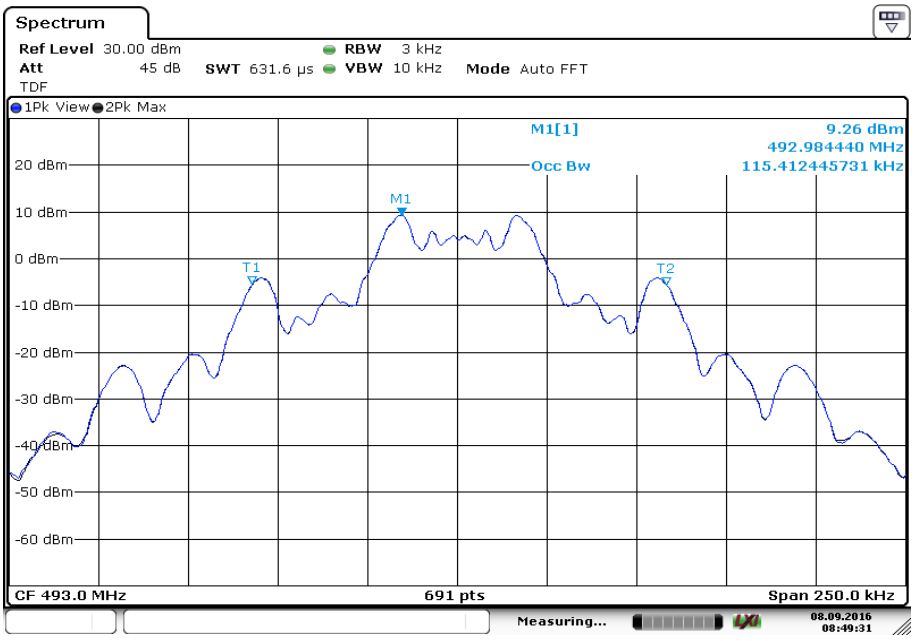
Plots:

Plot 1: lowest channel, 2.5 kHz tone



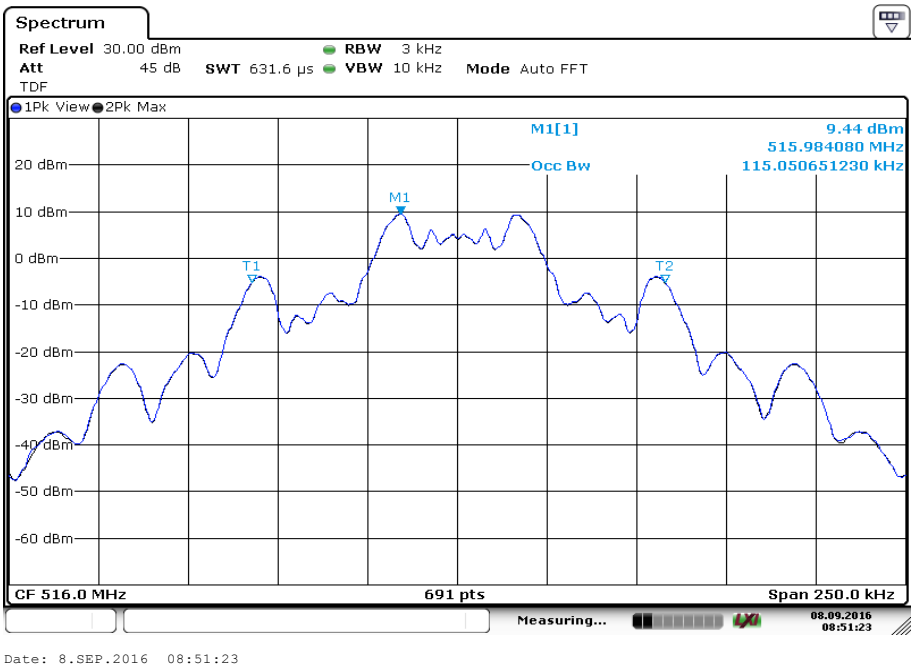
Date: 8.SEP.2016 08:44:57

Plot 2: middle channel, 2.5 kHz tone



Date: 8.SEP.2016 08:49:31

Plot 3: highest channel, 2.5 kHz tone



12.3 Transmitter unwanted emissions

Measurement description:

For the conducted measurements two traces are captured to show the difference between input- and output signals and to measure the output signal. Trace 1 shows the measurement results of the output signal and trace 2 shows the measurement results of the input signal.

Measurement:

Measurement parameter		
Detector:	Peak	
Sweep time:	Auto	
Resolution bandwidth:	25 dBc and 35 dBc-criteria:	1% of the authorized bandwidth
	$55+10\log_{10}(P_{MEAN}$ in Watts) dB - criteria	30 kHz
	$43+10\log_{10}(P_{MEAN}$ in Watts) dB - criteria	120 kHz / 1 MHz
Video bandwidth:	3 x resolution bandwidth	
Trace mode:	Max. hold	
EUT:	MC with max frequency deviation	
Test setup:	See sub clause 7.1 – A See sub clause 7.2 – A See sub clause 7.3 – A	
Measurement uncertainty:	See sub clause 9	

Limits:

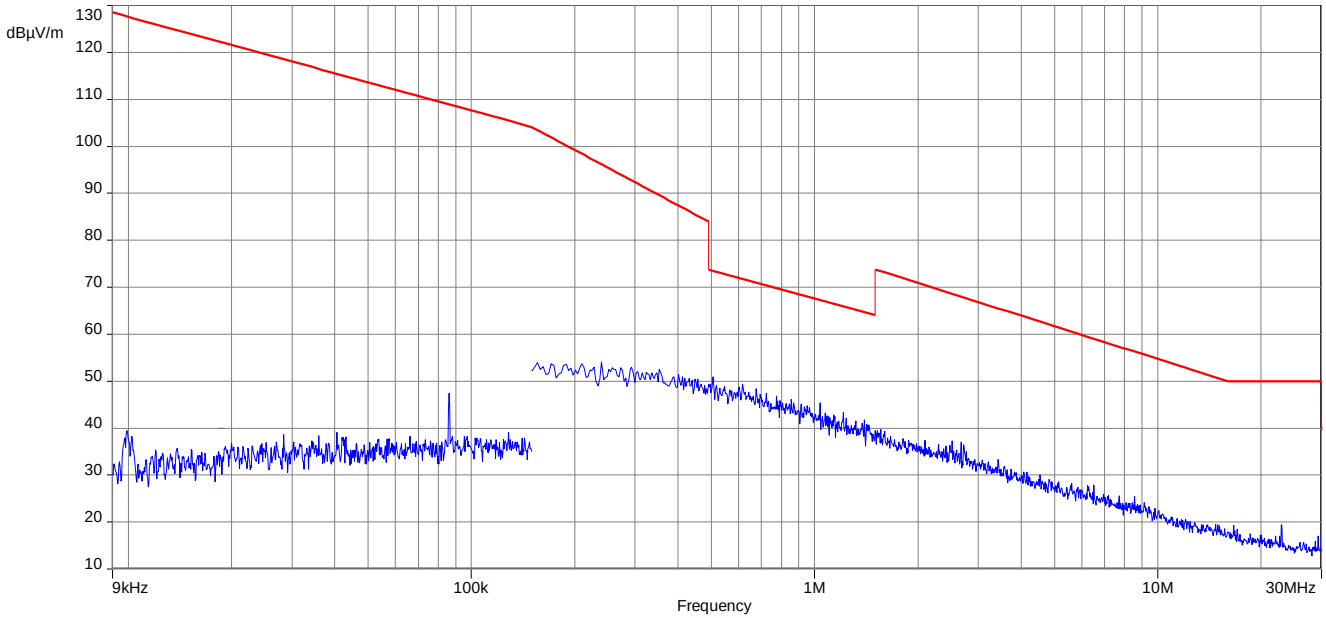
- at least 25 dB on any frequency that is removed from the operating frequency by more than 50%, up to and including 100% of the authorized bandwidth; and (FCC & IC)
- at least 35 dB on any frequency that is removed from the operating frequency by more than 100%, up to and including 250% of the authorized bandwidth. (FCC & IC)
- On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least $43 + 10*\log_{10}$ (mean output power in watts) dB. (FCC)
- at least $55 + 10*\log_{10}$ (P_{MEAN} in Watts) dB on any frequency removed from the operating frequency by more than 250% of the authorized bandwidth. (IC)

Results:

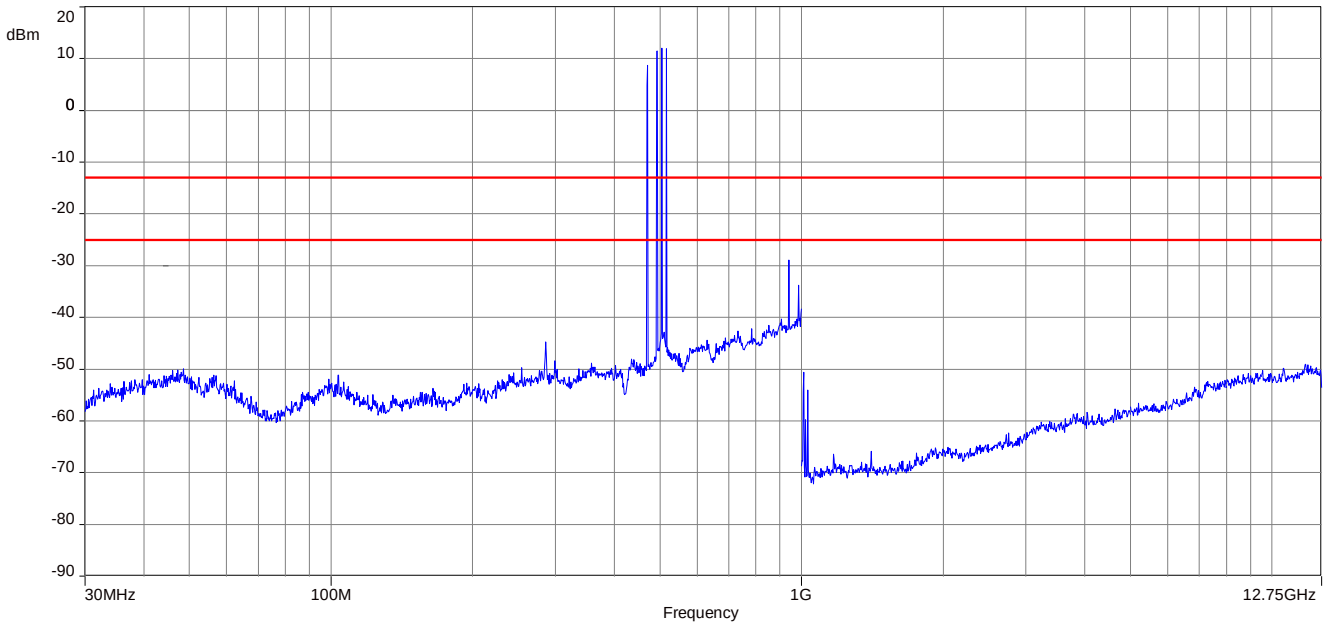
carrier frequencies (MHz)	unwanted emission frequency (MHz)	Limit FCC (dBm)	Limit IC (dBm)	level (dB) / (dBm) or remark
470.09; 493.03; 505.01; 516.02	286.08	-13	-25	-44.8
470.09; 493.03; 505.01; 516.02	940.1995	-13	-25	-28.9
470.09; 493.03; 505.01; 516.02	986.032	-13	-25	-33.7
470.09; 493.03; 505.01; 516.02	1000.995	-13	-25	-50.6
470.09; 493.03; 505.01; 516.02	1020.95	-13	-25	-59.8
470.09; 493.03; 505.01; 516.02	1031.95	-13	-25	-54.0

Plots: radiated, lowest, middle and highest channel + one additional channel at the combiner input

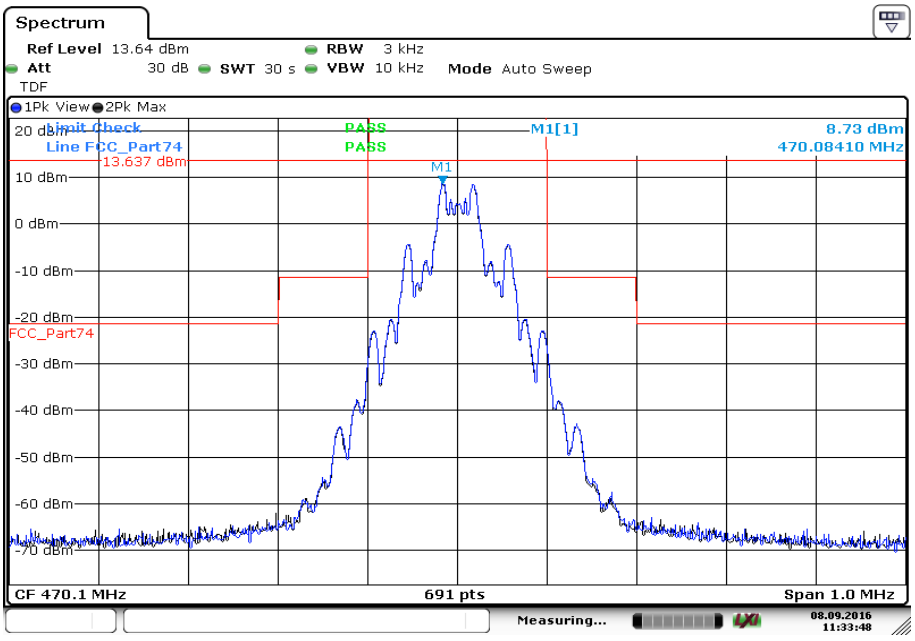
Plot 1: magnetic spurious emissions 9 kHz to 30 MHz



Plot 2: electrical spurious emissions, 30 MHz – 12.75 GHz

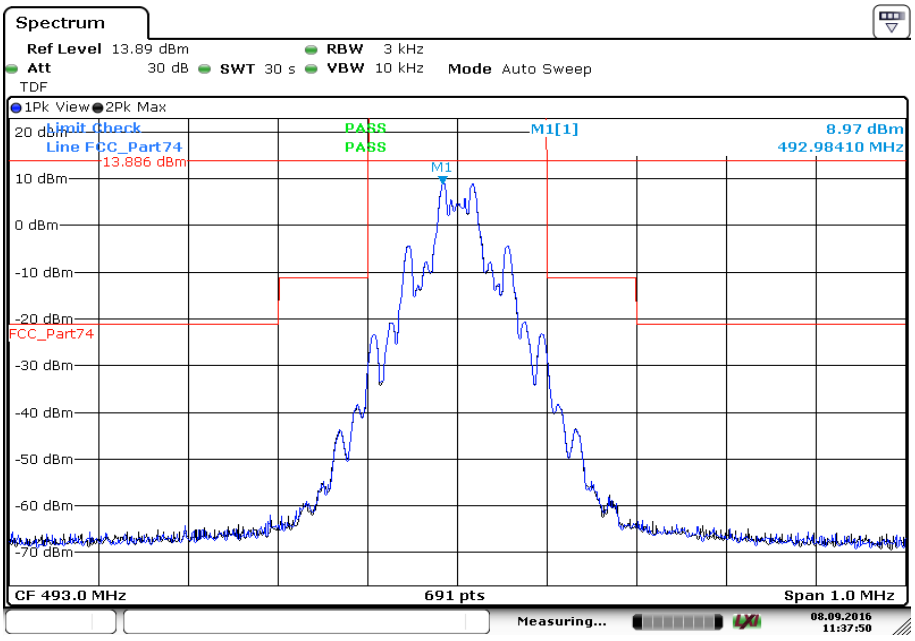


Plot 3: lowest channel, spectrum mask



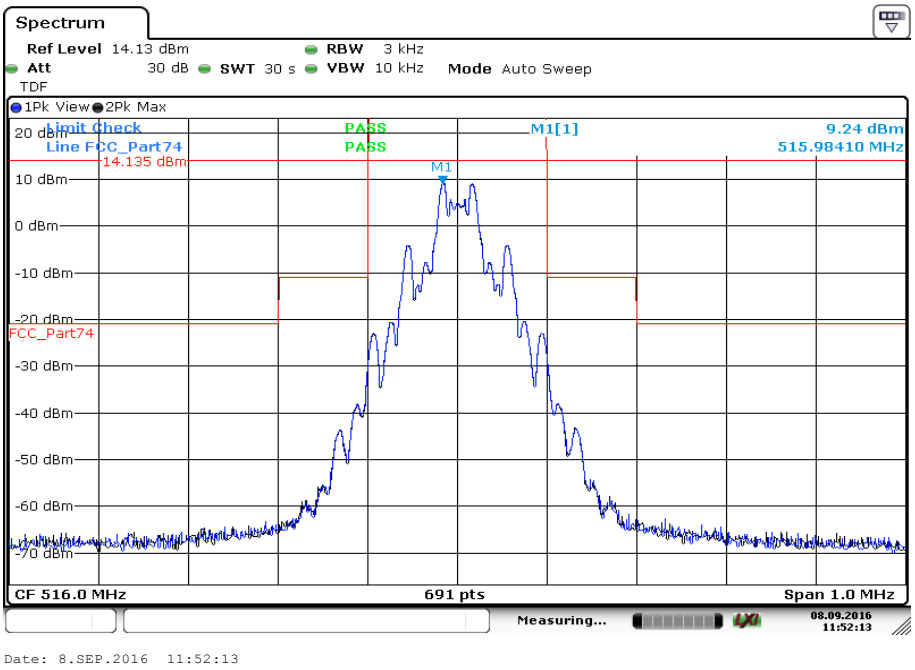
Date: 8.SEP.2016 11:33:48

Plot 4: middle channel, spectrum mask



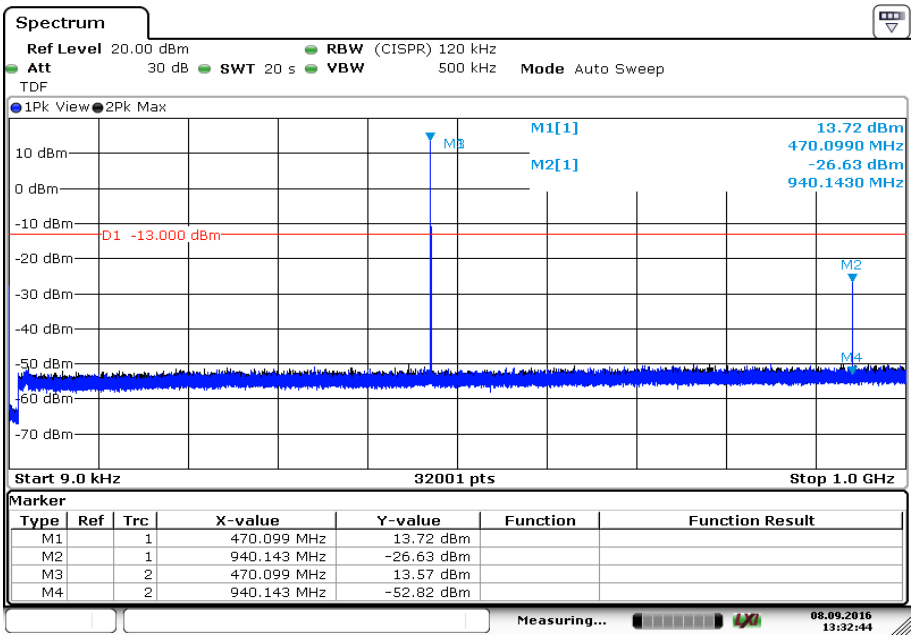
Date: 8.SEP.2016 11:37:50

Plot 5: highest channel, spectrum mask



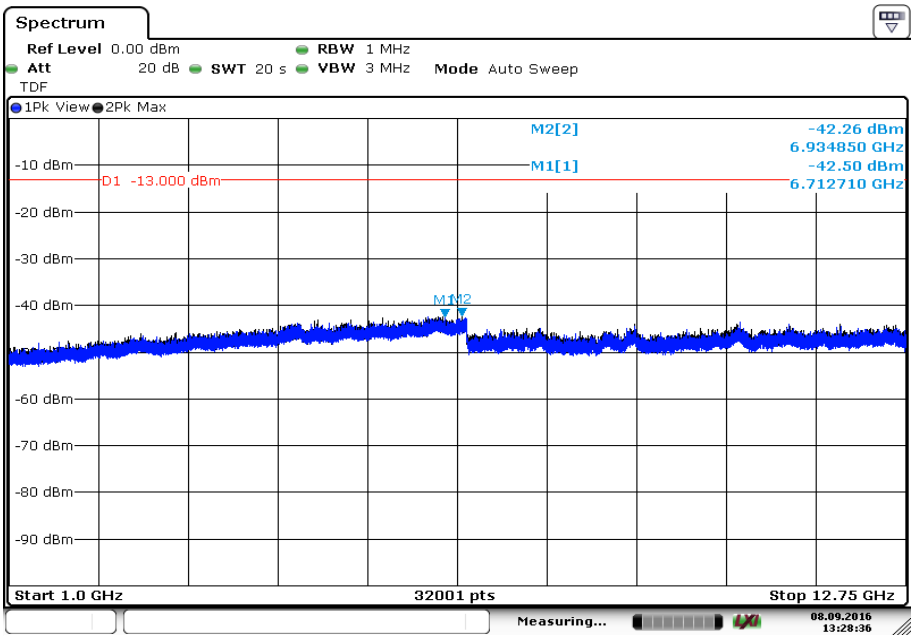
Plots: conducted

Plot 1: lowest channel, 9 kHz to 1 GHz, FCC requirement



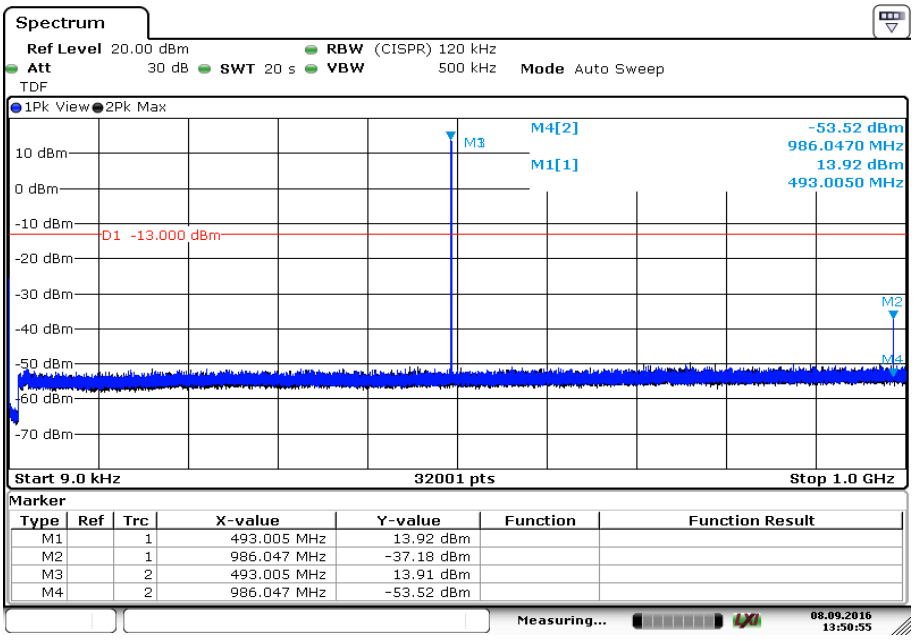
Date: 8.SEP.2016 13:32:44

Plot 2: lowest channel, 1 GHz to 12.75 GHz, FCC requirement



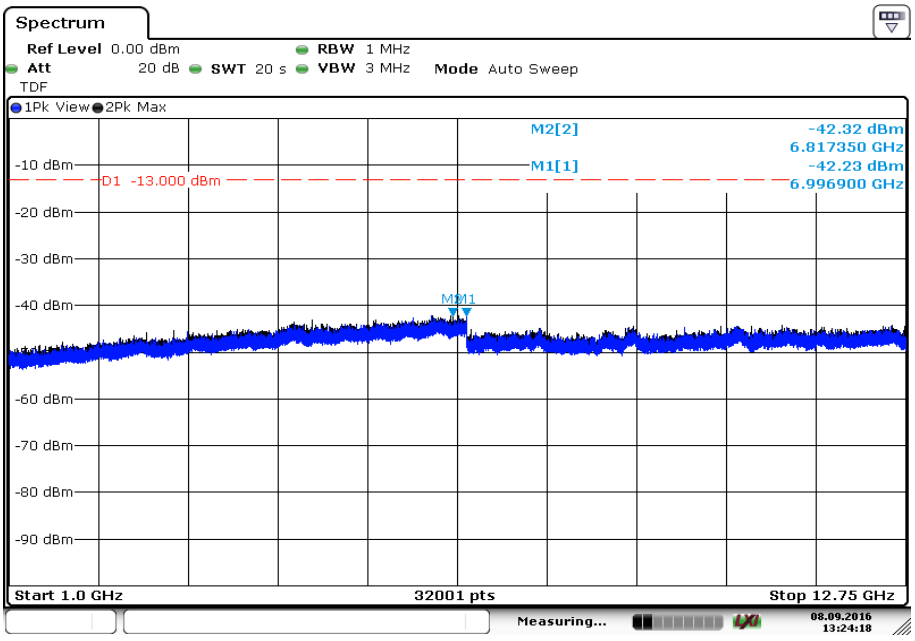
Date: 8.SEP.2016 13:28:35

Plot 3: middle channel, 9 kHz to 1 GHz, FCC requirement



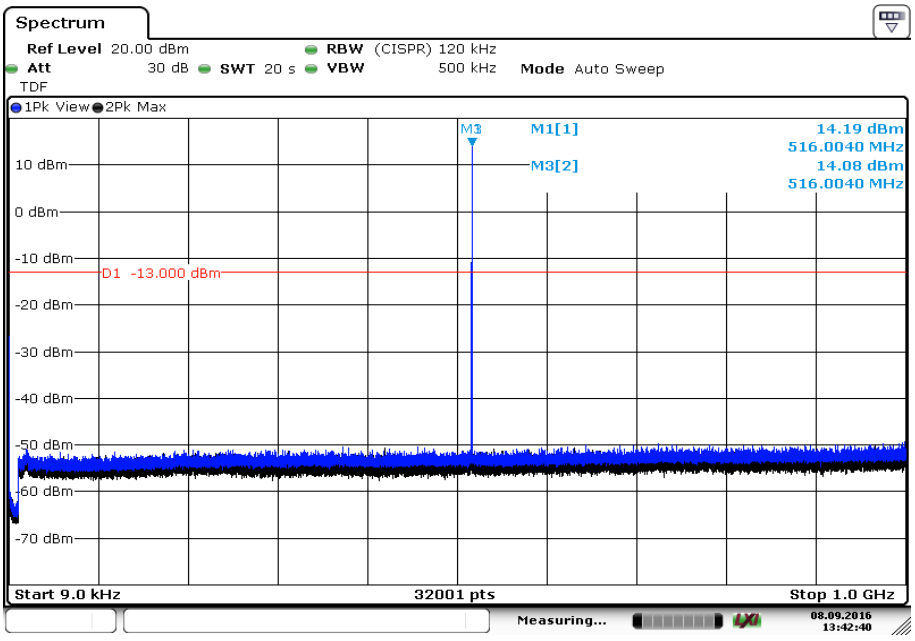
Date: 8.SEP.2016 13:50:55

Plot 4: middle channel, 1 GHz to 12.75 GHz, FCC requirement



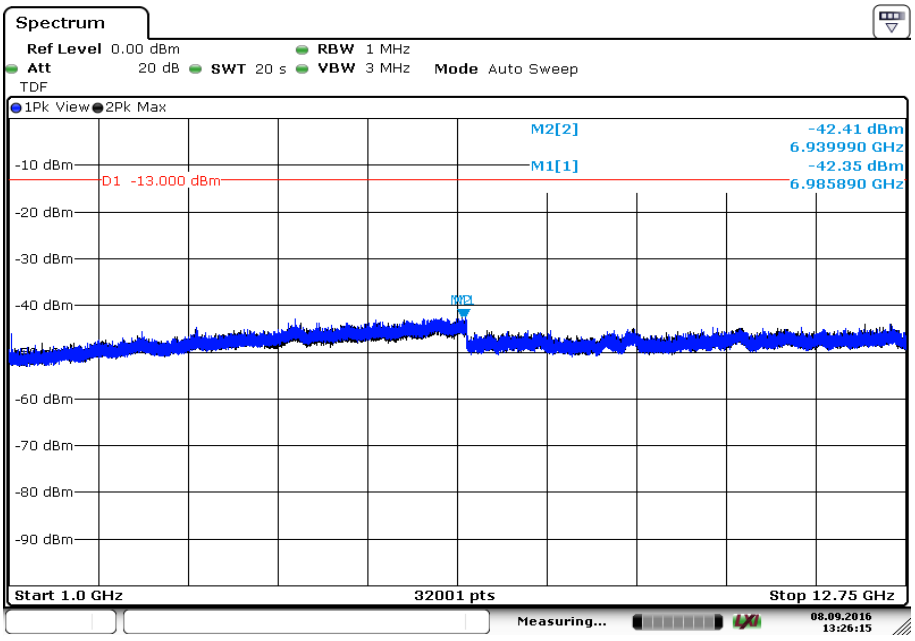
Date: 8.SEP.2016 13:24:18

Plot 5: highest channel, 9 kHz to 1 GHz, FCC requirement



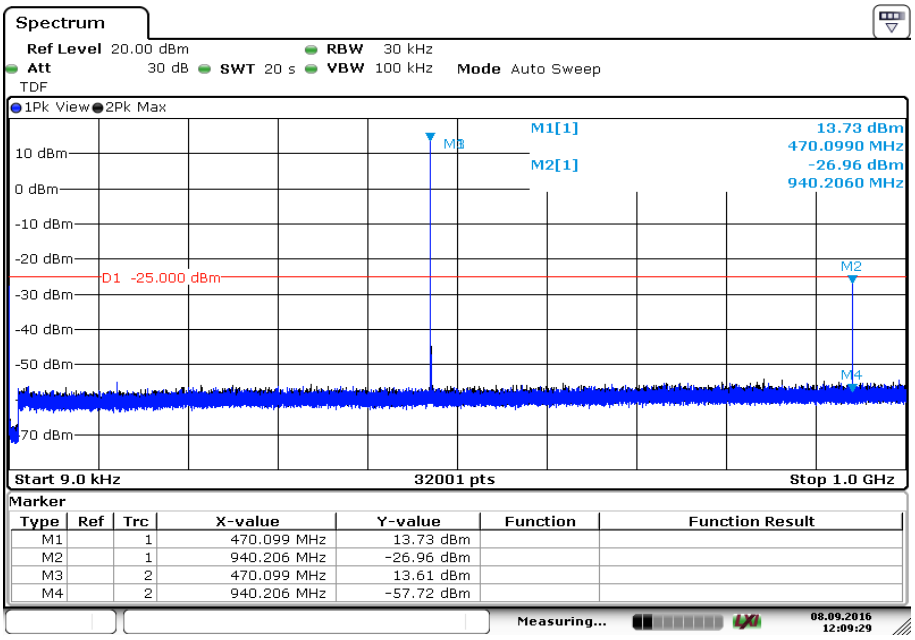
Date: 8.SEP.2016 13:42:40

Plot 6: highest channel, 1 GHz to 12.75 GHz, FCC requirement



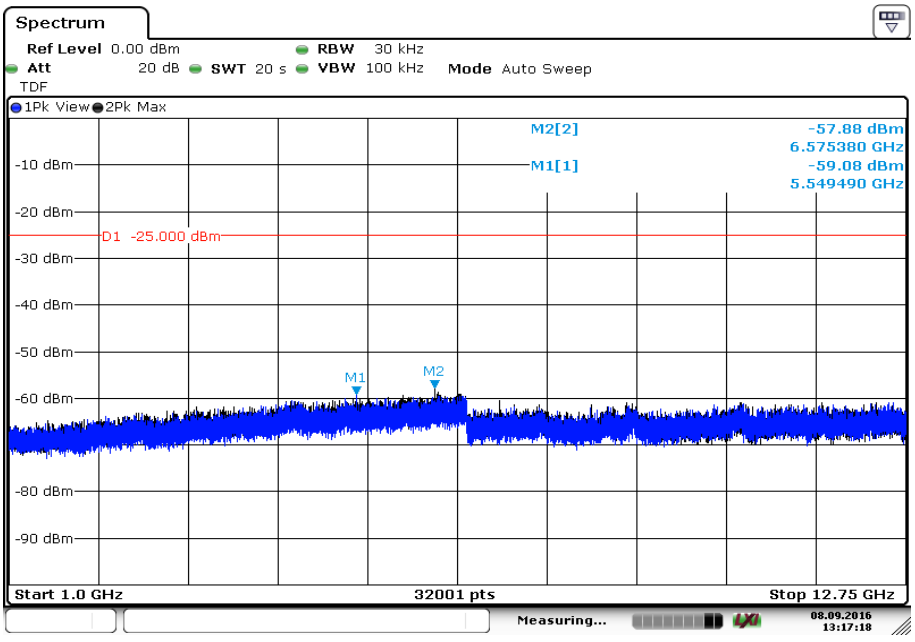
Date: 8.SEP.2016 13:26:15

Plot 7: lowest channel, 9 kHz to 1 GHz, IC requirement



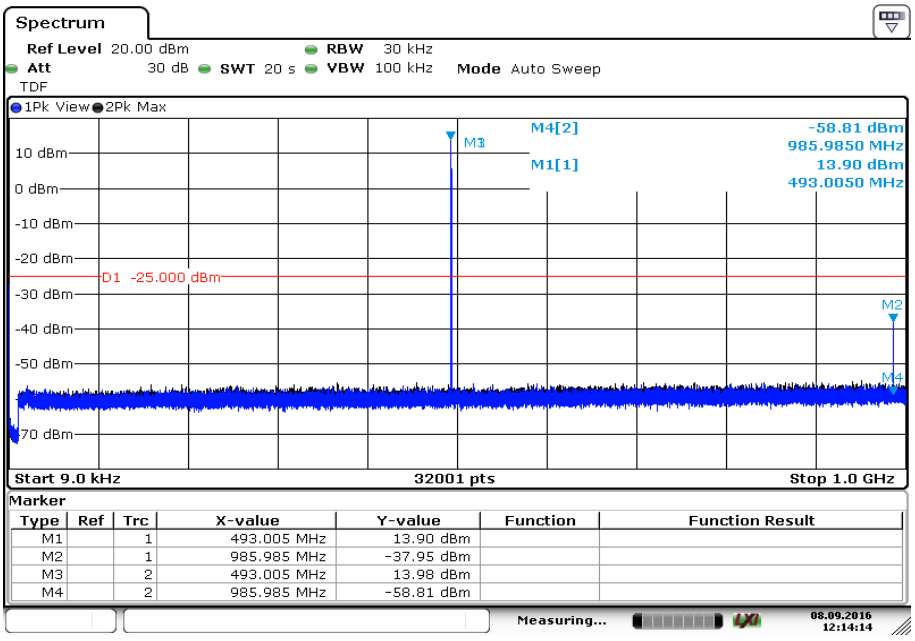
Date: 8.SEP.2016 12:09:29

Plot 8: lowest channel, 1 GHz to 12.75 GHz, IC requirement



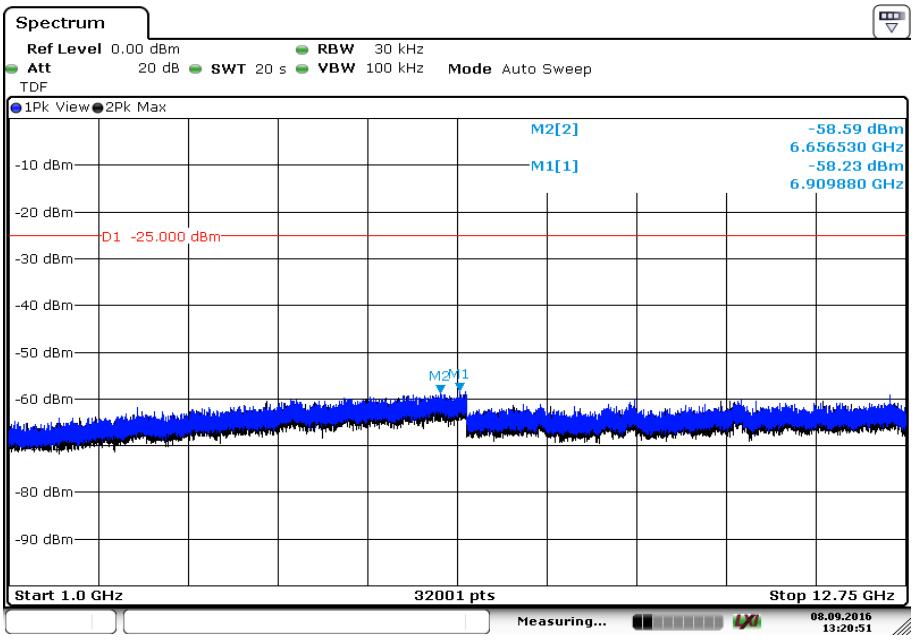
Date: 8.SEP.2016 13:17:18

Plot 9: middle channel, 9 kHz to 1 GHz, IC requirement



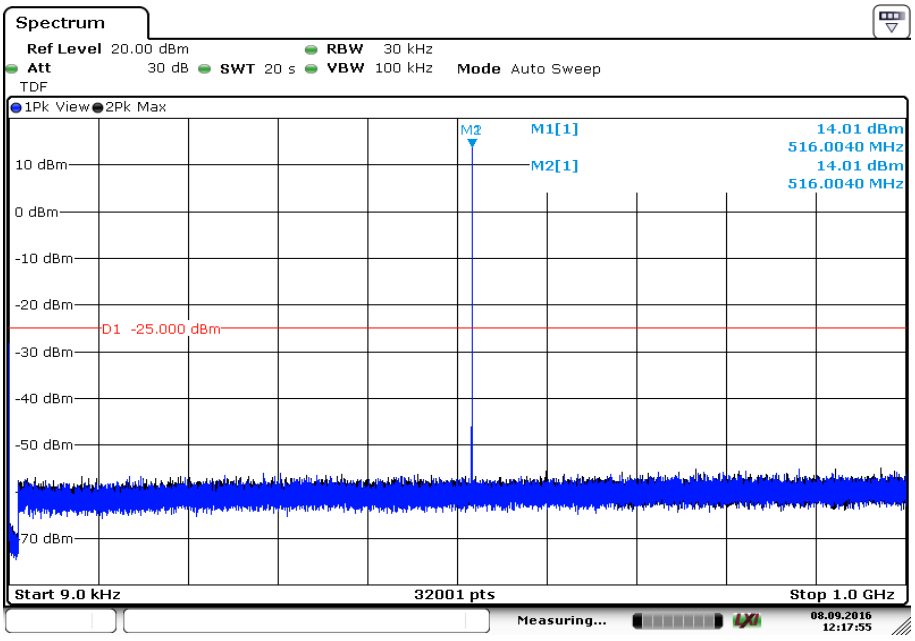
Date: 8.SEP.2016 12:14:14

Plot 10: middle channel, 1 GHz to 12.75 GHz, IC requirement



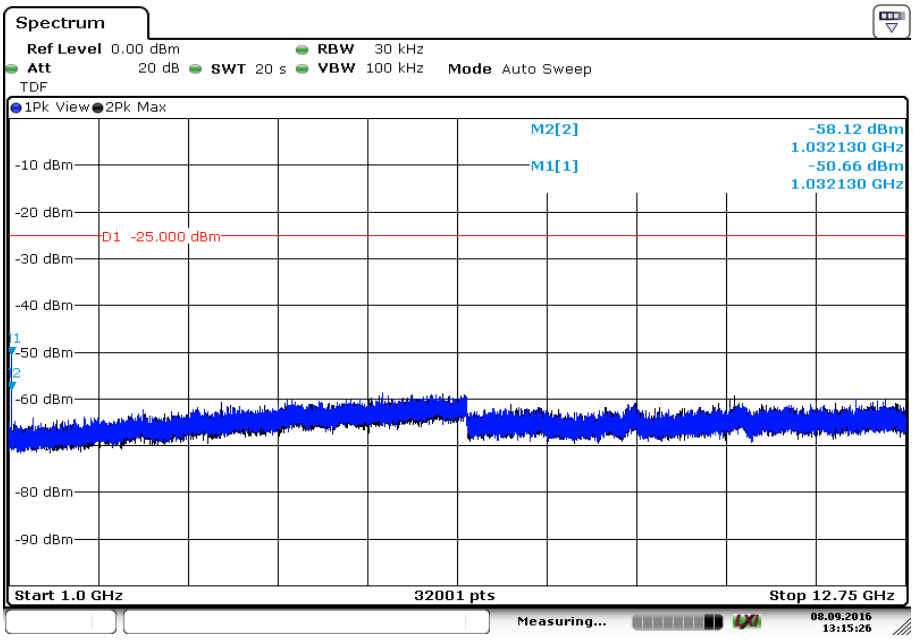
Date: 8.SEP.2016 13:20:51

Plot 11: highest channel, 9 kHz to 1 GHz, IC requirement



Date: 8.SEP.2016 12:17:55

Plot 12: highest channel, 1 GHz to 12.75 GHz, IC requirement



Date: 8.SEP.2016 13:15:26

12.4 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 7.3 – A
Measurement uncertainty:	See sub clause 9

Limits:

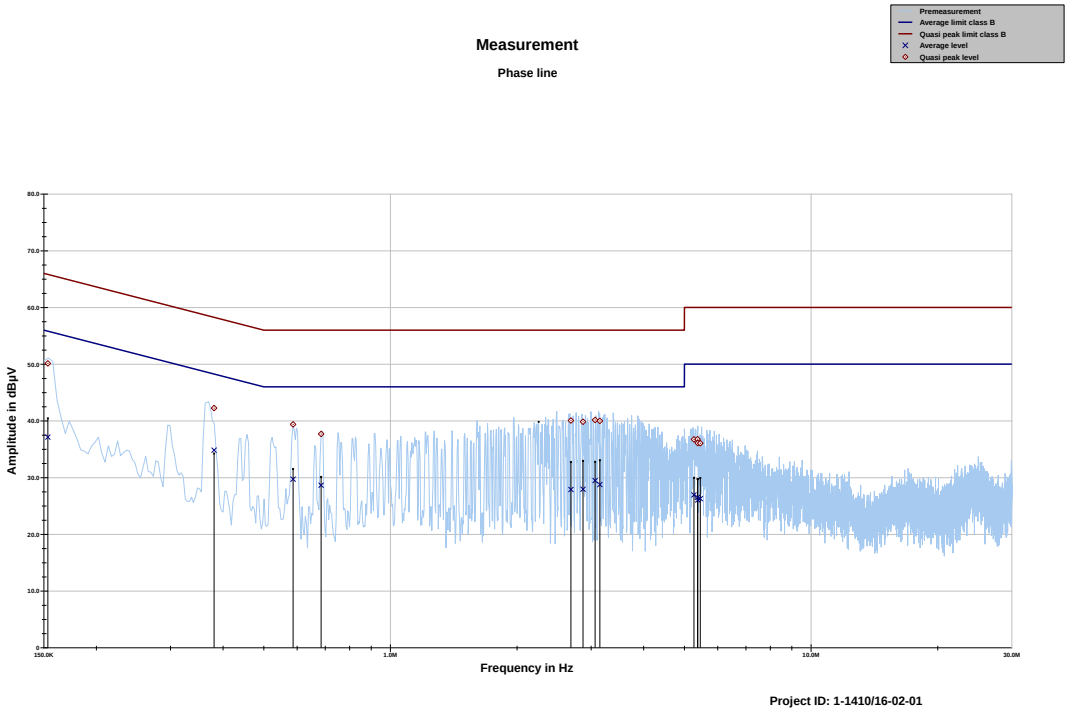
FCC & IC		
Frequency (MHz)	Quasi-Peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

Results:

TX Spurious Emissions Conducted < 30 MHz [dBµV/m]		
F [MHz]	Detector	Level [dBµV/m]
See table below the plots!		

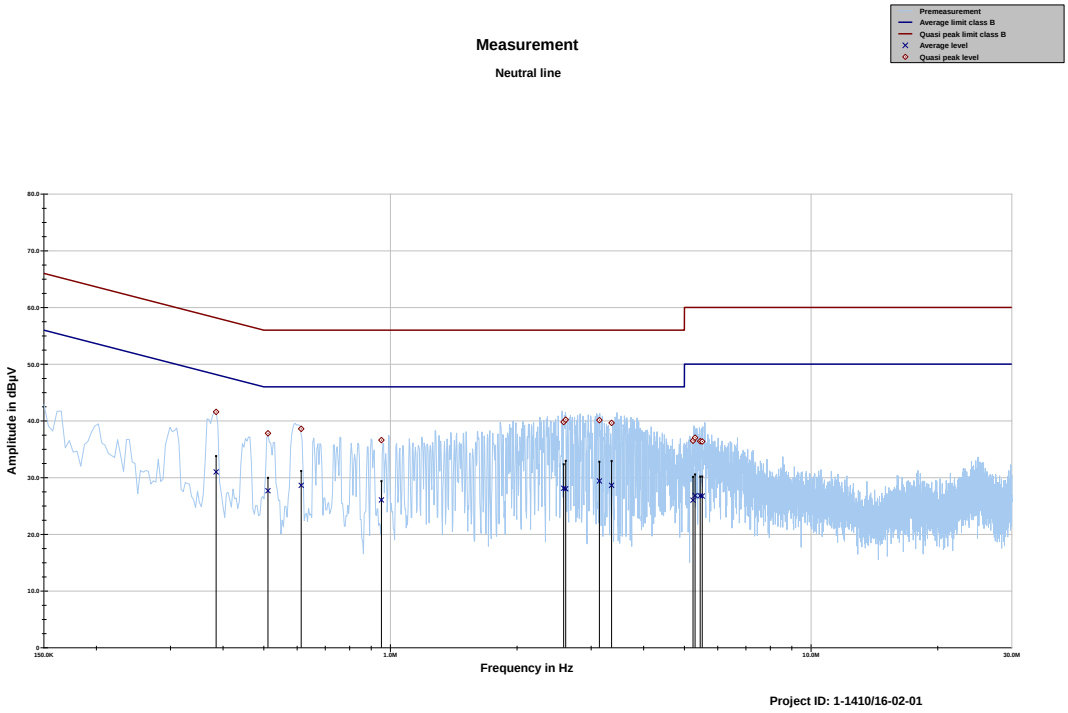
Plots:

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
0.153397	50.13	15.68	65.814	37.14	18.76	55.903
0.381001	42.25	16.00	58.258	34.85	14.55	49.400
0.587100	39.38	16.62	56.000	29.72	16.28	46.000
0.684536	37.69	18.31	56.000	28.65	17.35	46.000
2.686583	40.07	15.93	56.000	27.89	18.11	46.000
2.869779	39.84	16.16	56.000	27.94	18.06	46.000
3.067468	40.16	15.84	56.000	29.48	16.52	46.000
3.147913	39.99	16.01	56.000	28.77	17.23	46.000
5.268603	36.74	23.26	60.000	26.95	23.05	50.000
5.373874	36.76	23.24	60.000	26.52	23.48	50.000
5.380462	36.08	23.92	60.000	26.03	23.97	50.000
5.453414	36.05	23.95	60.000	26.29	23.71	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
0.385197	41.58	16.59	58.167	30.99	18.29	49.280
0.511595	37.81	18.19	56.000	27.68	18.32	46.000
0.613601	38.60	17.40	56.000	28.63	17.37	46.000
0.952302	36.61	19.39	56.000	26.06	19.94	46.000
2.581614	39.79	16.21	56.000	28.12	17.88	46.000
2.610934	40.21	15.79	56.000	28.02	17.98	46.000
3.138703	40.13	15.87	56.000	29.41	16.59	46.000
3.355650	39.64	16.36	56.000	28.64	17.36	46.000
5.240341	36.50	23.50	60.000	26.02	23.98	50.000
5.300660	37.03	22.97	60.000	26.83	23.17	50.000
5.452338	36.42	23.58	60.000	26.80	23.20	50.000
5.512622	36.36	23.64	60.000	26.75	23.25	50.000

Annex A Document history

Version	Applied changes	Date of release
	Initial release	2016-09-23

Annex B Further information

Glossary

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software
PMN - Product marketing name
HMN - Host marketing name
HVIN - Hardware version identification number
FVIN - Firmware version identification number

Annex C Accreditation Certificate

Front side of certificate

DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

Akkreditierung

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

CETECOM ICT Services GmbH
Untertürkheimer Straße 6-10, 66117 Saarbrücken

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

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

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

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

Frankfurt, 04.05.2016

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

Siehe Hinweise auf der Rückseite

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
10117 Berlin

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

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

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

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

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

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

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