

Partial
TEST REPORT
No.: 16-1-0120001T02a-C2

According to:
CFR Title 47, Part 15, Subpart E
§15.407 (U-NII)
for

Actia Nordic AB

VCM
FCC: 2AGKKVCM

Laboratory Accreditation and Listings
 Deutsche Akkreditierungsstelle D-PL 12047-01-01 D-PL 12047-01-03 D-PL 12047-01-04 Accredited EMC-Test Laboratory
accredited according to DIN EN ISO/IEC 17025
CETECOM GmbH Laboratory Radio Communications & Electromagnetic Compatibility Im Teelbruch 116 • 45219 Essen • Germany Registered in Essen, Germany, Reg. No.: HRB Essen 8984 Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964 E-mail: info@cetecom.com • Internet: www.cetecom.com
Laboratory Accreditation and Listings

Table of contents

1. SUMMARY OF TEST RESULTS.....	3
1.1. Tests measurement overview according of US CFR Title 47, Subpart 15C Standards:	3
2. ADMINISTRATIVE DATA	7
2.1. Identification of the testing laboratory	7
2.2. Test location	7
2.3. Organizational items	7
2.4. Applicant's details	7
2.5. Manufacturer's details	7
3. EQUIPMENT UNDER TEST (EUT).....	8
3.1. WLAN 5 GHz 802.11a/n Technical Data Of Main EUT as Declared by Applicant	8
3.2. EUT: Type, S/N etc. and short descriptions used in this test report	9
3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions	9
3.4. EUT set-ups	9
3.5. EUT operating modes	10
3.6. Configuration of cables used for testing	10
3.7. Worst Case Selection	10
4. DESCRIPTION OF TEST SYSTEM SET-UP'S	11
4.1. Test system set-up for conducted measurements on antenna port	11
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz	13
4.3. Test system set-up for radiated electric field measurement 30 MHz to 1 GHz	14
4.4. Test system set-up for radiated electric field measurement above 1 GHz	15
5. MEASUREMENTS	16
5.1. Duty Cycle	16
5.2. RF-Parameter - Transmitter output power (conducted and radiated)	17
5.3. RF Parameter –99% occupied Bandwidth	20
5.4. General Limit - Radiated field strength emissions below 30 MHz	22
5.5. General Limit - Radiated field strength emissions, 30 MHz - 1 GHz.....	24
5.6. General Limit – Radiated field strength emissions, above 1 GHz	26
5.7. RF-Parameter - Radiated Band Edge compliance measurements	28
5.8. Measurement uncertainties	30
6. INSTRUMENTS AND ANCILLARY.....	31
7. VERSIONS OF TEST REPORTS (CHANGE HISTORY)	36

Table of Annex			
Annex No.	Contents	Reference Description	Total Pages
Annex 1	Test results	CETECOM_16-1-0120001T02a-A1	68
Annex 2	External photographs of EUT	CETECOM_16-1-0120001T01a-A2	4
Annex 3	Internal photographs of EUT	CETECOM_16-1-0120001T01a-A3	10
Annex 4	Test set-up photographs	CETECOM_16-1-0120001T01a-A4	7
The listed attachments are an integral part of this report.			

1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests. Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

The presented Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies with WLAN technology and operating frequency range at 5150 - 5850 GHz according to IEE 802.11 a/n . Other implemented wireless technologies were not considered within this test report.

Following test cases have been performed to show compliance with valid Part 15.207/15.209/15.247 of the FCC CFR Title 47 Rules, Edition 1st November 2019 standards.

1.1. Tests measurement overview according of US CFR Title 47, Subpart 15C Standards:

Test cases	Port	References and Limits		EUT set-up	EUT op. mode	Result
		FCC Standard	Test limit			
TX-Mode						
99% occupied bandwidth	Antenna terminal (conducted)	2.1049(h)	99% Power bandwidth	2	1	Pass
26 dB bandwidth	Antenna terminal (conducted)	§15.303 + §15.407(a) (2) (5)	26 dB spectral density bandwidth	--	--	Remark 1)
Duty-Cycle	Antenna terminal (conducted)	KDB789033 + ANSI C63.10:2013	No Limit Criteria	--	--	Performed
Transmitter frequency stability	Antenna terminal (conducted)	§ 2.1055 + §15.407(g)	Operation within designated operational band	--	--	Remark 1

Maximum output power	Antenna terminal (conducted)	§15.407(a) (1)(iv) 5.15-5.25 GHz Client devices (2) 5.25-5.35 GHz & 5.47-5.725 GHz (3) 5.725-5.85 GHz	Power Limits (if Antenna Gain < 6 dBi) 250 mW lesser of 250mW or 11dBm+10logB 1 W	2	1	Pass
Peak Power Spectral density	Antenna terminal (conducted)	§15.407(a) (1)(iv) 5.15-5.25 GHz Client devices (2) 5.25-5.35 GHz & 5.47-5.725 GHz (3) 5.725-5.85 GHz	Power Spectral Density Limits (if Antenna Gain < 6 dBi) 11dBm/MHz 11dBm/MHz 30dBm/500kHz	--	--	Remark 1)
Maximum e.i.r.p. power	Antenna terminal (conducted) + Antenna Gain	§15.407(a) (1)(iv) 5.15-5.25 GHz Client devices (2) 5.25-5.35 GHz & 5.47-5.725 GHz (3) 5.725-5.85 GHz	e.i.r.p. Limits (if Antenna Gain < 6 dBi) 250 mW + 6 dBi lesser of 250mW or 11dBm+10logB + 6 dBi 1 W + 6 dBi	2	1	Pass + Applicants declaration: Antenna Gain
Antenna gain information	Antenna terminal (conducted)	§15.407(a) (1)(2)(3)	< 6dBi or if Antenna directional Gain > 6dBi reduction of Max. power & power spectral density by the amount in dB that the directional gain of the antenna exceeds 6 dBi	--	--	Applicants declaration: Antenna Gain

General field strength emissions within restricted bands + Band-Edge compliance radiated	Enclosure + Inter-connecting cables (radiated)	§15.407(b) (1)(2)(3)(4)(5)(6) (7)(8) §15.205 + §15.209	5150-5250 MHz 5250-5350 MHz 5470-5725 MHz all emissions outside operating band shall not exceed -27 dBm/MHz e.i.r.p. 5725-5850 MHz Spectrum Mask acc. to (4)(i) Restricted band limits + General field strength limits	1	1,2	Pass
Transmit power control + Dynamic frequency selection (DFS)	Antenna terminal (conducted)	§15.407 (h1)(h2)	Requirements: Masters Active clients Passive clients	--	--	Remark 1)
Discontinuous transmissions + Device security	FIRMWARE	§15.407(c) + §15.407(i)	No transmissions in case of either absence of information to transmit or operational failure + Protection of firmware by unauthorized parties	--	--	Not tested Applicants declaration of implementation
AC-Power Lines Conducted Emissions	AC-Power lines or Battery Charger	§15.207(a)	AC Power line conducted limits	--	--	Not applicable

Remark 1) Please refer to separate modular test report **MDE_LESSW_1302_FCCa** and **MDE_LESSW_1302_FCCb**
FCC ID: PV7.WIBEAR11N-DF1

Specific Absorption Rate (SAR) Measurements (separation distance user to RF-radiating element within 20cm)					
Test cases	Port	References & Limits		EUT set-up	EUT op. mode
		FCC Standard	Test Limit		
Specific Absorption Rate (SAR) requirements	Cabinet + Inter-connecting cables (radiated)	§2.1091 §2.1093 + IEEE 1528-2013 + KDB 865664D01v0r04	Specific Absorption Rate (SAR) for Devices Used by the General Public (Uncontrolled Environment) : 1.6 W/Kg as averaged over any 1 g tissue	--	--
Refer test report Test report no.: CETECOM_TR16-1-0120001T04					

Test report 16-1-0120001T02a-C2 dated 2020-08-03 replaces test report 16-1-00120001T02-C2, dated 2019-04-29. The replaced report gets invalid herewith.



.....
Dipl.-Ing. Niels Jeß
Head of Compliance Testing



Digital unterschrieben von
B.Sc. Mohamed Ahmed
DN: cn=B.Sc. Mohamed Ahmed, o=Cetecom GmbH, ou=RC/EMC, email=mohamed.ahmed@cetecom.com, c=DE
Datum: 2020.08.03 15:51:43 +02'00'

.....
B.Sc. Mohamed Ahmed
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing section:	Dipl.-Ing. N. Perez

2.2. Test location

2.2.1. Test laboratory “CTC”

Company name:	see chapter 2.1. Identification of the testing laboratory
---------------	---

2.3. Organizational items

Responsible for test report:	B.Sc. Mohamed Ahmed
Project leader:	Dipl.-Ing N. Perez
Receipt of EUT:	2017-08-16
Date(s) of test:	2016-08-01 to 2020-06-15
Date of report:	2020-08-03

Version of template:	13.02 , Mohamed [CETECOM]

2.4. Applicant's details

Applicant's name:	Actia Nordic AB
Address:	Hammarbacken 4A 19149 SOLLENTUNA Sweden
Contact person:	Mr. Salah Alazawi

2.5. Manufacturer's details

Manufacturer's name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. WLAN 5 GHz 802.11a/n Technical Data Of Main EUT as Declared by Applicant

EUT Model	VCM Combo Mid		
EUT Model Type	Vehicle Connectivity Master		
Hardware Version	31444563		
Software Version	C		
Firmware Version	IP21		
Frequency Channel B.W. (USA bands only)**	U-NII 1: 5150-5250 MHz	☒ Ch 36 40 44 48	☒ Bandwidth 20 MHz
		☒ Ch. 38 46	☒ Bandwidth 40 MHz
		☐ Ch. 42	☐ Bandwidth 80 MHz
	U-NII2A: 5250-5350 MHz	☒ Ch 52 56 60 64	☒ Bandwidth 20 MHz
		☒ Ch. 54 62	☒ Bandwidth 40 MHz
		☐ Ch. 58	☐ Bandwidth 80 MHz
	U-NII 2C: 5470-5725 MHz	☒ Ch 100 104 108	☒ Bandwidth 20 MHz
		☒ Ch 112 116 120	
		☒ Ch 124 128 132	
		☒ Ch 136 140	☒ Bandwidth 40 MHz
		☒ Ch. 102 110 118	
		☒ Ch 126 134	
	U-NII 3: 5725 -5850 MHz	☐ Ch 106 122	☐ Bandwidth 80 MHz
		☒ Ch 149 153 157	☒ Bandwidth 20 MHz
		☒ Ch 161 165	
		☒ Ch 151 159	☒ Bandwidth 40 MHz
		☐ Ch 155	☐ Bandwidth 80 MHz
Channels Power Settings	+15 (According to Applicant's Declaration Max. Rated Power Values)		
802.11a – Mode OFDM Modulation Data Rates	☒ BPSK 6 Mbps / 9 Mbps ☒ QPSK 12 Mbps / 18 Mbps ☒ 16-QAM 24 Mbps / 36 Mbps ☒ 64-QAM 48 Mbps / 54 Mbps		
802.11n – Mode OFDM Modulation Data Rates	☒ HT20 (MCS0 – MCS7) 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps ☒ HT40 (MCS0 – MCS7) 15/30/45/60/90/120/135/150 Mbps		
Antenna Details	☒ External, separate RF-connector		
Installed options (not tested within this test report)	☒ 802.11b/g/n ☒ GPS	Installed options (not tested within this test report)	
Antenna Type	Multiband Antenna Module		
ANT1 Gain:	8.2 dBi		
Cable Pathloss:	4.9 dB		
Internal Pathloss:	2.5 dB		
Test Mode Settings	Power Setting for conducted Measurements: UNII 1 2A 2C = 13 and for UNII 3 = 11 Power Setting for Radiated Measurement UNII 1, 2A, 2C and 3 = 15		
Power Supply	☒ DC power only: 12 Volt ☒ Nominal Test Voltage : 12 Volt		
Special EMI Components	--		
EUT sample type	☐ Production ☒ Pre-Production ☐ Engineering		
FCC label attached	☒ yes ☐ no		
Documents provided from Customer			
Name	Version	Date	Pages
Volvo_MAM_Data Sheet	--	2016	14
Technical Description of VCM (5610_400035)	1.6	2020-07-03	11
Antenna Path Loss (5610_40039)	1.0	2018-03-28	1

3.2. EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	VCM	Vehicle Connectivity Master	10093027	C	IP21
EUT B	VCM	Vehicle Connectivity Master	10408484	C	IP21

*) EUT short description is used to simplify the identification of the EUT in this test report.

3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	Main harness with power supply cables	--	--	--	--
AE 2	Multiband Antenna Module	31346764	--	--	--
AE 3	Dell Notebook	Latitude E6430			Windows 7

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

3.4. EUT set-ups

EUT set-up no. *)	Combination of EUT and AE	Remarks
set. 1	EUT B + AE 1 + (AE3)	Conducted measurement set-up AE3 only used for Setting the TX Mode
set. 2	EUT A + AE 1 + AE 2 + Cable 1+ (AE3)	Radiated Set-up AE3 only used for Setting the TX Mode

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

3.5. EUT operating modes

EUT operating mode no.*1)	Description of operating modes	Additional information
op. 1	TX-Mode	With help of special test firmware TX-mode was set-up. (VCM Certification Version 1.2.0.21 saved on AE3) Power Setting for conducted Measurements: UNII 1 2A 2C = 13 and for UNII 3 = 11
op. 2	TX-Mode	With help of special test firmware TX-mode was set-up. (VCM Certification Version 1.2.0.21 saved on AE3) Power Setting for Radiated Measurement UNII 1, 2A, 2C and 3 = 15

*1) EUT operating mode no. is used to simplify the test report.

3.6. Configuration of cables used for testing

Cable number	Description	Connections	Cable length
Cable 1	Antenna cable	Fakra	2.5m

3.7. Worst Case Selection

Worst Case Selection based on initial Power Results.

Due to Retest of the power Results Worst Case for Radiated may differ from Conducted Power Results.

Power Setting for Radiated was 15 and higher than the setting of conducted power.

4. Description of test system set-up's

4.1. Test system set-up for conducted measurements on antenna port

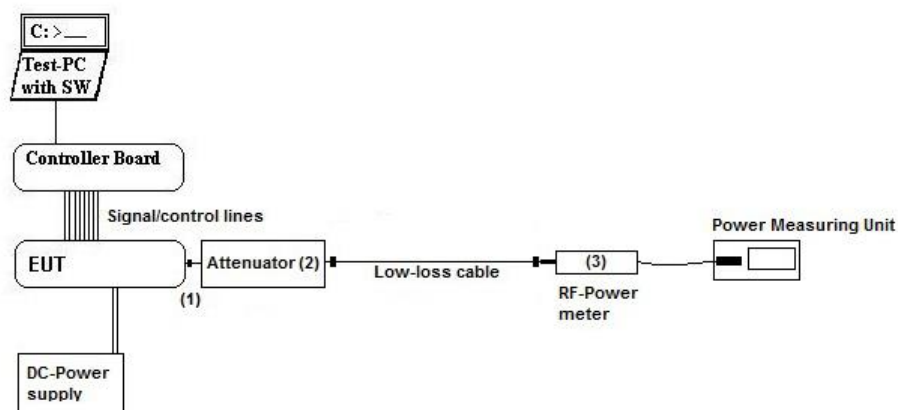
Conducted Set-up W1

Conducted RF-Setup 1 (W1 Set-up)

General description:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to the power meter (3) for conducted power measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings.

Schematic:



Testing method:

ANSI C63.10:2013,
KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Used Equipment

Passive Elements

Test Equipment

Remark:

☒ 20 dB Attenuator	☒ Power Meter	See List of equipment under each test case and chapter 6 for calibration info
☒ Low loss RF-cables	☒ DC-Power Supply	
☒	☒ Spectrum-Analyser	

Measurement uncertainty

See chapter 5.7

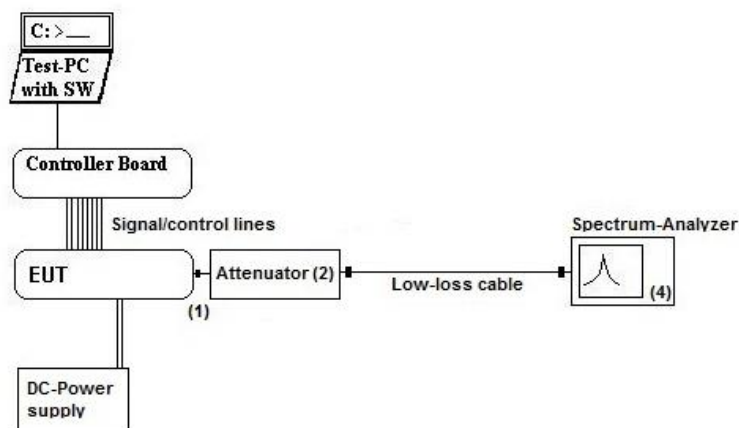
Conducted Set-up W2

Conducted RF-Setup 2 (W2 Set-up)

General description:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to spectrum-analyzer (4) for RF-conducted measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings of the spectrum-analyzer.

Schematic:



Testing method:

ANSI C63.10:2013,
KDB 789033 D02 General UNII Test Procedures New Rules v01r03

Used Equipment

Passive Elements	Test Equipment	Remark:
☒ 20 dB Attenuator	☒ Power Meter	See List of equipment under each test case and chapter 6 for calibration info
☒ Low loss RF-cables	☒ DC-Power Supply	
	☒ Spectrum-Analyser	

Measurement uncertainty

See chapter 5.7

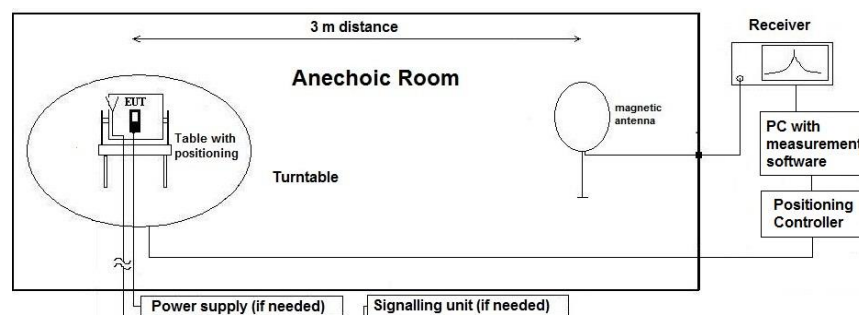
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1 , ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

General Description: Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter “General Limit - Radiated field strength emissions below 30 MHz”. The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

Exploratory, preliminary measurement

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0° to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$$E_C = E_R + AF + C_L + D_F - G_A$$

$$M = L_T - E_C$$

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor

E_C = Electrical field – corrected value

E_R = Receiver reading

G_A = Gain of pre-amplifier (if used)

L_T = Limit

M = Margin

All units are dB-units, positive margin means value is below limit.

Distance correction:

Reference for applied correction (extrapolating) factors due to reduced measurement distance:

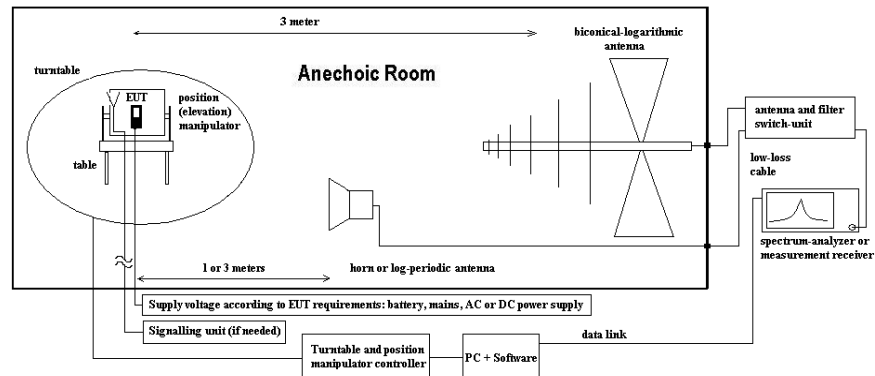
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

4.3. Test system set-up for radiated electric field measurement 30 MHz to 1 GHz

Specification: ANSI C63.4-2014 chapter 8.2.3, ANSI C63.10-2013 chapter 6.5

General Description: Evaluating the field emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

Schematic:



Testing method:

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: laying and Standing, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc. either on 10m OATS or 3m semi-anechoic room.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$$E_C = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

E_C = Electrical field – corrected value

E_R = Receiver reading

G_A = Gain of pre-amplifier (if used)

L_T = Limit

M = Margin

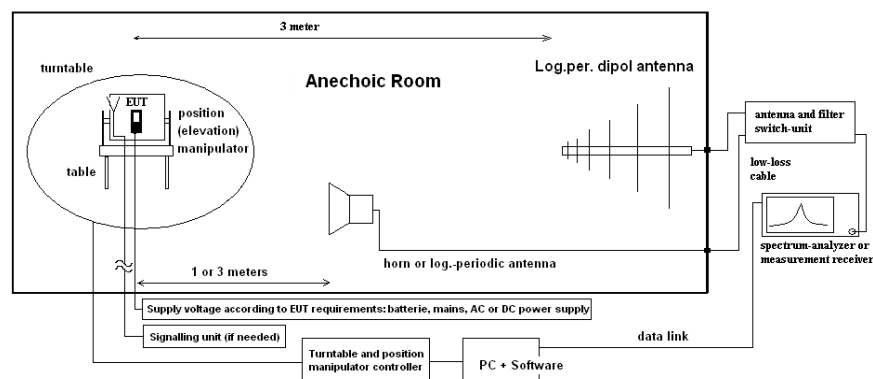
All units are dB-units, positive margin means value is below limit.

4.4. Test system set-up for radiated electric field measurement above 1 GHz

Specification: ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4

General Description: Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

Exploratory, preliminary measurements

The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software. The measurements are performed in laying and Standing polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined. Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out. On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$$E_C = E_R + AF + C_L + D_F - G_A \quad (1)$$

$$M = L_T - E_C \quad (2)$$

E_C = Electrical field – corrected value

E_R = Receiver reading

M = Margin

L_T = Limit

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

5. Measurements

5.1. Duty Cycle

5.1.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

Ambient Climatic conditions		Temperature: (22±2)°C		Rel. humidity: (45±15)%		
Test Site	☐ 441 EMI SAR	☐ 348 EMI cond.	☐ 443 EMI FAR	☒ 347 Radio.lab.	☐ 337 OATS	☐
Equipment	☐ 331 HC 4055	☐	☐	☒ 693 TS8997	☐	☐
Spectr. Analys.	☒ 801 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 693 TS8997	☐	☐
Power Meter	☐ 262 NRV-S	☐ 266 NRV-Z31	☐ 265 NRV-Z33	☐ 261 NRV-Z55	☐ 356 NRV-Z1	☐
Multimeter	☐ 341 Fluke 112	☐	☐	☐	☐	☐
DC Power	☐ 086 LNG50-10	☐ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐ 463 HP3245A
Supply Voltage	☐ 230 V 50 Hz via public mains		☒ 12 V DC			
Otherwise	☐ 530 Attenuator 10dB	☒ K4 Cable				

Method of measurement: ☒ conducted
☐ radiated

A special firmware program is used for test purposes. In contrast to normal operating mode a higher duty-cycle is set in order to facilitate the measurements. This is maximized at the extent possible.

The necessary duty-cycle correction factor is determined on nominal conditions on 1 channel for all sub-bands. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions.

Calculated with following formulas:

Duty cycle:	$x = \frac{T_{x_{on}}}{T_{x_{on}} + T_{x_{off}}}$	Duty cycle factor [dB]:	$10 \log \left(\frac{1}{x} \right)$
-------------	---	-------------------------	--------------------------------------

Results:

Set-up No.:	1
Op. Mode:	1

- ☐ The results were corrected in order to evaluate for worst-case result each time when average values are necessary for example average radiated emissions or similar
- ☒ No correction necessary: Duty-Cycle > 98%

5.2. RF-Parameter - Transmitter output power (conducted and radiated)

5.2.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ 443 System CTC-FAR-EMI-		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ 620 ESU 26	☐	☐
otherwise	☐ 600 NRVD	☐ 357 NRV-Z1	☒ 693 TS8997			
spectr. analys.	☐ 215 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
power supply	☐ 456 EA 3013A	☒ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 354 NGPE 40
otherwise	☐ 613 20 dB Attenuator	☐ 248 6 dB Attenuator	☐ 529 Power divider	☐ - cable OTA20	☐ 530 10dB Atten	☐ K5 Cable
Supply voltage	☐ 230 V 50 Hz via public mains		☒ 12 V DC			

5.2.2. Reference:

FCC	☒ Part 15 Subpart C, §15.407(a)(1)(2)(3)(4)
ANSI	☒ C63.10-2013
KDB Guidance no.	☒ KDB 789033 D02 General UNII Test Procedures New Rules v02r01: Subchapter E, <u>Method PM (3)(b)</u> ☐ KDB 662911 D01 Multiple Transmitter Output v02r01 (MIMO, Smart-antenna)
Limits	☒ U-NII 1: 5.15-5.25 GHz: FCC Outdoor access point: 1W + antenna gain max. 6dBi + Elevation > 30° 21 dBm EIRP FCC Indoor Access Point: 1W + antenna gain max. 6dBi FCC Mobile & Portable client: 250mW + antenna gain max. 6dBi ☒ Antenna gain more 6dBi (-> reduction necessary)
	☒ U-NII2: 5.25-5.35 GHz: FCC: lesser of 250mW or 11dBm+10log ₁₀ (B)
	☒ U-NII2extension: 5.470-5.725 GHz: FCC: lesser of 250mW or 11dBm+10log ₁₀ (B) + Antenna gain < 6dBi
	☒ U-NII3: 5.725-5.850 GHz: FCC ☒ max. conducted power: 1 Watt (30dBm) ☐ Antenna gain less 6dBi ☒ Antenna gain more 6dBi (-> reduction necessary)

5.2.3. Antenna characteristics:

- ☒ directional gain < 6 dBi (Applicants declaration)
- ☐ directional gain > 6 dBi (measured / applicant's declaration)
- Maximum declared Antenna gain [isotropic]: 8.2dBi
 - Due to long cables to antenna a pathloss of 4.9 dB is considered
 - Internal Losses are 2.5 dB

5.2.4. EUT settings:

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

Set-up No.:	1
Op. Mode:	1

5.2.5. Measurement method:

Method used	Reference to KDB	Remarks:
☐ SA	KDB 789033 D02 General UNII Test Procedures New Rules v02r01	Integration bandwidth method
☒ Power Meter	a.) Method PM	A wideband thermocouple RF-power meter as described by KDB was used. ☐ Duty-Cycle correction necessary ☒ A value correction is not necessary since the EUT is transmitting continuously at duty-cycle > 98%.

5.2.5.1.

a - 20MHz Bandwidth

Operational bands:	U-NII 1			U-NII-2A			U-NII 2C			U-NII-3		
Channel no.:	Channel 36 (5180MHz)	Channel 40 (5200MHz)	Channel 48 (5240MHz)	Channel 52 (5260MHz)	Channel 56 (5280MHz)	Channel 64 (5320MHz)	Channel 100 (5500MHz)	Channel 116 (5580MHz)	Channel 140 (5700MHz)	Channel 149 (5745MHz)	Channel 157 (5785MHz)	Channel 165 (5825MHz)
	a-Mode/13 Power Setting									a-Mode/11 Power Setting		
6Mbit	10.3	9.7	7.6	7.7	9.1	10.8	11	11.2	11.9	9.6	9.6	9.6
9Mbit	10.4	9.7	7.6	7.8	8.9	11	11	11.3	11.7	9.4	9.6	9.5
12Mbit	10.4	9.7	7.5	7.6	8.9	10.9	11	11.4	12	9.5	9.3	9.6
18Mbit	10.4	9.8	7.6	7.8	9	11	11.2	10.8	12.1	9.1	9.3	9.3
24Mbit	10.5	9.8	7.8	7.2	8.9	10.9	11	11.4	12	9.4	9.7	9.7
36Mbit	10.1	9.6	7.4	7.5	8.7	10.9	10.9	11.1	11.9	9.6	9.6	9.6
48Mbit	10.4	9.7	7.5	7.7	8.9	10.9	11.1	11.3	12	9.1	9.7	9.7
54Mbit	10.1	9.7	7.6	7.6	8.8	10.8	11	11.3	11.9	9.5	9.6	9.6
Operational bands:	(Outdoor use: EIRP-Limit of 21dBm)			U-NII-2A			U-NII 2C			U-NII 3		
FCC-Limits [dBm]	24.00			23.98			23.98			30.00		
Limit Check:	Limit Check:											
Highest conducted power value over channels and modulations on Fakra Port:	10.50			11.00			12.10			9.70		
Internal Path Loss	2.50			2.50			2.50			2.50		
Highest conducted power value over channels and modulations at the Module	13.00			13.50			14.60			12.20		
Declared antenna Gain:	8.20			8.20			8.20			8.20		
Cable Loss	4.90			4.90			4.90			4.90		
Margin to Limit:	7.70			7.18			6.08			14.50		
E.I.R.P in dBm:	13.80			14.30			15.40			13.00		
Verdict:	pass			pass			pass			pass		

n - 20MHz Bandwidth

Operational bands:	U-NII 1			U-NII-2A			U-NII 2C			U-NII-3		
Channel no.:	Channel 36 (5180MHz)	Channel 40 (5200MHz)	Channel 48 (5240MHz)	Channel 52 5260MHz	Channel 56 (5280MHz)	Channel 64 (5320MHz)	Channel 100 (5500MHz)	Channel 116 (5580MHz)	Channel 140 (5700MHz)	Channel 149 (5745MHz)	Channel 157 (5785MHz)	Channel 165 (5825MHz)
	n-Mode/13 Power Setting									n-Mode/11 Power Setting		
MCS0 - 6.5Mbps	10.7	9.8	7.4	7.5	9.1	11.2	11.3	11.2	11.8	9.5	9.7	9.8
MCS1 - 13Mbps	10.6	9.7	7.6	7.8	8.9	10.9	11	11	11.8	9.5	9.5	9.6
MCS2 - 19.5Mbps	10.1	9.5	7.4	7.6	8.8	10.7	10.9	10.8	11.6	9.5	9.5	9.5
MCS3 - 26Mbps	10.2	9.7	7.4	7.5	8.6	10.8	10.8	10.8	11.7	9.2	9.3	9.5
MCS4 - 39Mbps	10.1	9.4	7.2	7.6	8.6	10.6	10.7	10.8	11.4	9.1	9.2	9.3
MCS5 - 52Mbps	10.2	9.4	7.3	7.5	8.9	11	11.2	10.7	11.4	9.1	9.3	9.8
MCS6 - 58.5Mbps	10	9.4	7.5	7.7	9	10.9	11.2	11.4	12.1	9.7	9.8	9.7
MCS7 - 65Mbps	10.4	9.8	7.5	7.7	9	11	11.1	10.7	11.4	9.5	9.8	9.8
Operational bands:	U-NII 1 (Outdoor use: EIRP-Limit of 21dBm)			U-NII-2A			U-NII 2C			U-NII 3		
FCC-Limits [dBm]	18.80			21.78			21.78			27.80		
Limit Check:	Limit Check:											
Highest conducted power value over channels and modulations on Fakra Port:	10.70			11.20			12.10			9.80		
Internal Path Loss	2.50			2.50			2.50			2.50		
Highest conducted power value over channels and modulations at the Module	13.20			13.70			14.60			12.30		
Declared antenna Gain:	8.20			8.20			8.20			8.20		
Cable Loss	4.90			4.90			4.90			4.90		
Margin to Limit:	2.30			4.78			3.88			12.20		
E.I.R.P in dBm:	14.00			14.50			15.40			13.10		
Verdict:	pass			pass			pass			pass		

n - 40MHz Bandwidth

Operational bands:	U-NII 1		U-NII-2A		U-NII 2C			U-NII-3	
Channel no.:	Channel 38 (5190MHz)	Channel 46 (5230MHz)	Channel 54 (5270MHz)	Channel 62 (5310MHz)	Channel 102 (5550MHz)	Channel 118 (5590MHz)	Channel 134 (5670MHz)	Channel 151 (5755MHz)	Channel 159 (5815MHz)
	n-Mode/13 Power Setting							n-Mode/11 Power Setting	
MCS0 - 6.5Mbps	10	7.9	8.3	10.3	11.3	11.4	12	9.5	9.5
MCS1 - 13Mbps	10	8	8.2	10.5	11.2	11.3	12.1	9.6	9.5
MCS2 - 19.5Mbps	10	8	8.2	10.4	11.2	11.4	12	9.4	9.4
MCS3 - 26Mbps	10	7.8	8.3	10.5	11.2	11.4	12	9.5	9.5
MCS4 - 39Mbps	10.1	7.9	8.4	10.3	11.1	11.4	12	9.5	9.5
MCS5 - 52Mbps	9.8	7.8	8.2	10.3	11	11.3	12	9.5	9.4
MCS6 - 58.5Mbps	9.9	7.8	8	10.3	11	11.4	12.1	9.6	9.5
MCS7 - 65Mbps	9.7	7.7	7.9	10.2	11.1	11.3	11.9	9.5	9.4
Operational bands:	U-NII 1 (Outdoor use: EIRP-Limit of 21dBm)		U-NII-2A		U-NII 2C			U-NII 3	
FCC-Limits [dBm]	18.80		21.78		21.78			28.00	
Limit Check:	Limit Check:								
Highest conducted power value over channels and modulations on Fakra Port:	10.1		10.5		12.1			9.6	
Internal Path Loss	2.50		2.50		2.50			2.50	
Highest conducted power value over channels and modulations at the Module	12.60		13.00		14.6			12.10	
Declared antenna Gain:	8.20		8.20		8.20			8.20	
Cable Loss	4.90		4.90		4.90			4.90	
Margin to Limit:	5.40		7.98		6.38			15.10	
E.I.R.P in dBm:	13.40		13.80		15.40			12.90	
Verdict:	pass		pass		pass			pass	

5.2.6. Verdict: Pass

5.3. RF Parameter –99% occupied Bandwidth

5.3.1. Test location and equipment (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)	☐ 443 System CTC-FAR-EMI-	☐ Please see Chapter. 2.2.3
test site	☐ 441 EMI SAR ☐ 487 SAR NSA ☐ 347 Radio.lab. ☒ TS 8997	☐	☐
receiver	☐ 377 ESCS30 ☐ 001 ESS ☐ 489 ESU 40	☐	☐
spectr. analys.	☒ 801 FSU ☐ 120 FSEM ☐ 264 FSEK ☐ 489 ESU 40	☐	☐
antenna	☐ 574 BTA-L ☐ 133 EMCO3115 ☐ 302 BBHA9170 ☐ 289 CBL 6141 ☐ 030 HFH-Z2 ☐ 477 GPS		
signaling	☐ 392 MT8820A ☐ 436 CMU ☐ 547 CMU		
otherwise	☐ 266 NRV-Z31 ☐ 600 NRVD ☐ 110 USB LWL ☐ 482 Filter Matrix ☐ 378 RadiSense ☐ 693 TS8997		
DC power	☒ 671 EA-3013S ☐ 463 HP3245A ☐ 459 EA 2032-50 ☐ 268 EA- 3050 ☐ 494 AG6632A ☐ 498 NGPE 40		
otherwise	☐ 331 HC 4055 ☐ 248 6 dB Attenuator ☐ 529 Power divider ☐ - cable OTA20		
	☐ 530 10dB Attenuator ☐ K 4 Cable kit		
Supply voltage	☒ 12V DC ☐ 060 110 V 60 Hz via PAS 5000		

5.3.2. Test condition and measurement test set-up

link to test system (if used):	☐ air link ☒ cable connection ☐
Climatic conditions	Temperature: (22±3°C) Rel. humidity: (40±20)%

5.3.3. References of occupied and emission bandwidth

FCC	☒ FCC 2.202 for information ☒ Part 15 Subpart C, §15.407(e)
ANSI	☒ C63.10-2013
KDB Guidance no.	☒ 789033 D02 General UNII test procedures v02r01, Subchapter C
Limits	☒ necessary for maximum power limits depending of B ☒ FCC: decision if DFS necessary for decision if due 26dBc emissions falling in 5250-5350MHz band ☒ FCC §15.407(e): minimum 500kHz for band 5725-5850MHz

5.3.4. EUT Settings:

The EUT was instructed to send with different power/ data rates (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

5.3.5. Measurement method:

The **99% occupied bandwidth** was measured. Two markers are placed on frequency points such that left to lower f-marker and right to higher f-marker only 1% of the TX-power is contained. Between the markers, 99% of the power is laying. The RBW value is readjusted and the measurement repeated until the RBW/EBW ratio is around 1%. The operating modes have been taken the maximum data rates, which had been found out at the output power conducted measurements.

5.3.6. Spectrum-Analyzer Settings: (check if accord. KDB)

Span	Set as to fully display the emissions and at least 26 dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx 1%
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	PK (26 dB BW)/Sample (99% OBW)
Sweep mode	Repetitive Mode, MAX-HOLD

5.3.7. Measurement Results

a mode :

U-NII Band	Channel	Bandwidth (MHz)	Set up	Op mode	Result
1	36	17	1	1	Pass
2A	52	17	1	1	Pass
2C	100	17.2	1	1	Pass
3	149	17	1	1	Pass

n mode :

U-NII Band	Channel	Bandwidth (MHz)	Set up	Op mode	Result
1	36	18	1	1	Pass
2A	52	18	1	1	Pass
2C	100	18.2	1	1	Pass
3	149	18.2	1	1	Pass

n40 mode :

U-NII Band	Channel	Bandwidth (MHz)	Set up	Op mode	Result
1	38	36.5	1	1	Pass
2A	54	36.5	1	1	Pass
2C	102	36.8	1	1	Pass
3	159	36.8	1	1	Pass

5.4. General Limit - Radiated field strength emissions below 30 MHz

5.4.1. Test location and equipment

test location	☒ CETECOM Essen (Chapter. 2.2.1)	☐ Please see Chapter. 2.2.2	☐ Please see Chapter. 2.2.3
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 347 Radio.lab.
receiver	☒ 377 ESCS30	☐ 001 ESS	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170
signaling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL
DC power	☐ 456 EA 3013A	☒ 457 EA 3013A	☐ 459 EA 2032-50
line voltage	☐ 230 V 50 Hz via public mains	☒ 12V DC	

5.4.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
ANSI	C63.10-2013			
Frequency [MHz]	Field strength limit		Distance [m]	Remarks
	[μV/m]	[dBμV/m]		
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705 – 30	30	29.5	30	Correction factor used due to measurement distance of 3 m

5.4.3. Test condition and test set-up

Signal link to test system (if used):		☐ air link	☐ cable connection	☐ none
EUT-grounding		☒ none	☐ with power supply	☐ additional connection
Equipment set up		☒ table top		☐ floor standing
Climatic conditions		Temperature: (22±3°C) Rel. humidity: (40±20)%		
EMI-Receiver or Analyzer Settings	Scan data	☒ 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz ☒ 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz ☐ other:		
	Scan-Mode	☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyser Mode		
	Detector Mode:	Peak (pre-measurement) and Quasi-PK/Average (final if applicable)		
	Sweep-Time	Repetitive-Scan, max-hold Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle		
General measurement procedures		Please see chapter “Test system set-up radiated magnetic field measurements below 30 MHz”		

5.4.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

The EUT is put on operation on middle channel only. If critical peaks are found (Margin <10 dB) the lowest and highest channels will be performed too. For more information please see the diagrams.

Table of measurement results:

Diagram No.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.01a	Low	64	9 kHz-30 MHz	2	2	a-Mode 54Mbps PWR 15	☒	☐	☐	passed
2.01b	Low	64	9 kHz-30 MHz	2	2	a-Mode 54Mbps PWR 15	☒	☐	☐	passed
2.02a	Middle	140	9 kHz-30 MHz	2	2	n-Mode(HT20) MCS5 PWR 15	☒	☐	☐	passed
2.02b	Middle	140	9 kHz-30 MHz	2	2	n-Mode(HT20) MCS5 PWR 15	☒	☐	☐	passed
2.03a	High	159	9 kHz-30 MHz	2	2	n-Mode(HT40) MCS0 PWR 15	☒	☐	☐	passed
2.03b	High	159	9 kHz-30 MHz	2	2	n-Mode(HT40) MCS0 PWR 15	☒	☐	☐	passed

Remark: see diagrams in annex 1 for more details

5.4.5. Correction factors due to reduced meas. distance ($f < 30$ MHz)

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of $0.625 \times \lambda$. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors.

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (dmeas < D _{near-field})	2'te Condition (Limit distance bigger d _{near-field})	Distance Correction accord. Formula
kHz	9,00E+03	33333,33	5305,17	300	fulfilled	not fulfilled	-80,00
	1,00E+04	30000,00	4774,65		fulfilled	not fulfilled	-80,00
	2,00E+04	15000,00	2387,33		fulfilled	not fulfilled	-80,00
	3,00E+04	10000,00	1591,55		fulfilled	not fulfilled	-80,00
	4,00E+04	7500,00	1193,66		fulfilled	not fulfilled	-80,00
	5,00E+04	6000,00	954,93		fulfilled	not fulfilled	-80,00
	6,00E+04	5000,00	795,78		fulfilled	not fulfilled	-80,00
	7,00E+04	4285,71	682,09		fulfilled	not fulfilled	-80,00
	8,00E+04	3750,00	596,83		fulfilled	not fulfilled	-80,00
	9,00E+04	3333,33	530,52		fulfilled	not fulfilled	-80,00
	1,00E+05	3000,00	477,47		fulfilled	not fulfilled	-80,00
	1,25E+05	2400,00	381,97		fulfilled	not fulfilled	-80,00
	2,00E+05	1500,00	238,73		fulfilled	fulfilled	-78,02
	3,00E+05	1000,00	159,16		fulfilled	fulfilled	-74,49
	4,00E+05	750,00	119,37		fulfilled	fulfilled	-72,00
	4,90E+05	612,24	97,44		fulfilled	fulfilled	-70,23
	5,00E+05	600,00	95,49		fulfilled	not fulfilled	-40,00
	6,00E+05	500,00	79,58		fulfilled	not fulfilled	-40,00
MHz	7,00E+05	428,57	68,21	30	fulfilled	not fulfilled	-40,00
	8,00E+05	375,00	59,68		fulfilled	not fulfilled	-40,00
	9,00E+05	333,33	53,05		fulfilled	not fulfilled	-40,00
	1,00	300,00	47,75		fulfilled	not fulfilled	-40,00
	1,59	188,50	30,00		fulfilled	not fulfilled	-40,00
	2,00	150,00	23,87		fulfilled	fulfilled	-38,02
	3,00	100,00	15,92		fulfilled	fulfilled	-34,49
	4,00	75,00	11,94		fulfilled	fulfilled	-32,00
	5,00	60,00	9,55		fulfilled	fulfilled	-30,06
	6,00	50,00	7,96		fulfilled	fulfilled	-28,47
	7,00	42,86	6,82		fulfilled	fulfilled	-27,13
	8,00	37,50	5,97		fulfilled	fulfilled	-25,97
	9,00	33,33	5,31		fulfilled	fulfilled	-24,95
	10,00	30,00	4,77		fulfilled	fulfilled	-24,04
	10,60	28,30	4,50		fulfilled	fulfilled	-23,53
	11,00	27,27	4,34		fulfilled	fulfilled	-23,21
	12,00	25,00	3,98		fulfilled	fulfilled	-22,45
	13,56	22,12	3,52		fulfilled	fulfilled	-21,39
	15,00	20,00	3,18		fulfilled	fulfilled	-20,51
	15,92	18,85	3,00		fulfilled	fulfilled	-20,00
	17,00	17,65	2,81		not fulfilled	fulfilled	-20,00
	18,00	16,67	2,65		not fulfilled	fulfilled	-20,00
	20,00	15,00	2,39		not fulfilled	fulfilled	-20,00
	21,00	14,29	2,27		not fulfilled	fulfilled	-20,00
	23,00	13,04	2,08		not fulfilled	fulfilled	-20,00
	25,00	12,00	1,91		not fulfilled	fulfilled	-20,00
	27,00	11,11	1,77		not fulfilled	fulfilled	-20,00
	29,00	10,34	1,65		not fulfilled	fulfilled	-20,00
	30,00	10,00	1,59		not fulfilled	fulfilled	-20,00

5.5. General Limit - Radiated field strength emissions, 30 MHz - 1 GHz

5.5.1. Test location and equipment

test location	☒ CETECOM Essen (Chapter. 2.2.1)	☐ Please see Chapter. 2.2.2	☐ Please see Chapter. 2.2.3
test site	☒ 441 EMI SAR ☒ 487 SAR NSA		
receiver	☒ 377 ESCS30 ☐ 001 ESS	☐ 489 ESU 40 ☐ 620 ESU 26	
spectr. analys.	☐ 584 FSU ☐ 120 FSEM	☐ 264 FSEK	
antenna	☒ 574 BTA-L ☐ 133 EMCO3115	☐ 302 BBHA9170 ☐ 289 CBL 6141	☐ 030 HFH-Z2 ☐ 477 GPS
signalling	☐ 392 MT8820A ☐ 371 CBT32	☐ 547 CMU ☐ 594 CMW	
otherwise	☐ 400 FTC40x15E ☐ 401 FTC40x15E	☐ 110 USB LWL ☒ 482 Filter Matrix	
DC power	☐ 456 EA 3013A ☒ 457 EA 3013A	☐ 459 EA 2032-50 ☐ 268 EA- 3050	☐ 494 AG6632A ☐ 498 NGPE
line voltage	☐ 230 V 50 Hz via public mains	☒ 12V DC	

5.5.2. Requirements/Limits

FCC		☐ Part 15 Subpart B, §15.109, class B ☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205	
ANSI		☐ C63.4-2014 ☒ C63.10-2013	
Limit	Frequency [MHz]	Radiated emissions limits, 3 meters	
		QUASI Peak [µV/m]	QUASI-Peak [dBµV/m]
	30 - 88	100	40.0
	88 - 216	150	43.5
	216 - 960	200	46.0
	above 960	500	54.0

5.5.3. Restricted bands of operation FCC §15.205

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.20725-4.20775	37.5-38.25	1645.5-1646.5	9.3-9.5
6.215-6.218	73-74.6	1660-1710	10.6-12.7
6.26775-6.26825	74.8-75.2	1718.8-1722.2	13.25-13.4
6.31175-6.31225	108-121.94	2200-2300	14.47-14.5
8.291-8.294	123-138	2310-2390	15.35-16.2
8.362-8.366	149.9-150.05	2483.5-2500	17.7-21.4
8.37625-8.38675	156.52475-156.52525	2690-2900	22.01-23.12
8.41425-8.41475	156.7-156.9	3260-3267	23.6-24.0
12.29-12.293	162.0125-167.17	3332-3339	31.2-31.8
12.51975-12.52025	167.72-173.2	3345.8-3358	36.43-36.5
12.57675-12.57725	240-285	3600-4400	--
13.36-13.41	322-335.4	--	--
Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209			

5.5.4. Test condition and measurement test set-up

Signal link to test system (if used):	☐ air link	☐ cable connection	☒ none
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 0.8m height	☐ floor standing	
Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%	
EMI-Receiver (Analyzer) Settings	Scan frequency range: ☒ 30 – 1000 MHz ☐ other: Scan-Mode: ☒ 6 dB EMI-Receiver Mode ☐ 3 dB spectrum analyser mode Detector: Peak / Quasi-peak RBW/VBW: 100 kHz/300 kHz Mode: Repetitive-Scan, max-hold Scan step: 30 kHz Sweep-Time: Coupled – calibrated display if continuous tx-signal otherwise adapted to EUT's individual duty-cycle		
General measurement procedures	Please see chapter "Test system set-up for electric field measurement in the range 30 MHz to 1 GHz"		

5.5.5. MEASUREMENT RESULTS

Table of measurement results:

Diagram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
3.01a	Low	64	30 MHz – 1 GHz	2	2	54Mbit EUT V PWR 15	☒	☐	☐	passed
3.01b	Low	64	30 MHz – 1 GHz	2	2	54Mbit EUT H PWR 15	☒	☐	☐	passed
3.02a	Middle	140	30 MHz – 1 GHz	2	2	MCS5 HT20 EUT V PWR 15	☒	☐	☐	passed
3.02b	Middle	140	30 MHz – 1 GHz	2	2	MCS5 HT20 EUT H PWR 15	☒	☐	☐	passed
3.03a	High	159	30 MHz – 1 GHz	2	2	MCS0 HT 40 EUT H PWR 15	☒	☐	☐	passed
3.03b	High	159	30 MHz – 1 GHz	2	2	MCS0 HT 40 EUT V PWR 15	☒	☐	☐	passed

Remark: see diagrams in annex 1 for more details

5.6. General Limit – Radiated field strength emissions, above 1 GHz

5.6.1. Test location and equipment FAR

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☒ 443 EMI FAR	☐ 347 Radio.lab.	☐ 337 OATS	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU 40	☐	☐
antenna meas	☐ 574 BTA-L	☐ 289 CBL 6141	☐ 608 HL 562	☒ 549 HL025	☒ 302 BBHA9170	☐ 477 GPS
antenna meas	☐ 123 HUF-Z2	☐ 132 HUF-Z3	☐ 030 HFH-Z2	☒ 376 BBHA9120E		☐
antenna subst	☐ 071 HUF-Z2	☐ 020 EMCO3115	☐ 063 LP 3146	☐ 303 BBHA9170	☐	☐
multimeter	☐ 341 Fluke 112	☐	☐	☐	☐	☐
signalling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU	☐ 594 CMW		
DC power	☐ 086 LNG50-10	☒ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐
line voltage	☒ 12V DC		☐ 060 120 V 60 Hz via PAS 5000			

5.6.2. Requirements/Limits

FCC	☐ Part 15 Subpart B, §15.109 class B ☒ Part 15 Subpart C, §15.209 for frequencies defined in §15.205 ☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4)			
ANSI	☐ C63.4-2014 ☒ C63.10-2013			
Frequency [MHz]	Limits			
	AV [µV/m]	AV [dBµV/m]	Peak [µV/m]	Peak [dBµV/m] or [dBm/MHz]
above 1 GHz for frequencies as defined in §15.205	500	54.0	5000	74.0 dBµV/m
§15.407(b)(1)(2)(3)(4)	--	--	--	(b)(1): 5.15-5.25GHz: -27dBm eirp (b)(2): 5.25-5.35GHz: -27dBm eirp (b)(3): 5.47-5.725 GHz: -27dBm eirp (-17dBm/MHz eirp) (b)(4): 5.725-5.85GHz: Spectrum mask
FCC: Part 15B	500	54.0	5000	74.0 dBµV/m

5.6.3. Test condition and measurement test set-up

Signal link to test system (if used):	☐ air link	☐ cable connection	☒ none
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top 1.5m height		
Climatic conditions	Temperature: (22±3°C) Rel. humidity: (40±20)%		
Spectrum-Analyzer settings	Scan frequency range: ☒ 1 – 18 GHz ☐ 18 – 25 GHz ☐ 18 – 40 GHz ☐ other: Scan-Mode: ☒ 6 dB EMI-Receiver Mode ☐ 3 dB Spectrum analyser Mode Detector: Peak and Average RBW/VBW: 1 MHz / 3 MHz Mode: Repetitive-Scan, max-hold Scan step: 400 kHz Sweep-Time: Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle		
General measurement procedures	Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz"		

5.6.4. Measurement Results

Diagram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
4.01	Low	36	1GHz-7GHz	2	2	54Mbit EUT V PWR 15	☒	☒	☐	passed
4.02	Low	36	1GHz-7GHz	2	2	54Mbit EUT H PWR 15	☒	☒	☐	passed
4.03	High	165	1GHz-7GHz	2	2	MCS5 HT20 EUT V PWR 15	☒	☒	☐	passed
4.04	High	165	1GHz-7GHz	2	2	MCS5 HT20 EUT H PWR 15	☒	☒	☐	passed
4.05	Low	38	1GHz-7GHz	2	2	MCS0 HT 40 EUT H PWR 15	☒	☒	☐	passed
4.06	Low	38	1GHz-7GHz	2	2	MCS0 HT 40 EUT V PWR 15	☒	☒	☐	passed
4.07	High	159	1GHz-7GHz	2	2	MCS0 HT 40 EUT H PWR 15	☒	☒	☐	passed
4.08	High	159	1GHz-7GHz	2	2	MCS0 HT 40 EUT V PWR 15	☒	☒	☐	passed
4.11	Low	36	7GHz-18GHz	2	2	54Mbit EUT V PWR 15	☒	☒	☐	passed
4.12	Low	36	7GHz-18GHz	2	2	54Mbit EUT H PWR 15	☒	☒	☐	passed
4.13	High	165	7GHz-18GHz	2	2	MCS5 HT20 EUT V PWR 15	☒	☒	☐	passed
4.14	High	165	7GHz-18GHz	2	2	MCS5 HT20 EUT H PWR 15	☒	☒	☐	passed
4.15	Low	38	7GHz-18GHz	2	2	MCS0 HT 40 EUT H PWR 15	☒	☒	☐	passed
4.16	Low	38	7GHz-18GHz	2	2	MCS0 HT 40 EUT V PWR 15	☒	☒	☐	passed
4.17	High	159	7GHz-18GHz	2	2	MCS0 HT 40 EUT H PWR 15	☒	☒	☐	passed
4.18	High	159	7GHz-18GHz	2	2	MCS0 HT 40 EUT V PWR 15	☒	☒	☐	passed
4.21	Low	36	18GHz - 40GHz	2	2	54Mbit EUT V/V PWR 15	☒	☒	☐	passed
4.22	High	165	18GHz-40GHz	2	2	MCS5 HT 0 EUT H/V PWR 15	☒	☒	☐	passed
4.23	Low	38	18GHz-40GHz	2	2	MCS0 HT 40 EUT H/V PWR 15	☒	☒	☐	passed
4.24	High	159	18GHz-40GHz	2	2	MCS0 HT 40 EUT H/V PWR 15	☒	☒	☐	passed

Remark: see diagrams in annex 1 for more details

5.7. RF-Parameter - Radiated Band Edge compliance measurements

5.7.1. Test location and equipment FAR

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☒ 443 EMI FAR	☐ 347 Radio.lab.	☐ 337 OATS	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 489 ESU 40	☐	☐
antenna meas	☐ 574 BTA-L	☐ 289 CBL 6141	☐ 608 HL 562	☒ 549 HL025	☐ 302 BBHA9170	☐ 477 GPS
antenna meas	☐ 123 HUF-Z2	☐ 132 HUF-Z3	☐ 030 HFH-Z2	☐	☐	☐
antenna subst	☐ 071 HUF-Z2	☐ 020 EMCO3115	☐ 063 LP 3146	☐ 303 BBHA9170	☐	☐
multimeter	☐ 341 Fluke 112	☐	☐	☐	☐	☐
signaling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU	☐ 594 CMW	☐	☐
DC power	☐ 086 LNG50-10	☒ 087 EA3013	☐ 354 NGPE 40	☐ 349 car battery	☐ 350 Car battery	☐
line voltage	☒ 12V DC ☐ 060 120 V 60 Hz via PAS 5000					

5.7.2. Requirements/Limits

FCC	☐ Part 15 Subpart B, §15.109 class B ☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205 ☒ Part 15 Subpart C, §15.407(b)(1)(2)(3)(4)
ANSI	☐ C63.4-2014 ☒ C63.10-2013, Chapter 6.10.6

5.7.3. Test condition and measurement test set-up

Signal link to test system (if used):	☐ air link ☐ cable connection ☒ none
EUT-grounding	☒ none ☐ with power supply ☐ additional connection
Equipment set up	☒ table top 1.5m height ☐ floor standing
Climatic conditions	Temperature: (22±3°C) Rel. humidity: (40±20)%
Spectrum-Analyzer settings	Scan frequency range: ☐ 1 – 18 GHz ☐ 18 – 25 GHz ☐ 18 – 40 GHz ☒ other: see diagrams Scan-Mode: ☐ 6 dB EMI-Receiver Mode ☒ 3 dB Spectrum analyser Mode Detector: Peak and Average RBW/VBW: Left band-edge: 100kHz/300kHz Right band-edge: 1 MHz / 3 MHz Mode: Repetitive-Scan, max-hold Scan step: 40kHz or 400 kHz Sweep-Time: Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle
General measurement procedures	Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz" for general measurements procedures in anechoic chamber.

5.7.4. Measurement Method

For uncritical results where a measurement resolution bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed to show compliance.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands. The method is according ANSI C63.10:2013, Chapter 6.10.6 "Marker-Delta method",. The method consists of three independent steps:

- 1. Step:** Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.
- 2. Step:** Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.
- 3. Step:** The delta value recorded in step 2 will be subtracted from value recorded in step 1, thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in FCC §15.205 with the general limits of FCC §15.209

5.7.5. EUT settings

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

Set-up No.:	2
Op. Mode:	2

5.7.6. Results:for non-restricted bands near-by

5.7.6.1. Non-restricted bands near-by - limits according FCC §15.407

20 MHz

Diagramm no.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Peak-Value at Band-Edge [dBuV/m]	Difference [dB]	Limit [dBc]	Margin [dB]	Verdict	Remark:
			Peak-Value	Average-Value						
9.25	36	no	97,009	88,818	53,375	43,634	20	23,634	PASS	Ch36 a-Mode 54Mbit Standing ExtAnt
9.26	36	no	95,573	87,874	53,656	41,917	20	21,917	PASS	Ch36 a-Mode 54Mbit laying ExtAnt
9.29	100	no	93,228	85,718	52,873	40,355	20	20,355	PASS	Ch100 a-Mode 54Mbit Laying ExtAnt
9.30	100	no	95,167	87,002	53,695	41,472	20	21,472	PASS	Ch100 a-Mode 54Mbit Standing ExtAnt
9.33	149	no	91,827	84,835	55,9	35,927	20	15,927	PASS	Ch149 a-Mode 54Mbit Laying ExtAnt
9.34	149	no	93,514	85,356	55,9	37,614	20	17,614	PASS	Ch149 a-Mode 54Mbit Standing ExtAnt
9.49	36	no	95,427	88,085	53,458	41,969	20	21,969	PASS	Ch36 n-Mode MCS5 Laying ExtAnt
9.50	36	no	97,888	89,401	53,3	44,588	20	24,588	PASS	Ch36 n-Mode MCS5 Standing ExtAnt
9.53	100	no	93,697	85,189	53,626	40,071	20	20,071	PASS	Ch100 n-Mode MCS5 Laying ExtAnt
9.54	100	no	95,969	87,869	53,816	42,153	20	22,153	PASS	Ch100 n-Mode MCS5 Standing ExtAnt
9.57	149	no	90,992	83,491	57,819	33,173	20	13,173	PASS	Ch149 n-Mode MCS5 Laying ExtAnt
9.58	149	no	91,627	83,879	46,8	44,827	20	24,827	PASS	Ch149 n-Mode MCS5 Standing ExtAnt

40 MHz

Diagramm no.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Peak-Value at Band-Edge [dBuV/m]	Difference [dB]	Limit [dBc]	Margin [dB]	Verdict	Remark:
			Peak-Value	Average-Value						
9.73	38	no	87,338	79,017	52,669	35	20	15	PASS	Ch38 n-Mode MCS0 Laying ExtAnt
9.74	38	no	87,463	79,509	52,413	35	20	15	PASS	Ch38 n-Mode MCS0 Standing ExtAnt
9.77	102	no	87,145	78,583	42,482	45	20	25	PASS	Ch102 n-Mode MCS0 Laying ExtAnt
9.78	102	no	88,398	80,817	53,21	35	20	15	PASS	Ch102 n-Mode MCS0 Standing ExtAnt
9.81	151	no	85,037	76,941	53,3	32	20	12	PASS	Ch151 n-Mode MCS0 Laying ExtAnt
9.82	151	no	85,028	76,289	53,3	32	20	12	PASS	Ch151 n-Mode MCS0 Standing ExtAnt

5.7.6.2. Restricted bands near-by

(\$15.205 with limits accord. FCC §15.209)

20 MHz

Diagramm no.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Value at Band-Edge [dBuV/m]		Limits [dBuV/m]		Margin [dB]		Verdict	Remark:
			Peak-Value	Average-Value	Peak -Value	Average -Value	Peak -Value	Average -Value	Peak	Average		
9.27	64	yes	93,379	85,000	54,233	43,365	74	54	19,767	10,635	PASS	Ch64 a-Mode 54Mbit laying ExtAnt
9.28	64	yes	94,466	86,854	54	43,699	74	54	20	10,301	PASS	Ch64 a-Mode 54Mbit Standing ExtAnt
9.31	140	yes	92,423	85,417	53,3	43,423	74	54	20,7	10,577	PASS	Ch140 a-Mode 54Mbit Laying ExtAnt
9.32	140	yes	93,252	86,569	53,3	43,445	74	54	20,7	10,555	PASS	Ch140 a-Mode 54Mbit Standing ExtAnt
9.35	165	yes	91,404	84,499	55,675	45,147	74	54	18,325	8,853	PASS	Ch165 a-Mode 54Mbit laying ExtAnt
9.36	165	yes	93,087	84,983	55,039	45,089	74	54	18,961	8,911	PASS	Ch165 a-Mode 54Mbit Standing ExtAnt
9.51	64	yes	94,112	87,123	55	45	74	54	19	9	PASS	Ch64 n-Mode MCS5 Laying ExtAnt
9.52	64	yes	94,537	85,952	54,184	43,911	74	54	19,816	10,089	PASS	Ch64 n-Mode MCS5 Standing ExtAnt
9.55	140	yes	92,309	84,079	53,3	42,9	74	54	20,7	11,1	PASS	Ch140 n-Mode MCS5 Laying ExtAnt
9.56	140	yes	92,988	85,964	53,3	43,227	74	54	20,7	10,773	PASS	Ch140 n-Mode MCS5 Standing ExtAnt
9.59	165	yes	91,892	83,724	55,729	45,053	74	54	18,271	8,947	PASS	Ch165 n-Mode MCS5 Laying ExtAnt
9.60	165	yes	92,641	85,032	55,429	45,147	74	54	18,571	8,853	PASS	Ch165 n-Mode MCS5 Standing ExtAnt

40 MHz

Diagramm no.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Value at Band-Edge [dBuV/m]		Limits [dBuV/m]		Margin [dB]		Verdict	Remark:
			Peak-Value	Average-Value	Peak -Value	Average -Value	Peak -Value	Average -Value	Peak	Average		
9.75	62	yes	87,535	79,251	53,399	43,175	74	54	20,601	10,825	PASS	Ch62 n-Mode MCS0 Laying ExtAnt
9.76	62	yes	85,212	78,553	53,3	43,327	74	54	20,7	10,673	PASS	Ch62 n-Mode MCS0 Standing ExtAnt
9.79	134	yes	84,776	76,426	52,935	42,642	74	54	21,065	11,358	PASS	Ch134 n-Mode MCS0 Laying ExtAnt
9.80	134	yes	86,706	79,11	53,3	42,628	74	54	20,7	11,372	PASS	Ch134 n-Mode MCS0 Standing ExtAnt
9.83	159	yes	85,403	77,849	54,843	44,471	74	54	19,157	9,529	PASS	Ch159 n-Mode MCS0 Laying ExtAnt
9.84	159	yes	84,737	76,741	54,836	44,499	74	54	19,164	9,501	PASS	Ch159 n-Mode MCS0 Standing ExtAnt

5.7.7. Verdict: passed

5.8. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.

For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%							Remarks
Conducted emissions (U _{CISPR})	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB							-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB							E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-							-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB							Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	-	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--		
		12.75 - 26.5GHz	N/A	0.82	--	N/A	N/A	--		
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable	
		2.8 GHz - 12.75GHz	1.48	N/A	1.51	N/A	1.43	--		
		12.75 GHz - 18GHz	1.81	N/A	1.83	N/A	1.77	--		
		18 GHz - 26.5GHz	1.83	N/A	1.85	N/A	1.79	--		
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
			1.0 dB							Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
	-		See above: 0.70 dB							Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm							-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.0 dB							Magnetic field E-field Substitution
		30 MHz - 1 GHz	4.2 dB							
		1 GHz - 20 GHz	3.17 dB							

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Instruments and Ancillary

24. Jun. 20

The “Ref.-No” in the left column of the following tables allows the clear identification of the laboratory equipment.

6.0.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
335	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario=
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-	-	Spuri 7.2.5 or EMC 32 Ver. 9.15.00
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 9.15.00
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
670	Univ. Radio Communication Tester	CMU 200	106833	µP1 =V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)
693	TS8997	Test System	--	866 FSV3030 559 SMU200A 687 SMF100A 691 OSP120 805 OSP 157WX 866 FSV3030

6.0.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	13.05.2021
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	13.05.2021
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	23.05.2021
011	Insertion Unit (EMS-radiated)	URV5-Z2	864169/004	Rohde & Schwarz	24 M	-	
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Rohde & Schwarz	24 M	-	21.05.2021
013	Power Meter (EMS cond.)	NRVD	839111/003	Rohde & Schwarz	24 M	-	20.05.2021
014	Insertion Unit (EMS cond.)	URV5-Z2	838519/029	Rohde & Schwarz	24 M	-	20.05.2021
015	Insertion Unit (EMS cond.)	URV5-Z4	838570/024	Rohde & Schwarz	24 M	-	20.05.2021
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	22.05.2022
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Rohde & Schwarz	pre-m	3	
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.07.2021
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.05.2021
031	Absorbing Clamp	MDS-21	863325/015	Rohde & Schwarz	36 M	-	30.06.2021
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	23.05.2021
049	Current Clamp (injection)	F-120-2	48	FCC	24 M	-	22.05.2022
050	3-ph Coupling Decoupling Netw. (Burst)	CDN 300	176	Schaffner	36 M	-	30.05.2021
051	VHF-Current Probe 20-300 MHz	ESV-Z1	872421	Rohde & Schwarz	36 M	-	30.05.2021
052	Notch Filter DECT	WRCB 1887,82/1889,55SS	12	Wainwright Industries	pre-m	2	
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
058	capacitive clamp (Burst)	IP 4	99	Haefely	36 M	-	30.05.2021
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
065	attenuator, (6 dB) 50 Ohm, 250W	AT 50-6-250	521057	BNOS Electronics	12 M	1b	10.04.2021
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	20.10.2020
067	coupling decoupling-network	CDN 801-M2/M3	272	Lüthi	36 M	-	19.05.2023
069	EM - clamp	EM101	9535159	Lüthi	36 M	-	27.08.2022
072	coupling decoupling-network	CDN 801-M2/M3	276	Lüthi	36 M	-	19.05.2023
083	AC - power supply, 0-10 A	EAC/MT 27010	910502096	EURO TEST	pre-m	2	
084	AC - power supply, 0-5 A	ELABO-8-34214	-	ELABO	pre-m	2	
085	AC - power supply, 0-10 A	R250	-	Schunterm.&Benningh.	pre-m	2	
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
090	Helmholtz coil: 2x10 coils in series	Helmholtz coil: 2x10 coils in	-	RWTÜV	24 M	4	26.05.2022
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
094	artificial head (No.1)	4905	1566990	Brüel & Kjaer	pre-m	2	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	30.05.2021
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.05.2021
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	22.05.2022
121	notch filter GSM 1900	WRCB 1879,5/1880,5EE	15	Wainwright GmbH	12 M	1d	20.10.2020
122	notch filter GSM 1800	WRCB 1747/1748	12	Wainwright GmbH	12 M	1c	20.10.2020
131	RF-Current Probe	F-52	19	FCC	36 M	-	22.05.2023
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO	36 M	1c	08.04.2023
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	36 M	-	10.03.2020
142	attenuator (6 dB) 2 W, 8 GHz	DGL N	-	Radiall	12 M	1b	14.04.2021
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
254	high pass GSM1800/1900/DECT	5HC 2600/12750-1.5KK	23042	Trilithic	12 M	1c	20.10.2020
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24 M	-	19.05.2022
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
268	AC/DC power supply	EA 3050-A	9823636	Elektro Automatik	pre-m	-	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
284	coupling decoupling network	CDN 801-M1	1661	Lüthi	36 M	-	19.05.2023
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	20.10.2020
290	notch filter GSM 900	WRCA 901,9/903,1SS	3RR	Wainwright GmbH	12 M	1c	20.10.2020
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	20.10.2020
295	Racal Digital Radio Test Set	6103	1572	Racal	pre-m	3	
296	audio measurement amplifier	2636C (Reserve)	R=316568/004 B=1537541	Brüel & Kjaer	pre-m	2	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
299	audio microphone	134	-	Brüel & Kjaer	pre-m	2	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	14.05.2021
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	15.04.2023
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	20.03.2020
304	fix dipole antenna 1,6 GHz	EMCO 3125-307	9907-1001	ETS	pre-m	-	
305	fix dipole antenna 1,8-2,0 GHz	EMCO 3125-306	9907-1001	ETS	pre-m	-	
306	fix dipole antenna 2,45 GHz	EMCO 3125-308	9907-1001	ETS	pre-m	-	
307	fix dipole antenna 3 GHz	EMCO 3125-309	9907-1001	ETS	pre-m	-	
317	1000 Hz calibrator 94 dB SPL	4230 94dB	1542286	Brüel & Kjaer	12 M	-	
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Rohde & Schwarz	pre-m	3	
335	CTC-EMS-Conducted	System EMS Conducted	-	Rohde & Schwarz	12 M	5	14.04.2021
340	Digital Radiocommunication Tester	CMD 55	849709/037	Rohde & Schwarz	pre-m	3	
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	25.05.2022
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	23.05.2021
344	adaptor 150/50 Ohm	150/50	-	Krohne	36 M	-	02.06.2023
345	adaptor 150/50 Ohm	150/50	-	Krohne	36 M	-	02.06.2023
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
349	car battery 12 V	car battery 12 V	without	-	-	3	
350	car battery 12 V	car battery 12 V	without	-	-	3	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	21.05.2021
363	Kalibrieradapter HF-uns.	CR 100 A	without	Lüthi	24 M	-	29.05.2021
364	Kalibrieradapter HF-uns.	CR 100 A	128	Lüthi	24 M	-	29.05.2021
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	EM-Test	12 M	-	14.05.2021
368	ROD-Antenna	HFH 2-Z1	879283/31	Rohde & Schwarz	60 M	-	17.07.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	13.05.2021
374	Power Amplifier 0,8-3 GHz	60S1G3	306528	Amplifier Research	12 M	1a	27.03.2021
375	Directional Coupler	DC7144M1	306498	Amplifier Research	12 M	1a	27.03.2021
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	36 M	-	08.04.2023
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	13.05.2021
386	Coupling Decoupling Network	CDN USB/p	19397	Schaffner	36 M	-	19.05.2023
387	Coupling Decoupling Network	CDN L-801 M2	2051	Lüthi	36 M	-	19.05.2023
388	Coupling Decoupling Network	CDN L-801 T2	1929	Lüthi	36 M	-	19.05.2023
389	Digital Multimeter	Keithley 2000	0583926	Keithley	pre-m	-	
390	Industry Acoustic System	MO 2000 Set	2127100123	Sennheiser	pre-m	2	
394	Power Amplifier 80-1000 MHz	BLWA 0810-250/200	045610	Bonn-Elektronik	-	1a	27.03.2021
396	Thermo/Hygrometer	Thermo/Hygrometer	-	Conrad	24 M	-	09.01.2021
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	15.05.2021
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	10.03.2020
440	CDN for Datacable	CDN-UTP	CDN-UTP 029	EMC Partner AG, CH	36 M	-	30.05.2022
442	CTC-SAR-EMS	System EMS field (SAR)	-	ETS-Lindgren / CETECOM	12 M	5	27.03.2021
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	20.10.2020
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	20.10.2020
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	20.10.2020
450	6dB attenuator N/N	6806.17B 6dB	-	Huber & Suhner	12 M	-	30.05.2021
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
455	Oscilloscope	HP 54602B	US 350 336 45	Hawlett Packard	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	15.05.2021
462	AF-Generator	MX-2020	-	Conrad	-	4	
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.05.2021
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2021
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.05.2021
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	20.10.2020
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	19.05.2021
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	13.05.2021
491	ESD Simulator dito	ESD dito	ditto307022	EM-Test	12 M	-	13.05.2021
498	Power Supply	NGPE 40/40	402	Rohde & Schwarz	pre-m	2	
500	Industry Acoustic System	MO 2000 Set	100048	Sennheiser	pre-m	2	
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
512	notch filter GSM 850	WRCA 800/960-02/40-GEEK	SN 24	Wainwrght	12 M	1c	20.10.2020
517	relais switch matrix	HF Relais Box Keithley System	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	23.05.2021
524	Voltage Drop Simulator	VDS 200	0196-16	EM Test	24 M	-	21.05.2021
525	CDN coupling network	CNA 200	1196-01	EM Test	24 M	-	21.05.2021
526	Burst Generator	EFT 200 A	0496-06	EM Test	24 M	-	21.05.2021
527	Micro Pulse Generator	MPG 200 B	0496-05	EM Test	24 M	-	21.05.2021
528	Load Dump Simulator	LD 200B	0496-06	EM Test	24 M	-	21.05.2021
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
533	Impedance Stabilization Network	ISN T200A	25706	Teseq	36 M	-	20.05.2023
534	Impedance Stabilization Network	ISN T400A	24881	Teseq	36 M	-	20.05.2023
535	Impedance Stabilization Network	ISN T800	26321	Teseq	36 M	-	20.05.2023
536	Impedance Stabilization Network	ISN ST08	25867	Teseq	36 M	-	20.05.2023
541	Impedance Stabilization Network	ISN T8-Cat6	26373	Teseq Berlin	36 M	-	20.05.2023
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	05.08.2020
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	24 M	-	17.05.2021
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2021
550	System CTC S-VSWR Verification SAR-EMI	System EMI Field SAR S-VSWR	-	ETS Lindgren/CETECOM	24 M	-	02.10.2021
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	20.10.2020
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	08.05.2021
559	Vector Signal Generator	SMU200A	103736	Rohde Schwarz	24	-	22.05.2021
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	03.05.2022
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
592	CDN-HDMI	CDN-HDMI	A3029004	Frankonia / Dr.Hubert	36 M	-	20.05.2023
595	Analog Adder	TS8910	-	Rohde & Schwarz	pre-m	2	
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.05.2021
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
609	Sleeve Dipole Antenna	3126-700	00123808	ETS-Lindgren	36/12 M	-	11.10.2021
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
615	Analog Adder	TS8920	-	Rohde & Schwarz	pre-m	2	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	13.05.2021
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	Kogilink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
645	Power Amplifier	CBA 230M-080	T44236	TESEQ	-	1g	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	16.06.2022
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
672	Digitalmultimeter	Keithley 2700	1182075	Keithley	pre-m	-	
673	Diditalmultimeter	Keithley 2700	1181408	Keithley	pre-m	-	
674	Digitalmultimeter	Keithley 2700	1182090	Keithley	pre-m	-	
675	Digitalmultimeter	Keithley 2700	1162865	Keithley	pre-m	-	
676	Digitalmultimeter	Keithley 2700	1182092	Keithley	24 M	-	30.05.2021
677	Digitalmultimeter	Keithley 2700	1182089	Keithley	pre-m	-	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
679	Power Supply	High Speed Power Supply	0783417	Keithley	pre-m	-	
680	Power Sensor	NRP-Z21	100622	Rohde & Schwarz	pre-m	-	
682	Vector Signal Generator	SMU 200A	101319	Rohde & Schwarz	pre-m	-	
684	Widerstand 100 Ohm	SL 403-403	72973	Teseq	pre-m	-	
685	Widerstand 100 OHM	SL 403-403	72974	Teseq	pre-m	-	
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	-	-	
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	07.02.2021
689	Vector Signal Generator	SMU200	100970	Rohde&Schwarz	24 M	-	13.05.2022
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	24 M	-	30.05.2021
691	Open Switch and control Platform	OSB120	101056	Rohde&Schwarz	12 M	-	30.05.2021
695	ReRadiating GPS-System	AS-47	G1406003500001	Automotive Cons. Fink	-	3	
698	Sound Calibrator	Sound Calibrator 4231	2035208	Brüel & Kjaer	12 M	-	22.05.2021
700	Audio Analyzer	UPL 16	830695/0016	Rohde&Schwarz	24 M	-	12.05.2022
701	CMW500 wide. Radio Comm.	CMW500	158150	Rohde & Schwarz	24 M	-	05.11.2021
705	NRV-Z1	Power Sensor	893350/020	Rohde & Schwarz	12 M	-	12.05.2021
706	NRV-Z1	Power Sensor	830961/001	Rohde & Schwarz	12 M	-	12.05.2021
707	RadiCentre	CTR-1004B	10I00037SN038-1	D.A.R.E!! Instruments	24 M	-	
708	Laser powered Electrical Field Strength Probe	RadiSense 6	10I00037SN038	D.A.R.E.!! Instruments BV	24 M	-	09.05.2021

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
710	RF Power Amplifier	BLMA 2560-100	1610879	Bonn Elektronik	12 M	-	27.03.2021
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	12 M	-	04.07.2021
718	Robot	Dasy 5 / TX90	F11/5GM9A1/A/01	Stäubli	pre-m	-	
747	Spectrum Analyzer	FSU 26	200152	Rohde & Schwarz	12 M	-	13.05.2021
751	Digital Optical System	optoCAN-FD Transceiver	17-010416	mk-messtechnik GmbH	-	-	
752	Digital Optical System	optoCAN-FD Transceiver	17-010083	mk-messtechnik GmbH	-	-	
753	Digital Optical System	optoCAN-FD Transceiver	17-010084	mk-messtechnik GmbH	-	-	
754	Digital Optical System	optoCAN-FD Transceiver	17-010415	mk-messtechnik GmbH	-	-	
755	Digital Optical System	optoLAN-100-MAX	17-010795	mk-messtechnik GmbH	-	-	
757	WIDEBAND RADIO COMMUNICATION	CMW500	163673	Rohde&Schwarz	12 M	-	22.05.2021
758	Signal Generator	SMU 200A	100754	Rohde & Schwarz	24 M	-	14.05.2022
781	Power Supply	PS 2042-10 B	2815450369	Elektro-Automatik GmbH	-	-	
782	Power Supply	PS 2042-10 B	2815450348	Elektro-Automatik GmbH & Co.KG	-	-	
801	Spectrum Analyzer	FSU 26	100414	Rohde & Schwarz	12 M	-	13.05.2021
784	Power Supply	NGSM 32/10	00196	Rohde & Schwarz	12 M	-	
785	RSP	RF Step Attenuator 0...139.9dB	860712/012	Rohde & Schwarz	12 M	-	
788	Precision Omnidirectional Dipole	POD 618	6182558/Q	Seibersdorf Laboratories	36 M	-	30.06.2021
789	Precision Omnidirectional Dipole	POD 16	162496/Q	Seibersdorf Laboratories	36 M	-	30.06.2021
799	Transceiver	optoLAN-Gb	18-014746	mk messtechnik	pre-m	-	
802	Exposure Level Tester	ELT-400	O-0026	NARDA Safety Solutions	24 M	-	30.01.2021
803	Probe	ELT probe 3cm²	O-0026	Narda Safety Test Solution	24 M	-	30.01.2021
805	Open Switch and control Platform	OSP-B157WX 8 Port Switch,	101264	Rohde & Schwarz	12 M	-	30.05.2021
808	Diode Power Sensor	NRV-Z1	829894/001	Rohde & Schwarz	24 M	-	24.05.2021
816	GPIO-USB-HS	187965G-01L	16AE772	National Instruments	-	-	
817	GPIO-USB-HS	187965G-01L	16AC1EE	National Instruments	-	-	
818	GPIO-USB-HS	187965G-01L	16AE8D0	Natinal Instruments	-	-	
819	GPIO-USB-HS	187965G-01L	16AB93C	National Instruments	-	-	
820	GPIO-USB-HS	187965G-01L	16AE294	National Instruments	-	-	
821	GPIO-USB-HS	187965G-01L	16ACB9C	National Instruments	-	-	
822	GPIO-USB-HS	187965G-01L	16AE5B2	National Instruments	-	-	
823	Broadband Field Meter	NBM-550	H-0929	NARDA Safety Test Solutions	36 M	-	19.07.2022
824	E-Field Probe	EF 0691	H-0851	Narda Safety Test Solutions	36 M	-	06.08.2022
825	H-Field Probe	HF 3061	D-0805	NARDA Safety Test Solutions	36 M	-	06.08.2022
826	Electric and magnetic Field Analyzer	EHP-50F	510WY90125	NARDA Safety Test Solutions	36 M	-	01.10.2022
827	Transceiver	optoUSB-2.0	19-017001	mk-messtechnik GmbH	-	-	
828	Transceiver	optoUSB-2.0	19-017002	mk-messtechnik GmbH	-	-	
829	Battery Pack BP-84	Battery Pack BP-84	19-017271	mk-messtechnik GmbH	-	-	
866	SIGNAL ANALYZER	FSV3030	101247	Rohde&Schwarz	12 M	-	02.10.2020
874	Signal Generator	SMP22	100028	Rohde & Schwarz	36 M	-	13.05.2023
880	Laptop	Latitude 7400	JVDM2X2	Dell	no	-	
881	Laptop	Latitude 7400	37RJ2X2	Dell	no	-	
882	Laptop	Latitude 7400	4GYJ2X2	DELL	no	-	
885	Power Supply	Power Supply EA3632A	75305850	EA	no	-	
886	HD Kamera	dAV-Cr-HD-30-ww	19-018438	mk Messtechnik	no	-	
887	HD Camera	dAV-Cr-HD-30-ww-PS	19-018439	mk Messtechnik	no	-	
889	rack mount receiver	dAV-Rr-HD 19"	018247	mk Messtechnik	no	-	
902	Wideband Radio Communication Tester	CMW 500	168880	Rohde & Schwarz	12 M	-	13.05.2021

6.0.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No. 443)
	1d	System CTC-SAR-EMI (Ref.-No. 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1f	System CTC-CTIA-OTA (Ref.-No. 420)
	1g	System CTC-FAR-EMS (Ref.-No. 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration

7. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2018-08-22
C1	Measurement Data Update	2018-11-09
C2	Channel Occupied Bandwidth measurement added; ISED References removed	2019-04-29
C3	Measurement Data Update : Chapter 5.2	2020-08-03

End of Report