T E S T R E P O R T
No.: 18-1-0248301T07a

According to:

CFR Title 47, Part 15, Subpart C
§15.247 (DTS)

ISED-Regulations
RSS-Gen, Issue 5
RSS-247, Issue 2

for

Robert Bosch Car Multimedia GmbH

AIVIV10
Multimedia device with Bluetooth and WLAN

FCC ID: YBN-AIVIV10
ISED: 9595A-AIVIV10

Laboratory Accreditation
ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01 D-PL-12047-01-03 D-PL-12047-01-04
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The listed attachments are an integral part of this report.			

*) For Internal photographs of EUT, see applicant's documentation

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 2.412 to 2.462 GHz according to IEE 802.11 b/g/n. The EUT integrates a WLAN transmitter. 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 2017 and ISED RSS-247 Issue 2/RSS-Gen Issue 5 standards.

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

Test cases	Port	References & Limits			EUT set-up	EUT opera - ting mode	Result
		FCC Standard	RSS Section	Test Limit			
TX-Mode							
Timing of transmitter (pulsed operation)	Antenna Terminal or enclosure	§15.35	RSS-Gen, Issue 5, Chapter 6.10	--	--	--	for Information only
6 dB bandwidth	Antenna terminal (conducted)	§15.247(a)(2)	RSS-247, Issue 2 Chapter 5.2 b	≥ 500 kHz for DTS systems	2	1	Pass
99% occupied bandwidth	Antenna terminal (conducted)	--	RSS-Gen, Issue 5, Chapter 6.7	99% Power bandwidth	2	1	Pass
Transmitter Peak output power	Antenna terminal (conducted)	§15.247(b)(3)	RSS-247, Issue 2 Chapter 5.1 d	1 Watt Peak	2	1	Pass
Transmitter Peak output power radiated	Enclosure + Inter-connecting cables (radiated)	§15.247(b)(4)	RSS-247, Issue 2 Chapter 5.1 d	< 4 Watt (EIRP) for antenna with directional gain less 6 dBi	2	1	Pass (calculated)
Out-Of-Band RF- emissions Band-Edge emissions	Antenna terminal (conducted)	§15.247 (d)	RSS-Gen, Issue 5, Chapter 8.9	20 dB or RSS-Gen, Issue 4, Table 4 limits	1	1	Pass
Power spectral density	Antenna terminal (conducted)	§15.247(e)	RSS-247, Issue 2 Chapter 5.2 b	8dBm in any 3 kHz band	2	1	Pass
Transmitter frequency stability	Antenna terminal (conducted)	--	RSS-Gen, Issue 5, Chapter 8.11	Occupied bandwidth entirely outside restricted bands and prohibited TV bands	2	1	Pass

General field strength emissions + restricted bands	Enclosure + Inter-connecting cables (radiated)	§15.247 (d) §15.205 §15.209	RSS-247, Issue 2, Chapter 5.5 RSS-Gen: Issue 5: §8.9 Table 4+5+6	Emissions in restricted bands must meet the general field-strength radiated limits	1+3	1+3	Pass
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 5: Chapter 8.8 Table 3	FCC §15.107 class B limits §15.207 limits ISED: Table 3, Chapter 8.8	--	--	Not applicable

Specific Absorption Rate (SAR) Measurements (separation distance user to RF-radiating element within 20cm)							
Test cases	**Port**	**References & Limits**			**EUT set-up**	**EUT oper a-ting mod e**	**Result**
		FCC Standard	**RSS Section**	**Test Limit**			
Radio frequency radiation exposure requirements	Cabinet + Inter-connecting cables (radiated)	§1.1310(b) §2.1091 §2.1093	RSS-102 Issue 5	**SAR-Limits FCC:** 1.1310(b)	--	--	See separate test report CETECOM_TR18-1-0248301T09a
				RF-Field Strength Limits: FCC: "general population/ uncontrolled" environment Table 1 **ISED:** Table 4	1	1	

1.2. Attestation

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.

Digital signiert von: Christian Lorenz Datum: 2019.10.24 15:04:07 +02'00'

Digital signiert von: M.Sc. Patrick Marzotko Name: CN = M.Sc. Patrick Marzotko email = patrick.marzotko@cetecom.com C = DE O = Cetecom GmbH OU = RC/EMC Datum: 2019.10.24 15:01:35 +02'00'

....

Dipl.-Ing. Ch. Lorenz
Responsible for test section

M.Sc. P. Marzotko
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 laboratory:	Dipl.-Ing Volker Wittmann
Deputy:	Dipl.-Ing. Niels Jeß

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:	M.Sc. P. Marzotko
Project leader:	B.Sc. Mohamed Ahmed
Receipt of EUT:	2019-04-29
Date(s) of test:	2019-04-29 - 2019-08-30
Date of report:	2019-10-24
Version of template:	13.02

2.4. Applicant's details

Applicant's name:	Robert Bosch Car Multimedia GmbH
Address:	Robert-Bosch-Straße 200 31139 Hildesheim Germany
Contact person:	Mr. Dirk Zamow

2.5. Manufacturer's details

Manufacturer's name:	see applicant's details
Address:	see applicant's details

3. Equipment under test (EUT)

3.1. Technical data of main EUT declared by applicant

Model Nr.	AIVIV10		
Type	Multimedia device with Bluetooth and WLAN		
FCC ID	YBN-AIVIV10		
ISED	9595A-AIVIV10		
Frequency range (US/Canada -bands)	☒ 2412 MHz (Channel 01) to 2462 MHz (Channel 11) for 20 MHz BW ☒ 2422 MHz (Channel 03) to 2452 MHZ (Channel 09) for 40 MHz BW		
Type of modulation	See chapter 3.2		
Number of channels (USA/Canada -bands)	1 to 11		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☐ External, separate RF-connector		
Antenna Model	PCB Antenna		
Antenna Gain (measured, see test report TR18-1-0248301T11a)	3.2dBi		
Max. Conducted Output Power	Measured RMS Power 802.11b: 10.84 dBm 802.11g: 8.47 dBm 802.11n(20 MHz): 8.47 dBm 802.11n(40 MHz): 8.12 dBm		
EIRP WLAN	Calculated EIRP 802.11b: 10.84 dBm + 3.2 dBi = 14.04 dBm 802.11g: 8.47 dBm + 3.2 dBi = 11.67 dBm 802.11n(20 MHz): 8.47 dBm + 3.2 dBi = 11.67 dBm 802.11n(40 MHz): 8.12 dBm + 3.2 dBi = 11.32 dBm		
Installed options	☒ 802.11 a/n/ac (not tested within this report) ☒ Bluetooth EDR (not tested within this report) ☐ Bluetooth LE (not tested within this report)		
Power supply	☐ DC power Range: 2.3 V to 3.3 V (as specified by applicant) ☒ 13.5 V DC		
Special EMI components	--		
Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.?	☐ yes ☒ no		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	
ISED Certification Number attached	☐ yes	☒ no	

3.2. IEEE 802.11 overview: modulation and data rates

The modulations and data rates defined for 802.11 b/g/n transmitters are identified in the table below. Also it shows which operational mode is possible for the device under test (EUT) according applicant's information.

802.11**b**-Mode (DSSS System)		
Data rate [MBps]	Modulation type	Supported by EUT
1	DBPSK (Differential binary phase shift keying)	YES
2	DQPSK (Differential quadrature phase shift keying)	YES
5.5 / 11	CCK/PBCC (8-chip complementary code keying)	YES
22	ERP-PBCC (Packet binary convolutional coding)	NO

802.11**g**-Mode (OFDM system)		
Brutto data rate [MBps]	Modulation type of subcarriers	Supported by EUT
6 / 9	BPSK	YES
12 /18	QPSK	YES
24 / 36	16-QAM	YES
48 / 54	64-QAM	YES

Remark: 52 sub-carriers which can be modulated at different data-rates.

802.11**n**-Mode (OFDM)		
Brutto data rate [MBps]	Modulation type	Supported by EUT
7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps	HT20 (MCS0..MCS7)	YES
14.444/28.889/43.333/57.778/86.667/ 115.556/130/144.444 Mbps	HT20 (MCS8..MCS7)	NO
15/30/45/60/90/120/135/150 Mbps	HT40 (MCS0..MCS7)	YES
30/60/90/120/180/240/270/300 Mbps	HT40 (MCS8..MCS15)	NO

Comments: For additional details please refer to "A-IVI_Scope2_TechnicalPassport_0706207"

3.3. 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 S06	AIVIV10	Multimedia device with Bluetooth and WLAN	0005057	001	1049
EUT B S04	AIVIV10	Multimedia device with Bluetooth and WLAN	0005015	001	1049

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

3.4. 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	USB-cable (Dongle)	0,38m	S7291GC000379	Version-D1	--
AE 2	Power Supply Cable	--	--	--	--
AE 3	Notebook	Lenovo X200S	LVZT1DG	--	--
AE 4	WLAN router	Nighthawk(R) X4S	5K5188590067B	R7800	V1.0.2.46
AE 5	Smartphone	Samsung S8	--	--	Android 9

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

3.5. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A + AE 1 + AE 2 + AE 3	Used for radiated measurements.
set. 2	EUT B + AE 1 + AE 2 + AE 3	Used for conducted measurements.
set. 3	EUT A + AE 1+ AE 2 + AE 3 + AE4 + AE5	Radiated measurement set-up for simultaneous transmissions mode

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

3.6. EUT operating modes

EUT operating mode no.*1)	Description of operating modes	Additional information
op. 1	TX-Mode Burst 20 MHz	With help of special test firmware WLAN is switched to a bandwidth of 20MHz and a continuous traffic mode (duty cycle >98%) was set-up *2)
op. 2	TX-Mode Burst 40 MHz	With help of special test firmware WLAN is switched to a bandwidth of 40MHz and a continuous traffic mode (duty cycle >98%) was set-up *2)
op. 3	WLAN and Bluetooth normal operating mode	With help of software "Iperf" and a Bluetooth connection to a Bluetooth device EUT was put into **normal Wi-Fi and Bluetooth operation mode** simultaneously.

*1) EUT operating mode no. is used to simplify the test report.
*2) Please refer to document Instructions_RadioTypeApproval_9_6_2017 "Instructions for setting Operating Modes of WLAN, BT and BT-LE for Radio Type Approval."

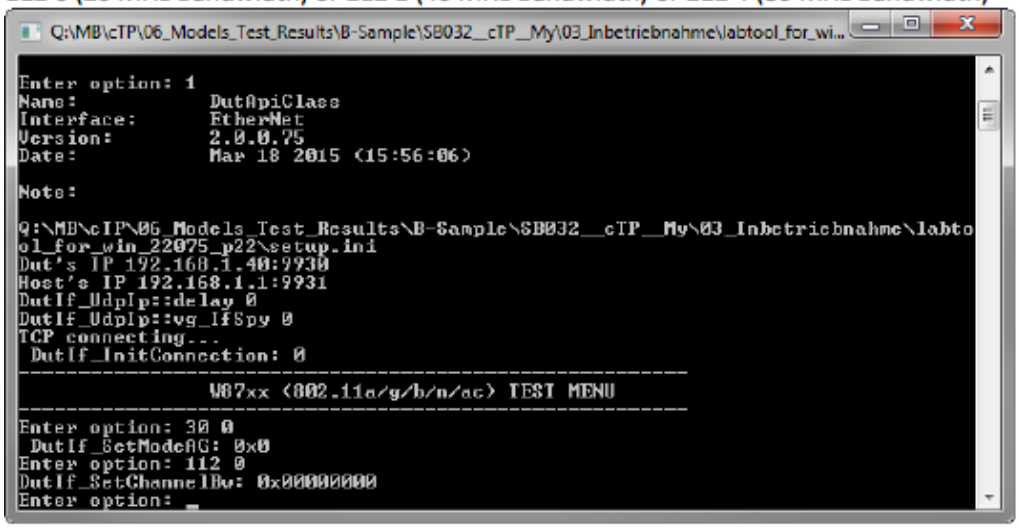
3.7. EUT Test Settings

3.7.1. Test tool information

Labtool version: 2.0.0.75
Labtool date: Mar 18 2015 (15:56:06)

The following settings have been done under SW Labtool:

Make the main settings which only have to be set once (per session):
30 0 (Choose the 2,4G band) or 30 1 (Choose the 5G band)
112 0 (20 MHz Bandwidth) or 112 1 (40 MHz Bandwidth) or 112 4 (80 MHz Bandwidth)



Now the parameters for Channel, Power level and modulation group has to be done:
22 1 14 0

For 802.11b the Power level is always 14 and the modulation group is 0
For 802.11g the Power level is always 11 and the modulation group is 1
For 802.11n (2,4GHz) the Power level is always 11 and the modulation group is 1
For 802.11n (5GHz) the Power level is always 10 and the modulation group is 1
For 802.11a the Power level is always 10 and the modulation group is 1
For 802.11ac the Power level is always 6 and the modulation group is 1

If a continuous burst is required use instead of the command 25 the command 17:

17 1 4

```
Enter option: 17 1 4
 DutIf_SetTxDataRate: 0x00000000
        TRPC ID: 2
 DutIf_SetTxContMode: 0x00000000
Enter option:
```

11b	
ID	DataRate
1	1M
2	2M
3	5.5M
4	11M

11g/a	
ID	DataRate
6	6M
7	9M
8	12M
9	18M
10	24M
11	36M
12	48M
13	54M

11n	
ID	DataRate
15	MCS0
16	MCS1
17	MCS2
18	MCS3
19	MCS4
20	MCS5
21	MCS6
22	MCS7

11ac	
ID	DataRate
101	VHT_SS1_MCS0
102	VHT_SS1_MCS1
103	VHT_SS1_MCS2
104	VHT_SS1_MCS3
105	VHT_SS1_MCS4
106	VHT_SS1_MCS5
107	VHT_SS1_MCS6
108	VHT_SS1_MCS7
109	VHT_SS1_MCS8
110	VHT_SS1_MCS9

In order to stop the TX:

17 0

```
Enter option: 17 0
 DutIf_SetTxContMode: 0x00000000
Enter option:
```

3.8. Worst case identification

The following WLAN modes were selected for testing after performing the maximum transmitted power tests.

WLAN Mode	Data Rate
802.11b	1 Mbit
802.11g	12 Mbit
802.11n, 20 MHz bandwidth	MCS0
802.11n, 40 MHz bandwidth	MCS7

Remarks: To see the results please refer to chapter 1.1 of the Annex report TR_18_1_0248301T07_A1

4. Description of test system set-up's

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

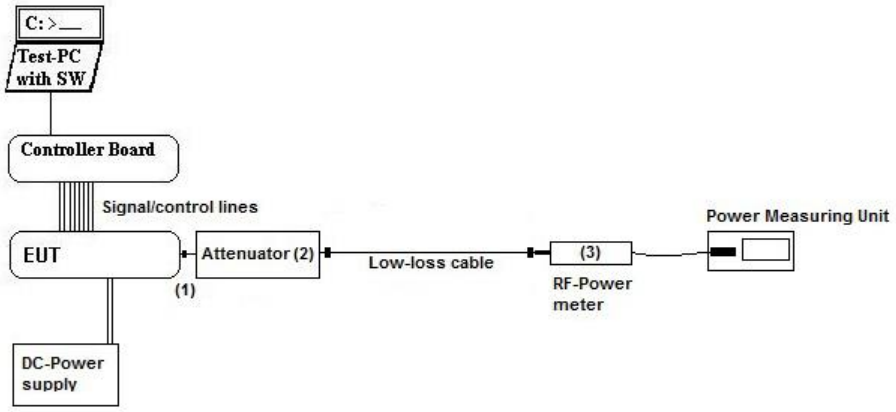
Conducted Set-up W1

W-LAN 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 558074 D01 DTS Meas.Guidance v05r02

Used Equipment

Passive Elements	Test Equipment	Remark:
☒ 20 dB Attenuator ☒ Low loss RF-cables	☒ Power Meter ☒ DC-Power Supply ☒ Spectrum-Analyzer	See List of equipment under each test case and chapter 8 for calibration info

Measurement uncertainty See chapter 5.10

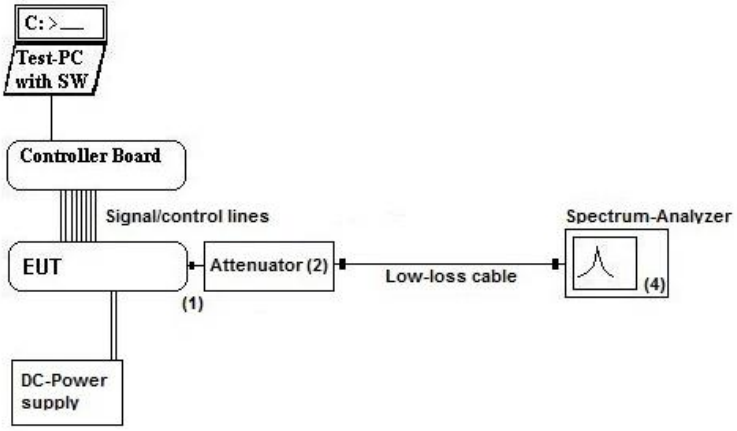
Conducted Set-up W2

W-LAN 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 558074 D01 DTS Meas. Guidance v05r02

Used Equipment

Passive Elements	Test Equipment	Remark:
☒ 20 dB Attenuator ☒ Low loss RF-cables	☒ Power Meter ☒ DC-Power Supply ☒ Spectrum-Analyzer	See List of equipment under each test case and chapter 8 for calibration info

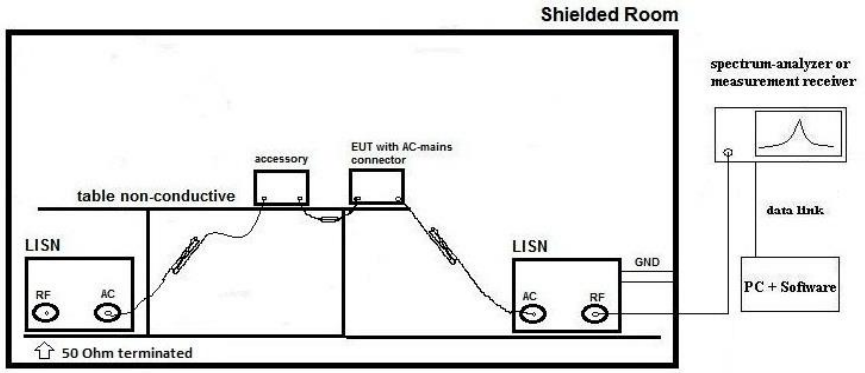
Measurement uncertainty See chapter 5.10

4.2. Test system set-up for AC power-line conducted emission measurements

Specification: ANSI C63.4-2009 chapter 7, ANSI C63.10-2013 chapter 6.2

General Description: The radio frequency voltage conducted back into the AC power line in the frequency range 150 kHz to 30 MHz has to be investigated. Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50 Ohm / 50 µH line impedance stabilization network (LISN) is used coupling the interface to the measurement equipment. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the ground plane. The measuring instrument is connected to the coaxial output of the LISN.
Tabletop devices were set-up on a 80 cm height above reference ground plane, floor standing equipment 10 cm raised above ground plane. Measurements have been performed on each phase line and neutral line of the devices AC-power lines. The EUT was power supplied with 120 V/60 Hz. The EUT was tested in the defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

Schematic:



Only schematic view, we refer to figure 6, 7 and 8 of ANSI C63.4-2009 for more details.

Testing method: **Exploratory, preliminary measurements** as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical operating mode of the equipment. A complete frequency-sweep with PK-Detector is performed on each current-carrying conductor.

Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3 dB) as a second step includes measurements with receivers detector set to Quasi-Peak and Average.

Formula:

$V_C = V_R + C_L$ (1)
$M = L_T - V_C$ (2)

V_C = measured Voltage –corrected value
V_R = Receiver reading
C_L = Cable loss
M = Margin
L_T = Limit

Values are in dB, positive margin means value is below limit.

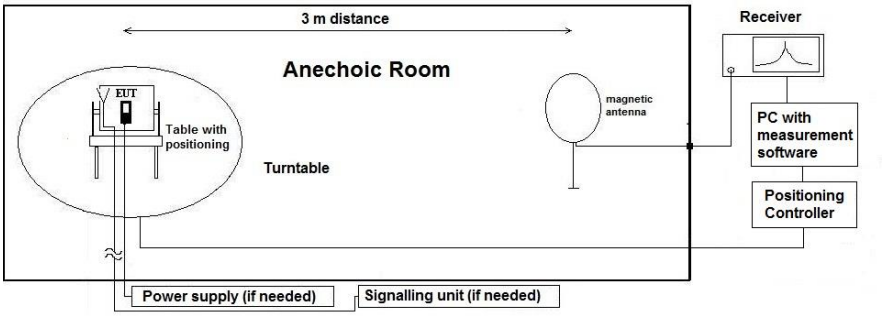
4.3. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: 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 it's 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.

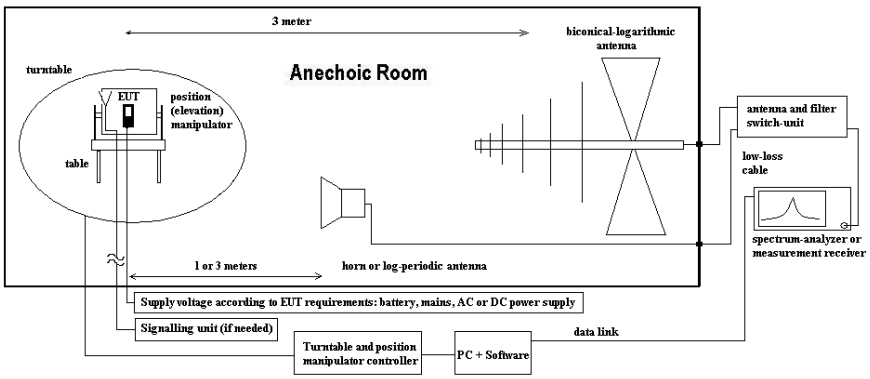
Distance correction: Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

4.4. 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 it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, 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:

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

$M = L_T - E_C$ (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

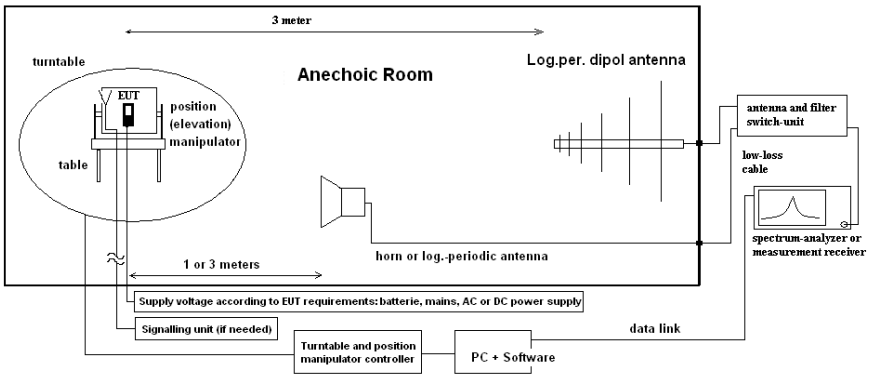
All units are dB-units, positive margin means value is below limit.

4.5. 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 18-1-4:2010 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 it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical 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:

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

$M = L_T - E_C$ (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. Measurement results

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	☒ TS 8997
equipment	☐ 331 HC 4055	☐	☐	☐	☐	☐
spectr. analys.	☒ 683 FSU26	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
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	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz				☒ 13.5 V DC	
otherwise	☐ 530 Attenuator 10 dB	☒ K4 Cable				

The necessary duty-cycle correction factor is determined on nominal conditions on one channel in each operable frequency-band. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions. The Duty-Cycle was constant, means without variations.

WLAN-Modes	Marker 1 [BTS ON']	Marker 2 [BTS ON']	TX on	TX off	Converted to DC	10log(1/DC)
	ms	ms	ms	ms		
b-Mode						
1MBit	493.587440	495.833333	493.58744	2.24589	0.99547	0.01972
11MBit	552.179487	554.166667	552.17949	1.98718	0.99641	0.01560
g-Mode						
6MBit	667.467949	671.089744	667.46795	3.62180	0.9946	0.0235
12MBit	273.717949	277.083333	273.71795	3.36538	0.9879	0.0531
n-Mode						
MCS0	392.628205	393.750000	392.62821	1.12180	0.9972	0.0124
MCS7	384.775641	388.141026	384.77564	3.36539	0.9913	0.0378

5.1.2. Results

Duty cycle calculations: $x = {TX_{ON}}/{(TX_{ON} + TX_{OFF})}$	Duty cycle factor: DC=	Regarding power: $10 * log({1}/{x})$ dB
		Regarding field strength: $20 * log({1}/{x})$ dB

☐ 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 – 6 dB and 99% Occupied Bandwidth

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.	☒ 683 FSU	☐ 120 FSEM	☐ 264 FSEK	☐ 714 FSW 67	☐	☐
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	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.2.2. Requirements:

FCC	☒ §15.247(a)(2), RSS-247, Chapter 5.2(1)
ISED	☒ RSS-Gen, Issue5 , Chapter 6.7
Remark	The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

5.2.3. EUT settings

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

5.2.4. Measurement method

The measurement was performed with the RBW set to 30kHz. The span was set to cover the complete carrier. Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. A 99% OBW measurement function was used to measure the bandwidth compared 99% of the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). The hopping-mode is switched off.

5.2.5. Spectrum-Analyzer Settings

Span	Set as to fully display the emissions and approximate 20dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx. 1% …3% of the emission width
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector)
Sweep mode	Repetitive Mode, Max hold

5.2.6. 6 dB Occupied Bandwidth Results:

6 dB Occupied Bandwidth Measurements				
Temperature :+21° C		**Voltage Supply 13.5V DC**	**Setup: 2**	**Op. Mode: 1**
Mode	**Frequency**	**6 dB Emission Bandwidth Measurements**	**Plot No.**	
	[MHz]	**[MHz]**		
b-mode (1Mbps)	2412	10.150	Remark 1	
	2437	10.150		
	2462	10.200		
g-mode (12Mbps)	2412	16.500		
	2437	16.500		
	2462	16.500		
n-mode_HT20 (MCS0)	2412	17.400		
	2437	17.600		
	2462	17.200		
n-mode_HT40 (MCS7)	2422	36.100		
	2452	35.550		
Remark: For further details please refer → Annex 1: Test results - **CETECOM_TR18_1_0248301T07a_A1**				

5.2.7. 6 dB Occupied Bandwidth Verdict: For Information only

5.2.8. 99% Occupied Bandwidth Results:

99% Occupied Bandwidth Measurements			
Temperature :+21 ° C	**Voltage Supply 13.5V DC**	**Setup: 2**	**Op. Mode: 1**

Mode	Frequency	99% Emission Bandwidth Measurements	Plot No.
	[MHz]	[MHz]	
b-mode (1Mbps)	2412	13.400	Remark 1
	2437	13.400	
	2462	13.300	
g-mode (12Mbps)	2412	16.500	
	2437	16.600	
	2462	16.600	
n-mode_HT20 (MCS0)	2412	17.600	
	2437	17.700	
	2462	17.700	
n-mode_HT40 (MCS7)	2422	36.410	
	2452	36.410	

Remark: For further details please refer → Annex 1: Test results - **CETECOM_TR18_1_0248301T07a_A1**

5.2.9. 99% Occupied Bandwidth Verdict: For Information only

5.3. General Limit – Maximum output power conducted

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.	☐ 584 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	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.3.2. Reference

FCC	☒ §15.247(b) (3) + KDB 558074 D01 15.247 DTS Meas Guidance v05r02 Chapter 8.3.2.3
ISED	☒ RSS-247 Issue 2, Chapter 5.4(4)
ANSI	☒ ANSI 63.10:2013 Chapter 11.9.2.3.2
Specification	*For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.*

5.3.3. EUT settings:

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

5.3.4. Test condition and measurement test set-up

Signal ink 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)%
General measurement procedures	Please see chapter “Test system set-up for conducted RF-measurement at antenna Port” (W1 Set-up)		

5.3.5. Measurement method and analyzer settings:

The measurement was performed in non-hopping transmission mode with the carrier set to lowest/middle and highest channel.

MEASUREMENT METHOD/ SPECTRUM-ANALYZER SETTINGS:

Measurement Method [1.)]	§15.247(b) (3) Maximum Peak	1.) ☐ PK1-Method RBW > 6 dB-bandwidth of the signal, ANSI 63.10: 2013, chapter 2.) ☐ PK2-Method (§5.2.1.2): Channel integration method (ANSI 63.10:2013) 3.) ☐ PK1-Method (§9.1.2 KDB): Peak Power Meter Method
	§15.247(b) (3) Maximum Average	4.) ☐ AVG1 - power averaging over EBW + integrated band power measurement 5.) ☐ AVG2 - trace averaging over EBW + integrated band power measurement 6.) ☒ RMS power meter method: ANSI 63.10:2013 Chapter 11.9.2.3.2 AVGPM-G
	MIMO	7.) ☐ Method as described in Chapter 3.8 was used for measurements on two available RF-Antenna ports.
Center Frequency		Nominal channel frequency
Span		30% higher than the EBW measured before
Resolution Bandwidth (RBW)		20 MHz
Video Bandwidth (VBW)		30 MHz
Sweep time		coupled
Detector		Peak, Max hold mode for method PK1/PK2 or RMS and trace average for method AVG1/AVG2
Sweep Mode		Repetitive mode, allow trace to stabilize
Analyzer-Mode		☐ normal ☐ activated channel integration method with limits set to the EBW of the signal

Remark 1: KDB 558074 D01 15.247 DTS Meas Guidance v05r02

5.3.6. RESULTS

APLICANT'S DECLARED ANTENNA CHARACTERISTICS:

☒ Directional Gain < 6 dBi (measured: difference between measured conducted and radiated eirp. power)
☐ Directional Gain > 6 dBi (measured / applicant's declaration) -> conducted power reduction necessary

Maximum measured antenna gain [isotropic]: **3.2 dBi**
Remark: See test report TR18_1_0248301T11a

Different modulation types and data rates were tested in order to find the maximum peak conducted output power. **Enclosed are only the maximum values for each modulation format**, pls. compare separate document A1 for all results.

Max. conducted output [dBm]				**Limit [dBm]**	**Result**
Set-up no.: 2 Op-Mode: 1	**Channel = 1 (2412 MHz)**	**Channel = 6 (2427 MHz)**	**Channel = 11 (2462 MHz)**		
b mode	**10.84 (1 Mbit/s)**	10.15 (1 Mbit/s)	10.77 (2 Mbit/s)	30	passed
g mode	**8.47 (12 Mbit/s)**	7.57 (9 Mbit/s)	**8.47 (54 Mbit/s)**	30	passed
n mode-20 MHz	8.34 (MSC7)	7.37 (MSC2)	**8.47 (MSC0)**	30	passed
	Channel = 3 (24122 MHz)	**Channel = 6 (2427 MHz)**	**Channel = 9 (2452 MHz)**	**Limit [dBm]**	**Result**
n mode-40 MHz	**8.12** (MSC7)	7.83 (MSC0)	7.92 (MSC1)	30	passed

Remark: For further details please refer → Annex 1: Test results - **CETECOM_TR18_1_0248301T07a_A1**

5.4. RF-Parameter - Power Spectral Density

5.4.1. 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.		☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐ 489 ESU 40	☒ 683 FSU26	☐
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	☐ 456 EA 3013A	☒ 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		
	☐ 513 20dB Attenuator		☐ K 4 Cable kit			
line voltage	☐ 230 V 50 Hz via public mains		☒ 13.5V DC			

5.4.2. REFERENCES: §15.247(e), RSS-247, Issue 2: Chapter 5.2(b)

(e) *For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.*

5.4.3. TEST CONDITION AND MEASUREMENT TEST SET-UP

Signal ink 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)%
General measurement procedures	Please see chapter “Test system set-up for conducted RF-measurement at antenna Port” (W2 Set-up)		

5.4.4. EUT SETTINGS:

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

5.4.5. MEASUREMENT METHOD/ SPECTRUM-ANALYZER SETTINGS

Measurement Method	☐ ANSI 63.10:2013	☐ PKPSD-Method ☒ AVGPSD Method
	☒ guidance 558074 D01 measurement DTS guidance v05r02	
Center Frequency	Nominal channel frequency	
Span	5..30% higher than the EBW measured before	
Resolution Bandwidth (RBW)	> 100 kHz (at least 3 times RBW) - pls. see diagram	
Video Bandwidth (VBW)	> 300 kHz - pls. see diagram	
Sweep time	coupled	
Detector	Peak, Max hold mode for method PKPSD or RMS method AVGPSD	
Sweep Mode	Repetitive mode, allow trace to stabilize (PKPSD) or single (AVGPSD)	
Addition of correction factors	external measuring set-up path-loss	

Remarks:--

5.4.6. RESULTS

Set-up no.: 2 Op. Mode: 1		**POWER SPECTRAL DENSITY** [dBm/3 kHz]		
T_{NOM} =21°C V_{NOM}		Low channel = 1 (2412 MHz)	Middle channel = 6 (2437 MHz)	High channel = 11 (2462 MHz)
Measured Level	20 MHz Bandwidth			
	b-mode (1 Mbps)	**-7.099**	-8.001	-7.685
	g-mode (12 Mbps)	**-15.206**	-15.725	-15.526
	n-mode (HT20) (MCS0)	**-13.635**	-14.848	-13.945
Limit	< 8dBm/3 kHz			

Set-up no.: 2 Op. Mode: 1		**POWER SPECTRAL DENSITY** [dBm/3 kHz]		
T_{NOM} =21°C V_{NOM}		Low channel = 3 (2422 MHz	---	High channel = 9 (2452 MHz)
Measured Level	40 MHz Bandwidth			
	n-mode (HT40) (MCS7)	**-10.190**	-11.077	-11.810
Limit	< 8dBm/3 kHz			

Remark: see diagrams for details on frequency in separate annex A: Test Results **TR18_1_0248301T07a_A1**

5.4.7. VERDICT: PASSED

5.5. RF-Parameter – Out-of-Band 20 dBc Conducted Emissions

5.5.1.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	☒ 683 FSU 26	☐ 714 FSW67	☐	☐
spectr. analys.	☐ 489 ESU	☐ 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	☒ 530 10dB Attenuator	☒ RTK161	☐ Directional Coupler 1539R-10			
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.5.2. Requirements:

FCC	☒ §15.247 (d)
ISED	☒ RSS-247. Issue 2. Chapter 5.5
Remark	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating. the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. based on either an RF conducted or a radiated measurement. provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval. as permitted under FCC15.247 paragraph (b)(3) / RSS-247section 5.4(d). the attenuation required shall be 30 dB instead of 20 dB

5.5.3. EUT settings

Fixed Channel Mode:
For FHSS-systems Hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

Hopping Mode:
For FHSS-systems Hopping mode was switched- ON so emissions from hopping channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

5.5.4. Measurement Method:

The measurements were performed with the RBW set to 100kHz & maximum carrier level was indicated with MAX-Hold positive peak detector using markers. Then a frequency line was set 20 dB below this measured maximum carrier level.

Then using RBW 100 kHz & spectrum analyzer span from 150 kHz to 25 GHz in three steps spurious emissions were measured with MAX-Hold positive peak detector.

The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

5.5.5. TABLE OF MEASUREMENT RESULTS:

5.5.5.1. 20 MHz BW

Set-up no.: 1 Op-Mode: 1	**RF-Conducted test: 30 dBc spurious emissions**					
Frequency Range	Low channel =1 (2412 MHz) b-mode 1 Mbit Level Reference (In-Band)= 3.48 dBm Limit= -26.52 dBm		Middle channel = 6 (2437 MHz) g-mode 12 Mbit Level Reference (In-Band) = -3.13 dBm Limit= -33.13 dBm		High channel = 11 (2462MHz) n-mode MCS0 Level Reference (In-Band)= -7.63 dBm Limit= -37.63 dBm	
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]
150kHz to 30 MHz	*1)	>-40	*1)	>-40	*1)	>-40
30 MHz to 2.8 GHz	*1)	>-40	*1)	>-40	*1)	>-40
2.8 to 25 GHz	*1)	>-38	*1)	>-40	*1)	>-40
Band-Edge	--	>-40	--	>-40	--	>-40

Remark: For further details please refer → Annex 1: Test results - **CETECOM_TR18_1_0248301T07a_A1**
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel, however here the 30dBc limit applies due to reported power values. All spurious level are found to be 30dBc under reference level.
*1) only noise, no remarkable peak found

5.5.5.2. 40 MHz BW

Set-up no.: 1 Op-Mode: 1	**RF-Conducted test: 30 dBc spurious emissions**					
Frequency Range	Low channel =3 (2412 MHz) n-mode MCS7 Level Reference (In-Band)= -8.15 dBm Limit= -38.15 dBm		High channel = 9 (2437 MHz) n-mode MCS7 Level Reference (In-Band) = -9.91 dBm Limit= -39.91 dBm			
	Frequency [MHz]	Value [dBc]	Frequency [MHz]	Value [dBc]		
150kHz to 30 MHz	*1)	>-40	*1)	>-40		
30 MHz to 2.8 GHz	*1)	>-40	*1)	>-40		
2.8 to 25 GHz	*1)	>-40	*1)	>-40		
Band-Edge	--	>-40	--	>-40		

Remark: For further details please refer → Annex 1: Test results - **CETECOM_TR18_1_0248301T07a_A1**
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel, however here the 30dBc limit applies due to reported power values. All spurious level are found to be 30dBc under reference level.
*1) only noise, no remarkable peak found

5.5.6. TEST RESULT: PASS

5.6. RF-Parameter – Frequency Stability

5.6.1.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.	☐ 683 FSU	☐ 120 FSEM	☐ 264 FSEK	☐ 714 FSW 67	☐	☐
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 354 NGPE 40
attenuator	☒ 613 20 dB Attenuator	☐ 248 6 dB Attenuator	☐ 529 Power divider	☐ - cable OTA20	☐ 530 10dB Atten	☐ K5 Cable
otherwise	☒ 331 HC4055	☒ 405 OPUS10	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 477 GPS	
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.6.2. Requirements:

ISED	☒ RSS-Gen, Issue5 , Chapter 6.11
Remark	Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

5.6.3. EUT settings

For FHSS-systems hopping mode was switched-off so fixed two different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

5.6.4. Measurement method

1. The First Measurement was done at Normal Temperature +20° C and ±15% of the supply voltage.
2. The Second Measurement was done at 3 different Temperatures -20° C (-4° F), +20° C (+68° F) and +50° C (+122° F), and the nominal supply Voltage
3. Also the 99% emission 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.

5.6.5. Spectrum-Analyzer Settings

Span	Set as to fully display the emissions and approximate 20dB below the PEAK level
Resolution Bandwidth (RBW)	Set to approx. 1% …3% of the emission width
Video Bandwidth (VBW)	3 times the resolution bandwidth
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector)
Sweep mode	Repetitive Mode, Max hold

5.6.6. Tmin – Vnom

Modulation	Channel	99% OBW	Tnom - Vnom		Vnom -Tmin	
			left Bandedge	right Bandedge	left Bandedge	right Bandedge
	MHz	MHz	MHz	MHz	MHz	MHz
b-mode 1 Mbit	2412	13.40000	2405.2000	2418.6000	2405.1000	2418.7000
	2437	13.40000	2430.2000	2443.6000	2430.2000	2443.7000
	2462	13.30000	2455.3000	2468.6000	2455.3000	2468.7000
g-mode 12 Mbit	2412	16.60000	2403.7000	2420.3000	2403.7000	2420.3000
	2437	16.60000	2428.7000	2445.3000	2428.7000	2445.3000
	2462	16.60000	2453.7000	2470.3000	2453.7000	2470.3000
n-mode HT20 MCS0	2412	17.60000	2403.2000	2420.8000	2403.2000	2420.8000
	2437	17.70000	2428.1000	2445.8000	2428.2000	2445.8000
	2462	17.70000	2453.1000	2470.8000	2453.2000	2470.9000
n-mode HT40 MCS7	2422	36.41026	2403.7949	2440.2051	2403.7949	2440.2051
	2452	36.41026	2433.7949	2470.2051	2403.7949	2440.2051

5.6.7. Tmax – Vnom

Modulation	Channel	99% OBW	Tnom - Vnom		Vnom -Tmax	
			left Bandedge	right Bandedge	left Bandedge	right Bandedge
	MHz	MHz	MHz	MHz	MHz	MHz
b-mode 1 Mbit	2412	13.40000	2405.2000	2418.6000	2405.1000	2418.7000
	2437	13.40000	2430.2000	2443.6000	2430.2000	2443.6000
	2462	13.30000	2455.3000	2468.6000	2455.2000	2468.6000
g-mode 12 Mbit	2412	16.60000	2403.7000	2420.3000	2403.7000	2420.3000
	2437	16.60000	2428.7000	2445.3000	2428.7000	2445.3000
	2462	16.60000	2453.7000	2470.3000	2453.6000	2470.3000
n-mode HT20 MCS0	2412	17.60000	2403.2000	2420.8000	2403.2000	2420.8000
	2437	17.70000	2428.1000	2445.8000	2428.1000	2445.8000
	2462	17.70000	2453.1000	2470.8000	2453.1000	2470.8000
n-mode HT40 MCS7	2422	36.41026	2403.7949	2440.2051	2403.7949	2440.2051
	2452	36.41026	2433.7949	2470.2051	2433.7949	2470.2051

5.6.8. Tnom – Vmin

Modulation	Channel	99% OBW	Tnom - Vnom		Vmin -Tnom	
			left Bandedge	right Bandedge	left Bandedge	right Bandedge
	MHz	MHz	MHz	MHz	MHz	MHz
b-mode 1 Mbit	2412	13.40000	2405.2000	2418.6000	2405.2000	2418.8000
	2437	13.40000	2430.2000	2443.6000	2430.2000	2443.6000
	2462	13.30000	2455.3000	2468.6000	2455.2000	2468.6000
g-mode 12 Mbit	2412	16.60000	2403.7000	2420.3000	2403.7000	2420.3000
	2437	16.60000	2428.7000	2445.3000	2428.7000	2445.3000
	2462	16.60000	2453.7000	2470.3000	2453.7000	2470.3000
n-mode HT20 MCS0	2412	17.60000	2403.2000	2420.8000	2403.2000	2420.8000
	2437	17.70000	2428.1000	2445.8000	2428.1000	2445.8000
	2462	17.70000	2453.1000	2470.8000	2453.1000	2470.8000
n-mode HT40 MCS7	2422	36.41026	2403.7949	2440.2051	2403.7949	2440.2051
	2452	36.41026	2433.7949	2470.2051	2433.7949	2470.2051

5.6.9. Tnom – Vmax

Modulation	Channel	99% OBW	Tnom - Vnom		Vmax -Tnom	
			left Bandedge	right Bandedge	feft Bandedge	right Bandedge
	MHz	MHz	MHz	MHz	MHz	MHz
b-mode 1 Mbit	2412	13.40000	2405.2000	2418.6000	2405.2000	2418.7000
	2437	13.40000	2430.2000	2443.6000	2430.2000	2443.6000
	2462	13.30000	2455.3000	2468.6000	2455.2000	2468.6000
g-mode 12 Mbit	2412	16.60000	2403.7000	2420.3000	2403.7000	2420.3000
	2437	16.60000	2428.7000	2445.3000	2428.7000	2445.3000
	2462	16.60000	2453.7000	2470.3000	2453.6000	2470.3000
n-mode HT20 MCS0	2412	17.60000	2403.2000	2420.8000	2403.2000	2420.8000
	2437	17.70000	2428.1000	2445.8000	2428.1000	2445.8000
	2462	17.70000	2453.1000	2470.8000	2453.1000	2470.8000
n-mode HT40 MCS7	2422	36.41026	2403.7949	2440.2051	2403.7949	2440.2051
	2452	36.41026	2433.7949	2470.2051	2433.7949	2470.2051

5.6.10. Frequency Stability Verdict: pass

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

5.7.1. 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	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU	☐ 594 CMW		
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☐ 671 EA-3013S	☒ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.7.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
ISED	RSS-Gen, Issue 5: §8.9 Table 5			
ANSI	C63.10-2013			
Frequency [MHz]	Field strength limit [µV/m]	[dBµV/m]	Distance [m]	Remarks
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

5.7.3. 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 Detector Mode: Sweep-Time	☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyzer Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) 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"		

5.7.4. 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:

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
2.01a	Low	1	9 kHz - 30 MHz	1	1	b-Mode-1Mbps-CH01-Laying	☒	☐	☒	Pass
2.01b	Low	1	9 kHz - 30 MHz	1	1	b-Mode-1Mbps-CH01-Standing	☒	☐	☒	Pass

Remark 1: See diagrams in separate annex TR18_1_0248301T07a_A1

5.7.5. 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 0.625xLambda. 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	fullfilled	not fullfilled	-80,00
	1,00E+04	30000,00	4774,65		fullfilled	not fullfilled	-80,00
	2,00E+04	15000,00	2387,33		fullfilled	not fullfilled	-80,00
	3,00E+04	10000,00	1591,55		fullfilled	not fullfilled	-80,00
	4,00E+04	7500,00	1193,66		fullfilled	not fullfilled	-80,00
	5,00E+04	6000,00	954,93		fullfilled	not fullfilled	-80,00
	6,00E+04	5000,00	795,78		fullfilled	not fullfilled	-80,00
	7,00E+04	4285,71	682,09		fullfilled	not fullfilled	-80,00
	8,00E+04	3750,00	596,83		fullfilled	not fullfilled	-80,00
	9,00E+04	3333,33	530,52		fullfilled	not fullfilled	-80,00
	1,00E+05	3000,00	477,47		fullfilled	not fullfilled	-80,00
	1,25E+05	2400,00	381,97		fullfilled	not fullfilled	-80,00
	2,00E+05	1500,00	238,73		fullfilled	fullfilled	-78,02
	3,00E+05	1000,00	159,16		fullfilled	fullfilled	-74,49
	4,00E+05	750,00	119,37		fullfilled	fullfilled	-72,00
	4,90E+05	612,24	97,44		fullfilled	fullfilled	-70,23
	5,00E+05	600,00	95,49	30	fullfilled	not fullfilled	-40,00
	6,00E+05	500,00	79,58		fullfilled	not fullfilled	-40,00
	7,00E+05	428,57	68,21		fullfilled	not fullfilled	-40,00
	8,00E+05	375,00	59,68		fullfilled	not fullfilled	-40,00
	9,00E+05	333,33	53,05		fullfilled	not fullfilled	-40,00
MHz	1,00	300,00	47,75		fullfilled	not fullfilled	-40,00
	1,59	188,50	30,00		fullfilled	not fullfilled	-40,00
	2,00	150,00	23,87		fullfilled	fullfilled	-38,02
	3,00	100,00	15,92		fullfilled	fullfilled	-34,49
	4,00	75,00	11,94		fullfilled	fullfilled	-32,00
	5,00	60,00	9,55		fullfilled	fullfilled	-30,06
	6,00	50,00	7,96		fullfilled	fullfilled	-28,47
	7,00	42,86	6,82		fullfilled	fullfilled	-27,13
	8,00	37,50	5,97		fullfilled	fullfilled	-25,97
	9,00	33,33	5,31		fullfilled	fullfilled	-24,95
	10,00	30,00	4,77		fullfilled	fullfilled	-24,04
	10,60	28,30	4,50		fullfilled	fullfilled	-23,53
	11,00	27,27	4,34		fullfilled	fullfilled	-23,21
	12,00	25,00	3,98		fullfilled	fullfilled	-22,45
	13,56	22,12	3,52		fullfilled	fullfilled	-21,39
	15,00	20,00	3,18		fullfilled	fullfilled	-20,51
	15,92	18,85	3,00		fullfilled	fullfilled	-20,00
	17,00	17,65	2,81		not fullfilled	fullfilled	-20,00
	18,00	16,67	2,65		not fullfilled	fullfilled	-20,00
	20,00	15,00	2,39		not fullfilled	fullfilled	-20,00
	21,00	14,29	2,27		not fullfilled	fullfilled	-20,00
	23,00	13,04	2,08		not fullfilled	fullfilled	-20,00
	25,00	12,00	1,91		not fullfilled	fullfilled	-20,00
	27,00	11,11	1,77		not fullfilled	fullfilled	-20,00
	29,00	10,34	1,65		not fullfilled	fullfilled	-20,00
	30,00	10,00	1,59		not fullfilled	fullfilled	-20,00

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

5.8.1. 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
signaling	☐ 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
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz		☒ 13.5 V DC			

5.8.2. Requirements/Limits

FCC		☐ Part 15 Subpart B, §15.109, class B ☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205	
ISED (IC)		☒ RSS-Gen., Issue 5, Chapter 8.9, Table 4+6 (licence-exempt radio apparatus) ☐ RSS-Gen., Issue 5, Chapter 7.1.2, Table 2 (receiver) ☐ ICES-003, Issue 6, Table 5 (Class B) ☒ RSS-247, Issue 2, Chapter 5.5 ☐ RSS-247, Issue 2, Chapter 6.2	
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

5.8.3. Restricted bands of operation (FCC §15.205/ RSS-Gen, Issue 5 Chapter 8.10, Table 6)

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			

5.8.4. 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 analyzer mode		
	Detector	Peak / Quasi-peak		
	RBW/VBW	100 kHz/300 kHz		
	Mode:	Repetitive-Scan, max-hold		
	Scan step	80 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"		

5.8.5. MEASUREMENT RESULTS

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

Table of measurement results:

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
3.01a	Low	1	30 MHz – 1 GHz	1	1	b-Mode-1Mbps-CH01-Laying	☒	☐	☒	Pass
3.01b	Low	1	30 MHz – 1 GHz	1	1	b-Mode-1Mbps-CH01-Standing	☒	☐	☒	Pass
3.02a	Mid	6	30 MHz – 1 GHz	1	1	g-mode-18Mbps-CH06-Laying	☒	☐	☒	Pass
3.02b	Mid	6	30 MHz – 1 GHz	1	1	g-mode-18Mbps-CH06-Standing	☒	☐	☒	Pass
3.03a	High	11	30 MHz – 1 GHz	1	1	n20-mode-MCS0-CH11- Laying	☒	☐	☒	Pass
3.03b	High	11	30 MHz – 1 GHz	1	1	n20-mode-MCS0-CH11-Standing	☒	☐	☒	Pass
3.04a	High	9	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH09-Laying	☒	☐	☒	Pass
3.04b	High	9	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH09- Standing	☒	☐	☒	Pass
3.05a	Low	3	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH03-Laying	☒	☐	☒	Pass
3.05b	Low	3	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH03- Standing	☒	☐	☒	Pass
3.06a	High	9	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH09-Laying	☒	☐	☒	Pass
3.06b	High	9	30 MHz – 1 GHz	1	1	n40-mode-MCS7-CH09-Standing	☒	☐	☒	Pass

Remark 1: See diagrams in separate annex TR18_1_0248301T07a_A1

5.9. General Limit - Radiated emissions, above 1 GHz

5.9.1. 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	☐	☐	☐	☐	☐
signaling	☐392 MT8820A	☐371 CBT32	☐547 CMU	☐594 CMW		
DCpower	☐086 LNG50-10	☒087 EA3013	☐354 NGPE 40	☐349 car battery	☐350 Car battery	☐
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz			☒ 13.5 V DC		

5.9.2. 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)			
ISED	☒ RSS-Gen., Issue 5, Chapter 8.9, Table 4+6 (transmitter licence excempt) ☐ RSS-Gen., Issue 5, Chapter 7.3, Table 3 (receiver) ☐ ICES-003, Issue 6, Chapter 6.2.2, Table 7 (class B) ☒ RSS-247, Issue 2, Chapter 5.5 ☐ RSS-247, Issue 2, Chapter 6.2			
ANSI	☐ C63.4-2014 ☒ C63.10-2013			
Frequency [MHz]	Limits			
	AV [µV/m]	AV [dBµV/m]	Peak [µV/m]	Peak [dBµV/m]
above 1 GHz for frequencies as defined in §15.205 or RSS-Gen., Issue 9, §8.9 - Table 5	500	54.0	5000	74.0

5.9.3. 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:		
	Scan-Mode	☒ 6 dB EMI-Receiver Mode ☐ 3 dB Spectrum analyzer 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"		

5.9.4. Measurement Results

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

5.9.4.1. Measurement Results 1GHz to 18GHz

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
4.01a	Low	1	1 GHz – 18 GHz	1	1	b-Mode-1Mbps-CH01	☒	☒	☐	Pass
4.02a	Mid	6	1 GHz – 18 GHz	1	1	g-mode-12 Mbit-CH06	☒	☒	☐	Pass
4.03a	High	11	1 GHz – 18 GHz	1	1	n20-mode-MCS0-CH11	☒	☒	☐	Pass
4.04a	Low	3	1 GHz – 18 GHz	1	1	n40-mode-MCS7-CH03	☒	☒	☐	Pass
4.05a	High	9	1 GHz – 18 GHz	1	1	n40-mode-MCS7-CH09	☒	☒	☐	Pass

Remark 1: See diagrams in separate annex TR18_1_0248301T07a_A1

5.9.4.2. Measurement Results 18GHz to 26.5GHz

Dia-gram no.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
4.01b	Low	1	18 GHz – 26.5 GHz	1	1	b-Mode-1Mbps-CH01	☒	☒	☐	Pass
4.02b	Mid	6	18 GHz – 26.5 GHz	1	1	g-mode-12 Mbit-CH06	☒	☒	☐	Pass
4.03b	High	11	18 GHz – 26.5 GHz	1	1	n20-mode-MCS0-CH11	☒	☒	☐	Pass
4.04b	Low	3	18 GHz – 26.5 GHz	1	1	n40-mode-MCS7-CH03	☒	☒	☐	Pass
4.05b	High	9	18 GHz – 26.5 GHz	1	1	n40-mode-MCS7-CH09	☒	☒	☐	Pass

Remark 1: See diagrams in separate annex TR18_1_0248301T07a_A1

5.10. RF-Parameter - Band Edge compliance measurements

5.10.1. 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	☐
Supply Voltage	☐ 016 Line Impedance Simulating Network: 120 V AC 60Hz			☒ 13.5 V DC		

5.10.2. Requirements/Limits

FCC	☐ Part 15 Subpart B, §15.109 class B ☒ Part 15 subpart C, §15.209 @ frequencies defined in §15.205
ISED	☐ RSS-210, Issue 8, Annex 8 ☒ RSS-247, Issue 1, Chapter 5.5 ☒ RSS-Gen: Issue 5: §8.9, Table 4+6
ANSI	☐ C63.4-2009 ☐ C63.4-2014 ☐ C63.10-2009 ☒ C63.10-2013, Chapter 6.10.6

5.10.3. Test condition and measurement test set-up

Signal ink 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 analyzer 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.		

5.10.4. 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.

5.10.5. EUT settings

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

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

5.10.6.1. Non-restricted bands near-by - limits according FCC §15.407 and RSS-247, Issue 1, Chapter 5.5

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						
9.01a	1	no	97.37	89.79	56.12	41.26	20	21.26	PASS	b-mode, PWR-Level 14 dBm used
9.02a	1	no	91.00	83.26	55.90	35.10	20	15.10	PASS	g-mode, PWR-Level 11 dBm used
9.03a	1	no	89.86	83.62	56.40	33.47	20	13.47	PASS	n20-mode, PWR-Level 11 dBm used
9.04a	3	no	86.53	79.90	55.53	31.01	20	11.01	PASS	n40-mode, PWR-Level 11 dBm used

Remark : The EUT complies to the band edge requirement under provision that the power level is adjusted to those listed in the table above.

5.10.7. Restricted bands near-by
(§15.205 with limits accord. FCC §15.209) and (RSS-Gen, Issue4, Chapter 8.10)

Diagramm no.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Value at Band-Edge [dBuV/m]		Limits [dBuV/m]		Duty-Cycle Correction for AV-detector	Margin [dB]		Verdict	Remark:
			Peak-Value	Average-Value	Peak -Value	Average -Value	Peak -Value	Average -Value	[dB]	Peak	Average		
9.01b	11	yes	99.25	96.58	57.92	46.80	74	54	0	16.08	7.20	PASS	b-mode, PWR-Level 14 dBm used
9.02b	11	yes	99.29	90.72	58.50	47.06	74	54	0	15.50	6.94	PASS	g-mode, PWR-Level 11 dBm used
9.03b	11	yes	100.02	90.71	58.50	47.29	74	54	0	15.50	6.71	PASS	n20-mode, PWR-Level 11 dBm used
9.04b	9	yes	96.96	88.01	63.58	50.37	74	54	0	10.42	3.63	PASS	n40-mode, PWR-Level 11 dBm used

Remark : The EUT complies to the band edge requirement under provision that the power level is adjusted to those listed in the table above.

5.11. 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 30 MHz - 1 GHz 1 GHz - 20 GHz	5.0 dB 4.2 dB 3.17 dB						Magnetic field E-field Substitution

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV , AVG, CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Documents from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth
ERP	Effective radiated power

7. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	736496	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	FCC, Federal Communications Commission Laboratory Division, USA (MRA US-EU 0003)
337 487 550 558	3462D-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

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

8.0.1. 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
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
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
371	Bluetooth Tester	CBT32	100153	CBT V5,30+ SW-Option K55, K57
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
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
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	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
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
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
607	Signal Generator	SMR 20	832033/011	V1.25
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	Setup V03.26, Test programm component V03.02.20
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)
699	Audio Analyzer	UPL16	833494/005	3.06

8.0.2. 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	-	23.05.2020
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	23.05.2020
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	23.05.2021
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	22.05.2022
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
033	RF-current probe (100kHz-30 MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	23.05.2021
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	16.11.2019
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	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
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
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO	36 M	1c	10.03.2020
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	36 M	-	10.03.2020
248	attenuator	SMA 6 dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6 dB 12W	-	Radiall	pre-m	2	
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	-	30.05.2020
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	30.05.2020
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	30.05.2020
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	30.05.2020
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
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	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	16.11.2019
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	16.11.2019
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	22.05.2020
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	-	14.03.2020
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	20.03.2020
331	Climatic Test Chamber -40/+180 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	10.01.2021
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2020
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	23.05.2021
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
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
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	22.05.2020
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	22.05.2020
389	Digital Multimeter	Keithley 2000	0583926	Keithley	pre-m	-	
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	01.07.2020
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	-	25.05.2020
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	10.03.2020
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	16.11.2019
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-10SSK	5	Wainwright Instruments GmbH	12 M	1c	16.11.2019
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-	1	Wainwright	12 M	1c	16.11.2019

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
		8SSK					
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	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	-	30.05.2020
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	30.05.2020
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	-	16.11.2019
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	16.04.2021
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.06.2020
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-60/10SS	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	16.11.2019
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
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	
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2021
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	16.11.2019
557	System CTC-OTA-2	R&S TS8991	-	Rohde & Schwarz	12 M	5	24.01.2020
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	03.05.2022
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	26.06.2020
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	-	
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	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	30.05.2020
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	30.05.2020
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	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 1,5m	-	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	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	30.05.2020
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
683	Spectrum Analyzer	FSU 26	200571	Rohde & Schwarz	12 M	-	30.05.2020
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.05.2020
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	24 M	-	30.05.2021
691	OSP120 Base Unit	OSP120	106833	Rohde & Schwarz	12 M	-	30.05.2020
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	29.05.2020
693	TS8997	CTC-Radio Lab 1_TS8997	-	Rohde&Schwarz	12 M	5	07.01.2020
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	
701	CMW500 wide. Radio Comm.	CMW500	158150	Rohde & Schwarz	24 M	-	30.07.2020
703	INNCO Antennen Mast	MA 4010-KT080-XPET-ZSS3	MA4170-KT100-XPET-ZSS3	INNCO	pre-m	-	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
704	INNCON Controller	CO 3000-4port	CO3000/933/384105 16/L	INNCO Systems GmBh	pre-m	-	
711	Harmonic Mixer 90 GHz - 140GHz	RPG FS-Z140	101004	RPG	36 M	-	22.02.2020
712	Harmonic Mixer 75 GHz - 110GHz	FS-Z110	101468	Rohde & Schwarz	36 M	-	22.02.2020
713	Harmonic Mixer, 50 GHz - 75GHz	FS-Z75	101022	Rohde & Schwarz	24 M	-	05.07.2021
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	24 M	-	04.07.2021
715	Harmonic Mixer, 140 GHz - 220GHz	FS-Z220	101009	RPG Radiometer Physics	36 M	-	03.08.2020
716	Harmonic Mixer 220 GHz to 325 GHZ	FS-Z325	101005	RPG Radiometer Physics	36 M	-	13.02.2020
748	Pickett-Potter Horn Antenna	FH-PP 4060	010001	Radiometer Physiscs	36 M	-	
750	Pickett-Potter Horn Antenna	FH-PP 220	010011	Radiometer Physics	36 M	-	
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 Transceiver	17-010795	mk-messtechnik GmbH	-	-	
757	WIDEBAND RADIO COMMUNICATION	CMW500	163673	Rohde&Schwarz	12 M	-	30.05.2020
781	Power Supply	PS 2042-10 B	2815450369	Elektro-Automatik GmbH &Co.KG	-	-	
782	Power Supply	PS 2042-10 B	2815450348	lektro-Automatik GmbH &Co.KG	-	-	
783	Spectrum Analyzer	FSU 26	100414	Rohde & Schwarz	12 M	-	30.05.2020
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	-	
786	SAR Probe	ES3DV3	3340	Speag	36 M	-	14.02.2021
787	OSP	OSP B157WX	101264	Rohde & Schwarz	24 M	-	30.05.2020
788	Precision Omnidirectional Dipole	POD 618	6182558/Q	Seibersdorf Labaratories	36 M	-	30.06.2021
789	Precision Omnidirectional Dipole	POD 16	162496/Q	Seibersdorf Laboratories	36 M	-	30.06.2021
790	Horn Antenna	ASY-SGH-124-SMA	29F14182337	Antenna System Solutions	36 M	-	08.10.2021
791	Pickett-Potter Horn Antenna	FH-PP-325	10024	Radiometer Physics	36 M	-	
792	Pickett-Potter Horn Antenna	FH-PP 075	10006	Radiometer Physics	36 M	-	
793	Pickett-Potter Horn Antenna	FH-PP 140	10008	Radiometer Physics	36 M	-	
794	Pickett-Potter Horn Antenna	FH-PP 110	10014	Radiometer Physics	36 M	-	
795	SGH Antenna	SGH-26-WR10	1144	Anteral S.L.	36 M	-	
798	WR-22 Rectangular Gain Horn	SAR-2309-22-S2	13254-01	SAGE Millimeter, Inc.	36 M	-	
799	Transceiver	optoLAN-Gb	18-014746	mk messtechnik	pre-m	-	
801	Spectrum Analyzer	FSP 13	100960	Rohde & Schwarz	24 M	-	14.01.2021
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	Thermo-Hygrometer	Web-Thermo-Hygrometer	02749814	W&T	24 M	-	
806	AC2600 Smart Wifi Router	Netgear Nighthawk x4S	5K5188590067B	Netgear	-	-	
807	Direct Coupler	Direct Coupler C-05020-10	511	ET Industries	-	-	
808	Diode Power Sensor	NRV-Z1	829894/001	Rohde & Schwarz	24 M	-	24.05.2021
809	Standard gain Horn Antenna	WR-159 Horn Antenna	-	Pasternack Enterprises Inc.	-	-	

8.1. 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)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	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

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2019-10-24

END OF TEST REPORT