T E S T R E P O R T
No.: 18-1-0081401T01a-C1

According to:

FCC Regulations
Part 15.205
Part 15.209
Part 15.247

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

for

Miele & Cie. KG

Wireless food Probe System
(Host H6880-2BP)

FCC ID: SSVNAEPI02
ISED: 5669B-NAEPI02

Laboratory Accreditation and Listings	
Accredited EMC-Test Laboratory	
AUTHORIZED RF LABORATORY	Authorized Test Lab, Lab Code: 20011130-00
accredited according to DIN EN ISO/IEC 17025	

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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.

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 FCC: §2.927 to §2.948 & ISED: RSP-100, Issue 11, 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) integrates a Proprietary 2.4 GHz RF Transceiver (FHSS).

Following test cases have been performed to show compliance with valid Part 15.205/15.209/15.247 of the FCC CFR Title 47 Rules, Edition 4th November 2016 & ISED RSS-247 Issue 2/ RSS-Gen Issue 5 standards.

1.1. Tests overview of US (FCC) and Canada ISED(RSS) Standards

Test cases	Port	References and Limits			EUT set-up	EUT op. mode	Result
		FCC Standard	RSS Section	Test limit			
TX-Mode							
20 dB bandwidth	Antenna terminal (conducted)	§15.247 (a)(1)	RSS-247, Issue 2: Chapter 5.1 a (1)	At least 25 kHz or 2/3 of 20 dB bandwith	2	1 + 2	Pass
Channel carrier frequency separation			RSS-247, Issue 2: Chapter 5.1 b		2	2	
99% occupied bandwidth	Antenna terminal (conducted)	2.1049(h)	RSS-Gen, Issue 5: Chapter 6.7	99% Power bandwidth	2	1	Tested for Information
Number of Hopping Channels	Antenna terminal (conducted)	§15.247 (a)(1) (iii)	RSS-247, Issue 2: Chapter 5.1 d	At least 15 Hopping Channels	2	2	Pass
Channel average Occupancy time and number of channels	Antenna terminal (conducted)	§15.247 (a)(1) (iii)	RSS-247, Issue 2: Chapter 5.1 d	0.4 seconds	2	2	Pass
Transmitter Peak output power	Antenna terminal (conducted)	§15.247 (b)(1)	RSS-247, Issue 2: Chapter 5.1 b	< 125 mW or 1W	2	1	Pass
Transmitter frequency stability	Antenna terminal (conducted)	--	RSS-Gen Issue 5, Chapter 6.11	Operation within designated operational band	2	1	Pass
Transmitter Peak output power radiated	Enclosure (radiated)	§15.247 (b)(4)	RSS-247, Issue 2: 5.1 (2)	< 125 mW (EIRP) for antenna with directional gain less 6 dBi	2	1	Pass
Out-Of-Band RF- emissions	Antenna terminal (conducted)	§15.247 (d)	RSS-247, Issue 2, Chapter 5.5	20 dBc Conducted Emissions in restricted bands	2	1	Pass
Band-Edge emissions	Enclosure (radiated)	§15.247 (d)	RSS-247, Issue 2, Chapter 5.5 RSS-Gen: Issue 5: §8.9 Table 5+6+7	Emissions in restricted bands must meet the general field strength radiated limits	1	1 + 2	Pass

General field strength emissions + restricted bands	Enclosure + Interconnecting cables (radiated)	§15.247 (d) §15.205 §15.209	RSS-247, Issue 2, Chapter 5.5 RSS-Gen: Issue 5: §8.9 Table 5+6+7	Emissions in restricted bands must meet the general field-strength radiated limits	1	1	Pass
AC-Power Lines Conducted Emissions	AC-Power lines	§15.207	RSS-Gen, Issue 5: Chapter 8.8 Table 4	FCC §15.107 class B limits §15.207 limits ISED: Table 3, Chapter 8.8	1	1	pass
RX Mode							
RECEIVER Radiated emissions	Enclosure+ Inter-connecting cables (radiated)	§15.109 §15.33 §15.35	RSS-Gen, Issue 5: Chapter 7.3	FCC 15.109 class B limits ISED-limits: Table 2, Chapter 7.1.2	--	--	Remark 1

Remark: See customers declaration.

RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm)							
Test cases	**Port**	**References & Limits**			**EUT set-up**	**EUT op. mode**	**Result**
		FCC Standard	**RSS Section**	**Test Limit**			
Radio frequency radiation exposure requirements	Cabinet + Inter-connecting cables (radiated)	§2.1091 §2.1093	RSS-102 Issue 5	**RF-Field Strength Limits:** **FCC:** "general population/ uncontrolled" environment Table 1	1	1	See separate test report CETECOM_18-1-0081401T03a

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.

The current version of the Test Report CETECOM_TR18-1-0081401T01a-C1 replaces the Test Report CETECOM_TR18-1-0081401T01a dated 2018-11-22. The replaced test report is herewith invalid.

Digital signiert von: Christian Lorenz
Datum: 2019.02.08 15:37:45 +01'00'

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: 2019.02.08 15:29:02 +01'00'

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

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 laboratory:	Dipl.-Ing. Niels Jeß
Deputy:	Dipl.-Ing. Volker Briddigkeit

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 and Project leader:	B.Sc. Mohamed Ahmed
Receipt of EUT:	2018-06-20
Date(s) of test:	2018-06-20 o 2018-11-19
Date of report:	2019-02-08
Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	Miele & Cie. KG
Address:	Carl-Miele-Platz 1 59302 Oelde Germany
Contact:	Mr. Andreas Fabrizius

2.5. Manufacturer's details

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

3. Equipment under test (EUT)

3.1. Certification data of main EUT declared by applicant

RF-Module	EPI7684 build inside host EUT A
Module Type	Transceiver
FCC Certification	
FCC ID	SSVNAEPI02
ISED/IC Certification	
ISED	5669B
PMN	EPI7684
UPN	NAEPI02
HVIN	10478824
FVIN	4528

3.2. Technical data of EUT declared by applicant

Integrated RF-Module	**EPI7684**		
Module Type	**Transceiver**		
Main Function	Proprietary 2.4 GHz RF Transceiver (FHSS-System)		
Frequency Band	2.4 GHz ISM Band (2400-2483.5 MHz)		
Frequency Channels (Range)	**2401.623-2481.284 MHz**		
Number of Channels	**600 Frequency Hopping Channels**		
Channel Bandwidth	11,43kHz		
Channels Power Settings	According to Applicant's declaration (Max. Typical Power Values)		
	Channel	**Channel Power**	
	Lowest Channel : 2401.623 MHz |	**20 dBm**	
	Middle Channel : 2441.380 MHz |	**20 dBm**	
	Highest Channel : 2481.280 MHz |	**10 dBm**	
Type of Modulation	none		
Emission Designator	N0X		
Hopping Sequence	Pseudo Random Sequence based on applicant's information, refer to separate document from the costumer		
Antenna Connections	☒ External, separate 1 RF Transceiver Port		
Antenna Details			
Antenna Type	Loop Antenna		
Antenna Ports Number |Type	1	2.4 GHz only	
Antenna Gain (Peak)	**-11 dBi** (According to Applicant's declaration)		
Total Number of Antennas	**1**		
Test Mode. Settings	PM_SAW Measurement Software		
Other Installed Options	None		
Power Supply	☒ AC power: 120 V AC using Laboratory Power Supply (set. 1)		
Power Supply	☒ DC power: 13 V DC + 3 V DC(EUTC) using Laboratory DC Power Supply (set. 2)		
Special EMI Components	--		
EUT Sample Type	☐ Production	☒ Pre-Production	☐ Engineering
Firmware	☐ for normal use	☒ Special version for test execution (See chapter 3.7)	
FCC / IC labels attached	☐ Yes	☒ No	

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 S01	Miele	Oven H6880-2BP	137336775	Pre-Production (B0-Series)	Pre-Production (B0-Series)
EUT B S03	EPI7684	Transceiver	0000143-18-08	Pre-Production (B0-Series	Pre-Production (B0-Series
EUT C S01	EPI7684	Transceiver	0000164-18-08	Pre-Production (B0-Series	Pre-Production (B0-Series

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

Remark: Wireless Food Probe System is EUT B built inside EUT A

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	DC Power Cable	--	--	--	--
AE 2	Loop Antenna	TBD	10697963	Production	--
AE 3	Wireless Food Probe	--	10478813	Production	--
AE 4	USB Cable	--	--	--	--
AE 5	Voltcraft VLP 1303 Pro	DC power Supply	E00085	--	--
AE 6	Dell Notebook (ctc522013)	Latitude E6430	GB3WXY1	Intel Core I5	Windows 7 Professional (64bit)

*) 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	Description
set. 1	EUT A + EUT B + AE 2 + AE 3 (+ AE 4 + AE 6) AE 4 and AE 6 was only used for setting the Test Mode	Radiated Measurements and Conducted Emissions
set. 2	EUT C + AE 1 + (+ AE4+ AE 5 + AE 6) AE 4, AE 5 and AE 6 was only used for setting the Test Mode	Conducted Measurements

*) 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.*)	Description of operating modes	Additional information
op. 1	TX-Fixed Channel (Modulated)- Mode	The EUT was put to **Fixed Channel Continuous transmissions mode (Frequency | Power Settings)** for **Lowest Channel : 2401.623 MHz | Nominal Power setting: 20dBm** **Middle Channel : 2441.380 MHz | Nominal Power setting: 20dBm** **Highest Channel : 2481.280 MHz | Nominal Power setting: 10dBm**
op. 2	TX-Hopping Channels (Modulated)- Mode	The EUT was put to **all Channels Hopping (Modulated) Continuous transmissions mode** with help of special Test Software.

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

3.7. EUT Software Settings

Special Test software was used
Software Name: **PM_SAW-Reader**
Software Version: **v0.2.0.134**
Software Date: **2015**

Freq. settings on the software

Lowest Channel : 2401.750 MHz |
Middle Channel : 2441.517 MHz |
Highest Channel : 2481.417 MHz |

Freq. measured on the Spectrum Analyser.

Lowest Channel : 2401.623 MHz |
Middle Channel : 2441.380 MHz |
Highest Channel : 2481.280 MHz |

4. Description of test system set-up's

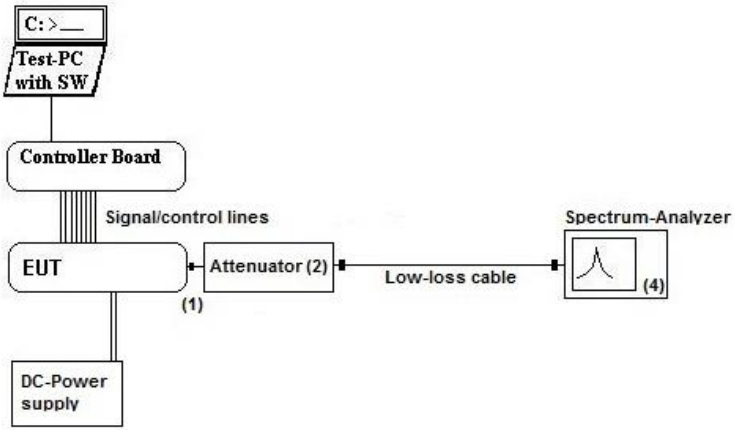
4.1. Test system set-up for conducted measurements on antenna port

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

Used Equipment

Passive Elements	Test Equipment	Remark:
☒ 20 dB Attenuator	☐ Power Meter OSP-B157	See List of equipment under each test case and chapter 8 for calibration info
☒ Low loss RF-cables	☒ DC-Power Supply	
	☒ Spectrum-Analyser	

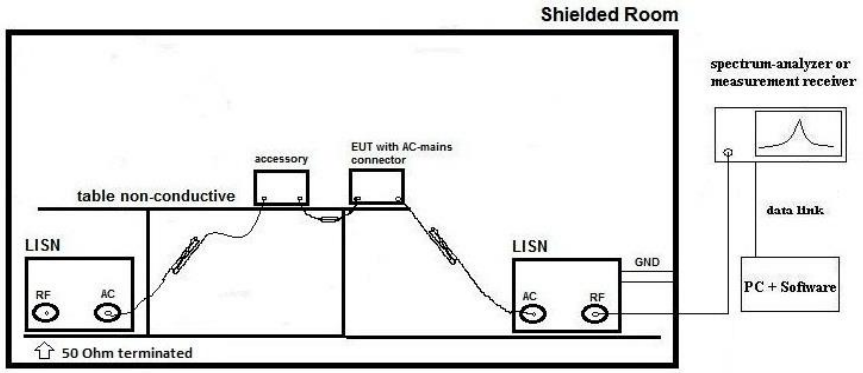
Measurement uncertainty See chapter 5.14

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 110 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.

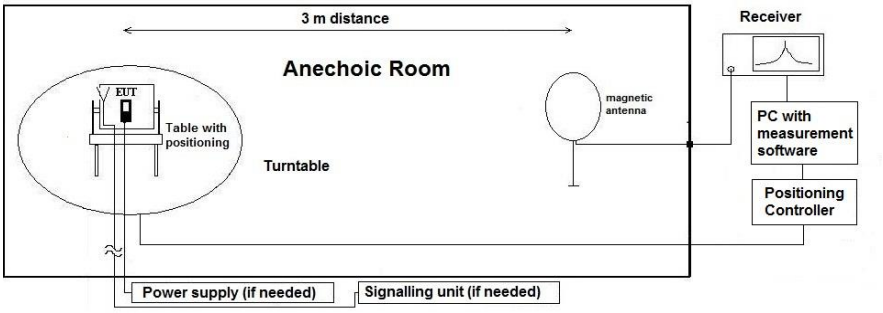
4.3. Test system set-up for radiated magnetic field measurements below 30 MHz

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:

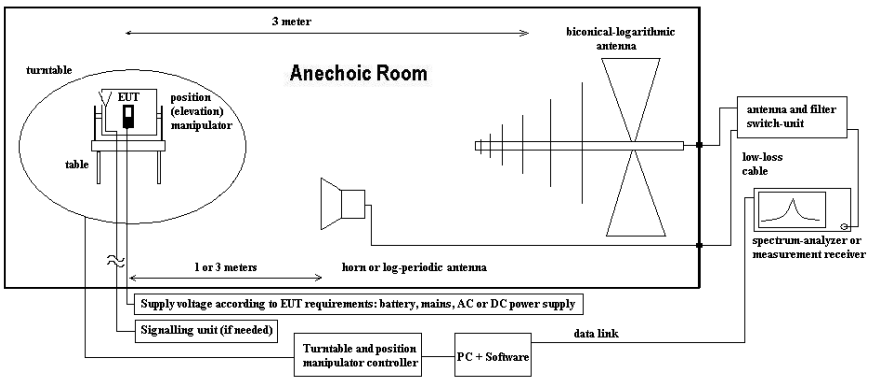
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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:

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

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

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

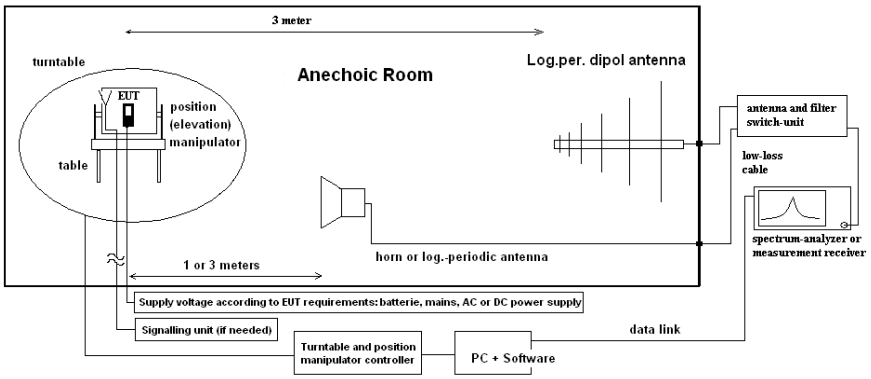
All units are dB-units, positive margin means value is below limit.

4.5. 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 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 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. Measurements

5.1. General Limit - Conducted emissions on AC-Power lines

5.1.1. 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	☐ 333 EMI field	☒ 348 EMI cond.				
receiver	☐ 001 ESS	☒ 377 ESCS 30	☐ 489 ESU 40	☐ 620 ESU 26		
LISN	☒ 005 ESH2-Z5	☐ 007 ESH3-Z6	☐ 300 ESH3-Z5 & 50Ω used for AE		☐ no LISN for AE	
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU	☐ 594 CMW		
line voltage	☒ 120 V/AC			☒ 060 120 V 60 Hz via PAS 5000 (for AE 4)		

5.1.2. Requirements

FCC		☐ Part 15 Subpart B, §15.107 (a) Class B ☒ Part 15 Subpart C, §15.207	
ISED		☒ RSS-Gen, Issue 5 Chapter 8.8, Table 4 ☐ ICES-003, Issue 6 Section 6.1 Class B Table 2	
ANSI		☐ C63.4-2014 ☒ C63.10-2009	
Limit	Frequency [MHz]	☒ Conducted limits	
		QUASI-Peak [dBµV]	AVERAGE [dBµV]
	0.15 – 0.5	66 to 56*	56 to 46*
	0.5 – 5	56	46
	5 – 30	60	50
Remark: * decreases with the logarithm of the frequency			

5.1.3. 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 (40 cm distance to reference ground plane (wall)		☐ floor standing EUT stands isolated on reference ground plane (floor)
Climatic conditions		Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver or Analyzer settings	Scan data	☐ 9 – 150 kHz, RBW = 200 Hz, Step = 61 Hz ☒ 150 kHz – 30 MHz RBW = 9 kHz, Step = 4 kHz ☐ other:		
	Scan-Mode Pre-measurement Final measurement	6 dB EMI-Receiver Mode Peak detector, Repetitive-Scan, max-hold, sweep-time 50 µs per frequency point Average & Quasi-peak detector at critical frequencies		
General measurement procedures		Please see chapter "Test system set-up for AC power line conducted emissions measurements"		

5.1.4. AC-Power Lines Conducted Emissions Results

Set-up no.: 4			**EUT OP-mode no.: 2**	
Diagram-No.	Used Detector	Power line	Mode Details	Result
1.01	☒ Peak (pre-scan) ☐ CAV (final) ☒ QP (final)	L1/ N	Normal Hopping Mode	**Pass**
Remark 1: For further details please refer → Annex 1: Test results **CETECOM_TR18-1-0081401T01a-A1**				

5.2. RF-Parameter – RF Power conducted

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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC			

5.2.2. Requirements:

FCC	☒ §15.247 (b) (1)
ISED	☒ RSS-247, Issue 2. Chapter 5.4 b.
ANSI	☒ C63.10-2013 Chapter 7.8.5

5.2.3. Reference: EUT 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

5.2.4. EUT settings:
For FHSS-systems hopping mode was switched-off so three fixed modulated 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.

5.2.5. Measurement method:
The measurement was performed in non-hopping transmission mode with the carrier set to lowest, middle and highest channel. The power was also checked for different data rates, modulation scheme or packet types if applicable.

5.2.6. Settings on Spectrum-Analyzer:

Center Frequency	Nominal channel frequency
Span	176 kHz
Resolution Bandwidth (RBW)	30 kHz > 20dB bandwidth
Video Bandwidth (VBW)	3 times the resolution bandwidth = 100kHz
Sweep time	coupled
Detector	Peak, Max hold mode
Sweep Mode	Repetitive mode

5.2.7. Conducted Power Results:

Conducted Output Power Measurements			
Temperature :+21 °C	**Voltage Supply 13 V DC - 3 V DC**	**Setup: 2**	**Op. Mode: 1**
Frequency Hopping OFF			

Channel	**Frequency**	**Max. Peak Output Power (Conducted)**		**Plot No.**
	[MHz]	**[dBm]**	**[mW]**	
Low	2401.62	**20.8**	**120.23**	Remark 1
Mid	2441.38	**20.0**	**100.0**	
high	2481.28	**10.3**	**10.72**	
Conducted Output Power Limits- FCC 15.247		**20.97 dBm**	**125 mW or 1 W**	
Conducted Output Power Limits - RSS-247, Issue 2				
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**				

5.2.8. Conducted Peak Output Power Verdict: Pass

5.3. RF-Parameter – Frequency Stability

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	☐ 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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC			

5.3.2. 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.

5.3.3. 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.

5.3.4. 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

5.3.5. Spectrum-Analyzer Settings

Span	Set as to fully display the emissions and approximate 20dB below the PEAK level
Resolution Bandwidth (RBW)	10kHz
Video Bandwidth (VBW)	1MHz
Sweep time	Coupled and low enough to have no gaps within power envelope
Detector	Peak
Sweep mode	Repetitive Mode, Max hold

5.3.6. Voltage Variation

Voltage [V]	Nominal Frequency [MHz]	Maximum frequency error		Verdict Limit= +/- 50ppm
		[MHz]	[ppm]	
Low Channel				
3.00	2401.626205	--	--	--
2.55		1.60	0.67	pass
3.45		0.00	0,00	pass
High Channel				
3.00	2481.289615	--	--	--
2.55		0,0048	1,94	pass
3.45		0,0016	0,65	pass

5.3.7. Temperature Variation

Temperature [V]	Nominal Frequency [MHz]	Maximum frequency error		Verdict Limit= +/- 50ppm
		[MHz]	[ppm]	
Low Channel				
-20	2401.626205	0.01282100	5.33847	pass
+50		0.01282000	5.338049682	pass
High Channel				
-20	2481.289615	0.01121800	4.52104	pass
+50		0.01602500	6.458335175	pass

5.3.8. Frequency Stability Verdict: pass

5.4. RF-Parameter – 99% Occupied Bandwidth

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	☐ 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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC			

5.4.2. Requirements:

FCC	☒ 2.1049(h) ☒ FCC 2.202 for information
ISED	☒ RSS-Gen, Issue4 , 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.

5.4.3. 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.

5.4.4. Measurement method

The measurement was performed with the RBW set to 5kHz. 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.

5.4.5. 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

5.4.6. 99% Occupied Bandwidth Results:

99% Occupied Bandwidth Measurements			
Temperature :+21 °C	**Voltage Supply 13 V DC - 3 V DC**	**Setup: 2**	**Op. Mode: 1**
Frequency Hopping OFF			
Channel	**Frequency**	**99 % Occupied Bandwidth**	**Plot No.**
[Number]	**[MHz]**	**[kHz]**	Remark 1
2401.62	2401.62	**12.179487**	
2441.38	2441.38	**12.179487**	
2481.28	2481.28	**12.179487**	
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**			

5.4.7. 99% Occupied Bandwidth Verdict: For Information only

5.5. RF-Parameter - 20 dB Bandwith

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	☐ 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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC			

5.5.2. Requirements:

FCC	☒ §15.247 (a) (1)
ISED	☒ RSS-247, Issue 2, Chapter 5.1 a
Remark	The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping mode stopped on a certain channel.

5.5.3. 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.

5.5.4. Measurement method

The measurement was performed with the RBW set to 3kHz. 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 DELTA Marker method was set to measure the bandwidth compared to the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). The hopping-mode is switched off.

5.5.5. 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

5.5.6. 20 dB Bandwidth Results:

20 dB Emission Bandwidth Measurements			
Temperature :+21 °C	**Voltage Supply 13 V DC - 3 V DC**	**Setup: 2**	**Op. Mode: 1**
Frequency Hopping OFF			
Channel	**Frequency**	**20 dB Emission Bandwidth Measurements**	**Plot No.**
[Number]	**[MHz]**	**[kHz]**	Remark 1
2401.62	2401.62	**11.428**	
2441.38	2441.38	**10.286**	
2481.28	2481.28	**9.143**	
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**			

5.5.7. 20 dB Bandwidth Verdict: Pass

5.6. RF-Parameter - Channel Carrier Frequency Separation for FHSS-systems

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
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		☒ 13 V DC + 3 V DC (AE5)			

5.6.2. Requirements:

FCC	☒ §15.247 (a) (1)
ISED	☒ RSS-247, Issue 2, Chapter 5.1 b
Remark	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

5.6.3. EUT settings

For FHSS-systems hopping mode was switched-on so that adjacent Frequency 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.

5.6.4. Measurement method

The measurement to prove this requirement was performed with a low RBW of 100kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

The span of the frequency analyzer was set to cover the carrier investigated as well as its neighbour channels. A frequency DELTA Marker method was set to measure the frequency separation between the channels.

5.6.5. Channel Carrier Frequency Separation Results:

Channel Carrier Frequency Separation Measurements			
Temperature :+21 °C	**Voltage Supply 13 V DC - 3 V DC**	**Setup: 2**	**Op. Mode: 1**
Frequency Hopping ON			
Neighboring Channels	**Carrier Frequency Separation**	**Minimum CFS**	**Plot No.**
[Number]	**[kHz]**	**[kHz]**	
Low channel	**134.728**	**25**	Remark 1
Mid Channel	**137.318**	**25**	
High Channel	**134.728**	**25**	
Hopping Channel Carrier Frequencies Separation Limits- FCC 15.247		**25 kHz**	
Hopping Channel Carrier Frequencies Separation Limits - RSS-247, Issue 2			
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**			

5.6.6. Hopping Channel Carrier Frequencies Separation Verdict: Pass

5.7. RF-Parameter – Number of Hopping Channels for FHSS-systems

5.7.1.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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC (AE5)			

5.7.2. Requirements:

FCC	☒ §15.247 (a) (1) (iii)
ISED	☒ RSS-247, Issue 2, Chapter 5.1 d
Remark	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

5.7.3. EUT settings

For FHSS-systems hopping mode was switched-on so that adjacent Frequency 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.

5.7.4. Measurement method

The measurement to prove this requirement was performed with a low RBW of 30kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

5.7.5. Number of Hopping Channels Results:

Number of Hopping Channels Measurements			
Temperature :+21 °C	**Voltage Supply 13 V DC + 3 V DC**	**Setup: 2**	**Op. Mode: 2**
Frequency Hopping ON		**Total Channels** 2.4 GHz Spectrum	**Plot No.**
		[Number]	Remark 1
		600	
Minimum Number of Hopping Channels Limits- FCC 15.247		**15**	
Minimum Number of Hopping Channels Limits - RSS-247, Issue 2			
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**			

5.7.6. Minimum Number of Hopping Channels Verdict: Pass

5.8. RF-Parameter – Average Time of Occupancy for FHSS systems

5.8.1.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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC (AE5)			

5.8.2. Requirements:

FCC	☒ §15.247 (a) (1) (iii)
ISED	☒ RSS-247, Issue 2, Chapter 5.1,d
Remark	The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.8.3. EUT settings

For FHSS-systems hopping mode was switched-on so that occupancy time of Frequency 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.

5.8.4. Measurement method:

The measurement was performed with a spectrum analyzer set to ZERO span. The device was set to work within the defined specification with frequency Hopping Mode ON. The spectrum-analyzer was set the MAX-Hold positive peak detector mode. 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.

5.8.5. Average occupancy time calculations:

Formula for calculating the dwell time (pseudo-hopping sequence over all channels assumed):

$$\text{Average Dwell Time} = Timeslot\ length \cdot \frac{Hop\ rate}{number\ of\ hopping\ channels} \cdot time\ period$$

The EUT employs Proprietary 2.4 GHz RF Transceiver Frequency Hopping system with total 600 channels. The maximum staying time of 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. = 0.4 seconds X 600 = 240 Seconds.

That means the average time of occupancy on any channel shall not be greater than 0.4 seconds within 240 seconds.

5.8.6. Average occupancy time Results:

Average Occupancy Time Measurements					
Temperature :+21 °C	**Voltage Supply 13 V DC + 3 V DC**			**Setup: 2**	**Op. Mode: 2**
Frequency Hopping ON					
Channel	**Single Transmission Time**	**Number of Transmissions in 1s**	**Number of Transmissions in 240s**	**Average Occupancy Time in 240 Seconds**	**Plot No.**
[Number]	**[milliseconds]**	**[Number]**	**[Number]**	**[milliseconds]**	Remark 1
low	0.344609	4	93*10	320.486	
Mid	0.344609	4	92*10	320.486	
high	0.201923	4	93*10	187.788	
Average Occupancy Time Limits- FCC 15.247				**≤ 400 milliseconds**	
Average Occupancy Time Limits - RSS-247. Issue 2					
Remark 1: For further details please refer → Annex 1: **CETECOM_TR18-1-0081401T01a-A1**					

5.8.7. Average Occupancy Time Verdict: Pass

5.9. RF-Parameter – Out-of-Band 20 dBc Conducted Emissions for FHSS systems

5.9.1.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	☐ 230 V 50 Hz via public mains		☒ 13 V DC + 3 V DC (AE5)			

5.9.2. 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

5.9.3. 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.

5.9.4. 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.

5.9.5. Out-of-Band 20 dBc Conducted Emissions Results:

Out-of-Band 20 dBc Conducted Emissions Measurements				
Temperature :+21 °C	**Voltage Supply 13 V DC + 3 V DC**		**Setup: 2**	**Op. Mode: 1**
Frequency Hopping OFF				
Channel	**Minimum Margin 0.15 MHz -30 MHz**	**Minimum Margin 30 MHz -2.8 GHz**	**Minimum Margin 2.8 GHz - 25 GHz**	**Plot No.**
[Number]	**[dBc]**	**[dBc]**	**[dBc]**	Remark 1
Low	**-24.88**	**-25**	**-23.74**	
Mid	**-26.42**	**-25**	**-23.98**	
high	**-26.18**	**-25**	**-23.50**	
Out-of-Band 20 dBc Conducted Emissions Limits- FCC 15.247			**≥ 20 dBc for Peak Power measurements**	
Out-of-Band 20 dBc Conducted Emissions Limits - RSS-247. Issue 2				
Remark 1: For further details please refer → Annex 1:**CETECOM_TR18-1-0081401T01a-A1**				

5.9.6. Out-of-Band 20 dBc Conducted Emissions- Hopping Mode OFF Verdict: Pass

Out-of-Band 20 dBc Conducted Emissions Measurements				
Temperature :+21 °C	**Voltage Supply 13 V DC + 3 V DC**		**Setup: 2**	**Op. Mode: 2**
Frequency Hopping ON				
Hopping Channel	**Minimum Margin 0.15 MHz -30 MHz**	**Minimum Margin 30 MHz -2.8 GHz**	**Minimum Margin 2.8 GHz - 25 GHz**	**Plot No.**
[Number]	**[dBc]**	**[dBc]**	**[dBc]**	Remark 1
0 - 591	**-26.33**	**-25.37**	**-26.99**	
Out-of-Band 20 dBc Conducted Emissions Limits- FCC 15.247			**≥ 20 dBc**	
Out-of-Band 20 dBc Conducted Emissions Limits - RSS-247. Issue 2				
Remark 1: For further details please refer → Annex 1:**CETECOM_TR18-1-0081401T01a-A1**				

5.9.7. Out-of-Band 20 dBc Conducted Emissions- Hopping Mode ON Verdict: Pass

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

5.10.1. 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
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.10.2. Requirements

FCC	Part 15. Subpart C. §15.205 & §15.209 ☒ Part 15.247 (d)			
ISED	RSS-Gen: Issue 5: §8.9 Table 5 & RSS-247 Issue 2, Chapter 5.5			
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

5.10.3. 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 analyser 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"		

5.10.4. Radiated Field Strength Emissions – 9 kHz to 30 MHz Results

Radiated Field Strength Emissions – 9 kHz to 30 MHz									
Temperature :+21 °C		**Frequency Hopping OFF**							
Diagram No. (Remark 1)	**Carrier Channel Range**	**Channel | Power**	**Set-up no.**	**OP-mode no.**	**Other Remarks**	**Used detector**			**Verdict**
						PK	**AV**	**QP**	
2.01	Low	2401.623 | 20dBm	1	1	--	☒	☐	☐	**Pass**
2.02	High	2441.385 | 20dBm	1	1	--	☒	☐	☐	**Pass**
2.03	Low	2481.280 | 20dBm	1	1	--	☒	☐	☐	**Pass**
Remark 1: For further details please refer → Annex 1:**CETECOM_TR18-1-0081401T01a-A1**									

5.10.5. 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

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

5.11.1. 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	☒ 671 EA-3013S	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.11.2. Requirements/Limits

FCC	☐ Part 15 Subpart B. §15.109. class B ☒ Part 15 Subpart C. §15.209 @ frequencies defined in §15.205 ☒ Part 15.247 (d)		
ISED	☒ RSS-Gen.. Issue 5. Chapter 8.9. Table 5+7 (licence-exempt radio apparatus) ☐ RSS-Gen.. Issue 5. Chapter 7.1.2. Table 3 (receiver) ☐ ICES-003. Issue 6. Table 5 (Class B) ☒ RSS-247 Issue 2. Chapter 5		
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

5.11.3. Restricted bands of operation (FCC §15.205/ RSS-Gen. Issue 5 Chapter 8.9. Table 7)

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			

5.11.4. 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	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"		

5.11.5. Radiated Field Strength Emissions – 30 MHz to 1 GHz Results

Radiated Field Strength Emissions – 30 MHz to 1 GHz									
Temperature :+21 °C		**Frequency Hopping OFF**							
Diagram No. (Remark 1)	**Carrier Channel Range**	**Channel | Power**	**Set-up no.**	**OP-mode no.**	**Other Remarks**	**Used detector**			**Verdict**
						PK	**AV**	**QP**	
3.01a	Low	2401.623 | 20dBm	1	1	--	☒	☐	☒	**Pass**
3.02a	High	2441.385 | 20dBm	1	1	--	☒	☐	☒	**Pass**
3.03a	Low	2481.280 | 20dBm	1	1	--	☒	☐	☒	**Pass**
Remark 1: For further details please refer → Annex 1:**CETECOM_TR18-1-0081401T01a-A1**									

5.12. General Limit - Radiated emissions. above 1 GHz

5.12.1. 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	☒714 FSW 67	☐
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	☒611 E3632A	☐087 EA3013	☐354 NGPE 40	☐349 car battery	☐350 Car battery	☐
line voltage	☐ 230 V 50 Hz via public mains		☒060 120 V 60 Hz via PAS 5000			

5.12.2. Requirements/Limits (CLASS B equipment)

FCC	☐ Part 15 Subpart B. §15.109 class B ☒ Part 15 Subpart C. §15.209 for frequencies defined in §15.205 ☒ Part 15.247 (d)			
ISED	☒ RSS-Gen.. Issue 5. Chapter 8.9. Table 5+7 (transmitter licence excempt) ☐ RSS-Gen.. Issue 5. Chapter 8.9. Table 3 (receiver) ☐ ICES-003. Issue 6. Chapter 6.2.2. Table 7 (class B) ☒ RSS-247. Issue 2. Chapter 5			
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 or RSS-Gen.. Issue 5. §8.10 - Table 5	500	54.0	5000	74.0 dBµV/m

5.12.3. 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 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"		

5.12.4. Radiated Field Strength Emissions – 1 GHz to 18 GHz Results

Radiated Field Strength Emissions – 1 GHz to 18 GHz									
Temperature :+21 °C	**Frequency Hopping OFF**								
Diagram No. (Remark 1)	**Carrier Channel**	**Channel Data Rate | Power**	**Set-up no.**	**OP-mode no.**	**Other Remarks**	**Used detector**			**Verdict**
						PK	**AV**	**QP**	
4.01	Low	2401.623 | 20dBm	1	1	--	☒	☒	☐	**Pass**
4.02	Mid	2441.385 | 20dBm	1	1	--	☒	☐	☐	**Pass**
4.03	high	2481.280 | 20dBm	1	1	--	☒	☒	☐	**Pass**
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**									

5.12.5. Radiated Field Strength Emissions – 18 GHz to 25 GHz Results

Radiated Field Strength Emissions – 18 GHz to 25 GHz									
Temperature :+21 °C	**Frequency Hopping OFF**								
Diagram No. (Remark 1)	**Carrier Channel**	**Channel Data Rate | Power**	**Set-up no.**	**OP-mode no.**	**Other Remarks**	**Used detector**			**Verdict**
						PK	**AV**	**QP**	
4.01a	Low	2401.623 | 20dBm	1	1	--	☒	☒	☐	**Pass**
4.02a	Mid	2441.385 | 20dBm	1	1	--	☒	☐	☐	**Pass**
4.03a	high	2481.280 | 20dBm	1	1	--	☒	☒	☐	**Pass**
Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**									

5.13. RF-Parameter - Radiated Band Edge compliance measurements

5.13.1. 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	☒611 E3632A	☐087 EA3013	☐354 NGPE 40	☐349 car battery	☐350 Car battery	☐
line voltage	☐ 230 V 50 Hz via public mains		☒060 120 V 60 Hz via PAS 5000			

5.13.2. Requirements/Limits

FCC	☐ Part 15 Subpart B. §15.109 class B ☒ Part 15 subpart C. §15.209 @ frequencies defined in §15.205 ☒ Part 15.247 (d)
ISED	☒ RSS-247. Issue 2. Chapter 5 ☒ RSS-Gen: Issue 5. Chapter 8.9. Table 5+7
ANSI	☐ C63.4-2009 ☐ C63.4-2014 ☐ C63.10-2009 ☒ C63.10-2013. Chapter 6.10.6

5.13.3. 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 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.		

5.13.4. 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 or RSS-Gen. Issue 5. Chapter 8.10. Table 7 with the general limits of FCC §15.209 or RSS-Gen. Issue 5 Chapter 8.9. Table 5.

5.13.5. EUT settings

The EUT was set in Hopping OFF as well as in Hopping ON modes with maximum power (if adjustable) according to applicants instructions.

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

5.13.6.1. Non-restricted bands near-by - limits according FCC §15.247 and RSS-247. Issue 1. Chapter 5.5

Set-up No.:	2
Op. Mode:	1 + 2

Diagram No.	Channel No.	Restricted band ?	Fundamental Value [dBuV/m]		Peak-Value at Band-Edge [dBuV/m]	Difference [dB]	Limit [dBc]	Margin [dB]	Verdict	Remark: Data Rate | Hopping ?
			Peak-Value	Average-Value						
9.01	0	NO	95,713	91,822	60,453	35,260	20,000	15,260	PASS	Fixed low Channel
9.03	0	NO	95,134	86,584	56,700	38,434	20,000	18,434	PASS	Hopping ON

Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**
Remark 2: No Duty-cycle correction factors are necessary

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

Set-up No.:	2
Op. Mode:	1 + 2

Diagram No.	Channel no.	Restricted band ?	Fundamental Value [dBuV/m]		Value at Band-Edge [dBuV/m]		Limits [dBuV/m]		Margin [dB]		Verdict	Remark: Data Rate | Hopping ?
			Peak-Value	Average-Value	Peak -Value	Average -Value	Peak -Value	Average -Value	Peak	Average		
9.02	high	YES	89,739	89,739	54,105	49,760	74,00	54,00	19,90	4,24	PASS	Fixed high Channel
9.04	high	YES	86,732	76,064	55,900	38,756	74,00	54,00	18,10	15,24	PASS	Hopping ON

Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0081401T01a-A1**
Remark 2: No Duty-cycle correction factors are necessary

5.14. 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. Dokuments 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	(MRA US-EU 0003)	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
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

8.1. Used equiment "CTC"

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

8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
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
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
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

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	16.05.2019
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	16.05.2019
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	16.05.2019
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	15.05.2019
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
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
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	30.04.2018
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	15.05.2019
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	
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	-	30.05.2019
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 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 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	-	30.05.2019
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	30.05.2019
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	
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	-	17.05.2019
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	-	07.01.2019
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2020
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	17.05.2019
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
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	-	24.05.2019
371	Bluetooth Tester	CBT32	100153	R&S	36 M	-	30.05.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	17.05.2019
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	30.05.2019
389	Digital Multimeter	Keithley 2000	0583926	Keithley	pre-m	-	
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	30.06.2019
405	Thermo-/Hygrometer	OPUS 10 THI	126.0604.0003.3.3.3.22	LUFFT Mess u. Regeltechnik GmbH	24 M	-	30.03.2019
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	06.03.2019
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	10.03.2020
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	-	30.05.2019
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	-	30.05.2019
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	-	16.05.2019
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.03.2019
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.06.2019
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	
517	relais switch matrix	HF Relais Box Keithley System	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	18.05.2019
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	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	30.07.2019
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	30.07.2019
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	-	30.03.2019
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	08.08.2019
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2019
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	30.05.2019
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	17.05.2019
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	15.05.2019
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	-	30.05.2019
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.03.2019
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	
642	Wideband Radio Communication Tester	CMW 500	126089	Rohde&Schwarz	24 M	-	24.05.2019
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	-	30.05.2019
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	29.03.2019
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.05.2019
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	24 M	-	16.05.2019
691	OSP120 Base Unit	OSP120	106833	Rohde & Schwarz	12 M	-	30.05.2019
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	30.05.2019
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	
701	CMW500 wide. Radio Comm.	CMW500	158150	Rohde & Schwarz	12 M	-	30.07.2019
703	INNCO Antennen Mast	MA 4010-KT080-XPET-ZSS3	MA4170-KT100-XPET-ZSS3	INNCO	pre-m	-	
704	INNCON Controller	CO 3000-4port	CO3000/933/38410516/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	36 M	-	22.05.2020
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	24 M	-	28.02.2020
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
747	Spectrum Analyzer	FSU 26	200152	Rohde & Schwarz	12 M	-	30.05.2019
748	Pickett-Potter Horn Antenna	FH-PP 4060	010001	Radiometer Physiscs	36 M	-	
749	Pickett-potter Horn Antenna	FH-PP 60-90	010003	Radiometer Physics	-	-	
750	Pickett-Potter Horn Antenna	FH-PP 140-220	010011	Radiometer Physics	-	-	
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	-	-	
758	Signal Generator	SMU 200A	100754	Rohde & Schwarz	24 M	-	11.10.2019
780	Spectrum Analyzer	FSH3	101726	Rohde & Schwarz	24 M	-	19.07.2019
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	-	30.05.2019
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	12 M	-	30.05.2019
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

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
--	Inital release	2018-11-22
C1	3.7 Test Software Version updated	2019-02-08
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END OF TEST REPORT