Test Report22-1-0126501T009a

Number of pages:	35	**Date of Report:**	2023-Dec-20
Testing company:	cetecom advanced GmbH Untertuerkheimer Str. 6-10 66117 Saarbruecken GERMANY	**Applicant:**	Dryad Networks GmbH
Product: **Model:**	**Wildfire Sensor** **WILDFIR-14**		
FCC ID:	2BAH4WILDFIR-14	**IC:**	30127-WILDFIR14
Testing has been carried out in accordance with:	**Title 47 CFR, Chapter I** **FCC Regulations, Subchapter A** Subpart C: § 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz **ISED-Regulations** **Radio Standards Specification** **RSS-Gen, Issue 5** General Requirements for Compliance of Radio Apparatus **RSS-247, Issue 3** Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Device Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	915 MHz LoRa		
Test Results:	**☒ The EUT complies with the requirements in respect of selected parameters subject to the test.** The test results relate only to devices specified in this document		
Signatures:			
	B.Eng. Martin Nunier Lab Manager Authorization of test report		Timo Franke Test Manager Responsible of test report

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1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. cetecom advanced does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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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.

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 of the above requirements are met in accordance with enumerated standards.

1.3 Summary of Test Results

The EUT integrates 915 MHz LoRa technology. Other implemented wireless technologies were not considered within this test report.

Test case	Reference Clause FCC ☒	Reference Clause ISED ☒	Page	Remark	Result
Maximum Peak conducted output power	§15.247(b)(2) §15.247(b)(3)	RSS-247, Issue 2, §5.4(a)	14	--	PASSED
Power spectral density	§15.247(e)(f)	RSS-247, Issue 2, §5.2(b) §5.3(a), §5.3(b)	15	--	PASSED
Emission Bandwidth 20 dB (FHSS) Emission Bandwidth 6 dB (DTS)	§15.247(a)(1)(i) §15.247(a)(2)	RSS-247, Issue 2, §5.1(a)(b) (FHSS) §5.2(a) (DTS)	12	--	PASSED
Carrier Frequency Separation	§15.247(a)(1)	RSS-247, Issue 2, §5.1(b)	19	--	PASSED
Number of Hopping Channels	§15.247(a)(1)(i)	RSS-247, Issue 2, §5.1(c)	20	--	PASSED
Time of Occupancy	§15.247(a)(1)(i) §15.247(f)	RSS-247, Issue 2, §5.1(c)	21	--	PASSED
Occupied Channel Bandwidth 99%	2.1049(h)	RSS-Gen, Issue 5, §6.7	11	--	PASSED
Emissions in non-restricted frequency bands	§15.247(d)	RSS-247, §5.5	18	--	PASSED
Conducted Band-Edge emissions	§15.247(d)	RSS-247, §5.5 RSS-Gen: Issue 5, §8.9 Table 5+6+7	16		PASSED
Radiated field strength emissions below 30 MHz	§15.209(a) §15.205(a)	RSS-Gen: Issue 5 §8.9 Table 6	25	--	PASSED
Radiated field strength emissions 30 MHz – 1 GHz	§15.209(a) §15.247(d) §15.205(a)	RSS-Gen: Issue 5 §8.9 Table 5+7 RSS-247, Issue 2, §5.5	28	--	PASSED
Radiated field strength emissions above 1 GHz	§15.209(a) §15.247(d) §15.205(a)	RSS-Gen: Issue 5, §8.9 Table 5+7 RSS-247, Issue 2, §5.5	30	--	PASSED
AC-Power Lines Conducted Emissions	§15.207	RSS-Gen Issue 5, §8.8, Table 4	--	--	N/A

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
N/A	Test case does not apply to the test object.
NP	The test was not performed by the cetecom advanced laboratory.

Decision Rule: cetecom advanced GmbH follows ILAC G8:2019 chapter 4.2.1 (Simple Acceptance Rule).

1.4 Summary of Test Methods

Test case	Test method
Maximum Peak conducted output power	ANSI C63.10:2020, §7.8.5, §11.9
Power spectral density	ANSI C63.10:2020, §11.10
Emission Bandwidth	ANSI C63.10:2020, §11.8
Occupied Channel Bandwidth 99%	ANSI C63.10:2020, §6.9.3
Carrier Frequency Separation	ANSI C63.10:2020, §7.8.2
Number of Hopping Channels	ANSI C63.10:2020, §7.8.3
Time of Occupancy	ANSI C63.10:2020, §7.8.4
Emissions in non-restricted frequency bands	ANSI C63.10:2020, §11.11, §6.10.5
Radiated field strength emissions below 30 MHz	ANSI C63.10-2020, §6.3, §6.4
Radiated field strength emissions 30 MHz- 1 GHz	ANSI C63.4-2014, §8.2.3; ANSI C63.10-2020 §6.3, § 6.5
Radiated field strength emissions above 1 GHz	ANSI C63.4-2014 §8.3; ANSI C63.10-2020 §6.3, § 6.6
Band-Edge emissions	ANSI C63.10-2020, §6.10, §7.8.7.2, §11.12
AC-Power Lines Conducted Emissions	ANSI C63.4-2014 §7; ANSI C63.10-2020 § 6.2

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	cetecom advanced GmbH
Address:	Untertuerkheimer Str. 6-10 66117 Saarbruecken Germany
Responsible for testing laboratory:	Dipl.-Ing. (FH) Andreas Luckenbill M.Sc.
Accreditation scope:	**DAkkS Webpage: FCC ISED**
IC Lab company No. / CAB ID:	3462D / DE0005
Test location 1:	Im Teelbruch 116; 45219 Essen
Test location 2:	--

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15% rH

2.3 Test Laboratories sub-contracted

Company name:	--

2.4 Organizational Items

Responsible test manager:	Timo Franke
Receipt of EUT:	2023-May-09
Date(s) of test:	2023-Jul-04 to 2023-Nov-28
Version of template:	23.1101

2.5 Applicant's details

Applicant's name:	Dryad Networks GmbH
Address:	Eisenbahnstraße 37 16225 Eberswalde Brandenburg Germany
Contact Person:	Carsten Brinkschulte
Contact Person's Email:	carsten@dryad.net

2.6 Manufacturer's details

Manufacturer's name:	Dryad Networks GmbH
Address:	Eisenbahnstraße 37 16225 Eberswalde Germany

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	22-1-01265S34_C01	Wildfire Sensor	WILDFIR-14	SILVANET WILDFIRE SENSOR	C10	WILDFIR-14	1.5.0
EUT 2	22-1-01265S38_C01	Wildfire Sensor	WILDFIR-14	SILVANET WILDFIRE SENSOR	119	WILDFIR-14_01	1.5.0
EUT 3	22-1-01265S39_C01	Wildfire Sensor	WILDFIR-14	SILVANET WILDFIRE SENSOR	113	WILDFIR-14	1.5.0

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

2.8 Untested Variant (VAR)

VAR No.*)	Sample No.	Product	Model	Type	SN	HW	SW

*) The listed additional untested model variant(s) (VAR) is/are not object of evaluation of compliance. For further information please see Annex 5: Declaration of applicant of model differences.
If the table above does not show any other line than the headline, no untested variants are available.

2.9 Auxiliary Equipment (AE)

AE No.*)	Sample No.	Auxiliary Equipment	Model	SN	HW	SW
AE 1	--	STLINK	V3SET	--	--	--
AE 2	--	Laptop HP	EliteBook	--	Intel Core I7	Windows 7
AE 3	22-1-01265S30_C01	Wildfire Sensor	WILDFIR-14 (Housing)	--	--	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report. If the table above does not show any other line than the headline, no AE was used during testing nor was taken into account for evaluation

2.10 Connected cables (CAB)

CAB No.*)	Sample No.	Cable Type	Connectors / Details	Length
CAB 1	--	USB-Cable	Micro USB cable	80 cm

*) CAB short description is used to simplify the identification of the connected cables in this test report. If the table above does not show any other line than the headline, no cable was used during testing nor was taken into account for evaluation

2.11 Software (SW)

SW No.*)	Sample No.	SW Name	Description	SW Status

*) SW short description is used to simplify the identification of the used software in this test report. If the table above does not show any other line than the headline, no SW was used during testing nor was taken into account for evaluation.

2.12 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
SET. 1	EUT 1 (+ AE 1 + AE 2 + AE 3 + CAB 1)[1)]	Used for radiated measurements < 30MHz
SET. 2	EUT 2 (+ AE 1 + AE 2 + AE 3 + CAB 1) [1)]	Used for radiated measurements > 30 MHz
SET. 3	EUT 3 + AE 1 + AE 2 + AE 3 + CAB 1 [1)]	Used for conducted measurements

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.
1) AE 1, AE 2, AE 3 and CAB 1 are just used for setup and are not part of the measurement.

2.13 EUT operation modes

EUT operating mode no.*1)	Operating modes	Additional information
OP. 1	TX on fixed channel in DTS-Mode	EUT was set to a fixed channel with LoRa DTS digital modulation parameter. BW 500 kHz; SF12; PWR setting 14 dBm Firmware used “sylva-cert_2023.08.22_1.bin”
OP. 2	TX on fixed channel in FHSS-Mode	EUT was set to a fixed channel with LoRa FHSS hopping parameter. BW 125 kHz; SF07; PWR setting 14 dBm Firmware used “sylva-cert_2023.08.22_1.bin”
OP. 3	TX with random hopping in FHSS-Mode	EUT was set to FHSS mode with random hopping enabled. Firmware used „EN_Silva_cert_FHSS_debug.bin“

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

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Firmware	☐ for normal use	☒ Special version for test execution	
Power supply	☐ AC Mains	-	
	☒ DC Mains *)	**5** V DC	
	☐ Battery	-	
Operational conditions	T_{nom}= 21 °C	T_{min}= -40 °C	T_{max}= +85 °C
EUT sample type	**Pre-Production**		
Weight	0.100 kg		
Size [LxWxH]	8.5 cm x 1.0 cm		
Interfaces/Ports	-		
For further details refer Applicants Declaration & following technical documents			
*): EUT is powered by 2 capacitors powered by a solar cell which provides around 1 V DC. For testing purposes a DC-Power-Supply with 5 V DC were connected to the solar cell output to keep the capacitors charged so that the EUT maintain in testmode and not cease operation.			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	902 MHz – 928 MHz		
Type of Modulation | Data Rate	LoRa		
Number of Channels (USA/Canada -bands)	DTS: 8	FHSS: 64	
Nominal Channel Bandwidth	DTS: 500 kHz	FHSS: 125 kHz	
Other installed options	☐ WLAN ☐ Bluetooth Classic ☐ Bluetooth LE (not tested within this report) ☐ Cellular transceiver (2G/3G/4G/5G/GPS, not tested in this report) ☒ None		
Antenna Type	Integral antenna		
Antenna Gain	Max.: 2.6 dBi		
Rated Output Power	Measured: 10.12 dBm		
EIRP Power (Calculated EIRP)	10.12 dBm + 2.6 dBi= 12.72 dBm		
FCC label attached	No		
Test firmware / software and storage location	EUT		
For further details refer Applicants Declaration & following technical documents			
Description of Reference Document (supplied by applicant)		**Version**	**Total Pages**
--		--	--

3.3 Modifications on Test sample

Additions/deviations or exclusions	--

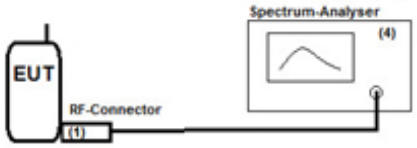
4 Measurements

4.1 Occupied Channel Bandwidth 99%

4.1.1 Description of the general test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Measurement is made using Rohde & Schwarz TS8997 test system.

4.1.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.1.3 Limit

When the occupied bandwidth limit is not stated in the applicable reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

4.1.4 Result

Diagram	Mode	Channel	Frequency [MHz]	99% Occupied bandwidth [MHz]
D01_001	OP. 1 / DTS	Low	903	502.198
D01_002	OP. 1 / DTS	Mid	909.4	503.131
D01_003	OP. 1 / DTS	High	914.2	502.994

Diagram	Mode	Channel	Frequency [MHz]	99% Occupied bandwidth [MHz]
D05_001	OP. 2 / FHSS	Low	902.3	125.475
D05_002	OP. 2 / FHSS	Mid	908.7	125.518
D05_003	OP. 2 / FHSS	High	914.9	125.406

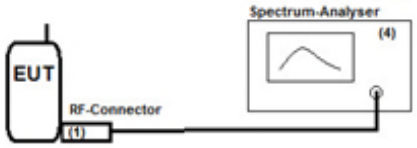
Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.2 Minimum Emission Bandwidth 6 dB / 20 dB

4.2.1 Description of the general test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

4.2.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.2.3 Limit

Limit [kHz]	Mode	Detector	RBW / VBW [kHz]
6 dB BW ≥ 500 kHz	DTS	MaxPeak	10 / 30
20 dB BW ≤ 500 kHz	FHSS	MaxPeak	3 / 10

4.2.4 Result

Diagram	Mode	Channel	Frequency [MHz]	6 dB bandwidth [kHz]	Result
D01_004	OP. 1 / DTS	Low	903	649.4	Passed
D01_005	OP. 1 / DTS	Mid	909.4	654.3	Passed
D01_006	OP. 1 / DTS	High	914.2	654.3	Passed

Diagram	Mode	Channel	Frequency [MHz]	20 dB bandwidth [kHz]	Result
D05_004	OP. 2 / FHSS	Low	902.3	138	Passed
D05_005	OP. 2 / FHSS	Mid	908.7	138	Passed
D05_006	OP. 2 / FHSS	High	914.9	138	Passed

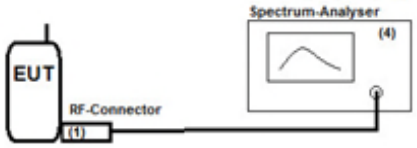
Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.3 Maximum Peak conducted output power

4.3.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to power meter (3) or 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.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Test method	Maximum peak conducted output power
	Integrated band power method(RBW < DTS-bandwidth of the signal)
Remarks	--

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

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

4.3.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.3.3 Limit

Frequency Range [MHz]	Mode	Limit [W]	Limit [dBm]	Detector	RBW / VBW
902 - 928	DTS	1	30	RMS	20 / 50 kHz
902 - 928	FHSS	1	30	MaxPeak	1 / 3 MHz

4.3.4 Result

Diagram	Mode	Channel	Frequency [MHz]	Max RMS Power [dBm]	Result
D02_001	DTS	Low	903	9.52	Passed
D02_002	DTS	Mid	909.4	9.56	Passed
D02_003	DTS	High	914.2	9.62	Passed

Diagram	Mode	Channel	Frequency [MHz]	Max Peak Power [dBm]	Result
D09_001	FHSS	Low	902.3	10.01	Passed
D09_002	FHSS	Mid	908.7	10.05	Passed
D09_003	FHSS	High	914.9	10.12	Passed

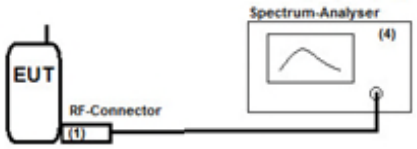
Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.4 Power spectral density

4.4.1 Description of the general test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Measurement is made using Rohde & Schwarz TS8997 test system.

Test method	AVGPSD Method
Remarks	--

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

4.4.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.4.3 Limit

Limit [dBm]	Mode	Detector	RBW / VBW [kHz]
≤ 8	DTS	RMS	3

4.4.4 Result

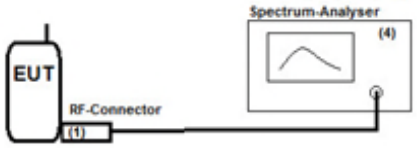
Diagram	Mode	Channel	Frequency [MHz]	PSD [dBm]	Result
D03_001	OP. 1 / DTS	Low	903	-10.67	Passed
D03_002	OP. 1 / DTS	Mid	909.4	-10.6	Passed
D03_003	OP. 1 / DTS	High	914.2	-10.7	Passed

Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.5 Conducted Band-Edge emissions

4.5.1 Description of the general test setup and methodology, see below example:

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured.
DTS-system set to a fixed channel.
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.

4.5.2 Measurement Location

Test site	120910 - Radio Laboratory 1

4.5.3 Limit

Frequency Range [MHz]	Pk Limit [dBc]	Detector	RBW / VBW [kHz]
902 - 928	20	Peak	100 / 300
902 - 928	30	Peak	100 / 300

4.5.4 Result

Non-restricted bands near-by

Diagram	Channel	Mode	Peak [dBc]	Result
D04_000	Low	OP. 1 / DTS	37.71	Passed
D04_999	High	OP. 1 / DTS	59.02	Passed

Diagram	Channel	Mode	Peak [dBc]	Result
D10_000	Low	OP. 2 / FHSS	38.80	Passed
D10_999	High	OP.2 / FHSS	59.09	Passed

Diagram	Channel	Mode	Peak [dBc]	Result
D10_111	Hopping	OP. 3 / FHSS	54.42 [1)]	Passed

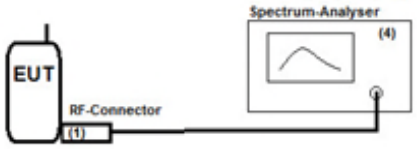
Remark: for more information and graphical plot see annex A1**TR22-1-0126501T009a-A1**
Remark 1: one diagram only to show low and high band-edge. Only low band-edge listed. High band-edge far away from limit.

4.6 Emissions in non-restricted frequency bands

4.6.1 Description of the general conducted test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Measurement is made using Rohde & Schwarz TS8997 test system.

The measurements were performed with the RBW set to 100 kHz & maximum carrier level was indicated with MAX-Hold positive peak detector using markers. Then a frequency line was set 20 or 30 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.

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.

4.6.2 Measurement Location

Test site	120910 - Radio Laboratory 1 (TS 8997)

4.6.3 Limit

Frequency Range [MHz]	Mode	Limit [dBc]
0.15 – 9500	DTS	30 [2]
0.15 – 9500	FHSS	20 [1]

Remark 1: limit where conducted power measurement complies based on peak detector
Remark 2: limit where conducted power measurement complies based on RMS detector

4.6.4 Result

Maximum Level Peak [dBc]

Diagram	Mode	Channel	Frequency [MHz]	Maximum level [dBm]	Limit [dBm]	Result
D04_101	DTS	Low			-19.97	Info
D04_102	DTS	Low	1806.25	-45.60		Passed
D04_201	DTS	Mid			-19.91	Info
D04_202	DTS	Mid	1819.25	-46.37		Passed
D04_301	DTS	High			-19.86	Info
D04_302	DTS	High	1828.75	-46.16		Passed

Diagram	Mode	Channel	Frequency [MHz]	Maximum level [dBm]	Limit [dBm]	Result
D10_101	FHSS	Low			-9.98	Info
D10_102	FHSS	Low	1804.75	-45.66		Passed
D10_201	FHSS	Mid			-9.93	Info
D10_202	FHSS	Mid	1817.25	-45.99		Passed
D10_301	FHSS	High			-9.85	Info
D10_302	FHSS	High	1830.00	-46.44		Passed

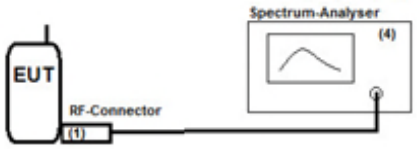
Remark2: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.7 Carrier Frequency Separation

4.7.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings

For FHSS-systems hopping mode was switched-on.
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.

4.7.2 Measurement Location

Test site	120910 - Radio Laboratory 1

4.7.3 Limit

Limit	Detector [MaxHold]	RBW / VBW [kHz]
≥ 25 kHz or 20 dB bandwidth	MaxPeak	10 / 1000

4.7.4 Result

Diagram	Mode	Channel	Frequency Separation[kHz]	Result
D06_001	OP. 3 / FHSS	Hopping	201.62	Passed

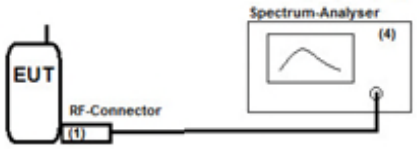
Remark: for more information and graphical plot see annex A1**TR22-1-0126501T009a-A1**
Remark 1: hopping mode switched on, no specific channel or frequency selected.

4.8 Number of Hopping Channels

4.8.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

Measurement is made using Rohde & Schwarz TS8997 test system.

EUT settings
For FHSS-systems hopping mode was switched-on.
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.

4.8.2 Measurement Location

Test site	120910 - Radio Laboratory 1

4.8.3 Limit

20 dB bandwidth of hopping channel	Limit [Number of happing channels]	Detector [MaxHold]	RBW / VBW [kHz]
≤ 250 kHz	≥ 50	MaxPeak	20 / 1000
≥ 250 kHz	≥ 25	MaxPeak	20 / 1000

4.8.4 Result

Diagram	Mode	Number of hopping channels	Result
D07_001	OP. 3 / FHSS	64	Passed

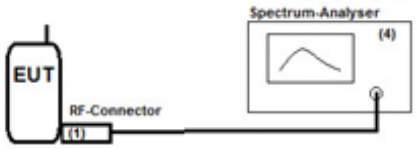
Remark: for more information and graphical plot see annex A1**TR22-1-0126501T009a-A1**

4.9 Time of Occupancy

4.9.1 Description of the general test setup and methodology, see below example:

The EUT's RF-signal is coupled out by a suitable antenna coupling connector. The direct RF-path is connected to the spectrum – analyzer for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 6)

EUT settings
For FHSS-systems hopping mode was switched-on.
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.

4.9.2 Measurement Location

Test site	120910 - Radio Laboratory 1

4.9.3 Limit

20 dB bandwidth of hopping channel	Limit [s]	Detector [MaxHold]	RBW / VBW [kHz]
≤ 250 kHz	≤ 0.4 s over 20 s	MaxPeak	100 / 1000
≥ 250 kHz	≤ 0.4 s over 10 s	MaxPeak	100 / 1000

4.9.4 Result

Diagram	Mode	Time of occupancy [ms]	Result
D08_001	OP. 3 / FHSS | 10 s	205.89	Passed
D08_002	OP. 3 / FHSS | 20 s	203.89	Passed

Remark: for more information and graphical plot see annex A1**TR22-1-0126501T009a-A1**

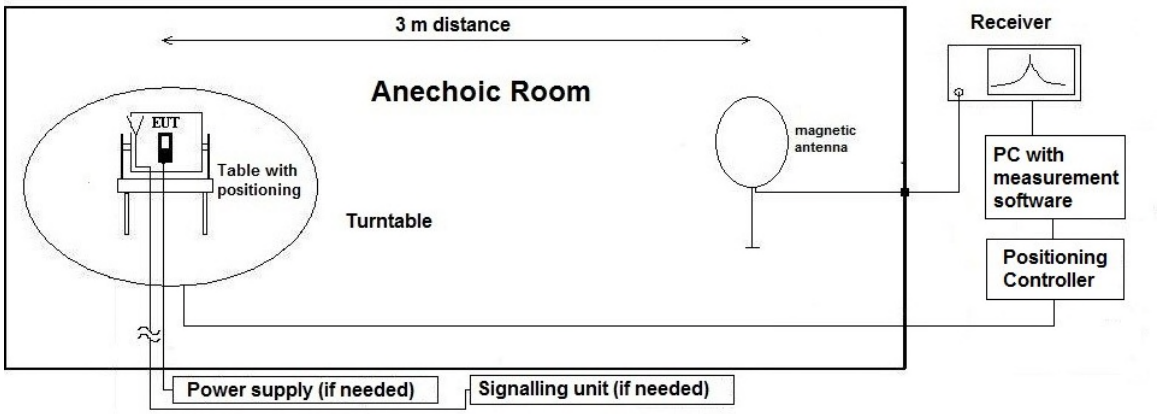
4.10 Radiated field strength emissions below 30 MHz

4.10.1 Description of the general test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

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 (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 (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.

4.10.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
19.83	18.9	-70.75	0.18	--	-51.67	-31.83	30 to 3 m correction used according ANSI C63.10-2013

Remark: This calculation is based on an example value at 458 kHz

4.10.3 Measurement Location

Test site	120901 - SAC3 - Radiated Emission <1GHz

4.10.4 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 < Dnear-field)	2nd Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9	33333.33	5305.17	300	fullfilled	not fullfilled	-80.00
	10	30000.00	4774.65		fullfilled	not fullfilled	-80.00
	20	15000.00	2387.33		fullfilled	not fullfilled	-80.00
	30	10000.00	1591.55		fullfilled	not fullfilled	-80.00
	40	7500.00	1193.66		fullfilled	not fullfilled	-80.00
	50	6000.00	954.93		fullfilled	not fullfilled	-80.00
	60	5000.00	795.78		fullfilled	not fullfilled	-80.00
	70	4285.71	682.09		fullfilled	not fullfilled	-80.00
	80	3750.00	596.83		fullfilled	not fullfilled	-80.00
	90	3333.33	530.52		fullfilled	not fullfilled	-80.00
	100	3000.00	477.47		fullfilled	not fullfilled	-80.00
	125	2400.00	381.97		fullfilled	not fullfilled	-80.00
	200	1500.00	238.73		fullfilled	fullfilled	-78.02
	300	1000.00	159.16		fullfilled	fullfilled	-74.49
	400	750.00	119.37		fullfilled	fullfilled	-72.00
	490	612.24	97.44		fullfilled	fullfilled	-70.23
	500	600.00	95.49	30	fullfilled	not fullfilled	-40.00
	600	500.00	79.58		fullfilled	not fullfilled	-40.00
	700	428.57	68.21		fullfilled	not fullfilled	-40.00
	800	375.00	59.68		fullfilled	not fullfilled	-40.00
	900	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

4.10.5 Limit

Radiated emissions limits, (3 meters)					
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m] *	Distance [m]	Detector	RBW [kHz]
0.009 – 0.09	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.09 – 0.11	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Quasi peak	0.2
0.11 – 0.15	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.15 – 0.49	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	9
0.49 – 1.705	24000 / f [kHz]	87.6 – 20Log(f) (kHz)	30	Quasi peak	9
1.705 - 30	30	29.5	30	Quasi peak	9

*Remark: In Canada same limits apply, just unit reference is different

4.10.6 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
2.01a	Low	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.01b	Low	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.02a	Mid	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.02b	Mid	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.03a	High	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.03b	High	mode 1 | DTS	No peaks >6 dB margin found	Passed
2.04a	Low	mode 2 | FHSS	No peaks >6 dB margin found	Passed
2.04b	Low	mode 2 | FHSS	No peaks >6 dB margin found	Passed
2.05a	Mid	mode 2 | FHSS	No peaks >6 dB margin found	Passed
2.05b	Mid	mode 2 | FHSS	No peaks >6 dB margin found	Passed
2.06a	High	mode 2 | FHSS	No peaks >6 dB margin found	Passed
2.06b	High	mode 2 | FHSS	No peaks >6 dB margin found	Passed

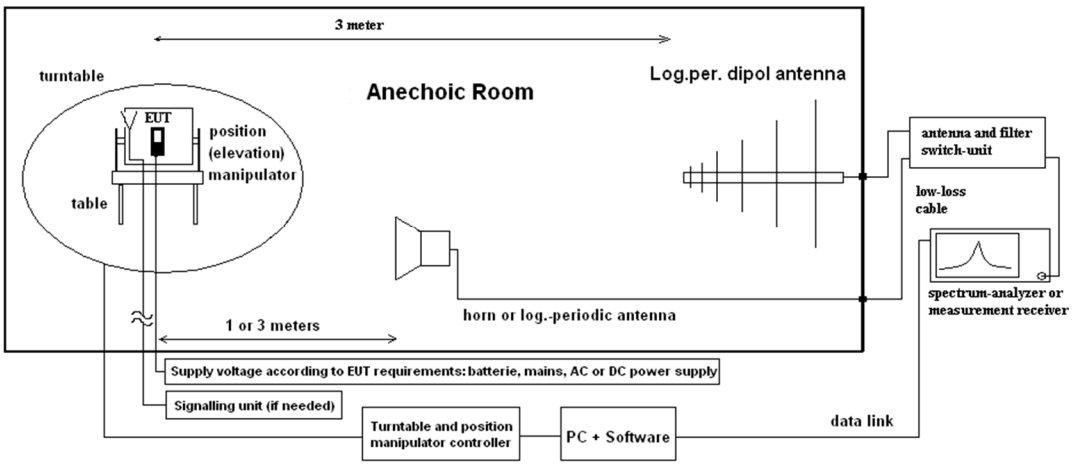
Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.11 Radiated field strength emissions 30 MHz – 1 GHz

4.11.1 Description of the general test setup and methodology, see below example:

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 semi anechoic room (SAR) and 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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

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

Measurement antenna: 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 main-taining 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.

4.11.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
32.7	22.25	--	3.1	--	25.35	58.05	--

Remark: This calculation is based on an example value at 800.4MHz

4.11.3 Measurement Location

Test site	120904 - FAC1 - Radiated Emissions

4.11.4 Limit Spurious

Radiated emissions limits, (3 meters)				
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Detector	RBW / VBW [kHz]
30 - 88	100	40.0	Quasi peak	100 / 300
88 - 216	150	43.5	Quasi peak	100 / 300
216 - 960	200	46.0	Quasi peak	100 / 300
960 - 1000	500	54.0	Quasi peak	100 / 300

4.11.5 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
3.01a	Low	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.01b	Low	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.02a	Mid	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.02b	Mid	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.03a	High	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.03b	High	OP. 1 / DTS	No peaks >6 dB margin found	Passed
3.04a	Low	OP.2 / FHSS	No peaks >6 dB margin found	Passed
3.04b	Low	OP.2 / FHSS	No peaks >6 dB margin found	Passed
3.05a	Mid	OP.2 / FHSS	No peaks >6 dB margin found	Passed
3.05b	Mid	OP.2 / FHSS	No peaks >6 dB margin found	Passed
3.06a	High	OP.2 / FHSS	No peaks >6 dB margin found	Passed
3.06b	High	OP.2 / FHSS	No peaks >6 dB margin found	Passed

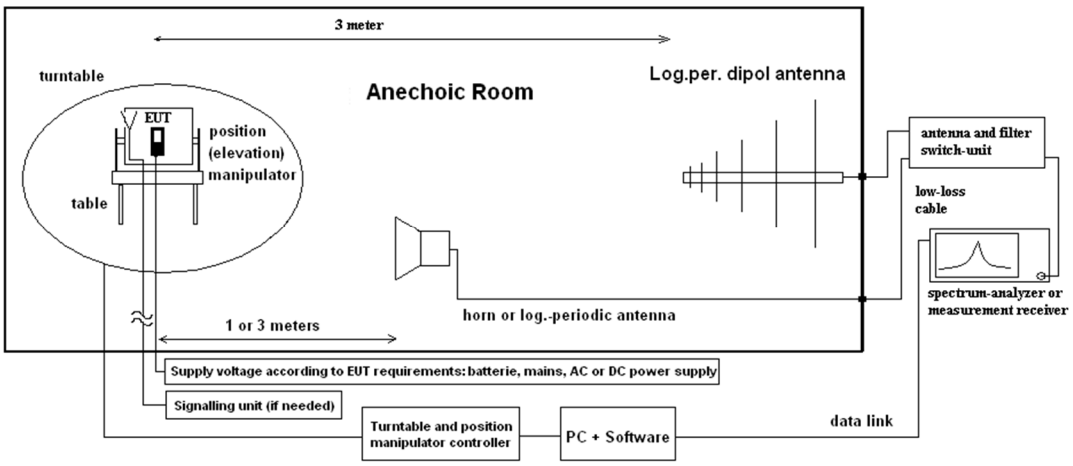
Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.12 Radiated field strength emissions above 1 GHz

4.12.1 Description of the general test setup and methodology, see below example:

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:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in 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 or three axis scan for portable/small equipment.

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

Formula:

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

$M = L_T - E_C$ (2)

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
A_F = 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.

4.12.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss + Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
29.37	41.20	--	24.28	16.92	46.3	CableLoss and PreAmp data in one data correction file

Remark: This calculation is based on an example value at 10 GHz

4.12.3 Measurement Location

Test site 1 – 18 GHz	120904 - FAC1 - Radiated Emissions

4.12.4 Limit

Radiated emissions limits, (3 meters)				
Frequency Range [MHz]	**Limit [µV/m]**	**Limit [dBµV/m]**	**Detector**	**RBW / VBW [kHz]**
Above 1000	500	54	Average	1000 / 3000
Above 1000	5000	74	Peak	1000 / 3000

4.12.5 Result

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 10 GHz	Result
4.01	Low	mode 1 | DTS	No peaks >6 dB margin found	Passed
4.02	Mid	mode 1 | DTS	No peaks >6 dB margin found	Passed
4.03	High	mode 1 | DTS	No peaks >6 dB margin found	Passed
4.04	Low	mode 2 | FHSS	No peaks >6 dB margin found	Passed
4.05	Mid	mode 2 | FHSS	No peaks >6 dB margin found	Passed
4.06	High	mode 2 | FHSS	No peaks >6 dB margin found	Passed

Remark: for more information and graphical plot see annex A1 **TR22-1-0126501T009a-A1**

4.13 Equipment lists

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
	120901 - SAC3 - Radiated Emission <1GHz			calchk	cal: 2015-Jul-21	cal: 10Y	cal: 2025-Jul-21
20442	Semi Anechoic Chamber	ETS-Lindgren Gmbh / Taufkirchen	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20482	filter matrix Filter matrix SAR 1	CETECOM GmbH	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20574	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH / Heideck	980026L	cal	cal: 2022-Jun-15	cal: 36M	cal: 2025-Jun-15
20620	Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100362	cal	cal: 2023-May-24	cal: 12M	cal: 2024-May-24
20885	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
25038	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH / Memmingen	879824/13	cal	cal: 2022-Jul-04	cal: 24M	cal: 2024-Jul-04
	120904 - FAC1 - Radiated Emissions			chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20020	Horn Antenna 3115 (Subst 1)	EMCO Elektronik GmbH	9107-3699	calchk	cal: 2021-Aug-17 chk: 2013-Apr-20	cal: 36M chk: 12M	cal: 2024-Aug-17
20066	Notch Filter WRCT 1900/2200-5/40-10EEK	Wainwright Instruments GmbH	5	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20121	Notch Filter WRCB 1879,5/1880,5EE	Wainwright Instruments GmbH	15	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20122	Notch Filter WRCB 1747/1748	Wainwright Instruments GmbH	12	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20254	High Pass Filter 5HC 2600/12750-1.5KK	Trilithic	23042	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20287	Pre-Amplifier 25MHz - 4GHz AMF-2D-100M4G-35-10P	Miteq Inc.	379418	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20290	Notch Filter WRCA 901,9/903,1SS	Wainwright Instruments GmbH	3RR	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20291	High Pass Filter WHJ 2200-4EE	Wainwright Instruments GmbH	14	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20338	Pre-Amplifier 100MHz - 26GHz JS4-00102600-38-5P	Miteq Inc.	838697	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20341	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	cal	cal: 2022-May-18	cal: 24M	cal: 2024-May-18
20448	Notch Filter WRCT 1850.0/2170.0-5/40-10SSK	Wainwright Instruments GmbH	5	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20449	Notch Filter WRCT 824.0/894.0-5/40-8SSK	Wainwright Instruments GmbH	1	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20484	Pre-Amplifier 2,5GHz - 18GHz AMF-5D-02501800-25-10P	Miteq Inc.	1244554	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20489	Test Receiver ESU40	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100030	cal	cal: 2023-May-24	cal: 12M	cal: 2024-May-24
20512	Notch Filter WRCA 800/960-02/40-6EEK (GSM 850)	Wainwright Instruments GmbH	24	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20549	Log. Per. Antenna HL025	Rohde & Schwarz Messgerätebau GmbH	1000060	calchk	cal: 2021-Aug-18	cal: 36M chk: 12M	cal: 2024-Aug-18
20558	Fully Anechoic Chamber 1	ETS-Lindgren Gmbh / Taufkirchen	-	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20608	Ultrabroadband-Antenna HL562	Rohde & Schwarz Messgerätebau GmbH / Memmingen	830547/009	cal	cal: 2023-Jul-04	cal: 36M	cal: 2026-Jul-04
20611	Power Supply E3632A	Agilent Technologies Deutschland GmbH	KR 75305854	cpu			
20690	Spectrum Analyzer FSU	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100302/026	cal	cal: 2023-May-25	cal: 24M	cal: 2025-May-25
20720	Measurement Software EMC32 [FAC]	Rohde & Schwarz Messgerätebau GmbH	V10.xx	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20868	High Pass Filter AFH-07000	AtlanTecRF	16071300004	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20883	Open Switch and control Platform OSP-B200S2 Satellite	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101432	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
20884	Open Switch and control Platform OSP320	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101391	chk	chk: 2023-Aug-22	chk: 12M	chk: 2024-Aug-22
	120910 - Radio Laboratory 1 (TS 8997)			chk	chk: 2023-Jul-10	chk: 12M	chk: 2024-Jul-10
20559	Vector Signal Generator SMU200A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	103736	cal	cal: 2023-May-25	cal: 24M	cal: 2025-May-25
20691	Open Switch and control Platform OSP157W 8 Port Plus	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100950	cal	cal: 2023-Jun-30	cal: 36M	cal: 2026-Jun-30
20805	Open Switch and control Platform OSP B157WX 40GHz 8Port Switch	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101264	cal	cal: 2023-May-26	cal: 36M	cal: 2026-May-26
20866	Signal Analyzer FSV3030	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101247	cal	cal: 2023-Jun-14	cal: 12M	cal: 2024-Jun-14
20871	NRP-Z81	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104631	cal	cal: 2023-May-23	cal: 12M	cal: 2024-May-23
20872	NRX Power Meter	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101831	cal	cal: 2022-May-17	cal: 24M	cal: 2024-May-17
20873	WTS-80 Schirmbox	CETECOM GmbH	P3101	cnn	cal: - chk: -	cal: - chk: -	cal: - chk: -
20904	Climatic Chamber ClimeEvent C/1000/70a/5	Weiss Umwelttechnik GmbH / Reiskirchen-Lindenstruth	58226223240010	cal	cal: 2022-Nov-29	cal: 24M	cal: 2024-Nov-29
20927	Signal Generator SMF 100A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102109	cal	cal: 2022-May-19	cal: 36M	cal: 2025-May-19

Tools used in 'P1M1'

4.13.1 Legend

Note / remarks	Interval of calibration & Verification
12M	12 months
24M	24 months
36M	36 months
10Y	10 Years

Abbreviation Check Type	Description
cnn	Calibration and verification not necessary
cal	Calibration
calchk	Calibration plus intermediate Verification
chk	Verification
cpu	Verification before usage

5 Results from external laboratory

None	-

6 Opinions and interpretations

None	-

7 List of abbreviations

None	-

8 Measurement Uncertainty valid for conducted/radiated measurements

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 contribution to the overall uncertainty according its statistical distribution calculated.

Issue No.	Measurement type	Reference	Frequency range of measurement		Calculated Uncertainty based on confidence level of 95.54%	Remarks
			Start [MHz]	Stop [MHz]		
1	Magnetic field strength	EN,FCC,JP,IC	0.009	30	4.86	Magnetic loop antenna, Pre-amp on
2	RF-Output power (eirp) Unwanted emissions (eirp) [dB]	EN,FCC,JP,IC	30	100	4.57	without Pre-Amp
			30	100	4.91	with PreAmp
			100	1000	4.02	without Pre-Amp
			100	1000	4.26	with PreAmp
			1000	18000	4.36	without Pre-Amp
			1000	18000	5.23	with PreAmp
			18000	33000	4.92	Schwarzbeck BBHA9170 (#20302) Antenna set-up non-waveguide antenna)
			33000	50000	4.17	Set-up for Q-Band (WR-22), non-wave guide antenna
			40000	60000	4.69	Set-up U-Band (WR-19), non-waveguide antenna
			50000	75000	4.06	External Mixer set-up V-Band (WR-15)
			75000	110000	4.17	External Mixer set-up W-Band (WR-6)
			90000	140000	5.49	External Mixer set-up F-Band (WR-8)
			140000	225000	6.22	External Mixer set-up G-Band (WR-5)
			225000	325000	7.04	External Mixer set-up (WR-3)
			325000	500000	8.84	External Mixer set-up (WR-2.2)
3	Radiated Blocking [dB]	EN	1000	18000	2.85	Typical set-up with microwave generator and antenna, value for 7GHz calculated
			18000	33000	4.66	Typical set-up with microwave generator and antenna
			33000	50000	3.48	WR-22 set-up
			50000	75000	3.73	WR-15 set-up
			75000	110000	4.26	WR-6 set-up
4	Frequency Error / UWB+FMCW [kHz]	EN, FCC,JP, ISED	40000	77000	276.19	calculated for 77 GHz (FMCW) carrier
			6000	7000	33.92	calculated for 6.5GHz UWB Ch.5
	Frequency Error / NFC [Hz]	EN, FCC,JP, ISED	11.00	14.00	20.76	calculated for 13.56MHz NFC carrier
5	TS 8997 conducted Parameters	FCC15/18 / ISED	30	6000	1.11	1. Power measurement with Fast-sampling-detector
			30	6000	1.20	2. Power measurement with Spectrum-Analyzer
			30	6000	1.20	3. Power Spectrum-Density measurement
			30	7500	1.20	4. Conducted Spurious emissions:
			0.009	30	2.56	5. Conducted Spurious emissions:
			2.4	2.48	1.95 ppm	6a. Bandwidth / 2-Marker Method for 2.4GHz ISM
			5.18	5.825	7.180 ppm	6b. Bandwidth / 2-Marker Method for 5GHz WLAN
			5.18	5.825	1.099 ppm	7 Frequency (Marker method) for 5GHz WLAN
			30	6000	0.11561µs	8 Medium-Utilization factor / Timing
			30	6000	1.85	9 Blocking-Level of companion device
			30	6000	1.62	9 Blocking Generator level
6	Conducted emissions	EN, FCC	0.009	30	3.57	general EMI-measurements on AC/DC ports

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2023-Dec-20
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End Of Test Report