FCC Measurement/Technical Report on

CMWA6600
IMx1 Gateway

FCC ID: 2AVQ2-CMWA6600
& contains
XPYEMMYW161 and QIPPLS62-W/W1

IC: 25894-CMWA6600
& contains
8595A-EMMYW161 and 7830A-PLS62W

Test Report Reference: MDE_SKF_1901_FCC_05

Test Laboratory:
7layers GmbH
Borsigstrasse 11
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Germany

Deutsche
Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

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1 APPLIED STANDARDS AND TEST SUMMARY

1.1 APPLIED STANDARDS

Type of Authorization
Certification for a cellular mobile device and for an Intentional Radiator (Digital Device / Spread Spectrum).

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 2 and 22, 24, 27, and 15 (10-1-20 Edition). The following subparts are applicable to the results in this test report.

Part 2, Subpart J - Equipment Authorization Procedures, Certification

§2.947 (f) – Composite system

Part 22, Subpart H – Cellular Radiotelephone Service

§ 22.905 – Channels for cellular service
§ 22.913 – Effective radiated power limits
§ 22.917 – Emission limitations for cellular equipment

Part 24, Subpart E – Broadband PCS

§ 24.232 – Power and antenna height limits
§ 24.235 – Frequency stability
§ 24.238 – Emission limitations for Broadband PCS equipment

Part 27; Miscellaneous Wireless Communications Services Subpart C – Technical standards

§ 27.50 – Power and duty cycle limits
§ 27.53 – Emission limits
§ 27.54 – Frequency stability

Part 15, Subpart C – Intentional Radiators

§ 15.201 Equipment authorization requirement
§ 15.207 Conducted limits
§ 15.209 Radiated emission limits; general requirements
§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz

Part 15, Subpart E – Unlicensed National Information Infrastructure Devices

§ 15.403 Definitions
§ 15.407 General technical requirements

The tests were selected and performed with reference to:

- FCC OET KDB 971168 applying attachment D01 “Measurement guidance for certification of licensed digital transmitters” D01 v03r01, April 9, 2018
- FCC OET KDB 996369 applying attachments D01 "Module Equip Auth Guide" v02, October 23, 2015 and D04 "Module Integration Guide" v02, October 12, 2020.
- FCC OET KDB 558074 applying attachment D01 “Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules”, v05r02, April 2, 2019.
- FCC OET KDB 789033 applying attachment D02 “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E”, v02r01, December 14, 2017.
- ANSI C63.26-2015
- ANSI C63.10-2013

1.2 FCC-ISED CORRELATION TABLE

Correlation of measurement requirements for Cellular Mobile Devices from FCC and ISED Canada

Part 22

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 22.913	RSS-GEN Issue 5+A1+A2, 6.12 RSS-132 Issue 3, 5.4
Peak-Average-Ratio	-	RSS 132 Issue 3: 5.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5+A1+A2, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 22.917	RSS-GEN Issue 5+A1+A2, 6.13 RSS-132 Issue 3, 5.5
Band Edge Compliance	§ 2.1051 § 22.917	RSS-GEN Issue 5+A1+A2, 6.13 RSS-132 Issue 3, 5.5
Frequency stability	§ 2.1055 § 22.355	RSS-GEN Issue 5+A1+A2, 6.11 RSS-132 Issue 3: 5.3
Field strength of spurious radiation	§ 2.1053 § 22.917	RSS-GEN Issue 5+A1+A2, 6.13 RSS-132 Issue 3: 5.5

Part 24

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 24.232	RSS-GEN Issue 5+A1+A2, 6.12 RSS-133 Issue 6, 6.4
Peak-Average-Ratio	§ 24.232	RSS 133 Issue 6: 6.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5+A1+A2, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 24.238	RSS-GEN Issue 5+A1+A2, 6.13 RSS-133 Issue 6, 6.5
Band Edge Compliance	§ 2.1051 § 24.238	RSS-GEN Issue 5+A1+A2, 6.13 RSS-133 Issue 6, 6.5
Frequency stability	§ 2.1055 § 24.235	RSS-GEN Issue 5+A1+A2, 6.11 RSS-133 Issue 6: 6.3
Field strength of spurious radiation	§ 2.1053 § 24.236	RSS-GEN Issue 5+A1+A2, 6.13 RSS-133 Issue 6: 6.5

Part 27

Measurement	FCC reference	ISED reference
RF Output Power	§ 2.1046 § 27.50	RSS-GEN Issue 5+A1+A2, 6.12 RSS-130 Issue 2, 4.6.2/4.6.3 RSS-139 Issue 3, 6.5 RSS-199 Issue 3, 4.4
Peak to Average-Ratio	§ 27.50	RSS-130 Issue 2: 4.6.1 RSS 139 Issue 3: 6.5 RSS-199 Issue 3, 4.4
Emission and Occupied bandwidth	§ 2.1049	RSS-GEN Issue 5+A1+A2, 6.7
Spurious Emission at Antenna Terminals	§ 2.1051 § 27.53	RSS-GEN Issue 5+A1+A2, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 3, 6.6 RSS-199 Issue 3, 4.5
Band Edge Compliance	§ 2.1051 § 27.53	RSS-GEN Issue 5+A1+A2, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 3, 6.6 RSS-199 Issue 3, 4.5
Frequency stability	§ 2.1055 § 27.54	RSS-GEN Issue 5+A1+A2, 6.11 RSS-130 Issue 2: 4.5 RSS-139 Issue 3: 6.4 RSS-199 Issue 3, 4.3
Field strength of spurious radiation	§ 2.1053 § 27.53	RSS-GEN Issue 5+A1+A2, 6.13 RSS-130 Issue 2: 4.7.1/4.7.2 RSS-139 Issue 3: 6.6 RSS-199 Issue 3, 4.5

Correlation of measurement requirements for DTS (e.g. WLAN 2.4 GHz, BT LE) equipment from FCC and ISED Canada

DTS equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5+A1+A2: 8.8
Occupied bandwidth	§ 15.247 (a) (2)	RSS-247 Issue 2: 5.2 (a)
Peak conducted output power	§ 15.247 (b) (3), (4)	RSS-247 Issue 2: 5.4 (d)
Transmitter spurious RF conducted emissions	§ 15.247 (d)	RSS-Gen Issue 5+A1+A2: 6.13 / 8.9/8.10; RSS-247 Issue 2: 5.5
Transmitter spurious radiated emissions	§ 15.247 (d); § 15.209 (a)	RSS-Gen Issue 5+A1+A2: 6.13 / 8.9/8.10; RSS-247 Issue 2: 5.5
Band edge compliance	§ 15.247 (d)	RSS-247 Issue 2: 5.5
Power density	§ 15.247 (e)	RSS-247 Issue 2: 5.2 (b)
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5+A1+A2: 6.8
Receiver spurious emissions	–	–

Correlation of measurement requirements for UNII / LE-LAN (e.g. WLAN 5 GHz) equipment from FCC and ISED Canada

UNII equipment

Measurement	FCC reference	IC reference
Conducted emissions on AC Mains	§ 15.207	RSS-Gen Issue 5+A1+A2: 8.8
Occupied bandwidth	§ 15.403 (i) (26 dB) / § 15.407 (e) (6 dB)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1 (99%) RSS-247 Issue 2: 6.2.4.1 (6 dB)
Maximum conducted output power	§ 15.407 (a) (1),(2),(3),(4)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Maximum power spectral density	§ 15.407 (a) (1),(2),(3),(5)	RSS-247 Issue 2: 6.2.1.1, 6.2.2.1, 6.2.3.1, 6.2.4.1
Transmitter undesirable emissions; General Field Strength Limits, Restricted Bands	§ 15.407 (b) § 15.209 (a)	RSS-Gen Issue 5+A1+A2: 6.13/8.9/8.10; RSS-247 Issue 2: 3.3/6.2 6.2.1.2, 6.2.2.2, 6.2.3.2, 6.2.4.2
Frequency stability	§ 15.407 (g)	RSS-Gen Issue 5+A1+A2: 6.11/8.11
Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS)	§ 15.407 (h)	RSS-247 Issue 2: 6.2.2.1, 6.2.3.1, 6.3
Antenna requirement	§ 15.203 / 15.204	RSS-Gen Issue 5+A1+A2: 6.8
Receiver spurious emissions	–	–

1.3 MEASUREMENT SUMMARY

47 CFR CHAPTER I FCC PART 22 Subpart H		**§ 2.1053**		
RF Output Power § 22.913				
The measurement was performed according to ANSI C63.26, 5.2.4.4			**Final Result**	
OP-Mode Radio Technology, Band, Modulation, Channel, ChBW, Resource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
UTRA, FDD V, QPSK, mid, 5 MHz, –, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 5, QPSK, mid, 5 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 5, QPSK, mid, 5 MHz, 12, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 5, QPSK, mid, 5 MHz, 25, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 5, QPSK, mid, 10 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 5, QPSK, mid, 10 MHz, 50, conducted	S01_AB09	2022-03-03	Passed	Passed
Field strength of spurious radiation § 22.917				
The measurement was performed according to ANSI C63.26, 5.5.2.3.1			**Final Result**	
OP-Mode Radio Technology, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
eFDD 5 + WLAN + Mira-Mesh, radiated > 1 GHz	S02_AB09	2022-02-14	Passed	Passed

47 CFR CHAPTER I FCC PART 24 Subpart E		**§ 2.1053**		
RF Output Power § 24.234				
The measurement was performed according to ANSI C63.26, 5.2.4.4			**Final Result**	
OP-Mode Radio Technology, Band, Modulation, Channel, ChBW, Resource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
UTRA, FDD II, QPSK, mid, 5 MHz, –, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 2, QPSK, mid, 5 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 2, QPSK, mid, 5 MHz, 12, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 2, QPSK, mid, 5 MHz, 25, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 2, QPSK, mid, 10 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 2, QPSK, mid, 10 MHz, 50, conducted	S01_AB09	2022-03-03	Passed	Passed
Field strength of spurious radiation § 24.236				
The measurement was performed according to ANSI C63.26, 5.5.2.3.1			**Final Result**	
OP-Mode Radio Technology, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
eFDD 2 + WLAN + Mira-Mesh, radiated > 1 GHz	S02_AB09	2022-03-02	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C		**§ 2.1053**		
RF Output Power § 27.50				
The measurement was performed according to ANSI C63.26, 5.2.4.4			**Final Result**	
OP-Mode Radio Technology, Band, Modulation, Channel, ChBW, Resource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
E-UTRA, eFDD 4, QPSK, mid, 5 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 4, QPSK, mid, 5 MHz, 12, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 4, QPSK, mid, 5 MHz, 25, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 4, QPSK, mid, 10 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 4, QPSK, mid, 10 MHz, 50, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 12, QPSK, mid, 5 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 12, QPSK, mid, 5 MHz, 12, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 12, QPSK, mid, 5 MHz, 25, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 12, QPSK, mid, 10 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 12, QPSK, mid, 10 MHz, 50, conducted	S01_AB09	2022-03-03	Passed	Passed

47 CFR CHAPTER I FCC PART 27 Subpart C		§ 2.1053		
RF Output Power § 27.50				
The measurement was performed according to ANSI C63.26, 5.2.4.4			**Final Result**	
OP-Mode Radio Technology, Band, Modulation, Channel, ChBW, Resource Blocks, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
E-UTRA, eFDD 7, QPSK, mid, 5 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 7, QPSK, mid, 5 MHz, 12, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 7, QPSK, mid, 5 MHz, 25, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 7, QPSK, mid, 10 MHz, 1, conducted	S01_AB09	2022-03-03	Passed	Passed
E-UTRA, eFDD 7, QPSK, mid, 10 MHz, 50, conducted	S01_AB09	2022-03-03	Passed	Passed
Field strength of spurious radiation § 27.53				
The measurement was performed according to ANSI C63.26, 5.5.2.3.1			**Final Result**	
OP-Mode Radio Technology, Measurement method	**Setup**	**Date**	**FCC**	**ISED (IC)**
eFDD 7 + WLAN + Mira-Mesh, radiated > 1 GHz	S02_AB09	2022-02-14	Passed	Passed

2 REVISION HISTORY / SIGNATURES

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	2022-06-03	--	valid
--	--	--	--

COMMENT: Not all applicable tests are performed, according to "KDB996369 D04 Module Integration Guide v02, October 12, 2020" spot checks for radiated spurious emissions tests above 1 GHz in simultaneous transmission modes are performed.
The RF output power of the approved cellular module at the external antenna connectors is determined for some modes.

(responsible for accreditation scope)
Dipl.-Ing. Marco Kullik

(responsible for testing and report)
Dipl.-Ing. Andreas Petz

7 layers GmbH, Borsigstr. 11
40880 Ratingen, Germany
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3 ADMINISTRATIVE DATA

3.1 TESTING LABORATORY

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-01| -02 | -03
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Dipl.-Ing. Marco Kullik
Report Template Version:	2021-09-09

3.2 PROJECT DATA

Responsible for testing and report:	Dipl.-Ing. Andreas Petz
Employees who performed the tests:	documented internally at 7Layers
Date of Report:	2022-06-03
Testing Period:	2022-02-14 to 2022-03-02

3.3 APPLICANT DATA

Company Name:	SKF Sverige AB
Address:	Aurorum 30 977 75 Lulea Sweden
Contact Person:	Ludo Gommers

3.4 MANUFACTURER DATA

Company Name:	please see Applicant Data

4 TEST OBJECT DATA

4.1 GENERAL EUT DESCRIPTION

Kind of Device product description	Enlight Collect Gateway
Product name	IMx1 Gateway
Type	CMWA6600
Declared EUT data by the supplier	
General product description	Radio Transceiver supporting Cellular WLAN, BT-LE and 802.15.4 based mesh radio.
Specific product description for the EUT	The IMx-1 Enlight Collect Gateway is gateway for SKF wireless sensor vibration monitoring network. The EUT contains radio modules for LTE (E-UTRA), UMTS (UTRA), WLAN, Bluetooth Low Energy and Mira-Mesh (proprietary technology). WLAN and BT-LE work only in exclusive-or mode.
Voltage Level	DC input: 9..36 V; PoE: 44..57 V (DC)
Voltage Type	DC (24 V nom.) or PoE (DC, 48 V nom.)
The EUT provides the following ports:	DC, LAN1+PoE, LAN2, Enclosure, Four external antenna connectors (SMA) for: – Cellular TX/RX – Cellular RX Diversity – WLAN / BT-LE (combined) – Mira-Mesh

4.2 EUT MAIN COMPONENTS

Sample Name	**Sample Code**	**Description**
EUT #ab09	DE1384000ab09	Test Sample
Sample Parameter	**Value**	
Serial No.	RC 0007	
HW Version	PCBA Rev 11	
SW Version	Test Firmware build-id 214753	
Comment	external antennas activated	

NOTE: The short description is used to simplify the identification of the EUT in this test report.

4.3 ANCILLARY EQUIPMENT

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But nevertheless Ancillary Equipment can influence the test results.

Device	**Details (Manufacturer, Type Model, OUT Code)**	**Description**
-	-	-

4.4 AUXILIARY EQUIPMENT

For the purposes of this test report, auxiliary equipment is defined as equipment which is used temporarily to enable operational and control features especially used for the tests of the EUT which is not used during normal operation or equipment that is used during the tests in combination with the EUT but is not subject of this test report. It is necessary to configure the system in a typical fashion, as a customer would normally use it.
But nevertheless Auxiliary Equipment can influence the test results.

Device	**Details (Manufacturer, Type Model, HW, SW, S/N)**	**Description**
External Antennas	Delock, 12545 with attached 1 m cable type ULA100, -, -, -	4 identical external antennas, mounted on an auxiliary metal plate (groundplane)

4.5 EUT SETUPS

This chapter describes the combination of EUTs and equipment used for testing. The rationale for selecting the EUTs, ancillary and auxiliary equipment and interconnecting cables, is to test a representative configuration meeting the requirements of the referenced standards.

Setup	**Combination of EUTs**	**Description and Rationale**
S02_AB09	#ab09, External Antennas,	Radiated Setup, with external antennas
S01_AB09	#ab09	Conducted Setup

4.6 OPERATING MODES / TEST CHANNELS

This chapter describes the operating modes of the EUTs used for testing.

Band / Mode	LTE eFDD 2	LTE eFDD 2	UTRA FDD II	LTE eFDD 4	LTE eFDD 4
Channel	MID	MID	MID	MID	MID
Cell BW [MHz]	5	10	5	5	10
CH no.	18900	18900	9400	20175	20175
f [MHz]	1880.0	1880.0	1880.0	1732.5	1732.5

Band / Mode	LTE eFDD 5	LTE eFDD 5	UTRA FDD V	LTE eFDD 7	LTE eFDD 7
Channel	MID	MID	MID	MID	MID
Cell BW [MHz]	5	10	5	5	10
CH no.	20525	20525	4183	21100	21100
f [MHz]	836.5	836.5	836.6	2535.0	2535.0

Band / Mode	LTE eFDD 12	LTE eFDD 12			
Channel	MID	MID			
Cell BW [MHz]	5	10			
CH no.	23095	23095			
f [MHz]	707.5	707.5			

Simultaneous transmissions:

Simult .Mode	STX2		
Technology	LTE	WLAN	Mira-Mesh
Band	eFDD2	5 GHz	2.4 GHz
Channel	LOW	MID	HIGH
Cell BW [MHz]	10	20	1
Resource Blocks	1, low	–	–
Modulation	QPSK	BPSK, a-mode	GFSK
CH no.	18650	100	80
f [MHz]	1850.6	5500	2480

Simult .Mode	STX5		
Technology	LTE	WLAN	Mira-Mesh
Band	eFDD5	2.4 GHz	2.4 GHz
Channel	LOW	HIGH	MID
Cell BW [MHz]	10	20	1
Resource Blocks	1, low	–	–
Modulation	QPSK	BPSK, b-mode	GFSK
CH no.	20450	13	41
f [MHz]	824.6	2472	2442

Simult .Mode	STX7		
Technology	LTE	WLAN	Mira-Mesh
Band	eFDD7	2.4 GHz	2.4 GHz
Channel	LOW	HIGH	MID
Cell BW [MHz]	10	20	1
Resource Blocks	1, low	–	–
Modulation	QPSK	BPSK, b-mode	GFSK
CH no.	20800	13	41
f [MHz]	2500.6	2472	2442

4.7 PRODUCT LABELLING

Please refer to the documentation of the applicant.

5 TEST RESULTS

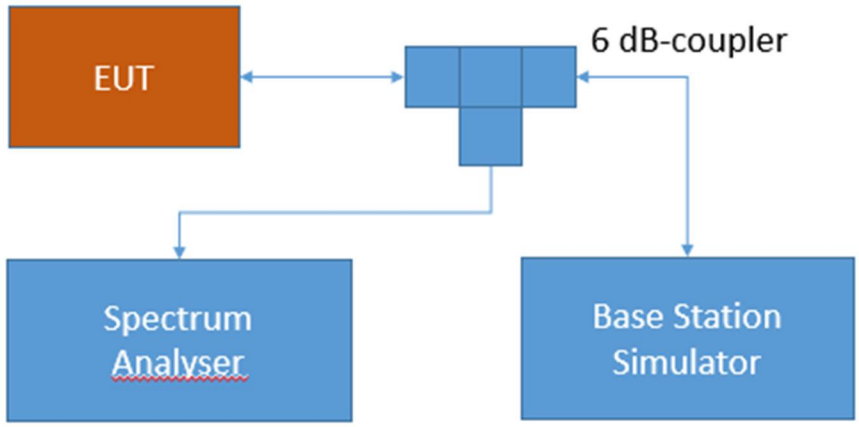
5.1 RF OUTPUT POWER

The test was performed according to: ANSI C63.26-2015, 5.2.4.4

5.1.1 TEST DESCRIPTION (COMMON)

This test case is intended to demonstrate compliance to the applicable RF Output power test case per § 2.1046 and RSS-GEN 6.12. The limit and the requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:



Test Setup FCC Part 22/24/27/90 Cellular;
RF Output power

The attenuation of the measuring and stimulus path are known for each measured frequency and are considered.

The Spectrum Analyzer settings can be directly found in the measurement diagrams.

5.1.2 TEST DESCRIPTION (SPECIFIC)

Standard **FCC PART 22 Subpart H, §22.913**

Standard **FCC PART 24 Subpart E, § 24.232**

Standard **FCC PART 27 Subpart E, § 27.50**

5.1.3 TEST REQUIREMENTS / LIMITS

FCC Part 22, § 22.913

(a) *Maximum ERP.* The ERP of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(5) The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts.

RSS-132; 5.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The transmitter output power shall be measured in terms of average power. The equivalent isotropically radiated power (e.i.r.p.) for mobile equipment shall not exceed 11.5 watts.

FCC Part 24, § 24.232

(c) Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

RSS-133; 6.4 Transmitter Output Power and Equivalent Isotropically Radiated Power

The equivalent isotropically radiated power (e.i.r.p.) for transmitters shall not exceed the limits given in SRSP-510.

SRSP-510; 5.1.2 Radiated Power and Antenna Height Limits – Mobile Stations

Mobile stations and hand-held portables are limited to 2 watts maximum e.i.r.p. The equipment shall employ means to limit the power to the minimum necessary for successful communication.

FCC Part 27, § 27.50

Band 13:

(b) The following power limits apply to transmitters operating in the 746-758 MHz, 775-788 MHz and 805-806 MHz bands:

(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output Power

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 12:

c) The following power and antenna height requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output Power

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 4 / 10 / 66:

d) The following power and antenna height requirements apply to stations transmitting in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz and 2180-2200 MHz bands:

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP. Fixed stations operating in the 1710-1755 MHz band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in these bands must employ a means for limiting power to the minimum.

RSS-139; 6.5 Transmitter Output Power

The equivalent isotropically radiated power (e.i.r.p.) for mobile and portable transmitters shall not exceed one watt.

Band 71:

(c) The following power requirements apply to stations transmitting in the 600 MHz band and the 698-746 MHz band:

(10) Portable stations (hand-held devices) in the 600 MHz uplink band and the 698-746 MHz band, and fixed and mobile stations in the 600 MHz uplink band are limited to 3 watts ERP.

RSS-130; 4.6.3 Transmitter Output

The e.r.p. shall not exceed 3 watts for portable equipment and indoor fixed subscriber equipment.

Band 7:

(h) The following power limits shall apply in the BRS and EBS:

(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

RSS-199; 4.4 Transmitter output power and equivalent isotropically power (e.i.r.p.)

The transmitter output power shall be measured in terms of average value.

For mobile subscriber equipment, the e.i.r.p. shall not exceed 2 W. For fixed subscriber equipment, the transmitter output power shall not exceed 2 W and the e.i.r.p. shall be limited to 40 W.

For equipment with multiple antennas, the transmitter output power and e.i.r.p shall be measured according to ANSI C63.26-2015.

5.1.4 TEST PROTOCOL

Temperature: 25 °C
Humidity: 31 %

The power is measured at the permanent external antenna connector. The highest value is printed in bold.

Part 22:

Radio Technology	Channel	Resource Blocks / Subcarrier	Bandwidth [MHz]	RMS Cond. Power [dBm]	FCC EIRP Limit [W]	IC EIRP Limit [W]	Max. Antenna Gain FCC [dBi]	Max. Antenna Gain IC [dBi]
UTRA FDD V	mid	n/a	5	**22.6**	11.5	11.5	18.0	18.0
LTE eFDD 5 QPSK	mid	1	5	21.1	11.5	11.5	19.5	19.5
LTE eFDD 5 QPSK	mid	12	5	20.0	11.5	11.5	20.6	20.6
LTE eFDD 5 QPSK	mid	25	5	20.0	11.5	11.5	20.6	20.6
LTE eFDD 5 QPSK	mid	1	10	21.1	11.5	11.5	19.5	19.5
LTE eFDD 5 QPSK	mid	50	10	20.2	11.5	11.5	20.4	20.4

Part 24:

Radio Technology	Channel	Resource Blocks / Subcarrier	Bandwidth [MHz]	RMS Conducted Power [dBm]	FCC EIRP Limit [W]	IC EIRP Limit [W]	Maximum Antenna Gain FCC [dBi]	Maximum Antenna Gain IC [dBi]
UTRA FDD II	mid	n/a	5	**21.8**	2.0	2.0	11.2	11.2
LTE eFDD 2 QPSK	mid	1	5	21.0	2.0	2.0	12.0	12.0
LTE eFDD 2 QPSK	mid	12	5	19.9	2.0	2.0	13.1	13.1
LTE eFDD 2 QPSK	mid	25	5	19.9	2.0	2.0	13.1	13.1
LTE eFDD 2 QPSK	mid	1	10	21.1	2.0	2.0	11.9	11.9
LTE eFDD 2 QPSK	mid	50	10	20.2	2.0	2.0	12.8	12.8

Part 27:

Radio Technology	Channel	Resource Blocks	Bandwidth [MHz]	RMS Conducted Power (dBm)	FCC Limit (W)	IC Limit (W)	Maximum Antenna Gain FCC (dBi)	Maximum Antenna Gain IC (dBi)
LTE eFDD 4 QPSK	mid	1	5	21.2	1 (EIRP)	1 (EIRP)	8.8	8.8
LTE eFDD 4 QPSK	mid	12	5	20.2	1 (EIRP)	1 (EIRP)	9.8	9.8
LTE eFDD 4 QPSK	mid	25	5	20.2	1 (EIRP)	1 (EIRP)	9.8	9.8
LTE eFDD 4 QPSK	mid	1	10	21.4	1 (EIRP)	1 (EIRP)	8.6	8.6
LTE eFDD 4 QPSK	mid	50	10	20.5	1 (EIRP)	1 (EIRP)	9.5	9.5
LTE eFDD 12 QPSK	mid	1	5	21.5	3 (ERP)	3 (ERP)	15.4	15.4
LTE eFDD 12 QPSK	mid	12	5	20.2	3 (ERP)	3 (ERP)	16.7	16.7
LTE eFDD 12 QPSK	mid	25	5	20.2	3 (ERP)	3 (ERP)	16.7	16.7
LTE eFDD 12 QPSK	mid	1	10	**21.6**	3 (ERP)	3 (ERP)	15.3	15.3
LTE eFDD 12 QPSK	mid	50	10	20.5	3 (ERP)	3 (ERP)	16.4	16.4
LTE eFDD 7 QPSK	mid	1	5	21.3	2 (EIRP)	2 (EIRP)	11.7	11.7
LTE eFDD 7 QPSK	mid	12	5	20.0	2 (EIRP)	2 (EIRP)	13.0	13.0
LTE eFDD 7 QPSK	mid	25	5	20.0	2 (EIRP)	2 (EIRP)	13.0	13.0
LTE eFDD 7 QPSK	mid	1	10	21.1	2 (EIRP)	2 (EIRP)	11.9	11.9
LTE eFDD 7 QPSK	mid	50	10	20.3	2 (EIRP)	2 (EIRP)	12.7	12.7

5.2 FIELD STRENGTH OF SPURIOUS RADIATION

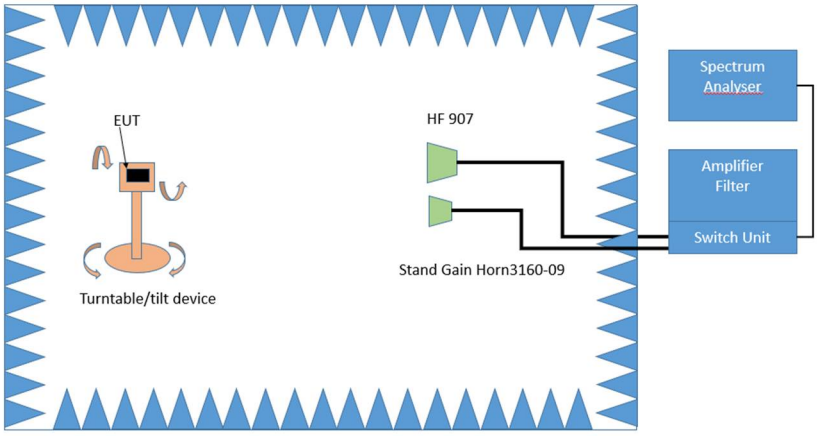
The test was performed according to: ANSI C63.26-2015, 5.5.2.3.1

5.2.1 TEST DESCRIPTION (COMMON)

This test case is intended to demonstrate compliance to the applicable radiated spurious emission measurements per § 2.1053 and RSS-GEN 6.13. The limit and requirements come from the applicable rule part and ISED RSS-Standard for the operating band of the cellular device.

The EUT was connected to the test setup according to the following diagram:

Frequency Range: 1 GHz – 26.5 GHz



Test Setup; Spurious Emission Radiated (FAC), 1 GHz-26.5 GHz

The test set-up is made in accordance to the general provisions of ANSI C63.26 in a typical installation configuration. The Equipment Under Test (EUT) is set up on a non-conductive table (tilt device) in the fully-anechoic chamber.
The measurement procedure is implemented into the EMI test software EMC32 from R&S. Exploratory tests are performed at 3 orthogonal axes to determine the worst-case orientation of a body-worn or handheld EUT. The final test on all kind of EUTs is also performed at 3 axes. A pre-check is performed while the EUT is powered from a DC power source.

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

Measurement above 1 GHz

Step 1:
The Equipment Under Test (EUT) was set up on a non-conductive support (tilt device) at 1.5 m height in the fully-anechoic chamber.
All steps were performed with one height (1.5 m) of the receiving antenna only.
The EUT is turned during the preliminary measurement across the elevation axis, with a step size of 45 °.
The turn table step size (azimuth angle) for the preliminary measurement is 45 °.
- Antenna distance: 3 m
- Detector: Peak
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled
- Turntable angle range: –180° to 135°
- Turntable step size: 45°
- Polarisation: Horizontal + Vertical

Step 2:
Due to the fact, that in this frequency range the test is performed in a fully anechoic room, the height scan of the receiving antenna instep 2 is omitted. Instead of this, a maximum search with a step size ± 45° for the elevation axis is performed.
The turn table azimuth will slowly vary by ± 22.5°.
The elevation angle will slowly vary by ± 45°
EMI receiver settings (for all steps):
- Detector: Peak,
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep time: coupled

Step 3:
Spectrum analyser settings for step 3:
- Detector: RMS
- Measured frequencies: in step 1 determined frequencies
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 s

5.2.2 TEST DESCRIPTION (SPECIFIC)

Standard **FCC PART 22 Subpart H**

Standard **FCC PART 24 Subpart E**

Standard **FCC PART 27 Subpart C**

5.2.3 TEST REQUIREMENTS / LIMITS

FCC Part 2.1053; Measurement required: Field strength of spurious radiation:

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate.

Part 22, Subpart H – Cellular Radiotelephone Service

§ 22 917 – Emission limitations for cellular equipment

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.
Excluded frequency range of operation: § 22.905: 869-894 MHz

RSS-132; 5.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz band immediately outside and adjacent to each of the sub-bands specified in Section 5.1, the power of emissions per any 1% of the occupied bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts).

(ii) After the first 1.0 MHz immediately outside and adjacent to each of the sub-bands, the power of emissions in any 100 kHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10 p (watts). If the measurement is performed using 1% of the occupied bandwidth, power integration over 100 kHz is required.

Part 24, Subpart E – Broadband PCS

§ 24 238 – Emission limitations for Broadband PCS equipment

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.
(b) Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.
Excluded frequency range of operation: § 24.229: 1850-1910 MHz

RSS-133; 6.5 Transmitter Unwanted Emissions

Mobile and base station equipment shall comply with the limits in (1) and (2) below.

(i) In the 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts).

(ii) After the first 1.0 MHz, the emission power in any 1 MHz bandwidth shall be attenuated (in dB) below the transmitter output power P (dBW) by at least 43 + 10 log10p (watts). If the measurement is performed using 1% of the emission bandwidth, power integration over 1.0 MHz is required.

FCC Part 27; Miscellaneous Wireless Communication Services

Subpart C – Technical standards

§27.53 – Emission limits

Band 13

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;

(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

RSS-130; 4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

RSS-130; 4.7.2 Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:
   (i) 76 + 10 log10 p (watts), dB, for base and fixed equipment and
   (ii) 65 + 10 log10 p (watts), dB, for mobile and portable equipment

b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

Band 12:

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS-130; 4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be attenuated below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

RSS-130; 4.7.2 Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:
   (i) 76 + 10 log10 p (watts), dB, for base and fixed equipment and
   (ii) 65 + 10 log10 p (watts), dB, for mobile and portable equipment

b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

Band 4/10/66:

(h) *AWS emission limits*—(1) *General protection levels.* Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least 43 + 10 $\log_{10}$ (P) dB.

RSS-139; 6.6 Transmitter Unwanted Emissions

Equipment shall comply with the limits in (i) and (ii) below.

(i) In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.

(ii) After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least 43 + 10 log10 p (watts) dB.

Band 7:

(m) For BRS and EBS stations, the power of any emissions outside the licensee's frequency bands of operation shall be attenuated below the transmitter power (P) measured in watts in accordance with the standards below. If a licensee has multiple contiguous channels, out-of-band emissions shall be measured from the upper and lower edges of the contiguous channels.

(4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log(P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

RSS-199; 4.5 Transmitter unwanted emissions

In the 1 MHz band immediately outside and adjacent to the channel edge, the unwanted emission power shall be measured with a resolution bandwidth of at least 1% of the occupied bandwidth for base station and fixed subscriber equipment, and 2% for mobile subscriber equipment. Beyond the 1 MHz band, a resolution bandwidth of 1 MHz shall be used. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full required measurement bandwidth of 1 MHz, or 1% or 2% of the occupied bandwidth, as applicable.

Equipment shall comply with the following unwanted emission limits:

b) for mobile subscriber equipment, the power of any unwanted emissions measured as above shall be attenuated (in dB) below the transmitter power, P (dBW), by at least:
   (i) 40 + 10 log10 p from the channel edges to 5 MHz away
   (ii) 43 + 10 log10 p between 5 MHz and X MHz from the channel edges, and
   (iii) 55 + 10 log10 p at X MHz and beyond from the channel edges
   In addition, the attenuation shall not be less than 43 + 10 log10 p on all frequencies between 2490.5 MHz and 2496 MHz, and 55 + 10 log10 p at or below 2490.5 MHz.

In (b), p is the transmitter power measured in watts and X is 6 MHz or the equipment occupied bandwidth, whichever is greater.

Band 71:

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log(P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

RSS-130; 4.7.1 General unwanted emissions limits

The unwanted emissions in any 100 kHz bandwidth on any frequency outside the low frequency edge and the high frequency edge of each frequency block range(s), shall be below the transmitter power, P (dBW), by at least 43 + 10 log10 p (watts), dB. However, in the 100 kHz band immediately outside of the equipment's frequency block range, a resolution bandwidth of 30 kHz may be employed.

RSS-130; 4.7.2 Additional unwanted emissions limits

In addition to the limit outlined in section 4.7.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

a) The power of any unwanted emissions in any 6.25 kHz bandwidth for all frequencies between 763-775 MHz and 793-806 MHz shall be attenuated below the transmitter power, P (dBW), by at least:
   (i) 76 + 10 log10 p (watts), dB, for base and fixed equipment and
   (ii) 65 + 10 log10 p (watts), dB, for mobile and portable equipment

b) The e.i.r.p. in the band 1559-1610 MHz shall not exceed −70 dBW/MHz for wideband signal and −80 dBW for discrete emission with bandwidth less than 700 Hz.

5.2.4 TEST PROTOCOL

Temperature: 23-27 °C
Humidity: 23-31 %

Part 22:

Radio Technology	Channel	Detector	Trace	Resol. BW /MHz	Frequency /MHz	Peak /dBm	Limit /dBm	Margin to Limit /dB
LTE eFDD5+WLAN+Mira	low	rms	maxhold	1	4122.667	-20.5	-13.0	7.5

Part 24:

Radio Technology	Channel	Detector	Trace	Resol. BW /MHz	Frequency /MHz	Peak /dBm	Limit /dBm	Margin to Limit /dB
LTE eFDD2+WLAN+Mira	low	rms	maxhold	–	–	–	–	–

Part 27:

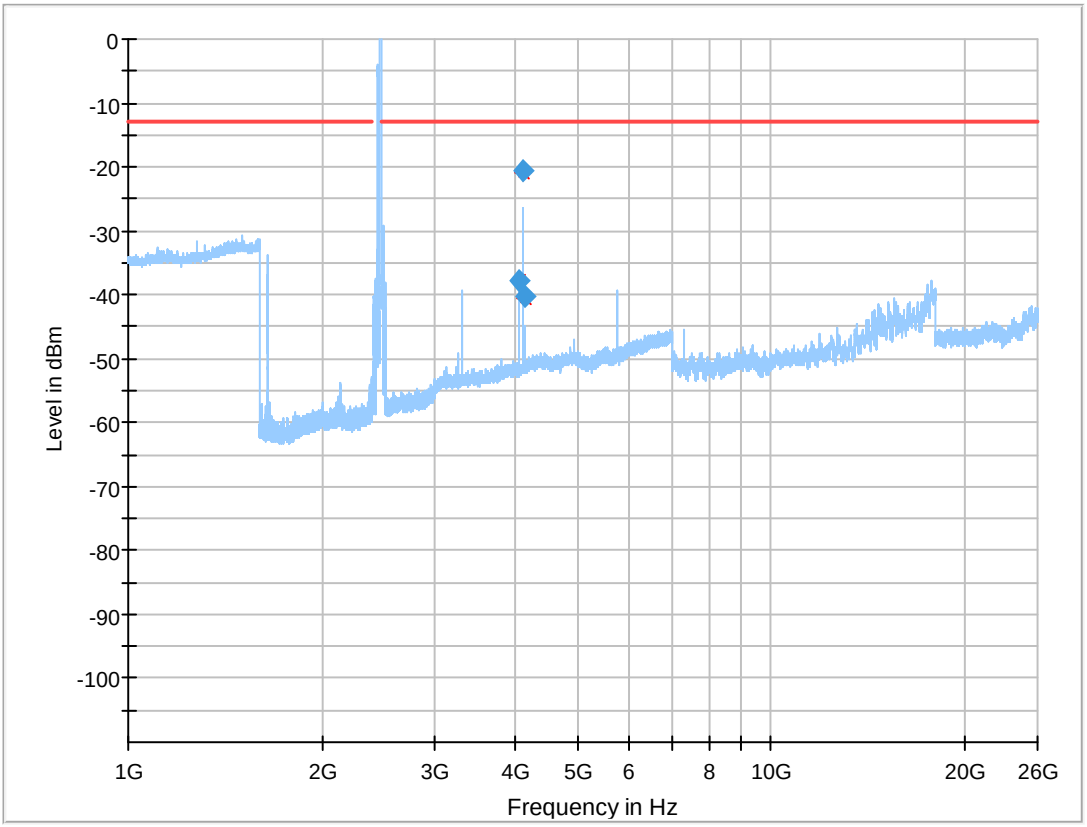
Radio Technology	Channel	Detector	Trace	Resol. BW /MHz	Frequency /MHz	Peak /dBm	Limit /dBm	Margin to Limit /dB
LTE eFDD7+WLAN+Mira	low	rms	maxhold	1	2549.596	-38.1	-25.0	13.1
LTE eFDD7+WLAN+Mira	low	rms	maxhold	1	2619.373	-35.7	-25.0	10.7
LTE eFDD7+WLAN+Mira	low	rms	maxhold	1	7486.750	-41.6	-25.0	16.6

Remark: Please see next sub-clause for the measurement plot.

5.2.5 MEASUREMENT PLOTS

Part 22:

Mode: STX5

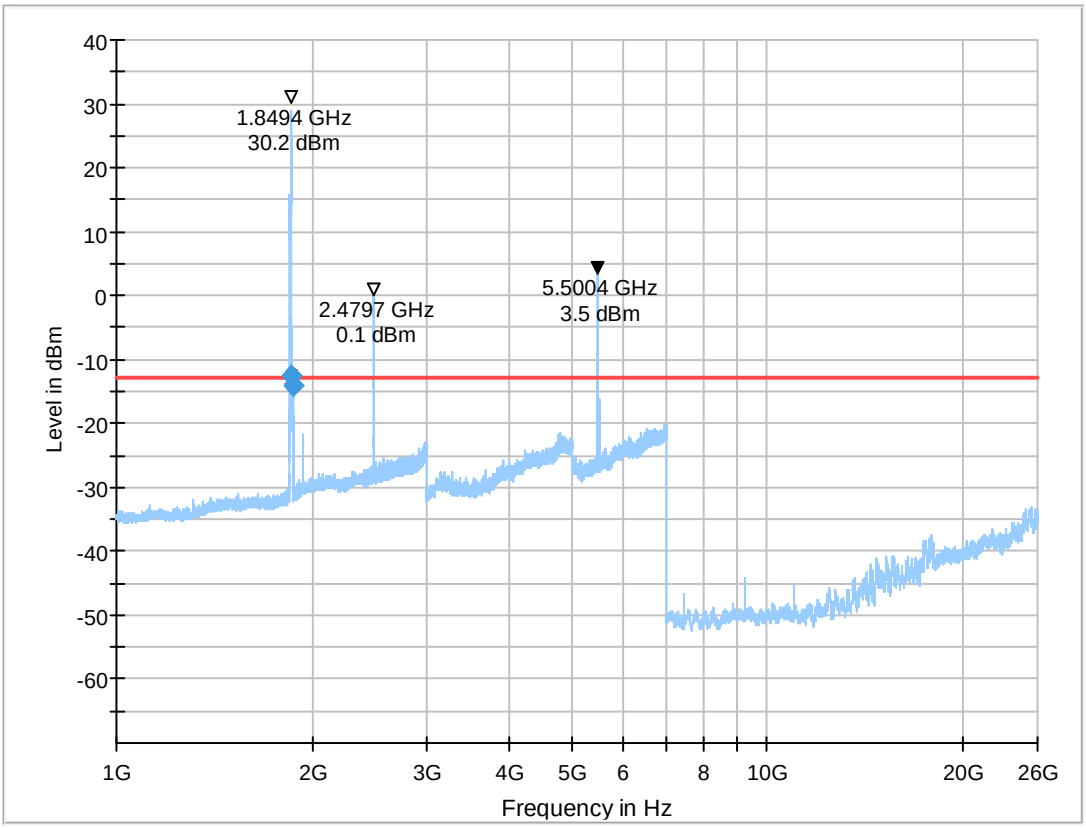


Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation	Corr. (dB)
4058.667	-37.8	-13.00	24.82	1000.0	1000.000	150.0	H	93.0	58.0	-94.5
4122.667	-20.5	-13.00	7.45	1000.0	1000.000	150.0	V	-111.0	-2.0	-93.8
4132.000	-40.3	-13.00	27.34	1000.0	1000.000	150.0	V	-111.0	-9.0	-94.3

Part 24:

Mode: STX2



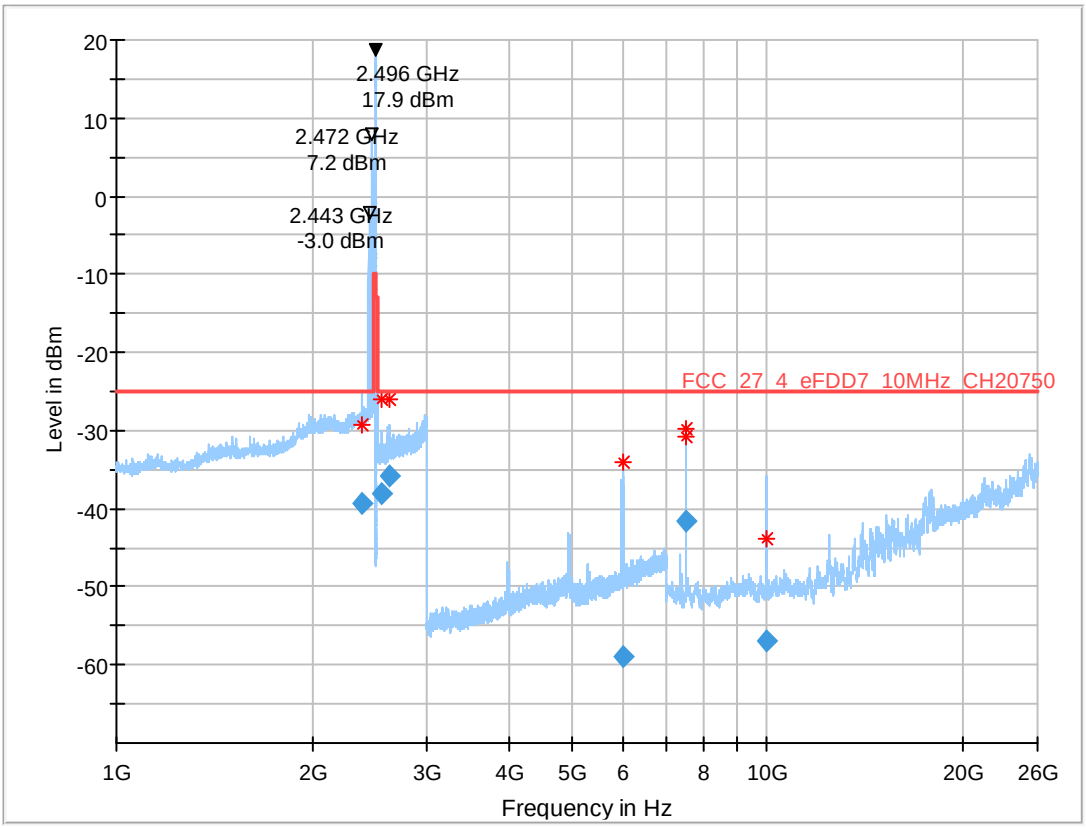
Final_Result

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm	Margi n	Meas. Time	Bandwidt h	Heigh t	Pol	Azimut h	Elevatio n	Corr. (dB)
1859.480	-12.5	-13.00	-0.46	1000.0	1000.000	150.0	H	-47.0	84.0	-64.6
1868.060	-14.1	-13.00	1.08	1000.0	1000.000	150.0	H	-49.0	80.0	-64.4

Note: The peaks at 1849, 2480 and 5500 MHz are the wanted emissions of the carrier. The frequency blocks of cellular operation are not excluded in the plot.

Part 27:

Mode: STX7

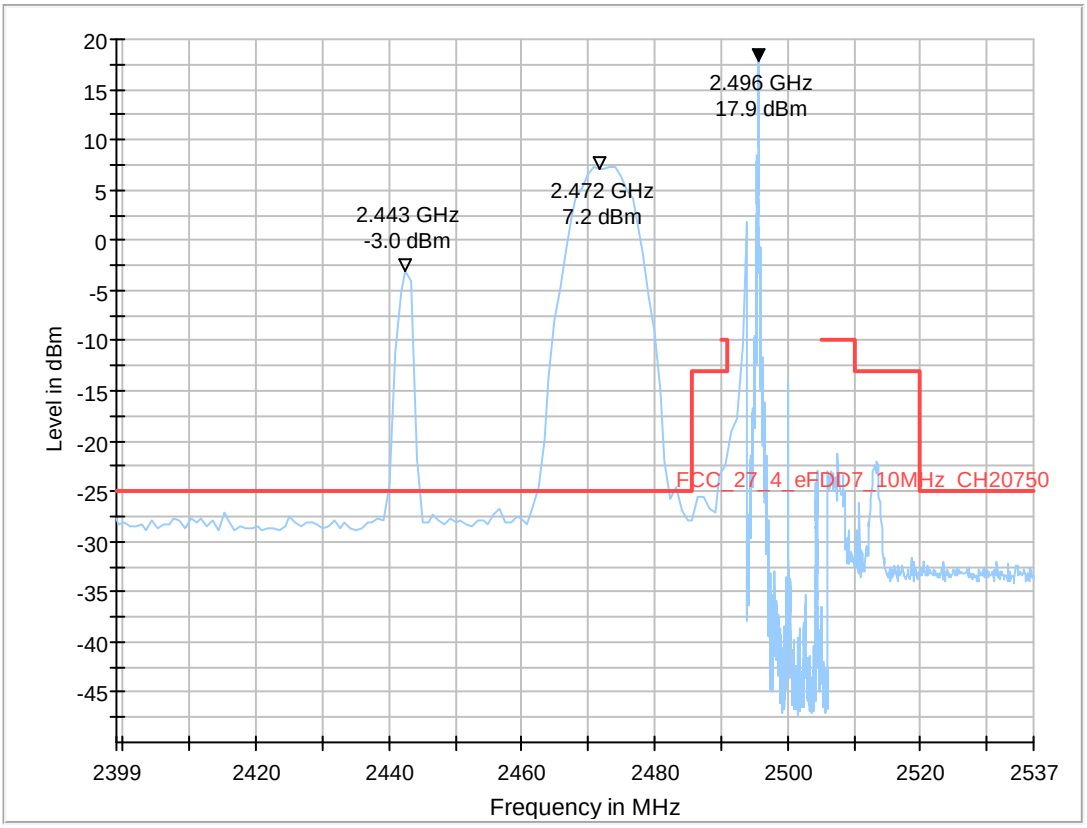


Final_Result

Frequency (MHz)	RMS (dBm	Limit (dBm)	Margin	Meas. Time (ms)	Bandwidth	Height	Pol	Azimuth	Elevation	Corr. (dB)
2389.420	-39.3	-25.00	14.33	1000.0	1000.000	150.0	V	39.0	110.0	-62.7
2549.596	-38.1	-25.00	13.12	1000.0	1000.000	150.0	V	52.0	92.0	-61.9
2619.373	-35.7	-25.00	10.66	1000.0	1000.000	150.0	H	-139.0	98.0	-61.5
5994.800	-59.0	-25.00	34.01	1000.0	1000.000	150.0	V	96.0	-13.0	-90.7
7486.750	-41.6	-25.00	16.56	1000.0	1000.000	150.0	V	3.0	97.0	-109.3
9981.000	-56.9	-25.00	31.93	1000.0	1000.000	150.0	V	10.0	90.0	-108.6

Note: The peaks at 2443, 2472 and 2496 MHz are the wanted signals of the carrier, at 2389 MHZ is noise.

Frequency range is zoomed to show the details around the three carrier signals:



5.2.6 TEST EQUIPMENT USED

- Radiated Emissions FAR

6 TEST EQUIPMENT

1 Radiated Emissions FAR (in a fully anechoic room)

Ref.No.	Device Name	Description	Manufacturer	Serial Number	Last Calibration	Calibration Due
1.1	Opus10 TPR (8253.00)	T/P Logger 13	Lufft Mess- und Regeltechnik GmbH	13936	2021-10	2023-10
1.2	AMF-7D00101800-30-10P-R	Broadband Amplifier 100 MHz - 18 GHz	Miteq			
1.3	5HC2700/12750-1.5-KK	High Pass Filter	Trilithic	9942012		
1.4	ASP 1.2/1.8-10 kg	Antenna Mast	Maturo GmbH	-		
1.5	Anechoic Chamber 03	FAR, 8.80m x 4.60m x 4.05m (l x w x h)	Albatross Projects	P26971-647-001-PRB	2021-04	2023-04
1.6	Fluke 177	Digital Multimeter 03 (Multimeter)	Fluke Europe B.V.	86670383	2020-04	2022-04
1.7	JS4-18002600-32-5P	Broadband Amplifier 18 GHz - 26 GHz	Miteq	849785		
1.8	FSW 43	Spectrum Analyzer	Rohde & Schwarz	103779	2021-06	2023-06
1.9	3160-09	Standard Gain / Pyramidal Horn Antenna 26.5 GHz	EMCO Elektronic GmbH	00083069		
1.10	WHKX 7.0/18G-8SS	High Pass Filter	Wainwright Instruments GmbH	09		
1.11	4HC1600/12750-1.5-KK	High Pass Filter	Trilithic	9942011		
1.12	TT 1.5 WI	Turn Table	Maturo GmbH	-		
1.13	3160-10	Standard Gain / Pyramidal Horn Antenna 40 GHz	EMCO Elektronic GmbH	00086675		
1.14	5HC3500/18000-1.2-KK	High Pass Filter	Trilithic	200035008		
1.15	TD1.5-10kg	EUT Tilt Device (Rohacell)	Maturo GmbH	TD1.5-10kg/024/3790709		
1.16	PAS 2.5 - 10 kg	Antenna Mast	Maturo GmbH	-		
1.17	AFS42-00101800-25-S-42	Broadband Amplifier 25 MHz - 18 GHz	Miteq	2035324		
1.18	HF 907	Double-ridged horn	Rohde & Schwarz	102444	2021-09	2024-09

The calibration interval is the time interval between “Last Calibration” and “Calibration Due”

7 ANTENNA FACTORS, CABLE LOSS AND SAMPLE CALCULATIONS

This chapter contains the antenna factors with their corresponding path loss of the used measurement path for all antennas as well as the insertion loss of the LISN.

7.1 LISN R&S ESH3-Z5 (150 KHZ – 30 MHZ)

Frequency		Corr.	LISN insertion loss ESH3-Z5	cable loss (incl. 10 dB atten-uator)
MHz		dB	dB	dB
0.15		10.1	0.1	10.0
5		10.3	0.1	10.2
7		10.5	0.2	10.3
10		10.5	0.2	10.3
12		10.7	0.3	10.4
14		10.7	0.3	10.4
16		10.8	0.4	10.4
18		10.9	0.4	10.5
20		10.9	0.4	10.5
22		11.1	0.5	10.6
24		11.1	0.5	10.6
26		11.2	0.5	10.7
28		11.2	0.5	10.7
30		11.3	0.5	10.8

Sample calculation

U_{LISN} (dB µV) = U (dB µV) + Corr. (dB)
U = Receiver reading
LISN Insertion loss = Voltage Division Factor of LISN
Corr. = sum of single correction factors of used LISN, cables, switch units (if used)
Linear interpolation will be used for frequencies in between the values in the table.

7.2 ANTENNA R&S HFH2-Z2 (9 KHZ – 30 MHZ)

Frequency	AF HFH-Z2)	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-40 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
0.009	20.50	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.01	20.45	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.015	20.37	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.02	20.36	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.025	20.38	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.03	20.32	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.05	20.35	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.08	20.30	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.1	20.20	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.2	20.17	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.3	20.14	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.49	20.12	-79.6	0.1	0.1	0.1	0.1	-80	300	3
0.490001	20.12	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.5	20.11	-39.6	0.1	0.1	0.1	0.1	-40	30	3
0.8	20.10	-39.6	0.1	0.1	0.1	0.1	-40	30	3
1	20.09	-39.6	0.1	0.1	0.1	0.1	-40	30	3
2	20.08	-39.6	0.1	0.1	0.1	0.1	-40	30	3
3	20.06	-39.6	0.1	0.1	0.1	0.1	-40	30	3
4	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
5	20.05	-39.5	0.2	0.1	0.1	0.1	-40	30	3
6	20.02	-39.5	0.2	0.1	0.1	0.1	-40	30	3
8	19.95	-39.5	0.2	0.1	0.1	0.1	-40	30	3
10	19.83	-39.4	0.2	0.1	0.2	0.1	-40	30	3
12	19.71	-39.4	0.2	0.1	0.2	0.1	-40	30	3
14	19.54	-39.4	0.2	0.1	0.2	0.1	-40	30	3
16	19.53	-39.3	0.3	0.1	0.2	0.1	-40	30	3
18	19.50	-39.3	0.3	0.1	0.2	0.1	-40	30	3
20	19.57	-39.3	0.3	0.1	0.2	0.1	-40	30	3
22	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
24	19.61	-39.3	0.3	0.1	0.2	0.1	-40	30	3
26	19.54	-39.3	0.3	0.1	0.2	0.1	-40	30	3
28	19.46	-39.2	0.3	0.1	0.3	0.1	-40	30	3
30	19.73	-39.1	0.4	0.1	0.3	0.1	-40	30	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -40 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values

7.3 ANTENNA R&S HL562 (30 MHZ – 1 GHZ)

(d_{Limit} = 3 m)

Frequency	AF R&S HL562	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
30	18.6	0.6	0.29	0.04	0.23	0.02	0.0	3	3
50	6.0	0.9	0.39	0.09	0.32	0.08	0.0	3	3
100	9.7	1.2	0.56	0.14	0.47	0.08	0.0	3	3
150	7.9	1.6	0.73	0.20	0.59	0.12	0.0	3	3
200	7.6	1.9	0.84	0.21	0.70	0.11	0.0	3	3
250	9.5	2.1	0.98	0.24	0.80	0.13	0.0	3	3
300	11.0	2.3	1.04	0.26	0.89	0.15	0.0	3	3
350	12.4	2.6	1.18	0.31	0.96	0.13	0.0	3	3
400	13.6	2.9	1.28	0.35	1.03	0.19	0.0	3	3
450	14.7	3.1	1.39	0.38	1.11	0.22	0.0	3	3
500	15.6	3.2	1.44	0.39	1.20	0.19	0.0	3	3
550	16.3	3.5	1.55	0.46	1.24	0.23	0.0	3	3
600	17.2	3.5	1.59	0.43	1.29	0.23	0.0	3	3
650	18.1	3.6	1.67	0.34	1.35	0.22	0.0	3	3
700	18.5	3.6	1.67	0.42	1.41	0.15	0.0	3	3
750	19.1	4.1	1.87	0.54	1.46	0.25	0.0	3	3
800	19.6	4.1	1.90	0.46	1.51	0.25	0.0	3	3
850	20.1	4.4	1.99	0.60	1.56	0.27	0.0	3	3
900	20.8	4.7	2.14	0.60	1.63	0.29	0.0	3	3
950	21.1	4.8	2.22	0.60	1.66	0.33	0.0	3	3
1000	21.6	4.9	2.23	0.61	1.71	0.30	0.0	3	3

(d_{Limit} = 10 m)

30	18.6	-9.9	0.29	0.04	0.23	0.02	-10.5	10	3
50	6.0	-9.6	0.39	0.09	0.32	0.08	-10.5	10	3
100	9.7	-9.2	0.56	0.14	0.47	0.08	-10.5	10	3
150	7.9	-8.8	0.73	0.20	0.59	0.12	-10.5	10	3
200	7.6	-8.6	0.84	0.21	0.70	0.11	-10.5	10	3
250	9.5	-8.3	0.98	0.24	0.80	0.13	-10.5	10	3
300	11.0	-8.1	1.04	0.26	0.89	0.15	-10.5	10	3
350	12.4	-7.9	1.18	0.31	0.96	0.13	-10.5	10	3
400	13.6	-7.6	1.28	0.35	1.03	0.19	-10.5	10	3
450	14.7	-7.4	1.39	0.38	1.11	0.22	-10.5	10	3
500	15.6	-7.2	1.44	0.39	1.20	0.19	-10.5	10	3
550	16.3	-7.0	1.55	0.46	1.24	0.23	-10.5	10	3
600	17.2	-6.9	1.59	0.43	1.29	0.23	-10.5	10	3
650	18.1	-6.9	1.67	0.34	1.35	0.22	-10.5	10	3
700	18.5	-6.8	1.67	0.42	1.41	0.15	-10.5	10	3
750	19.1	-6.3	1.87	0.54	1.46	0.25	-10.5	10	3
800	19.6	-6.3	1.90	0.46	1.51	0.25	-10.5	10	3
850	20.1	-6.0	1.99	0.60	1.56	0.27	-10.5	10	3
900	20.8	-5.8	2.14	0.60	1.63	0.29	-10.5	10	3
950	21.1	-5.6	2.22	0.60	1.66	0.33	-10.5	10	3
1000	21.6	-5.6	2.23	0.61	1.71	0.30	-10.5	10	3

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.4 ANTENNA R&S HF907 (1 GHZ – 18 GHZ)

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay + cable inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit, atten-uator & pre-amp)	cable loss 4 (to receiver)		
MHz	dB (1/m)	dB	dB	dB	dB	dB		
1000	24.4	-19.4	0.99	0.31	-21.51	0.79		
2000	28.5	-17.4	1.44	0.44	-20.63	1.38		
3000	31.0	-16.1	1.87	0.53	-19.85	1.33		
4000	33.1	-14.7	2.41	0.67	-19.13	1.31		
5000	34.4	-13.7	2.78	0.86	-18.71	1.40		
6000	34.7	-12.7	2.74	0.90	-17.83	1.47		
7000	35.6	-11.0	2.82	0.86	-16.19	1.46		

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (inside chamber)	cable loss 3 (outside chamber)	cable loss 4 (switch unit, atten-uator & pre-amp)	cable loss 5 (to receiver)	used for FCC 15.247
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	
3000	31.0	-23.4	0.47	1.87	0.53	-27.58	1.33	
4000	33.1	-23.3	0.56	2.41	0.67	-28.23	1.31	
5000	34.4	-21.7	0.61	2.78	0.86	-27.35	1.40	
6000	34.7	-21.2	0.58	2.74	0.90	-26.89	1.47	
7000	35.6	-19.8	0.66	2.82	0.86	-25.58	1.46	

Frequency	AF R&S HF907	Corr.	cable loss 1 (relay inside chamber)	cable loss 2 (High Pass)	cable loss 3 (pre-amp)	cable loss 4 (inside chamber)	cable loss 5 (outside chamber)	cable loss 6 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB	dB
7000	35.6	-57.3	0.56	1.28	-62.72	2.66	0.94	1.46
8000	36.3	-56.3	0.69	0.71	-61.49	2.84	1.00	1.53
9000	37.1	-55.3	0.68	0.65	-60.80	3.06	1.09	1.60
10000	37.5	-56.2	0.70	0.54	-61.91	3.28	1.20	1.67
11000	37.5	-55.3	0.80	0.61	-61.40	3.43	1.27	1.70
12000	37.6	-53.7	0.84	0.42	-59.70	3.53	1.26	1.73
13000	38.2	-53.5	0.83	0.44	-59.81	3.75	1.32	1.83
14000	39.9	-56.3	0.91	0.53	-63.03	3.91	1.40	1.77
15000	40.9	-54.1	0.98	0.54	-61.05	4.02	1.44	1.83
16000	41.3	-54.1	1.23	0.49	-61.51	4.17	1.51	1.85
17000	42.8	-54.4	1.36	0.76	-62.36	4.34	1.53	2.00
18000	44.2	-54.7	1.70	0.53	-62.88	4.41	1.55	1.91

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Tables show an extract of values.

7.5 ANTENNA EMCO 3160-09 (18 GHZ – 26.5 GHZ)

Frequency	AF EMCO 3160-09	Corr.	cable loss 1 (inside chamber)	cable loss 2 (pre-amp)	cable loss 3 (inside chamber)	cable loss 4 (switch unit)	cable loss 5 (to receiver)
MHz	dB (1/m)	dB	dB	dB	dB	dB	dB
18000	40.2	-23.5	0.72	-35.85	6.20	2.81	2.65
18500	40.2	-23.2	0.69	-35.71	6.46	2.76	2.59
19000	40.2	-22.0	0.76	-35.44	6.69	3.15	2.79
19500	40.3	-21.3	0.74	-35.07	7.04	3.11	2.91
20000	40.3	-20.3	0.72	-34.49	7.30	3.07	3.05
20500	40.3	-19.9	0.78	-34.46	7.48	3.12	3.15
21000	40.3	-19.1	0.87	-34.07	7.61	3.20	3.33
21500	40.3	-19.1	0.90	-33.96	7.47	3.28	3.19
22000	40.3	-18.7	0.89	-33.57	7.34	3.35	3.28
22500	40.4	-19.0	0.87	-33.66	7.06	3.75	2.94
23000	40.4	-19.5	0.88	-33.75	6.92	3.77	2.70
23500	40.4	-19.3	0.90	-33.35	6.99	3.52	2.66
24000	40.4	-19.8	0.88	-33.99	6.88	3.88	2.58
24500	40.4	-19.5	0.91	-33.89	7.01	3.93	2.51
25000	40.4	-19.3	0.88	-33.00	6.72	3.96	2.14
25500	40.5	-20.4	0.89	-34.07	6.90	3.66	2.22
26000	40.5	-21.3	0.86	-35.11	7.02	3.69	2.28
26500	40.5	-21.1	0.90	-35.20	7.15	3.91	2.36

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

7.6 ANTENNA EMCO 3160-10 (26.5 GHZ – 40 GHZ)

Frequency	AF EMCO 3160-10	Corr.	cable loss 1 (inside chamber)	cable loss 2 (outside chamber)	cable loss 3 (switch unit)	cable loss 4 (to receiver)	distance corr. (-20 dB/ decade)	d_{Limit} (meas. distance (limit)	d_{used} (meas. distance (used)
GHz	dB (1/m)	dB	dB	dB	dB	dB	dB	m	m
26.5	43.4	-11.2	4.4				-9.5	3	1.0
27.0	43.4	-11.2	4.4				-9.5	3	1.0
28.0	43.4	-11.1	4.5				-9.5	3	1.0
29.0	43.5	-11.0	4.6				-9.5	3	1.0
30.0	43.5	-10.9	4.7				-9.5	3	1.0
31.0	43.5	-10.8	4.7				-9.5	3	1.0
32.0	43.5	-10.7	4.8				-9.5	3	1.0
33.0	43.6	-10.7	4.9				-9.5	3	1.0
34.0	43.6	-10.6	5.0				-9.5	3	1.0
35.0	43.6	-10.5	5.1				-9.5	3	1.0
36.0	43.6	-10.4	5.1				-9.5	3	1.0
37.0	43.7	-10.3	5.2				-9.5	3	1.0
38.0	43.7	-10.2	5.3				-9.5	3	1.0
39.0	43.7	-10.2	5.4				-9.5	3	1.0
40.0	43.8	-10.1	5.5				-9.5	3	1.0

Sample calculation

E (dB µV/m) = U (dB µV) + AF (dB 1/m) + Corr. (dB)
U = Receiver reading
AF = Antenna factor
Corr. = sum of single correction factors of used cables, switch unit, distance correction, amplifier (if applicable)
Linear interpolation will be used for frequencies in between the values in the table.
distance correction = -20 * LOG (d_{Limit}/ d_{used})
Linear interpolation will be used for frequencies in between the values in the table.
Table shows an extract of values.

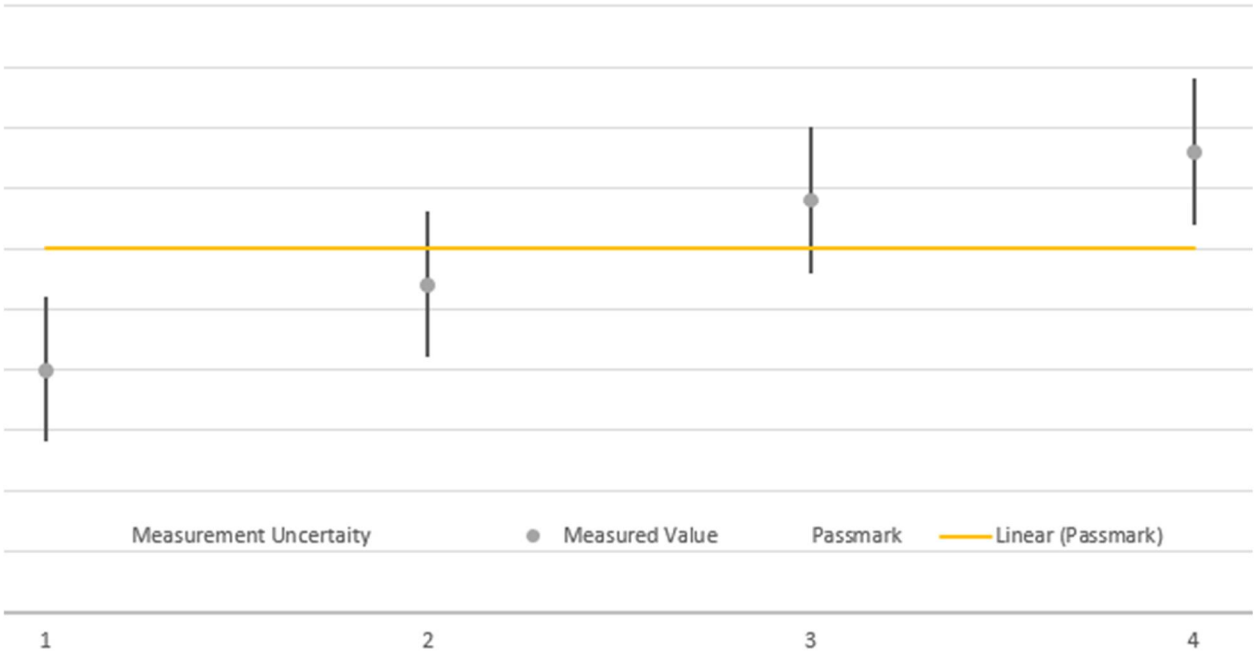
8 PHOTO REPORT

Please see separate photo report.

9 MEASUREMENT UNCERTAINTIES

Test Case(s)	Parameter	Uncertainty
- Field strength of spurious radiation	Field Strength	± 5.5 dB
- Emission and Occupied Bandwidth	Power Frequency	± 2.9 dB ± 11.2 kHz
- RF Output Power - Peak to Average Ratio	Power	± 2.2 dB
- Band Edge Compliance - Spurious Emissions at Antenna Terminal	Power Frequency	± 2.2 dB ± 11.2 kHz
- Frequency Stability	Frequency	± 25 Hz

The measurement uncertainties for all parameters are calculated with an expansion factor (coverage factor) k = 1.96. This means, that the true value is in the corresponding interval with a probability of 95 %.



The verdicts in this test report are given according the above diagram:

Case	Measured Value	Uncertainty Range	Verdict
1	below pass mark	below pass mark	Passed
2	below pass mark	within pass mark	Passed
3	above pass mark	within pass mark	Failed
4	above pass mark	above pass mark	Failed

That means, the laboratory applies, as decision rule (see ISO/IEC 17025:2017), the so called shared risk principle.