Test Report acc. to FCC Title 47 CFR Part 15
relating to
FEIG ELECTRONIC GmbH
ID MRMU400

Title 47 – Telecommunication
Part 15 – Radio Frequency Devices
Subpart C – Intentional Radiators
Measurement Procedure:
ANSI C63.4a-2017
ANSI C63.10-2020+Cor. 1-2023

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12053-01-03

MANUFACTURER	
Manufacturer name	**FEIG ELECTRONIC GmbH**
Manufacturer's grantee code	PJM
Manufacturer's address	Industriestr. 1a, 35781 Weilburg, Germany
Phone	+49 6471 3109 438
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Email	Elmar.Reichwein@feig.de

TESTING LABORATORY	
Test engineer	Mr. Anup Shrestha
Testing laboratory name	**TÜV NORD Hochfrequenztechnik GmbH & Co. KG**
Testing laboratory address	LESKANPARK, Building 10 Waltherstr. 49-51, 51069 Cologne Germany
Phone	+49 221 888895 16
Email	**ashrestha@tuev-nord.de**

RELEVANT STANDARD	
Title	**47 - Telecommunication**
Part	**15 – Radio Frequency Devices**
Subpart	**Subpart C – Intentional Radiators - Section 15.247**
Measurement procedure	**ANSI C63.10-2020+Cor. 1-2023, ANSI C63.4a-2017**

EQUIPMENT UNDER TEST (EUT)	
Equipment category	RFID Reader
Trade name	---
Type designation	**ID MRMU4000**
Serial no.	10000008
Antenna Variants	ID ANT. U82.82 ID ANT. U150/150 ID ANT. U280/210 ID ANT. U290/290 ID ANT. U580/290 ID ANT. U LOCFIELD® 75318-FG (intern)

Test result summary

The following table summarizes the results for the tested EUT corresponding with the essential requirements. Full testing may not be required. If partial testing was performed, this shall be indicated in the relevant column (N.t.[x], not tested, see clause 9) of the table below.

Clause	FCC Rule / Part	Transmitter Parameters	Test result
7.1	§ 15.203	Antenna requirement	**Pass**
7.2	§ 15.207	Conducted emission	**Pass**
7.3	§ 15.209	Radiated emission limits, general requirements	**Pass***
7.4	§ 15.205	Operation in the restricted bands	**Pass**
7.5	§15.247 (a)	Bandwidth	**Pass**
7.6	§15.247 (a)	Carrier frequency separation	**Pass**
7.7	§15.247 (a)	Number of hopping channels	**Pass**
7.8	§15.247 (a)	Average time of occupancy	**Pass**
7.9	§15.247 (b)	Peak output power	**Pass**
7.10	§15.247 (d)	Out of Band emission	**Pass**
7.11	§15.247 (i)	RF exposure evaluation	**Pass**

*As far as in this report statements on conformity are made, decision rules according to DIN EN ISO/IEC 17025:2018, 7.8.6 have been applied. If the report does not state otherwise, procedure 1 according to IEC Guide 115 ed.2.0 2021 (uncertainty of measurement calculated) has been applied on measurement and test procedures which are the base of this report. For more information see clause 8.1.

The equipment passed all the performed tests	
☒ **Yes**	☐ **No**

Signature	TÜVNORD Digital unterschrieben von Shrestha Anup Datum: 2025.07.02 13:30:20 +02'00'	TÜVNORD Digital unterschrieben von Trepper Ralf Datum: 2025.07.02 14:42:17 +02'00'
	Tested by	**Approved by**
Name	**Mr. Anup Shrestha**	**Mr. Ralf Trepper**
Designation	**RF Test engineer**	**Laboratory Manager**
Date of issue	**2025-07-02**	**2025-07-02**

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1 Revision History

Revision	Date of issue	Creator	Content of change
00	2025-04-30	A Shrestha	Initial release
01	2025-07-02	A Shrestha	Two external antenna types and one internal antenna type added in the table (page 15)
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Table 0-1: Revision History

Note: If the document has been changed by revision number, all previous documents are no longer valid and must be destroyed.

2 Introduction

This test report **is not an expert opinion** and consists of:

- Test result summary
- List of contents
- Introduction and further information
- Equipment application data
- Detailed test information
- List of measurement equipment with calibration validity
- Photographs and further test results (plots, graphs, etc.)

The tests were carried out in a representative assembly and in accordance with the test methods and/or requirements stated in:

Item	Applied Standard
Radio test	FCC Title 47 CFR Part 15 Subpart C Section 15.247
Radio test	**ANSI C63.10-2020+Cor. 1-2023** American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
Radio test	**ANSI C63.4-2017** American National Standard for Methods of Measurements of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz
Radio test	**558074 D01 15.247 Meas Guidance v05r02** Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC rules

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3 Administrative Data

3.1 Testing laboratory

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Waltherstr. 49-51
51069 Cologne
Germany

Phone: +49 221 8888 950

Accredited by:

DAkkS Deutsche Akkreditierungsstelle GmbH
DAkkS accreditation number: D-PL-12053-01

3.2 Applicant´s details

Company name	: FEIG ELECTRONIC GmbH
Address	: Industriestr. 1a
	35781 Weilburg
Country	: Germany
Contact person	: Mr. Elmar Reichwein
Telephone	: +49 6471 3109 438
Fax	: +49 6471 3109 99
Email	: Elmar.Reichwein@feig.de
Date of order	: 2025-02-25
Date of receipt	: 2025-02-27
Period of testing time	: 2025-03-24 - 2025-04-30

3.3 Manufacturer´s details

Manufacturer´s name	(please see Applicant´s details)
Address	(please see Applicant´s details)

4 Equipment under test (EUT)

4.1 EUT: short description

EUT Type designation	ID MRMU400
Type of equipment	RFID Reader
Trademark	---
S/N Serial no.	10000008
A/N: Article no	Module: 7027.000.10 (FCC) Device: 7023.000.10 (FCC) Rail Variant: 7025.000.10 (FCC)
HW Hardware status	FE1190
SW Software status	RF Stack V1.00

For issuing this report, the following product documentation was used:

Title	Description	Version
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4.2 Additional Equipment: Short description

Additional Equipment	Type
ID ANT.U82/82 UHF Near – Field Antenna	6601.000.00 S/N: 9766766
ID ANT.U LOCFIELD	200-300-50-FCC
ID ANT.U290/290-EU RFID Antenna UHF	S/N: 93886065
ID ISC.ANT.U580/290-EU RFID Antenna UHF	S/N: 9742800

4.3 EUT operating mode

EUT operating mode no.	Description of operating modes	Additional information
OP 1	Hopping mode	---
OP 2	Non-hopping mode	---
OP 3	Cont. Tag reading mode	---

4.4 Additional declaration and description of EUT

(Application´s declaration: ☐= not selected, ☒= selected)

<table>
<tr><td>EUT</td><td>☐ tabletop unit
☐ floor-standing
☐ wall-mounted
☒ built-in</td><td>Typical use
☒ fixed use
☐ portable use
☐ vehicular use</td><td>Typical operating cycle of EUT
☒ ≤ 1 sec
☐ ____________</td></tr>
<tr><td>Place of use</td><td colspan="3">☐ Residential, commercial and light industry
☒ Industrial environment
☐ Telecom centres only
☐ Vehicular use</td></tr>
<tr><td>Highest generated internal frequency</td><td colspan="3">24 MHz</td></tr>
<tr><td>Frequency used</td><td colspan="3">50 channels (902 MHz – 928 MHz)</td></tr>
<tr><td>Environment(s) in which the equipment is intended to be used</td><td colspan="3">-25°C - +55°C</td></tr>
<tr><td>ITU emission class</td><td colspan="3">69K7F7D (@ 902.75 MHz)
69K9F7D (@ 915.25 MHz)
70K2F7D (@ 927.25 MHz)</td></tr>
<tr><td>FCC ID</td><td colspan="3">PJMMRU400</td></tr>
</table>

<table>
<tr><th colspan="5">Power line</th></tr>
<tr><td>☐ AC</td><td>☐ L1, ☐ L2, ☐ L3, ☐ N, ☐ PE</td><td>--- V/ AC</td><td>☐ 50 Hz
☐ 60 Hz</td><td rowspan="2">EUT grounding:
☒ none
☐ with power supply
☐ additional</td></tr>
<tr><td>☒ DC</td><td colspan="3">24 V/ DC</td></tr>
</table>

Other ports

Port type	Function	Shielding	Total cable length used during the test
DC power supply	Power supply	☐ screened ☒ unscreened	3 m
Ethernet + PoE	Ethernet	☒ screened ☐ unscreened	3.05 m
RS485	Interface	☐ screened ☒ unscreened	2 m
I/O Digital Input Digital Output	Optocoupler Input Optocoupler Output	☐ screened ☒ unscreened	2 m
USB	Interface	☒ screened ☐ unscreened	---

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4.5 Modifications

Modification	☐ applicable ☒ not applicable
1	---
2	---

4.6 Description of Annexes

Description	Date	Identifications
External photographs of the **E**quipment **U**nder **T**est (EUT)	2025-05-08	Annex no. 1
Internal photographs of the **E**quipment **U**nder **T**est (EUT)	2025-05-08	Annex no. 2
Channel occupancy / bandwidth	2025-05-08	Annex no. 3
Label sample	2025-05-08	Annex no. 4
Functional description / User manual	2025-05-08	Annex no. 5
Test setup photos	2025-05-08	Annex no. 6
Block diagram	2025-05-08	Annex no. 7
Operational description	2025-05-08	Annex no. 8
Schematics	2025-05-08	Annex no. 9
Parts list	2025-05-08	Annex no. 10
Antenna requirements/Periodic Operation Characteristics/Transmission Times	2025-07-02	Annex no. 11

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5 Conclusions, observations and comments

The results of the tests stated in this report are exclusively applicable to the EUT as identified in this report. TÜV NORD Hochfrequenztechnik GmbH & Co. KG cannot be held liable for properties of the EUT that have not been observed during these tests.

TÜV NORD Hochfrequenztechnik GmbH & Co. KG assumes the sample to comply with the requirements of FCC Title 47 CFR Part 15, for the respective test sector, if the test results turn out positive.

Comments: ---

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6 Operational description

6.1 EUT details

The EUT is an Ultra High Frequency (UHF) mid-range reader for applications in industrial and logistic environments. It has a robust metal housing with connectors designed for applications in harsh environments (indoor/outdoor). The EUT is equipped with integrated antenna as well as two external antenna ports with internal multiplexer.

6.2 EUT configuration

The EUT is powered ON with an external supply voltage in the range from 12 V to 24 V DC or with Power over Ethernet (PoE). After EUT initialization, the operational and RF characteristics can be configured with the help of a manufacturer supplied software application known as **ISOStart FEIG**. With the provided application, the EUT can be configured to operate in a normal mode that requires a transponder tag or to operate in a continuous test mode. It is also possible to configure a single antenna port or all antenna ports with internal multiplexer.

6.3 EUT measurement description

Radiated measurements:

The EUT was tested in a typical fashion. During preliminary emission tests, the EUT was operated in the continuous measuring mode for worst-case emission mode investigation. Therefore, the final qualification testing was completed with the EUT operated in continuous measuring mode. All tests were performed with the EUT's typical voltage: 24 V DC.

To establish the maximum radiation, firstly, there have been viewed all orthogonal adjustments of the test samples, secondly the test ample have been rotated at all adjustments around the own axis between 0° and 360°, and thirdly, the antenna polarization between horizontal and vertical had been varied.

Radiated measurements from 9 kHz – 30 MHz, 30MHz – 1 GHz and above 1 GHz were performed using a small loop antenna, Linear polarized Logarithmic Periodic Broadband Antenna, stacked Logarithmic-Periodic Broadband Antenna for linear polarized and horn antennas respectively with a measuring distance of 3 m inside SAC.

Radiated measurements above 1 GHz is made by placing loose-laid RF absorber material on the ground plane.

Additionally, radiated emission measurements above 1 GHz are made using calibrated linearly polarized antennas, which may have a smaller beam width (main lobe) than do the antennas used for frequencies below 1 GHz. The measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.

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AC Conducted measurements:

The EUT was powered ON via PoE (Power over Ethernet) Switch. It has been tested with the activated EUT mode connected directly over PoE and without EUT mode. The typical voltage of 120 V AC / 60 Hz is provided on the artificial mains network.

Environmental Conditions during the tests

Temperature: 23 – 24°C // Relative Humidity: 23 – 35 % // Air Pressure: 1007 – 1020 hPa

7.1 Antenna requirement

7.1.1 Regulation

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

7.1.2 Test Results

Antenna Type	Antenna description	Frequency	Gain dBi	Nr. of Antennas
External (ID ANT.U LOCFIELD)	UHF reader co-axial cable antenna (linear)	902 – 928 MHz	-7	Max. 2
External (ID ANT.U82/82)	UHF near-field antenna	864 – 928 MHz	< 0	Max. 2
External (ID ANT.U290/290)	Circular polarized UHF RFID antenna	902 – 928 MHz	+6	Max. 2
External (ID ANT.U580/290)	Circular polarized UHF RFID antenna	902 – 928 MHz	+8	Max. 2
External (ID ANT.U150/150)	Circular polarized UHF RFID antenna	902 – 928 MHz	+2	Max. 2
External (ID ANT.U280/210)	Circular polarized UHF RFID antenna	902 – 928 MHz	+2	Max. 2
Internal (FEIG MRU400 Antenna US)	Circular polarized UHF RFID antenna	902 – 928 MHz	+2	Max. 2

The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.[x]**

Test setup photos / test results are attached	☒ **Yes**	☐ **No**	Annexe no.: 6, 11

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7.2 Conducted limits

7.2.1 Regulation

According to FCC §15.207 (a), except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Conducted Limits		
Frequency of Emission	**Quasi-Peak (QP)**	**Average (AV)**
MHz	**dBμV**	**dBμV**
0.15 - 0.5	66 to 56*	56 to 46*
0.5 - 5	56	46
5 -30	60	50
*Decreases with the logarithm of the frequency		

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535–1705 kHz, as measured using a 50 μH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation, and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

7.2.2 Test procedures

The EUT and the additional equipment (if required) are connected to the main power through a line impedance stabilization network (LISN). The LISN must be appropriate to ANSI C63.10-2013.
Additional equipment must also be connected to a second LISN with the same specifications described in the above section (if required).

7.2.3 Test Result

Test location and equipment

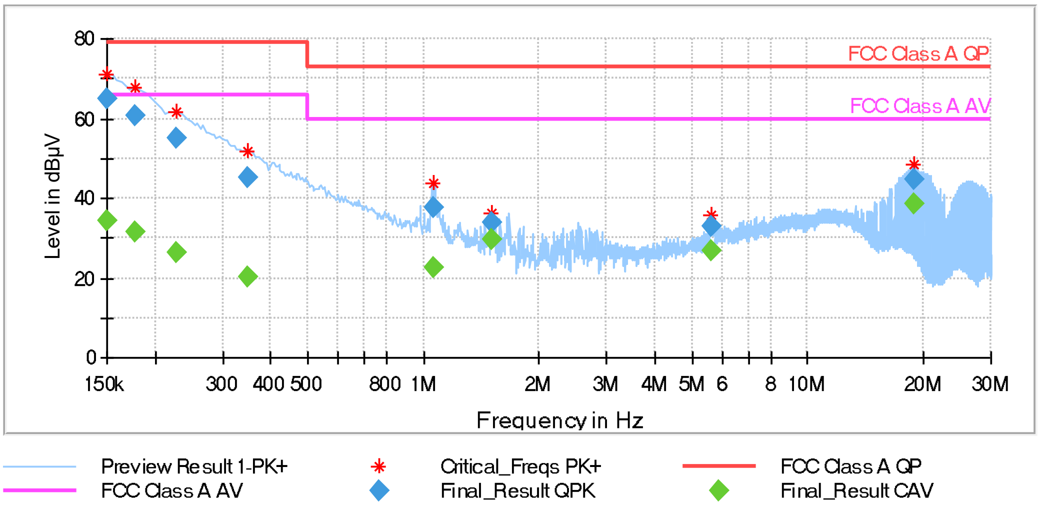
Test site	EMV Laboratory TÜV NORD Hochfrequenztechnik				
Receiver	☒ 665				
Additional equipment	☒ 272	☒ 60	☐ 71a	☒ 551	☐ 606a
	☒ 606b	☒ 606c			
Cable	☒ KISN2				
Test Software	☒ EMC32		☐ ELEKTRA		

Note: The EUT was configured to mode **OP3**.

<u>Measurement Plots</u>

Conducted emissions – PoE with EUT

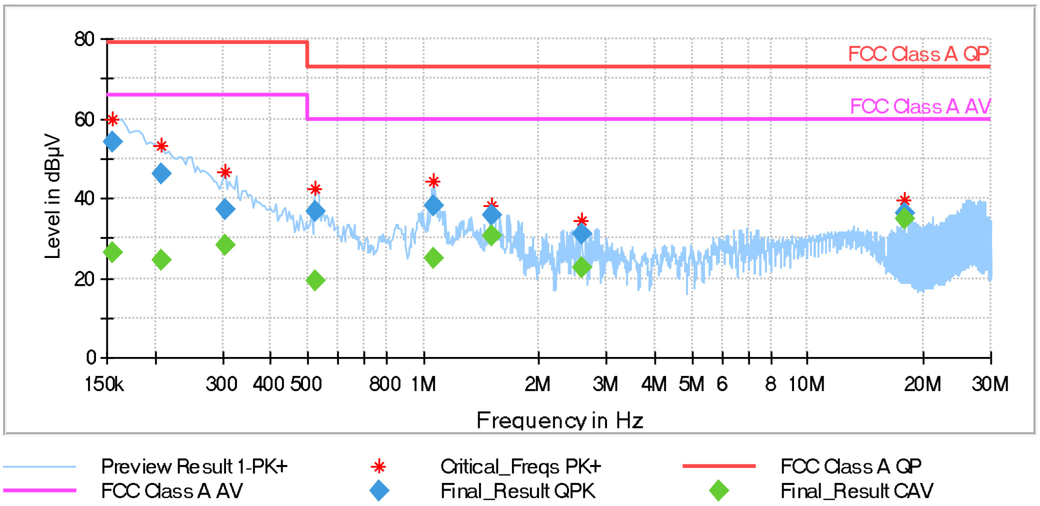
Full Spectrum



Frequency (MHz)	QuasiPeak (dBµV)	CAvg. (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	64.95	---	79.00	14.05	1000.0	9.000	N	GND	20.1
0.150000	---	34.25	66.00	31.75	1000.0	9.000	N	GND	20.1
0.177000	60.74	---	79.00	18.26	1000.0	9.000	L1	GND	20.1
0.177000	---	31.76	66.00	34.24	1000.0	9.000	L1	GND	20.1
0.226500	---	26.31	66.00	39.69	1000.0	9.000	L1	GND	20.1
0.226500	54.94	---	79.00	24.06	1000.0	9.000	L1	GND	20.1
0.348000	44.95	---	79.00	34.05	1000.0	9.000	L1	GND	20.1
0.348000	---	20.07	66.00	45.93	1000.0	9.000	L1	GND	20.1
1.068000	37.64	---	73.00	35.36	1000.0	9.000	L1	GND	20.2
1.068000	---	22.70	60.00	37.30	1000.0	9.000	L1	GND	20.2
1.513500	34.07	---	73.00	38.93	1000.0	9.000	L1	GND	20.2
1.513500	---	29.78	60.00	30.22	1000.0	9.000	L1	GND	20.2
5.622000	33.01	---	73.00	39.99	1000.0	9.000	L1	GND	20.3
5.622000	---	26.96	60.00	33.04	1000.0	9.000	L1	GND	20.3
18.969000	---	38.54	60.00	21.46	1000.0	9.000	N	GND	21.2
18.969000	44.85	---	73.00	28.15	1000.0	9.000	N	GND	21.2

Conducted emissions – PoE without EUT

Full Spectrum



Frequency (MHz)	QuasiPeak (dBµV)	CAvg. (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154500	54.30	---	79.00	24.70	1000.0	9.000	N	GND	20.1
0.154500	---	26.59	66.00	39.41	1000.0	9.000	N	GND	20.1
0.208500	---	24.27	66.00	41.73	1000.0	9.000	N	GND	20.0
0.208500	46.29	---	79.00	32.71	1000.0	9.000	N	GND	20.0
0.303000	37.20	---	79.00	41.80	1000.0	9.000	L1	GND	20.1
0.303000	---	28.29	66.00	37.71	1000.0	9.000	L1	GND	20.1
0.523500	36.82	---	73.00	36.18	1000.0	9.000	L1	GND	20.1
0.523500	---	19.42	60.00	40.58	1000.0	9.000	L1	GND	20.1
1.068000	38.13	---	73.00	34.87	1000.0	9.000	L1	GND	20.2
1.068000	---	24.73	60.00	35.27	1000.0	9.000	L1	GND	20.2
1.513500	---	30.82	60.00	29.18	1000.0	9.000	L1	GND	20.2
1.513500	35.57	---	73.00	37.43	1000.0	9.000	L1	GND	20.2
2.584500	---	22.43	60.00	37.57	1000.0	9.000	L1	GND	20.2
2.584500	30.98	---	73.00	42.02	1000.0	9.000	L1	GND	20.2
17.817000	---	34.89	60.00	25.11	1000.0	9.000	N	GND	21.2
17.817000	36.07	---	73.00	36.93	1000.0	9.000	N	GND	21.2

The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.**[x]

Test setup photos / test results are attached	☒ **Yes**	☐ **No**	Annexe no.:6

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7.3 Radiated emission limits, general requirements

7.3.1 Regulation

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Intentional radiator- radiated emission limits		
Frequency	**Field Strength**	**Measurement distance**
MHz	**µV / m**	**m**
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
above 960	500	3
Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz, or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.		

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part, and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz, and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

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(g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

7.3.2 Test Procedure

According to ANSI C63.4 Section "Radiated Emissions Testing", the EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360° to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna is 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization; the position of the EUT was changed in different orthogonal determinations.

Measurement procedures for electric field radiated emissions from 9 kHz - 1 GHz & 1 GHz - 40 GHz are covered in Clause of ANSI C63.4. The ANSI C63.4 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Sub clause of ANSI C63.4 states that the measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." We consider the "cone of radiation" to be the 3 dB beam width of the measurement antenna.

While the "bore-sighting" technique is not explicitly mentioned in ANSI C63.4, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including knowledge of the beam width of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTs, measuring system sensitivity, etc.

ANSI C63.4 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement, it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

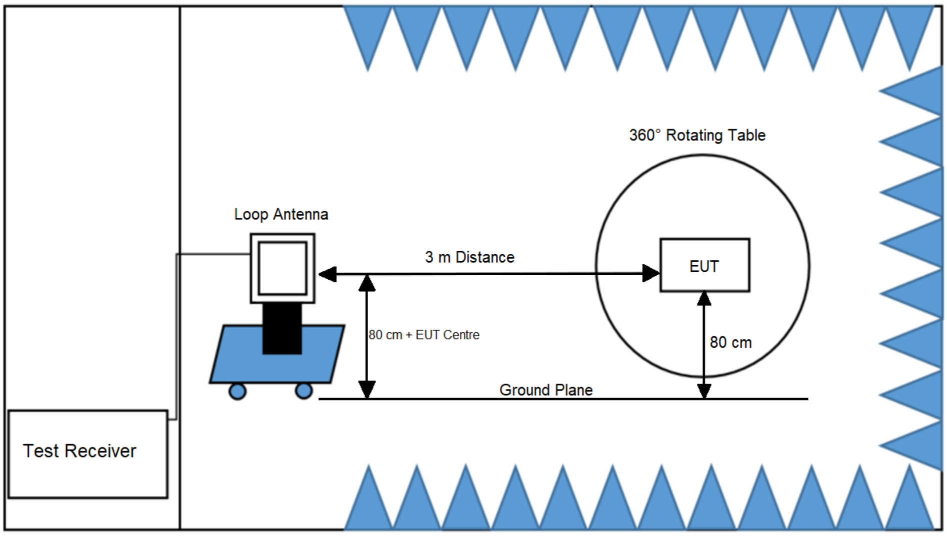
Radiated emissions test characteristics	
Frequency range	9 kHz - 40000 MHz
Test distance	10m, 3 m*
Test instrumentation resolution bandwidth	9 kHz (20 kHz – 30 MHz)
	120 kHz (30 MHz – 1.000 MHz)
	1 MHz (1000 MHz – 40000 MHz)
Receive antenna height	1 m (20 kHz – 30 MHz)
Receive antenna polarization	0° - 90° (20 kHz – 30 MHz)
Receive antenna scan height	1 m - 4 m (1000 MHz - 40000 MHz)
Receive antenna polarization	vertical/horizontal (Above 30 MHz)

*According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

7.3.3 Test Setups

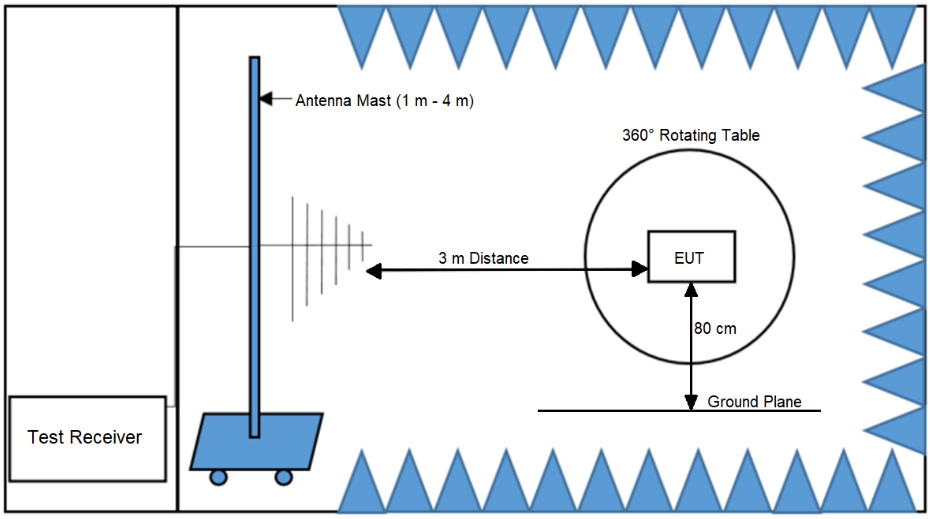
Radiated measurements setup (9 kHz – 30 MHz)

SEMI ANECHOIC CHAMBER (SAC)



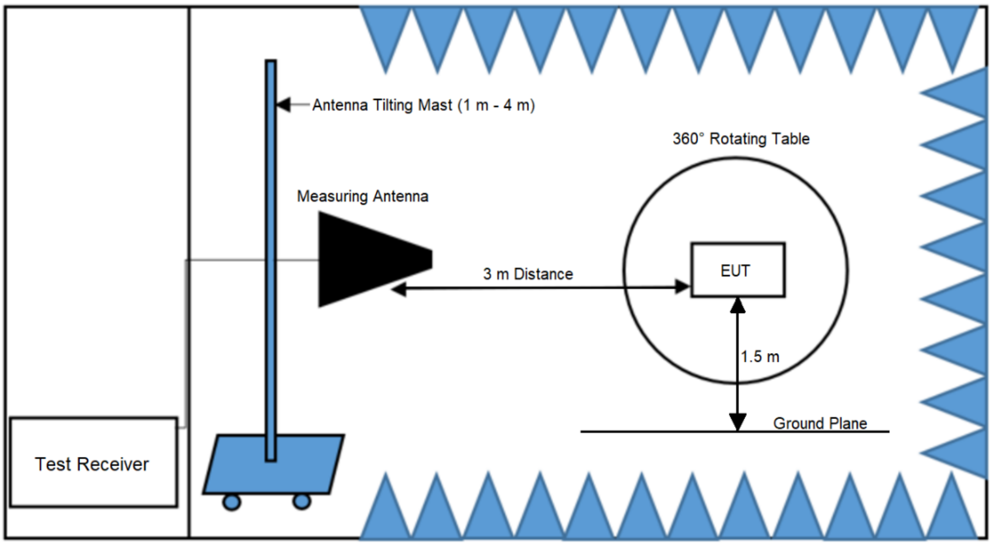
Radiated measurements setup (30 MHz – 1 GHz)

SEMI ANECHOIC CHAMBER (SAC)



Radiated measurements setup (1 GHz – 40 GHz)

SEMI ANECHOIC CHAMBER (SAC)



Radiated measurements from 9 kHz – 30 MHz, 30MHz – 1 GHz, 1 GHz – 18 GHz and 18 GHz – 40 GHz were performed using a small loop antenna, Linear polarized Logarithmic Periodic Broadband Antenna, stacked Logarithmic-Periodic Broadband Antenna for linear polarized and horn antenna respectively with a measuring distance of 3 m inside SAC as shown in the above test setup diagrams.

The measurement procedure for harmonics and spurious emissions at or below 40 GHz is taken from ANSI C63.10-2013.

7.3.4 Calculation of the field strength

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-amplifier (with the use of a pre-amplifier)

Receiver Level : Receiver reading without correction factors
Correction Factor : Antenna factor + cable loss

For example:
The receiver reading is 32.7 dBμV. The antenna factor for the measured frequency is +2.5 dB (1/m) and the cable factor for the measured frequency is 0.71 dB, giving a field strength of 35.91dBμV/m.
The 35.91dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm (35.91/20) = 62.44

For test distance other than what is specified but fulfilling the requirements of Section 15.31 (f) (1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/decade (inverse linear distance for field strength measurements).

7.3.5 Test Results

Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☒ 706 Semi Anechoic Chamber ☐ Radio laboratory					
Receiver	☐ 665	☐ 502	☒ 696			
Test equipment	☒ 406	☒ 445a	☐ 90b	☒ 704	☐ 183d	☐ 28a
	☐ 93	☐ 462	☒ 560	☐ 284	☐ 23	☒ 697
	☒ 698	☒ 707	☒ 708	☒ 709	☐ 223a	
Cable	☐ K60	☐ K80	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K198	☒ K199	☒ K203	☒ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☒ ELEKTRA			

Note: The EUT was configured to mode **OP1**. The measurements were performed with different types of external antennas.

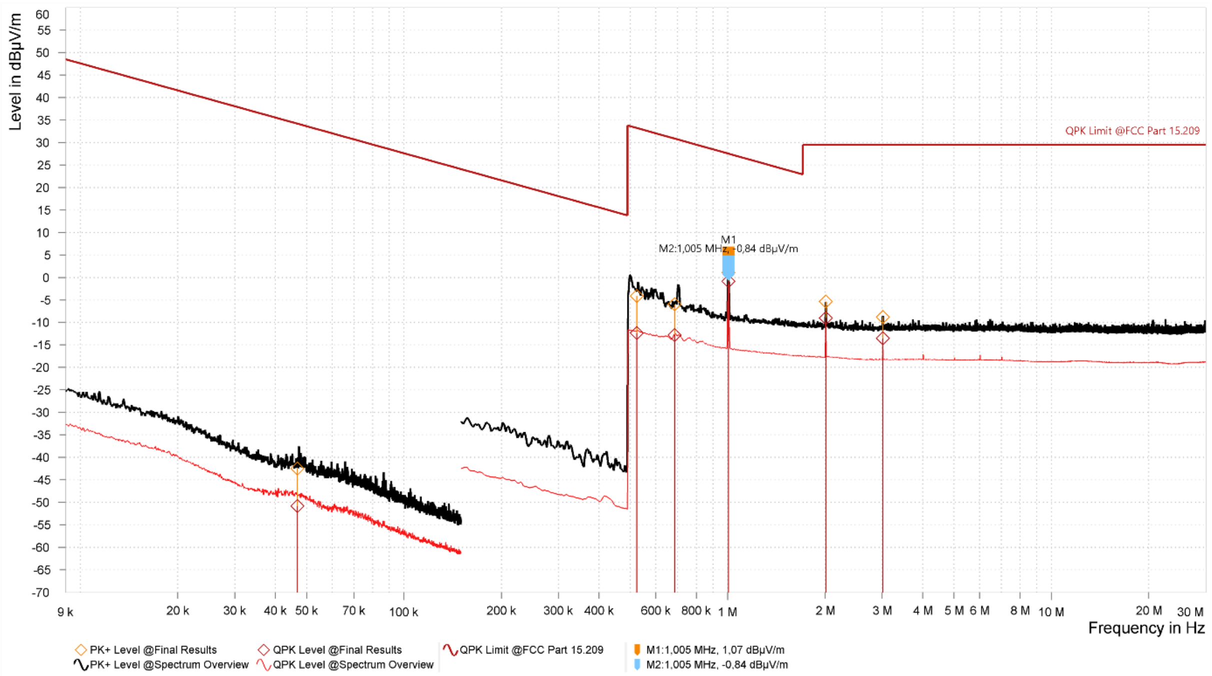
The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.**^{x}

Test setup photos	☒ **Yes**	☐ **No**	**Annex no. 6**

Measurement results for radiated spurious emission

9 kHz – 30 MHz

EUT connected with an external Antenna (ID ANT.U LOCFIELD)

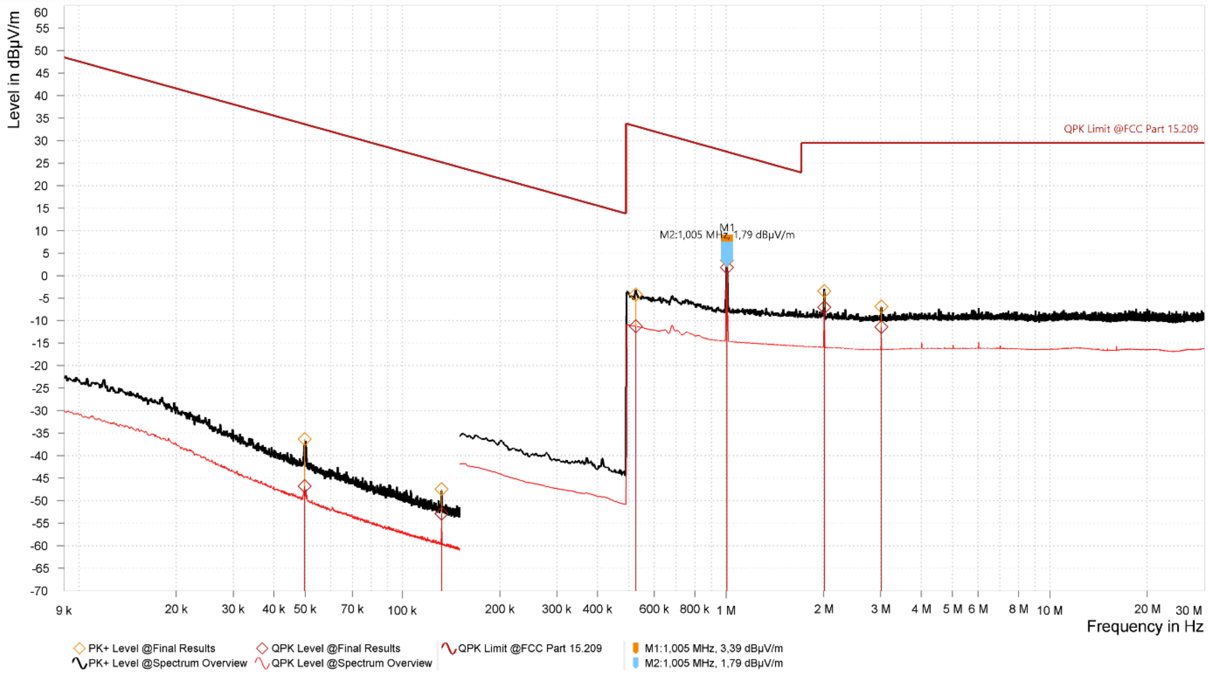


Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+: QPK Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
0.047	-50.82	34.18	85.00	-42.50	34.18	76.68	-58.03	V	-163	1.00	9.000
0.524	-12.35	33.22	45.58	-4.16	33.22	37.38	-18.26	V	30	1.00	9.000
0.686	-12.81	30.87	43.68	-5.99	30.87	36.85	-18.26	V	30	1.00	9.000
1.005	-0.84	27.52	28.36	1.07	27.52	26.45	-18.36	V	-45	1.00	9.000
2.009	-9.06	29.50	38.56	-5.39	29.50	34.89	-18.26	V	-60	1.00	9.000
3.014	-13.55	29.50	43.05	-8.82	29.50	38.32	-18.36	V	-30	1.00	9.000

EUT connected with an external Antenna (ID ANT.U82/82)

Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+: QPK Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
0.026	-43.96	39.22	83.18	-35.26	39.22	74.49	-57.82	V	-57	1.00	9.000
0.152	-43.49	23.95	67.43	-36.01	23.95	59.96	-58.16	V	-75	1.00	9.000
0.643	-13.26	31.43	44.69	-5.68	31.43	37.10	-18.26	V	-135	1.00	9.000
1.865	-16.71	29.50	46.21	-2.60	29.50	32.10	-18.26	V	30	1.00	9.000
6.034	-18.23	29.50	47.73	-10.81	29.50	40.31	-18.35	V	30	1.00	9.000
8.513	-18.53	29.50	48.03	-10.92	29.50	40.42	-18.35	V	60	1.00	9.000

EUT connected with an external Antenna (ID ANT.U580/290)



Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+: QPK Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
0.050	-46.78	33.65	80.43	-36.32	33.65	69.97	-58.06	V	-180	1.00	9.000
0.132	-52.87	25.19	78.06	-47.42	25.19	72.61	-58.16	V	-13	1.00	9.000
0.526	-11.23	33.18	44.41	-4.22	33.18	37.40	-18.26	V	135	1.00	9.000
1.005	1.79	27.52	25.73	3.39	27.52	24.13	-18.36	V	-58	1.00	9.000
2.009	-7.03	29.50	36.53	-3.44	29.50	32.94	-18.26	V	-60	1.00	9.000
3.014	-11.43	29.50	40.93	-6.84	29.50	36.34	-18.36	V	-15	1.00	9.000

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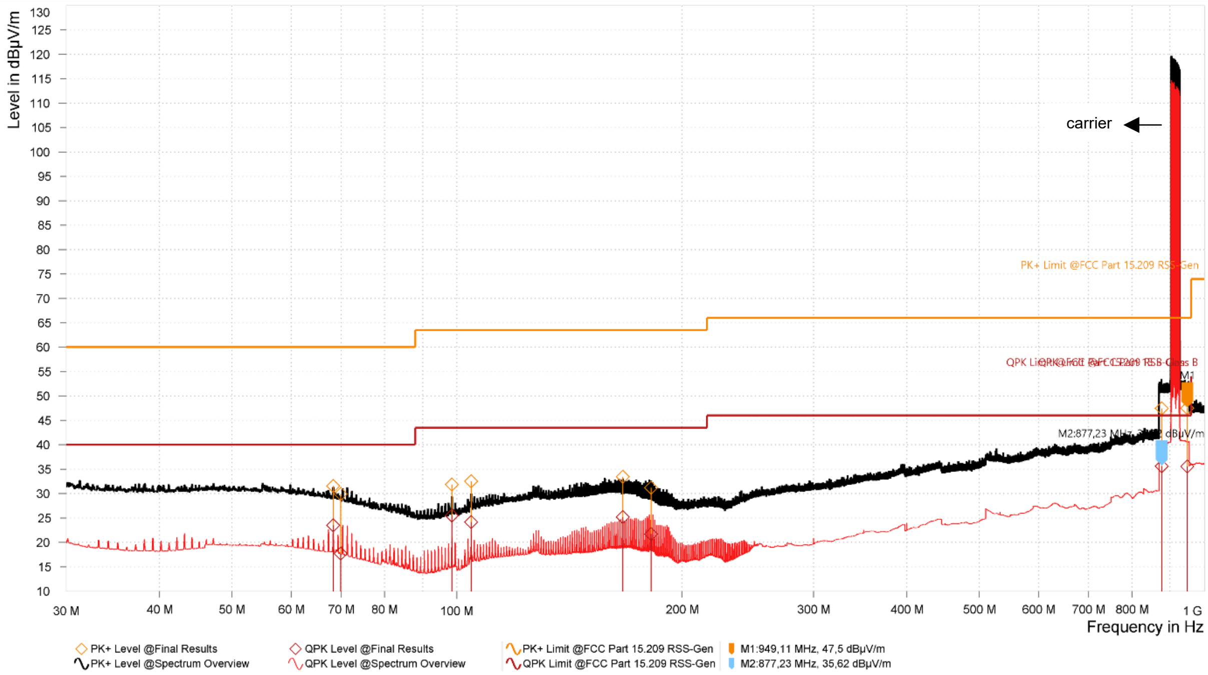
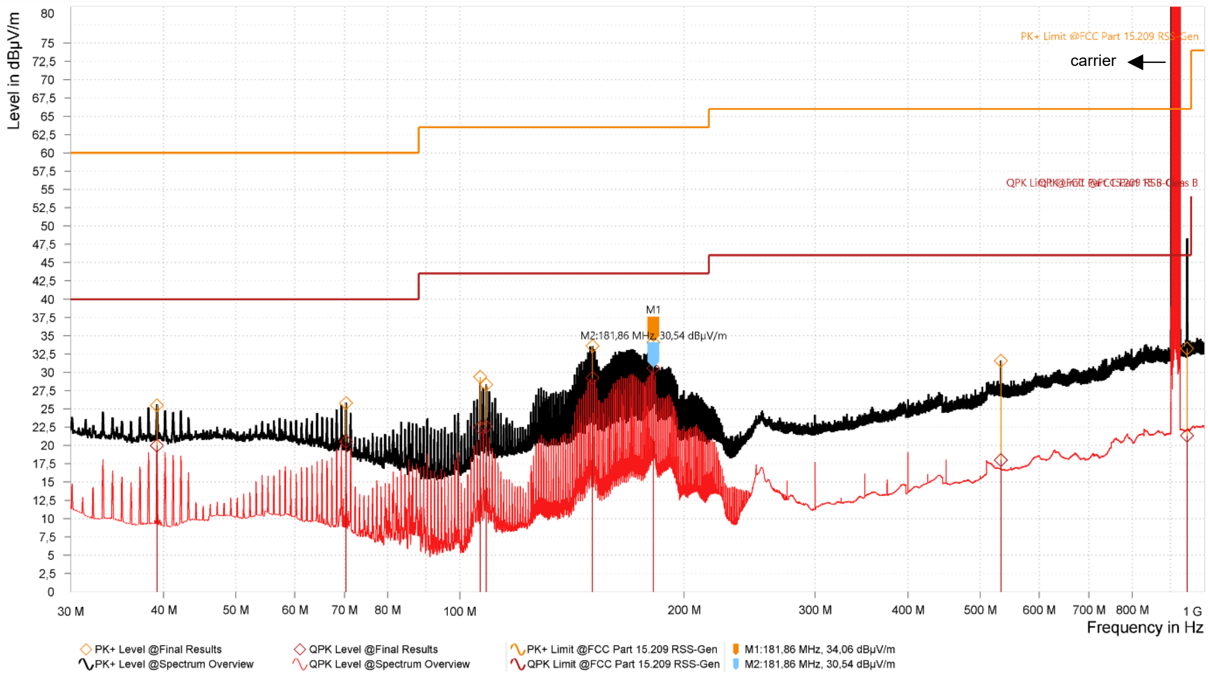
30 MHz – 1 GHz

EUT connected with an external Antenna (ID ANT.U LOCFIELD)



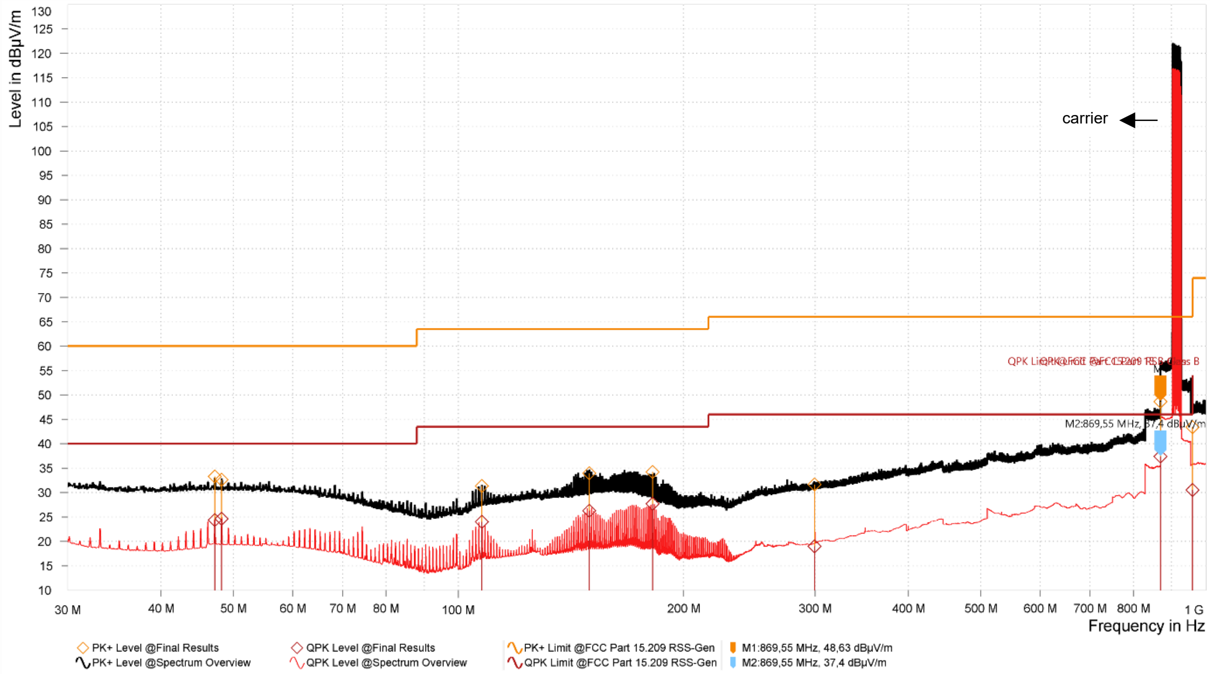
Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
68.310	23.47	40.00	16.53	31.56	60.00	28.44	15.42	V	0	1.00	120.000
69.900	17.67	40.00	22.33	29.89	60.00	30.11	15.14	V	-13	2.91	120.000
98.460	25.47	43.50	18.03	31.84	63.50	31.66	12.07	V	-90	1.00	120.000
104.490	24.15	43.50	19.35	32.51	63.50	30.99	13.18	V	-89	1.14	120.000
166.770	25.19	43.50	18.31	33.43	63.50	30.07	16.79	H	-163	1.00	120.000
181.830	21.68	43.50	21.82	31.18	63.50	32.32	15.15	H	-161	1.00	120.000
877.230	35.62	46.00	10.38	47.46	66.00	18.54	27.32	H	45	1.14	120.000
949.110	35.55	46.00	10.45	47.50	66.00	18.50	28.20	H	90	1.00	120.000

EUT connected with an external Antenna (ID ANT.U82/82)



Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
39.180	19.99	40.00	20.01	25.48	60.00	34.52	16.48	V	150	1.00	120.000
70.320	20.53	40.00	19.47	25.78	60.00	34.22	15.03	V	-75	1.00	120.000
106.500	22.45	43.50	21.05	29.38	63.50	34.12	13.51	V	16	1.14	120.000
108.510	22.59	43.50	20.91	28.32	63.50	35.18	13.79	V	-90	1.00	120.000
150.720	29.25	43.50	14.25	33.59	63.50	29.91	16.77	H	-165	1.46	120.000
181.860	30.54	43.50	12.96	34.06	63.50	29.44	15.15	H	-180	1.14	120.000
533.010	18.00	46.00	28.00	31.57	66.00	34.43	22.54	H	-163	1.00	120.000
948.030	21.35	46.00	24.65	33.24	66.00	32.76	28.19	H	-45	2.55	120.000

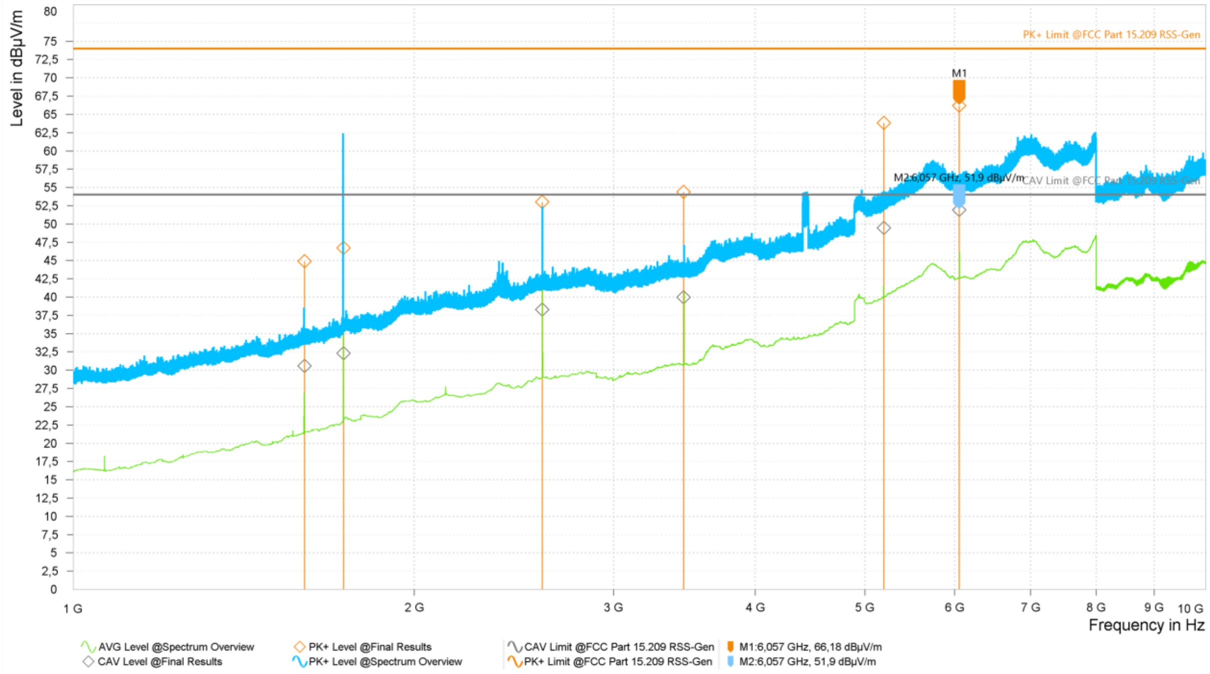
EUT connected with an external Antenna (ID ANT.U580/290)



Freq. [MHz]	QPK Level [dBµV/m]	QPK Limit [dBµV/m]	QPK Margin [dB]	PK+ Level [dBµV/m]	PK+ Limit [dBµV/m]	PK+ Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
47.220	24.38	40.00	15.62	33.32	60.00	26.68	17.18	V	134	1.46	120.000
48.210	24.65	40.00	15.35	32.63	60.00	27.37	17.12	V	105	1.00	120.000
107.520	24.00	43.50	19.50	31.34	63.50	32.16	13.65	V	45	1.00	120.000
149.700	26.27	43.50	17.23	33.97	63.50	29.53	16.71	H	-164	1.00	120.000
181.890	27.72	43.50	15.78	34.19	63.50	29.31	15.14	H	170	1.14	120.000
299.520	18.98	46.00	27.02	31.63	66.00	34.37	17.31	H	-133	2.57	120.000
869.550	37.40	46.00	8.60	48.63	66.00	17.37	27.35	V	-180	1.00	120.000
960.090	30.54	54.0	23.46	43.38	74.00	30.62	28.42	H	33	1.00	120.000

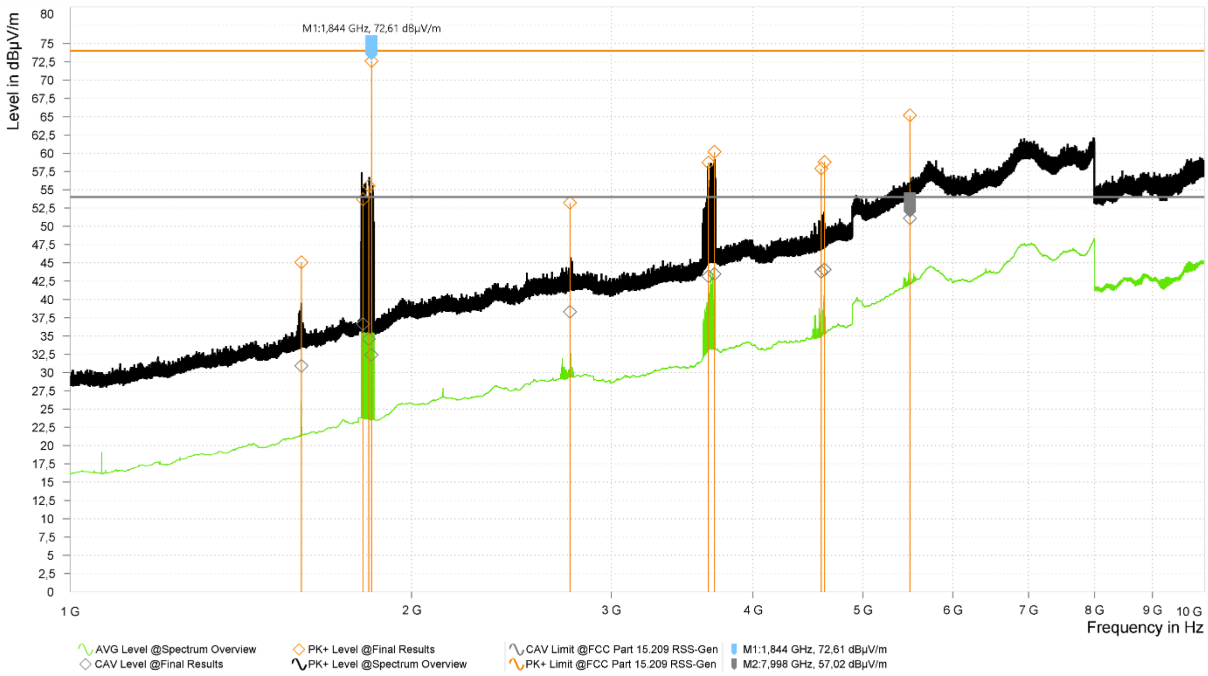
1 GHz – 10 GHz

EUT connected with an external Antenna (ID ANT.U LOCFIELD)



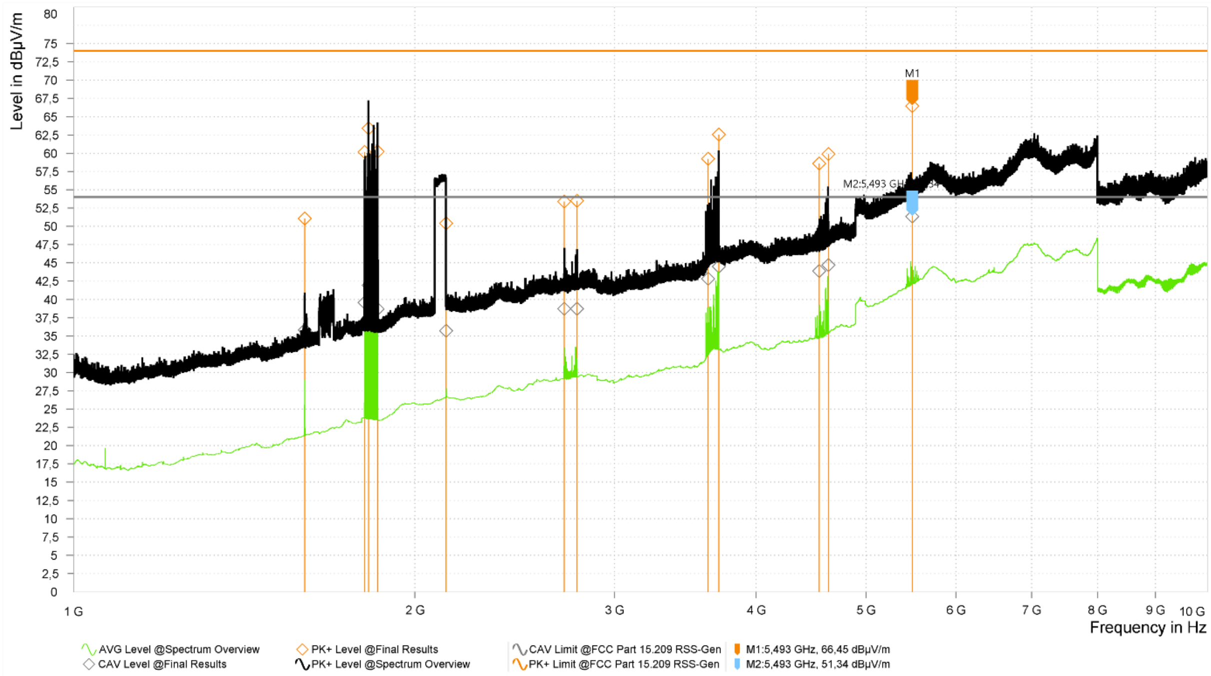
Freq. [MHz]	PK Level [dBµV/m]	PK Limit [dBµV/m]	PK Margin [dB]	CAV Level [dBµV/m]	CAV Limit [dBµV/m]	CAV Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
1600.140	44.87	74.00	29.13	30.57	54.00	23.43	30.66	V	-60	1.00	1000
1732.150	46.72	74.00	27.28	32.30	54.00	21.70	32.45	V	-75	2.82	1000
2594.580	52.99	74.00	21.01	38.28	54.00	15.72	36.18	V	-74	2.13	1000
3459.010	54.35	74.00	19.65	39.96	54.00	14.04	38.62	V	-134	2.95	1000
5196.930	63.81	74.00	10.19	49.43	54.00	4.57	43.66	V	152	2.78	1000
6057.390	66.18	74.00	7.82	51.90	54.00	2.10	45.60	V	-173	2.82	1000

EUT connected with an external Antenna (ID ANT.U82/82)



Freq. [MHz]	PK Level [dBµV/m]	PK Limit [dBµV/m]	PK Margin [dB]	CAV Level [dBµV/m]	CAV Limit [dBµV/m]	CAV Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
1599.230	45.06	74.00	28.94	30.94	54.00	23.06	30.66	V	-108	2.13	1000
1812.510	53.70	74.00	20.30	36.62	54.00	17.38	32.13	H	-75	1.42	1000
1833.500	55.53	74.00	18.47	34.57	54.00	19.43	32.04	H	105	1.43	1000
1843.500	72.61	74.00	1.39	32.41	54.00	21.59	31.94	H	105	2.95	1000
2759.230	53.22	74.00	20.78	38.31	54.00	15.69	36.58	H	106	1.43	1000
3655.010	58.74	74.00	15.26	43.17	54.00	10.83	40.73	H	-105	1.43	1000
3698.990	60.20	74.00	13.80	43.48	54.00	10.52	40.93	H	151	2.12	1000
4594.760	57.91	74.00	16.09	43.79	54.00	10.21	41.97	H	-106	2.95	1000
4625.240	58.78	74.00	15.22	44.10	54.00	9.90	42.21	H	180	1.13	1000
5502.480	65.19	74.00	8.81	51.11	54.00	2.89	45.32	H	-41	2.95	1000

EUT connected with an external Antenna (ID ANT.U580/290)



Freq. [MHz]	PK Level [dBµV/m]	PK Limit [dBµV/m]	PK Margin [dB]	CAV Level [dBµV/m]	CAV Limit [dBµV/m]	CAV Margin [dB]	Cor. [dB]	Pol.	Azimuth [deg]	Ant. Height [m]	Meas. BW [kHz]
1598.980	51.07	74.00	22.93	35.81	54.00	18.19	30.66	V	-165	1.77	1000
1805.500	60.17	74.00	13.83	39.58	54.00	14.42	32.14	H	120	2.12	1000
1820.480	63.41	74.00	10.59	41.94	54.00	12.06	32.11	V	-119	3.49	1000
1854.490	60.24	74.00	13.76	38.67	54.00	15.33	31.88	V	-119	3.85	1000
2131.180	50.43	74.00	23.57	35.70	54.00	18.30	34.69	H	58	1.95	1000
2708.510	53.40	74.00	20.60	38.71	54.00	15.29	36.50	V	-118	2.47	1000
2779.760	53.48	74.00	20.52	38.70	54.00	15.30	36.62	V	-149	2.13	1000
3629.000	59.25	74.00	14.75	42.83	54.00	11.17	40.15	V	-178	1.78	1000
3709.000	62.56	74.00	11.44	44.48	54.00	9.52	40.87	V	-165	3.13	1000
4546.730	58.58	74.00	15.42	43.87	54.00	10.13	41.63	H	-105	1.77	1000
4633.740	59.88	74.00	14.12	44.69	54.00	9.31	42.28	H	-119	1.00	1000
5493.010	66.45	74.00	7.55	51.34	54.00	2.66	45.26	H	-172	1.77	1000

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7.4 Operation in the restricted bands

7.4.1 Regulation

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

Restricted bands of operation			
Frequency Band MHz	**Frequency Band MHz**	**Frequency Band MHz**	**Frequency Band GHz**
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
[1]0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	([2])
13.36-13.41	---	---	---
[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz. **[2] Above 38.6**			

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

1. Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

2. Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

3. Cable locating equipment operated pursuant to §15.213.

4. Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.

5. Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

6. Transmitters operating under the provisions of subparts D or F of this part.

7. Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

8. Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only and shall not exceed the limits specified in §15.245(b).

9. Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only and shall not exceed the limits specified in §15.249(a).

10. White space devices operating under subpart H of this part are exempt from complying with the requirements of this section for the 608-614 MHz band.

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of § 15.245 shall not exceed the limits specified in § 15.245(b).

7.4.2 Test Results

Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☒ 706 Semi Anechoic Chamber ☐ Radio laboratory					
Receiver	☐ 665	☐ 502	☒ 696			
Test equipment	☒ 406	☒ 445a	☐ 90b	☒ 704	☐ 183d	☐ 28a
	☐ 93	☐ 462	☒ 560	☐ 284	☐ 23	☒ 697
	☒ 698	☒ 707	☒ 708	☒ 709	☐ 223a	
Cable	☐ K60	☐ K80	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K198	☒ K199	☒ K203	☒ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☒ ELEKTRA			

The equipment passed the performed tests	**☒ Yes****	**☐ No**	**☐ N.t.[x]**

Test setup photos	**☒ Yes**	**☐ No**	**Annex no. 6**

** *All emissions that falls under the restricted bands of operations are included in clause 7.3 and are marked blue.*

7.5 Bandwidth

7.5.1 Regulation

According to § 15.247 (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels is used.

(2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.5.2 Test Procedure

Test procedures were carried out according to ANSI C63.10-2020 section 6.9.

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7.5.3 Test Results

Channel	Centre Frequency (GHz)	99% BW (kHz)	20 dB BW (kHz)
Lower	902.75	69.7	71.8
Middle	915.25	69.9	71.5
Higher	927.25	70.2	72.4

Note: The EUT was configured to test mode **OP2**. The measurements were performed directly at the antenna port.

Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.**[x]

Test setup photos	☒ **Yes**	☐ **No**	**Annex no. 6**

7.6 Carrier frequency separation

7.6.1 Regulation

According to § 15.247 (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels is used.

7.6.2 Test Procedure

The test procedure was carried out according to ANSI C63.10-2020 section 7.8.2.

7.6.2 Test Results

Operating frequency	20 dBc frequencies MHz		Calculated centre frequencies MHz		Calculated channel separation kHz
@ 914.75 MHz	$F1_L$	914.71323	F1	914.75	500
	$F1_H$	914.78382			
@ 915.25 MHz	$F2_L$	915.21338	F2	915.25	
	$F2_H$	915.28427			

Note: The EUT was configured to mode **OP1**. The measurements were performed directly at the antenna port.

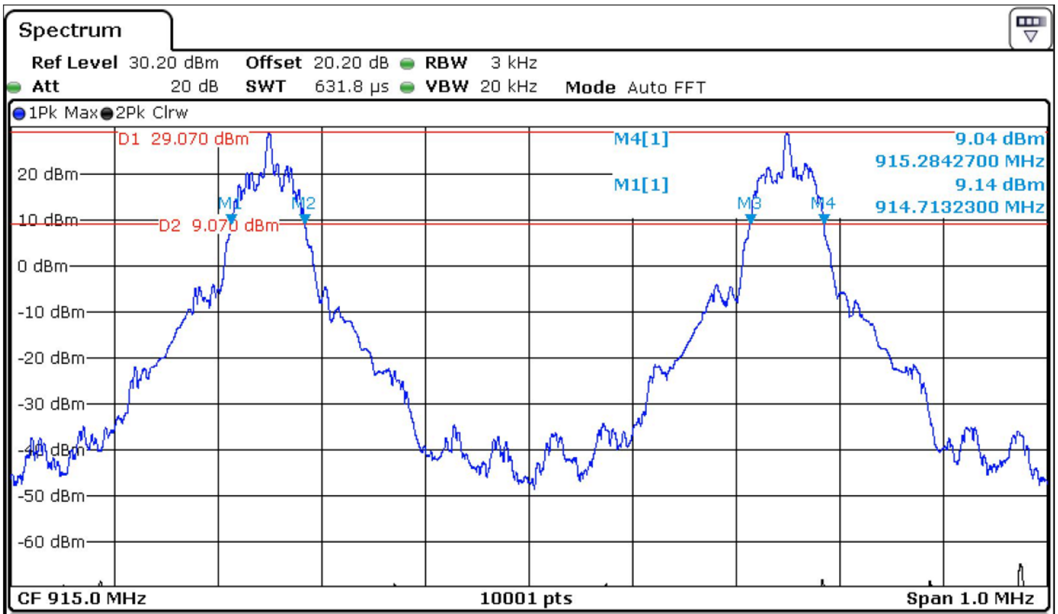
Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.**[x]

Test setup photos	☒ **Yes**	☐ **No**	**Annex no. 6**

Measurement plots



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	914.71323 MHz	9.14 dBm		
M2		1	914.78382 MHz	9.17 dBm		
M3		1	915.21338 MHz	9.16 dBm		
M4		1	915.28427 MHz	9.04 dBm		

7.7 Number of hopping frequencies

7.7.1 Regulation

According to § 15.247 (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

7.7.2 Test Procedure

The test procedure was carried out according to ANSI C63.10-2020 section 7.8.3.

7.7.2 Test Results

Operating Frequency Band	Number of hopping channels Measured	Number of hopping channels Limit
902 MHz – 928 MHz	50	---

Note: The EUT was configured to mode **OP1**. The measurements were performed directly at the antenna port.

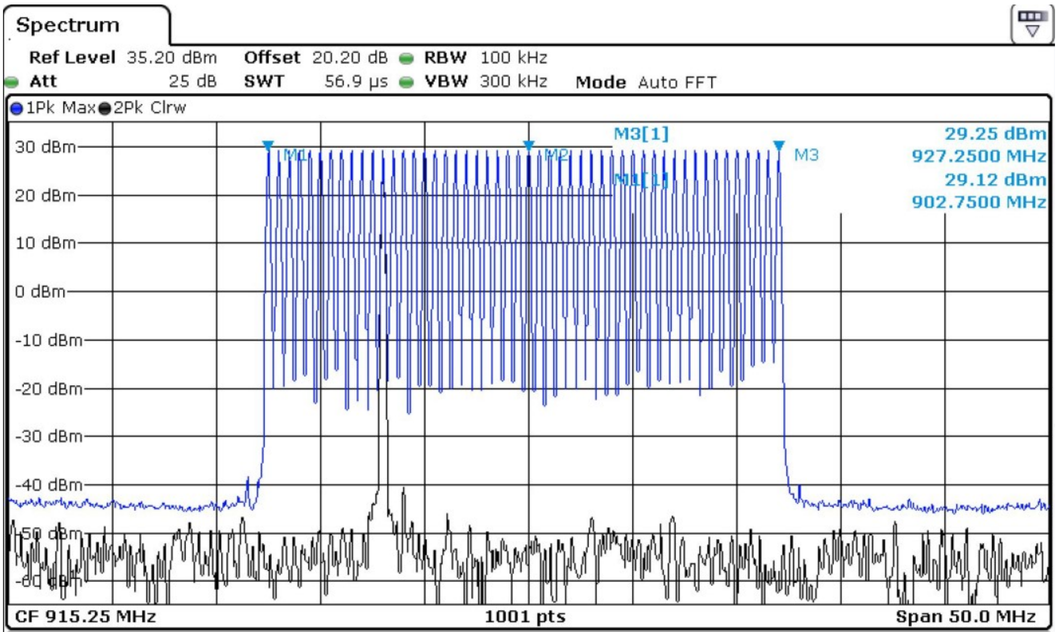
Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

The equipment passed the performed tests	☒ **Yes**	☐ **No**	☐ **N.t.[x]**

Test setup photos	☒ **Yes**	☐ **No**	**Annex no. 6**

Measurement plots



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	902.75 MHz	29.12 dBm		
M2		1	915.25 MHz	29.17 dBm		
M3		1	927.25 MHz	29.25 dBm		

7.8 Average time of occupancy

7.8.1 Regulation

According to § 15.247 (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

7.8.2 Test Procedure

The test procedure was carried out according to ANSI C63.10-2013 section 7.8.4.

7.8.3 Test Result

Operating Frequency MHz		Duration of a single transmission ms	Number of transmissions	Average time of occupancy ms	Limit ms
F_{Low}	902.75	196	2	392	400
F_{Middle}	915.25	196	2	392	400
F_{High}	927.25	196	2	392	400

Note: The EUT was configured to mode **OP1**. The measurements were performed directly at the antenna port.

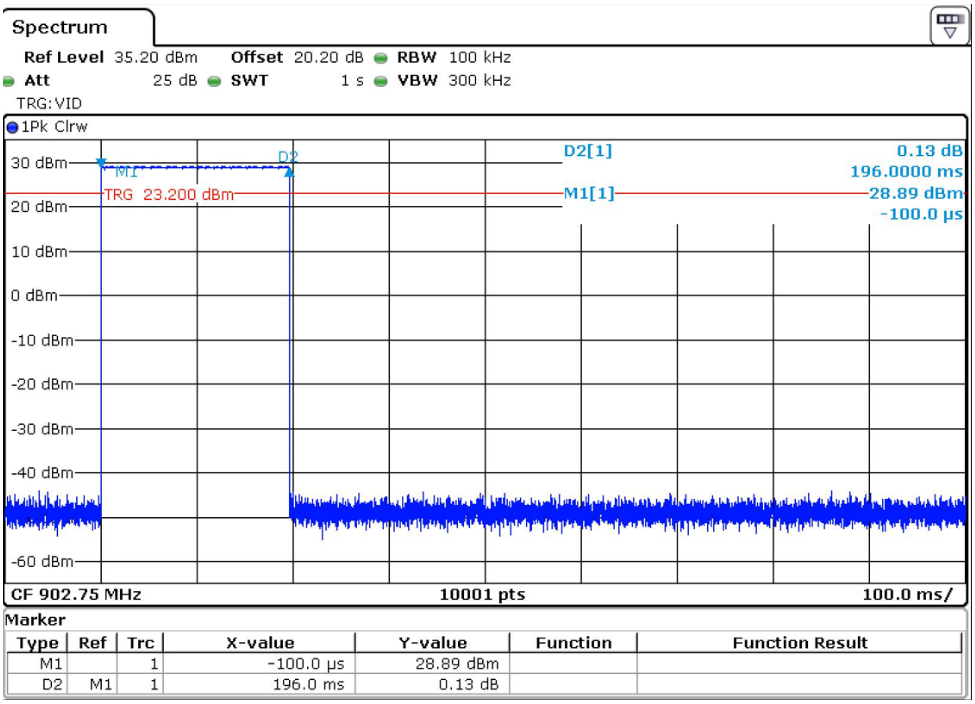
Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

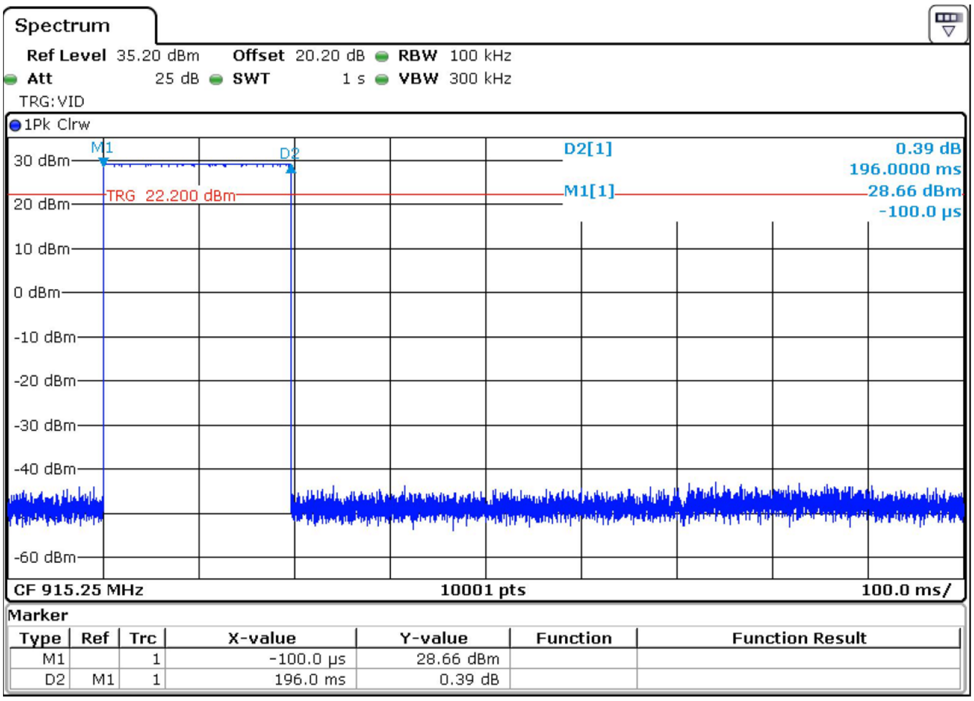
Measurement plots

Plots of single burst

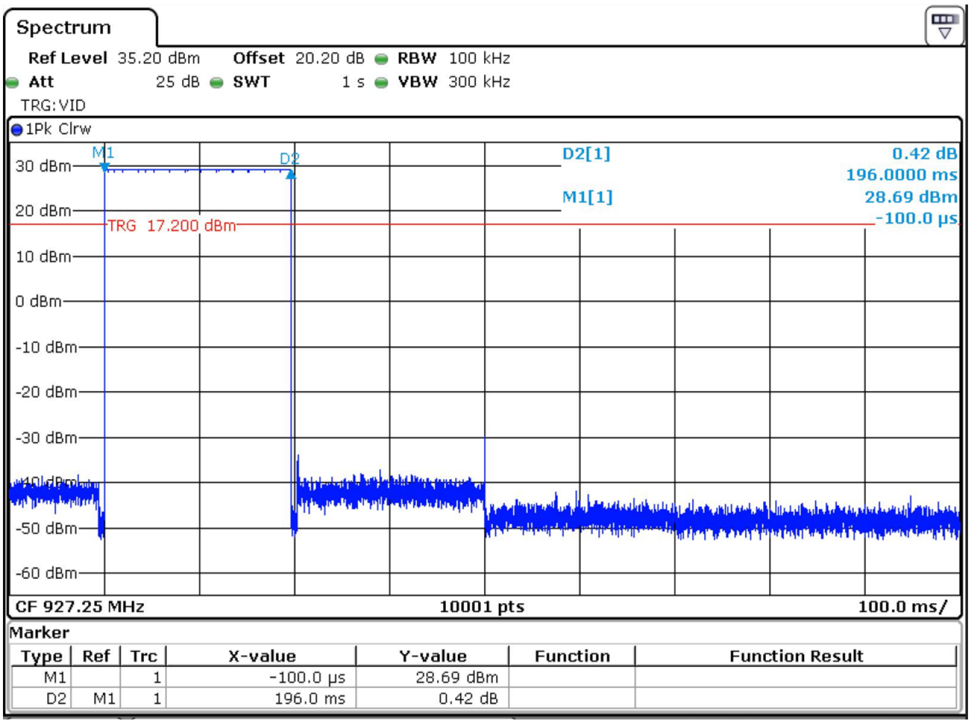
@ 902.75 MHz



@ 915.25 MHz

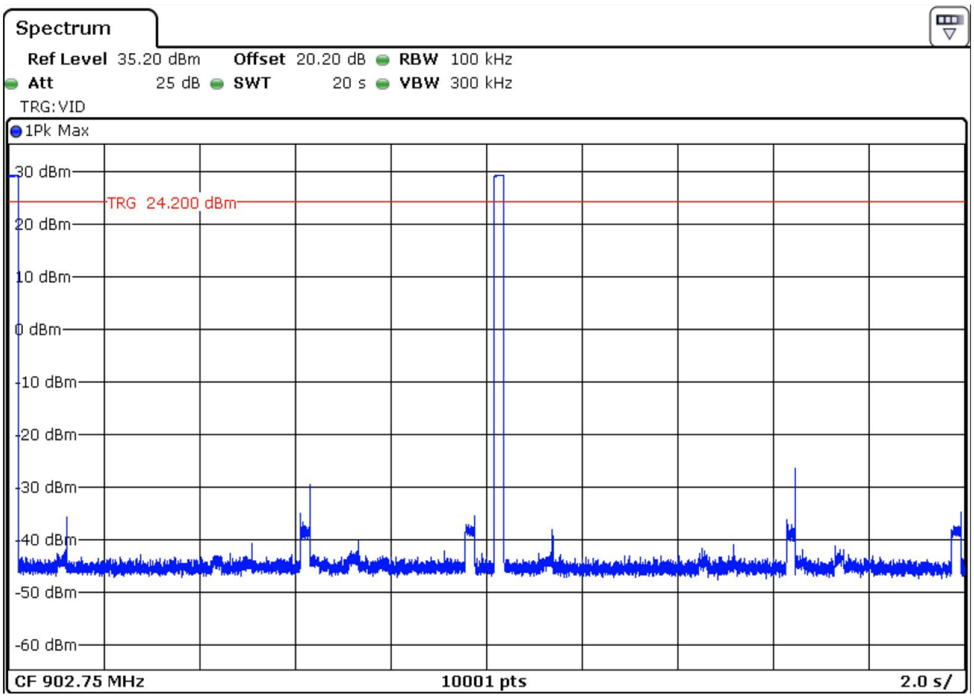


@ 927.25 MHz

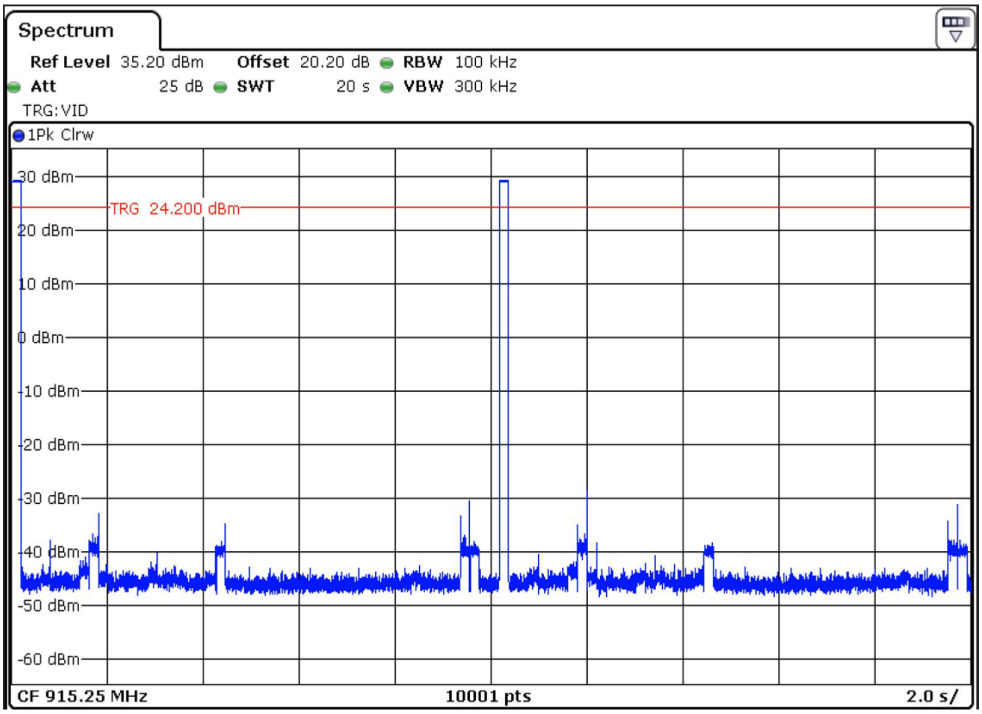


Plots of frequency occupation time

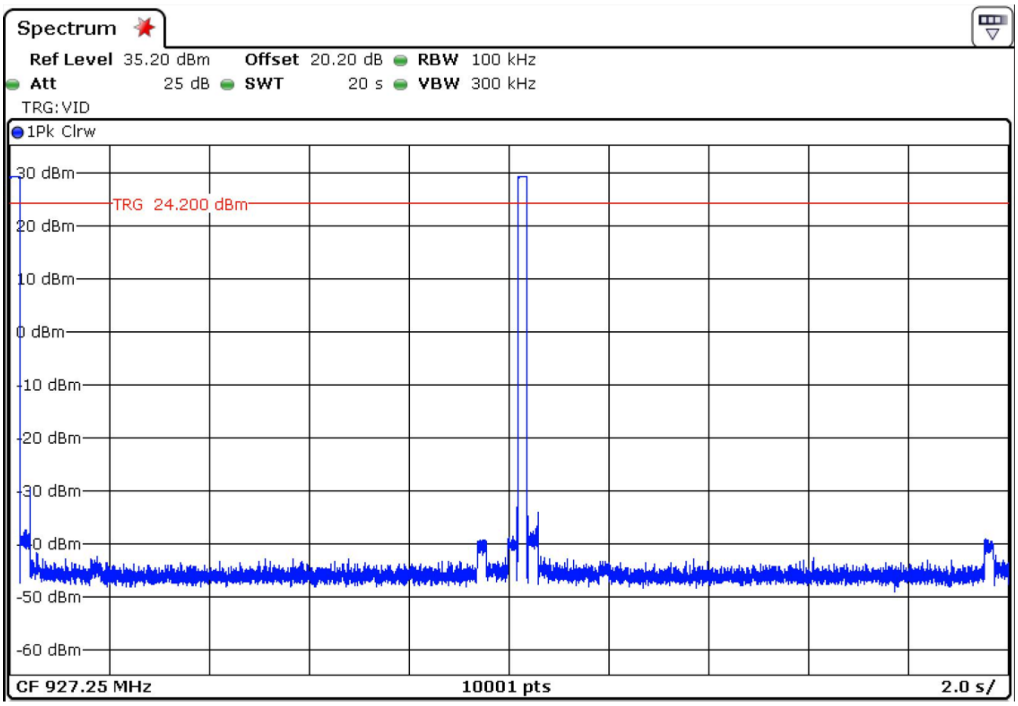
@ 902.75 MHz



@ 915.25 MHz



@ 927.25 MHz



The equipment passed the performed tests	☒ Yes	☐ No	☐ N.t.[x]

Test setup photos	☒ Yes	☐ No	Annex no. 6

7.9 Peak output power

7.9.1 Regulation

According to § 15.247 (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one-Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, *i.e.*, the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

7.9.2 Test procedure

The EUT and this peripheral (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360° to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna is changed in horizontal and vertical polarization; the position of the EUT was changed in different orthogonal determinations.

ANSI C63.4 Section “Radiated Emissions Testing”.

Measurement procedures for electric field radiated emissions from 9kHz - 1 GHz & 1 GHz - 40 GHz are covered in Clause of ANSI C63.4. The ANSI C63.4 measurement procedure consists of both an exploratory test and a final measurement. The exploratory test is critical to determine the frequency of all significant emissions. For each mode of operation required to be tested, the frequency spectrum is monitored. Variations in antenna height, antenna orientation, antenna polarization, EUT azimuth, and cable or wire placement is explored to produce the emission that has the highest amplitude relative to the limit.

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The final measurements are made based on the findings in the exploratory testing. When making exploratory and final measurements it is necessary to maximize the measured radiated emission. Sub clause of ANSI C63.4 states that the measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” We consider the “cone of radiation” to be the 3 dB beam width of the measurement antenna.

While the “bore-sighting” technique is not explicitly mentioned in ANSI C63.4, it is a useful technique for measurements using a directional antenna, such as a double-ridged waveguide antenna. Several precautions must be observed, including knowledge of the beam width of the antenna and the resulting illumination area relative to the size of the EUT, estimation for source of the emission and general location within larger EUTs, measuring system sensitivity, etc.

ANSI C63.4 requires that the measurement antenna is kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. That means that if the directional radiation pattern of the EUT results in a maximum emission at an upwards angle from the EUT, when a directional antenna is used to make the measurement, it will be necessary for it to be pointed towards the source of the emission within the EUT. This can be done by either pointing the antenna at an angle towards the source of the emission, or by rotating the EUT, in both height and polarization, to maximize the measured emission. The emission must be kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT is measured.

Radiated emissions test characteristics	
Test distance	10m, 3 m*
Test instrumentation resolution bandwidth	9 kHz (Below 30 MHz)
	120 kHz (30 MHz - 1000 MHz)
	1 MHz (Above 1000 MHz)
Receive antenna scan height	1 m (Below 30 MHz)
	1 m - 4 m (30 MHz - 15000 MHz)
	1 m – 2.5 m (18000 MHz - 40000 MHz)
	1 m (Above 40000 MHz)
Receive antenna polarization	0° or 90° (Below 30 MHz)
	vertical/horizontal (Above 30 MHz)

*According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

7.9.3 Calculation of the peak power (radiated)

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor – Pre-Amplifier (with the use of a pre-amplifier)

Receiver Level: Receiver reading without correction factors.

Correction Factor: field attenuation + cable loss

For example:
The receiver reading is +1.0 dBm. The field attenuation for the measured frequency is +19.5 dB and the cable factor for the measured frequency is 2.1 dB, giving a power of +22.6 dBm.
The +22.6dBm value can be mathematically converted to its corresponding level in W.
+22.6 dBm = 0.182 W = 182 mW

7.9.4 Test Results

Maximum output power at antenna port						
Frequency (MHz)	Bandwidth Type of detector kHz	Noted receiver level dBm	Correction factor dB	Level corrected dBm	Limit dBm	Margin dB
902.75	100, PK	9.2	20.2	29.4	30.0	0.6
915.25	100, PK	9.1	20.2	29.3	30.0	0.7
927.25	100, PK	9.1	20.2	29.3	30.0	0.7

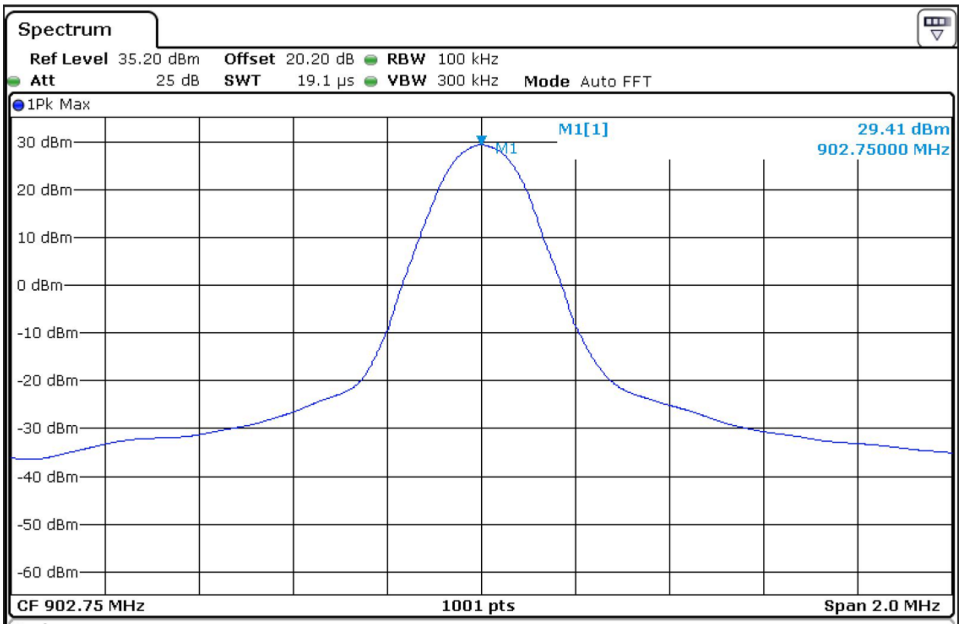
Note: The EUT was configured to test mode **OP2**. The measurements were performed directly at the antenna port.

Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

Measurement plots

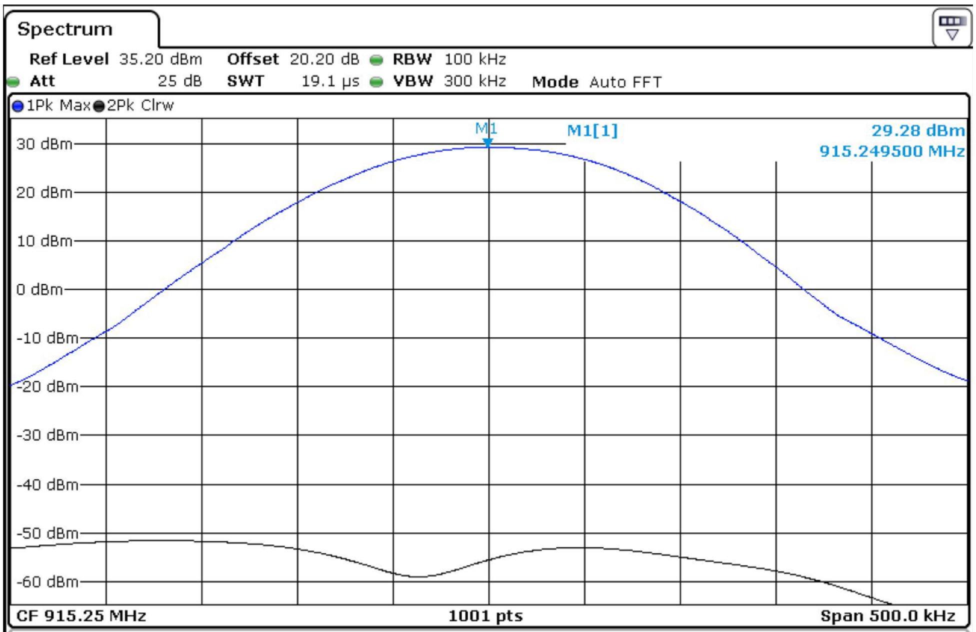
@ 902.75 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	902.75 MHz	29.41 dBm		

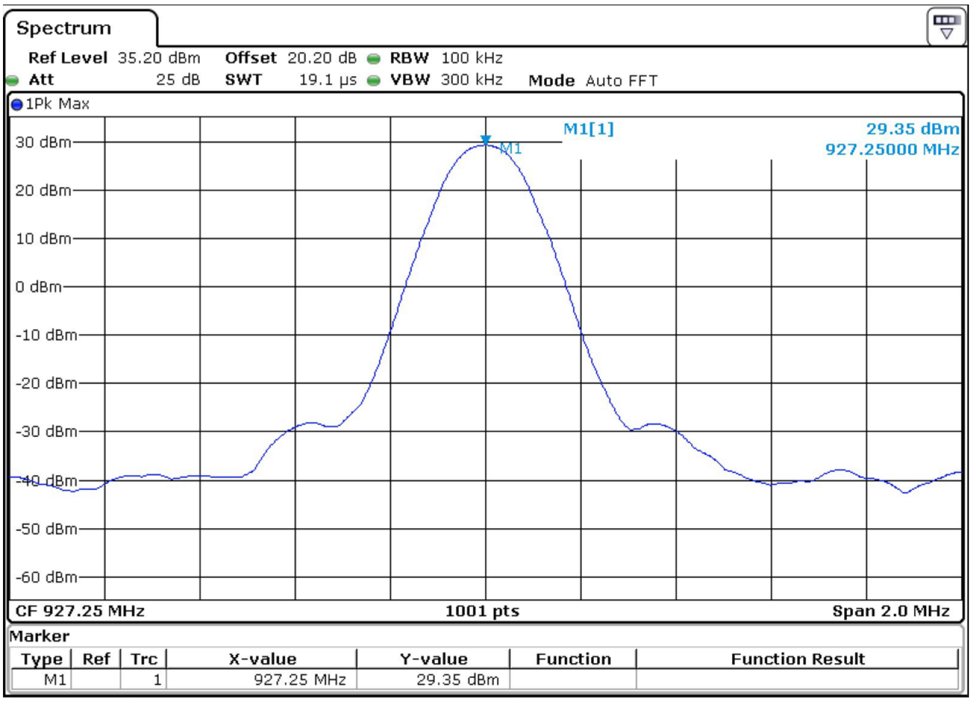
@ 915.25 MHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	915.2495 MHz	29.28 dBm		

@ 927.25 MHz



The equipment passed the performed tests	☒ Yes	☐ No	☐ N.t.^{x}

Test setup photos	☒ Yes	☐ No	Annex no. 6

7.10 Out of Band Emission

7.10.1 Regulation

According to § 15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

7.10.2 Calculation of the "Out of band emissions"

The field strength is calculated by the following calculation:

Corrected Level = Receiver Level + Correction Factor (without the use of a pre-amplifier)

Corrected Level = Receiver Level + Correction Factor - Pre-Amplifier (with the use of a pre-amplifier)

Receiver Level: Receiver reading without correction factors.

Correction Factor: field attenuation + cable loss

For example:
The receiver reading in a 100 kHz bandwidth is -45.0 dBm. The field attenuation for the measured frequency is +10.5 dB and the cable factor for the measured frequency is 1.5 dB, giving a power of -33.0 db. The measured peak power in a 100 kHz bandwidth is +3.6dBm. Therefore, the Attenuation can be calculated as follows:

Attenuation = measured peak power - out of band emission receiver reading = +3.6 dBm - (-33.0 dBm) = 36.6 dBm

7.10.3 Test procedure

The test procedure was carried out according to ANSI 63.10-2020 section 6.10.4

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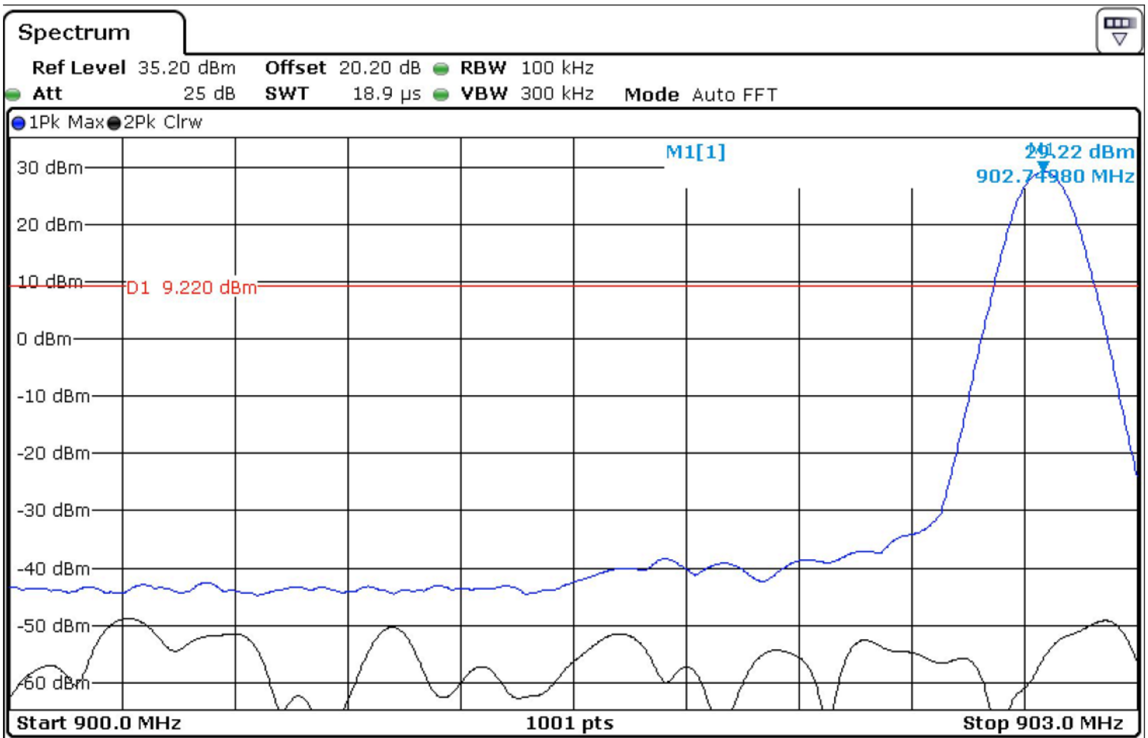
7.10.4 Test Results

Test location and equipment

Test site	☐ 660 Semi Anechoic Chamber ☐ 706 Semi Anechoic Chamber ☒ Radio laboratory					
Receiver	☒ 502	☐ 666	☐ 696			
Test equipment	☒ 90b	☐ 61	☐ 87	☐ 401	☐ 93	☒ 183d
	☐ 442	☐ 462	☐ 562	☒ 226	☐ 23	☐ 697
	☐ 698	☐ 707	☐ 708	☐ 709	☐ 385	☐ 689
Cable	☐ K189	☐ K193	☐ K194	☐ K59	☐ K51	☐ K176
	☒ K80	☐ K60	☐ K203	☐ K205	☐ K195	☐ K164
Test-Software	☐ EMC32		☐ ELEKTRA			

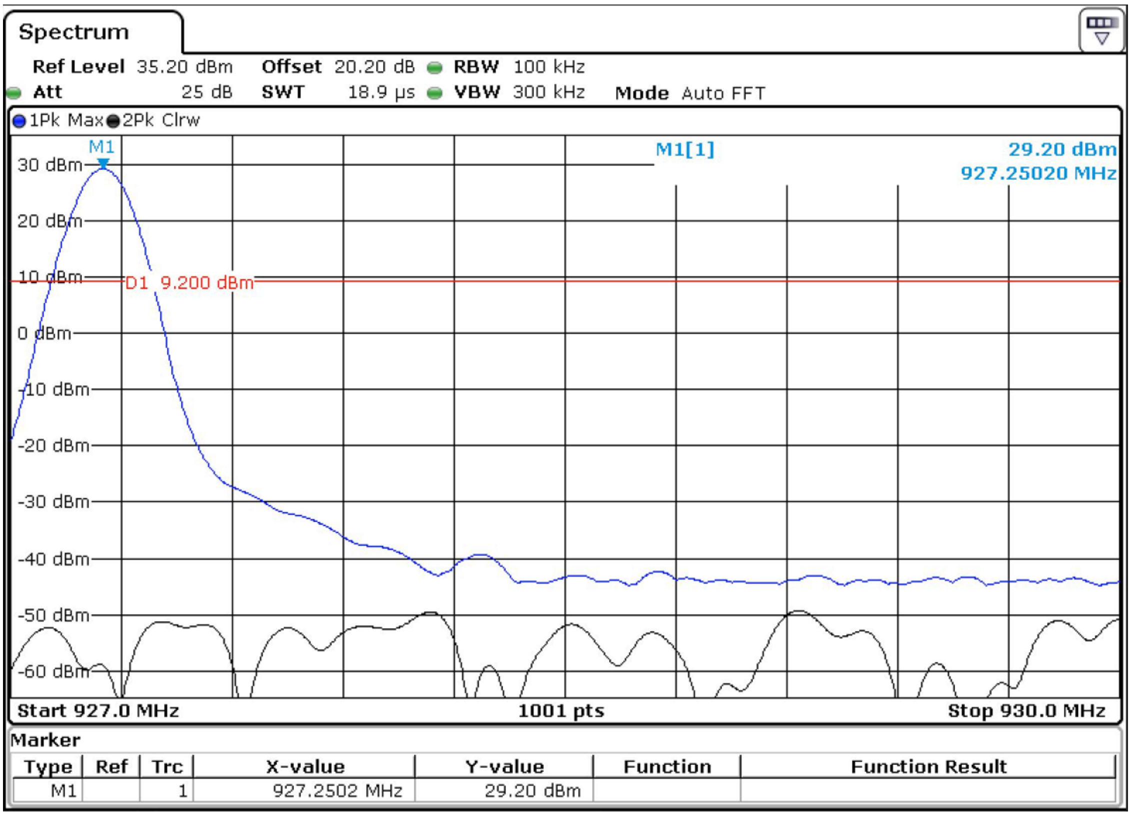
Note: The EUT was configured to mode **OP1**. The measurements were performed directly at the antenna port.

Out of Band emission in lower edge (hopping mode ON)



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	902.7498 MHz	29.22 dBm		

Out of Band emission in upper edge (hopping mode ON)



The equipment passed the performed tests	☒ Yes	☐ No	☐ N.t.x

Test setup photos	☒ Yes	☐ No	Annex no. 6

7.11 RF Exposure evaluation

7.11.1 Regulation

According to § 15.247 (i), radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

7.11.2 Test results

MPE calculation to the FCC ID: PJMMRU400

These equations are generally accurate in the far field of an antenna but will over predict power density in the near field, where they could be used for making a “worst case” prediction.

$$S = PG/4\pi R^2 \quad \text{or } S = EIRP/\left(4\pi R^2\right)$$

Where:

S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units e.g. mW)
G = power gain of the antenna in the direction of interest relative to the isotropic radiator
R = distance to the centre of radiation of the antenna (appropriate units e.g. cm)
EIRP = equivalent isotropically radiated power

Calculation:

Operating Frequency	EIRP**		Power density (S) 20 cm	
			Calculated	Limit
GHz	dBm	mW	W/ m^2	
902.75	35.4	3467.4	6.9	10.0
915.25	35.3	3388.4	6.7	10.0
927.25	35.3	3388.4	6.7	10.0

EIRP is calculated taking into consideration an EUT supported external antenna ID ANT: U290/290 with a maximum gain of 6 dBi.

8 Measurement Uncertainity

The total uncertainty of measurement is the result of the mathematically-statistically distribution of the individual measurement uncertainty (MU) of the used measurement equipment. It is supposed that all individual deviations accidentally but not inevitable normally distributed. The total deviation is supposed to be normally distributed (RSS=Root-Sum-of-the-Squares deviation corresponds to a measurement uncertainty which will be not exceeded with a probability of 68 %). Measurement uncertainty Δ, which will be not exceeded with a probability of 95 %, is 2 x RSS. For the following measurements and tests are the values as from the laboratory given:

Clause	Technical requirements	Value of measurement uncertainty	
7.2	Conducted emission	± 2.0 dB	
7.3	Radiated emission limits, general requirements	Conducted: ± 1.0 dB	ERP / EIRP: ± 4.0 dB
7.5	Bandwidth	$\pm 5*10^{-8}$	
7.6	Carrier frequency separation	$\pm 5*10^{-8}$	
7.8	Average time of occupancy	± 1.0 %	
7.9	Peak output power	Conducted: ± 1.0 dB	ERP / EIRP: ± 4.0 dB
7.10	Out of Band emission	Conducted: ± 1.0 dB	ERP / EIRP: ± 4.0 dB

Table 8-1: Uncertainty of measurement

8.1 Decision rule

As far as in this report statements on conformity are made, decision rules according to DIN EN ISO/IEC 17025:2018, 7.8.6 have been applied. If the report does not state otherwise, procedure 1 according to IEC Guide 115 ed. 2.0 2021 (uncertainty of measurement calculated) has been applied on measurement and test procedures, which are the basis of this report.

9. Additional information to the test report

Remarks	Description
N.t.[1]	Not tested, because the antenna is part of the PCB
N.t.[2]	Not tested, because the EUT is directly battery powered
N.t.[3]	Not tested, because not applicable to the EUT
N.t.[4]	Not tested, because not ordered

10. List of test equipment

State April 04. 2025					
Marking	**Manufacturer**	**SW/Type/Serial-No.**	**Last Cal./Val.**	**Next Cal. /Val. (± 1 month)**	**No.**
1 Measuring Instruments					
Attenuator	Tektronix	011-0085-00	Mar 24	Mar 27	61
Attenuator	Radiall	---	Nov 22	Nov 25	62
Attenuator 3dB	Suhner	6803/17	Nov 22	Nov 25	137
Attenuator 3dB / 18 GHz	Suhner	3dB/18GHz	Nov 22	Nov 25	299
Attenuator 6dB / 18 GHz	Suhner	6dB/18GHz	Nov 22	Nov 25	344
Attenuator 20dB / 20GHz	Parzich	40AH-20	Nov 22	Nov 25	354
Attenuator 3dB / 12,4 GHz	Narda	TB 50902-1, S/N: 35005	Mar 24	Mar 27	183a
Attenuator 6dB / 12,4 GHz	Narda	TB 50902-2, S/N: 36328	Mar 24	Mar 27	183b
Attenuator 10dB / 12,4 GHz	Narda	S/N: 36500	Mar 24	Mar 27	183c
Attenuator 20dB / 12,4 GHz	Narda	8491A, S/N: 6218	Mar 24	Mar 27	183d
Terminator	KDI	T173CS	Nov 22	Nov 25	490
Variable transformer	RFT	LS 002	---	---	154a
Variable transformer	Schunt+Ben	---	---	---	155
Power sensor	Marconi	6914	Apr 25	Apr 27	258
Power sensor	Rohde & Schwarz	NRP18SN	Apr 24	Apr 26	651
3-Path Diode Power Sensor 10 MHz to 8 GHz	Rohde & Schwarz	NRP8S	Feb 25	Feb 27	663
3-Path Diode Power Sensor 10 MHz to 18 GHz	Rohde & Schwarz	NRP18S-20	Feb 25	Feb 27	664
Coaxial Directional Coupler	Narda	3003-20	Feb 24	Feb 27	370/342
Coaxial directional coupler	Mini Circuits	ZFDC-20-5	Jun 24	Jun 26	434
Coaxial directional coupler	Narda+Suhner	4246B-20	Sep 22	Sep 25	472/492
Coaxial directional coupler	Narda	3045C-10	Sep 22	Sep 25	110a
Coaxial directional coupler	Narda	3044B-10	Sep 22	Sep 25	21a
Coaxial directional coupler	Narda	3044B-30	Sep 22	Sep 25	327
Coaxial directional coupler	Narda	3022 / 50204	Sep 22	Sep 25	303
Coaxial High Pass Filter	Mini circuits	NHP-700	Jun 24	Jun 27	435
Coaxial High Pass Filter	Mini circuits	NHP-200	Jun 24	Jun 27	405
Coaxial High Pass Filter	Mini circuits	NHP-25+	Jun 24	Jun 27	455
High Pass Filter	Mini circuits	VHF-3500+	Sep 22	Sep 25	451
High Pass Filter	Mini circuits	VHF-1200+	Jun 24	Jun 27	452
High Pass Filter	Morita Tech	MT-SCHLC-500/T300-0/0	Mar 24	Mar 27	703
High Pass Filter	Morita Tech	MT-SCHPFF-1000-T855-0/0	Mar 24	Mar 27	704
High Pass Filter	Morita Tech	MT-SCHPF-2000/ T1720-0/0	Mar 24	Mar 27	705
Bandpass Filter	Schomandl	BN86871	Dec 24	Dec 27	66
Bandpass Filter	Schomandl	BN68673	Dec 24	Dec 27	67
Band Reduction Filter	Morita Tech	MT-SC12FVRC-5250/X200-0/0	Mar 24	Mar 27	701
Band Reduction Filter	Morita Tech	MT-SCBRF-5597.5/255-0/0	Mar 24	Mar 27	702
Low Pass Filter	Mini circuits	SLP550	Jun 24	Jun 27	273
Low Pass Filter	Mini circuits	SLP550	Jun 24	Jun 27	274
Coaxial Fixed Attenuator DC – 1 GHz	Texscan	HFP50/10	Aug 23	Aug 26	60
8 Wire Impedance Stabilisation Network	Schwarzbeck	CAT5 8158	Jan 24	Jan 26	71a
T-Section - 50 W	Rohde & Schwarz	BN 42441/50	Dec 24	Dec 27	93
RF Current Injection Clamp 0.15 – 1GHz	Lüthi GmbH	EM 101	Mar 25	Mar 27	156
Absorbing Clamp MDS 30MHz – 1GHz	Lüthi GmbH	MDS-21	Jan 23	Jan 26	160
Insertion Unit	Rohde & Schwarz	URV5-Z4	Sep 24	Sep 26	162
Coaxial RF Termination - 0 – 1000 MHz	Telewave Inc.	TWL 35	Dec 24	Dec 27	164

Coaxial RF Termination - 0 – 1000 MHz	Telewave Inc.	TWL 60	Dec 24	Dec 27	165
Fixed Attenuator - DC – 1.5GHz	Bird	Mod/ 8343-060	May 23	May 26	177
CDN up to 230 MHz	MEB	KEN-M 2 /M 3	Nov 24	Nov 26	262
CDN up to 230 MHz	MEB	KEN-M 2 /M 3	Sep 24	Sep 26	264
Impulse limiter 10 dB	Rohde & Schwarz	ESH3 Z2	Jun 24	Jun 26	272
Fixed Attenuator - DC – 18 GHz | 30 dB	MTS	---	Mar 24	Mar 26	276
Termination Resistor 50 W	Radiall	404011	Dec 24	Dec 27	309
Branching device (4x) 50W	Rohde & Schwarz	892228/20	Sep 22	Sep 25	320
Dummy-Load - 2 – 18 GHz	Narda	MODEL 367NF	Jan 23	Jan 26	343
DC Block Adapter - 0.045 – 26.5 GHz	Hewlett-Packard	11742A	Mar 24	Mar 27	356
RF Probe 0.02 – 1000 MHz	Rohde & Schwarz	URY-Z7	Aug 22	Aug 25	368
150W attenuator	Weinschel	49-20-33	Nov 22	Nov 25	374
Fixed Coaxial Attenuator - DC – 18 GHz	Weinschel	23-6-34	Mar 23	Mar 26	375
Attenuator 60 dB (10 MHz – 8 GHz)	---	---	Mar 23	Mar 26	376
Insertion Unit 100V | 100 kHz – 2 GHz	Rohde & Schwarz	URY-Z4	Jun 24	Jun 26	417
Panoramic Adapter (Monitoring)	Schwarzbeck	PAN1550	---	---	429
DC-BLOCK - DC – 6.0 GHz |50 W	Mini Circuits	BLK-6-N+	Dec 24	Dec 27	462
DC-BLOCK – 0,1 GHz – 5.0 GHz	Microlab/FRX	HR-D18	Mar 24	Mar 27	90b
Terminating resistor 50Ω SMA	---	---	Jan 23	Jan 26	493
Terminating resistor 50Ω SMA	---	SC 60-601-0000-31	Jan 23	Jan 26	497
Fixed Attenuator –0 – 40 GHz	Anritsu	41KC-10	Jan 23	Jan 26	504
Fixed Attenuator – 0 – 40 GHz	Anritsu	41KC-10	Jan 23	Jan 26	505
Fixed Attenuator – 0 – 40 GHz	Anritsu	41KC-3	Jan 23	Jan 26	507
Electric Dummy Load	RA-NAV Lab.	DA-75U	---	---	526
Power Splitter / Combiner	Mini Circuits	ZESC-2-11	Nov 22	Nov 25	527
3 Way Power Splitter / Combiner	Mini Circuits	ZFSC-3-1	Mar 23	Mar 26	529
3 Way Power Splitter / Combiner	Mini Circuits	ZFSC-3-1	Mar 23	Mar 26	530
RF-Attenuator - 6 dB	Haefely	---	Mar 23	Mar 26	540
RF-Attenuator - 1– 120 MHz | 12 dB	Haefely	---	Mar 23	Mar 26	541
RF-Attenuator - 1– 120 MHz | 39 dB	Haefely	---	Mar 23	Mar 26	542
LISN 9kHz – 30 MHz	Schwarzbeck	NNLA 8120 (SN: 8120499A)	Dec 24	Dec 26	551
HV Probe P6013A	Tektronix	P6013A	Oct 24	Oct 26	559
VLISN 5µH	Schwarzbeck	8125-1944	Apr 24	Apr 26	585
VLISN 5µH	Schwarzbeck	8125-1945	Apr 24	Apr 26	586
20dB Attenuator, up to 18 GHz	Mini Circuit	BW-N20W5+	Nov 22	Nov 25	594
Step Attenuator - DC-18 GHz | 0 to 11 dB	Hewlett-Packard	8494B	Nov 22	Nov 25	604
Analyser Reference System	Spitzenberger & Spies	PAS 1000 SyCore + ARS 16/1	Jun 24	Jun 26	606a/b/c
Capacitive Coupling Clamp 5 kV	Schlöder	SFT 415	Jul 23	Jul 26	608
Current probe TRMS	BEHA APROB	CHB35	Jan 25	Jan 27	652
Semi Anechoic Chamber	COMTEST	SAC-3m	Apr 23	Apr 25	660
Maturo Turntable	Maturo	TT2.0SI (SN: TT2.05SI/817 SW: 1.0.0.4473)	---	---	667
Maturo Antenna Mast	Maturo	TAM4.5-E-10kg (SN: 10011/216/2588.01)	---	---	668
Maturo Controller	Maturo	FCU3.0/009/2588.01 (SN: 10014/2019)	---	---	669
EMC-Semi Anechoic Chamber (SAC)	Frankonia	SAC-5 Plus L-Dome Design	Jan 24	Jan 26	706
Frankonia Boresight Antenna Mast	Frankonia	FBM 1-4 SN: 0212	---	---	707
Frankonia Turntable	Frankonia	FTM 3-2 SN: FC06.1-2022-277	---	---	708
Frankonia Positioning Controller	Frankonia	FC06.1B SN: FC06.1-2022-277	---	---	709
Current probe 20 Hz – 100 MHz	Rohde & Schwarz	EZ-17 (0816.2063.03)	May 23	May 26	670

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Coupling Decoupling Network	AMETEK	CDN ST08A	Nov 24	Nov 26	672
BONN HF Switch Matrix DC – 8 GHz	BONN Elektronik	BAS 0080-3	---	---	682
External Directional Coupler	BONN Elektronik	BDC 1060-40/500	Feb 24	Feb 26	683
BI-Directional Coax. Coup. 50-1000 MHz	Narda	3020A	Nov 24	Nov 26	141
Vertical coupling plate	TÜV NORD HFT	---	---	---	265
Measuring table	TÜV NORD HFT	---	---	---	106
Data line coupling network	EM Test AG	CNV 504/ 508	---	---	285
OSP230 BASE Unit 2HU with TS	OSP230	S/N: 102031	June 23 Factory cal.	June 25	698
2 Generators					
EFT/Burst Generator	Schlöder	SFT 1400	Oct. 24	Oct 26	46a
ESD Generator	Schlöder	SESD 216	Feb 24	Feb 26	653
ESD Simulator	Schlöder	SESD200 S/N: 802653	Sep 23	Sep 25	112a
Signal Generator	Rohde & Schwarz	SMB100A SW 4.20.028.58	Nov 24	Nov 26	571
RF Generator	Rohde & Schwarz	SGT100A	Jun 24	Jun 26	636
Signal Generator	Rohde & Schwarz	SMG	Jun 24	Jun 26	136a
Signal Generator	Marconi	2042	Oct 2024	Oct 26	6
Signal Generator	Marconi	2024	Oct 2024	Oct 26	213
Puls Generator	EM Test	MPG 200	Apr 23	Apr 25	181
Surge Generator	H+H	MIG063 IN S-T	Jun 23	Jun 25	561
Wideband Radio Communication Tester (Only for monitoring)	Rohde & Schwarz	CMW500 S/N: 171332	---	---	691
3. Antennas					
Active Loop Antenna 8.3 kHz – 30 MHz	Rohde & Schwarz	HFH2-Z2E S/N: 101171	May 23	May 25	697
Biconical Ant. 30-300 MHz	Schwarzbeck	VHA9103/BBA9106	Jun 24	Jun 26	80/616
Biconical Ant. 20-300 MHz	Schwarzbeck	VHBB 9124 / BBA9106	Mar 25	Mar 27	692
Biconical Ant. 20-300 MHz	Schwarzbeck	VHBB 9124 / BBA9106	Mar 25	Mar 27	693
Biconical Antenna 9 kHz – 300 MHz	Schwarzbeck	EFS9218 / 9218-194	Jul 23	Jul 25	523
Double Ridged Horn	Schwarzbeck	BBHA9120C	Apr 24	Apr 26	169
Double Ridged Horn	Schwarzbeck	BBHA 9120A	Jun 24	Jun 26	284
Tri-Log Broadband	Schwarzbeck	VULB9168	Jun 23	Jun 25	406
Broadband Horn 14-40 GHz	Schwarzbeck	BBHA9170	Apr 24	Apr 26	442
Log Per Antenna 0.7-20 GHz	Schwarzbeck	STLP9148	Jun 23	Jun 25	445a
Log Per Antenna 0.2 – 3.5 GHz	Schwarzbeck	VUSLP 9111B	Mar 25	Mar 27	694
Log Per Antenna 0.2 – 3.5 GHz	Schwarzbeck	VUSLP 9111B	Mar 25	Mar 27	695
Log Per Antenna 1 GHz – 18 GHz	Rohde & Schwarz	S/N 352886/009	Jun 23 (Val. only)	Jun 25	700
Bilog Ant.	CHASE	CBL6111	Jun 24	Jun 26	167
Spectrum analyser Mixer 220 – 325 GHz	Radiometer Physics	SAM325 / 20029	Oct 23	Oct 25	591
Dual Mode Potter Horn 220-325 GHz	Radiometer Physics	325-WR2	---	---	592
Dual Mode Potter Horn 75-110 GHz	Radiometer Physics	---	---	---	649
Gain Horn Antenna 50-75 GHz	Dorado	GH-15-20	---	---	511
Standard Gain Horn 1.7 – 2.6 GHz	Narda	645	---	---	514
W-band active Sextupler with input drive amplifier	Spacek Labs Inc.	AW-6XW-0	---	---	221a
60 to 65 GHz active frequency quadrupler	Spacek Labs Inc.	A625-4XW-0	---	---	222a
Harmonic Mixer 40-60 GHz	Rohde & Schwarz	FS-Z60/ 100037	Oct 23	Oct 25	515
Gain Horn Antenna 40-60 GHz	Dorado	GH-19-20 / 070106	---	---	518
Spectrum analyser Mixer 90-140 GHz	Radiometer Physics	SAM140 / 20006	Oct 23	Oct 25	545
Dual Mode Potter Horn 90-140 GHz	Radiometer Physics	140-WR8	---	---	547
Spectrum analyser Mixer 140-220GHz	Radiometer Physics	SAM220 / 20002	Oct 23	Oct 25	546
Dual Mode Potter Horn 140-220 GHz	Radiometer Physics	220-WR5.1	---	---	548

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Harmonic Mixer 60-90 GHz	Rohde & Schwarz	FS-Z90 / 100062	Oct 23	Oct 25	501
Dual Mode Potter Horn 60-90 GHz	Radiometer Physics	90-W12	---	---	549
Gain Horn 33-55 GHz	Dorado	040810	---	---	383
Gain Horn 50-75 GHz	Dorado	031003	---	---	384
Gain Horn 75-110 GHz	Dorado	040808	---	---	385
Standard Gain Ant. 26.5-40 GHz	Maury Microwave	U211C	---	---	532/628
Waveguide Harmonic Mixer 50 – 75 GHz	Keysight	M1971V	Mar 24	Mar 26	673
Waveguide Harmonic Mixer 75 – 110 GHz	Keysight	M1971W	Mar 24	Mar 26	674
Stacked Log.-Per. Antenna 70 MHz – 10 GHz	Schwarzbeck	STLP 9129	---	---	662
Spectrum/Signal Analyzer Extension Module 110 GHz – 170 GHz (WR-6.5)	Virginia Diodes, Inc.	SAX 637	in calibration	in calibration	675
Spectrum/Signal Analyzer Extension Module 140 GHz – 220 GHz (WR-5.1)	Virginia Diodes, Inc.	SAX 636	in calibration	in calibration	677
Spectrum/Signal Analyzer Extension Module 220 GHz – 330 GHz (WR-3.4)	Virginia Diodes, Inc.	SAX 635	in calibration	in calibration	679
Conical Gain Horn Ant. 110 GHz – 170 GHz [21 dBi]	Virginia Diodes, Inc.	Conical Antenna WR-6.5	---	---	687
Conical Gain Horn Ant. 140 GHz – 220 GHz [21 dBi]	Virginia Diodes, Inc.	Conical Antenna WR-5.1	---	---	688
Diagonal Gain Horn Ant. 220 GHz – 330 GHz [26 dBi]	Virginia Diodes, Inc.	Diagonal Antenna WR-3.4	---	---	689
4. Amplifier					
RF-Power Amplifier 250 kHz – 150 MHz	ENI	3100LA	---	---	123
RF pre-amplifier 100kHz-1.3GHz	HP	8447E	Sep 24	Sep 26	166a
Mitteq amplifier 26.5-40 GHz	Mitteq	---	Mar 24	Mar 26	223a
RF pre-amplifier 1-18GHz	Narda	---	Mar 24	Mar 26	345
Mitteq Amplifier 18-26GHz	Mitteq	---	Jun 23	Jun 26	433
Microwave amplifier 12-28GHz	Schwarzbeck	BBV9719	Mar 24	Mar 26	443
Microwave amplifier 0.5-18GHz	Schwarzbeck	BBV9718	Mar 24	Mar 26	444
RF-Power Amplifier 10kHz-1000 MHz	Poetschke	8100 (Band 1) BHED (Band 2) BHED (Band 3)	---	---	684
RF-Power Amplifier 800 MHz – 4,2 GHz	Amplifier Research	10S1G4	---	---	685
RF-Power Amplifier 4 GHz – 8 GHz	Amplifier Research	35S4G8A	---	---	686
RF-Power Amplifier 0.69 GHz – 6 GHz	Rohde & Schwarz	BBA150-D110/E60	---	---	690
5. Power supplies					
Programmable Power Supply	Fluke	PM 2813	---	---	28a
Power Supply	HP	---	---	---	125
Power Supply	Sorensen	LM 30-6	---	---	134a
Power Supply	HP	6034L	---	---	226
Regulated Power Supply	Farnell	AP60-50	---	---	408
Power Supply	EA	PSI 8080-40-DT	---	---	560
Power Supply	HP	6032A	---	---	644
6. Meters					
Microwave Frequency Counter	Hewlett-Packard	5351B	Jun 23	Jun 25	432
Temperature test cabinet	Heraeus Vötsch	VMT04/35	---	---	102a
Temperature and Climate Test Chamber	Weiß Umwelttechnik, WKL 34/40	S.N.: 5667998 // SW: Simpac 1.5.10	Mar 24	Mar 26	562
Temperature test cabinet	Brabender	TTE 32/40 H	---	---	87
Web Sensor with PoE- temperature, humidiy / digital pressure gauage	COMET	T7610 S.N.: 24960098	Jan 24	Jan 26	711
Web Sensor with PoE- temperature, humidiy / digital pressure gauage	COMET	T7610 S.N.: 24960099	Jan 24	Jan 26	712
Digital-Hygro-Thermometer	Greisinger	GFTH95	Mar 25	Mar 28	57a
Volt & RF Power Meter	Rohde & Schwarz	URV35	Jun 22	Jun 25	161

Power Meter	Marconi	6960/ S.N: 1214	Dec 22	Dec 25	139a
Multimeter	Gossen Metrawatt	Metrahit pro	Jan 24	Jan 26	215a
Humidity/Temperature Measuring device	TESTO	Testo 625	Jan 24	Jan 26	259a
Multimeter	Gossen Metrawatt	Metrahit 26S	Dec 24	Dec 26	313
Level and Power Meter - 9 kHz – 3 GHz	Rohde & Schwarz	URY	Jun 24	Jun 26	307
Temperature test device	Ahlhorn	Almemo 2390-5 PT100	Apr 23	Apr 26	401/402
Digital-Vacuum-/Barometer	Greisinger	GDH12AN	Mar 25	Mar 28	558
Digital Storage Oscilloscope	Tektronix	TDS 2012C	Apr 24	Apr 26	568
Miniature Flat, Zero-Biased Schottky Detector –0.1– 18 GHz	Narda	4503A-03	Sep 24	Sep 26	613
Digital-Vacuum-/Barometer	Greisinger	GDH-200-14	Jan 24	Jan 27	632
Network Analyser 9 kHz -6 GHz	Rohde & Schwarz	ZVL6 (SN: 101268)	Nov 24	Nov 26	534
Signal Analyser 10 Hz – 30 GHz	Rohde & Schwarz	FSV 30 S/N: 100932	Oct 23	Oct 25	502
EMI Test receiver ESW26	Rohde & Schwarz	R&S ESW26 (SN: 101383/26 SW: R&S ESW2.10)	Jan 24	Jan 26	665
EMI Test Receiver ESW44	Rohde & Schwarz	R&S ESW44 SN: 103281	May 23	May 25	696
Signal analyser Keysight 50GHz	Keysight	UXA N9040B (SN: MY57213006 SW: A.27.02/2020 1.0)	Mar 24	Mar 26	666
7. test/control software					
EMC32	Rohde & Schwarz	V10.60.20	---	---	---
Maturo mcApp	Maturo	SW: V3.4.9.4537 (19.04.04)	---	---	---
SPS EMC	Spitzenberger & Spies	SW: V4.1.3	---	---	---
EMV-Soft	Schlöder GmbH	SW: V11.95	---	---	---
ISMISO	EM Test AG	SW: V3.63	---	---	---
ELEKTRA	Rohde & Schwarz	SW: V 5.02.1	---	---	---

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11. List of test cables

Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
3	N	0,5 - 8000	3	Cellflex
4	N	0,5 - 8000	3	Cellflex
12a	N	10 – 265000	6	Huber + Suhner
14a	BNC	10 – 1000	1.00	Telemeter
17a	APC3.5	10 – 26500	2.13	Huber + Suhner
18a	APC3.5	10 – 26500	2.13	Huber + Suhner
22	BNC	10 – 1000	1.50	---
27	BNC	10 – 1000	1.00	Fabrica Milanese Cond.
35	N	10 – 2000	1.10	Fujikura
40	BNC	---	0.50	Aircell
44	SMA	---	0.50	Huber + Suhner
45	SMA	10 – 18000	0.50	Huber + Suhner
48	SMA		0.50	Huber + Suhner
49	N	10 – 18000	1.00	Huber + Suhner
50	N	10 – 18000	1.00	Huber + Suhner
51	N	10 – 18000	1.00	Huber + Suhner
58	N	10 – 18000	2.00	Huber + Suhner
59	N	10 – 18000	1.00	Huber + Suhner
60	N	10 – 18000	2.00	Huber + Suhner
61	N	10 – 18000	1.00	Huber + Suhner
62	SMA	---	0.50	Huber + Suhner
63	SMA	10 – 18000	0.50	Huber + Suhner
64	SMA	10 – 18000	0.50	Huber + Suhner
65	APC3.5	10 – 26500	0.60	---
66	APC3.5	10 – 26500	0.60	---
67	APC3.5	10 – 26500	0.60	---
68	APC3.5	10 – 26500	0.60	---
76	SMA	10 – 30000	3.00	Gore
79	BNC/N	10 – 1000	5.00	---
80	SMA	---	0.25	Huber + Suhner
87	SMA	10 – 18000	0.15	Huber + Suhner
88	SMA	10 – 18000	0.15	Huber + Suhner
89	SMA	10 – 18000	0.15	Huber + Suhner
90	SMA	10 – 18000	0.15	Huber + Suhner
94	BNC	---	1.10	---
100	N	10 – 26500	6.00	Rosenberg
101	N	10 – 18000	2.90	Huber + Suhner
102	SMA	10 – 18000	2.00	Huber + Suhner
112	BNC	10 – 1000	0.50	---
114	SMA	10 – 18000	0.25	Huber + Suhner
116	SMA	10 – 18000	0.25	Huber + Suhner
119	N	10 – 20000	8.00	Jyebao
121	SMA	10 – 18000	1.50	Huber + Suhner
122	SMA	10 – 18000	2.00	Huber + Suhner
123	SMA	10 – 18000	2.00	Huber + Suhner
145	SMA	10 – 26500	8.00	Huber + Suhner
147	APC3.5	10 – 40000	1.50	Jyebao
148	APC3.5	10 – 40000	3.00	Jyebao
154	BNC	10 – 1000	1.00	---
158	SMA	10 – 26500	2.00	Huber + Suhner
161	SMA	10 – 18000	1.00	Huber + Suhner
162	APC3.5	10 – 26500	2.00	Huber + Suhner
163	APC3.5	10 - 26500	2.00	Huber + Suhner
164	APC3.5	10 – 26500	2.00	Huber + Suhner
165	APC2.9	10 – 26500	2.00	Huber + Suhner

Internal Cable Number	Connector Type	Frequency Range (MHz)	Cable Length (m)	Manufacturer
167	APC3.5	10 – 40000	1.00	Jyebao
168	APC3.5	10 – 40000	1.00	Jyebao
169	APC3.5	10 – 40000	1.00	Jyebao
170	APC3.5	10 – 40000	1.00	Jyebao
171	APC3.5	10 – 40000	1.00	Jyebao
172	SAM	---	0.90	Huber + Suhner
173	APC	10 – 26500	2.00	Huber + Suhner
174	APC	10 – 26500	---	Huber + Suhner
175	SMA	10 – 18000	0.40	Huber + Suhner
188	N	10 – 18000	5.00	Huber + Suhner
189	PC-PC	10 – 26500	6.00	Jyebao
190	PC-PC	10 – 26500	6.00	Jyebao
192	N-N	10 – 18000	3.0	Jyebao
193	N-N	10 – 18000	3.0	Jyebao
194	N-SMA	10 – 18000	2.0	Jyebao
195	N-SMA	10 – 18000	2.0	Jyebao
196	7/16-N	10 – 7000	5.0	TRU
197	N-7/16	10 – 7000	2.5	TRU
198	SMA – N	10 – 18000	1.5	Huber + Suhner
199	N-N	10 – 18000	2.5	Huber + Suhner
200	SMA – N	10 – 18000	1.5	Huber + Suhner
201	7/16 – 7/16	10 – 7000	3.0	RFS
202	N-N	10 – 18000	6,0	Huber + Suhner
203	N-N	10 – 18000	2.5	Huber + Suhner
204	N-N	10 – 18000	2.5	TRU
205	N-N	10 – 18000	7.0	Huber + Suhner
206	PC2.9 – PC2.9	10 – 40000	3.0	Huber + Suhner
207	PC2.9 – PC2.9	10 – 40000	7.0	Huber + Suhner
208	PC2.9 – PC2.9	10 – 40000	1,2	Teledyne Storm Microwave
209	PC2.9 – PC2.9	10 – 40000	1,2	Teledyne Storm Microwave
210	PC2.9 – PC2.9	10 – 40000	1,2	Teledyne Storm Microwave
211	---	10 – 40000	0,9	Junkosha
212	---	10 – 40000	0,9	Junkosha
213	BNC - BNC	0,1 - 4000	1	Huber + Suhner
214	BNC - BNC	0,1 - 4000	1	Huber + Suhner
215	BNC - BNC	0,1 - 4000	3	Huber + Suhner
216	BNC - BNC	0,1 - 4000	1	Agilent
217	BNC - BNC	0,1 - 2000	0,5	Sytronic
357	BNC - BNC	0,1 - 2000	1,5	---
EMV 1	BNC	---	2.00	Henn
EMV 2	BNC	10 – 1000	2.00	Henn
EMV 4	BNC	---	9.70	Henn
EMV 5	BNC	---	3.80	Henn
EMV 6	BNC/N	10 – 1000	5.00	Lüthi
EMV 7	BNC	10 – 1000	1.50	Henn
EMV 8	BNC	10 – 1500	1.70	Henn
EMV 9	BNC	10 – 1000	1.70	Henn
EMV 11	BNC	---	5.20	Hasselt
EMV 12	BNC	10 – 1000	2.40	Hasselt
EMV 13	BNC	10 – 1000	4.10	Hasselt
EMV 14	BNC	10 – 1000	2.50	Hasselt
EMV 15	BNC	---	0.90	Henn
EMV 16	Fischer	---	2.00	---
EMV 18a	Fischer	---	1.00	---
EMV 19a	Fischer	---	1.50	---
KISN2	BNC	10 – 2000	4.80	---

End of test report