TEST REPORT # EMCC-040197.1C, 2020-11-03

EQUIPMENT UNDER TEST:

Trade Name:	TCAS4 / MPZ2001066B
Type:	MPZ2001066B
Serial Number(s):	243540012
Equipment Class:	Low Power Transceiver
FCC ID:	2ADAT-TCAS4
Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Address:	Im Tiefen See 45 64293 Darmstadt GERMANY
Name:	Janis Butz
Phone:	+49 6151 803-8483
E-Mail:	Janis.Butz@hbm.com

RELEVANT STANDARD(S) : 47 CFR § 15.203, § 15.207, § 15.209

MEASUREMENT PROCEDURE: : ANSI C63.10-2013

TEST REPORT PREPARED BY:

Wolfgang Kiss
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Tested:

Wolfgang Kiss

Approved:

Reinhard Sauerschell

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0 REVISION HISTORY

Project number	Issue date	Chapter	Description
040197.1C	2020-11-03	n.a.	Initial issue

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the 47 CFR § 15.203, § 15.207, § 15.209 requirements applicable to intentional radiators.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Laboratory

Test Laboratory:	EMCCons DR. RAŠEK GmbH & Co. KG
Accreditation No.:	D-PL-12067-01-04
FCC Test Firm Registration No.:	368753
Address of Labs I, II, III and Head Office:	EMCCons DR. RAŠEK GmbH & Co. KG Boelwiese 8 91320 Ebermannstadt GERMANY
Address of Labs IV and V:	EMCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter GERMANY
Phone:	+49 9194 7262-0
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E-Mail:	info@emcc.de
Web:	www.emcc.de

1.4 Customer

Company Name:	Hottinger Baldwin Messtechnik GmbH
Street:	Im Tiefen See 45
City:	64293 Darmstadt
Country:	GERMANY
Name:	Mr Janis Butz
Phone:	+49 6151 803-8483
Fax:	+49 6151 803-98483
E-Mail:	Janis.Butz@hbm.com

1.5 Manufacturer

Company Name:	Hottinger Baldwin Messtechnik GmbH
Street:	Im Tiefen See 45
City:	64293 Darmstadt
Country:	GERMANY
Phone:	+49 6151 803-8483
E-Mail:	Janis.Butz@hbm.com

1.6 Dates and Test Location

Date of receipt of EUT: 2020-09-24
Test Date: CW 40/2020
Test Location: Lab IV

1.7 Ordering Information

Purchase Order: D29-4500736805/2000
Date: 2020-07-24
Vendor-Number: 806266

1.8 Climatic Conditions

Date	Temperature	Relative Humidity	Air Pressure	Lab	Customer attended tests
--	°C	%	hPa	--	--
2020-09-29	21	43	976	IV	No
2020-09-30	22	49	976	IV	No
2020-10-01	22	47	965	IV	No

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

The following data is based on customer's information.

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Trade Name:	TCAS4 / MPZ2001066B
Type:	MPZ2001066B
Serial No(s):	243540012
Application:	Low Power Transceiver
FCC ID:	2ADAT-TCAS4
Nominal Transmit Frequency:	15.7 kHz; 10.7 MHz
Modulation:	15.7 kHz unmodulated, 10.7 MHz FM
Power Supply:	24 VDC
Ports:	Signal and supply – 4 pole Lemo (Type EHG 1B) connector
Antenna:	Fixed magnetic antenna and integrated loop antenna (axis in horizontal direction)
No of variants:	None
Equipment category:	Table top equipment
Remarks:	None

2.2 Intended Use

The following information was delivered by the customer.

The EUT is a complete measuring system to measure torque on a rotating shaft. The standard use is inside a test stand.

2.3 EUT Peripherals/Simulators

The EUT was tested connected with

- Power supply TRIO-PS/1AC/24DC/5 (Phoenix Contact)
- Axon System Control Unit J1 CS10M
- Axon Stator Unit J1

2.4 Mode of operation during testing and test setup

The equipment under test (EUT) was operated during the tests under the following conditions:

Normal operation:
The rotor of the EUT was fixed and there was no torque applied to the EUT.

The EUT axis was in horizontal direction and connected to the Axon System Control Unit J1 CS10M. On the connection cable was a ferrite (VITROPERM 500F, Type T60006-L2063-W517) attached with 3 turns at the stator unit and a second ferrite (Würth 742 711 31) at the Axon control unit.
The Axon stator unit is part of the EUT and attached to the antenna.

For the emission test the Axon system control unit and the 24VDC power supply were operated outside of the test environment.

For the conducted emission test the EUT was powered with 24 VDC by the AC / DC supply TRIO-PS/1AC/ 24DC/5 delivered by the customer. The AC/DC power supply was connected to 120V / 60Hz.

2.5 Modifications required for compliance

Modification #1:
The radiated power of the power oscillator J1-CS10M had to be reduced according to customer's request.
A detailed description of this modification was delivered by the customer, see Annex 4.

Without modification the current consumption of the Axon control unit was about 805 mA.
After modification the current consumption of the Axon control unit was about 563 mA.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: Hottinger Baldwin Messtechnik GmbH
Type, Serial No. : MPZ2001066B, 243540012

Requirement	47 CFR Section	Report Section	Modification	Result
Antenna Requirement	§ 15.203	4.1	None	Passed
AC Power Line Conducted Emissions	§ 15.207	4.2	#1	Passed
Radiated Emissions 9kHz – 30 MHz	§ 15.209 § 15.205	4.3.4	#1	Passed
Radiated Emissions 30 MHz – 150 MHz	§ 15.209 § 15.205	4.3.8	#1	Passed

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.
Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.
The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013 and all applicable Public Notices received prior to the date of testing.All requirements were found to be within the limits outlined in this report.

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report.

Test personnel: Wolfgang Kiss
Issuance date: 2020-11-03

4 DETAILED TEST RESULTS

4.1 Antenna Requirement

4.1.1 Regulation

47 CFR § 15.203 Antenna requirement

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 carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, 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 which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

4.1.2 Test Result

The EUT is equipped with a fixed magnetic antenna and a loop antenna.

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No.:	243540012
Test personnel:	Wolfgang Kiss

The EUT meets the requirements of this section.

4.2 AC Power Line Conducted Emissions

4.2.1 Regulation

47 CFR § 15.207 Conducted limits

(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.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
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.

4.2.2 Test Procedures

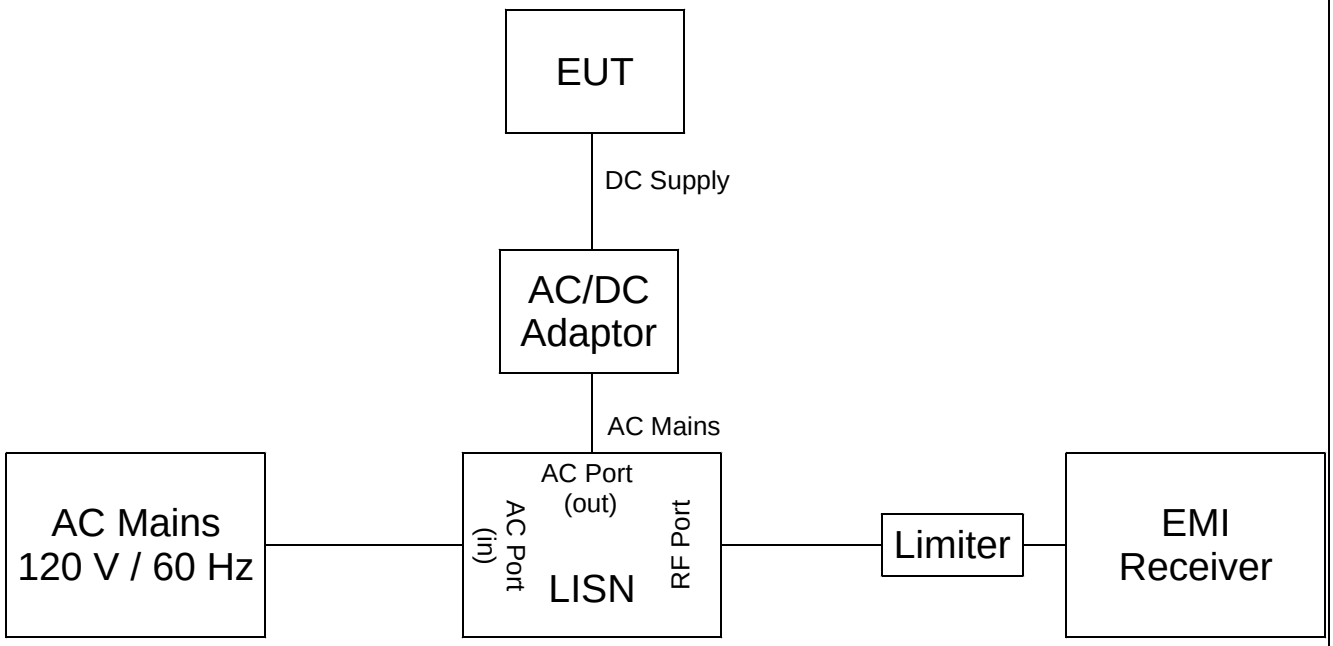
Testing is performed acc. to ANSI C63.10-2013.

Tabletop and their ancillary devices are placed on a nonconducting table with nominal dimension of 1.0 m by 1.5 m, height 0.8 m above the ground plane. The EUT is centered laterally (left to right facing the tabletop) on the tabletop and its rear is flush with the rear of the table. Accessories or peripherals that are part of a system tested on a tabletop are being placed in a test arrangement on one or both sides of the host with a 10 cm separation between the nearest points of the cabinets.

Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the center forming a bundle 30 cm to 40 cm long.

The measurement receiver is connected to the 50 Ω RF port of the LISN.

4.2.3 Test Setup



SCHEMATIC TEST SETUP

Requirement: 47 CFR, § 15.207
Procedure: ANSI C63.10-2013

Power source: #001
Receiver: #3846
LISN: #1901

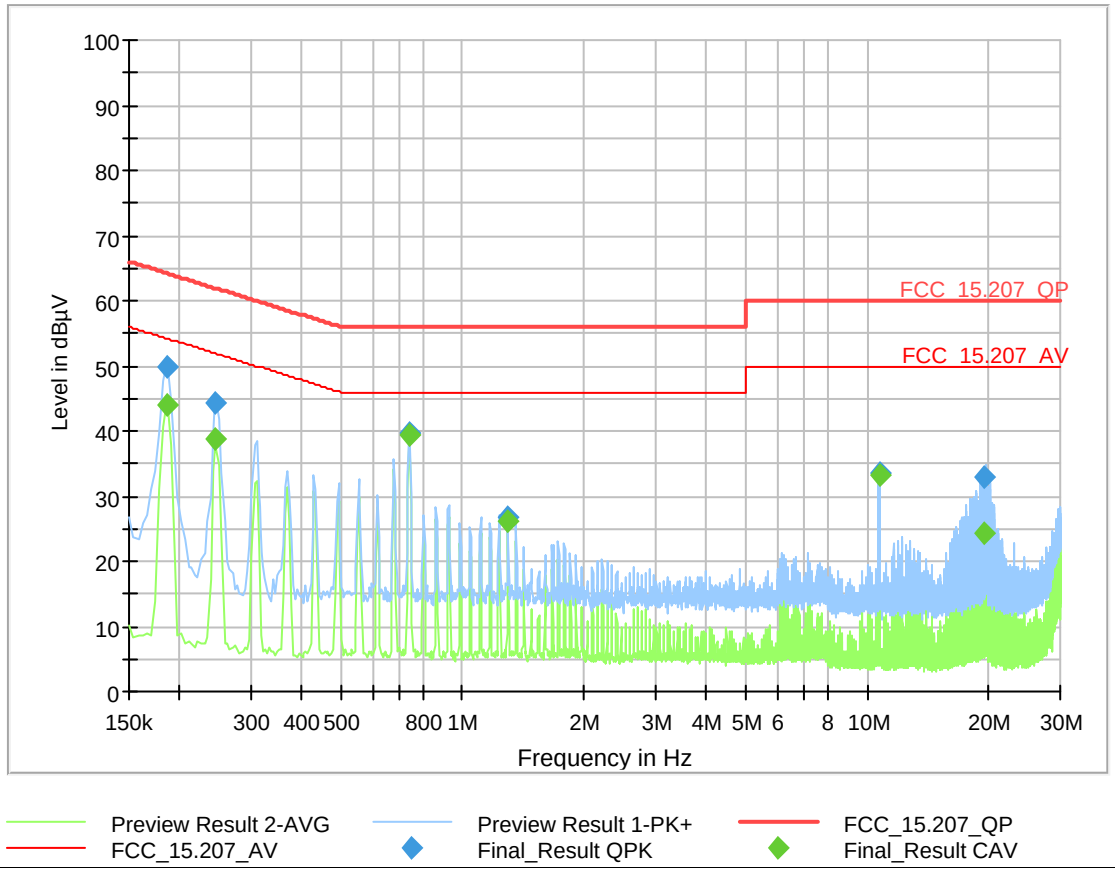
TEST EQUIPMENT USED:
Refer to chapter 5 of this document.
001, 1519, 1890, 1901, 2408, 2717, 3846, 4026, 4717, 5392

Sample photo of setup

Test on Hottinger Baldwin Messtechnik GmbH MPZ2001066B to 47 CFR § 15.203, § 15.207, § 15.209

4.2.4 Detailed Test Data

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No:	243540012
Mode:	Normal operation
Line:	L and N (max hold)



Final Result:

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.186	---	44.1	54.2	10.1	1000	9	L	10
0.186	49.8	---	64.2	14.4	1000	9	L	10
0.246	---	38.8	51.9	13.1	1000	9	L	10
0.246	44.4	---	61.9	17.5	1000	9	L	10
0.738	---	39.4	46.0	6.6	1000	9	L	10
0.738	39.6	---	56.0	16.4	1000	9	L	10
1.294	---	26.2	46.0	19.8	1000	9	L	10
1.294	26.9	---	56.0	29.1	1000	9	L	10
10.730	---	33.3	50.0	16.7	1000	9	L	10
10.730	33.5	---	60.0	26.5	1000	9	L	10
19.534	---	24.4	50.0	25.6	1000	9	L	10
19.534	32.8	---	60.0	27.2	1000	9	L	10

Worst case results listed, only.

4.2.5 Test Result

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No.:	243540012
Test date:	2020-10-01
Test personnel:	Wolfgang Kiss

The EUT meets the requirements of this section.

4.3 Radiated Emissions

4.3.1 Regulation

47 CFR § 15.31

(f)(2) At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). This paragraph (f) shall not apply to Access BPL devices operating below 30 MHz.

47CFR § 15.33 Frequency range of radiated measurements

(a) For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:
(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

47 CFR § 15.35 Measurement detector functions and bandwidths.

(a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long at the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

§15.205 Restricted bands of operation.

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

MHz	MHz	MHz	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.

47 CFR § 15.209 Radiated emission limits; general requirements.

(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:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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 located 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.

(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.

4.3.2 Calculation of Field Strength Limits

E.g. radiated emissions field strength limits for the frequency band 1.705 - 30 MHz:

30 µV/m at 30 meters

Using the equation:

$E_{dB\mu V/m} = 20 \log (E_{\mu V/m})$

where

$E_{dB\mu V/m}$ = Field Strength in logarithmic units (in dBµV/m)

$E_{\mu V/m}$ = Field Strength in linear units (in µV/m)

A field strength limit of 30 µV/m corresponds with 29.5 dBµV/m.

Distance correction (limit)
Remark: The preferred method is the correction of the measured field strength (refer to 4.3.3) instead of limit correction. Only one correction method shall be applied to a particular measurement.

For radiated emission from 9 kHz to 30 MHz the prescan limit was adjusted by a Distance Extrapolation Factor DF of 40 dB per decade, which is calculated by the following equation:

$DF = 40 \log (D_{test}/D_{specification})$
where

DF = Distance Extrapolation Factor (in dB)

D_{test} = Distance, where measurement was performed (in m)

$D_{specification}$ = Distance acc. to specification (in m)

Example: Assume a limit specified in 30 m and a measurement performed at 3 m: The distance correction factor is 40 log (30 / 3) = 40 dB. This factor is mathematically added to the limit by the following equation:
$E_{dB\mu V/m\_new} = E_{dB\mu V/m} + DF$
where

$E_{dB\mu V/m}$ = Field Strength limit in logarithmic units (in dBµV/m)

$E_{dB\mu V/m\_new}$ = Corrected Field Strength limit in logarithmic units (in dBµV/m)

DF = Distance Extrapolation Factor (in dB)

Example: Assume a limit of 29.5 dBµV/m specified in 30 m distance and the measurement performed at 3 m. The limit is adjusted by the distance correction factor of 40 dB to the new limit of 69.5 dBµV/m.

4.3.3 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF
where
FS = Field Strength (in dBµV/m)
RA = Receiver Amplitude (in dBµV)
AF = Antenna Factor (in dB (1/m))
CF = Cable Attenuation Factor (in dB)

Assume a receiver reading of 30 dBµV is obtained. The Antenna Factor of 10 dB(1/m) and a Cable Factor of 1.2 dB are added, giving a field strength of 41.2 dBµV/m in the measurement distance. The field strength of 41.2 dBµV/m value can be mathematically converted to its corresponding level in µV/m.

FS = 30 + 10 + 1.2 = 41.2
Level (in µV/m) = Common Antilogarithm (41.2/20) = 114.8

Distance correction (field strength)
Remark: The preferred method is the correction of the measured field strength instead of limit correction (refer to 4.3.2). Only one correction method shall be applied to a particular measurement..

If a measurement is performed at a different distance other than specified, the field strength at the specified distance can be obtained by the following equation:

$FS_{Dspecified} = FS_{Dtest} + EF \log (D_{test}/D_{specified})$
where
$FS_{Dspecified}$ = Field Strength at specified distance $D_{specified}$ (in dBµV/m)
FS_{DTest} = Field Strength at specified distance D_{Test} (in dBµV/m)
EF = Extrapolation factor, 40 dB/decade below 30 MHz and 20 dB/decade above 30 MHz
D_{test} = Measurement distance where test was performed (in m)
$D_{specified}$ = Measurement distance as specified by the rules (in m)

Assuming a recorded field strength of 107.7 dBµV/m at 18 kHz in a distance of 3 m. If the rules are specifying a limit in a distance of 300 m, the field strength recorded in 3 m is corrected by the distance. Therefore, the field strength $FS_{Dspecified}$ is 107.7 + 40 log (3 / 300) = 27.7 (in dBµV/m).

Remark: Using EMC32 software corrections are combined in the Corr. Factor as listed in the results' table.
"Result" represents the FS Result, "Corr." is the combined correction factor.

4.3.4 Radiated Emissions 9 kHz – 30 MHz

4.3.4.1 Test Procedures

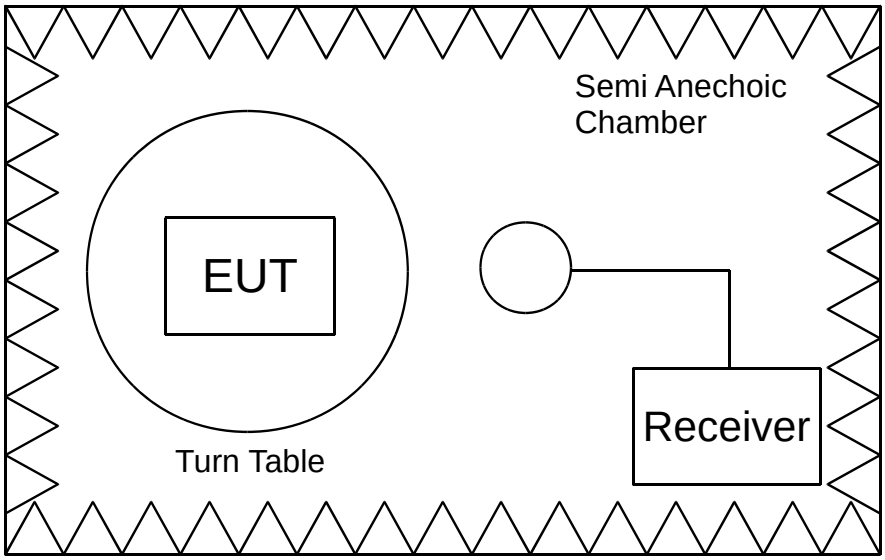
ANSI C63.10-2013, 6.4.3 Measuring antenna selection, location, and test distance
Radiated emission tests shall be performed in the frequency range of 9 kHz to 30 MHz, using a calibrated loop antenna as specified in 4.3.2, at a suitable site and measurement distance as specified in 5.3. This method is applicable for measuring radiated RF emissions from all units, cables, power cords, and interconnect cabling or wiring of the EUT, by applying the guidance provided in 5.10 along with guidance provided subsequently.

ANSI C63.10-2013, 6.4.6 Exploratory radiated emission tests
The tests shall be performed in the frequency range specified in 5.5 and 5.6, using the procedures in Clause 5, applying the appropriate modulating signal to the EUT, to determine cable or wire positions of the EUT system that produce the emission with the highest amplitude relative to the limit.
Exploratory measurements below 30 MHz are useful in determining the maximum level of emissions while manipulating and rotating the EUT; however, exploratory and final measurements may be made concurrently, provided care is taken to determine the maximum level of emissions for all configurations and orientations.
The test arrangement, measuring antenna guidelines and operational configurations in 6.3.1 and 6.3.2, shall be followed. The measurement antenna shall be positioned with its plane perpendicular to the ground at the specified distance. When perpendicular to the ground plane, the lowest height of the magnetic antenna shall be 1 m above the ground and shall be positioned at the specified distance from the EUT. When the EUT contains a loop antenna that can only be placed in a vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, and then orthogonal to the axis. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. When the EUT contains a loop antenna that can be placed in a horizontal or vertical axis, normal measurements shall be made aligning the measurement antenna along the site axis, orthogonal to the axis, and then with the measurement antenna horizontal. For each measurement antenna alignment, the EUT shall be rotated through 0° to 360° on a turntable. The report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB, then the following statement shall be made: “all emissions were greater than 20 dB below the limit.”

ANSI C63.10-2013, 6.4.7 Final radiated emission tests
Using the orientation and equipment arrangement of the EUT determined in 6.4.6, and applying the appropriate modulating signal to the EUT, perform final radiated emission measurements on the fundamental and highest spurious emissions.
Unless otherwise specified by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz – 30 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	200 Hz (< 150 kHz) 9 kHz (≥ 150 kHz)
Receive antenna height	1 m
Angular steps size during prescan:	90 °
Receive antenna orientations	2 (and EUT antenna in two polarizations)
Measurement chamber	Semi anechoic chamber (SAC)

4.3.5 Test Setup



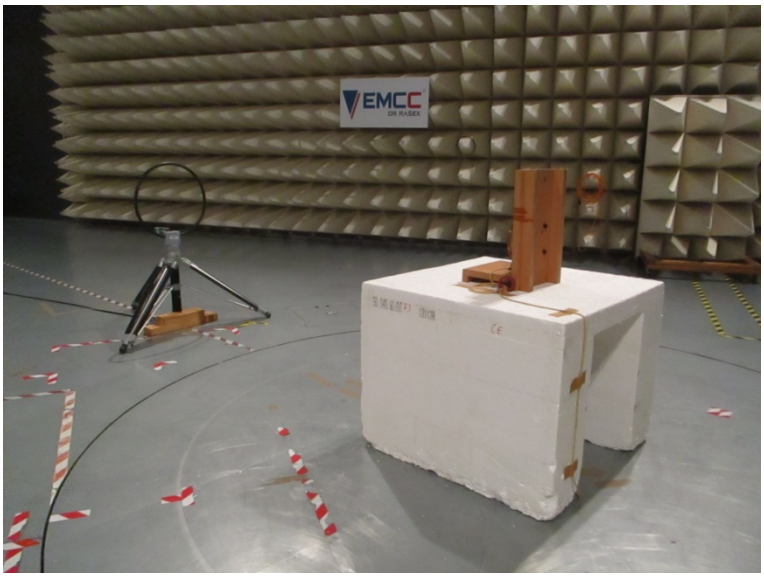
SCHEMATIC TEST SETUP

Requirement: 47 CFR, § 15.209
Procedure: ANSI C63.10-2013

Receiver: #3846
Antenna: #374

Test distance: 3 m

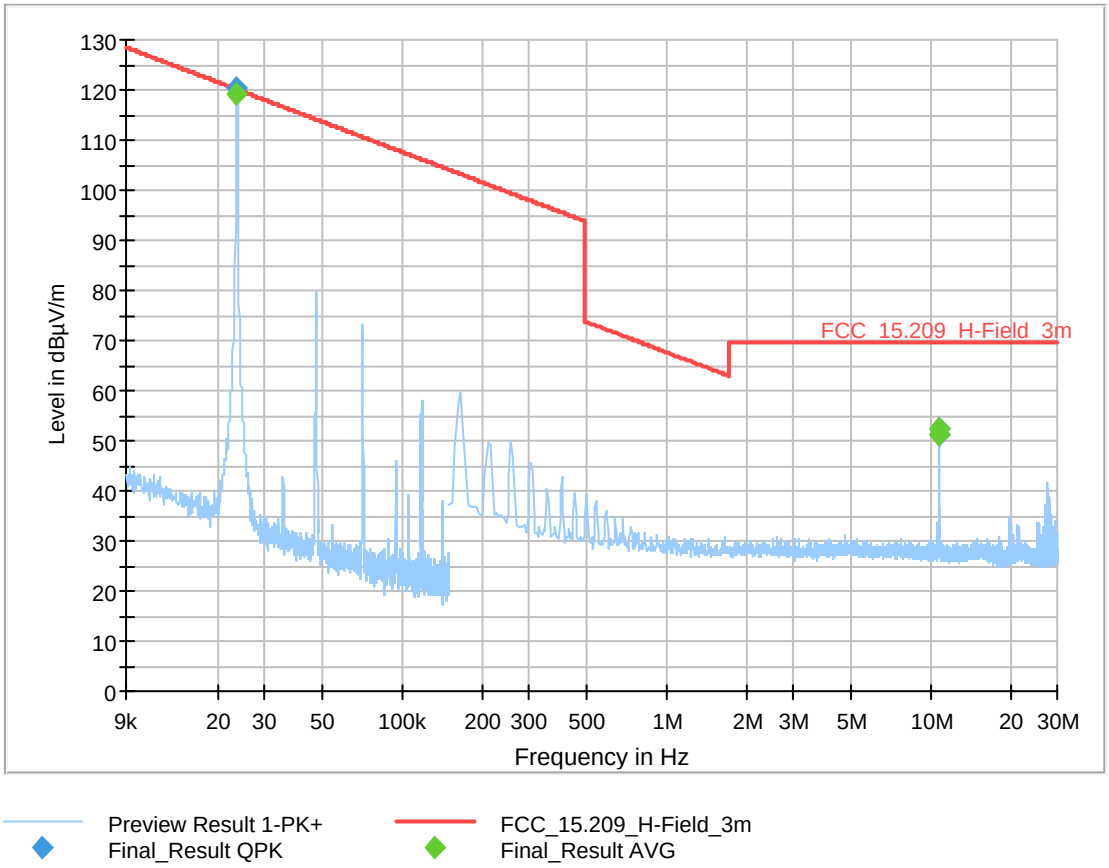
TEST EQUIPMENT USED:
Refer to chapter 5 of this document.
374, 1292, 1416, 1889, 2717, 2766, 3846, 4075, 4717, 5392



Sample photo of setup at SAC

4.3.6 Detailed Test Data

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No:	243540012
Mode:	Normal Operation



Final Result:

Frequency (MHz)	Detector	3 m Result (dBµV/m)	Distance Correction (dB)	30 m Result (dBµV/m)	30m Limit (dBµV/m)	300 m Result (dBµV/m)	300 m Limit (dBµV/m)	Margin
0.024	AV	119.1	-80			39.1	40.2	1.1
10.669	QP	52.5	-40	12.5	29.5			17.0
10.728	QP	51.4	-40	11.4	29.5			18.1

Worst case results listed, only.

Note: Final measurement performed in SAC.

4.3.7 Test Result

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No.:	243540012
Test date:	2020-10-01
Test personnel:	Wolfgang Kiss

The EUT meets the requirements of this section.

4.3.8 Test Site Correlation for H-Field Measurement in Semi-Anechoic Chamber (SAC)

Test procedure following KDB 414788 D01.

A correlation measurement was done with a MPZ1901036 (documented in the test report 040197.1ABB dated 2019-10-08).
The carrier frequency of 0.02 MHz and 10.7 MHz was measured in the semi-anechoic room (SAC) at a test distance of 3 m and at an open field site at a test distance of 3 m with the same calibrated loop antenna. Both EUTs have similar dimensions.
This measurement was used to evaluate a correction of the open field measurement to the semi-anechoic room measurement.

Frequency (MHz)	Detector	Distance (m)	F_{SAC} (dBµV/m)	F_{open} (dBµV/m)	f_C (dB)
0.02	AV	3	109.4	107.7	-1.7
10.7	QP	3	50.9	56.5	5.6

Test date: 2019-08-27

$f_C = F_{open} - F_{SAC}$

f_C is correlation factor from SAC to open field site field strength
F_{open} measured field strength at open field site
F_{SAC} measured field strength at SAC

4.3.9 Radiated Emissions 30 MHz – 150 MHz

4.3.9.1 Test Procedures

ANSI C63.10-2013 6.5 Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to 1000 MHz

This subclause specifies conditions for compliance testing in the frequency range above 30 MHz and below 1 GHz. The following subclauses describe the procedures that shall be used for making exploratory and final radiated emission tests for frequencies between 30 MHz and 1000 MHz. Measurements may be performed at a distance closer than that specified in the requirements, provided the measuring antenna is beyond its near-field range as determined by the Rayleigh criteria.

ANSI C63.10-2013, 6.5.3 Exploratory radiated emission tests

Exploratory measurements are used to identify the frequencies and amplitudes of the emissions while manipulating and rotating the EUT.

Exploratory radiated measurements shall be performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT. At near distances, for EUTs of comparably small size, it is relatively easy to determine the spectrum signature of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. Exploratory measurements shall be made on a test site per 5.2. Shielded rooms, not treated with RF absorption material, shall not be used for exploratory measurements.

For each mode of operation required to be tested, the frequency spectrum shall be monitored. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations.

ANSI C63.10-2013, 6.5.4 Final radiated emission tests

Using the orientation and equipment arrangement of the EUT, and based on the measurement results found during the exploratory measurement in 6.5.3, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit shall be selected for the final measurement. The final measurement shall follow all the procedures in 6.3 with the EUT operating on frequencies per 5.6. For each mode selected, record the frequency and amplitude of the highest fundamental emission (if applicable) and the frequency and amplitude of the six highest spurious emissions relative to the limit; emissions more than 20 dB below the limit do not need to be reported.

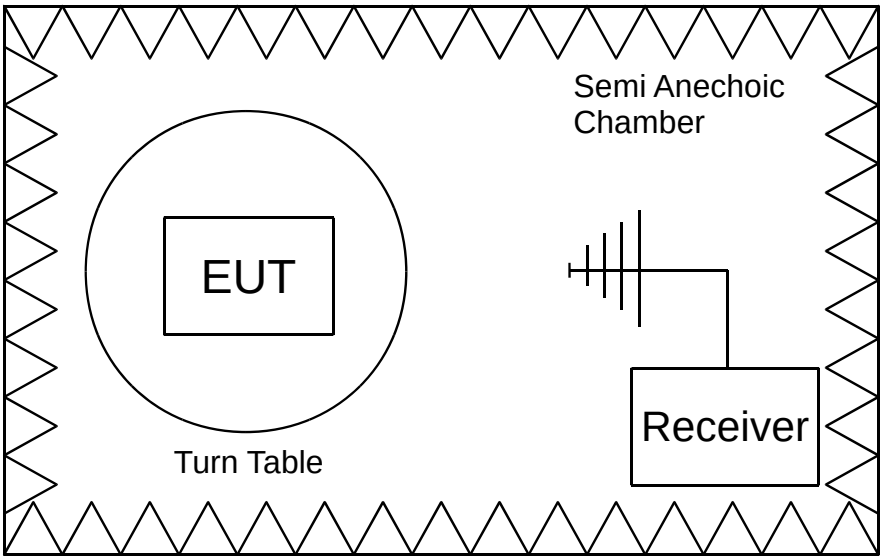
Measurements are performed with the EUT rotated from 0° to 360°, the antenna height scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

Variations in cable or wire placement shall be explored to maximize the measured emissions.

Unless specified otherwise by the regulatory authority, the instrumentation, detector functions, and bandwidths specified in 4.1.4.2.1 and 4.1.4.2.2 shall be used. For pulsed emissions, the procedure in 4.1.4.2.4 shall be used.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 150 MHz (tenth harmonic of EUT is 107 MHz)
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Angular steps size during prescan:	90 °
Receive antenna polarization	Vertical/Horizontal
Measurement location	Semi Anechoic Chamber (SAC)

4.3.9.2 Test Setup



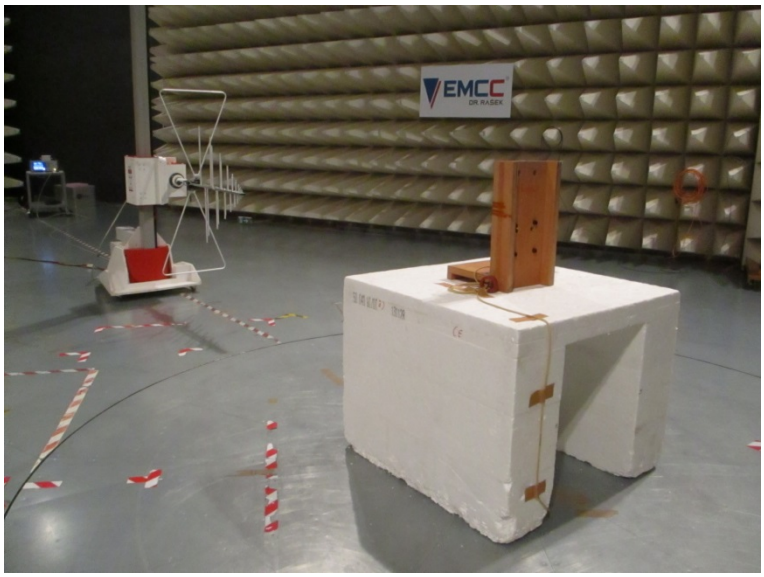
SCHEMATIC TEST SETUP

Requirement: 47 CFR, § 15.209
Procedure: ANSI C63.10-2013

Receiver: #3846
Antenna: #6041

Test distance: 3 m

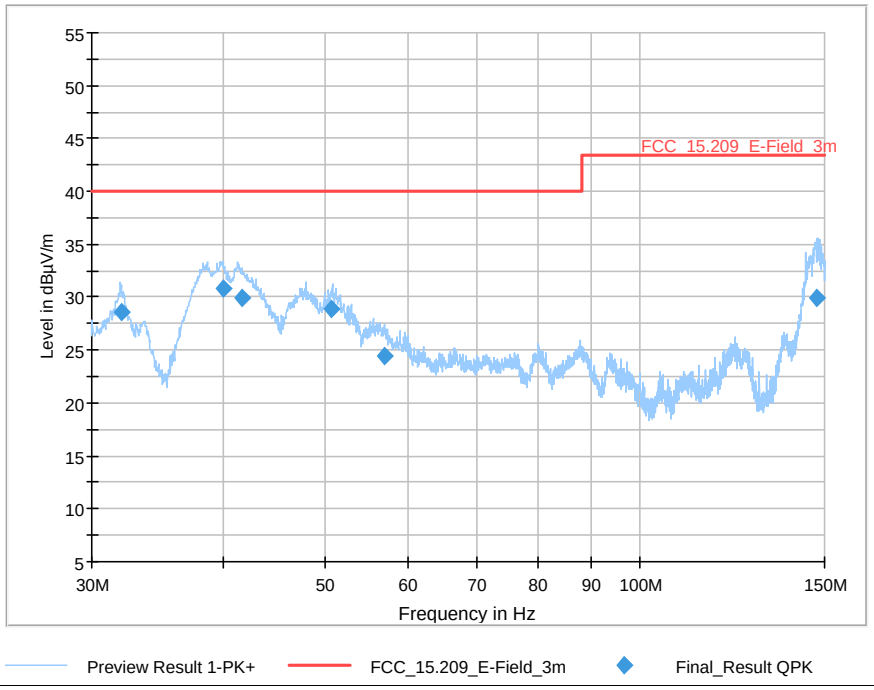
TEST EQUIPMENT USED:
Refer to chapter 5 of this document.
55, 1291, 1292, 1416, 1889, 2717, 2724, 2766, 3846, 4075, 4717, 5392, 6041



Sample photo of setup

4.3.9.3 Detailed Test Data

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No:	243540012
Mode:	Normal operation
Remark:	EUT horizontal, current reduced to 560 mA



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
32.02	28.5	40.0	11.5	1000	120.0	100.0	V	133	16.5
40.02	30.9	40.0	9.1	1000	120.0	100.0	V	-180	18.7
41.74	29.9	40.0	10.1	1000	120.0	103.0	V	-156	19.3
50.86	28.9	40.0	11.1	1000	120.0	100.0	V	-168	19.7
56.98	24.4	40.0	15.6	1000	120.0	100.0	V	-180	18.7
147.66	29.9	43.5	13.6	1000	120.0	182.0	H	99	14.1

Worst case results listed, only.

4.3.9.4 Test Result

Manufacturer:	Hottinger Baldwin Messtechnik GmbH
Type:	MPZ2001066B
Serial No.:	243540012
Test date:	2020-10-01
Test personnel:	Wolfgang Kiss

The EUT meets the requirements of this section.

5 TEST INSTRUMENTS

Ident#	Instrument	Manufacturer	Model No.	Last Calibration	Next Calibration
1	60-Hz-Converter	AEG	DAMK4/DAGK4	n/a	n/a
55	N-Cable N/50	Rohde & Schwarz	HFU2-Z4	2019-10	2020-10
374	Loop Antenna	Rohde & Schwarz	HFH 2-Z2	2018-11	2021-02
1291	Antenna Mast	Frankonia	FAM4	n/a	n/a
1292	Multi Device Controller	Frankonia	FC02	n/a	n/a
1416	Isolation Transformer	Daitron	J91097-11	n/a	n/a
1519	Pulse Limiter	Rohde & Schwarz	ESH3-Z2 357.8810.52	2020-09	2021-09
1889	SR-ULL-01, Semi-Anechoic Chamber (SAC)	EMCC/FRANK.	SAC-10	n/a	n/a
1890	SR-ULL-05, Absorber-Lined Shielded Chamber	EMCC / SIEM / FRANK	SC2-ULL	n/a	n/a
1901	V-LISN 50 Ohm// (50 uH + 5 Ohm)	Rohde & Schwarz	ESH2-Z5	2019-12	2020-12
2408	N-Cable N/50	EMCC DR. RASEK	RG 214	2019-12	2020-12
2717	Digital Multimeter	Agilent	U1241A	2020-03	2022-03
2724	5 W Attenuator 6dB	Weinschel	2	2019-07	2021-07
2766	DC Power Supply	MC Voice	DF-1730SBC-3A	n/a	n/a
3846	EMI Test Receiver	Rohde & Schwarz	ESU8	2020-03	2021-03
4026	Notebook	Dell	Latitude E6430	n/a	n/a
4075	Workstation	Dell	Optiplex 7010	n/a	n/a
4717	Web-Thermo-Hygrobarograph	Wiesemann & Theis GmbH WUT	57613 Web-T/Rh/P	2020-02	2022-02
5392	EMC Measurement Software	Rohde & Schwarz	EMC32	n/a	n/a
6041	TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	2019-10	2021-10

6 MEASUREMENT UNCERTAINTY

Measurement	Measurement Uncertainty
Conducted Emissions, AC mains (150 kHz – 30 MHz)	±3.5 dB
Radiated Emissions below 1000 MHz	±5.6 dB

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of 95%.

The given values have been calculated on the basis of the following documents:

CISPR 16-4-2:2011+A1:2014, Specification for radio disturbance and immunity measuring apparatus and methods - Part 4-2: Uncertainties, statistics and limit modelling - Measurement instrumentation uncertainty.

TR 100 028-1 V1.4.1 (2001-12), Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1

TR 100 028-2 V1.4.1 (2001-12), Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2

JCGM 100:2008, Evaluation of measurement data - Guide to the expression of uncertainty in measurement.

7 LIST OF ANNEXES

The following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test setup	3
Annex 2: External photographs of equipment under test	4
Annex 3: Photographs of ancillary equipment	5
Annex 4: Operational description	7