

FCC Test Report (Part 15C)

NFC

Test report no.:	LAB-531B (v3.0)	Date of report:	31-Mar-2023
Number of pages:	31	Project support engineer:	Jürgen Mitterer
Test period:	19-Aug-2022 to 04-Oct-2022		

Applicant:	Molex CVS Bochum GmbH, Meesmannstr. 103, 44807 Bochum, Germany, Mr. A. Langner		
Manufacturer:	Molex CVS Bochum GmbH, Meesmannstr. 103, 44807 Bochum, Germany		
EUT identification:	Molex, WCH-303 (WCH-303a)		
FCC ID:	WJLWCH-303	ISED ID:	7847A-WCH303

Testing laboratory:	Molex CVS Lab, Molex CVS Bochum GmbH, Meesmannstr.103, 44807 Bochum, Germany		
Tel.:	+49 234 51668-0		
e-mail:	Product.Validation.Bochum@molex.com		
FCC designation no.:	DE0017	ISED recognition no.:	DE0015
Laboratory manager:	Robert Müller		

Test result: The EUT complies with the requirements made in the referred test documents.

Approver:	Ines Baufeld	Technical review:	Robert Müller
Title:	Laboratory Quality Manager	Title:	Laboratory Manager

Signature: 
Signature: 

This test report may not be reproduced, except in full, without written permission of testing laboratory. Former issued versions of this report are declared as invalid. The test results in this test report relates only to the tested samples as received, which is mentioned in this test report. Molex CVS Bochum GmbH cannot be made responsible for any generalizations or conclusions drawn from this test report.

Table of contents

VERSION HISTORY	3
1. SUMMARY FOR FCC PART 15C TEST REPORT	4
1.1. EUT AND ACCESSORY INFORMATION	4
1.2. TECHNICAL CHARACTERISTICS	5
1.3. APPLIED STANDARDS	6
1.4. MEASUREMENT UNCERTAINTIES	7
1.5. DECISION RULE	7
1.6. RISK ASSESSMENT	8
1.7. SUMMARY OF TEST RESULTS	9
2. TEST SETUPS	10
2.1. CONDUCTED RF TEST SETUP (SETUP 1)	10
2.2. RADIATED EMISSIONS TEST SETUP (SETUP 2)	10
3. FIELD STRENGTH IN THE 13.56 MHZ BAND	11
3.1. TEST METHOD AND LIMIT	11
3.2. TEST RESULTS (FCC/ISED)	12
4. RADIATED EMISSIONS BELOW 30 MHZ	15
4.1. TEST METHOD AND LIMIT	15
4.2. TEST RESULTS (FCC, ISED)	16
5. RADIATED EMISSIONS ABOVE 30 MHZ	21
5.1. TEST METHOD AND LIMIT	21
5.2. TEST RESULTS (FCC, ISED)	22
6. FREQUENCY STABILITY, TEMPERATURE VARIATION	23
6.1. TEST REFERENCE AND LIMIT	23
6.2. TEST RESULTS (FCC, ISED)	24
7. FREQUENCY STABILITY, VOLTAGE VARIATION	25
7.1. TEST REFERENCE AND LIMIT	25
7.2. TEST RESULTS (FCC, ISED)	25
8. OCCUPIED BANDWIDTH	26
8.1. TEST METHOD AND LIMIT	26
8.2. TEST RESULTS 20dB OBW	27
8.3. TEST RESULTS 99% OBW	28
9. TEST EQUIPMENT	29
9.1. CONDUCTED RADIO	29
9.2. RADIATED EMISSION	30

Version History

Report Number	Date	Comment
LAB-531B (v1.0)	04-Oct-2022	1 st approved version
LAB-531B (v2.0)	17-Oct-2022	2 nd approved version Limit unit from “dB μ A/m” to “ μ V/m” corrected in table on page 11
LAB-531B (v3.0)	31-Mar-2023	3 rd approved version List of passive devices added

1. Summary for FCC Part 15C Test Report

Date of receipt	05-Jul-2022
Testing completed	21-Sep-2022
The customer's contact person	Mr. Antonios Langner
Test samples / setup pictures	LAB-531B_WJLWCH-303_FCC_NFC_Test_Setup_Photos_v1.0
HW change / difference document	none
Notes	none

1.1. EUT and accessory information

The EUT is an inductive wireless power transfer device (wireless charger) with RFID system (NFC) operating at 13.56 MHz. The EUT is tested without mobile phone in a continuous NFC transmission mode with active modulation, configured via UART interface (Duty cycle of 100 %).

The following test samples provided by the customer were tested.

ID	Description	Manufacturer	Type	S/N	HW Version	SW Version
DAB2220223	WPT Device	Molex	WCH-303a	51033785C10221887AEF AF0074	C10	23.3
DAB2220232	WPT Device	Molex	WCH-303a	51033785C10221887AEF AF0048	C10	23.3

The following accessories have been provided by the customer and belong to the equipment under test (EUT).

ID	Description	Manufacturer	Type	S/N	HW Version	SW Version
DAB210788E	DC power cable long (15W)	Molex	-	-	-	-
DAB2220242	DC power cable long (15W)	Molex	-	-	-	-

1.2. Technical characteristics

Power Supply [V]	Lead-acid battery (vehicle regulated) – 13.2 V DC		
Voltage Range [V]	$U_{nom} = 13.2$	$U_{min} = 11.1$	$U_{max} = 15.2$
NFC communication cut-off Voltage [V]	$U_{cut-off} = 9.0$ (NFC communication is stopped for $U < U_{cut-off}$)		
Temperatures Range [°C]	-20 .. +85		
Radio Type	NFC transceiver		
Operating Frequency [MHz]	13.56		
Operating Channels	Not channelized		
Antenna Type	Integral		
Antenna gain [dBi]	n.a.		
Product Category	RFID		
Modulation Type	ASK		
RFID Classification	Wideband (ISO14443, NFC...)		

Above technical information was provided by the applicant. For more details, please refer to the User's manual of the EUT.

1.3. Applied standards

Standard / Rule Part	Version	Year
CFR 47, FCC Part 15C	-	Jul-2022
ANSI C63.10	-	Jun-2013
ISED RSS-Gen	Issue 5 + AMD1 + AMD2	Feb-2021
ISED RSS-210	Issue 10 + AMD1	Apr-2020

Deviations or clarifications to these standards are noted in the related test result under “test method and limit”.

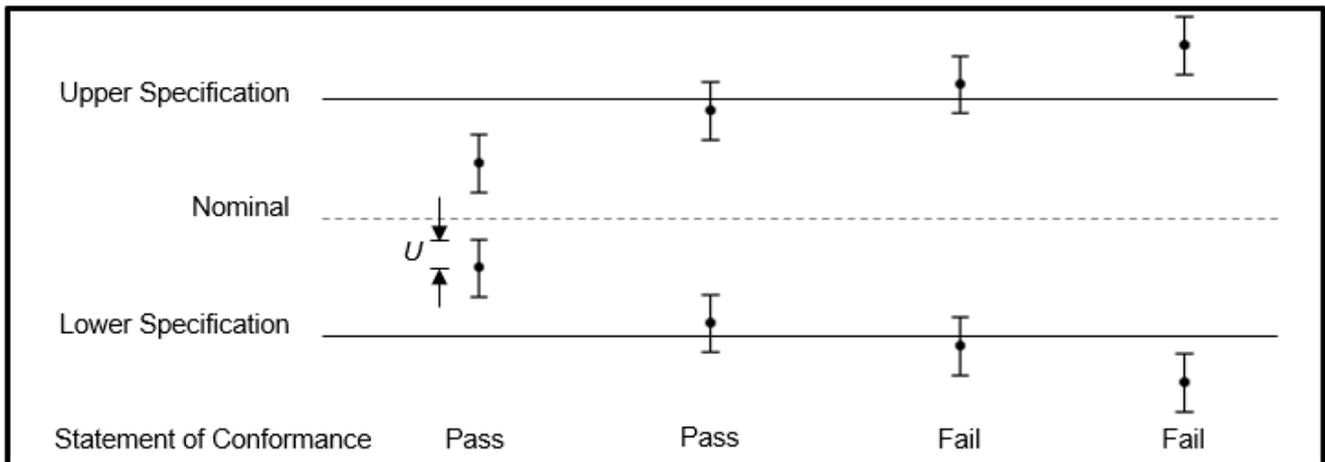
1.4. Measurement uncertainties

Parameter	Measurement Uncertainty	Maximum Uncertainty
Radio Frequency	$\pm 3.6 \times 10^{-7}$	$\pm 1 \times 10^{-5}$
Total RF Power, conducted	± 0.79 dB	± 1.5 dB
RF Power density, conducted	± 0.79 dB	± 3.0 dB
Spurious emissions, conducted	± 1.67 dB	± 3.0 dB
All emissions, radiated	± 5.38 dB	± 6.0 dB
Temperature	± 1.0 °C	± 3.0 °C
Humidity	± 2.0 %	± 5.0 %

These uncertainties represent an expanded uncertainty expressed approximately at the 95% confidence level using a coverage factor of $k=2$

1.5. Decision rule

Unless it is inherent in the requested customer specification or test standard, the “Binary Statement for Simple Acceptance” as defined in ILAC G8:2019 clause 4.2.1 is applied as decision rule for the conformity statement, see the following picture. Therefore, the measured values are compared directly with the limit values without taking the measurement uncertainty into account.



$U = 95\%$ expanded measurement uncertainty

1.6. Risk Assessment

Following the guidance of ILAC G8:2019 clause 5.2, the level of specific risk of False Accept or False Reject considering different decision rules and respectively expanded measurement uncertainties can be expressed as follows.

Decision Rule	Distance of Measurement Value to Limit	Probability of wrong Conformity Statement
6 Sigma	3 x Measurement Uncertainty	< 1 ppm
3 Sigma	1.5 x Measurement Uncertainty	< 0.16 %
ILAC G8:2009 Rule	1 x Measurement Uncertainty	< 2.5 %
ISO 14253.1:2017	0.83 x Measurement Uncertainty	< 5 %
Simple Acceptance, ILAC G8:2009 4.2.1	Measurement Value on Limit Line	50 % "worst case" scenario

1.7. Summary of test results

Section	Section in CFR 47	Section in RSS-Gen	Section in RSS-210	Name of the test	Result
3	15.225 (a)(b)(c)	-	B.6 (a)	Field strength in the 13.56 MHz band	PASSED
0	15.225 (d), 15.209	8.9	-	Radiated emissions below 30 MHz	PASSED
5	15.225 (d), 15.209	8.9	-	Radiated emissions above 30 MHz	PASSED
6	15.225 (e)	8.11	B.6 (b)	Frequency stability, temperature variation	PASSED
7	15.225 (e)	8.11	B.6 (b)	Frequency stability, voltage variation	PASSED
-	15.207	8.8	-	AC powerline conducted emissions	NA
8	15.215 (c)	6.7	-	Occupied bandwidth	PASSED

PASSED: The EUT complies with the essential requirements in the standard.

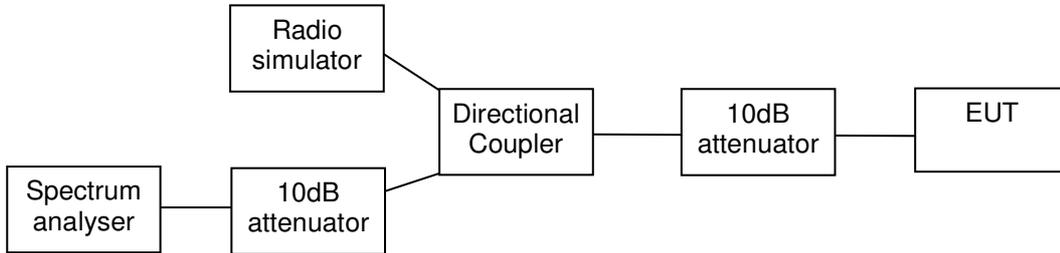
FAILED: The EUT does not comply with the essential requirements in the standard.

NP: The test was not performed.

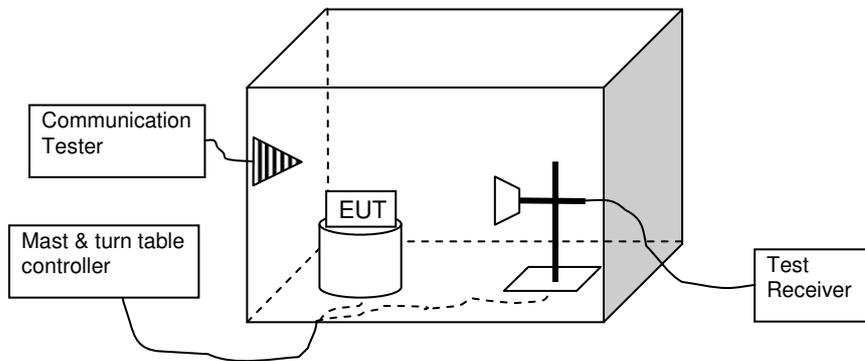
NA: The test was not applicable.

2. Test setups

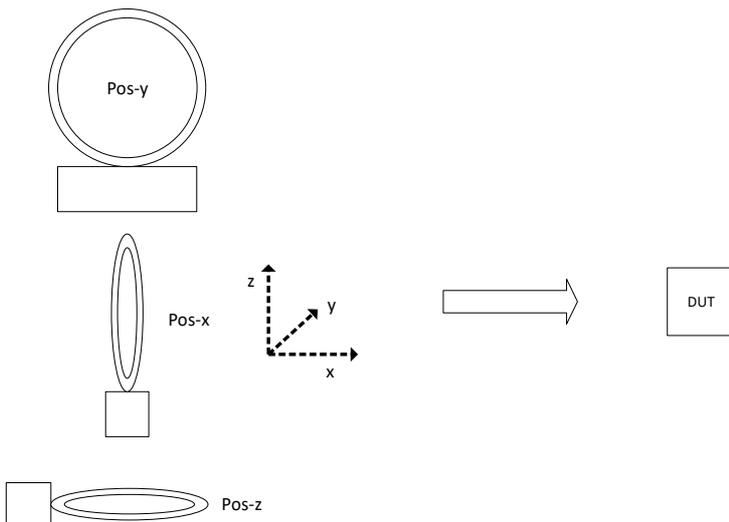
2.1. Conducted RF test setup (Setup 1)



2.2. Radiated emissions test setup (Setup 2)



Loop Antenna orientation:



3. Field strength in the 13.56 MHz band

EUT with DUT number	DAB2220232
Accessories with DUT numbers	DAB2220242
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+15 °C to +35 °C / 20 % to 75 %
Date of measurement	19-Aug-2022 – 21-Sep-2022
Test Responsible	Frank Wittmann
Test system SW / Version / Configuration	Rohde & Schwarz EMC32 / 10.60.20 / 1.6

3.1. Test method and limit

The measurement is made according to ANSI C63.10 and RSS-Gen as follows:

- ⇒ The measurement distance is 3 m with a shielded loop antenna. The magnetic field to electric field conversion factor is 51.5 dB ($\text{dB}\mu\text{A}/\text{m} = \text{dB}\mu\text{V}/\text{m} - 51.5 \text{ dB}$).
- ⇒ The Limit has been adjusted with the distance correction factor according to 15.31(f)(2). (+40 dB for 30 m distance and +80 dB for 300 m distance)
- ⇒ The measurement is divided into the Preliminary Measurement and the Final Measurement. The Preliminary Measurement and the Final Measurement are performed with the measuring antenna at 1m height. The equipment under test (EUT) is located on an 80 cm table, which is rotated by 360 degrees. The DUT is positioned in horizontal position on the test table.
- ⇒ During the Preliminary Measurement, the suspected frequencies are searched by using the PK detector and the measuring antenna is turned in 3 orthogonal positions (x-, y-, z-pos) to find out worst case position. In the Final Measurement the exact frequency and amplitude of these emissions are re-measured by using the applicable QP and AV detector.
- ⇒ The Final Measurement is performed if the Preliminary Measurement results are closer than 20 dB to the permissible limit.
- ⇒ The measurement results are obtained as described in the following formula: $E [\text{dB}\mu\text{V}/\text{m}] = U_{\text{RX}} + A_{\text{CF}}$
Where U_{RX} is receiver reading and A_{CF} is total correction factor including cable loss, antenna factor and preamplifier gain ($A_{\text{CF}} = L_{\text{CABLES}} + \text{AF} - G_{\text{PREAMP}}$).
- ⇒ Example values and calculation for one final QP measurement frequency at 13.56 MHz, see result in 3.2:
 $E [\text{dB}\mu\text{V}/\text{m}] = 46.57 + 21.00 = 67.57$

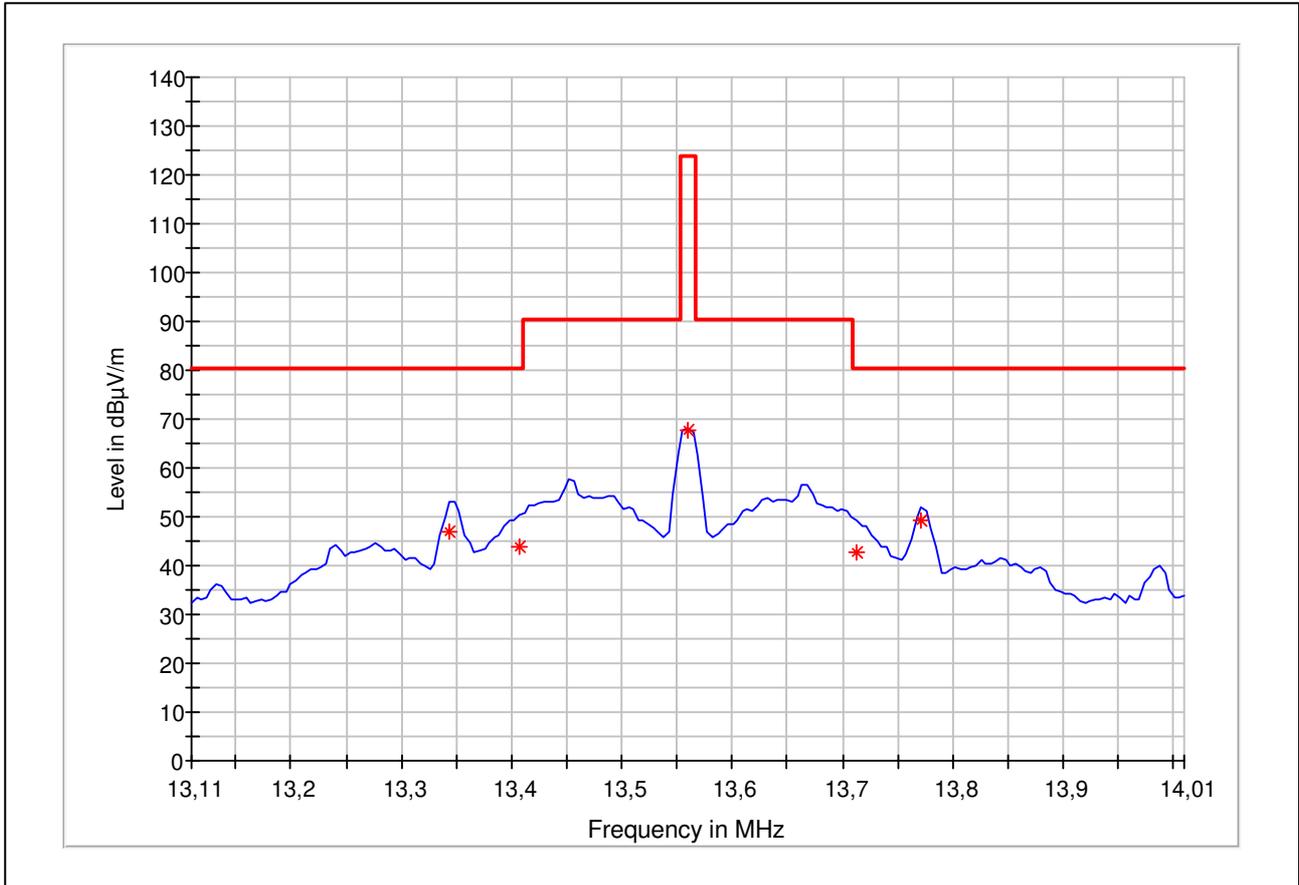
Limits for field strength (13.56 MHz band) measurements (3 m measurement distance)

Frequency range [MHz]	Limit [$\mu\text{V}/\text{m}$]	Limit [$\text{dB}\mu\text{V}/\text{m}$]	Detector
13.553 - 13.567	15.848 * 100	84 + 40 dB	QP
13.410 - 13.553	334 * 100	50.5 + 40 dB	QP
13.567 - 13.710			QP
13.110 - 13.410	106 * 100	40.5 + 40 dB	QP
13.710 - 14.010			QP

3.2. Test results (FCC/ISED)

DUT horizontal, Antenna x-position

Peak detector (RBW 10 kHz)



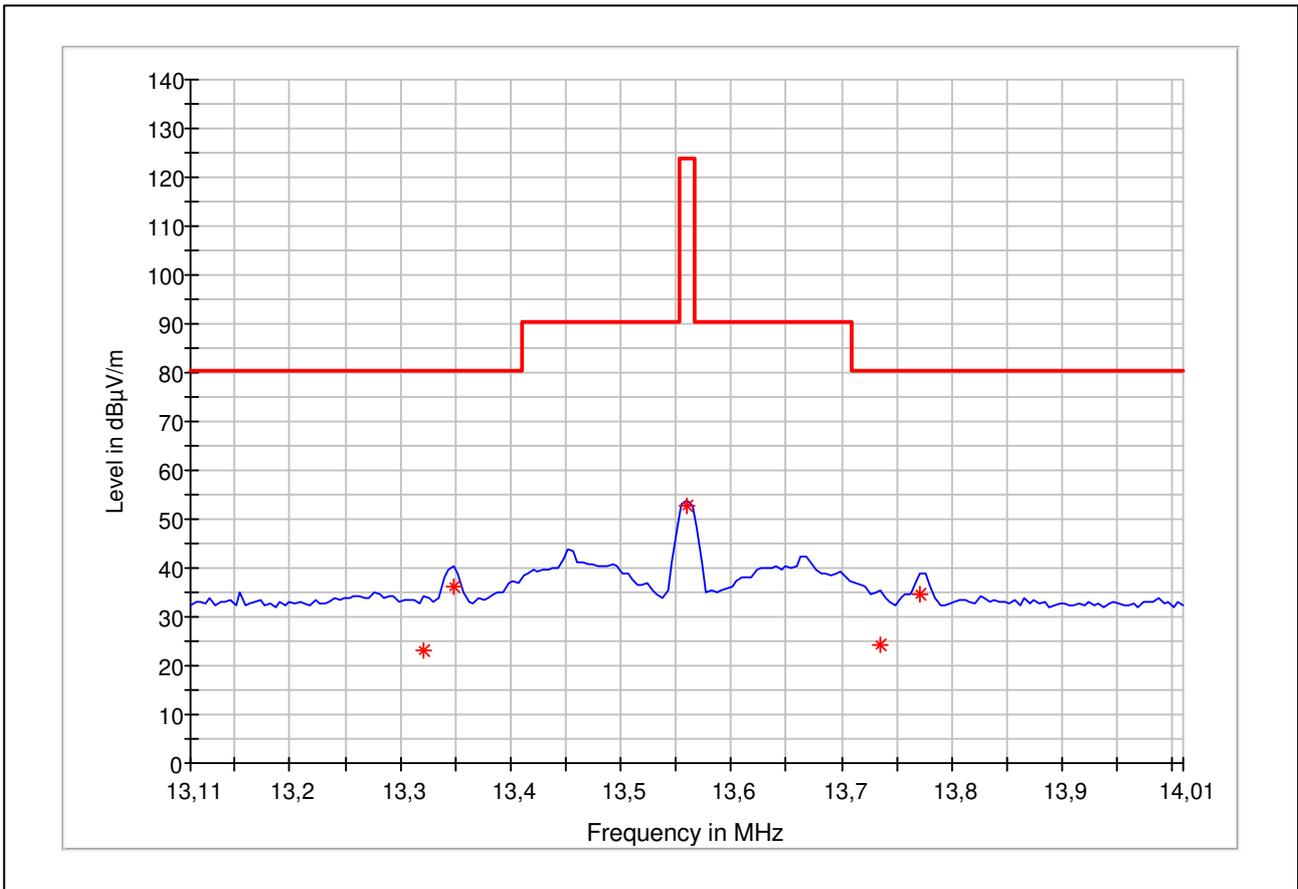
Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
13.344000	46.91	80.50	33.59	100.0	x-pos	255.0	21.0	horizontal	PASSED
13.407000	43.98	80.50	36.52	100.0	x-pos	242.0	21.0	horizontal	PASSED
13.560000	67.57	124.00	56.43	100.0	x-pos	255.0	21.0	horizontal	PASSED
13.713000	42.61	80.50	37.89	100.0	x-pos	255.0	21.0	horizontal	PASSED
13.771500	49.27	80.50	31.23	100.0	x-pos	245.0	21.0	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

DUT horizontal, Antenna y-position

Peak detector (RBW 10 kHz)



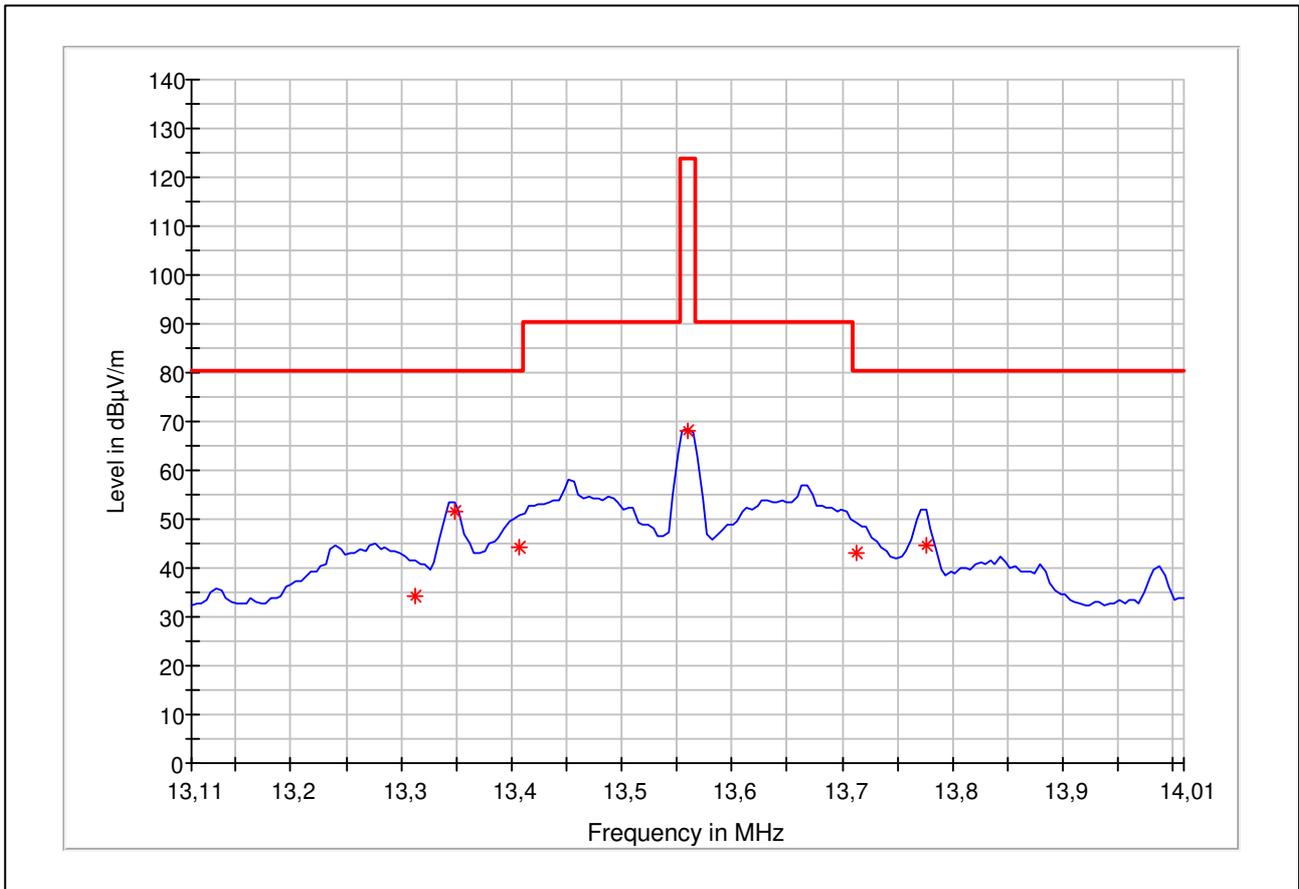
Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
13.321500	22.94	80.50	57.56	100.0	y-pos	337.0	21.0	horizontal	PASSED
13.348500	36.23	80.50	44.27	100.0	y-pos	315.0	21.0	horizontal	PASSED
13.560000	52.69	124.00	71.31	100.0	y-pos	321.0	21.0	horizontal	PASSED
13.735500	24.39	80.50	56.11	100.0	y-pos	310.0	21.0	horizontal	PASSED
13.771500	34.47	80.50	46.03	100.0	y-pos	302.0	21.0	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

DUT horizontal, Antenna z-position

Peak detector (RBW 10 kHz)



Quasi-Peak detector (RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
13.312500	34.29	80.50	46.21	100.0	z-pos	285.0	21.0	horizontal	PASSED
13.348500	51.50	80.50	29.00	100.0	z-pos	323.0	21.0	horizontal	PASSED
13.407000	44.22	80.50	36.28	100.0	z-pos	345.0	21.0	horizontal	PASSED
13.560000	67.91	124.00	56.09	100.0	z-pos	315.0	21.0	horizontal	PASSED
13.713000	42.97	80.50	37.53	100.0	z-pos	320.0	21.0	horizontal	PASSED
13.776000	44.53	80.50	35.97	100.0	z-pos	315.0	21.0	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

4. Radiated emissions below 30 MHz

EUT with DUT number	DAB2220232
Accessories with DUT numbers	DAB2220242
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+15 °C to +35 °C / 20 % to 75 %
Date of measurement	19-Aug-2022 – 21-Sep-2022
Test Responsible	Frank Wittmann
Test system SW / Version / Configuration	Rohde & Schwarz EMC32 / 10.60.20 / 1.6

4.1. Test method and limit

The measurement is made according to ANSI C63.10 and RSS-Gen as follows:

- ⇒ The measurement distance is 3 m with a shielded loop antenna. The magnetic field to electric field conversion factor is 51.5 dB ($\text{dB}\mu\text{A}/\text{m} = \text{dB}\mu\text{V}/\text{m} - 51.5 \text{ dB}$).
- ⇒ The Limit has been adjusted with the distance correction factor according to 15.31(f)(2). (+40 dB for 30 m distance and +80 dB for 300 m distance)
- ⇒ The measurement is divided into the Preliminary Measurement and the Final Measurement. The Preliminary Measurement and the Final Measurement are performed with the measuring antenna at 1m height. The equipment under test (EUT) is located on an 80 cm table, which is rotated by 360 degrees. The DUT is positioned in horizontal position on the test table.
- ⇒ During the Preliminary Measurement, the suspected frequencies are searched by using the PK detector and the measuring antenna is turned in 3 orthogonal positions (x-, y-, z-pos) to find out worst case position. In the Final Measurement the exact frequency and amplitude of these emissions are re-measured by using the applicable QP and AV detector.
- ⇒ The Final Measurement is performed if the Preliminary Measurement results are closer than 20 dB to the permissible limit.
- ⇒ The measurement results are obtained as described in the following formula: $E [\text{dB}\mu\text{V}/\text{m}] = U_{\text{RX}} + A_{\text{CF}}$
Where U_{RX} is receiver reading and A_{CF} is total correction factor including cable loss, antenna factor and preamplifier gain ($A_{\text{CF}} = L_{\text{CABLES}} + \text{AF} - G_{\text{PREAMP}}$).
- ⇒ Example values and calculation for one final QP measurement frequency at 1.132 MHz, see result in 4.2:
 $E [\text{dB}\mu\text{V}/\text{m}] = 3.89 + 21.19 = 24.99$

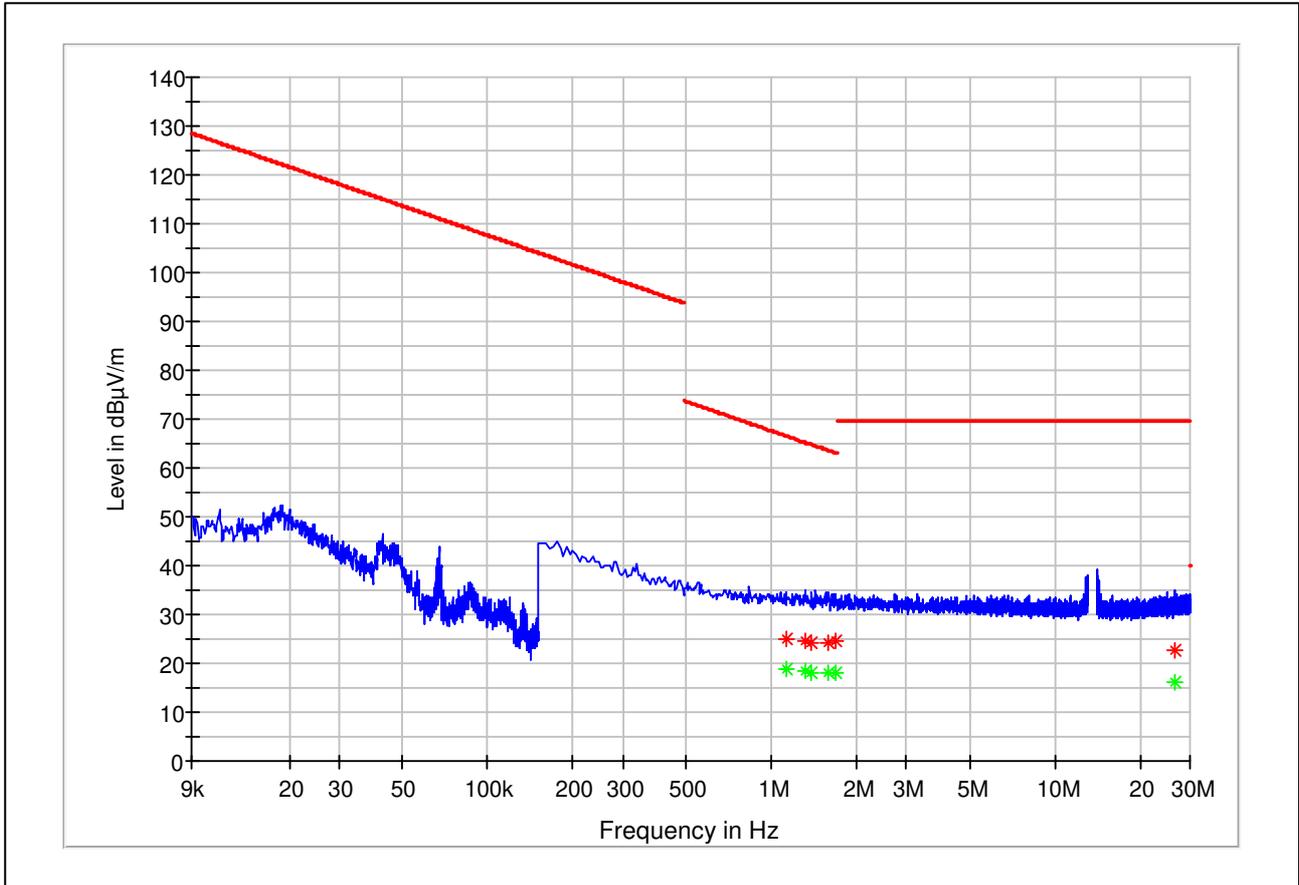
FCC and ISED limits for radiated emissions measurements (3 m measurement distance)

Frequency range [MHz]	Limit [$\mu\text{V}/\text{m}$]	Limit [$\text{dB}\mu\text{V}/\text{m}$]	Detector
0.009 - 0.09	$10000 * 2400 / f[\text{kHz}]$	128.5 - 93.8	AV
0.09 - 0.11			QP
0.11 - 0.19			AV
0.19 - 0.49			AV
0.490 - 1.705	$100 * 24000 / f[\text{kHz}]$	73.8 - 63.0	QP
1.705 - 30.0	$100 * 30$	69.5	QP

4.2. Test results (FCC, ISED)

DUT horizontal, Antenna x-position

Peak detector (< 150 kHz: RBW 200 Hz, > 150 kHz: RBW 10 kHz)



Quasi-Peak detector (< 150 kHz: RBW 200 Hz, >150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
1.131969	24.99	66.53	41.54	100.0	x-pos	328.0	21.1	horizontal	PASSED
1.321385	24.55	65.18	40.63	100.0	x-pos	135.0	21.0	horizontal	PASSED
1.391169	24.38	64.74	40.35	100.0	x-pos	230.0	21.0	horizontal	PASSED
1.595539	24.39	63.55	39.16	100.0	x-pos	299.0	20.9	horizontal	PASSED
1.680277	24.45	63.10	38.65	100.0	x-pos	135.0	20.9	horizontal	PASSED
26.472206	22.54	69.54	47.00	100.0	x-pos	193.0	21.7	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

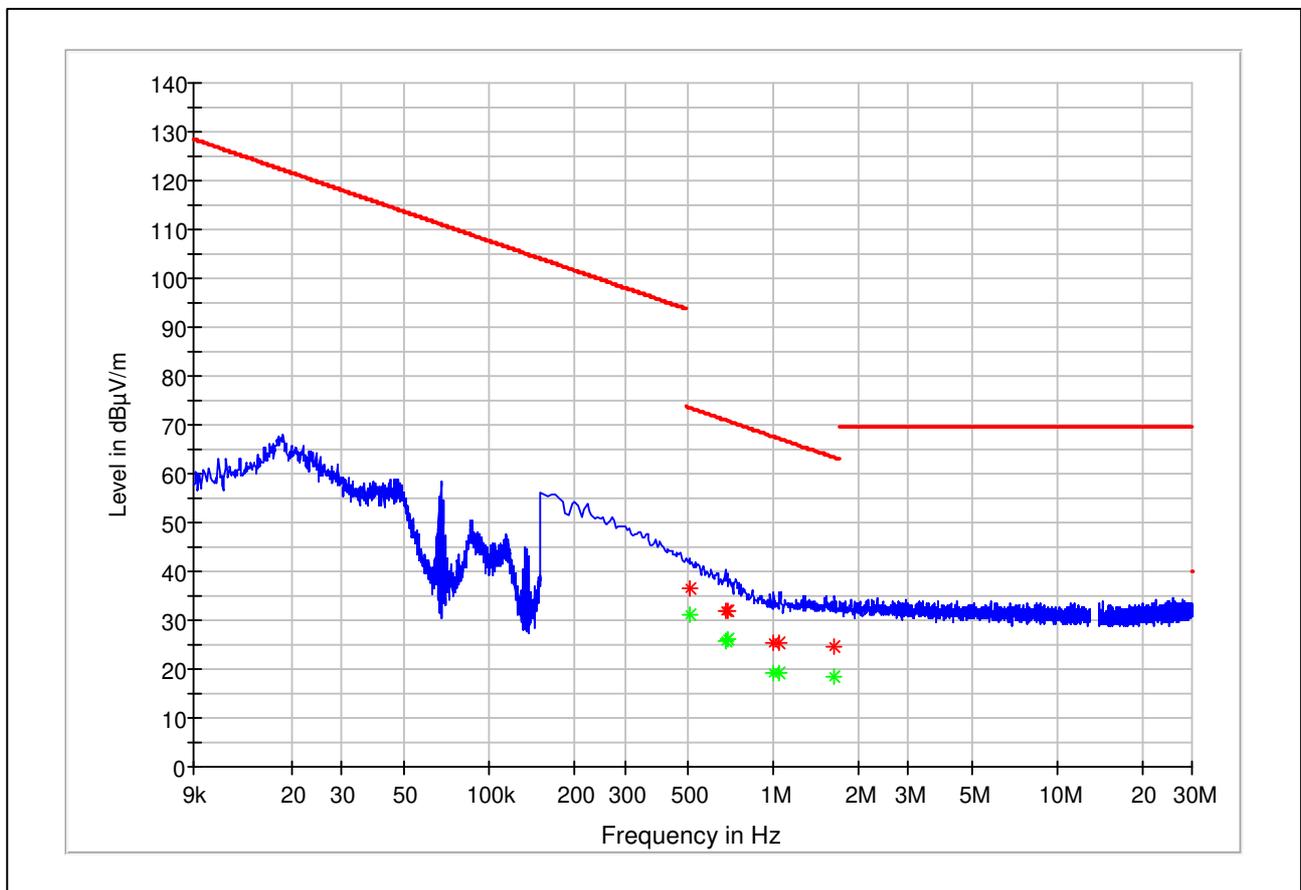
Average detector (< 150 kHz: RBW 200Hz, > 150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
1.131969	18.85	66.53	47.68	100.0	x-pos	328.0	21.1	horizontal	PASSED
1.321385	18.36	65.18	46.82	100.0	x-pos	135.0	21.0	horizontal	PASSED
1.391169	18.24	64.74	46.49	100.0	x-pos	230.0	21.0	horizontal	PASSED
1.595539	18.17	63.55	45.38	100.0	x-pos	299.0	20.9	horizontal	PASSED
1.680277	18.19	63.10	44.90	100.0	x-pos	135.0	20.9	horizontal	PASSED
26.472206	16.31	69.54	53.23	100.0	x-pos	193.0	21.7	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

DUT horizontal, Antenna y-position

Peak detector (< 150 kHz: RBW 200 Hz, > 150 kHz: RBW 10 kHz)



Quasi-Peak detector (< 150 kHz: RBW 200 Hz, >150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
0.503908	36.53	73.56	37.03	100.0	y-pos	75.0	21.1	horizontal	PASSED
0.678369	31.78	70.97	39.20	100.0	y-pos	103.0	21.1	horizontal	PASSED
0.688339	31.93	70.85	38.92	100.0	y-pos	5.0	21.2	horizontal	PASSED
1.002369	25.37	67.58	42.21	100.0	y-pos	315.0	21.1	horizontal	PASSED
1.052216	25.22	67.16	41.94	100.0	y-pos	223.0	21.1	horizontal	PASSED
1.645385	24.50	63.28	38.78	100.0	y-pos	0.0	20.9	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

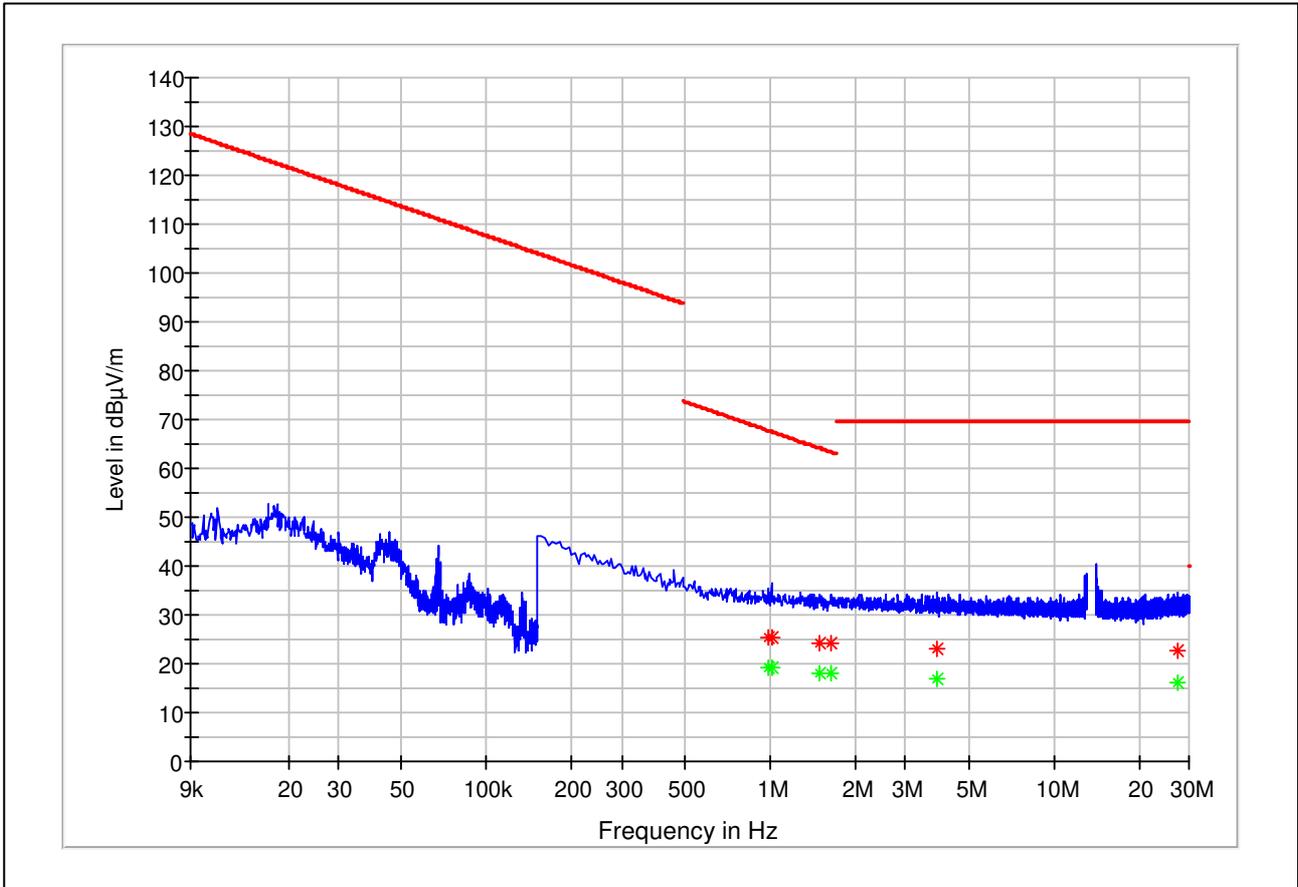
Average detector (< 150 kHz: RBW 200Hz, > 150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
0.503908	30.99	73.56	42.57	100.0	y-pos	75.0	21.1	horizontal	PASSED
0.678369	25.86	70.97	45.11	100.0	y-pos	103.0	21.1	horizontal	PASSED
0.688339	26.16	70.85	44.69	100.0	y-pos	5.0	21.2	horizontal	PASSED
1.002369	19.33	67.58	48.26	100.0	y-pos	315.0	21.1	horizontal	PASSED
1.052216	19.05	67.16	48.12	100.0	y-pos	223.0	21.1	horizontal	PASSED
1.645385	18.34	63.28	44.94	100.0	y-pos	0.0	20.9	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

DUT horizontal, Antenna z-position

Peak detector (< 150 kHz: RBW 200 Hz, > 150 kHz: RBW 10 kHz)



Quasi-Peak detector (< 150 kHz: RBW 200 Hz, >150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
0.982431	25.26	67.76	42.50	100.0	z-pos	97.0	21.1	horizontal	PASSED
1.007354	25.21	67.54	42.33	100.0	z-pos	23.0	21.1	horizontal	PASSED
1.500831	24.38	64.08	39.70	100.0	z-pos	32.0	21.0	horizontal	PASSED
1.635416	24.33	63.33	39.01	100.0	z-pos	338.0	20.9	horizontal	PASSED
3.883477	23.09	69.54	46.45	100.0	z-pos	116.0	21.0	horizontal	PASSED
27.511556	22.64	69.54	46.90	100.0	z-pos	343.0	21.7	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

Average detector (< 150 kHz: RBW 200Hz, > 150 kHz: RBW 9 kHz)

Frequency [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Height [cm]	Antenna Position	Azimuth [deg]	Transducer [dB]	EUT Orientation	Result
0.982431	19.12	67.76	48.64	100.0	z-pos	97.0	21.1	horizontal	PASSED
1.007354	19.04	67.54	48.50	100.0	z-pos	23.0	21.1	horizontal	PASSED
1.500831	18.15	64.08	45.93	100.0	z-pos	32.0	21.0	horizontal	PASSED
1.635416	18.11	63.33	45.22	100.0	z-pos	338.0	20.9	horizontal	PASSED
3.883477	16.84	69.54	52.70	100.0	z-pos	116.0	21.0	horizontal	PASSED
27.511556	16.22	69.54	53.32	100.0	z-pos	343.0	21.7	horizontal	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

5. Radiated emissions above 30 MHz

EUT with DUT number	DAB2220232
Accessories with DUT numbers	DAB2220242
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+15 °C to +35 °C / 20 % to 75 %
Date of measurement	19-Aug-2022 – 21-Sep-2022
Test Responsible	Frank Wittmann
Test system SW / Version / Configuration	Rohde & Schwarz EMC32 / 10.60.20 / 1.6

5.1. Test method and limit

The measurement is made according to ANSI C63.10 and RSS-Gen as follows:

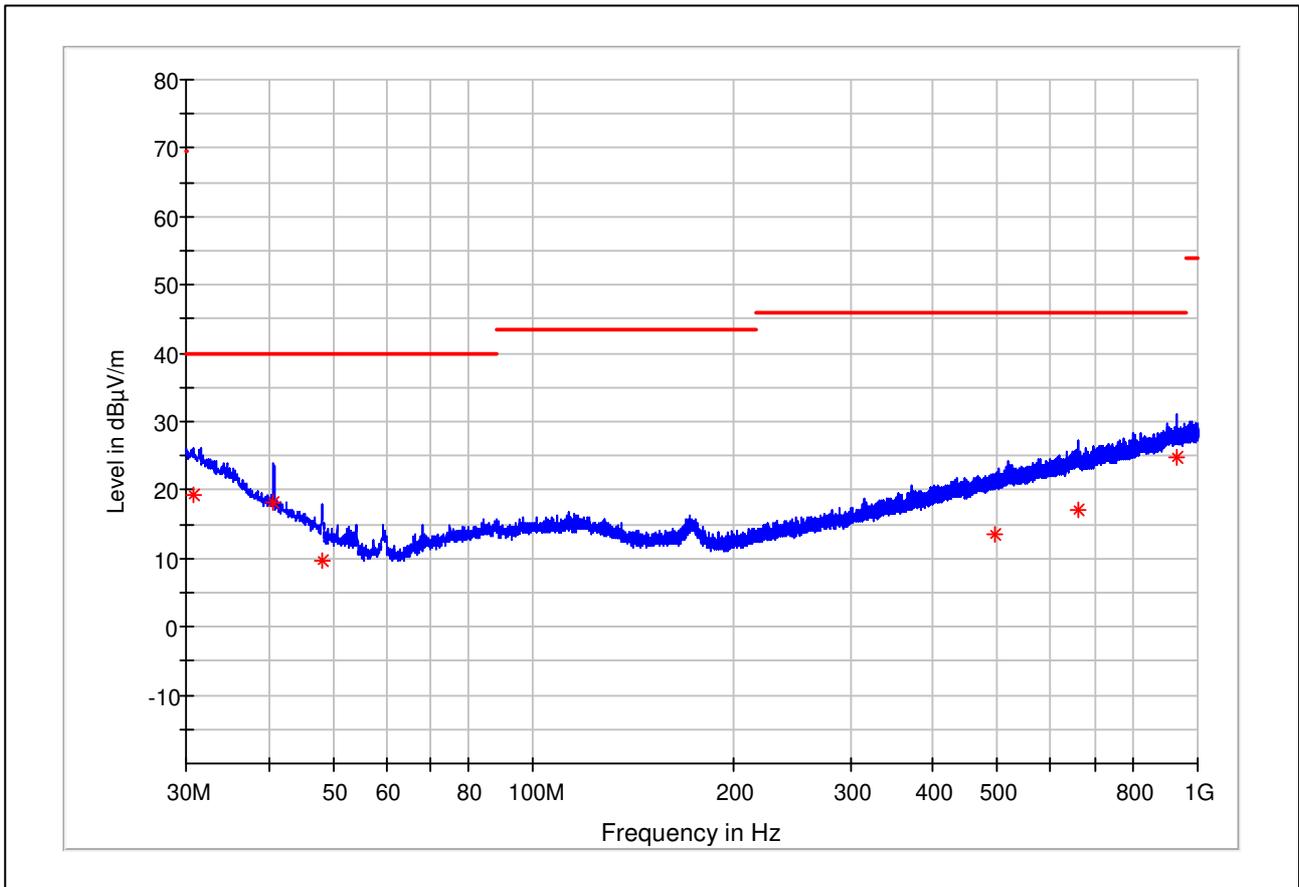
- ⇒ The equipment under test (EUT) is located on an 80 cm table, which is rotated by 360 degrees. The DUT is positioned in horizontal position on the test table.
- ⇒ The measurement is divided into the Preliminary Measurement and the Final Measurement.
The Preliminary Measurement and the Final Measurement is performed in 3 m distance without floor absorbers by rotating the turntable of 360 degrees and moving the antenna height between 1-4 m.
- ⇒ During the Preliminary Measurement the suspected frequencies are searched by using the PK detector.
In the Final Measurement the exact frequency and amplitude of these emissions are re-measured by using the applicable QP detector.
- ⇒ The Final Measurement is performed if the Preliminary Measurement results are closer than 20 dB to the permissible limit.
- ⇒ The measurement results are obtained as described in the following formula: $E \text{ [dB}\mu\text{V/m]} = U_{RX} + A_{CF}$
Where U_{RX} is receiver reading and A_{CF} is total correction factor including cable loss, antenna factor and preamplifier gain ($A_{CF} = L_{CABLES} + AF - G_{PREAMP}$).
- ⇒ Example values and calculation for one final QP measurement frequency at 40.67 MHz, see result in 5.2:
 $E \text{ [dB}\mu\text{V/m]} = 30.05 - 12.0 = 18.05$

FCC and ISED limits for radiated emissions measurements (3 m measurement distance)

Frequency range [MHz]	Limit [$\mu\text{V/m}$]	Limit [dB $\mu\text{V/m}$]	Detector
30 – 88	100	40	QP
88 – 216	150	43.5	QP
216 – 960	200	46	QP
960 – 1000	500	54	QP

5.2. Test results (FCC, ISED)

Peak detector (< 300 MHz: RBW 300 kHz, > 300 MHz: RBW 1 MHz)



Quasi-Peak detector (RBW 120 kHz)

Frequency [MHz]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Height [cm]	Polarisatin	Azimuth [deg]	Transducer [dB]	Result
30.824500	19.18	40.00	20.82	175.0	Vertical	53.0	-6.1	PASSED
40.670000	18.05	40.00	21.95	95.0	Vertical	345.0	-12.0	PASSED
48.090500	9.56	40.00	30.44	385.0	Horizontal	255.0	-17.2	PASSED
494.533000	13.62	46.02	32.40	205.0	Vertical	35.0	-7.2	PASSED
663.022000	17.00	46.02	29.02	259.0	Vertical	32.0	-3.8	PASSED
931.954500	24.68	46.02	21.34	265.0	Horizontal	332.0	-0.1	PASSED

No further emissions found less than 20 dB to the regulatory limit and no emission found in the restricted bands of operation.

6. Frequency stability, temperature variation

EUT with DUT number	DAB2220223
Accessories with DUT numbers	DAB210788E
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+15 °C to +35 °C / 20 % to 75 %
Date of measurement	22.08.2022
Test Responsible	Jürgen Mitterer
Test system SW / Version	Emissions_Radio_CEFCC / 1.9

6.1. Test reference and limit

The measurement is made according to ANSI C63.10 and RSS-210 as follows:

- ⇒ The EUT is placed in the chamber.
- ⇒ The climate chamber temperature is set to the maximum value and allowed to stabilize.
- ⇒ The transmit frequency is measured.
- ⇒ Temperature is lowered to the next temperature value and allowed to stabilize.
- ⇒ The steps 3-4 are repeated for each temperature.

FCC, ISED limits for frequency stability, temperature variation measurements

Frequency Deviation [%]
+/- 0.01

6.2. Test results (FCC, ISED)

Temperature [°C]	Time [min]	Frequency [MHz]	Deviation [%]	Result
50	0	13.55959	0,0030	PASSED
	2	13.55978	0.0017	PASSED
	5	13.55996	0.0003	PASSED
	10	13.55969	0,0022	PASSED
40	0	13.55972	0.0021	PASSED
	2	13.56000	0.0000	PASSED
	5	13.56004	0.0003	PASSED
	10	13.55988	0.0009	PASSED
30	0	13.55982	0.0014	PASSED
	2	13.56004	0.0003	PASSED
	5	13.55963	0.0027	PASSED
	0	13.55992	0.0006	PASSED
20	0	13.56006	0.0004	PASSED
	2	13.55992	0.0006	PASSED
	5	13.56008	0.0006	PASSED
	10	13.55988	0.0009	PASSED
10	0	13.56014	0.0011	PASSED
	2	13.55955	0.0033	PASSED
	5	13.55990	0.0007	PASSED
	10	13.55990	0.0007	PASSED
0	0	13.56014	0.0011	PASSED
	2	13.56022	0.0017	PASSED
	5	13.55945	0.0040	PASSED
	10	13.55982	0.0014	PASSED
-10	0	13.55988	0.0009	PASSED
	2	13.56014	0.0011	PASSED
	5	13.56026	0.0019	PASSED
	10	13.56014	0.0011	PASSED
-20	0	13.56018	0.0014	PASSED
	2	13.56012	0.0009	PASSED
	5	13.55986	0.0011	PASSED
	10	13.56037	0.0027	PASSED
-30	0	13.55996	0.0003	PASSED
	2	13.56004	0.0003	PASSED
	5	13.55963	0.0027	PASSED
	10	13.55978	0.0017	PASSED

7. Frequency stability, voltage variation

EUT with DUT number	DAB2220223
Accessories with DUT numbers	DAB210788E
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+20 °C / 20 % to 75 %
Date of measurement	29.08.2022
Test Responsible	Jürgen Mitterer
Test system SW / Version	Emissions_Radio_CEFCC / 1.9

7.1. Test reference and limit

The measurement is made according to ANSI C63.10 and RSS-210 as follows:

- ⇒ The EUT is placed in the chamber.
- ⇒ The climate chamber temperature is set to 20°C allowed to stabilize.
- ⇒ The EUT is connected to an adjustable power supply.
- ⇒ The frequency stability was measured at nominal voltage and at 85 % and 115 %.

FCC, ISED limits for frequency stability, voltage variation measurements

Frequency Deviation [%]
+ \- 0.01

7.2. Test results (FCC, ISED)

Voltage [V]	Frequency [MHz]	Deviation [%]	Result
Nominal (13.2)	13.55996	0.0003	PASSED
Minimum (11.2)	13.55972	0.0021	PASSED
Maximum (15.2)	13.55959	0.0030	PASSED

8. Occupied bandwidth

EUT with DUT number	DAB2220223
Accessories with DUT numbers	DAB210788E
Operation voltage [V] / [Hz]	13.2 V / DC
Result	PASSED
Remarks	none
Temp [°C] / humidity [%RH]	+15 °C to +35 °C / 20 % to 75 %
Date of measurement	04.10.2022
Test Responsible	Jürgen Mitterer
Test system SW / Version	Emissions_Radio_CEFCC / 1.9

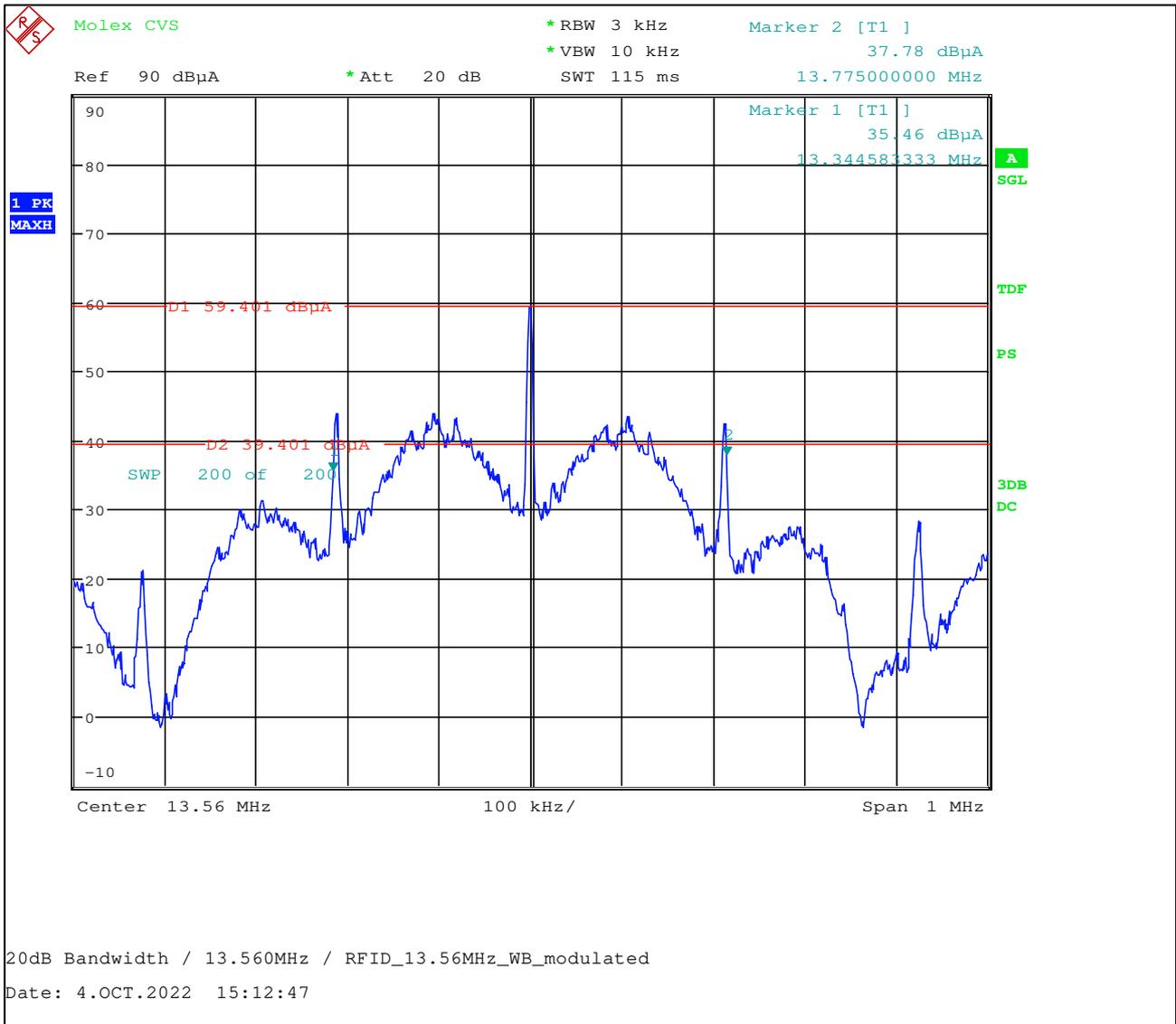
8.1. Test method and limit

The measurement is made according to FCC 15.215(c) and RSS-Gen.

FCC and ISED limits for occupied bandwidth measurements

20 dB Bandwidth Limit [MHz]	99 % Bandwidth Limit [MHz]
N.A.	N.A.

8.2. Test results 20dB OBW



Frequency [MHz]	20 dB Bandwidth [kHz]
13.56	430.4

9. Test Equipment

9.1. Conducted Radio

Equipment	Manufacturer	Type	SERIAL-NO.	Actual Calibration	Next Calibration
Signal Generator	ROHDE & SCHWARZ	SMP02	828269/008	12.05.2020	12.05.2023
Signal Generator	ROHDE & SCHWARZ	SMB100A	181275	04.05.2022	04.05.2023
Vector Signal Generator	ROHDE & SCHWARZ	SMBV100A	263158	05.05.2022	05.05.2023
EMI Test Receiver	ROHDE & SCHWARZ	ESU26	100077	04.05.2022	04.05.2023
Vector Signal Generator	ROHDE & SCHWARZ	SMJ100A	100845	09.05.2022	09.05.2024
Power Supply	Hewlett Packard - Agilent	E3632A	MY40011318	11.05.2020	11.05.2023
Temp. / Humidity Logger	Lufft	Opus 10	13262	21.01.2020	21.01.2023
Climatic Chamber	Vötsch	VT4002	521/85094	06.10.2020	06.10.2022

Passive devices:

Equipment*	Manufacturer	Type	SERIAL-NO.
Loop antenna 6 cm	ETS-Lindgreen	7405-901B	Radio 0001
10 dB attenuator	Pasternack	PE7001-10	Radio 0002
RF-cable 2m	Huber & Suhner	Sucoflex 104	563441/4
RF-cable 20 cm	Huber & Suhner	Sucoflex 104	199784/4
Directional coupler	Tyco electronics	M/A-COM 0.5 – 18 GHz	96341

*Passive components included in used signal path

9.2. Radiated Emission

Equipment	Manufacturer	Type	SERIAL-NO.	Actual Calibration	Next Calibration
Antenna	Schwarzbeck Mess-Elektronik	FMZB_1519	1519-056	22.07.2020	22.07.2023
Signal Generator	ROHDE & SCHWARZ	SMP02	828269/008	12.05.2020	12.05.2023
Signal Generator	ROHDE & SCHWARZ	SML01	100652	11.05.2021	11.05.2024
Power Supply	Hewlett Packard - Agilent	E3632A	KR75303301	11.05.2020	11.05.2023
Field Analyzer	Wandel & Goltermann	EMR20	P-0030	30.10.2020	30.10.2023
Antenna	ROHDE & SCHWARZ	HL025	359012/006		
Temp. / Humidity Logger	Lufft	Opus 10	13262	21.01.2020	21.01.2023
Antenna	ROHDE & SCHWARZ	HL562	100191	01.10.2021	01.10.2024
Antenna	ROHDE & SCHWARZ	HK-116: 20-300MHz	825177/0017	25.11.2021	25.11.2024
Antenna	ROHDE & SCHWARZ	HK-116: 20-300MHz	100401	21.08.2020	21.08.2023
Antenna	ROHDE & SCHWARZ	HL223	832369/006	04.05.2022	04.05.2025
Antenna	Schwarzbeck	UBA 9116	9116-396	27.07.2020	27.07.2023
Antenna	Emco	3115	9810-5588	24.03.2021	24.03.2024
Antenna	Schwarzbeck	BBHA-9120-D	01617	09.02.2022	09.02.2025
Antenna	ROHDE & SCHWARZ	HL223	100731	25.11.2021	25.11.2024
Antenna	Schwarzbeck Mess-Elektronik	VAMP 9243	9243-486	25.05.2021	25.05.2024
Isotropic Electric Field Probe	Wandel & Goltermann	Type 8	M-0082	30.10.2020	30.10.2023
Signal Generator	ROHDE & SCHWARZ	SMB100A	181275	04.05.2022	04.05.2023
EMI Test Receiver	ROHDE & SCHWARZ	ESW44	101733	17.05.2022	17.05.2023

Passive devices

Equipment*	Manufacturer	Type	SERIAL-NO.
OSP Switch Unit	ROHDE & SCHWARZ	OSP-320	103089
OSP Switch Unit	ROHDE & SCHWARZ	OSP-230	101023
Low Noise Amplifier	Miteq	LNA-40-00100800-15-10P	15383
RF Attenuator	Huber & Suhner	3dB DC-18GHz	751933 No.1
RF Attenuator	Huber & Suhner	3dB DC-18GHz	751933 No.2
RF Cable	Huber & Suhner	Sucoflex 104	506968
RF Cable	Huber & Suhner	Sucoflex 104	506967
RF Cable	Huber & Suhner	Sucoflex 126EA	517430
RF Cable	Huber & Suhner	Sucoflex 126PEA	0815

*Passive components included in used signal paths

End of Report